

Sexual Behaviour of Long-Tailed Macaques (*Macaca fascicularis*) in Semi-Natural Captivity, Tinjil Island, Indonesia

Rizka Hasanah¹, Vallen Sakti Maulana^{2*}, Entang Iskandar³

¹Study Program of Biology, Faculty of Mathematics and Natural Sciences, University of Palangkaraya, Central Kalimantan, Indonesia

²Study program of Primatology, Graduate School Program, IPB University, Bogor, Indonesia

³Primate Research Center, IPB University, Indonesia

Abstract

The long-tailed macaques (*Macaca fascicularis*) is a primate species widely used in ecology, socio-economics, and biomedical. Long-tailed macaques have a high degree of adaptation to various types of environments. This species can be used and traded as long as it is the product of captivity. Over time, with increasing demand, there is a tendency to increase the number of long-tailed macaques catch quotas from nature and reduce the habitat of these primates in Indonesia. This demand causes the need for a conservation effort to increase the long-tailed macaques' population outside their natural habitat. Tinjil Island is a semi-natural breeding place managed by the Primate Research Center (PRC), LPPM IPB University. We studied this area to observe the long-tailed macaques' daily behaviour. We observed sexual behaviour with the ad-libitum method. Overall, the frequency of each stage of sexual behaviour carried out by the long-tailed macaques is genital inspect by 20% (for 12 seconds), male mounts by 9% (for 5 seconds); intromission by 44% (for 26 seconds), ejaculation success by 17% (for 10 seconds), vocalization by 7% (for 4 seconds), and running by 3% (for 1.6 seconds). Success in sexual behaviour is influenced by the sex age of primates, the period of lust, and food availability. This study is expected to provide information on sexual behaviour that can support reproductive success and successful reproductive management of long-tailed macaques in captivity.

Key words: ad libitum, conservation effort, endangered species, Primate Research Center, successful breeding

1. Introduction

The long-tailed macaques (*Macaca fascicularis*) are a primate species widely used in ecology, socio-economics, and biomedical research. Long-tailed macaques are widely used in laboratories to develop vaccines and cell cultures. Long-tailed macaques are also found in several ecotourism objects. Long-tailed macaques have a high degree of adaptation to various types of environments. These primates can live in various conditions, from mangrove forests on the coast and lowlands to mountains with an altitude of 2000 meters above sea level. The long-tailed macaques are used to living in groups. The number in groups usually consists of 10-20 individuals in mangrove forests, 20-30 individuals in primary forests, and 30-50 individuals in secondary forests, with a multi-male multi-female family system. The home range is 50-100 ha for one group. Daily path length may reflect more immediate circumstances that prompted the movement of animals, many social

and environmental conditions that affect daily path length also affect home range (Kamarul *et al.* 2014).

Since 1977, the long-tailed macaques have been included in Appendix II of CITES (Convention International Trade in Endangered Species). The status means that the species can be used and traded as long as it is the product of captivity (Soehartono and Mardiasuti 2003). However, wild catches sold freely tend to exceed the catch quota set by the government, reducing the species' sustainability (Rameiyanti and Purnama 2008). As a result, in March 2022, the conservation status of long-tailed macaques on the IUCN red list rose from vulnerable to endangered (Hansen *et al.* 2022). There is a tendency to increase the number of capture quotas for long-tailed macaques from the wild, and the reduced habitat of these primates in Indonesia (Rameiyanti and Purnama 2008; Supriatna 2000), requires a conservation effort to increase long-tailed macaques populations outside their natural habitats. The species has also been

*Corresponding author

Email Address : vallensaktimaulana@gmail.com

introduced by human activity to islands outside of their natural range (Sha *et al.* 2009). Long-tailed macaques breeding on Tinjil Island are expected to increase the number of long-tailed macaques populations in Indonesia to reduce the threat of extinction and meet market needs nationally and internationally.

Tinjil Island is one of the islands administratively included in the Pandeglang Regency, Banten Province, which is located in the Indian Ocean south of the island of Java. This island is located at the coordinates of 6°57' 44" South Latitude, 105°47' 0" East Longitude. Since 1988, Tinjil Island has been a breeding ground for long-tailed macaques imported from South Sumatra, Lampung, and Banten. Tinjil Island was a semi-natural breeding place managed by the Primate Research Centre (PRC) IPB University, which aims to breed long-tailed macaques free of simian retrovirus (SRV) (Iskandar *et al.* 2009).

As a social primate, long-tailed macaques performs various daily behaviours such as foraging, drinking, playing, locomotion, resting, and mating. One aspect of behaviour that affects the success of captive breeding is the mating behaviour of these primates. Mating behaviour has a huge influence on the reproduction of these primates. The reproductive aspect plays a role in increasing the population and productivity of primates. Knowing the sexual behaviour of the long-tailed macaques in captivity can provide direction on appropriate actions and forms of management to produce animal production that meets expectations. This success can support breeding efforts. This study aims to identify the stages of sexual behaviour of long-tailed macaques in the Semi-Natural Captivity, Tinjil Island.

2. Materials and Methods

2.1. Location of Study

Observations were made at Tinjil Island Semi-Natural Captivity, Pandeglang Regency, Banten Province. Observations were made for five days, from July 11 to July 15, 2018. The group of long-tailed macaques (*Macaca fascicularis*) observed is a group that is in the path that intersects between OS-SH (Manci Group). The long-tailed macaques' groups observed were in locations around the basecamp and were habituated to the presence of observers.

2.2. Research Materials

The tools used in this research are stationery, watches, stopwatch, digital cameras, and observation sheets. The materials used in this study were a map of the Tinjil Island area and literature on long-tailed macaques.

2.3. Research Procedure

Observations of sexual behaviour were carried out using the ad-libitum method (Altmann 1974). The ad-libitum method in this study focused more on sexual behaviour following the research objectives. The stages of sexual behaviour and ethograms (Table 1) observed were male individuals inspecting female genitalia (genital inspect), male mounts, intromission, and ejaculation. The list of observed individuals and the time of observation is presented in Table 2.

3. Results

We observed the macaques for five days at Semi-Natural Captivity, Tinjil Island. Figure 1 to 5 shows the duration stages of long-tailed macaques' sexual behaviour. The stages of long-tailed macaques' sexual behaviour are based on observations.

Table 1. Ethogram

Types of mating behaviour	Information
Genital inspection	An individual looks at and touches or sniffs the genitals of another
Male mounts	The male approaches from behind and positions itself into some semblance of a copulatory position
Intromission	The male inserts his genitals into the female genitalia and thrusts his pelvis
Ejaculation	The release of male sperm

Table 2. List of individuals observed using the ad libitum method

Days to-	Number of individuals in the group	Observed individuals	Observation time*
1	35	A, B, C, D and E	11.00-11.30 (morning) 15.00-16.00 (afternoon)
2	17	A, B, C, D and E	09.20-10.00 (morning)
3	24	A, B, C, D and E	13.30-13.40 (afternoon)
4	32	A, B, C, D and E	11.40-12.00 (noon)
5	22	A, B, C, D and E	09.30-10.20 (afternoon)

Note: *observation time is adjusted to the given feeding schedule, and behavioural observation is adjusted to the presence of individuals approaching the place to eat.

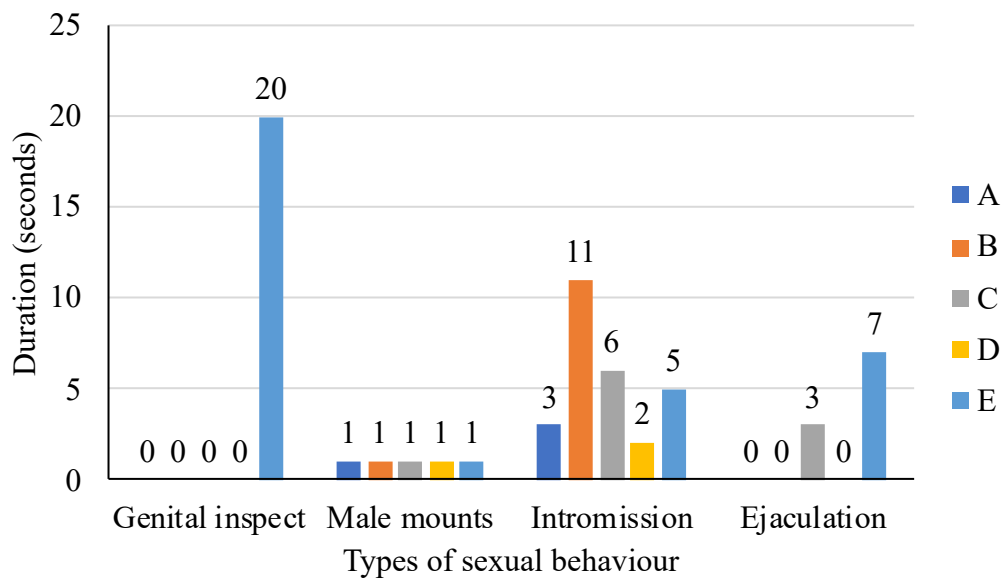


Figure 1. Duration of stages of long-tailed macaques' sexual behaviour on day 1

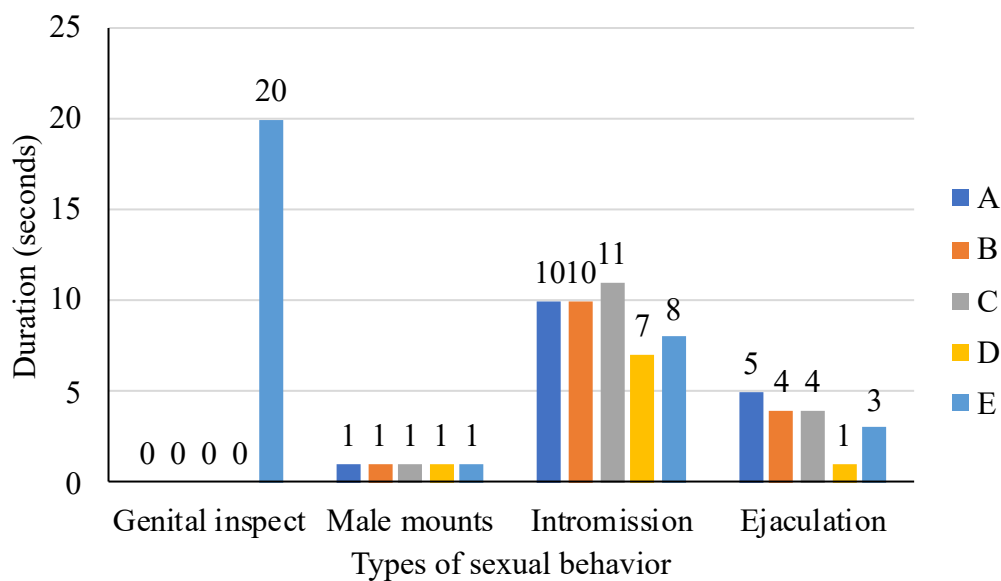


Figure 2. Duration of stages of long-tailed macaques' sexual behaviour on day 2

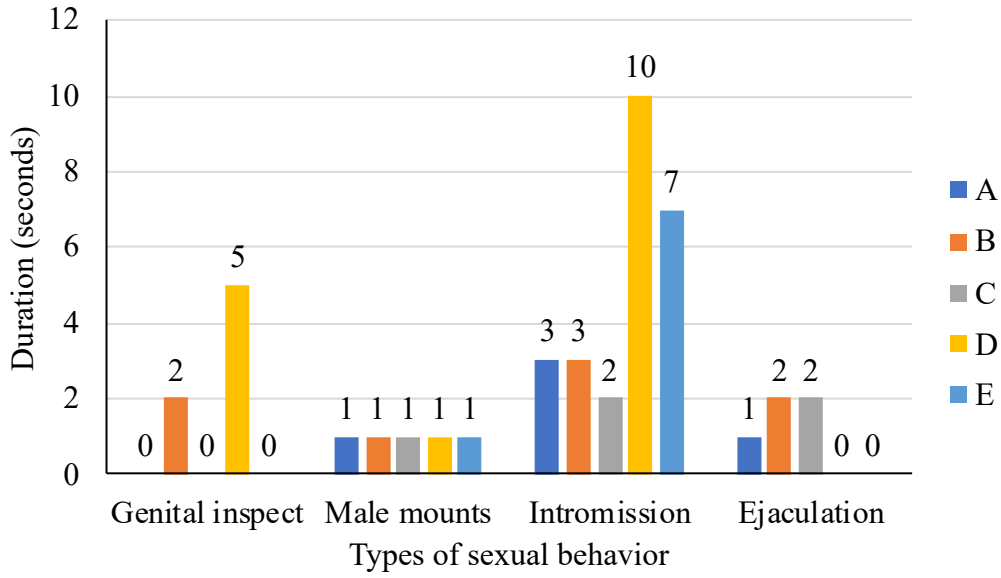


Figure 3. Duration of long-tailed macaques' sexual behaviour stages on day 3

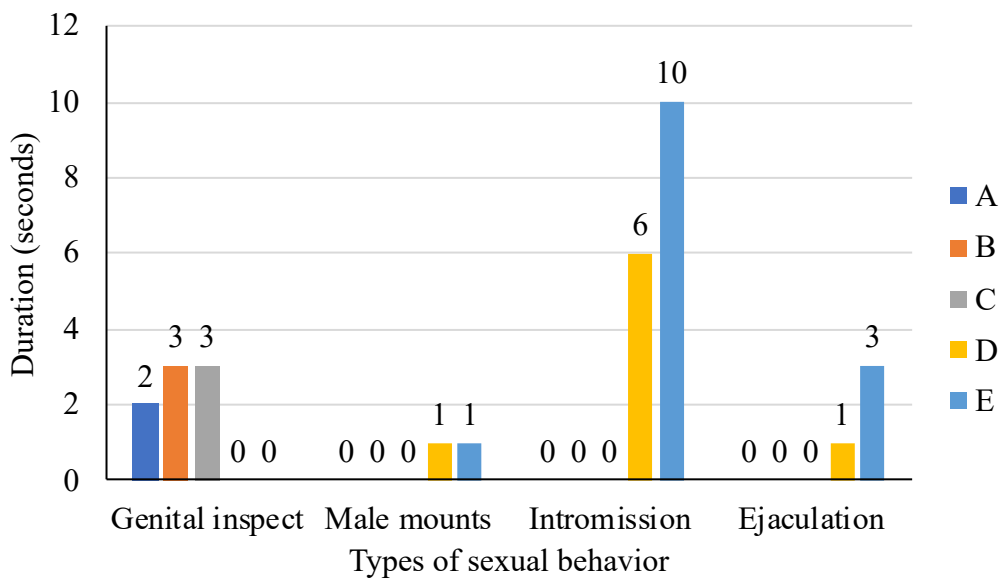


Figure 4. Duration of long-tailed macaques' sexual behaviour stages on day 4

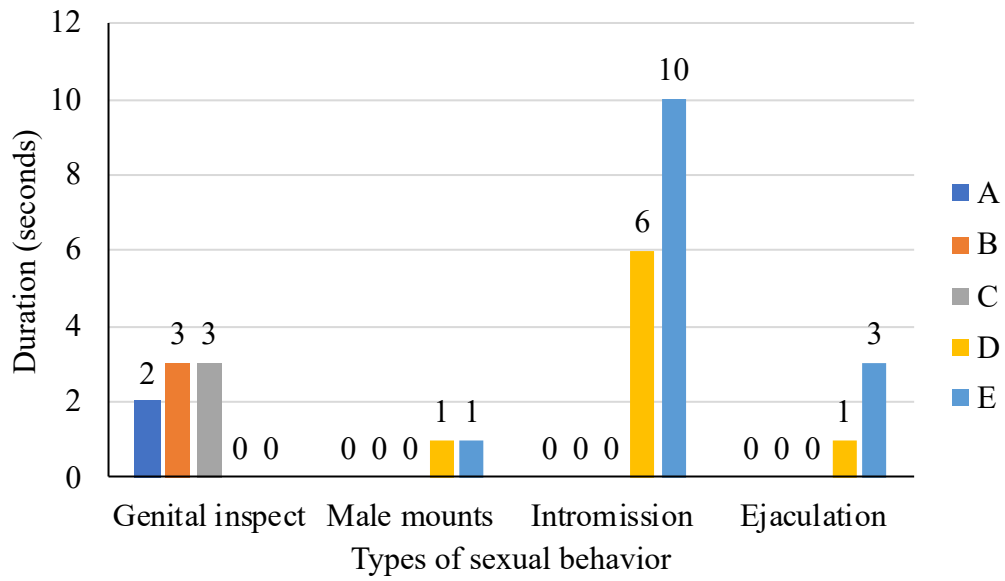


Figure 5. The fifth day of long-tailed macaques' sexual behaviour stages



Figure 6. (a) The behaviour of genital inspection by looking and touching, (b) the behaviour of the male mounts female, and (c) behaviour of intromission, thrusting, and ejaculation

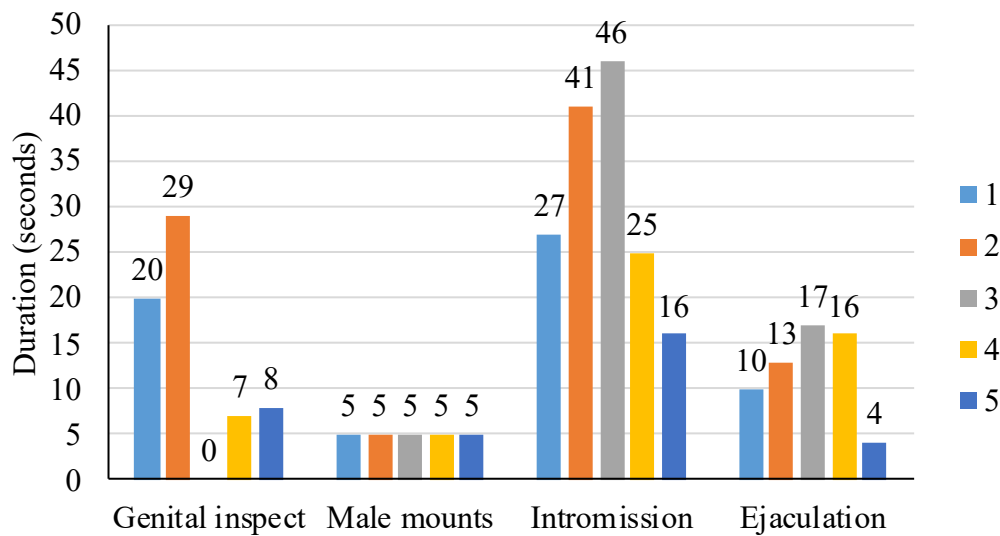


Figure 7. Total duration of sexual behaviour stages for five days of observation

The genital inspection (Figure 6a) is the first stage to be observed. Males against females carry out this behaviour. This behaviour is preceded by the behaviour of the male lifting the female's tail. However, some females are responsive and immediately raise their tails when approached by males. Based on observations, not all individuals perform a genital inspection. Individuals who did genital inspection did intromission and managed to mate, such as individuals E (day 1; Figure 1 and day 3; Figure 3), individuals A, B, and C (day 2; Figure 2), and B (day 4; Figure 1 and Figure 4).

The next behaviour, male mounts is carried out by the male mounts the female body by holding the female's hips and then resting her feet on the female calf (Figure 6b). Based on observations, the mount behaviour was almost carried out by all individuals observed for five days: individuals A, B, C, D, and E. The mount movement was a movement made by males quickly. It was recorded during the observation that the time needed to mount the female was only one second.

Intromission is the behaviour of the male inserts his genitals into the female genitalia and thrusts his pelvis (Figure 6c). After intromission, there is the possibility of ejaculation. Ejaculation is the behaviour of spraying sperm into the vagina. During the observation, no other positions were found when males and females did intromission. The male who did the previous intromission had mounted first.

Based on observations, the average adult male mating has an intromission duration of 2-12 seconds and is shown to be successful with ejaculation.

Based on five-day observational data, almost all stages of sexual behaviour occurred. Only on the third day, there was no genital inspection behaviour. The behaviour with the fastest average duration is the behaviour of the male mounts the female, which is only one second. Meanwhile, the longest duration of sexual behaviour stages performed by males is intromission behaviour (Figure 7).

4. Discussion

In this study, behavioural observations were made using the ad-libitum method. One of the advantages of the ad-libitum method is that it is carried out without time and object constraints so that it can be adjusted based on certain goals. The ad libitum method can be used to see sexual behaviour that occurs. The frequency of sexual behaviour is not as frequent as other behaviours, so it is possible not to obtain the desired behavioural data. The weakness of this method is not good if you want to know the proportion or frequency of overall behaviour in daily activities (Altman 1974).

Long-tailed macaques are a primate species with the largest abundance in Indonesia, with approximately 20 million individuals (Soehartono and Mardiasuti 2003). Long-tailed macaques have a hierarchy in the composition of groups that affect

the sexual behaviour of these primates. Adult male long-tailed macaques's with dominant positions will have more flexible mating access to female individuals. Sexual behaviour is a sexual act carried out by adult male and female individuals to carry out the reproductive process to produce offspring. Long-tailed macaques's can form pairs that can last for several days. During pairing, these monkeys can engage in sexual activity with other monkeys who are not partners. Long-tailed macaques generally perform mating behaviour more easily for couples who have formed several days, so the frequency of sexual activity is higher than sexual activity with partners who have not been formed before.

Mating behaviour is characterized by the willingness of females toward males to initiate sexual interactions. Sexual activity is mostly done in the morning. Dominant male individuals are more active in sexual activity than male individuals with lower hierarchy. Dominant male individuals are more active in approaching female individuals who are in heat for mating, and it is often seen that female individual in lust approach male individuals. Dominant male individuals are often seen threatening/attacking subordinate male individuals when mating female. Sexual behaviour of long-tailed macaques is more common in trees (arboreal), as much as 81.19%, compared to on land (terrestrial), which is as much as 18.81%. Once a long-tailed macaque pair has been formed, the female usually initiates the migration, and the male will follow and maintain closeness with the female (Kappeler and Schaik 2004). In long-tailed macaques, much copulation occurs during the pair is formed. The pair can last between 1-3 weeks, but the opposite sex can still mate with other individuals.

Genital inspection behaviour correlates with intromission, but not all intromission behaviour is preceded by genital inspection. Genital inspection behaviour is divided into three, namely by seeing (visual communication), kissing (olfactory communication), and touching (tactile communication). A male genital inspection is conducted to see whether the female is in estrus or not through the mucus in her genitals. Precopulation behaviour consists of the male-identifying the female in estrus and trying to compete for and courtship with the female (Poole 1985). Males carry out the genital inspection to determine the fertile period of females. Estrus is characterized by swelling of the sex skin, inflation of the skin

surrounding the anogenital region, and behavioural patterns (Engelhardt *et al.* 2005).

At the time of examination, males can respond based on smell. Females who are in their fertile period will secrete a pheromone liquid that can be smelled by males and attracts males to mate (Kevernee 1976). Genital inspection is a communication process between males and females who are about to mate (Kevernee 1976). Smell stimulates the male and can increase intromission and ejaculation. This behaviour also reduces aggressive behaviour in males and improves certain responses. The finding also indicates that the long-tailed macaques have a very strong sense of smell.

The male carries out the behaviour of mounting on the female before thrusting and intromission. Male mounts have no other position. The male body's stature and the female's readiness to mate affect this mounting's success and will continue in intromission. Ejaculation is the behaviour of spraying sperm into the vagina. In long-tailed macaques, this behaviour is characterized by increased thrusting movements and a grinning female face toward the mating male. After the male releases his sperm and releases his penis from the female's vagina, usually the female will make a distinctive sound several times. The female has a distinct set of vocalizations known as the "copulation call" which is heard during 80% of the copulation period (van Noordwijk 1985). Female long-tailed macaques mate several times throughout the day during fertility (Engelhardt *et al.* 2004). In addition, the male penis will see a thick white sperm fluid. Often males clean their genitals after releasing sperm.

Observations for five days showed that the success of the male in mounting and intromission would continue in ejaculation. The occurrence of ejaculation can be detected by: 1) the presence of ejaculate fluid (ejaculation plug) which is usually still scattered around the long-tailed macaques's genitals after copulation; 2) when pushing the penis (thrusting), the male will stop for a while, and his body vibrates after the male individual does it; 3) after finishing pushing the penis (thrusting), the female will run away from the male while making a copulation call.

At the time of mating behaviour, it is not uncommon for males to be rejected by females. Based on observations, the things that cause rejection from the female are: 1) the female is pregnant, breastfeeding

or weaning. Females carry out rejection behaviour towards males by running when approached by males. The female refuses to copulate because she is pregnant, breastfeeding, or because the female is in a higher social hierarchy, while the male is an animal with a lower social hierarchy. This behaviour can continue to become a fighting behaviour between the male and female. During the observation, mating failure occurred in individuals D (2nd day), E (3rd day), A, B and C (5th day). Failure begins with refusal from the first time they are approached, or the male gives up after checking the female's genitals; 2) the existence of coercion to the female that is not following the conditions. The male carries out the chase against the female by running. This behaviour includes the behaviour of forcing females to want to mate with males. The female being chased usually shows a grinning face (grimace), a sign that she does not want to be approached by the male.

The success of reproduction can be seen from the number of tillers treated and the number of populations in a group. The determining factors are:

- 1) Gender age. Male and female long-tailed macaque sex ages determine the success of the reproductive process. Long-tailed macaques have a different ages of sexual maturity in males and females. Sexual maturity in males is at the age of 4.2 years, while in females is 4.3 years (Napier and Napier 1967).
- 2) The cycle of lust. The lust cycle also determines the attraction of males and females to mates. The menstrual cycle (menstrual cycle) of long-tailed macaques is 28 days, about 11 days of estrus and 14-18 months of lactation. The average long-tailed macaques' maturity time is at the age of 3.5-5 years, with a breeding interval of 24-48 months (Fooden 1995). The gestation period for long-tailed macaques is around 160-186 days, the nursing period is 18 months, and the number of children per birth (litter size) is one.
- 3) Availability of feed. The success of female reproduction is closely related to the availability of feed. If the abundance of feed sources is high throughout the year, the birth rate will be higher than in years when there is a shortage of feed and in years with abundant feed and fruit availability. Activity and births occur earlier and more frequently than in years with low fruit availability (Kappeller and Schaik 2004). Pregnancy success

in long-tailed macaques couples averaged 66.67% (Iskandar 1998).

The long-tailed macaque is a primate species widely used for various purposes in ecology, socio-economics and biomedical. The existence of captive long-tailed macaques on Tinjil Island is expected to increase the number of long-tailed macaques populations in Indonesia to reduce the threat of extinction and meet market needs nationally and internationally. Success in captivity is also influenced by success in long-tailed macaques reproduction. Based on observations for five days, the stages of long-tailed macaques' sexual behaviour consisted of genital inspects of 21.31% (for 13 seconds), male mounts of 8.20% (for 5 seconds); intromission by 50.82% (for 31 seconds), and successful ejaculation by 19.67% (for 12 seconds). Success in reproduction is due to several factors, ranging from the sex age of adult males and females, the period of lust, and food availability in nature. The existence of information regarding the identification of stages in long-tailed macaques' sexual behaviour is expected to provide an overview and information so that it can provide recommendations to the authorities for better captive management actions.

References

- Altmann, J. 1974. Observational study of behaviour: sampling methods. *Behaviour*, 49, 227-267.
- Engelhardt, A., Pfeifer J.B., Heistermann, M., Niemitz C., van Hoof J.A.R.A.M, Hodges, J.K. 2004. Assessment of female reproductive status by male long-tailed macaques, *Macaca fascicularis*, under natural conditions. *Animal Behaviour*, 67(5), 915-24.
- Engelhardt, A., Hodges, J.K., Niemitz, C., Heistermann, M. 2005. Female sexual behaviour, but not sex skin swelling, reliably indicates the timing of the fertile phase in wild long-tailed macaques (*Macaca fascicularis*). *Hormones and Behavior*, 47(5), 195-204.
- Fooden, J., 1995. Systematic review of southeast asian longtail macaques (*Macaca fascicularis*) (Raffles 1821). *Fieldiana: Zoology*, 81, 1-206.

- Hansen, M.F., Ang, A., Trinh, T., Sy. E., Paramasiwam, S, Ahmed T, Dimalibot J, Jones-Engel L, Ruppert N, Griffioen C, Lwin N, Phiapalath P, Gray R., Kite S., Doak N., Nijman V., Fuentes A, Gumert M.D. 2022. *Macaca fascicularis*. The IUCN Red List of Threatened Species 2022: e.T12551A199563077. <https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T12551A199563077.en>. [Date accessed: 22 August 2022].
- Iskandar, E. 1998. Studi Tingkah Laku Pasangan *Macaca nemestrina* dan *Macaca fascicularis* Dewasa di PSSP LP-IPB [Unpublished Tesis]. Institut Pertanian Bogor, Bogor
- Iskandar E, Riendriasari, S.D., Sinaga, W. 2009. Dua Dekade Penangkaran Monyet Ekor Panjang (*Macaca fascicularis* Raffles 1821): Tinjauan Aspek Populasi, Habitat dan Manajemen. Laporan Penelitian [Unpublished Report]. Primate Research Center LPPM IPB, Bogor
- Kamarul, H., Ahmad, I., Badrul-Munir, M.Z., Syaizwan, Z., Aainaa, A. 2014. Ranging behavior of long-tailed macaques (*Macaca fascicularis*) at the entrance of Kuala Selangor Nature Park. *Malaysian Applied Biology*, 43(2), 129-142.
- Kappeler, P.M., van Schaik, C. 2004. *Sexual Selection in Primates: New and Comparative Perspectives*. Massachusetts: Cambridge University Pr.
- Kevernee, E.B. 1976. Sex attractants in primates. *Journal of Society of Cosmetic Chemists*, 27, 257-269.
- Napier, J.R., & Napier, P.H. 1985. *The Natural History of Primates*. Massachusetts: The MIT Press.
- Poole, T. 1985. *Tertiary Level Biology: Social Behaviour in Mammals*. New York (US): Blackie & Son Ltd.
- Rameiyanti, D., & Purnama, A.R. 2008. *Kuota monyet ekor panjang terus meningkat*. Available on http://www.profauna.org/content/id/berita/2008/monyet_macaca_fascicularis.html#top. [Date accessed: 5 January 2019]
- Sha, J.C.M., Gumert, M.D., Benjamin, P., Lee, Y.H., Fuentes, E., Rajathurai, S., Chan, S., Jones-Angel, L. 2009. Status of the long-tailed macaque *Macaca fascicularis* in Singapore and implications for management. *Biodiversity and Conservation*, 18, 2909-2926.
- Soehartono, T., Mardiasuti, A. 2003. *Pelaksanaan Konvensi CITES di Indonesia*. Jakarta: Japan International Cooperation Agency.
- Supriatna, J., & Wahyono, H.E. 2000. *Panduan Lapangan Primata Indonesia*. Jakarta: Yayasan Obor Indonesia.
- van Noordwijk, M.A. 1985. Sexual behaviour of Sumatran long-tailed macaque (*Macaca fascicularis*). *Zeitschrift fur Tierpsychologie*, 70, 277-296.