

Distribution of Long-tailed Macaque (*Macaca fascicularis*) in Deli Island, Pandeglang, Banten, Indonesia

Muhammad Fajrur Rifqi¹, Eko Sulistyadi², Ike Nurjuita Nayasilana^{1*}

¹Department of Forest Management, Faculty of Agriculture, Universitas Sebelas Maret, Jalan Ir. Sutami 36A, Surakarta, Indonesia, 57126.

²Research Center for Ecology and Ethnobiology, National Research and Innovation Agency of The Republic of Indonesia

Abstract

Deli Island is one of the habitats for the long-tailed macaque (*Macaca fascicularis*) outside its natural distribution. Little is known about the long-tailed macaques in Deli Island, including information on their habitat use. This study was conducted to determine the distribution pattern of long-tailed macaques in Deli Island. The study was conducted from 25 June–8 July 2022. The study used the transect method and the determination of the waypoint using GPS. Data were visualized in a map using ArcMap GIS 10.3 program to describe the presence and distribution of long-tailed macaques. A total of 27 groups of long-tailed macaques were observed on Deli island spread over several points. The troop size ranged between 12 to 36, and the largest group comprising 42 individuals was found in fishermen's huts. Results indicate for random distribution pattern of long-tailed macaques on Deli Island.

Key words: Deli Island, distribution, distribution pattern, long-tailed macaque

1. Introduction

Long-tailed macaques (*Macaca fascicularis*) are primates distributed in various Indonesian regions. Long-tailed macaques in Indonesia are thought to have originated from mainland Southeast Asia and migrated more than one million years ago (early Pleistocene) when mainland Asia and the Sunda plate merged (Fooden 1995). Geographically, long-tailed macaques are spread in tropical Southeast Asia, from northern Bangladesh and southern Burma to the south of the Indochina Peninsula, Kra isthmus, Peninsular Malaysia, Sumatra, Kalimantan, Java, the Lesser Sunda Islands to Timor, the Philippine Islands, and other small islands. Such as the Nicobar Islands in India (Sajuthi *et al.* 2016). They inhabit diverse habitats ranging from coastal, mangrove, nipah, watersheds, primary, secondary, and disturbed forests (Sajuthi *et al.* 2016). The species has a high survival rate in disturbed habitats and peripheral forests (Groves 2001; Sajuthi *et al.* 2016).

The existence of long-tailed macaques is easy to find in various living ecosystems, including Deli Island, which is geographically outside of its natural distribution. Deli Island is located at 7°01'00" LS - 105°31'25" east longitude, which administratively belongs to the area of Cikiruh Wetan Village, Cikeusik District, Pandeglang Regency, Banten Province of Indonesia. Deli Island is semi-natural breeding for long-tailed macaques, where the macaques are released in the forest but are still given little food (Paryadi *et al.* 2006). With the semi-natural captivity of long-tailed macaques on Deli Island, Indonesia's population is hoped to be more sustainable.

Animal and habitat management in semi-natural captivity are the most important activities to ensure the success of captive breeding. One important requisite for managing long-tailed macaque on Deli Island is knowledge of its distribution. Distribution is related to the home range, one aspect of habitat use. By knowing these aspects, appropriate habitat management can be determined so that animals

*Corresponding author

Email Address : nayasilana@staff.uns.ac.id

can breed optimally. Information regarding the distribution of long-tailed macaques on Deli Island is scanty. Thus, a study is needed to determine the distribution of long-tailed macaques on Deli Island to support habitat management. It is hoped that the data on the distribution of long-tailed macaques on Deli Island will serve as basic data for further studies.

2. Methods

The study was conducted on Deli Island, administratively located in Cikiruh Wetan Village, Cikeusik District, Pandeglang Regency, Banten Province (Figure 1). This research was conducted from 24 June to 9 July 2022.

Positioning System (GPS), binoculars, compass, watch, camera, tally sheet for observing long-tailed macaques, a set of computers, and ArcMap GIS software Version 10.3. The materials used in this study include a map of the Deli Island area and literature on long-tailed macaques.

Data on the distribution of long-tailed macaques were obtained using the transect method. The survey location was divided into six observation lines

evenly distributed across the island from the north, varying in lengths from 1000 meters to 2000 meters. The line transect is a plotless method in which the observer walks along a straight line, either randomly or systematically (Kühl *et al.* 2011). A straight line that intersects the island's width, the path was determined based on preliminary studies of potential encounters with long-tailed macaques. Additional data on encounters with long-tailed macaques outside the transect are also included to support distributed data based on the results of encounters over time. Forage tree preferences were examined using the Rapid Assessment method. According to IUCN (2007), rapid assessment is a method that can be used to quickly and accurately collect and record relevant observational data, both qualitatively and quantitatively at the observation site, to determine the type of forage plants and dominant trees of any behaviour in the macaque activity location.

The encounters of groups of long-tailed macaques were identified based on the composition of the group structure, the direction of group movement and the study of the long-tailed macaque

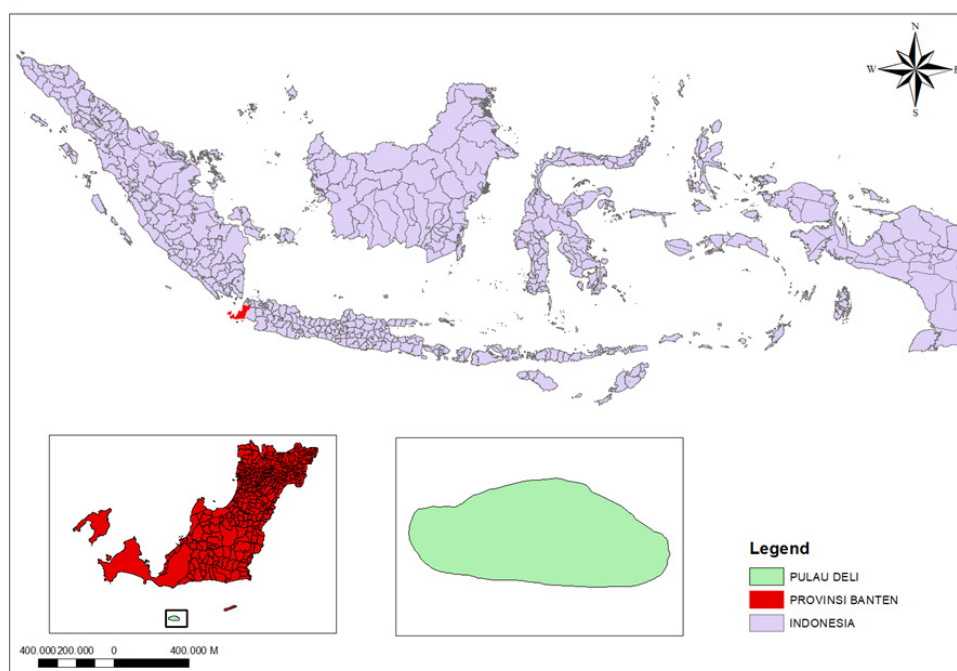


Figure 1. Location of Deli Island as the study area

ranges with the same habitat, which was observed from each encounter of long-tailed macaques. Group identification was carried out to deepen the distribution analysis and distribution pattern of the long-tailed macaque group.

The distribution studied was analyzed descriptively quantitatively. The distribution of long-tailed macaques visualized in a map using ArcMap GIS software Version 10.3. To determine the distribution pattern using the Average Nearest Neighbor Analysis or nearest neighbour analysis, introduced by Clark and Evans (1954), is a geographical quantitative analysis method used to determine the distribution pattern (Hidayat *et al.* 2021). Nearest Neighbor Ratio ranges from 0 to 2.15, which will have a random pattern if the value is around 1, a group pattern if the value is less than 1, and a uniform pattern if the value is greater than 1 (Riadhi *et al.* 2020).

3. Result

There were 119 encounter points with groups of long-tailed macaques collected from a field survey

conducted from June to July 2022. In the field survey, groups of long-tailed macaques were often found in northern coastal forest areas and forests around swamps. The group analysis results showed that 27 troops of long-tailed macaques spread on Deli Island (Figure 2).

Based on the field survey results, long-tailed macaques are often found on transect-2, transect-4, and several encounters on the north coast. The vegetation found at the location of the encounter was dominated by vegetation that produced fruit, including ketapang (*Terminalia catappa*), nutmeg (*Myristica fragrans*), loa (*Ficus racemosa*), butun (*Barringtonia asiatica*), guava (*Syzygium cymosum*), waru (*Hibiscus tiliaceus*), and kiara (*Ficus glomerata*).

The existence of a water source is a distribution factor other than food. Fresh water sources are found in swamps in the middle of Deli Island. Several encounter points on transect 2, transect 3, and transect 5 are located around the swamp. The results of the analysis of the distribution pattern of long-tailed macaques on Deli Island showed a random pattern

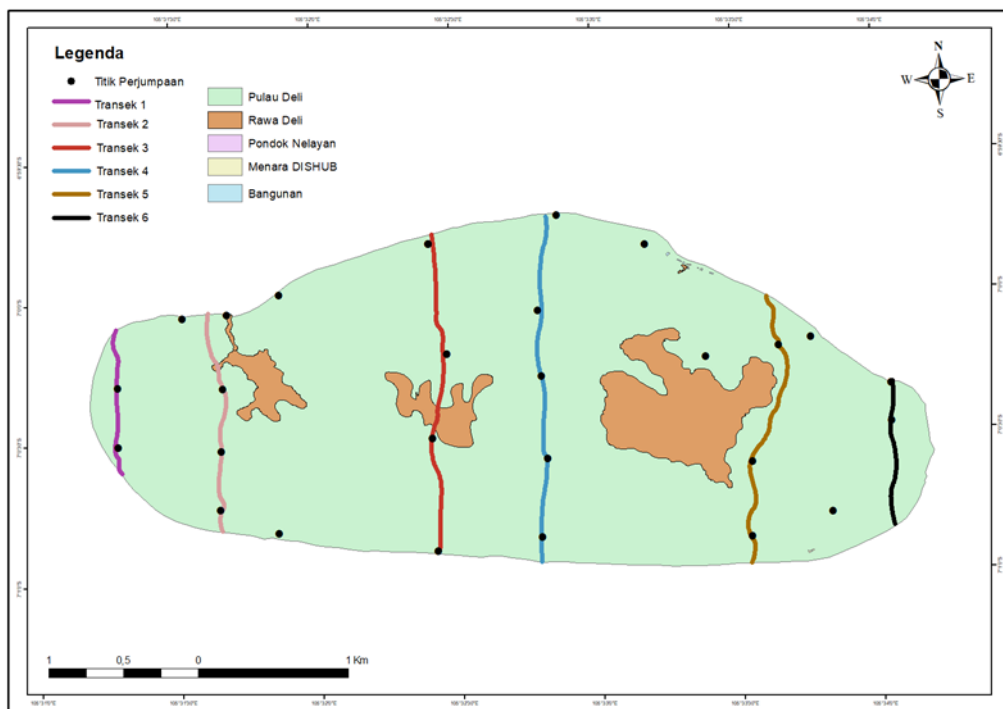
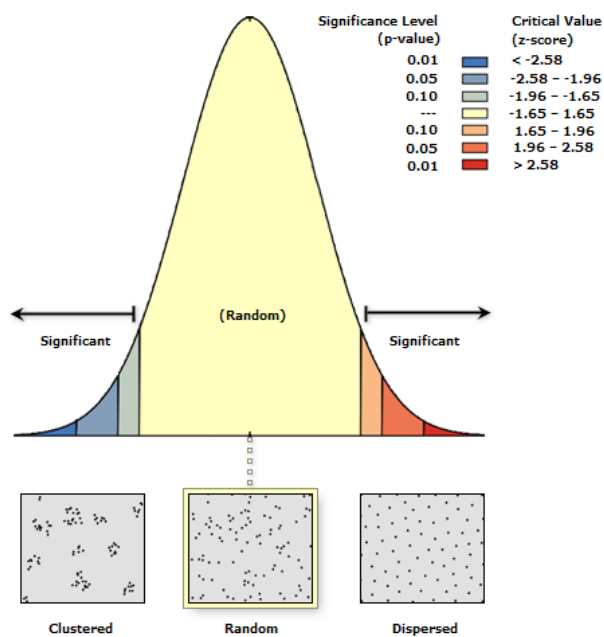


Figure 2. Waypoints of the long-tailed macaque groups

with a Nearest Neighbor Ratio of 1.089431 with an average distance of 298.0147 meters resulting in a (p-value) of 0.340807 with a (z-score) of 0, 952571 (Figure 3).

4. Discussion

The group analysis refers to the home range of long-tailed macaques in Yusuf's research (2010), stating that the estimated average area of the long-tailed macaque group on Tinjil Island is 6.9 ha. The habitat conditions of Deli Island and Tinjil Island have similarities. The vegetation condition is relatively the same, namely coastal vegetation, in the form of old trees such as Ketapang along the north and south coast vegetation dominated by pandanus (Holmes and van Balen 1996).



| Average Nearest Neighbor Summary | |
|----------------------------------|-----------------|
| Observed Mean Distance | 324,6663 Meters |
| Expected Mean Distance | 298,0147 Meters |
| Nearest Neighbor Ratio | 1,089431 |
| z-score | 0,952571 |
| p-value | 0,340807 |

Figure 3. Distribution Pattern of Long-tailed macaque group

Long-tailed macaques are often found in swamp forest habitat types and north coast habitat types (Figure 4). Long-tailed macaques are often found at this location because there are several forage trees, Zairina *et al.* (2015) explained that the availability of natural food plant species is one of the reasons macaques occupy these habitats. Payne *et al.* (2000) in Sulistyadi (2016) mention that long-tailed macaques are often found in coastal forests, mangrove forests, and coastal forests to find food in the form of fruit, insects, frog eggs, crabs, and other coastal invertebrates (Figure 5).

The vegetation found at the location of the encounter was dominated by vegetation that produced fruit. Following Romauli's (1993) statement in Santosa (1996), long-tailed macaques are *frugivorous animals* or fruit eaters, with the percentage of food being 71.01% for fruits and 6.06% for other types of food. According to the study, the long-tailed macaque's diet consisted of 64-66.7% fruits, 17.2% leaves, 8.9% flowers, 4.1% insects, and 3.2% other types of food (Rowe 1996; Sajuthi *et al.* 2016). The parts eaten by long-tailed Macaques are fruit, leaves, flowers, and some young bark (Figure 6). Long-tailed macaque encounters on transect 1, transect 3, transect 5, and transect 6 also occurred in fruit-producing vegetation such as ketapang, guava, and kiara trees. Santoso (1996) stated that long-tailed macaques found on Tinjil Island really like butun leaves (*Barringtonia asiatica*), the part that is eaten from the leaves is the leaf bone at the base and the tuber of the leaf shoots, which tastes sweet, the part of the fruit eaten is the flesh of the fruit. Such as songgom fruit (*Gluta wallichii*), guava, peuris (*Antidesma pyrifolium*), ki cau (*Dolichandrone spathacea*), sawo kecik (*Manilkara kauki*), ketapang, and types of *Ficus*. In addition to providing feed, these trees also function as a place for activities and shelter.



Figure 4. Long-tailed macaques observed on Deli Island

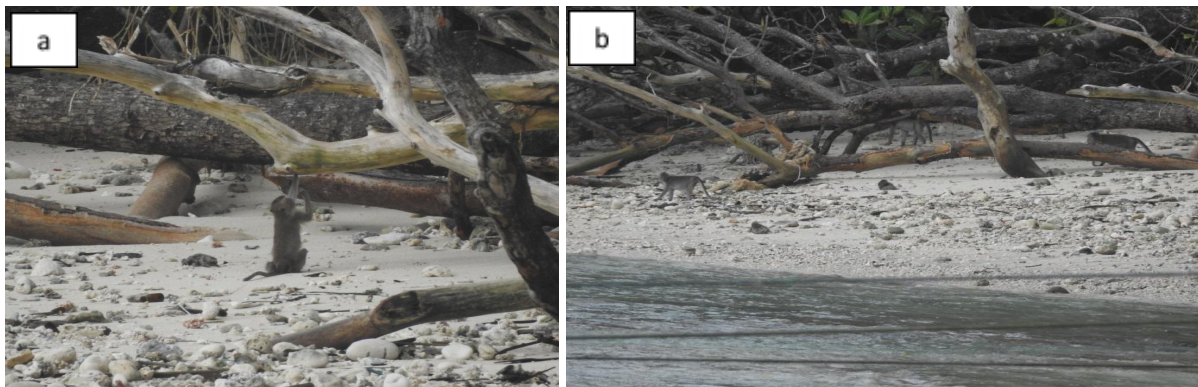


Figure 5. a) Long-tailed macaques eating coastal invertebrates attached to fallen logs, b) Long-tailed macaque encounters at a north coast location

Sembiring *et al.* (2012) in Ziyus *et al.* (2019) stated that water and food sources influence the distribution of long-tailed macaques. Crocket and Wilson (1980) and Fooden (1995), in Yanuar *et al.* (2009) mentioned that long-tailed macaques were found in various environments, with the greatest abundance in swamp forests and secondary forests. It happens because water is the most important factor for all living things, including long-tailed macaques. Alikodra (2010) in Sembiring *et al.* (2016) stated that there are several reasons why riparian areas play an important role for wildlife, including long-tailed macaques; (1) availability of water as a habitat

component is very important, (2) sufficient water available for plants will increase plant diversity to produce a good habitat for wildlife including long-tailed macaques, (3) riparian areas create a better microclimate for wild animals, (4) can serve as a migration corridor, (5) riparian areas are a link between various habitat conditions that result in meeting areas between habitats favoured by wild animals including long-tailed macaques. Alikodra (2002) in Srimulyaningsih and Suryadi (2018) states that wild animals need water for various processes, namely food digestion and metabolism, transporting waste materials, and cooling in evaporation.



Figure 6. a) and b) Guava fruit and Kandal kulit fruit are leftover food for long-tailed macaques, c) Long-tailed macaques eating the bark of young Butun Trees

The distribution pattern commonly occurs in nature is clustered or random (Indriyanto 2006; Sari *et al.* 2020; Asyofi *et al.* 2021). The availability of food is often the cause of the gathering of individuals in one place. According to Fuentes *et al.* (2007) in Fakhri *et al.* (2012), long-tailed macaques can adapt to various conditions, especially in habitats that are affected by human activities. The clustered distribution pattern will make it easier for individuals to relate to each other for various needs, such as reproducing and foraging for food (Ayunda 2011; Rozakiyah 2014; Munawaroh 2019). A random distribution pattern is where animals spread out in several places and group

together in other places. The random distribution pattern indicates the non-selective behaviour of the species towards its environment (Tarumingkeng 1994; Sinaga *et al.* 2017).

The behaviour of primates that form units or colonies also encourages the occurrence of clustered distribution patterns. The factors influencing the distribution pattern include vectorial, reproductive, social, and coactive factors (Asyofi *et al.* 2021). Vectorial factors arise from external environmental forces (such as wind, water movement and light intensity). Reproductive factors are related to the reproductive model of an organism, social factors are

more due to occupant behaviour (such as territorial behaviour), while coactive factors are generated from intraspecific interactions (such as competition) (Odum 1993; Sari *et al.* 2020; Asyrofi *et al.* 2021). The main factor in the existence of a population of long-tailed macaques is the source of food available in the habitat (Husni *et al.* 2017)

The concentration of long-tailed macaques in this area indicates a feed preference. The distribution pattern of long-tailed macaques on Deli Island is often found on the island's north side and around the swamp. Observations show that this is due to the abundance of trees that make up the feeding preferences of long-tailed macaques. While on the south side of the constituent vegetation in the form of *Pandanus* sp.

In conclusion there are 27 groups of long-tailed macaques (*Macaca fascicularis*) on Deli Island. The distribution pattern of the long-tailed Macaque group identified was *random* with a *Nearest Neighbor Ratio* of 1.089431 with an average distance of 298.0147 meters resulting in (p-value) 0.340807 with (z-score) 0.952571. The distribution of long-tailed macaques is often found in northern coastal forest habitats and forests around swamps.

Acknowledgements

Thank you to the National Research and Innovation Agency of The Republic of Indonesia. Survey Team; Mrs Yuli Setya Fitriana, Mr Rizki Kurnia Thohir, Mr Muhajir Hasibuan, Arie Mulia Lubis, who helped in data collection, CV Labsindo, Perum Perhutani Banten – BKPH Malimping for research permits.

References

Asyrofi, M., Sulistiyowati, H., Wimbaningrum, R. 2021. Pola distribusi populasi lutung jawa (*Trachypitecus auratus* E. Geoffroy Saint-Hilaire, 1812) di Cagar Alam Watangan Puger, Kabupaten Jember. *In Gunung Djati Conference Series*, 6: 63-70.

Ayunda, R. 2011. *Struktur Komunitas Gastropoda pada Ekosistem Mangrove di Gugus Pulau Pari Kepulauan Seribu*. [Undergraduate Thesis]. Program Studi Biologi Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Indonesia. Depok.

Clark, P. J., Evans, F. C. 1954. Distance to nearest neighbor as a measure of spatial relationships in populations. *Ecology*, 35(4): 445-453.

Fakhri, K., Priyono, B., Rahayuningsih, M. 2012. Studi awal populasi dan distribusi *Macaca fascicularis* Raffles di Cagar Alam Ulolanang. *Unnes Journal of Life Science*, 1(2): 119 – 125.

Fooden, J. 1995. *Systematic Review of Southeast Asian Longtail Macaques, Macaca fascicularis* (Raffles, 1821). Zoology. Published by Field Museum of Natural History. 81.

Groves, C.P. 2001. *Primate Taxonomy*. Washington, DC: Smithsonian Institution Press.

Hidayat, I., Nasution, S., Candra, F. 2021. Analisis pola distribusi lahan perkebunan di Kecamatan Bungaraya menggunakan pendekatan metode average nearest neighbor (studi kasus: Kecamatan Bungaraya, Kabupaten Siak Sri Indrapura). *JOM FTEKNIK*, 8(1): 1-8.

Holmes, D., van Balen, S. 1996. The birds of Tinjil and Deli Islands, West Java. *KUKILA*, (8): 117-126.

Husni, Rahmiyati, H., Mardiah, A., Faskanu, I. 2017. Populasi monyet ekor panjang (*Macaca fascicularis*) di kawasan Gua Sarang Gampong Iboih Kecamatan Suka Karya Kota Sabang. *Prosiding Seminar Nasional Biotik 2017*, 245 – 248.

Indriyanto. 2006. *Ekologi hutan*. Jakarta: PT. Bumi Aksara

IUCN, The World Conservation Union. 2007. *Pedoman dan Metodologi Rapid Assesment untuk Kerusakan Ekosistem Darat Pesisir Akibat Tsunami*. IUCN Publications Services Unit. Cambridge.

Kaho, N. P. L. B. R, Purnama, M. E., Kolloh, D. 2018. *Analisis Spasial Wilayah Jelajah dan Pola Distribusi Serta Perilaku Monyet Ekor Panjang (Macaca fascicularis) di Taman Rekreasi Gua Monyet Tenau, Kota Kupang*. Program Studi Kehutanan. Fakultas Pertanian. Universitas Nusa Cendana. Kupang.

- Kühl, H., Maisels, F., Acrenaz, M., Williamson, E.A. 2011. *Panduan Survei dan Pemantauan Populasi Kera Besar. Gland, Switzerland: IUCN.* <https://portals.iucn.org/library/sites/library/files/documents/SSC-OP-036-Id.pdf>. [Date accessed: 1 September 2022].
- Munawaroh. 2019. Explorasi monyet ekor panjang (*Macaca fascicularis*) di Desa Geger Kabupaten Bangkalan Madura. *Jurnal Pedago Biologi*, 7(2): 62-74.
- Odum, E. P. 1993. *Dasar-dasar Ekologi. Terjemahan oleh Tjahjono Samingandari buku Fundamentals of Ecology.* Gadjah Mada University Press: Yogyakarta.
- Paryadi, S., Santosa, Y., Ontarjo, J. 2006. Studi biaya dan pendapatan penangkaran monyet ekor panjang (*Macaca fascicularis*) dengan sistem terbuka, semi terbuka dan tertutup. *Media Konservasi*, 11(2): 59-65.
- Peraturan Menteri Kehutanan, Nomor: P.19/Menhut-II/2005 tentang Penangkaran Tumbuhan dan Satwa Liar.
- Riadhi, A. R., Aidid, M. K., Ahmar, A. S. 2020. Analisis penyebaran hunian dengan menggunakan metode nearest neighbor analysis. *VARIANSI: Journal of Statistics and Its Application on Teaching and Research*, 2(1): 45-61.
- Rozakiyah, Yolanda, R. Purnama, A.A. 2014. Kepadatan dan distribusi keong mas (*Pomacea canaliculata*) di saluran irigasi bendungan batang samo desa suka maju kabupaten rokan hulu. *Jurnal Biologi Tropis*, 8(2): 128-133
- Sajuthi, D., Astuti, D. A., Farajallah, D. P., Iskandar, E., Sulistiawati, E., Suparto, I. H. dan Kyes, R. C. 2016. *Hewan Model Satwa Primata: Macaca fascicularis: Kajian Populasi, Tingkah Laku, Status Nutrien, dan Nutrisi untuk Model Penyakit.* IPB Press. Bogor.
- Santosa, Y. 1996. Beberapa Parameter bio-ekologi penting dalam pengusahaan monyet ekor panjang (*Macaca fascicularis*). *Media Konservasi*, 5(1): 25 – 29.
- Santoso, Y. 1996. Analisis habitat dan potensi pakan monyet ekor panjang (*Macaca fascicularis*, Raffles) di Pulau Tinjil. *Media Konservasi*, 5(1): 5-9.
- Sari, F. N. I., Baskoro, K., Hadi, M. 2020. Estimasi Populasi dan Vegetasi Habitat Lutung Jawa (*Trachypithecus auratus* E. Geoffrey 1812) di Gunung Ungaran, Jawa Tengah. *Jurnal Biologi Tropika*, 3,47-56
- Sembiring, R. P., Setiawan, A., Darmawan, A. 2016. Penyebaran dan kelimpahan populasi monyet ekor panjang (*Macaca fascicularis*) di Cagar Alam Sibolangit. *Jurnal Sylva Lestari*, 4(3): 47 -58.
- Sinaga, W., Iskandar, E., Wahyudi, I., Sultan, K., Utomo, D., Paksi, Dewa, N., Indra, G., Januardi, Anwar, F., Sajuthi, D., dan Manangsang, J. 2017. Studi inventarisasi jenis dan sebaran primata endemik di wilayah pengelolaan Taman Nasional I dan II Taman Nasional Siberut, Sumatera Barat, Indonesia. *Jurnal Primatologi Indonesia*, 14(1): 9 – 13.
- Srimulyaningsih, R. dan Suryadi, L. D. S. 2018. Pola pergerakan monyet ekor panjang (*Macaca fascicularis*) di Cagar Budaya Ciung Wanara. *Wanamukti*. 21(2): 83 – 96.
- Sulistiyadi, Eko. 2016. Karakteristik komunitas mamalia besar di Taman Nasional Bali Barat (TNBB). *Zoo Indonesia*, 25(2): 142 – 159.
- Tarumingkeng, R.C., 1994. *Dinamika populasi: kajian ekologie kuantitatif.* Pustaka Sinar Harapan.
- Yanuar, A., Chivers, D. J., Sugardjito, J., Martyr, D. J., Holden, J. T. 2009. The population distribution of pigtailed macaque (*Macaca nemestrina*) and long-tailed macaque (*Macaca fascicularis*) in West Central Sumatra, Indonesia. *Asian Primates*, 1:2-11.
- Yusuf, T. M. M. 2010. *Karakteristik Wilayah Jelajah Monyet Ekor Panjang (Macaca fascicularis Raffles 1821) di Pulau Tinjil, Pandeglang, Banten.* [Undergraduate Thesis]. Departemen Konservasi Sumberdaya Hutan dan Ekowisata. Fakultas Kehutanan. Institut Pertanian Bogor. Bogor.
- Zairina, A., Yanuwiadi, B., dan Indriyani, S. 2015. Pola penyebaran harian dan karakteristik tumbuhan pakan monyet ekor panjang (*Macaca fascicularis*) di Hutan Rakyat Ambender, Pamekasan, Madura. *J-PAL*, 6(1): 1 – 12.
- Ziyus, N. A., Setiawan, A., Dewi, B. S., dan Harianto, S. P. Distribusi monyet ekor panjang (*Macaca fascicularis*) di Taman Nasional Way Kambas. *Jurnal Belantara*, 2(1): 35-42.