

Mammals' Abundance in Lingga Isaq Hunting Park Landscape, Aceh

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Abstract. Hunting-park is a conservation area with the unique attraction of periodically hunting in terms of wildlife management. Lingga Isaq Hunting-Park (LIHP) is one of 13 hunting parks in Indonesia. However, the utilization of LIHP as a hunting park is still facing obstacles; two of which are conflicts of interest among authorities and no data on the animals, especially mammals – the most hunted creatures in the park. Therefore, a study was conducted to identify the mammalian abundance and distribution. This data would be useful for essential decision-making for hunting-tourist attractions in LIHP. This study used the transect method, with 12 transect strips evenly distributed in those four function areas (protection forest, production forest, other use areas, and hunting park); three per each. We found 11 species of mammals belonging to 8 families. The protected forest had the highest biodiversity value ($H'=1.50$), while other areas had the lowest biodiversity value ($H'=1.16$). *Macaca fascicularis* had the highest abundance (23 individuals), while *Sus scrofa* was found in all landscape forests. Protected forests and other utilization areas have the highest habitat similarity, identified as having intense anthropogenic activities. The protected forest also has habitat similarity with a hunting park as both areas are legally protected. Based on mammalian species that had been found, there are only *Cervus unicolor*, *Muntiacus muntjak*, and *Sus scrofa* that are potential to be hunted for hunting tourism attractions.

Keywords: Abundance, distribution, mammalian, landscape, Lingga Isaq Hunting Park, hunting-attraction.

INTRODUCTION

Mammals are an important group of animals and play a significant role in ecosystems [1,2,3]. Mammals of various sizes, habitats and geographic areas have various functions as herbivores, carnivores, primary producers, pollinators, dispersers of fruits and seeds, pest control, ecosystem engineers, and energy flows [4].

Mammal abundance is an important parameter as a basis for population management in a landscape or ecosystem. Populations can change naturally due to births and immigration,

but also decrease as a result of mortality, emigration, and poor habitat quality. Mammals are sensitive and can experience the most significant population decline due to forest disturbances [4,5,6]. The decline in the abundance and distribution of mammals will have a negative impact on ecosystem processes. In the long run, this will limit the size of the population and the number of services this system provides to humans [7].

One form of mammal management by humans is hunting in hunting parks. According to Damm [8], hunting tourism is part of a triple-bottom line approach to sustainable conservation. This approach includes social, economic and ecological considerations in achieving two objectives, namely wildlife conservation and economic development through income sharing with local communities in the same area [9,10].

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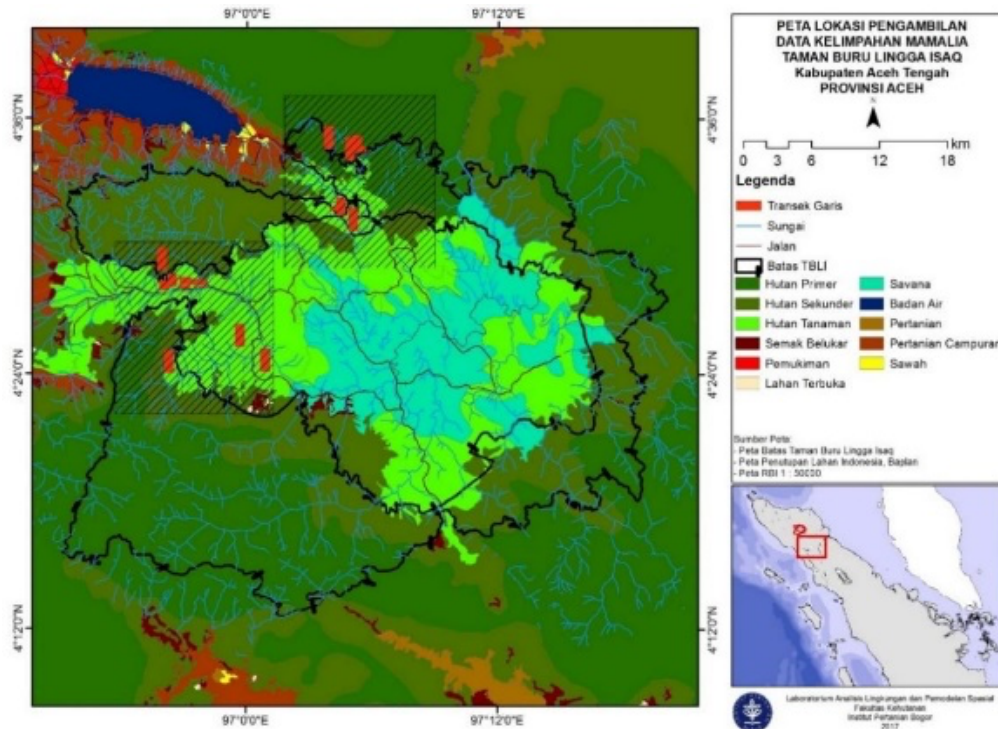


Figure 1 Sampling site for mammal abundance in Lingga Isaq Hunting Park, Aceh Tengah.

Lingga Isaq hunting-park (LIHP) area is one of the Indonesia hunting parks located in Aceh Tengah district, Aceh Province and has an ecosystem of tropical rain forest, pine forest, grassland, and shrubs. LIHP was appointed based on the Decree of the Minister of Agriculture Number 70/Kpts/Um12/1978 on February 7, 1978 with an area of 86.704 ha [7].

The hunting park is also an important part of efforts to conserve wildlife [11,12,13]. The existence of mammals as hunting animals in LIHP landscape is essential, not only as hunting tourism but also for ecological benefit. Mammals play essential roles in ecosystems, i.e predation, herbivory, ecosystem engineering, granivore, pollination, nutrient cycling, pest control, seed dispersal, and energy flow [7].

Mammals have sensitivity and experienced the most significant population decline due to forest disturbances [4,5,6]. The decline in abundance and distribution of mammals will have negative effects on ecosystem processes. In the long term, it will limit the number and amount of services these systems provide to human populations [7]. Poaching is one of the causes of the significant decline in mammalian populations [14,15,16,17], and it is also the cause of the decline in several endangered mammal species in LIHP [18]. The population decline must be accompanied by efforts to increase the population, either by way of habitat development or by other means.

LIHP has a high potential for biological resources, especially mammalian species, but information about this is still lacking. The potential of LIHP has not been managed optimally and impacted on less contribution to the community and local government. The area's management is only limited to a security approach and not integrated into the region's overall development. On the other hand, according to Damm [8], hunting tourism is part of a triple-bottom line approach to sustainable conservation. This approach includes social, economic and ecological considerations. Hunting tourism activities can achieve two goals: wildlife conservation and economic development through shared incomes with local communities in the same area [9,10]. The financial economy aspect has an important role in achieving ecological and economic sustainability [12].

One of the objectives of an area designated as a hunting-park is to provide ecological benefits that preserve biological diversity and develop the habitat and potential of hunting animals. Primary data related to animal distribution and abundance is essential to support the main purpose of hunting tourism activity. This information determines the condition and potential of hunting animals, especially mammals, in LIHP landscape. So far, there is very limited data on the abundance of mammals in LIHP, while information on the distribution and abundance of animal is very important to

support the main objectives of hunting tourism activities as well as conservation of animal species. Based on this, this study was conducted with the aim of assessing the abundance of mammals in the Lingga Isaq hunting park landscape. This information will describe the conditions and potential for hunting animals, especially mammals in the LIHP landscape. Furthermore, the population data will be very useful in predicting the growth rate of mammal populations, setting hunting quotas as compensation for hunting quotas [19], as well as formulating hunting park management plans.

METHODOLOGY

Time and Place

This research was conducted at four function area: protected forest (HL), production forest (HP), other use areas (APL), and Hunting park (TB) Central Aceh District, Aceh Province (Figure 1). Administratively, LIHP area includes Bintang sub-district, Linge sub-district, Laut Tawar sub-district and Pegasing sub-district. The largest part of LIHP is in Bintang and Linge sub-district [7]. Based on the Decree of the Minister of Environment and Forestry No. 747 of 2015, regarding the determination of the area of the Lingga Isaq Conservation Forest Management Unit, LIHP area was reduced to 86.320 ha, this area is under Aceh Qanun No. 19 of 2013 concerning Spatial Planning for the Aceh region of 2013-2033. The data was collected in August 2016.

Materials

The tools used in this research are the 2014 forest and water designation map, RBI Indonesia map 1:50.000, compass, altimeter, GPS, meter tape, and camera.

Procedure

Data collection on mammal diversity was carried out using the strip transect method with a sample unit size of 2 km long and 100 m wide (50 meters on the right and 50 m on the left). Twelve transects were spread over four types of Lingga Isaq hunting Park landscape; protected forest (Hutan Lindung/HL), production forest (Hutan Produksi/P), other use areas (Area Penggunaan Lain/APL), and hunting park (Taman Buru/TB), three transects of each landscape. Species abundance observation was carried out in the morning from 06.00 to 09.00 a.m. and in the afternoon from 4.00 to 6.00 p.m. Double counting is minimized by observing the behavior and movement of animals found directly, while for animals that are identified indirectly, the differences in the number and traces of animals per location found, the distance between traces/nests found, and the

alleged direction of movement are recorded [4]. Animal identification is carried out by referring to the mammal field guide book [20]. Conservation status is determined on the trade status of the CITES Appendix (Convention on International Trade of Endangered Species) and its rarity status according to the IUCN Red List (International Union for Conservation of Nature and Natural Resources) and the regulation of the Minister of Environment and Forestry Number P.106/MENLHK/SETJEN/KUM.1/ 12/2018.

Data analysis

The analysis of mammal species diversity was measured using the Shannon-Wiener Species Diversity Index with the following equation:

$$H' = -\sum p_i \ln p_i$$

Where:

H' : Shannon-Wiener Diversity index

p_i : Proportion of the i -th type (obtained from the number of i -th individuals divided by the total number of individuals obtained at a location)

Analysis of the abundance of mammal species is represented by the value of density with the following equation:

$$D = \frac{\text{number of individuals of the species}}{\text{area (unit)}}$$

Community similarity values at each observation location were calculated using Nonmetric Multidimensional (NMDS) with Bray Curtis dissimilarity index and Dendrogram illustrated using PAST 3.06 software.

$$NMDS = [Cn = 2jN/aN + bN]$$

Where:

jN : the number of individuals is lower or the same from the two habitats

aN : the number of individuals of all species in habitat A

bN : the number of individuals of all species in habitat B.

RESULTS AND DISCUSSION

Mammalian abundance

The number of mammal species found based on field observation using the strip transect method was 11 species from eight families. The mammal species found in the protected forest area were six species, production forests were four species, other uses were four species, and hunting parks were five species (Table 1).

Table 1 Species, number of individuals, and diversity index of mammals found in the Lingga Isaq Hunting Park Landscape

Family	Species	Number of individuals			
		HL	HP	APL	TB
Suidae	<i>Sus scrofa</i>	2	3	3	6
Bovidae	<i>Capricornis sumatraensis</i>	3			
Cercopitheciidae	<i>Trachypithecus cristatus</i>			9	
	<i>Macaca fascicularis</i>	9		6	8
	<i>Macaca namestrina</i>			1	3
	<i>Muntiacus muntjak</i>		2		4
Cervidae	<i>Cervus unicolor</i>	1			1
Felidae	<i>Prionailurus bengalensis</i>		1		
Hominidae	<i>Pongo abelii</i>	1			
Manidae	<i>Manis javanica</i>		1		
Viverridae	<i>Paradoxurus hermaphrodites</i>	5			
Diversity index (H')		1.50	1.28	1.16	1.44

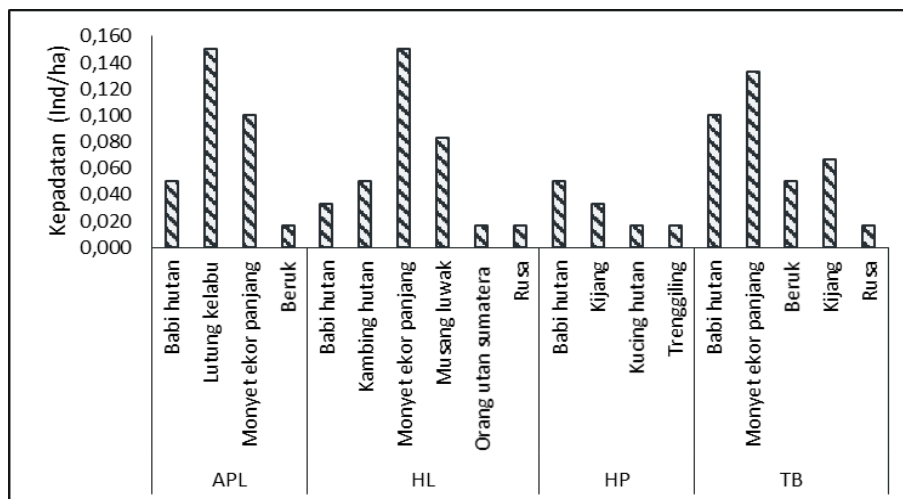
Note: (HL/Hutan Lindung): protected forest, (Hutan Produksi/HP) production forest, (Area Penggunaan lain/APL) another use area, and (Taman Buru/TB) hunting-park

The results of the Shannon-Wiener species diversity index analysis were sequentially in the protected forest ($H' = 1.50$), production forest ($H' = 1.28$), another use area ($H' = 1.16$), and hunting park ($H' = 1.44$). The protected forest has the greatest diversity value, followed by hunting-park. Those two areas are located nearby and function as protected function areas, where there is still area security even though it is not optimal. Production forest is in the third position, which is supported by areas and trees standing for animal life. Another use area has the smallest diversity value because in this area,

there are many human activities such as settlements and cultivation activities.

Mammal observation in Lingga Isaq hunting park landscape aims to see the potential for hunting target animals for the benefit of developing hunting tourism in Lingga Isaq hunting park area. The results showed that mammals' density in each area differed (Figure 2). Species from the family Cercopitheciidae had the highest density value. The Cercopitheciidae family known as has a high adaptability to environmental changes and can coexist with the community. In other use area, the species that has the highest population was grey langur (*Trachypithecus cristatus*) (0.15 individu/ha). In protected forest and hunting park, long-tailed monkey (*Macaca fascicularis*) was the species with the highest density (1.5 individu/ha in protected forest and 1.33 Individu/ha in hunting park), while in production forest, wild boar (*Sus scrofa*) was the species with the highest density (0.05 individu/ha).

Mammals from the family Cercopitheciidae, including grey langur and long-tailed monkey, had the highest population densities in three forest areas; protected forest, hunting-park and another use area. The three forest areas may be still able to meet their life needs, both for food and protection. In addition, in the other use area, grey langur and long-tailed monkey had a higher density value than other animals due to food abundance in this area. Gumert (2011) stated that many long-tailed monkeys' populations have habitats that overlap with human settlements [21]. According to Eudey (2008), long-tailed monkeys are animals that have high adaptation to land degradation [22], supported by the statement of Lee *et al.* (2005)



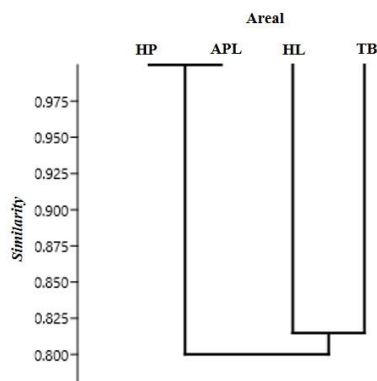
Note: (HL/Hutan Lindung): protected forest, (Hutan Produksi/HP) production forest, (Area Penggunaan lain/APL) another use area, and (Taman Buru/TB) hunting-park

Figure 2 Density of mammals in each type of forest area

that long-tailed monkeys colonize plantation areas in search of food grown by the community [23].

The wild boar (*Sus scrofa*) is a mammal with the highest population density in the protected forest area, besides that, this species can be found in all sampling locations. This result is in line with research conducted by Junaidi *et al.* (2012). The distribution of *Sus scrofa* can be found in all areas because this species is a generalist species or can live in various habitats [24]. In addition, people who are predominantly Muslims do not hunt *Sus scrofa*.

The similarity of mammal habitat in the Lingga Isaq hunting park landscape based on area status was carried out using the Bray-Curtis index (Figure 3). The area with the highest similarity value for mammal species is another use area and production forest. These two areas have a high intensity of human activities, causing the species of mammals to live the same. The abundance of these mammalian species is strongly influenced by vegetation conditions [25,26]. Protected forests and hunting-park which are conservation areas have a high community similarity value because the species that inhabit the area are almost the same. The protected forest and hunting park areas are conservation areas with primary forest land cover and adjoining area boundaries which cause the types of animals found to be almost the same.



Note: (HL/Hutan Lindung): protected forest, (Hutan Produksi/HP) production forest, (Area Penggunaan lain/APL) another use area, and (Taman Buru/TB) hunting-park

Figure 3 Dendrogram Bray-Curtis with single linkage in several types of conservation area and land cover in LIHP

The value of community similarity between the production forest-other use area and the protected forest-hunting park is different because the production forest-other use area has the community has cultivated relatively the same conditions, namely many areas. It is different with protected forest - hunting-park

where the community surrounding hunting park area disturbs area with the status of a conservation area to grow coffee. The conversion of forest land to coffee plantations has decreased the wealth and abundance of mammalian species [26,27,28]. Extensive agricultural systems with low-complexity landscapes need to be prioritized in conservation efforts because of their impact on ecosystem function [26]. However, hunting-park still has the same primary forest area as the protected forest, so the value of habitat similarity is high.

The existence of animal in the LIHP landscape is necessary for conservation activities, especially because in area such as protected forest, protected species are still found, likes *Pongo abelii*, which is one of the species on the verge of extinction over the past decade, including due to hunting and land change [5, 30, 31, 32, 33].

Conservation status

Conservation status (mammal communities found based on IUCN, CITES, and the regulation of the Minister of Environment and Forestry number P.106/MENLHK/SETJEN/KUM.1/12/2018 (Table 2).

Table 2 Mammalian conservation status in Lingga Isaq Hunting Park

Indonesia name	Scientific name	Conservation status		
		IUCN	CITES	P.106/2018
Kambing hutan Sumatera	<i>Capricornis sumatraensis</i>	VU	APP I	+
Monyet Ekor Panjang	<i>Macaca fascicularis</i>	LC	-	-
Lutung Kelabu	<i>Trachypithecus cristatus</i>	NT	APP II	-
Beruk	<i>Macaca nemestrina</i>	VU	-	-
Kijang	<i>Muntiacus muntjak</i>	LC	-	+
Rusa	<i>Cervus unicolor</i>	VU	-	+
Sambar				
Kucing kuwuk	<i>Prionailurus bengalensis</i>	LC	APP I	+
Orang utan Sumatera	<i>Pongo abelii</i>	CR	APP I	+
Trenggiling	<i>Manis javanica</i>	CR	APP I	+
Babi hutan	<i>Sus scrofa</i>	LC	-	-
Musang	<i>Paradoxurus hermaphrodites</i>	LC	APP III	-
Luwak				

Note: NT = Near Threatened; VU= Vulnerable, LC = Least Concern, CR = Critically Endangered; App I = Appendiks CITES I, App II = Appendiks CITES II; App III = Appendiks CITES III, + = Dilindungi berdasarkan P.106/MENLHK/SETJEN/KUM.1/12/2018.

Table 2 shows that three species are classified as vulnerable (VU): *Capricornis sumatraensis*, *Macaca nemestrina* and *Cervus unicolor*. Two species are critically endangered (CR), namely *Pongo abelii* dan *Manis javanica*. One species

near threatened (NT) is *Trachypithecus cristatus*. Meanwhile, according to CITES four species are included in Appendix 1, one species of appendix II and one species including to appendix III. According to PP No.7 1999 there are six species that are included in protected species [34].

LIHP area has mammal species that can be used as hunting targets, namely Sambar deer (*Cervus unicolor*), deer (*Muntiacus muntjak*), and wild boar (*Sus scrofa*). According to Kartono *et al.* [12], *Cervus unicolor* and *Muntiacus muntjak* are hunting animals that are an essential key as the basis for the management of hunting parks, one of which is a consideration for determining hunting quotas. The existence of mammals as one of hunting animals must be maintained or increased in population.

Management implication

Mammals are one of the attractive hunting attractions, so their presence, abundance, and distribution will determine the type, location, and appropriate management of a hunting park, including the Lingga Isaq Hunting-park. According to Arbieu *et al.* (2018), recreational ecosystem services like wildlife tourism are specific cultural ecosystem services that often involve relationships between the supply of opportunities to interact with biodiversity and the demand of wildlife tourists. They found that the relationships between biodiversity measures and visitor numbers differed among protected areas [35]. It implies that the diversity of habitat types in the Lingga Isaq Hunting-park can be managed to increase the heterogeneity of the mammalian habitat as well as the viewing area.

Deer and muntjak often attract enthusiasts for hunting because of the economic and aesthetic value of the trophy. As a herbivore animal, the Lingga Isaq hunting park must be managed to become a suitable habitat for herbivore animals. Alternatives that can be done include building a feed source area, a shelter area. Rahman *et al.* 2017 mentioned that forest landscape is the fundamental scale for deer management, and that secondary forests are potentially important landscape elements for deer conservation [36]. Considering at the four existing habitat types, it is essential to improve habitat quality to increase the abundance and distribution of mammals in the landscape of Buru Lingga Isaq Park.

CONCLUSION

The Lingga Isaq hunting-park has 11 types of mammals including the mammal species, they are Sumatran forest goat (*Capricornis sumatraensis*), long-tailed monkey (*Macaca*

fascicularis), grey langur (*Trachypithecus cristatus*), macaque (*Macaca nemestrina*), deer (*Muntiacus muntjak*), Sambar deer (*Cervus unicolor*), Kuwuk cat (*Prionailurus bengalensis*), Sumatran orangutan (*Pongo abelii*), pangolin (*Manis javanica*), wild boar (*Sus scrofa*), and palm civet (*Paradoxurus hermaphrodites*). Protected forest and hunting-park are areas that have a high level of species diversity. Long-tailed monkey have the highest abundance and wild boars are animals that found throughout area.

There are mammal species that have potential as hunting animal in LIHP: Sambar deer, deer and wild boar. The results of the analysis of the potential of this mammal require further action, namely carrying out habitat management and determining hunting quotas for the development of hunting activities in the future.

REFERENCES

- [1] Estes, J. A., Terborgh, J., Brashares, J.S., Power, M. E., Berger, J., Bond, W.J., Carpenter, R., Essington, T.E., Holt, R.D., Jackson, J.B.C., Marquis, R.J., Oksanen, L., Oksanen, T., Paine, R.T., Pickett, E.K., Ripple, W.J., Sndin, S.A., Scheffer, M., Schoener, T.W., Shurin, J.B., Sinclair, A.R.E., Soule, M.E., Virtanen, R., and Wardle, D.A. 2011. Trophic downgrading of planet Earth. *Science* **333** (6040) 301–306. Doi: 10.1126/science.1205106.
- [2] Davidson, A. D., J. K. Detling, and J. H. Brown. 2012. Ecological roles and conservation challenges of social, burrowing, herbivorous mammals in the world's grasslands. *J. Frontiers in Ecology and the Environment* **10** 477–486.
- [3] Ripple, W. J., and Beschta, R. L. 2012. Trophic cascades in Yellowstone: the first 15 years after wolf reintroduction. *J. Bio Con* **145** (1) 205–213.
- [4] Lacher, T. E. Jr.; Davidson, A. D.; Fleming, T.H.; Gómez-Ruiz, E. P.; McCracken, G. F.; Owen-Smith, N; Peres, C.A.; Vander Wall, S.B. 2019. The functional roles of mammals in ecosystems. *J. Mammalogy*. **100** (3) 942–964. <https://doi.org/10.1093/jmammal/gyyl83>
- [5] Kuswanda, W; Mukhtar, A.S. 2010. Pengelolaan populasi mamalia besar terrestrial di Taman Nasional Batang Gadis, Sumatera Utara, *J. Penelitian Hutan dan Konservasi Alam* **7** (1), 59-74. Doi: 10.20886/jphka.2010.7.1.59-74.
- [6] Shodi, N.S; Koh, L. P.; Clements, G. R.; Wanger, T. C.; Hill, J. ; Hamer, K. C.;

- Clough, Y.; Scharntke, T; Posa, M. R. C.; Lee, T. M. 2010. Conserving Southeast Asian forest biodiversity in human-modified landscapes, *J. Bio Con* **143** (10), 2375-2384.
Doi:10.1016/j.biocon.2009.12.029.
- [7] [BKSDA Aceh] Balai Konservasi Sumber Daya Alam Aceh. 2014. *Rencana Pengelolaan Jangka Panjang Taman Buru Lingga Isaw Periode 2014-2023 Kabupaten Aceh Tengah, Provinsi Aceh*. Yayasan LEBah dan BKSDA Aceh (ID): Aceh.
- [8] Hidayat, S. 1997. Suatu tinjauan status berdasarkan potensi flora dan fauna di Taman Buru Lingga Isaq. *J. Media Konservasi* **5** (1), 8995.
- [9] Damm, G. R. 2008. *Recreational Trophy Hunting: "What do we know and what should we do?"* In Baldus, R. D., G. R. Damm, dan K. Wollscheid, editor. *Best Practices in Sustainable Hunting a Guide to Best Practices from Around the World*. Hungary (HU): CIC International Council for Game and Wildlife Conservation; p. 5-11.
- [10] Child, B.; S. Ward; T. Tavengwa. 1997. *Zimbabwe's CAMPFIRE Programme: Natural Resource Management by the People*. Harare (ZW): IUCN-ROSA.
- [11] Ratag, E.Y; Santosa, A.P; Kartono; T.U. Nitibaskara. 2006. Kajian ekologi populasi rusa sambar (*Cervus unicolor*) dalam pengusahaan Taman Buru Gunung Masigit Kareumbi. *J. Media Konservasi* **11** (2), 39-45.
- [12] Kartono, A.P; Santosa, Yanto; Darusman, D; Thohari, A.M. 2008. Penentuan kuota buru dan introduksi populasi rusa sambar untuk menjamin perburuan lestari. *J. Media Konservasi* **13** (2), 53-58.
- [13] Santosa, Y; Firmansyah. 2012. Prospek pengembangan Kebun Buru Rusa Perum Perhutani BKPH Jonggol Jawa Barat berdasarkan tinjauan ekologi. *J. Ilmu Pertanian Indonesia* **17** (1), 69-78.
- [14] Sodhi, N.S.; T. M. Lee; L. P. Koh; B. W. Brook. 2009. A meta-analysis of the impact of anthropogenic forest disturbance on Southeast Asia's biotas. *J. Biotropica* **41**, 103-109
- [15] Havmøller, R. G.; Payne, J.; Ramono, W.; Ellis, S.; Yoganand, K.; Long, B.; Dinerstein, E.; William, A. C.; Putra, R. H.; Gawi, J.; Talukdar, B. K.; Burgess, N. 2016. Will current conservation responses save the critically endangered sumatran rhinoceros *Dicerorhinus sumatrensis*?. *J. Oryx* **50** (2), 355-359.
- [16] Farida, W. R. 2010. Trenggiling (*Manis javanica desmarest*, 1822) mamalia bersisik yang semakin terancam. *Fauna Indonesia* **9** (1), 5-9. <http://lipi.go.id>.
- [17] Steinmetz, R; W. Chutipong; N. Seuaturien; E. Chirngsaard; M. Khaengketkarn. 2010. Population recovery patterns of Southeast Asian ungulates after poaching. *J. Biological Conservation* **143** 42-51.
- [18] Linkie, M.; D. J. Martyr; J. Holden; A. Yanuar; A. T. Hartana; J. Sugiardjito; N. G. Williams. 2003. Habitat destruction and poaching threaten the Sumatran tiger in Kerinci Seblat National Park, Sumatra. *J. Oryx* **137** (1), 41-48.
- [19] Baldus, R. D., 2008. Wildlife: can it pay its way or must it be subsidized? didalam Baldus RD, Damm GR, Wollscheid K, editor. *Best Practices in Sustainable Hunting a Guide to Best Practices from Around the World*. Hungary (HU): CIC International Council for Game and Wildlife Conservation; p. 12-16.
- [20] Hanum, C. M. 2018. Lingga Isaq Hunting Park as a Basis of Sustainable Management: A Socio-Economic Study. *J. Manajemen Hutan Tropika* **23** (1), 32-44. Doi:10.7226/jtfm.23.1.32
- [21] Payne, J.; Francis, C. M.; Phillips, K.; Kartikasari, S.N. 2000. *Panduan Lapangan Mamalia di Kalimantan, Sabah, Sarawak dan Brunei Darussalam*. Jakarta: Prima Centra. ISBN:979-95964-0-8
- [22] Gumert, M., 2011. The Common Monkey of Southeast Asia: Long-tailed Macaque Populations, Ethnophoresy, and Their Occurrence in Human Environments *in*: Monkeys on the Edge: The Ecology and Management of Long-tailed Macaques and their Interface with Humans. Cambridge, UK: Cambridge University Press.
- [23] Eudey, A. A. 2008. The crab-eating macaque (*Macaca fascicularis*): widespread and rapidly declining. *J. Primate Conservation* **23** (1) 129-132. Doi: 10.1896/052.023.0115.
- [24] Lee, P. C; Priston, N. E. C. 2005. Perceptions of Pests: Human Attitudes to Primates, Conflict and Consequences for Conservation *in*. Commensalism and Conflict: The Primate-Human Interface (eds.). American society of primatologists.
- [25] Junaidi; Rizaldi; Novarino, W. 2012. Inventarisasi jenis-jenis mamalia di hutan pendidikan dan penelitian biologi (HPPB) Universitas Andalas dengn

- menggunakan camera trap, *J. Bio.UA.* **1** (1), 27-34. Doi:10.25077/JBIOUA.1.1.%P.2012.
- [26] Gordon, C.; Manson, R.; Sundberg, J.; Cruz-Angon, A. 2007. Biodiversity, profitability, and vegetation structure in a Mexican coffee agroecosystem. *J. Agriculture, Ecosystem and Environment* **118** 256-266. Doi:10.1016/j.agee.2006.05.023.
- [27] Gallina, S.; Mandujano, S.; Gonzalez-Romero, A. 1996. Conservation of mammalian biodiversity in coffee plantations of Central Veracruz, Mexico. *J. Agroforestry System* **33** 13-27. Doi:10.1007/BF00122886.
- [28] Caudill, S. A.; Vaast, P.; Husband, T. P. 2014. Assessment of small mammal diversity in coffee agroforestry in the Western Ghats, India. *Agroforest Syst* **88** 173-186. ISSN: 0167-4366.
- [29] Williams-Guillen, K.; Perfecto, I. 2010. Effects of agricultural intensification on the assemblage of leaf-nosed bats (Phyllostomidae) in a coffee landscape in Chiapas, Mexico. *J. Biotropica* **42** (5), 605-613.
- [30] Daily, G. C.; Ceballos, G.; Pacheco, J.; Suzan, G.; Sanchez-Azofeifa, A. 2003. Countryside Biogeography of Neotropical Mammals: Conservation opportunities in agricultural landscapes of Costa Rica. *J. Cons Bio* **17** (6), 1523-1739. Doi: 10.1111/j.1523-1739.2003.00298.x.
- [31] Wich, S. A.; Singleton, I.; Nowak, M. G.; Atmoko, S. S. U.; Nisam, G.; Arif, S. M.; Putra, R. H.; Ardi, R.; Fredriksson, G.; Usher, G.; Gaveau, D. L. A.; Kuhl, H. S. 2016. Land-cover changes predict steep declines for the Sumatran orangutan (*Pongo abelii*). *Sci Adv* **2** (3), 1-8. Doi: 10.1126/sciadv.1500789
- [32] Wich, S. A.; Fredriksson, G. M.; Usher, G.; Peters, H. H.; Priatna, D.; Basalamah, F.; Susanto, W.; Kuhl, H. 2012. Hunting of Sumatran orangutans and its importance in determining distribution and density. *J. Bio Con* **146** (1) 163-169. Doi: 10.1016/j.biocon.2011.12.006.
- [33] Wich, S.; Meijaard, E.; Marshall, A. J.; Husson, S.; Ancrenaz, M.; Lacy, R. C.; van Shaik, C. P.; Sugardjito, J.; Simorangkir, T.; Traylor-Holzer, K.; Doughty, M.; Suprianta, J.; Dennis, R.; Gumal, M.; Knott, C. D.; Singleton, I. 2008. Distribution and conservation status of the orang -utan (*Pongo* spp.) on Borneo and Sumatra: how many remain?. *J. Oryx* **42** (3), 329-339. Doi: 10.5167/uzh-3914.
- [34] Knop E; Ward PI; Wich S. 2004. Comparison of orangutan density in a logged and unlogged forest in Sumatra. *J. Bio Con* **120** (2), 183-188. Doi: 10.1016/j.biocon.2004.02.010.
- [35] Departemen Kehutanan. 1999. Lampiran Peraturan Pemerintah No. 7 tahun 1999 tentang Pengawetan Jenis Tumbuhan dan Satwa, tanggal 27 Januari 1999. Departemen Kehutanan. Jakarta.
- [36] Arbieu, U.; Grunewald, C.; Martín-López, B.; Schleuning, M.; Böhning-Gaese, K. 2018. Large mammal diversity matter for wildlife tourism in southern African protected areas: insights for management. *J. Eco Ser.* **31**, 481-490.