

## Short Communication: Diversity of small mammals (non-volant) in tropical peatland ecosystem of Orang Kayo Hitam Forest Park, Jambi, Indonesia

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**Abstract.** Dara W, Iswandaru D, Wulandari C, Novriyanti, Prasetia H. 2023. Short Communication: Diversity of small mammals (non-volant) in tropical peatland ecosystem of Orang Kayo Hitam Forest Park, Jambi, Indonesia. Intl J Bonorowo Wetlands 13: 30-35. Peatlands areas dominate Orang Kayo Hitam Forest Park (OKH Forest Park), Jambi, Indonesia. The largest forest fire in the OKH Forest Park area occurred in 2015, damaging more than 70% of the area. The event subsequently affected the existing biodiversity, especially the diversity of small mammals. Small mammals have an important role in the ecosystem as agents in regeneration and restoration, including in the OKH Forest Park. The method used is the cage trap method which is placed by systematic sampling. Traps were placed in two types of habitats, namely shrubs, and forests. The bait variation consisted of coconut, sweet potato, banana, and oil palm fruit. All baits were treated by burning to give off an aroma. The resulting data were analyzed quantitatively using the Shannon-Wiener Diversity Index. Types of small mammals found in shrubs and forest habitats are Malaysian field rats (*Rattus tiomanicus* (Miller, 1900)) and plantain squirrels (*Callosciurus notatus* (Boddaert, 1785)). The diversity index shows a low category with a value of ( $H' = 0.17884$ ). That indicates the condition of the habitat in the post-burnt peat ecosystem is still relatively depressed.

**Keywords:** Diversity, peatland, small mammals

### INTRODUCTION

Living things rely on peatlands to play a critical role in mitigating the impacts of global climate change (Sudrajat and Subekti 2019). However, the peatlands soil is not easily weathered, accumulates in an anaerobic state, and there is organic matter that is primarily undecomposed (Masganti et al. 2014). Peatlands are vulnerable ecosystems, and restoring them to their original condition is difficult in the event of damage. Peatland management must be carried out ecologically because peatlands are combustible ecosystems. The fire on peatlands is more dangerous as it can spread rapidly below the ground surface. The rehabilitation of burnt peatlands is a challenging and expensive task (Wibisono and Dohong 2017). In addition, the productivity of peatlands decreases due to the degradation of soil fertility, soil biology, and physical properties of the soil (Maftuah and Hayati 2019).

Orang Kayo Hitam Forest Park (OKH Forest Park) has a peat swamp ecosystem in Jambi Province, Indonesia (Wulandari et al. 2021). OKH Forest Park is located in two districts, Muaro Jambi District and Tanjung Jabung Timur District with an area of 18,363.79 ha. Based on the 2012 OKH Forest Park landscape map, there are five classes of land cover, namely primary swamps (18.7 ha), secondary swamps (10,710.35 ha), shrubs (7,394 ha), open land (1.35 ha), and swamps (109.92 ha). A major fire in 2015 resulted in more than 70% of the existing acreage being burned and

becoming an open area. Moreover, the OKH Forest Park is a *Panthera tigris* subsp. *sumatrae* (Pocock, 1929), Sumatran elephants (*Elephas maximus* subsp. *sumatranus* Temminck, 1847), gibbons (*Hylobates syndactylus* (Raffles, 1821)), and asian tapirs (*Tapirus indicus* Desmarest, 1819) (Mulyani and Iqbal 2020). OKH Forest Park still has tree species typical of peat ecosystems, such as *jelutung rawa* (*Dyera polyphylla* (Miq.) Steenis), *pulai rawa* (*Alstonia pneumatophora* Backer ex Den Berger), and several other tree species living places for the animals in it (Tamin et al. 2019). Degraded peatlands caused by repeated fires dominate the OKH Forest Park area, worsening forest and land degradation (Tamin et al. 2021). That will affect biodiversity and small mammals.

As of 2019, Indonesia is recorded to have approximately 776 mammals out of 12,000 species worldwide and is a country that ranks first in mammal diversity (Derajat 2022). Mammals are a group of vertebrate animals that have mammary glands. Mammals are divided into two based on their body size, namely large and small mammals (Irsaf et al. 2018). According to Apriyani and Nasihin (2017), small mammals, such as mice and squirrels, weigh less than five kilograms on adults. Rats are small nocturnal mammals with hair-covered heads, bodies, and tails (Heriyanto and Ristiyanto 2017). Small mammals have a higher metabolic rate and shorter life span than large mammals. Small mammals have a vital role in ecosystems, such as seed scatterers, pollinators, insect

population control, and prey for carnivorous animals (Kartono 2016). They are essential in supporting forest regeneration (Mazerolle et al. 2001). Research on small mammals has been widely carried out in Indonesia, such as Husson et al. (2018) in the Sebangau Peat Swamp Forest of Central Kalimantan Province, Harrison dan Rieley (2018) in the peat swamp forests of Southeast Asia, Derajat (2022) in Ujung Kulon National Park, Banten Province, Putra et al. (2022) at the Batu Tegi Forest Management Unit (KPH) of Lampung Province, and Ramadhani et al. (2019) in Ijen Nature Reserve, East Java Province. However, based on research that has been carried out, there have yet to be studied on small mammals in the OKH Forest Park peat ecosystem. This study illustrates how the condition of small mammal diversity in the OKH Forest Park peat ecosystem can support the restoration of peatlands. Therefore, this study aims to analyze the diversity of small mammal species in the OKH Forest Park peat ecosystem of Jambi Province, Indonesia.

## MATERIALS AND METHODS

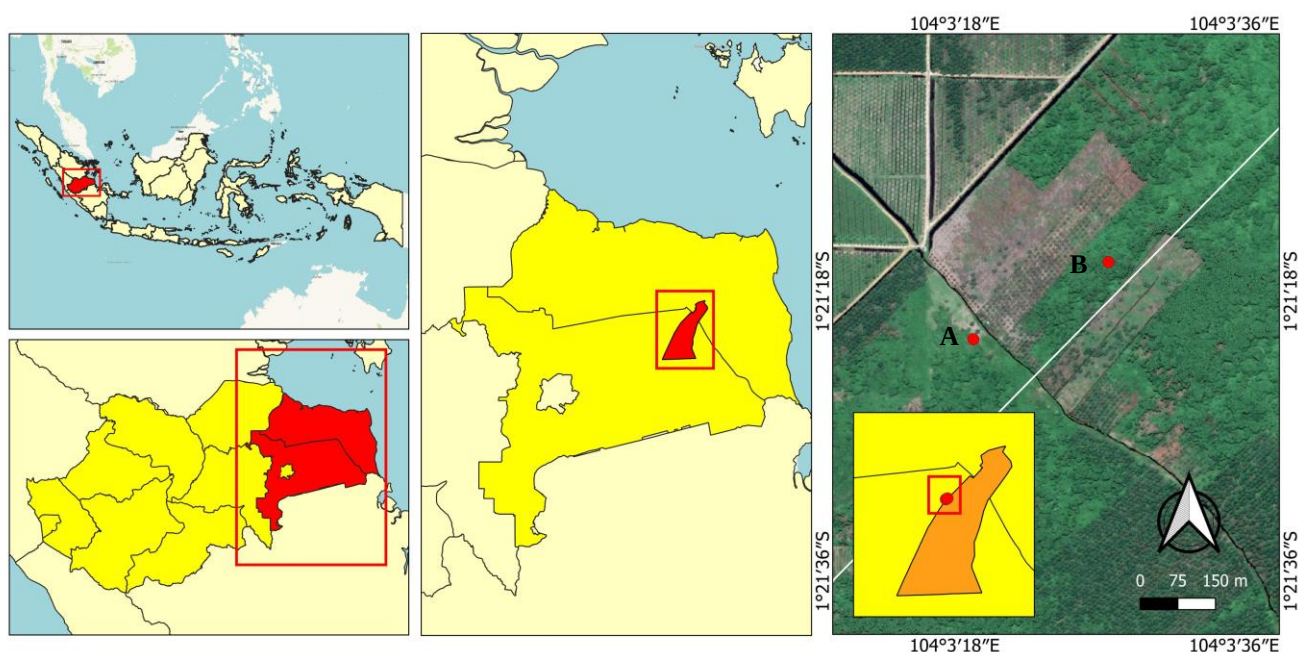
### Study area

This research was conducted in September 2022 at the peat ecosystem of the Orang Kayo Hitam Forest Park, Jambi Province, Indonesia, located in the Muaro Jambi and Tanjung Jabung Timur Districts. Observations were made in two types of habitat, namely scrub (Lat -1.355847°, Long 104.055337°) and Young Forest (Lat -1.354469°, Long 104.057755°). These two habitats were selected because they reflect the condition of the OKH Forest Park post-burning in 2015. Land cover characteristics in the

scrub habitat are filled with shrubs 1-2 meters high, while the land cover in Young Forests is dominated by mahang (*Macaranga* sp.), rengas (*Gluta renghas* L.), and punak wood (*Tetramerista glabra* Miq.) with a height of 5-8 meters and an average diameter of 16.8 cm. OKH Forest Park has an area of 18,363.79 ha, and based on the landscape map of OKH Forest Park in 2012, there are five land cover classes, namely secondary swamp (10,710.35 ha), primary swamp (18.7 ha), shrubs (7,394 ha), open land (1.53 ha), and swamp (109.92). The OKH Forest Park is predominantly comprised of peatlands designated as conservation areas. Therefore, this area is highly susceptible to burning, especially during drought-dominated periods, by peatlands included in the conservation area. Therefore, it is vulnerable and easily burnt, especially during dry spells. The location map of this research can be seen in Figure 1.

### Trapping procedures

This research followed the cage trap method (locally-made trap) performed by Rianisa et al. (2018). Traps were placed in two different habitat types: scrub and Young Forest. Traps are installed by systematic sampling at 20 meters and placed on both sides (right and left) of the inspection path. The distance between the trap and the inspection line is 5 meters each. The traps were made of wire 35 cm x 3 cm x 12 cm. Then, these traps were filled with bait such as coconut, sweet potatoes, bananas, and oil palm fruit. Before being placed in the trap, the bait is burned to release its fragrance. Traps were checked twice daily, in the morning from 07.00-09.00 am and in the evening from 04.00-06.00 pm, for eight days, and the baits were replaced twice a day.



**Figure 1.** Map of research locations in the Orang Kayo Hitam Forest Park, Jambi Province, Indonesia. A. Scrub, B. Young Forest

Every small mammal caught was identified, following the key identification in the Mammals in Kalimantan, Sabah, Sarawak, and Brunei Darussalam Field Guide by Payne et al. (2000) and Guidebook for Identification of Protected Wildlife Species; Mammals by KLHK (2019). The small mammals caught were recorded for their physical characteristics, documented, marked with hair paint, and released.

### Data analysis

The data obtained were analyzed using the Shannon Wiener Species Diversity Index ( $H'$ ) with excel and Spearman Correlation Analysis with SPSS. The level of species diversity is a mathematical measure of species diversity in a community. The determination of the species diversity index in this study used the Shannon-Wiener Index (Odum 1994), which is calculated by the following formula:

$$H' = - \sum_{i=1}^S (p_i) \ln p_i$$

Where:

$H'$  : Shannon Wiener diversity index

$S$  : number of types

$p_i$  : proportion of the  $i$ -th individual count ( $n_i/N$ )

$\ln$  : natural log

The Shannon Index has the following indicators:

$H' < 1.5$  = low diversity level

$1.5 \leq H' < 3.5$  = moderate diversity level

$H' > 3.5$  = high diversity level

Determining the relationship between bait and the diversity of small mammals in this study used Spearman correlation test analysis which was calculated using the following formula:

$$r_s = 1 - \frac{6 \sum_{i=1}^n [R(x_i) - R(y_i)]^2}{n(n^2 - 1)} = 1 - \frac{6 \sum_{i=1}^n d^2}{n(n^2 - 1)}$$

Where:

$r_s$  : spearman correlation coefficient

$R(x_i)$  and  $R(y_i)$  : ranking score data variables  $X$  and  $Y$

$n$  : amount of data

The Spearman correlation test has the following indicators:

$rs \rightarrow \pm 1$  : there is a very close relationship between the variables  $X$  and  $Y$ , if the sign is minus (-), then the relationship between variables is not unidirectional, and if the sign is positive (+), then the relationship between variables is unidirectional

$rs \rightarrow \pm 0$  : there is no relationship between the variables  $x$  and  $y$

$\pm 0.10 < rs < \pm 0.30$  : very weak variable relationship

$\pm 0.30 < rs < \pm 0.50$  : moderate variable relationship

$\pm 0.50 < rs < \pm 0.70$  : close variable relationship

$\pm 0.70 < rs < \pm 1$  : very close variable relationship

## RESULTS AND DISCUSSION

### Diversity of small mammals

Based on observations of small mammals caught during the study, only two species were found: the plantain Squirrel (*Callosciurus notatus* (Boddaert, 1785)) and the Malaysian Field Rat (*Rattus tiomanicus* (Miller, 1900)). This type of small mammal is found in scrub and Young Forest habitats. The results of calculating the number of individuals are presented in Table 1.

Two species were obtained, namely *C. notatus* and *R. tiomanicus*, with a total of 23 individuals. The *R. tiomanicus* species were found 22 individuals, with nine males and 13 females. In addition, the *C. notatus* species was found with a total of one individual only. However, the sex could not be identified due to its high mobility. The head and body length of the *R. tiomanicus* measured from the anus to the nose was 14-18.8 cm, the tail length measured from the tip of the tail was 12-18.1 cm, the total length measured was 26-36.9 cm, and the weight was 78-125 grams. The *R. tiomanicus*'s upper body is dark brown, the lower body is pale gray with white hair tips, and the tail is dark brown. The feet are relatively wide, with subtle bumps on the soles. The male *R. tiomanicus* has a pubic area far from the anus compared to the female *R. tiomanicus*. Some testicles hang down in male rats, while in female rats, there is a vaginal opening behind the bulge.

The *C. notatus* found had a head and body length of 17.5 cm, a tail length of 16 cm, a total length of the *C. notatus* measured was 33.5, and a weight of 210 grams. The upper body of the *C. notatus* has fine brownish spots with brown and black side stripes. The underside of *C. notatus* is dark and reddish. The male *C. notatus* has sex and anus, which are farther apart than the female *C. notatus*, and the male *C. notatus* has a penis length of 1 cm.

### Feed and diversity correlation test

Based on the correlation test results, it is known that bait variations and small mammal diversity are not correlated, or there is no significant relationship. This can be seen from the Sig. (2-tailed) which shows a value of 0.301, meaning that the relationship between bait and the diversity of small mammals is very weak. According to Raharjo (2017), if Sig. (2-tailed) > 0.05, the correlation between these variables is insignificant. The correlation coefficient value was obtained at -0.276, which showed a negative value meaning that the relationship between the two variables was not unidirectional (Table 2).

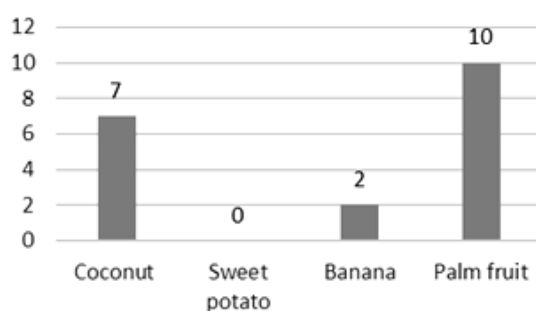
The results of the bait preferences showed that a higher number of small mammals were trapped using oil palm fruit and coconut baits compared to those caught with banana and sweet potato baits (Figure 2). Based on the data obtained in the two habitats, namely shrubs and Young Forest, seven were consumed for coconut bait, zero for sweet potato bait, two for bananas bait, and 10 for oil palm fruit bait. The total bait consumed was 19, and four traps contained two individuals.

**Table 1.** Types of small mammals found in Orang Kayo Hitam Forest Park, Jambi Province, Indonesia

| Family    | Local name          | Scientific name             | Individuals | Males (n) | Females (n) | H'      |
|-----------|---------------------|-----------------------------|-------------|-----------|-------------|---------|
| Muridae   | Plantain Squirrel   | <i>Callosciurus notatus</i> | 1           | -         | -           | 0.17884 |
| Sciuridae | Malaysian Field Rat | <i>Rattus tiomanicus</i>    | 22          | 9         | 13          |         |
|           | Individuals Total   |                             | 23          |           |             |         |

**Table 2.** Results of Spearman correlation between bait variation and diversity of small mammals in Orang Kayo Hitam Forest Park, Jambi Province, Indonesia

|                |                            | Correlations            | Bait variation | Diversity of small mammals |
|----------------|----------------------------|-------------------------|----------------|----------------------------|
| Spearman's rho | Bait variation             | Correlation coefficient | 1.000          | -0.276                     |
|                |                            | Sig. (2-tailed)         | 0.000          | 0.301                      |
|                |                            | N                       | 16             | 16                         |
|                | Diversity of small mammals | Correlation coefficient | -0.276         | 1.000                      |
|                |                            | Sig. (2-tailed)         | 0.301          | 0.000                      |
|                |                            | N                       | 16             | 16                         |

**Figure 2.** Types of feed used

## Discussion

The most commonly found species is the *R. tiomanicus*. This is because *R. tiomanicus* have a wide distribution area and food range. The *R. tiomanicus* are small mammals that are nocturnal and primarily terrestrial. It is often found in short thickets, secondary forests, mountains, and shrubs. Peninsular Malaysia, Java, Sumatra, Borneo, and several adjacent islands are where *R. tiomanicus* is distributed (Payne et al. 2000).

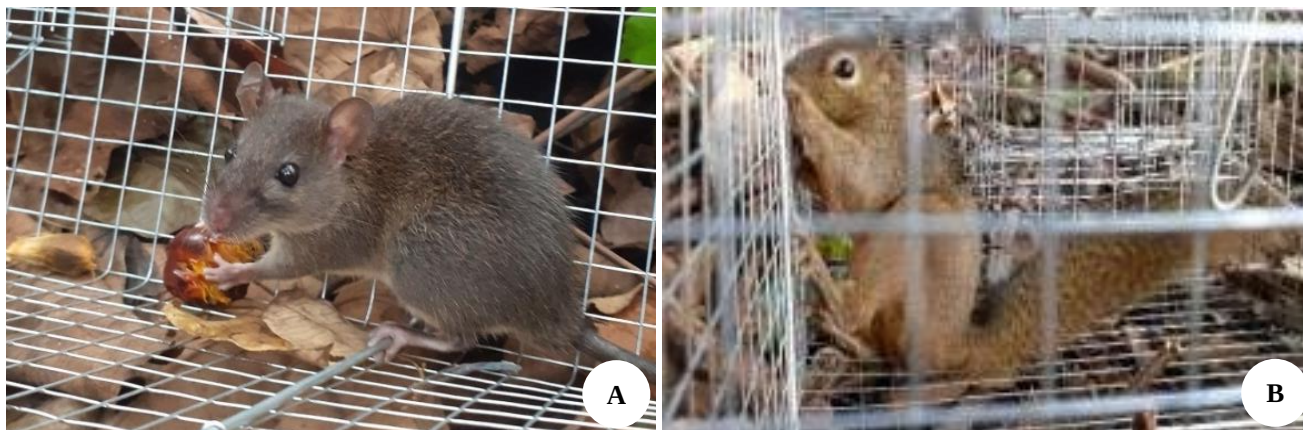
Of the 22 individuals of the *R. tiomanicus* that entered the trap, it was observed that the female individuals were recorded more than the male ones. This suggests that female mammals are more actively foraging than male mammals. According to Nasir (2012a), female mammals have a chance of being caught during the lambing and lactation season because, at that time, females need a large amount of food. Good adaptability to environmental conditions damaged after the fire in 2015 is one of the success factors for *R. tiomanicus* and *C. notatus* to breed. This is also influenced by the omnivorous feed, the lack of competition with other kinds of mammals, and the relatively high reproductive ability, so the population continues to increase. The International Union for Conservation of Nature (IUCN) reported that the

conservation status of *C. notatus* and *R. tiomanicus* shows the least concern (LC) category; currently, there is a tendency to increase the population of *C. notatus* and *R. tiomanicus* (Nasution and Fatah 2021). The species diversity index ( $H'$ ) indicates a low category with a  $H'=0.17884$ . That suggests the habitat conditions in post-burning peat ecosystems are still depressed, with minimal vegetation conditions producing fruit in both habitat types.

The *R. tiomanicus* belongs to the omnivore group but is likely to eat seeds (Priyambodo 2003), for example, the oil palm fruit. The results showed that *R. tiomanicus* preferred oil palm fruit bait over the other baits. This supported that, between the oil palm plantations and the research location, there is only a 2-meter wide canal. According to (Lim 2015), *R. tiomanicus* is found in oil palm plantations and takes refuge in piles of palm fronds and crowns. Besides that, *R. tiomanicus* also like roasted coconut as bait. This is because roasted coconut gives off a fragrant aroma which can invite small mammals to enter the trap (Nasir 2012b). Moreover, using oil palm fruit and roasted coconut as bait can last longer even though it is exposed to rain and not drying while exposed to heat (Nasir et al. 2017). The captured small mammals are shown in Figures 3A and 3B.

The OKH Forest Park area is dominated by peatlands that have experienced a decline in function or degradation. One of the causes is the repeated occurrence of fires which damage vegetation and exacerbate forest land degradation (Tamin et al. 2021). The vegetation types that dominated the Young Forests (Figure 4A) in OKH Forest Park after the fire were: mahang (*Macaranga* sp.), rengas (*G. rengas*), and punak wood (*T. glabra*). The average tree diameter in the Young Forest is 16.8 cm, with a trunk height of 5 to 8 meters. However, Young Forests can still be a habitat for small mammals because the Young Forest is a secondary forest where trees grow as a place to rest during the day and take shelter from predators (Lim 2015).





**Figure 3.** A. Malaysian field rat (*R. tiomanicus*), B. Plantain squirrel (*C. notatus*)



**Figure 4.** Habitat conditions of Young Forests (A), Shrubs (B)

Shrub habitat (Figure 4B) close to canals is one of the *R. tiomanicus* favorite areas. The *R. tiomanicus* can eat many types of feed available in nature, including those carried by flowing water (Nasir et al. 2017). In this area, *R. tiomanicus* can get food from water-drifting seeds, fruit, and leaves in the canals. Adequate food availability is thought to cause many *R. tiomanicus* to be caught. That follows the results of research by Nasir et al. (2017), which showed that food availability in scrub habitats comes from seeds produced by the constituent vegetation from the leftover food of other animals. In addition, the scrub habitat is filled with shrubs 1-2 meters high, making it suitable as a shelter for small mammals, including *R. tiomanicus*, from predators (Lim 2015).

In conclusion, 2 species of small mammals were found in the OKH Forest Park, namely *R. tiomanicus* and *C. notatus*. The total number of individuals found was 23. The diversity index shows a low category with a value of ( $H' = 0.17884$ ). That indicates the condition of the habitat in the post-burnt peat ecosystem is still relatively depressed. Variation of feed is not significantly related to the diversity of small mammals due to the specialist factor of small mammals feed and their small population.

## ACKNOWLEDGEMENTS

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## REFERENCES

- Apriyani P, Nasihin I. 2017. keanekaragaman jenis mamalia besar di kawasan Bukit Sarongge RPH Ciniro BKPH Garawangi KPH Kuningan. Jurnal Wanaraksa 11 (2): 1-7. DOI: 10.25134/wanaraksa.v11i2.4414. [Indonesian].
- Derajat N. 2022. Diversity of small mammals in Ujung Kulon National Park. Jurnal Inovasi Pendidikan Dan Sains 3(1): 18-23. DOI: 10.51673/jips.v3i1.934. [Indonesian]
- Harrison ME, Rieley JO. 2018. Tropical peatland biodiversity and conservation in Southeast Asia: Foreword. Mires Peat 22 (2018): 1-7. DOI: 10.19189/MaP.2018.OMB.382
- Heriyanto B, Ristiyo. 2017. Binatang Penular Penyakit Di Sekitar Lingkungan Rumah. Yayasan Pustaka Obor Indonesia, Jakarta. [Indonesian]

- Husson SJ, Limin SH, Adul, Boyd NS, Brousseau JJ, Collier S, Cheyne SM, D'Arcy LJ, Dow RA, Dowds NW, Dragiewicz ML, Smith E, Iwan, DAE, Iwan, Hendri, Houlihan PR, Jeffers KA, Jarrett BJM, Kulu IP, Morrogh-Bernard HC, Page SE, Perlett ED, Purwanto A, Capilla BR, Slahuddin, Santiano, Scjrevene SJJ, Struebig MJ, Thornton SA, Tremlett C, Yeen Z, Harrison ME. 2018. Biodiversity of the Sebangau Tropical Peat Swamp Forest, Indonesian Borneo. *Mires Peat* 22 (2018): 1-50. DOI: 10.19189/MaP.2018.OMB.352.
- Irsaf Z, Annawaty, Achmadi AS. 2018. Efektivitas perangkap yang digunakan dalam koleksi mamalia kecil rodensia dan eulipotyphla. *Jurnal Biocelbes* 12 (3): 79-86. [Indonesian]
- Kartono AP. 2016. keragaman dan kelimpahan mamalia di perkebunan sawit PT Sukses Tani Nusasubur Kalimantan Timur. *Media Konservasi* 20 (2): 85-92. DOI: 10.29244/medkon.20.2.%p. [Indonesian]
- KLHK (Kementrian Lingkungan Hidup dan Kehutanan). 2019. Panduan Identifikasi Jenis Satwa Liar dilindungi Mamalia. Kementrian Lingkungan Hidup dan Kehutanan. Jakarta. [Indonesian]
- Lim BL. 2015. The field rats and field mouse in Malaysia and Southeast Asia. *Utar Agric Sci J* 1 (3): 35-42.
- Maftuah E, Hayati A. 2019. Pengaruh persiapan lahan dan penataan lahan terhadap sifat tanah, pertumbuhan dan hasil cabai merah (*Capsicum annum*) di lahan gambut. *Jurnal Hortikultura Indonesia* 10 (2): 102-111. DOI: 10.29244/jhi.10.2.102-111. [Indonesian]
- Masganti, Wahyunto, Dariah A, Nurhayati, Yusuf R 2014. Karakteristik dan potensi pemanfaatan lahan gambut terdegradasi di Provinsi Riau. *Jurnal Sumberdaya Lahan* 8 (1): 59-66. DOI: 10.21082/jsdl.v8n1.2014.%25p. [Indonesian]
- Mazerolle MJ, Drolet B, Desrochers A. 2001. Small-mammal responses to peat mining of southeastern Canadian bogs. *Can J Zool* 79 (2): 296-302. DOI: 10.1139/cjz-79-2-296.
- Mulyani YA, Iqbal M. 2020. Burung-Burung Di Kawasan Sembilang Dangu. In ZSL Indonesia, Sumatera Selatan. [Indonesian]
- Nasir M, Amira Y, Mahmud AH. 2017. Keanekaragaman jenis mamalia kecil (Famili Muridae) pada tiga habitat yang berbeda di Lhokseumawe Provinsi Aceh. *Jurnal Bioleuser* 1 (1): 1-6. DOI: 10.22373/pbio.v6i1.4271. [Indonesian]
- Nasir M. 2012a. Kondisi Cuaca terhadap peluang menangkap mamalia kecil pada kawasan perkebunan sawit di Kabupaten Nagan Raya Provinsi Aceh. *Prosiding Seminar Nasional Biologi*, Medan. [Indonesian]
- Nasir M. 2012b. Distribusi mamalia kecil pada tiga lokasi di sekitar perkebunan sawit di Kabupaten Nagan Raya Provinsi Aceh. *Prosiding Seminar & Rapat Tahunan BKS- PTN B MIPA*, Medan. [Indonesian]
- Nasution ED, Fatah H. 2021. Rapid survei keanekaragaman hayati status konservasi Permen LHK (P.106/2018) dan IUCN di areal nilai konservasi tinggi perkebunan kelapa sawit. *Jurnal Agrifor XX* (106): 161-174. DOI: 10.31293/agrifor.v20i1.521. [Indonesian]
- Odum EP. 1994. Dasar-Dasar Ekologi. Edisi-3. Terjemahan Tjahjono Samangan. Universitas Gajah Mada Press, Yogyakarta. [Indonesian]
- Payne J, Francis CM, Phillips K, Kartikasari SN. 2000. Panduan Lapangan Mamalia di Kalimantan, Sabah, Serawak, dan Brunei Darussalam. Wildlife Conservation Society Indonesia Program, Jakarta. [Indonesian]
- Priyambodo S. 2003. Pengendalian Hama Tikus Terpadu. Penebar Swadaya, Jakarta. [Indonesian]
- Putra AB, Darmawan A, Dewi BS, Fitriana YR. 2022. Diversity of small mammals in four types of land cover in the Batutegei Forest. *Makila J* 16: 5-7. DOI: 10.30598/makila.v16i2.6297.
- Raharjo S. 2017. Uji Korelasi Rank Spearman dengan SPSS. SPSS Indonesia, X. <https://www.spssindonesia.com/2017/04/analisis-korelasi-rankspearman.html>. [Indonesian]
- Ramadhani C, Rahayu SE, Achmadi AS. 2019. Keanekaragaman mamalia kecil terestrial di Cagar Alam Kawah Ijen, Kabupaten Banyuwangi, Jawa Timur. *Jurnal Fauna Tropika* 28 (2): 112-121. DOI: 10.52508/zi.v28i2.4100. [Indonesian]
- Rianisa CD, Utamy I, Wassalwa M. 2018. Keanekaragaman jenis mamalia kecil (Muridae) Di Kawasan Deudap Pulo Aceh, Kabupaten Aceh Besar. *Prosiding Seminar Nasional Biotik* 2018: 362-366. DOI: 10.22373/pbio.v6i1.4271. [Indonesian]
- Sudrajat ASE, Subekti S. 2019. Pengelolaan ekosistem gambut sebagai upaya mitigasi perubahan iklim di Provinsi Kalimantan Selatan. *Jurnal Planologi* 16 (2): 219-237. DOI: 10.30659/jpsa.v16i2.4459. [Indonesian]
- Tamin RP, Ulfa M, Saleh Z. 2019. identifikasi potensi pohon induk pada tegakan tinggal Taman Hutan Raya Orang Kayo Hitam pasca kebakaran hutan. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*: 3: 10-17. DOI: 10.22437/jiituj.v3i1.7337. [Indonesian]
- Tamin RP, Ulfa M, Saleh Z. 2021. Identifikasi potensi permudaan alam di hutan rawa gambut Taman Hutan Raya Orang Kayo Hitam Provinsi Jambi Pasca Kebakaran Hutan. *Al-Kauniyah: Jurnal Biologi* 14 (1): 42-51. DOI: 10.15408/kauniyah.v14i1.15136. [Indonesian]
- Wibisono ITC, Dohong A. 2017. Panduan Teknis Revegetasi Lahan Gambut. Badan Restorasi Gambut Republik Indonesia, Jakarta. [Indonesian]
- Wulandari C, Novriyanti N, Iswandaru D. 2021. Integrating ecological, social and policy aspects to develop peatland restoration strategies in Orang Kayo Hitam Forest Park, Jambi, Indonesia. *Biodiversitas* 22 (10): 4158-4168. DOI: 10.13057/biodiv/d22i1005.