Density and Diversity of Herpetofauna Using a Transect Method Implemented in a Coconut Plantation (*Cocos nucifera* L.)

Ridwan Syarif(✉), Rijal Satria, Fitra Arya Dwi Nugraha, and Irma Leilani Eka Putri

Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Padang, Indonesia
rsyarif44@gmail.com

Abstract. Plantation openings are to blame for Indonesia's highest rates of forest loss. The goal of this study was to use the transect approach in Simbur Naik Village, Muara Sabak Timur District, Tanjung Jabung Timur Regency, "Jambi Province" to determine the diversity and density of herpetofauna in a coconut plantation. Pitfall traps and glue traps were used in conjunction with the transect design method to obtain the data. The transect design comprises of 10 parts, each measuring 50 m in length and 1 m in breadth on the left and right. Five glue traps and one pitfall trap were put along each transect. The herpetofauna of Simbur Naik village's coconut plantation typically exhibits poor environmental conditions. The findings indicate that Fejervarya limnocharis is the dominant species and that the Shannon-Wiener diversity index and species richness index of the Margalef herpetofauna in the Simbur Naik village coconut plantation are both low. The coconut plantation near Simbur Naik village has a herpetofauna density of 0.1 to 3.4 individuals per 100 m^2.

Keywords: Simbur Naik Village · Herpetofauna · Indonesia · Diversity · Coconut Plantation

1 Introduction

The rate of loss of primary forest cover is highest in Indonesia. [1]. In the period 2009–2013, the loss of forest cover in Indonesia was 1.13 million hectares annually. The amount of forest cover being lost in Indonesia is comparable to three football fields being lost each minute [2]. For the Sumatra region, most of the land is used as agricultural land, plantations, mining, industrial and residential areas [3]. One of the main causes of Indonesia's declining forest cover is the rising global demand for plantation-produced goods [4].

One of the widely developed plantations, apart from oil palm and rubber, is the coconut plantation (*Cocos nucifera* L.). Jambi Province has coconut plantations covering an area of 119,100 hectares and is one of the largest on the island of Sumatra after Riau [5]. Especially in East Tanjung Jabung Regency, the area of coconut plantations is 58,505 hectares. With an area of 58,505 hectares, the expansion of the coconut plantation area is predicted to continue [6].

M. Fadilah et al. (Eds.): IcoBioSE 2021, ABSR 32, pp. 240–248, 2023.
https://doi.org/10.2991/978-94-6463-166-1_32

One of the impacts of changing forests to plantations is wildlife [7] where conversion of forests to plantations can reduce species richness and abundance, and change community composition, in particular, can eliminate forest species [8]. In the end, biodiversity will be threatened with loss and those who survive will try to adapt to the new environment [7, 9, 10]. One of the wild animals impacted by the change of forests is the herpetofauna. Because herpetofauna, especially amphibians, are animals that are sensitive to changes in habitat [11]. Increased habitat fragmentation correlates with changing environmental conditions such as temperature and humidity and makes many species more vulnerable to population decline, including Herpetofauna [12, 13].

There has not yet been much study on the herpetofauna populations in coconut farms. On the other hand, groups of frogs and toads are bioindicator groups [14] that are sensitive to habitat changes [11]. Research in the plantation area was mostly carried out on rubber and oil palm plantations, while the research by [15] on coconut plantations in Gorontalo, Sulawesi was limited to the lizard group (Scincidae). Information on how herpetofauna diversity in coconut plantations needs to be explored more deeply for the benefit of taxonomy, ecology and conservation. The purpose of this study is to quantify the variety of the herpetofauna in coconut plantations in Simbur Naik village, East Muara Sabak sub-district, East Tanjung Jabung district, Jambi province.

2 Materials and Methods

The transect design method [16] was used with pitfall traps [17] and glue traps [18] to collect the data. This was done by tracing the transects which found 10 pieces with each transect having a length of 50 m with a 1 m left and right width. Transects were explored in the morning at 08.00 WIB until finished and at night at 20.00 WIB until finished. Each transect also installed a trap bucket with a volume of 0.0225 m^3m^3 which was planted into the soil to a depth of 40 cm with the mouth of the bucket parallel to the soil surface. Pitfall traps are installed during the day and checked at night the next day [3]. In the pitfall trap, litter is included as a shelter for trapped animals [3]. The glue trap was installed at 07.00 WIB and checked before noon. There are 5 glue traps for each transect on the prepared board/triple. The distance between glue is 10 m [19]. Each observation was carried out by measuring abiotic factors such as air temperature, humidity, soil temperature, air temperature, air pH and soil pH (Fig. 1).

Data were analyzed using the following indices:

1. Margalef species richness index (Dmg) [20]

$$Dmg = \frac{(S-1)(S-1)}{Ln\ Ln\ N}$$

The value of the species richness index is divided into the following criteria: if $0 <$ Dmg ≤ 2.5, it means that the species richness index is low, if $2.5 <$ Dmg ≤ 4, it indicates a moderate level of species richness, and if Dmg > 4 it indicates a high level of species richness.

2. Diversity index (H') Shannon-Wiener [21]

$$H' = -\sum_{i=1}^{n} pi\ \ln\ pi$$

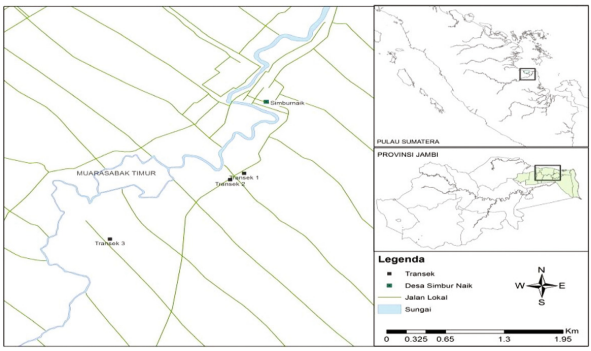

Fig. 1. Research location map. Sampling locations were marked with transect readings 1, 2, and 3.

The diversity index value is divided into several criteria, namely: If H' 1 denotes low diversity index, H' 3 denotes moderate diversity index, and H' > 3 denotes high diversity index.

3. Evenness Index [21]

$$E = \frac{H'}{\ln(S)}$$

The magnitude of E' < 0.3 indicates that the evenness of the species is low, E' = 0.3 0.6 the evenness of the species is classified as moderate and E' > 0.6 means that the evenness of the species is classified as high.

4. Simpsons dominance index (D') [22]

$$\mathrm{D} = \sum (Pi)^2$$

If a particular type or species dominates the community, the dominance index value is close to one (1), and if it is close to zero (0), no types or species dominate the community.

5. Population density [23]

$$\mathrm{D} = \frac{Ni}{A}\frac{Ni}{A}$$

3 Result and Discussion

The field survey was conducted for 7 days with a total sampling area of 1000 m^2m^2. A total of 45 individuals were observed consisting of 2 types of amphibians and 3 types of reptiles. The most common species found were *F. limnocharis* and the least were *I. biporcatus*, *E. multifasciata* and *I. braminus* 1 individual each (Table 1).

The species obtained in this study were also found in the studies of [3] and [24] which were also carried out in disturbed habitats, namely oil palm plantations, but in [24] I. braminus was not found. The species obtained are common species with low conservation

Table 1. Species of amphibians and reptiles in coconut plantation

No	Class	Family	Species
1	Amfibi	Dicroglossidae	*Fejervarya limnocharis,* Gravenhorst, 1829
2		Bufonidae	*Ingerophrynus biporcatus,* Gravenhorst, 1829
3	Reptil	Gekkonidae	*Hemidactylus frenatus,* Dumeril and Bibron, 1836
4		Scincidae	*Eutropis multifasciata,* Kuhl, 1820
5		Typhlopidae	*Indotyplhops braminus,* Daudin, 1803

value that easily adapt to disturbed habitats [3]. The species E. multifasciata was also found in [15] whose research location was in a coconut plantation.

In the coconut plantation, Simbur Naik village has a Margalef species richness index with a value of 1.05 which is relatively low. The shannon-winner diversity index value is 0.77 which indicates that the diversity value is low. The herpetofauna evenness index value in the coconut plantations of Simbur Naik village was classified as moderate with a value of 0.48 and the dominance index value was 0.60 which means that there are species that dominate (Table 2). In the coconut plantations of Simbur Naik village, the highest density was found in F. limnocharis species with 3.4 individuals/100 m^2m^2 and the lowest density was I. biporcatus, E. multifasciata and I. braminus with 0.1 individuals/100 m^2m^2 (Table 3).

The wealth index (Dmg) of herpetofauna species found in coconut plantations in Simbur Naik village is low with a value of 1.05. This result is lower than the wealth

Table 2. Herpetofauna diversity index in coconut plantation

Index	Value
Margalef's Wealth *(Dmg)*	1,05
Shannon-Winner Diversity *(H')*	0,77
Species Evenness *(E)*	0,48
dominance (*D*)	0,60

Table 3. The density of herpetofauna species in coconut plantation

Species	Density (individual /100 m^2m^2)
F. limnocharis	3,4
I. biporcatus	0,1
H. frenatus	0,8
E. multifasciata	0,1
I. braminus	0,1

index in oil palm plantations in South Sumatra province which has an index value of 3.9 [25] and is also lower than a secondary forest with a value of 3.6 and old oil palm with a value of 3.34 [24]. According to [25] the wealth index is influenced by canopy cover and bottom cover. The coconut plantation in Simbur Naik village does have a very simple vegetation structure, this plantation only has a crown of coconut leaves, and very little ground cover in the form of grass because the owner of the garden always cleans it regularly and does not have piles of dead wood. According to [28] said that the density of understorey variations can have a positive effect on the wealth of amphibians, understorey can provide shelter for herpetofauna. According to [27] increasing heterogeneity of vegetation types is an attempt to increase the richness of a species.

Herpetofauna diversity in coconut plantations in Simbur Naik village has a low diversity index value (H') with a value of 0.77. The low diversity of herpetofauna is caused by a homogeneous plant habitat [7]. Some ecological traits (forest structure, streamlined river substrate, and scarcity of accessible litter and wood chips) look homogenous in plantations [28]. The coconut plantations in Simbur Naik village are dominated by coconut plants, the river substrate which is close to the coconut plantation area is very simple because the river is always dredged to avoid silting and the herpetofauna microhabitat is minimal.

The herpetofauna evenness index on coconut plantations in Simbur Naik village is moderate, namely 0.48. The results of this evenness index are lower than the research by [25] where the herpetofauna evenness index in oil palm plantations in South Sumatra province which is relatively high at 0.79 is also lower than [24] in old oil palm plantations with a value of 0,93. [25] and [24] have a denser canopy cover that affects temperature and humidity. The presence of herpetofauna is also influenced by sunlight which can affect the environmental temperature so that the herpetofauna response tends to be active as long as the light intensity allows [19, 30]. According to [31], factors that affect species density include environmental factors and the topography of the location. Topography is related to differences in activity and space use patterns of each type of herpetofauna, while environmental factors relate to how a species is able to survive and respond to existing conditions. The stability of communities was described using the species evenness index [32]. This low evenness points to an unstable distribution of the herpetofauna [33].

The herpetofauna dominance index in coconut plantations in Simbur Naik village has a value of 0.60 which means close to 1. This indicates that there are species that dominate. *F. limnocharis* species was the most common species found compared to other species, so it dominated the coconut plantation area of Simbur Naik village. This is evidenced by the discovery of 34 individual species of F. limnocharis in this study. The F. limnocharis species is a species that is tolerant of various habitats [3].

The highest species density in coconut plantations in Simbur Naik village was *F. limnocharis* with 3.4 individuals/100 m^2m^2 and the lowest were *I. biporcatus*, *E. multifasciata*, and *I. braminus* with 0.1 individuals/100 m^2m^2. The high density of F. limnocharis because *F. limnocharis* is the most dominant species among other herpetofauna. In the coconut plantations of Simbur Naik village, the density value of amphibians ranges from 0.1 to 3.4 individuals/100 m^2m^2, which is higher than [9] whose density values range

from 0.1–0.30 individuals/100 m^2m^2. This difference can be caused by differences in the sampling area and the length of the sampling time.

According to the study's findings, Simbur Naik village's coconut plantations had a low variety (H') of herpetofuana., this showed that the diversity in coconut plantations in Simbur Naik village was not complex and community stability was low. According to [35], if an ecosystem has a more varied physical environment, the flora and fauna community there will be more complex, and the diversity of species will be larger. The low diversity of herpetofauna in the Simbur Naik village plantation indicates that there are species that dominate at that location as said by [36] when the diversity of an area is low, it means that there are species that dominate the area. In accordance with the results of this study, the dominance index was high, meaning that there was one that dominated, namely *F. limnocharis*. Based on the results of the even distribution of herpetofauna species in the coconut plantations of Simbur Naik village, which are classified as moderate and the distribution is not stable, it indicates that the distribution of individuals of each species tends to be depressed by the environment. Many factors affect the evenness of species including the availability of animals as prey, vegetation type, climate, micro-habitat and sunlight [30, 36, 37].

Plantations are included in the habitat disturbed by human activities. Based on this research, herpetofauna tend to be depressed by the environment. The existing herpetofauna will always adapt to the existing environment to the limit of its tolerance. If it cannot survive, the herpetofauna will continue to decrease or even be non-existent. According to [38] herpetofauna can function in knowing environmental conditions because herpetofauna is animals that depend on the existing environmental temperature. Depressed herpetofauna will experience a population decline so that it can reduce the existing ecological balance [39].

4 Conclusions

The herpetofauna of Simbur Naik village's coconut plantation typically exhibits poor environmental conditions. The findings indicate that *Fejervarya limnocharis* is the dominant species and that the Shannon-Wiener diversity index and species richness index of the Margalef herpetofauna in the Simbur Naik village coconut plantation are both low. The coconut plantation near Simbur Naik village has a herpetofauna density of 0.1 to 3.4 individuals per 100 m^2.

Acknowledgments. For supporting this work under contract number 837/UN3513/LT/2021, the author (F A D Nugraha) is grateful to Lembaga Penelitian dan Pengabdian Masyarakat Universitas Negeri Padang.

References

1. B.A. Margono, P.V. Petapov, S. Turubanova, M.C. Hensen, Primary forest cover loss in indonesia over 2000–2012. Nature Climate Change Available from http://www.nature.com/doifinder/10.1038/nclimate2277, 2014.

2. M.F. Barri, A.A. Setiawan, A.R. Oktaviana, A.P. Prayoga, A.C. Ichsan, Deforestasi tanpa henti; potret deforestasi di Sumatera Utara, Kalimantan Timur, dan Maluku Utara, Bogor: Forest Watch Indonesia, 2018.
3. H. Arief, Keanekaragaman jenis satwa liar di kawasan perkebunan kelapa sawit dan status perlindungannya: studi kasus kawasan unit pengelolaan PT. AGROWIYANA, Kabupaten Tanjung Jabung Barat Jambi, Media Konservasi Vol 16, 2011, pp. 73-77.
4. T.C. Wanger, A. Saro, D.T. Iskandar, B.W. Brook, N.S. Sodhi, Y. Clough, T. Tscharntke, Conservation value of cacao agroforestry for amphibian and reptiles in southeast Asia: combining correlative models with follow-up field experiments, Journal of Applied Ecology 46, 2009, pp. 823-832.
5. Direktorat Jendral Perkebunan, Statistik Perkebunan Indonesia 2018–2020, Jakarta: Sekretariat Direktorat Jendral Perkebunan, 2019.
6. A. Abdurachman, A. Mulyani, Pemanfaatan lahan berpotensi untuk pengembangan produksi kelapa. Jurnal litbang pertanian 22(1), 2003, p. 25.
7. H. Arief, Keanekaragaman jenis satwa liar di kawasan perkebunan kelapa sawit dan status perlindungannya: studi kasus kawasan unit pengelolaan PT. AGROWIYANA Kabupaten Tanjung Jabung Barat Jambi, Media Konservasi, Vol 16, 2011, pp. 73-77.
8. E.B. Fitzherbert, M.J. Struebig, A. Morel, F. Danielsen F, C.A. Bruhl, P.F. Donald, B. Phalan, How will oil-palm expansion affect biodiversity? Trends Ecol Evol. Trends in ecology & evolution 23, 2008, pp. 538–545.
9. S.N. Stuart, J.X. Chanson, N.A. Lox, B.E. Young, A.S.L. Rodrigue, D.L. Fischman, R.W. Waller, Status and trend of amphibians deelines and extinctions worldwide. Science, 306, 2004, pp. 1783-1786.
10. B.D. Todd, B.B. Rothermel, Assessing quality of clearcut habitats for amphibian: effect on abundances versus vital rates in the southern toad (Bufo terrestis), Biology Conservation 133, 2006, pp. 178-185.
11. R.A. Alford, S.J. Richards, Global amphibian declines a problem in applied ecology, Annual Review of Ecology and Systematics 39, 1999, pp. 133-165.
12. R.M. Lehtinen, J.B. Ramanamanjato, J.G. Raveloarison Edge effect and extinction proneness in a herpetofauna from Madagascar, Biodiversity and Conservation 12(7), pp. 1357–1370.
13. T. Muslim, Herpetofauna community establishment on the micro habitat a result of line mines fragmentation in East Kalimantan, Indonesia, Biodiversity 18(2), 2017, pp. 709-714.
14. D.T. Iskandar, Amfibi Jawa dan Bali, Bogor: Puslitbang-LIPI, 1998.
15. F.H. Faz, M.D. Kusrini, A.P. Karton, Kelimpahan, komposisi, dan ukuran kadal di berbagai habitat berbeda pada ekoton Hutan Nantu, Provinsi Gorontalo, Zoo Indonesia 28 (1), 2019, pp. 33-45.
16. W.R. Heyer, M.A. DonNely, M.W. Mcdiarmid, L.C. Hayek, M.S. Foster, Measuring and monitoring biological diversity standard methods for amphibians, Washington: Smithsonian Institution Pres, 1994.
17. R.B. Bury, P.S. Corn, Evaluation of pitfall trapping in Northwestern Forest: traps arrays with fences, Journal of Wildlife Management, 51, 1987, p. 8.
18. A.M. Bauer, R.A. Sadler, 1992, The use of mouse glue traps to capture lizards, Herpetological, Review 23, 1987, pp. 112-113.
19. M.D. Kusrini, Metode survei penelitian herpetofauna, Bogor: IPB Press, 2019.
20. A.E. Magurran, Ecological diversity and its measurement, London: Croom Helmed Limited, 1988.
21. A.E. Magurran, Measuring Biological Diversity, Australia: Blackwell Science ltd., 2004.
22. E.P. Odum, Fundamental of ecology, Philadhelpia: Sounders, 1997.
23. C.Y. Huang, P.C.L. Hou, Density and diversity of litter amphibians in a monsoon forest of southern Taiwan, Zoological Studies 43(4), 2004, pp. 795-802.

24. R.T. Kwatrina, Y. Santosa P. Maulana, Keanekaragaman spesies herpetofauna pada berbagai tipe tutupan lahan di lansekap perkebunan sawit: studi kasus di PT. BLP Central Borneo, Journal of Natural Resources and Environmental Management 9(2), 2018, pp. 304–313.
25. S.S. Rejeki, Y. Santosa, Dampak perkebunan kelapa sawit terhadap keragaman jenis herpetofauna di PT. WAIMUSI Agroindah Sumatera Selatan, Konfigurasi IOP Seri: Ilmu Bumi dan Lingkungan 336, 2019.
26. I.A.A. Janiawati, M.D. Kusrini, A. Mardiastuti, Structure and composition of reptile communities in human modified landscape in Gianyar Regency, Bali, HAYATI Journal of Biosciences 23(2), 2016, 85-91.
27. N. Rios-López, A.T. Mitchell, Herpetofaunal dynamics during secondary succession, Herpetologica, 63(1), 2007, pp. 35-50.
28. A. Faruk, D. Belabui, N. Ahmda, R.J. Knell, T.W. Garner, Effect of oil-palm plantation on diversity of tropical anurans, Conservation Biology 27, 2013, pp. 615-624.
29. N. Greenberg, Ethological considerations in the experimental study of lizard behavior, Behavior and Neurology of Lizard, 1978, p. 203.
30. T. Halliday, K. Adler, 2000, The Encyclopedia of reptiles and amphibians, New York: Fact on File Inc, 1978.
31. R. Eprilurahman, M.F. Himly, T.F. Qurniawan, Studi keanekaragamasn reptil dan amfibi di kawasan ekowisata Linggo Asri, Pekalongan, Provinsi Jawa Tengah, Berkala Penelitian Hayati vol 15(1), 2009, pp. 93– 97.
32. A. Arista, G.D. Winarno, R. Hilmanto, Keanekaragaman jenis amfibi untuk mendukung kegiatan ekowisata di desa Braja Harjosari Kabupaten Lampung Timur, Biosfera, 34 (3), 2017, pp. 103 -109.
33. A. Maulidi A, M. Jakaria, N. Fitriyana, M. Rizik, 2019, Herpetofauna diversity at Munggu Village, Landak Regency, West Kalimantan Province, Indonesia, Biogemesis vol 7, 2017, pp. 116-123.
34. M. Syazali, A.A. Idrus, G. Hadiprayitno, Densitas amfibi di pulau Lombok Nusa Tenggara Barat, Jurnal Biologi Tropis 17(2), 2017.
35. T. Tambunan, Metode ekologi untuk penelitian ladang laboratorium, Jakarta: Universitas Indonesia Press, 2013.
36. M.J. Cox, P.P. Van Dijk, J. Nabhitabhata, K. Thirakhupt, A Photographic guide to snakes and other reptiles of Peninsular Malaysia, Singapore and Thailand, London (GB): New Holland Publishers Ltd. 1998.
37. I. Das, Reptiles of South-East Asia, New Holland Publishers, UK, 2010, pp. 123.
38. M.B. Hofer, D.G. Barker, L.K. Ammerman, P.T. Chippindale, Systematics of pythons of the *Morelia amethistina* complex (Serpentes: Boidae) with the description of three new species, Herpetological Monograph 14, 2000, pp. 139-185.
39. M. Mistar. Panduan lapangan amfibi & reptil di area mawal provinsi Kalimantan Tengah (Catatan Dari Hutan Lindung Beratus), Kalimantan Tengah: Orang utan survival foundation, 2008.