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KEANEKARAGAMAN JENIS HERPETOFAUNA DI KAWASAN EKOWISATA MANGROVE CUKUNYINYI, PESAWARAN, LAMPUNG

DIVERSITY OF HERPETOFAUNA IN CUKUNYINYI MANGROVE ECOTOURISM AREA, PESAWARAN, LAMPUNG

Mhd Muhajir Hasibuan[1)], Nurika Arum Sari[1)], Mohammad Ashari Dwiputra[2)], Rizki Dimas Permana[2)], Firma Rianingsih[1)], Alfian Zamzami Adirama[1)], Oka Rani Witjaya[1)], Abdi Oktarian Zamili[1)], Paolo M. Nainggolan[2)], Adi Aryawan[2)], Ajis Purnomo[3)], Bambang Sudarsono[3)], Hamdani[3)],Yusratul Aini[4)]

[1)] Program Studi Rekayasa Kehutanan, Jurusan Teknologi Produksi dan Industri, Institut Teknologi Sumatera
[2)] Program Studi Sains Lingkungan Kelautan, Jurusan Sains, Institut Teknologi Sumatera
[3)] PT Bukit Asam Tbk, Unit Pelabuhan Tarahan, Lampung
[3)] Program Studi Kehutanan, Fakultas Pertanian, Universitas Nusa Cendana

*Email: Mhd.hasibuan@rh.itera.ac.id

ABSTRACT

Mangrove are important coastal ecosystems that provide a variety of ecosystem services and ecological functions. These ecosystem services include natural barriers that protect coastal areas from cyclones, tsunamis, and erosion. Habitats for breeding, foraging, and nursery for various species of aquatic and tereterial species. The benefits provided by mangrove are contrast to the rate of degradation. Various parties have a responsibility to contribute to efforts to maintain a sustainable environment. Biodiversity has been globally recognised as one of the determining factors for the sustainability of an ecosystem. The study aims to assess the diversity of herpetofauna species in the Cukunyinyi Mangrove ecotourism area as an instrument of environmental monitoring. The method in this study was the Visual Encounter Survey (VES). The diversity of herpetofauna (H') observed in the area was 1.06 inside the Ecotourism Area and 0.56 outside the ecotourism area. The indices of species richness (Dmg) in each area were 1.24 and 0.72. The two regions have evenly distributed with an evenness value of more than 80%. No species protected under national regulation, two species whose trade was restricted internationally and included in the CITES Appendix II.

Keywords: Herpetofauna; diversity; mangroves area; protected spesies.

1. INTRODUCTION

Mangroves are forest vegetation that can be found growing between the tide line, coral beaches, dead coral flats, and thin layers of sand, mud, or muddy beaches (Saparinto, 2007). Mangrove are important coastal ecosystems that provide a variety of ecosystem services and ecological functions (Kauffman *et al*., 2017). These ecosystem services include natural barriers that protect coastal areas from cyclones, tsunamis, and erosion (Asari *et al*., 2021; Nur & Hilmi, 2021), habitats for breeding, foraging, and nursery for various species of fish and other aquatic species (Vincentius *et al*., 2018). Mangroves are also important habitats for terrestrial animals, both resident and migratory species, including species that are both nationally and internationally protected (Hernowo *et. al*., 2007; Azimah & Tarmiji, 2018; Kartono *et al.*, 2008). Ecotourism opportunities in mangrove areas are also important, as these activities can improve the livelihoods of coastal communities (Eddy *et al*., 2016; Sarhan, 2018). Globally, mangrove

ecosystems are also recognised for their ability to sequester and absorb massive amounts of carbon and significantly contribute to climate change mitigation (Donato *et al.,* 2011).

The benefits provided by mangrove are contrast to the rate of degradation. Research has shown that the rate of mangrove area shrinkage (reaching 0.7% per year) is higher than the rate of tropical forest deforestation (0.5% per year) (Friess *et al*., 2019; Hamilton & Casey, 2016; IPCC, 2019). Most of the threats to mangrove ecosystems come from anthropogenic and natural factors (Giri *et al*., 2011).

Indonesia has lost 10-31% of its mangrove forests (Hamilton & Friess, 2018), with annual deforestation rates between 0.26-0.66% (Hamilton & Casey, 2016). This massive loss is also mainly due to the conversion of mangrove forests into ponds (Eddy *et al*., 2021). This has led to increased carbon emissions, and a range of environmental and socioeconomic problems in coastal areas, as well as biodiversity loss.

Various parties have the responsibility to contribute in biodiversity conservation efforts both in conservation areas and established areas that have high biodiversity potential. In addition to the government, private parties/companies are obliged to protect the environment as a conservation effort against damage caused by their activities (UU No. 32 tahun 2009). More specifically, PP No. 73 tahun 2012 explains that the National Mangrove Ecosystem Management Strategy is implemented in a coordinated manner as a basis and guideline for the Government, Local Governments, business actors, and the community.

The Cukunyinyi Mangrove Ecotourism Area is one of the strategic locations that requires environmental studies, especially biodiversity in a sustainable manner. The Cukunyinyi mangrove area is located in Teluk Pandan sub-district, Pesawaran Regency, Lampung. This mangrove area is managed independently by the village community in collaboration with PT Bukit Asam TBK. Biodiversity has been globally recognised as one of the determining factors for the sustainability of an ecosystem (Laurilla-Pant *et al*., 2015). Furthermore, according to Magurran (2013), the biodiversity's current condition needs to be known on an ongoing basis so that it can be used as an indicator of the company's sustainability in natural resource management. This research was conducted to assess the biodiversity of one of the studies that rarely received attention, namely Herpetofauna (Amphibians and Reptiles) (Kusrini, 2008).

2. Method

2.1 Data Collection

Data were collected from 11-14 August inside and outside the Cukunyinyi Mangrove Area, Pesawaran Regency, Lampung (Figure 1). Data collection was carried out on three transects consisting of:

1) Transect 1 (jalur 1) is located within the ecotourism area which is determined based on the Village Regulation (Perdes) of Sidodadi Village Number 01 of 2022 on the Management of Mangrove Protection Areas of Sidodadi Village, Teluk Pandan District, Pesawaran Regency.;
2) Transect 2 (jalur 2) is located outside the ecotourism area, to the west of the area separated by a river; and
3) Transect 3 (jalur 3) is a pond that has been out of production for more than 20 years..

Data were collected using the Visual Encounter Survey (VES). Each observation in the transect was conducted by 2-3 observers with about 2 hours for each repetition. Data were collected from 19.00 to 21.00 Western Indonesia Time. Each species found was identified with identification books of the following: Amphibians and Reptiles of South Sumatra: Sembilang-Dangku and Surrounding Areas (Kusrini, 2020); Field Manual of Amphibians and Reptiles of Batang Toru Forest Area (Kamsi *et al*., 2017).

2.2 Data Analysis

Species diversity

The species diversity index was obtained using the following Shannon-Wiener diversity index (Magurran, 2013).

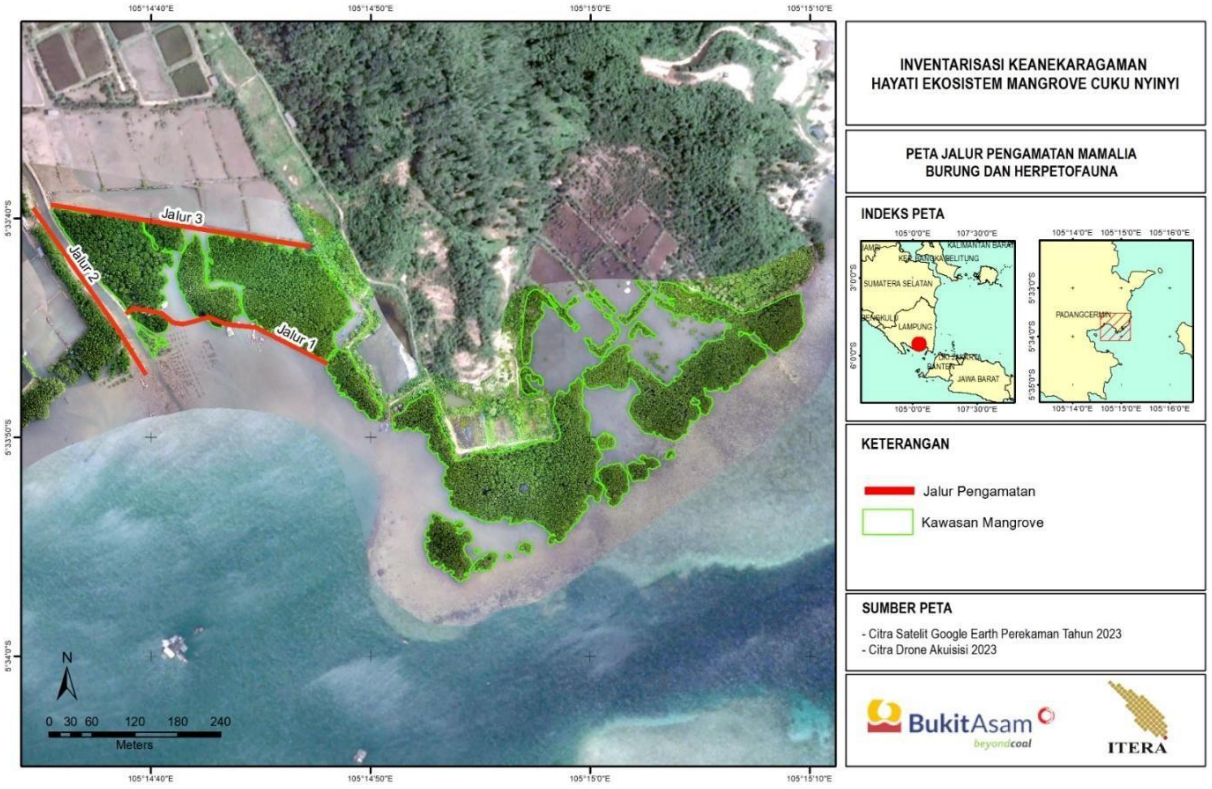

Figure 1. Herpetofauna Observation Transect in the Study Area

H' = -Σ Pi. ln (Pi) = -Σ (ni/N). ln (ni/N)

Notes:

H' = Diversity index;

ni = Number of individuals of species i; and

N = Number of individuals of all species.

Significance test of H' value across communities was conducted using t test according to Hutcheson (1970) with the following equation.

$$h = \frac{'_1 - '_2}{\sqrt{a('_1) + a('_2)}}$$

$$a\,'(\quad) = \frac{\sum . [n\,()]^2 - . [\sum n\,()]^2}{[a(') + a(')]^2}$$

$$d = \frac{1 \qquad 2}{\left(\frac{a\,'_1(\quad)}{}\right) + \left(\frac{a('_2)}{}\right)}$$

Notes:

th= the value of t-count

Var(H1')= variety of Shannon diversity index of the first sample

Var(H2')= variety of diversity index of the second sample

H1'= first sample diversity index

H2'= diversity index of the second sample

N1 and N2 = the total number of individuals in the first and second samples, respectively.

df = degrees of freedom.

The null hypothesis tested was that there was no significant difference between the diversity index of the first transect and the second transect. The test criterion used is if t-count $t_{-h} \leq t_{\alpha/2;df}$ it is concluded that the null hypothesis is accepted, i.e. there is no significant difference in the Shannon

diversity index of the first transect and the second transect.

Evenness Index (E)

The evenness index was analysed using the following formula (Magurran, 2004):

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

Notes:
E= Evenness index
S = Number of species

H'= Species diversity index.

Species richness index (Dmg)

The value of species richness found using the following formula (Magurran, 2004):

$$D_{mg} = \frac{S-1}{\ln N}$$

Description:
Dmg= Margalef richness
N= number of individuals
S= number of species observed
ln= natural logarithm.

Jackknife species estimations

The Jackknife index was used to estimate the species richness of herpetofauna at the study site. The equation for estimating the species richness of the Jackknife species richness index is as follows (Heltse & Forrester 1983):

$$S = s + \left(\frac{n-1}{n}\right)(k)$$

Notes:
S = Jackknife species richness estimate
s = total species observed
n = number of sample units
k = number of unique species (found in only one sample unit)

Herpetofauna community similarity

The community similarity index used is the Morisita index modified by Horn by the equation:

$$M_{jk} = \frac{2\sum_{i=1}^{S} x_{ij}.x_{ik}}{\sum_{i=1}^{s} x_{ij}^2 + \sum_{i=1} x_{ik}^2}$$

Notes:
Mik= Morisita similarity index of the i-th and the k-th communities by species
xij and xik=abundance of the i-th species in the kth community and the kth community, respectively.
s=total number of species.

3. RESULTS AND DISCUSSION

3.1 Species composition

Direct research in the Cukunyinyi mangrove ecotourism area recorded 4 species of herpetofauna consisting of 3 species of reptiles and 1 species of amphibians. In addition to the species found directly, there are two other species recorded, based on information from the community, using the study area for survival, the two species are Mangrove Cat Snake and Reticulated Python (Table 1). Schneider's Bockadam is the most frequently encountered species in the study area.

Table 1. Herpetofauna Species Encounters in the Study Area

Local Nama	English name	Species name	Family	ETA	NTA1	NTA2	Total
Biawak air	Common Water Monitor	*Varanus salvator*	Varanidae	2	-	-	2
Cicak	Common House Gecko	*Hemidactylus frenatus*	Gekkonidae	2	-	1	3
Katak sawah	Java Wart Frog	*Fejervarya cancrivora*	Dicroglossidae	-	1	-	1
Ular tambak	Schneider's Bockadam	*Cerberus schneiderii*	Homalopsidae	1	3	-	4

Local Nama	English name	Species name	Family	ETA	NTA1	NTA2	Total
* Ular cincin emas	Mangrove Cat Snake	*Boiga dendrophila*	Colubridae	-	-	-	-
* Ular Sanca	Reticulated Python	*Malayopython reticulatus*	Phytonidae	-	-	-	-
Total				**5**	**4**	**1**	**10**

Notes: ETA= Ecotourism area (transect 1), NTA1= non ecotourism area 1 (transect 2), NTA2= non ecotourism area 2 (transect 2), * = the outcome of the interview.

The results of the study only recorded 1 individual frog of the species F. cancrivora. The frogs were found in a small stream between transect 1 and transect 2. The low number of frog findings in the study area is in line with the research of Ulumuddin (2016) which states that Anura generally cannot tolerate high salinity, so only a few types of frogs are found in mangrove habitats, one of which is *F. cancrivora*. Iskandar (1998) added that only two species of frogs are resistant to saltwater or brackish water, one of which is *F. cancrivora* which has a high level of tolerance/adaptation to water content in a habitat.

3.2 Species Diversity

Biodiversity is the entire diversity of life forms on earth and their interactions. Biodiversity has two main components, namely species richness which is the number of species in an area and evenness, which is the relative abundance of an individual in each species (Feldhamer *et al.*, 1999). The results of the study in the research area showed that the general site species diversity value was 1.28. The results of the t-Shannon test showed that there was no significant difference (α=0.05) in the value of Shannon-Wiener diversity (H') between observation lines. However, the diversity value in transect 1 (1.16) was higher than that in transect 2 (0.56). Species diversity in transect 3 could not be determined because only 1 species of Herpetofauna was found.

Similar to the diversity index, the evenness index (E) and species richness (Dmg) found in transect 1 were also higher than transect 2 (Figure 2). In general, the findings of species in the study area tend to be distributed in evenness with a value of more than 0.85. Kartono *et al.* (2017) explained that the number of individuals in an area is considered evenly distributed if it has an evenness value of more than 0.80.

The total expected finding of Herpetofauna species in the study area based on the jackknife index is 4 species. The similar result is also shown in the Chao-1 value which shows that the expected species finding is 4 species. The alleged findings of this species are based on the abundance of species found in the study area. The more species that have low individual values (rare) or unique (1 individual), the higher the presumed species found in the area. Based on the interpretation of the analysis results, the observations made in the area have recorded the maximum number of species (4 species).

The results of the biodiversity study in the research area show that biodiversity in the area set as an ecotourism area is higher than the area outside the area, especially areas that have had significant land cover changes in transect 3 which is a former pond. The prohibition of activities that interfere with the sustainability of the mangrove ecosystem in the ecotourism area indirectly affects the survival of herpetofauna.

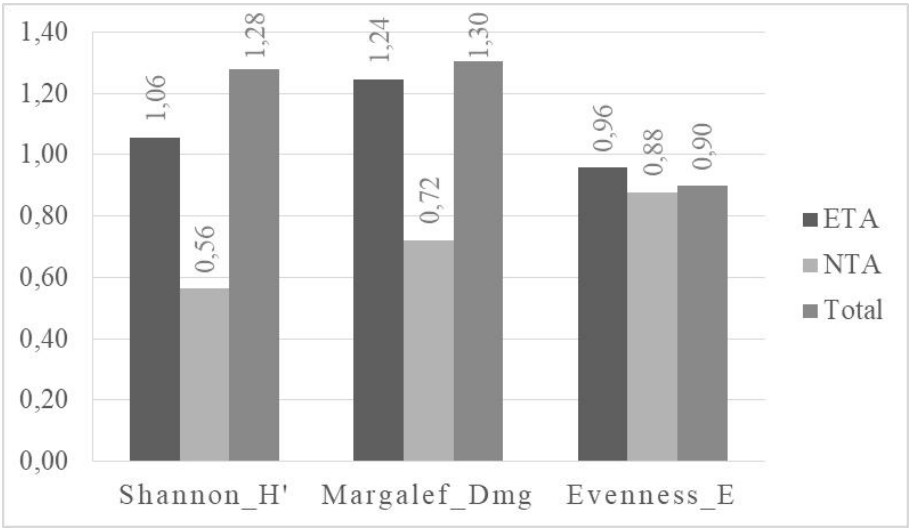

Figure 2. A comparison of Herpetofauna Species Diversity Values in the study area

3.2 Community Similarities

Biodiversity studies expressed by biodiversity indices (species richness, diversity and evenness) may conclude incorrect results if community similarity is not analysed. The values of the three measures may be the same, but the composition of the species found is different. Therefore, it is necessary to analyse community similarity (Burkhalter et al., 2013).

Morisita community similarity (Figure 3) shows that the herpetofauna community found in transect 1 has a similarity of 59% (0.59) with transect 3. While the similarity of transect 1 tends to have a low value with transect 2 of 30%. This is possible because the composition of individuals and species found in transect 2 tends to be different from other transects. Transect 2 found Schneider's Bockadam which was not found in other transects. Findings of F. cancrivora also tend to be more numerous compared to the other 2 transects. River flows found in transect 2 is thought to be the cause of different species findings that have an impact on differences in the herpetofauna community of the study area.

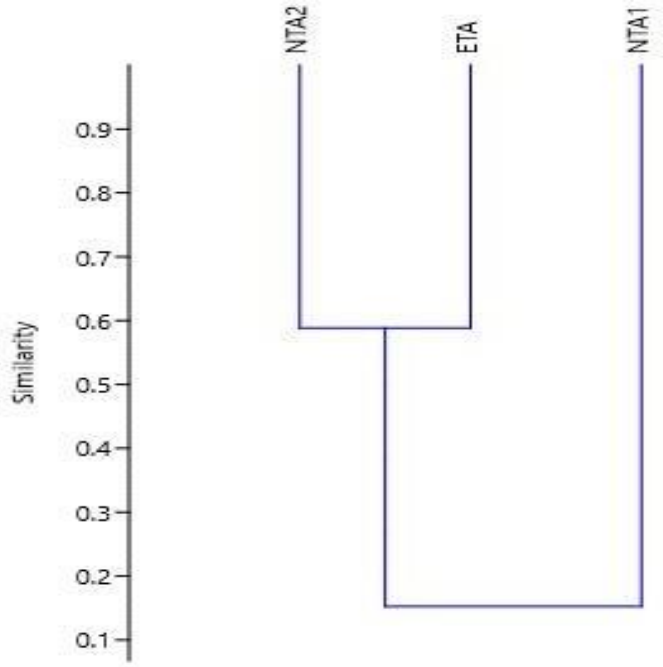

Figure 3. Similarity of Morisita communities to Herpetofauna occurrence in the study area

3.3 Protection And Conservastion

Herpetofauna species encountered in the study area, either directly or indirectly, are not nationally protected species based on the Minister of Environment and Forestry Regulation Number P.106/MENLHK/SETJEN/KUM.1/12/2018. However, two of the 6 herpetofauna species are internationally monitored and protected species. These two species are the Common Water Monitor and Reticulated Python. These two species are included in appendices II of CITES, which means that their trade is internationally monitored and must comply with the agreements in the CITES regulations. The Conservation Status of the species found in the study area can be seen in Table 2.

Table 2. Conservation Status of Herpetofauna Species in the Study Area

Local Nama	English name	Species name	Species Protection and Conservation		
			P.106	IUCN	CITES
Biawak air	Common Water Monitor	*Varanus salvator*	NP	LC	App II
Cicak	Common House Gecko	*Hemidactylus frenatus*	NP	LC	Na
Katak sawah	Java Wart Frog	*Fejervarya cancrivora*	NP	LC	Na
Ular tambak	Schneider's Bockadam	*Cerberus schneiderii*	NP	LC	Na
* Ular cincin emas	Mangrove Cat Snake	*Boiga dendrophila*	NP	LC	Na
* Ular Sanca	Reticulated Python	*Malayopython reticulatus*	NP	LC	App II

Notes: P.106= P.106/MENLHK/SETJEN/KUM.1/12/2018, NP= Not Protected, LC= least Concern, Na= Non Appendices.

The Common Water Monitor and Reticulated Python are internationally concerned because they are both species that are frequently hunted and traded both nationally and internationally. The purpose of hunting and trading these two species varies, from the presence of pests, being used as pets, consumed, and used as raw materials for products (Kasterine *et al*., 2012; Uyeda, 2014). These two species also have various uses, from basic needs to industrial scale needs (Farida *et al*., 2014; Uyeda, 2015; Nijman, 2016; Yudha *et al*., 2021).

The presence of both species is important in mangrove ecosystems. In addition to being predators for other species, these species also play a role in accelerating the occurrence of energy in mangrove ecosystems, especially the Common Water Monitor which is a detritivor species (Uyeda *et al*., 2013).

The existence of regulations (Perdes) in the Cukunyinyi mangrove ecotourism area is expected to be able to protect the survival of herpetofauna in it. Based on records during the research as well as information from residents and administrators, hunting activities were not found in the area after the establishment of the area accommodated by the Village Regulation.

4. CONCLUSIONS AND SUGGESTIONS

The study recorded 4 species of Herpetofauna directly, plus 2 species indirectly. Species diversity in the ecotourism area transect was higher (1.05) compared to the non-ecotourism area transect (0.56). The value of evenness in the area (0.95) was also higher than that of the non-area (0.88). The species richness value also revealed the trend that the value in the area (1.24) was higher than that outside the area (0.72). No nationally protected species were found in the study area, however 2 species of herpetofauna were in CITES Appendices II.

Research related to the diversity of other taxa needs to be carried out in order to comprehensively analyse habitat conditions. In addition, it is necessary to improve the

environment so that it can be a suitable habitat for wildlife.

5. ACKNOWLEDGEMENT

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REFERENCES

[IPCC] The Intergovernmental Panel on Climate Change. 2019. *The 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Bangkok: IPCC. https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

Asari, N., Suratma, M. N., Ayob, N. A. M., Hamid, N. H. A. 2021. *Mangrove as a natural barrier to environmental risks and coastal protection*. *Mangroves: Ecology, Biodiversity and Management* 13:305–322.

Azimah, A. R., & Tarmiji, M. 2018. *Habitat requirements of migratory birds in the Matang Mangrove Forest Reserve, Perak. Journal of Tropical Forest Science (JTFS)* 30, (3), 304–311. DOI: 10.26525/jtfs2018.30.3.304311.

Donato, D. C., Kauffman, J. B., Murdiyarso, D., Kurnianto, S., Stidham, M., Kanninen, M., 2011. *Mangroves among the most carbon-rich forests in the tropics. Nature Geoscience* 4, (5):293–297.

Eddy, S., Milantara, N., Sasmito, S. D., & Kajita, T., 2021. *Anthropogenic drivers of mangrove loss and associated carbon emissions in South Sumatra, Indonesia. Forest* 12, (187): 1–14. Doi: https://doi.org/10.3390/f12020187.

Eddy, S., Rasyid, R. M., Iskandar, I., Mulyana, A. 2016. *Community-based mangrove forests conservation for sustainable fisheries. Jurnal Silvikultur Tropika* 7 (3):42–47.

Farida, M.Y., Jumari, Muhammad, F. 2014. *Etnozoologi Suku Anak Dalam (SAD) Kampung Kebun Duren Desa Lantak Seribu Kecamatan Renah Pamenang Kabupaten Merangin Provinsi Jambi. Jurnal Biologi* 3, (1): 29-39.

Feldhamer, G. A., Drickamer, L. C., Vessey, S. H., Merritt, J. F. 1999. *Mammalogy: Adaptation, Diversity and Ecology*. Boston: McGraw-Hill.

Friess, D. A., Rogers, K., Lovelock, C. E., Krauss, K. W., Hamilton, S. E., Lee, S. Y., Lucas, R., Primavera, J., Rajkaran, A., & Shi, S. 2019. *The state of the world's mangrove forests: Past, present, and future. Annual Review of Environment and Resources* 44, 89–115. Doi: https://doi.org/10.1146/annurev-environ-101718-033302.

Giri, C., Ochieng, E., Tieszen, L. L., Zhu, Z., Singh, A., Loveland, T., Masek, J., Duke, N. 2011. *Status and distribution of mangrove forests of the world using earth observation satellite data. Global Ecology and Biogeography* 20, (1):154–159.

Hamilton S. E., Casey D., 2016. Creation of a high spatio-temporal resolution global database of continuous mangrove forest cover for the 21st century (CGMFC-21). Global Ecology and Biogeography 25(6):729–738.

Hamilton, S. E., Friess, D. A., 2018. *Global carbon stocks and potential emissions due to mangrove deforestation from 2000 to 2012. Nature Climate Change* 8, (3): 240–244.

Hernowo, J. B., Priambodo, E. & Siregar, S. 2007. *Inventarisasi Keanekaragaman Fauna di Demosite Kawasan MangroveBatu Ampar, Kalimantan Barat*. Kerjasama Laboratorium Satwa Liar, Departemen Konservasi Sumberdaya Hutan dan Ekowisata, Institut Pertanian Bogor dengan

Lembaga Pengkajian dan Pengembangan Mangrove Indonesia.

Hutcheson, K. 1970. *A test for comparing diversity based on the Shannon formula. Journal of Theoretical Biology* 29, (1):151–154. https://doi.org/10.1016/0022-5193(70)90124-4.

Iskandar, D. T. 1998. *Amphibia Jawa dan Bali*. Bogor: Puslitbang Biologi-LIPI, pp: 132.

Kamsi, M., Handayani, S, Siregar, A. J., Frediksson, G. 2017. *Buku Panduan Lapang Amfibi dan Reptil Kawasan Hutan Batang Toru*. Medan: Herpetology Mania Publishing.

Kartono A.P., Ginting A., Santoso N. 2008. *Karakteristik habitat dan wilayah jelajah bekantan di hutan mangrove Desa Nipah Panjang Kecamatan Batu Ampar Kabupaten Kubu Raya Provinsi Kalimantan Barat. Media Konservasi* 13, (3):1-6.

Kartono, A. P., Prayogi, K. D., & Maryanto, I. 2017. *Keanekaragaman jenis kelelawar di hutan pendidikan gunung walat sukabumi jawa barat. Zoo Indonesia* 26, (1), 33-43. Doi: 10.52508/zi.v26i1.3533.

Kasterine, *et al*. 2012. *The trade in South-East Asian Python Skins*. Geneva: International Trade Centre.

Kauffman, J. B., Arifanti, V. B., Hernández, T. H., delCarmen, J. G. M., Norfolk, J., Cifuentes, M., Hadriyanto, D., Murdiyarso, D., 2017. *The jumbo carbon footprint of a shrimp: carbon losses from mangrove deforestation. Frontiers in Ecology and the Environmen*t 15, (4):183–188.

Kusrini, M. D. 2008. *Pedoman Penelitian dan Survei Amfibi di Alam.* Bogor: Fakultas Kehutanan IPB.

Kusrini, M.D. 2020. *Amfibi dan Reptil Sumatera Selatan: Areal Sembilang–Dangku dan Sekitarnya*. Bogor: Pustaka Media Konservasi.

Laurila-Pant, M., Lehikoinen, A., Uusitalo, L., & Venesjärvi R. 2015. *How to value biodiversity in environmental management? Ecological Indicators*, 55:1-11. http://dx.doi.org/10.1016/j.ecolind.2015.02.034 .

Magurran AE. 2004. *Ecological Diversity and Its Measurement*. London: Cambridge University Press.

Magurran, A.E. 2013. *Measuring Biological Diversity*. New Jersey: John Wiley & Sons, pp: 272. https://www.wiley.com/en-us/Measuring+Biological+Diversity-p-9781118687925.

Nijman, V. 2016. *Perceptions of Sundanese Men Towards the Consumption of Water Monitor Lizard Meat in West Java, Indonesia. Biawak* 10: 22-25.

Nur, S. H., Hilmi E., 2021. *The correlation between mangrove ecosystem with shoreline change in Indramayu coast.* IOP Conference Series: Earth and Environmental Science 819, (1):1-7.

Saparinto, Cahyo. 2007. *Pendayagunaan Ekosistem Mangrove*. Semarang: Dahara Prize.

Sarhan, M. 2018. *The economic valuation of mangrove forest ecosystem services : A review*. *The George Wright Forum* 35, (3):1–16.

Ulumuddin, Y. I. 2016. Menggapai untung dari mangrove Belitung: Melindungi hutan mangrove dan meningkatkan kesejahteraan manusia. In R. Siburian, & J. Haba (Eds.), *Konservasi mangrove dan kesejahteraan masyarakat* (pp.127). Jakarta: Yayasan Pustaka Obor Indonesia.

Uyeda, L. T. 2015. *The Water Monitor Lizard Varanus salvator, Behaviour, Ecology, and Human Dimensions in Banten, Indonesia (thesis)*. Washington: University of Washington.

Uyeda, L., Entang, I., Aaron, W., Randall, K. 2013. *Nocturnal Activity of Varanus*

Salvator on Tinjil Island, Indonesia. Biawak 7, (1): 25-30.

Uyeda, L., Iskandar, E., Purbatrapsila, A., Pamungkas, J., Wirsing, A., Kyes, R. 2014. *Water Monitor Lizard (Varanus salvator) Satay: A Treatment for Skin Ailments in Muarabinuangeun and Cisiih, Indoneisa. Biawak* 8, (1): 35-38.

Vincentius, A., Nessa, M. N., Jompa, J., Saru, A., Nurdin, N., Rani, C. 2018 *Influential factors analysis towards mangrove cover and production of demersal fish in Maumere Bay, Indonesia*. *AACL Bioflux* 11, (3):810–822.

Yudha, P. Y., Kusrini, M. D., Arida, E. 2021. *Perburuan dan Perdagangan Biawak Air, Varanus salvator (Laurenti, 1768) di Daerah Bogor.* In Seminar Nasional Perhimpunan Masyarakat Etnobiologi Indonesia. Bogor: Perhimpunan Masyarakat Etnobiologi Indonesia.