

Herpetofauna in the Ledok Ombo Natural Tourism Area, Malang District, East Java

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Abstract

Herpetofauna have an important role as predators and pest controllers. In addition, herpetofauna is also an environmental bioindicator in maintaining the balance of the ecosystem. Ecosystems in the Ledok Ombo Nature Tourism are declining due to the large number of tourists. The purpose of this study was to determine the diversity of herpetofauna in the Ledok Ombo Nature Tourism Area, Malang Regency. Herpetofauna specimens were collected using a Visual Encounter Survey, Purposive Sampling at 07-11 PM. Specimens were collected three times one week apart in March 2022. The data was analyzed using Shannon Weiner Diversity, Pielou Evenness, Margalef Richness, and Simpson Dominance indices. Habitat characteristics were recorded. Water-air temperature and air humidity were recorded. The results showed nine species of amphibians (*Chalcorana chalconota*, *Microhyla achatina*, *Duttaphrynus melanostictus*, *Phrynooidis aspera*, *Leptobrachium hasseltii*, *Odorrana hosii*, *Rhacoporus reinwardtii*, *Polypedates leucomystax*, *Ocxydozyga lima*) and nine species of reptiles (*Cyrtodactylus marmoratus*, *Hemidactylus frenatus*, *Gonocephalus kuhlii*, *Broncochela jubata*, *Eutropis multifasciata*, *Pareas carinatus*, *Ahetulla prasina*, *Dendrelaphis pictus*, *Lycodon subcinctus*). The index values of diversity, evenness, richness, and dominance are 1,591, 0,088, 3,250, and 0,398, respectively. Habitat character affects the composition of herpetofauna. The physical factors value range for water temperature is 23 - 24.55°C, air temperature 25.05 - 27.15°C, and air humidity 77.25 - 84.75%.

Keywords: biodiversity; ecosystem; amphibian; reptile; ledok ombo

Introduction

At a particular food chain level, herpetofauna plays a significant role in an ecosystem as predators and pest controllers. Due to their sensitivity to environmental change, some additional species can be utilized as environmental bioindicators (Muslim & Sari, 2016). Environmental bioindicators are biotic elements that serve

as markers for time, place, natural conditions, and environmental quality alterations brought on by human activity (Pratiwi, undated). Unfortunately, it is quite alarming how few people understand how important their place in the ecology is, particularly in developing nations (Yuliany, 2021).

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East Java has one of the highest deforestation rates on the island of Java. East Java has to be researched more since there is an imbalance in the amount of study done there compared to other parts of Java island (Kusrini et al., 2021). According to BPSKM data (2020), Malang Regency is one of several regions with a fairly large area, namely 2,977.05 km², flanked by several rows of mountains and various rivers. It makes many ecotourism areas found in this area. Ledok Ombo is one of the natural tourism areas with a potential ecosystem for reptiles and amphibians; however, it has not been properly recorded.

The presence of humans in an ecosystem can have a significant effect. According to Manrique et al. (2019), habitat modification can seriously impact the ecological, reproductive and physiological attributes of the herpetofauna that inhabit it. According to Cruz et al. (2016), fragmentation and loss of natural habitats are the biggest threats to biodiversity, especially in the tropics. Habitat destruction plays the main role in decreasing the abundance and diversity of species. In some rare cases, some tropical ecosystems modified by humans can sometimes enrich the diversity of amphibian and reptile species (Ndriantsoa *et al.*, 2017).

This study aimed to determine the diversity of herpetofauna in the Ledok Ombo Nature Tourism Area, Malang Regency.

Research Methods

Specimen collection was carried out in March 2022, with three repetitions at the research location, divided into three zones based on habitat characteristics (Camping Ground, Agroforestry, River area). The search and sampling were conducted by visiting the observation site at night through the active Visual Encounter Survey (VES)

method modified by purposive sampling with a time search of 4 hours, starting from 7-9 pm. Measurement of physical factors is measured every hour during the specimen collection process.

Specimen identification based on literature, field manuals, and web databases. The identification guidebook used in this study included a book entitled "Guide to Herpetofauna (Amphibian and Reptile) TNAP" by M. Farikhin Yuanurefa et al. (2012), "West Java Amphibian Identification Guide" by Mirza Kusrini (2013), "A Field Guide To The Reptiles Of South-East Asia" by Indraneil Das (2010), as well as amphibian database (<https://amphibiaweb.org>) and reptiles database (<https://reptile-database.reptarium.cz/>).

Voucher specimens were taken to the Ecology Laboratory of the Biology Study Program, Faculty of Science and Technology, UIN Malang, to be preserved as research evidence. The preservation process is carried out at the Ecology Laboratory of the Biology Study Program, Faculty of Science and Technology, State Islamic University of Maulana Malik Ibrahim Malang.

The data were analyzed through Shannon-Weiner Species Diversity Index, Pielou Evenness Index, Margalef species richness index, and Simpson dominance index.

Research Results and Discussion

The result of this study showed 9 species of amphibians (*Chalcorana chalconata*, *Microhyla achatina*, *Duttaphrynus melanostictus*, *Phrynomantis aspera*, *Leptobrachium hasseltii*, *Odorrana hosii*, *Rhacophorus reinwardtii*, *Polypedates leucomystax*, *Occydozyga lima*) and also nine species of reptiles (*Cyrtodactylus marmoratus*, *Hemidactylus frenatus*,

Gonocephalus kuhlii, *Broncochela jubata*,
Eutropis multifasciata, *Pareas carinatus*,

Ahetulla prasina, *Dendrelaphis pictus*,
Lycodon subcinctus). **Figure 1a & 1b**

Figure 1a

Anurans specimens caught from study area (A: *Occidozyga lima*, B: *Microhyla achatina*, C: *Odorrana hosii*, D: *Polypedates leucomystax*, E: *Duttaphrynus melanostictus*, F: *Phrynoedis aspera*, G: *Leptobrachium hasseltii*, H: *Chalcornis chalconota*, I: *Rhacophorus reinwardtii*)



Figure 2

Study area location of Ledok Ombo, Malang Regency

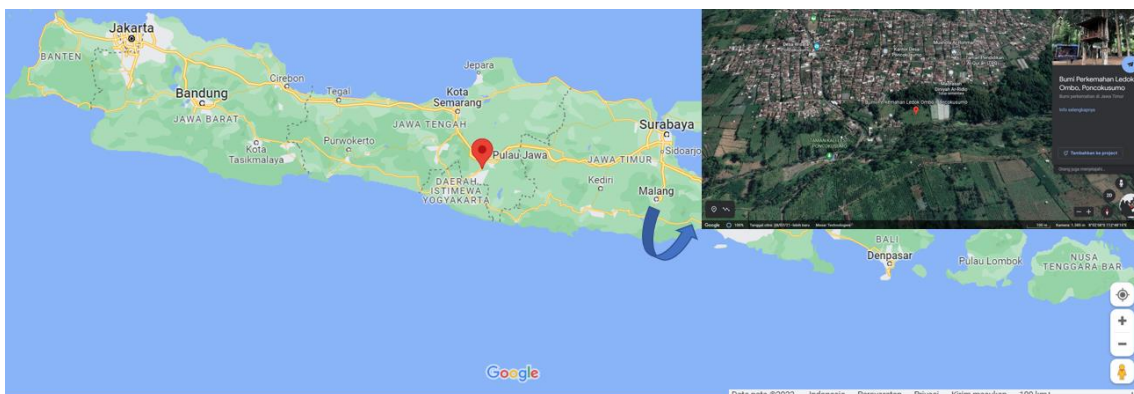


Figure 1b

*Reptiles specimens caught from study area (A: *Cyrtodactylus marmoratus*, B: *Gonocephalus kuhlii*, C: *Lycodon subcinctus*, D: *Bronchocela jubata*, E: *Ahaetulla prasina*, F: *Dendrelaphis pictus*, G: *Pareas carinatus*, H: *Hemidactylus frenatus*, I: *Eutropis multifasciata*)*

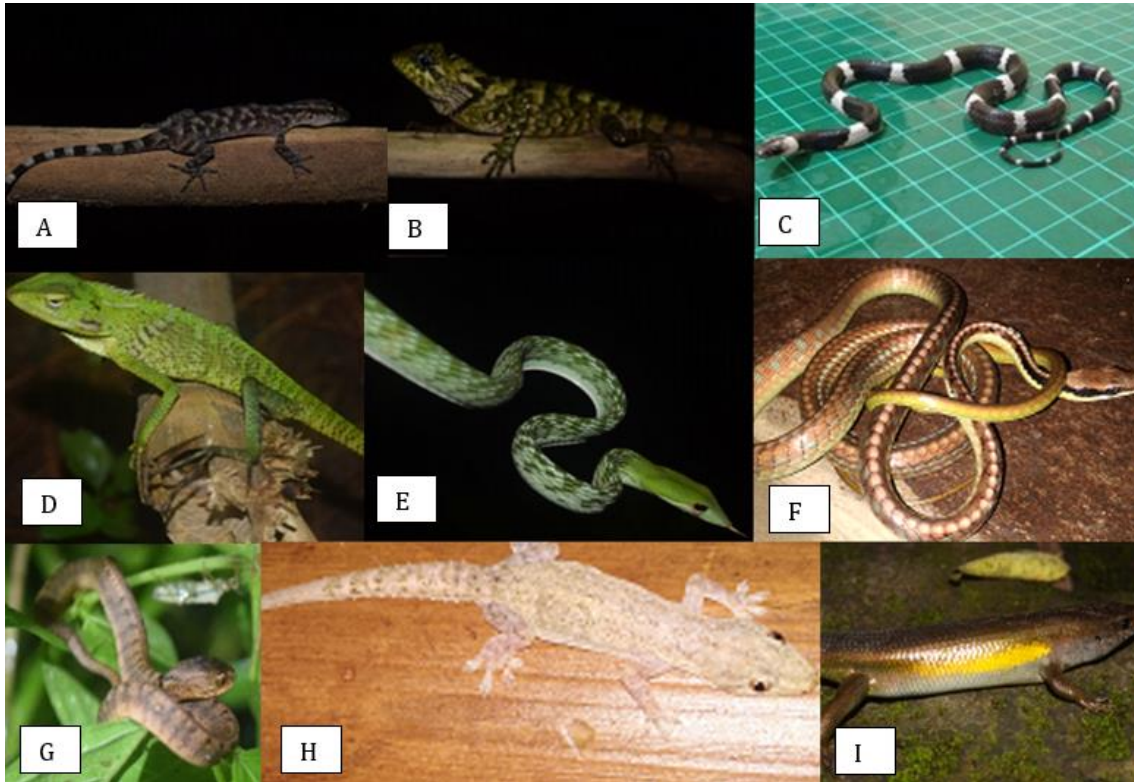


Figure 3a

Zone 1: Camping ground (a-e respectively: camping area, toilet, musholla, tree house, cafeteria)



Figure 3b

Zone 2: Agroforestry (a-f respectively: bamboo trees, cassava plantation, banana plantation, ground cover, chili plantation, arboretum)

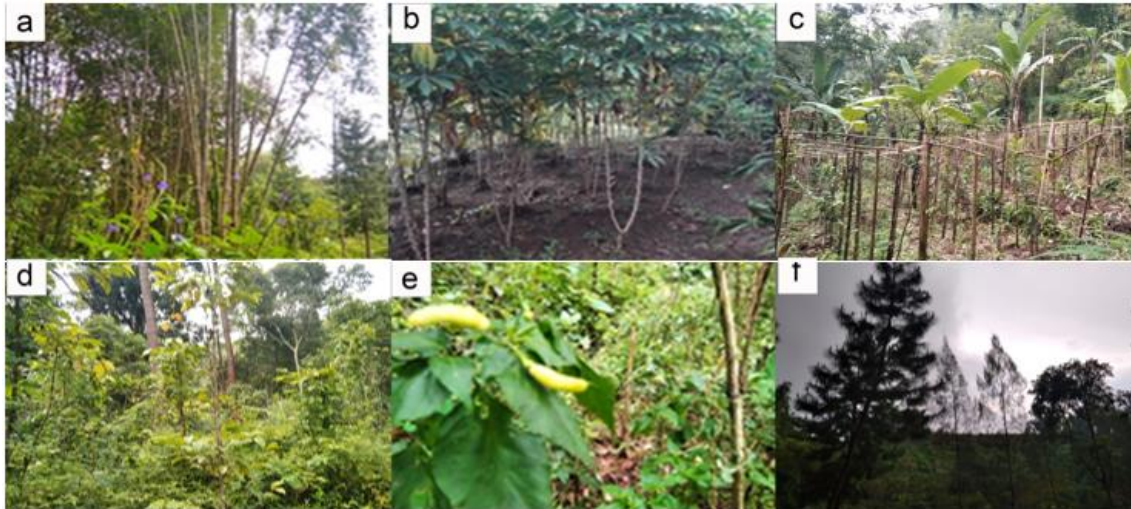
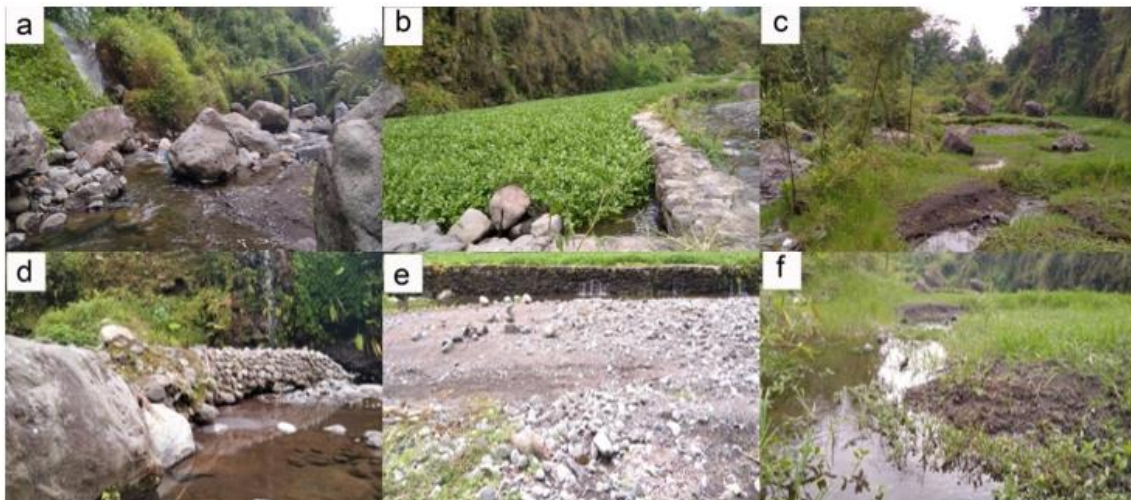


Figure 3c

Zone 3: River area (a-f respectively: rocky river, watercress plantation, bamboo trees, rock bedded river, wet rocky ground covered river, puddle area)



Malang Regency is an area with many potential places as tourist areas. Many tourist attractions exist in the Malang district, but not all places are exposed and well-maintained. One is the Ledok Ombo nature tourism area, commonly known as the Ledok Ombo campground (Martha,

2017). Ledok Ombo is located on the slopes of the Bromo Tengger Semeru National Park. Precisely in Pandansari village, Poncokusumo sub-district, Malang district. The location of this place is located on a plateau with lots of standing pine trees. There is also a river close to the campsite (Devi, 2019) (**Figure 2**).

Table 1
Herpetofauna composition in study area

No	Class	Family	Species	Conservation (IUCN, 2021)
1	Amphibia	Ranidae	<i>Chalcorana chalconota</i>	<i>Least Concern</i>
2			<i>Odorrana hosii</i>	<i>Least Concern</i>
3		Microhylidae	<i>M. achatina</i>	<i>Least Concern</i>
4		Bufonidae	<i>Duttaphrynus melanostictus</i>	<i>Least Concern</i>
5			<i>Phrynoedis aspera</i>	<i>Least Concern</i>
6		Megophryidae	<i>Leptobrachium hasseltii</i>	<i>Least Concern</i>
7		Rhacophoridae	<i>Rhacophorus reinwardtii</i>	<i>Near Threatened</i>
8			<i>Polypedates leucomystax</i>	<i>Least Concern</i>
9		Dicroglossidae	<i>Ocyydozyga lima</i>	<i>Least Concern</i>
10	Reptilia	Gekkonidae	<i>Cyrtodactylus marmoratus</i>	<i>Least Concern</i>
11			<i>Hemidactylus frenatus</i>	<i>Least Concern</i>
12		Agamidae	<i>Gonocephalus kuhlii</i>	<i>Vulnerable</i>
13			<i>Broncochela jubata</i>	<i>Least Concern</i>
14		Scincidae	<i>Eutropis multifasciata</i>	<i>Least Concern</i>
15		Colubridae	<i>Pareas carinatus</i>	<i>Least Concern</i>
16			<i>Ahetulla prasina</i>	<i>Least Concern</i>
17			<i>Dendrelaphis pictus</i>	<i>Least Concern</i>
18			<i>Lycodon subcinctus</i>	<i>Least Concern</i>

Table 2
Herpetofauna index value

	Zone*			Sum
	1	2	3	
Species	8	14	11	18
Individual sample	47	28	112	187
Diversity index (Shannon Weienner)	1,159	2,283	1,261	1,591
Eveness Index (Pielou)	0,557	0,865	0,526	0,088
Species richness index (Margalef)	1,818	3,901	2,119	3,250
Dominance index (Simpson)	0,508	0,143	0,463	0,3979

*Zone 1: Camping ground (terrestrial), zone 2: forest and agroforest area (arboreal), zone 3: Ledok ombo river area (aquatic)

Table 3*Coordinate of the zones*

Zone	Coordinate
Zona 1 (Camping ground)	S08°C 04.100'E112°48.376'
Zona 2 (Agroforestry)	S08°C 03.157'E112°48.823'
Zona 3 (River flow area)	S08°C 03.311'E112°49.147'

Table 4*Herpetofauna distribution on each zone*

Species	Zone		
	1	2	3
<i>Chalcorana chalconata</i>	√		√
<i>Microhyla achatina</i>	√		√
<i>Duttaphrynus melanostictus</i>		√	
<i>Phrynoidis aspera</i>		√	
<i>Leptobrachium hasseltii</i>	√	√	√
<i>Odorrana hosii</i>	√	√	√
<i>Rhacoporus reinwardtii</i>		√	
<i>Polypedates leucomystax</i>		√	
<i>Occydozyga lima</i>			√
<i>Cyrtodactylus marmoratus</i>	√	√	√
<i>Hemydactylus frenatus</i>	√	√	
<i>Gonocephalus kuhlii</i>	√	√	
<i>Broncochela jubata</i>		√	√
<i>Eutropis multifasciata</i>		√	√
<i>Pareas carinatus</i>		√	√
<i>Ahetulla prasina</i>			√
<i>Lycodon subcinctus</i>			√
<i>Dendrelaphis pictus</i>		√	

Tabel 5*Environmental parameter data during the study*

	Water temperature (celcius)			Air temperature (celcius)			Air humidity (%)		
	zone 1	zone 2	zone 3	zone 1	zone 2	zone 3	zone 1	zone 2	zone 3
Repetition 1	-	-	24,55	27,15	26,99	25,05	77,25	77,75	83,5
Repetition 2	-	-	23,95	26,1	26,2	25,8	77,75	77,25	84,5
Repetition 3	-	-	23,75	25,75	25,65	25,45	79,5	78,75	84,75

The study location is divided into three zones. The first zone is the camping area, which has a terrestrial habitat type with the dominance of pine trees and various microhabitats such as tree houses, stalls, prayer rooms, small ponds, and bathrooms (**Figure 3a**). The second zone is an agroforestry area with an arboreal habitat dominated by cassava, shrubs, bamboo, and other plants (**Figure 3b**). The third zone is a river area with an aquatic habitat consisting of rocks, river walls, and the river itself (**Figure 3c**). The coordinates for the location of the research zone can be seen in **table 3**.

In this study, a total of 187 individuals were found from 10 families and 18 species of herpetofauna, consisting of nine reptiles and nine amphibians. The most common type found is *Chalcorana chalconota*. The families found in this study included two species of Ranidae, one species of Microhylidae, two species of Bufonidae, one species of Megophryidae, two species of Rhacoporidae, one species of Dicoglossidae, two species of Gekkonidae, two species of Agamidae, one species of Scincidae, and four species of Colubridae. (**Table 1; Figure 1a; Figure 1b**)

Based on the data calculations in **table 2**, there were 18 species of herpetofauna consisting of nine species of amphibians and nine species of reptiles, containing 187 individuals altogether, 143 of which are amphibians and 44 of which are reptiles. The total number of species found in zones 1, 2, and 3 sequentially are 8, 14, and 11 species, with a total of 47, 28, and 112 individuals. From these data, it can be seen that zone 3, a river area, has the highest of individuals recorded, followed by zone 1, and the least by zone 2. It could be due to herpetofauna, especially amphibians, according to Mardinata et al. (2018), like places or

habitats with high humidity. And some species can not be separated from the water, even their whole life.

Based on the diversity index, the diversity index value of all zones in Ledok Ombo is 1,591. It shows that the diversity in the Ledok Ombo Tourism Area is moderate, according to the explanation of Sulaeman et al. (2020). According to Fachrul (2007), the diversity index value is said to be moderate if it is between numbers 1 and 3. Zone two, a vegetation zone, has the highest level of diversity compared to other zones. It is because zone two has the highest number of species with the least number of individuals and low dominance. Following the explanation in the journal Alimuddin (2016), the value of the diversity index (H') will be higher if a community consists of individuals from various species or genera, while the diversity index will be lower if many individuals come from one species or genus. Furthermore, Shannon Wiener's diversity is considered to be larger if the evenness index is higher while dominance is lower. Shannon Wiener's diversity is said to be at its highest if every species has the same probability of emerging.

The total species dominance index was 0.398, which means the herpetofauna species dominance index was low. Under the statement of Nento et al. (2013), if the dominance index is less than 0.50, it means low dominance and shows almost no species dominating.

Based on the evenness index using the Pielou formula, it can be seen that the cumulative evenness index value of all zones in Ledok Ombo is 0.088. It shows that the level of evenness in the Ledok Ombo Tourism Area is almost even; by the explanation of Wirabumi & Sudarsono (2017) that if the evenness index value

ranges from 0.76-0.95, it means that the evenness index value is almost even.

The evenness index values in zones 1, 2, and 3 are sequentially 0.557, 0.865, and 0.526 and also sequentially show the criteria of fairly even, almost even, and relatively even. Zone 2 has the highest level of evenness which is an agroforestry area. According to Arfiati et al. (2019), a high evenness index indicates individuals with a high and even distribution of composition. According to Arfiati et al. (2019), this also indicates a community with stable growth and development and an ecosystem with high diversity. Meanwhile, according to Khatimah (2018), the lesser evenness can be caused by the dominance of certain types of herpetofauna.

Based on the Species richness index using the Margalef formula, it is known that the accumulative value of the evenness index in all zones in the Ledok Ombo Nature Tourism Area is 3,250. It shows that species richness in Ledok Ombo is in a low category because, according to Magurran (1998), in Wirabumi & Sudarsono (2017), richness will be said to be low if it is less than 3.5, moderate if it is between 3.5-5, and high if it is more than 5.

The species richness index values in zones 1, 2, and 3, respectively, are 1.818, 3.901, and 3.901 and also sequentially show the criteria for low, medium, and low wealth. The highest level of richness is owned by zone 2, an agroforestry area. At the same time, the lowest wealth index value can be seen in zone 1, a camping area. Susiana et al. (2011) claim that a variety of abiotic and biotic factors, including environmental circumstances, food availability, predator predation, and competition, have an impact on a species' richness in nature. The diversity in a population's structure and the

number of species can also be impacted by pressure and environmental changes. With this, it can be seen that zone one, a camping area, has a low species richness, which might be caused by the environment's homogenous and predominately pine tree-dominated environmental structure.

Based on the Dominance index using the Simpson formula, it is known that the cumulative Dominance Index value for all zones in the Ledok Ombo Nature Tourism Area is 0.398. It shows that the level of dominance in Ledok Ombo is low, and there tends to be no dominant herpetofauna species. Because according to Desinawati et al. (2018), a dominance index with a range of 0-0.5 indicates that no species dominates, whereas if the range reaches 0.5-1, it indicates that certain species dominate. As shown by this observation, zones 1 and 3 are primarily dominated by *Chalcorana chalconota* species. It is believed to have an impact on the measured dominance index value. In order, the dominance indices in zones 1, 2, and 3 are 0.508, 0.143, and 0.463, respectively. These findings show that the lower the evenness value is, the higher the dominance value is.

Conversely, the lower the evenness score, the more evidence there is of a dominant species population, according to Nahlunnisa et al. (2016). The smaller the diversity value is, the higher the dominance value is. according to the assertion made by Thukral et al. (2019) that the diversity value diminishes as the dominance value rises.

Herpetofauna encounters in a zone are influenced by the type and composition of the habitat in that zone. It is because the preferences of animals in choosing a place to live are thought to have a close relationship with food availability and the existing constituent vegetation. It is supported by

Wanda et al. (2012), who explained that the heterogeneity of vegetation in a habitat affects the various types of Anura encountered. Similarly, according to Fatmawati et al. (2021), The composition and structure of vegetation are essential habitat conditions to support animal life. Environmental abiotic factor also affects the presence of the specimens (**Table 5**). The composition of the herpetofauna species found in each zone can be seen in **table 4**.

Conclusion

The number of species obtained was 187, belonging to 9 families and 18 species of Herpetofauna. The herpetofauna species diversity index in Ledok Ombo was 1.591, the species evenness index was 0.088, the species richness index was 3.250, and the dominance index was 0.398. Abiotic factors such as habitat characteristics affect the herpetofauna species found. Physical factors are known to be in optimum conditions as a herpetofauna environment for life, namely with water temperature 23-24.55°C, air temperature 25.05-27.15°C, and air humidity 77.25-84.75%. Future research needs to be done with the addition of passive methods, such as the trapping method, to facilitate the capture of unreachable or hidden species when direct searches are carried out.

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