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Amphibian Diversity in the Kawasan Taman Wisata Alam, Bogor, Indonesia

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Abstract. Amphibians play an important role in the ecosystem, where they act as predators of various types of insects and are important biological indicators. However, in reality some amphibian habitats are lost and their activities are disrupted due to the construction of inns and restaurants. This study aims to determine the diversity of amphibians in the Bogor Natural Park. This research used VES (Visual Encounter Survey), in which samples were captured by hand and identified morphologically. The sample in this study was anura in the area where the natural park was located. Data were collected and analyzed using the Shannon-Wiener Index, Relative Abundance Index, and Species Richness Index (Margalef). A total of 13 species were obtained which belong to 6 families. Amphibian diversity index $H' = 0.929$. The highest abundance of *Chalcorana chalconota* was 78.81%. Species Richness Index $DMg = 1.858$. This study proved that the diversity of amphibians in Bogor Natural Park is low and the level of species richness is in the low category.

1. Introduction

Biodiversity supports human civilization in many ways. Humans do not only receive direct benefits in the form of food, medicine, and pollination, but humans also depend on their contribution to the nutrient cycle (food chain), climate regulation, and soil formation (Magurran, 2005). When there is a destruction of biodiversity, there would be changes in the environment such as in terms of the movement of energy and nutrients through air, water and soil, and through the food chain (Ehrlich, Foreword; Schulze & Mooney, 1994).

The Ordo Anura is recorded with the largest number in Indonesia. This family has 319 species in 14 genera (Frost, 2017). Some of its species are predicted to be endemic to Sumatra and Java (Kurniati, 2005).

Amphibians, especially at the egg stage and tadpoles, are very sensitive to environmental damage. Therefore, amphibians are an important biological indicator, whereby a change in the frog population can be a measurement of the health of the surrounding environment (Kusrini, 2013). If in an area there are no frogs / toads found, it can be said that the quality of the environment in the area is very bad (Iskandar & Mumpuni, 2004; IUCN, 2007).

Around the world, natural forests are in crisis. Plants and animals that live in it are threatened with extinction. Indonesia is the country with the fastest deforestation in the world (Arif, 2016). The results of the FWI analysis show that deforestation in the 2013-2017 period was estimated to reach approximately 5.7 million hectares or around 1.46 million hectares per year (Ramanamanjato, et al



2012). This figure has increased from the average deforestation compared to the 2009-2013 period, namely 1.1 million hectares per year (Forest Watch Indonesia, 2019).

Research on amphibian diversity has been conducted by Annawaty & Paserang (2009) where the diversity of amphibians in the Lore Lindu National Park, Central Sulawesi found 5 types of amphibians, including *Bufo melanostictus*, *Bufo celebensis*, *Fejervarya cancrivora*, *Rana* (*Hylarana*) *erythraea* and *Kaloula baleata* Muller. Real et al (2019) in their research at the Lekawai Resort, Bukit Baka National Park, West Kalimantan, discovered 24 types of frogs consisting of the Bufonidae family (5 species), Dicroglossidae (6 species), Ranidae (7 species), Rhacophoridae (2 species), Megophryidae (3 species) and Microhylidae (1 species). Another study conducted by Subeno (2018) recorded 10 species in the diversity study in the Upper Mount Sindoro River in Central Java, including *Phrynowis aspera*, *Fejervarya limnocharis*, *Limnonectes kuhlii*, *Limnonectes microdiscus*, *Megophrys montana*, *Microhyla achatina*, *Huia masonii*, *Hylarana chalconota*, *Odorrana hosii* and *Rhacophorus margaritifer* (Verga, et al. 2012). Hidayah, et al. (2018) in the Coban Putri Nature Tourism Area, East Java recorded 7 types of frogs, including *Chalcorana chalconota*, *Huia masonii*, *Odorrana hosii*, *Leptobrachium hasseltii*, *Duttaphrynus melanostictus*, *Phrynowis asper* and *Polypedates leucomystax*. The highest frequency is by the species *Chalcorana chalconota* (Dolgener, et al. 2014). The differences in the discovery of amphibians in each study were influenced by several factors, including; differences in season and efforts made in searching for amphibians (Poynton, et al. 2007). The calculation of effort is usually based on the length of time searching in the field and the surveyed area which affects the acquisition of amphibians obtained (Kusrini, 2008). The importance of diversity research is undertaken because of its significance to human life on earth and because species are being lost at an accelerating rate due to climate change and deforestation (Tockner et al 2006).

Although research on the diversity of amphibians has been done, very little research has been carried out on the diversity of amphibians locations that have experienced deforestation and development, especially in Bogor Natural Park. This study aims to determine the diversity of amphibians (ordo anura) in the Bogor Natural Park area. The results of several studies that have been conducted show that several types of endemic and rare frogs that live in the Natural Park area, after experiencing deforestation and lodging construction. However, there has been no research on the diversity of amphibian species. This is what underlied us to carry out this research. The findings in this study are expected to help further researchers to find out the habitats of each type of amphibian in the Natural Park and provide information to managers about the diversity of amphibian species to be preserved.

2. Methodology

The research was conducted from April 2019 to June 2019 at the Telaga Warna Natura; Park, Puncak Bogor. Based on geographic location, this area is located between 6042'24" - 6043'24" South Latitude and 107011'05" - 107020'00" East Longitude with an altitude ranging from 1,400m to 1,800m (asl).

This study used the VES (Visual Encounter Survey) method by walking in a predetermined area or habitat within a predetermined time period (Kusrini, 2008).

Research Procedures

The research was carried out by carrying out random searches at each predetermined place. Species were searched along the research route, caught amphibians by hand and identified by morphology and using the SVL (Snout Vent Length) method.

Physical data was taken every time amphibians were discovered. An air temperature of 19.2° C and a humidity of 85.8% Rh were measured using a weathermeter. The water temperature of 19.7° C was measured using a thermometer. Water pH of 8 was measured using a digital pH meter.

Data Collection and Data Analysis

This research data included the name of the type and the number of individuals/types of amphibians (anura) around the area of the Natural Park. Before being analyzed, the data for each type recorded were grouped by family along with the total number of each individual found.

Data analysis was performed with the help of Microsoft Excel. To analyze the data, we use the following formula:

1. Species Diversity Index (*Shannon-Wiener*)

The analysis of the diversity of amphibians in the research location was carried out by calculating the Shannon-Wiener diversity index (Brower & Zar, 1997), with the following formula:

$$H' = -\left\{ \sum \left(\frac{ni}{n} \right) \ln \ln \left(\frac{ni}{n} \right) \right\}$$

Information:

H' = Shannon-Wiener Index,

ni = Number of species (i),

N = Total recorded individuals of all species

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

Table 1. Diversity Index Criteria

Diversity Index (H')	Information
H' > 3	High
1 ≤ H' ≤ 3	Medium
H' ≤ 1	Low

(Wilhm & Dorris, 1968 ; Masson, 1981).

2. Relative Abundance Index

Abundance analysis is to determine the description of a species composition in the community (Melati, 2007).

$$Pi = \left(\frac{ni}{N} \right)$$

Information:

ni = Number of species (i),

N = Total recorded individuals of all species

3. Species Richness Index (*Margalef*)

Species richness was determined by the large number of species in a community where the more species identified, the higher the species richness (Margalef, 1958; Ismawan, 2015).

$$DMg = \frac{S - 1}{\ln \ln N}$$

Information:

R = Species Richness Index

S = Number of species

N = Total recorded individuals of all species

Table 2. Species Richness Index Criteria

Species Richness Index (R)	Information
R > 4	High
2,5 > R < 4	Medium

R < 2,5

Low

4. Environmental physico-chemical parameters measured included water temperature, air temperature, air humidity and water pH.

The results of physical data measurements show that all environmental physico-chemical parameters were still suitable for amphibian survival. Optimal growth of Anura requires environmental temperatures ranging from 19-31° C (Pujaningsih, 2007). Anura requires higher humidity than reptiles and other terrestrial animals (Ludwig, 1945; Ardiansyah et al., 2014). It is feared that the water pH range below 4-5 can kill amphibian and tadpole embryos (Kusrini, 2008).

3. Result and Discussion

The research data consisted of the total sample of amphibians recorded which was 637 individuals. Types and families of amphibians obtained in the study can be seen in Table 3.

Table 3. The types of amphibians found in the Bogor Nature Park area

No	Amphibian Data		
	Family	Types	Total
1	Dicroglossidae	<i>Limnonectes kuhlii</i>	9
		<i>Limnonectes microdiscus</i>	36
2	Ranidae	<i>Amnirana nicobariensis</i>	12
		<i>Chalcorana chalconota</i>	502
		<i>Odorrana hosii</i>	11
3	Rhacophoridae	<i>Philautus auriafasciatus</i>	10
		<i>Nyctixalus margaritifer</i>	2
		<i>Rhacophorus reinwardtii</i>	2
		<i>Rhacophorus margaritifer</i>	41
4	Megophryidae	<i>Megophrys montana</i>	1
5	Microhylidae	<i>Microhyla achatina</i>	4
		<i>Microhyla palmipes</i>	6
6	Bufoidea	<i>Duttaphrynus melanostictus</i>	1

Amphibian Species Diversity

Based on the calculation of species diversity using the Shannon-Wiener formula, the index value of species diversity $H' = 0.929$ for the value of species diversity in the area. The index value above shows that the diversity of species was in the low category.

Abundance Species of Amphibians

Abundance is the total number of individual amphibians during observation. Abundance index value provides an overview of the species composition in the community.

Table 4. Relative Species Abundance of Amphibians in Natural Park Area

No	Amphibians Abundance	
	Species	Percentage (%)
1	<i>Limnonectes kuhlii</i>	1,41
2	<i>Limnonectes microdiscus</i>	5,65

3	<i>Amnirana nicobariensis</i>	1,88
4	<i>Chalcorana chalconota</i>	78,81
5	<i>Odorrana hosii</i>	1,73
6	<i>Philautus auriafasciatus</i>	1,57
7	<i>Nyctixalus margaritifer</i>	0,31
8	<i>Rhacophorus reinwardtii</i>	0,31
9	<i>Rhacophorus margaritifer</i>	6,44
10	<i>Megophrys montana</i>	0,16
11	<i>Microhyla achatina</i>	0,63
12	<i>Microhyla palmipes</i>	0,94
13	<i>Duttaphrynus melanostictus</i>	0,16

Species of Amphibians

Based on calculations using the Margalef wealth index, the amphibian species wealth level obtained IN the Bogor Natural Park was worth 1.858. This value indicates that the Nature Tourism Park has low species richness.

The Shannon diversity index is used to obtain a population description through the number of individuals of each species in a community. The index of species diversity in the Natural Park research location was $H' = 0.929$. This means that the diversity in the Natural Park is in the low category. The dominance of the *Chalcorana chalconota* frog is the main cause of the low diversity index obtained. The more even the number of a species is in abundance, the more diverse it will be. The diversity is also assumed to increase because the collection becomes more even (Maguran, 2005). Another cause is due to human activities. The factors that influence the high and low diversity of species in a community are habitat conditions and also the presence of disturbance either naturally or due to human activities (Pratiwi, 1987). The low intensity of rainfall during the study was also a factor in the low diversity value. The best time to take samples is during the rainy season because that is when most amphibians spawn (Kusrini, 2008).

Abundance is the total number of individual amphibians during observation. The highest species abundance in Natural Park was obtained by *Chalcorana chalconota* at 78.81%. Based on field observations, this type of frog was found in all areas of the research location. *Rana chalconata* is a type of frog that has great tolerance to habitat changes; they can live in primary forest or are disturbed to man-made habitats, such as rice fields, fields and ponds close to forests; but they cannot live far from the forest (Kuniarti, 2010). The lowest species abundance was obtained by *Duttaphrynus melanostictus* and *Megophrys montana* with an abundance value of 0.16%.

Based on calculations using the Margalef species wealth index formula, the Natural Park area had an R value of 1.858. This implies that species richness is low. This happens because the vegetation is not diverse and the habitat for frogs is reduced due to development. Complex habitats can measure the abundance, wealth and diversity of amphibians. The more complex means the more diverse and the higher value of wealth and abundance (Lancaster, 1979set).

4. Conclusion

The study showed that the diversity index of amphibians in Bogor Natural Park is low and the species richness of amphibians is in the low category.

Suggestions from the authors include for future researchers who want to use a title or theme that is relevant to this study, it is suggested to collect data during the rainy season so that there are more possible types of amphibians.

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