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Amphibian Diversity (Order Anura) in Bogor, Indonesia

Amphibian Diversity in Cimisblung Bogor West Java

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Abstract. Amphibians play a vital role as bio indicators of environmental health. This study aims to calculate the diversity of species, the abundance and the evenness of amphibians in the area of Cimisblung Resort Cisarua, Gunung Gede Pangrango National Park (TNGGP). Visual Encounter Surveys method was used to determine the species richness of the area, to compile a species list and to estimate the relative abundance of species, by observing the trunks of bush trees in the Cimisblung River flow. Data analysis used Species Diversity Index, Species Evenness Index, Species Abundance Index and Dominance Index. The results showed that the frogs obtained in the Cimisblung area were 151 individuals, 13 species from 5 families, the diversity index (*Shannon-Wiener*) showed that in the Cimisblung River $H' = 1.780$ the evenness index for species $E = 0.694$ and the dominance index $D = 0.286$. Amphibian diversity (Order Anura) in the Cimisblung region is moderate.

1. Introduction

Indonesia is a tropical country that has a fairly high diversity of flora and fauna. The richness of natural resources in Indonesia is inseparable from the various components of the ecosystem which form a suitable habitat for the development of various species. One of the many fauna found in Indonesia is amphibians which are included in the phylum chordata.

Amphibians are one of the ecosystem components that have a very important role for the continuity of ecological processes (Davic, Robert & Welsh, Hartwell, 2004; Sousa-Guedes, et.al, 2020). Amphibians are nocturnal (nocturnal) animals that live generally in aquatic and terrestrial habitats (Bannet, 1999; Rahmania, 2014; Tockner et al., 2006) from inundated below the surface of the water to live in the top of tall trees (Iskandar, 1998). Ecologically, amphibians act as primary consumers of predators such as insects or other invertebrates (Iskandar, 1998).

The Anura nation is a nation that is best known to the public and is found in almost all parts of the world (Kusrini, 2013). Most of the Indonesian amphibians generally belong to Rhacophorus margaritifer. Members of this nation are known as frogs or toads in Indonesian. These frogs are generally short and broad, consisting of head and body parts and have two pairs of legs where the hind limbs are larger than the forelimbs. The feet have webs used for jumping and swimming. Anura has vocal cords and the male will make sounds to attract the female. Fertilization generally takes place externally. The eggs that hatch will usually grow into larvae that are different from the adult form and are known as tadpoles. Nearly all tadpoles will undergo metamorphosis when they turn into adults, although some immediately become adults. In Indonesia, there are about 450 species which represent about 11% of all Anura in the world. Of all, 28 types of Anura are found in West Java which consists



of six families, namely Bufonidae, Dicroglossidae, Microhylidae, Megophryidae, Ranidae, and Rhacophoridae.

Amphibians have an important role in the food chain (Wang, G., 2020). Most amphibians are predators that eat various types of insects or insect larvae. Frogs that live in rice fields, for example, are known to eat a variety of insects that are pests to agriculture. Frogs can also suppress the presence of insects that are detrimental to human health (Kusrini, 2013).

Gunung Gede Pangrango National Park has an area of 21,975 ha. The park is located between longitude 106 ° 51'-107 ° 02'E and latitude 6 ° 41-6 ° 51'S. Administratively, the national park is divided between the districts of Bogor, Cianjur and Sukabumi (Kusrini, 2007). According to Ace (2015), Gunung Gede Pangrango National Park (TNGGP) is representative of the remaining mountainous tropical rain forests on the island of Java, with high biodiversity. Approximately 1,500 types of flora and 1,000 types of fauna live in this area. One of the fauna that is not widely known by the public, especially researchers, is the frog. Based on preliminary research, the number of frogs in TNGGP is around 25 species, six of which are endemic to Java and one is endemic to West Java. One species has been designated as the national animal, namely the red frog.

Research on amphibian diversity has been carried out at the Nature Conservation Bodogol Sukabumi, West Java by Dharma in 2011, which found 8 types of amphibians (Anura) belonging to 3 families. Another research was conducted by Darmawan (2008) at the ex-HPH PT RKI Bungo Regency, Jambi Province, amphibians which were found in all research locations in the ex-HPH PT RKI, were as many as 37 species from 5 families.

2. Methodology

Research Area

The research was carried out in August 2019. The research location was the Cimisblung River Area, Gunung Gede Pangrango National Park, starting from the Curug Pariuk Waterfall with the coordinate point S 6°43'48.5"S 106°57'32.5"E to the border of the Safari Park area with the coordinates S 6°43'33.9"S 106° 57'28.5"E at an altitude of 1312 mdpl. The length of the research location was about 500m. This distance was taken because it borders the Cisarua Safari Park area.

Methods

The method used in this research was Visual Encounter Surveys by following the river and observing rocks, water, leaves and trees around the river, with a distance of 500 meters along the river. VES was used to determine the species richness of an area, compile a species list, and estimate the relative abundance of species (Kusrini, 2008).

Data Collection Technique

Data collection involves recording data on amphibians including the types of amphibians found, when they were found, the number of individuals in each species, the location where they were found, and their behavior at the time they were found. We also measured the SVL (Snout Vent Length) or the length of morphology from the tip of the snout to the anus and other morphological characters in each species. Moreover, we also recorded amphibian habitat data including data collection time, measuring water pH, measuring temperature and humidity.

Data Analysis

Data analysis used to determine the diversity of amphibians (*Order Anura*) in the Cimisblung area was the following formula:

Species Diversity Index

Species diversity is an expression or index that links the number of species and the number of individuals. The diversity index uses the Shannon index which is often referred to as the Shannon-Wiener (Kusrini, 2008).

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

$$P_i = \frac{\sum \text{jenis amfibi}}{\sum \text{total amfibi}} = \frac{N_i}{N}$$

Information:

H' = Species Diversity Index

P_i = Proportion of species 1 (chance of importance for each species (N_i/n))

N_i = Number of individuals of each type (value of importance of each type)

N = Value of importance of the question (total number of all individuals)

Species diversity index criteria:

$H' < 1$, the community is in an unstable condition

$1 < H'$, the community is in a moderate condition

$H' > 3$, the community is in good shape

Species Evenness Index

According to Putra (2012), the evenness index value can describe the stability of a community. The Evenness Index value (E) ranges from 0 - 1. The smaller the value of E or close to zero, the more unequal the distribution of organisms in a community that is dominated by a particular type. Conversely, the greater the value of E or close to one, the organism in the organism community is more evenly distributed. The equation used to calculate the Evenness Index is as follows:

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

Information:

E = Species Evenness Index

H' = Species Diversity Index

S = Number of Types

Environmental community criteria based on the evenness index:

$0,00 < E < 0,50$ distressed community

$0,50 < E < 0,75$ unstable community

$0,75 < E < 1,00$ stable community

Species Abundance Index

Abundance is the total number of individual amphibians during observation. The abundance index provides an overview of the species composition in the community. To find out the relative abundance, the following formula is used (Putra, 2012):

$$IS = \Sigma = \frac{\sum \text{jenis amfibi}}{\sum \text{total amfibi}} \times 100\%$$

The relative abundance index values are classified into three categories, namely high ($> 20\%$), medium ($15\% - 20\%$), and low ($< 15\%$).

Domination Index

According to Imperato, V, et.al. (2019) a group of the most dominant species in their environment and organisms called Dominant. If the dominance in a community is high, it indicates low diversity. According to Munthe (2012) and Hidayat (2020), the dominance index is used to determine the extent to which a species or genus dominates another group. The calculation method used the Simpson dominance index formula as follows:

$$D = P_i^2$$

Information:

D = Domination Index

P_i^2 = Proportion of species

Species domination criteria based on the domination index:

D = <1 >0 is categorized as "stable"

D = >1 is categorized as "unstable"

3. Result and Discussion

In this study, 5 amphibian families (Order Anura) were discovered, consisting of 13 species from a total of 151 individuals found. These families included the families Megophryidae, Bufonidae, Rhacophoridae, Ranidae and Dicroglossidae.

The amphibian species with the highest number of individuals were *Huia masonii* with 76 individuals, and *Rana hosii* with 19 individuals. Meanwhile, the species with the fewest individuals were *Nyctixalus margaritifer*, *Megophrys montana*, and *Bufo melanostictus*, found only 1 individual each.

Table 1. Types of amphibians found in the Cimisblung Resort Area, Cisarua, Gunung Gede Pangrango National Park (TNGGP)

Family Name	Species Name	Individual
Megophryidae	<i>Leptobrachium hasseltii</i>	6
	<i>Megophrys montana</i>	1
Bufonidae	<i>Bufo melanostictus</i>	1
	<i>Leptophryne cruentata</i>	12
Rhacophoridae	<i>Rhacophorus javanus</i>	7
	<i>Philautus aurificatus</i>	5
	<i>Nyctixalus margaritifer</i>	1
Ranidae	<i>Rana calconata</i>	6
	<i>Odorrana hosii</i>	19
	<i>Huia masonii</i>	76
Dicroglossidae	<i>Limnonectes kuhlii</i>	8
	<i>Fejevaryia limnocharis</i>	3
	<i>Limnonectes microdiscus</i>	6

Species Diversity Index, Evenness Index and Species Dominance Index

Table 2 below shows that after calculating with the species diversity formula (Shannon-Wiener) the diversity of amphibians in Cimisblung has a diversity index of $H' = 1.780$ and an evenness index of 0.694 and a dominance index with value ($D = 0.286$).

Table 2. Species Diversity Index, Evenness Index and Species Dominance Index

Index	Value
Species Diversity Index	1,780
Evenness Index	0,694
Dominance Index	0,286

Species Abundance Index

Figure 1 below shows the results of the calculation of the abundance index value of the amphibian species (Order Anura) found at the research location.

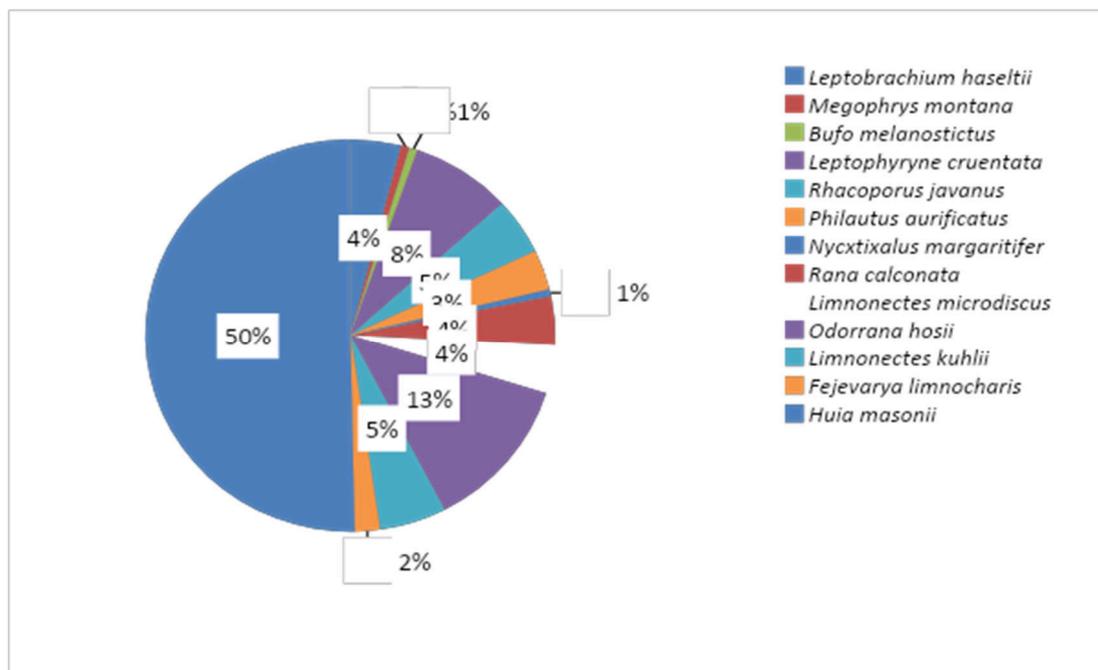


Figure 1. Amphibian Species Abundance Index Diagram (Order Anura) in the Cimisblung River Area, Gunung Gede Pangrango National Park

Species Diversity and Species Evenness Indexes

In this study, the results of calculations using the Shannon-Wiener Diversity Index indicated that the diversity of amphibians in Cimisblung had a diversity index of $H' = 1.780$. This result is categorized as moderate, because it ranges from $1 < H' < 3$. In this case, the diversity in Cimisblung is higher than Satyawati (2009) in the TWA Suranadi area, which obtained a value of 0.92, which means that the diversity index is low and is comparable to Arista's research (2017) in Braja Harjosari Village, East Lampung Regency, which obtained a diversity index of 1.0 which is classified as moderate.

In this study, the evenness of species 0.694 was categorized as unstable because $0.50 < E < 0.75$. The evenness index in this study was different from Arista (2017)'s evenness index value of 0.90, which shows the stability of a community. This difference was due to the availability of food, shade trees and water sources in Arista (2017)'s research location which are spread across the area.

Species Abundance Index

Dharma (2011) found that the highest species found was *Limnonectes kuhlii* which was around 47.12%. In Satyawan (2009), the highest species found was *Bufo biporcatus* 67%. Meanwhile, Putra (2012) discovered that the highest species found was *Limnonectes kuhlii* of 30%. In this study, *Huia masonii* was the largest species encountered at the time of the study at 50%. This was probably due to differences in habitat in each study.

According to Ace (2015), *Huia masonii* is always located close to a fast-flowing river, where the water is clear and the river has big rocks. This could be the reason why these species were found to be the largest, while the second highest number of species was *Rana hosii* with 19 individuals. According to Kusriani (2013), although these frogs are more common in primary forests, these frogs can also live in logged-over forests, which is adjacent to a clean river.

Nyctixalus margaritifer was one of the least species found at the time of research, at 1%. In the IUCN list, this species is vulnerable and, according to Kusriani (2013), this species is very rare because of its nature that tends to hide in wood holes. This may be the reason why only a few of this species was discovered.

Species Dominance Index

In this study, a dominance index was obtained with a value ($D = 0.286$). This result is categorized as stable and no species dominates other species because $D = <1> 0$. The total number of individuals obtained was 151 individuals from 13 types of amphibians belonging to 5 families. This indicates the dominance by one species. *Bufo biporcatus* was a species that dominates the TWA area compared to other species with a proportion of 63% of the total individuals found.

4. Conclusion

From the research on the diversity of amphibians in the Cimisblung area, it can be concluded that 151 individuals belonging to 13 species from 5 families were found. The Shannon-Wiener diversity index showed that in the Cimisblung River $H'=1.780$, $E=0.694$, and $D=0.286$. This demonstrates that the diversity of amphibians in the Cimisblung area is moderate.

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