JPBIO (Jurnal Pendidikan Biologi)
Vol. 8, No. 1, April 2023, 34 – 42 //e-ISSN 2540-802X
http://jurnal.stkippersada.ac.id/jurnal/index.php/JBIO/index

Comparison of ground insects diversity in cikaweni and canopy PPKA bodogol sukabumi tracks, west java

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Article Info

Article History:
Received 18 December 2022
Revised 05 March 2023
Accepted 12 April 2023
Published 30 April 2023

Keywords:
Canopy
Cikaweni
Diversity
Ground insect
Pitfall trap

ABSTRACT

Nature Conservation Education Center (PPKA) Bodogol is one of the utilization zones that plays a role in preserving biodiversity. The purpose of this research was to explore the comparison of diversity and diversity index of ground insects in the Cikaweni and Canopy PPKA Bodogol, Sukabumi. The method used in this research is line transect by making a 500 m long transect line and divided into 10 plots. Each plot measures 2.5m x 2.5m, with a distance between plots of 50 m. Data processing was carried out using the Shannon-Wiener index, Eveness and similarity index. The results we got in this study found 33 individuals from 23 species of ground insects. In the Cikaweni track, the diversity value is 2.31 and the evenness index is 0.89, while in the canopy track the diversity value is 2.14 and the evenness index value is 0.93. These results indicate that both pathways belong to the moderate category without any dominating species. While the similarity index of the two tracks was 19% with only 3 species found in both tracks, namely Acheta sp., Blattella sp., and Euborellia annulipes, which means that both tracks have a low level of similarity.

Citation: Ilyas, M., Farandika, A. D., Khansa, A. A., Mailantasya, R., Chaira, S., Djamahar, R., & Rusdi. (2023). Comparison of ground insects diversity in cikaweni and canopy PPKA bodogol sukabumi tracks, west java. *JPBIO (Jurnal Pendidikan Biologi), 8*(1), 34-42. DOI: https://doi.org/10.31932/jpbio.v8i1.2086

INTRODUCTION

Indonesia is a country with a very high diversity of flora and fauna (Lose et al., 2015). One of the animal species that exist are insects. Insects are the most diverse types of animals and have various functions, their existence in a wide range, so that insects have an important role in the

ecosystem. One example of the diversity of insects is ground insects. Ground insects are insects that live both on the ground and in the ground. Insects can be found in terrestrial habitats, for example ground, and also insects that can fly (Hasyimuddin et al., 2017). During the reproductive process, the height and decline of the insect population depends on the factors of the insects themselves and factors that are influenced by environmental conditions (Maesyaroh, 2016). The role of ground insects in the ecosystem is as decomposers, detrivores, herbivores and predators. Ground insects can be used as indicators to determine the stability of an ecosystem (Agustinawati et al., 2016).

The level of diversity of ground insects can vary in several places. In physically controlled ecosystems, species diversity is often low, i.e. species with strong physical and chemical constraints will be high in natural ecosystems. The existence of ground insects in ecosystems is limited by appropriate geological and ecological factors, resulting in differences in the diversity of insect species. This is due to differences in climate, season, altitude, and type of food (Borror et al., 1992).

The diversity and distribution of ground insects is influenced by environmental factors (Kinasih et al., 2017). Parameters in the ecosystem are measured to determine the value of species diversity. The diversity index is a mathematical description used to facilitate analysis of the number of individual species found in an area and information on the large number of individual species (Tambunan et al., 2013). Nature Conservation Education Center (PPKA) Bodogol is a conservation area located in Mount Gede Pangrango National Park (TNGGP) (Setia, 2008). This area is one of the utilization zones that plays a role in biodiversity conservation and inform the public about the natural wealth of tropical rain forests.

PPKA Bodogol has several research lines, such as Rasamala, Cikaweni, Cipanyairan I and Cipanyairan II, Cipadaranteun, Africa, and Tangkil. This path represents all types of habitats in the area. Making the route aims to facilitate research activities, and there are routes that focus more on tourist routes (Ario, 2010). Many studies have been reported on ground insects in Indonesia, including (Rizali et al., 2002), (Qodri, 2015), (Andrianni et al., 2017), (Rahayu et al., 2020), but specifically the diversity of ground insects in PPKA Bodogol, there are still few studies reported. Therefore, researchers feel the need to conduct research on the diversity of ground insects in PPKA Bodogol, namely on the Canopy and Cikaweni routes. The purpose of the research to be conducted is to find out what types of ground insects are found in the Canopy and Cikaweni lines of the PPKA Bodogol Sukabumi West Java, and to find out the differences in the diversity index of these insects in the Canopy and Cikaweni lines of the PPKA Bodogol Sukabumi, West Java.

RESEARCH METHODS

Research Design

The research employed a survey method with an line transect technique, which was observing ground insects by exploring Cikaweni and Canopy hiking routes. The research was conducted on June 16-18, 2021 at the area of the Bodogol Nature Conservation Education Center (PPKA) located on the slopes of Mount Gede Pangrango Sukabumi West Jawa, particularly in Cikaweni and Canopy routes.

Population and Samples

The research population included all ground insects found in along the Cikaweni and Canopy routes at PPKA Bodogol. Sampling and observation of ground insects was carried out using a random sampling technique with Pitfall traps and hand collecting. The Pitfall trap technique is used to trap insects walking on the ground, while the hand collecting technique is used to catch insects hiding under rocks under leaves, or on stems.

Instruments

The method used in determining the sampling point is a line transect, by making a transect line 500 m long and divided into 10 plots. Each plot measures 2.5m x 2.5m, with a distance of 50 m between plots. Tools used are stationery, colored mica covers, paper labels, small or medium sized plastic medicine, sample bottles, styrofoam, detergent solution with a ratio of 1:100, methyl eugenol, wire, 70% alcohol, pH meter, GPS, hygrometer, lux meter, and ground shovel. Insect samples were then identified by observing their morphological characteristics and characteristics by looking at the book Introduction to Insect Studies (Borror et al., 1992)and field guides.

Procedures

The stages of the research included determining observation sites on the Cikaweni and Canopy lines, using line transects to determine sampling points for soil insects, then plots were placed at each point to set traps, after that identifying the samples found and writing down their characteristics and counting the number of individuals. and documenting it in color pictures. The next stage is collecting data on soil insects found along the route. Data on soil insects in each lane were analyzed using the diversity, evenness and similarity formulas based on their characters and identified environmental parameter data in the two lanes.

Data Analysis

The ground insects obtained were described based on their morphology and the number of individuals and the number of species were counted. The ground insect community was calculated using the Shannon Wiener diversity index as follows:

Diversity is categorized into three types, low, moderate, and high as indicated in Table 1. The calculation of species diversity (H') followed Shannon – Wienner (Odum, 1996):

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

$$H' = -\sum_{i=1}^{n} \left[\frac{n_i}{N} \ln \frac{n_i}{N} \right]$$

Where:

Pi = Comparison of total individuals of a species to total species
n = Total species
ni = Total individual per species i (i= 1,2,3,...n)
N = Total individual species found
ln = Natural logarithm

Table 1. Classification of Shannon – Wiener diversity index score

Shannon – Wiener index score	Category
<1	Low diversity, low distribution of each species individuals, and low community stability.
1-3	Moderate diversity, moderate distribution of the number of individuals of each species, and moderate community stability.
>3	High diversity, high distribution of the number of individuals of each species, and high community stability.

To calculate the value of evenness, the following formula can be used (Ulfah et al., 2019):

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

Where:
E = Evenness value of species
S = The number of species in each plot (number of species)
H' = Species diversity
ln = Natural logarithm

Then the composition of ground insect species in each lane was analyzed with the bray-curtis similarity index, with the following formula (Ricotta & Podani, 2017):

$$Bc_d = \frac{\Sigma|x_i - x_j|}{(x_i + x_j)}$$

Where:
B = Bray-Curtis dissimilarity index
x_i, x_j = the number of individuals of the 1st species

RESULTS

Based on observations made in two Bodogol PPKA lines, namely Canopy and Cikaweni, 33 individuals of 23 species of ground-surface insects were found and identified. Ground insect species are spread across 2 substrates, namely ground and litter. Ground insects found in the two routes are shown in Table 2 and Table 3.

Table 2. The types of ground insects found on the Cikaweni route

Cikaweni Route			
No.	**Famili**	**Species Name**	**Amount**
1		Sp.1	1
2	Melolonthidae	*Phyllophaga sp.*	1
3	Dynastidae	*Megasoma sp.*	1
4	Chrysomelidae	*Chrys sp.*	6
5	Staphylinidae	*Paederus littoralis*	1
6	Gryllidae	*Teleogryllus sp.*	2
7		*Gryllus sp.*	1
8		*Acheta sp.*	1
9		Sp.2	1
10	Ectobiidae	*Blatella sp.*	1
11	Pamphagidae	*Asiotmethis sp.*	1
12	Anisolabididae	*Euborelia annulipes*	1
13	Forficulidae	*Forficula sp.*	1
Total			19

Table 3. Types of Ground Insects found on the route *Canopy*

Canopy Route			
No.	**Famili**	**Species Name**	**Amount**
1	Gryllidae	*Acheta sp.*	4
2	Aphrophoridae	*Philaenus sp.*	2
3	Blaberidae	*Pseudophoraspis sp.*	1
4	Forficulidae	*Forficula sp.*	1
5	Reduviidae	*Triatoma sp.*	1
6	Carabidae	*Carabus nemoralis*	1
7	Lampyridae	*Photuris sp.*	1
8	Anisolabididae	*Euborellia annulipes*	1
9	Drilidae	*Platerodrilus sp.*	1
10	Ectobiidae	*Blatella sp.*	1
Total			14

Table 4. Diversity (H'), Evenness, and Species Similarity Index in the Cikaweni and *Canopy route*

Route	**Species Name**	**Amount**	**(H')**	**(E)**	**(%)**
Cikaweni	Sp.1	1	2.31	0.89	19%
	Phyllophaga sp.	1			
	Megasoma sp.	1			
	Chrys sp.	6			
	Paederus littoralis	1			
	Teleogryllus sp.	2			
	Gryllus sp.	1			
	Acheta sp.	1			
	Sp.3	1			
	Blatella sp.	1			
	Asiotmethis sp.	1			
	Euborelia annulipes	1			
	Forficula sp.	1			
	Total		19		
Canopy	*Acheta sp.*	4	2.14	0.93	
	Philaenus sp.	2			
	Pseudophoraspis sp.	1			
	Forficula sp.	1			
	Triatoma sp.	1			
	Carabus nemoralis	1			
	Photuris sp.	1			
	Euborellia	1			

Route	Species Name	Amount	(H')	(E)	(%)
	annulipes				
	Platerodrilus sp.	I			
	Blatella sp.	I			
	Total		14		

Table 5. Enviromental Physical Parameters

Physical Parameters						
	Cikaweni Route			Canopy Route		
Plots	Canopy cover (%)	Soil pH	Temperature (°C)	Canopy cover (%)	Soil pH	Temperature (°C)
1	87.64	6.2	25.4	87.60	6.2	22
2	88.14	6.2	25.4	85.30	6.3	22
3	85.85	6.2	25.4	89.67	6.3	22
4	86.78	6.3	25.4	90.86	6.4	22
5	83.46	6.3	25.4	88.80	6.3	22
6	89.02	6.2	25.4	90.48	6.3	22
7	86.74	6.2	25.4	92.69	6.2	22
8	84.02	6.3	25.4	93.29	6.2	22
9	86.57	6.3	25.4	94.36	6.3	22
10	87.11	6.3	25.4	94.12	6.2	22

DISCUSSION

Based on the table above, the level of diversity of soil insect species on the Canopy route is classified as moderate with a value of H' = 2.14 as well as on the Cikaweni route with an H' = 2.31 which is also included in the medium category. This moderate diversity of soil insect species can occur due to the location of the area and the diversity of habitats. The location of this area determines the number of types of inhabitants. The location of the path in an area that has maintained the diversity of its habitat, which tends to be dominated using conservation land, greatly determines the types of soil insects that allow it to adapt.

Furthermore, the level of evenness of species shows the balance of the individual distribution of each species and the results show that the value of evenness in both pathways is high. High evenness indicates that the number of individuals in each species is relatively equal. The level of evenness of species can be determined by the Evennes formula, where if the value is $0<E\leq0.4$, then the level of evenness is classified as low, if the value is $0.4<E\leq0.6$, then it is classified as medium, and if the value is E>0, 6, it is classified as high. The similarity index was analyzed using the Bray Curtis formula, from both locations a value of 0.19 or 19% was obtained. This shows that the Canopy route and the Cikaweni route have a different community structure because they only have 19% in common.

Based on calculations using the Evennes index, it was found that the evenness of soil insect species in the Canopy route was relatively high, with a value of E = 0.931, while in the Cikaweni route the value of E = 0.898 was also included in the high category. This high evenness indicates that there are no soil insect species that dominate the communities in the Canopy and Cikaweni lanes.

Meanwhile, analysis of the percentage similarity of species in the two lanes shows the figure of 19%. with the species found on the Cikaweni route totaling 13 species, on the Canopy route 10

species were found and there were 3 species found on both routes namely*Acheta sp., Blattella sp.,* and *Euborellia annulipes.*

The diversity of soil insect species in the two lanes is categorized as moderate, but there is a difference in values between the two, where the Cikaweni route shows a higher number than the Canopy route. This is because the Cikaweni route has a lower canopy cover percentage value as shown in Table 4. It is classified as a homogeneous forest with the dominant vegetation there, namely trees *Pinus sp.* This statement is in accordance with the opinion of (Ruslan, 2009) that in a homogeneous forest, the vegetation canopy cover is low, allowing more sunlight to penetrate, allowing herbaceous vegetation to survive. Meanwhile, in heterogeneous forests, the canopy cover is denser and sunlight penetration is less.

The diversity of soil insects is also influenced by the plants on it. The litter produced by vegetation is a food source for soil insects and a place to take shelter. It is also an important factor supporting the life, abundance, and reproduction of plant-eating soil insect species.

Factors that affect the diversity of soil insect species include temperature and pH, found in the Cikaweni line showing a value of 25.4 C and in the Canopy, line showing a value of 22 °C where the temperature in the two lines is included in the optimum temperature for insect growth and development. This is in accordance with the opinion of (Handani et al., 2015) which states thatInsects have a certain temperature range to survive, outside of this temperature range, insects will die. In general, the effective temperature range for insects to survive is the lowest temperature of 15 °C, the optimum temperature of 25 °C, and the highest temperature of 45 °C. Temperature is an important factor in the growth and development of insects which will affect the increase in insect populations.

Besides temperature, soil pH also has a significant impact on insect life. The results of measuring the pH of the two pathways showed that there was no significant difference between the pH values in the two pathways, which was around 6. Therefore, the observation area was included in the acidic category because the pH value was below 7. This acidic condition was influenced by soil water content and organic matter with high potassium and calcium content (Haneda & Sirait, 2012). However, this pH is good enough to support insect life.

The number of insects found on both routes was also influenced by the liquid used as traps. In this study the liquid used was clove oil. Clove oil, which contains methyl eugenol, is a compound that attracts insects, especially fruit flies. This substance evaporates easily and gives off an aromatic odor. Methyl eugenol is available in the market at an affordable price, and easy to use (Patty, 2012).

CONCLUSION

The soil insects observed in the Cikaweni and Canopy PPKA Bodogol routes totaled 23 species with a total of 33 individuals, and no soil insect species dominated the communities in both routes. The level of diversity of soil insects in both tracks was moderate with a similarity level of 19%. The species found in the Cikaweni route totaled 13 species, while in the Canopy route there were 10 species, so it can be concluded that there were differences in the diversity of soil insects between the two lanes where the Cikaweni route showed higher diversity compared to the Canopy route. Suggestions for further research are the need for further research on the diversity of soil insects in PPKA Bodogol using other trapping methods so that they can be used as comparison material.

ACKNOWLEDGMENT

The authors would like to send their gratitude to the rangers and officers at the The Bodogol Nature Conservation Education Center (PPKA) of Mount Gede Pangrango National Park who

helped in collecting data in the field. We also thank to the Department of Biology Education Universitas Negeri Jakarta for the research fund in the course of Excursion Study.

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