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Soil Arthropods Diversity in Sungai Suci Bengkulu Ecosystem

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ABSTRACT: Sungai Suci is a part of Bengkulu that is 400 meters above sea level. Sungai Suci is located in a coral coastal area with three ecosystems: the bamboo ecosystem and the sea pine ecosystem; soil arthropods are among the animals that inhabit those two environments. This study aims to look into the variety of soil arthropods in the ecosystem of Sungai Suci. Sampling bamboo and sea pine ecosystems was done by taking soil from the root areas of bamboo and sea pine. For each ecosystem, five soil samples are taken randomly as replication. The soil was placed in a smaller funnel and left for two weeks at room temperature 24^{o}C, and 12 hours of irradiation. Soil arthropods obtained from the three ecosystems were identified, and their numbers were recorded. The most common type of arthropod found in the three ecosystems was acarina. The study results showed that the diversity values of the bamboo and sea pine ecosystems, respectively, were 1.44 and 0.49; and. Dominance values for the bamboo and sea pine ecosystems, respectively, are 0.38 and 0.82. The evenness values of the bamboo and sea pine, respectively, are 0.56 and 0.18.

Keywords: Arthropods, Bamboo, Bengkulu, Diversity, Ecosystem, Sea Pine

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INTRODUCTION

Bengkulu is a province on the island of Sumatra, Indonesia, with various ecosystems. The ecosystems in Bengkulu include forests, swamps, oil palm plantations, rice fields, bamboo, sea pine, and others. The Sungai Suci Regency is one area in Bengkulu with a diverse ecosystem. Sungai Suci Regency has at least two ecosystems: bamboo and sea pine. Various kinds of flora and fauna are suspected to inhabit this ecosystem's two land areas.

Abiotic and biotic components of soil ecosystems are interconnected and have complicated properties (Hanafiah, 2005). Temperature, light, and soil moisture are examples of abiotic elements. Biologic components, on the other hand, can take the shape of soil fauna or organisms engaged in different soil processes, such as nutrient flow, pathogen population control, soil property improvement, organic matter breakdown, and soil organic matter mixing (Kinasih et al., 2017). Fauna that live in the ecosystem of the Sungai Suci residents include arthropods.

In comparison to other phyla, Arthropoda is the largest. The world's most common animal group is the arthropod. In 2017, Kinasih et al. claimed that arachnids could live in various conditions on land. Arthropods can be found in forests, lowlands, seaside, and highlands, whereas other phyla are not found in all these locations. Among the types of arthropods, there are soil arthropods that live on the soil's surface and litter in the root area of plants.

Soil arthropods are a group of animals that have an essential role in the ecosystem. They consist of various types, including insects, spiders, and crustaceans that live in the soil or on the surface of the soil. Soil arthropods act as decomposers of organic matter, soil engineers, litter transformers, and predators. The most crucial role of soil fauna in the ecosystem is as a decomposer of organic material available to green plants (Sari, 2015). Arthropods influence soil fertility. Arthropods decompose organic materials and break down organic particles. The diversity of soil arthropods is influenced by environmental factors such as vegetation type. Therefore, arthropods can act as bio-indicators of an ecosystem (Adisoemarto, 1998).

Rezatinur et al. 2016 stated that the soil surface fauna can be used to indicate soil fertility. Arthropods play an essential role in the ecosystem. They influence the agricultural sector because agricultural stability can be known through the large diversity and abundance of arthropods in agricultural locations (Sulistyorini, 2015). Insects are also necessary for human life. In an ecosystem, this biodiversity can offer a variety of ecological services that cooperate to create a stable and sustainable ecosystem. (Jankielsohn, 2018).

Soil arthropods are one of the components that can describe a situation regarding the environment; when diversity is high, the environment is likely. Arthropods have a role in the ecosystem, including improving soil structure, helping plants by improving soil health, and providing nutrients. By improving the soil structure and providing nutrients, soil arthropods indirectly help plants reproduce faster and produce offspring more quickly.

Information regarding soil arthropods in sea pine and bamboo ecosystems must be improved. Exploration of the diversity of soil arthropods and their abundance is needed as initial information for monitoring the environmental condition of the ecosystem in the Suci River Regency. Agroecosystem monitoring requires information about the role of the ecosystem and factors that influence the number of types and individual numbers of soil arthropods.

RESEARCH METHODS

Research location

This research was conducted in Sungai Suci Regency, Central Bengkulu, Bengkulu district. Samples were taken from three ecosystems: marine pine and bamboo ecosystems. The Sungai Suci Regency has a height of 200-300 meters above sea level.

Research Data Source

Data source in this research uses primary data obtained from direct data collection. Data was obtained by taking bamboo and sea pine ecosystem samples. Samples are taken using a sample ring. The number of samples from each ecosystem is ten samples. Samples were obtained and placed on berlesse funnel with a light period of 12 hours per day. At the bottom of the blessed funnel is a bottle used as a container for arthropods. After that, arthropod samples were identified based on morphology with the Borror et al. 1996 identification key. The number of arthropods obtained was counted, and diversity, dominance, and evenness index calculations were carried out.

Figure 1 Berlesse funnel

Data Analysis

Shannon-Wiener diversity index (1963) was used to count and analyze the number of persons in the sample data:

$$H' = - \Sigma (pi) (\log pi)$$

Explanation:

H' = species diversity index

Pi = proportion of the total number of samples of species-i

Table 1. Value of diversity index

Value index H	Category
H<1	Low diversity
1<H<3	Moderate diversity
>3	High diversity

Dominance values are calculated with a formula:

$$C=\Sigma (Pi)^2$$

With explanation:

C=domination index
Pi=ni/N
Ni= The number of individuals
N= Total number of arthropod individuals

Dominance values are matched with a dominance index (Odum, 1966):

Table 2. Domination index value

Index value C	Category
0-0.50	Low domination
0.5-0.75	Moderate domination
>3	High domination

Next, the value of evenness is calculated using the formula:

$$E= H' / \ln S$$

Explanation:
H'= diversity value
S= total types
The evenness value is then matched with the evenness index

Table 3. Evenness indeks value

Evennes index	Category
0<E< 0.4	Low evenness
0.4<E<0.6	Moderate evenness
0.6<E<1.0	High evenness

RESULTS AND DISCUSSION

One aspect of biodiversity that is crucial to the ecosystem is arthropods. Arthropods can take on the roles of detritivores, herbivores, predators, and parasitoids. Herbivores can become pests because they cause economic losses. Predators and parasitoids can act as natural enemies of pests so that pest populations are maintained. Different vegetation and supporting factors influence the existence of many arthropods or their population in an ecosystem (Fauzi et al., 2023).

Table 4. Soil arthropods in the bamboo ecosystem

No	Genus	ni
1	Anopheles	4
2	Arachnida	1
3	Scolopendra	3
4	Collembola	5
5	Fopius	11
6	Gerromorpha	1
7	Lyctus	1
8	Monomorium	17
9	Paederus	1
10	Solenopsis	26
11	Tachys	1
12	Thrips	4
13	Acarina	147
		222

Note: ni = number individu

The number of arthropods obtained in the bamboo ecosystem was 222, with the number of genera being 12 without Acarina and Arachnidae, which are orders and families. The most frequently found soil arthropods in the Sungai Suci bamboo ecosystem, Central Bengkulu, were mites/acarina, with the number of individuals being 147. Most of the acarina found acted as decomposers or detritivores. Apart from acarina, the arthropods often found are of the order Hymenoptera. The hymenoptera members obtained from the bamboo ecosystem are Solenopsis and Monomorium (Table 4).

The number of arthropods obtained in the sea pine ecosystem was 925 (Table 5). The number of genera obtained was 15 without acarina. The most numerous arthropods found in the marine pine ecosystem were acarina, with 847 individuals (Table 5).

According to Soegianto (1994), species diversity is a feature of communities that arises from the biological structure of an ecosystem. Based on the results obtained in this research, the diversity index value of the bamboo ecosystem is 1.44 (Table 6). The arthropod diversity index value in the bamboo ecosystem is moderate.

According to Wiener (1963), diversity index values between values 1 and 3 are included in the moderate diversity category. The results presented indicate the great diversity and well-balanced environment that the arthropods inhabit in the Sungai Suci bamboo ecosystem.

Table 5. Soil arthropods in the Sea Pine ecosystem

No	Genus	ni
1	Scolopendra	1
2	Fopius	8
3	Anopheles	3
4	Paederus	3
5	Tingidae	1
6	Gryllus	1
7	Acarina	847
8	Nilaparvata	1
9	Collembola	38
10	Aranaeidae	3
11	Monomorium	9
12	Plagiolepis	7
13	Cherishes	1
14	Solenopsis	1
15	Coptotermes	1
		925

Note: ni = number individu

The diversity index value for sea pine is 0.49 (Table 6), which means that the arthropods in the sea pine ecosystem are included in the low diversity category according to the Shannon-Wiener index (1963). A lack of resources can cause low diversity, inter-intraspecies competition, interference from predators or natural enemies, temperature and climate disruption, and others. The existence and quantity of different species or populations of arthropods in an environment are influenced by variations in the vegetation and life support factors. Compared to ecosystems with few natural resources, ecosystems with diverse resources support more living things (Lawton et al., 1998). The value of diversity increases with the number of families and arthropods (Evangelia, 2016).

Tabel 6. Indeks value on two ecosystems

Index	Bamboo	Sea Pine
Diversity	1.44	0.49
Dominance	0.38	0.82
Evenness	0.56	0.18

The dominance index values in the bamboo ecosystem (Table 6) indicate that there are generally low or no dominance arthropods. According to Sirait (2008), a high diversity index value indicates a low dominance index value. Low dominance suggests that there are generally equal numbers of arthropods in each species distributed over the region, preventing dominance. Low species domination means that there are approximately equal quantities of each variety of arthropod and that the population is dispersed such that no species dominates over the other. (Dina, 2017)

In the sea pine ecosystem, medium-scale dominance occurs. This shows that there are species of soil arthropods that dominate sea pine. This dominance is caused by the large number of individuals of acarina, and they do not spread, thus suppressing the populations of other arthropods. It is suspected that the absence of natural enemies in the ecosystem, life-supporting factors, and an inadequate environment for the life of land arthropod species other than acarina make the sea pine ecosystem dominated by acarina. Due to its high population density, biomass, and significant importance in ruling the ecosystem, the dominant species has abundance (Oka, 1995).

The Evenness index in this study shows that in the bamboo ecosystem, it is moderate; the arthropods are pretty spread out and do not cluster at just one point. The Evennes index value in the sea pine ecosystem shows a value of 0.18, which means that soil arthropods do not spread in this ecosystem area.

CONCLUSION

Thirteen soil arthropods were found in the bamboo habitat, while in the sea pine ecosystem, there were sixteen types. The diversity index shows the differences between the bamboo ecosystem and the sea pine ecosystem, where the arthropod population in the bamboo ecosystem is in the moderate category, and the sea pine ecosystem is in the low category. This difference can be caused by differences in life-supporting factors such as food, temperature, the presence of natural enemies, interspecies and intraspecies competition, and disturbances that can reduce the population of soil arthropods.

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