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Diversity of Soil Macrofauna in Lembah Harau, West Sumatra

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Abstract. Soil macrofauna constitutes fauna that inhabits both the soil surface and subsurface. Soil macrofauna plays a crucial role in ecosystems by safeguarding soil fertility through the decomposition of organic matter within the soil. Biodiversity is an essential aspect supporting the sustainability of living organisms on Earth. Macrofauna can serve as bioindicators of environmental quality, particularly soil conditions. The presence of soil macrofauna aids in the land recovery process by enhancing the physical, chemical, and biological properties of the soil. The objective of this research is to identify the diversity of soil macrofauna in varying environmental conditions. The employed methodology involves surveys and direct observations conducted in the Lembah Harau Forest Area in the Payakumbuh City of Limapuluh Kota Regency, West Sumatra Province. Sampling is conducted using monoliths in aquatic environments, canopy-covered areas, and open regions. The central portion of the monolith is excavated at depths of 10 cm, 20 cm, and 30 cm successively, followed by hand sorting. The diversity of soil macrofauna discovered falls into the moderate category (H'=2.77) with a macrofauna evenness of 0.726. These values are within the moderate range, indicating a relatively even distribution of soil macrofauna in the surveyed location. The predominant species identified is Ruticulitermes Hesperus.

Key words: Bioindicator, Biodiversity, Soil Macrofauna

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INTRODUCTION

Soil biodiversity is one form of alpha diversity that plays a crucial role in maintaining and enhancing soil functions to support life within it. Plants, animals, and all living organisms engage in various activities in the soil, exhibiting closely interdependent relationships. The population of soil organisms is determined by the quality of vegetation, and vice versa. Soil is also a part of an ecosystem composed of biotic and abiotic factors [1].

Soil fauna refers to fauna that inhabits both the surface and subsurface of the soil, with an example being soil macrofauna. Based on body size, soil fauna can be classified into four groups: microfauna, mesofauna, macrofauna, and megafauna [1]. Soil macrofauna itself plays a crucial role in the soil ecosystem. Its role includes protecting soil nutrients by decomposing coarse organic materials into finer particles, which are subsequently released as excrement. Moreover, it can homogenize decomposed organic matter in the upper layers of the soil and facilitate the integration of mineral and organic materials in the soil.

The process of decomposition in the soil would not proceed effectively without the assistance of soil macrofauna. The presence of soil macrofauna is highly dependent on the availability of energy and food sources for its survival. Macrofauna can serve as a sensitive indicator of environmental changes; thus, it is well-suited for identifying soil or land quality. Macrofauna is more commonly found in humid environments with soil conditions ranging from weak to neutral acidity. In such conditions, macrofauna can be utilized as a bioindicator of environmental quality, especially soil conditions. Based on the food chain, macrofauna is categorized into three groups: herbivores, carnivores, and decomposers [2]; [3].

Considering the aforementioned exposition, soil macrofauna becomes a significant subject for in-depth study. Therefore, research has been conducted on the diversity of soil macrofauna in the Lembah Harau Forest area of West Sumatra. This study aims to identify the diversity and distribution of soil macrofauna in that region.

MATERIALS AND METHODS

Time and Location

The soil macrofauna sampling was conducted in the Lembah Harau Forest Area, Payakumbuh City, Limapuluh Kota Regency, West Sumatra Province, from May 26 to May 29, 2022. The identification of soil macrofauna was carried out at the Biotechnology and Engineering Laboratory,

Faculty of Science and Technology, Universitas Jambi.

Equipment and Materials

The equipment used in this research includes a monolith with dimensions of 25x25 cm, gloves, tweezers, 5 kg plastic bags, plastic wrap, white cloth, scoop, label paper, sample bottles, transparent tape, scissors, plastic cups, soil thermometer, and pH meter. The materials used in this research are 70% alcohol (1 liter) and detergent.

Research Procedure

The method employed in this research involved surveying and direct observation at the research site. Sampling of soil macrofauna on the soil surface was done using the monolith method, with three different location conditions: near water, under canopy cover, and in open areas, each with three repeated samplings. Meanwhile, the sampling of soil-dwelling organisms used the hand-sorting method.

Monolith Method Stages

The capture of macrofauna using the monolith method involved placing the monolith on the surface of the sampling location. The central part of the monolith was excavated to depths of 10 cm, 20 cm, and 30 cm successively. The excavated soil was sorted on a white cloth to obtain the macrofauna contained in the soil. Each macrofauna found at different excavation depths was placed in different sample bottles, labeled according to the depth at which the soil macrofauna were discovered. The identification of soil macrofauna samples was observed using a binocular microscope.

The Stages of Hand Sorting Method (Hand-Shortir)

The data retrieval stage using the Hand Sorting Method (hand-shortir) is as follows:

1. Hand sorting is conducted by extracting a portion of the excavation yield from the monolith.
2. Sample search is performed using the Hand Sorting Method on each soil sample.
3. The obtained macrofauna is then preserved in sample bottles containing 70% alcohol and labeled.
4. The samples are subsequently transported to the laboratory for identification, and Shannon and Wiener diversity index calculations are carried out.

RESULTS AND DISCUSSION

Based on the research conducted in the forest area of Lembah Harau, West Sumatra, 10 orders of soil macrofauna were identified, divided among three characteristic research locations: 1. Near-water areas revealed 7 orders of soil macrofauna, 2. Open areas

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disclosed 7 orders of soil macrofauna, 3. Canopy-covered areas uncovered 8 orders of soil macrofauna. Field data obtained were processed to determine the Shannon-Wiener Diversity Index and evenness of soil macrofauna species in the Lembah Harau Forest Area, West Sumatra (Table 1).

Tabel 1. Results of Diversity and Evenness Calculation of Soil Macrofauna Species

No	Ordo	Lokasi			H'	E
		A	T	BK		
1.	Scorpiones				2,27	0,72
	Androctonus crassicauda	1	0	0		
2.	Scolopendromorpha					
	Scolopendra sp.	1	2	0		
	Akymnopellis chilensis	0	1	1		
3.	Hemiptera					
	Nilaparvata lugens	1	0	0		
4.	Coleoptera					
	Therates labiatus	1	0	0		
	Sp. 1	0	0	1		
	Leptocoris sp.	0	1	0		
5.	Hymenoptera					
	Solenopsis invicta	2	0	2		
	Odontomachus sp.	0	1	0		
	Odontomachus aciculatus	0	1	0		
	Solenopsis sp.	1	0	0		
	Dolichoderus toratichus	0	1	0		
	Drynidae sp.	0	1	0		
	Sp. 2	0	0	1		
	Oechophylla smaradigna	0	1	0		
6.	Blattodea					
	Ruticulitermes hesperus	4	0	20		
	Macrotermes gilvus	14	0	5		
	Coptotermes sp.	0	0	1		
	Pycnoscelus surinamensis	0	0	1		
7.	Ophistopora					
	Lumbricina sp.	1	2	6		
8.	Blataria					
	Parcoblata notha	0	1	0		
9.	Araneae					
	Phidippus sp.	0	1	0		
10.	Orthoptera					
	Gryllus pennsylvanicus	0	1	0		

Note: A : Water, T : Open, BK : Under Canopy

Different soil macrofauna species found in various stations may be attributed to the mobile nature of these soil mesofauna; thus, unfavorable environmental conditions can prompt their relocation. The presence of soil fauna is significantly influenced by environmental factors, both biotic and abiotic. Abiotic environmental factors include physical aspects such as soil texture, soil structure, and chemical factors like pH, salinity, organic matter content, and soil mineral elements. Meanwhile, biotic factors influencing soil fauna include microflora and plants. Plants contribute to soil moisture and provide organic matter favored by soil fauna [4].

The active role of soil macrofauna in decomposing soil organic matter can sustain and restore soil productivity, supported by the surrounding environmental factors. The diversity and population density of soil macrofauna at a location are influenced by the physico-chemical characteristics of its habitat and the biological traits of the soil macrofauna. Light intensity affects the population of various soil macrofauna types, with higher light intensity correlating with a decrease in soil macrofauna population.

Based on the three criteria of the Shannon-Wiener index, where H' < 1 indicates low soil macrofauna diversity, 1 < H' < 3 indicates moderate diversity, and H' > 3 indicates high diversity [1]. Biodiversity represents the totality of organism life in a specific area [4]. The calculation results using the Shannon-Wiener index for the analyzed identification data show a diversity (H') of 2.277, categorizing it as moderate based on the Shannon-Wiener index.

Evenness refers to the uniform distribution of individuals among species. According to the evenness index (E) calculation, the evenness of soil macrofauna is 0.726, placing it in the moderate category. This suggests a relatively even distribution of soil macrofauna at the location, possibly due to the presence of abundant litter that can be transformed by soil macrofauna into organic matter, serving as a plentiful food or nutrient source for soil macrofauna [4].

The increase in soil macrofauna diversity with higher soil organic matter content and the dominance of understory vegetation is attributed to the utilization of soil organic matter and plant residues by soil macrofauna as a food source. The research also highlights that soil organic matter significantly determines the population density of soil organisms, including soil fauna. Higher soil organic content leads to greater diversity of soil fauna in an ecosystem [4].

CONCLUSION

Based on the parameter indices, the diversity value (H') is found to be 2.277 according to the Shannon-Wiener index, with H' = 2.77 falling into the moderate category. The evenness index (E) is recorded at 0.726, also falling within the moderate category. This suggests that the evenness of soil macrofauna in the location tends to be uniform.

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Further research is needed regarding the diversity of soil macrofauna species in the Lembah Harau region of West Sumatra.

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