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DIVERSITY OF SOIL SURFACE ARTHROPODS IN THE FOREST SURROUNDING BIOLOGY DEPARTMENT MANADO STATE UNIVERSITY

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Abstract

Diversity in animals is a variation of the structure, shape, number, and other properties at a particular time and place. Diversity describes a situation that varies from one person to another, objects that occur cause differences in size, shape, texture, and amount. Arthropods are animals with segmented legs, and segments on the body belong to the animals that live both above and below the ground. This research aims to know the diversity and types of ground surface arthropods in the forest surrounding the Department of Biology, Faculty of Mathematics and Natural Science, Manado State University. This research is located in the forest area of the Department of Biology, Faculty of Mathematics and Natural Science, Universitas Negeri Manado, Tonsaru village, South Tondano District, Minahasa Regency, North Sulawesi. Taking data using the pitfall trap method and analyzing using Shannon Wiener diversity index, species richness index, species evenness index, and species dominance. The data collection and collection results obtained as many as 12 genera with a total of 166 individuals. Namely, *Myrmica, Carebara, Paraponera, Papederinae, Anisolabis, Hogna, Spirostreptus, Cafius, Phalangium, Opilio, Oxidus, and Pholidoptera*. The diversity index value yields 1,11043. The species richness index shows a value of 2,1518. Index the evenness of the species showed a value of 0,44687. The dominance of type indicates a value of 0,457. The level of diversity is moderate, species richness is low, evenness is moderate, and species dominance is low.

Key words: *Diversity, Arthropods, Forest.*

INTRODUCTION

The forest of the Department of Biology, Faculty of Mathematics and Natural Sciences, UNIMA, is included in the category of the urban forest, which is located between the UNIMA campus environment and residential areas. However, lately, it has been widely used as research land in farming.

Diversity describes a different situation for a living thing related to size, shape, and number. Animals are a group of living things included in many-celled (multicellular) living things. Diversity in animals can be caused by the influence of evolution and adaptation to the environment or habitat so that it can bring up various variations in terms of size, number, morphological structure, and physiology (Lavelle et al., 1994). Soil surface arthropods are included in soil biodiversity (Leksono, 2017), which have a significant role in

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changing the soil's physical, chemical, and biological properties through immobilization and humification processes. In the decomposition path of steadfast organic matter, soil surface arthropods have a more dominant role in the fragmentation process and provide many prevalent habitat facilities for further decomposition. (Setiawan and Maulana, 2019)

The problem of this research is that the types and levels of diversity of soil surface arthropods in the forest area of the Biology department of Manado State University have not been identified. Therefore, this study aimed to determine the diversity and types of ground surface arthropods found in the forest surrounding the Department of Biology, Manado State University.

RESEARCH METHODS

This research was conducted from February to March 2022. The research was located in the forest area of the Department of Biology, FMIPA UNIMA, Tonsaru Village, South Tondano District, Minahasa Regency, North Sulawesi.

Data retrieval

This study uses the pitfall trap method (Abdillah et al., 2019), which is a ground-level animal trap using small plastic cups (top and bottom diameters of 7.5 cm and 4.5 cm) (Figure 1.) which contain a mixture of water and granulated sugar, which is placed on each observation plot with two locations 2.). The plots consisted of 10 plots at each location using a straight line transect with a distance of 2 meters between plots (Figure 3.). The traps that have been installed are left for 1 x 24 hours. Arthropods trapped in pitfall traps under anesthesia using 70% alcohol.

Figure 1. Pitfall trap
Source: Personal Documentation

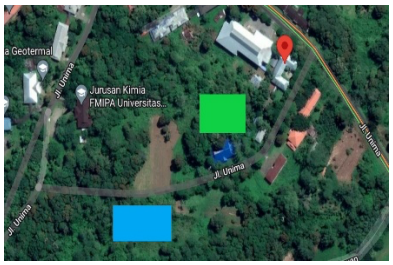

Figure 2. Research Location
Source: Personal Documentation

Figure 3. Plot Creation
Source: Personal Documentation

Identification Process

The process of identifying ground surface arthropods trapped in a pitfall trap using a mobile phone camera with the Google Lens software application. The Kanisius insect determination key book, and the Suin Soil Animal Ecology book. After the identification process, it is written in the observation table according to the order, family, and genus classification. Moreover, calculated the total number of

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individuals who have been obtained.

Data Analysis

After identifying the data by counting the number of arthropods according to the classification of orders, families, and genera, the data were analyzed by descriptive analysis using the formula for diversity indices using Microsoft Excel 2013 software. The diversity indices are:

Shannon Wiener Index (Magguran, 1988) :

H' = $-\sum pi \ln pi$ known pi = $\frac{ni}{N}$

Information :

H' = Diversity index of species diversity

ni = Total type multiplied by 1 (i = 1)

N = Total individuals

ln = Natural logarithm

Species Evenness Index (Ludwig and Reynolds. 1988):

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

Information :

E = Specific evenness index

H' = Shannon Wiener diversity index/species diversity

S = Number of types

ln = Natural logarithm

Species Richness Index (Ludwig and Reynolds. 1988):

R = $\frac{(S-1)}{\ln N}$

Information :

R = Specific richness index

S = Number of types

ln = Natural logarithm

N = Total individuals

Species Domination (Ludwig and Reynolds. 1988):

C = Σ $(pi)^2$ where pi = $\frac{ni}{N}$

Information :

C = Type dominance

ni = Number of individuals

N = Total individuals

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RESULTS AND DISCUSSION

Diversity of Ground Surface Arthropods

The identification results were taken at two locations with 20 plots. From the data collection and collection results obtained, as many as 12 genera were with a total of 166 individuals. Namely Myrmica, Carebara, Paraponera, Papederinae, Anisolabis, Hogna, Spirostreptus, Cafius, Phalangium, Opilio, Oxidus, and Pholidoptera. (Table 1.)

Table 1. Animal results obtained from two locations

No	Order	Family	Genus	Quantity
1	Hymenoptera	Myrmicini	*Myrmica*	102
2	Hymenoptera	Formicidae	*Carebara*	46
3	Hymenoptera	Formicidae	*Paraponera*	7
4	Coleoptera	Staphylinidae	*Papederinae*	2
5	Dermaptera	Anisolabididae	*Anisolabis*	2
6	Araneae	Lycosidae	*Hogna*	1
7	Spirostreptida	Spirostreptidae	*Spirostreptus*	1
8	Coleoptera	Staphylinidae	*Cafius*	1
9	Opiliones	Phalangiidae	*Phalangium*	1
10	Opiliones	Phalangiidae	*Opilio*	1
11	Polydesmida	Paradoxomatidae	*Oxidus*	1
12	Orthoptera	Tettigonidae	*Pholidoptera*	1
Total				166

The diversity index value shows the results of 1.11043 (Table 2.), which is classified as a moderate category. This follows the criteria of the Shannon Wiener index, namely if H' is less than 0 then it is declared low category. If H' is between 1.0 to 3.0, then it is declared a medium category. If H' is more than 3.0, it is declared a high category (Suterisni et al., 2018). The genus Myrmica is more numerous than all the genera that have been identified. This is because their habitat is in a forest ecosystem of litter, and they live in colonies by eating several types of animals that have rotted and some plants that have died and dried up. It is estimated that there is a possibility of the influence of traps containing a mixture of water and sugar so that the three genera of ants, namely Myrmica, Carebara, and Paraponera, can enter the trap.

Table 2. Index analysis results by Shannon Wiener .

No	Genus	Total	pi	ln pi	pi ln pi
1	*Myrmica*	102	0,61446	-0,48701	-0,2993
2	*Carebara*	46	0,27711	-1,28335	-0,3556
3	*Paraponera*	7	0,04217	-3,16608	-0,1335
4	*Paperidae*	2	0,01205	-4,41884	-0,0532
5	*Anisolabis*	2	0,01205	-4,41884	-0,0532

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6	*Hogna*	1	0,00602	-5,11199	-0,0308
7	*Spirostreptus*	1	0,00602	-5,11199	-0,0308
8	*Cafius*	1	0,00602	-5,11199	-0,0308
9	*Phalangium*	1	0,00602	-5,11199	-0,0308
10	*Opilio*	1	0,00602	-5,11199	-0,0308
11	*Oxidus*	1	0,00602	-5,11199	-0,0308
12	*Pholidoptera*	1	0,00602	-5,11199	-0,0308
	Total	166		H'	1,11043

Based on the opinion of Borror et al. (1992), some animals belonging to the Formicidae family have the behavior of preying on other types of individuals, looking for food from other organisms that are dead and decaying. Meanwhile, other genera, such as Papederinae, Anisolabis, Hogna, Spirostreptus, Cafius, Phalangium, Opilio, Oxidus, and Pholidoptera, are fewer in number. This is because these genera have nomadic nature. There are factors of different habitat conditions from the two data collection locations. The first location of the forest has many shady trees compared to the second location, which has relatively few trees and is dominated by grass and shrubs. Overall the more individuals and the number of species obtained, the higher the diversity and vice versa. This is also due to the availability of food, which causes the number of types of arthropods on the soil surface to be significant. This follows the statement from Ruslan (2009) that ground surface arthropods will occupy and continue their lives in an environment with the availability of food ingredients following their habitat.

Table 3. The results of the analysis of the species richness index

S	N	ln N	R
12	166	5,11199	2,1518

Table 4. The results of the analysis of the species evenness index and species dominance

H'	S	ln S	E	C
1,11043	12	2,48491	0,44687	0,457

The species richness index shows a value of 2.1518, which is classified as a low category (Table 3.). This is because the number of animal genera that are in a state of lame 102 individuals, and there is one individual, so the species richness in the forest ecosystem of the Biology Department, Faculty of Mathematics and Natural Sciences, UNIMA is in a low category.

The value species evenness index shows a value of 0.44687, which belongs to the category of medium evenness, so it can be said that the community in the ecosystem around the forest in the Biology department of the Faculty of Mathematics and Natural Sciences, UNIMA is classified as unstable (Table 4). On the other hand, species dominance shows a value of 0.457, which belongs to the low dominance category because the dominant genus is *Myrmica.*

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Classification and Characteristics of Ground Surface Arthropods

Each animal data obtained was identified as having different morphological characteristics. The identification process is carried out by knowing the visible morphological characteristics using an identification key and randomly matching the images in several references using the Kanisius determination key book, the Suin Land Animal Ecology book, and the Google Lens software application.

Figure 4. *Myrmica Sp* Source: Personal Documentation

Figure 5. *Carebara Sp* Source: Personal Documentation

Figure 6. *Paraponera Sp* Source: Personal Documentation

Figure 7. *Papederinae* Sp Source: Personal Documentation

Figure 8. *Anisolabis* Sp Source: Personal Documentation

Figure 9. *Hogna* Sp Source: Personal Documentation

Figure 10. *Spirostreptus* Sp Source: Personal Documentation

Figure 11. *Cafius* Sp Source: Personal Documentation

Figure 12. *Phalangium* Sp Source: Personal Documentation

Figure 13. *Opilio* Sp Source: Personal Documentation

Figure 14. *Oxidus* Sp Source: Personal Documentation

Figure 15. *Pholidoptera* Sp Source: Personal Documentation

Myrmica Sp (Figure 4.) is a genus of ants belonging to the order Hymenoptera and the Family Formicidae. Its distribution is in the holarctic climate and high mountains of Southeast Asia. It has a morphology of tibial spurs from the middle and hind legs. The mouth has a small flat appendage with long antennae, and the whole body is reddish brown (Sielezniew et al., 2010).

Carebara Sp (Figure 5.) is a genus of ants belonging to the order Hymenoptera and the Family Formicidae. Carebara is a genus of ants that live on the ground or under rocks. This genus is generally found in open habitats, garden habitats, and forest edges. (Moffett, 1988). It has morphological characteristics. Namely, the head is truncated, like a shield, with the frontal lobes extending forward to form a wide round lamina, the rectangular head is longer than the width, the sides are straight to slightly convex, and the posterolateral corners are rounded. Relatively larger size and dark reddish brown to black (Akbar & Bharti, 2017).

Paraponera Sp (Figure 6.) is a genus of ants belonging to the order Hymenoptera and the Family

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Formicidae. Paraponera is a genus of giant ants with a body length of more than 2 cm. It is potentially aggressive in tropical habitats with a morphology all black has long antennae. The genus Paraponera has habitats at the base of trees, and some have nests. Colonies can grow to more than 2000 individuals (Breed & Harrison, 1988).

Papederinae Sp (Figure 7.) is a genus of beetles belonging to the order Coleoptera and the family Staphylinidae. It has a morphology that is in size ranges from 1 to 35 mm, with some in the range of 2 to 8 mm and has an elongated body shape with a round shape. This genus has crawling behavior like ants when things are safe. If its activity is disturbed, this beetle will raise the abdomen/stomach to look like a scorpion to scare off predators who eat it or interfere with its life activities (Anlas & Ethem, 2008).

Anisolabis Sp (Figure 8.) is an arthropod belonging to the order Dermaptera and the family Anisolabididae. It has a morphology that is about 2.5 to 3 cm long and is grayish or black with light yellow legs, and has two springtails behind the abdomen (Julie et al., 2012).

Hogna Sp (Figure 9.) is a genus of spiders belonging to the order Araneae and Family Lycosidae. It has a morphology that the abdomen is oval and not bigger than the cephalothorax (the part of the head that is attached to the thorax). The body is gray, brown, and faded black. The back body is brown with fine gray hairs. Fork-like lines start from the eye towards the body's back (Limbu et al., 2018).

Spirostreptus Sp (Fig. 10.) is a genus of millipedes belonging to the order Spirostreptida and the Family Spirostreptidae. It has a long body morphology, a segmented body, has many legs. The head is round with an antenna on the head, and the movement is slow (Minelli, 2015).

Cassius Sp (Figure 11.), Genus Cafius is a beetle belonging to the order Coleoptera and the family Staphylinidae. Morphology, that is, has a slender and long body. It has long and short antennae. Mouth grate and suck. The abdomen is large, tapered at the end, and has an elytra or short springtail. Adults are blackish brown, sometimes slightly reddish. This genus acts as a predator, saprophage, polyphage, and bioindicator of soil fertility (Chatzimanolis et al., 2012).

Phalangium Sp (Fig. 12.) is a genus of spiders belonging to the order Opiliones and the Family Phalangiidae. The morphology of the genus Phalangium is to have long and slender legs and a short and round body. Adult body length is estimated at 3.5 to 9 mm, and males are generally smaller than females. The upper surface of the body is colored in an indistinct and variable gray or light brown pattern, and the lower surface of the body is cream (Gainett et al., 2022).

Opilio Sp (Fig. 13.) is a genus of spiders belonging to the order Opiliones and the Family Phalangiidae. Opilio is a spider genus with a morphology of dark spots on the body and is generally blackish-green and gray. It has long, slender legs and a round body shape (Snegovaya et al., 2018).

Oxidus Sp (Fig. 14.) is a genus of millipedes belonging to the order Polydesmida and the family Paradoxomatidae. The genus Oxidus, which is often called star dung, belongs to the class Diplopoda arthropods. It has a morphology that is a stick-sized body and a length of up to 20 mm, black and reddish brown, and yellowish-brown legs. The legs are numerous (Jovanovic et al., 2016).

Pholidoptera Sp (Fig. 15.) is a genus of crickets belonging to the order Orthoptera and the Family

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Tettigoniidae. It has morphological characteristics, namely elongated antennae-like threads. Mouthparts adapted for chewing and biting, modified protothorax, hind legs like the legs of a jumping grasshopper, wing shape, and venation. Moreover, it has a sound-producing stridulator organ (Kanuch et al., 2017).

CONCLUSION

The types of ground surface arthropods found around the forest in the Department of Biology, Faculty of Mathematics and Natural Sciences, UNIMA, amounted to 12 genera and 166 individuals. Namely, *Myrmica, Carebara, Paraponera, Papederinae, Anisolabis, Hogna, Spirostreptus, Cafius, Phalangium, Opilio, Oxidus,* and *Pholidoptera*. The level of diversity is moderate, species richness is low, evenness is moderate, and species dominance is low.

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