

## Arthropoda Community Structure in Conservation Forest and Oil Palm Plantation in Java Tengah Village Area, Hatonduhan District, Simalungun Regency

Srinatalia Silaen<sup>1</sup>, Welmar Olfan Basten Barat<sup>2</sup>

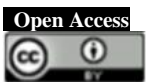
<sup>1</sup> University of Hkbp Nommensen /faculty of animal husbandry / Indonesia/ Jl. Sutomo No.4A, Perintis, East Medan District, Medan City, North Sumatra

<sup>2</sup> HKBP Nommensen Pematangsiantar University/Aquatic Resources Management/Indonesia/ Jl. Sangnawaluh No.4, Siopat Suhu, Siantar Tim. District, Pematangsiantar City, North Sumatra

Corresponding Author e-mail\*: [srinatalia.silaen92@gmail.com](mailto:srinatalia.silaen92@gmail.com)

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### Abstract

The research about composition and structure of Arthropoda community was conducted at oil palm plantations Arthropoda were collected at oil palm plantation, conservation forest and forest edge sites (between conservation forest and plantation area) by survey method with systematic random sampling for arthropoda in litter and soil. A total of four Arthropoda species that belonging to 2 orders, 3 families, 4 general and 57 individuals was collected. The highest number of individuals *Isotomiella* sp. (14 ind) family *Isotomidae*. Arthropoda community composition consists of 3 families & 4 species: *Neanuridae* (*Lobella* sp.), *Brachystomellidae* (*Brachystomella* sp.) & *Isotomidae* (*Isotomiella* sp. & *Folsomides* sp.), Arthropoda community structure The highest density is in the litter location I (16 ind / m<sup>2</sup>) while the lowest density is in location III (3.56 ind / m<sup>2</sup>). The highest soil density is in location I (4,538.56 ind / m<sup>3</sup>) & the lowest density is in location III (789,761 ind / m<sup>3</sup>). The highest relative density is location III (100%) & the lowest relative density is found in location I (litter, 5.8%) & (soil, 8.9%). The highest Shannon-Wiener diversity index, both litter and soil, were found in location I (litter 1.28) & (soil, 1.38) and the lowest diversity index was found in location III (0). The highest similarity index for Sorensen was location III (75.71%) and the lowest was the comparison between locations II & I (20%).

**Keywords:** Arthropoda, community, oil palm plantation.

### 1. Introduction

Arthropoda is called springtails, because at the end of the abdomen there is an organ that looks like a tail and functions as an organ of motion by working like a spring (Suhardjono, Deharveng and Bedos, 2012). Arthropoda is commonly known as an organism that lives in the soil and has an important role as a remodel of soil organic matter. Soil organisms are one of the constituent components of soil ecosystems that play an important role in various decomposition processes and energy flows so that they can affect soil fertility (Doles, *et al.*, 2001; Delgado *et al.*, 2020; Soong *et al.*, 2020). The existence and density of a type of soil animal in an area is highly dependent on environmental factors, both abiotic environmental factors and biotic environmental factors (Suin, 1989; Jan *et al.*, 2021; Dalrymple *et al.*, 2020).

Arthropoda is a primitive arthropod that lives in the ground, Arthropoda is known as spring-tail because in

the tail there is an additional structure, namely furcula which functions as a jumping device with a spring-like way, so it can jump up to 75-100 mm. Arthropoda is commonly known as an organism that lives in the soil and has an important role as a remodel of soil organic matter. In addition to decomposing materials organic, these soil organisms play a role in distributing organic matter in the soil, increasing fertility and improving the physical properties of the soil (Indriyati and Wibowo, 2008; Hoffland *et al.*, 2020; Prescott & Vesterdal, 2021; Huang *et al.*, 2020). Moisture, acidity and soil temperature will affect in the process of decomposition of organic matter. Such changes will certainly affect the abundance and diversity of Arthropoda. The role of soil organisms aims to improve and maintain soil quality and fertility. Oil palm plantations are one of the interesting ecosystems to study because the land processing is carried out traditionally. The Hatonduhan oil palm plantation,

Simalungun Regency is an area that has extensive plantations with land management that does not follow cultivation guidelines, thus creating a unique ecosystem for Arthropoda.

## 2. Methods

Arthropoda is one of the most influential soil fauna, functions as a controller of life that determines the population of pathogenic bacteria and fungi in the ecosystem also suggests that as a component of the ecosystem, Arthropoda (spring-tail) has a role that is not small and diverse depending on the type or group. Arthropoda are able to occupy a wide variety of ecological niches and are sensitive to changes in ecosystems. Each type of different habitat is inhabited by different types and groups of species. In the newly identified region of Indonesia Arthropoda about 250 species from 124 general from 17 families. In Indonesia Arthropoda is estimated to number around 1500-15,000 species. Arthropoda species diversity maintenance activities in oil palm plantations can result in differences in the composition of each type of Arthropoda. On each month, the type of *Onychiurid sp.* (*Onychiuridae*), and *Isotomid sp. 1* (*Isotomidae*) has a relatively smaller average number of individuals compared to *Isotomid sp. 2* (*Isotomidae*), *Isotomid sp. 3* (*Isotomidae*), *Entomobryid sp. 6* (*Entomobryidae*), *Entomobryid sp. 7* (*Entomobryidae*), and *Chypoderid*

*sp.* (*Chypoderidae*). Meanwhile, the type of *Isotomy sp. 5* (*Isotomidae*) was found to have the highest monthly population compared to other species. Environmental factors can also affect the presence or absence of Arthropoda such as weather, soil, and vegetation living on it. Jawa Tengah II Village is an area that has a very large area of rice fields and oil palm plantations in addition to community residential areas. Rice fields and plantations are usually inhabited by various types of animals for their survival, because this is determined by the structure and needs of these animals such as, food, development, adaptation to the environment and so on. These conditions give rise to many different types of animals including the diversity of Arthropoda.

## 3. Data collection

Data collection techniques are carried out by observing and counting arthropods using a microscope. Arthropods obtained are collected based on morphological characters, then re-observation and imaging using a microscope for identification purposes. Arthropod identification data up to the genus level were analyzed descriptively. The operationalization of variabel.



Fig. 1 Map of the Research Location Area

## 4. Result and Discussion

Arthropoda Community Composition total of four species of Arthropoda have been obtained belonging to 2 orders, 3 families, 4 genus, and 57 individuals (Tables 1 and 2). The order Poduromorpha obtained two families, namely: *Neanuridae* (20 individuals) and *Brachystomellidae* (12 individuals), while the order *Entomobryomorpha* obtained only one family *Isotomidae* (25 individuals). The highest number of species found in the family *Isotomidae* is the species *Isotomiella sp.* (23 individuals) and *Folsomides sp.* (2 individuals) in three locations. The highest number of individuals is found in the species *Isotomiella sp.* (23 individuals) from the family *Isotomidae*.



Location (a)



Location (b)



Location (c)

Fig. 1 Observing the condition of palm trunks that are worthy of study (a), counting and examining the number of types of Arthropoda tribes from three observation locations (b), and (c) reviewing the condition of litter that has been replanted and old tree trunks, usually Arthropoda tribe animals around wet tree trunks.

Table 1. Number of individuals of the Collembola tribe in the PTPN IV Area Litter Unit Tonduhan

Table 1: Number of individual Collembola on Litter in Oil palm plantation area				
No	Family Species	Location		
		Oil palm	Intermediate land	Conservation forest
<b>I Brachystomellidae</b>				
1	<i>Brachystomella</i> sp.	-	2	3
<b>II Isotomidae</b>				
2	<i>Isotomiella</i> sp.	4	3	5
3	<i>Folsomides</i> sp.	-	-	1
<b>III Neanuridae</b>				
4	<i>Lobella</i> sp.	-	4	9
Individuals total		4	10	18
Family total		1	3	3
Genus total		1	3	3
Species total		1	3	3

Table 1.1. Number of Collembola individuals on Soil in oil palm plantation area

No	Family Species	Location		
		Oil palm	Intermediate land	Conservation forest
<b>I Brachystomellidae</b>				
1	<i>Brachystomella</i> sp.	-	3	4
<b>II Isotomidae</b>				
2	<i>Isotomiella</i> sp.	2	5	3
3	<i>Folsomides</i> sp.	-	-	1
<b>III Neanuridae</b>				
4	<i>Lobella</i> sp.	-	3	4

Individuals total	2	11	12
Family total	1	3	3
Genus total	1	3	3
Species total	1	3	3

Description: (-) Not found.

Table 2. Density (ind/m<sup>2</sup>), Relative density (%) and Frequency of presence (%) in litter samples in three types of land in the oil palm plantations area

	K	KR	K	KR	K	KR
	(ind/m <sup>2</sup> )	(%)	(ind/m <sup>2</sup> )	(%)	(ind/m <sup>2</sup> )	(%)
<b>Brachystomellidae</b>						
1. <i>Brachystomella</i> sp.	-	-	1,78	20	2,67	16,7
						2,22
2. <i>Isotomiella</i> sp.	3,56	100	3,56	40	4,44	27,8
3. <i>Folsomides</i> sp.	-	-	-	-	0,89	5,5
<b>Neanuridae</b>						
4. <i>Lobella</i> sp.	-	-	3,56	40	8	50
						22,22
Total	3,56	100	8,9	100	16	100
						83,33

Description: (-) Not found.

Table 3. Diversity index and equitability index Collembola in oil palm plantation area

No	Parameter	Litter samples		
		Oil palm	Intermediate land	Conservation forest
1	Diversity Index (H')	0 <sup>a</sup>	1,05 <sup>b</sup>	1,18 <sup>c</sup>
2	Equitability	-	0,96	0,85
Sample of sand				
1	Diversity Index (H')	0 <sup>a</sup>	1,06 <sup>b</sup>	1,28 <sup>c</sup>
2	Equitability index (E)	-	0,97	0,92

Description: The number followed by the same lowercase letter on each row of the diversity index shows a diversity index value that is not significantly different based on the 5% t-test.

Table 4. Sorensen Arthropoda Similarity Index in Area of oil palm plantations area

Litter Samples			
Location	Oilpalm	Intermediate land	Conservation forest
Oil palm	-	50 %	40 %
Intermediate Land	-	-	84,71 %*
Conservation forest	-	-	-
Litter samples			
Location	Oil palm	Intermediate land	Conservation forest
Oil palm	-	50 %	40 %
Intermediate Land	-	-	85,71 %*
Conservation forest	-	-	-

Description: (\*) The similarity index shows significant type differences between stations, (-) None.

Table 5. Average Physico-Chemical Factors of Soil in Three Habitats in oil palm plantation

Location				
No.	Parameters	Oil palm plantation	Intermediate land	Conservation forest
1	Soil temperature (°C)	26,83	25,67	24,67
2	Soil moisture content (%)	29	37,5	40,5
3	Soil pH	4,75	5,13	5,5
4	Nitrogen levels Total (%)	0,19	0,20	0,48

From the results of observations obtained in the Toduhan unit area, the highest number of species was *Isotomiella* sp., with a total of 4 species. In the results of conservation in the forest, there are five species. This does not show a very significant difference between the location at PTPN IV and the conservation carried out in the forest. The results of forest conservation carried out around PTPN IV land show that the number of species is not that different from the number in oil palm and also intermediate land in the research location.

The results of the diversity index and equitability index for Collembola in oil palm plantation areas can be seen in Table 3, which shows that the diversity index (H') is higher in the conservation forest in the litter samples carried out, namely with values of 1.18° and 1.28°, respectively. and the Equitability Index (E) value is 0.92.

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