

Soil Macrofauna as Bioindicator on Aek Loba Palm Oil Plantation Land

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Abstract. The sustainability of oil palm plantation was investigated on the condition of oil palm plantation soil. Soil macrofauna have been reported to be a potential bio indicator of soil health and quality. This research has been conducted at PT. Socfindo Kebun Aek Loba in February 2017- April 2018. The difference in the length of time of utilization and management of plantation land in each generation also determines the presence, both species, density, relative density, and the frequency of the presence of soil macrofauna. This research was conducted to determine the species richness, density and attendance frequency of soil macrofauna on oil palm plantation land of PT. Socfin Indonesia (Socfindo) Aek Loba plantation area. Determination of the sampling point is done by the Purposive Random Sampling method, soil macrofauna sampling using the Quadratic and Hand Sorting methods with a size of 30x30 cm. There are 29 species of soil macrofauna which are grouped into 2 phyla, 3 classes, 11 orders, 21 families, and 27 genera. The highest density value is in the Generation II area of 401.53 ind / m² and the lowest density value is in the Generation IV area of 101.59 ind / m². Attendance Frequency of soil macrofauna in the four generations consists of 4 species, namely *Pontoscolex corethrus*, *Geophilus flavus*, *Vostax apicedentatus*, and *Solenopsis fugax*. The highest frequency of species presence is *P. corethrus*, which indicates a good soil bioindicator. In conclusion it showed that the quality of the soil has good organic matter content.

Keywords. *Densitas, attendance frequency, species richness, Pontoscolex corethrus*

Abstrak (Indonesian) Keberlanjutan perkebunan kelapa sawit membutuhkan penelitian tentang kondisi tanah perkebunan kelapa sawit. Makrofauna tanah telah dilaporkan sebagai indikator biologi potensial untuk kesehatan dan kualitas tanah. Penelitian ini telah dilakukan di PT. Socfindo Kebun Aek Loba pada Februari 2017 - April 2018. Perbedaan dalam lamanya waktu pemanfaatan dan pengelolaan lahan perkebunan di setiap generasi juga menentukan keberadaan, baik spesies, kepadatan, kepadatan relatif, dan frekuensi keberadaan makrofauna tanah. Penelitian ini bertujuan untuk mendata jumlah spesies makrofauna tanah, membandingkan kepadatan dan frekuensi kehadiran makro fauna tanah pada kebun kelapa sawit yang berbeda umur pemanfaatannya (generasi I, II, III, dan IV) dan pengelolaan kebun di PT. Socfin Indonesia (Socfindo) Aek Loba. Penentuan titik sampling dilakukan dengan metode Purposive Random Sampling. Pengambilan sampel makrofauna tanah menggunakan metode Kuadrat dan Hand Sorting dengan ukuran 30x30 cm. Terdapat 29 spesies makrofauna tanah yang dikelompokkan ke dalam 2 filum, 3 kelas, 11 ordo, 21 famili, dan 27 genus. Nilai kepadatan kebun Generasi I sebesar 106,67 ind/m², nilai kepadatan kebun Generasi II sebesar 401,53 ind/m², nilai kepadatan kebun Generasi III sebesar 34,92 ind/m² dan nilai kepadatan kebun Generasi IV sebesar 101,59 ind/m². Frekuensi kehadiran makrofauna tanah yang terdapat pada ke empat generasi terdiri dari 4 spesies, yaitu *Pontoscolex corethrus*, *Geophilus flavus*, *Vostax apicedentatus*, dan *Solenopsis fugax*. Frekuensi kehadiran spesies yang paling tinggi adalah *P. corethrus* yang mengindikasikan sebagai bioindikator tanah yang baik. Yang menunjukkan bahwa kualitas tanah memiliki kandungan bahan organik yang baik.

Kata kunci. Densitas, frekuensi kehadiran, kekayaan spesies, *Pontoscolex corethrus*.

1. Introduction

Opening and construction of PT. Socfin Indonesia in the plantation area of Aek Loba, Asahan Regency, North Sumatra Province, was first started in 1931. At present, there is an area of the I (one) to IV (four) generation. The areas of generation IV, III, and II are converted from the forest area to become oil palm plantations, which began in Generation IV in 1931-1956 (± 25 years), in 1956-1981 (± 50 years), in the planting year 1981-2006 (± 75 years), and in the

planting year 2006-present (± 86 years). Generation III planting year 1943-1968 (± 25 years), the planting year 1968-1993 (± 50 years), and in the planting year 1993 to present (± 74 years). Generation II planting years 1970-1995 (± 25 years), and planting years 1995 to present (± 47 years), while Generation I was converted from rubber plantation area to oil palm plantations in the 1987-2010 planting year now (± 30 years).

Oil palm plantations of PT. Socfindo area of Aek Loba since the beginning of its activities in 1931 until

now there has been an increase in management, causing the existing land for plantation areas to be increasingly limited, and often the land is used continuously without regard to its maintenance, not even giving the land an opportunity to renew the physical condition- chemical-biology naturally, or restored fertility. This situation causes a decrease in physical, chemical, and biological soil fertility.

In general, oil palm plants from the beginning of planting to old age can be said to have never been touched by the treatment of soil treatment, both in the dish and in the gawangan. In addition, fertilization treatment and the application of herbicides, as well as the spreading of discs or footrests of harvesters, even the application of fertilizers that are very difficult to dissolve, such as Rock Phosphate and dolomite will cause the soil in the disc to become more dense and compact, this situation causes the porosity of the soil to narrow, so that the drainage and respiration of roots, and soil biota will be disrupted, and resulting in the difficulty of the root system and soil biota developing and activities on the land.

Excessive use of chemical fertilizers can damage the physical, chemical and biological characteristics of the soil, as well as reduce the population and the presence and biodiversity of soils [24]. Furthermore, ~~that~~ the decline in soil fauna diversity was due to intensive land management, fertilizing and monoculture planting in conventional system, extra spaces before and after (slash) are unnecessary [9]. Biodiversity, including the presence of soil fauna, is one component in soil ecosystems that plays a role in improving soil structure, increasing pore space, aeration, drainage, water storage capacity, decomposition of organic residues, mixing of soil particles and microbial distribution [2][13]. Soil fauna in carrying out its life

activities is very much determined by environmental factors, such as physical, chemical, biotic conditions and availability of food, as well as ways of processing land that can generally affect soil fauna populations, both density, frequency of attendance, composition, and diversity its species [26]

The purpose of this study is to evaluate the presence of soil macrofauna species contained in the Aek Loba oil palm plantation, evaluate the density of soil macrofauna species contained, in the Aek Loba oil palm plantation evaluate the soil macrofauna species that can be used as bioindicators that can live and breed well.

2. Material and Methods

2.1. Time and Place

This research was conducted in the area of PT. Socfindo located in Aek Loba Garden, Aek Kuasan District, Asahan Regency, North Sumatra Province at the coordinates 03°35'24.90" - 03°40'58.36" LU and 100°33'56.90" - 100°43'17.65" BT and the height ranges from 31 to 36 m above sea level. Furthermore, identification and analysis of data from soil macrofauna samples were obtained at the Ecology Laboratory of the Department of Biology, USU FMIPA Medan.

2.2. Research Methods

This research was conducted using the Survey Method, and the determination of the location of the sample plots was carried out using the Purposive Random Sampling method, namely by selecting a random location on the palm oil estate every generation, and the type of soil (Table 1). Furthermore, soil macrofauna sampling was carried out using the Quadratic and Hand Sorting Method.

Table 1. The Condition of the soil before planting and the year of planting oil palm plantations in the area of aek loba oil palm plantations and the length of land use

Generation	I	II	III	IV
The initial ecosystem	Rubber plant	Forest	Forest	Forest
Year of Planting	1. 1987 – now	1. 1970-1995	1. 1943-1968	1. 1931-1956
		2. 1995 – now	2. 1968-1993	2. 1956-1981
			3. 1993 – now	3. 1981-2006
				4. 2006 - now
Year of utilization	± 31years	± 47years	± 74years	± 86years

Source : PT. Socfindo (2017).

2.2.1. Soil Macrofauna Collection

Earthworms were sampled between February 2017 - April 2018. At each location of oil palm plantations between predetermined generations, plot measuring 30 x 30 cm were made with Stainless Steel Monolite, sampling was done with the distance between each nearest box with 10 m. Soil sample was taken from each plot and placed in a plastic bag for measuring pH and water content. Soil macrofauna were hand-

sorted, and cleaned with water. They were grouped base on the similarity in morphology shape. The number of species individuals were counted, stored in plastic bag and preserved with formalin 4%. The samples were transferred into a sample bottle containing alcohol 70%. The soil macrofauna were identified in the laboratory to be identified [1][23][24][4][25].

2.2.2. Soil Macrofauna Identification

Macrofauna sample were grouped according to their morphotype. The samples were identified by loops, binocular stereo microscopes, and using several reference books [6][7] [12][20] [21] [23][24].

2.2.3. Measurement of Soil

Measurement of soil physical and chemical properties is carried out directly (in situ) and before soil is taken from the square plot. Soil relative humidity and pH was measured using a soil tester. Soil temperature was measured using a Soil Thermometer.

2.3. Data Analysis

Types of soil macrofauna and the number of individuals of each type obtained were calculated: Population density, Relative Density of each type, Community Composition, and Frequency of Presence using the following formula [26]:

2.3.1. Density (D):

$$D = \frac{\text{Total number of individuals of the species in all the sampling}}{\text{total study area}}$$

2.3.2. Relative Density (RD) :

$$RD = \frac{\text{Density of species}}{\text{Total density of all species}} \times 100\%$$

2.3.3. Attendance Frequency (AF):

$$AF = \frac{\text{Qty. sample plot that occupied a species}}{\text{Total sample units}} \times 100\%$$

Where : 0 – 25 % = accidental (very rare); 25 – 50 % = accessory (rare), – 75 % = constant (often); > 75 % = (very often).

2.3.4. Bioindicator species

According to value $RD \geq 10\%$ and $AF \geq 25\%$

3. Result and Discussion

3.1. Soil Macrofauna Species List

Results of research conducted on the oil palm plantation area of PT. Socfindo in the Aek Loba plantation area, Asahan Regency, North Sumatra Province, obtained 29 (twenty nine) soil macrofauna species included in 2 (two) phylum, 3 (three) Class, 11 (eleven) order, 21 (twenty one) family, 29 (twenty nine) genus and species, as listed in Table 2. The most abundant soil macrofauna is from the Arthropod Phylum, which consists of 4 (four) Classes, namely the Arachnid Class, consisting of 1 Order, 4 Families, and 6 Genus / Species; Chilopoda class (1 order, 1 family, and 1 genus / species); Diplopoda (2 orders, 2 families, and 2 genera / species); and Insect (5 orders, 14 families, 15 genera / species). Whereas the least found soil macrofauna is from the phylum Annelida, which consists of 1 (one) class, namely Chaetopoda which consists of 1 order, 3 families, 4 Genus / Species.

Table 2. Species Presence Compositing of Soil Macrofauna At Four Sites Aek Loba Oil Palm Plantation

Phylum & Class	Orders & Family	Genus/Species	Local Name	Generation			
				I	II	III	IV
1. Annelida :							
1) Chaetopoda	1. Oligochaeta						
	1) Glossoscolecidae	1. <i>Pontoscolex corethrurus</i>	Cacing tanah	+	+	+	+
	2) Megascolecidae	2. <i>Peryonix</i> sp.	Cacing tanah	+	-	-	-
		3. <i>Pheretima</i> sp.	Cacing tanah	+	-	+	-
	3) Enchytraeidae	4. <i>Fridericia</i> sp.	Cacing tanah	-	-	+	-
2. Arthropoda :							
1) Arachnida	2. Araneae						
	1) Linyphiidae	5. <i>Tapinopa bilineata</i>	Laba-laba	+	-	-	-
	2) Lycosidae	6. <i>Pardosa amentata</i>	Laba-laba	+	-	-	-
		7. <i>Pardosa glacialis</i>	Laba-laba	+	-	-	-
	3) <u>Phryniidae</u>	8. <i>Paraphrynum mexicanus</i>	Laba-laba	+	+	-	+
	4) Sicariidae	9. <i>Loxosceles laeta</i>	Laba-laba	+	-	-	-
		10. <i>Loxosceles taino</i>	Laba-laba	+	-	-	-
2) Chilopoda	3. Geophilomorpha						
	1) Geophilidae	11. <i>Geophilus flavus</i>	Lipan/kelabang	+	+	+	+
3) Diplopoda	4. Julida						
	1) Julidae	12. <i>Julus virgatus</i>	Kaki seribu	-	-	+	+
	5. Polydesmida						

	1) Polydesmidae	13. <i>Polydesmuscollaris</i>	Keluwing	-	-	-	+
4) Insecta	6. Blattodea						
	1) Blattidae	14. <i>Blatta orientalis</i>	Kecoak tanah	+	+	-	+
	2) Ectobiidae	15. <i>Blattella germanica</i>	Kecoak jerman	+	-	-	-
	7. Coleoptera						
	1) Carabidae	16. <i>Calosoma Platipus wilsonii scrutator</i>	Kumbang	+	-	-	-
	2) Tenebrionidae	17. <i>Alphitophagus bifasciatus</i>	Kumbang	-	+	-	+
		18. <i>Helops aereus</i>	Kumbang	-	+	-	-
		19. <i>Cynaesus angustus</i>	Kumbang	-	-	-	+
		20. <i>Alphitobius diaperinus</i>	Kumbang	-	+	-	+
	3) Curculionidae.	21. <i>Platypus wilsoni</i>	Kumbang	+	-	-	-
	4) Scarabaeidae	22. <i>Dynastes granti</i>	Kumbang badak	-	+	+	-
	5) Erotylidae	23. <i>Loberus impressus</i>	Kumbang	-	+	-	-
	6) Ptinidae	24. <i>Ptinus ocellus</i>	Kumbang	+	-	-	-
	8. Dermaptera						
	1) Labiidae	25. <i>Vostax apicedentatus</i>	Cecopet kecil	+	+	+	+
	9. Diptera						
	1) Syrphidae	26. <i>Syrphus vittafrons</i>	Larva Lalat	-	+	-	-
	10. Hymenoptera						
	1) Formicidae	27. <i>Odontoponera denticulata</i>	Semut hitam	+	+	-	+
		28. <i>Oecophylla longinoda</i>	Semut merah	+	-	+	-
		29. <i>Solenopsis fugax</i>	Semut Hitam	+	+	+	+
Total number of species in every generation				19	13	9	12
Total number of species in all location				53			

Information :+ = present, - = absent.

The most commonly found Arthropods come from the Insect Class (Table 2). A large number of soil macrofauna from the Insect Class were found at the study site because Insect is a fauna group that has a large number of species and spread, as well as a very wide tolerance range and is found below the surface of the soil such as forest floor, grassland, plantation and agricultural areas. Some studies of soil macrofauna as has been done, show that soil macrofauna from Insect class is the most common [3][15][16][18][19][22]. Most soil macro-arthropod animals are soil digging animals, mainly from groups of insects (insects) that live under plant litter and actively improve soil structure [26]

Insects that are found in many research sites are from the order Coleoptera (beetles). The number of beetle species found indicates that environmental factors, such as temperatures ranging from 24-28 °C at the study site are suitable as living habitat for these species. Jumar (2000) stated that insects from the order Coleoptera have a certain temperature range where if he lives outside the tolerance range then the insect will die of cold or heat. In general, Coleoptera has an effective temperature range is 15°C (minimum), 25°C (optimum), and temperature 45°C

(maximum). However, many Coleoptera can't survive at temperatures between 38°C-44°C.

Diplopoda and Chilopoda, Chaetopoda, and Coleoptera act as a soil digger. They play an important role in improving the physical, chemical, and biological properties of the soil through a process of immobilization and humification [7].

In the decomposition of organic matter, soil macrofauna plays a greater role in the process of fragmentation (comminution), as well as providing better environmental facilities (microhabitat) for further decomposition processes carried out by the mesofauna and soil microfauna groups, as well as various types of bacteria and fungi. Furthermore, soil macrofauna also plays a role in reshuffling dead plant and animal matter, transporting organic matter from the surface to the soil, improving soil structure, and the process of soil formation. Thus the soil macrofauna plays an active role to maintain soil fertility or soil health [1][11].

3.2. Density (D) and Relative Density (RD) of Soil Macrofauna

It is found that the value of density and relative density of soil macrofauna varies in oil palm

plantations with different generations and the age of plants, with the highest total value of soil macrofauna as many as 401.53 individuals/m² from 13 species / soil macrofauna species in Generation I, i.e., the 1987 planting year to the present, with land use that has lasted for ± 30 years; then as many as 398.40 individuals / m² from 19 species / species of soil macrofauna in Generation II, i.e., the planting year 1970-1995, 1995 until now, which have been planted for twice (in 1 year), with land use that has lasted for ± 47 years; as many as 184.12 individuals/m² from 9 species of soil macrofauna in Generation III, namely the planting years 1943-1968, 1968-1993, 1993 until now which have been planted for three times (in 1 year), with land use that has lasted for ± 74 years; and as many as 101.59 individuals/m² from 12 species of soil macrofauna in Generation IV, namely planting years 1931-1956, 1956-1981, and 1981-2006, 2006 until now (4 times planting), with land use already underway for ± 86 years, as shown in Table 3.

Soil macrofauna density in an area is very abundant. This indicates that biotic environmental factors (producers, consumers, and decomposers), and abiotics (soil physics-chemistry, such as temperature, humidity, pH, organic content, etc.) in the area strongly supports the survival of these animals. On the contrary, if there is no animal species found in an area where the surroundings area are abundant, this shows that environmental factors in the area do not support and inhibit the survival of these animals. [24].

The high value of soil macrofauna density obtained in Generation II oil palm plantations, as many as 401.53 individuals/m² from 13 species due to physical-chemical and biological environmental conditions which support better survival of soil macrofauna, such as soil temperature (26 -28⁰C), humidity (60-85%), pH (6-6.8), and dominant basic vegetation, such as: *Sida retusa*, *Mimosa pudica*, *Axonopus compressus*, *Panicum repens*, *Andropogon aciculatus*, *Imperata cylindrica* as shown in Table 3.

The lowest soil macrofauna density values were found in the Generation IV oil palm plantation

area 101.59 individuals/m² from 12 species. This was due to the physical-chemical and biological environmental conditions, such as soil temperature (24-26⁰C), soil moisture (45-65%), pH (5.9-6.8) as seen in Table 3. These results indicate that the soil moisture value at the location of this generation IV garden is less humid, which ranges from 45-65% when compared to the location of the garden in other generations (Table 4.6). This situation also affects the presence and density of soil macrofauna. This is consistent with what was stated, that the presence of soil macrofauna is strongly influenced by soil moisture because the body of soil macrofauna is generally not resistant to drought. It is concluded that, soil moisture has a positive effect on soil macrofauna[1][26].

Table 3 also shows the type of soil macrofauna that has the highest population density value at the location of oil palm plantations for all generations is an earthworm of the *P. corethrurus* species, with a density value (D) of 328.54 individuals/m², relative density (RD) by 82.46% at Generation I, then followed by Generation III with a density value (K) of 139.67 individuals/m², relative density (RD) of 75.87%, Generation II with a density value (D) of 96.81 individuals/m², relative density (RD) of 24.11%, and Generation IV with a value of density (D)of 77.77 individuals/m², relative density (RD) of 76.55%. This situation shows that earthworms of the *P. corethrurus* species have high dominance in the area of oil palm plantations for all generations.

The earthworm of the *P. corethrurus* species is a single species that often dominates on forest conversion land into intensive agricultural and plantation land. This situation causes changes in earthworm diversity in the form of reduced, even the loss of native species and the emergence of migratory species (exotic). Furthermore, the results of an earthworm inventory study in Sumberjaya, West Lampung on various agricultural lands after forest conversion was obtained from the *P. corethrurus* species as the dominant species. *P. corethrurus* is a species commonly found on oil palm plantations [5][9].

Table 3. Soil Macrofauna Density and Relative Density Obtained at Each Location / Generation of Research in the Oil Palm Plantation of PT. Socfindo Areal Aek Loba

Species	Generation							
	I		II		III		IV	
	D (individuals/m ²)	RD (%)	D (individuals/m ²)	RD (%)	D (individu/m ²)	RD (%)	D (individu/m ²)	RD (%)
1. <i>Pontoscolex corethrurus</i>	328,54	82,46	96,81	24,11	139,67	75,87	77,77	76,55
2. <i>Peryonix sp</i>	1,59	0,40	-	-	-	-	-	-
3. <i>Pheretima sp.</i>	1,59	0,40	-	-	7,93	4,31	-	-
4. <i>Fridericia sp.</i>	-	-	-	-	4,76	2,59	-	-
5. <i>Tapinopa bilineata</i>	1,59	0,40	-	-	-	-	-	-
6. <i>Pardosa amentata</i>	1,59	0,40	-	-	-	-	-	-
7. <i>Pardosa glacialis</i>	1,59	0,40	-	-	-	-	-	-
8. <i>Paraphrynusmexicanus</i>	1,59	0,40	3,17	0,79	-	-	1,59	1,57
9. <i>Loxosceles laeta</i>	1,59	0,40	-	-	-	-	-	-
10. <i>Loxosceles taino</i>	1,59	0,40	-	-	-	-	-	-
11. <i>Geophilus flavus.</i>	15,87	3,98	7,93	1,97	19,04	10,34	3,17	3,12
12. <i>Julusvirgatus</i>	-	-	-	-	1,59	0,86	1,59	1,57
13. <i>Polydesmus collaris</i>	-	-	-	-	-	-	4,76	4,69
14. <i>Blatta orientalis</i>	9,52	2,39	11,11	2,77	-	-	1,59	1,57
15. <i>Blattella germanica</i>	6,35	1,59	-	-	-	-	-	-
16. <i>Calosoma scrutator</i>	1,59	0,40	-	-	-	-	-	-
17. <i>Alphitophagus bifasciatus</i>	-	-	1,59	0,40	-	-	1,59	1,57
18. <i>Helops aereus</i>	-	-	3,17	0,79	-	-	-	-
19. <i>Cyaneus angustus</i>	-	-	-	-	-	-	1,59	1,57
20. <i>Alphitobius diaperinus</i>	-	-	6,35	1,58	-	-	1,59	1,57
21. <i>Platypus wilsoni</i>	1,59	0,40	-	-	-	-	-	-
22. <i>Dynastes granti</i>	-	-	4,76	1,19	1,59	0,86	-	-
23. <i>Loberus impressus</i>	-	-	1,59	0,40	-	-	-	-
24. <i>Ptinus ocellus</i>	1,59	0,40	-	-	-	-	-	-
25. <i>Vostax apicedentatus</i>	6,35	1,59	19,04	4,74	1,59	0,86	3,17	3,12
26. <i>Syrphus vittafrons</i>	-	-	1,59	0,40	-	-	-	-
27. <i>Odontoponera denticulata</i>	7,93	1,99	239,66	59,69	-	-	1,59	1,57
28. <i>Oecophylla longinoda</i>	1,59	0,40	-	-	3,17	1,72	-	-
29. <i>Solenopsis fugax</i>	4,76	1,19	4,76	1,19	4,76	2,59	1,59	1,57
	398,40	100,00	401,53	100,00	184,12	100,00	101,59	100,00

Information : - = Not Found

The results of data analysis regarding the frequency and presence of soil macrofauna in Table 4 shows that 4 species of soil macrofauna were obtained, namely *P. corethrurus*, *Geophilus flavus*, *Vostax apicedentatus*, and *Solenopsis fugax* found in four generations with absolute, constant, accessory frequency values and accidental.

Earthworms from species *Pontoscolex corethrurus* are found with the frequency of absolute presence (very often). This shows that the species is a species that has a broad tolerance range to environmental conditions. *Pontoscolex corethrurus* is an earthworm species that has extensive adaptability and tolerance to various environmental conditions. In addition, it has the ability to consume soil with low quality organic matter [21]

Centipedes of the species *Geophilus flavus* were found with a frequency of absolute (often) presence in generation I, constant (often) in generation III, and accessories (rarely) in generation II and IV. *Geophilus flavus* is a species of the Chilopoda class. One of the soil macrofauna that plays a role in the ecosystem is Chilopoda, which generally has almost

the same role as other soil macrofauna as a decomposer. If the animal died it can provide additional soil and urine also plays a role in adding nutrients to the soil, as a bio-indicator of land and predators that play a role in the balance of an ecosystem [5].

Vostax apicedentatus (toothed earwig) species were found with a frequency of constant presence (often) in the location of the area of generation I and II gardens. It has a frequency of presence of accessories (rare) in Generation IV and frequency of accidental presence (very rare) in Generation III. The presence of a ticker from the *Vostax apicedentatus* species indicates that this species has a good adaptability to environmental conditions, a wide distribution in plantation areas, and a wide feed range (an omnivor toothed earwig). The species has a wide geographical distribution from temperate to tropical regions. The distribution of toothed earwing in Indonesia included Sumatra, Java, Sulawesi, Kalimantan, and Papua. Furthermore, the cocopets are commonly found in areas with high rainfall and humidity [10][27].

Table 4. Attandance Frequency and of Soil Macrofauna Species in Oil Palm PT. Socfindo Kebun Aek Loba

SPECIES	GENERATION							
	I		II		III		IV	
	AF (%)	Category	FA (%)	Category	AF (%)	Category	AF (%)	Category
1. <i>Pontoscolex corethrurus</i>	100,00	Absolute	100,00	Absolute	100,00	Absolute	100,00	Absolute
2. <i>Peryonix sp</i>	14,28	Accidental	-	-	-	-	-	-
3. <i>Pheretima sp. ???</i>	14,28	Accidental	-	-	42,86	Accessory	-	-
4. <i>Fridericia sp ???</i>	-	-	-	-	42,86	Accessory	-	-
5. <i>Tapinopa bilineata</i>	14,28	Accidental	-	-	-	-	-	-
6. <i>Pardosa amentata</i>	14,28	Accidental	-	-	-	-	-	-
7. <i>Pardosa glacialis</i>	14,28	Accidental	-	-	-	-	-	-
8. <i>Paraphrynus mexicanus</i>	14,28	Accidental	28,57	Accessory	-	-	14,28	Accidental
9. <i>Loxosceles laeta</i>	14,28	Accidental	-	-	-	-	-	-
10. <i>Loxosceles taino</i>	14,28	Accidental	-	-	-	-	-	-
11. <i>Geophilus flavus.</i>	85,71	Absolute	42,86	Accessory	71,43	Constant	28,57	Accessory
12. <i>Julusvirgatus</i>	-	-	-	-	14,28	Accidental	14,28	Accidental
13. <i>Polydesmus collaris</i>	-	-	-	-	-	-	14,28	Accidental
14. <i>Blatta orientalis</i>	71,43	Constant	57,14	Constant	-	-	14,28	Accidental
15. <i>Blattella germanica</i>	14,28	Accidental	-	-	-	-	-	-
16. <i>Calosoma scrutator</i>	14,28	Accidental	-	-	-	-	-	-
17. <i>Alphitophagus bifasciatus</i>	-	-	14,28	Accidental	-	-	14,28	Accidental
18. <i>Helops aereus</i>	-	-	14,28	Accidental	-	-	-	-
19. <i>Cyaneus angustus</i>	-	-	-	-	-	-	14,28	Accidental
20. <i>Alphitobius diaperinus</i>	-	-	57,14	Constant	-	-	14,28	Accidental
21. <i>Platypus wilsoni</i>	14,28	Accidental	-	-	-	-	-	-
22. <i>Dynastes granti</i>	-	-	28,57	Accessory	14,28	Accidental	-	-
23. <i>Loberus impressus</i>	-	-	14,28	Accidental	-	-	-	-
24. <i>Prinus ocellus</i>	14,28	Accidental	-	-	-	-	-	-
25. <i>Vostax apicedentatus</i>	57,14	Constant	57,14	Constant	14,28	Accidental	28,57	Accessory
26. <i>Syrphus vittafrons</i>	-	-	14,28	Accidental	-	-	-	-
27. <i>Odontoponera denticulata</i>	28,57	Accessory	100,00	Absolute	-	-	14,28	Accidental
28. <i>Oecophylla longinoda</i>	14,28	Accidental	-	-	28,57	Accessory	-	-
29. <i>Solenopsis fugax</i>	42,86	Accessory	42,86	Accessory	42,86	Accessory	14,28	Accidental

Information : 0 – 25 % = Accidental(very rare), 25 – 50 % = Accessory(rare), 50 – 75 % =Constant (often), > 75 % =Absolute (very often)

Black ants from the *Solenopsis fugax* species are found with the frequency of the presence of accessory (rare) in generation I, II, and III, and accidental (very rare) in generation IV. Although the presence of this species is not constant (often) or absolute (very often), this species was found in all four generations. This shows that the ants of the *Solenopsis fugax* species are quite suitable for living in this oil palm plantation location. According to Sandjaya (2008) ants are the most successful of all insect groups. These animals are everywhere in terrestrial habitats and are quite numerous.

3.3. Soil Macrofauna as Bioindicator

Soil macrofauna is highly dependent on the quality of the soil, so that the soil macrofauna can be

used as a bioindicator of soil quality. Soil macrofauna which has RD $\geq 10\%$ and AF $\geq 25\%$ or has the ability to live and breed properly are the bio-indicator used for soil quality. In the area of oil palm plantations of PT. Socfindo in Aek Loba obtained 3 species that can live and breed well (RD value $\geq 10\%$ and AF $\geq 25\%$), namely *P. corethrurus*, *Geophilus flavus*, and *Odontoponera denticulate* species. However, only the *P. corethrurus* species can be found in every generation from generation I to generation IV. Whereas, *Geophilus flavus* can only be found in generation III, and *Odontoponera denticulate* is only found in generation. The presence of *P. corethrurus* indicates that soil quality has high organic matter content II.



Figure 1. Soil macrofauna species as soil bio-indicator in the oil Palm Plantation Area of PT. Socfindo Kebun Aek Loba :A. *Pontoscolex corethrurus*, B. *Geophilus flavus*, C. *Odontoponera denticulate*.

4. Conclusion

There are 29 species of soil macrofauna which are grouped into 2 phyla, 3 classes, 11 orders, 21 families, and 27 genera. The highest density value is in the Generation II area of 401.53 ind/m² and the lowest density value is in the Generation IV area of 101.59 ind/m². Frequency of the presence of soil macrofauna in the four generations consists of 4 species, namely *Pontoscolex corethrurus*, *Geophilus flavus*, *Vostax apicedentatus*, and *Solenopsis fugax*. Soil macrofauna that act as bio-indicators in the Aek Loba garden area are *Pontoscolex corethrurus*, *Geophilus flavus*, and *Odontoponera denticulate*.

5. Suggestion

To get better result, it is recommended to conduct research in the dry and rainy seasons, as well as before and after applying fertilizers (inorganic and organic), as well as pesticides. To increase the presence of soil macrofauna which plays an important role in increasing soil fertility and maintaining the balance of soil ecosystems, organic fertilizer should be given regularly, at least once in 6 months.

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