Soil fauna diversity on the area with several treatments on the oil palm trunk

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Abstract. This study aimed to assess the fauna present on plantation land with various treatments of oil palm trunks after being cut. Treatments of oil palm trunks included (i) palm trunks left in the form of logs; (ii) oil palm trunks were chopped after being cut; and (iii) oil palm trunks were removed from the plantation area. Macrofauna sampling was done by the method of pitfall trap, squared and hand sorting. Mesofauna samples were taken using the Berlesse-Tullgren Funnel method. The results found a variety of macrofauna belonging to 2 phyla, 5 classes, 9 orders, 10 families and 10 species. The value of total macrofauna population density for the treatment palm trunks left in the form of logs was 5115.18 individuals m⁻², for chipping treatment was 8010.04 individuals m⁻², and for the treatment palm trunk removed was 2843.47 individuals m⁻². Mesofauna obtained in this study belonging to 1 phylum, 5 classes, 1 sub-class, 13 orders and 22 families. The total population density of the mesofauna family for the treatment palm trunks left in the form of logs was 1120 individuals m⁻², for chipping treatment was 1200 individuals m⁻², for logging treatment was 880 individuals m⁻².

1. Introduction
The area of oil palm plantations in North Sumatra province is ± 417,838 ha. About 4,343 ha of old plants that will be replanted [1]. Oil palm replanting is carried out after the plants are about 25 years old, by cutting old palm trees and placing them on plantation land. In 2016 researchers found that the community made protests against the plantations and accused the piles of oil palm trunks of causing increased attacks on pests and diseases on their farms. They hope that palm oil stems will be burned, but this is not possible if plantation want to get ISPO or RSPO certificates. Currently large private and state-owned plantations chop oil palm trunks using heavy equipment to reduce the size of palm oil stems. However for smallholders, oil palm trunks are left in the form of logs.

Some results of chemical analysis show that oil palm trunks contain large amounts of starch and sugar [2],[3]. Of all the parts of oil palm trees, starch and sugar are highest in the stem [4]. Theoretically, a total of 3.35 million tons of starch can be produced from 13.97 million tons of palm trunks which are cut down annually for replanting in Malaysia [5] [6]. However, in contrast to the extraction of starch from corn, wheat, cassava and potatoes, extraction of starch from oil palm stems is more difficult. This is caused by the oil palm starch stored in coarse vascular bundle parenchymal cells. This coarse vascular bundle contains a high percentage of lignin which inhibits damage and rupture of parenchymal cells [7]. Starch granules also fill the cavity between cells and help adhesion to the interface between fibers.
Returns of oil palm trunk into plantation area have a positive impact on increasing soil organic matter. The impact of increased soil organic matter is the increase of water retention. Currently, water availability is the biggest problem in agriculture and plantations. Moreover, the oil trunk will give nutrients for the next plant. On the other hand, the unproperly management palm trunk has the possibility of being a nest of pests and diseases. Anticipation will be made if an inventory of ecosystem changes is caused by the presence of oil palm trunks. Therefore, this study aims to assess the soil fauna present in the area around oil palm trunks from time to time in oil palm plantations due to the application of palm trunks that are chipped, non chipping compared to those without oil palm trunks.

2. Material and method

Research was conducted on Aek Pancur's oil palm plantation in Tanjung Morawa Village, Deli Serdang Regency, North Sumatra, that owned by the Indonesian Oil Palm Research institute, from May- November 2018.

2.1. Research Method

Palm trunks were treated in 3 ways: (i) replanting area with palm trunks left in the form of logs; (ii) replanting area with a chipping system; and (iii) oil palm trunk removed from replanting areas (without oil palm trunks). For the treatment of the clump system, replanting activities are carried out in a conventional manner where the subsequent fallen palm oil trunks are stacked in the area. While for the treatment of the chipping system, the old plant trunks chipped with a dimension of maximum thickness of 20 cm, while for replanting areas without old palm trunks, the oil palm trunks were removed from the replanting area or research area. 5 samples was taken from each treatment.

2.2. Implementation of Research

From each treatment, 5 sample areas were selected where the samples were taken by soil using soil corer in the trunk area that was collected without being chopped, donated and chopped, and without any treatment of palm oil stems. The time for taking fauna samples was in the morning (starting 6-9 AM) using a modified soil corer from PPKS with a diameter of 10 cm and the depth of the soil sampled was 10 cm from the ground. Observations were made 5 times in 3 months (observation 0 = before cutting; I = on July 10; II = on July 23; III = on August 3; IV=on July 30 and V= on September 18, 2018) with conditions of soil temperature (23.8 ± 0.36°C).

2.3. Macrofauna extraction

Method Sampling of active soil macrofauna at the surface of the soil was carried out using the Pitfall Trap method. Ten plastic buckets with a surface diameter of 15 cm placed and planted with a distance between one bucket and another ± 10 m at each treatment. Each plastic bucket was protected from rain and sunlight by providing a roof with a size of 30 × 30 cm as high as 15 cm from the ground. Then the bucket filled with a solution of 60% alcohol as much as 250 mL and was added with a few detergent solution. This Pitfall Trap bucket was installed at 8 AM and taken after 24 hours. Trapped soil macrofauna was put into sample bottles according to the plot and preserved with 60% alcohol [8]. The quadratic method was also used for sampling soil macrofauna which was less active on the ground but more active in the soil. Soil samples at each sampling point were taken as many as 8 plots using a 25x25 cm monolith squared device, the soil was taken to a depth of 30 cm. The distance between one square and another was ± 10 m. Soil macrofauna obtained by the hand sorting method was collected and cleaned with water and then put into a sample bottle containing 60% alcohol to be identified.
2.4. Mesofauna extraction
Extraction was done using the Barlese-Tullgren Funnel method [9]. The working principle of this method was that living soil mesofauna will be stimulated using heat from the lamp to leave the ground and fall into the collection bottle which was filled with 60% alcohol. Extraction was carried out at least 4 days until the soil was dry.

2.5. Mesofauna and Macrofauna observation parameters
The fauna obtained from extraction in a collection bottle containing 60% alcohol was then observed using a microscope to determine the type and population.

1. Population Density (PD) = \(\frac{\text{Number of type individuals}}{\text{(Number of plots} \times \text{plot area)}}\)
2. Relative Density (RD) = \(\frac{\text{Total density of all types}}{\text{Density of a type}}\) x 100%
3. Frequency of Attendance (FA) = \(\frac{\text{Number of plots occupied by a type}}{\text{Total plot number}}\) x 100%

3. Results

3.1. The presence of soil fauna on several management of oil palm oil trunk
The macrofauna obtained in the palm replanting area with the different management of the oil palm trunk, the palm trunks left in the form of logs treatment, chipping treatment, and removed treatment (without oil palm trunk) consisted of 2 phylums, 5 classes, 9 orders, 10 families, and 10 species. The macrofauna obtained at the time before palm tree cut was only 6 species. The number of species found in each treatment after cutting was 10 species (Table 1). In other words there was an increase in the population of soil macrofauna. Musca domestica was only found in chipping treatments. Earthworms that were not present before the palm cut, were present after the palm was cut down at the second observation (15 weeks after cutting).

The most common mesofauna in the oil palm area for all treatment of oil palm stems was Arthropods. It was acceptable because Arthropoda is the largest phylum of kingdom Animalia and is the most dominant animal in the world. The results of 5 observations within 3 months are mesofauna obtained included 1 phylum, 5 classes, 1 sub-class, 13 orders, and 22 families. Mesofauna before the palm tree was cut only consists of 2 families. However after cutting the number of families obtained at each treatment increased. This was because changes in the land cover affected the index of soil mesofauna populations (Table 2).

The Staphylinidae family (rove beetle) was a family of mesofauna which was always found in every observation that was carried out after the oil palm stem has been cut, from observations 4 days after cutting, 15 days after cutting, 42 days after cutting, and 61 days after cutting. The Staphylinidae family was not discovered before the palm tree was cut.
| Phylum & Class | Ordo | Family | Species | Treatment | Palm trunks left in the form of logs | Chipping palm trunk | Removed palm trunk |
|---------------|------|--------|---------|-----------|-------------------------------------|--------------------|-------------------|
| I. Arthropoda |      |        |         |           | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 2 | 3 | 4 |
| Insecta       |      |        |         |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1. Orthoptera | 1    | Gryllida| 1.Gryllus sp. |           |   |   |   |   |   |   |   |   |   |   | + | + | + | + | + | + | + | + | + | + |
| 2. Hymenoptera| 2    | Formicidae | 2.Odontoponera sp. |           |   |   |   |   |   |   |   |   |   | + | + | + | + | + | + | + | + | + | + |
| 3. Formicidae | 3    | Formicidae | 3.Solenopsis sp. |           |   |   |   |   |   |   |   |   |   | + | + | + | + | + | + | + | + | + | + |
| 3. Coleoptera | 4    | Curelioniidae | 4.Sitophilus oryzae |           | - | - | + | + | + | + | + | + | - | - | + | + | + | + |
| 4. Coleoptera | 4    | Curelioniidae | 5.Rhynchophorus ferrugineus |           | - | - | - | - | - | - | - | - | + | + | + | + |
| 5. Dermaptera | 6    | Forficulidae | 6.Forficula sp. |           | - | - | - | - | - | - | - | - | + | + | + | + |
| Arachnida     | 6    | Araneida | 7.Aranea sp. |           | - | + | + | + | + | + | + | + | - | - | + | + | + | + |
| Diplopoda     | 7    | Polydesmida | 8.Polydesmus sp. |           | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hexapoda      | 8    | Diptera | 9.Musca domestica |           | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| II. Annelida  |      |        |         |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Chaetopoda    | 9    | Oligochaeta | 10.Pontoscollex corethrurus |           | - | - | + | + | + | - | - | + | + | + | + | + |

Note: 0 = Before cutting (July 10, 2018), 1 = 4 days after felling (July 23, 2018), 2 = 15 days after cutting (August 3, 2018), 3 = 42 days after cutting (August 30, 2018); 4 = 61 days after cutting (September 18, 2018); (+) = present, (-) = absent.
Table 2. Soil Meso Fauna found in various treatments for oil palm trunks

| Class         | Sub Class | Ordo   | Family       | Treatment                                      |
|--------------|-----------|--------|--------------|-----------------------------------------------|
|              |           |        |              | Palm trunks left in the form of logs | Chipping palm trunk | Removed palm trunk |
|              |           |        |              | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 2 | 3 | 4 |
| 1. Arachnida | 1. Acari  | 1. Astigmata | 1. Acarida | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 2. Oribatida | 2. Phthiracarida | - | - | - | + | - | + | + | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           |         | 3. Eupthiracarida | - | + | + | - | - | - | - | + | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 4. Haplozetida | - | + | - | - | + | - | - | + | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 5. Poronoticae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2. Insecta   | 6. Coleoptera | 10. Nitidulida | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 7. Hemiptera | 12. Aradida | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              | 8. Hymenoptera | 13. Formicidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              | 9. Thysanoptera | 14. Thripidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3. Symphyla  | -         | -      | -            | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4. Entognatha | 10. Collembola | 16. Isotomidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 17. Entomobryidae | - | - | - | - | + | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 18. Onychiuridae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 19. Lepidocyrtidae | - | - | - | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              |           | 11. Diplura | 20. Anajapygidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|              | 12. Protura | 21. Eosentomidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5. Chilopoda | 13. Geophilomorpha | 22. Geophilidae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Note: 0 = Before cutting (July 10, 2018), 1 = 4 days after felly (July 23, 2018), 2 = 15 days after cutting (August 3, 2018), 3 = 42 days after cutting (August 30, 2018); 4 = 61 days after Cutting (September 18, 2018); (+) = present, (-) = absent
3.2. Population Density, Relative Density, and Frequency of Presence of Soil Fauna

3.2.1. Macrofauna
The highest value of total density (PD) was obtained from macrofauna in the treatment of chipping that was equal to 8010.04 ind m⁻², while the palm trunks left in the form of logs treatment obtained a total density of 5115.18 ind m⁻², and a decrease in the removed palm trunk treatment of 2843.47 ind m⁻² (Table 3). The highest value of PD in the palm trunks left in the form of logs treatment was the species Gryllus sp. (cricket) of 1326.96 ind m⁻² with a relative density (RD) of 25.94%, and attendance frequency (FA) of 100%. The lowest PD value in this treatment was the Polydesmus sp. (millipedes) and R. ferrugineus (sago beetle) amounting to 17.69 ind m⁻² with RD of 0.34%, and FA of 40% and 20% respectively. In the treatment of chipping, the highest PD value was in the species Odontoponera sp. (black ants) amounting to 1716.20 ind m⁻² with RD of 21.42% and FA of 100%, while the lowest value of K in this treatment was in the species Polydesmus sp. (millipedes) of 17.69 ind m⁻² with RD of 0.22%, and FA of 20%. The highest PD value in the removed palm trunk treatment was in the species Sitophilus sp. (rice lice) amounting to 1008.49 ind m⁻² with KR of 35.66%, and FA of 80%, while the lowest value of PD in this treatment was in the species Pheretima sp. (earthworm) of 32 ind m⁻² with KR of 1.13%, and FA of 60% (Table 3).

The frequency of the presence and constancy of the soil macrofauna in the palm trunks left in the form of logs treatment as an accidental soil macrofauna groups was found 1 species, 1 species was found as an accessory, 1 species was found as a constant, and 5 species were as an absolute. In the chipping treatment, macrofauna include as accidental constancy group was 2 species, none include a the accessory constancy group, 1 species include as a constant constancy, and absolute as many as 5 species. Soil macrofauna in the removed palm trunk treatment was found in 1 species, constant found as many as 1 species, absolute as many as 5 species, and accessories not found. Some species that dominate in all treatments as an absolute constants were Gryllus sp., Odontoponera sp., Salenopsis sp., Sitophilus sp., and Aranea sp (Table 3).

3.2.2. Mesofauna
The highest total density value of mesofauna was obtained from the chipping treatment 1200 ind m⁻², followed by the palm trunks left in the form of logs treatment 1120 ind m⁻², while the removed palm trunk treatment had the lowest total value of 880 ind m⁻² (Table 4).

The highest PD and RD values in the palm trunks left in the form of logs treatment were from the Euphthiracaridae and Staphylinidae families with a value of 200 ind m⁻² and 17.86%, while the lowest values in this treatment were obtained from the families Acaridae, Poronoticae, Tetragnathidae, Laridae, Entomobrydae, and Lepidocyrtidae with values 40 ind m⁻² and 3.57%. The highest PD and RD values in the chipping treatment were from the Phthiricaridae family and Staphylinidae with values of 160 ind m⁻² and 13.33%, while the lowest values in this treatment were obtained from families Phalangiidae, Isotomgidae, and Eosentomidae with 40 ind m⁻² and 3.33%. The highest PD and RD family values in the removed palm trunk treatment were from the Poronoticae family 200 ind m⁻² and 22.73%, while the lowest values in this treatment were obtained from the Phthiricaridae, Anajapygidae, and Geophilidae families 40 ind m⁻² and 4.55%.
Table 3. Population density, relative density, and frequency of presence and constancy of soil macrofauna in the treatment of oil palm trunks

| No | Family            | Palm trunks left in the form of logs | Chipping palm trunk | Removed palm trunk |
|----|-------------------|--------------------------------------|---------------------|---------------------|
|    |                   | PD (ind m⁻²) | RD (%) | FA (%) | constancy | PD (ind m⁻²) | RD (%) | FA (%) | constancy | PD (ind m⁻²) | RD (%) | FA (%) | constancy |
| MACROFAUNA |                      |            |        |        |           |            |        |        |           |            |        |        |           |
| 1  | *Gryllus* sp.     | 1326.97    | 25.94  | 100    | Absolute | 1079.26    | 13.47  | 100    | Absolute | 353.86     | 12.45  | 80     | Absolute |
| 2  | *Odontotomera* sp.| 1309.27    | 25.60  | 100    | Absolute | 1716.21    | 21.43  | 100    | Absolute | 831.56     | 29.24  | 100    | Absolute |
| 3  | *Salenopsis* sp.  | 796.18     | 15.57  | 80     | Absolute | 424.63     | 5.30   | 100    | Absolute | 247.69     | 8.71   | 80     | Absolute |
| 4  | *Sitophilus* sp.  | 1273.89    | 24.90  | 80     | Absolute | 4387.83    | 54.78  | 80     | Absolute | 1008.49    | 35.47  | 80     | Absolute |
| 5  | *R. ferrugineus*  | 17.69      | 0.35   | 20     | Accidental | 0         | 0      | 0      | 0         | 0         | 0      | 0      | 0         |
| 6  | *Forficula* sp.   | 0          | 0      | 0      | 0         | 0          | 0      | 0      | 0         | 0         | 0      | 0      | 0         |
| 7  | *Aranea* sp.      | 336.16     | 6.57   | 80     | Absolute | 247.69    | 3.09   | 80     | Absolute | 353.86     | 12.44  | 80     | Absolute |
| 8  | *Polydesmus* sp.  | 17.70      | 0.35   | 40     | Accessories | 17.69    | 0.22   | 20     | Accidental | 0         | 0      | 0      | 0         |
| 9  | *Musca domestica* | 0          | 0      | 0      | 0         | 35.39     | 0.44   | 20     | Accidental | 0         | 0      | 0      | 0         |
| 10 | *P. corethrurus*  | 37.33      | 0.73   | 60     | constant | 101.33    | 1.27   | 60     | constant | 32         | 1.13   | 60     | constant |

Population Density (ind m⁻²), RD = Relative Density (%), FA = Frequency of Attendance (%), Constancy = Nature of Macrofauna Existence, Accidental = Very Rare (FA Value 0-25%), Accessories = Rarely (FA value 25-50%), Constant = Frequent (FA 50-75% Value), Absolute = Very Often (FA Value > 75%)
Table 4. Population density, relative density, and frequency of attendance and constancy of soil mesofauna in the treatment of oil palm trunks

| No | Family       | Palm trunks left in the form of logs | Chipping palm trunk | Removed palm trunk |
|----|--------------|--------------------------------------|---------------------|-------------------|
|    |              | PD (ind $m^{-2}$) | RD (%) | FA (%) | constancy | PD (ind $m^{-2}$) | RD (%) | FA (%) | constancy | PD (ind $m^{-2}$) | RD (%) | FA (%) | constancy |
| 1  | Acaridae     | 40 | 3.57 | 20 | Accidental | 80 | 6.67 | 20 | Accidental | - | - | - |
| 2  | Phthiracaridae | 80 | 7.14 | 20 | Accidental | 160 | 13.33 | 40 | Accessories | 40 | 4.55 | 20 | Accidental |
| 3  | Euphthiracaridae | 200 | 17.86 | 20 | Accidental | 80 | 6.67 | 20 | Accidental | 80 | 9.09 | 40 | Accessories |
| 4  | Haploteridae | 80 | 7.14 | 40 | Accessories | 120 | 10 | 60 | constant | 80 | 9.09 | 20 | Accidental |
| 5  | Poronoticae | 40 | 3.57 | 20 | Accidental | - | - | - | - | 200 | 22.73 | 40 | Accessories |
| 6  | Lycosidae | 80 | 7.14 | 20 | Accidental | - | - | - | - | 80 | 9.09 | 40 | Accessories |
| 7  | Tetragnathidae | 40 | 3.57 | 20 | Accidental | - | - | - | - | - | - | - | - |
| 8  | Laridae | 40 | 3.57 | 20 | Accidental | - | - | - | - | - | - | - | - |
| 9  | Phalangidae | 40 | 3.33 | 20 | Accidental | - | - | - | - | - | - | - | - |
| 10 | Nitidulidae | 80 | 6.67 | 20 | Accidental | - | - | - | - | - | - | - | - |
| 11 | Staphylinidae | 200 | 17.86 | 80 | Absolute | 160 | 13.33 | 60 | constant | 80 | 9.09 | 20 | Accidental |
| 12 | Aradidae | 120 | 10.71 | 20 | Accidental | - | - | - | - | - | - | - | - |
| 13 | Formicidae | - | - | - | - | 240 | 20 | 60 | Konstan | - | - | - | - |
| 14 | Thripidae | - | - | - | - | 40 | 3.33 | 20 | Accidental | - | - | - | - |
| 15 | Scutigerellidae | 120 | 10.71 | 20 | Accidental | - | - | - | - | - | - | - | - |
| 16 | Isotomidae | - | - | - | - | 40 | 3.33 | 20 | Accidental | 80 | 9.09 | 20 | Accidental |
| 17 | Entomobryidae | 40 | 3.57 | 20 | Accidental | 80 | 6.67 | 40 | Accessories | 80 | 9.09 | 40 | Accessories |
| 18 | Onychiuridae | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | Lepidocyrtidae | 40 | 3.57 | 20 | Accidental | - | - | - | - | - | - | - | - |
| 20 | Anajapygidae | - | - | - | - | 40 | 3.33 | 20 | Accidental | 40 | 4.55 | 20 | Accidental |
| 21 | Eosentomidae | - | - | - | - | 40 | 3.33 | 20 | Accidental | - | - | - | - |
| 22 | Geophilidae | - | - | - | - | - | - | - | - | - | - | - | - |

Note: PD = Population Density (Ind $m^{-2}$), RD = Relative Density (%), FA = Frequency of Attendance (%), Constancy = Nature of Mesofauna Existence, Accessories = Rarely (FA value 25-50%), Constant = Frequent (FA 50-75% Value), Absolute = Very Often (FA Value> 75%).

Total 1120 100 1200 100 880 100

Accessories = Rarely (FA value 25-50%), Constant = Frequent (FA 50-75% Value), Absolute = Very Often (FA Value> 75%).
Based on data of the frequency of attendance (FA) and mesofauna constituents during the five observations, that in the palm trunks left in the form of logs treatment accidental mesofauna groups were found in 11 families, the absolute only 1 family were found and none without a constant constancy (Table 4). In the treatment of chipping, the soil mesofauna include in the accidental group, there were 6 families, accessories and constant as many as 2 families and none family was included in absolute constancy. Soil mesofauna at the removed palm trunk treatment of soil mesofauna insert as accidental groups consist of 8 families, and as many as 4 families were assessed as a constant and absolute family.

From a total of 22 soil mesofauna families found in the three treatments for five observations, there were 5 soil mesofauna families that could live and develop well in an area that had a RD value of ≥ 10% and FA ≥ 25%, they were Phthiracaridae, Haplozetidae, Poronoticae, Staphylinidae, and Formicidae. However, none of the soil mesofauna families can live and develop well in all treatment of oil palm trunks after being cut. Only the family of Staphylinidae was capable of living and developing well in two areas, at palm trunks left in the form of logs treatment area and at the area where palm trunk chipped. While the other 4 families are Phthiracaridae, Haplozetidae, and Formicidae in the area treated only by chipping, and the Poronoticae family can live and developed well in areas without oil palm trunks only. Of the five mesofauna families that have RD values ≥ 10% and FA ≥ 25%, three of them come from the Acari (tungau) sub-class and the Oribatida order. The three families are Phthiracaridae, Haplozetidae, and Poronoticae. The total KR value of the three families reached 46.06%.

3.3. Discussion

Arthropods, the most abundant fauna obtained in this study, was the largest phylum of Kingdom Animalia and is the most dominant fauna in the world [10]. The high number of the total macrofauna population density at the chipped palm trunk treatment is caused by the presence of small oil palm trunks as a source of nutrition or food ingredients for several species that live around the area of oil palm plantations. The effect of reduced size of palm trunk is exposure of nutrients such as starch and sugar that naturally are inside of palm trunk to soil for consumption of macrofauna. Moreover, the chipped of palm oil trunk might be able to modify soil characteristics. The physical and chemical factors of the soil such as humidity, soil temperature, pH, soil water content, C-organic, are better and the conditions are more suitable compared to other treatments. This is because the life of soil fauna is also related and interacts with other factors, such as the physical and chemical factors of the environment in which they live. The existence of this interaction greatly determines the spread and density of the fauna [11]. *M. domestica* species are keen on habitats that have many sources of nutrition. Therefore, the chipping treatment was found more than the palm trunks left in the form of logs treatment and the palm trunks removed treatment. The food consumed also affects the number and development of fly eggs. The more food and nutrients contained, the faster and bigger the population [12].

Polydesmus sp. put into a accessory (rare) constancy in the palm trunks left in the form of logs treatment and as an accidental (very rare) in chipping treatment, while in the palm trunks removed treatment this species was not found. This indicates a decrease in the frequency of attendance due to disruption of activities from macrofauna activities due to the changing physical chemical properties of the soil.

*Rhynchophorus ferrugineus* was put as an accidental in the palm trunks left in the form of logs treatment and in other treatments this species was not found. It is presumed that this species lives and breeds on intact oil palm trunks. This species also lives on piles of coconut stems, dead coconut plants that are still standing, and rotten piles of wood. It is the most harmful among other known palm pests, because the infestations are often not detected until the fronds wilt and the crown collapses suddenly by which time the tree is beyond recovery [13]. The late detection of red palm weevil infestations constitutes a serious problem in the fight against this lethal pest of coconut palms.

Forficula sp. were accidental (rare) found in the palm trunks removed treatment, not found in the palm trunks left in the form of logs treatment and in chipping treatment. This species likes habitats that have high humidity. Forficula sp. generally moves in the afternoon with 60-
80% humidity range. Other environmental factors such as temperature and light intensity also influence its diversity.

Species of *Odontoponera* sp. is a characteristic soil macrofauna in almost all treatments because it has an abundant amount and broad tolerance to environmental conditions so that it can live and develop well in these treatment locations. This result is similar to the opinion which states that the Fomicidae family includes *Odontoponera* sp. generally has a broad tolerance range in the neighborhood where it is spread so widely (cosmopolitan)[14]. This shows that the species *Odontoponera* sp. is more commonly found in disturbed habitats such as yards, gardens and agricultural areas.

Sitophilus sp. in the chipping treatment has population density (PD) values 54.77% and frequency of attendance (FA) 80% and its PD and FA value in the palm trunks removed treatment was 35.66% and 80% respectively. Sitophilus sp. can live and develop in almost every treatment, this shows that fire ants are almost tolerant in every environment and have a wide spread. The ability of soil fauna including soil macrofauna to live and develop well in a habitat is largely determined by the physical, chemical, and biological conditions of the soil as well as the availability of food needed [15]. In mesophones, the dominance of the family Staphylinidae is always obtained at four times sampling after overgrowing because the family Staphylinidae (rove beetle) comes from the order Coleoptera which is a decomposer Arthropod. Decomposer arthropods are very useful in existing food web processes, so their existence is very important in an ecosystem [16].

The Entognatha class includes three orders, namely Protura, Diplura, and Collembola (spring tail) which mostly live in the soil, and act as eaters of organic matter (detritivores). Therefore, their existence in the environment is very beneficial. Collembola is the most common family order found in this study. Collembola is a large role animal. Collembola's role includes the remodeling of organic matter, fungal eaters, indicators of changes in soil conditions, and predators [17]. Symphylla is a fast runner. They are mainly herbivores and detritus eaters that live deep in the ground, under rocks, in decaying wood, and in other humid places. Symphylan gardens, *Scutigerella immaculata* can become plant pests [18].

The difference in the treatment of oil palm trunks on the new planting area creates differences in the types and populations of soil fauna. Thus, the inventory of soil animals on land that are often given organic material is compulsory, in order to anticipate the detrimental fauna population explosion in oil palm plantation area.

4. Conclusions

There were variety of macrofauna belonging to 2 phyla, 5 classes, 9 orders, 10 families and 10 species. The value of total macrofauna population density for the treatment palm trunks left in the form of logs was 5115.18 individuals m$^{-2}$, for chipping treatment was 8010.04 individuals m$^{-2}$, and a for the treatment palm trunk removed was 2843.47 individuals m$^{-2}$. Mesofauna obtained in this study belonging to 1 phylum, 5 classes, 1 sub-class, 13 orders and 22 families. The total population density of the mesofauna family for the treatment palm trunks left in the form of logs was 1120 individuals m$^{-2}$, for chipping treatment was 1200 individuals m$^{-2}$, for logging treatment was 880 individuals m$^{-2}$.

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