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CHANGES OF SOIL FAUNA DIVERSITY IN SEVERAL TYPES OF SUPER WET TROPICAL RAIN FOREST AREA

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Abstract

Land type changes in the super wet tropical rain forest area caused fluctuations in the diversity of soil fauna which caused disruption of ecosystem balance. This research was conducted for four months, in November 2017-February 2018. Data on soil fauna was taken using pitfall traps and hand sorting. Furthermore, the soil fauna data obtained were identified and calculated the value of the diversity index, evenness and dominance on each type of land for four months. The results showed that forests had a high diversity index of soil fauna, which were 3,134, 3,313 and 3,314 in the first to the third month. While in the 4th month the forest diversity index decreased to 2,981. In open land, the soil fauna diversity index value is moderate, which is 2.631, 2.998, 2.782 and the diversity index increases in the fourth month, is 3.084. Mixed gardens have a value of the fauna diversity index of 2,728, 3,113, 2,870 and increased in the fourth month of 3,084. Whereas monoculture gardens have diversity index values of 2,527, 3,214, 2,935 and 2,927. Changes in land types of super wet tropical rainforests have an effect on changes in the level of diversity of soil fauna and not always these changes reduce the level of diversity of soil fauna.

Keywords: Soil Fauna; Diversity; Land Use; Tropical; Decrease; Monoculture.

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1. Introduction

Super wet tropical rainforest has no real dry season which has a higher rainfall (6500 mm/per year) which has many types of soil fauna as an important agent of controlling ecosystems [1]. This component has a role in doing energy flow process in a field. Besides, soil fauna has a role in doing decomposition on litter and dead animal, repairing soil structure through density, increased pose space, aeration and microbial spread [2].

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Soil fauna diversity of a field has a characteristic of quality of an ecosystem, because this group is very sensitive towards environment change [3]. On a proper environment, it will appear the higher soil fauna diversity and vice versa. For their activities, soil fauna group acquire certain requirements related to the situation of its environment. Therefore, a forest has become a good habitat for the most of soil fauna. And also, forest has prepared some requirements for soil fauna for their existence [4].

Some type usage of fields on pinang-pinang super wet tropical rainforest are natural forest, open field, mixed farm and monoculture farm. Type usage of its field can affect increasing, decreasing and also losing soil fauna biodiversity in there. Natural ecosystem on a field is as a home for the most of soil fauna [5]. Meanwhile, ecosystem on a field which has many variated levels of vegetation, it can affect higher level of soil fauna diversity. On the contrary, fewer the type of field which has diversity of vegetation, lower the level of soil fauna diversity [6].

The soil fauna diversity on maintain quality of an ecosystem of an environment in an agriculture is crucial. The soil fauna has an important role in sustaining the cycle of carbon on terrestrial ecosystem. It still lacks of soil fauna identification on farming area, especially on monoculture farm and mixed farm, and also its open field as a transmission area and natural forest in super wet tropical rainforest, which affects the intensive process towards soil fauna diversity.

The change type of natural forest has become many types of field usage that also affects the change of soil fauna diversity. The change of its diversity, of course, will appear how the condition of soil ecology system on every type of its field. Considering the limitation of its field, the information of soil fauna diversity on some type of super wet tropical rainforest achieved, so that it will acquire the research of the change of soil fauna diversity on some type of super wet tropical rainforest in Padang.

2. Materials and Methods

This research has done for 4 months, it started from November 2017 until February 2018. The research sample was received in 4 different fields, there are: natural forest, open field, mixed farm and monoculture farm in super wet tropical rainforest in Pinang-Pinang. Ulu Gadut, Padang, West Sumatra (Fig.1). The area extended 460-550 m asl. This area is at coordinates 100o 29’40” and 100o30’20” E and is between 0o54’55” and 0o 55’45” S. This area has a wet tropical (Monsoon) climate with an average annual temperature of 27oC and relative humidity of 73% -80%.

Meanwhile Collecting, Identifying and Analysing data has done in Laboratory of Insect Ecology, Faculty of Agriculture, Andalas University. The equipment which is used in this research are the field equipment such as, writing tools, label, machete, cup of glass, propylin glycol, mica plate, wood chopsticks and rope. While the equipment which is used in the laboratory are alcohol 96%, soil fauna identification book, petri dish, millimetre blog, camera, paintbrush, secondary lighting lamp, microscope, tweezers and 100cc V-pot collection tube.

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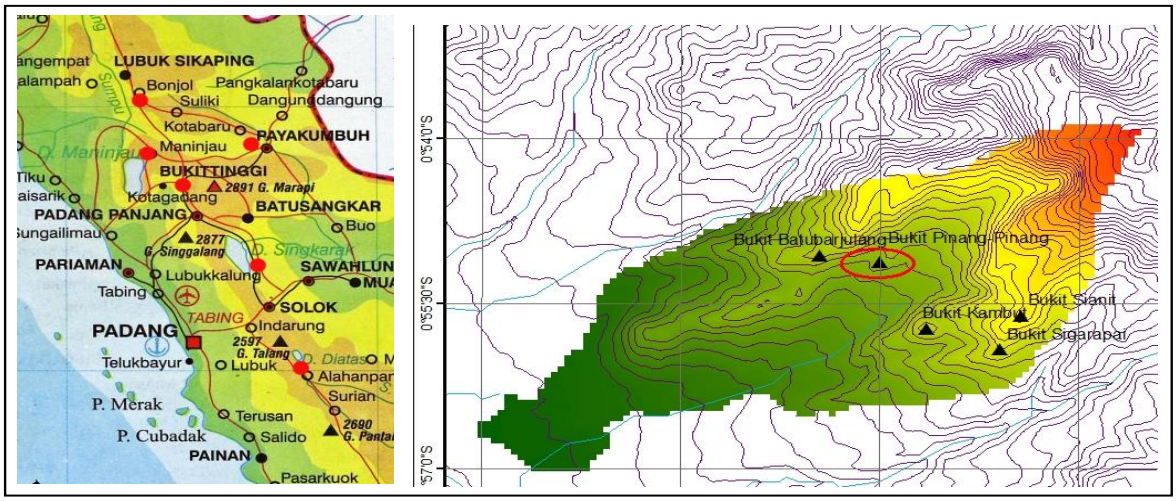

Figure 1: Location of study area Pinang-Pinang, Ulu Gadut, West Sumatera Indonesia

Determining the sample retrieved point has been done using purposive random sampling method which based on each (toposequence) on each type of super wet tropical rainforest field in pinang-pinang. Each toposequence are determined by using 4 plot sample retrieving point, where each plot has 40 x 40 m sample retrieved width. Then, the sample retrieved method are used pitfall trap with using prophylin glycol and hand sorting for 4 months. next, the researcher brings the soil fauna to the laboratory for being collected, identified and analysed. And then, the collection of soil fauna was put in the 100cc V-pot collection tube with alcohol 96%. Each tube was placed the retrieved location label. Each soil fauna in the collection tube identified using microscope with using Borror identification book 7th edition, Insects Identification of Australia, Taxonomy Web and Bug Guide. The Identified Soil Fauna determined the diversity index on each type of super wet tropical rainforest field. Besides, it determined to measure average index, evenness index and domination of soil fauna on some type of field usage in Pinang-Pinang valley of super wet tropical rainforest.

3. Results and Discussions

3.1. Abundance of Soil Fauna

The result of research shows that amount of individual soil fauna for 4 types of super wet tropical rainforest field which are get by using pitfall trap and hand sorting method are 3225, which is categorised into 4 phylum, 12 classes, 26 orders, 132 families and 290 morphospecies (Table 1). Type of forest field has the highest quantities of order rather than other type of field on the 1st month, there are 15 orders. On the 2nd month, type of mixed farm has the same quantity of order in the type of forest field, there are 12 orders. On the 3rd and 4th month, the highest overflowed soil fauna in the level of order is in the type of forest field, there are 14 and 13 orders of soil fauna. Open field and monoculture farm have the lowest order rather than the other ones, there are 11 and 12 orders of soil fauna on the 1st month, 10 and 11 orders on the 2nd month, 10 and 9 orders on the 3rd month, and 10 and 12 orders on the 4th month. Even in the type of mixed farm has quite s Table 1, there are 12, 12, 11 and 12 orders of soil fauna from the 1st month until the 4th month. Besides, the amount of individual and level of soil fauna's species and families are the highest on a forest for every month. The open field and monoculture farm have the amount of individual and

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level of soil fauna's species and families is same on the open field. Therefore, the forest is the natural habitat for soil fauna which has many facilities for supporting activity and existence of the soil faunas.

From the group of some orders which has been identified, Hymenoptera, Coleoptera, Collembola and Orthoptera are the most soil fauna groups which has been found on the 4 types of field for 4 months. By the 4 orders above, the overflowed of Hymenoptera has the highest value of overflowed soil fauna. Almost every month, Hymenoptera can be found in 4 types of super wet tropical rainforest with the highest quantity of them, especially from the Formicidae family. According to [7] Hymenoptera is the soil fauna which has spread in every forest. Besides, based on the most of Hymenoptera, it has the regular for both their social structure and their existence. Meanwhile the order of Isoptera, Phasmatodea, Julida, Pscoptera, Mollusca and Chordata have the lowest overflowed soil fauna for 4 months (Table 2). It is caused that the lower group of their orders which is found in a field. Therefore, their existence shows that its field is not the proper habitat for them. Besides, their threat towards the populations of soil fauna are getting decreased every year. The food availability is the main aspects in the overflowed soil fauna. Table 1 shows that the amount of individual, species, family, order and filum of soil fauna for the 4 types of super wet tropical rainforest in Pinang-Pinang.

Table 1: The number of phylum, class, order, family, morphospecies and individual of soil fauna on four types of fields of the super wet tropical rainforest of Pinang-Pinang. 1st month: November 2017, 2nd month: December 2017, 3rd month: January 2018, 4th month: February 2018

No	Month	Classifies	Natural Forest	Open Field	Mixed Farm	Monoculture Farm
1.	1st month	Phylum	3	1	2	2
		Class	8	5	6	6
		Order	15	11	12	12
		Family	46	30	34	32
		Morphospecies	70	41	50	44
		Individual	307	190	307	254
2.	2nd month	Phylum	1	1	2	2
		Class	4	4	5	5
		Order	11	10	12	11
		Family	31	27	35	26
		Morphospecies	53	39	50	39
		Individual	195	130	136	111
3.	3rd month	Phylum	2	2	2	2
		Class	7	5	6	5
		Order	13	10	12	9
		Family	37	25	26	25
		Morphospecies	61	40	41	37
		Individual	211	200	183	130
4.	4th month	Phylum	2	2	2	2
		Class	5	6	5	5
		Order	12	10	11	12
		Family	36	23	32	24
		Morphospecies	64	44	56	39
		Individual	335	168	227	141

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Table 2: Abundance of soil fauna on four types of fields of the super wet tropic rainforest of Pinang-Pinang

No	Order	Abudance of soil fauna /month															
		Natural Forest				Open Field				Mixed Farm				Monoculture Farm			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Araneae	22	2	13	9	11	2	4	10	24	7	4	15	2	4	5	6
2	Acarina	0	0	4	2	1	3	2	-	2	1	3	1	2	4	3	-
3	Blattodea	4	1	5	2	-	-	-	-	-	-	-	1	-	-	-	-
4	Coleoptera	13	44	31	25	6	27	28	16	4	13	23	18	10	16	13	12
5	Dermaptera	2	4	1	8	-	-	-	9	-	1	-	-	-	1	-	3
6	Diptera	9	7	17	7	3	13	4	4	13	7	9	9	15	8	16	5
7	Hemiptera	2	3	0	4	3	1	2	-	5	2	-	2	1	-	-	1
8	Hymenoptera	198	101	114	241	142	73	130	106	198	80	110	123	197	57	73	93
9	Phasmatodea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
10	Isoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
11	Lepidoptera	1	-	-	-	1	-	-	-	-	1	1	-	2	-	-	1
12	Orthoptera	23	14	7	10	8	6	4	7	23	7	4	10	15	10	11	5
13	Psocoptera	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-
14	Julida	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
15	Polydesmida	-	-	1	-	-	1	-	-	3	1	-	-	1	1	-	-
16	Geophilomorpha	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-
17	Scolopendromorpha	2	-	1	1	-	-	-	1	-	-	1	-	1	-	-	-
18	Decapoda	-	-	-	1	1	-	-	-	-	-	-	1	-	-	-	-
19	Isopoda	13	3	4	-	-	-	-	-	4	-	3	1	-	-	1	1
20	Collembola	15	16	11	24	9	2	6	12	22	13	5	12	6	8	2	8
21	Megadrilacea	-	-	-	2	-	-	-	1	7	3	20	32	2	2	7	5
22	Anura	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	Rodentia	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Squamata	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Plamorbioidea	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2 shows that in the type of forest (for 4 months), there are not found some individual of soil fauna which is come from order's of Phasmatodea, Isoptera, Julida and Geophilomorpha. Their group are characterised as temporal in the research field. The width of type of research field with the litter condition which is spread all over it, it can open up the habitat which is quite spread for soil fauna. According to [8] the fewer soil fauna or almost none of it on some period in that area shows that it is not the proper habitat for them, if there has found some of soil fauna on the small amount for any period, it showed that the fauna is characterized as temporal towards that research field.

On the Table 2, there are some order's which is not found on open field. There are Plamorbioidea, Squamata, Anura, Rodentia, Balltodea, Isopoda, Pscoptera, Isoptera dan Phasmatodea. The types of their orders are order of soil fauna which are important in existing the function of ecosystem in a field. Many groups of any order's which is not found in this field because there is few vegetation on it which affect the few soils organic supply. Based on [9], the soil organic supply is much determined the existence of Soil Fauna Population. And also, it has the role as the Subtract for the most of soil fauna groups. The overflowed soil fauna is determined by the soil organic supply availability, where this organic created from the overflowed litter which fell to the surface. So that, when there are many litters falling to the surface, it shows that many vegetations grow above it. On the contrary, if there are few vegetations in an area, it will decrease the soil organic supply created, so that, the overflowed of soil is decreasing too. According to [10], the top vegetation can supply stage cover which can maintain fluctuation of temperature and humidity, and also it can share the main litter in increasing the soil fertility. Physically, the top litter vegetations can protect

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the surface from raindrop plants, while it can chemically increase the C-Organic, supply nitrogen, and phosphor. The diversity of vegetation is determined towards the cycle of carbon and the increasing soil fauna biodiversity [11] [12] [13].

On the type of mixed farm (Table 2), there are some order's which are not found in the research location, such as Phasmatodea, Isoptera, Julida, Geophilomorpha, Anura, Rodentia, Squamata and Plamorbioidea. Many order's which are not found in it caused the effect of herbicide and fertilizer which is used by the farmer for maintaining the beneficial effort of plant. In fact, it shows as same as the overflowed soil fauna in monoculture farm. In this type of field, many soil fauna order's' groups are not found, such as Anura, Rodentia, Squamata, Plamorbioidea, Julida, Decapoda, Geophilomorpha and Psocoptera. So that, we can conclude that the effect of giving chemical incentive to the beneficial effort of plant environment will affect and also vanish the existence of some soil fauna groups. Based on [14] the chemical which is used for maintaining the beneficial of plant will affect negative impact to the overflowed soil fauna. The chemical can affect some environmental problem, one of them is to decrease the overflowed soil fauna and also to bias which can cause the extinction of a type of soil fauna.

The overflowed soil fauna on some types of super wet tropical rainforest field shows that the soil fauna group are fond of forest as their natural habitat than other types of fields (Table 2). The litter and the grass on the super wet tropical rainforest ground give the proper space for the existence of the soil fauna. So that, the perpetuation and maintaining to the forest should be bone for protecting the overflowed soil fauna.

Diversity of Soil Fauna

Table 3 shows that the level of diversity, average and domination of soil fauna on some types of super wet tropical rainforest in Pinang-Pinang. Natural habitat is the best habitat for most of the soil fauna. The soil fauna diversity index on the 1st month until the 3rd month on the type of natural forest is increasing, there are 3.134, 3.313 and 3.314. it shows that forest is as their natural habitat of the soil fauna, it can supply other habitat which is sui Table for the soil fauna's daily life. With the diversity of vegetation which grows in the natural forest and the litter which falls on the forest ground, it can cause the increase of the soil fauna diversity which exist in that field. This has been supported from [15] that the diversity of dynamic population of soil fauna can be caused by the heterogeneity of vegetation of that field. And then [16] argues that soil fauna is the main component from an ecosystem of an area with higher level of diversity. In fact, natural forest can facilitate movement and existence space for the most of soil fauna. But on the 4th month, the index of soil fauna diversity in the forest is decreased (2.891) and it become the lowest index of soil fauna diversity among other types of fields. This can be showed that the soil fauna mobilization on the type of forest is more active than other types of field. The ability of forest supplies source of nutrition and the variation of their habitat, it can affect the soil fauna group which has the width movement space distance and shrunken the limit factor. According to [17] soil fauna distributions in a proper area by the organic supply existence because it can supply many sources of food, so that soil fauna is not determined on an area.

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Table 3: Diversity index, Evenness dan dominance soil fauna at super wet tropical rainforest Padang, Ulu Gadut,

No	Month	Parameter	Forest	Open Field	Mixed Farm	Monoculture
1.	1st month	Diversity Index	3.134	2.631	2.728	2.527
		Evenness	0.552	0.464	0.481	0.445
		H'Max	5.673	5.673	5.673	5.673
		Dominance	0.105	0.145	0.168	0.159
2.	2nd month	Diversity Index	3.313	2.998	3.113	3.214
		Evenness	0.584	0.528	0.549	0.566
		H'Max	5.673	5.673	5.673	5.673
		Dominance	0.063	0.089	0.099	0.069
3.	3rd month	Diversity Index	3.314	2.782	2.870	2.935
		Evenness	0.584	0.490	0.506	0.517
		H'Max	5.673	5.673	5.673	5.673
		Dominance	0.068	0.103	0.109	0.089
4.	4th month	Diversity Index	2.891	3.084	3.183	2.927
		Evenness	0.509	0.544	0.561	0.516
		H'Max	5.673	5.673	5.673	5.673
		Dominance	0.138	0.073	0.069	0.090

The type of open field has the tendency of soil fauna diversity which increase from the 1st month until the 4th month, there are: 2.631, 2.998, 2.782, 3.084. growing the bottom vegetation such as grass, bushes and (weeds) on the 4th month increasing the soil fauna diversity. The increasing fluctuation of the index of soil fauna diversity on the open field shows that tree vegetation is not only a reason of soil fauna diversity. Based on [18], having a change of forest field usage become an open field through agriculture area can be caused by vanishing biodiversity than the natural ecosystem. Next, [19] argues that weeds or the grass which grow on an area to increase soil fauna diversity. The grass or weeds on an area can create micro season which is suiTable with the existence of the soil fauna activity.

The index of soil fauna diversity can also fell fluctuation on the type of farm field, both on the mixed farm and on the monoculture farm. The mixed farm has index value of soil fauna diversity: 2.527, 3.214, 2.935 and 2.927. the mixed and monoculture farm have almost same from the management of farm field, but monoculture farm is more intensive in using chemical in maintaining beneficial plant. According to [20], maintaining the beneficial plant management with using chemicals can decrease the ecosystem of soil fauna diversity on the tropical area. Next, [21] stated that the incoming chemicals in the ground can decrease the amount and composition of soil fauna, also if it continues without any significant control, it will cause the extinction for one of soil fauna group.

Instead of the index of soil fauna diversity, Table 3 also shows that level of average and domination of soil fauna on some types of super wet tropical rainforest field. The parameter level of soil fauna average is different comparable with the soil fauna domination in a field. Type of forest field has the highest average value with almost every month than other type of fields. The average value of soil fauna on the type of forest is 0.509-0.584, which means that the average level of soil fauna in

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that field is in the middle. The type of the open field has 0.464-0.544 average level, which means that its level is in the middle too. Type of mixed farm has 0.481-0.561 and the type of monoculture farm has 0.446-.556 average level which means that the average level of soil fauna on the type of farm area is in the middle. [22] stated that the 0.4 average level < average value < 0.6, it means that the soil fauna average in an area is in the middle. Next, [23] stated that the average level of soil fauna in an area was determined from the amount of the same individual or species, where it will reach maximum value if all individuals which is found can act as homogeny. Generally, Individual homogeneity in an area determined by environment homogeneity.

The dominations show that the most amount of a species from an individual which lives there. The domination value of the soil fauna is different comparable than the average value, where the average will decrease if domination value increase and vice versa. The highest average value from the all type of field is from the mixed farm, where Hymenoptera, especially from ordo of Formicidae, shows that the dominant amount is compared with other amount of types of soil fauna. Ants are the general term for the family of Formicidae and most of them are from the group of Hymenoptera. And also, they are the soil fauna groups which has found in all types of super wet tropical rainforest field. They have social life with the strong strata level, so that they can survive in every tropical rainforest. According to [24], they give the symbiotes with many insects, plants and fungi. This symbiotes is giving any advantages and taking variations of forms. Without giving symbiotes with them, their organism will decrease their population until reaching extinction.

4. Conclusions

The change of natural forest usage on the super wet tropical rainforest in Pinang-Pinang decreased the overflowed and the level of soil fauna diversity, open field with the lowest level of vegetation field has shrunken the soil fauna movement space. While mixed farm and monoculture farm with the system of maintaining management of beneficial plant which is relatively intensive will increase the existence line of soil fauna in that area. But for the space factor, which means that how long a field is leaving it alone without organizing and maintaining, and also homogeny and few top vegetations in an area, it will cause dominations on the bottom vegetations on that area which create micro season which is suiTable for their activities and growth for the most of the soil fauna.

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