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THE FAMILY DIVERSITY OF SOIL ARTHROPODS IN NEWLY RECLAIMED COAL MINED LAND IN CENTRAL BENGKULU

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ABSTRACT

Coal strip mining destroyed forest ecosystem and converted into barren land. Mined land reclamation is aimed at restoring the original ecosystem. Community structure and species composition are some of ecosystems to be considered in mined land reclamation. Over time, plant and animal species compositions in reclaimed mined land are expected to approach the original ones. The objective of this study were to determine the family diversity of soil surface arthropods in recently reclaimed coal mined land and compare it with that of natural forest nearby. Results showed that each mined site had between 9 to 14 families of Arthropods, while the natural forest had only 7 families.The Simpson's Index of Diversity in natural forest was 0.67, slightly higher than the mined sites, which were between 0.57 to 0.64. The Jaccard Index of Similarity between mined sites and natural forest Arthropods was low, between 20.0 to 25.0 percent.

Keywords: coal mined, Arthropods, biodiversity

INTRODUCTION

Coal strip mining has drastically altered the ecosystem. A previously forested area is turned to bare land after mining. During the mining, geological material lying deep under the soil was brought to the surface. This material which will of aluminum, iron, zinc, and copper (Rahim, 2000). Mined land has low organic matter and soil organisms (Gould and Liberta, 1981).

After mining, it is necessary for the mining company to restore the mined land. Mined land restoration is often considered as ecosystem reconstruction, and there is a need to set goals, objective and criteria to determine the success of restoration (Cooke and Johnson, 2002). Community structure and species composition are some of ecosystems characteristics to be considered as the objective of restoration. Over time, not only plant, but also animal species composition is expected to approach that of the original ecosystem.

One group of animals, soil surface Arthropods, play significant role in organic matter decomposition which in turn will improve soil fertility. The objective of this study were to determine diversity of soil surface arthropods in become the main components of main soil after mining generally has low fertility (Munawar, 2003). The use of heavy machinery during land reclamation causes soil compaction, reducing soil fertility, permeability and water holding capacity (Bussler, *et al.* 1984). Often, coal mined land is highly acidic, resulting in high solubility newly reclaimed mined land and compare it with that of natural forest nearby.

MATERIALS AND METHODS

Sites

The research was done in 2001, in newly reclaimed mined soil in Central Bengkulu. Sampling of arthropod was done in the mined area having different ages of vegetation, namely 7 years, 6 years, 5 years and 4 years. The vegetation was composed of legume trees, *Paraserianthes falcataria* and *Acacia mangium*. In addition, sampling was also done in natural forest nearby for comparison.

Data collection

The soil arthropods were collected using trap method. Plastic cups, 7 cm in diameter and 10 cm in height, were submerged in the soil so that the mouths of the cups were at the same level of the

soil surface. Each cup was filled with 100 milliliters of dilute formaldehyde solution (4% in concentration). A plastic cover sizing 20 x 20m cm was placed 15 cm above each trap to prevent rain entering the cup. The traps were placed systematically, 5 x 5 m, in 10% of each area. After four days, the traps were collected and the animals were identified (Lilies, 1992; Suin, 1989).

Data analyses

To determine whether the number of traps was sufficient, a curve showing the relation of family number and trap number was drawn for each area. If the graph showed a flat line, then the number of traps was considered sufficient.

The diversty of families were determined using the number of families and Simpon's diversity index (Wiryono, 2009).

Simpson's Diversity index (Ds),

$$Ds = 1 - \sum_{i=1}^{s} (pi)^2$$

Where $pi = \frac{ni}{N}$ (the proportion of family i to the whole families).

Equity index was calculated using this formula:

$$Es = \frac{Ds}{D\max}$$

Where D maximum = $\frac{(S-1)(N)}{S(N-1)}$

Where S = the number of families

Index of Similarity by Jaccard was used to determine similarity between sampling sites (Wiryono, 2009).

$$\text{Index of Jaccard } IS_j = \frac{c}{a+b+c} \times 100\ \%$$

c = common species

a= number of species found only in the first site

b = number of species found only in the second site

RESULTS AND DISCUSSION

Arthropod diversity

A total of 20 families of arthropods were found in reclaimed mined land. For each mined site, the number ranged from 9 to 14. These numbers were higher than that of natural forest nearby, which was only 7. The age of vegetation did not affect much the number of families. The Simpson's Index of diversity, however, showed that natural forest had the highest diversity, which was 0.67. This was due to its high equity. In natural forest, each family had relative many indinidividuals, while in mined land, some families had very few individuals. For comparison, natural forest in Lebong District, Bengkulu, had higher number of Arthropod families, namely 16, but the same Simpson's Index of Diversity which was 0.67 (Yetti, 2005). In pine plantation, in Central Aceh District the number of Arthropod family was between 10 and 11 with Simpson's between 0.50 and 0.58 (Fauziah, 2007).

Among the Arthropod families, Formicidae was the most abundant one in every site. This family was also found the most abundant in natural forest and pine plantation in Lebong District (Yetti, 2005) and in pine plantation in Aceh (Fauziah, 2007). These facts indicated that formicidae survive in several ecosystem types.

Community similarity

The percent of similarity in term of Atrhropod family composition between reclaimed mined land and natural forest near by is very low. The oldest reclaimed mined land had the highest percentage, but the number was still low, namely 25%. The other sites had even lower percentage. The difference between mined land and natural forest might be caused by the difference in environmental conditions between the two sites. Mined land had relatively open ground surface with little litter accumulation, while the natural floor was more closed and had thichker litter layer. Some species found only in mined site, such as Cynidae, Acrididae and Gryllidae, were known to prefer open space with high temperature and low humidity (Adianto, 1982).

Table 1: The average number of individual Arthropods found in a square meter for each site

NO	FAMILY	MINED LAND				Natural Forest
		7 years old	6 years old	5 years old	4 years old	
1	Formicidae	1021.7	454.0	750	2006.2	1521.5
2	Salticidae	120.0	70.6	78.5	259.9	195.1
3	Blattidae	9.1	2.8	44.2	52	52
4	Family x*	257.7	211.9	152.1	675.7	
5	Gryllidae	36.5	16.9	63.8	249.5	
6	Halticidae	34.2	2.8	24.5	41.6	
7	Cydnidae	11.4	2.8	4.9	20.8	
8	Acricidae	22.8	19.8	24.5		
9	Hydrometryidae	25.1				
10	Forficulidae	20.5				
11	Melandryidae	20.5				
12	Scolpendridae	27.4				
13	Polydesmiadae	9.1				39
14	Julidae		25.4	9.8	135.1	
15	Glomeridae		5.7		10.4	
16	Cucujidae		11.3	4.9		
17	Termitidae		8.5	4.9		
18	Cossidae		8.5			
19	Rhinotermitidae		2.8			338.1
20	Tetigonidae			4.9		
21	Thyreocoridae					117
22	Arthropaneura					1209.4

Note: Family x: unidentified arthropods

Table 2. Simpson's Index of diversity (Ds) of Arthropods for each site

Sites	Number of families	Number of individuals	Ds	D max	Es
7 yr old mined land	13	709	0.57	0.92	0.61
6 yr old mined land	14	299	0.64	0.93	0.69
5 yr old mined land	12	237	0.64	0.92	0.61
4 yr old mined land	9	332	0.61	0.89	0.69
Natural Forest	7	267	0.67	0.86	0.78

Note: Es = Equity index; D max = maximum diversity

Table 3. Jaccard's Index of similiarity (%) among sites

Sites		Mined land				Natural Forest
		7 yr old	6 yr old	5 yr old	4 yr old	
Mined Land	7 yr old	100				
	6 yr old	42.1	100			
	5 yr old	47.1	73.0	100		
	4 yr old	43.7	60.0	61.0	100	
Natural Forest		25.0	22.2	20.0	23.1	100

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