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**DIVERSITY OF FOREST FLOOR ARTHROPOD FAMILIES IN PINE  
PLANTATION FOREST AND NATURAL FOREST  
IN KOTA DONOK, LEBONG REGENCY,  
BENGKULU PROVINCE**

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**ABSTRACT**

Tropical rainforest is well known for its very high diversity of plant and animals. High rate of deforestation, however, has threatened this diversity. Reforestation using few species has created forest stand quite different in species composition than the natural forest. This study was aimed at measuring family diversity of forest floor arthropods in *Pinus merkusii* plantation forest and natural forest nearby in Talang Donok Sub-District, Lebong Regency, Bengkulu Province. This study found more families as well as individuals of forest floor arthropods in natural forest (131 individuals from 16 families) than in pine plantation forest (53 individuals from 7 families). However, the Simpson indexes diversity were almost the same, namely 0.67 in natural forest and 0.61 in pine plantation. The two sites had low similarity index of Jaccard, which was 44%, but high similarity index of Ellenberg, which was 90%. The second index was considered a better indicator because it took into account not only the number of families but but also their abundance.

*Keywords: Soil arthropod diversity, pine plantation, Bengkulu Province*

**INTRODUCTION**

Indonesia has vast areas of tropical rain forest known for its very high diversity of plants and animals. A single tree in tropical rain forest may support 150 species of beetle (arthropod) and a hectare of forest area may harbor 300 species of trees (Terborgh, 1992). However, this high diversity has been threatened by deforestation which reach more than a million hectares per year in Indonesia (Forest Watch Indonesia, 2001; Pusinfo Departemen Kehutanan, 2007).

For several decades the Ministry of Forestry has tried to rehabilitate the damaged forest through its reforestation program. One of tree species widely planted for reforestation in the 1980's were *Pinus merkusii*. This

tree species was also planted for reforestation in Talang Donok Sub-District, Lebong Regency, Bengkulu Province. The reforestation program in Talang Donok was successful but the resulting single species pine plantation has different species composition and structure than the surrounding natural forest.

The change in tree species composition may have impact on the diversity of forest floor arthropods. Different species of trees may results leaf litter having different chemical and physical properties, resulting in different palatability and nutrient content. A study by Supono and Wiryono (2009) showed that reclaimed mined land planted with *Paraserianthes falcataria* and *Acacia mangium* had different composition soil arthropod families than



natural forest composed of many species of trees. A study by Erwin from the Smithsonian Institute in Panama rain forest (Terborgh, 1992) showed that each species of arthropod specialized in limited species of trees. There is a hypothesis, therefore, that forest composed of many species of trees may support higher diversity of arthropods than single species forest. However, a study by Donoso *et al* (2010) in Barro Colorado Island in Panama, failed to find association between tree diversity and litter arthropod diversity. They suggested that factors other than tree species diversity may better explain the high arthropod diversity in tropical forests.

This study was aimed at measuring the diversity of forest floor arthropods in pine plantation forest and natural forest in Talang Donok Sub-District, Lebong Regency, Bengkulu Province.

## MATERIALS AND METHODS

This study was conducted in September through October 2004 and in March 2005 in two sites, pine plantation forest and natural forest, in Talang Donok Sub-District, Lebong Regency, Bengkulu Province. The pine plantation was 800 m above sea level and the natural forest was 811 m above sea level. Both sites has A climatic type of Schmidt and Ferguson, with rainfall between 2000-4000 mm a year.

### *Arthropod collection and identification*

The soil arthropods were collected for each site 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. Identification of samples was done using

the books of Lilies (1992) and Suin (1989).

### *Environmental factors*

Physical factors measured for each site were temperature, relative humidity, and light intensity. The measurements were done in the morning (8, AM), afternoon (1 PM) and late afternoon (4 PM). Data of rainfall were taken from regional climate office. Dry mass and thickness of leaf litter was measured for each site.

### *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 diversity of families were determined using the number of families and Simpson's diversity index (Krebs, 1978).

Simpson's Diversity index (Ds),

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

Where  $pi =$

(the roportion  $\frac{ni}{N}$  of family  $i$  to the whole families). Equity index was calculated using this formula:

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

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

Where  $S =$  the number of families. Similarity between two sites was measured using Index of Similarity by Jaccard and similarity Index of Ellenberg (Muelser-Dumbois and Ellenberg, 1974).



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

c = common families

a = number of families found only in pine plantation

b = number of families found only in natural resources

$$\text{Index } IS_E = \frac{Mc:2}{Ma + Mb + (Mc:2)} \times 100\%$$

Mc = number of individuals of common families. Ma = number of individuals of families found only in pine plantation.

Mb = b number of individuals of families found only in natural forest.

Table 1. The abundance of families of forest floor arthropods in pine plantation forest and natural forest.

No	Family	Number of individuals	
		Pine plantation	Natural Forest
1	Formicidae	32	70
2	Rhinotermitidae	6	1
3	Salticidae	5	15
4	Gryllidae	7	24
5	Melondryidae	1	1
6	Termitidae	1	1
7	Thyreocoridae	1	1
8	Acrididae		2
9	Aegeridae		1
10	Elateridae		1
11	Cucujidae		1
12	Halticidae		1
13	Chrysomelidae		1
14	Tetragnathidae		1
15	Family X*		1
16	Family Y*		1
TOTAL		53	131

Note: \*Families X and Y were unidentified.

## RESULTS AND DISCUSSION

As many as 131 individuals belonging to 16 families of forest floor arthropods were found in natural forest, and 53 individuals from 7 families in pine plantation forest (Table 1).

Formicidae was the most abundant family in both sites. The Simpson's diversity indexes of arthropod family were 0.67 and 0.61 for natural forest and pine plantation respectively, while the

Table 2. Diversity indexes and equity indexes of families of forest floor arthropods in pine plantation forest and natural forest.

Sites	Diversity Index	Equity Index
Pine plantation	0.61	0.69
Natural Forest	0.67	0.71

Similarity Index of Jaccard = 43.75%.

Similarity index of Ellenberg = 89.69%

Table 3. Environmental factors in pine plantation forest and natural forest.

Environmental condition	Sites	
	Pine plantation	Natural Forest
AVERAGE		
TEMPERATURE (°C)		
Morning (8 AM)	24	23
Afternoon (1 PM)	26	26
Late afternoon (4 PM)	25	24
LIGHT		
INTENSITY (lux)		
Morning (8 AM)	113.6	136.6
Afternoon (1 PM)	156.4	190.2
Late afternoon (4 PM)	124.4	158.4
RELATIVE		
HUMIDITY (%)		
Morning (8 AM)	80	86
Afternoon (1 PM)	83	77
Late afternoon (4 PM)	84	83
LAND SLOPE (%)	21	20
LITTER		
Litter thickness (cm)	2.76	3.65
Litter dry weight (g/m <sup>2</sup> )	572	595

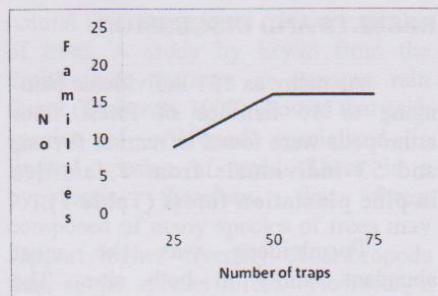


Figure 1. The relationship of the number of arthropod families and number of traps in natural forest.

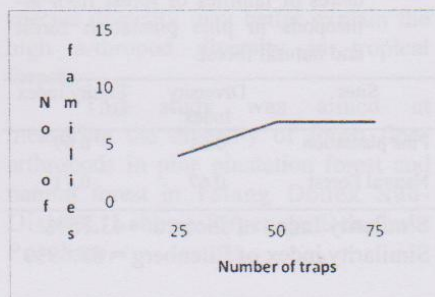


Figure 2. The relationship of the number of arthropod families and number of traps in pine plantation forest.

equity indexes were 0.71 and 0.69 respectively (Table 2). The similarity index of Jaccard was 43.75% while that of Ellenberg was 89.69%. The temperatures were relatively the same for the two sites, so were the relative humidity except at 1 PM which was relatively higher in pine plantation. The natural forest had slightly higher light intensity, thicker and heavier litter than the pine plantation (Table 3). The curves relating the number of traps and the number of families showed flat line after the 50<sup>th</sup> trap, indicating that the number of traps was sufficient both in pine plantation and natural forest (Figures 1 and 2).

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