Research Article

Diversity of Ants (Hymenoptera: Formicidae) on Several Types of Plantations in Dharmasraya Regency, West Sumatra Province

Keanekaragaman Semut (Hymenoptera: Formicidae) Pada Beberapa Tipe Perkebunan di Kabupaten Dharmasraya, Provinsi Sumatera Barat

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Abstract: Ant diversity in the plantation ecosystem has an important role in maintaining the balance of the ecosystem and the continuity of crop production. It aims to find out ant diversity and the role of ants present in oil palm, rubber, and cocoa plantation ecosystems in Dharmasraya District. The research location is Kecamatan Pulau Punjung, Sitiung, and Koto Besar. The method used in this research is Systematic Random Sampling (Random Design Selected). Sampling using the Qudran Protocol method is Soil And Leaf Litter Sieving, Pitfall trap, Bait Trap, and Hand Collecting. Identification is done at the Laboratory of Animal Taxonomy, Biology Department, Faculty of Mathematics and Natural Sciences, Andalas University. The diversity and evenness of ants in some types of plantations in Dharmasraya Regency were moderate (H '<1) and (E <0.63). There were 16 species of ants; the most abundant species were *Aneplolephis graciliphes* and *Odontoponera denticulate.*

Keywords: ants, cocoa, diversity, oil palm, plantations, rubber

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Abstrak: Keanekaragaman semut dalam ekosistem perkebunan memiliki peran penting dalam menjaga keseimbangan ekosistem dan kelangsungan produksi tanaman. Bertujuan untuk mengetahui keanekaragaman semut dan peran semut yang terdapat pada ekosistem perkebunan kelapa sawit, karet dan kakao di Kabupaten Dharmasraya. Lokasi penelitian yakni Kecamatan Pulau Punjung, Sitiung, dan Koto Besar. Metode yang digunakan dalam penelitian yakni Sistematis Random Sampling (Rancangan Acak Terpilih). Pengambilan sampel menggunakan metode Qudran Protocol yaitu metode Soil And Leaf Litter Sieving, Pitfall trap, Bait Trap dan Hand Collecting. Identifikasi dilakukan pada Laboratorium Taksonomi Hewan, Jurusan Biologi, Fakultas MIPA, Universitas Andalas. Keanekaragaman dan Kemerataan semut pada beberapa tipe perkebunan di Kabupaten Dharmasraya tergolong sedang yakni (H'<1), dan (E<0,63). Ditemukan sebanyak 16 spesies semut dan spesies yang paling melimpah adalah *Aneplolephis graciliphes* dan *Odontoponera denticulata*.

Kata kunci: semut, kakao, karet, kelapa sawit, keanekaragaman, perkebunan

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INTRODUCTION

The plantation is an agricultural agroecosystem cultivated on a large scale, with the main commodity being long-lived plants. The main plantation commodities in Indonesia include oil palm, coconut, cocoa, rubber, coffee, tea, pepper, nutmeg, cloves, and cinnamon. Of these several commodities, oil palm, cocoa, and rubber are currently the mainstay commodities cultivated on a large scale and in smallholder plantations. Cultivation of these commodities produces an agroecosystem with different descending characters. According to Yenti *et al.* (2020), oil palm is a monoculture ecosystem dominated by one type of plant. Various wild plants are also in the oil palm ecosystem as undergrowth. In the oil palm fields, there is litter left over from weathering of the leaves. Oil palm cultivation is also relatively long, reaching 20-28 years; even in some provinces, it can get 30 years. According to Muhammad *et al.* (2019), the rubber ecosystem uses a monoculture system. On the surface of the garden, there is leaf litter. The litter covers most of the soil surface, preventing the growth of weeds or other wild vegetation. In contrast to the oil palm and rubber ecosystems, in the cocoa ecosystem, there are lamtoro plants as shade; besides that, there are also banana, coconut, duku, and taro plants. This condition causes the cocoa ecosystem to be more complex than oil palm and rubber. In addition, on the ground surface, there is also litter and branches left over from pruning. The different characteristics of the ecosystem will affect the organisms contained therein, one of which is ants.

Ants are social insects that belong to the order Hymenoptera and the family Formicidae. Ants have a wide distribution, various numbers, and types, making them easily recognizable (Romarta *et al.*, 2020). This insect has approximately 12,000 species. According to Yaherwandi *et al.* (2019), species are spread worldwide, most of which are in the tropics. Ward *et al.* (2015) reported that there are about 15,000 species of ants that have been scientifically described. Wilson *et al.* (2016) stated that it is estimated that there are around 20,000 species of ants in the world, with most species yet to be described. The role of ants in nature can have a positive and negative influence on humans. It's just that the positive aspects cannot be enjoyed directly by humans, for example, their role as predators (Hakiki *et al.* 2020), decomposing organic (Melketa *et al.* 2022), controlling pests (Febriani *et al.* 2020) and even helping pollinate (Solin *et al.* 2019). The plantation ecosystem is one of the habitats inhabited by ants.

Ants form large colonies in plantation ecosystems, affecting the composition of the arthropods in the habitat. Most ants act as predators. Some of them work as natural enemies in plantation crops. In the oil palm ecosystem, ants are reported to be able to control fire caterpillars and bagworms. Two caterpillars prey on *O. smaragdina*, namely Setora nitens and Sethosea asigna, while the species of sac caterpillar that preys on is Brachycyrtta griseus (Falahudin 2011). In addition, it was reported by Widihastutya *et al.* (2020) that *Myopopone castanea* ants are predators of the larvae of *Oryctes rhinoceros*. The existence of the same life niche between *M. castanea* ants and *O. rhinoceros* larvae opens up excellent opportunities to utilize these ants as biological agents. In cocoa plants, ants can suppress *Helopeltis* sp (Amanda *et al.* 2020). In addition, on cocoa plantations in Dharmasraya Regency, West Sumatra, it was reported that ants could reduce the control of the cocoa pod borer (*Conopomorpha cramerella*)

(Suherlina *et al*. 2020). It's just that information on the use of ants in rubber plantations has not been widely reported.

Ant diversity in plantation ecosystems has been widely reported. Ikbal *et al*. (2014) said six genera, namely *Dolichoderus* sp., *Anoplolepis* sp., *Paratrechina* sp., *Crematogaster* sp., *Pheidole* sp., and *Pheidologeton* sp., in the cocoa plantation ecosystem in Banjaroya Village, Kalibawang District, Yogyakarta. Suyadi *et al*. (2021) reported ten species of ants in the cacao plant ecosystem with litter and distance treatments from the forest in North Lore District. There is still little information about the diversity of ants in the ecosystems of oil palm, rubber, and cocoa plantations in West Sumatra Province. Information about the diversity of ants can be used as a basis for using ants as biological agents in plantation ecosystems. In addition, this information will become the basis for managing oil palm, rubber and cocoa plantations which can conserve the presence of ants. This study aims to study ant species in several types of plantation ecosystems in Dharmasraya District, West Sumatra Province.

MATERIALS AND METHODS

Determination of land and plant samples

This research was a survey conducted on three types of plantation ecosystems in Dharmasraya District. Locations were selected based on criteria, namely land area, plant age, and commodity types, namely Pulau Punjung, Sitiung, and Koto Besar Districts. At each predetermined location, one plot of land with an area of ± 1 ha was selected. The total land used for sampling was nine lands. The age of the plant for oil palm commodities was eight years, while for rubber and cocoa, it is four years. In each land, 10 sample plants were determined. One sample plant was selected in each row. Sampling was carried out for four months with an interval of 1 month.

Ant sampling

Sampling using the Soil and Leaf litter sieving method was conducted to collect ants on the soil surface, especially those found in leaf litter. Under the sample plants, a plot measuring 1 m x 1 m was made. In this plot, litter with a thickness of 10 cm was taken. The litter was sieved on a tray using a stainless steel sieve measuring 4 cm x 5 cm x 6 cm, with a sieve of 5 mesh. The collected ants were stored in a collection bottle containing 70% alcohol. Hole traps or hole traps are placed under the sample plants. In one sample plant, 4 Pitfall traps were installed, and the distance of the traps from the sample plants was 1 m—a total of 40 catches. The pitfall trap is a glass with a diameter of ±7 cm and a height of 10 cm. Fill ¼ the part with detergent water. Traps are placed in the ground at a depth of ± 10 cm. The pitfalls were incubated for 1 hour. The trapped ants were collected in a collection bottle filled with 70% alcohol. The trap uses bait in the form of mackerel (tuna). The bait is placed in the paper, then hung on the sample plants. In the sample plants, one bait was installed. The traps were set for 3 hours. Total in one land there are ten traps. The direct collection was done on the soil surface and sampled plants and litter. This method collects ants that were missed by the previous method.

Sorting and Identification

Separation of the ants must be done quickly to avoid damage to the specimen by the presence of particles or layers of soil. The ants are sorted and stored in sample bottles or vials containing 70% alcohol. The ant specimen will be mounted, placed on the card point, and positioned so that its characteristic shape, which is essential in the identification process, can be seen clearly, so the ant is set facing towards the right. On the ventral or thoracic side, a special glue is given to place the ant on the end of the card point. , and for small specimens, three or four can be mounted on one card point, so the mounting process is based on differences in morphospecies. Identification was carried out at the species level, referring to Nazarreta *et al.* (2021) and Bolton (1994).

Data analysis

Ant diversity in each type of plantation was analyzed using the diversity index α Shannon-Wienner (H') and the Simpson index (1/D). Diversity analysis used Primer version 5 for Windows.

RESULTS AND DISCUSSION

Number of Ant Species and Individuals in Several Plantation Types

The total number of individual ants collected was 5,365 individuals consisting of 16 species (Table 1). In oil palm found 1512 individuals consisting of 12 species. In rubber, found 1318 composed of 7 species. It was found in 2525 individuals consisting of 5 ecosystem species in cocoa. *A. graciliphes* and *O. denculata* were the species that had the highest number of individuals in all ecosystems. *O. simillimus* (f. smith) is the species with the lowest number of individuals. In the study, *D. thoracicus* species were only found in cocoa ecosystems, not found in rubber and oil palm ecosystems. *A. graciliphes* has the highest number in all plantation ecosystems. This is because these ants can adapt to the conditions around them and have a wide distribution. This is the same as reported by Romarta *et al*. (2020) that *A. gracilipes* has the highest number of individuals because of its large foraging area, is invasive, adaptable, and often causes losses to other fauna species (as competitors or predators). So it is called a scavenger predator because it preys on various fauna in the litter and canopy.

O. denticulate species have many individuals found in several ecosystems, namely oil palm, rubber, and cocoa. These ants were active on the ground and can live in various commodities. Rizali *et al*. (2008) reported that this species is found in soil habitats, spread throughout all commodities, and found in each location. This ant is classified as a cryptic species that only lives in the soil or litter and does not appear on the soil surface. Little *O. simillimus* is found in oil palm, cocoa, and rubber plantations; due to its ecology, where *O. simillimus* is found in forest ecosystems that are still maintained and their habitat has not been disturbed, if a forest occupied by this species is disturbed, then their colonies will move a safer place. In this study, the ecosystem used was the ecosystem of oil palm plantations cultivated by the community, and their habitat has been disturbed. *D. thoracicus* is found only on cocoa plants but not on rubber and oil palm plantations. *D. thoracicus* has the highest number of individuals in the *D. thoracicus* cocoa ecosystem. This is because they have high foraging activity, are abundant in numbers, and can live in hot areas and open habitats. This species is often mistaken for black ants. This is the same as reported by Khoo & Ho (1992); these ants can act as predators, and these ants can suppress the population of *Helopeltis* sp.

Table 1. The number of species and number of individual ants in several types of plantations.

Spesies	**Pulau Pumjung**			**Sitiung**			**Koto Besar**		
	*** Op**	**Ru**	**Co**	**Op**	**Ru**	**Co**	**Op**	**Ru**	**Co**
Aneplolepis gracillipes	277	353	347	235	172	137	148	239	72
Brachipanera sp2 of HH	3	0	0	0	0	0	0	0	0
Camponotus thoramemyrmex	0	53	0	0	0	0	0	0	0
Crematogaster cf. pagenhofferi	10	0	0	126	0	0	0	0	4
Diacamma scalpratum	0	2	0	0	0	0	0	0	0
Dolichoderus thoracicus	0	0	904	0	0	393	0	0	412
Odontoponera denticulate	106	75	7	100	141	93	107	0	73
Oechophylla smaragdina	0	49	0	0	125	0	0	0	0
ondonthomachus risosus	4	0	44	13	15	8	11	7	0
Ondonthomachus simillimus	1	0	0	0	0	0	0	0	0
Pheidol sp3 of HH	266	23	19	0	57	0	0	0	12
Polyrachis (Polyrachis) ypsilon	34	7	0	55	0	0	18	0	0
Polyrhacis (Mymhopla) armata	3	0	0	0	0	0	0	0	0
Polyrhacis clives	2	0	0	0	0	0	0	0	0
Polyrhacis sp	2	0	0	0	0	0	0	0	0
Tetraponera attenuata	1	0	0	0	0	0	0	0	0

*Remarks: Op (Oil Palm), Ru (Rubber), Co (Cocoa).

Species Diversity and Evenness Index

The results of calculating the highest diversity index with a value of 1.35 while the lowest is 0.81 (Table 2). This shows that the diversity of ants is in the medium or medium category (H' 1<H<3). The moderate type at the highest score is caused by human activities in managing agricultural land that pay little attention to environmental aspects and is influenced by existing ecological factors and the diversity of components that make up the ecosystem. The results of the diversity index analysis show that the oil palm ecosystem is relatively more stable than other ecosystems.

Table 2. Diversity Index (H') and Evenness (E'). Ants on several types of plantations

Location	Oil palm		Rubber		Cocoa	
	*H	E	H	E	H	E
Pulau Punjung	1,35	0,54	1,21	0,62	0,81	0,51
Sitiung	1,34	0,83	1.14	0,88	0,96	0,69
Koto Besar	1,01	0,73	0,13	0.02	0,88	0,54

The diversity of ants on plantations can be influenced by several factors, which may contribute to higher diversity. Plantations with diverse vegetation structures and greater habitat complexity support higher ant diversity. According to Perfecto *et al.* (1997), different microhabitats, such as leaf litter, tree canopies, and understory vegetation, provide varied niches for ant species. Added by Gibb & Hochuli (2002), plantations that encompass a higher number of plant species are likely to support more diverse ant communities. A diverse plant community provides a wider range of resources and nesting sites for different ant species. The surrounding landscape composition and connectivity can influence ant diversity on plantations. Plantations embedded within a diverse landscape matrix or adjacent to natural habitats may receive species influx from the surrounding areas, leading to higher diversity (Tscharntke & Brandl 2004). The next factor thought to influence the diversity of ants on plantations, according to Klein (2007), is certain plantation management practices, such as reduced pesticide use, promotion of native vegetation, and maintenance of ecosystem processes, can positively impact ant diversity by creating favorable conditions for different species.

CONCLUSIONS

The type of plantation does not affect the diversity of ants contained in the diversity and evenness. *A. graciliphes* and *O. denticulata* have the highest number of individuals. The most dominant species in several plantations were *A. graciliphes*.

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