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STUDY OF THE ECOLOGICAL POPULATIONS AND NESTING *Oecophylla smaragdina* FABR. ON OIL PALM PLANTATIONS AS A BIOLOGICAL CONTROL INDICATOR

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ABSTRAK

Oecophylla smaragdina merupakan predator untuk menghalangi mangsa semut, mempengaruhi persaingan antarspesies, dan memfasilitasi mutualis dan parasit dalam melacak semut *Oecophylla*. Kajian ekologi sarang semut *O. smaragdina* dengan mengukur kepadatan populasi sarang pada pohon kelapa sawit dengan variasi umur pohon yang berbeda. Kepadatan, aktivitas semut, dan kemungkinan terdeteksi sarang hanya terdapat pada pohon kelapa sawit dengan variasi umur tanaman kelapa sawit yang berbeda. Oleh karena itu, sarang dapat berfungsi sebagai petunjuk yang dapat diandalkan untuk berinteraksi antar spesies dan menjadi faktor penting dalam membentuk komunitas di sekitar koloni *Oecophylla*. Interaksi *Oecophylla* dalam beberapa cara telah menjadi mangsa potensial yang dapat dijadikan biological control di daerah berisiko tinggi. Hasil penelitian ditemukan pada total 4782 individu dari varian jenis sarang di kelapa sawit. Sarang *O. smaragdina* berbentuk agak bulat lonjong dengan ukuran daun berbeda-beda rata-rata berkisar antara luas 4,19-24,14 cm². Terbentuknya sarang ini juga dipengaruhi oleh faktor abiotik dan biotik. Jarak terdekat sarang dari batang pohon tengah sekitar 1 m, dan terjauh hingga 3,4 m. Sarang dibuat dengan model bervariasi dari ketinggian. Hasil tersebut juga menemukan bahwa variasi bentuk sarang yang dibuat oleh *O. smaragdina* mempunyai jumlah individu yang berbeda-beda.

Kata Kunci: Ekologi Populasi *O. smaragdina*, sarang semut rangrang dan perkebunan kelapa sawit.

ABSTRACT

Oecophylla smaragdina ants are predators to deter ant prey, influence interspecies competition, and facilitate mutualists and parasites in tracking *Oecophylla* ants. Study of the ecology of *O. smaragdina* ant nests by measuring nest population density on oil palm trees with different tree ages. Density, ant activity, and the possibility of detecting nests were only found on oil palm trees with different ages of oil palm plants. Therefore, nests can serve as reliable clues for interactions between species and be an important factor in forming communities around *Oecophylla* colonies. *Oecophylla* interactions in several ways have become potential prey that can be used as biological control in high risk areas. The research results were found in a total of 4782 individuals from various types of nests in oil palms. The nests of *O. smaragdina* are slightly oval with different leaf sizes, with an average area ranging from 4.19 to 24.14 cm². The formation of this nest is also influenced by abiotic and biotic factors. The closest distance to the nest from the central tree trunk is about 1 m, and the furthest up to 3.4 m. Nests are made in models varying in height. These results also found that variations in the shape of the nest made by *O. smaragdina* had different numbers of individuals.

Keyword: Ecological weaver ants, *O. Smaragdina*, nests and oil palm plantation

INTRODUCTION

The position of a species in the environment about a resource significantly impacts its access to that resource. This can have significant behavioral implications; for example, effective foraging methods have evolved to make use of available resources while taking into account an individual's position in the ecosystem (Ydenberg, 2007). This is especially true in animals like social insects, which build spatially anchored nests (at least in the short term). The location of a nest in the environment is likely to affect resource access and, as a result, the fitness of the individual within it (McGlynn *et al.*, 2013). Sanders *et al.* (2007) proposed that the composition of ant communities is influenced by local resource abundance, while temperature influences patterns on larger scales. This proposal assumes that small differences in microclimate may not necessarily impact ant communities at a local level. This idea was essentially put forth as a challenge to ant community ecologists, which has yet to be thoroughly examined.

A polydomous wood ant colony's combined nests and trails thus function as a resource redistribution network: food resources are worked down the trails between pairs of nests, resulting in colonization resource redistribution organized at a local level (Ellis & Robinson, 2016; Ellis *et al.*, 2017). Honeydew is the primary food source for wood ants, as it is a geographically and temporally stable resource (Domisch, Risch & Robinson, 2016). As a result, a worker's access to food will be determined not only by the location of their nests inside the stable foraging environment but also by the position of their nests within the nest network structure. Workers from the same colony who live in various nests have varying levels of access to resources. The ecological repercussions of this uneven access to resources of nests within the network, as well as the influence of this differential access on the colony's organization, remain unknown.

Weaver ants (*Oecophylla smaragdina*) are arboreal, eusocial insects (Family: Formicidae; Order: Hymenoptera). They play a significant role in pest management, food, and medicines (Itterbeck *et al.*, 2014). In Southeast Asia, Australia, and Africa, *O. smaragdina* is consumed as food, used in traditional medicines, and pest management (Offenberg *et al.*, 2013; Wetterer, 2017). They are used as natural bio-control agents against agricultural pests by indigenous farmers in Southeast Asia (Peng & Christian, 2005; Crozier *et al.*, 2010). Three interconnected environmental elements, namely climate, soil, and water availability for various places, such as agricultural areas, influence the existence of organisms in the forest (Suin,

1997). Monoculture forests, such as oil palm plantations, are forests that contain only one type of species (cultivated) or trees with similar features. Oil palm farms, for example, have both advantages and disadvantages. If pests or diseases attack one tree in a monoculture forest, it will swiftly spread to other trees. Similarly, the diversity of animal species is limited. If the type of plant is uniform, insect pests could spread swiftly.

Nests in a polydomous system may survive and bud based only on their traits, with no ecological implications from the nest network structure. Survival and budding based solely on a nest's intrinsic characteristics would imply a low level of integration between nests in the system, and that a polydomous colony is nothing more than a collection of mutually non-aggressive nests rather than a single cooperative and functional entity. If the nests of a polydomous system are all part of the same functional unit, however, each nest's survival and budding will be influenced not just by inherent nest features, but also by its position in the colony nest network or more general colony-level impacts.

In industrial agriculture forests, *O. smaragdina* Fabr. is the most common ant. In an oil palm plantation, various kinds of ants play an important role. Ants are members of the Formicidae family, which belongs to the Hymenoptera order. Ants are split into about 12,000 groups, with the tropics having a disproportionately large number. Ants are recognized for their well-organized colonies and nests, which can include thousands of ants. Worker ants, soldier ants, male ants, and queen ants are the different sorts of ants (Suhara, 2009). In terms of biology, the order Hymenoptera is a fascinating set of orders because wasps, bees, and other insects exhibit a wide range of habits and complicated behavior in terms of social organization.

Ecology population of Weaver ants is the most common Hymenopyera in a plantation (*O. smaragdina* Fabr.). These ants are commonly seen nesting in a variety of tree species. Weaver ants (*O. smaragdina* Fabr.) are typically regarded as a nuisance on trees, especially when harvesting, due to their unpleasant bite. *O. smaragdina* plays an ecological role in defending the garden against pests and diseases (Falahudin, 2012). These ants naturally hunt on other insects that wreak havoc on a plant. *O. smaragdina* can fight pests and cause serious damage or disease transmission to plants. Several studies have shown that *O. smaragdina* can consume green ladybugs, leaf-eating caterpillars, fruit-eating caterpillars, and fleas on chocolate, cashews, and oranges and that *O. smaragdina* can repel mice (Suhara, 2009).

Weaver ants (*O. smaragdina*) can build new nests. It's crucial to understand the weaver ant population dynamics in oil palm fields. As a result, this capability will result in the formation of a new colony. It's crucial to understand the weaver ant population dynamics to assess its potential in oil palm fields. The social organization of ants in new colonies in oil palm

plantations is similarly influenced by population dynamics. Weaver ants (*O. smaragdina*) are insects that have to go through a complete transformation. Rangrang ants (*O. smaragdina*) can be used to track the health of an ecosystem. If there are many weaver ant nests (*O. smaragdina*) in a region, it indicates that the ecosystem is safe; nevertheless, if there are no weaver ant nests (*O. smaragdina*) in the area, the ecosystem is disturbed. Monoculture or plantation forestry, such as oil palm plantations, is one example (Mele and Cuc, 2004).

Despite being well-studied for other biological characteristics, the colony organization of *O. smaragdina* has received less attention (Schlüns et al. 2009). Researchers are interested in understanding how weaver ants (*O. smaragdina*) survive in monoculture forests. The dynamics of nest formation and the individual nests within each colony will influence the process of building a new nest in the ecosystem. Biotic and abiotic factors also influence weaver ant population dynamics in oil palm farms. Studying colony structure may help explain how the social structure within the nest influences individual behavior outside the nest. Therefore, the goal of the current study was to describe the colony structure of *O. smaragdina* within the nests of this species.

MATERIALS AND METHODS

Site. The research was conducted in 2016 at an oil palm plantation in Banyuasin Regency-South Sumatra-Indonesia. The material used in the study was an ant weaver nest (*O. smaragdina* Fabr.) preserved in 70% alcohol. Various tools were utilized, including ropes, specimen bottles, tweezers, scissors, gloves, digital cameras, pH meters, Lux meters, hygro-thermometers, plastic bags, and GPS (Global Positioning System).

Data Collection. We investigated the study ecology of the nest networks of the colony weaver ant *O. smaragdina*, a member of the ecologically important species group arboreal (Stockan & Robinson, 2016; Stockan et al., 2016). Weaver ants are the dominant invertebrate predator in their environment oil plantation; they hunt and scavenge for a variety of invertebrate prey, including other ant species (Domisch et al., 2016; Mabelis, 1984; Savolainen & Vepsäläinen, 1988). However, most of the food for weaver ant colonies is provided by foraging for honeydew collected from sap-feeding hemipterans in the canopy (Domisch et al., 2016; Rosengren & Sundström, 1991).

This research employed a descriptive quantitative method, using a 500-meter-long transect on a 50-hectare land area. The transect extended from southwest to northeast, with a distance of up to 10 meters between each transect. In oil palm plantations, observation

variables included nest distribution and nest architecture. Ant colony data was observed by tracing transect lines in oil palm farms with age variations of 2 years, 3 years, and 4 years. The lack of preference for a particular tree species suggests that the resources available from the different tree species at the site are approximately equal. Their large size, stable food sources, and lack of significant predators and competitors mean that weaver ant nests are often present in the same location for a long period (Risch, Ellis, & Wiswell, 2016; Robinson & Robinson, 2008).

Environmental Factors. All the nests were retrieved between 10 a.m. and noon, a time when weaver ants were least busy based on a preliminary study. Each nest was stored in individual plastic buckets. Factors such as topography (height of the site), surrounding vegetation, and climate have been observed as supportive variables. Activity outside the nest varies based on the climate. In the wet tropics, activity occurs constantly, while in the drier part of seasonal climates, there is a diurnal pattern (Lokkers, 1990). In Sumatera Selatan, activity is seven times higher in the wet season than during the dry season and stops completely below 22°C and dry 30-33°C. Prey is mainly brought in during daylight hours, potentially reflecting the ants' excellent eyesight, which enables a visual hunting technique. Brood is brought after dark (Lokkers, 1990).

Data analysis. Data was collected using the method described below to estimate species population Weaver ants on nest with analysis of variance regression models software SPSS. In general, simple linear regression finds the best straight line for describing the relationship between two variables. In its simplest form, which is what we consider here, it does not do a very good job of assessing how well the line describes the data, but provides useful information. For this situation, the sample line : $y = a + bx$ is an estimate of the population line : $Y = \alpha + \beta x$, and a and b are estimates of α and β respectively. For a specific value of X_1 = length (cm), X_2 = width (cm), Y = populasi *O. smaragdina*. the value for y calculated from the regression equation is called the regression estimate of Y at the value

RESULT AND DISCUSSION

a. Topographic

Oil palm plantations are located at an altitude of 155 feet above sea level in Banyuasin Regency, South Sumatra Province, with the coordinates of 02°49,758' latitude and 104°44,885' east longitude. The temperature in the plantation varies between 30 and 32°

degrees Celsius. The soil is brown to blackish, with pH levels ranging from 5 to 6. The research area is 50 hectares and consists of three oil palm age groups, namely 2 years, 3 years, and 4 years, as determined by tracing a 500-meter long transect line consisting of 25 oil palm trees with a 20-meter spacing between each position.

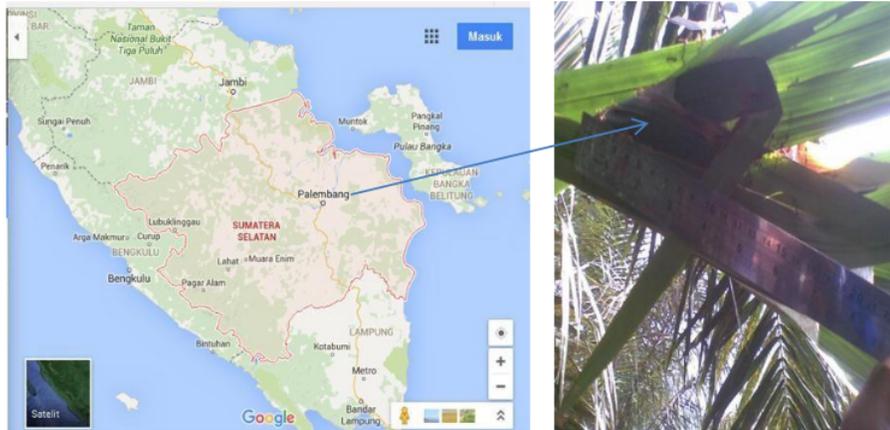


Figure 1. Map location research on South Sumatera

b. Ecological studies of nest size and number of individuals

The results of observations of studies on the ecology of ant nests and the number of *O. smaragdina* for 3 weeks at different ages can be seen in Table 1

Tabel 1. Average Nest Size and Number of Individuals During 3 Weeks of Observation

Age (years)	Age		Width (cm)	Length (cm)	Wide (cm ²)	Number of Individual
	A week					
4	1		5,29	24,58	130,03	557
	2		5,14	24,14	124,08	519
	3		4,9	22,45	110,01	546
						1622
3	1		5	24,28	121,40	525
	2		4,8	23,2	111,36	516
	3		4,87	25,25	122,97	529
						1570
2	1		4,75	23,5	111,63	528
	2		5,2	23,4	121,68	537
	3		4,25	17,5	74,38	525
						1590
Jumlah			4,91	23,14	93,41	4782

Source: Data primer, 2015

The size of the nest also influences the number of individuals of *O. smaragdina* on oil palm plants of different ages. The results of the regression analysis and ANOVA are shown in the table as follows:

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.554 ^a	.307	.076	12.67296
2	.558 ^b	.311	-.102	13.83523

- a. Predictors: (Constant), width, length
 b. Predictors: (Constant), width, length and replication

Table 4. ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	426.377	2	213.189	1.327	.333 ^b
	Residual	963.623	6	160.604		
	Total	1390.000	8			
2	Regression	432.931	3	144.310	.754	.566 ^c
	Residual	957.069	5	191.414		
	Total	1390.000	8			

- a. Dependent Variable: Population *O. smaragdina*
 b. Predictors: (Constant), width, length
 c. Predictors: (Constant), width, length and replication

Table 5. Excluded Variables^a

Model	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance	
1	Replication	.079 ^b	.185	.860	.082	.759

- a. Dependent Variable: Population
 b. Predictors in the Model: (Constant), Width, Length

c. Abiotic factors of oil palm plantations

The results of direct on field measurements of abiotic factors on oil palm plantations in Banyuasin Regency can be seen in Table 2. Then other abiotic factors are supported by secondary data from the South Sumatra Meteorology, Climatology and Geophysics Agency (MCGA) (28 December 2015– 11 January 2016).

Table 2. Results of environmental factor measurements every week

Parameter	I	II	III
Minggu Ke-			

Temperature (°C)	30,6	32,1	30,4
Rainfall (mm)	496	496	496
Light Intensity (%)	22	22	22
Humidity (%)	76	74	84

Source: Meteorology, Climatology and Geophysics Agency (MCGA) 2016

We wanted to investigate if there is a connection between temperature changes and the diversity of ant communities at different geographical locations and elevations. To do this, we decided to change the light conditions at a local level to see if the patterns in ant communities that are seen on a large scale are also reflected in the behavior of ant communities at a smaller scale. Our research showed that differences in colony sizes can be attributed to the levels of light present at the nest sites. While the amount of light passing through the canopy to the ground is linked to ant colony sizes, our experiment revealed that the light directly at the nest itself is the predominant factor influencing the variation in colony size.

d. Discussion

The population dynamics and nest characteristics of weaver ants (*O. smaragdina*) in the monoculture forest of oil palm plantations in Banyuasin Regency are studied. During 3 weeks of observation, the weaver ant nest population (*O. smaragdina*) was found the most, specifically in oil palm plants aged 4 years, with a total of 42 nests. The high population of weaver ant nests (*O. smaragdina*) on palm trees aged 4 years is due to a large amount of food available, so with many food sources comes a high ability to produce eggs. According to the findings of Nofia, Jasmi, and Armein (2012), weaver ants (*O. smaragdina*) build a large number of nests in fruit trees such as guava trees. It is suspected that the amount of food available is large so with many food sources, the ability to produce eggs is also high. More ant nests were discovered because of the findings of this study. However, because of the overuse of pesticides in oil palm plantations, the researchers only discovered 75 nests.

Aside from reproduction, the high population of weaver ant nests (*O. smaragdina*) is related to food availability. Fruit pests such as mealybugs are a food source for weaver ants (*O. smaragdina*), which are commonly found in oil palm trees over the age of four. According to Suhara's (2009) research, weaver ants (*O. smaragdina*) require additional food. Sugar, for example, is produced by mealybugs and aphids. This food source is used to provide extra energy during the early stages of nest formation (Sodiq and Dwi, M., 2009). With a total of 13 nests, the lowest population of weaver ant nests (*O. smaragdina*) was found in oil palm plantation

areas aged 2 years. Because of the scarcity of food sources, there was a low population of weaver ant nests (*O. smaragdina*) in oil palm plantation areas after 2 years.

According to Harlan (2006), in his study on foraging activities and the transfer of weaver ant (*O. smaragdina*) larvae, the highest foraging activity (*O. smaragdina*) was divided into two times, namely 10.00-11.00 and 14.00-15.00 WIB. The high foraging activity in the form of insects is most likely due to ant interaction on different trees within the same colony. This is related to the research done on the dynamics of the ant nest population. Foraging activities influence the number of nests in oil palm plantations. Workers on the trails are frequently transferring resources along defined tracks, such as honeydew, invertebrate prey, and brood. Temperature plays a significant role in the nesting and foraging behavior of weaver ants. The other research report that High activity for nesting with about 116 of these ants was observed at 9:00 pm, where the temperature was about 21 °C. Moderate activity with about 55 and 71 ants at 8:00 am and 6 pm with an average temperature of 21 °C and 25 °C respectively was noted (Sangma and Surya, 2020)

The results of analysis using regression can be seen in Tables 2, 3, and 4 that nest size significantly influences the population size of *O. smaragdina*. Observing nest population dynamics in oil palm plantations based on plant age groups reveals distinct differences in distribution. Population growth in unrestricted environmental conditions is an ideal event that is unlikely to occur all the time because, of abiotic factors (Table 2) in reality, the carrying capacity of the environment in the form of supply and provision is limited (Tarumingkeng, 1994). This result is also influenced by abiotic factors. Abiotic factors have a strong relationship with the presence of individual weaver ants in the nest ($R=0.76$) (see Table 3). The plant age factor is also directly proportional to the presence of the entire population of weaver ants in the nest.

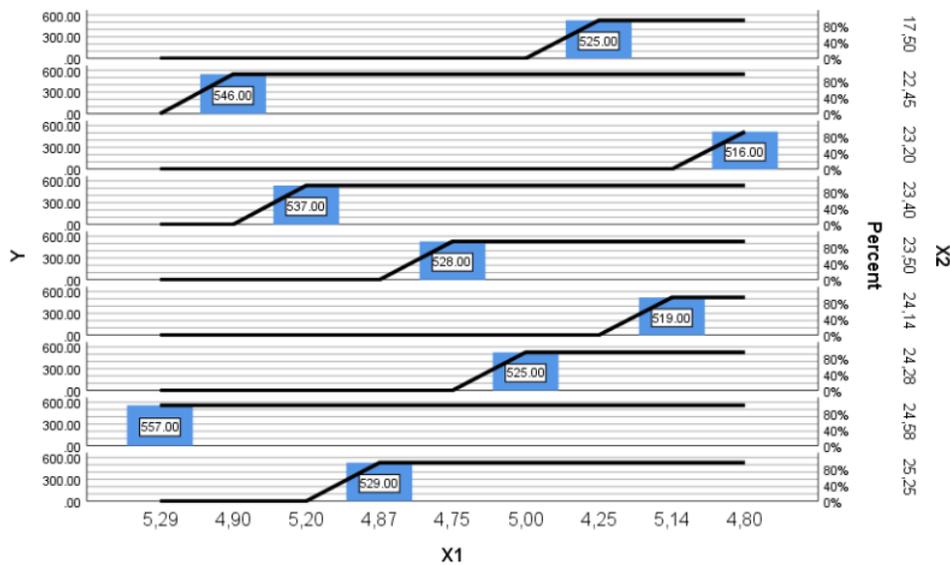


Figure 1. Graph of Analysis Regression Population Number of *O. smaragdina* Ants after 3 Weeks of Observation (X1= length, X2= width, Y=population ants)

In each nest of the weaver ant queen (*O. smaragdina*), there are males, females, warriors, larvae, and pupae, as shown in Table 1. The nest size was statistically analyzed, showing a wide variation, with the smallest of 74,38 cm² and the largest being 130,03 cm³ (Table 1). The number of individuals observed varied at different times in the oil palm plantations of different ages. During the first week of observation in 4-year-old oil palm farms, an average of 557 individuals was observed, which was the highest number. In the second week, the number of individuals decreased by an average of 519 (a total of 1570 individuals), and in the third week, the number of individuals increased by an average of 546. The weaver ant queen (*O. smaragdina*), males, females, warriors, larvae, and pupae can all be found in each nest. Table 1 shows that varying numbers of individuals were observed at different times in oil palm plantations of different ages. In the first week of observation, an average of 557 individuals was seen in oil palm farms aged 4 years, which was the highest number during the observation period. In the second week, the number of individuals decreased by an average of 519 (total 1570) individuals, and then in the third week, the number of individuals increased by an average of 546 individuals.

The population dynamics of weaver ants (*O. smaragdina*) nesting in three age groups of oil palm trees covering an area of 50 hectares in oil palm plantations are illustrated in Figure 1. For three weeks, and with three replications, observations of the nest population dynamics of

weaver ants (*O. smaragdina*) in the three oil palm age groups showed variations in nest populations. The number of ants in a nest varied, with an average range of 500 to 1500 individuals (as shown in Table 1), and approximately 300 adult ants in a colony. Soldier ants and worker ants work together to construct nests that imitate the shape of the plant's leaves. The other research in colony weaver ants found that ¹Workers show very high fidelity to trails, rarely switching between trails once they have been recruited (Ellis & Robinson, 2016; Gordon, Rosengren, & Sundström, 1992). We define a polydomous colony as two or more nests connected by inter-nest trails (Ellis et al., 2014). Our definition of a colony is based on functional resource exchange between nests, rather than based on aggression or relatedness. We used the same mapping method employed by Ellis et al. (2014) previously at this site to map the same colonies over 4 additional time points over the next 2 years. For each colony, at each mapping time point, we recorded the spatial and topological layout of the nests, trees, and trails. When documenting the trails, we measured the length of the trail, the compass direction of the trail, and the traffic on the trail. The traffic on the trail was measured as the length of the trail needed to find 10 workers, which can be converted into several ants per cm of trail and then the number of ants on the entire length of the trail.

The shape of the ant nest is influenced by the leaves of oil palm plants. The nests are tetragonal in shape and are parallel to one another (Figure 2). An ant colony is a large family with multiple nests and individuals that are familiar with each other and closely collaborate in a specific area. During a 3-week observation period, 75 ant nests were collected from oil palm trees aged 2-4 years. The nests were measured for length, width, and the number of individuals. The results show that the nests come in a variety of sizes and shapes. For example, the largest nest, with an average width of 5.29 cm and an average length of 24.58 cm, was obtained from 4-year-old oil palm plants in the first week of observation (see Figure 2). On the other hand, the smallest nest, with a width of 4.8 cm and a length of 23.2 cm, was found on 3-year-old oil palm plants in the second week of observation (see Table 1).

Arboreal ants, like *O. smaragdina*, build their nests in the tree canopy by weaving together numerous young leaves using silk extracted from the larva's mouth. These nests are polydomous, which means that one colony can inhabit multiple nests in the same or different trees (Holldobler & Wilson, 1990). A study showed that the most common nesting sites were on the 9th midrib, with as many as 58 nests. This can be attributed to the abundance of immature leaves on the 9th midrib, making it easier for the ants (*O. smaragdina*) to weave leaves into a nest. The uneven distribution of pheromones and their link to the likelihood of encountering an ant can impact Oecophylla interactions in various ways. Potential prey may avoid high-risk

6 areas. For example, the chrysomelid beetle *Rhyparida wallacei* avoids feeding on leaves contaminated with *O. smaragdina* anal spots, compared to leaves without these pheromones. This effect may cascade and lead to increased fitness of the host plant (Offenberg et al., 2004 a,b, 2006). Additionally, competing species may adjust their behavior in anticipation of future encounters with *Oecophylla* (Offenberg, 2007).

In addition to protecting the nest from natural enemies, the midribs also protect it from sunlight. Another discovery was that most nests were found between 1-2 meters above ground level, with a total of 62 nests from all age groups of oil palm. This is likely because being 1-2 meters above ground level makes it easier for weaver ants (*O. smaragdina*) to conduct their foraging activities. Depending on the nesting plant, each nest has a unique shape and properties. Nests of *O. smaragdina* found in oil palm plants are rectangular and come in different sizes. The size of the nest varies depending on its shape.

The composition and size of weaver ant nests (*O. smaragdina*) in oil palm plantations change with the seasons. This creates new opportunities for the development of *O. smaragdina*. The age of the oil palm plant and environmental factors affect the formation and expansion of *O. smaragdina* nests. Understanding the dynamics of *O. smaragdina* nests will help agricultural communities use weaver ants as a natural pest control method in oil palm fields. Two main models have been proposed to understand colony odor in social insects: the "gestalt" model and the "individualistic" model (Crozier & Dix 1979, Crozier & Pamilo 1996). According to the Gestalt model, individuals continuously exchange chemical cues with others, usually through trophallaxis (Boulay et al. 2000) or allogrooming (Schockaert et al. 1997, Lenoir & al. 2001). This results in a more or less uniform odor across the colony, made up of a blend of individual odors. According to the individualistic model, each individual retains its odor, with little or no exchange between individuals. Consequently, the colony odor consists of a greater or lesser variety of odors depending on the level of genetic and/or environmental diversity within the colony.



a



b



Figure 2. Form of a nest of arboreal ants (*O. smaragdina*) on oil palm plants: (a) rectangular shape located on young leaves, (b) triangular shape located on old leaves, (c) oval shape located on old leaves, and (d) hexagonal

The gestalt model is now widely accepted as the general rule among eusocial insects (Lenoir et al. 1999). However, there are some indications that a perfect colony gestalt is not always realized. Many aggression bioassays reveal a range of responses by individuals towards the same intruder. Boulay et al. (2000), for example, argued in favor of the gestalt model for *Camponotus felleus*, despite reporting that upon re-introduction to their colony of origin, workers that had been isolated from their colony for up to 40 days could be attacked by one worker and simultaneously solicited for trophallaxis by another. With the increase in the nest population, the worker ants also construct another nest called the satellite nest in another location of the host tree not far from the mother nest, which is a nest without a queen. This satellite nest was constructed to ease the mother nest from overpopulation and shift some of its broods. Major workers functioned as soldiers, few foragers, and minor workers attended the broods (Sangma and Surya, 2021)

Conclusion

Based on the results and discussion provided, we can conclude that in the study of population ecology, weaver ant nests vary in size, with a total of 4782 individuals observed. The study revealed that the highest number of individuals were found in four-year-old oil palm plants (1622 individuals), followed by two-year-old and three-year-old oil palm plants. It was observed that abiotic factors influence nest formation and population numbers on each plant. The shapes and characteristics of weaver ant (*O. smaragdina*) nests in oil palm plantations include rectangular and tetragonal shapes, which are influenced by biological factors such as food availability, natural enemies, and the presence of parents.

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