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

STUDI POPULASI EKOLOGIS DAN SARANG *Oecophylla smaragdina* FABR. DI PERKEBUNAN KELAPA SAWIT SEBAGAI INDIKATOR PENGENDALIAN BIOLOGIS

Irham Falahudin[1]*, Thoriq Alfarabi[2]
[1]*Departement of Biology, State Islamic University Raden Fatah Palembang-Indonesia*
[2]*Department of Biology Education, State Islamic University Raden Raden Fatah Palembang*
**Corresponding author:* irhamfalahudin_uin@radenfatah.ac.id

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Abstract

Weaver ants (*Oecophylla smaragdina* Fabr.) are social insects that have an ecological role in ecosystems of oil palm plantations. *Oecophylla* is a predator that prevents ant prey and influences interspecies competition. The study of the ecological population of *Oecophylla smaragdina* Fabr. Has not been reported, focusing on measuring nest and population density in plantations with varying ages. Important research in understanding the role of *Oecophylla* as a potential biological control agent in plantations. The purpose of the study was to determine the population density and nest as indicators of biological control. The study was conducted in Banyuasin Regency, South Sumatra, with a purposive sampling method, collecting ant nest data based on variations in plant age. The results of our study found that the number of individuals was 4,782 from various nests. The nests found were round and oval with an area ranging from 4.19–24.19 cm². The nests found were at a height of between 1 m and 3.4 m. Population and the formation of nests are also influenced by abiotic and biotic factors. The formation of nests is an indication of interactions between species and is an important factor in the study of the population ecology of *Oecophylla* as a biological control.

Keywords*:* Ecological population of *Oecophylla smaragdina* Fabr.; Nests; Oil palm plantion

Abstrak

Semut rangrang (Oecophylla smaragdina Fabr.) merupakan serangga sosial yang memiliki peran ekologis dalam ekosistem perkebunan kelapa sawit. Oecophylla merupakan predator untuk menghalangi mangsa semut dan memengaruhi persaingan antarspesies. Kajian ekologi populasi Oecophylla smaragdina Fabr. dengan mengukur bentuk sarang dan kepadatan populasinya pada tanaman kelapa sawit dengan variasi umur tanaman belum banyak informasi datanya. Penelitian ini menjadi penting untuk mendapatkan peran Oecophylla sebagai biologi kontrol hama yang potensial di perkebunan. Tujuan penelitian untuk mengetahui kepadatan populasi dan bentuk sarang sebagai indikator pengendalian biologis. Penelitian dilaksanakan di Kabupten Banyuasin Sumatera Selatan dengan metode purposive sampling yaitu pengumpualan data sarang semut berdasarkan variasi umur tanaman. Hasil penelitian ditemukan jumlah individu Oecophylla sebanyak 4,782 dari berbagai sarang. Sarang yang ditemukan berbentuk bulat dan lonjong dengan luas sarang berkisar antara 4,19–24,19 cm^2. Sarang yang ditemukan berada diketinggian antara 1 m hingga 3,4 m. Populasi Oecophylla dan terbentuknya sarang ini juga dipengaruhi oleh faktor abiotik dan biotik, terlihat dari hasil populasi berbeda. Pembentukan sarang berfungsi sebagai petunjuk interaksi antar spesies dan menjadi faktor penting dalam studi ekologi populasi Oecophylla sebagai pengendalian Biologis.

Kata kunci*: Ekologi populasi Oecophylla smaragdina Fabr.; Perkebunan kelapa sawit; Sarang*

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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 (Markus & Hamedani, 2007; Öst et al., 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). The canopy level, the actual importance of competition or, more precisely the strength of mosaic distribution, has been challenged (Ribas & Schroeder, 2002; Sanders et al., 2007). Canopy surface roughness, crown contact, and liana interconnection at mosaic gaps between ant territories may interfere with the process of competition (Blüthgen & Stork, 2007; Yanoviak & Kaspari, 2000), thus affecting the chances of detecting it, even in cases where competition is indeed a structuring force (Lach et al., 2010; Parr & Gibb, 2010). The role of these factors in ant species distribution has, at best, only been speculatively discussed in the literature (Dejean et al., 2010). 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 et al., 2017; Ellis & Robinson, 2016). Honeydew is the primary food source for wood ants, as it is a geographically and temporally stable resource (Domisch et al., 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 (Van Itterbeeck et al., 2014). In Southeast Asia, Australia, and Africa, *O. smaragdina* is consumed as food, and 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 (Crozier et al., 2010; Peng & Christian, 2005). 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.

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

The research was conducted in 2016 at an oil palm plantation in Banyuasin Regency-South Sumatera-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).

We investigated the study ecology of the nest networks of the colony waver ant *O. smaragdina*, a member of the ecologically important species group arboreal (Robinson & Stockan, 2016; Stockan & Robinson, 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, 1983; 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 m long transect on a 50 ha land area. The transect extended from southwest to northeast, with a distance of up to 10 m between each transect. In oil palm plantations, observation variables included nest distribution and nest architecture. Ant colony data were observed by tracing transect lines in oil palm farms with age variations of 2; 3; 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 et al., 2016; Robinson & Robinson, 2008).

All the nests were retrieved between 10:00 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 South Sumatra, 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 was collected using the method described below to estimate the species population of Weaver ants on the 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: $Y= \alpha + bx$ 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 $X1$= length (cm), $X2$= width (cm), Y= populace *O. smaragdina*. the value for y calculated from the regression equation is called the regression estimate of Y at the value.

RESULTS

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 (Figure 1). The temperature in the plantation varies between 30 and 32 °C. The soil is brown to blackish, with pH levels ranging from 5–6. The research area is 50 ha and consists of three oil palm age groups, namely 2; 3; and 4 years, as determined by tracing a 500 m long transect line consisting of 25 oil palm trees with a 20 m spacing between each position.

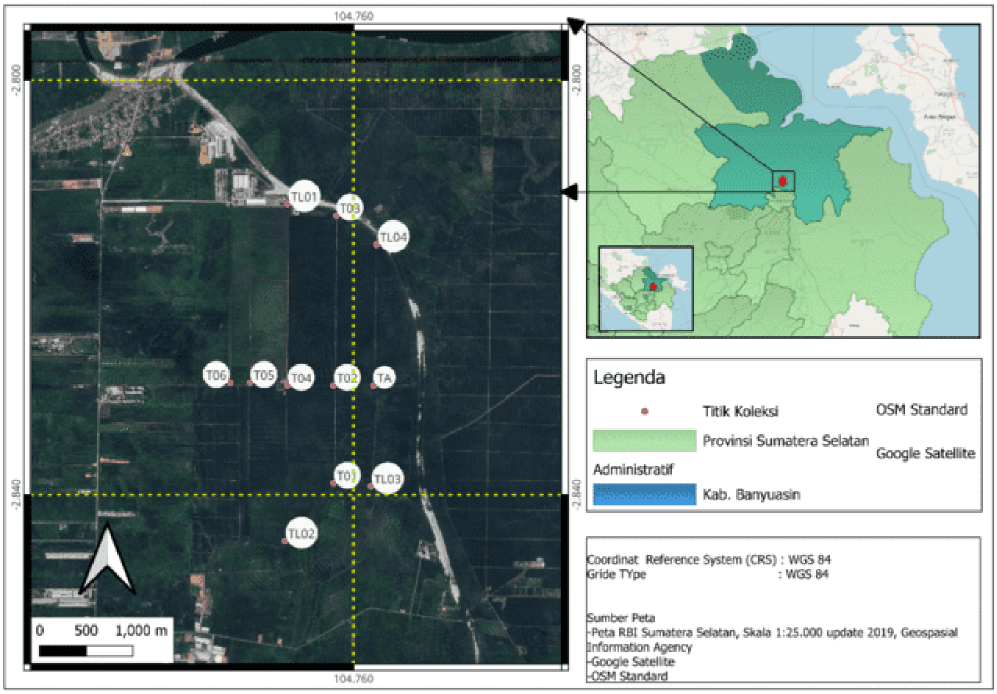

Figure 1. Map location research on Banyuasin Regency, South Sumatra

Ecological Studies of Nest Size and Number of Individuals

Research conducted on oil palm plantations has provided an overview of the population ecology of *O. smaragdina* with the number of individuals in the population differing at each age of the plants observed. 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.

Table 1. Average nest size and number of individuals during 3 weeks of observation

Age of palm oil (years)	A week	Width (cm)	Length (cm)	Wide (cm2)	Number of individuals
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

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 Tables 2, 3, 4, and Figure 2.

Table 2. 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

Note: a. predictors: (constant), width, length; b. predictors: (constant), width, length, and replication

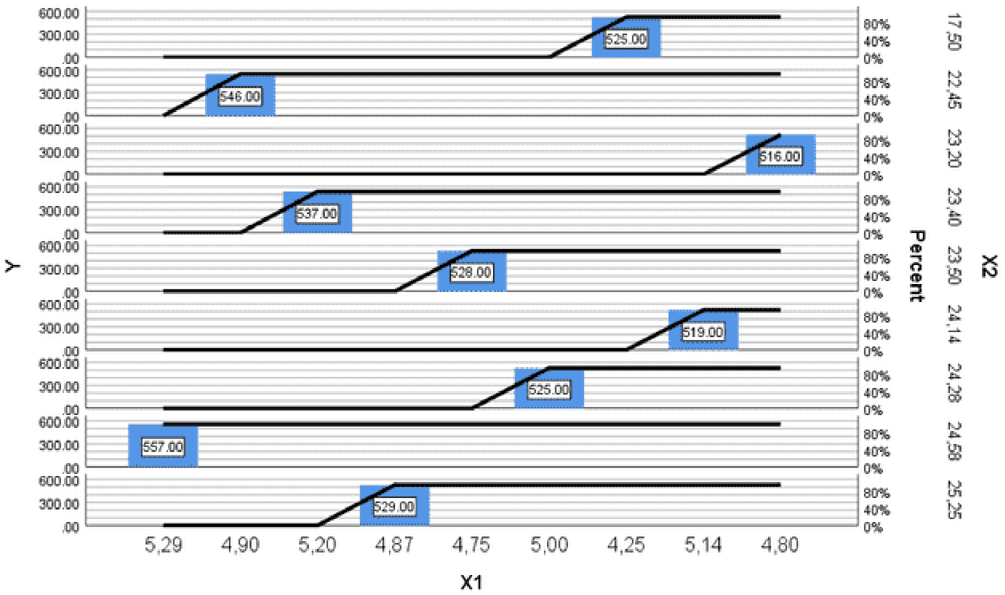

Figure 2. Graph of analysis regression population number of *Oecophylla smaragdina* Fabr. ants after 3 weeks of observation (X1= length, X2= width, Y= population ants)

Table 3. ANOVA[a]

No.	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			

Note: a. dependent variable: population *O. smaragdina*; b. predictors: (constant), width, length; c. predictors: (constant), width, length, and replication

Table 4. Excluded variables

Model	Beta in	t	Sig.	Partial correlation	Collinearity statistics tolerance
Replication	.079[b]	.185	.860	.082	.759

Note: a. dependent variable: population; b. predictors in the model: (constant), width, length

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 5. The 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 5. Results of environmental factor measurements (average/week)

Parameter	Week to-		
	I	II	III
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 on 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. Local habitat features in terms of composition, organization, and diversity of local communities. Habitat parameters comprised abiotic (e.g., temperature regimes, soil parameters) as well as biotic variables (e.g., structure and diversity of the underlying vegetation).

Observation and measurement of nest shapes found in the ecology of Oecophylla smaragdina populations on oil palm plantations in Banyuasin Regency. The results of observations of several ant nests carried out showed four variations in the shape of nest models formed from the duration and number of populations found as in Figure 3.

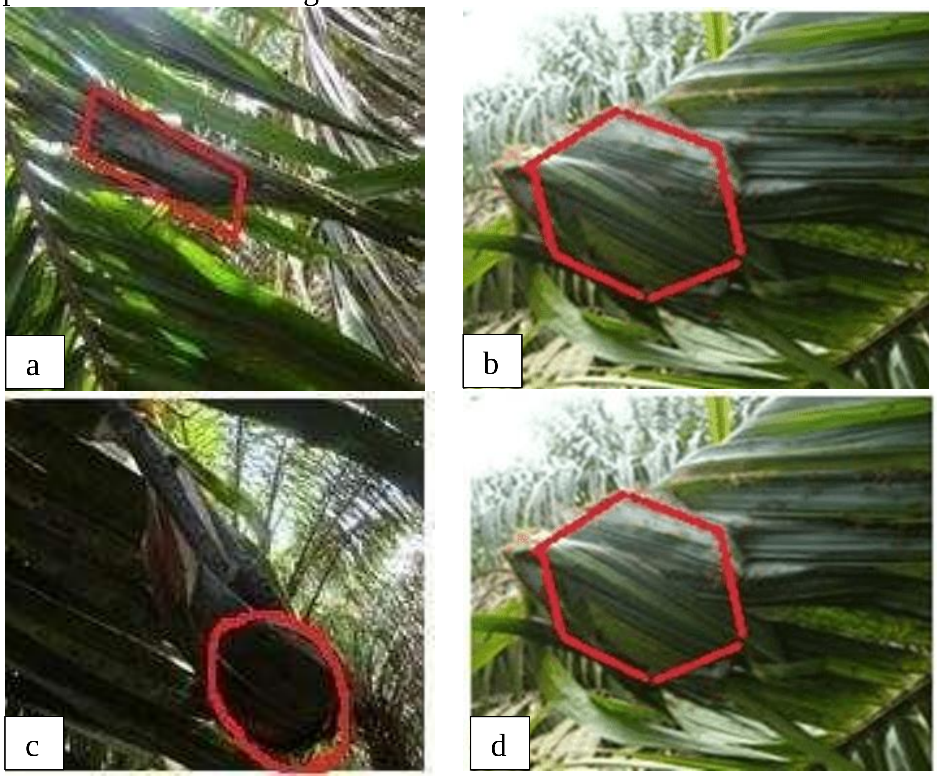

Figure 3. Form of a nest of arboreal ants (*O. smaragdina*) on oil palm plants: (a) rectangular shape located on young leaves, (b) triangular shape located on old leaves, (c) oval shape located on old leaves, and (d) hexagonal

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 and Zeswita (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 Martiningsia (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.

The ecology population of weaver ants is the most common *Hymenoptera* 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 & Cuc, 2004).

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, when 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 & Prasad, 2021).

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 (Tarumengkeng, 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) (Table 3). The plant age factor is also directly proportional to the presence of the entire population of weaver ants in the nest. Multidimensional statistics were applied to reveal which environmental parameters are important in structuring these communities (Pfeiffer et al., 2003; Wells et al., 2004; 2006).

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 cm^2 and the largest being 130.03 cm^3 (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 of 1,570) 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 ha 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 500–1.500 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 workers show very high fidelity to trails, rarely switching between trails once they have been recruited (Ellis & Robinson, 2016; Gordon et al., 1992). We define a polydomous colony as two or more nests connected by inter-nest trails (Ellis et al., 2017). 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., 2017) 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 the 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 (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 (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 (Hölldobler & 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 areas. For example, the chrysomelid beetle *Rhyparida Wallace* 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; 2005; 2013). 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 m above ground level, with a total of 62 nests from all age groups of oil palm. This is likely because being 1–2 m 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 & Pamilo, 1996; Crozier & Dix, 1979). According to the Gestalt model, individuals continuously exchange chemical cues with others, usually through trophallaxis (Boulay et al., 2000) or allogrooming (Lenoir et al., 2001; Schockaert et al., 2007). 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.

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.

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 fellah*, 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, a few foragers, and minor workers attended the broods (Sangma & Prasad, 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 4,782 individuals observed. The study revealed that the highest number of individuals was found in four-year-old oil palm plants (1,622 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. From the conclusions decided, several suggestions can be followed up, such as research on nest analysis based on plant types on plantations, whether they have the same or different population sizes, so in-depth research is needed to assist in the biology of pest control on plantations.

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