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Abundance of ants (Hymenoptera: Formicidae) and the functional groups in two different habitats

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Abstract. *Triyogo A, Budiadi, Widyastuti SM, Subrata SA, Budi SS. 2020. Abundance of ants (Hymenoptera: Formicidae) and the functional groups in two different habitats. Biodiversitas 21: 2079-2087.* Land development often affects the quantity and diversity of ants (Hymenoptera: Formicidae). The aim of this study, therefore, was to determine and compare the ant species abundance and the functional groups between two different habitats, representing land development, including pioneer and agroforestry. This research involved a survey of the ants at the Forest Research Education (FRE) of Wanagama I Yogyakarta, and data were accumulated over a period of five months (April, May, June, July, and August). In addition, pit-fall trap and direct collection methods were used, involving the placement of 54 pit-fall traps at two habitats, and the ant specimens were retrieved after a two day period. The results show the total individual abundance of 2,310 and 2,067, on agroforestry and pioneer, respectively. Furthermore, the species richness and diversity index was higher in agroforestry (7; 2.01), compared with pioneer (6; 1.49), where the three dominant species include, *Anoplolepis gracilipes*, *Solenopsis* sp., *Odontoponera denticulata*; and *Anoplolepis gracilipes*, *Odontoponera denticulata*, *Camponotus* sp., respectively. Conversely, the highest amount of invasive ants (*Solenopsis* sp.) was observed in agroforestry, which negatively impacted on the presence of native species (*Odontoponera denticulata*). In addition, PCA analysis showed the development of three ant groups on each habitat, hence agroforestry made more real differences in the aspect of species abundance, and none in terms of richness. Therefore, notable differences were observed in the ant communities between both habitats, and agroforestry was indicated as a disturbed area, based on the increment in tramp and invasive ants, alongside low abundance of native and functional groups.

Keywords: Agroforestry, ant diversity, functional group, pioneer habitat

INTRODUCTION

The process of land development or succession is generally followed by changes in the community structure over a certain period of time (Buma et al. 2017), aimed at restoring the ecosystem through species diversity and by the formation of new compositions. This progression is terminated after attaining balanced landscape conditions in the ecosystem, and restoring the damages made to the community. Furthermore, successions have traditionally been categorized as primary, which occurs in areas with no previous support for living organisms, or secondary, as seen in degraded forest regions, resulting from disturbances in remnant vegetation.

The habitat where succession occurs provides important information on vegetation or fauna diversity, and possible interactions between biotic and abiotic components (Mace et al. 2012). This process possibly occurs through (1) natural regeneration, or (2) accelerated by human intervention (Horn 1975), which specifically requires management decisions, during the selection of plant or site (Zhu 2005). This includes the practice of revegetation, and other forms of land use, including agroforestry practice (Triyogo et al. 2019). Furthermore, agroforestry practices are considered suitable for both ecological and economic benefits (van Noordwijk et al. 2012), due to the tendency to reduce risks associated with land damage (Jiang et al. 2017), ability to prevent damages from pests (Pumarino et al. 2015), and increase the farmers' income (Salazar-Diaz and Tixier 2019).

Previous studies on the impacts of land-use system, including agroforestry, and the relationship with arthropod diversity have been conducted (Triyogo et al. 2019), although researches to specifically examine the level of species response to variations in habitat types are limited. Moreover, numerous questions related to biodiversity in different habitats have been raised, with respect to the impact of changes in the shape of ecosystems, where the community at the species level is considered capable of describing the processes and functions (Gray et al. 2018) using ants as indicators (Folgarait 1998; Hashimoto & Mohamed 2010; Woodcock 2011). This approach is adopted because of the abundance (Schultz 2000) and voracity (Folgarait 1998) of this species, which poses important ecological functions (Del Toro et al. 2012; Meyer et al. 2013), and is also known to exhibit complex interactions during ecological condition assessment programs (Majer and Nichols 1998; Wang et al. 2001; Pecarevic et al. 2010).

Holldöbler and Wilson (1990) stated that ants indicate a healthy ecosystem, while the number of species significantly correlates with the faunal characteristics of soil (number of orders and richness) (Touyama et al. 2002). These are biological markers used to evaluate environmental changes, due to the ease of collection, the dominant characteristic biomass, advanced taxonomy, and sensitivity to environmental changes (Agosti and Alonso 2000; Shahabudin 2011). Furthermore, other studies on red-wood ant (*Formica lugubris*) provide an overview of the composition and concentration of heavy metals (Skaldina et al. 2018), despite the limitations experienced while specifically assessing of insect response on a species-level. These consequently raise questions connected with the possibility of differences in ant community structure between natural and agroforestry habitat, and the probability of being affected by changes in land development.

The Forest Research Education (FRE) of Wanagama I focus on the creation of suitable study materials related to the biophysical, hydrological and socio-economic success of succession processes, forest rehabilitation, and critical areas. These forest areas comprises of several compartments assumed to describe the process of land development, including the conditions of pioneers or agroforestry. However, studies on changes in the structure of ants community following various land developments at FRE has never been conducted, hence this investigation compares the communities in two different types of habitat assumed to represent possible variations in land development. Furthermore, the information about ant functional groups present in the studied areas are expected to serve as bioindicators of the current condition. The objectives of this research, therefore, were to compare (i) the diversity of ants in different habitats, (ii) the species composition as well as community structure, and (iii) the functional groups on ants.

MATERIALS AND METHODS

Study area

This study was performed in FRE of Wanagama 1, Gunung Kidul District, Yogyakarta Province, approximately 35 km south-east of Yogyakarta city, Indonesia. The research focus was on two different habitats representing land development, including: (i) pioneer, observed in compartment 6 (S 07°54.276′-E 110°31.518′). This region was mostly occupied by gamal tree (*Gliricidia sepium*), with the stand age of approximately more than 20 years, at the time of this investigation. (ii) Agroforestry area, conducted in compartment 17 (S 07°54.236′-E 110°31.917′). In addition, the distance recorded between both habitats was about 3 km (Figure 1).

The difference between these two habitats was marked by the vegetation component and human interventions (Table 1). Therefore, data on insect and environment were collected in April, May, June, July, and August 2018.

Ant collection and identification procedure

Ants were surveyed during a five-month period (April to August 2018). Table 2 shows the measurement of various parameters, which were recorded alongside, including air temperature of each plot, obtained with a temperature probe (Baldr Digital Thermometer), light intensity, determined using a digital lux meter (DX-100 Takemura Electric Works Ltd.), and also percentage humidity.

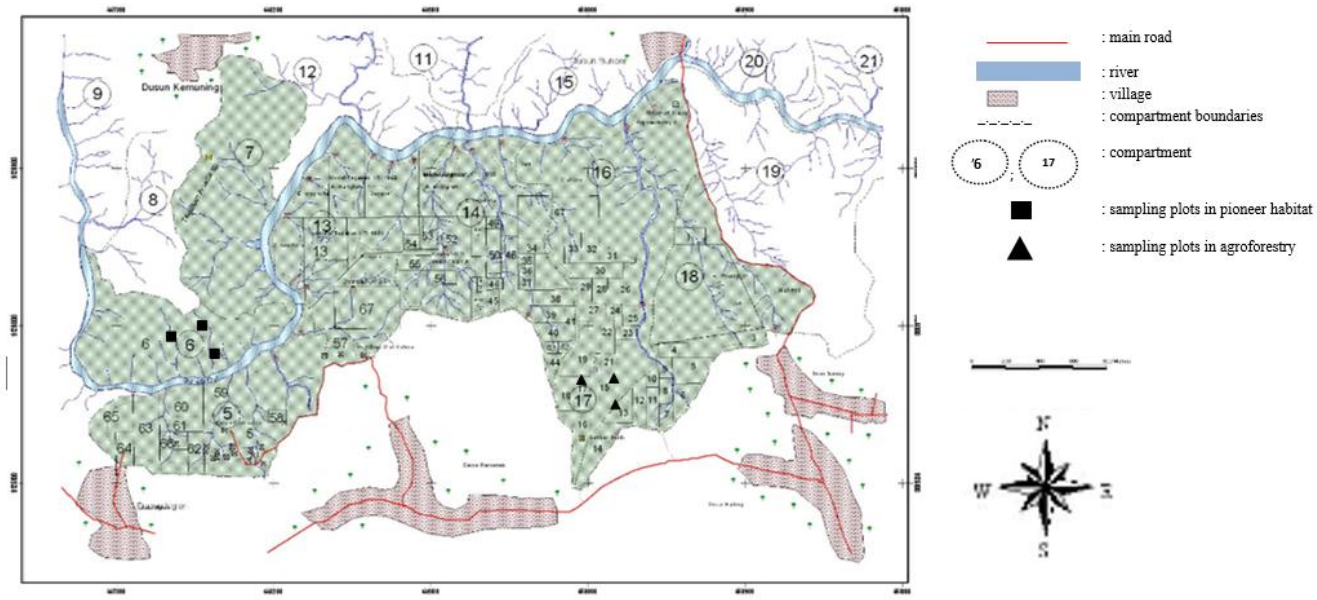

Figure 1. Map of the FRE Wanagama I. The spatial arrangement of the plots used on each habitat, pioneer (compartment 6) and agroforestry (compartment 17) was indicated by square and triangle form, respectively

Table 1. Description on each habitat, agroforestry and pioneer, was based on vegetation growth during the five observation months and data related to soil condition

Month-	Plant composition	
	Agroforestry	**Pioneer**
April	Trees (*Eucalyptus* sp.); Old perennial tropical grass *(Pennisetum purpureum*); weeds (*Ageratum conyzoides*); Legume (Groundnut *Arachis villosulicarpa*); Banana (*Musa* sp.); Empon-empon (Traditional medicinal plants); and Herbs.	Pioneer tree species (*G. sepium*); shrubs (*Caesalpinia sappan* and *Eupatorium odoratum*)
May	Trees (*Eucalyptus* sp.); Banana (*Musa* sp.); Empon-empon (Traditional Medicinal plants).	
June	Trees (*Eucalyptus* sp.); Cassava (*Manihot utilisima*); Banana (*Musa* sp.).	
July	Trees (*Eucalyptus* sp.); Young perennial tropical grass *(Pennisetum purpureum*); Cassava (*Manihot utilisima*); Banana (*Musa* sp.); and Herbs.	
August	Trees (*Eucalyptus* sp.); Young perennial tropical grass *(Pennisetum purpureum*); Cassava (*Manihot utilisima*); Banana (*Musa* sp.); Empon-empon (Traditional Medicinal plants); and Herbs.	
Description	In this present study, practice of agroforestry was in early level (Triyogo et al. 2017). This area has Alfisols soil (clay fraction is dominated by kaolinite) and deeper (up to 90 cm) soil depth (Supriyo 1992) found soil organic carbon content in 0-10 cm layer under various forest stands to vary from 1.3 to 2.8 %, with soil depth can be 110 cm deep (Supriyo et al. 2013; Supriyo 1992).	Prior to rehabilitation, the area was characterized by scarce and scattered soil patches between rocks. There were no human activities on this site. Plant pioneer species *G. sepium* dominated with various ages with dense crown density. Supriyo (2004) classified the soil that developed in these areas as Entisols (Lithosol) on the basis that it has shallow soil depth (< 20 cm).

Table 2. Environment condition on each habitat, agroforestry and pioneer, were observed on April to August 2018

Month	Agroforestry			Pioneer		
	Temperature (ºC)	**Humidity (%)**	**Light intensity (Lux)**	**Temperature (ºC)**	**Humidity (%)**	**Light intensity (Lux)**
April	31.3	77	8270.9	32	77	8087.6
	31	75.7	9570	32.5	75.7	8186
	31.6	78	8796.5	31	78	8056.7
May	32.9	73	7146.6	32	73	8298
	33	72.3	7021.6	32.5	72.3	8278
	32.8	73	7156	32	73	8196.7
June	32	65	7625	35	68.5	7233
	34.45	64.8	7565	32.4	67	7014.7
	34.15	65	7840	32.3	67.6	6729
July	33.7	69	12840	32.2	67.5	9600
	32	69	11450	31	74	9689.7
	32	71	12057	31.5	75	9674
August	41.6	43	14500	36.7	67	10900
	42.8	44.5	14489	38	68.7	9889.7
	42.9	43	14340	40	66	9736.9

A total of 6 sampling plots, measuring 20x20 m^2 were randomly placed on the habitats, with pioneer and agroforestry consisting of 3 each. Also, 9 pitfall traps were placed in the center of the individual plot, by using a grid method (Triyogo et al. 2017; 2019), hence a total of 108 were set up at each observation time. Therefore, the ant collection process was performed two times in a month (once per two weeks), summing up to 10 observations during the five-month period. The pitfall trap was a plastic container measuring 45 mm in diameter and 55 mm deep, which was half-filled with 50% ethylene solution, and buried with the rim flush to the ground surface at each point (Ribeiro et al. 2011). In addition, an inverted petridish was positioned directly above each trap to avoid filling by rainfall, without impeding the access by ants.

Furthermore, the ants were counted in digital photographs of ceramic plates, and the collected insects are brought to the laboratory for identification up to the species level. In addition, specimen observation was conducted using the stereomicroscope (SCW PG Carton Optical Industries), while taxonomic keys were used for species identification (Bolton 1994; McArthur 2007; Heterick 2009; Terayama 2009), and through online ant databases (Antweb.org, Antbase.net) Therefore, classification was

performed based on the five functional groups, including: (i) Generalized Myrmicinae (GM): *Crematogaster* sp.; (ii) Opportunist (OPP): (*A. gracilipes*, *Tetramorium* sp., *P. megacephala*); (iii) Cryptic species (CS): *Pyramica* sp., *Solenopsis* sp.; (iv) Subordinate Camponotini (SC): *Camponotus* sp.; and (v) Specialist Predator (SP); *O. denticulata* (Andersen 1995, 1997).

Data analysis

The number of genus, subfamily and species obtained from the two habitats was counted for each observation month. Subsequently, the total abundance of individual ant per species was pooled based on habitat, and the relative abundance (number of individual per ant species per trap) was also calculated. In addition, species richness, Diversity (H`) (Krebs (2009) and Evenness index's (J`) (Pielou 1969) were measured, and Morisita`s similarity index (Morisita 1959) was used to make a comparison between the ant communities of both areas under investigation.

The abundance of individual ants was pooled for each habitat, on the basis of functional groups (Andersen 1995, 1997). The data obtained was adopted in the exploration of community structure, using the principal coordinates analysis (PCA), while vector overlays were applied to visualize the species correlated with the first two axes. In addition, vector calculation was performed based on the correlation between each species' abundance and the first two PCA axes, and is known to indicate the strength and sign of the relationship between each species and the PCA axes. However, only vectors measuring a length of at least 0.5 were included, and X^2 test was used to compare the difference in functional structure (a total of species and individuals) between two habitats on a 5 x 2 contingency table. Statistical analyses were performed using SPSS version 22.0.

RESULTS AND DISCUSSION

Diversity of ants

Table 3 shows a total of 4,373 ants, belonging to eight species and three subfamilies, recorded during the five-month observation period (April-August).

The total abundance of each species varied between the study locations (Figure 2.A), and with the exception of *P. megacephala*, *Solenopsis* sp., and *Pyramica* sp., the others were identified in both agroforestry and pioneer. Meanwhile, observation in terms of relative abundance showed variations between both habitats (Figure 2.B), with *A. gracilipes* being comparably higher, and *O. denticulata* lower on agroforestry. In addition, *Solenopsis* sp. was not present in the pioneer area, while *Pyramica* sp. was recognized in low abundance, and absent on agroforestry.

Our results demonstrate a comparably higher total abundance of ant species on agroforestry habitat, characterized by species richness and diversity (Table 4). However, the result shows similarity in terms of ant community between both sample locations (Table 4).

The results of eigenvalues for the three axes of Principal Component Analysis (PCA) regarding the abundance of eight species were 2.96, 1.77, and 1.40 on agroforestry, which provided 87.3% explanation for variance, in the aspect of species abundance. Meanwhile, the values reported for pioneer were 2.62, 1.67, and 1.07, explaining 89.4% of the variance. Figures 3.A and 3.B showed differences in the community structures, while PCA for the abundance of ant species in paired agroforestry (Figure 3.A) and pioneer (Figure 3.B) indicated a strong tendency for three groups on each habitat type.

Each functional group showed different changes in terms of richness and abundance, particularly in the lower units of pioneer habitat, with the exception of GM, while OPP demonstrated the least value (Figures 4.A and 4.B). Based on these conditions, a comparison of the five groups showed no significant difference between habitat type (X^2 test, df=3, $p>0.05$), although the parameter of functional composition obtained using abundance was significantly different ($p<0.01$). Therefore, GM and CS were identified to be higher on agroforestry, while OPP, SP, and SC were more superior in pioneer.

Table 4. Species richness, Diversity (H`), Evenness (E`), and Similarity index among ant communities at two different habitats

Type of habitat	Species richness	Diversity (H`)	Evenness (E`)	Similarity
Agroforestry	7	2.01	0.28	0.83
Pioneer	6	1.49	0.30	

Table 3. The presence of ant on subfamily and species level on two different habitats during five observation month

Subfamily	Species	Agroforestry					Pioneer				
		April	May	June	July	August	April	May	June	July	August
Formicinae	*Anoplolepis gracilipes*	+	+	+	+	+	+	+	+	+	+
Formicinae	*Camponotus* sp.					+				+	+
Ponerinae	*Odontoponera denticulata*	+	+	+	+	+	+	+	+	+	+
Myrmicinae	*Crematogaster* sp.	+	+	+	+	+			+		+
Myrmicinae	*Tetramorium* sp.		+							+	+
Myrmicinae	*Pheidole megacephala*		+								
Myrmicinae	*Pyramica* sp.									+	
Myrmicinae	*Solenopsis* sp.				+	+					

Note: "+"= present

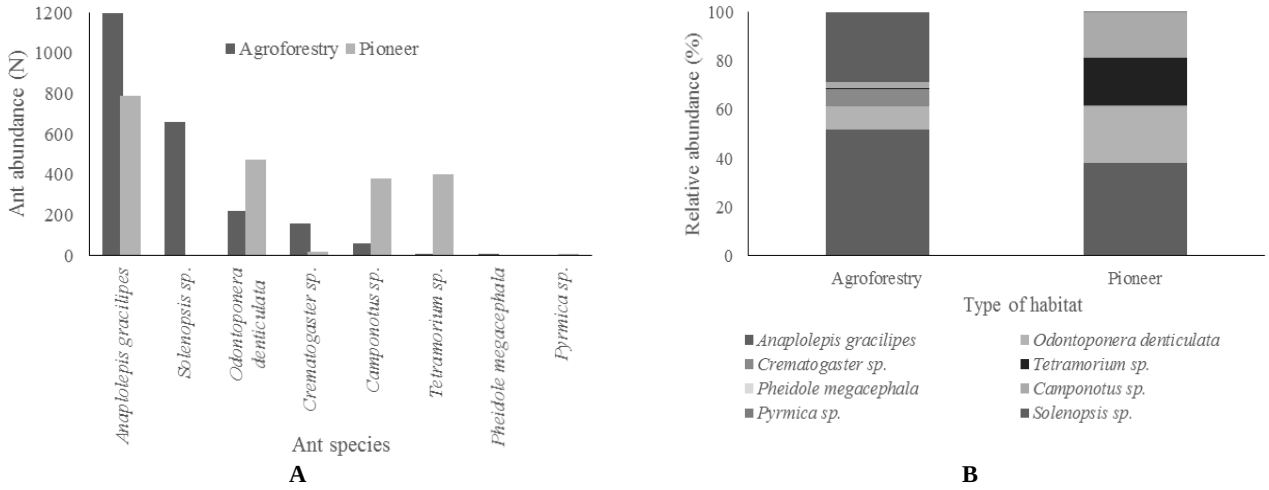

Figure 2. Observation of ant species at two different types of habitats. A. The total abundance of ant species, and b. Percentage of ant species

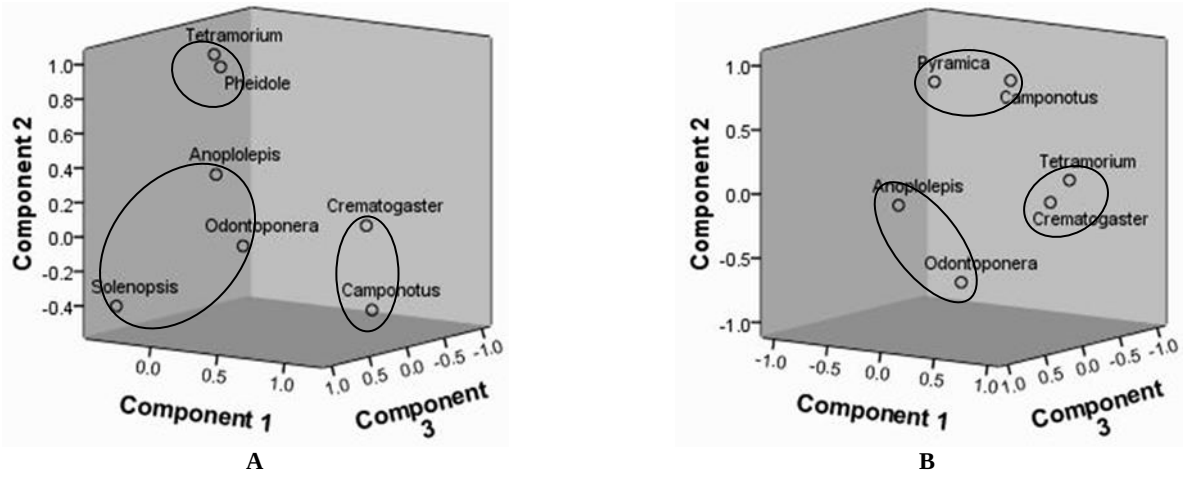

Figure 3. Principal component analysis of community structure based on abundance data on two types of habitats: A. Agroforestry, B. Pioneer land

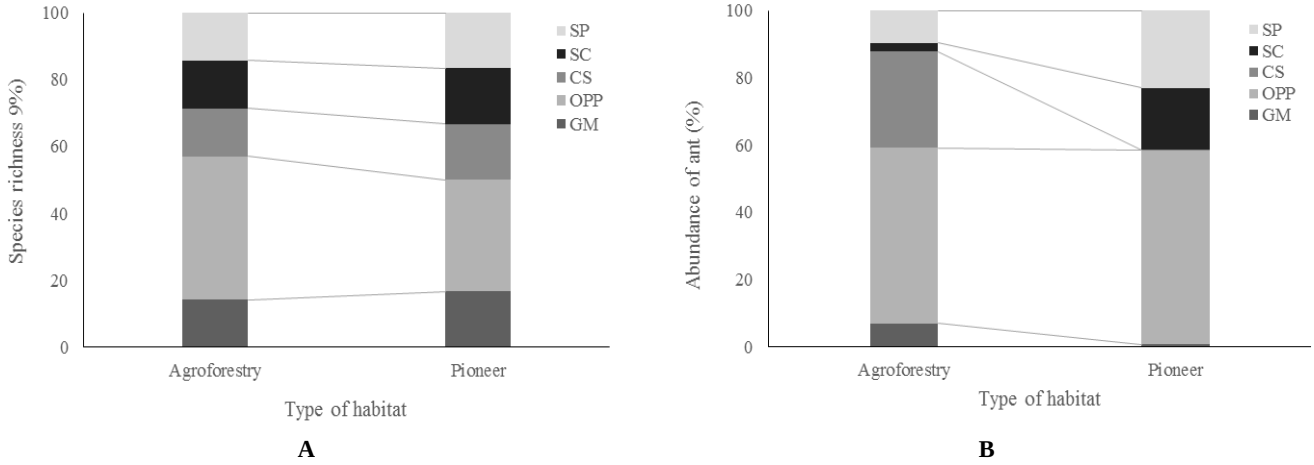

Figure 4. Composition of species richness (A) and abundance (B) in five functional groups. Functional groups were defined as follows (Andersen 1995, 1997): GM, Generalized Myrmicinae (*Crematogaster* sp.); OPP: Opportunist (*Anoplolepis gracilipes*, *Tetramorium* sp., *Pheidole megacephala*); CS: Cryptic species (*Pyramica* sp., *Solenopsis* sp.); SC: Subordinate Camponotini (*Camponotus* sp.); SP: Specialist Predator (*Odontoponera denticulata*). Different letters above the bar indicate significant difference in different habitats

Discussion

Diversity of ants

The presence of ants has been highlighted a major bioindicator in ecosystems (Diamé et al. 2018; Andersen 2018). However, relatively few studies have examined the possible differential abundance, based on functional groups on different used lands or habitats. This study aimed at identifying the differences in patterns between the richness, abundance, and functional groups of ant species identified in agroforestry and pioneer habitats. The results showed a higher abundance in the agroforestry, which is a human landscape modified by integrating woody vegetation (trees or shrubs) with crops and animal production systems (Mosquera-Losada et al. 2009; Torralba et al. 2016). This system consequently increases the biodiversity and ecosystem services (Torralba et al. 2016), and plant diversity was observed to be a stronger predictor of ant diversity (Li et al. 2017). Conversely, pioneer habitat represented the former condition of FRE Wanagama I as a critical land, which is dominated by soil and rocks, covered by the dominant species of *G. sepium* and understories. In addition, the directional modification in plant communities observed at a certain time (from the pioneer to the next level of succession), was generally followed by a change in the extent of interaction between plants and consumers (phytophagous insect) (Brown 1984), while the value for abundance correlates with the above-ground vegetation as a food resource, and also as a protectant against phytophagous organisms (Rubiana et al. 2015).

This study results show the inability for differences in plant structure and composition to vary the dominant ant species between the locations under investigation. In addition, *A. gracilipes* was identified as the most abundant in both, followed by *Solenopsis* sp. (identified in only agroforestry), *Crematogaster* sp. (abundant in agroforestry), *O. denticulata, Camponotus* sp. and *Tetramorium* sp. (abundant in pioneer), while *P. megacephala* and *Pyramica* sp occurred in low amounts in the two habitats.

Anoplolepis gracilipes is a yellow crazy ant with strong invasive characteristics, which originates from Asian regions and is known to exhibit pest behaviors (Wetterer 2005; Drescher et al. 2007; Tschinkel and King 2017). This present study shows thes dominance of this species in both habitats. In addition, *A. gracilipes* has previously been documented as a useful indicator, due to the fast spreading accompanying changes in habitat, alongside the intirinsic ability to influence native species (Gillespie and Reimer 1993; Sinu et al. 2017). Previous study have also reported this species as behaviorally dominant in terms of speedy discovery and monopolization of food baits, compared with the native ants (Drescher et al. 2011), Furthermore, they are capability of building supercolonies (Stewart et al. 2014; Sinu et al. 2017), indicating the ability to affect the indigenous fauna and biotic interactions on a novel habitat. The study outcome supports previous reports stipulating an association between the ant and land-use systems with the characteristic features of low tree canopy cover (Bos et al. 2008), identified in the agroforestry area. However, the dominance of *A. gracilipes* in both investigated locations indirectly shows the potential capacity to monopolize numerous living resources.

The results also demonstrate the positive impact of agroforestry on the abundance of *Solenopsis* sp., which was not feasible in the pioneer, while *P. megacephala* was recognized as a low abundant species in agroforestry. Previous study demonstrated how the positive effects of plant diversification in agroecosystems cause an upsurge in the prevalence of a predator (Dassou and Tixier 2016), while some other researches established a strong association between the genus *Solenopsis* populations and human-altered habitats (Zettler et al. 2004), as seen in agroforestry. Hence, these systems and other anthropological activities are expected to have an indirect positive impact in terms of abundance, into becoming a cosmopolitan tramp species (Tschinkel 2006; Ascunce et al. 2011).

The abundance of the native ant *O. denticulate* was comparably higher on the pioneer area. Previous study reported on the possibility for the genus *Odontoponera* to prefer inhibiting specific regions (Yamane 2009; Terayama 2009), as seen in the features of the pioneer land observed in this study. Therefore, the lower abundance in agroforestry was attributed to the pressure of three aggressive and invasive species, including the dominant *Solenopsis* sp., and *A. gracilipes*, alongside *P. megacephala* which was low in abundance. This outcome corroborates the findings that recognize the existence of invasive species as an important indicator of damaging possibilities towards the local communities (Rabitsch 2011), therefore leading to a decline in the species richness and evenness of ant community (Chan and Guenard 2019).

This study data affiliates the abundant of *Crematogaster* sp. in agroforestry with the presence of crops and the factor of temperature. The assumption was based on the report stipulating the genus *Crematogaster* as a group of nectar foraging minor pests of some plants, which exhibit greater activity in the afternoon (Sanfiorenzo et al. 2018; Patient et al. 2019). However, *Crematogaster* was also identified in pioneer, due to the intrinsic ability for the genus cosmopolitan to thrive in a variety of habitats, including tree canopies or on branches (Gawade and Patwardhan 2019; Radchenko and Dlussky 2019). Conversely, an observation of the *Camponotus* sp. showed a different pattern, with greater abundance in the pioneer area, although both *Camponotus* and *Crematogasters* form associations known as parabiosis, under similar habitats (Menzel et al. 2008; Orivel and Leroy 2011). This study result showed the respectively higher suitability in pioneer and agroforestry habitat.

Community structure

Our study shows a total of three groups of ant communities amongst the two habitats, which include firstly, C*amponatus* sp. and *Crematogaster* sp., as the generalized predators in agroforestry. This association has been identified in many parts of the world (Menzel et al. 2008), characterized by the ability to share similar foraging trails and nests, and is also known as parabiosis (Orivel and Leroy 2011). These two insects have also been affiliated

with extrafloral nectaries (Santos and Del-Claro 2009; Sanfiorenzo 2018), and previous reports have explained the inability for parabiotic ants to prefer foraging in the understory plants or on the ground. Hence, there is a reduced tendency of widespread in the soil and vegetation (Vicente et al. 2014, 2016). As shown in the pioneer habitat, *Camponotus* sp. tends to be close with *Pyramica* sp. while *Crematogaster* sp. closer with *Tetramorium* sp .. Thus, our results indicate that the association that has existed in another habitat was able to change due to the presence of other ants species or change of habitat.

Secondly: the combination of *A. gracilipes*, *Solenopsis* sp, and *O.denticulate* identified either in agroforestry, which collectively play an important role as a predator, including similarities in the characteristics of sensitivity towards habitat disturbances. Conversely, intercropping was identified as a practical way of increasing plant diversity in agroecosystems, which provides an alternative food and habitat source to arthropods, including general predators (Dassou et al. 2015; Rubiana et al. 2015), and also the studied cropping systems. This was due to the ability to contribute towards several ecosystems, including the aspect of pest regulation (Dassou et al. 2016).

Thirdly; the final group consisted of *Tetramorium* sp and *P. megacephala* was found in agroforestry habitat. Previous studies have shown the high tendency for genus *Pheidole* and *Tetramorium* of tramp species to exist in habitats with the human association (agroecosystem in this study), and also exhibit invasive characteristics (McGlynn 1999; Schultz and McGlynn 2000; Rubiana 2015).

Functional groups

Despite the species and abundance of ants, another approach towards determining the conditions of an ecosystem was by observing the variations in functional groups (Read and Anderson 2000), which cause altertions in processes and services (Gonzáles et al. 2018). In addition, ant diversity is generally known to increase alongside an elevation in land quality and plant composition (Rubiana et al. 2015; Dassau and Tixier 2016), which is consistent with the findings of this current investigation, which showed no difference in the functional group of both study locations. However, the pattern indicates greater values, based on the species richness, and also significantly higher records for GM and CS, in terms of ant abundance, in the agroforestry, compared to pioneer. This is in accordance with a previous study, which reported on the greater effect of different land quality on the structure of ant community, compared to diversity (Kwon et al. 2014).

The most common ants present in both locations were the OPP, which has previously been reported as general foragers, known to occupy waste ground or poor habitat (Andersen 1995). In addition, the subordinate, camponotini, presented with similar pattern as SP. The functional group data demonstrated a preference for SC in the pioneer lands, characterized by low plant diversity and the dominance of one plant species, subsequently leading to colonization by SP. However, low plant diversity tends to influence an increase in specialist herbivores on a smaller scale (Dassau and Tixier 2016), which consequently affects SP abundance positively.

The abundance of SC on pioneer suggests the habitat to be an undisturbed area, representing the initial condition of FRE Wanagama I as a critical location with naturally occurring succession and minimum human interventions. In addition, the dominance of *G. sepium* tree species within a wide age range results in the development of a closed canopy cover, which leads to littered forest floors. Conversely, the agroforestry is a developed form of pioneer, devoid of canopy covers. These areas are characterized by high human activities, including land management, clearing, weeding, planting, and crop plant maintenance. The appearance of GM is generally related to the level of land damage, which is apparently unaffected by use modifications (Gómez et al. 2013). This investigation demonstrated an unexpectedly abundant amount of GM in agroforestry, which presumably resulted from the lack of interaction between ant species, while group SC and SP were more in the pioneer habitat. Furthermore, several factors were assumed to influence the shape of structure and the community of ant, including interspecific relationships (Hölldobler and Wilson 1990), as well as interactions with plants, animals and fungi (Schultz and McGlynn 2000).

In conclusion, there were variations between the ant communities in natural habitat (pioneer) and those exposed to human interventions (agroforestry). Based on functional groups, significant differences were observed in terms of ant abundance, which was on the basis of species richness. Furthermore, an increment in tramp ants, alongside the low abundance of native species, and the nature of the functional groups found in agroforestry are indicative of a disturbed area. These results suggest the need to conduct proper practices, in order to provide an ecologically positive impact.

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