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# The Dominance of Tramps Ants in The Settlement Area of Semarang, Central Java

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## Abstract

The high rate of urbanization in Semarang have caused the land conversion from forest into various human need spaces. The land conversion is not only affect the life of humans but also the animals, including ants. The objectives of this study were to examine the dominance of tramp ants in the settlement area of Semarang City. The method used was the bait trap method using chicken intestine as a bait. Samples of ants were collected from four habitats, i.e., waste disposal area, traditional markets, house area, and urban parks. This study found four dominant ants, i.e., *Anoplolepis gracilipes, Paratrechina longicornis, Solenopsis geminata* and *Monomorium pharaonis*. Two of them were categorized as tramp ants (*Anoplolepis gracillipes* and *Paratrechina longicornis*). The highest diversity of ants was found in house (H'= 2.72). The waste area tends to be an ideal habitat for particular species, which was proved by the low value of Simpson's dominance index (iD = 0.06) and a high value of evenness index (E=0 0.89). This study provides new information about tramp ants population as pest in urban area. The findings would be beneficial for controlling the population of tramp ants, which are disturbing humans in the settlement area.

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## INTRODUCTION

As one of the big cities in Indonesia, Semarang has become an urbanization destination to improve people's destiny. The population is increasing from year to year in which resulted in an increasing need for shelter. Settlements are the top land use in the city of Semarang with a total area of 373.70 km$^2$ (Central Statistics Agency of Semarang City, 2015). Ecosystem transformation from forest to urban development have imposed pressures on biological diversity (Rastogi, 2011)

The high land-use alteration from forests to settlements certainly have an impact on spesies richness and disturbing various animal habitats including insect (Carpintero & Lopez, 2014). Thus, insects tend to look for the new habitats that coexist with human existence. Indirectly, humans facilitate insects by providing food sources, suitable shelter and also helping them to spread to other places. Gullan and Cranston (2010) suggested that human activities that inadvertently facilitate these insects can cause a negative impact on urban areas. One of the insects that has a significant impact on the urban area is ants.

Ants are social insects that have a hierarchy in their castes, namely male ants, queens, workers, and soldiers. Ants are some of the most numerous and ecologically important animals in the world and occur in most terrestrial biomes from the tropics to the arctic zone (Klimes & Okrouhlk., 2015). The ants have a strong correlation with ecosystems variable such as vegetation, microclimate, soil, and other soil fauna (Latumahina et al., 2015). The existence of ants also can play a role as a bioindicator for agricultural ecosystem condition (Meidalima et al., 2017). Tramp ants are an omnivorous group of ants and only need a simple place to live such as home appliances and wood gaps. The dominance of tramp ants has a negative impact on biodiversity and even for humans.

The relationship between tramp ant species and their habitat in urban areas has been widely studied, among others, in Bogor (Rizali et al, 2008) and in Palu area (Hasriyanty et al, 2013). However, there was still not much research that discusses the existence of tramp ants and their influence on the community structure of ants in settlements. This study is important because the tramp ants could affect negatively not only on fauna diversity but also on humans. Hence, it is necessary to conduct ants population management based on their characteristics.

The objectives of this study were to examine the community structure of ants and the dominance of tramp ants in the area of the settlement in Semarang City. This study was expected to determine the impact of the tramps ants on urban area along with its management.

## METHODS

The research was carried out in several habitats in the residential area of Semarang City. The research areas were grouped into four habitats, i.e. temporary waste, markets, homes, and parks. Ant samples in each habitat were from three altitude groups (0-10, 101-200 and 201-300 m asl). Each habitat consisted of 20 plots, so that a total of 240 plots were found. Observation and sampling of ants in each plot was carried out using chicken intestine as the bait due to it was easily obtained and it had a high nutrient content.

This method was carried out to obtain ants species and know the role of ants in each habitat (Wielgoss et al., 2010). Ant sampling was carried out for ± 2 hours by observing the ants that come to the bait. The number of ants was calculated and the ant was collected in bottles containing 70% alcohol for identification in the laboratory. Ant sampling was carried out in the morning at 09.00 - 11.00 WIB. Physical environmental factors measured in this study including air temperature, air humidity, and light intensity. The study was conducted in September 2018 - January 2019.

### Identification of ant specimens

All specimens obtained were identified to the species level by referring to Bolton's identification key (Bolton, 1994). Identification keys at the species level were based on observations on the number of petioles, the shape of the abdomen, the shape of the petiole, the shape of the mandible and also the number of segments in the abdomen.

### Data analysis

The structure of ants communities and dominance of tramp ants in settlement areas was analyzed using relative abundance index, Shannon-Wiener diversity index, evenness index, and species dominance index.

## RESULTS AND DISCUSSION

The richness species of ants obtained in various area of residential settlements in the city of Semarang amounted to 28 species and the total number of individuals was 13.390. Of all species found, several types of ants were only found in

park habitat, i.e. *Ponera* sp. and *Diacamma rugosum*.

Tramp species namely *Anoplolepis gracilipes* and *Paratrechina longicornis* were found in all research site. This sentence is consistent with Apriyanto's (2015) research that the types of ants found in urban areas are P. *longicornis* and A. *gracilipes*.These tramp ants can use narrow spaces or gaps to build nests and can also compete in the competition for food sources with other ant species.

**The abundance of ant species in residential areas**

The abundance index of ant species in the settlements of Semarang City shows varied results. Ants found in all study site were *P. longicornis* and *A. gracilipes* while ants that were only found in park habitats were *Ponera* sp, and *Diacamma rugosum* (Table 1). High levels of ant population in one habitat are affected by competition factors, especially food and roaming areas where stronger ant species will monopolize food sources and roaming areas (Latumahina et al., 2018).

**Table 1**. The relative abundance index (%) of ants in each habitat in the settlement area of Semarang City, H: Houses, TM: Traditional markets, P: Parks, W : Waste Disposal, 1: altitude of 0-100 m, 2: altitude of 101-200 m and 3: altitude of 201-300 m.

| Species | Habitat | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H1 | TM1 | P1 | W1 | H2 | TM2 | P2 | W2 | H3 | TM3 | P3 | W3 |
| D. thoracicus | 3,4 | 0 | 0 | 2.8 | 5.3 | 0 | 5.2 | 2.7 | 7 | 0 | 0 | 4.8 |
| *T. melanocephalum* | 6.6 | 9.1 | 4.4 | 10.1 | 4.1 | 12.1 | 12 | 10.2 | 4.1 | 6.6 | 4.2 | 7 |
| *Crematogaster* sp | 0 | 8.1 | 0 | 4.3 | 0 | 8.7 | 0 | 5.7 | 0.4 | 5.6 | 0 | 4.2 |
| *M. pharaonis* | 10.3+ | 10.5+ | 0 | 9.1 | 11.2+ | 10.8+ | 0 | 0.9 | 5 | 11+ | 4.5 | 2.3 |
| *M. destructor* | 5,8 | 6.2 | 0 | 8.1 | 2.8 | 4.3 | 0 | 2,4 | 2.9 | 4.1 | 0 | 4 |
| *M. floricola* | 0 | 5.5 | 0 | 4.9 | 0 | 8.8 | 0 | 3.9 | 0 | 6.5 | 0 | 2.8 |
| *O. smaragdina* | 2.3 | 0 | 3.4 | 0 | 5.9 | 0 | 6.1 | 0 | 0 | 0 | 2.4 | 0 |
| *O. simillimus* | 1 | 3 | 0 | 0 | 1 | 1.1 | 0 | 0 | 1 | 4.1 | 1.3 | 0 |
| *S. geminata* | 6.9 | 0 | 22.4+ | 0 | 6.6 | 0 | 14.3+ | 4.2 | 12.2+ | 0 | 19.1+ | 6.2 |
| *S. invicta* | 4.4 | 0 | 13.6 | 5.3 | 3 | 0 | 0 | 0 | 10.3 | 0 | 11.3 | 0 |
| *A. gracilipes** | 11.1+ | 13.9+ | 21.5+ | 10.9+ | 8.2 | 12.4+ | 27.9+ | 13.4+ | 7.9 | 8.1 | 20.7+ | 14.6+ |
| *P. longicornis** | 14.6+ | 19.9+ | 15.6+ | 16.7+ | 12+ | 18+ | 19.3+ | 14.8+ | 10.4+ | 17.9+ | 26.7+ | 16.3+ |
| *O. denticulata* | 1.4 | 0 | 2.5 | 0 | 0.7 | 0 | 2.9 | 0.4 | 2 | 0 | 1.4 | 0.2 |
| *D. rugosum* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 | 0 |
| *P. arcuata* | 1.5 | 0 | 1.7 | 0 | 0.6 | 0 | 0 | 1.7 | 1.4 | 0 | 0 | 2.2 |
| *T. pacificum* | 5.4 | 0 | 0 | 4.9 | 6.8 | 0 | 0 | 6.9 | 16.6 | 0 | 0 | 4.5 |
| *T. bicarinatum* | 9.3 | 4.7 | 5.2 | 6.6 | 9.3 | 3.3 | 2.6 | 10.9 | 0 | 5.6 | 0 | 11.6 |
| *C. albosparsus* | 0 | 3.7 | 0.9 | 0 | 0 | 5.8 | 1.3 | 0.5 | 0 | 6.6 | 0 | 0.6 |
| *C. barbatus* | 0 | 6.6 | 0 | 0 | 0 | 3.9 | 0 | 0 | 0 | 13.8 | 1.1 | 0 |
| *Irydomirmex* sp | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 | 2 | 0 | 0 | 0 | 2.7 |
| *Pheidole* sp | 0 | 3.3 | 0 | 3.3 | 0 | 2.9 | 4.6 | 1.5 | 0 | 3.7 | 0 | 2.8 |
| *P.imparis* | 5.9 | 4.8 | 0 | 6.4 | 8.7 | 7.1 | 0 | 8.8 | 8.5 | 5.8 | 5.6 | 5.4 |
| *Nylanderia* sp | 3.7 | 0 | 8.3 | 0 | 4.1 | 0 | 0 | 0 | 4.1 | 0 | 0 | 0 |
| *T. allaborans* | 0.8 | 0 | 0 | 0 | 0.8 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 |
| *Ponera* sp | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 | 0 | 0 | 0 | 0.4 | 0 |
| *C. affinis* | 0 | 0 | 0 | 0 | 2.1 | 0 | 0.3 | 0 | 1 | 0 | 0 | 0 |
| *T. albipes* | 1.7 | 0 | 0 | 5.8 | 5.2 | 0 | 0.4 | 8.1 | 2.5 | 0 | 0 | 6.5 |
| *Pachycondyla* sp | 1.9 | 0 | 0 | 0 | 0.5 | 0 | 0.9 | 0 | 1.5 | 0 | 0 | 0 |

Note: + = Ant dominant category; * = Ant tramp

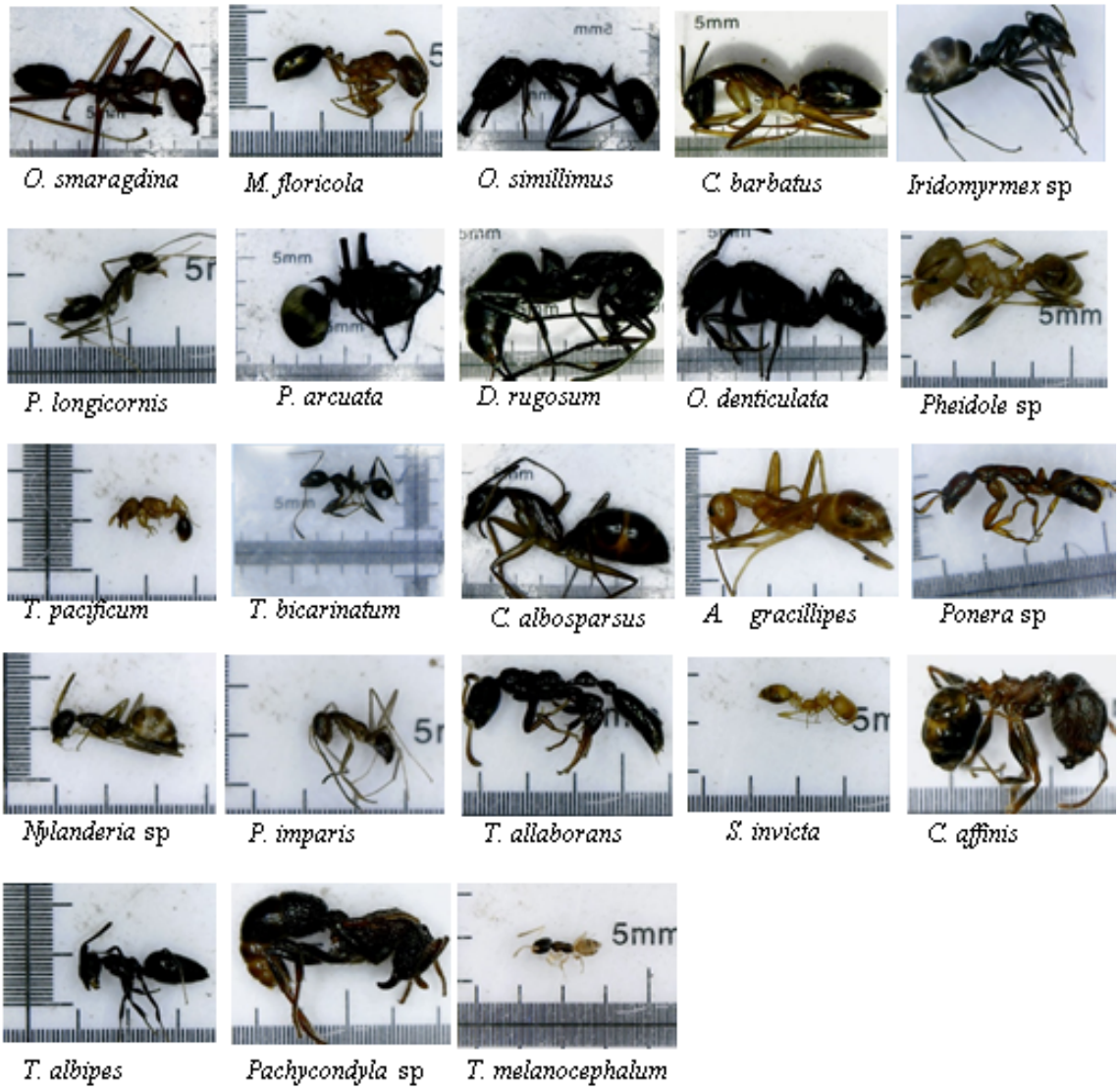


**Figure 1**. Ant species found in several habitat in settlement area of Semarang City

*P. longicornis* is an ant found throughout settlement areas. The existence of human activity does not become an inhibiting factor for this ant to develop, even in environmental conditions with poor sanitation. The temperature in all habitat of settlement areas are still in the optimal category for the development of ants, ranged from 29.4-31.5 °C. According to Riyanto (2007) the temperature range of 25-32 °C is the optimal and tolerant temperature for ant activity in the tropics.

*A. gracilipes* are ants found in all settlement areas other than *P. longicornis*. *A. gracilipes* is a cosmopolitan ant species that can be found in habitats with human activities such as settlements. *A. gracillipes* is one of the largest invasive ants with a size of about 1-2 mm, with a brownish yellow body. This species has the highest number of individuals due to its large foraging area, so it is called a scavenger predator because it preys on various fauna in litter and canopy. This type is found on the stems and leaves of various species of trees and shrubs in the settlement area (Latumahina, 2011).

*Tetraponera allaborans* are ants that are only found on the house with litter. The existence of litter can be used by some ants as a source of organic material. The yard used as the location of the study was full of dried leaves (litter) where the litter was a place for the decomposition of organic matter by soil macrofauna, one of which was *T. allaborans* ant.

The abundance of ants in the study location is also influenced by environmental factors, where there will be a change in response by ants to disturbances in their habitat. Some environmental factors that are thought to be very influential in ant abundance are light intensity, temperature, humidity, wind and also human activities (Andersen, 2000).

The types of ants found in almost all research locations are P. *longicornis*, A. *gracilipes* and T. *melanocephalum* The ability of tramp ants to adapt to the surrounding environment makes these ants found in a variety of habitats. A large number of individuals can provide dominance over other types of ants so as to reduce the number of species and the number of individuals from other insects. In addition to tramp ants, there are ant species that are only found in specific habitats such as T. *allaborans*. T. *allaborans* are found only in home habitats, especially on home yards because these ants have habitats that are under piles of litter.

**Ant diversity in residential areas**

Diversity is the combination of the number of species that found in an ecosystem or species richness and number of individuals of each species (Gusmari et al., 2018). The species diversity index value in all observed habitats in Semarang city has varied values. The highest diversity index value was found in house at 101-200 m asl with a value of 2.72 and the lowest was in park habitat at 201-300 m asl with a value of 2.02. This phenomenon is caused by the presence of tramp ants and it effect to type and number of individual species in a place. Tramp ants are also able to colonize well when compared to other species in disturbed habitats, as seen from *A. gracilipes* and *P. longicornis* which are categorized as quite dominant in all settlement habitats.

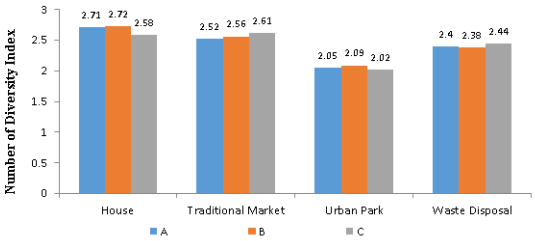


**Figure 2**. Ants diversity index in the residential area of Semarang City (A : 0-100 m ASL, B : 101-200 m ASL, C : 201-300 m ASL)

The high value of species diversity shows that the ecosystem has sufficient food sources available for ants. The composition of ant species in disturbed habitats tends to be influenced by the presence of certain species. Disturbing habitat and the presence of invasive ants have a significant impact on the diversity of ants in the residential area of Semarang City.

The presence of invasive tramp ants, such as *A. gracilipes* in an ecosystem can affect the structure of other ant communities, this is because tramp ants are able to compete with local ants in terms of food sources. *A. gracillipes* was reported as species that belong to 100 most destructive invasive species and it was categorized as the 5 most dangerous invasive ant species for the surrounding environment (Apriyadi et al., 2016), it also easily involved in deadly fight with other species (Drescher at al., 2011 ; Mezger & Pfeifer, 2011). It can be said that dominant ants can regulate the structure of ant communities and other animals in the habitat (Israel et al.,2012).

The presence of ants in tropics areas is also influenced by several factor, not only predation, nesting sites, food availability, composition of plant (Putri et al., 2018) but also environmental factors such as air temperature, soil moisture and pH which is reffered to as microclimate. Microclimate has an influence on the presence of ants and changes in microclimate can also influence the changes in the physiological processes of ants, so that it affects the diversity of ant species (Siriyah, 2016). This is because each ant has a tolerance limit to their respective environmental factors. They have a strong correlation with ecosystem variables such as vegetation, microclimate, soil, and other soil fauna (Shahabudin, 2011) so, ants can respond to changes that occur in an ecosystem (Pecarevic, 2010).

**Evenness index of ant species in the residential area of Semarang City**

Evenness index describes the individual

**Table 2**. Number of individuals (N), number of types (S) of ants in each habitat in the residential area

| | H1 | TM1 | P1 | W1 | H2 | TM2 | P2 | W2 | H3 | TM3 | P3 | W3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 1318 | 1248 | 704 | 1435 | 1363 | 956 | 605 | 1245 | 1092 | 1390 | 685 | 1349 |
| S | 20 | 13 | 11 | 14 | 20 | 13 | 14 | 18 | 19 | 13 | 13 | 18 |

**Table 3**. Environmental physical factors in each habitat in the settlement area of the city of Semarang

| Environmental Factors | Habitat | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H1 | TM1 | P1 | W1 | H2 | TM2 | P2 | W2 | H3 | TM3 | P3 | W3 |
| Air temperature (°C) | 30.2 | 29.4 | 30.3 | 32.5 | 29.7 | 29.2 | 30.3 | 31.5 | 29.2 | 29.3 | 29.5 | 30.8 |
| RH (%) | 23.4 | 25.9 | 21.5 | 19.7 | 21.6 | 22.4 | 20.8 | 21.2 | 23.4 | 22.1 | 23.3 | 20.3 |
| Light intensity (lux) | 1455 | 1389 | 1442 | 1532 | 1487 | 1451 | 1469 | 1551 | 1434 | 1401 | 1493 | 1541 |

distribution of each species in a habitat. Evenness index is correlated with the presence of species dominance that can be seen from the dominance index. Evenness shows the degree of evenness abundance of individuals between species, which used as an indicator of dominance symptoms between each species in a community or to find out evenness of one species vegetation in one community (Latumahina, 2016).

The evenness index of ant species in the residential area of Semarang has varied values (Figure 2). The lowest evenness index of ants found in Park habitat at 101-200 m asl is 0.54. Low evenness values are caused by the presence of species that dominate in these locations, namely A. *gracilipes* and *P. longicornis*. The presence of invasive tramp ants can have a significant impact on the existence of other species. *P. longicornis* generally forages in groups, if one member of the colony finds food, the members of the colony will communicate with other members of the colony, so that in a few minutes lots of ants will be found around the food (Apriyanto, 2015).

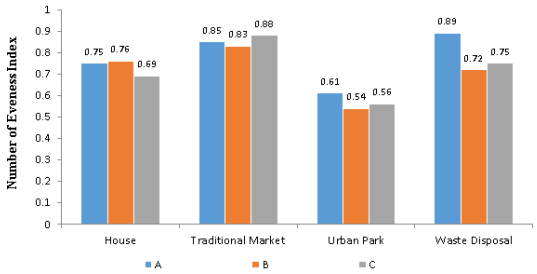


**Figure 3**. Evenness index of ant species in each habitat of ssettlement area (A : 0-100 m ASL, B : 101-200 m ASL, C : 201-300 m ASL)

Invasive tramp ants have the ability to utilize narrow spaces for nesting, even in dirty places, so that, with these abilities tramp ants can compete with other species in occupying space and also fighting over food sources. Ants in settlements that are interested in various types of bait and habitat in the house are *P. longicornis*. This type of ant is found in poor sanitation and is called as pest in tropical area (Latumahina et al., 2013)

The highest evenness index value is found in temporary trash disposal habitat at 0-100 m asl (0.89). The high evenness index means that there is no dominating activity between one type of ant to the others. Trash at 0-100 m asl has various types of waste like domestic waste. Domestic waste can be food source for ants, so that the competition between ants rarely occurs because of the abundant food.The existence of human activity does not become a limiting factor for some ants in their lives especially for tramp ants. The human activity will indirectly be a supporting matter in the availability of feed, this can be seen from the presence of organic waste and leftovers in various places. This is consistent with the opinion of Enri et al., (2010) that the existence of human activities around the habitat also plays a role in supporting the availability of feed for ants.

**The dominance of species in residential areas of the city of Semarang**

The ants that dominate the settlement habitats of Semarang City are *P. longicornis*, *A. gracilipes, M. pharaonis*, and *S. geminata*. The largest dominance index value is found in Park at 201-300 m asl which is 0.17 and the lowest dominance index value is found in the waste disposal at 0-100 m asl. (Figure 3). A large dominance index value means there is a dominance activity of species against the others. This dominance activity causes some ants to lose space to survive because they lose competing with certain species.

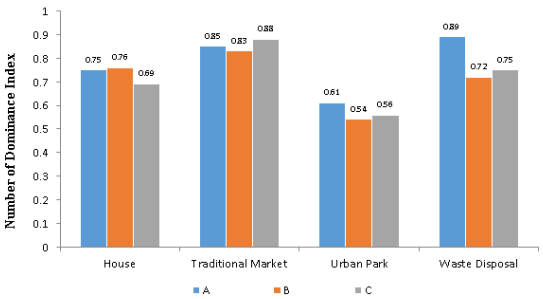


**Figure 4**. Dominant index of ant species in each settlement habitat (A : 0-100 m ASL, B : 101-200 m ASL, C : 201-300 m ASL)

*A. gracilipes* and *P. longicornis* are tramp ants that dominate throughout settlement habitats. *A. gracilipes* has extensive foraging areas and eats various types of fauna in litter and canopies (small isopods, myriapods, and other soil insects) that make them called predators. *A. gracilipes* have larger colonies than ants in general called supercolony. Excellence in terms of the number of colonies and aggressiveness provides a greater opportunity for *A. gracilipes* to find and monopolize available resources, either spatial or food resources (Grubber et al., 2012). *A. gracilipes* is a species originating from the lowlands in tropical rainforests with habitats that have high humidity.

*P. longicornis* is also an ant species that has a high number of individuals in each settlement habitat. It is an omnivore who consumes both living and dead insects, honey dew, fruit and plant

exudates as well as some types of food found in settlements (Latumahina, 2014). *P. longicornis* also has a high adaptation to the characteristics of habitat, it can live in areas that are very disturbed, dry and have high humidity. Worker ants of *Paratrechina* sp. are omnivorous, consuming dead and alive insects, seeds, fruits, plant exudates, and household food (Ikbal et al., 2014).

This research provides new information about the nature, characteristics and dominance of tramp ants in urban areas. This finding is beneficial for ant control by considering the ecological equilibrium level in order to anticipate economic loss and and health problem like itchy.

## CONCLUSION

The most common type of tramp ants found in the settlement area of Semarang were *Anoplolepis gracilipes* and *Paratrechina longicornis*. The ants' diversity index in this area was categorized as stable (H = 1.8 - 3.5). The park habitat has the lowest evenness index (E = 0.52) and the highest dominance index (iD = 0.17). The tramp ants were found in all habitat type of settlement area (residential, traditional market, park, and waste disposal).

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