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ANT SPECIES DIVERSITY (HYMENOPTERA, FORMICIDAE) IN THE PURWODADI BOTANICAL GARDENS, EAST JAVA, INDONESIA

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ABSTRACT

The ant species diversity in tropical Asia has been investigated in several locations, however, these studies mainly focused on well preserved forests or plantations. The ant fauna in urban parks has only been investigated in a limited number of locations in Singapore, Hong Kong, Macao, and Indonesia. We investigated the ant fauna in the Purwodadi Botanical Gardens, East Java, and compared it to the ant fauna obtained in the Bogor Botanical Gardens. In the Purwodadi Botanical Gardens, we employed the following sampling methods that were also carried out in Bogor: (1) visual searching of ants on tree trunks, (2) visual searching of litter and top-soil ants by hand sifting (3) visual searching of ant colonies, (4) visual searching of foraging workers. In total, 109 species in 44 genera from 9 subfamilies were collected. The number of species collected from litter and soil in Purwodadi was remarkably smaller than that in Bogor, while the ant species diversity on tree trunks was similar to that of Bogor. Of the 109 species, 68 were common to Bogor. Arboreal ants were more similar than ground ants between Bogor and Purwodadi.

Key words: ants, diversity, fauna, Indonesia

INTRODUCTION

In the Oriental tropics, a high species richness of ants has been shown in several national parks and forest reserves in Malaysia, Thailand, and Vietnam (e.g. Brühl et al., 1998; Chung & Maryati, 1996; Eguchi et al., 2005; Malsch et al., 2003; Watansasit et al., 2007; Yamane et al., 1996, 2002, 2018, 2021). For example, Yamane et al. (2021) reported the occurrence of 579 species in 96 genera in Lambir Hills National Park in Sarawak, and Malsch et al. (2003) provided a list of 489 species in 76 genera from Pasoh forest in Peninsular Malaysia. Such a high species diversity of ants has been reported not only in well preserved forests, but also in an artificial park in an urban area. Ito et al. (2001) reported that 216 species in 66 genera (61 genera in the paper) representing all the subfamilies known from the Oriental region (Ward, 2014) were collected in the Bogor Botanical Gardens, West Java, Indonesia. Subsequent research by Herwina & Nakamura (2007) added 10 species that were not recorded by Ito et al. (2001). Thus, in total 226 species have been recorded from this botanical garden. The Bogor Botanical Gardens, located in the commerce center of Bogor, is one of the most famous tourist places in

Indonesia. It is surprising that even in such urban park with much human disturbance ant species richness is so high. A recent review of urban ant studies by Brassard et al. (2021) showed that the species number obtained in the Bogor Botanical Gardens by Ito et al. (2001) is the largest among 112 studies on urban ants. In addition, a number of ecologically interesting species are distributed in the area and have been studied by Ito and his co-workers (e.g. Ito 2013, 2016; Ito & Yamane, 2014, 2020, see references in Ito et al., 2001).

To know whether such high diversity of ants is common in artificial parks in the Oriental tropics, we investigated the ant species diversity in the Purwodadi Botanical Garden, East Java, from 1995 to 2003. The result was compared to that obtained in the Bogor Botanical Gardens from 1990 to 1998 by Ito et al. (2001). The species fauna of urban parks may change. This study will provide basic information for monitoring future changes in urbanization and ant diversity.

MATERIALS AND METHODS

Our investigation was carried outin the Purwodadi Botanical Gardens (7˚48’ S, 112˚44’ E, 309 m altitude, 85 ha), East Java, Indonesia (Fig. 1). The garden, established in 1941, is located in the rural area of Malang. The average annual rainfall in Purwodadi is approximately 2600 mm. Rainfall in this area is distinctly seasonal: dry months usually last five to seven months from May or June to October or November (Noerdjito & Nakamura, 1999). During the dry season, rainfall is low (average monthly rainfall, 12 to 46 mm, Noerdjito & Nakamura, 1999).

The Bogor Botanical Gardens (6˚ 35’ S, 106˚47’ E, 259 m altitude, 87 ha), which served as a comparison site in this study, was established in 1817 in the center of Bogor city. There is no distinctive dry season in Bogor, with even less rainfall in June to August. The annual rainfall is approximately 3800 mm (Noerdjito & Nakamura, 1999). The distance between the two botanical gardens is approximately 670 km.

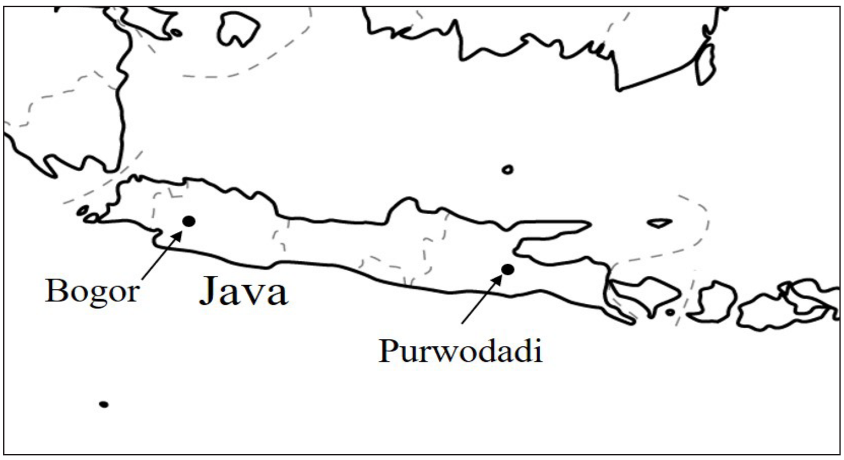

Figure 1. Location of Purwodadi and Bogor, Java, Indonesia.

Ito et al. (2001) investigated the ant fauna in the Bogor Botanical Gardens using several sampling methods, among which sifting leaf litter and surface soil as well as searching ants on tree trunks, is the most efficient way to obtain an overview of the ant fauna. Therefore, in Purwodadi, we also used these two methods, in addition to visually searching ant colonies and foraging workers as follows:

1. Searching ants on tree trunks. In January of 2001, we chose 10 trees from each of 10 areas (100 trees in total) in the garden. Ants walking on a tree trunk at ca. 1–1.5 m above the ground were collected with either an aspirator or tweezers for 5 min. If ants followed a distinctive trail, only 5 individuals were collected from it, then other parts of the trunk were investigated.
2. Sifting leaf litter and surface soil. In January of 2001, we set up 10 quadrats (30 cm x 30 cm) in each of 10 areas, totaling 100 quadrats. Leaf litter and soil (1 ~ 2 cm deep) were collected form each quadrat and sifted with a handheld strainer (20 cm x 25 cm) with 8 mm x 8 mm mesh on a tray to collect the dropping ants. Sorting continued until all ant species present in the gathered litter and soil had been collected; no specific time limit was set.
3. Visual searching of ant colonies. From 1995 to 2003, we visited the garden five times, and investigated the biology of *Stictoponera bicolor*. Colonies of other ant species found and collected as a by-product of the surveys were also used in this study.
4. Visual searching of foraging workers. In addition to the three methods mentioned above, we also collected foraging ants with forceps at several sites. Particularly in January of 2003, we intensively collected foraging ants from all over the garden.

Sorting to species level was mainly based on morphological criteria. Most specimens were identified by comparison with specimens in the SKY Collection and Eguchi collection. These collections include several specimens that have been directly compared with type specimens, as well as many type specimens recently described from the Oriental regions. The species accumulation curves for ants collected from soil and litter, and on tree trunks were obtained by using EstimateS (Colwell, 2009). Data from Bogor were based on Ito et al. (2001). Statistical analyses were conducted using R (R Core Team, 2022). Voucher specimens will be deposited in the Bogor Zoological Museum (Cibinong), and a part of specimens is tentatively kept in the FI collection (Kagawa) and SKY collection (Kagoshima).

RESULTS

Ants in Purwodadi

Fauna: A total 109 species in 44 genera were collected (Table 1, Appendix 1). The subfamilies Myrmicinae (43 spp.), Formicinae (29 spp.), and Ponerinae (18 spp.) accounted for 86% of the total ant species (Table 1). The most species-rich genera were *Polyrhachis* (11 spp.) and *Pheidole* (10 spp.). Species/taxon composition is summarized below according to the sampling methods.

Tree trunks: Ants were collected from 94 out of 100 trees (Fig. 2). The average number of species per tree was 2.3 ± 1.6 (range 0–6). In total, 52 species were found, of which 18 species were collected from only one tree, and 10 species were collected from two trees. The expected number of species to be collected by this method is 68.2 ± 8.2 (Chao-2). Myrmicinae, which constituted 46.2 % (24 species) of the species collected on tree trunks, was the most dominant subfamily. *Crematogaster sewardi* (Myrmicinae) and *Paratrechina longicornis* (Formicinae) were the most dominant species, each found on 19 trees. Other dominant ant species found on more than 10 trees were *Anoplolepis gracilipes* (16 trees), *Tapinoma melanocephalum* (16 trees), *Odontomachus simillimus* (14 trees), *Nylanderia* sp. 3 (11 trees), and *Crematogaster treubi* (11 trees).

Litter and surface soil: Of 100 quadrats, 89 included ants (Fig. 2). The average number of species per quadrat was 2.0 ± 1.3 (range 0-6). In total, 44 species were collected from litter and surface soil, of which 18 species were collected from only one quadrat and 6 species were found from two quadrats. The expected number of species to be collected by this method is 71 ± 13.3 (Chao-2). The subfamily Myrmicinae was the most dominant (23 spp.), followed by the subfamily Ponerinae (12 spp.). The most dominant species was *Lophomyrmex opaciceps*, found in 26 quadrats, followed by *Brachyponera* sp. 1 (21 quadrats), *Nylanderia* sp. 1 (15 quadrats), *Technomyrmex kraepelini* (12 quadrats) and *Carebara affinis* (11 quadrats).

Other methods: Beside numerous colonies of *Stictoponera bicolor* for behavioral studies, we collected 57 colonies of 33 species. Of these species, 12 species were not collected by the quantitative methods. In addition to the species collected by the three methods mentioned above, we collected 26 species by visual searching of foraging workers.

Table 1. Number of ant species collected for each genus and subfamily in Purwodadi, Bogor, and both botanical gardens

	No. species				No. species		
	Purwodadi	**Bogor**	**Both**		**Purwodadi**	**Bogor**	**Both**
Amblyoponinae	**1**	**4**	**1**	*Lophomyrmex*	1	1	1
Mystrium	1	1	1	*Lordomyrma*	0	1	0
Prionopelta	0	1	0	*Meranoplus*	1	2	1
Stigmatomma	0	2	0	*Monomorium*	4	4	2
Dolichoderinae	**9**	**10**	**6**	*Myrmecina*	1	3	1
Dolichoderus	1	4	1	*Myrmicaria*	0	1	0
Iridomyrmex	1	0	0	*Pheidole*	10	14	1
Tapinoma	2	2	2	*Pristomyrmex*	0	1	0
Technomyrmex	5	4	3	*Recurvidris*	0	1	0
Dorylinae	**3**	**8**	**1**	*Rhopalomastix*	1	1	0
Aenictus	2	3	0	*Solenopsis*	0	1	0

	No. species				No. species		
	Purwodadi	**Bogor**	**Both**		**Purwodadi**	**Bogor**	**Both**
Chrysapace	0	1	0	*Strumigenys*	3	10	2
Dorylus	0	1	0	*Syllophopsis*	0	1	0
Ooceraea	1	2	1	*Tetramorium*	9	11	6
Parasyscia	0	1	0	*Trichomyrmex*	1	1	1
Ectatomminae	**2**	**2**	**1**	*Vollenhovia*	0	4	0
Holcoponera	0	1	0	**Ponerinae**	**18**	**43**	**12**
Stictoponera	2	1	1	*Anochetus*	1	5	1
Formicinae	**29**	**60**	**23**	*Brachyponera*	2	2	1
Acropyga	1	1	1	*Buniapone*	1	1	1
Anoplolepis	1	1	1	*Centromyrmex*	0	1	0
Camponotus	6	9	3	*Cryptopone*	0	2	0
Colobopsis	3	4	2	*Diacamma*	1	1	0
Echinopla	1	1	1	*Ectomomyrmex*	2	1	1
Gesomyrmex	0	1	0	*Euponera*	0	1	0
Nylanderia	2	6	2	*Harpegnathos*	0	1	0
Oecophylla	1	1	1	*Hypoponera*	3	8	2
Paraparatrechina	2	4	2	*Leptogenys*	4	6	2
Paratrechina	1	1	1	*Mesoponera*	0	1	0
Polyrhachis	11	25	9	*Myopias*	1	1	1
Pseudolasius	0	6	0	*Odontomachus*	1	2	1
Leptanillinae	**0**	**2**	**0**	*Odontoponera*	1	2	1
Leptanilla	0	2	0	*Platythyrea*	1	3	1
Myrmicinae	**43**	**78**	**22**	*Ponera*	0	4	0
Calyptomyrmex	0	1	0	*Pseudoneoponera*	0	1	0
Cardiocondyla	3	5	3	**Proceratinae**	**1**	**5**	**0**
Carebara	4	6	2	*Discothyrea*	1	3	0
Cataulacus	1	1	1	*Probolomyrmex*	0	2	0
Crematogaster	4	6	1	**Pseudomyrmecinae**	**3**	**4**	**1**
Epelysidris	0	1	0	*Tetraponera*	3	4	1
Eurhopalothrix	0	1	0				

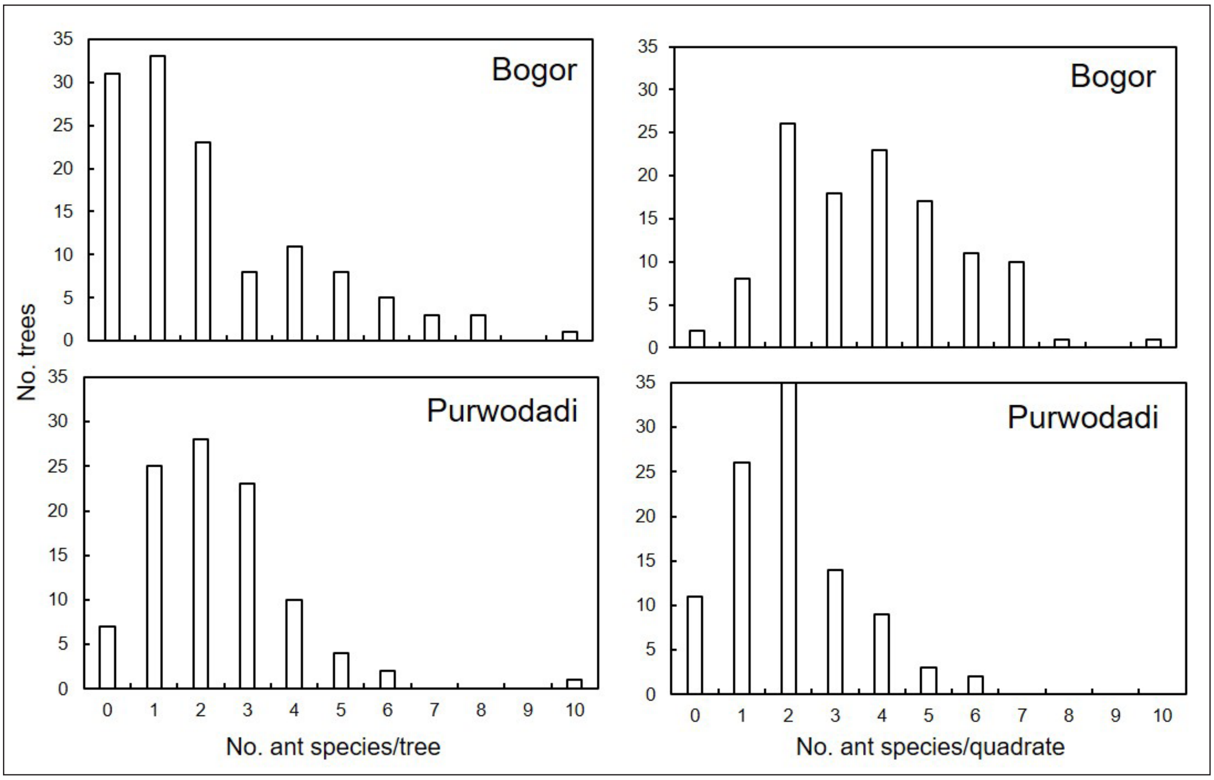

Figure 2. The frequency distribution of ant species number per sampling unit in Purwodadi and Bogor.

Comparison between Bogor and Purwodadi

The combination of the two quantitative methods resulted in the identification of 69 species in Purwodadi (52 on trees, 44 in litter, with 27 species overlapping), while 117 species were collected in Bogor (53 species on trees, 85 species in litter, with 21 are overlapping). The number of ant species per tree in Purwodadi (2.3 ± 1.5) was slightly but significantly larger than that in Bogor (2.2 ± 2.2, Mann-Whitey U-test, Z = -2.1, P = 0.036) (Fig. 2). However, the species accumulation curves indicated no difference in the total species richness on tree trunks between the two sites (Fig. 3). Furthermore, the expected number of species from trees in Purwodadi (68.5 ± 6.9) is almost identical to Bogor (69 ± 9.3). In contrast, the average number of ant species per quadrat in Purwodadi (2.0 ± 1.3) was significantly smaller than that in Bogor (3.8 ± 1.9, U-test, Z = -7.1, P < 0.0001) (Fig. 2), and a significant difference in the total species richness was found between the two sites (Fig. 3). The expected number of species from litter and soil surface in Purwodadi (71 ± 13) was smaller than that in Bogor (100 ± 8.7).

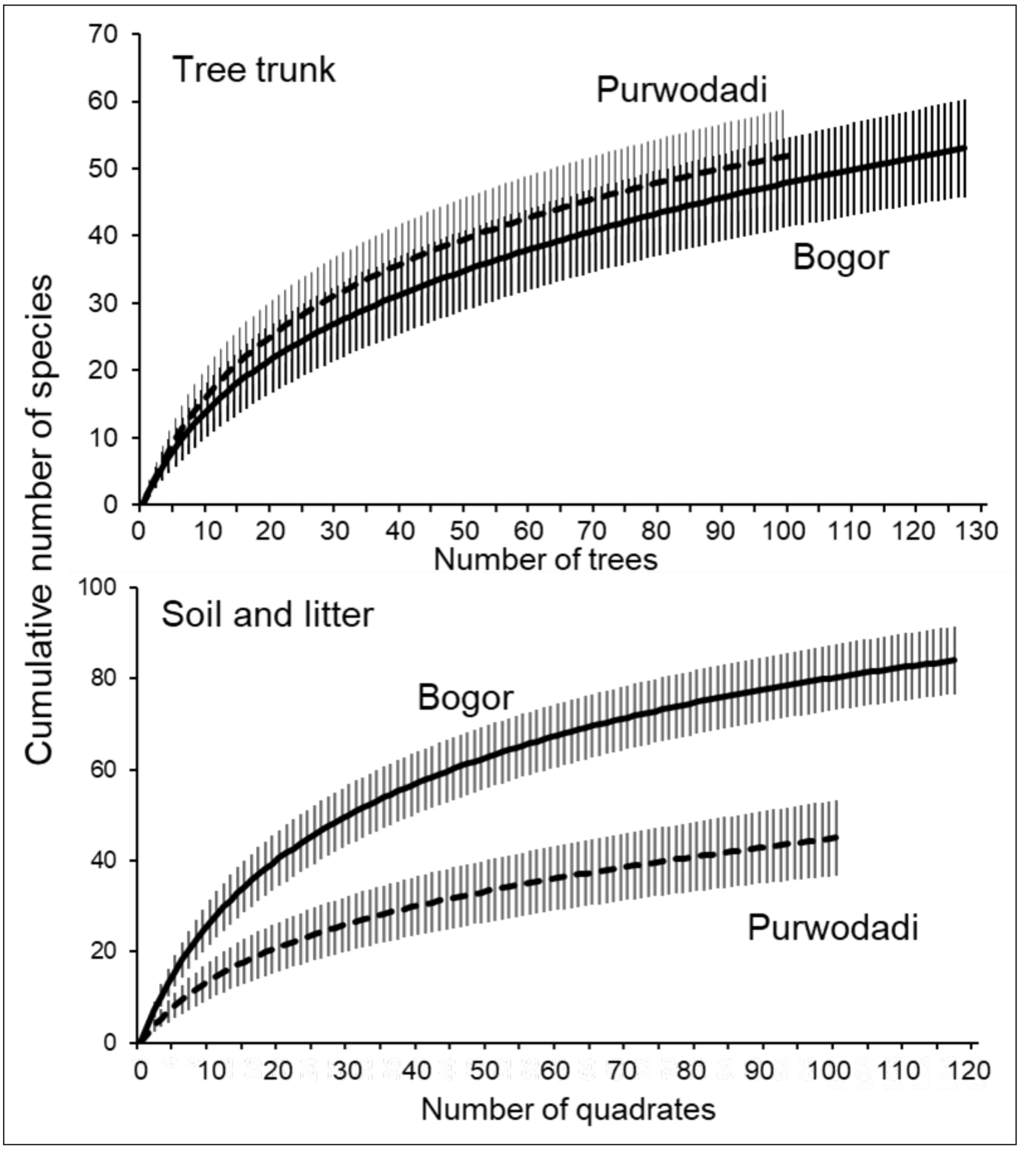

Figure 3. Species accumulation curves for ants on tree trunk and ants in quadrates in Bogor and Purwodadi. Error bars show 95% confidence intervals and non-overlapping bars show significant differences between the two study sites.

In contrast, the average number of ant species per quadrat in Purwodadi (2.0 ± 1.3) was significantly smaller than that in Bogor (3.8 ± 1.9, U-test, Z = -7.1, P < 0.0001) (Fig. 2). A significant difference in the total species richness was found between the two sites (Fig. 3). The expected number of species from litter and soil surface in Purwodadi (71 ± 13) was smaller than that in Bogor (100 ± 8.7).

Among the 52 species collected on tree trunks using quantitative methods, 16 species were also collected by the same methods in Bogor (Fig. 4). Of the 16 common ants, five species -*Oecophylla smaragdina*, *Nylanderia* sp. A, *Odontomachus simillimus*, *Anoplolepis gracilipes*, and *Crematogaster sewardi*- were dominant in both botanical gardens. *Paratrechina longicornis* was one of the most dominant ants in Purwodadi, whereas this species was collected from only one tree in Bogor. In contrast, *Platythyrea* sp. 3 and *Dolichoderus thoracicus* were commonly collected from tree trunks in Bogor, but were found on only a few trees in Purwodadi. Among the 44 species collected by litter shifting, 19 species were collected by the same methods in Bogor (Fig. 4). Of these, four species -*Odontomachus simillimus*, *Hypoponera* sp. N5, *Technomyrmex kraepelini*, and *Lophomyrmex opaciceps*- were dominant in both botanical gardens. *Tetramorium meshena* was common in Bogor (17 quadrates) but was collected only once in Purwodadi.

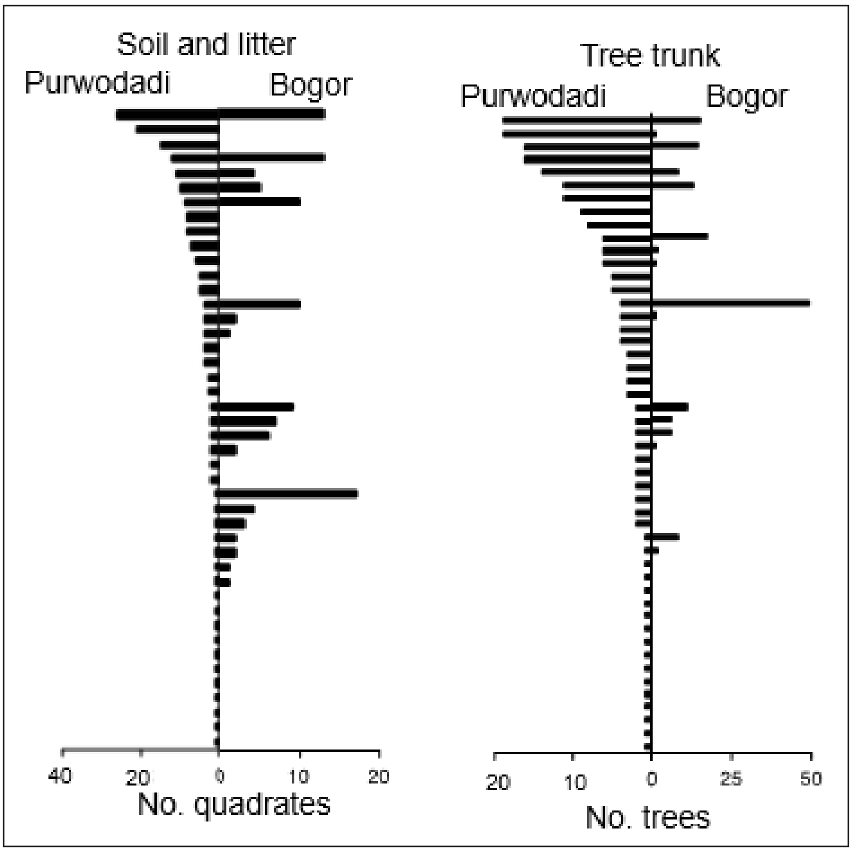

Figure 4. Comparison of the abundance of each species between Purwodadi and Bogor. Abundance was shown by the number of quadrates for ants collected from soil and litter, and the number of trees for ants on tree trunk. The left side of each figure shows the top to bottom order of frequency of occurrence in Puruwodadi, and the right side shows the frequency of that species in Bogor.

Of 109 species collected by all methods in Purwodadi, 68 species were also found in the Bogor Botanical Gardens (Table 1). The overlap (Nomura-Simpson index = 0.61) is quite high, and comparable to previous values for three lowland areas in West Java (0.62 ~ 0.68 among Bogor, Ujung Kulong, and Pangandaran, Ito et al., 2001). Among the three major subfamilies, Formicinae showed a significantly higher overlap (79%, 23 of 29 spp.) than Myrmicinae (51%, 22 of 43 spp.), pairwise comparisons using Chi-squared test corrected by the Holm method, $P < 0.05$), whereas no statistical difference was found between Formicinae and Ponerinae (66%, 12 of 18 species), and between Myrmicinae and Ponerinae. In particular, 9 of 10 *Polyrhachis* species collected in Purwodadi can be found in Bogor. In contrast, less than half of the myrmicine ants are common to both sites. In *Pheidole*, which is the most species-rich myrmicine genus in Purwodadi, only one of 10 species collected in Purwodadi is known to Bogor.

DISCUSSION

In the Bogor Botanical Gardens, Ito et al. (2001) reported the occurrence of 216 species in 66 genera of ants. The number of both species (109 spp.) and genera (44 genera) collected in the Purwodadi Botanical Gardens is much smaller than that in Bogor. The difference of research efforts between Bogor and Purwodadi apparently affects the species number. In Bogor, Ito et al. (2001) spent more than 300 man-days over nine years, whereas in Purwodadi, we investigated ants only less than 40 man-days. The results of the two quantitative collections indicate that the differences between Bogor and Purwodadi are not only due to differences in collection effort, but also to the clearly lower ant diversity in Purwodadi. However, the number of ant species in Purwodadi is higher than that in many other surveyed areas reviewed by Brassard et al. (2021): of the 112 studies on urban ants, more than 100 ant species were recorded in only six sites (Abidjan in Ivory Coast, Bogor Botanical Gardens, Macao, three sites in Brazil). All these sites are located in a tropical zone, indicating that ant species diversity in the tropical zone is higher even in urban areas.

One of the reasons for the lower species richness in Purwodadi is the lower species richness of ground ants. The number of species in the litter and soil surface in Purwodadi was markedly smaller than that in Bogor (Fig. 3). One of the possible reasons for this tendency is the lower rainfall in Purwodadi, which affects ground-dwelling ants. Generally, arboreal ants exhibit greater resistance to desiccation compared to ground ants (Hood & Tschinkel, 1990). During the exceptionally dry season in Bogor in 1998, arboreal ants such as *Oecophylla smaragdina, Dolichoderus thoracicus* and *Crematogaster sewardi* remained active and dominant, while the density of ground ants was remarkably low (Ito, pers. obs.). The ant species diversity on tree trunks did not differ between Bogor and Purwodadi. A notable characteristic of tree ants in Bogor is the presence of many trees without ants on their trunks: in 30 out of 127 trees, no ants were collected from the tree trunk (see Fig. 2, Ito et al., 2001), whereas in Purwodadi, only six out of 100 trees examined were without ants (Fisher test, $P = 0.0002$). However, even though we did not record the height of trees, it is possible that foraging ants are less abundant on the trunks of tall trees without lower branches. Such trees are common in Bogor but rare in Purwodadi and may host many canopy ants. If we could collect ants from the canopy, the number of arboreal ant species in the Bogor Botanical Gardens would undoubtedly increase.

Ito et al. (2001) described the characteristics of the ant fauna in the Bogor Botanical Gardens in comparison with well-preserved tropical rainforests as follows: (1) low species numbers in Dolichoderinae (10 spp.) and Formicinae (60 spp.), (2) a remarkably low species number in *Crematogaster* (6 spp.), and (3) the low densities and species number of the ant-hunter genera in Dorylinae (*Aenictus, Cerapachys, Lioponera, Ooceraea,* etc., 7 spp.). These features may relate to the following reasons: (1) collection methods (no particular collection methods such as fogging and climbing up in trees), (2) absence of plants having mutualistic interactions with *Crematogaster*, and (3) low diversity of prey ants, and (4) small area of research site (Ito et al.

2001). All these characteristics are also found in Purwodadi, suggesting that such "distorted" ant fauna is common in botanical gardens and urban parks in anthropogenic environments.

Of the 71 species identified at species level, the following exotic and/or tramp ants, as shown in Brassard et al. (2021), are: *Iridomyrmex anceps, Tapinoma melanocephalum, Technomyrmex difficilis, Ooceraea biroi, Anoplolepis gracilipes, Paratrechina longicornis, Cardiocondyla wrougtonii, Monomorium floricola, M. pharaonis, Trichomyrmex destructor, Tetramorium lanuginosum,* and *T. simillimum.* These species are widespread, and dominant in many tropical and subtropical regions. All but *Iridomyrmex anceps* were also collected in the Bogor Botanical Gardens. Thus, 11 of the 64 ant species found in both botanical gardens are exotic or tramp ants. Despite intensive ant collection efforts in urban areas around the Bogor distinct, Rizali et al. (2008) also failed to find *Iridomyrmex anceps* in any locations. Therefore, this common exotic ant may not be settled in and around Bogor. However, *Iridomyrmex anceps* is common and abundant in the Thousand Islands archipelago north of Jakarta, West Java (Rizali et al., 2011).

One of the important factors affecting beta diversity (i.e. the difference in species richness among study sites) is the mode of dispersal (Qian, 2009ab). For ants, two contrasting dispersal strategies by queens exist: independent colony foundation (ICF) by alate queens and dependent colony foundation (DCF) via fission with workers (Peeters & Ito 2001). The range of dispersal by DCF is remarkably limited if compared to ICF by alate queens, because DCF species can move to new places only by walking. Thus, species similarity between two remote sites is expected to be higher in ICF species than in DCF species. Particularly in isolated urban environments, it is difficult for new DCF species to invade and become established, and it is expected that the fauna of DCF species will vary widely among locations. Unfortunately, the knowledge on the mode of colony foundation and queen morphology of each species in Indonesia is too scarce to fully investigate this hypothesis. If we examine known ponerine ants lacking alate queens (*Diacamma* and *Leptogenys*) and doryline ants (*Aenictus, Ooceraea*), 3 out of 8 DCF species (two species of *Aenictus*, *Ooceraea biroi, Diacamma* sp.2, four species of *Leptogenys*) collected in Purwodadi can also be found in Bogor, compared to 10 out of 13 likely ICF ponerine species (with alate queens). Even though the relationship between dispersal strategies (with alate queens or not) and species similarity is statistically insignificant (Fisher test, $p = 0.164$), it is worthy of further investigation.

Species overlap between Bogor and Purwodadi varies markedly among ant genera. Specifically, several species of *Polyrhachis* are found in the two both botanical gardens, whereas only one of the ten *Pheidole* species collected in Purwodadi is common to Bogor. Most species in *Polyrhachis* and *Pheidole* may exhibit ICF by alate queens, as ergatoid queens are rare in these genera. Independent colony foundation by dealate queens has been reported in several species of both genera (e.g. Lenoir & Dejean, 1994; Rissing et al., 1996; Sasaki et al., 1996). The Philippine local populations of *Pheidole aglae* represent the only known example of ergatoid queens in *Pheidole* (General et al., 2021), while brachypterous queens are known in *Polyrhachis robsoni* (Heinze & Hölldobler, 1993).

Polygynous species, such as some species of introduced *Pheidole* including *P. megacephala* (Passera, 1994; Sarnat et al., 2015) and *Polyrhachis dives* (Yamauchi et al., 1987), may perform DCF. A marked difference between *Polyrhachis* and *Pheidole* is their nesting habitat: many species of *Polyrhachis* are arboreal (Robson & Kohort, 2007), whereas the majority of *Pheidole* are ground nesting species (Eguchi, 2001, 2008). The significant difference in rainfall between Bogor and Purwodadi may specifically impact ground-dwelling ants. In Purwodadi, during the dry season, the ground becomes dry enough to create cracks that are not present in Bogor. Hence, we can expect greater difference in ground-nesting ant communities compared to arboreal ones. Further investigations into the ant fauna across various localities and nesting habits of different species will be necessary to find out whether the patterns shown here are generally observed in tropical forests.

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Appendix 1. List of ants collected in Kebun Raya Purwodadi between 1998 and 2003

	Colony code	No. Quad-rates	No. Trees	Occurrence in Bogor
Subfamily Amblyoponinae				
Mystrium camillae Emery, 1889	FI03-(35, 36)			O
Subfamily Dolichoderinae				
Dolichoderus thoracicus (F. Smith,1860)		2	4	O
Iridomyrmex anceps (Roger, 1863)				x
Tapinoma indicum Forel, 1895			2	O
Tapinoma melanocephalum (Fabricius, 1793)			16	O
Technomyrmex albipes (F. Smith, 1861)	FI03-71	1	3	O
Technomyrmex difficilis Forel, 1892			1	O
Technomyrmex elatior Forel, 1902	FI01-83		4	x
Technomyrmex kraepelini Forel, 1905		12	8	O
Technomyrmex vitiensis Mann, 1921	FI98-276			O
Subfamily Dorylinae				
Aenictus breviceps Forel, 1912 (=sp. 5 of FI, = sp.29 of SKY)	FI01-120			x
Aenictus sundalandensis Jaitrong and Yamane, 2013 (= sp. 4 of FI)	FI03-80			x
Ooceraea biroi (Forel, 1907)	FI01-(74, 103)	3		O
Subfamily Ectatomminae				
Stictoponera bicolor (Emery, 1889)	FI94-36, FI98-268, FI01-118, and many	3	9	x
Stictoponera binghamii (Forel, 1900)	FI01-100			O
Subfamily Formicinae				
Acropyga acutiventris Roger, 1862		1	1	O
Anoplolepis gracilipes (F. Smith, 1857)		2	16	O
Camponotus (Myrmanblys) bedoti Emery, 1893			1	O
Camponotus (Myrmanblys?) sp. 12 of FI (= sp.95 of SKY)				O
Camponotus (Myrmamblys) sp. 19 of FI (= sp. 27 of SKY)				x
Camponotus (Myrmamblys) sp. 20 of FI (= sp. 36 of SKY, *C. aurelianus*-gp.)				x
Camponotus (Tanaemyrmex) carinifer Vihmeyer, 1916 (=sp. 6 of FI, = sp. 72 of SKY)				O
Camponotus (Tanaemyrmex) sp. 21 of FI (= sp. 48 of SKY)	FI98-(272,282, 285), FI01-(79, 80, 101), FI03-69,	1	1	x
Colobopsis vitrea (F. Smith) *(=Camponotus* sp. Ej-7 of FI (= sp. 9 of SKY)			2	O
Colobopsis sp. 1 of FI *(= Camponotus* sp. 18 of FI, *Colobopsis* cf sp.9 of SKY)				O
Echinopla lineata Mayr, 1862				O
Nylanderia sp. 1 of FI (= sp. 5 of SKY)		15	11	O
Nylanderia sp. 2 of FI (= sp. 6 of SKY)		8		O
Oecophylla smaragdina (Fabricius, 1775)			6	O
Paraparatrechina sp. 1 of FI (=sp. 7 of SKY)			6	O
Paraparatrechina sp. 2 of FI (= sp. 8 of SKY)			9	O
Paratrechina longicornis (Latreille, 1802)		1	19	O

	Colony code	No. Quad-rates	No. Trees	Occurrence in Bogor
Polyrhachis (Chariomyrma) arcuata (Le Guillo, 1842)				O
Polyrhachis (Cyrtomyrma) pagana Santschi, 1928				O
Polyrhachis (Myrma) tyrannica F. Smith, 1858			2	O
Polyrhachis(Myrma) sp.18 of FI (aff. sp. 13 of SKY)				O
Polyrhachis (Myrmhopla) abdominalis F. Smith, 1858				O
Polyrhachis (Myrmhopla) armata (Le Guillou, 1842)				O
Polyrhachis (Myrmhopla) bicolor F. Smith, 1858				O
Polyrhachis (Myrmhopla) tibialis caligata Emery, 1895				O
Polyrhachis (Myrmhopla) dives F. Smith, 1857	FI98-281			O
Polyrhachis (Myrmhopla) rufipes F. Smith, 1858				x
Polyrhachis (Myrmhopla) sp. 17 of FI (nr. *bicolor*)				x
Subfamily Myrmicinae				
Cardiocondyla kagutsuchi Terayama, 1999				O
Cardiocondyla tjibodana Karavaiev, 1935				O
Cardiocondyla wrougtonii (Forel, 1890)			1	O
Carebara sp. 1 (= *Oligomyrmex* sp. 5 of FI, *O.* sp. 8 of SKY)	FI98-273, FI01-(96, 121)	4	4	O
Carebara sp. 2 (=*Oligomyrmex* sp. 14 of FI, *O.* sp. 19 of SKY)	FI01-77			x
Carebara affinis (Jerdon, 1851)	FI98-278, 279, 280, 283	11	6	O
Carebara diversa (Jerdon, 1851)	FI01-113	2	3	x
Cataulacus granulatus (Latreille, 1802)				O
Crematogaster quadriruga Forel (= sp. 9 of FI, = sp. 70 of SKY)			1	x
Crematogaster rothneyi Mayr, 1879	FI98-288			x
Crematogaster sewardi Forel, 1901	FI01-113		19	O
Crematogaster treubi Emery, 1896 (= sp. 10 of FI, = sp. 10 of SKY)	FI03-72	1	11	x
Lophomyrmex opaciceps Viehmeyer, 1922		26	1	O
Meranoplus bicolor (Guréin-Méneville, 1844)	FI98-275	1	2	O
Monomorium floricola (Jerdon, 1851)			6	O
Monomorium pharaonis (Linnaeus, 1758)			1	O
Monomorium sp. 11 of FI	FI01-124	1		x
Monomorium sp. 12 of FI (= sp. 4 of SKY)		7		x
Myrmecina sundanica Okido, Ogata and Hosoishi, 2020 (= sp. F)		1	1	O
Pheidole ghigii Emery, 1900		1		x
Pheidole pieli Santchi, 1925		8	1	x
Pheidole plagiraria F. Smith, 1860		1		O
Pheidole planifrons Santschi, 1920				x
Pheidole protea Forel, 1912			2	x
Pheidole sp. 35 of FI (= sp. eg-100, cf. *nodifera* F. Smith, 1858)	FI98-277, FI01-122		1	x
Pheidole sp. 36 of FI (= sp. eg-58, cf. *oceanica* Mayr, 1866)		4	5	x
Pheidole sp. 37 of FI			3	x

	Colony code	No. Quad-rates	No. Trees	Occurrence in Bogor
Pheidole sp. 38 of FI (= sp. eg-117, cf. *tjibodana* Forel, 1905)	FI01-98	6	2	x
Pheidole sp. 39 of FI	FI01-85			x
Rhopalomastix sp. 2 of FI (= sp. 3 of SKY)			1	x
Strumigenys godeffroyi (Mayr, 1866)		1		O
Strumigenys mitis (Brown, 2000)		1		O
Strumigenys yanintra Bolton, 2000		5		x
Tetramorium eleates Forel, 1913	FI01-123	1		O
Tetramorium kheperra (Bolton, 1976)		2	2	O
Tetramorium lanuginosum Mayr, 1870		1	1	O
Tetramorium meshena (Bolton, 1976)		1		O
Tetramorium pacificum Mayr, 1870			3	O
Tetramorium simillimum (F. Smith, 1851)	FI01-76			O
Tetramorium sp. 15 of FI (cf. *insolens* (1861))		2	1	x
Tetramorium sp. A of FI (= *Rhoptromyrmex* sp. 2 of SKY)	FI01-90			x
Tetramorium sp. B of FI (= *Rhoptromyrmex* sp. 3 of SKY)				x
Trichomyrmex destructor (Jerdon, 1851)			1	O
Subfamily Ponerinae				
Anochetus graeffei Mayr, 1870 (= sp. 3)		4		O
Brachyponera wallacea (Yamane, 2004) (=*P.* sp. 17 of FI, *Pachycondyla* sp.42 of SKY)				x
Brachyponera sp.1 of FI cf. sp. 8 of SKY (=*Pachycondyla* sp.16 of FI)	FI01-74, 99, 102	21	1	O
Buniapone amblyops (Emery, 1887)				O
Diacamma sp.2 of FI (= sp.13 of SKY)	FI98-274, 290, FI01-81, 82	5	4	x
Ectomomyrmex cf. javanus Mayr, 1867		1		O
Ectomomyrmex cf. annamitus (André, 1892) (= *Pachycondyla* sp. 15 of FI, *P.* sp. 24 of SKY)				x
Hypoponera sp. Ej-1 of FI (aff. sp. 25 of SKY)	FI01-97, 111,			x
Hypoponera sp. N5 of FI (= sp. 19 of SKY)	FI98-286	10		O
Hypoponera sp. N8 of FI (aff. sp. 28 of SKY)		4		O
Leptogenys peuqueti (André, 1887)	FI01-108, FI03-73	2	1	O
Leptogenys sp. 7 of FI (*peuqueti*-gp.)				O
Leptogenys sp.29 of FI (= sp. 23 of SKY, *borneensis* Wheeler, 1919-gp.)				x
Leptogenys sp. 11 of FI (*diminuta* (F. Smith, 1857)-gp., sp 48 of SKY, *L. laeviceps*?)	FI01-107, FI98-291	1		x
Myopias emeryi (Forel, 1913)				O
Odontomachus simillimus F. Smith, 1858	FI98-289	9	14	O
Odontoponera denticulata (F. Smith, 1858)	FI01-127	4	2	O
Platythyrea sp.3 of FI (= sp. 7 of SKY, *parallera* F. Smith, 1859-*gp.*)			1	O
Subfamily Proceratiinae				
Discothyrea sp. 4 of FI		1		x
Subfamily Pseudomyrmecinae				
Tetraponera allaborans (Walker, 1859)			3	O
Tetraponera attenuata F. Smith, 1877			5	x
Tetraponera inversinodis Ward, 2001			2	x