Diversity of ants (Hymenoptera: Formicidae) in mangrove forest of Pariaman

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Abstract. Ants are a social insect with high diversity and distributed widely to the world in many types of habitats including mangrove ecosystem. They also plays important role in mangrove ecosystem, but the study of ant in this habitat of West Sumatra still scanty. The purpose of this study was to understand the ant diversity in mangrove ecosystem of Pariaman, West Sumatra. The collection method used in this research is baited trap, beating and hand collection. A total of 11 species, 10 genera of ants belonging to 3 subfamilies were found in this study. Formicinae is the subfamily with highest number of species (5 spp.) and follows by Myrmicinae (4 spp.) and Dolichoderinae (2 spp.). The following invasive and tramp species were found in the present study, *Anoplolepis gracilipes*, *Tapinoma melanocephalum*, *Tetramorium simillimum*, and *Tetramorium bicarinatum*. The ant species diversity index in this study is moderate ($H' = 1.2$), while the evenness index classified as moderate ($E = 0.5$), and no species of ants dominate of this area were found ($D = 0.5$)

1. Introduction
Ants belong to the Phylum Arthropoda, Class Insecta, and Order Hymenoptera which are most abundant animals in tropical habitats. Indonesia have 17% species of ants (1,836 species) from total ±15,000 species in the world [1, 2]. Ants plays important role in ecosystem such as detritivore, herbivore, predator and bio-indicator in biodiversity [3].

Ants were distribute widely in terrestrial habitat except the north and south poles, including mangrove ecosystem. Mangrove was known from its specific diversity of flora as well as its fauna [4]. The presence of ants in mangrove forest was influenced by many factors, including nesting site, food sources, and human activities. The previous study also reported that the function of ants as predator of insect pest on mangrove plants genus *Sonneratia*, *Rhizophora* and *Bruguiera* [5]. The ants has spread worldwide through human commerce to many other parts of the world [6, 7]. While in the mangrove ecosystem, ants spreads through by rotten logs and branches, viviparous seeds, and epiphytes of mangrove trees in which colonies of ants nest might be transported by such seasonal currents over long distances [8].

The mangrove forest of Pariaman in West Sumatra Province is reducing its diversity and area every year due to the human activities around this area [9, 10, 11]. The degradation of mangrove forest in Pariaman was recorded from 7 ha to 3.8 ha in 2012 [9]. Many studies of ants in Sumatra were conducted, except ant diversity in mangrove ecosystem of West Sumatra. The following studied were done in West Sumatra: ant genus *Odontomachus* [12], diversity of ants in Mount Singgalang [13], ants in
banana plantation\textsuperscript{[14]}, ants in epiphyte plants\textsuperscript{[15]}, ants in Angso Duo Island, Pariaman\textsuperscript{[16]}, subterranean ants\textsuperscript{[17, 18]}, ant genus \textit{Anochetus}\textsuperscript{[19]}, ant genus \textit{Myrmecina}\textsuperscript{[20]}, ants in Mount Talang\textsuperscript{[21]}, ants in oil palm plantation\textsuperscript{[22]}, ants in wheat and potato plantations\textsuperscript{[23]}. However, the diversity index of mangrove in this location was low\textsuperscript{[24]}, and this will effect to fauna in this mangrove ecosystem, including ants. The present study aims to understand the diversity of ants in mangrove forest of Pariaman City.

2. Methods
The ants were collected from the mangrove forest of Manggung, District North Pariaman, Pariaman city, West Sumatra (0° 36’03”S, 100° 06’48”E). While ant sampling was conducted by using a baited trap, beating, and hand collecting methods.

The baited trap was used for collecting ground ants which attracted to the bait\textsuperscript{[25, 26]}. Total 20 baits were placed along 200 m line with interval 10 m and the purpose of this method is to collect ants on the ground that is attracted by the bait. The baited trap was set for 1 hour (09.00 AM-10.00AM). Then ants were collected every 10 minutes and put in vial filled with ethanol 70%. The Beating method aims to collect the arboreal ants. Ants are knocked from the vegetation, onto a sheet placed beneath the plants. Then every ants on the sheet were remove to the vial filled with ethanol 70%. The hand collecting is a sampling method that actively and visually searching the ants in their nest in the rotten wood, under the stones, in the soil, in the lower vegetation, and in the leaf litters. The specimens were kept in small plastic vials filled with 70% ethanol.

The specimens were identified by referring to Bolton\textsuperscript{[27]}, Hashimoto and Rahman\textsuperscript{[28]}, Antwiki\textsuperscript{[2]}. And all specimen were deposited in Laboratory of Ecology, Biology Department, Faculty Mathematics and Natural Sciences, Universitas Negeri Padang.

3. Results and Discussion
A total 11 species of ant was collected at mangrove forest of Pariaman which belonging to three subfamilies, 10 genera and 520 individuals. The highest number of species were found in Formicinae (five species), followed by Myrmicineae (four species) and Dolichoderineae (two species). \textit{Dolichoderus thoracicus} was species with the highest number of individuals collected (Table 1). The finding of majority of the ant species in subfamily Formicinae is different from the previous studies, but the dominancy trend for the subfamily Formicinae, Myrmicineae, and Dolichoderineae was similar to previous studies that distributed worldwide and found at various type of environment\textsuperscript{[5, 14, 15, 17, 22, 23, 29, 30]}.

However, Dakir\textsuperscript{[5]} also conducted study on diversity of ants in mangrove forest of Kolaka, South East Sulawesi and Muara Angke, Jakarta, but he found more species (18 species) compare to the present study. The subfamily Pseudomyrmicineae was recorded in that study, but not found in the present study. The species composition of mangrove plants also different which the mangrove genus \textit{Bruguiera} not found in present study. In other hand, the study of Ariyyanto et al.\textsuperscript{[30]} in mangrove forest of North Kayong was recorded only eight species. This number was lower than the present study, and they only used baited trap for collecting ants. The species composition of mangrove forest probably affect the number of collected species, because of in that study area contains only two species of mangrove, \textit{Rhizophora} sp. and \textit{Nypa fruticans}\textsuperscript{[30]}.

The study of ant diversity by Sartika\textsuperscript{[19]} was conducted in small island namely Angso Duo, Pariaman which is close to the location of present study (3.2 km from the coastal of Pariaman city), but that island without mangrove forest. In that study, they collected 13 species of ants in that island, but only three species similar to the present study, \textit{Anoplolepis gracilipes}, \textit{Ochoephylla smaragdina}, and \textit{Tapinoma melanocephalum}. 

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Table 1. List of subfamily, genera and species of ant collected in mangrove forest at Pariaman City, West Sumatra. BT = Baited Trap, B = Beating, HC = Hand Collecting

| No | Subfamily           | Sampling Methods | Species                  | BT  | B   | HC  |
|----|---------------------|------------------|--------------------------|-----|-----|-----|
|    | Dolichoderinae      |                  | Dolichoderus thoracicus  (F. Smith, 1860) | 110 | 181 | 43  |
| 1  |                     |                  | Tapinoma melanocephalum (Fabricius, 1793) | 83  | 0   | 7   |
| 2  | Formicinae          |                  | Anoplolepis gracilipes (F. Smith, 1857) | 27  | 0   | 0   |
| 3  |                     |                  | Camponotus sp.           | 0   | 0   | 2   |
| 4  |                     |                  | Colobopsis sp.           | 0   | 16  | 0   |
| 5  |                     |                  | Nylanderia taylori (Forel, 1894) | 2   | 0   | 0   |
| 6  |                     |                  | Oecophylla smaragdina (Fabricius, 1775) | 0   | 10  | 0   |
| 7  |                     |                  |                          |     |     |     |
| 8  | Myrmicinae          |                  | Monomorium monomorium (Bolton, 1987) | 28  | 0   | 0   |
| 9  |                     |                  | Pheidole sp.             | 0   | 0   | 7   |
| 10 |                     |                  | Tetramorium bicarinatum (Nylander, 1846) | 0   | 0   | 2   |
| 11 |                     |                  | Tetramorium simillimum (F. Smith, 1851) | 0   | 0   | 2   |
|    | ∑ total individual  |                  |                          | 250 | 207 | 63  |
|    | ∑ species           |                  |                          | 5   | 3   | 6   |
|    | ∑ genus             |                  |                          | 5   | 3   | 5   |
|    | ∑ subfamily         |                  |                          | 3   | 2   | 3   |

The number of ant species collected from the mangrove forest by Baited Trap, Beating, Hand Collecting methods were five, three and six species, respectively (Table 1). By using the Beating method, Dolichoderus thoracicus is species with highest number of individual collected in mangrove forest of present study, and followed by Colobopsis sp. and Oecophylla smaragdina. Dolichoderus thoracicus was collected from 10 species of mangrove plants, while Colobopsis sp. in two species, and Oecophylla smaragdina in one species (Table 2). In the present study we not measure or analyze the specific association between ant and mangrove plants.

The invasive status of ants that we used was based in Pfeiffer et al. \[3^1\] and Antwiki \[2\] with adjustments to include tramp species status as well. Tramp species is alien species with wide distribution and usually distributed by human commerce to many parts of the world, but are mostly confined to human-modified habitats. The invasive ants are the most successful introduced species being able to penetrate natural ecosystems (disturbed or undisturbed) and to outcompete native ants and affect other organisms \[^{31}\]. Then we identified in mangrove forest of the present study that Tetramorium simillimum and Tetramorium bicarinatum as tramp species, and Anoplolepis gracilipes and Tapinoma melanocephalum as the invasive ants. The present of tramp and invasive species in such kind area will affect the native diversity. In the mangrove forest of Pariaman, this condition probably caused by the high activities of human in this area. The spreading of invasive ants is actually started from the coastal line, including the mangrove ecosystem \[^{7}\].
Table 2. List of ant species collected by using beating methods in mangrove forest at Pariaman City, West Sumatra.

| Species                  | Mangrove Plants           | Individual |
|--------------------------|----------------------------|------------|
| Dolichoderus thoracicus  | Calophyllum inophyllum     | 9          |
| Cerbera manghas          |                            | 2          |
| Dolichandrone spathacea  |                            | 11         |
| Hibiscus tiliaceus       |                            | 11         |
| Macaranga tanarius       |                            | 13         |
| Melastoma candidum       |                            | 13         |
| Nypa fruticans           |                            | 18         |
| Piper aduncum            |                            | 4          |
| Rhizophora apiculata     |                            | 22         |
| Sonneratia caseolaris    |                            | 78         |
| Colobopsis sp.           | Rhizophora mucronata       | 9          |
| Terminalia catappa       |                            | 7          |
| Oecophylla smaragdina    | Calophyllum inophyllum     | 10         |
| ∑ total                  |                            | 207        |

4. Conclusion
The ant species from this study showing four species recognized as tramp and invasive species. Most of these species were collected from baited trap methods. The spreading of invasive ants is actually started from the coastal line, including the mangrove ecosystem.

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