

## Alien Ant Species (Hymenoptera: Formicidae) in Taksin Maharat National Park, Tak Province

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### Abstract

The alien ant species were carried out from Taksin Maharat National Park, Tak Province, western Thailand between December 2022 and July 2023 in three seasons: winter (December 2022), summer (April 2023), and rainy (July 2023). Pitfall traps were used to collect alien ants from two different kinds of habitats including 1) nature trail and 2) staff and tourist residences. A total of eight species, seven genera in three subfamilies were found in the study area. Of which, a species belongs to subfamily Dolichoderinae, *Tapinoma melanocephalum* (Fabricius, 1793); two species in subfamily Formicinae that are *Anoplolepis gracilipes* (Smith, 1857) and *Paratrechina longicornis* (Latreille, 1802); and five species in subfamily Myrmicinae consisting of *Monomorium floricola* (Jerdon, 1851), *Monomorium pharaonis* (Linnaeus, 1758), *Solenopsis geminata* (Fabricius, 1804), *Tetramorium kheperra* (Bolton, 1976), and *Trichomyrmex destructor* (Jerdon, 1851). Currently, 15 alien ant species were previously recorded from Thailand. Thus, the alien ants found in this study were 53.33% of the alien ant species reported in Thailand. The most alien species were found in the summer. *Anoplolepis gracilipes* was the most abundant species that it can be adapted to all environments and likely to become an invasive alien species in natural forest ecosystem.

**Keywords:** Alien ant species, Pitfall traps, Nature trail, Western Thailand

### 1. Introduction

Ants are eusocial insects of the family Formicidae, order Hymenoptera, as same as bees and wasps. Currently, they are denominated as 14,223 valid species, 342 genera, 16 families worldwide [1, 2]. Recently, over 540 named species of ants were recorded [3-10] from Thailand. Ants are one of the most diverse and numerous insects. They have a cosmopolitan distribution, especially in tropical forests and can create habitats from the ground up to tree canopy. Unfortunately, they cannot live in Antarctica because the entire continent is covered with ice [3, 11-12]. Ants are susceptible to environmental change and can spread in natural and disturbed forest areas. Therefore, it is widely employed as an indicator for forest integrity and biodiversity assessment [13]. Furthermore, they were used as an indicator for plant society

determination in Khao Yai National Park, Thailand [14]. Most ants are predators, they hunt insects or small animals for feeding. Some of them are categorized as alien ant species, capable of adapting and spreading in both forest and disturbed areas successfully. The invasion impacts ecological systems by lowering biodiversity in the areas. Office of Natural Resources and Environmental Policy and Planning or ONEP [15] reported 5 species of ants that were listed in Thai register of alien species which should be secured, controlled, and eliminated. The list consists of three species of the invasive species in Thailand (list 1): Yellow crazy ant (*Anoplolepis gracilipes*), Tropical fire ant (*Solenopsis geminata*), and Ghost ant (*Tapinoma melanocephalum*), none from invasive alien species that have invasive tendency in Thailand (list 2), one species of not invasive species in Thailand (list 3): African big-headed ant (*Pheidole megacephala*), and one species of the invasive species that has still not invade Thailand (list 4): Fire ant (*Solenopsis invicta*). These alien species aggressively compete with local species for feeding and habitats and may cause the loss of biodiversity since they are highly adaptable and dominantly occupy those areas. [3]. Moreover, an additional of 15 alien ant species has been reported in Thailand, including Honey ant (*Iridomyrmex anceps*), Black household ant (*Ochetellus glaber*), Ghost ant (*Tapinoma melanocephalum*), White-footed ant (*Technomyrmex albipes*), Difficult techno ant (*Technomyrmex difficilis*), Yellow crazy ant (*Anoplolepis gracilipes*), Red-brown thorn box ants (*Lioponera longitarsus*), Flower ant (*Monomorium floricola*), Pharaoh ant (*Monomorium pharaonis*), Bigheaded ant (*Pheidole megacephala*), Tropical fire ant (*Solenopsis geminata*), Common three-pronged ant (*Tetramorium kheperra*), Woolly ant (*Tetramorium lanuginosum*), Destructive trailing ant (*Trichomyrmex destructor*), and Black crazy ant (*Paratrechina longicornis*). This study aimed to clarify the species and spreading of alien ants in Taksin Maharat national park, Tak province, which is one of the conserved areas that has high biodiversity and being a popular tourist attraction in the western forests.

## 2. Materials and Methods

### 2.1 Study site

This study was conducted in Taksin Maharat National Park, locating in Amphoe Mueang and Mae Sot, Tak Province. The area of interest was divided into two kinds according to type of usage which are nature trail (16°46'59.0"N, 98°55'10.0"E, Elevation: 905 m) and staff and tourist residences (16°46'51.0"N, 98°55'46.0"E, Elevation: 940 m) (Figure 1)

### 2.2 Fieldwork and data collection

The pitfall trap was utilized in each area of interest by placing the diameter 8.5 cm plastic cups within 30 pits which approximately 10 meters apart from each other in a straight line. The 70% (w/v) ethanol was then added into the cups and left for 24 hours. After that, the ant specimens were carried out from the traps and submerged in 95% w/v ethanol. The survey was conducted three times, covering all seasons in Thailand between December 2022 and July 2023: winter (December 2022), summer (April 2023), and rainy (July 2023).

### 2.3 Ant Identification

The alien ants collected within the areas of interest were dried by the card-point method. The individual ant specimen was mounted on a card point cut into triangular shape with the pin by laying its back on the edge of a block and the card point pressed lightly against the specimen. The alien ants were identified by Weeyawat Jaitrong by using the book, ants of Thailand [3]. The specimens are housed in the natural history museum, national science museum (THNHM), Pathum Thani Province, Thailand.

## 2.4 Data Analyses

Shannon-Weiner function [16] was used to evaluate the ant species diversity between the areas as following equation (1):

$$H = \sum_{i=0}^s (pi)(\ln pi) \quad (1)$$

where H = Species diversity index

s = number of species

pi = proportional abundance of  $i^{\text{th}}$  species = (ni/N)

Frequency of species occurrence [17] was determined according to equation (2).

$$\% \text{ Frequency} = \frac{\text{No. of times ant were found}}{\text{No. of times survey}} \times 100 \quad (2)$$

|                            |             |               |
|----------------------------|-------------|---------------|
| The level of frequency is: | Very common | = $\geq 70\%$ |
|                            | Moderate    | = 40-69%      |
|                            | Rare        | = 40%         |

The similarity of ant species between two areas were examined by using Sorensen similarity coefficient (S) [18] as following equation (3).

$$S = \frac{2a}{(2a+b+c)} \quad (3)$$

where a = The number of species found in both sites

b = The number of species found in site B not in site A

c = The number of species found in site A not in site B

## 3. Results and discussions

A total of 1,365 alien ants were collected from Taksin Maharat National Park. They were categorized into eight species, seven genera in three subfamilies. These alien ants consisted of a species in subfamily Dolichoderinae, *Tapinoma melanocephalum* (Fabricius, 1793), two species in subfamily Formicinae, *Anoplolepis gracilipes* (Smith, 1857) and *Paratrechina longicornis* (Latreille, 1802) and five species in subfamily Myrmicinae, *Monomorium floricola* (Jerdon, 1851); *Monomorium pharaonis* (Linnaeus, 1758); *Solenopsis geminata* (Fabricius, 1804); *Tetramorium kheperra* (Bolton, 1976), and *Trichomyrmex destructor* (Jerdon, 1851) (Table 1) (Figure 2). These species accounted for 53.33% of the alien ant species reported in Thailand.

According to the study areas, eight and three species of alien ants were found in staff and tourist residences and nature trail, respectively. The most abundant five species belong to subfamily Myrmecinae, accounting for 62.5% of the total alien ants found in the areas. In addition, two species from subfamily Formicinae and a species from subfamily Dolichoderinae were also counted. The two latter subfamilies were 25% and 12.5% of the total alien ants found in the study areas. Our results were compatible with the assessment of alien ants in the other areas of Thailand, in which, the ants in subfamily Myrmecinae were

more numerous than the others. This finding is also consistent with a report from [19], who found that the ants in subfamily Myrmicinae were the most diverse ants in forests and other of habitats. Since that, it can be found more frequently than the ants from another subfamily.

When analyzing the diversity index values, it was found that the staff and tourist residences had the highest diversity of alien ant species ( $H' = 1.16$ ), whilst much lesser diversity in nature trail ( $H' = 0.53$ ). This is unsurprising because the more human activity, the more possibility of alien ants in that area. Normally, the alien ant species mainly spread into any country via transportation routes such as seaport and airport. The ants, then, invade into human communities, agricultural areas, or degraded forests through groups of tourists, imported consumption goods, or scraps which can be a source of food for these alien ants as well [20]. Some of alien ant species, especially, yellow crazy ant (*A. gracilipes*), although it lives in open areas, it can invade natural forest because it is highly adaptable to various environments. It also invaded agricultural ecosystems and human habitats [21]. Fortunately, food and consumer goods are prohibited in nature trail so, the diversity of alien ants is still low in the area. Of these, the recent pattern of alien ant invasion has guided us to an appropriate spread prevention measure by promoting awareness of imported goods contaminated with alien ant species, for instance, electronic devices, food, agricultural products, etc. Another human activity should be under constraint, such as clearing of conserved forest, because this activity can possibly lead to spreading of alien species as well. Moreover, food and travelling in conserved areas should be also restricted.

The frequency of species occurrence from Table 2 illustrated only rare level of frequency in nature trail which contained three species of alien ants, including *M. pharaonis*, *T. kheperra* and *T. destructor*. While two levels of frequency were found in staff and tourist residences, in which, the moderate level of frequency consisted of *A. gracilipes* and seven species of alien ants were rarely found, including *M. floricola*, *M. pharaonis*, *P. longicornis*, *S. geminate*, *T. melanocephalum*, *T. kheperra*, and *T. destructo*. The most abundance species found in this study, *A. gracilipes*, was supported by many ant research groups in Thailand and other countries. Of those, they reported this invasive species could adapt well in human disturbing environment and the invasion significantly impacted structural composition, integrity, functionality, and biodiversity of ecosystems [22-23]. The yellow crazy ant was also guaranteed to become a solid invasive species in southeast Asia and other regions ([24]. Furthermore, the ant may take advantage of its bigger size to intrude on another species. [20]. Hence, *A. gracilipes* is the most dangerous alien ant species.

The similarity index between alien ant species found in nature trail and staff and tourist residences with a value of 0.35, where three species among eight alien species are similar between the areas. This might be as a consequence of human activities in both areas and long period invasion or adaptation of some species to natural forest. More importantly, the difference of alien species also depends upon food and area characteristics, i.e. the height above sea level, slope, flat level, or valley nearby ([13, 25]

Here, the alien ant species were numerated successfully by using pitfall trap which it was suggested to be the most effective traps for the capture or collection of Arachnida, Coleoptera, Hymenoptera, Lepidoptera, Orthoptera and other arthropods [26]. It is intriguing that an abundance of ant species was collected by pitfall trap in the summer more significant than the other season. This might be due to lacking water in the summer, unlike the other season which has more sources of water and humidity. The dryness, thus, triggers the ants to seek water in provided trap. The result also agrees with a recommendation from Francys [27] who recommended employing pitfall trap in dry season to collect various species of ants.

**Table 1.** Species of alien ants found in Taksin Maharat national park, Tak Province

| Subfamilies    | Genera              | Scientific name                                   |
|----------------|---------------------|---|
| Dolichoderinae | <i>Tapinoma</i>     | <i>Tapinoma melanocephalum</i> (Fabricius, 1793)  |
| Formicinae     | <i>Anoplolepis</i>  | <i>Anoplolepis gracilipes</i> (Smith, 1857)       |
|                | <i>Paratrechina</i> | <i>Paratrechina longicornis</i> (Latreille, 1802) |
| Myrmicinae     | <i>Monomorium</i>   | <i>Monomorium floricola</i> (Jerdon, 1851)        |
|                |                     | <i>Monomorium pharaonis</i> (Linnaeus, 1758)      |
|                | <i>Solenopsis</i>   | <i>Solenopsis geminata</i> (Fabricius, 1804)      |
|                | <i>Tetramorium</i>  | <i>Tetramorium kheperra</i> (Bolton, 1976)        |
|                | <i>Trichomyrmex</i> | <i>Trichomyrmex destructor</i> (Jerdon, 1851)     |
| Total          | 7 Genera            | 8 Species   |

**Table 2.** A list of species, percentage of occurrences and total individual of ant in two different land usage.

| Scientific name                   | Frequency occurrence (percent) |               |
|-----------------------------------|--------------------------------|---------------|
|                                   | Staff and tourist residences   | Nature trails |
| 1 <i>Anoplolepis gracilipes</i>   | 0.0                            | 57.78**       |
| 2 <i>Monomorium floricola</i>     | 0.0                            | 1.11*         |
| 3 <i>Monomorium pharaonis</i>     | 1.11*                          | 3.33*         |
| 4 <i>Paratrechina longicornis</i> | 0.0                            | 1.11*         |
| 5 <i>Solenopsis geminata</i>      | 0.0                            | 1.11*         |
| 6 <i>Tapinoma melanocephalum</i>  | 0.0                            | 4.44*         |
| 7 <i>Tetramorium kheperra</i>     | 2.22*                          | 24.44*        |
| 8 <i>Trichomyrmex destructor</i>  | 1.11*                          | 3.33*         |

Note: \*\*\* Very common, \*\* Moderate, and \* Rare

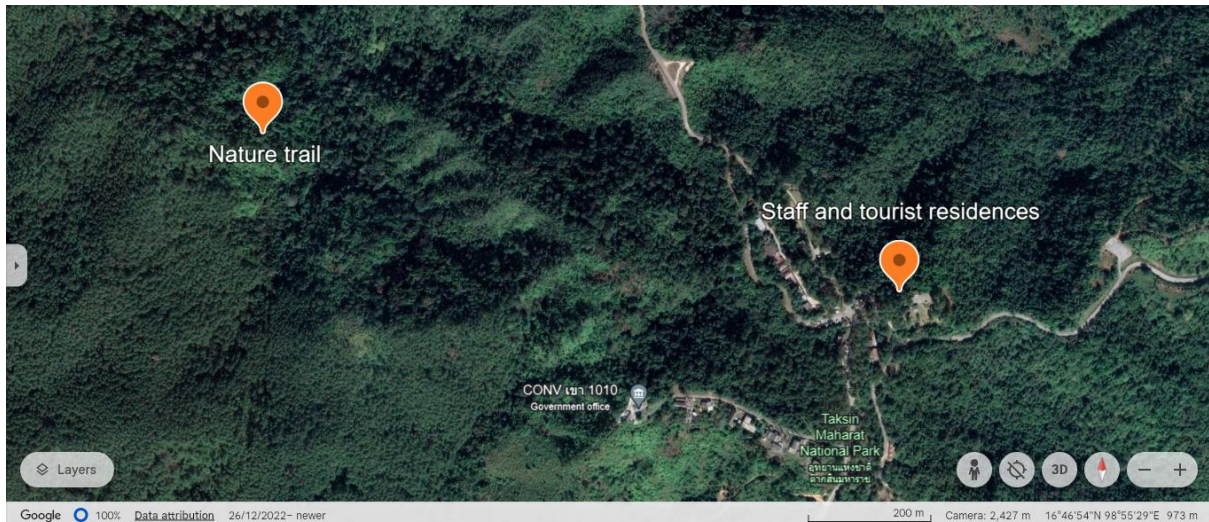


Figure 1. Study site location in Taksin Maharat National Park, Tak Province Google earth. (<https://earth.google.com>) (date: 15 May 2024)

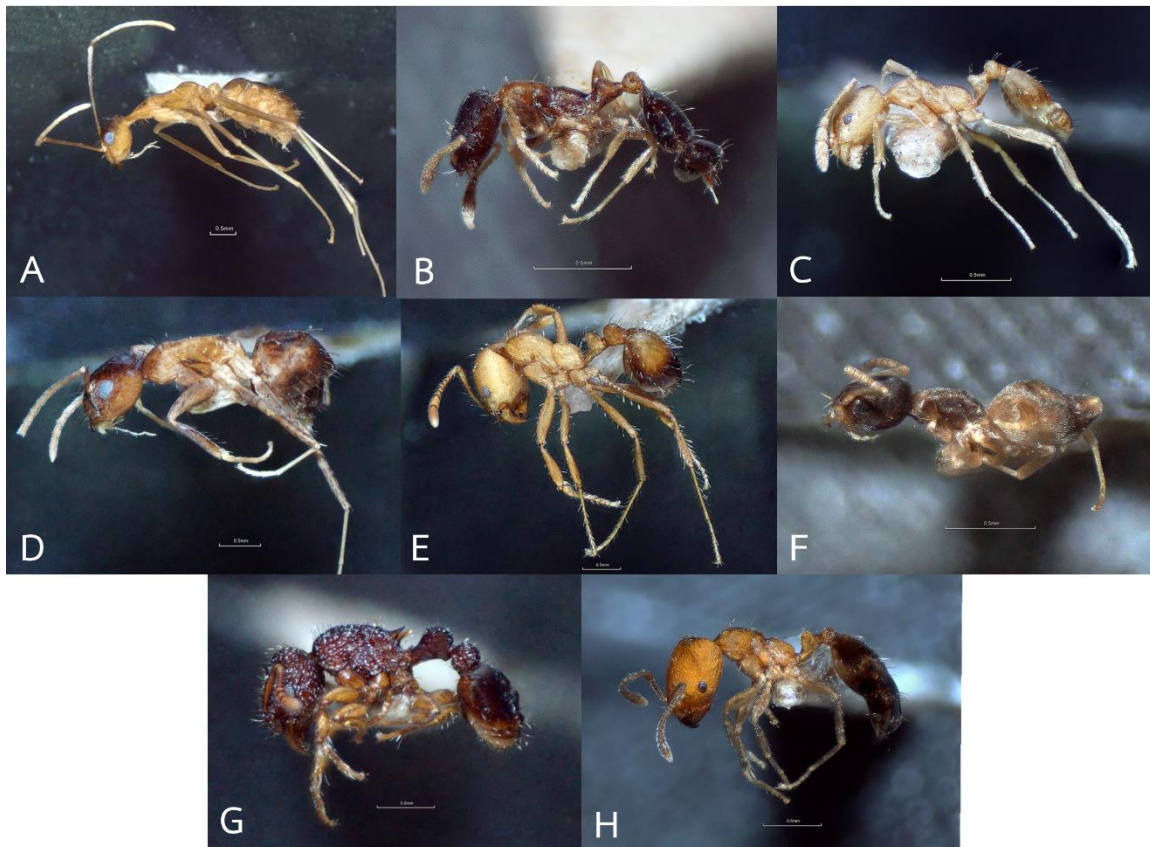


Figure 2. The eight alien ant species found in Taksin Maharat National Park: A, *Anoplolepis gracilipes* (Smith, 1857); B, *Monomorium floricola* (Jerdon, 1851); C, *Monomorium pharaonis* (Linnaeus, 1758); D, *Paratrechina longicornis* (Latreille, 1802); E, *Solenopsis geminate* (Fabricius, 1804); F, *Tapinoma melanocephalum* (Fabricius, 1793); G, *Tetramorium kheperra* (Bolton, 1976); H, *Trichomyrmex destructor* (Jerdon, 1851).

#### 4. Conclusion

The study of alien ant species in Taksin Maharat National Park, Tak province indicated eight species which are from three subfamilies. Of these, *A. gracilipes* (yellow crazy ant) was the most abundant species in which the ant might take advantage from its bigger size to intrude another species as well as spreading and building colony rapidly in a new environment. Since the existence of alien ants in the National Park areas, an appropriate preventive measure thus should be restricted with tourism, scraps, waste management, and other activities that might allow invasion of alien ant.

#### 5. Acknowledgements

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