Predation behaviour of *Myopopone castaneae SMITH* ants against some insect larvae in the laboratory

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**Abstract.** *Myopopone castaneae* ants are known to be predators of the larvae of *Oryctes rhinoceros*. These ants attack their prey alive by biting and stinging them to death before the hemolymph fluid is consumed. Despite the minimal information available, these ants have the potential to prey on 2.8 - 3 larvae for a period of 5 days. Therefore, the purpose of this research was to evaluate the predation behavior of *M. castaneae* ants against several types of insect larvae in the laboratory. This investigation was performed at the pest laboratory, Faculty of Agriculture, North Sumatra University from May to July 2020. The results showed the fastest prey time of 2-3 days on 3 *Omphisa fuscidentalis* larvae, while the longest was observed against *Rhynchophorus ferrugineus* species, at 3 larvae for 6-7 days. In addition, the typical predation behavior and symptoms include the presence of scars and gradual blackening on the cuticles. Moreover, ants tend to carry their offspring to the dead larvae of *O. rhinoceros* and *R. ferrugineus*, while *O. fuscidentalis* is conveyed to the nest for consumption by the colony.

1. Introduction

The horn beetle (*Oryctes rhinoceros* L.) is a major pest in oil palm plants. The area of oil palm plantations that are heavily attacked by this pest affected to a 0.2-0.3 ton/ha decline in production during the 18 months of harvest in the first year [1]. Furthermore, *Rhynchophorus ferrugineus* has been identified as the major causative pest of death in coconut plants. This is evidenced by the holes (>20) observed on the shoots in cases of severe attacks, which consequently prompts a fatal fall [2]. In addition, *Omphisa fuscidentalis* larvae have the capacity to create holes in bamboo stems, and further destroy the inner part [3]. The three larvae stipulated above, including the *Hermetia illucens* were identified in piles of palm kernel fruit waste consume organic materials to survive [4].

The pest control techniques predominantly used by land managers involve the application of chemicals or insecticides. This approach is considered to have a highly detrimental impact on biodiversity. *Integrated Pest Management* (IPM) is one of the most popular control methods adopted on recent times, due to the environmentally friendly characteristics, and the potential to prevent population explosion. The efforts to control *O. rhinoceros* in an integrated manner includes sanitation exploiting natural enemies, and also by applying pheromones and neem powder [5].

The horn beetle IPM has an important component of utilizing natural enemies, including predators and parasitoids. This involves using ants recognized as a biological agent. In addition, oil palm plantations are characterized by weaver ants *Oecophylla smaragdina* that are able to prey on...
Setora nitens larvae with a fairly high predation level [6]. Ants and crickets are common predators, well-known to attack caterpillar/larvae pests in Indonesian oil palm plantations [7]. Marheni [8] reported on the ability for M. castanea (Hymenoptera: Formicidae) to predate O. rhinoceros larvae. These ant colonies forage on soil, leaf litter, as well as rotting wood, and are known as obligate predators to arthropods. Particularly, M. castanea attacks prey by stinging and biting to death, before sucking up the hemolymph fluid and reserving only the cuticle.

Widihastuty [9] estimated a total of 5 day required for a colony of M. castanea ants to prey on 2.8 - 3 O. rhinoceros larvae. The strength of mandibles is important during hunting, due to the application in lifting and dismembering the prey [10]. There is minimal information available regarding this predatory ant. Therefore, this research was performed to evaluate the predation behaviour of M. castaneae against several types of insect larvae in the laboratory.

2. Materials and methods

The research was conducted from April to May 2020 at the Pest Laboratory, Faculty of Agriculture, University Sumatera Utara, Medan. In addition, the study on behavior and symptoms of predation involved a descriptive method, while the duration of handling prey required a non-factorial completely randomized design with 4 repetitions. The treatments comprise the administration of O. rhinoceros larvae, O. rhinoceros larvae + honey, R. ferrugineus larvae, O. fuscidentalis larvae, and H. illucens larvae. The similarity of the habitats of some of these larvae and their easy availability considered in the selection of larvae to be tested in this study.

![Figure 1](image_url)

Figure 1. Glass boxes research by inserting a pile of palm stems followed by the addition colony of *M. castanea* ants were inoculated with insect larvae.

This research commenced by preparing the site, characterized by 20 glass boxes measuring 40 X 20 X 20 cm each. *M. castaneae* ants and larvae *O. rhinoceros* were obtained from oil palm plantations by collecting them manually using a hoe and a machete, while the other three types of larvae were obtained by buying them at a poultry shop. The research was then performed by inserting a pile of palm stems measuring 20 cm x 15 cm into the box. This was followed by the addition of 50 imago, 25 larvae, and 25 pupae of *M. castanea* ants after 24 hours. Every four glass boxes were inoculated with three insect larvae, according to the designated treatment, as shown in figure 1. Subsequently, another similar inoculation was performed after the previous three have been consumed. This cycle was repeated up to five times, and observations were made daily by evaluating the ant behavior and calculating the time required to handle each larvae.
3. Results and discussions

3.1. Predation behaviour and symptoms of predation

Based on the results of observations in the laboratory, the symptoms of predation and the behavior of preying on *M. castaneae* ants on the larvae of *O. rhinoceros* without additional honey and with the addition of honey did not show any difference as shown in figure 2 A and B. The *M. castaneae* reportedly attacks preys by stinging and biting the prey to death. The initial predation symptom includes the appearance of black spots on the cuticle of *O. rhinoceros*, followed by a gradual color change to brownish and then black. These features extend to the entire surface, and is also observed with *O. rhinoceros* larvae. However, the gradually changing cuticles are accompanied by the body being torn apart with bites [11].

The predation symptoms exhibited by *R. ferrugineus* larvae resemble *O. rhinoceros*. This is initiated by the black spots observed on the cuticles, before a pale yellow color was formed, followed by the development of black spots, which enlarge to completely engulf the entire cuticle. Scars were observed in all larvae, as shown in figure 2 C. *O. fuscidentalis* additionally showed symptoms in the form of blackened cuticles and scars. However, no yellowing or yellowish cuticle changes were observed, as shown in figure 2 D.

*M. castaneae* ants consumed the hemolymph fluid of their prey which dies slowly until leaving only the head and cuticle. In addition, there was a higher tendency to exhaust the preys independently, and consume the body parts completely. This finding is congruent with Marheni [8], where *M. castanea* ants had a similar predation pattern. In addition, the ants also had the ability to eat the entire *O. rhinoceros* body 1st instar larvae. The predation behavior observed on ants was similar for all prey larvae. However, worker ants tended to first immobilize the victim by stinging, before making attempts to tear it apart using mandibles. Then one by one the other worker ants around will also help
to paralyze their prey to death. Larabee and Suarez [12] acknowledged the strength of mandible as very important during hunting.

Figure 3 A, B and C shows observations on the dead larvae of *O. rhinoceros* and *R. ferrugineus* found that *M. castaneae* ants carried their larvae to the dead prey larvae to eat the hemolymph fluid together. This behavior is thought to ensue due to the large size of the prey larva so that the transfer of the ant colony to the dead prey larvae make it easier for worker ants than to carry their dead prey to their colony nests. Wilson [13] found similar findings, and reported on the transfer of prey from *M. castaneae* ants to their offspring. This behavior is not comparable the performance while consuming *O. fuscidentalis* larvae, as an opposite disposition is observed, as shown in figure 3 D. This involves towing the prey to individual nests, and is presumably due to the smaller larvae size in contrast with *O. rhinoceros* and *R. ferrugineus*. This finding is congruent with Ito [14], where *M. castaneae* carried body pieces to the nest while preying on Tenebrio mollitor larvae in the laboratory, in addition his study also state, larval hemolymph feeding (LHF) is performed about 38 times, and one worker caste monopolizes over 50% of the movement (21 times), while the other consumes one to three times.

### 3.2. Duration of handling prey

The fastest prey handling time for *M. castaneae* was observed in treatments with *O. fuscidentalis* larvae, at 2-3 days per 3 larvae, as shown in table 1. This was presumably attributed to the prey morphology, which resembles the 1st instar larvae *O. rhinoceros*. The characteristic white, soft, and thin cuticle facilitate the ease for *M. castaneae* to tear and eat hemolymph fluids. These two larvae have similar small body size. Junaedi et al. [15] performed a preference test, and showed an inclination of *M. castaneae* towards 1st instar larvae, due to the smaller size, compared to the 3rd variety.

![Figure 3](image.png)

**Figure 3.** Predation behaviour of *M. castaneae* ants against (A) *O. rhinoceros* larvae; (B) *O. rhinoceros* larvae + honey; (C) *R. ferrugineus* larvae; (D) *O. fuscidentalis* larvae.
Table 1. Prey handling duration of *M. castaneae* ants on 3 larvae of several insects.

| Treatment                | Average (days) |
|--------------------------|----------------|
| *O. rhinoceros*          | 4.45d          |
| *O. rhinoceros* + honey  | 5c             |
| *R. ferrugineus*         | 6.5b           |
| *O. fuscidentalis*       | 2.68a          |
| *H. illucens*            | -              |

Meanwhile, the longest prey handling was observed in treatments with *R. ferrugineus* larvae, at 6-7 days per 3 larvae (table 1). This characteristic was attributed to the aggressive resistance demonstrated, indicated by the number of dead ants in a split state or torn apart inside the glass box. The resistance posed by the mandibles present on *R. ferrugineus*, which was used to bite and tear the predator. Moreover, the confrontation was also performed in treatments with *O. rhinoceros* larvae + honey and without honey. The *O. rhinoceros* used in this study were 3rd instar larvae, which was capable of biting with mandible. This leads to elongated prey handling time similar to *R. ferrugineus* larvae, at 4-5 days per 3 larvae (table 1). Widihastuty [9] 3rd instar prey larvae are more capable of providing resistance to predators in the predation process because the 3rd instar larvae's body is larger than other prey larvae.

In contrast with other prey larvae, *H. illucens* were not preyed upon by *M. castaneae* ants. This is possibly due to the characteristic slippery cuticles, resulting in difficulties during consumption. Legaspi et al. [16] reported on the differences in preying time for both species, despite the similar acceptance level. This phenomenon was attributed to the disparity in avoidance capability, and frequency of meeting with predators.

4. Conclusion
The typical predation symptoms of *M. castaneae* ants include the presence of scars on the cuticles, followed by the gradually blackening. In addition, the predator’s offspring are carried against the dead larvae of *O. rhinoceros* and *R. ferrugineus*, while *O. fuscidentalis* is conveyed to the nest for feasting by the colony. The fastest prey consumption was observed with *O. fuscidentalis*, at 2-3 days per 3 larvae. Meanwhile, the longest was observed with *R. ferrugineus*, at 6-7 days per 3 larvae. Therefore, *O. fuscidentalis* species demonstrate the best potential for application as prey for *M. castaneae* ants.

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