Escuela Agrícola Panamericana, Zamorano

Agricultural Science and Production

B.S. in Agricultural Sciences

Special Graduation Project

Ants (Hymenoptera: Formicidae) of Zamorano

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Honduras, october 2024

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Abstract

Ants, as key members of the Formicidae family within the Hymenoptera order, play crucial roles in ecosystems through diverse behaviors such as predation, scavenging, seed collection, and mutualistic relationships. In Zamorano, there is limited knowledge about ant species, therefore, we aimed to document, identify, create an identification guide, and analyze the importance of the ants present on campus. The study was conducted during two collection periods: September to November 2023 and May to July 2024. Direct sampling methods were employed using manual collections with forceps and a pencil brush. Sampling locations were selected to represent the diversity of habitats on campus. In addition, specimens deposited in the Insect Collection were revised. A total of 440 specimens were collected, representing 17 species*: Atta mexicana* (Smith, F.), *Camponotus atriceps* (Smith, F.), *Camponotus conspicuus* (Smith, F.), *C. planatus* (Roger)*, C.* sp.1*, C.* sp.2*, C.* sp.3, *Crematogaster crinosa* Mayr, *C.* sp.1, *C.* sp.2, *Ectatomma ruidum* Roger, *Odontomachus opaciventris* Forel, *Pachycondyla harpax* (Fabricius), *Pseudomyrmex gracilis* (Fabricius), *Pseudomyrmex pallidus* (Smith, F.), *Solenopsis geminata* (Fabricius), and *S. picea* Emery. Among these, *Atta mexicana*, commonly known as leafcutter ants, is particularly significant due to its impact on agricultural crops. The most common species was *S. picea*, while *P. pallidus* was the rarest. The residential areas resulted in having the highest diversity of species on campus while the Indian Mast Tree (*Polyalthia longifolia* (Sonn.)) had the most abundance. Based on the collections and reviewed material in the collection, a total of 25 species are now known in Zamorano. An identification guide for the species in Zamorano was created.

Key words: Beneficials, defoliators, ecology, pests, taxonomy

Resumen

Las hormigas, como miembros clave de la familia Formicidae dentro del orden Hymenoptera, juegan papeles cruciales en los ecosistemas a través de diversos comportamientos como depredación, carroñeo, recolección de semillas y relaciones mutualistas. En Zamorano, hay un conocimiento limitado sobre las especies de hormigas; por lo tanto, este estudio tuvo como objetivo documentar, identificar, crear una guía de identificación y analizar la importancia de las hormigas presentes en el campus. El estudio se realizó durante dos periodos de colecta: De septiembre a noviembre de 2023 y de mayo a julio de 2024. Se emplearon métodos de muestreo directo utilizando recolecciones manuales con pinzas y pincel. Los lugares de muestreo se seleccionaron para representar la diversidad de flora y hábitats del campus de Zamorano. Se recolectó un total de 440 especímenes, que representaban 17 especies: *Atta mexicana* (Smith, F.), *Camponotus atriceps* (Smith, F.), *Camponotus conspicuus* (Smith, F.), *C. planatus* (Roger), *C.* sp.1, *C.* sp.2, *C.* sp.3, *Crematogaster crinosa* Mayr, *C.* sp.1, *C.* sp.2, *Ectatomma ruidum* Roger, *Odontomachus opaciventris* Forel, *Pachycondyla harpax* (Fabricius), *Pseudomyrmex gracilis* (Fabricius), *Pseudomyrmex pallidus* (Smith, F.), *Solenopsis geminata* (Fabricius), y *S. picea* Emery. Entre ellas, *Atta mexicana*, comúnmente conocida como hormiga cortadora de hojas, es particularmente significativa debido a su impacto en los cultivos agrícolas. La especie más comúnmente observada fue *S. picea*, mientras que *P. pallidus* fue la más rara. Las zonas residenciales resultaron tener la mayor diversidad de especies en el campus, mientras que el árbol *Polyalthia longifolia* (Sonn.) tuvo la mayor abundancia de especies. Con base en las colectas y el material revisado en la colección, ahora se conoce un total de 25 especies de hormigas en Zamorano. Se elaboró una guía de identificación de las especies en Zamorano.

Palabras clave: benéficos, defoliadores, ecología, taxonomía

Introduction

Ants, are integral members of the Formicidae family within the Hymenoptera order, a taxonomic group that encompasses other notable species like bees, wasps, and ichneumons (Hölldobler & Wilson, 1990). Eusocial insects such as ants live in colonies that are centered around one or a few reproductive individuals. These reproductive ants are supported by non-reproductive workers who take care of the brood, gather food, build nests, and defend the colony (Guénard, 2005) Despite there being over 12,000 ant species currently described (Bolton Bolton et al., 2006), according to Hölldobler and Wilson (1990), it is believed that there may be no fewer than 20,000 species within the Formicidae family.

Ants undergo complete metamorphosis, transitioning from eggs to larvae, pupae, and eventually adults, with their life cycle varying by species and environment (Holbrook, 2009). Colonies are structured into three castes: queens (reproductive), workers (non-reproductive), and drones which are short-lived males with wings for mating (Agosti et al., 2000). Major workers, also known as soldiers, are larger and primarily responsible for colony defense and handling larger food items, while minor workers are smaller, more numerous, and engage in a variety of tasks including brood care, foraging, and cleaning (Ferguson et al., 2023). Ants exhibit diverse foraging behaviors, including mutualistic relationships with plants and insects, like leafcutter ants cultivating fungus for food (Caroll & Janzen, 1973; Mcvean, 2019). Communication in ant societies relies on pheromones and touch, with chemical trails used for recruitment and task coordination (Hölldobler, 1978; Hölldobler & Wilson, 1970).

Ants play a crucial role in agriculture, providing a range of ecosystem services that enhance crop productivity and sustainability (Anjos et al., 2022). Their presence in agricultural systems can significantly reduce pest populations, leading to decreased plant damage and increased yields (Evans et al., 2011). A meta-analysis of various studies revealed that ants effectively control non-honeydew-producing pests, which are detrimental to crops (Drummond & Choate, 2011). This pest control service underscores the potential benefits of integrating ants into farming practices to promote sustainable agriculture (Anjos et al., 2022).

However, ants can also engage in mutualistic relationships with certain pest species, such as aphids and scale insects, which can lead to increased populations of these honeydew-producing insects (Hölldobler & Wilson, 1990). Some ant species, like the Argentine ant (L*inepithema humile* (Mayr)), tend to aphids and protect them from predators in exchange for honeydew, a sugary substance produced by the aphids (Lach et al., 2009). Additionally, leaf-cutter ants (*Atta* and *Acromyrmex*) can cause direct harm to crops through their ability to defoliate plants, leading to significant agricultural losses (Hölldobler & Wilson, 1990)The dual role of ants as both protectors and potential pests illustrates the necessity for careful management strategies in agricultural settings(Drummond & Choate, 2011).

Ants contribute to soil health through their nesting and foraging activities (Hölldobler & Wilson, 1990). The tunnels created by ant colonies enhance soil aeration and water infiltration, which are essential for healthy plant root systems (Folgarait, 1998). Research has shown that the presence of ants can increase wheat yields by 36% due to enhanced soil nitrogen levels and improved water retention (University of Sydney, 2011). This natural soil conditioning not only enriches the soil with nutrients as ants recycle organic matter but also improves the overall stability of the ecosystem, fostering a conducive environment for plant growth (Peters et al., 2016).

Ants play a significant role in the secondary seed dispersal of certain herbaceous plants, a process known as myrmecochory, which is crucial for maintaining plant diversity and promoting healthy ecosystems in agricultural landscapes(Vander Wall & Longland, 2004). Certain ant species, known as seed-harvesting ants, collect seeds and transport them back to their nests, where they store them for future consumption(Sasidharan & Venkatesan, 2019). This behavior not only aids in the dispersal of various plant species but also enhances germination rates, as the seeds benefit from the nutrient-rich environment of ant nests (Fernandes et al., 2018). By facilitating the spread of native plants and crops, ants contribute to increased biodiversity, which can improve ecosystem resilience and productivity (Underwood & Fisher, 2006).

According to (AntWeb, 2024), Honduras currently houses 555 ant species. One of the most notable is the red imported fire ant (*Solenopsis invicta* Buren) and the leafcutter ants from the genera *Atta* and *Acromyrmex.* This aggressive ant poses significant threats to local biodiversity and human health due to its painful sting and tendency to invade homes and businesses (ABAT, 2018). A recent study conducted in Cusuco National Park (CNP) identified a total of 162 ant species belonging to nine subfamilies and 60 genera (Wint et al., 2024). This significant finding underscores the importance of continuing investigations in various regions of Honduras, as many species remain unidentified, revealing the potential biodiversity present in the country. Furthermore, the ongoing investigation at the Zamorano campus aligns with this emphasis on biodiversity, reinforcing the need for comprehensive studies across different ecological contexts within Honduras.

The objectives of this study are to document and identify species of ants on the Zamorano Campus, determine the importance of the species present and creating an identification guide to serve as a foundation to future investigations about the Formicidae family in the entomological collection of Zamorano.

Materials and Methods

Location of Study

This study was conducted at the Panamerican School of Agriculture Zamorano, located in San Antonio de Oriente, Francisco Morazán, Honduras, 30 km along the highway from Tegucigalpa to Danlí. The research took place during September-November 2023 and May-July 2024. The average minimum temperature was 13.97°C from September-November 2023 and 20°C from May-July 2024, while the average maximum temperature was 29.6°C and 30.6°C for the same periods, respectively. The average precipitation was 22.67 inches during September-November 2023, and the average humidity was 76% during the same period.

Collection of Specimens

The primary method used for specimen collection in this investigation was direct sampling. Romero and Jaffe (1989) highlight hand collection as an efficient direct sampling method, thus justifying its use in this study. Ants were carefully gathered from surfaces using forceps and a pencil brush. Small and fast-moving specimens were collected using the pencil brush and larger specimens were collected using the forceps. The collection sites selected for this study included productive crops, trees and other areas on the Zamorano campus that ants were found inhabiting. Upon collection, the specimens were placed into glass/plastic vials containing 70% alcohol for preservation. The vials were then labeled with the date and location of where the recollection was made. Thereafter, they were transported to the entomological laboratory for their respective mounting, identification and species count.

The locations selected for ant collections were chosen to cover a broad area of the campus, aiming to represent the diversity of habitats found across Zamorano. According to Dunn et al. (2009), ants inhabit the majority of terrestrial environments, so the sampling sites for this study included but were not limited to crop systems (Table 1). They also included a variety of locations such as the Doris Stone Cafeteria, the Wilson Popenoe Library, The Zamorano Market, areas people normally transit or live, and the learning-by-doing modules, which were all classified as residential areas (see table 4). This approach ensured that the collections would provide a comprehensive representation of the campus ecosystem. The sampled flora for this study included Mango (*Mangifera indica),* Bell pepper (*Capsicum annuum),* Plantain (*Musa sp.),* Chives (*Allium schoenoprasum),* Hibiscus flower (*Hibiscus sp.),* Fig Tree (*Ficus sp.),* Neem (*Azadirachta indica),* Indian Mast Tree (*Polyalthia longifolia),* Palm Tree (*Phoenix roebelenii),* Nacedero (*Trichanthera gigantea), and* Valeriana (*Valeriana officinalis)* (Table 3).

Table 1

Sampled flora and hosts of Formicidae in Zamorano from September-November 2023 and May-August 2024

Family	Specie	Common name
Anacardiaceae	*Mangifera indica* (Linnaeus)	Mango
Solanáceas	*Capsicum annuum* (Linnaeus)	Bell pepper
Musaceae	*Musa sp.* (Linnaeus)	Plantain
Amaryllidaceae	*Allium schoenoprasum* (Linnaeus)	Chives
Malvaceae	*Hibiscus sp.* (Linnaeus)	Hibiscus flower
Moraceae	*Ficus sp.* (Linnaeus)	Fig Tree
Melicacea	*Azadirachta indica* (Adanson)	Neem
Annonaceae	*Polyalthia longifolia* (Sonn.)	Indian Mast Tree
Arecaceae	*Phoenix roebelenii* (O'Brien)	Palm Tree
Acanthus	*Trichanthera gigantea* (Humb. & Bonpl.)	Nacedero
Caprifoliaceae	*Valeriana officinalis* (Linnaeus)	Valeriana

Mounting and identification of Specimens

The vials for each collecting event were revised, and ants were sorted into morpho-species. One or two specimens from each morpho-species were selected for mounting. Smaller specimens were mounted on points, while larger specimens were mounted on entomological pins.

The identification of the specimens was carried out using dichotomous keys. Keys from (Gutiérrez-Martínez, 2014) were employed to determine the subfamily and genus levels. To identify species within the *Crematogaster* genus, the key by (Longino, 2003) was used. Species within *Psuedomyrmex* were identified using the key by (Ward, 1985). Additionally, a comparison with species in the entomological collection was conducted to identify species such as *Ectatomma ruidum* (Roger), *Pachycondyla harpax* (Fabricius), *Pseudomyrmex gracilis* (Fabricius), and *Solenopsis geminata* (Fabricius).

Photographs of the identified specimens were taken using a Canon EOS Rebel T5i camera mounted on a stereoscope LEICA EZ4 at 70x magnification. The images were transferred from the camera to the desktop using Canon's EOS Utility software, and photo editing was performed using the software Picolay.

Results and Discussion

A total of 440 specimens were collected during this investigation, representing 17 species across eight genera in the subfamilies Formicinae, Ponerinae, Myrmicinae, and Pseudomyrmecinae (Table 2). Five specimens collected in *Camponotus* (3 specimens) and *Crematogaster* (2 specimens) genera were only identified to the genus level.

One notable finding from this investigation was the identification of *Camponotus planatus* Roger, which was present in the collection but had only been identified to the genus level. In addition, five species are reported for the first time in Zamorano: *Crematogaster crinosa* (Mayr), *Atta mexicana* (Smith), *Solenopsis picea* (Emery), *Pseudomyrmex pallidus* (Smith, F.), and *Odontomachus opaciventris* (Forel).

The subfamilies Formicinae and Myrmicinae were equally represented in terms of species diversity, highlighting their ecological importance on the Zamorano campus. Formicinae, which includes large-bodied species such as those from *Camponotus*, plays an essential role in both arboreal and terrestrial environments, often acting as scavengers or predators (Hölldobler & Wilson, 1990). On the other hand, Myrmicinae is one of the most species-rich subfamilies globally, widely distributed across various habitats and known for its functional diversity that ranges from seed dispersal to predation (Philip S. Ward et al., 2015)

Table 2

*Table showing the species of the Formicidae family found throughout collections made in the Zamorano campus from September-November 2023 and May-June 2024 (**species in the collection that weren´t previously identified)*

Subfamily	genus	Species
Ectatomminae	*Ectatomma*	*ruidum* (Roger)
Formicinae	*Camponotus*	*atriceps* (Smith, F.)
	Camponotus	*conspicuus* (Smith, F.)
	Camponotus	*planatus* Roger**
	Camponotus	sp.1

Subfamily	genus	Species
	Camponotus	sp.2
	Camponotus	sp.3
Myrmicinae	*Atta*	*mexicana* (Smith, F.)
	Crematogaster	*crinosa* Mayr
	Crematogaster	sp.1
	Crematogaster	sp.2
	Solenopsis	*picea Emery*
	Solenopsis	*geminata* (Fabricius)
Ponerinae	*Odontomachus*	*opaciventris* Forel
	Pachycondyla	*harpax* (Fabricius)
Pseudomyrmicinae	*Pseudomyrmex*	*gracilis* (Fabricius)
	Pseudomyrmex	*pallidus* (Smith, F.)

The revision of the entomological collection at Zamorano was a critical component of this study, providing a comprehensive overview of ant species present in both Honduras and the Zamorano Campus. The analysis revealed a total of 34 ant species, with 20 species identified specifically on the Zamorano campus (Table 2). Despite the lack of published investigations detailing the total number of ant species in Honduras, a recent study by (Wint et al., 2024) indicates the presence of 162 species in Cusuco National Park. Furthermore, the online (AntWeb, 2024) database lists 555 ant species in Honduras. However, these figures are not directly comparable to the species identified in this study, as the Zamorano entomological collection has not been updated since the last major revision between 1984 and 1993, with only one new addition*, Neivamyrmex* sp., recorded in 2017 and 2018. In contrast, the AntWeb database is continuously updated, reflecting ongoing research and discoveries.

This study focused solely on the ant species within the Zamorano campus, identifying 17 species that correspond to the 20 species present in the collection. Notably, six species from the previous collection (1988-1992) were identified in this study: *Camponotus atriceps* (Smith, F.) (formerly *Camponotus abdominalis*), *Camponotus conspicuus* (Smith, F.), *Ectatomma ruidum* (Roger), and *Pachycondyla harpax* (Fabricius) (Table 2).

Several species previously recorded on the campus were not found in this study, including *Camponotus coruscus* (Emery), *Camponotus sericeiventris* (Guérin-Méneville), *Ectatomma* *tuberculatum* (Olivier), *Gnamptogenys striatula* (Mayr), *Odontomachus bauri* (Emery), *Odontomachus brunneus* (Patton), Atta sp*.*, *Crematogaster* sp., *Tapinoma* sp., *Neivamyrmex* sp., and *Nomamyrmex* sp. (Table 3). The absence of these species could be attributed to several factors, including habitat changes, ecological shifts, or the possibility that these species have become less prevalent due to environmental pressures or competition from newly established species.

Table 3

*Table showing species of the Formicidae family found in the entomological collection of Zamorano (*Species found on the Zamorano Campus)*

Subfamily	Genus	Species
Formicinae	*Camponotus*	*atriceps* (Smith, F.) *
	Camponotus	*conspicuus* (Smith, F.) *
	Camponotus	*coruscus* (Emery)
	Camponotus	*sericeiventris* (Guérin-Méneville) *
	Camponotus	sp.
Ponerinae	*Ectatomma*	*ruidum* (Roger)*
	Ectatomma	*tuberculatum* (Olivier)*
	Gnamptogenys	*striatula* (Mayr)*
	Odontomachus	*bauri* (Emery)*
	Odontomachus	*brunneus* (Patton)*
	Pachycondyla	*harpax* (Fabricius)*
	Pachycondyla	*apicalis* (Latreille)
	Pachycondyla	sp.
	Paraponera	sp.
Pseudomyrmicinae	*Pseudomyrmex*	*flavircornis* (Smith, F.)
	Pseudomyrmex	*gracilis* (Fabricius)*
	Pseudomyrmex	sp.
Myrmicinae	*Atta*	sp.*
	Acromyrmex	sp.
	Crematogaster	sp.*
	Monomorium	sp.
	Solenopsis	*geminata* (Fabricius)*
	Pheidole	sp.*
	Trachymyrmex	sp.*
	Zacryptocerus	sp.*
	Azteca	sp.
Dolichoderinae	*Dolichinderis*	*monacis* Roger
	Iridomyrmex	sp.
	Monacis	*bispinosa* Roger
	Tapinoma	sp.*
Ecitoninae	*Eciton*	*burchelli* (Weswood)
	Eciton	*hamatum* (Fabricius)
	Neivamyrmex	sp.*
	Nomamyrmex	sp.*

Table 4 shows a detailed analysis of the diversity and abundance of Formicidae species collected on the Zamorano campus from September-November 2023 and May-July 2024 per sampling site.

The results indicate that the Indian Mast Tree (*Polyalthia longifolia - (Sonn.) Thwaites*) supports the highest diversity of ant species, with a total of 63 observations of *Crematogaster* sp.1. Other notable species in this location include *Ectatomma ruidum* (Roger) (11 observations) and *Solenopsis geminata* (Fabricius) (23 observations).

In contrast, residential areas, while hosting a variety of species, showed lower diversity compared to the Indian Mast Tree. Species such as *Atta mexicana* (Smith, F.) (20 observations), *Camponotus atriceps* (Smith, F.) (4 observations), and *Solenopsis geminata* (2 observations) were present, but the overall number of species was more limited compared to other locations on campus.

The palm tree supported species such as *Odontomachus opaciventris* Forel (22 observations) and *Crematogaster* sp.1 (21 observations), while the neem tree had the highest abundance of *Solenopsis picea* Emery with 39 observations, alongside *Ectatomma ruidum* (7 observations).

Table 4

Diversity and abundance for the species of the Formicidae family collected from September-November 2023 and May-July 2024 on the Zamorano Campus

Location	Species found	Number of observations
Residential Areas	*Ectatomma ruidum (Roger)*	6
	Odonotmachus opaciventris Forel	2
	Camponotus sp.2	2
	Pachychondyla harpax (Fabricius)	2
	Solenopsis geminata (Fabricius)	2
	Camponotus planatus Roger	7
	Atta mexicana (Smith, F)	20
	Camponotus conspicuus (Smith, F)	3
	Pseudomyrmex pallidus (Smith, F)	2
	Camponotus atriceps (Smith, F)	4
Hibiscus Flower (Hibiscus sp. (Linnaeus))	*Camponotus sp.3*	6
	Camponotus sp.1	5
	Odonotomachus opaciventris Forel	3
	Solenopsis geminata (Fabricius)	4
	Crematogaster sp.2	2

Location	Species found	Number of observations
Palm Tree (Phoneix roebelenii (O'brien))	*Odonotomachus opaciventris Forel*	22
	Solenopsis geminata (Fabricius)	1
	Crematogaster sp.1	21
	Camponotus sp.2	1
Nacedero (Trichanthera gigantea (Humb & Bonpl.))	*Camponotus atriceps (Smith, F)*	8
	Odontomachus opaciventris Forel	2
Indian Mast Tree (Polyalthia longifolia (Sonn.))	*Crematogaster sp.1*	63
	Crematogaster crinosa Mayr	5
	Ectatomma ruidum (Roger)	11
	Camponotus conspicuus (Smith, F)	6
	Camponotus sp.1	5
	Solenopsis geminata (Fabricius)	23
	Solenopsis picea Emery	10
	Camponotus planatus Roger	1
Chives (Allium schoenoprasum (Linnaeus))	*Crematogaster crinosa Mayr*	1
	Solenopsis geminata (Fabricius)	2
	Solenopsis picea Emery	7
	Camponotus sp.3	7
Beef Cattle Module/soil	*Camponotus atriceps (Smith, F)*	1
	Atta mexicana (Smith, F)	4
	Ectatomma ruidum (Roger)	2
	Solenopsis picea Emery	9
Neem (Azadirachta indica (Adanson))	*Ectatomma ruidum (Roger)*	22
	Odontomachus opaciventris Forel	4
	Camponotus conspicuus (Smith, F)	2
	Camponotus planatus Roger	13
	Crematogaster sp.1	1
	Solenopsis geminata (Fabricius)	6
	Solenopsis picea Emery	41
	Atta mexicana (Smith, F)	8
Fig Tree (Ficus sp. (Linnaeus))	*Odontomachus opaciventris Forel*	3
	Solenopsis geminata (Fabricius)	4
	Solenopsis picea Emery	7
	Crematogaster sp.2	2
Mango (Mangifera indica (Linnaeus))	*Crematogaster crinosa Mayr*	5
	Solenopsis picea Emery	8
	Camponotus sp.3	2
	Psuedomyrmex gracilis (Fabricius)	12
Plantain (Musa sp. (Linnaeus))	*Camponotus conspicuus (Smith, F)*	6
	Solenopsis geminata (Fabricius)	4
Valeriana (Valeriana officinalis (Linnaeus))	*Odonotmachus opaciventris Forel*	4
Bell pepper (Capsicum annuum (Linnaeus))	*Camponotus sp.3*	7

Figure 1 illustrates the overall diversity of ant species found in the study. The graph shows the number of species observed for each genus, with *Camponotus* being the most diverse, represented by several distinct species. This finding aligns with the known high diversity of *Camponotus* genus, which includes over 1,000 species worldwide (Hölldobler & Wilson, 1990).

The presence of multiple *Camponotus* species highlights the ecological importance of this genus in the Zamorano ecosystem. *Camponotus* ants are known for their roles in wood decomposition, nutrient cycling, and as predators of other insects, making them key components of tropical ecosystems (King et al., 2018).

Figure 1

Diversity of species for the Formicidae family collected from September-November 2023 and May-July 2024 on the Zamorano Campus

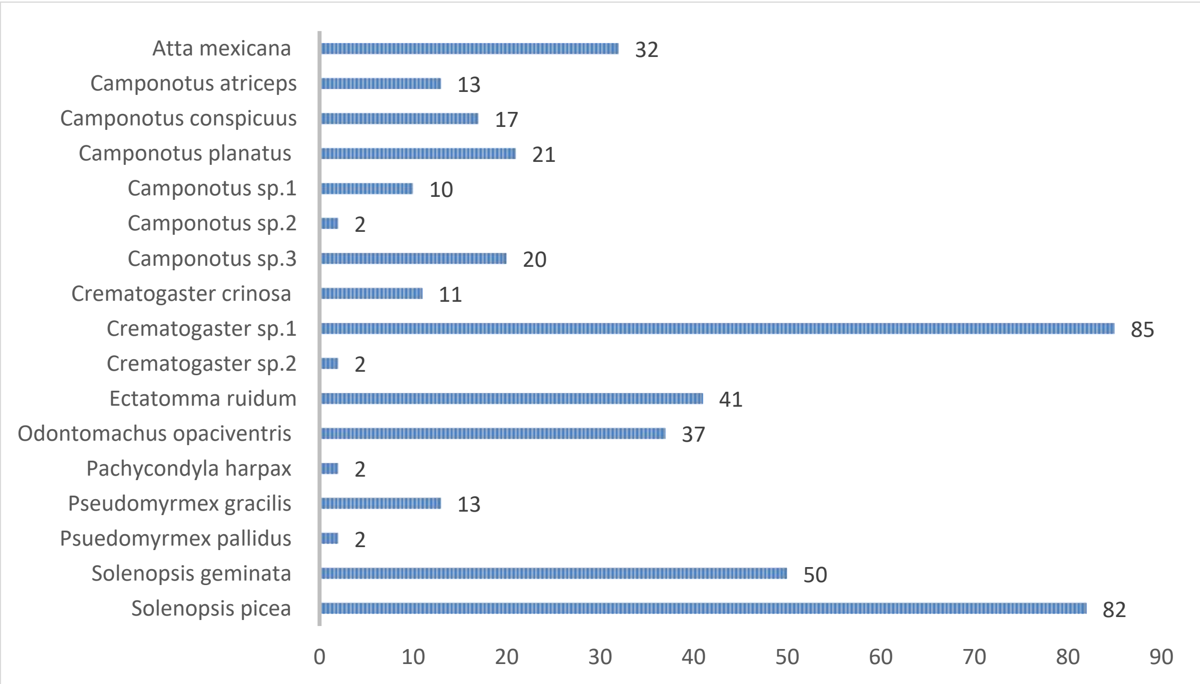
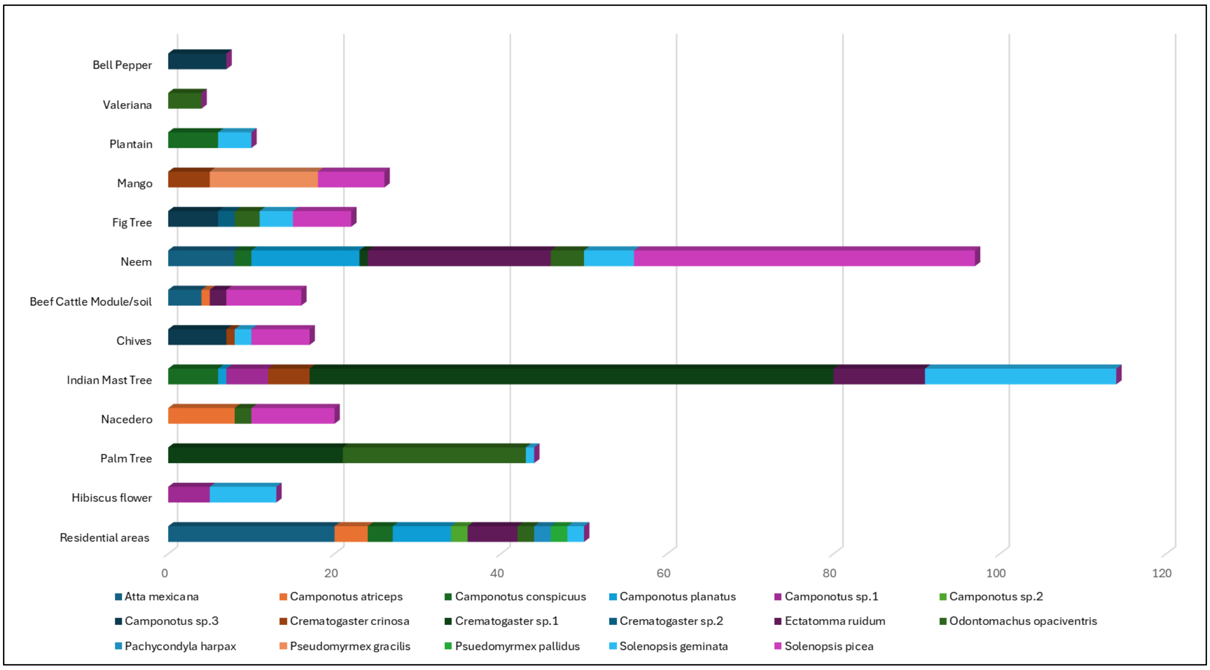


Figure 2 provides a visual representation of the diversity and abundance of Formicidae species collected from various sampling sites on the Zamorano campus during the periods of September to November 2023 and May to July 2024. This figure highlights the relationship between species diversity and the number of individual ants observed across different habitats. The data indicates that while certain sites, such as the Indian Mast Tree (*Polyalthia longifolia* (Sonn.)), show a high abundance of ants, with 63 observations of *Crematogaster* sp.1, the overall diversity of species is lower, with only 7 distinct species identified at this location. In contrast, the residential areas exhibited the highest diversity, with 11 different species recorded. This suggests that the residential areas provide a more varied habitat that supports a broader range of ant species compared to the Indian Mast Tree (*Polyalthia longifolia).*

Figure 2

Diversity and abundance for collected species of the Formicidae family per sampling site on the Zamorano campus



The following is a synopsis of the genera and species

Genus *Camponotus*

Ants belonging to *Camponotus* genus are commonly known as carpenter ants due to their tendency to chew through wood. Unlike termites, carpenter ants do not consume the wood; instead, they excavate it to create their nests and then discard the wood fragments, this behavior can make them a nuisance, particularly when they invade homes (Silverman et al., 2007). They typically inhabit trees, can infest wooden structures in homes, often indicating the presence of rotting or moisture-damaged wood (Chapman, 1998)

Six species of *Camponotus* were identified in this study: *Camponotus atriceps* (Smith, F), *Camponotus planatus* (Roger), *Camponotus conspicuus* (Smith, F), *Camponotus* sp. 1, *Camponotus* sp. 2, and *Camponotus* sp. 3. Due to the large size of *Camponotus* genus, which includes over 1,000 identified species, finding dichotomous keys for their identification at the species level can be complicated.

Camponotus planatus **(Roger)**

Camponotus planatus (Figure 3), commonly known as the compact carpenter ant, is widely distributed from Mexico to Colombia (Creighton, 1950). Although not generally considered a major pest, it is increasingly recognized as a structural pest due its habit of excavating wooden structures to create nesting sites, which can weaken the wood's integrity and raise concerns among homeowners (Warner & Scheffrahn, 2004). *Camponotus planatus* was primarily found on the Neem Tree (*Azadirachta indica*) on the Zamorano campus, with a total of 13 observations. However, it was also seen 7 times in residential areas of the campus. At the Neem tree, their colony activity was primarily fast paced, with ants moving in and out of cracks in the tree trunk. According to (Warner & Scheffrahn, 2004) this species typically resides in hollow twigs, abandoned termite galleries, and voids in tree trunks, which supports the observations made. In contrast, in the residential areas, they were primarily observed on bicycle handles, always in groups of 3-5 individuals, without carrying anything.

Diagnosis: This species exhibits 12-segmented antennae, with the last segment slightly elongated and bullet-shaped. The scape, or first antennal segment, is notably longer than the width of the head. Worker ants of this species range in size from 3 to 6 mm. The body is covered with abundant, long, golden hairs, particularly on the head, thorax, and abdomen, with fewer hairs on the legs and even fewer on the base of the scape. Notably, *Camponotus planatus* lacks a stinger. The thorax is evenly convex, which is a typical trait of carpenter ants. The thorax and head are ash brown, while the gaster is black. This species has a single petiolar segment and belongs to the subfamily Formicinae, within the tribe Camponotini (Warner & Scheffrahn, 2004).

Figure 3

Camponotus planatus. A. Head view. B. Dorsal view. C. Lateral view.

***Camponotus atriceps* (Smith, F.)**

Camponotus atriceps (Figure 4) was previously known as *Camponotus abdominalis* until Bolton's 1995 catalogue corrected the name. This species is found across the tropical and subtropical regions of the Americas. In agricultural settings, *Camponotus atriceps* contribute to pest control by feeding on various insects that can harm crops. For instance, it has been observed in coffee farms, where they may help manage populations of harmful insects like aphids, which are notorious for infesting crops such as *Coffea arabica* (Linnaeus) (La Mora et al., 2015)However, their role is complex, because it is also a significant predator of beneficial insects, particularly stingless bees, which are vital for pollination in many agricultural systems. The article by (Oliveira et al., 2021) highlights that *Camponotus atriceps* can access and damage stingless bee colonies, causing direct harm to these important pollinators.

On the Zamorano campus it was was primarily observed in the Nacedero (*Trichanthera gigantea*), with a total of 8 observations, and in residential areas a total of 4 times. They were not seen in large groups but rather alone or in pairs transiting along sidewalks. At the Nacedero, they were primarily observed moving in and out of crevices, with their nests hidden from view.

Diagnosis: 12 segmented antennae present and lacks a stinger. Minor workers have a propodeum that is narrow, elongated, and tent-like in cross-section, lacking a distinct angle between the lateral and dorsal surfaces. The clypeus has a central longitudinal ridge, and the head is relatively short and broad. The antennae, or scapes, are also relatively short and typically covered with abundant long, erect hairs. The mesosoma is usually densely covered in hair as well (Longino et al., 2002). The queen can be larger, measuring between 16-18 mm. The coloration is characterized by a brown head and back, with a yellow abdomen that features brown stripes.

Figure 4

Camponotus atriceps. A. Head view. B. Dorsal view. C. Lateral view.

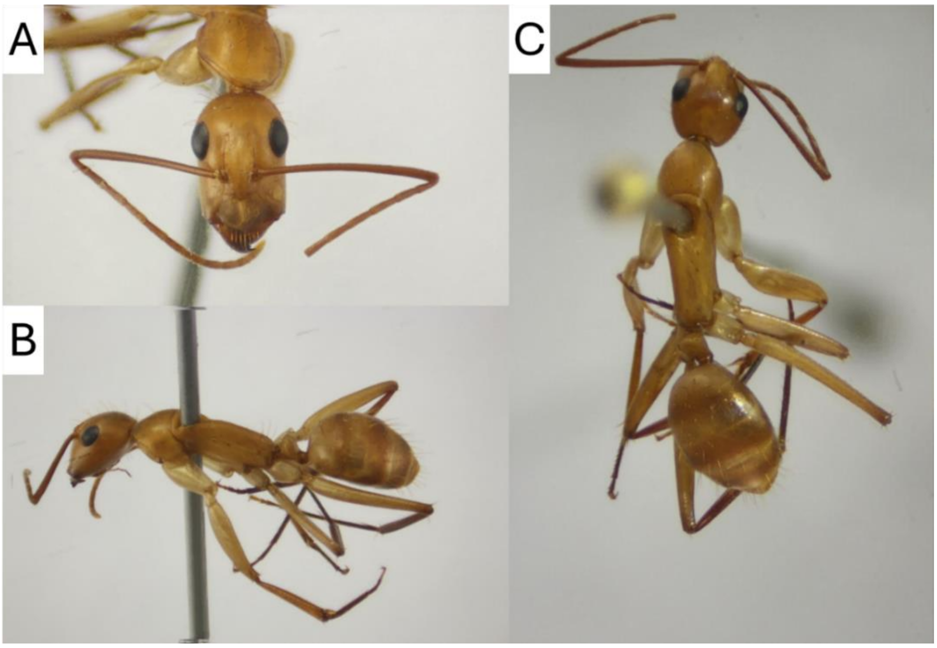
***Camponotus conspicuus* (Smith, F)**

Camponotus conspicuus (Figure 5) was observed at several locations, including the Indian Mast Tree (*Polyalthia longifolia*) (6 observations), residential areas (3 observations), Neem tree (*Azadirachta indica*) (2 observations), and plantain plants (*Musa sp.)* (6 observations). However, no distinct nest was observed in any of these areas. Instead, the ants were seen scattered, moving around the soil and crawling onto the trees. In the residential areas, they were spotted on a wooden desk inside a room. This behavior aligns with the natural tendencies of carpenter ants to excavate through wood for nesting purposes, as they were likely exploring the wooden desk in search of suitable nesting sites or foraging resources. This species is currently present in the entomological collection of Zamorano; thus, its identification was done by making a morphological comparison between the specimen in the collection and the one collected in this study.

Diagnosis; Workers vary in size, with minor workers measuring approximately 6-9 mm and major workers reaching lengths of 12-14 mm. The coloration of *Camponotus conspicuus* typically ranges from black to dark brown, with a shiny appearance. The head is robust and broader than the thorax, and the eyes are well-developed, providing excellent vision. The antennae consist of 12 segments, and the mandibles are strong and adapted for biting and carrying food. The body is characterized by a smooth and shiny surface, with a distinct petiole connecting the thorax to the gaster (abdomen).

Figure 5

Camponotus conspicuus. A. Head view. B. Dorsal view. C. Lateral view.

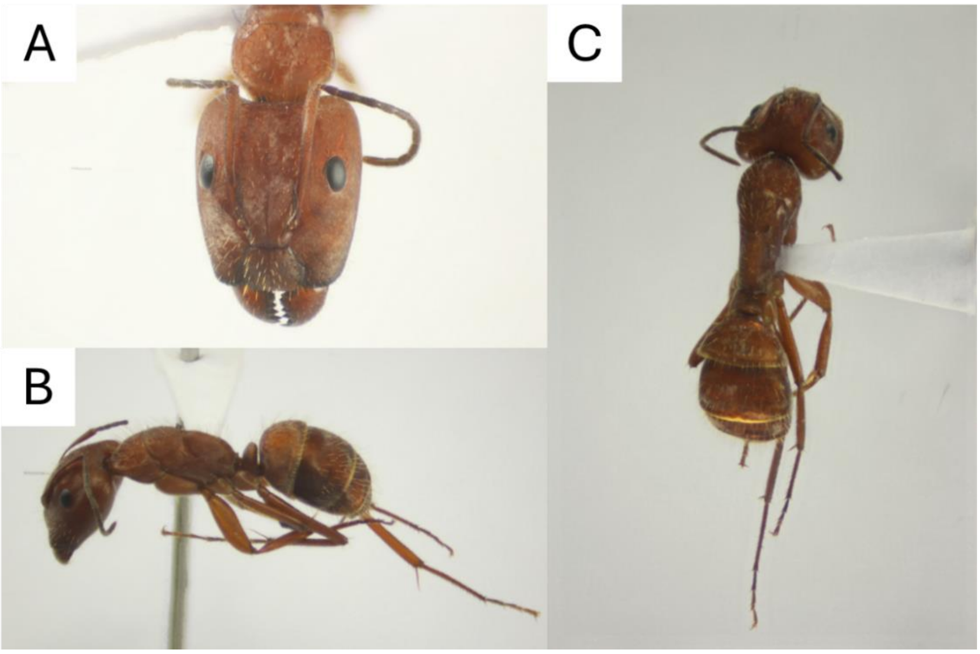


***Camponotus* sp.1**

The following species (Figure 6) was observed five times on a hibiscus plant (*Hibiscus sp.)*, primarily around the soil surrounding it. A visible nest was located at the base of the hibiscus, and the ants were seen transiting in and out of this nest. Additionally, the species was observed five times on the Indian Mast Tree, exhibiting similar behavior; however, no nest was visible in this case. Identifying this species to the species level proved challenging, as no specific identification key for this ant species was found.

Figure 6

Camponotus sp.1. A. Head view. B. Dorsal view. C. Lateral view.



***Camponotus* sp.2**

This species (Figure 7) was observed a total of two times in the residential area, specifically on a window and a desk in a room. No nest was found nearby; however, given the nature of *Camponotus*, which excavates through wood, it is believed that the ants were either seeking a suitable area to nest or scavenging for food items. Identifying this species at the species level was also complicated due to a lack of available identification keys.

Figure 7

Camponotus sp.2. A. Head view. B. Dorsal view. C. Lateral view.

***Camponotus* sp.3**

This species (Figure 8) was observed a total of 20 times, specifically on chives (7 observations), fig trees (6 observations), and bell peppers (7 observations). During the collection process, it was noted that the ants were small and fast-paced, making them somewhat challenging to collect. Most of the time, they were observed in groups, moving up and down the soil in the areas where they were collected. Due to the limited availability of dichotomous keys for the *Camponotus* genus, identifying this species at the species level proved to be difficult.

Figure 8

Camponotus sp.3. A. Head view. B. Dorsal view. C. Lateral view.

Genus *Crematogaster*

Crematogaster ants, commonly known as "acrobat ants" due to their unique ability to curve their abdomens upwards, are a highly diverse and widely distributed genus (Saarinen, 2004)They thrive in tropical, subtropical, and warm-temperate regions around the world. Belonging to the Myrmicinae subfamily—the largest within the ant family—*Crematogaster* ants are notable for their global distribution and species richness (Blaimer, 2012). The genus includes approximately 467 described species and about 300 subspecies (Barry Bolton & Fisher, 2011). In tropical and subtropical areas, these ants typically build their nests in trees, often choosing locations like branches, twigs, or beneath tree bark and moss (Blaimer, 2012).

Crematogaster ants play important roles in ecosystems by contributing to biodiversity, aiding in decomposition and nutrient cycling, establishing mutualistic relationships with plants, controlling herbivore populations, and participating in seed dispersal (Morgan & Wilson, 1999).

Three identified species: *Crematogaster crinosa* Mayr, *Crematogaster* sp.1 and *Crematogaster sp.2*

***Crematogaster crinosa* Mayr**

During the collection of this species (Figure 9), it was found alongside nymphs of *Membracis mexicana* Guérin-Méneville on an Indian Mast Tree (*Polyalthia longifolia* (Sonn.)) (Appendix A), suggesting a mutualistic relationship between the two. A total of 11 observations were recorded on campus, distributed across the following locations: chives (*Allium schoenoprasum* (Linnaeus)) (1 observation), Neem tree (*Azadirachta indica* (Adanson)) (5 observations), and mango (*Mangifera indica* (Linnaeus)) (5 observations). Collecting these ants was relatively easy due to their small size and slow movement. Notably, they were observed in very close proximity to the *Membracis mexicana* nymphs, feeding on the sugary substance released by them.

This mutualistic relationship is concerning for agricultural crops, as *Membracis mexicana* is known to be a sap-sucking insect that can damage plants *(De-la-Mora & Pinero, 2023)* Consequently, the presence of this species highlights its importance in agricultural settings and underscores the need for careful monitoring and control, given that its mutualistic relationship is based on providing protection for a pest that can harm crops.

Diagnosis: 11 segmented antennae. Petiole and postpetiole present. Heart shaped gaster with petiole attached dorsally to gaster. sparse erect setae over short, appressed hairs. The dorsal face of the petiole is short with convex sides, and the propodeal spines are short and upturned. Additionally, this species features an even covering of erect setae on the fourth abdominal tergite and a long, sharp anteroventral petiolar process (Longino, 2003).

Figure 9

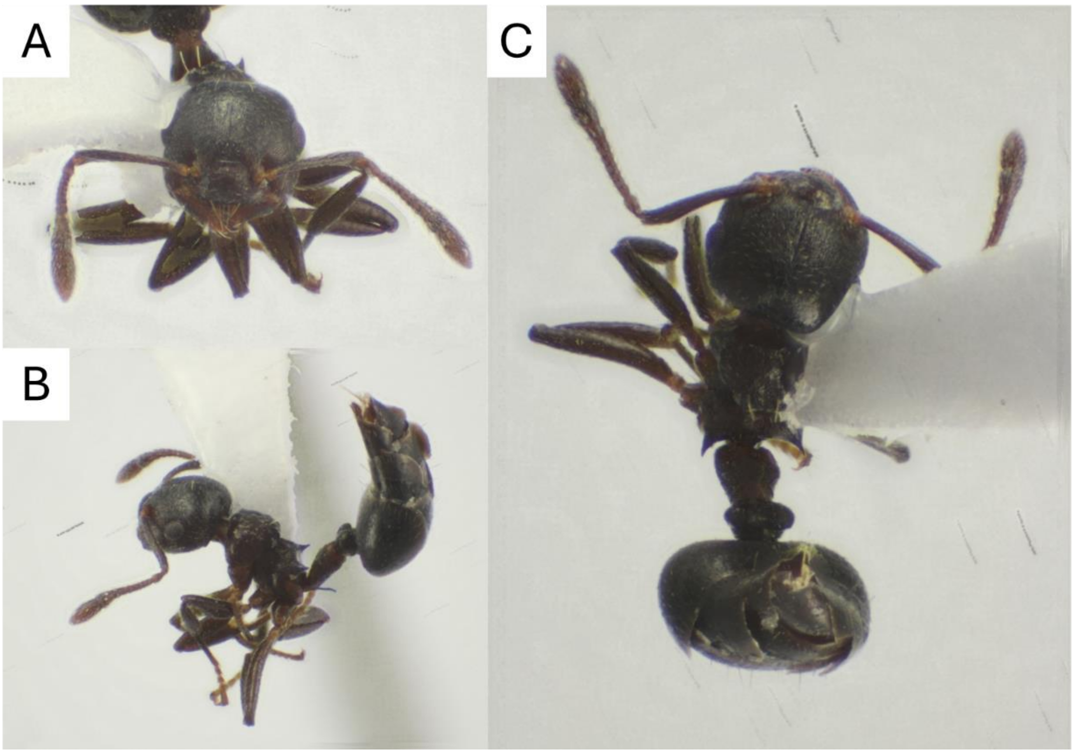
Crematogaster crinosa. A. Head view. B. Dorsal view. C. Lateral view.

***Crematogaster* sp.1**

This species (Figure 10) was only identified to the genus level due to the lack of available identification keys. However, it was the most frequently observed species on campus, with a total of 85 observations recorded. These observations were distributed across the following locations: Palm Tree (*Phoneix roebelenii* (O'Brien)) with 21 observations, Indian Mast Tree (*Polyalthia longifolia* (Sonn)) with 63 observations, and Neem Tree (*Azadirachta indica* (Adanson)) with 1 observation. Notably, their collection was facilitated by their small size and slow movement. Although their nest was not visible, the ants were seen moving around the branches of the trees from which they were collected, typically in large groups.

Figure 10

Crematogaster sp.1. A. Head view. B. Dorsal view. C. Lateral view.

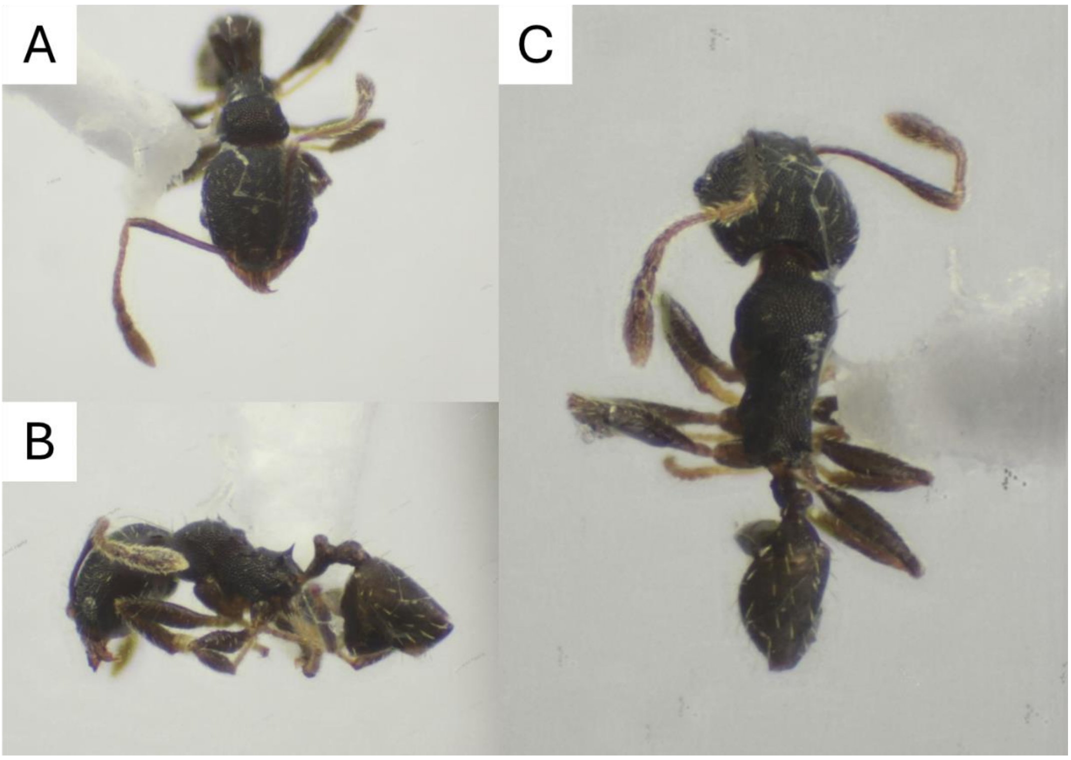


***Crematogaster* sp.2**

The following species (Figure 11) was observed a total of two times during the collection, specifically on the fig tree (*Ficus* sp. (Linnaeus)). They were seen interacting with aphids present on the leaves of the fig tree, indicating a mutualistic relationship like that of *Crematogaster crinosa* and *Membracis mexicana* Guérin-Méneville*.* Despite their slow movement, collecting them was challenging due to their small size.

Figure 11

Crematogaster sp.2. A. Head view. B. Dorsal view. C. Lateral view.



Genus *Atta*

Ants belonging to the genus *Atta*, commonly known as "leafcutter ants," comprise approximately 15 known species. However, *Atta* is not the only genus of ants known as leafcutters; other genera include *Acromyrmex* and *Trachymyrmex*, all of which belong to the tribe Attini (Hölldobler & Wilson, 1990).These ants primarily inhabit wet tropical forests in the Neotropics, ranging from southern Mexico to Brazil (San Diego Zoo Wildlife Alliance, 2024). Leafcutter ants are recognized as agricultural pests because they harvest fresh plant material, mainly leaves, to cultivate a specialized fungus species (*Leucoagaricus gongylophorus*) in underground nest chambers. The ants and the fungus share a mutualistic relationship, depending on each other for survival (Hölldobler & Wilson, 1990; San Diego Zoo Wildlife Alliance, 2024).

***Atta mexicana* (Smith, F.)**

Throughout this investigation, this species (Figure 12) was observed a total of 32 times, with 20 observations in residential areas, 4 at the beef cattle module, and 8 at the neem tree *(Azadiractha indica* (Adanson)*)*.

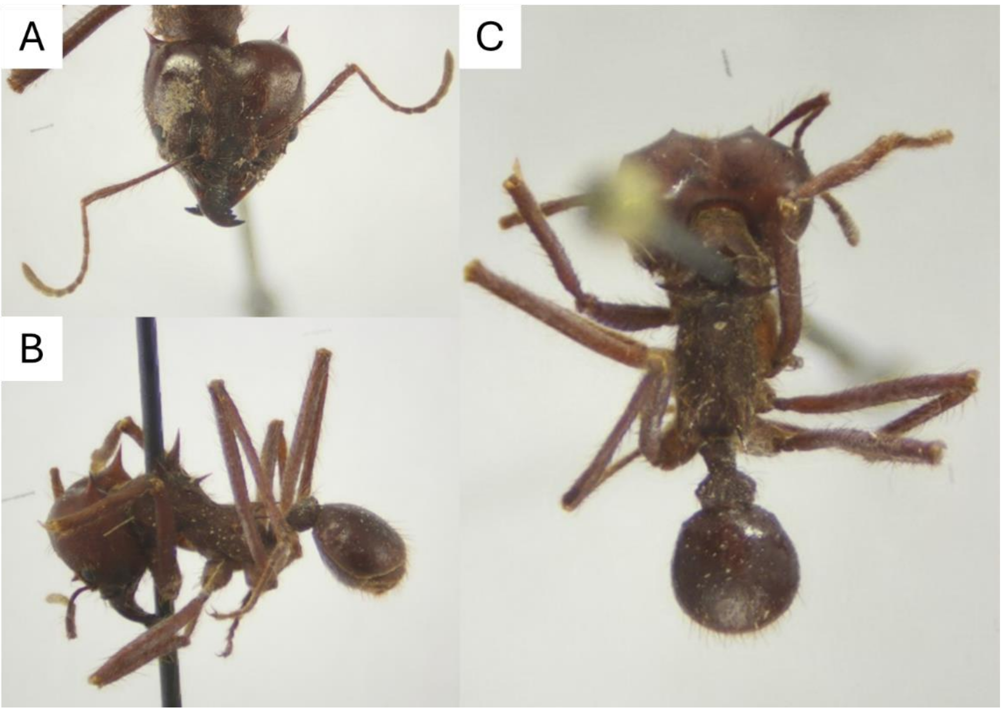
The ants were consistently seen in groups, carrying leaves, plant fragments, and seeds back to their nest. Nests were visible at all locations and were notably large. Minor workers were observed at the entrance of the nests, while major workers were seen transporting leaves and plant fragments.

In agriculture, *Atta mexicana* plays a dual role. While they are beneficial in nutrient cycling and soil aeration due to their leaf-cutting behavior, they can also pose a threat to crops by damaging young plants as they harvest leaves. Their mutualistic relationship with aphids, which they protect in exchange for honeydew, can further exacerbate their impact on agricultural systems by promoting pest populations (Gómez-Díaz et al., 2023) Additionally, *Atta mexicana* is a notable pest of sugarcane foliage, causing significant economic losses in the yields of various crops such as trees, citrus, fruits, cocoa, coffee, corn, and pastures (Murguía-González et al., 2018)

Diagnosis: The posterior cephalic lobes and the first gastral tergite are smooth and lack erect hairs, with a shiny surface. The concave area between the cephalic lobes is relatively shallow, and the angle between its sides exceeds 90 degrees ((AntWiki, 2014). The pronotal spines are comparatively short. The queens of this species typically measure between 23 to 28 mm in length, while the worker ants vary significantly in size, ranging from 3 to 16 mm. The largest workers, known as majors, measure between 15 and 22 mm. The coloration of *Atta mexicana* is generally reddish-brown. The second abdominal node is notably wider, and the thorax is more elongated compared to closely related species like *Atta cephalotes* (Linnaeus). Additionally, the ants possess well-defined mandibles that are adapted for cutting leaves ((AntWiki, 2014).

Figure 12

Atta mexicana. A. Head view. B. Dorsal view. C. Lateral view.



Genus *Solenopsis*

Ants from the *Solenopsis* genus, commonly referred to as fire ants, are part of the Myrmicinae subfamily. This genus includes around 192 recognized species (AntCat, 2024b). They are predominantly located in tropical regions such as Central and South America. However, they can also be found in certain temperate zones, including areas of North America (Britannica, 2024). *Solenopsis Invicta* Buren, have significant ecological, economic, and social impacts. Ecologically, they disrupt local wildlife and ecosystems by preying on various species, including ground-nesting birds, small mammals, and reptiles, which can lead to declines in their populations and even potential extinctions (Allen et al., 2004)

Solenopsis ants generally have mandibles with four teeth. The front part of their face, called the clypeus, has two ridges and can have up to five small teeth, with a single hair between the ridges. The head has frontal lobes, which might have vertical lines but are usually smooth. These ants have antennae with 10 segments, ending in a 2-part club, and the scapes (the first segment of the antenna) rarely reach the back corners of the head. Their pronotum, or upper front body, is smooth and doesn't have spikes or bumps. The area where the pronotum meets the propodeum (the back part of the body) usually has a deep groove, and the propodeum itself is rounded without teeth. The sides of the middle body often have horizontal lines. The segments connecting the thorax and abdomen (the petiole and postpetiole) are well-formed, with the petiole often looking wider than the postpetiole from the side but thinner when viewed from above (Mackay & Pacheco, 2013).

Solenopsis picea **Emery**

Solenopsis picea (Figure 13) is vital in coffee agriculture as a natural predator of the coffee berry borer (*Hypothenemus hampei* (Ferrari)), achieving predation rates of up to 78.3%, which significantly reduces pest populations, mitigates crop damage, and decreases reliance on chemical pesticides, thereby promoting sustainable farming practices (Constantino-Chuaire et al., 2022)

This species was observed a total of 82 times on the Zamorano campus, distributed at the following locations: Nacedero (*Trichanthera gigantea* (Humb & Bonpl.)) (10 observations), chives (*Allium schoenoprasum* (Linnaeus)) (7 observations), Beef Cattle Module (9 observations), Neem tree (*Azadirachta indica* (Andason)) (41 observations), Fig Tree (*Ficus* sp. (Linnaeus)) (7 observations), Mango (*Mangifera indica* (Linnaeus)) (8 observations). Their nest was visible at all locations, and they were observed to be fast moving with a painful sting that produced a burning and itching sensation. Their collection was easy because they would climb up the foreceps being used to collect them. This behavior seemed like a defense mechanism as they sensed danger, and their instinct was to attack.

Diagnosis: Worker: This ant is typically black or dark brown, sometimes lighter or two-toned, with the abdomen (gaster) being darker. It is medium sized with a nearly square head that has fine punctures and short hairs. Presence of acidopore, petiole and pospetiole. 10 segmented antennae with 2 segmented club at the end. Queen: The queen is uniformly brown. The teeth on the sides of the clypeus are prominent, extending about 0.030 mm beyond the front edge. The scape is thick, measuring 0.090 mm in diameter. Thin vertical lines are visible on the frontal lobes, and the scape, head, and pronotum have coarse punctures. Male: The male is very dark brown, almost black, with lighter brown legs and antennae. The clypeus is slightly concave, without any tooth, bump, or angle along the edge (Mackay & Pacheco, 2013).

Figure 13

Solenopsis picea. A. Head view. B. Dorsal view. C. Lateral view.

***Solenopsis geminata* (Fabricius)**

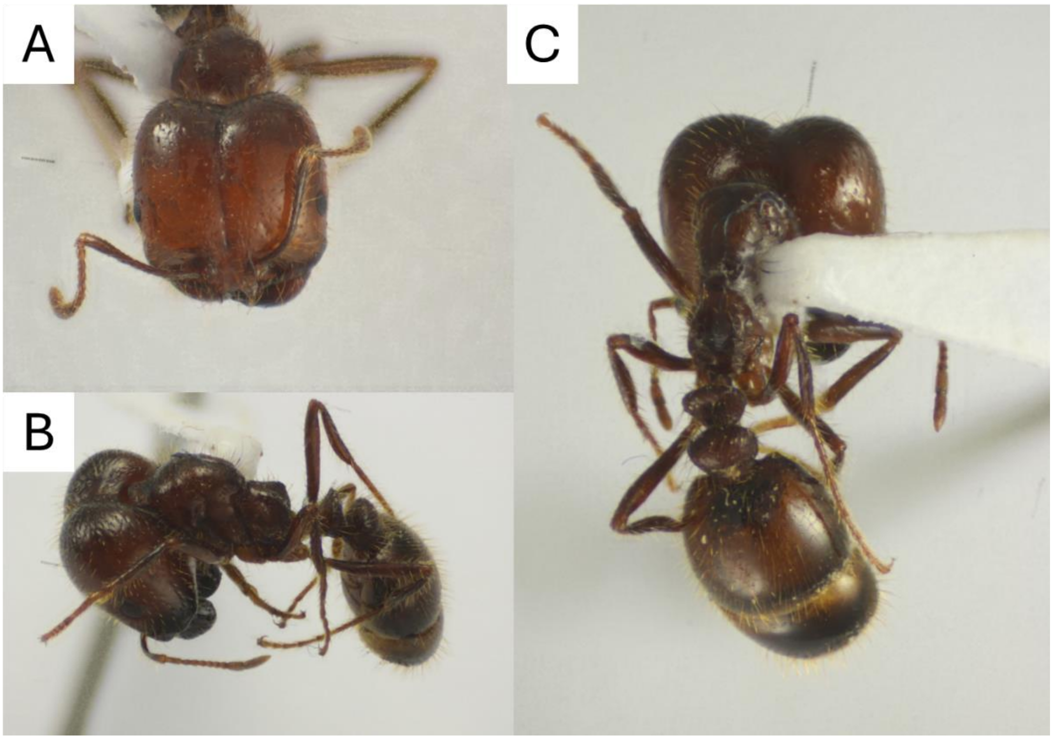
Solenopsis geminata, commonly known as the tropical fire ant (Figure 14), is ecologically significant in agricultural settings as it preys on pest insects, helping to control their populations; however, it can also negatively impact crop yields and human activities due to its aggressive behavior and painful sting, which poses risks to both farmers and livestock (Global Invasive Species Database, 2024).

This species of ant was observed a total of 50 times on the Zamorano campus, with collections made in the following locations: residential areas (2 observations), hibiscus (*Hibiscus* sp. (Linnaeus)) (8 observations), palm tree (*Phoenix robelenii* (O'Brien)) (1 observation), Indian mast tree (*Polyalthia longifolia* (Sonn.)) (23 observations), chives (*Allium schoenoprasum* (Linnaeus)) (2 observations), neem (*Azadirachta indica* (Adanson)) (6 observations), fig tree (*Ficus* sp. (Linnaeus)) (4 observations), and plantain (*Musa* sp. (Linnaeus)) (4 observations). Nests were visible at all sites, and the ants were noted to be fast paced. When in contact with them they produce a painful sting that produced an itching and burning sensation.

Diagnosis: This ant has a noticeably large, almost square head with sides that run parallel. There is a deep groove running down the front of the head, starting from a distinct notch in the top middle part. Its mandibles are black, with the teeth sometimes completely worn down (Wetterer, 2011). The antennae have 10 segments and a 2-segmented club. The eyes are small, with fewer than 30 ommatidia. The mesosoma is robust, with a promesonotal suture that is indistinct or absent. The petiole has a distinct node, and the gaster is large. Diagnostic features include the presence of a sting and the lack of an acidopore (Global Invasive Species Database, 2024).

Figure 14

Solenopsis geminata. A. Head view. B. Dorsal view. C. Lateral view.



Genus *Pseudomyrmex*

Pseudomyrmex is primarily found in tropical and subtropical regions of the Americas, with many species inhabiting the canopies of forests associated with various plant species, particularly acacias (P. S. Ward, 1993). This genus is the largest within its subfamily, comprising over 200 recognized species and subspecies These ants are characterized by their long, slender bodies, well-developed stinger, large eyes, and the presence of both a petiole and a postpetiole (Whitcomb et al., 1972).

***Psuedomyrmex gracilis* (fabricius)**

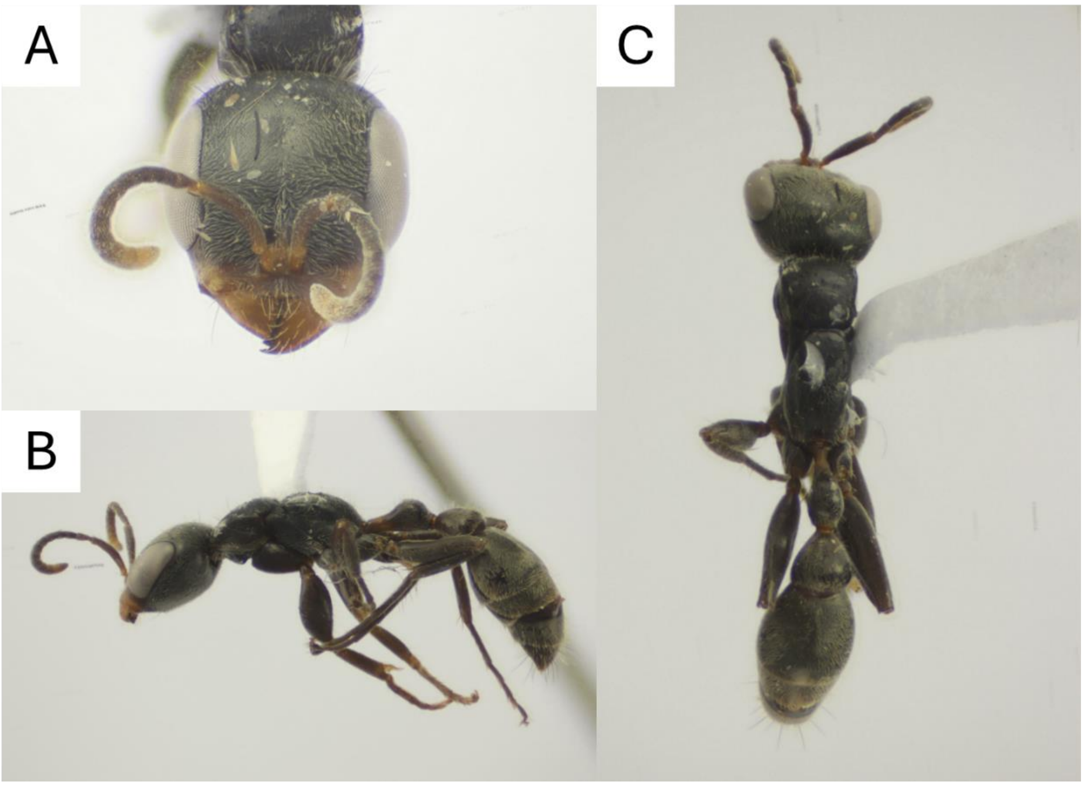
Pseudomyrmex gracilis (Figure 15), commonly known as the slender twig ant or elongate twig ant, plays a significant ecological role as a generalist predator and mutualist in various habitats, particularly in tropical and subtropical regions (Toth, 2007).

This species was observed a total of 13 times on the Zamorano Campus, with all observations made on mango trees. Although their nests were not visible, the ants were seen actively moving up and down the tree trunks and twigs

Diagnosis: Color varies by region, ranging from black to entirely orange or a combination of orange and black. Slender, elongated body with very large eyes (more than 1.5 times longer than they are wide), positioned laterally. Presence of ocelli (small simple eyes), 12-segmented antennae with short outward-curved scapes, lacking a club. Short and wide clypeus. Their mandibles are relatively short and triangular, containing 7-10 teeth. Petiole and postpetiole present. The petiole is pedunculate (stalk-like), with a somewhat flattened, oval node when viewed from above, while the postpetiole is oval when viewed from the side and rounded triangular from above. The gaster (the rear part of the abdomen) has dense, appressed pubescence and a mix of erect setae, which become more abundant near the apex. Well defined stinger is present (Philip S. Ward & Branstetter, 2022).

Figure 15

Pseudomyrmex gracilis. A. Head view. B. Dorsal view. C. Lateral view.



***Psuedomyrmex pallidus* (Smith, F)**

On the Zamornao campus this species was collected a total of two times in residential areas, specifically on the pavement of a transited area of the entomology lab. Nest was not seen nearby, thus suggesting that it was only transiting the area.

Diagnosis: *Pseudomyrmex pallidus* (Figure 16), commonly known as the elongate twig ant, is a small, slender ant species ranging from 3.0 to 5.0 mm in length, characterized by its yellow to light brown coloration. Workers have large eyes, short antennal scapes, and a shiny head without fine pubescence, with head widths measuring between 0.68 and 0.89 mm. This species is known for its opportunistic nesting behavior, often found in the hollow stems of dead grasses and woody twigs, typically at the intersection of grassy and wooded habitats (Ward, 1985).

Figure 16

Pseudomyrmex pallidus. A. Head view. B. Dorsal view. C. Lateral view.

Genus *Ectatomma*

Ectatomma, commonly referred to as hunting ants, is a genus within the Ponerinae subfamily, consisting of around 12 species that are native to the tropical regions of continental America (Fernandez et al., 2021)These ants are distinguished by their hunting habits and preference for living on the ground. They usually create small colonies and construct their nests in rotting wood or among fallen leaves (Hölldobler & Wilson, 1990). Found mainly in tropical areas, they primarily use the soil and forest floor for nesting and foraging (Fernandez et al., 2021).

Ectatomma ruidum **(Roger)**

This species (Figure 17) was observed a total of 41 times distributed in the following locations: residential areas (6 observations), Indian Mast Tree (*Polyalthia longifolia* (Sonn.)) (11 observations), Neem tree (*Azadrachta indica* (Andason)) (22 observations).

Diagnosis: color ranges from reddish brown to almost black. The pronotum features a distinct central prominence and a pair of dorsal or shoulder-like teeth on the sides. The petiolar node, when viewed from the side, is high and thin, with the upper half having vertical and nearly parallel front and back faces. The head, when seen from the front, has a mostly straight and horizontal outline across the area between the eyes (Fernández, 1991).

Figure 17

Ectatomma ruidum. A. Head view. B. Dorsal view. C. Lateral view.

Genus *Odontomachus*

Ants of the genus *Odontomachus*, commonly known as trap-jaw ants, are distinguished by their elongated mandibles, which can open up to 180° and snap shut rapidly on prey. They demonstrate exceptional control over their mandibular movements, enabling precise and forceful handling of prey. Additionally, their mandibles are used for more delicate tasks, such as caring for larvae and building nests (MacGown et al., 2014). This genus includes 75 recognized species (AntCat, 2024a)and is widely distributed across the Neotropics and Southeast Asia (MacGown et al., 2014).

***Odontomachus opaciventris* Forel**

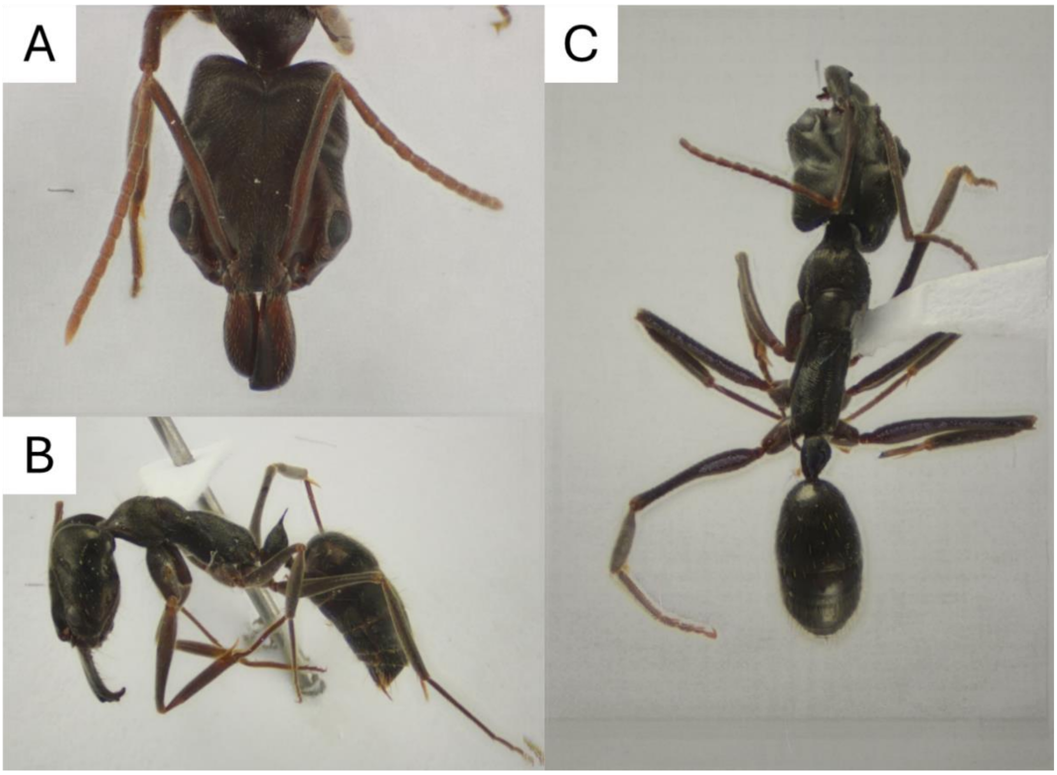
Odontomachus opaciventris (Figure 18), utilizes a unique mandible strike mechanism that allows it to capture and subdue small prey with remarkable speed and precision, making it an efficient predator of various agricultural pests, including caterpillars and other immature insects that damage crops (La Mora et al., 2008) They prey on various pests, including termites, fruit flies, and tenebrionid larvae, effectively utilizing their powerful mandibles to capture and subdue these small organisms.

This species was found a total of 37 times on the Zamorano campus, distributed in the following locations: residential areas (2 observations), palm tree (*Phoenix roebelenii* (O'Brien)) (22 observations), Neem tree (*Azadirachta indica* (Andason)) (4 observations), Fig tree (*Ficus* sp. (Linnaeus)) (3 observations), valeriana (*Valeriana officinalis* (Linnaeus)) (4 observations).

Diagnosis: The ant has a pear-shaped head (pyriform) that is longer than it is wide, with a noticeable constriction towards the back. Its mandibles are long and powerful, capable of opening up to 180°. The antennae consist of 12 segments, with the scape (the first segment) being long and slightly curved. The body features a distinct petiole, which is cone-shaped and ends in a sharp spine, setting it apart from species with more rounded or cylindrical petioles. The mesosoma, or midsection, is often coarsely sculptured with ridges or striations, especially on the propodeum (the rear part of the midsection). The gaster (the abdomen) is smoother and more reflective compared to the rest of the body. The ant's overall coloration is typically dark, often blackish (Franca et al., 2024).

Figure 18

Odontomachus opaciventris. A. Head view. B. Dorsal view. C. Lateral view.



Genus *Pachychondyla*

Ants of the genus *Pachycondyla*, which belong to the Ponerinae subfamily, include around 17 recognized species predominantly found in tropical and subtropical regions (AntCat, 2024a; Dornhaus & Powell, 2009). These ants display a diverse range of physical traits and behaviors, varying from elusive leaf litter inhabitants to large, aggressive species that occupy both terrestrial and arboreal environments (Dornhaus & Powell, 2009).

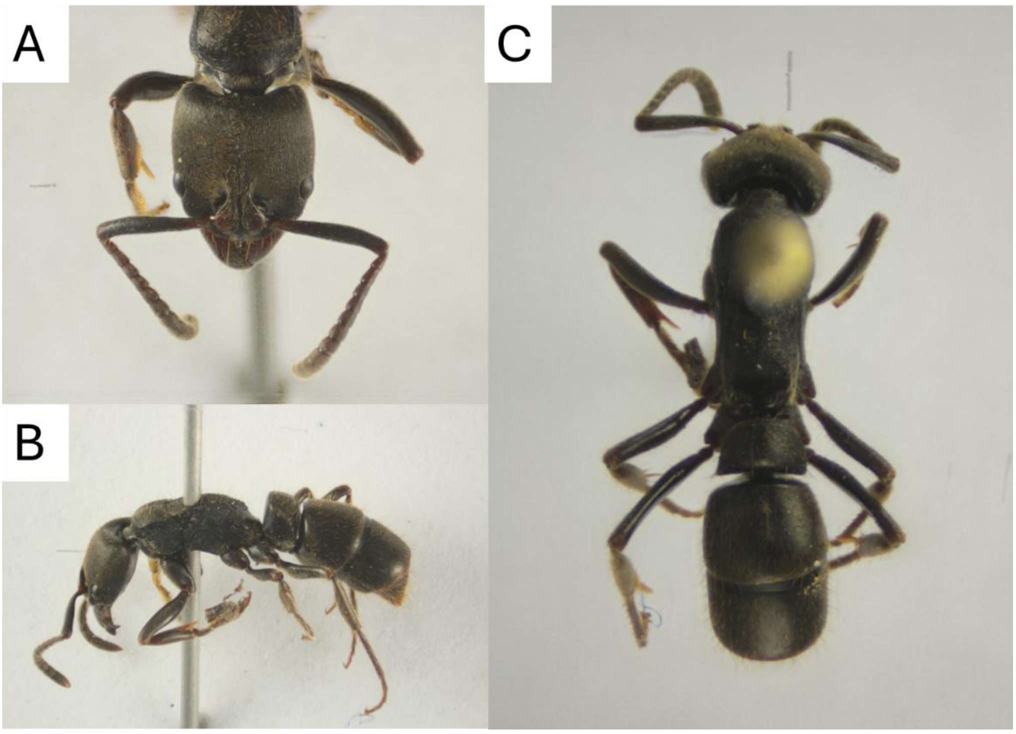
***Pachychondyla harpax* (Fabricius)**

This species (Figure 19) primarily feeds on small insects and other arthropods, playing a crucial role in controlling pest populations and contributing to the ecological balance within its habitat (Mina & Joseph, 2021). It was observed twice on the Zamorano campus, specifically in the residential areas. It was seen on the pavement outside the entomology lab. No nests of this species were identified in the surrounding area; therefore, it was likely just passing through while foraging for food items to carry back to its nest.

Diagnosis: Workers typically range from 8 to 12 mm in length and exhibit a dark brown to black coloration, often with bluish or metallic reflections. The head is elongated and slightly wider than the thorax, featuring well-developed compound eyes that are relatively small but positioned closer to the anterior edge of the head. The antennae consist of 12 segments, with the scapes extending beyond the posterior margin of the head. A notable feature is the absence of the malar carina, which distinguishes it from some other species in the genus. The pronotal carina is poorly developed but forms a shiny raised line, while the metanotal suture is absent on the dorsum of the mesosoma. The petiole is rectangular with a distinct dorsal face, and the postpetiole has an anterior face that forms a right angle with the dorsal face, which may be slightly concave (Mina & Joseph, 2021)

Figure 19

Pachychondyla harpax. A. Head view. B. Dorsal view. C. Lateral view.



Conclusions

As a result of ant collections conducted from September-November 2023 and May-July 2024, a total of 17 ant species were identified from the Zamorano campus, including *Atta mexicana* (Smith, F.), *Camponotus atriceps* (Smith, F.), *C. conspicuus* (Smith, F.), *C. planatus* (Roger), *C.* sp.1, *C.* sp.2, *C.* sp.3, *Crematogaster crinosa* Mayr, *C.* sp.1, *C.* sp.2, *Ectatomma ruidum* Roger, *Odontomachus opaciventris* Forel, *Pachycondyla harpax* (Fabricius), *Pseudomyrmex gracilis* (Fabricius), *Pseudomyrmex pallidus* (Smith, F.), *Solenopsis geminate* (Fabricius), and *Solenopsis picea* Emery.

The residential areas resulted in having the highest diversity of species while the Indian Mast Tree resulted in having the highest abundance of species.

An identification guide was elaborated to aid in future investigations of the Formicidae family on the Zamorano campus.

Recommendations

Future research should focus on identifying the species that were not classified to the species level, particularly within the genera *Atta, Crematogaster* and *Camponotus*.

Acquiring additional books and identification keys for Formicidae species in the entomological lab would greatly enhance the resources available for accurate ant species identification.

Conducting collections throughout all months of the year to obtain quantitative data about the abundance, diversity and interaction of ants with host plants.

Studying the impact that *Atta mexicana* (Smith, F.) has on agricultural crops present on the campus.

Evaluating different methods of ant collection to determine which is more efficient to collect more specimens.

Do further research to identify species that are within the collection but remain unidentified to the species level.

Elaborating an identification key of the ant species of Zamorano to aid the identification of species of the campus.

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Appendices

Appendix A

Photograph showing mutualistic relationship between crematogaster crinosa Mayr and membracis mexicana Guérin-Méneville nymphs