Survey of Ant Genera and Biodiversity in Toco, Trinidad

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Abstract: Tropical regions are widely known for their high species diversity, which is often threatened by the growth and encroachment of human activity into natural areas. The ants of Trinidad have been studied, but most surveys and records are restricted to the Port of Spain area on the northeastern coast. Ant biodiversity is an important bioindicator, allowing us to measure the effects of ecosystem disturbances such as human interference, pollution, and climate change. This creates a way to measure changes in the ecosystem as well as potentially assessing the success of efforts to help the environment. Additionally, soil-dwelling ants often act as ecosystem engineers by creating mounds and tunnel systems. This results in important changes to soil chemical composition and can also increase soil arthropod diversity. A large portion of both terrestrial biodiversity and biomass is constituted of ants, due to their ubiquity and global distribution. This study is focused on the ant biodiversity in northeastern Trinidad, a region approximately 87 km from Port of Spain. Over the course of seven days, ants were surveyed on the Jammev Beach Resort property (Toco), a relatively rural area, using baited ground pitfall trap and baited arboreal pitfall traps. Ant specimens were also freely collected from the environment when available. A total of 298 specimens were collected, representing 12 genera and tribes of Formicidae. The most prevalent ants were *Tertamorium* sp with 105 specimens and unidentifiable Formicinae with 88 specimens. A Shannon Diversity Index of 1.925 was obtained, indicating an average amount of diversity.

Keywords: Formicidae, survey, biodiversity, pitfall trapping

Surveys reveal which species are in a particular area, and most studies from Trinidad have taken place closer to Port of Spain. Few, if any have focused on Toco. Toco, is on the northern coast of the island, compared to Port of Spain, which is located on the northwestern coast of the island. Tropical regions are well known to have high species richness, and with growing human interference as urban regions in Trinidad grow, that diversity may decrease. It is important to know what species are present, as well as how that number is changing to best serve conservation functions. In 1922, only about 150 species of ants had been recorded from Trinidad and Tobago (Wheeler 1922) while the current number is about 276 species across 65 genera and 10 subfamilies (Starr and Hook 2003). Among these, three species, *Solenopsis invicta* (Hymenoptera: Formicidae) (Buren), *Solenopsis geminata* (Hymenoptera: Formicidae) (Fabricus), and *Trichomyrmex destructor* (Hymenoptera: Formicidae) (Jerdon) are introduced non-native ants. Studies on *S. invicta* indicate that its effect on native ants is worsened when accompanied by human disturbance of the area, making it easier for *S. invicta* to spread (King and Tschinkel 2008). With growing human interference as urban regions in Trinidad grow, ant diversity may decrease as invasive species expand. One study recorded that after the introduction of *S. invicta*, the species richness of ants dropped by 70%while the number of native individuals dropped by 90% (Porter and Savignano 1990). However, many ant species impact health, agriculture, and urban sectors of the economy, native or not. In

Trinidad in the summers of 1988 and 1989, there were numerous reports of ants invading the neonatal and pediatric units of hospitals, thought to bite infants and act as mechanical vectors for pathogens (Chadee and Le Maitre 1990). Between the four species *Monomorium pharonis* (Hymenoptera: Formicidae) (Linneaus), *Tapinoma sessile* (Hymenoptera: Formicidae) (Say), *Solenopsis molestus* (Hymenoptera: Formicidae) (Buren) and *Solenopsis sp*, four human pathogenic bacteria were isolated. Many ants are also known to have painful bites or stings, to which some people have allergic reactions to, and are in some cases fatal (McGain and Winkel 2002). The *Oecodomas sp.* leaf cutting ants of Trinidad are known to repeatedly strip entire trees bare, with an observed preference for cultivated trees, especially orange. Agricultural endeavors in areas where these ants are abundant is a challenge to producers. In one case, a mango tree was observed to be completely stripped overnight (Brent 1886). Within ant colonies, the role a worker individual takes changes over time, usually from a brood caretaker, to nest construction, to foraging (Gordon 1996). Ants constitute a large portion of terrestrial biodiversity and are the most diverse group of social insects. Additionally, they possess an important role as ecosystem engineers that improve the quality of the soil (Mahalakshimi et al 2016).

Materials and Methods

Ground pitfall traps (Figure 1) were constructed by using 16 oz and 8 oz plastic cups (Great Value Walmart, Bentonville, AR) and baited with 2cm x 2cm squares of beef liver. To place the trap, a hole is dug so that the edge of the cup is level with the ground and the trap is placed inside. Covers were used to prevent the trap from filling with rainwater and were constructed with foam plates (Great Value Walmart, Bentonville, AR) and wooden dowel rods(Casey's Wood Products, Wiscasset, ME). Arboreal traps (Figure 2) were constructed with 16 oz and 8 oz plastic cups (Great Value Walmart, Bentonville, AR), hung with twine and weighted with 16.9oz plastic bottles (Coca-Cola Company Atlanta, GA) filled with local substrate. Arboreal traps were hung using three loops on the low hanging branches of various trees. Sugar water made with two tablespoons brown sugar (Jolly Foods, Oxford, Oxfordshire) acted as bait. Both protein and carbohydrate-based baits were utilized in order to prevent bias towards one type of food preference. Ants acting as foragers balance the colonies' need for both carbohydrate and protein food bases, so traps of each type were set up (Dussutour and Simpson 2009). When provided with too high of a protein diet however, workers die prematurely, but this effect is lessened when larvae are present in a colony (Dussutour and Simpson 2009). The ants collected were foraging outside of the colony for food resources, and thus belong to the worker caste. Liver acted as the protein bait, and sugar water as the carbohydrate to ensure that colonies foraging for either would be attracted to the traps. Ants were also collected freely from the environment in order to reduce the bias of any species that failed to be attracted to either bait.

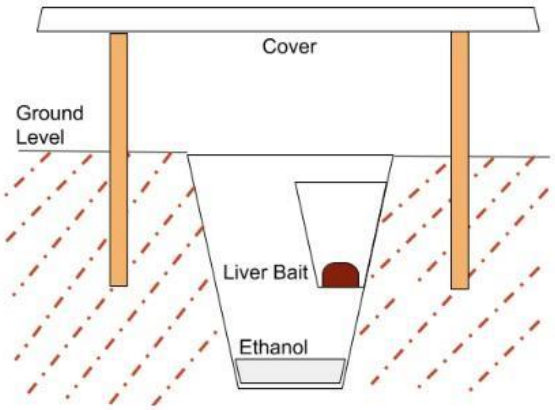

Fig. 1. Ground Pitfall Trap

Traps were checked twice a day, in the morning and the afternoon, and specimens were collected for seven days. Specimens were stored and transported in 3-dram glass vials (BioQuip, Rancho Dominguez, CA) filled with 75% ethanol. This study aimed to collect and document the ant genera in Toco, Trinidad.

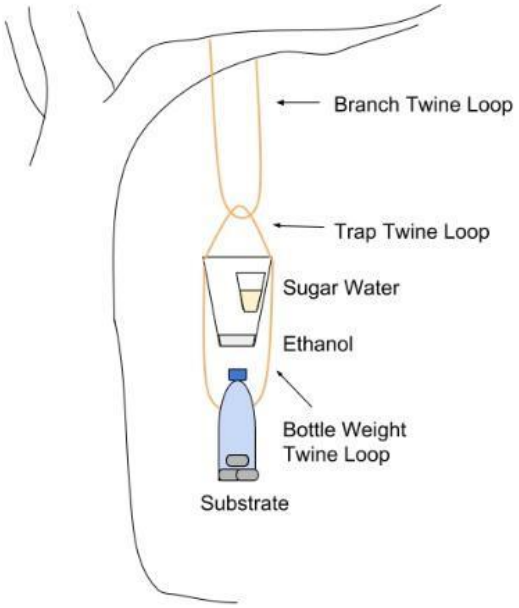

Fig. 2. Arboreal Pitfall Trap

Identification to subfamily was completed using the key developed by Baccaro et al. (2015) and to genus using the key present in Bolton (1994). Using the number of genera collected as well as the count of individuals per genus, a Shannon Diversity Index was calculated (Spellerberg and Fedor 2003).

Results

A total of 298 ants were collected, representing 7 subfamilies and 12 genera (Figure 3). The subfamilies represented included Myrmicinae, Dolichoderinae, Proceratiinae, Formicinae, Dorylinae,

Ponerinae and Pseudomyrmecinae. The genera collected included *Cephalotes sp.*, *Azteca sp.*, *Spinctomyrmex sp.*,

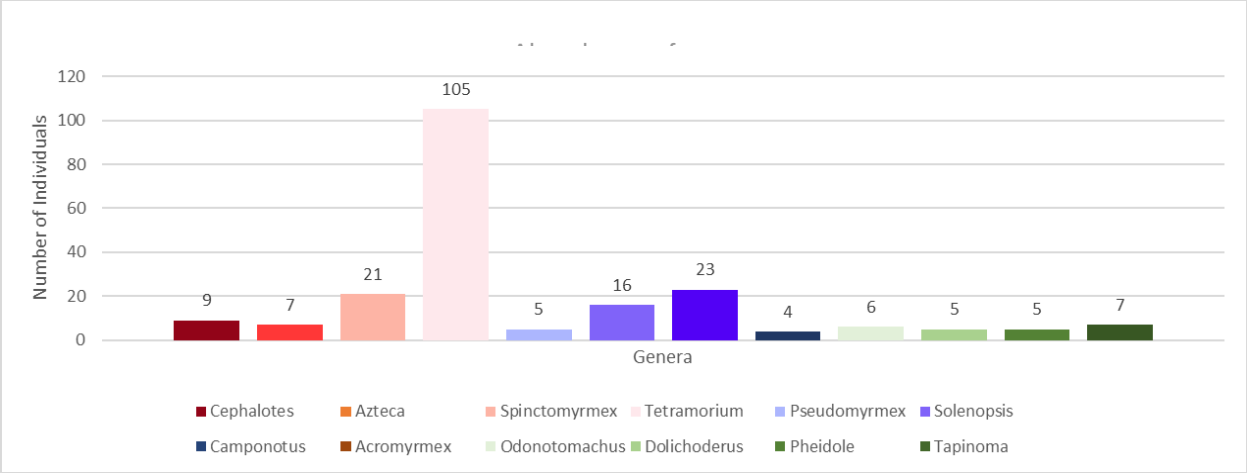

Fig. 3. Counts of individuals per genera

Tetramorium sp., *Solenopsis sp.*, *Camponotus sp.*, *Acromyrmex sp.*, *Odonotomachus sp.*, *Dolichoderus sp.*, *Phediole sp.*, and *Tapinoma sp.*. Only a small number of specimens were identified to the level of species, including *Cephalotes atratus* (Hymenoptera: Formicidae) (Linnaeus), *Cephalotes spinosus* (Hymenoptera: Formicidae) (Person who described the species), *Acromyrmex octospinosus* (Hymenoptera: Formicidae) (Reich) , and *Odonotomachus bauri* (Hymenoptera: Formicidae) (Emery) (Bolton1995, De Andrade and Urbani 1999). Of the 298 specimens, 88 belonged to the subfamily Formicinae. For evenness, numbers per genera ranged from five up to 105, for richness, 12 genera were collected. A Shannon Diversity index of 1.925 was calculated, indicative of a normal amount of diversity (Peet 1974).

Discussion

Out of the 10 subfamilies of ants present in Trinidad as a whole, 6 appear to be in Toco. Regarding evenness, the number of specimens caught for each species ranged from one to as many as 105. The most prevalent genus collected was *Tetramorium sp.*, with high numbers of Formicinae as well. Regarding richness, 12 genera from 6 subfamilies were collected. The subfamilies Myrmecinae, Formicinae, and Dolichoderinae appeared to have more representatives than those of other groups. A total of 298 species were collected from this location. The genera collected here were all ones that occur naturally in Trinidad and Tobago. There are a recorded 65 genera of ants in Trinidad and Tobago, but only 12 were found in this location (Starr and Hook 2003).

Ants of the genus *Cephalotes sp.* tend to nest in tree cavities, the entrance of which is guarded by soldiers who are unique in that they form a “living door” to barricade against predators (Powell 2008). This was also observed here in Toco, as a few of the specimens of *Cephalotes atratus* collected were from a tree cavity with high soldier activity. *Azteca sp.* ants are strictly arboreal and have been observed to act as both pests on coffee bushes and pest control for *Pieris rapae* (Lepidoptera: Pieridae) (Linnaeus)

(Vandermeer et al. 2002). Raids between colonies, sometimes of different genera have been observed in *Spinctomyrmex sp*. as a means of gathering food, and with the various genera of ants in the area, there are plenty of viable colonies which they could prey on (Buschinger et al. 1989). *Tetramorium sp.* is found in habitats ranging from open grasslands, to forest edges, to well-developed forests and typically nest in rotting logs and under rocks in soil. They also forage above ground, which could explain why so many were collected from pitfall traps (Wheeler 1910). Conservation efforts monitoring the number of species rely on information regarding biodiversity (Moore and Palmer 2005). As urban areas in Trinidad expand, human and ant contact is likely to increase, so knowledge about the ant species present in the region will be useful to those in sectors such as pest control and public health. Ants are also known to affect agriculture by destroying crops and biting/stinging wildlife, so relevant species should be identified (Allen et al. 1994). Invasive or introduced ants should also be monitored, and measures taken should they begin to negatively affect ecological, health, agricultural, or commercial fields. *Pseudomyrmex sp.* is a large and diverse genus, with many nesting in hollowed out twigs. They possess the ability to sting (Bolton 2003) and were commonly observed foraging on the ground or along the stems of plants close to the ground. The genus Solenopsis sp. is perhaps best known for *S. invicta*,which is present in many areas, including Trinidad and Tobago as an invasive species (Starr and Hook 2003). Known as “fire ants”, this genus is renowned for its painful sting. They are also known as “thief ants” and are sometimes found in colonies that are not their own. Only a few of the cosmopolitan pest species in this genus have been extensively studied (Pacheco et al. 2013). Believed to possibly be the largest ant genus, *Camponotus sp* have a global distribution, and a high amount of species richness (Bolton 1995). Ants in this genus also greatly vary based on geographical distribution (Bolton and Fisher 2012). Like *Oecodomos sp., Acromyrmex sp.* are also leaf cutting ants, and build fungus gardens to cultivate within their colonies (Nygaard et al. 2011). Trap jaw ants, *Odonotmachus sp*. have been the subjects of study due to the unusual strength in their jaws, which they use for prey capture, nest defense, and predator evasion (Larabee 2015). Another large genus is *Dolichodrus sp.*, which is found worldwide and is a group of diurnal surface scavengers (Kempf 1972). *Pheidole sp*., like *Camponotus sp*, is another larger hyperdiverse cosmopolitan genus with over 900 species described. It is commonly the most abundant ant in both numbers and biomass, however their colonies are usually small and difficult to find (Wilson 2003). The genus *Tapinoma sp*. is made up of mostly arboreal, generalist foragers (Hölldobler and Wilson 1990). Some *Tapinoma sp*. also sometimes tend to aphids and scale insects to obtain honeydew (Powell and Silverman 2010). Ants contribute a large portion of terrestrial biomass and act as ecosystem engineers by modifying their environment and having numerous relationships with other flora and fauna. They also assist with the decomposition process and improve the soil quality within the environments that they are present (Mahalakshimi et al 2016). The distribution of ants includes almost all terrestrial ecosystems, and are highly divergent. While only about 11,970 species of ants have been described, there are an estimated 15,000 total. Ant biodiversity can be used as a bioindicator to ecosystem responses to disturbance, usually associated with humans. Land use change, pollution, and climate change are all ecosystem

disturbances that have resulted from humans modifying the environment, and ant biodiversity can be used to quantify their effects (Mahalakshimi et al 2016).

Limitations for this study may be the duration, as specimens were only collected over the period of a week. The bait was not alternated between the ground and arboreal pitfall traps. There is a possibility that if they had been alternated more genera may have been collected. Future studies can include a longer collection duration or survey a larger area of Trinidad.

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