A survey of *Odontomachus sp* and General Observations of Nesting Preferences on the Island Nation of Dominica in the West Indies.

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ABSTRACT

Odontomachus sp were collected from various locations across the island nation of Dominica in the West Indies. Specimens were captured in nest series and information about their location, elevation, nesting substrate, and co-existence with termites and other Formicidae were recorded. High resolution images of each species collected were recorded for identification and morphological records on each caste type collected including workers, males, alate queens, and queens. Two species were found, most prominently *Odontomachus bauri*, and additionally in a single sample, *Odontomachus ruginodis*.

INTRODUCTION

Within Formicidae there is a multitude of diverse adaptations and morphological modifications that permit members of the family to live in habitats around the globe. Within the Formicidae subfamily of Ponerinae is the genus *Odontomachus*. This term in translation means large jaw, and rightly so when a member of the genus is observed. Commonly known as “Trap-Jaw” ants, these Ponerines have elongate and narrow mandibles that lock open at a near 180° angle. “Most, but not all, trap-jawed species also posses one or two pairs of prominent, long sensory hairs which point forward when the mandibles are held fully open. Stimulating these so called trigger hairs releases closure of the mandibles, accompanied in larger species by an audible click” (Carlin & Gladstein, 1989). This clicking sound has led the people of Dominica to commonly call these ants the Tac-Tac. These jaws are released to snap shut at incredible speeds upon the triggering of these long sensory hairs. It has been recorded that this jaw snapping movement completes from start to finish within 0.33-1.00 miliseconds, making it the fastest known animal action (Gronenberg 1993). This is akin to how a Venus Fly Trap's leaves are triggered to close upon the disturbance of hairs within the trapping leaf. This snapping action can be used to capture prey, attack rivals, defend from predators, and generate a unique means of escape. It has been observed that *Odontomachus* utilize the force of the jaw snapping action to propel themselves away from a threat or even to launch a threat away from themselves. It is quite a

remarkable behavior to observe. These ants can be found in leaf litter foraging for prey items and tend to avoid a noticeable presence as they stalk the ground (Deyrup & Cover (2004). Most colonies are small, numbering less than 100 individuals. Members of this genus have become an invasive pest in the gulf states of the United States of America, ranging from south Texas all the way to Florida.

The purpose of this project was to collect specimens of *Odontomachus* throughout the island nation of Dominica to obtain a general sense of their distribution and make observations about their biology, natural history, and nesting preferences. There exists no published literature on this subject for the island nation of Dominica, therefore it is hoped that the findings of this research will not only fill in a gap that has yet to be explored, but to pave the way for the answering of future questions about *Odontomachus* in Dominica.

Materials and Methods

All ant specimens were collected in vials of 95% ethanol with future DNA sequencing in mind. A slip of paper with a number was placed in each vial ahead of collection so that it could be associated with a certain collecting event. Collecting events are unless otherwise noted done as nest series. Immediately after each collecting event the coordinates, elevation, date, and relevant notes were recorded on a cell phone using the application titled “GPS Essentials”.

Methods of capture included the use of Bioquip insect forceps and a manual aspirator. Colony specimens captured with the aspirator were dumped in mass when first able into cups of 95% ethanol to kill them before moving them to an appropriate vial. Colonies were sought out both locally and on trips to destinations around the island. Areas with leaf litter, rotting logs, and termite mounds were specifically targeted as they would be the most promising based on known *Odontomachus* biology.

After collecting, each vial had it's contents put into a Rose Entomology Sorting Tray under a Leica GZ4 dissecting microscope to be examined. Specimens were sorted by caste and counted. Some specimens of each caste were selected to be point-mounted and photographed. Each vial was processed

one at a time and all contents were returned immediately before moving on to the next vial.

Species identification was conducted using imagery and distribution maps. Primary images and distribution maps used were from www.AntWeb.org. Images provided by AntWeb for *Odontomachus sp* that were known to inhabit islands of the West Indies were compared to what was seen under the microscope and to the images that were photographed of the selected specimens. Equipment used for photographing were a Nikon D300, 4 Nikon SB-R 200 Slave Flashes, mylar ring, Bolt ring LED for focusing, table top tripod, ball head, focusing ball, and several lens extensions. The computer software used for processing the images was Adobe Photoshop Lightroom. Images were cropped and had lighting adjusted for the best quality available.

Results

Figure 1

Locations of areas were *Odontomachus sp.* . . were collected and not collecting. Red points represent collections and yellow pins indicate areas where *Odontomachus sp.* were not found.

Table 1

Specimen Locality data.

Vial #	Specimens	GPS Location	Date	Locality	Forest Type	Elevation	Collector
3	*O. bauri*	N15°29'18.9", W061°15'10.2"	06/05/15	Callinago Territory	Disturbed Atlantic Forest	512 feet	A. Graf
5	*O. bauri*	N15°20'46.1", W061°22'09.0"	06/07/15	Springfield Research Station	Secondary Rain Forest	984 feet	A. Graf
2	*O. bauri*	N15°20'48.3", W061°22'08.6"	06/07/15	Springfield Research Station	Secondary Rain Forest	n/a	J. Rangel
12	*O. bauri, O. ruginodis*	N15°17'58.6", W061°22'53.3"	06/10/15	Roseau Botanical Gardens	n/a	167 feet	A. Graf
11	*O. bauri*	N15°21'03.0", W061°21'47.9"	06/11/15	Springfield Research Station	Secondary Rain Forest	1594 feet	A. Graf
14	*O. bauri*	N15°21'01.9", W061°21'47.9"	06/11/15	Springfield Research Station	Secondary Rain Forest	1604 feet	A. Graf
18	*O. bauri*	N15°20'59.2", W061°21'48.8"	06/11/15	Springfield Research Station	Secondary Rain Forest	1611 feet	A. Graf
16	*O. bauri*	N15°23'51.4", W061°18'44.9"	06/11/15	Emerald Pool Trail	Primary Rain Forest	1155 feet	A. Graf
17	*O. bauri*	N15°19'45.0", W061°19'29.3"	06/12/15	Boiling Lake Trail	Primary Rain Forest	1686 feet	A. Graf
8	*O. bauri*	N15°35'06.7", W061°28'19.8"	06/15/15	Cabritz Coastal Fort Trail	Dry Forest	200 feet	A. Graf

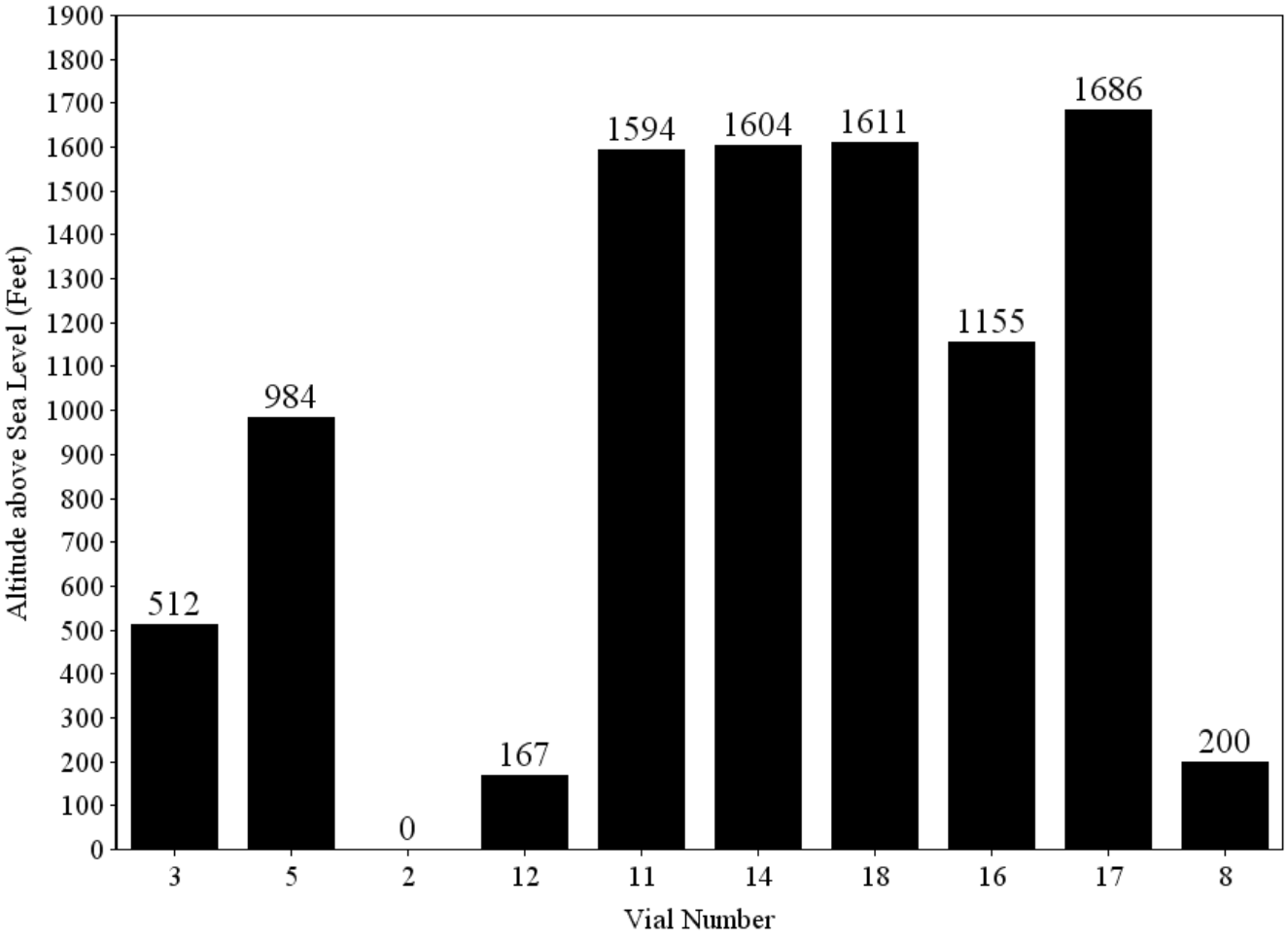

Figure 2

This graph indicates the elevations at which each collecting vial number was found.

Table 2

Localities where *Odontomachus sp.* were not found while collecting.

Location	GPS Coordinates	Elevation	Date	Forest Type
Syndicate Nature Trail	N15°31'31.06", W61°25'1.90"	1830 feet	06/02/15	Primary Montane Forest
St. Davids Bay	N15°25'54.06", W61°15'19.83"	25 feet	06/05/15	N/A
Lake Letang	N15°20'27.66", W61°18'34.30"	2550 feet	06/09/15	Primary Elfin Forest
Lake Boeri	N15°21'4.44", W61°19'15.18"	2870 feet	06/09/15	Primary Elfin Forest

Table 3
Nesting Substrates and Co-habitation Data

Vial #	Colony Information
3	Under large rock, damp soil
5	Base of tree, inside rotting portions under leaf litter
2	Lone foraging individual
12	Nest in rotting log, two species, queens founding new colonies found within a few feet
11	Forest, inside the bottom of a ground based termite mound
14	Forest, inside the bottom of a ground based termite mound
18	Forest, inside the bottom of a ground based termite mound
16	Forest, inside rotting log, co-habitating with other formicidae and termites
17	In leaf litter around rotting logs
8	In deep leaf litter under pile of rotting logs with termites and other formicidae

Table 4
Caste Specimens Count

Vial #	Workers	Males	Alate Queens	Queens
3	31	0	0	0
5	41	0	0	0
2	1	0	0	0
12	17	0	0	3
11	17	1	0	0
14	28	1	0	0
18	159	3	3	0
16	29	0	1	0
17	14	0	0	0
8	60	0	0	0

The species found and identified were *Odontomachus bauri* and *Odontomachus ruginodis*. *O. bauri* made up the majority of all the samples, whereas only two specimens of *O. ruginodis* were found. The following figures are photographs of the castes of each species that were collected. **Figures 3** through **10** are *O. bauri* and **Figures 11** through **14** are *O. ruginodis*.

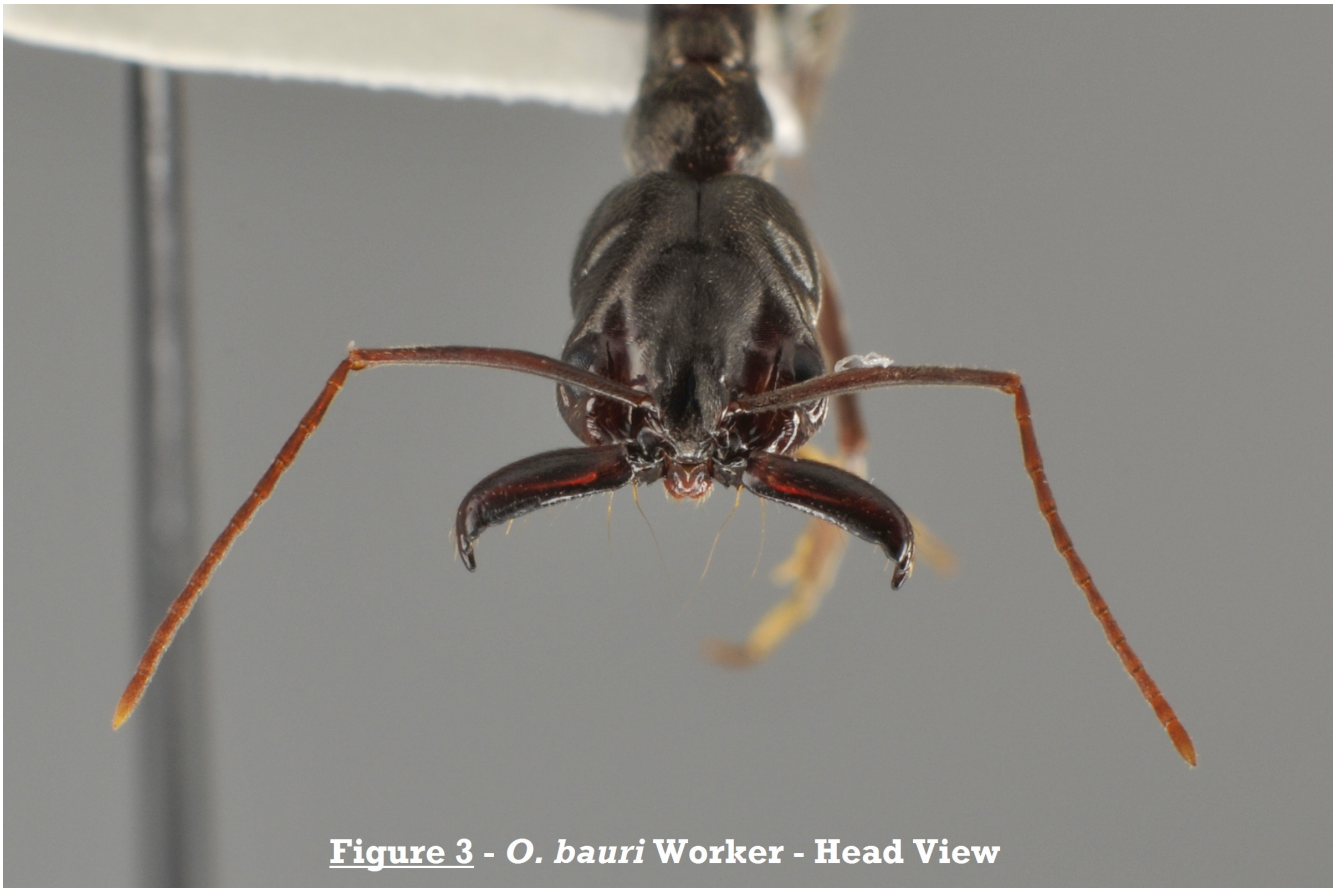

Figure 3 - ***O. bauri*** **Worker - Head View**

Figure 4 - ***O. bauri*** **Worker - Lateral View**

Figure 5 - ***O. bauri*** **Male - Head View**

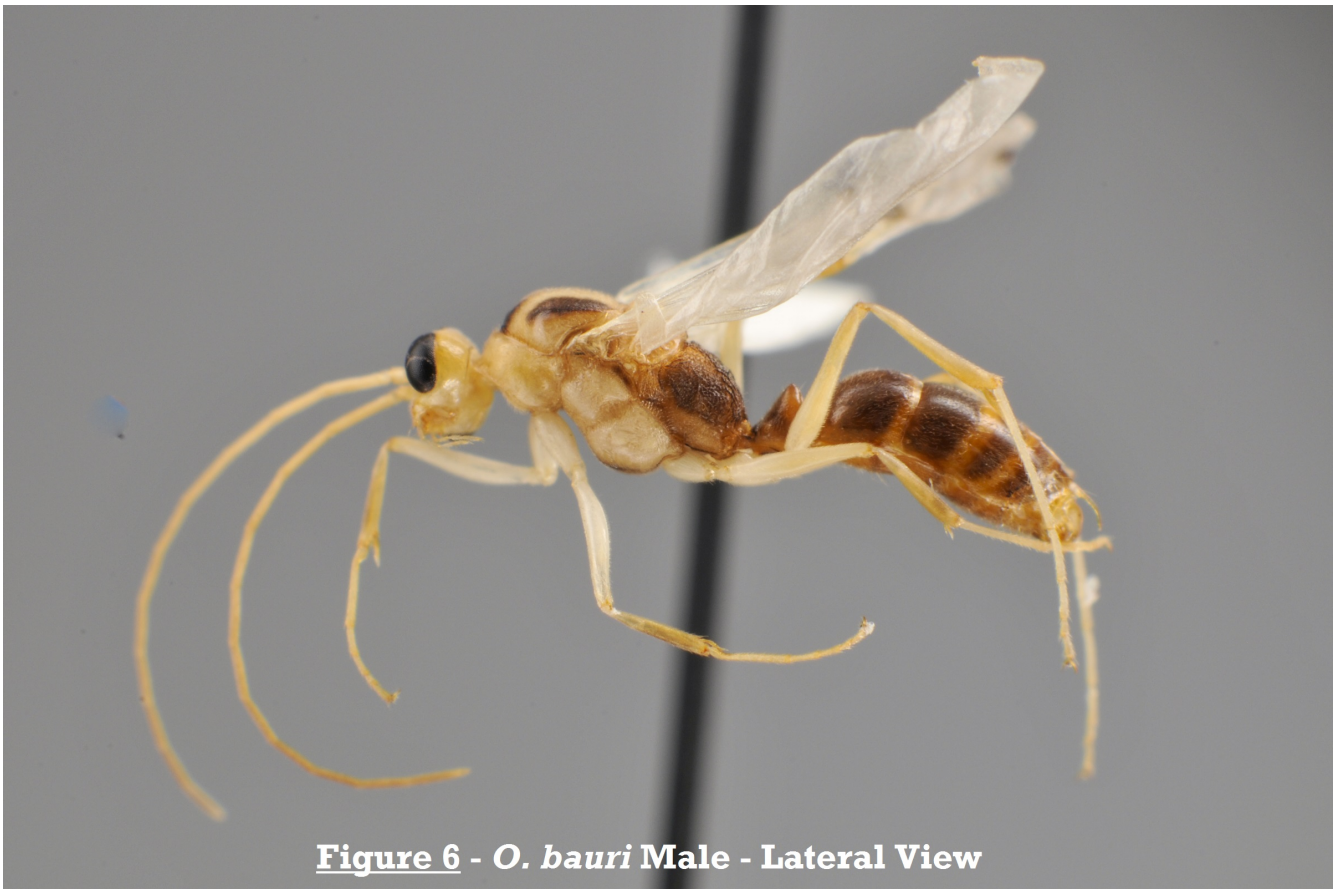

Figure 6 - ***O. bauri*** **Male - Lateral View**

Figure 7 - *O. bauri* Queen - Lateral View

Figure 8 - *O. bauri* Queen - Lateral View

Figure 9 - *O. bauri* Alate Queen - Head View

Figure 10 - *O. bauri* Alate Queen - Lateral View

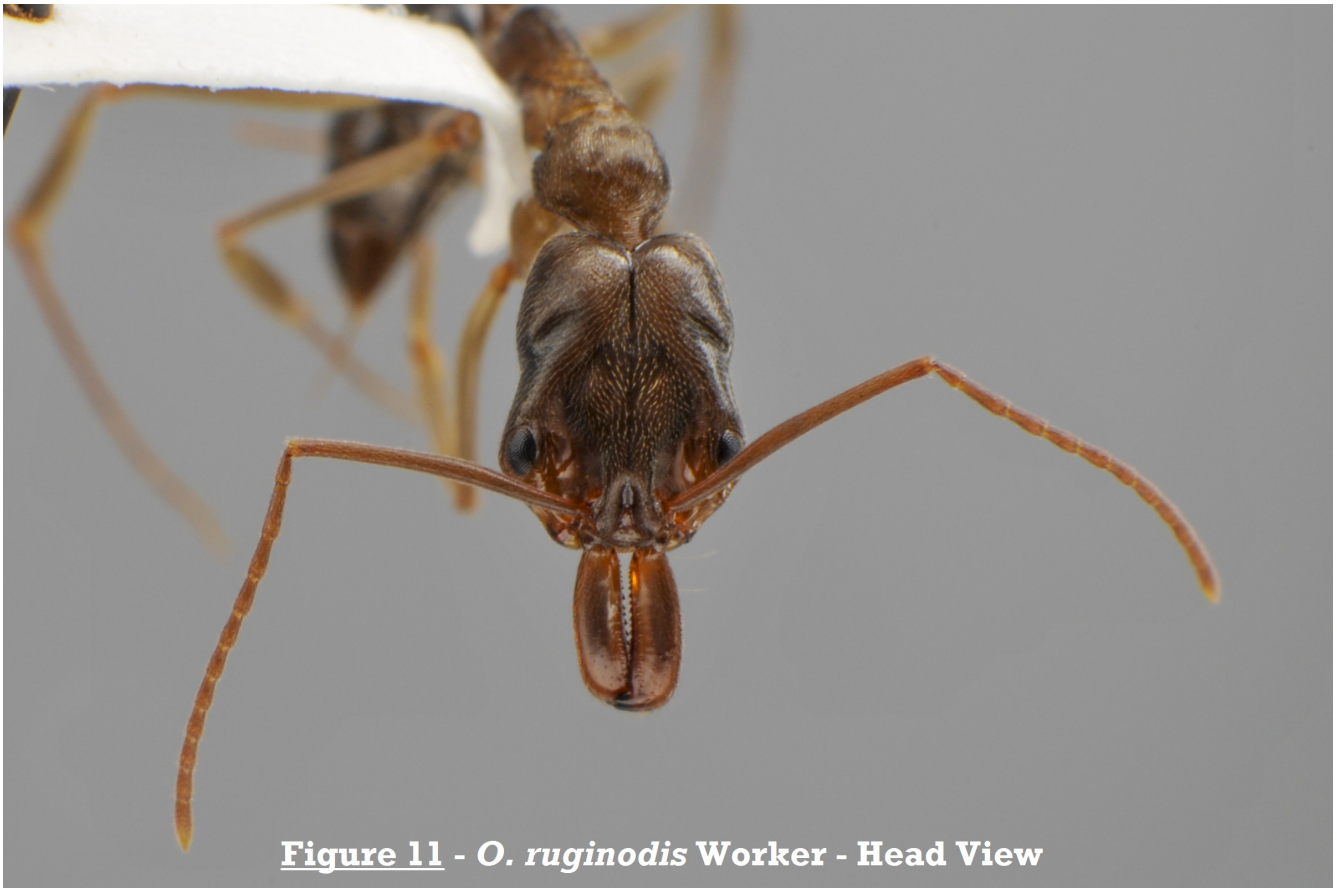

Figure 11 - ***O. ruginodis*** **Worker - Head View**

Figure 12 - ***O. ruginodis*** **Worker - Lateral View**

Figure 13 - ***O. ruginodis*** **Queen - Head View**

Figure 14 - ***O. ruginodis*** **Queen - Lateral View**

DISCUSSION

The results indicate that the Island Nation of Dominica, like other islands in the West Indies, have an established population of *Odontomachus sp*. that can be found in varying habitats. In **Figure 1** you can observe that there are four locations that were visited that did not yield any *Odontomachus spp*. Information about those locations can be seen in **Table 2**. Extensive searching for *Odontomachus* occurred in these four locations just as was done for all the others. The common theme for three out of the four locations is the elevation being much higher than any of the collecting events. It is quite possible that *Odontomachus* cannot become established at such elevations above sea level, despite all of the available moisture, leaf litter, and decaying tree matter. No termite mounds were found at these locations, which have been a common nesting site of *Odontomachus*. Research focusing on this potential relationship will need to be conducted to explore precisely why they could not be found at these elevations. It should also be noted that other ant genera were seen in these locations. Some collecting events were within close proximity of each other, namely the collecting events within the extensive land property of the Springfield Research Station, making them appear as one collecting event on the map due to being zoomed out far enough to cover the entire island. Common themes in the areas where *Odontomachus* were collected was damp leaf litter, rotting logs, ground based termite mounds, and elevations between 200 and 1686 feet. Future research could focus on a much larger sample size of as many different nesting locations and types as possible to generate data leading to what the tolerance levels of *Odontomachus* are on Dominica.

Data in **Table 1** lays out the localities of the collecting events and the forest type they were found in. A majority of the collecting events occurred in Secondary Rain Forest due to the amount of collecting events within Springfield Station's property boundaries and the limitations of the trip. *Odontomachus* were found in Dry Forest, Disturbed Atlantic Forest, Primary Rain Forest, and Secondary Rain Forest. The collecting event that occurred within the Botanical Gardens of Roseau did

not receive a categorization for forest type due to the area not being a naturally occurring forest, but instead an engineered arrangement of plant life and habitats. Vial #12's contents came from the Botanical Gardens and remains the most interesting of the vials due to it being the only vial containing more than one species of *Odontomachus*. Therefore it contains more than a single nest series. While searching with an employee of the gardens named Gerald, we uncovered three *Odontmachus* queens, each within a few feet of each other, but all settled in a spot, most likely founding a new nest. One of these queens was smaller and different in color. This queen was later identified as *Odontomachus ruginodis*. Within a few feet of these three queens a complete colony of *Odontomachus bauri* was discovered inside a small log in the leaf litter. Is is to be stressed that these queens were NOT found inside that colony. One worker of *O. ruginodis* was collected while collecting from this colony however. Since they all came from within two to three feet of each other, they are all placed in the same collecting event. Vial #8 that came from Cabrits was without a doubt the hardest search of all. It was expected that none would be found there due to the nature of Dry Forests and the favoring of humid and damp conditions by *Odontomachus*. However *Odontomachus* was found after about an hour and a half of search on a trail between Fort Shirley and the Fort Commandant's Quarters. An area on the side of the trail that had leaf litter at least 3 or 4 inches deep with fallen tree limbs, logs, and other woods scattered around yielded a colony of *Odontomachus*. There were termites in the wood as well, including other Formicidae. It had been stated that Cabrits had been drier than usual, therefore it could be that the timing of collecting was not favorable as *Odontomachus* colonies were likely in decline.

According to **Figure 2** the elevations that *Odontomachus* can be found at varied from almost sea level and up to nearly 1700 feet above sea level. It should be noted that is quite possible that *Odontomachus sp*. can be found on the island at elevations above 1700 feet. However, on a hike to Middleham Falls (2000-2300 feet) not a single colony or forager of *Odontomachus* was found on the trail. Fallen logs and leaf litter were checked periodically to no avail and no ground based or tree-based termite mounds were found either. It is possible that these elevations are inhospitable for

Odontomachus, however such a notion would need to be further investigated by attempting to collect in multiple areas on the island at these high elevations. Additionally this suggests that the presence of termites are an important part of *Odontomachus* biology and establishment across the island. Future research should be conducted to look specifically and extensively at this relationship. The elevation for Vial #2 is incomplete due to the nature in which I received the vial and collecting information. The vial contained a lone forager collected by a professor that was visiting.

As seen in **Table 3**, *Odontomachus sp*. were found in many different types of ecological zones and within a range of favored substrates. It would appear that most *Odontomachus sp*. favor, when available, the ground-level portions of termite mounds that are ground based. Three nest series, labeled as Vial 11, 14, and 18 followed this trend. It is likely that this comes from a combination of potential benefits that can be advantageous for *Odontomachus*. Firstly, the termites themselves are a nutritional source of protein that could sustain the ants and their larvae. Secondly, termites are known for their incredible ability to create their own climates within their mounds. It is possible that the area of substrate where the mound meets the ground is ideal for nesting conditions and rearing of young in *Odontomachus sp*. While collecting it was observed that the termites avoided contact with the *Odontomachus*. When ground-based termite mounds were lifted up to see under them, the areas that contained the *Odontomachus* were completely clear of termites. Lastly the termite mound can be seen as a provider of defense. The mud material of the mounds are hard and provide a shield against attack or undesired external conditions such as the rain, wind, or temperature. *Odontomachus* are known as leaf litter ants, remaining primarily hidden while hunting for prey items. This combination of a hidden nesting site, a steady supply of nutrition within the mound, climate control, and defensive benefits make this choice of nesting seem quite ideal. Not a single *Odontomachus* colony was found to be inside a termite mound that was in a tree above the ground. No workers were observed to forage up in the trees either. Vial #16 was of interest due to the observed inhabitants of the log in addition to the *Odontomachus*. The log seemed to be partitioned into 3 territories, one with termites, another with a

different genus of Formicidae, and in a corner were the *Odontomachus*. How these social insects are interacting with each other or not is a question that could be asked in future research. Once again, it would appear there is a connection between *Odontomachus* nesting preference and termites.

The information in **Table 4** was recorded for sake of documenting exactly what was found in each collecting event. While collecting, the goal was to obtain as many specimens from the colony as possible, even until none remained. It is known that *Odontomachus sp*., like other Ponerines, have smaller colony populations than most other Formicidae. Instead of thousands they tend to have a few hundred or less even in a strong and thriving colony. As seen in the chart, no fertile egg laying queens from a nest were actually captured. As mentioned before, the only ones captured were alone founding new nests. With queens being close to the size of the worker caste, it is hard to distinguish them in the field while scanning through a disturbed colony. Both male and female alates were few. Only the largest of colonies seemed to have any at all while going through them. Vial #18 is the collecting event that yielded the most ants. Prior to collecting Vial #18, Vial #14 had been collected from underneath a very large termite mound. It was around the size of a small boulder and took a great deal more strength to move. Vial #14 however only yielded a very small colony of *Odontomachus*. Vial #18 in contrast came from under a termite mound roughly the size of soccer ball. Of course it could be that the larger termite colony was simply invaded only recently by *Odontomachus*. Another possibility is that the size of the termite mound and it's relative population are large enough to keep the *Odontomachus* within a small confinement and resist them. It should be noted that Vial #18 had its specimens collected via manual aspirator which was much more effective than using the soft tip forceps.

Figures 3 through **14** show the high resolution images taken of representative specimens for each caste that was collected of both *O. bauri* and *O. ruginodis*. Since no thriving colony of *O. ruginodis* was found, no males or alate queens could be imaged. The representatives imaged of *O. ruginodis* were the only two specimens found. The males are the most extreme when it comes to morphological differences among the caste. In **Figure 3**, you can see the trigger hairs that when

stimulated cause the unlocking and snapping shut of the mandibles. On all specimens it can also be seen that the mesoplueron is without setae or striations, being relatively bare and even glossy.

Conclusion

Odontomachus bauri is well established on the island nation of Dominica and should be further researched to answer questions about their relationship with termites and why certain nesting preferences are favored over others. *Odontomachus ruginodis* could have extensive populations that were simply not found, or it could be that they are not yet established enough for their presence to be noticed. Because it was only found in the Roseau Botanical Gardens it is possible that O*dontomachus ruginodis* is an invasive species. *Odontomachus* bauri can be found within nearly any place on the island that has leaf litter, rotting logs, ground-based termite mounds, or other suitable nesting substrates with the exception of high elevations.

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Sources and References

GRONENBERG, W., J. TAUTZ, AND B. HÖLLDOBLER. 1993.
Fast trap jaws and giant neurons in the ant *Odontomachus*.
Science 262: 561-563.

Carlin, Norman F., and David S. Gladstein. "The “Bouncer” Defense of *Odontomachus* Ruginodis and Other Odontomachine Ants (Hymenoptera: Formicidae)." Psyche: A Journal of Entomology 96, no. 1-2 (1989): 1-19.

Deyrup, Mark, and Stefan Cover. "A New Species Of *Odontomachus* Ant (Hymenoptera: Formicidae) From Inland Ridges Of Florida, With A Key To *Odontomachus* Of The United States." Florida Entomologist 87, no. (2) (2004): 136-44.