Thatch Ants:Territoriality of a *Formica* Species in Relation to Neighborhood and Thatch Mound Size.

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ABSTRACT

Territoriality instincts in *Formica obscuripes* are an understood trait. Few studies have been done to further determine the variables which affect the degree of their territoriality. Our first experiment addressed the effects of mound volume and distance from a host colony where ants from a neighboring mound were introduced to a novel mound in groups of ten or more. Our second experiment consisted of pairing the ants into five groups and reciprocally measuring success of introduced ants to foreign mounds. The third experiment investigated territorial instincts in a neutral environment. Each experiment was carried out as a basis of study in order to observe territorial behavior of *Formica obscuripes*. This research was conducted in order to gain better knowledge of the interactions and social environment between neighboring thatch ant colonies.

KEY WORDS

Formica obscuripes, Thatch Ants, territorial behavioral traits, habitat, formic acid, alarm pheromones, threat posture, aggression, colony, death time.

INTRODUCTION

Ants may exhibit common territorial traits such as defending habitat, water and food supply and their larvae, even when interacting with genetically related individuals from proximal mounds. For example, thatch ants (*Formica obscuripes*), the most dominant ant species in the Northern Hemisphere, protect their interests with stinging bites and the release of formic acid from Dufour's gland secretions which serves as both defense substance and alarm pheromones (Pomeratantz, M. 1972). The substance that the ants excrete is a complex 3-Octanol which is in the mandible creating the effect of excitement and attraction that leads to a threat posture (Pomeratantz, M. 1972). This alarm mechanism is sent out over ten centimeters. If the alarm is not reinforced by additional pheromones, the signal is lost after a few minutes.

Studies which address the territorial behaviors of *F. obscuripes* are important because they increase understanding of reactions to, and interactions with, neighboring communities in one of the most common ant in the Northern Hemisphere. As such, studies on the territorial behavior of this species, may inform spacing of thatch mound structures, and tolerance to change and crowding where thatch mounds are densest. This is especially important because high disturbance may increase the presence of Formica thatch mounds in more fragmented habitats which are increasing world-wide. Studies on *F. obscuripes* have shown a degree of aggressive behavior when neighboring ants intrude on home colonies. However, we are aware of no study which observes the territorial behaviors of *F. obsicuripes* in a managed prairie ecosystem, which makes our research exclusive. In highly disturbed and managed ecosystems such as disturbed prairies, Formica thatch mounds may reach high densities in which neighbor mounds are closely related. Because of this close relation, it is possible there could be variation in territoriality associated with proximity of nearby mounds. Conversely, proximal mounds may represent a greater threat, and territoriality could increase in relation to proximity.

We hypothesized that we would observe an influence on time of death based on mound volume or distance from host colony in a prairie ecosystem. In a second experiment, we hypothesize that mound volume and distance of mound from neighboring ant colonies would have an effect on time of death. In a third experiment, we hypothesized that ants in one-to-one encounters on neutral territory will display little aggression.

METHODS

Site Description

Our study was conducted at Glacial Heritage Preserve near Littlerock, WA. This 1,000-acre prairie preserve (46.8921 degrees N latitude, 123.0362 degrees W longitude) is owned by Thurston County and has undergone intensive restoration efforts by The Nature Conservancy and several partner organizations such as the DNR (Department of Natural Resources).

Biology

Thatch Ants (*Formica obscuripes*) are prominent in the Northern hemisphere. This particular species constructs large mounds made of small sticks, dried grass, and conifer needles. Workers are sterile, wingless females ranging in size from 1/20 inch long to approximately 1/2 inch long. They vary in size and are divided into major (large) and minor (small) workers. *F. obscuripes* sprays predators with formic acid as a method of self defense. *F. obscuripes* are identifiable by a red head and thorax, with a black abdomen.

Experiment 1: Group Drop Observation:

We established the first visible mound near an entry road as the control colony. Ten mounds were then selected, numbered one through ten, and measured for depth, area, and distance using a fifty meter tape and meter stick from the control mound. Ten ants were collected from each colony and tagged with pink Wet and Wild enamel (#427E) on the abdomen to differentiate them from the host colony ants. Each collection of ants was dropped as a group on top of the control colony at ten second intervals; life/death behavior was recorded for each of the ten individuals as a group.

Experiment 2: Individual Drop Observation:

Five ants were selected from each mound and tagged with enamel. The ten sample mounds were then paired into five groups, varying in distance, and cross sampled individually into their corresponding mounds. Observational data was collected in ten second intervals for each individual ant and observations were made for independent territorial reactions or non-reactions of individual subjects.

Experiment 3: Neutral Territory Observation:

A tree stump was selected as neutral territory. Two random mounds, not included in experiments one or two, were selected and five ants were collected from each mound. Ants from mound B were tagged with enamel. One ant from each mound was placed simultaneously on neutral territory to observe potential territorial behavior, and behavioral characteristics were recorded.

RESULTS

Experiment 1: We found no significant effect due to mound volume on the time of death for each group of *F. obscuripes* placed in the host colony (P=.44) (Fig. 1). Additionally, we found no significant effect due to distance between each mound and the time of death for each group of *F. obscuripes* placed in the host colony (P=.31) (*Fig. 2)*. Although we hypothesized that both variables would influence the time of death, our data suggests otherwise.

*Experiment 2***:** We hypothesized that both variables, distance of mound, and volume of mound would influence the time of death in experiment two. However, only mound volume was related to death time. We found no significant effect due to distance of mounds on the death time for each individual *F. obscuripes* in a group of five placed in any foreign colony (P=.43) (*Fig. 3).* We found that the mound volume in this experiment was significant (P<0.001) and approximately 22% of the data is explained by this relationship (R^2 =.23) (*Fig. 4.)*

Experiment 3: We found that out of ten pairs of ants, only in trial number four was there an assumed casualty when ant B overpowered ant A (*Fig. 5)*. We hypothesized that ants in one-to-one encounters would show little aggression, and our results support our original hypothesis**.**

DISCUSSION

Our data suggest that the bigger the *F. obscuripes* ant mounds, the more intense territorial behavior they display. However, our sample size was low, and our R^2 values are too high to pronounce solid evidence for this factor concerning territorial behavior of *F. obscuripes* ants. The time of death was shorter for ants coming from smaller mounds. In Experiment 1, where only one host mound was used, we did not find a significant relationship between the size of mound and time of death (P = 0.44), which suggests it is likely any observed pattern was found due to chance. In Experiment 2 we tested the effect of the size of mounds among several hosts. We found that 0.23 proportion of variation was explained by the relationship between size of mound and intensity of territorial behavior. This shows evidence that size of the mounds affects the intensity of territorial behavior of *F. obscuripes* ants. We found a P-value of less than 0.001, from which one can conclude that this relationship was almost not found due to chance; this could suggest two possibilities. One is that *F. obscuripes* ants are more aggressive and display more intense territorial behavior towards ants from smaller mounds. It could also suggest that ants from bigger mounds are more capable of defending themselves, and, therefore, are more aggressive. Bigger mounds could also be more territorial, if they are more aggressive.

There is a weak correlation in regards to distance between mounds and territorial behavior. In experiment 1, no relationship was found (P= 0.30). A non-significant relationship was also found in Experiment 2, in which multiple hosts were used (P =0.43). Our evidence does not speak clearly enough to draw a conclusion. While a non-significant relationship was found, other studies have shown distance to be a stronger factor. For instance, Robin Stuart and Joan Herbers conducted a study in 2000 at the University of Vermont, in which they tested several factors pertaining to territorial behavior. It was found that *distance* and genetic similarity were the two most dependent factors in affecting territorial behavior (Stuart, 2000)". Therefore, a further study with a higher sample size, would be desirable.

In almost every case we noticed foreign ants becoming immobile within seconds, for when *F. obscuripes* become aware of outsiders they attack by "simultaneously bite[ing] with their mandibles, [while] direct[ing] the[ir] spray forward toward the bite (Pomerantz, 72)". Thus, the following are notable exceptions. In Experiment 2, when the second ant from Mound 7 was placed into Mound 6, it was killed after one minute. The third ant in this same series successfully escaped from the mound. This ant's results could not be used, for we were measuring death time only. It should also be taken into account that these two mounds were very close to each other; only 10.8 meters away. This occurrence might suggest that relationships between mounds are more accepting when they closer to each other. Perhaps ants that are closer neighbors are more accepting of familiar smells. Or, *F. obscuripes* that are closer in proximity feel stronger or more comfortable in a mound that smells more familiar, giving them strength to escape. In the same nest mate recognition study referenced above, it clearly states olfactory cues are the primary way in which ants recognize nest mates (Stuart, 2000). A more in-depth study with a bigger sample size should be done to test this more specific variable of smell.

Also pertaining to ant's sense of smell, it should be noted that we wanted to rule out the possibility of the nail polish playing a factor in our results. The nail polish, as mentioned above, is used solely for the purpose of identification. Therefore, ants from several colonies were painted and then returned to their own colony to observe what would occur. At this point, ants from this colony did swarm the newly painted ant but did not attack. One could conclude, the other ants may have smelled the nail polish but still recognized the underlying smell, which was that of their own colony.

In Experiment 3, in only one out of the five trials was there an example of a significant attack in neutral territory. In the other four cases, the two ants appeared to move away from each other or avoided each other, even if there was some sign of acknowledgement. This could be attributed to the strong territorial nature of ants. These observations may indicate that once *F. obscuripes* are placed in foreign territory, their territorial behavior is such that they immediately separate.

It's possible *F. obscuripes* lack any sense of autonomy; without their colonies, they have no function or purpose. A bigger sample size should be taken to further this study.

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GRAPHS

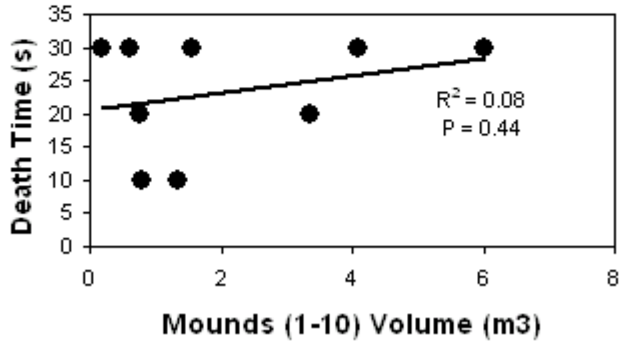
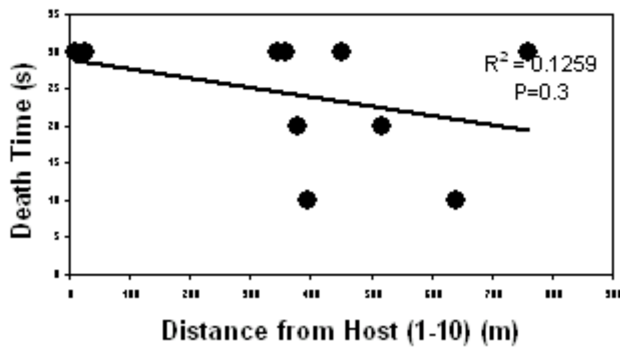


Figure 1



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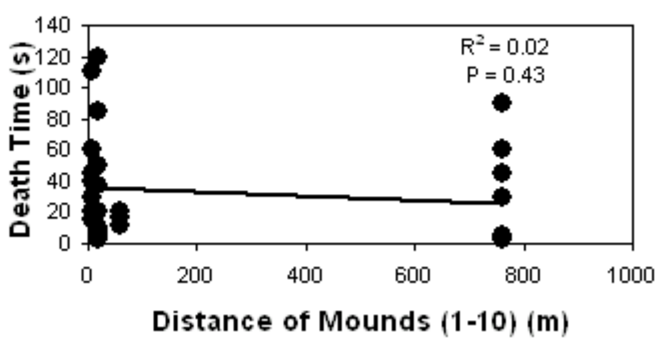

Figure 3

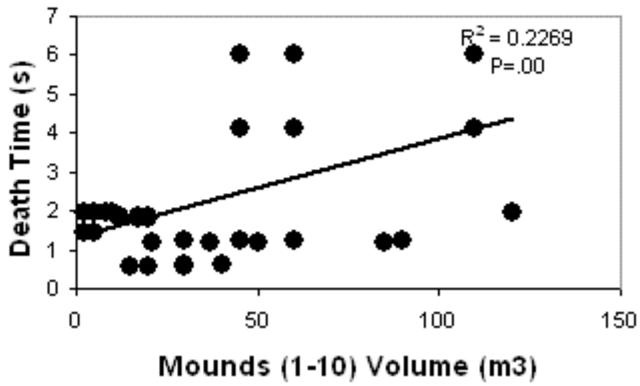

Figure 4

Trial	
1	Ran in opposite directions
2	Briefly faced each other, ran in opposite direction
3	Briefly attacked each other then ran in opposite directions
4	Briefly Briefly face each other, colony B ant attacks colony A ant, colony A ant defends itself (squares off) - Ant B overpowers Ant A (begins to drag Ant A)
5	Ran in opposite directions

Figure 5

<u>FIGURE LEGEND</u>

Figure 1. describes experiment one and the correlation between mound volume and agression of host *F. obscuripes* determined by quickness of execution of intruding *F. obscuripes* (death time).

Figure 2. describes experiment one and the correlation between the distance from the host mound and agression of *F. obscuripes* determined by host *F. obscuripes* quickness to execute intruding *F. obscuripes* (death time).

Figure 3. describes experiment two and the correlation between mound volume and agression, determined by quickness of execution (death time), of *F. obscuripes* in paired cross sampled mounds.

Figure 4. (D) describes experiment two and the correlation between distance of paired cross sampled mounds, and agression, determined by quickenss of execution (death time), of *F. obscuripes.*

Figure 5. describes the reactions of the *F. obscuripes* from colony A and B when placed on neutral territory.