Risk Averse Foraging in Formicine Ants

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Introduction

Ants are eusocial insects whose workers may engage in foraging as their exclusive activity for most of their adult life. Most ant communication, and thus much of the mechanism for maintenance of social organization, is thought to be chemical. When workers encounter food, they may leave pheromone trails to alert other workers to productive forage, enhancing food acquisition for the whole colony (Traniello 1989). Some ants also emit alarm pheromones in response to danger or trauma. This may elicit either swarming an attacker or escape behavior (Jackson and Ratnieks 2006).

In order to examine the time-dependence of ant communication, I measured the intervals between ant visits subsequent to one worker's discovery of a rich food source. I predicted a decreasing logarithmic curve, representing a scenario in which subsequent ants would reach the food with increasing speed. The curve would thus asymptote at some minimum interval corresponding to a maximum speed of travel for individual ants.

I also examined risk awareness. By capturing foraging ants and removing them, but depriving them of the opportunity to emit alarm pheromones, I hoped to test whether ants were aware of the disappearance of compatriots without such cues. Without these cues, I expected the rate of chance encounter to determine these intervals.

Methods

I chose to work with what I believe to be a single species of ant in the subfamily Formicinae. I made the subfamilial identification on the basis of segmented antennae, a petiole with a single node, and the profile of the thorax. However, there are records for

37 species of ant in Clearwater County, and 24 of those are in Formicinae (Linksvayer [no year]), so I could not confidently make a species-level identification.

I selected 14 nests in Itasca State Park, Clearwater County, Minnesota, USA. At each nest I cut a slice of apple (*Malus domestica*) with a mass of approximately 25 grams, placing it at a distance of 30 cm from the entrance to a nest of ants. In seven instances, I allowed the ants to discover and exploit the apple unmolested, noting the time after placement at which each of the first 30 ants arrived. At the remaining seven nests, I removed every ant that arrived at the food, while attempting to minimize the physical trauma, and thus the possibility of deposition of alarm pheromones. I accomplished the removal by primitive means: I stabbed the soil with a drinking straw, and then slipped a butter knife underneath, removing both the trapped ant and a very thin layer of soil. An improvised aspirator proved too slow to capture single ants without causing all other nearby ants to flee. As with the first set of nests, I timed the arrival of all ants; however, I did so for only 30 minutes, even if 30 ants did not arrive.

Results

The interval between ant_n and ant_{n+1} at non-predated nests exhibited a decreasing trend and a weak logarithmic association with the number of ants n that had preceded ant_{n+1} (R^2 =0.436, Fig. 1). The between-ant interval (745 seconds) at predated nests was significantly longer than that at non-predated nests (36.3 seconds), and sometimes exceeded the time allotted for monitoring (t = 3.39, p < .05, d.f. = 12, Fig. 2). The interval between visits for colonies subject to artificial predation was not significantly different from the time it took for ants to encounter food for the first time (t = .122, p > 0.90, d.f. = 12).

Discussion

The pattern of ant visits to bait at nests not subject to artificial predation corresponded rather weakly to my prediction. There was considerable stochasticity in the timing of subsequent ant visits, and they tended to arrive in small clusters—forty seconds might elapse followed by three ants in quick succession. The number of replicates was quite small, however, and it is likely that more samples would reduce the noisiness of the data. Time constraints prevented me from counting the first 30 ants to visit bait at colonies where individuals were removed, hindering subsequent comparison to the trend for non-predated ants.

The difference in visit intervals between the predated and non-predated conditions is highly significant given the modest sample size, but some of this difference is likely an artifact of my own lack of dexterity. During early trials, I took a few seconds to capture ants for removal, during which time they had time to flee over a distance of several centimeters, and possibly lay alarm pheromones in the process. In later trials I learned to capture the ants more deftly, and I no longer observed intervals in excess of 20 minutes. This implies that alarm trails persist for at least that long, but exploring the temporal dependence of alarm signals was beyond the purview of this study.

The lack of difference between the intervals of visits by predated ants and the interval required for initial discovery of the food is suggestive, but equivocal. There is not enough information here to say whether traffic to the food was insufficient to generate a strong pheromone trail, or whether the ants were in fact displaying an aversion to risk based on the absence of removed ants. In early trials, some ants certainly had time to lay down alarm trails, and in these cases risk aversion seemed clear; I observed no subsequent visits for 20 minutes or more. However, in trials where the ants were removed less conspicuously, risk aversion is less pronounced. The intervals remain substantially longer than in non-predated colonies—but indistinguishable from chance initial encounters.

This study would have benefited from some perfunctory background reading. For example, some formicine ants prefer high-fat, high-protein foods to sugar-rich foods such as apple (Lynch *et al.* 1980), although they do forage on fruit as well (Talbot 1943). Thus, it is possible I might have chosen either a more appropriate bait for my species, or a more appropriate species for the available bait. My inability to positively identify the ant species in question precluded any such bait specificity—greater familiarity with the taxa in question would have made these results more useful. That said, I am reasonably confident that all the ants in the study were at least of the same species, and they are evidently willing to eat fruit.

A future study might also be more deliberate, devoting more time to data collection. More patient observation would facilitate comparison between conditions.

References

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Figures

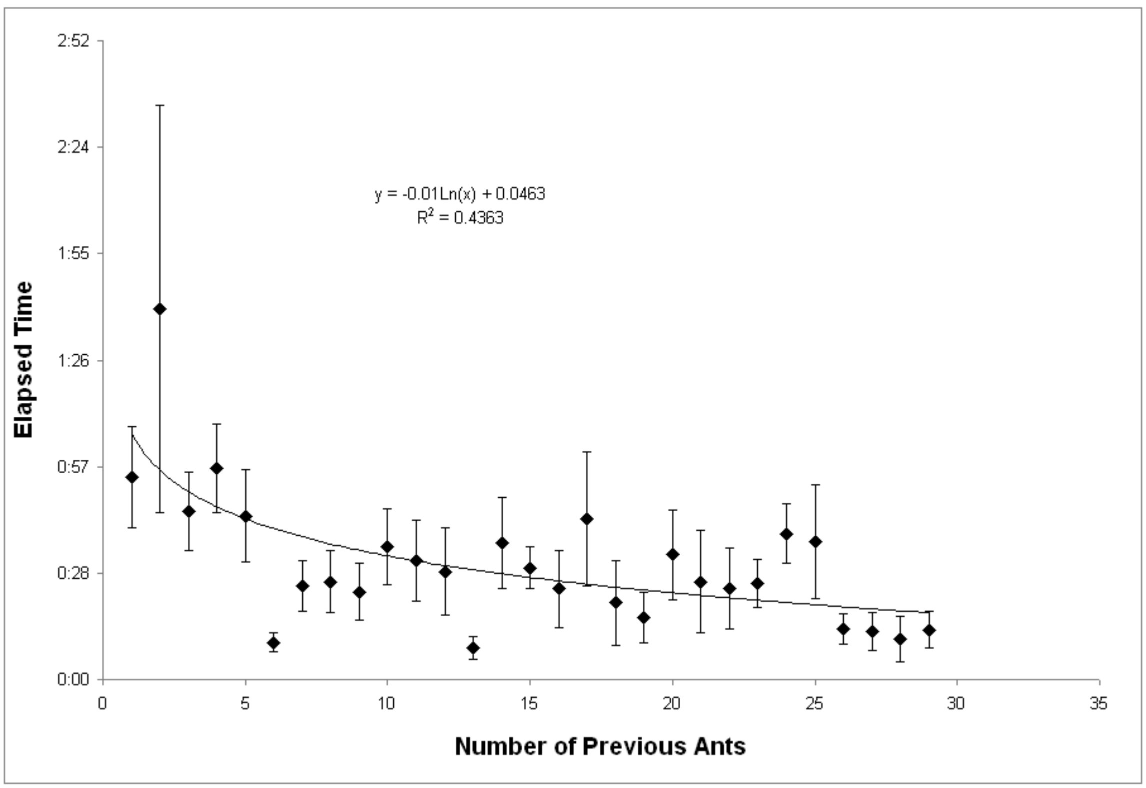

Figure 1: Mean elapsed time (minutes: seconds, ± S.E.) between ant visits as a function of the number of ants having previously visited the bait, in nests not subject to artificial predation.

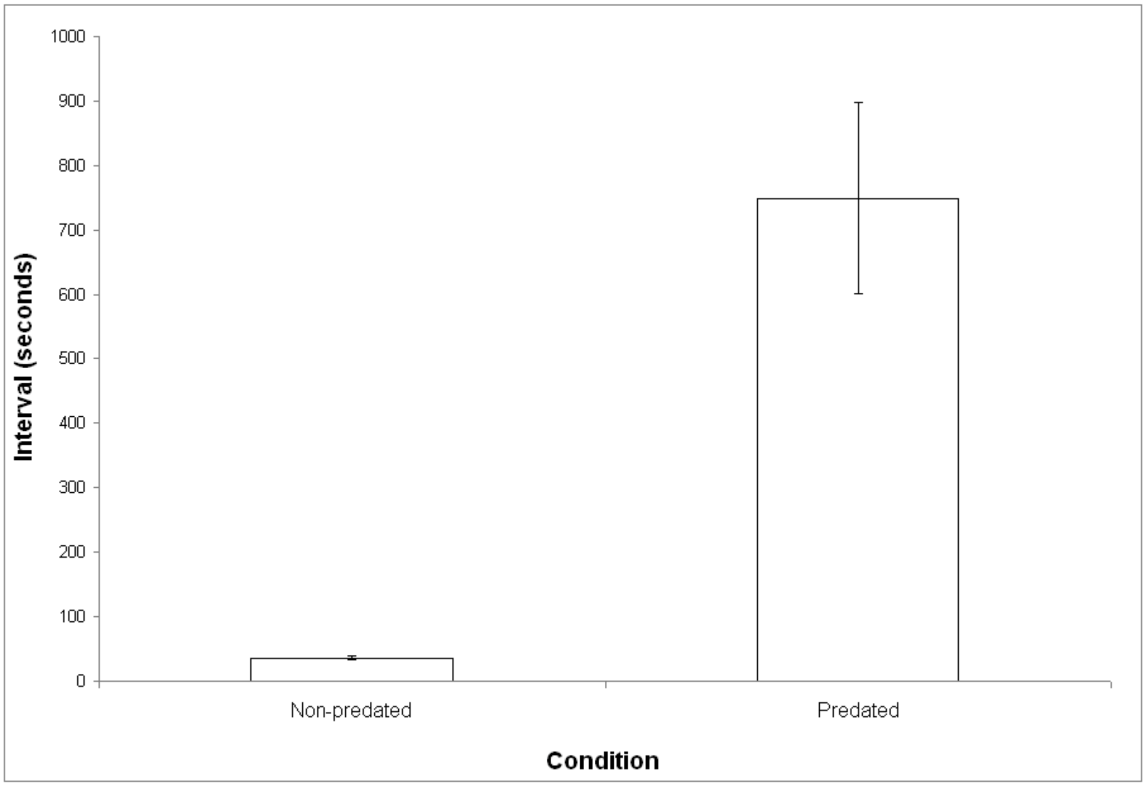

Figure 2: Mean (± S.E.) interval between ant visits with and without artificial predation.