

Cleptobiosis in the ant *Ectatomma ruidum* in Nicaragua

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Summary

Observations of the ponerine ant *Ectatomma ruidum* suggested that this is a cleptobiotic species which appears to use the pheromone trails of other ant species to locate individual workers carrying food. To test this hypothesis an arena was set up to quantify the position of each *E. ruidum* that entered the arena with respect to its position on or off a well-established foraging trail of *Pheidole radoszkowskii*, a myrmicine. Encounters between *E. ruidum* and *P. radoszkowskii* are described. Quantitative data and behavioral observations support the cleptobiosis hypothesis. This study adds yet another dimension to the diverse array of foraging strategies of the Ponerinae.

Introduction

Cleptobiosis has been defined as the relation in which one species robs the food stores or scavenges in the refuse piles on another species, but does not nest in close association with it (Hölldobler and Wilson, 1990; 636). However, the term is generally used to describe the situation where a worker of one species robs the food from a returning forager of another species (Wroughton, R. C., quoted by Wheeler, 1910). Although food robbing, or cleptobiosis has been described in ants by many authors (Wroughton, 1892; Forel, 1901; Wheeler, 1910; Abe, 1971; Maschwitz and Mühlenberg, 1973; Hölldobler, 1986), its occurrence as a foraging strategy of *Ectatomma ruidum* has never been reported. In this study we describe observations that suggest that *E. ruidum* engages in cleptobiosis at least on a facultative basis.

Ectatomma ruidum (Roger) is a widely distributed neotropical ant. It is ubiquitous in Central and South America, ranging from the rain forests of the Atlantic lowlands to the dry forests of the Pacific lowlands (Weber, 1946; Brown, 1958; Kempf, 1972). Our initial observations were made at the Las Mercedes Experimental Station of the Instituto Superior de Ciencias Agropecuarias (ISCA), on the outskirts of Managua,

Nicaragua. While surveying ground-foraging ants with the use of fish baits, we noted that *E. ruidum* seemed to be associated with other, smaller, species of ants at the baits. Of the 6 common species in the study area, *E. ruidum* had the highest percentage of occurrence with other species (67%) and the lowest percentage occurring alone (33%). The percentage of co-occurrence for *Solenopsis geminata*, *S. globularia*, *Tetramorium caldarium*, *Pheidole subarmata* and *Forelius pruinosus* was 5%, 26%, 29%, 23% and 22% respectively (the study comprised 9 surveys of 160 baits each). These results could have simply reflected a high density and wide distribution of *E. ruidum* nests in the study area, as has been reported for other regions (Levings and Frank, 1982; Lachaud, 1990). However, were this the case, we should also have found an overall high proportion of baits occupied by this species, and that was not the case. *E. ruidum* was found, on the average, in 20.1% of the baits throughout the study (Perfecto, 1991). This led us to speculate about a possible positive association of *E. ruidum* with other species. This speculation was corroborated with another, independent observation.

On the morning of July 6, 1986, we discovered a well-defined foraging trail of *Acromyrmex octospinosus* (Reich) in the city of Managua. The *A. octospinosus* workers on the trail were carrying small pieces of dry bread. In addition to the *A. octospinosus* workers on the trail, there were *E. ruidum*, seemingly using the same trail. For a period of 30 minutes we recorded the presence of all individuals of *E. ruidum* with reference to their position either on or off the trail. We divided the total area into trail (1.9 m²) and non-trail (7.1 m²) area, and estimated the number of *E. ruidum* per square meter in both areas. The results indicated that *E. ruidum* had significantly higher numbers of workers per square meter on the trail area ($\bar{X} \pm \text{SD} = 3.67 \pm 1.23$; Kolmogorov-Smirnov test, $p = 0.031$) than on the non-trail area ($\bar{X} \pm \text{SD} = 0.30 \pm 0.17$). In addition, during the 30 minute period, on three occasions an *E. ruidum* worker actually engaged an *A. octospinosus* worker, taking the bread into its own mandibles, and on one occasion actually wrested the bread from the *A. octospinosus* worker and carried it off. However, only in one occasion was *E. ruidum* successful in removing the bread from the mandibles of the *A. octospinosus* worker and carrying it back to its nests. After the *A. octospinosus* trail was no longer active we recorded the number of *E. ruidum* on and off the previous trail and found no significant differences between workers on the trail ($\bar{X} \pm \text{SD} = 1.19 \pm 0.79$; Kolmogorov-Smirnov test, $p = 0.143$) and off the trail ($\bar{X} \pm \text{SD} = 0.70 \pm 0.23$). These results led us to hypothesize that the widely distributed *E. ruidum* engages in cleptobiosis as one of its foraging strategies.

To test this hypothesis, we set out several arenas (5260 cm²) in an area dominated by *Pheidole radoszkowskii*, but also frequented by *E. ruidum*. Fish baits were placed in the center of the arena, and left to attract *P. radoszkowskii*. The arenas that accumulated the most distinct trails of *P. radoszkowskii* were used for observations similar to those made on the *A. octospinosus* trail. For a minimum of 5 minutes, at a 5 second interval, we recorded the position of each *E. ruidum* that entered that arena with respect to the *P. radoszkowskii* trail. The experiment was repeated twice, on July 7 and July 8, 1986. We estimated that the *P. radoszkowskii* trail encompassed only 4/9 of the total arena area. Therefore, we expect that *E. ruidum* would spent 4/9 of its time on the trail by chance alone.

The results support the hypothesis that *E. ruidum* engages in cleptobiosis. On July 7 and 8, workers of *E. ruidum* spent a significantly higher fraction of time (in seconds) on the trail ($\bar{X} \pm SD = 49.29 \pm 39.41$ for July 7, and 228.33 ± 151.61 for July 8; Student t-test, $p = 0.011$ for July 7, and $p = 0.010$ for July 8) than was expected by chance ($\bar{X} \pm SD = 27.34$ for July 7, and 131.27 ± 93.94 for July 8). In addition, a total of 40 and 111 direct encounters between *E. ruidum* and *P. radoszkowskii* were recorded for the two sampling dates.

In addition to the quantitative data, behavioral observations strongly supported the cleptobiosis hypothesis. An individual *E. ruidum* would enter the arena and, during the course of frequent antennation, eventually make their way either to the edge of the arena, where they frequently would exit, or to the *P. radoszkowskii* trail. Arrival at the trail was usually accompanied by an obvious increase in general movement, as though a stimulant had excited the individual far above its previous level. Rapid search behavior ensued, with even more frequent antennation. There seemed to be little concern with locating the bait (none of the 25 individuals involved in the timed observations actually arrived at the bait), but rather the search seemed to be aimed at locating individuals of *P. radoszkowskii*, attacking them and removing whatever pieces of bait they were carrying. In a typical encounter (a total of 151 encounters were observed), the *E. ruidum* worker grasps the *P. radoszkowskii* worker in its mandibles, sometimes attempts to sting it, and antennates the captive's body. The captive ant is then released, usually unharmed, but occasionally immobilized or dead from a sting. Because of the background color of the arena, the small size of the bait particles that the *P. radoszkowskii* were carrying and the rapidity at which encounterings were occurring, it was impossible to record all of the successful resource thefts, although we strongly suspect that the event that caused each *E. ruidum* individual to leave the arena (after an encounter) was the acquisition of a piece of bait from a *P. radoszkowskii* worker.

The above observations were made during a period when well-defined and active foraging trails had been established, but the actual number of ants at the bait was small. As the recruitment of *P. radoszkowskii* progressed, *E. ruidum* individuals had increasing difficulty maintaining themselves in the trail area, and what began as an attack of *E. ruidum* on *P. radoszkowskii*, ended as an attack of five or ten *P. radoszkowskii* on the original attacker.

Subsequent observations on *P. radoszkowskii* trails on the ground confirmed the common occurrence of *E. ruidum* workers removing bits of resources from the mandibles of *P. radoszkowskii* workers after the stereotypical encounters. Subsequent casual observations suggested that food robbing is a common foraging strategy for *E. ruidum*, although apparently with large ant species it is not a simple matter to actually remove the resource, as confirmed by our observations of the *A. octospinosus* trail.

In conclusion, from qualitative and quantitative observations it seems that *E. ruidum* engages in cleptobiotic behavior, utilizing foraging trails of other species, when possible. This is the first time that this behavior is reported and found to be relatively common in a Ponerine species, adding yet another behavioral trait to the wide array report for the Ponerinae (Hölldobler, 1984; Lachaud et al. 1984; Breed and Bennett, 1985; Lachaud, 1985; Overall, 1986; Pratt, 1989).

These results also provide supporting evidence for Pratt's (1989) report that *E. ruidum* workers employ recruitment behavior when encountering rich or difficult food sources, and that this recruitment consists of orientating pheromone trails. It was previously reported that *E. ruidum* engaged only in an archaic type of mass recruitment but with no apparent use of a chemical trail (Lachaud, 1985). However, it is highly unlikely that a species could detect other species pheromone trails, yet remain unable to lay and detect pheromone trails of its own species. Furthermore, Pratt (1989) also provided evidence that the trail pheromone of *E. ruidum* is not colony specific, which makes it more likely for *E. ruidum* to be able to detect other species' pheromones, even though it belongs to a different subfamily.

Pratt (1989) also suggests that his study supports Brown's (1950, 1958) hypothesis that the Myrmecinae are derived from an ectatommine ancestor. He argues this on the basis that the Dufour's gland appears to be the source of the recruitment pheromone in *E. ruidum* and other ectatommines, but is unknown as a source of recruitment pheromone in other ponerines. In our study, the observations of cleptobiosis occurred with ants of the genus *Pheidole* and *Acromyrmex*, both mermicines. If in fact the Myrmicinae are derived from an ectatommine ancestor, this could partially explain why *E. ruidum* is able to detect a pheromone trail layed by mermicines.

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