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BEHAVIOR OF TWO MYRMECOPHILES OF PARAGUAYAN LEAF-CUTTING ANTS

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ABSTRACT

A new taxa of chelodesmid millipedes were found to be associated with the leaf-cutting ant, **Atta sexdens rubropilosa** Forel, in Paraguay. This millipede apparently feeds upon the discarded fungal substrate of the ant gardens, and apparently uses the trail pheromone of this ant in locating nests, as indicated by its behavior in the field and its ability to follow natural trail pheromone in the laboratory. The clubonid spider, **Corinna vertebrata** Mello-Leitao, was found to be a myrmecophile of the grass-cutting ant, **Acromyrmex landolti fracticornis** (Forel). This spider was additionally a good myrmecomorph and had a gait and body orientation similar to that of its. host. Nevertheless, although this spider lived in the nests of its host, and although it did leave the nest with its host on foraging bouts, it predated stray foragers. It is thought that this spider presents a case of mimesis, although aggressive mimicry is a distinct possibility.

SUMARIO

Este trabajo detalla el comportamiento de un taxon nuevo de **diplopoda** y una araña clubonida que se asocian con hormigas cortadoras paraguayas. El milpiés sigue pistas feromonales de su huésped, mientras que la araña se asemeja a su huésped, vive con ella y frecuentemente la consume. Se discute la literatura relacionada con la depredación de hormigas obreras por arañas, y hormigas que también se asocian con hormigas cortadoras paraguayas.

INTRODUCTION

Many organisms live with ants (myrmecophily) and many others resemble ants (myrmecomorphy) Of these phenomena, myrmecophily is the better documented (Wheeler, 1910; Wilson, 1971) and can be found in a diverse array of invertebrate and vertebrate taxa. Nevertheless, our understanding of the adaptive significance of myrmecophily will tend to increase as more diligent observations are conducted.

The phenomena included in myrmecomorphy are thought to be due to selection pressures of either predators (Baetsian mimicry) in which the ant model incurrs a lower predation pressure than would a non-ant-mimicking organism, or they may be due to their hosts (Wassmanian mimicry), in which those mimics that are most ant-like are accepted by their host, while those that are not are rejected. In the case of Wassmanian mimicry, pheromonal mimicry may be more important than strict myrmecomorphy (Rettenmeyer, 1970). Myrmecomorphy may also be important in lowering predation pressure on the mimic through a process known as mimesis, in which the mimic is lost in a crowd of ants. Little data are presently available on mimesis, and this hypothesis must remain tentative. Myrmecomorphy was reviewed for spiders by Reiskind (1977), while mimicry has been reviewed in detail by Rettenmeyer (1970).

This report examines the behavior of two common myrmecophiles of Paraguayan leaf-cutting ants, and is based on collections and observations made from 1974 through 1976. These observations supplement the list of attine myrmecophiles of Weber (1972). Additionally, the literature on the regular predation of worker ants by spiders is reviewed.

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DIPLOPODA

A new species and genus of **chelodesmid** was

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found often on the physical foraging trails of **Atta sexdens rubropilosa** with the bulk of the sightings occurring in winter and early spring. Individuals were frequently seen entering the nest entrances or foraging galleries of its host, and were always observed only on the physical foraging trails of its host. When removed from the physical foraging trails and displaced up to 30 cm. from the trails, the millipeds always found their way back to the foraging trail and then continued on their way. Near the nest and foraging gallery entrances, worker ants were often observed trying to impede the movements of the millipedes. However, the workers could not grasp the body and the milliped always entered the entrance successfully.

In the laboratory, millipedes readily fed upon discarded fungal substrate of **A. sexdens rubropilosa**, and it is likely that this is a normal food of the millipedes in the field. **A. sexdens rubropilosa** discards its fungal substrate in subterranean detritus chambers, and thus this milliped must enter the nest to consume this rich and concentrated food source.

I created pheromone trails of **A. sexdens rubropilosa**, whose major component of the trail pheromone is 3-ethyl-2,5-dimethyl pyrazine (Cross et al, 1974), by disecting whole poison glands, mixing these in acetone, and then applying with toothpick to a filter paper disc mounted on a phonograph turntable.

This method permits a uniform application of pheromone in a regular circle. The pheromone impregnated disc was removed and the acetone carrier allowed to evaporate before experiments were conducted. Controls consisted of disc treated with only acetone in a like fashion. Discs were placed in a small plastic container, and individual millipedes were introduced into the chamber. I always obtained a positive pheromonal response, consisting o f millipedes following the pheromonal trail for $\geqslant$ 75% of the test ring circumference. Positive controls were never obtained ($N = 15$ for each). This suggests that the millipedes can detect trail pheromones and can use these for orientation (chemoklinotaxis).

In addition, **Stachyproctus cameranii, Strongylomorpha** sp., and **Metasoma** sp., were also obtained from the physical foraging trails of **A. sexdens rubropilosa** and **Sandalodesmus** sp., was collected from the superficial refuse heaps of **Acromyrmex landolti fracticornis.**

That millipedes are associated with leaf-cutting ants is not surprising in light of the colony sizes and trophic ecology of these ants. Also, it is not surprising that some of these millipedes would depend almost exclusively upon this bountiful food supply, or that they would use the pheromonal cues of the ants. A similar, better documented system occurs with millipedes associated with army ants (Rettenmeyer, 1970), which also have large colonies and concentrated food and detritus caches.

ARANEAE

Corina vertebrata Mello-Leitao (Clubonidae) was a myrmecophile and myrmecomorph associated with **Acromyrmex landolti fracticornis** (Forel). Both sexes were present throughout the year, specially during spring, with females always being more numerous. These spiders lived in the nest tumuli of the ants, often entering through abandoned turrent entrances. These spiders always walked with a slow gait while raising their legs high and deliberately above the substrate. This gait is the same as that employed by its host, and only upon close inspection could the spider be distinguished from its host.

During the winter (July), individual spiders were seen repeatedly in the foraging columns of **A. landolti fracticornis.** On at least 11 occasions, spiders were observed to move away from the foraging colum and to pounce on solitary foragers as they passed. The ant was then dragged a short distance from the column and consumed on the spot.

The behavior of this spider is remarkable. First, it is an apparent myrmecophile, living in the nests of **A. landolti fracticornis.** Second, it is an apparent myrmecomorph. The body plan closely resembles its model, with the abdomen constricted and extended, and the cephalothorax strongly resembling the thorax and head of an attine ant. Spines on the thorax, typical of **Acromyrmex**, are however lacking. The posture of the spider is decidedly ant like, and can only be distinguished from the ant at close examination. When walking, the forelegs are held forward, appearing as antenna. The gait closely resembles that of an attine ant, and its presence in the foraging columns of its host suggests that this may be a case of mimesis (Rettenmeyer, 1970). Because it preys on **A. landolti fracticornis**, at least during the winter, it is possible that this may be a case of aggressive mimicry, i.e., that the mimic is deceiving the ant that it then eats. When touched by an ant in the foraging column, the spider speeds up momentarily and then resumes its normal gait, with no evidence of alarm

observed in the ant that touched it. Controlled laboratory experiments are required to eludicate the exact nature of this association.

Table 1 list other documented relationships in which spiders regularly prey upon ant workers. There is generally a small amount of information on this subject, but based on the omnipresence of both ants and spiders in practically all types of habitats, this list is probably very incomplete.

Table 1. Known regular spider predators of ants, other than reproductives.

Spider predator	Ant prey	Authority
Triaeris patellaris (Onopidae)	**Cyphomyrmex costalis**	Weber, 1957
Oecobius annulipes (Oecobiidae)	**Plagiolepis pygmaea**	Glatz, 1967
Stedatoda fulva (Theridiidae)	**Pogonomyrmex badius**	Holldobler, 1969
Zodarium frenatum (Zodariidae)	**Cataglyphis bicolor**	Harkness, 1975
Dinopis longipes (Dinopidae)	Atta spp.	Robinson, 1977 Robinson & Robinson, 1971
Corinna vertebrata (Clubonidae)	**Acromyrmex landolti**	This report
Stodis aurata (Salticidae)	**Aphaenogaster** spp. **Crematogaster** spp. **Tetramorium** spp. **Formica** spp.	Edwards et al., 1974
(Lycosidae)	Atta, spp.	Whitcomb, 1974
(Araneae)	Atta spp.	Mariconi, 1970

OTHER TAXA

In addtition to these records, other associates were found with Paraguayan leaf-cutting ants. These include other ants: **Odontomachus** chelifer, which nests in the abandoned foraging galleries of A. **sexdens rubropilosa** (Fowler, 1980a); **Pheidole oxyops**, which frequently, but not exclusively nests on the nest tumuli of A. **sexdens rubropilosa** (Fowler, 1980b); **Myrmecocrypta squamosa**, which nests near the superificial detritus heaps of A. **landolti fracticornis** and uses the discarded fungal substrate to grow its own fungus garden (Fowler & Robinson, 1979); and **Hylomyrma balzani**, which nests in the nest periphery of **Acromyrmex crassispinus**.

Collembola (**Cyphoderus** sp.) are common inquilines of A. **sexdens rubropilosa** colonies and reached epidemic proportions in our laboratory colonies. Also **Hypopoi acarina** were found on workers of both A. **sexdens rubropilosa** and A. **landolti fracticornis** as well as on **Acromyrmex lundi, Acromyrmex rugosus**, and **Atta vollenweideri**. Both collembola and mites are common associated of leaf-cutting ants (Weber, 1972).

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