ANTS ON *CECROPIA* TREES IN URBAN SAN JOSÉ, COSTA RICA

JAMES K. WETTERER
Center for Environmental Research & Conservation, Columbia University
New York, NY 10027

The symbiosis between ants and Cecropia trees is among the best-studied ant-plant relationships (Belt 1874, Müller 1874, Janzen 1969, Longino 1989). Resident *Azteca* ants, the commonest *Cecropia* symbionts, typically defend their host trees against herbivory and overgrowth by vines (Janzen 1969, Schupp 1986, Rocha and Bergallo 1992). *Cecropia* trees, in turn, provide resident ants with shelter within their trunks and with food in the form of nutrient-rich Müllerian bodies on the base of the petioles and pearl bodies on the undersides of the leaves (Rickson 1971). Resident ants also often gain additional nutrition through feeding on honeydew produced by homopterans which the ants tend within the *Cecropia* trunk (Belt 1874, Wheeler 1942).

In the forests of Costa Rica, the majority of *Cecropia* trees, including *Cecropia obtusifolia* Bertol., are occupied by mutualistic *Azteca* ants (Longino 1989). In the present study, I surveyed ants on *C. obtusifolia* trees planted as ornamentals in the capital city of San José, Costa Rica, to determine whether these trees, isolated from native forest by several kilometers of urban areas, were occupied and protected by *Azteca* ants.

In June 1996, I surveyed ants on all 27 *C. obtusifolia* trees planted in the plaza in front of the Costa Rican National Museum near the center of San José, Costa Rica. Trees ranged from 0.5 to 7 m in height. For trees five meters or more in height (estimated to the nearest 1 m), I collected from the trunk all ants I could reach (up to ~2.5 m). For trees three meters or less in height (estimated to the nearest 0.5 m), I examined every leaf for ants, and searched the entire trunk for any ant nest entrance holes. When surveying, I shook all trees to stimulate ant activity. Voucher ant specimens from this study are in the Museum of Comparative Zoology, Harvard University and the Smithsonian Institution.

Ants were on twelve of the 27 *C. obtusifolia* trees. Ants were more common on larger trees: on nine of twelve large trees (> 2 m height), and three of fifteen small trees (< 2 m height) ($X^2 = 8.3$, $P < 0.05$). There were only three species of ants on the trees: *Paratrechina longicornis* (Latreille), *Acromyrmex octospinosus* (Reich), and *Azteca* sp. (Table 1). *P. longicornis* was by far the most common and widespread ant, occurring on ten of the twelve trees with ants (Table 1). *A. octospinosus*, a leaf-cutting ant, was also common, with foragers carrying leaf fragments and pieces of other vegetable matter coming down six trees. There was leaf-cutting ant damage on the leaves of at least three additional trees without leaf-cutters present. One of these damaged trees had *P. longicornis* and two were without any ants on them. *Azteca* ants were on only two *Cecropia* trees, both five meters in height. On these two trees, large numbers of *Azteca* poured out of their nests within the trunk when I shook the tree. The *Azteca* workers could not be identified to species because queens are needed for such identification and I could not cut down and dissect these ornamental *Cecropia* trees to obtain the queens. Dense setae on the workers' scapes and tibiae indicated they did not belong to the "alfari" group (Longino 1991a, b.) *Paratrechina longicornis* occurred in both trees occupied by *Azteca*, but *A. octospinosus* occurred in neither. The *P. longicornis* and *A. octospinosus* nested in the ground in the plaza, whereas the *Azteca* sp. nested within the trunks of the *Cecropia* trees. I noted tens to hundreds of unharvested Müllerian bodies on the leaf petioles of the small *Cecropia* trees.

TABLE 1. ANTS ON TWELVE *CECROPIA OBTUSIFOLIA* TREES IN THE PLAZA IN FRONT OF THE COSTA RICAN NATIONAL MUSEUM, SAN JOSÉ, COSTA RICA. IN ADDITION, FIFTEEN *C. OBTUSIFOLIA* TREES HAD NO ANTS (ONE 6 M, TWO 5 M, THREE 1.5 M, SEVEN 1 M, AND TWO 0.5 M TALL). CRAZY ANT = *PARATRECHINA LONGICORNIS*; LEAF-CUTTER = *ACROMYRMEX OCTOSPINOSUS*, AND AZTECA = *AZTECA* SP.; X = ANTS PRESENT; D = LEAF-CUTTING ANT DAMAGE OBSERVED.

Tree	height (m)	Crazy ant	Leaf-cutter	*Azteca*
1	7	X	X	
2	6	X	X	
3	6	X		
4	6		X	
5	5	X	X	
6	5	X		X
7	5	X		X
8	3		X	
9	2	X	D	
10	1.5	X	X	
11	1.5	X		
12	1.5	X		

The most numerous ants on the *C. obtusifolia* trees in urban San José were *P. longicornis*. *P. longicornis* is called the "crazy" ant because of the fast, jerky movements of the workers. This species is of Old World origin, but is now one of the most common tramp ants throughout the tropics and subtropics, usually associated with disturbance, e.g., in disturbed natural environments, in urban environments, and even on ships (Weber 1940, Smith 1965, Miller 1994, Ferster and Prusak 1994, Klotz et al. 1995; Delabie et al. 1995). *P. longicornis* dominates a variety of disturbed habitats, including the Dry Tortugas, the highly-exposed, outermost islands of the Florida Keys (Hölldobler and Wilson 1990) and the disturbed artificial ecosystems of Biosphere 2, a 1.28-hectare greenhouse structure outside Tucson, Arizona (Wetterer et al. 1997). In Biosphere 2, the main source of carbohydrates for *P. longicornis* was honeydew produced by homopterans (Wetterer et al. 1997). This also appeared to be the major food source of tramp ants on *Cecropia* trees in Hawaii (Wetterer 1997), and probably in the present study as well.

A. octospinosus foragers were also common on the San José *Cecropia* trees. These leaf-cutting ants are native to Central America, South America, and the Caribbean (Weber 1972). They seem to do well in disturbed urban habitats and are also common in Panama City, Panama (personal observation). In the both the wet and dry forests of Costa Rica, *A. octospinosus* foragers typically cut the leaves of small herbaceous plants, fallen flowers, and fallen fruit parts (Wetterer 1991, Wetterer et al. 1998). They appear to be opportunists, however, and will cut the leaves and flowers of plantation trees (Lewis 1975) and even collect insect frass (Wetterer et al. 1998).

Azteca ants occupied only two 5-m *Cecropia* trees in the museum plaza, 7% of the trees studied. This is a much lower occupancy rate than in natural habitats in Costa Rica. For example, Longino (1989) found that on transects through the Arenal and Monteverde areas (400-1500 m elevation), obligate *Azteca* mutualists occupied 86% of

all *Cecropia* trees. The majority of the trees without *Azteca* were saplings. Questions arise as to how the *Azteca* ants came to occupy two *Cecropia* trees in San José, so far away from native forest. It seems likely that the *Azteca* ants had already colonized these trees before they were transplanted to San José. Longino (1989) found that most unoccupied *Cecropia* trees showed evidence within their trunks of *Azteca* colonies that had died. It is unknown whether any of the unoccupied trees in San José once housed *Azteca* colonies.

The *Azteca* ants showed no evidence of excluding crazy ants from their host *Cecropia* trees. It may be that the *Azteca* ants do not recognize this non-indigenous ant as a threat. Alternatively, the *Azteca* colonies may not be capable of fending off the large numbers of crazy ants. On the other hand, the *Azteca* ants in San José appeared to be excluding the native leaf-cutting ants. *A. octospinosus* foragers were not attacking either of trees occupied by *Azteca*, but were attacking or had attacked at least nine of the 25 *Cecropia* trees without *Azteca*.

It would be interesting to census these *Cecropia* trees at a later date to determine whether the *Azteca* ants persist in the trees and spread to others, or whether crazy ants exterminate them as they appear to have done with ant species in other disturbed environments (Hölldobler and Wilson 1990, Wetterer et al. 1997, see also Zenner Polania 1994).

Earlier studies have indicated that *C. obtusifolia* trees are not obligately dependent on ants (see Wetterer 1997). *C. obtusifolia* has been introduced to Hawaii, apparently as an ornamental (Wagner et al. 1990). *Azteca* ants have not been recorded in Hawaii. Either they did not accompany the *Cecropia* trees to Hawaii or did not survive there. Still, the *Cecropia* trees are thriving in disturbed lowland forests of Hawaii in the complete absence of mutualist *Azteca* ants (Wetterer 1997). In part, this success may be because most of *C. obtusifolia*'s Neotropical herbivores and competitors are absent in Hawaii. A similar absence may explain their survival in urban San José.

I thank M. Wetterer and J. C. Morales for comments on this manuscript; S. Cover for identifying the ants; E. Olson for inviting me to teach on his OTS 96-3 course. Financial support was provided by the Organization for Tropical Studies and Columbia University.

Summary

Three species of ants inhabited 12 of 27 *Cecropia* trees in urban San José, Costa Rica: crazy ants (*Paratrechina longicornis*) in ten, leaf-cutting ants (*Acromyrmex octospinosus*) in six, and "*Cecropia*" ants (*Azteca* spp.) in only two. Occupancy rate by *Azteca* was much lower than in local forest *Cecropia*. *P. longicornis* inhabited both *Azteca*-occupied trees, but *A. octospinosus* occurred in neither.

References Cited

BELT, T. 1874. The naturalist in Nicaragua. University of Chicago Press. Chicago, IL.

DELABIE, J. H. C., I. C. DO NASCIMENTO, P. PACHECO, AND A. B. CASIMIRO. 1995. Community structure of house-infesting ants (Hymenoptera: Formicidae) in southern Bahia, Brazil. Florida Entomol. 78: 264-270.

FERSTER, B., AND Z. PRUSAK. 1994. A preliminary checklist of the ants (Hymenoptera: Formicidae) of Everglades National Park. Florida Entomol. 77: 508-512.

HÖLLDOBLER, B., AND E. O. WILSON. 1990. The Ants. Harvard University Press, Cambridge, MA.

JANZEN, D. H. 1969. Allelopathy by myrmecophytes: the ant *Azteca* as an allelopathic agent of *Cecropia*. Ecology 50: 147-153.

KLOTZ, J. H., J. R. MANGOLD, K. M. VAIL, L. R. DAVIS, JR., AND R. S. PATTERNSON. 1995. A survey of the urban pest ants (Hymenoptera: Formicidae) of Peninsular Florida. Florida Entomol. 78: 109-118.

LEWIS, T. 1975. Colony size, density and distribution of the leaf-cutting ants, *Acromyrmex octospinosus* (Reich) in cultivated fields. Trans. Royal Entomol. Soc. 127: 51-64

LONGINO, J. T. 1989. Geographic variation and community structure in an ant-plant mutualism: *Azteca* and *Cecropia* in Costa Rica. Biotropica 21: 126-132.

LONGINO, J. T. 1991a. Taxonomy of *Cecropia*-inhabiting *Azteca* ants. J. Natur. Hist. 25: 1571-1602.

LONGINO, J. T. 1991b. *Azteca* ants in *Cecropia* trees: taxonomy, colony structure, and behavior. In: C. R. Huxley and D. F. Cutler (Eds.). Ant-plant interactions. pp. 271-288. Oxford Press, New York, NY.

MILLER, S. E. 1994. Dispersal of plant pests into the Virgin Islands. Florida Entomol. 77: 520-521.

MÜLLER, F. 1874. The habits of various insects. Nature 10: 102-103.

RICKSON, F. R. 1971. Glycogen plastids in Müllerian body cells of *Cecropia peltata* - a higher green plant. Science 173: 344-347.

ROCHA, C. F. D., AND H. G. BERGALLO. 1992. Bigger ant colonies reduce herbivore residence time on leaves of an ant-plant: *Azteca muelleri* vs. *Coelomera ruficornis* on *Cecropia pachystachya*. Oecologia 91: 249-252.

SCHUPP, E. W. 1986. *Azteca* protection of *Cecropia*: ant occupation benefits juvenile trees. Oecologia 70: 379-385.

SMITH, M. R. 1965. House-infesting Ants of the Eastern United States. Their Recognition, Biology, and Economic Importance. Tech.l Bull. 1326, Agric. Res. Serv., United States Depart. Agric.

WAGNER, W. L., D. R. HERBST, AND S. H. SOHMER. 1990. Manual of the flowering plants of Hawaii. vol. 1. University of Hawaii Press, Honolulu, HI.

WEBER, N. A. 1940. Ants on a Nile River steamer. Ecology 21: 292-293.

WEBER, N. A. 1972. Gardening ants: the attines. American Philosophical Society. Philadelphia, PA.

WETTERER, J. K. 1991. Foraging ecology of the leaf-cutting ant, *Acromyrmex octospinosus*, in a Costa Rican rain forest. Psyche 98: 361-371.

WETTERER, J. K. 1997. Ants on *Cecropia* in Hawaii. Biotropica 29: 128-132.

WETTERER, J. K., C. DUNNING, M. YOSPIN, AND A. HIMLER. 1997. Invertebrate Diversity and Ecology in Biosphere 2. Sonoran Arthropod Studies Institute, Tucson, AZ. pp. 119-122. Invertebrates in Captivity Conference Proceedings.

WETTERER, J. K., D. S. GRUNER, AND J. E. LOPEZ. 1998. Foraging and nesting ecology of *Acromyrmex octospinosus* in a Pacific dry forest of Costa Rica. In press, Florida Entomol.

WHEELER, W. M. 1942. Studies of neotropical ant-plants and their ants. Bull. Mus.Compar. Zool. 90: 1-263.

ZENNER POLANIA, I. 1994. Impact of *Paratrechina fulva* on other ant species. pp 121-132. In: Exotic ants: Biology, impact, and control of introduced species, Westview Press, Boulder, CO.