

Seasonal Foraging Activity and Bait Preferences of Ants on Barro Colorado Island, Panama¹

Daniel A. Hahn²

Interdisciplinary Program in Insect Science, University of Arizona, Tucson, Arizona 85721, U.S.A.

and

Diana E. Wheeler

Department of Entomology, University of Arizona, Tucson, Arizona 85721, U.S.A.

ABSTRACT

A yearlong arboreal baiting survey of ants was conducted during 1983 on Barro Colorado Island, Panama. Because of a severe El Niño event, the 1983 dry season in Panama was exceptionally long and dry with a distinct boundary between the dry and wet seasons. Baits, located on tree trunks, attracted both terrestrial and arboreal ants, allowing comparisons between the two groups. Species composition at baits changed dramatically with season. Baits were primarily occupied by arboreal species during the dry season, while wet season baits were occupied mostly by terrestrial species. Arboreal and terrestrial ants differed markedly in their preferences for protein- or carbohydrate-based baits; arboreal ants preferred protein-based baits and terrestrial ants preferred carbohydrate-based baits. Foraging preference for protein suggests that protein resources were limiting for arboreal ants, particularly during the dry season, and that carbohydrate resources were limiting for terrestrial ants. Fundamental differences in arboreal and terrestrial habitats may promote the differences in foraging strategies observed during an annual cycle in a seasonal tropical forest.

RESUMEN

Durante el año de 1983 se realizó un estudio mirmecológico en la isla de Barro Colorado, Panamá. Debido a que el fenómeno "El Niño" fue muy severo ese año, la estación seca fue excepcionalmente intensa y larga; además, se observó una diferencia marcada entre la estación seca y la húmeda. Se colocaron cebos en los troncos de los árboles que atrajeron hormigas terrestres y arbóreas, lo que permitió la comparación de estos dos grupos. La composición de las especies atraídas por los cebos varió notablemente de acuerdo a la temporada; durante la estación seca predominaron las especies arbóreas, mientras que en la húmeda predominaron las terrestres. Las hormigas arbóreas y las terrestres difirieron notablemente en su preferencias por cebos preparados con proteínas o carbohidratos. Las hormigas arbóreas prefirieron las proteínas, mientras que las terrestres prefirieron los carbohidratos. La inclinación por proteínas sugiere que éstas son un recurso limitante para las hormigas arbóreas, particularmente durante la estación seca; mientras que los carbohidratos lo son para las hormigas terrestres. Las diferencias fundamentales entre los ambientes arbóreo y terrestre puede promover diferencias en las estrategias de forrajeo observadas durante el ciclo anual del bosque tropical.

Key words: ants; bait preferences; Barro Colorado Island; El Niño; foraging; forest canopy; Panama; seasonality.

ANTS ARE A MAJOR COMPONENT OF TROPICAL FORESTS and play an important role in structuring biotic interactions (Hölldobler & Wilson 1990, Tobin 1991, Davidson 1997). Tropical ant communities can be divided into arboreal and terrestrial assemblages. The arboreal habitat, dominated by tree crowns, and the terrestrial habitat, dominated by leaf litter, differ markedly in their physical structure and local climates (Andersen 2000, Yanoviak & Kaspari 2000).

Tropical litter ant assemblages are generally

made up of many opportunistic, behaviorally subordinate species with small- to medium-sized colonies (Levings & Trainello 1981, Levings 1983, Jackson 1984, Andersen 2000, Yanoviak & Kaspari 2000). In the Neotropics, mortality during dispersal and abiotic factors such as desiccation stress and disturbance appear to have the greatest effect on terrestrial ant assemblages, with competition and dominance interactions playing a lesser role (Majer 1976a, b, c; Leston 1978; Levings and Trainello 1981; Levings 1983; Jackson 1984; Kaspari 1993; Byrne 1994; Andersen 2000).

Conversely, canopy ant communities are populated by aggressive, numerically dominant species that from a mosaic of territories (Room 1971; Les-

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² Corresponding author; e-mail: dhahn@u.arizona.edu

ton 1978; Majer 1976a, b, c; Levings & Trainello 1981; Jackson 1984; Longino & Nadkarni 1990; Andersen 2000; Yanoviak & Kaspari 2000). Thus, competition is a major force structuring canopy ant communities, and abiotic factors are less important in structuring canopy assemblages than those in the litter assemblage (Andersen 2000, Yanoviak & Kaspari 2000).

We studied the activity of ants at carbohydrate- and protein-based baits on Barro Colorado Island (BCI), Panama, through one seasonal cycle during 1982–1983. BCI is a tropical moist forest island located in the Lake Gatun portion of the Panama Canal (Holdridge *et al.* 1971). Rainfall patterns on BCI have a strongly seasonal component with most rain falling during an annual wet season, usually from May to December (Rand & Rand 1982). The phenology of many species of plants and animals on BCI have been documented and seem to rely closely on a number of biotic and abiotic factors associated with these seasons (Leigh *et al.* 1982).

Our first goal was to determine if the foraging activity of arboreal and terrestrial assemblages on tree trunks changed between the dry and wet seasons. Microclimate, particularly moisture and temperature, has been identified as the main abiotic force governing ant activity patterns in habitats ranging from deserts to tropical rain forests (Hunt 1974, Schumacher & Whitford 1974, Briese & Macauley 1980, Levings 1983, Levings & Windsor 1982, Kaspari 1993, Andersen 2000, Kaspari & Weiser 2000). Specifically, Levings (1983) and Kaspari and Weiser (2000) have shown that ant activity at baits in a variety of locations on BCI (including the litter surface, shrubby vegetation, and tree trunks) is significantly higher during the wet season than during the dry season. In addition, study of natural moisture gradients and watering experiments have shown that foraging activity is positively related to moisture within each season (Levings 1983, Levings & Windsor 1982, Kaspari 1993, Kaspari & Weiser 2000).

In addition to desiccation risk, moisture is associated with resource availability. The availability of insect prey and exudates, the primary dietary components of most ant species, is greater in the canopy, the litter, and understory shrubs during the wet season than in the dry season (Jones 1987, Wolda 1988, Basset 1991, van Schaik *et al.* 1993). Within a single season, wet patches also support a higher density of small arthropod prey than dry patches (Levings & Windsor 1982). Thus, patterns of resource availability associated with moisture and desiccation risk drive the positive relationship

between moisture and activity in litter ants. Considering these factors, we expected the activity of terrestrial ants to be highest on baits during the wet season.

Moisture and resource availability, combined with differences in the role of competition in structuring canopy communities, may lead to different patterns of foraging activity in arboreal ants. Due to greater solar radiation and less moisture availability, the tropical canopy is probably a more abiotically challenging habitat for ants than the litter throughout the year. These challenges would likely be at their greatest during the dry season when solar radiance is high and precipitation and exudate availability are low (Dietrich *et al.* 1982, Rand & Rand 1982, Jones 1987, Wolda 1988); however, a comparative study of arboreal and ground-nesting ants in the Temperate Zone has shown that arboreal ants are much more resistant to desiccation stress than terrestrial ants (Hood & Tschinkel 1990). Thus, tropical arboreal ants may be less affected by abiotic stresses than litter ants. An examination of foraging patterns over the two seasons allowed us to narrow the range of factors affecting the activity levels in the two assemblages.

Our second goal was to determine if ants from the two assemblages differed in their preferences for baits representing carbohydrate or protein resources. Plant-based food webs, such as the tropical forest canopy, are more nitrogen-limited than detritus-based food webs, such as leaf litter (Swift *et al.* 1979, Mattson 1980, Pimm 1982, Vitousek 1982). The difference in nitrogen richness is based on the relatively low nitrogen to carbohydrate ratios in plants relative to litter-decomposing microorganisms (1:40 vs. 1:10). Given this difference, arboreal ants should be nitrogen-limited, and terrestrial ants should be relatively more carbohydrate-limited (Tobin 1994, Davidson 1997, Yanoviak & Kaspari 2000, Kaspari & Yanoviak 2001). This led to the prediction that canopy-foraging ants would show a preference for protein baits and litter-foraging ants would prefer carbohydrate baits. The studies of both Yanoviak and Kaspari (2000) and Kaspari and Yanoviak (2001) compared the foraging preferences of ants attracted to bait stations containing protein, carbohydrate, and water in the canopy and on the litter surface on BCI during the beginning of the dry season. They showed that protein-based baits in the canopy attracted many more foragers than protein baits in the litter. There was no significant difference in accumulation at carbohydrate baits between the two habitats. We determined if arboreal ants foraging on tree trunks also display a pref-

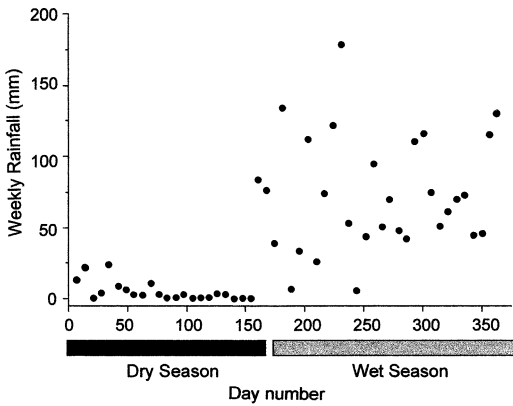


FIGURE 1. Weekly rainfall totals for Barro Colorado Island, Panama, during the sampling period (16 November 1982–17 November 1983).

erence for nitrogen-rich protein baits and if preferences were stable through time.

METHODS

SITE AND TRANSECTS.—This study was conducted on Barro Colorado Island (BCI) from 16 November 1982 through 17 November 1983. Three transects were chosen (each 500 m in length) that followed trails in the Hubbell–Foster permanent tree monitoring plot. One transect followed the Drayton trail, and the other two followed the Armour trail. Each transect consisted of 50 individually marked trees *ca* 10 m apart along the trail. Each tree was identified to species using the Hubbell–Foster database. Identities of individual trees in this study are available from the authors by request.

The 1982–1983 dry season was the most severe, beginning earlier, lasting the longest, and having the least rain since 1929, when the Panama Canal Commission began keeping records. Using rainfall records, we defined the dry season as beginning in mid-November 1982 (corresponding with day 1 of this study, 16 November 1982) and lasting 22 weeks (corresponding approximately with day 155 of this study, 21 April 1983; Fig. 1). The remainder of this study was carried out during the wet season (day 156, 22 April 1983) through the last sampling day in this study (day 364, 17 November 1983).

BAITING.—On each sampling day, 50 trees in a single transect were baited by using twine to attach one 15 ml clear plastic conical centrifuge tube containing a blended mixture of honey and bananas

and another 15 ml tube containing tuna *ca* 15 cm apart on the trunk at breast height. This is a convenient location because ants from both arboreal and terrestrial assemblages will forage low on tree trunks (Longino & Colwell 1997). Morning trials were run between 0630 and 0830 h and evening trials between 1830 and 2030 h. The three transects were sequentially sampled on different days, alternating between morning and evening in each block so that morning and evening samples were evenly dispersed throughout the year; i.e., the first three sampling dates were morning samples of transects 1, 2, and 3, respectively and the second three sampling dates were evening samples of transects 1, 2, and 3, respectively. This pattern was repeated throughout the study to yield a total of 33 trials. Of these 33, 6 morning and 6 evening trials were conducted during the wet season, and 12 morning and 9 evening trials were done during the dry season. During the trials, tubes were left on the trees for approximately two hours, after which they were capped and brought back to the lab.

IDENTIFICATION AND CLASSIFICATION.—The number and species of ants contained in the tubes were determined. Voucher specimens of all species have been deposited in the ant collection at Harvard University's Museum of Comparative Zoology. Species were classified as arboreal or terrestrial by observing the approach and departure directions of foragers at the baits during the study. Ants were considered arboreal if they nested in and foraged primarily on trees or in the canopy as revealed by following recruitment trails. Only two ground-nesting ants, *Ectatomma tuberculatum* and *Paraponera clavata*, foraged primarily in the canopy and were classified as arboreal. Ants were designated as terrestrial if they nested and foraged primarily on the ground.

Individual species that occurred on ten or more baits during the duration of the study were placed in one of three preference categories based on bait occupancy (protein, carbohydrate, or equal preferences). A binomial test with a null model of equal preferences (probability of occurring on a protein bait = probability of occurring on a carbohydrate bait = 0.5) was used to evaluate if a species showed a distinct preference for one type of bait. A *P*-value of less than 0.05 was taken as evidence for a preference. *P*-values and the proportion of carbohydrate baits occupied throughout the study can be found in Appendix 1 for all species that occurred on ten or more baits during the duration of the study.

STATISTICAL ANALYSIS.—Exploratory data analysis showed no effects of transect, time of day, or tree species on bait occupancy rates; these variables were not considered in subsequent analyses. To determine whether or not there were differences in bait occupancy by arboreal or ground-foraging ants during each of the two seasons, we used two-way analysis of variance (ANOVA) with season (wet or dry) and assemblage (arboreal or terrestrial) as factors and a season \times assemblage interaction term. Tukey's HSD correction for multiple comparisons was used to test for significant differences between groups within the two-way ANOVA. Because overall bait preferences within an assemblage did not differ between the two seasons, Student's *t*-tests were used to determine if mean bait occupancy differed between carbohydrate- and protein-based baits for ants of both assemblages over the entire year. Pearson's chi-square test was used to determine if the distribution of species bait preferences differed among species in the two assemblages. Some authors have suggested that chi-square tests are not appropriate if any of the cells contains less than five observations, as in this case; however, Yarnold (1970) has shown that 2×3 cell chi-square tests are robust as long as the average expected cell frequency is not lower than a certain critical value. Yarnold's (1970) critical value for 2×3 cell chi-square tests is calculated as $[5(\text{no. of expected cells} < 5)/(\text{no. of rows}) (\text{no. of columns})]$. In our case, the average expected value was 4.67 and Yarnold's (1970) critical value was 3.33. All analyses were performed using the JMP IN (SAS 1996) statistical package.

RESULTS

ASSEMBLAGE BASED PATTERNS IN FORAGING ACTIVITY.—Fifty-eight of the 59 species collected at baits could be designated as either primarily arboreal or terrestrial. Ants from both assemblages foraged on tree trunk baits throughout the year (Fig. 2). To investigate seasonal effects on foraging, the mean number of baits occupied per sampling day by arboreal and terrestrial ants was compared between the two seasons (two-way ANOVA, full model, $F_{3,62} = 27.97$, $P < 0.001$). Bait occupancy differed significantly between the two assemblages ($F_{1,62} = 7.80$, $P = 0.007$), and between the two seasons ($F_{1,62} = 24.78$, $P < 0.001$); there was a significant interaction between assemblage and season ($F_{1,62} = 58.58$, $P < 0.001$). Comparing activity between seasons within an assemblage, arboreal ants occupied significantly more baits per sampling event

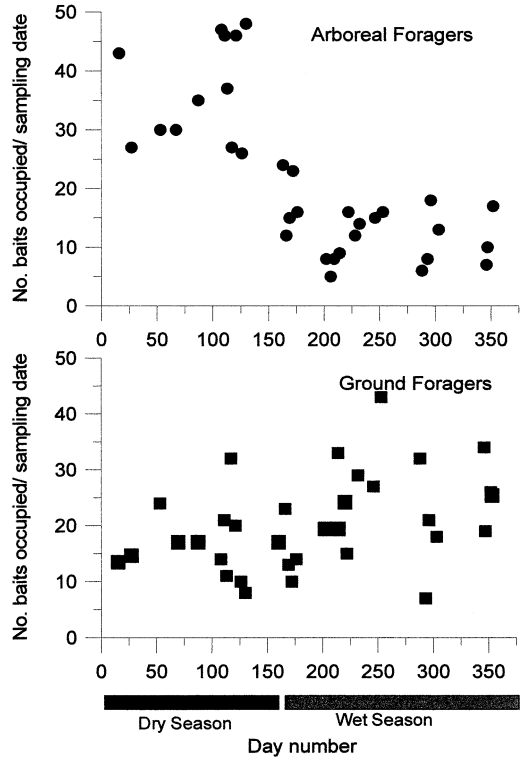


FIGURE 2. Occupancy of baits by arboreal ants was highest during the dry season and dropped precipitously at the onset of the wet season. Terrestrial ant activity was not significantly different between the seasons.

during the dry season than the wet (Tukey's HSD test, $P < 0.05$, mean no. of baits \pm SE; dry = 36.8 ± 2.13 and wet = 13.0 ± 1.61). There was no difference in bait occupancy by terrestrial ants during the two seasons (Tukey's HSD test, $P > 0.05$, mean no. of baits \pm SE; dry = 17.1 ± 2.13 and wet = 22.1 ± 1.61). Comparing activity between assemblages within a season, arboreal ants occupied significantly more baits per sampling day than terrestrial ants during the dry season (Tukey's HSD test, $P < 0.05$, mean no. of baits \pm SE; arboreal = 36.8 ± 2.13 , and terrestrial = 17.1 ± 2.13). Conversely, terrestrial ants occupied significantly more baits per sampling day than arboreal ants during the wet season (Tukey's HSD test, $P < 0.05$, mean no. of baits \pm SE; arboreal = 13.0 ± 1.61 and terrestrial = 22.1 ± 1.61).

BAIT PREFERENCES.—Because within-assemblage bait preferences did not differ between the wet and dry seasons, the data for both seasons were combined. Overall, arboreal ants occupied significantly more

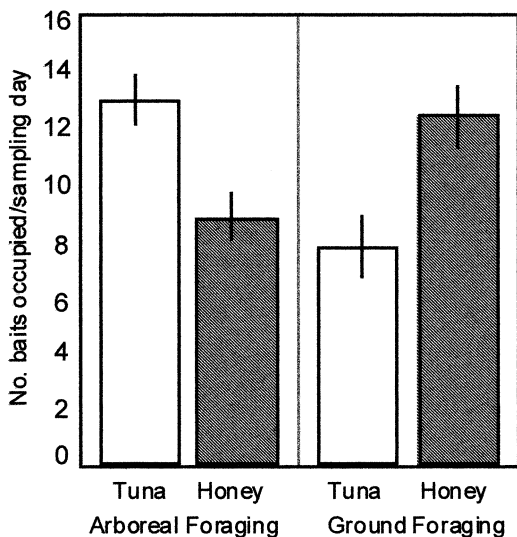


FIGURE 3. Arboreal ants preferred protein baits (tuna) over carbohydrate baits (honey + banana) ($t = 2.33$, $P = 0.023$, $df = 63$). Terrestrial ants preferred carbohydrate baits over protein baits ($t = 3.97$, $P = 0.002$, $df = 64$). Vertical bars = 1 SE. $N = 33$ sampling events over the course of the study.

tuna baits than honey baits per sampling date, whereas the reverse was true for terrestrial ants (Fig. 3).

Arboreal and terrestrial species that were collected on at least ten baits throughout the study were classified by their preferences using a binomial test (protein preference, carbohydrate preference, or equal preferences; Appendix 1). A greater percentage of arboreal species preferred protein baits (26.3% protein preference vs. 5.3% carbohydrate and 68.4% equal preferences for 19 species) and a greater percentage of terrestrial species preferred carbohydrate baits (33.3% carbohydrate preference vs. 0% protein and 66.7% equal preferences for 9 species). A Pearson's chi-square analysis revealed that there was a marginally significant difference in the distributions of preference between arboreal and ground ants ($\chi^2 = 5.740$, $df = 2$, $P = 0.0567$).

DISCUSSION

Two patterns were apparent in this study. First, the foraging activity of arboreal and terrestrial ants as measured by baits on tree trunks differed between the two seasons. Second, at the assemblage level, arboreal ants preferred protein baits whereas terrestrial ants preferred carbohydrate baits.

FORAGING ACTIVITY.—Terrestrial ants occurred on baits at moderate levels throughout the study, occupying slightly (but not significantly) more baits during the wet season. This pattern agrees with the activity patterns of the terrestrial assemblage previously established on BCI. Levings (1983) and Kaspari and Weiser (2000) both found that terrestrial ant assemblages respond to desiccation stress between seasons and among sites within a season by reducing activity. Levings and Windsor (1984) suggested that terrestrial ants probably reduced their activity levels in response to a combination of resource limitation and increased desiccation risk because the density of most litter arthropods is positively correlated with soil moisture both between seasons and years. Interestingly, a study of litter arthropods on BCI by Wheeler and Levings (1988) during the same 1982–1983 El Niño event as this study showed that terrestrial ants followed the same moisture-correlated pattern of activity reported during previous dry seasons. With the onset of the wet season, however, all ant activity increased more quickly than expected, based on estimates from several years' data. Extreme deviations in climate patterns can result in nonlinear effects on seasonal activity patterns of tropical ants. Our data, in agreement with previous studies, suggest that moisture is correlated with foraging activity in terrestrial tropical ants; however, our results do not allow us to determine what factors (*i.e.*, microclimate, resource availability, or competition) are responsible for the observed differences in activity. Because terrestrial assemblages are generally made up of many opportunistic species with small- to medium-sized colonies that are often behaviorally subordinate, it is likely that the risk of desiccation and depressed resource availability combine to decrease terrestrial ant activity in the dry season (Levings & Trainello 1981, Levings 1983, Jackson 1984, Andersen 2000, Yanoviak & Kaspari 2000, Kaspari & Weiser 2000).

In our study, arboreal ants occupied baits on tree trunks with greater frequency than did terrestrial ants during the dry season, with a precipitous drop in activity at the onset of the wet season. Bait occupancy by arboreal ants during the wet season was *ca* 65 percent lower than during the dry season. This is in contrast to the pattern seen by Kaspari and Weiser (2000), who found that total ant activity on baits placed at breast height on trees during the wet season was 20 percent higher than during the dry season.

There are several possible explanations as to why our results do not agree with those of Kaspari

and Weiser (2000). The difference in activity on tree trunks in their study was due to species they classified as habitat generalists, species found in several locations (including the litter and foraging on low shrubs) rather than arboreal specialists. In our study, most of their habitat generalists would be classified as terrestrial. In agreement with Kaspari and Weiser (2000), our data showed a 29 percent increase in bait occupancy by terrestrial ants during the wet season, although this difference was not statistically significant. Explanations for the absence of an increase in arboreal ant activity during the dry season in Kaspari and Weiser's (2000) study may include preference for the ingredients used in our baits (tuna and a mixture of honey and bananas vs. peanut butter) and the duration of baiting (2 hours in our study vs. 1 hour). Another explanation may be differences in sampling. Kaspari and Weiser (2000) took their dry season samples only during two weeks in early December, whereas our dry season samples were taken throughout the entire dry season from mid-November until mid-April. In addition, our samples were taken contiguously throughout the course of a single year, whereas their wet and dry season samples were taken in different years (1994 wet, 1997 dry). Lastly, because the 1982–1983 dry season was extremely dry due to an El Niño event, the patterns observed in our study may be not representative of an average dry–wet season cycle.

The high level of arboreal ant activity on tree trunks in this study suggests that they extend their ranges and increase foraging intensity during the dry season. This expansion coincides with a drop in abundance of most canopy prey insect groups during the dry season (Jones 1987, Wolda 1988, Basset 1991). In addition, carbohydrate-rich resources such as homopteran exudates, nectar, and fruits also drop in abundance from wet season levels (Wolda 1988, van Schaik *et al.* 1993). Like many other animals, arboreal ants may extend their foraging ranges when resource levels decline (Schoener 1983, Davies & Houston 1984). Because arboreal ants increase their activity on tree trunks during the dry season when desiccation risk is high, desiccation stress is probably less important in regulating the activity of arboreal ants relative to terrestrial ants. This may be the result of several physiological mechanisms utilized by arboreal ants to resist desiccation stress more effectively than terrestrial ants (Hood & Tschinkel 1990). Canopy ant communities are populated by aggressive, numerically dominant species that form a mosaic of territories (Room 1971; Leston 1978; Majer 1976a,

b, c; Levings & Trainello 1981; Jackson 1984; Longino & Nadkarni 1990; Yanoviak & Kaspari 2000). Arboreal ants may not be able to afford a reduction in activity levels during the dry season due to the risk of losing territory. Therefore, resource limitation and competition in the canopy environment may necessitate the year-round maintenance of territories among arboreal species, allowing them to harvest adequate amounts of nitrogen. Further studies of resource distributions and ant responses to resource addition and removal are needed to distinguish between these hypotheses.

BAIT PREFERENCES.—In addition to differences in seasonal activity patterns between the two assemblages, arboreal ants preferred tuna baits to honey baits, particularly during the dry season, while terrestrial ants slightly preferred honey to tuna baits throughout the year. When species were classified according to their preferences, a greater proportion of arboreal species preferred protein baits and a greater proportion of terrestrial species preferred carbohydrate baits. If ants choose baits based on the current needs of the colony (Hölldobler & Wilson 1990, Kaspari 1993), ants should prefer a certain type of bait when the nutrients represented in that bait are most limiting in the environment. Thus, our results suggest that arboreal ants are protein-limited, particularly during the dry season, and terrestrial ants are carbohydrate-limited.

Our results agreed with the predictions of Tobin (1994) and Davidson (1997), and with the findings of Yanoviak and Kaspari (2000) and Kaspari and Yanoviak (2001); we found the same patterns of preference on tree trunks as they found in the canopy and litter. Therefore, assemblage-based preferences for protein and carbohydrates are general and occur throughout the foraging range of each assemblage.

While our data agree with the hypothesis that habit-based nutrient availability plays a central role in structuring ant assemblages, the importance of nutrient limitation remains to be tested. Without a well-resolved phylogenetic framework, broad comparisons of assemblages are difficult to interpret. Habitat-based factors may cause the observed differences in species activity patterns or preferences, or these characteristics may have been present in species before they colonized the two habitats. The two hypotheses are not mutually exclusive, and some combination of them seems likely. It is interesting to note that similar patterns of community structure have been observed between arboreal

and ground assemblages in both the Old and New World tropics (Andersen 2000).

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APPENDIX 1.

Species	Foraging location	Total baits occupied	% Total baits occupied in evening	% Total baits occupied carbohydrate	Binomial <i>P</i> -value	Bait preference
Subfamily Dolichoderinae						
<i>Azteca aurita</i>	Arboreal	15	40	40	0.607	Equal
<i>Azteca</i> sp. 1	Arboreal	84	48	37	0.021	Protein
<i>Azteca</i> sp. 2	Arboreal	11	9	27	0.227	Equal
<i>Azteca</i> sp. 3	Arboreal	24	33	38	0.308	Equal
<i>Azteca</i> sp. 4	Arboreal	14	57	50	1	Equal
<i>Azteca</i> sp. 5	Arboreal	8	88	25		
<i>Azteca</i> sp. 6	Arboreal	15	33	27	0.119	Equal
<i>Azteca</i> sp. 7	Arboreal	12	25	25	0.146	Equal
<i>Azteca</i> sp. 8	Arboreal	1	100	0		
<i>Dolichoderus debilis</i>	Arboreal	7	14	14		
<i>Tapinoma fulvum</i>	Arboreal	53	100	49	1	Equal
Subfamily Formicinae						
<i>Brachymyrmex</i> sp. 1	Ground	34	59	59	0.392	Equal
<i>Camponotus ager</i>	Arboreal	1	100	100		
<i>C. atriceps</i>	Arboreal	17	100	41	0.692	Equal
<i>C. linnaei</i>	Arboreal	2	50	0		
<i>C. novogranadensis</i>	Arboreal	1	0	100		
<i>C. sericeiventris</i>	Arboreal	33	3	30	0.035	Protein
<i>C. simillimus</i>	Arboreal	2	100	50		
<i>C. zoc</i>	Arboreal	1	0	0		
<i>Camponotus</i> sp. 1	Arboreal	2	0	50		
<i>Paratrechina guatemalensis</i>	Ground	37	76	73	0.008	Carbohydrate

APPENDIX 1. *Continued.*

Species	Foraging location	Total baits occupied	% Total baits occupied in evening	% Total baits occupied carbohydrate	Binomial <i>P</i> -value	Bait preference
Subfamily Myrmicinae						
<i>Cephalotes umbraculatus</i>	Arboreal	1	0	0		
<i>Crematogaster brasiliensis</i>	Arboreal	19	53	47	1	Equal
<i>C. curvispinosa</i>	Arboreal	1	100	100		
<i>C. distans</i>	Arboreal	2	0	0		
<i>C. erecta</i>	Arboreal	7	25	29		
<i>C. limata</i>	Arboreal	62	37	34	0.015	Protein
<i>C. parabiatica</i>	Arboreal	24	38	42	0.541	Equal
<i>C. victima</i>	Ground	10	90	30	0.344	Equal
<i>Crematogaster</i> sp. 1	Arboreal	31	48	32	0.071	Equal
<i>Pheidole</i> sp. 1	Ground	1	100	100		
<i>Pheidole</i> sp. 2	Arboreal	6	100	17		
<i>Pheidole</i> sp. 3	Ground	1	100	100		
<i>Pheidole</i> sp. 4	Ground	1	100	100		
<i>Pheidole</i> sp. 5	Arboreal	7	71	57		
<i>Pheidole</i> sp. 6	Ground	121	48	59	0.069	Equal
<i>Pheidole</i> sp. 7	Arboreal	6	33	33		
<i>Pheidole</i> sp. 8	Arboreal	12	33	25	0.146	Equal
<i>Pheidole</i> sp. 9	Arboreal	91	57	37	0.021	Protein
<i>Pheidole</i> sp. 10	Ground	27	59	67	0.089	Equal
<i>Pheidole</i> sp. 11	Ground	27	52	67	0.089	Equal
<i>Rogeria blanda</i>	Ground	2	0	100		
<i>R. scandens</i>	Ground	2	50	100		
<i>Solenopsis</i> sp. 1	Ground	39	38	41	0.337	Equal
<i>Solenopsis</i> sp. 2	Ground	1	0	0		
<i>Solenopsis</i> sp. 3	Arboreal	29	32	55	0.711	Equal
<i>Wasmannia auropunctata</i>	Ground	95	34	54	0.006	Carbohydrate
Subfamily Poinerinae						
<i>Ectatomma ruidum</i>	Ground	288	21	60	<0.001	Carbohydrate
<i>E. tuberculatum</i>	Arboreal	67	39	36	0.027	Protein
<i>Odontomachus bauri</i>	Ground	3	67	100		
<i>O. hastatus</i>	Arboreal	1	100	100		
<i>Pachycondyla carinulata</i>	Ground	4	0	100		
<i>P. stratinoda</i>	Unknown	3	0	100		
<i>P. villosa</i>	Ground	8	33	88		
<i>Paraponera clavata</i>	Arboreal	22	86	91	<0.001	Carbohydrate
Subfamily Pseudomyrmicinae						
<i>Pseudomyrmex</i> sp. 1	Arboreal	4	0	25		