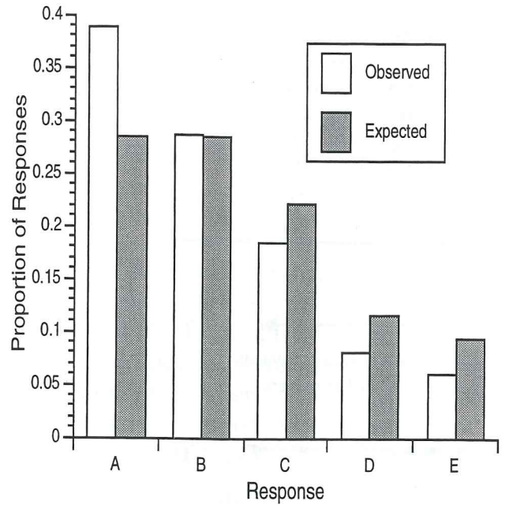

FIG. 2. Comparison of observed and expected proportions of each response category after *Atta cephalotes* ants were separated from their leaves in Corcovado National Park, Costa Rica. See text for definitions of response categories.

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Are leaf-cutting ants (*Atta cephalotes*) misnamed? The disproportionate use of different plant parts by leaf-cutting ants

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Abstract: *Atta cephalotes* leaf cutting ants collect a variety of plant parts to cultivate a fungus that they then consume. Different plant parts likely have different nutritive value for the fungus; therefore we hypothesized that *A. cephalotes* would use plant parts disproportionately to their relative abundance. We found that *A. cephalotes* used flowers more frequently than their observed abundance would suggest. These findings may be explained because flowers generally have fewer secondary metabolites, less cellulose, and higher nutritive value per mass than leaves. Leaves were used by ants in all samples, likely due to their high spatial and temporal abundance throughout the lowland tropical forest. Further research could investigate the consequences of different proportions of plant parts for fungal production in *A. cephalotes* nests.

Key Words: fungus, cultivation, flowers

Introduction

Leaf-cutting ants (*Atta cephalotes)* are found in Costa Rican lowland forests (Stevens 1983). *A. cephalotes* collect plant material which they use to cultivate fungus; they then harvest the fungal hyphae to feed the colony. The survival of the colony is dependent on the efficiency of the colony's fungal production (Quilan and Cherrett 1977; Weber 1966; Wilson 1971). Stevens (1983) hypothesized that ants use plant parts in the proportion that optimizes fungal production. Wirth et al. (1997) suggested that flowers and reproductive plant parts are higher in energy, may contain fewer secondary metabolites, and may be easier to cut than leaves. Therefore, we predicted that leaf-cutter ants would use flowers, fruits, and seeds in greater proportion than their observed abundance would suggest.

Methods

We conducted our experiment from 07:30 – 11:30 on 2 February 2003 in Corcovado National Park, Costa Rica. Sample sites (n = 18) were located along the Rio Claro, Espavales, and Guanacaste trails. We defined each leaf-cutter ant trail we passed as an independent site. When possible, we followed each trail to the nest and collected leaves one meter from the entrance, i.e. before it branched into a larger number of trails. If we could not locate the nest, we collected plant fragments where the ant trail crossed our footpath.

At each site we collected 50 – 100 of the plant fragments being carried to the nest by ants crossing an arbitrary point on their trail. We separated each leaf fragment sample into categories: leaf, flower (defined as petal, sepal or reproductive organs), stem, fruit, seed, and dead matter. For each sample, we weighed each group of parts separately and calculated the percent of total biomass for each part in that sample. We then calculated the average percentages from all samples.

Results

Percent biomass differed significantly between the six categories: leaf, flower, stem, fruit, seed, and dead material (Fig. 1; $F = 21.9$, $df = 5, 102$, $P = < 0.001$). Of total biomass from all trails, leaves represented 41 ± 8.0% (mean ± SE), and flowers were 46 ± 13.2%.

Leaf fragments were present on each trail. Ants carried flower parts on 78% of the trails, with flowers contributing 6 – 94 %

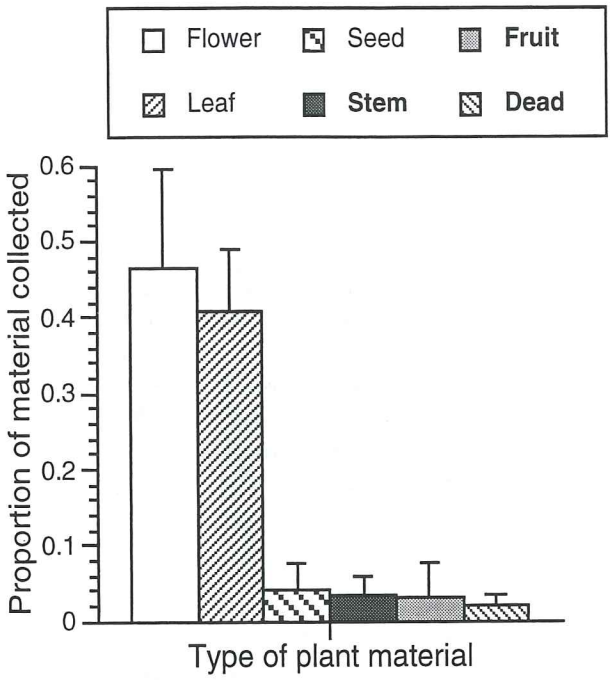

FIG. 1. Proportions (mean ± SE) of plant material types collected across all trails by *Atta cephalotes* in Corcovado National Park, Costa Rica. ($F = 21.9$, $df = 5, 102$, $P < 0.001$; $n = 18$ trails)

of total biomass per trail. There was only one trail that had a substantial percentage (42%) of fruit. The other trails had zero or negligible percentages of fruit.

Discussion

We found that leaf-cutter ants transport approximately equal proportions of leaf and flower parts to their nest, despite the far greater abundance of green leaf matter in nature. Higher flower usage may be a result of several factors. During the dry season, flower and reproductive parts that are higher in energy and contain fewer secondary defense compounds than green leaf material attract foraging ants (Wirth et al. 1997). Flowers may be less tough than leaves, which would make them easier for the ants to cut and possibly more valuable as a food source for the fungi. High variation in flower usage between trails may be related to the patchiness of flower distribution.

We found very little fruit usage at the start of the dry season. Most fruit does not ripen until the beginning of the wet season. In one trail, *Ficus* fruit, which ripens continually throughout the year, comprised 42% of the fruit usage. High usage of figs on this trail may indicate that fruit is used when it is available.

Leaf usage was observed on all trails. Leaves are available in all seasons in Corcovado National Park, so this is not unexpected. However, as the percentage of leaf use was lower than for flowers, it appears that ants do use plant parts disproportionately to their natural abundance. To further our understanding of ant preference, future studies might compare leaf cutter ant use of plant parts to their relative abundance in the local environment.

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