appeared to contain > 70 of the saturniid caterpillars. The caterpillars were very large (≈ 8-10 g, 10 cm long, 1.5 cm diameter), covered with spines, aposomatically colored green and pink, and appeared to be in the final larval stadium.

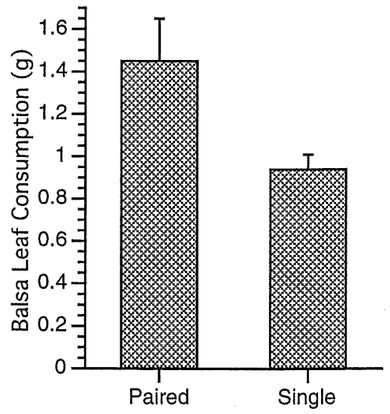

Fig. 1. Amount of balsa leaf biomass consumed by individuals placed in paired and solitary treatments during 12 hour treatment periods (n = 24 individuals) at Corcovado National Park, Costa Rica.

Discussion

The saturniid caterpillars seem to feed more efficiently in groups and are extremely gregarious. After 12 hours of acclimatization in large mesh containers with paper partitions, six individuals broke through their dividers and moved into the adjoining chamber to form six pairs. Wild caterpillars were always grouped, often 5-8 per balsa leaf. This behavior may have been selected for because of advantages in feeding efficiency, as a menacing threat to potential predators, or (if the caterpillars are poisonous) because an individual member of a group is less likely to be picked off by a naive predator than a solitary individual.

We cannot be certain that this herbivore species only feeds on balsa trees. However, we could not find any other acceptable hosts (with the exception of one caterpillar, who would not eat any more of the alternative leaf in subsequent trials). If this saturniid is not a specialist on balsa, it at least has a strong preference for balsa. This preference may be genetically fixed or the result of an acquired preference for the leaves on which they had fed for several instars. Further tests with other tree species (or perhaps a positive species identification and a literature search) would provide a better understanding of saturniid leaf preference. We were surprised that the species was not described in *Costa Rican Natural History* (Janzen 1973) because it was so large and conspicuous. In spite of its abundance on one tree at this time, the species may be quite rare.

Either balsa has no short-term inducible chemical defenses or these caterpillars have evolved a neutralizing counter-adaptation such as an effective detoxification system. We found relatively high levels of herbivory and several species of herbivores on all twenty balsa trees we surveyed, suggesting that balsa trees generally allocate resources toward rapid growth rather than chemical defenses and routinely tolerate high herbivory.

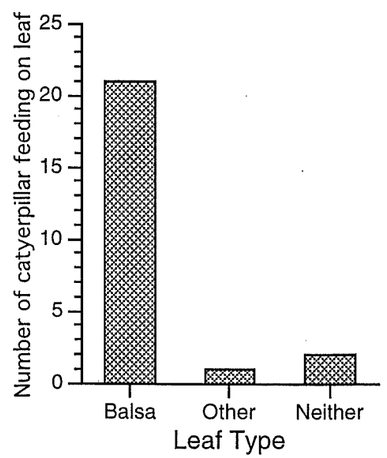

Fig. 2. Saturniid caterpillar food preference when presented a choice between balsa and 4 other species with similar leaf morphology (n = 24 caterpillars) at Corcovado National Park, Costa Rica.

FORAGING STRATEGIES AND NICHE PARTITIONING IN *ATELES GEOFFROYI* AND *CEBUS CAPUCINUS*

Gregory M. Lief, Anita L. Mannan, Angela C. Rutherford

Abstract. Ateles geoffroyi (Spider monkey) and *Cebus capucinus* (White-Face monkey) share overlapping territories and often forage side by side in the rainforest canopy of Corcovado National Park. We hypothesized that niche partitioning allows the two species to share territories and food resources. *A. geoffroyi* and *C. capucinus* forage at the same time of day, but forage on different food resources; *A. geoffroyi* forage on fruits and leaves while *C. capucinus* prefer insects. This differentiation in food choices indicates resource partitioning between *A. geoffroyi* and *C. capucinus*, thus allowing cohabitation of the same canopy area.

Introduction

Resource partitioning is widely believed to contribute to the coexistence of species. Divergence of foraging behavior is one way to reduce interspecific competition. At Corcovado National Park, four monkey species coexist in overlapping ranges, yet exhibit no aggressive behavior towards one another, even when foraging in neighboring trees. There is overlap in food use between species, but variation in foraging behavior is high. For example, although species eat the same foods, they may not forage at the same time (Chapman 1987). We hypothesized that *Ateles geoffroyi* and *Cebus capucinus*, the two most common species, partition food resources by foraging at different times of day and/or foraging on different resources. The alternative hypothesis is that no niche partitioning occurs because food resources are not limiting. We tested our predictions in a three-day observational study of monkey foraging behavior at Corcovado National Park, Costa Rica.

Methods

We observed *A. geoffroyi* and *C. capucinus* on 2 - 4 February 1996, along Senderos Rio Claro and Escavales. We haphazardly chose individual monkeys within troops to observe for a minimum of five minutes. We recorded food choice, time spent foraging (defined as searching for and eating food), and time spent per tree while foraging. We collected samples of each food eaten by the monkeys in order to identify food species.

We compared the diets of the two monkey species with a G-test. We used an ANOVA to test for a relationship between time spent per tree, food type, and percent time foraging for each species.

Results

Ateles geoffroyi and *Cebus capucinus* both spent the same percentage of time foraging in the morning as in the afternoon (mean ± SE = 48 ± 7 vs. 48 ± 10; F = 0.91, df = 1, 7, P = .36), although we located fewer monkeys in the morning than the afternoon (n = 5 vs. 26). Both monkey species foraged extensively for fruits (56% and 50% of foraging time for *A. geoffroyi* and *C. capucinus* respectively; Figure 1), but whereas *A. geoffroyi* also foraged extensively on leaves (39% of foraging time), *C. capucinus* foraged on insects (50% of foraging time). Differences between monkey species in their foraging time budgets were significant (G = 7.56, df = 2, P < .025; Figure 1). *A. geoffroyi* spent more seconds per tree while foraging (mean + SE = 242 + 26 vs. 145 + 26; F = 5.00, df = 1, 20, P = 0.03; Figure 2), although time spent per tree did not change across food types (F = 0.16, df = 1, 20, P = 0.69; Figure 2).

Discussion

Ateles geoffroyi and *Cebus capucinus* foraged at the same time of day, indicating that there is no temporal resource partitioning. However, the monkeys do appear to occupy different food niches, which may minimize competition and allow the two species to coexist in space and time. *A. geoffroyi* foraged more frequently on leaves and fruit while *C. capucinus* concentrated on insects. This dietary partitioning suggests that resources are limiting and that past competition has been a strong force causing the divergence of these species diets. The resulting specialized

diets may be equally profitable because the species spent the same percentage of their time foraging (≈ 61.1% in both cases). If so, we would predict a lower capture rate for the high energy food type so that energy gain on different food types is equalized. Alternatively, food resources may be unlimited and dietary partitioning an artifact of learned group traditions (Chapman 1990). To test this alternative, a future study might evaluate whether the amount of available food resources (fruits, insects and leaves) exceeds, or barely meets, the energetic and nutritional needs of the local monkey populations

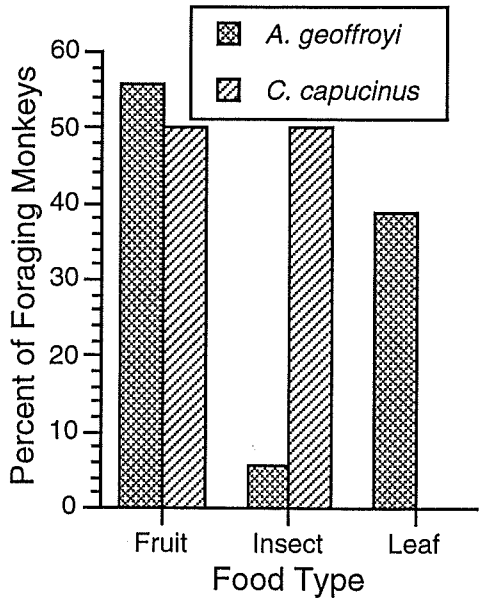

Fig. 1. Percent of *A. geoffroyi* and *C. capucinus* observed foraging on three different food types in Corcovado National Park, Costa Rica (n = 18 *A. geoffroyi* and n = 8 *C. capucinus*).

Interestingly, *A. geoffroyi* monkeys spend more time in each tree while foraging. Because the time spent foraging in each tree did not change with food type, this difference is probably a result of the different ways the species forage instead of their food preferences. *A. geoffroyi* appear more agile and use their prehensile tails more often, which gives them access to a larger proportion of the tree (pers. obs.). The greater time spent within each tree may be a result of this increase in foraging area. A study analyzing the proportion of total tree area in which the two species forage could test this hypothesis. Alternatively, movement costs might be lower for *C. capucinus* so they shift trees sooner when resources become depleted. If so, we would predict *C. capucinus* 's foraging success rate to diminish less than *A. geoffroyi*'s before they switched trees.

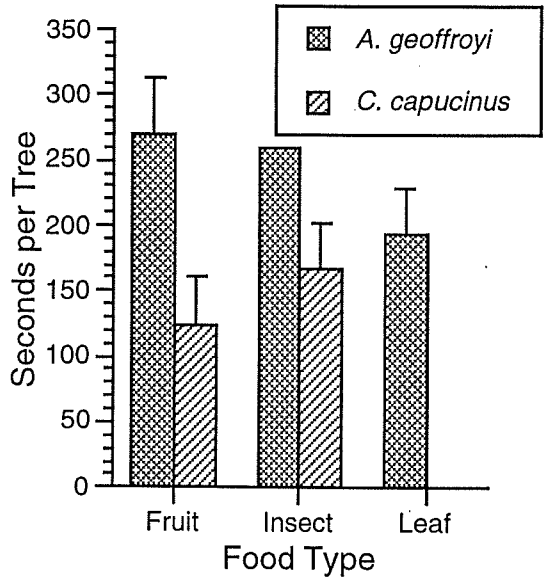

Fig. 2. Average time *A. geoffroyi* and *C. capucinus* spent per tree while foraging on different food types in Corcovado National Park, Costa Rica

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Chapman, Colin A. 1987. Flexibility in diets of three species of Costa Rican primates. Folia primatola **49**: 90-105.