correlation between syrphid length and mosquito length. If ammensalism were evident, one would expect to see syrphids dominating and mosquitoes losing out on the limited DOM resources. If ammensalism occurred, it should be intensified at low DOM levels due to increased competition.

This study leaves an essential question unanswered: what causes the positive correlation between syrphid and mosquito size? It may be due to (1) commensalism in the processing chain, or (2) a surplus of DOM relative to the needs of the mosquitoes so that competition which would not be visible with a DOM overabundance. By experimentally manipulating syrphid numbers, the true nature of this correlation would appear. If competition was prevalent, mosquito size would decrease, while commensalism would increase mosquito size.

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GROUPIE SATURNIIDS AND THEIR BALSA ADDICTIONS

Sarah E. Kopplin and Matthew K. Little

Abstract. Saturniid caterpillars are social herbivores that feed on the balsa tree (*Ochroma lagopus*). Paired caterpillars ate significantly more leaf biomass than isolated individuals. When presented a choice between balsa leaves and leaves of other species, caterpillars almost exclusively preferred balsa. Caterpillars fed equally on both control leaves and leaves that were cut 12 hours previously to simulate herbivory, suggesting that balsa may lack short term inducible defenses against such herbivory. Apparently balsa trees frequently support high herbivore populations and sustain large tissue losses.

Key words: Saturniid caterpillar, balsa tree, Ochroma lagopus, *gregarious behavior, chemical defenses*

Introduction

We encountered a large aggregation of enormous saturniid caterpillars feeding on a balsa tree (*Ochroma lagopus*) in Corcovado National Park, Costa Rica. We hypothesized that: (1) gregarious behavior of the saturniids may be an evolutionarily selected behavior that increases foraging efficiency; (2) caterpillars feed exclusively on the balsa tree; and (3) balsa have high levels of herbivory because they do not have an inducible chemical defense strategy. We tested these hypotheses by comparing the consumption rates of paired and solitary caterpillars, by offering caterpillars leaves from other tree species, and by comparing caterpillar preferences for control leaves vs. previously damaged leaves.

Methods

Interactions between balsa trees and saturniid caterpillar were simulated in a laboratory at Corcovado National Park, Costa Rica. Twelve caterpillars and all balsa leaf samples were collected from a solitary balsa tree ≈ 100 m southwest of the field station on the Sendero Naranjos.

We placed four pairs of caterpillars and four isolated individuals in eight 1 l containers. In two separate trials, we fed balsa leaves to all caterpillars to determine whether paired caterpillars ate more than isolated individuals. We weighed each leaf before and after the saturniids fed for 12 hours, to obtain an estimated consumption rate for each caterpillar. We then weighed a single leaf before and after a 12 hour period to estimate average water loss of the leaves, and adjusted the values accordingly.

In two additional trials, we determined whether balsa leaves were preferred over leaves of four other species with similar leaf morphologies. Twelve caterpillars were presented with two leaves of comparable size, one being a balsa leaf. We recorded which leaf type they were feeding upon after one hour.

To examine potential short-term induced chemical defenses by the balsa tree, we simulated herbivory by cutting 6 wedges (≈ 10% leaf area) across veins in each of 6 leaves that had little previous herbivory. After 12 hours, we removed the damaged leaves, and a set of undamaged control leaves, from the tree and offered matched pieces of damaged and control leaves to 12 individual caterpillars. One hour later, we recorded which leaf type each caterpillar was feeding on. We repeated the procedure one hour later with the same set of caterpillars but a different set of leaves.

Finally, we surveyed 20 balsa trees, and trees from a number of other tree species, to look for populations of saturniids and to assess levels of damage due to herbivory of any kind.

We used a paired t-test to compare consumption rates of individual and paired caterpillars. We tested for leaf preferences with Chi-square analyses.

Results

Individual caterpillars that were feeding as pairs consumed 64% more balsa leaf than caterpillars that were feeding alone (Fig. 1, $t = 2.00$, $df = 14$, $P = 0.06$). Equal numbers of caterpillars fed on leaves with simulated herbivory as on control leaves ($n = 12$ and 12, respectively). When given a choice between balsa and leaves of other species, 21 of 24 caterpillars fed exclusively upon balsa (Fig. 2, $X^2 = 31.7$, $df = 2$, $P < 0.05$). We carefully searched 20 other balsa trees throughout several hectares, but did not find any other trees containing the same caterpillar species. We could not obtain an exact count, but our study tree

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.

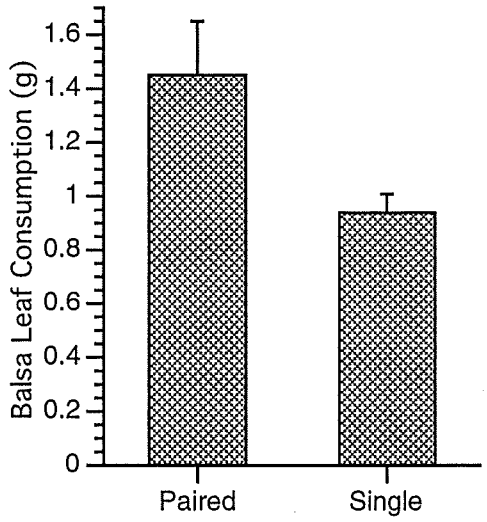

Fig. 1. Amount of balsa leaf biomass consumed by individuals placed in paired and solitary treatments during 12 hour treatment periods (n = 24 individuals) at Corcovado National Park, Costa Rica.

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.

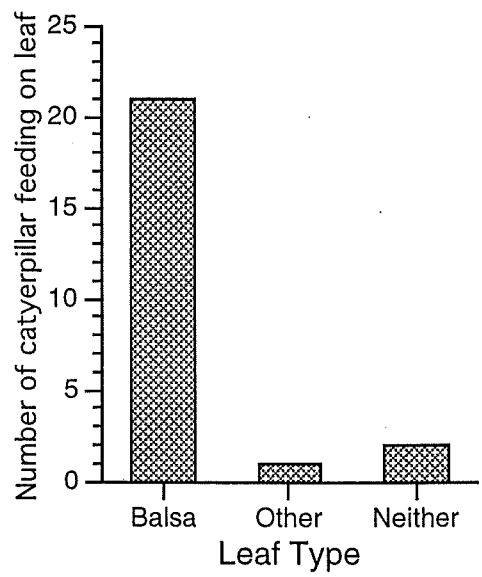

Fig. 2. Saturniid caterpillar food preference when presented a choice between balsa and 4 other species with similar leaf morphology (n = 24 caterpillars) at Corcovado National Park, Costa Rica.