A POSSIBLE ADAPTATION IN TIPULIDAE TO REDUCE PREDATION BY INHABITING *CHUSQUEA LONGIFOLIA* NODES

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Abstract: Cranefly larvae, (Diptera: Tipulidae) that typically reside in moist soils can be found in the accumulated litter within the nodes of a bamboo species (*Chusquea longifolia)* in the highland forest of Cerro de la Muerte. We hypothesized that cranefly oviposition in nodes is an adaption that reduces predation from arthropods and birds. We ran timed transects to observe potential avian predators of craneflies, and randomly sampled both *C. longifolia* nodes and 0.1 m^2 forest floor plots, counting cranefly larvae and potential arthropod predators. We found cranefly larvae exclusively in the nodes, and while we did not find a difference in the density of arthropod predators between nodes and forest floor, we infer that pressure from avian predators is reduced in the nodes due to a higher abundance of ground predators (Large-footed Finches) than node predators (Yellow-billed Caciques). The data suggest a selection differential between larvae on nodes and the forest floor, but we still lack knowledge of whether adults preferentially oviposit in nodes.

Key Words: adaptation, Chusquea longifolia, *cranefly larvae, predation,* Tipulidae

INTRODUCTION

Chusquea longifolia is a common understory bamboo of the oak-dominated forest of Cerro de la Muerte. It contains cup shaped nodes on its stem that collect detritus. Kemp et. al (2004) found that cranefly (Diptera: Tipulidae) larvae can inhabit these nodes. This is an unusual habitat for cranefly larvae because most are found in aquatic environments or in moist soil on the forest floor (Bland, 1978).

Cranefly larvae may face different predation risks on the forest floor and in nodes. Densities of generalist predators, such as spiders and beetles, may be greater on the ground, where a rich community of detritivores, scavengers, and predators inhabit the litter. It seems probable that predators foraging on the ground would acquire more prey per unit effort than those that attempted to forage in the isolated patches of detritus in the nodes.

This suggests the hypothesis that cranefly oviposition in *C. longifolia* nodes is an adaptation to reduce larval predation. We tested two predictions from this hypothesis: (1) a higher abundance of cranefly larvae per gram detritus in nodes than on the forest floor, and (2) reduced predation in the nodes.

METHODS

On 27-28 January, 2006, we performed stratified random sampling of cranefly larvae and their predators within the oak-bamboo forests, near the Cuerici Biological Station, in Cerro de la Muerte, Costa Rica. At each of 16 sites randomly chosen from along 250 m of trail, we overturned leaf litter and removed all arthropods found in the detritus of a 20 x 50 cm ground plot with forceps. We recorded the number of cranefly larvae and the number of potential predators found in

each sample. We collected the same data from two randomly selected *C. longifolia* nodes at each site. We bagged the detritus from two nodes and one ground plot, and measured dry weight to standardize arthropod abundances by grams of detritus. The average mass (± SE) of detritus per bamboo node was 10.6 ± 1.4 g, which compared to an average of 156.3 ± 15.0 g of litter searched per sample plot on the forest floor.

In addition to various arthropod predators, at least two avian species probably prey on cranefly larvae in this system. The Large-footed Finch (*Pezopetes capitalis)* forages for arthropods on the ground by using a stereotypical maneuver that involves kicking up detritus with their large feet (Stiles et al. 1989), while the Yellow-billed Cacique (*Amblycercus holocericeus)* is reported to sometimes forage for arthropods in bamboo nodes (C. Solano, pers. comm.). To observe potential avian predators of cranefly larvae, we walked 14 15-minute transects in the same area. We identified all ground birds and monitored their behavior, noting whether they were foraging on the forest floor or on *C. longifolia* nodes. We tested whether cranefly or bird and arthropod abundances were different between nodes and forest floor using Fisher Exact tests.

RESULTS

There were more cranefly larvae per gram of detritus in nodes than on the forest floor, with all 9 individuals found in nodes (Fisher Exact, P = 0.001). There were also more cranefly larvae in nodes than on the forest floor per minute spent searching (Fisher Exact, P = 0.03). All cranefly larvae appeared to be of the same species; at least three stadia were represented in our sample (including the last larval stadium).

Per gram of detritus, we found similar numbers of predatory spiders and beetles on the forest floor (n= 5 and 2 respectively) compared to in nodes (n= 2 and 1 respectively (Fisher Exact, P = 0.21). Our collections also included a snail, which appeared to be resident in the nodes, but was presumably non-predatory.

There were fewer avian predators that specialize in foraging within bamboo (0 Yellow-billed Caciques) vs. on the forest floor (6 Large-footed Finches; Fisher Exact, P = 0.09). Two of the Large-footed Finches were actively foraging in ground detritus. We observed two unidentified birds perched on *C. longifolia* shoots, but these birds did not forage in the nodes while we watched nor did they appear adapted for that foraging behavior.

DISCUSSION

Our results were consistent with the hypothesis that the tipulid we studied is a specialist of detritus clumps in bamboo nodes. We found nine larvae inhabiting nodes and none within 14.8x the biomass of similar soil litter. Although arthropod predator abundances did not differ between nodes and forest floor, predatory birds were absent in nodes. From our observations of Large-footed Finches foraging, we speculate that this species could efficiently find and consume large numbers of cranefly larvae on the forest floor, thereby exerting greater predation

pressure on cranefly larvae than predatory arthropods.

With the data collected, we cannot determine whether craneflies oviposit preferentially in nodes. It could be that craneflies oviposit indiscriminately but larvae inhabiting the forest floor are subject to strong predation. Nonetheless, our findings still suggest a selection differential that could, given the necessary genetic variation, lead to the hypothesized behavioral adaptation by adult craneflies to oviposit in *C. longifolia* nodes. Further studies could monitor adult cranefly ovipositing behavior to better address this question.

LITERATURE CITED

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