Distribution and abundance of Tipulid larvae in bamboo litter clumps in a high-elevation Costa Rican forest

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Abstract: We investigated factors influencing the distribution and abundance of Tipulid larvae living in a unique microhabitat: clusters of organic matter trapped in stem nodes of *Chusquea longifolia* bamboo. We hypothesized that nodes with high amounts of organic matter would contain high densities of tipulids, and that tipulid abundance would be higher in the understory of primary forest than in secondary habitat. We sampled bamboo plants in each habitat and found that tipulid abundance was positively related to organic matter content, but was unaffected by habitat type. The community of invertebrates and microorganisms in bamboo litter clumps remains a largely unstudied system, though this abundant microhabitat may be important to numerous populations within the fauna of high-elevation forest.

Key words: Chusquea longifolia*, cranefly, litter trap, Tipulidae*

Introduction

The shoots of *Chusquea longifolia,* a common understory bamboo species on Cerro de la Muerte (Janzen 1989), contain a series of cuplike nodes (dense groups of leaf stems emanating from a single point on the main stem) which catch leaves and other debris and often hold a small amount of fine particulate organic matter. On 27 January 2004 at Cuerici Biological Station, we observed several cranefly (Tipulidae) larvae embedded in these organic matter traps. Tipulid larvae have not previously been noted in this unique microhabitat; their more common larval habitat is aquatic, although some are known to inhabitat terrestrial plants and fungi (Borror and Delong 1964, M. Ayres pers. comm.).

We examined the effects of organic matter accumulation and habitat type on the distribution and abundance of these bamboo-living tipulids. Because tipulids generally feed on decaying plant material (Borror and Delong 1964), we hypothesized that the number and biomass of tipulids in a particular node would be related to the amount of organic matter trapped in that node, with more organic matter supporting more tipulids. We also tested differences in tipulid number between secondary growth and the understory of primary forest, predicting that greater litter fall into the nodes of understory bamboo would lead to greater tipulid abundance and biomass in this habitat.

Methods

Our study site was Cuerici Biological Station (elev. 2580 m), near Cerro de la Muerte, Costa Rica. On 29 January 2004, we sampled tipulids inhabiting bamboo along trail transects in two habitats, secondary growth and primary forest understory. Transects (one in each habitat) were at similar elevations and consisted of eight points 10 m apart. At each point, we alternated sampling on the right and left side of the trail and located the nearest stand of bamboo shoots at least 2 m off the trail. Stands were defined as a tight cluster of individual bamboo shoots (usually 10 - 20) that formed a group distinctly separated from other bamboo. Within the stand we selected two shoots; the one with the most organic matter (high OM) and the one with the least (low OM) to ensure an adequate range in our measures. Organic matter was defined as matter collected in the crotch of the node. At each shoot, we clipped off and bagged

the node with the most organic matter, along with the node above it. We then sorted each sample for tipulids and organic matter and measured the mass of each tipulid. The organic matter was filtered through a 0.5 mm mesh to eliminate coarse material, leaving only FPOM which is the size of OM used by tipulid larvae, then weighed. We evaluated tipuloid abundance with a general linear model that included habitat type (primary forest vs. secondary growth), stand nested within habitat type (defined as a random effect), OM mass (continuous variable), and the interaction between OM mass and habitat.

RESULTS

We found a total of 29 tipulid larvae, 19 on understory bamboo plants and 10 on secondary bamboo plants. All nodes on which tipulids were found contained some amount of organic matter, although a few tipulids were found in nodes with very low amounts. There was a strong correlation between tipulid number and tipulid biomass per node ($r = 0.90$), so we only report statistical results for tipulid number.

There was a significant effect of OM mass on tipulid number ($F_{1,17} = 20.67$, $P < 0.0001$). Effects of habitat ($F_{1,17} = 0.95$, $P = 0.35$), stand ($F_{14,17} = 1.16$, $P = 0.33$), and the interaction of OM mass and habitat ($F_{1,17} = 2.75$, $P = 0.10$) were not significant (Fig. 1).

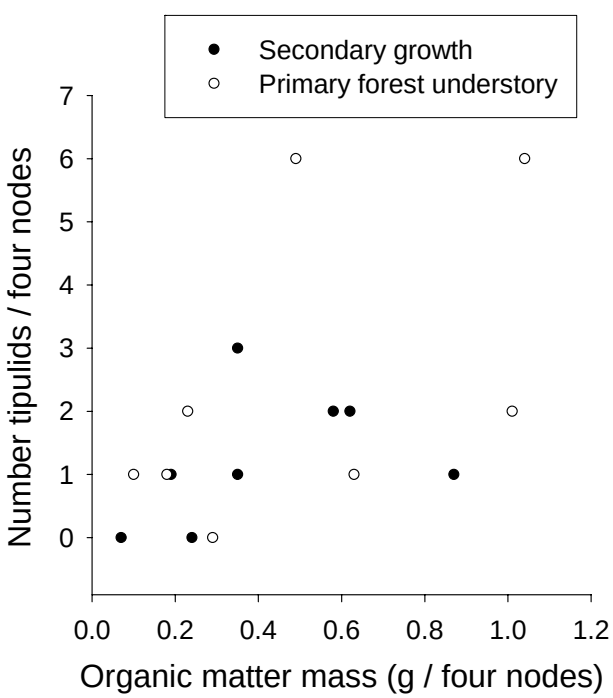

Figure 1. Abundance of tipulid larvae associated with bamboo vs. organic matter captured within bamboo branching nodes. Each point represents one bamboo stand within one of two habitat types.

DISCUSSION

Our results supported the hypothesis that greater organic matter accumulation in bamboo nodes leads to greater numbers and biomass of tipulid larvae. However, our second hypothesis, that tipulids would be more abundant in understory than secondary habitat, was not supported. Contrary to our expectations, the amount of organic matter within bamboo nodes did not differ between habitat. Nevertheless, we cannot entirely discount the possibility that habitat type influences tipulid larvae abundance, because we did find nearly twice as many tipulids in understory bamboo than in secondary growth. Future studies should further investigate this trend, as well as other potential mechanisms influencing tipulid distribution and abundance, such as age and density of bamboo stands, sunlight, temperature, and preferred habitat of adult craneflies.

If the tipulids we investigated are bamboo node specialists, it is likely that the local population dynamics of tipulids are closely linked with the occurrence of *C. longifolia* bamboo. Because *C. longifolia* populations in this region have a synchronized, semelparous life history (fruiting and dying at approximately 25 - 30 year intervals; Carlos Solano, pers. comm.), the bamboo-node microhabitat must sometimes disappear over large areas, depriving the tipulids

of their larval environment. The degree of specialization of tipulids on this microhabitat should be examined to understand the effects of bamboo life history on tipulid population dynamics.

Also, another species of bamboo, *Chusquea subtessalata,* occurs at slightly higher elevations at Cuerici, and studies of the differences in tipulid habitat quality between these two species would be valuable. Casual searches revealed some tipulids in *C. subtessalata* nodes but densities appeared to be much lower than on *C. longifolia* (M. Kemp, pers. obs.), perhaps because the high-elevation bamboo species does not have dense, litter-collecting nodes.

Litter clumps on bamboo shoots constitute an unexplored microhabitat that presents exciting opportunities for novel natural history and in-depth ecological investigation, especially given the prevalence of *Chusquea* species in high-elevation forests. Although tipulid larvae were the most common and obvious members of this "bamboo node fauna," we observed a surprising diversity of other arthropods, including members of Aranea, Coleoptera, Diplura, Hemiptera and Lepidoptera; a wealth of microorganisms, fungi, and mites must also be present as well. We hope that our basic findings will stimulate further studies of this unique community.

LITERATURE CITED

Borror, D. J. and D. M. DeLong. 1964. An introduction to the study of insects. Holt, Rinehart and Winston: New York, NY.

Janzen, D. H. 1989. Costa Rican natural history. The University of Chicago Press: Chicago, IL.