DENSITY AND STRUCTURE OF MELASTOMACEOUS PLANTS IN HIGH AND LOW WIND ENVIRONMENTS

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Abstract. The species composition of plant communities in exposed environments often consists of individuals capable of adapting structurally to the harsh conditions. We examined plants in two different habitat types, exposed ridge and leeward forest, to determine how plants on the ridge differ in their structural adaptations. We found that the ridgeline plants had thicker leaves and woodier stems. We argue that these differences are due either to phenotypic growth responses of the stressed plants, or to a difference in species composition between the two plots. Additionally, Melastomes were more abundant at the exposed ridge plots, suggesting that this family is well adapted to harsh conditions. (ALG)

INTRODUCTION (TCB)

Overall species composition and individual physical structure within a community will often change in response to increased exposure to wind and/or sunlight. The distribution of species in a stressed community changes via the replacement of poorly adapted species with those better able to grow in the more exposed area. Additionally, individuals in the exposed area can change plastically, allocating additional resources to structural support.

Whether due to species compositional changes, or plastic changes by the individual, the plants that grow in exposed areas can be expected to show several structural characteristics: their stems will be modified for enhanced support, their leaves may be thicker in order to resist tearing, and their leaves may be smaller, in order to reduce the surface area available for wind drag and torsion.

We focused on the structural changes that occured within a single plant family, Melastomaceae, in response to a high wind and sun environment. Melastomaceous plants are easily identified and are common in all forest types of the Monteverde Cloud Forest. They can be found in the Elfin Forest along the ridge, as well as in the leeward cloud forest. Because Melastomes are found in both areas, we hypothesized that at the exposed site on the ridge, species composition and structural adaptations would differ from those of Melastomes growing lower on the trail. We predicted that the stems of plants on the ridge would be woodier, and their leaves would be thicker and smaller.

METHODS (ALG)

We sampled plants in the Monteverde Cloud Forest in Costa Rica, on 16-18 January 1992. Our high wind plots were consecutive sections of exposed ridge on Sendero Brillante, and our low wind plots were consecutive sections along Sendero Bosque Nuboso, between the park entry and the side trail to El Camino. The estimated altitudinal difference was 100m. Wind speed was measured several times at each plot during the three days of observation.

Each plot was 2m x 5m; 1m of vegetation on either side of 5m of trail. One of our high plots was 10m long and included only one side of the trail

because there was no vegetation on the other side.

In each plot we counted the number of Melastomaceous plants (identified by their characteristic venation) and grouped them into three height classes: <0.5m, 0.5-1m, and >1m. We did this for two reasons: first, to exclude small plants from our sample because they may have been too young to exhibit plastic growth responses or they may have been species unable to thrive under the existing conditions, and second, to look for differences in each community's size structure.

After categorizing the plants, we then randomly selected a total of five plants from the larger two classes (or all plants of these classes if there were less than five) and randomly selected three leaves from each of these plants. For each leaf we measured maximum width, maximum length, and thickness (thickness of the lamina was measured with calipers 0.5cm from and parallel to the central vein). We also classified the stem of each plant as herbaceous or woody.

We continued sampling until we obtained more than 25 trees at each of the high and low sites.

RESULTS (TCB)

We counted plants in 28 quadrats, measuring leaf thickness, area, and stem woodiness for 53 individuals within those quadrants (Table 1). Six quadrats were located along the exposed ridge, with the other 22 along the lower part of the Sendero Bosque Nubosa. Wind speed in the upper quadrats ranged from 10-20 mph. In the lower quadrats the wind speed was consistently less than 1 mph.

Table 1. Density and structure of Melastomaceous plants in two habitat types.

	High Wind	Low Wind
Wind speed	10-20 mph	<1 mph
# plots	6	22
# plant sampled	26	27
Mean leaf area (cm^2)	89±105	100±112
Mean leaf thickness (mm)	0.68±0.26	0.38±0.08
# herbaceous plants	6	18
# woody plants	19	9

Plant leaf area did not differ between the two environments ($p>0.5$). Leaf thickness was greater in the high plots ($p<0.001$), and the plant stems were woodier (χ^2, $p<0.005$).

We counted the plants in each quadrat and calculated the density of plants in each size class (<0.5m, 0.5-1m, and >1m). The density of plants in the first and last two size classes was higher in the upper quadrats, but was the same for plants in the intermediate size class.

DISCUSSION (TCB)

As hypothesized, Melastomes on the ridge had thicker leaves and woodier stems. This difference is most likely due to both plastic and species composition changes between the two sites. When individual plants are stressed they can often respond by increasing their secondary growth which makes their leaves thicker and stronger, and their stems woodier. Additionally, as an environment be-

comes harsher, better adapted species will replace more poorly adapted ones.

Both of these aspects of plant community change in response to a harsh environment were probably prevalent in this study. However, because we did not identify the species at each site, we were unable to quantify the species compositional changes. Qualitative observation showed that, in our quadrats, species in all size classes differed between the two sites. Two species seemed the most prevalent on the ridge: a tree species that at the lower site was above our sampling size, and an herb that covered the ground almost 100% in many cases. No single species seemed to be prevalent at the lower site.

Another observation we made was that Melastomes seemed to dominate the ridge top community, whereas they were much less dense in the lower area. This implies that either the family is well adapted to stressful environments, or that the species in this family are very common everywhere, with a few able to thrive in high wind and sun. It would be useful to look at the percentage of species that are Melastomes and the species diversity in the two areas, to gain further insight into the response of Melastomaceous to increased environmental stress.