EFFECT OF LEAF TEXTURE ON EPIPHYLL COVER IN A HIGH-ELEVATION FOREST

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Abstract: The distribution of epiphylls is affected by various environmental factors, especially leaf surface characteristics. We examined the relationship between epiphyll cover of leaves and three indices of texture (pubescence, waxiness, and roughness) in the Talmanca Mountains of Costa Rica. We found that epiphyll cover decreased with pubescence, increased with waxiness, and was not related to roughness. Our findings conflict with previous studies performed at lower elevation cloud forests, which suggests that epiphyll species composition or ability to adhere to leaves may vary between habitats.

Key Words: Cerro de la Muerte, leaf pubescence, leaf roughness, leaf waxiness

INTRODUCTION

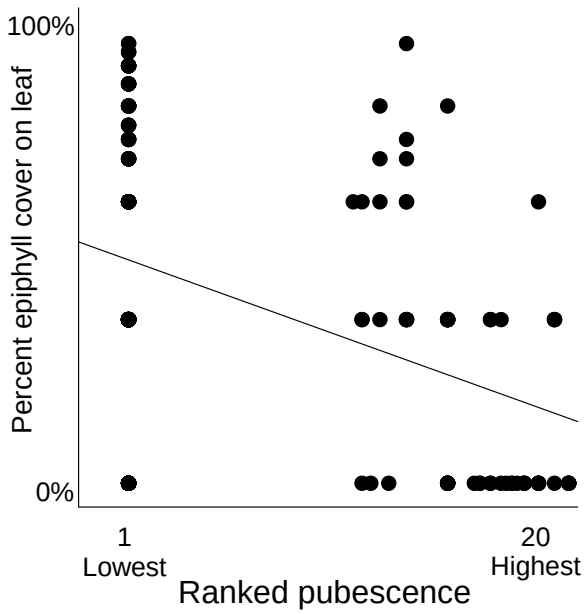
Epiphylls, small epiphytes that grow on leaves, are prevalent and well-researched in tropical cloud forests (Bykowski and Liebert 1994, Ginsburg et al. 1995, Morales 2000). In cooler and drier high-elevation forests, however, epiphylls have a limited distribution due to reduced precipitation (Hartshorn 1983). With limited moisture, leaf morphology may be more important in determining epiphyll distribution at high elevations compared to low elevations. Past studies have found conflicting evidence concerning the effect of leaf morphology on epiphyll cover: Ginsburg et al. (1995) found that rough leaves had relatively high epiphyll cover, while Morales (2000) reported more epiphyll growth on smooth leaves.

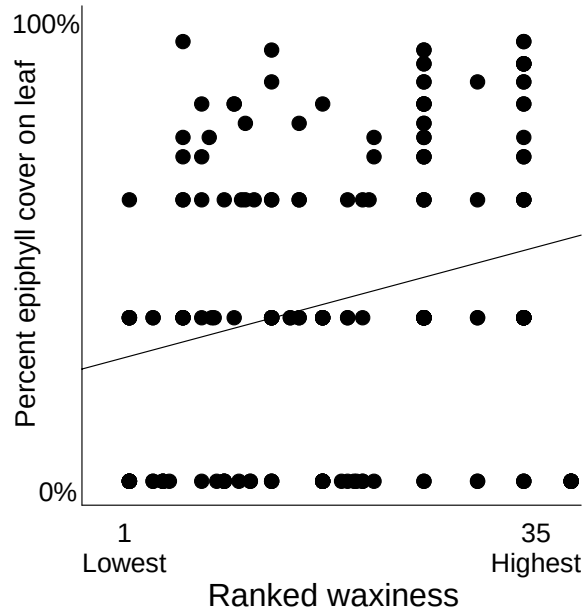
We hypothesized that leaf texture affects epiphyll distribution in the high-elevation oak-dominated forest at Cerro de la Muerte, Costa Rica. Using three indices of texture (pubescence, waxiness, and roughness), we quantified the effect of leaf texture on leaf epiphyll cover. We predicted that epiphyll cover would be highest on leaves with low pubescence, low waxiness, and low roughness.

METHODS

Our study was conducted on 28 January 2005 in primary oak-dominated forest north of Estacion Biologica Cuerici at Cerro de la Muerte. We selected 10 plots (1 m^2) between elevations of 2800 and 2890 m in which epiphylls were found on at least one leaf in 50% or more of individual plants. All plots had similar canopy cover (75 - 100% by visual estimate) and vegetative structure (understory shrubs and herbs). For every shrub and herbaceous plant in a plot, whether it had epiphylls or not, we collected one median-aged leaf, defined as the leaf at the middle node on the main stem. Leaves were omitted if they were less than 3 cm long.

We visually estimated leaf epiphyll cover to the nearest 10% on all leaves ranging from 0 - 100% (11 categories total). We





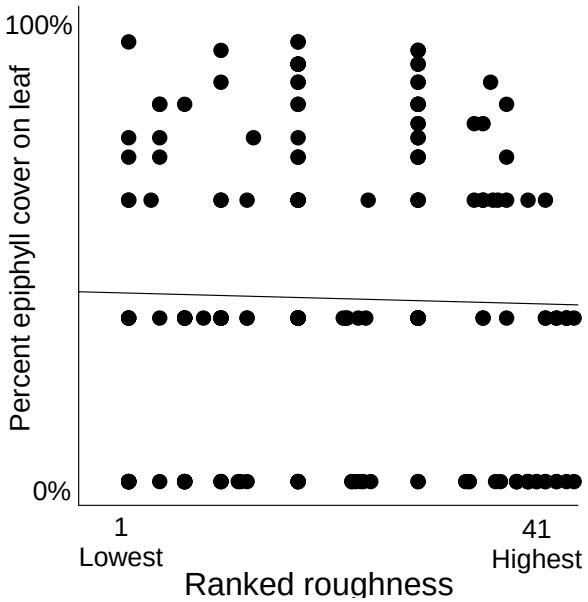


Figure 1. The relationship between percent epiphyll cover and three measures of leaf texture: pubescence, waxiness, and roughness. Percent epiphyll cover decreases with pubescence, increases with waxiness, and is independent of roughness (Spearman's Rho correlations on ranked averaged data).

ranked these categories of percent epiphyll cover, with 1 being the lowest value (0% epiphyll cover) and 11 the highest (100% epiphyll cover). Based on plant and leaf morphologies (shape, venation, thickness, color, and texture), we sorted leaves into morphotypes that corresponded to individual plant species.

Each morphotype was then assessed for degree of pubescence, waxiness, and roughness, and ranked from lowest to highest. When morphotypes had tied ranks, we assigned them the average of the ranks they would have received if they had not been tied (Zar 1999). This resulted in ranked categories of 1-20 for pubescence, 1-35 for waxiness, and 1-41 for roughness, with 1 being the lowest rank for each trait. We then used JMP 5.0.1 to perform a non-parametric Spearman's Rho correlation for ranked values of epiphyll cover, pubescence, waxiness, and roughness.

RESULTS

We collected 188 leaves from 45 distinct leaf morphotypes from the 10 plots. Epiphylls on the leaves we collected were

predominantly liverworts. Epiphyll cover was negatively correlated with pubescence (non-parametric Spearman's Rho correlation, $\rho = -0.40$, $P < 0.0001$, $n = 188$; Fig. 1) and positively correlated with waxiness ($\rho = 0.25$, $P = 0.0006$, $n = 188$). There was no significant relationship between epiphyll cover and roughness ($\rho = -0.02$, $P = 0.74$, $n = 188$).

Discussion

High pubescence may prevent epiphylls from adhering to the leaf surface. Our finding that more epiphylls are found on waxier leaves suggests that epiphylls are more likely to attach, germinate, and grow on waxy leaves. It is possible that waxy leaves last longer, so epiphylls have more opportunities to colonize them or more time to grow once established (Coley 1988). Also, epiphyll reproductive structures, such as gemmae, may adhere more easily to waxy surfaces (Morales 2000).

Roughness apparently had no effect on the likelihood of epiphyll germination or growth. This could be because our scale of roughness was too crude, or because the range of variation in roughness that we found was not large enough to produce an effect.

The high elevation forest at Cerro de la Muerte is subject to extreme seasonality and fluctuations in light conditions, temperature, and moisture regimes. Therefore, it is not surprising that our results conflict with a study conducted in the cloud forest at Monteverde, which found that waxy leaves had decreased epiphyll cover and rough leaves had increased epiphyll cover (Ginsburg et al. 1995). It is possible that epiphylls at Cerro de la Muerte have a greater ability to adhere to leaf surfaces than at Monteverde, or that different species of epiphylls exist in the two habitats. We recommend further study on how the distribution of epiphylls on different leaf morphologies varies between different ecosystems, to elucidate how environmental conditions affect epiphyll attachment.

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