Epiphyte Communities in *Cupressus lusitanica* Windbreaks and *Myrsine coriacea*, Monteverde, Costa Rica

Casey Halstead

University of Colorado at Boulder in conjunction with CIEE Monteverde

ABSTRACT

Monteverde, Costa Rica is home to a quintessential lower montane cloud forest that supports an amazing diversity of epiphytes. Windbreaks comprised of the exotic *Cupressus lusitanica* are common surrounding deforested areas. *C. lusitanica* appears to be poor epiphyte habitat when compared to a native species *Myrsine coriacea.* This survey was conducted using species richness and occurrence data collected using transparent acetates. This survey examines the idea that *C. lusitanica* supports reduced epiphyte diversity. The survey determined that the apparent difference in epiphyte richness and community composition is significant. ANCOVA analysis revealed several negative correlations for *M. coriacea* but not *C. lusitanica.* Lichen and moss abundance were affected by each other's abundance as well as by CBH.

RESUMEN

Monteverde, Costa Rica alberga un bosque montane bajo nuboso que sostiene una diversidad asombrosa de epifitas. Los rompe-vientos abarcados por la exótica *Cupressus lusitanica* son comunes en áreas deforestadas de los alrededores. *Cupressus lusitanica* aparece ser un hábitat pobre en epifitas cuando se compara con la especie nativa *Myrsine coriaceae*. Este estudio fue conducido usando la riqueza de especies y los datos de la ocurrencia recogidos usando los acetatos transparentes. Este estudio examina además la idea de que *C. lusitanica* disminuye la diversidad de epifitas. El estudio determinó que la diferencia evidente en riqueza de epifitas y la composición de la comunidad es significativa. El análisis de ANCOVA reveló varias correlaciones negativas para *M. coriaceae* pero no en *C. lusitanica*. La abundancia de líquenes y musgos se vio afectada por cada otras abundancia así como por CBH.

INTRODUCTION

The lower montane cloud forest of Monteverde, Costa Rica may support the most diverse epiphyte communities in the world with approximately 250 vascular (Ingram 1996) and 190 bryophyte (Gradstein 2000) species identified from a single 4 hectare plot. However, epiphyte diversity in the area's second growth forests, including native and planted non-native trees, appears to be greatly reduced. Deforestation in Monteverde facilitated the negative effects of dry season winds by promoting soil loss that reduced pasture grass production thereby reducing milk yields (Burlingame 2000). In the 1980's local farmers were encouraged to plant windbreaks in order to protect soil and grasses, shield cattle, and restore forest coverage (Burlingame 2000). This effort resulted in over 500,000 trees being planted (Burlingame 2000) in approximately 1000 windbreaks that stretch a combined distance of 185 km (Harvey 2000). A handful of studies have examined the ecology of windbreaks of the Monteverde area (Harvey 1999, Harvey and Haber 1999, Harvey 2000a, b), however, no study has been conducted on a species specific basis or focused on epiphytic communities.

Cupressus lusitanica (Cupressaceae) is among the most commonly used windbreak species (Harvey 2000a, Harvey 2000b, Nielsen and DeRosier 2000, Burlingame 2000) and appear to be poor habitat for epiphytes (*personal observations*). *Cupressus lusitanica* is an exotic tree used because of a fast growth rate, ease of cultivation on cleared land and extensive low branching (Burlingame 2000, Zuchowski 2005). *Myrsine coriacea* is a native tree with similar growth patterns (Haber et al. 2000) and, unlike *C. lusitanica,* appears to be good habitat for epiphytes (*personal observations*). *Myrsine coriacea* is not planted in windbreaks although the common name "*tapa viento*", Spanish for blocks wind, implies it has potential. If *M. coriacea* is better habitat for epiphytes it may provide a native alternative to *C. lusitanica.* This study compares epiphyte communities between the two species in an attempt to determine whether the apparent reduction in epiphyte richness is significant. Since epiphytes are a dominant component of cloud forest ecosystems, a study of this nature will increase understanding of the role *C. lusitanica* windbreaks play in the ecosystem and help establish how effective this species is as a reforestation tool. In addition studies investigating why the richness is reduced cannot be undertaken until the difference is established to be significant.

A variety of biological phenomena support the idea that epiphyte richness and occurrence should be the same between species. For instance, epiphytes are not dependent on their hosts for nutrients. In addition, epiphyte communities become more complex with age and the specimens analyzed are of equal age (potentially younger in the case of *M. coriacea*).

Other phenomena support the idea *C. lusitanica* should have increased richness. For instance, Island Biogeography Theory (IBT) predicts that targets of an equal distance from propagule sources and equal size and equal age should harbor equal richness and abundance. The average size of *C. lusitanica* in the study area is nearly double that of *M. coriacea*. Therefore, IBT predicts increased richness and abundance on *C. lusitanica*.

Personal observations as well as biological phenomena contradict the idea that richness and abundance is increased. *Cupressus lusitanica* has very fast growth rates and studies conducted by Gentry and Vasquez (1993) showed that epiphyte diversity is reduced on species with rapid growth rates. In addition *C. lusitanica* lacks resources that might attract disperser further supporting the idea that *C. lusitanica* would have reduced richness and abundance. Finally, conifers have been known to alter their environmental chemistry which may prevent epiphyte growth. Since biological phenomena exist to explain equal, reduced, or increased richness and abundance I conducted a survey to determine if the observed richness and abundance are reduced on *C. lusitanica.*

METHODS

This survey was conducted during the rainy season in a second growth lower montane forest adjacent to the Estación Biológica, Monteverde, Costa Rica (GPS). The site was chosen because succession on this property has progressed for a known amount of time allowing for assumptions to be made about tree ages. The *C. lusitanica* examined were planted in 1987; the *M. coriacea* examined grew as a result of natural succession that began in 1987. This led to the assumption that all *M. coriacea* were of the same age, or younger than the *C. lusitanica*. The area was paralleled, on one side, by intervened but intact forest. The remainder of the site surrounding consisted of second growth forest, a road and several residential establishments.

This study analyzed epiphyte communities on 36 individual trees (18 per species). Richness estimations were conducted on a morphospecies basis. Total richness was determined by visual analysis of tree boles in an area between 0 m and 3 m from the tree base. Occurrence data were collected using transparent acetates with 304, 1 cm^2, cells and recorded on a presence or absence basis. For this presence or absence data was collected for lichen, moss, ferns, orchids and non-orchid angiosperms. Bryophytes were considered present if they occupied $\geq$ 50% of the area of a cell; vascular plants were considered present if found regardless of the percent of the cell they occupied. Acetates were pinned to the east side of trees at 30 cm and 80 cm above ground. Occurrence data was pooled. Tree size measurements were taken using the circumference at breast height (cbh) method. In this study "BH" is defined as eye level for an individual who 1.75 m tall. In the event that a tree forked before this height the larger of the two forks was measured. The data were analyzed using ANCOVA, linear regression, and T-test.

RESULTS

A total of 26 morphospecies were identified and consisted of seven orchids, six lichen, five mosses, five ferns and three non-orchid angiosperms. However, in occurrence surveys, non-orchid angiosperms were absent and orchids were least abundant (n = 47), followed by ferns (n = 186). Lichens (n = 4078) and mosses (n = 13,329) were most abundant. Richness, total epiphyte abundance, and lichen abundance were found to be significantly higher on *M. coriacea* while moss abundance was found to be significantly greater on *C. lusitanica* (Fig. 1). ANCOVA revealed no significant relationship between variables for *C. lusitanica* (Table 1). ANCOVA revealed several significant relationships for *M. coriacea* (Table 2). All relationships reported by ANCOVA were negative (Fig. 2).

DISCUSSION

The results support the impression that *C. lusitanica* harbors reduced epiphyte richness and abundance. A negative correlation goes against predictions that arise from IBT. Since hundreds of studies support IBT, I argue this is a result of a unique characteristic of *C. lusitanica.* The idea that *C. lusitanica* has unique characteristic is further supported by ANCOVA results since the correlations between moss, lichen, DBH, and richness that were found on *M. coriacea* were not found on *C. lusitanica.*

Now that the apparent reduction in epiphyte growth has been established future studies can investigate ecological explanations for this result. This may be due to conifers ability to alter the surrounding chemistry. In addition I observed bark peeling off of *C. lusitanica.* A reduction of animal traffic in these areas may also be responsible for this reduction. It is for these reasons I recommend future studies focus on bark characteristics such as chemistry and adhesion as well as the presence of dispersers.

Studies of Monteverde windbreaks have shown that they are a powerful reforestation tool by providing habitat for a variety of forest tree species, including those associated with primary growth forests (Harvey 2000a). This is reportedly because of the shade they provide (Harvey 2000a). This study has shown that *M. coriacea* supports greater biodiversity. For this reason I propose that it would be a better windbreak species. Beyond the increase in epiphyte richness *M. coriacea* has fruits that attract frugivorous birds (Haber et al. 2000). Removal of *C. lusitanica* windbreaks might disturb characteristics that allow primary growth forest trees to grow. Therefore I argue that *M. coriacea* should be added to *C. lusitanica* windbreaks in order to increase the occurrence and variety of these species. Unfortunately, *M. coriacea* is a light loving species and current windbreak structure may prevent its proliferation. It is for this reason that I recommend future studies also investigate thinning effects on *C. lusitanica* windbreaks. If thinning of *C. lusitanica* windbreaks does not alter their ability to support primary growth trees and increases the ability to support *M. coriacea* then the combination of these two species may prove to be a more powerful reforestation tool.

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