FOREST STRUCTURE ON OPPOSITE SIDES OF CERRO CALIZOS RIDGE AT PALO VERDE, COSTA RICA

CHAD M. VALDERRAMA, ANNA R. NOWOGRODZKI , S. ALLIE HUNTER, GABRIEL H. CALVI AND MELISSA A. BARGER

Abstract: The Cerro Calizos limestone ridge at Palo Verde, Costa Rica divides a deciduous, tropical dry forest into north- and south-facing slopes. The north side has gentle slopes, while the south side is steep; the slopes also differ in microclimate. We hypothesized forest structure would differ on the two slopes, and predicted that the north side would have greater number and size of trees, total basal area, canopy cover, ground cover, and sapling density. We found more ground cover and canopy cover on the north side, and greater DBH on the south side, but no differences in basal area, number of trees, or sapling density. The lack of significant difference in most of these measures of forest structure was surprising given that the differences in slope are likely to cause differences in soil depth and moisture-holding capacity in this seasonally dry tropical forest.

Key Words: slope, topography, tropical dry forest

INTRODUCTION

Even on a very small scale, topographical features can cause differences in productivity and plant distributions, especially in mountainous regions (Ricklefs 1990). The Cerro Calizos limestone ridge in Palo Verde National Park, Costa Rica divides the local deciduous, tropical dry forest into north- and south-facing slopes. These slopes differ in aspect, with the south slope receiving more solar radiation and perhaps more wind. Therefore, microclimate probably differs between the two slopes. On the north side, slopes are gentle and the saddle-shaped topography may result in less erosion and thus deeper soils, than on the steeper south side. We hypothesized that forest structure would differ on the two sides of this ridge. We expected the north side to have larger and more numerous trees, and higher total basal area, canopy cover, ground cover, and sapling density.

METHODS

We set up parallel transects 30 m off the Guayacan trail on the north side of the ridge and 30-45 m below the cliff face on the south. There were seven circular plots, 25 m in diameter, approximately 100 m apart along each transect. Transects were set up running N/S and E/W through the center of each plot. To measure forest structure, we quantified sapling density, canopy cover, ground cover, number of trees, diameter at breast height (DBH) of trees, and basal area for each plot. Within 0.5 m on each side of the transects, we measured sapling density, defined as the number of woody plants above breast height < 6 cm in diameter. To measure percent canopy cover, we took the average of

five spherical densiometer readings, one in the center of each plot and one in each of the four quadrants. We included the cliff on the south side as measured canopy cover (because it prevented sunlight from reaching the understory). Percent ground cover of the whole plot was visually estimated. We counted the number of trees > 6 cm DBH per plot and measured the diameter of each. Basal area was measured from the center of each plot using a 10x English prism.

We recorded the elevation in meters of the center of the plot with an altimeter, calibrated to 0 m at the Palo Verde marsh. Because the slope on the south side was estimated to be 30° steeper, plot sizes were slightly different. To account for this, we corrected sapling density and number of trees for plot size after data collection, using the formula: corrected plot size = cos 30 * measured plot size. We analyzed these data using JMP 5.0.1 and verified the assumption of normality and homogeneity of variance. ANOVAs were used on each measure to determine differences between the two sides of the ridge, and a non-parametric Spearman's Rho correlation matrix was used to assess whether our measures of forest structure were correlated.

RESULTS

Percent ground cover and elevation were greater on the north side than the south side of Cerro Calizos (Table 1). DBH differed slightly, being higher on the south side. There were no differences in basal area, or in sapling or tree density (Table 1).

We calculated a correlation matrix, using Spearman's Rho, for all measures of forest structure, combining data from both slopes. The only significant correlations were between number of trees and basal area ($\rho = 0.63$, $P = 0.01$), DBH and elevation ($\rho = -0.60$, $P = 0.02$), and percent canopy cover and ground cover ($\rho = 0.70$, $P = 0.005$).

DISCUSSION

We found significantly higher canopy cover and ground cover on the north side of the ridge. This may be because soils on the north side are probably deeper and retain moisture longer into the dry season.

Table 1. Differences in forest structure metrics between north and south sides of the Cerro Calizos ridge, Palo Verde. Values are means ± 1 SE; n = 7 circular plots, 25 m in diameter, per slope.

Metric	North	South	P
Basal area	8.0 ± 2.4	7.9 ± 1.7	0.9008
Ground cover (%)	21.57 ± 13.25	7.14 ± 10.17	0.0143
Sapling density	7.1 ± 3.5	8.4 ± 5.9	0.6172
DBH	15.99 ± 2.74	19.50 ± 3.93	0.0764
Tree density	34.1 ± 5.0	30.1 ± 6.6	0.2159
Canopy cover (%)	62.40 ± 4.49	44.78 ± 26.89	0.1130
Elevation	139.9 ± 10.1	105.0 ± 16.6	0.0005

Also because of these characteristics, leaf-fall may be later on the north side than the south side of the ridge. When we collected data, we noted that many of the trees on the south side had already lost their leaves, resulting in a more open canopy. Additionally, we included the cliff on the south side as measured canopy cover, so the true difference in forest canopy cover between the north and south sides was probably greater than our results indicated.

The finding that canopy cover and ground cover were positively correlated was unexpected, since increased canopy cover often prevents light from reaching the understory. However, in this dry deciduous forest, canopy cover may not be dense enough on either side of the ridge to affect growth and development of understory plants. Also, if the north side has richer soil, this could result in both greater canopy cover and ground cover. The higher average DBH on the south side, however, is difficult to explain if the soil is poorer there. Although there was a difference in mean elevations between our two transects, this difference (35 m) seems unlikely to be biologically significant.

Overall, these results indicate that there are relatively few differences in forest structure between these two habitats. This was surprising, given the probable differences in soil depth, moisture-holding capacity, and microclimate associated with these north- and south-facing slopes.

LITERATURE CITED

Bailey, R. 1996. Ecosystem geography. Springer-Verlag New York, Inc.: Fort Collins, CO.

Begon, M., J. L. Harper, and C. R. Townsend. 1990. Ecology: Individuals, populations and communities. Blackwell Scientific Publications: Boston.

Ricklefs, R. E. 1990. Ecology. W. H. Freeman and Company: New York.