

Stand Dynamics of Secondary Forest Growth at the Firestone
Reserve,
Barú, Costa Rica

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I. Introduction

The Isla del Cielo Reserve is an area formally occupied by lowland rainforest, which was cleared for cattle ranching in the 1950s and 1960s. In 1993, ranching operations ceased on the property, and it was left largely undisturbed to permit the growth of secondary forest. The purpose of this study is to provide baseline data quantifying the maturity of the trees currently on the site, using a modified version of the TEAM protocol, for the ultimate goal of monitoring the continued progress of the reserve's reforestation over the next several years.

Readily identifiable trees and large shrubs growing on the plot being studied include *Piper* (pictured in Figure 1), *Miconia* (Figure 2), *Psidium* (Figure 3), *Psycotria* (Figure 4), and *Cecropia* (Figure 5). Additionally, one genera of bamboo, *Guadua*, grows on the plot (Figure 6).



Figure 1 Piper



Figure 2 *Miconia*



Figure 3 *Psidium*



Figure 4 *Psycotria*



Figure 5 *Cecropia*



Figure 6 *Guadua*

II. Materials and Methods

This study was conducted using a modified version of the TEAM protocol for biodiversity assessment (www.teaminitiative.org). The study area selected is immediately north of the Upper Loop Trail (fig 7.) in habitat that was cleared for grazing until 1991-1992, and then abandoned to natural re-growth. The origin (lower-left corner) of the study plot was chosen to be a small boulder on the edge of the trail. A rebar stake was placed at each of the four corners of a 30 x 30 meter plot. Bamboo stakes were placed at 3 meter intervals along the sides of the square. String was tied from one end of the plot to the other, first connecting the rebar corners, forming a square, then connecting the bamboo stakes directly across from one another to form 100 3 x 3 meter quadrats within the study area (see *Figure 7*). Trees and shrubs with

diameters greater than or equal to 1.5 cm at breast height were plotted on a grid and their diameters were recorded.

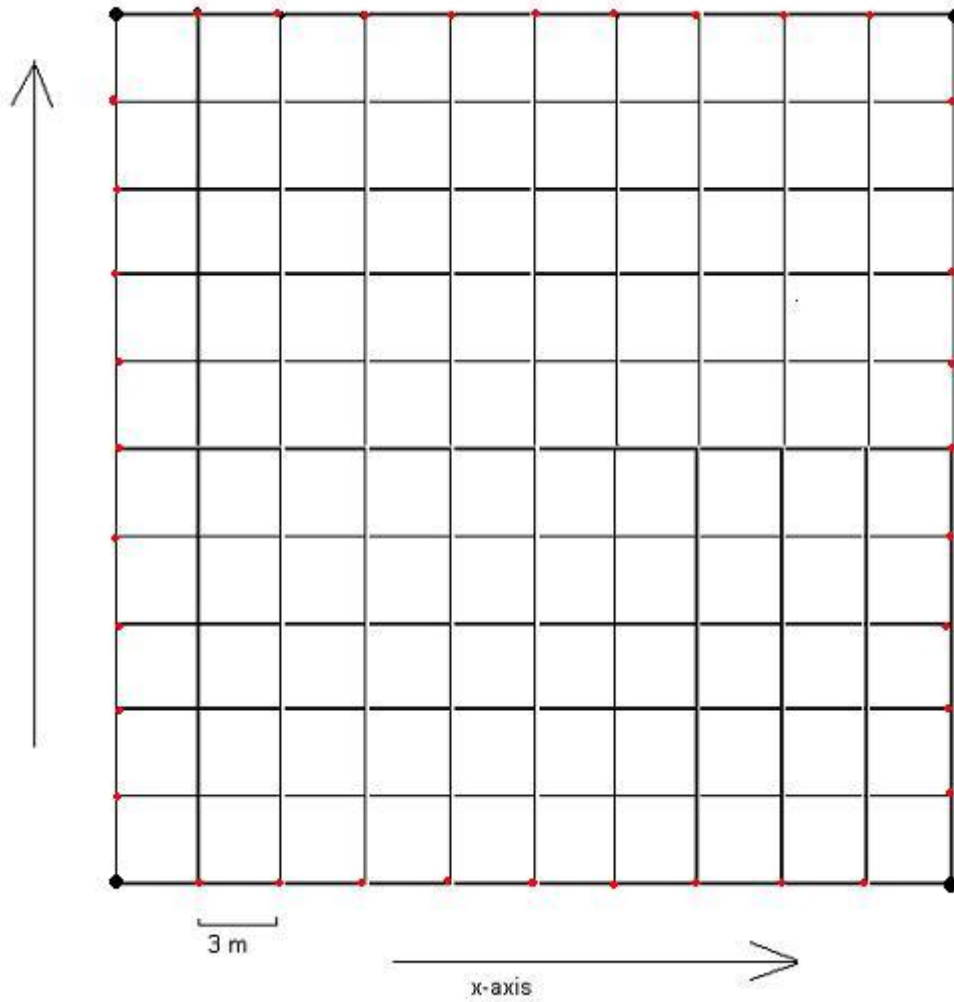


Figure 7 Tree plot

III. Results and Discussion

The distribution of trees and shrubs within the plot is given in *Figure 8*:

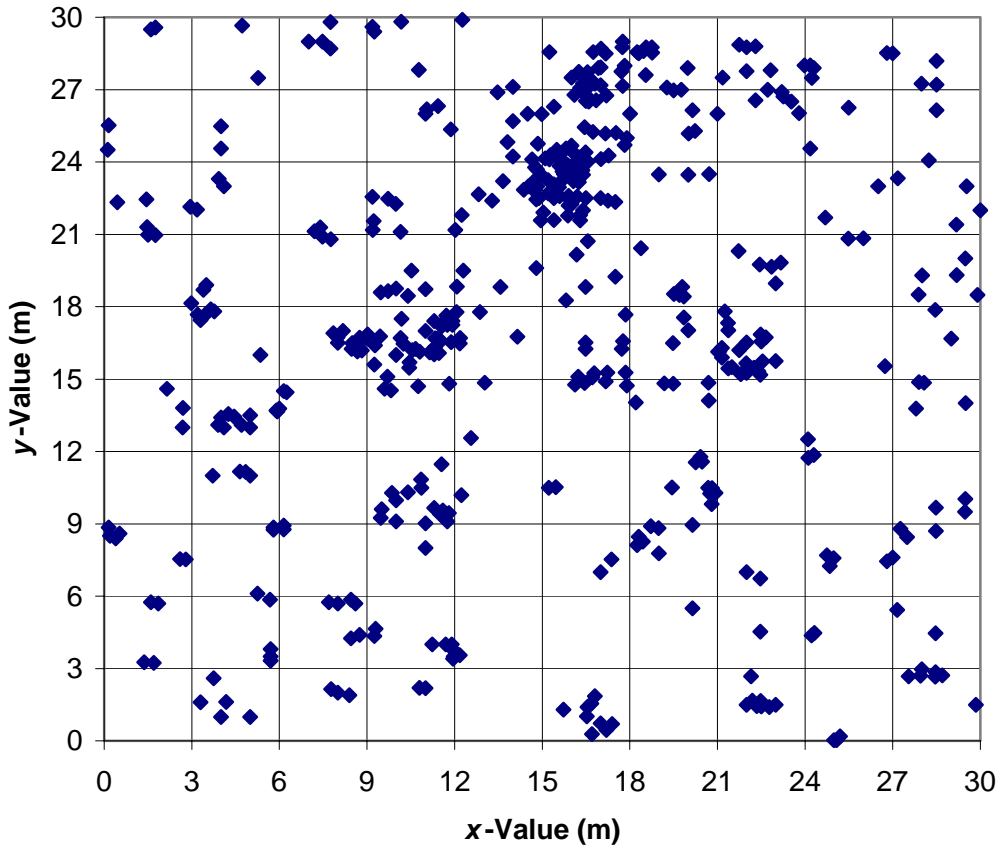


Figure 8 Placement of trees and shrubs within plot

The numbers of individuals within the plot of each (diameter) size bracket represented are given in Figure 9:

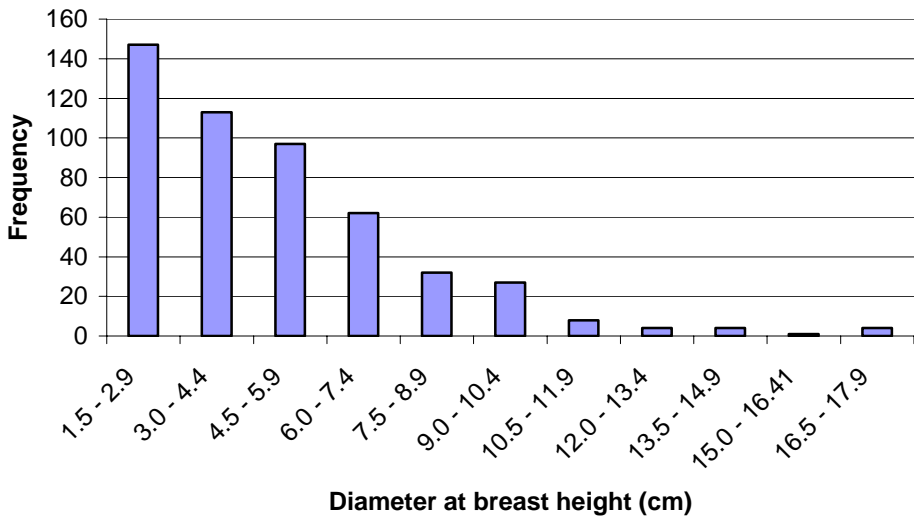


Figure 9 Frequency of diameter sizes

The dispersion pattern of organisms can be quantified with a variance/mean ratio, where random distributions approximate ratios of 1, clumped distributions have ratios in excess of 1, and over-dispersed patterns have ratios of less than 1. The distribution of trees and shrubs in the 100 quadrats have a variance/mean ratio of 6.6, indicative of a highly clumped distribution. This was confirmed with a chi-squared analysis using the poisson function to compute expected quadrat densities:

Quadrat tree density	Expected # of quadrats from Poisson function	Observed # of quadrats	Chi-squared
0	0.83	12	173.148
1	3.98	5	6.27566
2	9.54	24	60.37211
3	15.23	10	6.564469
4	18.24	15	12.33407
5	17.48	8	3.66217
6	13.95	7	3.512128
7	9.55	4	1.675934
8	5.72	2	0.699763
9	3.04	5	8.217473
10	1.46	1	0.686219
11	0.63	0	0
12	0.25	0	0
13	0.09	0	0
14	0.03	1	31.31598
15	0.01	1	98.06675
16	0.00	0	0
17	0.00	0	0
18	0.00	0	0
19	0.00006	1	17329.05
20	0.00	1	72355.11
21	0.00	0	0

22	0.00	0	0
23	0.00	0	0
24	0.00	0	0
25	0.00	0	0
26	0.00	0	0
27	0.00	1	5.6E+09
28	0.00	0	0
29	0.00	1	1.98E+11
30	0.00	0	0
31	0.00	1	8.03E+12

The chi-squared value of 8.23×10^{12} with 99 degrees of freedom demonstrates that the clumped distribution is highly significant ($P \ll 0.0001$).

The stand dbh distribution is remarkably even, with all size classes well represented.

IV. Discussion.

The study plot has been abandoned to natural recovery for at least 12 years at the time of this assessment. The extent of recovery is less than expected, with many shrub species present but relatively few tree species providing canopy cover. The reasons for the slow rate of recovery are not known, but may include damage to the soil cover which often accompanies forest clearance on steep hillsides, and continued occasional grazing by cows until March 2005.

Follow-up studies should address the density and distribution of the pioneer canopy tree species *Cercropia*, and be accompanied by quantitative measures of canopy coverage.

V. Acknowledgements.

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