THE SUPPLY-SIDE ECOLOGY OF THE FOREST ON BCI: A ROLE FOR DISPERSAL LIMITATION?

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Seed dispersal sets the stage for population and community dynamics since, where no seed arrives, no recruit will be produced. Despite this fact, few large-scale, long-term projects have monitored seed dispersal in diverse tropical plant communities. In this article, I describe an extensive research program underway on the 50-ha Forest Dynamics Plot on Barro Colorado Island (BCI), designed to better understand the dispersal phase of recruitment and its relationship to the establishment phase.

On January 1, 1987, Dr. S. Joseph Wright of the Smithsonian Tropical Research Institute (STRI) began monitoring the community-wide rain of plant propagules and reproductive debris in the 50-ha plot on BCI. Just prior to that time, Dr. Wright and field technician José Polanco placed 200 traps along the trail system that snakes through the 50-ha plot (Figure 1). Each trap is constructed from a 0.5 m x 0.5 m PVC frame supporting a shallow, open-topped, 1 mm nylon-mesh bag, suspended 0.8 m above the ground on four PVC stakes.

During the first year of monitoring, Mr. Polanco identified and counted, on a weekly basis, every seed, fruit, and flower > 1 mm that fell into the traps. Osvaldo Calderón took over as the new field technician on January 1, 1988, at which time it was decided to record flowers on a presence/absence basis by species for each trap each week, while continuing to count all seeds and fruits > 1 mm. Together, Mr. Polanco and Mr. Calderón have counted and identified over 1,000,000 items from 450 species of trees, shrubs, lianas, and epiphytes!

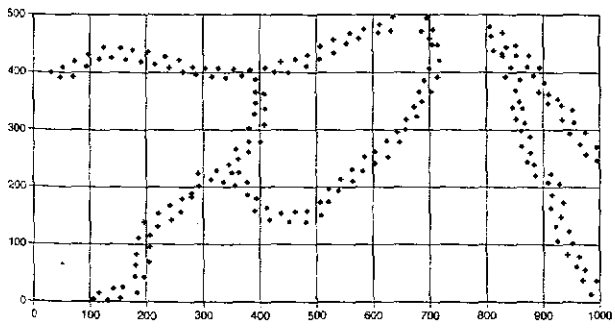

Fig. 1. Locations of the 200 phenological monitoring traps found along the trail system of the 50-ha Forest Dynamics Plot on BCI.

Dr. Wright's objective in undertaking this project, funded by STRI's Environmental Studies Program, was to better characterize the reproductive phenology of this species-rich plant community. To this end, the project has been quite fruitful.

When I learned of this trapping project, I recognized the potential for using the data to quantify community-wide spatial patterns of the seed-rain within the 50-ha Forest Dynamics Plot, and to understand its consequences for population and community dynamics. Armed with eight years of data, Dr. Wright and I are using the mature fruit and seed data for tree and shrub species to characterize spatial patterns of the seed "input", that is, the supply-side ecology, of the forest on BCI. The most striking results from our analyses have been the small numbers of species found per trap, relative to the tree and shrub community of the 50-ha plot. Over the 8-yr trapping period, we recorded an average of 15 out of 108 (14%) canopy tree species per trap (Figure 2). This observation suggests that dispersal limitation may be an important phenomenon with consequences for the dynamics of this community. That is, viable seeds do not appear to be reaching all sites in which they could produce seedling and sapling recruits.

One might criticize our estimates of the species-richness of the local seed-rain by pointing out that the seed traps miss secondary seed-dispersal by rodents, ants, and others which should homogenize the seed-rain. However, there are also reasons to argue that our method may provide an over-estimate of the species-richness of the local seed-rain. Since seeds were only scored for maturity, but not for viability (despite the prevalence of pests, parasites, and predators that damage seeds prior to primary dispersal), and since many of the species found in a given trap represent a single seed during the 8-yr interval, we may have over-estimated the mean number of species dispersing viable seeds to each trap location.

In 1994, we began a complementary endeavor to the seed-trapping program. The objective of the new monitoring project is to further test the dispersal-limitation hypothesis, as well as the null hypothesis that shade tolerant tropical tree seedlings are competitively equivalent. Each year since 1994, during the dry season, Eduardo Sierra has identified, measured, and mapped all seedlings in three 1 m x 1 m plots surrounding, at a distance of 2 m, each of the 200 seed traps. In addition, since the main database for the 50-ha plot only includes stems ≥ 1 cm dbh, Mr. Sierra also began censusing saplings (woody stems ≥ 50 cm in height and < 1 cm dbh) in 5 m x 5 m plots centered on each of the 200 traps. By comparing the recruit "output" relative to the seed "input" in the community, we will soon be able to address: 1) whether positive correlations exist between seeds/trap and conspecific recruits, thereby providing an indirect test of dispersal limitation, and 2) whether random sampling of the local seed-rain predicts the local composition of recruits, thereby indirectly testing for competitive equivalence at the seedling/small sapling stage. If non-random thinning from the seed to seedling or sapling stage exists, we will be able to conduct appropriate statistical tests to better understand the non-random nature of recruitment. ■

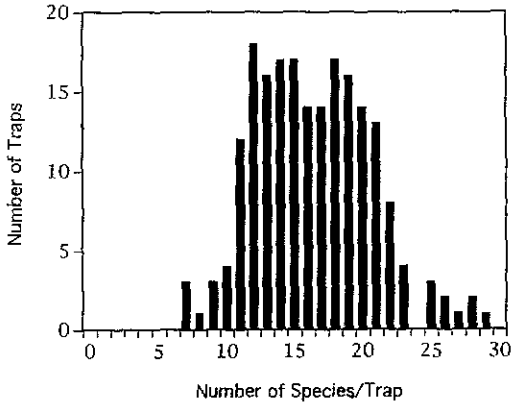

Fig. 2. Histogram of the number of canopy tree species (found as seeds) per trap over the 8-yr period, inclusive (n=200 traps).

K. E. Harms. 1996. CTFS Newsletter.

Erratum

Seed-traps were 0.71 x 0.71-m = 0.5 m^2