

We use identical methods to monitor flower and seed production and the recruitment, growth and mortality of seedlings for trees and lianas (woody vines) in four Neotropical forests. A large number of census stations (120 to 250) are located within a large Forest Dynamics Plot at each site. Each station includes one 0.5-m² flower/seed trap and three 1-m² seedling plots (Fig. 1). Detailed descriptions of the methods used in the seed and seedling components of the study follow.

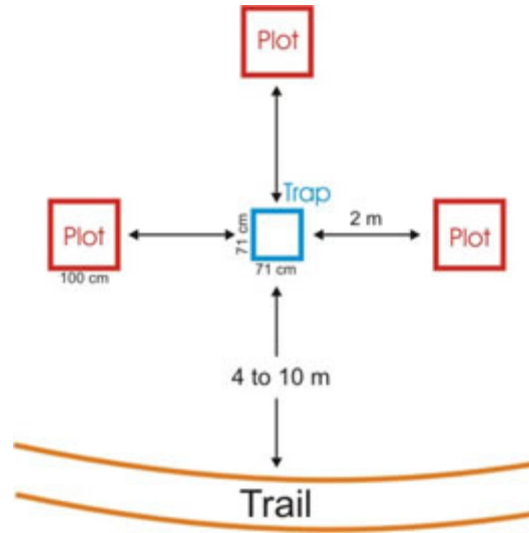


Figure 1. A schematic diagram of a census station at Barro Colorado Island, Panamá or Yasuni, Ecuador. Census stations are identical at Luquillo, Puerto Rico and the Parque Nacional San Lorenzo, Panamá except there were no pre-existing trails at these sites.

FLOWERS AND SEEDS

We census flower/seed traps (Fig. 2) each week in Panamá, every second week in Puerto Rico and twice each month in Ecuador. Botanically gifted technicians identify all plant reproductive parts to species. Flowers of all species and reproductive buds of selected species are recorded on a logarithmic scale (1, 2-10, 11-100, 101-1000, >1000). Staminate flowers are recorded separately in Panamá. Immature fruit, mature fruit, seeds, “capsules”, fruit damaged by pre-dispersal predators, and fruit fragments are counted for all species. A filled endosperm distinguishes mature from immature fruit for most species. “Capsules” refer to pedicels, bracts, valves or another fruit part that arboreal vertebrates never consume and enable estimates of fruit consumption by arboreal vertebrates. Approximately 80% of our species have a “capsule” that can be identified to species. Fruit damaged by pre-dispersal seed predators bear an emergence hole. Fragments occur when birds, bats and arboreal vertebrates drop fruit parts. We estimate the number of whole fruits represented by fragments by counting points of attachment to pedicels. We can convert among seeds, “capsules” and mature fruit using seed-to-fruit and capsule-to-fruit ratios determined for each species. Photographs of all reproductive parts for Panama can be viewed and downloaded (http://striweb.si.edu/esp/tesp/plant_search_quick.htm).

Each flower/seed trap has a surface area of 0.5 m². Traps consist of a square, open-topped, 1-mm mesh bag supported by a polyvinyl chloride (PVC) frame (Fig. 2). Two legs of each trap are mounted on lengths of concrete reinforcing bar previously driven into the ground to ensure that traps never move. Traps are located at 13.5 m intervals on alternating sides of pre-existing trails and randomly between 4 and 10 m from the trail at Barro Colorado Island and Yasuni and randomly at Luquillo and the Parque Nacional San Lorenzo where there were no pre-existing trails

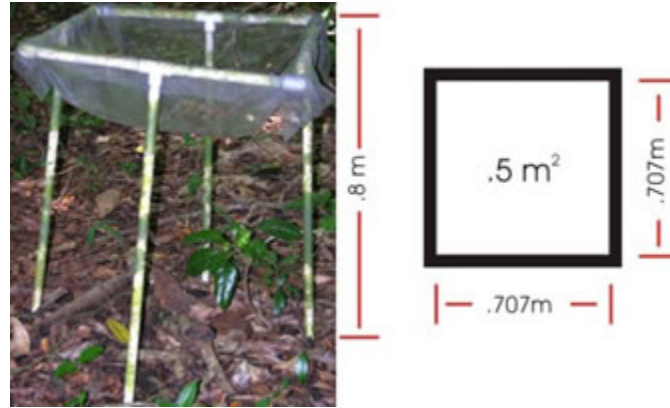


Figure 2. A flower/seed trap on Barro Colorado Island, Panamá.

The materials used to build one flower/seed trap follow:

- Six meters of PVC pipe cut into four 80-cm legs and four 70.7-cm sides
- Four PVC elbows – forms corners (see Fig. 1)
- Four PVC “tees” – point of attachment for legs (see Fig. 1)
- Two meters of 0.25-inch diameter concrete reinforcing bar (driven 0.5 m into ground to hold two legs in place)
- One four foot by four foot (1.3 m by 1.3 m) piece of window screen material (we use plastic coated fiberglass window screen). Replacements will be needed.
- One meter of wire (to fix screen to PVC frame)

We use 0.5 inch diameter PVC for water lines. Electrical conduit will not work. The PVC elbows and tees can be replaced with PVC “right angles out”. “Right angles out” form the corners of a cube, are used in irrigation systems, but are hard to find in wet, tropical countries.

SEEDLINGS

We census seedling plots (Fig. 1) once each year at all sites. Every woody seedling is identified, measured (height and number of leaves), and permanently tagged with a numbered band. Canopy photographs are taken over each seedling plot each year to assess light availability.

Species-level identifications are enabled by the pioneering work of Dr. Nancy Garwood for Panamá and Ecuador (X reference to Nancy’s book; unpublished) and by the relatively modest number of species for Puerto Rico. Height is measured from the ground along the main stem to the apical meristem. Any branches are gently gathered together, and height is then measured to the apical meristem along the longest branch. The number of leaves is not recorded for plants with more than 50 leaves.

We measured every woody seedling less than 50 cm tall in the initial census at each site. We continue to census seedlings that grow taller than 50 cm. Seedlings too small to support a numbered band (< 3 cm tall) are temporarily marked with color coded plastic tooth picks. The tooth picks are replaced by numbered bands in subsequent censuses if the seedling survives to an appropriate size.

The annual censuses document seedling recruitment, growth and mortality. The proximity of seed traps and seedling plots enables an evaluation of the seed-to-seedling transition through comparisons of seed inputs and seedling recruitment. Canopy photographs enable evaluation of seedling light dependence.

