ECOLOGICAL FIELD METHODS:
CHARACTERIZING VEGETATION STRUCTURE

Vegetation structure has important implications on resource availability, carbon stocks, succession, and community composition. This exercise will teach you standard methods for characterizing forest structure.

Learning Objectives

1. To describe the components of vegetation structure and the value of collecting such data.
2. To learn methods of estimating tree density, diameter at breast height (DBH), canopy openness, size class distribution, and basal area for forest characterization and monitoring.
3. To obtain practice in two plotless sampling methods: transects and point-centered quarters.
4. To learn the proper use of compass, reel tapes, and diameter tapes.
5. To learn procedures for estimating density, basal area, and size-class distribution of individuals.
6. To interpret vegetation structure data to assess reforestation outcomes and make predictions about future forest structure.

Background

- Density and size class distribution of trees is an indicator of forest age, successional status, and future forest composition.
- A 10-ha pasture was reforested in 2006 with several tree species in approximately a 3x3 m spacing. The recovery of natural forest structure and diversity is being monitored through time as the plot matures.
- The intact forest at Lalo Loor is a fragment of ~250 hectares. Density of large trees may decrease in forest fragments due to higher mortality; at the same time, sapling density may increase or decrease depending on disturbance, light availability, edge effects, effects on seed dispersers and herbivores, impacts of cattle and other factors (Laurance 2001).

RESEARCH QUESTION

How does vegetation structure (tree density, basal area, and size class distribution) differ between intact semi-deciduous forest and reforested areas in coastal Ecuador?

HYPOTHESES – enter your expectations in the space below.

DATA COLLECTION

1. Work in groups. Obtain a reel tape, diameter tape, compass, and stake flag.
2. Your group will be assigned to sample either the forest or the reforestation plot. Set up a 60 m long transect at the starting location indicated by your instructor.

Point-Centered Quarter Method:

3. Establish sampling points at 0, 20, 40 and 60 meters along your transect (4 points per group). At each point estimate density of trees <10 cm dbh and >10 cm dbh using the Point-Quarter Method (see diagram below):
    - establish the center point
    - using a compass, visually divide the area around the point into four quarters (NE, SE, SW, NW).
    - record the distance in meters to the *center* of the nearest tree <10cm DBH in each quarter.
    - also record the distance in meters to the *center* of the nearest tree >10cm DBH in each quarter
    - measure the diameter at breast height (DBH in cm) of the trees >10 cm using a diameter tape. (Note: DBH is taken at 1.37 m). For trees with multiple trunks, measure the DBH of all trunks. (The *area* of each will be added for basal area calculations).
    - do not include shrubs, dead trees or trees less than 2 m tall.

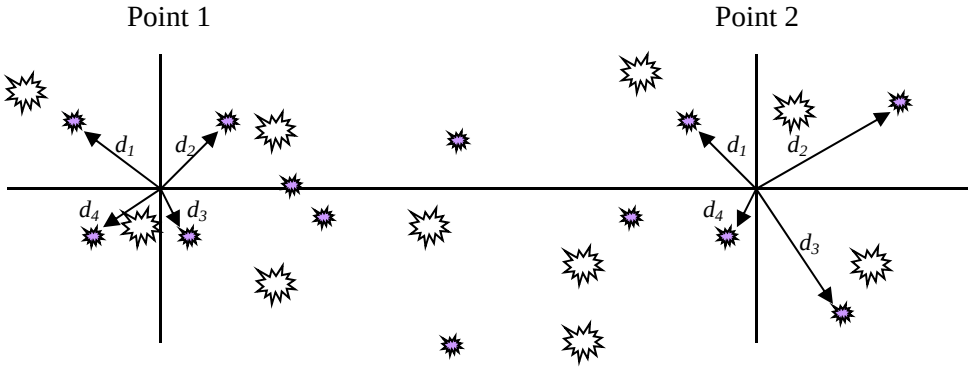

Fig. 1: This diagram shows how to measure distance to trees <10cm dbh
You will also measure the distance to the nearest tree >10cm in each quadrant.

DATA ANALYSIS

Share data with the other group that sampled in your forest type (reforestation or intact forest). All analyses below will be based on the 8 points (64 trees) sampled in your forest type.

1. Tree Density estimation from point-quarters (tree density = # trees/ha)

- Calculate the density of trees <10 cm and >10 cm DBH in your forest type using the equation at right:

D = density estimate (per m^2)
n = # of points sampled
π = 3.14159
d_{ij} = distance from point i to nearest plant in quadrant j (in meters)

$$D = \frac{4(4n-1)}{\pi \sum_{ij} \left(d_{ij}^{\ 2}\right)}$$

- Convert the densities to # trees/hectare. 1 ha = 10,000 m^2
- You will now have two density estimates for your forest type: $D_{>10cm}$ and $D_{<10cm}$

2. Size class distribution - a size class distribution is a histogram of the frequency of trees of different sizes in a forest.

- Calculate percentage of trees in each of the following DBH classes (10-20, 20-30, 30-40, 40-50, >50 cm) out of the total number of trees >10 cm observed.
- Multiply $D_{>10}$ (per ha) by the proportion of trees in each size class to obtain density for that size class.
- Plot size class distribution (density of individuals vs. size class) for each size class including 0-10 cm ($D_{<10}$) and all the size classes listed above.

3. Basal area (BA) estimation - B.A. is the total area in a forest occupied by trees >10cm DBH

- Convert diameters (in cm) of all trees >10 cm into area (cm^2).
- Calculate the mean area of all trees, and multiply by density ($D_{>10}$). This is the estimated basal area per hectare (in cm^2/ha). You may divide the numerator by 10,000 to obtain BA in m^2/ha.

4. Share results:

- Share your density, basal area, size class graph with groups who sampled the other forest type before interpreting the outcomes of the study.

DATA REPORTING & INTERPRETATION:

1. Report all results as described above.
2. Do the results appear to support or refute your hypotheses?
3. How do tree density and basal area differ between intact forest and the reforested area? What factors might explain any differences you observe?
4. Do the size class distributions differ between intact forest and reforested area? Discuss the factors that might account for the patterns you see.
5. What can you predict about the future structure of the forest (in both locations)?