Christiana River Basin Critical Zone Observatory: Preliminary Results from the Vegetation Survey for Validation of Airborne LiDAR Imagery

Investigators: John Van Stan, Stephanie Stotts, Delphis Levia, James Pizzuto, Donald Sparks

OBJECTIVES:

The objectives of this study were to: (1) identify sites with a variety of different vegetation coverage types (i.e., conifer, deciduous, mixed, and meadow) from within the airborne LiDAR coverage zone, (2) select areas of dense, medium, and sparse vegetation density from the previously selected vegetation coverage areas, (3) select 30-40 circular sample plots with a 15m radius from the previously selected areas of varying vegetation coverage and density, (4) to perform a vegetation survey, including plot-scale data (location, LAI, closure, and density) and individual-scale data (location, species, height, dbh, and crown class) for use in ground truthing of airborne LiDAR.

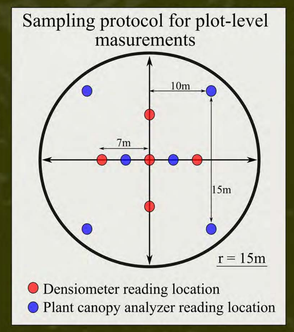
METHODS:

Site Selection:

Areas of conifer, deciduous, mixed, and meadow vegetation types were identified using aerial photographs. Forested sites were then classified as sparse, medium, and dense. During field visits, plot centers were selected such that they were located at least 20m from any man made objects. The coordinates of each plot center was recorded with a Trimble GeoXH, and photos were taken from the North, South, East, and West and from the center looking up (1.3m from the ground).

Plot Level Measurements:

Average crown closure was measured using a spherical densiometer (Paletto and Tosi 2009). Average LAI value was measured using 6 points collected by a plant canopy analyzer (Licor LAI-2000), as outlined by Jensen et al (2008), and, when necessary, corrected per Gower & Norman (1991).



Individual Level Measurements:

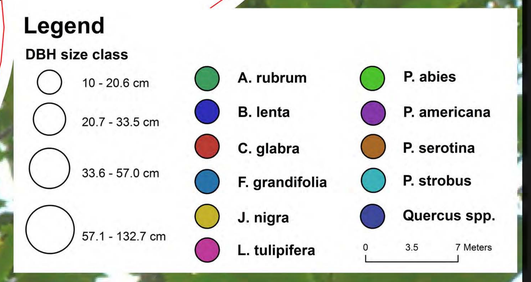
At the individual level, the species, location, height, dbh, and crown classification were recorded. The location of each tree with a dbh greater than 10cm was recorded by measuring the distance and azimuth of each tree from the center point with a laser ranger finder. The laser ranger finder was also used to measure tree heights. For each tree, the height was measured three times, and these values were averaged.

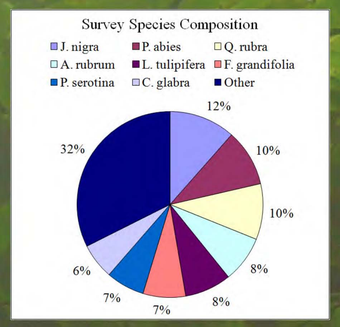
Sparse Coniferous (Pine) Site	
Stand density (trees / hectare)	297
LAI (sq. meter / sq. meter)	4.6
Canopy closure (%)	56.94
Dominant trees (%)	14.29
Suppressed trees (%)	9.52
Mean dbh (cm)	40.5

Dense Coniferous (Spruce) Site	
Stand density (trees / hectare)	636.62
LAI (sq. meter / sq. meter)	4.8
Canopy closure (%)	62.98
Dominant trees (%)	0.00
Suppressed trees (%)	0.00
Mean dbh (cm)	35.0

Sparse Mature Hardwood Site	
Stand density (trees / hectare)	170
LAI (sq. meter / sq. meter)	4.3
Canopy closure (%)	69.84
Dominant trees (%)	16.67
Suppressed trees (%)	16.67
Mean dbh (cm)	49.7

Dense, Mature Oak-Hickory Site	
Stand density (trees / hectare)	312
LAI (sq. meter / sq. meter)	4.3
Canopy closure (%)	65.89
Dominant trees (%)	18.18
Suppressed trees (%)	9.09
Mean dbh (cm)	31.2





RESULTS:

A total of 27 different trees species were recorded from the experimental plots with *J. nigra* being the most common species. The mean percentage of dominant and suppressed trees among all plots was 16% and 13%, respectively. Mean canopy closure among denser plots was approximately 60%. The mean LAI for all plots was 3.1 ± 1.3 (SD). The maximum plot LAI recorded was 4.9, whereas the minimum plot LAI was 1.0. For the deciduous plots, the mean LAI was 3.0 ± 1.2 (SD) compared to 4.7 ± 0.1 (SD) for the two coniferous plots. The relatively low mean LAI for all plots is, in part, attributed to a mean stand density of 190 trees per hectare.

REFERENCES:

Gower, S.T., Norman, J.M., 1991. Rapid estimation of leaf area index in conifer and broad-leaf plantations. Ecology 72: 1896-1900.
Jensen, J.L.R., Humes, K.S., Vierling, L. A., Hudak, A.T., 2008. Discrete return lidar-based prediction of leaf area index in two conifer forests. Remote Sensing of the Environment 112: 3947-3957.
Paletto, A. and Tosi, V., 2009. Forest canopy cover and canopy closure: comparison of assessment techniques. Eur J Forest Res 128:265–272.