Analysis of Woody Debris in Varied Successional Stages in a Northern Hardwood Forest

Jessica Swindon

Introduction:

Nutrient storage and cycling in a forest ecosystem are impacted by changes in forest structure and composition which can be linked to the degree of succession. The amount and composition of annual litter fall plays a significant role in both nutrient storage and cycling by providing the forest floor with a consistent flux of nutrients, primarily carbon as well as calcium, magnesium and potassium. Woody debris is thought to contribute to the carbon cycle by providing the ecosystem with a consistent yet sustained source of nutrients. Quantifying the total biomass of downed wood in a stand allows for conclusions to be made about contributions to the carbon cycle. In this study coarse woody debris (CWD) volume per hectare and fine woody debris (FWD) biomass will be calculated in order to make conclusions regarding the carbon stock of the forest. The study will take place in treatment plots so that future studies can be completed to predict how the addition of nutrients effects the carbon stock. Understanding woody debris is important because it gives insight into wildlife habitat and productivity and base cation availability. Carbon stock allows for conclusions to be made about co2 sequestration. This study aims to..

Study site:

The study site consists of 10 northern hardwood stands of varying successional stages in the White Mountain National Forest, New Hampshire. Eight of the stands are located within the Bartlett Experimental Forest (C1-C8), 1 stand is located in the Hubbard Brook Experimental Forest and the other in Jeffers Brook Forest. The stands are generally even aged and had been logged sometime between 1875 and 1990. Each stand contains a control plot and 3 treatment plots (N, P and N&P). Some stands contain calcium treatment plots but were discluded from this experiment due to time and resource constraints. Dominant tree species of young stands (<35 yrs) are dominated by pin cherry (Prunus pensylvanica), American beech (Fagus grandifolia), yellow birch (Betula alleghaniensis) and white birch (B. papyrifer). Stands 35-65 years consist primarily of American beech, sugar maple (Acer saccharum), yellow birch and white birch meanwhile the older stands include all the species previously listed plus red maple (Acer rubrum) (Acker 2006).

Methods:

Measuring the volume and biomass of woody debris in Bartlett Experimental Forest will allow me to quantify carbon stocks of stands of varying ages. Woody debris will be examined in stands C1, C2, C4, C6, C7 and C8. To measure the volume of coarse woody debris I will be using the line-intersect sampling technique similar to that of the techniques used in Acker, 2006 which was originally adapted from USFS Forest Inventory Analysis (PNW FIA, 2002). A permanent center post will be installed in the control, N, P and N&P plots that is bright pink with a white stripe across the top half. Four transects will be ran starting from the center post, using a 25m or greater meter tape, in the direction of each orange corner post. Any piece of woody debris that is ≥ 30mm, over 1 meter long and intersects the transect will be considered coarse woody debris (CWD) for this experiment. Debris will only be measured if present below or equal to 45 degree angle. Transects will be labeled according to what corner they run to (i.e A1). Diameter at intersection, length and decay class will be recorded. The exact location of the log along the transect will also be recorded. Large end and small end diameter will be measured for a more accurate volume and cover estimate (Waddell, 2002). It is important to acknowledge if a piece of debris came from outside the plot in order to accurately predict treatment effects on woody debris therefore the source of the fallen woody debris will be recorded. In order to prevent double counting, pin flags will be temporarily placed by debris pieces that have already been surveyed. If a piece happens to intersect with two transect lines an average of the two diameters at intersection will be used. Decay class will be based on the USDA forest service criteria (Source 3). The following equation is used by the FIA program to accurately estimate the volume of a downed log while incorporating the tapering aspect (Waddell, 2002).



The following protocol has been modified from Vadeboncouers protocol of FWD surveying in C1 and C2 in 2006. The control and 3 treatment plots (N, P, N&P) in stands C1, C2, C4, C6, C7, and C8 of Bartlett Experimental Forest will be surveyed. In each plot, the D1 post will be selected as the reference point. The FWD plot will be placed 3 m perpendicular to the closest litter basket (C3) so that each plot has one FWD subplot. The FWD plots (2x2m) will be marked with four bright pink posts with a white stripe across the top half (2.83 m apart-diagonal from each other). Subplots should be easy to relocate in the future. Twigs will be collected in .5 x .5m nested subplots and separated into two size classes <7.5mm and 7.5-16mm. Twigs and branches 16-30mm in size will be collected in the remaining area (See attached picture). Twigs with sections of >30mm in diameter will be cut where the diameter exceeds this threshold. Leaf litter from the past two years will be brushed aside and anything on top of or under the layers will be considered part of the experiment and measured and collected. Dead branches detached from trees but suspended over the forest floor will be collected up to 2.5m in height. No branches or twigs will be collected if leaning above a 45° angle. The samples will be bagged and returned to the lab where they will be dried at 60°C (Vadeboncoeur, 2007) for 24 hours. The dried samples will be weighed to estimate biomass per hectare.

Expected results:

Older stands (C7, C8) will have a greater total volume per hectare of coarse woody debris since the older trees have more time to develop.

Future Studies:

 Early successional species of northeast hardwood forests such as pin cherry (Prunus pensylvanica) and yellow birch (Betula alleghaniensis) are relatively high in calcium meanwhile beech (Fagus grandifolia) and white birch (Betula papyrifera) which are dominant species in middle to old age forests have moderate to low concentrations of calcium (Hamburg et al. 2003). The shift in species that occurs overtime will lead to fallen woody debris containing varied nutrient stocks to provide a gradual release of important minerals like calcium and other nutrients such as carbon. It is important to understand how stand age relates to woody debris in order know the impact on nutrient fluxes to the forest floor.

Citations:

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