An Investigation of Tree Biomass in the Great Smoky Mountains National Park

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An Investigation of Tree Biomass in the Great Smoky Mountains National Park

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Abstract
We determined the biomass (carbon storage) of four forest types in the Great Smoky Mountains National Park: pine/oak, cove hardwood, northern hardwood, and spruce/fir. Based on the GLOBE Programs land cover protocols (www.gbbc.gov), and the University of New Hampshire’s GLOBE Carbon Cycle Program (http://globecarboncycle.unh.edu/), we knew that species and tree circumference would be the two most critical factors in determining biomass, but we also hypothesized that number of trees in a study site and the elevation of the site would impact biomass. We hypothesized that old growth forest would contain greater biomass than a young forest. We recorded tree species and circumference for every tree that had a circumference greater than 15 centimeters in each plot of 900 square. The circumference of a total of 219 trees represented 22 different species, as well as forest type, elevation, and GPS coordinates for each plot, were recorded.

Hypotheses
Old growth forest will contain greater biomass than a young forest.

The number of trees in a study site and the elevation of the site will impact biomass.

Research questions
1. Which forest type will contain the most biomass in our study?
2. What factors will contribute to the greatest biomass?
3. The number of trees in the study site and the elevation of the study site will impact biomass.
4. Elevation of the study site and the elevation of the tree will impact biomass.
5. Species of the tree

Study Sites
Plot 1 – Spruce/Fir 5760 feet elevation
Plot 2 – Northern Hardwood 4052 feet elevation
Plot 3 – Pine and Oak 2290 feet elevation
Plot 4 – Pine and Oak 2830 feet elevation
Plot 5 – Cove Hardwood 3496 feet elevation

*Old Growth

Conclusions
Based on the results of our data, we found that circumference of the tree and not its species, had the greatest impact on biomass. Other researchers have shown that species would have a significant impact. We believe our result was due to the disproportional number of species measured in our study plots. Some species contained 56 individuals while others had only 1. This would affect our homogeneity of variance. We also found that the old growth forest contained the greatest biomass of the five sites and was statistically different from the spruce/fir forest and pine and oak forests we measured.

Acknowledgements
This project would not have been possible without Dr. Sherry Herron, and the Department of Biological Sciences at the University of Southern Mississippi. Special thanks to the members of Dr. Herron’s 2014 Field Biology course: Kylee Duett, Antoine Gates, Kim Hardy, Zundra Lucas, Linda Nix, Elizabeth Schlosser, Veshell Lewis, Mary Smith, Patrick Stasley, and Aresia Watson. The map came from the Great Smoky Mountains National Park website: http://www.nps.gov/grsm/index.htm

Descriptive Summary of Each Plot

<table>
<thead>
<tr>
<th>Plot</th>
<th>Species</th>
<th>Trees</th>
<th>Different Species</th>
<th>Circumference</th>
<th>Elevation</th>
<th>Biomass</th>
<th>Total Above Ground Carbon Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>40.769</td>
<td>26.899</td>
<td>6,103,742</td>
<td>6,651,371</td>
<td>1,178</td>
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</tr>
<tr>
<td>2</td>
<td>6</td>
<td>69.974</td>
<td>77.248</td>
<td>15,846,261</td>
<td>7,023,130</td>
<td>1,137</td>
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<tr>
<td>3</td>
<td>11</td>
<td>56.780</td>
<td>35.997</td>
<td>19,493,557</td>
<td>9,746,778</td>
<td>1,106</td>
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<tr>
<td>4</td>
<td>7</td>
<td>88.000</td>
<td>55.992</td>
<td>6,521,043</td>
<td>3,260,521</td>
<td>1,107</td>
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</tr>
<tr>
<td>5</td>
<td>5</td>
<td>119.746</td>
<td>10.171</td>
<td>21,469,292</td>
<td>10,738,846</td>
<td>1,098</td>
<td></td>
</tr>
</tbody>
</table>

Multiple Regression Model

Model 1: Plot, Circumference, Elevation, and Tree Species as the IV and Biomass as the DV

Mean - 56756, SD - 48.223

Coefficients Table Examining Variables Potentially Influencing Biomass Within a Study Plot

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standardized Coefficients</th>
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</thead>
<tbody>
<tr>
<td>Plot 1</td>
<td>56756</td>
<td>48.223</td>
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<tr>
<td>Circumference</td>
<td>19.729</td>
<td>0.701</td>
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<tr>
<td>Species</td>
<td>-0.020</td>
<td>-0.510</td>
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<tr>
<td>Elevation</td>
<td>0.044</td>
<td>0.610</td>
</tr>
</tbody>
</table>

Multiple Regression Model Summary Table Examining Factors Influencing Biomass

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>125.664</td>
<td>4</td>
<td>31.662</td>
<td>19.729, p = .001, r2 = .679</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>48.223</td>
<td>4</td>
<td>12.056</td>
<td>19.729, p = .001, r2 = .510</td>
<td></td>
</tr>
</tbody>
</table>

Statistical Analysis
Using SPSS to analyze the data, tree circumference was found to be the factor that explained the greatest variability in biomass (F = 19.729, p = .001, r2 = .679). We also found that old growth forest contained more biomass than younger forests (F = 21,469,292, young forest biomass = 125.664, p = .001, r2 = .701). A multivariate regression analysis was performed to identify the variables which had the greatest influence on biomass. Independent variables tested included: the plots, circumference, number of trees within a plot, and elevation of the plot, with the dependent variable of biomass. The average tree circumference for all plots together was 56.756 cm (x = 56.756, SD = 48.223). This model was found to be statistically significant and was able to account for 70% of the biomass in our study sites (F[12,560] = 125.664, p = .001, R2 = .701). Based on our coefficients table, we found that circumference had the largest power in explaining biomass when combined with the other independent variables tested for (t = 19.729, p = .001, R2 = .679). In this model, the actual species was not statistically significant for explaining biomass.