Forest Land Cover Analysis for Conservation Management Using Remote Sensing within Protected Land in West Virginia

Abreu-Vigil, G., Adaktilou, N., Landenberger, R.

Abstract/Purpose

The West Virginia Land Trust (WVLT) is a nonprofit land conservation organization, dedicated to protecting land from development. The land protected in perpetuity by the WVLT is dominated by mature forest and agricultural land but also includes early successional forest and reclaimed mine lands. The focus of this study is on mature forest because they sequester carbon at high rates, filter precipitation and therefore provide clean water and are the foundation for diverse ecological communities. An estimate of the forested land in these protected areas provides a greater understanding of the many environmental services that these lands offer. The present study quantifies the forested areas protected by the WVLT using the Statewide spectral classification for WV Land Cover and is used here as the basis for developing a technique to estimate carbon sequestration potential in mature forest. The area covered by forest and the respective potential for carbon sequestration as quantified in the study is essential ecological and management information for the WVLT.

Study Area

- The study area for this research is the protected land managed by the WVLT
- 64 parcels of land totaling at 57.56 km²

Land Cover and Forest Cover

Input Data:
- Statewide spectral classification for 2016 WV Land Cover developed in the West Virginia GIS Tech Center
- Created using geographic object-based image analysis, random forest machine learning, and National Agriculture Imagery Program (NAIP)
- 25 total classes, 9 forest classes – aggregated together for total forest estimate

Methodology for estimating forested land cover:
1) Identify and digitize WVLT properties
2) Reclassify and aggregate forest classes
3) Clip forest raster with property boundaries for forested area estimate
4) Collect field data to determine biomass/area
5) Use forested area to calculate carbon estimate

Figure 2: Summit Bechtel Reserve with NAIP LC (right) and aerial (left)

Fee Lands and Easement Properties

Fee Lands are properties owned by the WVLT and are indefinitely protected from natural resource removal. While Easement properties are managed by the WVLT but can potentially be logged based on their respective timber/mineral rights. The land on both will be compared within both of quantity of forest and percentage of forest.

Percentage of forest on FP = forested land on FP / all land on FP

Percentage of forest on EP = forested land on EP / all land on EP

Fee average area: 1.019 km²
Easement average area: 1.257 km²

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fee</td>
<td>92.79</td>
<td>29.31</td>
</tr>
<tr>
<td>Easement</td>
<td>81.91</td>
<td>21.24</td>
</tr>
</tbody>
</table>

Carbon Estimates

Field Data Collection:
- Organization of volunteers to record diameter breast height (DBH) in 15 randomly selected areas in Tom’s Run Preserve
- Mature mixed mesophotic forest in Tom’s Run is relatively representative for all properties and was used for estimating carbon for all properties

Calculations:
- Broad leaf above/below ground biomass: Biomass=0.16155*(dbh) 2.310647
- Average of 16.5% of biomass is carbon
- Average sum of carbon per sample areas: 1586.69 kg carbon
- Divide carbon/area by 403.89 m²: 3.933 kg carbon/m²
- Forest area: 5.055e7 m² * 3.933 kg carbon/m²

Conclusions

- Based on the forest land cover, the total forested area on all the properties is 50.549 square km
- The total carbon stored in tree biomass is then 198,809,807 kg of carbon

Next Steps

- Estimate on-ground carbon storage by measuring course woody debris
- Estimate below ground carbon storage
- Predict biomass more accurately by calculating mass per species/forest type

Volunteer acknowledgments: Tim Warner, Paula Hunt, Mark Brazaitis, JoNell Strough, Nathan LaFata
For more information please contact: gaa0006@mix.wvu.edu