

Carbon Pools in Reforested Mine Lands and the Lilley Cornett Old Growth Woods

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Overview

The southern Appalachian forest region is a temperate rainforest with a very large terrestrial carbon pool. Deforestation has converted much of this pool into atmospheric CO₂. Between 1992 and 2012, 6.8% of the region's forests will be removed (US EPA, 2005). Reforestation efforts have focused attention to southern Appalachian forests for their high carbon sequestration potential. If inadequate reclamation processes are used, mined lands could become terrestrial sinks for the CO₂ that is released during soil disturbance.

In order to better understand mined lands' potential as carbon sinks, it is important to quantify the terrestrial carbon pool of undisturbed old growth forests in the southern Appalachian region, as well as measure carbon sequestration rates of reforested mine lands. To assess storage potential, this study documents carbon storage in an old growth forest (Lilley Cornett Woods) and compares the soil organic carbon content of three reforested mine reclamation sites of varying ages with the old growth site.



Traditionally reclaimed valley fill.



14 year-old ARRI site

Appalachian Regional Reforestation Initiative (ARRI):

Traditional reclamation involves heavy compaction of mining soil that inhibits tree growth. The goal of the ARRI is to implement coal mine reclamation conducive to reforestation. ARRI encourages 4 feet of mine soil be dumped on the compacted surface. End-dump requires that this soil not be compacted; strike-off requires that be minimally compacted. These reclamation methods allow tree roots to penetrate the soil and greatly increase tree survival rate (<http://arri.osmre.gov/About/AboutARRI.shtm>).

Methods

Soil organic carbon (SOC) was estimated at every site. Total organic carbon (TOC) was estimated in the Lilley Cornett Woods. Carbon pools were documented in four potential terrestrial sinks.

Living, above-ground biomass (AGB) measurements were completed in four plots of 30 foot radius at breast height. Regression equations were used to calculate carbon density per unit area.

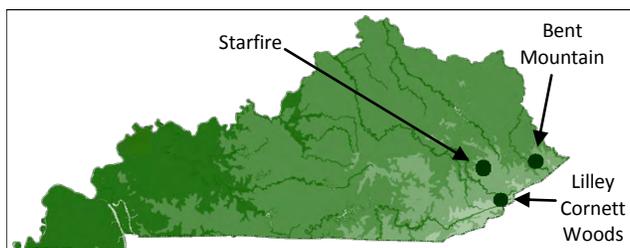
Coarse woody debris (CWD), defined as large, dead plant biomass, was measured for volume in four plots. Carbon density per unit area was calculated.

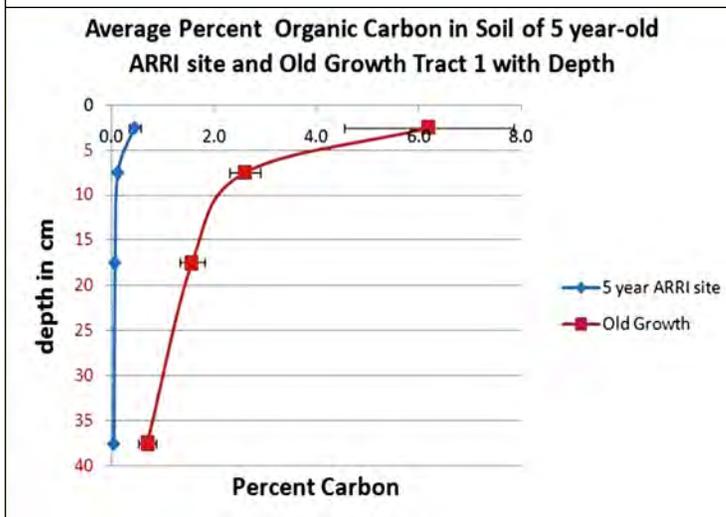
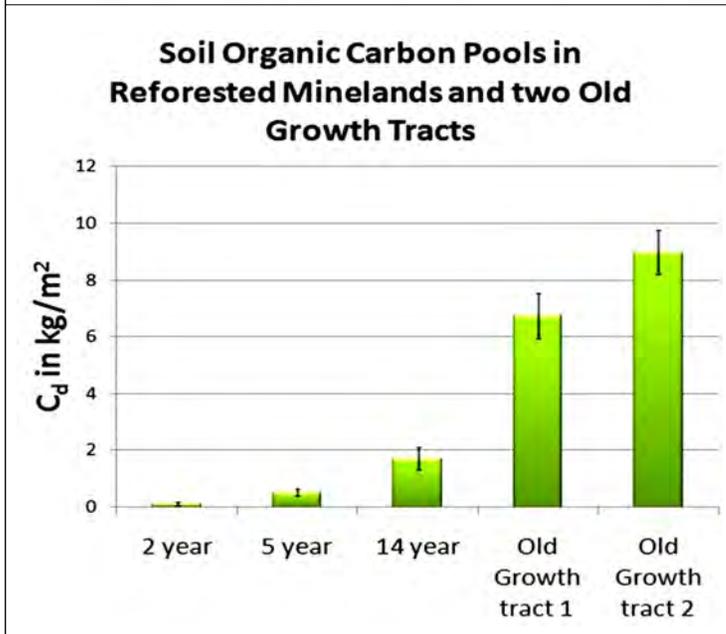
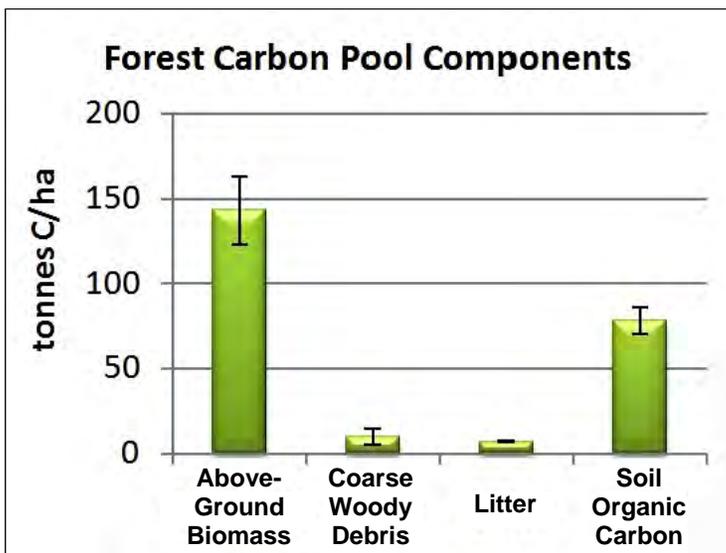
Forest litter was analyzed to find percent carbon content using an isotope ratio mass spectrometer (IRMS). The average depth and density of forest litter was measured, then multiplied by the percent carbon of litter samples.

Soil organic carbon was derived by analyzing 50cm soil pits, sampled at four varying soil depths. An IRMS was used to find percent carbon content.

Sites of Interest

Old growth forest data was collected at the Lilley Cornett Woods, a protected forest preserve in Letcher County, Kentucky. Appalachian Regional Reforestation Initiative (ARRI) sites were located at the Bent Mountain and Starfire surface mines.





Results

The Lilley Cornett old growth forest stores 14.3 kg C/m² in live vegetation, which suggests that the southern Appalachian region has carbon sequestration potential as replanted forests mature and approach old growth carbon storage levels. Soil organic carbon development occurs as reclaimed mine sites mature. Reforested sequestration rates are 1.2 Mg C ha⁻¹ yr⁻¹.

Conclusion

ARRI reforestation techniques have proved to be effective in the sequestration of carbon through soil organic carbon development. Additionally, there is potential for further carbon storage through reforestation on mined lands, as indicated by the large carbon pool in the Lilley Cornett old growth forest. Because of this, ARRI reclamation methods should continue to be employed and studied.

Areas of Further Research

A more in-depth study of the carbon pool of the Lilley Cornett Forest is needed. Taking into account spatial variability of carbon storage would greatly benefit carbon pool estimate accuracy. Also, continued study of the ARRI reforested sites as they mature would be beneficial. Eventually, a total terrestrial carbon pool estimate could be made of ARRI sites.

References

US Environmental Protection Agency. (2005). *Mountain-top mining/valley fills in Appalachia: final programmatic environmental impact statement (FPEIS)*. (EPA Publication No. 9-03-R-05002). Retrieved from <http://www.epa.gov/region3/mtntop/eis.htm>

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