Ashley National Forest Assessment

Carbon Stocks Report

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for:
Ashley National Forest

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Introduction

The existing Ashley National Forest Plan does not address carbon stocks or provide any direction in carbon stock management. This review of current conditions and trends of carbon stocks is an abbreviated summary of three recent U.S. Department of Agriculture Forest Service papers, cited below.

Carbon Sequestration

The Ashley National Forest provides the ecosystem service of carbon sequestration. Maintaining healthy, productive, native vegetation is effective in reducing carbon dioxide, which is a major greenhouse gas and factor in climate change (USDA Forest Service 2016)

Carbon sequestration is the uptake and storage of carbon in vegetation, dead plant matter, and soils. This sequestration occurs as carbon dioxide is removed from the atmosphere and “fixed” during photosynthesis into plant biomass. Carbon is also stored in dead plant materials, including coarse woody debris and litter. Microbial decomposition adds additional carbon into soils as soil organic carbon (Reeves 2016). Ecosystems store and release carbon at the same time, with carbon being released back to the atmosphere from respiration and decomposition processes. An area is called a carbon sink if it accumulates more carbon in plant biomass than the rate of releasing carbon dioxide; conversely, an area is a carbon source if it releases more carbon than the rate of carbon fixation into plant biomass (USDA Forest Service 2015).

Different areas on the Ashley National Forest can store different amounts of carbon. How much carbon can be sequestered depends on several factors, including the type of vegetation community, parent materials, soils and climate. Forested areas can store more carbon than non-forested areas, and meadows and healthy rangelands can store more carbon than arid shrub land and desert plant communities (Reeves 2016).

Carbon Stocks within Forested Areas

Forests generally act as carbon “sinks” because the rate at which carbon is taken up and stored exceeds the rate at which carbon is released back to the atmosphere. The amount of carbon stored is called a carbon stock (USDA Forest Service 2015).

Forest carbon stocks are contained in seven different pools: above and below ground live tree, standing and down dead trees, understory, forest floor, and soil organic carbon. The total forest ecosystem carbon (combining all seven pools) generally increased in the Intermountain Region, including on the Ashley National Forest, between 2005 and 2013 (USDA Forest Service 2015). However viewing regional forests between 1950 and 2011 indicates the forests in the Intermountain Region are trending toward becoming a carbon source instead of a carbon sink. The estimated total loss of carbon in the region for that period is 89.4 Tg C (Teragrams of Carbon) (USDA Forest Service 2016).

Forest carbon stocks are influenced by disturbances and environmental factors. Environmental factors include the increase in carbon dioxide concentrations in the atmosphere, nitrogen deposition, the availability of key nutrients, and climate variability (precipitation levels, temperatures, etc.). Disturbances include fires, timber harvest, insect epidemics, diseases, and stand age (USDA Forest Service 2016). Middle-aged forest stands sequester the most carbon. Young forest stands take up less carbon from the atmosphere and aging stands shift to higher rates of decomposition and carbon release. In recent years, environmental factors of warming temperatures and droughts have also resulted in lower rates of tree growth, and higher rates of decomposition (USDA 2016).

Insect epidemics reduced carbon storage in every forest of the Intermountain Region between 1990 and 2011, with a jump in disturbance levels beginning in 2005 (USDA 2016). Disturbance records summarized for the Ashley National Forest indicate the impacts to carbon stocks during the same period came from insect epidemics (87 percent), fires (10 percent), and timber harvest (3 percent). Forests within the Ashley National Forest have also lost carbon stocks to climate variability during the 1990 to 2011 period, and have shown overall decreases in carbon stocks.

Forest management goals include management for carbon sequestration and healthy carbon stocks. Management practices that work toward reducing disturbances, maintaining the health of the forest vegetation and floor, and quickly regenerating forest stands can effectively retain carbon (USDA 2015). However carbon sequestration rates may decline due to climate changes and associated disturbances. Future projections for the Intermountain Region include continued increase in average annual temperatures and potential changes to precipitation. Temperature and precipitation patterns may influence insect epidemics, forest stand growth, and fires on the Ashley National Forest (USDA 2016).

Harvested Wood Products

Forest carbon stocks include harvested wood products. Harvested wood products include wood used for lumber, furniture, and all wood material (including bark) removed from the Ashley National Forest. This includes products that are in use or that have been discarded. Although wood products from the Ashley National forest are important, the products are estimated to make up only 0.82 percent of the total carbon stock in the Intermountain Region (USDA 2015). Annual timber harvests in the Region peaked in 1972 and have ranged from 0.065 Tg (Teragrams) [65,000 MgC (Megagrams of Carbon) yr-1] to 0.658 Tg [658,000 MgC yr-1] (USDA 2015).

Carbon Stocks in Non-Forested Areas

Rangelands in the Intermountain Region are generally carbon sinks, but can become carbon sources when influenced by climate or disturbances. Both below-ground (soil) carbon stocks and above-ground (shrub) carbon stocks have been studied.

Carbon stocks within soils develop mainly from organic materials in the soil and from decomposition processes. About 58 percent of soil organic matter is soil organic carbon. Soils vary in how much carbon they can store and at what depths their carbon is stored. Variables in soil carbon depend on the soil parent material, soil physical and chemical properties, the climate, microorganisms in the soil, and the type of vegetation supported (Reeves 2016). The organic carbon within soils is the largest pool of terrestrial carbon in the Intermountain Region. Worldwide soils contain approximately three times the amount of carbon that is stored in vegetation and the atmosphere combined (Reeves 2016).

Soils can store and release carbon at the same time and act as a net sink or source of carbon. The carbon stocks in soils are influenced strongly by climate and vegetation. Soils have the potential to sequester additional carbon if temperatures decrease and moisture increases. Conversely soils may lose carbon stocks if temperatures warm without additional moisture or under drought conditions. Shifts in non-forested vegetation communities may impact the amount and depth where most soil carbon is stored. Rangelands degraded by overgrazing or taken over by invasive annuals like cheatgrass or saltlover (Halogeton) slowly lose soil carbon, as well as their carbon stock within vegetation. Where degraded land areas are improved more soil carbon may be stored (Reeves 2016).

Most soils in the Intermountain Region currently hold their maximum soil organic carbon for the existing climate. Generally soils in hotter/drier areas contain a near surface soil organic carbon content (by mass) of 0.5 percent and in cooler/moister areas a near surface soil organic carbon of 8 percent (Reeves 2016).

Soil organic carbon and soil organic matter are important in sustaining vegetation. Organic carbon in soils is the main source of energy for microorganisms in the soil that work to cycle nutrients and make them available for plants. Soil organic carbon supports important soil functions including cation (positively charged ions) exchange, binding harmful metals, and allowing infiltration and storage of water (Reeves 2016). One of many soil microorganisms, (fungi) produces a glycoprotein called glomalin. Glomalin contains 20 to 40 percent of soil carbon and acts like a glue, holding soil particles together and building soil structure, helping soils resist erosion and maintain porosity (USDA 2002).

Above-ground carbon within shrubs has been measured for all of the non-forested lands in the Intermountain Region, using vegetation structure, composition, height and type data. Carbon density of shrubs is highly varied in the region, with the average across three height ranges ranging from 1.19 to 12.45 Mg ha -1. The differences in shrub carbon stocks is expected to be related to the diversity of shrub heights and species within the region (Reeves 2016).

Management Implications

All carbon stocks are important to maintain. Carbon stocks within soils are slow to change, but help determine many soil properties - including soil productivity. Carbon stocks within live and dead vegetation can vary more quickly, due to management or events like wildfire. The Forest can sequester carbon and help mitigate greenhouse gas effects, and carbon stored in vegetation and organic matter provides the carbon source for soils

References

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