Topic: HOW DOES THE CENTRAL APPALACHINA RED SPRUCE FOREST INFLUENCE SOIL ORGANIC CARBON?

Issue: Historic timber harvesting of red spruce and related soil erosion, burning, and forest conversion to hardwood in the central and southern Appalachians has resulted in large losses of soil organic carbon into the atmosphere as CO_2 – a greenhouse gas. Recent studies suggest that restoring red spruce with targeted forest management plans could restore significant amounts of this carbon within a century while also improving regional habitat for threatened wildlife and ecosystem services like drinking water security.

- **Red spruce and similar trees promote accumulation of soil carbon.** Research tells us that the cool conifer forest species of the north like red spruce are the best at accumulating soil carbon.
- **There is more carbon in the soils than in the atmosphere and the vegetation combined.** Most of the soil organic carbon in the world is found in the cool moist conifer forests and permafrost tundra areas of the North.
- **Large releases of CO_2 likely resulted from harvest activities that caused fires and forest type conversion from spruce to hardwood associated during local railroad expansion around 1900.** Studies in the southern and central Appalachians have documented red spruce range decreases of 90% or more due to timber harvest and associated fires from 1860-1940. This disturbance and species composition shift likely resulted in a massive release of carbon from deep organic forest floors (up to 3 feet deep) and subsurface soil layers into the atmospheric CO_2 pool that is not fully understood in the context of its contribution to climate change.
- **Planting red spruce and encouraging red spruce to return to its historic locations can help return significant amounts of the lost carbon back to the landscape in less than 100 years.** Recent data suggests that at least 6.6 Tg of carbon (equivalent to 56.4 million barrels of oil) would be incorporated in the forest floor within ~80 years by managing to restore historic spruce dominated stands that were disturbed by historic timber harvest **in West Virginia alone** - a small portion of the historic red spruce range.
- **Old growth red spruce could sequester even more carbon.** Studies in similar cool moist systems in the northwest U.S. show that high quality old growth conifer forests store lots of carbon. Managing red spruce towards an old growth forest in the next 100 years would promote transfer of significant atmospheric carbon into the soil of the central Appalachians. Over time, organic carbon produced in red spruce forests would be stored deeper and deeper under the soil surface, and create longer term carbon storage.
- **Restoring red spruce forests will improve ecosystem services.** Deep forest floors under red spruce represent a significant water storage tool that can buffer watersheds against both flooding and drier periods. The endangered Cheat Mountain Salamander and rare Virginia Northern Flying Squirrel have also been linked to red spruce influenced habitat, and would likely benefit from restoration.
- **Red spruce has an uncertain future, but could prove to be more resilient than current models suggest.** Recent studies show that red spruce stands are expanding and had a larger pre-harvest extent than prior research acknowledged. Therefore, climate change projections that red spruce will disappear from the southern and central Appalachians within this century should be regarded with cautious skepticism when planning red spruce restoration goals, especially in light of its potential to help mitigate climate change.

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