THE UNIVERSITY of NEW MEXICO

Research Brief for Forest Managers

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Carbon Dynamics of Longleaf Pine Restoration

Forests help regulate the climate by sequestering carbon from the atmosphere. Natural disturbances, such as fire, and management actions can reduce forest carbon storage. However, many forests evolved with frequent fire and fire-maintained forests provide habitat for many species. Treatments to restore fire-dependent forests require carbon removal by thinning and carbon emissions by prescribed burning. Quantifying how these treatments influence total ecosystem carbon is necessary for better understanding the carbon tradeoffs of forest restoration.

In a study at Fort Benning, Georgia we used a landscape simulation model to quantify the carbon consequences of different levels of thinning and burning treatments and the provision of red-cockaded woodpecker (RCW) habitat. We simulated a no-action control, which results in succession away from pine-dominated forest to broadleaved dominated forest. We simulated a burn-only treatment designed to maintain pine-dominated forest using a 3-year fire rotation. We also simulated an active restoration program that included, thinning, planting longleaf pine, and regular prescribed burning. The restoration treatment was designed to maximize RCW habitat. We found that total ecosystem carbon decreased with increasing treatment intensity (Figure 1). We also found that active management (thinning, planting, and burning) caused a substantial increase in RCW habitat (Figure 2). By the end of the 100-year simulation period, the control had the highest total ecosystem carbon, but less than 5% of the landscape was viable RCW habitat. The burn-only had 12% less carbon than the control and approximately 25% of the landscape was RCW habitat. The restoration treatment had 22% less carbon than the control, but approximately 90% of the landscape was RCW habitat.

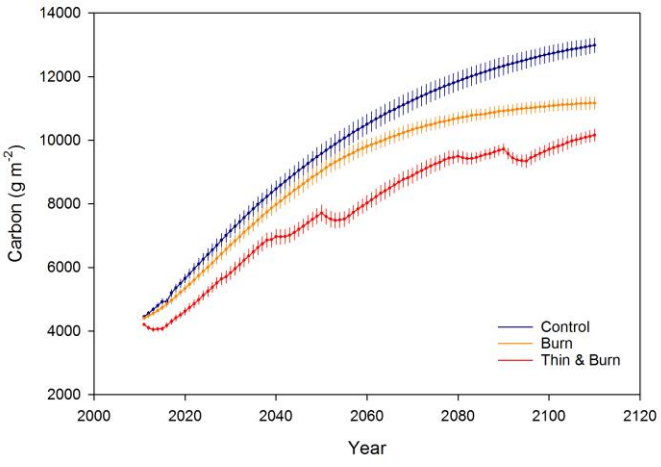

Figure 1: Mean and standard deviation of total ecosystem carbon by treatment.

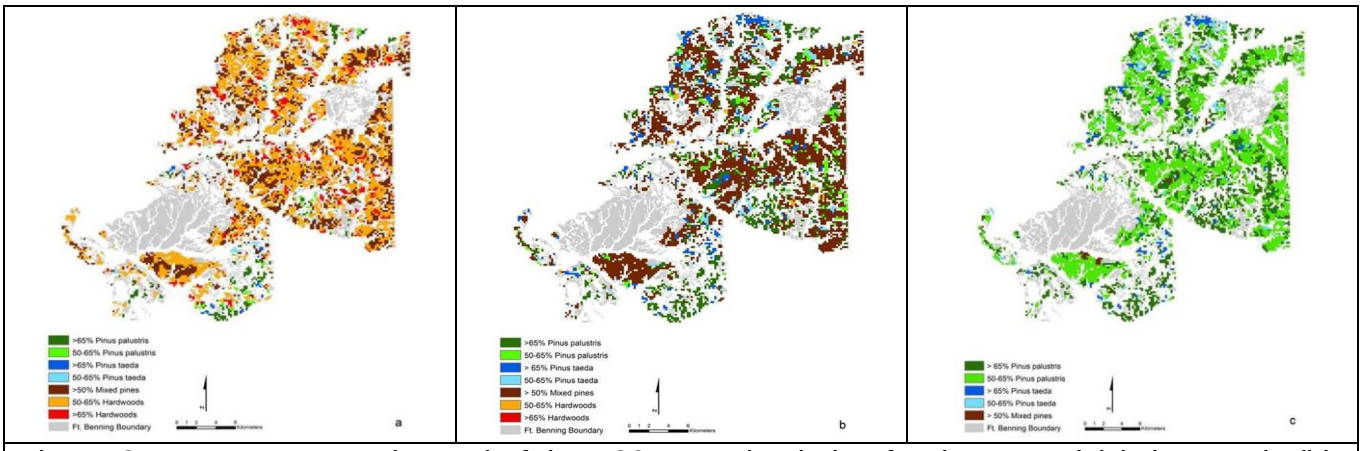

Figure 2: Forest cover at the end of the 100-year simulation for the control (a), burn-only (b), and restoration (c) treatments. Dark and light green are the most suitable red-cockaded woodpecker habitat.

Our results demonstrate that regardless of the treatment scenario, total ecosystem carbon increases at Fort Benning. Our results also demonstrate that because regular fire use primarily impacts small trees, total ecosystem carbon continues to accumulate. Active management to restore longleaf pine forest and RCW habitat requires periodic carbon removals from thinning, but results in a large increase in RCW habitat. While restoration does require a reduction in carbon, the importance of restored longleaf pine forests to other species is an important consideration in management planning.

Management Implications:

- Restoring longleaf pine forest and maintaining it with regular burning increases red-cockaded woodpecker habitat.
- Burning alone can help maintain habitat, but is insufficient to cause substantial increases in habitat availability.
- Active longleaf pine restoration on average results in 28 Mg ha^{-1} less carbon than the fire-suppressed, broadleaved dominated forest.

References:
Martin, K.L., M.D. Hurteau, B.A. Hungate, G.W. Koch, M.P. North. 2015. Carbon tradeoffs of restoration and provision of endangered species habitat in a fire-maintained forest. Ecosystems 18: 76-88.

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