IMPACT OF A SHELTERWOOD HARVEST ON THE NET CARBON BALANCE OF A SPRUCE/HEMLOCK DOMINATED FOREST IN MAINE

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Forest management practices can have a large impact on rates of carbon sequestration in forest, yet little research has explored the magnitude and direction of these changes for different management practices. This is a critical issue in the northeastern U.S., where a majority of forests are managed with varying degrees of intensity. Harvesting activities give rise to a short-term decline in leaf area and an increase in detritus on the forest floor, but whether this leads to a reduction in net carbon sequestration over time depends greatly on rates of individual tree growth after harvest. We evaluated the impact of a commercial shelterwood harvest on forest carbon sequestration in a spruce-hemlock forest in central Maine. A cut-to-length system with forwarding was used. Under this management system, one ~60-year rotation includes three harvests, each removing about one-third of the basal area. This type of management has increased dramatically throughout the region over the past decade.

Harvesting removed about 15 Mg C/ha (SEM=2.1) (~30%), and created about 5.3 Mg C/ha (SEM=1.1) of aboveground and 5.2 Mg C/ha (SEM=0.7) of root/stump detritus. Leaf-area index and litterfall declined by about 40% with harvest. A comparison of summer-time net ecosystem exchange (NEE) of carbon between unharvested and harvested stands, both pre- and post-harvest, indicated that NEE for this period declined following the harvest by about 18%, which is less than expected based on basal area and LAI changes. Soil respiration declined slightly with harvest, suggesting no major soil C loss after harvest; harvesting had little effect on soil moisture and temperature. Three years after harvest, summer daytime NEE measurements indicate similar rates of carbon sequestration in both the harvested and unharvested stands. These results suggest that the forest has returned to pre-harvest rates of carbon sequestration faster than expected due to either increased total uptake or more efficient formation of woody biomass following forest harvest.