

Title:

Rehabilitation forestry and carbon market access on overharvested, former industrial northern hardwood-conifer forests

Authors:

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Abstract:

Many former industrial timberlands in the Northeast experienced decades of unsustainable and heavy cutting. Today, thousands of hectares remain less than fully stocked. Finding economical rehabilitation methods is critical to restoring these forests, yet few studies have examined specific approaches. The goal of this study is to quantify how 13 distinct rehabilitation scenarios impact long-term forest dynamics and opportunities for carbon market participation. Forest structure and composition were inventoried on 400 hectares of overharvested timberland in northern Vermont using 155 prism plots. Silvicultural treatments were modeled over 100 years using the Forest Vegetation Simulator. Stand structural metrics, carbon sequestration and net present value of timber harvests were compared for each treatment using related measures ANOVA and Tukey's HSD post-hoc tests. Carbon offset credits were quantified according to the requirements of the Climate Action Reserve and the American Carbon Registry. An ANOVA comparing silvicultural treatments indicates that a long-term strategy of limited or no harvesting achieves significantly ($p < 0.05$) greater carbon storage, averaging 75-94 Mg C/ha over 100 years in live and dead trees and harvested wood products. However, a range of initial actions may be used with this long-term strategy without significantly reducing carbon storage. These include silvicultural clearcuts and targeted, variable density thinning. When offset credits are taken into account, natural recovery becomes appealing because it generates credits 10-30 years earlier than other treatments. This approach also achieves the greatest total number credits at 222 Mg CO₂/ha when paired with no future harvesting. If commercial timber management is a priority, initial recovery followed by low-intensity, individual tree selection harvests can achieve credits of 89 Mg CO₂/ha. Although overharvested forests face distinct challenges, it is possible in some cases to simultaneously restore productivity, generate carbon credits and commercially harvest timber. These results are relevant to thousands of hectares across the Northeast.