



North Atlantic Fire Science Exchange



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Research Brief for Resource Managers

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Insect damage versus prescribed fire: comparing long-term carbon impacts

Clark KL, Renninger HJ, Skowronski N, Gallagher M and Schäfer KVR (2018) Decadal-scale reduction in forest net ecosystem production following insect defoliation contrasts with short-term impacts of prescribed fires. Forests 2018, 9, 145.

[Click here](#) for original paper.

Many states in the North Atlantic region are participants in the Regional Greenhouse Gas Initiative, which encourages limits on carbon dioxide (CO₂) emissions into the atmosphere. Forests have long been hailed as carbon sinks, or areas that will absorb CO₂ by the process of photosynthesis during growth. Forest and fire managers wonder where the released forest carbon ends up when a fire burns through an area, but then the forest produces a flush of new green growth. Managers want to know if prescribed fire is very different from an insect defoliation or a wind disturbance when it comes to carbon accounting for their state.

Dr. Kenneth Clark and his colleagues at the USFS/Rutgers Pinelands Field Station in New Jersey set out to document the long-term carbon impacts of two prescribed fires (2008 and 2013) versus an intense gypsy moth defoliation in 2007. The gypsy moth infestation occurred in an oak-dominated forest around the field station where carbon flux measurements (the amount of carbon

Management Implications

- Disturbances such as prescribed fire and insect defoliation have different impacts on carbon storage in forests.
- The effects of prescribed fire on carbon storage are short-term whereas the effects of gypsy moth defoliation can last at least a decade.
- Understanding how prescribed fire impacts forest carbon can help managers develop carbon-conscious forest management practices.

dioxide entering and exiting the forest ecosystem) had been underway for many years. The prescribed fires occurred near another local tower in predominantly pitch pine forest. Obtaining measurements before and after the insect and fire disturbances gave insight into how each forest recovered its ability to sequester (store) carbon within each forest.

Results showed that after gypsy moth defoliation, standing dead trees as well as coarse woody debris increased. This led to an increase in decomposition and the release of more CO₂ (part of ecosystem respiration, or Re). This increase in woody debris also decreased the forest's ability to absorb carbon as a system over time (net ecosystem production, or NEP; see Figure 1, left panel, black bars). This occurred even though the

trees and shrubs that recovered or started from seed were photosynthesizing at similar rates to pre-gypsy moth levels.

Prescribed fires induced a different reaction in the pitch pine stand. Although a large amount of carbon was lost during the burns, the forest recovered its ability to absorb the same amount of carbon as soon as the next growing season. The carbon lost during the fire equaled the carbon gains in the forest after only two to three years (NEP, see Figure 1, right panel, black bars).

This study shows that the process of prescribed burning does not strongly affect

the long-term carbon balance of the pitch pine forest. Burning every five years would still result in carbon storage, primarily in wood and soil, in upland pitch pine stands. With slightly longer intervals, the forest would be an even larger carbon sink. On the other hand, gypsy moth defoliation results in a long-term effect on the ability of the forest to sequester carbon. As of the 2016 measurements, the forest stand had not recovered its pre-disturbance carbon storage abilities. These findings are relevant for managers in understanding how to compare the carbon impacts of prescribed fire compared to natural disturbances and to help determine carbon-neutral prescribed fire intervals.

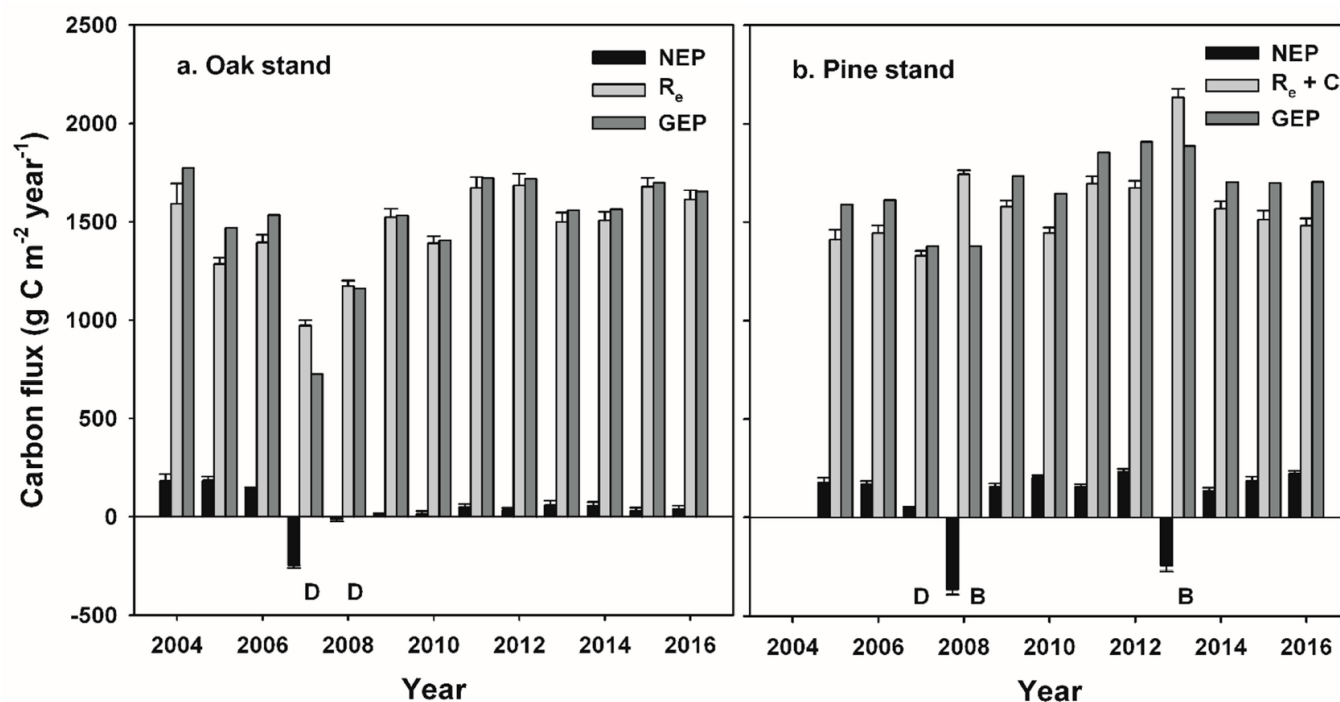


Figure 1. Net ecosystem production (NEP), ecosystem respiration (R_e) and combustion losses during prescribed fires (C), and gross ecosystem productivity (GEP) at the (a) oak and (b) pine stands. Error bars for NEP and R_e indicate maximum deviations from mean annual NEP or R_e values resulting from error analyses of gap-filling for missing half-hourly net ecosystem exchange of CO₂ (NEE) data. “D” indicates defoliation by gypsy moth and “B” indicates prescribed burns.

(Figure 1. from Clark et al 2018, see citation, previous page)