MIXED-PINE FORESTS, FIRE & SNAGS IN UPPER MICHIGAN

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Dead standing trees, known as snags, remain after various types of disturbances in forests. In addition to providing habitat for flora and fauna, snags are an important part of nutrient cycling and carbon sequestration processes. Knowing characteristics of snags from benchmark or reference forests provides useful guidelines for those wishing to manage within the natural range of variability. Moreover, if so desired, forest managers can create snags with prescribed fire, girdling, and topping techniques. This study had two purposes: 1) to characterize the snag community of reference mixed-pine plots and compare them with altered plots and 2) characterize differences in snag progression using the techniques discussed above.

In 38 reference and 47 altered 500-m^2 plots (5,382-ft^2) at Seney National Wildlife Refuge, the diameter at breast height (dbh) and stem densities of live trees and snags were measured. Reference plots were dominated by live red pines (*Pinus resinosa*) and, to a lesser degree, eastern white pines (*P. strobus*). As expected jack pines (*P. banksiana*) dominated altered plots.

Snags were found in 87% of reference plots and 85% of altered plots. The reference plots had a snag density of 45.8 snags ha^{-1} (113.2 snags ac^{-1}) which falls within the range of old-growth red pine forests in Minnesota (24-140 snags ha^{-1}, 59.3-354.9 snags ac^{-1}). The altered plots had 76.1 snags ha-1 (188.1 snags ac^{-1}). Analyses, however, suggest that there were only differences between reference and altered plot snag structure in the 10-cm (3.94-in) and 25-cm (9.84-in) size classes.

As part of an experimental treatment, 15 red pines, 5 eastern white pines, 61 jack pines, and 26 aspens (*Popu-*


Photo: Ken Chamberlain

MANAGEMENT IMPLICATIONS

1) Reference plots are red pine-dominated and are comprised of larger snags than altered jack pine-dominated plots.

2) Mechanical treatments yield different patterns of snag development compared to prescribed burned trees.

3) Burned snags decay slower than topped or girdled snags & 64% of girdled trees snap within four years.

4) Species longevity, snag size, and distances between trees must also be considered when evaluating snag longevity.

Want to learn more?
Greg Corace at Seney National Wildlife Refuge (greg_corace@fws.gov; 906-586-9851 x14.

Corace, R.G., III, A.T. Stout, P.C. Goebel, and D.M. Hix. 2013. Snag benchmarks and treatment options for mixed-pine forest restoration in eastern Upper Michigan. Restoration Ecology 21(5): 608-616.

lus spp.) (total=107 trees) >18-cm (7-in) dbh, were girdled using common logging equipment in July and August 2007. To account for wind protection from other trees, the distance to nearest tree and the number of trees in a 10-m (32.8-ft) radius were recorded during girdling. The development of decay classes (DC) of girdled trees was compared with retrospective analyses of snags created in 2004 from prescribed fire and topped trees. In 2008, four years after the creation of the prescribed fire and topped snags, 30 prescribed fire trees and 31 topped trees were sampled. The prescribed fire snag sample was composed of 18 jack pines, 9 red pines, and 3 eastern white pines while the topped snag sample was composed of 26 jack pines and 5 aspens.

After four years of treatment, snags were classified into DCs ranging from 1 to 5, where recently dead trees characterize DC1 and severely decayed trees characterize DC5. The modal DC for prescribed fire, girdled trees, and topped trees were DC3 (43%), DC4 (38%), and DC2 and DC3 (45%) respectively (Figure 1). Girdled short-lived species, such as jack pine and aspen, were less likely to be in DC1 than girdled long-lived species, such as red pine.

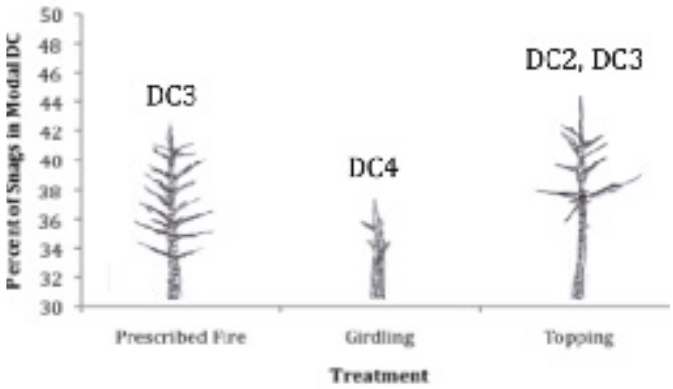

Figure 1. Percent of modal decay class (DC) stages for prescribed fire, girdling, and topping.

Different species' DC development rates were affected by different factors, including height, size, and distance to nearest tree. For example, predictor variables for girdled jack pines DC development were dbh and distance to nearest tree, but the predictor variable for prescribed fire jack pine snags DC development was the number of trees within a 10-m (32.8-ft) radius.

It is unclear what factors are causing mortality of small trees within the altered forests and more research is needed, particularly concerning the possibility that snags are developing from competition. Due to the prevalence of live jack pine, prescribed fires in altered areas are expected to be more severe, and increase the abundance of dead trees, than prescribed fires in reference areas.

Emulating natural disturbance patterns has been demonstrated to be highly valuable in numerous studies. In the northern Lake States, forests that were formally mixed-pine (red pine and eastern white pine), have been transformed by anthropogenic forces, such as fire suppression. Currently, many of these areas are artificially regenerated pine plantations and monotypic jack pine forests. We suggest that reference mixed-pine forests in northern Lake States that contain 24-140 snags ha^{-1} (59.3-345.9 snags ac^{-1}) may set a baseline for managers willing to promote more natural structural patterns in plantations and other stands. And by using the range of treatments studied, land managers may emulate natural disturbance patterns to produce a larger variety of habitat, dead and live, for a greater variety of flora and fauna.

Related information:

Fraver, S. and B. J. Palik. 2012. Stand and cohort structure of old-growth *Pinus resinosa*-dominated forests of northern Minnesota, USA. Journal of Vegetation Science 23:249-259.