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267 Tree Mortality by Fire in Oak Savanna Restoration (Minnesota)

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Between 1964 and 1981, 112 fires on twelve blocks (ranging in size from 2.6 to 28.6 ha) with a total area of 153 ha were conducted on the Cedar Creek Natural History Area to restore oak savanna and tallgrass prairie. Burns totaling 1472 ha were conducted on sixty-two April and May dates. Tree survival and mortality has been observed on twenty-eight permanent one-fiftieth hectare plots since 1968. Plot data were grouped by the frequency of fire into five classes: control (no burns), infrequent (2 burns), frequent (6-9 burns), very frequent (11 burns), and annual or near-annual (15 and 17 burns).

Tree numbers increased on the control plots during the seventeen year period since ingrowth exceeded mortality. Mortality was significant on all other treatments—22 and 25 percent on infrequent and very frequent burns, and 50 and 44 percent on frequent and annual burns. These results are in some ways difficult to interpret.

Trees killed by annual fires add fuel for future fires. When fires are less frequent, the accumulation of surface fuel may have a similar effect. The increase in tree numbers on unburned control plots and the lower mortality on infrequently burned plots seems plausible, but the lower mortality on very frequent burns is puzzling. This suggests that complicating factors such as age, size, species, and site are interacting with burn frequency.

Overall, mortality was 36 percent for *Quercus ellipsoidalis* and 29 percent for *Q. macrocarpa*. Mortality decreased as tree diameter increased, ranging from 75 percent for trees 10 cm and smaller, to 30 percent for trees between 10 and 17 cm in diameter. Trees over 17 cm generally increased in number as more individuals were added to this size class than were removed from it by mortality.

Our results suggest that annual or near-annual burning is an effective management strategy in savanna restoration because it reduces the number of trees reaching maturity. In addition, burning this frequently results in low-intensity fires that are relatively easy to control. The results also suggest that it may be possible to get similar results in the early stages of restoration with burns two or even three years apart.

Later, when frequent burns have reduced stocking to a desirable level, the frequency of maintenance fires may be planned on the basis of shrub and herb responses. For example, annual or near-annual fires may be needed to control shrub height and density. Or, if shrubs are not abundant, longer intervals may be allowed between burns.