

FIRE AND LANDSCAPE DYNAMICS IN YELLOWSTONE NATIONAL PARK

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Objectives

This study is an investigation of long-term patch dynamics in the mosaic of forest communities covering the subalpine plateaus of Yellowstone Park. Our specific objectives are the following:

- (1) We will map the present forest mosaic of a 600,000-ha area, showing the age (number of years since the last destructive fire) and successional stage of each more-or-less homogeneous patch of forest.
- (2) Using this map, we will measure the area of each patch created by past fires, determine the size distribution of patches, and estimate the frequency and predictability of formation of patches of each size.
- (3) We will reconstruct the changes during the last 200-300 years in individual forest stands and in the entire landscape mosaic, and use these reconstructions to answer the following questions:
  - (a) Has the Yellowstone landscape been characterized by quasi-equilibrium conditions, in which the proportion of the total area covered by early, middle, and late successional stages and the diversity of plant communities represented have remained more-or-less constant, or have these parameters fluctuated greatly in the last 250 years?
  - (b) If we find that the entire landscape has been in a state of equilibrium (which we may not find), then what is the minimum land area necessary for landscape dynamics to approach this condition, i.e., to what extent could the Park be divided into isolated subunits without these subunits losing the quasi-equilibrium state?
  - (c) How have the proportions of forest successional stages varied over time in units of the Park that have special ecological interest, such as elk summer range, grizzly bear habitat, or the watershed of Yellowstone Lake?

The information gained from this research hopefully will shed some light on current theoretical questions regarding the prevalence of equilibrium vs. nonequilibrium conditions in natural ecosystems (White 1979, Shugart and West 1981, Romme and Knight 1982). It may also be useful in interpreting and managing recent ecological changes in Yellowstone Park. The project has been funded by the National Science Foundation (Grant No. BSR-8408181). We collected field data in the summers of 1984 through 1987, and expect to complete the research in 1988.

### Methods

Mapping of the forest mosaic was done by teams of 2-4 persons each (mostly undergraduate and graduate students). Fairly homogeneous patches were located in the field using cover-type maps prepared by D. G. Despain from aerial photographs. In each stand, the teams collected increment cores from dominant trees and wedges from fire-scarred relicts (where available) to be used in determining stand age and fire history (Arno and Sneek 1977). They also subjectively classified the stand into 1 of 4 successional stages (Despain 1977). The cores and fire-scar wedges were returned to the laboratory for analysis. Upon completion of the stand-age map, we reconstructed the forest mosaics that existed at various times in the last 250 years using methods described in Romme (1982).

### Results

We sampled a total of 430 stands from 1984-1987. We documented 66 fires since 1735 that burned at least 10 ha each. Preliminary reconstructions of past forest mosaics indicate that the area was dominated by early successional stages in the 1700's, by middle successional stages in the 1800's, and by late successional stages in the present century. We are continuing our analyses of smaller portions of the study area, such as the western watershed of Yellowstone Lake, and plan to complete the work in 1988.

### Conclusions

Our preliminary conclusion is that a dynamic equilibrium of forest successional stages has not characterized this large (140,000 ha) area. Rather the landscape dynamics have been dominated by the effects of extensive fires in the early 1700's. Many fires have occurred since, but they have not burned as large an area as those earlier fires. Another major burning cycle may begin within the next century, as extensive areas are now developing flammable late successional forests.

Literature Cited

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