

THE EFFECTS OF FIRE ON FOREST FLOOR VEGETATION IN
PONDEROSA PINE FORESTS IN THE SOUTHERN BLACK HILLS

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Objectives

The objective of this study is to carry out an ecological analysis of vegetation occurring under the ponderosa pine canopy in Wind Cave National Park and to define the relationship between this vegetation and fire. The N.P.S. has expressed special interest in areas which have been invaded by ponderosa pine since the national policy of fire suppression was established near the turn of the century.

Prescribed burning is being carried out on two wooded study areas following the initial vegetation analysis which was carried out last summer (1979). The vegetation on unburned controls for the burned sites has been analyzed as well.

Our study of the vegetation is designed so as to consider species distribution patterns within each vegetational type and to compare and contrast the communities with one another.

Two kinds of results are anticipated from this study. First, we will contribute to the general knowledge of fire as an ecological and evolutionary force of nature. This study should contribute, in particular, to our knowledge of fire's role in the establishment of ecotones. The ecotone here, the interface of grassland and pine forest, is of particular interest because both community types are widespread in North America. It should complement the ongoing prairie studies of F. R. Gartner (R. Klucas, Wind Cave N.P., Pers. Comm.).

Second, this research, by delimiting the effects of fire on ponderosa pine understories in the Black Hills, will provide new, useful information to planners and managers. They will be able to weigh alternatives for land use more accurately because they will have foreknowledge of the effects of prescribed burning (or comparable wildfires) vs. fire suppression on the pine understory.

Fire in ponderosa pine (*Pinus ponderosa* Laws) is one of the better documented aspects of western U.S. fire ecology (e.g., Behan, 1975; Weaver, 1974). At least one excellent summary of fire in South Dakota's Black Hills exists (Gartner and Thompson, 1973). F. R. Gartner continues to work in Wind Cave N.P.. His present studies center on the

prairie communities of the area (R. Klucas, U.S.N.P.S., Wind Cave N.P., Pers. Comm.). However, relatively little is known about the relationship between fire and the understory components of ponderosa pine communities (Bevan, 1975; Gartner and Thompson, 1973; and C. and J. Bock, personal experience in publication, 1978, 1978). We have found that ignoring vegetation below the forest canopy sometimes can lead to inappropriate and over-costly management programs (see J. Bock, Raphael and C. Bock, 1978). From an ecological standpoint, the sub-canopy layers are critical to the maintenance of species richness and diversity within the ecosystem (op. cit. and C. Bock, Raphael and J. Bock, 1978). Before a sound management program can be constructed, it is always useful and often essential to have a clear picture of the composition and ecological role of understory communities.

For a considerable portion of their distribution in the Black Hills, ponderosa pines occur in what has been called the "forest-grass ecotone" (Gartner and Thompson, 1973). This makes the literature concerning fire and the Great Plains pertinent as well, and it is extensive (see References in Vogl, 1974). Gartner and Thompson (1973) describe forest clearings in the Black Hills which they suggest may be fire-maintained (p. 48). In our study area with ponderosa pine's relative, Jeffrey pine, in the Sierra Nevada, Wilken (1967) suggested that Sierran brushfields may be fire maintained as well.

In summary, the literature and our previous research experience suggest that an investigation of ponderosa pine and fire in the Black Hills, as we have described here, is relevant to current ecological research and the findings should be readily applicable to current planning and management decisions.

Methods

Our 19 study plots are all 20 meters wide and 33, 50, or 67 meters in length. Belt transects are run along the lengths of each plot and along a mid-line parallel to and half-way between these boundary lines. Sampling is done at 1/3 m intervals. Each sample site is approximately 1 cm². All plants are identified at each sampling spot and their heights (or D.B.H.) and reproductive conditions recorded.

The study plots are subdivided into 10 x 5 m "sections". On each study plot all woody vegetation is recorded for 40 "sections". For each woody species, dimensions of specimens (20 samples per species per study plot) are recorded on each of 17 study plots.

From the vegetational data we are calculating cover, relative dominance, frequency and relative frequency for the plants of each study area (Smith, 1974). We also are summarizing the heights, reproductive conditions, life stages, etc. for selected species. This will enable us to characterize each of the study areas in several ways.

Post-fire censuses of the burned areas will enable us to obtain information about rates and species composition of regeneration and colonization of the burned areas by plants. Post-fire recensusing of the

unburned areas will give us an index of year-to-year variation in vegetation. That variation will be taken into consideration as we analyze the burned areas.

Chi-square contingency tables are being constructed for the vegetational measurements to determine the degree to which the habitats differ from one another and how the impacts of burning affect those differences. Litter presence and depth have been averaged for all plots. Percent canopy and shrub density calculations are proceeding as is the analysis of pre-fire samples.

A prescribed burn encompassing four study plots was carried out on October 17, 1979. Preparation is being made for another prescribed burn in April, 1980.

Prior to the burn, Jolls, J. Bock, and Richard Klucas, W.C.N.P. Biologist, collected soil samples, litter sample, and classes 2 (Oct. 17) and 3 (Oct. 15) twig samples along the cone transects. Samples were taken to the University of Colorado for further analysis.

The fire line around the area to be burned was completed on the morning of October 17, 1979. At 12:45 P.M. there was a 7/10 cloud cover, the wind was 6 m.p.h. gusting to 12 from the west, the temperature was 60°F, and the relative humidity was 51%.

The burn was ignited by D. Shilts and R. Klucas, W.C.N.P., at 1:20 p.m. by means of a flame thrower and a drip torch.

Results and Conclusions

This project is not far enough along at this time to allow us to present results and conclusions.

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