

THE EFFECTS OF FIRE ON COARSE WOODY DEBRIS IN ROCKY MOUNTAIN CONIFEROUS FORESTS



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Primary productivity, the accumulation of nutrients, and other important ecosystem processes are largely dependent on the mineral soil organic matter that has developed during hundreds or thousands of years. In forest ecosystems, the decomposition of coarse woody debris, woody roots, twigs, leaves and micro-organisms is a primary source of this organic matter. Large quantities of coarse woody debris are typically produced following natural disturbances such as fires, pest/pathogen outbreaks, and windstorms, which make a significant contribution to the formation of soil organic matter (SOM). In contrast, timber harvesting often removes most of the coarse woody debris (CWD), which could result in a decrease in the quantity and a change in the quality of mineral soil organic matter.

The Yellowstone fires of 1988 continue to provide an excellent opportunity to study the effects of fires of various intensities on ecosystem processes. Ecosystems develop under conditions that are constantly changing, but which remain within some range of natural variability. At present, national forest managers are uncertain as to the quantity of CWD which should be left in a stand following timber harvest in order to maintain levels of SOM which are within the range of natural variability (RNV). Little empirical data exists which help characterize the range of natural variability with regard to CWD in lodgepole pine forests, and it is therefore difficult to assess current timber harvesting practices in terms of how much CWD should be left at each site. We began a pilot study in late summer of 1995 to begin to address this deficiency. A larger study of broader scope,

based on results from this pilot study, is planned for an additional two to three years, beginning in 1996. This study will attempt to measure specific processes which include the distribution, decomposition, combustion by natural fires, and removal of CWD, rather than trying to obtain a direct measurement of forest productivity, which varies with climatic conditions and stand age.

The specific objectives of this project are:
i) Compare the mass and distribution of coarse woody debris that remains following fires of varying intensities to that which remains following various timber harvesting regimes in the Rocky Mountain Region; ii) estimate the amount of CWD that is combusted or converted to charcoal following fires of varying intensities in stands of varying stages of development; and iii) estimate the length of time necessary for every square meter of the forest soil to be affected by CWD under natural conditions.

♦ STUDY AREA

Research sites for the project are located in Yellowstone National Park in northwestern Wyoming and in the Medicine Bow National Forest in southeastern Wyoming.

Initial work has been done in lodgepole pine (*Pinus contorta* var. *latifolia*) stands in the nearby Medicine Bow National Forest, where timber harvests of varying intensities have occurred for decades. Measurements of CWD and woody roots

were made in stands of lodgepole pine on sites of similar substrate and elevation in Yellowstone National Park, and these measurements were compared to the Medicine Bow estimates.

All stands were at least 3 ha in size. Sites in the Yellowstone study were selected based on two important criteria: 1) a chronosequence of post-fire ages ranging from 7 - 150 years, located in 10 stands of similar habitat type; and 2) a series of 10 stands which represent the range of burn intensities of the 1988 fires. The Medicine Bow and Yellowstone sites are similar with regard to climate and vegetation.

◆ FIELD METHODS

Tree age data, either from tree cores or annual rings on stumps, were used to estimate stand ages and disturbance histories. For all stands in both the study areas, (both disturbed and the adjacent control stands) the following data were obtained: mass (Mg/ha) and percent cover of standing and detrital bolewood and large branch wood by size class, decay class, and approximate time of origin. Estimates of percent cover of each size class were obtained using the line intercept method. Litter was removed by raking, and then weighed, and subsamples were returned to the lab to obtain dry weights.

Mass of woody roots and root crowns was estimated by using allometric equations which utilize bole diameters (Pearson et al. 1984). Standing dead and live bolewood biomass were estimated in 4m x 30m quadrats using similar allometric equations developed by Pearson et al. (1984).

◆ PRELIMINARY RESULTS

Initial estimates indicate that almost twice as much CWD remains following intense fires than that which remains following clearcutting. However, these data are only preliminary and short-term in nature. Obviously, additional field work will be conducted in the next two years to obtain larger data sets from which to base the comparisons.

◆ REFERENCES CITED

- Pearson, J.A., T.J. Fahey, and D.H. Knight. 1984. Biomass and leaf area in contrasting lodgepole pine forests. *Can. J. for. Res.* 14: 259-265.