1983

The "Unnatural Fuel Buildup" Issue

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ABSTRACT: Fuel buildup is a natural process that can become unnatural when certain kinds and amounts of fuel extend uncommonly across the landscape. Unnatural fuel buildups occur more readily in short-interval types than in long-interval types and may never occur in some long-interval types. A knowledge of fuel buildup is important in planning how to introduce fire successfully but not in determining the need for it.

The phrase "unnatural fuel buildup" is troublesome because it lacks a commonly understood and accepted definition. To clarify this concept, I will emphasize that fuel buildup is a natural process that can become unnatural when certain kinds and amounts of fuel extend uncommonly across the landscape. For example, if practically all of the seral ponderosa pine in the Selway-Bitterroot Wilderness contained a well-developed understory of Douglas-fir ladder fuel, the situation would probably be considered an unnatural buildup because of the uncommon extent of this fuel situation. Although large buildups of fuel are usually referred to as unnatural, light accumulations may also be unnatural. For example, frequent human-caused ignitions could lead to unnaturally light fuel accumulations.

Unnatural fuel buildup, therefore, is a matter of degree or circumstances. A practical concern of land managers is to know the critical level of fuel buildup. This requires knowing when fuels on an area are increasing to a level much higher than before organized fire suppression. Kinds and amounts of fuel vary considerably over the landscape. The fuel mosaic is composed of dead and live vegetation on the ground and of vegetation that is vertically continuous with it. Each forest ecosystem probably has a characteristic fuel mosaic. When this characteristic mosaic becomes extremely unbalanced toward certain fuel situations, it is unnatural.

In discussing the impact of fire suppression on fuel buildup, Habeck (this Proceedings) and van Wagendonk (this Proceedings) draw opposite conclusions. Nevertheless, both, in my view, are correct. In the absence of fire in short-interval types, fuels accumulate, particularly fine fuels, because of shrub and conifer understory development. The extent of this buildup seems significant enough to me to be viewed as unnatural in some areas.

In long-interval types, Habeck (this Proceedings) pointed out that impacts of fire suppression on plant succession and fuel accumulation have been minimal. This is especially true in the cedar-hemlock forests studied by Habeck and in the wet forests of the Pacific Northwest where fire intervals can be several hundred years. Although the occurrence of unnatural fuel buildups in these forests types seems unlikely (because decay rather than fire recycles the dry matter), the mosaic of successional communities in these wet forest types may have been affected by the past years of fire suppression. Certainly vegetation composition and structure would be affected over several hundred years of fire suppression.

Habeck showed that downed woody fuel loadings vary considerably with stand age. My studies throughout the Northern Rocky Mountains have also shown this, and I think our findings suggest that heavy fuel accumulations are not necessarily unnatural.

A major difference between long- and short-interval types is that available fuels are produced more readily in short-interval types. Development of substantial fine fuels from herbaceous vegetation and abundant, porous litter coupled with drier environments are major reasons for the usually higher flammability in short-interval types. The drier environments associated with these types produce cured herbaceous vegetation over much of the summer. Live ladder fuels become readily available to burn because of the flammable surface fuels.

Fire intervals and environments differ considerably among long-interval types. For example, cedar-hemlock forests occur in warm, moist sites and typically have very long fire-free intervals. Decay of dead vegetation and recycling of nutrients progress more rapidly than in cooler, drier sites. In contrast, subalpine fir forests with lodgepole pine as a seral species occur in cool, dry sites. Fire intervals vary widely here but tend to be much shorter in the same regions where cedar-hemlock forests occur. Decay of dead vegetation proceeds slowly. Interpretations of unnatural fuel buildups could differ considerably among these long-interval forest types.
Habeck suggests that the fire potential from unnatural fuel buildup and continuity of cover in short-interval types will increase the likelihood of stand replacement fires in adjacent long-interval types, resulting in loss of old-growth trees. The question raised by his suggestion is whether fuel buildups in short-interval types increase the likelihood of fire in long-interval types. For cedar-hemlock forests, I suspect that fuel buildup in adjacent short-interval types is not a significant threat. Cedar-hemlock stands tend to occur on lower, moist sites affording some protection from wind. Except for small stands vulnerable to fire sweeping in from adjacent fuels, they must still burn from their own fuels. Too, I suspect cedar-hemlock stands were often recycled by surface fire during extremely dry years when burnout of duff caused extensive root mortality. Fuel buildup in short-interval types does seem likely to increase stand replacement fire in subalpine fir and lodgepole pine forests. These forests tend to lie above short-interval types. Fires developing in lower short-interval types could easily continue upslope and become crown fires in the subalpine fir and lodgepole pine.

I would also like to comment on the often-stated assumption that fuels accumulate with time. The generality of the assumption is implicit to the unnatural fuels buildup issue. Like many generalities, it is true sometimes but often misapplied. Vegetative biomass does accumulate with time because photosynthesis produces organic matter on a regular basis. Not all biomass is fuel, however. Forest fuel is organic matter that could burn if ignited. Some biomass is simply unavailable as fuel. For example, much biomass is synthesized annually in living tree boles that will not burn in forest fires.

Biomass becomes available as fuel in an irregular manner. Biomass from branches and tree boles becomes fuel when added to the fuel complex on the ground. Dead branches and tree boles accumulate on the ground in response to natural causes of mortality and factors causing downfall. Causes of mortality such as fire, insects, disease, suppression or natural thinning, and wind and snow damage affect stands at erratic intervals. Thus, buildup of downed dead biomass occurs in an irregular manner and is not necessarily related to stand chronology. In fact, fuel loadings and flammability can decrease with time because downed dead organic material decays. Regeneration of conifers develops live ladder fuels that in time may grow out of the surface fire zone. This also forms a pattern of an increase in available fuel followed by a decrease.

An interesting aspect of fire is that it both decreases fuels by consuming them and increases fuels by killing living vegetation. In short-interval types, frequent fires under a no-suppression regime maintain fuels at minimal levels. In long-interval types, however, fires under a no-suppression regime may increase fuels and lead to higher levels of flammability for longer periods of time than under a suppression regime.

Finally, I offer the thought that in most ecosystems, it is unimportant to judge whether fuel buildups are natural or unnatural. In managing wildernesses, parks, and other natural areas, our attention should be focused on maintaining a natural balance of successional stages. Mosaics of successional stages offer a more fundamental and reliable basis for determining naturalness than do fuel buildups. Fuel buildups coincide with certain vegetation successional stages in some ecosystems but not in others. For example, development of Douglas-fir ladder fuels beneath ponderosa pine represents a fuel buildup that coincides with that successional stage. Vegetation and fuels would be judged alike as natural or unnatural. On the other hand, in aspen forests extensive areas of mature and overmature age classes could reasonably be viewed as unnatural. Fuels, however, are highly variable and nearly always should be viewed as natural. Knowledge of fuel buildups is important in planning how to involve fire but not in determining the need for it. In other words, knowledge of fuel is important in appraising fire behavior potentials and planning strategies for ignition but not in deciding whether fire is needed to maintain natural ecosystems. Of course, this is not true outside of these natural areas where fuel buildups can indicate a definite need for prescribed fire.

A policy of fire suppression should lengthen fire-free intervals in both short- and long-interval types. In short-interval types, occasional escaped fires tend to be more severe and may reduce or eliminate open stands of old dominant seral species. Also, suppression over long periods could lead to losses of certain seral species through plant succession.

In long-interval types, such as subalpine fir on cool, dry sites, concern about unnatural fuel buildups may be legitimate even if desirable species or community types are present. Here lack of periodic fire might permit an unnatural tieup of nutrients that could unnaturally affect plant community composition and structure. In cedar-hemlock forests on warm, moist sites, however, decay might be rapid enough to prevent unnatural fuel buildups.

Regardless of whether fuel buildups are natural, fuel accumulations having high fire intensity and fire severity potentials must be reckoned with in managing fire. To manage for a natural role of fire, planned ignitions, in my view, are necessary to deal with fuels and topography that have high potential for fire to escape established boundaries or to eliminate undesirable plant communities.

It is necessary for practitioners to develop criteria that permit sound decisions on when to introduce scheduled ignitions. In developing these criteria, unnatural fuel buildups should be of minor concern in establishing the need for fire to maintain natural conditions but of major concern in deciding how fire can be introduced successfully.
Proceedings—
Symposium and Workshop on Wilderness Fire

Missoula, Montana, November 15-18, 1983

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Proceedings of a Symposium Sponsored by:

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