Do burn piles need rehabilitation? *Peter Kolb MSU Extension Forestry*

Burning woody debris piles to treat excessive fuels that result from thinning a younger stand (left below) or a commercial logging operation (right below) is an effective practice for landowners and forest managers. The

Fig 1. A burn pile (left) consisting of fine loose fuels from precommercial thinning and a pile (right) composed of larger fuels from logging cleanup).

Fig2. Three levels of burn severity with low severity on top and high severity on bottom.

composition, size and timing of when they are burned can have strong influences on the impacts that burning has on the soils beneath the piles and how quickly these areas recover to support native vegetation. "Fire severity" is the term used to assess how much heat was imparted on the soil surface, or how much damage was caused to the vegetation where the fire burned. This is not be the same as "fire intensity," which denotes how high the flames burned out of the pile. For the purpose of burn pile rehabilitation we are less interested in fire intensity—which is of greater concern when we are actually burning the piles because tall flames will determine how far the fire effects will travel to surrounding vegetation, or how far burning embers will be thrown into the distance, possibly igniting surrounding fuels and allowing for a fire escape.

Fire severity is caused by heat from the fire either damaging soil or the vegetation it comes in contact with. It is driven by both the amount of energy released, and how long energy (heat) occurs in any location—also known as fire duration. Somewhat counter intuitive to what we see when a fire burns, a slow smoldering fire can cause much greater damage to soils and vegetation than a fast explosive fire because heat moves downward into the soil very slowly. For example, Figure 1 shows the results of two very different debris piles. The fire on the upper left was from a loose pile, stacked 10ft high with dried dead and green branches that threw flames 20 feet into the air and burned out in about 3 hours. The fire on the upper right consisted of fine branches, larger branches, and logs that had no market value. It only threw flames 10 feet into the air, but burned for almost 6 days. The impact to the underlying soil is seen in Figure 2. The upper picture shows minimal impact to the soil from the loosely stacked pile of fine debris (upper left fire) and the lower two pictures are from fires that burned increasing concentrations of large fuels for multiple days (analogous with the upper right picture of Figure 1). What you see are ash layers (ranging in color from white to tan and orange) of different depths, covering the darker mineral soil underneath. Intact organic matter and fine roots in the mineral soil under the ash indicates little heat damage, whereas lighter colored dusty mineral soil indicates heating and baking.

Ash color is dependent on the heat and duration of the fire. Black charcoal is the result of incomplete combustion, low temperatures, and low oxygen levels often found along the lower edges of the fire. Charcoal can be a good soil amendment because it is highly porous and can trap and hold moisture and nutrients that plants can extract and use. It also is an indicator that organic nitrogen from the organic material burned has not been turned into a gas, and remains in higher concentration in the surrounding soil. Some studies indicated that charcoal can persist in/or on the soil for thousands of years. White ash is completely combusted organic material where only the basic non-organic elements are left behind. It can be rich in macronutrients such as phosphorus, potassium , calcium and sulfur, which is why ungulates such as deer and elk like to lick it. Orange or tan ash is organic mater that have been heated to the extent that chemical changes occur to the inorganic components such as iron oxidation, and is the same process that converts clay into pottery. The original plant based macronutrients may not be as available in this material, reducing its value for nutrient recycling. All ash is initially quite alkaline, which ties up nutrients and makes them unavailable for plants. Ash from a burn pile has another challenging characteristic: it has all of the water driven from its mineral particles which initially can make it very resistant to water penetration and absorption. Once it has been rewetted, such as after a winter snowpack, it exhibits an opposite effect. It absorbs water very quickly, but holds onto it very tightly preventing water from moving through it into the mineral soil. Thus the ash can maintain a gooey consistency with dry soil underneath.

Fig 3. Rehabilitating a burn pile with a small tractor can take less than 1/2 hour.

Thick ash layers from a burn pile presents a medium that can be very hostile to native plant revegetation and large burn pile sites may persist for 30 years or longer. Unfortunately, noxious weeds tend to have he best ability to colonize such sites and they typically become thistle, hounds tongue and mullein hot spots. Alternatively, they can easily be treated and offer the opposite—sites with exceptional productivity for understory plant or tree growth. To achieve this result, the ash layer simply has to be broken up and lightly mixed with the underlying unheated mineral soil layer. Forest soil is typically slightly acidic, which neutralizes the alkalinity of the ash. The mixing with mineral soil also breaks up the water impervious layer that ash tends to form, and when combined actually improves the water and nutrient holding capacity of the mineral soil. Mixing can be accomplished with a shovel, or more quickly with a small tractor as seen in Figure 3. On average, rehabing 12 piles took me about 20 minutes per pile. The easiest technique was to use a “push-pull” tactic where the bottom of the bucket edge was placed about an inch into the mineral soil and then pushed through the burn area.

Then the bucket edge is placed over the pushed-together pile and dragged back through the pile while slightly bouncing the bucket up and down to create an irregular surface of mixed ash and mineral soil. This is done from different angles until the burn area is treated in its entirety. Note, it is important to spend 10 minutes prior to tractor work piling larger remaining woody debris into a small adjacent pile to burn again at a later date as such pieces can greatly inhibit soil mixing with a blade. Also, do not make burn piles on top of stumps. Fresh stumps will not burn, and are most unpleasant to hit with your tractor or to maneuver around.

The final step is to plant seedlings and/or seed the rehabilitated burn piles. Natural tree seedling germination is often abundant on such disturbed sites if you are willing to wait a few years. An irregular soil surface that has not been driven over too often by a tractor is a great seedbed and fairly resistant to erosion. If a pile is burned in late fall, spring is the time to rehab when the soil is no longer water saturated (or you might compact the soil). Typically 40-100 seeds per square foot are recommended for adequate occupancy of new grass seedlings. As a trial I seeded Dutch white clover, Paiute orchard grass and native Mountain brome (Figure 4) because they are preferred by wildlife and well suited for such sites. After one summer I found varied results, with orchard grass consistently performing the best, Dutch white clover providing surprisingly good cover on the mildly shaded and moister sites, and very poor response from the mountain brome (Figure 5). Seed size is very different for these three species with clover providing 24 tiny seeds to every 12 of orchard grass and 1.6 seeds of mountain brome. The large size of the mountain brome seeds may have led to a lot of predation from a local flock of wild turkeys, and made it much more expensive to cover the same area as the other two species. A valley bottom burn-site without rehab was also seeded as a “no-treatment test” and resulting in virtually no seedling recruitment.

Fig 4. Seed size between white clover (top), orchard grass (middle) and Mountain brome (bottom).

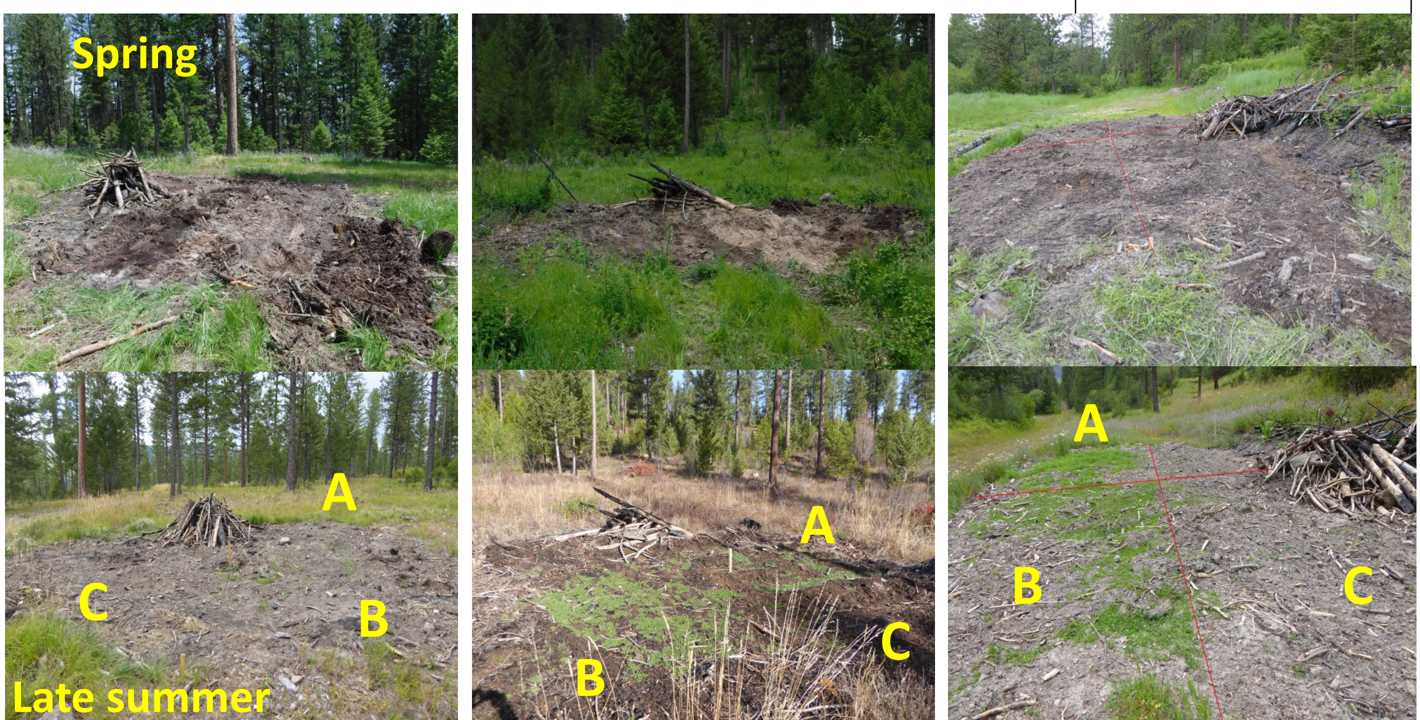

Fig 5. Burn pile location and conditions varied from a dry ridge top (left), mid- slope (center) and valley bottom (right). The dry ridgetop site showed the poorest response though wild turkeys frequently used the site as a dust bath. North and east aspects and the higher humidity in the valley bottom showed good responses from orchardgrass (A) and Dutch white clover(B) with poor response from Mtn brome (C). An important consideration is that herbicides cannot be used over clover to control weeds.