Monitoring of Slash Piles Burned in Stream Environment Zones: 2003 and 2008

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Denise Downie, Forest Soil Scientist
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Introduction

Over the past decade, LTBMU has inadvertently burned several slash piles within Stream Environment Zones (SEZs). These actions were not taken deliberately; rather they were the result of miscommunication or lack of adequate communication. An informal, small scale qualitative monitoring effort was undertaken in 2003 to investigate and document the impacts resulting from burning these piles. The monitoring questions included:

1. Did the burn result in evidence of erosion of soil or ash? Did the burn result in evidence of deposition of soil or ash to a water body?
2. Was the burn intensity (as inferred from soil properties and litter) high, moderate, or low?
3. Did the burn result in detrimental impacts to soil structure?
4. Did the burn "sterilize"" the soil such that vegetation cannot grow in the burn pile footprint?
5. What is the likelihood that nutrients released by the burn were transported to adjacent water bodies?

Methods

In 2003, limited qualitative soil and vegetation data were collected, along with other site observations. In 2008, additional photos and vegetation data were collected. The 2008 vegetation data is summarized in Table 1 at the end of this report.

Pile locations were all in the South Lake Tahoe area. One pile was located in Pioneer Unit 15, which is near the junction of Pioneer Trail and Highway 50. Three piles were located in Pioneer Unit 11, below the road that services the Meyers landfill site. Three piles were located near the end of the road into Baldwin Beach, and one pile was adjacent to Cathedral Road between Highway 89 and Fallen Leaf Lake. A map and photos are included as attachments.

Results and Discussion

For the most part, results are discussed in terms of the monitoring questions. Answers to the monitoring questions are based on a very limited data set of 7-8 burn piles, so should not be extrapolated beyond the kinds of soil and SEZ conditions found in the Tahoe basin.

The monitoring questions do not address the relationship of slash pile size and burn impacts. Larger piles and larger fuel size classes tend to burn hotter and longer, resulting in a greater likelihood of more severe impacts. Pre-burn information about pile size and fuel size was not collected, but a photo of one pile during burning is included.

Burn pile footprints were generally oval or oblong in shape, with observed diameters ranging from 10 to 37 feet with an average of 16 by 25 feet. Some of the diameters are probably larger than the actual piles, because fire is often allowed to creep outside the pile perimeter during burning.

1. Did the burn result in evidence of erosion of soil or ash? Did the burn result in evidence of deposition of soil or ash to a water body?

There was no evidence of erosion of soil or ash movement around any of the pile footprints. Slope steepness on all sites was less than 5%.

2. Was the burn intensity (as inferred from soil properties and litter) high, moderate, or low?

This question did not prove as easy to answer as expected. Burn intensity is inferred from soil water repellency (hydrophobicity), degree of litter and vegetation consumption, and soil color and structural changes. One pile footprint had severely hydrophobic soil, but hydrophobicity was also present outside the burn footprint, suggesting that the hydrophobic condition was present before the fire.

Reddened surface soil color was present in 2 of the pile footprints. Reddened soil color is associated with temperatures above 400° C which can alter physical and chemical soil properties (Ulery and Graham, 1993). Hydrophobic conditions are created between 176° C and 204° C and are destroyed at temperatures above 288° C (DeBano et al. 1998). Thus reddened color and lack of hydrophobic conditions may be found together. However, absence of hydrophobicity may imply soil temperatures below 176 °C or above 288° C.

After a wildfire, the degree of litter consumption and the diameter of branches and stems that burn are used to infer burn severity. This did not prove to be a useful measure in this monitoring, because during burning of the pile, the fuels are stirred and fuels near the edges are moved to the center. Thus unconsumed litter left on the surface of the burn may have been deposited at the end of the burning time, and does not necessarily indicate that burn temperatures were low.

3. Did the burn result in detrimental impacts to soil structure?

No changes in soil structure were noted, and surface soils were structureless in some instances. Surface structure changes are associated with organic matter combustion and changes in mineral soil physical and chemical properties.

4. Did the burn "sterilize" the soil such that vegetation cannot grow in the burn pile footprint?

Fire can effectively sterilize soils by destroying the microbial populations and seeds stored in the soils and by inhibiting infiltration. The latter happens under hydrophobic conditions and when ash mobilized by raindrop impact clogs and/or seals surface soil pores, but these conditions are all reversible over time. High temperatures that alter soil physical and chemical properties can also inhibit plant growth; these changes are generally not reversible.

The degree of vegetative recovery suggests that sterilization did not occur. Vegetative canopy cover ranged from 10% to 85%, with four of the seven sites having 75% to 85% vegetative cover. On the site with 10% cover, about 60% of the burn footprint exhibited evidence of soil disturbance by burrowing animals (photo). Burrowing activity was evident in the area adjacent to the burn as well. One of the Baldwin sites had 50% cover; since this is also one of the oldest burns, it should probably be considered the site with the worst recovery. However, the Baldwin area has undergone a lot of other disturbance, including a wildfire, and subsequent activities such as removal of dead trees may have also inhibited vegetative recovery. The Cathedral site, burned in 2007, had 30% vegetative canopy. Aspens (Populus tremuloides) have responded well to fire on this site, with numerous saplings ranging from 2-6 feet in height (photo). These saplings likely began resprouting after they were cut in 2004, and experienced a light surface burn when an adjacent slash pile was allowed to creep (Scott Parsons, personal communication). The 10% whitethorn (Ceanothus cordulatus) cover on this site is expected to increase dramatically in the next year or two, as whitethorn grows rapidly and the plants appeared vigorous.

5. What is the likelihood that nutrients released by the burn were transported to adjacent water bodies?

Only the Pioneer 11 sites were adjacent to water; an intermittent stream was located about 25 feet away. The other sites were meadow and wet meadow SEZ types. No evidence of erosion was observed at any of the sites, so surface deposition of nutrients to water bodies is unlikely. Given that SEZs are generally well-vegetated, it seems likely that most subsurface nutrients released by the pile burns would be taken up by plants adjacent to the burn site.

Conclusions

Although this is qualitative monitoring based on a small sample size, the results suggest that burning piles in SEZs may have relatively slight impacts on soil, vegetation, and water quality, especially if pile size is controlled in order to limit soil temperature. However, the photos from Pioneer Unit 15 suggest that even large, hot pile burns may revegetate well in SEZs, which are some of our more resilient ecosystems. Erosion would likely be a concern on steeper slopes than those observed in this analysis.

Table 1. Burn pile vegetation data collected August 13, 2008; observers Denise Downie and Dave Kearney.

Location (Project name and unit)	Year Burned	Estimated Total Plant Cover	Major Species Cover	Other Species (numbers denote individual plants)
Pioneer 15	fall 2002	80%	25% Achillea millefolium 35% Lotus purshianus	5 Pinus jeffreyi 4 Pinus contorta Epilobium angustifolium Aster spp. Trifolium angustifolium Sidalcea oregana Gayophytum diffusum Fescue spp. Timothy spp. Poa spp.
Pioneer 11 downstream (note: 60% of burned area and some of adjacent area is disturbed by rodent activity.)	fall 2001	10%	---	6 Pinus contorta 2 Ceanothus cordulatus 1 Manzanita spp. Lupinus lepidus Lotus nevadensis Gayophytum diffusum
Pioneer 11 middle	fall 2001	75%	60% Ceanothus cordulatus	4 Pinus contorta 2 Pinus jeffreyii Achillea millefolium Lupinus lepidus Aster spp. Gayophytum diffusum Lotus nevadensis

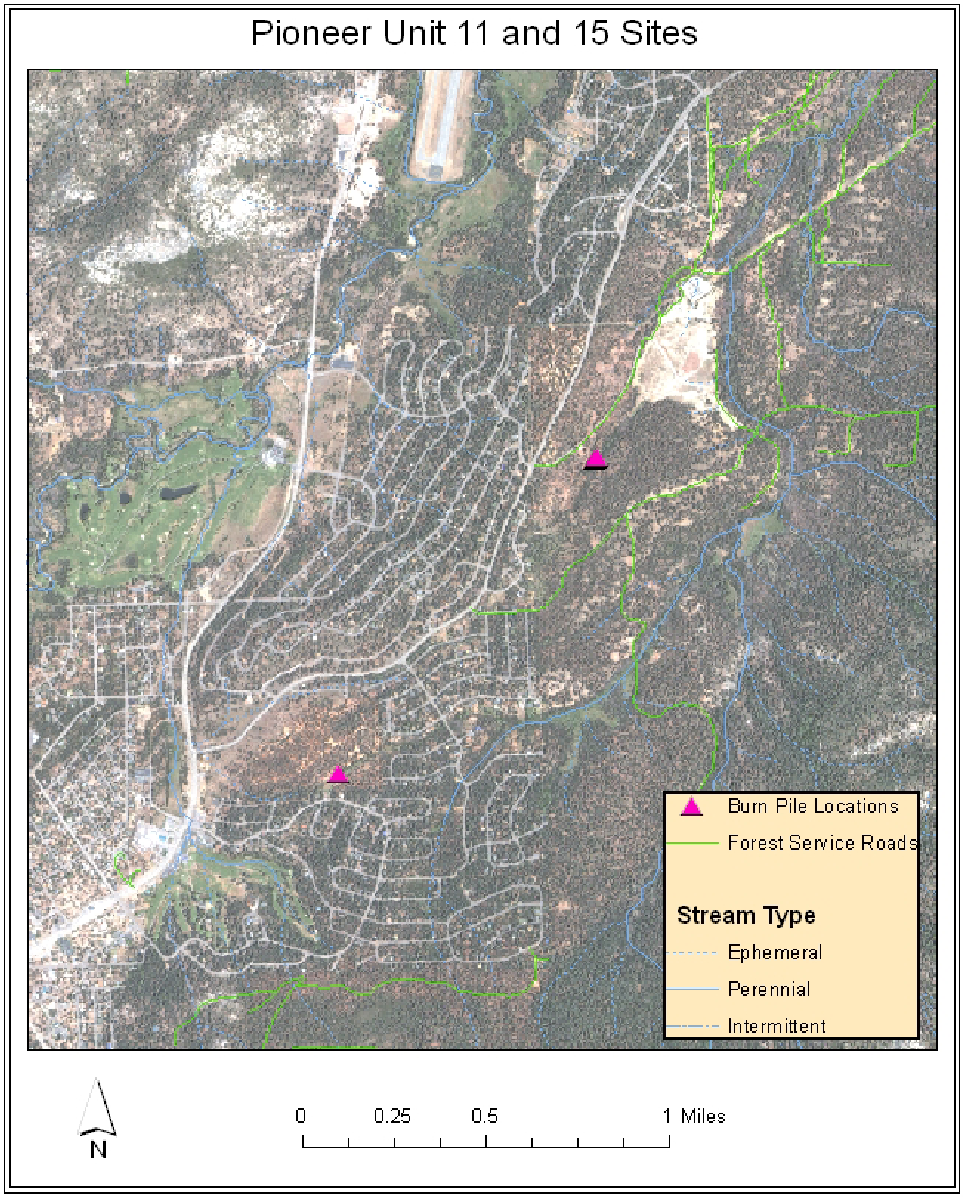
Location (Project name and unit)	Year Burned	Estimated Total Plant Cover	Major Species Cover	Other Species (numbers denote individual plants)
Pioneer 11 upstream	fall 2001	85%	---	2 Pinus jeffreyi3 Pinus contortaAchillea millefoliumBromus spp.Poa spp.Lotus nevadensisCeanothus cordulatus (approx. 2.5 feet high and 6-8 ft wide)Aster spp.
Baldwin 1	Before 2002	75% (3/4 of burn area has 100% cover)	---	2 Pinus contorta Carex spp. Juncus balticus Salix lucida Lupinus lepidus
Baldwin 2	Fall 2002	50%	40% Carex spp.	1 Pinus contorta Rumex acetosella Salix lemonii Carex spp.
Cathedral	Fall 2007?	30%	10% Ceanothus cordulatus 10% aspen (2-7ft high)	Ribes cereum Amelanchier utahensis Gayophytum diffusum Vicia spp.

References Cited

DeBano, L.F., D.G. Neary, and P.F. Ffolliott, 1998. Fire's Effects on Ecosystems. John Wiley and Sons, Inc. New York, NY.

Ulery, A. L. and R. C. Graham, 1993. Forest fire effects on soil color and texture. Soil Sci. Soc. Am. 57:11 135-140 (1993).

Attachment 1 - Maps



Baldwin and Cathedral Road Sites

Attachment 2 – Photos

Photo 1.. Pioneer 15 during burning, fall 2002..

Photo 2. Pioneer 15 the day after burning, fall 2002

Photo 3. Pioneer Unit 15, July 2003.

Photo 4. Pioneer Unit 15, August 2008

Photo 5. . Pioneer 15, middle of burn footprint, August 2008.

Photo 6. Pioneer 11, downstream pile, July 2003

Photo 7. Pioneer 11, downstream pile, August 2008.

Photo 8. Pioneer 11, downstream pile, disturbance from burrowing.

Photo 9. Pioneer Unit 11, middle pile, July 2003.

Photo 10. Pioneer Unit 11, middle pile, August 2008.

Photo 11. Pioneer 11, upstream pile, July 2003.

Photo 12. Pioneer 11, upstream pile, August 2008.


Photo 13. Baldwin3, near road, July 2003.

Photo 14. Baldwin3, near road, August 2008.


Photo 15. Baldwin 1, near shed, by road, July 2003.


Photo 16. Baldwin 1, near shed, by road, August 2008.

Photo 17. Baldwin 2, July 2003.

Photo 18. Baldwin 2, August 2008.

Photo 19. Cathedral, adjacent to road, August 2008.

Photo 20. Cathedral, adjacent to road, August 2008 (area to left of Photo 19).