Webinar Brief for Resource Managers

Great Basin Fire Science Delivery | 1664 N. Virginia St./MS 0186, Reno, NV 89557 | 775-784-1107 | emb@cabnr.unr.edu

Post-Fire Wind and Water Erosion in the Great Basin: Results and Management Implications

November 22, 2010
Wind: Matt Germino, Idaho Statue University
Water: Jason Williams, Hyrdologist, USDA-ARS

Management Implications

- Sometimes the best thing to do to avoid worsening erosion after a fire is to leave the area alone; disturbing areas upwind may create a cascading effect downwind, worsening damage. Erosion control is a landscape level problem.
- Only about 10% vegetation cover is required to reduce erosion post-fire to pre-fire erosion levels.
- Ecosystem heterogeneity helps to prevent erosion; microsites can develop windbreak communities.

Project Summary: Matt Germino from ISU and Jason Williams from USDA ARS discuss post-fire wind and water erosion issues and associated management implications, respectively.

Abstract:
Wind: Dust storms are becoming more frequent in recent years, which harkens back to the Dust Bowl, one of the largest ecological disasters to hit the country. Like the dust bowl, the current situation can also be attributed to human activity. Dust can negatively influence human health, safety, economics, crop yield, local weather, and local and distant water issues (e.g. dust in the Rockies affects melt rate, which has cascading negative effects). Fire has been identified as a factor that contributes to an increase in erosion, and thereby, the amount of dust. Fire severity and frequency has increase over the last few decades; where fires would occur at the scale of decades, they are now occurring every few years. Matt and his associates are conducting ongoing research into the effects of fire on erosion. They focus on the extent, the time and place, causes and consequences, and the methods by which to manage and mitigate the negative effects. Using several methods of monitoring, including sensors and sediment collectors, they have been able to evaluate fires' effects on erosion. Erosion is dependent on three characteristics: Erosivity (wind speed at ground level, increases with increasing wind speed), erodibility (how loose the soil is) and Supply of Erodible Mass (how much is available in terms of soil). After a fire, there is less vegetation, which leads to more wind, which can lead to more erosion (depending on erodible mass). Erosivity is evaluated using LIDAR over time, which analyzes changes in elevation. Erodibility is measured by planar sensors which detect wind and airborne particles. Germino and others learned that the threshold wind speed for

dislodging particles is constant, regardless of cover (cover, however, may prevent wind from reaching that speed naturally). Erosion was found to be higher under shrubs than open areas in a post burn area. The consequences of erosion can be a loss of soil nutrients (small, nutrient rich particles are the first to go) which can disrupt other biological and nonbiological functions (such as nutrient uptake and water retention).

Water: There are several factors that control the hydrologic responses of soils in the Great Basin: Soil characteristics (i.e. texture, bulk density, structure, organic matter, stability, surface rock, and water repellency), Topography, and Canopy/ground cover. Water repellency is influenced heavily by organic materials that leech/decompose into the soil. Fire changes many of the characteristics of the soil, and thereby, can make erosion more severe. Fire affects soil in the Great Basin by: decreasing interception and storage, exacerbating water repellency, reducing roughness/increasing flow, and initiates concentrated flow. In unburned areas, the primary method of soil particle movement is from splash sheet (drops of water will move particles a little with the force of impact, but flow is greatly reduced/mitigated by the vegetation community), whereas in burned areas, the primary method is concentrated flow processes (cascading effect of water without mitigating vegetation will increase volume and flow, which causes an avalanche effect). Jason William and colleagues researched runoff/erosion on pre- and post-fire (at several intervals) using artificial rainfall. Their findings show that pre-fire follows rainsplash properties. Immediately after a fire, the processes are dominated by concentrated flow, to concentrated flow transitioning to rainsplash one year after the fire, to almost pre-fire levels of rainsplash only two years after the fire. However, they caution that recovery is site and temporally specific; an area can recover quickly in a few years or take decades to return to pre-fire levels of vegetation, and 40% vegetation is needed for processes to shift to rainsplash. Annual variability of precipitation is also a key factor, as acute, heavy rainfall is a major cause of erosion. With more frequent and higher intensity fires than observed historically, erosion is worsening in a lot of areas of the Great Basin.

Management Implications

- It takes approximately 3 years for a burned area to return to pre-fire levels of erosion (highly site specific)
- Risk evaluation should be considered in a probabilistic framework: Storm intensity and site susceptibility
- Cursory models are available at the time of the webinar, with advancements forthcoming

Question and Answer Session (52:26):

Is there any data comparing the erosion resistance between sites reclaimed?

Water: There are some data sets like that. Agencies may want to treat cheatgrass, but some cover may be better than none. Strictly concerned about water erosion, but with risk of fire, there may be some ecological reasons to consider. Some is better than nothing. We are just starting to learn about how plants influence infiltration.

Wind: Sites we looked at stabilized with 10% cover, and doesn't really matter what kind of cover it is. There are several efforts measuring background wind erosion in undisturbed sites, but there is so little wind erosion it's hard to get data. Detection and time to observe erosion may be too small and too long, respectively. Not many papers that address that question.

How are you each measuring cover?

Wind: We used a point intercept approach, using points along a line or random location with 36 points. Foliar cover, line intercept, and low-lying grasses were included in the analysis. The limitation is a focus on ground based vegetation, but the process affects large areas. LIDAR is an important tool used. Configuration of cover is important as much as amount of cover that is affecting erosion.

Water: We used a line transect method. We measured gaps and took into account what populated them. What's on the ground in the gap? Litter?

How large are fire that are most likely affected by wind erosion?

Wind: First sites were on the order of 1,000-2,000 acres. Not much erosion. Next were 10,000 or larger and have plenty of wind erosion. We did not seize the opportunity to find threshold of burn size. Between 1000 and 10,000 acres, varies by landscape around the fire. If there is some identifiable burn size, it's larger than 1,000 acres.

What about fire return interval in regards to erosion? Are more erosive more likely to burn? I'm thinking weeds are more like disturbance space and more likely to reburn.

Wind: There is a lack of good imperial evidence to give a factual evidence. Spit balling, I'd say if a site loses organic matter and nitrogen that will diminish shrub islands, especially after multiple fires. Data indicate rangeland in good shape with cheatgrass that only burned once, interspersed shrub island is persistent. This is an important pattern because those interspaces are one of the microsites where exotics such as cheatgrass can take hold. Think about what would it take for a fire return interval and cheatgrass invasion to make more of landscape have soils typical of interspace. 4 times in 20 years will increase the microsites to more suit invasives, you see positive feedback, more cheatgrass, more fires.

Water: Pretty much the same thing. Shrub to cheatgrass, don't know how that changes infiltration. A question we would really like to address.

Have you looked at debris mudflow systems in great basin systems? Do debris mudflows fit within your hydrologic vulnerability model?

Water: Not an area of research we are involved in. That model is more about hill slope processes, but you could use the same conceptual model.

Is there any evidence that temporary wind breaks could be installed in burn areas to prevent wind erosion while vegetation still establishes? Would it be economically feasible over several thousand acres?

Wind: I don't think it would be feasible, and the impacts of putting them up, the disturbance itself would be something to be concerned of. Once burned, not much we can do. In the summer/fall, when sites are most vulnerable, staying off site is all we can do. I've contemplated what could go on, but really the management requires a longer term perspective. Grazing regimes and vegetation abundance treatments and how they lend themselves to erosion should be considered. How each management unit is related to the landscape? Will fire cause a cascade? That's where management can make a difference.

Having too much shrubs can increase the wind erosion? Which is something cows can impact based on land management.

Wind: What we found is that the supply rate of erodible sediment is not uniform over the landscape after a fire. We found microsite hotspots where you were more likely to see more sediment to provide to the wind to make dust clouds, usually under shrubs. I was speculating that areas with a lot of shrubs, which could be lightly to moderately grazed, for many decades to a century, more sagebrush, those sites we could predict to see greater loss of sediment.

Is chemical soil stabilization practical or warranted?

Wind: What you spray on a site, if vulnerable to wind erosion, will be transported downwind and have effects. Chromide is used on small areas sometimes. What would you do on a 100k – 500k area? Might be practical to look at where saltation will initially occur and do airplane stabilization in erosion starting zones. Might stabilize downwind fire, but this is only speculation. Hopefully we will develop models soon. I don't know about the costs or collateral impacts.

Small scale tests have been done that bind soil surface. The finding is that the results are mixed done on small plots. The wind erosion is a bigger problem from the larger landscape involved. I don't think much research has been done, and only on small areas, and the results were mixed at best. My big concern would be from a cost benefit perspective. Would it prove out? We need to look deeper and do more research. If we had the 500k+ acre fire again, it would not be feasible. I don't remember what chemicals were used. There was an ARS out of Logan 10-15 years ago.

How do you measure raindrop infiltration rates?

Water: We use artificial rainfall and measure what comes off, and the rest is assumed to be interception and infiltration. Working on separating those two.

Soils were more water repellent in certain years even without fire influence. Why would this be?

Water: Water repellency occurs on both burned and unburned. Water repellency forms from leaching of organic materials onto soils from year to year, on burned sites or unburned sites. Differences are due to different plant matter on different sites, which is highly spatially variable, and also dictated by soil moisture content.

Are these research findings being incorporated into AGWA?

Water: Our hydrology work will someday be incorporated into AGWA.