Introduction
Increasingly large, frequent, and severe fires across the western United States are creating difficult restoration challenges for land managers. Despite the wide usage of current fire restoration techniques, many studies have shown little to no benefit when compared with a no action alternative. Some research has even shown negative impacts, such as the spread of invasive species. The use of select post-fire colonizing mosses or “fire mosses” is a promising alternative restoration tool never been investigated for use in high severity burned environments.

What is fire moss?
“Fire moss” colonization is a little know natural phenomenon that occurs after wildfires throughout the western United States and many other areas around the world. As early seral pioneer species, the common ruderal moss species: Funaria hygrometrica, Ceratodon purpureus, and Bryum argenteum can form continuous ground cover within several months to years following high severity wildfire.

Fire mosses are strong candidates for restoration because they are:
- **Cosmopolitan** (found on every continent). Fire mosses are not invasive to post-fire sites worldwide and research could have universal application.
- **Desiccation tolerant.** Mosses can be dried and stored in a dormant state for decades or possibly even millennia. They can then be applied and rehydrated during the crucial moments after wildfire.
- **High water holding capacity.** Mosses have been shown to hold up to 1,400% of their dry weight in water, allowing them to absorb runoff from post-fire flash flooding.
- **Succeeded by grasses and vascular plants.** After serving as early post-fire soil stabilizers, fire mosses are succeeded by later seral stage species.

In Brief:
- More post-fire restoration options are needed. Fire mosses possess traits that make them good candidates: desiccation tolerance, soil aggregation ability, high water holding capacity, and universal distribution.
- Fire moss can be grown on field sites and respond best to the presence of heavy ash as is common in high-severity burned areas.
- Greenhouse moss production to create material for field application has been successful. Ash additions and frequent watering schedules result in more moss growth.
- Further research is being conducted to develop fire moss into an easily applicable and effective tool. When paired with current Burned Areas Emergency Response (BAER) treatments we hope to increase overall response capabilities.

Figure a: Wallow fire 2011 (two months post-fire)
What research has been done on fire moss?

- Fire moss field trials were conducted using burn pile footprints. The center of each pile was used to simulate high severity burn conditions typified by a heavy layer of ash, while the periphery of each pile was used to represent moderate burn conditions (figure b). Mosses grew prolifically on the heavy ash layer demonstrating that high severity burn conditions are most conducive to fire moss growth. These results are significant because high severity sites are where the soil stabilizing abilities of fire moss are most needed.

- Now that fire moss application has been proven successful, it is imperative we develop a reliable source for producing moss inoculum (dried moss fragment mix used for introducing mosses to burned sites). Greenhouse trials were conducted to determine optimal growing conditions for mosses. We found continuous watering schedules and an ash addition allowed for greater percent cover of moss.

- Both field and greenhouse research is ongoing and improvements in moss growing capabilities are improving exponentially!

How can fire moss be applied?

- More research is being conducted to determine optimal application methods for fire moss. Application strategies under current focus include:
  - Fire moss inoculum could be included in post-fire seed mixes with little extra cost and labor (figure d).
  - Inoculum could be more applied by hand on a finer scale to slopes and drainages directly above communities at risk of impacts from flash flooding.

- Please contact the Northern Arizona University School of Forestry’s Forest and Rangeland Soil Ecology lab for information on how you can become involved in fire moss field trials: henrygrover@nau.edu (802) 734-0249 Bowkerlab.blogspot.com (lab blog site)