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Does Wildfire and Cheatgrass Invasion in a Sage-steppe Ecosystem Change Soil Texture?

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Does wildfire and cheatgrass invasion in a sage-steppe ecosystem change soil texture?
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ABSTRACT
Fire and land-use changes influence vegetation types and alter below-ground carbon storage and soil characteristics; additionally, shrub-steppe environments are prone to cheatgrass invasion and subsequent alterations in soil morphology and characteristics following fire. We compared soil particle size, texture, consistence, structure, color and pH among adjacent but distinct vegetation types (sagebrush, cheatgrass, and restored vegetation); and laboratory hydrometer analyses from paired sites in different vegetation types. Our data compared soil particle size, texture, color, and presence of calcium carbonate, were described qualitatively in the field (Utah Geological Survey Standard Methods). Lab textural analyses were determined with a Hydrometer Method (ASTM D 422-63). Calcium carbonate content was quantified using a pressure calci meter.

INTRODUCTION
Native vegetation (sagebrush, Artemisia tridentata) in the sage-steppe ecosystem provides habitat for a variety of wildlife and protects soil by reducing erosion and contributing organic litter. Cheatgrass (Bromus tectorum) invades sage-steppe ecosystems after a disturbance, such as a fire. Fire and vegetation type affect water infiltration and repellency (hydrophobicity) and ultimately influence soil texture (DeBano 2000). We compared field soil profiles and laboratory hydrometer analyses from paired sites in different vegetation types to determine the effects of cheatgrass invasion and bunch grass restoration on soil particle size.

STUDY SITE
Our study site (Figure 1) was located on Kuna Butte (43.4457, -116.4474) approximately 3km SSW of Kuna, Ada County, ID. It had three distinct vegetation zones (sagebrush, cheatgrass, bunchgrass). The area burned in 1983, 2000 and 2013. After the 1983 fire, the Bureau of Land Management seeded part of the area with bunchgrass in an effort to restore native vegetation.

METHODS
• Two soil pits (60-80cm) dug in each of three vegetation zones (bunchgrass, sagebrush, cheatgrass).
• Sites designated by habitat: Bunch-Cheat (BC); Bunch-Sage (BS); and Cheat-Sage (CS).
• Soil textures, soil color, and presence of calcium carbonate, were described qualitatively in the field (Utah Geological Survey Standard Methods).
• Lab textural analyses were determined with a Hydrometer Method (ASTM D 422-63).
• Calcium carbonate content was quantified using a pressure calci meter.

RESULTS
• There was no change in soil texture among different vegetation types (Figure 1).
• Silt-loam was the most common soil type (Table 1).
• Field and hydrometer analyses showed similar textural analyses (Table 1).
• Within a soil pit, particle size and distribution varied with depth (Figure 2).
• There were minimal differences between recently burnt and unburnt soil profiles (Table 2).
• CaCO3 (%) increased with depth (Figure 3).

DISCUSSION
• Norton et al. (2004) and Boxell and Drohan (2009) found differences in soil morphology.
• Soil morphology changes due to differences in soil hydrology (infiltration and eluviation rates).
• Related to stem density of vegetation.
• Our results showed that clay content may not change after wildfire (Norton et al. 2004).
• The presence of CaCO3 may have influenced soil particle size by causing inaccurate classifications of nodules as sand.
• Similarities in soil textures could be due to:
  • Insufficient time for soil development following fire and establishment of vegetation (but see Boxell & Drohan 2009).
  • Minimal influence of vegetation type on underlying soil characteristics.
  • Inadequate sampling and/or sample distribution.

CONCLUSIONS & FUTURE WORK
• Detailed analysis of soil morphology and hydrology might reveal differences among vegetation types.
• Further study would involve more soil pits with greater spatial separation, more samples, and more accurate methods of laboratory particle size analysis (Mastersizer Laser).
• To ensure our field location is not an anomaly, we would duplicate the study in a different location with similar field conditions.

REFERENCES
Boxell, J. and Drohan, P.J., 2009, Surface soil physical and hydrological characteristics in Bromus tectorum (cheatgrass) versus Artemisia tridentata (sagebrush) habitat, Geoderma, v. 149, p. 305-311.