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Land-Use Legacies of Cultivation in Shrublands: Ghosts in the Ecosystem

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ABSTRACT

Shrublands across the West are currently threatened by land uses such as urban sprawl, energy development, and agricultural development which impact ecosystem function through altered fire cycles, expansion of invasive species, modified hydrology, and intensified soil erosion. Historically, shrubland ecosystems have already been impacted by many of these same disturbances. Unlike our forested ecosystems, much of the land-use history in our shrublands has been forgotten or ignored. But our human endeavor can leave lasting changes on the landscape, referred to as "land-use legacies", for decades to centuries. Looking for land-use legacies does not equate with looking for someone to blame. People have always sought to use the resources from the land on which they live. By not recognizing land-use legacies, however, we are not taking full advantage of the potential to learn about how shrublands respond to and recover from a myriad of disturbances. This paper will highlight one of the overlooked land uses within shrublands associated with homesteading - cultivation. Understanding what has happened on the landscape in the past can offer a great deal of information regarding its potential in the future.

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INTRODUCTION

Historic land uses can leave lasting impacts on ecosystems, known as "land-use legacies", for decades to centuries (Foster et al. 2003). However, evidence of historic land use is not always visible on the landscape. In addition, some historic land uses are eclipsed by the attention that other uses receive, such as livestock grazing. One of these "ghosts" in the ecosystem that is not always easy to see and is often overlooked is homesteading. Homesteading is often forgotten because the material evidence of this land use has been disappearing over time (figure 1). Therefore, without records of what happened or knowledge of what to look for, it would be easy to miss the fact that people had, at one time, homesteaded in an area. But just because the material evidence is not visible does not mean the land use associated with homesteading has not left a legacy. This paper will highlight one of these often overlooked land-use legacies - cultivation.

HOMESTEADING AND CULTIVATION

The Homestead Act of 1862 allowed for acquisition of up to 160 acres of federal land. This legislation required that the applicant be a head of household or 21 years of age and either be a citizen of the United States or provide proof of declaration to become one. To gain patent (or "prove up") on the claim, applicants were required to prove five years residence and cultivation of the land. This process was designed to show that the patentee intended to live on the claim and would add value to it through investment in infrastructure such as fencing, water developments, permanent structures and cultivation (Gates 1968).

Cultivation, along with livestock grazing, was a primary land use during homesteading. Although the Homestead Act of 1862 required proof of cultivation, it was not until the Enlarged Homestead Act of 1909 that legislation required a certain amount of land be cultivated within a specified timeframe in order to gain patent (Peffer 1972). The Enlarged Homestead Act doubled the acreage of land available for patent to 320 acres. Under this new law, 20 acres had to be under cultivation by the second year and 40 acres continuously under cultivation from the third year to the final year (Peffer 1972). This new cultivation requirement was a product of the popularity and promotion of dry farming (agriculture without irrigation) in the U.S. (Gates 1968; Peffer 1972).

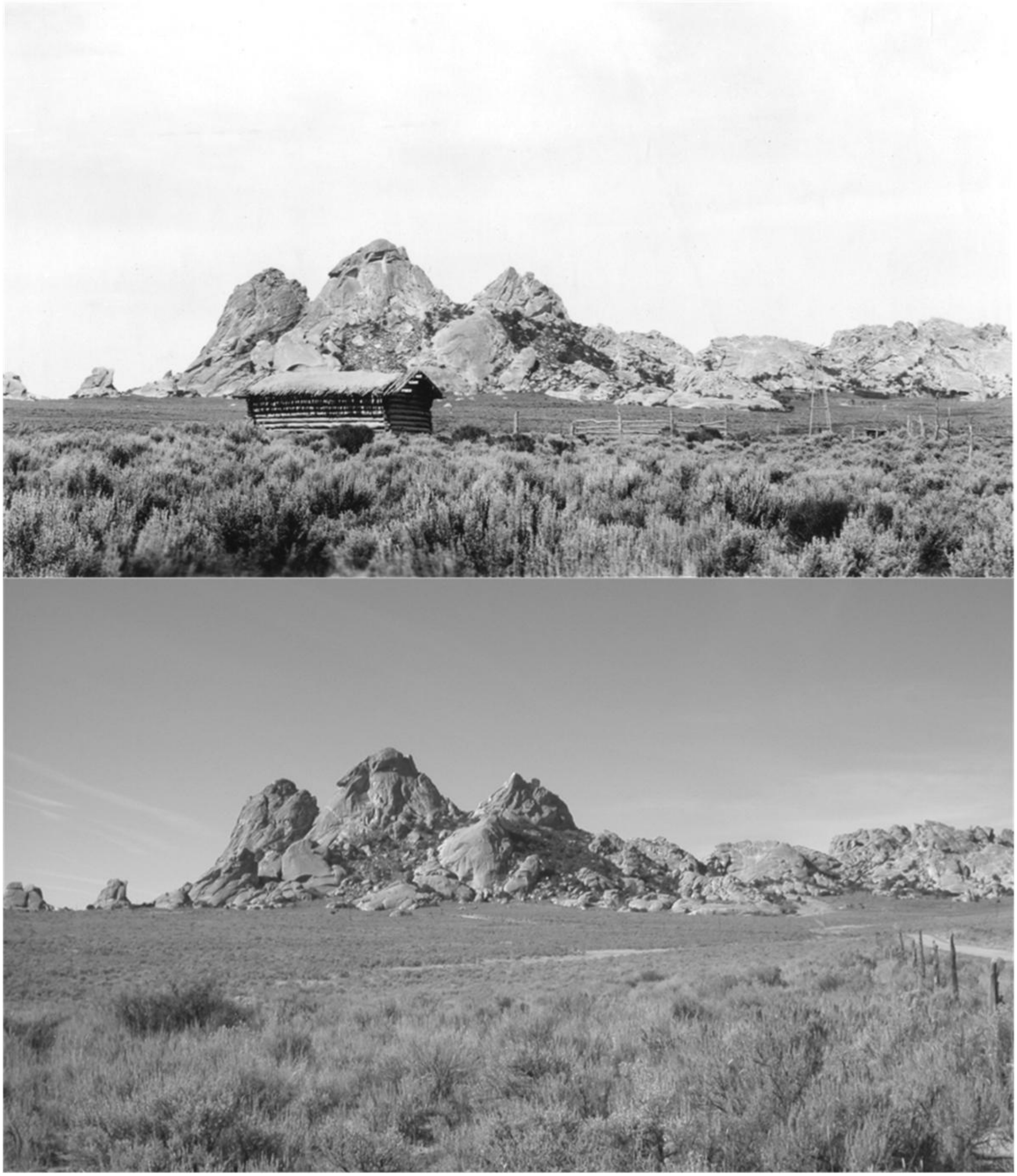

Figure 1. The material evidence of homesteads can fade over time, but the land-use legacies of cultivation remain. The top photo shows structural remains of a homestead in southern Idaho in 1930 (Photo courtesy of Utah State Historical Society). The bottom photo shows the same area in 2005 (Photo by Lesley Morris).

Dry farming methods at the time were straight forward but very labor intensive. First, the land had to be cleared of shrubs and other vegetation. This was accomplished in a variety of ways including dragging a rail or a railroad tie behind a team of horses or digging them out with an axe and hoe (Scofield 1907; Schillinger and Papendick 2008). Once cleared, the land was plowed as “deep as possible” to break up the soil, usually around 7 to 10 inches in depth (Buffum 1909). Finally, the field was “harrowed” with a wide frame fixed with large spikes hanging toward the ground (Schillinger and Papendick 2008). Harrowing was used to pulverize the soil surface and break any capillary action which might allow water to evaporate (figure 2; Scofield 1907; Schillinger and Papendick 2008). Half of the field was kept in this harrowed state for a season to accumulate and "store" water while the other half was planted (Buffum 1909; Peffer 1972). The idea was that if no other plants were allowed to use the soil moisture, all of it would be available to the crop planted on the site. Thereby, dry farming only used water stored in the soil from precipitation without additional irrigation.

Figure 2. A dry-farm field ready for planting in Park Valley, Utah in 1911 (Photo courtesy of Utah State Historical Society).

Several factors drove the popularity of dry farming. It was called the "new science of agriculture" because of the research focus it gained at the agricultural universities in the West (Morris et al. 2011a). It was promoted by railroad companies because they could advance the use of their tracks as transport to markets as well as sell off their most arid land grants from the federal government (Strom 2003; Orsi 2005). Land companies purchased railroad land grants and went into business promoting the development of arid lands for agriculture (Bowen 2003; Morris et al. 2011a; Wrobel 2002). Dry farming, particularly that of dry-land wheat, was also promoted by the federal government through legislation that subsidized wheat prices during World War I and through legislation like the Enlarged Homestead Act. The combination of promotion, legislation and economics made the Enlarged Homestead Act the most popular of all the federal provisions to dispose of the public lands in the West. In the first year of its passage, applications for patents were filed on over 18 million acres of land (Gates 1968) and the following decade had the most homesteads filed.

Starting in the 1920s, several factors began to unravel dryland farming in the West. First, the price of wheat, which had been subsidized by the federal government during World War I, declined rapidly (Hyde 1937). Secondly, many blamed the droughts beginning in the 1920s and continuing through the 1930s for crop failures (Bowen 2001; Gates 1968). However, the drought years simply made a bad situation worse because many of the locations where dry farming was attempted were unsuitable from the start (Roet 1985). In the rush created by land companies to gain land and grow wheat, many settlers were lured to submarginal lands where agriculture of any kind could not thrive due to low precipitation, harsh climate, and unsuitable soils (Bowen 2001; Bowen 2003; Wrobel 2002). Areas that were less suitable for agriculture from the beginning have an even greater capacity for cultivation legacies (Cramer et al. 2008). Though many of these abandoned farms no longer have structures on them to indicate this historic land use, the legacies of dry farming remain on the landscape. Often, abandoned old fields can be seen from aerial photographs for decades to almost a century after they were first cultivated (figure 3; Elmore et al. 2006; Morris and Monaco 2010; Stylinski and Allen 1999).

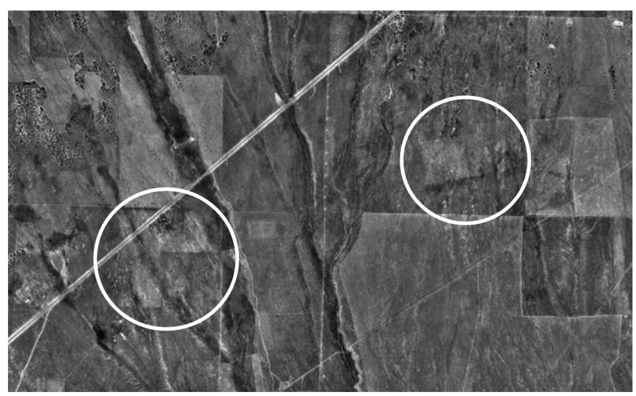

Figure 3. Aerial photo taken in 1999 showing two old fields (in circled areas) that were first cultivated nearly a century ago then abandoned (Photo courtesy of USGS).

LAND-USE LEGACIES OF CULTIVATION

Cultivation leaves legacies on shrubland vegetation, hydrology and soils. Native species recovery after cultivated lands are abandoned may take decades (Daubenmire 1975; Rickard and Sauer 1982; Standish et al. 2007) to over half a century (Elmore et al. 2006; Morris et al. 2011b; Simmons and Rickard 2002; Stylinski and Allen 1999). Old fields can have lower total plant cover, lower species richness, and lower frequency and cover of perennial grasses (Elmore et al. 2006). In addition, forb cover is generally lower in old fields (Dormaar and Smoliak 1985; Morris et al. 2011b; Rickard and Sauer 1982; Simmons and Rickard 2002;) while exotic forb cover is higher (Morris et al. 2011b; Rickard and Sauer 1982; Stylinski and Allen 1999). Old fields also tend to be dominated by invasive grasses, such as cheatgrass (*Bromus tectorum* L.)(Daubenmire 1975; Elmore et al. 2006; Rickard and Sauer 1982). Shrub composition can be altered in old fields and recovery of sagebrush cover after dry farming can take longer than other disturbances, well over 90 years in some places (Morris et al. 2011b). Seed banks of native species tend to be impoverished by cultivation (Cramer et al. 2008) while agricultural weeds form persistent soil seed banks that are likely to also dominate the soil seed bank after abandonment (Ellery and Chapman 2000; Cramer and Hobbs 2007).

The land-use legacies of cultivation also impact hydrology including soil moisture, soil water holding capacity, run off and infiltration. Cultivation legacies can have a greater effect on differences in soil water movement between plowed and never plowed sites than the differences in soil water movement between two soil series (Schwartz et al. 2003). In fact, soil hydraulic conductivity can remain affected for well over 25 years after cultivation ceases and such alterations may be very difficult to restore (Fuentes et al. 2004). Water availability can also be reduced by soil compaction in old fields (Standish et al. 2006). Finally, plowing has been shown to reduce infiltration rates (Gifford 1972) and the recovery potential of infiltration rates on plowed land with grazing is much lower than is predicted for grazing alone (Gifford 1982).

Cultivation legacies impact the physical and chemical properties of soils (Standish et al. 2008). Physical changes, such as soil compaction can create physical boundaries to plant development (Buschbacher et al. 1988; Uhl et al. 1988; Unger and Kaspar 1994) or soil loosening which can favor invasive species (Kyle et al. 2007). The physical disturbance of soil through cultivation increases the potential for erosion (Navas et al. 1997; Schillinger and Papendick 2008). There are also legacies that manifest as changes in soil organic carbon and fertility (Mclauchlan 2006). Loss of soil organic matter content in cultivated land was reported at 20-25 percent in comparison to noncultivated adjacent land within the first 30 years of dry farming (Bracken and Greaves 1941, Schillinger and Papendick 2008). Total soil organic matter can be lower in old fields up to 53 years after abandonment even while rebuilding at smaller scales under plants (Burke et al. 1995). However, even when systems regained some soil organic matter, the rate of recovery had not matched the rate of loss during cultivation (Ihori et al. 1995).

WHY DO THESE LAND-USE LEGACIES MATTER?

Homesteading for the purpose of dry farming was widespread across the West and, therefore, so was the abandonment of this land use. It was estimated that nearly 23 million acres of rangeland were cultivated and abandoned by the late 1930s (Stewart 1938). In the Intermountain West, one fourth of the 12 million acres of degraded rangelands were reportedly abandoned plowed lands (Pearse and Hull 1943). There were 2 million acres of abandoned dry farmed and irrigated land in southern Idaho alone by 1949 (Stewart and Hull 1949). Land-use legacies resulting from cultivation now exist in all landownership types including private property and public lands managed by the Bureau of Land Management, National Park Service, and the US Forest Service. Therefore, the legacies in these old fields have the potential to underlie all management objectives. Old fields from homesteading may exist within rangeland seedings on private property or within areas slated for restoration to enhance recreation and wildlife use. They can be part of areas where fuels management is needed or revegation is desired following wildfires. Better knowledge of the “ghosts” of land-use past in shrublands, like cultivation, will provide more understanding of the function of these systems and reduce the likelihood of misunderstanding their future potential (Foster et al. 2003).

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