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Reducing Livestock Effects on Public Lands in the Western United States as the Climate Changes: A Reply to Svejcar et al.[1]

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Beschta et al. (2013) synthesized the ecological effects of climate change and ungulate grazing on western public lands, grounding their recommendations in ecological considerations and federal agency legal authority and obligations. Svejcar et al. (2014) suggest that Beschta et al. (2013) neither "present a balanced synthesis of the scientific literature" nor "reflect the complexities associated with herbivore grazing." Svejcar et al. (2014) "dispute the notion that eliminating [livestock] grazing will provide a solution to problems created by climate change," although we made no such claim. Instead, Beschta et al. (2013: p. 474) indicate that removal or reduction of livestock across large areas of public land will reduce a pervasive ecological stress, diminishing cumulative impacts on these ecosystems under climate change. We respond to three livestock grazing issues raised by Svejcar et al. (2014): (1) legacy vs. contemporary effects, (2) fuels reduction and fire effects, and (3) grazing complexity and restoration.

1) Contemporary and legacy livestock use has caused combined effects.

Livestock effects began soon after their introduction to semi-arid ecosystems west of the Rockies, which had evolved in an absence of large herds of ungulates (Mack and Thompson 1982). Contemporary grazing impacts (as described in Beschta et al. 2013) compound "legacy" effects, including: altered fire regimes; biological soil crust loss, soil loss, and compaction; altered composition, structure, and function of upland, riparian, and stream biological communities; altered streamflow regimes; and reduced food-web support and physical habitat for terrestrial and aquatic biota (Blackburn 1984; Belsky et al. 1999; Kauffman and Pyke 2001; Belnap and Lange 2003; Fleischner 2010). Combined legacy and current grazing effects have left many streams with degraded riparian vegetation, accelerated bank erosion, widened and/or incised stream channels, and altered water quality (increased temperatures and sediment loads). These changes have many negative biological effects, including those on imperiled resident and anadromous fish (NRC 1996; NRC 2002). Because the legacy effects of livestock were significant and extensive, contemporary grazing studies tend to *under*estimate ecological impacts, as they compare changes within already diminished systems (Fleischner 1994).

While some livestock impacts (e.g., soil loss or channel incision) may not be fully reversible in short timeframes, recovery of native plant communities and soil functions, which underpin terrestrial ecosystems, often occur when the causes of degradation are removed or reduced. Despite changes in public land grazing practices over time, evidence indicates that contemporary livestock use thwarts ecological recovery. Cessation of livestock grazing can result in recovery of soil properties (Kauffman et al., 2004), riparian vegetation (Hough-Snee et al. 2013 and **Figure 1**), and channel morphology (Opperman and Merenlender 2004 and **Figure 1**), relative to areas that continue to be grazed.

Riparian and stream ecosystems (Belsky et al. 1999; NRC 2002) and aspen (*Populous tremuloides*) communities (Seager et al. 2013) are biologically diverse and especially susceptible to the effects of livestock use. For example, recent studies in Wyoming (Hessl and Graumlich 2002), Nevada (Kay 2003), Montana (Kimble 2007), Oregon (Seager 2010), and Utah (Kay 2011) point to high levels of livestock herbivory over many decades, sometimes in combination with wild ungulate impacts, as a major factor inhibiting aspen growth from seedling/sprouts into saplings and trees. These long-term effects hamper the ability of this tree species to persist in many western ecosystems. Livestock grazing also has widespread effects on the frequency and distribution of native grasses, forbs, and shrubs, and native wildlife species dependent upon those plants [e.g., sage-grouse (*Centrocercus urophasianus*); Manier et al. 2013].

2) Livestock grazing is not a viable tool for reducing fuels and wildfire effects.

Livestock grazing in western US landscapes altered natural fire regimes by decreasing the frequency of low-severity fires beginning in the early 1900s (Swetnam and Betancourt 1998), making large areas prone to invasion by woody species and, in turn, more susceptible to high-severity fires (Chambers and Pellang 2008). Furthermore, cheatgrass (*Bromus tectorum*), an annual exotic, spread rapidly throughout the Intermountain West as a result of livestock movement and overgrazing (Mack, 1986), contributing to more frequent burning. Cheatgrass dominates nearly 70,000 km^2 in the Great Basin and is a component on an additional 250,000 km^2 (Diamond et al. 2012). Reisner et al. (2013) found that: livestock grazing increases cheatgrass dominance in sagebrush steppe, reduced grazing may be one of the most effective means of conserving and restoring imperiled sagebrush ecosystems, and livestock grazing is not likely a viable tool for reducing cheatgrass dominance because it promotes cheatgrass invasion.

3) Although livestock grazing has complex ecological consequences, large-scale reductions in grazing effects are likely to reduce cumulative ecosystem degradation.

Recognizing the complexity of grazing issues was central to the synthesis and recommendations included in Beschta et al. (2013). Our analyses provided an integrative view of that complexity: we discussed three classes of ungulates (domestic, feral, wild), drawing examples from diverse vegetation types (shrub steppe, desert, conifer forest) and ecological attributes (such as water quality, hydrology, riparian areas, soils, hydrology, biodiversity). Nevertheless, compelling reasons exist to single out livestock as a cause of ecological harm to native plant communities, terrestrial and aquatic habitats, and watershed processes (Belsky et al. 1999; Kauffman and Pyke 2001; Belnap and Lange 2003; NRC 2002). Livestock use is a principal cause of desertification in arid and semi-arid landscapes (Swetnam and Betancourt 1998; Belnap and Lange 2003; Fleischner 2010). It has the most extensive land-use footprint on western public lands (Beschta et al. 2013), and it continues at major public expense (Vincent 2012). Livestock production also contributes directly and indirectly to greenhouse gases, raising increasing concern about its climate effects (Ripple et al 2014). The cessation or removal of factors that cause degradation or prevent recovery is the most effective and robust approach to ecological restoration (Kauffman et al. 1997). Unlike many stressors, livestock use is subject to human control.

Svejcar et al. (2014) assert that position statements by the American Fisheries Society (Armour et al. 1991) and the Wildlife Society (2010) "do not advocate removing livestock from western rangelands." These position statements, however, as well as those of the Society for Conservation Biology (Fleischner et al. 1994), conclude that public-land grazing impacts need to be dramatically reduced to allow recovery of degraded ecosystems—an explicit recommendation of Beschta et al. (2013). Moreover, these position statements were developed without consideration of climate change effects.

Livestock use of public lands in the West remains a major stressor with effects of increasing concern under the overarching stressor of climate change. Its removal or reduction is an ecologically efficient and unambiguous approach for restoring resilience to large areas of these lands (see synthesis in Beschta et al. 2013). Because livestock grazing has diminished biodiversity and degraded ecosystems, the burden of proof for maintaining the grazing status quo is on Svejcar et al (2014). But they offer no evidence that livestock use is compatible with the recovery of livestock-degraded uplands, riparian areas, or stream systems, or with retention of native species in arid and semi-arid ecosystems. Absent such evidence, and in the context of a changing climate, the only rational, effective, and direct alternative for ecologically restoring many western public lands is to reduce the effects of their most prominent stressor—livestock.

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Figure 1. A photopoint demonstrating vegetation and stream channel change following removal of livestock in the Northern Great Basin (Barnhardy Meadows, Hart Mountain National Antelope Refuge, Oregon). Upper photo was taken October, 1990 after approximately one century of livestock grazing during which livestock use was managed by the US Fish and Wildlife Service from 1940-1990. Lower photo was taken August, 2013 following 22 years of rest from livestock grazing. In this ecosystem, the reestablishment of willows (*Salix* spp.) and other wetland obligate species, as well as increased aspen recruitment, has occurred. Previously eroding stream banks have stabilized and stream channels narrowed since the removal of livestock on the refuge. Photo credits: (upper) Bill Pyle and (lower) Schyler Ries.