

**Grazing Is Not Binomial (i.e., Grazed or Not Grazed): A Reply to Herman**

Herman (2019) equated managed cattle grazing to free-roaming (unrestricted) horse grazing. Managed grazing effects are not similar to unrestricted grazing effects. Grazing can vary in timing of use, frequency, intensity, and type of grazing animal and, thereby, can have very different effects. Therefore, management can determine the consequences and benefits of grazing on ecosystem services and function. Grazing by domestic livestock in the western United States, however, is often considered “bad,” largely because of the misconception that current grazing practices are similar to historical unrestricted grazing. Historical grazing, however, does not equate to current managed grazing (Borman 2005). The opinion that grazing has widespread negative impacts is largely based on studies evaluating historical overgrazing practices and attributing legacy impacts from homestead era unrestricted grazing to current grazing practices. This has led to the treatment of grazing as binomial; that is, it is either grazed or not grazed. The idea of grazing as a generic, two-dimensional disturbance, without considering timing, intensity, frequency, and type of grazing animal, is illogical and hinders natural resource management (Borman 2005).

Historical unrestricted grazing negatively impacted western US rangelands. From 1905 to 1935, the majority (93%) of rangelands in public domain were depleted and continuing to decline from unrestricted grazing (Box 1990). Improvements in grazing management following this period resulted in vast improvements in the condition of federal lands, with the amount of land classified as poor condition declining from 58% to 11% and as fair to excellent increasing from 21% to 63% between 1936 and 1988 (Box 1990). When managed grazing has resulted in improvement in rangeland condition across vast areas, it is illogical to make oversimplified and unsupported claims that grazing degrades these landscapes or that grazing

management is not achieving its goals of sustaining or improving condition on the majority of rangelands.

Properly managed livestock grazing can have positive, minimal negative, or neutral impacts on rangelands. Early stocking rate research was conducted with the specific goal of identifying ecologically sustainable levels of use. Moderate livestock grazed (approximately 40%–50% use of available forage) compared to long-term exclusion of livestock produced few differences in rangelands (e.g., Courtois et al. 2004; Manier and Hobbs 2006). Grazing can also have positive effects on landscape diversity and habitats of individual species (Fuhlendorf et al. 2006). Livestock grazing can encourage native vegetation recruitment in rangelands seeded with competitive introduced grasses. Cattle grazing may also help mediate some of the impacts of climate change (Pyke and Marty 2005).

The disturbance ecology of contemporary western US rangelands differs markedly from the pre-European era. Modern-day management challenges include altered fire regimes and their interaction with invasive plant species, and grazing can be used as a tool to help ameliorate these issues. For example, wildfires are a threat to lower elevation, hotter sagebrush communities, and associated wildlife because of the risk of postfire exotic annual grass invasion and development of an exotic annual grass-fire cycle that prevents the reestablishment of sagebrush and other native vegetation. Moderate cattle grazing, by removing fine fuels and increasing the ratio of live to dead plant materials, can decrease the likelihood of wildfire propagation and modify fire behavior (lower temperatures, reduced rate of spread, and shorter flame lengths) to improve suppression effectiveness (Diamond et al. 2009, Davies et al. 2016). Moderate grazing can reduce the susceptibility of native bunchgrasses to fire mortality by reducing fine fuel accumulations near their growing points and, thereby, limit postfire invasion of exotic annual grasses (Davies et al. 2009).

In contrast, heavy, repeated yearly use by livestock without rest can promote exotic annual grass invasion by depleting native herbaceous vegetation. Heavy, repeated spring grazing can also decrease herbaceous vegetation and promote increases in woody vegetation. Season-long grazing can be problematic because animals may overuse preferred areas. Unrestricted use by livestock in areas that have a large disparity in timing of senescence between riparian and upland vegetation can result in overuse of riparian areas. Other examples of mismanagement exist, but these issues can be addressed with proper grazing management that controls the frequency, intensity, and timing of defoliation.

Rangelands face many threats including climate change, altered fire regimes, invasive plants, anthropogenic development, and mismanagement. Domestic livestock grazing effects, however, depend on management and can be negative, neutral, or positive and can vary by the response variable of interest. For example, some wildlife species may be favored by livestock grazing while others may be negatively impacted and these effects may vary by differences in grazing management. Broadly generalizing grazing and ignoring that management can dictate its effects is not consistent with current science and will limit our ability to effectively sustain rangeland ecosystem services and function. The challenge for the future is to figure out how to continue the progress on public rangelands (from historical conditions) and adapt to new challenges: increasing atmospheric carbon dioxide that encourages fast-growing invasive plants, climate shifts, megafires, and introductions of new invasive species.

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