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CONSERVATION IN PRACTICE

Prescribed cattle grazing as a tool for native prairie management: Lessons from the Tualatin River basin, Oregon

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Prairie and oak (*Quercus* spp.) savanna are important disturbance-dependent habitats in the Willamette Valley–Puget Trough–Georgia Basin ecoregion (WPG). Estimates of previous extent and current cover of prairie habitat suggest that between 2% and 10% of presettlement prairie remains (Dunwiddie and Bakker 2011; Vesely and Rosenberg 2010; Intertwine Alliance 2013). Previous to Euro-American settlement, Native Americans burned prairies to discourage encroachment of trees and shrubs, maintain habitat for grazing ungulates, and increase productivity and diversity of herbaceous plant species. Due to conversion to agriculture, land development, invasion by nonnative vegetation, reduction in elk (*Cervus canadensis*) numbers, and fire exclusion, native prairie and savanna have declined dramatically in this ecoregion. Several state and regional species of concern are reliant on prairie and savanna habitats (ODFW 2016; Altman 2011), and restoration of prairies remains a top priority for agencies and organizations with a conservation mission.

The focus on prairie and savanna conservation in the WPG ecoregion over the past several decades has led to the development of many prairie-oak focused partnerships, emerging science and management practices, and increased protection and restoration of these habitats (Dunwiddie and Bakker 2011; Stanley et al. 2011; Intertwine Alliance 2013). Land managers of these properties are tasked with reestablishing native species, constantly managing the threat of invasive species, and encouraging or introducing regular disturbance regimes to maintain ecosystem function. Without disturbance, such as fire and grazing, prairie and savanna habitats lose diversity of grasses, sedges, rushes, and forbs. Over time, woody species encroach, thatch builds up, and areas of bare ground disappear. Bare ground is required for annual species to germinate and for several species of birds and pollinators to nest (Altman and Stephens 2012; Kimoto et al. 2012).

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At the heart of the WPG, the Tualatin River basin lies in the northern Willamette Valley in northwestern Oregon and is an important landscape for fish and wildlife, supporting "over 200 species of birds, 28 species mammals, 14 species of reptiles and amphibians, and a wide variety of insects, fish and plants," including numerous at-risk and rare species (USFWS 2013). Conservation plans developed by federal, state, and regional agencies identify the Tualatin Basin as a top priority for conservation of prairie and savanna habitats (USFWS 2013; ODFW 2016). The majority of the watershed lies within Washington County, the second most populous county in Oregon, which includes the western suburbs of Portland, Oregon. The region supports a robust agricultural economy; planned urban development; and high levels of investment, expertise, and collaboration in natural area conservation. However, relationships among these potentially conflicting interests are complex and sometimes dysfunctional.

While fire remains a critical component of prairie management from an ecological perspective, a number of climatic and logistic barriers exist (Hamman et al. 2011). In places like the urban-fringed and populated Tualatin River basin, prescribed burning is increasingly difficult to implement. Already the window for permitted controlled burning is narrow, while the need to reduce fuels and manage thatch is increasing. Given the trend toward hotter and drier summers (Steel et al. 2011), the use of fire is no longer a reliably available tool, as restrictions on burning have become more stringent in the face of increasing public fear as well as climate change (Hamman et al. 2011). Land managers must therefore find complements and alternatives to relying on prescribed fire alone to create disturbance to manage native prairie.

Using cattle to manage native prairie is an emerging tool and area of study in the Pacific Northwest. Prescribed grazing is an effective management tool in habitats once occupied by large ungulates, such as elk (Henrichs 1997; Vesley and Rosenberg 2010; Marty 2005), and best management practices are emerging (Chaney 2014). With correct timing and stocking, grazing can increase diversity, productivity, nutrient cycling, and carbon (C) sequestration (Humphrey 2000; Itzkan 2014; Marty 2005). Various intensities of cattle grazing, as opposed to managing prairie through mowing, can promote a mosaic of grass heights and a structurally diverse prairie, and can be used during periods of seasonal restrictions for nesting birds. In some cases, even extremely heavy stocking can achieve desirable results (figure 1). Species of concern that depend on prairie habitat, such as several species of grassland birds and bees, have specific grass height requirements that have been achieved through cattle grazing (Derner et al. 2014; Kimoto et al. 2012; Johnson et al. 2011).

GOALS AND APPROACH

With cooperation from landowners, managers, and cattle operators, and support from the Wildlife Conservation Society Climate Adaptation Fund and Tualatin Riverkeepers, we grazed two Tualatin Basin prairie sites in 2016 and 2017: Butler Mitigation Bank (Butler) and the Hutchinson Wetland Restoration Program conservation easement (Hutchinson). Both sites are located in Washington County, Oregon, along the Tualatin River and have been restored as native prairie from previous agricultural uses. Butler is a 38 ha (93 ac), privately owned wetland mitigation bank and Hutchinson is a 142 ha (351 ac) property, owned by the Joint Water Commission with a conservation easement held by the USDA Natural Resource Conservation Service and managed by the Tualatin Soil and Water Conservation District. At both prairie sites, the ecological goal of grazing was to improve diversity of the native herbaceous

Figure 1

(a) A pasture dominated by nonnative grasses prior to grazing, and (b) the release of native wildflowers as a result. Grazing was the only treatment applied. Photo (a) credit: Jason Bradford, Farmland LP, 2011.

(a)

(b)

plant community. With the necessary disturbance and reduction in grass cover and thatch that grazing provided, our approach was to over-seed native forbs after grazing.

While the goal of cattle grazing was the same at both sites, site attributes and grazing management methods differed between them (table 1). We grazed both sites in late spring and early summer. In addition to spring grazing, we implemented a short-term fall grazing to further prepare ground for seeding and seeded site-appropriate native prairie forb mixes at both sites following grazing.

We monitored the grazing area on both prairies to ensure that the treatment met the requirements of the grazing plans (maintain a 10 cm [4 in] minimum stubble height), to decide when cattle should be moved or removed, and to document short-term changes to the vegetation associated with grazing. Using a 1 by 1 m (3 by 3 ft) square quadrat, we visually assessed the percentage foliar cover of each species encountered in the plots, the percentage of bare ground exposed, and the percentage cover of thatch or brown plant material (litter). In addition, we recorded plant height in centimeters by measuring the closest green plant material to both the inner and outer corners of the plot. Where no plant material was within 10 cm of a corner (bare ground or thatch), we recorded the plant height at 0 cm.

We monitored 100 plots (quadrats) at Hutchinson and 22 plots at Butler. We monitored all plots once before grazing and approximately once per week during the

Table 1

Site attributes and grazing methods for two native prairie sites in the Tualatin River basin, Oregon.

Attribute	Butler 2016	Butler 2017	Hutchinson 2017
Dominant soil	McBee silty clay loam/ Wapato silty clay loam	McBee silty clay loam/Wapato silty clay loam/Chehalis silty clay loam	McBee silty clay loam
Dominant grasses	*Deschampsia cespitosa/ Danthonia californica*	*Deschampsia cespitosa/ Danthonia californica*	*Festuca rubra*
Area grazed (ac)	10	20	58
Grazing plan layout	1 pasture; continuous grazing	1 pasture; continuous grazing	8 pastures; cows had access to one large pasture continuously with new pastures rotated weekly
Stocking rate	0.83 ac cow^{-1}	1.67 ac cow^{-1}	2.23 ac pair^{-1}
Timing	Mid-May to June (5 weeks) September (2 weeks)	Late May to June (5 weeks)	June to July (8 weeks) November (2 weeks)
Herd composition	12 yearlings	12, 2-year olds	26 cow/calf pairs

Table 2

Absolute percentage cover of vegetation after five weeks of grazing for two prairie sites in the Tualatin River basin, Oregon.

Site	Year	Native grass (%)	Nonnative grass (%)	Native forbs (%)	Nonnative forbs (%)	Native sedges/ rushes (%)	Bare ground (%)	Thatch (%)
Butler	2016	71.9	0.0	15.6	0.0	4.1	8.2	2.4
Butler	2017	54.6	0.0	7.3	4.1	10.0	13.8	2.5
Hutchinson	2017	6.5	31.9	0.1	0.1	0.0	0.1	61.6

grazing period. In larger pastures that were grazed longer, we monitored up to six times.

RESULTS

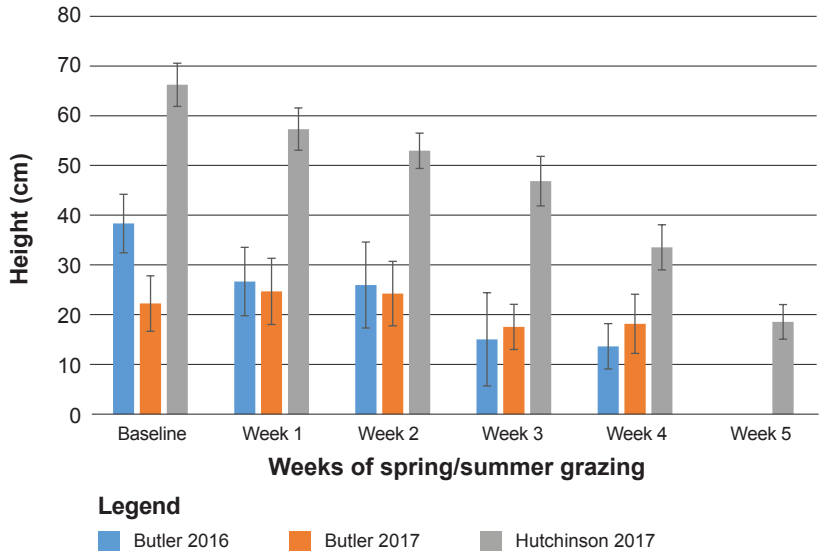
Grazing did create disturbance at both prairie sites, but the extent of that disturbance varied due to differences in site attributes, timing, and stocking density. Five weeks of grazing resulted in a decrease in most vegetation cover at both sites and in both years (table 2). However, results for bare ground and thatch differed between sites. At Butler, after one year of grazing (2016), bare ground increased and thatch decreased, while at Hutchinson, cattle exposed less bare ground due to an increase in dead or trampled plant material during the grazing period. Vegetation height at Butler in the first year of grazing (2016) decreased much more quickly than it did at Hutchinson, while in the second year of grazing at Butler (2017) vegetation height started lower and remained more stable. Vegetation remained taller at Hutchinson, and it took two extra weeks of grazing in order to approach vegetation heights achieved at Butler (figure 2).

Grass Cover. While the two prairie sites were both dominated by grass with low levels of forb cover, bare ground, and thatch, Hutchinson had more grass cover and taller grass before cattle were introduced (table 3). At Hutchinson, the decrease in percentage grass cover after grazing (table 2) represents not more grass grazed, but rather the large amount of trampled and senesced plant material converted to thatch (see "Timing" section).

Vegetation cover and composition at Butler in 2017 represents pregrazing conditions for that year, but were likely affected by grazing and seeding in 2016. A decrease in native grass cover, increase in native and nonnative forbs, and increase in bare ground are notable at Butler between the two years.

Figure 2

Change in height during the grazing periods at two prairie sites in the Tualatin Basin, Oregon.



Timing. The slightly later season grazing at Hutchinson (June and July) as compared to Butler nonetheless significantly affected grazing results as grasses go dormant and turn brown rapidly at this point. The later start date also accounted for greater overall cover of vegetation and taller grass heights at baseline.

Stocking Rate and Pasture Layout. We used a greater number of cows per acre at Butler than at Hutchinson. This resulted in more rapid vegetation responses (both height and cover) and greater overall disturbance (more bare ground) at Butler than Hutchinson.

SUCCESSES

We successfully used cattle to create disturbance and manage native prairies at two Tualatin Basin sites. This disturbance allowed for a reduction in thatch and seeding and germination of a more diverse suite of native plants. At Butler, where we have data from the year after seeding, we achieved an increase in native forb cover and diversity. Additionally, through successful partnerships with landowning entities, we were able to refine this method and learn important lessons to further develop best practices.

Engaging cattle operators in developing our goals, refining our methods, and implementing our plan had multiple benefits. The collaborative approach we employed allowed for successful partnership and ecological results that would not have been possible from the angle of a prairie ecologist alone. We found cattle operators to be cooperative and accessible when we treated the use of their cattle as a service and compensated them for this service. Traditionally, public lands are leased for grazing, and pasture management decisions are made by the operators for the benefit of their product. In approaching cattle grazing as a pay-for-service management

tool, we were able to balance the needs of the operator with ecological goals.

CHALLENGES

There were some challenges in implementing a grazing program on native prairies in the Tualatin Basin. While development of best management practices for the use of cattle grazing in native prairie management is still in progress, it was difficult to find willing landowners and available prairies on which to further hone and apply these methods. As a rare habitat type, native prairie sites in the Tualatin Basin are almost entirely owned and managed by public agencies or land trusts. These landowners have invested many years and public dollars in protecting and restoring these prairies and are therefore cautious in changing management approaches on their lands. With over-grazing often pointed to as a cause of habitat degradation, cattle are not easily welcomed into conservation practices. Overcoming this history poses a challenge.

Avenues for allowing grazing on public lands are typically in the form of a lease whereby a cattle operator pays to use lands for an agricultural benefit. While these agreements are a useful starting point, using cattle to graze native prairies to create disturbance is a very different objective than is ensuring a long-term, sustainable forage source. Management toward forage-oriented goals alone may include guidelines for stocking density or timing that are not appropriate for meeting ecological goals related to disturbance or weed control.

Additionally, as with any form of disturbance, exposing bare ground and creating space for native plant diversity also allows for competition from nonnative plants. After one year of grazing at Butler, we recorded both an increase in native forbs as well as nonnative forbs. While grazing appears to be an effective management tool for maintaining native prairie, as with any disturbance, landowners must be aware of weeds and how they respond to this treatment.

LESSONS LEARNED AND CONSIDERATIONS

As prescribed grazing on native prairies continues to be developed as a management tool, data and examples such as Butler and Hutchinson are useful in developing best practices. Here we provide some lessons and considerations for implementing this approach elsewhere.

Clear Management Objectives. Grazing prescriptions must be crafted according to site-specific conditions and prairie management needs. The objective of grazing in this study was to reduce vegetation height, thatch, and grass cover in order to improve diversity of the native herbaceous plant community. Grazing for disturbance requires high stocking rates and more thorough utilization, while grazing to maintain an already diverse prairie structure may require fewer animals and shorter rotations. Other goals and objectives, such as grazing to control noxious weeds or to promote rare plant species, require different grazing prescriptions and were not assessed in this study.

Timing. Proper timing is crucial to successful application of grazing as a management tool. Seasonal timing of cattle grazing should directly relate to ecological site objectives and current conditions, and timing will differ depending on both. Spring grazing in the WPG appears to reduce grass cover as it occurs at a time when grasses are in their peak growing season (Fransen et. al 2017), but also coincides with peak bloom time for many native wildflowers. Given that both prairies grazed in this study were initially dominated by grasses with few flowering plants, spring was an appropriate time to graze. As WPG prairie grasses are dormant by mid-summer, spring grazing allowed us to maximize forage benefits for cattle while also reducing perennial grasses.

Just a few weeks' difference in grazing timing at Hutchinson and Butler produced markedly different results. These effects should be considered and adapted to the goals one might have related to managing native prairies.

In line with grazing management guidelines for nonnative pasture, cattle operators needed to move cows to irrigated pasture or feed hay in August and September. We are currently investigating the possibility that areas of emergent wetland vegetation, still green in late summer, could sustain cows during this time of year. Like wet and mesic prairies, deeper emergent wetlands tend to be dominated over time by highly competitive graminoids, such as common spikerush (*Eleocharis palustris*) and cattail (*Typha*), at the expense of many annual and early seral perennial species such as blunt spikerush (*Eleocharis obtusa*), northern water plantain (*Alisma triviale*), American speedwell (*Veronica americana*), plantainleaf buttercup (*Ranunculus alismifolius*), and many others. Results of these trials will be presented in future publications.

Stocking Rate. As with timing, the number of cattle used depends on forage composition and objectives. We achieved higher percentage bare ground and reduced thatch cover with a higher cattle density. We also found that bare ground, especially enhanced with fall grazing, allowed weeds to establish and increase.

Table 3

Absolute percentage cover of vegetation at baseline condition prior to seasonal grazing for two prairie sites in the Tualatin River basin, Oregon.

Site	Year	Native grass (%)	Nonnative grass (%)	Native forbs* (%)	Nonnative forbs (%)	Native sedges/ rushes (%)	Bare ground (%)	Thatch (%)
Butler	2016	81.4	0.0	13.1	0.0	4.7	2.5	2.1
Butler	2017	62.5	0.1	18.4	5.4	7.3	15.8	2.0
Hutchinson	2017	15.9	78.2	2.3	3.9	0.0	2.3	6.1

* Forbs were seeded after fall grazing in 2016 at Butler.

Land managers of native prairies should plan to seed these areas with competitive native plants and manage weeds as well.

Planning and Partnerships. Substantial time is needed for meetings and collaboration with landowners and cattle operators, particularly if the land is owned or managed by a public agency. Lands managed for a conservation purpose rarely have the infrastructure (e.g., fences and developed watering locations) needed to safely manage cattle. In addition, there may be institutional or legal agreements that make even the temporary installation of this kind of infrastructure difficult. A large part of our success was due to involving cattle operators in grazing plans early on and in balance with conservation objectives.

CONCLUSION

Unlike most eastern Oregon grasslands, Willamette Valley wet prairies are highly productive, resilient grasslands hosting a broad array of tough, tenacious perennial grasses, sedges, rushes, and forbs. Many species of smaller annuals and early seral perennials also inhabit these habitats. Our investigation suggests that targeted grazing can create space for these annuals and less competitive perennials, resulting in significant increases in plant diversity. As with any disturbance treatment, land managers must be aware of and if needed mitigate for invasive weeds.

REFERENCES

Altman, B. 2011. Historical and current distribution and populations of bird species in prairie-oak habitats in the Pacific Northwest. Northwest Science 85(2):194-222.

Altman, B., and J.L. Stephens. 2012. Land Managers Guide to Bird Habitat and Populations in Oak Ecosystems of the Pacific Northwest. The Plains, VA: American Bird Conservancy and Klamath Bird Observatory.

Chaney, M. 2014. Livestock Grazing System Guidelines for Western Washington Native Prairie. Olympia, WA: USDA Natural Resources Conservation Service.

Derner, J.D., D.J. Augustine, and E.J. Kachergis. 2014. Cattle as ecosystem engineers. Western Confluence 1(Winter 2014):10-13.

Dunwiddie, P.W., and J.D. Bakker. 2011. The future of restoration and management of prairie-oak ecosystems in the Pacific Northwest. Northwest Science 85(2):83-92.

Fransen, S., G. Pirellis, M. Chaney, L. Brewer, and S. Robbins. 2017. The Western Oregon and Washington Pasture Calendar. A Pacific Northwest Extension Publication: PNW 699. Oregon State University, University of Idaho, and Washington State University.

Hamman, S.T., P.W. Dunwiddie, J.L. Nuckols, and M. McKinley. 2011. Fire as a restoration tool in Pacific Northwest prairies and oak woodlands: Challenges, successes, and future directions. Northwest Science 85(2):317-328.

Henrichs, L. 1997. Grazing as a technique for prairie restoration. University of Minnesota, St. Paul, MN. Restoration and Reclamation Review 2(5):1-8.

Humphrey, J.W. 2000. Effects of late summer cattle grazing on the diversity of riparian pasture vegetation in an upland conifer forest. Journal of Applied Ecology 37(6):986-996.

Intertwine Alliance. 2013. Regional Conservation Strategy. Portland, OR: The Intertwine Alliance.

Itzkan, S. 2014. Upside (Drawdown): The Potential of Restorative Grazing to Mitigate Global Warming by Increasing Carbon Capture on Grasslands. Somerville, MA: Planet-TECH Associates.

Johnson, T.N., P.L. Kennedy, T. DelCurto, and R.V. Taylor. 2011. Bird community responses to cattle stocking rates in a Pacific Northwest bunchgrass prairie. Agriculture, Ecosystems and Environment 144:338-346.

Kimoto, C., S.J. DeBano, R.W. Thorp, R.V. Taylor, H.J. Schmalz, T. DelCurto, T.N. Johnson, P.L. Kennedy, and S. Rao. 2012. Short-term responses of native bees to livestock and implications for managing ecosystem services in grasslands. Ecosphere 3:1-19.

Marty, J. 2005. Effects of cattle grazing on diversity in ephemeral wetlands. Conservation Biology 19(5):1626–1632.

ODFW (Oregon Department of Fish and Wildlife). 2016. The Oregon Conservation Strategy. Salem, OR: Oregon Department of Fish and Wildlife.

Stanley, A.G., P.W. Dunwiddie, and T.N. Kaye. 2011. Restoring invaded Pacific Northwest prairies: Management recommendations from a region-wide experiment. Northwest Science 85(2):233-246.

Steel, Z.L., M. Wilkerson, P. Grof-Tisza, and K. Sulzner. 2011. Assessing species and area vulnerability to climate change for the Oregon Conservation Strategy: Willamette Valley Ecoregion. Davis, CA: University of California.

USFWS (United States Fish and Wildlife Service). 2013. Tualatin River National Wildlife Refuge Comprehensive Management Plan. Tualatin, OR: US Fish and Wildlife Service.

Vesely, D.G., and D.K. Rosenberg. 2010. Wildlife Conservation in the Willamette Valley's Remnant Prairies and Oak Habitats: A Research Synthesis. Corvallis, OR: Oregon Wildlife Institute. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/cpt-wildlifeconservation-willamettevalley-oakprairiesynthesis-vers1_1-2010.pdf.