Integrating Domestic and Wild Ungulate Grazing into Forest Restoration Plans at the Landscape Level

NORTHERN ARIZONA UNIVERSITY
Ecological Restoration Institute

The Ecological Restoration Institute at Northern Arizona University is a pioneer in researching, implementing, and monitoring ecological restoration of dry, frequent-fire forests in the Intermountain West. These forests have been significantly altered during the last century, with decreased ecological and recreational values, near-elimination of natural low-intensity fire regimes, and greatly increased risk of large-scale fires. The ERI is working with public agencies and other partners to restore these forests to a more ecologically healthy condition and trajectory—in the process helping to significantly reduce the threat of catastrophic wildfire and its effects on human, animal, and plant communities.

Cover photo: This ERI white paper discusses ways to restore and create quality habitat for domestic and wild ungulates as part of effective landscape-scale forest restoration efforts on federal lands across the western United States.

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Executive Summary

What issues will restorationists, ranchers, and managers of public lands face as landscape-scale forest restoration efforts, such as those funded by the Collaborative Forest Landscape Restoration Program, begin to intersect with grazing interests on public lands? At this juncture, restoration planners, land managers, and others have yet to address this important ecological-social aspect of landscape-scale forest restoration process. And for their part, many ranchers don't yet realize these restoration efforts are being planned and how they may affect them.

This ERI white paper provides land managers, ranchers, and others with insights from recent research literature to a set of issues that will likely arise as landscape-scale restoration efforts proceed across the Intermountain West. These issues include ensuring quality habitat for domestic and wild ungulates, how long to "rest" treated areas before allowing domestic livestock grazing, how to integrate grazing with prescribed fire, grazers as vectors as well as regulators of unwanted plant species, the potential of grassbanks as a conservation strategy, and improving grazing monitoring protocols to match the scope of landscape-scale restoration.

Land managers, forest restoration advocates, ranchers, and others concerned with how to integrate domestic and wild ungulate grazing into landscape-scale restoration efforts should consider the following points:

- Providing quality habitat for domestic and wild ungulates should be integrated with other planning concerns related to the timing and sequencing of forest restoration treatments across the landscape.
- More applied research is needed to determine how long a treated area should "rest" before domestic grazers are allowed to return to an allotment. Existing "guidelines" are supported by limited scientific data.
- Land managers, restoration planners, ranchers, and scientists need to discuss and research ways to integrate grazing with a prescribed burning schedule.
- Land managers, ranchers, and restorationists should be aware that ungulates, especially cattle and, to a lesser extent, elk, help spread unwanted plant species.
- The targeted use of domestic grazers to control or eliminate unwanted plant species has potential if the correct grazers are employed and the timing and intensity of grazing is coordinated to reduce the unwanted plant's reserves.
- Grassbanks may provide another means of accomplishing needed restoration activities by exchanging forage rights for either conservation work or passive restoration.
- Monitoring grazing allotments within landscape-scale restoration treatments needs to address restoration-related concerns, not only grazing concerns.

Introduction

The American West is in transition. The fundamental issues of water rights and resource uses remain, and many of the notable human and institutional actors are still in place, but the course of the West is beginning to shift from exclusively extractive endeavors to include large-scale restorative actions. For example, the once mighty, and still formidable, business of ranching remains active, although ranchers are now increasingly being asked to interact with multiple resource interests, including those of restorationists who plan to reestablish the health of frequent-fire forests in the Intermountain West. How will these old and new interests learn to coexist during this period of change? More to the point, what are the issues restorationists, ranchers, and managers of public lands will face as landscape-scale forest restoration efforts, such as those funded by the Collaborative Forest Landscape Restoration Program (www.fs.fed.us/restoration/CFLR/index.shtml), begin to intersect with grazing allotments on public lands? At this juncture, restoration planners, land managers, and others have yet to address this important ecological-social aspect of landscape-scale forest restoration process. And for their part, many ranchers don't yet realize this restoration effort is underway and how it may affect them.

This ERI white paper provides land managers, ranchers, and others with insights from recent research literature to the following set of questions that will likely arise as landscape-scale restoration efforts proceed across the Intermountain West.

- How should restoration treatments be implemented to ensure there is quality habitat for all grazing animals, both domestic and wild?
- How long will a restoration treatment area need to "rest" following treatment before domestic livestock grazing can resume?
- What is the best way to integrate domestic livestock grazing into a prescribed burning schedule?
- Will ungulates act as vectors for unwanted plant species following restoration treatments? Could domestic grazers be used to control unwanted plant species?
- What role might "grassbanks" play in landscape-scale forest restoration efforts?
- Can the current agency grazing monitoring protocols be improved to address issues related to landscape-scale forest restoration efforts?

Implementing Restoration Treatments to Benefit Both Domestic and Wild Grazing Animals

Domestic and wild ungulates, which in forested landscapes across the American West include cattle, sheep, elk, deer and pronghorn antelope, need four basic things: forage, water, minerals, and cover. With these needs in mind, a landscape-scale forest restoration treatment plan that creates a dynamic mosaic of forage and cover with access to a stable supply of water and minerals will help produce habitats for a wide variety of ungulates (Wisdom and others 2004, Milchunas 2006, Graham and others 2010). These restoration efforts can be enhanced by combining them with ranching methods and agency allotment oversight that limit the number of animals and control the means of resource dispersal (forage, water, minerals) through the use of appropriate grazing rotation schedules, exclosures (i.e., fencing), water and mineral placement, and herders (Graham and others 2010). The use of prescribed fire will also play an important role because it is often needed to maintain palatable forage cover and reduce standing, coarse herbaceous litter that ungulates avoid because it is difficult to digest.

Forage and Browse

Forage in the frequent-fire forests of the American West consists of cool- and warm-season grasses, sedges,

forbs, while browse includes woody plants from shrubs to trees. Although each grazing ungulate species has its own forage preference (e.g., cattle and sheep are primarily grazers, deer are primarily browsers), they also tend to eat whatever is available depending on the season and the level competition from other ungulates. Various studies (McConnell and Smith 1970, Riegel and others 1991, Germaine and others 2004, Gibbs and others 2004, Laughlin and others 2008, Long 2008, Bartusvige and Kennedy 2009) and past experience suggest that within a few years after restoration treatments forage should become more plentiful as areas become more open and competition with trees is reduced. Browse, in turn, may decrease due to increased use of prescribed burning and the number of exotics could increase due to disturbance. Aspen may increase due to resprouting after prescribed burning and because of less elk herbivory due to increased forage levels. Domestic and wild ungulates will vie for this enhanced resource base and will likely increase their health and populations as long as it is available.

Water and Minerals

Water is a limiting factor for many creatures in the Interior West, and ungulates are no different. Domestic and wild ungulates find water in streams, ponds, lakes, rivers, and man-made structures, such as stock tanks. In arid and semi-arid landscapes, cattle, elk, and pronghorn tend to use habitats within one mile of water while white-tailed deer select habitat within 0.25 mile of water (Rosenstock and others 1999, Cook 2002). Managing ungulates in and around natural water sources is extremely important because they can cause significant damage to the water source, the surrounding vegetation, and adjacent soils. Fencing riparian areas and piping water from a natural source to a stock tank can help prevent this kind of damage. For example, Porath and colleagues (2002) found that by co-locating water tanks and mineral blocks 15 feet apart and 0.3 mile from a stream in a forested range in Oregon, they decreased the number of cattle using the adjacent riparian area, especially in the spring when forage was abundant. Similarly, Cooney (1952) found that salt dispersed throughout an elk range in Montana was effective in reducing animal concentrations.

Cover

Ungulates use cover (i.e., trees and shrubs or tall grasses) as rest areas, places to hide from predators, and for shade. As Graham and his colleagues (2010) note, "Water and forage are major determinants of how animals use a range but cover and its transition to openings are important determinants of range quality (Senft et al., 1987; Ganskopp, 2001). These transitions or forest edges along with their inherent ecotones are rich in wildlife, both in numbers of individuals and number of species (Thomas et al., 1979)….Cover, combined with its location and juxtaposition to water, forage and salt, influences how an ungulate moves through its range (Ganskopp, 2001)." They go on to recommend, "In both transitory and permanent ranges, the general management concept to decrease ungulate and other forest conflicts is to disperse animals throughout the extent of their range so no one locale is over used by animals for foraging, bedding or resting." Other studies (Thomas and others 1979, Germaine and others 2004) indicate that mule deer need cover for use during the day (i.e., day-beds). For instance, Germaine and colleagues recommend "that stands of sapling and pole-sized trees having greater than 40% midstory canopy closure be retained in treated forest…." Such stands, according to these researchers, should be greater than 0.01 acre in size and retain deciduous and coniferous trees for mule deer forage and concealment needs. Thomas and others (1979) recommend a 40% cover/60% forage ratio as the optimal mix for elk. Meanwhile, Vavra and his colleagues (2005) suggest that the number of these cover patches can be reduced in landscapes with irregular topography because topography itself makes hiding easier for wild ungulates. They do, however, recommend that cover patches be strategically placed to allow animals to move safely between them.

Forest restoration treatments will likely make elk and deer easier targets for hunters due to increased visibility and access within treated areas. Researchers at the Starkey Project—a multi-agency research undertaking in northeastern Oregon (http://www.fs.fed.us/pnw/starkey/)--recommend maintaining some level of hiding cover

for elk and deer. For example, Wisdom and others (2004, p. 751) suggest that forest planners should: "Manage for, and retain security areas for, elk in watersheds when planning the layout of harvest units in time and space. Security areas serve primarily to mitigate any increase in elk vulnerability to hunting when timber activities result in increased visibility and human access in a watershed. A security area for elk was defined by Hillis et al. (1991: 38) as a nonlinear block of hiding cover at least 250 acres and at least one-half mile from roads open to motorized traffic….In particular, Hillis et al. suggested that security areas are most effective…when [they] compose at least 30 percent of a watershed."

All these research findings about cover suggest that restoration planners concerned with ungulate habitat should strive to create a diverse landscape mosaic with openings, sufficient forest/meadow edge, and various successional stages of vegetation, including dense cover for hiding, birthing, and resting. This will produce habitat for a variety of ungulates as well as many other animal species.

Resting Treatment Areas before Allowing Domestic Grazing to Resume

How soon domestic grazing animals can return to allotments after initial restoration treatments are completed remains one of the most important questions for forest restoration planners and land managers. Many statements from ecologists call for resting grazing allotment areas after restoration treatments (Belsky and Blumenthal 1997, Moore and others 1999, Allen and others 2002, New Mexico Restoration Principles 2006). Likewise, there is an unwritten U.S. Forest Service guideline that suggests resting areas burned by wildfires for two years before allowing grazing animals to return (Mork 2010). Unfortunately, there is little scientific research to support any of these conclusions.

There is some useful information from researchers at the Starkey Project, however. For example, Wisdom and his colleagues (2004) found that "Timber harvest is likely to cause an immediate but short-term (1- to 3-year) decline in forage availability in the harvest units, followed by a large increase in forage that may last 10 years or longer." (p. 752). Likewise, Long and colleagues (2008) noted that, "Nutritional quality of herbaceous forage species in treatment stands did not change significantly during the first few years after treatment (fuels reduction) but by the fifth year after treatment had increased above maximum mean values observed in control stands in both spring and summer." These two studies from northeastern Oregon suggest that three to five years following restoration treatment would be a reasonable rest period.

Writing from the Apache-Sitgreaves National Forests (A-S) in east-central Arizona, White (2005) takes a different approach. Instead of specifying a timeframe before cattle or sheep can return to a grazing allotment after fire (natural or prescribed), he focuses on the minimum conditions of four variables that he believes must be met: 1) soil stability (ground cover), 2) plant composition, 3) forage production, and 4) structural range developments that meet Forest Service standards and are adequate to maintain or support grazing management. All of these minimum standards must be met before allowing cattle to graze, according to White:

- Either a minimum of 75% of the natural basal and/or aerial organic cover as identified by the Terrestrial Ecosystem Survey (TES) for the A-S for the map unit being inventoried or a minimum Fair soil condition to meet soil stability standards.
- Either a minimum of 75% community similarity in terms of plant composition as defined by the TES for the map unit being inventoried or Fair range conditions.
- A minimum of 100 pounds dry weight equivalent per acre of forage production as defined by Forest Service Region 3.

These research findings, although limited, suggest that federal agencies should be prepared to wait more than two years before allowing domestic grazing on restored allotments lest they jeopardize two important goals of restoration treatments—restoring the understory and returning low-intensity prescribed fire as an ecosystem process. Having forage reserves or swing allotments (Forest Service) or reserve common allotments (BLM) in place to provide permittees with adequate areas to graze their cattle or sheep will be necessary. In addition, research designed to further explore the best way to address this question is needed.

Integrating Grazing with a Prescribed Burning Schedule

Existing concepts and plans for landscape-scale forest restoration call for treating the land with prescribed burning either alone or following mechanical thinning with multiple entries over the course of decades (Allen and others 2002, Friederici 2003, Youtz and others 2008). However, few, if any, researchers have studied just how such a prescribed burning program will be integrated with continued grazing allotments. There are two basic concerns that arise: 1) there will not be enough grass (fuel) to carry a fire due to too much grazing (Center for Biological Diversity 2003) and 2) there will not be enough forage for all grazers if areas are burned too frequently (Tiedemann and others 2000, Vavra and others 2005). Some balance must be struck between these two possibilities.

There may be a way to integrate prescribed burning with the current grazing allotment system. Once the land management agency decides to implement a prescribed burning program on a given cycle, then the grazing rotation on an allotment could be adjusted to meet that cycle. For example, a grazing allotment program could be designed that rests (i.e., the complete withdrawal of a pasture or pastures from the rotation during a given grazing cycle) or defers (i.e., using pastures in such a way that cool- or warm-season grasses are not grazed by domestic livestock more than two years in a row) sites for some period (e.g., two or three years) prior to the scheduled prescribed burn. This would allow sufficient time to pass, assuming the site received enough moisture, to grow enough grass to carry fire. While this is a possible solution, integrating grazing and burning in a restoration context is another topic that would benefit from more in-depth research.

Ungulates: Vectors and Regulators of Unwanted Plant Species

Animals disperse seeds after passing them through their digestive system, carrying them in their fur or hooves, or by spitting them out. Writing about the seed dispersal potential of cattle, elk and deer, Bartuszevige and Endress (2008) note: "Large domestic and native ungulates have the potential to disperse large quantities of seeds throughout the landscape….All three species (cattle, elk, deer) act as seed dispersers for native and exotic plants." As one might expect given the forage tendencies of cattle and elk, Bartuszevige and Endress found that cattle fecal pats had a greater species richness and density of exotic grasses compared to other ungulates, while elk fecal pats had greater species richness and density of native and exotic forbs compared to other ungulates. The work of these and numerous other researchers indicates that ungulates are, indeed, vectors for unwanted plant species (although see Stohlgren and others [1999] who found no consistent difference between native or exotic species richness due to livestock grazing). This suggests that grazing animals, especially cattle because they tend to eat exotic grasses and dispense large quantities of seeds, can be a source for unwanted invasive plant species in restored areas. However, a study by Tate and others (2003) suggests that most cattle-dispersed seed will be found at "cattle attractants" (e.g., watering areas; shady, resting areas; gentle slopes) while seeds deposited by elk and deer will likely be dispersed across different areas and habitats.

One invasive plant species of concern, cheatgrass (*Bromus tectorum*), is known to increase following ecological disturbances, including overgrazing and fire (James 2007). It is especially prolific in the sagebrush ecosystem of the Great Basin where it has altered fire regimes and reduced forage (Reid and others 2008, Rowland and others 2010). The extent to which cheatgrass will increase in ponderosa pine or other fire-adapted forest ecosystems after restoration treatments remains an open question (although see prescribed fire-related studies by Crawford and others 2001, Keeley and McGinnis 2007). Work in northern Arizona suggests that grazing either following thinning and burning (Sorensen and McGlone 2010) or after a wildfire (Mork 2010) helps spread cheatgrass, especially whenever drought conditions occur after these events. These research studies suggest that cheatgrass has the potential to become a serious management problem following restoration treatments on grazing allotments.

If land managers find that they need to control cheatgrass and encourage native grass and forbs species, there may be ways to use grazing animals to help in their efforts. Known by such names as "targeted grazing," "prescribed grazing" and "prescription grazing," these strategies use either single or multiple grazing species in very controlled situations to control or eliminate plant pests. The basic idea is to set pest plants back by 1) grazing them when they are most vulnerable (i.e., typically early in the growth process) and 2) doing so frequently enough (possibly for several growing seasons) to eliminate the population and let desirable plant species thrive (Frost and Launchbaugh 2003). Such grazing tactics manipulate three basic variables—herbivore selection, seasonal timing, and grazing intensity. The authors of The Targeted Grazing Handbook (Peischel and Henry, Jr. 2006), for example, provide information about a wide variety of western pest plants and the animals that will control them. They indicate that sheep, goats, and/or cattle can be used to control cheatgrass by an intensive method known as "flash grazing." A recent dissertation (Diamond 2009) also records the successful use of targeted grazing and late-season prescribed burning to control cheatgrass. The U.S. Fish & Wildlife Service and the Bureau of Land Management have active programs in this area, and the USFWS National Wildlife Refuge System website has a good explanation of the process (see http://www.fws.gov/invasives/staffTrainingModule/methods/grazing/introduction.html).

Monitoring, both pre- and post-treatment, is critical in order to make this management practice work properly. Knowing exactly when a plant is in its most vulnerable growth stage is vital in order to get the animals in the field. Likewise, observing the responses of both the targeted species and other desirable species is key to understanding whether the treatment is working or needs to be modified. Monitoring is needed for several growing seasons to determine the effects on plant density, cover, biomass, species composition, and seed bank dynamics.

Grassbanks: A New Form of Partnership between Ranchers and Restorationists

As restoration treatments progress and are completed, it may be necessary to remove domestic grazing animals from an existing allotment to either prevent them from interrupting the thinning or prescribed burning process or to delay grazing on newly treated areas until the understory growth is sufficient and stable. In such cases, already existing set-aside areas, known as forage reserves, swing allotments or reserve common allotments, will be available from land management agencies for ranchers and their displaced cattle. Permittees can transfer their cattle to this new acreage with no additional fees or responsibilities until such time as their original allotment is again available. Grassbanking may be another option for temporarily holding domestic grazers.

Grassbanking is a "partnership that leverages conservation practices across multiple ownerships based on the exchange of forage for tangible conservation benefits" (National Grassbank Network 2003). The first and, perhaps, the most well-known grassbank was created by the Malpai Borderlands Group, who coined and registered the term, and used their grassbank to obtain a conservation easement from a neighboring rancher to stop a housing

project. More recent grassbanking efforts in the western United States, mainly by The Nature Conservancy, have provided ranchers with grazing rights in exchange for conservation benefits such as resting a high-value habitat, the use of prescribed fire, and wildlife habitat improvements (Gripne 2005a).

There are several examples of grassbanks in the western United States, including Malpai (AZ), Vina Plains Grassbank (CA), Valle Grande/Rowe Mesa Grassbank (NM), Rocky Mountain Front Grassbank (MT), Matador Ranch (MT), Heart Mountain Grassbank (WY), and the Triple Peak Forage Reserve (WY). All these enterprises consist of partnerships between non-profits, government agencies, and ranchers. Several provide grazing areas for ranchers whose federal grazing allotments are being treated and/or require rest from grazing. See http://www.compatibleventures.com/grassbank_fact_sheets.html for more details about these projects.

While these existing grassbanks demonstrate the potential of trading forage areas for conservation/restoration benefits, there are several challenges in creating and maintaining a grassbank.

- Raising the necessary funds to purchase the sizable acreage needed for a grassbank can be daunting (Gripne 2005a). This explains why many existing grassbanks are on lands that individuals or organizations already own or on public lands.
- Even when the land is available, raising money to pay the rancher can be difficult and time consuming, and often is done with little assurance that rancher will not walk away from the proposed deal. As Courtney White, director of the Quivira Coalition, told a *New York Times* reporter, grassbanks have "all the costs of a ranch but none of the income" (Robbins 2006).
- The participants need to have a clear idea of the benefits they will gain from the partnership. This has proven difficult in terms of measuring the conservation/restoration benefits (i.e., ecosystem services) that may accrue to the conservation organization, public agency, or general public.
- There can be problems when dealing with federal agencies in terms of completing the necessary documents, such as environmental assessments, in a timely and legally defensible manner.
- There can also be problems in terms of completing restoration treatments on time so that the grassbanking agreement does not have to be redone (Gripne 2005b).
- These obstacles have made grassbanking a less attractive conservation tool in recent years. Nevertheless, the use of a grassbank as part of a landscape-scale forest restoration effort may prove to be a collaborative solution for both ranchers and restorationists if some of these obstacles can be overcome.

Establishing a Grazing Monitoring Protocol that Addresses Landscape-scale Forest Restoration

Whether at the stand scale or the landscape level, monitoring the effects of domestic and wild ungulate grazing is an important part of a successful forest restoration project. Without monitoring, sites may become overgrazed leading to several kinds of environmental problems, including lack of vegetation to carry prescriptive fires, soil compaction, erosion, loss of important plant and animal species, and water pollution. Public agencies have monitoring protocols in place for their grazing allotments (e.g., U.S. Forest Service Region 3 1997), but they are somewhat limited in terms of their application to a multi-resource, landscape-scale forest restoration process. Moreover, agency staffing levels for range conservationists and technicians are a limiting factor in terms of how much monitoring takes place. What can be done to solve these two situations?

First, existing federal agencies may need to expand their data collection procedures to address questions such as: Are grazers reducing the numbers of browse species? Is early season grazing having an effect on cheatgrass populations? Did the grazing rotation provide enough grass for a scheduled prescribed burn? What understory

plants, especially forbs, are increasing and/or decreasing under the current grazing rotation? How well are domestic and wild ungulates co-existing on the landscape? What is the condition of riparian areas on the allotment? The answers to these and other questions may be determined using existing monitoring procedures, while in other cases they may require new procedures.

Resolving the second situation is going to require either a quicker way to assess allotment conditions (i.e., a rapid assessment methodology or RAM) or more people who are capable and willing to monitor the conditions of the allotments. Allison and others (2007) discuss a RAM they used to assess 25 allotments (586,000 acres) on the Santa Fe National Forest in northern New Mexico over the course of a few weeks. They did so by establishing at least one "key area" of five acres or more within each allotment. Each key area represented a vegetation type on the allotment, and was located 0.25 mile to 1 mile from a water source, on slopes less than 15 percent, and on soils in satisfactory condition. Photo points were established and used at each key area. Plant cover and composition as well as residual forage biomass was determined using the step-point method (Evans and Love 1957). Stubble height of forage grasses was measured to determine grazing intensity in order to determine thresholds below which grazing is detrimental to plants and site stability. They also quantified the soil moisture depth at each key area by taking a soil core and noting the depth where moist and dry soil met. Lastly, domestic and wild ungulate use was assessed by doing pellet-group counts along a belt transect. This provided an approximation of animal use over time and identified the relative use by different ungulate species. The data set was then compiled and analyzed, and the allotments placed into three categories: 1) suitable for continued grazing, 2) unsuitable for continued grazing, and 3) grazing status requires further investigation. Although it varies depending on the site and the experience of the personnel, a RAM of this type on one key area typically takes two to four hours with a crew of four to six people (Dr. Jerry Holechek, pers. comm.). The authors note that this RAM "has been requested on numerous occasions throughout the New Mexico region since 2002 and adopted as collaborative approach to joint agency-permittee monitoring efforts."

To address the multiple resource issues that will occur following restoration treatments on grazing allotments, federal agencies might work more collaboratively with permittees to expand the monitoring process. This is slowly starting to take place in different parts of the West, especially after the U.S. Forest Service and the BLM signed Memorandums of Understanding with the Public Lands Council to promote voluntary cooperative monitoring (Thompson 2004, Fernandez-Gimenez and others 2005a). In Wyoming, for example, voluntary permittee monitoring of rangelands now occurs on the Bridger-Teton National Forest, and the University of Wyoming Cooperative Extension Service has published a booklet about the subject (Peterson 2006; see Peterson 2008 for an update of these activities). Nevada and Idaho have a similar guide to monitoring for ranchers (Perryman and others 2006, Sanders 2006).

Fernandez-Gimenez and her colleagues (2005a, 2005b) found supporting evidence for this trend in their survey of permittees and land managers in Arizona. Their results indicate that while permittees and land managers disagreed about issues such as government regulation/loss of personal freedom, whether or not federal rangeland management should strongly emphasize livestock grazing and the level of effort expended to protect rare and endangered species, they agreed strongly that permittees should help monitor their allotments; many agreed this should be mandatory. Both groups generally agreed that such a collaborative approach would produce benefits for all, including improved range condition, improved ability to determine whether management objectives were met, providing protection from lawsuits, protecting private property rights, and, ultimately, establishing a better management practices and social understanding (i.e., communication, cooperation, and trust) between permittees and land management agencies.

Conclusion

Across the western United States, nearly 16 million of the 19 million acres of federally managed ponderosa pine forests are located on active federal grazing allotments (Stade 2008, Stade and Salvo 2009). Since it is fairly certain that the federal grazing allotment system will continue in its present form (although it is possible that grazing fees could increase; E&E News 2011, Taylor 2011), anyone interested in restoring ponderosa pine forests at the landscape scale may want to consider the following points about how to integrate grazing and forest restoration:

- A landscape-scale forest restoration treatment plan will require including the goal of providing habitat for both domestic and wild ungulates. Developing a dynamic mosaic of interconnected foraging, resting, birthing, and hiding areas needed by cattle, elk, antelope, and deer is essential. The planning for this should be integrated with other planning concerns related to the timing and sequencing of restoration treatments across the landscape.
- In most circumstances, a functional mix of restoration forestry and ranching practices can be used to control resource conflicts between domestic and wild ungulates.
- The responses of domestic and wild ungulates to restoration treatments will differ, but eventually cattle, elk, antelope, and deer will all use the improved forage in restored areas, although cattle, elk, and antelope will most likely feed on the grass and forb component while deer will continue to forage on woody species and oak mast.
- More applied research is needed to determine how long a treated area should "rest" before domestic grazers are allowed to return to an allotment. Existing guidelines are not presently supported by scientific data.
- Land managers, restoration planners, and scientists need to discuss and research ways to integrate grazing with a prescribed burning schedule. Resting or deferring grazing across an allotment prior to a scheduled prescribed may be a viable solution, especially if there adequate moisture during this period to assure adequate grass growth.
- Land managers and restorationists should be aware that ungulates, especially cattle and, to a lesser extent, elk, help spread unwanted plant species, including cheatgrass. Withholding grazing in areas where populations of unwanted plant species exist, especially when they are in the seed-bearing stage should be encouraged. Reduced grazing during droughts should also be considered as a way to help avoid the spread of unwanted plants, such as cheatgrass.
- The targeted use of domestic grazers to control or eliminate unwanted plant species has potential if the correct grazers are employed and the timing and intensity of grazing is coordinated to reduce the unwanted plant's resources. Ill-timed efforts will not work. Monitoring of results is essential.
- Grassbanks may provide another means of accomplishing needed restoration activities by exchanging forage rights for either conservation work or passive restoration. The costs and benefits of such arrangements have to be carefully considered, however.
- Monitoring grazing allotments within landscape-scale restoration treatments needs to be able to answer restoration-related concerns, not only grazing concerns. Moreover, a greater level of monitoring is needed and could be done using existing federal agency personnel in combination with allotment permittees and interested citizens. Rapid assessment methodologies might also be appropriate.

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Ecological restoration is a practice that seeks to heal degraded ecosystems by reestablishing native species, structural characteristics, and ecological processes. The Society for Ecological Restoration International defines ecological restoration as "an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability.…Restoration attempts to return an ecosystem to its historic trajectory" (Society for Ecological Restoration International 2004).

Throughout the dry forests of the western United States, most ponderosa pine forests have been degraded during the last 150 years. Many ponderosa pine areas are now dominated by dense thickets of small trees, and lack their once diverse understory of grasses, sedges, and forbs. Forests in this condition are highly susceptible to damaging, stand-replacing fires and increased insect and disease epidemics. Restoration of these forests centers on reintroducing frequent, low-intensity surface fires—often after thinning dense stands—and reestablishing productive understory plant communities.

The Ecological Restoration Institute at Northern Arizona University is a pioneer in researching, implementing, and monitoring ecological restoration of dry, frequent-fire forests in the Intermountain West. By allowing natural processes, such as fire, to resume self-sustaining patterns, we hope to reestablish healthy forests that provide ecosystem services, wildlife habitat, and recreational opportunities.

The ERI Issues in Forest Restoration series provides overviews and policy recommendations derived from research and observations by the ERI and its partner organizations. While the ERI staff recognizes that every forest restoration is site specific, we feel that the information provided in the series may help decisionmakers elsewhere.

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