SUPPLEMENTAL BIBLIOGRAPHY:

ADDITIONAL DOCUMENTS RELEVANT TO ANALYSIS OF ALTERNATIVES FOR THE BUREAU OF LAND MANAGEMENT SIXTEEN-STATE VEGETATION MANAGEMENT PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT (Annotations)

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ADDITIONAL DOCUMENTS RELEVANT TO ANALYSIS OF ALTERNATIVES FOR THE BUREAU OF LAND MANAGEMENT SIXTEEN-STATE VEGETATION MANAGEMENT PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT (Annotations)

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FUELS TREATMENT

Causes and Treatments of Woody Plant Increase in Western Forests

Allen, C.D., et al. 2002. Ecological restoration of southwestern pine ecosystems: a broad perspective. Ecological Applications (in press).

> This paper promotes a broad and flexible perspective on the ecological restoration of Southwestern ponderosa pine forests from decades of livestock grazing, fire suppression and logging. This paper states that restoration methods to restore Southwestern forests require "varying combinations of young tree thinning and reintroduction of low-intensity fires." **(Abstract p. 1)**
>
> The authors argue for using historic reference conditions as general guides rather than "rigid restoration prescriptions. In the long term, the best way to align forest conditions to track ongoing climate changes is to restore fire, which naturally correlates with current climate. Some stands may need substantial structural manipulation (thinning) before fire can safely be reintroduced. In other areas, such as large wilderness and roadless areas, fire alone may suffice as the main tool of ecological restoration, recreating the natural interaction of structure and process." **(Abstract, p. 1)**
>
> The paper offers principles of ecological restoration and cautions against impatience, over-reaction to crown fire risks and perverse economic incentives that can lead to destructive activities that can further degrade forests.

Brown, R. 2001. Thinning, fire, and forest restoration: a science-based approach for national forests in the interior Northwest. Defenders of Wildlife.

> This report is a succinct and readable review of the scientific basis for active management techniques (e.g., thinning and prescribed fire) in forest restoration in the Pacific Northwest. The author discusses fire ecology and management of three main forest types: **dry forests** made up mostly of ponderosa pine; moister, **mixed conifer forests** made up of trees such as grand and white fir; and, at still higher elevations, **cold forests** of subalpine fir and Engelmann spruce.
>
> Many of the author's suggestions are cautions based in the recognition that "forest restoration" projects can do more harm than good:
>
> "Planning also needs to recognize that conditions other than historic (or "natural") may need to be maintained in order to provide essential habitat for at risk wildlife until such time as suitable habitat can be restored more broadly on the landscape" **(p. 18).**
>
> "It will also be essential to acknowledge how little empirical scientific study supports assumptions of the efficacy of thinning to restore habitat and reduce fire frequency. **While additional scientific research is necessary, much can also**

be learned from routine monitoring, especially if it is structured to reflect a more consistent case studies approach. . ." (p. 31)

Forest treatments can also themselves be a source of negative impacts – by damaging soils, killing overstory trees, removing important dead and decaying wood, or increasing fire hazards. The sale of any of the cut trees should be avoided, or at least decoupled from the felling of trees. As the author notes, "'Salvage' logging, founded on a purely commercial premise, often with truncated environmental considerations and its own peculiar funding imperatives, cannot be expected to provide restoration benefits" **(p. 22).**

Center for Biological Diversity. 2002. Livestock grazing, fire regimes, and tree densities (appendix). Center for Biological Diversity. **www.biologicaldiversity.org.**

What are the causes of declining forest health in the western United States? Usually managers point to the role of 20th century fire suppression, or in some cases the effects of logging. Yet almost a century ago, some ecologists had already identified a third factor: livestock grazing and increasing densities of young trees in western forests. This appendix to a larger report details the evidence that livestock have played a large part in producing our present forest health crisis.

The mechanisms of the influence of livestock grazing on forest composition are familiar from their better-known role in the spread of juniper across western landscapes:

- "livestock consume and lower the density of grasses that would otherwise compete with tree seedlings for space, water and nutrients, and

- livestock remove the herbaceous understory which provides fuel for 'cool' surface fires that kill regenerating trees" **(p. 1).**

The question of what impact livestock have on forest heath role is complicated (compared to fire suppression, for example) because the two processes have occurred together almost everywhere in the West. (This is a prime example of where a lack of controls – i.e., ungrazed forests - prevents us from fully understanding what the impacts are). Leopold recognized this problem as early as 1923, when he wrote **"Whether grass competitors or fire was the principle deterrent to timber reproduction is hard to answer because the two factors were always paired, never isolated." (quoted p. 2)** This is an important point, worth belaboring: the use of controls, and the monitoring and comparison of treatment outcomes with those of controls, is a basic scientific approach that needs to be built into BLM's vegetation management.

Fortunately, a few natural controls do exist, and the authors describe three of them. In one case, two neighboring ponderosa pine forests in central Washington had not been burned for at least 125 years. **The forest that had never been grazed had 85 trees less than 4 inch dbh per acre, while the grazed forest (with little grass) had a density of 3,291 trees less than 4 inch dbh per acre. (p. 3)** This remarkable difference was due to grazing alone – not to fire suppression. The two other cited studies, from Utah and Idaho, show similar patterns. One of those studies concludes that **"Our findings challenge the widely accepted notation that the high frequency of fires in ponderosa pine savannah was the prime cause for the prevention of succession to denser stands of ponderosa pine or to shade-tolerant but fire-sensitive conifers. . ." (p. 3)**

Such studies clearly demonstrate that livestock grazing is a cause of "doghair" growth of young trees in ponderosa pine forests. The BLM needs to incorporate this relevant scientific information in its plans to improve forest health. As the authors of the appendix write, **"This is not only a historical problem: as long as livestock are present, the problem will remain. Furthermore, it is clear that grazing is not just a range issue. It is a silvicultural issue. . ." (p. 4)** (and as such, it needs to be analyzed wherever timber sales, forest restoration, or juniper control activities are being analyzed.)

Causes and Treatments of Woody Plant Increase in Western Shrub and Grasslands

Covington, W.W. and L.F. DeBano. 1990. Effects of fire on pinyon-juniper soils. *In* J.S. Krammes (technical coordinator). Effects of fire management of Southwestern natural resources: Proceedings of the symposium 1988 November 15-17; Tucson, AZ. General Technical Report RM-191. Fort Collins, CO: United States Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 78-86.

Utah Juniper (*Juniperus osteosperma*) stands share many of the same characteristics of naturally low fuel loads as singleleaf pinyon stands. Fuel loads in Utah juniper stands rarely exceed 1-3 tons per acre, and thus, have insufficient fine fuels to facilitate fire spread or high fire severity.

Evans, R.A. 1988. Management of pinyon-juniper woodlands. General Technical Report INT-249. Ogden, UT: United States Department of Agriculture, Forest Service, Intermountain Research Station. 1-34.

Burning pinyon-juniper stands requires at least 600-700 pounds per acre of fine surface fuels in order to carry fire. Where cheat grass builds up, it can act as a fine surface fuel and increase the frequency of fires in pinyon-juniper stands.

Folliott, P.F. and G.J. Gottfried. 2002. Dynamics of a pinyon-juniper stand in northern Arizona: a half-century history. Res. Pap. RMRS-RP-35. Fort Collinns, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 10 p.

Despite the concern being generated by the issue, this succinct report describes one of "only a few long-term studies of the stand dynamics in the pinyon-juniper woodlands of the southwestern United States" **(p. 1).** In 1991 the authors completely resampled a 2-acre plot of pinyon-juniper forest that had previously been sampled in 1938, 1948, and 1958.

The authors discovered that:

- Juniper and pinyon had increased on the site since pre-settlement times, but the great majority of that increase occurred between 1890 and 1920, when heavy livestock grazing and fire suppression coincided with a period of cool, moist climate "probably 'ideal' for the germination of juniper seeds throughout the region."

- "**The annual increase of 1.2 trees per acre does not reflect the 'massive invasion' of trees suspected by many people.** The common perception that pinyon-juniper woodlands are occupying more land might be related more to the observed increases in crown diameter and total height of existing trees than to an increase in tree numbers" (**pp. 9-10, emphasis added).**

This paper is relevant to the BLM vegetation management in several respects:

1) It provides a cautionary example of why monitoring is an essential part of (and in this case a necessary **precursor** to) vegetation management. It also shows how impressions of long-term changes **not** based on the results of long-term monitoring can be misleading.
2) It includes useful references to publications containing evidence of high tree recruitment during periods of most intensive livestock grazing. Such evidence should be useful in helping BLM managers understand the role that grazing plays in woody plant increase, and to see that grazing is a silvicultural as well as a range issue.

Gruell, G.E. 1999. Historical and modern roles of fire in pinyon-juniper*. In* S.B. Monsen and R. Stevens (compilers). Proceedings: ecology and management of pinyon-juniper communities within the Interior West: Sustaining and restoring a diverse ecosystem. 1997 September 15-18. Provo, UT. Proceedings RMRS-P-9. Ogden, UT. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. 24-28.

In areas where fire has been excluded but livestock grazing has occurred, tree densities can be increased but understory vegetation can be so sparse that there are insufficient surface fuels to spread fire except under the most extreme, severe conditions.

Wangler, M.J. and R.A. Minnich. 1996. Fire and succession in pinyon-juniper woodlands of the San Bernadino Mountains, California. Madrono 43(4): 493-514.

Singleleaf pinyon (*Pinus monophylla*) occurs in a variety of habitat types; consequently, fire frequency, behavior, and effects are highly variable. The mean Fire Return Interval (FRI) ranges from 15-20 years for sites with sufficient fine fuels to carry surface fires, to 50-100 years or more on sites with patchy fuels. On xeric (dry) sites which have infertile, shallow, rocky soils, fires were fairly infrequent because of sparse growth of vegetation sufficient to carry fires. The exception would be during years where relatively high precipitation allowed sufficient herbaceous growth to carry surface fires. Singleleaf pinyon communities in these dry sites can have extremely long FRIs, ranging 450 years or more.

Welch, B.L., and C. Criddle. 2002. Countering misinformation concerning big sagebrush (Unpublished manuscript)

The authors are a plant physiologist with the USDA-Forest Service, Rocky Mountain Research Station Shrub Sciences Laboratory, and a member of the National Wildlife Federation. Their purpose is to counter what they consider a set of unexamined assumptions about big sagebrush that have supported and driven a war by the range management community against big sagebrush. The eight "axioms of range or vegetation management" that they examine are the following:

1) Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis)* does not naturally exceed 10 percent canopy cover and mountain big sagebrush (*A. t.* ssp. *vaseyana)* does not exceed 20 percent canopy cover;

2) As big sagebrush canopy cover increases over 12-15%, bare ground increases and perennial grass cover decreases;

3) Removing, controlling, or killing big sagebrush results in 2- or 3-fold (or more) increase in perennial grass production;

4) Nothing eats big sagebrush;

5) Biodiversity increases with removing, controlling, thinning, or killing big sagebrush;

6) Mountain big sagebrush evolved in an environment with a mean fire interval of 20 to 30 years;

7) Big sagebrush is an agent of allelopathy; and

8) Big sagebrush is a highly competitive, dominating, suppressive plant species.

The authors conclude that "**most, if not all, the sins attributed to big sagebrush by the range management community is the result of livestock grazing**" **(p. 2).** For the most part, the listed statements appear to be received wisdom—rationalizations "to justify removing, thinning, controlling or killing of big sagebrush" **(p. 2)** rather than well-tested hypotheses.

The relevance of this paper to any attempts to manage sagebrush abundance is obvious.

Wright, H. A., L. F. Neuenschwander, C.M. Britton. 1979. The role and use of fire in sagebrush-grass and pinyon-juniper plant communities: A state-of-the-art review. General Technical Report INT-58. Ogden, UT: United States Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 11-20.

This review of the role of fire in controlling the spread of pinyon and juniper into grasslands and shrublands, published in 1979, readily acknowledged the central role of grazing in causing the spread of woody species.

"[Historically] droughts and competition from grass probably only served to slow the invasion and growth of junipers in adjacent grasslands, because the trees are easily established during wet years, especially when shade is present. Then fire, occurring about every 10 to 30 years, kept the junipers restricted to shallow, rocky soils and rough topography."

"**For the last 70 years, however, heavy livestock grazing has reduced grass competition as well as fuel for fires.** Reduced competition from grasses has permitted pinyon and juniper to invade adjacent communities rapidly and the reduced number of fires, each of a lower intensity than the fires before heavy grazing, has left the juniper unchecked." **(p. 15)**

Grazing is a prime cause of pinyon-juniper expansion: for all intents and purposes livestock grazing is a vegetation **treatment** whose effect is to favor trees over grasses and shrubs. If the BLM wishes to reduce the abundance of pinyon and juniper, it needs to address the causes—and consider the full range of options—for slowing and reversing their spread. The full range of options includes reducing grazing pressure just as clearly as it includes chaining, spraying herbicides, and prescribed fire. Moreover, to the extent that grazing or fire suppression are root causes of the problem, a long-term solution requires that they be dealt with more permanently.

Wildlands-Urban Interface

Cohen, J. 1999. Reducing the wildland fire threat to homes: where and how much? *In* A. Gonzales-Caban and P. Omi (technical coordinators). Proceedings of the symposium on fire economics, planning, and policy: bottom lines. General Technical Report. PSW-GTR-173. Albany, CA: United States Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 189-195.

The best available science produced from the Forest Service's Fire Sciences Lab in Missoula, Montana, reveals that the most effective means of protecting structures from wildland fires centers on managing vegetation in the areas immediately adjacent to them, up to a maximum 200 feet radius around structures. According to the nation's foremost authority on wildland fire risks to urban structures, Jack Cohen, "the evidence indicates that home ignitions depend on the home materials and design and only those flammables within a few tens of meters of the home (home ignitability). The wildland fuel characteristics beyond the home site have little if any significance to wildland-urban Interface home losses.… Extensive wildland vegetation management does not effectively change home ignitability."

Cohen's statement is extremely important. It means that wildland vegetation management projects targeting areas further than 200 feet from structures are do not have home protection as a primary objective. Such projects need to be discussed and evaluated in terms of their real purpose.

Nowicki, B. 2002. Effectively treating the wildlands-urban interface to protect houses and communities from the threat of forest fire. Center for Biological Diversity. www.biologicaldiversity.org

This paper is the source for the Wildlands Urban Interface (WUI) definition that is used in the Restore Native Ecosystems Alternative (RNEA). The definition of the WUI in the RNEA is based on the definitions and calculations in this paper and are based on an extensive literature search. (Because our proposal follows Nowicki's review so closely, we've included several of the references he cites within, and then at the end of this article summary.)

The RNEA advocates that the BLM design WUI projects to protect homes and communities from fire, rather areas far from homes, in the backcountry, where the focus should be on restoring ecological integrity and restoring fire back into the ecosystem.

The summary of the Nowicki paper explains that treatments are needed to protect houses and communities in the Wildlands Urban Interface:

"The protection of houses and communities from the threat of forest fire depends upon the proper treatment of the wildland-urban interface (WUI), the area directly adjacent to houses and communities. The protection of the house depends entirely on treatment of the home ignition zone – the house itself and the area within 60 meters (200 feet) of the house. This is necessary to protect the house from the various forms of ignition present during forest fires, regardless of what treatments are implemented in the adjacent forest. In addition, an overlapping defensible community space treatment can provide opportunities for firefighters to protect other flammable features of a community. The largest defensible space required under maximal conditions is less than 500 meters (1640 feet) wide. However, most communities require treatment extending less than 400 meters 1312 feet) from the house" **(p. 1).**

The paper covers the following topics and addresses the scientific literature for each:

- Protecting the House
- Defensible Community Space
- Firefighting Strategy
- Beyond the Defensible Space
- Maintaining the WUI
- Prioritization

Some of these topics are highlighted below:

Protecting Homes

There are three ways that forest fires can ignite houses, and each one implies can be countered by specific preventative steps:

1) Radiant heat from flames igniting houses

Experimental studies and modeling have found that trees removed within 40 meters from a house protects it from radiant ignition from flames of a torching and crowning fire **(Cohen 2000a).** Since these studies were based on severe conditions, treatment distances can be less. Studies have also found that if treatments were extended to 60 meters, this would provide additional safely in areas with steep slopes and extremely tall trees **(p.2).**

The Nowicki paper notes that homesite protection does not require the removal of all vegetation; rather, adequately spaced trees from the house and forest can provide heat protection by blocking radiating heat of the forest fire **(Cohen and Butler 1998) (p. 2).**

2) Flames reaching houses through surrounding vegetation

The Nowicki paper describes the flammable material around a house that can carry fire and ignite the house. Woodpiles adjacent to houses is a major threat. It has been found that most houses ignite from a relatively low-intensity surface fire rather than a crown-fire **(Cohen 2000b)** (which can spread to and ignite more substantive fuels such as woodpiles). Grass and needle litter can carry fire right up to a house, or to a tree, shrub or structure next to a house. This can be prevented by raking a line around the perimeter of a house. Ground fuels next to a house can be eliminated with rock landscaping, cement sidewalks, green grass and regular raking of needles and dried vegetation **(Cohen 2000b) (p. 2).**

3) Firebrands carried by wind to fall on or near houses

Firebrands are an "extremely dangerous source of ignition on and adjacent to houses. Even highly effective fire prevention or suppression miles from the homesite cannot protect houses from this threat of ignition. Similarly, WUI treatments that neglect firebrand ignitions will be dangerously ineffective at protecting houses and communities from forest fires" **(Nowicki 2002) (p. 3).**

Creating Defensible Community Space

The Nowicki paper recommends that additional thinning up to 500 meters may enhance a community's resilience to wildfire and provide firefighter safety. This paper presents significant detail about how the 500 meter zone for community protection and firefighter safety was determined. The calculation was based on work by Butler and Cohen (1998). The width requirements for the firefighter safety zone are related to the "average sustained flame length of the forest fire flame front at the edge of the safety zone" **(Butler and Cohen 1998) (p. 3).**

The calculation in the paper "incorporate a large safety factor by adopting a strong bias toward maximum values, including the range of high winds and steep slopes, whether or not such conditions are present or physically possible" **(p. 4).** The flame length used in the calculation is based on tree height, and addresses the flame length of different height of trees **(p. 4).**

The paper argues the important point that "defensible community space does not require the removal of all trees within the area. It involves thinning the forest to create breaks in the continuity of tree crowns, and removing ladder fuels and small-diameter understory trees" **(p. 4).**

This treatment is based on forest type, average tree height and slope. Specific recommendations are suggested, and the paper stresses that it is important to retain large fire resistant trees which are about to suppress the growth of flammable brush, reduce wind speeds and block heat from the fire **(p. 4).**

Beyond the Community Space

Research by Jack Cohen has found that managing vegetation beyond the immediate vicinity of the home has little affect on ignitions. This conclusion is cited below:

"The evidence suggests that wildland fuel reduction may be inefficient and ineffective: inefficient because wildland fuel reduction for several 100 meters or more around homes is greater than necessary for reducing ignitions from flames; ineffective because it does not sufficiently reduce firebrand ignitions" **(Cohen. 1999 p. 192).**

References cited in above review:

Butler, B. W. and J.D. Cohen. 1998. Firefighter safety zones: a theoretical model based on radiative heating. Fire Behavior Research Unit, Rocky Mountain Research Station, Intermountain Fire Sciences Laboratory. U.S. Department of Agriculture. www.firelab.org

Cohen, J. D. 1999. Reducing the wildland fire threat to homes: where and how much? USDA Forest Service Gen. Tech. Rep. PSW-GTR-173. www.firelab.org (*see* vol. 1, annotated bibliography submitted to the BLM for the Restore Native Ecosystems Alternative).

Cohen, J. D. 2000a. Preventing disaster: home ignitability in the wildland-urban interface. Journal of Forestry 98(3): 15-21.

Cohen, J.D. 2000b. Examination of the home destruction in Los Alamos associated with the Cerro Grande Fire July 10, 2000. USDA Forest Service, Fire Sciences Laboratory. www.firelab.org.

Cohen, J.D. and J. Saveland. 1997. Structure ignition assessment can help reduce fire damages in the W-UI. Fire Management Notes 57(4): 19-23.

EXOTIC SPECIES

Microbiotic Crusts and Invasion

Belnap, J. 1995. Surface disturbances: their role in accelerating desertification. Environmental Monitoring and Assessment 37: 39-57.

The author 1) documents just how very slow is recovery from trampling/disturbance in desert soils populated by microbiotic crusts and 2) argues that desertification and permanent loss of productive capacity threatens millions of hectares of semiarid lands here in the United States.

The data on soil recovery rates is similar to that in articles that we submitted with the Restore Native Ecosystem Alternative, version 1. Even disturbances such as trampling by cattle can:

increase soil albedo (→ cooler soil)	(recovery time up to 250 years)
kill cyanobacteria, lichen, and mosses	(recovery times of 35-250 years)
severely damage soil nitrogenase activity	(no recovery after 9 years)
decrease nitrogen content of vascular plants	
decrease soil fungal biomass	(recovery time unknown)
decrease soil nematode and arthropod number and diversity	(recovery unknown)

The author describes significantly reduced biological activity and a decline in soil fertility (particularly nitrogen) in disturbed soils. This is troubling because, as Belnap points out, **"reduced fertility of systems is one of the most definitive and problematic aspects of desertification" (p. 47).**

"Input of available nitrogen from atmospheric and parent material sources is extremely low in arid regions, and these systems generally depend on biologically fixed nitrogen and nitrogen released from the decomposition of organic matter" **(p. 53).** At least in cold-desert pinyon-juniper and grassland ecosystems of southern Utah, biological crusts are the dominant source of nitrogen **(p. 40).** In such places crusts are not just a minor component of the ecosystem, or a matrix filling in the empty spaces between plants. They are a dominant member of the community, driving key ecological processes, and they need to be conserved as a key part of the native vegetation. Beyond that, their loss results in desertification. This article helps to explain why that is so.

Roads and Invasion

Hodkinson, D.J. and K. Thompson. 1997. Plant dispersal: the role of man. Journal of Applied Ecology 34: 1484-1496.

A comparison of the abundance and composition of plant seed “floras” spread by a variety of human activities in Britain, including car travel, horticulture, and topsoil movement.

The authors conclude:

“In considering the likely future spread of species across the landscape, man must now be included, not just as a modifier of the landscape itself, but also as a major (perhaps *the* major) dispersal vector” (p. 1492).

Their studies of plant seed dispersal were performed in Britain, but their data, as well as that in the references they cite (from studies around the world) is unmistakable: humans, and the choices we make are responsible for the distribution of invasive species. The implications for BLM land management – in particular the role of roads, cars, and off-road vehicles in the spread of weeds – must be addressed and not avoided.

Among the observations in the paper relevant to BLM vegetation management decisions are:

- The numbers of seeds carried by vehicles traveling on unsurfaced roads is (based on published studies) two to three orders of magnitude greater than are found on vehicles traveling mostly on surfaced roads **(pp.1489-1490)**. (The two cited studies of vehicles on unsurfaced roads found >8,000 and 513-1330 seeds per vehicle, respectively). It is clear that, on BLM lands, with unsurfaced roads and frequent off-road vehicle use, the magnitude of seed transport by vehicles is likely to be towards the high end of the range.

- “Seeds may be dispersed [by cars] over very large distances (hundreds of kilometers) but are most likely to be dispersed between 3 and 40 km . . . **distances that are several orders of magnitude greater than most other dispersal mechanisms.” (p. 1490)**

- **Automobile use and other human activities can transport plant species that otherwise might have great difficulty spreading**. Of the 193 species increasing their range size in England, “the great majority (131) possess no obvious adaptations for dispersal by wind, animals or water. The alternative anthropogenic pathways we describe provide plausible dispersal mechanisms for many of these species” **(p. 1491)**. In other words, these are plants that, if they weren’t being spread by humans, might not be spreading at all (or would be spreading much more slowly).

- The species of plant that were spread by automobiles in this study tended to have small, persistent seeds, and to come from species that are small, fast-growing, and produce many seeds **(p.1490)**. It seems that these are the very species that are most likely to escape initial notice and to be particularly difficult to eradicate once discovered.

Given the apparent role of automobiles in dispersing plant seeds and widening plant species ranges, decisions about where to allow and encourage vehicle use (even by building roads) are vegetation management decisions, and need to be treated as such in the BLM's decision processes.

Lesica, P. and K. Ahlenslager. 1993. New vascular plant records and the increase of exotic plants in Glacier National Park, Montana. Madrono 40(2): 126-131.

This study reports 39 additions to the flora of Glacier National Park (14 of them exotics). The authors note that the number of exotic plant species introduced into Glacier National Park has increased as number of visitors has increased.

The locations listed for the new records of exotic plants give a sense of how the new exotics are arriving and which habitats they are most able to invade. Human activities obviously aid them in both respects. Examples of the type of locations where the new exotic plant species were found are:

- "compacted soil in the garage area at the park headquarters"
- "along the footpath between yard at the park headquarters"
- "in the residence area at West Glacier"
- "in the picnic area"
- "in a disturbed area at Polebridge Ranger Station"
- "on roadsides and along railroad line"
- "on bare slopes and ridges"

Tyser, R.W., J. M. Asebrook, R.W. Potter, L.L. Kurth. 1998. Roadside revegetation in Glacier National Park U.S.A: effects of herbicide and seeding treatments. Restoration Ecology 6(2): 197-206.

In Glacier National Park, road construction has led to the invasion of roadside native prairie by a suite of exotic plants, including *Phleum pratense* (timothy) and *Centaurea maculosa* (spotted knapweed). In plots reseeded and sprayed for three years to restore native vegetation, the authors found a mixture of desired and undesired changes. Relative to control plots, exotic forbs decreased and native grasses increased in sprayed plots (good), but native forbs decreased and exotic grasses increased (bad). The data and extensive discussion make it clear that it may simply not be possible to restore pre-disturbance native vegetation to roadsides in the park. At least some of the impacts of the road-building are essentially permanent and not possible to mitigate.

The management recommendations on page 205 are exceptional. They describe a practical and conservative approach to managing road corridors to minimize the spread of exotic plants. The final prescription supports the principles of vegetation management that we propose in the Restore Native Ecosystems Alternative:

"**The traditional paradigm that road construction is a 1-2 year engineering project must shift to one where road corridors are considered to be ongoing biological projects.** This new paradigm should also recognize the important impact that road construction and renovation have on encouraging the dispersal of alien flora" **(p. 205 (emphasis added)).**

Fire and Invasion

D'Antonio, C.M. and P.M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecology and Systematics 23: 63-87.

Many BLM management decisions affect the spread and increase of exotic grass species, whether annual grasses in the Intermountain West, plantings of crested wheatgrass; or lovegrasses, bufflegrass, and giant reed in the southwest. This article puts those regional management issues in a global perspective, one in which the human-caused spread of invasive grass species (often intentionally introduced) is altering ecosystems around the world.

Invasions by alien grasses are especially significant because (1) they are to a large extent irreversible and (2) they often alter ecosystem processes in invaded areas, causing functional as well as compositional change. Far from being just a "new player" in the landscape**, invasive grasses can actually change "the rules of the game"** within which other species must compete to survive. The cheatgrass/wildfire cycle is one well-known example, but D'Antonio and Vitousek describe dozens of other cases in which introduced grasses have altered ecosystems through competition and affected resource supply, geomorphology and microclimate, and increasing the fire frequency.

D'Antonio and Vitousek conclude that "the effects of alien grasses on ecosystem function (fire, nutrient loss, altered local microclimate, prevention of succession) are significant on the local scale and are becoming increasingly important on regional and global scales. Moreover, **the interaction of competition with alien grasses, fire, and the prevention of succession now represents a substantial global threat to biological diversity on the genetic, population and species levels" (p. 79).**

In an additional, cautionary note, D'Antonio and Vitousek write that "the number of cases in which ecosystem effects of grass invasions have been intensively studied (as opposed to described or speculated about) is small." In many cases, we simply don't know what the effects of the introduced grasses are.

In this light, a precautionary approach to maintaining healthy ecosystems and native communities would mean minimizing the further spread of exotic grasses, whether through management activities that favor them (e.g., grazing, soil disturbance) or (especially) by their intentional planting.

Herbicides and Exotics: Unintended Impacts

Hayes, M.P. and C.A. Pearl. 2001. *Rana aurora aurora* (Northern red-legged Frog) movement. Herpetological Review 32(1).

> This brief note provides rare documentation of the long distances that northern red-legged frogs can travel. One marked frog was found 2.4 kilometers from the breeding pond where it had been first been captured, while three other adult frogs were recaptured after moving more than a kilometer. All four recaptured frogs had traveled more than any red-legged frog had ever been known to move, highlighting just how little is known about the life histories and habitat use of amphibian species.
>
> The fact that the northern red-legged frog, usually associated with wetlands, range so far into upland habitats is a reminder of why BLM vegetation and habitat management needs to be integrated on a landscape scale. For instance, frogs and other amphibians are particularly sensitive to pesticides, which they easily absorb through their skin. To preserve amphibian biodiversity, it may not be sufficient to simply keep pesticides out of wetlands where these animals breed. Surrounding uplands are just as important to amphibians at other life stages, so prohibition on herbicide use may be equally important there. (Action- RESTORATION 15)

Idaho Department of Agriculture Press Release. 2001. "Preliminary samples indicate herbicide in crop damage." June 20, 2001.
http://www.agri.state.id.us/press/2001_6-20a.htm

> **AND**

Idaho Department of Agriculture Press Release. 2002. "Idaho State Department of Agriculture completes Oust investigation. April 29, 2002.
http://www.agri.state.id.us.press/2003_1-18.htm

> These two press releases refer to an incident in which BLM's use of Oust, a sulfonyurea-based pesticide caused damage to crops up to a quarter mile away from the application site. Such damage to plant reproduction, even significant distance its point of application is one of Oust's known side effects, and is a prime reason for BLM to prohibit the use of sulfonylurea pesticides on its lands. (Action- RESTORATION 16)
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> This incident is a concrete reminder that **unintended, unexpected, non-target effects do occur**, and that their effects can be serious. It's important to remember that if the impacted plants had not been crops – if they had been just native plants on BLM land - it seems quite likely that the reproductive damage would have gone unnoticed, and in any case, the response against the BLM would not have taken place. But of course Oust and other pesticides do have such non-target impacts and it is essential that the BLM make a realistic accounting of them when deciding whether and how to use pesticides.

WATERSHEDS

Riparian/Aquatic Habitat: Effects of Livestock Grazing

Kauffman, J.B., R.L. Beschta, N. Otting, D. Lytjen. 1997. An ecological perspective of riparian and stream restoration in the western United States. Fisheries 22(5): 12-24.

> The four authors have between them seen and studied an enormous number of riparian areas in Oregon, California, Washington, and other western states. This article summarizes their knowledge and conclusions regarding how (and how not) to restore riparian areas.
>
> They emphasize that in essentially all cases, "**the first and most critical step in ecological restoration is passive restoration, the cessation of those anthropogenic activities that are causing degradation or preventing recovery.** Given the capacity of riparian ecosystems to naturally recover, often this is all that is needed to achieve successful restoration" **(p. 12).**
>
> Unfortunately, <u>many</u> riparian restoration projects don't follow this formula, and instead undertake active restoration projects (e.g., instream structures, channel reconfiguration, and planting programs) without halting degrading land uses, such as domestic livestock grazing in riparian zones.
>
> The authors' discussion of active and passive restoration is very important in the context of the development of the current BLM vegetation management EIS. They understand and thoroughly explain how, in many cases, **the simple cessation of a damaging activity** (grazing) is the most effective restoration tool available. Cessation of grazing <u>is</u> passive in the sense that it doesn't involve the kind of active movement of rocks or streambed or plant plugs that other strategies might use. But it does result in often dramatic recovery of riparian areas **(see examples on pp. 15, 18, and 19)**. The decision to stop grazing in riparian areas is thus a vegetation management decision - and one with more effective consequences (in terms of vegetation change) than any other management option available. Likewise, the decision to leave cattle in a riparian area (with predictable effects on vegetation) is also a vegetation management decision, whether or not managers consider it to be so. The BLM must confront this reality in its evaluation of different alternatives in the current NEPA process.
>
> Kauffman and Beschta and their co-authors recommend:
>
> "Reviews of instream habitat management projects throughout the western United States clearly indicate that passive restoration has been the critical first step in successful riparian restoration programs (references). In many cases, this was all that was needed to initiate restoration of riparian ecosystems. Because of the high costs and potential failure with active restoration and manipulation, we recommended that project managers monitor and observe the natural recover process for an appropriate period of time (e.g., 10 years) after implementing passive restoration. Then, if managers ascertain that natural

recovery is limited or not occurring, implementation of active restoration projects might begin" **(p. 19).**

Regarding the use of cattle as a possible restoration tool in riparian areas:

"While some have suggested that livestock can be used as a 'tool' in riparian enhancement, there is no ecological basis to indicate that livestock grazing, under any management strategy, can accelerate riparian recovery more rapidly than total exclusion" (p. 20).

WILDLIFE

Wildlife: Grassland, Sagebrush, and Pinyon-Juniper Habitat

Connelly, J.W., M.A. Schroeder, A.R. Sands, C.E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28(4): 967-985.

Reliance of Sage Grouse on Intact Sagebrush Habitat

Sage grouse (*Centrocercus urophasianus*) populations have been in decline since as early as the 1930s causing concern amongst sportsmen and biologists. In 1999 in Washington State it was petitioned that western sage grouse be listed under the Endangered Species Act. Sage grouse rely on intact sagebrush (*Artemisia* spp.) habitat for all aspects of their life cycle including winter habitat, nest success, breeding, and brood-rearing. "Grouse nesting under sagebrush experience greater nest success (53%) than those nesting under other plant species (22%)." Sage grouse tend to nest under sagebrush 29-80 cm and under those sagebrush having larger canopies. As the quantity and quality of sagebrush have declined in the past 50 years, so have populations of sage grouse.

Population Biology of Sage Grouse

Sage grouse have variable migratory habits including:

1) non-migratory, (>10 km one way) between seasonal ranges
2) one-stage migratory, (movement between two seasonal ranges)
3) two-stage migratory, (movement amongst three seasonal ranges)

"Clutch size of sage grouse is extremely variable and relatively low compared to other species of gamebirds." Thus, the high level of variability and migratory patterns, nesting habits and clutch size requires that sage grouse habitat must be managed with special care in order to ensure their livelihood.

The Influence of Land Use on Sage Grouse Populations

Grazing: Although there have been few direct studies on the influence of grazing on sage grouse populations, grass height and cover have been found to influence sage grouse nest site selection and success.

Development: “Construction of roads, powerlines, fences, reservoirs, ranches, farms, and housing developments have resulted in sage grouse habitat loss and fragmentation.”

Sage Grouse Habitat Management

The following four guidelines are proposed for sage grouse habitat management:

1) Monitor sage grouse habitat and adjust management according to range condition. “Do not base land treatments according to schedules, targets or quotas.”
2) Remove encroaching junipers and other conifers using techniques that cause minimum disruption to standing sagebrush.
3) To decrease the possibility of sage grouse flying into fences, make fences visible when they are located within 1 km of seasonal ranges.
4) Minimize the building of tall structures such as powerlines as they provide perch sites for raptors that prey on the sage grouse.

Sage Grouse Habitat Protection

Careful management strategies can be used to minimize sage grouse habitat loss including but not limited to the following:

1) Sage grouse habitat should have 15-25% canopy cover of sagebrush, >15% canopy cover for grasses and ≥10% cover for forbs. Additionally, such habitat should have a high priority for wildfire suppression and not be considered for sagebrush control programs.
2) Where there has been large-scale habitat loss, initiate restoration efforts.
3) When there is drought reduce stocking rates and always manage grazing to account for possible drought conditions.
4) Suppress wildfires in all breeding habitats and avoid sagebrush removal.
5) In summer brood-rearing habitat, avoid using practices that will “reduce soil moisture, increase erosion, cause invasion of exotic plants, and reduce abundance and diversity of forbs.”
6) Avoid the use of toxic organophosphorus and carbamate insecticides in sage grouse brooding areas.

Knick, S.T. and J.T. Rotenberry. 1995. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. Conservation Biology 9(5): 1059-1071.

Some bird species are totally dependent for successful reproduction on shrub-steppe vegetation. This paper details the habitat dependence of three of those species – sage sparrow, Brewer’s sparrow, and sage thrasher – as well as two grassland bird species that are not dependent on shrub-steppe vegetation. The methodology used, which combines recent and historic bird counts, vegetation sampling, and satellite photographs, to produce habitat selection models based on logistic regression, is impressive and so are the results.

The results show that all three “shrub-steppe” birds are strongly dependent on local shrub cover, with close to 100% occupancy of areas of full shrub cover, and near complete absence from areas without shrubs. Also, **two of three species (the sage sparrow and the sage thrasher) were also sensitive to landscape level habitat fragmentation**, meaning that even given complete local shrub cover, they were more likely to be found in large, continuous shrub patches than in smaller fragmented patches (*see* Figures 3 and 5, Table 3, and Discussion).

This information is important (and ominous) because the degradation and fragmentation of shrubsteppe habitats is continuing on a large scale in the western United States, in part due to human activities (land uses). Conversion of shrubsteppe to annual grassland is largely irreversible, and this article makes clear that as the shrubsteppe goes, so go its obligate bird inhabitants.

MONITORING

Ambos, N., G. Robertson, J. Douglas. 2000. Dutchwoman Butte: a relict grassland in central Arizona. Rangelands 22(2): 3-8.

Dutchwoman Butte is an isolated 100-acre Arizona butte which, due to its isolated location and steep topography, has never been grazed. It is thus a natural control or exclosure, providing information about pristine, ungrazed grasslands (and about the effects of grazing) that would otherwise simply have been lost.

The vegetation and forage production of the Butte are remarkable. “The most striking aspect of Dutchwoman Butte is the diversity, density, and vigor of the grasses” **(p. 5).** “The canopy coverage of grasses ranges from approximately 35% to 40% [compared to 15.8% on a nearby, similar but grazed allotment] and the vigor is high with most of the grama grasses reaching knee high and some of the species such as cane beardgrass and green sprangletop reaching waist high.” **(p. 5-6)** The dominant grass species on Dutchwoman Butte occur at only trace amounts on the grazed allotment **(p. 7),** while curly mesquite (the dominant on many grazed sites, comprising more than 90% of grass cover) accounts for only 5% of grass cover on the Butte. The authors also found that the diverse grass community on the Butte also showed “extreme patchiness of species composition” with many species seeming to occur in localized swards.

Other differences of the Butte from similar but grazed landscapes include the scarcity of snakeweed on it, it’s four-fold (!) greater production of forage, soils that are much less dense and which top out in terms of carbon content **(see Figures on page 7)**.

Relictual landscapes such as Dutchwoman Butte are exceedingly rare, and deserve complete protection for the valuable opportunity they afford to establish baseline conditions for vegetation, soil, and watersheds.

They also point to the absolute necessity (if we are to understand healthy grassland functioning) of establishing reference exclosures across the BLM land. Dutchwoman Butte offers the type of information that would be provided by large exclosures had they been established several hundred years ago. However, even more recent exclosures do provide us insight to what vegetation be without grazing. For instance, in this study an exclosure on a grazed plot (established in 1934) had soil structure and density, and root development that were much closer to those found on Dutchwoman Butte than on the immediately adjacent grazed lands. Thus, the conditions in the exclosure were in several quantifiable respects fairly representative of what would be found in an undamaged landscape: they had recovered to their relatively pristine state.