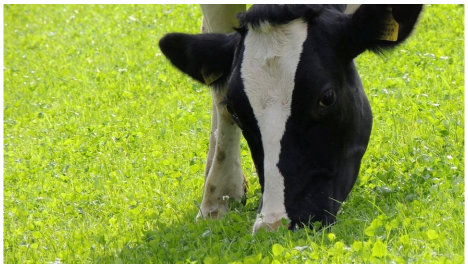
Environmental Activists



Download PowerPoint Presentation: Environmentalist Rhetoric: Fighting "science" with science

All of the publications listed below have been used in environmental activists literature (letters, reports, etc.) to demonize grazing. I assume the reason is to reduce or eliminate grazing on public land. Each publication is followed by a short summary that highlights if and how grazing is used in the publication. Publications can be found by topic or by searching for the author using the "FIND" command under the Edit command in your web browser.

Publication Topics

- Biological Crusts
- Grazing – General
- Grazing Systems
- Grazing and Cheatgrass
- Sagebrush Ecosystems
- Sage-grouse
- Stocking Rate, Utilization, Grazing Capacity
- Upland Water Development
- Riparian Grazing
- Livestock Pollution of Streams

Biological Crusts

Deines, L., R. Rosentreter, D.J. Eldridge, and M.D. Serpe. 2007. Germination and seeding establishment of two annual grasses on lichen-dominated biological soil crusts. Plant and Soil 295(1-2): 23-35. NO GRAZING IN STUDY

Background: Biological soil crusts dominated by lichens are common in shrub-steppe ecosystems in northwestern US.

Objective: To investigated effects of crusts on seed germination and initial seedling establishment of two annual grasses: cheatgrass and small fescue (native).

Methods: We determined germination time courses on bare soil and two types of biological soil crusts; one was predominantly lichen crust and the other an assortment of lichens and mosses (mixed crust). Experiments were preformed in growth chambers.

Results:

1. Germination on the lichen crust for both grasses was about a third of that on bare soil.
2. Mean germination time (MGT) was 3–4 days longer on the lichen crust compared to bare soil.
3. No difference in % germination or MGT between the mixed crust and bare soil for both grasses.
4. For both grasses, root penetration of germinating seeds on the lichen crust was lower than on the bare soil or mixed crust surfaces.
5. The effects of the lichen crust on germination and root penetration reduced in seedling establishment 78% for small fescue and 85% for cheatgrass relative to the bare soil.

Conclusion: Lichen-dominated biological soil crust can inhibit germination and root penetration, but the extent of these effects depends on the composition of the crust.

No grazing in study, but one mention in the paper's Introduction:*"Cheatgrass tolerates disturbances, including livestock grazing and fire, better than many native plants, and competes successfully for resources with other vascular plants (Harris 1977; Melgoza et al. 1990). Cheatgrass is a prolific seeder, can germinate in most seasons, and the seed bank can remain viable for 5 years (Rice and Dyer 2001). Cheatgrass, however, may be less effective at invading areas with an intact biological soil crust (Kaltenecker et al. 1999)."*

Ponzetti, J. M., B. McCune, and D. A. Pyke. 2007. Biotic soil crusts in relation to topography, cheatgrass and fire in the Columbia Basin, Washington. The Bryologist 110(4):706-72. NO GRAZING IN STUDY

Objective: We studied lichen and bryophyte soil crust communities in a grazing allotment in sagebrush steppe where biotic soil crusts were largely intact. The allotment was rested from grazing for 12 years, but experienced an extensive series of wildfires.

Methods: The 350 plots, (4 x 0.5 m), were stratified by topography.

Results:

1. We found 60 species or species groups, averaging 11.5 species groups per plot.
2. Lichen and bryophyte soil crust communities differed with topographic positions.
3. Draws were most disturbed, apparently from water erosion and mass wasting from the steepened sides.
4. Draws had the lowest average species richness of all areas examined.
5. Biotic crust species richness and cover were inversely related to cheatgrass cover, but positively related to cover of native bunchgrasses.

Conclusion: We observed good recovery of crusts following fire, but only in those areas dominated by perennial bunchgrasses. The resilience of the biotic crust is this study was likely due to the low abundance of cheatgrass, low amounts of soil disturbance and high moss cover. These fires have not resulted in an explosion of the cheatgrass population, perhaps because of **the historically low levels of livestock grazing.**

Serpe, M.D., J.M. Orm, T. Barkes, and R. Rosentreter. 2006. Germination and seed water status of four grasses on moss-dominated biological soil crusts from arid lands. Plant Ecol. 185:163-178.NO GRAZING IN STUDY

Objective 1: To investigate the effects of biological crusts on the germination of four grasses: Idaho Fescue, sheep fescue, Snake River wheatgrass and cheatgrass (growth chamber experiments).

Methods: We recorded germination time courses on bare soil and two types of biological soil crusts for each grass. Crusts were either dominated by tall moss or short moss.

Results:

1. Percent germination on short-moss crust was about 50% lower than on bare soil
2. Germination time was 4 days longer on short-mosses than on bare soil.
3. Tall-moss crust did not reduce the final germination percentage but increased germination time.
4. Similar results were observed in all four grasses studied.

Objective 2: To investigate how moss crusts affect germination, we analyzed the water status of seeds on bare soil and moss crusts.

Results:

1. Six days after seeding, the water content of seeds on bare soil was about twice that of seeds on tall- or short-moss crust.
2. Changes in seed weight and water potential in seeds revealed that seeds on tall mosses reached higher water content than those on short mosses.
3. The increase in the water content of seeds on tall mosses occurred as the seeds gradually fell through the moss canopy.

Conclusion: Our results indicate that biological soil crusts with distinct structural characteristics can have different effects on seed germination and that biological soil crust dominated by short mosses have a negative effect on seed water status and reduced seed germination.

Shinneman, D. J., W. L. Baker, P. Lyon. 2008. Ecological restoration needs derived from reference conditions for a semi-arid landscape in Western Colorado, USA. J. Arid Environ. 72(3): 207-227.

Introduction: Semi-arid ecosystems cover tens of millions of hectares in the Intermountain West of the United States, and most have altered plant communities due to land use, especially livestock grazing. Thus, relatively unaltered ‘‘reference’’ plant community information is needed to guide restoration.

Methods: Plant communities were sampled over a large (600,000 ha) semiarid landscape in western Colorado, within pinion–juniper woodlands, sagebrush shrublands, and grasslands, and over conditions ranging from relict areas without livestock grazing to heavily utilized areas.

Results:

1. With few exceptions, grass and forb cover, biological soil crust cover, and species diversity declined with increasingly degraded conditions.
2. Non-native species cover varied with ecological condition.
3. Landscape-level species abundance also differed with ecological condition.
4. Herbaceous species generally exhibiting less constancy and cover within degraded areas compared to reference areas (no grazing in the reference area).

Conclusions: These semi-arid ecosystems will require both active (e.g., reseeding) and passive (grazing management) restoration approaches, at local- and landscape-levels, respectively, if the goal is to restore native plant composition and abundance.

Grazing General

Anderson, J.E. and R.S. Inouye. 2001. Landscape-scale changes in plant species abundance and biodiversity of a sagebrush steppe over 45 years. Ecol. Monographs 71(4): 531- 556. Grazing exclosure study, confounded with precipitation

Objectives:

1. To assess long-term changes in abundance and distribution of major species and life forms
2. To assess changes in species richness and plot similarity
3. To test if plant cover and stability of cover are positively associated with species richness
4. To test if invasibility is inversely related to native plant cover and richness.

Methods: Plant cover, density, and frequency were sampled on 79 permanent plots 9 times in 45 years.

Results:

1. Cover of shrubs plus perennial grasses was 18% in 1950, the vegetation was heavily dominated by sagebrush. Perennial grass cover was only 0.5%.
2. Elevated precipitation after 1957, increased shrub cover 25% by 1965.
3. By 1975 cover of perennial grasses had increased 13-fold.
4. Richness of shrubs, perennial grasses, and forbs per plot steadily increased from 1950 to 1995.
5. Vegetative heterogeneity also increased, similarity among plots declined from 72% to 40%.

Conclusion: Adequate cover of native species can render these semiarid communities more resistant to invasion. Maintaining richness and cover of native species should be a high management priority for these ecosystems.

This was not a study about grazing degradation but about changes in landscape over 45 years. From the paper: *"We conclude that the increases in plant-species diversity and heterogeneity from 1950 to 1995 are largely the result of a recovery of vegetation from drought and grazing."* **Earlier in the paper:***"Composition and structure of the vegetation in 1950 were undoubtedly also influenced by the severe and prolonged drought conditions through the 1930s and 1940s, as documented for other steppe ecosystems in the region."*

Bock, Carl E., Jane H. Bock, and Hobart M. Smith. 1993. Proposal for a System of Federal Livestock Exclosures on Public Rangelands in the Western United States. Conservation Biology 7(3):731-733.

This paper is an opinion piece and not a research paper even though it's in a peer-reviewed journal.

Fleischner, T.L. 1994. Ecological Costs of Livestock Grazing in Western North America. Conservation Biology 8(3): 629-644.

Abstract: Livestock grazing is the most widespread land management practice in western North America. Seventy percent of the western United States is grazed, including wilderness areas, wildlife refuges, national forests, and even some national parks. The ecological costs of this nearly ubiquitous form of land use can be dramatic. Examples of such costs include loss of biodiversity; lowering of population densities for a wide variety of taxa; disruption of ecosystem functions, including nutrient cycling and succession; change in community organization; and change in the physical characteristics of both terrestrial and aquatic habitats. Because livestock congregate in riparian ecosystems, which are among the biologically richest habitats in arid and semiarid regions, the ecological costs of grazing are magnified in these sites. Range science has traditionally been laden with economic assumptions favoring resource use. Conservation biologists are encouraged to contribute to the ongoing social and scientific dialogue on grazing issues.

Several scientists have taken issue with Fleischner's review.

Holechek, J.L., H. de Souza Gomes, F. Molinar, and D. Galt. 1998. Grazing intensity: Critique and approach. Rangelands 20(5):15-18.REVIEW

Summary: Many ranchers and range managers object to grazing intensity guidelines on public lands because if rigidly or improperly applied they can cause undue hardship or make grazing economically impractical. We agree that rigid, inflexible standards aimed at forcing conservative use on all parts of the range would put ranchers in an impossible situation. Under the best grazing management almost any piece of rangeland will have small areas that are heavily grazed in certain years. There must be a reasonable balance between what is practical for the rancher and what is needed to sustain and improve rangeland health.

Holechek, J. L., H. Gomez, F. Molinar, and D. Galt. 1999. Grazing studies: what we've learned. Rangelands 21(2):12-16. REVIEW

Summary: The USDA-NRCS continues to recommend 50% use of forage resources. However research convincingly shows 40-45% use is moderate on most rangelands and 30-35% use is needed for improvement in rangeland vegetation.

Holechek, J. L., R. D. Pieper, C. H. Herbel. 2010. Range Management: Principles and Practices. 6th ed. Prentice-Hall. Upper Saddle River, NJ.TEXTBOOK

There's nothing wrong with textbooks as references, but I doubt that the information published in Holechek is original research.

Mack, R. N. and J. N. Thompson. 1982. Evolution in steppe with few, large hooved mammals. Amer. Natur. 119(6): 757-773. REVIEW

Summary: East of the Rockies grasses are C_3 or C_4 often rhizomatous grasses. These grasses evolved with with large groups of bison. The bunchgrasses in the Great Basin evolved with low numbers of large herbivores due to seasonal moisture. In addition, lack of C_4 grasses in the Great Basin is likely due to low moisture levels when temperatures are warm. West of the Rockies bunchgrasses and cryptogrammic crusts were destroyed by domestic livestock and soon replaced by winter annuals.

Manier, D. J., and N. T. Hobbs. 2006. Large herbivores influence the composition and diversity of shrub-steppe communities in the Rocky Mountain, USA. Oecologia 146:641–651.

Introduction: It's widely believed that wild and domestic herbivores have changed the structure and composition of arid and semi-arid plant communities in the West. These ideas have rarely been tested in long-term, well-replicated studies.

Objective: We examined the effects of removing large herbivores from semi-arid shrub lands for 40-50 years using 17 fenced exclosures in western Colorado.

Results:

1. Shrub cover was greater inside the exclosure than outside.
2. Cover and frequency of forbs was less inside the exclosures (protected) relative to grazed plots.
3. Protection from grazing did not affect cover or frequency of grasses, biotic crusts, or bare soil.
4. Plant species richness and diversity were similar between treatments.
5. Protected areas were dominated by fewer species, primarily sagebrush.
6. Removing herbivores changed the relationship between plant species richness and evenness.
7. Species evenness was positively correlated with richness in protected plots ($r^2 = 0.54$).
8. However, evenness and richness were inversely related in grazed plots (r^2 adjacent = 0.72, r^2 distant = 0.84).

Conclusions: Grazing promoted relationships between plant species that might otherwise compete for resources without grazing. No grazing caused small changes in cover and diversity of herbaceous plants and increased shrub cover. The exclusion of grazing changed the relationship between plant species evenness and richness.

Mueggler, W. F. 1975. Rate and pattern of vigor recovery in Idaho fescue and Bluebunch wheatgrass. J. Range Manage. 28(3): 198-204. NO GRAZING IN STUDY

Objective: The rate and pattern recovery of protected individual Idaho fescue and bluebunch wheatgrass were studied for 5 years after heavy and extreme clipping.

Methods: FESCUE: Heavy clipping removed 75% of the plant at the flowering stage (July 13). Extreme clipping removed 100% (to a 1-cm stubble) at flowering, then clipped 75% of the regrowth as plants neared seed-ripe stage.WHEATGRASS: Heavy clipping removed 50% of the total herbage weight just before full emergence of the flower stalks (June 25). Extreme clipping entailed the heavy clipping treatment plus clipping regrowth to a uniform 8-cm stubble height when unclipped plants were at the dough stage of development (July 17).

1. Bluebunch wheatgrass was not only more sensitive to clipping, but recovered vigor more slowly than Idaho fescue.
2. Idaho fescue of moderately low vigor required approximately 3 years and bluebunch wheatgrass a projected 6 years to approach normal vigor.
3. Recovery from very low vigor may take more than 6 years of protection for Idaho fescue and 8 years for bluebunch wheatgrass.
4. Maximum leaf length can be used as a reliable index of Idaho fescue vigor.
5. Flower stalk numbers combined with maximum lengths indicate vigor in bluebunch wheatgrass.

This is a clipping, not a grazing study. Grazing is discussed in this paper in the context of developing livestock grazing systems as you can see by the way Mueggler lays out the study in the Introduction of the paper. **From Mueggler (1975):***"Range scientists and managers are faced with the complex problem of devising grazing systems that (1) permit maximum returns from the forage resource, (2) perpetuate the forage potential, and (3) remain compatible with other resource values (e.g., water, wildlife, and recreation) inherent in a given unit of rangeland."* AND *"Grazing and clipping studies over the past 40 years have contributed substantially to our understanding of the adverse plant response to grazing. Such information is, of course, essential for development of effective grazing systems."* **AND***"The results are relevant to development of grazing systems based upon physiological requirements of important range plants."*

Vallentine, J. F. 1990. Grazing Management. Academic Press. San Diego, CA. TEXTBOOK

There's nothing wrong with textbooks as references, but I prefer to read the original publication.

Grazing Systems

Briske, D. D., J. D. Derner, J. R. Brown, S. D. Fuhlendorf, W. R. Teague, K. M. Havstad, R. L. Gillen, A. J. Ash, W. D. Willms. 2008. Rotational grazing on rangelands: reconciliation of perception and experimental evidence. Range. Ecol. and Manage. 61(1): 3-17.REVIEW

Briske's paper reviews rotational grazing literature in a less then favorable view, but I believe this was a major point in the paper.

From Briske's paper: *"Grazing research has not adequately assessed the effects of grazing at large scales, which often results in patch- and area-specific grazing. Smaller pastures usually result in more uniform grazing, which may not adequately describe how livestock graze large landscapes. In large pastures (1500–2000 ha), Teague and others showed rest associated with rotational grazing improves plant species composition of frequently grazed patches compared to continuously grazed pasture with similar stocking rates. Applying research results from small-scale experiments to large ranch enterprises may not be appropriate because these ecological processes often do not scale up in a linear fashion. The effects of grazing systems at large scales need to be rigorously evaluated."* Citations in the passage were omitted for length.

Van Poollen, H. W. and J. R. Lacey. 1979. Herbage response to grazing systems and stocking intensities. J. Range Manage. 32(4): 250-253.REVIEW

Summary: This paper is a review of pertinent literature shows that grazing systems and grazing intensities both influence herbage production on western ranges. Mean annual herbage production increased by 13% when grazing systems were implemented at a moderate stocking intensity. Increases were larger (35% and 27%) when continuous livestock use was reduced from heavy (60-80%) to moderate (40-60%), and moderate to light (20-40%), respectively. This suggests that adjustments in livestock numbers have a greater effect on herbage production than do grazing systems.

Comment: The passage doesn't say grazing systems have no effect on herbage production. This is not an either or proposition. Obviously, reducing animal numbers in a continuous system will increase plant production. But introducing a grazing system also increased forage production 13% on moderately (40-60%) stocked rangeland.

Grazing and Cheatgrass Invasion

Chambers, J. C., B. A. Roundy, R. R. Blank, S. E. Meyer, A. Whittaker. 2007. What makes Great Basin sagebrush ecosystems invadible by Bromus tectorum? Ecol. Monographs 77(1): 117–145.NO GRAZING IN STUDY

Objective: We conducted a study in sagebrush ecosystems at two Great Basin locations examining differences in resource availability and invasibility of cheatgrass over elevation gradients and in response to direct and interacting effects of removal of perennial herbaceous vegetation and fire.

Methods: We monitored environmental conditions, soil variables, and cheatgrass establishment and reproduction for two years.

Results:

1. Soil water and nitrate availability decreased with decreasing elevation.
2. Lower-elevation sites had greater annual variability in soil water availability than upper-elevation sites.
3. Soil nitrate levels were highest at all elevations when soils were wettest.
4. Nitrate availability was not more variable at lower elevations.
5. Removal of herbaceous perennials increased soil water and nitrate availability, but burning without removal had only minor effects.
6. Cheatgrass had low establishment, biomass, and seed production on high-elevation sites and on a mid-elevation site during a cold, short, growing season probably due to ecophysiological limitations resulting from cold temperatures.
7. Establishment, biomass, and seed production were variable at low elevations and best explained by soil characteristics and spatial and temporal variation in soil water.
8. Removal and fire had minor effects on emergence and survival, but biomass and seed production increased two to three times following removal, two to six times after burning, and 10–30 times following removal and burning.

Conclusion: Our data indicate that invasibility varies across elevation gradients and appears to be closely related to temperature at higher elevations and soil water availability at lower elevations. High variability in soil water and lower average perennial herbaceous cover may increase invasion potential at lower elevations. Soil water and nitrate availability increase following either fire or removal, but on intact sites native perennials typically increase following fire, limiting cheatgrass growth and reproduction. Following resource fluctuations, invasibility is lowest on sites with relatively high cover of perennial herbaceous species (i.e., sites in high ecological condition).

Definition of removal: Vegetation removal treatments were applied to the study plots in the spring of each treatment year (2001-02) during active vegetation growth (mid to late May). Removal of herbaceous vegetation was accomplished by spraying with glyphosate (Roundup). The 50% removal treatment involved hand spraying every other plant in the plot while carefully shrouding nontarget individuals. The 100% removal treatment was accomplished by spraying all herbaceous vegetation in the plot. Cheatgrass that emerged in the 50% removal plots or that were not killed in the 100% removal plots were removed by hand to minimize the contribution of current year individuals to the seed bank.

Definition of burned: The burn treatment was performed in 2001-02 in early to mid October for Nevada and early November for Utah. Treatments involved placing burn barrels 11.2 ft in diameter around each plot, adding 9.9 lbs of clean and weed-free dry straw for consistent fuel loading, and lighting the plots with drip torches. All vegetation plus the straw was consumed in the burns.

Pg 21 *"Our soil water data indicate that regardless of the presence of big sagebrush, disturbances like overgrazing that remove all or part of the perennial herbaceous grasses and forbs result in decreased water uptake and significantly higher soil water availability within the upper soil profile. In contrast, disturbances like fire that only remove shrubs have marginally significant and short term effects on soil water within the upper soil profile if perennial herbaceous species are fire-tolerant and are a substantial component of the system."*

Pg 25 *"Fire and overgrazing by livestock are clearly associated with the progressive invasion of cheatgrass into the semiarid shrublands of the Great Basin (Knapp 1996)."* **AND** *"Our species removals may not mimic the effects of overgrazing, especially in terms of soil nutrient dynamics, and additional research is needed to examine the effects of a one-time vs. chronic disturbance."*

Pg 26 *"The susceptibility of crested wheatgrass sites to invasion by cheatgrass following overgrazing by livestock or other disturbances is likely to be just as high as for sagebrush sites in similar ecological settings.*"

Note: Overgrazing mentioned in the paper 7 times; grazing 3 times

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Hempy-Mayer, K. and D.A. Pyke. 2008. Defoliation effects on Bromus tectorum seed production: implications for grazing. Rangeland Ecol. Manage. 61(1):116-123.THIS WAS A CLIPPING STUDY AND NOT GRAZING IN STUDY

Objective: A clipping experiment carried out at two cheatgrass-dominated sites evaluated grazing as a potential control method for cheatgrass and seedbed preparation for native plant reseeding projects.

Methods: Treatments involved clipping plants at two heights (tall = 7.6 cm, and short = 2.5 cm), two phenological stages (boot and purple), and two frequencies for plants in boot and once for purple-stage. We estimated end-of-season seed density (seeds/m^2) by sampling viable seeds from plants, litter, and soil of each treatment.

Results:

1. Unclipped control plants produced 13,000 and 20,000 seeds/m^2
2. Plants clipped short at the boot stage and again 2 weeks later produced the fewest seeds and were the most successful treatment.
3. Seed densities were 123–324 seeds/m^2 at site one, and 769–2,256 seeds/m^2 at site two.
4. Literature suggests a maximum acceptable cheatgrass seed density of approximately 330 seeds/m^2 for successful native plant restoration through reseeding.

Conclusion: This study helped pinpoint optimal clipping treatments for cheatgrass control, but it questions the potential for livestock grazing to be an effective seed-bed preparation technique in native plant reseeding projects in cheatgrass-dominated areas.

Mack, R. N. 1981. Invasion of Bromus tectorum L. into western North America: an ecological chronicle. Agro-Ecosystems 7: 145-165.REVIEW

This paper is the history of cheatgrass invasion in the West. Cheatgrass was likely introduced in wheat plantings, in alfalfa fields, in straw used to pack dry goods, in cattle bedding and in the dung of transported cattle. It was first documented in North America in 1889 at Spence’s Bridge, British Columbia. Cheatgrass grass was collected in Washington north of Ritzville along the Great Northern Railroad route in 1893 and at Provo, Utah in 1894. All three were wheat- growing districts. Cheatgrass was purposely planted in near Pullman, WA in 1897 as new a grass for the overgrazed ("exhausted") range.” More was likely planted in 1915 as 100-day grass. Overgrazing and abandoned grain fields led to the breakdown of soil crusts and therefore invasion of annual grasses.

Cheatgrass grass was collected in Washington north of Ritzville along the Great Northern Railroad route in 1893 and at Provo, Utah in 1894.

By the early 1890's the rangelands in the Pacific Northwest had been badly overgrazed, an effort was mounted to find more resistant species or varieties (Lamson-Scribner, 1899). Cheatgrass was deliberately introduced at least once during this turn of the century search or new grasses for the overgrazed ("exhausted") range.

Stocking Rate, Utilization, Grazing Capacity

Galt, D., F. Molinar, J. Navarro, J. Joseph, J. Holechek. 2000. Grazing capacity and stocking rate. Rangelands 22(6): 7-11. NOT ORIGINAL RESEARCH

I've read this paper several time and I'm still not really sure I understand it.

We believe that in the 21st century, various range management decisions on public and private rangelands will depend heavily on grazing capacity surveys. Over the past 10 years several similar scientifically based procedures for determining stocking rates and grazing capacity have been developed. They are becoming somewhat standardized on animal intake rates, forage production determination, key area selection, and adjustments for slope and distance from water.

Many range professionals now advocate a 25% harvest coefficient when grazing capacity and stocking rates are assigned. We believe this idea has considerable merit for arid and semi-arid areas from vegetation, livestock production, and multiple-use stand points.

Grazing capacity surveys provide a basis for ranch value, annual adjustments in stocking rates, grazing fees on public lands, and may soon be used in administration of subsidies that promote conservative stocking. They can also play an important role in allocation of forage to livestock and wildlife.

Note: *“While a sound grazing capacity survey can help establish the number of livestock a ranch will support through time, it must always be recognized that grazing capacity may have little relevance to livestock numbers sustainable in a given year or group of years. Although a good grazing capacity survey can be helpful in many range management decisions, it should not become a replacement for information on range trend, grazing use, and range condition.”*

Definition of grazing capacity from paper: *"Grazing capacity is considered to be the average number of animals that a particular range or ranch will sustain over time. It is based on stocking rate. Stocking rate is defined by the Society for Range Management as the amount of land allocated to each animal unit for the grazable period of the year. Determination of stocking rate and grazing capacity involve the same procedures, except that grazing capacity estimates require adjustment of forage production to the hypothetical average year."*

Sagebrush Ecosystems

France, K. A., D. C. Ganskopp, C. S. Boyd. 2008. Interspace/undercanopy foraging patterns of beef cattle in sagebrush habitats. Rangeland Ecol. Manage. 61(4): 389-393. GRAZING

Objectives:

1. To investigate grazing patterns of cattle with respect to undercanopy (shrub) and interspace tussocks
2. To determine the influence of cattle grazing on screening cover
3. To relate shrub morphology to undercanopy grazing

Results:

1. Cattle initially graze grass tussocks between shrubs, and begin foraging on tussocks beneath shrubs as interspace plants are depleted.
2. Grazing under-canopy grass tussocks was negligible at light-to-moderate utilization levels (< 40% by weight).
3. Grass tussocks under spreading, umbrella-shaped shrub canopies were less likely to be grazed than those beneath erect, narrow canopies.
4. Horizontal screening cover decreased with pasture utilization.
5. Removal of 75% of the herbaceous standing crop induced about a 5% decrease in screening cover in all strata from ground level to 1 m with no differences among strata.
6. This implied that shrubs constituted the majority of screening vegetation.
7. Our data suggest that conservative forage use, approaching 40% by weight, will affect a majority (about 70%) of interspace tussocks and a lesser proportion (about 15%) of potential nest-screening tussocks beneath sagebrush.
8. Probability of grazing of tussocks beneath shrub is also affected by shrub morphology.

Reisner, M. D. 2010. Drivers of plant community dynamics in sagebrush steppe ecosystems: cattle grazing, heat and water stress. PhD Dissertation, Oregon State Univ. Corvallis, OR. GRAZING

The study took place at the landscape level across 75 sites capturing a range of soil and landscape properties and cattle grazing levels similar to those found across the Great Basin.

Results:

1. Cumulative cattle grazing stress levels were a major component of both the overlapping heat and water stress gradients driving sagebrush interactions with herbaceous species.
2. Sagebrush facilitated herbaceous species when the highest stress levels were most frequent and strongest. Competition was most frequent and strongest at the lowest stress levels.
3. Squirreltail and Sandberg bluegrass had the highest competitive abilities. They also showed the strongest facilitation at the upper limits of their stress tolerances.
4. Sagebrush interactions with cheatgrass were strikingly different than those with native bunchgrasses.
5. Sagebrush interactions with native bunchgrasses shifted from competition to facilitation with increasing heat, water, and grazing stress, but its interactions remained competitive with cheatgrass regardless of stress.
6. Shifts in the interactions between sagebrush and native bunchgrasses were occurred regardless community stability.
7. This study documents the first evidence of native species facilitation decreasing community invasibility.
8. Sagebrush facilitation increased native bunchgrass composition, which reduced cheatgrass invasion under shrubs compared to the interspaces. This decreased invasibility did not translate into lower invasibility at the community level because of the limited spatial scale over which facilitation occurs.
9. Sagebrush facilitation increased community stability at intermediate stress levels but decreased it at high stress levels. Facilitation became a destabilizing force when native bunchgrass species became strongly dependent on sagebrush

facilitation for their continued persistence in the community.

10. Ecosystem invasibility was dependent on the size of and connectivity between basal gaps in perennial vegetation, driven by changes in the structure and spatial aggregation of the native bunchgrass community.
11. Landscape orientation and soil physical properties determined risk to invasion.
12. Resident bunchgrass and biological soil crust communities provided resistance to invasion by reducing the size of and connectivity between basal gaps and thereby limiting available resources for cheatgrass establishment.
13. High levels of cattle grazing reduced ecosystem resilience by reducing native bunchgrass and biological soil crust abundance and altering bunchgrass community composition and facilitated cheatgrass invasion.

Jones, A. 2000. Effects of cattle grazing on North American arid ecosystems: a quantitative review. W. North American Nature. 60(2): 155-164.REVIEW

Objective: A quantitative review was conducted of the effects of cattle grazing in arid systems on 16 response variables ranging from soil bulk density to total vegetative cover to rodent species diversity. Various studies from North American arid environments that used similar measures for assessing grazing effects on the same response variables were used for the review.

Methods: We searched for cattle grazing studies for the years 1945–1996. Only studies that compared grazed areas with nearby ungrazed areas, were conducted in arid environments of the western U.S., and with site descriptions that included xeric vegetation were included in the analyses. It was necessary to lump studies that used different grazing systems. 54 were selected for the analyses.

Response variables were analyzed separately. They were: 1) rodent species diversity; 2) rodent species richness; 3) vegetation diversity; 4) total vegetation cover; 5) shrub cover; 6) grass cover; 7) forb cover; 8) total vegetation biomass; 9) tree seedling survival; 10) non-tree seedling survival; 11) cryptogamic crust cover; 12) litter cover; 13) litter biomass; 14) soil bulk density; 15) infiltration rate and 16) soil erosion.

"The analyses did not take into account certain details of individual studies, such as stocking rates and intensity and timing of grazing, that could affect measured impacts."

AND *"Each study was assigned to serve as a single data point in paired comparisons of grazed versus ungrazed sites. All analyses tested the 1-tailed null hypothesis that grazing has no effect on the measured variable."*

Results: Eleven of 16 analyses (69%) revealed detrimental effects of cattle grazing, suggesting that cattle can have a negative impact on North American xeric ecosystems. Grazing negatively impacted soil-related variables (3 of 4 categories tested), followed by litter cover and biomass (2 of 2 categories tested), and rodent diversity and richness (2 of 2 categories tested). Vegetative variables showed more variability in terms of quantifiable grazing effects, with 4 of 8 categories testing significantly.

Conclusion: Overall, these findings may shed light the variables that may be effectively used by land managers to measure ecosystem integrity and rangeland health in grazed systems.

"Nearly 54 studies analyzed were found to be quasi-experiments (no randomization, but other experimental qualifications are met) rather than strict experiments in which experimental units are randomly assigned to control and treatment. Because of this, I do not infer causation between results presented in this review and western rangelands in general. I view these results as a basis for understanding which features of North American arid environments are most likely to suffer general impacts of grazing rather than as evidence relevant to the issue of the sustainability (or lack of it) of livestock grazing on western rangelands."

Sage Grouse

Aldridge, C. L. and M. S. Boyce. 2007. Linking occurrence and fitness to persistence: habitat based approach for endangered Greater Sage-grouse. Ecol. Appl. 17(2): 508-526.NO GRAZING IN STUDY

We identified critical nesting and brood-rearing habitat for the endangered Greater Sage-Grouse in Alberta at a landscape scale. Models showed that Sage-Grouse select for heterogeneous patches of moderate sagebrush cover and avoid anthropogenic edge habitat for nesting. Anthropogenic landscape features included distance measures for roads, trails, oil well sites, crop (cultivated lands), and urban (town, farmstead, energy infrastructure) areas, as well as a density measure for each variable. Nests were more successful in heterogeneous habitats, but nest success was independent of anthropogenic features. Broods selected heterogeneous high-productivity habitats with sagebrush while avoiding human developments, cultivated cropland, and high densities of oil wells.

“Removing some of these impoundments may allow water to recharge former mesic sites, rather than retain water behind a dam or within a dugout.” Pg. 523

Grazing was not examined in this study, but was mentioned **in the Introduction:** *“Range conditions should be assessed locally and grazing could be used to adaptively manage and enhance these habitats (Aldridge et al. 2004). For instance, removing cattle or reducing grazing intensity in some areas may result in increased shrub cover and/or plant species diversity (Manier and Hobbs 2006).”* **And in the discussion:** *“Recent droughts resulting in reduced cover could have made these habitats even more risky for Sage-Grouse chicks, particularly if livestock grazing intensities were not subsequently reduced.”*

Aldridge, C.L. and R.M. Brigham. 2003. Distribution, status and abundance of Greater Sagegrouse, Centrocercus urophasianus, in Canada. Canadian Field-Natur. 117: 25-34. REVIEW

This paper reviewed the historic and present distribution of greater sage-grouse in Canada. Sage-grouse have been eliminated from approximately 90% of its estimated historic distribution. Number of yearling males recruiting to leks each spring has been low, suggesting that production and overwinter survival of young are a major problem as is low chick survival rate, with only 18% surviving to 50 days of age. These declines could be related to one or any combination of habitat changes, livestock grazing pressure, oil and gas developments, or climate change, all of which could lead to increased predation rates and decreased survival. Not a scientific experiment, the paper reviewed sage-grouse population numbers and speculated about the cause of the decline.

Grazing passage: *“Overgrazing has long been suggested as one of the main reasons for declining sage-grouse numbers (Dalke et al. 1963; Braun et al. 1977; Connelly and Braun 1997; Beck and Mitchell 2000). The removal of vegetation cover by cattle can have an impact on sage-grouse populations, either by reducing habitat suitability (Beck and Mitchell 2000) or by increasing the exposure of birds and nests to predators or extreme weather, all of which decrease survival and nest success (Watters et al. 2002). Important mesic sites in southern Alberta that provide lush forbs and insects as food resources for chicks are a limiting factor (Aldridge and Brigham 2002). Livestock grazing in these areas could therefore negatively impact chick survival and should be managed to optimize growth of forbs and grasses so as to increase chick survival (Beck and Mitchell 2000; Aldridge and Brigham 2002). Heavy grazing pressure during drought conditions could intensify these effects. Windberg (1975)(unpublished report) suggested that the declines indicated by lek counts in Alberta since 1968 correspond to an increase in intensity of livestock grazing in the southeastern part of the province. Grazing may simply decrease the carrying capacity of sage-grouse habitat (Windberg 1976)(unpublished report), especially in years with below average annual precipitation.”*

Aldridge, C. L., S. E. Nielsen, H. L. Beyer, M. S. Boyce, J. W. Connelly, S. T. Knick, M. A. Schroeder. 2008. Range-wide patterns of Greater Sage-grouse persistence. Diversity and Distrib. 14(6): 983–994. NOT A GRAZING STUDY

Spatial patterns in greater sage-grouse range contraction can be explained by losses due to cultivation, climatic trends, human population growth and historical locations of sage-grouse populations. Future sage-grouse range loss may relate to recent changes in land use and habitat condition, including energy developments and invasions by non-native species such as cheatgrass and West Nile virus. Our results suggest that initial conservation efforts should focus on maintaining large expanses of sagebrush habitat, enhancing quality of existing habitats, and increasing habitat connectivity.

Grazing mentioned in Introduction: *“We did not find any relationship with livestock density in 2002. However, livestock numbers do not necessarily correlate with range condition, given that intensity, duration, and distribution ultimately affect rangeland health (Holechek et al., 2001). Further examination of historical and current effects of livestock grazing on sage-grouse persistence is needed (Connelly et al., 2000; Crawford et al., 2004).” And Discussion: “Not only will habitat quality decline with warmer and drier conditions, but climate change (drier conditions) also has the potential to influence impacts caused by livestock grazing (Connelly et al., 2000), invasions of non-native species and change fire frequency (Connelly et al., 2000, 2004). While seasonal precipitation patterns cannot be changed, livestock grazing practices could be altered in dry years to reduce the removal of herbaceous vegetation.*

Barnett, J. F. and J. A. Crawford. 1994. Pre-laying nutrition of sage-grouse hens in Oregon. J. Range Manage. 47: 114-118.NO GRAZING IN STUDY

Objective: Plant species and nutritional composition of sage-grousehen diets were determined during the pre-laying period in SE Oregon in 1990 and 1991.

Methods: We collected 42 female sage-grouse during a 5-wk period before incubation (4 March-8 April).

Results:

1. Hens ate 21 foods.
2. Sagebrush was eaten most often but forbs were18 to 50% of the diet by weight.
3. Desert-parsley, hawksbeard, long-leaf phlox, everlasting, mountain-dandelion, clover, Pursh's milk-vetch, buckwheat, and obscure milk vetch made up 11% of the diet.
4. Forbs were selected over sagebrush in both low and big sagebrush cover types.
5. All forbs were higher incrude protein and phosphorus and many were higher in calcium than sagebrush.
6. Forbs increased nutrient content of the diet.
7. Fewer forbs were present in the diet in 1991 than in 1990, which coincided with reduced sage-grouse productivity.

Conclusion: Forbs consumption during the pre-laying period may affect reproductive success.

Passages in the paper about grazing were in Methods: *"During the past 10 years, stocking rates of livestock ranged from 0.13 to 0.18 AUMs/ ha, and grazing occurred from April through December: rates were adjusted annually according to range conditions and forage availability. The study area was grazed in 1990, but not 1991."* **AND Discussion:***"Historic overgrazing and fire suppression in many portions of the western range of sage-grouse have resulted in increased sagebrush cover and decreased herbaceous understory. Because of the apparent importance of forbs to pre-laying female sage-grouse, management activities should allow for restoration of an array of early-season forbs within sagebrush stands."*

Beck, J. L. and D. L. Mitchell. 2000. Influences of livestock grazing on sage-grouse habitat. Wildlife Society Bulletin 28(4): 993-1002.

This paper reviews the impacts of grazing on sagebrush steppe ecosystems; sage-grouse habitat was emphasized. Authors examined how direct and indirect of livestock grazing potentially alters sage-grouse habitat.

Conflicting findings were reported in the paper. For example, sagebrush density increased, while the production of forbs and grasses decreased with sheep grazing. In another study, increases in sagebrush were not associated with grazing. In addition, the removal of grazing was not linked to an increase in the herbaceous productivity of one site, but the removal of grazing in a similar study resulted in the increase of basal cover of perennial grasses. The importance of grazing history, season of usage, and community composition when analyzing the effects of grazing upon an ecosystem was discussed. I (Beth Burritt) have problems with this review. To read more click here

From the paper: *". . .livestock grazing should be managed to allow optimum growth of forbs, grasses, and sagebrush. Management for a variety of sagebrush covers should exist with important use areas reflecting the general preference of sage-grouse for sagebrush cover of 5-10% in summer or 20-35% in winter (Eng 1986). Grazing system, season of use, grazing duration, kind of livestock, and stocking intensity should be adjusted to maximize desired vegetal effects for sage-grouse on ranges on a case-by-case basis"*

Coates, P. S. 2007. Greater Sage-grouse (Centrocercus urophasianus) nest predation and incubation behavior. Ph.D. Dissertation. Idaho State Univ. Pocatello, ID.NO GRAZING IN STUDY

Objectives and Methods: I used continuous videography at sage-grouse nests to document fine-scale incubation rhythms, identify predators, and record predation behavior in NE Nevada. An information-theoretic modeling approach was used to relate factors that characterized habitat, timing of incubation, and predators to nest success and incubation rhythms. Raven numbers were reduced to measure the effects of raven reduction on sage-grouse nest success.

Results:

1. Females exhibited relatively high incubation constancy (96%) and tended to leave nests to forage during morning and evening twilight.
2. Yearlings left nests for longer, more often, and at times of greater daylight than adults.
3. Compared to adults, yearlings had greater trade-offs between foraging and hiding eggs.

4. Yearling sage-grouse nests failed more than nests of adults.
5. Common ravens and American badgers were confirmed destroying nests. Raven depredations happened most often at night.
6. Yearling sage-grouse nests failed more than those of adults.
7. Time gone from the nest, nest failure, and probability of raven-caused depredation were positively correlated with raven abundance.
8. Raven reduction increased sage-grouse nest success, but badgers appeared to partially compensate for removal od raven.
9. Nest herbaceous understory was positively related to incubation constancy because more understory around nests saved parental energy by reducing parent heat loss.
10. Differences in nest habitat characteristics existed between nests depredated by ravens and badgers, such as shrub canopy cover, herbaceous understory, and forb biomass.
11. Canopy cover was inversely related to raven depredation.

Conclusion: Thus, habitat characteristics appeared to interact with predator ratios and abundance increasing the probability of sage-grouse nest failure. Ravens forage within degraded sage-grouse nest habitat. Ravens appear to influence incubation behavior, depredation rates and in some areas may negatively influence sage-grouse productivity. In human-altered landscapes, these negative effects may be substantial.

Grazing mentioned in preface: *"Important habitat alteration factors include agricultural practices (Dalke et al. 1963, Wallestad and Pyrah 1974, Swenson et al. 1987), energy development (Aldridge 1998, Holloran 2005), roadway creation and associated development (Patterson 1952), fences (Braun 1998), livestock overgrazing (Beck and Mitchell 2000), wildfire (Nelle et al. 2000), and establishment of non-native vegetation (Knick et al. 2003). Other factors affecting grouse include infectious disease (Naugle et al. 2004) and climate (Back et al. 1987)."*

Coggins, K. A. 1998. Relationship between habitat changes and productivity of sage-grouse at Hart Mountain National Antelope Refuge, Oregon. M.S. Thesis. Oregon State University. Corvallis, OR.
GRAZING EXCLOSURE STUDY

Objective: Two sample periods (1989-1991 and 1995-1997) were compared to determine the collective effect of increased crop year precipitation and reduced livestock grazing on key habitat components in 4 cover types and on sage-grouse productivity measures.

Results:

1. Habitat sampling during 1995-97 indicated that spring and summer forb cover and residual grass cover increased in most cover types compared to 1989-91.
2. Nest success was greater in 1995-97 compared to 1989-91.
3. 1989-91: 65% hens initiated nests, 22% were successful, and 33% recruited chicks into the 1 August population.
4. 1995-97: 99% hens initiated nests, 37% were successful, and 39% recruited chicks into the 1 August population.

Conclusions: More forbs provided hens better nutrition and increased their ability to attempt nesting. Residual grass cover likely concealed nest better and increased nest success. Greater brood success and summer forb availability probably allowed hens to stay in upland brood-rearing habitats longer reducing movements by hens with broods and increase chick survival.

Connelly, J. W. and C. E. Braun. 1997. Long-term changes in sage-grouse Centrocercus urophasianus populations in western North America. Wildlife Biology 3:229-234.REVIEW

This paper focused on several factors contributing to a loss of sagebrush nesting habitat. There is a section on livestock grazing.

From the paper:*"There is little scientific data linking grazing practices to sage-grouse population levels."*

Connelly, J. W., C. E. Braun, M. A. Schroeder, C. A. Hagen. 2007. Setting the record straight: a response to "Sage-Grouse at the Crossroads." Rangelands 29(6): 35-39.

This paper is a rebuttal to a paper by Brunner in Rangelands: *"The Society for Range Management website characterizes the journal Rangelands as providing a forum for "scientifically correct" information. We argue that the paper by Brunner contains little scientific information but is replete with opinion and unsubstantiated statements. We see nothing wrong with individuals expressing opinions in natural resource journals, as long as those papers are identified as such. However,* *the article by Brunner was not identified as opinion. Thus there is a danger that information provided in this article could be viewed as "fact." The dissemination of scientifically correct data and identification of uncertainty associated with the conservation and management of sage-grouse is very important and could be facilitated by collaborative efforts sponsored jointly by range and wildlife professionals. These efforts should be built on a foundation of good science. We suggest that Rangelands demonstrate its commitment to good science by formally withdrawing the paper by Brunner."*

Connelly, J. W., M. A. Schroeder, A. R. Sands, C. E. Braun. 2000. Guidelines to manage sagegrouse populations and their habitats. Wildl. Society Bull. 28(4): 967-985. NO GRAZING IN STUDY

In Wyoming big sagebrush habitats, resting areas from livestock grazing may improve understory production as well as decrease sagebrush cover.

Suggested guidelines:

1. Manage breeding habitats to support 15-25% canopy cover of sagebrush, perennial herbaceous cover averaging # 18 cm in height with # 15% canopy cover for grasses and # 10% for forbs and a diversity of forbs during spring.
2. For non-migratory grouse using habitats that are distributed uniformly, protect (i.e. do not manipulate) sagebrush and herbaceous understory within 3.2 km of all occupied leks.
3. For non-migratory grouse occupying habitats that are not distributed uniformly protect suitable habitats # 5 km from all occupied leks.
4. For migratory populations, identify and protect breeding habitats within 18 km of leks.
5. In areas of large-scale habitat loss (# 40% of original breeding habitat), protect all remaining habitats from additional loss or degradation.

Grazing Passages:*"There is little direct experimental evidence linking grazing practices to sage-grouse population levels (Braun 1987, Connelly and Braun 1997). However, grass height and cover affect sage-grouse nest site selection and success (Wakkinen 1990, Gregg 1991, Gregg et al. 1994, Delong et al. 1995, Sveum et al. 1998a). Thus, indirect evidence suggests grazing by livestock or wild herbivores that significantly reduce the herbaceous understory in breeding habitat may have negative impacts on sage-grouse populations (Braun 1987, Dobkin 1995)."* **AND** "Activities responsible for the loss or degradation of sagebrush habitats also may be used to restore these habitats. These activities include prescribed fire, grazing, herbicides, and mechanical treatments." **AND***"Grazing pressure from domestic livestock and wild ungulates should be managed in a manner that at all times addresses the possibility of drought."***AND***"More information is needed on characteristics of healthy sagebrush ecosystems and the relationship of grazing to sage-grouse production."*

Holloran, M. J. and S. H. Anderson. 2005. Spatial distribution of Greater Sage-grouse nests in relatively contiguous sagebrush habitats. Condor 107(4): 742-752.NOT A GRAZING STUDY

Objective: We used radio-telemetry to locate sage-grouse nests in relatively contiguous sagebrush habitats in WY to investigate the spatial arrangement of nests relative to lek and other nest locations.

Results:

1. 64% of the nests were within 5 km of a lek
2. There was no relationship between lek size and lek-to-nest distance.
3. Closely spaced nests tended have lower success and a higher probabilities of both nests having the same fate compared to isolated nests.
4. Data suggested nesting site-area fidelity when the nest was successful.
5. The average nest were successful regardless of proximity to the lek up to 8.5 km. (the study did not extend further than 8.5 km)
6. Although a grouped pattern of nests occurred within 5 km of a lek, the proportion of nesting females located farther than 5 km could be important for population viability.

Conclusion: Managers should limit strategies that negatively influence nesting habitat regardless of lek locations, and preserve adequate amounts of unaltered nesting habitat within treatment boundaries to maintain nest dispersion and provide sites for related individuals.

Grazing was mentioned only twice in the paper:
Introduction:*"Shrubland and grassland bird species are declining faster than any other group of species in North America, primarily due to human caused destruction and degradation of their habitats (i.e., livestock grazing, land conversion, natural resource development, habitat treatment; Knick et al. 2003)."* **AND Methods:***"Although habitat manipulations (i.e., fire, herbicide application) and livestock grazing occurred in the study area."*

Knick, S. T., D. S. Dobkin, J. T. Rotenberry, M. A. Schroeder, W. M. Vander Haegen, C. van Riper. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. Condor 105(4): 611-634.REVIEW

Summary: Degradation, fragmentation, and loss of native sagebrush have imperiled these habitats. Even though more than 70% of all remaining sagebrush habitat in the United States is publicly owned, <3% of it is protected. We review the threats facing birds in sagebrush habitats. Management and conservation of birds in sagebrush habitats requires more research: (1) identification of primary land-use practices and their influence on birds and sagebrush habitats, (2) better understanding of bird responses to habitat components and disturbance of sagebrush ecosystems, (3) improved hierarchical designs for surveying and monitoring programs, and (4) linking bird movements and population changes during migration and winter to dynamics on breeding areas. This research is essential because sagebrush habitats can be altered by land use, spread of invasive plants, and disrupted disturbance regimes beyond a threshold at which natural recovery is unlikely.

Knick, S.T., A.L. Holmes, and R.F. Miller. 2005. The role of fire in structuring sagebrush habitats and bird communities. Studies in Avian Biology 30:1–13.REVIEW

In lower elevation sagebrush communities, fire has changed in from infrequent events that can maintain a landscape mosaic and plant community processes to frequent events that convert sagebrush communities to annual invasive grasslands.

In higher elevation sagebrush ecosystems, the lack of fire has increased dominance by sagebrush, reduced herbaceous plants in the understory, and expanded juniper-pinyon woodlands. As these woodlands increase, populations of birds decline.

Response of birds living in sagebrush habitats was related to the fire frequency, size, complexity (or patchiness), and severity. Small-scale fires causing patches of sagebrush did not influence bird populations. Large-scale fires resulted in large expanses of annual grasslands.

Our understanding of the effects of fire on sagebrush and birds in is limited. Almost all studies of fire effects on birds have been opportunistic, correlative, and lack controls. We should use the large number of prescribed burns to better understand cause-and-effect relationships. We need to use the opportunities provided by planned burns to understand the spatial and temporal influence of fire on sagebrush landscapes and birds.

Kuipers, J. L. 2004. Grazing system and linear corridor influences on greater sage-grouse (Centrocercus urophasianus) habitat selection and productivity. M.S. Thesis. University of Wyoming. Laramie, WY.GRAZING STUDY

Sage-grouse range-wide population declines have induced criticism of livestock management practices in sagebrush steppe.

Objective 1: To clarify the influences of livestock grazing management on sage-grouse nesting and early brood rearing (EBR) habitats, we radio-collared 101 sage-grouse females and tracked them to seasonal habitats.

Methods (Experiment 1):

Females were collared near 2 leks within close proximity of 4 livestock grazing systems near Lander, Wyoming, from 2000-2003. Systems included: 1) a high intensity spring rotational deferred (DR), 2) a summer grazed moderate to light intensity rest rotational (SR), 3) a spring and fall grazed moderate to light intensity rest rotational (SFR), and 4) an area rested from livestock grazing (NG). We measured vegetation at nest and early brood rearing sites (10-14 days post hatch) and random locations within systems. Vegetation was compared at successful versus unsuccessful nests, sage-grouse use habitats (nests and broods) versus all systems combined, and system versus system.

Results:

1. Nests had greater total shrub canopy cover, successful nests had greater residual grass heights, and early brood rearing sites had greater total shrub cover and food forbs.
2. Vegetation did influence selection and success, although the influence was weak.
3. SR and NG created better sage-grouse habitat during the study.
4. Improved habitat was attributed to reduced spring grazing and low forage utilization rather than grazing system.

Objective 2: Additionally, we examined the influences of maintained roads, 2-tracks roads, and trails on sage-grouse nest selection and success.

Methods: We used 253 radio-collared females from nests near Lander, Pinedale, and Kemmerer, WY.

Results: (This is correlation data. Remember correlation is not cause and effect)

1. Trails had negative influences on nest success at 27 yards, no influence at 54 yards and a positive influence at 108 yards.
2. Maintained roads and 2-tracks had positive influences on nest success at 108 yards.
3. Two-track roads at 27 yards and trails at 54 yards increased the likelihood of nest selection, while 2-tracks at 108 yards decreased selection.

Lupis, S. G., T. A. Messmer, T. Black. 2006. Gunnison sage-grouse use of Conservation Reserve Program fields in Utah and response to emergency grazing: a preliminary evaluation. Wildl. Society Bull. 34(4): 957-962. GRAZING STUDY BUT ON GUNNISON SAGE-GROUSE

Objective: Little information is available on the use of areas enrolled in the Conservation Reserve Program (CRP) by Gunnison sage-grouse or the impacts of grazing on their habitat selection and movement patterns.

Methods: Using radiotelemetry, we monitored 13 Gunnison sage-grouse in San Juan County, Utah, USA during 2001–2002 to determine their use of CRP. Additionally, in 2002 some of the CRP land used by the birds in 2001 was grazed under a drought emergency declaration. This afforded us an opportunity to monitor their response to livestock grazing.

Results:

1. Although Gunnison sage-grouse used CRP for nesting, brood-rearing, and summer habitat, CRP was not selected in greater proportion than its availability on the landscape.
2. Bird-use sites in the CRP did not entirely meet habitat guidelines recommended by the Gunnison Sage-Grouse Rangewide Steering Committee.
3. Most of the sage-grouse we monitored avoided CRP fields when livestock were present. The one exception to this was a hen with a brood.

Conclusion:*"We believe long-term maintenance of CRP in San Juan County will result in achieving habitat conditions that are more desirable for Gunnison sage-grouse. Future livestock management practices in areas used by Gunnison sage-grouse should incorporate short-term, high-intensity deferred-grazing rotations."*

Moynahan, B. J., M. S. Lindberg, J. J. Rotella, J. W. Thomas. 2007. Factors affecting nest survival of Greater Sage-grouse in northcentral Montana. J. Wildl. Manage. 71(6): 1773-1783. NO GRAZING IN STUDY

Objective: We studied greater sage-grouse in north central Montana, USA, to examine the relationship between nest success and habitat conditions, environmental variables, and female sage-grouse characteristics.

Methods: During 2001–2003, we radiomarked 243 female greater sage-grouse, monitored 287 nests, and measured 426 vegetation plots at 4 sites in a 3,200-km^2 landscape.

Results:

1. Nest survival varied with: 1) year, grass 2) canopy cover, 3) daily precipitation with a 1-day lag effect, and 4) nesting attempt.
2. In all years, daily survival rate increased on the day of a rain event and decreased the next day.
3. Success of early (first 28 d of nesting season) nests ranged from 23.8% in 2001 to 31.6% in 2003,
4. Survival of late (last 28 d of nesting season) nests ranged from 27.6% in 2001 to 41.8% in 2003.
5. Re-nests experienced higher survival than first nests.
6. Grass cover was the only important model term that could be managed, but direction and magnitude of the grass effect varied.
7. Site, shrub and forb canopy cover, and Robel pole reading were less useful predictors of nest success.
8. Above measurements varied little over time or in space during the study.
9. We note a marked differences between predicted values and interpretations of apparent nest success compared to maximum-likelihood estimates.
10. Annual apparent nest success (0.46) was, on average, 53% higher, than estimates that used individual, environmental, and habitat co-variates.
11. Differences between estimates was highly variable (range = +8% to +91%).
12. Management of habitats for nesting sage-grouse should focus on increasing grass cover to increase survival of first nests and contribute to favorable

conditions for re-nesting, which should be less likely if survival of first nests increases.

Conclusions:*"Condition of nesting habitats will likely vary with intensity of grazing, species of grazer (and relative preference for grass [i.e., cattle] or forbs [i.e., sheep]), species composition of the herbaceous community, and annual and seasonal precipitation. Selection of study sites with greater variation in sagebrush and grass cover and in grazing regimes may be better able to describe the effect of those factors on nest success at large scales."*

Pederson, E. K., J. W. Connelly, J. R. Hendrickson, W. E. Grant. 2003. Effect of sheep grazing and fire on sage-grouse populations in southeastern Idaho. Ecol. Model. 165(1): 23-47. NO GRAZING IN STUDY, MODELLING STUDY

Populations of sage-grouse in United States and Canada are declining range-wide. Livestock grazing is considered one of the causes of the decline. However, no data were available to support this statement. Therefore a model was used to simulate the effects of grazing and fire on temporal and spatial aspects of sagebrush community vegetation and sage-grouse population dynamics.

Stevens, B. S. 2011. Impacts of fences on greater sage-grouse in Idaho: collision, mitigation, and spatially ecology. MS Thesis, University of Idaho. NOT A GRAZING STUDY

Marking fences caused an 83% reduction in collisions with fencing in the greater sage-grouse. Collisions occurred most often during lekking season, they also increased the closer the fences were to the lek and with lek size (numbers of grouse).

Wolfe, D. H., M. A. Patten, E. Shochat, C. L. Pruett, S. K. Sherrod. 2007. Causes and patterns of mortality in lesser prairie-chickens Tympanuchus pallidicinctus and implications for management. Wildl. Biol. 13 (Suppl. 1): 95-104.

This research deals with the lesser prairie-chicken not the greater sage-grouse.

Wolfe, D. H. M. A. Patten, and S. K. Sherrod. 2009 Reducing grouse collision mortality by marking fences (Oklahoma). Ecological Restoration. 27:(2) 141-143.

This research deals with the lesser prairie-chicken not the greater sage-grouse.

Vavra, M. 2005. Livestock grazing and wildlife: developing compatibilities. Rangeland Ecol. Manage. 58(2): 128-134.REVIEW

Managed grazing has the potential to maintain habitat diversity and quality. Where a single-species management predominates (sage-grouse or elk winter range), grazing systems specific to the needs of a species can be implemented.

Managed livestock grazing can have 4 general impacts on vegetation: 1) alter plant community composition, 2) increase the productivity of selected species, 3) increase the nutritive quality of the forage, and 4) increase the diversity of the habitat by altering its structure. Implementing a grazing management plan to enhance wildlife habitat requires an interdisciplinary approach. Knowledge of plant community dynamics, habitat requirements of the wildlife species, and potential effects on the livestock used are basic to successful system design. However, any habitat change made for a single species may create adverse, neutral, or beneficial changes for other species. Management actions, other than development of a grazing system, are often required for habitat manipulations to be successful.

These are a few passages from Vavra's review:*"Grazing management to improve forage quality for sage-grouse appears possible. Forbs are important for sage-grouse (Peterson 1970). Grazing management that sets back succession should provide improved forage for sagegrouse if the grazing treatment is intermittent so forbs are either not eaten by livestock or allowed to regrow."* AND *"As succession progresses, perennial grasses increase with a decrease in forbs component. In northern Nevada, on meadows important to sage-grouse in summer, Evans (1986) demonstrated that timed cattle grazing provided regrowth of forbs that attracted sage-grouse. The availability of nutritious forb regrowth continued throughout the summer on the grazed sectors, whereas on the ungrazed meadows, forbs matured and sage-grouse foraged elsewhere."* AND *"Unfortunately, there is little supporting data on optimum habitat. In the case of sage-grouse, there is disagreement on the factors causing species decline or the potential remedial actions. The point is that the development of a grazing plan to benefit a species of interest may be more interpretation and art, and less the application of scarce science."*

Woodward, J. K. 2006. Greater sage-grouse (Centrocercus urophasianus) habitat in central Montana. MS Thesis. Montana State University. Bozeman, MT. NO GRAZING IN STUDY

Greater sage-grouse habitat was studied in central Montana primarily on Wyoming big sagebrush dominated rangeland.

Objective: To compare shrub and herbaceous parameters within (use, random or non-use) and between seasonal habitats (nest, brood, winter).

Results:

1. Nesting occurred in areas with greater total shrub cover and height, and taller live and residual grass than randomly available.
2. Hens nested under shrubs that were taller and more productive than random shrubs.
3. Brood and paired random sites were similar for all variables.
4. Shrub cover and density were greater in winter use sites than non-use sites although residual grass height and cover were similar.
5. Herbaceous vegetation was more important during nesting and brood rearing than in winter.
6. Sagebrush cover (5 to 36%) was the most consistent component of sage-grouse habitat.

Conclusion: The differences between cover for nesting, brood, and winter were small. Therefore, any manipulation attempting to improve one seasonal habitat would impact the other.

From the thesis:*"Loss, fragmentation, and degradation of sagebrush grassland habitats have been attributed to invasive plant species, fire, conversion to cropland, removal of sagebrush hypothesized to increase livestock grazing capacity, and to a lesser extent grazing, housing developments, mining and energy developments (Braun 1998, Knick 1999, Connelly et al. 2000, Wambolt et al. 2002)."*

With sustained grazing pressure the number of grazed plants increases, decreasing the average herbaceous plant height.

A discussion of cattle grazing and management was included in the management implications section.

Also from the thesis: "*Because the average grass and forb cover at my study site was similar to what was recommended by Connelly et al. (2000), and because there was high variation in grazing pressure, I assume that some portions of my study site would benefit much more from improved grazing management than others."* **AND** *"Adams et al. (2004) recommended grazing in light intensities to produce mosaics in vegetation and increase herbaceous production that is beneficial to nesting and brood rearing sage-grouse. They believe that patchy grazing increases the availability of forbs and stimulates their growth in uplands."*

Upland Water Development

Gillen, R.L., W. C. Kreuger, R.F. Miller. 1984. Cattle distribution on mountain rangeland in northeast Oregon. J. Range Manage. 37(6): 549-553. GRAZING STUDY

Methods: Cattle grazing distribution patterns were studied through observation and plant utilization during 3 summer grazing seasons under continuous and deferred-rotation grazing systems.

Results:

1. Small riparian meadows were most preferred. Meadows covered 3-5% of the total observation area, but 24-47% of all cattle were observed in those plant communities.
2. Logged forest communities ranked second in preference when available.
3. Relatively open-m *menziesii* plant communities were the most preferred forested habitats.
4. Deferred grazing equalized cattle use between logged areas and *P. ponderosa-P. menziesii* forests and increased cattle use of riparian meadows.
5. Cattle least preferred heavily forested sites.
6. Slope gradient was the only physical factor consistently associated with cattle grazing distribution.
7. Water distribution was not correlated with grazing patterns in upland plant communities.
8. Multiple regression models could not predict grazing distribution patterns with useful precision.

Pinchak, W.E., M.A. Smith, R.H. Hartand J.W. Waggoner, Jr. 1991. Beef cattle distribution patterns on foothill range. Journal of Range Management 44(3):267-275. GRAZING STUDY

Objective: To quantify use patterns of range sites by beef cattle on summer foothill range near Arlington, WY.

Methods: Grazing periods were: July 15 to August 9, 1980, June 15 to July 26, 1981, and 15 June 15 to August 2, 1982. Daily observations were made of radio-telemetry collared cattle (3 per pasture).

Results:

1. Cattle distribution was affected by location of water and slope steepness.
2. 77% of use was within 366 m of water.
3. Approximately 65% of the pasture was beyond 723 m from water and received 12% of use.
4. Cattle concentrated use (79%) on slopes less than 7%.
5. Consequently 35% of the area, on or surrounded by slopes >l0%, received only 7% of use.
6. Loamy, grazable woodland and wetland sub-irrigated range sites were most preferred.
7. They accounted for over 65% of observed use, but were less than 35% of the land area.
8. Course upland and shallow loamy sites were not preferred
9. Site preference varied cattle as areas further from water were utilized.
10. Forage use was correlated (r = 0.41 to 0.69) with biomass and its crude protein content regardless of plant species.
11. As the forage became more similar, in terms of biomass and crude protein content, less variation in use was accounted for by the forage variables (0-37%).

These two studies found no relationship between upland water sites and location of forage use.

Riparian Grazing

Armour, C., D. Duff and W. Elmore. 1994. The effects of livestock grazing on western riparian and stream ecosystem. Fisheries 19(9): 9-13. Need to get paper.

This is a policy paper that is nearly 20 years old. I'm not sure how relevant it is.

Summary:

1. Domestic livestock grazing is permitted on approximately 307 million acres of federal land in the western states that is administered by the BLM and USFS.
2. Overgrazing of riparian and stream ecosystems by domestic livestock has damaged thousands of linear miles in the ecosystems.
3. The position of the American Fisheries Society is to advocate livestock management practices that result in recovery and protection of riparian and stream ecosystems.
4. This policy statement addresses problems caused by overgrazing, and action items that the Society advocates to be implemented to correct problems.
5. The Society does not advocate ceasing of domestic livestock grazing on public lands.
6. The policy states that grazing is acceptable providing that its management is compatible with the ecological requirements of healthy riparian and stream ecosystems.

Belsky, A.J., A. Matzke, S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the Western United States. Journal of Soil and Water Conservation 54:419-431.REVIEW

This paper reviews the major effects of livestock grazing on stream and riparian areas in the arid West. It focuses on results from peer-reviewed, experimental studies. It also summarizes comparative studies of grazed vs. protected areas.

Summary

1. Livestock grazing was found to negatively affect water quality and seasonal quantity, stream channel morphology, hydrology, riparian zone soils, instream and streambank vegetation, and aquatic and riparian wildlife.
2. No positive environmental impacts were found.
3. Livestock also caused negative impacts at both the landscape and regional levels.

Conclusion: Livestock grazing continues to be detrimental to stream and riparian ecosystems in the West.

From the paper: “Some people continue to support grazing. These advocates argue that most of the damage occurred 50-100 years ago; however, recent studies clearly document that livestock continue to degrade western streams and rivers, and that riparian recovery is contingent upon total rest from grazing.”

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An Ecosystem Perspective of Riparian Zones. BioScience 41(8): 540-551. No grazing

The paper doesn't mention grazing, livestock, nor damage from either.

Gary, H.L., Johnson, S.R., and Ponce, S.L. 1983. Cattle grazing impact on surface water quality in a Colorado front range stream. Journal of Soil and Water Conservation. 38(2): 124-126.

Results

1. Cattle grazing in pastures bisected by a small perennial stream had only minor effects on water quality.
2. Suspended solids and nitrate nitrogen did not increase with grazing.
3. Ammonia nitrogen increased only once during the study under moderate grazing.
4. Indicator bacteria densities in the stream water were higher when at least 150 cattle were grazing.
5. After removal of cattle or when 40 head of cattle were grazing, bacterial counts dropped to levels similar to those in an adjacent, ungrazed pasture.
6. About 5% of the total manure produced by cattle contributed to pollution and/or enrichment of the stream.

Kauffman, J.B. and W. C. Krueger. 1984. Livestock Impacts on Riparian Ecosystems and Streamside Management Implications... A Review. Journal of Range Management 37(5): 430-438.REVIEW

Platts, W.S. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19: 389-423.REVIEW

Historical management practices have allowed streamside environments to deteriorate.

Detrimental effects of grazing:

1. Affect the streamside environment by changing, reducing, or eliminating the vegetation bordering the stream.
2. Channel morphology can be changed by accrual of sediment, alteration of channel substrate, disruption of the relation of pools to riffles, and widening of the channel.
3. The water column can be affected by increasing water temperature, nutrients, and suspended sediment, and by changes in the timing and volume of streamflow.
4. Livestock can trample streambanks, causing banks to slough off, creating false or retreating banks, and accelerating bank erosion.
5. Documenting and evaluating effects of these alterations are difficult because natural events can produce similar alterations and effects.

Fishery biologists must determine:

1. how different grazing systems affects various aquatic components
2. how changes in these components affect fish health and survival

Whether a stream suffers from a catastrophic, debilitating event or from an accumulation of lesser events (such as those resulting from livestock grazing) over a longer period of time, the result for fishes can be the same, and recovery may take years.

Improved livestock management will result in:

1. more stable streambanks and stream channels
2. reduction of soil erosion
3. reduced stream sedimentation
4. improvement of streamside vegetative cover
5. improved water quality
6. increased riparian forage
7. increased fish production
8. increase the abundance and diversity of terrestrial wildlife.

Proper management of livestock will increase resource values and, in turn, economic benefits to all users. A short-term loss of forage for livestock may occur when overused and degraded riparian communities are put under proper management, but increased forage production should ultimately be a result of improved resource management.

Weitkamp, D.E. and Katz, Max. 1980. A Review of Dissolved Gas Supersaturation Literature. Transaction of the American Fisheries Society. pages 659-702.REVIEW

Need to get paper. Nothing in the abstract about in stream vegetation increasing oxygen levels in water to harm fish.

Abstract: Dissolved gas supersaturation is caused by natural and human processes. Supersaturation can result in gas bubble disease, which has been described in a wide variety of fishes and invertebrates. In recent years dissolved gas supersaturation resulting from dams and thermal discharges has killed fish in several cases. This review discusses most of the available literature dealing with dissolved gas supersaturation and the recorded cases of gas bubble disease.

Livestock Pollutants to Stream

Fegan, N. G. Higgs, P. Vanderlinde, and P. Desmarchelier. 2004. Enumeration of Escherichia coli O157 in cattle numbers using most probable number technique and automatic immunomagnetic separation. Letters in Applied microbiology 38(1):56-59.

This is a methods paper and not about stream pollution by cattle.

Pell, A.N. 1997. Manure and microbes: Public and animal health problems? Journal of Dairy Science 80:2673-2681.