Long-Term Trends With And Without Grazing In The Sagebrush Ecosystem In Wyoming

Terence P. Yorks, Herbert G. Fisser, W. A. Laycock, and Kathleen M. Capels
Department of Renewable Resources
University of Wyoming, Laramie

Figure 1. The "Farson" exclosure

Background

Vegetation provides habitat and forage to support rangeland livestock and wildlife production, while furnishing protective ground cover to conserve the soil itself. Plants are also critically important to tourism and recreation. Consequently, almost everyone in Wyoming has a vested interest in what is happening to our plant cover and in maintaining or improving its quality.

Few ecological issues bring out more serious discussion than the changes that have occurred or are occurring to our vegetation over time. Charges and countercharges fly from those who feel livestock are "hoofed locusts", which permanently impoverish range resources by their presence, all the way to those who advocate grazing as essential to ensure plant reproduction and growth. Most scientists and land managers need a point of reference to study whether changes in either direction are indeed occurring and to separate out what are the benign, destructive, or beneficial effects of grazing management techniques. For everyone, the question remains, how do we objectively discover what is really going on?

Exclosures

One of the most obvious ways to reveal the impact livestock or other grazing animals have on plants is to build a fence around a part of the area in question and then compare the vegetation in the grazed portions

with the ungrazed parts—over many years. As this monitoring continues, a result of no observable change or difference may be as important as finding a visible effect. It would be hard for anyone to argue that an area is being overgrazed (or undergrazed) if the plants do equally well on both sides of a fence that allows grazing by animals on just one side. This fenced portion of a rangeland that a particular kind of animal is kept from using is called an exclosure.

To be effective, an exclosure must be large enough so grazing animals cannot reach over its fence to its middle and a more or less complete vegetative community can maintain itself within it. It must be located in a representative part of a pastured area. This can vary, depending on whether one wishes to observe the effects of grazing near to or far away from water, or on a particular kind of soil or slope or exposure. Exclosures must be built with a type of fence appropriate for the kind of animal whose effects one wishes to study. It is also helpful to place them away from regularly used roads to reduce the likelihood of vandalism or other human-induced disturbances.

A critical aspect for Wyoming is that the study of exclosures cannot be made in a single year—or even completed within a five-year effort. Real changes, be they positive or negative, can take a great many years to develop (or become apparent) because of our dry and highly variable environment. For example, a level of grazing stress that plants can cope with in wet years may cause collapse with the same grazing pressure after drought. Alternatively, a recovery might be held back by a lack of grazing during wet years, when there is enough growth to perhaps benefit from partial removal by animals. If such cycles are occurring, they may sometimes need to come full circle several times before their effects are measurable. The ability to separate what turn out to be just localized, unimportant deviations from large general trends is one key to working with these exclosures.

The Exclosure Network In Wyoming

The University of Wyoming began intensive studies of the relationships among vegetation, animals, soils, and climate in 1959, using a set of exclosures in the Big Horn Basin, Wind River Basin, Little Colorado Desert, and Red Desert. These were constructed of barbed wire in winter sheep- or summer steer-grazing areas. Additional exclosures, some with woven-wire fenced sections high enough to exclude deer, antelope, and elk, were built through the 1960s. Most were placed in out-of-the way locations so they would not be inadvertently disturbed. Older exclosures do exist around the state, some dating from the 1930s, and these have been included in the study network.

The [currently missing] map shows the general location of many of the sites having exclosures greater than one acre (0.5 hectare) in size. Neither the building, maintenance, nor study of these exclosures would be possible without money and regular personal attention. The Bureau of Land Management has provided continuing annual support for the original construction and repeated surveys of these exclosures. The re-photographing of the exclosures was funded by the Wyoming Cooperative Extension Service with Renewable Resource Extension funds. Further contributions have come from a variety of other sources, including Mcintire-Stennis funds, the USDA Soil Conservation Service, and the Renewable Resources Department of the University of Wyoming.

Exclosure Study Methods

Photographs are basic tools for the scientific study of vegetation change over time. In the future, as the power of computers and software to analyze images increasingly improves, an archive of high-quality pictures creates the potential to more accurately look back at a site than might otherwise be possible from limited-funding field investigations. Even now, the ability to simply see whether there is a difference is of value to quantitative scientists and the public alike. Accordingly, some representative photographic evidence from Wyoming exclosure studies has been selected as the heart of this brochure.

To provide a substantial anchor for the photographs, additional data has been sampled over the years.

This includes:

- climate, which is tracked with maximum/minimum thermometers and rain gauges to isolate the extent of local variations;
- permanent plots, on which the ground cover of herbaceous vegetation and plant litter is measured using a "point frame";
- permanent quadrats, which use a grid with fixed stakes to follow how much area is covered by the leaf and branch canopies of shrubs;
- soil pits, which are dug to characterize the soil profile for the area, along with compaction tests to indicate any direct effects of trampling;
- erosion transects in selected exclosures, which are lines with carefully established heights to measure any changes in soil levels;
- phenology transects, which allow the biological stages of selected plants (including the timing of their initial growth in spring, their flowering, and seed set) to be followed through the year, among years, and among sites; and
- in some exclosures, permanent quadrats on which the production of herbaceous species is estimated.

All of the above techniques can measure both strips sprayed with herbicides to control shrub cover and adjacent unsprayed reference areas, so the selective response of the shrubs and grasses can be better known. Further, all these methods can be combined with different grazing systems by maintaining exclosures in the midst of varying livestock- or game-grazing regimes.

The Selected Images

Photographs of the exclosures have been made at intervals since their construction, including general perspectives, fenceline contrasts, and documentation of the various transects. Most of the results tend to be rather subtle and are not easy to see. From the thousands of images available, we have selected a few that seem to most clearly illustrate the range of results that the exclosures have revealed so far. The process began by traveling to many of the exclosures in 1986 with the older photographs in hand, looking for effects that were both most representative and most likely to be visible on the printed page. The new images were taken as closely as possible to the precise location of the previous photographs and at the same time during the year, so possible changes would not be confused either by the viewing perspective or stage of plant growth.

Among the characteristics that determined the choice of photographs for this review were the image quality of the older pictures (which were not always taken under optimal conditions), their ability to tell more than a very limited part of the story, and the constraints of reasonable-cost reproduction. From the winnowed set of original photographs, the timing, angles, filtration, and the rest of what goes into professional-level image-making were employed in creating a new set of photographs, which could bring to the reader what the objectively educated eye saw. Because the comparative final publication was quite significantly delayed, the initial follow-up images were repeated in 1996, after another ten years had passed.

What the reader should be looking for is the difference between the vegetation inside and outside the exclosures. This includes the balance among species, individual plant sizes, and the amount of bare ground. Then, for each set of photographs, what is the contrast over time—do differences become less or more apparent? Have the grasses or the shrubs relatively, or absolutely, increased? Have either or both decreased? Do the plants seem to be healthy? Do they appear stressed? Have they had sufficient resources available to set seed?

In making these comparisons, one should remember that the fences themselves tend to create several effects. Both humans and animals find fences interesting and selectively concentrate their activities nearby. For livestock, this can be especially true where another of the practical effects of fences occurs—collecting snow—which results in enhanced growth in our dry environment. Even when what is behind the exclosure

fence is not greener than the surrounding area, the possibility remains that it might lead the animals to have a look, and then to take an extra bite while stopped. Humans magnify the impacts of the animals' interest by driving up to (and even along) the fences in heavy pickup trucks, whose weight increases trampling effects a great many times more than walking would do. Thus, when examining fenceline photos, one needs to focus a bit away from the fence itself to make a more generally accurate comparison.

The frontispiece (Figure 1) is a 1986 view of a typical exclosure, built to observe the effects of livestock grazing on plant growth. A detailed study of this exclosure, made in 1993 and 1994 by Dr. Julia Johnson-Barnard, found that while shrub height was significantly greater inside the "Farson" exclosure (as it was at seven other sites in southeast Wyoming), there were no significant differences in shrub cover, herbaceous cover, or bare ground inside and outside the exclosure.

Figure 2 shows a high site southeast of Lander called "McGraw Flat". What should first strike the eye are the combined results of additional moisture left by snow deposited behind the heavy fence posts inside the exclosure and of livestock congregating along the fence just outside it. This is even more apparent in the "Farson" picture (Figure 1) but it occurs to some extent at "McGraw Flat". If one follows the fence around the exclosure in the "McGraw Flat" photo, however, one can see the approximate size of the exclosure and begin to observe what careful scientific study has discovered: that here at least, just as at the "Farson" site, there is no significant difference overall between the vegetation inside and outside the exclosure. The exception is where vehicle impacts occur outside, as in the extreme left foreground of the photos. The more explicitly scientific conclusion of similarity should become visibly more obvious in the 1996 repeat image,

Figure 2. The "McGraw Flat" exclosure

1986

1996

"Lower Government Draw", southeast of Lander, was sprayed with herbicides in 1959 to reduce shrub cover in an experimental strip pattern. The upper photograph in the Figure 3 set is an aerial view from 1978, with the sprayed strips still clearly visible after twenty years. The exclosure is roughly outlined by the red box just above center left. Other than the presence of the fence, it does not yet stand out from the rest of the area. Note how close the site is to the stock pond (about a spray-strip width to its upper right).

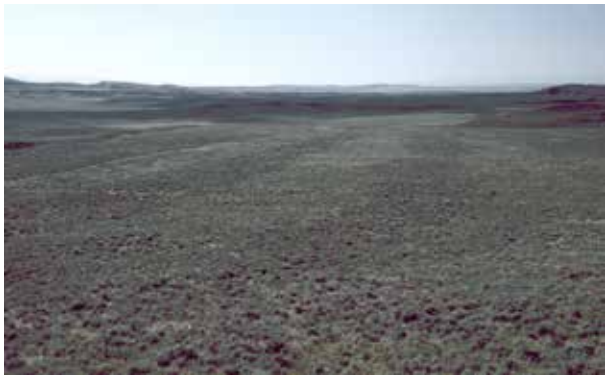
Figure 3. "Lower Government Draw" overview set

1978

By 1986, in the second photograph (taken from a ridge, resulting in a somewhat different viewing angle, so the strips run from the lower left towards the upper right), the exclosure is slightly more easily found by the difference between a portion of its vegetation and its surroundings (1/4 of the way below the top center).

1986

Outside and in some parts within the exclosure, the sprayed strips have been largely re-covered by sagebrush, although their yield of perennial grasses has remained higher than in the adjoining strips where no herbicide was applied.



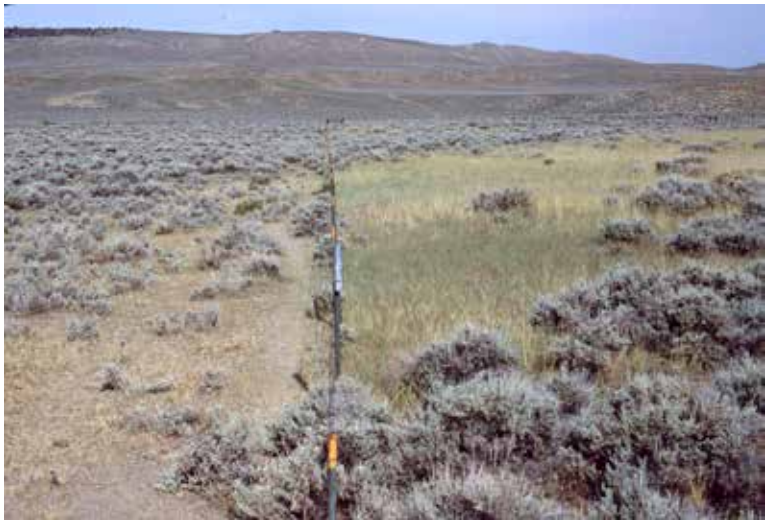
1996

In 1996, both the exclosure and the sprayed strips have become still less obviously different from their surroundings. Nevertheless, the "island" of open grass running across the edge of the exclosure has become even more visible in the upper left center of the image. The next set of photographs were taken across this grassy area.

Looking more closely at the southeast edge of the "Lower Government Draw" exclosure in the second set (Figure 4), the regrowth of sagebrush between the 1972 photo and the 1986 repeat image is most obvious outside the exclosure, to the left of the fence.

Figure 4. "Lower Government Draw" SE corner set

1972



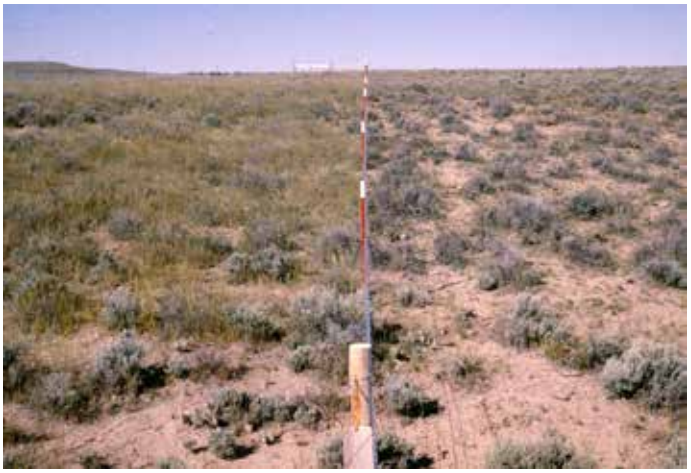
1986

1996

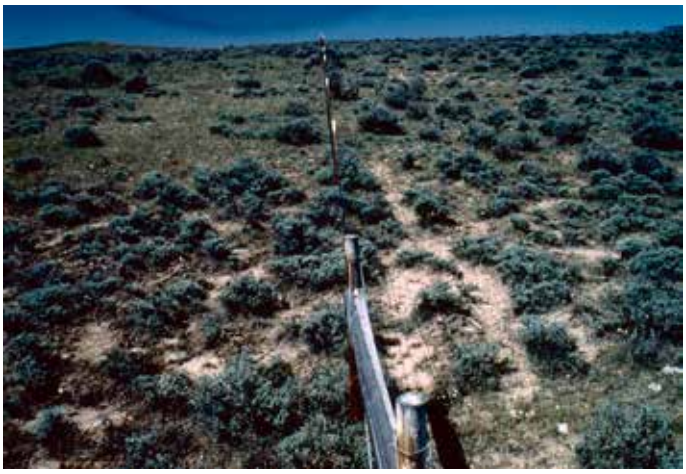
That it is occurring on both sides of the fence, however, becomes apparent in the 1996 photo. A nearly pure dominance by needle-and-thread and western wheatgrass has been retained only in the ungrazed area, on the right side of the fence. The edges of the strip that was sprayed with herbicide for shrub control were still visible within the protected exclosure after almost 30 years, but they have increasingly blurred after 40 years. Being near open water, the area outside this exclosure receives particularly heavy cattle use. Despite the visible grazing removal of grass stems and the recovery of sagebrush on the outside of the exclosure, the measured perennial grass yield does not differ significantly between the inside and the outside.

The upper (1962) photograph in Figure 5 is of another herbicide-sprayed strip at the "Bud Kimball" exclosure east of Worland. The outside of the exclosure is very obviously visible to the right. A reduction in the standing crop of grasses was attributed to stocking rates that were too high, because the managers had not taken drought years into proper account. By 1986, however, differences inside and outside the exclosure have become much less easily discernible, except for a relative absence of bluebunch wheatgrass on the outside. In 1996, the differences are smaller still and may even favor the outside for grasses. The density of perennial grasses has restricted sagebrush regrowth on both sides of the exclosure fence by out-competing young sagebrush for the limited water resource. This photograph set provides additional evidence that with proper care in livestock use rates and their timing, grazing may not be harmful to the vegetation.

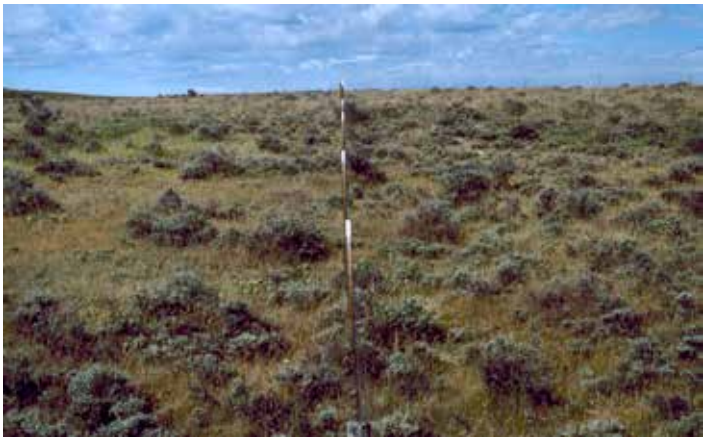
Figure 5. "Bud Kimball" exclosure set



1962



1986



1996

"Demer", east of Worland, is the hottest and driest site in this survey. Extreme spring overgrazing by sheep occurred outside the exclosure before the 1972 photograph in Figure 6. That resulted in virtually all of the native vegetation being replaced by cheatgrass and other annuals. A small quantity of the invader plants were present inside the exclosure. By 1986, a large increase in the size of the sagebrush has occurred inside the exclosure, as opposed to an almost complete lack of change on the outside, in the cheatgrass stand. Total grass yield in the protected area was twice what occurred outside of it. There has been a very slow return of bluebunch wheatgrass on the inside, which has continued into 1996.

Figure 6. "Demer" exclosure set

1972

1986

1996

One of the most striking of all the exclosure sites is "Owl Draw", southeast of Casper (Figures 7, 8, and 9). Here, in addition to the barbed wire cattle or sheep exclosure, an adjoining section was built with twelve-foot-high woven wire to keep out all game animals. The general area is predominantly sagebrush steppe, but it also has some pinyon-juniper nearby. With steeper terrain than the other sites in this brochure, "Owl Draw" might be expected to have more kinds of game animals present. Similar to what has been shown for several other sites, the difference between the outside of both the livestock and game exclosures in Figure 7 and the inside of the barbed wire livestock exclosure in Figure 8 has consistently been not very great.

Figure 7. "Owl Draw" outside both the livestock and the game exclosures

1967

1986

1996

Figure 8. "Owl Draw" inside the livestock exclosure

1967

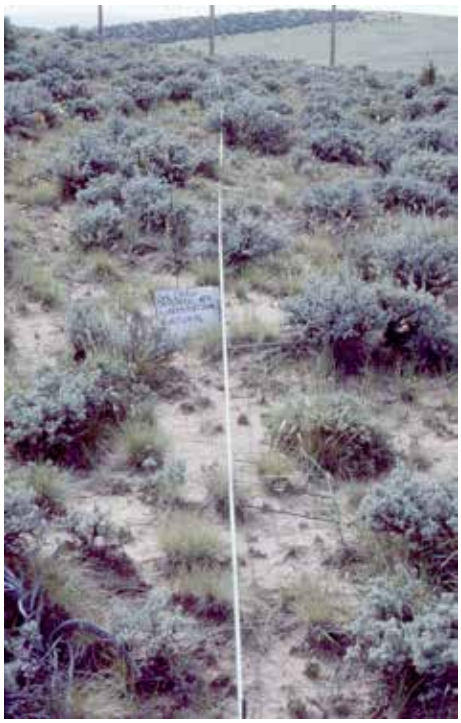
1986

1996

In 1986, the appearance of bare ground where game as well as domestic animals have been kept out from the "Owl Draw" exclosures was extremely striking (Figure 9, overleaf). Taller grass seedheads in 1996 obscure this difference somewhat, but a close-up (1996a) has been added to illustrate that while some recovery may have occurred, the ground-level cover remains relatively limited. Complete protection from larger-animal grazing does not appear to be an answer to vegetation management at this site.

Figure 9. “Owl Draw” inside the game exclosure


1971


1986


1996


1996a

Although we have more to learn about just why game animals may be so important here, the likeliest explanation is that America’s native vegetation evolved with a variety of grazing animals. Removing that mixture of grazers and their balanced vegetation use leads to what has appropriately been called ‘stagnation’. Some of this same phenomenon may be the reason for what can be seen in the “Farson” photograph (Figure 1). It may appear to go against common logic that plants can do better when grazed than they do when left alone, but many plants seem to need to have some foliage removed to reach their best potential, just as roses do in our gardens. While too much grazing is undoubtedly destructive, not enough may be so, too.

In Sum

These pictures tell just a little bit of the story that exclosures are revealing in Wyoming and on rangelands throughout the country. We hope you will be looking at those isolated bits of fencing with a more interested eye when you see them in the future. These are an invaluable resource, and they need your support for their continued existence and study.

Acknowledgments

Special thanks are due to Dr. F. E. Busby and Dr. J. E. Dodd for their believing in the original idea and seeing that it was begun, to Dr. Edward DePuit for thoroughly reviewing the text interpretations early on, and to the many individuals in the Bureau of Land Management for helping us to once again find the exclosures after Dr. Fisser's untimely death (and the consequent loss of his internal practical guidance system to find these anything-but-main-road sites).

All of the oldest photographs were taken by either by Dr. Herbert G. Fisser or one of his students. The 1986 shots were made by Dr. Terence Yorks, with the assistance of Dr. Fisser and Kathleen Capels. The 1996 set was taken by Dr. Yorks, with the assistance of Dr. Capels. Dr. Yorks made the editorial selections and oversaw their computerization from the 35mm Kodachrome originals in the original 1986 draft, its revisions in 1996 through 1998, and in 2016. All photographic originals were made in late June or early July, for consistency in growth stages of the vegetation.

Notes regarding this prospective publication, August 2016

This document was originally intended to be a folio-sized Wyoming Agricultural Extension Service brochure. Full funding was never realized to transform its various drafts into final printed form.

At High Level Research in Smithfield, Utah, the current text version began with an Epson V750 Pro scan of a 4 August 1998 hard-copy text-only draft, which had passed a review by all three primary authors for anticipated final publication. This digitization was followed by the use of Adobe Acrobat Pro for text recognition. The appropriate original slides from earlier complete drafts were rescanned in 48 bit color and a resolution of 3200 dpi with the V750. These scans were cleaned up and more closely color balanced in Photoshop CS6, and the text was reset by TPY using InDesign CS6. Besides fixing obviously faulty translations by the text recognition program, small adjustments have been made to the text itself to reflect editorial clarity learned in the interim.