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MERLIN RANCH

2006 RANGE REPORT FOR UCROSS AND MERLIN RANCHES

Prepared for
Merlin Ranch, Ucross Division
Management Team

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INTRODUCTION

This document presents the results of three rangeland health monitoring transects from the Merlin and Ucross Ranches. The sites were read in mid-September 2006. The first in the Coal Creek Pasture was established in 2002. The second in the Stonehouse Pasture was established in 2003. Both of these lay on the Ucross Ranch. The third transect was read on the Merlin Ranch in the Hall Homestead Pasture and established in 2005.

Merlin and Ucross Ranches seek improved rangeland health and wildlife habitat. Ucross began its own monitoring program in 2000, with outsourcing of monitoring in 2002. Permanent rangeland health transects have been established in the following locations:

2002 – Ray's Ravine, Coal Creek Pasture;
2003 – Stonehouse Pasture;
2004 – Sahara Draw Pasture, North Childress Pasture;
2005 – Shady Lane Pasture, Hall Homestead, and the Hall Pasture.

Merlin and Ucross have begun a program of establishing new transect sites and re-reading those previously established sites. This provides management information from newly sampled pastures, plus data on shifting rangeland health indicators and data sets through time from older transects. For this document, data collected along with management recommendations from each site will be presented. These serve to help management analyze proper timing of grazings, stocking rates, stock densities, plant recovery periods between grazings, and nutrients supplied by forage to livestock.

Next, since each of these sites had been sampled previously, data comparisons will be displayed comparing 2006 figures with those from the transect establishment year. Commentary and management recommendations are included.

The next section of this report briefly summarizes findings and management recommendations from each study site. It then reviews four fundamental ecosystem processes that serve as the basis of the rangeland assessment. These are the water cycle, mineral cycle, energy flow, and succession.

The report presents 2006 findings from each transect, followed by data comparisons between years. Next, nutrient samples from clipped plants are analyzed. The report concludes by describing the methods used in data collection.

This report is presented to the management team at Merlin and Ucross Ranches to improve decision making and aid in the effort to improve rangeland health and wildlife habitat.

SUMMARY OF FINDINGS AND MANAGEMENT RECOMMENDATIONS PRESENTED IN THIS REPORT

Coal Creek Pasture

This site was located on a mild slope in an open basin in the Coal Creek Pasture. Western wheatgrass was the dominant plant species found in 2002, as well as 2006. Additional desired perennial grass plants and forbs are preferred on this site. Forbs may be lacking due to continued herbicide treatment of leafy spurge in the area. Should herbicide treatments continue, lack of forbs should be expected. Desired perennial grass plants may have been grazed in the early growing season. With the resulting dry summer of 2006, these plants could have gone dormant and were not seen by sample day of mid-September. Importantly, no signs of erosion were found on this mild slope. Site photos are presented here displaying the covered soil surface. Rangeland trend was stable. For the 2007 grazing season, management should consider grazing the plants earlier in the year to allow desired perennial bunchgrasses a change to grow in the early season. Watch grazing durations in the spring, for these plants suffering through the dryness of 2006 need a chance to replenish lost root reserves.

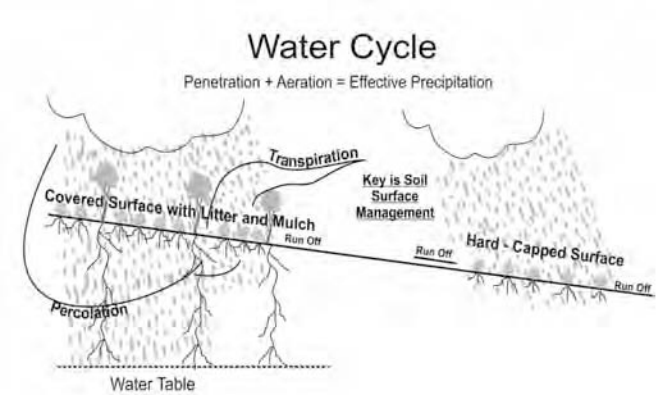
Stonehouse Pasture

This site had been grazed in early 2005 and not again until late 2006. This allowed plants nearly two uninterrupted growing seasons, and the ensuing plant growth was apparent. Plants appeared of a tall stature, even in the severely dry year of 2006. No signs of erosion were observed, even with an alarming increase in percent bare soil. Desired perennial bunchgrasses were found in 2003, but not in 2006. While range trend was stable and production was high, lack of desired species and the increase in bare soil requires continued monitoring. Management should use the strong plant vigor seen in this area as an example of the benefits extended plant recovery periods may provide elsewhere. Management should also apply animal impact to this pasture in 2007 that will knock the abundant 2006 growth to the soil surface as litter, where it will cover that bare ground.

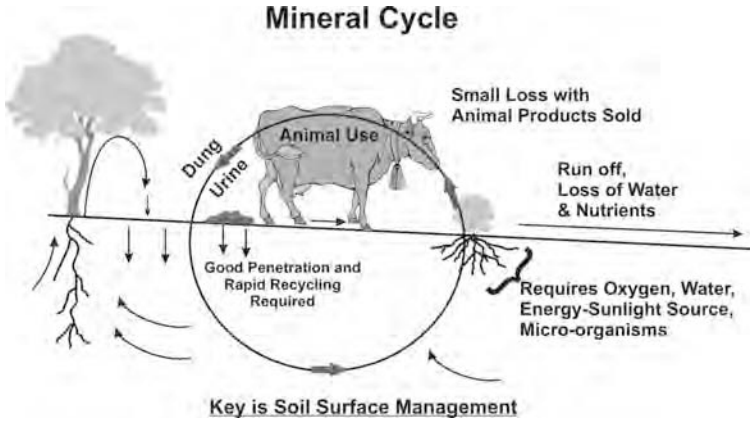
Hall Homestead

This pasture underwent a Lawson Renovator treatment in fall 2005. A transect site was established in the area that would allow management to compare effectiveness of the treatment through time. However, the treatment missed the transect site.

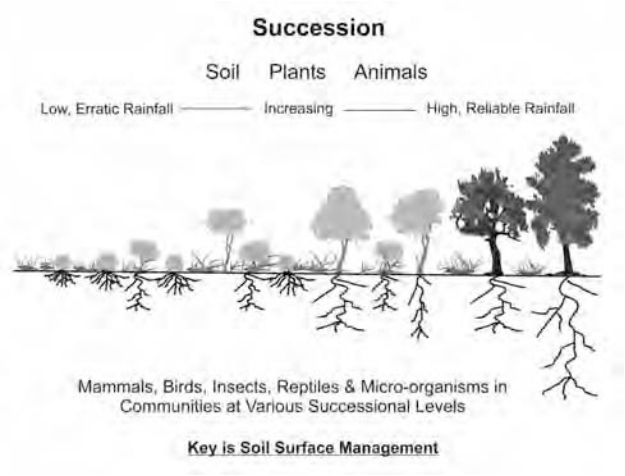
The Hall Homestead Pasture fully displayed the effects of a dry summer in 2006. Plant vigor was low on most species, including sagebrush. Site photos in this report will show sagebrush of exceptionally poor vigor. Plant productivity was far below the site's potential. Signs of water and wind erosion were observed. Desired grass plants found in 2005 were not observed in 2006. Data will show that the most abundant plants on the soil surface changed significantly between the two years. Management should consider this pasture for extended recovery periods between grazings. The Lawson Renovator treatment represented an investment of energy into the soil surface. Management must allow pasture plants a chance to recover from this infusion. Most importantly, prevent excessive harvest of plants and prevent lengthy grazing durations in spring.



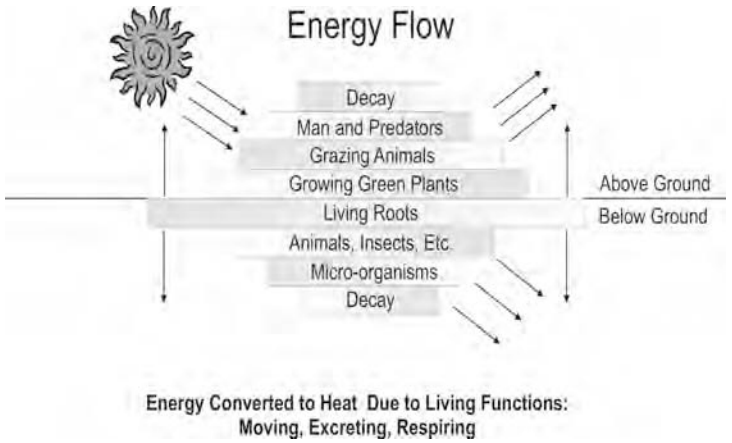
An effective water cycle requires covered soil and high biodiversity. When effective, most water soaks in quickly where it falls. Later, it's released slowly through plants that transpire it, or through rivers, springs, and aquifers that collect through seepage what the plants don't take. When biodiversity is reduced and soil exposed, much water runs off as floods. What little soaks in is released rapidly from evaporation which draws moisture back up through the soil surface (Savory, 1993).



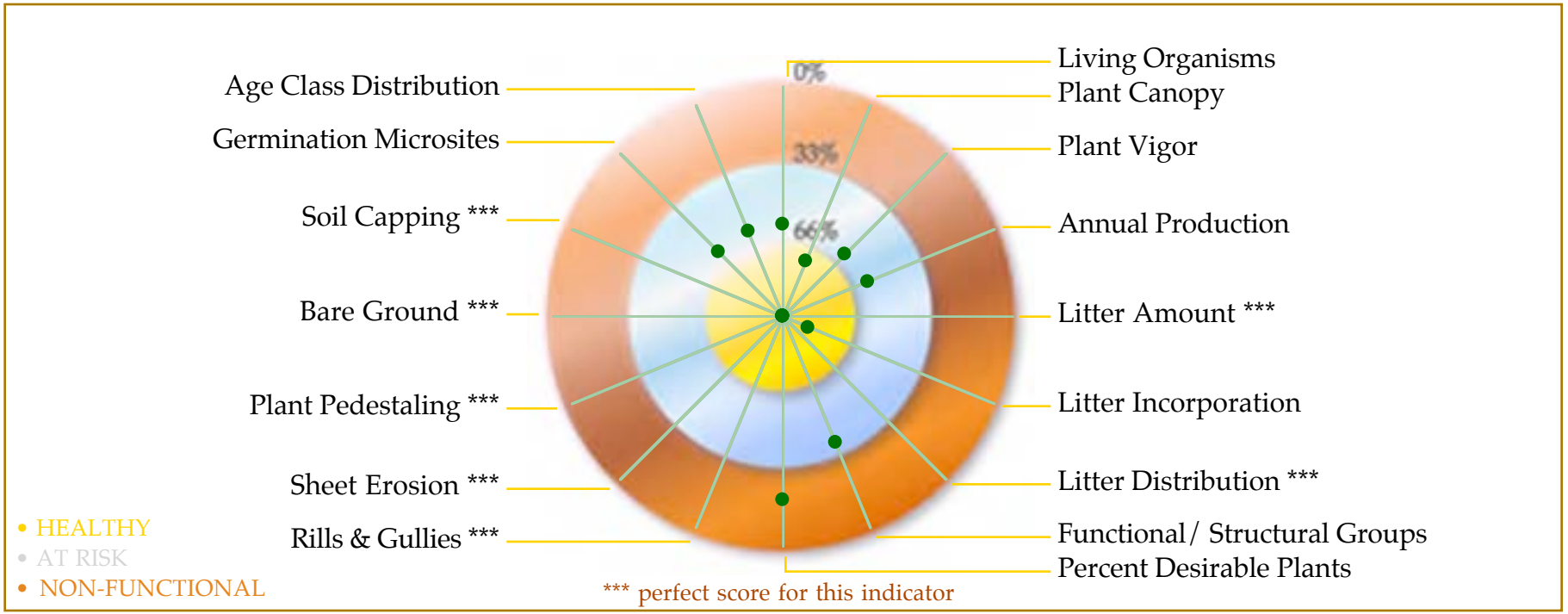
Like the water cycle, an effective and rapid mineral cycle requires covered soil and high biodiversity. When effective, many nutrients cycle between living plants and living soil continually. When soil is exposed and biodiversity low, nutrients become trapped at various points in the cycle, or are lost to wind and water erosion (Savory, 1993).



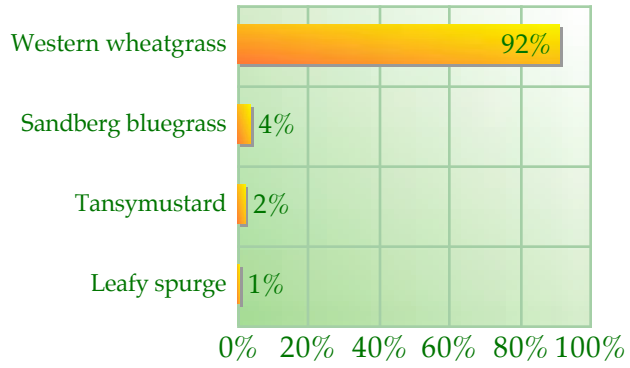
With few exceptions, communities strive to develop toward ever-greater complexity, and thus stability. From unstable bare ground, where biodiversity is low, stable complex range or forest communities, high in biodiversity develop over time (Savory, 1993). This is succession.



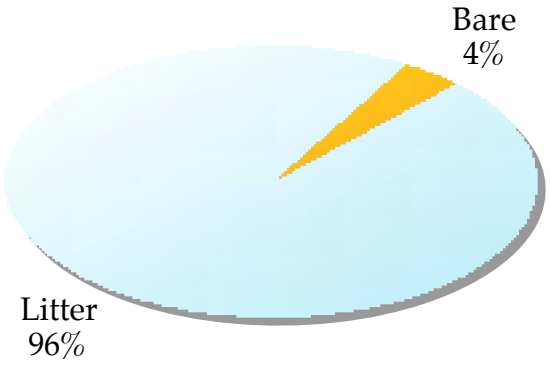
Almost all life requires energy that flows daily from the sun. The basic conversion of this solar energy to useable form takes place through plant material on land and in water. Energy passes from plants to whatever eats them, and in turn eats the consumers of plants. Energy doesn't cycle, but flows through the ecosystem until it's consumed (Savory, 1993).



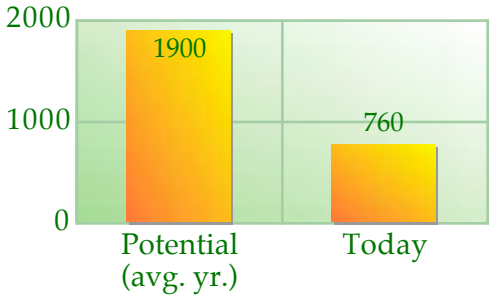
Basal Cover by Species - Top 4 Species



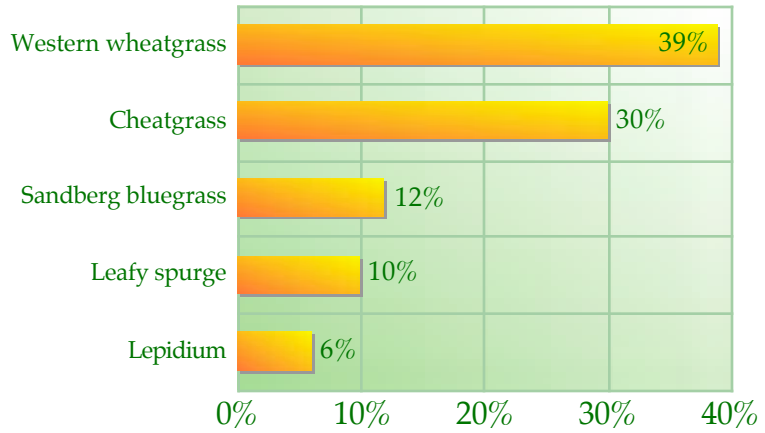
2006 Basal Cover



Forage Production



Predominant Species: Composition by Weight



Additional Info: Overall Site Score: **77**

Apparent range trend:

Site sampled September 16, 2006.

11 plant species encountered at site.

No big sagebrush found in area for data collection.

Relative basal plant spacing: 1.3 inches.

Plant species encountered at site:

Western wheatgrass
Sandberg bluegrass
Needleandthread
Cheatgrass
Kentucky bluegrass
Tansymustard
Leafy spurge
Fringed sage
Silver sage
1 unknown perennial forb
1 unknown annual forb

Coal Creek Pasture (Transect MRT02)

This site was first studied in 2002 to be representative of the Coal Creek Pasture. It was located above a wash, whose presence would serve as an additional indicator of rangeland health. Should this wash erode more rapidly, a change in management should occur. Photos of this wash will be shown in the following pages where it will be evident that erosion was not occurring.

The first plot studied at the Coal Creek site.

The first indicator studied was **living organisms** where signs of skunk, deer, and pronghorn were recorded. Missing were the songbirds and insects recorded in prior years. This could be due to a snowstorm that occurred on sample day. This indicator received a 60.

The **plant canopy** received a mid-range score at 74. This pasture was grazed in spring, and no signs of use were seen on sample day, suggesting plants had regrown after the grazing event. Even during the dry growing season of 2006, the plant canopy was tall, but not dense, and much sunlight energy struck the soil surface without being intercepted by plant leaves. See the 2006 photo (as shown above) compared with that taken in 2002 on page 10.

Plant vigor received a mid-range score of 62. While many of the abundant Western wheatgrass plants grew to tall stature, few had produced seed in the year. Other desired perennial grasses seen in the area such as needleandthread produced no seed. Since the area had not been grazed in summer 2006, lack of seed production provided a good indicator of the severity of the drought.

Plant production received a 60. The Wyoming State Range Site Guides (USDA, 1990) suggests that production should be 1900 pounds per acre in an average year. Production in the 10 sampled plots studied along the transect line were well below this mark. Further, the single clipped plot contained 760 pounds per acre production. This, again, suggests the summer was very dry.

Litter amount on the soil surface was high. This indicator received a perfect score.

When examining **litter incorporation**, we dig a finger into the soil and determine where litter ends and soil begins. At the Coal Creek site, some litter was elevated above the soil surface and not incorporating readily. This indicator received an 88. However, our notes from this site through time suggest incorporation is improving.

Litter was well **distributed** over the soil surface, with little of the surface bare. Litter distribution received a perfect score.

The **functional and structural groups** indicator received a lower score at 40. This indicator examines both the number of plant species found in the plot, as well as their growth form. Shrubs, for example, have roots that may penetrate deeply into the soil profile, taprooted forbs may not reach such depths, and grasses may have roots not reaching far into the soil. Above the surface, the canopy of shrubs may trap wind-driven snow, where the canopy of grass plants may catch little snow. These are examples of the structure and function of different plant groups. At the Coal Creek site, the plant community was dominated by Western wheatgrass. Other forbs, grasses, and shrubs were largely lacking. More plant diversity is preferred for diversity of root structure and ability to trap snow and moisture. Thus, **percent desirable plants** received a low score at 20. Also note that some leafy spurge plants were encountered along the transect line.

The water cycle indicators of **rills and gullies**, **scouring and sheet erosion**, **plant pedestaling**, and **bare ground**, all received perfect scores. Little bare soil was found on the site, no signs of wind or water erosion were observed, and no plants were pedestalled. This is an example of a highly effective water cycle.

Additionally, no **soil crust** was seen. This indicator also received a perfect score.

Germination sites are those points on the soil surface where a new plant can begin life. Such sites can often be characterized as much by what they are not as by what they are. For example, heavy litter cover, crusted soils, exposure to herbivory, and competition from other plants may all diminish germination site quality. At Coal Creek, competition from the rhizomatous Western wheatgrass appeared to be aggressive. This will limit the ability of new plants to germinate.

Examining **age class distribution** of plants proved to be extremely difficult, since the site was dominated by Western wheatgrass. This indicator received a 60.

Additional comments:

Energy flow was moderate at Coal Creek, with much sunlight energy striking the soil surface, but some being intercepted by grass leaves. The mineral cycle was rapid where litter covered the soil and was incorporating. The water cycle was effective with no signs of soil erosion. Within community dynamics, additional desired species are preferred. Range trend here was stable.

Management recommendations:

The major concerns at this site are two-fold. First, is the lack of forbs. Second, is the reduced incidence of desired perennial grasses such as green needlegrass. In both cases, a dry summer could be the cause. Another cause of lack of forbs could be herbicide treatment of leafy spurge in the area. This may be necessary to control spurge through time, and the resulting lack of forbs should be expected.

The reduced observation of desired perennial bunchgrasses could be due to another cause. This pasture was used as calving grounds in March, and the herd returned in late May and early June. It is likely that the bunchgrasses growing at this time of year were grazed. Then, due to dry conditions, these plants lacked the ability to regrow and went dormant for the season. By sampling day in mid-September, they could not be found on the soil surface. While this does not present a problem, the situation should not be repeated through time on these important plants.

Next season, graze the pasture earlier in the spring. In this way, sufficient soil moisture should exist that would allow grazed perennial bunchgrasses a chance to regrow. They should then produce seed and create a greater presence at the site.

Early-warning indicators:

If management actions are improperly applied, look for decreased litter cover and signs of erosion. Soil will move on this mild slope if given a chance. It should be readily apparent that either grazing durations or grazing timing must change.

If management actions are properly applied, look for abundant presence of litter and an increased presence of desired perennial bunchgrasses and forbs.

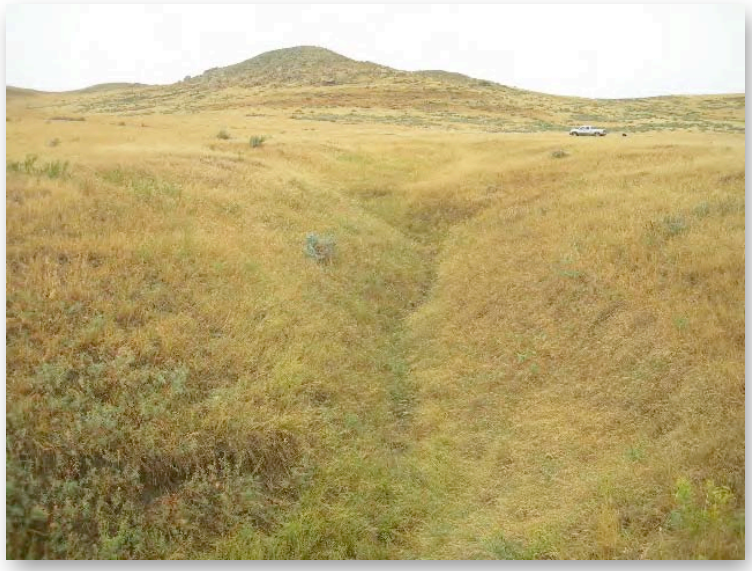
Transect view. Photo taken August 22, 2002.

Transect view. Photo taken September 16, 2006.

First quadrat studied. Photo taken August 22, 2002.

First quadrat studied. Photo taken September 16, 2006.

View of cut below transect site. Photo taken August 22, 2002.



View of cut below transect site. Photo taken September 16, 2006.

SAGEBRUSH DATA

2002	2006	
no data collected		*Line intercept:*
		Number of big sage plants encountered
		Line Intercept: Age Class Distribution
		seedling
		young
		mature
		decadent
		Average plant height
		Percent canopy intercept
		Density per 1000 square feet

PRODUCTION: Pounds per acre

2002	2006
1000	760

ADDITIONAL INFORMATION

Site sampled August 22, 2002.
Site sampled September 16, 2006.

RELATIVE PLANT SPECIES COMP. BY WEIGHT RANKING (TOP 5 SPECIES)

2002	2006
Western wheatgrass	Western wheatgrass
Cheatgrass	Cheatgrass
Kentucky bluegrass	Sandberg bluegrass
Japanese brome	Leafy spurge
Tansymustard	Lepidium

BASAL COVER

2002	2006	
7%	4%	Bare
91%	96%	Litter
3%	0%	Live

RELATIVE BASAL PLANT SPACING

2002	2006
1.1 inches	1.3 inches

RELATIVE BASAL PLANT SPACING BY SPECIES (Top 5 species in 2001, and four found in 2006)

2002	2006
Western wheargrass	Western wheatgrass
Kentucky bluegrass	Sandberg bluegrass
Dandelion	Tansymustard
Leafy sprurge	Leafy spurge
Sandberg bluegrass	

PLANT SPECIES FOUND IN TRANSECT AREA

2002	2006	
22	***12***	***Total count***
X	X	Cheatgrass
X		Japanese brome
X	X	Western wheatgrass
X	X	Needleandthread
X		Green needlegrass
X		Prairie junegrass
X	X	Kentucky bluegrass
X	X	Sandberg bluegrass
X	X	Leafy spurge
X	X	Tansymustard
X		Dandelion
X		Musk thistle
X		Scarlet globemallow
X		Western yarrow
X	X	Lepidium
X		Tapertip hawksbeard
X	X	Silver sagebrush
X	X	Fringed sage
2	1	Unknown perennial forbs
2	1	Unknown annual forbs

DISCUSSION OF COAL CREEK PASTURE DATA BETWEEN 2002 AND 2006

Photos

Comparing photos between years on the previous page clearly shows more abundant growth in 2006. The 2002 photos were taken not long after ownership changed and new management was added. Plants appeared to be of much lower vigor then. Stature of plant growth appears to be much higher in 2006 as can be seen in the transect view and quadrat photos. As will be discussed below, plant productivity was estimated in 2002 and actually clipped in 2006. The 2002 estimation appears now to be quite high. Further, the photos of the cut between the two years suggest no additional erosion was occurring as evidenced by plant cover on the slopes. This site was chosen in 2002 with this cut in mind as an early-warning mechanism that management actions were being inappropriately applied. These photos positively suggest that management actions are maintaining soil stability on this site.

Sagebrush data

Little sagebrush was found on the site in either year, and no data was collected.

Production

In 2002 plant productivity was estimated at 1000 pounds per acre. This figure was used repeatedly throughout the 2002 report. In 2006 a single plot was clipped and production calculated at 760 pounds per acre. This is considerably less than the 2002 estimate. As the photos show, 2006 production appeared to be much greater than 2002. We greatly overestimated production in 2002. The low productivity compared with the site's potential of 1900 pounds per acre suggests additional changes in species composition are desired. Having additional shrubs and forbs in the area should elevate productivity greatly.

Composition by weight

Little change was seen between the two years in terms of the two most productive species. Western wheatgrass still dominated the site, while cheatgrass produced well. The remaining most productive species all changed. However, in both sampling years, the remaining species composed a small percentage of the plant community. Such changes in the composition by weight chart should be expected through time.

Basal cover

The amount of bare ground found on the site dropped slightly between 2002 and 2006, while the amount of litter rose a few percentage points. In both years, the amount of bare ground found on this site was minimal.

Results showed that live cover dropped from 3% to zero. This does not present a concern. When collecting these data, a steel rod is lowered to the soil surface. In 2002, three percent of the hits fell on a perennial plant, perhaps dandelions. In 2006, however, the rod did not strike the base of a perennial plant. Western wheatgrass, which dominated the site, has a small plant base, making

determination of a strike by the rod difficult. The change in percentage as displayed in the tables is due to sampling error based on the diameter of the sampling rod as much as anything.

Relative basal plant spacing

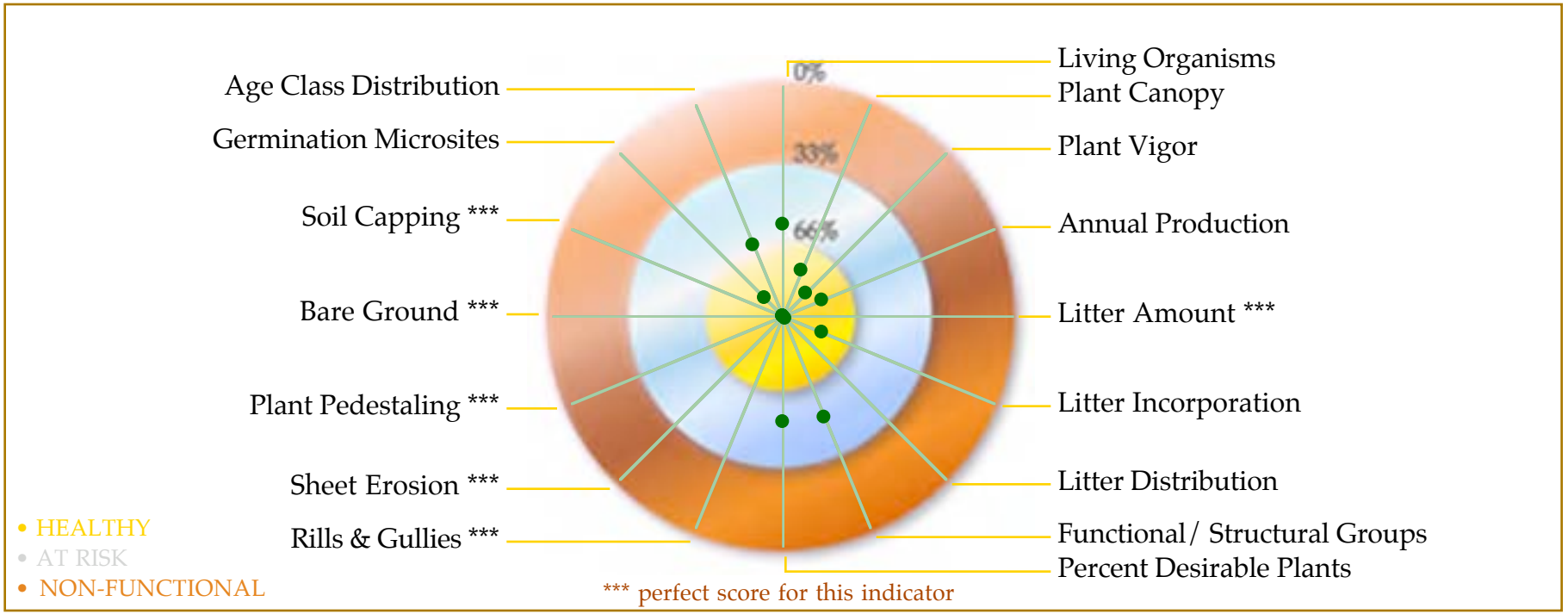
After dropping the steel rod to the soil surface and basal cover data were collected, a measurement is taken from the rod to the nearest perennial plant. The process was repeated at Coal Creek for 100 data points along the tape, and the resultant distance averaged. Such a measurement can be compared through time, producing basal spacing of plants on the soil surface. The distance to the nearest perennial plant increased by 0.2 inches from 2002 to 2006. At this time, such an increase does not present a concern. However, this distance should be watched through time for any further increases.

Relative basal spacing by species

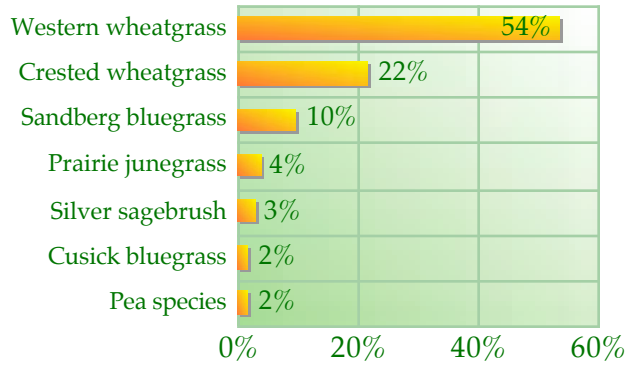
When the distance to the nearest perennial plant measurement was taken, that nearest plant's species is recorded. When the nearest species is recorded for 100 data points along the tape measure, an indication of relative basal plant spacing by species is determined. In both sampling years, 92% of the nearest perennial plants recorded were Western wheatgrass. This species clearly dominated the soil surface. The remaining eight percent of the species encountered changed to some degree, but these species compose a small percentage of the soil surface.

Plant species list

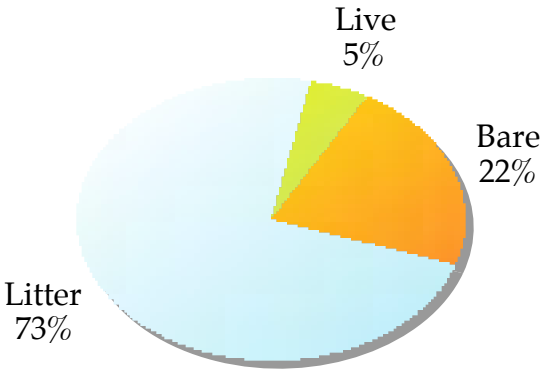
The number of plant species found while walking the transect site declined by 10 between the two years. While this may seem like a high number, note that many of these were forbs. Herbicide sprayed in the area may have a significant impact on these species' ability to grow. Further, no Japanese brome was found in 2006. This is a positive sign. Conversely, green needlegrass was found in 2002, but not in 2006. This is a negative sign, for this highly desired grass should be found in the area.



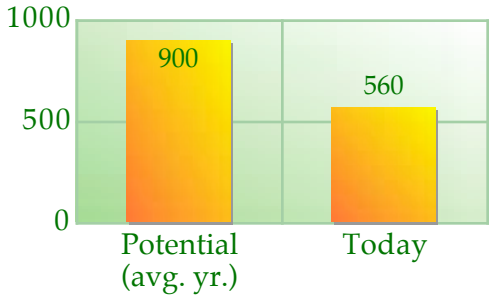
Basal Cover by Species - Top 7 Species



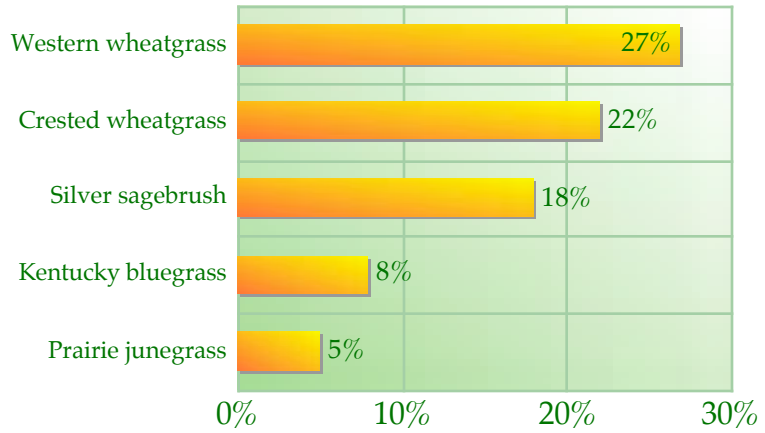
2006 Basal Cover



Forage Production



Predominant Species: Composition by Weight



Additional Info: Overall Site Score: **84**

Apparent range trend:

Site sampled September 16, 2006.

18 species encountered at site.

Silver sagebrush data:
Line intercept: 14 plants encountered, 8% canopy cover.
Average plant height: 9 inches.
14% seedlings, 43% young, 29% mature, 14% decadent.
Belt transect: 95 silver sage plants growing in 1000 square feet.

Relative basal plant spacing: 0.94 inches.

Plant species encountered at site:

Crested wheatgrass
Western wheatgrass
Sandberg bluegrass
Cusick bluegrass
Kentucky bluegrass
Threadleaf sedge
Lepidium
Salsify
Western yarrow
Tansymustard
Golden pea
Curlycup gumweed
Silver sage
Fringed sage
Cudweed sagewort
Douglas rabbitbrush
Broom snakeweed
Unknown annual forb

Stonehouse (Transect MRT03)

This site was chosen to be representative of terrain and vegetation in the Stonehouse Pasture. It lies on a mild slope not far from both water and the pasture boundary fence. The site was established in 2003.

The first plot studied at the Stonehouse site.

The first indicator studied was **living organisms**. We saw rabbits and observed signs of deer and pronghorn. Various songbirds were also heard in the area. This indicator received a score of 60.

The **plant canopy** on this ungrazed site achieved a tall stature for such a dry year. See the site photos above and on the previous page and note their height. Much sunlight energy was intercepted by living plant leaves, but some also struck the soil surface. This indicator received a 78.

Plant vigor received a high score at 86. Many plants were of tall stature, had produced seed, and were firmly rooted to the soil surface.

According to the Wyoming State Range Site Guides (USDA, 1990), **annual production** in an average moisture year should be 900 pounds per acre. Production within the sample plots was estimated to be below this mark. Further, the single clipped plot yielded production of 560 pounds per acre. In a poor rainfall year, soil information suggests this site should produce 450 pounds per acre. Thus, the clipped plot produced more than was expected of it in the dry year of 2006.

Some of the plants displayed signs of grazing. Western wheatgrass was the only plant bitten along the transect tape where only light use was observed.

Much litter was found on the soil surface. The point intercept method revealed that 73% of the soil contained litter. **Litter amount** received a perfect score.

Litter incorporation received an 82 for its score. This important indicator suggests the speed of the mineral cycle. While litter appeared to be contacting the soil well, it was not mixing well with the soil. Better mixing of litter with soil will speed the mineral cycle and result in an increased score.

Litter was well **distributed** across the soil surface. This indicator received a perfect score.

The **functional and structural groups** indicator examines number of species in a plot, plus the growth structure of plants found. At Stonehouse, this indicator received a 52. Most plots contained one or two grass species, a shrub, and a forb species. Additional grass and forb species are desired here whose root structures serve to elevate nutrients stored at different levels of the soil profile. Forbs also provide forage for wildlife.

The **percent desired plants** indicator received a 54. Again, additional perennial grasses and forbs should be seen here. Further, the undesired species leafy spurge was found in some of the plots.

The water cycle at Stonehouse was functioning well. Perfect scores were awareded for **rills and gullies**, **scouring and sheet erosion**, **plant pedestaling**, **bare ground**, and **soil crusting**. No signs of water or wind erosion were seen, and plants were not pedestaled. The point intercept method revealed that 22% of the surface was bare. Room for improvement exists in this regard, but for such a site with its reduced production, this number is not unacceptable.

Germination microsites received a high score at 88. Litter cover was not excessive, nor would a thick soil crust inhibit seedling success. The main inhibitor of seedling success is lack of protection from herbivory and the elements. However, many germination sites existed on the soil surface.

When examining **age class distribution**, plants were classed according to their age. Seedlings, young plants, mature plants, and those that are decadent are examined. At Stonehouse, different age classes of silver sagebrush and crested wheatgrass were observed. This indicator received a 66.

Additional comments:

Energy flow was at high levels, where even in a dry year, plants produced well, and much sunlight energy was intercepted by living plant leaves. The mineral cycle was rapid, not slowed by excessive grazing or poor litter distribution. The water cycle was effective with no signs of erosion and a covered soil surface. Within community dynamics, additional desired plant species are desired on site. The infrastructure in terms of water and mineral cycles was present. The site now needs time to recover from past management and allow for the more desired species to make their presence. Range trend here was stable.

Management recommendations:

This site was grazed later in the summer of 2006. In such a dry year, management provided every opportunity for these plants to produce seed and store energy needed to make it through winter. Furthermore, this site had not been grazed since spring 2005. Thus, nearly two growing seasons had elapsed between grazing events by cattle. Ecosystem processes were functioning well, and plant vigor was high even during an incredibly dry year. Management has done an excellent job of building infrastructure in terms of ecosystem function on this site. Hopefully, in time, the land will respond with increased species diversity and provide those desired perennial bunchgrasses and forbs.

This pasture should serve as a good example of what extended recovery periods can produce in the area. Even during the dry summer of 2006, plants produced well here and had likely increased vigor from 2005. They will carry such vigor into 2007 as well. Can grazing plans be adjusted on the ranch to allow extended recovery periods in other pastures? If so, many benefits may result.

When planning grazing for coming years, this pasture should be considered for additional grazing pressure. This may serve to extend recovery periods on other pastures for the benefit of the whole ranch. In time, allow this pasture another chance at extended recovery periods.

With the above being said, please examining the following pages where data sets are compared between years. A large increase in percent bare ground occurred on this site between 2003 and 2006. With the strong plant growth year of 2006, it is hoped that much of this plant material will fall to the soil surface and provide litter cover.

Early-warning indicators:

If management actions are improperly applied on this site, look first for increased presence of bare ground and soil erosion. Also look for reduced plant vigor. These signs would indicate that grazing durations are too long, recovery periods are too short, and/or that timing of grazing needs adjusting.

If management actions are properly applied, look for increased presence of desired plant species such as forbs and perennial bunchgrasses.

Stonehouse transect view. Photo taken August 23, 2003.

Stonehouse transect view. Photo taken September 16, 2006.

Photo taken August 23, 2003.

Photo taken September 16, 2006.

SILVER SAGEBRUSH DATA

2004	2006	
		Line intercept:
20	14	*Number of silver sage plants encountered*
		Line Intercept: Age Class Distribution
0%	14%	seedling
10%	43%	young
90%	29%	mature
0%	14%	decadent
10 inches	8 inches	*Average plant height*
20%	8%	*Percent canopy cover*
115	95	*Density per 1000 square feet*

PRODUCTION: Pounds per acre

2003	2006
680	760

ADDITIONAL INFORMATION

Site sampled August 23, 2003.
Site sampled September 16, 2006.

RELATIVE PLANT SPECIES COMP. BY WEIGHT RANKING (TOP 5 SPECIES)

2003	2006
Silver sagebrush	Western wheatgrass
Kentucky bluegrass	Crested wheatgrass
Western wheatgrass	Silver sagebrush
Crested wheatgrass	Kentucky bluegrass
Prairie junegrass	Prairie junegrass

BASAL COVER

2003	2006	
8%	22%	Bare
88%	73%	Litter
4%	5%	Live

RELATIVE BASAL PLANT SPACING

2003	2006
0.5 inches	0.9 inches

RELATIVE BASAL PLANT SPACING BY SPECIES (Top 7 species)

2003	2006
Western wheatgrass	Western wheatgrass
Cusick bluegrass	Crested wheatgrass
Crested wheatgrass	Sandberg bluegrass
Kentucky bluegrass	Prairie junegrass
Sandberg bluegrass	Silver sagebrush
Idaho fescue	Cusick bluegrass
Bluebunch wheatgrass	Golden pea

PLANT SPECIES FOUND IN TRANSECT AREA

2003	2006	
24	***18***	***Total count***
X	X	Silver sagebrush
X	X	Crested wheatgrass
X	X	Western wheatgrass
X	X	Kentucky bluegrass
X	X	Western yarrow
X	X	Sandberg bluegrass
X	X	Broom snakeweed
X		Prairie junegrass
X	X	Fringed sage
X		Dandelion
X		Hood's phlox
X		Lupine
X		Green needlegrass
X		Bluebunch wheatgrass
X		Sulfur buckwheat
X	X	Douglas rabbitbrush
X		Idaho fescue
X	X	Cudweed sagewort
X	X	Curlycup gumweed
X	X	Salsify
X	X	Golden pea
X	X	Cusick bluegrass
	X	Threadleaf sedge
	X	Lepidium
	X	Tansymustard
1		Unknown perennial forb
1	1	Unknown annual forb

DISCUSSION OF STONEHOUSE PASTURE DATA BETWEEN 2003 AND 2006

Photos

Examination of the transect view photos on the previous page clearly shows more abundant grass growth in 2006 than 2003. Silver sage is readily apparent in the prior year, but is largely obscured by grass in the 2006 photo. The 2006 photo is a bit blurred due to falling snow, but the change in grass growth is evident.

The quadrat photos also show additional grass growth in 2006. The bare ground seen in 2003 appears to have decreased with the 2006 photo. However, note the changes in basal cover as discussed below. A final photo observation is that some silver sage plants have established themselves in this quadrat that were not seen before.

Sagebrush data

Compare the silver sagebrush data on the preceding page. The number of silver sage plants encountered on both the transect line intercept and the belt transect was significantly reduced. The average plant height was shorter, suggesting less leader growth on the individual plants, and the total canopy cover was also reduced. Finally, no seedling or decadent plants were observed on the transect line in 2003. Both were found in 2006, suggesting the silver sage community is replacing itself. Note that silver sagebrush is often classified as a riparian plant. The dry year of 2006 likely contributed to its lack of vigor. Such changes in this species do not present a concern at this time. Silver sage is a strong survivor. It will weather the dry cycle and maintain its presence in the community.

Production

The Wyoming State Range Site Guides for the Stonehouse Pasture suggest that plant productivity should be 450 pounds per acre. We clipped a single plot of grass, shrubs, and forbs totaling 560 pounds per acre. Thus, in the dry year productivity outperformed the suggested standard. This is encouraging. But the addition of desired perennial grass and forb species will increase production even further.

Composition by weight

In the composition by weight table, note that the five most producing species were present in both sample years. They simply shifted position in the table. Where silver sage had a better production year in 2003, two grass species outperformed it in 2006. Such shifting is likely on this site through time.

Basal cover

These data present the greatest cause for alarm. Eight percent of the soil surface was bare in 2003, while 22% was bare in 2006. This is a significant increase that requires continued monitoring.

Where did the ground covering litter go? We may speculate the cause of this shift. First, the area had not been grazed in nearly two full growing seasons. Thus, excessive harvest by livestock that would remove any

potential litter source can be ruled out as a cause. Next, a heavy, wet snow may not have blanketed the area that would have driven elevated plant material to the soil. Third, given the lack of hoof action due to the extended rest period, no animal impact was applied. Thus, it may be that prior years' plant growth remained attached to plant bases and had not yet fallen to the ground as litter. Combinations of hoof action and snow cover would knock standing plant material to the soil surface as litter, increasing the percent cover of litter. Given this speculation, however, management is now charged with the duty of further observation in this area. Such increases in percent bare soil may lead to erosion down the road. Watch the area for changes in ground cover.

Relative basal plant spacing

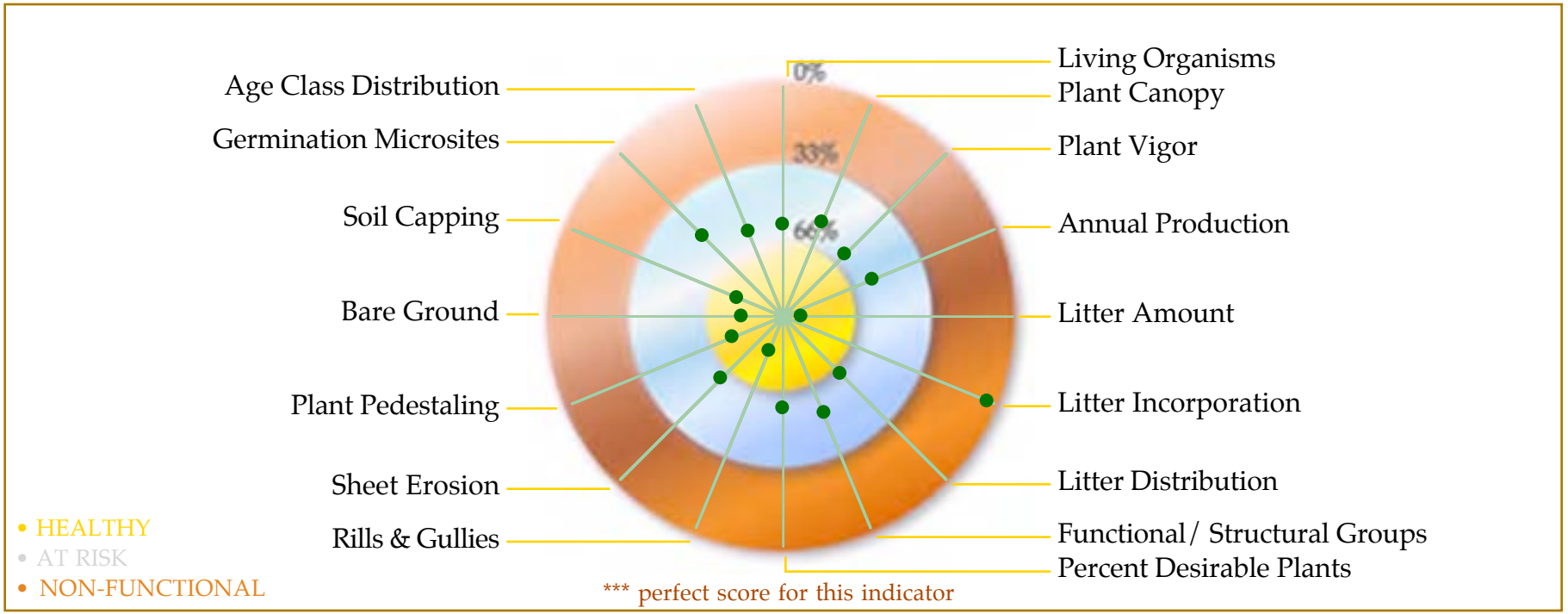
Spacing between plants increased from 0.5 inches to 0.9 inches, nearly doubling. This also presents a concern. What caused such an increase when the area had not been grazed in nearly two full growing seasons? With increased plant vigor and production, why did plant spacing not decrease? Part of the explanation here may lie with Kentucky bluegrass. When examining relative basal spacing by species, Kentucky bluegrass was found repeatedly in 2003. It was not encountered at all in the measurements in 2006. This moisture-loving species composed little of the plant community in 2006, possibly resulting in the disturbing change.

Relative basal spacing by species

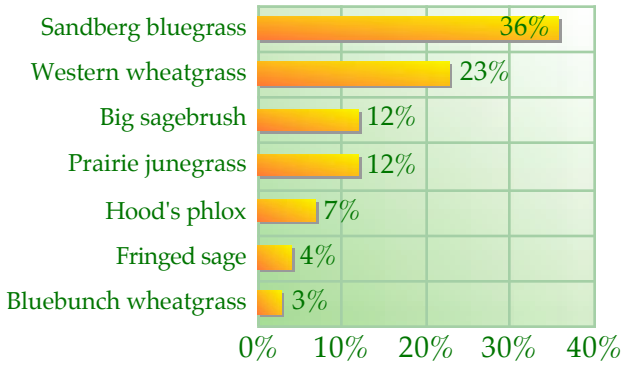
As already noted, Kentucky bluegrass was not found using the point intercept method in 2006. We can only speculate as to the cause for this. When examining the relative basal spacing by species data from the two sample years, we find that Western wheatgrass dominated the plant community in both years, with presence that barely changed. All of the other species listed on the table form a small percentage of the basal cover.

Plant species list

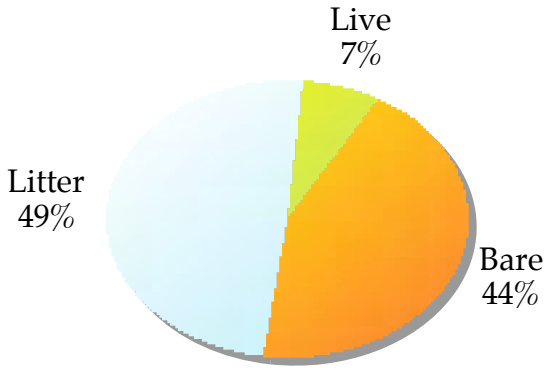
The number of plant species encountered while walking the transect site declined between the two sample years. While the reduction was small, the plants lacking were significant. These consisted of forbs, plus green needlegrass, bluebunch wheatgrass, and Idaho fescue. All are highly desired in the community. We cannot explain why these species were not found on sample day. Their absence requires further observation of this site.



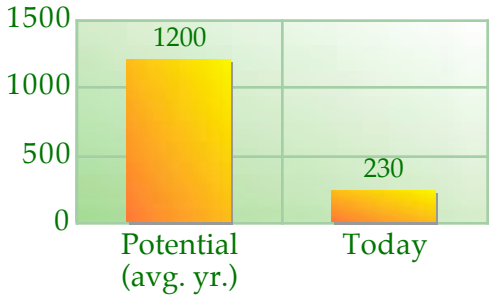
Basal Cover by Species - Top 7 Species



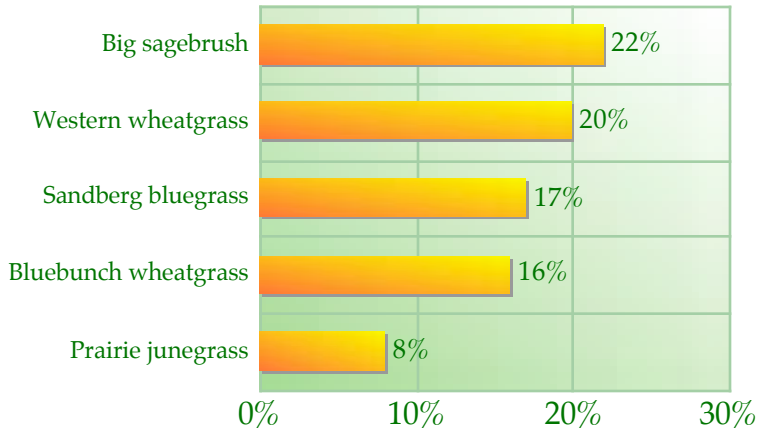
2007 Basal Cover



Forage Production



Predominant Species: Composition by Weight



Additional Info: Overall Site Score: **63**

Apparent range trend:

Site sampled September 16, 2006.

19 plant species encountered at site.

Big sagebrush data:
Line intercept: 32 plants encountered, 9% canopy cover.
Average plant height: 12.5 inches.
3% young plants, 81% mature, and 16% decadent.
Belt transect: 211 plants found growing in 1000 square feet.

Relative basal plant spacing: 1.6 inches.

Plant species encountered at site:

Sandberg bluegrass
Western wheatgrass
Prairie junegrass
Bluebunch wheatgrass
Smooth brome
Sixweeksgrass
Blue grama
Western yarrow
Hood's phlox
Pricklypear cactus
Vagrant lichen
Moss species
Longleaf phlox
Big sagebrush
Broom snakeweed
Silver sagebrush
Fringed sagebrush
Rubber rabbitbrush
Unknown perennial forb
Threadleaf sedge

Hall Homestead (Transect MRT06)

This site was chosen to be part of the Lawson Renovator treatment project conducted in fall 2005. Data was gathered at this site in 2005, with comparison intended to be made after the treatment. Unfortunately, the renovator passed by this transect location.

The first plot studied at the Hall Homestead site.

The first indicator studied was **living organisms** at the Hall Homestead site. We recorded seeing signs of deer, rabbits, and a hawk. This indicator received a 60.

The **plant canopy** was low. See the plot photo above and note the poor plant canopy, even of the sagebrush. The area appeared to have suffered during the dry summer of 2006. This indicator received a 56. Continuing, many plants had not produced seed for the year, nor had they reached a tall stature. This is further evidence of the drought. **Plant vigor** received a 62.

The Wyoming State Range Site Guides suggest potential production on this site should be 1200 pounds per acre in an average year (USDA, 1990). On sample day, a single plot was clipped with total production of 230 pounds per acre. This difference is significant. Even estimating production in the transect quadrats revealed low prouctivity. **Annual production** received a 58. Note that some signs of grazing were observed in the transect plots. Utilization of sandberg bluegrass and Western wheatgrass could best be described as "light."

In some of the study plots the **amount of litter** was at desirable levels. In others, however, litter amount was too light. This indicator received a 92. Additional litter is desired to help cover the soil surface and prevent erosion.

Litter incorporation received a 74 for its score. In some plots, litter was contacting the soil surface, but was not mixing well. In other plots, litter was elevated above the soil surface. Without soil contact, litter does not decompose biologically, and the mineral cycle is slowed.

Litter distribution received a 64. Litter was becoming light in some of the study plots and was not covering the soil surface well.

When examining **functional and structural groups**, we found at least five plant species in most study plots. One however, only contained three plant species. In some plots, both shrubs and grasses were observed, but forbs were lacking. This indicator received a 54. Additional forbs and perennial bunchgrasses are desired on this site. This would help the **percent desired plants** indicator, which received a 60. Fortunately, no noxious weeds were observed in the area.

Signs of both water and wind erosion were observed. Small **rills** were observed where water was carrying soil away. Wind was causing **sheet erosion** as small soil particles were being carried away. Coarser soil particles remain behind resulting in a layer of gravel called desert pavement. These indicators received scores of 84 and 62 respectively. Further, wind erosion was resulting in **plant pedestaling**. As wind removes soil away from the base of a plant, the plant appears to be sitting up on a pedestal. Fortunately, no root exposure was seen.

Bare soil was evident in the study plots. This indicator received an 82. Further, the point intecept method revealed that 44% of the soil was bare. This is high for such a site.

Throughout the study plots, a **soil crust** was found. This crust was only a few centimeters thick and was likely caused by recent precipitation events. This indicator received a 78.

Germination sites are those areas on the soil surface where a new plant can find a start on life. Factors that limit germination success include excessive litter cover, soil crusting, and exposure to herbivory and the elements. At Hall Homestead, germination success would be limited by exposure to the elements and herbivory. This indicator received a 60.

When examining plants for **age class distribution**, some plots contained only mature plants. Others contained several plants that appeared to be decadent. One contained different age classes of perennial grasses as a positive sign. This indicator received a 60.

Additional comments:

Energy flow was reduced, allowing much sunlight energy to strike the soil surface rather than being intecepted by desired plant leaves. The mineral cycle was slowed by some elevated litter not contacting the soil surface where it could be broken down. The water cycle was less effective with signs of wind and water erosion apparent. Excessive bare soil also exists here. Within community dynamics, the Japanese brome found a year earlier was not seen at all. Other desired plant species were in the area, but not in the abundance desired. Range trend here was stable.

Management recommendations:

This site appeared to be suffering severely from the dry summer. Even hearty sagebrush appeared poorly. Under such conditions, management's first concern must be on covering the soil surface and preventing erosion. Covering the soil surface requires having plant growth that can fall to the soil as litter. This means planning grazing so as not to severly graze plants. Management did this well in 2006. Continuing, compare the photos of the Hall Homestead site with those of the Stonehouse. While Stonehouse received more moisture in 2006 than Hall, plant vigor was much stronger at Stonehouse. Consider Hall Homestead for extended recovery periods, perhaps as long as two full growing seasons between grazing events. This will help improve plant vigor, even during dry years. Much of this plant growth could then be available as litter when it falls to the soil surface and helps prevent erosion.

Keep these thoughts in mind when reflecting on the area's Lawson Renovator treatment. The Lawson treatment represented an investment of time and money into the soil surface. Management must allow this treatment to bear fruit, which will require healing time after the treatment. Keep grazing durations short during treatment response and prevent excessive grazing of plans. Also consider extending recovery periods to help build up organic material on the soil surface. In time, recovery times may be shortened once again, but management must allow the Lawson effort time to work.

Early-warning indicators:

Signs of wind and water erosion were evident on this site. Improper use of tools such as grazing duration, timing, and recovery periods will result in increased signs of erosion. Rills will become larger. Plant pedestaling will result in root exposure that was not apparent in 2006. Keep an eye on these few indicators as quick signals that management plans must be changed.

If management actions are properly applied, look for increased plant vigor and increased litter on the soil surface. Then, look for decreased signs of soil erosion, which will mark a large improvement for this site.

Transect view of the Hall Homestead site. Photo taken September 2, 2005.

Transect view of the Hall Homestead site. Photo taken September 16, 2006.

The first plot studied. Photo taken September 2, 2005.

The first plot studied. Photo taken September 16, 2006.

BIG SAGEBRUSH DATA

2005	2006	
		Line intercept:
38	32	*Number of big sage plants encountered*
		Line Intercept: Age Class Distribution
0%	0%	seedling
18%	3%	young
82%	81%	mature
0%	16%	decadent
11.5 inches	12.5 inches	*Average plant height*
16%	9%	*Percent canopy cover*
186	211	*Density per 1000 square feet*

PRODUCTION: Pounds per acre

2005	2006
760	230

ADDITIONAL INFORMATION

Site sampled September 3, 2006.
Site sampled September 16, 2006.

RELATIVE PLANT SPECIES COMP. BY WEIGHT RANKING (TOP 5 SPECIES)

2005	2006
Big sagebrush	Big sagebrush
Bluebunch wheatgrass	Western wheatgrass
Fringed sage	Sandberg bluegrass
Prairie junegrass	Bluebunch wheatgrass
Broom snakeweeed	Prairie junegrass

BASAL COVER

2005	2006	
49%	44%	Bare
43%	49%	Litter
8%	7%	Live

RELATIVE BASAL PLANT SPACING

2005	2006
1.1 inches	1.6 inches

RELATIVE BASAL PLANT SPACING BY SPECIES (Top 7 species)

2005	2006
Threadleaf sedge	Sandberg bluegrass
Western wheatgrass	Western wheatgrass
Needleandthread	Prairie junegrass
Prairie junegrass	Big sagebrush
Big sagebrush	Hood's phlox
Bluebunch wheatgrass	Fringed sage
Blue grama	Bluebunch wheatgrass

PLANT SPECIES FOUND IN TRANSECT AREA

2005	2006	
23	***19***	***Total count***
X	X	Bluebunch wheatgrass
X	X	Western wheatgrass
X	X	Prairie junegrass
X		Japanese brome
X	X	Blue grama
X		Green needlegrass
X	X	Threadleaf sedge
X		Needleandthread
X	X	Big sagebrush
X	X	Fringed sage
X	X	Silver sagebrush
X	X	Broom snakeweed
X	X	Rubber rabbitbrush
X	X	Western yarrow
X		Vetch species
X	X	Hood's phlox
X	X	Pricklypear cactus
X		Curlycup gumweed
X		Lepidium species
X	X	Vagrant lichen
X		Plains daisy
X		Musk thistle
	X	Sandberg bluegrass
	X	Smooth brome
	X	Sixweeksgrass
	X	Moss species
	X	Longleaf phlox
1	1	Unknown perennial forb

DISCUSSION OF HALL HOMESTEAD PASTURE DATA BETWEEN 2005 AND 2006

Photos

See the transect photos on the previous page. In the transect view photos, an apparent difference in sagebrush vigor is evident, with 2006 containing much less vigorous growth. Leader lengths appear to be shorter in 2006. Further, the sage plant that dominates the plot photos is of much lower vigor in 2006. It even appears to have lost leaves. Much of this can be attributed to the dry year of 2006. Also note the amount of bare soil seen in the plot photos.

Sagebrush data

In 2006 on the line intercept, fewer big sagebrush plants were encountered along the tape measure than in 2005. More of them were decadent and were a little taller than before. Much of this variation is likely due to placement of the tape measure on the ground. The largest change here came from the significant reduction in sagebrush plant canopy. These figures confirm what was seen in the site photos: sagebrush plants had a tough year in 2006. On the belt transect, the number of big sagebrush plants growing in a certain area did increase in 2006. This suggests that while the older plants struggled, new plants were able to germinate.

Production

At 230 pounds per acre, production in 2006 was well below that of 2005 and the site potential of 1200 pounds per acre.

Composition by weight

When viewing this table, different rangeland plant species performed well in the two different sampling years. Big sagebrush still dominated the study plots, but the remaining plant species changed in abundance by weight between the years. Such changes are likely through time.

Basal cover

A slight drop in percent bare soil was seen between the two years. This is highly desirable, for covering soil is a primary concern at this site. Like other data sets presented here, basal cover may change significantly year to year.

Relative basal plant spacing

Relative basal plant spacing (distance to nearest perennial plant) changed by 0.5 inches between the two years. This is a significant increase. What caused such change in a year's time, especially considering the area had not been grazed in 2006? No clear answer exists for this question. It could be that due to the dry year, plant crowns shrunk on the soil surface. This would mean that the distance to any one particular plant increased. Sampling error could also be to blame. The tape measure laid across the ground in 2005 may not have followed exactly the same course in 2006. Whatever the cause, such change requires monitoring through time.

Relative basal spacing by species

On the relative basal spacing by plant species chart, note that plant species changed significantly between the two years. What caused such change? While no clear answer exists, it is known that different plant species perform differently in any given year. Threadleaf sedge was the plant species encountered most often on the soil surface in 2005, but did not make the chart in 2006. The same can be said for Sandberg bluegrass that topped the chart in 2006. We cannot explain such changes in plants found on the soil surface.

Plant species list

The number of plant species found at the Hall Homestead site did not change significantly between the years. However, the species found did. Desired species of needleandthread and green needlegrass were not observed in 2006. Conversely, species such as smooth brome and Sandberg bluegrass were not found in 2005. It is likely that such changes in plants observed is drought related. Beyond that, we cannot offer an explanation for such changes.

NUTRIENT ANALYSIS

At each study site, a single plot of plant growth was clipped and weighed to determine production. Next, species not likely to be selected by livestock, such as sagebrush, were discarded. The remaining plants were sent to Midwest Labs in Omaha, NE where a nutrient analysis is performed. The results from the three sites studied in 2006 are below:

	Coal Ck.	StoneHse	Hall Home
Crude Protein (%)	11.9	4.5	5.2
Acid Detergent Fiber (%)	42.6	44.5	45.8
Total Digestible Nutrients (%)	54	51.8	50.3
Net energy-lactation (Mcal/lb)	0.55	0.52	0.51
Net energy-maintenance (Mcal/lb)	0.52	0.49	0.47
Net energy-gain (Mcal/lb)	0.29	0.27	0.26
Sulfur (%)	0.15	0.07	0.06
Phosphorus (%)	0.21	0.07	0.06
Potassium (%)	0.68	0.39	0.3
Magnesium (%)	0.12	0.06	0.07
Calcium (%)	0.34	0.31	0.28
Sodium (%)	0.07	<0.01	0.03
Iron (ppm)	557	125	702
Manganese (ppm)	49	27	38
Copper (ppm)	5	2	2
Zinc (ppm)	21	13	14

When examining the sample results, note the superiority of Coal Creek. Crude protein, total digestible nutrient (a measure of energy), and many of the trace minerals are all at higher levels than the other two sites. The samples from Stonehouse and Hall Homestead more closely represent nutrient content of rangeland plants in mid-September. Interestingly, when the Coal Creek site was first sampled in 2002, nutrient content was also high. We cannot explain such results. It is worth considering that in both years, plants sent to the lab would have been nearly entirely Western wheatgrass.

None of the samples shows signs of toxicity with trace minerals, but several trace minerals were below desired levels. These, specifically, were copper, zinc, and phosphorus.

As has been done in previous years, each of these samples will be assessed in relation to the needs of an 1100-pound lactating cow of average milking ability. Using the Nutrient Requirements of Beef Cattle tables (NRC, 1984), the requirements of this cow are stated as follows:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	2#	12.1#	27g	22g

If this animal meets her dry matter requirements, the sample obtained at **Coal Creek** will provide the following:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	2.6#	11.6#	33g	21g

This cow's protein requirements were easily met by the high protein content of the sample. Her energy levels (TDN) were short by 0.5 pounds per day. Calcium was abundant in the sample, and the cow's phosphorus

requirement was nearly met. Further, the calcium to phosphorus ratio was 1:1.5, which is well within the recommended limit of 1:7.

The **Stonehouse** sample will provide the following to the same 1100-pound cow, assuming she meets her dry matter requirements:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	1#	11#	30g	7g

As can be seen, the forage sample does not meet the needs of the lactating cow. She is short significantly in protein and phosphorus. The calcium to phosphorus ratio is 1:4 and within acceptable limits.

Finally, the **Hall Homestead** will provide the following to the same cow:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	1.1#	10.9#	27g	7g

Like the Stonehouse sample, forage from Hall Homestead falls short of meeting the cow's needs.

Management recommendations gained from nutrient analysis

Compiling data on a nutrient analysis serves as a guide for management in considering nutritional factors as they relate to livestock performance. It is intended to be a "shotgun" approach to examining livestock performance, rather than serving as a precise science. Note that in any given pasture, forage sampled is not the only forage available to a grazing animal. The 1100-pound lactating cow may find different plant species within the same pasture that may improve her performance. The following recommendations are intended to help management prevent problems with the analyses presented here.

Rangeland plants lose their ability to meet the needs of a lactating cow as they begin dormancy. Timing of dormancy onset varies by year. These data make a case for either locating the herd of cows with their calves in pastures whose forage is better (such as haygrounds), or weaning. Early weaning will help maintain the body condition of the cow with the onset of winter, as she is not "pulled down" by her calf.

Should calves be left on the cow on dry rangeland pastures well into fall and early winter, these data support supplemental feeding of the cow. Have the ranch's hay tested for nutrient content. It is likely that the ranch's own hay stores will meet the protein needs of a dry cow. This makes purchase of costly protein supplement unnecessary. Meet the cow's trace mineral's needs with mineral supplementation in the last trimester of pregnancy.

MONITORING METHODS

On September 16, 2006, Mark Gordon of Merlin Ranch and Todd Graham of Aeroscene toured Ucross Ranch, examining potential study sites. They selected three study sites to be sampled in 2006.

Todd Graham read those transects on the same day. He laid out a 200-foot tape measure along the soil surface that served as the basis of the monitoring protocol. A variety of methods were then conducted from this tape measure (Figures 1 and 2).

Figure 1: five-gallon bucket lids used to mark transect locations

Each location was photographed and described. This description included a list of plants, activities of animals, and type of soil and terrain. A background field form was used to record the following information:

1. Site name;
2. Date;
3. Investigators;
4. Location description;
5. Details of transect layout and orientation;
6. Production characteristics (from area soil survey);
7. Current weather conditions;
8. History of pasture use;
9. Wildlife observations;
10. Soil characteristics;
11. Vegetation characteristics; and
12. Reasons for site choice.

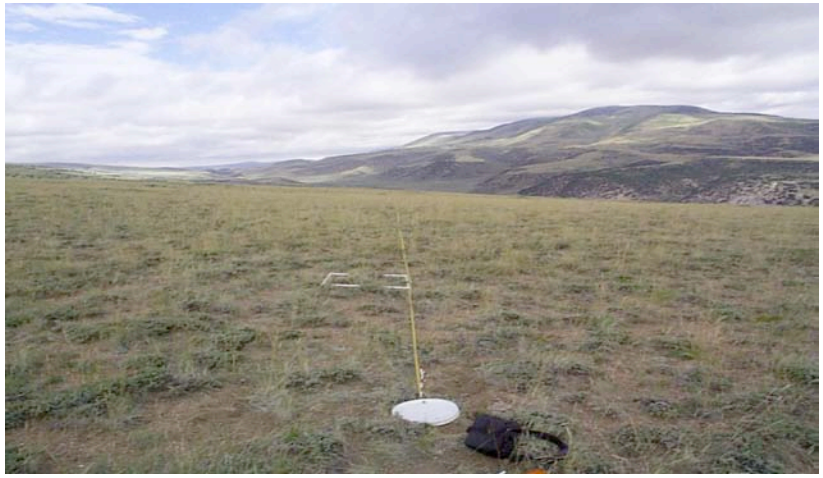


***Figure 2: Permanent transects were 200 feet long and were permanently marked* on each end.**

Ten plots along the transect line were examined and 16 indicators of rangeland health were evaluated (Figure 3). The first plot lay at the 10-foot mark on the tape measure, and each successive plot was read at 20-foot intervals (10,

30, 50, 70 feet, etc.) Ocular utilization estimates were also recorded.

A rangeland health qualitative scoring guide accompanies this document that portrays how each of the 16 indicators was evaluated. Each indicator is assigned a score from one to five, with five being the score that best reflects achievement of the landscape goals for that site. As an example, consider the "litter distribution" indicator. If it was found that litter displayed "mostly uniform, slightly patchy" appearance, this indicator would be assigned a score of "4." Each of the 16 indicators was scored in this way at each of the 10 plots.

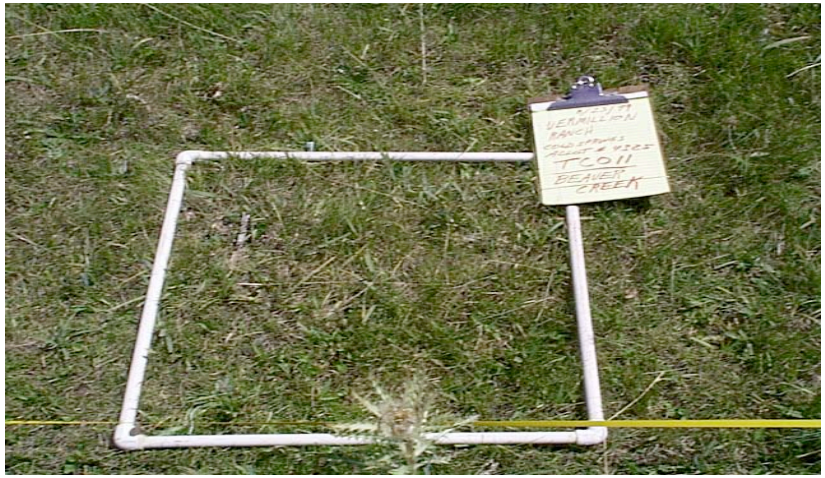


Figure 3: The first plot on a transect. [This plot lies in Colorado.]

When all 10 plots have been evaluated, the scores for each indicator are tallied. Using the litter distribution indicator example, the scores may read 4, 3, 5, 2, 4, etc. up to ten plots. Assume that this indicator's score totaled 36. (If all plots received a "5", a perfect score would be achieved at 50 points.) Then, multiply this score by two. This allows the indicator's score to be plotted on the target (Figure 4) for visual portrayal on a 100 point scale. In the example, litter distribution would receive a 72 for its score. This indicator would be plotted on the Web at the 72 mark, which lies in the silver target zone. Using the colors of the Olympics, gold is preferred, silver in the mid range, and bronze is least desired.

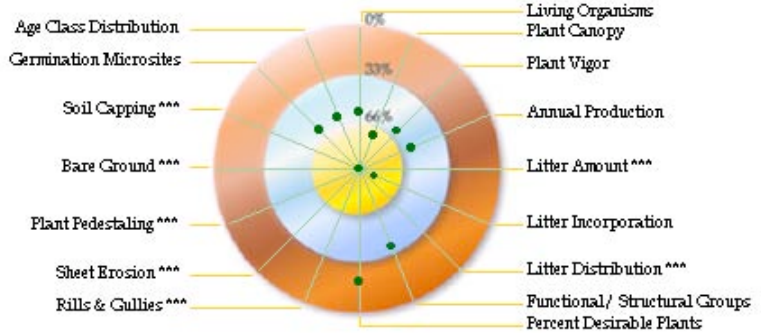


Figure 4: The target portrays results of each of the 16 indicators studied based on field scores.

An overall site score is then sought. This score is calculated by averaging the total score for each of the 16 indicators. For example, adding the scores for all 16 indicators together may produce a total of 1456. By

dividing this figure by 16, an overall site score of 91 is achieved. The overall site score will be displayed in the "Additional Information" box. This figure will change through time, and progress toward the stated landscape description goal can be tracked.

Additionally, the 16 indicators of rangeland health provide information for making management decisions. This report provides a brief narrative on how each indicator was evaluated and what management recommendations arose through their evaluation.

The Wyoming State Range Site Guide suggests potential production for each site. The site's average-year production figure was used to produce the bar graph featured in Figure 5 below. A single plot was clipped at each site. The clipped plants were dried, and then weighed. The resulting weight in pounds per acre is displayed as the "today" figure.

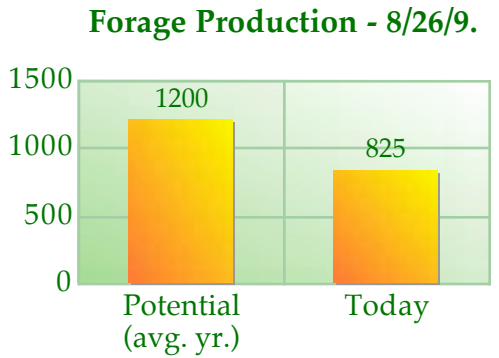


Figure 5: Plant production on sample day as compared with the site's potential from the soil survey.

While looking in each study plot, that species estimated to be most abundant by weight is evaluated. A value of "5" is then assigned for that species. The next most abundant by weight received a "4" and so on until the five most abundant species by weight have been recorded. The procedure is repeated for all 10 study plots. The percentage composition of each species is calculated based on its scoring versus other species encountered in the plots. The most abundant will have the highest scores and the highest percentage composition. A chart with the five heaviest species is then generated like the one featured in Figure 6 below.

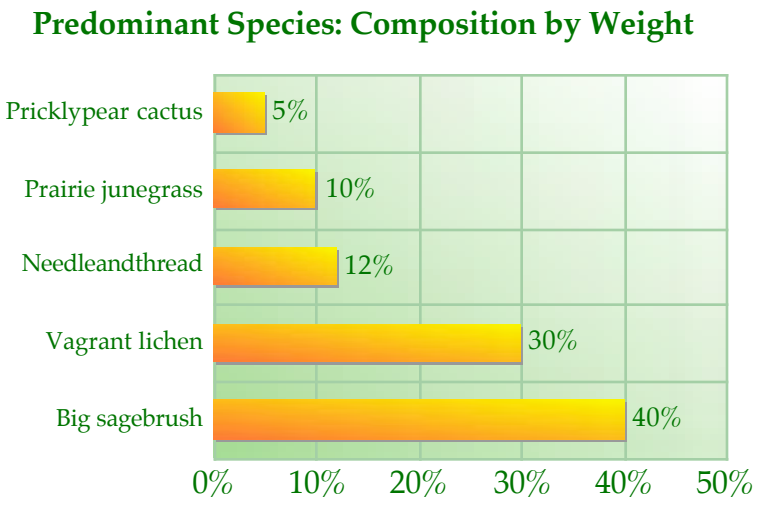


Figure 6: The most abundant species as composition by weight.

A sample of forage plants most likely to be selected by cattle is sent to Midwest Labs, Inc. in Omaha, Nebraska. The nutrient analysis returned is presented in the body of this report.

The procedure also uses the 200-foot tape measure as a base for collecting information such as ground cover and plant density. Using the point intercept method, a steel rod is lowered to the soil surface using a point frame (Figure 7).

Figure 7: The point frame used in point intercept sampling for gathering ground cover and plant density data.

The rod is lowered to the soil surface every other foot along the 200-foot tape measure. At each point, ground cover is classed as bare soil, litter, or live plant cover. After examining all 100 points, the percentage of each class is calculated. A pie chart is generated portraying the results (Figure 8).

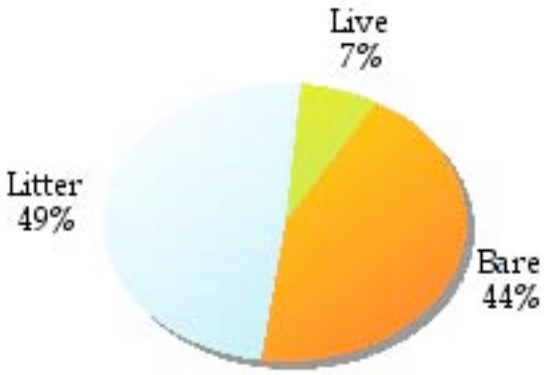


Figure 8: The ground cover chart generated by using the point intercept method.

At each point ground cover data was collected, data on basal cover by plant species was gathered. When the point intercept rod was lowered to the soil surface, the distance to the nearest perennial plant was measured. The average distance for all 100 points is calculated and the average distance to nearest perennial figure is found and displayed in the "Additional Information" box. Simultaneously, this nearest plant's species was recorded. The seven species representing the closest perennial plants (the most dense) are portrayed in the "Basal Cover by Species" bar graph (Figure 9).

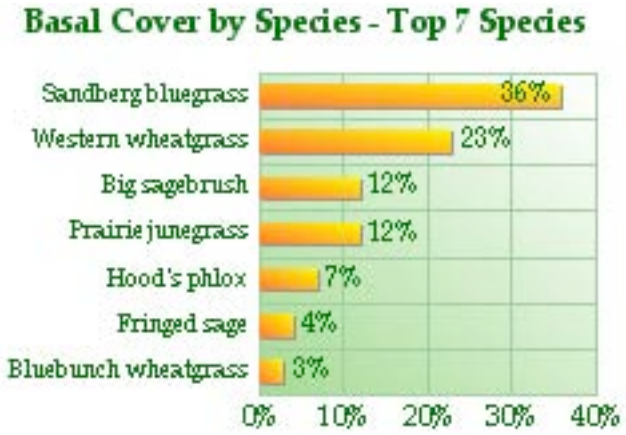


Figure 9: Basal cover by species bar graph created by measuring the distance to the nearest perennial plant using the point intercept method. The seven most numerous species are displayed here.

This means of collecting plant density data was developed by the Holistic Management International in Albuquerque, NM.

Rangeland Health Indicators Scoring Guide

Side One

Indicator	5	4	3	2	1
Living Organisms	Abundant signs of non-plant life. Many different life forms.	Several signs of non-plant life; different life forms.	Moderate signs of non-plant life. Some different life forms.	Few signs of non-plant life and different life forms.	Little, if any, sign of non-plant species.
Plant Canopy	Canopy: 81 -100% of plot. Best photosynthetic activity.	Canopy: 61-80% of plot. Good photosynthetic activity.	Canopy: 41-60% of plot. Moderate photosynthetic activity.	Canopy: 21-40% of plot. Photosynthetic area low.	Canopy 0-20% of plot. Photosynthetic area very low.
Plant vigor	Capability to produce seed or vegetative tillers is not limited relative to recent climatic conditions.	Capability to produce seed or veg. tillers is only slightly limited relative to recent climatic conditions.	Capability to produce seed or vegetative tillers is somewhat limited relative to recent climatic conditions.	Capability to produce seed or vegetative tiller is greatly reduced relative to recent climatic conditions.	Capability to produce seed or vegetative tillers is severely reduced relative to recent climatic conditions.
Annual Production	Exceeds 80% of potential production.	60-80% of potential production.	40-60% of potential production.	20-40% of potential production.	Less than 20% of potential production.

Indicator	5	4	3	2	1
Litter Cover	30-70% of soil surface in plot covered with litter.	20-30% of soil surface in plot covered with litter.	10-20% of soil surface in plot covered with litter.	1-10% of soil surface in plot covered with litter.	No litter present on soil surface in plot.
Litter Incorporation	Litter mixing well with soil, resulting in more rapid mineral cycle.	Litter partially mixing with soil. Litter contacting soil.	Some mixing of litter with soil. Some elevated litter.	Reduced mixing of litter with soil; elevated litter; lesser litter amount.	Litter amount is light, resulting in slow cycling.
Litter distribution	Uniform across plot.	Less uniformity of litter cover in plots.	Litter becoming associated with prominent plants or other obstructions.	Plot showing general lack of litter, with patches around prominent plants.	Litter largely absent.
Functional/ Structural Groups	F/S groups and number of species in each group closely match that expected for site.	Number of F/S groups slightly reduced and/or number of species slightly reduced.	Number of F/S groups moderately reduced and/or number of species moderately reduced.	Number of F/S groups reduced and/or number of species significantly reduced.	Number of F/S groups greatly reduced and/or number of species dramatically reduced.
Percent Desirable Plants	Desirable species exceed 80% of plant community. Scattered intermediates.	community are desirable species. Remainder mostly intermediates and/or a few undesirables present.	40-60% desirable plant species. And/or some presence of undesirable species.	20-40% of desirable plant species in plot. And/or strong presence of undesirable species.	Less than 20% of plants are desirable species. And/or undesirable species dominate plot.

Rangeland Health Indicators Scoring Guide

Side Two

Indicator	5	4	3	2	1
Rills and Gullies	Rills or gullies absent.	Rills or gullies with blunted and muted features.	Rills or gullies small and embryonic, and not connected into a dendritic pattern.	Rills and gullies connected with dendritic pattern.	Well defined and actively expanding dendritic pattern.
Scouring or sheet erosion	No visible scouring or sheet erosion	Small patches of bare soil or scours. No desert pavement.	Patches of bare soil or scours developing. Formation of desert pavement.	Patches of bare areas or scours are larger. Desert pavement more widespread.	Bare areas and scours well developed and contiguous. Abundant desert pavement.
Plant pedestaling	No pedestals present.	Active pedestaling or terecette formation is rare.	Slight active pedestaling.	Moderate active pedestaling. Occasional exposed roots.	Abundant active pedestaling. Exposed plant roots are common.
Bare ground	Amount and size of bare areas nearly to totally match that expected for the site.	Slightly to moderately higher than expected for the site. Bare areas are small and rarely connected.	Moderately higher than expected for the site. Bare areas are of moderate size and sporadically connected.	Moderately to much higher than expected for the site. Bare areas are large and occasionally connected.	Much higher than expected for the stie. Bare areas are large and generally connected.

Indicator	5	4	3	2	1
Soil Crusting	No physical crusting present.	Recently formed physical crust seen over some of plot.	Recently formed physical crust seen over much of plot.	Older physical crust formed over much of plot.	Plot dominated by older physical crust.
Germination Microsites	Microsites present and distributed across the site.	Some formation of crust, soil movement, litter that would degrade microsites.	Developing crusts, soil movement, and/or litter degrading microsites; developing crusts are fragile.	Soil movement, crusting, litter, lack of protection sufficient to inhibit some germination and seedling establishment.	Soil movement, crusting, litter, lack of protection sufficient to inhibit most germination and seedling establishment.
Age class distribution	Variety of age classes seen in plot.	Some sign of seedlings and young plants.	Seedlings and young plants missing.	Some deteriorating plants present.	Primarily old or deteriorating plants present.

RANGELAND HEALTH

In its 1994 report Rangeland Health, the National Research Council defined rangeland health as the degree to which the integrity of the soil and the ecological processes of rangeland ecosystems are sustained. Range in good health produces more forage and better wildlife habitat, while watershed condition is improved, resulting in more stable stream flows and higher water quality (NRC, 1994). Healthy range generally supports more plant and animal diversity and provides greater ecological stability in terms of productivity and population flux.

The monitoring methods used here were intended to observe changes in rangeland health through time. Both qualitative observations and quantitative methods were employed. Both are intended to provide decision-making information to land managers. Methods used in generation of this report are aligned with the findings with the Rangeland Health document.

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