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MERLIN RANCH

2005 RANGE REPORT FOR UCROSS AND MERLIN RANCHES

Prepared for
Merlin Ranch, Ucross Division
Management Team

Prepared by Rangewise

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INTRODUCTION

This document presents the findings of four rangeland health monitoring transects read on Merlin and Ucross Ranches in early September 2005. One of these at Ray's Ravine, was established in 2001. It was re-read in 2005 to examine changes in rangeland health. Another transect was established in 2005 on the newly acquired Shady Lane Pasture. Finally, two other transects were established on Merlin Ranch, one on the Hall Pasture and one in the Hall Homestead Pasture. In 2005, the Hall Pasture was being considered for renovation by a Lawson Renovator.

Merlin and Ucross Ranches seek improved rangeland health and wildlife habitat. Ucross began its own rangeland monitoring effort in summer 2000, and the Rangewise service was added to it repertoire in summer 2002. Rangewise established transects at the following locations:

2002 – Ray's Ravine, Coal Creek Pasture;
2003 – Stonehouse;
2004 – Sahara Draw Pasture, North Childress Pasture.

The studies serve to help management analyze proper timing of grazing, stocking rates, stock densities, plant recovery periods between grazings, and nutrients supplied by forage for anticipating livestock performance and needs.

The next section of this report briefly summarizes findings and management recommendations from each study site. It then briefly reviews four ecosystem processes serving as the basis of the rangeland assessment.

The report then presents the findings from the Ray's Ravine study. These will then be compared with the data taken in 2001. Results from each of the other three transects will be presented.

Next, nutrient samples from clipped plants are analyzed. Lastly, the monitoring methods used in collecting the data are described.

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

SUMMARY OF FINDINGS AND MANAGEMENT RECOMMENDATIONS

Ray's Ravine

A transect was first established here in 2001 and reread in 2005. Production was much higher in 2005 in the single plot clipped. Production and basal cover of the desired bunchgrass green needlegrass improved significantly. However, the desired species winterfat appeared to decline in both productivity and basal cover. Ground cover did not change between the two years. The total number of plant species found in the area increased slightly.

Management should celebrate the increased presence of green needlegrass. Such recovery of this desired species suggests recovery periods between grazings have been adequate and that utilization rates have not been excessive. The decline in winterfat warrants further attention. Prevent heavy use of winterfat, especially during winter grazing.

Hall Pasture

This site is being considered for a Lawson Renovator treatment whose intent is to disturb sagebrush dominance in the area and favor the growth of perennial grasses and forbs. The study site was specifically chosen in the pasture in an area that lacked forbs and grass as compared with other areas in the pasture. Sagebrush in the area was of nearly the same age class, with a canopy cover of 48%.

The Lawson treatment should help promote the growth of forbs and grasses in the area in the short term, as sagebrush will be greatly disturbed. The Lawson machine also heavily impacts the soil. Post-treatment, management must monitor this area and watch for the potential growth of noxious weeds resulting from such heavy soil disturbance. Management must also ensure that grazing durations remain short and utilization rates are not excessive as disturbed plants recover from the treatment.

Hall Homestead

The site was chosen as an area of concern, in which additional perennial bunchgrasses and forbs preferred by wildlife are desired. This area contained a large number of plant species for such a rangeland setting at 38. It also contained nearly 50% bare ground, which is too high. Species such as threadleaf sedge and Western wheatgrass were abundant, suggesting past grazing durations or utilization rates may have been excessive. Conversely, desired species such as needleandthread and bluebunch wheatgrass were also prominent in the area. In time, it is hoped that the presence of these desired plants increases.

During the early season grazing event, utilization rates were not excessive. Plants that were bitten showed significant regrowth and had produced vigorously during the growing season. If this area is to be grazed twice in the same growing season, the key to improved rangeland health here will be a light spring grazing, followed by adequate plant recovery during the summer, before the pasture can be grazed again.

Shady Lane

This pasture was a newly acquired addition to the Ucross Ranch. Indicators revealed that the pasture had been grazed for long durations and low stock densities in the past. Much plant material had accumulated near sagebrush plants and was not being incorporated into the soil. In 2005, management reversed this practice with high stock densities and a much shorter grazing duration. The effect was to return much standing dead plant material to the soil surface where it can be broken down by microorganisms of decay. The new litter will also help prevent erosion. Thus, the grazing/hoof action event of 2005 helped promote speed of the mineral cycle and effectiveness of the water cycle.

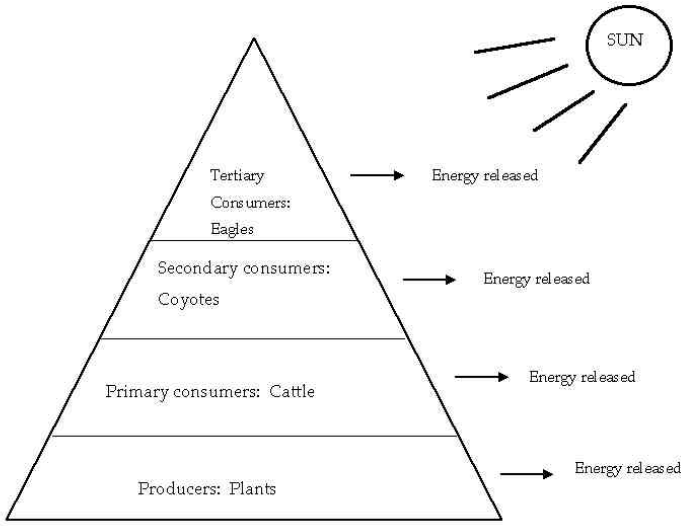
Consider grazing this pasture early in the growing season. With a greater chance of soil moisture, hoof action will be more effective here, and the litter returned to the soil in 2005 may then be mixed with the soil as mulch. This should help speed the mineral cycle further. Then, rest the pasture through the hot growing season and provide plants recovery time through the growing season. This is something they have not known with past management. The effect should be to increase plant vigor throughout the pasture.

Nutrient analyses

Plants were clipped at each site and sent to a lab where a nutrient analysis was obtained. Results for each site are displayed in the body of the report. The Hall Homestead site returned a superior sample with high crude protein and trace minerals. Ray's Ravine had reasonably high protein, but quite low phosphorus and other trace minerals. Both the Hall Pasture and Shady Lane had low crude protein levels, but better levels of trace minerals.

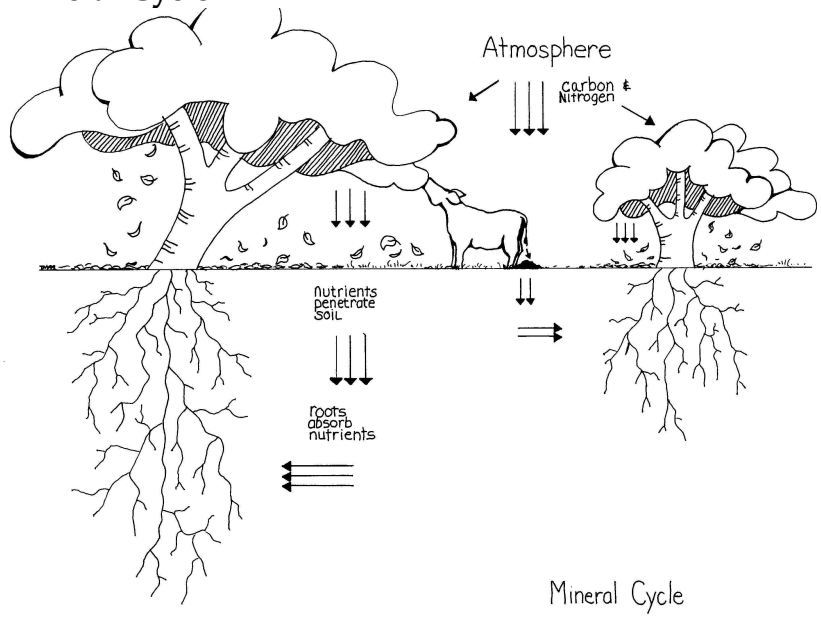
The ecosystem processes of energy flow, mineral cycle, water cycle, and succession are reviewed next.

Energy Flow



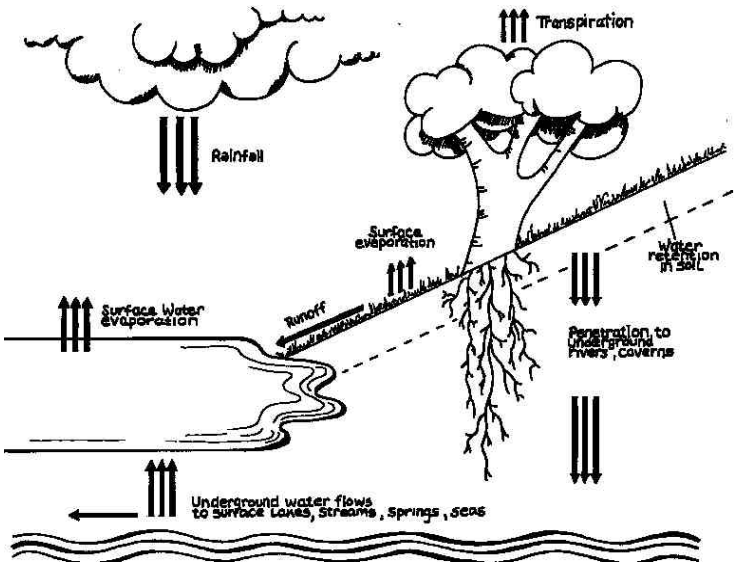
Almost all life requires energy that flows daily from the sun. The basic conversion of this solar energy to useable form takes place through plant material on land and in water. Energy passes from plants to whatever eats them, and in turn eats the consumers of the plants. Energy doesn't cycle, but flows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

Mineral Cycle



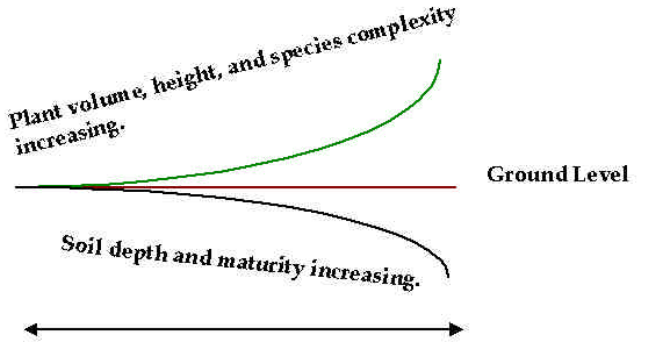
An effective mineral cycle requires covered soil and high biodiversity. When effective, many nutrients cycle between living plants and living soil continually. When soil is exposed and biodiversity low, nutrients become trapped at various points in the cycle, or are lost to wind and water erosion (Savory,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

Water Cycle



Like mineral cycling, an effective water cycle also 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, most 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).

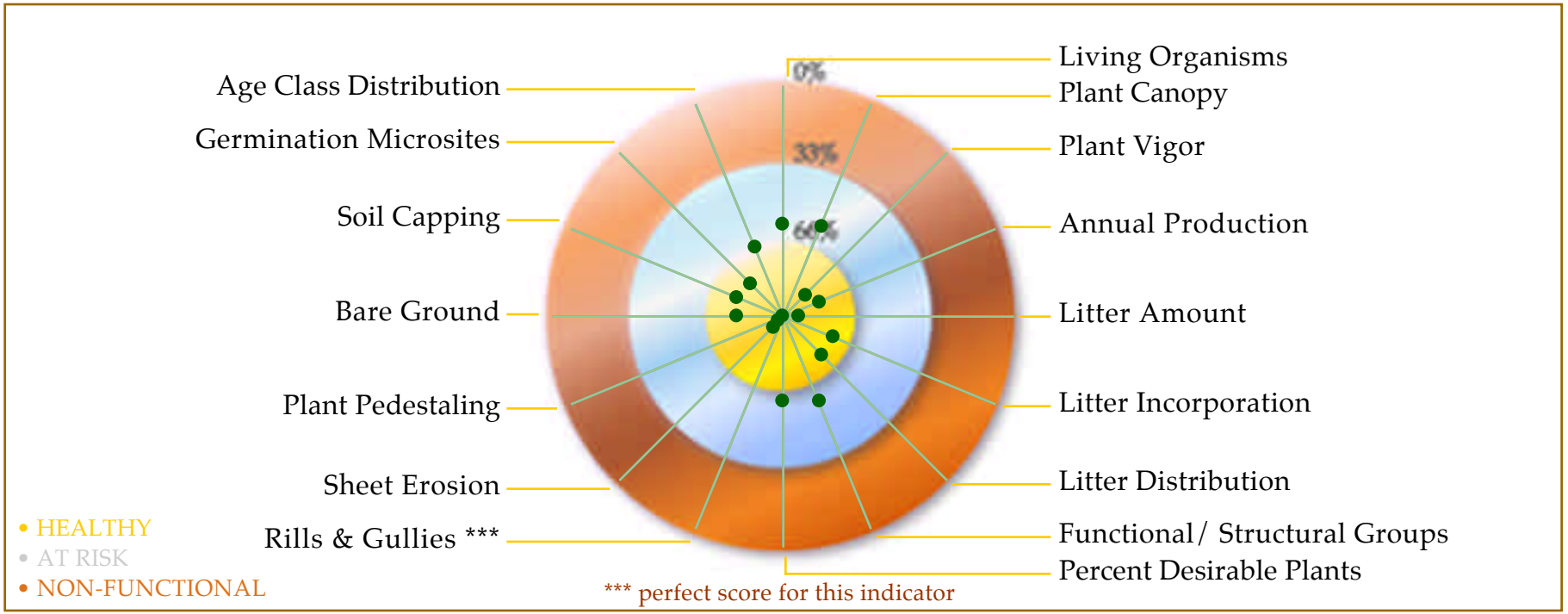
Community dynamics



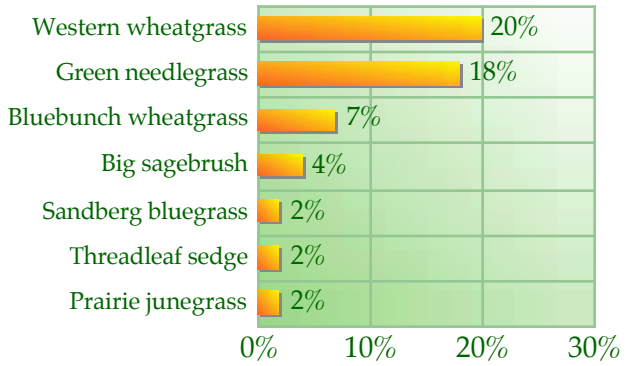
Fewer species	More species
Greater number of individual species	Lower numbers of each species
Wider fluctuations	Greater stability
Increasing floods and droughts	Decreasing floods and droughts

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.

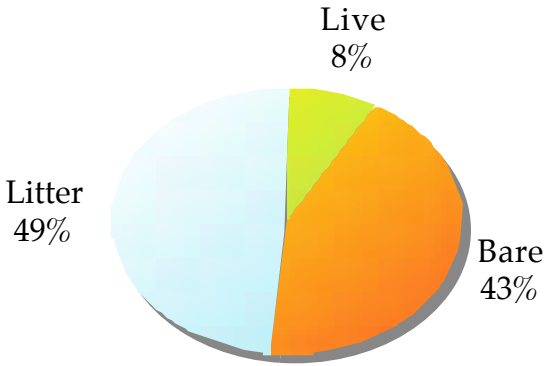
Data summaries from
Merlin Ranch
study sites of
Ray's Ravine
and Shady Lane
follow



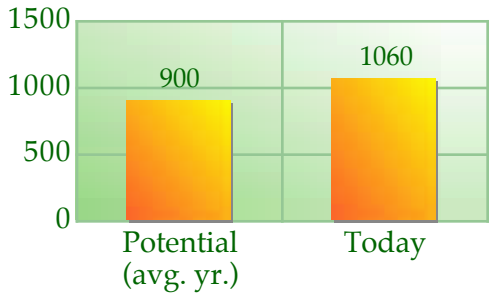
Basal Cover by Species - Top 7 Species



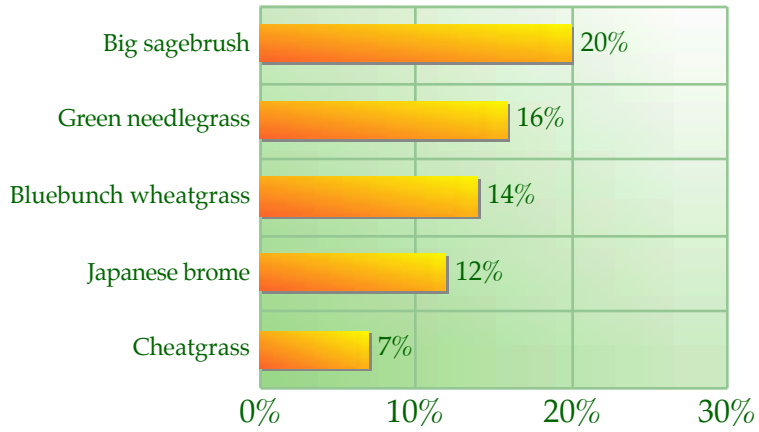
2005 Basal Cover



Forage Production



Predominant Species: Composition by Weight



Additional Info: Overall Site Score: **78**

Apparent range trend:

Site sampled September 4, 2005.

24 plant species encountered at site.

Big sagebrush data:
Line intercept: 10 plants encountered, 14% canopy cover.
Average plant height: 22 inches.
90% mature plants, 10% decadent.
Belt transect: 37 big sage plants growing in 600 square feet.

Relative basal plant spacing: 1.7 inches.

Plant species encountered at site:

Green needlegrass
Needleandthread
Bluebunch wheatgrass
Japanese brome
Western wheatgrass
Prairie junegrass
Big sagebrush
Broom snakeweed
Silver sagebrush
Winterfat
Lepidium species
Leafy spurge
Tansymustard
False dandelion
Scarlet globemallow
Plains daisy
2 unknown perennial forbs
Sixweeksgrass
Needleandthread
Cheatgrass
Threadleaf sedge
Hood's phlox
Sandberg bluegrass

Ray's Ravine (Transect MRT01)

This site was chosen in 2002 to represent the area of Ray's Ravine. It was reread in 2005 to track changes in rangeland health.

The first plot studied at the Ray's Ravine site.

The first indicator studied was **living organisms**. We noted signs of rabbits and pronghorn. Flies, ants, grasshoppers, and a red tailed hawk were observed. This indicator received a 60.

The **plant canopy** varied over the study plots, where some plots contained abundant plant material that collected sunlight energy, while others with little canopy allowed energy to strike the soil surface. This indicator received a 57.

Plant vigor received a high score at 87. Most plants in the study plots were of tall stature, were firmly rooted to the soil surface, and many had produced seed in 2005.

Annual production was high in the area. Production in the single clipped plot surpassed the suggested level of production expected for such a site. Production in the study plots did not all reach the clipped plot's level of performance, but production in each study plot was strong. This indicator received an 83.

The **amount of litter** seen in the study plots was high. This indicator received a 93. Further, different years worth of litter were observed on the soil surface, suggesting that past utilization rates on this site have not been excessive.

Litter incorporation received a 77. Some litter in the study plots was elevated above the soil surface, but most of it was contacting the ground. In no plots was litter mixing strongly with soil.

In most study plots, litter was well **distributed** across the soil surface. In others, however, it had more of a patchy appearance. This indicator received a 77.

When examining **structural and functional groups**, six to seven plant species were found in each plot. Additional plant species are required in these plots with their varied root structures that will help elevate nutrients stored at different levels of the soil profile. This indicator received a 60.

Within **percent desirable plants**, many of the desired plant species were present in the plots. However, undesired species such as leafy spurge, cheatgrass, and Japanese brome still have a strong presence in the community. This indicator received a 63.

No signs of water erosion were seen. **Rills and gullies** received a perfect score.

Some signs of **wind erosion** were observed in only one of the plots. This indicator received a 93.

Minor **plant pedestals** were seen in only one of the plots. This indicator received a 97.

Some of the study plots contained significant **bare ground**, while others contained none. Further, the point intercept method revealed that 43% of the soil surface lacked cover. This is not unreasonable for this site, but room for improvement exists. This indicator received an 80.

Only a recent **soil crust** was found on the soil surface. This indicator received a 78.

Germination sites were numerous on the soil surface. The success of a new plant's growth would only be limited by lack of protection from herbivory if it began growing in a spaces between plants. This indicator received an 80.

Different **age classes** of plants were observed in the study plots. Younger age classes of green needlegrass and bluebunch wheatgrass were evident. This indicator received a 67.

Additional comments:

Energy flow was at moderate levels, where the plant canopy intercepted much sunlight energy, but some of it struck the soil surface without being captured by living plants. The mineral cycle was rapid, but could still be improved with better litter incorporation. The water cycle was effective. Within community dynamics, the desired species of green needlegrass appears to be increasing dramatically in the area. See the data tables on the following pages and the discussion that follows for more on this trend. Range trend was improving.

Management recommendations:

Management has taken many strides to improve this site already. (See discussion on following pages.) As this pasture is grazed at different times of the year, management should focus on two areas that will allow continued improvement.

The first of these is preventing excessive harvest of plants. Manage for more moderate levels of use. Remember that during the growing season, perennial bunchgrass plants tend to stop growing if over 50% of the plant's leaf material is removed. As evidenced by litter amount on the soil surface, management in recent years has excelled in this regard.

The second means of continuing to improve this site is ensuring that abundant opportunity exists for plants to regrow between grazings. As evidenced from comparing data from 2002 to 2005, management has also done well here.

Early-warning indicators

If management actions are improperly applied here, look first for increases in bare soil and decreases in litter amount. Also look for decreased plant vigor and signs of erosion.

If managemet actions are properly applied in the area, look for continued improvements in plant vigor, even during dry years. Look for the amount of bare ground to diminish and the amount of litter to increase. In time, favorable changes in species composition will also become evident.

The following pages present data from the Ray's Ravine site taken in the years 2002 and 2005. A discussion of these data follows.

Ray's Ravine transect view Photo taken September 25, 2002

Ray's Ravine transect view Photo taken September 4, 2005

First plot studied at Ray's Ravine. Photo taken September 25, 2002

First plot studied at Ray's Ravine. Photo taken September 4, 2005

SAGEBRUSH DATA

2002	2005	
		Line intercept:
13	10	*Number of big sage plants encountered*
		Line Intercept: Age Class Distribution
0%	0%	seedling
8%	0%	young
92%	90%	mature
0%	10%	decadent
15 inches	22 inches	*Average plant height*
12%	14%	*Percent canopy intercept*
62	37	*Density per 600 square feet*

PRODUCTION: Pounds per acre

2002	2005
400	1060

ADDITIONAL INFORMATION

Site sampled August 22, 2002.
Site sampled September 4, 2005.

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

	2002	2005
	Big sagebrush	Big sagebrush
	Bluebunch wheatgrass	Green needlegrass
	Western wheatgrass	Bluebunch wheatgrass
	Prairie junegrass	Japanese brome
check this	Winterfat	Cheatgrass

BASAL COVER

2002	2005	
43%	43%	Bare
49%	49%	Litter
8%	8%	Live

RELATIVE BASAL PLANT SPACING

2002	2005
1.1 inches	1.7 inches

RELATIVE BASAL PLANT SPACING BY SPECIES (TOP 7 SPECIES)

2002	2005
Western wheatgrass	Western wheatgrass
Bluebunch wheatgrass	Green needlegrass
Big sagebrush	Bluebunch wheatgrass
Winterfat	Big sagebrush
Hood's phlox	Sandberg bluegrass
Longleaf phlox	Threadleaf sedge
Prairie junegrass	Prairie junegrass

PLANT SPECIES FOUND IN TRANSECT AREA

2002	2005	
22	*24*	***Total count***
X	X	Prairie junegrass
X	X	Western wheatgrass
X	X	Cheatgrass
X	X	Japanese brome
X	X	Sandberg bluegrass
X	X	Bluebunch wheatgrass
X	X	Needleandthread
X	X	Green needlegrass
X	X	Threadleaf sedge
X	X	Lepidium species
X	X	Hood's phlox
X	X	Tansymustard
X	X	Scarlet globemallow
X	X	Plains daisy
X		Curlycup gumweed
X	X	Leafy spurge
X		Pricklypear cactus
X		Longleaf phlox
X	X	Big sagebrush
X	X	Winterfat
X	X	Broom snakeweed
	X	Sixweeks grass
	X	Silver sagebrush
	X	False dandelion
	2	Unknown perennial forbs
X		Kentucky bluegrass

DISCUSSION OF RAY'S RAVINE DATA

Photos

When examining the photos on the previous page, note first the more vigorous grass growth in 2005 versus 2002. Grasses grew much more robustly in the later year. Further, note the lack of vigor on sagebrush plants in 2002. Sagebrush displayed much more growth in 2005. Further, note in the photos of the quadrat that the sagebrush plant growing in the upper left-hand photo in 2002 was dead in 2005. These photos suggest that 2005 was a much better moisture year than 2002 and that sagebrush appears to be replacing itself in the community. See more comments below.

Sagebrush data

Sagebrush data was gathered using line intercept methodology where sagebrush plants, the canopy of those plants, and the height of the respective plants are counted along the transect's tape measure. A slight decrease in the number of plants encountered along the tape measure was found. When examining the age class of these plants, the younger plants found in 2002 appeared to be more mature, while some in 2005 appeared to be decadent. This suggests this species is replacing its members in the community. Further, the average plant height figure suggests those plants grew to taller stature by 2005. This complements the percent canopy cover figure for both years. Thus, while there were fewer plants along the tape measure in 2005 versus 2002, the plants that were there got bigger.

The density of sagebrush found on the transect site showed significant change. The measurement was taken by carrying a five-foot long rod along the tape measure and counting the number of brush plants rooted within the resultant area. These data suggest that the density of sagebrush at this site dropped significantly.

Note: All data collection methods are described in the Methods section of this report.

Production

Production data was obtained by clipping a single plot of plants that appeared to best represent the area. Note that the production of plants was significantly higher in 2005. This could be both due to a better moisture year in 2005, and improved plant vigor in the area. With a change in management, it is possible that area plants that now know longer recovery periods between grazings have a more abundant root structure are possess the energy to grow more leaf material above ground.

Composition by weight

This method assesses the most productive plants by weight. 2005 showed strong production of the desired bunchgrass green needlegrass. This species does not thrive with short recovery periods between grazings and heavy utilization rates. The fact that it was present in such abundance in 2005 shows strong improvement in this community's composition.

On the negative side, winterfat dropped from the list of the greatest producing species. Winterfat was found in the area, but not in the abundance it was in 2002. This

fact warrants continued monitoring of the site. The possibility does exist that this desired species is being overutilized by either wildlife or livestock, perhaps through winter use.

Basal cover

Basal cover of plant material did not change between the two years.

Relative basal plant spacing

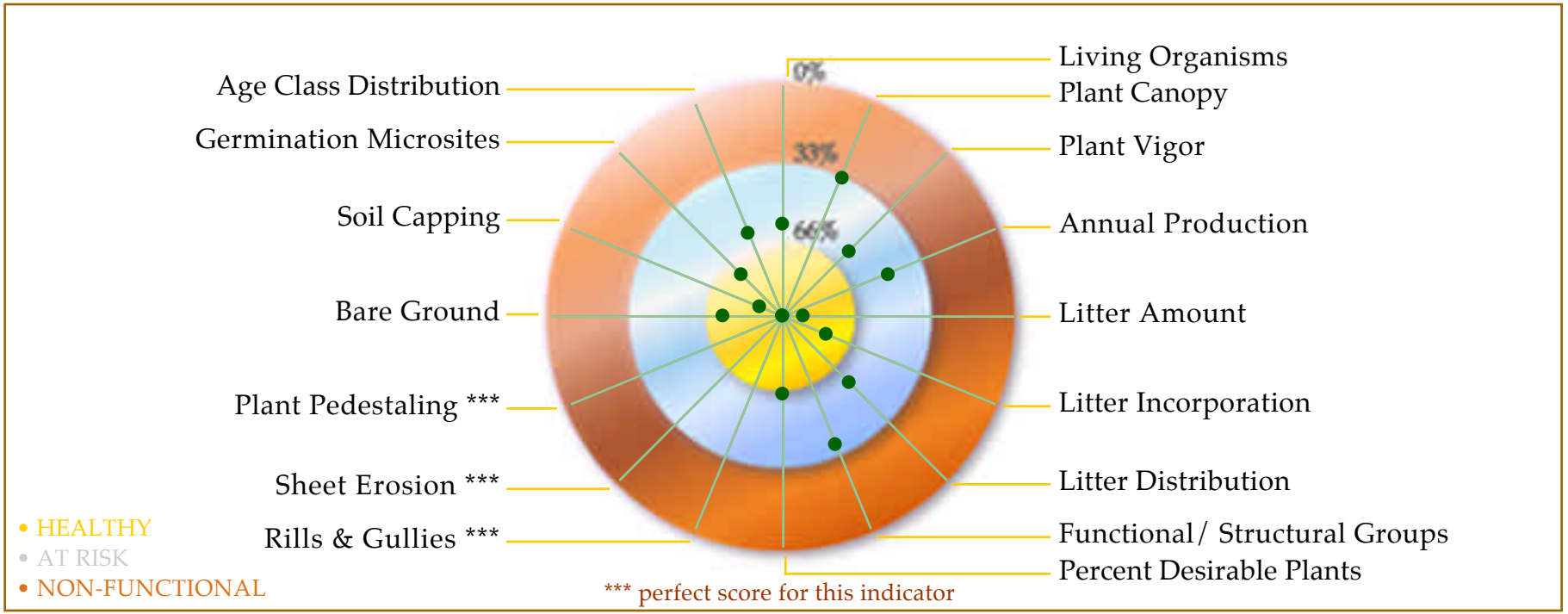
These data represent the relative distance between perennial plants. In general, small numbers are better, for it suggests the distance between perennial plants is not large. The fact that the average distance between plants grew by 0.6 inches is cause for concern. Where did the plants that grew in 2002 go? This is one of the few negative data sets for this transect. Production, composition by weight, and basal plant spacing by species suggest strong improvements. It is possible that competition from thriving desired species such as green needlegrass is driving other species away. Regardless of the reason, this measure requires continued attention.

Relative basal spacing by species

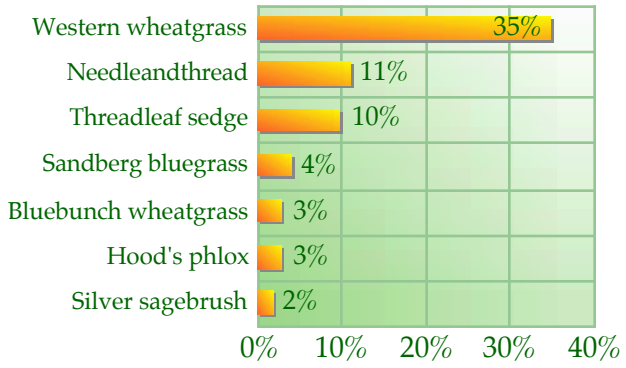
These data break down that relative distance between plants into composition by species. Again, note the strong presence of green needlegrass in 2005. This is highly encouraging. On the negative side, the presence of winterfat appeared to have decreased significantly between the two years. This bears further consideration.

Plant species list

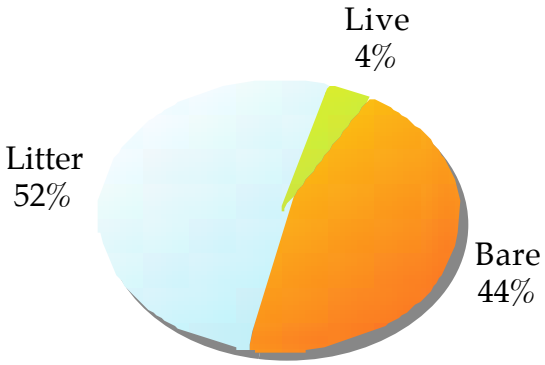
Two more plant species were found in 2005 than 2002. Silver sagebrush was found in 2005, but not in 2002. For such a site as Ray's Ravine, this may be a positive indicator. More perennial forbs were found in the area, which represents another positive sign. On the negative side, curlycup gumweed was not found in 2005. This is a species highly desired by sage grouse. It is a preferred species at Ray's Ravine.



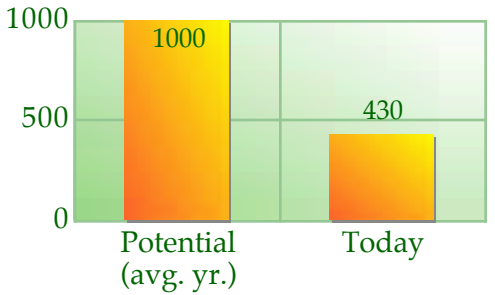
Basal Cover by Species - Top 7 Species



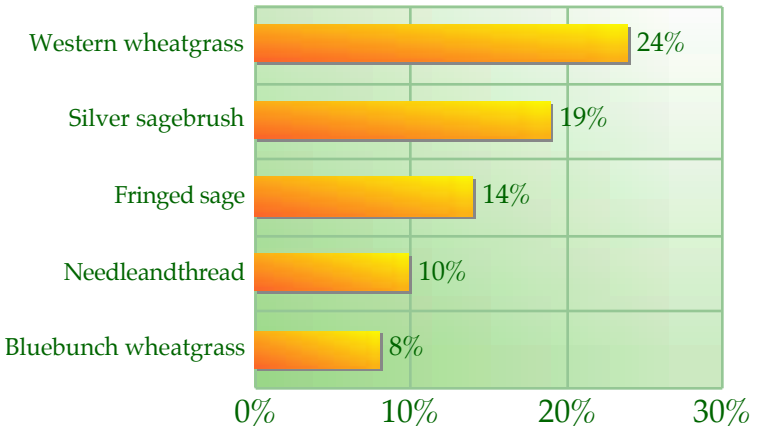
2005 Basal Cover



Forage Production



Predominant Species: Composition by Weight



Additional Info: Overall Site Score: **71**

Apparent range trend:

Site sampled September 4, 2005. 22 plant species encountered at site.
Big sagebrush data:
Line intercept: 19 plants encountered, 16% canopy cover.
Average plant height: 24 inches.
16% young plants, 68% mature, 16% decadent
Belt transect: 26 big sagebrush plants growing in 750 square feet.

Silver sagebrush data:
Line intercept: 10 plants encountered, 12% canopy cover.
Average plant height: 22 inches.
100% of plants were mature.
Belt transect: 66 silver sage plants growing in 750 square feet.

Relative basal plant spacing: 1.3 inches.

UTM coordinates of site: 13T 374222 4939213

Plant species encountered at site:

Japanese brome
Green needlegrass
Western wheatgrass
Blue grama
Needleandthread
Kentucky bluegrass
Prairie junegrass
Threadleaf sedge
Cheatgrass
Bluebunch wheatgrass
Sandberg bluegrass
Silver sagebrush
Big sagebrush
Fringed sage
Broom snakeweed
Serviceberry
Tansymustard
Leafy spurge
Lepidium species
Western yarrow
Vetch species
Unknown perennial forb

Shady Lane (Transect MRT08)

This site was chosen as an area representative of the Shady Lane Pasture. While sagebrush species were not always prominent in this steep draw, we chose the site specifically in a sagebrush stand to provide management additional information on changes in the sagebrush community through time.

The first plot studied at the Shady Lane site.

The first indicator examined at this site was **living organisms**, where a red tailed hawk, kestrels, ants, flies, rabbits, and bees were observed. Exo-skeletons of various insects and signs of pronghorn were also observed. This indicator received a 60.

The **plant canopy** was light in the area as can be seen in the photo above. Much sunlight energy struck the soil surface rather then being intercepted by desired plant leaves. This indicator received a lower score at 34.

Plant vigor received a 60. Plants in the area were firmly rooted to the soil surface and had grown to a good stature in the area, but many perennial bunchgrasses had not produced seed.

Production of the clipped plot was 430 pounds per acre, versus a potential in an average year of 1200. This clipped plot likely had lower production than the surrounding area and much less composition of sabgebrush. Signs of utilization were seen in the area: moderate use of western wheatgrass, light use of threadleaf sedge, and lght use of needleandthread. This indicator received a 51.

On this mild slope, the **amount of litter** was quite high. This indicator received a 91. Further, **litter incorporation** received a high score at 80. When examining these two indicators, an obvious recent change in management was observed. Examination of litter lying on the soil revealed that several years worth of litter had mixed together. It is presumed that older plant stems had remained connected to their plant base through time, or had been suspended above the soil surface. In 2005 management greatly increased stock densities in this pasture, resulting in more intense animal impact. It appeared as if hooves had knocked much of the elevated litter to the soil surface at one time, resulting in mixes of litter ages being collected on the soil surface. Soil contact should bring litter closer to soil-borne organisms of decay where it ma be broken down and reused by living plants. Thus, increasing stock densities as was done in 2005 likely resulted in improvements in both the mineral cycle and water cycle in one event.

Litter collecting on the soil described above was moderately well **distributed** across the soil surface. In the past, cattle likely selected certain plants as they remained in this pasture for lengthy grazing durations. Others, however, likely were avoided. In 2005 with a change in management, those plants that had likely gone ungrazed were disturbed through hoof action, resulting in much accumulated plant material being knocked to the soil surface all in one spot. Those plants that cattle had grazed in the past did not possess large accumulations of aging plant material. Thus, in 2005, a patchy distribution of litter appeared as a result of the hoof action applied. This indicator received a 60.

Functional and structural groups received a low score at 40. Some of the study plots contained fewer than five plant species. Others contained no forbs. Additional forbs and plant species are required to help cycle nutrients with different root structures and help catch wind-driven snow through different plant canopies.

The **percent desired plants** indicator received a 66. Desired shrubs and grasses were present and usually in abundance. Having more forbs in the area will help this score improve.

No signs of soil erosion were observed. Perfect scores were awarded for **rills and gullies**, **scouring/sheet erosion**, and **plant pedestaling**. It is likely that the increased stock densities applied in 2005 aided function of the water cycle adding so much organic material to the soil that helps trap moisture and prevent erosion.

The amount of **bare ground** was recorded to be 44% through the point intercept method. For this upland site on a mild slope, this amount is reasonable. However, with changed management, this percent should drop through time and will be a good indicator of rangeland health improvement. This indicator received a 74.

Only a minor **soil crust** was found was found in the study plots. It is likely that this formed from rains that fell after cattle had left the pasture. This indicator received a 89.

Germination sites appeared to be abundant on the soil. Litter that had accumulated will help a new plant find a start on life. Once litter is more uniformly distributed over the soil surface, this indicator should improve. It received 74 in 2005.

When examing different **age classes** of plants in the study plots, we found different ages of sagebrush and likely needleandthread. This indicator received a 60.

Additional comments:

Energy flow on the site was moderate, as plant leaves harvested some sunlight energy, but much energy also struck the soil surface where it was lost. The mineral cycle appeared to have been slow in the past, but with changed management in 2005, received an infusion of much litter that contacted the soil surface. This should speed the mineral cycle in coming years. The water cycle was effective, with no signs of erosion. As plant material added to the soil in 2005 begins to decopose, the moisture-holding capacity of the soil should improve. Within community dynamics, the desired plant species were present in the area, but not in the desired abundance. Additional forbs are also desired in the area. Apparent range trend here was stable.

Management recommendations:

If at all possible in 2006, graze this pasture earlier in the growing season. Management has done much to knock old, standing plant material to the soil as litter during the impact/grazing of 2005. Now use hoof action again when the soil should be wetter and mix litter with the soil. This should improve both the mineral and water cycles even further.

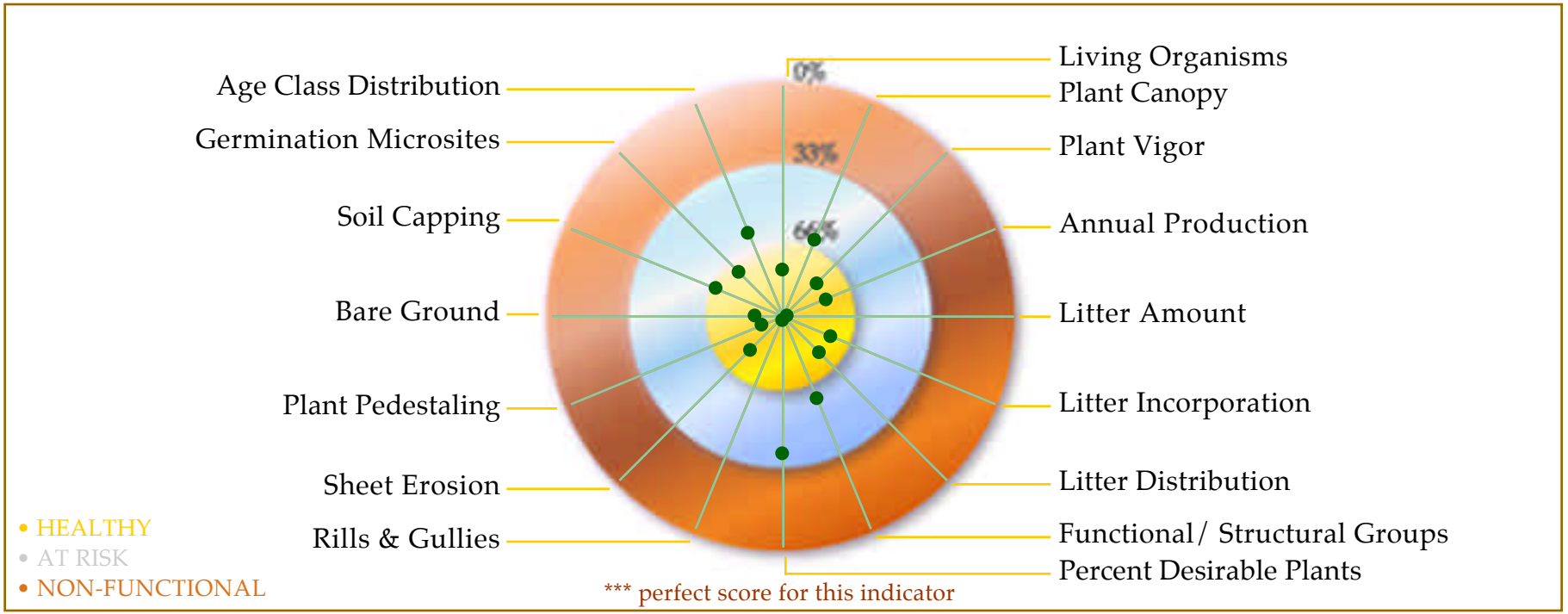
Past management appears to have applied longer grazing durations and lower stock densities to this pasture. Management should now alter this regime and allow the pasture plants uninterrupted growth opportunity through the hot part of the growing season. Graze the pasture in the earlier growing season, and then rest it through the hot summer. During this early season graze, prevent excessive utilization of grazed plants. Manage for moderate levels of use that will allow plants to recover from the bite more quickly.

Early-warning indicators

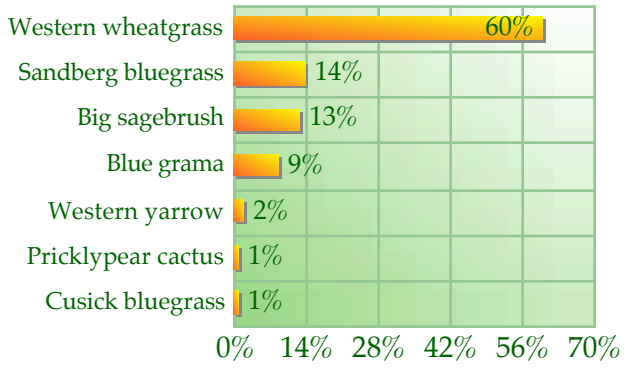
If management actions are improperly applied at this site, look first for increased erosion. Then look to decreased litter cover and poor litter distribution. Also look for decreased plant vigor. These indicators would suggest that grazing intensity has been too high. They might also suggest that cattle are returning for a second graze in the same growing season before plants have had a chance to recover from that first bite.

If management actions are properly applied, look for improved litter incorporation and litter distribution. On this site, these indicators signal improvements in the mineral and water cycles. This would allow improvements in plant vigor (and also production). A shift in plant species composition toward more desired species is then more likely.

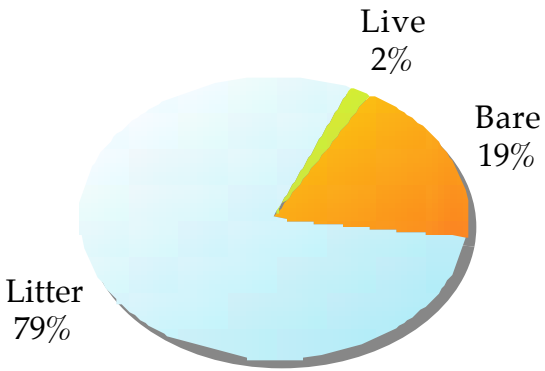
Data Summaries from
Merlin Ranch
study sites of
Hall Pasture
and
Hall Homestead
are displayed below.



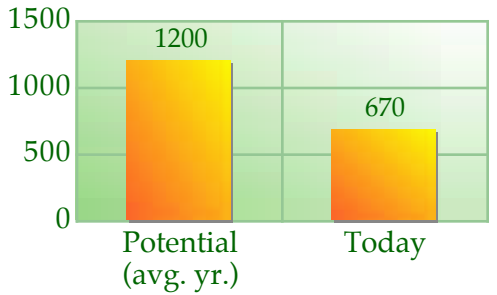
Basal Cover by Species - Top 7 Species



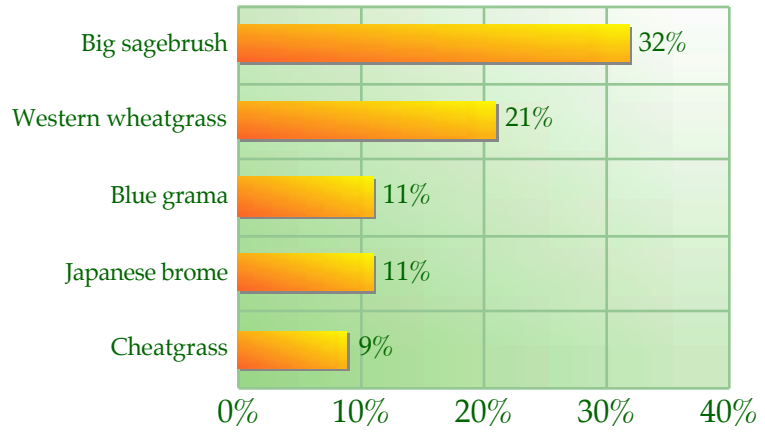
2005 Basal Cover



Forage Production



Predominant Species: Composition by Weight



Additional Info: Overall Site Score: **76**

Apparent range trend: →

Site sampled 9/4/05.

21 plant species were found at the transect site.

Big sagebrush data:
Line intercept: 56 plants encountered, 48% canopy cover.
Average plant height: 26 inches.
Age class distribution: 95% mature, 3% decadent
Belt transect: 103 big sagebrush plants encountered in 1000 square feet.

Relative basal plant spacing: 1.6 inches.

UTM coordinates of site: 13T 0375390 4915369

Plant species encountered at site:

Japanese brome
Cusick bluegrass
Cheatgrass
Western wheatgrass
Blue grama
Needleandthread
Threadleaf sedge
Prairie junegrass
Sixweeks grass
Sandberg bluegrass
Silver sagebrush
Big sagebrush
Winterfat
Lepidium
Pricklypear cactus
Western yarrow
Tansymustard
Vagrant lichen
Scarlet globemallow
Dandelion
1 unknown annual forb

Hall Pasture (Transect MRT07)

This site was chosen to be included in the potential Lawson Renevator treatment site. In an effort to improve rangeland health and wildlife habitat, Merlin Ranch will participate in a vegetative treatment designed to decrease sagebrush predominance and promote the growth of forbs and perennial grasses.

The first plot studied at the Hall Pasture site.

This site was chosen specifically due to its lack of desired perennial bunchgrasses and forbs. Such plants could be seen in abundance in the pasture, but not in this particular area. For some reason, bunchgrasses and forbs appeared to be in lesser amounts compared with nearby areas. The study will track changes in these species' presence following the treatment.

The first indicator examined was **living organisms**, where ants, flies, and exoskeletons of an unknown large insect were prominent. Kestrels, a red tailed hawk, meadowlarks, mice, a horned toad, and rabbits were also observed. Pronghorn droppings were prominent. This indicator received an 80.

The **plant canopy** was dominated by sagebrush. Given the prominence of sagebrush in the area and the lesser canopies of perennial grasses and forbs, much sunlight energy struck the soil surface, rather than being intercepted by desired plants leaves. This indicator received a 64 for its score.

When examining **plant vigor**, sagebrush growth was hearty. Leader growth was over six inches on most plants in the area. Perennial bunchgrasses were of tall stature, most had produced seed, and were firmly rooted to the soil surface. Size of perennial bunchgrasses plant bases appeared to be smaller. This may be an indicator of less than desired plant vigor. This indicator received an 80.

The soil survey suggests that potential **production** in an average year is 1200 pounds per acre. One plot was clipped on sample day that yielded 670 pounds per acre. Note that light grazing was observed on Western wheatgrass and threadleaf sedge. Of this 670 pounds per acre, roughly 40% of it was production by big sagebrush.

Litter amount was high in the study plots. Much of the litter was composed of sagebrush leaves and previous years' perennial bunchgrass growth. This indicator received a high score at 98.

In most study plots, litter was lying on the soil surface, but did not appear to be breaking down rapidly. In one of the plots, litter was suspended above the soil. We speculate that densities of sagebrush may inhibit the movement of livestock in this area, thus reducing the amount and effectiveness of animal impact the site receives. **Litter incorporation** received a 78.

In most study plots, litter appeared to be well **distributed** over the soil surface. In some plots, however, litter cover had become light, resulting in a more patchy appearance. This indicator received a 78.

The **functional and structural groups** indicator asks the examiner to count the number of plant species in a plot, and also consider the growth structure of those species. In some plots forbs were lacking, meaning that their root structure would not be present to help elevate nutrients stored in the soil. Some plots contained only six plant species total. This indicator received a 62.

The **percent desired plants** was low. Undesired species such as Japanese brome and cheatgrass dominated the plots, while desired bunchgrasses and forbs were uncommon. This indicator received a low score at 40.

Only a minor sign of water erosion was found on this mild slope. The **rills and gullies** indicator received a 98.

Some signs of wind erosion were found, with the corresponding presence of desert pavement. Such erosion was not severe, resulting in a score of 80 for **scouring and sheet erosion**.

With the wind erosion, only minor **plant pedestals** were found. No root exposure was seen. This indicator received a 90.

The amount of **bare ground** observed in the plots was not exceptional for a site such as this. Some plots contained nearly no bare soil, while others contained a bit too much. Bare areas could usually be found away from big sagebrush plants. This indicator received an 88.

An older **soil crust** was found in the area. This physical crust was greater than one-half inch thick in some plots and would prevent the movement of moisture into the soil. This indicator received a 68.

Germination microsites, where a new plant could find a start on life, were numerous in the study plots. The soil crust formed in some areas, plus competition for resources from annual plants like cheatgrass were inhibitors to germination success. This indicator received a 72.

The last indicator examined was **age class distribution**. Big sagebrush appeared to be largely of the same age in the area and in the study plots. Different age classes of perennial bunchgrasses were difficult to detect, but some younger needleandthread plants were evident. This indicator received a 60.

Additional comments:

Energy flow was at moderate levels, with abundant canopies of sagebrush, Japanese brome, and cheatgrass. However, much sunlight energy still struck the soil surface. The mineral cycle was effective, but could function more rapidly if litter lying on the soil surface was better mixed with soil. The water cycle was effective, with few signs of erosion. The physical soil crust was a concern. Within community dynamics, the desired perennial bunchgrasses were less abundant. Only a few needleandthread plants were found, and the desired species of green needlegrass and bluebunch wheatgrass were not found at all. Forbs desired by wildlife were also not prominent. Apparent range trend was stable.

Managment recommendations:

This area is being considered for treatment by the Lawson Renovator. This treatment will help disturb big sagebrush and provide a great litter source for the area. We support a pilot project in this area to learn the beneficial effects of the treatment for both rangeland health and wildlife. This area in particular is composed of sagebrush that appears to be largely of the same age. Further, desired bunchgrasses and forbs found in other areas of the pasture were lacking at this site. The Lawson treatment should help stimulate the growth of bunchgrasses and forbs. Such species may also compete well with Japanese brome and cheatgrass found in the area.

We applaud Merlin Ranch's efforts to document the changes this use of technology will have on the range. Knowing how the land will recover from the disturbance will be great information for assessing the ecologic and economic value of the treatment. Such factors can be considered through time and across the landscape.

Management must watch the Lawson machine's effects carefully, though. This particular implement's action greatly disturbs the soil and appears to be designed for more sod-bound landscapes. The Hall Pasture's land is not sod-bound, nor is the soil excessively capped. Management should examine this area after the treatment to ensure that the renovator did not stimulate the growth of noxious weeds.

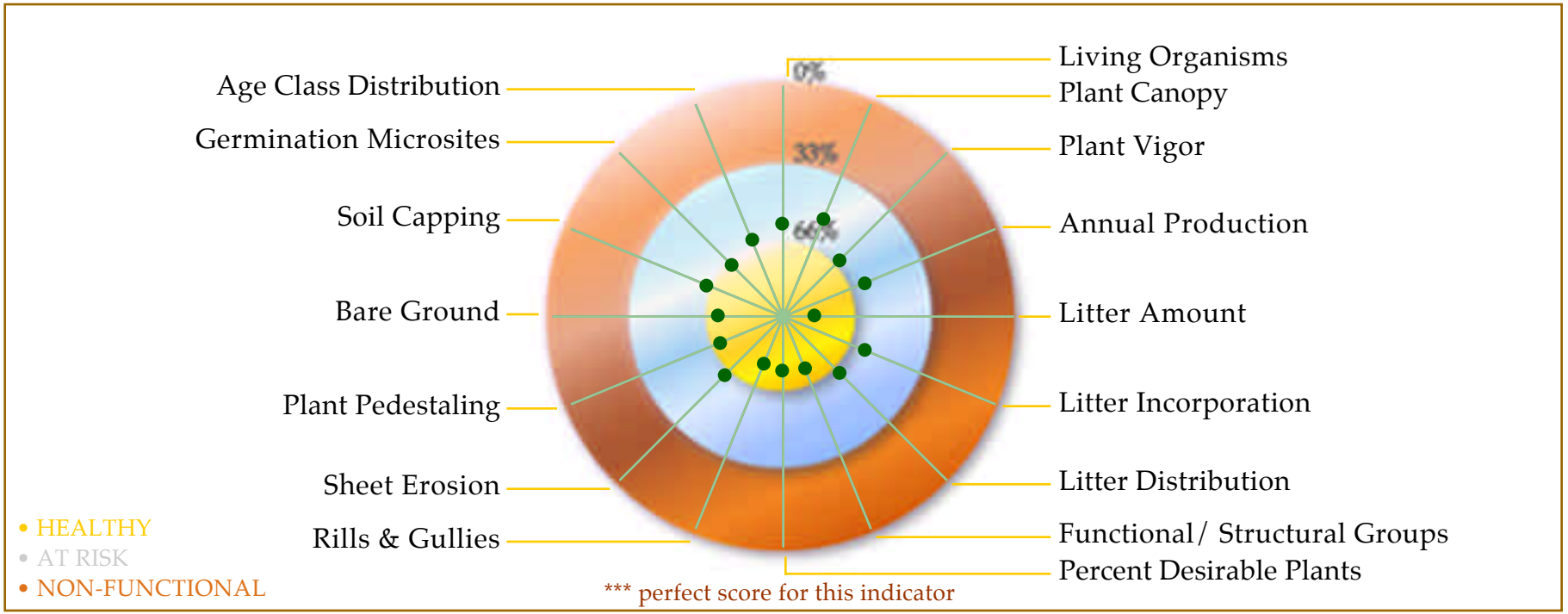
One of the keys to evaluating the success of the Lawson treatment will be post-treatment land mangement. Prevent excessive harvest of those desired bunchgrasses and ensure that plenty of time exists between grazing events for them to recover from a previous bite. If the treatment stimulates growth of desired grass, you don't want to inhibit its growth succes through over utilization and overgrazing.

Early-warning indicators:

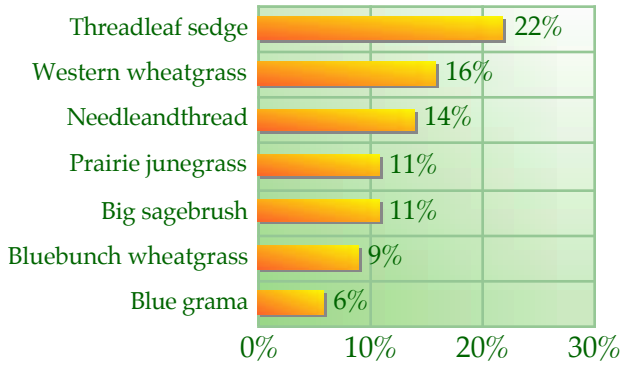
If the vegetative treatment is unsuccessfully applied, look for increased erosion on this mild slope.

Don't be alarmed if Japanese brome and cheatgrass respond vigorously to the treatment. In fact, if the treatment is performed in fall 2005 or spring 2006, explosive growth of these species is likely in summer 2006. In time, however, species such as needleandthread will recover from the disturbance and will emerge as strong competitors to cheatgrass.

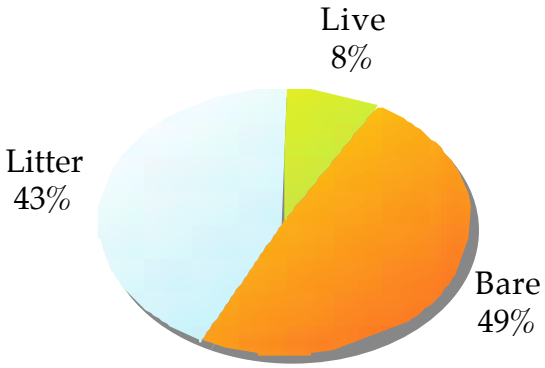
Four or five years after the treatment is performed, examine the area to determine fi the composition of desired species has increased. If they have, much can be learned about the Lawson treatment, as well as the effectiveness of management post-treatment.



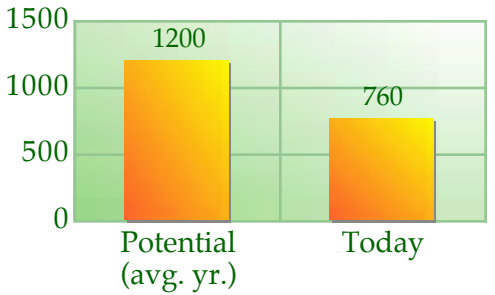
Basal Cover by Species - Top 7 Species



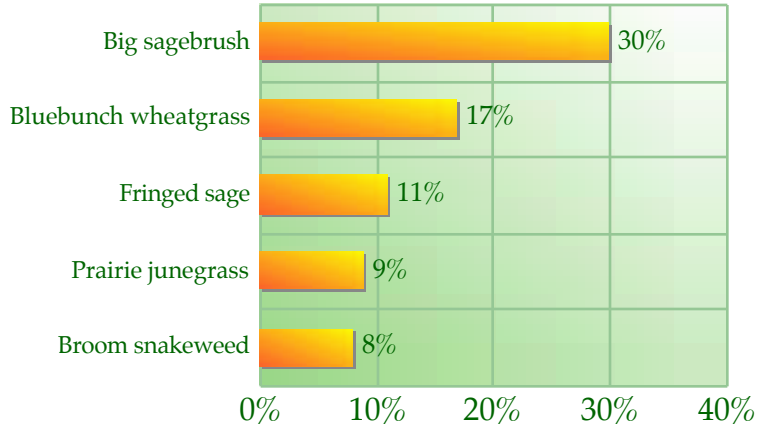
2005 Basal Cover



Forage Production



Predominant Species: Composition by Weight



Additional Info: Overall Site Score: **68**

Apparent range trend:

Site sampled 9/3/05

24 plant species encountered at site.

Big sagebrush data:
Line intercept: 38 plants encountered, 15.5% canopy cover.
Average plant height: 11.5 inches.
18% young plants, 82% mature plants.
Belt transect: 186 big sage plants growing in 1000 square feet.

Relative Basal Plant Spacing: 1.1 inches.

UTM coordinates of site: 13T 0376195 4913591

Plant species encountered at site:

Bluebunch wheatgrasss
Western wheatgrass
Prairie junegrass
Japanese brome
Blue grama
Western wheatgrass
Green needlegrass
Threadleaf sedge
Needleandthread
Big sagebrush
Fringed sage
Silver sagebrush
Broom snakeweed
Rubber rabbitbrush
Western yarrow
Vetch species
Hood's phlox
Pricklypear cactus
Curlycup gumweed
Lepidium species
Vagrant lichen
Plains daisy
Musk thistle
1 unknown perennial forb

Hall Homestead (Transect MRT06)

This site was chosen to be representative of the hall Homestead Pasture. It was also chosen as an area of concern. Management would like to track the composition and movement of desired perennial bunchgrasses in the area. Given the area range site, increased presence of desired perennial bunchgrasses and forbs for wildlife is highly desired.

The first plot studied at the Hall Homestead site.

We first looked for signs of **living organisms** in the area. We observed rabbits, a red tailed hawk, grasshoppers, ants, and flies. We also saw signs of sagegrouse and pronghorn. This indicator received a 60 for its score.

The **plant canopy** within study plots was light. Much sunlight energy struck the soil surface, rather than being intercepted by living plant leaves. This indicator received a 54.

When examining **plant vigor**, we noted that many, but not all perennial bunchgrasses had produced seeed, were of tall stature, and were well rooted to the soil surface. Others, however, had not produced seed and also lacked a large plant base. Some needleandthread plants, for example, had quite small bases. These mature plants should have a large plant base, almost the size of your fist. These are symptoms of less than optimal vigor in the desired bunchgrasses. This indicator received a 66.

The Wyoming State Range Site Guide suggests that **production** in an average moisture year should be roughly 1000 pounds per acre. Within the single plot clipped, production was 760 pounds per acre. When estimating production in the 10 study plots examined along the transect, production was less than this clipped plot. Note that some plants had been grazed: light use on green needlegrass, needleandthread, and Western wheatgrass. Use on threadleaf sedge could be characterized as moderate. This indicator received a 62.

For this site, the **amount of litter** found in the study plots was good. Two years' worth of litter could be found on the soil surface, suggesting that harvest rates have not been excessive in the past two growing seasons. This indicator received a high score at 82.

Litter was not **incorporating** well with the soil. Litter was rarely suspended above the soil, but often could be found lying idly on the soil, rather than breaking down and forming new soil. This suggests the mineral cycle is slower than it could be. This indicator received a 62.

In some study plots, litter was well **distributed** over the soil, but in others litter cover was patchy and becoming light. This indicator received a 66.

The **structural and functional groups** indicator examines the number of plant species found in a plot, as well as the root and canopy structures of those species present. Most study plots had between 10 and 15 plant species with a mix of grasses, forbs, and shrubs. Grasses tend to have roots that spread widely in the soil. Forbs tend to have a tap root that penetrates more deeply into the soil. Finally, shrubs such as sagebrush have a root structure that reaches to great depths of the soil profile. All three root strucutres help to elevate nutrients from different depths and reaches of the soil. Further, sagebrush can help catch blowing snow, rather than letting it blow away. This indicator received a high score at 76.

The **percent desirable plants** indicator also received a 76. The only undesirable plant species found in the plots was Japanese brome, and it was not prominent. Desired grasses, forbs, and shrubs could be found in each plot, but many were dominated by intermediate species, such as prairie junegrass, Western wheatgrass, and fringed sage. We would prefer to see these intermediates replaced by more desired species.

Some signs of water erosion were found on this mild slope. Some rills and small channels were apparent on the soil surface suggesting water erosion. The **rills and gullies** indicator received a 78.

Signs of wind erosion were also found. Winds appeared to have removed some finer soil particles, leaving the coarser materials behind. When gravel is left behind, the action is called the formation of desert pavement, which could be found in the plots. The **scouring and sheet erosion** indicator received a 64.

Further, as wind blows soil away, plant crowns are often exposed on "pedestals." **Plant pedestals** were found, but not to the extent that roots were exposed. This indicator received a 70.

Bare ground received a 72. When looking in the plots, we found more bare ground than expected. Further, the point intercept method revealed that 49% of the soil was uncovered. With this site's potential, bare ground should be around 35% or less.

A **soil crust** was found that likely developed during summer rains. It was less than one-half inch thick. This indicator received a 64.

The **germination microsites** indicator received a 68. This was a good store for this site. Germination success was limited by competition from threadleaf sedge and the fact that new seedlings could be exposed to herbivory if they grew away from the safety of big sagebrush plants.

When evaluating **age class distribution**, one looks for the presence of differing age classes: seedling plants, young plants, mature, and decadent plants. We noted few decadent or seedlings of any species. Mature plants were abundant, but younger plants of big sagebrush, bluebunch wheatgrass, and green needlegrass were observed. Such observations are encouraging, for they suggest that these desired species are replacing themselves in the community. This indicator received a good score at 64.

Additional comments:

Energy flow was reduced where much sunlight energy struck the soil surface rather than being intercepted by desired plant leaves. The mineral cycle was effective, but could be sped with improved litter incorporation. The water cycle was less than effective with signs of both wind and water erosion. Too much bare soil exists on this site. Within community dynamics, the desired species were present and in abundance, and many plant species were found here. The only undesired species was Japanese brome. Improvements in community dynamics will be seen with increased abundance of desired perennial bunchgrasses and forbs desired by wildlife. Apparent range trend appeared to be stable.

Management recommendations:

During the early-season grazing event of 2005, management ensured that utilization rates were not excessive. This means that those plants grazed had ample opportunity to recover and replenish lost root energy. Plants in the area should have developed a full root structure during the hot part of the growing season in 2005. This should enable plant growth during spring of 2006, if decent moisture falls.

If this pasture is to be grazed twice in the same growing season, management must ensure that plants have adequately recovered from the first grazing event. Given an early-season grazing as was performed in 2005 and ample moisture afterward, plants should have enough recovery time to be grazed again later in the season.

Early-warning indicators:

If management actions are improperly applied on this site, look for increases in erosion. If grazing durations are excessive, or utilization rates to severe, more soil will be exposed to the elements and potentially lost. Plant vigor will also decline and production will drop. Those desired bunchgrasses and forbs will also have less presence in the community and will be replaced by prairie junegrass, Western wheatgrass, and other intermediate species.

If management actions are properly applied, look first for improvements in plant vigor, especially increases in size of perennial bunchgrass base size. Needleandthread and green needlegrass will have a larger plant base. Also look for decreases in erosion, bare ground, and the presence of Japanese brome.

NUTRIENT ANALYSIS

At each study site, a single plot was clipped whose plant material is weighed to determine productivity. After taking the weight measurement, species not likely to be selected by cattle, such as sagebrush, are discarded. Those potentially preferred by cattle are sent to Midwest Labs in Omaha, NE where a nutrient analysis is obtained. The results from the four sites studied in 2005 are displayed below.

	Ray's	**Hall Home**	**Hall Past**	Shady
Crude Protein (%)	7	10.3	6.71	5.94
Acid Detergent Fiber (%)	39.7	33.6	35.4	38
Total Digestible Nutrients (%)	57.3	64.2	62.2	59.3
Net energy-lactation (Mcal/lb)	0.58	0.66	0.64	0.6
Net energy-maintenance (Mcal/lb)	0.56	0.64	0.62	0.58
Net energy-gain (Mcal/lb)	0.33	0.37	0.34	0.34
Sulfur (%)	0.15	0.18	0.14	0.15
Phosphorus (%)	0.05	0.16	0.1	0.08
Potassium (%)	0.83	0.85	1.15	0.88
Magnesium (%)	0.21	0.14	0.14	0.11
Calcium (%)	0.86	0.68	0.72	0.76
Sodium (%)	<0.01	0.02	<0.01	<0.01
Iron (ppm)	461	436	216	643
Manganese (ppm)	66	44	41	98
Copper (ppm)	3	4	2	3
Zinc (ppm)	15	25	11	13

When examining these figures, the strong crude protein component obtained at the Hall Homestead site stands out. This is an exceptional level of protein for rangeland plants in mid-September. Also note the disparity in phosphorus levels among the four samples. Hall Homestead again appears to be superior, while Ray's Ravine has quite low phosphorus levels. Levels of trace minerals such as those found at Ray's are more expected for these rangeland plants in early September.

As has been done in prior 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 for 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 **Ray's Ravine** will provide the following:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	1.5#	12.4#	84	5g

The high energy content (TDN) of the forage suggests she will meet her energy needs. Crude protein is slightly short, while phosphorus is quite low. Further, the calcium to phosphorus ratio is nearly 17:1. This exceeds the maximum recommended ratio of 8:1. If this were the only forage available to this cow during lactation, she would require trace mineral supplementation for the phosphorus deficiency, and may require protein supplementation as well.

Moving to the **Hall Homestead** sample, the forage will provide the following to the animal:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	2.2#	13.9#	67g	16g

This sample of rangeland plants was the best of the lot collected in 2005. The cow easily met her protein, energy, and calcium requirements. She is still a bit short on phosphorus. However, the calcium to phosphorus ratio is within recommended limits. Had this lactating cow grazed this area in early September, strong performance should have been expected.

At the **Hall Pasture** site, the collected sample would have provided the following to our 1100-pound lactating cow:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	1.4#	13.4#	71g	10g

The crude protein component of the Hall Pasture's sample was much lower than its neighbor in the Hall Homestead. Thus, this cow would not meet her protein requirements were this the only forage she could access. The sample's strong TDN figures suggest she would easily meet her energy needs. Phosphorus is again low, but the calcium to phosphorus ratio is non unreasonable.

Finally, at **Shady Lane** the sample obtained low levels of crude protein and phosphorus. This forage would have provided the following to the cow:

Dry Matter	Crude Protein	TDN	Ca	P
21.6#	1.3#	12.8#	75g	8g

As expected, this sample would not meet the protein requirements of the lactating cow. The sample contained a strong TDN component, where her energy needs would have been met. Phosphorus is lacking, and the calcium to phosphorus ratio exceeded the recommended maximum of 8:1. If this were the only forage available to this cow in the Shady Lane Pasture, she would require some supplement if she were to remain in the pasture for longer grazing durations.

Management recommendations for 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.

The management implications from this exercise are two-fold. First, at Ucross, data have displayed trace mineral deficiencies through the years. Cows may be sacrificing stored nutrient reserves for calf performance through lactation during late summer. This suggests that if cows have access to no other forage, early weaning may be in order. This would allow cows to restore lost nutrient reserves prior to entering later trimesters of pregnancy. Ideally, this would increase a cow's longevity.

Second, management must return deficient minerals to the cow's body. This is best accomplished after weaning. Good pasture and/or decent quality hay should help with the major requirements like protein. It is also advisable to have ranch hay tested for nutrient content. If the hay contains needed trace minerals, then expensive

trace mineral supplementation may not be needed until the last trimester of pregnancy.

METHODS FOR LEVEL III RANGEWISE PROCEDURES

On September 3, 2005 Mark Gordon of Merlin Ranch and Todd Graham of Rangewise toured Ucross and Merlin Ranches examining potential study sites. They selected two on Merlin Ranch: a reread of the site previously established at Ray's Ravine and Shady Lane. They selected sites in the Hall Pasture and Hall Homestead on Merlin Ranch.

Todd Graham read the transects during the following two days. 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 are then conducted from this tape measure (Figures 1 and 2).

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

We photographed and described each location. This description included a list of plants, activities of animals, and type of soil and terrain. We used a background field form 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.

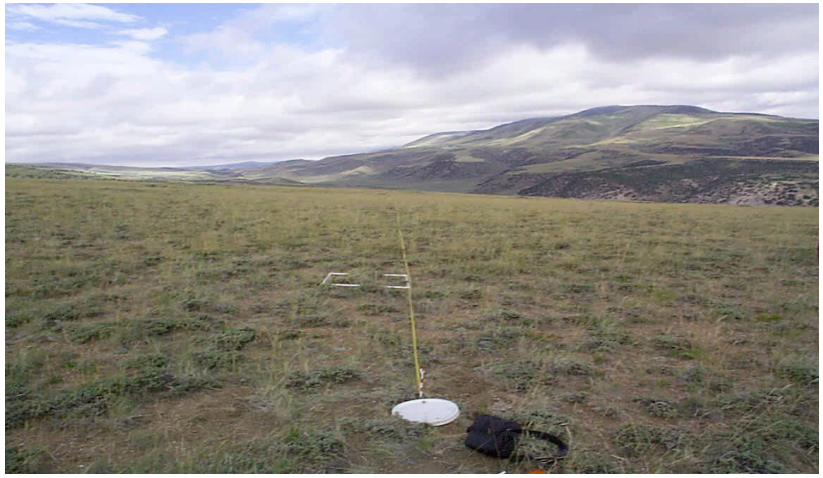


***Figure 2: Rangewise transects were 200 feet long and were permanently marked* on each end.**

We examined 10 plots along each transect in which we scored 17 indicators of rangeland health (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 and production reconstruction was performed of harvested plants using Forest Service height/weight tables.

A Rangewise scoring matrix accompanies this document that portrays how each of the 17 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 we found that litter displayed "mostly uniform, slightly patchy" appearance, we would assign it a score of "4." Each of the 17 indicators was scored in this way at each of the 10 plots.

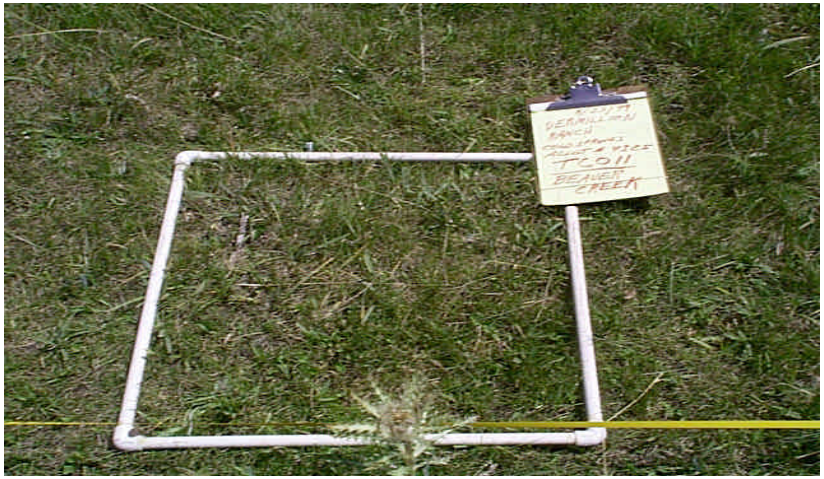


Figure 3: The first plot on a transect. [This plot lies in Colorado.]

When all 10 plots have been evaluated, we tally the scores for each indicator. Using the litter distribution indicator example, we might find that the scores 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, we multiply this score by two. This allows us to plot the indicator on the RangeWeb (Figure 4) for visual portrayal on a 100 point scale. In our example, litter distribution would receive a 72 for its score. This indicator would be plotted on the Web at the 72 mark, or what we would also call "at risk."

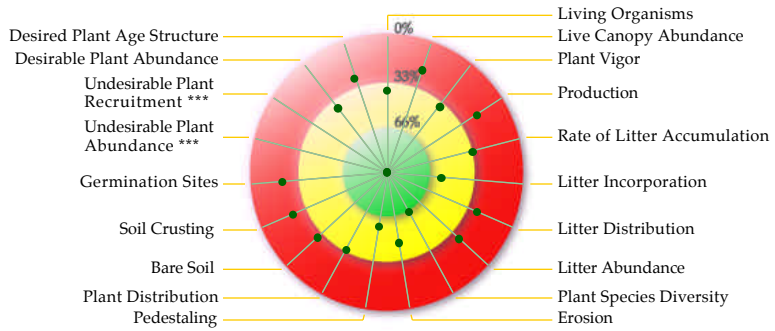


Figure 4: The RangeWeb portrays results of each of the 19 indicators studied. RangeWeb's software plots each indicator on the Web based upon its field score.

Rangewise then seeks an overall site score. This score is calculated by averaging the total score for each of the 19 indicators. For example, we might find that by adding the scores of all 19 indicators produces a total of 1456. By dividing this figure by 19, we arrive at an overall site score of 77. 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 17 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 suggest potential production for each site. We used the site's average-year production figure to produce a bar graph featured in Figure 5 below. We then clipped a single plot to produce the actual or "today" figure displayed in the bar graph.

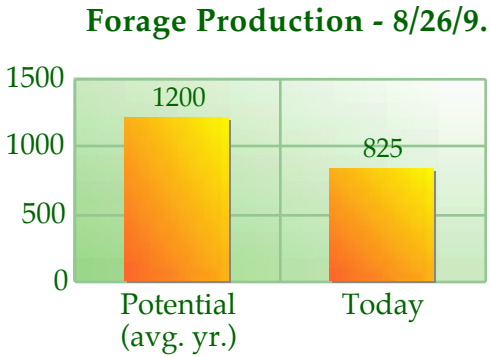


Figure 5: Plant production on sample day as compared with the site's potential from the soil survey.

While looking in each study plot, we estimate which species will be the most abundant by weight. We then assign a value of "5" 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. We perform the procedure for all 10 study plots. We can then calculate the percentage composition of each species based on its scoring versus other species

encountered in the plots. The most abundant will have the highest scores and the highest percentage composition. We then generate a chart with the five heaviest species like the one featured in Figure 6 below.

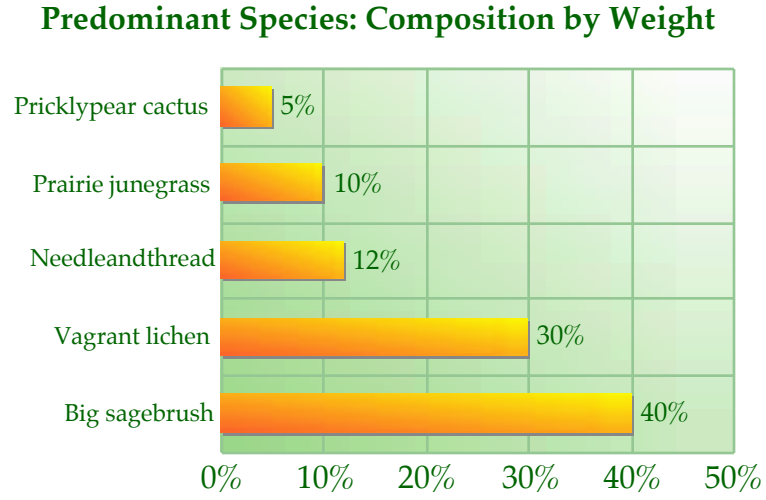


Figure 6: The most abundant species as composition by weight.

We then clip a sample of forage plants most likely selected by cattle and send the package 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," we lower a steel rod 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, we gather ground cover data, which is classed as either bare soil, litter, or live plant cover. After examining all 100 points, we calculate the percentage of each class represented at the site. A pie chart is generated portraying the results (Figure 8).

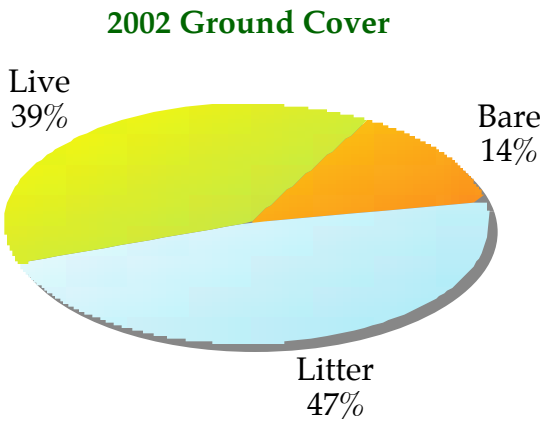


Figure 8: The ground cover chart generated by using the point intercept method.

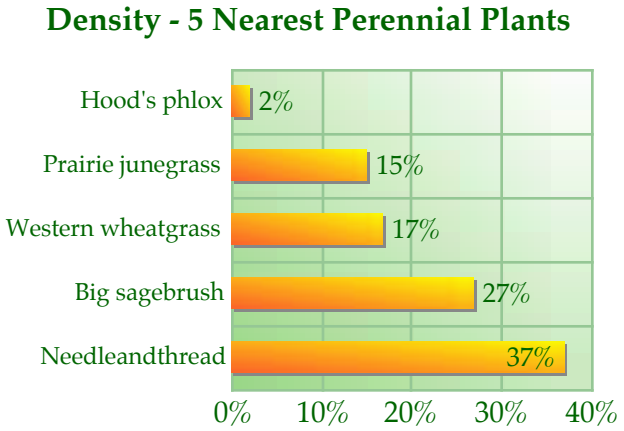


Figure 9: Plant density bar graph created by measuring the distance to the nearest perennial plant using the point intercept method. The five most numerous species (most dense) are displayed here.

At each point ground cover data was collected, we also gathered data on plant basal cover. When the point intercept rod was lowered to the soil surface, we measured the distance to the nearest perennial plant. We averaged this distance over all 100 points to arrive at the plant spacing figure displayed in the "Additional Information" box. Simultaneously, we would record this plant's species. The five species that represent the closest perennial plants are portrayed in the "Density: 5 nearest perennial plants" bar graph (Figure 9).

This means of collecting plant density data was developed by the Allan Savory Center for Holistic Management in Albuquerque, NM.

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.

Rangewise provides an invigorating way of viewing and understanding land health. Like many monitoring processes, it observes rangeland health over time. Unlike other monitoring processes, it presents this information in a way that provides decision-making information to land managers. The land will tell you what it needs to function well. Rangewise interprets that request into management action. Rangewise is aligned with the findings and prescriptions of Rangeland Health.

Rangewise Level III Scoring Guide
July 2003 Revision
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.	60 - 80% of plant 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.

Rangewise Level III Scoring Guide
July 2003 Revison
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.

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