



# Merlin Ranch

## *2021 Rangeland Health Monitoring*

By



## EXECUTIVE SUMMARY

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The Merlin Ranch monitoring program was initiated in 2006 to track changes in rangeland health and provide information for improving grazing management decision-making. A total of 17 permanent rangeland health transects have since been established, including one new site in the North Tipperary Pasture, which was added in 2021.

Monitoring data was collected at three sites in 2021: Tipperary, North Tipperary and Hall Homestead. Rangeland health across these three sites varied. The Tipperary and North Tipperary had both been grazed in July and plant vigor was lagging due to two consecutive years of drought. By contrast, vigor in the Hall Homestead was high with good seed production evident on the grasses. All three pastures showed room for improvement in the abundance of desired perennial grasses, but North Tipperary was the only pasture where recruitment of desired grasses appeared active. Slower recruitment in the Tipperary and Hall Homestead was indicative of drought stress and potentially a need for increased animal impact. Both the Hall Homestead and Tipperary displayed increases in bare ground and reductions in litter. This was likely a product of the drought in Hall Homestead, but the trend in Tipperary was longer lasting suggesting a need for lighter utilization.

Pastures on the Merlin Ranch appear particularly sensitive to early season grazing. Thus, strategies that defer spring grazing for one to two years have benefited the ranch as a whole. Further, pasture subdivisions have facilitated implementation of shorter grazing durations, longer recovery periods, and altered season of use. These strategies have been integral to the successful improvement of rangeland health across the ranch over the past decade. No major changes to the current grazing program were needed in 2021, but minor adjustments to utilization rates, number of grazing events and/or length of recovery periods may help pastures recover from the drought more rapidly once the rains return.

## INTRODUCTION & PURPOSE

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This document presents the findings from three rangeland health transects assessed on the Merlin Ranch in August 2021. Two of the three sites had been previously established and one (North Tipperary) was added this year. These sites were chosen to track changes in rangeland health through time, determine trend, and provide recommendations for adjusting grazing management to improve pasture performance. The map above displays the general location of each monitoring, which were:

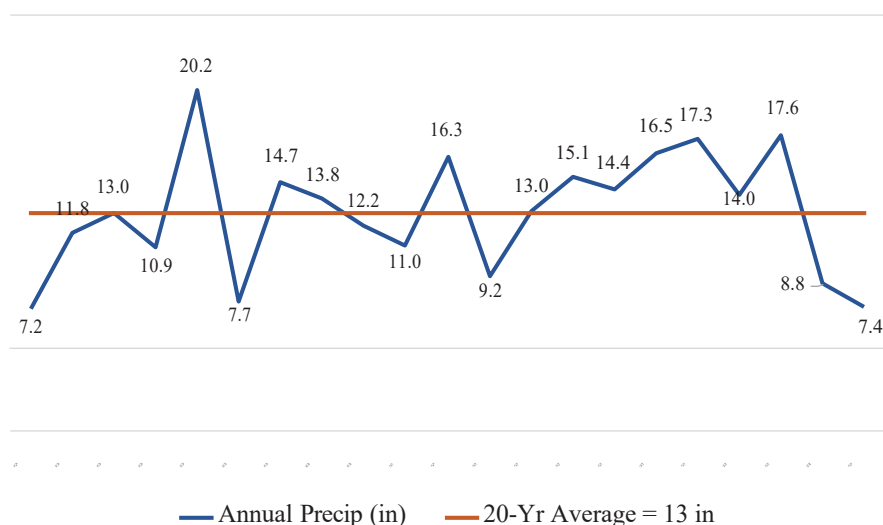
- Hall Homestead (MRT06)
- Tipperary (MRT10)
- North Tipperary (MRT29)

## SUMMARY OF FINDINGS & MANAGEMENT RECOMMENDATIONS

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Bare ground, plant vigor, plant production and species composition are all influenced over time by a combination of management practices and precipitation. For the purposes of this report, and to provide some context for its findings, the most recent 20 years of precipitation data was pulled from the Buffalo Weather Station via the Western Regional Climate Center's website. The chart below summarizes the trend in precipitation and provides actual figures for each individual year. The mean precipitation for the past twenty years has been 13 inches. In 2021, total annual precipitation was low at 7.4 inches.

Annual Precipitation for Buffalo, WY  
2001-2021



Data sourced from the Western Regional Climate Center database, Climate Station 481165:  
<https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?wy1165>

A summary of the findings from each of the three transects monitored in 2021 is provided below, along with management recommendations for continued improvement of the resource base. See the data and discussion from each site provided later in this document for added detail.

### Hall Homestead (MRT06)

Rangeland health in the Hall Homestead was moderately high in 2021 and the trend through time appeared stable. The effects of two consecutive years of drought were evident in a slight increase in bare ground and reduction in litter but continued high plant vigor indicated that recovery periods have been appropriately long. In addition, species richness was the highest it's been since 2009, which was remarkable given the drought. No changes to the current grazing strategy were warranted for this area. Keeping utilization rates light over the coming 2-3 years will help built litter to ensure the water cycle remains effective.

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### **Tipperary (MRT10)**

Rangeland health in the Tipperary was moderate in 2021 and the trend through time slightly downward. Bare ground displayed a steady increase and litter had declined since 2012, though both remained within an acceptable range and the water cycle was functional. The successional process appeared active within the shrub community but lagging within the herbaceous community. There was a noticeable lack of younger perennial grasses and a lower than desired abundance of species like needleandthread and green needlegrass. However, species composition remained fairly stable through time with dominance by big sagebrush, western wheatgrass, bluebunch wheatgrass, and threadleaf sedge. Finally, forage production was well below expected levels due to a combination of drought and a recent grazing event.

Grazing durations in this pasture have been appropriately short in recent years. No major changes to the existing management program were necessary, but lengthening the recovery periods as much as possible and maintaining a light utilization rate in 2022 and 2023 will help correct the trends in ground cover and improve plant vigor.

### **North Tipperary (MRT29)**

Rangeland health in North Tipperary was moderate in 2021. This was the first year of data collection for this transect so no trend information was yet available. The water cycle appeared effective though the level of bare ground could likely be improved. Mineral cycling was moderately rapid, and the successional process was active given the presence of younger green needlegrass and bluebunch wheatgrass plants in the area. Energy flow indicators showed the greatest room for improvement with a lower plant canopy and reduced plant vigor. No major course corrections in grazing management were warranted. This pasture was capable of supporting a second, dormant season, grazing event with a light utilization rate.

## Hall Homestead (MRT06) Site Summary

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This site was established in mid-2000's with the intention of capturing change following sagebrush removal using a Lawson Renovator. Unfortunately, the Lawson Renovator missed the study site, so the area has remained native rangeland dominated by big sage.

### Transect View



Photo taken August 26, 2009

### Quadrat View



Photo taken August 26, 2009



Photo taken August, 22, 2013



Photo taken August, 22, 2013



### Transect View



Photo taken August 22, 2017

### Quadrat View



Photo taken August 22, 2017



Photo taken August 10, 2021



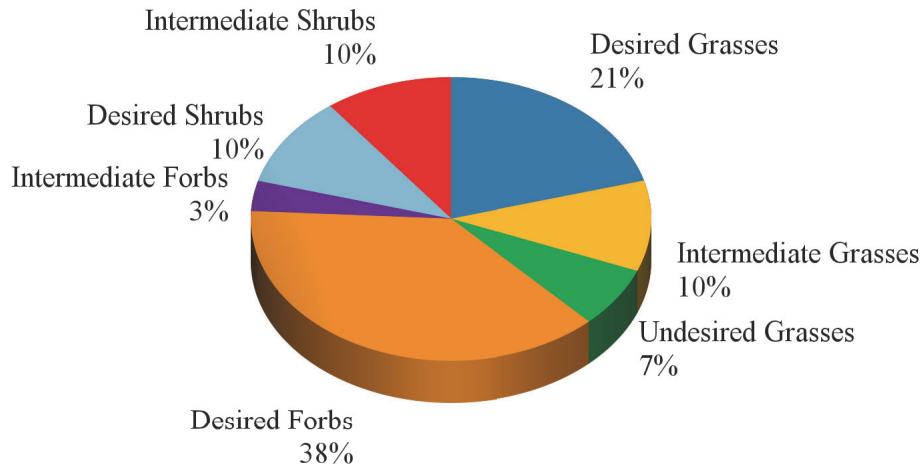
Photo taken August 10, 2021

The Site Photos show a mature stand of Wyoming big sagebrush with little change since 2009. The shrub canopy has been fairly dominant and a look at the Quadrat photos reveals a moderate level of bare ground.

# Plant Community Composition

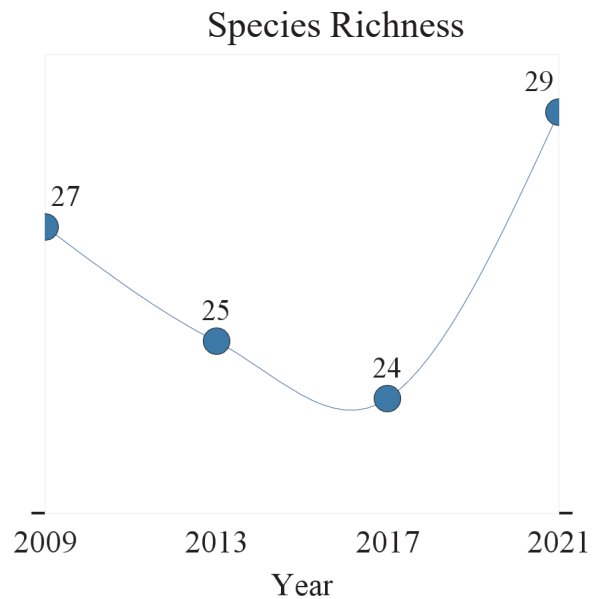
Hall Homestead (MRT06)

## Composition by Functional Group



### Key Interpretations:

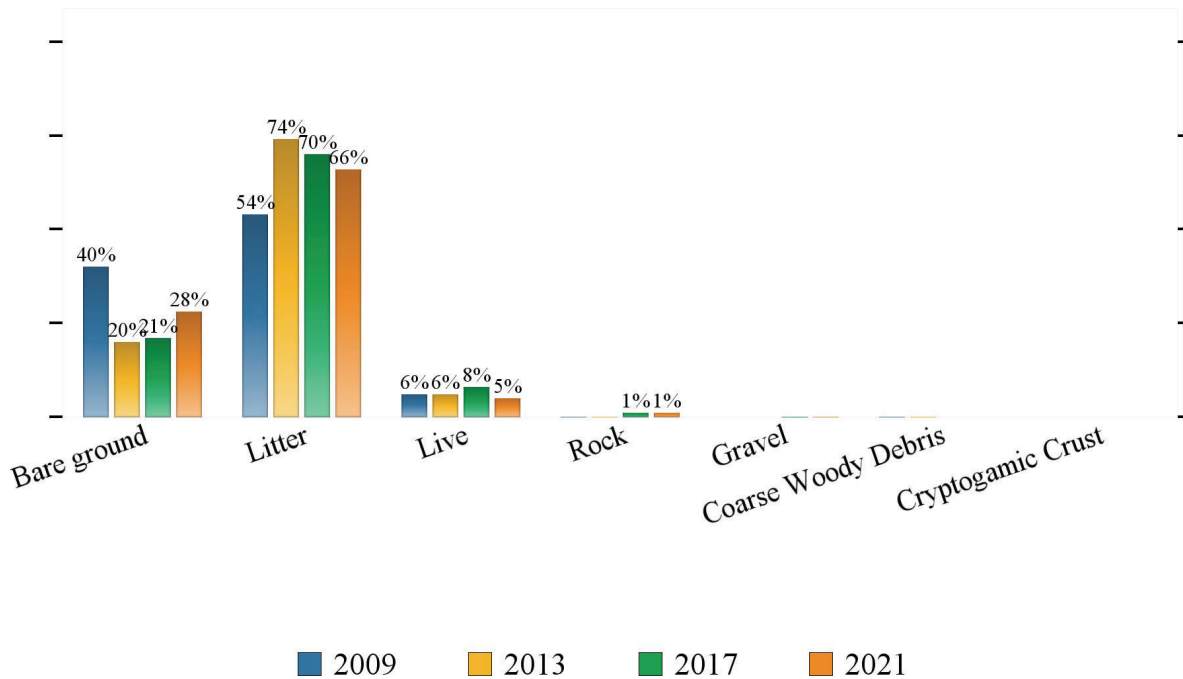
Species richness in this area has remained in a desired range through time and showed an uptick in 2021 with 29 recorded plants despite the drought. The pie chart displays the distribution of species across functional groups in 2021. Desired Grasses, Forbs and Shrubs were the dominant functional groups together accounting for 69% of the species richness. These groups included plants such as bluebunch wheatgrass, green needlegrass, needleandthread, western wheatgrass, western yarrow, vetch, sego lily, scarlet globemallow, penstemon, phlox, and big sagebrush. Intermediate species accounted for 23% of the richness and included prairie junegrass, Sandberg bluegrass, broom snakeweed, fringed sagewort, peppergrass, and pricklypear. Undesired species composed 7% of the richness and included cheatgrass and Japanese brome.





# Ground Cover

Hall Homestead (MRT06)



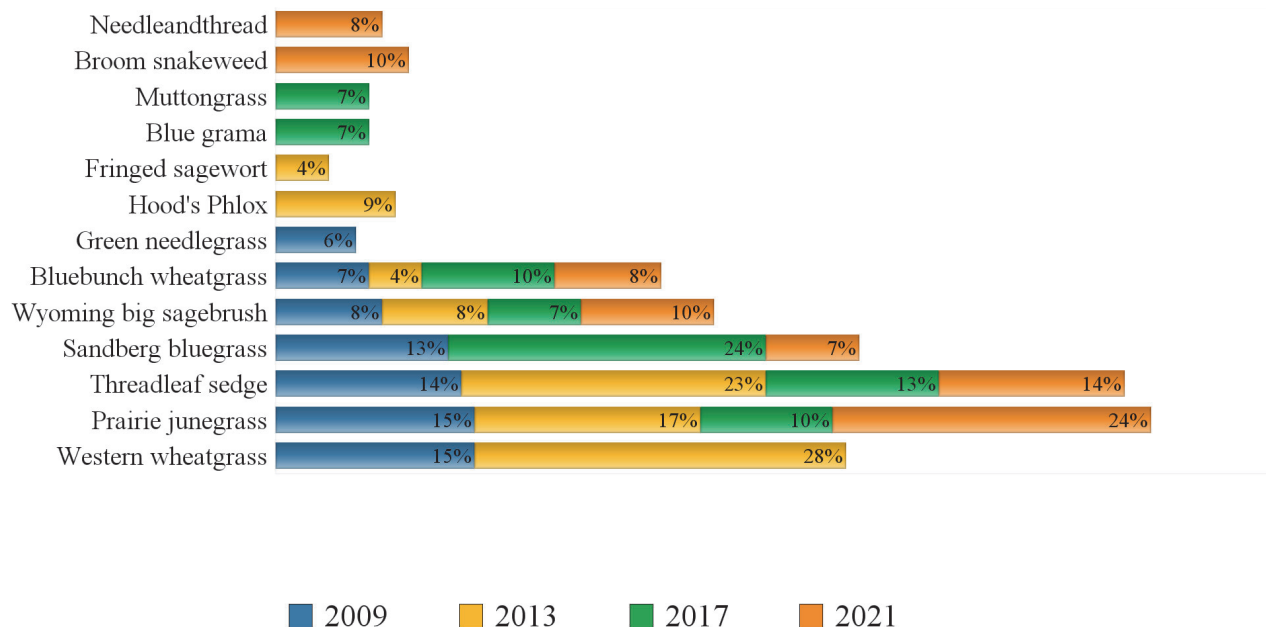
## Key Interpretations:

Ground Cover data provide important information on hydrologic function and site stability. Through time, bare ground has declined, though it displayed a slight increase between 2017 and 2021. Litter cover displayed an inverted pattern, increasing substantially between 2009 and 2013, remaining high through 2017 and showing a slight decline as of 2021. The reduction in plant productivity, and therefore residual material to become litter, due to two consecutive years of drought in 2020 and 2021 likely influenced both the increase in bare ground and reduction in litter. Live cover has changed only slightly over time revealing decent presence by mature bunchgrasses and shrubs.

Altogether, these data reveal functionality within the water cycle, but also room for improvement. Some degree of bare ground should be expected for this site, but ideally would hover in the 15% -20% range. Site stability was moderately high.

## Relative Basal Cover (Top 7 Species)

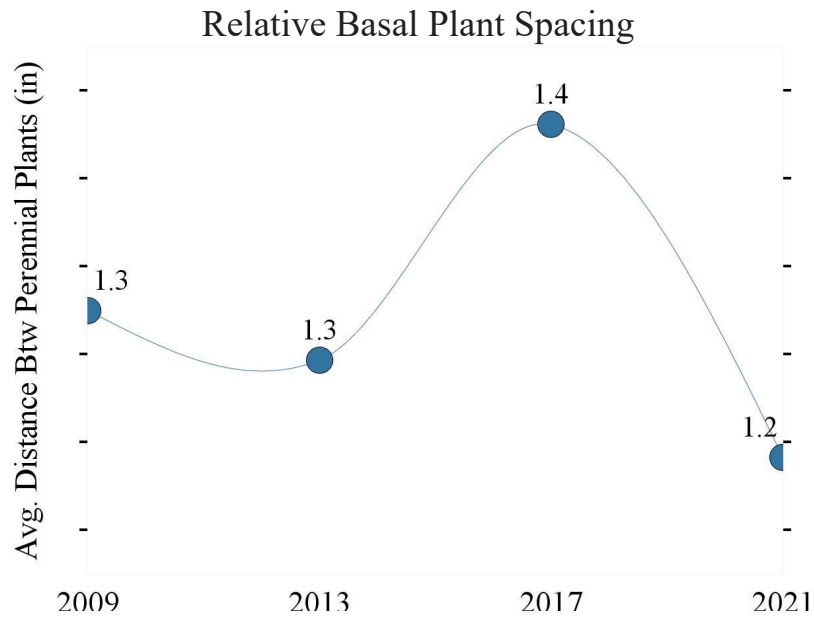
Hall Homestead (MRT06)



### Key Interpretations:

The Relative Basal Cover chart offers a look at the suite of *perennial* plant species dominating the soil surface and therefore information on the composition of the perennial plant community. These data highlight a shift away from dominance by western wheatgrass after 2013. Intermediate species like prairie junegrass, Sandberg bluegrass, fringed sagewort, and/or broom snakeweed have composed a greater than desired proportion of the basal cover over time. Green needlegrass and needleandthread, two desired species that would ideally compose a substantial portion of the basal cover, have generally been low in abundance, though needleandthread increased sufficiently to rank among the top seven most basally abundant plants for the first time in 2021. Several desired species including threadleaf sedge, bluebunch wheatgrass and big sagebrush have been consistently abundant.

All in all, these data reveal a decent perennial plant community composition as well as room for improvement. A sustained abundance of needlegrasses such that they compose a substantial and consistent portion of the basal cover over time would be ideal.

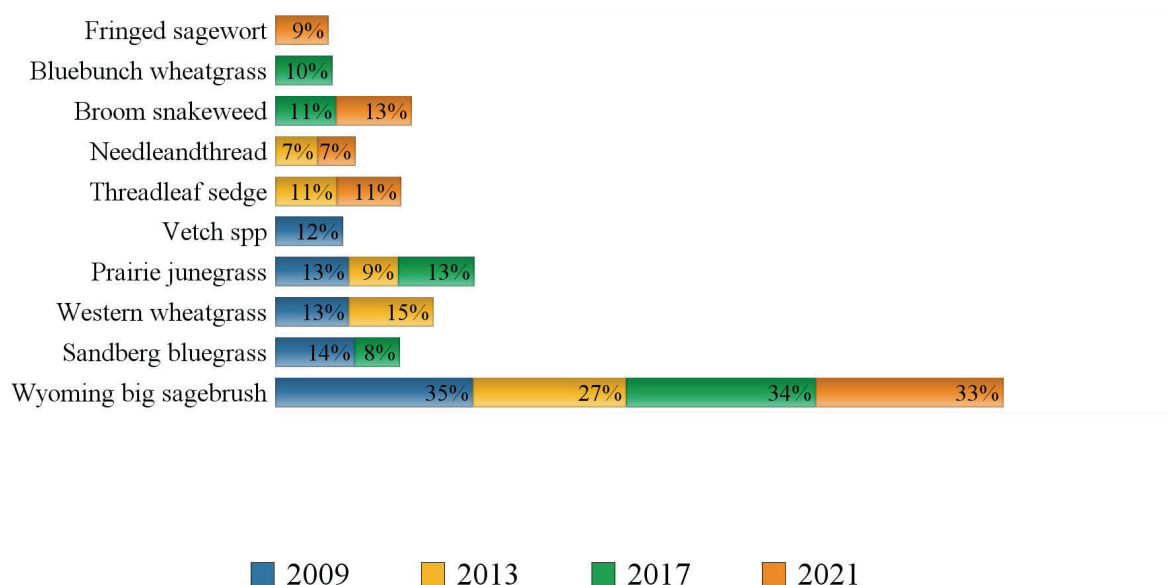


#### **Key Interpretations:**

The Relative Basal Plant Spacing metric assesses the average distance between perennial plants on the soil surface and provides insight in the stability of the site. Perennial plants should be tightly spaced, providing good soil coverage to limit erosion and prevent undesired species from gaining a foothold in the community. Here, the average distance between perennial plants had varied only slightly through time. The average distance to the nearest perennial of 1.2 inches in 2021 was a favorable result, though findings of one inch or less are ideal for this metric.

# Community Composition by Weight

Hall Homestead (MRT06)



## Key Interpretations:

The Community Composition by Weight chart displays the top five most productive species by weight offering a look at species composition from the perspective of plant production and biomass. This chart highlights the dominance of big sagebrush in this area, which has consistently accounted for roughly 1/3 of the annual production by weight. The relative contributions of other plants have varied through time in response to both moisture and the timing of grazing events. In 2021, this pasture had yet to be grazed at the time of assessment and herbaceous production was slightly reduced due to drought. The top producers by weight were big sagebrush, broom snakeweed, threadleaf sedge, fringed sagewort and needleandthread.

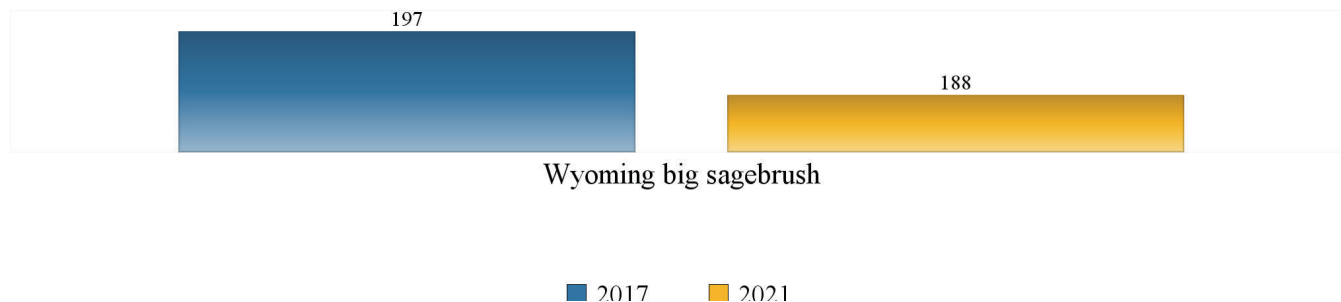
A look at the collective dataset reveals several important points about species composition through time: First, annual grasses, though present, have never been overly abundant. This is an indication that noxious weeds like cheatgrass have not been able to gain a competitive advantage within this plant community. Second, Wyoming big sagebrush has been more dominant than desired. This site was intended for a Lawson Renovator treatment but was accidentally missed so sagebrush has remained abundant. Finally, highly desired perennial grasses like western wheatgrass, green needlegrass, needleandthread and bluebunch wheatgrass have made low to modest contributions to production in any given year. Short of another treatment to reduce the sagebrush canopy, the current balance of perennial grasses and sagebrush will likely remain fairly consistent into the future. This plant community provides decent forage, but herbaceous production will likely remain limited by the shrub canopy.



# Shrub Data

Hall Homestead (MRT06)

Shrub Density (stems/1000 sq ft)



## Line Intercept Data

### 2009

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

15%  
9  
0%  
8%  
79%  
13%  
0%

### 2013

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

18%  
8  
0%  
0%  
90%  
10%  
0%

### 2017

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

21%  
11  
0%  
0%  
100%  
0%  
0%

### 2021

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

29%  
11  
0%  
8%  
88%  
4%  
0%

**Key Interpretations:**

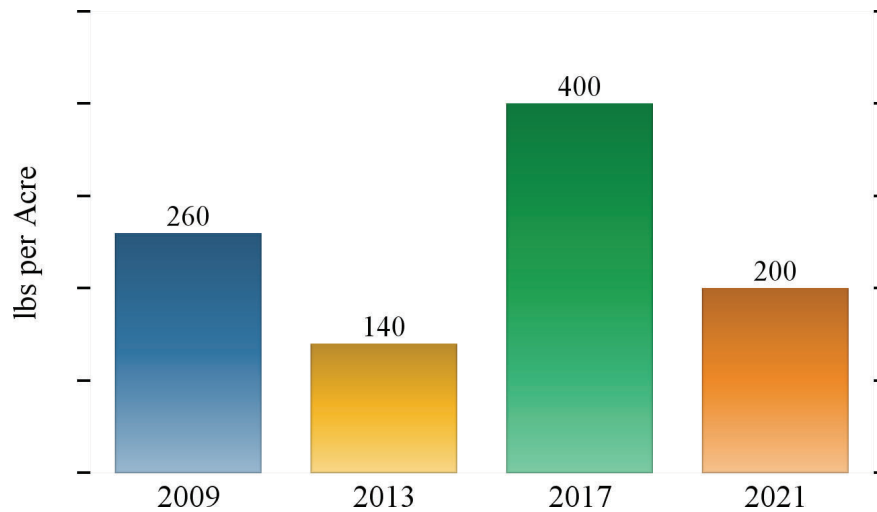
The Shrub Density data reveal a minor decline in the total number of sagebrush plants per 1000 square feet. Rather than suggesting decline, this trend likely reflects maturation and competition. When plants are younger and smaller, there is more room on the soil surface for a greater number but as they mature some individuals may be weeded out as the canopy expands.

The Line Intercept data displays a slow but steady increase in the percent canopy intercept through time. The sagebrush canopy was approximately 15% in 2009 and by 2021, it had increased to 29%. The 2021 data reveal active turnover in this community as well with 8% of plants qualifying as young and 4% as decadent. The remaining 88% were mature. This was an indication that the sagebrush community is replacing itself as older individuals age out.

## Forage Production

Hall Homestead (MRT06)

Average Production in Pounds per Acre

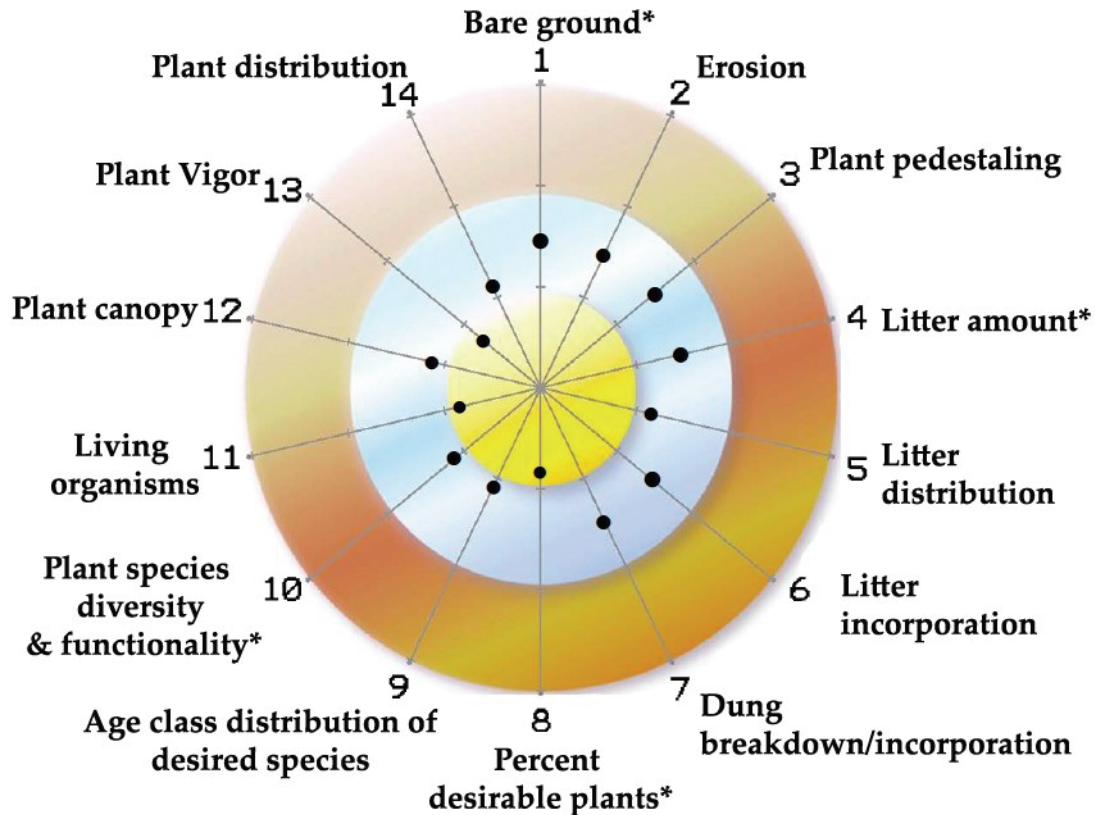


### Key Interpretations:

According to Web Soil Survey, potential annual production in a drought year for this ecological site is 485 pounds per acre. Production in this pasture has been below this level in all monitoring years reflecting the suppressive effect of the dense sagebrush canopy on the herbaceous community. This pasture had yet to be grazed at the time of monitoring in 2021 and production was 200 pounds per acre.

# Bullseye

Hall Homestead (MRT06)



The Bullseye provides an overview of range condition at a specific point in time based on a visual assessment of 14 indicators of rangeland health. Bare ground was moderate with some bare areas appearing larger and showing connection to other bare areas. This site was located on a mild slope and there were minor signs of both wind and water erosion. A few flow patterns were evident heading down the hill. Plant pedestaling was obvious in some areas but minor in others. On the whole, the water cycle appeared moderately effective with room for improvement.

Litter build-up was a bit light and somewhat patchy in distribution. More litter to help cover the bare areas would be ideal and would help improve litter distribution. Litter was in contact with the soil surface and displayed slow, but active incorporation. Dung breakdown appeared moderate as well with some sign of bug activity in younger cowpies but older cowpies showing signs of oxidation rather than decomposition. On the whole, the mineral cycle appeared slow to moderate in speed.



Species richness was high, especially for a dry year, with 29 plants recorded in the vicinity of the transect. The percent desired species was also high. The plant community was largely composed of desired grasses, forbs and shrubs. Cheatgrass and Japanese brome were the only true undesired species found. A handful of younger bluebunch, needleandthread and green needlegrasses were observed, indicating slow but active recruitment of desired species. This was a positive sign that the successional process was maintaining the desired plant community. Despite this, the abundance of desired grasses and forbs was lower than desired, reducing the score for species diversity and functionality a bit.

As habitat, this area provided a decent mix of cover and forage. The area receives use by sage grouse, antelope, deer, elk and a variety of other wildlife species. The plant canopy was slightly reduced due to two consecutive years of drought and was allowing a moderate amount of sunlight to strike the ground. Plant vigor, however, was fairly high with good seed production evident on the grasses and decent leaders showing on the sagebrush. Plant distribution was mostly even but with room for more plants, particularly perennial grasses, to help cover the soil surface. These observations indicate that energy flow was mostly effective.

# Management Recommendations

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Hall Homestead (MRT06)

Rangeland health in the Hall Homestead was moderately high in 2021 and the trend through time appeared stable. The effects of two consecutive years of drought were evident in a slight increase in bare ground and reduction in litter but continued high plant vigor indicated that recovery periods have been appropriately long. In addition, species richness was the highest it's been since 2009, which was remarkable given the drought.

This site was historically slated for brush management but was unfortunately missed leaving the dense sagebrush overstory in place. This has suppressed herbaceous production and slowed successional activity. The existing plant community composition as of 2021 was decent, showing low abundance of cheatgrass and Japanese brome but lacking the desired abundance of perennial grasses. Short of treating the sagebrush community to reduce its density, change in this area will likely remain slow.

Merlin Ranch has managed this area effectively through time with short grazing durations, long recovery periods and moderate utilization rates. In 2021, the pasture was grazed in mid-October for 10-12 days and cattle were not due back until the following year. This was an appropriate grazing duration. Given the need to build litter, keeping utilization rates light will be important for the next 2 to 3 years, particularly if conditions remain dry.

## *Early Warning Indicators*

Grazing managers require a feedback mechanism to determine if management actions are being properly implemented. That mechanism comes in the form of early warning indicators. Such indicators are the earliest signs that course corrections are required, and they may be contrasted to late-warning indicators, which may require more time consuming and costly corrections.

If management actions move this site in a desired direction, look first for maintained high plant vigor. Next, look for improved litter accumulation and reductions in bare ground. If a positive trend continues, look for more active recruitment of desired grasses and improved abundance of species like green needlegrass and needleandthread.

If management actions move things in an undesired direction, look first for reductions in plant vigor. This will indicate that recovery periods are too short. Next, look for increases in bare ground and reductions in litter, suggesting that grazing durations are too long and/or utilization rates too high. Finally, look for shifts in species composition that favor a greater abundance of annual grasses and intermediate species such as prairie junegrass, Sandberg bluegrass, fringed sagewort, and peppergrass. Such shifts would indicate that the season of use needs to be examined.

## Tipperary (MRT10) Site Summary

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This site was chosen in 2007 to be representative of the Tipperary pasture. The site lies on the shoulder of a slope amongst the mix of hills, slopes, and bottoms found in the area. Since the site was established, additional fencing has been added to divide the pasture into smaller units, effectively increasing stock density, shortening grazing durations, and lengthening plant recovery periods.

### Transect View



Photo taken August 16, 2007

### Quadrat View



Photo taken August 16, 2007



Photo taken August 23, 2012



Photo taken August 23, 2012



### **Transect View**



Photo taken August 22, 2017

### **Quadrat View**



Photo taken August 22, 2017



Photo taken August 10, 2021



Photo taken August 10, 2021

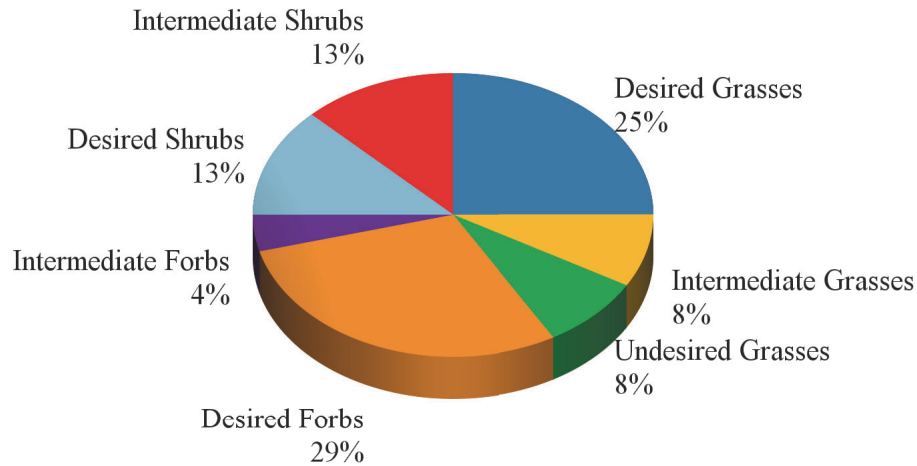
The Site Photos show illustrate the mix of grasses and sagebrush that characterized this site. Plant vigor and productivity has varied through time. The 2017 photos show particularly high vigor as evidenced by the tall bunchgrasses in the foreground and background of the Transect View photo. Cattle had grazed this pasture in mid-late July 2021 and utilization rates appear light, though plant stature was much lower in 2021 compared to 2017, a result of drought. The Quadrat photos reveal decent little cover and low bare ground in all years.



# Plant Community Composition

Tipperary (MRT10)

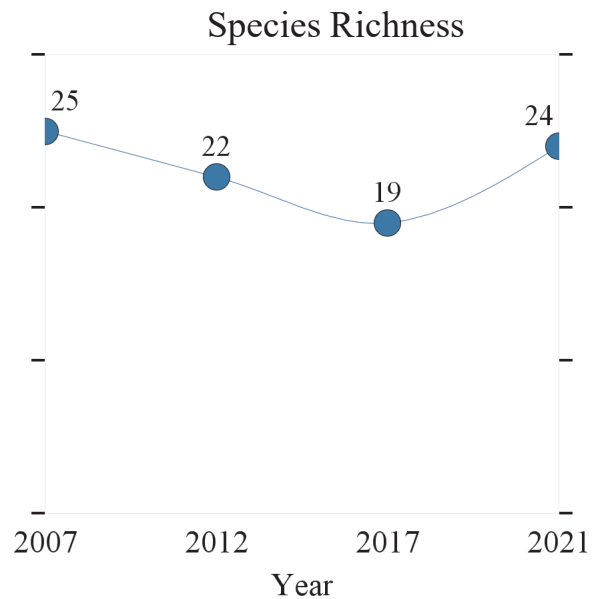
## Composition by Functional Group



### Key Interpretations:

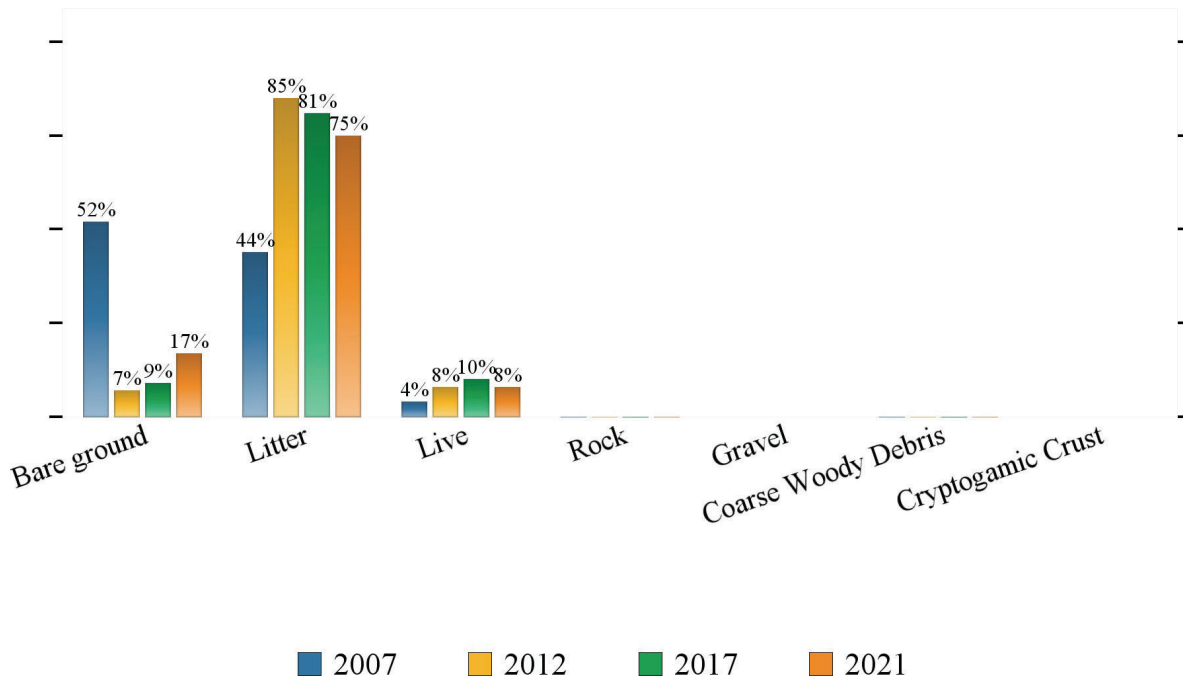
Plant Species Richness has varied over time, dipping from a high of 25 recorded plants in 2007 to a low of 19 in 2017 and then climbing again to 24 in 2021. This was a desired level of species richness for the area, particularly in such a dry year.

The pie chart displays the distribution of species across functional groups in 2021. Desired Grasses, Forbs and Shrubs accounted for 67% of the total richness and included species such as bluebunch wheatgrass, green needlegrass, needleandthread, western wheatgrass, blue grama, hairy goldenaster, phlox, scarlet globemallow, scurfpea, showy fleabane, big sagebrush and fourwing saltbush. Intermediate plants accounted for 25% of the richness and included fringed sagewort, broom snakeweed, pricklypear, prairie junegrass, Sandberg bluegrass, and peppergrass. Japanese brome and cheatgrass were the only Undesired species encountered.



# Ground Cover

Tipperary (MRT10)



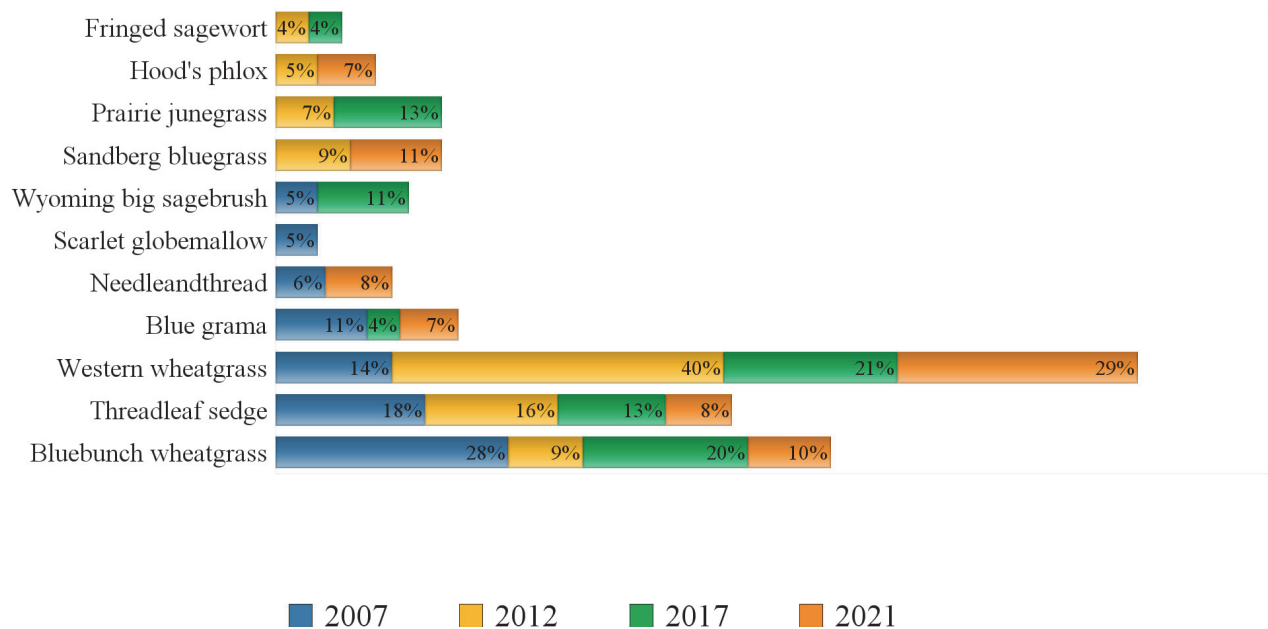
## Key Interpretations:

The Ground Cover data show a strong favorable trend in bare ground between 2007 and 2012 followed by a slow increase in bare ground since. Litter cover has followed an inverse pattern, building dramatically in the early years and then declining slightly since. Live cover, however, has remained fairly high since 2012, ranging from 8-10% and indicating good presence by mature perennial bunchgrasses and shrubs.

Despite the trend, the 2021 ground cover data were within the expected ranges for this ecological site and indicated a mostly effective water cycle as well as moderately high site stability.

## Relative Basal Cover (Top 7 Species)

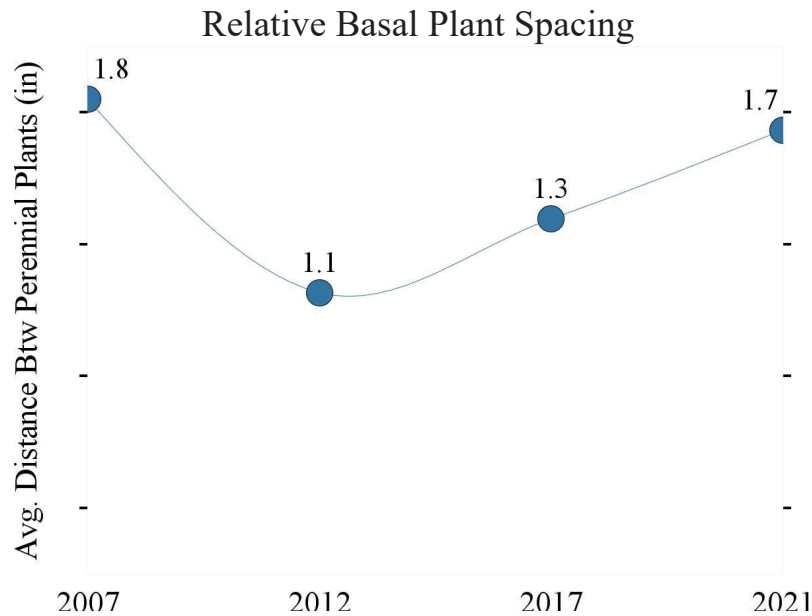
Tipperary (MRT10)



### Key Interpretations:

In terms of basal cover, bluebunch wheatgrass, threadleaf sedge and western wheatgrass have consistently been among the top perennial plants covering the soil surface. All three are desired species expected to be found in abundance in this area. Intermediate species like Sandberg bluegrass and prairie junegrass have remained fairly low in abundance, which was also desired.

In 2021, the dominant perennial plants at the level of the soil surface were western wheatgrass, Sandberg bluegrass, bluebunch wheatgrass, needleandthread, threadleaf sedge, blue grama and Hood's phlox. Ideally, needlegrasses and bluebunch wheatgrass would be more dominant than Sandberg bluegrass, but on the whole this represented a favorable perennial plant community.



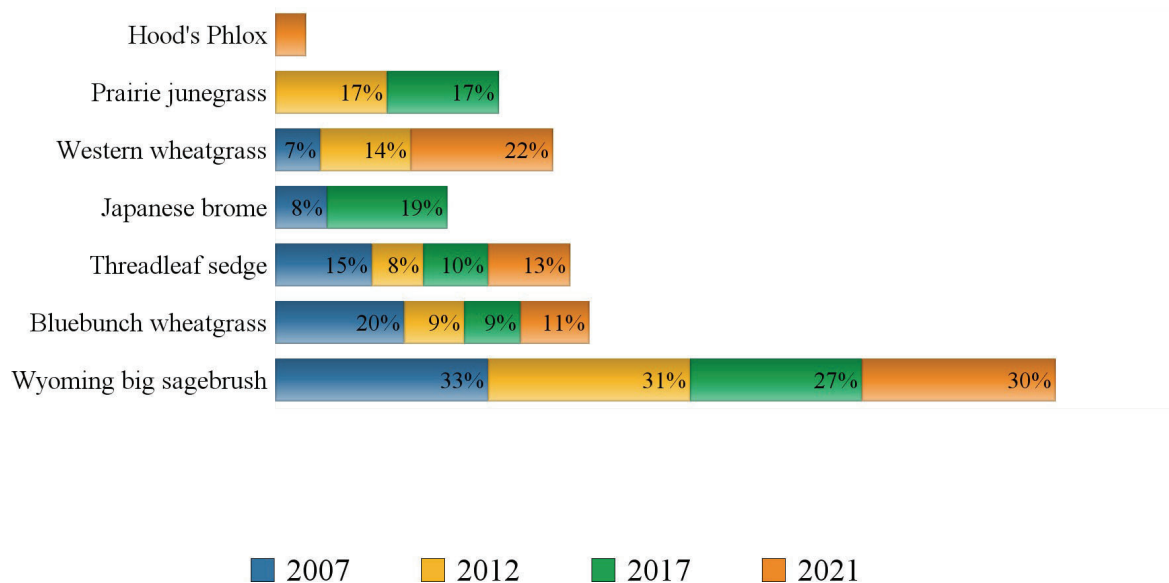
#### **Key Interpretations:**

This metric shows an increase in the average distance between perennial plants in recent years. The most favorable result of 1.1 inches was found in 2012 when western wheatgrass increased quite substantially in basal cover. Since western wheatgrass is rhizomatous, an increase in this species abundance often correlates to a reduction in the relative basal plant spacing.

The 2021 result of 1.7 inches reveals room for improvement. Ideally the trend since 2012 will reverse and the average distance between perennial plants will again begin to decline. Findings of one inch or less are ideal for this metric indicating tight spacing between perennial plants to limit erosion and prevent undesired species from gaining a foothold in the community.

# Community Composition by Weight

Tipperary (MRT10)



## Key Interpretations:

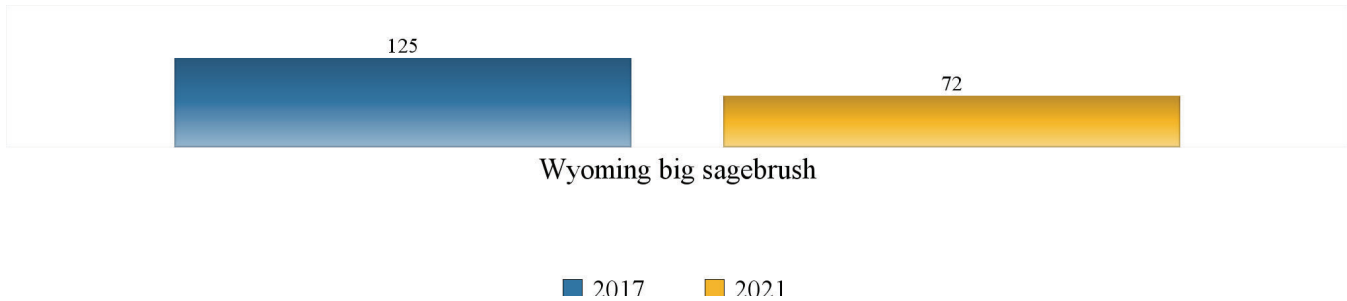
This chart highlights a fair amount of consistency over time in the composition of most productive plants by weight: big sagebrush, bluebunch wheatgrass, threadleaf sedge and western wheatgrass have all been among the top producers in most years. These are all desired species expected to compose much of the forage production in this area. Ideally, one or two needlegrasses would also contribute and their presence in this chart would represent an improvement in species composition in the future.

The presence of annuals like Japanese brome or cheatgrass in the community composition by weight chart signifies an overabundance in the community. These are low biomass plants so they must be abundant to outrank higher biomass (perennial) plants in production by weight. Japanese brome has been sporadically abundant in this pasture, likely in response to seasonal and annual precipitation patterns. In wetter years when much of the moisture falls early in the growing season, annuals will often increase. Due to the 2021 drought, Japanese brome had a poor growth year and did not rank among the top producers. Ideally, an increase in successional activity that favors more rapid recruitment of desired grasses over time will help increase competition and limit future expansion of undesired annuals.

# Shrub Data

Tipperary (MRT10)

Shrub Density (stems/1000 sq ft)



## Line Intercept Data

### 2007

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

19%  
15  
0%  
0%  
100%  
0%  
0%

### 2012

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

16%  
12  
0%  
0%  
0%  
0%  
0%

### 2017

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

20%  
12  
0%  
0%  
96%  
4%  
0%

### 2021

#### Wyoming big sagebrush

Percent Canopy Intercept  
Average Height - inches  
*Age Class: Seedling*  
*Age Class: Young*  
*Age Class: Mature*  
*Age Class: Decadent*  
*Age Class: Dead*

19%  
14  
0%  
0%  
93%  
7%  
0%

**Key Interpretations:**

Shrub Data track the abundance and successional trajectory of target species through time. The density of big sagebrush has varied over time with fluctuations in the rate of recruitment. In 2021 density was moderate at 72 plants per 1000 square feet.

The Line Intercept data show only minor variability in the percent canopy intercept, which has ranged from 16-20% cover over time. Younger plants have yet to be intercepted by the transect line, though they were observed in the area in most years. A majority of the sagebrush community was mature in 2021 with a small (4%) proportion showing decadence.

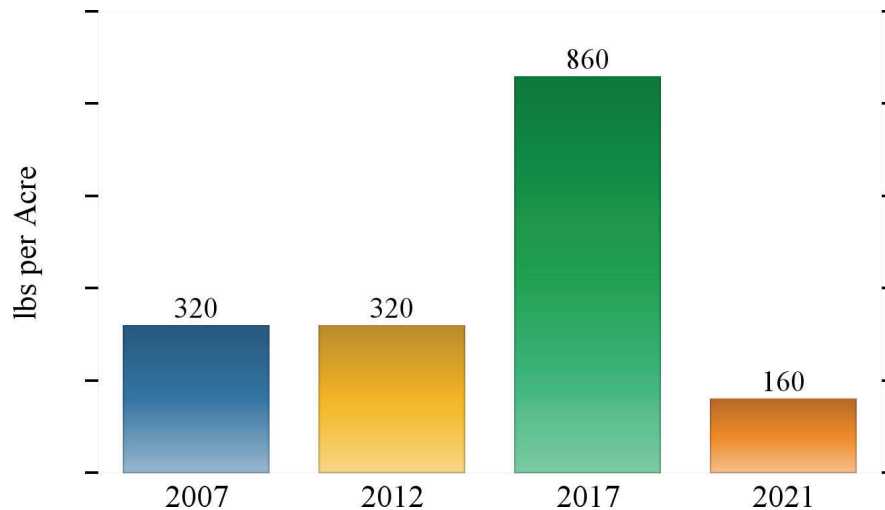
These data indicate slow turnover and maintenance within the sagebrush community. Canopy cover and density were moderate in 2021.



# Forage Production

Tipperary (MRT10)

Average Production in Pounds per Acre

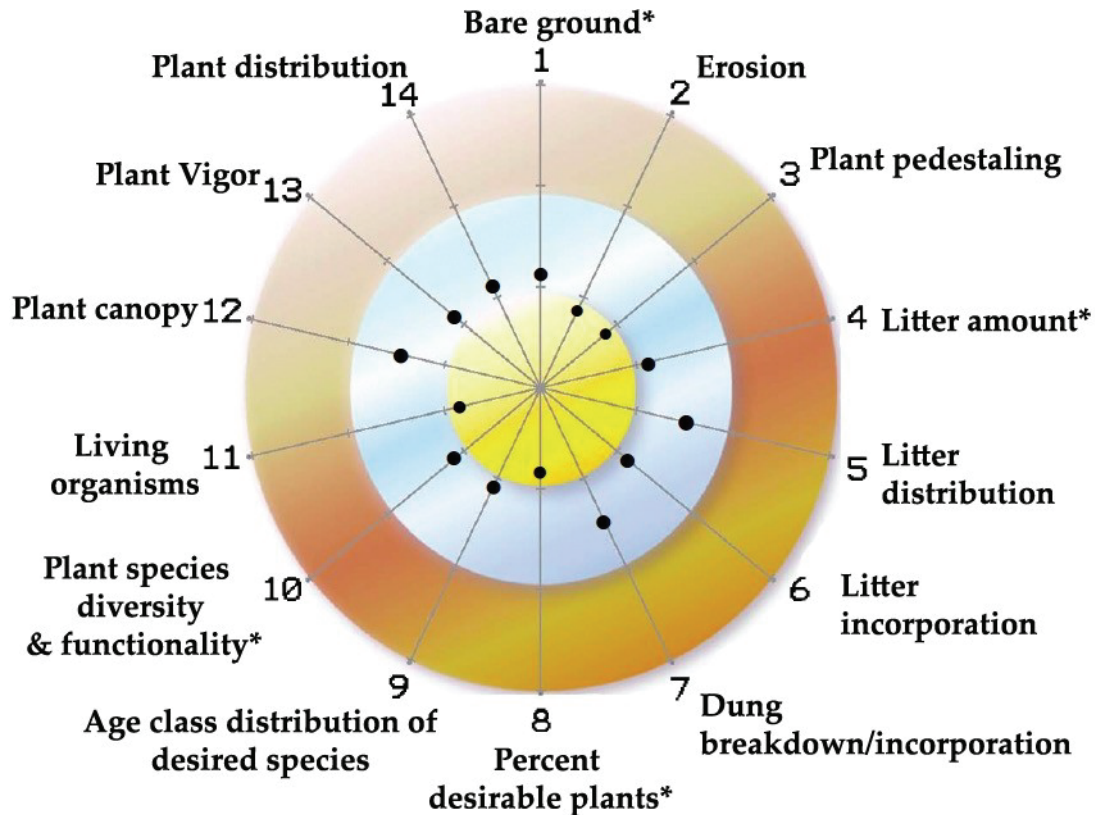


## Key Interpretations:

According to the NRCS's Web Soil Survey, the potential production for this ecological site in a drought year is 623 pounds per acre. The only year in which production exceeded this level was 2017, which produced 860 pounds per acre. Production was low in 2021, partly due to the fact that cattle came out of this pasture in late July, just a week or two prior to monitoring and the dry conditions had limited regrowth. However, the ranch had received some rain in early August, which had resulted in a bit of green up and should have aided recovery.

# Bullseye

Tipperary (MRT10)



The Bullseye provides an overview of range condition at a specific point in time based on a visual assessment of 14 indicators of rangeland health. Bare ground was moderate, showing some room for improvement but signs of erosion and plant pedestaling were minor. In addition, there was almost no cap on the soil surface. These findings indicate that the water cycle was largely effective. Had it rained, most of the moisture would have been absorbed into the soil rather than running off.

Litter accumulation was decent, but a bit on the light side and its distribution was patchy. Although litter was in contact with the soil surface, it was laying idly rather than mixing into the soil. Cowpies in the area were older, showing minimal signs of breakdown. These observations indicate that the mineral cycle was slower.

Species richness was moderately high with 24 plants recorded in the vicinity of the transect. The percent desired species was high and the only two undesired plants encountered were cheatgrass and

Japanese brome. There was obvious turnover taking place within the sagebrush community as evidenced by a mix of younger, mature and decadent plants. Younger fourwing saltbushes were also present. In contrast to the shrub community, the perennial grass community lacked younger age classes and most plants were mature. Although the plant community as a whole displayed a decent composition with a moderate abundance of annuals, the high value perennial bunchgrasses, particularly green needlegrass and needleandthread, lacked the desired abundance.

As habitat, this area provided a valuable mix of forage and cover. Deer, elk, antelope, songbirds, insects and a variety of other wildlife use the site regularly. The plant canopy was a bit reduced with a fair amount of sunlight striking the ground. This was the result of both drought and a mid-summer grazing event. Plant vigor also appeared slightly reduced with few seedheads evident on the grasses. Again, this was related to the timing of the grazing event and the lack of moisture to stimulate recovery. Ungrazed plants had seeded out, though stature was a bit low. Finally, plant distribution was mostly even but with some room for more recruitment of herbaceous species on the soil surface. These findings indicate that energy flow was moderately effective.

# Management Recommendations

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Tipperary (MRT10)

## *Management Recommendations*

Rangeland health in the Tipperary was moderate in 2021 and the trend through time slightly downward. Bare ground had increased and litter declined since 2012, though both remained within an acceptable range and the water cycle was functional. The successional process appeared active within the shrub community but lagging within the herbaceous community with a lack of younger perennial grasses and a lower than desired abundance of species like needleandthread and green needlegrass. However, species composition has remained fairly stable through time with dominance by big sagebrush, western wheatgrass, bluebunch wheatgrass, and threadleaf sedge. Finally, forage production was well below the desired level due to a combination of drought and a recent grazing event.

Cattle grazed the Tipperary for 10-15 days and were moved in late July just before a series of rain events hit the ranch. The timing of this move was good in that the subsequent moisture spurred the grasses out of drought-induced dormancy and into a late summer green-up. Management was planning to bring cattle back into this pasture later in the fall or dormant season for another short duration graze. No changes to the overall grazing strategy, which focuses on short grazing events, long recovery periods and higher stock densities, was warranted. However, given the low forage production results, low seed production on grasses, and the undesired trends in bare ground and litter, it would be ideal to plan on some extra recovery for this pasture coupled with lighter utilization rates over the coming 1-2 years. This will help increase the amount of residual forage and ensure that plants regain their vigor following the drought.

## *Early Warning Indicators*

Grazing managers require a feedback mechanism to determine if management actions are being properly implemented. That mechanism comes in the form of early warning indicators. Such indicators are the earliest signs that course corrections are required, and they may be contrasted to late-warning indicators, which may require more time consuming and costly corrections.

If management actions move this site in a desired direction, look first for improved plant vigor, particularly better seed production. Next, look for improved litter accumulation and reductions in bare ground. If a positive trend continues, look for ongoing active recruitment of desired species like bluebunch wheatgrass, green needlegrass, needleandthread and winterfat followed by increased abundance of desired species and greater forage productivity.

If management actions move things in an undesired direction, look first for reductions in plant vigor. This will indicate that recovery periods are too short. Next, look for increases in bare ground and reductions in litter, suggesting that grazing durations are too long and/or utilization rates too high. Finally, look for shifts in species composition that favor a greater abundance of annual grasses and intermediate species such as prairie junegrass, Sandberg bluegrass, fringed sagewort, and peppergrass.

## North Tipperary (MRT29) Site Summary

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This monitoring site was established in 2021 to represent the North Tipperary Pasture. The transect was placed in an open sagebrush flat approximately one quarter mile from stockwater in an area cattle tend to utilize frequently.

### Transect View



Photo taken August 10, 2021

### Quadrat View



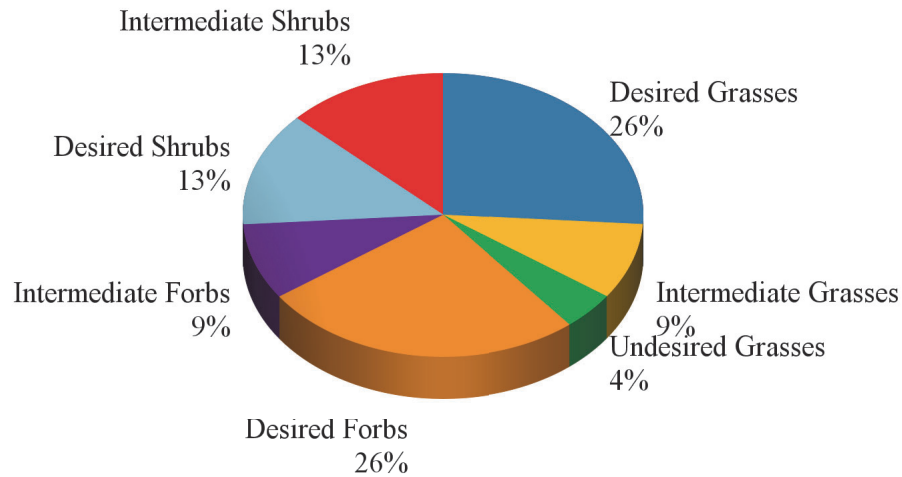
Photo taken August 10, 2021

The Site Photos show a dense sagebrush overstory and modest herbaceous understory. Plant vigor appears a bit low due to drought, which had limited the ability of plants to recover after an early July grazing event. The Quadrat photo displays decent litter and soil coverage by rooted plants as well as some bare ground.

# Plant Community Composition

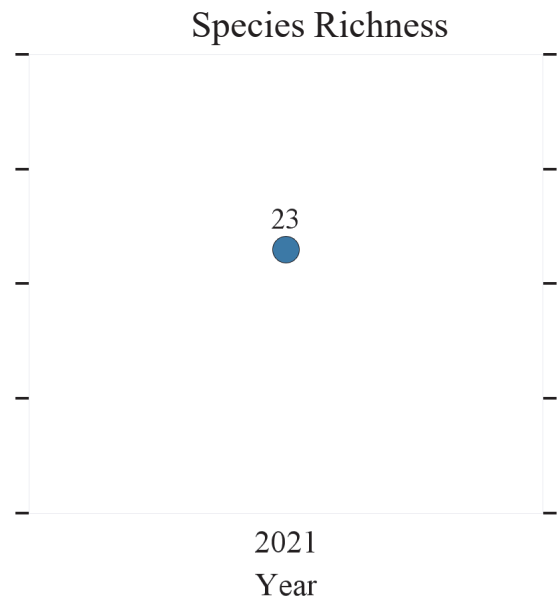
North Tipperary (MRT29)

## Composition by Functional Group



### Key Interpretations:

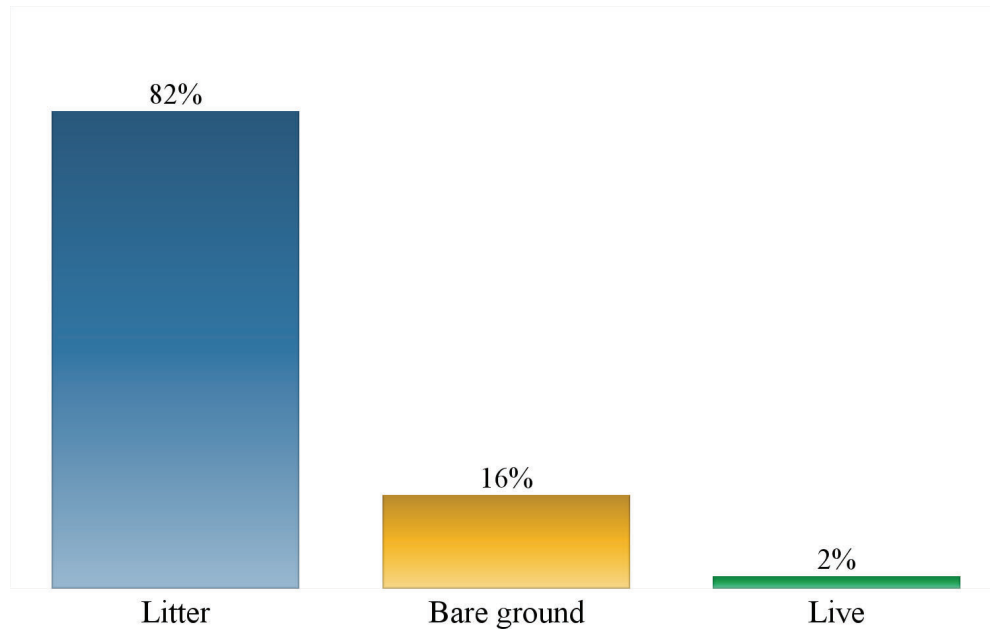
Species richness was moderately high in 2021 with 23 plants recorded in the vicinity of the transect. The pie chart shows the distribution of plants across functional groups. Desired Grasses, Forbs and Shrubs accounted for 65% of the total richness. These groups included blue grama, bluebunch wheatgrass, green needlegrass, needleandthread, threadleaf sedge, western wheatgrass, western yarrow, scarlet globemallow, winterfat and big sagebrush. Intermediate plants accounted for 31% of the richness and included broom snakeweed, fringed sagewort, peppergrass, prairie junegrass, mustard, Sandberg bluegrass, and pricklypear. Cheatgrass was the only Undesired species encountered.





## Ground Cover

North Tipperary (MRT29)



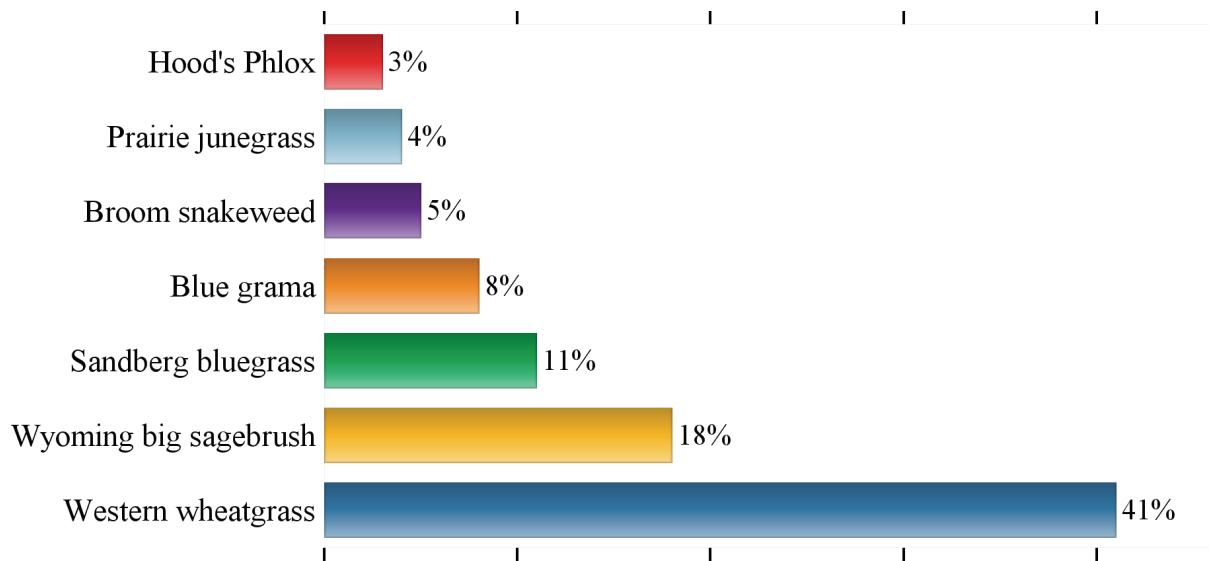
### Key Interpretations:

Ground Cover data provide important information on hydrologic function and site stability. Here, bare ground was modest at 16%, litter cover was fairly high at 82% and live cover was low at 2%. The low live cover finding suggested room for improvement in the abundance of mature perennial grasses covering the soil surface. Altogether, these data indicate that the water cycle was effective and site stability fairly high.



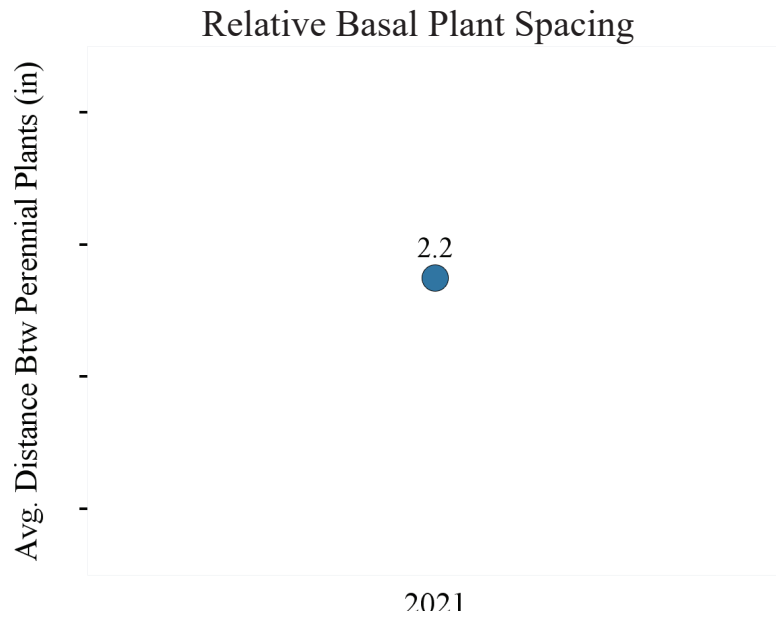
## Relative Basal Cover (Top 7 Species)

North Tipperary (MRT29)



### Key Interpretations:

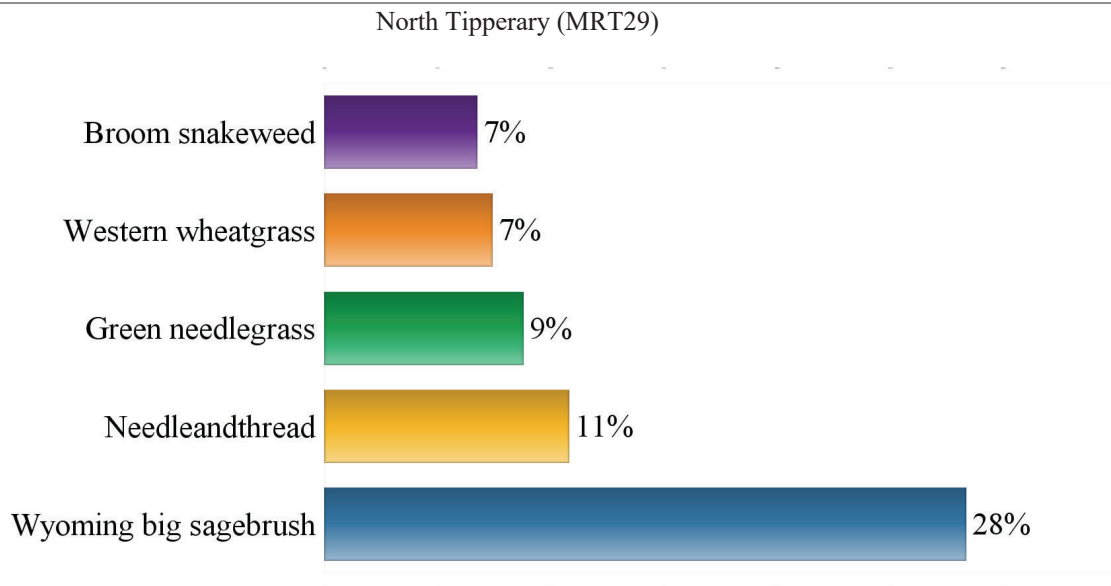
The Relative Basal Cover chart offers a look at the suite of *perennial* plant species dominating the soil surface and therefore information on the composition of the perennial plant community. Western wheatgrass accounted for the bulk of the basal cover (41%). This was followed by big sagebrush (18%), Sandberg bluegrass (11%), blue grama (8%), broom snakeweed (5%), prairie junegrass (4%) and Hood's phlox (3%). The abundances of western wheatgrass and big sagebrush were favorable, but these data highlight a lack of needlegrasses and bluebunch wheatgrass. Intermediate species like Sandberg bluegrass, prairie junegrass, and broom snakeweed accounted for a greater proportion of the basal cover than was ideal. As this site improves, shifts in species composition toward the higher value perennial bunchgrasses should be expected.



#### **Key Interpretations:**

The Relative Basal Plant Spacing metric assesses the average distance between perennial plants on the soil surface and provides insight in the stability of the site. Perennial plants should be tightly spaced, providing good soil coverage to limit erosion and prevent undesired species from gaining a foothold in the community. Here, the average distance between perennial plants was higher than desired at 2.2 inches. Findings of one inch or less are ideal for this metric.

## Community Composition by Weight

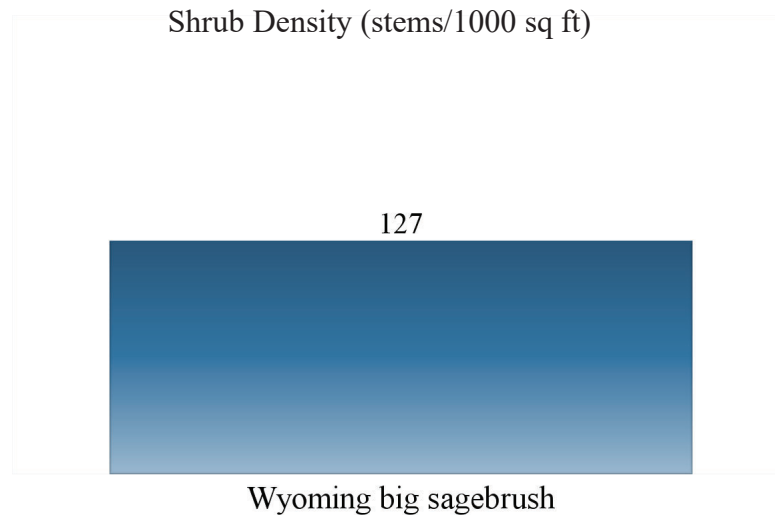


### Key Interpretations:

The Community Composition by Weight chart displays the top five most productive species by weight offering a look at species composition from the perspective of plant production and biomass. Wyoming big sagebrush accounted for much of the production in 2021. This was to be expected, particularly in a drought year when herbaceous production was reduced. Much of the remaining production was accounted for by desired perennial grasses - needleandthread, green needlegrass and western wheatgrass. Despite their low basal cover, these species showed higher productivity than intermediate and annual grasses, which was a positive finding. Some improvement in the relative abundance of plants contributing to the community composition by weight would be ideal, but on the whole these data reflect decent plant community composition.

# Shrub Data

North Tipperary (MRT29)



## Line Intercept Data

	Wyoming big sagebrush
Percent Canopy Intercept	32%
Average Height - inches	21
Age Class: Seedling	0%
Age Class: Young	0%
Age Class: Mature	71%
Age Class: Decadent	11%
Age Class: Dead	18%

## Key Interpretations:

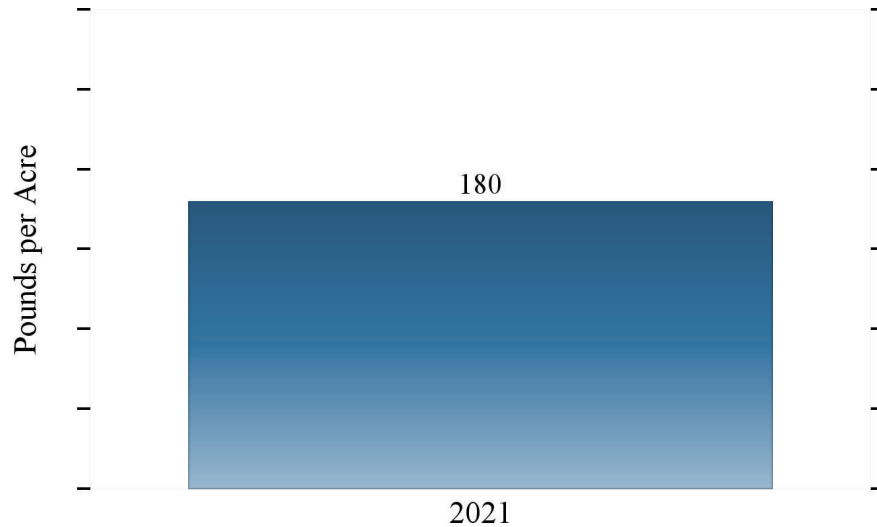
Sagebrush density was fairly high at 127 plants per 1000 square feet. The Line Intercept data show that sagebrush accounted for 32% canopy cover and most of the community was mature. No younger plants were encountered along the transect, though younger individuals were observed in the area. Eleven percent of the community was decadent and 18% was dead. These data indicate slow decline and possible turnover within the sagebrush community, a good sign that it was maintaining itself. Some reduction in sagebrush canopy would have a positive effect on herbaceous productivity.



# Forage Production

North Tipperary (MRT29)

Average Production in Pounds per Acre

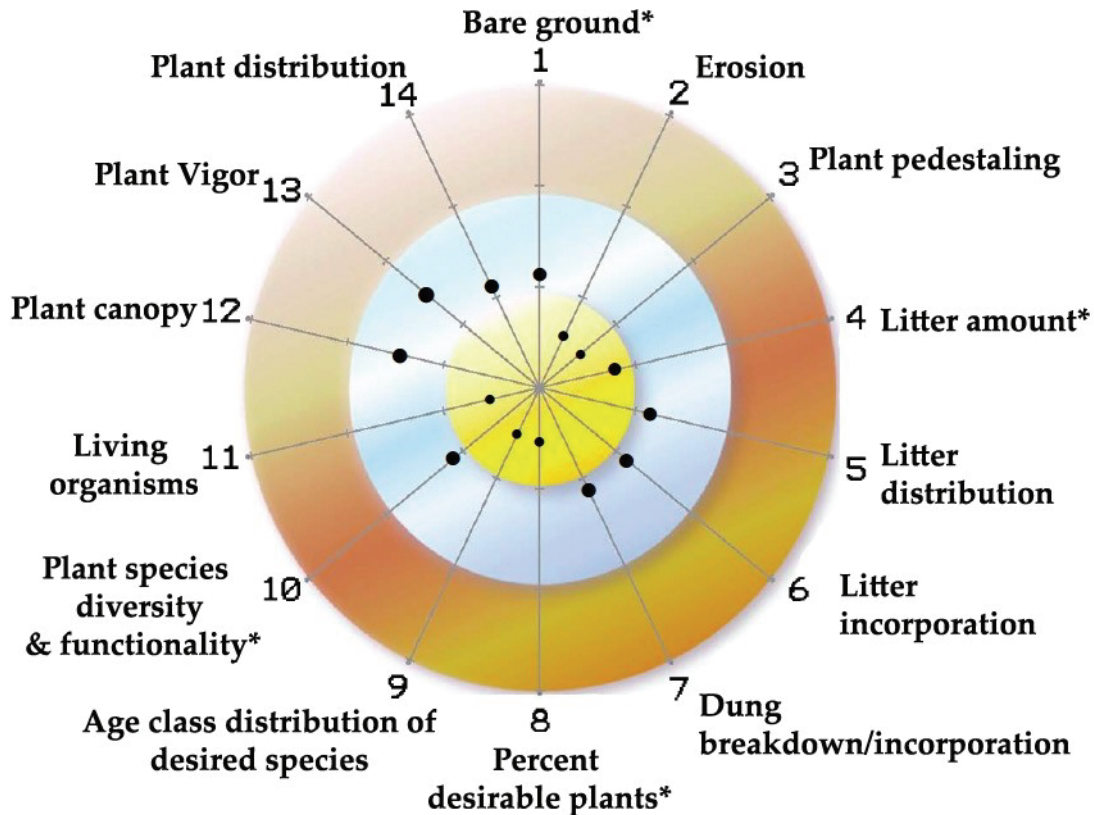


## Key Interpretations:

According to Web Soil Survey, this area should be capable of producing 675 pounds per acre even in a drought year. This pasture had been grazed and 2021 represented the second consecutive year of below average rainfall. Temperatures became hot in June and most plants were pushed into early dormancy by the drought conditions. These factors together resulted in a low forage production result of 180 pounds per acre.

# Bullseye

North Tipperary (MRT29)



The Bullseye provides an overview of range condition at a specific point in time based on a visual assessment of 14 indicators of rangeland health. Bare ground in North Tipperary was moderate, but within the expected range. Despite being located on a mild slope and having experienced recent heavy rains, this area showed no signs of water erosion. Wind erosion was also minimal and plant pedestaling minor. There was a slight soil cap. Overall, the water cycle was effective allowing moisture to be absorbed into the soil rather than running off.

Litter cover was fairly high and its distribution mostly even with some patchiness in certain areas. Litter was clearly mixing with the soil surface where cattle had moved through, but other areas also showed litter sitting up above the ground. Younger and older cowpies were present throughout the site, but overall the mineral cycle appeared moderately rapid.

Species richness was moderately high in 2021 (24 recorded plants in the area). The percent desired

species was also high and cheatgrass was the only undesired plant observed. Quite a few younger green needlegrasses and bluebunch wheatgrasses were observed in the areas, particularly near the beginning of the transect. Younger winterfat and a handful of younger sagebrush were also moving around. These were good signs of activity within the succession process. Species diversity and functionality still displayed room for improvement. Although the abundance of cheatgrass was fairly low, the highly desired perennial bunchgrasses were also lacking abundance. Ideally, winterfat would also be a more prominent member of the plant community.

As habitat, this area provided a desired balance of forage and cover. Elk pellets were observed in the vicinity of the transect and the area receives use by a mix of wildlife including deer, coyotes, songbirds, rodents, raptors and insects. The plant canopy was reduced from an early July grazing event and a lack of moisture to encourage recovery afterwards. Vigor also appeared reduced as evidenced by few seedheads on the grasses and shorter leaders on the sagebrush. The distribution of plants across the soil surface was mostly even, but some areas showed room for colonization by herbaceous plants.

# Management Recommendations

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North Tipperary (MRT29)

## *Management Recommendations*

Rangeland health in North Tipperary was moderate in 2021. This was the first year of data collection for this transect so no trend information was yet available. The water cycle appeared effective though the level of bare ground could likely be improved. Mineral cycling was moderately rapid, and the successional process was active given the presence of younger green needlegrass and bluebunch wheatgrass plants in the area. Energy flow indicators showed the greatest room for improvement with a lower plant canopy and reduced plant vigor.

Cattle grazed this pasture in early to mid-July for 7 days. Stock density was fairly high with 280 pairs moving through. The timing of this grazing event provided good early growth opportunity for desired species, supporting the recruitment of younger plants that was observed. The current strategy of short grazes, higher stock density and long recovery periods continues to be appropriate for this area. Given the lower vigor observed on the grasses, providing another year of springtime rest would be a good idea, but this pasture was capable of supporting a second grazing event if needed as long as utilization rates were kept light.

## *Early Warning Indicators*

Grazing managers require a feedback mechanism to determine if management actions are being properly implemented. That mechanism comes in the form of early warning indicators. Such indicators are the earliest signs that course corrections are required, and they may be contrasted to late-warning indicators, which may require more time consuming and costly corrections.

If management actions move this site in a desired direction, look first for improved plant vigor, particularly better seed production. Next, look for improved litter accumulation and reductions in bare ground. If a positive trend continues, look for ongoing active recruitment of desired species like bluebunch wheatgrass, green needlegrass, needleandthread and winterfat followed by increased abundance of desired species and greater forage productivity.

If management actions move things in an undesired direction, look first for reductions in plant vigor. This will indicate that recovery periods are too short. Next, look for increases in bare ground and reductions in litter, suggesting that grazing durations are too long and/or utilization rates too high. Finally, look for shifts in species composition that favor a greater abundance of annual grasses and intermediate species such as prairie junegrass, Sandberg bluegrass, fringed sagewort, and peppergrass.



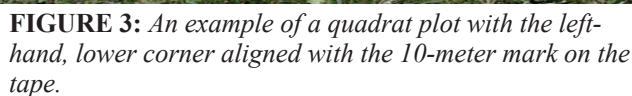
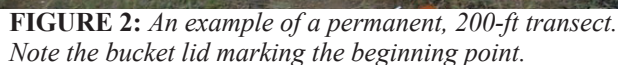
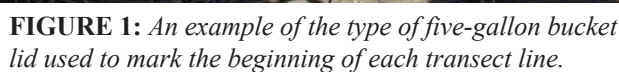
Six different monitoring methods were used to gather data and information at this monitoring site:

- Photographs
- Line-point intercept
- Most abundant plant by weight
- Line-intercept
- Belt Transect
- Qualitative indicators of rangeland health (Bullseye)

The same suite of monitoring methods was repeated at each monitoring site visited during the summer 2016 monitoring effort. A 200-foot tape measure, laid along the soil surface, served as the basis of the monitoring protocol, and represented the transect line. A five-gallon bucket lid was nailed to the soil surface to permanently mark the beginning point of each transect (Figures 1).

Photographs of each transect (Figure 2), as well as of a 4.8 square foot quadrat placed at the 10-foot mark along the transect (Figure 3) were taken at each site.

Each assessment began with a qualitative examination of rangeland health using the Bullseye method developed by Gadzia & Graham (2009). This approach was based on several valuable sources, but one worthy of mention here is the 1994 report *Rangeland Health* by the National Research Council. This report 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 qualitative rangeland health indicators used in this initial assessment describe functionality in four fundamental ecosystem processes: the water cycle, mineral cycle, successional process, and energy flow.

An effective water cycle requires covered soil and high biodiversity. When effective, most water soaks into soils quickly where it falls, without running off. Later, this moisture is released slowly through plants that transpire it, or through rivers, springs, and aquifers that collect through seepage what the plants don't use. When biodiversity is reduced and soils exposed, much water runs off the soil surface. What little soaks in is released rapidly from evaporation which draws moisture back up through the soil surface (Figure 4; Savory, 1993).

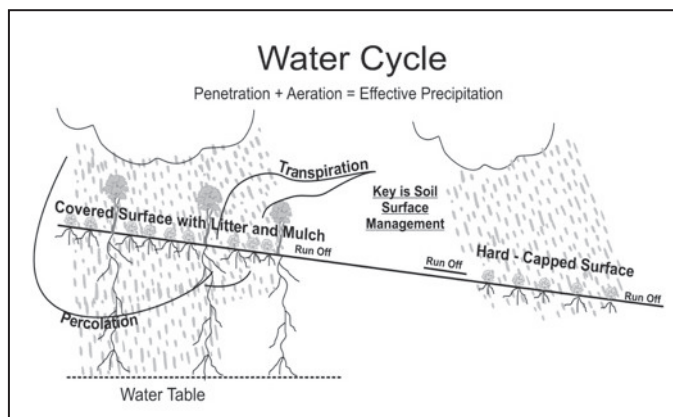


FIGURE 4: A visual of the water cycle.

The water cycle was described as either “effective,” or “ineffective.” If the water cycle was described as effective, then precipitation appeared to be moving into the soil and evaporation from the soil surface was minimal. Conversely, sites with an ineffective water cycle displayed signs of water leaving the site, such as erosion, plant pedestaling, and soil capping.

Like the water cycle, an effective and rapid mineral cycle requires covered soil and high biodiversity. When effective, many nutrients cycle continuously between living plants and living soil. When soil is exposed and biodiversity low, nutrients become trapped at various points in the cycle, or are lost to wind and water erosion (Figure 5; Savory, 1993).

In the monitoring report, the *speed* of the mineral cycle was described. If the cycle was moving slowly, then nutrients were not moving back into the system. An indicator of this would be past years' plant growth (known as litter) either elevated above the soil surface or lying idly on the soil surface and showing signs of oxidation rather than decomposition. Ideally, litter should contact the soil surface where soil-borne organisms of decay may begin to break it down and speed the re-utilization of nutrients in the system.

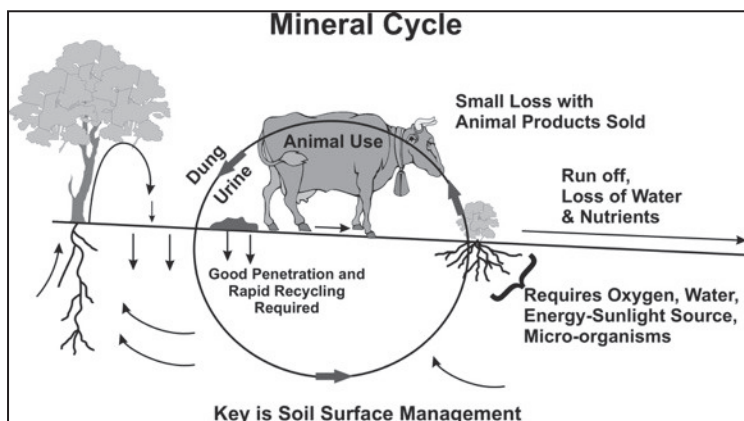


FIGURE 5: A visual of the mineral cycle.

With few exceptions, ecological communities tend to cycle through processes of building complexity in response to disturbances, which tend to reduce complexity. From unstable bare ground, where biodiversity is low, stable complex range or forest communities, high in biodiversity tend to develop over time (Figure 6; Savory, 1993). This is succession.

The plant communities composing a site help characterize past management actions as well as shape current expectations for land and livestock performance. Thus, in this monitoring report, plant community composition was described and classified as high seral (meaning desirable), mid seral (neither desired nor undesired), and low seral (weedy or less desired). Importantly, indicators like the presence of seedlings and young plants of different species represent early changes in plant communities likely to become evident in coming years. Such observations further inform management expectations.

Almost all life requires energy that flows 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 whatever eats the consumers of plants. Energy doesn't cycle, but flows through the ecosystem until it is consumed (Figure 7; Savory, 1993).

In this report, energy flow was described as "elevated," "moderate," or "reduced." Sites with elevated levels of energy flow showed signs that much solar energy was being captured by living plants and that much photosynthesis was occurring. The indicators of elevated energy flow include robust canopy cover, high plant vigor, and high plant stature. Conversely, sites with reduced energy flow showed signs that much sunlight energy was striking the soil surface and not being captured. These sites displayed higher levels of bare ground (relative to expectations for the ecological site and to current climatic conditions), lower plant canopies, vigor and stature.

A rangeland health qualitative scoring guide describing the parameters for each of 14 indicators of rangeland health was used to evaluate each site (more information on the Bullseye Target method and scoring can be found here:

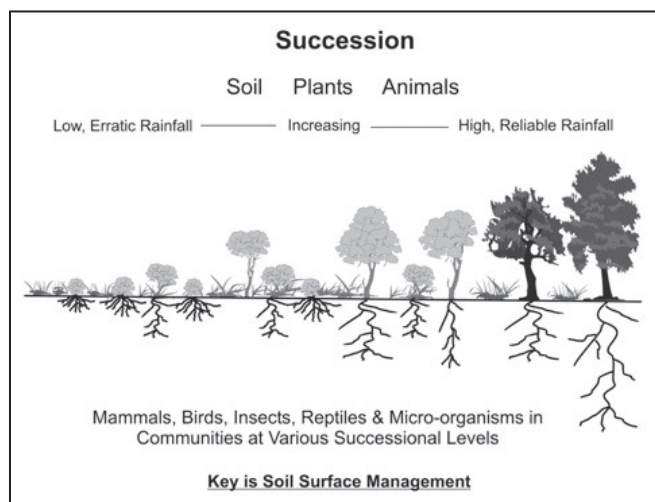


FIGURE 6: A visual of the successional process.

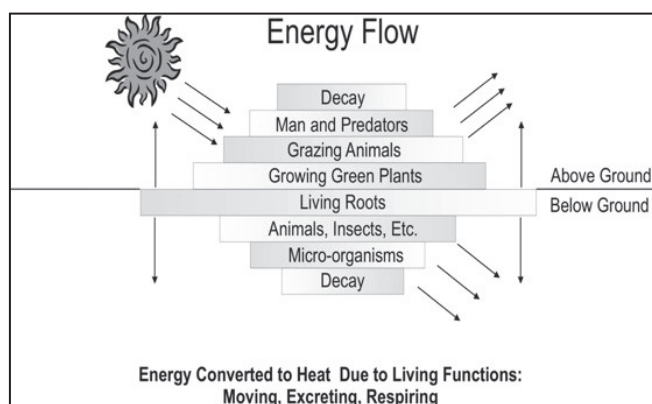


FIGURE 7: A visual of the flow of energy through ecological systems.

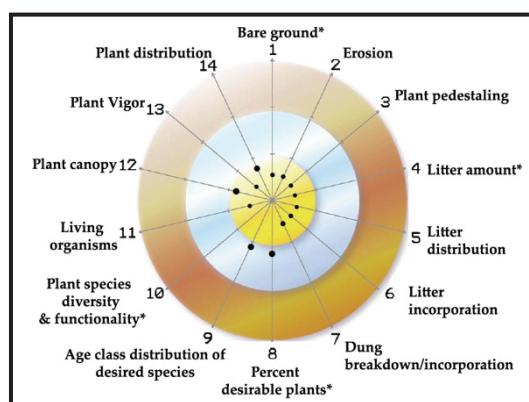


FIGURE 8: The Bullseye Target provides a representation of 14 indicators of rangeland health assessed during the qualitative component of the monitoring effort.



<http://ranchadvisory.com/rangelands-monitoring>). Each indicator was assigned a “score” relative to its degree of functionality. Each score has an associated color and position on the “Bullseye Target,” providing an efficient, but effective means of characterizing the condition of a site (Figure 8). If, for example, the indicator “litter distribution” displayed uniform cover across the soil surface, this indicator was considered functional, and a mark was placed in the gold area on the Bullseye Target. The final product provides management with a visual portrayal of ecosystem function at a given point in time.

In addition to the qualitative methods described above, several quantitative methods were part of the monitoring process. First, a custom soil survey was generated for the sample area using NRCS’s Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>). The custom report generated provides information on desired plant species, expected shifts in species composition under differing management regimes, and expected productivity of a site. Using this information, indicators for desired plant community composition, functional and structural groups, and expected levels of erosion, bare ground, and litter cover can be reviewed and compared to current conditions.

Second, various data were collected at each site along a permanent, 200-foot transect using a variety of monitoring methods:

#### 1. Line-point Intercept Method

With this method, a steel rod or sturdy metal wire is lowered to the soil surface at every other foot along the tape measure (Figure 9) for a total of 100 points. At each point where the wire touches the ground, data on ground cover (bare soil, litter, living plants or rock/gravel) are collected. The data from all 100 points are then compiled and the percentage of each ground cover type calculated.

In addition to ground cover data, the line-point intercept method is used to collect information on the most abundant perennial plant species covering the soil surface and the average distance to perennial plants. At each point where the wire is lowered to the ground, the distance to the nearest perennial plant is measured and the species recorded. This data gets compiled for all 100 points and the distance to each species averaged. These data provide a look at perennial plant species composition at the level of the soil surface and how common they are.



**FIGURE 9:** A visual of the line-point intercept method. The metal rod is lowered to the soil surface. Whatever it touches is recorded as “ground cover”. The ruler is used to measure the distance to the nearest perennial plant.

#### 2. Most Abundant Plant by Weight

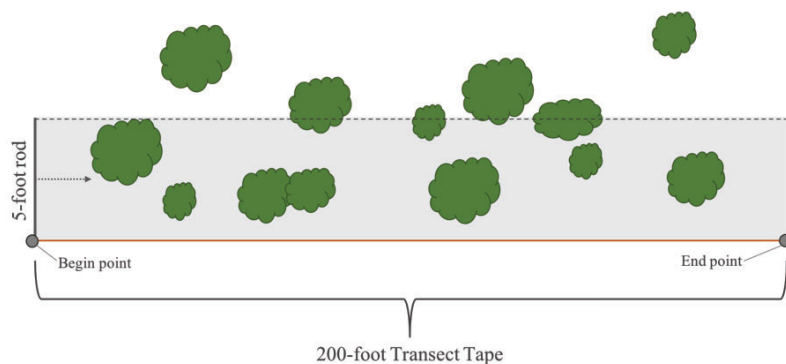
This method measures plant species composition by productivity. Quadrats get evaluated every 20 feet starting at the 10-foot mark to determine which species produce the most biomass by weight. The top five most abundant species by weight are estimated within each quadrat with the most abundant species receiving a score of 5 and the least abundant receiving a score of 1. The combined scores yield a percent composition by species for each monitoring site, and the top five most abundant plant species by weight are presented in a chart like the one portrayed in Figure 12.

### 3. Line Intercept Method

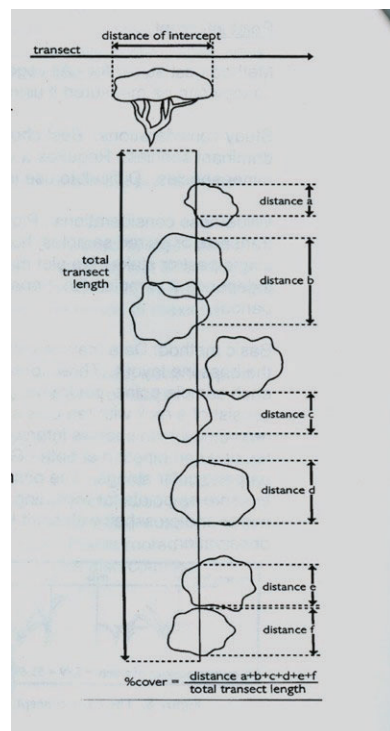
This method is used to measure the canopy cover of shrubs. Data is collected by looking straight down on the transect tape measure and recording the number of centimeters of canopy intercepted by shrub species (Figure 10). The age class (seedling, young, mature, decadent, dead) and plant height are also recorded. These data are then tallied by species and displayed as an average or percentage. Tracking this data through time provides information on habitat values and succession within the shrub communities.

### 4. Belt Transect Method

Complementing the line-intercept data, shrub density is measured using the belt transect method. In this method, a five-foot long rod was held perpendicular to the transect tape and the number of shrubs intercepted by the rod recorded by species (Figure 11). Following this protocol along the entire 200 feet of the tape provided a shrub density estimate for the site (i.e., number of shrubs per 1000 square feet).



**FIGURE 11:** An illustration of the belt transect method.



**FIGURE 10:** An illustration of the line intercept method. The straight line (no arrows) represents the outstretched tape measure of the transect. Each polygon represents the canopy cover of a shrub. The canopy intercept for each shrub is represented by the dotted lines.



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## ABOUT THE AUTHORS

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Ranch Advisory Partners, Inc. provides agricultural advisory services in the ecological and financial aspects of ranching and agricultural properties. Services include total ranch management; structured finance strategies; operations financial optimization; agricultural operations design, implementation, and oversight; grazing planning; rangeland health evaluations and monitoring; wildlife habitat vegetative manipulation and monitoring; and hydrology.



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