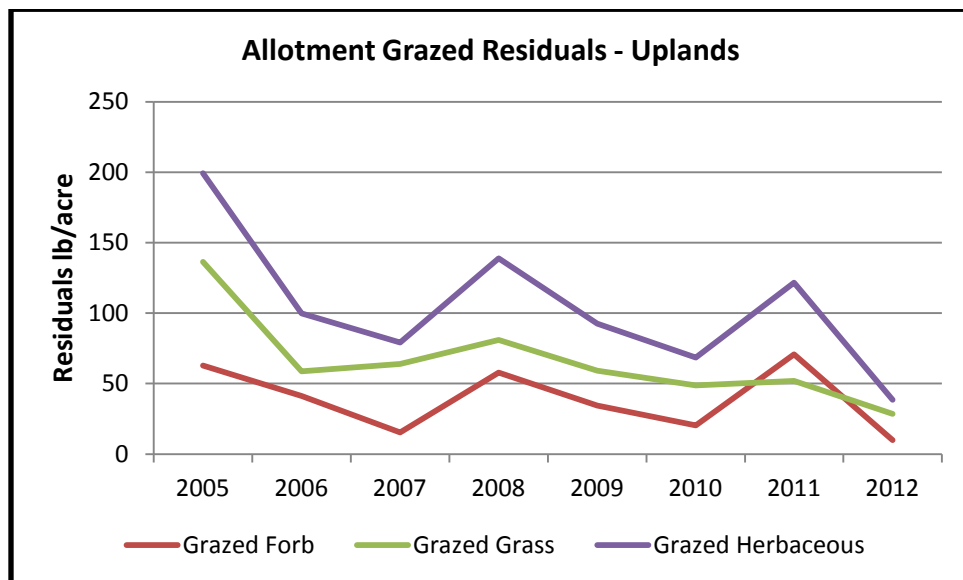


## DUCK CREEK ALLOTMENT SUMMARY 2005 THRU 2012

March 3, 2013



### Report By

**Western Watersheds Project<sup>1</sup>**  
**Wild Utah Project<sup>2</sup>**  
**Yellowstone to Uintas Connection<sup>3</sup>**

<sup>1</sup> Jonathan Ratner [www.westernwatersheds.org](http://www.westernwatersheds.org)

<sup>2</sup> Jim Catlin, Allison Jones [www.wildutahproject.org](http://www.wildutahproject.org)

<sup>3</sup> John Carter [www.yellowstoneuintas.org](http://www.yellowstoneuintas.org)

## INTRODUCTION

Data collection for this report began in 2005 and has continued through 2012. The purpose of this effort is to provide quantitative data to BLM and the public as well as other agencies and organizations that may find it useful in addressing livestock grazing. During these years, data has been collected on upland and riparian forage production; utilization by livestock; riparian greenline and adjacent meadow stubble heights; shrub, grass and forb canopy; ground cover, and bank alteration. Over 2500 samples of grasses and forbs were clipped, dried and weighed to arrive at riparian and upland grazed and ungrazed herbaceous residual vegetation following grazing. Utilization results were obtained by comparing grazed and ungrazed (caged) plots. Aerial and ground censuses were conducted to determine the numbers of cattle grazed.

In 2009, BLM issued a decision to implement a four pasture deferred rotation grazing system and additional water troughs in upland locations. Prior to implementation of this system, the allotment was grazed by 641 cow/calf pairs plus 500 adult sheep and their lambs. Cattle grazing occurred from early May until late September while sheep grazed in spring and in winter after cattle left the allotment. The data and analysis in this report evaluate the performance of this new system.

## METHODS

1. Upland Utilization: In 2005, 7 locations were established in Wyoming big sagebrush areas near BLM or Utah Division of Wildlife Resources monitoring sites. A 4-foot square welded cage with wire mesh was placed at the location with five transects radiating outward at systematic intervals of 0, 72, 144, 216 and 288 degrees from magnetic north. Along each transect, 36" x 36" plots were clipped with grasses and forbs placed into separate sample bags. A single 36" x 36" plot was clipped within the cage footprint. Samples were placed in ziplock bags which were opened air dried and weighed at the office. In 2006, five additional locations were equipped with cages and similarly sampled, giving 12 total upland locations. Multiple cages were placed at several of these locations to increase the sample size of the ungrazed plots. This method was adapted from the Paired Plot Method<sup>4</sup>, but is different in that community production and residuals were measured, not individual species.
2. Riparian Utilization: In 2005, 3 locations were established adjacent to the greenline on Duck Creek and Six Mile Creek to determine production and utilization by comparing grazed and ungrazed forage residuals. Transects of 100' length were placed up- and downstream from the central cage. Plots (36" x 36") were clipped at the 50' and 100' points along these transects as well as in the cage footprint. In 2010, four additional locations were added. Duplicate cages were placed at the original three locations in 2007. The original cages were replaced with all welded steel panel cages in 2007 to reduce damage by livestock. These cages have a 32" x 40" footprint and plots were clipped to this footprint size.

---

<sup>4</sup> BLM. 1996. Utilization Studies and Residual Measurements. Interagency Technical Reference: Cooperative Extension Service, USDA Forest Service, Natural Resources Conservation Service and the Bureau of Land Management.

3. Stubble Heights: Two methods were used to collect stubble heights. In the first method<sup>5</sup>, stubble heights were measured along the greenline with a goal of collecting a minimum of 30 data points on each side of the stream. Measures were taken at approximately 3' intervals either by tape or pacing. Nebraska sedge was the greenline species selected for monitoring due to agency focus on that species. Adjacent meadow stubble heights were measured just outside the greenline on the grass species present. See the next paragraph for the second method.
4. Bank Alteration: The Multiple Indicators Method<sup>6</sup> (MIM) was used for collecting bank alteration data. Stubble heights were collected along the greenline on each side of the stream using the MIM Frame while also collecting the bank alteration data.
5. Canopy and Ground Cover: The Line – Intercept Method<sup>7</sup> was used to collect data for shrub, grass and forb canopy as well as ground cover. The data was collected along the transects at the upland utilization sites. Fifty points were collected along each transect at 2 foot intervals.

## RESULTS AND DISCUSSION

A map of the allotment, streams, upland water developments and sample locations is provided in Figure 1. Table 1 provides additional descriptions of sample locations, including sample site designations that have been used previously, and latitude and longitude (UTM) coordinates. Photographs of upland and riparian conditions at each sample location are provided in Appendices I and 2. All Tables are provided in Appendix 3.

Counts of cattle on the allotment were conducted in four of the eight years of study (Table 2). These included aerial censuses by Wild Utah Project (WUP and Lighthawk), ground censuses by both WUP and BLM and a verbal report from the permittee for the 2005 grazing season. During 2005, the north half of the allotment (Pastures 1 and 2) was partially rested to protect seedings on private lands within the allotment boundary. From a discussion with the permittee and a partial on-ground census, it is estimated that 300 cow/calf pairs grazed the allotment in 2005. In 2006 and 2008, aerial census found 450 and 304 cow/calf pairs. No counts were done in 2007 and 2009. In 2010, the aerial census found 570 pairs during the grazing season, dropping to 148 just before leaving the allotment. In 2011, BLM counted 601 pairs, while a WUP census found 531. Based on these data, in the years prior to implementation of the new grazing system (2005 – 2009), roughly half of permitted numbers were being grazed and following implementation (2010 - 2012), close to the permitted numbers were grazed. The problem of permittee reported actual use vs actual counts was addressed in Catlin et al (2010)<sup>8</sup> showing that permittees reported near permitted numbers even when grazing fewer livestock.

---

<sup>5</sup> Ibid

<sup>6</sup> Burton, T.A., S.J. Smith, and E.R. Cowley. 2008. Monitoring Stream Channels and Riparian Vegetation – Multiple Indicators. Interagency Technical Bulletin Version 5.0. BLM/ID/GI-08/001+1150.

<sup>7</sup> Herrick, J.E., J.W. Van Zee, K.M. Havstad, L. M. Burkett, and W.G. Whitford. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. USDA-ARS Jornada Experimental Range, Las Cruces, New Mexico.

<sup>8</sup> Catlin, J., Carter, J., and A. Jones. Range Management in the Face of Climate Change *in* Monaco, T.A. et al. comps. 2011. Proceedings – Threats to Shrubland Ecosystem Integrity; 2010 May 18-20; Logan, UT.

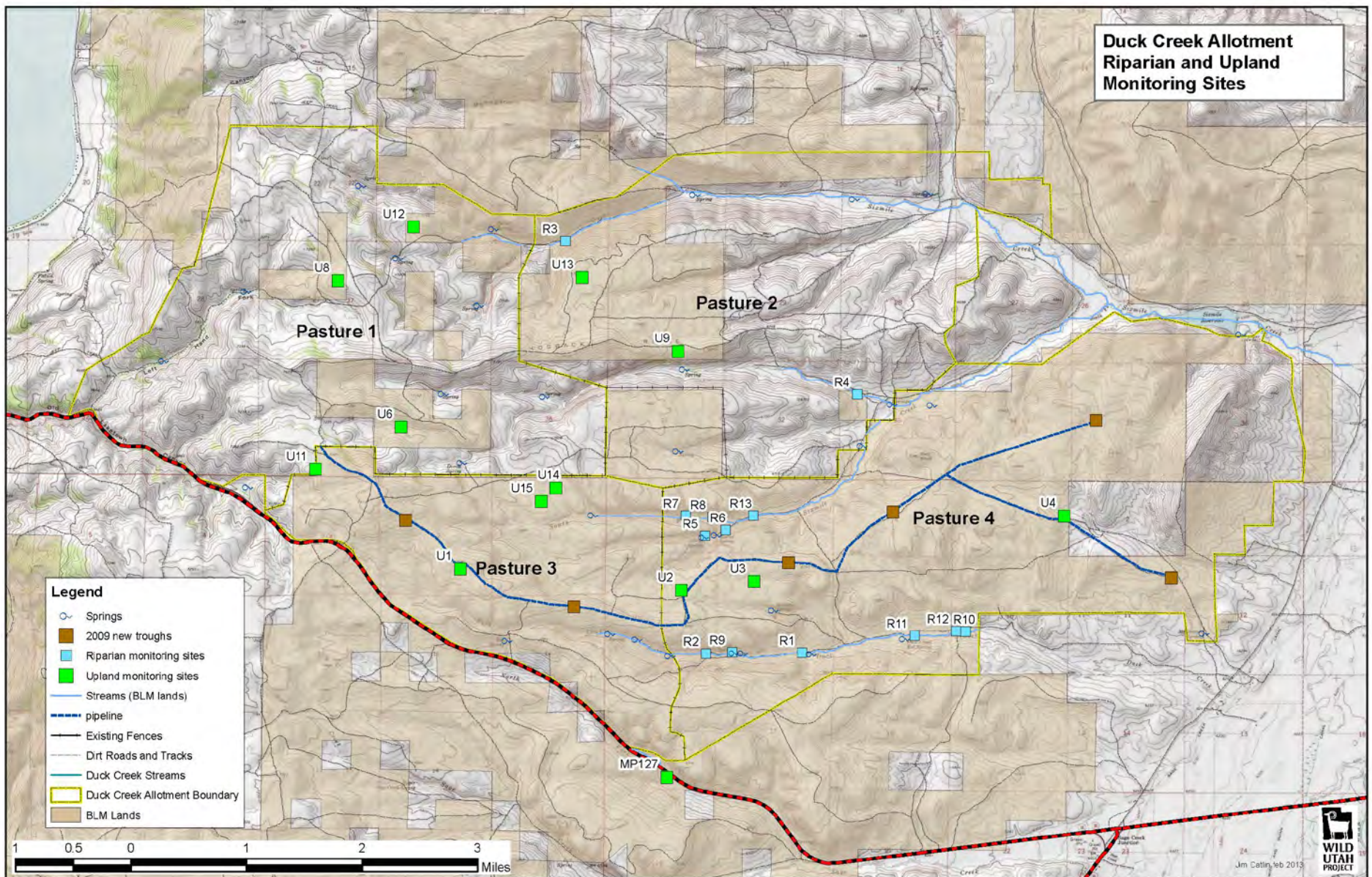
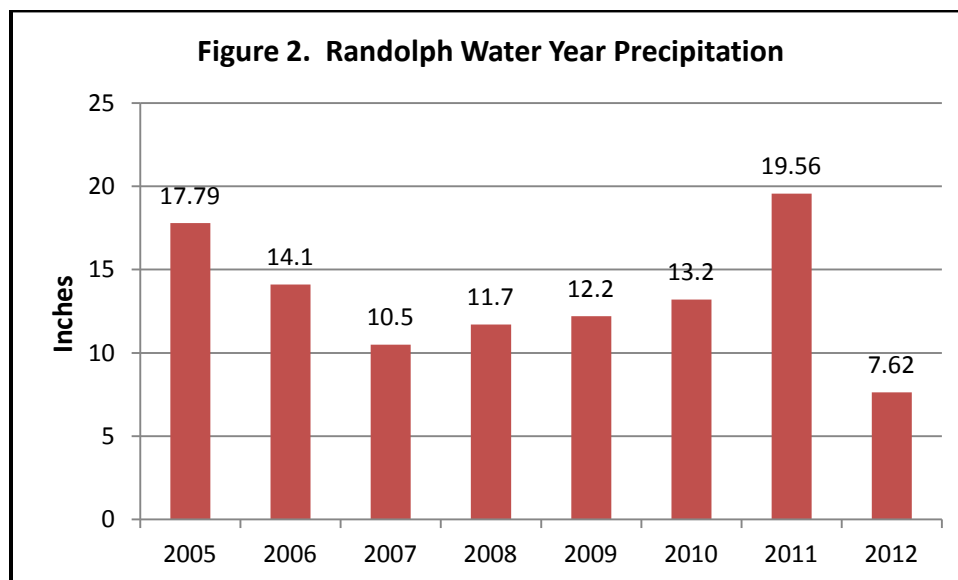


Figure 1. Map of Sample Locations, Allotment/Pastures and Water Troughs Added in 2009



The Randolph climate monitoring station<sup>9</sup> was used to represent the annual water year precipitation for the Duck Creek allotment, which reportedly ranges from 12 – 16 inches<sup>10</sup>. A chart of the annual water year precipitation is provided in Figure 2, showing that 2005 and 2011 were years of higher than the normal precipitation of 13.5", 2006 and 2010 were near normal, and the remaining years were below normal to varying degrees, with 2012 being the lowest year during the study.



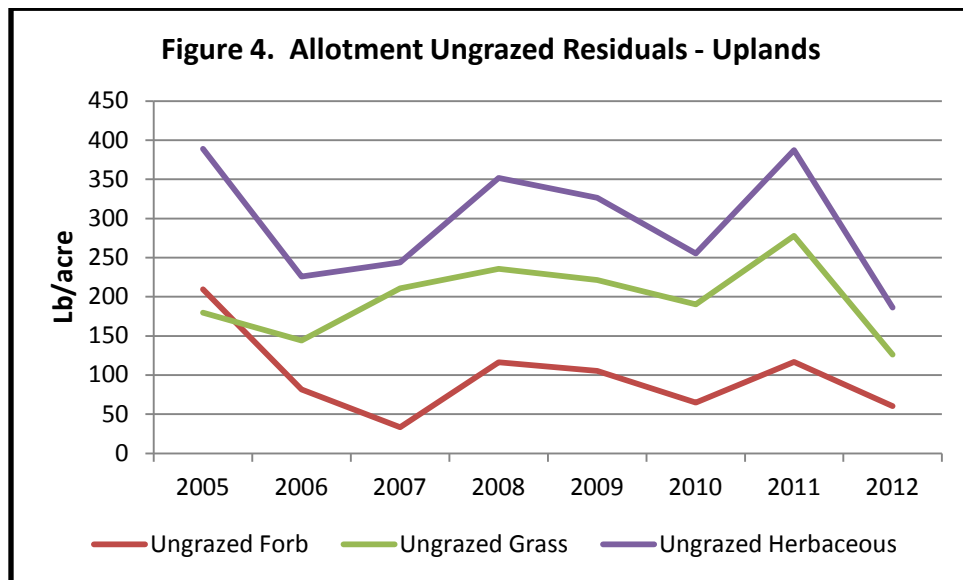
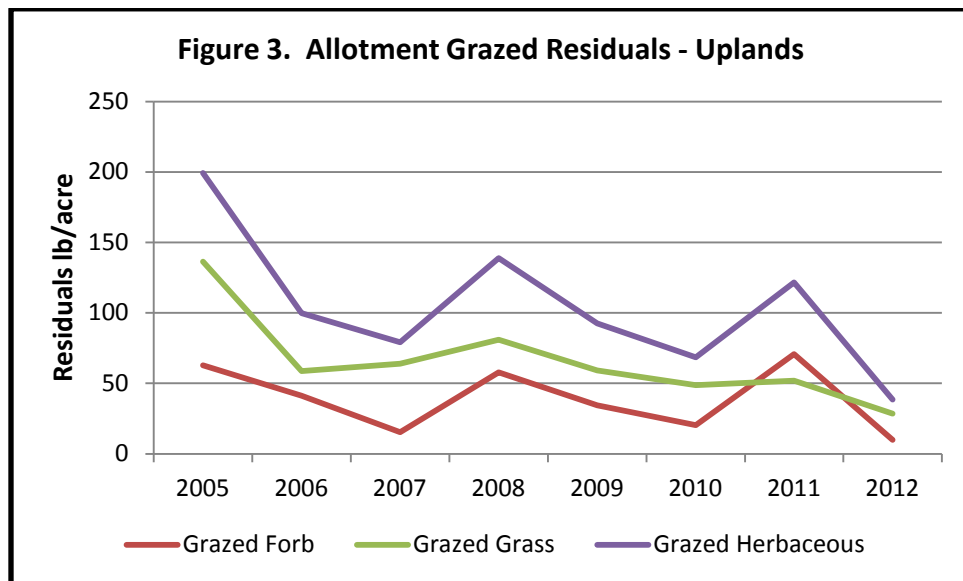
### Upland Residual Vegetation

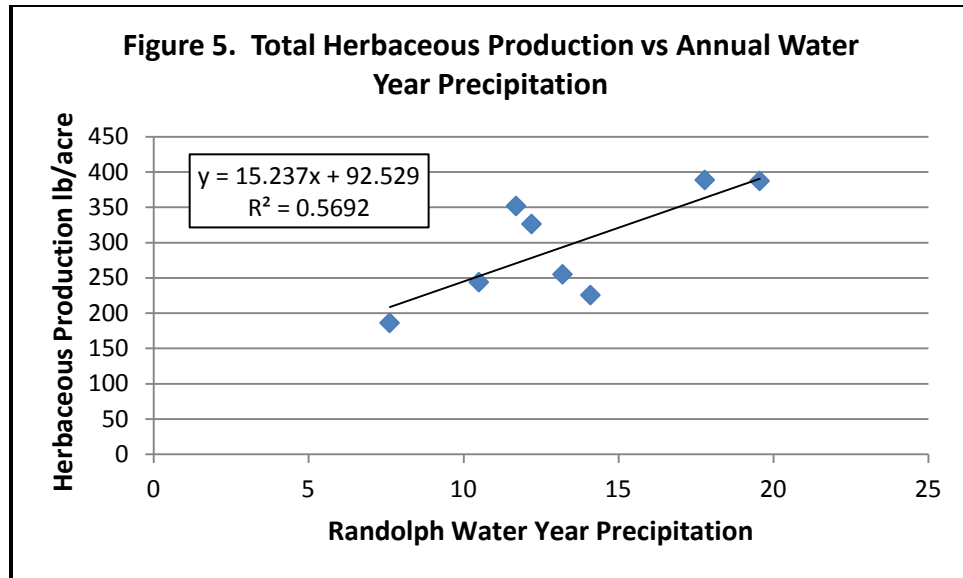
Residual amounts of herbaceous vegetation (grasses, forbs and total herbaceous vegetation) for each location and pasture as well as the allotment totals for all years are provided in Tables 3, 4 and 5 for grazed plots and in Tables 6, 7 and 8 for ungrazed, or caged plots. Figure 3 shows the grazed and ungrazed residuals for grasses, forbs and total herbaceous vegetation. Grass residuals declined from 136 lb/acre in 2005 to 28.6 lb/acre in 2012, while grazed residual total herbaceous vegetation declined from 199.2 lb/acre in 2005 to 38.6 lb/acre in 2012.

Ungrazed residuals, i.e. annual production in caged plots reflected precipitation with higher values in the wet years of 2005 and 2011 and lower values in the driest years of 2007 and 2012. Grass production ranged from a high of 235 lb/acre in 2008 to a low of 126 lb/acre in 2012. Total herbaceous production ranged from a high of 388 lb/acre in 2005 to a low of 186.3 lb/acre in 2012. Figure 5 illustrates the relationship between annual herbaceous production and water year precipitation. All plots were clipped after the cattle grazing season ended and were in late summer or fall after the growing season ended. Clipping plots at this time of year captured all regrowth following cattle removal from the different pastures.

<sup>9</sup> Western Regional Climate Center <http://www.dri.edu/wstrn-rgl-climate-center>

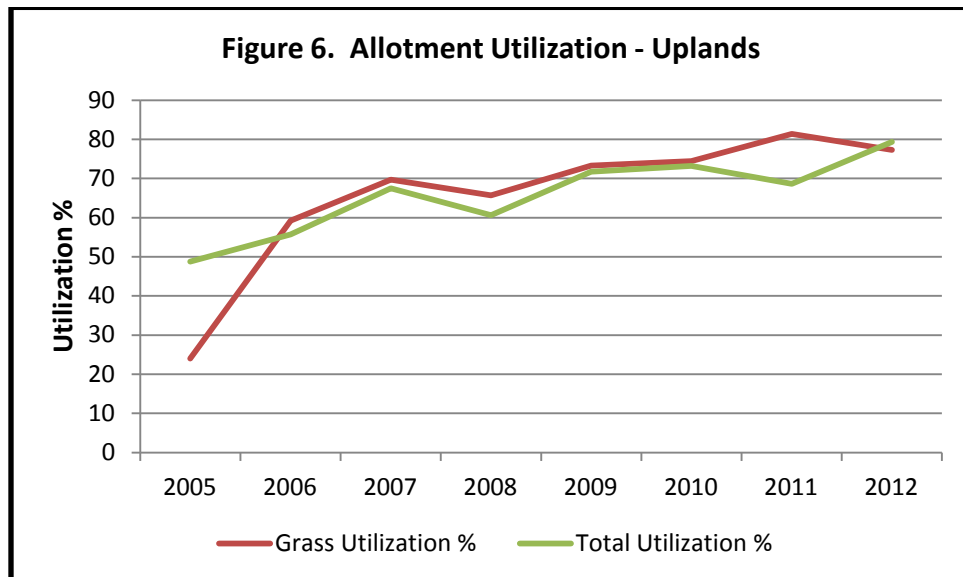
<sup>10</sup> USDA. 1982. Rich County Soil Survey. Soil Conservation Service.





### Upland Utilization

Utilization of herbaceous vegetation in upland locations was determined for grasses and total herbaceous vegetation. Results are provided in Tables 9 and 10 and Figure 6. Utilization of grasses (24%) and total herbaceous vegetation (48.8%) in 2005 were lower due to partial rest applied in the north half of the allotment. Partial rest was a result of an incomplete fence allowing some use in the north pastures. In other years, utilization of grasses ranged from a low of 59.2% in 2006 to highs of 81.4% and 77.3% in 2011 and 2012. Utilization of total herbaceous

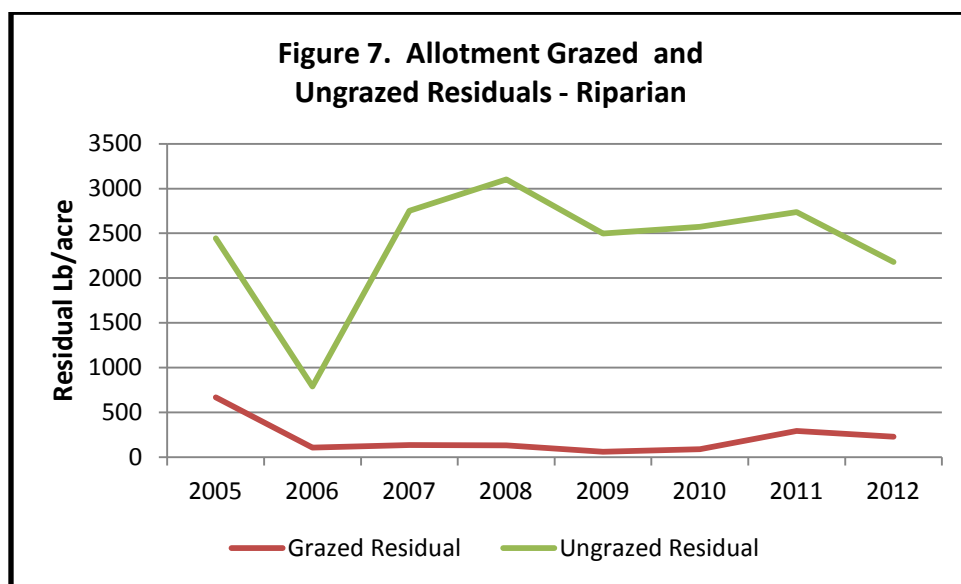


forage was lowest in 2005 at 48.8% ranging up to a high of 79.3% in 2012. Figure 6 depicts this rising level of utilization even during the above normal precipitation year of 2011 and reflects the increased stocking levels that approached, but were lower than, the permitted numbers.

### Riparian Residual Vegetation

Residual herbaceous vegetation in riparian areas included both grasses and forbs. These were not separated due to the amount of time required to separately clip grasses and forbs as well as the propensity of cattle to graze them together as the forbs were generally entwined within the grasses, making it difficult for cattle to separate them. Results for grazed and ungrazed residuals are provided in Tables 11 and 12 and in Figure 7. Grazed residuals were highest in 2005. This was due to the partial rest applied to the north half of the allotment in that year. When considering years in which all riparian areas were grazed, the residual herbaceous vegetation ranged from a low of 59.3 lbs/acre in 2009 to a high of 290.9 lbs/acre in 2011 with most years near 100 lb/acre. There was a 228.2 lb/acre residual in 2012 even though this was a dry year. This was due to two sites on Duck Creek (Sites R1 and 2) experiencing a high water table from the previous wet year.

The ungrazed, or caged, plot residuals ranged from a low of 2180.6 lb/acre in 2012 to a high of 3103.5 lb/acre in 2008. A much lower number was found in 2006, but in that year, cages were damaged which resulted in small areas that appeared ungrazed being clipped. New, more robust cages were installed in 2007 to alleviate this problem.

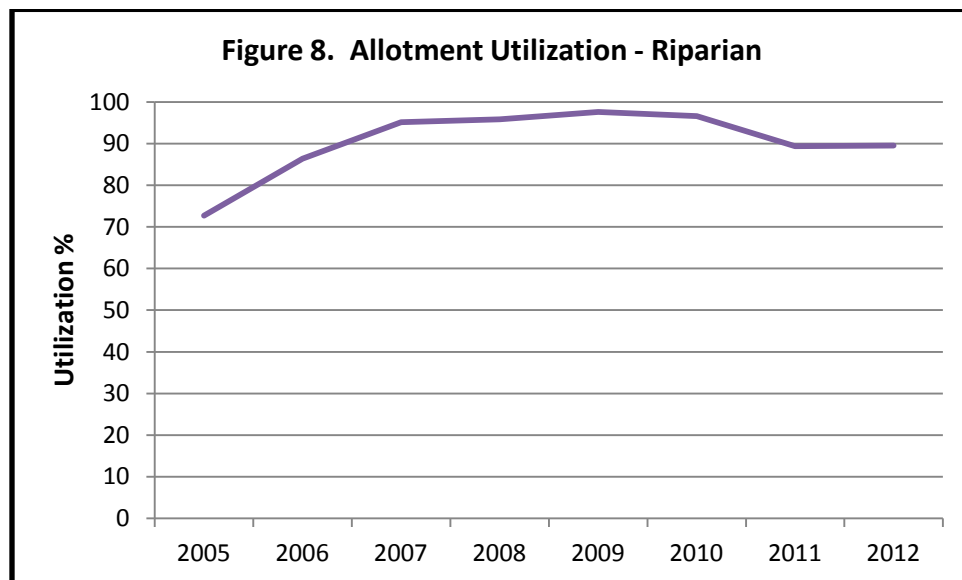


### Riparian Utilization

Utilization of riparian herbaceous vegetation was lowest in 2005, reflecting the partial rest applied to the north half of the allotment (Table 13 and Figure 8). In the other years, utilization ranged from a low of 86.4% in 2006 to a high of 97.6% in 2009. There was no apparent effect of the grazing system and upland water developments on these numbers as utilization was near the maximum possible in all years after 2005. When stocking levels were lower prior to implementation of the new water troughs and grazing system (Table 2), utilization levels ranged from 86.4% to 97.6%. After implementation, utilization ranged between 89.4% and 96.6%. So,



no distinguishable difference can be found before and after implementation of the new system. The grazed residuals were so low compared to the ungrazed residuals, that even in 2006 when “ungrazed residuals” were very low due to the damaged cages, utilization remained high at 86.4%.

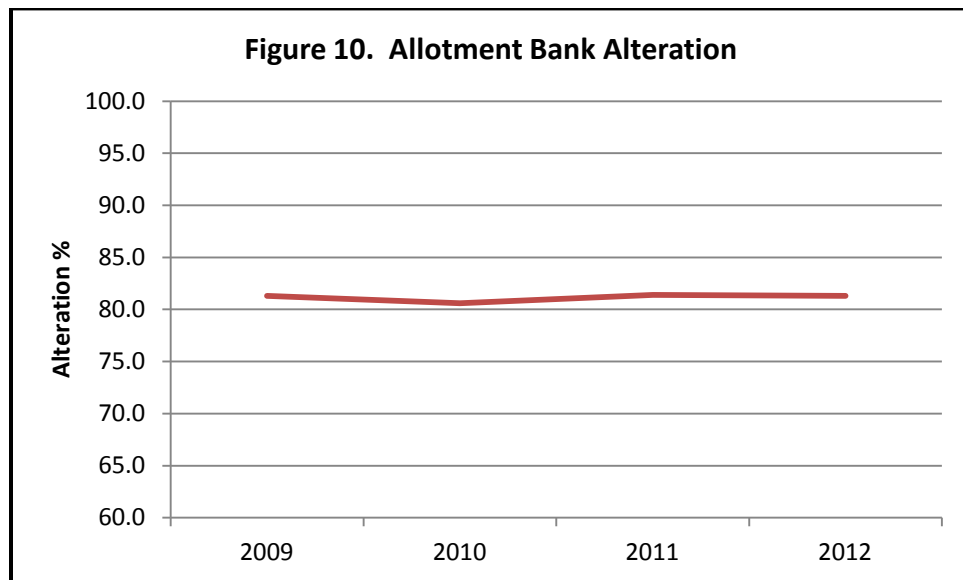
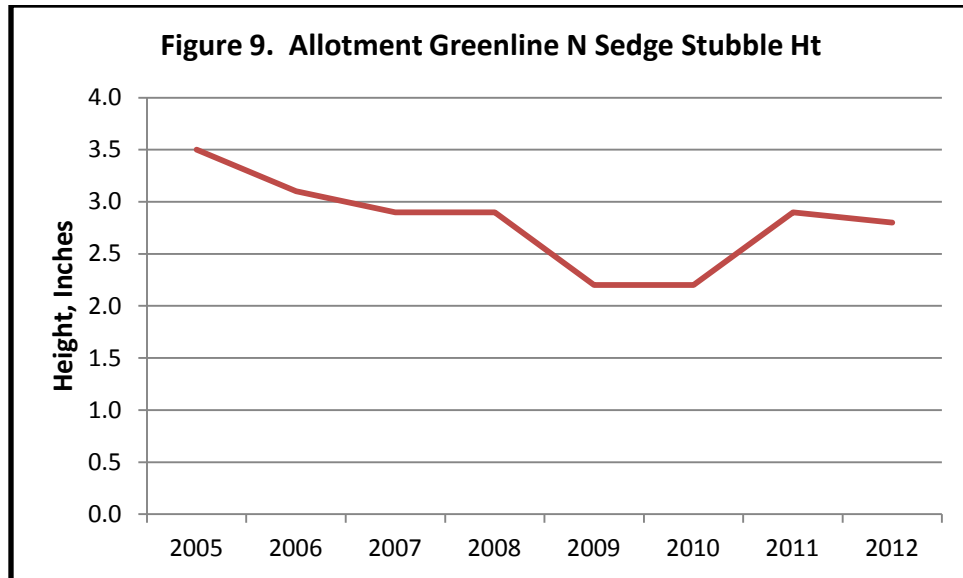


### Riparian Stubble Heights

Stubble heights for Nebraska sedge along the riparian greenline are shown in Table 14 and Figure 9. These ranged from a high of 3.5” in 2005, once again reflecting the partial rest provided in the north half of the allotment, to a low of 2.2” in 2009 and 2010. Figure 9 shows a declining trend in greenline stubble height. The year that the grazing system was implemented (2010) resulted in an average stubble height of 2.2” which then increased in 2011 and 2012 back to levels found in prior years (2006 to 2008), so no effect of the upland water and grazing system was detected. Measures of stubble height of riparian grasses (redtop and meadow foxtail) in 2005 at locations R1 and R2 averaged 1.2”, while in 2011 and 2012, measures taken at locations R1, 2, 5, 6 and 8 averaged 1.5” and 1.4” respectively.

### Riparian Bank Alteration

Multiple Indicator Monitoring measures were taken for bank alteration from 2009 thru 2012 (Table 15 and Figure 10). Average bank alteration appeared to be the maximum possible with all areas except those protected by overhanging shrubs or vertical banks being trampled and altered by livestock. Bank alteration ranged between 80.6% and 81.4% with no difference between bank alteration in 2009 (the year prior to implementation of the new water troughs and grazing system) and the amount of bank alteration found during the three years following implementation.



### Upland Canopy and Ground Cover

In 2012, WUP conducted measurements of canopy and ground cover at most of the upland locations. Results are shown in Table 16. Bare soil averaged across all grazed sites was 35% with shrub interspaces having 25.1% bare soil. The MP127 reference site had 14% bare soil with only 8% bare soil in shrub interspaces. Canopy cover measures were taken for comparison to published guidelines<sup>11</sup> for sage grouse which are summarized in Table 17. Those guidelines

<sup>11</sup> Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

specify canopy cover and height requirements for grasses, forbs and sagebrush during breeding, brood-rearing and winter periods.

Average sagebrush canopy of 37.1% exceeded the recommended guidelines for all periods, while canopy cover of grasses and forbs greater than 7" in height averaged 0.5%, while total forb and grass canopy irrespective of height averaged only 7.9%. The guidelines indicate that for breeding habitat in spring and summer this cover value should be  $\geq 15\%$ . At an ungrazed reference site (MP127) in the Highway 30 right of way adjacent to the allotment, total grass and forb canopy was 36%, while total canopy of grasses and forbs >7" was 14% or very near the guideline. As reported earlier, grass heights in grazed riparian areas averaged less than 2", indicating no cover exists in these critical summer brood-rearing areas for sage grouse and chicks when grazed by livestock. These measures were taken following the grazing season and after the growing season, so account for regrowth.

## **Conclusions**

The installation of new upland water developments and implementation of a four-pasture deferred rotation grazing system were intended to alleviate pressure on riparian areas and lead to improved riparian conditions. Measurement of upland and riparian utilization, and riparian stubble height began in 2005 and extended thru three years of implementation of this new system, beginning with the 2010 grazing period. Results showed that upland utilization trended up throughout the entire study with utilization being higher by a small margin in uplands after grazing system implementation, but likely reflecting the higher stocking rates in the years following implementation of the new system.

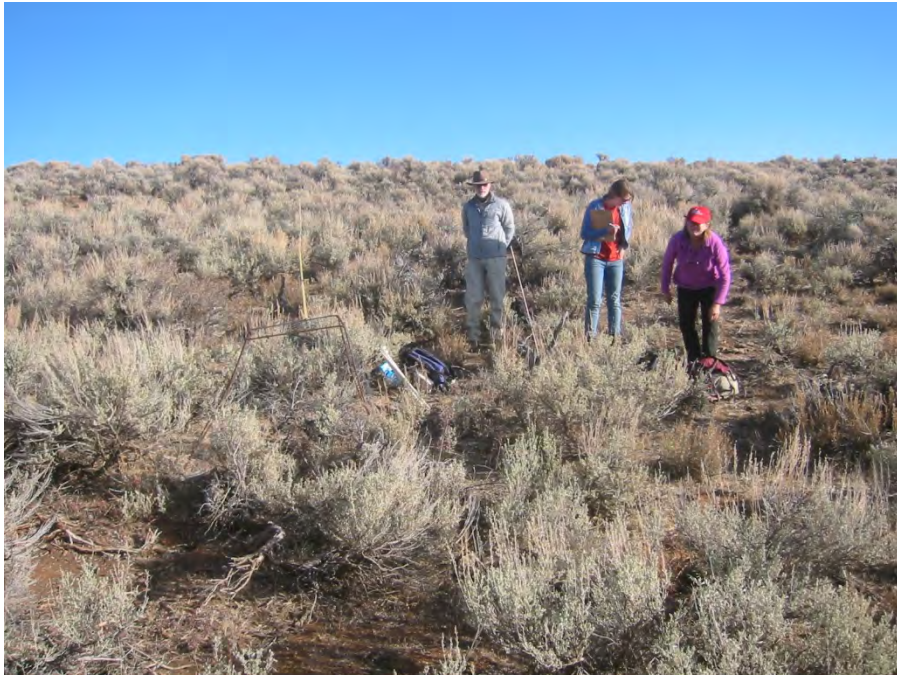
Riparian utilization remained high throughout the study period with no improvement resulting from implementation of new water sources or the deferred rotation grazing system. Greenline stubble height of Nebraska sedge declined over the study period with a slight move up in 2011 and 2012, reflecting two sites that were flooded as a result of the wet year in 2011. Stubble height was at a low point in 2010, prior to that wet year, and in the first year of operation of the new system. Bank alteration did not differ before or after implementation of the system and remained above 80%. The implementation of upland water and the deferred grazing system did not result in lowered use or bank trampling in the riparian zone.

Current upland herbaceous vegetation production in the allotment remains well below potential with excessive bare soil. Cover for sage grouse nesting and brood-rearing during both early and late summer brood-rearing is far from recognized guidelines with essentially no cover in riparian zones.

The results of this study demonstrate that grazing systems and upland water developments do not lead to lower livestock use in riparian areas.

**APPENDIX 1**  
**UPLAND SITE PHOTOS**

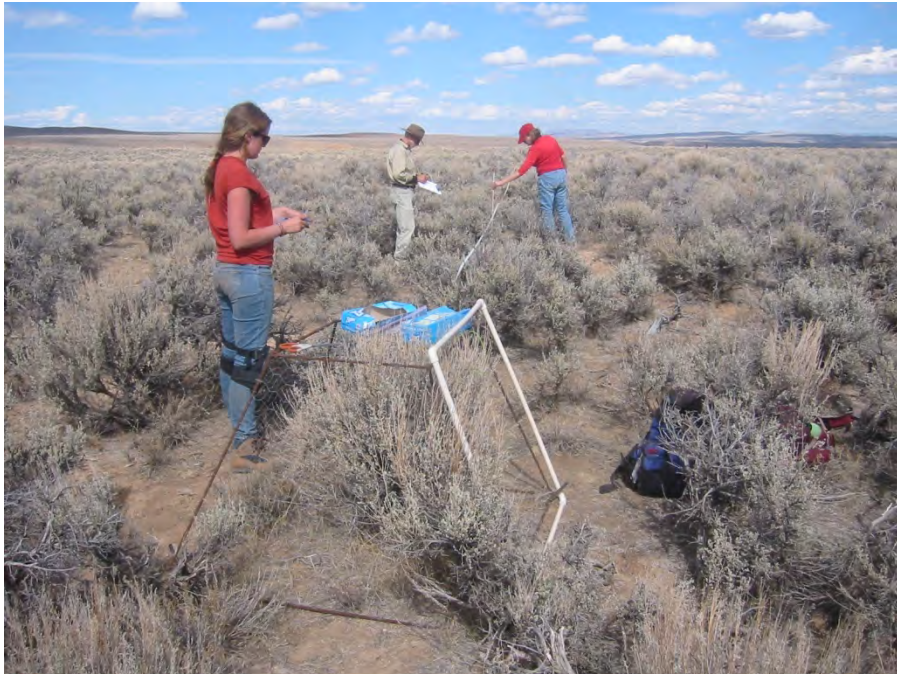




**Upland Site U1 - October 11, 2012**

**Upper Left:** Site overview  
**Upper Right:** Cage plot with cage removed  
**Lower Left:** 0° 50' plot





**Upland Site U2 - October 11, 2012**

**Upper Left:** Site overview  
**Upper Right:** Cage plot with cage removed  
**Lower Left:** 0° 50' plot

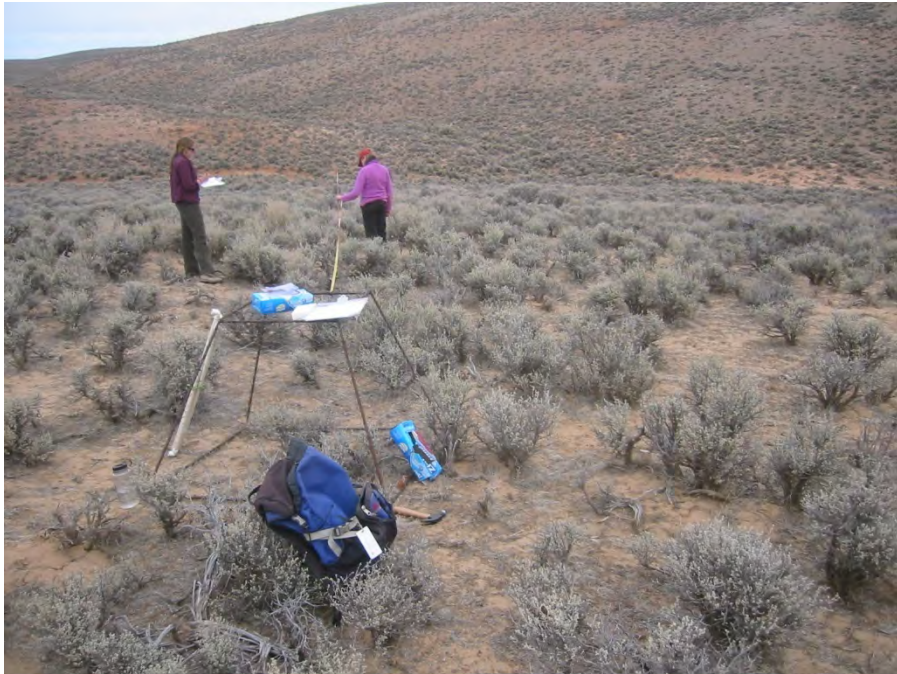




**Upland Site U3 - October 12, 2012**

Upper Left: Site overview  
 Upper Right: Cage plot with cage removed  
 Lower Left: 0° 50' plot





**Upland Site U4 - October 12, 2012**

- Upper Left: Site overview**
- Upper Right: Cage plot with cage removed**
- Lower Left: 0° 50' plot**





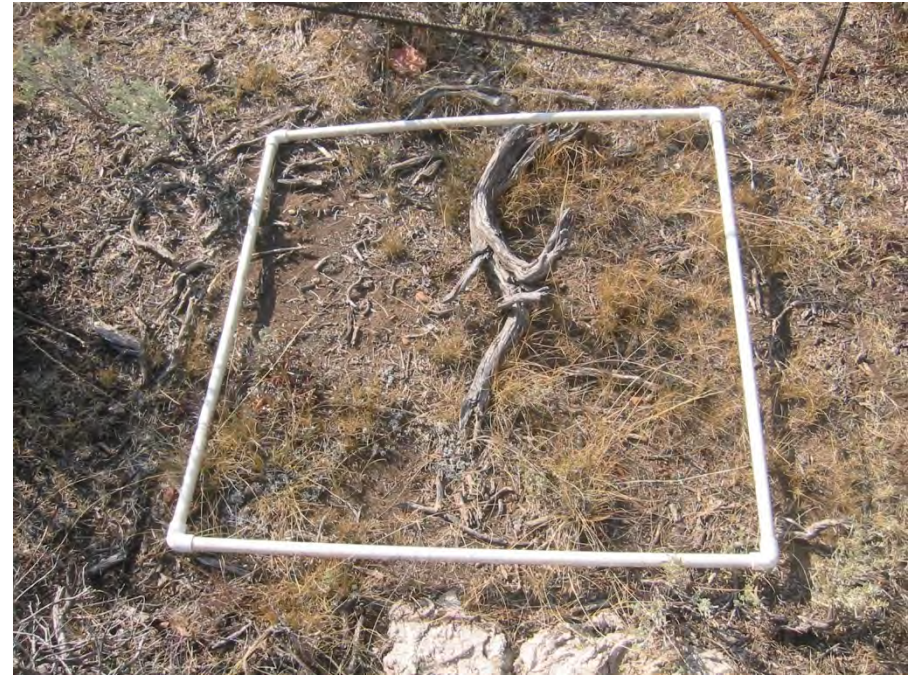
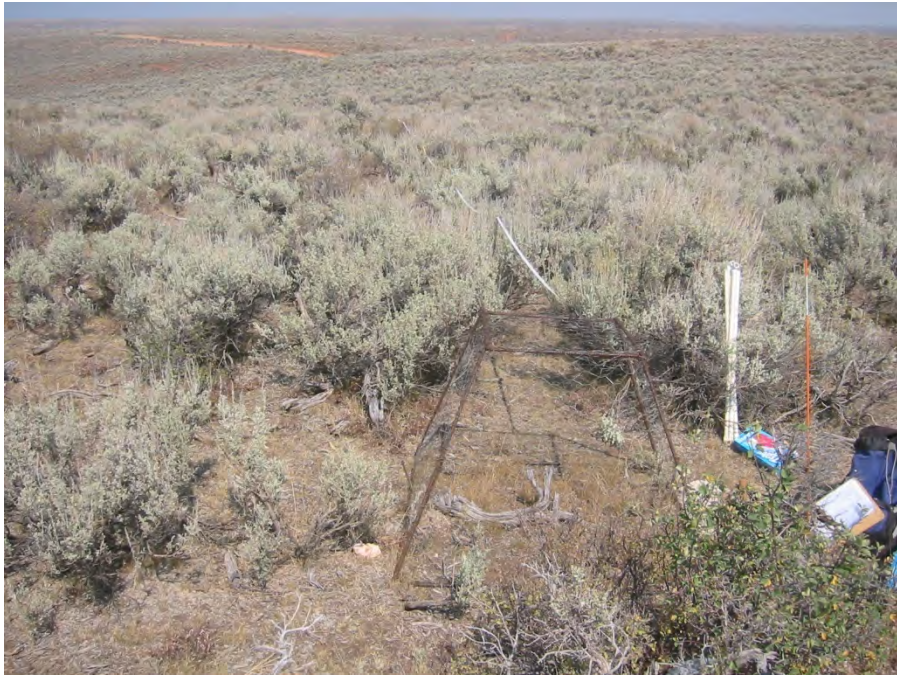
**Upland Site U6 - October 10, 2012**

**Upper Left: Site overview**

**Upper Right: Cage moved by others - no photo**

**Lower Left: 0° 50' plot**





**Upland Site U8 – September 17, 2012**

- Upper Left: Site overview**
- Upper Right: Cage plot with cage removed**
- Lower Left: 0° 50' plot**





### Upland Site U9 – September 17, 2012

- Upper Left: Site overview
- Upper Right: Cage plot with cage removed
- Lower Left: 0° 50' plot

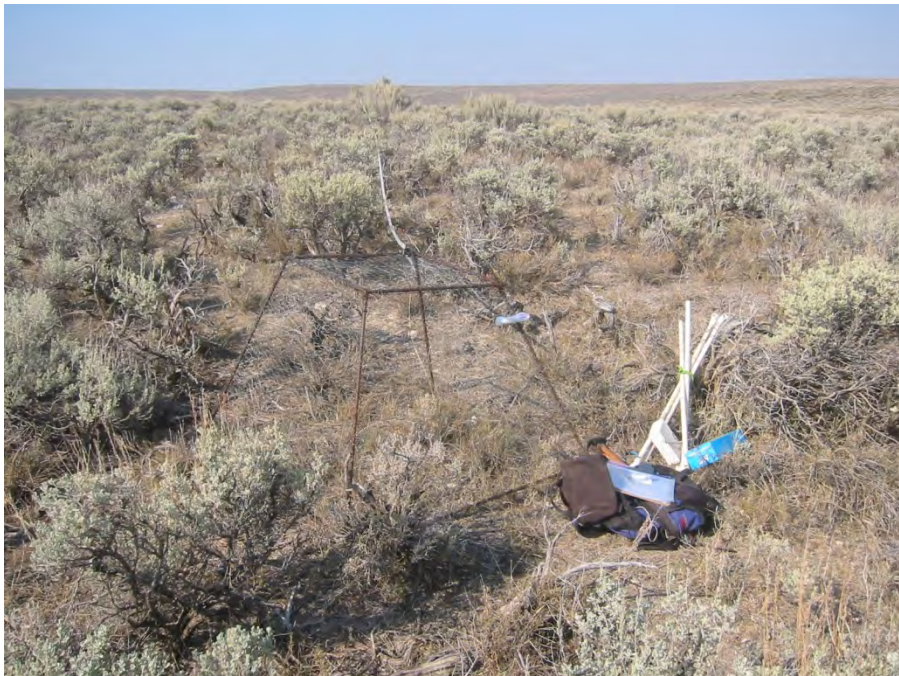




**Upland Site U11 – September 19, 2012**

**Upper Left:** Site overview  
**Upper Right:** Cage plot with cage removed  
**Lower Right:** 0° 50' plot

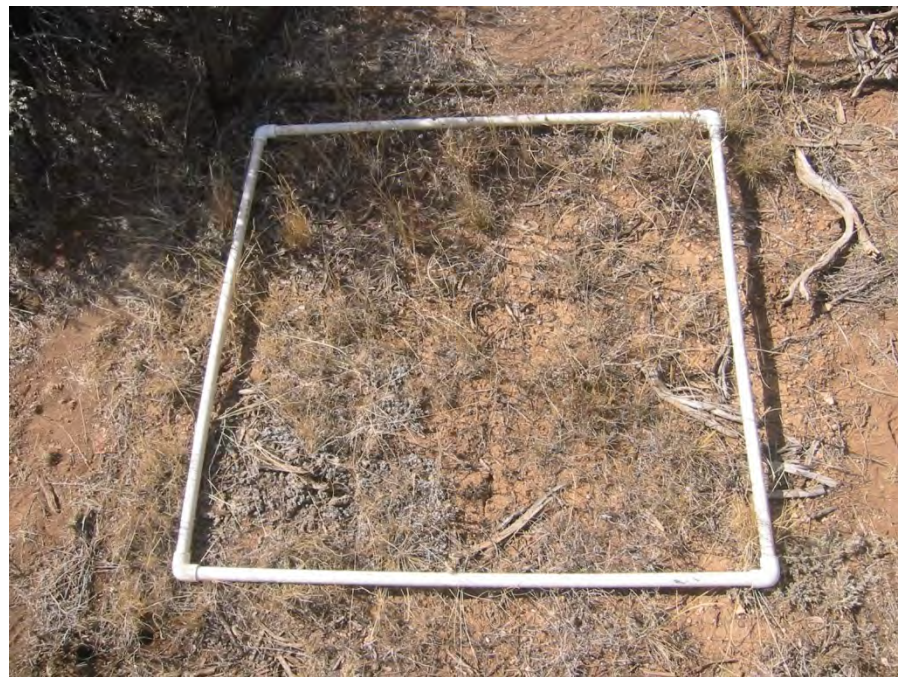




**Upland Site U12 – September 17, 2012**

- Upper Left:** Site overview
- Upper Right:** Cage plot with cage removed
- Lower Left:** 0° 50' plot

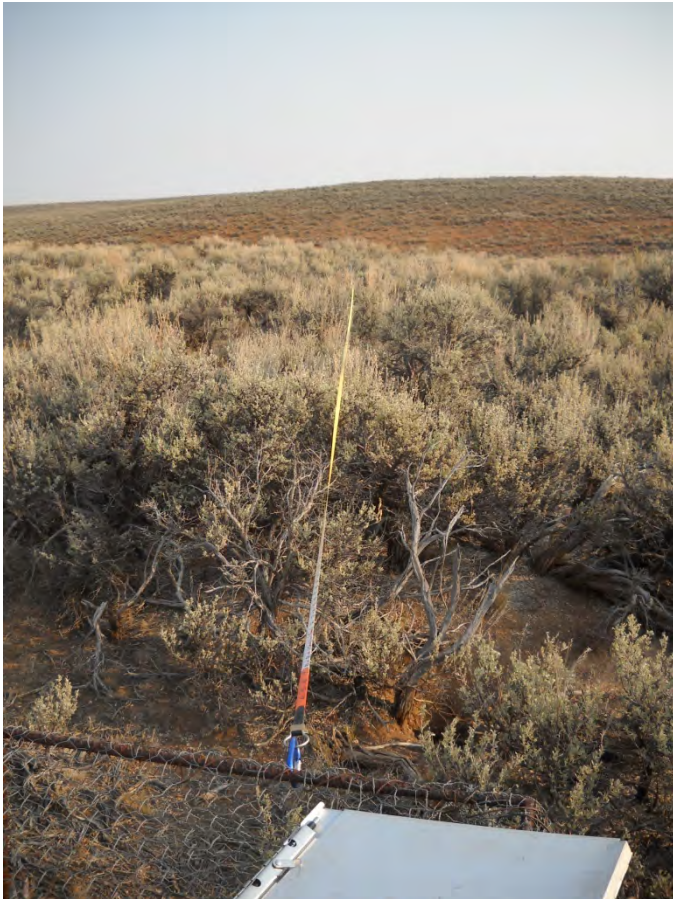




**Upland Site U13 – September 16, 2012**

- Upper Left:** Site overview
- Upper Right:** Cage plot with cage removed
- Lower Left:** 0° 50' plot





**Upland Site U14 – September 17, 2012**

**Upper Left: Site overview**

**Upper Right: Cage plot with cage removed**

**Lower Right: 0° 50' plot**





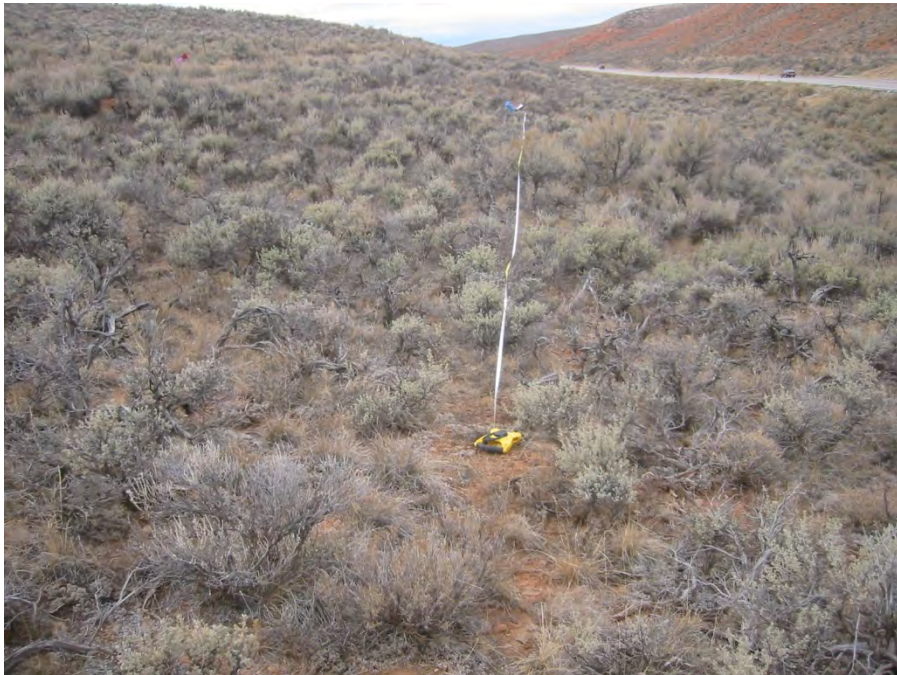
**Upland Site U15 – September 17, 2012**

**Upper Left:** Site overview

**Upper Right:** Cage plot with cage removed

**Lower Right:** 0° 50' plot



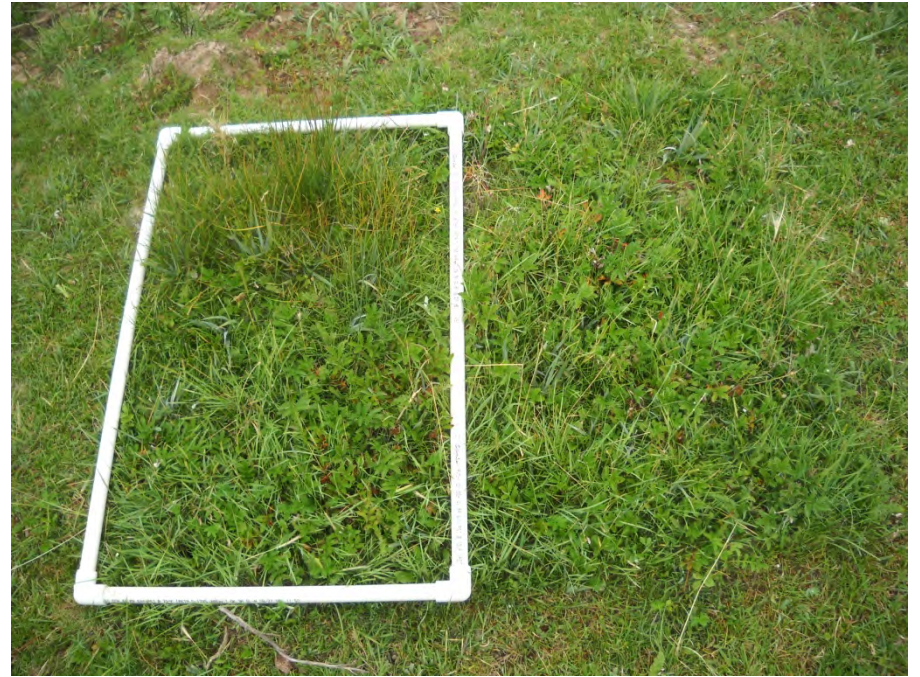


**Upland Site MP127 – October 12, 2012**  
**This site is in the Highway 30 Right of Way – No cage**

**Upper Left: Site overview**  
**Upper Right: Pin Location at center of transects**  
**Lower Right: 132° 50' plot**

**APPENDIX 2**  
**RIPARIAN SITE PHOTOS**





**Riparian Site R1 – August 30, 2012**

<b>Upper Left:</b>	<b>Transect overview</b>
<b>Upper Right:</b>	<b>Cage plot with cage removed</b>
<b>Lower Left:</b>	<b>50' upstream plot</b>

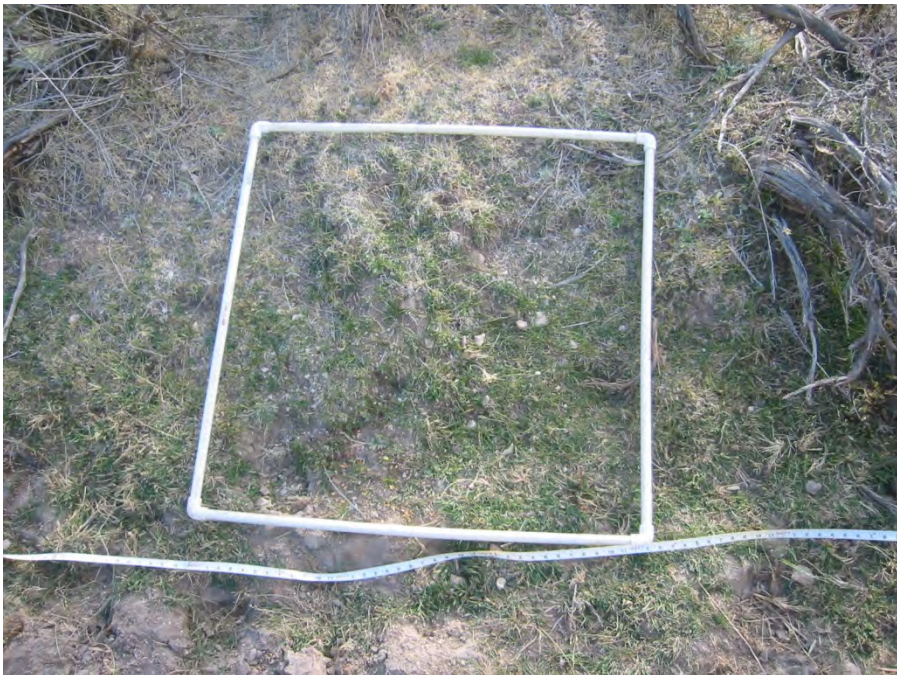




**Riparian Site R2 – August 28, 2012**

- |                     |  |
|---------------------|--|
| <b>Upper Left:</b>  | <b>Transect overview, cage destroyed</b>   |
| <b>Upper Right:</b> | <b>No cage plot as cage destroyed, photo shows meadow margin down to bare soil</b> |
| <b>Lower Left:</b>  | <b>50' upstream plot</b>   |





**Riparian Site R3 – September 16, 2012**

<b>Upper Left:</b>	<b>Transect overview</b>
<b>Upper Right:</b>	<b>Cage plot with cage removed</b>
<b>Lower Left:</b>	<b>50' upstream plot</b>





**Riparian Site R4 – September 17, 2012**

<b>Upper Left:</b>	<b>Transect overview, cage overturned</b>
<b>Upper Right:</b>	<b>No cage photo as cage overturned</b>
<b>Lower Left:</b>	<b>50' upstream plot</b>





**Riparian Site R5 – September 15, 2012**

<b>Upper Left:</b>	<b>Stubble ht location at spring</b>
<b>Upper Right:</b>	<b>Adjacent riparian meadow</b>
<b>Lower Left:</b>	<b>Dead tree collapsed fence, enclosure grazed</b>





**Riparian Site R6 – September 15, 2012**

<b>Upper Left:</b>	<b>Transect overview</b>
<b>Upper Right:</b>	<b>Cage plot with cage removed</b>
<b>Lower Left:</b>	<b>50' upstream plot</b>

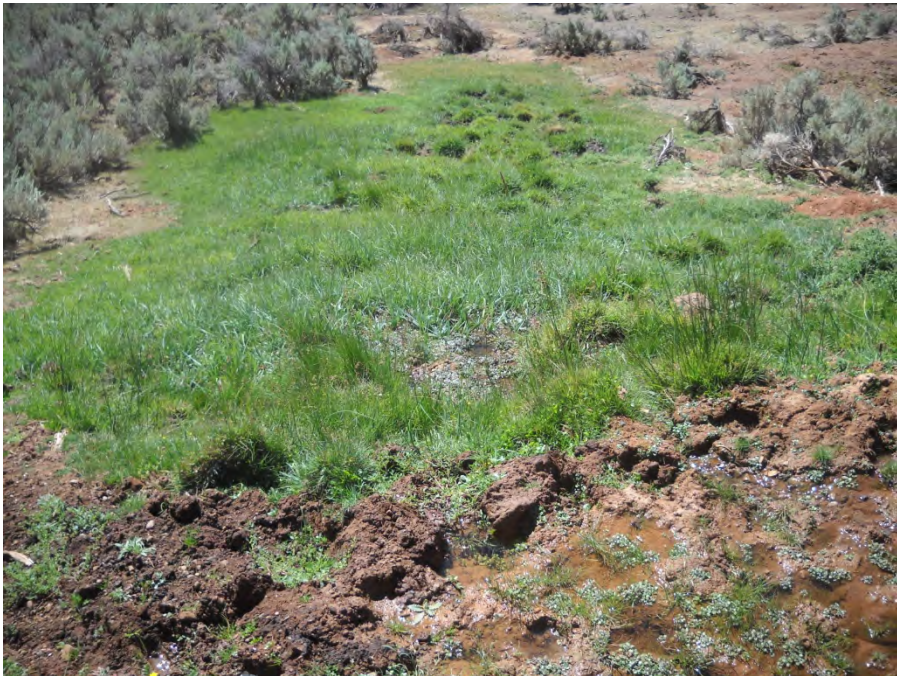




**Riparian Site R8 – September 15, 2012**

<b>Upper Left:</b>	<b>Transect overview, cage overturned</b>
<b>Upper Right:</b>	<b>No cage photo as cage overturned</b>
<b>Lower Left:</b>	<b>50' upstream plot</b>

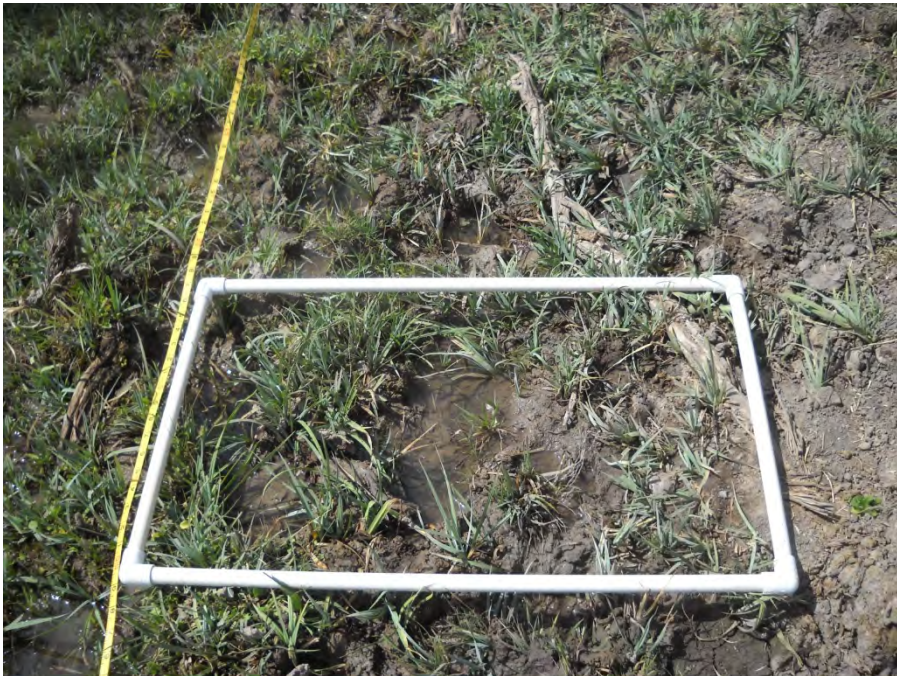




**Riparian Site R9 – August 28, 2012**

<b>Upper Left:</b>	<b>Spring No. 1 Source</b>
<b>Upper Right:</b>	<b>Spring No. 3 Source</b>
<b>Lower Left:</b>	<b>View towards Duck Cr from Spring No. 1 showing lack of defined channel due to trampling</b>

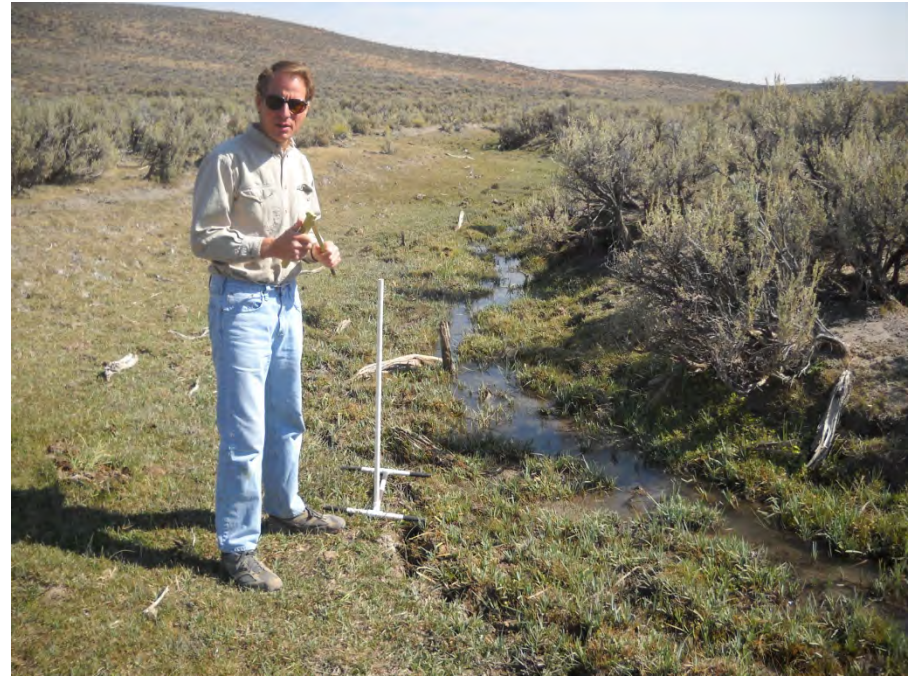




**Riparian Site R10 – August 30, 2012**

<b>Upper Left:</b>	<b>Transect overview</b>
<b>Upper Right:</b>	<b>Cage plot with cage removed</b>
<b>Lower Left:</b>	<b>50' upstream plot</b>





**Riparian Sites R11, 12, 13 – September 19, 2012**

<b>Upper Left:</b>	<b>R11 Duck Cr MIM 1</b>
<b>Upper Right:</b>	<b>R12 Duck Cr MIM 2</b>
<b>Lower Left:</b>	<b>R 13 SF Six Mile Cr MIM</b>

**APPENDIX 3**  
**TABLES**



**Table 1. Sample Site Designations and Locations (NAD 83)**

Site No	Data Type	Other designations		UTM East	UTM North
<b>Upland Utilization Locations</b>					
U1	Upland Utilization			480806	4628156
U2	Upland Utilization	Near BLM DCT7		483885	4627859
U3	Upland Utilization			484901	4627982
U4	Upland Utilization			489224	4628894
U6	Upland Utilization	Near BLM DCT2		479977	4630134
U8	Upland Utilization	Near BLM DCT1		479100	4632171
U9	Upland Utilization	Near BLM DC3		483505	4631363
U11	Upland Utilization			478788	4629543
U12	Upland Utilization			480148	4632922
U13	Upland Utilization			482506	4632218
U14	Upland Utilization			482138	4629286
U15	Upland Utilization			481936	4629098
MP127	Upland Ungrazed Site	Hwy 30 Milepost 127		462869	4625843
<b>Stubble Ht and/or Riparian Utilization Locations</b>					
R1	Stubble Height	RS1 and U5		485567	4626990
R2	Stubble Height	RS2		484229	4626975
R3	Stubble Height	U7		482265	4632726
R4	Stubble Height	U10		486334	4630592
R5	Stubble Height	wp123		484226	4628614
R6	Stubble Height	wp124		484504	4628698
R7	Stubble Height	wp125		483946	4628896
R8	Stubble Height	wp126		484326	4628877
R9	Stubble Height	wp129		484595	4626983
R10	Stubble Height	wp208		487849	4627284
<b>Stubble Ht and Bank Alt MIM Locations</b>					
R11	Stubble Ht and Bank Alt	Duck Creek #1 MIM	Lower Stake	487139	4627223
R12	Stubble Ht and Bank Alt	Duck Creek #2 MIM	Lower Stake	487716	4627289
R13	Stubble Ht and Bank Alt	Six Mile Cr South Fork	Lower Stake	484886	4628897

**Table 2. Cattle Counts**

Year	Mature Cattle	Comment
2005	300	Estimated from Permittee report and ground census
2006	450	WUP aerial census
2007	--	No census
2008	304	WUP aerial census
2009	--	No census
2010	570/148	WUP aerial census, lower number at end of grazing period
2011	601/531	BLM gate count/WUP census
2012	--	No census

**Table 3. Upland Grazed Plot End of Season Residual Forbs – Pounds per Acre**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	134.3	64.9	19.1	45.4	26.2		37.6	7.5
1	8	76.7	35.4	28.6	45.7	28.5		60.6	20.5
1	12		51.8	20.7	80.2	51.4		88.7	10.1
2	9	3.2	0.5	5.9	26.4		1.7	5.8	18.7
2	13		82.1	35.6	72.0	61.0	16.8	205.4	4.7
3	1	52.3	40.1	21.4	118.7	20.3	14.2	25.7	24.5
3	11		50.3	7.2	19.3	8.4	24.5	25.3	0.2
3	14		30.9	12.5	72.5	58.2	25.5	128.1	2.3
3	15		19.0	8.2	40.9	16.5	30.9	45.2	3.7
4	2	40.0	11.2	3.0	59.1	25.2	7.7	47.1	8.1
4	3	30.2	28.9	2.5	66.2	47.7	40.4	45.7	8.0
4	4	103.1	78.8	19.7	48.0	35.4	20.8	134.1	11.6
<b>Means for All Plots</b>		62.8	41.2	15.4	57.9	34.5	20.3	70.8	10.0

**Table 4. Upland Grazed Plot End of Season Residual Grasses – Pounds per Acre**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	167.4	88.3	52.7	63.0	45.6		40.7	27.8
1	8	179.1	46.3	100.5	93.2	49.4		98.0	69.3
1	12		67.1	71.4	59.9	62.7		81.1	37.7
2	9	216.5	141.9	117.8	100.0		34.8	49.7	45.4
2	13		67.8	98.4	59.5	31.5	23.2	38.8	17.4
3	1	80.7	21.4	38.5	47.3	76.3	30.8	63.3	44.2
3	11		31.0	94.1	136.5	81.3	59.3	30.2	14.8
3	14		30.9	34.0	61.7	46.1	27.8	25.9	20.7
3	15		22.5	21.9	85.9	31.5	35.1	22.5	18.9
4	2	70.0	50.2	38.4	104.2	78.7	91.3	75.3	18.8
4	3	69.7	47.1	33.2	70.4	77.7	78.0	47.5	17.6
4	4	171.0	90.8	65.8	89.1	70.4	55.9	48.3	10.2
<b>Mean for All Plots</b>		136.3	58.8	63.9	80.9	59.2	48.7	51.8	28.6



**Table 5. Upland Grazed Plot End of Season Residual Grasses and Forbs Combined – Pounds per Acre**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	301.7	153.2	71.7	108.4	71.9		65.5	35.4
1	8	255.8	81.7	129.1	138.9	72.2		158.5	89.8
1	12		118.9	92.1	140.1	107.8		169.8	47.9
2	9	219.7	142.4	123.7	126.4		36.5	55.4	64.1
2	13		149.9	134.0	131.5	92.4	37.7	244.2	22.1
3	1	133.1	61.5	59.9	166.0	96.6	45.0	89.0	68.8
3	11		81.3	101.4	155.8	89.8	83.8	55.4	15.0
3	14		61.8	46.5	134.2	104.3	53.3	154.1	23.0
3	15		41.5	30.1	126.9	48.0	66.0	67.7	22.6
4	2	110.0	61.4	41.4	163.2	103.8	98.9	122.4	26.9
4	3	99.9	76.0	35.6	136.6	125.4	118.4	93.3	25.6
4	4	274.1	169.6	85.5	137.1	105.8	76.7	182.4	21.8
<b>Mean for All Plots</b>		199.2	99.9	79.2	138.8	92.5	68.5	121.5	38.6

**Table 6. Upland Caged Plot End of Season Residual Forbs – Pounds per Acre**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	372.1	129.0	55.4	216.4	212.2		119.4	
1	8	89.6	90.6	74.6	104.5	319.8		85.3	9.8
1	12		150.3	130.1	254.8	183.4		366.7	158.0
2	9	116.2	6.4	1.1	22.4		106.6		52.5
2	13		177.0	23.5	74.6	261.2	141.8		91.9
3	1	245.2	154.6	34.1	142.9	101.8	119.4	25.6	131.3
3	11		32.0	3.2	108.4	25.2	40.5	102.3	28.3
3	14		147.1	5.3	157.8	119.4	54.4	275.1	50.8
3	15		6.4	2.1	76.0	23.1	32.0	68.9	12.7
4	2	168.4	17.1	2.1	102.7	97.7	24.9	25.6	147.7
4	3	204.7	33.0	0.0	73.6	93.5	36.2	50.1	12.7
4	4	269.1	37.3	69.3	132.2	55.4	247.3	131.1	35.4
<b>Mean for All Plots</b>		209.3	81.7	33.4	116.2	105.1	64.9	116.6	60.3

**Table 7. Upland Caged Plot End of Season Residual Grasses – Pounds per Acre**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	270.8	312.4	169.5	185.5	166.3		324.1	
1	8	194.0	187.6	308.1	397.7	268.7		506.4	235.8
1	12		163.1	315.6	366.7	312.4		371.0	215.6
2	9	184.4	170.6	120.5	288.9		13.9		116.4
2	13		177.0	118.3	397.7	110.9	259.1		220.9
3	1	42.6	88.5	271.9	157.8	156.7	214.3	211.1	116.4
3	11		52.2	324.1	715.7	660.3	551.2	627.4	79.4
3	14		59.7	155.7	77.8	96.7	84.2	267.6	95.6
3	15		39.4	134.3	111.6	216.4	102.7	138.6	121.2
4	2	274.0	206.8	256.9	117.6	136.5	159.9	226.0	189.3
4	3	100.2	120.5	201.5	76.8	77.8	103.8	183.7	62.4
4	4	190.2	150.3	150.3	247.3	134.3	97.0	114.1	50.3
<b>Mean for All Plots</b>		179.5	144.0	210.6	235.7	221.3	190.2	277.7	126.0

**Table 8. Upland Caged Plot End of Season Residual Grasses and Forbs Combined – Pounds per Acre**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	642.9	441.4	224.9	401.9	378.5		443.5	
1	8	283.6	278.3	382.7	502.1	588.5		591.7	245.6
1	12		313.4	445.6	621.5	495.7		737.7	373.6
2	9	300.6	177.0	121.5	311.3		120.5		168.9
2	13		353.9	141.8	472.3	372.1	400.9		312.8
3	1	287.9	243.1	306.0	300.6	258.5	333.7	223.9	247.8
3	11		84.2	327.3	824.1	685.5	591.7	729.8	107.7
3	14		206.8	161.0	235.6	216.1	138.6	542.7	146.4
3	15		45.8	136.5	187.6	239.5	134.7	207.5	133.8
4	2	442.4	223.9	259.1	220.3	234.2	184.8	251.6	337.0
4	3	304.9	153.5	201.5	150.3	171.3	140.0	233.8	75.1
4	4	459.3	187.6	219.6	379.5	189.8	344.4	245.2	85.7
<b>Mean for All Plots</b>		388.8	225.7	244.0	351.9	326.4	255.1	387.4	186.3



**Table 9. Upland Utilization of Grasses - Percent**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	38.2%	71.7%	68.9%	66.0%	72.6%		87.4%	
1	8	7.7%	75.3%	67.4%	76.6%	81.6%		80.7%	70.6%
1	12		58.9%	77.4%	83.7%	79.9%		78.1%	82.5%
2	9		16.8%	2.2%	65.4%				61.0%
2	13		61.7%	16.8%	85.0%	71.6%	91.0%		92.1%
3	1		75.8%	85.8%	70.0%	51.3%	85.6%	70.0%	62.0%
3	11		40.6%	71.0%	80.9%	87.7%	89.2%	95.2%	81.3%
3	14		48.2%	78.2%	20.7%	52.4%	67.0%	90.3%	78.4%
3	15		43.0%	83.7%	23.0%	85.5%	65.8%	83.8%	84.4%
4	2	74.4%	75.7%	85.1%	11.5%	42.3%	42.9%	66.7%	90.1%
4	3	30.5%	60.9%	83.5%	8.3%	0.1%	24.8%	74.1%	71.8%
4	4	10.1%	39.6%	56.2%	64.0%	47.6%	42.4%	57.7%	79.7%
<b>Mean for All Plots</b>		24.0%	59.2%	69.7%	65.7%	73.3%	74.4%	81.4%	77.3%

**Table 10. Upland Utilization of Grasses and Forbs Combined - Percent**

Pasture	U Site No	2005	2006	2007	2008	2009	2010	2011	2012
1	6	53.1%	65.3%	68.1%	73.0%	81.0%		85.2%	
1	8	9.8%	70.7%	66.3%	72.3%	87.7%		73.2%	63.4%
1	12		62.1%	79.3%	77.5%	78.3%		77.0%	87.2%
2	9	26.9%	19.5%	-1.8%	59.4%		69.7%		62.0%
2	13		57.7%	5.5%	72.2%	75.2%	90.6%		92.9%
3	1	53.8%	74.7%	80.4%	44.8%	62.6%	86.5%	60.2%	72.2%
3	11		3.4%	69.0%	81.1%	86.9%	85.8%	92.4%	86.0%
3	14		70.1%	71.1%	43.0%	51.7%	61.5%	71.6%	84.3%
3	15		9.5%	78.0%	32.4%	80.0%	51.0%	67.4%	83.1%
4	2	75.1%	72.6%	84.0%	25.9%	55.7%	46.5%	51.4%	92.0%
4	3	67.2%	50.5%	82.3%	9.1%	26.8%	15.4%	60.1%	65.9%
4	4	40.3%	9.6%	61.1%	63.9%	44.3%	77.7%	25.6%	74.6%
<b>Mean for All Plots</b>		48.8%	55.7%	67.5%	60.6%	71.7%	73.2%	68.6%	79.3%

**Table 11. Riparian Grazed Plot End of Season Residual Grasses and Forbs Combined – Pounds per Acre**

Pasture	Original Site No	R Site No	2005	2006	2007	2008	2009	2010	2011	2012
2	U7	3	1461.5	129.7	162.5	141.6	29.0	26.9	366.3	7.7
2	U10	4	453.5	54.3	137.7	89.8	48.7	8.3	39.8	31.4
4	U5	1	85.9	136.4	88.7	140.1	100.1	31.8	158.2	389.9
4	RS2	2						194.1	336.4	549.4
4	WP208	10						61.3	314.5	251.9
4	WP126	8						189.3	447.9	125.0
4	WP124	6						71.5	178.2	101.5
<b>Means for All Plots</b>			667.0	106.8	134.3	130.6	59.3	87.3	290.9	228.2

**Table 12. Riparian Caged Plot End of Season Residual Grasses and Forbs Combined – Pounds per Acre**

Pasture	Original Site No	R Site No	2005	2006	2007	2008	2009	2010	2011	2012
2	U7	3	1986.0	820.5	1768.9	3644.0	1086.5	550.6	1684.2	2769.6
2	U10	4	3873.3	792.8	4003.8	3181.1		2619.3		
4	U5	1	1475.6	749.1	2483.2	2485.4	3907.2	4326.3	2492.5	1026.0
4	RS2	2						1676.1	3017.4	
4	WP208	10						3570.3	2536.8	2776.6
4	WP126	8						1806.8	3998.0	
4	WP124	6						3455.9	2701.0	2150.2
<b>Means for All Plots</b>			2444.9	787.4	2752.0	3103.5	2496.8	2572.2	2738.3	2180.6



**Table 13. Riparian Utilization - Percent**

Pasture	Original Site No	R Site No	2005	2006	2007	2008	2009	2010	2011	2012
2	U7	3	26.4%	84.2%	90.8%	96.1%	97.3%	95.1%	78.2%	99.7%
2	U10	4	88.3%	93.1%	96.6%	97.2%		99.7%		
4	U5	1	94.2%	81.8%	96.4%	94.4%	97.4%	99.3%	93.7%	62.0%
4	RS2	2						88.4%	88.9%	
4	WP208	10						98.3%	87.6%	90.9%
4	WP126	8						89.5%	88.8%	
4	WP124	6						97.9%	93.4%	95.3%
<b>Means for All Plots</b>			72.7%	86.4%	95.1%	95.8%	97.6%	96.6%	89.4%	89.5%

**Table 14. Nebraska sedge End of Season Stubble Heights - Inches**

Pasture	Original Site No	R Site No	2005	2006	2007	2008	2009	2010	2011	2012
2	U7	3		2.9	3.0		2.0	2.3	2.9	2.7
2	U10	4	6.4	2.8	3.1	3.7	2.1	1.9	2.2	3.0
4	U5	1	2.3	3.6	3.6	3.1	2.6	1.7	2.4	2.2
4	RS2	2	1.7		2.0	2.2	1.6	2.0	2.5	7.3
4	WP208	10						2.2	2.5	2.3
4	WP126	8				3.0	2.6	2.7	3.7	1.8
4	WP124	6				2.3	2.7	2.7	3.7	1.8
4	WP123	5				3.1	3.2	3.4	3.4	1.7
4	DC MIM 1	11			3.0		1.6	1.7	2.7	2.7
4	DC MIM 2	12				2.6	1.6	1.3	2.5	2.5
4	SF MIM	13					1.9	1.9	3.4	2.7
<b>Means for All Plots</b>			3.5	3.1	2.9	2.9	2.2	2.2	2.9	2.8

Table 15. Duck Creek Allotment Bank Alteration - Percent					
Site	R Site No	2009	2010	2011	2012
D Cr MIM1	11	79.0%	76.8%	85.0%	93.8%
D Cr MIM2	12	81.8%	82.5%	90.7%	75.4%
S Fk MIM	13	83.0%	82.5%	68.5%	74.8%
Mean for all Sites		81.3%	80.6%	81.4%	81.3%

Table 16. Canopy Cover of Shrubs, Grasses and Forbs, Ground Cover for Crusts and Bare Ground - Percent

Site	Shrub, total	Sagebrush % above 40 cm (16")	Sagebrush % above 25 cm (9")	Sagebrush Total Canopy %	Grass Canopy %	Forb Canopy %	Grass Canopy % >= 7"	Forb Canopy % >= 7"	Biological Crust Ground Cover %	Bare Ground Total %	Bare Ground No Plant Canopy %
U1	46.8	22.6	33.6	37.6	4.4	0.8	0.8	0.0	0.0	20.4	13.6
U2	50.3	26.1	40.6	46.8	3.3	2.0	0.0	0.0	0.0	36.0	24.7
U3	41.6	20.0	29.6	35.2	8.4	0.4	0.8	0.4	0.0	37.8	27.6
U4	34.0	6.8	24.0	33.2	8.4	1.2	0.0	0.0	2.0	52.0	41.6
U6	50.0	18.0	25.0	40.0	6.0	5.0	0.0	0.0	0.0	26.0	15
U8	54.0	24.0	38.0	38.0	18.0	0.0	0.0	0.0	0.0	6.0	2
U9	44.0	14.0	30.0	40.0	10.0	2.0	0.0	0.0	0.0	16.0	10
U12	38.0	6.0	18.0	26.0	10.0	0.0	2.0	0.0	0.0	40.0	32
U13	50.0	30.0	40.0	46.0	6.0	2.0	0.0	0.0	0.0	24.0	12
Mean	43.9	18.1	30.3	37.1	6.5	1.4	0.4	0.1	0.4	35	25.1
MP127	45.0	15.0	30.0	25.5	30.0	6.0	11.0	3.0	1.0	14.0	8

Table 17. Connelly et al (2000) Guidelines for Sage Grouse Habitat

Arid Sites	Breeding Habitat		Brood Rearing Habitat		Winter (exposed above snow)	
	Height, inches	Cover, percent	Height, inches	Cover, percent	Height, inches	Cover, percent
Sagebrush	11.8 – 31.5	15 – 25	15.7 – 31.5	10 – 25	9.8 – 13.7	10 – 30
Grass and Forb	>7"	≥15	Variable	>15	Na	na