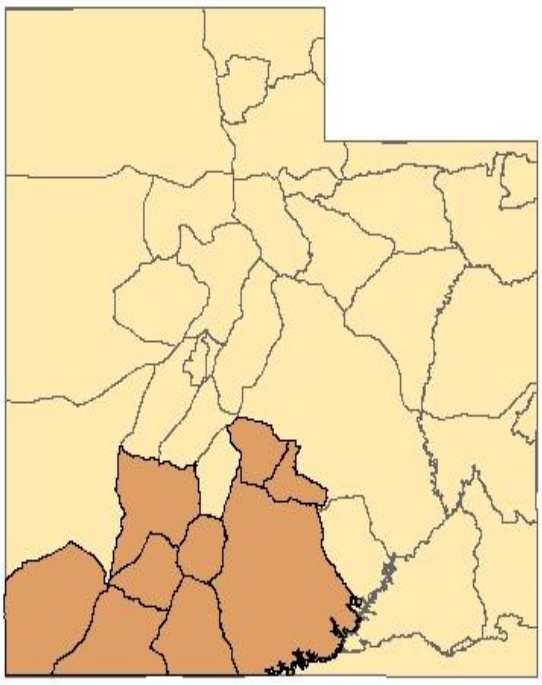
UTAH BIG GAME
RANGE TREND UNIT SUMMARIES
2013
Wildlife Management Units
22, 24, 25A, 25B, 25C, 27, 28, 29, 30



PUBLICATION NUMBER 14-16
REPORT FOR FEDERAL AID PROJECT W-82-R-58

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

Utah Big Game Range Trend Unit Summaries
2013
Wildlife Management Units
22, 24, 25A, 25B, 25C, 27, 28, 29, 30

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Performance Report for Federal Aid Project W-82-R-58

Publication No. 14-16

UTAH DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife Resources
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Reports for all regions, with accompanying photographs, are available online at http://wildlife.utah.gov/range/.

PROGRAM NARRATIVE

State: UTAH

Project Number: W-82-R-58

Grant Title: Wildlife Habitat Research and Monitoring

Project Title: Wildlife Habitat Monitoring/Range Trend Studies

Need: The ability to detect changes in vegetation composition (range trend) on big game winter ranges is an important part of the Utah Division of Wildlife Resources (UDWR) big game management program. The health and vigor of big game populations are closely correlated to the quality and quantity of forage in key areas. The majority of the permanent range trend studies are located on deer and elk winter ranges, however on certain management units, studies are located on spring and/or summer ranges, if vegetation composition on these ranges is the limiting factor for big game populations. Range trend data are used by wildlife biologists for habitat improvement planning purposes, reviewing Bureau of Land Management (BLM) and United States Forest Service (USFS) allotment management plans, and as one of several sources of information for revising deer and elk herd unit management plans.

Objective: Monitor, evaluate, and report range trend within designated key areas throughout the state, and inform DWR biologists, public land managers and private landowners of significant changes in plant community composition in these areas.

Expected Results or Benefits: Range trend studies in each region will be reread every five years, and vegetation condition and trend assessments will be made for key areas. UDWR biologists, land management personnel from the USFS and BLM, and private landowners will use the range trend database to evaluate the impact of land management programs on big game habitat. Annual reports are readily available on the Division's website, on CDs, and in hard copies located in UDWR regional offices, BLM and USFS offices, and public libraries. Special studies (habitat project monitoring and big game/livestock forage utilization studies) will give UDWR biologists and public land managers additional information to address local resource management problems.

REMARKS

The work completed during the 2013 field season and reported in this publication involves the reading of interagency range trend studies in the UDWR's Southern Region. Most trend studies surveyed in these management units were established in the 1980's and reread at 5-year intervals.

The following Bureau of Land Management and U.S. Forest Service offices provided information and/or assistance in completion of the trend studies, which add to the value of this interagency report:

Bureau of Land Management
- Cedar City Field Office
- Grand Staircase-Escalante National Monument
- Kanab Field Office
- Fillmore Field Office
- Richfield Field Office
- St. George Field Office

Dixie National Forest
- Cedar City Ranger District
- Escalante Ranger District
- Pine Valley Ranger District
- Powell Ranger District
- Teasdale Ranger District

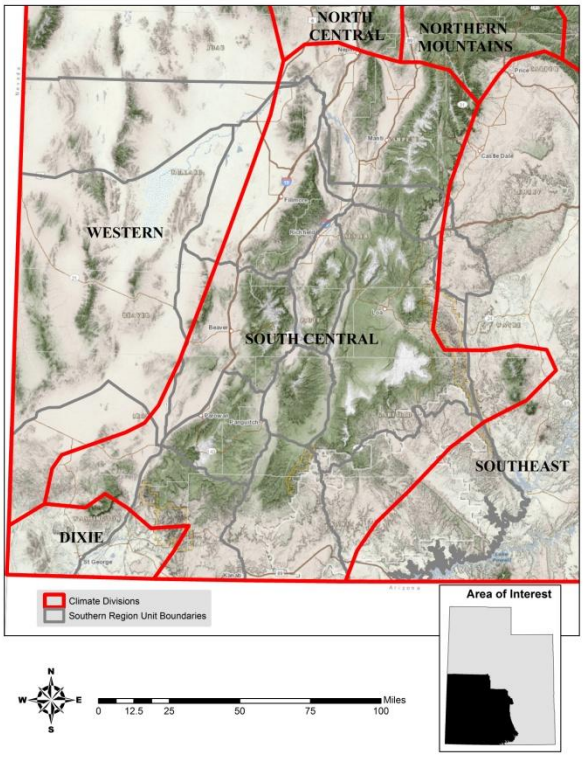
Fishlake National Forest
- Beaver Ranger District
- Fillmore Ranger District
- Richfield Ranger District

Private landowners were cooperative in allowing access to study sites located on their land.

RANGE TREND UNIT SUMMARY OVERVIEW

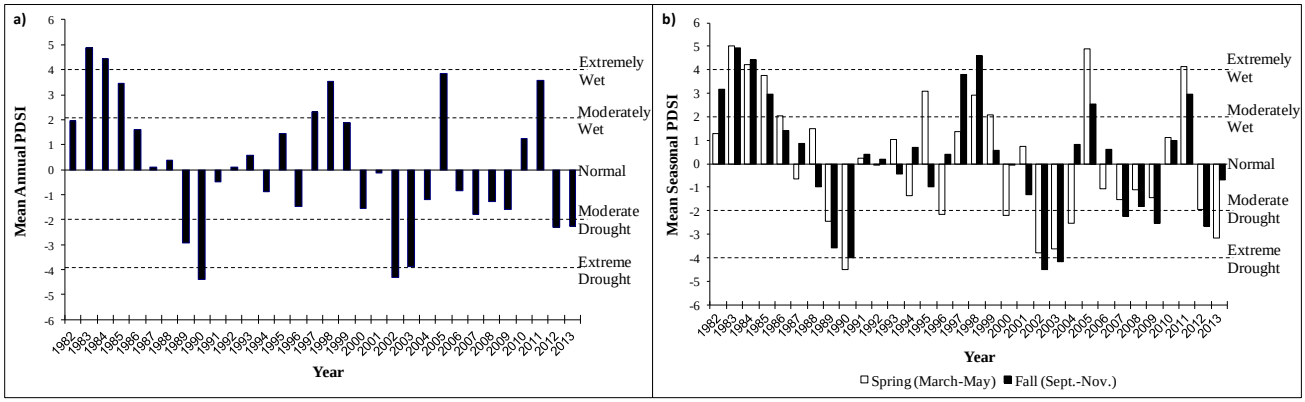
Boundary Description and Geography: Each unit summary includes the boundary description outlining the boundary for the unit. The geography section details the major features of the unit

Palmer Drought Severity Index Climate Divisions



Climate Data: The state of Utah is divided into seven climatic divisions for estimating the Palmer Drought Severity Index (PDSI) and the southern region occurs within four of these divisions; Western (Division 1), Dixie (Division 2), South Central (Division 4), and Southeast (Division 7). The PDSI shows cumulative drought conditions based on precipitation and temperature. Long-term drought is cumulative, so the intensity of the current drought is based not only upon the prevailing conditions but also upon those of previous months (Climate Prediction Center Internet Team, 2005).

The PDSI is based on climate data gathered from 1895 to 2013. The data reported in this summary covers the years over which these sites have been sampled (1982-2013). The PDSI uses a scale where zero indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). In the figure below, graph "a" represents the mean annual PDSI for the south central region and graph "b" shows the mean PDSI by season, spring (March-May) and fall (Sept.-Nov.) for the south central region(Climate Prediction Center Internet Team, 2005).



Big Game Habitat: The big game habitat is discussed within each of the unit summaries. This section is a general description of the big game habitat within the unit. Habitat maps for deer and elk show the seasonal ranges for year-long, winter, and summer habitat.

Land Ownership: Land ownership and big game seasonal range were overlaid within a Geographic Information System (GIS) program to create tables for both mule deer and elk to represent estimated habitat acreage by season and ownership. If there was not habitat for a specific season (summer, winter, year-long) then that column was omitted.

LANDFIRE Existing Vegetation Coverage: The Existing Vegetation Cover (EVC) layer represents the vertically projected percent cover of the live canopy layer for a 30-m grid cell. EVC is generated separately for tree, shrub, and herbaceous cover functional groups using training data and other layers. Percentage tree, shrub, and herbaceous canopy cover training data are generated using plot-level ground-based visual assessments. Once the training data are developed, relationships are then established separately for each functional group between the training data and combination of Landsat, elevation, and ancillary data. Each of the derived data layers (tree, shrub, herbaceous) has a potential range from 0-100 percent, which are merged into a single composite EVC layer (LANDFIRE).

The LANDFIRE data reported in this summary includes the major functional groups (shrubland, conifer, grassland, and other) and various subgroups of importance found within the unit boundaries. Acres and percent of total are reported for each individual vegetation type with the group percent of total for each of the major groups also reported. Agricultural, developed, riparian, and other groups are classified as other.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Semi-Desert Shrub-Steppe	66,032.04	11.31%	
	Inter-Mountain Basins Big Sagebrush Shrubland	54,103.02	9.27%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	31,447.25	5.39%	
	Great Basin Xeric Mixed Sagebrush Shrubland	6,980.96	1.20%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	4,289.99	0.73%	
	Quercus gambelii Shrubland Alliance	3,983.31	0.68%	
	Inter-Mountain Basins Big Sagebrush Steppe	846.43	0.14%	
	Artemisia tridentata ssp. vaseyana Shrubland Alliance	752.36	0.13%	
	Inter-Mountain Basins Montane Sagebrush Steppe	54.26	0.01%	
	Other Shrubland	4,973.86	0.85%	29.71%
Conifer	Colorado Plateau Pinyon-Juniper Woodland	268,993.04	46.07%	
	Great Basin Pinyon-Juniper Woodland	7,700.85	1.32%	
	Inter-Mountain Basins Juniper Savanna	3,750.68	0.64%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	14,289.29	2.45%	
	Other Conifer	3,477.81	0.60%	51.08%
Grassland	Native Grassland	10,451.42	1.79%	1.79%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	71,091.29	12.18%	
	Introduced Upland Vegetation-Annual and Biennial Forbland	1,114.2	0.19%	
	Introduced Upland Vegetation-Perennial Grassland and Forbland	921.16	0.16%	12.53%
Other	Hardwood	561.1	0.10%	
	Riparian	5,675.73	0.97%	
	Agricultural	6,633.14	1.14%	
	Developed	12,863.29	2.20%	
	Other	2,833.74	0.49%	4.89%
Total		583,820.2		

Limiting Factors to Big Game Habitat: This section discusses some of the major limiting factors for big game habitat in the unit. Many of the limitations are determined from the range trend study site data, such as abundance of cheatgrass, pinyon and juniper, sagebrush, and other habitat types. Other known limitations such as wildfire, energy development, habitat fragmentation, etc. are determined from other sources.

Treatments/Restoration Work: There has been an active effort to address many of the limitations within each unit through the Watershed Restoration Initiative (WRI). This section outlines the work that has been done on the unit through WRI projects. A map of the projects that have occurred on the unit through the WRI program and a map of the fire history from 2000-2013 is available for each unit. A total amount of acres for each type of treatment is provided in a table for each unit.

Range Trend Studies: Many of the range trend study sites were established in the 1980's and have many years of data associated with them. A table details the year an individual study was established, whether it is active or suspended, and the ecological site description. Another table shows the disturbance history for those sites that have had a known disturbance that occurred on the site.

Study Trend Summary (Undisturbed Sites): Sites that have not been disturbed since site establishment are considered undisturbed, though many of them have had historic disturbances. Trends were reported by grouping sites into an ecological site based on soil characteristics, elevation, precipitation, and dominant vegetation type. Trends for each individual ecological site were evaluated by analyzing directional shifts in mean densities and covers for shrubs and trees. Not all sites had shrubs or trees present. When this was the case, these graphs were omitted from the summary. The implied trend for the herbaceous understory was evaluated by comparing mean values of nested frequencies and covers from sample year to sample year. Occupancy trends of big game species are also discussed and were evaluated by comparing mean pellet group counts of individual species from sample year to sample year.

Range trend study sites were summarized based on their ecological site descriptions (ESD). ESDs provide a consistent means for interpreting the landscape. Additionally, ESDs provide a way to identify similar ecological potentials and allow for predictable landscape responses to disturbances or management inputs based on repeating landscape patterns. Sites are classified based on abiotic and biotic features such as soil characteristics and plant community composition. The most common ESDs within big game seasonal ranges study sites are semidesert, which are lower in elevation, upland ESDs, which are mid elevation, and mountain ESDs which are higher elevation sites.

Study Trend Summary (Disturbed Sites): Sites that have experienced a treatment or disturbance over the study years have been grouped together based on treatment or disturbance type. Treatments were further broken down into pre and post treatment categories. Only the latest pre-treatment year from each site was averaged into pre-treatment data while the post-treatment years were categorized into five-year increments that were averaged with their corresponding post-treatment years and are presented as 1-5 years post treatment, 6-10 years post treatment, etc. Changes in shrubs, trees, herbaceous understory, and occupancy of wildlife and domestic animals were also described for each of the treatment types.

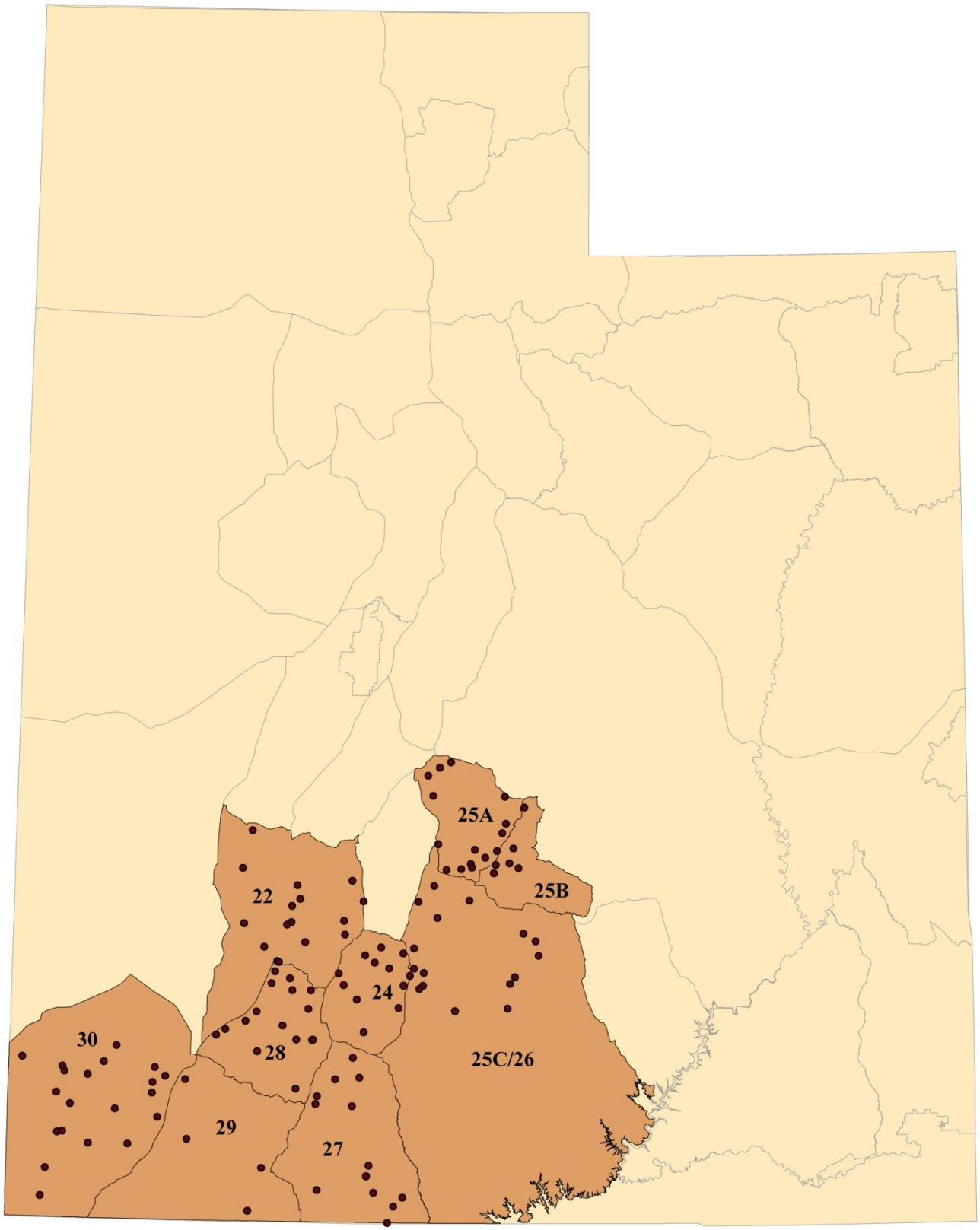
Deer Winter Range Condition Assessment: The desirable components index (DCI) for deer was created by Range Trend Program personnel as a tool to address condition and/or value of winter ranges for mule deer. This index is meant to be a companion to, not a replacement for, the site-specific range trend assessments that are found in the annual Utah Big Game Range Trend Studies report. This index was designed to score mule deer winter range based upon several important vegetation components (i.e., preferred browse cover, shrub decadence, shrub young recruitment, cover of perennial grasses, cover of perennial forbs, cover of annual grasses, and presence of noxious weeds). Although the index may be useful for assessing habitat for other species (i.e. sage grouse and elk), the rating system was devised to specifically address mule deer winter range requirements.

This index is used primarily to determine whether a particular site has the vegetation components necessary to be good winter range for mule deer. It can also be used to identify areas where habitat restoration projects may be needed and assist land managers in determining possible rehabilitation options. Because it does not take into account factors such as soil stability, hydrologic function, and other environmental factors, it should not be used to assess a sites function and/or condition as typically used by federal land management agencies.

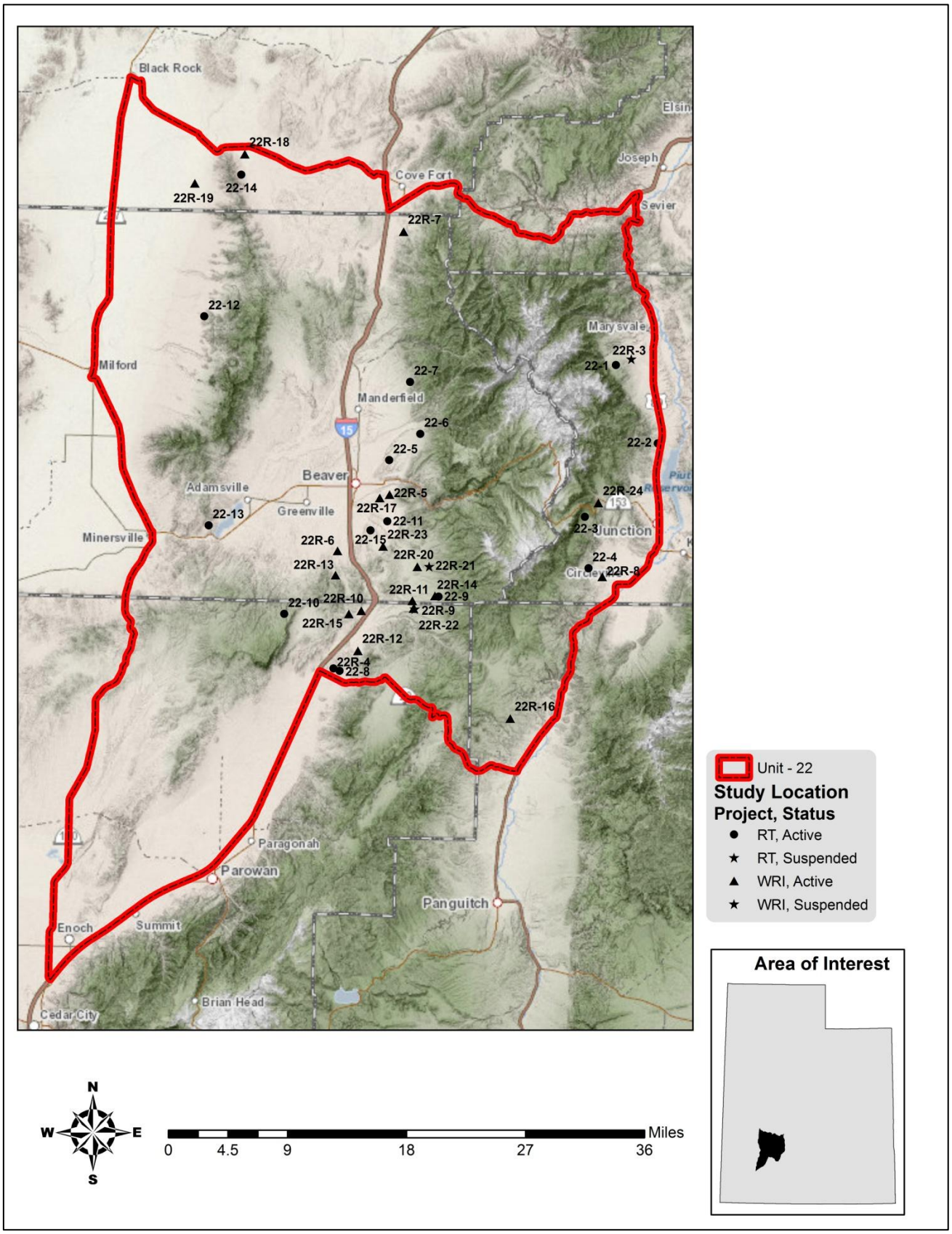
Changes in DCI over the sample years for both treated and untreated sites are included in the figures near the end of the summary. Care should be taken when interpreting these tables as the number of sites included in each year may vary. This could be misleading if the overall DCI seems to be improving when really the very poor or poor sites may be excluded due to a lack of sampling in a certain year.

Discussion and Recommendations: Each of the ecological site descriptions were assessed for their overall threats based on species composition and cover. Common threats to these sites were pinyon-juniper encroachment, introduced perennial and/or annual grass species. Impacts of these threats include reduced vigor of understory species, a decrease in herbaceous diversity, and/or increased fire potential. Some sites did not have these issues and were classified as none identified.

UNIT SUMMARIES



1. WILDLIFE MANAGEMENT UNIT 22 - BEAVER



WILDLIFE MANAGEMENT UNIT 22 - BEAVER

Boundary Description

> **Iron, Garfield, Piute, Beaver, and Millard counties** - Boundary begins at SR-130 and I-15; north on SR-130 to SR-21; north on SR-21 to SR-257; north on SR-257 to the Black Rock road; east on the Black Rock road to I-15; south on I-15 to I-70; east on I-70 to US-89; south on US-89 to SR-20; west on SR-20 to I-15; south on I-15 to SR-130.

Management Unit Description

Geography

The Beaver wildlife management unit includes both the east and west slopes of the Tushar Mountains south of I-70. It also contains the Mineral Mountains south of the Black Rock road, a portion of Parowan Valley, and Fremont Wash. Delano Peak on the Tushar Mountains is the unit's highest point at an elevation of 12,173 feet. The lowest area in the unit is about 5,000 feet in the valley near Milford. The highest point in the Mineral Mountains is 9,578 feet on Granite Peak and Jack Henry Knoll at 8,668 feet is the highest area in the Black Mountains.

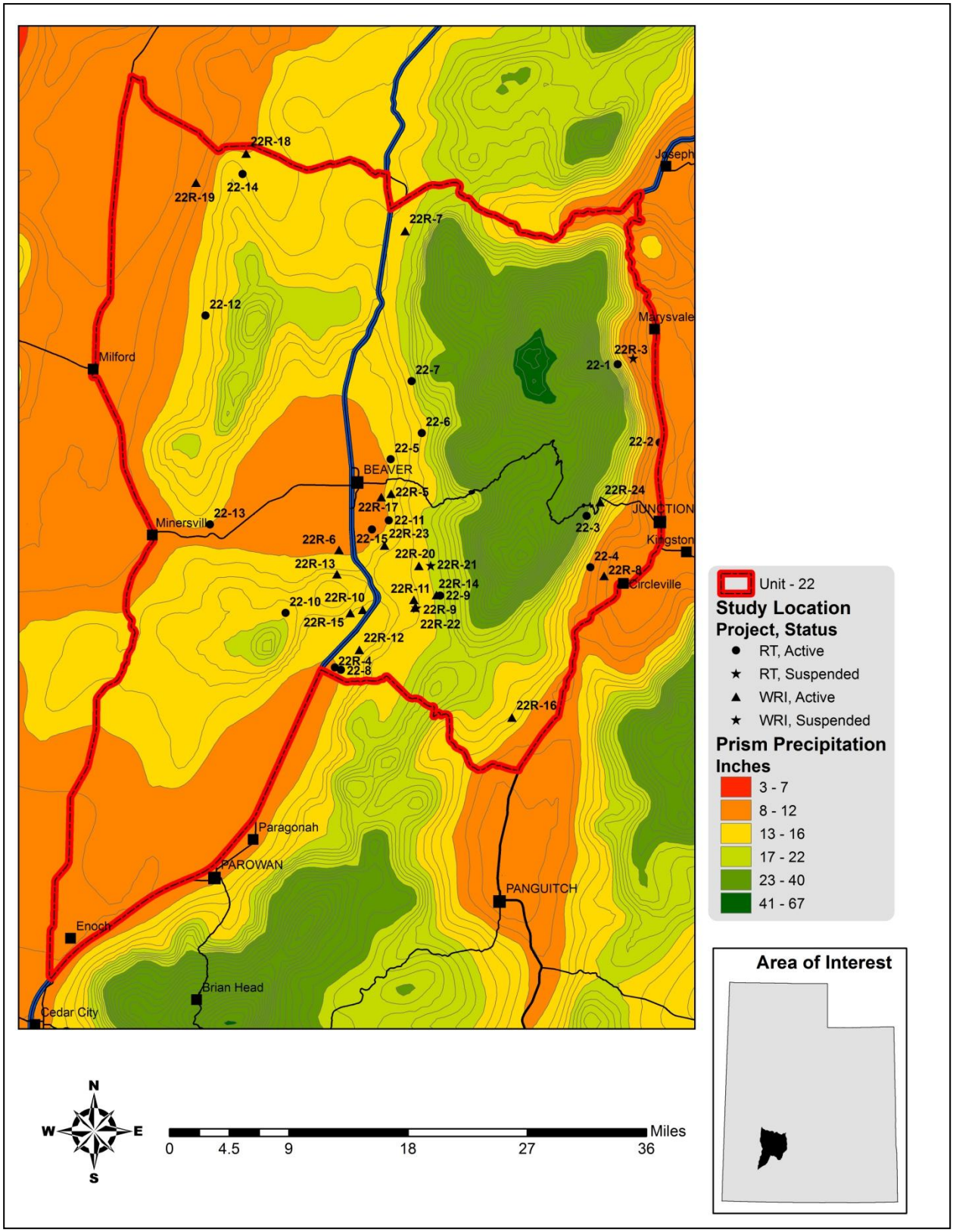
The east side of the Tushar Mountains is comprised of drainages, which empty into the Sevier River. The major tributaries are Deer Creek, Beaver Creek, Bullion Creek, Cottonwood Creek, Ten Mile Creek, City Creek, Birch Creek, Pine Creek and Chokecherry Creek. Between Circleville and Marysvale, a broad river valley with gradual slopes joins the steep mountain slopes and sheer cliffs of the Tushar Mountains. The portions north of Marysvale and south of Circleville (including Marysvale and Circleville Canyons) are composed of disjunctive pinyon-juniper canyons. Towns in this area include Sevier, Marysvale, Junction, and Circleville.

The west side of the Tushar Mountains is comprised of drainages, which empty into the Beaver River. The major tributaries are Indian Creek, North Creek, South Creek, and Merchant Creek. The low to mid elevation on west side of the Tushar Mountains is composed of gradual sloping hills and flats that are transverse by I-15 north to south. On the west side of the wildlife unit, the Black Mountains and the Mineral Mountains are typical of the arid mountains of western Utah. Neither support streams with permanent flows. Towns in this area include Beaver, Milford, and Minersville.

Climate Data

The 30 year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 8 inches on the far west and east sides of the unit to 43 inches on the high elevation peaks of the Tushar Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within the 11-16 inch precipitation zone (Map 1.1) (PRISM Climate Group, Oregon State University, 2013).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 1.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 1.1b) (Time Series Data, 2014).



Map 1.1: The 1981-2010 PRISM Precipitation Model for WMU 22, Beaver (PRISM Climate Group, Oregon State University, 2013).

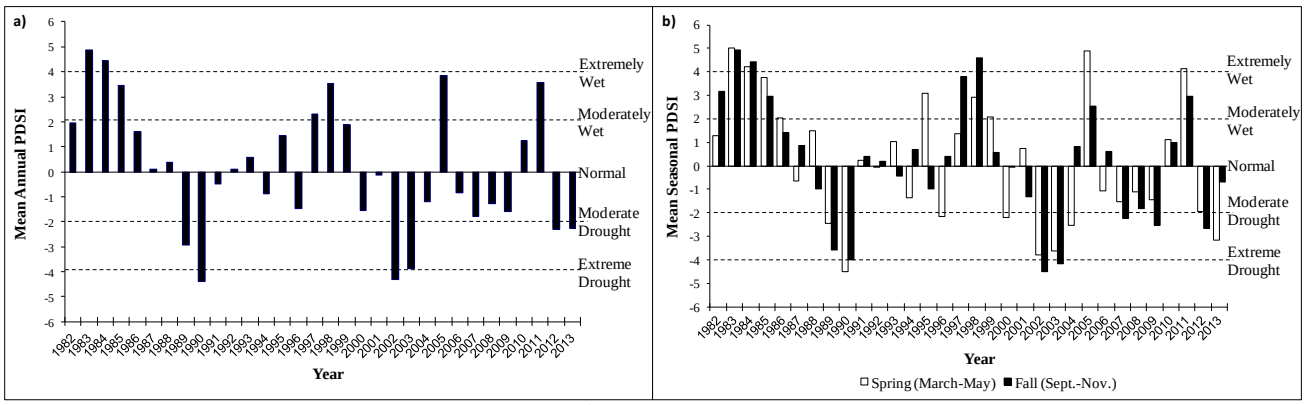


Figure 1.1: The 1982-2014l Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.)(Time Series Data, 2014).

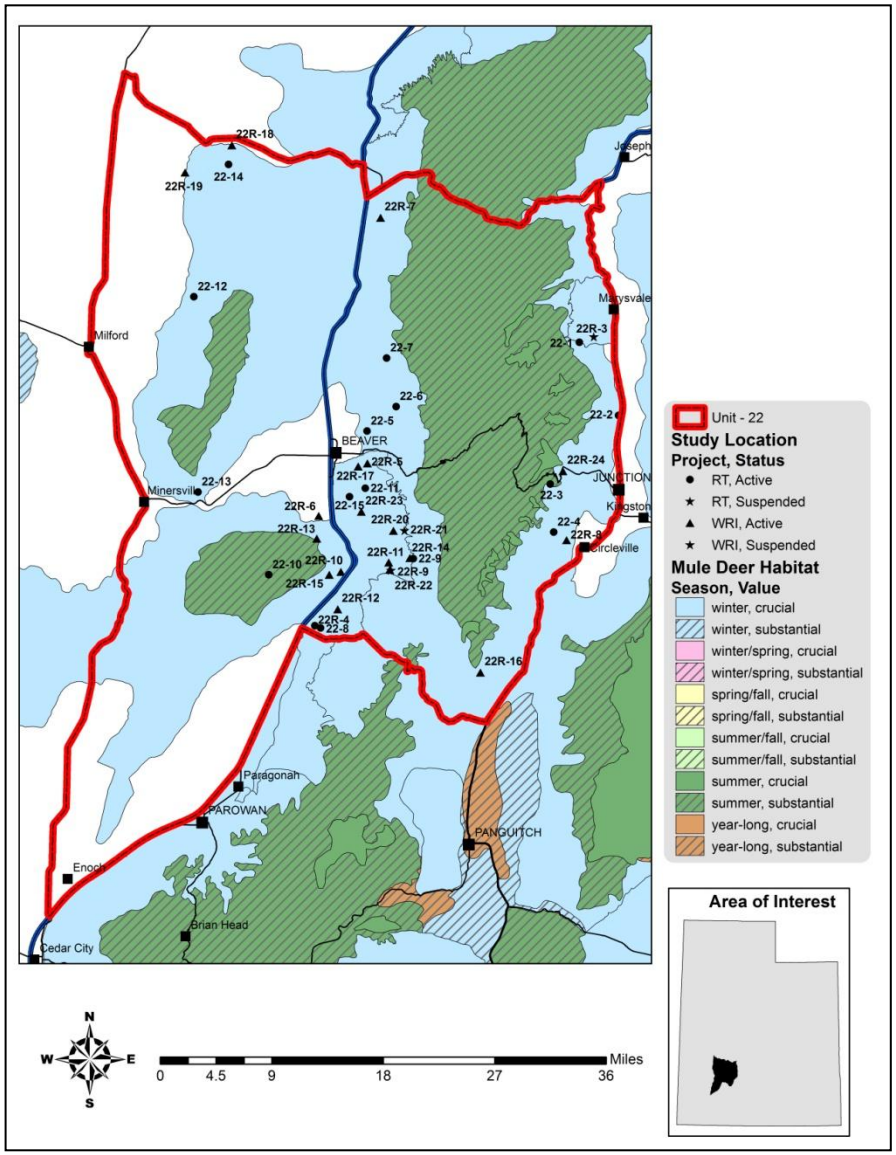
Big Game Habitat

Total mule deer range in the wildlife management unit is estimated at 884,514 acres with 299,560 acres of this classified as summer range and 584,955 acres classified as winter range (Table 1.1 and Map 1.2). Total elk range is estimated at 523,458 acres with 79,234 acres of this being classified as year-long range, 237,015 as summer range, and 207,209 as winter range (Table 1.1 and Map 1.3). There is sufficient summer and winter range for both deer and elk (Table 1.1). Most of the big game winter range in this unit is located on Forest Service or BLM managed lands. Minor portions of the winter range in the unit occur on private holdings, Utah State School Trust Lands, and Division of Wildlife Resources management areas.

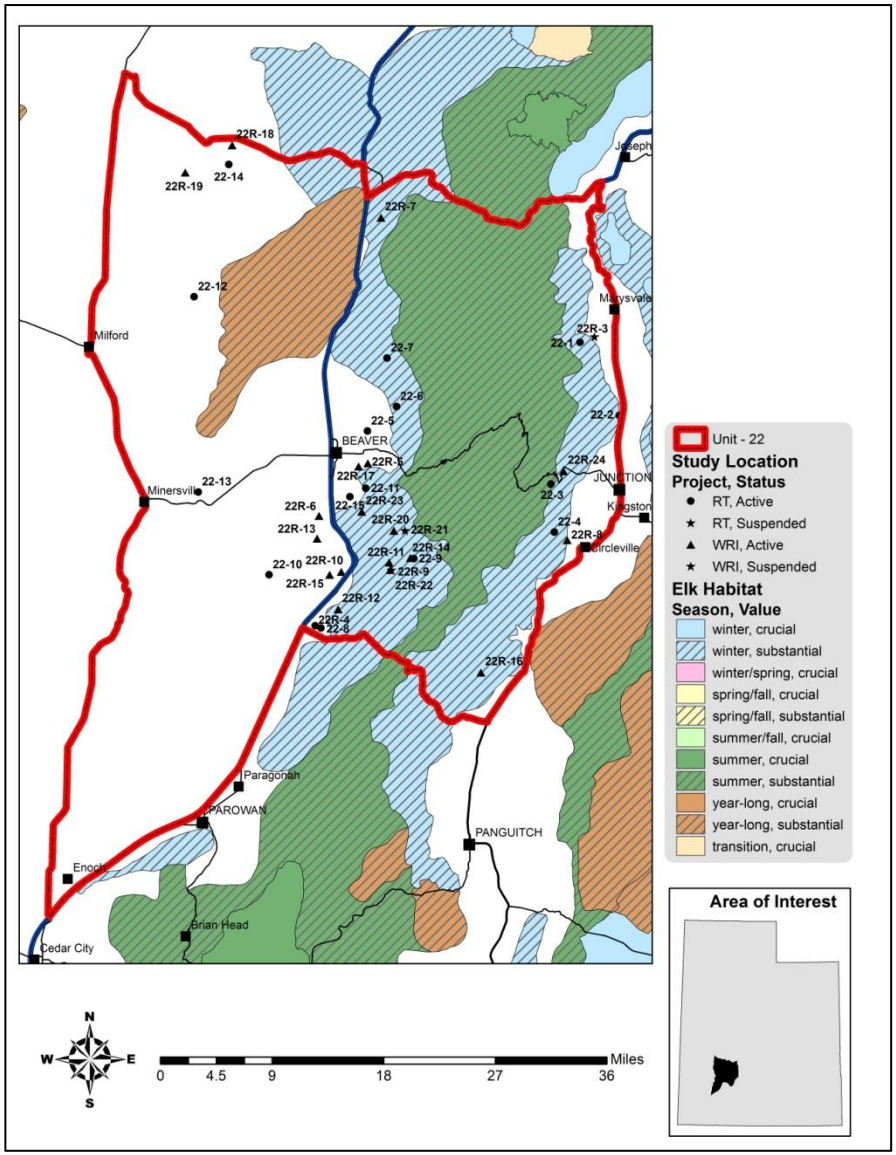
According to LANDFIRE Existing Vegetation Coverage models, important shrublands consist of less than 30% of the deer winter range on the unit. The majority of deer winter range is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Annual grasslands, primarily cheatgrass (*Bromus tectorum*), also comprise a substantial proportion of the deer winter range and pose an increased threat of wildfire. Other coverage types make up a minimal proportion of the deer winter range (Table 1.4).

Black and Mineral Mountains lack good summer range, but have vegetation similar to most deer wintering areas of southern Utah. Both the Black and Mineral Mountains have relatively steep, rugged slopes with areas of rocky outcrops. The Black Mountains are unlike the Mineral Mountains in that the top is dominated by gently rolling sagebrush hills and dry meadows.

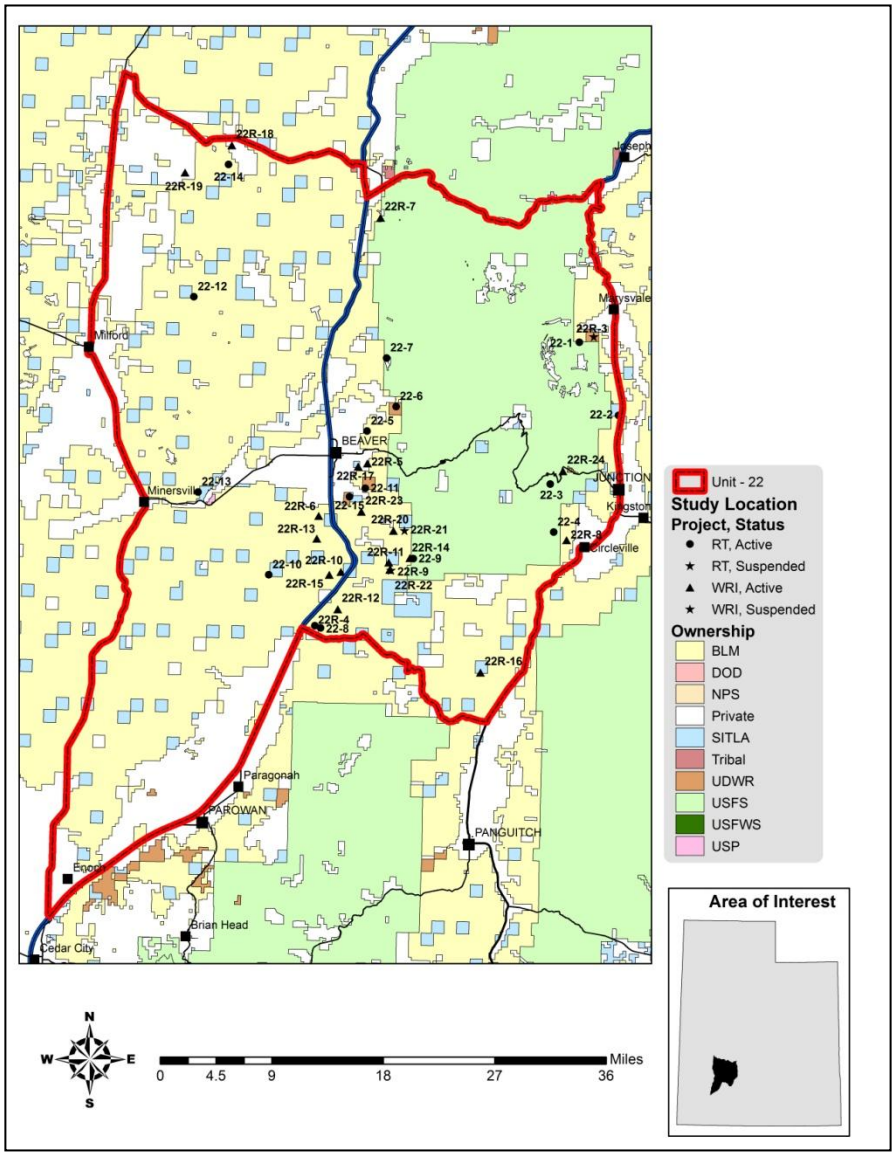
The Tushar Mountains are more typical of the high elevation mountains of central and southern Utah and contain good summer range for deer and elk. The Tushar's have many small lakes and perennial streams. The western slopes of the Tushar Mountains are more gradual and receive sufficient precipitation to create good intermediate deer range, which is used in the spring and fall and during mild winters. On the east side of the Tushar Mountains, the normal winter range boundaries range from 6,200 feet on the valley floor to 8,500 feet in the upper basins. Oak Basin often winters deer up to the 8,600-foot level. The upper limit along the steeper portions of the east face of Tushar Mountains is 7,200 feet. Severe winter range occupies 47,223 acres, 71% of the normal winter range (Huff & Bowns, 1965). The upper limit of severe winter range is normally 7,000 feet, but goes as high as 8,000 feet in Oak Basin. Winter deer concentrations are found on south and southeast facing slopes. Minor migrations from the summer ranges of units 23 - Monroe and 24 - Dutton onto unit 22 winter ranges occur each year, but the major movement is an elevation movement from summer to winter range within the unit.



Map 1.2: Estimated mule deer habitat by season and value for WMU 22, Beaver.



Map 1.3: Estimated elk habitat by season and value for WMU 22, Beaver.



Map 1.4: Land ownership for WMU 22, Beaver.

	Year-Long Range		Summer Range		Winter Range	
	Area (acres)	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	0	0%	299,560	34%	584,955	66%
Elk	79,234	15%	237,015	45%	207,209	40%

Table 1.1: Estimated mule deer and elk habitat acreage by season for WMU 22, Beaver.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	207,791	69%	82,197	14%
BLM	66,681	22%	398,025	68%
SITLA	7,431	3%	43,020	7%
Tribal Land	0	0%	252	<1%
Private	17,655	6%	58,240	10%
UDOT	0	0%	2	<1%
USP	<1	<1%	483	<1%
UDWR	0	0%	2,736	<1%
Total	**299,560**	**34%**	**584,955**	**66%**

Table 1.2: Estimated mule deer habitat acreage by season and ownership for WMU 22, Beaver.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	0	0%	212,423	90%	70,528	34%
BLM	63,957	81%	7,408	3%	104,766	51%
SITLA	6,554	8%	1,976	<1%	12,897	6%
Private	8,683	11%	14,890	6%	17,259	8%
Tribal Lands	0	0%	0	0%	252	<1%
UDWR	40	<1%	0	0%	1,507	<1%
USP	0	0%	318	<1%	0	0%
Total	**79,234**	**100%**	**237,015**	**100%**	**207,209**	**100%**

Table 1.3: Estimated elk habitat acreage by season and ownership for WMU 22, Beaver.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Semi-Desert Shrub-Steppe	66,032.04	11.31%	
	Inter-Mountain Basins Big Sagebrush Shrubland	54,103.02	9.27%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	31,447.25	5.39%	
	Great Basin Xeric Mixed Sagebrush Shrubland	6,980.96	1.20%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	4,289.99	0.73%	
	Quercus gambelii Shrubland Alliance	3,983.31	0.68%	
	Inter-Mountain Basins Big Sagebrush Steppe	846.43	0.14%	
	Artemisia tridentata ssp. vaseyana Shrubland Alliance	752.36	0.13%	
	Inter-Mountain Basins Montane Sagebrush Steppe	54.26	0.01%	
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Conifer	Colorado Plateau Pinyon-Juniper Woodland	268,993.04	46.07%	
	Great Basin Pinyon-Juniper Woodland	7,700.85	1.32%	
	Inter-Mountain Basins Juniper Savanna	3,750.68	0.64%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	14,289.29	2.45%	
	Other Conifer	3,477.81	0.60%	51.08%
Grassland	Native Grassland	10,451.42	1.79%	1.79%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	71,091.29	12.18%	
	Introduced Upland Vegetation-Annual and Biennial Forbland	1,114.2	0.19%	
	Introduced Upland Vegetation-Perennial Grassland and Forbland	921.16	0.16%	12.53%
Other	Hardwood	561.1	0.10%	
	Riparian	5,675.73	0.97%	
	Agricultural	6,633.14	1.14%	
	Developed	12,863.29	2.20%	
	Other	2,833.74	0.49%	4.89%
Total		583,820.2		

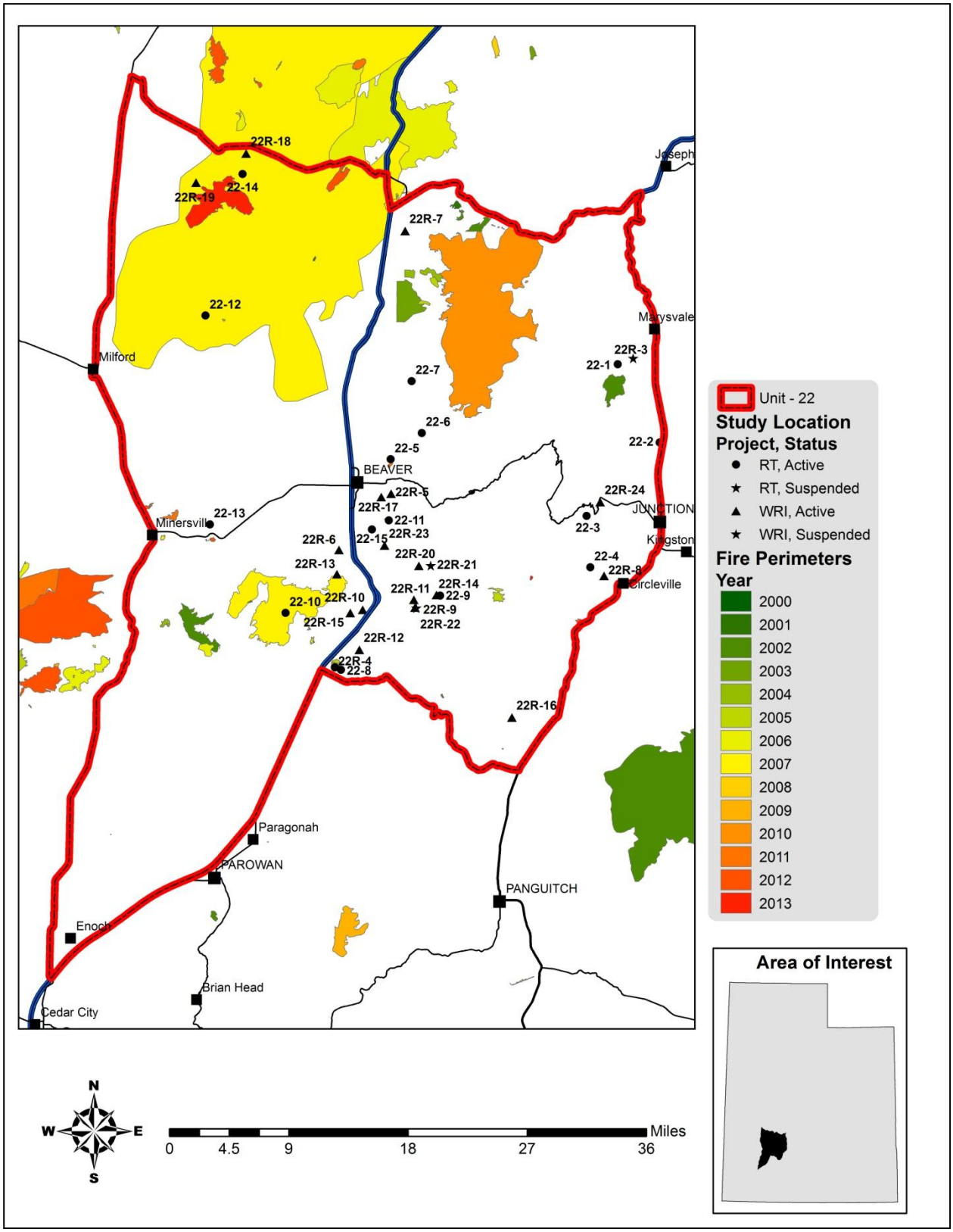
Table 1.4: LANDFIRE existing vegetation coverage (LANDFIRE: LANDFIRE 1.2.0, 2010)of deer winter range for WMU 22, Beaver.

Limiting Factors to Big Game Habitat

Historically, on the west side of the Tushar Mountains most of the use on the winter range was on the Black and Mineral Mountains. The winter ranges on these mountains were used quite extensively in the past by deer migrating from summer range on the Tushars. These migrations were essentially eliminated by the construction and fencing of I-15. Two underpasses and one overpass were constructed to aid deer in crossing I-15, however, these have had limited success. Meanwhile, the winter range on the east side of I-15 must carry the burden. Still, there is ample range for deer in normal winters. Only in severe winters when the usable range is limited to the lowest areas near the freeway does winterkill become a substantial problem.

Wildfire has also had a considerable impact on the deer winter range in the unit, particularly in the northern portion of the unit. The Milford Flat fire of 2007 was the largest wildfire in Utah's recorded history at 356,665 acres, and burned most of the northern portions of the Mineral Mountains and much of the surrounding valleys and foothills. In 2007, the Greenville fire burned 14,716 acres on Black Mountain (Map 1.5). The Dog Valley fire of 1996 burned a portion on the northern end of WMU22 and a large number of the southern portion of WMU 21 around the I-15 and I-70 Junction. All of these wildfires removed large expanses of important sagebrush and shrubland communities. While response to rehabilitation efforts and recovery has varied, available shrub forage remains highly reduced from pre-fire levels. The abundance of cheatgrass, primarily within the lower elevation sagebrush communities, increases the threat of catastrophic wildfires within the unit (Balch, D'Antonio, & Gómez-Dans, 2013).

Encroachment by pinyon-juniper woodland communities also poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 22 (Table 1.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000).

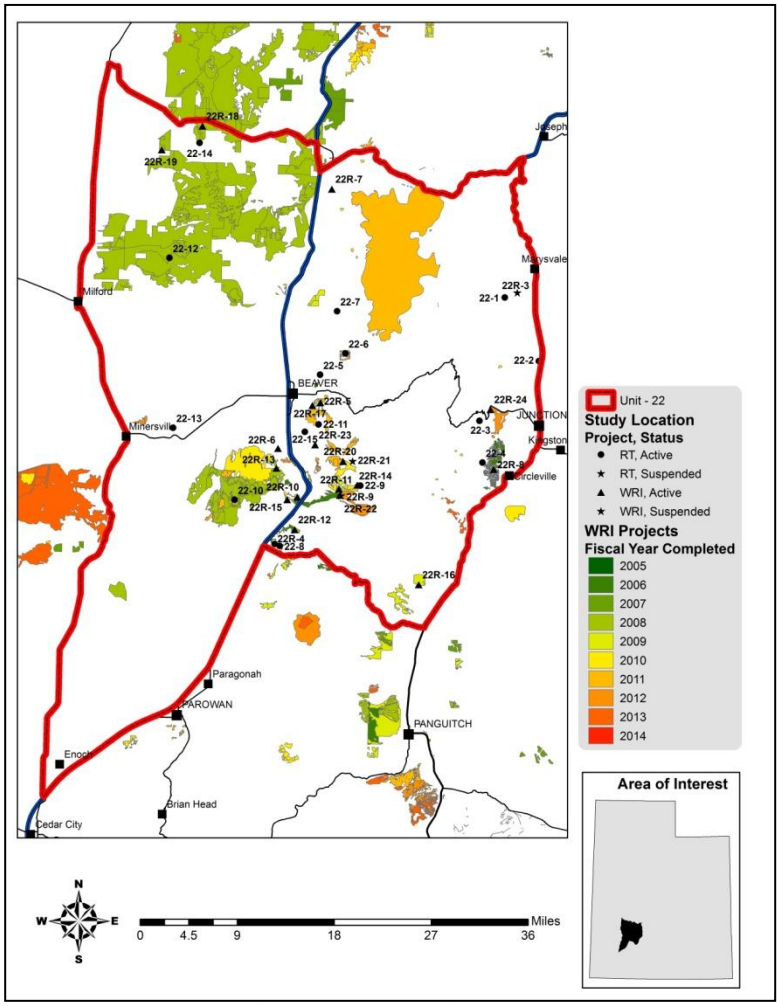


Map 1.5: Land coverage of fires by year from 2001-2013 for WMU 22, Beaver (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2014).

Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 174,186 acres of land have been treated within the Beaver unit since the WRI was implemented in 2004. As seen on the map, treatments occasionally overlap one another bringing the total treatment acres to 238,013 acres for this unit (Map 1.6). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

The majority of treatment acreage, especially seeding and chaining, was done in conjunction with restoration efforts of wildfires within the unit. Treatments to reduce pinyon-juniper woodlands such as bullhog, chaining, brush saw, and lop-and-scatter are the next most common management practices. Other common management treatments are those to rejuvenate sagebrush stands such as chaining and harrow treatments are also common. Herbicide treatments within the unit are primarily used to control cheatgrass and restore other more desirable species (Table 1.5).



Map 1.6: WRI treatments by fiscal year completed for WMU 22, Beaver.

Treatment Action	Acres
Seeding	177,845
Chaining	34,369
Prescribed Fire	6,342
Bullhog	6,292
Lop and Scatter	5,319
Harrow	3,989
Brush Saw	1,080
Planting/Transplanting	1,057
Herbicide	1,035
Road Decommissioning	491
Disc	158
PJ Push	36
***Total Land Area Treated**	**174,186**
Total Treatment Acres	**238,013**

Table 1.5: WRI treatment action size (acres) for WMU 22, Beaver.
*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 22 on a regular basis since 1985, with studies being added or suspended as was deemed necessary (Table 1.6). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Monitoring studies of WRI projects have been sampled since 2004. When possible, WRI monitoring studies are established prior to treatment and sampled on a regular basis following treatment. Due to the long-term nature of the studies, many of the Range Trend and WRI studies have had some sort of disturbance or treatment prior to or since study establishment (Table 1.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
22-1	Deer Flat	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Mountain Stony Loam (Mountain Big Sagebrush)
22-2	Piute Reservoir	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Semidesert Shallow Loam (Wyoming Big Sagebrush)
22-3	Oak Basin	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Mountain Loam (Mountain Big Sagebrush)
22-4	Wades Canyon	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Stony Loam (Wyoming Big Sagebrush)
22-5	Bone Hollow	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Loam (Wyoming Big Sagebrush)
22-6	Beaver Table	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Loam (Wyoming Big Sagebrush)
22-7	Sheep Rock	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Loam (Mountain Big Sagebrush)
22-8	Muley Point	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
22-9	Rocks Reseeding	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Loam (Mountain Big Sagebrush)
22-10	Doubleup Hollow	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Loam (Mountain Big Sagebrush)
22-11	B Hill	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
22-12	Big Cedar Cove	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Gravelly Loam (Wyoming Big Sagebrush)
22-13	Minersville Reservoir	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
22-14	Antelope Mountain	RT	Active	‘85, ‘91, ‘98, ‘03, ‘08,‘13	Upland Loam (Mountain Big Sagebrush)
22-15	South Creek	RT	Active	‘98, ‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
22R-3	Marysvale WMA	RT	Suspended	‘98	Not Verified
22R-4	Above Fremont Wash	RT	Active	‘99, ‘03, ‘08,‘13	Semidesert Stony Loam (Wyoming Big Sagebrush)
22R-5	Black Mountain	WRI	Active	‘04, ‘07, ‘12	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-6	Greenville Bullhog	WRI	Active	‘04, ‘07, ‘12	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-7	Sulphurdale	WRI	Active	‘05, ‘08, ‘13	Upland Loam (Wyoming Big Sagebrush)
22R-8	P-Hill Dixie	WRI	Active	‘05, ‘08, ‘13	Semidesert Gravelly Loam (Wyoming Big Sagebrush) South
22R-9	South Beaver Dixie (Now 22R-22)	WRI	Suspended	‘06	Not Verified
22R-10	South Beaver Bullhog	WRI	Active	‘06, ‘10	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-11	South Bever SITLA Chaining	WRI	Active	‘07, ‘10	Upland Stony Loam (Wyoming Big Sagebrush)
22R-12	South Beaver Bullhog 2	WRI	Active	‘07, ‘10	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-13	Greenville Bench Bullhog 2	WRI	Active	‘07, ‘11	Upland Loam (Wyoming Big Sagebrush)
22R-14	South Beaver Rocky Wash	WRI	Active	‘08, ‘11	Upland Loam (Mountain Big Sagebrush)
22R-15	South Beaver Bullhog Year 4	WRI	Active	‘08, ‘11	Upland Stony Loam (Wyoming Big Sagebrush)
22R-16	Spry Sagebrush Restoration	WRI	Active	‘08, ‘11	Upland Stony Loam (Mountain Big Sagebrush)
22R-17	Beaver Easement Harrow	WRI	Active	‘08, ‘11	Not Verified
22R-18	A&F Drill 1	WRI	Active	‘08, ‘11	Not Verified
22R-19	A&F Drill 2	WRI	Active	‘08, ‘11	Not Verified
22R-20	South Beaver Year 5	WRI	Active	‘10, ‘13	Upland Shallow Hardpan (Mountain Big Sagebrush)
22R-21	South Beaver Year 5 Reference	WRI	Suspended	‘10	Not Verified
22R-22	South Beaver Dixie	WRI	Active	‘10	Not Verified
22R-23	South Beaver Year 7	WRI	Active	‘12	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-24	City Creek	WRI	Active	‘11	Not Verified

Table 1.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 22, Beaver.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
22-1	Deer Flat	Chain Unknown		1968		
		Seed Unknown		1968		
22-3	Oak Basin	Dixie Harrow Unknown		1965	600	
		Seed Unknown		1965	600	
		Wildfire		Between 1985-1990		
22-6	Beaver Table	Cable Unknown		1957		
		Seed Unknown		1957		
		Lop and Scatter		2003-2008		
22-7	Sheep Rock	2-way Chain Unknown		Fall 1981		
		Seed Unknown		Fall 1981		
		Wildfire		1981-1984		
		Bullhog		2009-2011		
22-8	Muley Point	Wildfire	Lee's Wash	2005	195	
		Aerial Seed		2005		
22-9	Rocks Reseeding	Dixie Harrow Unknown		1962		
		Seed Unknown		1962		
22-10	Doubleup Hollow	Wildfire	Greenville Bench	2007		
		Aerial Seed		2007		
22-11	B' Hill	Chain Unknown		1959		
		Aerial Seed		1959		
22-12	Big Cedar Cove	Wildfire	Milford Flat	2007	356,665	
		1-way Ely Chain	Milford Flat Fire Rehabilitation	Fall 2007	76,454	1,218
		Aerial Seed Before	Milford Flat Fire Rehabilitation	Fall 2007	76,454	1,218
		Aerial Seed After	Milford Flat Fire Rehabilitation	Fall 2007	76,454	1,218
22-13	Minersville Reservoir	Wildfire	Minersville	July 1998	4,052	
		1-way Smooth Chain		Oct. 1998		
		Aerial Seed Before		Oct. 1998		
		Aerial Seed After		Feb. 1999		
22-14	Antelope Mountain	Wildfire		1996		
		Chain Unknown		1996		
		Seed Unknown		1996		
		Wildfire	Milford Flat	2007	356,665	
22R-4	Above Fremont Wash	Lop and Scatter		2008-2013		
22R-5	Black Mountain	Aerial Seed	Black Mountain	2004		PDB
		Lop and Scatter		Between 2004-2007		
		2-way Dixie Harrow	Beaver Easement Property Treatment	Fall 2008	205	1,294
		Broadcast Before	Beaver Easement Property Treatment	Fall 2008	205	1,294
		Aerial Seed After	Beaver Easement Property Treatment	Winter 2009	205	1,294
22R-6	Greenville Bullhog	Bullhog	Greenville Bench	Fall 2004	1,500	PDB
		Rangeland Drill	Greenville Bench	Fall 204	1,500	PDB
		Aerial Seed After	Greenville Bench	Fall 204	1,500	PDB
22R-7	Sulphurdale	Chain Unknown		50's or 60's		
		Seed Unknown		50's or 60's		
		Lop and Scatter	Sulphurdale	Fall 2005		BLM
22R-8	P-Hill Dixie	2-way Dixie Harrow	P-Hill One-way Harrow	Winter 2005-2006	1,784	119
		Broadcast After	P-Hill One-way Harrow	Winter 2005-2006	1,784	119
22R-9	South Beaver Dixie	Chain Unknown		Historic		
		Seed Unknown		Historic		
22R-10	South Beaver Bullhog	Bullhog	South Beaver Vegetation Enhancement Yr 4	Fall 2008-Summer 2009	1,520	1,224
		Aerial Seed Before	South Beaver Vegetation Enhancement Yr 4	Dec. 2008	1,358	1,224
22R-11	South Beaver SITLA Chaining	2-way Ely/Smooth Chain	South Beaver SITLA vegetation enhancement	Nov.-Dec 2008	400	918
		Aerial Seed Before	South Beaver SITLA vegetation enhancement	Nov.-Dec 2008	400	918
		Dribbler	South Beaver SITLA vegetation enhancement	Nov.-Dec 2008	400	918

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
22R-12	South Beaver Bullhog 2	Bullhog	South Beaver Vegetation Enhancement Project	Winter 2007-2008	385	895
		Aerial Seed After	South Beaver Vegetation Enhancement Project	Spring 2008	385	895
22R-13	Greenville Bench Bullhog 2	Bullhog	BLM Project	2008 or 09		
		Aerial Seed	Greenville Bench Aerial Seeding	Dec. 2007	11,065	993
22R-14	South Beaver Rocky Wash	Bullhog	South Beaver Vegetation Enhancement Yr 4	Fall 2008-Summer 2009	1,520	1,224
		Aerial Seed Before	South Beaver Vegetation Enhancement Yr 4	Dec. 2008	1,358	1,224
22R-15	South Beaver Bullhog Year 4	Bullhog	South Beaver Vegetation Enhancement Year 4	Fall 2008-Summer 2009	1,520	1,224
		Aerial Seed Before	South Beaver Vegetation Enhancement Year 4	Dec. 2008	1,358	1,224
22R-16	Spry Sagebrush Restoration	Chain Unknown		Fall 1966		
		Seed Unknown		Fall 1966		
		Lop and Scatter	Spry Sagebrush Restoration	Spring 2009	1,745	1,173
22R-17	Beaver Easement Harrow	Aerial Seed		After property was purchased		
		2-way Dixie Harrow	Beaver Easement Property Treatment	Fall 2008	205	1,294
		Broadcast Before	Beaver Easement Property Treatment	Fall 2008	205	1,294
		Aerial Seed After	Beaver Easement Property Treatment	Winter 2009	205	1,294
22R-18	A&F Drill 1	Wildfire	Milford Flat	2007	356,665	
		Rangeland Drill	Milford Flat Fire Rehabilitation - Missouri Flat	Fall 2007	7,925	1,007
22R-19	A&F Drill 2	Wildfire	Milford Flat	2007	356,665	
		Rangeland Drill	Milford Flat Fire Rehabilitation - JK	Fall 2007	520	1,010
22R-20	South Beaver Year 5	Bullhog	South Beaver Vegetation Enhancement Year 5	Oct. 2010-Jan. 2011	1,760	1,711
		Aerial Seed Before	South Beaver Vegetation Enhancement Year 5	Oct. 2010	1,760	1,711
22R-22	South Beaver Dixie	Chain Unknown		Historic		
		Seed Unknown		Historic		
		1-way Dixie Harrow	South Beaver Vegetation Enhancement Year 1	Winter 2005-2006	1,646	104
		Broadcast Before	South Beaver Vegetation Enhancement Year 1	Winter 2005-2006	1,646	104
22R-23	South Beaver Yr 7	Bullhog	South Beaver Vegetation Enhancement Year 7		1,366	2,227
22R-24	City Creek	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Bullhog	City Creek Sagebrush-steppe Enhancement Year 1	Fall 2011-Spring 2012	1,080	1,995

Table 1.7: Range trend and WRI studies known disturbance history for WMU 22, Beaver.

Study Trend Summary (Undisturbed Sites)

Mountain (Mountain Big Sagebrush)

There are two studies [Deer Flat (22-1) and Oak Basin (22-3)] classified as Mountain (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 1.6). Both studies occur on the east side of the Tushar Mountains. The Deer Flat study is located on the high bench above Marysvale at the mouth of Threemile Canyon. It is located on the last foothill bench before the steeper slopes and canyons begin. The Oak Basin study is located within Oak Basin above Junction.

Shrubs/Trees: The primary browse on the Deer Flat study is a mixture of black sagebrush (*Artemisia nova*) and mountain big sagebrush (*A. tridentata* ssp. *vaseyana*). The primary browse on the Oak Basin study is mountain big sagebrush. Other preferred browse species are common on both sites, but occur at much lower coverage than the sagebrush species. The mean line-intercept cover of sagebrush is good on these sites

ranging from 13% in 2003 to near 18% in 2013%. The mean cover of sagebrush has been increasing since 2003 primarily due to the continued recovery from a wildfire on the Oak Basin study that occurred between the 1985 and 1991 surveys. The mean cover of other preferred browse species has ranged from 2% to 5%, but with a decrease in 2008 (Figure 1.2a). The average height of the mountain big sagebrush is approximately 2 feet on both sites, making browse available through much of the year in mild winters. The demographics of the sagebrush population was a mixture of mostly mature and decadent plants in 1998 to 2008, but there was a large increase in young sagebrush plants on the Oak Basin study and a large decrease in decadence on the Deer Flat study in 2013 (Figure 1.2b).

Pinyon pine and Utah juniper are encroaching on the Deer Flat study, but are not present on the Oak Basin study. The mean density of pinyon-juniper trees increased markedly in 2003, but has remained similar since that time (Figure 1.3a). Despite the stable density, mean tree cover has steadily increased from 7% in 2003 to near 14% in 2013 (Figure 1.3b). The increase in mean tree cover corresponds to increases in the average size of trees in photographs. The Deer Flat study is classified as being in Phase I transitioning to Phase II of the woodland succession. The Deer Flat study site is under threat of further encroachment by pinyon-juniper trees, which would result in decreased cover of valuable browse and forage species.

Herbaceous Understory: Both study sites have a good herbaceous component dominated by perennial grass. However, the dominant grass species are seeded species that are often considered aggressive at higher elevation and precipitation. These include intermediate wheatgrass (*Agropyron intermedium*), crested wheatgrass (*A. cristatum*), and smooth brome (*Bromus inermis*). This is particularly pronounced on the Oak Basin study site. Numerous native species also occur on the sites, but at much lower cover and frequencies than the introduced species. Competition with these introduced grasses may limit other desirable herbaceous species. Mean nested frequency of perennial grasses has fluctuated, but has remained relatively high since 1998 (Figure 1.4a). The mean cover of perennial grass decreased from 20% in 1998 to around 13%-14% in 2003 through 2013 (Figure 1.4b). Annual grass species are rare on both study sites.

Native perennial forb species composition is diverse with moderate nested frequency and cover. The mean nested frequency of perennial forb species increased in 2008, but mean cover decreased from near 5% in 1998 to 2%-3% in 2003 through 2013 (Figure 1.4).

Occupancy: Pellet group transect data indicates that deer predominately occupy these studies. The mean abundance of deer pellet groups has ranged from a high of 98 days use/acre in 2003 to a low of 34 days use/acre in 2008. Deer occupancy is generally higher on the Deer Flat study than on the Oak Basin study. Elk pellet groups are typically sampled in low abundance on both study sites, though pellet groups were sampled in moderate abundance on the Deer Flat study in 2003. Livestock sign from cattle was very abundant on the Oak Basin study in 1998, but has been more moderate in subsequent sample years (Figure 1.5).

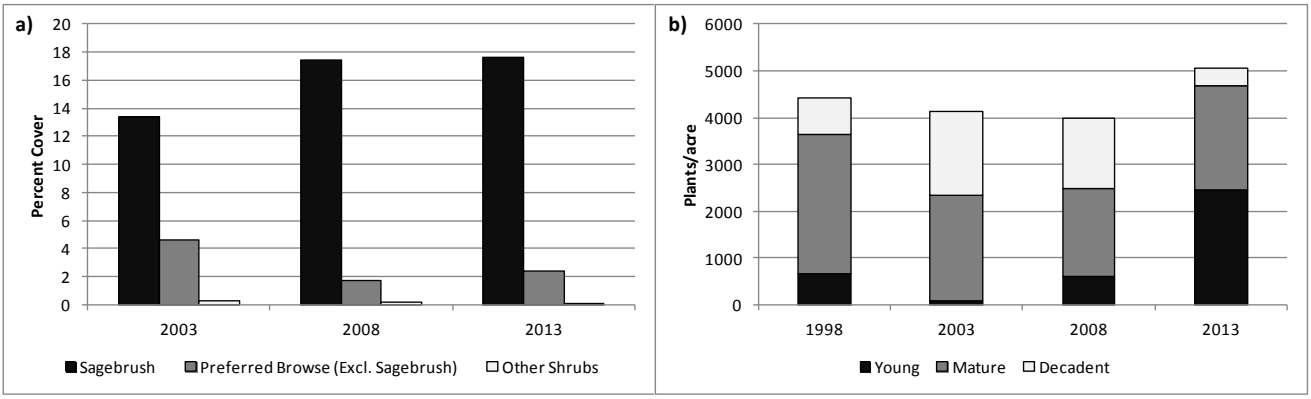


Figure 1.2: Shrub summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

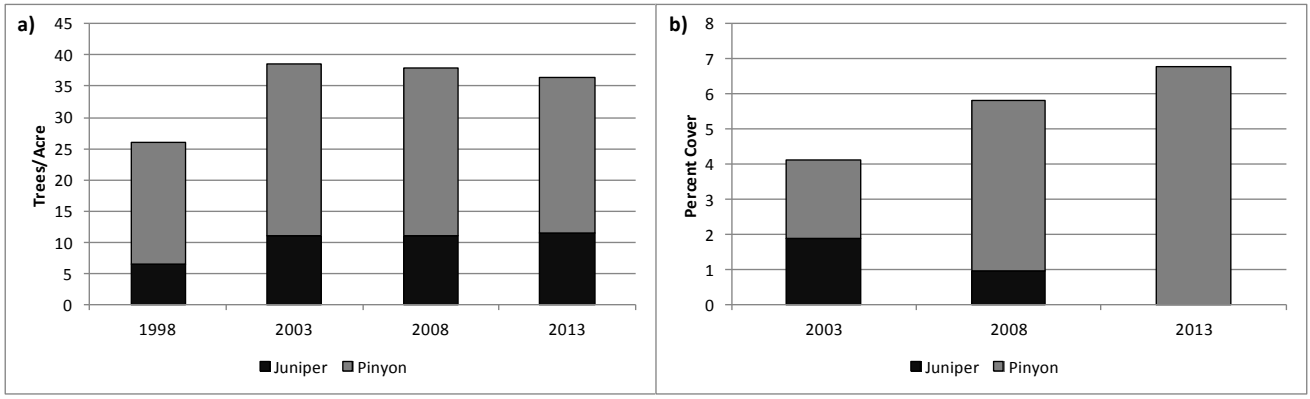


Figure 1.3: Tree summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 22, Beaver. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

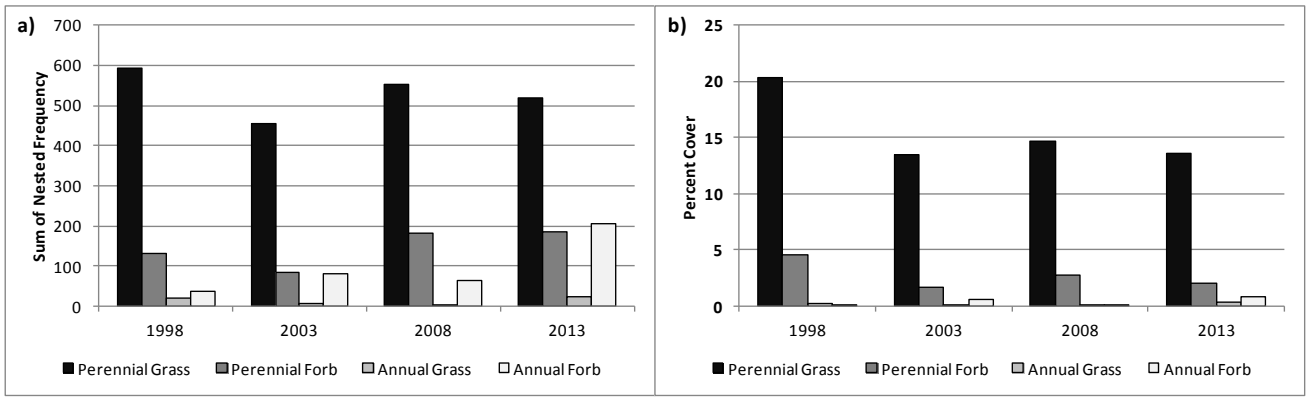


Figure 1.4: Herbaceous functional group summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

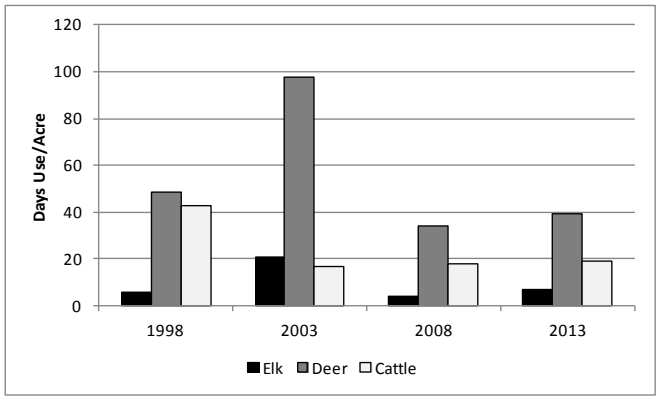


Figure 1.5: Mean pellet transect data for the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 22, Beaver.

Upland (Mountain Big Sagebrush)

There is one study [Rocks Reseeding (22-9)] classified as an Upland (Mountain Big Sagebrush) ecological site that remained undisturbed over the report period (Table 1.6). The study is located on the south end of the Tushar Mountains on Coyote Bench.

Shrubs/Trees: The primary browse on the Rocks Reseeding study is a mixture of mountain big sagebrush and antelope bitterbrush (*Purshia tridentata*). The mean line-intercept cover of sagebrush is good on this site ranging from 14% in 2003 to near 15% in 2013. The mean cover of the only other preferred browse species, bitterbrush, has ranged from 11% in 2003 to 18% in 2013 (Figure 1.6a). The average height of the mountain big sagebrush is approximately 2 feet and between 3 to 4 feet for bitterbrush, making browse available through

much of the year in mild winters. The demographics of the sagebrush population have been generally comprised of mature plants, but the number of decadent plants was substantially higher in 2008. Recruitment of young sagebrush plants has remained above 10% of the population since 1998 (Figure 1.6b).

Despite the good health of the browse community, encroachment from Utah juniper trees is a concern on the site. Density of pinyon-juniper trees has steadily increased since 1998 (Figure 1.7a), and mean tree cover has also increased since 2003 (Figure 1.7b). The increase in mean tree cover corresponds to increases in the average size of trees in photographs. The site is classified as being in Phase I transitioning to Phase II of woodland succession. The study site is under threat of further encroachment by pinyon-juniper trees, which would result in decreases in valuable browse and forage species.

Herbaceous Understory: The study site has a good herbaceous component dominated by perennial grass. However, the dominant grass species is the seeded species crested wheatgrass and other herbaceous species are limited on the site. Competition with this introduced grass may limit other desirable herbaceous species. Mean nested frequency of perennial grasses has fluctuated, but has remained relatively high since 1998 (Figure 1.8a). The mean cover of perennial grass decreased from 23% in 1998 to 15% in 2003, but increased steadily to 24% in 2013 (Figure 1.8b). Annual grass species are rare on the site.

Native perennial forb species are lacking on the site with low nested frequency and cover of all sampled species. Nested frequency of the annual forb blue-eyed Mary (*Collinsia parviflora*) is high, but cover of this short-lived annual species fluctuates from year to year and is generally minimal (Figure 1.8).

Occupancy: Pellet group transect data indicates that deer and cattle predominately occupy this study. The mean abundance of deer pellet groups has ranged from a high of 23 days use/acre in 2003 to a low of 15 days use/acre in 2013. Elk pellet groups are typically sampled in low abundance on the study site. The abundance of livestock sign from cattle has ranged from a high of 32 days use/acre in 2008 to a low of 19 days use/acre in 2003 (Figure 1.9).

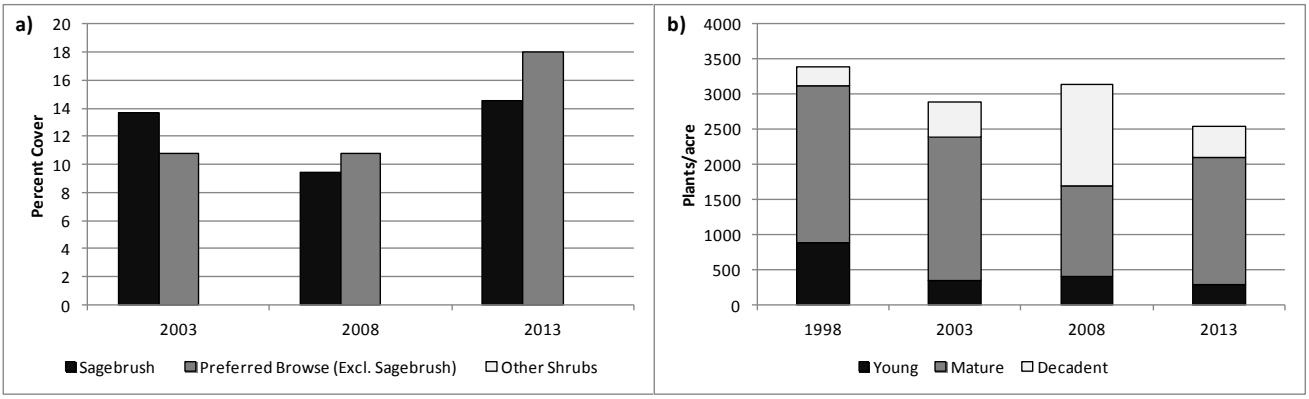


Figure 1.6: Shrub summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

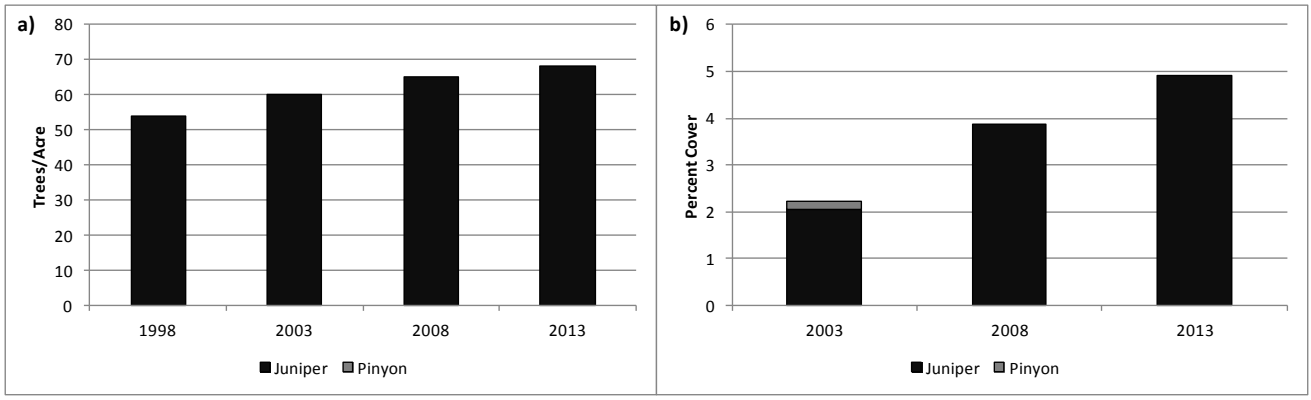


Figure 1.7: Tree summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 22, Beaver. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

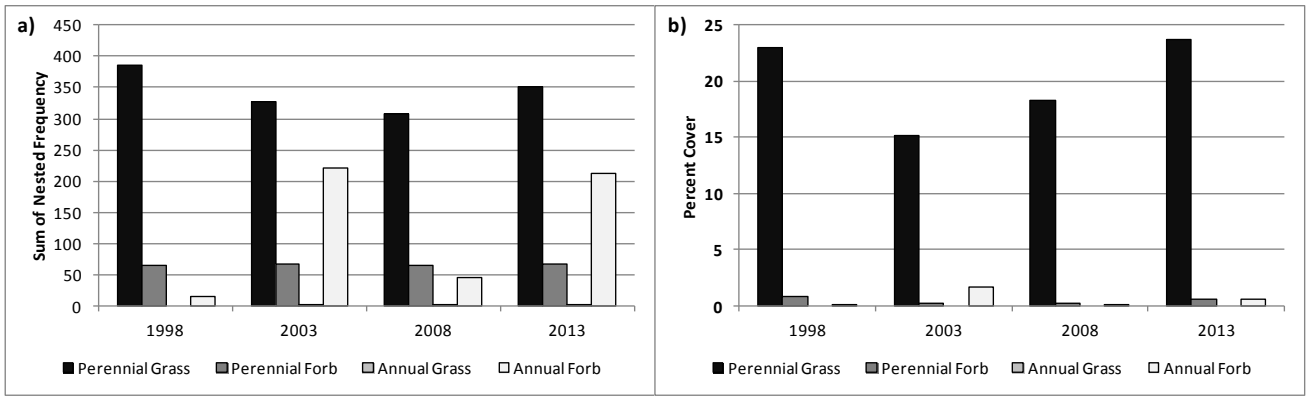


Figure 1.8: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

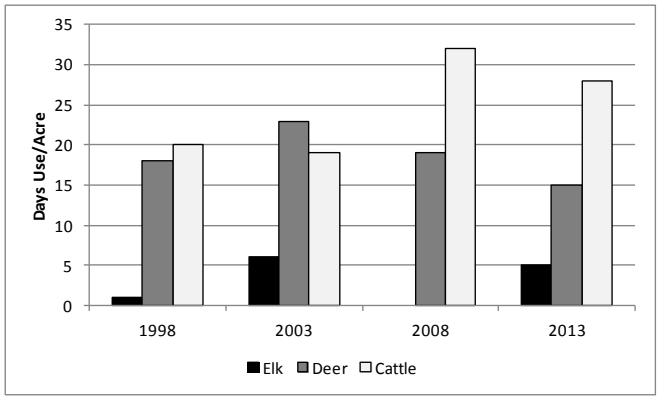


Figure 1.9: Mean pellet transect data for the Upland (Mountain Big Sagebrush) study (n=1) for WMU 22, Beaver.

Upland (Wyoming Big Sagebrush)

There are three studies [Wades Canyon (22-4), Bone Hollow (22-5), and Beaver Table (22-6)] classified as Upland (Wyoming Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 1.6). The Wades Canyon study is located west of Circleville on the bench at the mouth of Wades Canyon. Both the Bone Hollow and Beaver Table studies are located on the foothills northeast of Beaver.

Shrubs/Trees: The primary browse on all three studies is Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*). The mean line-intercept cover of sagebrush is good on these sites, and has steadily increased from 12% in 2003 to just over 17% in 2013. Much of this increase is attributed to a large increase in cover on the Beaver Table study. Antelope bitterbrush was sampled on the Beaver Table study and is the only other

preferred browse species sampled in line-intercept cover. Bitterbrush cover has remained similar on this site and has been between 2% to 3% since 2003 (Figure 1.10a). The average height of Wyoming big sagebrush on all of the studies is approximately 1.5 feet to 2 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been comprised of a mixture of mature and decadent plants with recruitment of young plants being less than 10% of the population on all the study sites since 1998. Despite the increase in cover of sagebrush, the mean density of sagebrush has steadily decreased on these sites since 1998 (Figure 1.10b).

Encroachment from pinyon pine and Utah juniper trees is a concern on these sites, particularly the Bone Hollow study. The mean density of pinyon-juniper trees has steadily increased since 1998 (Figure 1.11a), and mean tree cover increased substantially in 2013 (Figure 1.11b). The highest density and cover of pinyon-juniper occurs on the Bone Hollow study at 287 trees/acre and 25%, respectively, in 2013. The other two study sites maintain lower cover and density, but repeat photographs show trees increasing in size and density since study establishment on all of the studies. The Bone Hollow study is classified as Phase II and the other two studies are classified as being in Phase I transitioning to Phase II of the woodland succession. These study sites are under threat of further encroachment by pinyon-juniper trees, which would result in decreases in valuable browse and forage species.

Herbaceous Understory: These study sites have a fair herbaceous component dominated primarily by native perennial grasses. Mean nested frequency of perennial grasses decreased in 2003 and 2008, but was moderately high in 1998 and 2013. The mean cover of perennial grass decreased from 8% in 1998 to 5% in 2003 and 2008, but increased to 7% in 2013. The annual grass species cheatgrass was very abundant on the Bone Hollow and Beaver Table studies in 1998, but has been sampled at much lower cover in subsequent years (Figure 1.12). Cheatgrass remains an increased fire threat on both of these studies, particularly Bone Hollow. Cheatgrass is rare on the Wades Canyon study.

Native perennial forb species composition is in general, fairly diverse on these studies, but with low nested frequency and cover of all sampled species (Figure 1.12). The weedy annual forb burr buttercup (*Ranunculus testiculatus*) has increased in frequency and cover on the Bone Hollow study since 1998.

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy these study sites. The mean abundance of deer pellet groups has ranged from a high of 131 days use/acre in 2008 to a low of 43 days use/acre in 2013 (Figure 1.13). All of the studies show similar abundance of deer pellet groups sampled.

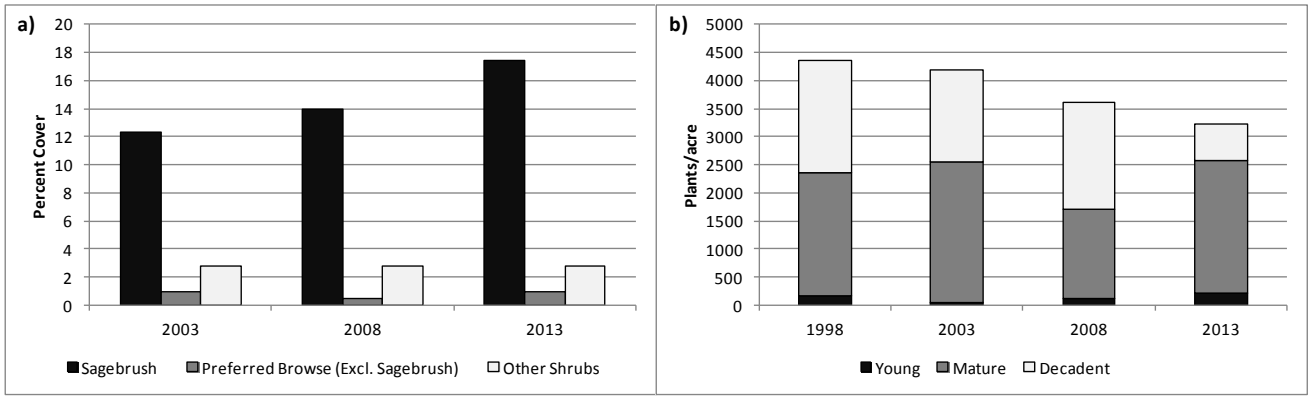


Figure 1.10: Shrub summary of the Upland (Wyoming Big Sagebrush) studies (n=3) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

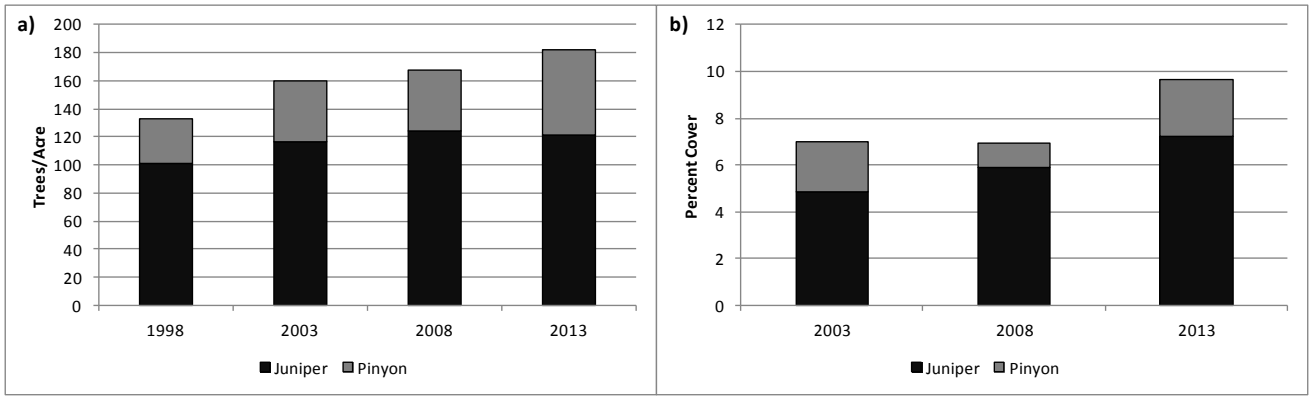


Figure 1.11: Tree summary of the Upland (Wyoming Big Sagebrush) studies (n=3) for WMU 22, Beaver. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

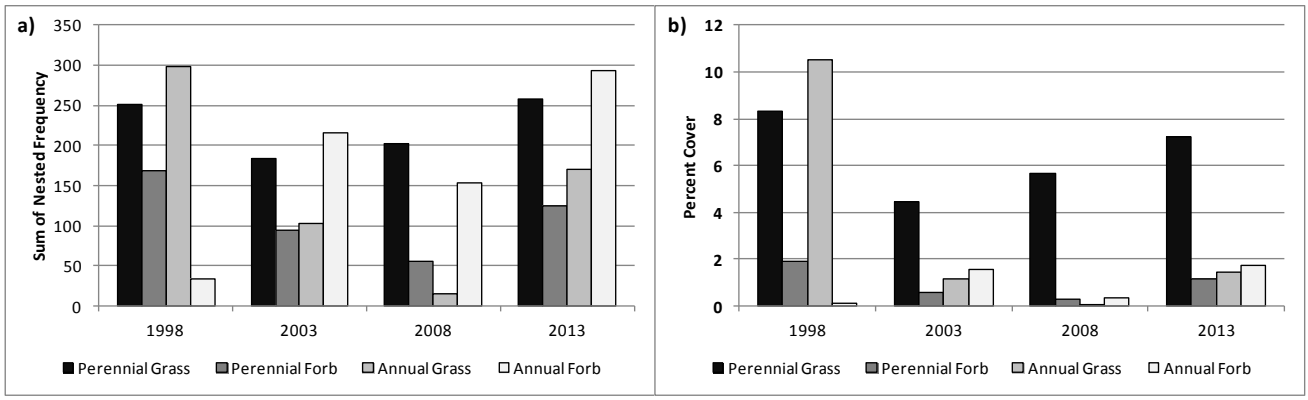


Figure 1.12: Herbaceous functional group summary of the Upland (Wyoming Big Sagebrush) studies (n=3) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

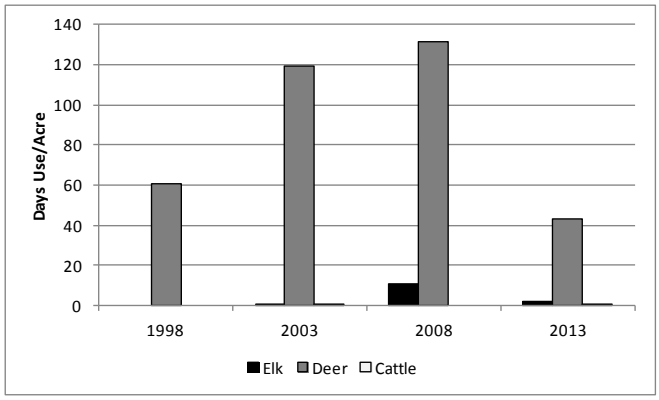


Figure 1.13: Mean pellet transect data for the Upland (Wyoming Big Sagebrush) studies (n=3) for WMU 22, Beaver.

Semidesert (Wyoming Big Sagebrush)

There are four studies [Piute Reservoir (22-2), 'B' Hill (22-11), South Creek (22-15), and Above Fremont Wash (22R-4)] classified as Semidesert (Wyoming Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 1.6). The Piute Reservoir study is located just west of Highway 89 at the northern end of Piute Reservoir. Both the 'B' Hill and South Creek studies are located on the foothills southeast of Beaver. The Above Fremont Wash study is located northeast of the junction of I-15 and Highway 20.

Shrubs/Trees: The primary browse on all four studies is Wyoming big sagebrush with no other preferred browse species sampled in cover measurements on any of the studies. The mean line-intercept cover of

sagebrush is good on these sites, and has remained similar at 10% to 11% since 2003(Figure 1.14a). Trends in cover have varied on individual sites, however. Sagebrush cover increased from 11% to 17% from 2003 to 2013 on the South Creek study, but decreased from 8% to 4% over the same period on the Above Fremont Wash study. The average height of Wyoming big sagebrush on all of the studies is approximately 1.5 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been a mixture of mature and decadent plants with recruitment of young plants comprising less than 10% of the population on most of the study sites since 1998. The South Creek study site is the exception with recruitment of young plants ranging from 6% to 50% of the population. Despite the stable trends of the mean density of sagebrush, there has been a steady decrease in density on both the Piute Reservoir and Above Fremont Wash studies since 1998. The large increase in density on the South Creek study has influenced the positive trends of the mean (Figure 1.14b).

Encroachment of pinyon pine and Utah juniper trees is not a concern on most of these sites and mean density and cover are generally low (Figure 1.15). Repeat photographs do show some encroachment of pinyon-juniper trees on the Above Fremont Wash study, but all the studies are currently classified as being in Phase I of woodland succession.

Herbaceous Understory: These study sites have a fair herbaceous component. The 'B' Hill study is dominated by the introduced grass species crested wheatgrass and Russian wildrye (*Elymus junceus*), but the other studies are primarily dominated by native grass species. The mean nested frequency of perennial grasses decreased in 2003 and 2008, but was moderately high in 1998 and 2013. The mean cover of perennial grass decreased from 11% in 1998 to 8% in 2003 and 2008, but increased to 10% in 2013. The annual grass species cheatgrass is very abundant on the South Creek and Above Fremont Wash, driving the mean annual grass trend (Figure 1.16). Cheatgrass remains a threat for increased fire on both of these studies. Cheatgrass is rare on the Piute Reservoir and 'B' Hill studies.

Native perennial forb species composition is generally diverse on these studies, but with low nested frequency and cover of all sampled species (Figure 1.16).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy these study sites. The mean abundance of deer pellet groups has ranged from a high of 58 days use/acre in 2008 to a low of 26 days use/acre in 2013 (Figure 1.17). The South Creek and Above Fremont Wash studies typically have the highest abundance of pellet groups.

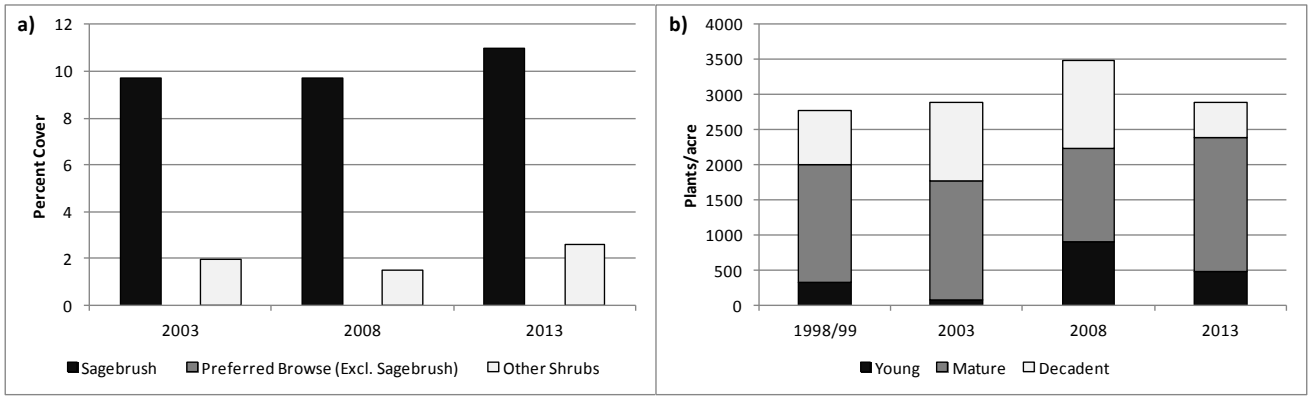


Figure 1.14: Shrub summary of the Semidesert (Wyoming Big Sagebrush) studies (n=4) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

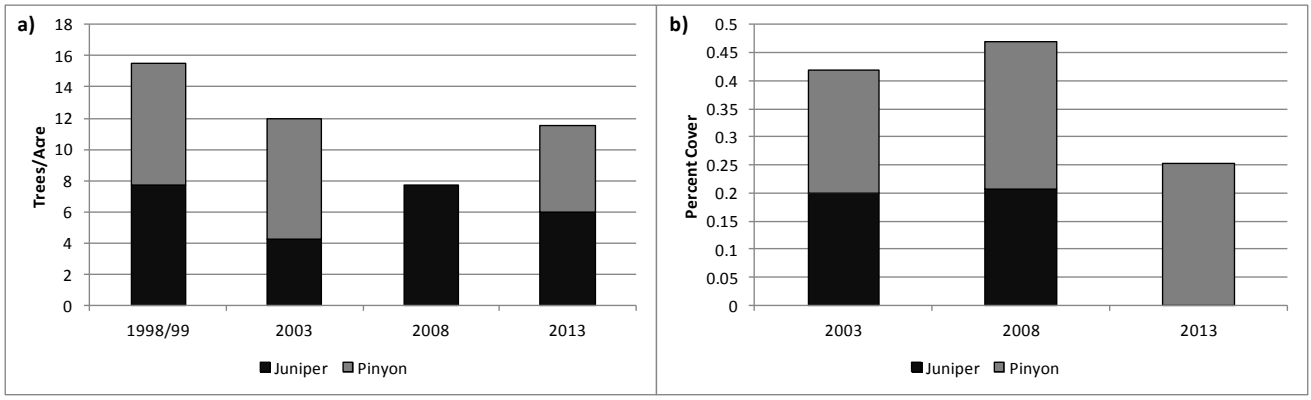


Figure 1.15: Tree summary of the Semidesert (Wyoming Big Sagebrush) studies (n=4) for WMU 22, Beaver. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

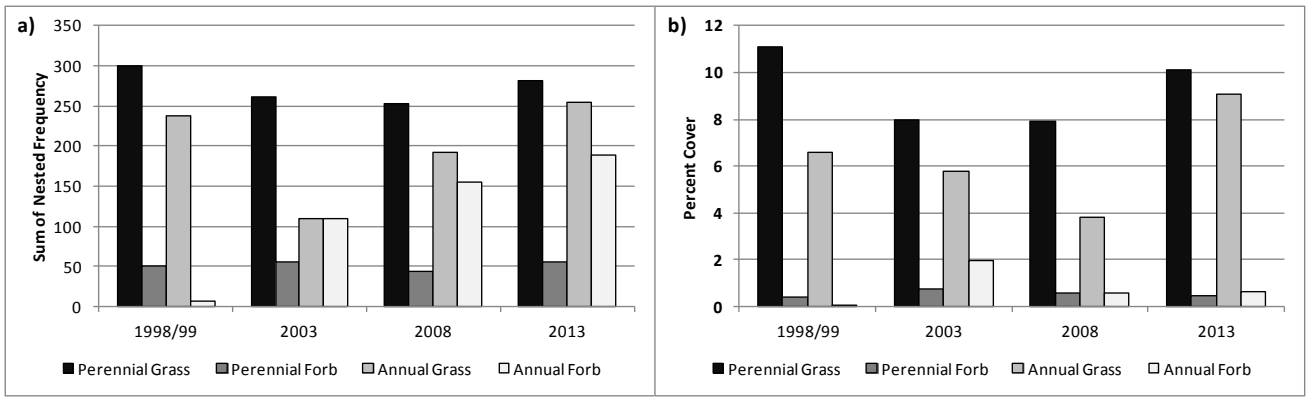


Figure 1.16: Herbaceous functional group summary of the Semidesert (Wyoming Big Sagebrush) studies (n=4) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

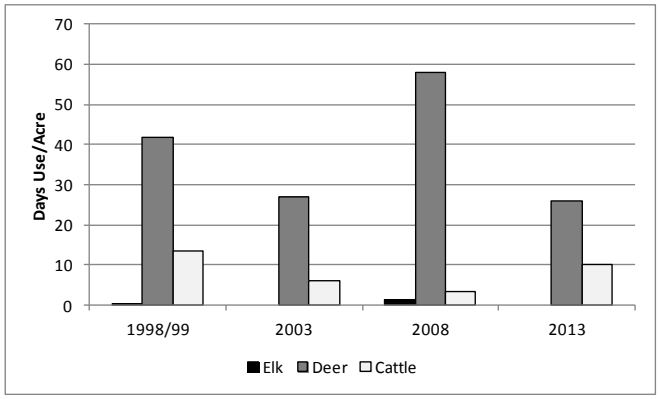


Figure 1.17: Mean pellet transect data for the Semidesert (Wyoming Big Sagebrush) studies (n=4) for WMU 22, Beaver.

Study Trend Summary (Treated/Disturbed Sites)

Bullhog

There are eight studies [Sheep Rock (22-7), Greenville Bullhog (22R-6), South Beaver Bullhog (22R-10), South Beaver Bullhog 2 (22R-12), Greenville Bench Bullhog 2 (22R-13), South Beaver Rocky Wash (22R-14), South Beaver Bullhog Year 4 (22R-15), and South Beaver Year 5 (22R-20)] that were treated with a bullhog during the report period (Table 1.7). All of the studies except the Sheep Rock study are located south of Beaver, but north of the I-15 and Highway 20 junction. The Sheep Rock study is northeast of Manderfield at the mouth of Sheep Rock Canyon. All of the studies are classified as either Upland (Mountain Big

Sagebrush) or Upland (Wyoming Big Sagebrush) ecological sites (Table 1.6). Generally, the target of the bullhog treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on all of the studies is either mountain big sagebrush or Wyoming big sagebrush. Antelope bitterbrush is also common on the Sheep Rock, Greenville Bullhog, Greenville Bench Bullhog 2, and South Beaver Rocky Wash studies. Sagebrush was being impacted by pinyon-juniper encroachment on these studies; the mean line-intercept cover of sagebrush was low on many of the sites. The mean cover of sagebrush was reduced following treatments from near 4% to just over 2%. The mean of cover of preferred browse, primarily antelope bitterbrush, increased slightly from 1% to 1.5% following treatment (Figure 1.18a). The mean density of sagebrush also decreased from 1,428 plants/acre to 793 plants/acre. However, changes in demographics of the sagebrush populations have been positive on most of the studies. Decadent plants dominated the populations prior to treatment, but decadent plants became a minor component following treatment. The recruitment of young plants was 10% or less on all studies prior to treatment, but recruitment of young plants was greater than 10% following treatment (Figure 1.18b). It is expected that with the improved recruitment and health of the sagebrush following treatment that the sagebrush will continue to increase on most of the treatment sites.

The mean density and cover of pinyon pine and Utah juniper trees was high at 280 trees/acre and 28%, respectively, prior to treatment. The mean density of pinyon-juniper trees decreased to 23 tree/acre and the mean cover decreased to 5% following treatment (Figure 1.19). Remaining density and cover is generally provided by trees that were intentionally not treated or small trees that were left standing.

Herbaceous Understory: The herbaceous component was generally lacking prior to treatment on these studies, and there was a general increase in all of the herbaceous functional groups following treatment. Perennial grass and annual forb species had the largest response increasing in mean cover from 4% to 10% and 1% to 8%, respectively. Perennial forb cover increased from 1% to 3%. Annual grass, namely cheatgrass, was rare on most study sites prior to treatment except the South Beaver Bullhog study, which had 13% cover of annual grass. Following treatment mean annual grass cover increased from 2% to 4% (Figure 1.20). Annual grass decreased on the South Beaver Bullhog to 2%, but increased substantially on the Greenville Bullhog, South Beaver Bullhog 2, Greenville Bench Bullhog 2, and South Beaver Rocky Wash studies. Cheatgrass remains a threat for increased fire on all of these studies.

Occupancy: Pellet group transect data indicates that deer primarily occupy these study sites, but elk are present on the Sheep Rock and South Beaver Rocky Wash studies. The mean abundance of pellet groups of all animals combined has been less than 17 days use/acre both prior to and following treatment (Figure 1.21).

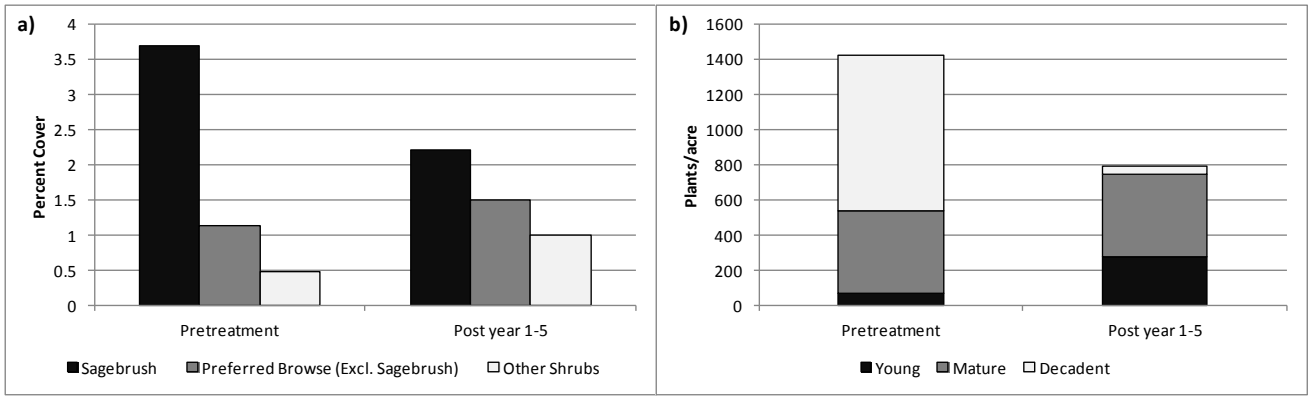


Figure 1.18: Shrub summary of the Bullhog treatment studies (n=8) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

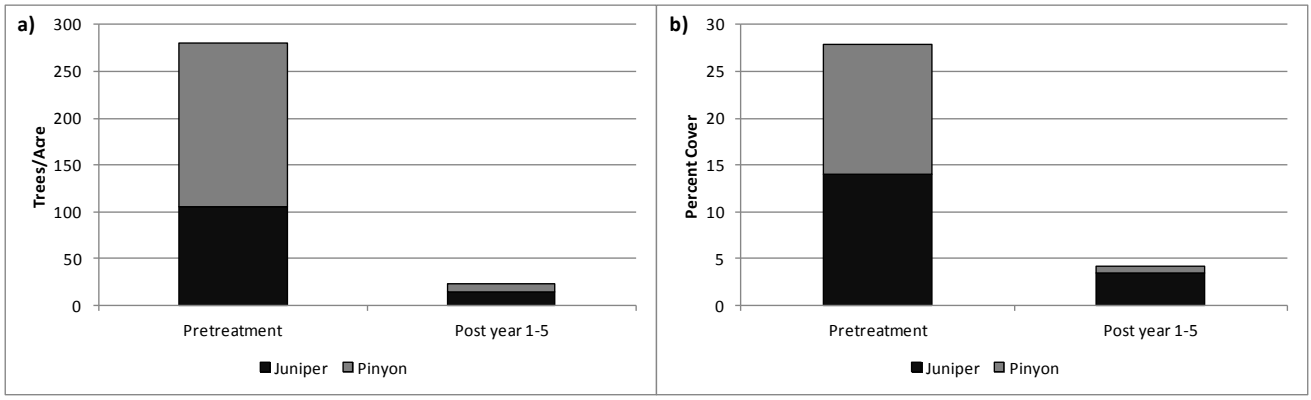


Figure 1.19: Tree summary of the Bullhog treatment studies (n=8) for WMU 22, Beaver. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

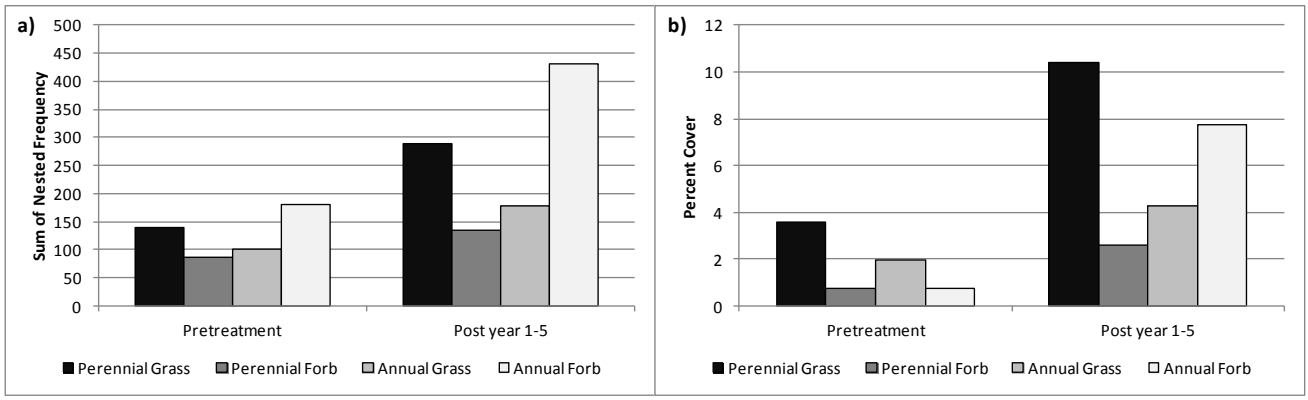


Figure 1.20: Herbaceous functional group summary of the Bullhog treatment studies (n=8) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

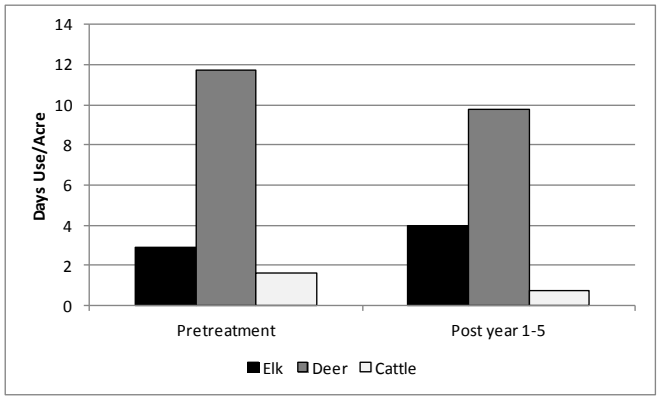


Figure 1.21: Mean pellet transect data for the Bullhog treatment studies (n=8) for WMU 22, Beaver.

Chaining

There is one study [South Beaver SITLA Chaining (22R-11)] that was treated with a chaining during the report period (Table 1.7). The study is located south of Beaver on Coyote Bench. The study is as an Upland (Wyoming Big Sagebrush) ecological site (Table 1.6). The target of the chaining treatment was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on the study is Wyoming big sagebrush, and no other preferred browse species were sampled in line-intercept cover. Sagebrush was being impacted by pinyon-juniper encroachment on this study, and the mean line-intercept cover of sagebrush was low at near 2% prior to treatment. The mean cover of sagebrush was reduced following treatments, but remained near 2% (Figure 1.22a). The mean density

of sagebrush also decreased from 1,540 plants/acre to 500 plants/acre. However, changes in demographics of the sagebrush populations have been positive on the study. Decadent sagebrush plants dominated the population prior to treatment, but decadent plants became a minor component following treatment. The recruitment of young plants was minimal prior to and following the treatment (Figure 1.22b

The mean density and cover of pinyon pine and Utah juniper trees was high at 427 trees/acre and 27%, respectively, prior to treatment. The mean density of pinyon-juniper trees decreased to 116 tree/acre and the mean cover decreased to 1% following treatment (Figure 1.23). Remaining density and cover was generally provided by small trees that survived the treatment.

Herbaceous Understory: The herbaceous component was fair prior to treatment on this study. Perennial forb and annual forb species had the largest response increasing in mean cover from 4% to 5% and less than 1% to 8%, respectively. Perennial grass cover decreased from 4% to 3%. Annual grass, namely cheatgrass, was rare on the study site prior to treatment, and decreased in nested frequency following the treatment (Figure 1.24).

Occupancy: Pellet group transect data indicates that animal presence on this site is limited. No animal use was sampled prior to treatment, but deer and elk pellets were sampled at a low abundance of 5 days use/acre following the treatment (Figure 1.25).

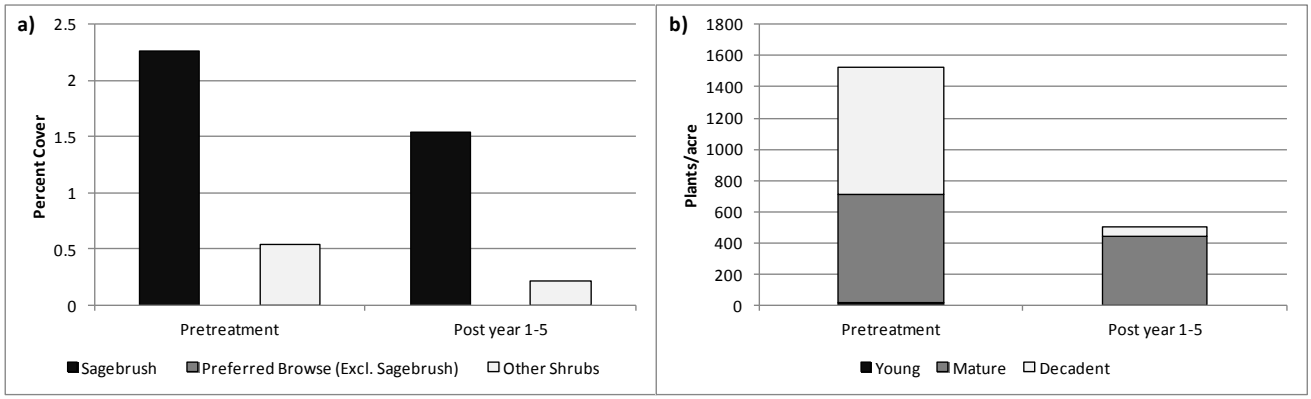


Figure 1.22: Shrub summary of the Chaining treatment study (n=1) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

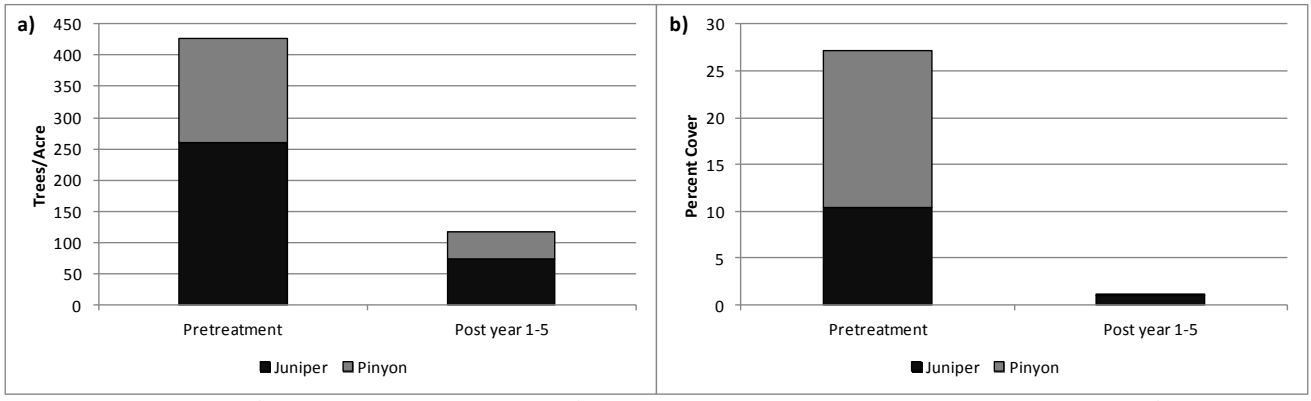


Figure 1.23: Tree summary of the Chaining treatment study (n=1) for WMU 22, Beaver. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

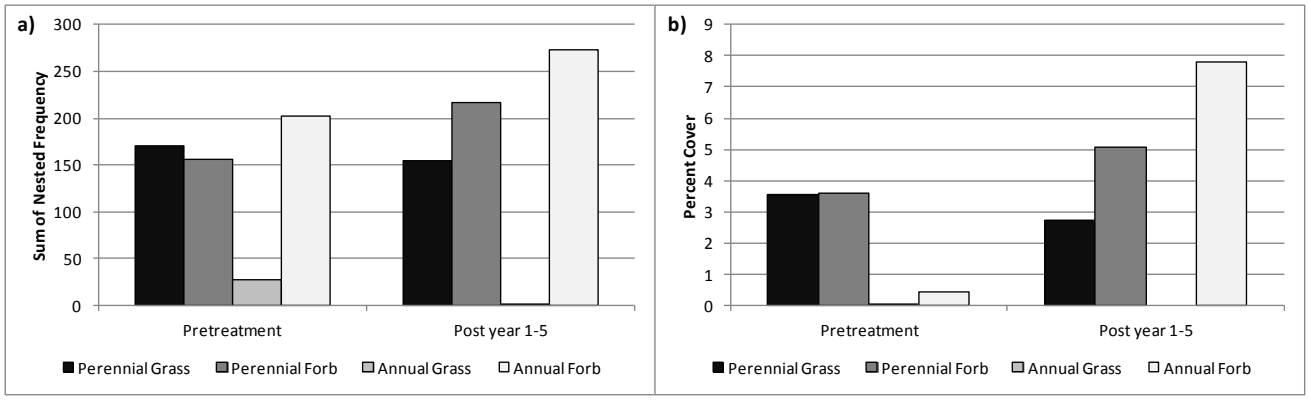


Figure 1.24: Herbaceous functional group summary of the Chaining treatment study (n=1) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

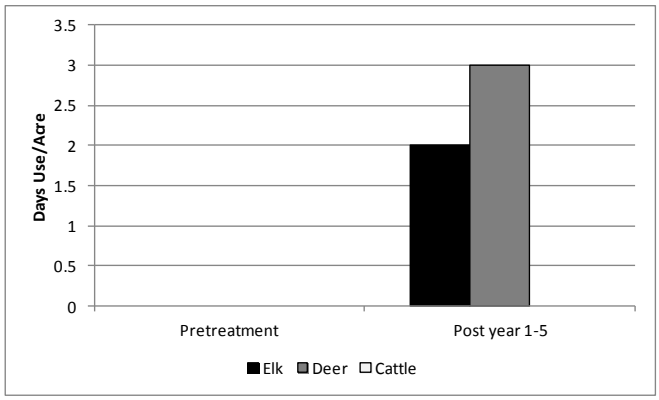


Figure 1.25: Mean pellet transect data for the Chaining treatment study (n=1) for WMU 22, Beaver.

Harrow

There are three studies [Black Mountain (22R-5), P-Hill Dixie (22R-8), and Beaver Easement Harrow (22R-17)] that were treated with a harrow during the report period (Table 1.7). The Black Mountain and Beaver Easement Harrow studies are both located on the bench just southeast of Beaver. The P-Hill Dixie study is located to the east of Circleville. The Black Mountain and Beaver Easement Harrow studies are classified as Upland (Wyoming Big Sagebrush) ecological sites and the P-Hill Dixie study is classified as a Semidesert (Wyoming Big Sagebrush) ecological site (Table 1.6). Generally, the target of the harrow treatments was to rejuvenate degraded sagebrush and increase the herbaceous understory.

Shrubs/Trees: The primary browse on all of the studies is Wyoming big sagebrush. No other preferred browse species were sampled in line-intercept cover. The mean cover of sagebrush was reduced following treatments from near 21% to just over 10% (Figure 1.26a). The mean density of sagebrush also decreased from almost 4,500 plants/acre to 3,300 plants/acre. Changes in demographics of the sagebrush populations have been positive on most of the studies. Mean decadence has decreased in the population and the mean recruitment of young plants increased following the harrow treatments (Figure 1.26b). Encroachment from pinyon pine and juniper trees has not been a major concern on these studies.

Herbaceous Understory: The herbaceous component was fair to good on the Black Mountain and Beaver Easement Harrow studies, but was generally lacking on the P-Hill study prior to treatment on these studies. All of the study sites had an herbaceous component comprised primarily of native grass and forb species. Annual grass, primarily cheatgrass, had the largest response increasing in mean cover from 2% to 18%. This increase is primarily driven by the Beaver Easement Harrow study, which increased in annual grass cover from 3% to 48% following treatment. Cheatgrass remains a substantial threat for increased fire on this study. Annual grass species are rare on the P-Hill study and are sampled at much lower cover on the Black Mountain

study. The mean perennial grass cover increased from 6% to 8% and mean perennial forb cover increased from 2% to 3%. The mean annual forb cover remained similar, but the mean sum of nested frequency decreased following treatment (Figure 1.27).

Occupancy: Pellet group transect data indicates that deer primarily occupy these study sites. The mean abundance of pellet groups for deer decreased from 36 days use/acre prior to treatment to 17 days use/acre following treatment (Figure 1.28).

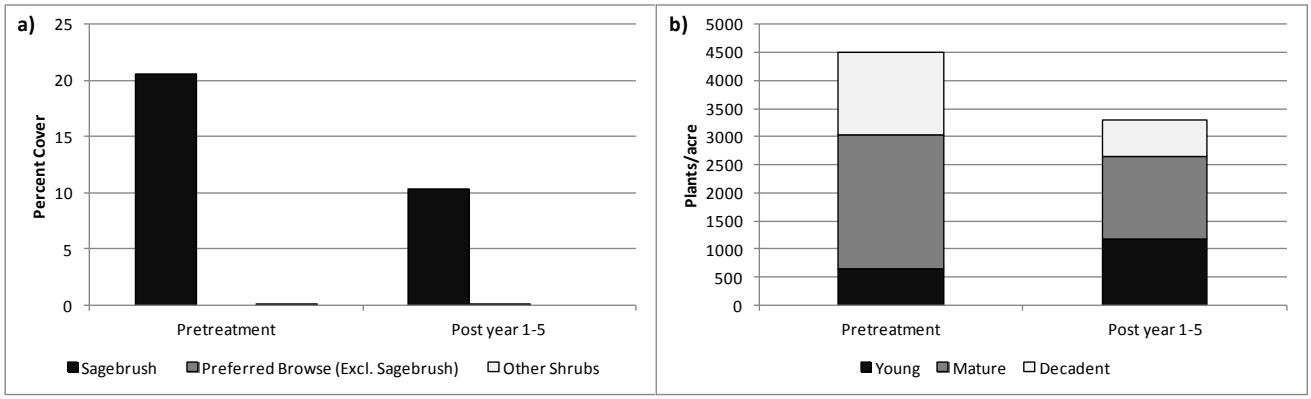


Figure 1.26: Shrub summary of the Harrow treatment studies (n=3) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

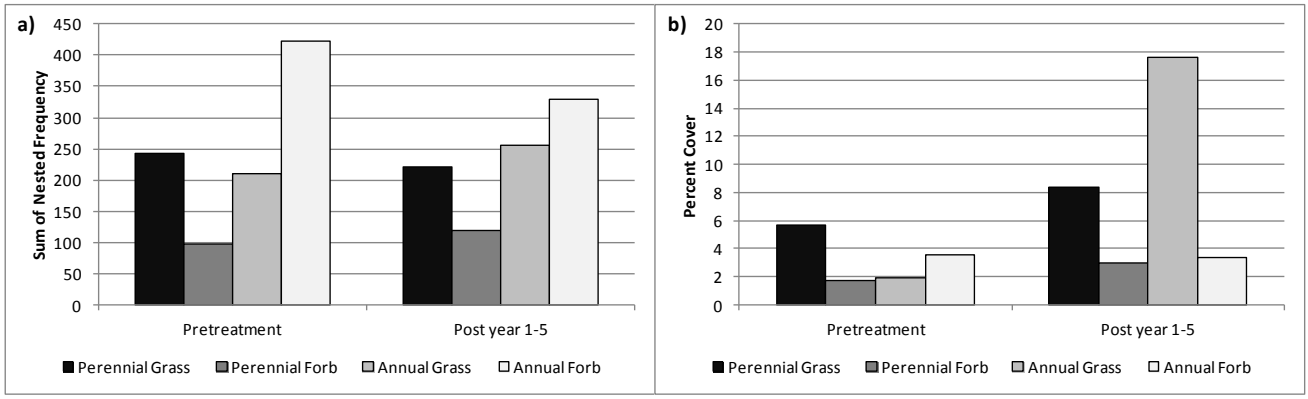


Figure 1.27: Herbaceous functional group summary of the Harrow treatment studies (n=3) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

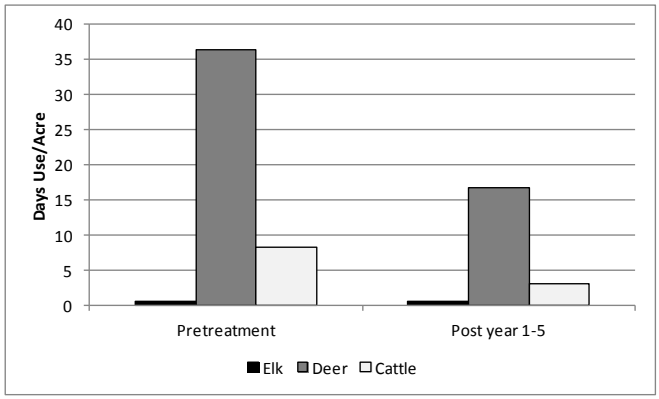


Figure 1.28: Mean pellet transect data for the Harrow treatment studies (n=3) for WMU 22, Beaver.

Lop and Scatter

There are two studies [Sulphurdale (22R-7) and Spry Sagebrush Restoration (22R-16)] that were treated with a lop and scatter during the report period (Table 1.7). The Sulphurdale study is located southeast of the I-15 and I-70 interchange, to the east of Sulphurdale. The Spry Sagebrush Restoration is located to the northwest of the junction with Highway 89 and Highway 20, to the east of Spry. The Spry Sagebrush Restoration study is classified as an Upland (Mountain Big Sagebrush) ecological site and the Sulphurdale study is classified as an Upland (Wyoming Big Sagebrush) ecological site (Table 1.6). Generally, the target of these lop and scatter treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on the Spry Sagebrush Restoration is mountain big sagebrush with a small component of antelope bitterbrush. The primary browse on the Sulphurdale study is antelope bitterbrush with a substantial component of Wyoming big sagebrush. The mean cover of sagebrush increased from near 6% prior to treatments to just over 9% following treatment. The other preferred browse species, bitterbrush, remained similar in cover following treatment (Figure 1.29a). The mean density of sagebrush remained similar following treatment, but the mean density of decadent plants decreased and the mean density of young plants increased substantially (Figure 1.29b).

The mean density and cover of pinyon pine and Utah juniper trees was moderate at 140 trees/acre and 9%, respectively, prior to treatment. The mean density of pinyon-juniper trees decreased to 19 tree/acre and the mean cover decreased to less than 1% following treatment (Figure 1.30). Remaining density and cover is generally provided by young trees that were missed in the treatment.

Herbaceous Understory: The study sites have a good herbaceous component dominated by perennial grasses. However, the dominant grass species are seeded species such as crested wheatgrass, intermediate wheatgrass, and smooth brome. Competition with these introduced grasses may limit other desirable herbaceous species. Perennial grass had the largest response increasing in mean cover from 11% to 17%. Annual forb cover and frequency decreased following treatment primarily due to decreases on the Sulphurdale study. There was little change in the mean cover of the other functional groups (Figure 1.31). Annual grass species, primarily cheatgrass, are common on the Sulphurdale study, but are rare on the Spry Sagebrush Enhancement study. Cheatgrass remains a substantial threat for increased fire on the Sulphurdale study site.

Occupancy: Pellet group transect data indicates that deer primarily occupy these study sites, with higher abundance of pellet groups typically sampled on the Sulphurdale study. The mean abundance of pellet groups for deer increased from 13 days use/acre prior to treatment to 36 days use/acre following treatment (Figure 1.32).

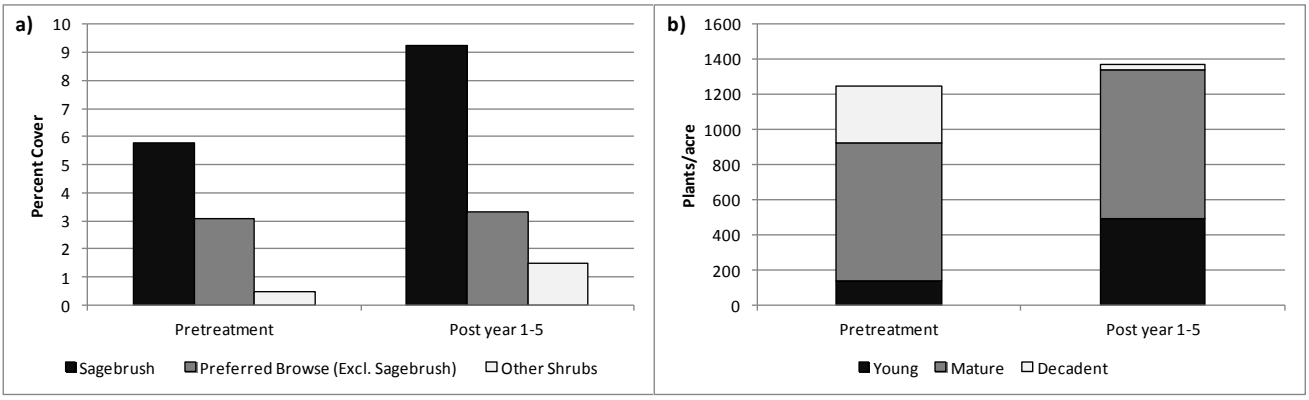


Figure 1.29: Shrub summary of the Lop and Scatter treatment studies (n=2) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

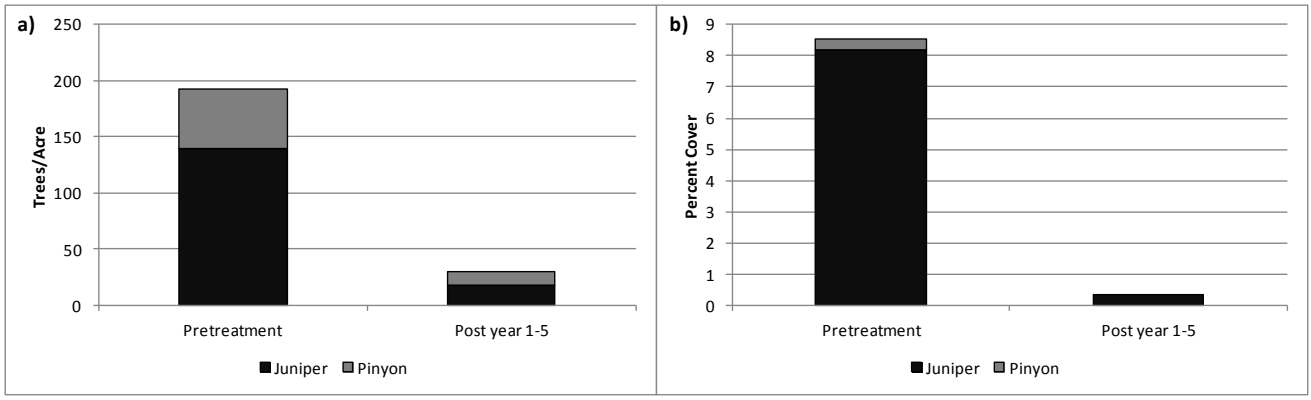


Figure 1.30: Tree summary of the Lop and Scatter treatment studies (n=2) for WMU 22, Beaver. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

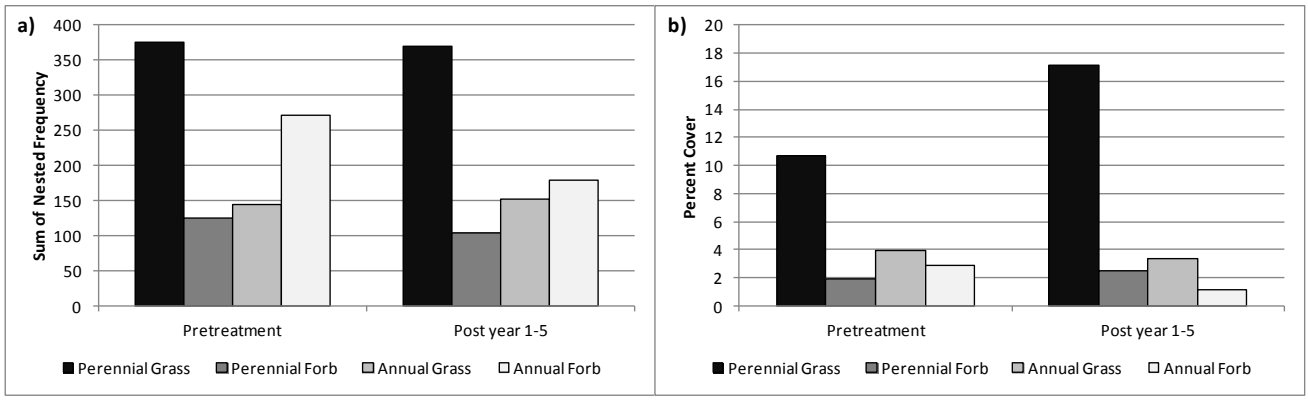


Figure 1.31: Herbaceous functional group summary of the Lop and Scatter treatment studies (n=2) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

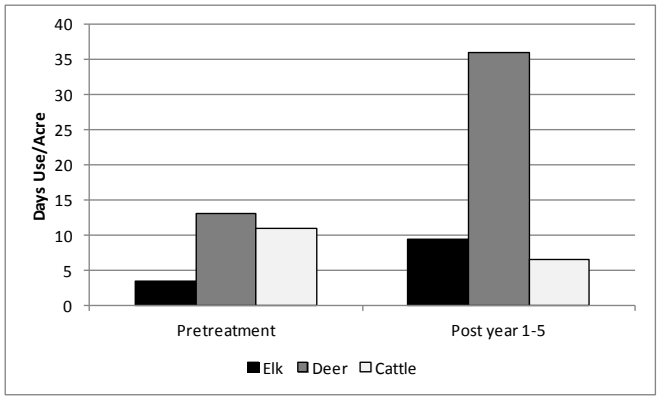


Figure 1.32: Mean pellet transect data for the Lop and Scatter treatment studies (n=2) for WMU 22, Beaver.

Wildfire

There are five studies [Muley Point (22-8), Doubleup Hollow (22-10), Big Cedar Cove (22-12), Minersville Reservoir (22-13), and Antelope Mountain (22-14)] that were burned in wildfires during the report period (Table 1.7). The Big Cedar Cove and Antelope Mountain studies burned in the Milford Flat fire in 2007; the Doubleup Hollow study burned in the Greenville fire in 2007; the Muley Point study burned in the Lee's Wash fire in 2005; and the Minersville Reservoir burned in the Minersville fire in 1998. The Muley Point and Minersville Reservoir studies are classified as Semidesert (Wyoming Big Sagebrush) ecological sites; the Big Cedar Cove study is classified as an Upland (Wyoming Big Sagebrush) ecological site; and the Doubleup Hollow and Antelope Mountain studies are classified as Upland (Mountain Big Sagebrush) ecological sites (Table 1.6).

Shrubs/Trees: The primary browse on all of the studies was either mountain big sagebrush or Wyoming big sagebrush. Antelope bitterbrush comprised nearly half of the preferred browse on the Doubleup Hollow study, but other preferred browse was rare on other study sites. Prior to disturbance, sagebrush was common on all of the study sites with a mean line-intercept of 11%. Following the wildfires, nearly all of the shrub species were removed from the studies and mean cover has remained less than 1% 6-10 years following disturbance (Figure 1.33a). Prior to disturbance the demographics of the sagebrush population was a mixture of decadent and mature plants with limited recruitment of young plants. Following the wildfires, the small populations of sagebrush have been comprised primarily of mature plants (Figure 1.33b). Encroachment from pinyon pine and Utah juniper trees was minimal on most study sites except the Doubleup Hollow study, so a summary of trees was therefore not included in this report.

Herbaceous Understory: The herbaceous component was mixed across the sites, but was generally dominated by perennial and annual grasses on all of the sites with a much lower abundance of forb species. Perennial grass species have increased substantially on the sites, increasing from 6% cover prior to disturbance to 16% cover 6-10 years after disturbance. Most of this increase is due to the seeded species crested wheatgrass and intermediate wheatgrass, which were seeded following the wildfires on many of the sites. Annual grasses, primarily cheatgrass, decreased 1-5 years following the wildfire on most of the study sites. However, annual grass cover increased to higher than pre-fire levels 6-10 years following disturbance (Figure 1.34). Cheatgrass remains a substantial threat for further fire on all of these studies.

Occupancy: Pellet group transect data indicates that deer primarily occupied these study sites prior to the fires. The mean abundance of pellet groups of wildlife species have steadily decreased following the wildfires. The abundance of cattle sign has increased on many of the sites (Figure 1.35), likely due to the increased forage available from seeded perennial grass species.

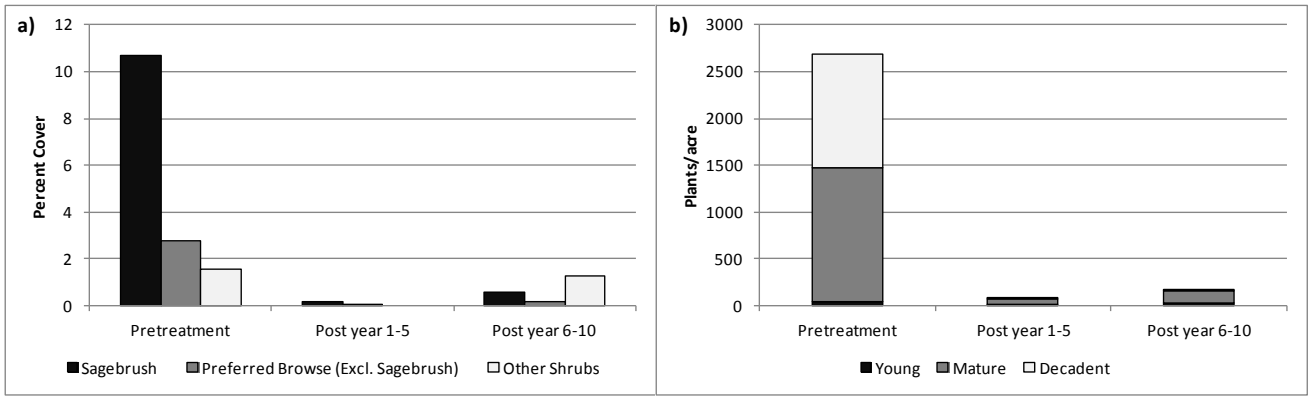


Figure 1.33: Shrub summary of the Wildfire disturbance studies (n=5) for WMU 22, Beaver. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

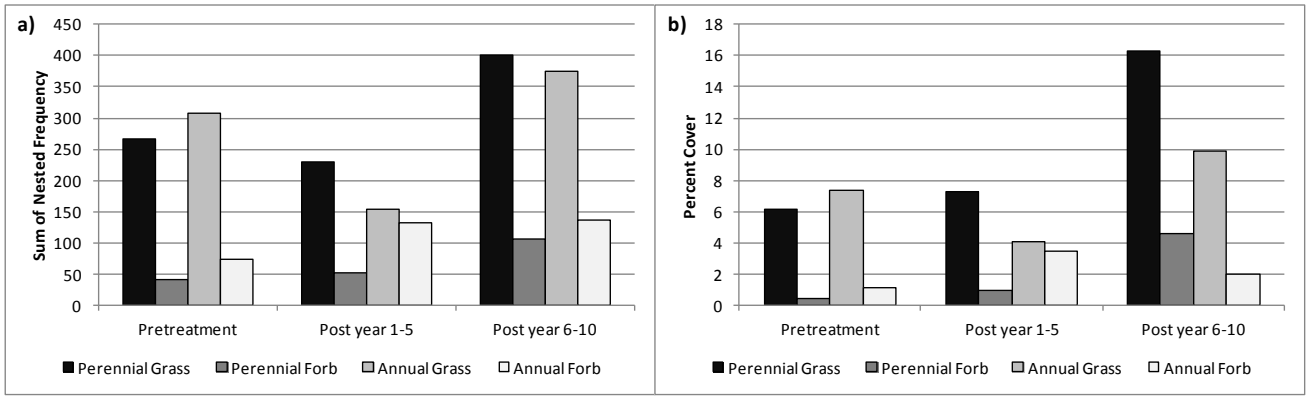


Figure 1.34: Herbaceous functional group summary of the Wildfire disturbance studies (n=5) for WMU 22, Beaver. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

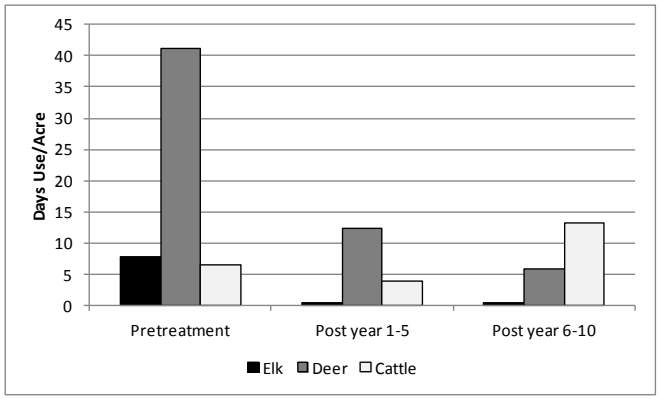
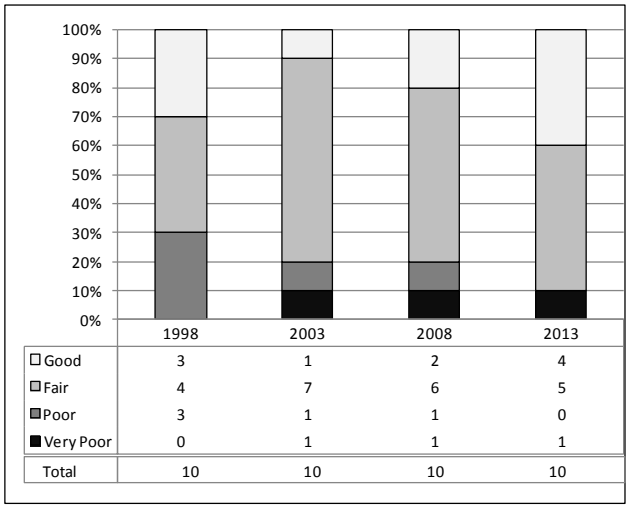


Figure 1.35: Mean pellet transect data for the Wildfire disturbance studies (n=5) for WMU 22, Beaver.

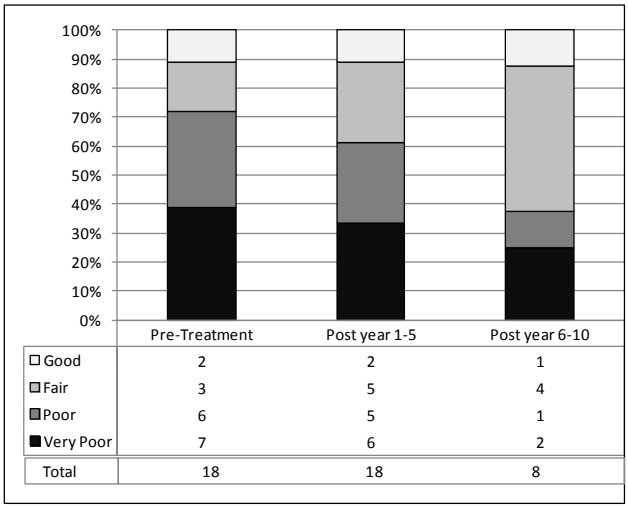
Deer Winter Range Condition Assessment

The condition of deer winter range within the Beaver management unit has generally improved on the study sites sampled since 1998. The majority of sites sampled within the unit are considered to be in fair to good condition based on the most current sample data, and the proportion of sites classified as being in poor or very poor condition has consistently decreased since 1998 (Figure 1.33 and Figure 1.34). The only undisturbed study that is currently considered to be in poor condition is the Above Fremont Wash study, which has a depleted browse component and is dominated by cheatgrass. The condition of disturbed and treated sites typically improves with increased time after disturbance on this unit with the exception of sites, which burned in wildfire. The majority of disturbed or treated study sites that ranked as being in poor or very poor condition 6-10 years after disturbance are those burned by wildfire. These study sites generally are still lacking in available browse species, and typically have increased amounts of cheatgrass. The only other treated study site considered to be in poor condition is the Sheep Rock study which has limited browse and is dominated by the introduced perennial grass crested wheatgrass (Map 1.7 and Table 1.8).



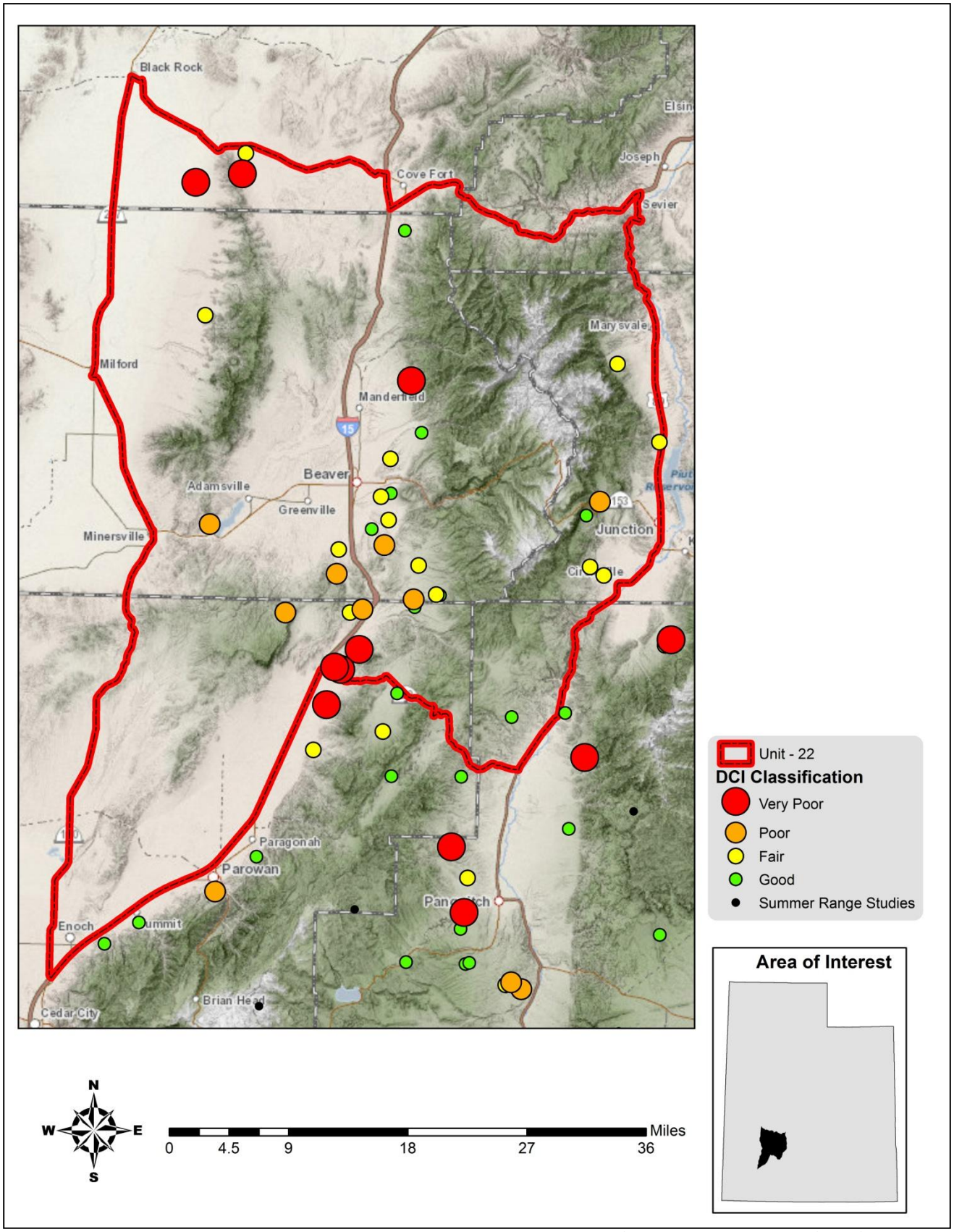
	1998	2003	2008	2013
Good	3	1	2	4
Fair	4	7	6	5
Poor	3	1	1	0
Very Poor	0	1	1	1
Total	10	10	10	10

Figure 1.36: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 22, Beaver.



	Pre-Treatment	Post year 1-5	Post year 6-10
Good	2	2	1
Fair	3	5	4
Poor	6	5	1
Very Poor	7	6	2
Total	18	18	8

Figure 1.37: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 22, Beaver.



Map 1.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 22, Beaver.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
22-1	Deer Flat	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
22-2	Piute Reservoir	None Identified		
22-3	Oak Basin	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
22-4	Wades Canyon	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
22-5	Bones Hollow	PJ Encroachment Annual Grass	High Moderate	Reduced understory shrub and herbaceous vigor. Increased fire potential.
22-6	Beaver Table	PJ Encroachment Annual Grass	Moderate Low	Reduced understory shrub and herbaceous vigor. Increased fire potential.
22-7	Sheep Rock	Introduced Perennial Grass Annual Grass	Moderate Low	Reduced diversity of desirable grass and forb species. Increased fire potential.
22-8	Muley Point	Annual Grass	High	Increased fire potential.
22-9	Rocks Reseeding	PJ Encroachment Introduced Perennial Grass	Moderate Moderate	Reduced understory shrub and herbaceous vigor. Reduced diversity of desirable grass and forb species.
22-10	Doubleup Hollow	Annual Grass	Moderate	Increased fire potential.
22-11	B Hill	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
22-12	Big Cedar Cover	Annual Grass	High	Increased fire potential.
22-13	Minersville Reservoir	Annual Grass	High	Increased fire potential.
22-14	Antelope Mountain	Annual Grass	High	Increased fire potential.
22-15	South Creek	Annual Grass	High	Increased fire potential.
22R-4	Above Fremont Wash	Annual Grass	High	Increased fire potential.
22R-5	Black Mountain	Annual Grass	Moderate	Increased fire potential.
22R-6	Greenville Bench Bullhog	Annual Grass	Moderate	Increased fire potential.
22R-7	Sulphurdale	Annual Grass	Moderate	Increased fire potential.
22R-8	P-Hill Dixie	None Identified		
22R-10	South Beaver Bullhog	Annual Grass	Low	Increased fire potential.
22R-11	South Beaver SITLA Chaining	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
22R-12	South Beaver Bullhog 2	Annual Grass	Moderate	Increased fire potential.
22R-13	Greenville Bench Bullhog 2	Annual Grass	Moderate	Increased fire potential.
22R-14	South Beaver Rocky Wash	Annual Grass	Moderate	Increased fire potential.
22R-15	South Beaver Bullhog Year 4	None Identified		
22R-16	Spry Sagebrush Restoration	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
22R-17	Beaver Easement Harrow	Annual Grass	Extreme	Increased fire potential.
22R-18	A&F Drill 1	Annual Grass Introduced Perennial Grass	Moderate Low	Increased fire potential. Reduced diversity of desirable grass and forb species.
22R-19	A&F Drill 2	Annual Grass Annual Forb	High Moderate	Increased fire potential. Reduced diversity of desirable grass and forb species.
22R-20	South Beaver Year 5	None Identified		
22R-22	South Beaver Dixie	Annual Grass Introduced Perennial Grass	Low Low	Increased fire potential. Reduced diversity of desirable grass and forb species.
22R-23	South Beaver Year 7	P-J Encroachment	High	Reduced understory shrub and herbaceous vigor.
22R-24	City Creek	P-J Encroachment	High	Reduced understory shrub and herbaceous vigor.

Table 1.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 22, Beaver. All assessments are based off of the most current sample date for each study site.

Discussion and Recommendations

Upland and Mountain (Mountain Big Sagebrush)

The higher elevation upland and mountain sites, which support mountain big sagebrush communities, are generally considered to be in good condition for deer winter range habitat on the Beaver management unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. While in generally good condition, these sites appear to be prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. In addition, introduced perennial grasses are often the dominant herbaceous component on these study sites. While providing valuable forage, these grass species can often be aggressive at higher elevation and precipitation and can reduce the prevalence and abundance of other more desirable native grass and forb species.

It is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue in these communities. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Upland (Wyoming Big Sagebrush)

The mid elevation upland Wyoming big sagebrush communities are generally considered to be in fair condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire and those studies, which have burned since 1998, are typically in poor to very poor condition. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

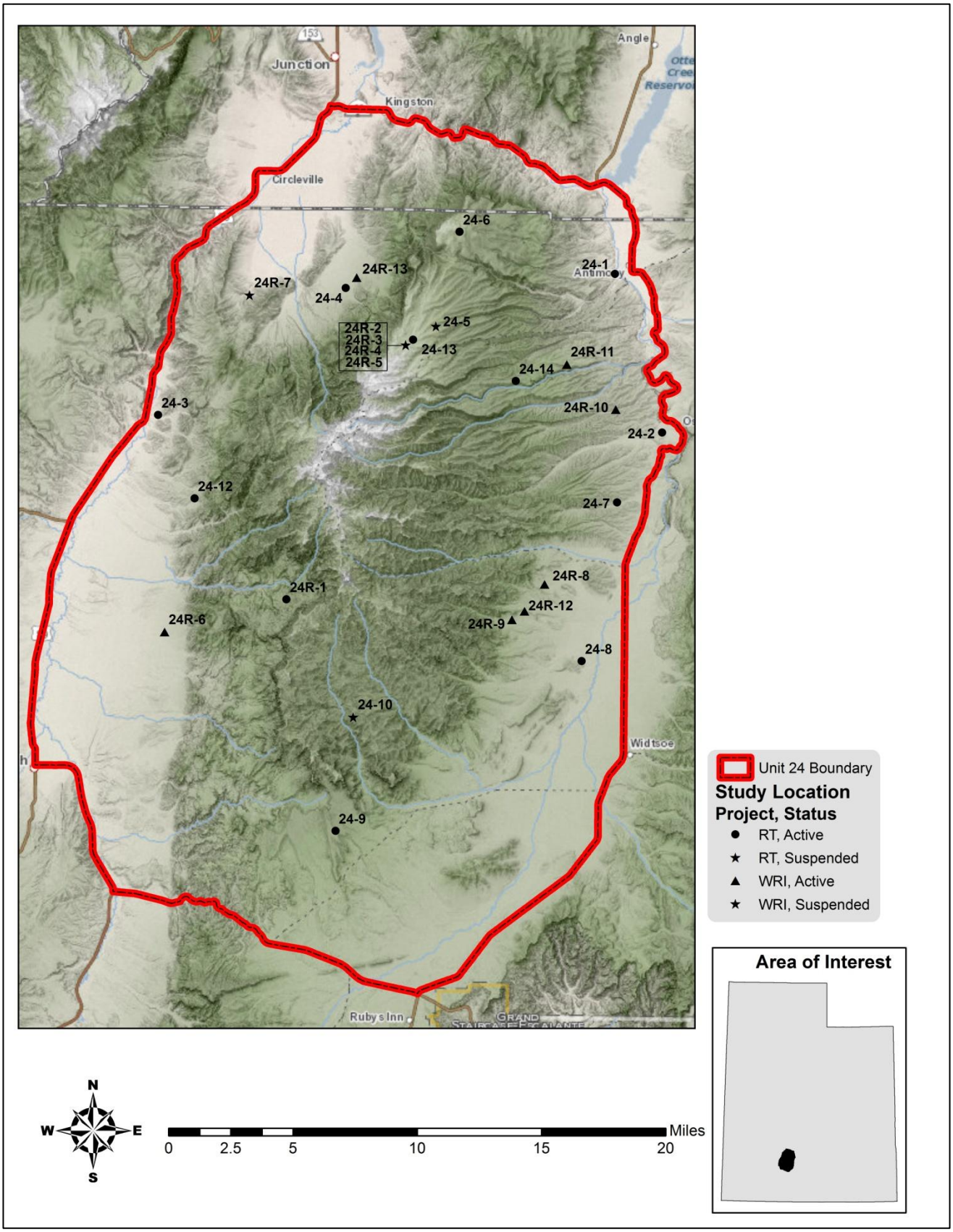
It is recommended that work to reduce pinyon-juniper encroachment should continue in these communities. Care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

Semidesert (Wyoming Big Sagebrush)

The lower elevation semidesert Wyoming big sagebrush communities that have not been disturbed are generally considered to be in fair condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire and those studies, which have burned since 1998, are in poor to very poor condition. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are susceptible to invasion from annual grass, primarily cheatgrass. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire on within these communities. Encroachment from pinyon-juniper trees is not typically an issue within these communities.

It is recommended that work to diminish fuel loads and create firebreaks should continue within these communities in order to reduce the threat of catastrophic fire. Treatments to establish and increase browse species more rapidly following wildfire should also be implemented, and treatments to increase browse species on historic fires should be considered. If a treatment to rejuvenate sagebrush occurs, care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites.

2. WILDLIFE MANAGEMENT UNIT 24 - MT. DUTTON



WILDLIFE MANAGEMENT UNIT 24 - MT. DUTTON

Boundary Description

Iron, Garfield, Piute, Beaver, and Millard counties - Boundary begins at US-89 and SR-62; south on US-89 to SR-12; east on SR-12 to the Widtsoe-Antimony Road; north on the Widtsoe-Antimony Road to SR-22; north on SR-22 to SR-62; west on SR-62 to US-89.

Management Unit Description

Geography

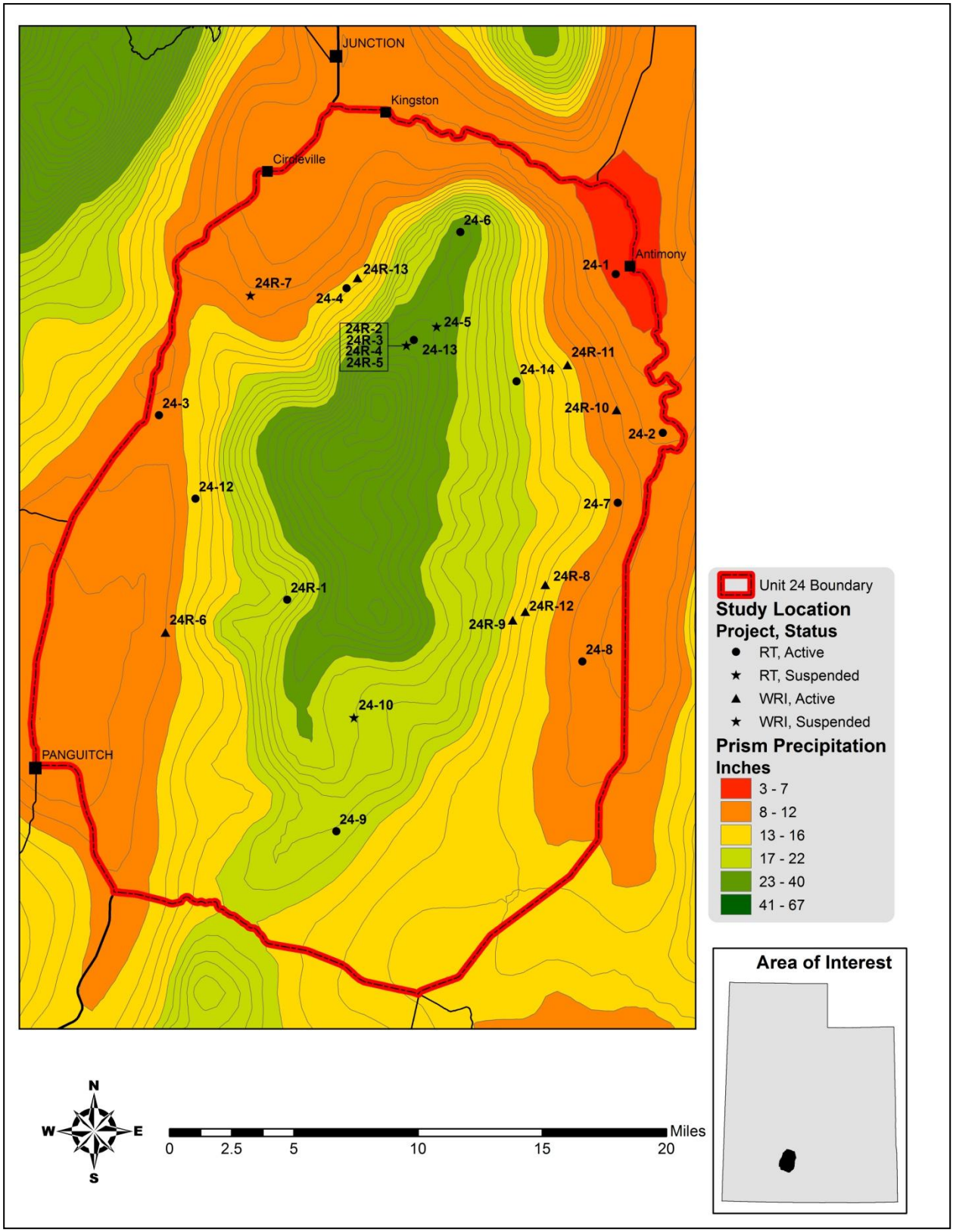
The Mt. Dutton wildlife management unit includes both the east and west slopes of Mt. Dutton and Table Mountain, which is to the south of SR-62. It also contains the Sevier River Valley east of US-89, a portion of Panguitch East Bench, and John's Valley. Mt. Dutton is the unit's highest point at an elevation of 11,036 feet near the center of the unit. The low point in the unit is about 6,000 feet in the valley near Kingston. Towns in this area include Panguitch, Circleville, Kingston, and Antimony.

The east side of Mt. Dutton is comprised of drainages, which empty into the East Fork of the Sevier River. The major tributaries are Hoodle Creek, Forest Creek, Pine Creek, Deer Creek, Cow Creek, Cottonwood Creek, Rock Creek, North Fork Prospect Creek, and South Fork Prospect Creek. The west side of Mt. Dutton is comprised of drainages, which empty into the Sevier River. The major tributaries are Sand Wash, Sanford Creek, Bull Rush Creek, and Lost Creek. East of Circleville lays Circle Valley with gradual slopes that join the steep mountain slopes and sheer cliffs of Table Mountain. The portions east and south Circleville are composed of disjunctive pinyon-juniper canyons.

Climate Data

The 30-year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 6 inches on the far northeast side of the unit to 32 inches on the high elevation peaks of Mt. Dutton. All of the Range Trend and WRI monitoring studies on the unit occur between 7-25 inch precipitations zones (Map 2.1) (PRISM Climate Group, Oregon State University, 2013)

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 2.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 2.1b) (Time Series Data, 2014).



Map 2.1: The 1981-2010 PRISM Precipitation Model for WMU 24, Mt Dutton (PRISM Climate Group, Oregon State University, 2013).

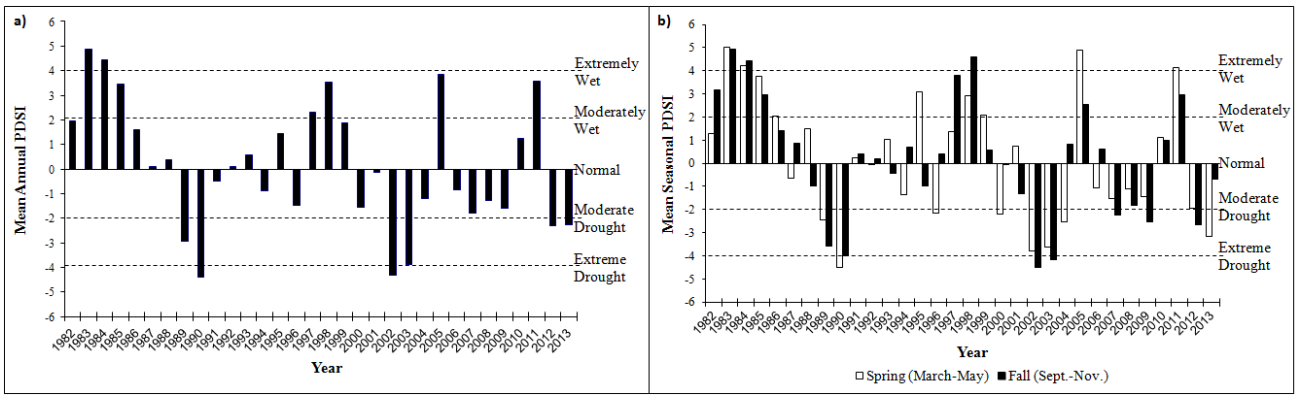


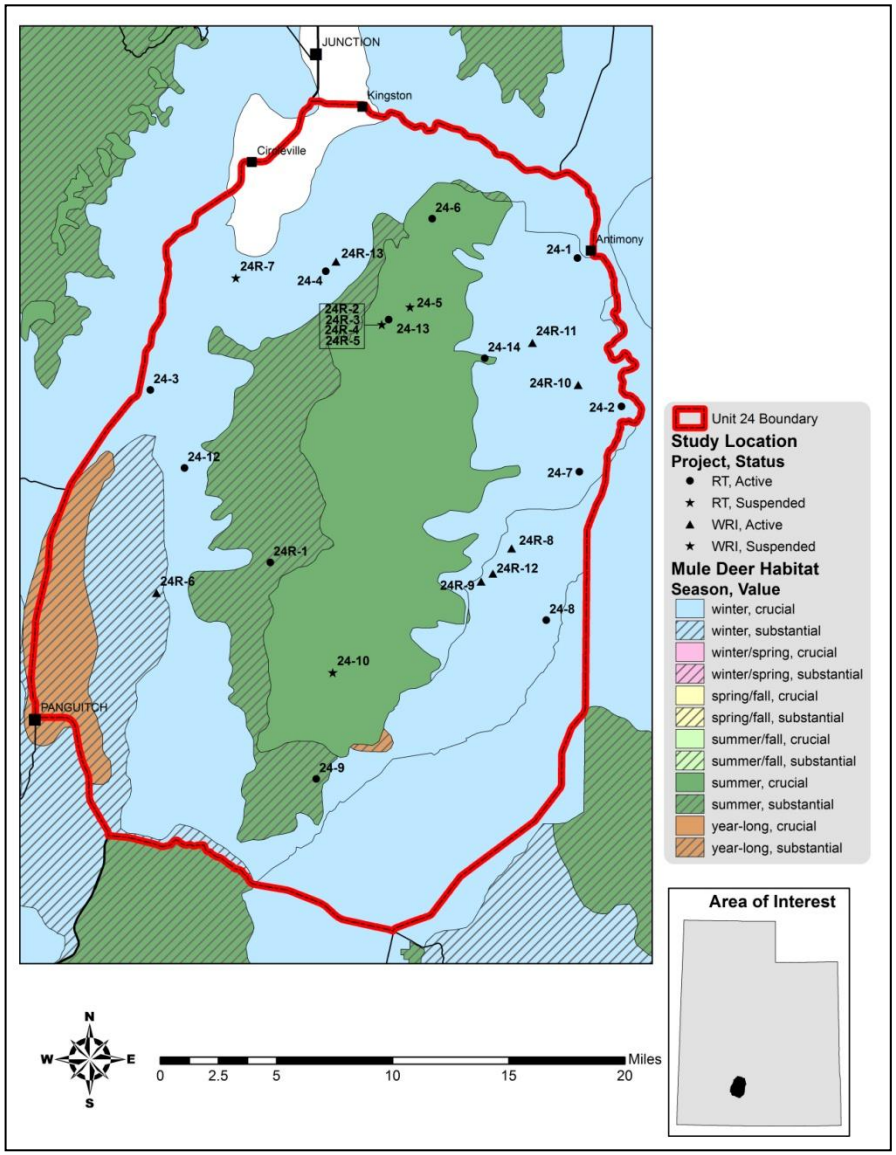
Figure 2.1: The 1982-2014l Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2014).

Big Game Habitat

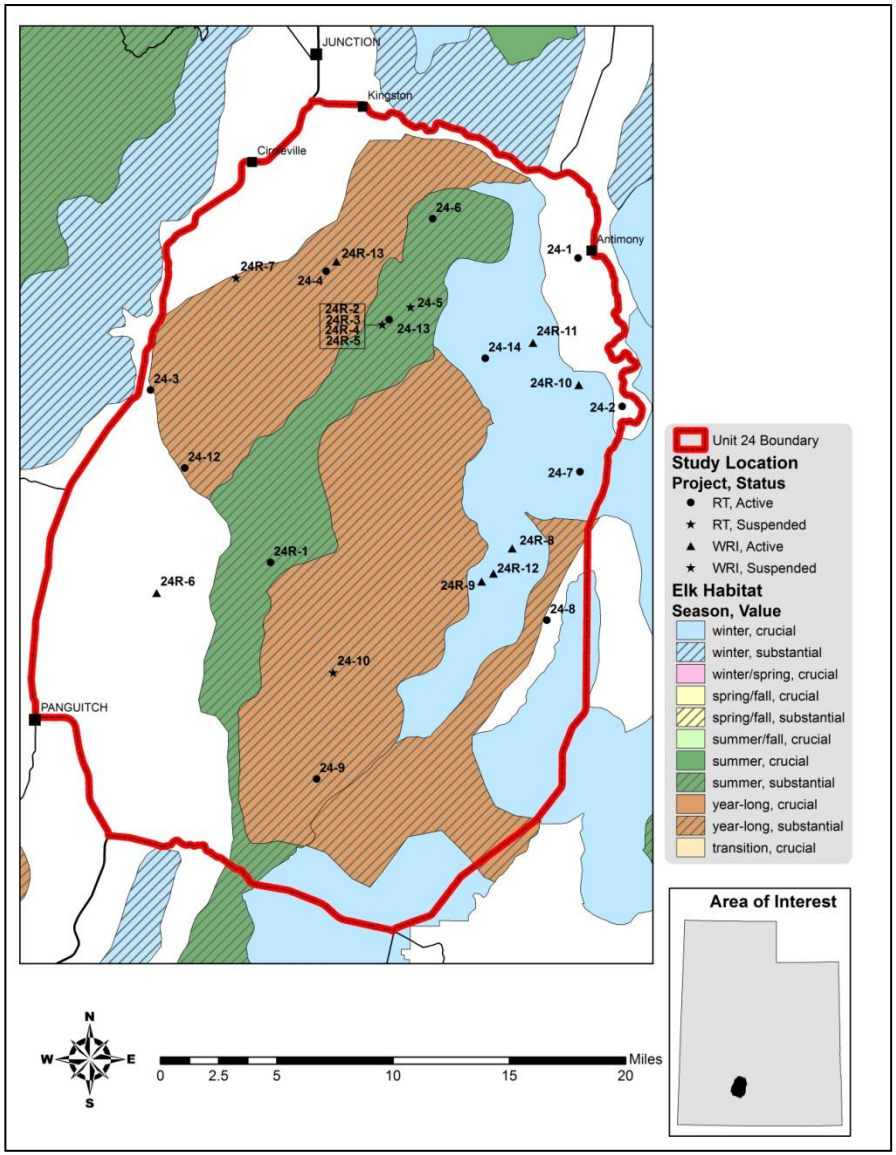
Total mule deer range in the wildlife management unit is estimated at 411,333 acres with 16,238 acres of this classified as year-long, 139,232 acres classified as summer range, 255,864 acres as winter range (Table 2.1and Map 2.2). Total elk range is estimated at 301,353 acres with 165,512 acres of this being classified as year-long range, 51,145 as summer range, and 84,696 as winter range (Table 8.3 and Map 2.3). Most of the big game winter range in this unit is located on Forest Service or BLM managed lands. Minor portions of the winter range in the unit occur on private holdings, Utah State School Trust Lands, and Division of Wildlife Resources management areas.

According to LANDFIRE Existing Vegetation Coverage models, important shrublands comprise just over 30% of the deer winter range on the unit. The majority of deer winter range is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Annual grasslands, primarily cheatgrass (*Bromus tectorum*), also make up a substantial proportion of the deer winter range and pose an increased threat for wildfire(Balch, D'Antonio, & Gómez-Dans, 2013). Other cover types comprise a minimal proportion of the deer winter range (Table 2.4).

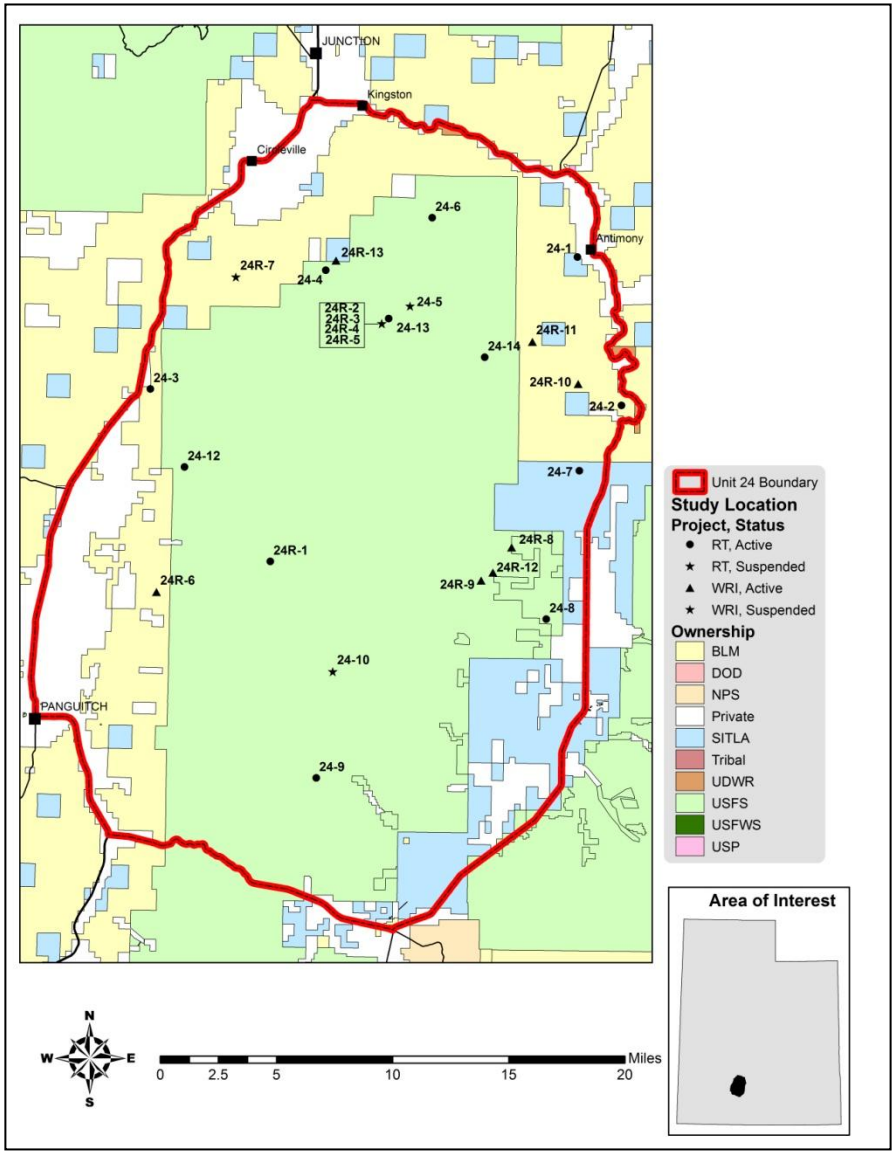
The wildlife unit encompasses Mt. Dutton with its surrounding foothills and valleys. Mt. Dutton is typical of the mesic, high mountain plateaus of southern Utah. The unit has good deer summer range that is centrally located within the unit, while much of the deer winter range surrounds the high mountain plateaus of Mt. Dutton and Table Mountain. Much of the elk range is considered year-long and centrally located on the plateaus and benches of Mt. Dutton and Table Mountain, while elk winter range is restricted to the higher benches and foothill on the eastern portion of the unit.



Map 2.2: Estimated mule deer habitat by season and value for WMU 24, Mt. Dutton.



Map 2.3: Estimated elk habitat by season and value for WMU 24, Mt. Dutton.



Map 2.4: Land ownership for WMU 24, Mt. Dutton.

	Year-Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	16,238	4%	139,232	34%	255,864	62%
Elk	165,512	55%	51,145	17%	84,696	28%

Table 2.1: Estimated mule deer and elk habitat acreage by season for WMU 24, Mt. Dutton.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	489	3%	139,214	100%	113,730	45%
BLM	1,054	7%	0	0%	77,576	30%
SITLA	81	<1%	18	<1%	35,468	14%
Private	14,614	90%	0	0%	28,332	11%
UDWR	0	0%	0	0%	728	<1%
USP	0	0%	0	0%	24	<1%
UDOT	0	0%	0	0%	4	<1%
Total	**16,238**	**100%**	**139,232**	**100%**	**255,864**	**100%**

Table 2.2: Estimated mule deer habitat acreage by season and ownership for WMU 24, Mt. Dutton.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	140,565	85%	51,145	100%	38,175	45%
BLM	14,573	9%	0	0%	15,598	18%
SITLA	7,678	5%	0	0%	22,682	27%
Private	2,691	2%	0	0%	8,226	27%
UDWR	4	<1%	0	0%	11	<1%
UDOT	0	0%	0	0%	4	<1%
Total	**165,512**	100%	**51,145**	**100%**	**84,696**	**100%**

Table 2.3: Estimated elk habitat acreage by season and ownership for WMU 24, Mt. Dutton.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Coleogyne ramosissima Shrubland Alliance	2,559.09	1%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	74,091.39	18%	
	Great Basin Semi-Desert Chaparral	4,596.89	1%	
	Inter-Mountain Basins Big Sagebrush Shrubland	9,243.38	2%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	11,435.53	3%	
	Inter-Mountain Basins Greasewood Flat	4,858.21	1%	
	Inter-Mountain Basins Montane Sagebrush Steppe	3,223.83	1%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	14,515.47	3%	
	Rocky Mountain Lower Montane-Foothill Shrubland	2,720.11	1%	
	Other Shrubland	5,423.53	1%	31.44%
Conifer	Abies concolor Forest Alliance	4888.68	1%	
	Colorado Plateau Pinyon-Juniper Woodland	153835.17	36%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	9,003.64	2%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	4,176.12	1%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	7,552.52	2%	
	Southern Rocky Mountain Ponderosa Pine Woodland	9,579.64	2%	
	Other Conifer	2,394.30	1%	45.37%
Conifer-Hardwood	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	30,754.27	7%	7.29%
Grassland	Native Grassland	5,239.39	1.24%	1.24%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	10,269.51	2.43%	2.43%
Other	Hardwood	15,452.41	3.66%	
	Riparian	6,832.85	1.62%	
	Agricultural	15,403.71	3.65%	
	Developed	6,280.20	1.49%	
	Other	7,591	1.80%	12.22%
Total		421,921.29		

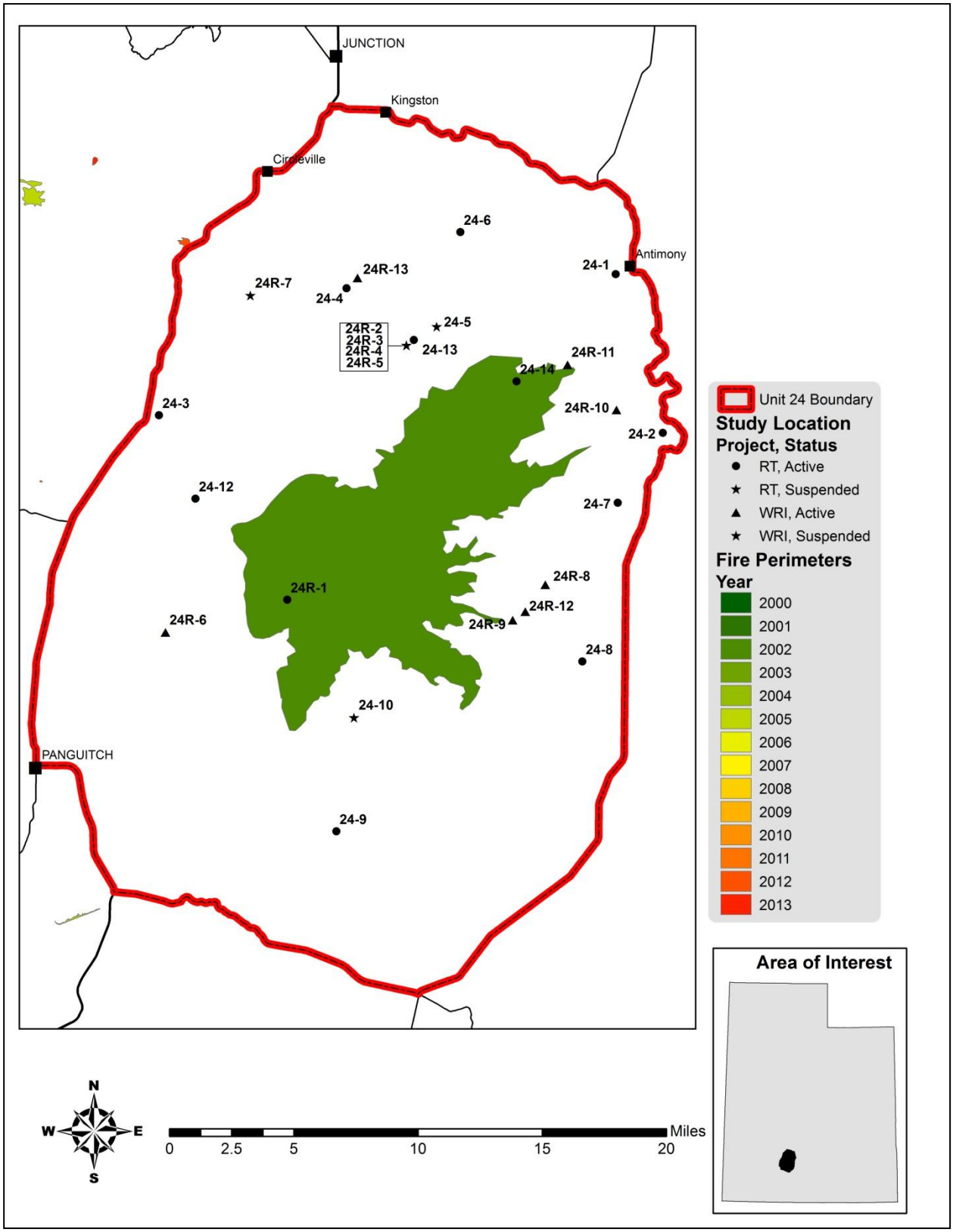
Table 2.4: LANDFIRE existing vegetation coverage (LANDFIRE: LANDFIRE 1.2.0, 2010)) of deer winter range for WMU 24, Mt. Dutton.

Limiting Factors to Big Game Habitat

Wildfire has had a substantial impact on the deer summer and winter ranges in the unit, particularly in the central portion. The Sanford fire of 2002 was a prescribed burn that went out of control and burned 60,740 acres, a significant portion of the central plateau and northeastern benches of Mt. Dutton (Map 2.5). The Sanford fire removed large expanses of important sagebrush and shrubland communities. While response to rehabilitation efforts and recovery has varied, available shrub forage on the winter range generally remains reduced from pre-fire levels. However, response to the fire within the high mountain communities with mixed conifer and aspen has generally responded with the reduction of conifer trees and the rejuvenation of aspen clones. Due to the lack of range trend and watershed restoration monitoring sites within the burn area, it is difficult to assess vegetation trends and responses to the Sanford fire.

Encroachment by pinyon-juniper woodland communities also poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 24 (Table 2.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000).

Introduced perennial grass species such as crested wheatgrass (*Agropyron cristatum*), intermediate wheatgrass (*Agropyron intermedium*), and smooth brome (*Bromus inermis*) are common on several of the study sites in the unit. These introduced species are competitive species with other native perennial grass and forb species and can potentially limit more indigenous compositions within the unit's communities.

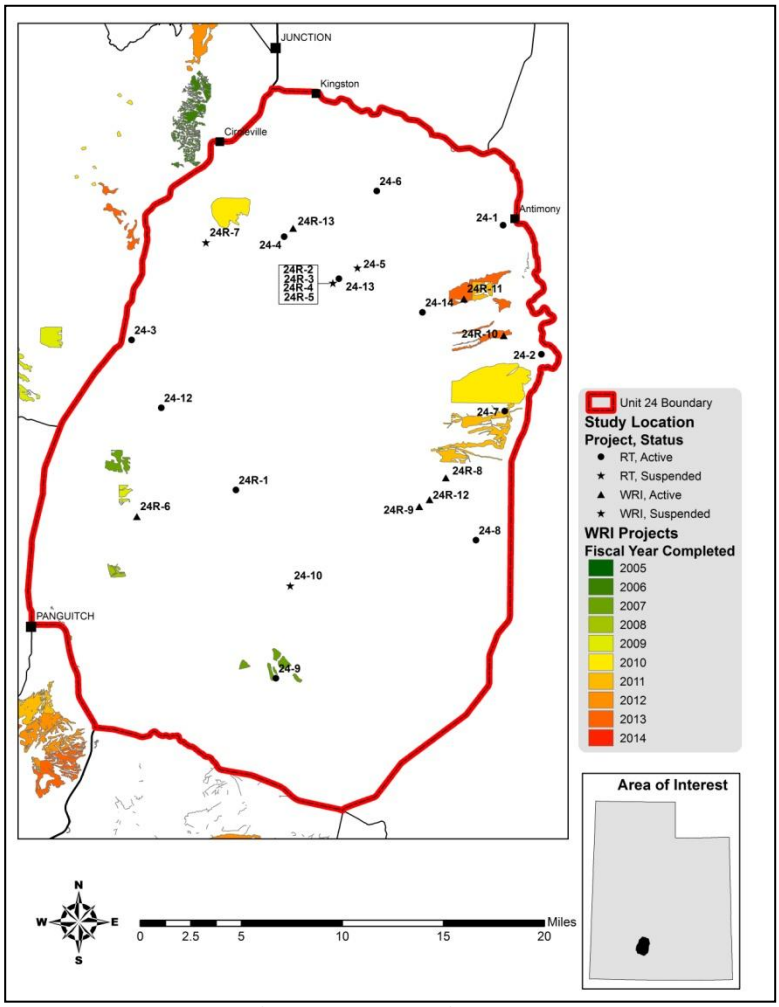


Map 2.5: Land coverage of fires by year from 2001-2013 for WMU 24, Mt. Dutton (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2014).

Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 10,875 acres have been treated within the Mt. Dutton unit since the WRI was implemented in 2004 (Map 2.6). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

The majority of treatment acreage, especially bullhog, chaining, lop-and-scatter and seeding, was done to reduce pinyon and juniper woodlands. Other common management treatments are those to rejuvenate sagebrush stands such as chaining, mowing and harrow treatments. Herbicide treatments within the unit are primarily used to control cheatgrass and restore other more desirable species (Table 2.5).



Map 2.6: WRI treatments by fiscal year completed for WMU 24, Mt. Dutton.

Treatment Action	Acres
Anchor Chain	1,672
Bullhog	1,032
Harrow	1,424
Herbicide application	28
Mower	37
Lop-and-scatter	2,385
Seeding (primary)	6,888
Seeding (secondary/shrub)	404
***Total Acres Treated**	**14,171**
Total Treatment Acres	**10,875**

Table 2.5: WRI treatment action size (acres) for WMU 24, Mt. Dutton.
*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 24 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (Table 2.6). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Monitoring studies of WRI projects have been sampled since 2004. When possible, WRI monitoring studies are established prior to treatment and sampled on a regular basis following treatment. Due to the long-term nature of the studies, many of the Range Trend and WRI studies have had some sort of disturbance or treatment prior to or since study establishment (Table 2.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
24-1	North Pole Canyon	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
24-2	Deer Creek Bench	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Semidesert Loam (Black Sagebrush)
24-3	North Bull Rush	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Semidesert Loam (Black Sagebrush)
24-4	Mud Spring Chaining	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Upland Stony Loam (Pinyon-Utah Juniper)
24-5	Suicide	RT	Suspended	‘87 ‘91 '92 ‘97	
24-6	Table Mountain	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	High Mountain Loam (Mountain Big Sagebrush)
24-7	Cow Creek	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
24-8	Prospect Seeding	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Mountain Loamy Bottom (Basin Wildrye)
24-9	Mud Spring	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Upland Shallow hardpan (Black Sagebrush-Bluegrass)
24-10	Barnhurst Ridge	RT	Suspended	‘87 ‘91 ‘97	Not Verified
24-12	Marshall Basin	RT	Active	‘87 ,‘91, ‘97 ,‘03, ‘08,‘13	Upland Stony Loam (Mountain Big Sagebrush)
24-13	Jones Corral	RT	Active	‘03, ‘08,‘13	High Mountain Loam (Mountain Big Sagebrush)
24-14	Pine Canyon	RT	Active	‘13	Mountain Shallow Loam (Mountain Big Sagebrush)
24R-1	Sanford	RT	Active	‘98 ‘03, ‘08,‘13	High Mountain Loam (Aspen)
24R-2	Jones Corral Cattle Exc.	RT	Suspended	‘98	Not Verified
24R-3	Jones Corral Outside	RT	Suspended	‘98	Not Verified
24R-4	Jones Corral Wildlife Exc.	RT	Suspended	‘98	Not Verified
24R-5	Jones Corral Total Exc.	RT	Suspended	‘98	Not Verified
24R-6	Panguitch East Bench Harrow	WRI	Active	‘04, ‘07, ‘12	Not Verified
24R-7	Horse Valley Burn	WRI	Suspended	‘05	Not Verified
24R-8	Johns Valley	WRI	Active	‘11	Not Verified
24R-9	Johns Valley 2	WRI	Active	‘12	Not Verified
24R-10	Antimony Lop and Scatter	WRI	Active	‘12	Not Verified
24R-11	Antimony PJ Reduction	WRI	Active	‘12	Not Verified
24R-12	Johns Valley 3	WRI	Active	‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
24R-13	Circleville	WRI	Active	‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)

Table 2.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 24, Mt. Dutton.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
24-4	Mud Springs Chaining	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Lop and Scatter		2003-2008		
24-6	Table Mountain	Prescribed Fire		Prior to 1987		
7	Cow Creek	Disc		Prior to 1987		
		Rangeland Drill		Prior to 1987		
		Lop and Scatter	Cow and Cottonwood Creek Lop and Scatter	Nov. 2011	2100	1794
24-8	Prospect Seeding	Disc		1968		
		Seed Unknown		1968		
24-9	Mud Spring	1-way Dixie Harrow	Sevier Plateau Dixie Harrow	Fall 2006	500	461
		Seeding	Sevier Plateau Dixie Harrow	Fall 2006	500	461
24-12	Marshall Basin	Chain Unknown		Fall 1984	900	
		Seed Unknown		Fall 1984	900	
		Wildfire		1996		
24-14	Pine Canyon	Prescribed Fire	Sanford	2002	60740	
24R-1	Sanford	Prescribed Fire	Sanford	2002	60740	
		Seed Unknown		2002		
24R-6	Panguitch East Bench Harrow	1-way Dixie Harrow	Panguitch East Bench	Oct. 2004	300	PDB
		Broadcast Before	Panguitch East Bench	Oct. 2004	300	PDB
		Aerial After	Panguitch East Bench	Dec. 2004	300	PDB
24R-8	Johns Valley	Chain Unknown		Historic	7685	
		Seed Unknown		Historic	7685	
		Bullhog	2012 John's Valley Sage Steppe restoration	2011		2055
24R-9	Johns Valley 2	Chain Unknown		Historic	7685	
		Seed Unknown		Historic	7685	
		Bullhog	Johns Valley Sage-steppe Restoration II (& III)	2012		2400 & 2677
24R-10	Antimony Lop and Scatter	Lop and Scatter	Antimony Fuels Reduction and Habitat improvement	Summer 2012	586	2597
		Chain Unknown	Antimony Fuels Reduction and Habitat improvement	2013		2597
24R-11	Antimony PJ Reduction	Bullhog	Antimony PJ reduction and riparian improvement (phase V)	Fall 2012	1005	2239
		Aerial Before	Antimony PJ reduction and riparian improvement (phase V)	Fall 2012	1005	2239
24R-12	Johns Valley 3	Bullhog	Johns Valley Sage-steppe Restoration III	Winter 2013/2014	1100	2677
24R-13	Circleville	2-way Ely Chain	Circleville Vegetation Enhancement	2013	460	2706
		Aerial Before	Circleville Vegetation Enhancement	2013	460	2706

Table 2.7: Range trend and WRI studies known disturbance history for WMU 24, Mt. Dutton.

Study Trend Summary (Undisturbed Sites)

High Mountain (Mountain Big Sagebrush)

There are two studies [Table Mountain (24-6) and Jones Coral (24-13)] classified as High Mountain (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 2.6). Both studies occur on the northern summits of Mt Dutton. The Table Mountain study is located on Bear Flat, which is part of the Sevier Plateau and is the major formation that forms Table Mountain, and at the top of Pole Canyon. The Jones Coral study is located on a more centralized high mountain valley north of the Jones Coral Guard Station.

Shrubs/Trees: The Jones Coral study site has a scarce amount of browse species found on the site and this site drives the downward trend. The lack of mountain big sagebrush may be due to the high amounts of perennial grasses and forbs that form a dense sod across the site. The primary browse on the Table Mountain study is mountain big sagebrush (*Artemisia. tridentata* ssp. *vaseyana*) intermixed with mountain snowberry (*Symphoricarpos oreophilus*). Other preferred browse species are common on the site, but occur at much lower cover than the sagebrush species. The mean line-intercept cover of sagebrush is good on these sites ranging from 10% in 2003 to near 15% in 2013%. The mean cover of sagebrush has varied since 2003, but has generally increased and has recovered from a prescribed fire that occurred prior to site establishment in

1987. The mean cover of other preferred browse species has ranged from near 6% to 13%, but with a slight increase in 2008 (Figure 2.2a). The average height of the mountain big sagebrush has decreased and has ranged from approximately 2 feet to 1.5 feet, making browse unavailable through much of the winter months. Since 1997, the demographics of the sagebrush population have transitioned from a young population to a more mature population, but there was an increase in young plants in 2008. Decadent plants have remained a minor component on the Table Mountain study. The density of mountain big sagebrush has generally increased from 1997 to 2013; however, density has varied widely over that same duration (Figure 2.2b).

Conifer encroachment is likely not a significant factor on the High Mountain (Mountain Big Sagebrush) ecological sites. However, Douglas fir (*Pseudotsuga menziesii*) is present on the Table Mountain study, but not significant enough to be captured using current methodologies. Although conifer encroachment may not be a considerable concern on the study sites themselves, repeat photographs show a considerable presence of young to mature conifer trees within the surrounding aspen stands that will likely lead to successive replacement and a decrease in the surrounding understory diversity.

Herbaceous Understory: Both Table Mountain and Jones Coral studies have a good herbaceous component dominated by perennial grasses with the shared dominant species being Letterman needlegrass (*Stipa lettermanii*). However, the seeded species smooth brome (*Bromus inermis*) has a dominant presence on the Jones Coral site and is often considered aggressive at higher elevation and precipitation. Competition with this introduced grass may limit other desirable herbaceous species. Numerous native species also occur on the sites, but at much lower cover and frequencies. Mean nested frequencies of perennial grasses have fluctuated slightly, but have remained relatively high since 1997 (Figure 2.3a). The mean cover of perennial grass has remained stable, ranging from 19% to 21% since 1997 (Figure 2.3b). Annual grass species are absent on both study sites.

Native perennial forb species composition is moderately diverse with moderately high average nested frequencies and covers. The mean nested frequencies and covers of perennial forb species have increased from 480 to 804 and 16% to 20%, respectively since 1997 (Figure 2.3).

Occupancy: Pellet group transect data indicates that elk predominately occupy these studies. The mean abundance of elk pellet groups has ranged from a high of 61 days use/acre in 1997 to a low of 16 days use/acre in 2013. The mean abundance of deer pellet groups has ranged from a high of 53 days use/acre to a low of 6 days use/acre in 2013. Deer occupancy is generally higher on the Table Mountain study. The mean abundance of livestock sign from cattle has been low to moderate since 1997. Cattle occupancy is higher on the Jones coral study site and is the main driver of the trend (Figure 2.4).

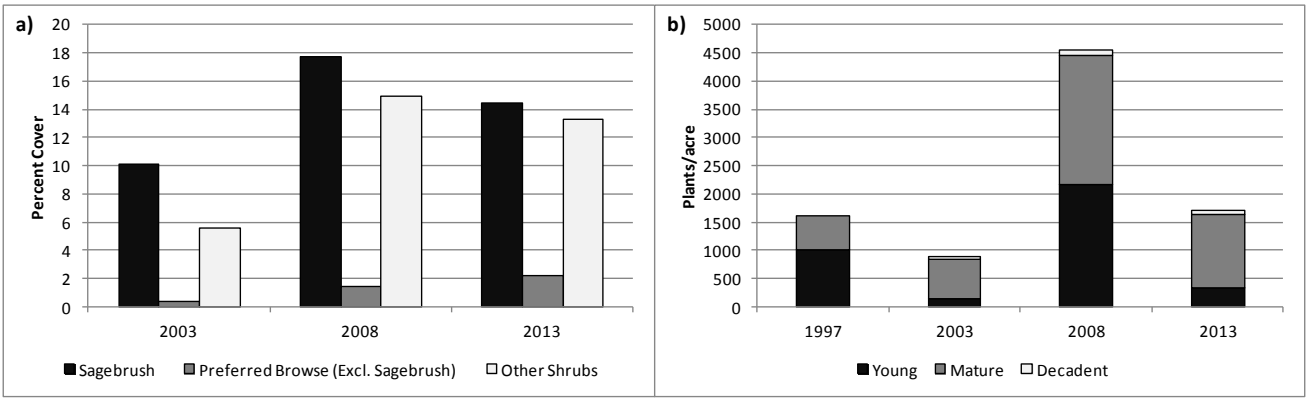


Figure 2.2: Shrub summary of the High Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 24, Mt.Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

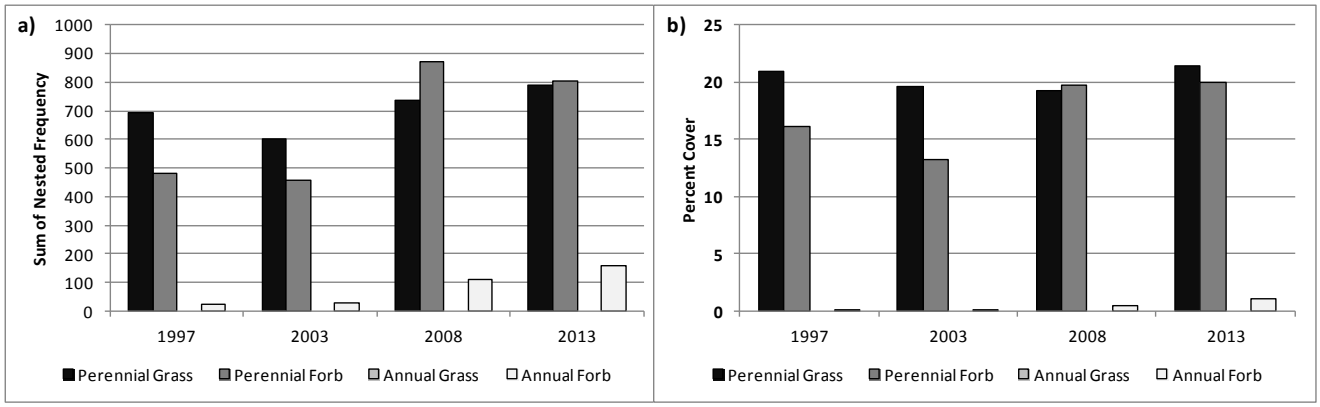


Figure 2.3: Herbaceous functional group summary of the High Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

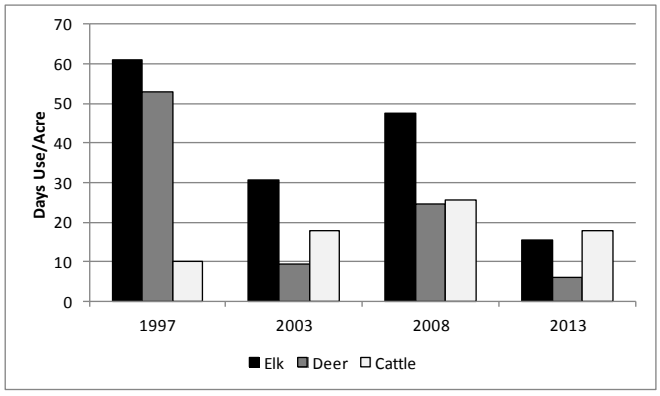


Figure 2.4: Mean pellet transect data for the High Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 24, Mt. Dutton.

Mountain (Basin Wildrye)

There is one study [Prospect Seeding (24-8)] classified as a Mountain (Basin Wildrye) ecological site that remained undisturbed over the report period (Table 2.6). The study is located in John's Valley on the southeast end of Mt. Dutton.

Shrubs/Trees: The primary browse on the Prospect Seeding study is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). The mean line-intercept cover of sagebrush has steadily increased on this site ranging from less than 1% in 2003 to near 3% in 2013. The average height of the Wyoming big sagebrush has remained less than 1.5 feet, making browse moderately available through much of the year in mild winters. The demographics of the sagebrush population have been generally comprised of mature plants. However, the number of decadent plants was substantially higher in 2003 and comprised nearly all of the sagebrush population. Recruitment of young sagebrush plants has remained below10% of the population most sample years since 1997, but was higher in 2008 at 17% of the sagebrush population (Figure 2.5b).

Encroachment from Utah juniper trees is not a concern for the site.

Herbaceous Understory: The study site has a good herbaceous component comprised mainly of perennial grass. However, the dominant grass species is the seeded species crested wheatgrass (*Agropyron cristatum*) and other herbaceous species are limited on the site. Competition with this introduced grass may limit other desirable herbaceous species. Mean nested frequency of perennial grasses has fluctuated, but has remained relatively high most sample years since 1997. There was a marked decrease in the mean nested frequency of perennial grasses in 2003 (Figure 2.6a). The mean cover of perennial grass decreased markedly from 12% in 1997 to under 4% in 2003, but increased to 16% and 12% in 2008 and 2013, respectively (Figure 2.6b). Annual grass species are absent on the site.

Native perennial forb species composition is lacking on the site with low nested frequency and cover of all sampled species (Figure 2.6).

Occupancy: Pellet group transect data indicates that cattle predominately occupy this study. The mean abundance of elk pellet groups has precipitously decreased since 1997 with a high at 48 days use/acre in 1997 to absent in 2013. The abundance of deer and pronghorn pellet groups has remained low since 1997. The abundance of livestock sign from cattle has varied from high abundance to moderate abundance since 1997 with a high at 64 days use/acre in 1997 to a low of 23 days use/acre in 2013 (Figure 2.7).

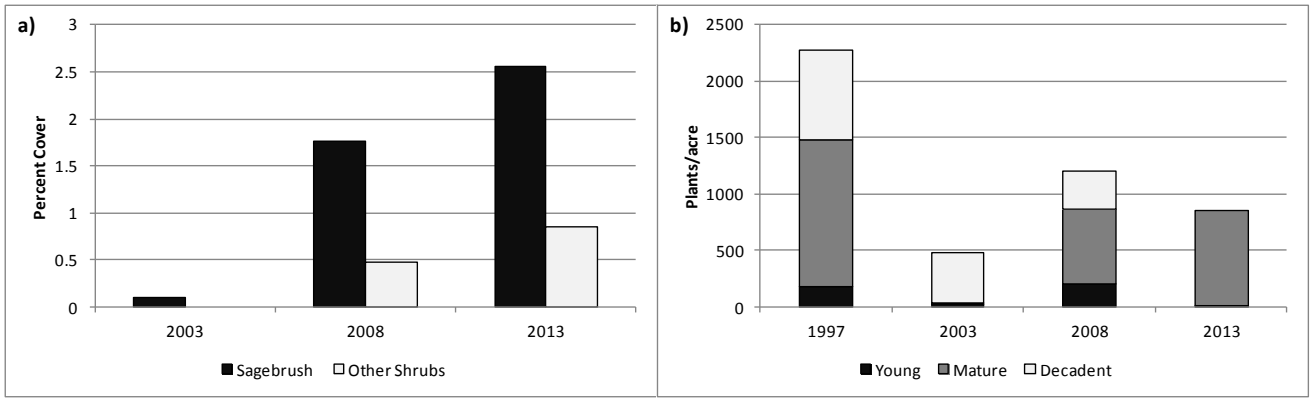


Figure 2.5: Shrub summary of the Mountain (Basin Wildrye) study (n=1) for WMU 24, Mt. Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

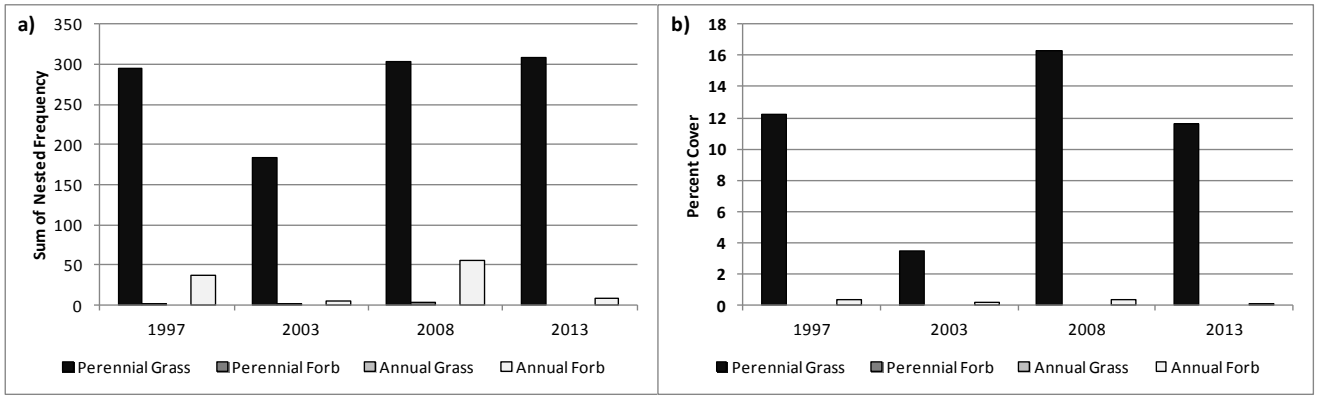


Figure 2.6: Herbaceous functional group summary of the Mountain (Basin Wildrye) study (n=1) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

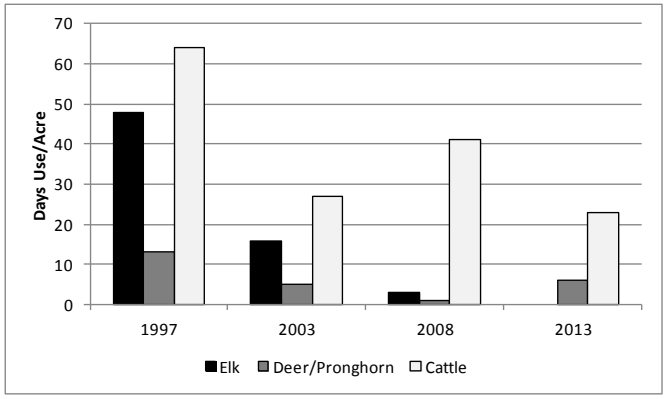


Figure 2.7: Mean pellet transect data for the Mountain(Basin Wildrye) study (n=1) for WMU 24, Mt. Dutton.

Upland (Mountain Big Sagebrush)

There is one study [Marshall Basin (24-12)] classified as Upland (Mountain Big Sagebrush) ecological site that remained undisturbed over the report period (Table 2.6). The Marshall Basin study is located northeast of Bear Valley Junction (SR 20 and US 89) on an upper bench at the mouth of Marshall Canyon.

Shrubs/Trees: The primary shrub species on the site is the increaser species rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *hololeucus*). The mean line-intercept cover of shrub species, other than preferred browse, is comprised mainly of rubber rabbitbrush, which has remained near 3% since 2003. The mean line-intercept cover from mountain big sagebrush has been minimal to absent since 2003. In 1997 and 2003, the sagebrush sampled was represented by one plant, which equates to about 20 plants/acre. The demographic of sagebrush transitioned from mature to decadent over the same sample period. As of 2008, sagebrush plants are still present on the site but density is no longer measurable using current sampling techniques (Figure 2.8b).

Encroachment from pinyon pine and Utah juniper trees is not a current concern for the Marshall Basin study. Due to the study having pinyon and juniper trees in the past, the site does have potential for future reestablishment of pinyon-juniper trees and is currently considered to be in Phase I of Woodland Succession.

Herbaceous Understory: The herbaceous understory is dominated primarily by the perennial grass species crested wheatgrass. Mean nested frequency of perennial grasses has generally increased since 2003, but decreased considerably in 2008. The mean cover of perennial grass decreased from 12% in 1997 to approximately 8% in 2003 and 2008, but increased to 18% in 2013. The annual grass species cheatgrass has remained low in mean nested frequency and cover since 1997. However, with the appropriate conditions, the potential of substantial increases in abundance and cover of cheatgrass (*Bromus tectorum*) remains a threat to future rehabilitation projects of the site. Increases in cheatgrass cover also leads to increased fire potential and prevents any future reestablishment of beneficial browse species as forage for big game (Figure 2.9).

Perennial and annual forb composition is deficient in diversity and is low in mean nested frequency and cover of all sampled species (Figure 2.9).

Occupancy: Pellet group transect data indicates that elk predominantly occupy the Marshall Basin study site, but has ranged from low to moderate abundance. The mean abundance of elk pellet groups has ranged from a high of 32 days use/acre in 2013 to a low of 7 days use/acre in 208 (Figure 2.10).

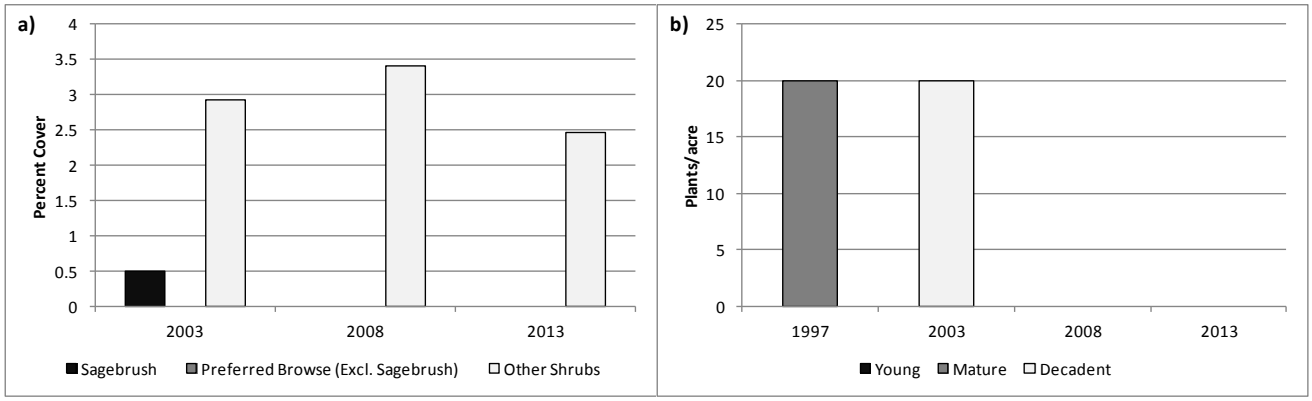


Figure 2.8: Shrub summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 24, Mt. Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

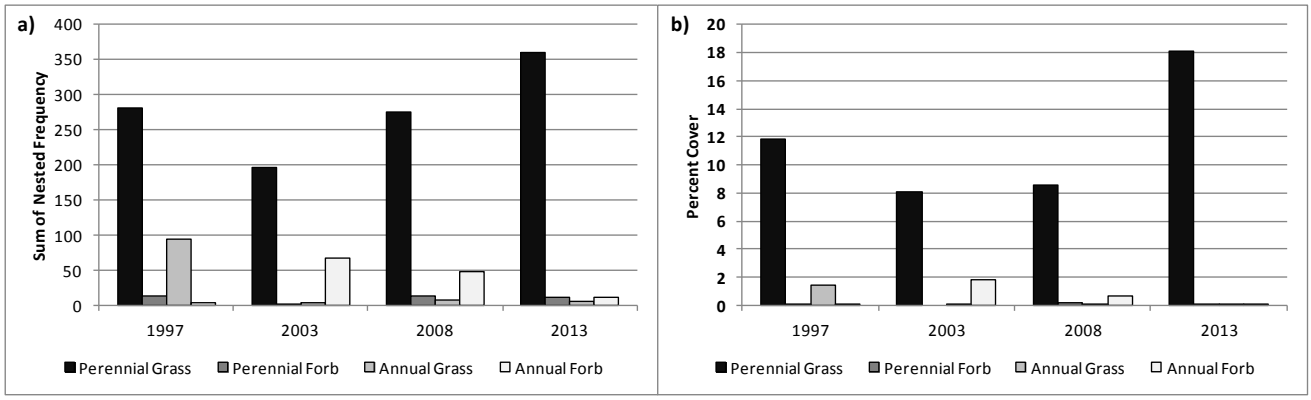


Figure 2.9: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

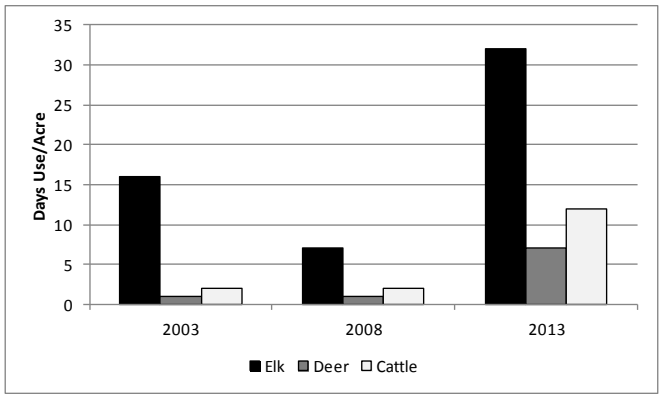


Figure 2.10: Mean pellet transect data for the Upland (Mountain Big Sagebrush) study (n=1) for WMU 24, Mt. Dutton.

Semidesert (Wyoming Big Sagebrush)

There are two studies [North Pole Canyon (24-1) and North Bull Rush (24-3)] classified as Upland (Wyoming Big Sagebrush) ecological site that remained undisturbed over the report period (Table 2.6). The North Pole Canyon study is located west of Antimony on the bench at the mouth of Pole Canyon, while the North Bull Rush study is located on the foothills east of the Sevier River and south of Circleville Canyon.

Shrubs/Trees: The primary browse species for the two studies is Wyoming big sagebrush with no other preferred browse species sampled in cover measurements. The mean line-intercept cover of sagebrush is good on these sites (Figure 2.11a). Trends in cover have varied on individual sites, however. Sagebrush cover has steadily increased from 5% to 14% from 2003 to 2013 on the North Pole Canyon study, but has remained stable near 10% cover on the North Bull Rush study. The average height of Wyoming big sagebrush on all of the studies is approximately 1.5 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been a mixture of mature and decadent plants with mean recruitment of young plants comprising less than 10% of the populations on the study sites since 1997. The mean density of sagebrush decreased from 1997 to 2008, but increased substantially in 2013. However, the increase is due to significant increases in density on the North Bull Rush study and is not driven by the North Pole Canyon study, which had a marked decrease in density in 2013 (Figure 2.11b).

Encroachment from pinyon pine and Utah juniper trees is not a concern on these sites. Pinyon and juniper trees have not been observed on either site.

Herbaceous Understory: These study sites have a fair herbaceous component dominated primarily by native perennial grasses. The perennial grass species blue grama (*Bouteloua gracilis*) is the most common species shared between the two studies; however, needle-and-thread (*Stipa comata*) is the dominant grass on the North

Bull Rush study. The mean nested frequency of perennial grasses has steadily increased from 1997 to 2008, with a slight decrease in 2013. The mean cover of perennial grass increased steadily from 17% in 1997 to 47% in 2008, but decreased to 30% in 2013. Cheatgrass has not been observed on the North Pole Canyon study, but has been observed on the North Bull Rush study in negligible cover values (Figure 2.12).

Native perennial forb species composition is limited in diversity on these studies with low nested frequency and cover of all sampled species (Figure 2.12).

Occupancy: Pellet group transect data indicates that deer and livestock are the main species occupying these study sites; however, both have decreased in average pellet group abundance since 2003. The mean abundance of deer pellet groups has ranged from a high of 35 days use/acre in 2003 to a low of 8 days use/acre in 2013. Cattle sign has ranged from a high 45 days use/acre in 2008 to 3 days use/acre in 2013 (Figure 2.13). Neither study appears to have more pellet groups of one species over another.

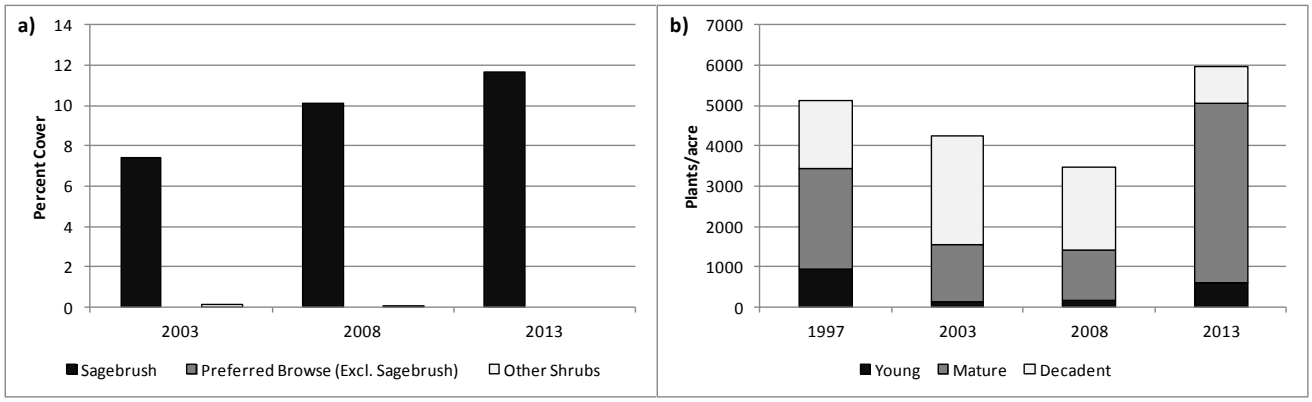


Figure 2.11: Shrub summary of the Semidesert (Wyoming Big Sagebrush) studies (n=2) for WMU 24, Mt. Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

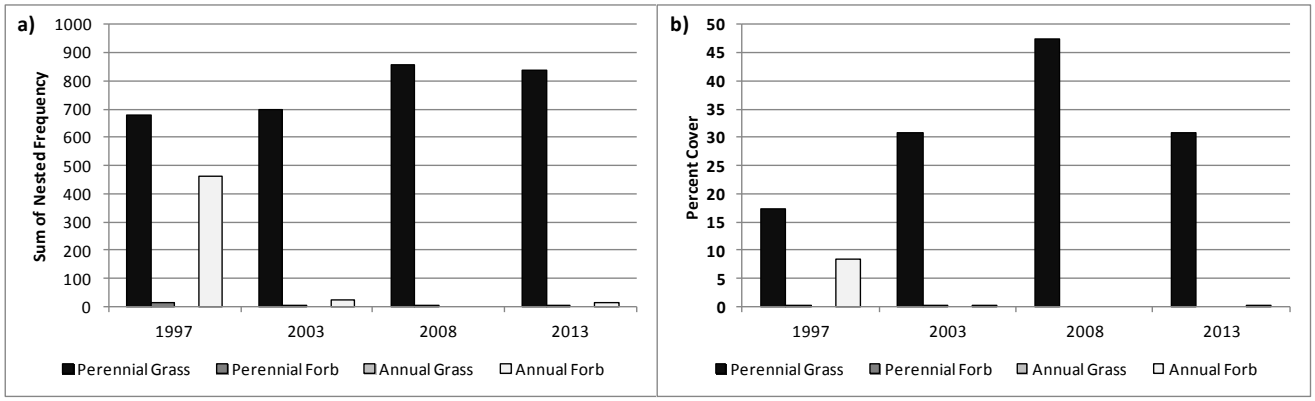


Figure 2.12: Herbaceous functional group summary of the Semidesert (Wyoming Big Sagebrush) studies (n=2) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

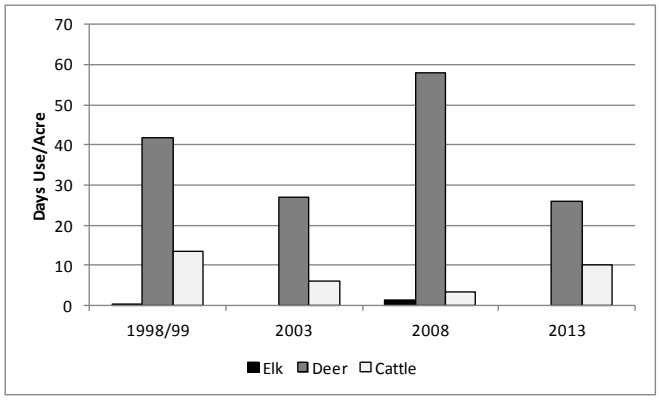


Figure 2.13: Mean pellet transect data for the Semidesert (Wyoming Big Sagebrush) studies (n=2) for WMU 24, Mt. Dutton.

Semidesert (Black Sagebrush)

There is one study [Deer Creek Bench (24-2)] classified as Semidesert (Black Sagebrush) ecological site that remained undisturbed over the report period (Table 2.6). The Deer Creek Bench study is located just west of SR 22 and Black Canyon WMA, and south of Antimony.

Shrubs/Trees: The primary browse on the Deer Creek Bench study is black sagebrush (*Artemisia nova*) with slenderbush eriogonum (*Eriogonum microthecum*) as the other preferred browse species sampled in cover measurements on the study. The mean line-intercept cover of sagebrush is good on the site, and has remained similar at 18% to 19% since 2003(Figure 2.14a). The average height of black sagebrush on the study is approximately 1 foot tall or less, making browse moderately available through much of the year in normal winters. The demographics of the sagebrush population have generally been mature plants with a moderate amount of decadent plants throughout the population. Recruitment of young plants has comprised less than 10% of the population on most sample years, but recruitment was 13% of the population in 1997. Density of black sagebrush has been generally stable at approximately 6,000 to 7,000 plants/acre most sample years since1997, but density increased to nearly 9,000 plants/acre in 2003 (Figure 2.14b).

Encroachment from pinyon pine and Utah juniper trees is not a concern on the Deer Creek Bench study.

Herbaceous Understory: The study site has a fair herbaceous component co-dominated primarily by native perennial grass species Indian ricegrass (*Oryzopsis hymenoides*), bottlebrush squirreltail (*Sitanion hystrix*), and needle-and-thread. The mean nested frequency and cover of perennial grasses has steadily increased from more moderate levels in 1997 to moderately high in 2013. The mean cover of perennial grass has steadily increased from 4% in 1997 to 11% in 2013. The annual grass species cheatgrass is limited on the site (Figure 2.15). Although cover is low, cheatgrass increases the threat for fire on this study.

Native perennial forb species composition is generally fairly diverse on the Deer Creek Bench study, but with moderately low nested frequency and cover of all sampled species (Figure 2.15).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 121 days use/acre in 1997 to a low of 60 days use/acre in 2008 (Figure 2.16).

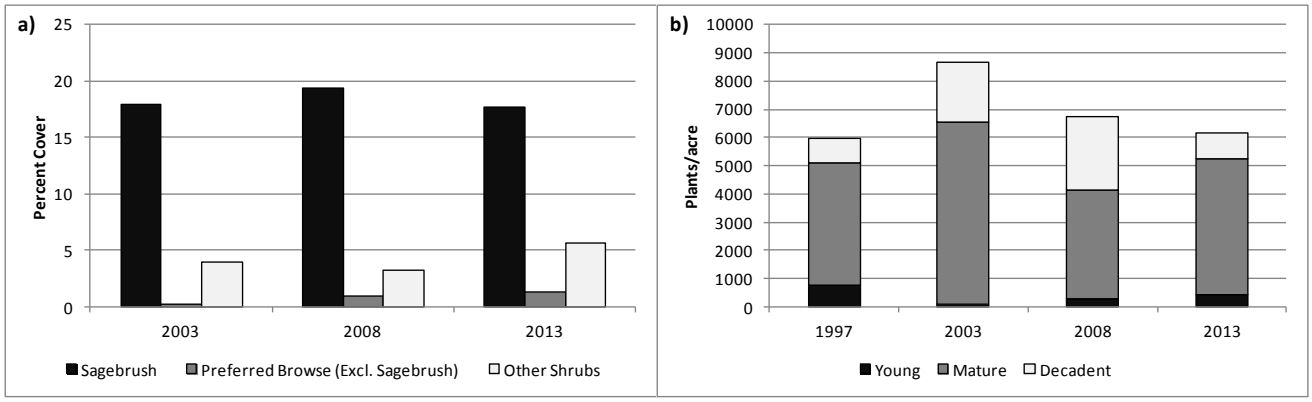


Figure 2.14: Shrub summary of the Semidesert (Black Sagebrush) study (n=1) for WMU 24, Mt. Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

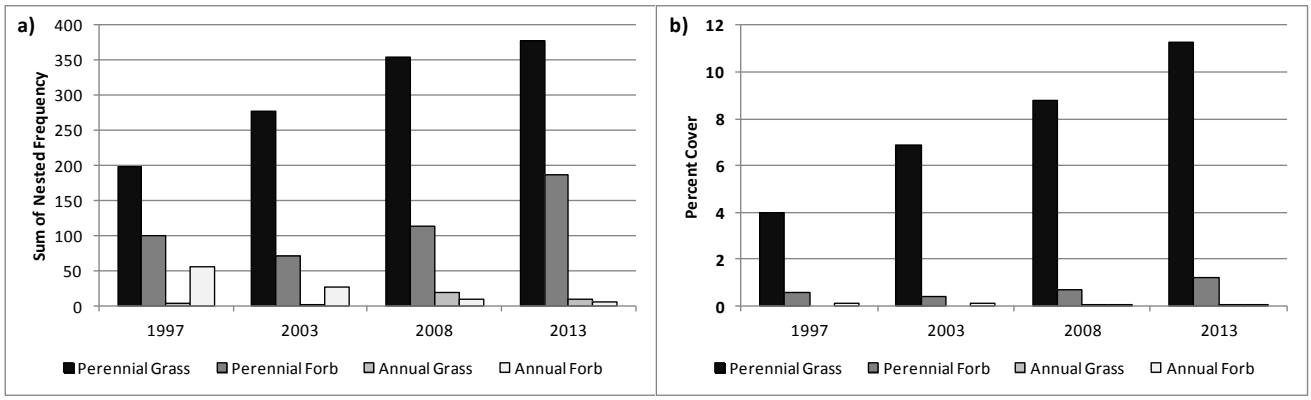


Figure 2.15: Herbaceous functional group summary of the Semidesert (Black Sagebrush) study (n=1) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

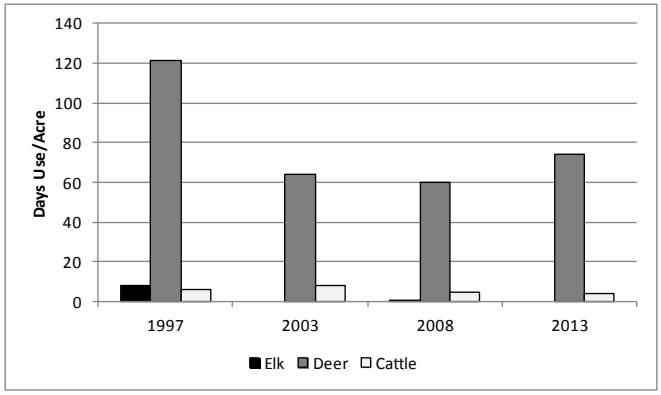


Figure 2.16: Mean pellet transect data for the Semidesert (Black Sagebrush) study (n=1) for WMU 24, Mt. Dutton.

Study Trend Summary (Treated/Disturbed Sites)

Harrow

There are two studies [Mud Spring (24-9) and Panguitch East Bench Harrow (24R-6)] that were treated with a harrow during the report period (Table 2.7). The Mud Spring study is located south of Circleville on the western foothills of Table Mountain, while the Panguitch East Bench Harrow study is located on the foothills west of Blind Spring Mountain, which is found northeast of Panguitch. The Mud Spring study is classified as Upland (Mountain Big Sagebrush - Indian Ricegrass) ecological site. The Panguitch East Bench Harrow study's ecological site has not yet been verified (Table 2.6). Generally, the target of the harrow treatments was to rejuvenate degraded sagebrush and increase the herbaceous understory.

Shrubs/Trees: The primary browse species on the Mud Spring study is black sagebrush, while Wyoming big sagebrush is the primary browse species on the Panguitch East Bench Harrow study. The mean cover of sagebrush was reduced following treatment from near 20% to 10%, but rebounded to 19% at post year 6-10 (Figure 2.17a). The mean density of sagebrush followed a similar trend decreasing from near 13,000 plants/acre to 8,300 plants/acre, but rebounded to 13,300 plants/acre in post year 6-10. Changes in demographics of the sagebrush populations appear to have been positive for the studies with the initial populations shifting from a mature and decadent demographic to populations centered within a young and mature demographic (Figure 2.17b).

Encroachment from pinyon pine and juniper trees is not a concern on these studies.

Herbaceous Understory: The herbaceous component has been good over the duration of the studies. The herbaceous component was comprised primarily of native grass and forb species. Annual grass, primarily cheatgrass, has not been observed on the sites and annual forbs have been observed in low nested frequency and cover since pretreatment. Mean nested frequency for perennial grasses and forbs has remained high and relatively stable since pretreatment. Mean perennial grass cover has increased slightly from near 10% at pretreatment to 12% and 13% for the post treatment samplings (Figure 2.18).

Occupancy: Pellet group transect data indicates that elk, deer, and cattle occupy these study sites and have been low in abundance since treatment (Figure 2.19). However, the mean is suppressed by the Panguitch East Bench Harrow study due to lack of occupancy by wildlife. The Mud Spring study has moderate abundance of elk pellet groups found on site, while deer and cattle have remained low in abundance.

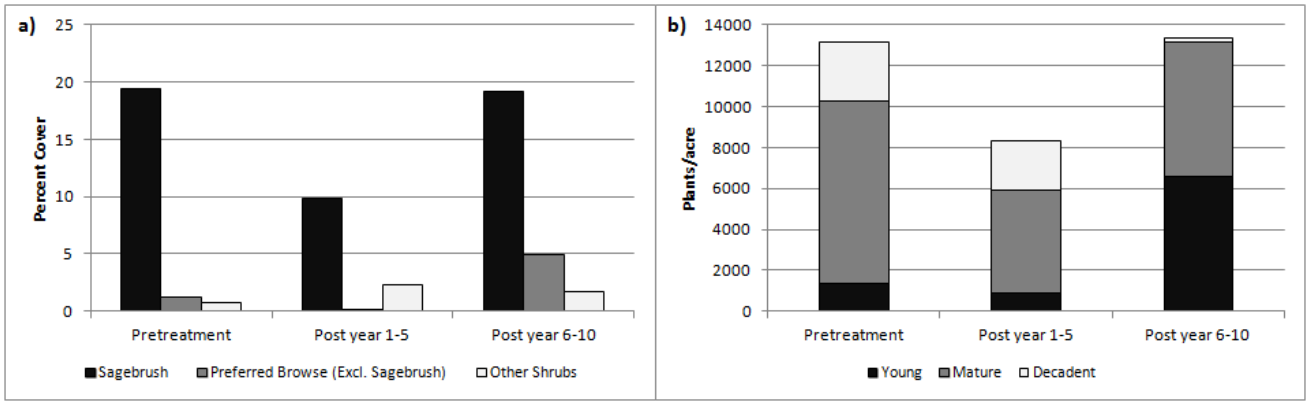


Figure 2.17: Shrub summary of the Harrow treatment studies (n=2) for WMU 24, Mt. Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

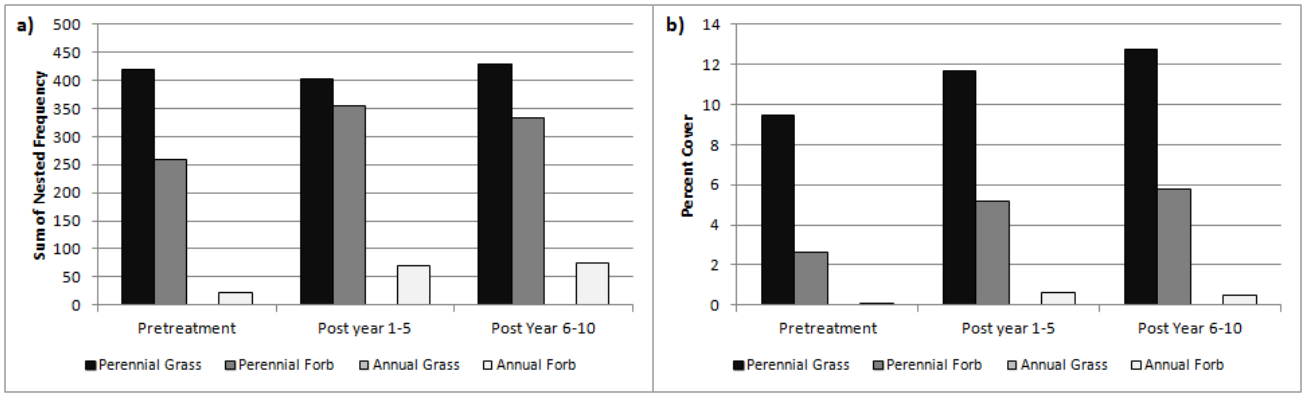


Figure 2.18: Herbaceous functional group summary of the Harrow treatment studies (n=2) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

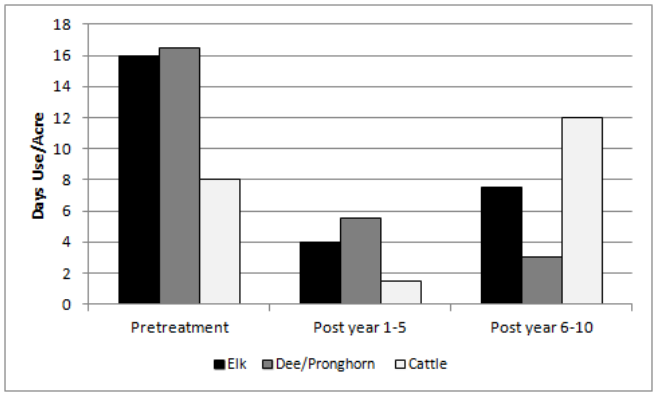


Figure 2.19: Mean pellet transect data for the Harrow treatment studies (n=2) for WMU 24, Mt. Dutton.

Lop and Scatter

There are two studies [Mud Spring Chaining (24-4) and Cow Creek (24-7)] that were treated with a lop and scatter during the report period (Table 2.7). The Mud Spring study is located south of Circleville on the western foothills of Table Mountain. The Cow Creek study is located south of Antimony and Black Canyon on upper foothills of Mt. Dutton just west of Johns Valley. The Mud Spring Chaining study is classified as an Upland (Mountain Big Sagebrush - Indian Ricegrass) ecological site and the Cow Creek study is classified as a Semidesert (Wyoming Big Sagebrush) ecological site (Table 2.6). Generally, the target of the lop and scatter treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The Mud Spring Chaining has one additional year of post-treatment, thus the post year 6-10 trends are driven exclusively by the Mud Spring Chaining Study and is not comparable to the previous sample years. The primary browse on the Mud Spring Chaining is mountain big sagebrush. The primary browse on the Cow Creek study is Wyoming big sagebrush. The mean cover of sagebrush remained similar following treatment (Figure 2.20a). The trend for mean sagebrush density is likely being driven by the Cow Creek study. The mean density of mature and young sagebrush increased from 528 plants/acre to 1,083 plants/acre and 120 plants/acre to 288 plants/acre, respectively following treatment (Figure 2.20b).

The Mud Spring Chaining has one additional year of post-treatment, thus the post year 6-10 trends are driven exclusively by the Mud Spring Chaining Study and is not comparable to the previous sample years. The mean density and cover of pinyon pine and Utah juniper trees was moderate at 154 trees/acre and 17%, respectively, prior to treatment. The mean density of pinyon-juniper trees decreased to 73 tree/acre and the mean cover decreased to 4% following treatment (Figure 2.21). Young trees that were missed in the treatment generally provide the remaining density and cover.

Herbaceous Understory: The Mud Spring Chaining has one additional year of post-treatment, thus the post year 6-10 trends are driven exclusively by the Mud Spring Chaining Study and is not comparable to the previous sample years. The study sites have a good herbaceous component dominated by perennial grasses. However, the dominant grass species are seeded species such as crested wheatgrass, intermediate wheatgrass, and smooth brome; with crested wheatgrass being shared by both studies. Competition with these introduced grasses may limit other desirable herbaceous species. Perennial grasses were the most responsive with an increase in mean cover from 10% to 16% following treatment. Perennial forb frequency and cover had no improvement in frequency and cover following treatment (Figure 2.22). Annual grass species, primarily cheatgrass, is not a concern on either study.

Occupancy: Pellet group transect data indicates that no one species occupy these study sites more than another; however, further pretreatment data suggests that the Cow Creek study has had higher elk occupancy in the past, but is not represented within this summary. The mean abundance of pellet groups for elk increased from

1 day use/acre prior to treatment to 14 days use/acre following treatment. The mean abundance of pellet groups for deer/pronghorn remained similar following treatment. The elk and deer/pronghorn pellet group trends are being driven by the Cow Creek study. The Mud Spring Chaining study has one more post year reading than the Cow Creek study; therefore, the post year 6-10 trends are driven by the Mud Spring Chaining study with a decrease in deer and elk mean pellet group (Figure 2.23).

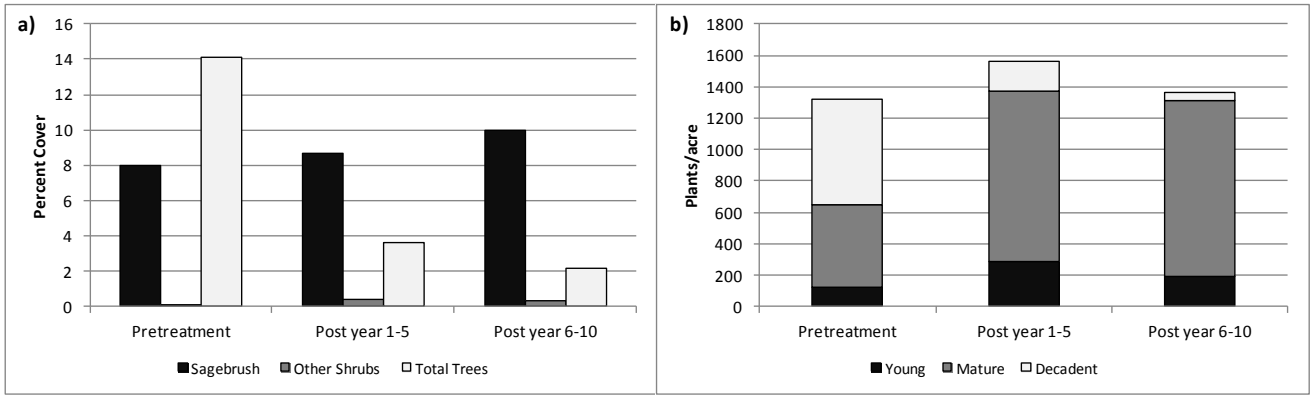


Figure 2.20: Shrub summary of the Lop and Scatter treatment studies (n=2) for WMU 24, Mt. Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

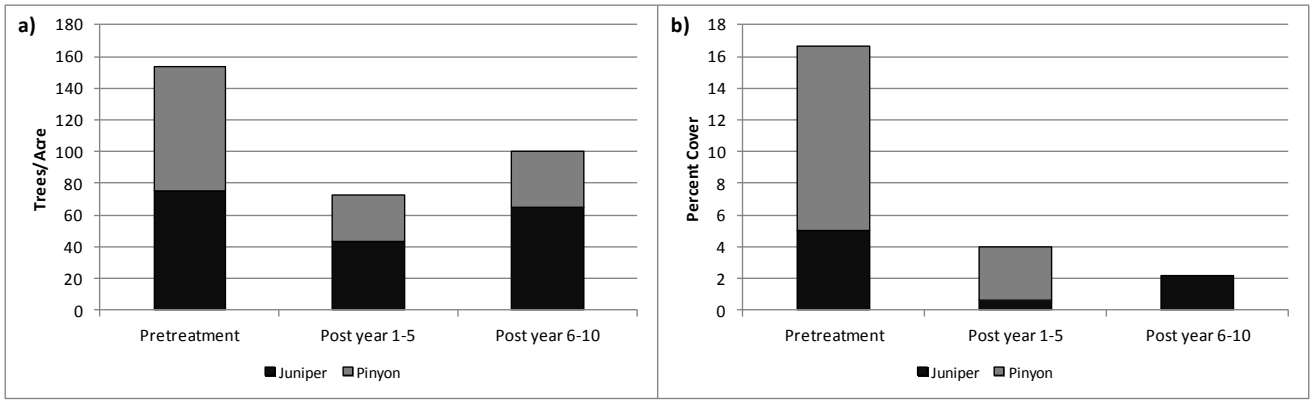


Figure 2.21: Tree summary of the Lop and Scatter treatment studies (n=2) for WMU 24, Mt. Dutton. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

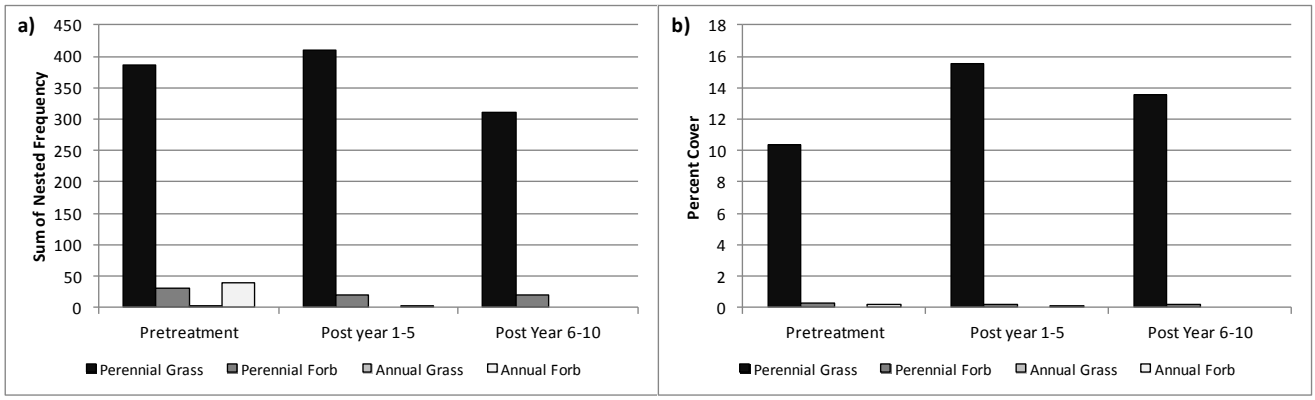


Figure 2.22: Herbaceous functional group summary of the Lop and Scatter treatment studies (n=2) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

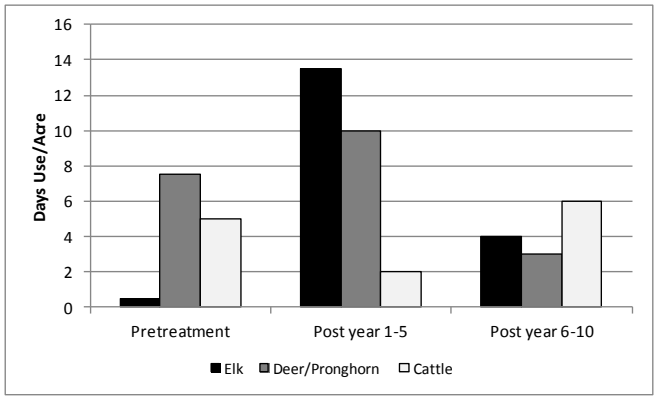


Figure 2.23: Mean pellet transect data for the Lop and Scatter treatment studies (n=2) for WMU 24, Mt. Dutton.

Fire

There is one study [Sanford (24R-1)] that was burned in a prescribed fire during the report period (Table 2.7). The Sanford study is located near the top of the Right Fork of Sanford Creek and below Adams Head. The Sanford study is classified as a High Mountain (Aspen) ecological site (Table 2.6).

Shrubs/Trees: The primary browse on the Sanford study is mountain big sagebrush. Line-intercept cover is not available for this study for the pretreatment sample year due to line-intercept collection beginning during post-treatment years. Mean line-intercept cover for mountain big sagebrush has steadily increased from 0% to near 3% following the prescribed burn (Figure 2.24a); however, the presence of sagebrush on the Sanford study is limited to a small population of mature plants (Figure 9.30b). The mean line-intercept cover of aspen (*Populus tremuloides*) following the fire has steadily increased from near 5% to near 26%. Since the prescribed burn, encroachment as described by mean line-intercept cover for conifer trees has increased slightly from 8% to 10% (Figure 2.25b). Density measurements for aspen and conifer trees have not been preformed following the fire, and data is lacking in the description for these two populations and how they may be changing.

Herbaceous Understory: The herbaceous component was moderate in abundance prior to the prescribed burn. Perennial grasses and forbs have dominated the herbaceous understory since pre-treatment. Following the fire, the herbaceous understory was limited, but having been released from conifer dominance following the fire, the herbaceous component has steadily increased and is considered to be in high abundance. Mean cover of perennial grasses and forbs has increased from 1% to 16% and 1% to 12%, respectively. Some of the increases in perennial grasses' mean nested frequency and cover are due to the seeded species crested wheatgrass, intermediate wheatgrass, and smooth brome, which were likely seeded following the fire. Annual grasses, primarily cheatgrass, have been limited following the fire (Figure 2.26).

Occupancy: Pellet group transect data indicates that deer primarily occupy the Sanford study site. The mean abundance of deer pellet groups have steadily increased from low abundance in 2003 to moderate abundance in 2013 and is likely due to the increased availability of forgeable herbaceous species. Elk and cattle sign was present on the site, but in low abundance (Figure 2.27).

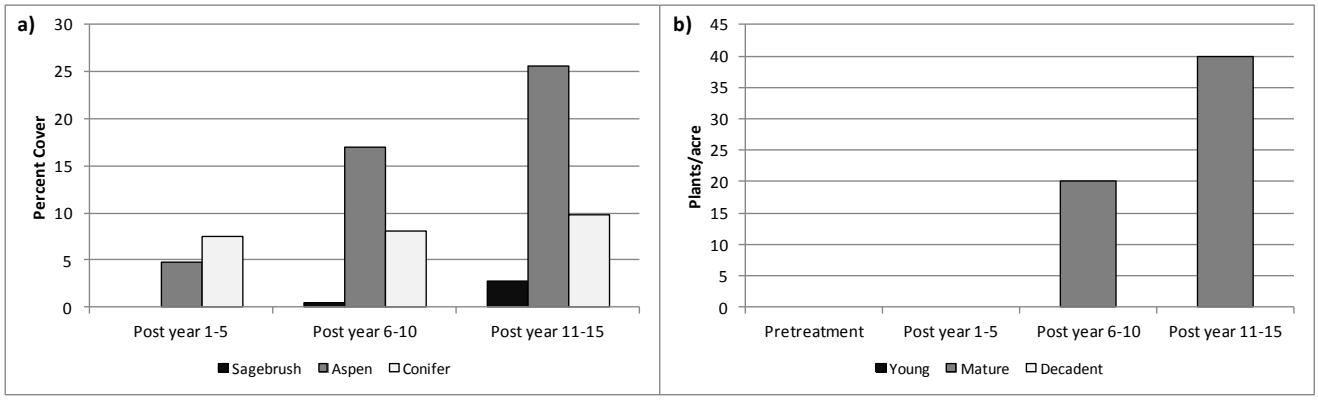


Figure 2.24: Shrub summary of the Wildfire disturbance study (n=1) for WMU 24, Mt. Dutton. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

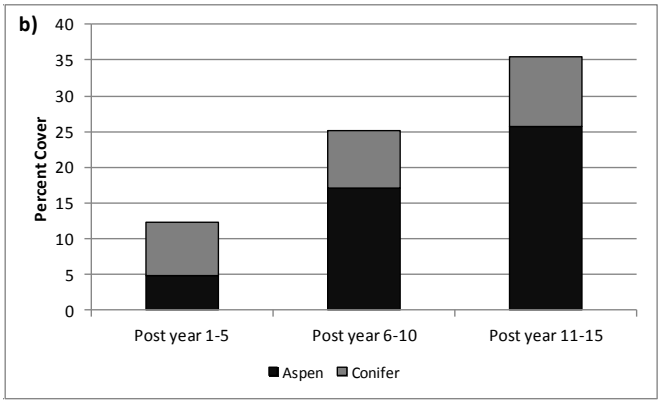


Figure 2.25: Tree summary of the Wildfire disturbance study (n=1) for WMU 24, Mt. Dutton. b) Mean line-intercept cover estimate for aspen and conifer trees.

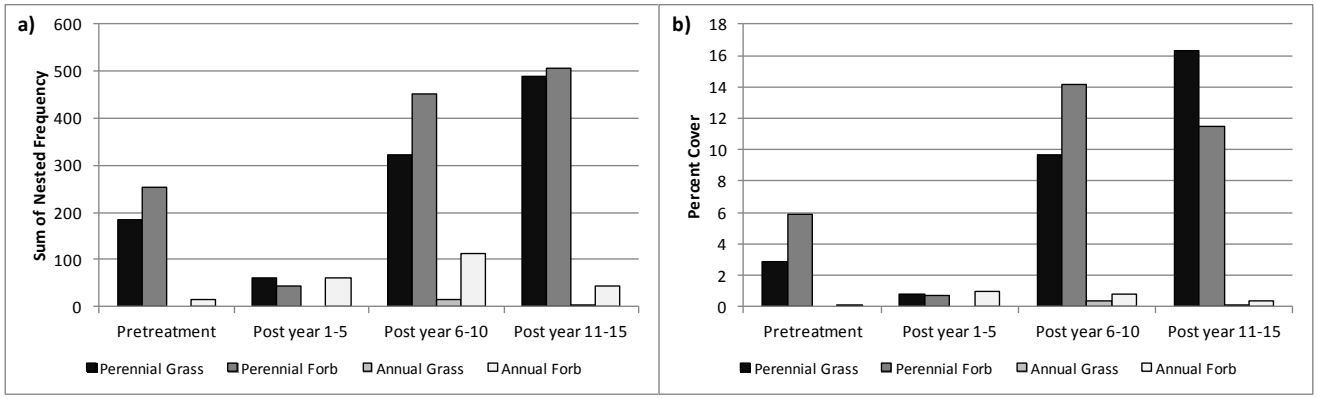


Figure 2.26: Herbaceous functional group summary of the Wildfire disturbance study (n=1) for WMU 24, Mt. Dutton. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

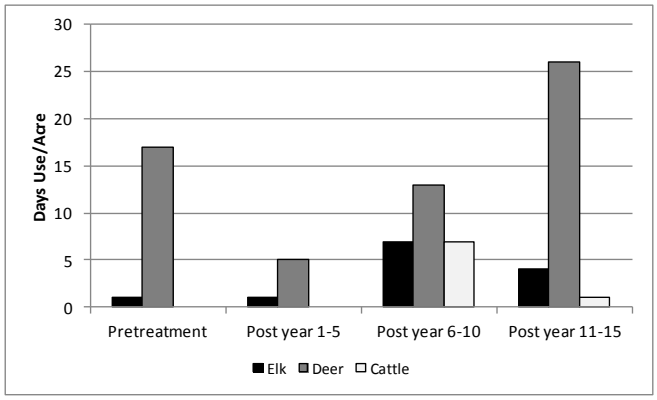


Figure 2.27: Mean pellet transect data for the Wildfire disturbance study (n=1) for WMU 24, Mt. Dutton.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Mt. Dutton management unit has generally improved on the study sites sampled since 1997. The majority of sites sampled within the unit are considered to be in fair to good condition based on the most current sample data, and the proportion of sites classified, as being in very poor condition has remained consistent, except in 2003, when two-thirds of the sites were classified as being very poor (Figure 2.28 and Figure 2.29). The only undisturbed study during the report period that has consistently remained in very poor condition is the Marshall Basin study, which has maintained a depleted browse component, and an herbaceous understory lacking in perennial forbs. The condition of disturbed and treated sites typically improves with increased time after disturbance on this unit. Mud Spring Chaining, Panguitch East Bench Harrow, and Cow Creek are the three studies that fit within this generalization. Mud Spring Chaining did not show immediate improvement in condition following treatment, and only reaching fair condition 11-15 years following treatment. Panguitch East Bench Harrow attained good condition 6-5 years following treatment, and Cow Creek's condition improved to good 1-5 years following treatment. All other remaining studies within the unit are within the pre-treatment sampling status. These study sites generally are still lacking in available browse and perennial forb species (Map 2.7 and Table 2.8).

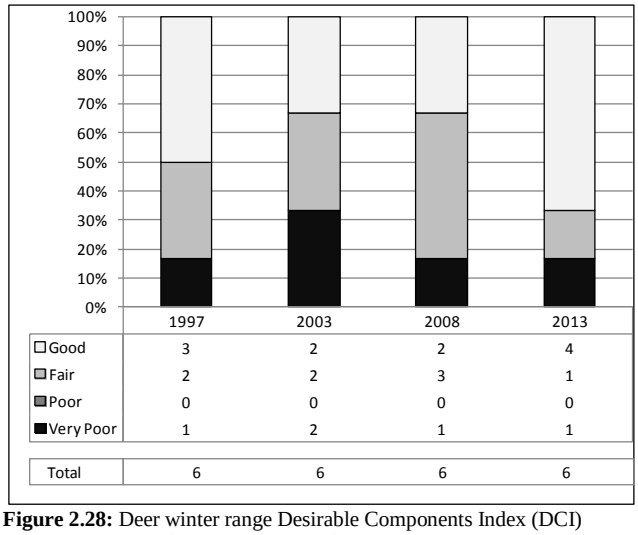


Figure 2.28: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 24, Mt. Dutton.

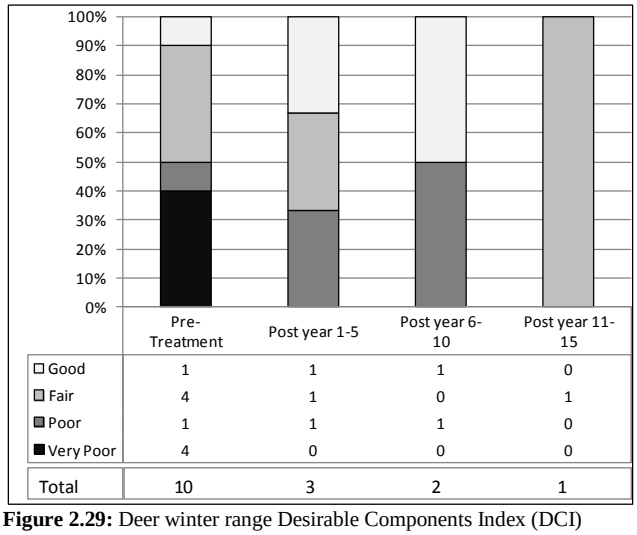
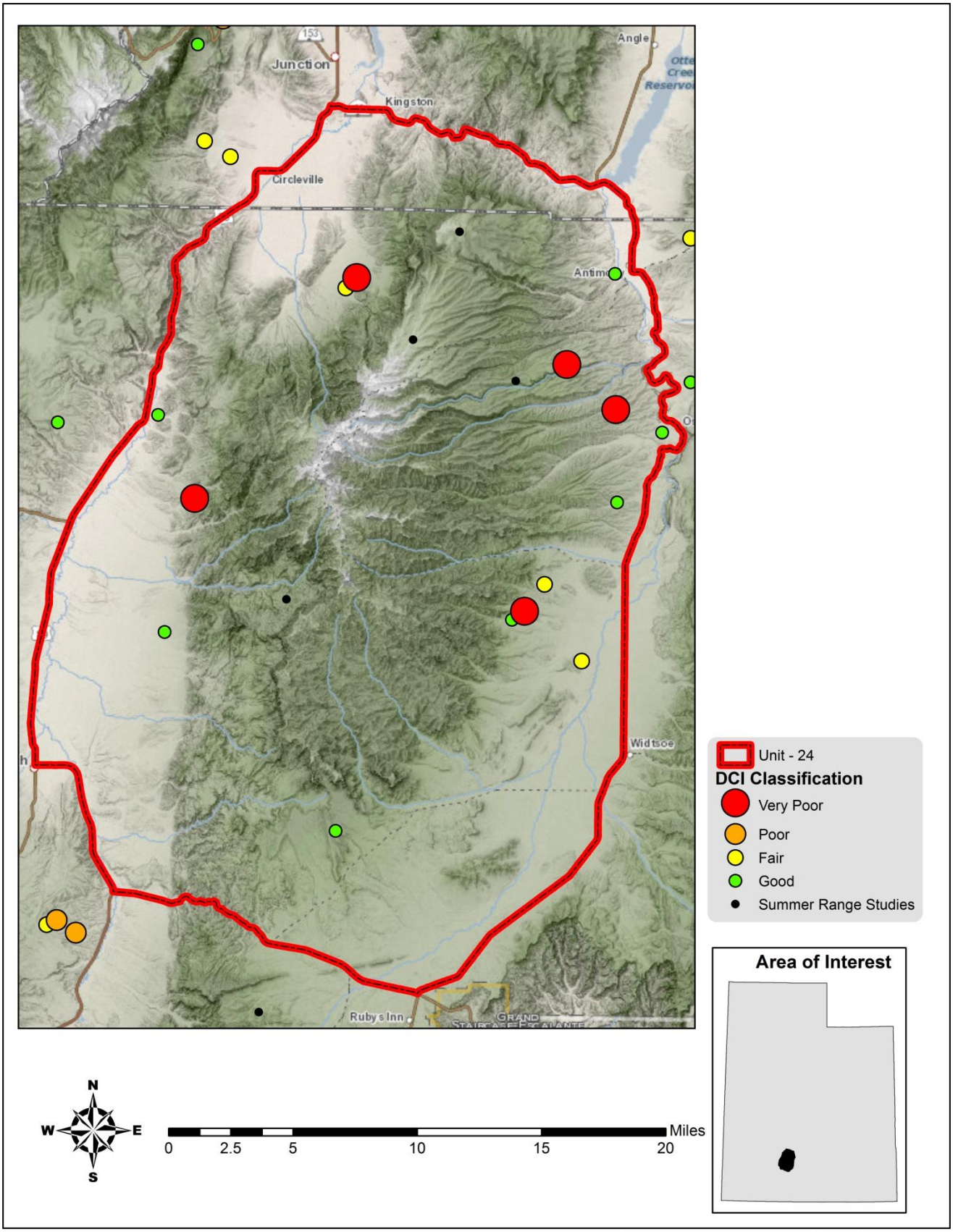


Figure 2.29: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 24, Mt. Dutton.



Map 2.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 24, Mt. Dutton.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
24-1	North Pole Canyon	None Identified		
24-2	Deer Creek Bench	Annual Grass	Low	Increased fire potential.
24-3	North Bull Rush	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
24-4	Mud Spring Chaining	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
24-6	Table Mountain	None Identified		
24-7	Cow Creek	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
24-8	Prospect Seeding	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
24-9	Mud Spring	None Identified		
24-12	Marshall Basin	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
24-13	Jones Corral	None Identified		
24-14	Pine Canyon	None Identified		
24R-1	Sanford	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
24R-6	Panguitch East Bench Harrow	Sagebrush Age Class Homogenization	High	Reduced community structure and diversity.
24R-8	Johns Valley	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
24R-9	Johns Valley 2	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
24R-10	Antimony Lop and Scatter	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
24R-11	Antimony PJ Reduction	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
24R-12	Johns Valley 3	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
24R-13	Circleville	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.

Table 2.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 24, Mt. Dutton. All assessments are based off of the most current sample date for each study site.

Discussion and Recommendations

Mountain (Basin Wildrye) and Upland (Mountain Big Sagebrush)

The higher elevation upland and mountain sites that support Wyoming big sagebrush and mountain big sagebrush communities are generally considered to be in poor condition for deer winter range habitat on the Mt. Dutton management unit. These communities should have the potential to support robust shrub populations that provide valuable browse in mild and moderate winters; however, drought conditions have limited browse suitability as valuable winter range.

Although pinyon-juniper encroachment has not been a problem on these studies, it is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue where needed in these communities. It is recommended that work to reestablish a viable browse and herbaceous components may be achieved by reseeding. It is necessary to keep in mind that when restoring herbaceous species, care should be taken in species selection, and preference should be given to native grass species when possible. In addition, areas with competitive seeded perennial grass species can be slow to reestablish shrub species on the site and may need additional restoration work for establishment.

Semidesert (Black Sagebrush)

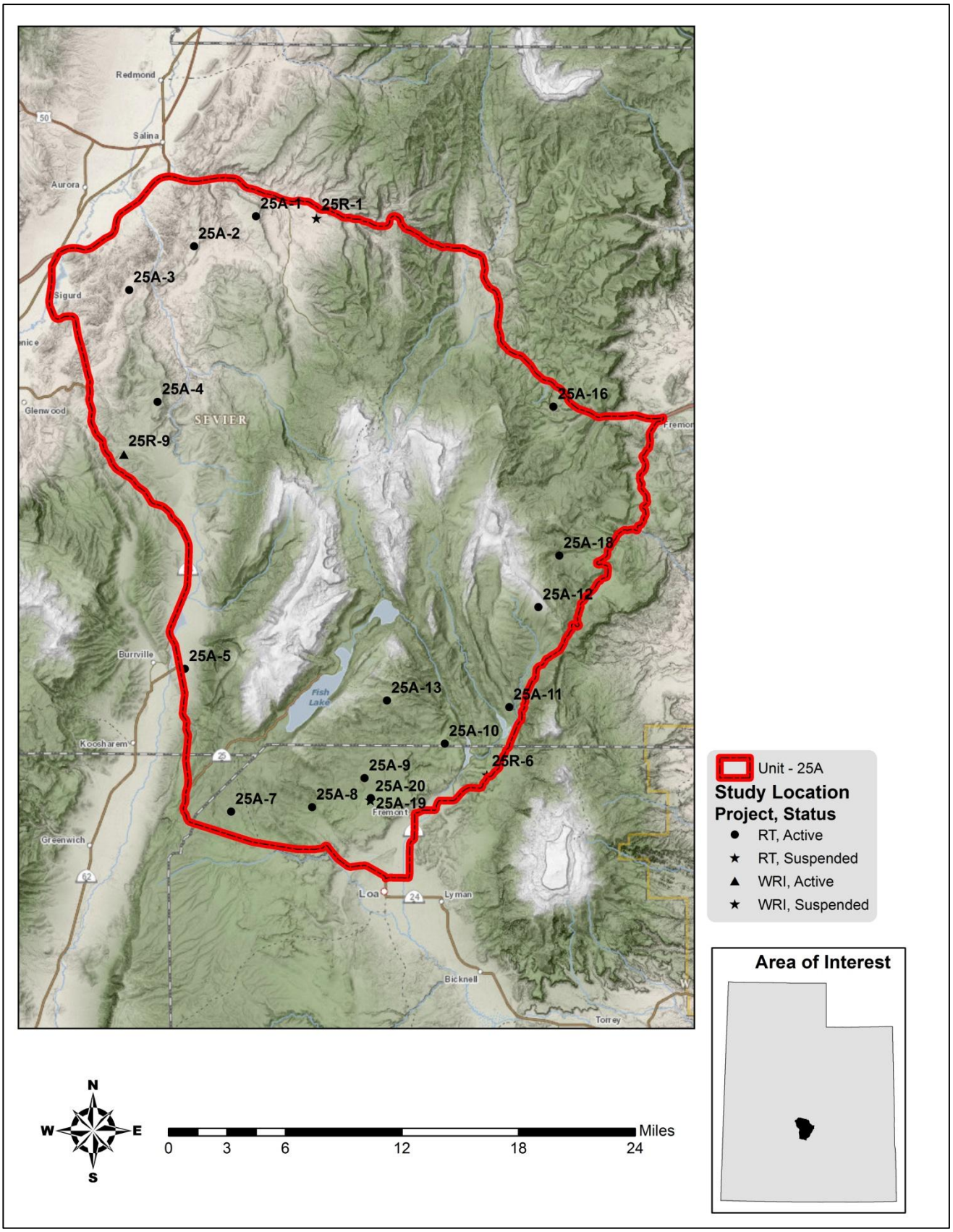
The low elevation semidesert black sagebrush communities are generally considered to be in good condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. Additionally, these communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

Although the pinyon and juniper trees are limited on the range trend study site, It is recommended that work to reduce pinyon-juniper encroachment should continue in these communities where encroachment occurs. Care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

Semidesert (Wyoming Big Sagebrush)

The lower elevation semidesert Wyoming big sagebrush communities that have not been disturbed are generally considered to be in good condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire. As with semidesert black sagebrush communities, the Wyoming big sagebrush communities respond similarly to wildfire, pinyon-juniper encroachment, and cheatgrass invasion and should be treated the same when performing habitat rehabilitation projects.

3. WILDLIFE MANAGEMENT UNIT 25A – FISHLAKE



WILDLIFE MANAGEMENT UNIT 25A – FISHLAKE

Boundary Description

> **Sevier, Piute, and Wayne counties** - Boundary begins at SR-24 and US-89 at Sigurd; south on SR-24 to SR-72 at Loa; north on SR-72 to I-70; west on I-70 to US-89; south on US-89 to SR-24.

Management Unit Description

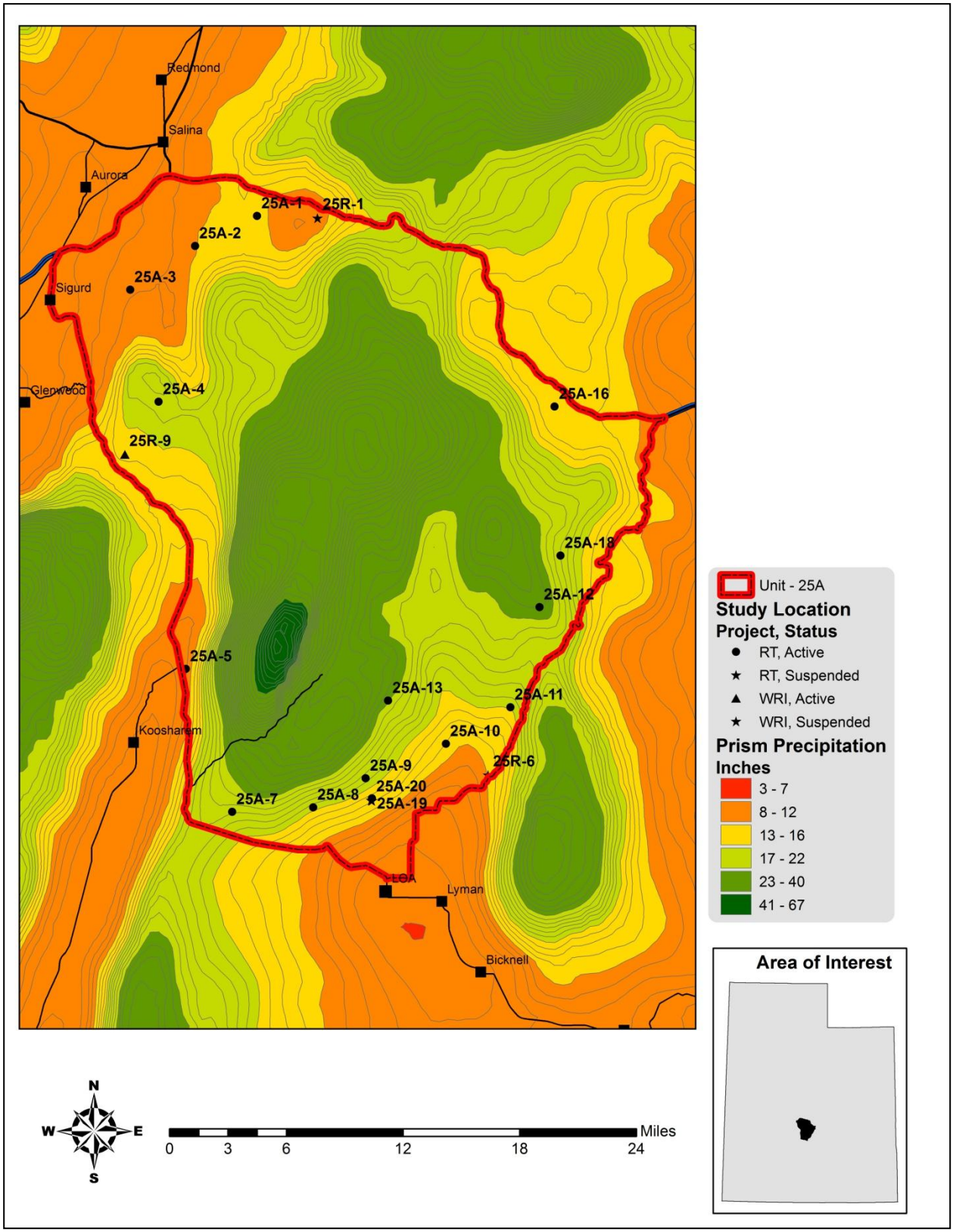
Geography

The Fish Lake unit includes Fish Lake Mountain and its associated drainages; Otter Creek to the west and the Fremont River with its major tributaries, 7-mile Creek and UM Creek to the east. Some steep, relatively rough areas exist in the drainage heads along the northwestern side, but most of the unit is an inclined, rolling plateau. Elevation ranges from 11,600 feet on the Fish Lake Hightop Plateau to 5,200 feet at Sigurd. Towns in this area include Fremont and Sigurd.

Climate Data

The 30-year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 8 inches on the south and northwest of the unit to 41 inches on the high elevation peak of the Fish Lake Hightop Plateau. All of the Range Trend and WRI monitoring studies on the unit occur within 11-23 inches of precipitation (Map 3.1).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 3.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 3.1b) (Time Series Data, 2014).



Map 3.1: The 1981-2010 PRISM Precipitation Model for WMU 25A, Fishlake (PRISM Climate Group, Oregon State University, 2013).

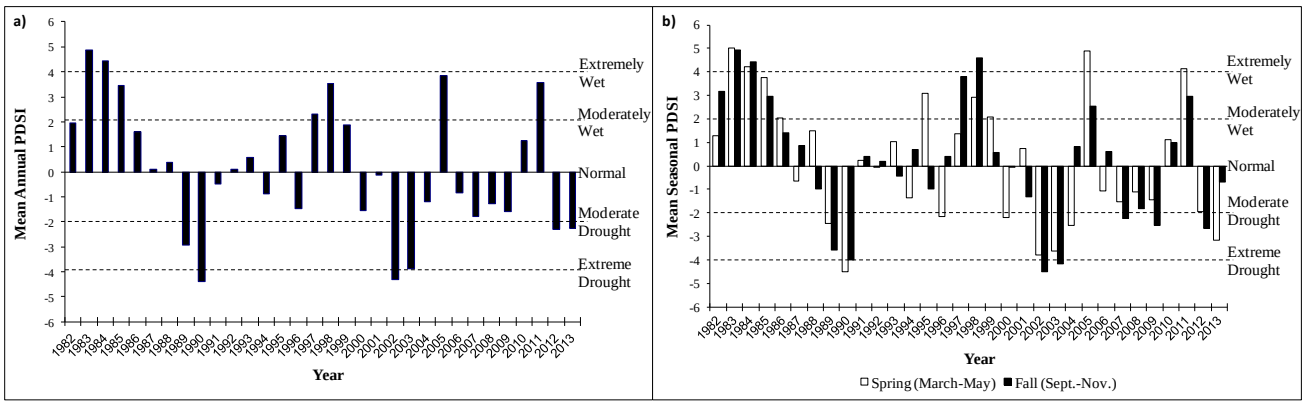


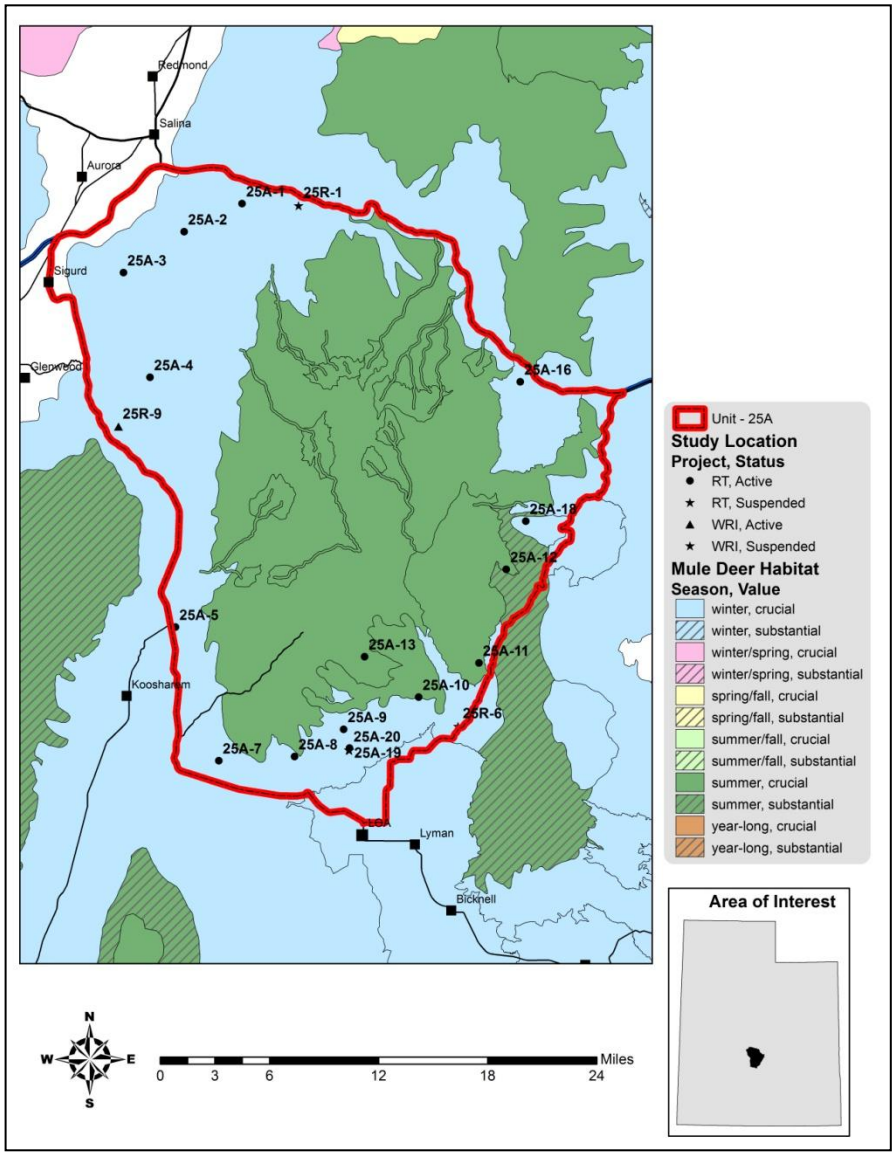
Figure 3.1: The 1982-2014l Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2014).

Big Game Habitat

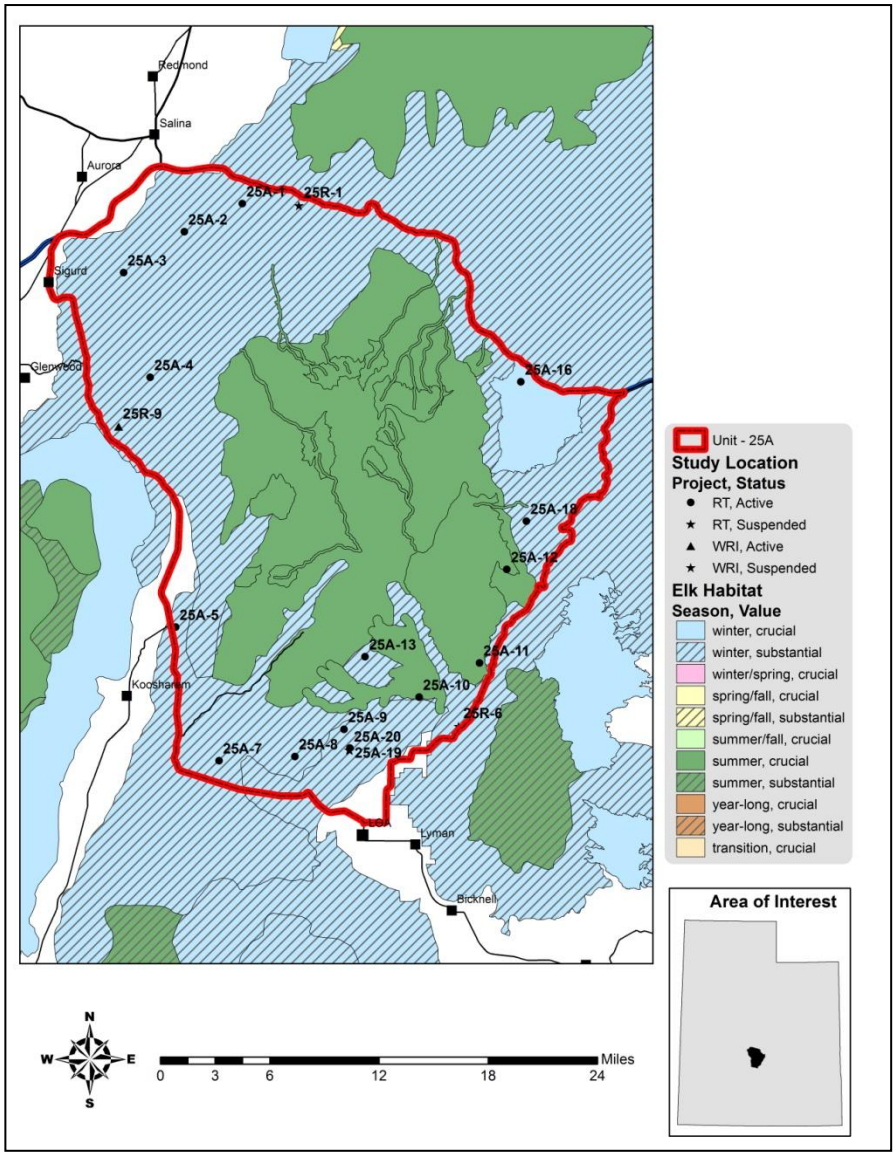
Total mule deer range in the wildlife management unit is estimated at 430,833 acres with 241,169 classified as summer range and 189,664 acres classified as winter range (Table 3.1 and Map 3.2). Total elk range is estimated at 425,746 acres with 187,480 acres of this being classified as summer range and 238,265 as winter range (Table 3.1 and Map 3.3). Most of the big game winter range in this unit is located on Forest Service, BLM, and private holdings. Minor portions of the winter range in the unit occur on Utah State School Trust Lands, Division of Wildlife Resources management areas, and Tribal Lands.

According to LANDFIRE Existing Vegetation Coverage models, important shrublands comprise almost 30% of the deer winter range on the unit. The majority of deer winter range is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Annual grasslands, primarily cheatgrass (*Bromus tectorum*), comprise a small proportion of the deer winter range and pose a minimal threat for wildfire. Other coverage types comprise a minimal proportion of the deer winter range (Table 3.4).

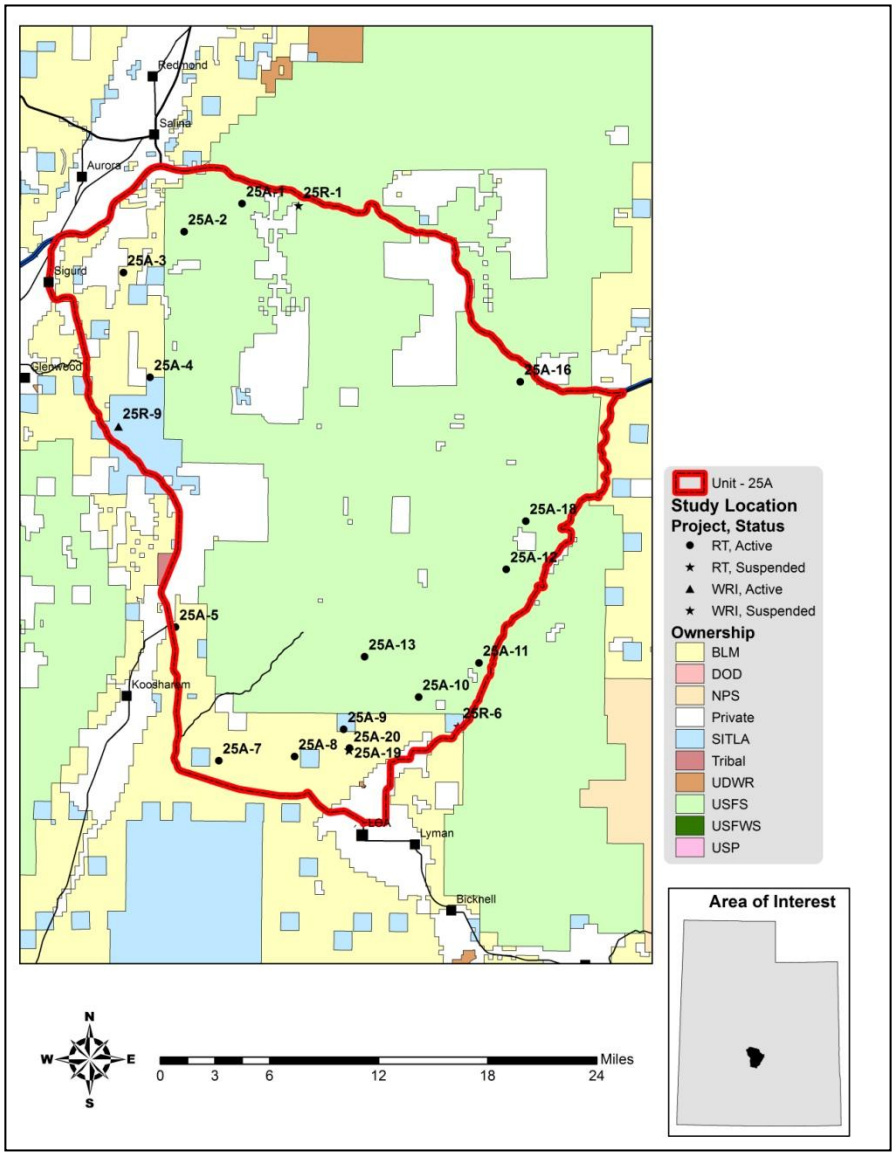
The northern two-thirds of the unit include the high elevation Fish Lake Mountains and constitute summer range for deer and elk. Winter range is primarily confined to the lower elevations of the southern third of the unit and the sagebrush benches on the west side above Highway 24. Antelope are present and are normally found in the more open areas of the deer and elk winter range. Excessive accumulations of snow during severe winters confine deer below the 8,600-foot contour. Pinyon-juniper on both normal and severe wintering areas provide extremely important protective cover for elk and deer, while the closely associated sagebrush type produces the bulk of the required forage.



Map 3.2: Estimated mule deer habitat by season and value for WMU 25A, Fishlake.



Map 3.3: Estimated elk habitat by season and value for WMU 25A, Fishlake.



Map 3.4: Land ownership for WMU 25A, Fishlake.

	Summer Range		Winter Range	
	Area (acres)	*%*	*Area (Acres)*	*%*
Mule Deer	241,169	56%	189,664	44%
Elk	187,480	44%	238,265	56%

Table 3.1: Estimated mule deer and elk habitat acreage by season for WMU 25A, Fishlake.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	199,169	83%	88,754	47%
BLM	5,507	2%	53,156	28%
SITLA	279	<1%	14,950	8%
Tribal Land	0	0%	51	<1%
Private	36,297	15%	32,657	17%
UDOT	0	0%	43	<1%
UDWR	0	0%	52	<1%
Total	**241,169**	**100%**	**189,664**	**100%**

Table 3.2: Estimated mule deer habitat acreage by season and ownership for WMU 25A, Fishlake.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	159,8425	85%	127,801	54%
BLM	13	<1%	59,966	25%
SITLA	316	<1%	14,913	6%
Private	27,310	15%	35,519	15%
UDOT	0	0%	48	<1%
UDWR	0	0%	19	<1%
Total	**187,502**	**100%**	**238,265**	**100%**

Table 3.3: Estimated elk habitat acreage by season and ownership for WMU 25A, Fishlake.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Artemisia tridentata ssp. vaseyana Shrubland Alliance	2,792.83	0.64%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	55,906.64	12.75%	
	Great Basin Semi-Desert Chaparral	1,433.78	0.33%	
	Inter-Mountain Basins Big Sagebrush Shrubland	13,555.61	3.09%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	14,835.49	3.38%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	2,066.27	0.47%	
	Inter-Mountain Basins Montane Sagebrush Steppe	14,063.56	3.21%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	11,565.63	2.64%	
	Quercus gambelii Shrubland Alliance	1,899.03	0.43%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	6,977.85	1.59%	
	Rocky Mountain Lower Montane-Foothill Shrubland	2,777.71	0.63%	
	Other Shrubland	2,631.82	0.60%	29.77%
Conifer	Abies concolor Forest Alliance	3,130.87	0.71%	
	Colorado Plateau Pinyon-Juniper Woodland	112,333.46	25.63%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	33,356.95	7.61%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	2,240.62	0.51%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	44,395.28	10.13%	
	Other Conifer	1,265.20	0.29%	44.88%
Grassland	Native Grassland	15,209.56	3.47%	3.47%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	2,540.41	0.58%	0.58%
Other	Hardwood	62,837.57	14.34%	
	Riparian	5,400.85	1.23%	
	Agricultural	4,066.48	0.93%	
	Developed	8,567.30	1.95%	
	Other	12,499.02	2.85%	21.30%
Total		438349.79		

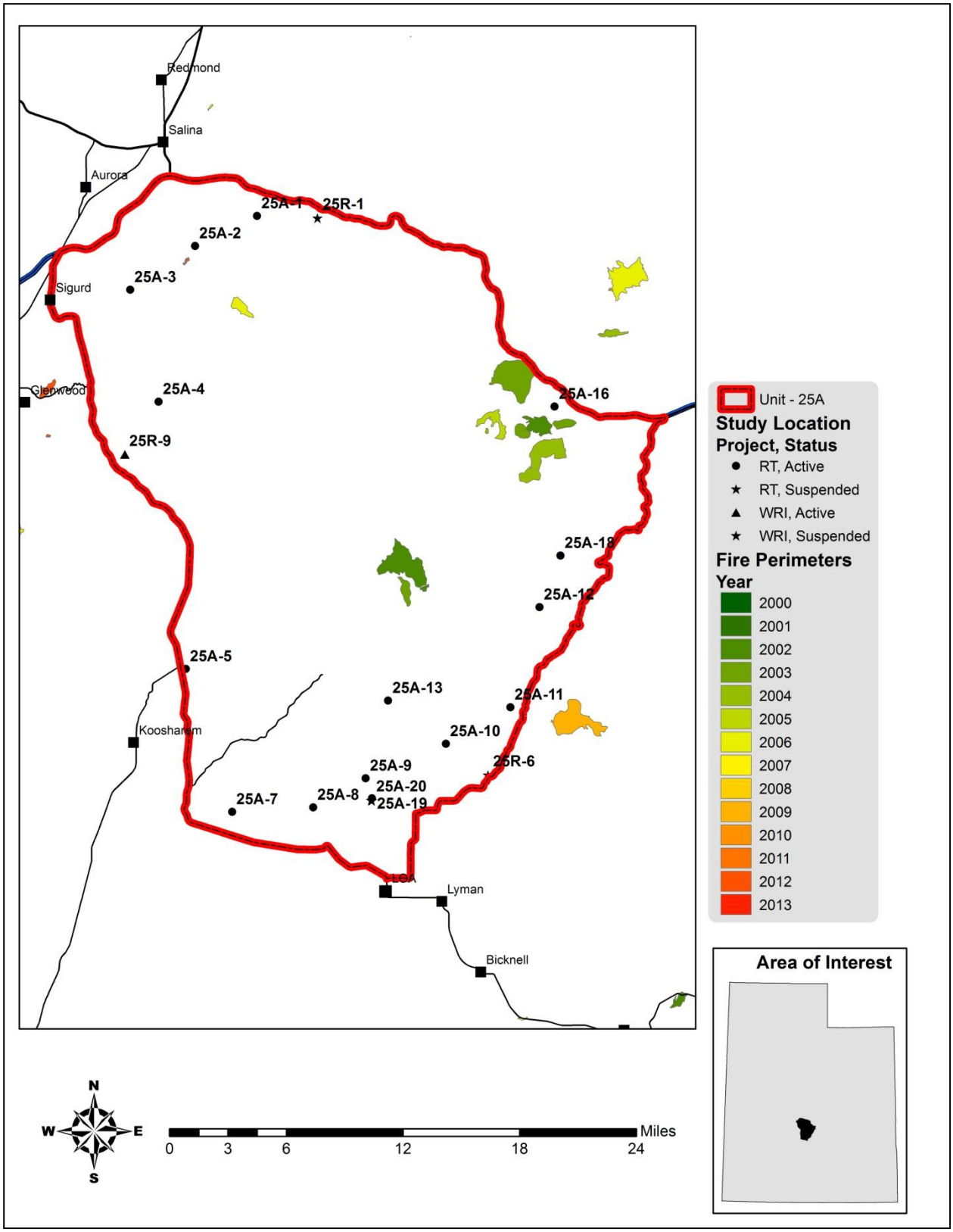
Table 3.4: LANDFIRE existing vegetation coverage (LANDFIRE: LANDFIRE 1.2.0, 2010)of deer winter range for WMU 25A, Fishlake.

Limiting Factors to Big Game Habitat

A history of heavy overgrazing by sheep and cattle is largely responsible for the present composition of most of the vegetative communities. Although overgrazing may still occur in some areas, grazing restrictions and management plans have been implemented on both Forest Service and BLM lands. Range conditions appear to be improving in most areas. Browse species increased as the competition from grasses and forbs was reduced by the heavy grazing. The result was large areas of deer winter range with abundant browse forage. However, good spring-fall deer range or transition range is lacking. During these seasons, deer seek succulent green grasses and forbs. Because the herbaceous component is inadequate, depredation occurs on private croplands, especially alfalfa fields. The UDWR is working with the other agencies to improve spring-fall ranges with chaining, spraying, harrowing, and/or seeding projects. Additionally gas and oil exploration and road building are current land management concerns. There is presently a moderately high density of roads in the area. Although off-road use of vehicles is prohibited, OHV's and four-wheel drive vehicles have access throughout the unit.

Wildfire has had minimal impact on the deer winter range in the unit. The majority of the fires in this unit have occurred on or near Moroni Peak. The 2003 Moroni Peak fire was the largest wildfire in the unit at 2,545 acres. It burned in three separate parts with the largest portion being on Moroni Peak. There have been two other fires on the unit greater than 1,000 acres. The Johnson fire burned 1,845 acres in 2002 on Mt. Marvine and a second Moroni Peak fire burned 1,526 acres in 2004. The majority of the other fires in this unit burned 300-600 acres at a time, having a negligible impact on deer winter range (Map 3.5).

Encroachment by pinyon-juniper woodland communities also poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 25A (Table 3.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000)

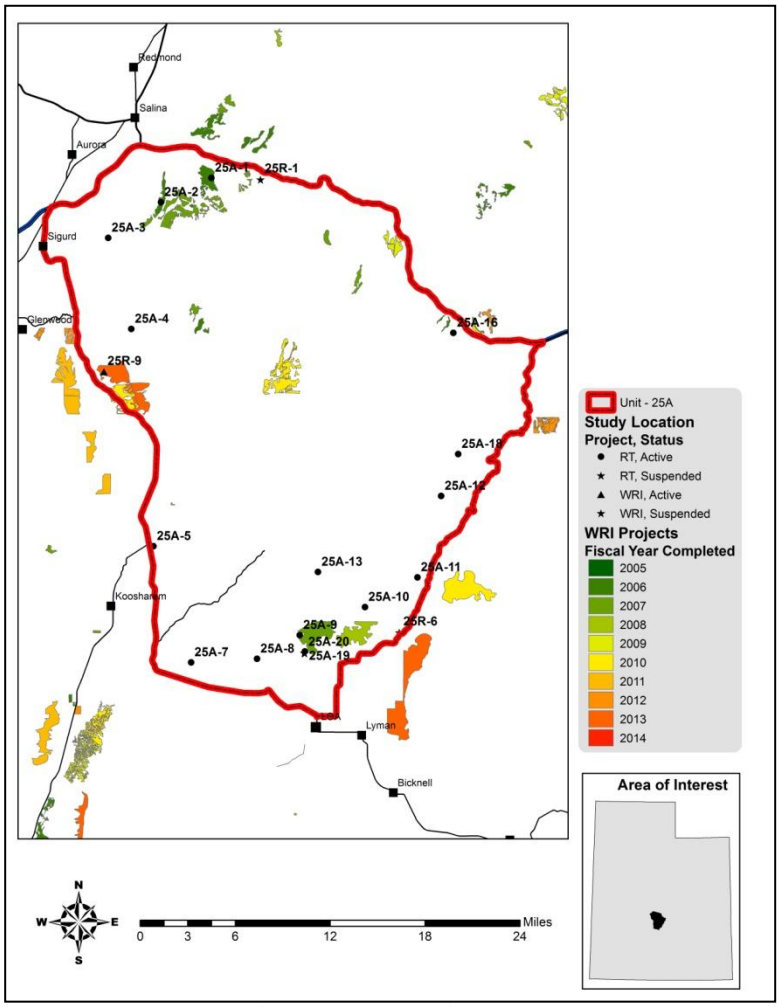


Map 3.5: Land coverage of fires by year from 2001-2013 for WMU 25A, Fishlake (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2014).

Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 12,626 acres of land have been treated within the Fishlake unit since the WRI was implemented in 2004. Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

Treatments to reduce pinyon-juniper woodlands such as chaining and lop-and-scatter are among the most common management practices. The use of seeding to supplement the herbaceous understory is also very common. Other common management practices are those used to rejuvenate sagebrush stands such as mow and harrow treatments (Table 3.5).



Map 3.6: WRI treatments by fiscal year completed for WMU 25A, Fishlake.

Treatment Action	Acres
Chaining	1,646
Harrow	7,365
Logging	52
Lop and Scatter	2,276
Mow	2,212
Seeding (primary)	6,971
Seeding (secondary/shrub)	2,503
***Total Land Area Treated**	**12,626**
Total Treatment Acres	**23,025**

Table 3.5: WRI treatment action size (acres) for WMU 25A, Fishlake.

*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 25A on a regular basis since 1985, with studies being added or suspended as was deemed necessary (Table 3.6). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Monitoring studies of WRI projects have been sampled since 2005. When possible, WRI monitoring studies are established prior to treatment and sampled on a regular basis following treatment. Due to the long-term nature of the studies, many of the Range Trend and WRI studies have had some sort of disturbance or treatment prior to or since study establishment (Table 3.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
25A-1	Triangle Mountain	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Upland Shallow Loam (Pinyon-Utah Juniper)
25A-2	Black Mountain	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Upland Shallow Loam (Pinyon-Utah Juniper)
25A-3	Sage Flat	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Semidesert Loam (Wyoming Big Sagebrush)
25A-4	Durfee Homestead	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Mountain gravelly loam (Mountain Big Sagebrush)
25A-5	Praetor Slope	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Semidesert Loam (Wyoming Big Sagebrush)
25A-7	Evans Reservoir	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Mountain Loam (Mountain Big Sagebrush)
25A-8	Lower Dog Flat	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-9	Row of Pines	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-10	Cedarless Flat	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Semidesert Loam (Wyoming Big Sagebrush)
25A-11	Forsyth Reservoir	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Upland Loam (Black Sagebrush)
25A-12	East Tidwell	RT	Active	‘91, ‘99, ‘04, ‘09,‘13	High Mountain Loam (Mountain Big Sagebrush)
25A-13	Ox Spring	RT	Active	‘91, ‘99, ‘04, ‘09,‘13	High Mountain Loam (Mountain Big Sagebrush)
25A-14	Row of Pines Exclosure	RT	Active	‘91, ‘99, ‘04, ‘09,‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-16	Tommy Hollow	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-18	Elk Camp	RT	Active	‘85, ‘91, ‘99, ‘04, ‘09,‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-19	Row of Pines Livestock Exclosure	RT	Suspended	‘99, ‘04, ‘09	Not Verified
25A-20	Row of Pines Total Exclosure	RT	Suspended	‘99, ‘04, ‘09	Not Verified
25R-9	Sand Ledges	WRI	Active	‘12	Not Verified

Table 3.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 25A, Fishlake.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
25A-1	Triangle Mountain	Chain Unknown		1970		
		Seed Unknown		1970		
		2-way Dixie Harrow	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	Fall 2005	4,079	216
		Broadcast Seeding	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	Fall 2005	1,600	216
25A-2	Black Mountain	Chain Unknown		1984		
		Seed Unknown		1984		
		2-way Dixie Harrow	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	Fall 2005	4,079	216
		Broadcast Seeding	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	Fall 2005	1,600	216
25A-4	Durfee Homestead	Chain Unknown		1983		
		Seed Unknown		1983		
		Wildfire		1985-1991		
25A-5	Praetor Slope	Chain Unknown		1964	1,400	
		Seed Unknown		1964	1,400	
		2-way Dixie Harrow		2002	3,000	
		Seed Unknown		2002	3,000	
25A-7	Evans Reservoir	2-way Dixie Harrow		Fall 1999		
		Seed Unknown		Fall 1999		
25A-8	Lower Dog Flat	Chain Unknown		1980		
		Seed Unknown		1980		
		2-way Dixie Harrow	Seven Mile-North Mountain Dixie Harrow	Fall 2006	6,000	594
		Broadcast Before	Seven Mile-North Mountain Dixie Harrow	Fall 2006	6,000	594
25A-10	Cedarless Flat	Chain Unknown		1987		
		Seed Unknown		1987		
25A-13	Ox Spring	Prescribed Fire		1989 or 1990		
25A-14	Row of Pines Exclosure	Chain Unknown		late 1980's		
		Seed Unknown		late 1980's		
		2-way Dixie Harrow	Seven Mile-North Mountain Dixie Harrow	Fall 2006	6,000	594
		Broadcast Before	Seven Mile-North Mountain Dixie Harrow	Fall 2006	6,000	594
25A-18	Elk Camp	Prescribed Fire		1990		
25A-19	Row of Pines Livestock Exclosure	Chain Unknown		late 1980's		
		Seed Unknown		late 1980's		
25A-20	Row of Pines Total Exclosure	Chain Unknown		late 1980's		
		Seed Unknown		late 1980's		
25R-9	Sand Ledges	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Lop and Scatter	Sandledges Lop and Scatter Project Phase II	Jun. 2013	2,275	2334

Table 3.7: Range trend and WRI studies known disturbance history for WMU 25A, Fishlake.

Study Trend Summary (Undisturbed Sites)

High Mountain (Mountain Big Sagebrush)

There are two studies [East Tidwell (25A-12) and Ox Spring (25A-13)] classified as High Mountain (Mountain Big Sagebrush) ecological site that remained undisturbed over the report period (Table 3.6). These study sites occur respectively to the east and south of Johnson Reservoir. These sites are considered summer range.

Shrubs/Trees: The primary browse species are mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and black sagebrush (*A. nova*). Other preferred browse species are sparse on the sites. The majority of the

shrub cover comes from other shrubs. Sagebrush cover has increased slightly over the sample years but remains relatively low (Figure 3.2a). The average height of sagebrush on these studies is less than 1 foot tall, limiting the availability of browse through much of winter. The age classes of the sagebrush populations, specifically young and mature plants, were high in proportion to one another throughout the years, and young plants were considered to be particularly high in density in 2009 and 2013 (Figure 3.2b). There were no trees located within the study area.

Herbaceous Understory: This study sites has a good herbaceous component dominated by native perennial grasses and forbs. This site supports and variety of native grasses with mutton bluegrass (*Poa fendleriana*) being the most abundant in both frequency and cover. Cheatgrass (*Bromus tectorum*) is not found on this site (Figure 3.3).

In addition, a diverse number of native perennial and annual forbs provided a fair amount of cover (Figure 3.3b).

Occupancy: Pellet group transect data indicates that elk primarily use these sites. The mean abundance of elk pellet groups has ranged from a high of 85 days use/acre in 2008 and 2013 to a low of 70 days use/acre in 2009. Cattle and deer occupancy have been low and have remained that way over the sample years (Figure 3.4).

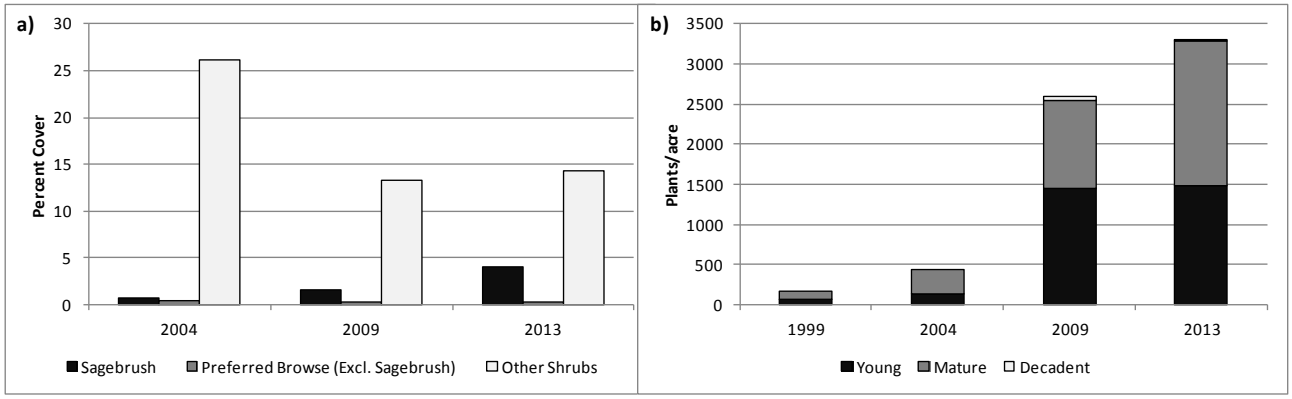


Figure 3.2: Shrub summary of the High Mountain (Mountain Big Sagebrush) study (n=2) for WMU 25A, Fishlake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of silver sagebrush.

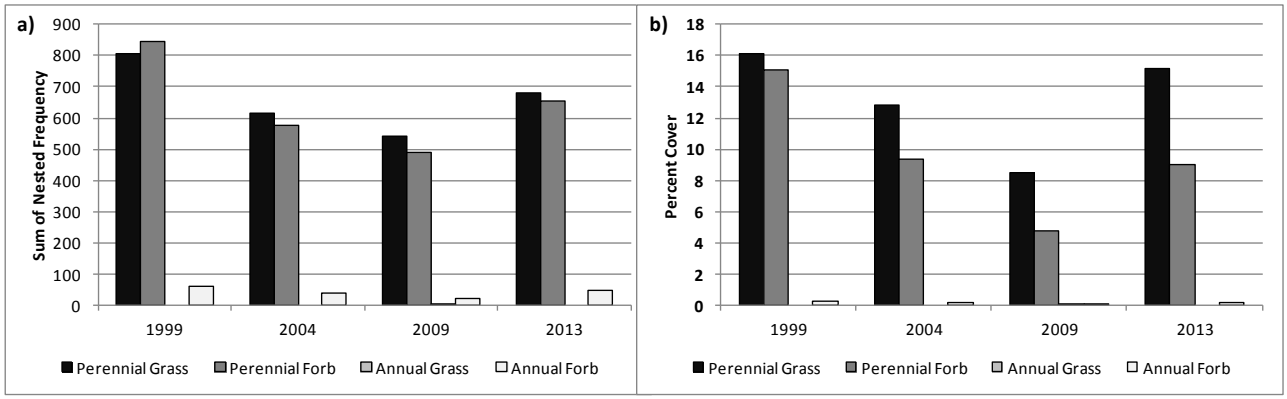


Figure 3.3: Herbaceous functional group summary of the High Mountain (Mountain Big Sagebrush) study (n=2) for WMU 25A, Fishlake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

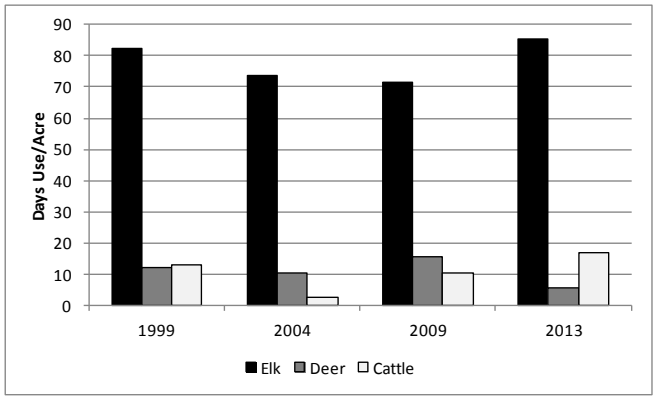


Figure 3.4: Mean pellet transect data for the High Mountain (Mountain Big Sagebrush) study (n=2) for WMU 25A, Fishlake.

Mountain (Mountain Big Sagebrush)

There is one study [Durfee Homestead (25A-4)] classified as an mountain (Mountain Big Sagebrush) ecological site that remained undisturbed over the report period (Table 3.6). It is located east of Glenwood and SR-24.

Shrubs/Trees: The sagebrush cover on this site is relatively low, however there is a diverse number of other preferred species like Gambel oak (*Quercus gambelii*) and antelope bitterbrush (*Purshia tridentata*) that are the primary browse species on this study. The mean line-intercept cover of sagebrush remains low but the cover of other preferred shrubs has been slowly increasing over the years (Figure 3.5a). The average height of mountain big sagebrush on this study site is just less than 2 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush population were mostly mature plants since 1999, with an increase in young sagebrush plants in 2004 and decadent plants in 2009; however, the population is quite small (Figure 3.5b).

Juniper (*Juniperus* sp.) is a very minor component on Durfee Homestead (Figure 3.6). At this point pinyon and juniper do not pose a threat of encroachment.

Herbaceous Understory: The herbaceous understory of the Durfee Homestead study is comprised of a mixture of native and introduced perennial grasses of moderate frequency and cover. The introduced annual grass cheatgrass is present on the site in low to moderate frequency and low cover. Cheatgrass does not pose a threat of increased fire at this point, but could be hazardous if it were to increase in cover. Both annual and perennial forbs are generally low in frequency and cover (Figure 3.7).

Occupancy: Pellet group transect data indicates that animal occupancy of these studies is relatively low. The exception to this would be in 1999 when elk occupancy was moderate. The mean abundance of all animal pellet groups has been 15 days use/acre or less across all study years (Figure 3.8).

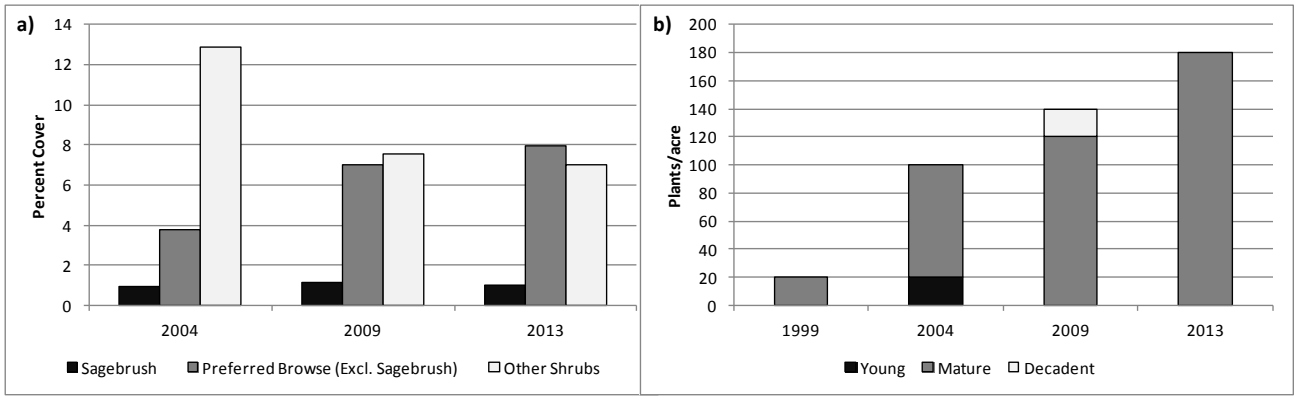


Figure 3.5: Shrub summary of the Mountain (Mountain Big Sagebrush) study (n=1) for WMU 25A, Fishlake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

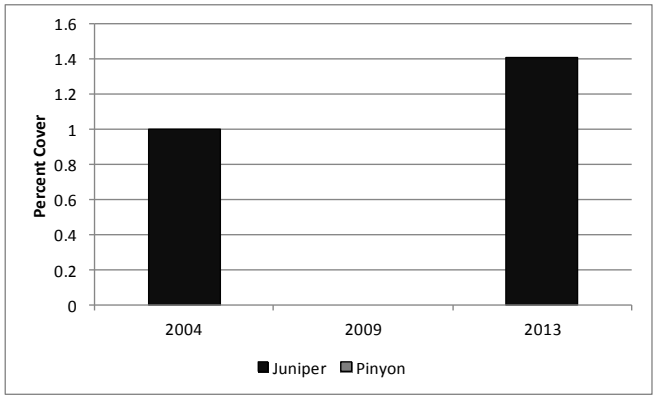


Figure 3.6: Tree summary of the Mountain (Mountain Big Sagebrush) study (n=1) for WMU 25A, Fishlake. Mean line-intercept cover estimate for pinyon pine and Utah juniper.

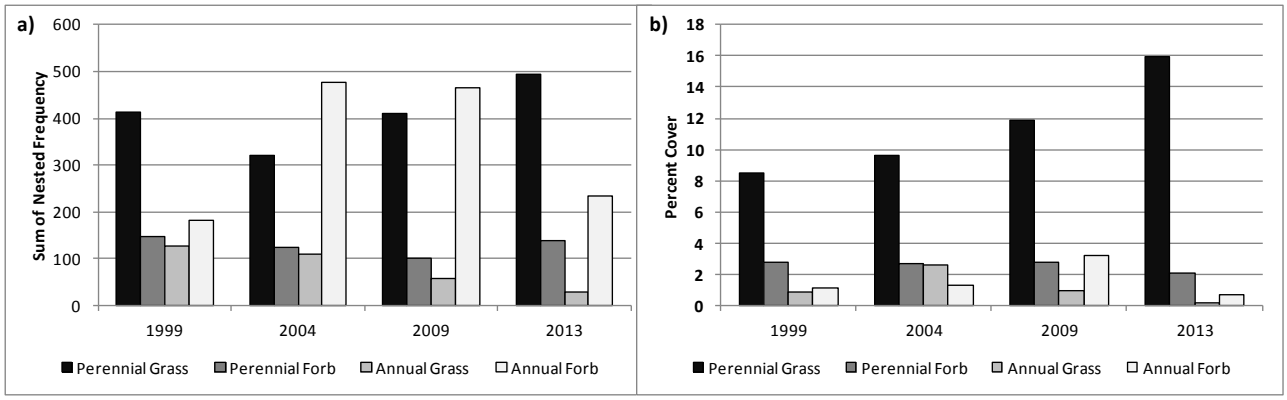


Figure 3.7: Herbaceous functional group summary of the Mountain (Mountain Big Sagebrush) study (n=1) for WMU 25A, Fishlake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

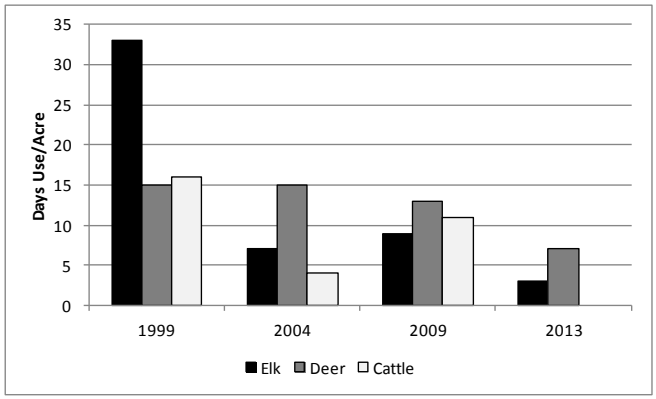


Figure 3.8: Mean pellet transect data for the Mountain (Mountain Big Sagebrush) study (n=1) for WMU 25A, Fishlake.

Upland (Mountain Big Sagebrush)

There are three studies [Row of Pines (25A-9), Tommy Hollow (25A-16), and Elk Camp (25A-18)] classified as Upland (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 3.6). Row of Pines is located northwest of Fremont on the Row of Pines Bench. Tommy Hollow and Elk Camp are on the east side of the unit, with Tommy Hollow being just south of I-70 and east of Moroni Peak and Elk Camp west of SR-72 just off the Last Chance Road.

Shrubs/Trees: The primary browse on these studies was mountain big sagebrush and black sagebrush. Trends in cover and composition have varied on individual sites. The mean line-intercept cover of sagebrush is good on all studies and maintains about 15% cover on all sites (Figure 3.9a). The average height of mountain big sagebrush on all of the studies is approximately 1.5 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have remained fairly consistent from year to year with mature plants comprising the majority of the population with young and decadent plants varying from year to year (Figure 3.9b). Tree density and cover have steadily increased over the sample years with the greatest increase occurring in 2013 (Figure 3.10).

Herbaceous Understory: The general herbaceous composition for all sites is moderate perennial grass cover with relatively low forb cover. Tommy Hollow has the highest grass cover of all the sites and is composed primarily of native species. Cheatgrass is not present on any of these sites. Perennial and annual forb frequency and cover have remained low over the sample years (Figure 3.11).

Occupancy: Pellet group transect data indicates that animal use varies from site to site, but cattle occupancy has been low for all sites. Row of Pines had low animal presence on most years. Tommy Hollow had high occupancy for both deer and elk in 1999 (96 and 93 days use/acre respectively) but dropped to moderate and low in the subsequent years. The mean abundance of elk pellet groups for Elk Camp has remained moderate with a high of 39 days use/acre in 2009 to a low of 21 days use/acre in 1999. Deer use of Elk Camp has varied widely with a mean abundance of pellet groups as high as 105 days use/acre in 2009 to as low as 2 days use/acre in 2013 (Figure 3.12).

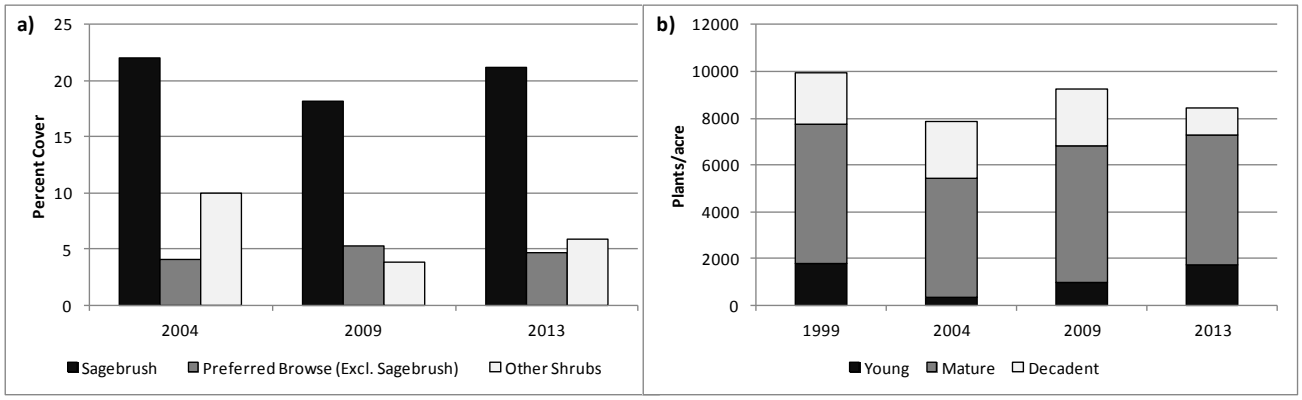


Figure 3.9: Shrub summary of the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 25A, Fishlake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

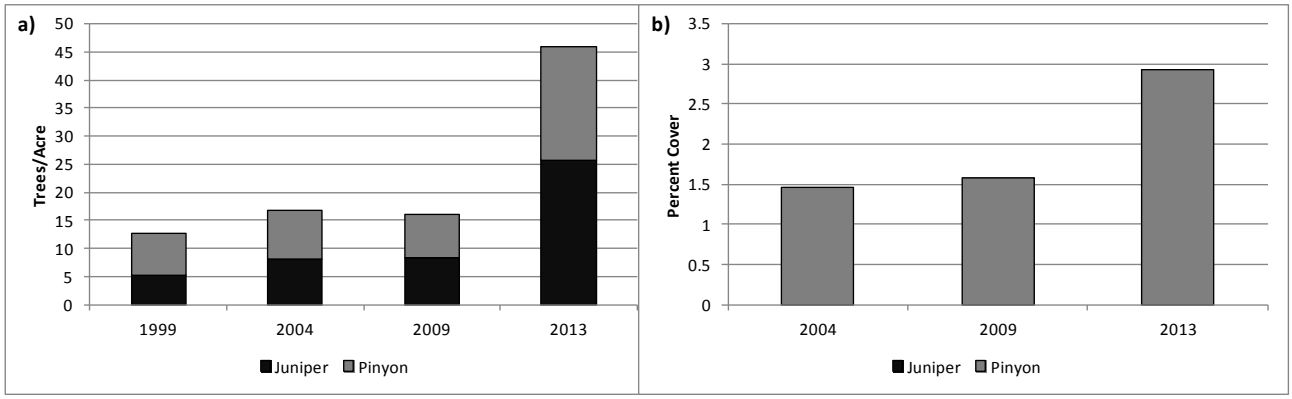


Figure 3.10: Tree summary of the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 25A, Fishlake. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

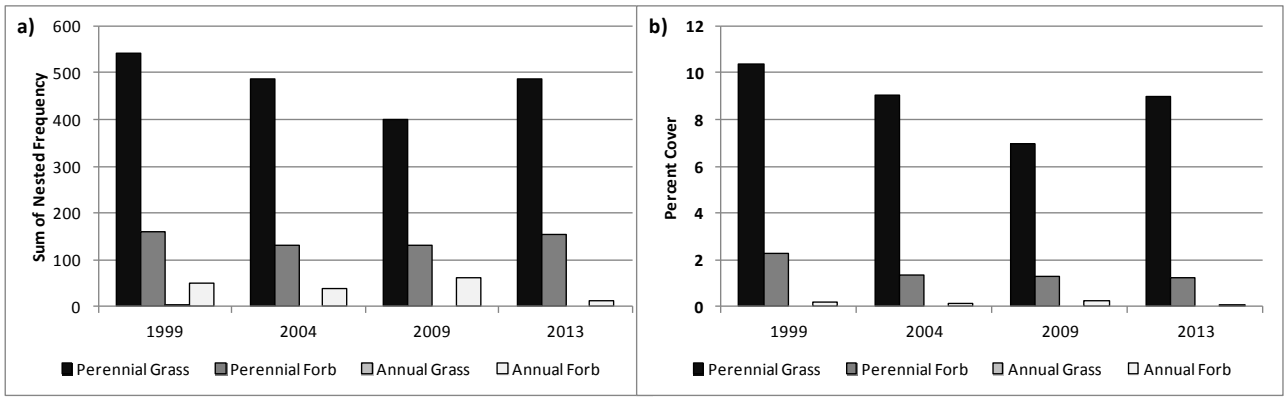


Figure 3.11: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 25A, Fishlake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

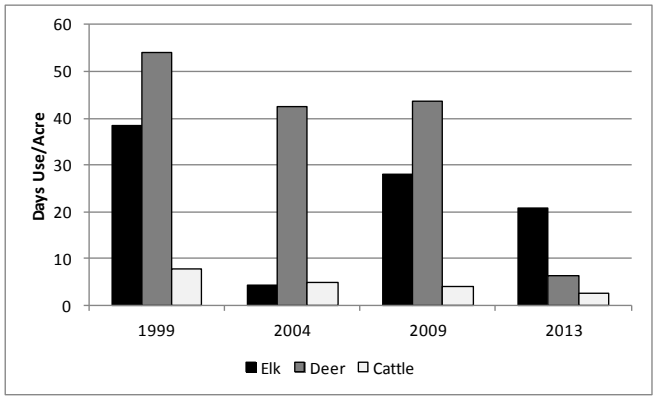


Figure 3.12: Mean pellet transect data for the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 25A, Fishlake.

Upland (Black Sagebrush)

There is one study [Forsyth Reservoir (25A-11)] classified as an Upland (Black Sagebrush) ecological site that remained undisturbed over the report period (Table 3.6). Forsyth Reservoir is located west of SR 72 just north of Forsyth Reservoir.

Shrubs/Trees: The primary browse species on this study is black sagebrush. The mean line-intercept cover of sagebrush is good on this site and has steadily increased over the sample years (Figure 3.13a). The average height of black sagebrush is less than 1 foot tall, making browse unavailable in normal winters. The demographics of the sagebrush population have varied from year to year. The recruitment of young plants was high in 1999 and 2013; and density of decadent plants was high in 1999, 2004, and 2009; while density of mature plants has been fairly consistent throughout each sample period (Figure 3.13b). Pinyon pine (*Pinus edulis*) cover has varied from year to year but remains less than 1% (Figure 3.14).

Herbaceous Understory: Native perennial grasses dominate the herbaceous understory with relatively low forb cover. Cheatgrass is not present on this site. Perennial and annual forb frequency and cover have remained low over the sample years (Figure 3.15).

Occupancy: Pellet group transect data indicates that elk primarily occupy Forsyth Reservoir. The mean abundance of elk pellet groups has ranged from as high as 60 days use/acre in 1999 to as low as 3 days use/acre in 2013. Deer and cattle use of this area has been less than 10 days use/acre across all years (Figure 3.16).

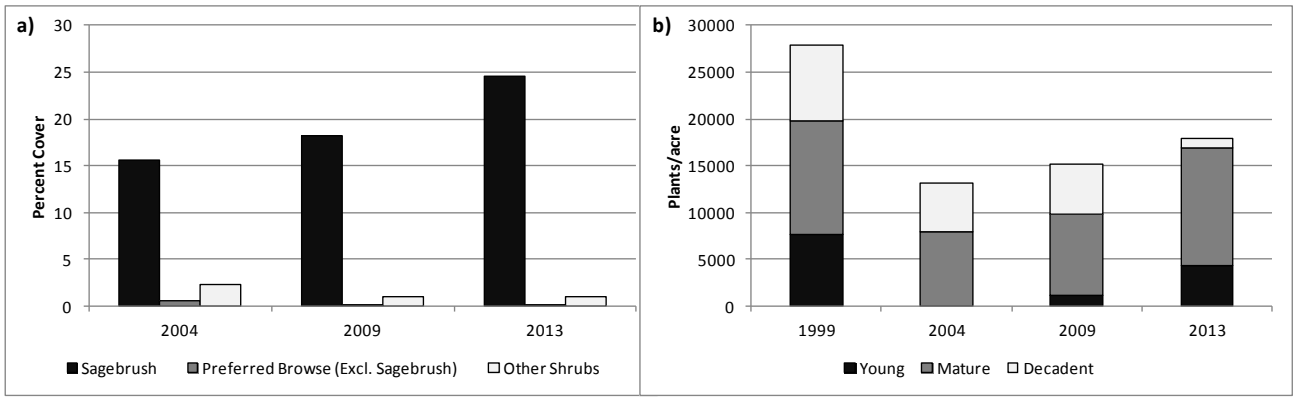


Figure 3.13: Shrub summary of the Upland (Black Sagebrush) study (n=1) for WMU 25A, Fishlake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia* spp.) species.

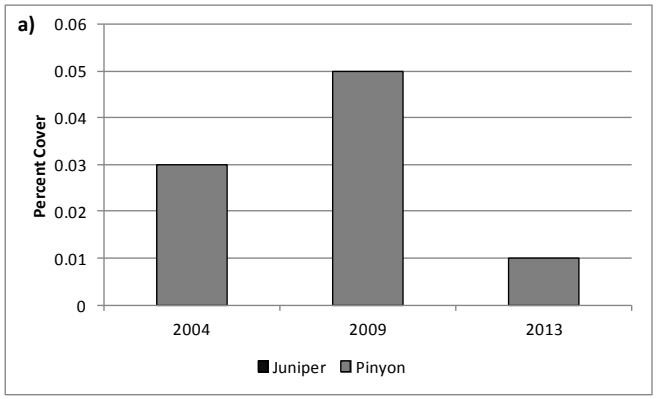


Figure 3.14: Tree summary of the Upland (Black Sagebrush) study (n=1) for WMU 25A, Fishlake. a) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

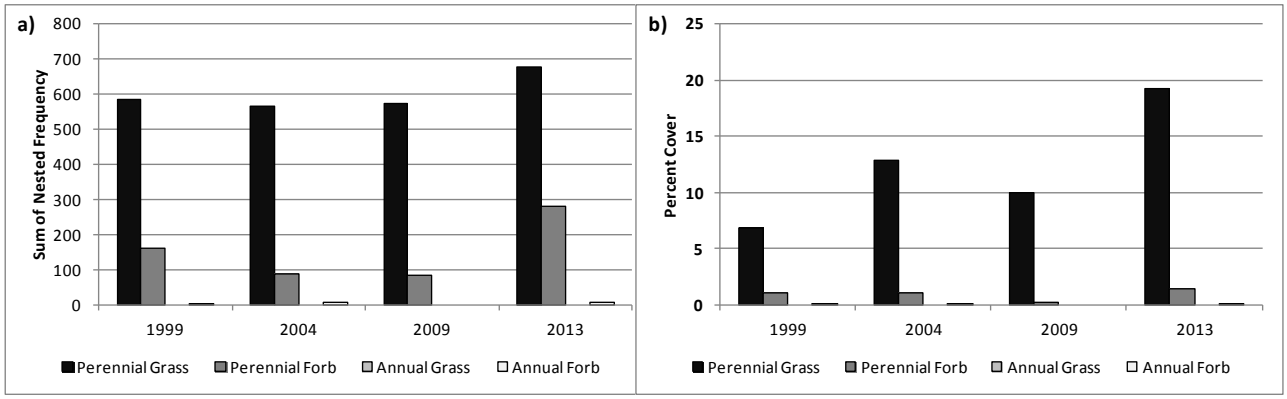


Figure 3.15: Herbaceous functional group summary of the Upland (Black Sagebrush) study (n=1) for WMU 25A, Fishlake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

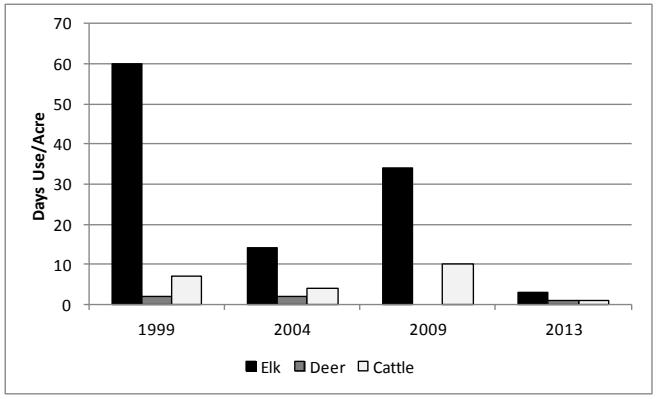


Figure 3.16: Mean pellet transect data for the Upland (Black Sagebrush) study (n=1) for WMU 25A, Fishlake.

Semidesert (Wyoming Big Sagebrush)

There are two studies [Sage Flat (25A-3) and Cedarless Flat (25A-10)] classified as Semidesert (Wyoming Big Sagebrush) ecological site that remained undisturbed over the report period (Table 3.6). The Sage Flat study is located east of Rocky Ford Reservoir in the Sage Flat. The Cedarless Flat study is located just west of Mill Meadow Reservoir on Cedarless Flat.

Shrubs/Trees: The primary browse on these studies are Wyoming big sagebrush with no other preferred browse species sampled in cover measurements on these studies. The mean line-intercept cover of sagebrush is good on this site, and has remained above 12% (Figure 3.17a). The average height of Wyoming big sagebrush on this study is approximately 1.5 feet tall, making browse available through much of the year in

normal winters. These sagebrush populations have generally been comprised of a mixture of mature and decadent plants with recruitment of young plants being high in 1999 and 2013 (Figure 9.18b). There were no trees sampled on these study sites in any of the sample years.

Herbaceous Understory: These study sites have a fairly poor herbaceous component. Sage Flat is dominated by cheatgrass and annual forbs. Cheatgrass increases the risk of fire and threatens the resiliency of this site. Cedarless Flat has low to moderate perennial grass cover and frequency, with little to no cover from forbs. Cedarless Flat does not have cheatgrass, but it does have perennial introduced grasses, which include crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), and Russian wildrye (*Elymus junceus*), that could decrease understory diversity (Figure 3.18).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy these study sites. The mean abundance of deer pellet groups has ranged from a high of 140 days use/acre in 2004 to a low of 20 days use/acre in 2013 (Figure 3.19).

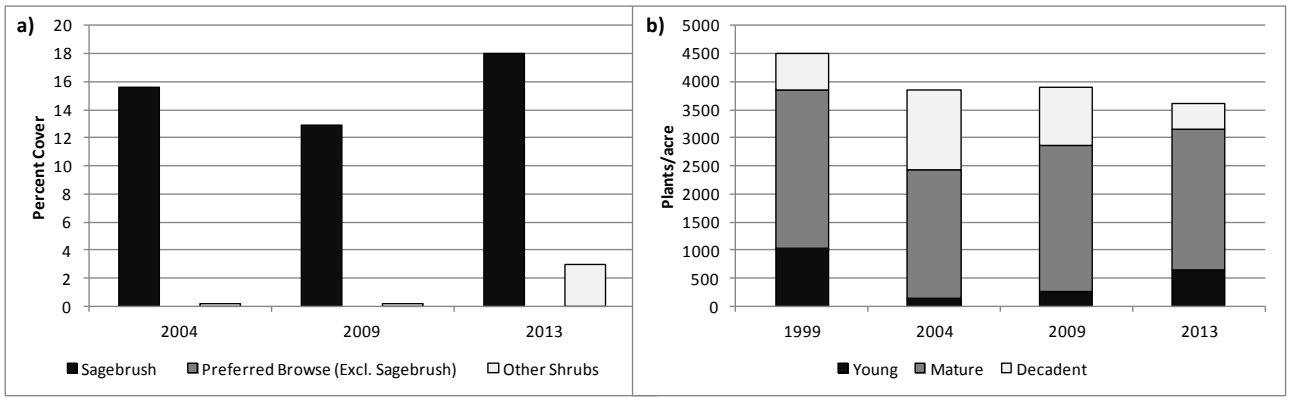


Figure 3.17: Shrub summary of the Semidesert (Wyoming Big Sagebrush) studies (n=2) for WMU 25A, Fishlake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

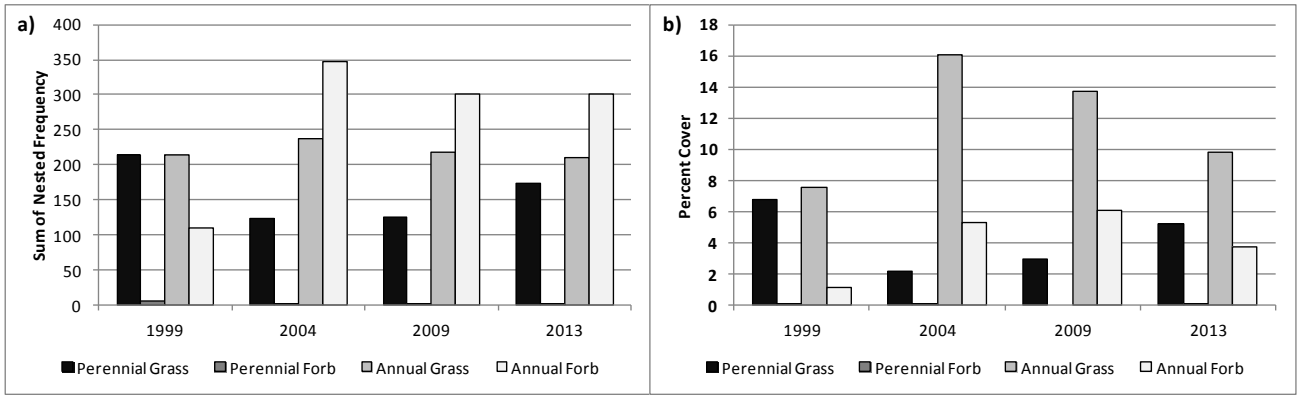


Figure 3.18: Herbaceous functional group summary of the Semidesert (Wyoming Big Sagebrush) studies (n=2) for WMU 25A, Fishlake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

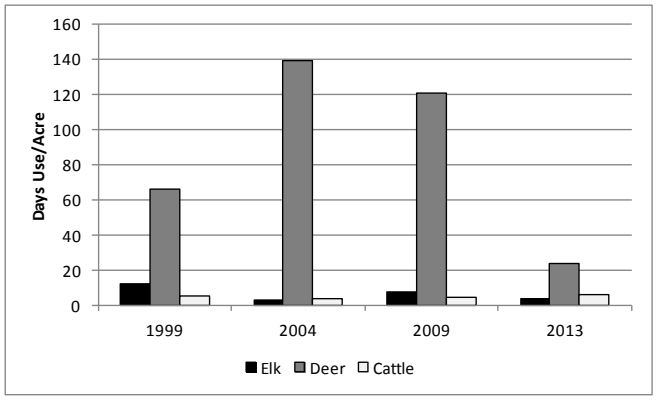


Figure 3.19: Mean pellet transect data for the Semidesert (Wyoming Big Sagebrush) studies (n=2) for WMU 25A, Fishlake.

Study Trend Summary (Treated/Disturbed Sites)

Harrow

There are six studies [Triangle Mountain (25A-1), Black Mountain (25A-2), Praetor Slope (25A-5), Evans Reservoir (25A-7), Lower Dog Flat (25A-8), and Row of Pines Exclosure (25A-14)] that were treated with harrow during the report period (Table 3.6). The Triangle Mountain and Black Mountain studies are south of Salina on Triangle Mountain and Black Mountain, respectively. The Praetor Slope study is located just east of Burrville on Praetor Slope. Evans Reservoir and Lower Dog Flat are located just north of SR 24 on the Awapa Plateau. The Row of Pines Exclosure study is west of Fremont on the Row of Pines Bench. Evans Reservoir is classified as Mountain (Mountain Big Sagebrush), Triangle Mountain and Black Mountain are Upland (Pinyon-Utah Juniper), Lower Dog Flat and Row of Pines Exclosure are Upland (Mountain Big Sagebrush), and Praetor Slope is a Semidesert (Wyoming Big Sagebrush) site (Table 3.7). Generally, the target of the harrow treatments was to rejuvenate degraded sagebrush and increase the herbaceous understory

Shrubs/Trees: The primary browse on Evans Reservoir and Lower Dog Flat is mountain big sagebrush, black sagebrush is the main browse species on Triangle Mountain and Black Mountain, and Wyoming big sagebrush is the primary browse species on Praetor Slope and Row of Pines Exclosure. There were no other preferred shrubs recorded on any of these sites. The mean cover of sagebrush decreased in the first 5 years after treatment, but as time since treatment has increased the number of decadent shrubs within the populations has conversely decreased (Figure 3.20a). While the mean density of sagebrush decreased after treatment so has the number of decadent shrubs. Recruitment of young has increased after treatment (Figure 3.20b).

Herbaceous Understory: These study sites have a good herbaceous component dominated by perennial grasses. However, the dominant grass species are seeded species such as crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*Agropyron intermedium*) on all sites except Evans Reservoir, Lower Dog Flat, and Row of Pines Exclosure, which have native perennial grasses as the dominant species. Competition with these introduced grasses may limit other desirable herbaceous species. Perennial grass had the largest response increasing in mean cover from 13% to 21%. The mean annual and perennial forb cover and frequency has remained similar both before and following treatment. Annual grass is rare to absent on these sites (Figure 3.22).

Occupancy: Pellet group transect data indicates that deer experienced a decline in occupancy from 31 days use/acre to 15 days use/acre as time since treatment increased. While elk experienced an increase in occupancy from 15 days use/acre to 24 days use/acre as time since treatment increased. The mean abundance of pellet groups for cattle varied from year to year, but always stayed below 15 days use/acre (Figure 3.23).

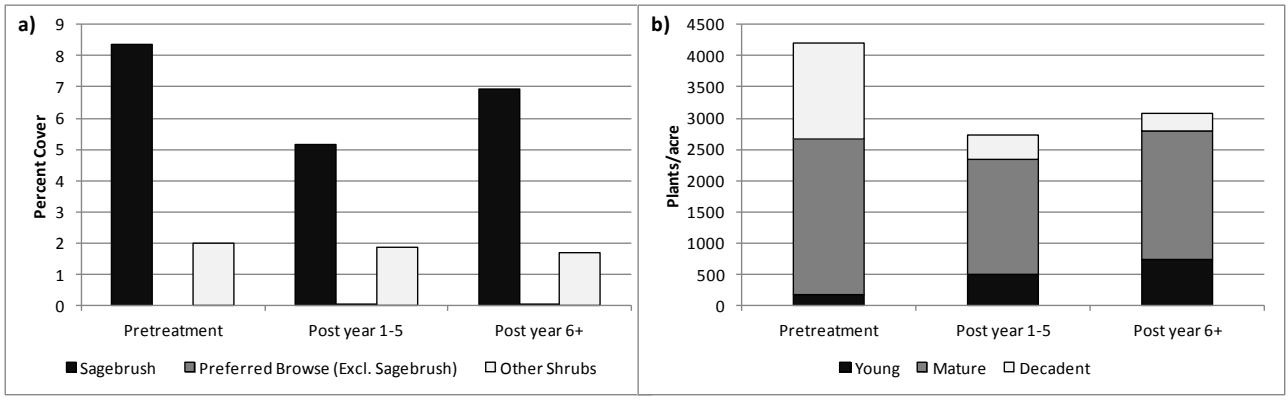


Figure 3.20: Shrub summary of the Harrow treatment studies (n=6) for WMU 25A, Fishlake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

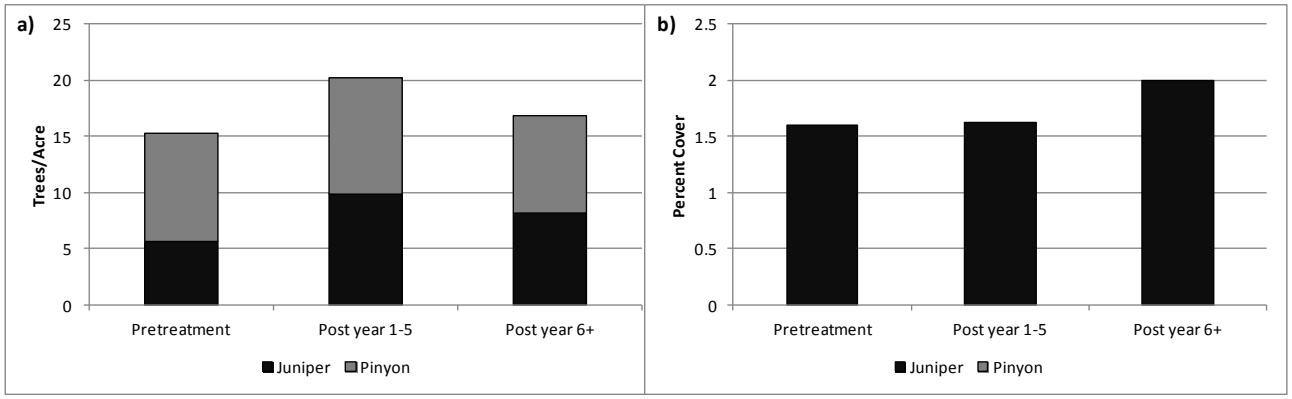


Figure 3.21: Tree summary of the Harrow treatment studies (n=6) for WMU 25A, Fishlake. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

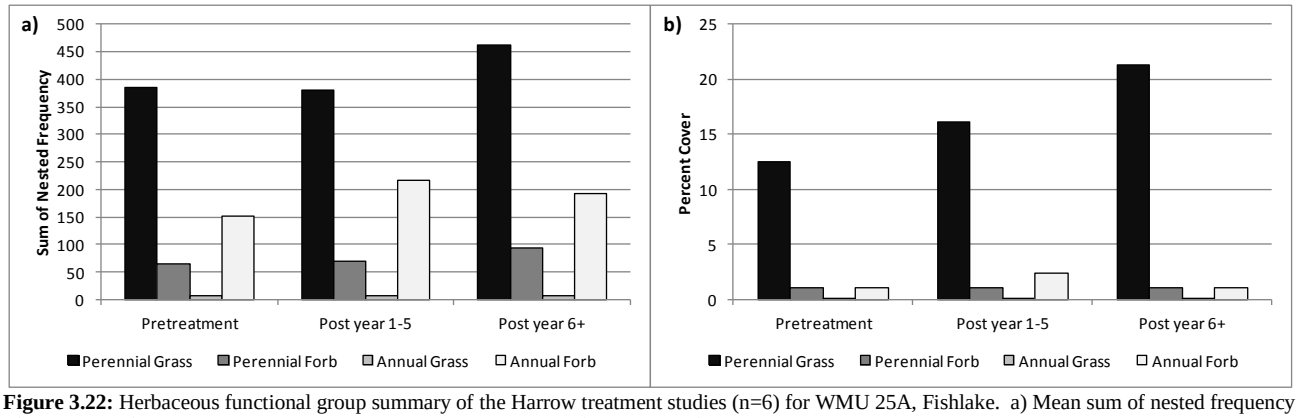


Figure 3.22: Herbaceous functional group summary of the Harrow treatment studies (n=6) for WMU 25A, Fishlake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

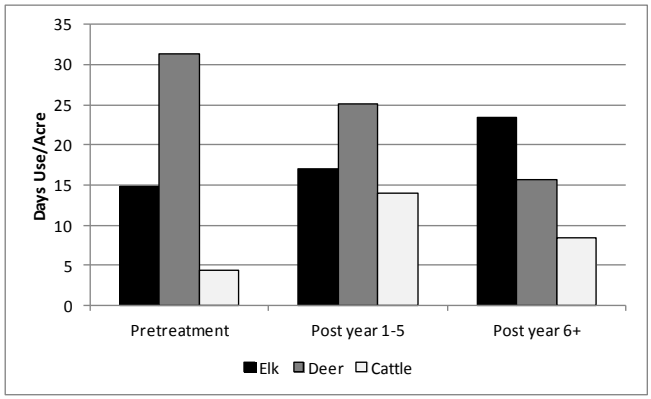


Figure 3.23: Mean pellet transect data for the Harrow treatment studies (n=6) for WMU 25A, Fishlake.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Fishlake management unit has generally improved on the study sites sampled since 1998. As of 2013, the majority of the undisturbed sites sampled within the unit are considered to be in good condition with the exception of the Sage Flat site, which has remained in very poor to poor condition on all sample years (Figure 3.24). This is due to the high amount of annual grass present on this site. The treated study sites are more variable with most sites being fair to good (Figure 3.25). There are two studies, Triangle Mountain and Black Mountain, which were in very poor condition pre-treatment and have remained that way as time since treatment has increased. Poor deer winter range conditions on these sites are likely due to very low browse cover (Map 3.7 and Table 3.8). Because of a reduction in browse cover, Praetor Slope went from being good at pre-treatment to fair at post treatment. Evans Reservoir, Lower Dog Flat, and Row of Pines Exclosure have improved since treatment.

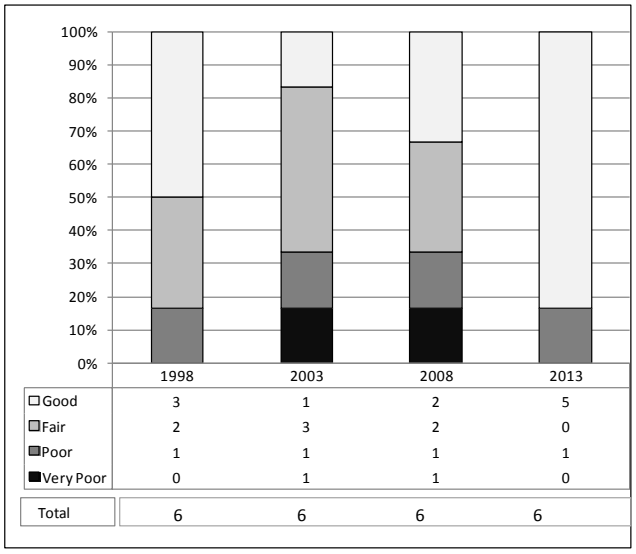


Figure 3.24: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 25A Fishlake.

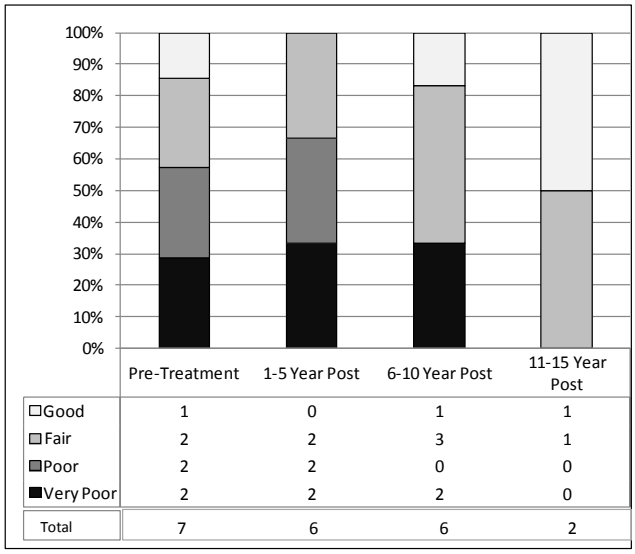
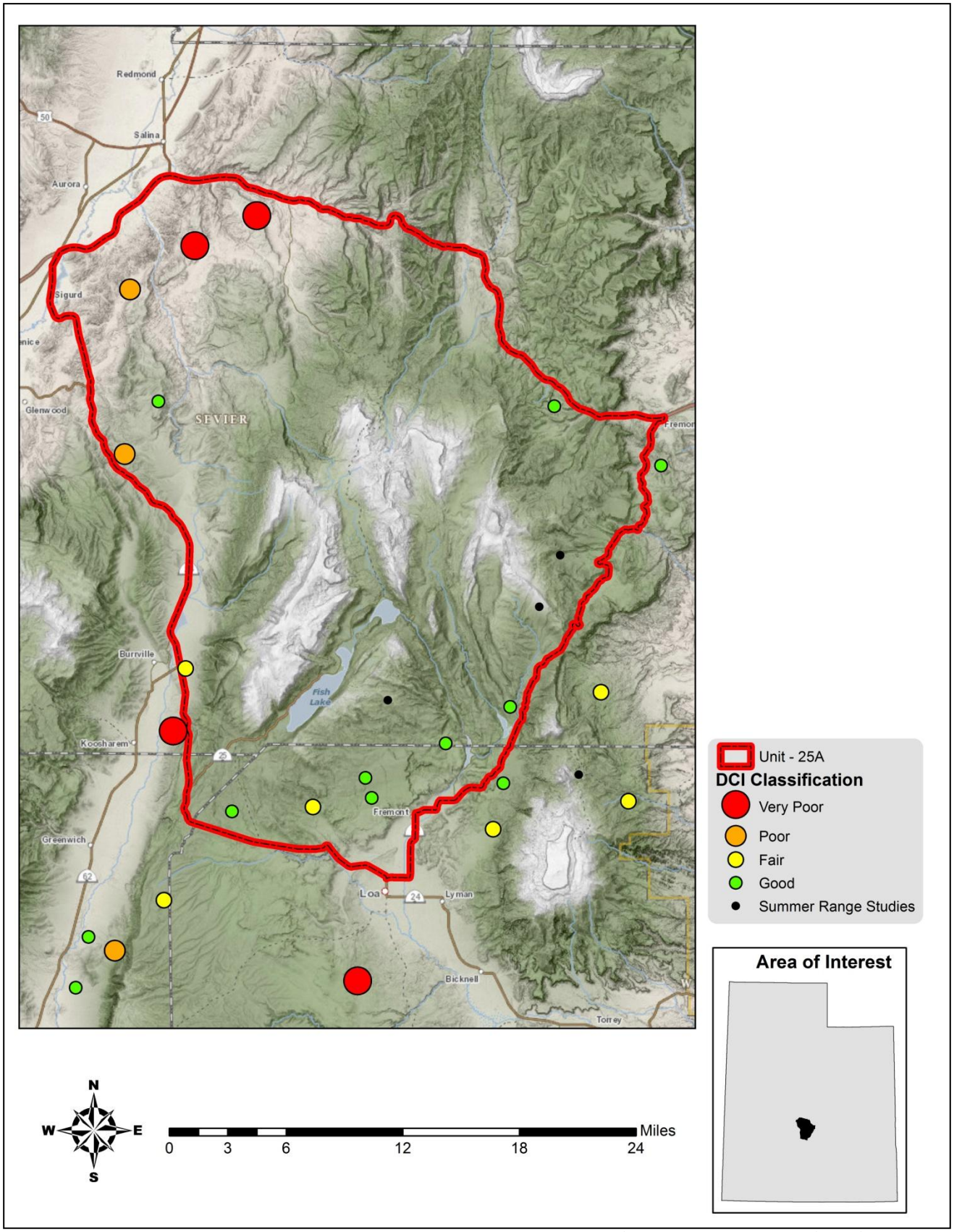


Figure 3.25: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 25A, Fishlake.



Map 3.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 25A, Fishlake.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
25A-1	Triangle Mountain	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species.
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25A-2	Black Mountain	Annual Grass	Low	Increased fire potential.
		Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25A-3	Sage Flat	Annual Grass	High	Increased fire potential.
25A-4	Durfee Homestead	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25A-5	Praetor Slope	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species.
25A-7	Evans Reservoir	None Identified		
25A-8	Lower Dog Flat	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25A-9	Row of Pines	None Identified		
25A-10	Cedarless Flat	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
25A-11	Forsyth Reservoir	None Identified		
25A-12	East Tidwell	None Identified		
25A-13	Ox Spring	None Identified		
25A-14	Row of Pines Exclosure	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
25A-16	Tommy Hollow	None Identified		
25A-18	Elk Camp	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25R-9	Sand Ledges	Annual Grass	Low	Increased fire potential.
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
		PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
25A-1	Triangle Mountain	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species.
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25A-2	Black Mountain	Annual Grass	Low	Increased fire potential.
		Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25A-3	Sage Flat	Annual Grass	High	Increased fire potential.
25A-4	Durfee Homestead	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.

Table 3.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 25A, Fishlake. All assessments are based off the most current sample date for each study site.

Discussion and Recommendations

Mountain and Upland (Mountain Big Sagebrush)

The higher elevation upland and mountain sites that support mountain big sagebrush communities are generally considered to be in good condition for deer winter range habitat on this unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. While in generally good condition, some of these sites appear to be prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. In addition, introduced perennial grasses are often the dominant herbaceous component on these study sites. While providing valuable forage, these grass species can often be aggressive at higher elevation and precipitation and can reduce the prevalence and abundance of other more desirable native grass and forb species.

It is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue where needed in these communities. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Upland (Pinyon-Utah Juniper)

The mid elevation upland sites support a pinyon-Utah juniper community and are generally considered to be in very poor condition for deer winter range habitat on this management unit. This community is dominated by pinyon and juniper trees that provide good cover, but offer little to no browse or forage opportunities. This community is prone to infilling by pinyon-juniper trees into differing ecological sites that surround pinyon-juniper communities and thereby reducing understory shrub and herbaceous cover within adjacent ecological sites if not addressed.

It is recommended that work to reduce pinyon-juniper cover (e.g. bullhog, chaining, lop and scatter, etc.) should continue in this community. Depending on initial tree cover and residual species, reseeding may be necessary to restore herbaceous understory.

Upland (Black Sagebrush)

The mid elevation upland black sagebrush community is considered to be in good condition for deer winter range habitat on this unit. This community supports a robust shrub population that provides valuable browse in moderate to severe winters. Currently this site has no threats, but in general these communities are prone to encroachment from pinyon-juniper trees which can reduce understory shrub and herbaceous health if not addressed. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

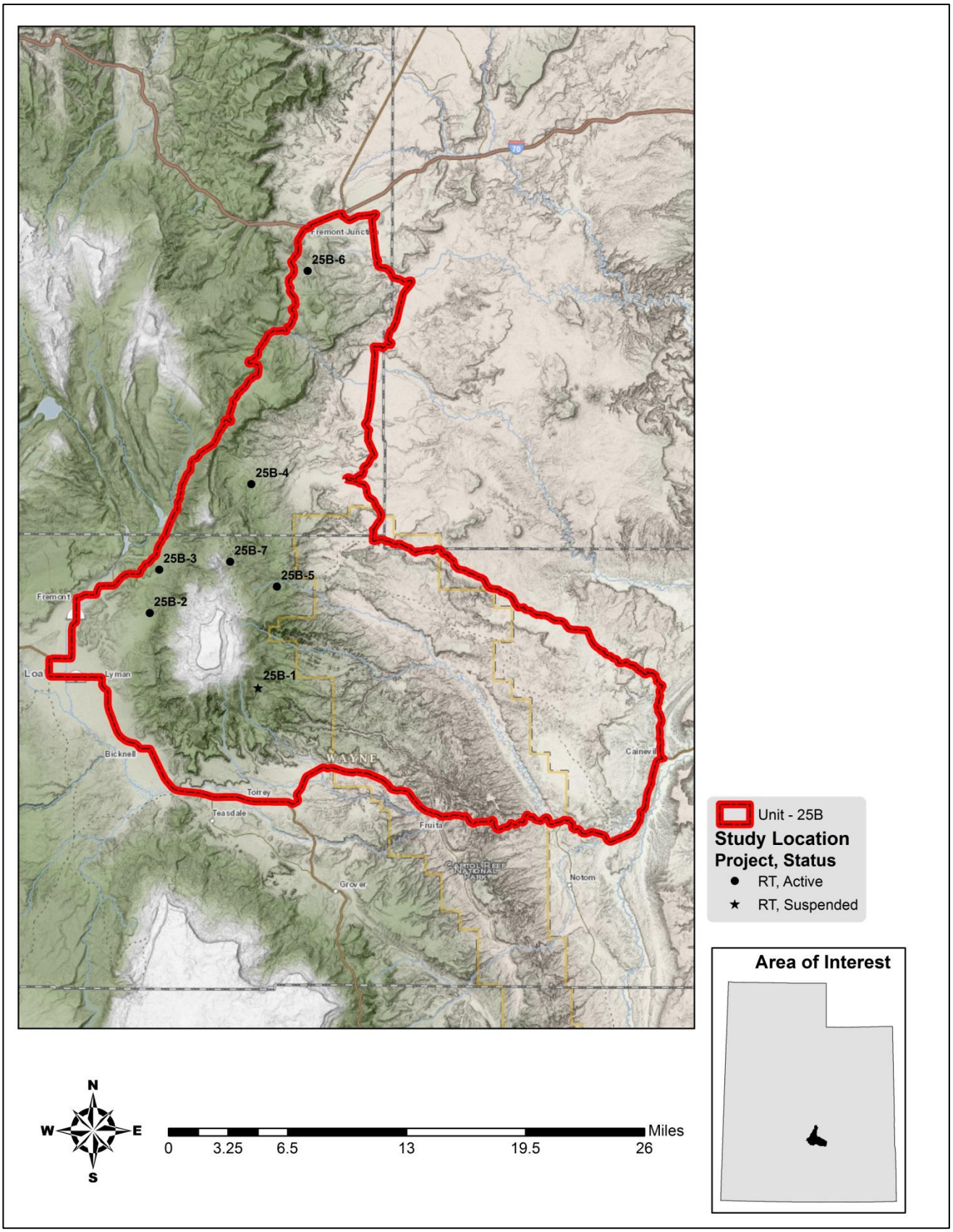
It is recommended that, when necessary, work to reduce pinyon-juniper encroachment should continue in these communities. Care should be taken in selecting treatment methods that will not increase annual grass loads. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

Semidesert (Wyoming Big Sagebrush)

The lower elevation semidesert Wyoming big sagebrush communities that have not been disturbed are considered to be in poor to good condition for deer winter range habitat on the unit. This community supports robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are susceptible to invasion from annual grass, primarily cheatgrass. Cheatgrass can increase fuel loads and the threat of wildfire as well as decreases the habitat value. The disturbed community lacks a good shrub population and is in fair condition. Encroachment from pinyon-juniper trees is not typically an issue within these communities.

It is recommended that work to diminish fuel loads and create firebreaks should continue within these communities in order to reduce the threat of catastrophic fire. Treatments to establish and increase browse species more rapidly following wildfire should also be implemented, and treatments to increase browse species on historic fires should be considered. If a treatment to rejuvenate sagebrush occurs, care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites.

4. WILDLIFE MANAGEMENT UNIT 25B – THOUSAND LAKE



WILDLIFE MANAGEMENT UNIT 25B – THOUSAND LAKE

Boundary Description

Sevier, and Wayne counties - Boundary begins at the junction of SR-24 and SR-72 at Loa; southeast on SR-24 to the Cainville Wash road; north on the Caineville Wash road to the junction of I-70 and SR-72; south on SR-72 to SR-24 at Loa.

Management Unit Description

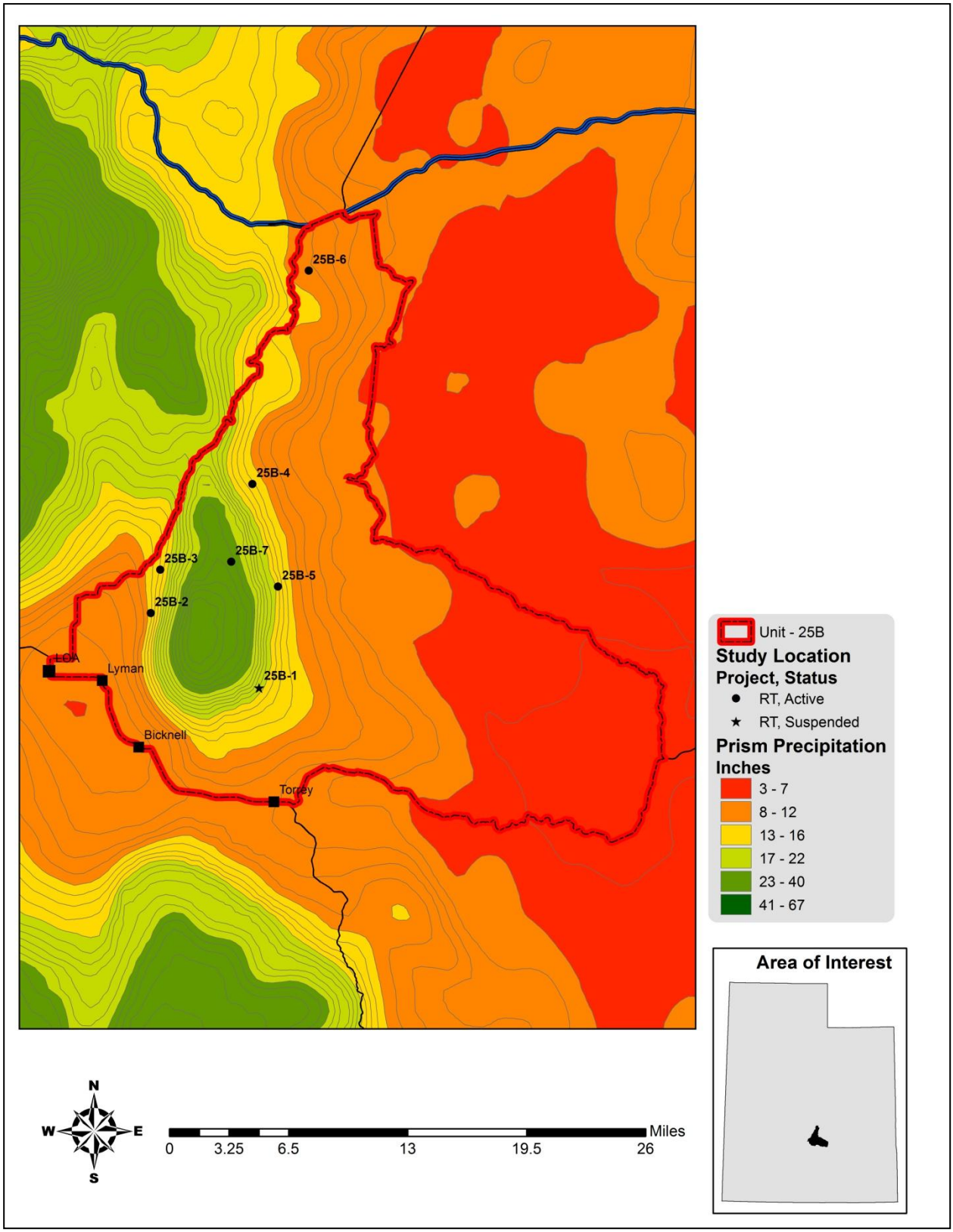
Geography

The Thousand Lake Wildlife Management unit is part of the larger management unit 25 - Plateau. This unit is divided into three sub units, Fish Lake (25A), Thousand Lake (25B), and Boulder Mountain (25C). Management unit 25B was named after Thousand Lake Mountain, a lava-capped plateau with numerous small natural lakes. This mountain reaches an elevation of 11,295 feet and overlooks Capital Reef National Park and the desert country east of the unit. At the extreme southeastern corner of the unit is Caineville and is the lowest point in elevation in the herd unit at about 4,100 feet. The vegetation composition varies greatly throughout the unit with respect to topographical relief and elevation. The major towns in this unit are Fremont, Loa, Bicknell, and Caineville.

Climate Data

The 30 year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 3 inches on the lower east side of the unit to 29 inches on Thousand Lake Mountain. All of the Range Trend and WRI monitoring studies on the unit occur within 12-24 inches of precipitation (Map 4.1) (PRISM Climate Group, Oregon State University, 2013).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 4.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 4.1b) (Time Series Data, 2014).



Map 4.1: The 1981-2010 PRISM Precipitation Model for WMU 25B, Thousand Lake(PRISM Climate Group, Oregon State University, 2013).

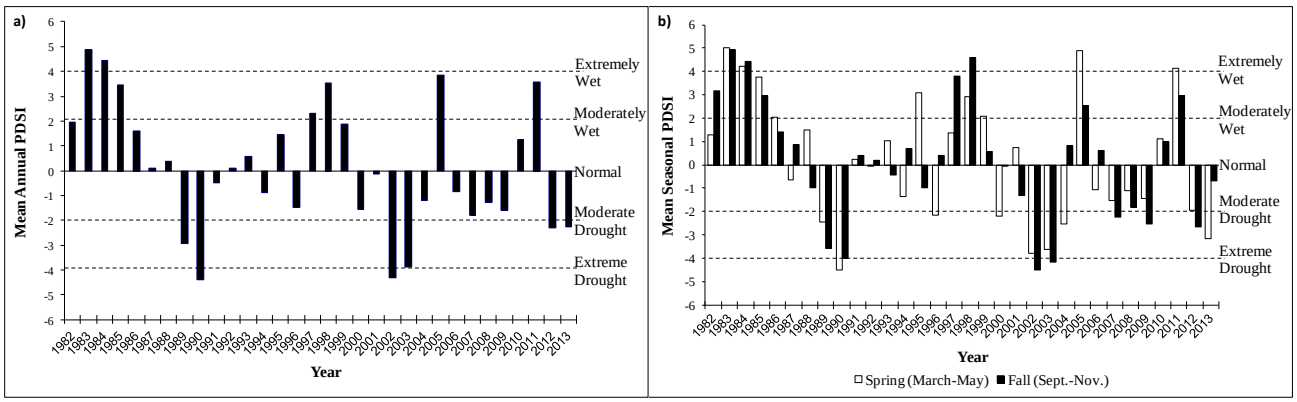


Figure 4.1: The 1982-2014l Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2014).

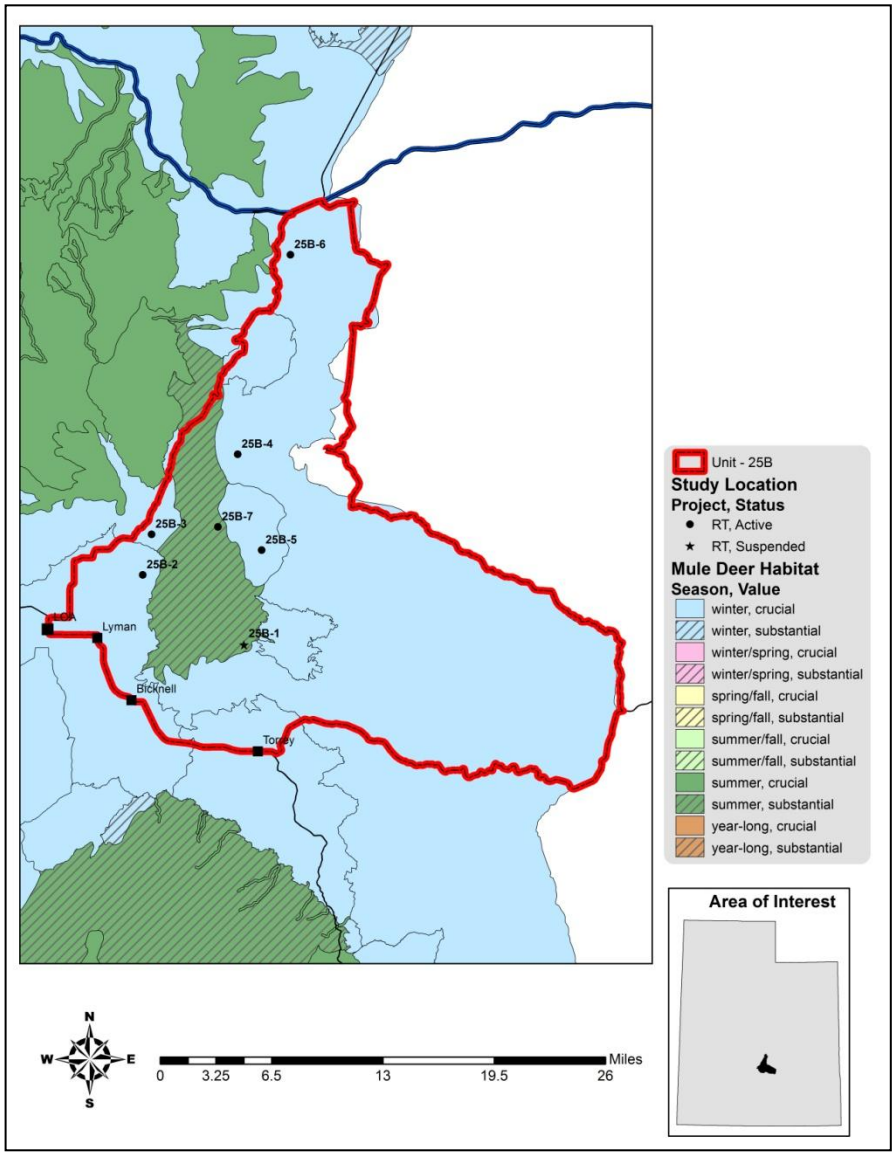
Big Game Habitat

Total mule deer range in the wildlife management unit is estimated at 314,652 acres with 39,301 acres classified as summer range and 275,351 acres classified as winter range (Table 4.1 and Map 4.2). Total elk range is estimated at 172,845 acres with 28,629 acres of this being classified as summer range and 144,217 as winter range (Table 4.1 and Map 4.2). There is a substantial amount of winter range for deer and elk, however, summer range is limiting for both species (Table 4.1). Most of the big game winter range in this unit is located on Forest Service or BLM managed lands. Minor portions of the winter range in the unit occur on private holdings, Utah State School Trust Lands, and National Park Service lands.

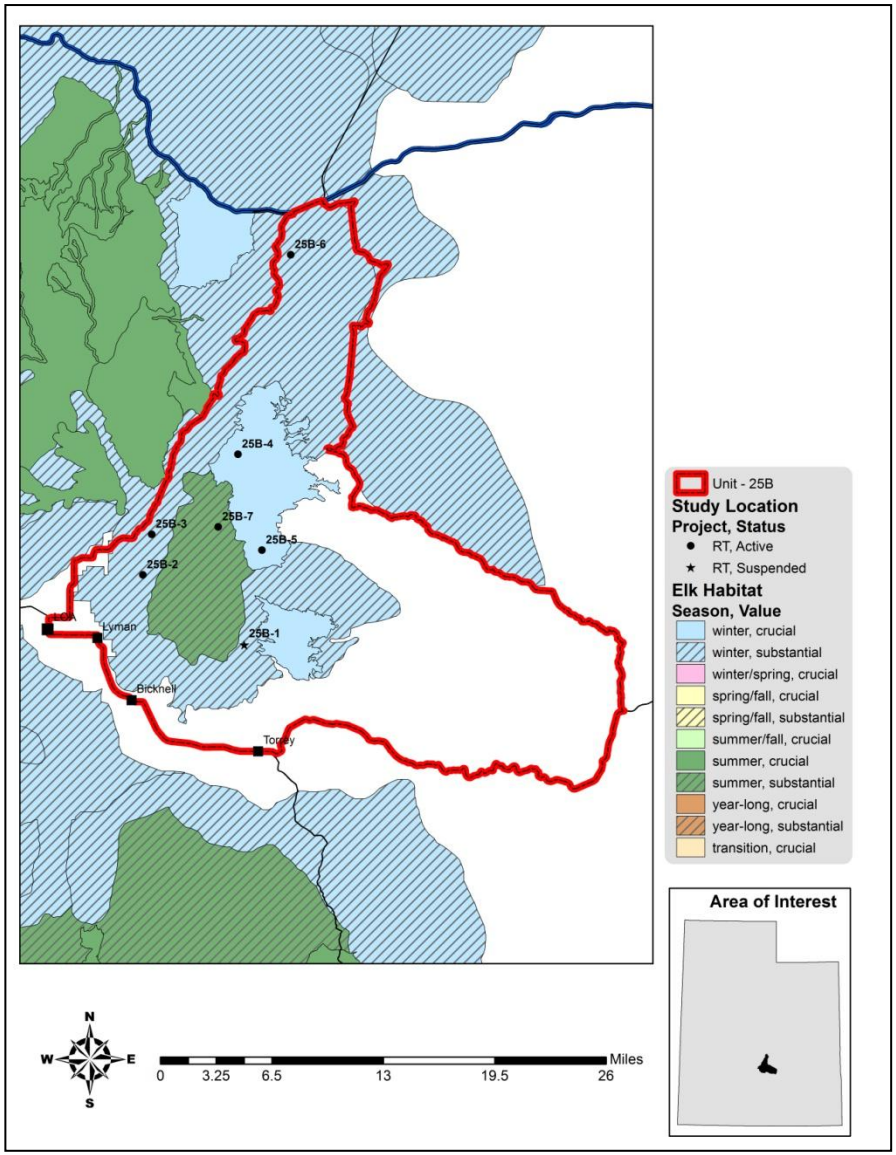
According to LANDFIRE Existing Vegetation Coverage models, important shrublands comprise around 32% of the deer winter range on the unit. Another 32% of deer winter range is conifer of which, 24% is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Annual grasslands, primarily cheatgrass (*Bromus tectorum*), comprise a very small proportion of the deer winter range and pose a minimal threat for wildfire. Other coverage types comprise an equal proportion of the deer winter range (Table 4.4).

The unit has good winter range with ample protective cover, large basins, draws, and open ridges. The upper limits of the normal winter range vary from 8,400 feet at the northern boundary to 9,000 feet on the south end of the Thousand Lake Mountain. The lower normal winter range limit is between 6,000 and 7,400 feet in elevation. At present, the winter range appears ample to support the deer and elk from the Thousand Lakes unit and many wintering deer from the adjacent Fish Lake unit. Solomon Basin, Sage Flat, Horse Valley, Sand Flat, Paradise Flat, and Lyman Slopes are all winter concentration areas.

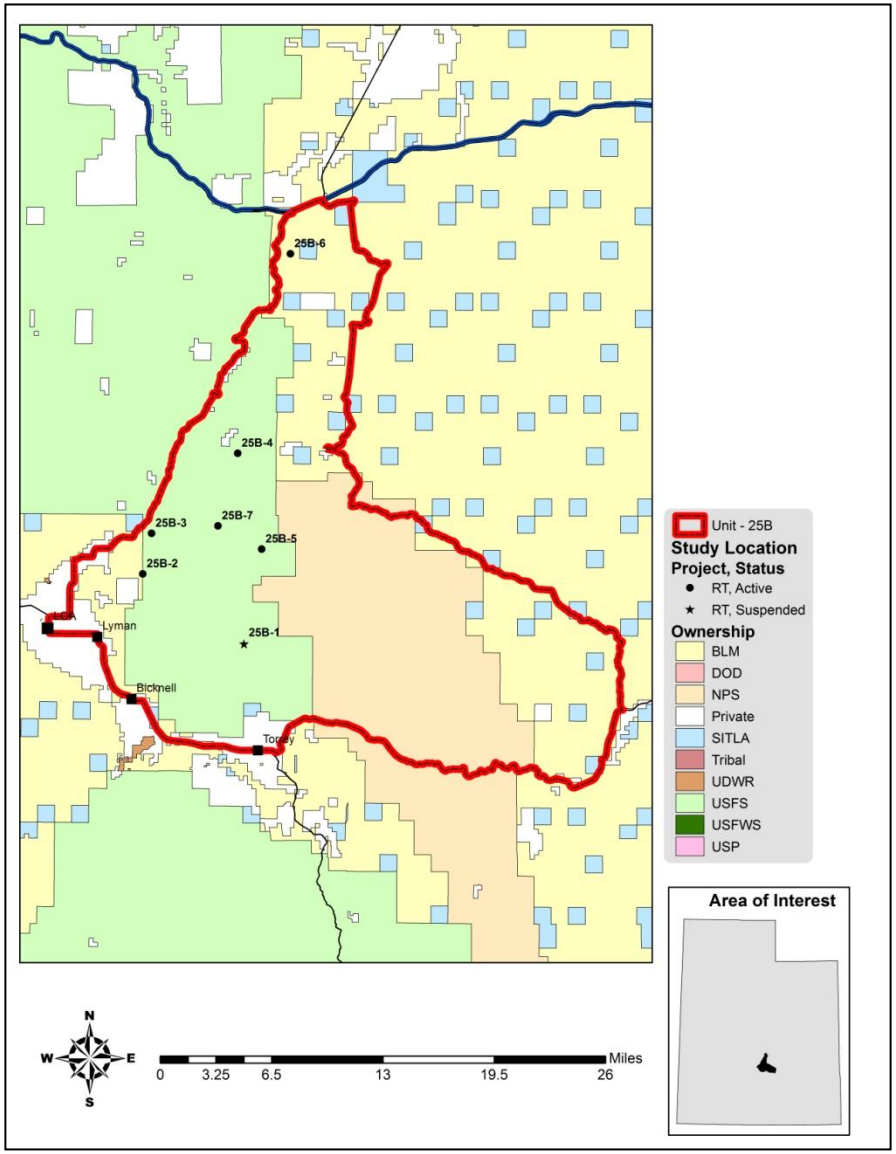
The condition of the spring and summer range is a current management concern. As the snow begins to recede in the spring, deer seek green grasses and forbs, which are very scarce on the overgrazed spring ranges. At this time, the early green-up in the alfalfa and grain fields on private land near Loa, Fremont, Lyman and Torrey are very attractive to wildlife and depredation becomes a problem.



Map 4.2: Estimated mule deer habitat by season and value for WMU 25B, Thousand Lake.



Map 4.3: Estimated elk habitat by season and value for WMU 25B, Thousand Lake.



Map 4.4: Land ownership for WMU 25B, Thousand Lake.

	Summer Range		Winter Range	
	Area (acres)	*%*	*Area (Acres)*	*%*
Mule Deer	39,301	12%	275,351	88%
Elk	28,629	17%	144,217	83%

Table 4.1: Estimated mule deer and elk habitat acreage by season for WMU 25B, Thousand Lake.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	38,955	99%	65,673	24%
BLM	0	0%	82,550	30%
SITLA	0	0%	9,557	4%
Private	45	<1%	14,963	5%
NPS	301	<1%	102,609	37%
Total	**39,301**	**100%**	**275,351**	**100%**

Table 4.2: Estimated mule deer habitat acreage by season and ownership for WMU 25B, Thousand Lake.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	28,629	100%	65,444	45%
BLM	0	0%	44,615	31%
SITLA	0	0%	6,117	4%
Private	0	0%	4,712	3%
NPS	0	0%	23,329	16%
Total	**28,629**	**100%**	**144,217**	**100%**

Table 4.3: Estimated elk habitat acreage by season and ownership for WMU 25B, Thousand Lake.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Colorado Plateau Mixed Low Sagebrush Shrubland	12,690	3.91%	
	Coleogyne ramosissima Shrubland Alliance	3,986	1.23%	
	Inter-Mountain Basins Big Sagebrush Shrubland	29,288	9.02%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	1,383	0.43%	
	Inter-Mountain Basins Greasewood Flat	1,658	0.51%	
	Inter-Mountain Basins Mat Saltbush Shrubland	2,883	0.89%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	32,302	9.95%	
	Inter-Mountain Basins Montane Sagebrush Steppe	1,769	0.54%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	4,439	1.37%	
	Southern Colorado Plateau Sand Shrubland	8,968	2.76%	
	Other Shrublands	3,688	1.14%	31.73%
Conifer	Colorado Plateau Pinyon-Juniper Woodland	77,527	23.87%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	6,125	1.89%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	1,162	0.36%	
	Southern Rocky Mountain Ponderosa Pine Woodland	3,683	1.13%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	14,170	4.36%	
	Other Conifer	1,196	0.37%	31.98%
Grassland	Native Grassland	7,953	2.45%	2.45%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	3,114	0.96%	0.96%
Exotic Tree-Shrub	Introduced Riparian Vegetation	456	0.14%	0.14%
Other	Hardwood	7,069	2.18%	
	Riparian	2,460	0.76%	
	Agricultural	4,074	1.25%	
	Developed	2,582	0.80%	
	Other	90,139	27.76%	32.74%
Total		324,763		

Table 4.4: LANDFIRE existing vegetation coverage(LANDFIRE: LANDFIRE 1.2.0, 2010) of deer winter range for WMU 25B, Thousand Lake.

Limiting Factors to Big Game Habitat

Grazing, uranium exploration, and logging are the three uses that have had the most impact on the Thousand Lakes unit. Grazing of cattle, horses, and sheep commenced with the settlement of the region in the 1860's. The range was open to anyone and was used from the time the snow melted enough in the spring to get livestock on the mountain, until the snow drove them off in the fall. Much of the east side, especially the Solomon Basin area, was used year-round by cattle. Because of the plentiful, well-dispersed water sources, the relatively flat mountaintop was also heavily grazed each summer. This overgrazing resulted in soil compaction and loss at water sources, erosion problems, decreased water quality, and a decrease of the herbaceous component of the vegetative community, until a nearly monotypic shrub type remained. The Forest Service has gradually increased grazing restrictions in order to allow the range to recover. Currently many areas are beginning to show improvements, but it will take a long time for the land to recover naturally.

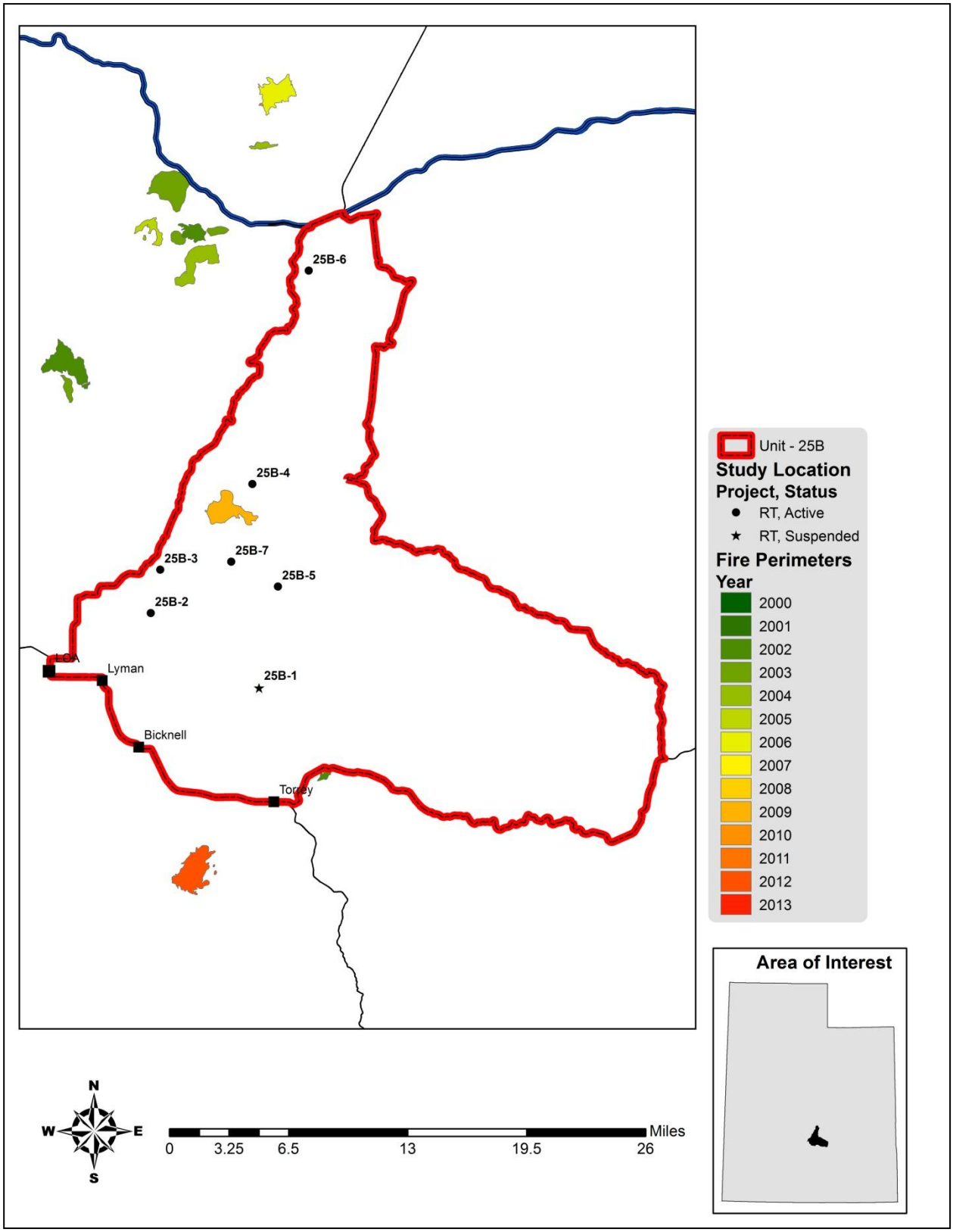
Uranium prospectors have left their mark on the land. Four-wheel drive vehicles and heavy equipment tracks are present on the unit and are still visible. Gas and oil exploration is an ongoing activity and coal deposits in the Last Chance area have drawn proposals for both underground and strip mining. SR-72, which forms the western boundary of the unit, is maintained for year-round use. This will tend to encourage more recreation and tourism through the area and may increase highway collisions with wildlife.

Stands of ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), and Engelmann spruce (*Picea engelmannii*) are found on the mountain with many areas having been logged in the past. Fire suppression has contributed to the accelerated succession of the high mountain aspen-meadows to climax stands of Engelmann spruce. Canopy closure in these spruce forests nearly eliminates all understory species, resulting in a significant loss of forage production.

Wildfire has had a minimal impact on the deer winter range in the unit. The Solomon Basin fire of 2009 was the only wildfire in the unit at 1,619 acres. It burned an area north of Flat Top peak near Solomon Basin. There have been no other recent fires on deer winter range (Map 4.5).

Encroachment by pinyon-juniper woodland communities also poses a threat to important sagebrush rangelands. Pinyon-juniper woodlands constitute a fair amount of the vegetation coverage within the deer

winter range on WMU 25B (Table 4.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000).

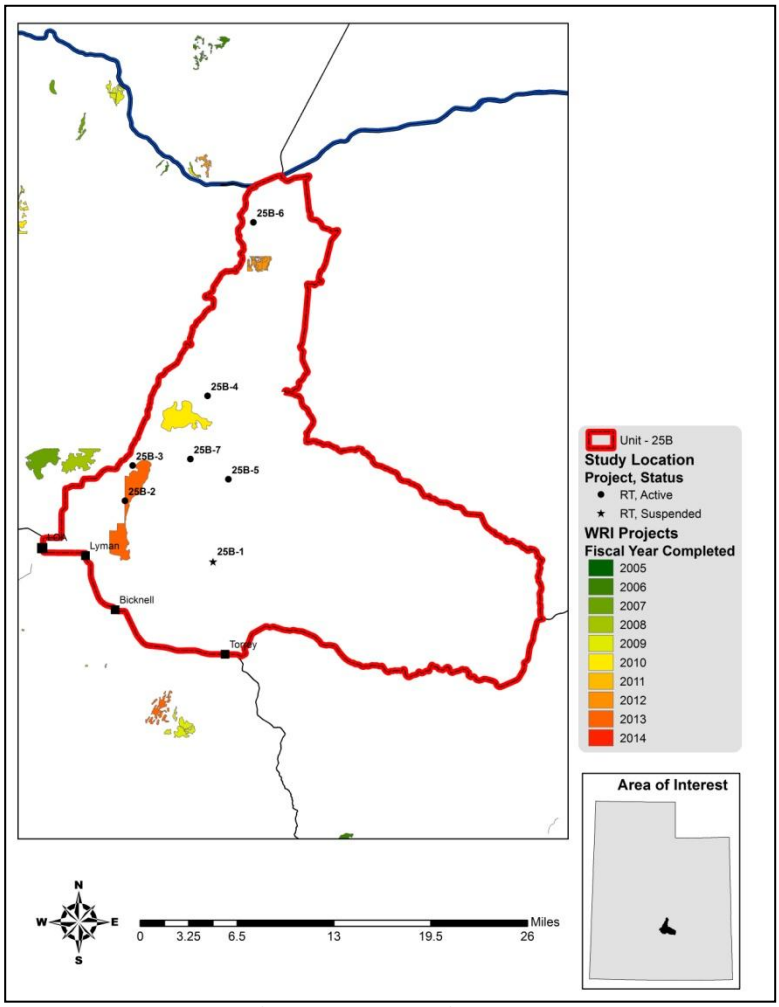


Map 4.5: Land coverage of fires by year from 2001-2013 for WMU 25B, Thousand Lake (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2014).

Treatments/Restoration Work

There has been an active effort to address some of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 6,698 acres of land have been treated within the Thousand Lake unit since the WRI was implemented in 2004. As seen on the map, treatments occasionally overlap one another bringing the total treatment acres to 7,825 acres for this unit (Map 4.6). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

Treatments to reduce pinyon-juniper woodlands such as bullhog and chaining are among the most common management practices. The use of seeding to supplement the herbaceous understory is also very common (Table 4.5).



Map 4.6: WRI treatments by fiscal year completed for WMU 25B, Thousand Lake.

Treatment Action	Acres
Chaining	539
Seeding (primary)	3,129
Seeding (secondary/shrub)	587
Bullhog	3,569
***Total Land Area Treated**	**6,698**
Total Treatment Acres	**7,825**

Table 4.5: WRI treatment action size (acres) for WMU 25B, Thousand Lake.

*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 25B on a regular basis since 1985, with studies being added or suspended as was deemed necessary (Table 4.6). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Due to the long-term nature of the studies, many of the Range Trend studies have had some sort of disturbance or treatment prior to or since study establishment (Table 4.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
25B-1	Thousand Lake	RT	Suspended	'85, '91, '99	Not Verified
25B-2	Horse Valley	RT	Active	'85, '91, '94, '99, '04, '09,'13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25B-3	Sage Flat	RT	Active	'85, '91, '94, '99, '04, '09,'13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25B-4	Solomon Basin	RT	Active	'94, '99, '04, '09,'13	Upland Loam (Black Sagebrush)
25B-5	Polk Creek	RT	Active	'85, '91, '94, '99, '04, '09,'13	Mountain Loam (Black Sagebrush)
25B-6	Little Deer Peak	RT	Active	'85, '91, '99, '04, '09,'13	Upland Loam (Wyoming Big Sagebrush)
25B-7	Hens Peak Aspen	RT	Active	'13	High Mountain Stony Loam (Aspen)

Table 4.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 25B, Thousand Lake.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
25B-2	Horse Valley	Bullhog	Cedar Creek Winter Range Enhancement	Fall 2012	3569	818
25B-7	Hens Peak Aspen	Wildfire	Hens Peak	July 1996	630	
		Seeding		1996?		

Table 4.7: Range trend and WRI studies known disturbance history for WMU 25B, Thousand Lake.

Study Trend Summary (Undisturbed Sites)

Mountain (Black Sagebrush)

There is one study [Polk Creek (25B-5)] classified as Mountain (Black Sagebrush) ecological site that remained undisturbed over the report period (Table 4.6). This study site occurs just south of Polk Creek Ridge.

Shrubs/Trees: The primary browse species are black sagebrush (*Artemisia nova*) and antelope bitterbrush (*Purshia tridentata*). There are a few other low cover browse species present on the site. Shrub line intercept cover has remained relatively stable from year to year and overall is fairly good (Figure 4.2). The average height of black sagebrush on this study is a little over 1 foot tall, making browse mostly available through much of the year in mild winters, but may not be available during normal and heavy snow years. The demographics of black sagebrush population were a high number of mature shrubs throughout the years, with decadence and young plants varying from year to year (Figure 4.2).

Both pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) are present within the study area. Pinyon-juniper cover has continued to increase over the study years, while density has decreased slightly. There was also some ponderosa pine (*Pinus ponderosa*) sampled on the study site in 1999 (Figure 4.3).

Herbaceous Understory: This study sits has a fairly good herbaceous component dominated by perennial native grasses, with no single species dominating frequency or cover. There are no annual grasses found on

this site. Perennial and annual forb frequency and cover are both relatively low and fluctuate from year to year (Figure 4.4).

Occupancy: Pellet group transect data indicates that deer primarily occupy this study. The mean abundance of deer pellet groups has ranged from a high of 70 days use/acre in 2009 to a low of 20 days use/acre in 1999. Elk and cattle occupancy are low and fluctuate slightly from year to year (Figure 4.5).

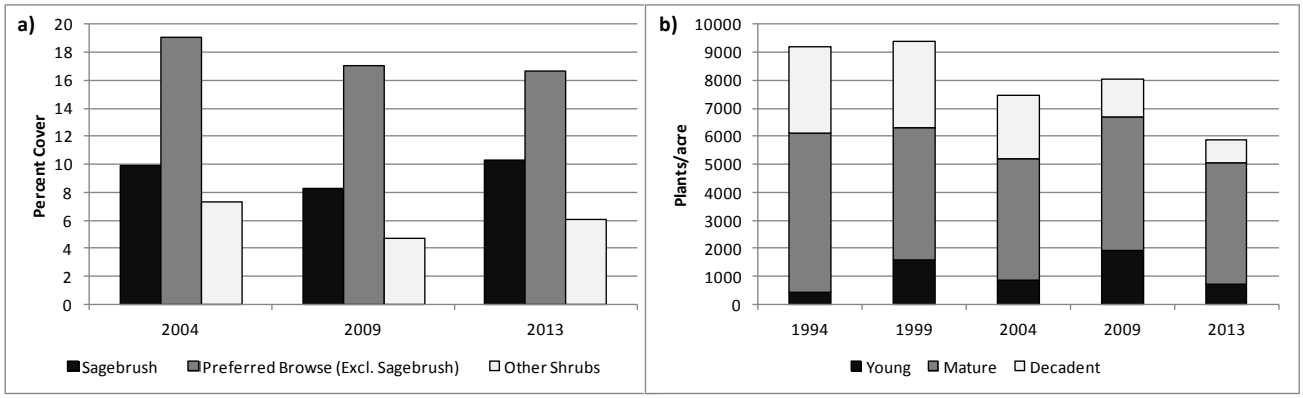


Figure 4.2: Shrub summary of the Mountain (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of silver sagebrush.

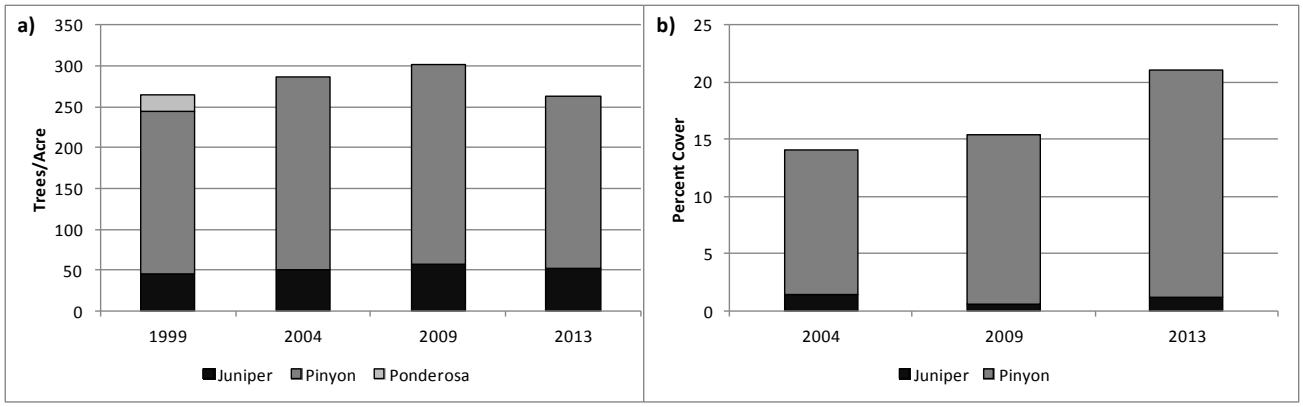


Figure 4.3: Tree summary of the Mountain (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

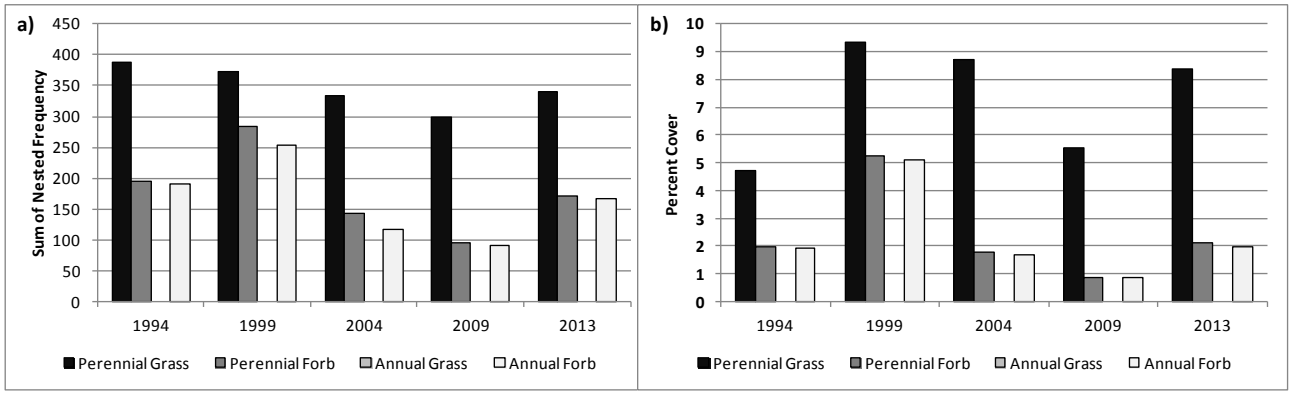


Figure 4.4: Herbaceous functional group summary of the Mountain (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

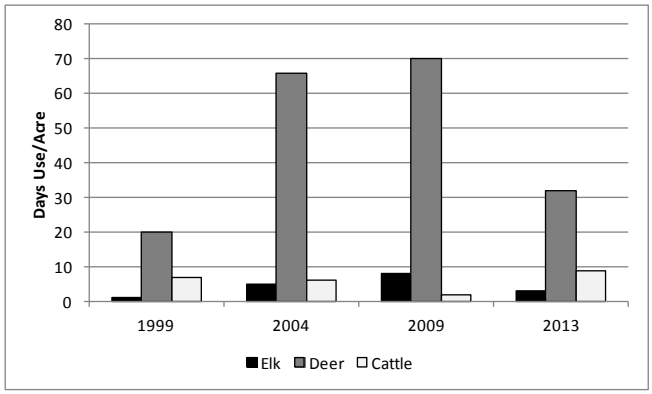


Figure 4.5: Mean pellet transect data for the Mountain (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake.

Upland (Mountain Big Sagebrush)

There is one study [Sage Flat (25B-3)] classified as an Upland (Mountain Big Sagebrush) ecological site that remained undisturbed over the report period (Table 4.6). Sage Flat is located just south of Forsyth Reservoir in Sage Flat Canyon.

Shrubs/Trees: The primary browse on the Sage Flat study is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) with very few preferred or other shrub species present. The mean line-intercept cover of sagebrush is good on this site, at about 20% cover. The average height of mountain big sagebrush on all of the studies is just over 1 foot tall, making browse mostly available through much of the year in normal winters. The demographics of the sagebrush populations was a mixture of young, mature, and decadent plants with composition varying greatly from year to year. Density of young sagebrush was highest in 1994 and 1999, while density of decadent plants was highest in 1999 and 2009 (Figure 4.6).

Herbaceous Understory: There is very little herbaceous understory on the Sage Flat study. In general the herbaceous cover is less than 7%. Grass and forb frequency and diversity are low as well. There are no annual grasses on this site (Figure 4.7).

Occupancy: Pellet group transect data indicates that deer predominately occupy this study. The mean abundance of deer pellet groups has ranged from a high of 21 days use/acre in 1999 to a low of 1 day use/acre in 2013. Elk and cattle pellet groups are typically sampled in low abundance on the study site (Figure 4.8).

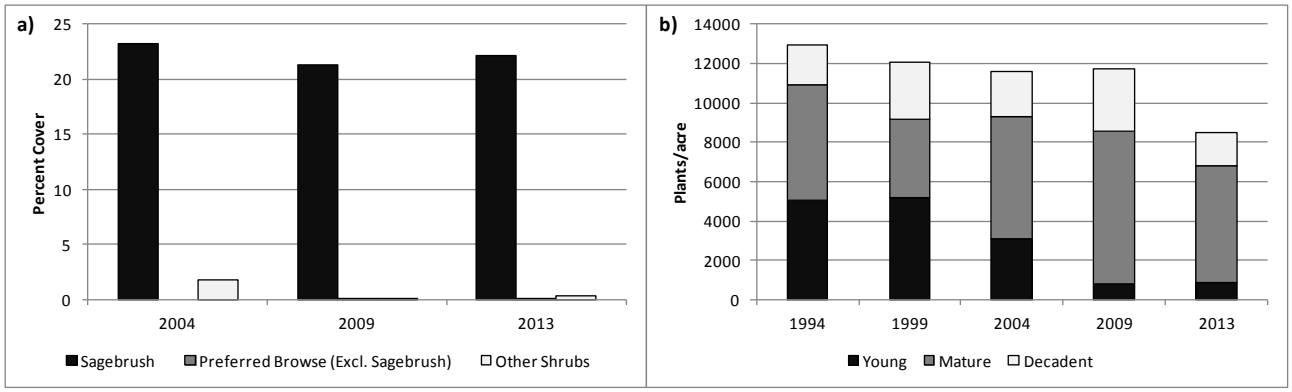


Figure 4.6: Shrub summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

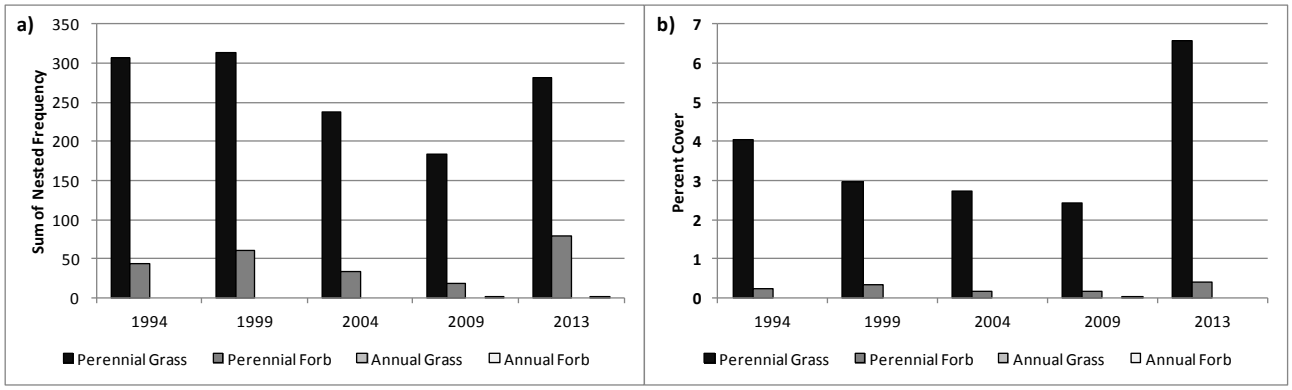


Figure 4.7: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

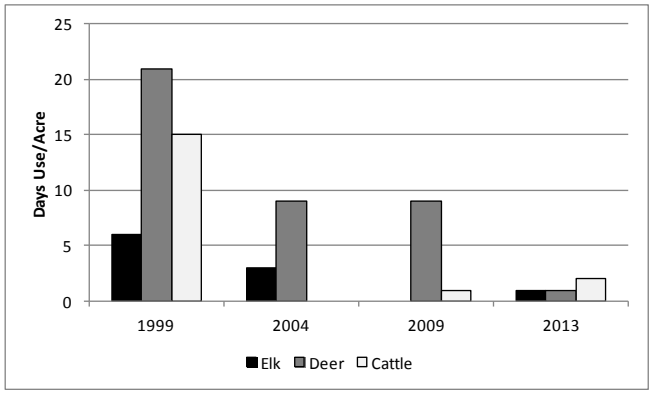


Figure 4.8: Mean pellet transect data for the Upland (Mountain Big Sagebrush) study (n=1) for WMU 25B, Thousand Lake.

Upland (Wyoming Big Sagebrush)

There is one study [Little Deer Peak (25B-6)] classified as an Upland (Wyoming Big Sagebrush) ecological site that remained undisturbed over the report period (Table 4.6). Little Deer Peak is located east of SR 72 just north of Little Deer Peak.

Shrubs/Trees: The primary browse on this study is Wyoming big sagebrush. The mean line-intercept cover of sagebrush is good, usually maintaining around 15% cover except in 2009 when it dropped to less than 10% (Figure 4.9a). The average height of sagebrush is approximately 1 foot tall, making browse mostly available through much of the year in normal winters. The demographics of the sagebrush population are a mixture of mature and decadent plants with decadence being especially high in 2009 (Figure 4.9b). There were no trees sampled on this study.

Herbaceous Understory: The general herbaceous composition is high perennial grass with relatively low forb cover. The dominant perennial grass species are blue grama (*Bouteloua gracilis*) and bottlebrush squirrel tail (*Sitanion hystrix*), but species diversity is low. Perennial and annual forb frequency and cover have remained low over the sample years (Figure 4.10).

Occupancy: Pellet group transect data indicates that deer and elk occupy this study. The mean abundance of elk pellet groups has ranged from as high as 44 days use/acre in 1999 to as low as 11 days use/acre in 2009. The mean abundance of deer pellet groups has ranged from a high of 31 days use/acre in 1999 to a low of 11 days use/acre in 2013 (Figure 4.11).

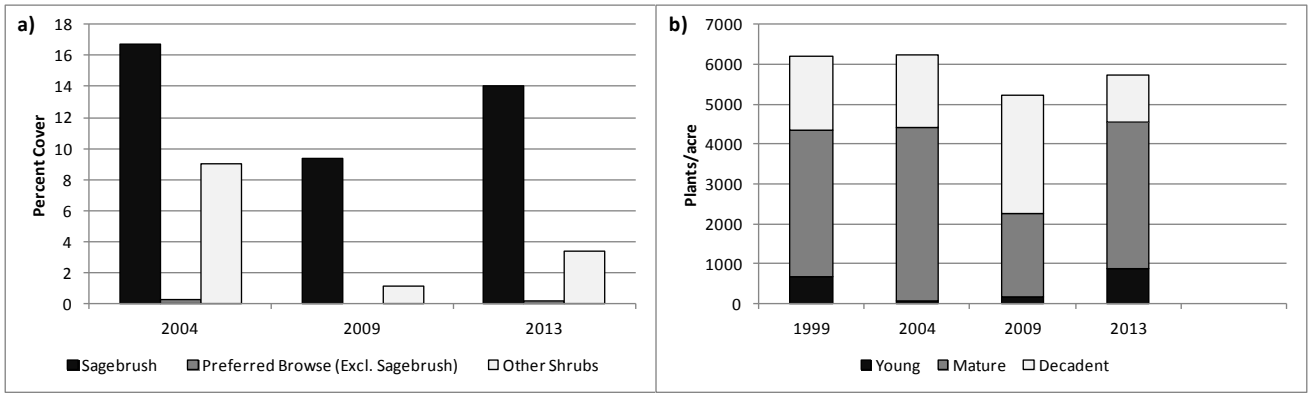


Figure 4.9: Shrub summary of the Upland (Wyoming Big Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

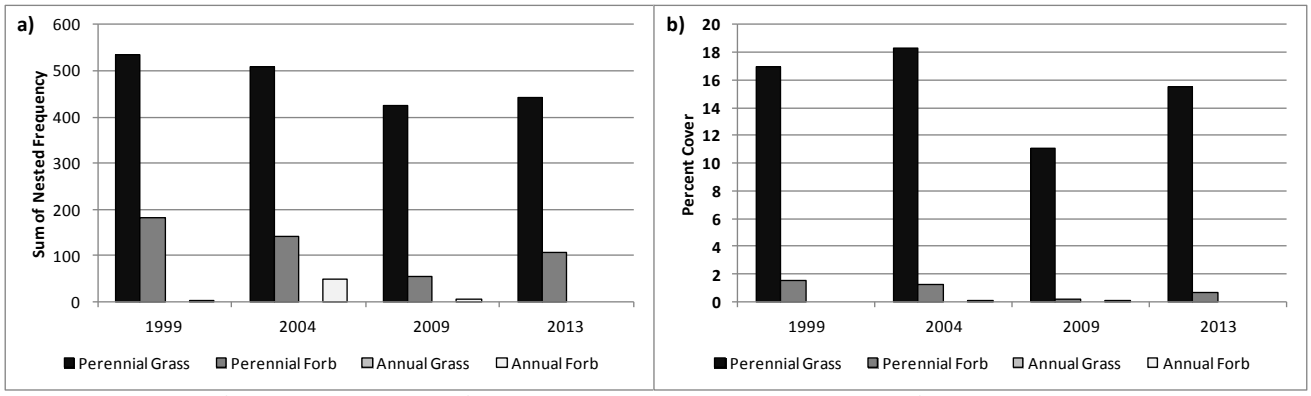


Figure 4.10: Herbaceous functional group summary of the Upland (Wyoming Big Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

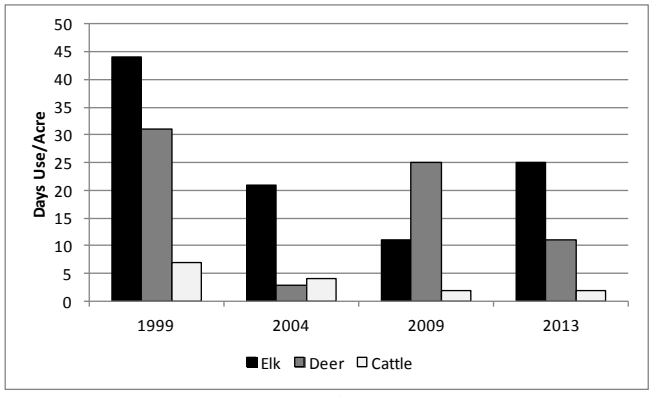


Figure 4.11: Mean pellet transect data for the Upland (Wyoming Big Sagebrush) study (n=1) for WMU 25B, Thousand Lake.

Upland (Black Sagebrush)

There is one study [Solomon Basin (25B-4)] classified as a Upland (Black Sagebrush) ecological site that remained undisturbed over the report period (Table 4.6). The Solomon Basin study is located on the east side of Solomon Basin near Morrell Pond.

Shrubs/Trees: The primary browse on this study is a mixture of black sagebrush and mountain big sagebrush with a few other preferred browse species sampled in cover measurements. The mean line-intercept cover of sagebrush is good on this site and has remained above 14% (Figure 4.12a). The average height of sagebrush on this study is approximately 2 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush population have generally been comprised of mature plants with some

young and decadent plants. Sagebrush density has remained consistent throughout the study years (Figure 4.12b). Tree density and cover have increased over the sample years and could pose a threat to understory diversity and cover (Figure 4.13).

Herbaceous Understory: This study site has a fair herbaceous component. There is no one species that is dominant, and although frequency and cover are low, diversity is high (Figure 4.14). Grass cover is made up of perennial native species with no annual exotic grasses present. Forb composition is mainly comprised of native perennial species, but fluctuates in composition from year to year.

Occupancy: Pellet group transect data indicates that, with the exception of 1999 when elk presence was high, deer almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 45 days use/acre in 2009 to a low of 5 days use/acre in 2013 (Figure 4.15).

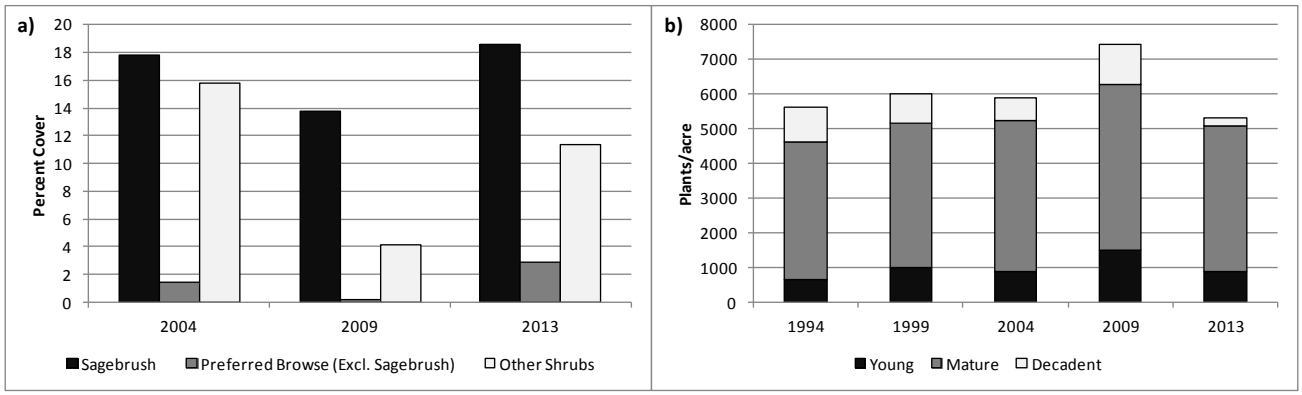


Figure 4.12: Shrub summary of the Upland (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

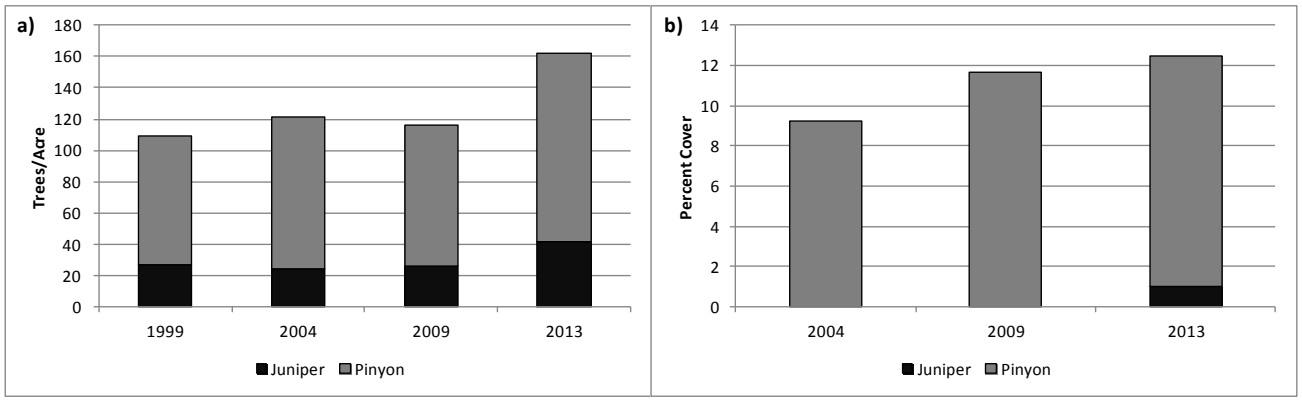


Figure 4.13: Tree summary of the Upland (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

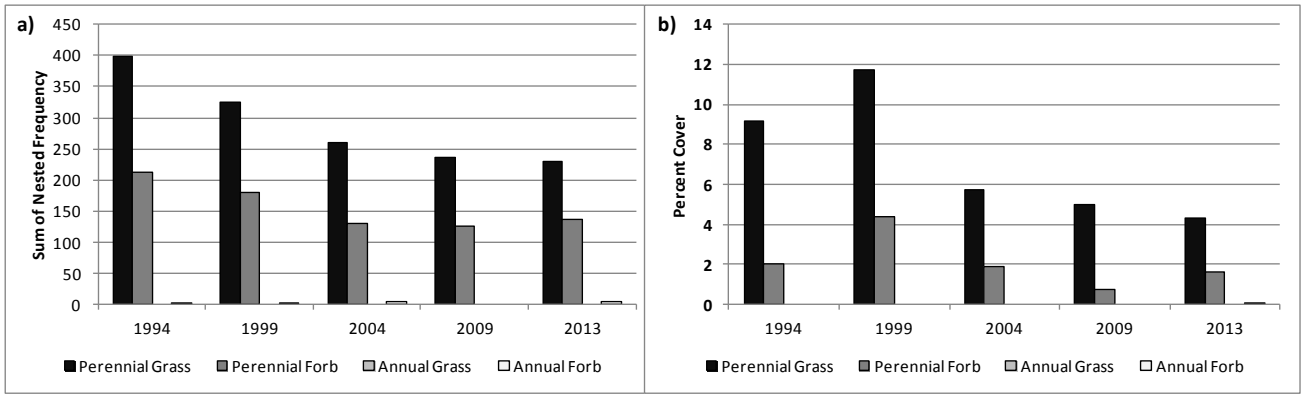


Figure 4.14: Herbaceous functional group summary of the Upland (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

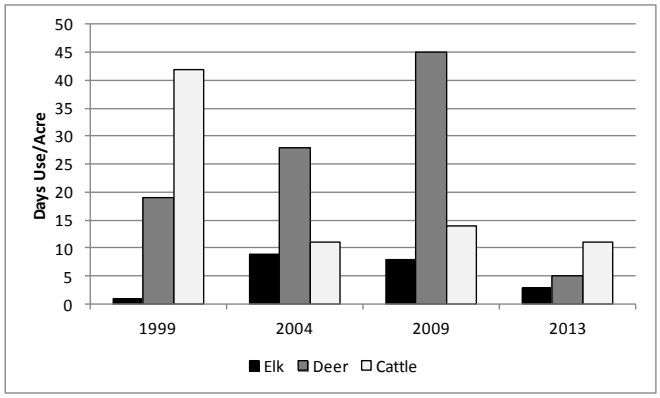


Figure 4.15: Mean pellet transect data for the Upland (Black Sagebrush) study (n=1) for WMU 25B, Thousand Lake.

Study Trend Summary (Treated/Disturbed Sites)

Bullhog

There is one site [Horse Valley (25B-2)] that was treated with a bullhog during the report period (Table 4.7). This study is located northeast of Lyman. This study is classified as an Upland (Mountain Big Sagebrush) ecological site (Table 4.6). Although Wyoming big sagebrush is found on the site, the Upland (Mountain Big Sagebrush) ecological site was the best fit for this site. Generally, the target of the bullhog treatments is to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on this study is Wyoming big sagebrush with a small amount of black sagebrush sampled as well. Pinyon-juniper encroachment was still in phase I and had yet to impact sagebrush substantially, as mean line-intercept cover of sagebrush was around 20%. The mean cover of sagebrush increased following treatment from 20% to 21% (Figure 4.16a). The mean density of sagebrush decreased by almost 1,000 plants per acre, however, changes in sagebrush population demographics would indicate a transition to a more mixed community after the treatment. Decadent plants have decreased while mature and young plants have increased after treatment (Figure 4.16b). It is expected that with the improved recruitment and health of the sagebrush following treatment, that the sagebrush will continue to increase on the treatment site.

The mean density of pinyon pine (*Pinus edulis*) trees was over just over 100 trees/acre pre-treatment. The mean tree density decreased to less than 100 tree/acre following treatment (Figure 4.17a). Mean tree cover was less than 1% pre-treatment and was reduced to less than half a percent post treatment. Remaining density and cover is generally provided by trees that were partially masticated or small trees that were left standing.

Herbaceous Understory: The herbaceous understory was generally lacking prior to treatment of this study. Following treatment there was an increase in the perennial grass and forb functional groups. Perennial forb species had the largest response increasing in both mean frequency and cover. However, cover remains less than 2% for both forbs and grasses (Figure 4.18). There were no annual grasses present on this site.

Occupancy: Pellet group transect data indicates that deer primarily occupy this study site. The mean abundance of pellet groups of deer has been about 17 days use/acre prior to treatment, but dropped to 1 day use/acre following treatment (Figure 4.19).

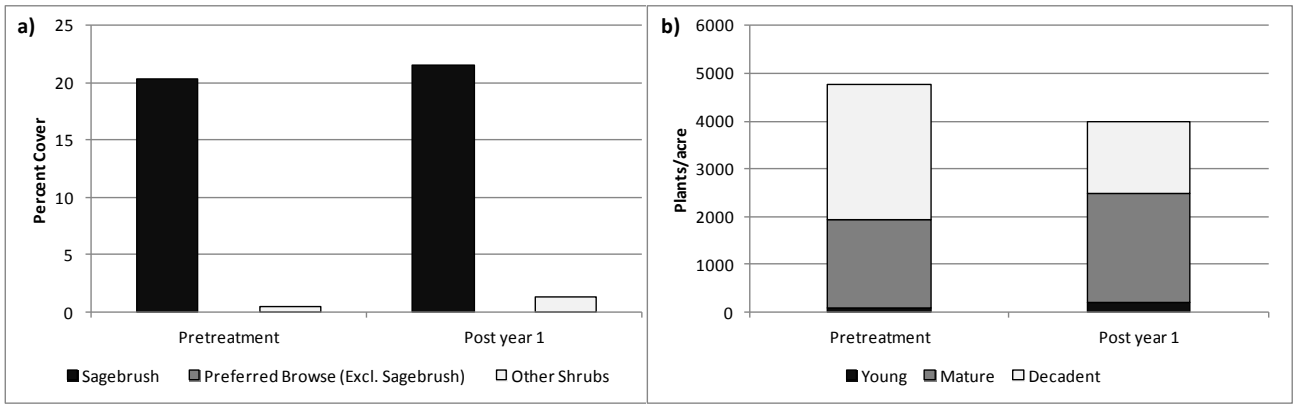


Figure 4.16: Shrub summary of the Bullhog treatment studies (n=1) for WMU 25B, Thousand Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

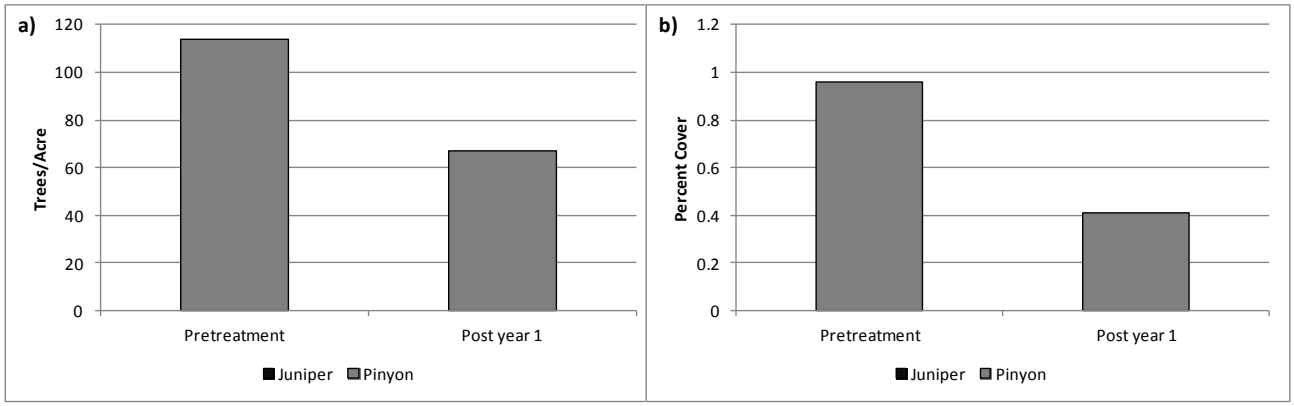


Figure 4.17: Tree summary of the Bullhog treatment studies (n=1) for WMU 25B, Thousand Lake. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

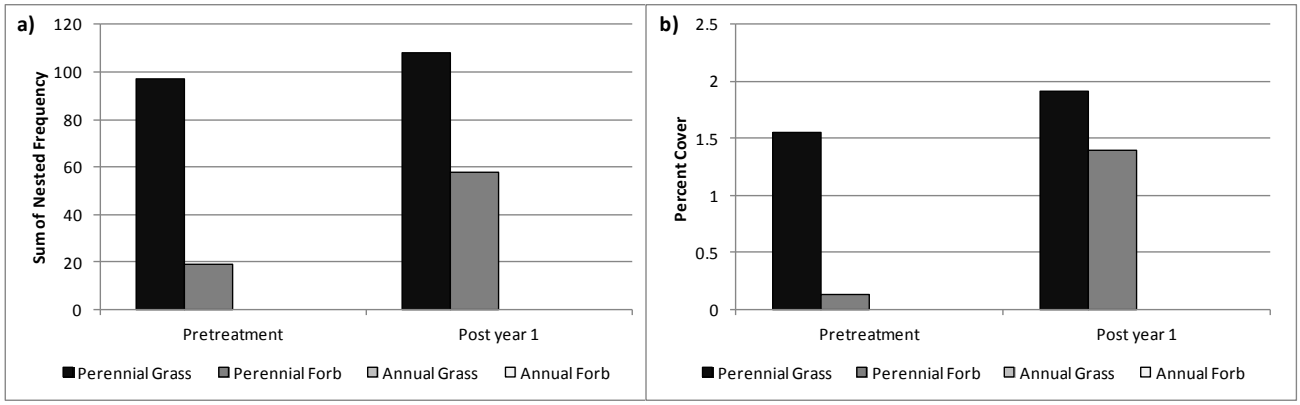


Figure 4.18: Herbaceous functional group summary of the Bullhog treatment studies (n=1) for WMU 25B, Thousand Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

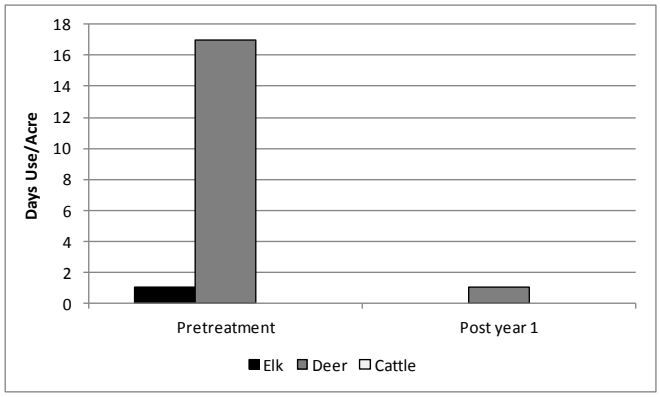


Figure 4.19: Mean pellet transect data for the Bullhog treatment studies (n=1) for WMU 25B, Thousand Lake.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Thousand Lake management unit has generally improved on the study sites sampled since 1994. The majority of the undisturbed sites sampled within the unit are considered to be in good to fair condition, with the exception of 2009 when sites were considered fair to poor (Figure 4.20). The mid potential sites Solomon Basin and Polk Creek are the sites that are in fair to poor condition. The treated study site transitioned from poor pre-treatment to fair post treatment (Figure 4.21). At the last reading there were no study sites that were in poor or very poor condition (Map 4.7 and Table 4.8).

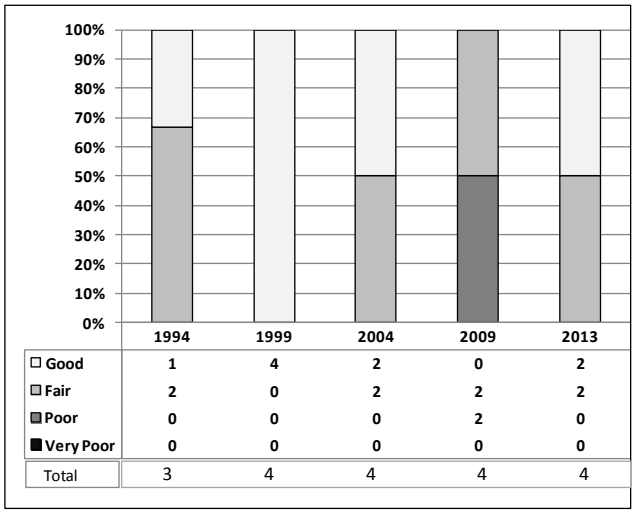


Figure 4.20: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 25B Thousand Lake.

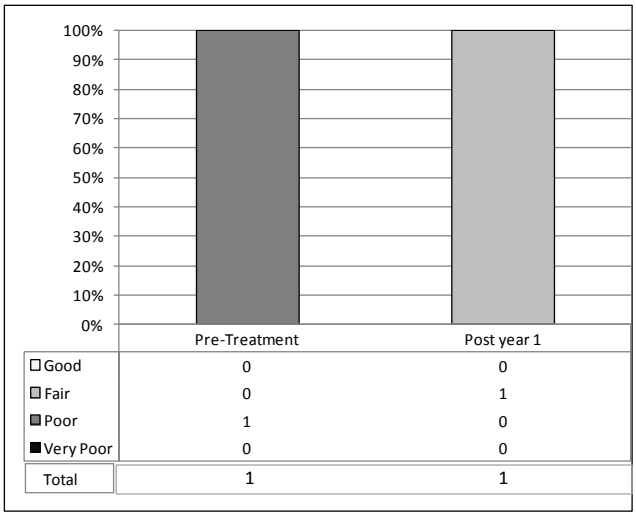
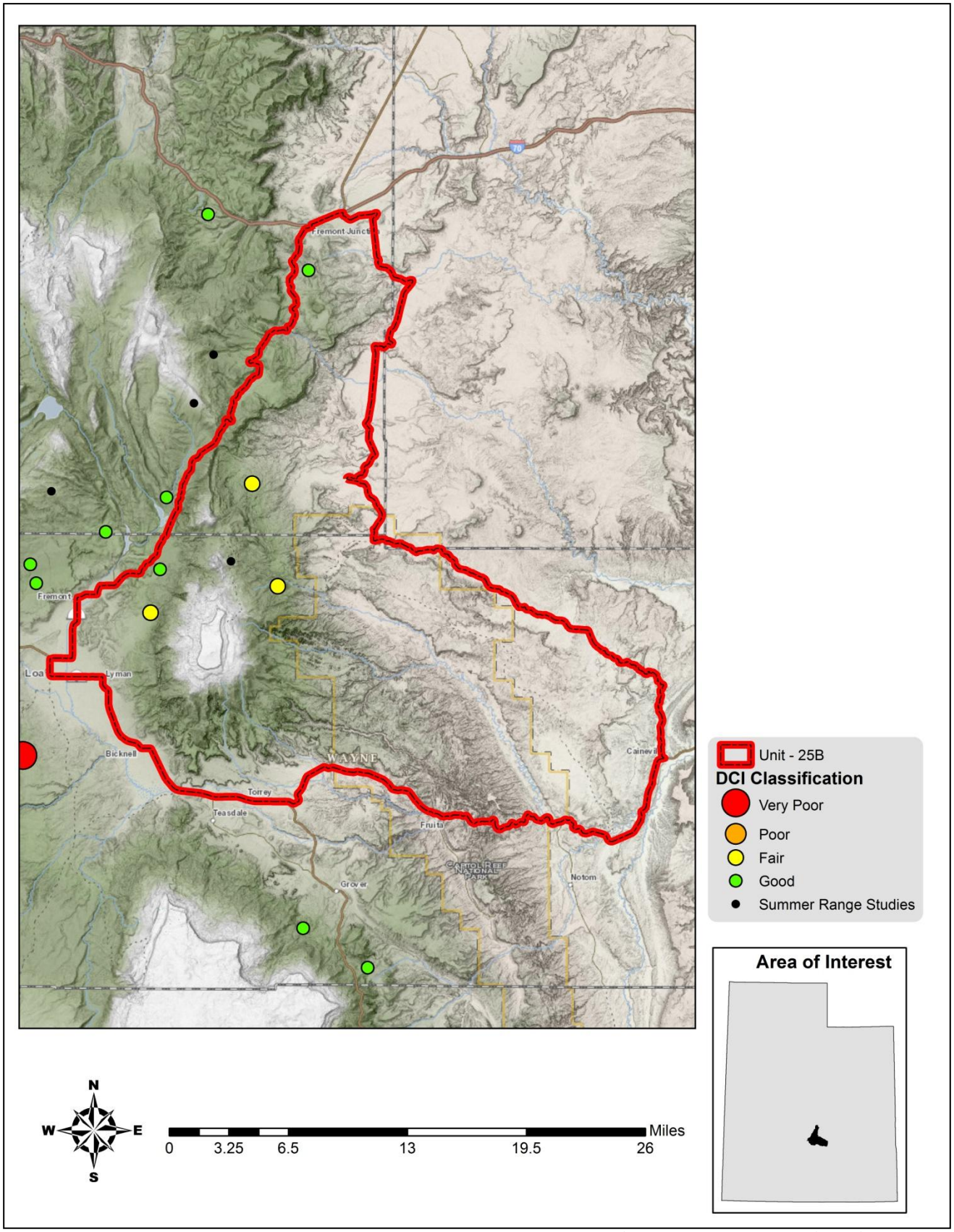


Figure 4.21: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 25B, Thousand Lake.



Map 4.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 25B, Thousand Lake.

Study # .	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
25B-2	Horse Valley	None Identified		
25B-3	Sage Flat	None Identified		
25B-4	Solomon Basin	PJ Encroachment	Low-Moderate	Reduced understory shrub and herbaceous vigor.
25B-5	Polk Creek	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
25B-6	Little Deer Peak	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
25B-7	Hens Peak Aspen	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
		Annual Grass	Low	Increased fire potential.
		Conifer Encroahment	Low	Reduced aspen and understory herbaceous vigor.

Table 4.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 25B, Thousand Lake. All assessments are based off the most current sample date for each study site.

Discussion and Recommendations

High Mountain (Aspen)

The high elevation high mountain site supports an aspen community and is generally considered to be substantial summer range for mule deer and elk habitat on the Thousand Lake management unit. This community supports a diverse herbaceous understory that provides valuable forage during the summer months. This site is in generally good condition, with any threats in its current condition being low.

It is recommended to continue to monitor this community for any potential threats that may arise in the future.

Mountain and Upland (Black Sagebrush)

The higher elevation upland and mountain sites, which support black sagebrush communities, are generally considered to be in fair condition for deer and elk winter range habitat on the Thousand Lake management unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. These sites are generally only in fair condition, likely because they are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed (Table 4.8).

It is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue in these communities. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Upland (Mountain Big Sagebrush)

The mid elevation upland sites which support mountain big sagebrush communities are generally considered to be in fair to good condition for deer winter range habitat on this unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. Currently these sites are not experiencing any threats or limiting factors.

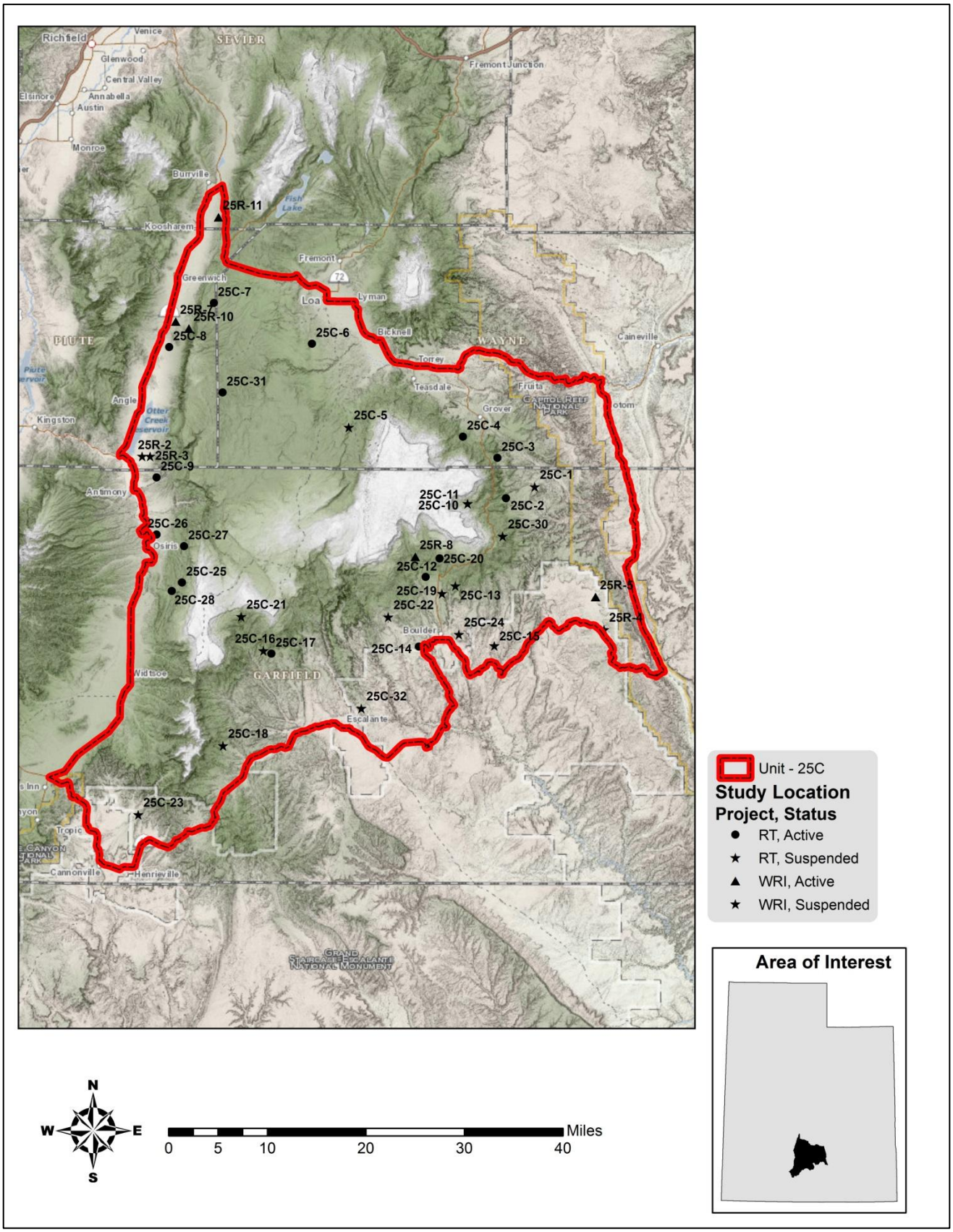
It is recommended that monitoring continue on these sites to identify any threats that may arise.

Upland (Wyoming Big Sagebrush)

The mid elevation upland Wyoming big sagebrush community is generally considered to be in good condition for deer winter range habitat on this unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. While generally in good condition, these communities have the potential to have introduced perennial grasses dominate the herbaceous component. While providing valuable forage, these grass species can often be aggressive, reducing the prevalence and abundance of native grass and forb species.

It is recommended that monitoring continue to identify any further threats on this site. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

5. WILDLIFE MANAGEMENT UNIT 25C - BOULDER



WILDLIFE MANAGEMENT UNIT 25C - BOULDER

Boundary Description

Sevier, Garfield, Piute, and Wayne counties - Boundary begins at SR-24 and US-89 at Sigurd; south on SR-24 to SR-62; south on SR-62 to SR-22; south on SR-22 to the Widtsoe-Antimony road; south on the Widtsoe-Antimony road to SR-12; east on SR-12 to the Burr Trail at Boulder; east on the Burr Trail to the Notom Road; north on the Notom Road to SR-24; east on SR-24 to the Caineville Wash road; north on the Caineville Wash road to I-70; west on I-70 to US-89; south on US-89 to SR-24.

Management Unit Description

Geography

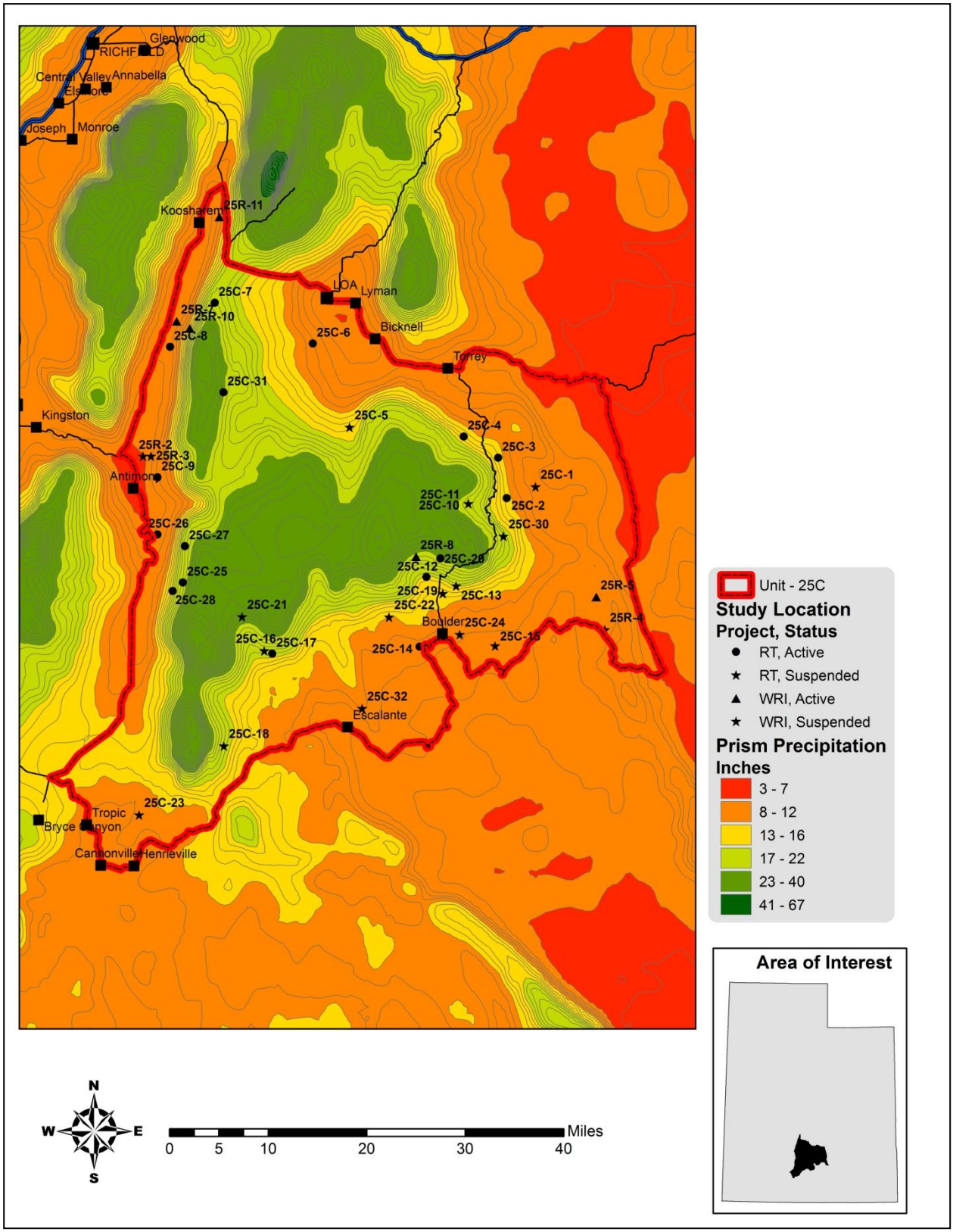
The Boulder wildlife management unit includes the high country of the Aquarius Plateau, which is commonly known as Boulder Mountain as well as its slopes down to the south and west through variable desert terrain that make up the major portion of the winter range in Unit 25C. The Boulder Wildlife Management Unit also encloses areas to the north including Parker Mountain (Awapa Plateau), Boulder Mountain, Miners Mountain, and portions of the Waterpocket Fold and Capitol Reef National Park. Parker Mountain is an open rolling plateau with a maximum elevation of 9,600 feet and northeast exposure. The Aquarius Plateau is a high, lava-capped mountain plateau rising to 11,322 feet in elevation on Boulder Mountain. Miners Mountain is a large anticline located in the northeast corner of the unit. Municipalities located along the unit boundaries are Koosharem and Antimony on the west; Loa, Lyman, Bicknell, Teasdale, and Torrey on the north; with Escalante and Boulder on the south side.

A small section along the west side of Parker Mountain drains west into Otter Creek. The southern section of the unit drains to the south into the Escalante River, while the remainder of the unit drains to the north into the Fremont River.

Climate Data

The 30-year (1981-2010) annual precipitation PRISM model shows precipitation ranges between 5 to 7 inches at Capitol Reef, 10 to 12 inches at Boulder and Escalante on the southern border, and 25 to 30 inches on Boulder Mountain. All of the Range Trend and WRI monitoring studies on the unit occur between 7-24 inch precipitations zones (Map 5.1) (PRISM Climate Group, Oregon State University, 2013).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 5.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 5.1) (Time Series Data, 2014).



Map 5.1: The 1981-2010 PRISM Precipitation Model for WMU 25C, Boulder (PRISM Climate Group, Oregon State University, 2013).

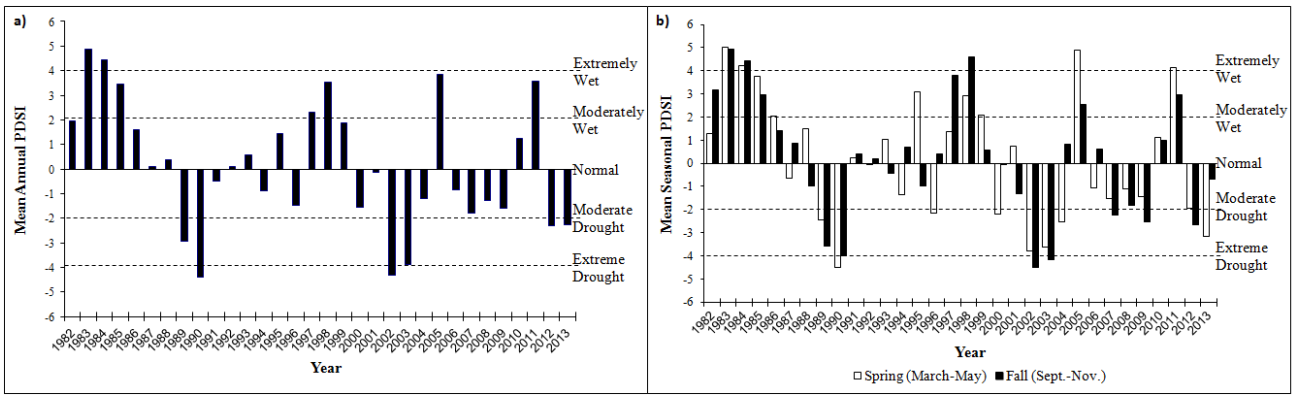


Figure 5.1: The 1982-2014 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2014).

Big Game Habitat

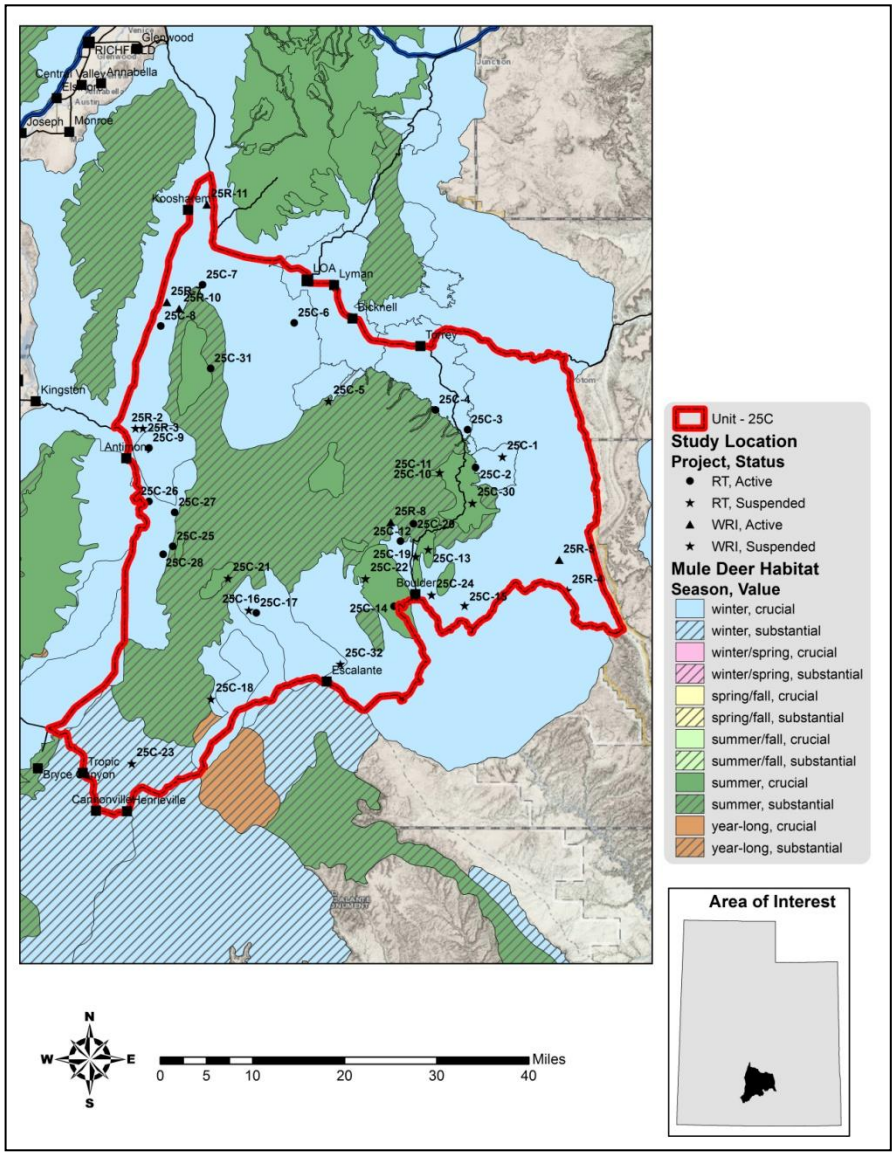
Total mule deer range in the wildlife management unit is estimated at 2,109,053 acres with 42,311 being classified as year-long range, 1,432,127 acres classified as winter range, and 634,615 acres classified as summer range (Table 5.1 and Map 5.2). Total elk range is estimated at 1,103,026 acres with 1,675 acres of this being classified as year-long range, 425,791 as summer range, and 675,560 as winter range (Table 5.1 and Map 5.3). Most of the big game winter range in this unit is located on Forest Service or BLM managed lands. Minor portions of the winter range in the unit occur on private holdings, Utah State School Trust Lands, and Division of Wildlife Resources management areas.

According to LANDFIRE Existing Vegetation Coverage models, important shrublands comprise less than 30% of the deer winter range on the unit. The majority of deer winter range is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Annual grasslands, primarily cheatgrass (*Bromus tectorum*), is not a major land type contributor within deer winter range and poses little threat for wildfire. Other cover types comprise a minimal proportion of the deer winter range (Table 5.4).

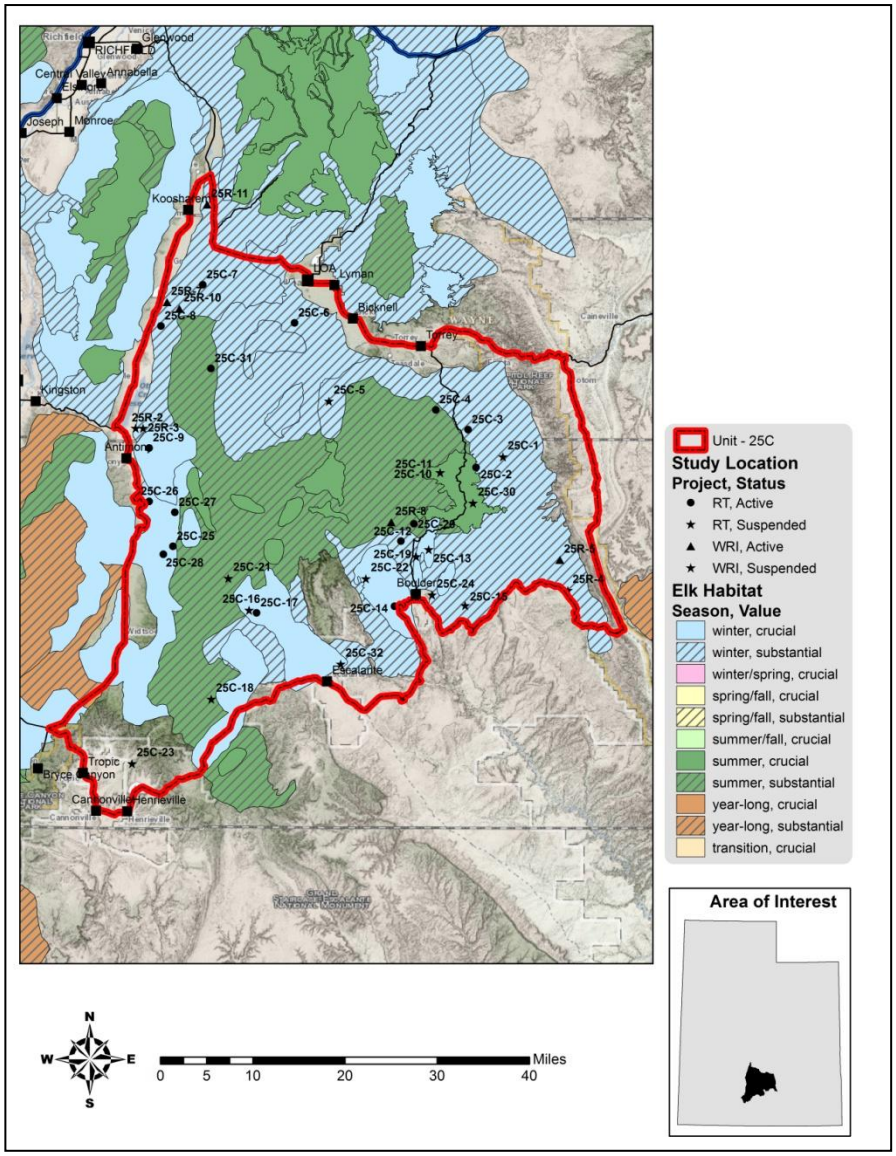
The winter range is large enough to support all of the deer summering on the unit. With a few localized exceptions, it is in mostly good condition. Huff & Coles (1966) drew the upper limits of the winter range between 8,000 and 8,400 feet and the lower limits between 6,500 and 7,000 feet. The pinyon-juniper and sagebrush types with various combinations of the two, dominate the winter range. South of Boulder Mountain, there is abundant winter range. However, much of the country is slickrock canyons and mesas that support few deer. Most wintering takes place on the lower slopes and at the base of the mountain. The upper limits of the normal winter range are uniform at 8,000 feet across the south slopes of the Boulder Mountain. Seven thousand feet is the usual upper limit during severe winter conditions. The lower limit for most wintering deer on the south side of the unit is Highway 12. On the west, side of the Aquarius Plateau between Antimony and Widtsoe winter range is more restricted. The mountain drops off steeply from Griffin Top to the river valley. Deer can typically utilize vegetation up to 9,000 feet during normal winters, but are limited to an upper limit of around 8,000 feet during severe winters. The lower boundary for severe winters is the bottom of the valley on the Sevier River, which is approximately 6,500 feet.

Summer range is limited to specific areas on Parker Mountain and Boulder Mountain. Boulder Mountain contains approximately 50,000 acres above 10,500 feet (Christensen & Bogedahl, 1983). This high summer range is unsuitable for fawning and receives only light deer use in late summer. Most fawning and summer use is concentrated underneath the lava rock rim where stands of aspen, fir, and spruce are interspersed with

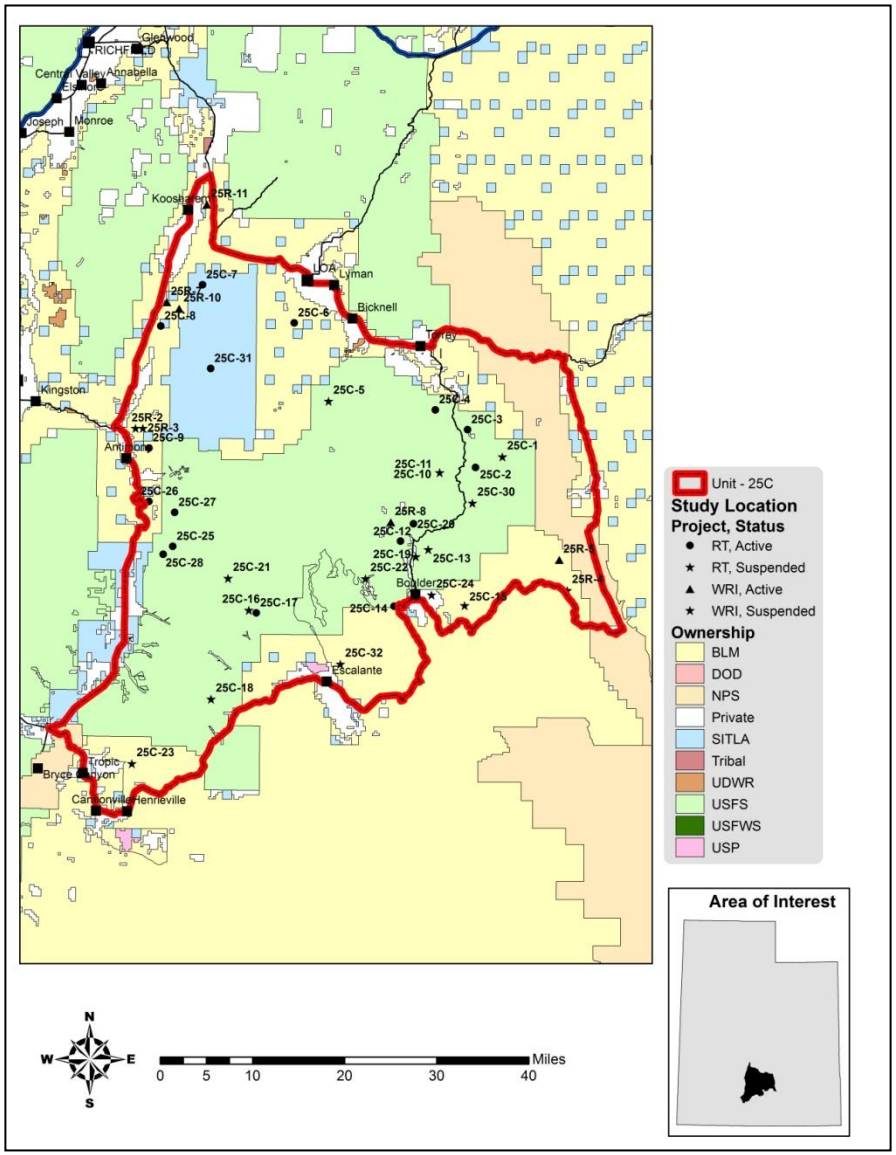
sage flats and meadows. Because of fire suppression, the trend is toward a more dense spruce climax community. Logging and/or prescribed burns may help maintain this important habitat in a seral stage, which is more productive and more favorable to big game. Lower down the slopes, ponderosa pine with its associated mountain brush understory receives limited summer use. Summer range on Parker Mountain is more limited to the higher southern end, where aspen stands in association with big sagebrush and antelope bitterbrush provide excellent fawning areas.



Map 5.2: Estimated mule deer habitat by season and value for WMU 25C, Boulder.



Map 5.3: Estimated elk habitat by season and value for WMU 25C, Boulder.



Map 5.4: Land ownership for WMU 25C, Boulder.

	Year-Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	42,311	2%	634,615	30%	1,432,127	67%
Elk	1,675	<1%	425,791	39%	675,560	61%

Table 5.1: Estimated mule deer and elk habitat acreage by season for WMU 25C, Boulder.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	21,534	51%	429,081	68%	232,815	16%
BLM	18,453	44%	143,227	23%	906,177	63%
NPS	0	0%	6,451	1%	102,656	7%
SITLA	639	2%	52,905	8%	87,707	6%
Private	1685	4%	2,951	<1%	132,368	5%
UDOT	0	0%	0	0%	3	<1%
USP	0	0%	0	0%	4,539	<1%
UDWR	0	0%	0	0%	1,101	<1%
Total	**42,311**	**100%**	**634,615**	**100%**	**1,432,127**	**100%**

Table 5.2: Estimated mule deer habitat acreage by season and ownership for WMU 25C, Boulder.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	1,578	94%	368,293	87%	260,050	39%
NPS	0	0%	0	0%	29,938	4%
BLM	0	0%	15,224	4%	269,878	40%
SITLA	93	6%	39,562	9%	89805	13%
Private	4	<1%	2,712	<1%	24,338	4%
UDWR	0	0%	0	0%	221	<1%
USP	0	0%	0	0%	1,329	<1%
Total	**1,675**	**100%**	**425,791**	**100%**	**675,560**	**100%**

Table 5.3: Estimated elk habitat acreage by season and ownership for WMU 25C, Boulder.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Artemisia tridentata ssp. vaseyana Shrubland Alliance	3,612.58	0.27%	
	Coleogyne ramosissima Shrubland Alliance	16,986.27	1.27%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	215,536.08	16.08%	
	Great Basin Semi-Desert Chaparral	5,670.61	0.42%	
	Inter-Mountain Basins Big Sagebrush Shrubland	62,021.16	4.63%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	4,142.10	0.31%	
	Inter-Mountain Basins Greasewood Flat	4,955.62	0.37%	
	Inter-Mountain Basins Mat Saltbush Shrubland	1,556.32	0.12%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	19,479.76	1.45%	
	Inter-Mountain Basins Montane Sagebrush Steppe	19,431.05	1.45%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	18,731.18	1.40%	
	Quercus gambelii Shrubland Alliance	1,113.31	0.08%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	4,201.25	0.31%	
	Rocky Mountain Lower Montane-Foothill Shrubland	5,313.67	0.40%	
	Southern Colorado Plateau Sand Shrubland	4,660.05	0.35%	
	Other Shrubland	1,200.49	0.00%	28.98%
Conifer	Abies concolor Forest Alliance	2,380.96	0.18%	
	Colorado Plateau Pinyon-Juniper Woodland	372,860.84	27.81%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	104,855.89	7.82%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	17,405.04	1.30%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	9,544.95	0.71%	
	Southern Rocky Mountain Ponderosa Pine Woodland	59,004.37	4.40%	
	Other Conifer	1,002.11	0.07%	42.29%
Conifer-Hardwood	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	92,920.87	6.93	6.93%
Grassland	Native Grassland	27,671.66	2.06%	2.06%
Exotic Tree-Shrub	Introduced Riparian Vegetation	1,116.20	0.08%	0.08%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	7,133.97	0.53%	0.53%
Other	Hardwood	58,424.81	4.36%	
	Riparian	22,639.98	1.69%	
	Agricultural	22,655.99	1.69%	
	Developed	18,138.27	1.35%	
	Other	134,416.79	10.03%	19.11 %
Total		1,340,784.19		

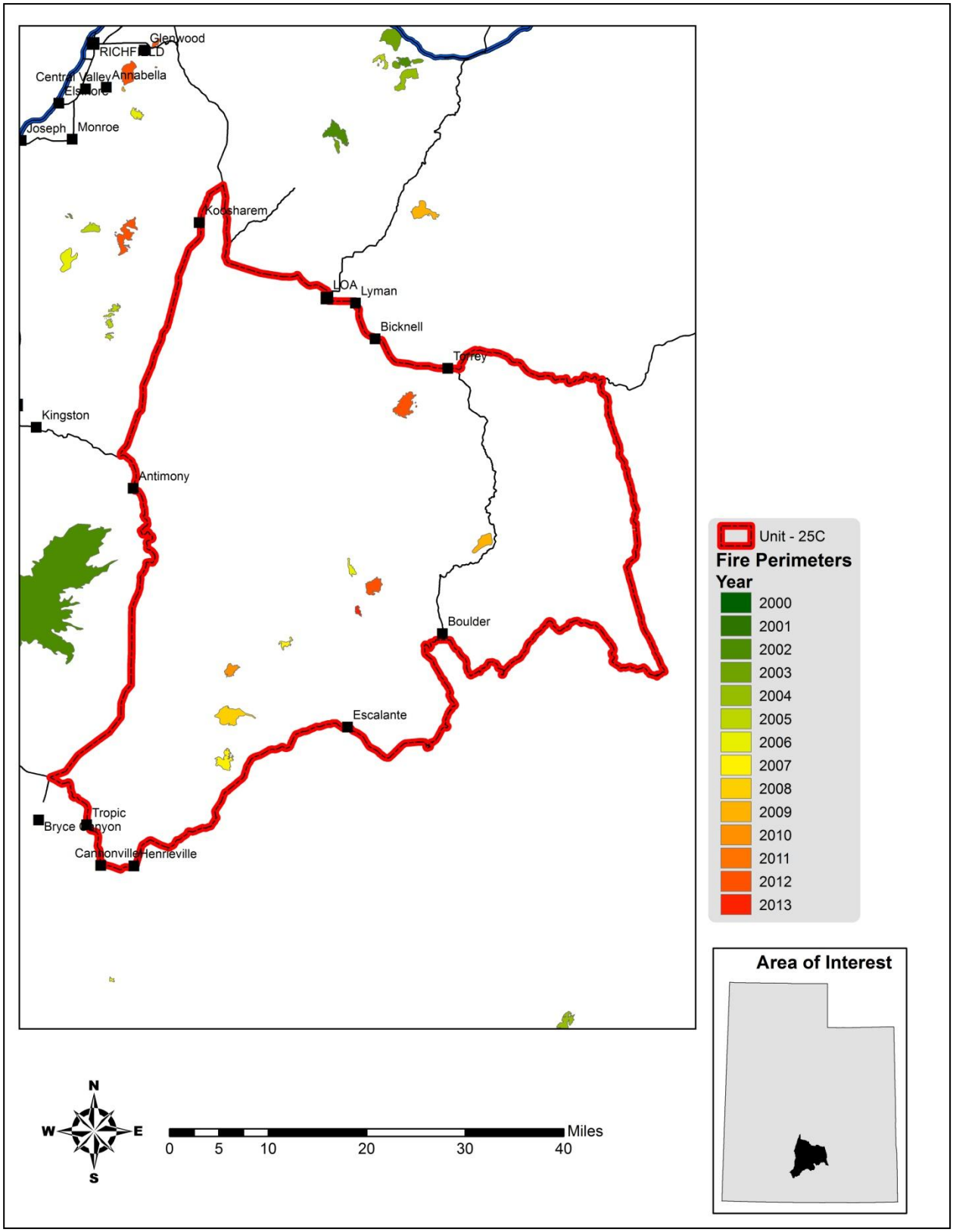
Table 5.4: LANDFIRE existing vegetation coverage of deer winter range for WMU 25C, Boulder (LANDFIRE: LANDFIRE 1.2.0, 2010).

Limiting Factors to Big Game Habitat

The Boulder Plateau and the surrounding winter range have a wide variety of multiple uses that stem from a diverse range of landownership and land management principles. Private land practices mainly include ranching and alfalfa production, while state and federal land uses include livestock grazing, mineral and resource exploration and extraction, road building, OHV riding, camping, and wilderness designations. Many of the land uses within the unit can be harmonious with the management of big game habitat while other land practices may negatively affect its management within the unit. There is ample range for deer in normal winters. Only in severe winters when the usable range may become limited. Additionally, the potential to increase forage for wintering deer and elk is substantial and can be gained by the removal of encroached pinyon and juniper trees that are very pronounced along benches and flats of the Boulder Plateau.

Wildfire has not made a substantial impact on the deer winter range in the unit. Additionally, few of the range trend studies have captured wildfire events, which means any response by rehabilitation efforts or recovery of sagebrush communities within the fire perimeters since the year 2000 have not been evaluated.

Encroachment by pinyon-juniper woodland communities also poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 25C (Table 5.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000).

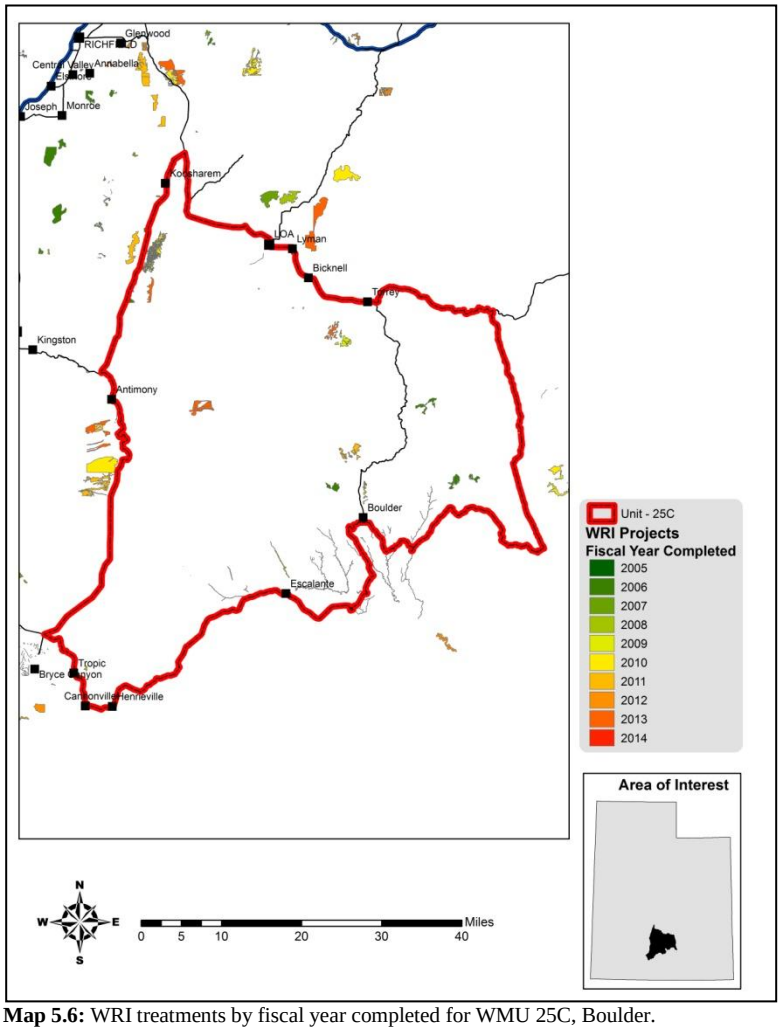


Map 5.5: Land coverage of fires by year from 2001-2013 for WMU 25C, Boulder (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2014).

Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). There has been 12,503 treatment acres on this unit with 16,488 total acres treated due to overlapping treatments (Map 5.6). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

The majority of treatment acreage, especially seeding, was done in conjunction with restoration efforts of wildfires within the unit. Treatments to reduce pinyon-juniper woodlands such as bullhog, chaining, brush saw, and lop-and-scatter are the next most common management practices. Other common management treatments are those to rejuvenate sagebrush stands such as chaining and harrow treatments are also common (Table 5.5).



Map 5.6: WRI treatments by fiscal year completed for WMU 25C, Boulder.

Treatment Action	Acres
Brush beater (mower)	16
Bullhog	237
Harrow	4,753
Mower	804
Prescribed fire	1,900
Seeding (primary)	6,404
Lop and scatter	2,374
***Total Acres Treated**	**16,488**
Total Treatment Acres	**12,503**

Table 5.5: WRI treatment action size (acres) for WMU 25C, Boulder.
*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 25C on a regular basis since 1985, with studies being added or suspended as were deemed necessary (Table 5.6). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Monitoring studies of WRI projects have been sampled since 2004. When possible, WRI monitoring studies are established prior to treatment and sampled on a regular basis following treatment. Due to the long-term nature of the studies, many of the Range Trend and WRI studies have had some sort of disturbance or treatment prior to or since study establishment (Table 5.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
25C-1	Yergy	RT	Suspended	‘85 ‘91 ‘94 ‘98 ‘03, ‘08	Not Verified
25C-2	Wildcat	RT	Active	‘85 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25C-3	Happy Valley	RT	Active	‘85 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	Mountain Loam (Pondorasa Pine)
25C-4	North Slope	RT	Active	‘85 ‘91 ‘98 ‘03, ‘08,‘13	Mountain Loam (Ponderosa Pine)
25C-5	Giles Hollow	RT	Suspended	‘85 ‘91 ‘94 ‘98 ‘03	Not Verified
25C-6	Terza Flat	RT	Active	‘85 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
25C-7	Cedar Grove	RT	Active	‘85 ‘91 ‘98 ‘03, ‘08,‘13	Upland Shallow Loam (Mountain Big Sagebrush)
25C-8	South Narrows	RT	Active	‘85 ‘91 ‘94 ‘98 ‘03, ‘08,‘09,‘13	Semidesert Loam (Wyoming Big Sagebrush)
25C-9	Dry Wash	RT	Active	‘85 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	Upland Stony Loam (Mountain Big Sagebrush)
25C-10	Pleasant Creek Exclosure (In)	RT	Suspended	‘91 ‘94 ‘98	Not Verified
25C-11	Pleasant Creek Exclosure (Out)	RT	Suspended	‘91 ‘94 ‘98	Not Verified
25C-12	Nazer Draw	RT	Active	‘87 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	Mountain Shallow Loam (Ponderosa Pine)
25C-13	Short Neck	RT	Suspended	‘87 ‘91 ‘94 ‘98 ‘03	Not Verified
25C-14	New Home Bench	RT	Active	‘87 ‘91 ‘98 ‘03, ‘08,‘13	Semidesert Sandy Loam (Wyoming Big Sagebrush)
25C-15	Steep Creek Bench	RT	Suspended	‘87 ‘91 ‘94 ‘98 ‘03	Not Verified
25C-16	Whites Flat	RT	Suspended	‘87 ‘91 ‘94 ‘98	Not Verified
25C-17	Varney-Griffin Chaining	RT	Active	‘87 ‘91 ‘98 ‘03, ‘08,‘13	Mountain Loam (Mountain Big Sagebrush)
25C-18	Allen Canyon	RT	Suspended	‘87 ‘91 ‘98	Not Verified
25C-19	Rock Bench	RT	Suspended	‘87 ‘91	Not Verified
25C-20	Baldys	RT	Active	‘87 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	High Mountain Loam (Aspen)
25C-21	Griffin	RT	Suspended	‘87 ‘91 ‘94 ‘98	Not Verified
25C-22	Salt Gulch	RT	Suspended	‘87 ‘91 ‘94 ‘98	Not Verified
25C-23	Coal Bench	RT	Suspended	‘87 ‘91 ‘98 ‘03, ‘08	Not Verified
25C-24	Black Ridge	RT	Suspended	‘87 ‘91 ‘98	Not Verified
25C-25	Center Creek	RT	Active	‘87 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	Mountain Loam (Mountain Big Sagebrush)
25C-26	Black Canyon	RT	Active	‘87 ‘91 ‘98 ‘03, ‘08,‘13	Semidesert Gravelly Loam (Black Sagebrush)
25C-27	Poison Creek Bench	RT	Active	‘87 ‘91 ‘94 ‘98 ‘03, ‘08,‘13	Mountain Gravelly Loam (Mountain Big Sagebrush)
25C-28	North Creek	RT	Active	‘87 ‘91 ‘98 ‘03, ‘08,‘13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25C-30	Pole Corral Draw	RT	Suspended	‘98	Not Verified
25C-31	Parker Mountain Aerator	RT	Active	‘03, ‘08,‘13	Mountain Loam (Mountain Big Sagebrush)
25C-32	Antone Flat	RT	Suspended		Not Verified
25R-2	Lower Meadow Estates	RT	Suspended	‘97 ‘03	Not Verified
25R-3	Upper Meadow Estates	RT	Suspended	‘97 ‘03	Not Verified
25R-4	Onion Field	WRI	Suspended	‘04	Not Verified
25R-5	Lamp Stand	WRI	Active	‘04,‘07,‘12	Not Verified
25R-7	North Narrows Dixie	WRI	Active	‘08,‘09,‘10,‘13	Semidesert Loam (Wyoming Big Sagebrush)
25R-8	Sawmill Point Aspen	WRI	Active	‘10,‘13	High Mountain Loam (Aspen)
25R-10	Parker Front	WRI	Active	‘13	Upland Gravelly Loam (Mountain Big Sagebrush)
25R-11	Brown Spring	WRI	Active	‘13	Upland Loam (Wyoming Big Sagebrush)

Table 5.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 25C, Boulder.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
25C-1	Yergy	Chain Unknown		1970		
		Seed Unknown		1970		
		1-way Dixie Harrow		Fall 2005		
		Seed Unknown		Fall 2005		
25C-2	Wildcat	Chain Unknown		1970		
		Seed Unknown		1970		
		Unknown Bullhog		2003-2008		
25C-3	Happy Valley	Wildfire		Jun. 1984		
		Seed Unknown		1984?		
25C-12	Nazer Draw	Seed Unknown		1955	1,200	
25C-17	Varney-Griffin Chaining	Chain Unknown		1981	1,100	
		Seed Unknown		1981	1,100	
		Bullhog		2003-2008	1,100	
25C-23	Coal Bench	Chain Unknown		1966		
		Seed Unknown		1966		
25C-25	Center Creek	Prescribed Fire		1984		
		Seed Unknown		Historic		
25C-27	Poison Creek Bench	Prescribed Fire		1994		
25C-28	North Creek	Wildfire		2002		
25C-31	Parker Mountain Aerator	2-Aerator		2002		
25R-1	Gooseberry	Chain Unknown		Fall 1997		
		Seed Unknown		Fall 1997		
25R-4	Onion Field		Circle Cliffs			PDB
25R-5	Lamp Stand	Truax Drill	Circle Cliffs-Year 1	Nov. 2004		PDB
25R-7	North Narrows Dixie	2-way Dixie Harrow	North Narrows Year 1	Fall 2008	1,368	1,155
		Broadcast Before	North Narrows Year 1	Fall 2008	1,368	1,155
		Broadcast After	North Narrows Year 1	Fall 2008	1,368	1,155
25R-8	Sawmill Point Aspen	Logging/Selective	Sawmill Point/Baldy's Ridge Aspen Improvement	2010-2011	9,40	1,691
25R-10	Parker Front	2-Way Smooth	Parker Front PJ Removal	2013-2014	788	2,547
		Aerial Before	Parker Front PJ Removal	2013-2014	500	2,547
25R-11	Brown Spring	Bullhog	Parker Front PJ Removal	2013-2014	788	2,547
		Aerial Before	Parker Front PJ Removal	2013-2014	500	2,547

Table 5.7: Range trend and WRI studies known disturbance history for WMU 25C, Boulder.

Study Trend Summary (Undisturbed Sites)

High Mountain (Aspen)

There is one study [Baldys (25C-20)] classified as a High Mountain (Aspen) ecological site that remained undisturbed over the report period (Table 5.6). The study is located centrally on the southeastern aspect of Boulder Mountain, and is approached from the East Fork Boulder Creek.

Shrubs/Trees: The primary browse on the Baldys study is a mixture of Woods rose (*Rosa woodii*) and Utah serviceberry (*Amelanchier utahensis*). The mean line-intercept cover of preferred browse species is poor at 1% cover or less since 2003. Although mountain snowberry (*Symphoricarpos oreophilus*) is not considered a browse species, it does receive some use by wildlife and makes up much of the understory. Additionally, it has increased in cover from 12% in 2003 to 20% and 2013 (Figure 5.2a).

Conifer tree encroachment is not a threat on the Baldys study. The mean density of aspen trees has steadily increased from 428 plants/acre in 1998 to 2,081 plants/acre in 2013 (Figure 5.3a). Despite the increase in density, mean tree cover has decreased from 72% in 2003 to 47% in 2013 (Figure 5.3b). The decrease in mean tree cover is likely due to the maturation of the aspen stand.

Herbaceous Understory: The Baldys study site has a good herbaceous component dominated by native perennial grasses and forbs. Mean nested frequency of perennial grasses has fluctuated, but has remained

relatively high since 1994 (Figure 5.4a). The mean cover of perennial grass has gradually increased from 12% in 1994 to 15% in 2013 (Figure 5.4b). Annual grass species have not been observed on the study.

Native perennial forb species composition is diverse with high nested frequency and cover. The mean nested frequency of perennial forb species increased markedly in 1998 with a corresponding increase in mean cover that increased from 10% in 1994 to 26% in 1998 (Figure 5.4).

Occupancy: Pellet group transect data indicates that elk predominately occupy this study. The mean abundance of elk pellet groups has ranged from a high of 45 days use/acre in 2008 to a low of 18 days use/acre in 2013. Deer and cattle occupancy is generally low on the Baldys study; however, deer and cattle sign were sampled in moderate abundance in 2008 (Figure 5.5).

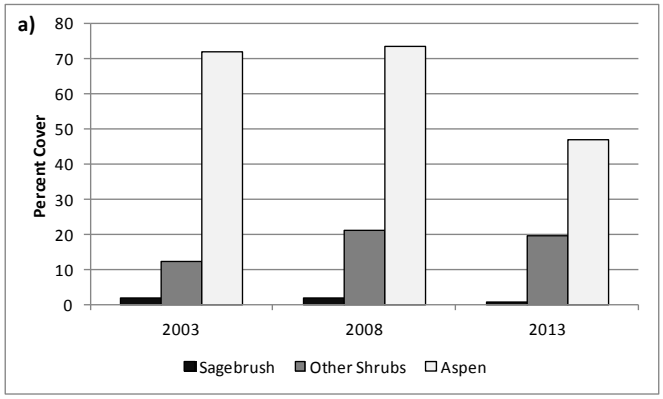


Figure 5.2: Shrub summary of the High Mountain (Mountain Big Sagebrush) study (n=1) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups.

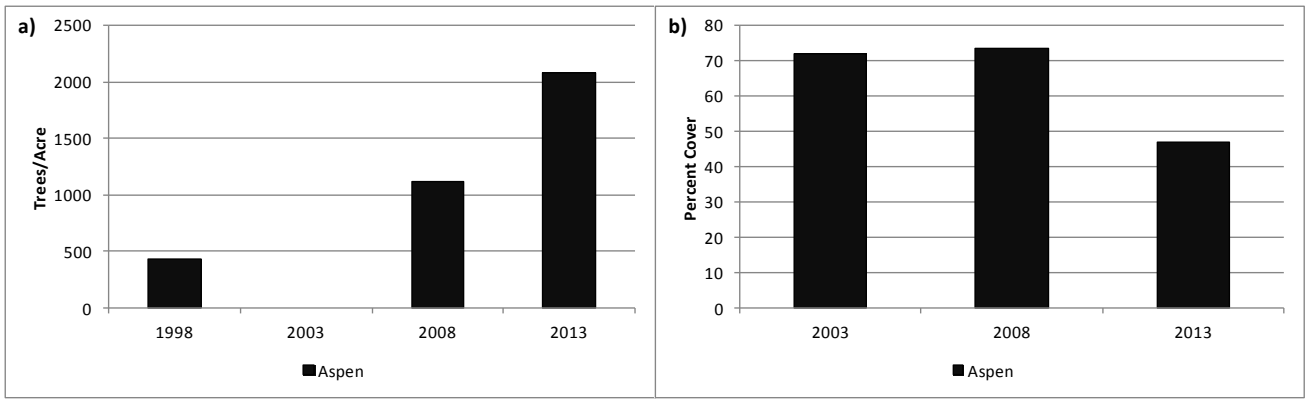


Figure 5.3: Tree summary of the High Mountain (Aspen) study (n=1) for WMU 25C, Boulder. a) Mean point-quarter tree density estimates for quaking aspen (*Populus tremuloides*). b) Mean line-intercept cover estimate for quaking aspen.

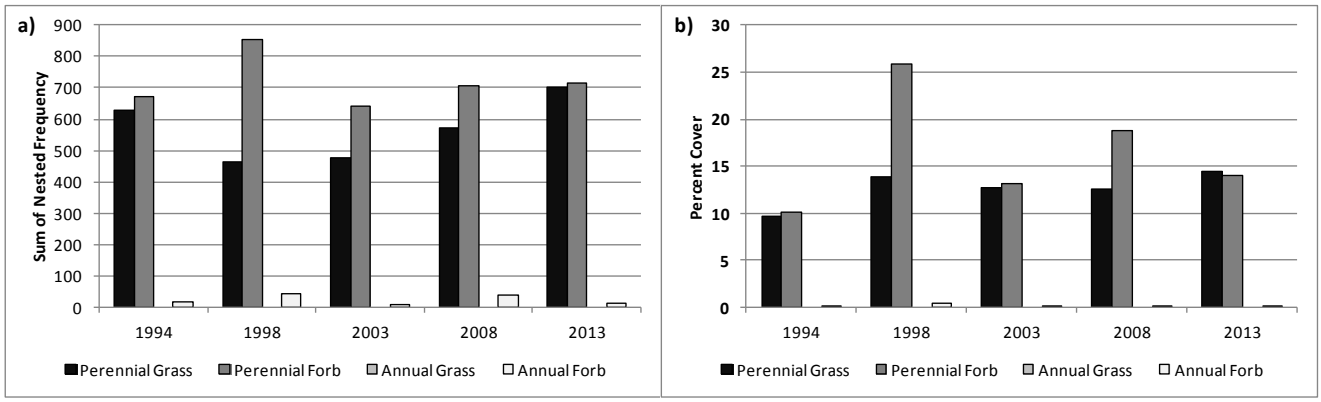


Figure 5.4: Herbaceous functional group summary of the High Mountain (Mountain Big Sagebrush) study (n=1) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

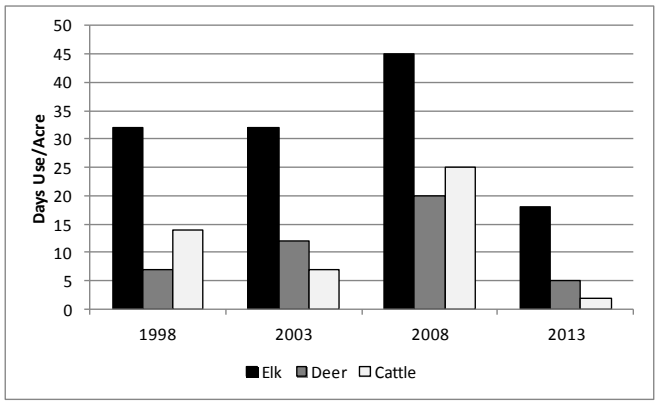


Figure 5.5: Mean pellet transect data for the High Mountain (Mountain Big Sagebrush) study (n=1) for WMU 25C, Boulder.

Mountain (Mountain Big Sagebrush)

There is one study [Center Creek (25C-25)] classified as Mountain (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 5.6). The Center Creek study is located on the east side of John's Valley in North Creek Draw.

Shrubs/Trees: The primary browse on the Center Creek study is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). The mean line-intercept cover of sagebrush is good on this site remaining similar at 12% since 2003 (Figure 5.6a). The average height of the mountain big sagebrush is approximately 1.5 feet making browse available through much of the year in mild winters. The demographics of the sagebrush population have been generally comprised of a mixture of mature and young plants, and decadent plants have been low in all sample years (Figure 5.6b).

Encroachment from Utah juniper and pinyon pine trees is not a concern on this site.

Herbaceous Understory: The study site has a good herbaceous component dominated by perennial grass. However, the dominant grass species is the seeded species smooth brome (*Bromus inermis*) with a moderate presence of crested wheatgrass (*Agropyron cristatum*). Competition with these introduced grasses may limit other desirable herbaceous species. Mean nested frequency of perennial grasses has fluctuated, but has remained relatively high since 1994 (Figure 5.7a). The mean cover of perennial grasses has fluctuated over the sample years from high of 24% in 1998 to a low of 15% in 2008 (Figure 5.7b). Annual grass species are rare to absent on this site over the sample years.

Native perennial forb species composition is good on the site with moderately high nested frequency and cover (Figure 5.7).

Occupancy: Pellet group transect data indicates that deer, elk, and cattle have predominately occupied these studies. The mean abundance of deer pellet groups has ranged from a high of 36 days use/acre in 1998 to a low of 15 days use/acre in 2013. Elk pellet groups have ranged from a high of 32 days use/acre in 2008 to a low of 6 days use/acre in 1998. The abundance of livestock sign from cattle has ranged from a high of 33 days use/acre in 1998 to a low of 17 days use/acre in 2008 (Figure 5.9).

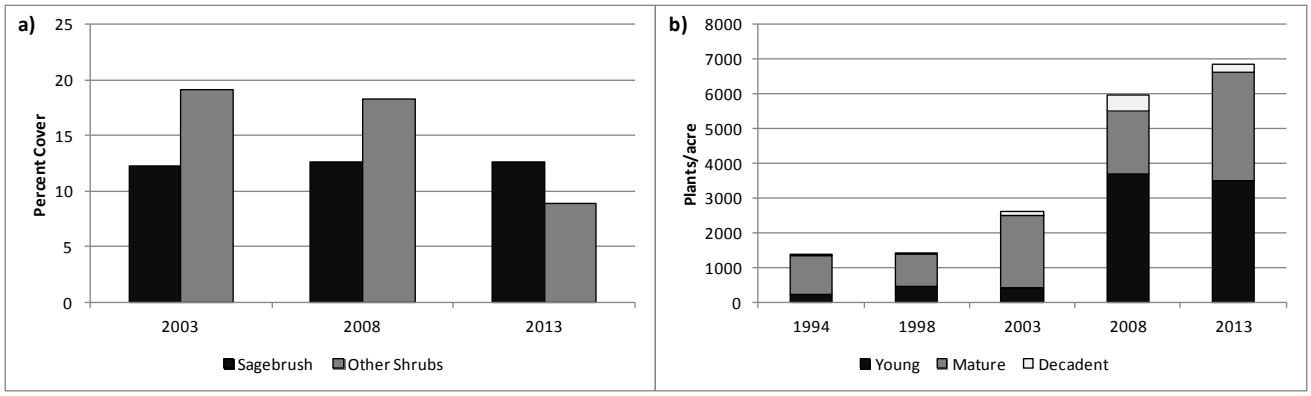


Figure 5.6: Shrub summary of the Mountain (Mountain Big Sagebrush) studies (n=1) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

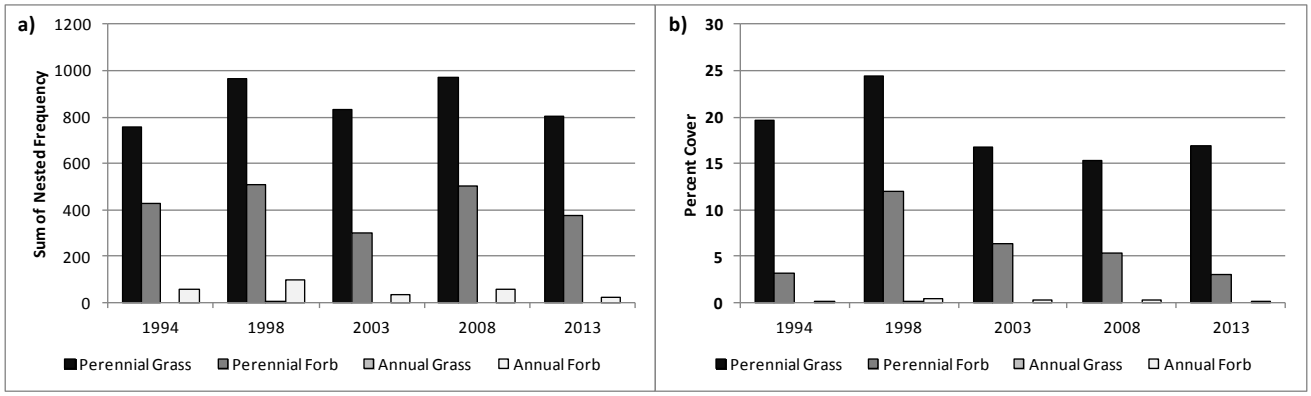


Figure 5.7: Herbaceous functional group summary of the Mountain (Mountain Big Sagebrush) studies (n=1) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

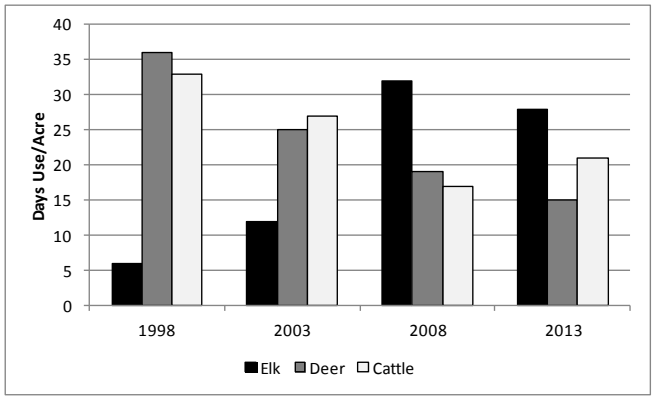


Figure 5.8: Mean pellet transect data for the Mountain (Mountain Big Sagebrush) studies (n=1) for WMU 25C, Boulder.

Mountain (Ponderosa)

There are three studies [Happy Valley (25C-3), North Slope (25C-4), and Nazer Draw (25C-12)] classified as Mountain (Ponderosa) ecological sites that remained undisturbed over the report period (Table 5.6). The

Happy Valley and the North Slope studies are located south of Grover on the north slope of the Boulder Plateau while the Nazer Draw study is located north of Boulder on a flat near the top of Nazer Draw.

Shrubs/Trees: The primary browse common on all three studies is antelope bitterbrush (*Purshia tridentata*). Black sagebrush is the predominant browse species available to wildlife on the Nazer Draw study, but is infrequent on the North Slope and Happy Valley studies. The mean line-intercept cover of sagebrush is driven almost exclusive by the Nazer Draw study, and has decreased slightly from 9% in 2003 to 7% in 2008 then increasing to 10% in 2013. Other preferred shrubs, namely bitterbrush, has gradually increased in mean cover on these sites from 12% in 2003 to 15% in 2013 (Figure 5.9a). The average height of black sagebrush on the Nazer Draw study has averaged between 1.5 feet to 2 feet tall, and the average height of bitterbrush on these sites have also averaged between 1.5 feet to 2 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations are again driven mainly by the Nazer Draw study and have generally been comprised of mature and young plants with higher ratio of young plants to decadent plants most sample years. Young plants have had a mean density greater than 10% most sample years, except in 1998 when young plants were not sample on the North Slope and Happy Valley studies. Despite the slight change in cover of sagebrush, the mean density of sagebrush decreased significantly on the Nazer Draw and the North Slope studies (Figure 5.9b).

The mean density of pinyon-juniper trees has steadily increased since 1998, while ponderosa pine (*Pinus ponderosa*) has maintained similar densities over the same period. The mean density and cover of pinyon-juniper has increased from 27 trees/acre in 1998 to 55 trees/acre in 2013 and 3% in 2003 to 5% in 2013, respectively (Figure 5.10a). Trends for ponderosa pine are driven primarily by the Happy Valley study. Mean pinyon-juniper tree cover has increased slightly since 2003, but is considered relatively low (Figure 5.10b). The North Slope study is classified as Phase II while the Nazer Draw study is classified as being in Phase I of the woodland succession. These study sites are likely under threat of further encroachment by pinyon-juniper trees, which would result in decreases in valuable browse and forage species.

Herbaceous Understory: These study sites have a good to fair herbaceous component dominated primarily by native perennial grasses blue grama (*Bouteloua gracilis*) and mutton bluegrass (*Poa fendleriana*). However, the seeded species crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*A. intermedium*) are present on the Happy Valley and Nazer Draw sites. These seeded species are considered aggressive at higher elevation and precipitation. Competition with this introduced grass may limit other desirable herbaceous species. A moderate number of native species also occur on the sites, but at much lower cover and frequencies. Mean nested frequency of perennial grasses has remained high and stable since 1994. There was a notable increase in mean nested frequency of perennial grasses in 1998. The mean cover of perennial grass species has been slightly more variable, but has still followed a similar pattern with a marked increase in mean cover of perennial grasses from 10% in 1994 to 18% in 1998, but stabilizing between 11% and 14% from 2003 to 2013, respectively. The annual grass species cheatgrass is present on the Happy Valley and Nazer Draw studs, but has been very low in abundance and cover each sample year (Figure 5.11), and is likely not a threat on both of these studies. If increases in abundance and cover occur and persist, than the threat of increased fire potential may arise.

Native perennial forb species composition is fairly diverse on these studies, but with low nested frequency and cover of all sampled species, except for the palatable species Carruth's sagewort (*Artemisia carruthii*), which has been common on the Happy Valley and North Slope studies (Figure 5.11).

Occupancy: Pellet group transect data indicates that deer most frequently occupy these study sites. The mean abundance of deer pellet groups has ranged from a high of 63 days use/acre in 2003 to a low of 26 days use/acre in 2013 (Figure 5.12). All of the studies show similar abundance of deer pellet groups sampled.

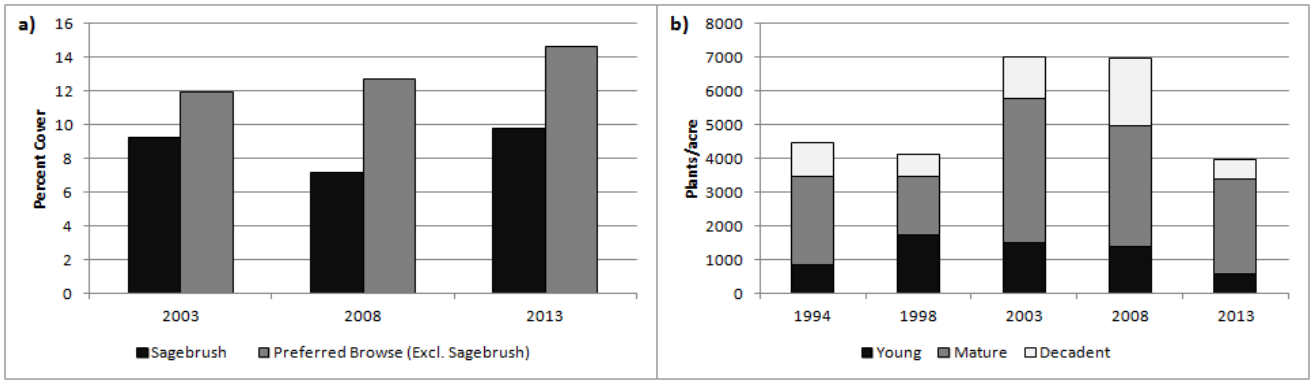


Figure 5.9: Shrub summary of the Mountain (Ponderosa) studies (n=3) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

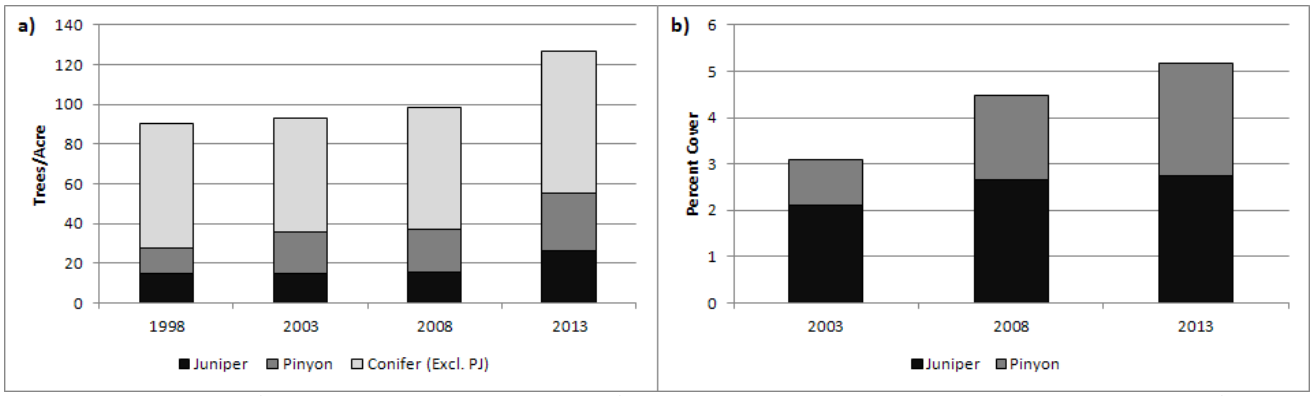


Figure 5.10: Tree summary of the Mountain (Ponderosa) studies (n=3) for WMU 25C, Boulder. a) Mean point-quarter tree density estimates for Utah juniper *(Juniperus osteosperma*), pinyon pine and (*Pinus edulis*). Ponderosa pine (*P. ponderosa)* is represented as other conifer. b) Mean line-intercept cover estimate for Utah juniper and pinyon pine.

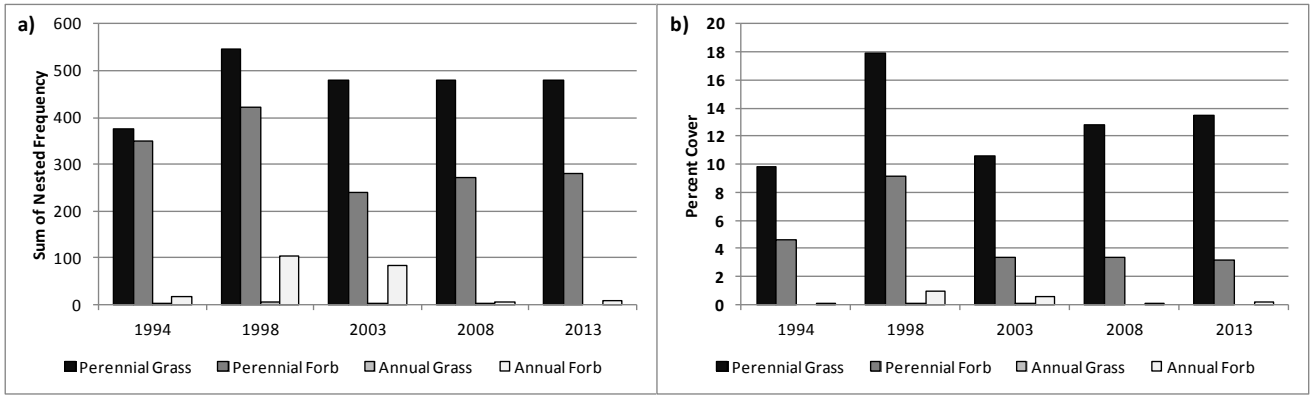


Figure 5.11: Herbaceous functional group summary of the Mountain (Ponderosa) studies (n=3) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

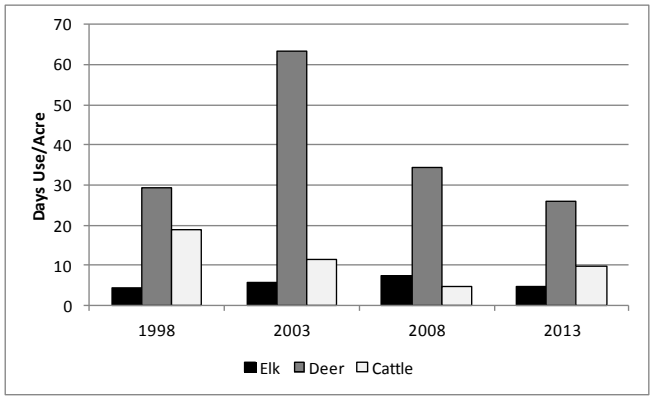


Figure 5.12: Mean pellet transect data for the Mountain (Ponderosa) studies (n=3) for WMU 25C, Boulder.

Upland (Mountain Big Sagebrush)

There are two studies [Cedar Grove (25C-7) and Dry Wash (25C-9)] classified as Upland (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 5.6). Although Wyoming big sagebrush occurs on the Dry Wash study, the study's ecological site description best fits within an Upland (Mountain Big Sagebrush) ecological site. The Cedar Grove study is located northwest of Loa on the flat east of Hatch Canyon. The Dry Wash study is located east of Antimony on a flat north of Dry Wash.

Shrubs/Trees: The primary browse on the Cedar Grove study is Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and black sagebrush (*Artemisia nova)*, while the primary browse species on the Dry Wash study is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). The mean line-intercept cover of sagebrush is good on these sites, and has steadily increased from 14% in 2003 to just over 17% in 2013 (Figure 5.13a). The average height of Wyoming big sagebrush on all of the studies is approximately 1 foot to 1.5 feet tall, making sagebrush fairly available through much of the year in normal winters. The demographics of the sagebrush populations have generally been comprised of mature plants with mean recruitment of young plants comprising less than 10% of the population most sample years, except in 1994 when mean recruitment of young sagebrush was 22% of the combined populations . Mean decadent plants within the populations have been low most sample years, but was high in 2003 and 2008. Despite the increase in mean cover of sagebrush, the mean density of sagebrush has remained stable on these sites since 1998 (Figure 5.13b). Herbaceous trends prior to 1998 are driven exclusively by the Cedar Grove study.

Although pinyon pine trees are present on the Dry Wash study, but neither pinyon pine nor juniper are able to be sampled in density measurements and have not been included in this portion of the summary. Encroachment from pinyon pine is a minor concern on the Dry Wash study. The density of pinyon pine trees has remained low and stable since 1998 (Figure 5.14a), and tree cover has remained stable since 2003 (Figure 5.14b). The Dry Wash study is classified as Phase I of the woodland succession. The study is likely not under threat of further encroachment by pinyon pine trees or loss in valuable browse and forage species.

Herbaceous Understory: These study sites have a fair to good herbaceous component dominated primarily by native perennial grasses. Mean nested frequency of perennial grasses has generally remained stable since 1994, but there was a slight decrease in 2003 that corresponds with the areas local drought conditions. However, mean cover of perennial grass has steadily increased from 6% in 1994 to near 10% in 2013, except when mean perennial grass cover increased abruptly. The annual grass species cheatgrass was very abundant on the Dry Wash study in 1998 and 2003, but has been sampled at much lower cover in subsequent samplings (Figure 5.15). Due to the presence of cheatgrass, Dry Wash remains at risk for increased fire potential and loss of the browse and herbaceous components. Cheatgrass is absent on the Cedar Grove study.

Native perennial forb species composition is fair on Cedar Grove study, but low in diversity on the Dry Wash study. Both studies display low in nested frequencies and covers for all sampled species (Figure 5.15).

Occupancy: Pellet group transect data indicates that elk and deer predominantly occupy these study sites, but seem to favor the Dry Wash study more as made apparent by the higher abundance in pellet groups for that study. The mean abundance of elk pellet groups has ranged from a high of 51 days use/acre in 2003 to a low of 28 days use/acre in 2013, while deer/pronghorn has a lower mean abundance range from a high of 37 days use/acre in 2003 to a low of 18 days uses/acre in 2008 (Figure 5.16).

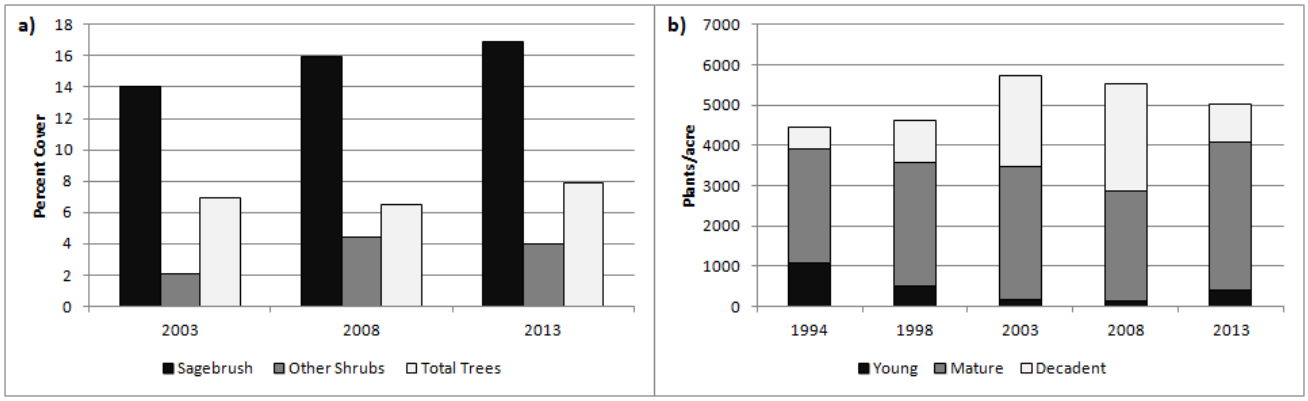


Figure 5.13: Shrub summary of the Upland (Mountain Big Sagebrush) studies (n=2) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

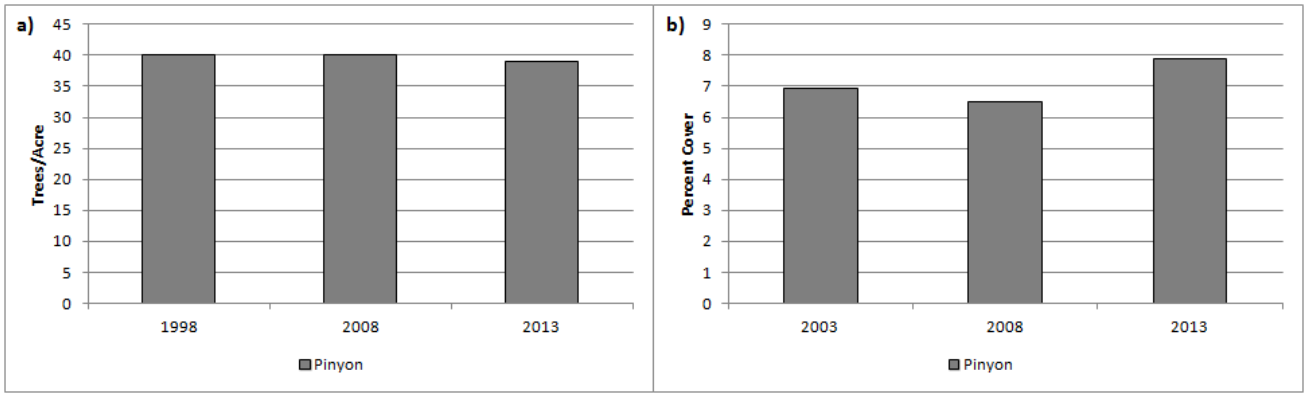


Figure 5.14: Tree summary of the Upland (Mountain Big Sagebrush) study (n=1) for WMU 25C, Boulder. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*). b) Mean line-intercept cover estimate for pinyon pine.

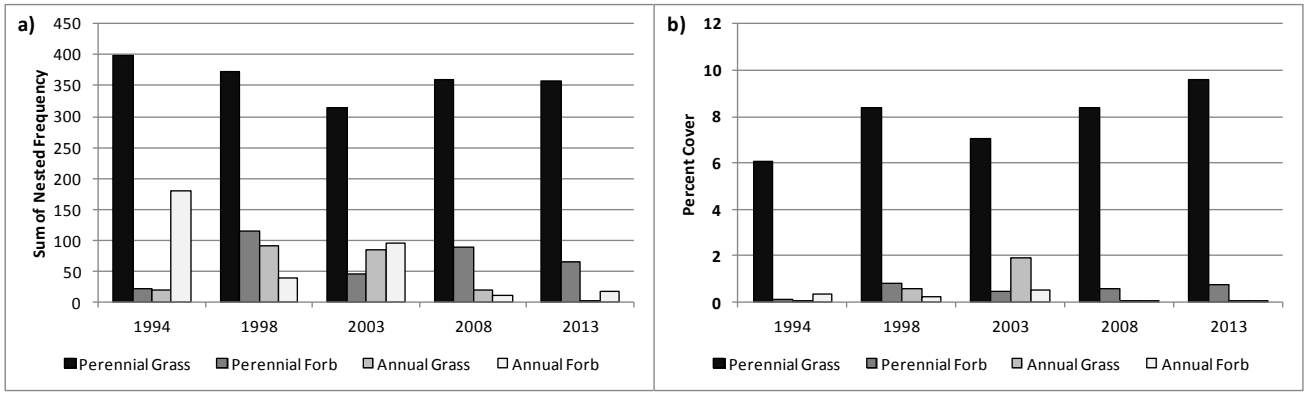


Figure 5.15: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) studies (n=2) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

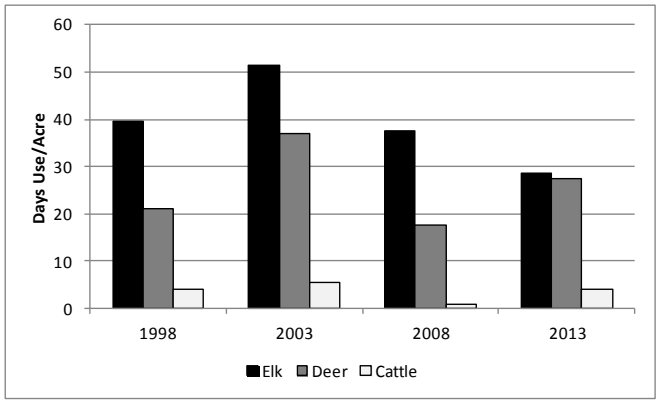


Figure 5.16: Mean pellet transect data for the Upland (Mountain Big Sagebrush) studies (n=2) for WMU 25C, Boulder.

Semidesert (Wyoming Big Sagebrush)

There are three studies [Terza Flat (25C-6), South Narrows (25C-8), and New Home Bench (25C-14)] classified as Semidesert (Wyoming Big Sagebrush) ecological site that remained undisturbed over the report period (Table 5.6). The Terza Flat study is located south of Loa at the northern end of Terza Flat. The South Narrows study is located just off SR 62 north of Otter Creek Reservoir on the foothills of Pine Peak. The Mountain Home Bench Study is located on a bench southwest of Boulder between Hells Backbone Rd. and an airstrip.

Shrubs/Trees: The primary browse on all three studies is Wyoming big sagebrush with no other preferred browse species being sampled with significant cover on the South Narrows and New Home Bench studies. The Terza Flat study is limiting in sagebrush cover and suppresses the overall mean of sagebrush cover for the ecological site. The mean line-intercept cover of sagebrush is good on these ecological sites, and has increased slightly from at 8% to 13% since 2003 (Figure 5.17a). The trend in cover has increased on individual sites, except for the South Narrows study where sagebrush cover has varied. The average height of Wyoming big sagebrush on all of the studies is approximately 1.5 to 2 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been mature plants most sample years, but decadent sagebrush comprised the majority of the sagebrush populations in 2003 and 2008. Recruitment of young plants comprised less than 10% of the populations on most sample years. The Terza Flat study site is the exception with recruitment of young plants being as high as 21% of the population in 2013. Trends of the mean density of sagebrush increased between 1994 and 2003, but the increase in decadence in 2003 likely influenced the mean density trend downward between 2008/09 to 2013 sample periods (Figure 5.17b).

Encroachment from pinyon pine and Utah juniper trees is not a major concern on most of these sites and mean density and cover are generally low. The New Home Bench study was the only site within the ecological site to have a considerable amount of Utah juniper on its site. While tree densities have remained stable since 1998, juniper tree cover has steadily increased on the site since 2003 (Figure 5.18). Repeat photographs also show some encroachment of pinyon-juniper trees on the site, but are currently considered to be in Phase I of woodland succession.

Herbaceous Understory: These study sites have a fair herbaceous component dominated primarily by the native perennial grass blue grama (*Bouteloua gracilis*) on the South Narrows and New Home Bench studies, while the Terza Flat study is dominated by the weedy annual forb species halogeton (*Halogeton glomeratus*). The mean nested frequency of perennial grasses decreased from 1994 to 2003, but recovered and was moderately high in 2008, but decreased again in 2013. The mean cover of perennial grass followed the same trend as mean nested frequency, decreasing from over 9% in 1994 to 5% in 2003, and then increasing to 9% and 8% in 2008 and 2013, respecively. The annual grass species cheatgrass (*Bromus tectorum*) is infrequent

on the South Narrows and New Home Bench studies, and absent on the Terza Flat study (Figure 5.19). Cheatgrass is likely not a threat for increased fire on ethier of the studies it is found on.

Native perennial forb species composition is generally homogenous on these studies, which also have low nested frequency and cover for all sampled species (Figure 5.19).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy these study sites. The mean abundance of deer pellet groups has ranged from a high of 81 days use/acre in 2008 to a low of 33 days use/acre in 2013 (Figure 5.20). The New Home Bench study typically has the highest abundance of pellet groups and is the main driver of the trend.

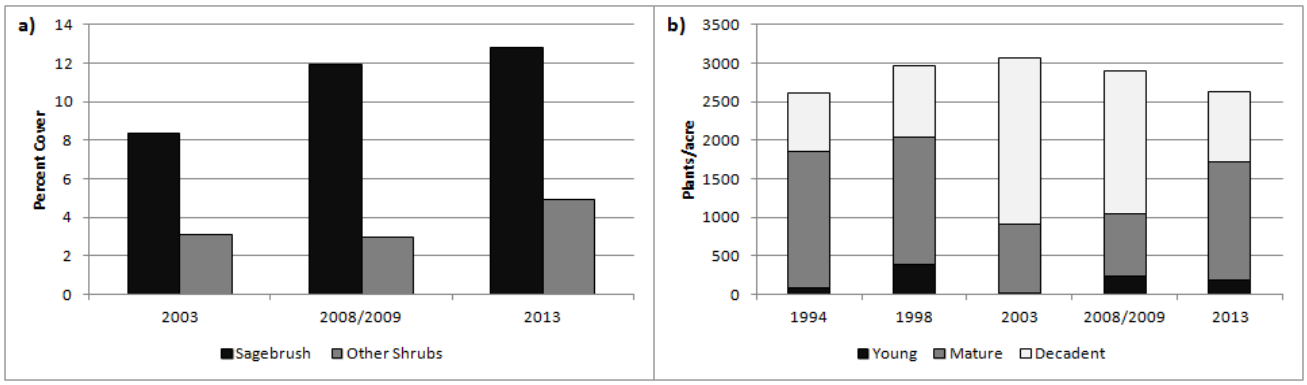


Figure 5.17: Shrub summary of the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

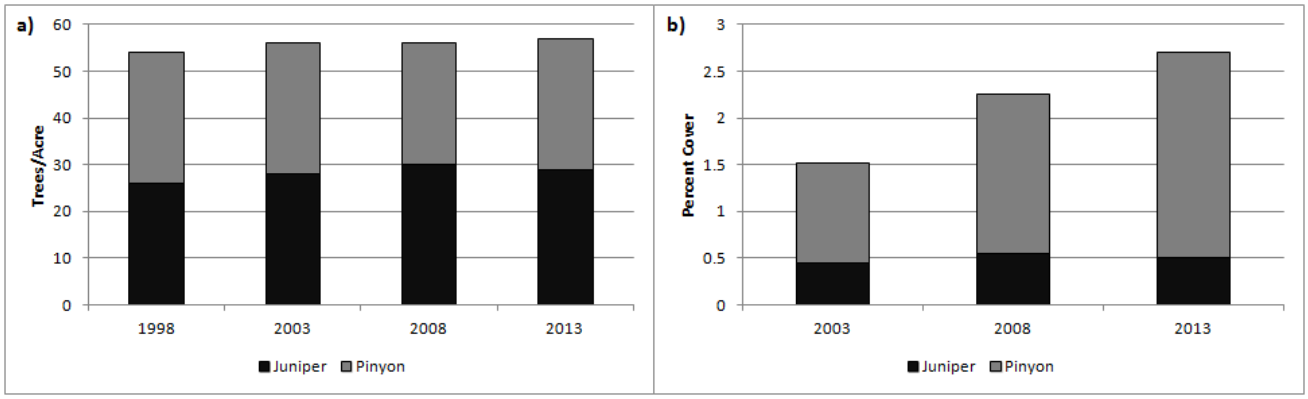


Figure 5.18: Tree summary of the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 25C, Boulder. a) Mean point-quarter tree density estimates for Utah juniper *(Juniperus osteosperma*) and pinyon pine (*Pinus edulis*). b) Mean line-intercept cover estimate for Utah juniper and pinyon pine.

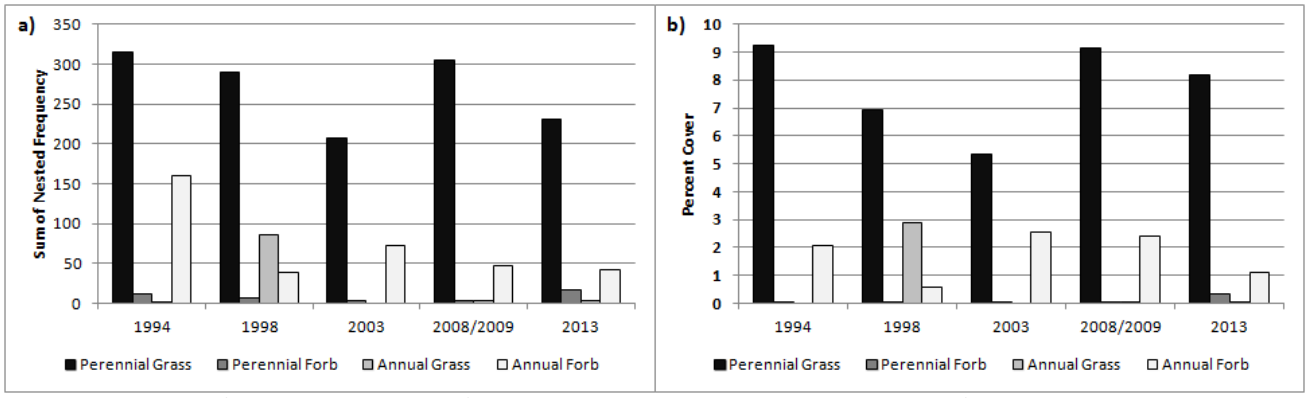


Figure 5.19: Herbaceous functional group summary of the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

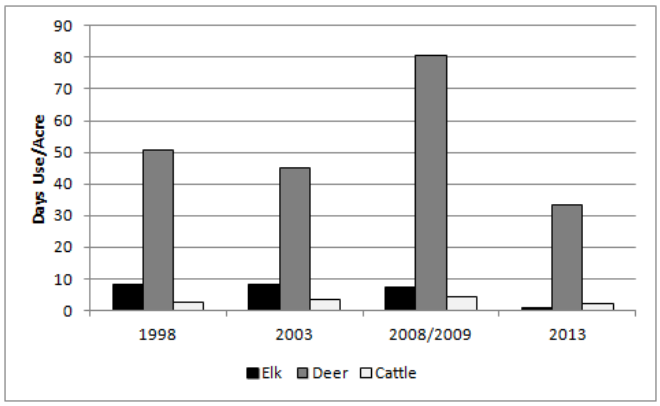


Figure 5.20: Mean pellet transect data for the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 25C, Boulder.

Semidesert (Black Sagebrush)

There is one study [Black Canyon (25C-26] classified as a Semidesert (Black Sagebrush) ecological site that remained undisturbed over the report period (Table 5.6). The Black Canyon study is located south of Antimony just east of SR 22 on a flat above Black Canyon.

Shrubs/Trees: The primary browse on the Black Canyon study is black sagebrush (*Artemisa nova*) with Wyoming big sagebrush occurring on the site, but not as abundantly as black sagebrush. The mean line-intercept cover of sagebrush is good on the site, and has generally increased in cover from 15% in 2003 to 23% in 2008 and 2013 (Figure 5.21a). The average height of Wyoming big sagebrush on all of the studies is approximately less than a foot tall, making browse mostly unavailable through much of the year in normal winters. The demographics of the sagebrush population has generally been mature plants with recruitment of young plants comprising less than 10% of the population on most sample years. The mean density of sagebrush has generally remained stable since 1998 (Figure 5.21b).

Encroachment from pinyon pine and Utah juniper trees is not a concern on the Black Canyon study site and is considered to be non-encroached.

Herbaceous Understory: These study sites has a fair herbaceous component dominated primarily by the native perennial grass blue grama (*Bouteloua gracilis*). The mean nested frequency of perennial grasses has remained stable since 1997, while the mean cover of perennial grass has generally decreased since 1998; however, there was an initial increase cover from 13% in 1998 to 18% in 2008, but cover decreased to 10% in 2013. The annual grass species cheatgrass is absent on the Black Canyon study (Figure 5.22).

Native perennial forb species composition is generally uniform on these studies and has had low nested frequency and cover values for all sampled species (Figure 5.22).

Occupancy: Pellet group transect data indicates that deer predominantly occupy the Black Canyon study site. The mean abundance of deer pellet groups has ranged from a high of 54 days use/acre in 2013 to a low of 15 days use/acre in 2003 (Figure 5.23).

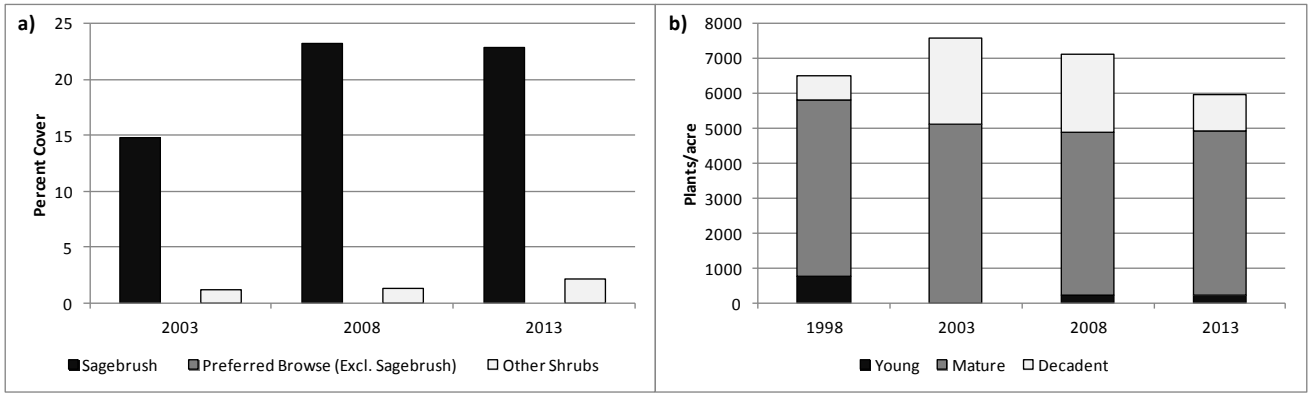


Figure 5.21: Shrub summary of the Semidesert (Black Sagebrush) study (n=1) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

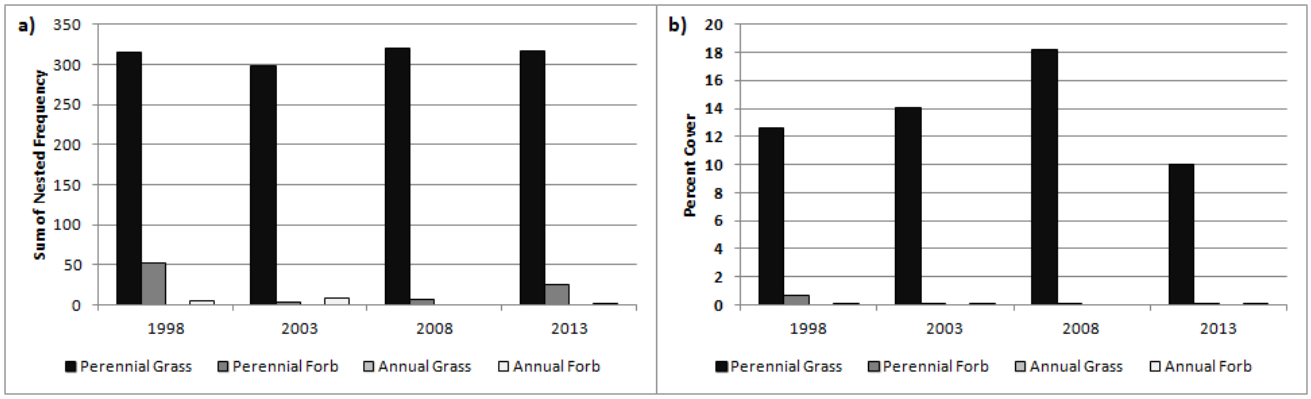


Figure 5.22: Herbaceous functional group summary of the Semidesert (Black Sagebrush) study (n=1) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

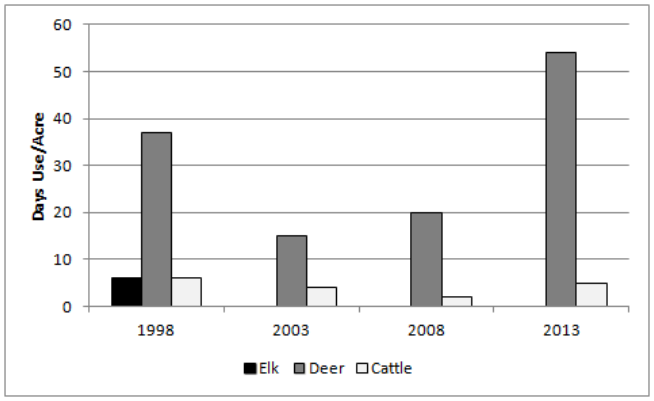


Figure 5.23: Mean pellet transect data for the Semidesert (Black Sagebrush) study (n=1) for WMU 25C, Boulder.

Study Trend Summary (Treated/Disturbed Sites)

Bullhog

There are three studies [Wildcat (25C-2), Varney-Griffin Chaining (25C-17), and Brown Spring (25R-11)] that were treated with a bullhog during the report period (Table 5.7). The Wildcat study is east of the Wildcat guard station and SR 12 and is located on a flat on the east aspect of the Boulder. The Varny-Griffin Chaining study is located northeast of the town of Escalante on the south aspect of the Boulder at the top of White Flat just northeast of North Creek Canyon. The Brown Spring study is located on foothills east of the town Koosharem. Studies are classified as either Mountain (Mountain Big Sagebrush) or Upland (Mountain Big Sagebrush-Indian Ricegrass) ecological sites (Table 5.6). Generally, the target of the bullhog treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on all of the studies is either mountain big sagebrush or Wyoming big sagebrush. Due to the studies being in Phase I of woodland succession, pinyon-juniper trees were likely having a minor impact on the shrubs in the Wildcat and Varney-Griffin Chaining studies with mean line-intercept cover of sagebrush being high on the sites. However, both studies responded well to treatment with sagebrush mean cover increasing from 10% in post year 1-5 to 17% post year 6-10 (Figure 5.24a). The mean density of sagebrush increased in post year 1-5, but the largest response occurred post year 6-10 with sagebrush increasing from near 4,000 pants/acre to just over 9,000 plants/acre. Moreover, changes in sagebrush demographics have been positive with increased young recruitment in post year 6-10. The recruitment of young plants was less than 10% on all studies prior to treatment (2003), but recruitment of young plants was good following treatment. Decadent plants within the populations prior to treatment and following treatment have remained similar in density (Figure 5.24b). Following treatment, it is expected that the sagebrush populations with the improved recruitment and health of the sagebrush, will continue to increase on most the treatment sites, especially within the mature demographic. The Brown Spring study is only represented within the pretreatment portion and is not a significant contributor to the sagebrush populations.

The mean density and cover of pinyon pine and Utah juniper trees was high at pretreatment with 183 trees/acre and 17%, respectively. However, the Brown Spring study inflates the pretreatment data and would be much lower at 67 trees/acre and 6%, respectively. The Brown Spring study has a total pinyon-juniper density and cover of 418 trees/acre and 42%, respectively. The mean density and cover of pinyon-juniper trees has been low during the post year 1-5 and post year 6-10 samplings (Figure 5.25).

Herbaceous Understory: The herbaceous component was generally lacking prior to treatment on the Brown Spring study and suppresses the pretreatment data, but the herbaceous component on the Wildcat and Varney-Griffin Chaining studies have been good prior to and after treatment. Without the Brown Spring study, mean nested frequency for perennial grasses generally remains stable, while mean cover generally decreases. Mean nested frequency and cover of perennial and annual forbs consistently decreases following the bullhog treatments. The annual grass cheatgrass has not been sampled on any of the studies (Figure 5.26), and is not a threat for increased fire potential.

Occupancy: Pellet group transect data indicates that elk primarily occupy Wildcat and Varney-Griffin Chaining studies, while deer occupy the Brown Spring study. The mean abundance for elk pellet groups was at a high of 50 days use/acre in pretreatment and a low of 31 days use/acre in post year 6-10. Mean abundance of deer pellet groups was at a high of 31 days use/acre in pretreatment and a low of 13 days use/acre in post year 6-10. Occupancy trends for all animal species have consistently decreased since pretreatment (Figure 5.27).

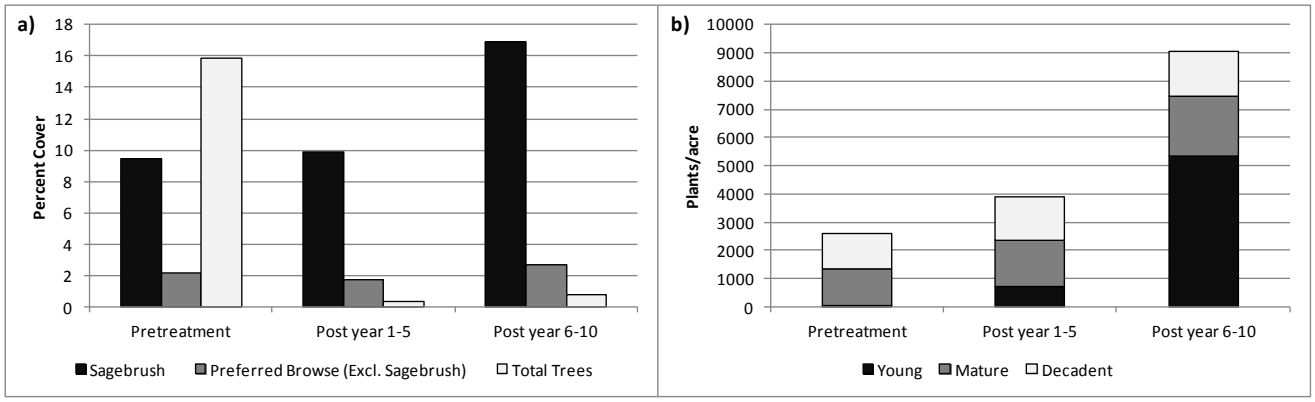


Figure 5.24: Shrub summary of the Bullhog treatment studies (n=3) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

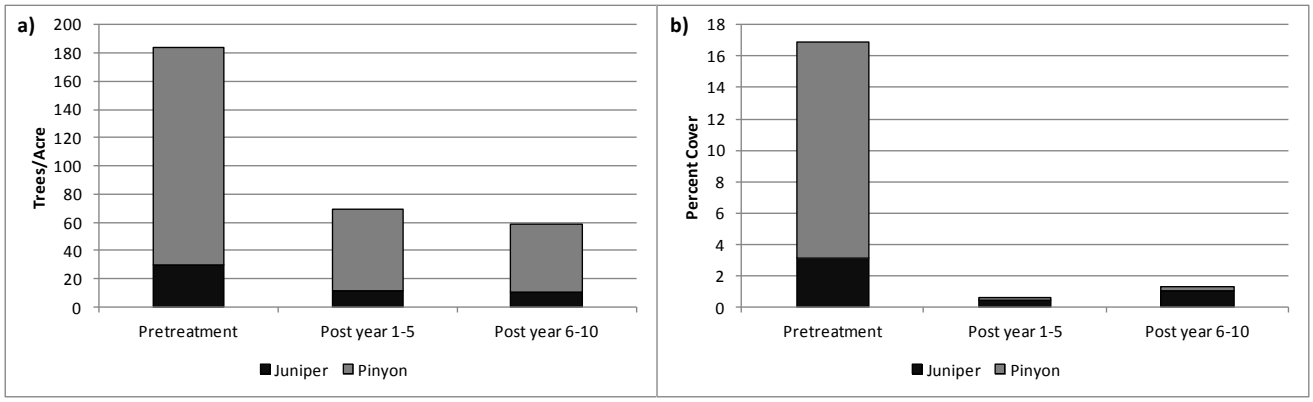


Figure 5.25: Tree summary of the Bullhog treatment studies (n=3) for WMU 25C, Boulder. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

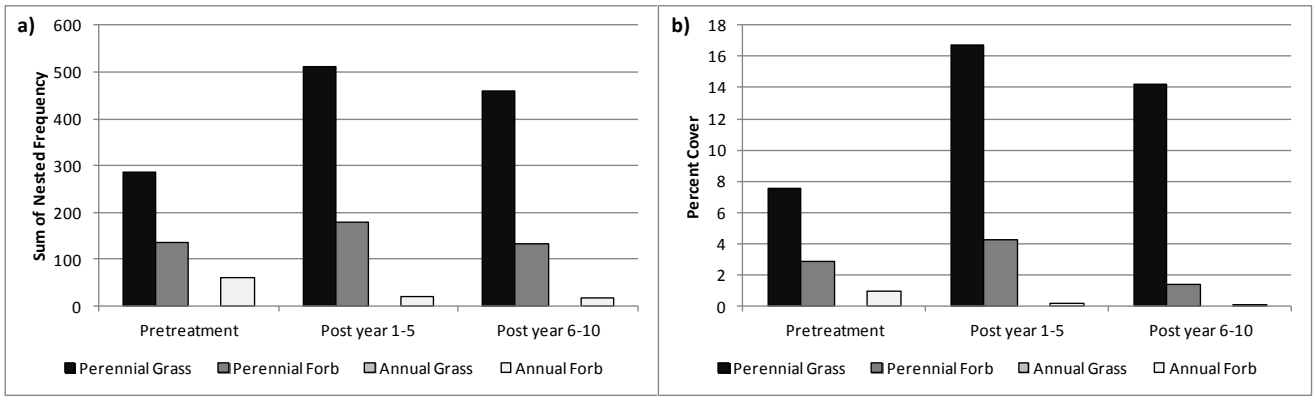


Figure 5.26: Herbaceous functional group summary of the Bullhog treatment studies (n=3) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

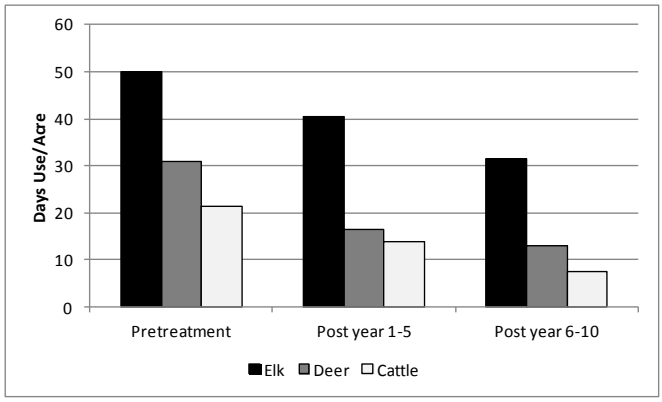


Figure 5.27: Mean pellet transect data for the Bullhog treatment studies (n=3) for WMU 25C, Boulder.

Harrow

There is one study [North Narrows Dixie (25R-7)] that was treated by harrow during the report period (Table 5.7). The North Narrows Dixie study is located on bench north of Otter Creek Reservoir and south of Koosharem. The North Narrows Dixie study is classified as Semidesert (Wyoming Big Sagebrush) ecological site (Table 5.6). Generally, the target of the harrow treatments was to rejuvenate degraded sagebrush and increase the herbaceous understory.

Shrubs/Trees: The primary browse on the North Narrows Dixie study is Wyoming big sagebrush. The preferred browse species forage kochia (*Kochia prostrata*) was also sampled in line-intercept cover. The mean cover of sagebrush was reduced following treatment from near 23% to 9% following the post treatment samplings (Figure 5.28a). The mean density of sagebrush also decreased from near 7,100 plants/acre to near 3,000 plants/acre for the following post treatment years. Changes in demographics of the sagebrush populations have been fairly positive on the study. Mean decadence has decreased in the population and the mean recruitment of young plants increased following the harrow treatments (Figure 5.28b).

Encroachment from pinyon pine and juniper trees has not been a concern for the study.

Herbaceous Understory: The herbaceous component has increased from fair to good on the North Narrows Dixie study. The study site had an herbaceous component comprised primarily of native and introduced grasses and forb species. The mean perennial grass cover increased from 8% to 14% and 13% during the subsequent post treatment sample years. Mean perennial and annual forb cover had a moderate response in the sample year following treatment. Annual grass, primarily cheatgrass, had a fair response in mean nested frequency following treatment. Due to its presence, cheatgrass remains a threat for increased fire on this study (Figure 5.29).

Occupancy: Pellet group transect data indicates that deer have primarily occupied the study site; however, there was a significant decrease in deer pellet abundance following treatment. The mean abundance of pellet groups for deer decreased from a high of 59 days use/acre prior to treatment to 4 and 13 days use/acre for the subsequent sample periods (Figure 5.30).

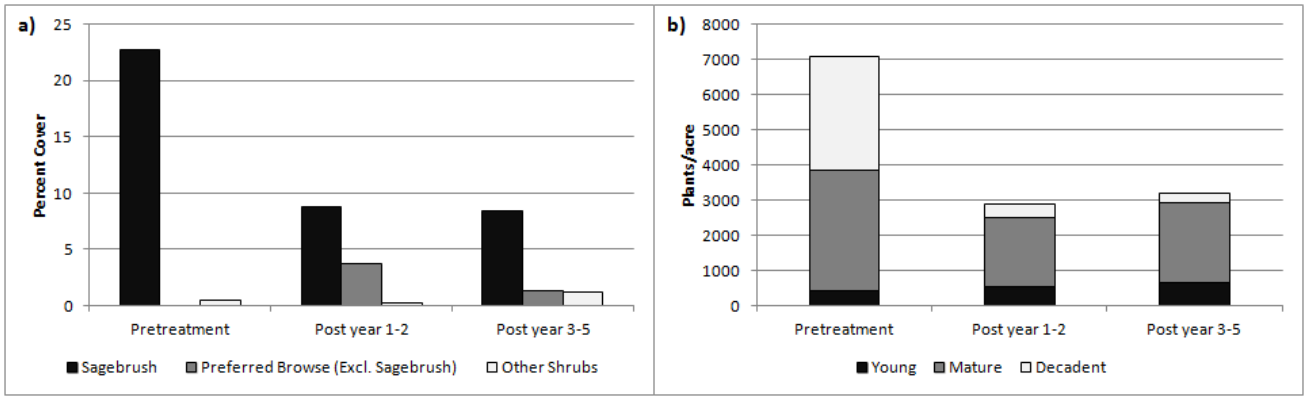


Figure 5.28: Shrub summary of the Harrow treatment study (n=1) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

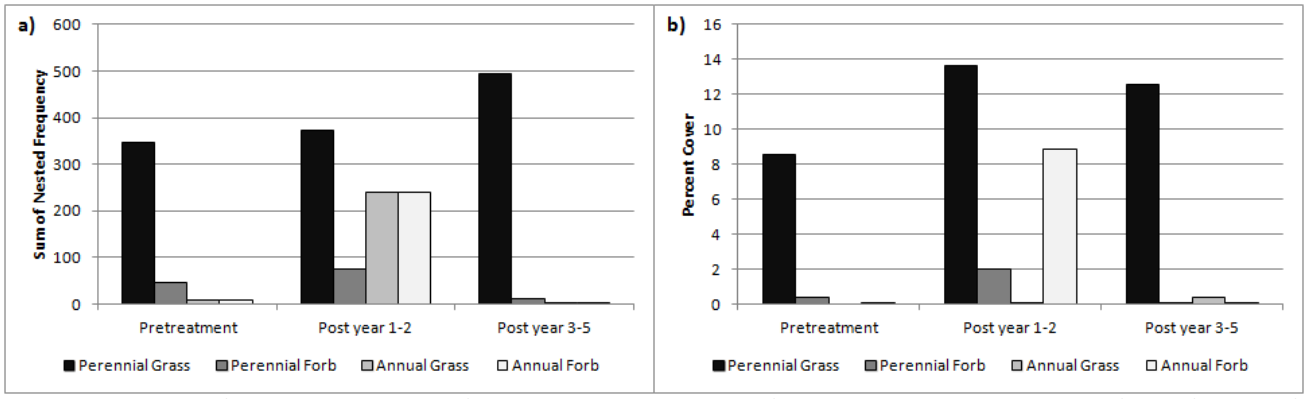


Figure 5.29: Herbaceous functional group summary of the Harrow treatment study (n=1) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

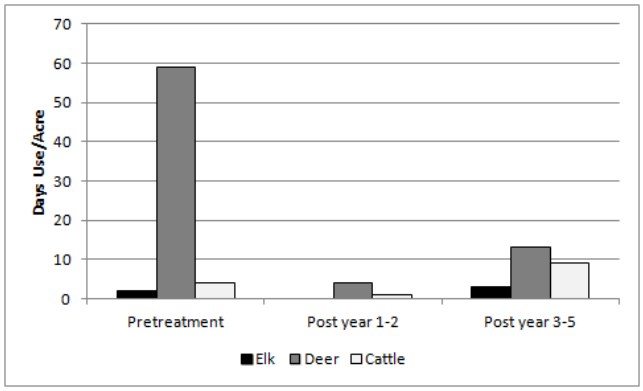


Figure 5.30: Mean pellet transect data for the Harrow treatment study (n=1) for WMU 25C, Boulder.

Aerator

There is one study [Parker Mountain Aerator (25C-31)] that was treated by a two-way aerator treatment during the report period (Table 5.7). The Parker Mountain Aerator Study is located southwest of Loa on the north end of the Boulder Plateau. The study was treated prior to the establishment of the study.

Shrubs/Trees: The primary browse on the Parker Mountain Aerator study is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). The mean line-intercept cover of sagebrush is good on this site ranging from 12% in 2003 to near 38% in 2013 (Figure 5.31a). The average height of the mountain big sagebrush is approximately 1.5 feet making browse available through much of the year in mild winters. The demographics

of the sagebrush population have been generally comprised of mature plants, and the ratio of young plants to decadent plants was substantially higher in 2008 and 2013 (Figure 5.6b).

Encroachment from Utah juniper and pinyon pine trees is not a concern on this site.

Herbaceous Understory: The study site has a good herbaceous component dominated by perennial grass. Mean nested frequency of perennial grasses has fluctuated, but has remained relatively high since 2003 (Figure 5.32a). The mean cover of perennial grasses increased from 8% in 2003 to 12% in 2013 (Figure 5.32b). Annual grass species have not been sampled on this site over the sampled years.

Native perennial forb species composition is good on the site with moderately high nested frequencies and covers of all sampled species with the lupine (*Lupinus argenteus*) providing the majority of forb cover (Figure 5.32).

Occupancy: Pellet group transect data indicates that deer and cattle have predominately occupied these studies. The mean abundance of deer pellet groups has remained similar over the sampled years ranging from 13 days use/acre in 2003 to 15 days use/acre in 2008 and 2013. The abundance of livestock sign from cattle has steadily increased over the sample years increasing from 8 days use/acre in 2003 to 50 days use/acre in 2013 (Figure 5.33).

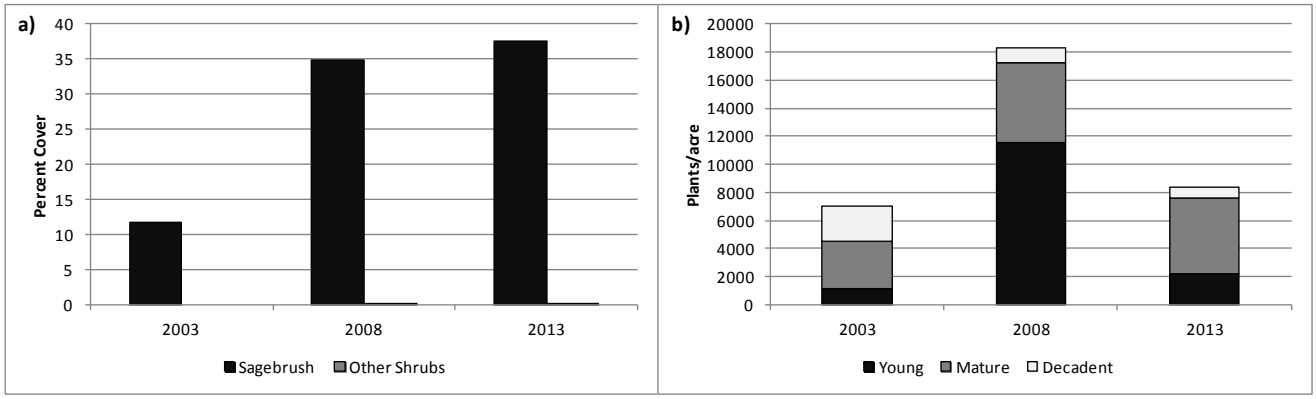


Figure 5.31: Shrub summary of the Harrow treatment study (n=1) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

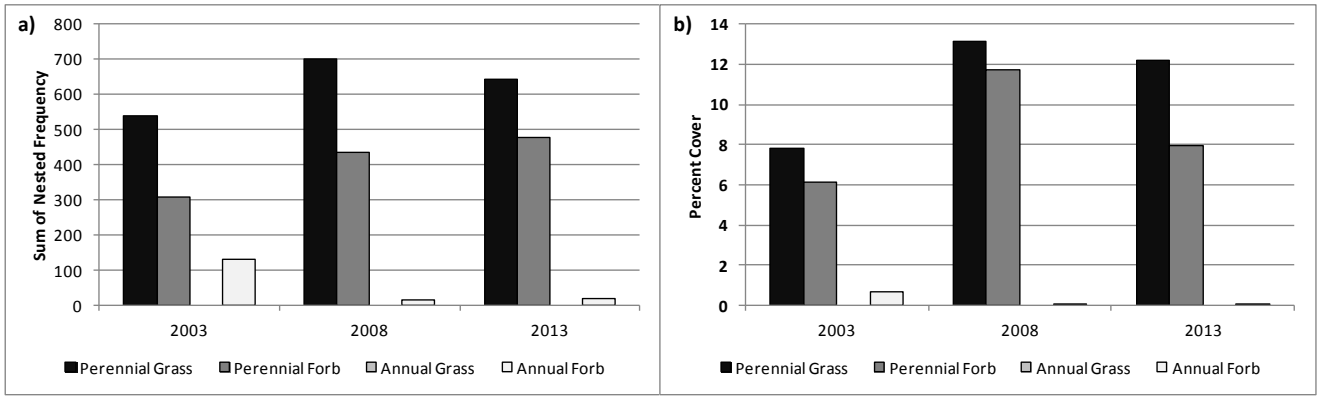


Figure 5.32: Herbaceous functional group summary of the Harrow treatment study (n=1) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

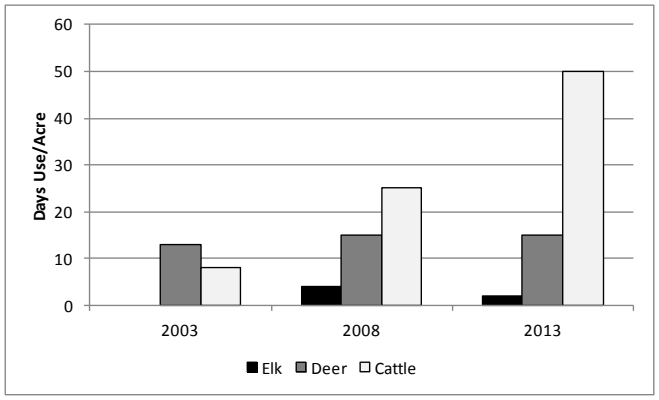


Figure 5.33: Mean pellet transect data for the Harrow treatment study (n=1) for WMU 25C, Boulder.

Drill Seeding

There is one study [Lamp Stand (25R-5)] that was treated by drill seeding during the report period (Table 5.7). The Lamp Stand study is located on a bench above the Bitter Creek Divide located within the Grand Staircase National Monument and adjacent to Capital Reef National Park. The Lamp Stand study has not been classified within an ecological site (Table 5.6). Generally, the target of the drill seeding treatment was to rejuvenate and increase the sagebrush and herbaceous understory components.

Shrubs/Trees: The primary browse on this study is Wyoming big sagebrush, but is limited in abundance. No other preferred browse species were sampled in line-intercept cover. The mean cover of sagebrush increased following treatment from near 0% during pretreatment and post year 1-5 to less than 1% in post year 6-10 (Figure 5.34a). The mean density of sagebrush has increased, but sagebrush is minimal and is only represented by a few individuals (Figure 5.34b). Encroachment from pinyon pine and juniper trees is not a concern on the Lamp Stand study.

Herbaceous Understory: Prior to treatment, the herbaceous component was poor on the Lamp Stand study, but was good following treatment. The study site had an herbaceous component comprised primarily of seeded, introduced and native perennial grass and annual forb species. The seeded perennial grass species created wheatgrass (*Agropyron cristatum*) had the strongest response with mean annual cover increasing from 0% pretreatment to 11% in post year 1-5, but decreasing to 3% in post year 6-10. Annual grass, primarily cheatgrass, also had a large response increasing in mean cover from 0% pretreatment to 2% in post year 1-5, but decreasing to 0% in post year 6-10. Cheatgrass remains a potential threat for increased fire on this study (Figure 5.35).

Occupancy: Pellet group transect data indicates that elk primarily occupy this study site. The seeding appears to have had a positive effect on wildlife with elk responding, albeit small, to the increase in forage on the site. The mean abundance of pellet groups for elk increased from 0 days use/acre prior to treatment to 16 and 9 days use/acre for the respective post treatment sampling years (Figure 5.36).

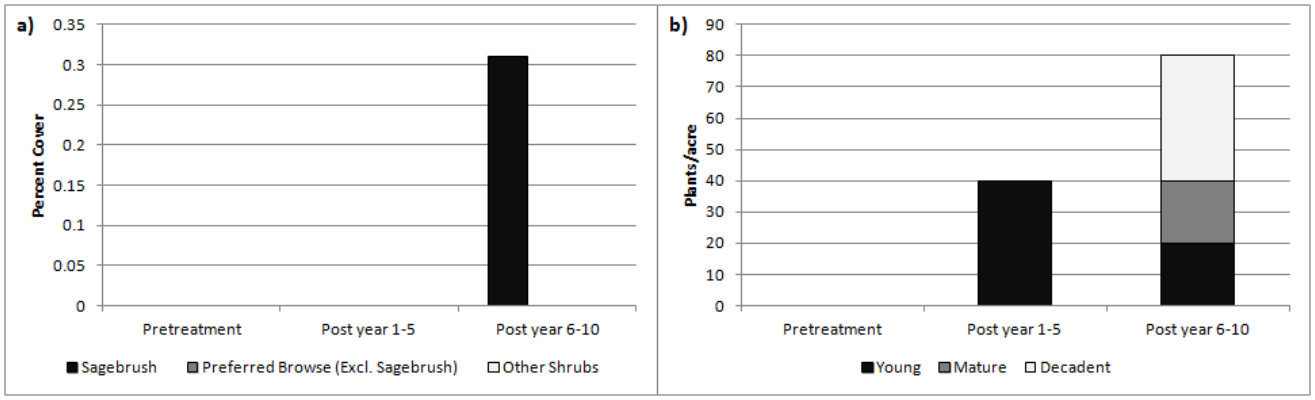


Figure 5.34: Shrub summary of the Harrow treatment study (n=1) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

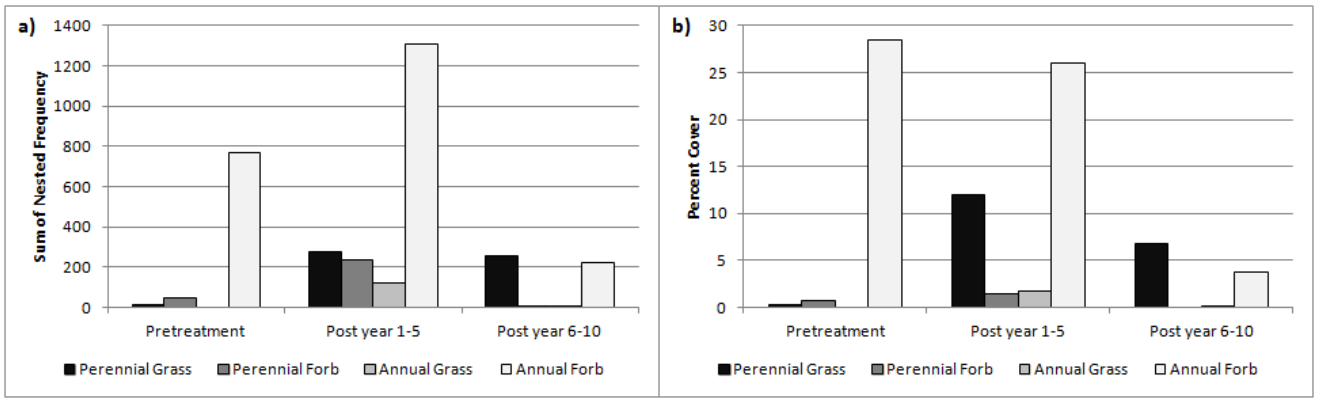


Figure 5.35: Herbaceous functional group summary of the Drill Seeding treatment study (n=1) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

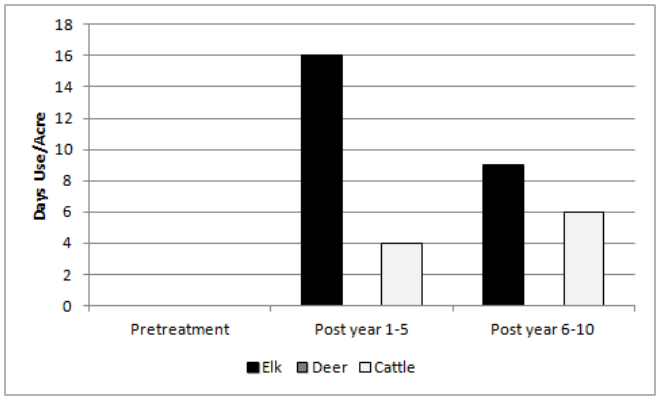


Figure 5.36: Mean pellet transect data for the Harrow treatment study (n=1) for WMU 25C, Boulder.

Fire

There are two studies [Poison Creek Bench (25C-27) and North Creek (25C-28)] that were burned in wildfires during the report period (Table 5.7). The Poison Creek and North Creek studies burned in unknown fires in 1994 and 2002, respectively. Both studies are located south of Antimony on the bench east of Black Canyon and John's Valley. Poison Creek Bench is classified as a Mountain (Mountain Big Sagebrush) ecological site, while the North Creek study is classified as an Upland (Mountain Big Sagebrush-Indian Ricegrass) ecological site (Table 5.6).

Shrubs/Trees: The primary browse on both studies is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) mixed with black sagebrush (*A. nova*) as a minor component. Antelope bitterbrush comprised nearly half of the preferred browse on both studies prior to the fires, but have since been limited. Prior to disturbance, sagebrush was common on all of the study sites, and has steadily increased in mean line-intercept cover with each subsequent sampling following the disturbance and has nearly recovered all the cover lost prior to the fires (Figure 5.37a). Prior to disturbance the demographics of the sagebrush population was a mixture of decadent and mature plants with limited recruitment of young plants. Following the fires, the small populations of sagebrush, nearly 1,000 plants/acre, have been comprised primarily of mature and young plants at just over a mean total density of 7,000 plants/acre (Figure 5.37b). Encroachment from pinyon pine and Utah juniper trees was minimal on the North Creek study and are absent on the Poison Creek study; therefore, the Poison Creek study was not included in the tree summary (Figure 5.38).

Herbaceous Understory: The herbaceous component was mixed in the quality of diversity across the sites, but both sites were dominated by perennial grasses on all of the sites. Perennial forb species were nearly as abundant as perennial grasses during the pre-disturbance and post year 1-5 sampling, but perennial forb abundance diverged from perennial grass for the remaining post sample years. Perennial grass species have increased substantially on the sites, increasing from 6% cover prior to disturbance to 14% cover at 16-20 years after disturbance. An annual grass, primarily cheatgrass, is found only on the North Creek study and has steadily increased in abundance and cover since the disturbance of the fire (Figure 5.39). Cheatgrass is a threat for increased fire on the North Creek study.

Occupancy: Pellet group transect data indicates that cattle primarily occupy these study sites. The mean abundance of pellet groups of wildlife species has been low and has generally decreased following the fires. The abundance of cattle sign has varied in abundance since pre-disturbance and ranged from a high at 26 days use/acre to a low of 6 days use/acre (Figure 5.40).

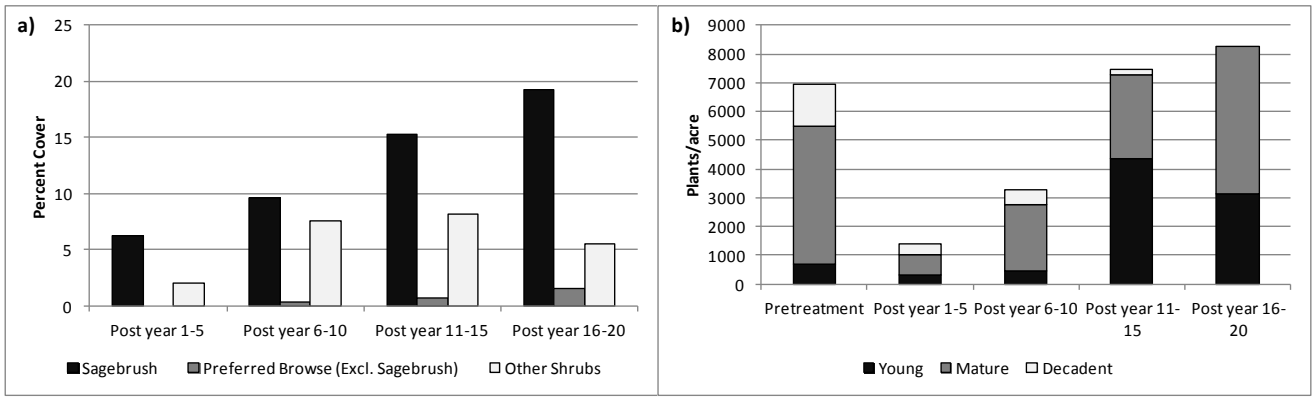


Figure 5.37: Shrub summary of the Wildfire disturbance studies (n=2) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

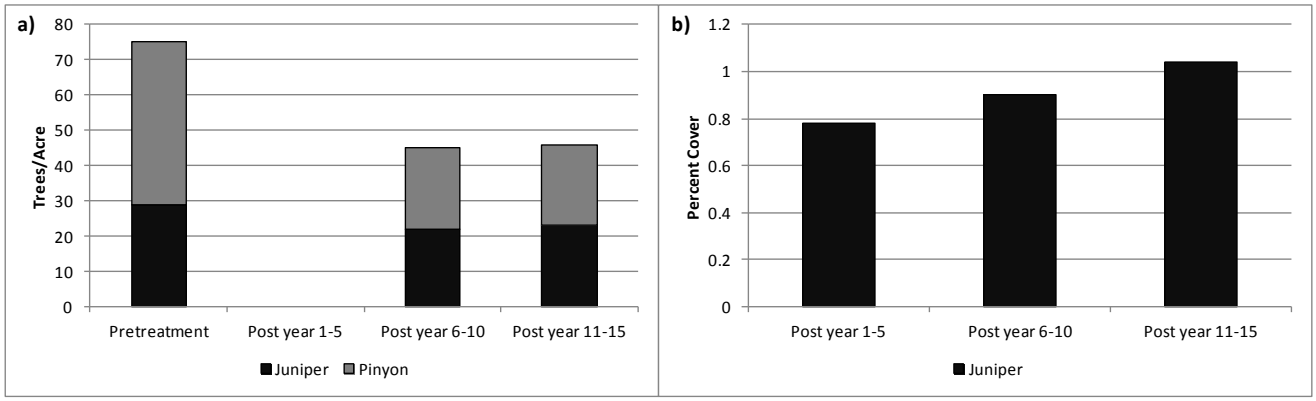


Figure 5.38: Tree summary of the Wildfire disturbance studies (n=2) for WMU 25C, Boulder. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

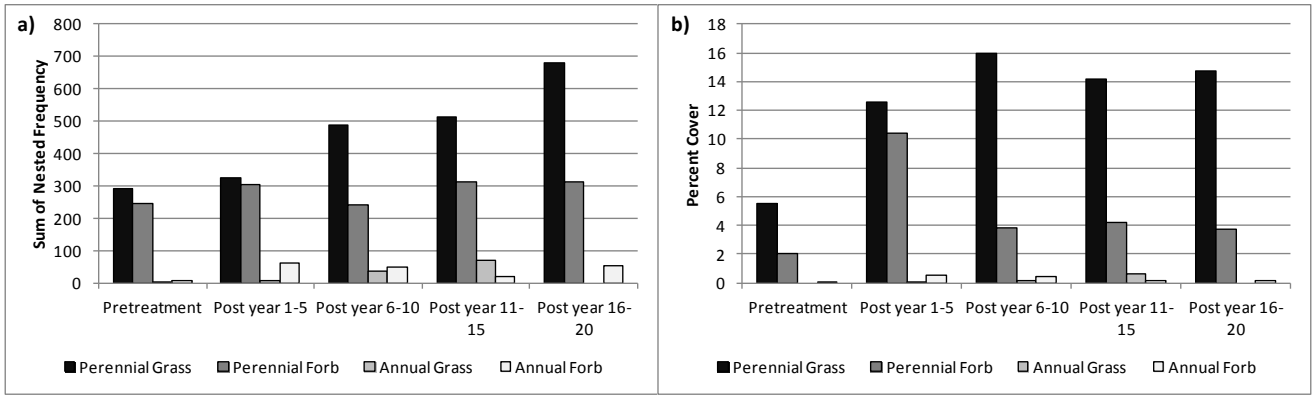


Figure 5.39: Herbaceous functional group summary of the Wildfire disturbance studies (n=2) for WMU 25C, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

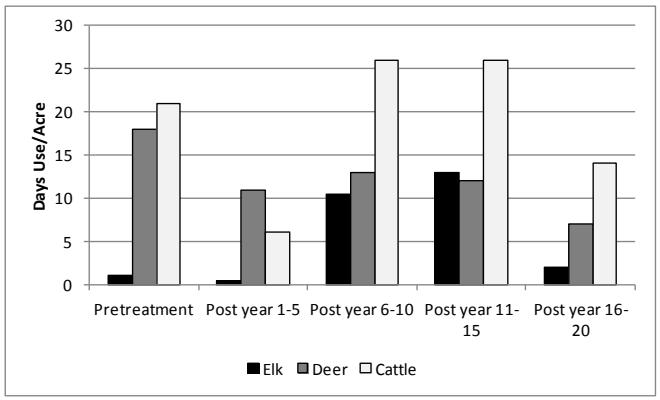


Figure 5.40: Mean pellet transect data for the Wildfire disturbance studies (n=2) for WMU 25C, Boulder.

Logging

There is one study [Sawmill Point Aspen (25R-8)] that was logged to rejuvenate aspen during the report period (Table 5.7). The Sawmill Point Aspen study is located north of the town Boulder midway up West Fork Boulder Creek on the south aspect of Boulder Mountain. The Sawmill Point Aspen study is classified as a High Mountain (Aspen) ecological site (Table 5.6).

Shrubs/Trees: The primary browse on Sawmill Point Aspen was antelope bitterbrush (*Purshia tridentata*) comprised, but was rare on the study. Prior to disturbance, bitterbrush was not sampled on the study site, but was sampled a less than 1% average cover following treatment. Mountain snowberry is the most common

shrub species to occur on the site, which decreased in mean line-intercept cover from 8% pretreatment to 4% post treatment (Figure 5.41a).

Conifer encroachment was reduced by logging with mean line-intercept cover for conifer decreasing from 22% pretreatment to 1% post-treatment (Figure 5.42a). Although there was a decrease in aspen cover, the mean density of aspen trees increased from 128 trees/acre pretreatment to 331 trees/acre post-treatment (Figure 5.42a).

Herbaceous Understory: The herbaceous component was fair and was generally dominated by perennial grasses and forbs. Following treatment, perennial grass and forb species decreased in mean cover from 12% to 6% and 15% to 5%, respectively (Figure 5.43). Annual grasses and forbs are absent to rare on the study site.

Occupancy: The mean abundance of pellet groups of wildlife species sampled has been low, with all wildlife pellet groups being sampled at less than 10 day use/acre for both pretreatment and post-treatment samplings (Figure 5.44).

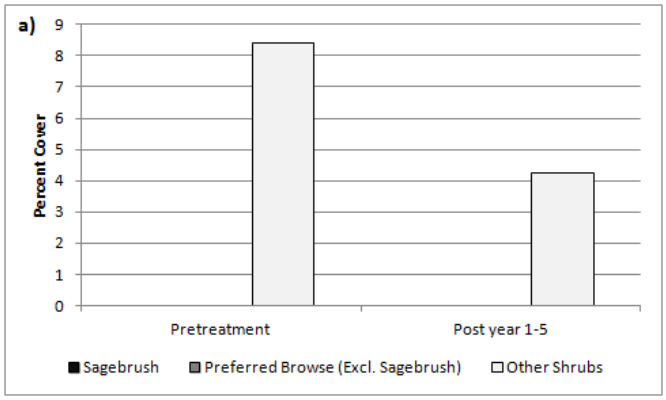


Figure 5.41: Shrub summary of the Logging disturbance study (n=1) for WMU 25C, Boulder. a) Mean line-intercept cover estimate of shrub groups.

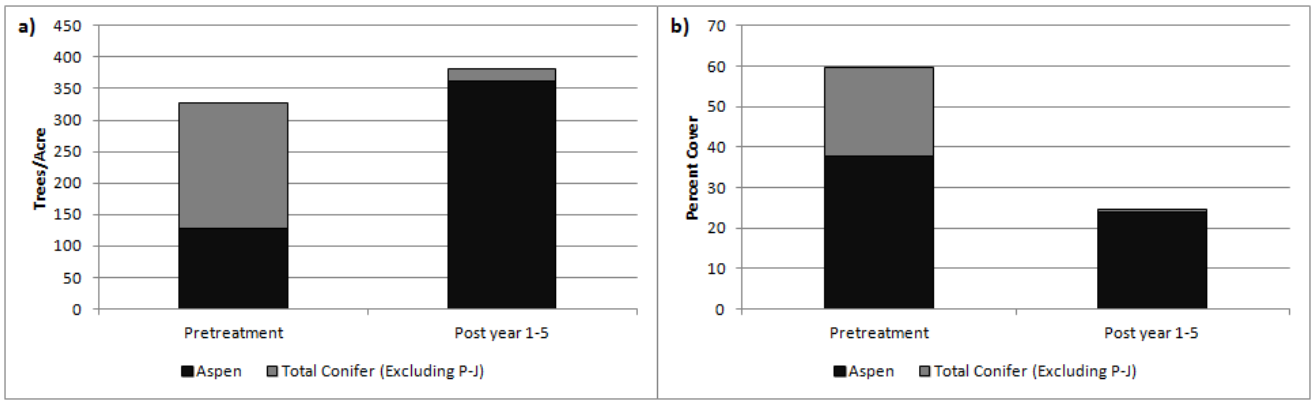


Figure 5.42: Tree summary of the Logging treatment study (n=1) for WMU 25C, Boulder. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

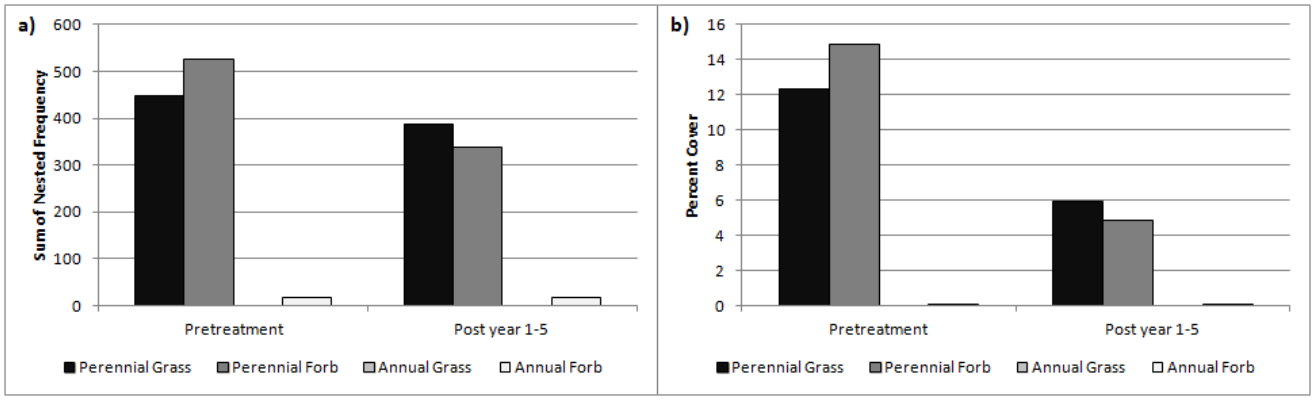


Figure 5.43: Herbaceous functional group summary of the Logging disturbance study (n=1) for WMU 25, Boulder. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

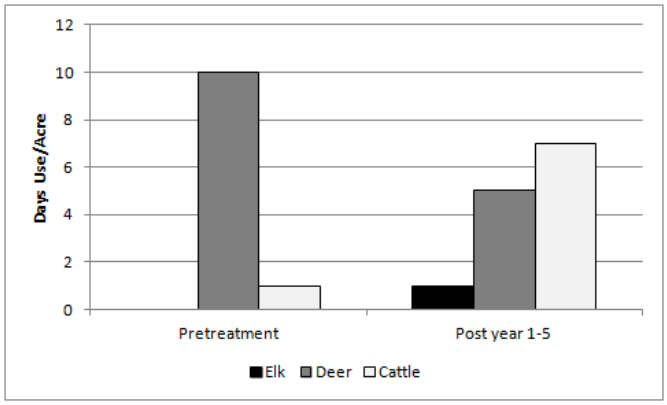
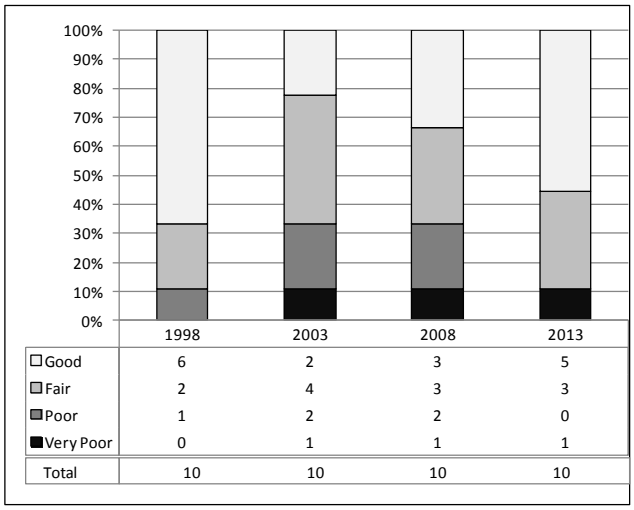


Figure 5.44: Mean pellet transect data for the Logging disturbance study (n=1) for WMU 25C, Boulder.

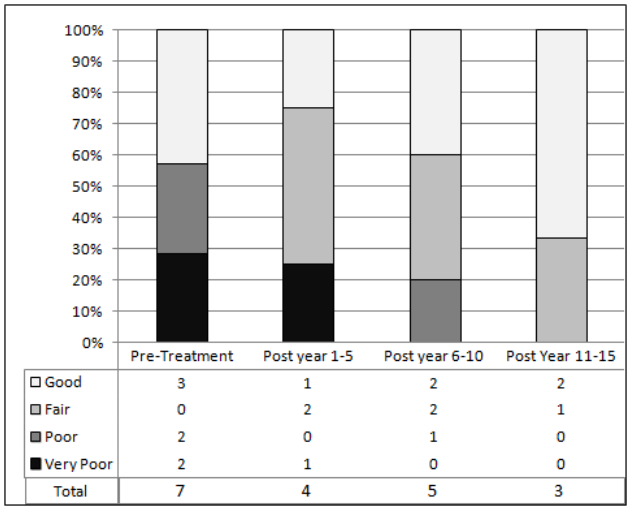
Deer Winter Range Condition Assessment

The condition of deer winter range within the Boulder management unit has improved slightly in quality as a whole since 1998. The majority of sites sampled within the unit are considered to be in fair to good condition based on the most current sample data, and the proportion of sites classified as being in poor or very poor condition has varied since 1998, but the poor condition class has transitioned to good since the last evaluation (Figure 5.45 and Figure 5.46). The only undisturbed study that has consistently and is currently considered to be in very poor condition is the Terza Flat study which has a depleted browse component and lacks a quality herbaceous component that is dominated by the weedy annual forb halogeton. The condition of disturbed and treated sites typically improves with increased time after disturbance on this unit. The disturbed or treated study sites ranked as being in poor or very poor condition are absent in post year 11-15. The North Creek study site was ranked as being in poor condition at 6-10 post years due to a depleted browse and herbaceous components. Cheatgrass has also been present on the North Creek study since the fire disturbance. The very poor condition class is only observed within the pre-treatment and post year 1-5 sample periods, which is primarily due to the lack of browse and herbaceous components of their respective studies (Map 5.7 and Table 5.8).



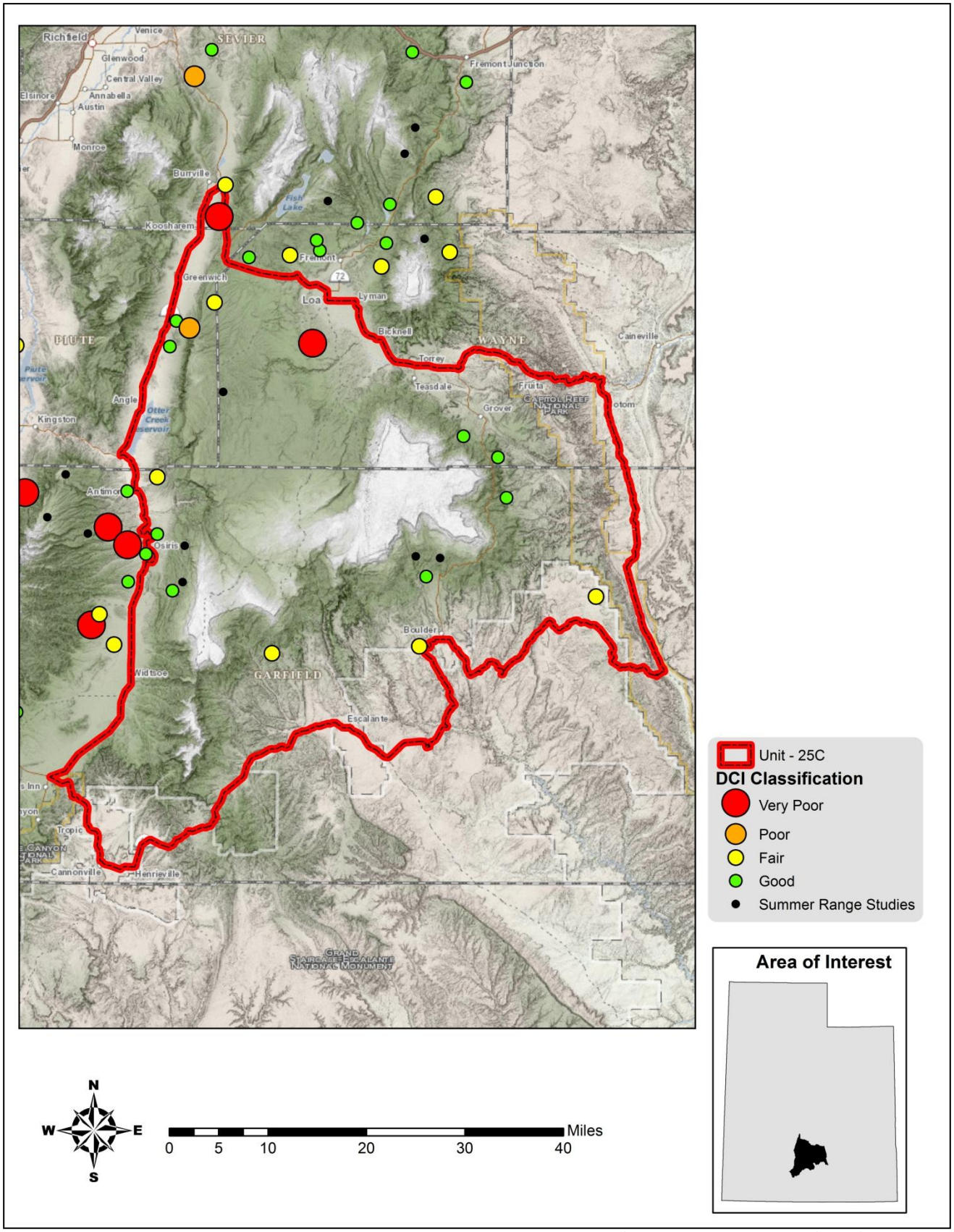
	1998	2003	2008	2013
Good	6	2	3	5
Fair	2	4	3	3
Poor	1	2	2	0
Very Poor	0	1	1	1
Total	10	10	10	10

Figure 5.45: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 25C, Boulder.



	Pre-Treatment	Post year 1-5	Post year 6-10	Post Year 11-15
Good	3	1	2	2
Fair	0	2	2	1
Poor	2	0	1	0
Very Poor	2	1	0	0
Total	7	4	5	3

Figure 5.46: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 25C, Boulder.



Map 5.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 25C, Boulder.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
25C-2	Wildcat	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25C-3	Happy Valley	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
25C-4	North Slope	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25C-6	Terza Flat	Annual Forb	Moderate	Reduced diversity of desirable grass and forb species.
25C-7	Cedar Grove	None Identified		
25C-8	South Narrows	Annual Grass/PJ Encroachment	Low	Increased fire potential.
25C-9	Dry Wash	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
25C-12	Nazer Draw	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25C-14	New Home Bench	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
25C-17	Varney-Griffin Chaining	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
25C-20	Baldys	None Identified		
25C-25	Center Creek	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
25C-26	Black Canyon	None Identified		
25C-27	Poison Creek Bench	None Identified		
25C-28	North Creek	PJ Encroachmen/Annual Grass	Moderate	Reduced understory shrub and herbaceous vigor.
25C-31	Parker Mountain Aerator	Annual Grass	Low	Increased fire potential.
25R-5	Lamp Stand	Annual Forb	High	Reduced diversity of desirable grass and forb species.
25R-7	North Narrows Dixie	Annual Grass	Low	Increased fire potential.
25R-8	Sawmill Point Aspen	Conifer Encroachment	Low	Reduced understory shrub and herbaceous vigor.
25R-10	Parker Front	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
25R-11	Brown Spring	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.

Table 5.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 25C, Boulder. All assessments are based off the most current sample date for each study site.

Discussion and Recommendations

Mountain and Upland (Mountain Big Sagebrush)

The higher elevation mountain and upland sites, which support mountain big sagebrush communities, are generally considered to be in good condition for deer winter range habitat on the Boulder management unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. These communities are prone to wildfire. If wildfire occurs within these communities, they generally respond well with sagebrush reestablishment occurring within 10 to 15 year following disturbance and as such, these community types are essential as deer winter range habitat. Pinyon trees are found on just one of the studies within these ecological sites and are found in low density and cover, which suggests that the understory of shrubs and herbaceous health will likely not need to be addressed in the near future. Introduced perennial grasses are common on just one study while the remaining study sites maintain health populations of native herbaceous species. While providing valuable forage, introduced grass species can often be aggressive at higher elevations and precipitation zones and can reduce the prevalence and abundance of other more desirable native grass and forb species.

Work within these two ecological sites required for habitat rehabilitation is minimal. Individual studies may be taken on a case-by-case basis to address concerns of pinyon-juniper encroachment by use of bullhog, chaining, lop and scatter, etc. When reseeding is necessary to restore herbaceous species, care should be taken in species selection, and preference should be given to native grass species when possible.

Semidesert (Black Sagebrush)

The lower elevation semidesert black sagebrush communities are generally considered to be in fair to good condition for deer winter range habitat on the unit. The study that represents these communities supports robust stands of black sagebrush and Wyoming big sagebrush that provide valuable browse in moderate to severe winters. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

However, pinyon-juniper encroachment and cheatgrass invasion has not been a problem on the representative study.

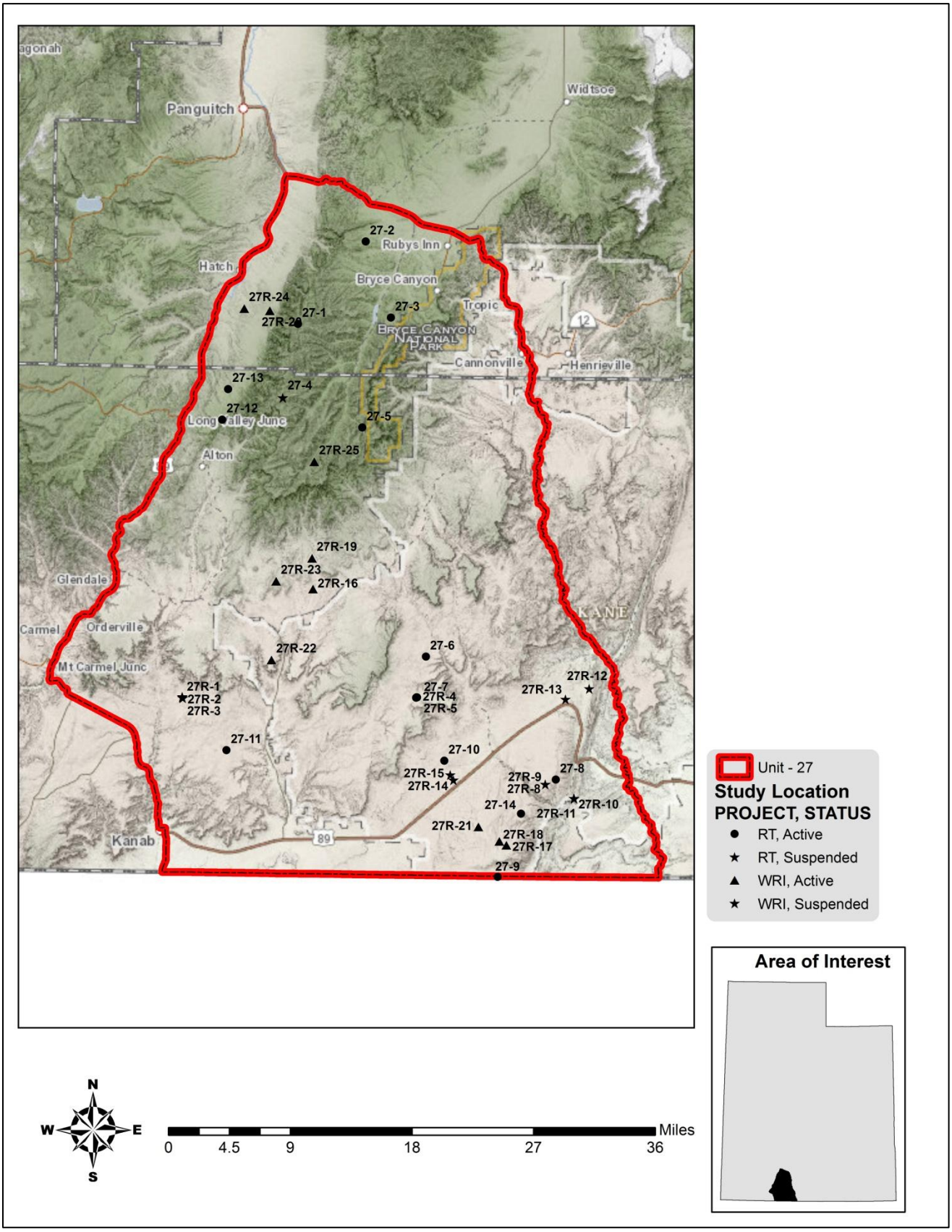
In order to make recommendations concerning rehabilitation, it is suggested that more studies may be needed to better evaluate the rehabilitation needs for this particular community type.

Semidesert (Wyoming Big Sagebrush)

The lower elevation semidesert Wyoming big sagebrush communities that have not been disturbed are generally considered to be in good condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are generally prone to wildfire. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are susceptible to invasion from annual grass, primarily cheatgrass. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire on within these communities. However, cheatgrass invasion has been minimal on the representative studies. Encroachment from pinyon-juniper trees is not typically an issue within these communities.

Due to the slow recovery of these community types from fire, it is recommended that work to diminish fuel loads and create firebreaks should continue within these communities in order to reduce the threat of catastrophic fire. Treatments to establish and increase browse species more rapidly following wildfire should also be implemented. If a treatment to rejuvenate sagebrush occurs, care should be taken in selecting treatment methods that will not increase annual grass loads.

6. WILDLIFE MANAGEMENT UNIT 27 - PAUNSAGAUNT



WILDLIFE MANAGEMENT UNIT 27 - PAUNSAUGUNT

Boundary Description

> **Garfield and Kane counties -** Boundary begins at US-89A and the Utah-Arizona state line; north on US-89A to US-89; north on US-89 to SR-12; east on SR-12 to the Paria River; south along the Paria River to the Utah-Arizona state line; west along this state line to US-89A.

Management Unit Description

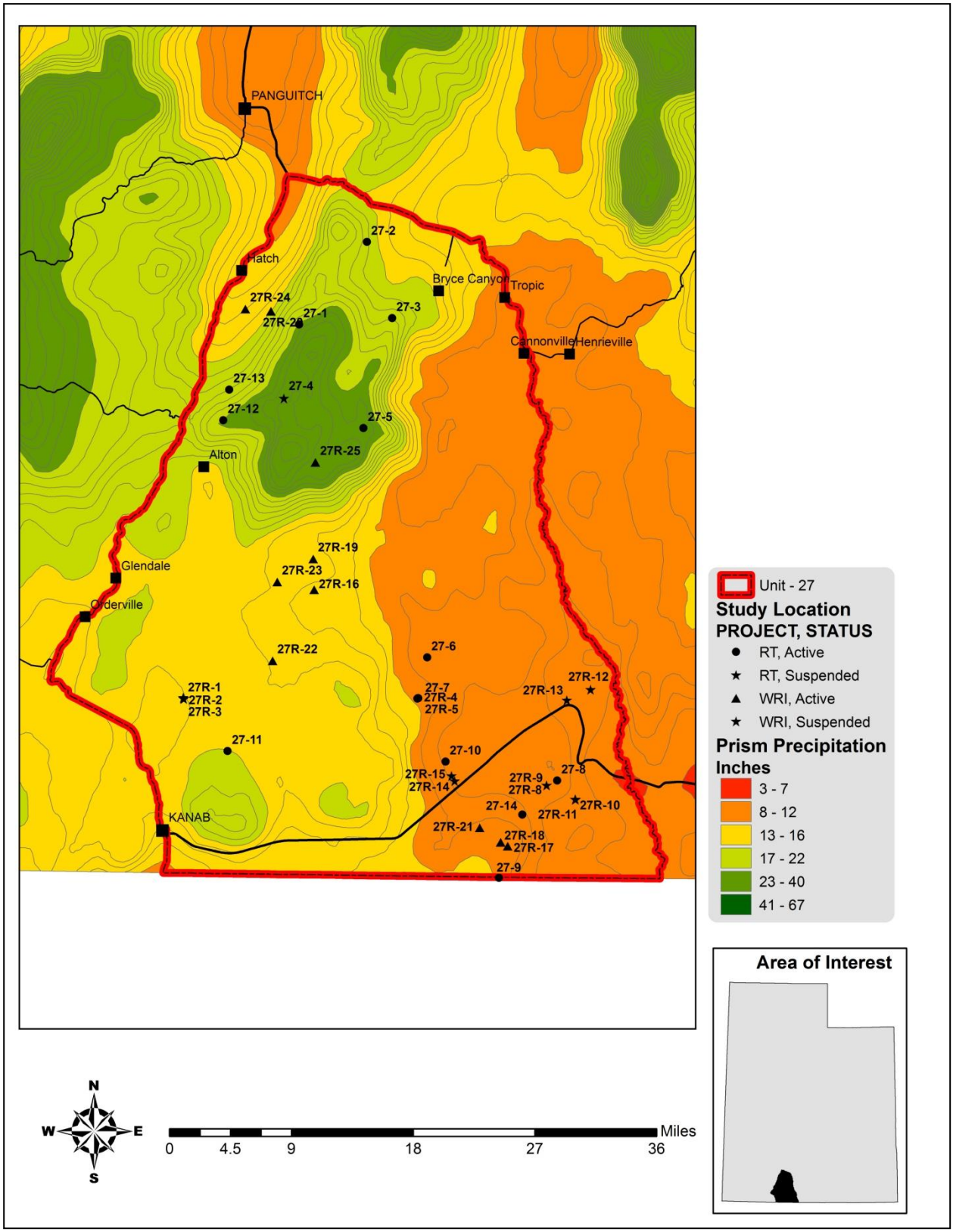
Geography

The Paunsaugunt wildlife management unit is located in south central Utah. It includes the Paunsaugunt Plateau in the northern part of the unit and the lower benches that stretch to the south extending to the Utah and Arizona Border. The highest portion of the unit is Pink Cliff (9,394 ft), which is found on the Paunsaugunt Plateau. The Paunsaugunt Plateau is mainly considered as summer range. The Pink Cliffs of Bryce Canyon National Park and the Sunset Cliffs to the west delineate the southern rim of the Paunsaugunt Plateau. Terrain of the transitional and/or winter range is characterized by gently sloping terraces interspersed by extensive cliff formations. The Skutumpah Terrace lies between the Pink Cliffs and White Cliffs; the Wygaret Terrace, Nephi Pasture, and No Man's Mesa lie between the White and Vermillion Cliffs. Buckskin Mountain is a lower elevation mountain that is located in the southeast portion of the unit. The bulk of the winter range is found on the Wygaret Terrace and the buckskin mountain.

Climate Data

The 30-year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 7 inches on the southeast side of the unit to 28 inches on the high elevation plateau of the Paunsaugunt Plateau. All of the Range Trend and WRI monitoring studies on the unit range from 9-25 inch precipitation zone (Map 6.1) (PRISM Climate Group, Oregon State University, 2013).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 6.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 6.1b) (Time Series Data, 2014).



Map 6.1: The 1981-2010 PRISM Precipitation Model for WMU 27, Paunsaugunt (PRISM Climate Group, Oregon State University, 2013).

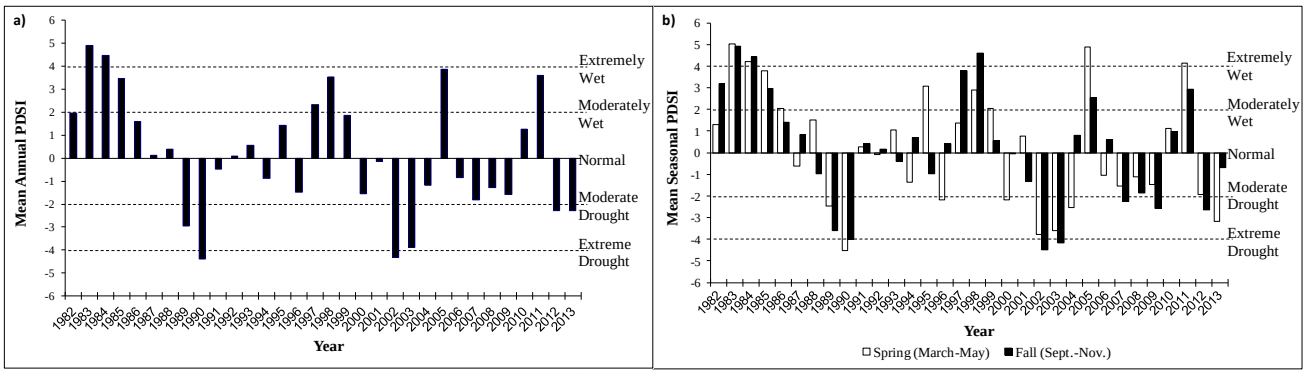


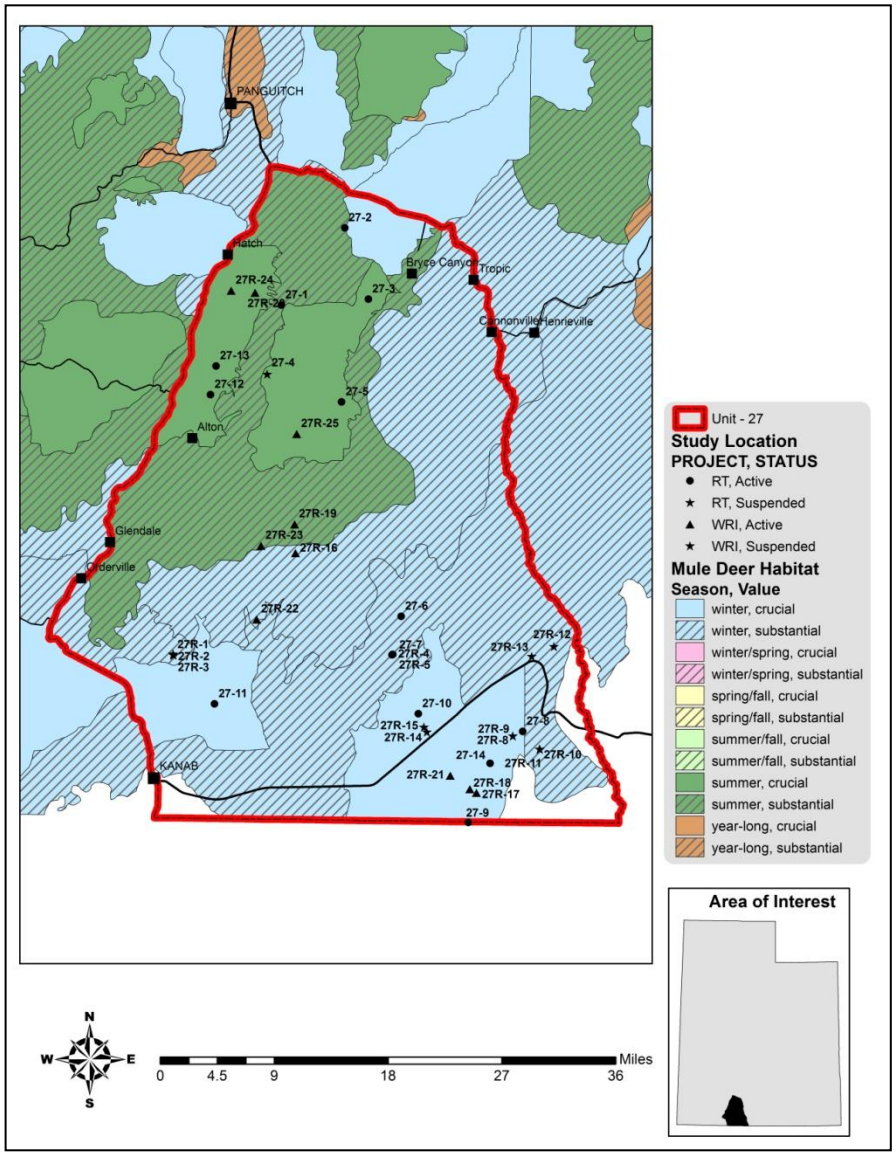
Figure 6.1: The 1982-2014 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2014).

Big Game Habitat

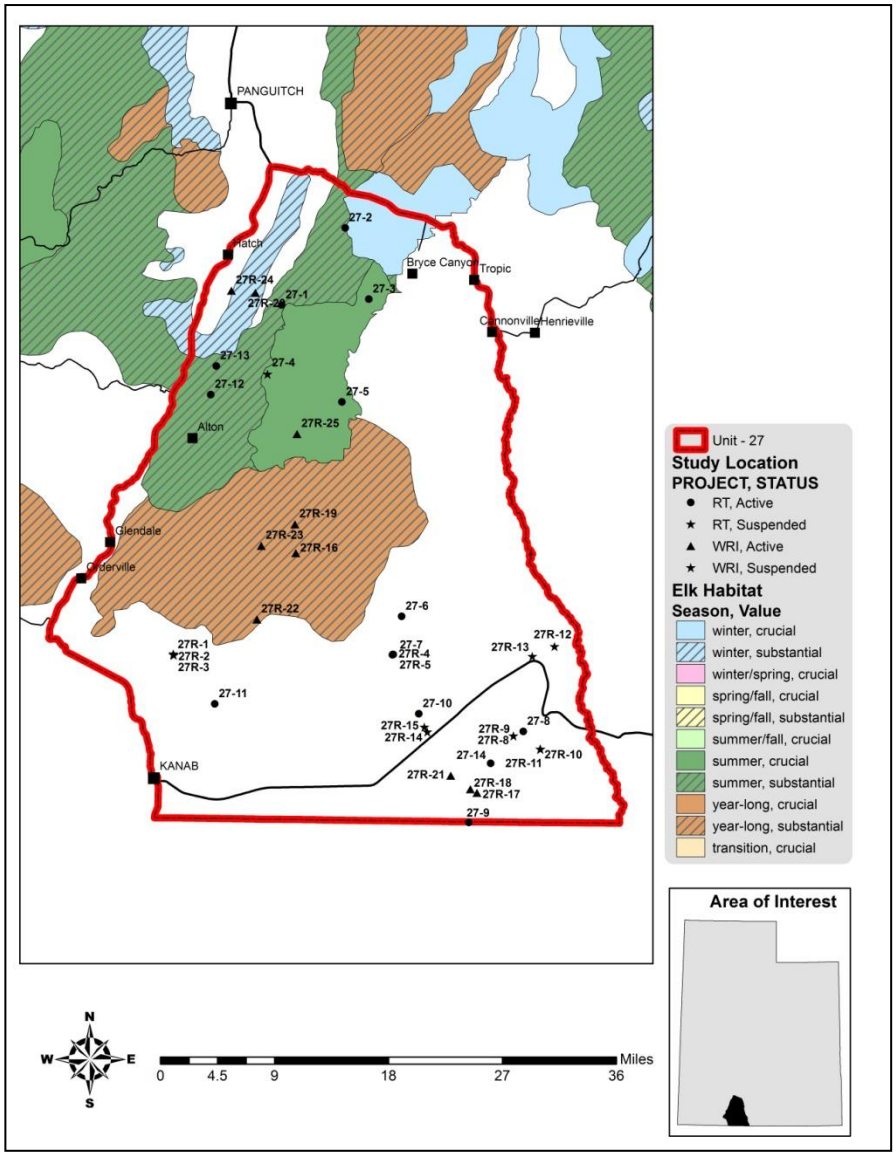
Total mule deer range in the Paunsaugunt wildlife management unit is estimated at 921,463 acres with 608,702 acres of this classified as winter range and 312,761 acres classified as summer range (Table 7.1 and Map 6.2). Total elk range is estimated at 358,841 acres with 175,971 acres of this being classified as year-long range, 144,438 as summer range, and 38,432 as winter range (Table 7.1 and Map 6.3). Most of the big game winter range in this unit is located on Forest Service or BLM managed lands. Minor portions of the winter range in the unit occur on private holdings, Utah State School Trust Lands, National Park Service and Division of Wildlife Resources management areas. The Paunsaugunt Plateau provides the bulk of the summer range in the unit with an average elevation of 9,000 feet.

According to LANDFIRE Existing Vegetation Coverage models, important shrublands comprise less than 31% of the deer winter range on the unit. The majority of deer winter range is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Other coverage types comprise a minimal proportion of the deer winter range (Table 6.4).

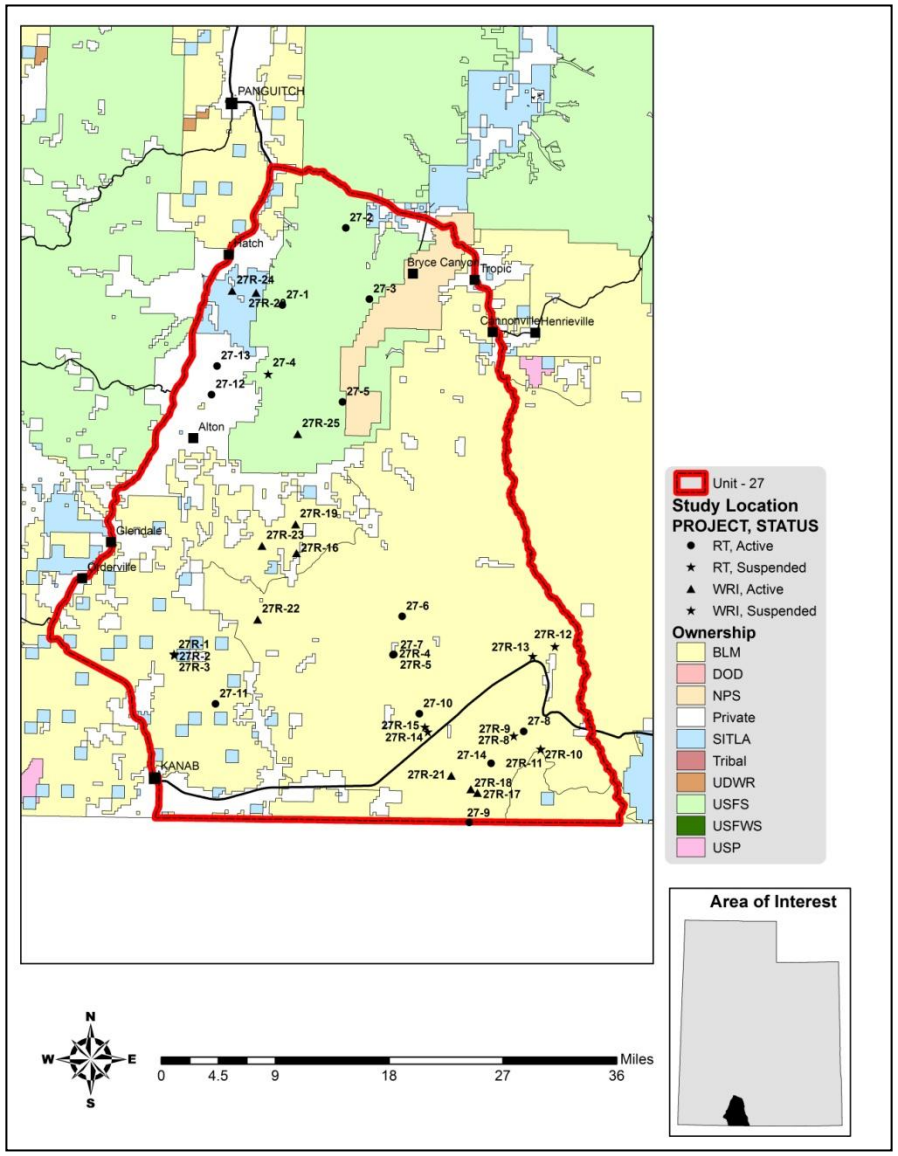
The key areas that have been identified on the summer range are the mixed mountain brush community in the upper reaches of Proctor Canyon, a high elevation black sagebrush-grass community between Ahlstrom Hollow and Johnson Bench, the ponderosa pine type on Whiteman Bench, the conifer clear-cut with its associated aspen resurgence below the Sunset Cliffs near Sand Pass, and the grass meadow type in Podunk Creek. Three studies were established in 1987 on deer winter range, which are all on BLM land. Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) community is the dominant vegetation type on the two Nephi Pasture sites, and black sagebrush (*Artemisia nova*) predominates on the Five Mile Mountain study site. An additional five study sites were established in 1997 to include important areas previously missed by trend studies. These include critical winter ranges on the south end of the unit on Buckskin Mountain, Telegraph Flat, and Crocodile. Two additional sites at Moon's Landing and Heaton, on the west side of the unit, sample mountain brush and sagebrush/bitterbrush transitional ranges at around 8,000 feet. In 1998, six trend studies were established at several exclosures in the unit to determine differences in grazing treatments. These studies are found at the exclosure complexes in Nephi Pasture and John R. Flat. Both of these areas are important deer wintering areas. The three John R. Flat exclosure studies were suspended in 2008.



Map 6.2: Estimated mule deer habitat by season and value for WMU 27, Paunsaugunt.



Map 6.3: Estimated elk habitat by season and value for WMU 27, Paunsaugunt.



Map 6.4: Ownership coverage for WMU 27, Paunsaugunt.

	Year-Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	0	0%	312,761	34%	608,702	66%
Elk	175,971	49%	144,438	40%	38,432	11%

Table 6.1: Estimated mule deer and elk habitat acreage by season for WMU 27, Paunsaugunt.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	112,047	36%	19,238	3%
BLM	76,318	24%	506,112	83%
SITLA	17,355	6%	13,846	2%
NPS	17,562	6%	15,149	3%
Private	89,475	29%	15,149	9%
Total	**312,761**	**100%**	**608,702**	**100%**

Table 6.2: Estimated mule deer habitat acreage by season and ownership for WMU 27, Paunsaugunt.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	3,762	3%	91,693	64%	14,292	37%
BLM	128,680	89%	6,611	5%	2,695	7%
SITLA	3,894	3%	1,4443	1%	8,489	22%
UDOT	0	0%	11	<1%	0	0%
Private	38,326	27%	39,833	28%	12,932	34%
NPS	1,310	<1%	4,858	3%	13	<1%
Total	**175,971**	**100%**	**144,438**	**100%**	**38,432**	**100%**

Table 6.3: Estimated elk habitat acreage by season and ownership for WMU 27, Paunsaugunt.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	124,787	13.04%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	33,169	3.46%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	25,144	2.63%	
	Coleogyne ramosissima Shrubland Alliance	23,185	2.42%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	20,428	2.13%	
	Southern Colorado Plateau Sand Shrubland	19,002	1.99%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	8,027	0.84%	
	Other	37,548	3.92%	30.43%
Conifer	Colorado Plateau Pinyon-Juniper Woodland	420,594	43.94%	
	Southern Rocky Mountain Ponderosa Pine Woodland	36,907	3.86%	
	Abies concolor Forest Alliance	28,013	2.93%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	12,148	1.27%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	10,757	1.12%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	7,603	0.79%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	6,314	0.66%	
	Other	2,303	0.24%	54.81%
Grassland	Native Grassland	13,546	1.42%	1.42%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	5,823	0.61%	
	Introduced Upland Vegetation-Perennial Grassland and Forbland	4	0.00%	0.61%
Other	Non-vegetated	57,539	6.01%	
	Riparian	17,033	1.78%	
	Sparsely Vegetated	13,264	1.39%	
	Developed	11,341	1.18%	
	Exotic Tree-shrub	9,277	0.97%	
	Hardwood	7,890	0.82%	
	Agricultural	5,633	0.59%	12.74%
Total		957,277		

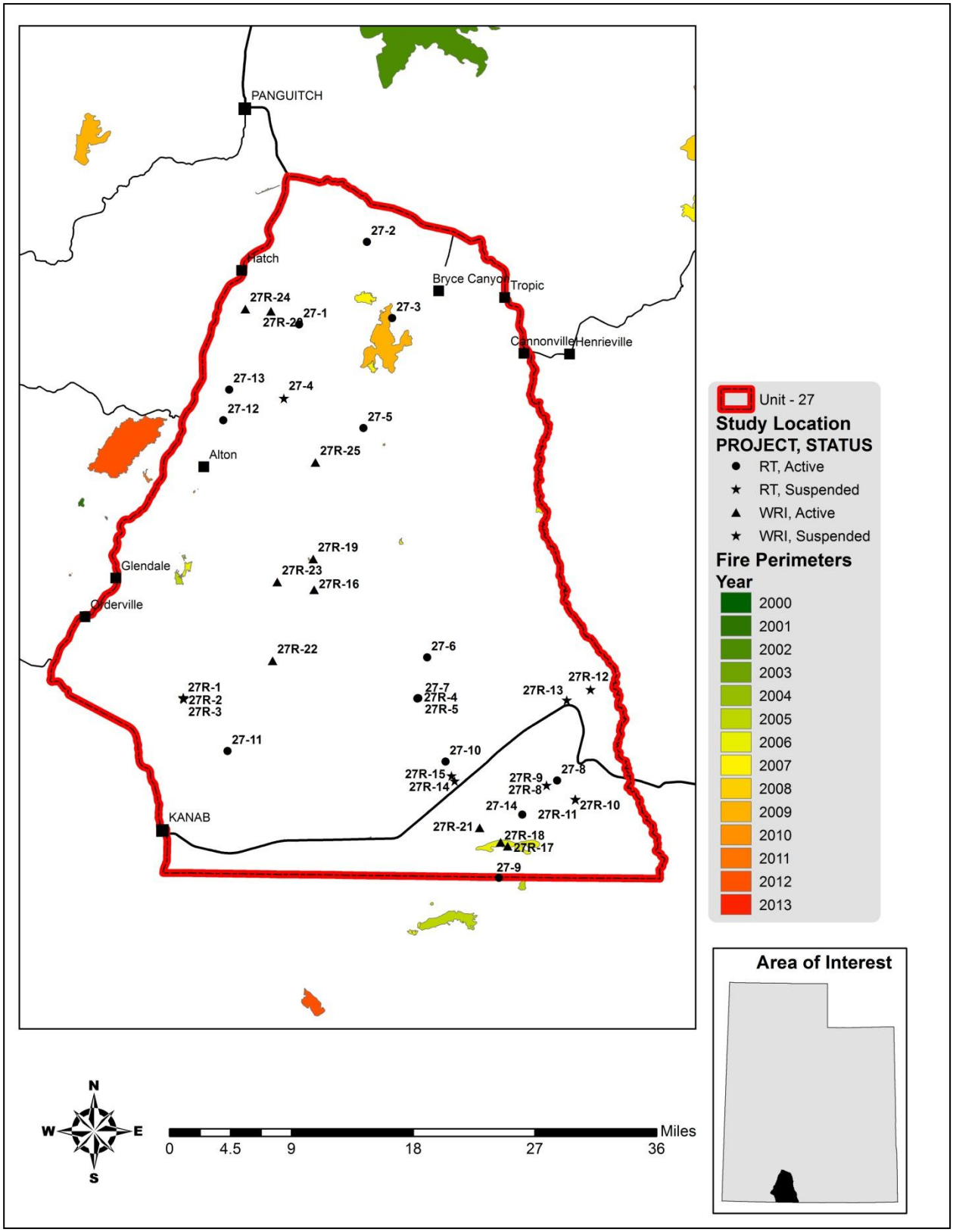
Table 6.4: LANDFIRE existing vegetation coverage (LANDFIRE: LANDFIRE 1.2.0, 2010) of deer winter range for WMU 27, Paunsaugunt (LANDFIRE: LANDFIRE 1.2.0, 2010).

Limiting Factors to Big Game Habitat

The main habitat limitation found on the winter range of this unit is encroachment by pinyon-juniper woodlands, and poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 27 (Table 6.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000).

The limiting factors on summer ranges on this unit include encroachment of conifer and presence of seeded non-native grass species. The Paunsaugunt Plateau has encroachment of conifer into aspen communities as illustrated by the Sieler Creek study (27R-25). The encroachment of conifer into aspen communities has the potential to change the herbaceous and shrub components of the aspen community (Stam, Malechek, Bartos, Bowns, & Godfrey, 2008). The reduction of the herbaceous and shrub community can have negative impacts on summering mule deer and elk. Many of the valleys along the East Fork of the Sevier River and its tributaries have been reseeded with aggressive non-native grass species such as smooth brome (*Bromus inermis*) and intermediate wheatgrass (*Agropyron intermedium*) to reduce erosion and improve depleted rangeland condition. These grasses can be competitive, reduce the abundance of desirable forb and grass species, and limit the establishment of shrubs (Otfinowski, Kenkel, & Catling, 2006). The Podunk Creek (27-5) study site is an example of reduced herbaceous and shrub components due to the introduction of non-native perennial grasses.

Highway mortality is another limiting factor. This has been particularly pronounced east of Kanab along Highway 89. In 2013, a high fence and six deer underpasses were constructed to allow deer to pass through and reduce highway mortality. Fencing may pose some barrier to deer migration to the wintering grounds. Other portion of Highway 89 north of Kanab has areas of significant mortality.

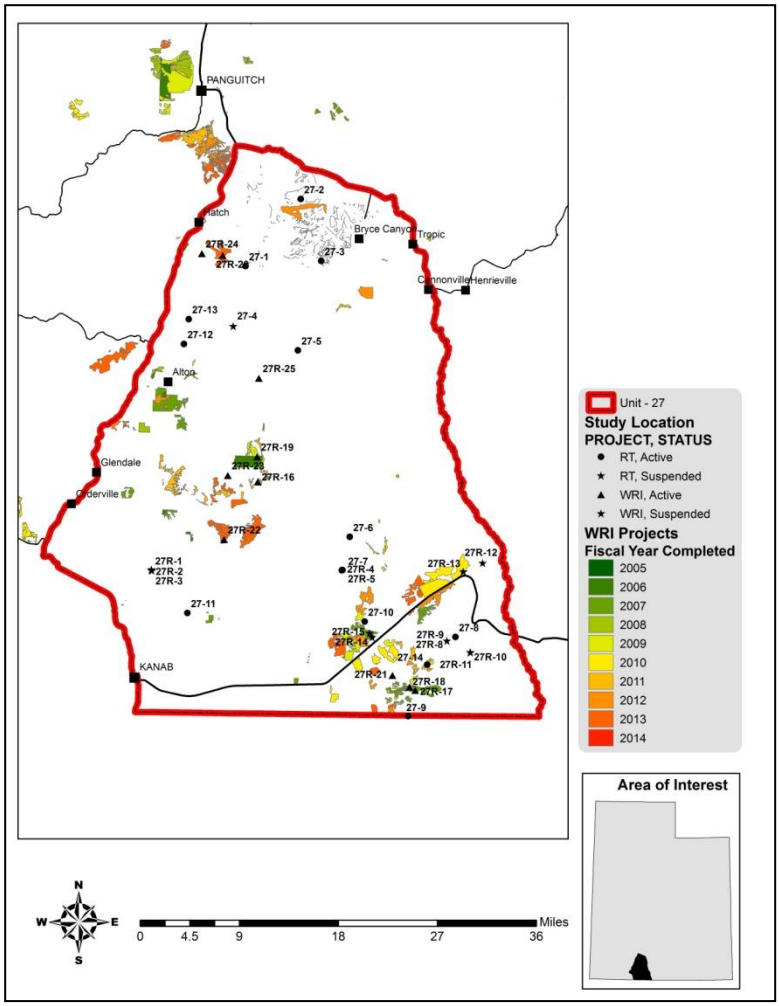


Map 6.5: Land coverage of fires by year from 2001-2013 for WMU 27, Paunsaugunt (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2014).

Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 65,021 acres have been treated within the Paunsaugunt unit since the WRI was implemented in 2004 (Table 6.5). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

The majority of treatment acreage was to reduce pinyon-juniper woodlands such as bullhog, chaining, brush saw, and lop-and-scatter are the next most common management practices. In conjunction with these treatments, the area is seed to improve herbaceous and shrub understory vegetation. Other common management treatments are those to rejuvenate sagebrush stands such as chaining and harrow treatments are common. Herbicide treatments within the unit are primarily used to control cheatgrass and restore other more desirable species (Table 6.5).



Map 6.6: WRI treatments by fiscal year completed for WMU 27, Paunsaugunt.

Treatment Action	Acres
Bullhog	5,640
Chaining	7,937
Disc	1,834
Harrow	6,751
Herbicide application	14
PJ push	798
Road decommissioning	482
Seeding (primary)	21,609
Seeding (secondary/shrub)	3,819
Lop and Scatter	14,564
Prescribed fire	1,353
***Total Land Area Treated**	**41,058**
Total Treatment Acres	**65,021**

Table 6.5: WRI treatment action size (acres) for WMU 27, Paunsaugunt.
*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 27 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (Table 6.6). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Monitoring studies of WRI projects have been sampled since 2004. When possible, WRI monitoring studies are established prior to treatment and sampled on a regular basis following treatment. Due to the long-term nature of the studies, many of the Range Trend and WRI studies have had some sort of disturbance or treatment prior to or since study establishment (Table 6.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
27-1	Proctor Canyon	RT	Active	‘87 ‘92 ‘97 ‘03, ‘08,‘13	Mountain Loam (Browse)
27-2	Ahlstrom Hollow	RT	Active	‘87 ‘92 ‘97 ‘03, ‘08,‘13	Mountain Loam (Black Sagebrush)
27-3	Whiteman Bench	RT	Active	‘87 ‘92 ‘97 ‘03, ‘08,‘13	Mountain Shallow Loam (Ponderosa Pine)
27-4	Sand Pass	RT	Suspended	‘87 ‘92 ‘97 ‘03	Not Verified
27-5	Podunk Creek	RT	Active	‘87 ‘92 ‘97 ‘03, ‘08,‘13	High Mountain Loam (Mountain Big Sagebrush)
27-6	Nephi Pasture I	RT	Active	‘87 ‘92 ‘97 ‘03, ‘08,‘13	Upland Sand (Mountain Big Sagebrush)
27-7	Nephi Pasture Exclosure Outside	RT	Active	‘87 ‘92 ‘97 ‘98 ‘03, ‘08,‘13	Upland Sand (Mountain Big Sagebrush)
27-8	Fivemile Mountain	RT	Active	‘87 ‘92 ‘97 ‘03, ‘08,‘13	Semidesert Shallow Loam (Black Sagebrush)
27-9	Buckskin Mountain	RT	Active	‘97 ‘03, ‘08,‘13	Upland Shallow Loam (Cliffrose)
27-10	Telegraph Flat	RT	Active	‘97 ‘03, ‘08,‘13	Semidesert Loam (Wyoming Big Sagebrush)
27-11	Crocodile	RT	Active	‘97 ‘03, ‘08,‘13	Upland Sand (Mountain Big Sagebrush)
27-12	Moons Landing	RT	Active	‘97 ‘03, ‘08,‘13	Mountain Stony Loam (Antelope Bitterbrush)
27-13	Heaton	RT	Active	‘97 ‘03, ‘08,‘13	Mountain Loam (Black Sagebrush)
27-14	Mustang Pond South	RT	Active	‘13	Upland Shallow Loam (Cliffrose)
27R-1	John R. Flat Total Exclosure	RT	Suspended	‘98 ‘03, ‘08	Not Verified
27R-2	John R. Flat Livestock Exclosure	RT	Suspended	‘98 ‘03, ‘08	Not Verified
27R-3	John R. Flat Exclosure Outside	RT	Suspended	‘98 ‘03, ‘08	Not Verified
27R-4	Nephi Pasture Total Exclosure	RT	Active	‘98 ‘03, ‘08,‘13	Upland Sand (Mountain Big Sagebrush)
27R-5	Nephi Pasture Livestock Exclosure	RT	Active	‘98 ‘03, ‘08,‘13	Upland Sand (Mountain Big Sagebrush)
27R-8	Five Mile Mountain Outside	RT	Suspended	‘98	Not Verified
27R-9	Five Mile Mountain Exc.	RT	Suspended	‘98	Not Verified
27R-10	Cockscomb Exclosure	RT	Suspended	‘98	Not Verified
27R-11	Cockscomb Outside	RT	Suspended	‘98	Not Verified
27R-12	Paria Road 1	WRI	Suspended	‘04	Not Verified
27R-13	Paria Road 2	WRI	Suspended	‘04	Not Verified
27R-14	Telegraph Flat 2	WRI	Suspended	‘04	Not Verified
27R-15	Telegraph Flat 1	WRI	Suspended	‘04	Not Verified
27R-16	Alton/Millcreek LS	WRI	Active	‘05,‘12	Not Verified
27R-17	Buckskin 2	WRI	Active	‘05,‘08,‘13	Upland Shallow Loam (Cliffrose)
27R-18	Buckskin 1	WRI	Active	‘05,‘08,‘13	Upland Shallow Loam (Cliffrose)
27R-19	Alton-Millcreek 2	WRI	Active	‘07,‘10	Not Verified
27R-20	Hatch Bench	WRI	Active	‘12	Not Verified
27R-21	Buckskin Lop and Scatter	WRI	Active	‘12	Not Verified
27R-22	Pine Point Hand thin	WRI	Active	‘12	Not Verified
27R-23	UKC Thompson Creek	WRI	Active	‘13	Upland Loam (Mountain Big Sagebrush)
27R-24	Hatch Bench 2	WRI	Active	‘13	Upland Shallow Hardpan (Black Sagebrush-Bluegrass)
27R-25	Sieler Creek	WRI	Active	‘13	High Mountain Loam (Aspen)

Table 6.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 27, Paunsaugunt.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
27-2	Ahlstrom Hollow	Wildfire		1997-2002		
27-3	Whiteman Bench	Logging/Clear-Cut		Historic		
27-5	Podunk Creek	Contour Trench		1960's		
		Seed Unknown		1960's		
27-10	Telegraph Flat	Two-way Chain	Clay Hole Chaining	1966		
		Aerial Before	Clay Hole Chaining	1966		
		Lop and Scatter	Five Mile Mountain Habitat Restoration Phase III	Fall 2008-Spring 2009	1,043	1,169
27-11	Crocodile	Seed Unknown		1960's		
27-13	Heaton	Seed Unknown		Historic		
		2-Aerator		1997-2003		
27-14	Mustang Pond South	Lop and Scatter	Buckskin Lop and Scatter FY12	Fall 2011	603	2,002
27R-16	Alton/Millcreek LS	Push	Alton/Millcreek	2009-2011		Private
		Seed Unknown	Alton/Millcreek	2009-2011		Private
27R-17	Buckskin 2	Lop and Scatter	Buckskin P-J Thinning 2005	Nov. 2005	882	112
		Aerial	Buckskin P-J Thinning 2005	Nov. 2005	418	112
		Wildfire	Buckskin	2006	1,437	
		1-way Ely Chain	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	Fall 2006	1,437	453
		Aerial Before	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	Fall 2006	1,437	453
		Aerial After	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	Fall 2006	1,437	453
27R-18	Buckskin 1	Wildfire	Buckskin	2006	1,437	
		1-way Ely Chain	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	Fall 2006	1,437	453
		Aerial Before	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	Fall 2006	1,437	453
		Aerial After	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	Fall 2006	1,437	453
27R-19	Alton-Millcreek 2	Lop and Scatter	Alton/Mill Creek Sagebrush Restoration - Year 1	Dec. 2005-Feb. 2006	1,630	188
		Bullhog	Alton/Mill creek Sagebrush Restoration - Year 3	Oct. 2008-Feb. 2009	912	900
		Aerial Before	Mill Creek Aerial Seeding	Oct. 2008	912	1313
27R-20	Hatch Bench	2-way Ely Chain	Hatch Bench Vegetation Enhancement Phase I	Fall 2012	1,134	2,069
		Aerial Before	Hatch Bench Vegetation Enhancement Phase I	Fall 2012	1,134	2,069
		Dribbler	Hatch Bench Vegetation Enhancement Phase I	Fall 2012	1,134	2,069
		Aerial After	Hatch Bench Vegetation Enhancement Phase I	Jan. 2013	1,134	2,069
27R-21	Buckskin Lop and Scatter	Lop and Scatter	Buckskin Lop and Scatter FY13	Spring 2013	630	2,383
27R-22	Pine Point Hand thin	Lop and Scatter	Pine Point Handthin	Winter 2012-2013	2,525	2,359
		Aerial	Pine Point Handthin	Fall 2012	2,525	2,359
27R-23	UKC Thompson Creek	2-way Smooth Chain	UKC Thompson Creek	Fall 2014	959	2,701
		Aerial Before	UKC Thompson Creek	Fall 2014	959	2,701
27R-24	Hatch Bench Phase II	Lop and Scatter	Hatch Bench Vegetation Enhancement Phase II	Fall 2013	2,989	2,690
27R-25	Seiler Creek	Logging/Clear-Cut	Sieler Stewardship	-	834	2,716

Table 6.7: Range trend and WRI studies known disturbance history for WMU 27, Paunsaugunt.

Study Trend Summary (Undisturbed Sites)

High Mountain (Mountain Big Sagebrush)

There is one study [Podunk Creek (27-5)] classified as a High Mountain (Mountain Big Sagebrush) ecological site that remained undisturbed over the report period (Table 6.6). The study occurs on the southeast end of the Paunsaugunt Plateau near the head of Podunk Creek.

Shrubs/Trees: The primary browse on the Podunk Creek study is a mixture of Parry rabbitbrush (*Chrysothamnus parryi*) and stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus*). Preferred browse species are rare on the site (Figure 6.2b).

Herbaceous Understory: This site has a good herbaceous component dominated by perennial grass. However, the dominant grass species are comprised of seeded species that are often considered aggressive at higher elevation and precipitation. These include intermediate wheatgrass (*Agropyron intermedium*) and smooth brome (*Bromus inermis*). Numerous native species also occur on the site, but at much lower cover and frequency than the introduced species. Competition with these introduced grasses may limit other desirable herbaceous species. Mean nested frequency of perennial grasses has fluctuated, but has remained relatively high since 1992 (Figure 6.3a). The mean cover of perennial grass has fluctuated over the sample years from 44% in 1992 to as low as 23% in 2003 and 30% in 2013 (Figure 6.3b). Annual grass species are rare on this study site.

Native perennial forb species composition is diverse with moderate to high nested frequency and cover. The mean nested frequency and cover of perennial forb species has fluctuated over the sample years in 2008 with a high cover near 16% in 1992 and a low cover of 6% in 1997 (Figure 6.3).

Occupancy: Pellet group transect data indicates that cattle predominately occupy these studies. The mean abundance of cattle pellet groups has ranged from a high of 72 days use/acre in 2003 to a low of 36 days use/acre in 2008. Deer and elk pellet groups are typically sampled in low abundance on this study site (Figure 6.4).

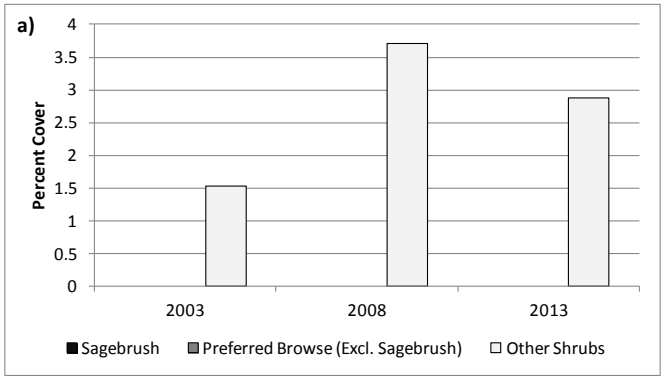


Figure 6.2: Shrub summary of the High Mountain (Mountain Big Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups.

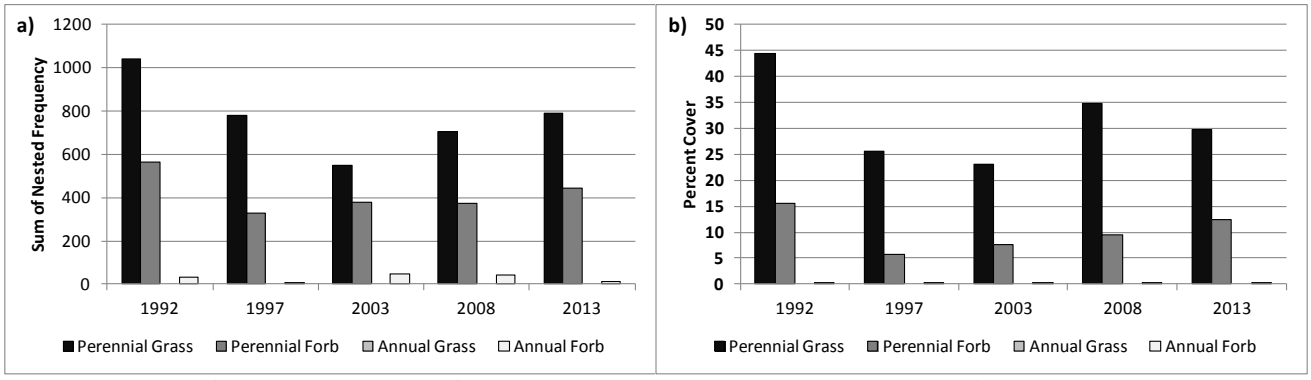


Figure 6.3: Herbaceous functional group summary of the High Mountain (Mountain Big Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

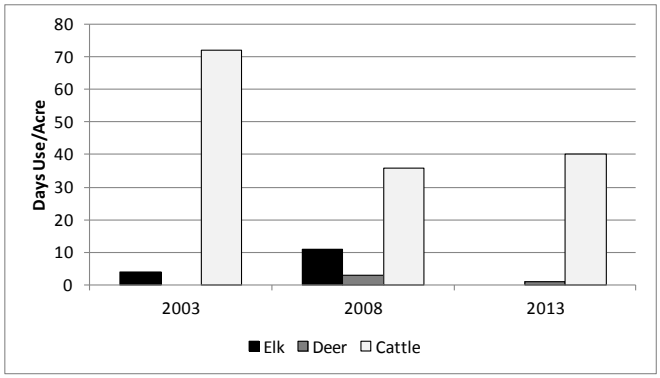


Figure 6.4: Mean pellet transect data for the Mountain (Mountain Big Sagebrush) study (n=1) for WMU 27, Paunsaugunt.

Mountain (Browse/Antelope Bitterbrush)

There are two studies [Proctor Canyon (27-1) and Moons Landing (27-12)] classified as Mountain (Browse) and Mountain (Antelope Bitterbrush) ecological sites, respectively, that remained undisturbed over the report period (Table 6.6). Both studies occur on the west side of the Paunsaugunt Plateau. The Proctor Canyon study is located on an open ridge south of Proctor Canyon. The Moons Landing study is located north of Alton on the ridge top above Roundy Canyon.

Shrubs/Trees: The primary browse on both of these studies is a mixture of antelope bitterbrush, sagebrush, and mountain snowberry (*Symphoricarpos oreophilus*). Other preferred browse species are common on both sites, but occur at much lower coverage. The mean line-intercept cover of preferred browse species is good on these sites ranging from 41% in 2003 to near 48% in 2013. The mean cover of sagebrush has been increasing since 2003 with both sites showing an increase in sagebrush cover. The mean cover of other preferred browse species has increased from 34% to 38% since 2003 (Figure 6.5a). The average height of the mountain big sagebrush is approximately 2 feet on the Moon Landing site and black sagebrush is a foot and a half on both sites, making browse available through much of the year in mild winters. The demographics of the sagebrush population has been a good mixture of young and mature with a small percentage of decadent plants within the population, but there was a increase in decadent sagebrush plants on the Moons landing study in 2008 (Figure 6.5b).

Pinyon and juniper occur in low abundance on both of these sites.

Herbaceous Understory: Both study sites have a good herbaceous component dominated by native perennial grass. Mean nested frequency of perennial grasses decreased from 1992 to 2003, which may correspond to the drought that occurred 2002-2003, although cover and frequency has increased since 2003 and has remained relatively high (Figure 6.6a). The mean cover of perennial grass decreased from 18-19% in 1992 to around 9% in 2003 and increase to 13% in 2013(Figure 6.6b). Annual grass species are rare on both study sites.

Native perennial forb species composition is diverse with moderate nested frequency and cover. The mean nested frequency and cover of perennial forb species has fluctuated over the sample years with a high cover of 9% in 1992 and a low cover of 3% in 2003 (Figure 6.6).

Occupancy: Pellet group transect data indicates that deer predominately occupy these studies. The mean abundance of deer pellet groups has ranged from a high of 103 days use/acre in 2008 to a low of 65 days use/acre in 2013. Deer occupancy is generally higher on the Moons Landing study than on the Proctor Canyon study. Elk pellet groups are typically sampled in low abundance on both study sites. Livestock sign from cattle was moderately abundant on the moons landing study in 2008, but has been low in subsequent sample years (Figure 6.7).

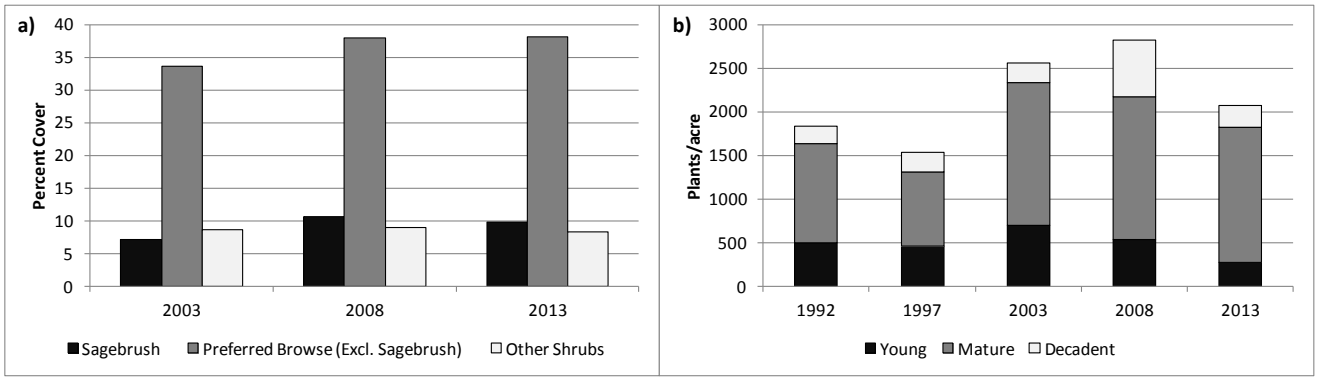


Figure 6.5: Shrub summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

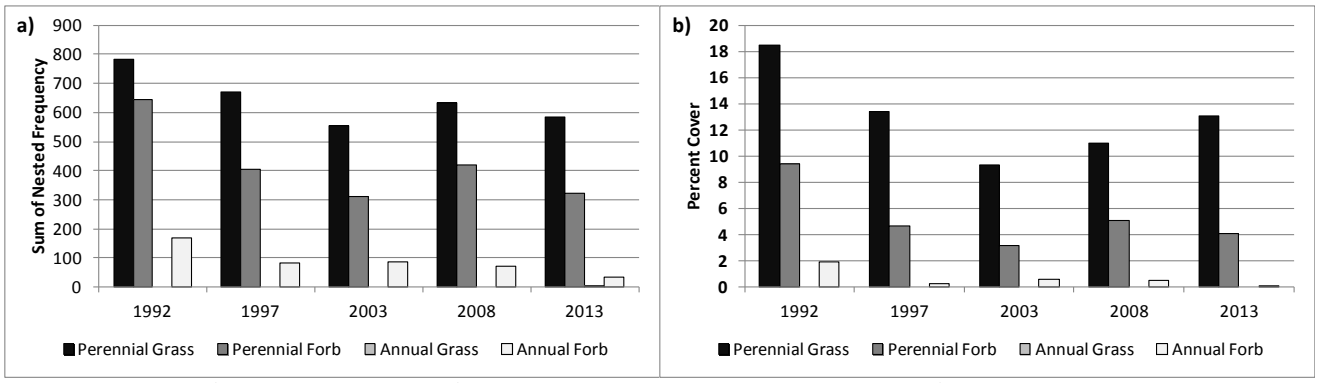


Figure 6.6: Herbaceous functional group summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

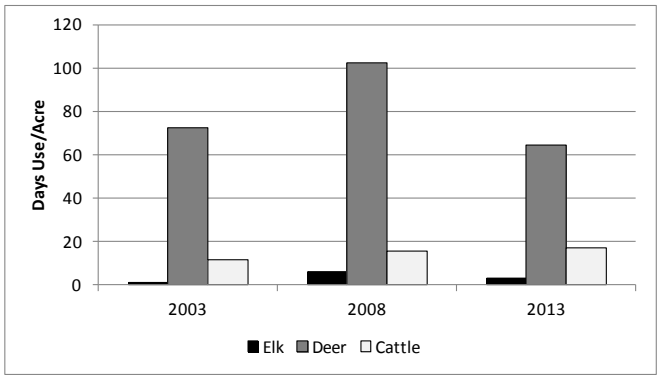


Figure 6.7: Mean pellet transect data for the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 27, Paunsaugunt.

Mountain (Ponderosa Pine)

There is one study [Whiteman Bench (27-3)] classified as a Mountain (Ponderosa Pine) ecological site that remained undisturbed over the report period (Table 6.6). The study is located on the south end of the North end of the Paunsaugunt Plateau on Whiteman Bench.

Shrubs/Trees: The primary browse on the Whiteman Bench study is a mixture of black sagebrush, dwarf rabbitbrush (*Chrysothamnus depressus*), and antelope bitterbrush. The mean line-intercept cover of sagebrush is low on this site ranging from 1-2% since 2003. The mean cover of the bitterbrush and dwarf rabbitbrush, has ranged from 3%and 7% in 2003 to 6% and 10% in 2008, respectively (Figure 6.8a). The average height of the browse species is approximately 1 foot, making these shrubs less available as browse during winter months. The demographics of the sagebrush population have been generally comprised of mature plants, but

the number of decadent plants was substantially higher in 1992 and 2008. Recruitment of young sagebrush plants has been mixed with little recruitment in 2003 and 2013, while in 1992, 1997, and 2008 recruitment of young was 10% of the population (Figure 6.8b).

Ponderosa pine (*Pinus ponderosa*) has dominated the tree over story on this site and has ranged in cover from 17 to 23% since 2003 (Figure 6.9b).

Herbaceous Understory: The study site has a good herbaceous component dominated by perennial forbs. Mean nested frequency of perennial forbs has fluctuated, but has remained relatively high since 1992 (Figure 6.10a). The mean cover of perennial forbs decreased from 9% in 1992 to 5% in 1998, but increased steadily to 9% in 2013 (Figure 6.10b). Annual grass species are rare on the site.

Native perennial grass species composition is good on the site with moderate to high nested frequency and cover. Cover of grass decreased from 7% in 1992 to 2% in 2003, but has steadily increased to 8% in 2013 (Figure 6.10b).

Occupancy: Pellet group transect data indicates that deer and elk predominately occupy this study. The mean abundance of deer pellet groups has ranged from a high of 26 days use/acre in 2008 to a low of 13 days use/acre in 2013. Elk pellet groups has ranged from a high of 29 in 2008 to a low of 1 in 2013. The abundance of livestock sign from cattle has been low since 2003 (Figure 6.11).

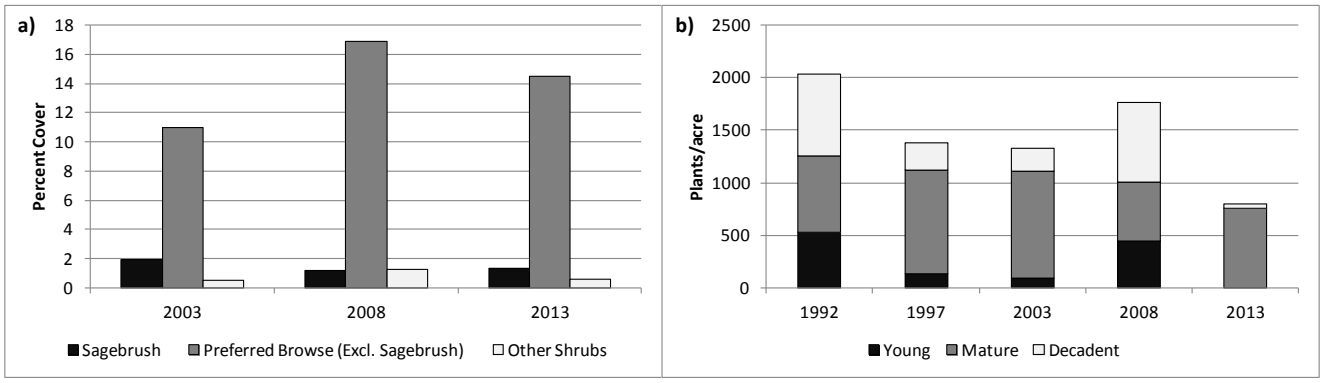


Figure 6.8: Shrub summary of the Mountian (Ponderosa Pine) study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

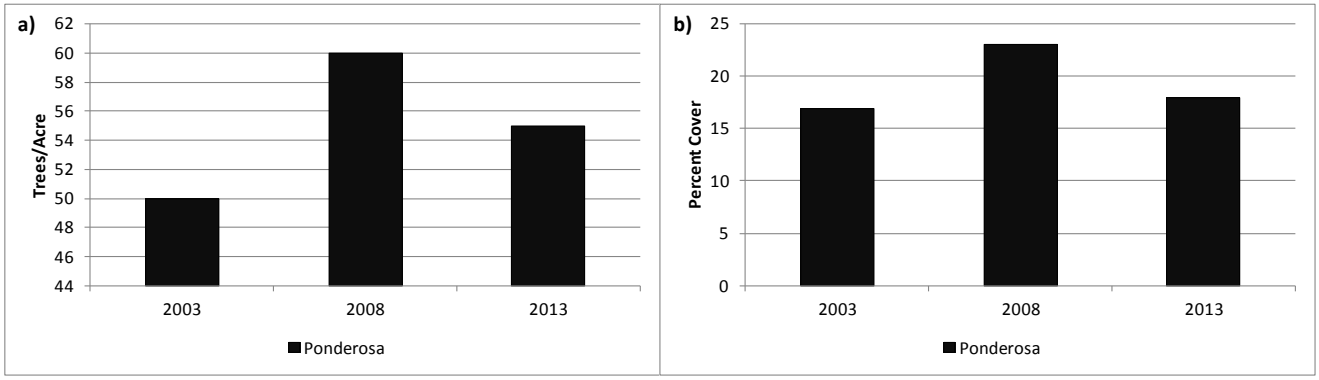


Figure 6.9: Tree summary of the Mountain (Ponderosa Pine) study (n=1) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for ponderosa pine (*Pinus ponderosa*). b) Mean line-intercept cover estimate for ponderosa pine.

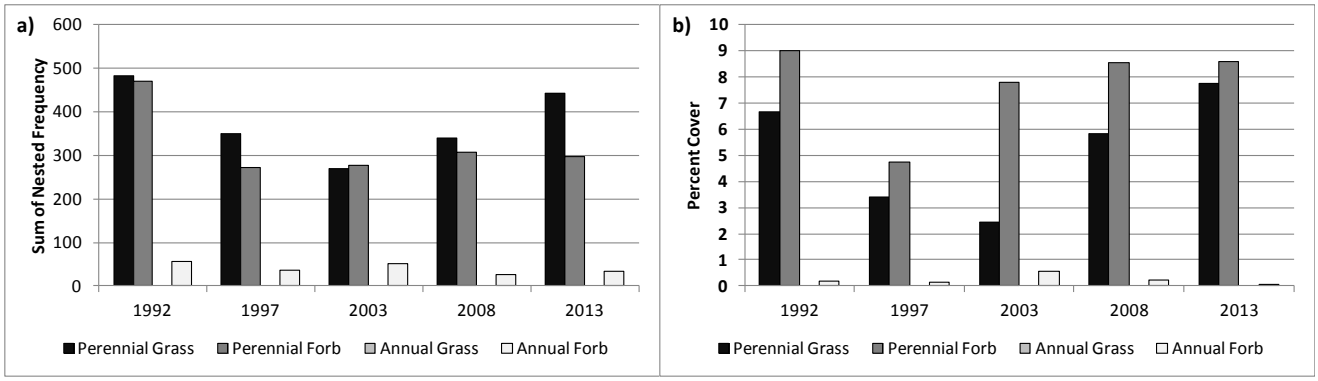


Figure 6.10: Herbaceous functional group summary of the Mountain (Ponderosa Pine) study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

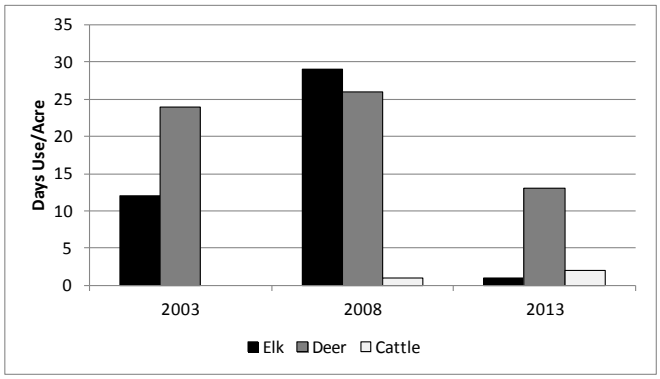


Figure 6.11: Mean pellet transect data for the Mountain (Ponderosa Pine) study (n=1) for WMU 27, Paunsaugunt.

Upland (Basin Big Sagebrush)

There is five study [Nephi Pasture I (27-6), Nephi Pasture Exlosure Outside (27-7), Crocodile (27-11), Nephi Pasture Total Exclosure (27R-4), and Nephi Pasture Livestock Exclosure (27R-5)] classified as an Upland (Basin Big Sagebrush) ecological site that remained undisturbed over the report period (Table 6.6). The studies are located on the south of the Paunsaugunt Plateau on the Wygaret Terrace and Nephi Pasture.

Shrubs/Trees: The primary browse on these studies is a mixture of basin big sagebrush, antelope bitterbrush (*Purshia tridentata*), and Utah serviceberry (*Amelanchier utahensis*). The mean line-intercept cover of sagebrush is good on these sites ranging from 9% in 2003 to 11% in 2013. The mean cover of the only other preferred browse species, has ranged from 13% in 2003 to 16% in 2013 (Figure 6.12a). The average height of the mountain big sagebrush is approximately 3 feet and between 2 to 3 feet for bitterbrush, making browse available through much of the year in normal winters. The demographics of the sagebrush population have been generally comprised of mature and decadent plants. Recruitment of young sagebrush plants has fluctuated over the sample years (Figure 6.12b).

Despite the good health of the browse community, encroachment from Utah juniper trees is a concern on the sites. Density of pinyon-juniper trees has steadily increased since 2003 (Figure 6.13a), and mean tree cover has increased steadily since 2003 (Figure 6.13b). The increase in mean tree cover corresponds to increases in the average size of trees in photographs. These sites are classified as being in Phase I and Phase I transitioning to Phase II of the woodland succession. The study sites are under threat of further encroachment by pinyon-juniper trees, which would result in decreases in valuable browse and forage species.

Herbaceous Understory: These study sites have a marginal herbaceous component dominated by a mixture of perennial grass and perennial forb species. The mean cover of perennial grass decreased from 4% in 1998 to

less than 1% in 2008 (Figure 6.14b). Annual grass species are rare on these sites though in 1998 cheatgrass was common on the site.

Native perennial forb species composition is marginal on these sites, though cover of forbs has increased since 1992 from 1% to 3% in 2013 (Figure 6.14).

Occupancy: Pellet group transect data indicates that deer and cattle predominately occupy these study sites. The mean abundance of deer pellet groups has ranged from a high of 100 days use/acre in 2003 to a low of 44 days use/acre in 2013. Elk pellet groups are typically sampled in low abundance on the study site. The abundance of livestock sign from cattle has ranged from a high of 18 days use/acre in 1998 to a low of 3 days use/acre in 2008 (Figure 6.15).

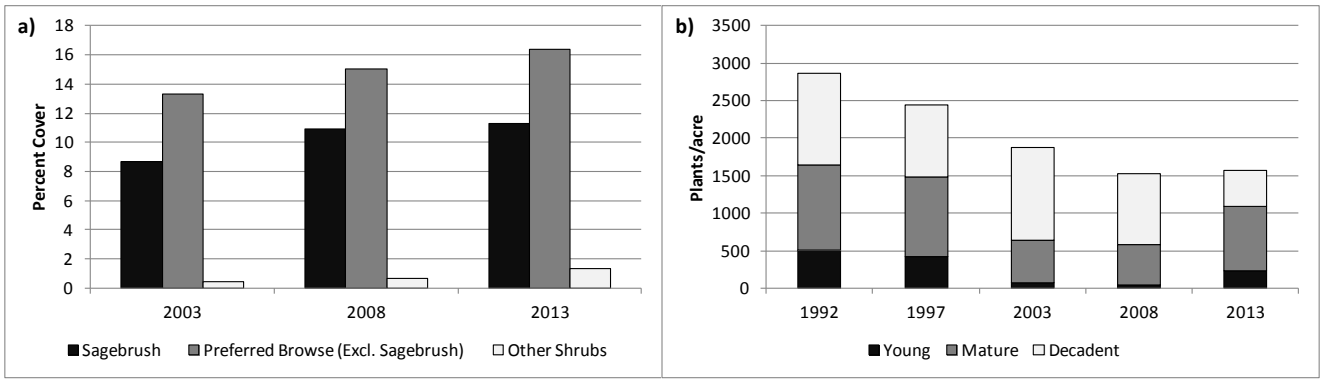


Figure 6.12: Shrub summary of the Upland (Basin Big Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

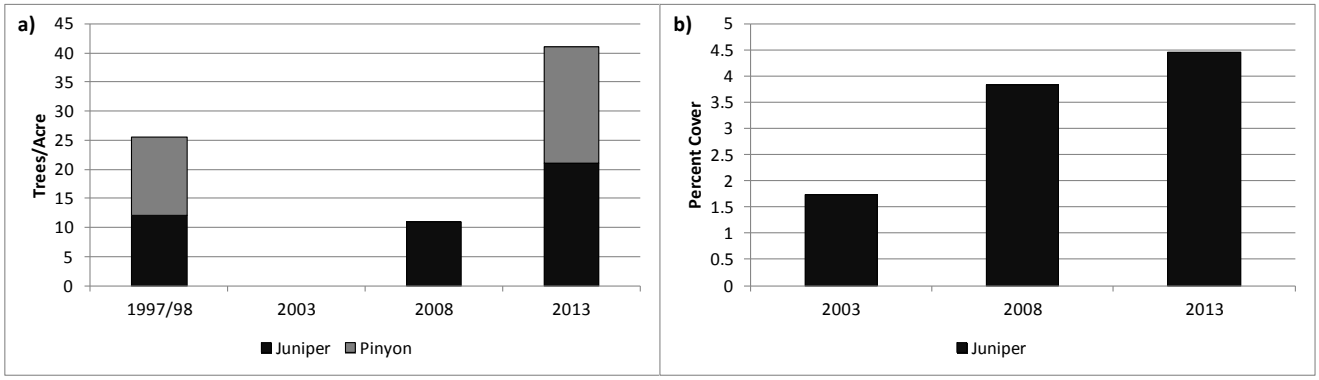


Figure 6.13: Tree summary of the Upland (Basin Big Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

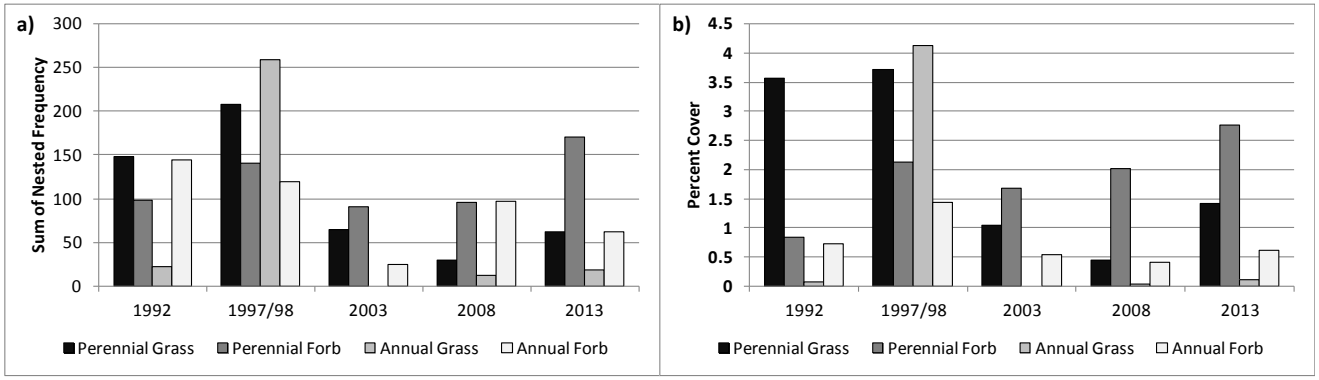


Figure 6.14: Herbaceous functional group summary of the Upland (Basin Big Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

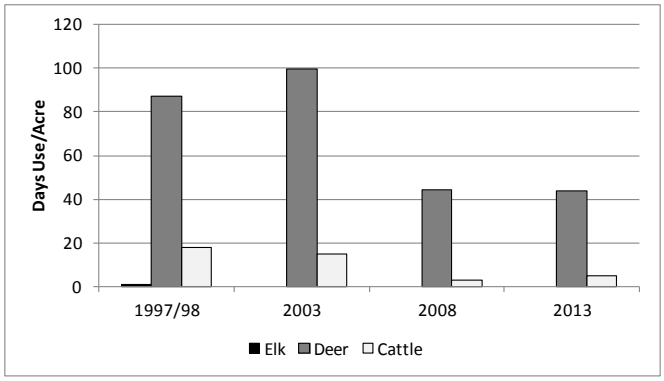


Figure 6.15: Mean pellet transect data for the Upland (Basin Big Sagebrush) study (n=1) for WMU 27, Paunsaugunt.

Upland (Cliffrose)

There is one study site [Buckskin Mountain (27-9)] classified as Upland (Cliffrose) ecological site that remained undisturbed over the report period (Table 6.6). This study is located on Buckskin Mountain on the Arizona/Utah boarder.

Shrubs/Trees: The primary browse on this study is Basin big sagebrush (*A. tridentata* ssp. *tridentata*) and Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*). The mean line-intercept cover of sagebrush and cliffrose on this site is good, which steadily increased from 7% and 8% in 2003 to just over 12% and 15% in 2013, respectively (Figure 6.16a). The average height of basin big sagebrush on this study is approximately 2.5 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been comprised of a mixture of mature and decadent plants with recruitment of young plants comprising more than 10% of the population except for 2008. Despite the increase in cover of sagebrush, the mean density of sagebrush has steadily decreased on these sites since 1997 (Figure 6.16b).

Encroachment from pinyon pine and Utah juniper trees is a concern on these sites, particularly the Bone Hollow study. The mean density of pinyon-juniper trees has increased slightly since 2003 (Figure 6.17a), and mean tree cover increased steadily since 2003 at 7% to 11% in 2013 (Figure 6.17b). This study is classified as Phase I transitioning to a Phase II of the woodland succession. This study site is under threat of further encroachment by pinyon-juniper trees, which would result in decreases in valuable browse and forage species.

Herbaceous Understory: This study site has a poor herbaceous component dominated primarily by annual grass species cheatgrass. Mean nested frequency of perennial grasses has remained low on the site, and cover has remained less than 1% since 1997. The mean cover of annual grass species cheatgrass was very abundant in 1997, but has steadily decreased from 26% in 1997 to 3% in 2013 (Figure 6.18). However, cheatgrass remains an increased fire threat on this site.

Native perennial forb species composition is poor on this study with low nested frequency and cover of all sampled species (Figure 6.18).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 100 days use/acre in 2008 to a low of 38 days use/acre in 2013 (Figure 6.19).

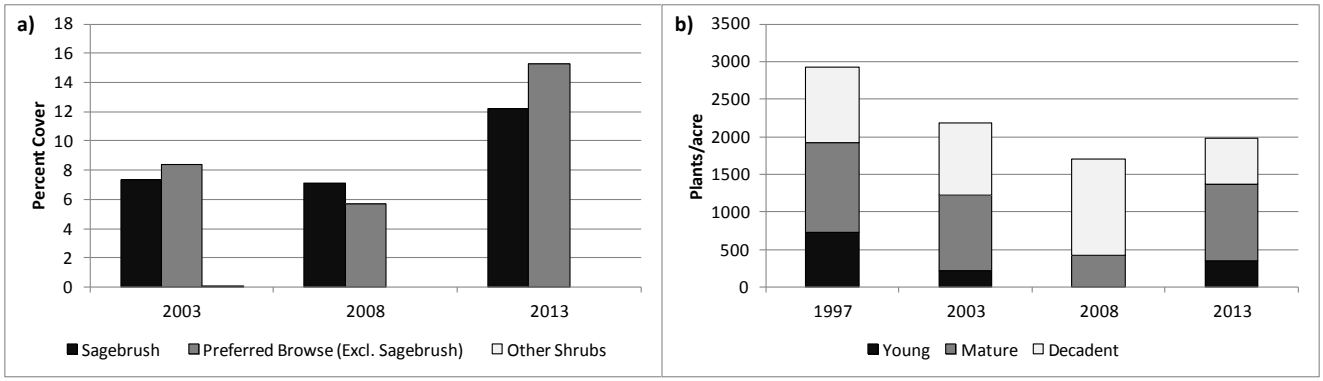


Figure 6.16: Shrub summary of the Upland (Cliffrose) study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

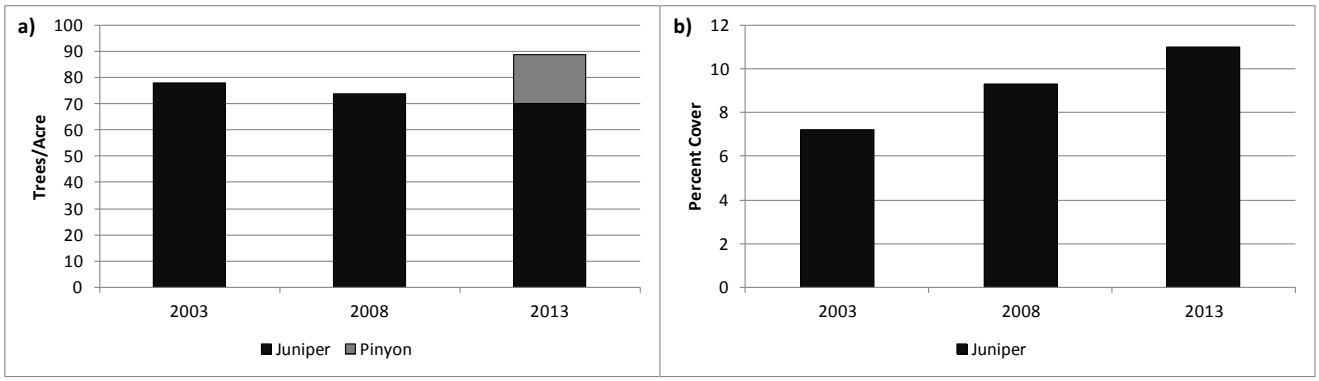


Figure 6.17: Tree summary of the Upland (Cliffrose) study (n=1) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

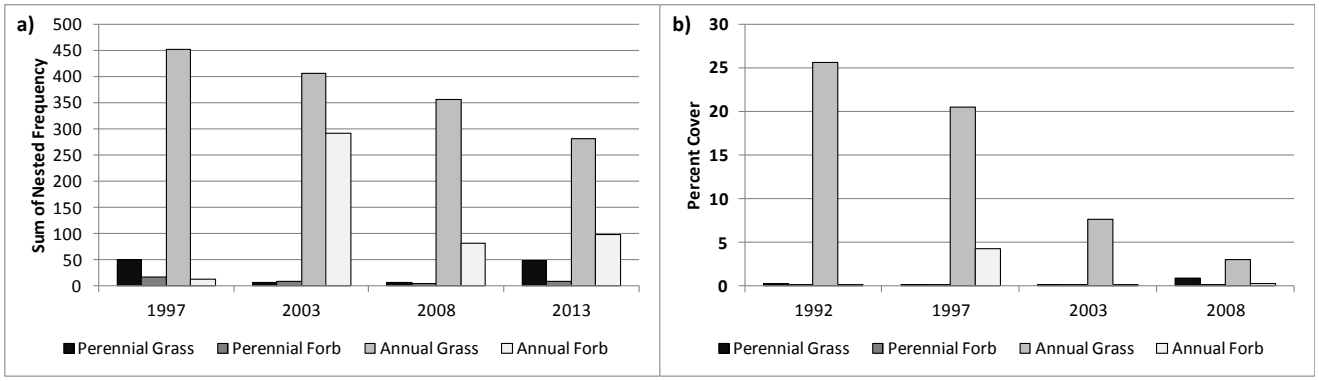


Figure 6.18: Herbaceous functional group summary of the Upland (Cliffrose) study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

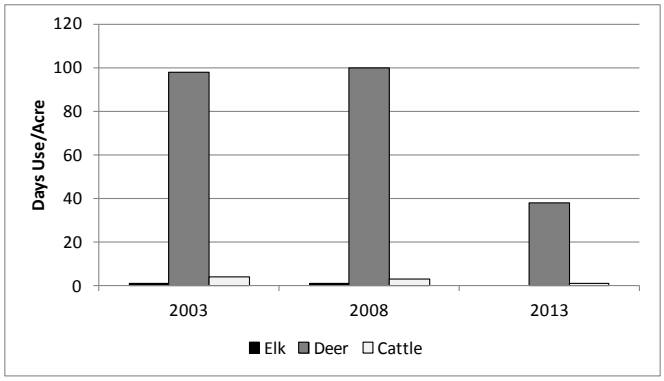


Figure 6.19: Mean pellet transect data for the Upland (Cliffrose) study (n=1) for WMU 27, Paunsaugunt.

Semidesert (Black Sagebrush)

There is one study [Fivemile Mountain (22-2)] classified as a Semidesert (Black Sagebrush) ecological site that remained undisturbed over the report period (Table 6.6). The Fivemile Mountain study is located on the south end of Fivemile Mountain.

Shrubs/Trees: The primary browse on this study site is black sagebrush with no other preferred browse species sampled in cover measurements. The mean line-intercept cover of sagebrush is good, and has increased from 15% in 2003 to 23% in 2013 (Figure 6.20a). The average height of black sagebrush on all of the studies is approximately 1.5 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been comprised of a mixture of mature and decadent plants with recruitment of young plants comprising less than 10% of the population on most of the study sites since 1992 (Figure 6.20b).

Encroachment from pinyon pine and Utah juniper trees is a concern on this site, though mean density and cover are generally low (Figure 6.21). Repeat photographs do show some encroachment of pinyon-juniper trees, but the site is currently classified as being in Phase I of the woodland succession.

Herbaceous Understory: This study sites have a marginal herbaceous component dominated primarily by native perennial grasses. The mean cover of perennial grass has remained stable ranging from 2% to 4% over the sampled years. The annual grass species cheatgrass was moderately abundant in 1997 and 2003, but has been not very abundant in other sample years (Figure 6.22). Cheatgrass remains a threat for increased fire on this site.

Native perennial forb species composition is generally diverse on these studies, but with low nested frequency and cover of all sampled species (Figure 6.22).

Occupancy: Pellet group transect data indicates that deer and cattle almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 35 days use/acre in 2008 to a low of 15 days use/acre in 2013. The mean abundance of cattle pellet groups has been low ranging from 4-5 days use/acre since 2003 (Figure 6.23).

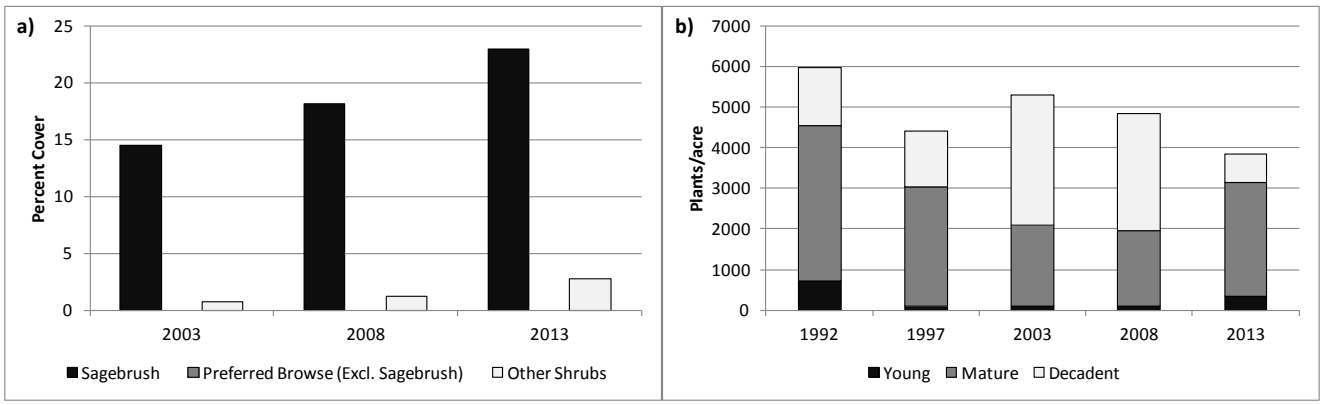


Figure 6.20: Shrub summary of the Semidesert (Black Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

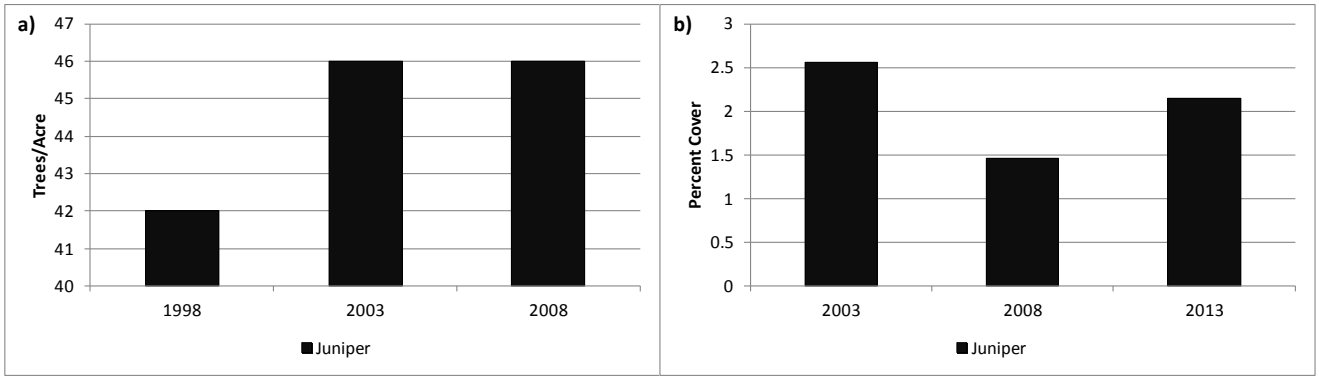


Figure 6.21: Tree summary of the Semidesert (Black Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

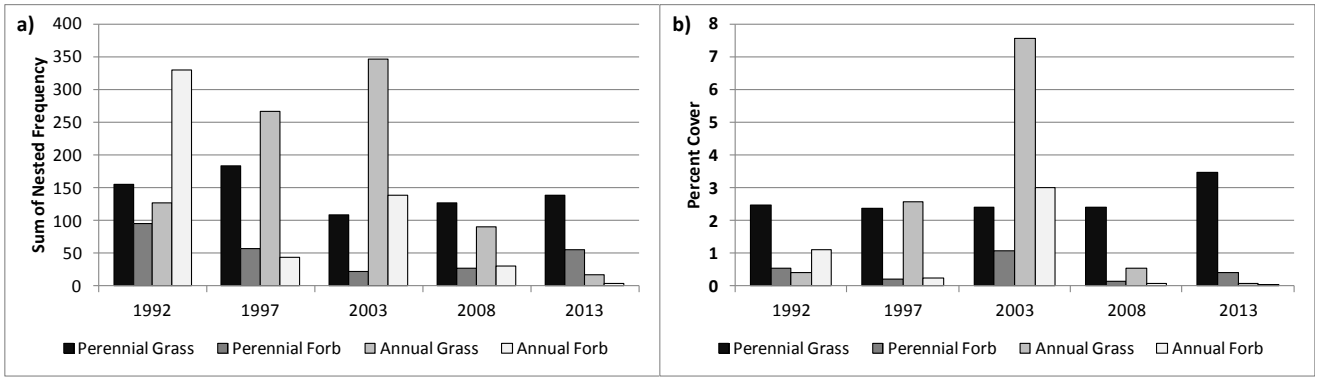


Figure 6.22: Herbaceous functional group summary of the Semidesert (Black Sagebrush) study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

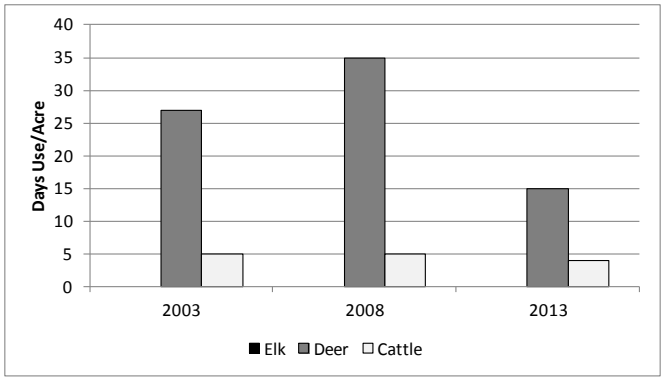


Figure 6.23: Mean pellet transect data for the Semidesert (Black Sagebrush) study (n=1) for WMU 27, Paunsaugunt.

Study Trend Summary (Treated/Disturbed Sites)

Bullhog

One study [Alton-Millcreek 2 (27R-17)] that was treated with a bullhog during the report period (Table 6.7). The study is located south of Paunsaugunt Plateau on a bench west of Mill Creek. The study is as an Upland (Black Sagebrush) ecological site (Table 6.6). The target of the bullhog treatment was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on the study is black sagebrush and Wyoming big sagebrush though cover of these browse species was low. Sagebrush was being impacted by pinyon-juniper encroachment on this study, and the mean line-intercept cover of sagebrush was low at near 1% prior to treatment. The mean cover of sagebrush increased slightly to 2% following treatment (Figure 6.24a). The mean density of sagebrush also decreased from 1,000 plants/acre to 880 plants/acre. However, changes in demographics of the sagebrush populations have been positive on the study. Decadent sagebrush plants dominated the population prior to treatment, but decadent plants became a minor component following treatment. The recruitment of young plants was minimal prior to and following the treatment (Figure 6.24b).

The mean density and cover of pinyon pine and Utah juniper trees was high at 266 trees/acre and 19%, respectively. The mean density of pinyon-juniper trees decreased to 12 tree/acre and the mean cover decreased to 0% following treatment (Figure 6.25). Remaining density and cover was generally provided by small trees that survived the treatment.

Herbaceous Understory: The herbaceous component was fair prior to treatment on this study. Perennial forb and annual forb species had the largest response increasing in mean cover from 4% to 5% and less than 1% to 8%, respectively. Perennial grass cover decreased from 4% to 3%. Annual grass, namely cheatgrass, was rare on the study site prior to treatment, and decreased in nested frequency following the treatment (Figure 6.26).

Occupancy: Pellet group transect data indicates that animal presence on this site is low with deer and elk predominantly occupying this site. Deer and elk presence was sampled prior to treatment at 1 and 7 days use/acre to 6 and 14 days use/acre following the treatment, respectively (Figure 6.27).

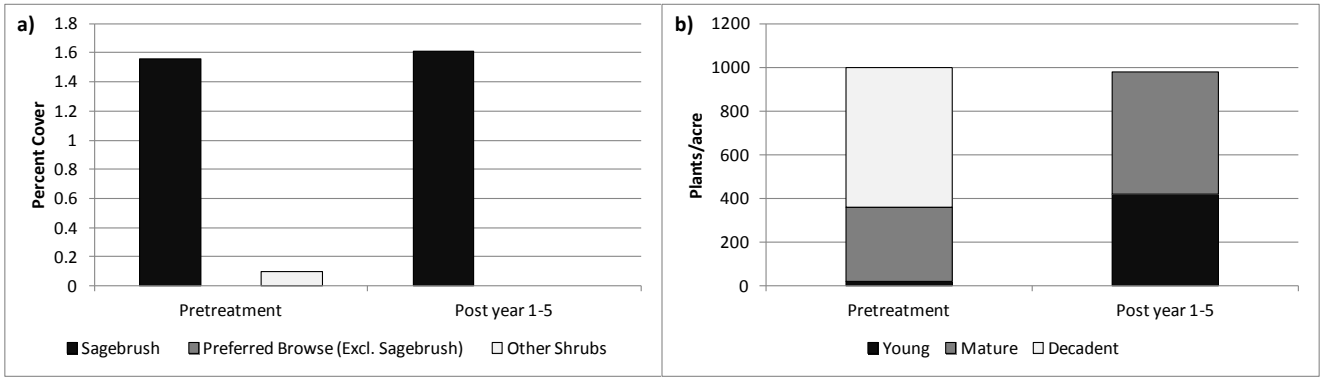


Figure 6.24: Shrub summary of the Bullhog treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

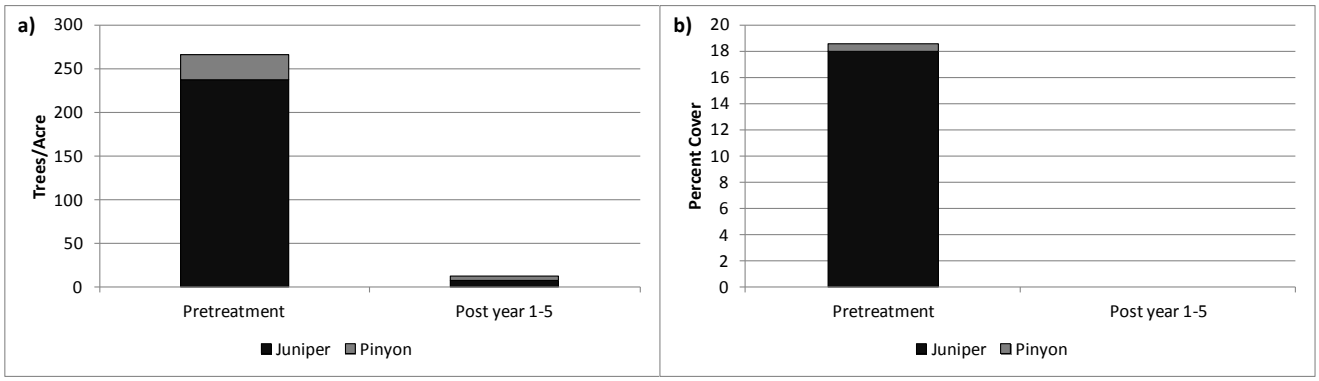


Figure 6.25: Tree summary of the Bullhog treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

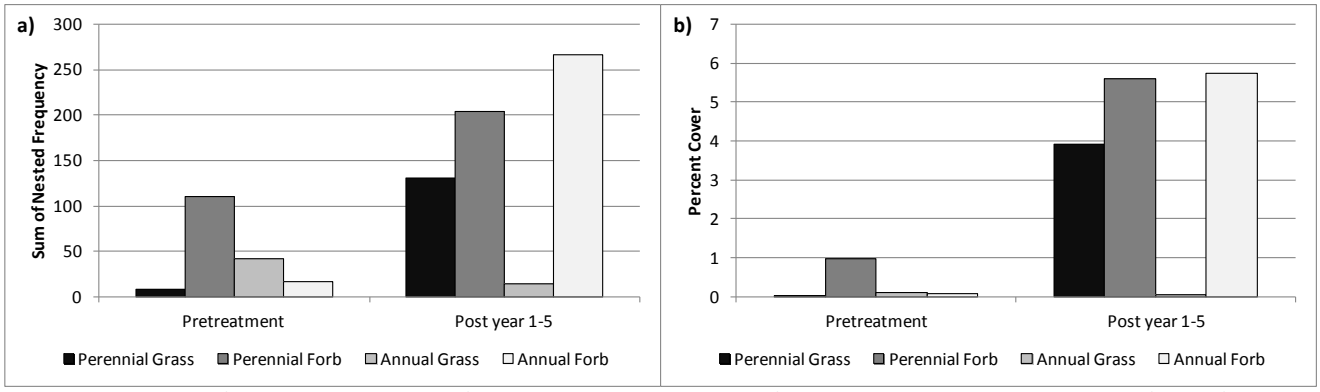


Figure 6.26: Herbaceous functional group summary of the Bullhog treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

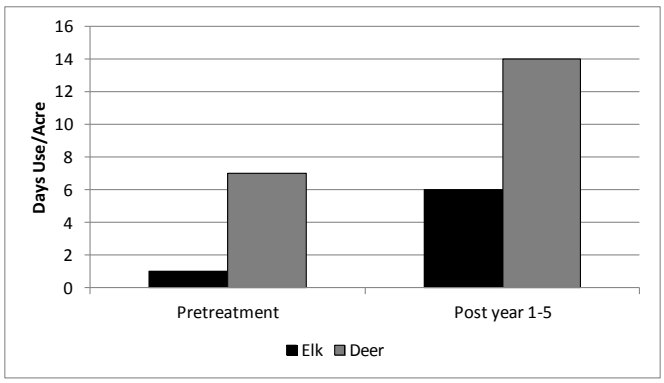


Figure 6.27: Mean pellet transect data for the Bullhog treatment study (n=1) for WMU 27, Paunsaugunt.

Aerator

One study [Heaton (27-13)] was treated with an aerator during the report period (Table 6.7). The study is located south of Hatch west of Highway of 89 below the Paunsaugunt plateau. The study is as an Upland (Black Sagebrush) ecological site (Table 6.6). Generally, the target of the aerator treatments was to rejuvenate degraded sagebrush and increase the herbaceous understory.

Shrubs/Trees: The primary browse on the study is black sagebrush and bitterbrush. The mean quadrat cover of sagebrush was reduced following treatments from 25% in 1997 to 8% in 2013 (Figure 6.28a). The mean density of sagebrush also decreased from 8,800 plants/acre in 1997 to 4,500 plants/acre in 2013. However, changes in demographics of the sagebrush populations have remained positive on the study. The recruitment of young plants has been good with recruitment above 10% since 1997 (Figure 6.28b).

Pinyon and juniper trees are rare on the site.

Herbaceous Understory: The herbaceous component was fair prior to treatment on this study, but following the treatment perennial grasses have increased substantially in cover on the site. Perennial forb and annual forb species have remained similar following the treatment. Perennial grass cover increased from 12% in 1997 to 25% in 2013 (Figure 6.29).

Occupancy: Pellet group transect data indicates that animal presence on this site is predominately from deer and cattle. Deer and cattle presence was sampled prior to treatment at 45 and 25 days use /acre and following the treatment 83 and 92 days use/acre in 2008 and 57 and 45 days use/acre in 2013, respectively (Figure 6.30).

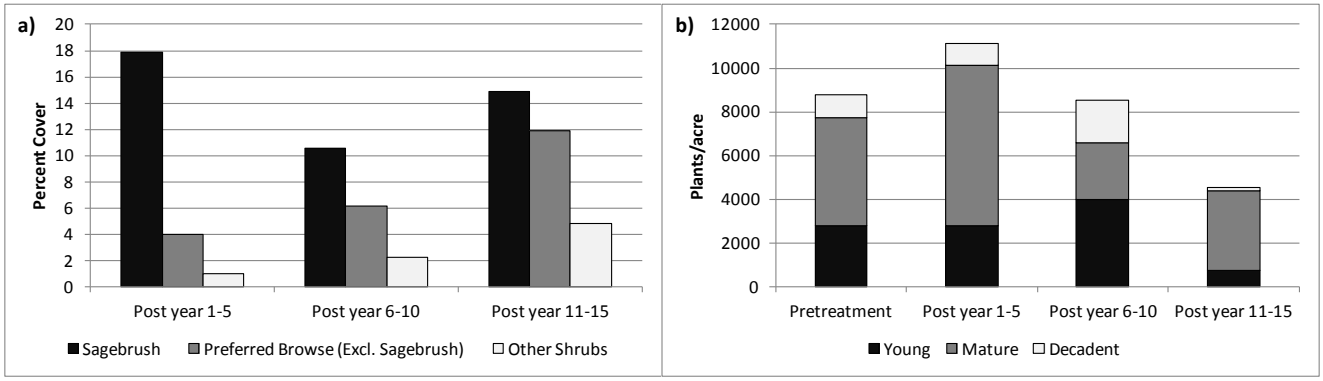


Figure 6.28: Shrub summary of the Aerator treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

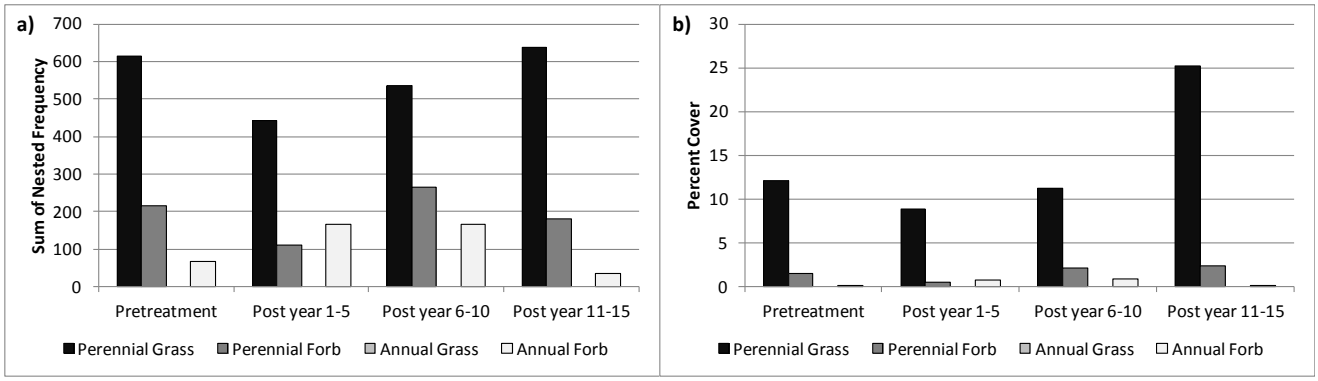


Figure 6.29: Herbaceous functional group summary of the Aerator treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

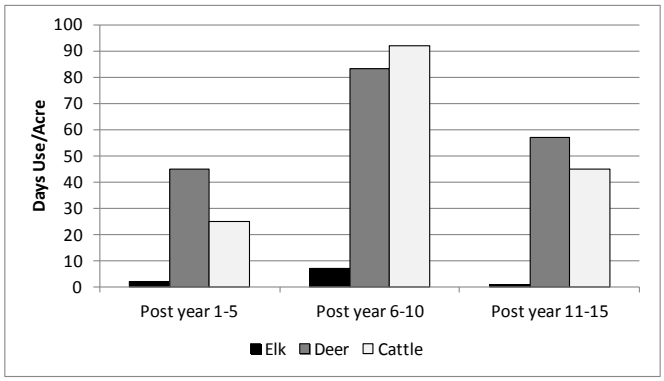


Figure 6.30: Mean pellet transect data for the Aerator treatment study (n=1) for WMU 27, Paunsaugunt.

Dozer push

One study [Alton-Millcreek LS (27R-16)] was treated with a dozer push during the report period (Table 6.7). The Alton-Millcreek LS study is located south of Paunsaugunt Plateau on a bench west of Mill Creek. The study is an Upland (Wyoming Big Sagebrush) ecological site (Table 6.6). Generally, the target of the dozer push treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on this study is mountain big sagebrush. The mean cover of sagebrush was rare prior to treatment, but was still sampled on the site following the treatment (Figure 6.31a). The mean density of sagebrush also decreased from 180 plants/acre to 40 plants/acre (Figure 6.31b).

The mean density and cover of pinyon pine and Utah juniper trees was high at 314 trees/acre and 25%, respectively. The mean density of pinyon-juniper trees decreased to 21 tree/acre and the mean cover decreased to 0% following treatment (Figure 6.32). Small trees that survived the treatment generally provided remaining density and cover.

Herbaceous Understory: The herbaceous component was poor prior to treatment. The herbaceous component was comprised primarily of native grass and forb species. Perennial grass, primarily seeded species, had the largest response increasing in mean cover from 1% to 21%. The mean annual forb cover decreased from 6% to 2% following the treatment (Figure 6.33).

Occupancy: Pellet group transect data indicates that presence of animals was low on the site. The mean abundance of pellet groups for deer decreased from 8 days use/acre prior to treatment to 4 days use/acre following treatment (Figure 6.34).

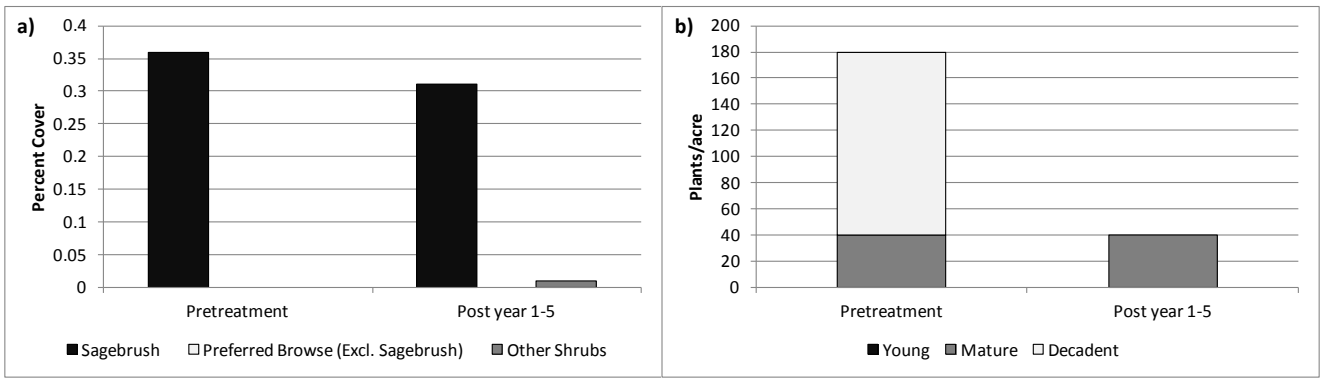


Figure 6.31: Shrub summary of the Push treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

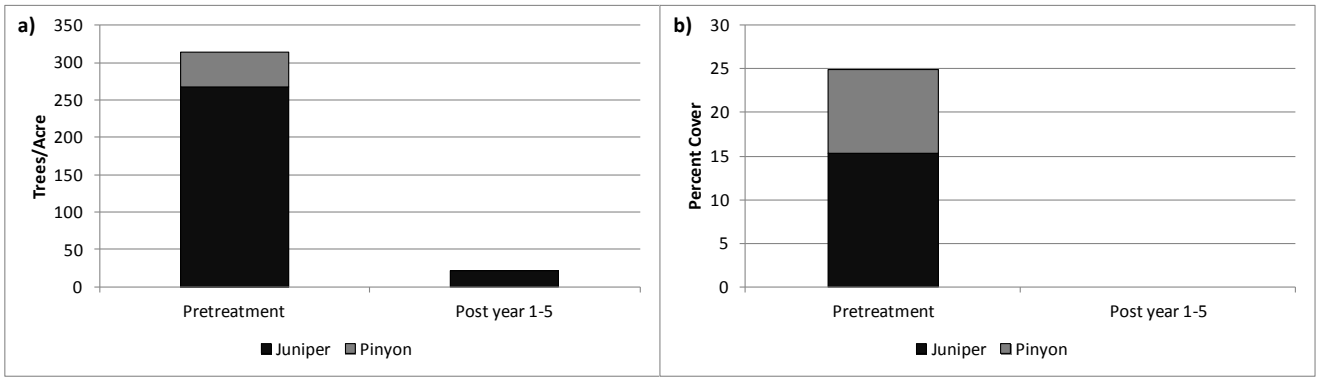


Figure 6.32: Tree summary of the Push treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

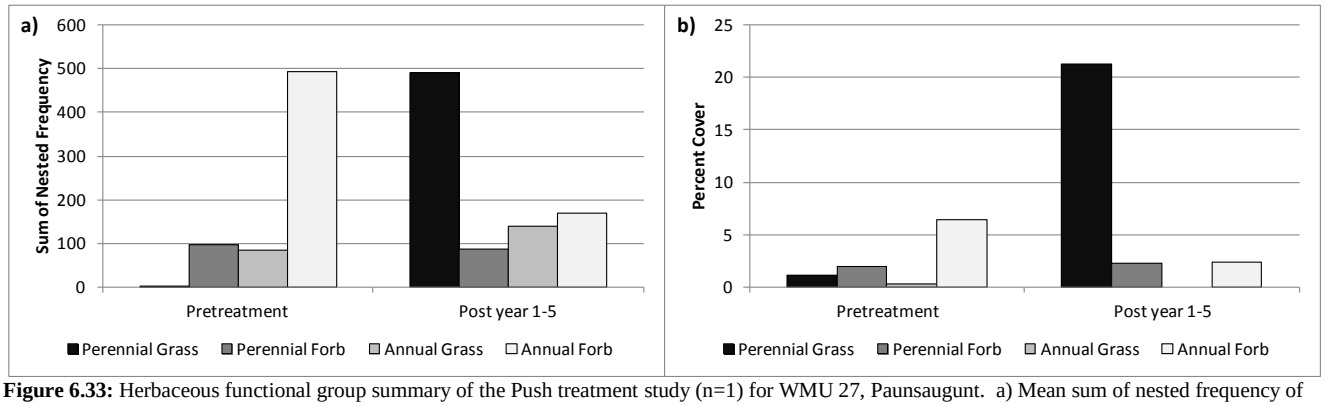


Figure 6.33: Herbaceous functional group summary of the Push treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

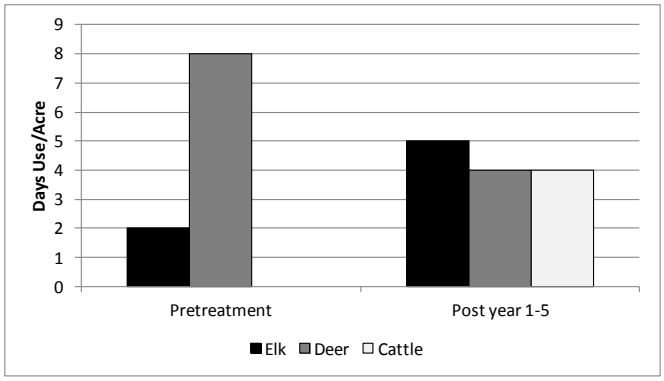


Figure 6.34: Mean pellet transect data for the Push treatment study (n=1) for WMU 27, Paunsaugunt.

Lop and Scatter

There is one study [Telegraph Flat (27-10)] that was treated with a lop and scatter during the report period (Table 6.7). The Telegraph Flat study is located east of Kanab and north of Highway 89 on Telegraph Flat. This study is classified as a Semidesert (Wyoming Big Sagebrush) ecological site (Table 6.6). Generally, the target of lop and scatter treatments are to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on the Telegraph Flat is Wyoming big sagebrush with a small component of Stansbury cliffrose. The mean cover of sagebrush increased slightly from near 20% prior to treatments to just over 21% following treatment. The other preferred browse species, cliffrose, increased in cover from 4% to 8% following treatment (Figure 6.35a). The mean density of sagebrush decreased from 9,180 plants/acre to 6,960 plants/acre following treatment, but the mean density of decadent plants decreased and the mean density of young plants increased substantially (Figure 6.35b).

Prior to treatment, the mean density and cover of pinyon pine and Utah juniper trees were moderate at 140 trees/acre and 9%, respectively. Following treatment, the mean density of pinyon-juniper trees decreased to 19 tree/acre and the mean cover decreased to less than 1% (Figure 6.36). The remaining tree density and cover is generally provided by young trees that were missed in the treatment.

Herbaceous Understory: The study site has a poor herbaceous component with low abundance of plants being sampled prior to and following the treatment. There was little change in the mean cover of the other functional groups following the treatment (Figure 6.37).

Occupancy: Pellet group transect data indicates that deer primarily occupy this study site. The mean abundance of pellet groups for deer decreased from 29 days use/acre prior to treatment to 7 days use/acre following treatment (Figure 6.38).

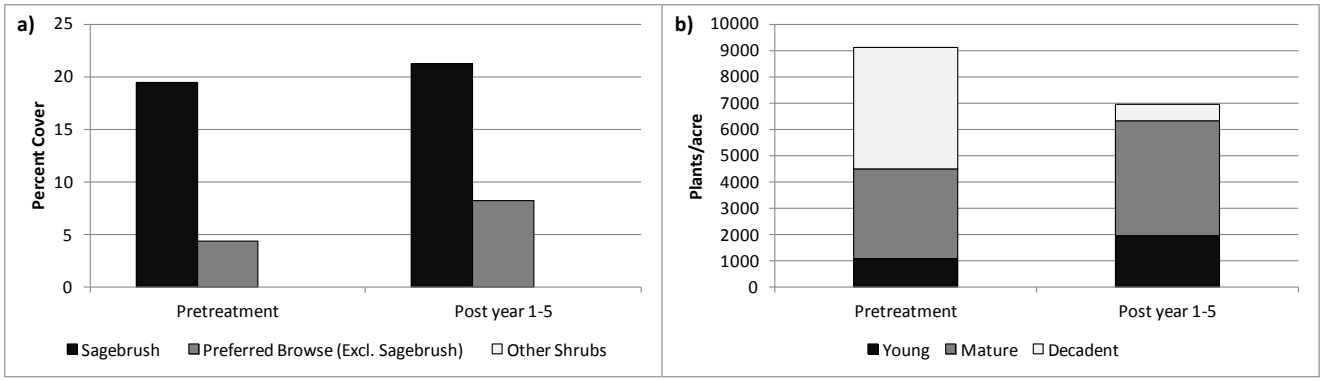


Figure 6.35: Shrub summary of the Lop and Scatter treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

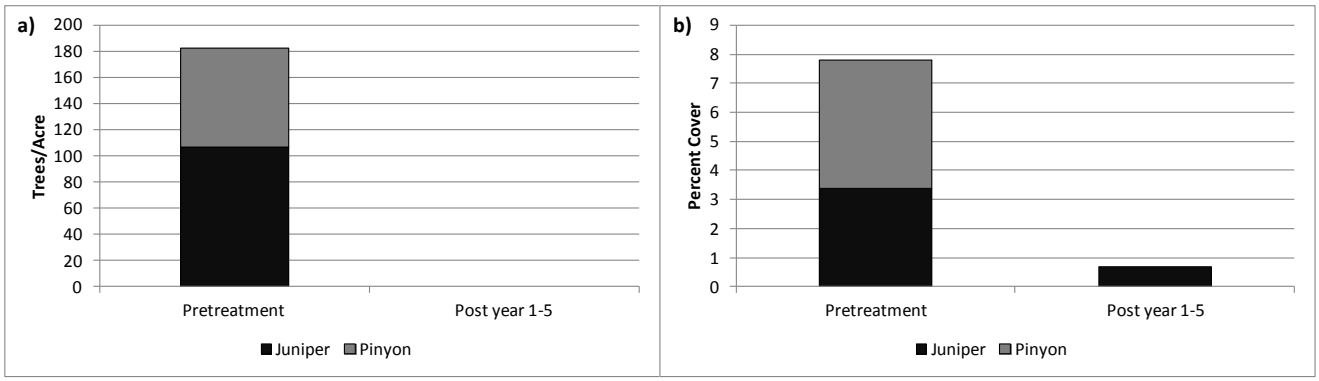


Figure 6.36: Tree summary of the Lop and Scatter treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

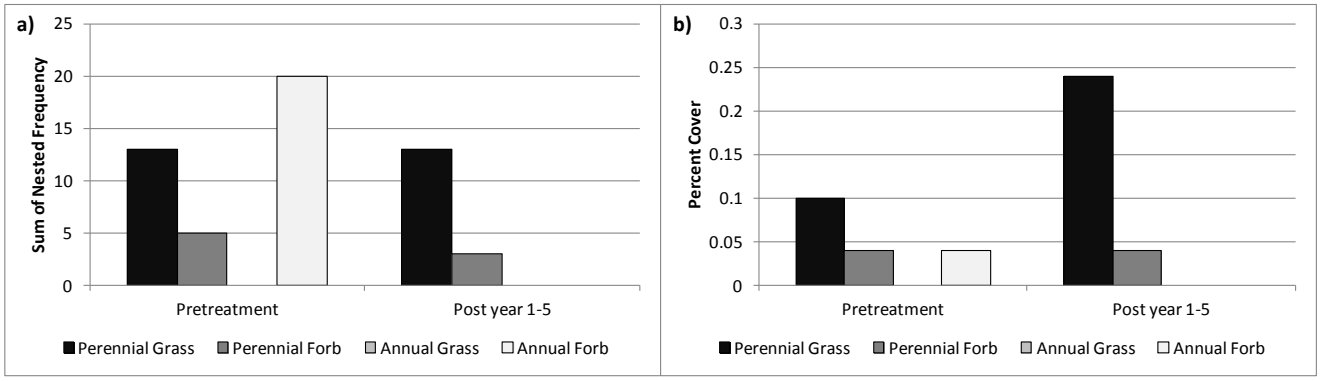


Figure 6.37: Herbaceous functional group summary of the Lop and Scatter treatment study (n=1) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

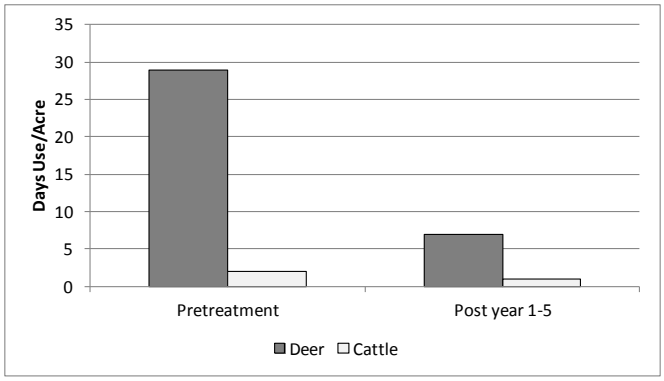


Figure 6.38: Mean pellet transect data for the Lop and Scatter treatment study (n=1) for WMU 27, Paunsaugunt.

Wildfire

There are three studies [Ahlstrom Hollow (27-2), Buckskin 2 (27R-17), and Buckskin 1 (27-18)] that were burned in wildfires during the report period (Table 6.7). The Ahlstrom Hollow study burned sometime between the sample years 1997-2002; the Buckskin 1 and Buckskin 2 studies burned in the Buckskin fire in 2006. The Ahlstrom Hollow study is classified as a Mountain (Black Sagebrush) ecological site; the Buckskin 1 and Buckskin 2 studies are classified as an Upland (Cliffrose) ecological site (Table 6.6). Ahlstrom Hollow was only partially burned and has been excluded from this summary.

Shrubs/Trees: The primary browse species on the Buckskin 1 and Buckskin 2 study sites was Stansbury cliffrose, Wyoming big sagebrush, and forage kochia. Prior to disturbance, pinyon and juniper were dominant on the site. Following the wildfire, nearly all of the shrub species were removed from the study sites. Preferred browse species have increased on the site, primarily forage kochia, increased from 2% prior to disturbance to 10% 6-10 years post disturbance (Figure 6.39a). Prior to disturbance, the demographics of the sagebrush population was a mixture of decadent and mature plants with limited recruitment of young plants (Figure 6.39b).

The mean density and cover of pinyon pine and Utah juniper trees was moderate at 209 trees/acre and 36%, respectively, prior to treatment. The mean density of pinyon-juniper trees decreased to 10 trees/acre and the mean cover decreased to less than 1% following treatment (Figure 6.40).

Herbaceous Understory: The herbaceous component was mixed across the sites, but was generally dominated by perennial grass and forb on all of the sites, though prior to the wildfire, annual forb was common the Buckskin 1 and Buckskin 2 study sites. Perennial grass species have increased substantially on the sites, increasing from less than 1% cover prior to disturbance to 4% cover 6-10 years after disturbance. Mean cover of annual grasses, primarily cheatgrass, has slowly increased over the sample years (Figure 6.41). Cheatgrass remains a substantial threat for increased fire on the Buckskin 1 and Buckskin 2 study sites.

Occupancy: Pellet group transect data indicates that deer, elk, and cattle primarily occupied these study sites. The mean abundance of pellet groups of elk have steadily decreased following the wildfires, but the mean abundance of deer have steadily increased on the study sites. The abundance of cattle sign has increased on the sites (Figure 6.42), and is likely due to the increased forage available from seeded perennial grass species.

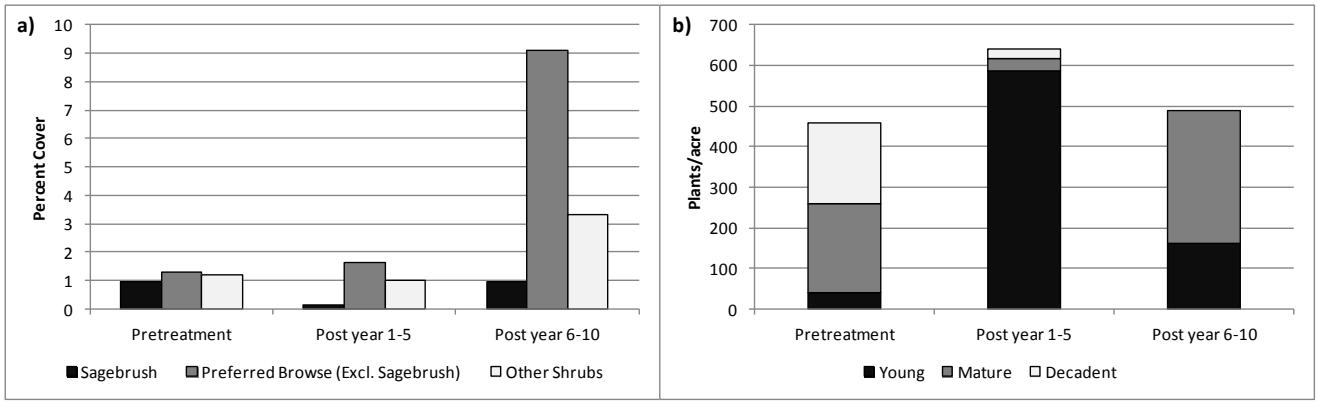


Figure 6.39: Shrub summary of the Wildfire disturbance studies (n=2) for WMU 27, Paunsaugunt. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

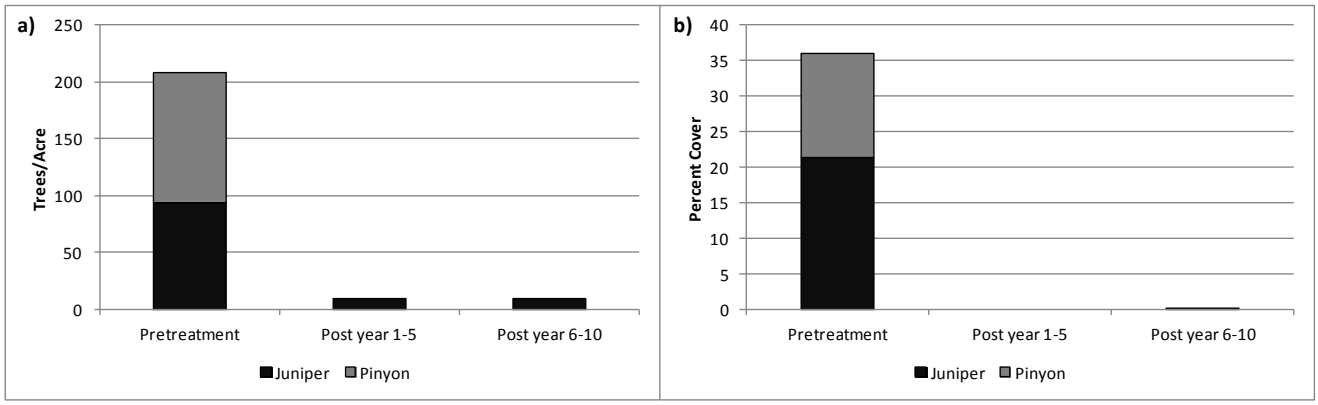


Figure 6.40: Tree summary of the Wildfire disturbance studies (n=2) for WMU 27, Paunsaugunt. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

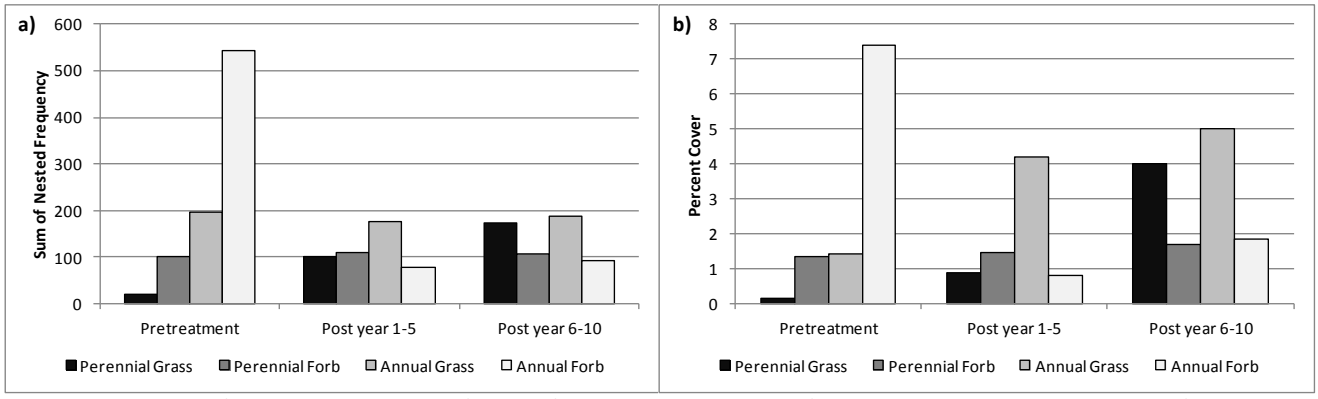


Figure 6.41: Herbaceous functional group summary of the Wildfire disturbance studies (n=2) for WMU 27, Paunsaugunt. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

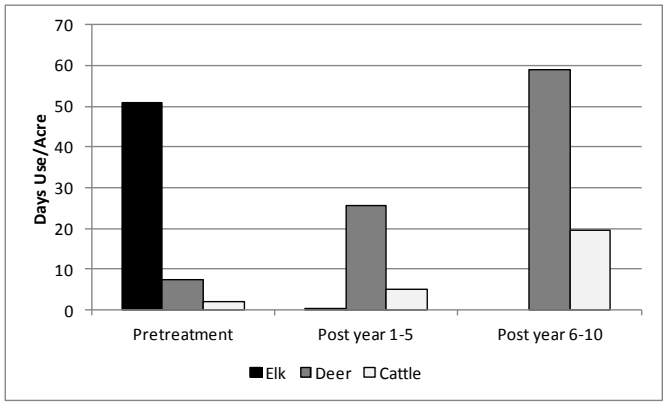


Figure 6.42: Mean pellet transect data for the Wildfire disturbance studies (n=2) for WMU 27, Paunsaugunt.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Paunsaugunt management unit has generally decreased from 1997/98-2008, but improved in 2013. The majority of sites sampled within the unit are considered to be in fair to good condition based on the most current sample data, and the proportion of sites classified as being in poor or very poor condition has decreased since 2008 (Figure 6.43 and Figure 6.44). The two undisturbed studies that are currently considered to be in poor condition are the Nephi Pasture Total Exclosure and Mustang Pond studies, which have a marginal herbaceous understory, but have fair browse components. The condition of disturbed and treated sites typically improves with increased time after disturbance on this unit with the exception of sites, which burned in wildfire. The majority of disturbed or treated study sites ranked as being in poor or very poor condition 1-5 years after disturbance are those burned by wildfire or had depleted shrub understory. These study sites generally are still lacking in available browse species (Map 6.7 and Table 6.8).

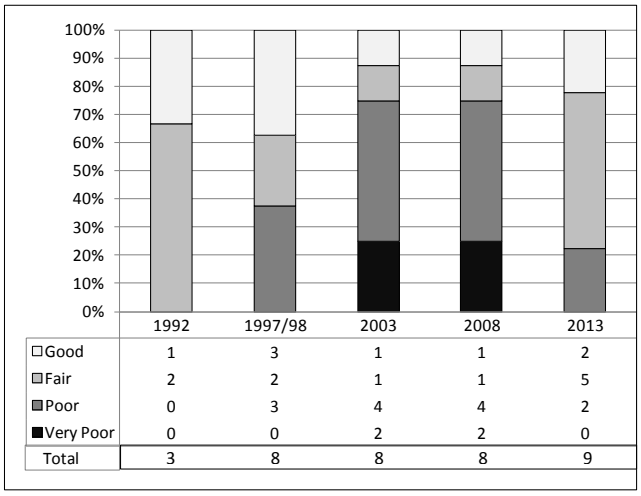


Figure 6.43: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 27, Paunsaugunt.

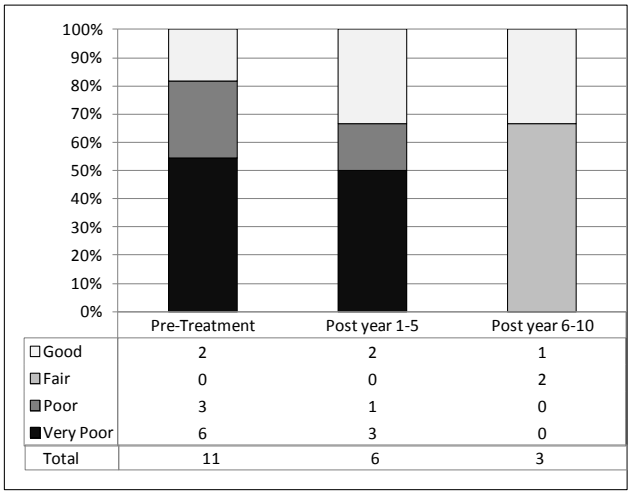
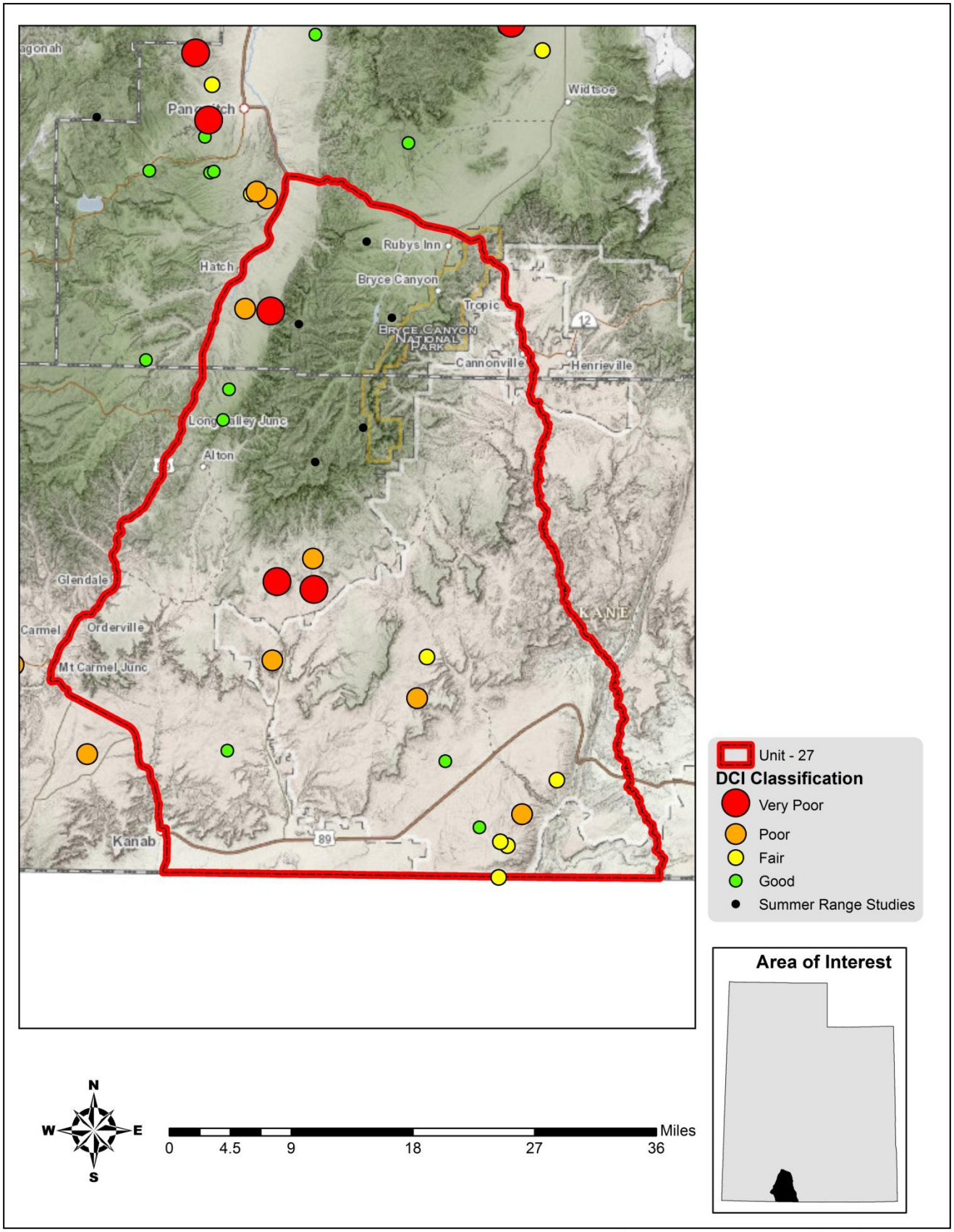


Figure 6.44: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 27, Paunsaugunt.



Map 6.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 27, Paunsaugunt.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
27-1	Proctor Canyon	Conifer Encroachment	Low	Reduced understory shrub and herbaceous vigor.
27-2	Ahlstrom Hollow	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
27-3	Whiteman Bench	None Identified		
27-5	Podunk Creek	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
27-6	Nephi Pasture I	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
27-7	Nephi Pasture Exclosure Outside	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
27-8	Fivemile Mountain	Annual Grass PJ Encroachment	Low Low	Increased fire potential. Reduced understory shrub and herbaceous vigor.
27-9	Buckskin Mountain	Annual Grass PJ Encroachment	Moderate Moderate	Increased fire potential. Reduced understory shrub and herbaceous vigor.
27-10	Telegraph Flat	None Identified		
27-11	Crocodile	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
27-12	Moons Landing	None Identified		
27-13	Heaton	None Identified		
27-14	Mustang Pond South	Annual Grass	Moderate	Increased fire potential.
27R-4	Nephi Pasture Total Exclosure	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
27R-5	Nephi Pasture Livestock Exclosure	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
27R-16	Alton/Millcreek LS	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
27R-17	Buckskin 2	Annual Grass	Moderate	Increased fire potential.
27R-18	Buckskin 1	Annual Grass	Moderate	Increased fire potential.
27R-19	Alton-Millcreek 2	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
27R-20	Hatch Bench	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
27R-21	Buckskin Lop and Scatter	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
27R-22	Pine Point Hand thin	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
27R-23	UKC Thompson Creek	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
27R-24	Hatch Bench 2	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
27R-25	Sieler Creek	Conifer Encroachment	High	Reduced understory shrub and herbaceous vigor.

Table 6.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 27, Paunsaugunt. All assessments are based off the most current sample date for each study site.

Discussion and Recommendations

High Mountain (Aspen)

The high elevation aspen site, which was established to monitor an aspen improvement project, is in poor condition. Even though only one site monitors this community type, it has been observed that conifer encroachment is affecting the aspen community on the Paunsaugunt Plateau with aspen being severely encroached. The herbaceous and shrub layers are in poor condition and provide little cover.

It is recommended that work to remove conifer from aspen stand should continue in these communities. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Mountain (Black Sagebrush/Bitterbrush/Browse)

The higher elevation mountain sites, which support basin big sagebrush communities, are generally considered to be in good condition for deer winter range habitat on the Paunsaugunt management unit. This community support robust shrub population that provide valuable browse in mild winters, and good herbaceous and browse community during transitional and summer months. While in generally good condition, these sites appear to be prone to encroachment from pinyon and juniper trees, which can reduce understory shrub and herbaceous health if not addressed.

It is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue in these communities. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.
Upland (Mountain Big Sagebrush/Black Sagebrush-Bluegrass*)*

The mid elevation sites which support basin big sagebrush communities are generally considered to be in good condition for deer winter range habitat on the Paunsaugunt management unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. While in generally good condition, these sites appear to be prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. On many of these sites, pinyon and juniper have increased in cover and density over the sampled years.

It is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue in these communities. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Upland (Cliffrose)
The mid elevation upland cliffrose communities that have not been disturbed are generally considered to be in fair condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire and those studies, which have burned since 2006, are typically in poor to very poor condition. If wildfires occur within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

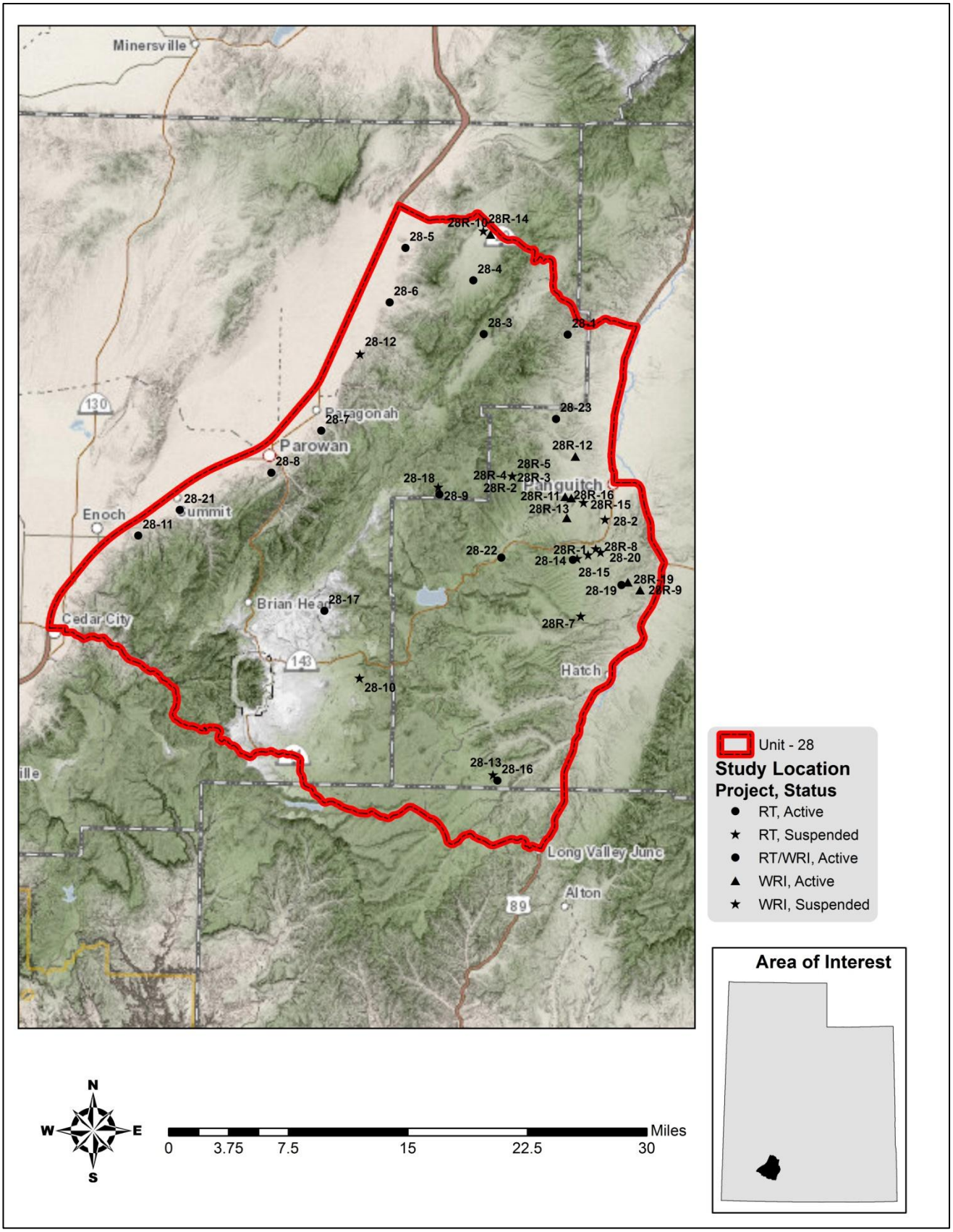
It is recommended that work to reduce pinyon-juniper encroachment should continue in these communities. Care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

Semidesert (Wyoming Big Sagebrush/Black Sagebrush)

The lower elevation semidesert Wyoming big sagebrush and black sagebrush communities are generally considered to be in fair condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire and if wildfires occur within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are susceptible to invasion from annual grass, primarily cheatgrass. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire on within these communities. These communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed.

It is recommended that work to diminish fuel loads and create firebreaks should continue within these communities in order to reduce the threat of catastrophic fire. Treatments to establish and increase browse species more rapidly following wildfire should also be implemented, and treatments to increase browse species on historic fires should be considered. If a treatment to rejuvenate sagebrush occurs, care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites.

7. WILDLIFE MANAGEMENT UNIT 28 – PANGUITCH LAKE



WILDLIFE MANAGEMENT UNIT 28 – PANGUITCH LAKE

Boundary Description

> **Garfield, Iron and Kane Counties -** Boundary begins SR-14 and US-89; north on US-89 to SR-20; west on SR-20 to I-15; south on I-15 to SR-14; east on SR-14 to US-89.

Management Unit Description

Geography

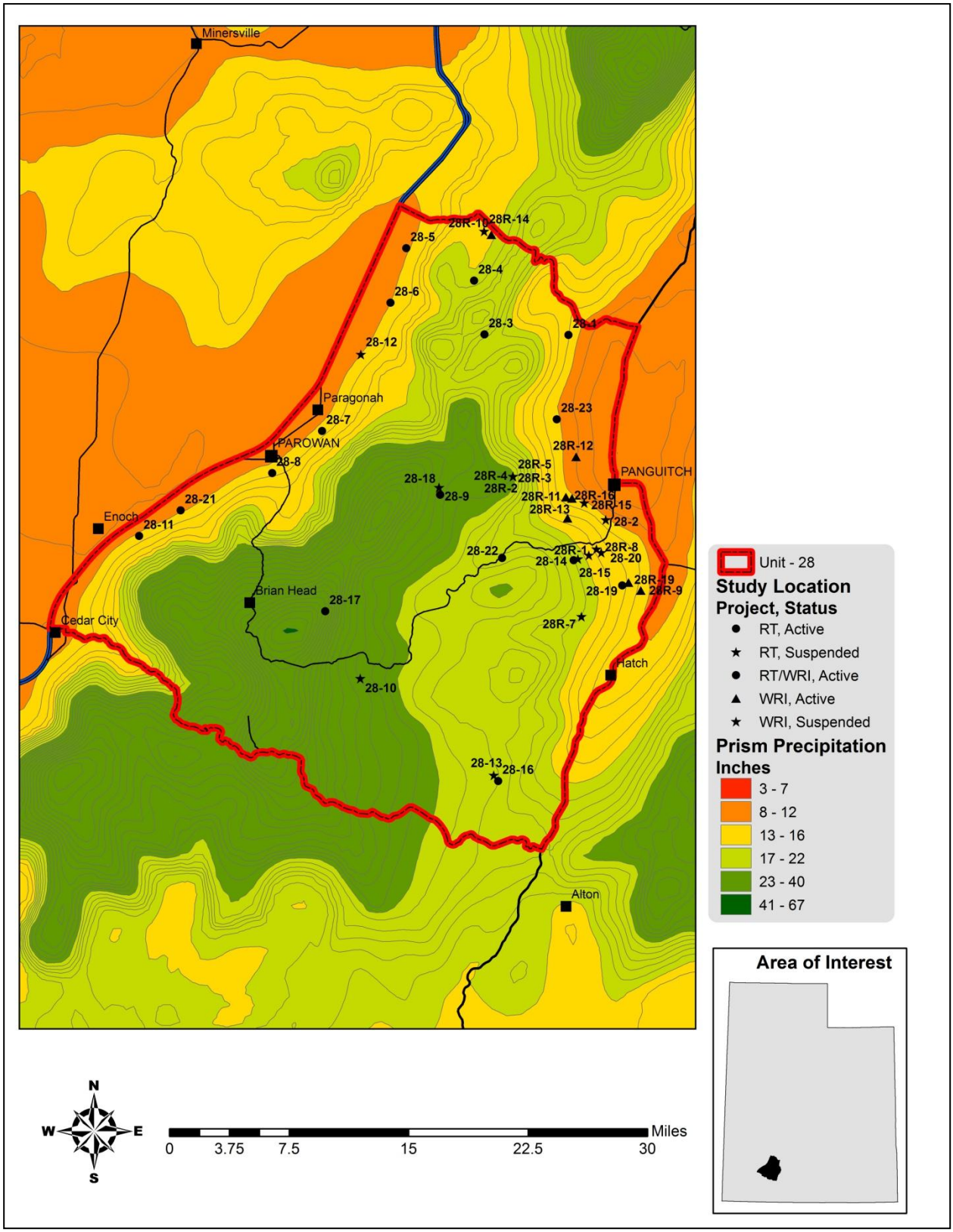
The Panguitch Lake wildlife management unit includes the section of the Colorado Plateau that falls between I-15 and US-89. It also contains the Markagunt Plateau, Cedar Breaks, Upper Bear Valley, Buckskin Valley, and Grass Valley. Brain Head Peak, the highest point of the Markagunt Plateau, reaches 11,307ft. The lowest point is about 5,700ft and occurs along I-15. Towns in this area include Parowan, Paragonah, Panguitch, and Hatch.

Cedar Breaks National Monument area is headwaters of Mammoth Creek tributary of the Sevier River. Panguitch Creek flows into Panguitch Lake, which also feeds into the Sevier River. This management unit also includes Three Creeks Drainage, Buckskin Wash, Bear Creek, and Rattlesnake and Ashdown Creeks, which flow through the Ashdown Gorge Wilderness area.

Climate Data

The 30 year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 8 inches on the far west and east sides of the unit to 41 inches on the high elevation peak of Brian Head. All of the Range Trend and WRI monitoring studies on the unit occur within 8-40 inches of precipitation (Map 7.1).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 7.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 7.1b) (Time Series Data 2014).



Map 7.1: The 1981-2010 PRISM Precipitation Model for WMU 28, Panguitch Lake(PRISM Climate Group, Oregon State University, 2013).

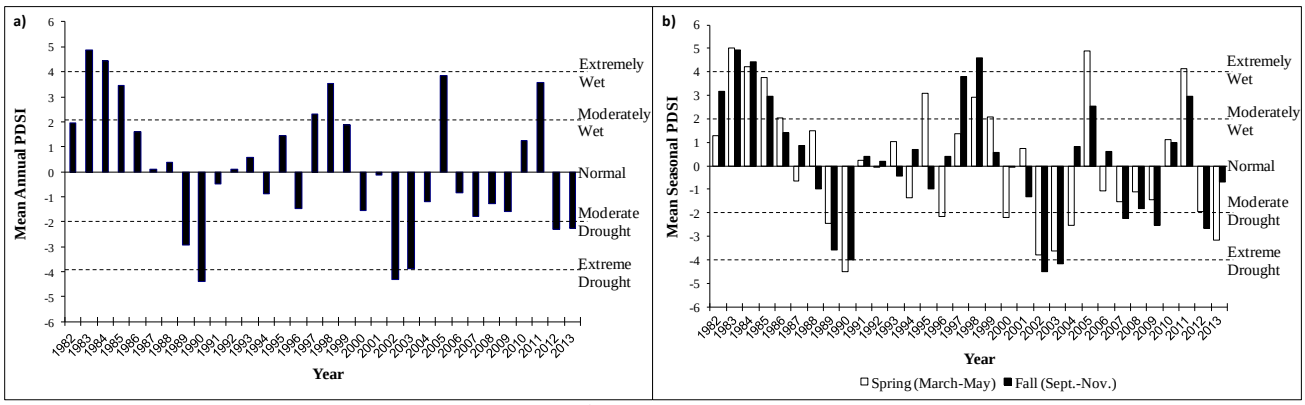


Figure 7.1: The 1982-2014l Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.).

Big Game Habitat

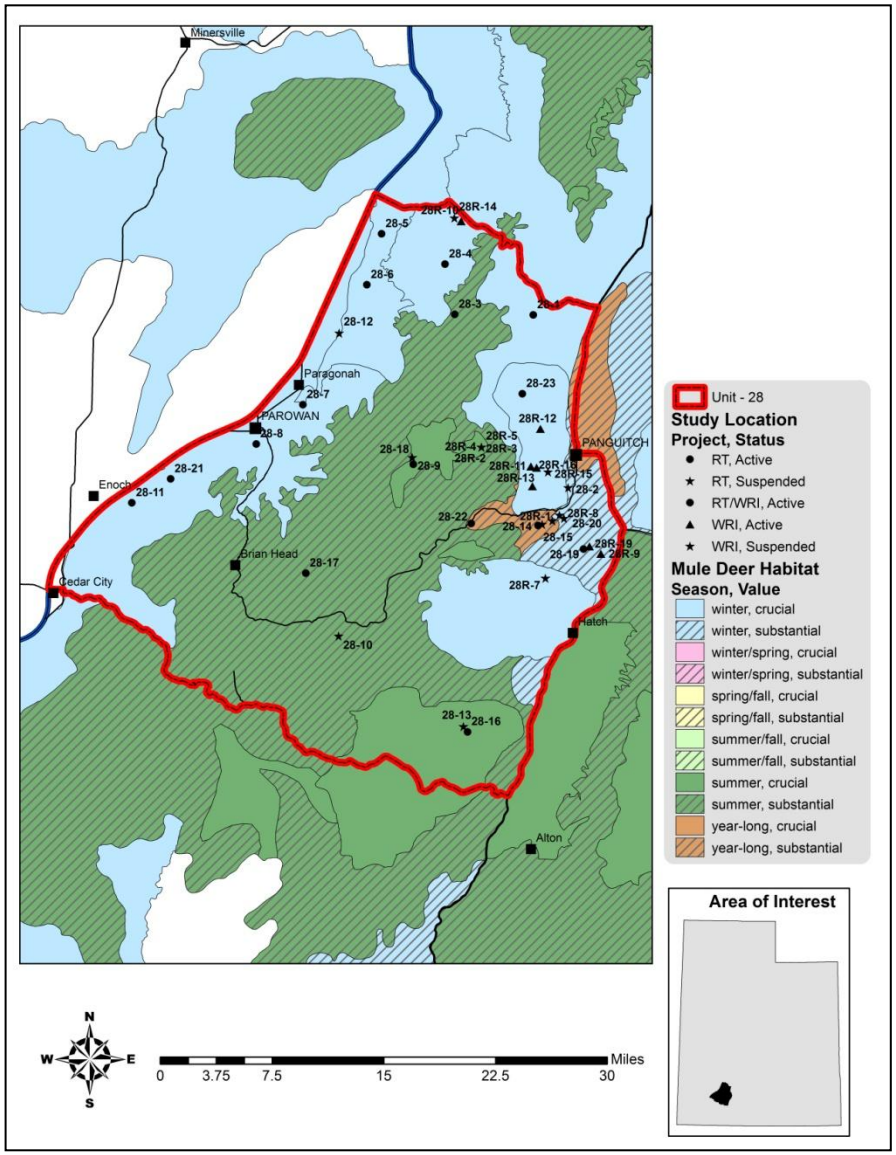
Total mule deer range in the wildlife management unit is estimated at 571,132 acres with 9,960 acres classified as year-long range, 255,936 acres of this classified as winter range, and 305,235 acres classified as summer range (Table 7.1 and Map 7.2). Total elk range is estimated at 418,701 acres with 21,165 acres of this being classified as year-long range, 86,275 as winter range 311,261, and as summer range (Table 7.1 and Map 7.3). There is a substantial amount of summer range for deer and elk, however, winter range is limiting for both species as compared to summer range (Table 1). Most of the big game winter range in this unit is located on Forest Service or BLM managed lands. Minor portions of the winter range in the unit occur on private holdings, Utah State School Trust Lands, and Division of Wildlife Resources management areas.

According to LANDFIRE Existing Vegetation Coverage models, important shrublands comprise less than 25% of the deer winter range on the unit. The majority of deer winter range is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Annual grasslands, primarily cheatgrass (*Bromus tectorum*), comprise a small proportion of the deer winter range and pose a minimal threat for wildfire. Other coverage types comprise a minimal proportion of the deer winter range (Table 7.4).

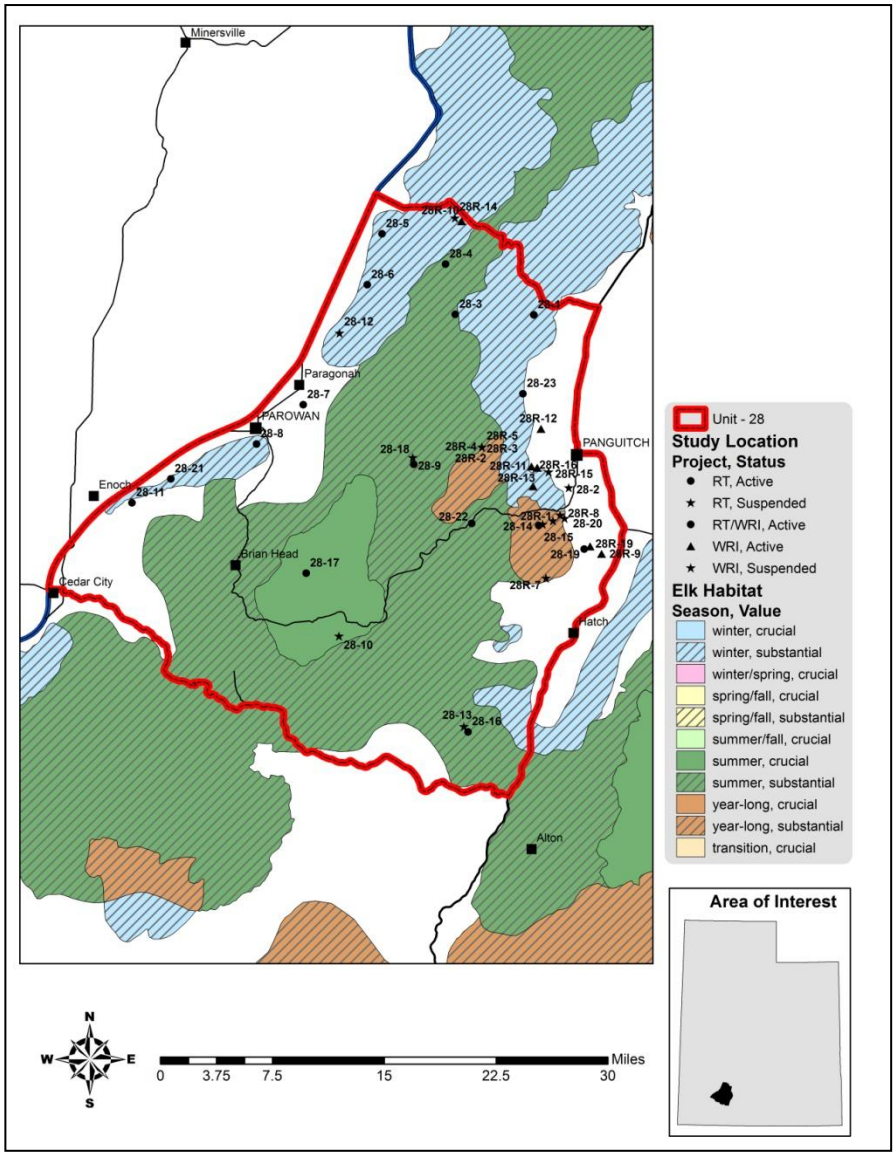
The winter range on the eastern portion of the unit is higher in elevation and experiences colder temperatures than on the Parowan side; and consequently, far fewer deer winter on the Panguitch side. Key areas that were identified on the winter range on the eastern side of the unit include the following: pinyon-juniper woodlands south of Panguitch, seeded range at the north end of Upper Bear Valley, the mixed brush type in Buckskin Valley, and the pinyon-juniper chaining in the Three Creeks drainage. These study sites range in elevation from 7,100 to 7,600 feet and represent key areas within the limits of normal winter range on the east side. The only severe winter range available on the unit is located on the pinyon-juniper slopes below the Hurricane Cliffs and on the sagebrush flats that extend from the slopes to I-15. During severe winters the deer on this herd unit are packed into the narrow area between the cliffs and I-15. Habitat availability is effectively reduced by 80% during these severe winters.

The key areas that were identified by the local interagency committee for this unit include the Wyoming big sagebrush type west of Swayback Knoll, a Wyoming big sagebrush type in the mouth of Cottonwood Creek, a pinyon-juniper chaining east of Paragonah, a big sagebrush/pinyon-juniper ecotone in Grass Valley south of Parowan, and a mountain big sagebrush/pinyon-juniper ecotone in Elliker Basin. The importance of each of these areas for deer has increased over the years as sagebrush flats have been converted into agricultural lands.

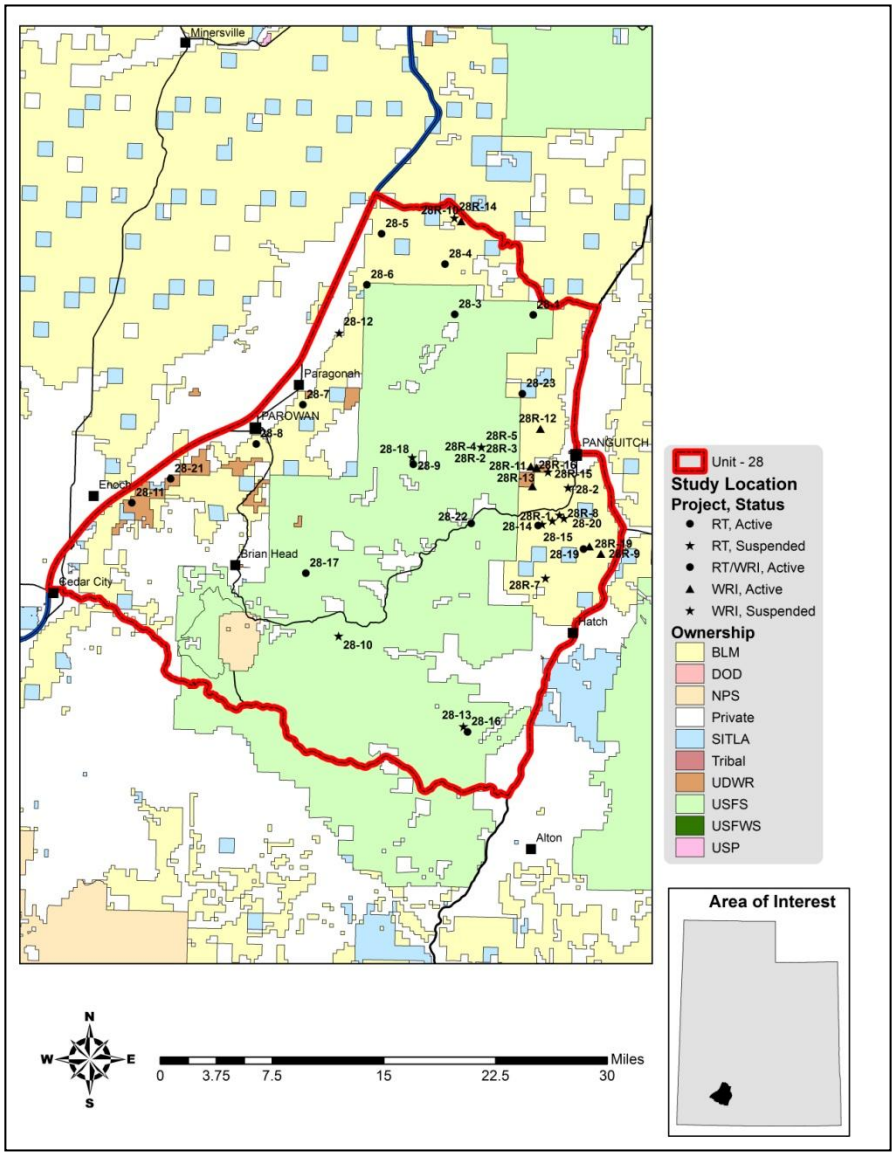
Summer range is not considered a limiting factor for this deer herd. Summer range on the northern portion of the unit generally lies between 8,000 and 9,000 feet and consists largely of gentle rolling terrain. Summer ranges on the south side of the unit reach elevations of over 10,000 feet bordering Cedar Breaks National Monument.



Map 7.2: Estimated mule deer habitat by season and value for WMU 28, Panguitch Lake.



Map 7.3: Estimated elk habitat by season and value for WMU 28, Panguitch Lake.



Map 7.4: Land ownership for WMU 28, Panguitch Lake.

	Year-Long Range		Summer Range		Winter Range	
	Area (acres)	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	9,960	2%	305,235	53%	255,936	45%
Elk	21,165	5%	311,261	75%	86,275	21%

Table 7.1: Estimated mule deer and elk habitat acreage by season for WMU 28, Panguitch Lake.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	2,797	28%	233,149	76%	56,641	22%
BLM	3,479	35%	8,665	3%	122,330	48%
SITLA	140	1%	1,698	<1%	10,743	4%
Private	3,545	36%	55,262	18%	56,992	22%
NPS		0%	5,995	2%	0	0%
UDOT	0	0%	1	<1%	0	0%
UDWR	0	0%	465	<1%	9,231	4%
Total	**9,960**	**100%**	**305,235**	**100%**	**255,936**	**100%**

Table 7.2: Estimated mule deer habitat acreage by season and ownership for WMU 28, Panguitch Lake.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	9,620	46%	231,036	74%	33,642	39%
BLM	9,306	44%	14,480	5%	37,157	43%
SITLA	1,783	8%	2,179	<1%	1,941	2%
Private	457	2%	56,285	18%	9,674	7%
NPS	0	0%	5,995	2%	0	0%
UDWR	0	0%	1,287	<1%	3,861	5%
Total	**21,165**	**100%**	**311,261**	**100%**	**86,274**	**100%**

Table 7.3: Estimated elk habitat acreage by season and ownership for WMU 28, Panguitch Lake.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Artemisia tridentata ssp. vaseyana Shrubland Alliance	1,088.84	0.19%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	33,876.24	6.00%	
	Great Basin Semi-Desert Chaparral	10,739.65	1.90%	
	Great Basin Xeric Mixed Sagebrush Shrubland	2,914.92	0.52%	
	Inter-Mountain Basins Big Sagebrush Shrubland	18,681.36	3.31%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	18,023.52	3.19%	
	Inter-Mountain Basins Montane Sagebrush Steppe	2,499.71	0.44%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	17,476.65	3.09%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	4,906.69	0.87%	
	Rocky Mountain Lower Montane-Foothill Shrubland	11,014.75	1.95%	
	Other Shrublands	5,379.06	0.95%	22.42%
Conifer	Abies concolor Forest Alliance	18,705.16	3.31%	
	Colorado Plateau Pinyon-Juniper Woodland	166,099.11	29.41%	
	Great Basin Pinyon-Juniper Woodland	415.88	0.07%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	16,857.73	2.99%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	2,499.27	0.44%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	20,154.50	3.57%	
	Southern Rocky Mountain Ponderosa Pine Woodland	42,025.67	7.44%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	73,055.26	12.94%	
	Other Conifer	2,776.37	0.49%	60.67%
Grassland	Native Grassland	11,774.45	2.09%	2.09%
Exotic Herbaceous	Introduced Upland Vegetation-Annual and Biennial Forbland	343.60	0.06%	
	Introduced Upland Vegetation-Annual Grassland	2,421.65	0.43%	
	Introduced Upland Vegetation-Perennial Grassland and Forbland	728.79	0.13%	0.62%
Other	Hardwood	27,019.60	4.78%	
	Riparian	8,865.31	1.57%	
	Agricultural	8,742.33	1.55%	
	Developed	15,318.09	2.71%	
	Other	20,274.59	3.59%	14.21%
Total		564,678.76		

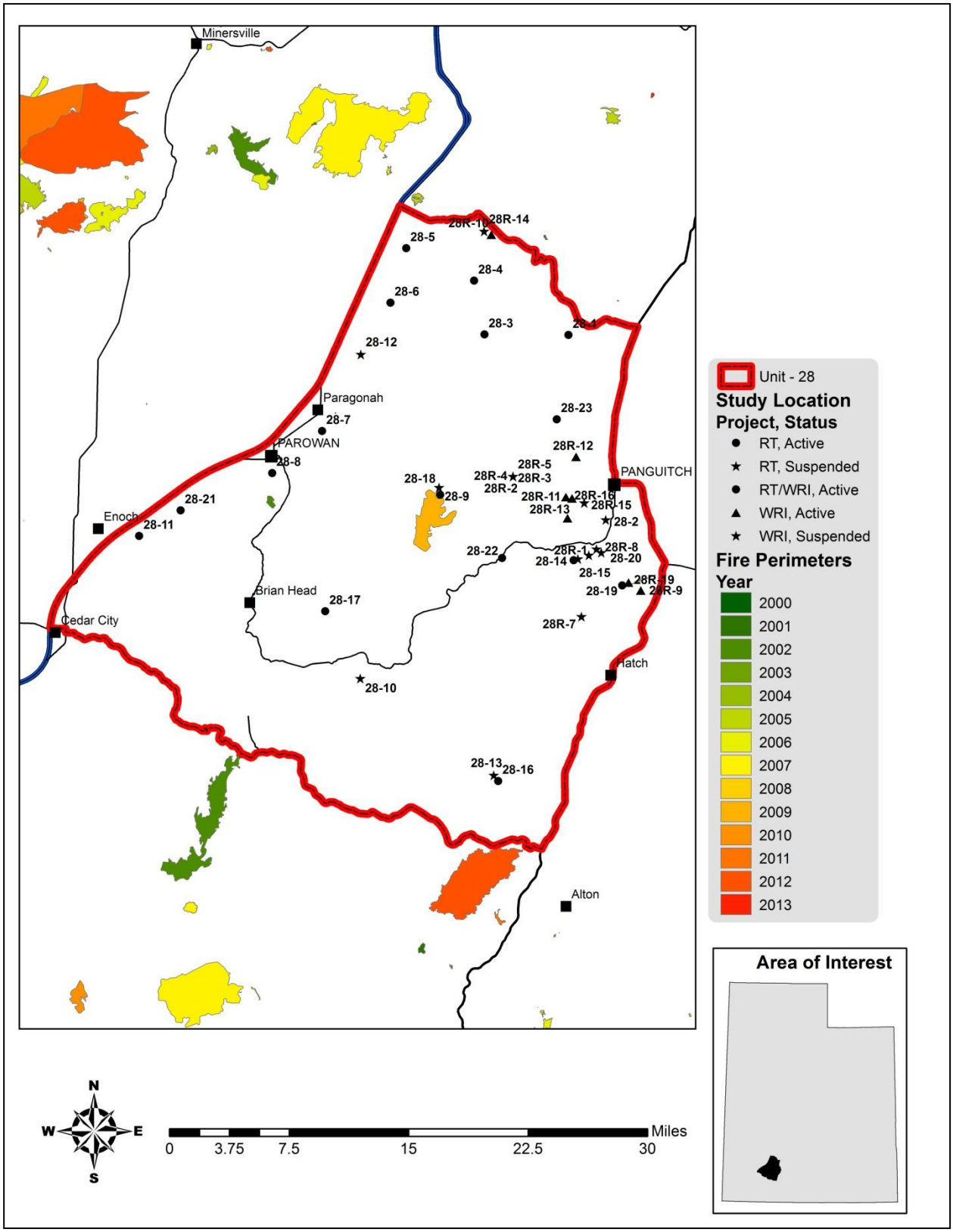
Table 7.4: LANDFIRE existing vegetation coverage(LANDFIRE: LANDFIRE 1.2.0, 2010) of deer winter range for WMU 28, Panguitch Lake.

Limiting Factors to Big Game Habitat

Many sagebrush flats have been converted to sprinkler irrigated agricultural lands; mainly from Highway U-20 to Parowan. Due to depredation problems, deer fences were constructed around many of these fields. In addition, the deer-proof fence along the I-15 corridor severely limits the winter range available to deer on the west side of the freeway. Urbanization of former winter range is continuing, especially in the Fiddler's Canyon area north of Cedar City. Of particular concern is the fact that much of the severe winter range from U-20 to Cedar City is privately owned. Additional habitat losses are to be expected on these privately owned parcels of land.

Wildfire has had a minimal impact on the deer winter range in the unit. The Horse Valley fire of 2009 was the largest wildfire in the unit at 2,889 acres. It burned an area west of Panguitch near Five Mile Ridge. All other recent fires burned less than 200 acres and have had negligible impact on deer winter range (Map 7.5).

Encroachment by pinyon-juniper woodland communities also poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 28 (Table 7.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000).

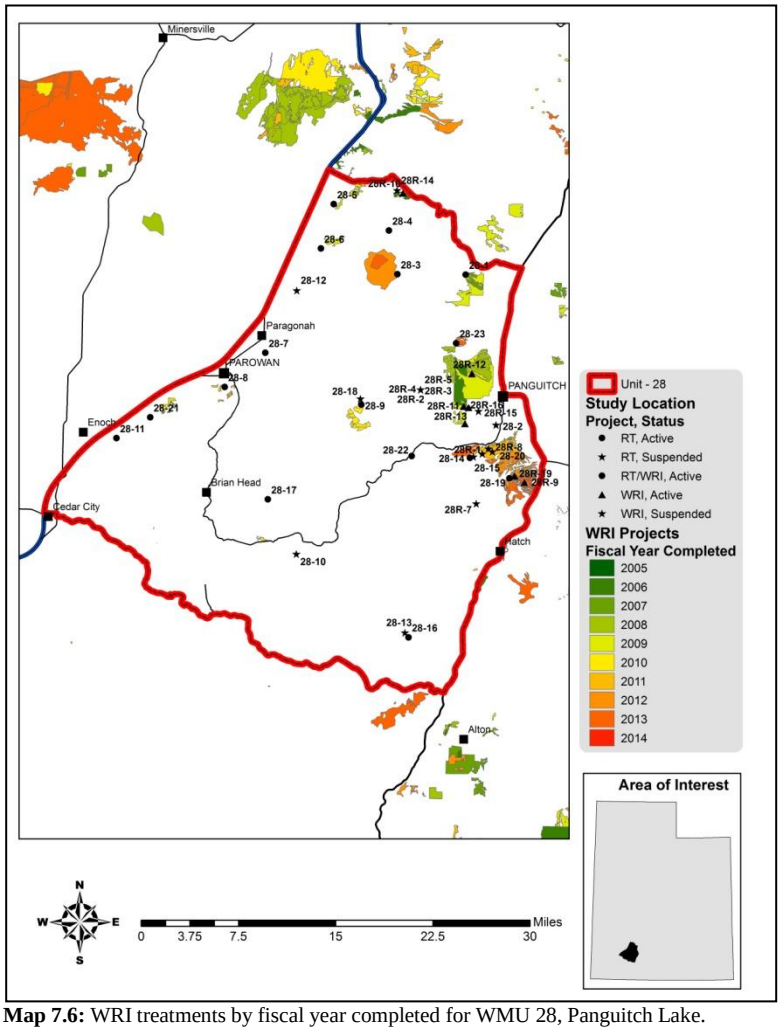


Map 7.5: Land coverage of fires by year from 2001-2013 for WMU 28, Panguitch Lake.

Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 26,006 acres of land have been treated within the Panguitch Lake unit since the WRI was implemented in 2004 (Map 7.6). Treatments frequently overlap one another bringing the total treatment acres to 34,263 acres for this unit (Table 7.5). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

Treatments to reduce pinyon-juniper woodlands such as bullhog, chaining, prescribed fire, and lop-and-scatter are among the most common management practices. The use of seeding to supplement the herbaceous understory is also very common. Other common management practices are those to rejuvenate sagebrush stands such as chaining, mowing, and harrow treatments (Table 7.5).



Map 7.6: WRI treatments by fiscal year completed for WMU 28, Panguitch Lake.

Treatment Action	Acres
Seeding (primary)	8,865
Chaining	940
Prescribed Fire	3,527
Bullhog	7,583
Mow	985
Harrow	1,942
Lop and Scatter	10,419
***Total Land Area Treated**	**26,006**
Total Treatment Acres	**34,263**

Table 7.5: WRI treatment action size (acres) for WMU 28, Panguitch Lake.

*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 28 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (Table 7.7). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Monitoring studies of WRI projects have been sampled since 2005. When possible, WRI monitoring studies are established prior to treatment and sampled on a regular basis following treatment. Due to the long-term nature of the studies, many of the Range Trend and WRI studies have had some sort of disturbance or treatment prior to or since study establishment (Table 7.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
28-1	Three Creeks	RT	Active	'87, '92, '98, '03, '08,'13	Upland Stony Loam (Mountain Big Sagebrush)
28-2	Panguitch	RT	Suspended	'87, '92, '98	Not Verified
28-3	Bear Valley	RT	Active	'87, '92, '98, '03, '08,'13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
28-4	Buckskin Valley	RT	Active	'87, '92, '98, '03, '08,'13	Mountain Loam (Mountain Big Sagebrush)
28-5	Swayback Knoll	RT	Active	'87, '92, '98, '03, '08,'13	Semidesert Loam (Wyoming Big Sagebrush)
28-6	Cottonwood	RT	Active	'87, '92, '98, '03, '08,'13	Semidesert Loam (Wyoming Big Sagebrush)
28-7	Paragonah	RT	Active	'87, '92, '98, '03, '08, '13	Upland Gravelly Loam (Black Sagebrush)
28-8	Grass Valley	RT	Active	'87, '92, '98, '03, '08, '13	Upland Loam (Wyoming Big Sagebrush)
28-9	Little Valley	RT	Suspended	'87, '92, '98	Not Verified
28-10	Red Desert	RT	Suspended	'87, '92, '98	Not Verified
28-11	Elliker Basin	RT	Active	'87, '92, '98, '03, '08, '13	Upland Loam (Wyoming Big Sagebrush)
28-12	Hurricane Cliffs	RT	Suspended	'87	Not Verified
28-13	Asay Knoll	RT	Suspended	'92, '98	Not Verified
28-14	Sheep Hollow West	RT	Active	'98, '03, '08, '13	Upland Clay (Black Sagebrush)
28-15	Sheep Hollow East	RT	Suspended	'98, '03, '08, '13	Upland Clay (Black Sagebrush)
28-16	Asay Bench	RT	Active	'03, '08, '13	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
28-17	Sidney Valley	RT	Active	'03, '08, '13	Subalpine Loam (Geranium)
28-18	Shakespeare Hollow	RT	Active	'03, '08, '13	High Mountain Loam (Silver Sagebrush)
28-19	DD Hollow	RT/WRI	Active	'03, '11	Not Verified
28-20	South Canyon	RT	Suspended	'03	Not Verified
28-21	South Summit WMA	RT	Active	'08, '13	Semidesert Loam (Basin Big Sagebrush)
28-22	Haycock Mountain	RT	Active	'13	Mountain Loam (Mountain Big Sagebrush)
28-23	Threemile Creek	RT	Active	'13	Upland Shallow Loam (Pinyon-Utah Juniper)
28R-1	Panguitch III	RT	Suspended	'98	Not Verified
28R-2	Five Mile Ridge Cattle Exc.	RT	Suspended	'98	Not Verified
28R-3	Five Mile Ridge Outside	RT	Suspended	'98	Not Verified
28R-4	Five Mile Ridge Wildlife Exc.	RT	Suspended	'98	Not Verified
28R-5	Five Mile Ridge Total Exc.	RT	Suspended	'98	Not Verified
28R-7	Sage Hen Hollow	RT	Suspended	'00, '01	Not Verified
28R-8	South Canyon Burn 1	WRI	Suspended	'05	Not Verified
28R-9	South Canyon 2	WRI	Active	'05, '12	Not Verified
28R-10	Buckskin Valley Highway 20	WRI	Active	'05, '08, '09, '13	Upland (Mountain Big Sagebrush-Indain Ricegrass)
28R-11	Five Mile Hollow	WRI	Active	'05	Not Verified
28R-12	Fivemile 2	WRI	Active	'07, '11	Not Verified
28R-13	Panguitch Creek Chaining	WRI	Active	'08, '11	Not Verified
28R-14	Buckskin Valley Highway 20 Reference	WRI	Suspended	'09	Not Verified
28R-15	Panguitch Creek WMA	WRI	Active	'09, '10, '13	Upland Shallow Hardpan (Black Sagebrush-Bluegrass)

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
28R-16	Panguitch Creek WMA Reference	WRI	Suspended	'09	Not Verified
28R-19	South Canyon	WRI	Active	'11	Not Verified

Table 7.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 28, Panguitch Lake.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
28-1	Three Creeks	Chain Unknown		1967		
		Seed Unknown		1967		
		Lop and Scatter		1987-1992		
		Prescribed Fire		2003?		
		Lop and Scatter		2003-2008		
28-3	Bear Valley	Chain Unknown		Historic		
		Seed Unknown		Historic		
28-5	Swayback Knoll	Wildfire	Laub Fire	Summer 2012	40	
		Broadcast After	Laub and Cotton Fire Rehab	Fall 2013	43	2469
		Browse Seed Planter	Laub and Cotton Fire Rehab	Fall 2013	43	2469
28-6	Cottonwood	Chain Unknown		1970		
		Seed Unknown		1970		
28-7	Paragonah	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Lop and Scatter		1998-2003		
		Lop and Scatter		2008-2013		
28-8	Grass Valley	Chain Unknown		mid 1960's		
		Seed Unknown		mid 1960's		
		Lop and Scatter		1998-2003		
28-11	Elliker Basin	Seed Unknown		Historic		
		Lop and Scatter		Spring 1992		
28-14	Sheep Hollow West	Lop and Scatter		1996-1997		
28-19	DD Hollow	Bullhog	BLM Project	Fall 2003	765	BLM
		Seed Unknown	BLM Project	2008?	765	BLM
28-21	South Summit WMA	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Herbicide		Historic		
		Lop and Scatter		Historic		
28-23	Threemile Creek	2-way Ely Chain	Panguitch West Bench Habitat Improvement	Fall 2012	276	2373
		Aerial Before	Panguitch West Bench Habitat Improvement	Fall 2013	276	2373
		Dribbler	Panguitch West Bench Habitat Improvement	Fall 2014	276	2373
		Aerial After	Panguitch West Bench Habitat Improvement	Fall 2015	276	2373
28R-9	South Canyon 2	Bullhog	South Canyon (Hillsdale)	Oct. 2012-Feb. 2013	2695	2311
		Aerial Before	South Canyon (Hillsdale)	Sept. 2012	2279	2311
28R-10	Buckskin Valley Highway 20	Seed Unknown		Historic		
		2-way Dixie Harrow	Buckskin Valley Hwy 20	Sep. 2005	270	242
		Broadcast Before	Buckskin Valley Hwy 20	Sep. 2005	270	242
28R-11	Five Mile Hollow	Lop and Scatter	Five Mile Hollow Sagebrush Restoration-Year 3	Fall 2008-Spring 2009	6465	901
28R-12	Fivemile 2	Lop and Scatter	Five Mile Hollow Sagebrush Restoration-Year 3	Fall 2008-Spring 2009	6465	901
28R-13	Panguitch Creek Chaining	Bullhog	Panguitch Creek WMA PJ Thinning	Spring 2009	28	1206
		Aerial Before	Panguitch Creek WMA PJ Thinning	Nov. 2008	383	1206

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
28R-15	Panguitch Creek WMA	2-way Ely/Smooth Chain	Panguitch Creek WMA PJ Thinning	Nov. 2008	383	1206
		Aerial Before	Panguitch Creek WMA PJ Thinning	Nov. 2008	383	1206
		Dribbler	Panguitch Creek WMA PJ Thinning	Nov. 2008	383	1206
28R-19	South Canyon	Bullhog	South Canyon Year 2	Oct. 2011-Jan. 2012	1901	2027
		Aerial Before	South Canyon Year 2	Oct. 2011	1901	2027

Table 7.7: Range trend and WRI studies known disturbance history for WMU 28, Panguitch Lake.

Study Trend Summary (Undisturbed Sites)

Subalpine (Geranium)

There is one study [Sidney Valley (28-17)] classified as Subalpine (Geranium) ecological site that remained undisturbed over the report period (Table 7.6). The Sidney Valley study is located northeast of Brain Head, just off of Sidney Valley road.

Shrubs/Trees: This site is considered a dry meadow Shrubs and trees do not occur within the study area, so a summary of shrubs and trees was therefore not included in this report. Repeat photographs show that there are some conifer trees that surround the meadow.

Herbaceous Understory: This study site is comprised exclusively of herbaceous plants. Perennial grasses are dominated by Stipa species (*Stipa* sp.) with other native grass species also present. Perennial grass cover was about 28% in 2003, but dropped down to 23% in 2008, and has since come back up to around 27% in 2013. Although perennial grass frequency and cover vary from year to year, annual grass frequency and cover remains zero (Figure 7.2).

Forbs are fairly diverse but low in nested frequency and cover at an individual species level. Perennial forb cover has increased from 10% in 2003 up to 35% in 2013. The perennial species western yarrow (*Achillea millefolium*) and common dandelion (*Taraxacum officinale*) made up the majority of the perennial forb cover (Figure 7.2). The presence of common dandelion could be an indicator of over grazing in the past.

Occupancy: Pellet group transect data indicates that elk almost exclusively occupy this study site. The mean abundance of elk pellet groups has ranged from a high of 135 days use/acre in 2008 to a low of 45 days use/acre in 2013 (Figure 7.3).

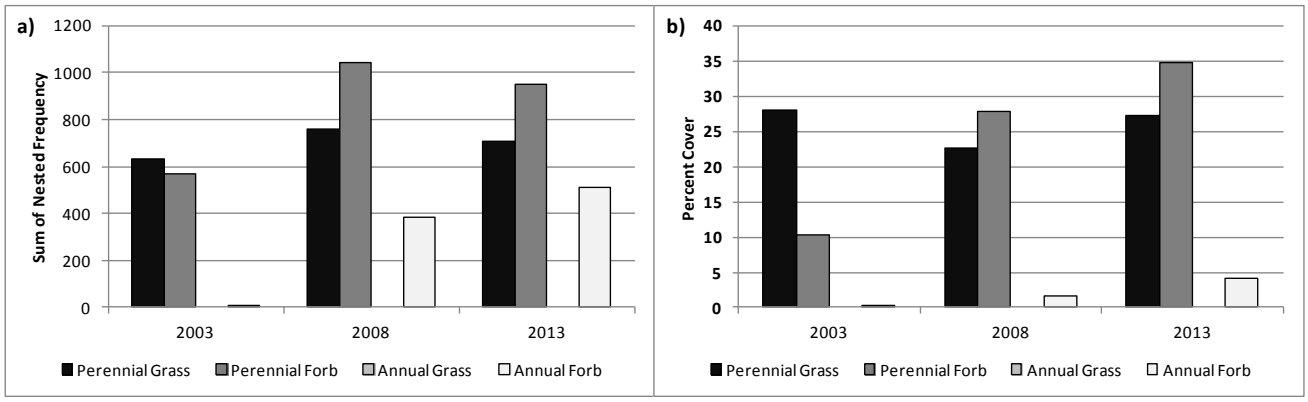


Figure 7.2: Herbaceous functional group summary of the Subalpine (Geranium) study (n=1) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

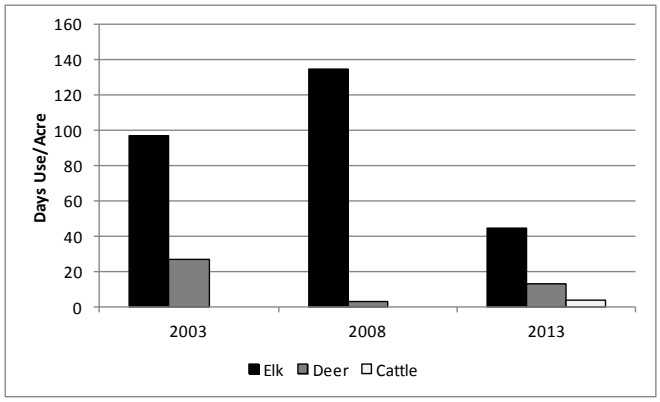


Figure 7.3: Mean pellet transect data for the Subalpine (Geranium) study (n=1) for WMU 28, Panguitch Lake.

High Mountain (Silver Sagebrush)

There is one study [Shakespeare Hollow (28-18)] classified as High Mountain (Silver Sagebrush) ecological site that remained undisturbed over the report period (Table 7.6). This study site occurs to the north of Panguitch Lake, just west of Panguitch.

Shrubs/Trees: The primary browse species are silver sagebrush (*Artemisia cana*) and antelope bitterbrush (*Purshia tridentata*). There are a few other low cover browse species present on the site. Shrub line intercept cover has remained stable from year to year and overall is good (Figure 7.4). The average height of silver sagebrush on this study is approximately one-foot tall, making browse available through much of the year in normal winters. The demographics of silver sagebrush population were a high number of mature shrubs throughout the years, with decadence being high in 2008 (Figure 7.4).

There were no trees located within the study area so summary of trees was not included in this report. However, repeat photos show that there are quaking aspen (*Populus tremuloides*) near the study.

Herbaceous Understory: This study sites has a good herbaceous component dominated by perennial grasses and forbs. This site supports and variety of native and introduced grasses with Kentucky bluegrass (*Poa pratensis*) and mutton bluegrass (*Poa fendleriana*) being the most abundant in both frequency and cover. Perennial grass cover experienced an increase from near 10% in 2003 up to 23-24% in 2008 and 2013, respectively. There are no annual grasses found on this site (Figure 7.5).

In addition, a diverse number of perennial and annual forbs provide limited cover. Perennial forb cover fluctuated around 10% cover each year while annual forb cover was consistently low (Figure 7.5).

Occupancy: Pellet group transect data indicates that deer and elk occupancy fluctuates from year to year on this study. The mean abundance of deer pellet groups has ranged from a high of 23 days use/acre in 2003 and 2008 to a low of 9 days use/acre in 2013. Whereas elk pellet abundance has ranged from a high of 24 days use/acre in 2003 to 4 days use/acre in 2013. Cattle occupancy has been low and continues to decline over the years (Figure 7.6).

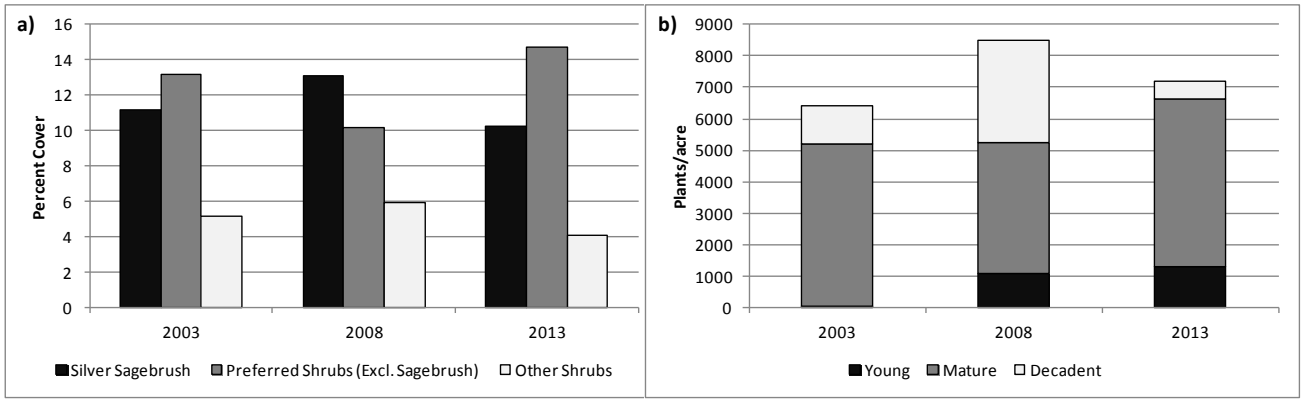


Figure 7.4: Shrub summary of the High Mountain (Silver Sagebrush) study (n=1) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of silver sagebrush.

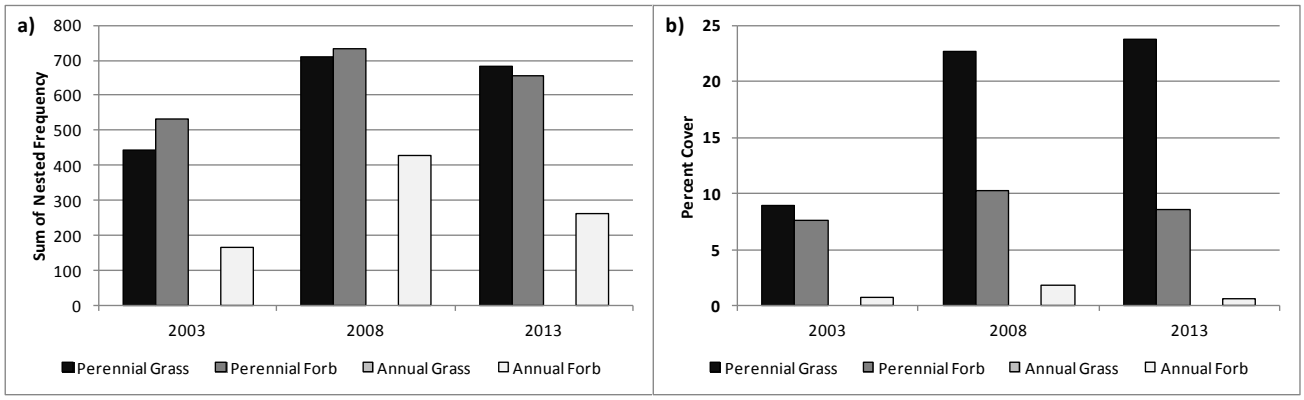


Figure 7.5: Herbaceous functional group summary of the High Mountain (Silver Sagebrush) study (n=1) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

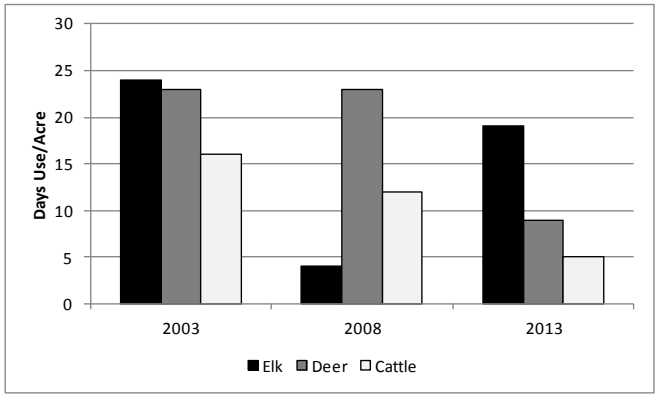


Figure 7.6: Mean pellet transect data for the High Mountain (Silver Sagebrush) study (n=1) for WMU 28, Panguitch Lake.

Mountain (Mountain Big Sagebrush)

There are two studies [Buckskin Valley (28-4) and Haycock Mountain (28-22)] classified as an Mountain (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 7.6). Buckskin Valley is located just south of SR 20 in Buckskin Wash and Haycock Mountain is just off SR 143 11 miles south of Panguitch. Buckskin Valley was established in 1992 while Haycock Mountain was established in 2013, so the majority of the data comes from Buckskin Valley.

Shrubs/Trees: The primary browse on the Buckskin Valley study is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) with antelope bitterbrush and mountain snowberry (*Symphoricarpos oreophilus*) as other prominent species. Haycock Mountain is a mixture of black sagebrush (*Artemisia nova*), mountain big

sagebrush, and antelope bitterbrush. The mean line-intercept cover of sagebrush is good on Buckskin Valley ranging from 30-35% on over the sample years. The apparent decline in sagebrush cover in 2013 comes from the addition of Haycock Mountain study, which had 10% sagebrush cover causing a decrease in the mean of the two sites. The average height of sagebrush on Buckskin Valley is approximately 2.5 feet tall and 2 feet on Haycock Mountain, making browse available through much of the year in normal winters. The demographics of the sagebrush populations was a mixture of mostly mature and decadent plants 1992-2008, with an increase in young sagebrush plants in 2013 (Figure 7.7).

Juniper (*Juniperus* sp.) is a very minor component on Buckskin Valley and is not present on Haycock Mountain (Figure 7.8). At this point pinyon and juniper do not pose a threat of encroachment.

Herbaceous Understory: The herbaceous understory of Haycock Mountain is comprised of a high number of perennial native grasses of low frequency and cover, that when combined total about 19%. Buckskin Valley is a mixture of perennial, annual, native, and introduced grasses and forbs. Since site establishment, the introduced annual grass cheatgrass (*Bromus tectorum*) has generally increased in frequency and cover. In 2013 cheatgrass had higher frequency and cover (12%) than the combined perennial grasses (6%) on this site (Figure 7.9). The high presence of cheatgrass is a potential threat to increased fire on this site.

Forbs contribute less than 2% cover on Haycock Mountain. Buckskin Valley also has relatively low forb frequency and cover. The exception to this is in 2003 when annual forb cover was 10% (Figure 7.9).

Occupancy: Pellet group transect data indicates that deer predominately occupy these studies. The mean abundance of deer pellet groups has ranged from a high of 60 days use/acre in 2013 to a low of 43 days use/acre in 2008. Elk and cattle pellet groups are typically sampled in low abundance on both study sites (Figure 7.10).

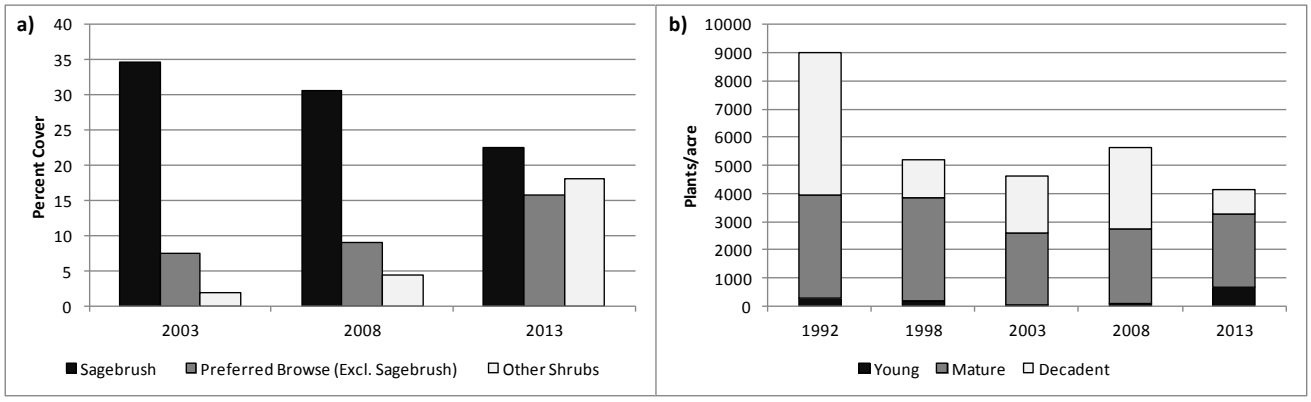


Figure 7.7: Shrub summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

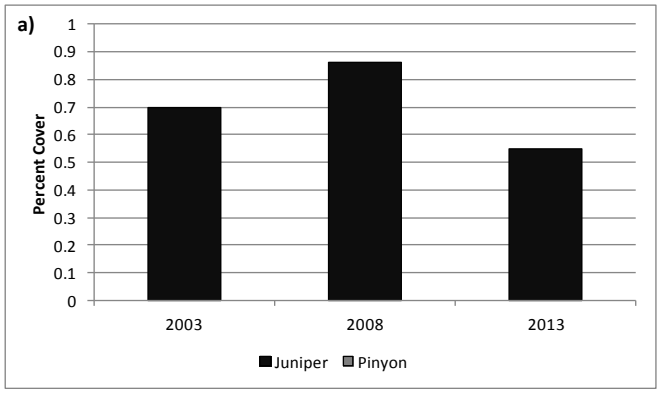


Figure 7.8: Tree summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

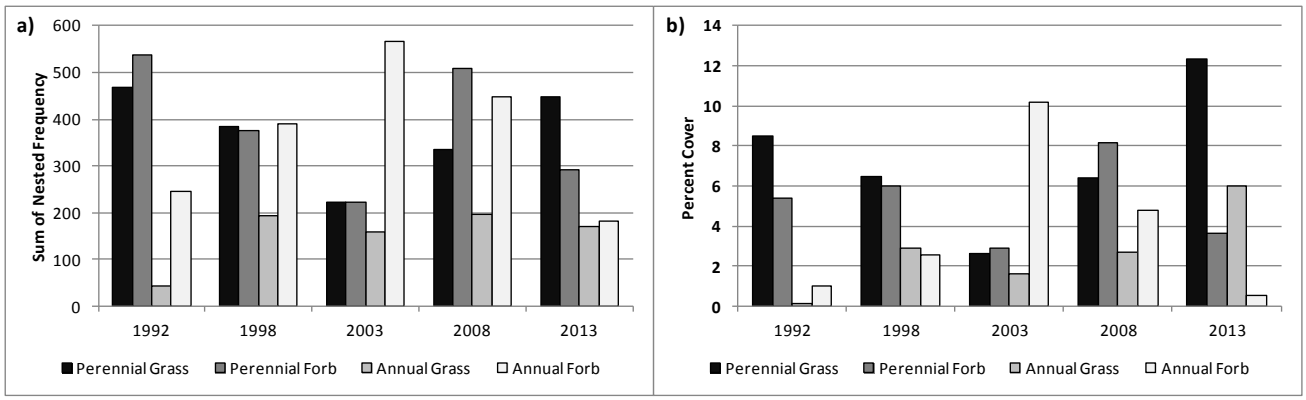


Figure 7.9: Herbaceous functional group summary of the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

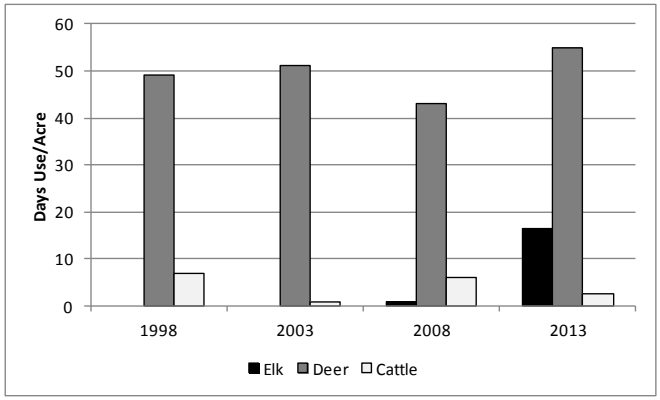


Figure 7.10: Mean pellet transect data for the Mountain (Mountain Big Sagebrush) studies (n=2) for WMU 28, Panguitch Lake.

Upland (Mountain Big Sagebrush)

There are two studies [Bear Valley (28-3) and Asay Bench (28-16)] classified as Upland (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 7.6). Bear Valley is located south of SR 20 just off Bear Valley road. Asay Bench is located west of Highway 89 and just east of Asay Knoll.

Shrubs/Trees: The primary browse on both studies is mountain big sagebrush. Trends in cover have varied on individual sites. The mean line-intercept cover of sagebrush is good on Asay Bench, but has recently dropped from 20% in 2008 to 15% in 2013 (Figure 7.11). Whereas on Bear Valley sagebrush cover increased from 6% in 2008 to 9% in 2013. The average height of mountain big sagebrush on all of the studies is approximately

1.5 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have varied greatly from year to year. The recruitment of young plants has been highest in 1998 and 2013, mature plants have been highest in 2003 and 2013, while decadent plants were greatest in 2008 (Figure 7.11). Encroachment from pinyon pine and Utah juniper trees was nonexistent on these sites except the so a summary of trees was therefore not included in this report.

Herbaceous Understory: The general herbaceous composition for both sites is high perennial grass with relatively low forb cover. The studies differ in that the dominant perennial grass species for Asay Bench is mutton bluegrass, a native species, while the dominant grass species for Bear Valley is crested wheatgrass (*Agropyron cristatum*) an introduced species that can often outcompete other herbaceous species. Another potential concern on the Bear Valley study is the presence of cheatgrass. Both frequency and cover of cheatgrass have remained low, therefore not posing a major threat now (Figure 7.12).

Perennial and annual forb frequency and cover have remained low over the sample years with the exception of annual forb cover on Bear Valley in 1998, which reached nearly 10% (Figure 7.12).

Occupancy: Pellet group transect data indicates that deer and elk occupy Asay Bench while cattle favor Bear Valley. The mean abundance of elk pellet groups for Asay Bench has ranged from as high as 37 days use/acre in 2013 to as low as 13 days use/acre in 2008 while Bear Valley was less than 11 days use/acre across all study years. The mean abundance of deer pellet groups has ranged from a high of 61 days use/acre in 2008 to a low of 19 days use/acre in 2003 for Asay Bench while Bear Valley was less than 20 days use/acre across all years. The mean abundance of cattle use for Bear Valley ranged from as high as 65 days use/acre in 1998 to less than 11 days use/acre in 2008 while Asay Bench was less than 12 days use/acre across all study years (Figure 7.13).

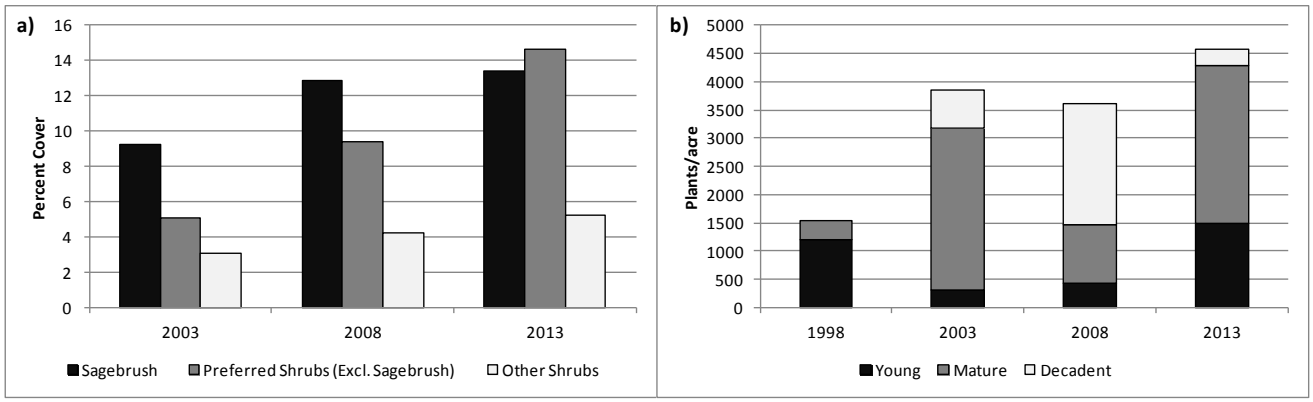


Figure 7.11: Shrub summary of the Upland (Mountain Big Sagebrush) studies (n=2) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

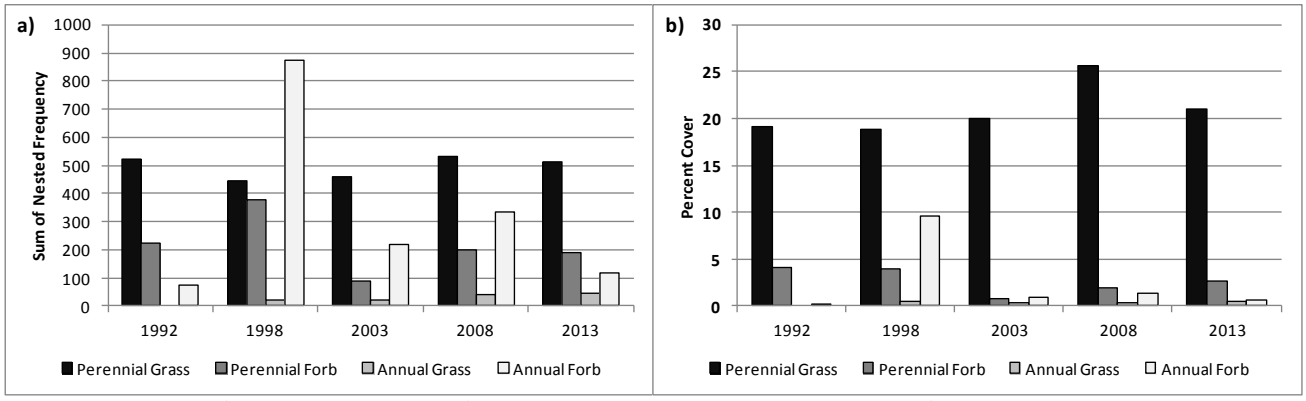


Figure 7.12: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) studies (n=2) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

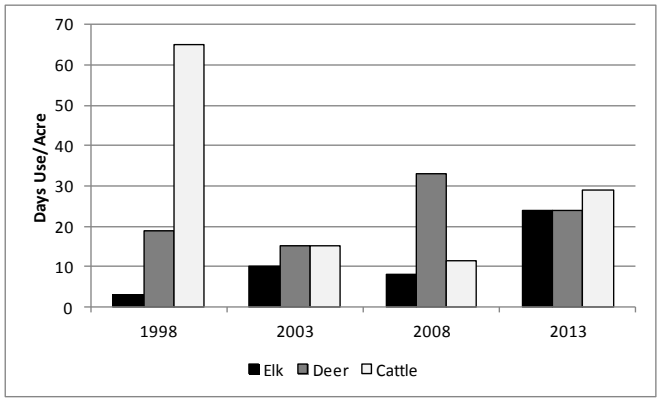


Figure 7.13: Mean pellet transect data for the Upland (Mountain Big Sagebrush) studies (n=2) for WMU 28, Panguitch Lake.

Semidesert (Wyoming Big Sagebrush)

There is one study [Cottonwood (28-6)] classified as Semidesert (Wyoming Big Sagebrush) ecological site that remained undisturbed over the report period (Table 7.6). The Cottonwood study is located just east of I-15 at the base of Hurricane Cliffs.

Shrubs/Trees: The primary browse on this study is Wyoming big sagebrush with no other preferred browse species sampled in cover measurements on this study. The mean line-intercept cover of sagebrush is good on this site, and has remained around 8-9% since 2003 (Figure 7.14a). The average height of Wyoming big sagebrush on this study is approximately 2 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush population have generally been comprised of a mixture of mature and decadent plants with recruitment of young plants being very low since 1998. There has been a slight decrease in sagebrush density since 2003 (Figure 7.14b).

There were no trees sampled on this study site in any of the sample years, so a summary of trees was not included in this report.

Herbaceous Understory: This study site has a fairly poor herbaceous component dominated primarily by cheatgrass. The one exception to this was 2003 when cheatgrass frequency was 50 and cover was less than 1%. Perennial grass cover is less than 7% across all sample years (Figure 7.15). Cheatgrass increases the risk of fire and threatens the resiliency of this site.

Perennial forb cover has varied from 2% to 8% on this site but still remains less than cheatgrass cover. Annual forb cover is consistently around 1% or less (Figure 7.15).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 121 days use/acre in 2008 to a low of 41 days use/acre in 1998 (Figure 7.16).

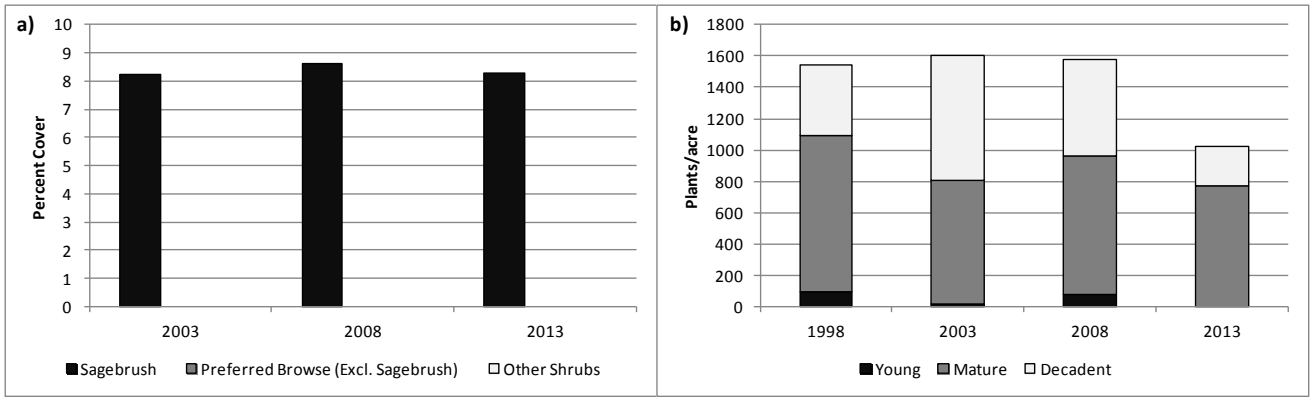


Figure 7.14: Shrub summary of the Semidesert (Wyoming Big Sagebrush) study (n=1) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

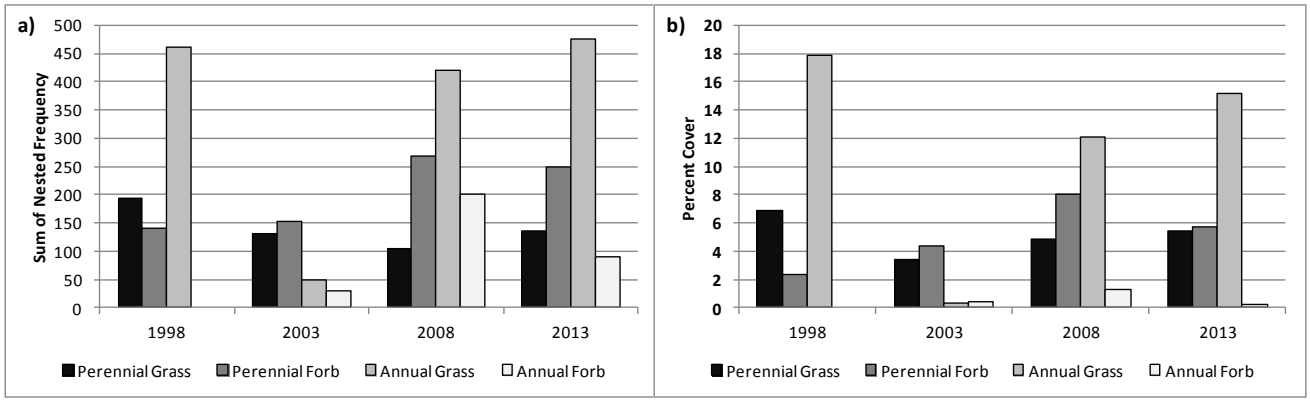


Figure 7.15: Herbaceous functional group summary of the Semidesert (Wyoming Big Sagebrush) study (n=1) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

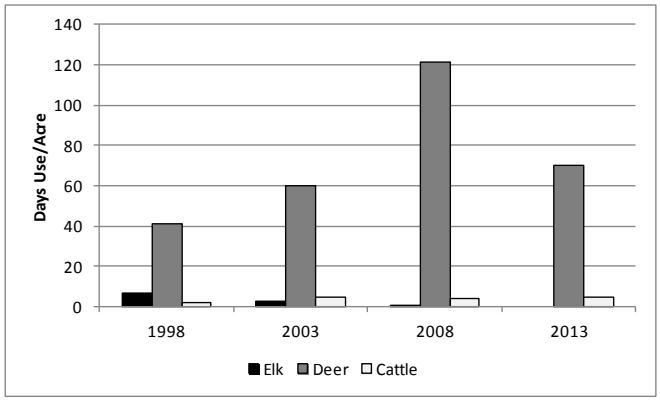


Figure 7.16: Mean pellet transect data for the Semidesert (Wyoming Big Sagebrush) study (n=1) for WMU 28, Panguitch Lake.

Semidesert (Basin Big Sagebrush)

There is one study [South Summit WMA (28-21)] classified as a Semidesert (Basin Big Sagebrush) ecological site that remained undisturbed over the report period (Table 7.6). The South Summit WMA study is located just south of Summit at the base of the Hurricane Cliffs.

Shrubs/Trees: The primary browse on this study is basin big sagebrush (*A. tridentata* ssp. *tridentata*). The mean line-intercept cover of sagebrush is good on this site, and has steadily increased from 11% in 2008 to almost 13% in 2013. There are only a few other species of shrubs on the site and they provide limited cover (Figure 7.17a). The average height of basin big sagebrush on all of the studies is almost 3 feet tall, making

browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been comprised of a mixture of mature and decadent plants with recruitment of young plants being very low. Although cover has increased, density of sagebrush has decreased slightly since 2008 (Figure 7.17b).

There were no trees sampled on this site in either 2008 or 2013, so a summary of trees was therefore not included in this report.

Herbaceous Understory: These study sites have a fair herbaceous component dominated primarily by perennial grasses. Mean nested frequency and cover of native perennial grasses have increased since 2008. This site has the perennial introduced grass bulbous bluegrass (*Poa bulbosa*) at 3% cover in 2008 and 12% cover in 2013. Bulbous bluegrass threatens the diversity of this site. The annual grass species cheatgrass was also present on this site but is less than 1% cover (Figure 7.18). Cheatgrass would only be a threat if it increased in cover.

Both perennial and annual forbs were less than 1% across both sample years (Figure 7.18).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 96 days use/acre in 2008 to a low of 36 days use/acre in 2013 (Figure 7.19).

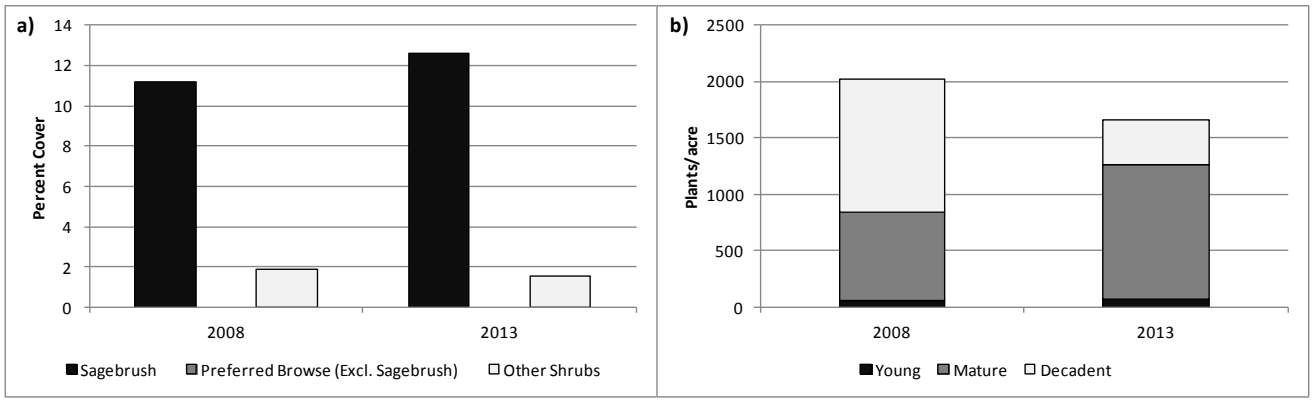


Figure 7.17: Shrub summary of the Semidesert (Basin Big Sagebrush) study (n=1) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

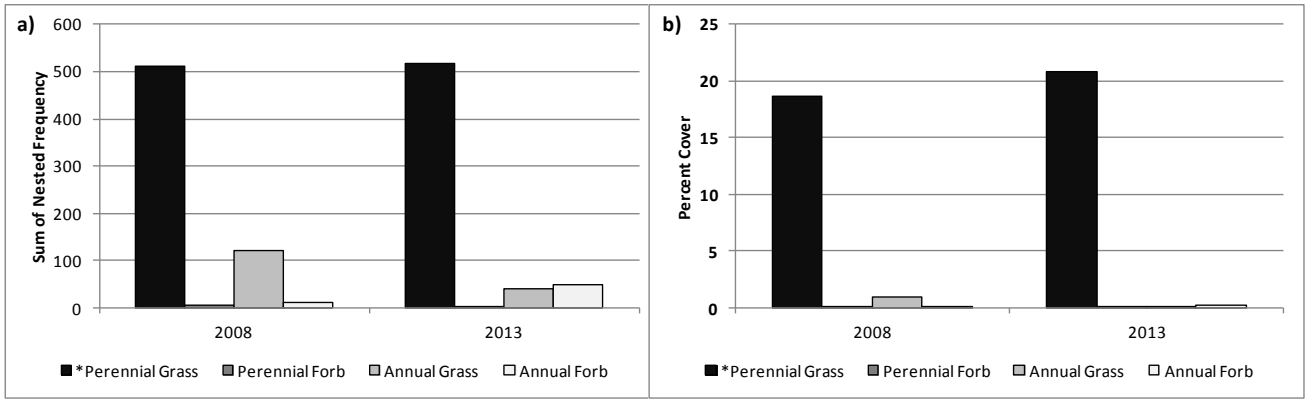


Figure 7.18: Herbaceous functional group summary of the Semidesert (Basin Big Sagebrush) study (n=1) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.
*Nested frequency and cover of bulbous bluegrass have been removed from the perennial grass totals.

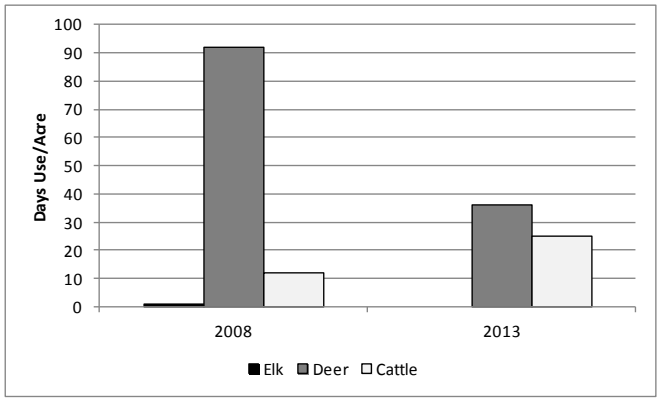


Figure 7.19: Mean pellet transect data for the Semidesert (Basin Big Sagebrush) study (n=1) for WMU 28, Panguitch Lake.

Study Trend Summary (Treated/Disturbed Sites)

Bullhog

There are two studies [DD Hollow (28-19) and Panguitch Creek (28R-13)] that were treated with a bullhog during the report period (Table 7.7). DD Hollow is located south of Panguitch, but north of Hatch, west of Highway 89. Panguitch Creek is west of Panguitch along Panguitch Creek. Neither of these studies have a verified ecological site (Table 7.6). Generally, the target of the bullhog treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on both of the studies is black sagebrush (*A. nova*), with a small amount of mountain big sagebrush sampled on DD Hollow. Antelope bitterbrush is also found on DD Hollow. Sagebrush was being impacted by pinyon-juniper encroachment on these studies; the mean line-intercept cover of sagebrush was low on many of the sites. The mean cover of sagebrush increased following treatments from 2.5% to almost 9%. The mean of cover of preferred browse and other shrubs also increased following treatment (Figure 7.20a). The mean density of sagebrush also increased from just over 2,000 plants/acre to almost 7,000 plants/acre. Changes in demographics of the sagebrush populations have also been positive on these studies. Decadent and mature plants dominated the populations prior to treatment, but decadent plants became a minor component following treatment. The recruitment of young plants was low on all studies prior to treatment, but recruitment of young plants increased substantially following treatment (Figure 7.20b). It is expected that with the improved recruitment and health of the sagebrush following treatment, that the sagebrush will continue to increase on most of the treatment sites.

The mean density and cover of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees was high at almost 400 trees/acre and near 40%, respectively, with the majority of the trees being pinyon pine. The mean density of pinyon-juniper trees decreased to less than 100 tree/acre and the mean cover decreased to around 5% following treatment (Figure 7.21). Remaining density and cover is generally provided by trees that were intentionally left standing or small trees that were left standing.

Herbaceous Understory: The herbaceous understory was generally lacking prior to treatment of these studies. Following treatment there was a general increase in all of the herbaceous functional groups except annual grass. Perennial forb species had the largest response increasing in mean cover from less than 1% to 4.5%. Perennial grass cover increased from almost 1% to 3.5% and annual forb cover increased from less than 1% to almost 2%. Annual grass, namely cheatgrass, was rare on most study sites prior to treatment and remained rare after treatment (Figure 7.22).

Occupancy: Pellet group transect data indicates that deer primarily occupy these study sites. The mean abundance of pellet groups of deer has ranged for as high as 19 days use/acre prior to treatment to 12 days use/acre following treatment (Figure 7.23).

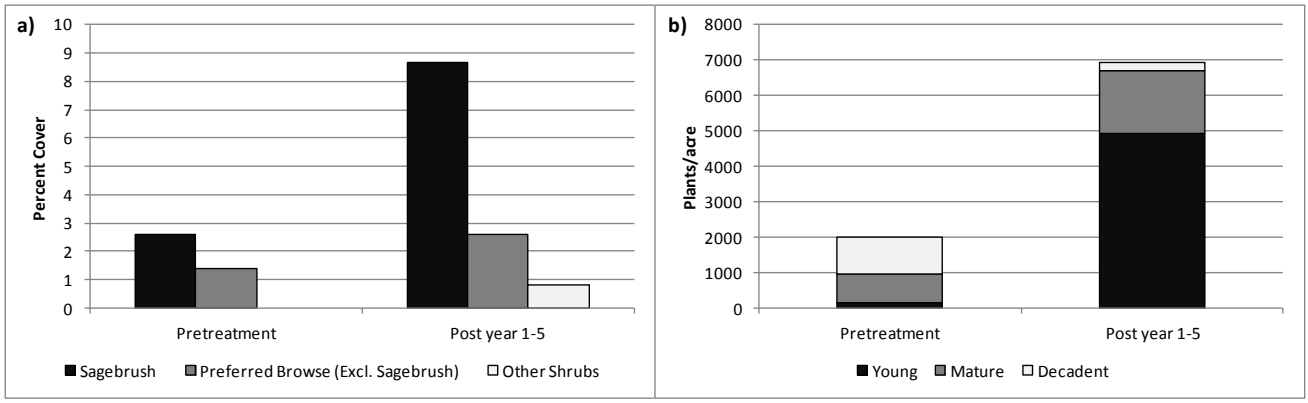


Figure 7.20: Shrub summary of the Bullhog treatment studies (n=2) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

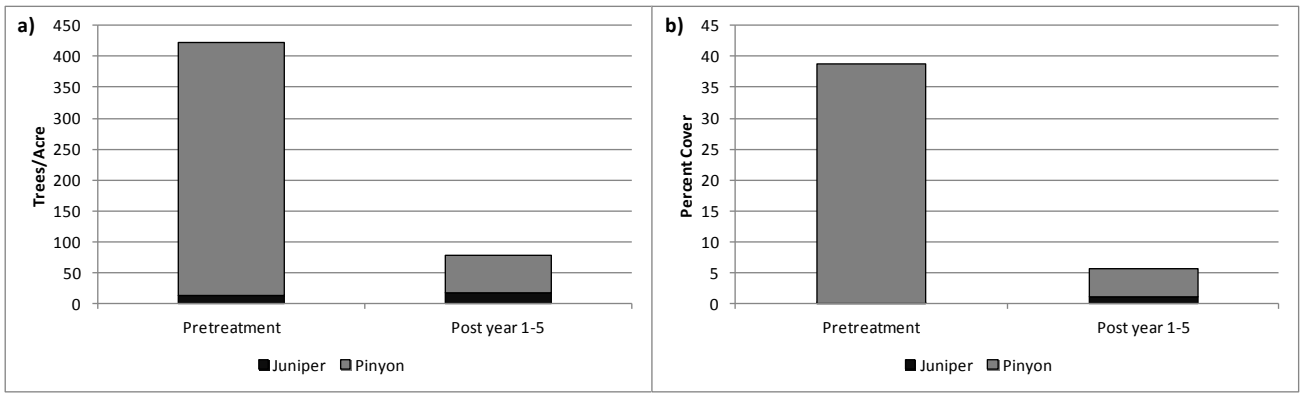


Figure 7.21: Tree summary of the Bullhog treatment studies (n=2) for WMU 28, Panguitch Lake. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

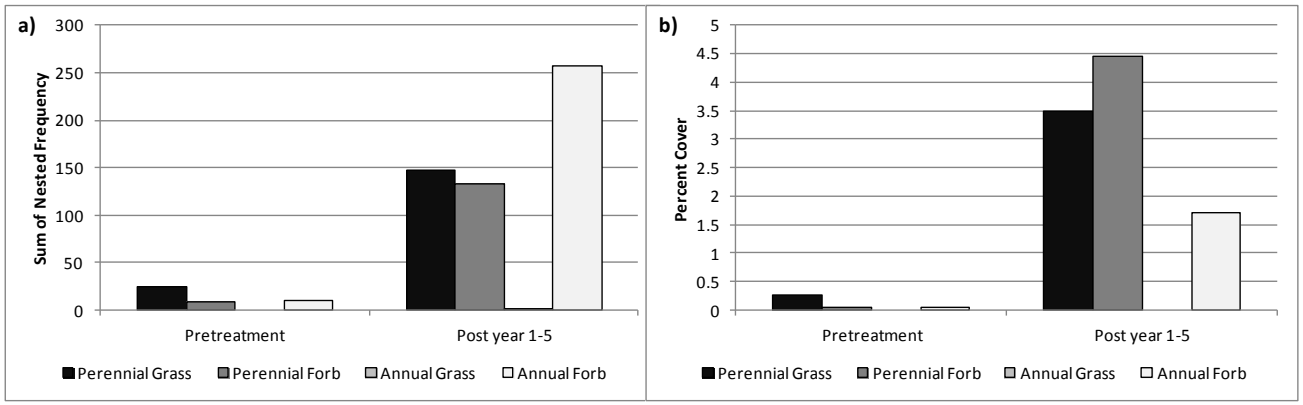


Figure 7.22: Herbaceous functional group summary of the Bullhog treatment studies (n=2) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

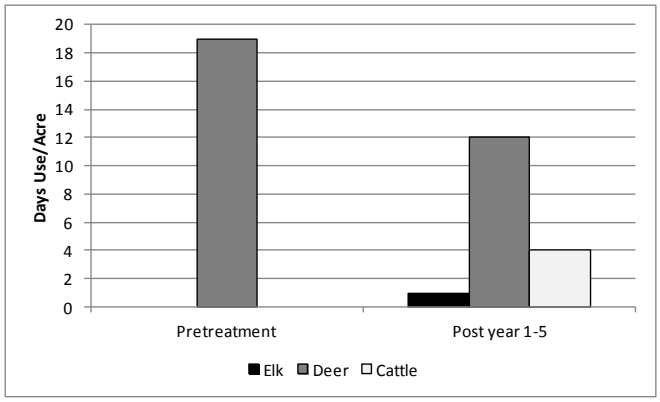


Figure 7.23: Mean pellet transect data for the Bullhog treatment studies (n=2) for WMU 28, Panguitch Lake.

Chaining

There are two studies [Threemile Creek (28-23) and Panguitch Creek WMA (28R-15)] that were treated with a chaining during the report period (Table 7.7). The Threemile Creek study is located northwest of Panguitch just south of the Garfield County line. Panguitch Creek WMA is located southwest of Panguitch just south of Panguitch Creek. Threemile Creek is considered an Upland (Pinyon-Juniper) ecological site while Panguitch Creek WMA is considered an Upland (Black Sagebrush) ecological site (Table 7.6). The target of the chaining treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory. Since these sites were only sampled after the treatment 1 and 5 years post treatment are reported.

Shrubs/Trees: The primary browse on these studies is black sagebrush, with no other preferred browse species sampled in line-intercept cover. Treatment objectives tell us that sagebrush was being impacted by pinyon-juniper encroachment on these studies, though it is unclear as to what extent without pretreatment data. The mean cover of sagebrush increased from 4% 1 year post treatment to 10% five years post treatment (Figure 7.24a). The mean density of sagebrush also increased from 200 plants/acre to 7,500 plants/acre. Changes in demographics of the sagebrush populations have been positive on these studies. Decadent and mature sagebrush plants dominated the population 1 year post treatment, but became a minor component following treatment. The recruitment of young plants was minimal 1 year post treatment but have since increased 5 years post treatment (Figure 7.24b).

The mean density and cover of pinyon pine and Utah juniper trees has declined from 100 trees/acre and just over 2%, 1 year post treatment, to 80 trees/acre and less than 1%, 5 years post treatment respectively (Figure 7.25). The remaining density and cover was generally provided by small trees that missed treatment and a few other trees that survived the treatment.

Herbaceous Understory: The herbaceous understory was fairly depleted one-year post treatment but has seen an increase 5 years post treatment. This is most evident in perennial grass frequency and cover, increasing from 3% to 15% over the sample years. Perennial grass composition is mainly native species. Perennial forbs also saw an increase in frequency and cover, though it was a very slight change (Figure 7.26).

Occupancy: Pellet group transect data indicates that animal occupancy on this site is almost exclusively by deer. Deer presence was low one-year post treatment at less than 5 days use/acre. Five years following the treatment deer presence has increase to 45 days use/acre (Figure 7.27).

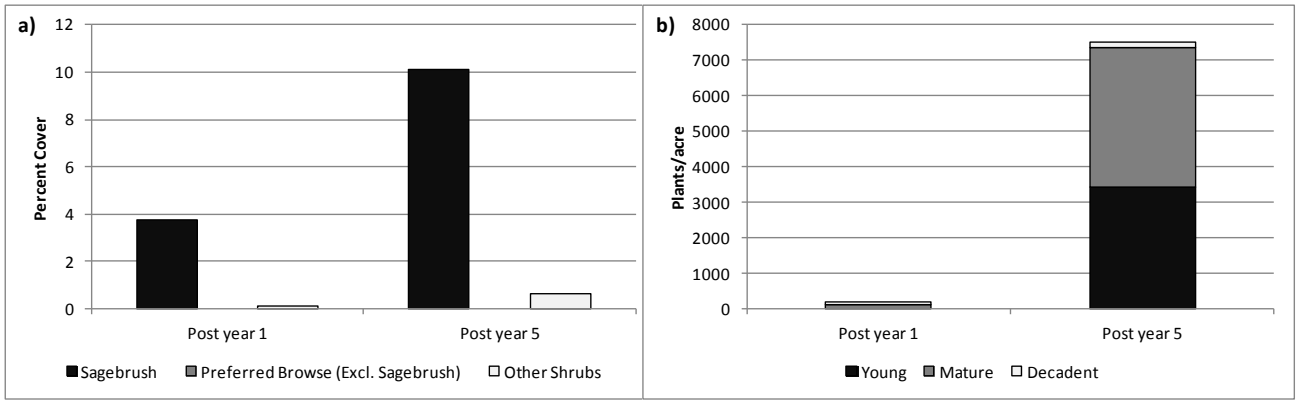


Figure 7.24: Shrub summary of the Chaining treatment studies (n=2) for WMU 28, Panguitch Creek. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

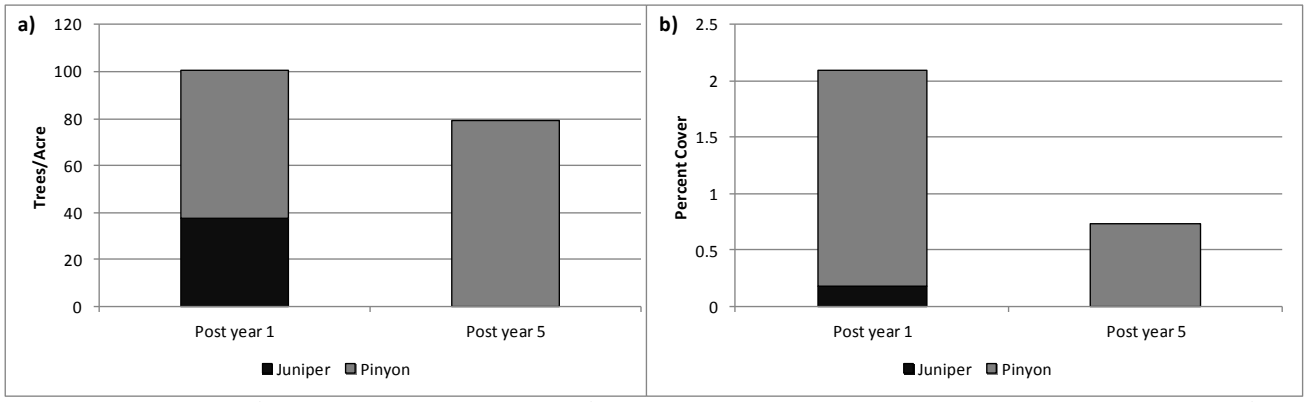


Figure 7.25: Tree summary of the Chaining treatment studies (n=2) for WMU 28, Panguitch Creek. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

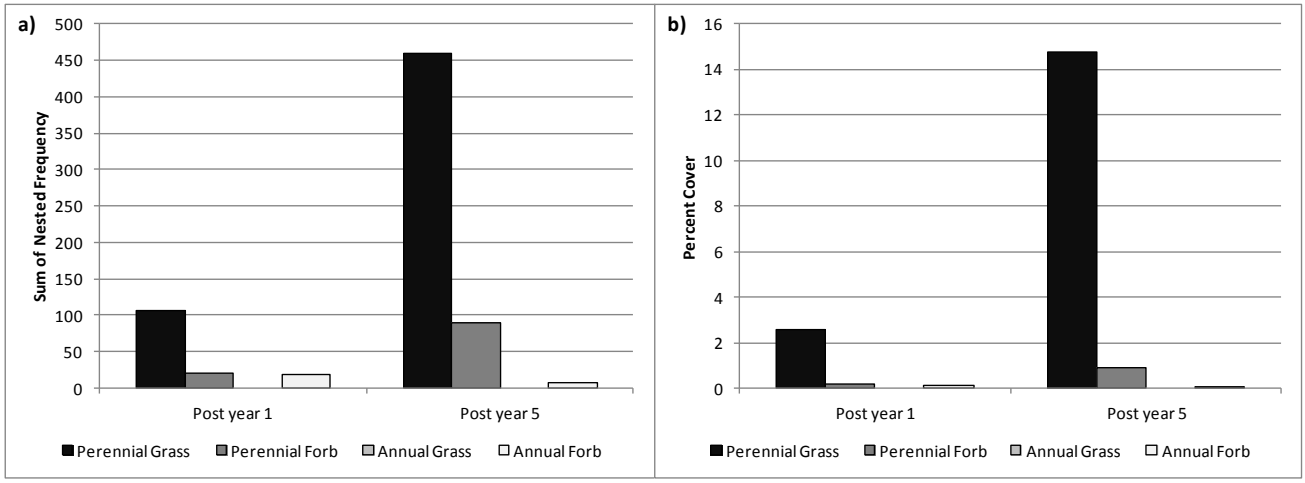


Figure 7.26: Herbaceous functional group summary of the Chaining treatment studies (n=2) for WMU 28, Panguitch Creek. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

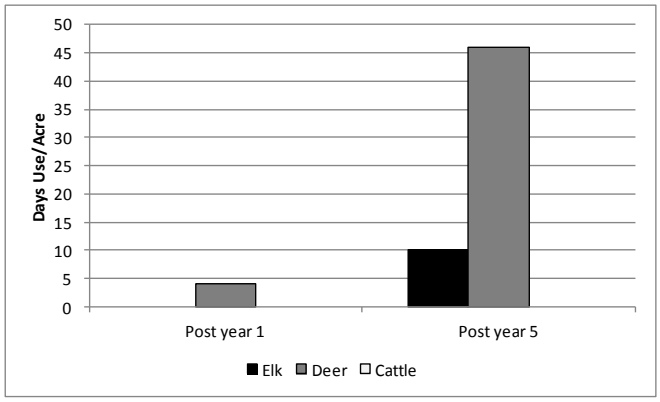


Figure 7.27: Mean pellet transect data for the Chaining treatment studies (n=2) for WMU 28, Panguitch Creek.

Harrow

There is one study [Buckskin Valley Highway 20 (28R-10)] that was treated with a harrow during the report period (Table 7.7). It is located just south of Highway 20 in Buckskin Wash. This study is classified as Upland (Mountain Big Sagebrush) ecological site (Table 7.6). Generally, the target of the harrow treatments was to rejuvenate degraded sagebrush and increase the herbaceous understory.

Shrubs/Trees: The primary browse on this study is mountain big sagebrush. No other preferred browse species were sampled in line-intercept cover. The mean cover of sagebrush was reduced from 20% pre-treatment to 3% 1-5 years post treatment and has since experienced an increase to 6% 6-10 years post treatment (Figure 7.28a). The mean density of sagebrush also decreased from 6,500 plants/acre before treatment to 2,000 plants/acre 1-5 years post treatment and up to 3,600 plants/acre 6-10 years post treatment. Changes in demographics of the sagebrush population have been positive following treatment. Mean decadence has decreased and the mean recruitment of young plants increased following the harrow treatment (Figure 7.28b). Encroachment from pinyon pine and juniper trees has not been a major concern on this study, thus tree density and cover for this site will not be included in this report.

Herbaceous Understory: The herbaceous understory on the Buckskin Valley Highway 20 study is comprised mainly of perennial grasses and forbs. Pre-treatment perennial grass cover was 15%, 1-5 years post treatment cover increased to 17%, and 6-10 years after treatment cover continues to increase and is around 33%. While there has been a positive response from treatment from perennial grass, the majority of the cover comes from crested wheatgrass, which is an introduced perennial grass species. Competition with this introduced grass may limit establishment other desirable herbaceous species. There was little to no annual grass species sampled on the study. There was a slight increase in perennial forb frequency and cover (Figure 7.29).

Occupancy: Pellet group transect data indicates that cattle primarily occupy these study sites. The mean abundance of pellet groups for cattle decreased from 36 days use/acre prior to treatment to 12 days use/acre 6-10 years following treatment (Figure 7.30).

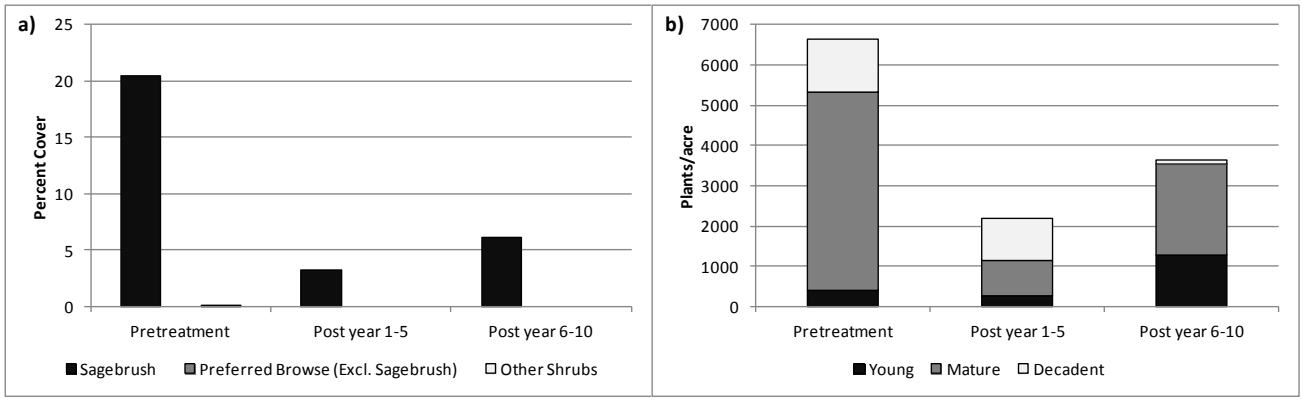


Figure 7.28: Shrub summary of the Harrow treatment study (n=1) for WMU 28, Panguitch Creek. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

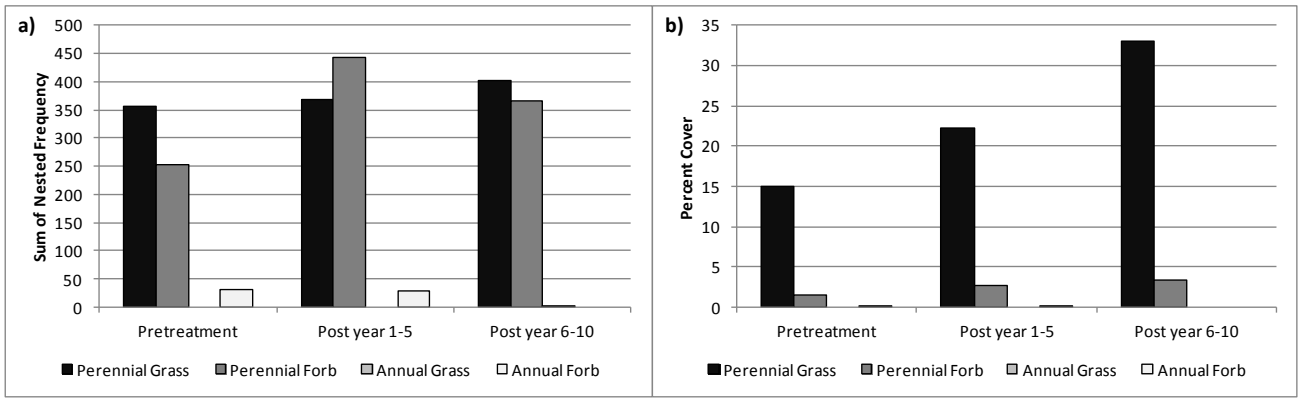


Figure 7.29: Herbaceous functional group summary of the Harrow treatment study (n=1) for WMU 28, Panguitch Creek. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

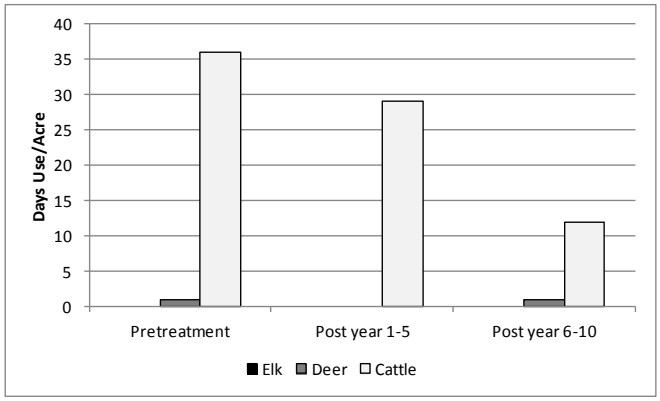


Figure 7.30: Mean pellet transect data for the Harrow treatment study (n=1) for WMU 28, Panguitch Creek.

Lop and Scatter

There are six studies [Three Creeks (28-1), Paragonah (28-7), Grass Valley (28-8), Elliker Basin (28-11), Sheep Hollow West (28-14), and Fivemile 2 (28R-12)] that were treated with lop and scatter during the report period (Table 7.7). The Paragonah, Grass Valley, and Elliker Basin studies are located just east of I-15 south of Paragonah, Parowan, and Summit, respectively. Three Creeks, Sheep Hollow West, and Fivemile 2 are all located near Panguitch, with Three Creeks being as far north as Highway 20 and Sheep Hollow West being as far south as SR 143. Three Creeks is classified as Upland (Mountain Big Sagebrush); Paragonah and Sheep Hollow West are Upland (Black Sagebrush); Grass Valley and Elliker Basin are Upland (Wyoming Big Sagebrush); and Fivemile 2 does not have a verified ecological site description (Table 7.6). Generally, the

target of lop and scatter treatments is to reduce pinyon-juniper tree cover in order to restore sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on Three Creeks, Grass Valley, and Elliker Basin is mountain big sagebrush with a very small component of preferred and other shrubs. While black sagebrush is the main browse species on Paragonah, Sheep Hollow West, and Fivemile 2. Paragonah also had some gambel oak and Sheep Hollow West had quite a bit of antelope bitterbrush. The mean cover of sagebrush has increased as time since treatment has increased. Sagebrush cover increased from 5% prior to treatments to almost 20% 11 years following treatment. The preferred browse and other shrub cover increased slightly following treatment (Figure 7.31a). The mean density of sagebrush increased from a little over 3,000 pretreatment to 4,500 after treatment and has remained similar as time since treatment increases. The demographics of the sagebrush populations following treatment have stayed nearly the same with decadent and mature plants dominating with very little recruitment of young, except 1-5 years post treatment which had a fair amount of young (Figure 7.31b).

The mean density and cover of pinyon pine and Utah juniper trees was moderately low at just over 70 trees/acre and almost 7%, respectively, prior to treatment. The mean density of pinyon-juniper trees decreased to less than 10 trees/acre and the mean cover decreased to less than 1% following treatment (Figure 7.32). Remaining density and cover is generally provided by young trees that were missed in the treatment.

Herbaceous Understory: The study sites have a good herbaceous component dominated by perennial grasses. However, the dominant grass species are seeded species such as crested wheatgrass and intermediate wheatgrass on all sites except Sheep Hollow West and Fivemile 2 which have native perennial grasses as the dominate species. Competition with these introduced grasses may limit other desirable herbaceous species. Perennial grass had the largest response increasing in mean cover from 9% to 14%. Annual and perennial forb cover and frequency fluctuate following treatment but generally remain the same. Annual grass cover decreased after the treatment but has fluctuated from year to year (Figure 7.33). Annual grass species, primarily cheatgrass, is rare to absent on the Three Creeks, Sheep Hollow West, and Fivemile 2 sites but can be fairly common on the remainder of the studies. Cheatgrass is a potential threat for increased fire on Paragonah, Grass Valley, and Elliker Basin. The perennial introduced grass bulbous bluegrass is found on the Grass Valley and Elliker Basin study sites.

Occupancy: Pellet group transect data indicates that deer primarily occupy these study sites, with higher abundance of pellet groups as time since treatment increases. The mean abundance of pellet groups for deer increased from 35 days use/acre prior to treatment to 80 days use/acre following treatment (Figure 7.34).

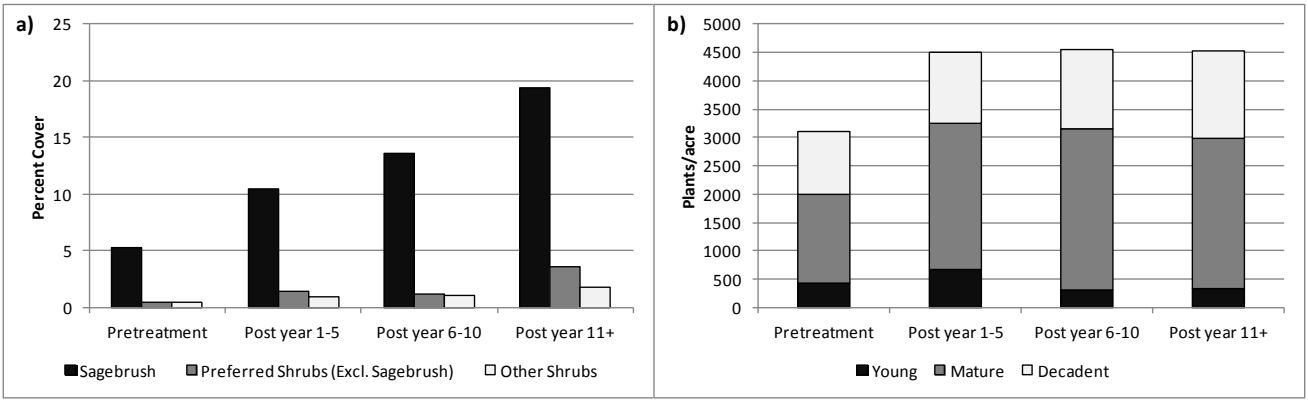


Figure 7.31: Shrub summary of the Lop and Scatter treatment studies (n=6) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

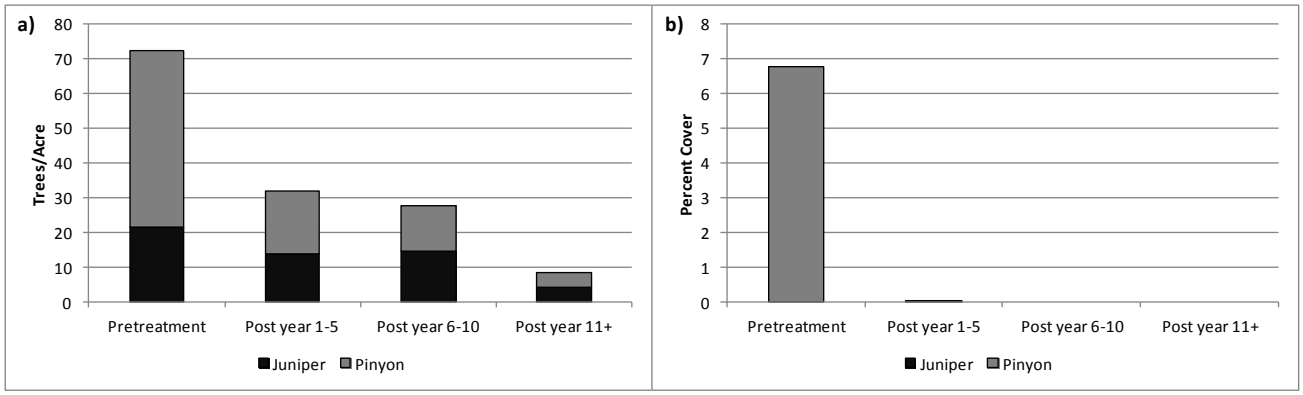


Figure 7.32: Tree summary of the Lop and Scatter treatment studies (n=6) for WMU 28, Panguitch Lake. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

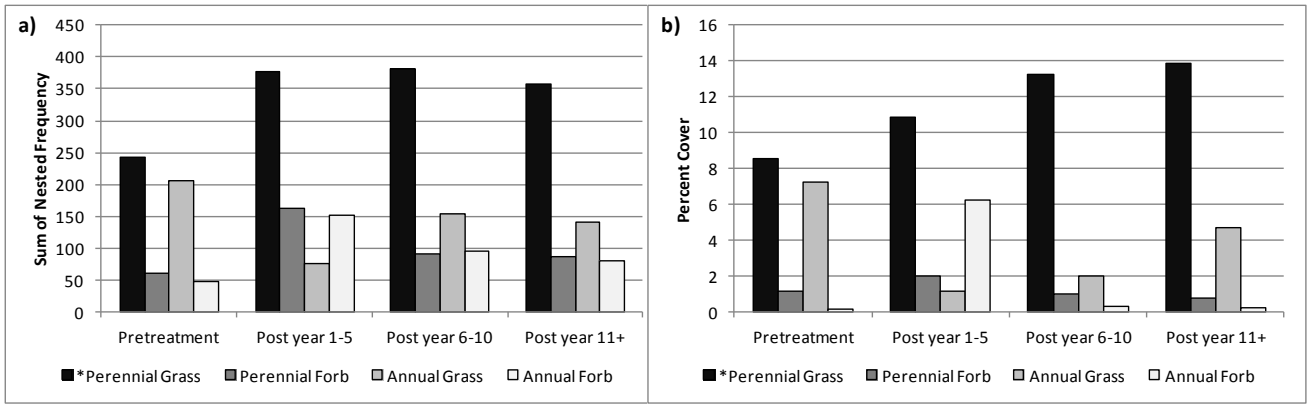


Figure 7.33: Herbaceous functional group summary of the Lop and Scatter treatment studies (n=6) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.
*Bulbous bluegrass frequency and cover were subtracted from the perennial grass category

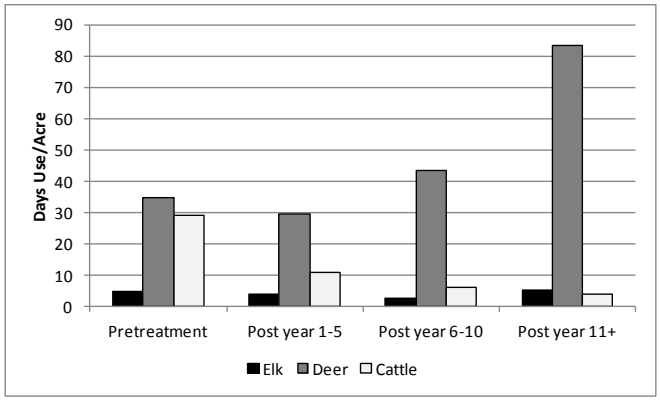


Figure 7.34: Mean pellet transect data for the Lop and Scatter treatment studies (n=6) for WMU 28, Panguitch Lake.

Wildfire

There is one study [Swayback Knoll (28-5)] that was burned in a wildfire during the report period (Table 7.7). The Swayback Knoll study burned in the Laub fire in 2012. This study is classified as Semidesert (Wyoming Big Sagebrush) ecological sites (Table 7.6).

Shrubs/Trees: The primary browse species was Wyoming big sagebrush. There were no other preferred browse species on the study site. Prior to disturbance, sagebrush had a line-intercept cover of 11%. Following the wildfire, nearly all of the shrub species were removed from the study and sagebrush cover is now less than 1% (Figure 7.35a). Prior to disturbance the demographics of the sagebrush population was a mixture of

decadent and mature plants with limited recruitment of young plants. Following the wildfire, the small population of sagebrush is comprised primarily of mature and decadent plants (Figure 7.35b). Encroachment of pinyon pine and Utah juniper trees has not been a concern on this study.

Herbaceous Understory: The herbaceous understory was limited prior to treatment to less than 10%. Annual forbs increased in frequency and cover after the fire. Cheatgrass cover was 2% prior to the wildfire but increased to 20% following the fire and is the dominant species on the site (Figure 7.36). Cheatgrass remains a substantial threat for increased fire on this study.

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy this study sites. Prior to the fire deer use was 93 days use/acre while after the fire it dropped down to 14 days use/acre (Figure 7.37).

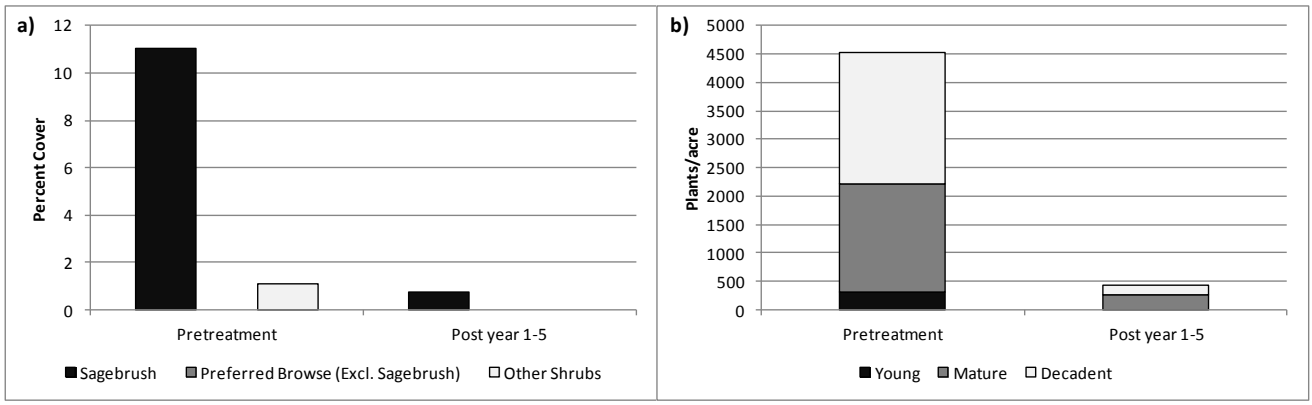


Figure 7.35: Shrub summary of the Wildfire disturbance study (n=1) for WMU 28, Panguitch Lake. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

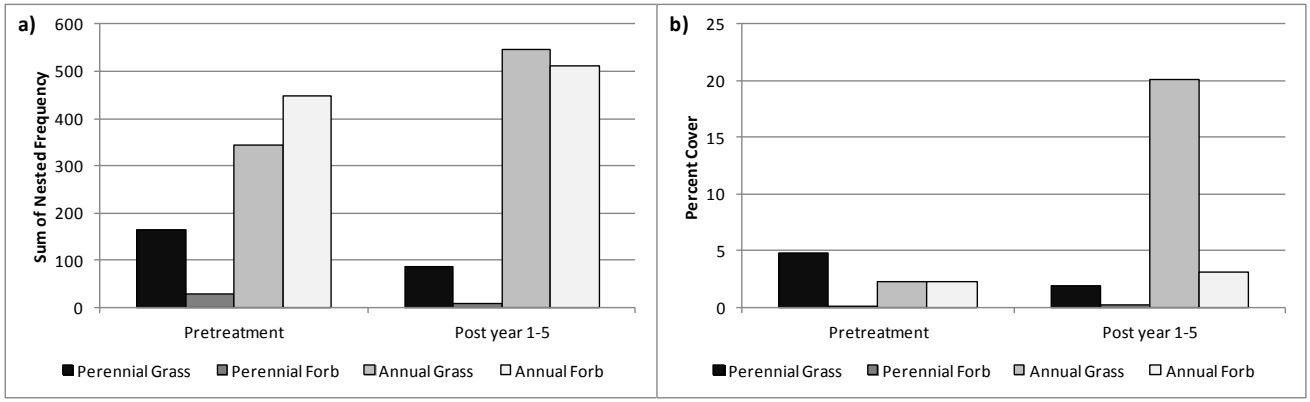


Figure 7.36: Herbaceous functional group summary of the Wildfire disturbance study (n=1) for WMU 28, Panguitch Lake. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

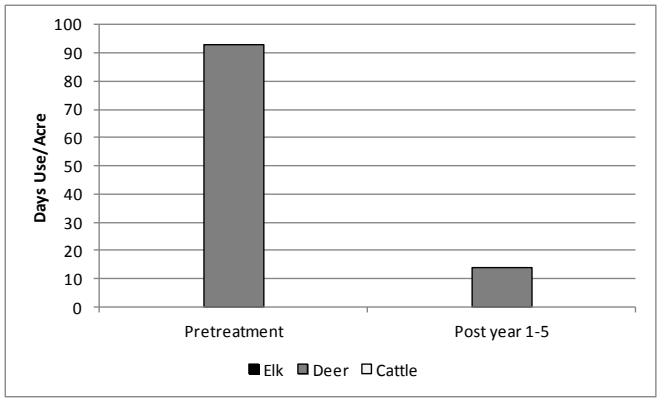


Figure 7.37: Mean pellet transect data for the Wildfire disturbance study (n=1) for WMU 28, Panguitch Lake.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Panguitch Lake management unit has generally improved on the study sites sampled since 1998. The majority of the undisturbed sites sampled within the unit are considered to be in poor to fair condition with the exception of the most current sample data in which the sites are considered to be in fair to good condition (Figure 7.38). The treated study sites are more variable due in part to the steady decrease in sites included in the figure as time since treatment increases (Figure 7.39). There are three studies, Swayback Knoll, Threemile Creek, and Panguitch Creek that were in very poor condition at the last reading (Map 7.7 and Table 7.8). Both Panguitch Creek and Threemile Creek were treated with a bullhog and chain, respectively, and have low browse and herbaceous cover. Panguitch Creek was in very poor condition pretreatment and has remained even after treatment; there is no pretreatment data for Threemile Creek. Swayback Knoll experienced a fire and went from fair to very poor due to a drastic reduction in browse cover as well as an increase in annual grass cover.

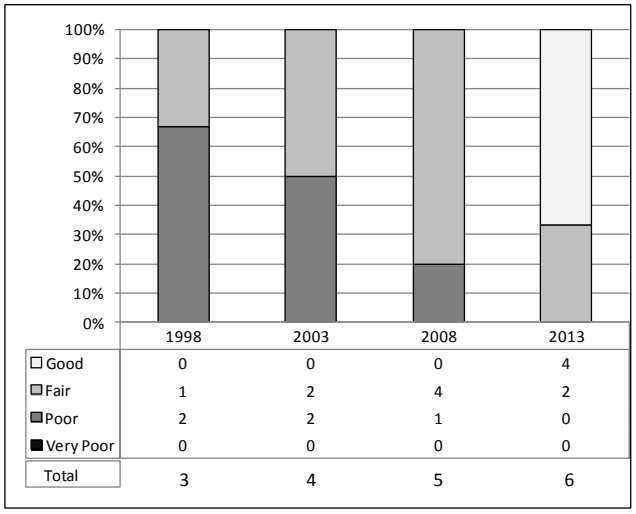


Figure 7.38: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 28 Panguitch Lake.

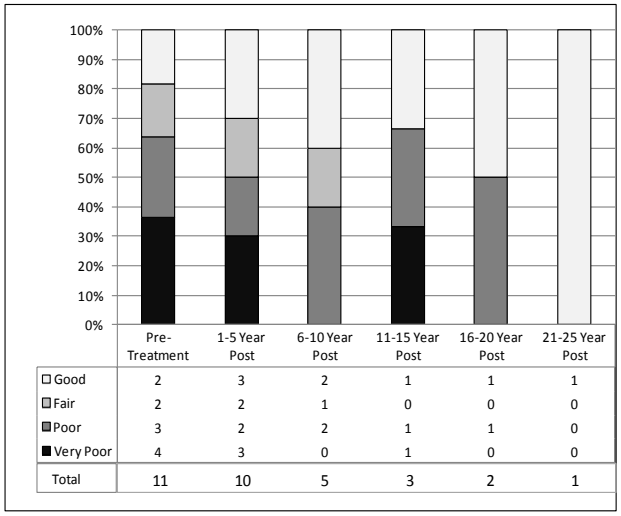
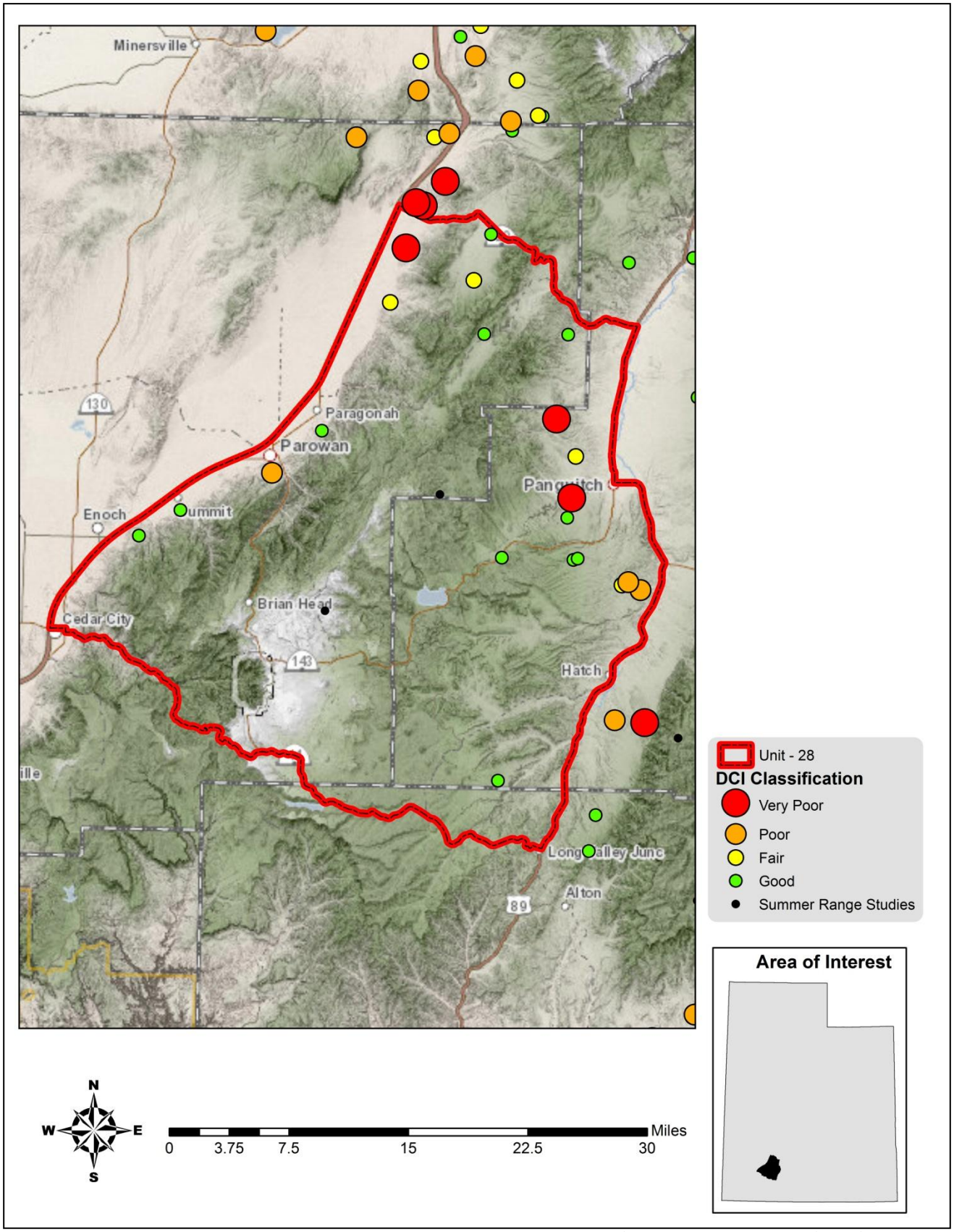


Figure 7.39: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 28, Panguitch Lake.



Map 7.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 28, Panguitch Lake.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
28-1	Three Creeks	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
28-3	Bear Valley	Introduced Perennial Grass Annual Grass	High Low	Reduced diversity of desirable grass and forb species. Increased fire potential.
28-4	Buckskin Valley	Annual Grass PJ Encroachment	High Low	Increased fire potential. Reduced understory shrub and herbaceous vigor.
28-5	Swayback Knoll	Annual Grass	High	Increased fire potential.
28-6	Cottonwood	Annual Grass	High	Increased fire potential
28-7	Paragonah	Introduced Perennial Grass PJ Encroachment	Low Low	Reduced diversity of desirable grass and forb species. Reduced understory shrub and herbaceous vigor.
28-8	Grass Valley	Introduced Perennial Grass	Moderate	Reduced diversity of desirable grass and forb species.
28-11	Elliker Basin	Introduced Perennial Grass Annual Grass	Low Low	Reduced diversity of desirable grass and forb species. Increased fire potential.
28-14	Sheep Hollow West	None Identified		
28-16	Asay Bench	None Identified		
28-17	Sidney Valley	None Identified		
28-18	Shakespeare Hollow	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species.
28-19	DD Hollow	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
28-21	South Summit WMA	Introduced Perennial Grass Annual Grass	Moderate Low	Reduced diversity of desirable grass and forb species. Increased fire potential.
28-22	Haycock Mountain	None Identified		
28-23	Threemile Creek	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
28R-9	South Canyon 2	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor.
28R-10	Buckskin Valley Highway 20	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species.
28R-11	Five Mile Hollow	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.
28R-12	Fivemile 2	None Identified		
28R-13	Panguitch Creek	Introduced Perennial Grass PJ Encroachment	Low Low	Reduced diversity of desirable grass and forb species. Reduced understory shrub and herbaceous vigor.
28R-15	Panguitch Creek WMA	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
28R-19	South Canyon	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.

Table 7.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 28, Panguitch Lake. All assessments are based off of the most current sample date for each study site.

Discussion and Recommendations

Subalpine (Geranium)

The high elevation subalpine site supports a geranium community and is generally considered to be in good condition for elk summer range habitat on the Panguitch Lake management unit. This community supports a diverse herbaceous understory that provides valuable forage during the summer months. This site is in generally good condition, with no limiting factors or threat in its current condition.

It is recommended to continue to monitor this community for any potential threats that may arise in the future.

High Mountain (Silver Sagebrush)

The high elevation high mountain site supports a silver sagebrush community and is generally considered to be in good condition for deer and elk summer range habitat on the Panguitch Lake management unit. This community supports a diverse herbaceous understory that provides valuable forage during the summer months. While in generally good condition, introduced perennial grasses are present in the herbaceous component on this study site. While providing valuable forage, these grass species can often be aggressive at higher elevation and precipitation and can reduce the prevalence and abundance of other more desirable native grass and forb species.

It is recommended that monitoring of this community continue. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Upland and Mountain (Mountain Big Sagebrush)

The higher elevation upland and mountain sites, which support mountain big sagebrush communities, are generally considered to be in good condition for deer winter range habitat on this unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. While in generally good condition, these sites appear to be prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. In addition, introduced perennial grasses are often the dominant herbaceous component on these study sites. While providing valuable forage, these grass species can often be aggressive at higher elevation and precipitation and can reduce the prevalence and abundance of other more desirable native grass and forb species.

It is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue in these communities. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Upland (Pinyon-Utah Juniper)

The mid elevation upland site supports a pinyon-Utah juniper community and is generally considered to be in very poor condition for deer winter range habitat on this management unit. This community is dominated by pinyon and juniper trees that provide good cover, but offer little to no browse or forage opportunities. This community is prone to infilling from pinyon-juniper trees which can reduce understory shrub and herbaceous cover if not addressed.

It is recommended that work to reduce pinyon-juniper cover (e.g. bullhog, chaining, lop and scatter, etc.) should continue in this community. Depending on initial tree cover and residual species, reseeding may be necessary to restore herbaceous understory.

Upland (Wyoming Big Sagebrush)

The mid elevation upland Wyoming big sagebrush communities are generally considered to be in fair condition for deer winter range habitat on this unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. These communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous cover if not addressed. Also, introduced perennial grasses can dominant the herbaceous component on some of these study sites. While providing valuable forage, these grass species can often be aggressive, reducing the prevalence and abundance of native grass and forb species. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

It is recommended that work to reduce pinyon-juniper encroachment should continue in these communities. Care should be taken in selecting treatment methods that will not increase annual grass loads. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible. Treatments to reduce annual grass may be necessary on some sites. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

Upland (Black Sagebrush)

The mid elevation upland black sagebrush communities are generally considered to be in good condition for deer winter range habitat on this unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. Annual

grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

It is recommended that work to reduce pinyon-juniper encroachment should continue in these communities. Care should be taken in selecting treatment methods that will not increase annual grass loads. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

Semidesert (Wyoming Big Sagebrush)

The lower elevation semidesert Wyoming big sagebrush community that has not been disturbed is generally considered to be in fair condition for deer winter range habitat on the unit. This community supports robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire and the study, which has burned since 1998, is in very poor condition. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are susceptible to invasion from annual grass, primarily cheatgrass. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire on within these communities. Encroachment from pinyon-juniper trees is not typically an issue within these communities. Areas along I-15 maybe susceptible to heavy browsing due to I-15 limiting deer migration.

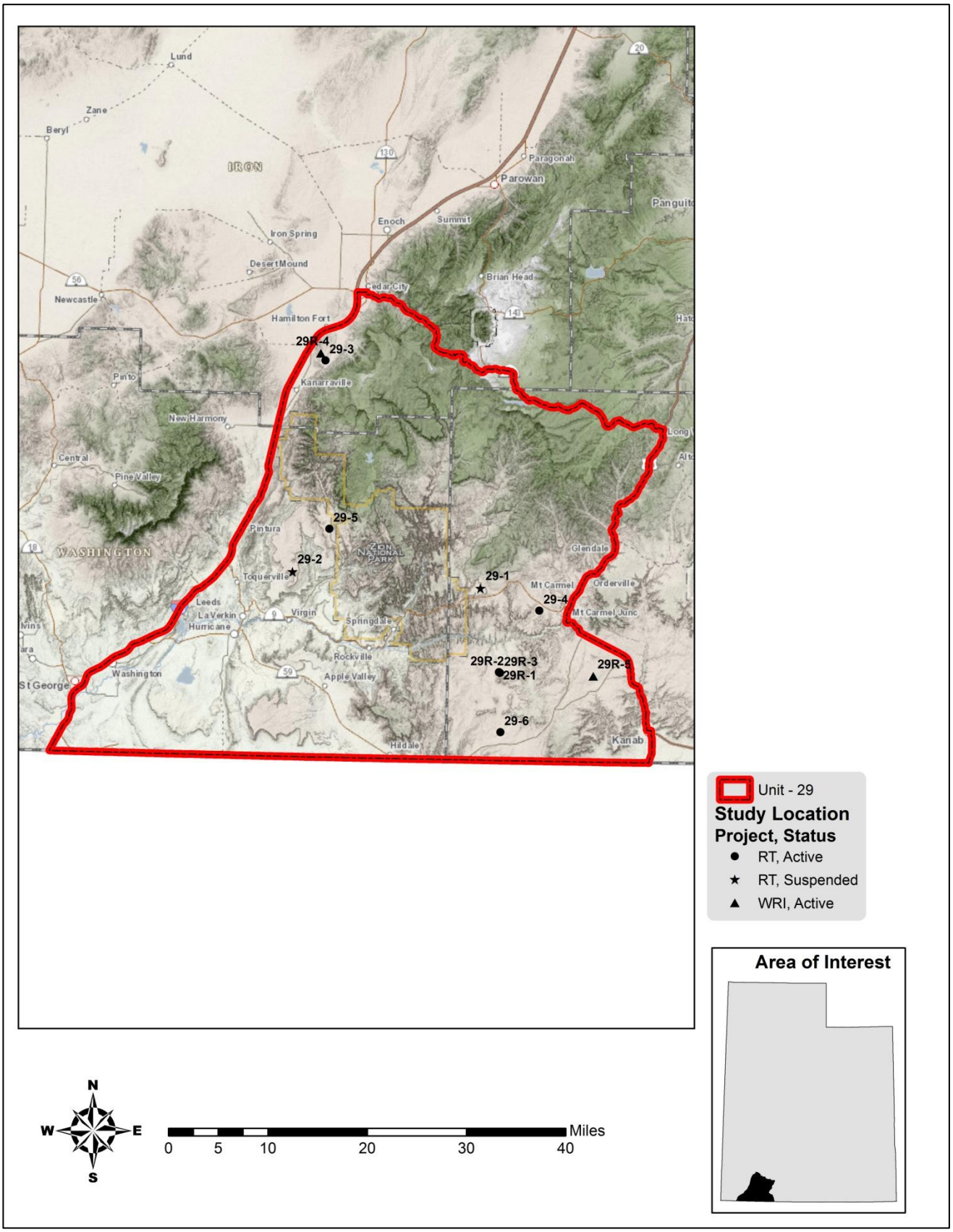
It is recommended that work to diminish fuel loads and create firebreaks should continue within these communities in order to reduce the threat of catastrophic fire. Treatments to establish and increase browse species more rapidly following wildfire should also be implemented, and treatments to increase browse species on historic fires should be considered. If a treatment to rejuvenate sagebrush occurs, care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites.

Semidesert (Basin Big Sagebrush)

The lower elevation semidesert basin big sagebrush community has not been disturbed is generally considered to be in good condition for deer winter range habitat on the unit. This community supports a robust shrub population that provides valuable browse in moderate to severe winters. However, this community is prone to wildfire. If wildfire occurs within this community, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. This community is susceptible to invasion from annual grass, primarily cheatgrass. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire on within this community. Encroachment from pinyon-juniper trees is not typically an issue within this community.

It is recommended that work to diminish fuel loads and create firebreaks should continue within these communities in order to reduce the threat of catastrophic fire. Treatments to establish and increase browse species more rapidly following wildfire should also be implemented, and treatments to increase browse species on historic fires should be considered. If a treatment to rejuvenate sagebrush occurs, care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites.

8. WILDLIFE MANAGEMENT UNIT 29 – ZION



WILDLIFE MANAGEMENT UNIT 29 – ZION

Boundary Description

Iron, Kane and Washington Counties - Boundary begins at I-15 and the Utah-Arizona state line; north on I-15 to SR-14; east on SR-14 to US-89; south on US-89 to US-89A; south on US-89A to the Utah-Arizona state line; west on the Utah-Arizona state line to I-15.

Management Unit Description

Geography

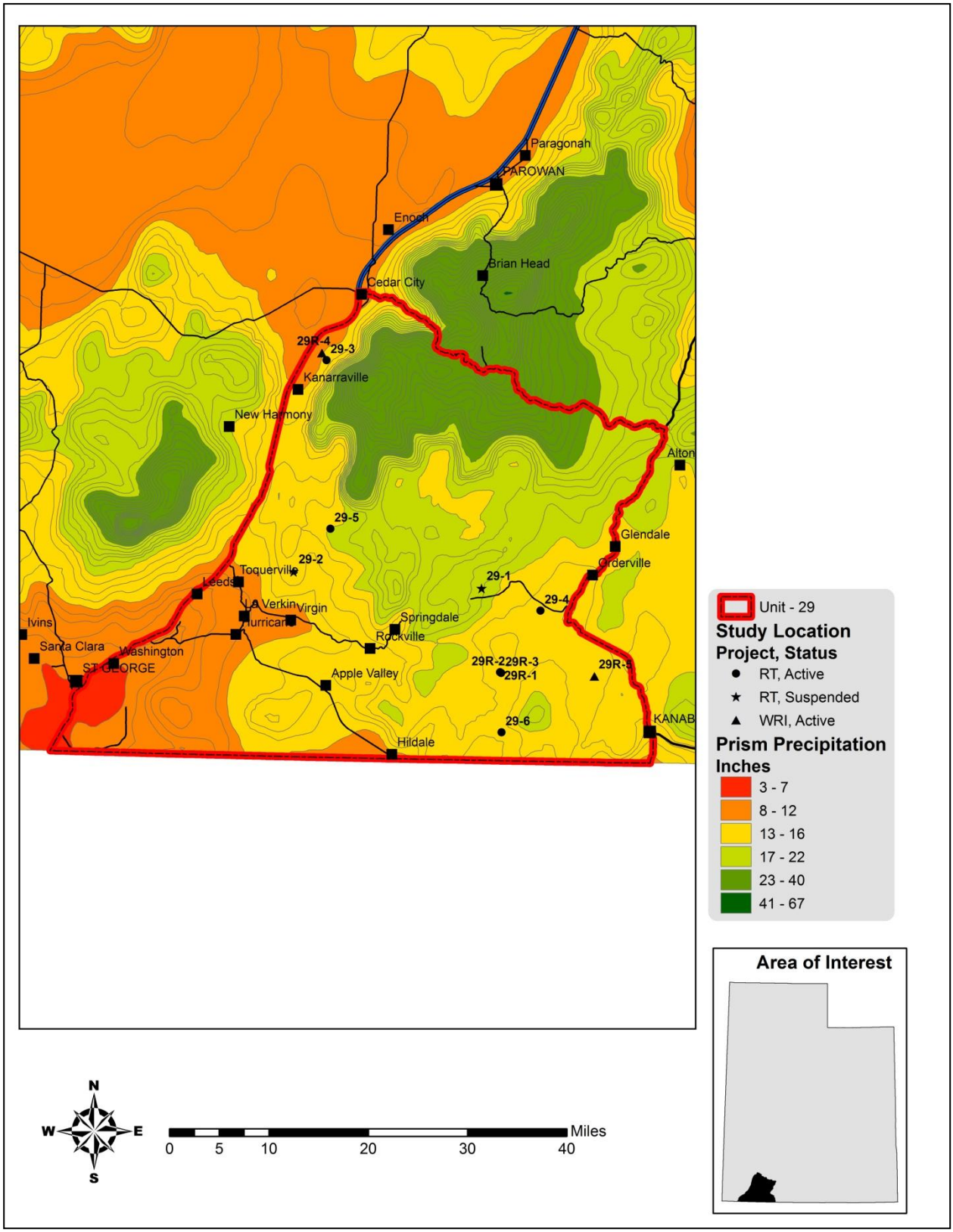
The Zion wildlife management unit includes the southern portion of the Markagunt Plateau. It also contains Pine Spring Knoll, Kolob Peak, and Little Creek Mountain. Pine Knoll located in the north eastern part of the unit is the highest point at an elevation of 10,000 feet. The low point in the unit is about 2,500 feet just east of St George. Zion National Park is also included in this unit with its highest point being Horse Ranch Mountain at an elevation of 8,726 feet and its lowest point is Coalpits Wash at 3,666 feet. It occurs at the junction of the Mojave Desert, Colorado Plateau, and Great Basin giving it a unique assembly of flora and fauna in addition to a variety of geographical configurations such as canyons, buttes, mesas, natural arches, and monoliths. Towns in this area include Kanarraville, Hurricane, Springdale, Rockville, Mt Carmel, with cities like St George and Cedar City on the unit boundaries.

There are a number of streams within this unit such as La Verkin Creek, Muddy Creek, Blue Creek, Crystal Creek, and Deep Creek most of which are tributaries of the Virgin River. The Virgin River is formed by the confluence of the North Fork Virgin and the East Fork Virgin just outside of Zion national park near the town of Springdale. Navajo Lake and Kolob Reservoir are also found within this unit.

Climate Data

The 30-year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 3 inches on the southwest side of the unit to 40 inches on the high elevations just south of Brian Head. All of the Range Trend and WRI monitoring studies on the unit occur within 8-22 inches of precipitation (Map 8.1).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central division (Division 4). The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 8.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 8.1b) (Time Series Data 2014).



Map 8.1: The 1981-2010 PRISM Precipitation Model for WMU 29, Zion (PRISM Climate Group, Oregon State University, 2013)

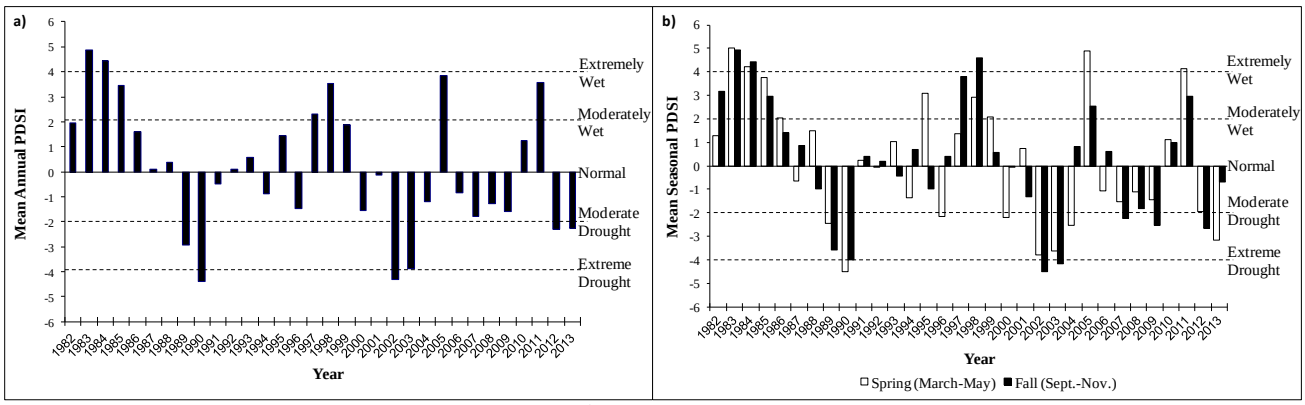
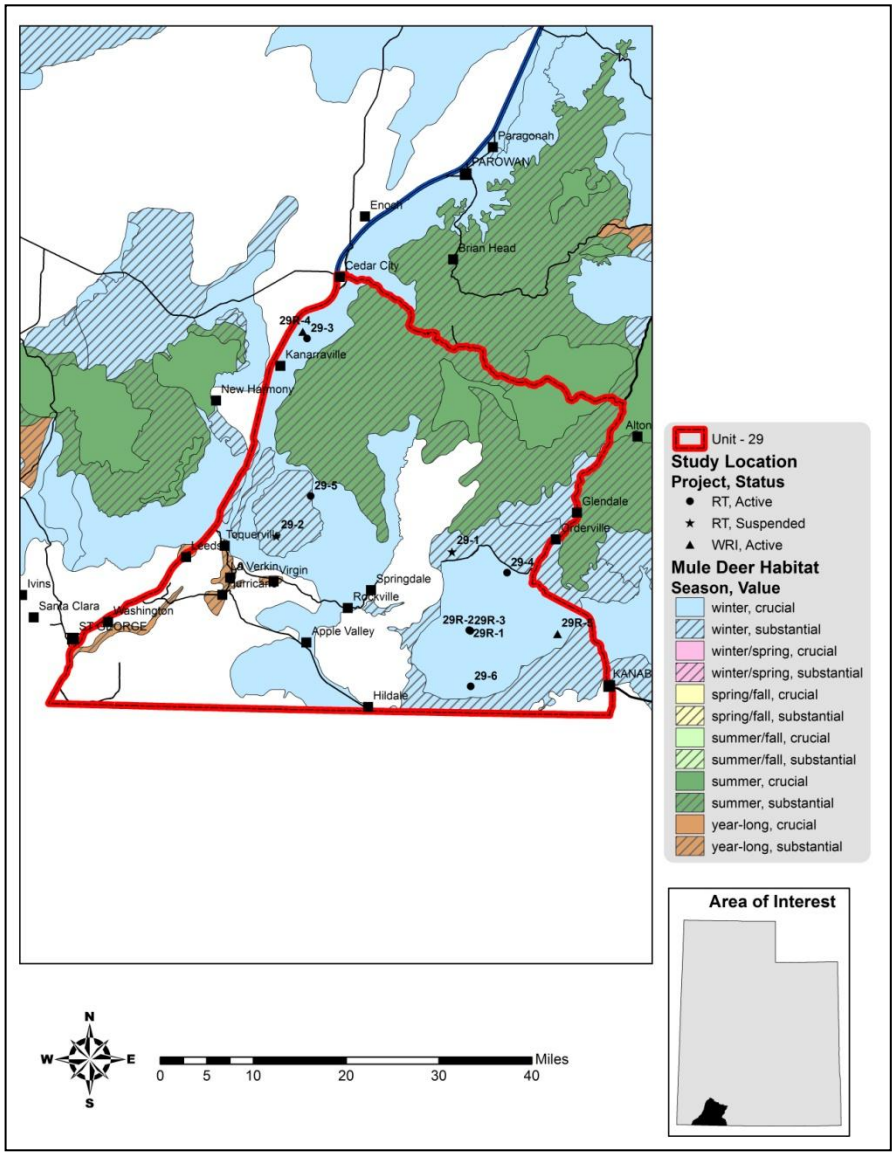


Figure 8.1: The 1982-2014l Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.).

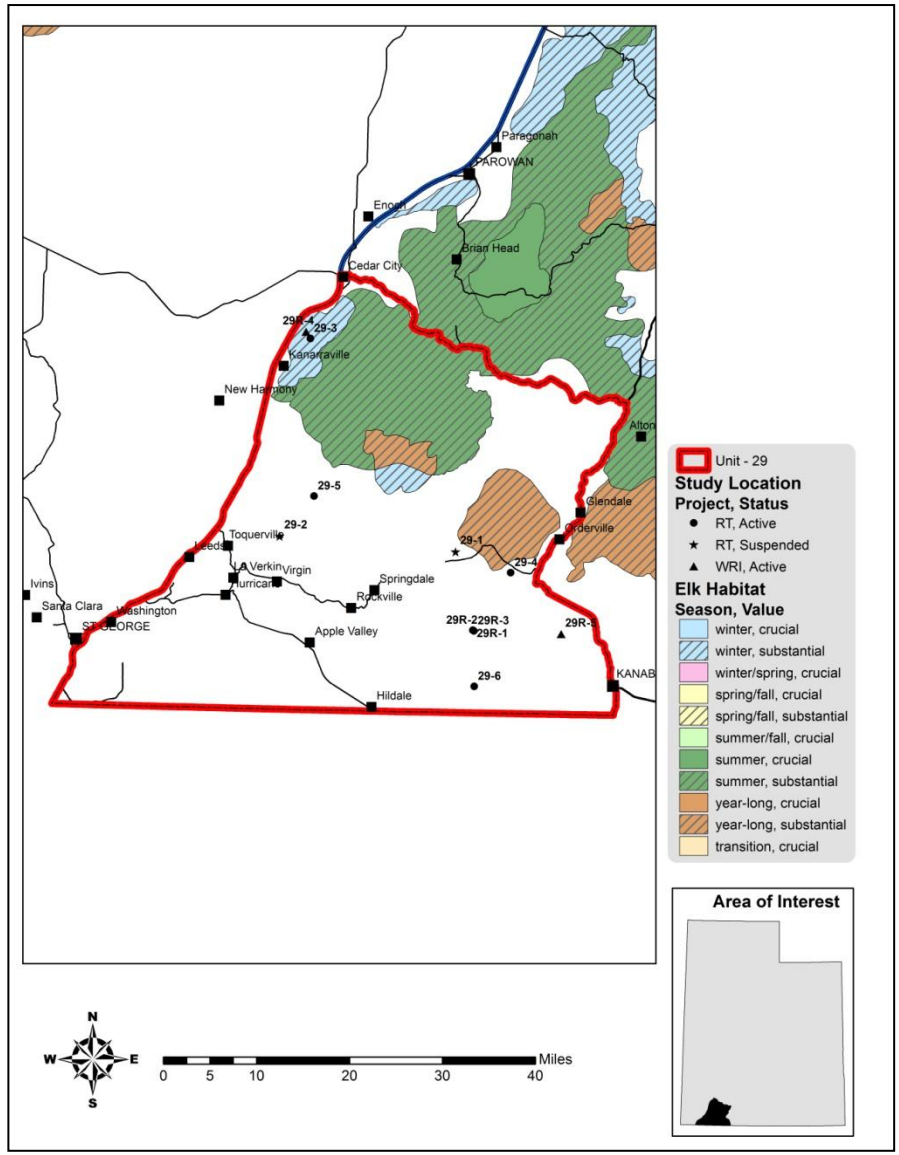
Big Game Habitat

Total mule deer range in the wildlife management unit is estimated at 786,593 acres with 15,496 acres classified as year-long range, 468,539 acres of this classified as winter range, and 302,558 acres classified as summer range (Table 8.1 and Map 8.2). Total elk range is estimated at 263,427 acres with 62,809 acres of this being classified as year-long range, 30,616 as winter range, and 170,002 as summer range (Table 8.1 and Map 8.3). There is a substantial amount of winter range for deer and elk, however, summer range is limiting for elk but not limiting for deer (Table 1). Most of the big game winter range in this unit is located on BLM, NPS, and private land holdings. Minor portions of the winter range in the unit occur on Utah State School Trust Lands, Tribal Lands, and USFS managed lands.

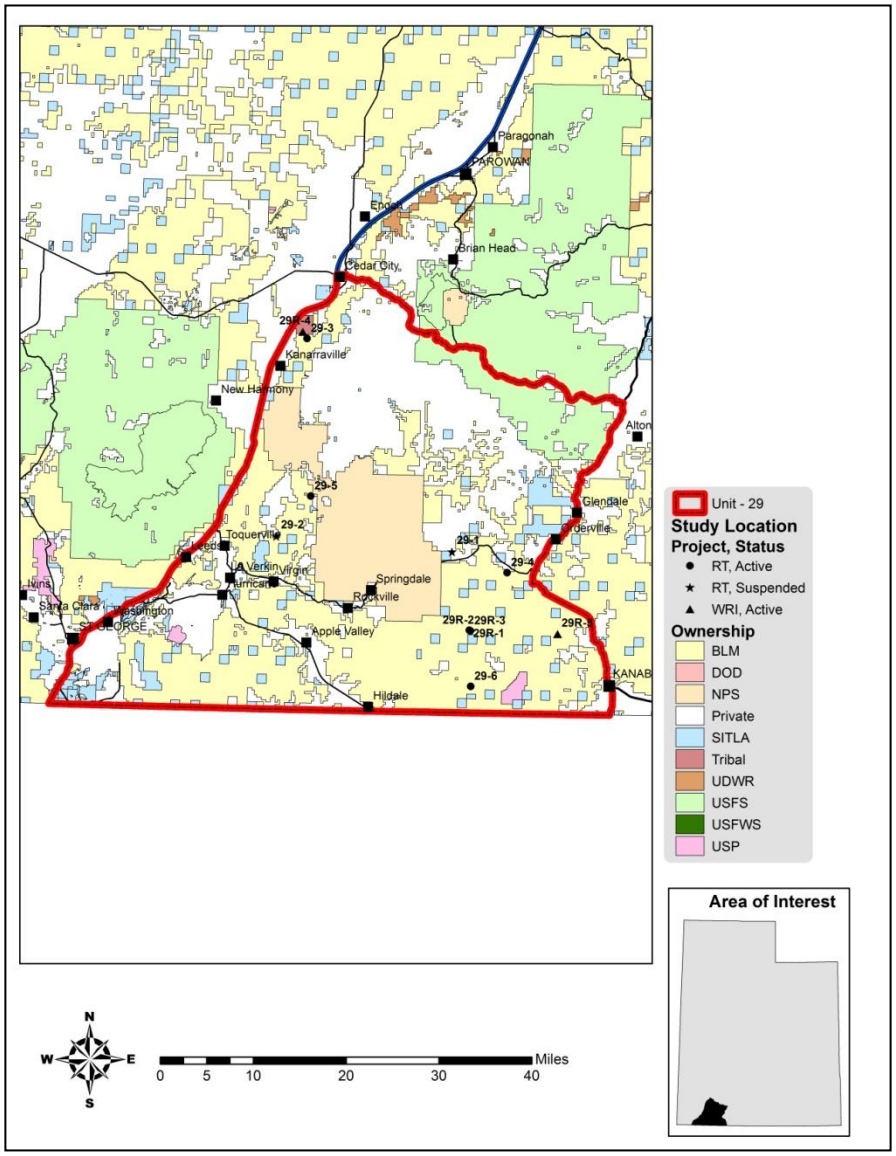
According to LANDFIRE Existing Vegetation Coverage models, important shrublands comprise around 35% of the deer winter range on the unit. The 34% of deer winter range is comprised of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) woodlands. While these woodlands provide valuable escape and thermal cover for wildlife, encroachment and invasion into historic shrublands reduces available browse and decreases the carrying capacity of the unit. Annual grasslands, primarily cheatgrass (*Bromus tectorum*), comprise a small proportion of the deer winter range and pose a minimal threat for wildfire. Other coverage types comprise a minimal proportion of the deer winter range (Table 8.4).



Map 8.2: Estimated mule deer habitat by season and value for WMU 29, Zion.



Map 8.3: Estimated elk habitat by season and value for WMU 29, Zion.



Map 8.4: Land ownership for WMU 29, Zion.

	Year-Long Range		Summer Range		Winter Range	
	Area (acres)	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	15,496	2%	302,558	39%	468,539	59%
Elk	32,809	24%	170,002	65%	30,616	12%

Table 8.1: Estimated mule deer and elk habitat acreage by season for WMU 29, Zion.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	0	0%	60,677	20%	1276	<1%
BLM	1,273	8%	17,834	6%	267,245	57%
SITLA	55	<1%	7110	2%	37,551	8%
Tribal Land	0	0%	0	0%	2,294	<1%
Private	14,169	91%	181,429	60%	88,230	19%
NPS	0	0%	35,809	12%	68,198	15%
UDOT	0	0%	0	0%	18	<1%
USP	0	0%	0	0%	3,727	1%
Total	**15,496**	**100%**	**302,558**	**100%**	**606,147**	**100%**

Table 8.2: Estimated mule deer habitat acreage by season and ownership for WMU 29, Zion.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	0	0%	12,526	7%	0	0%
BLM	21,860	35%	12,939	8%	14,572	48%
SITLA	7,324	12%	2,023	1%	2,389	8%
Private	33,441	53%	133,731	79%	5,963	19%
NPS	184	<1%	8,783	5%	5,604	18%
Tribal Land	0	0%		0%	2,088	7%
Total	**62,809**	**100%**	**392,551**	**100%**	**30,616**	**100%**

Table 8.3: Estimated elk habitat acreage by season and ownership for WMU 29, Zion.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Arctostaphylos patula Shrubland Alliance	20,670	1.87%	
	Coleogyne ramosissima Shrubland Alliance	23,783	2.16%	
	Colorado Plateau Blackbrush-Mormon-tea Shrubland	18,479	1.68%	
	Southern Colorado Plateau Sand Shrubland	11,258	1.02%	
	Inter-Mountain Basins Big Sagebrush Shrubland	46,614	4.23%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	19,064	1.73%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	9,197	0.83%	
	Inter-Mountain Basins Montane Sagebrush Steppe	4,330	0.39%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	14,520	1.32%	
	Mojave Mid-Elevation Mixed Desert Scrub	58,456	5.30%	
	Quercus gambelii Shrubland Alliance	22,786	2.07%	
	Quercus turbinella Shrubland Alliance	24,142	2.19%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	29,098	2.64%	
	Rocky Mountain Lower Montane-Foothill Shrubland	14,006	1.27%	
	Sonora-Mojave Creosotebush-White Bursage Desert Scrub	57,081	5.17%	
	Other Shrublands	13,298	1.21%	35.06%
Conifer	Abies concolor Forest Alliance	14,550	1.32%	
	Colorado Plateau Pinyon-Juniper Woodland	320,468	29.05%	
	Great Basin Pinyon-Juniper Woodland	54,021	4.90%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	2,709	0.25%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	3,728	0.34%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	20,922	1.90%	
	Southern Rocky Mountain Ponderosa Pine Woodland	30,816	2.79%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	35,685	3.23%	
	Other Conifer	2,459	0.22%	44.00%
Grassland	Native Grassland	25,705	2.33%	2.33%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	24,784	2.25%	
	Other Exotic Herbaceous	579	0.05%	2.30%
Exotic Tree-Shrub	Introduced Riparian Vegetation	2,020	0.18%	0.18%
Other	Hardwood	44,228	4.01%	
	Riparian	19,580	1.77%	
	Agricultural	18,028	1.63%	
	Developed	23,347	2.12%	
	Other	72,681	6.59%	16.12%
Total		1,103,093		

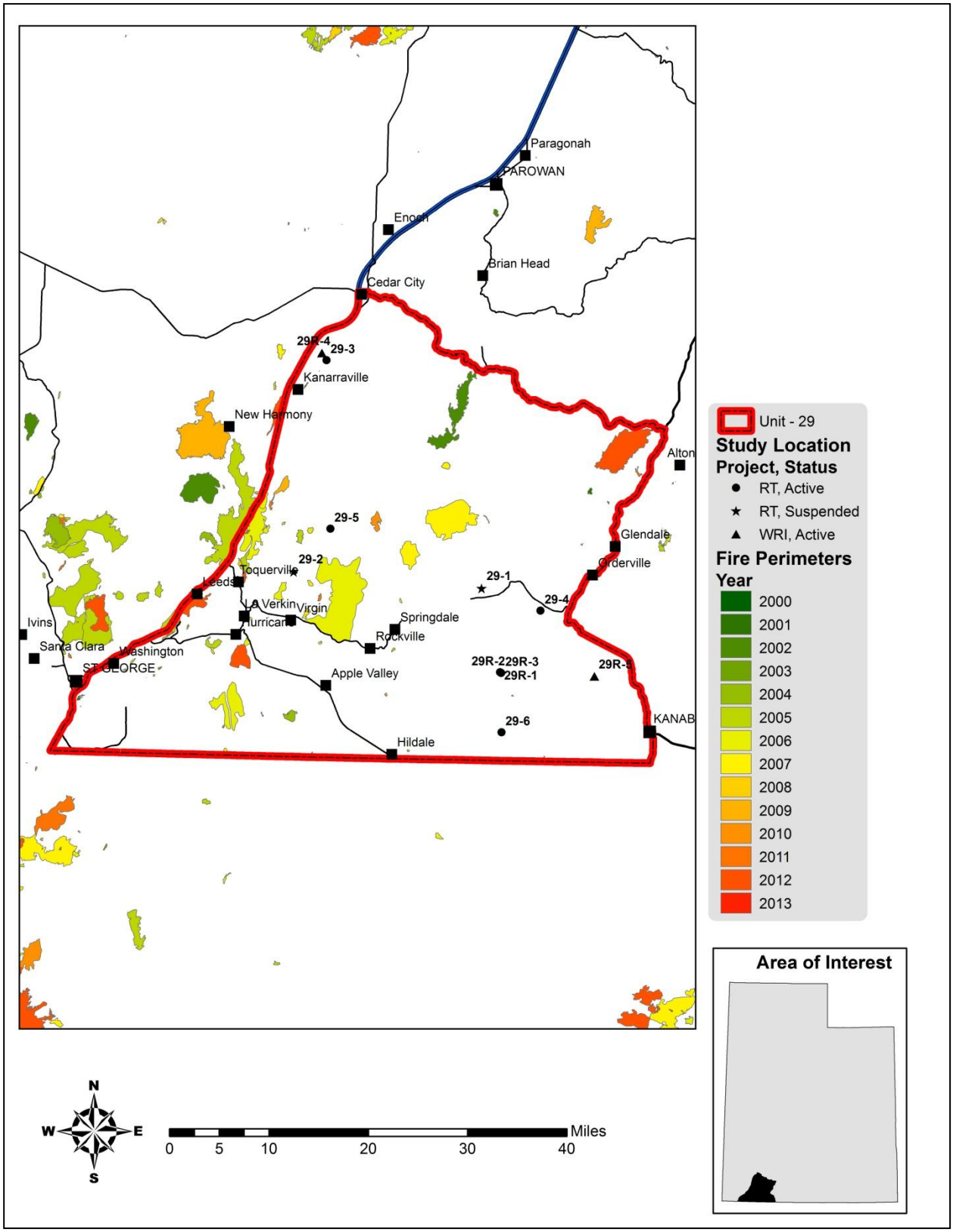
Table 8.4: LANDFIRE existing vegetation coverage (LANDFIRE: LANDFIRE 1.2.0, 2010) of deer winter range for WMU 29, Zion.

Limiting Factors to Big Game Habitat

Winter range is a limiting factor on the west side of the Zion Unit from Cedar City south to Toquerville where it is adjacent to I-15. Pinyon-juniper encroachment, browse decadence, and invasion of cheatgrass are diminishing the winter range condition on the unit. In addition, the majority of the summer range occurs on private land with increased summer home development becoming more of a management problem.

Wildfire has also had an impact on the deer winter range in the unit. The Kolob fire of 2006 was the largest wildfire in the unit at 17,631 acres, and burned almost entirely within the western boundary of Zion National Park. The Ranch fire of 2006 burned 6,108 acres of deer winter range on the west side of the unit near Pintura. The Shingle fire of 2012 and Big Wash fire of 2002 burned several thousand acres each of deer summer range in the northern portion of the unit. There have been other large fires that have occurred within the unit boundaries but did not occur on deer habitat. All other recent fires burned less than 1,000 acres and have had negligible impact on deer winter range (Map 8.5).

Encroachment by pinyon-juniper woodland communities also poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 29 (Table 8.4). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife (Miller, Svejcar, & Rose, 2000).

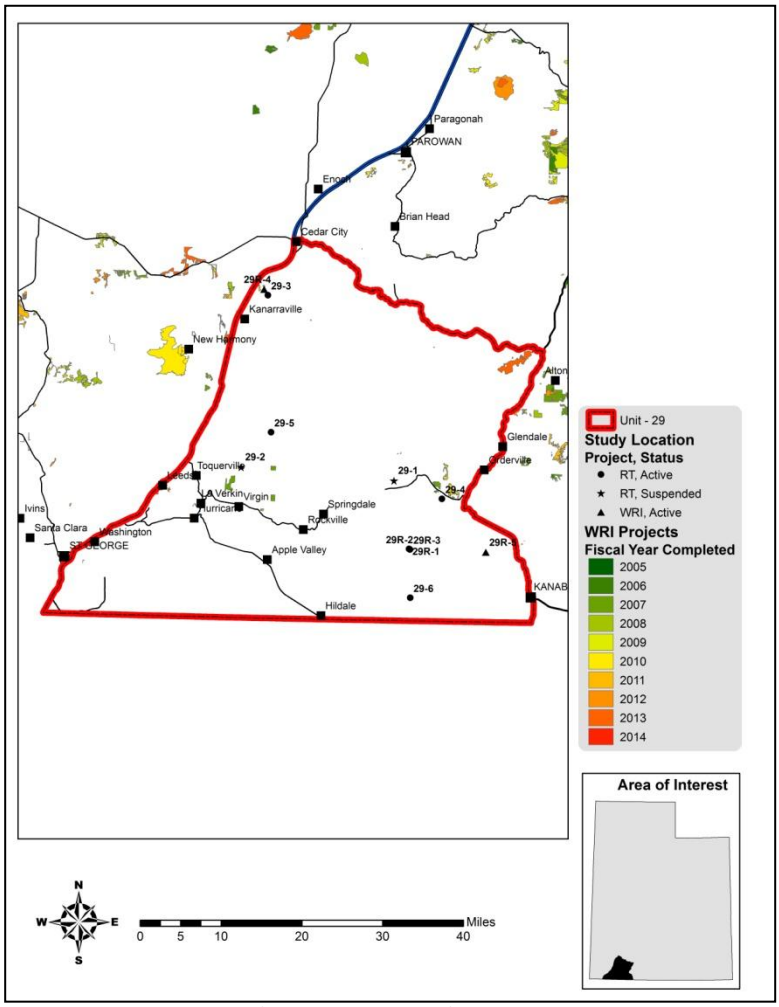


Map 8.5: Land coverage of fires by year from 2001-2013 for WMU 29, Zion.

Treatments/Restoration Work

A total of 5,509 acres of land have been treated within the Zion unit since the WRI was implemented in 2004. As seen on the map, treatments frequently overlap one another bringing the total treatment acres to 8,329 acres for this unit (Map 8.6). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

Treatments to reduce pinyon-juniper woodlands such as bullhog, PJ push, and lop-and-scatter are among the most common management practices. The use of seeding to supplement the herbaceous understory is also very common. Other common management practices are those to rejuvenate sagebrush stands such as disking, and harrow treatments (Table 8.5).



Map 8.6: WRI treatments by fiscal year completed for WMU 29, Zion.

Treatment Action	Acres
Bullhog	1,150
Disc	349
Harrow	45
Herbicide	37
PJ push	394
Seeding (primary)	5,451
Seeding (secondary/shrub)	866
Lop and Scatter	37
***Total Land Area Treated**	**5,509**
Total Treatment Acres	**8,329**

Table 8.5: WRI treatment action size (acres) for WMU 29, Zion.

*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 29 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (Table 8.6). Due to changes in sampling methodologies, only data sampled following the 1992 sample year are included in this summary. Due to the long-term nature of the studies, many of the Range Trend studies have had some sort of disturbance or treatment prior to or since study establishment (Table 8.7).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
29-1	Wilson Ranch	RT	Suspended	'87 '92 '98	Not Verified
29-2	Smith's Mesa	RT	Suspended	'98 '03, '08	Not Verified
29-3	North Hills	RT	Active	'98 '03, '08,'13	Upland Loam (Mountain Big Sagebrush)
29-4	Barracks Chaining	RT	Active	'03, '08,'13	Upland Loam (Mountain Big Sagebrush)
29-5	Kolob Terrace	RT	Active	'13	Upland Loam (Mountain Big Sagebrush)
29-6	Elephant Butte	RT	Active	'13	Upland Sand (Mountain Big Sagebrush)

Table 8.6: Range trend and WRI project studies monitoring history and ecological site potential for WMU 29, Zion.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
29-3	North Hills	Chaining		1967		
		Seeding		1967		
		Lop and Scatter		2008-2013		
29-4	Barracks Chaining	Chaining		Historic		
		Seeding		Historic		

Table 8.7: Range trend and WRI studies known disturbance history for WMU 29, Zion.

Study Trend Summary (Undisturbed Sites)

Upland (Mountain Big Sagebrush)

There are three studies [Barracks Chaining (29-4), Kolob Terrace (29-5), and Elephant Butte (29-6)] classified as Upland (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 8.6). Barracks Chaining and Elephant Butte are on the east side of the unit with Barracks Chaining just west of the Mt Carmel junction and Elephant Butte north of the Utah/Arizona border. Kolob Terrace is just outside the western border of Zion National Park.

Shrubs/Trees: The primary browse on all three of these studies is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), antelope bitterbrush (*Purshia tridentata*), and Gambel oak (*Quercus gambelii*). The Elephant Butte study is the exception to having mountain big sagebrush, but has basin big sagebrush on the site. The mean line-intercept cover of sagebrush appears to increase over time but this is due to the addition of the Elephant Butte site in 2013, which has almost 30% sagebrush cover. The average height of mountain big sagebrush on all of the studies is just over 1.5 feet tall, making browse mostly available through much of the year in normal winters. Barracks Chaining, the only site recorded in the first two years does experience an increase in density from less than 100 plants/acre in 2003 to over 700 plants/acre in 2008. Density of young sagebrush was high in 2008 while the demographics of the sagebrush populations in 2013 was more of a mixture of young, mature, and decadent plants (Figure 8.2).

Kolob Terrace does not have any trees recorded on the site while Elephant Butte has a moderate amount of trees and was added in 2013. The mean density of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus*

osteosperma) trees has decreased slightly over time, while mean tree cover has increased. This suggests that infilling is occurring on these sites which poses a threat to shrub and herbaceous cover (Figure 8.3).

Herbaceous Understory: With the exception of Barracks Chaining, there is very little herbaceous understory on these study sites. Although frequency and cover are low, diversity is moderate. Annual grass is present on all three sites but remains fairly low in cover. Both annual and perennial fob cover are low on all of the sites (Figure 8.4).

Occupancy: Pellet group transect data indicates that deer predominately occupy these studies. The mean abundance of deer pellet groups has ranged from a high of almost 90 days use/acre in 2013 to a low of 42 days use/acre in 2003. Elk and cattle pellet groups are typically sampled in low abundance on both study sites (Figure 8.5).

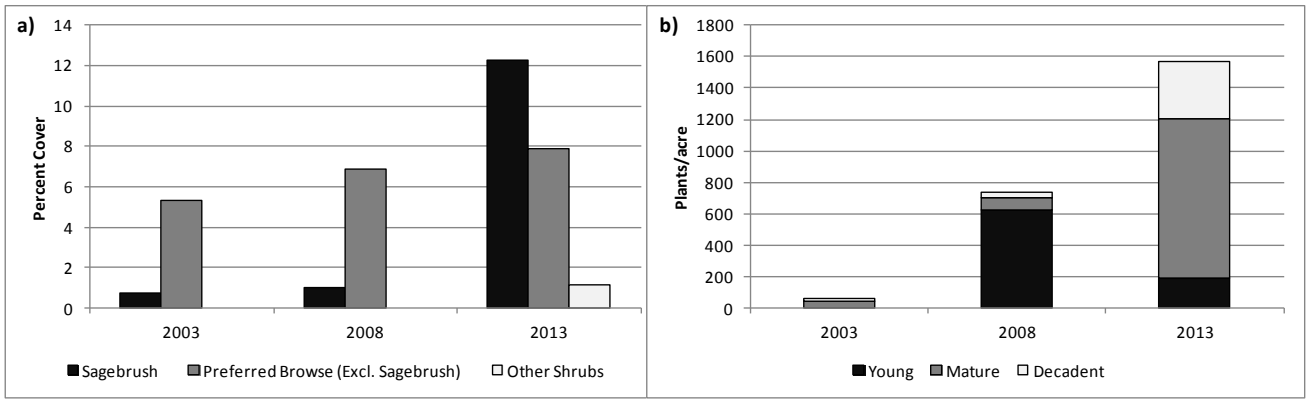


Figure 8.2: Shrub summary of the Upland (Mountain Big Sagebrush) study (n=3) for WMU 29, Zion. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

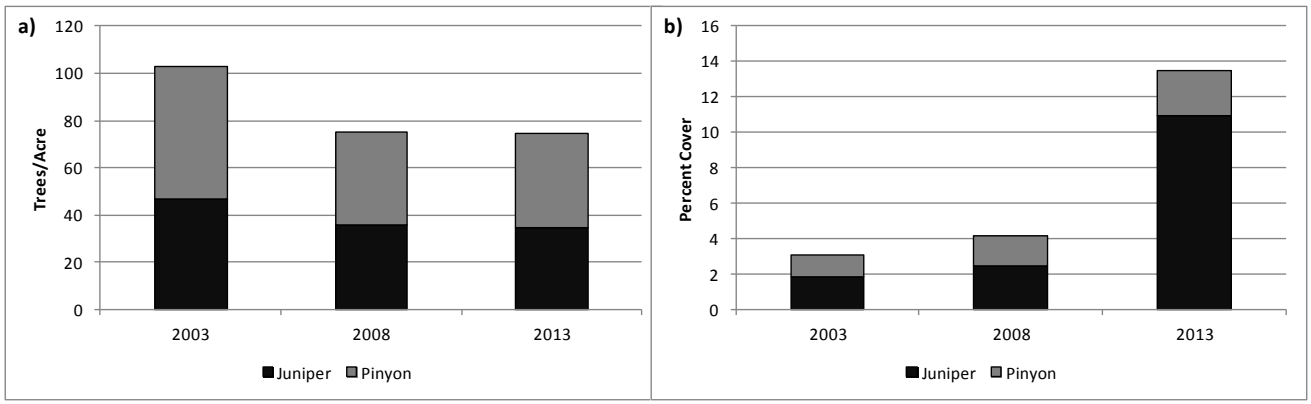


Figure 8.3: Tree summary of the Upland (Mountain Big Sagebrush) study (n=3) for WMU 29, Zion. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

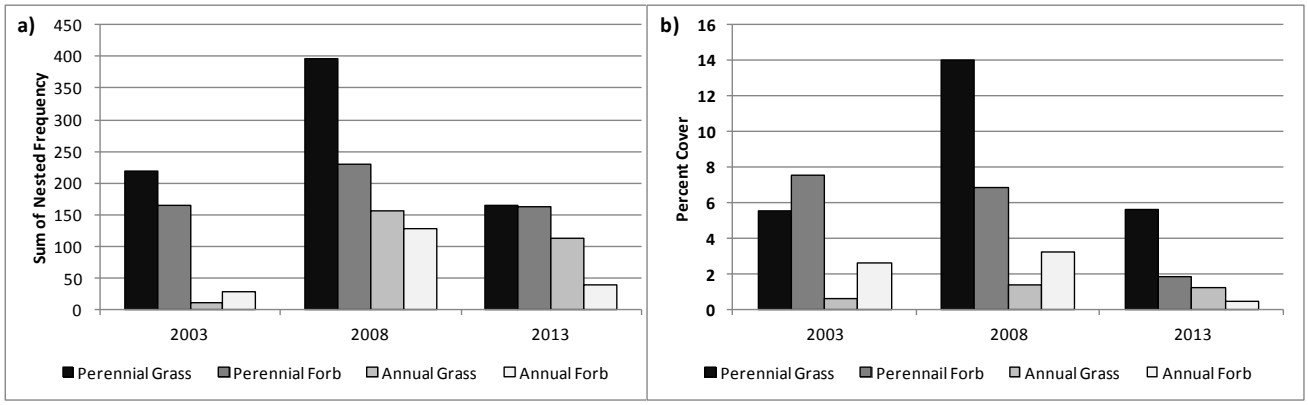


Figure 8.4: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) study (n=3) for WMU 29, Zion. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

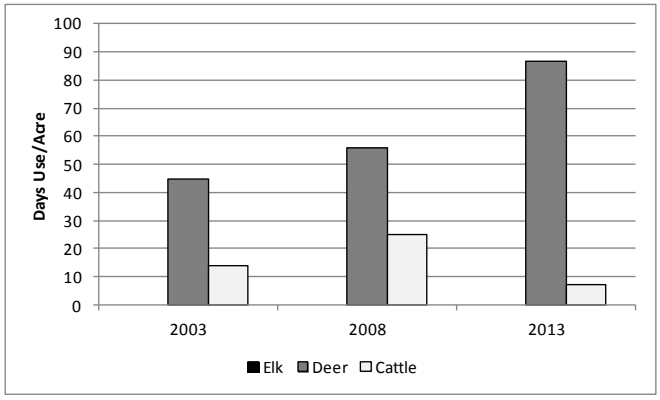


Figure 8.5: Mean pellet transect data for the Upland (Mountain Big Sagebrush) study (n=3) for WMU 29, Zion.

Study Trend Summary (Treated/Disturbed Sites)

Lop and Scatter

There is one site [North Hills (29-3)] that was treated with lop and scatter during the report period (Table 8.7). This study is located between Kanarraville and Cedar City. This study is classified as an Upland (Mountain Big Sagebrush) ecological site (Table 8.6). Generally, the target of the lop and scatter treatments is to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on this study is mountain big sagebrush with some preferred shrubs like Utah service berry (*Amelanchier utahensis*) and Gambel oak present as well. Pinyon-juniper encroachment was still in phase I and had yet to impact sagebrush substantially, as mean line-intercept of sagebrush was around 12%. The mean cover of sagebrush decreased following treatment from 12% to 10% (Figure 8.6a). The mean density of sagebrush plants increased by a couple of hundred plants per acre after treatment. The changes in sagebrush population demographics transitioned from more mature and decadent plants before treatment to more mature and young plants after treatment (Figure 8.6b). It is expected that with the improved recruitment and health of the sagebrush following treatment, that the sagebrush will begin to increase on the treatment site.

The mean density of pinyon pine and Utah juniper trees was over just over 60 trees/acre pre-treatment. The mean tree density decreased to just under 50 trees/acre following treatment (Figure 8.7a). Remaining density and cover is generally provided by young trees that were left standing.

Herbaceous Understory: The herbaceous understory was fairly low prior to treatment of this site. Following treatment there was an increase in across functional groups. Perennial grass species had the largest response

increasing in cover. However, the dominant perennial grass species is crested wheatgrass (*Agropyron cristatum*), which could decrease the diversity of the herbaceous understory. Cheatgrass, the annual invasive grass was also present on this site, but with cover less than 1% (Figure 8.8).

Occupancy: Pellet group transect data indicates that deer primarily occupy this study site. The mean abundance of pellet groups of deer has been about 60 days use/acre prior to treatment but dropped to just over 20 days use/acre following treatment (Figure 8.9).

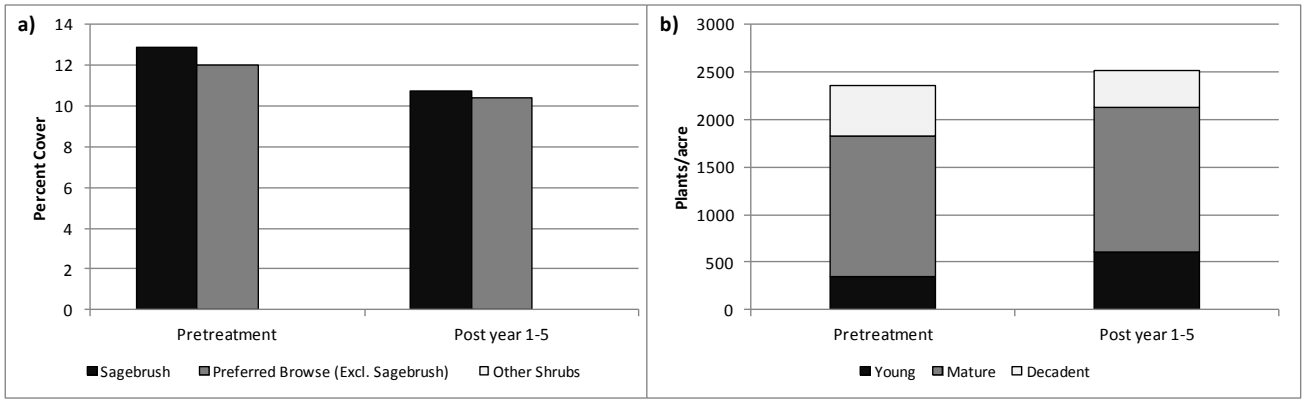


Figure 8.6: Shrub summary of the Lop and Scatter treatment study (n=1) for WMU 29, Zion. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

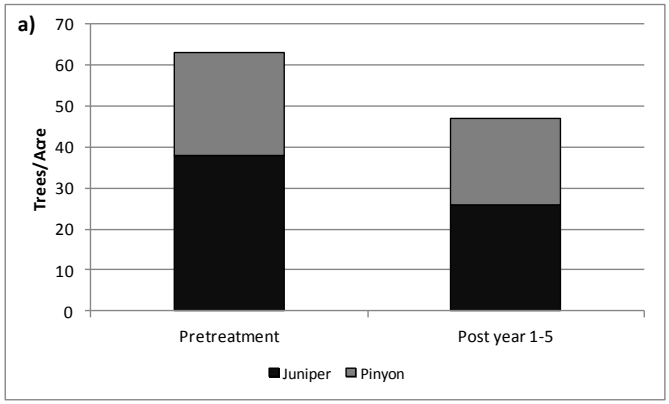


Figure 8.7: Tree summary of the Lop and Scatter treatment study (n=1) for WMU 29, Zion. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*).

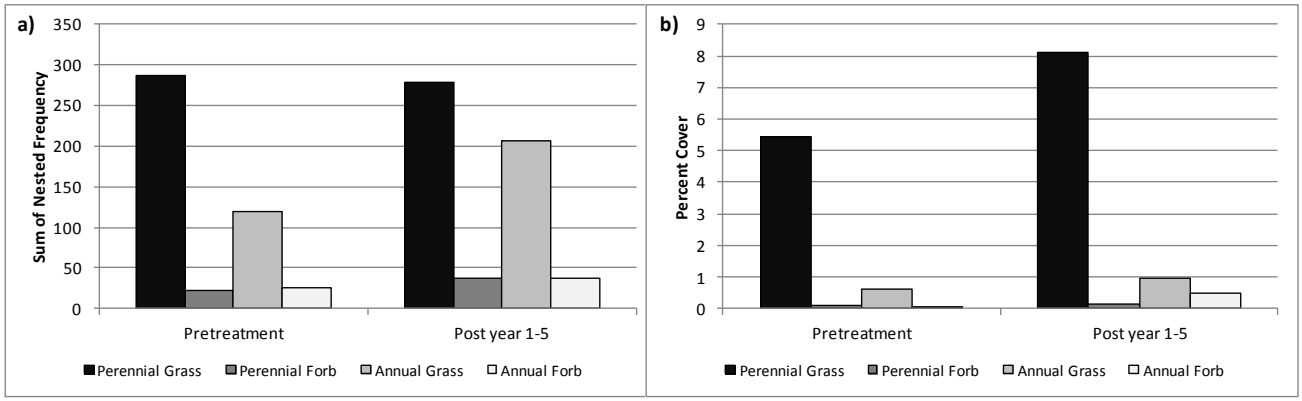


Figure 8.8: Herbaceous functional group summary of the Lop and Scatter treatment study (n=1) for WMU 29, Zion. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

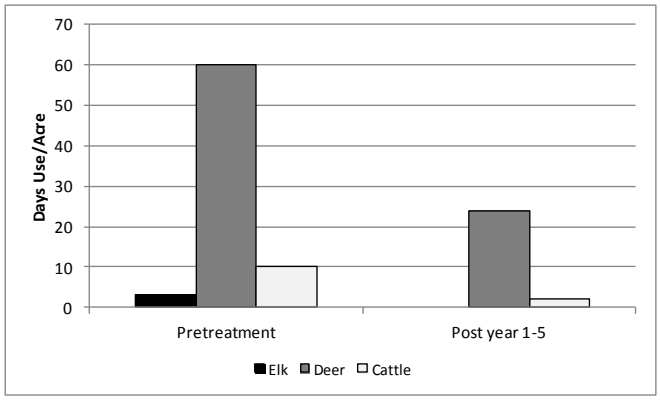


Figure 8.9: Mean pellet transect data for the Lop and Scatter treatment study (n=1) for WMU 29, Zion.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Zion management unit has varied on these studies sites since 2008. Barracks Chaining has gone from very poor to fair to poor, mainly due to sagebrush density and demographics. Kolob Terrace and Elephant Butte were added in 2013 and were considered fair and very poor respectively (Figure 8.10). The disturbed site, North Hills, was considered fair prior to treatment and good after treatment. This improvement can be contributed to a diversification of the sagebrush population demographics as well as an increase in perennial grasses (Figure 8.11). At the last reading most sites were considered poor to fair (Map 8.7 and Table 8.8).

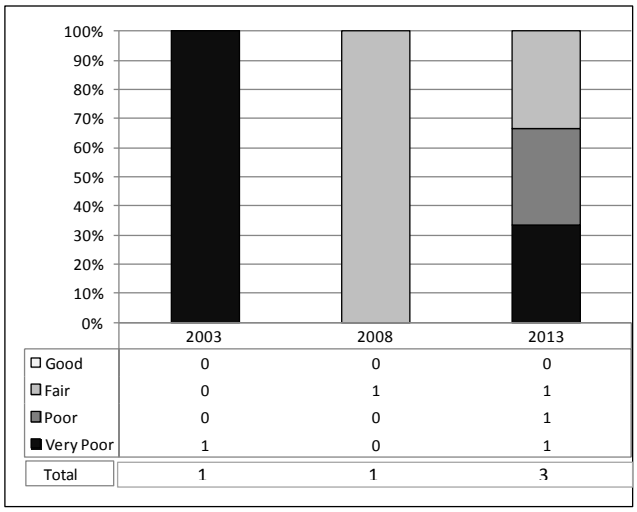


Figure 8.10: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 29 Zion.

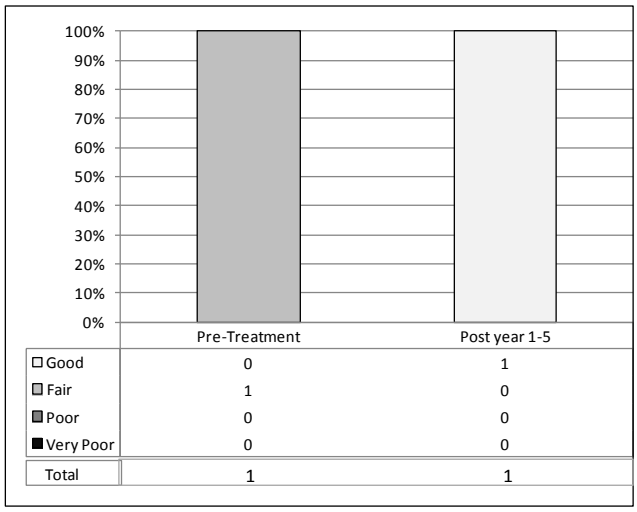
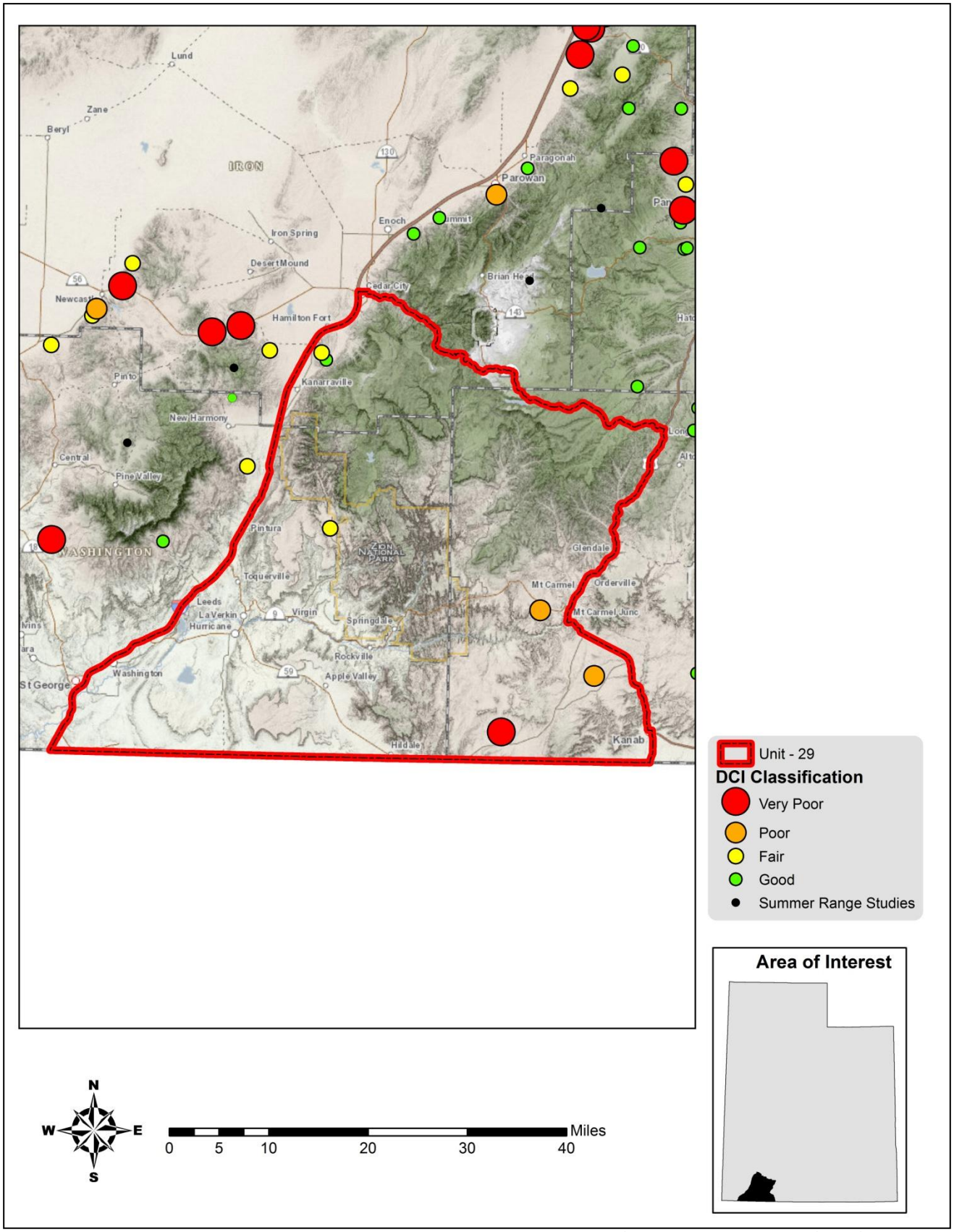


Figure 8.11: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 29, Zion.



Map 8.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 29, Zion.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
29-3	North Hills	Introduced Perennial Grass	Moderate-High	Reduced diversity of desirable grass and forb species.
		Annual Grass	Low	Increased fire potential.
29-4	Barracks Chaining	Introduced Perennial Grass	Moderate-High	Reduced diversity of desirable grass and forb species.
		Annual Grass	Low	Increased fire potential.
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor.
29-5	Kolob Terrace	Annual Grass	Low	Increased fire potential.
29-6	Elephant Butte	PJ Encroachment	Moderate	Reduced understory shrub and herbaceous vigor.

Table 8.8: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 29, Zion. All assessments are based off of the most current sample date for each study site.

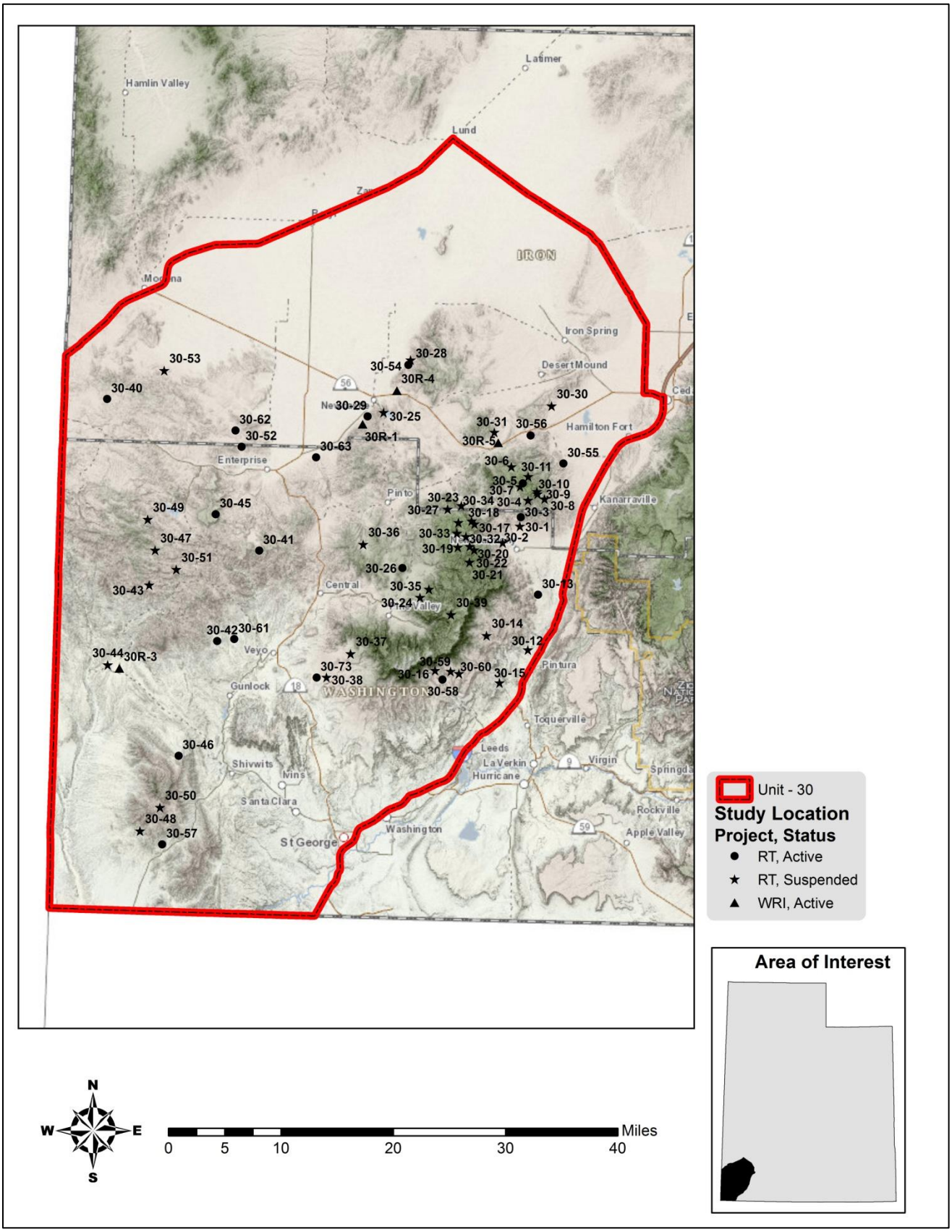
Discussion and Recommendations

Upland (Mountain Big Sagebrush)

The mid elevation upland sites which support mountain big sagebrush communities are generally considered to be in very poor to good condition for deer winter range habitat on this unit. These communities support robust shrub populations that provide valuable browse in mild and moderate winters. These sites appear to be prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. In addition, introduced perennial grasses are often the dominant herbaceous component on these study sites. While providing valuable forage, these grass species can often be aggressive at higher elevation and precipitation and can reduce the abundance of other more desirable native grass and forb species. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire within these communities.

It is recommended that work to reduce pinyon-juniper encroachment should continue in these communities. Care should be taken in selecting treatment methods that will not increase annual grass loads. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible. Treatments to reduce annual grass may be necessary on some sites. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

9. WILDLIFE MANAGEMENT UNIT 30 - PINE VALLEY



WILDLIFE MANAGEMENT UNIT 30 - PINE VALLEY

Boundary Description

Iron and Washington counties - Boundary begins at I-15 and the Utah-Arizona state line; north on I-15 to SR-56; west on SR-56 to the Lund Highway; northwest along the Lund Highway to the Union Pacific railroad tracks at Lund; southwest on the Union Pacific railroad tracks to the Utah-Nevada state line; south on this state line to the Utah-Arizona state line; west on this state line to I-15.

Management Unit Description

Geography

The Pine Valley wildlife management unit is located in the southwest corner of Utah. It includes three physiographic regions: Mojave Desert, Great Basin, and Colorado Plateau. The Mojave Desert is located in the southern portion of the unit. The Great Basin is located in the central and northern sections of the unit. The eastern section of the unit, mainly the Pine Valley Mountains and Harmony Mountains, are on the western edge of the Colorado Plateau. These physiographic regions have a diverse array of vegetation communities and transitional communities that are important areas for wildlife.

The Pine Valley wildlife management unit includes several mountain ranges. These include the Pine Valley Mountain range, Harmony Mountains, Cove Mountain, Atchinson Mountain, Bull Valley Mountains, McFarlane Mountain, Mineral Mountain, Bull Mountain, Beaver Dam Mountains, Antelope Range, Iron Mountain, Swett Hills, and Eightmile Hills. The highest point in the unit is Signal peak at 10,365 feet, which is located on the south end of the Pine Valley Mountains. The lowest area in the unit is located in the southern portion of the unit in the Mojave Desert at 2,220 feet. The major cities and towns located within the unit include Cedar City, St George, Enterprise, Veyo, Newcastle, New Harmony, Central, and Pine Valley.

Climate Data

The 30-year (1981-2010) annual precipitation PRISM model shows precipitation ranges on the unit from 7 inches on the southern part of the unit to 35 inches on the high elevation peaks of the Pine Valley Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within the 11-31 inch precipitation zone (Map 9.1) (PRISM Climate Group, Oregon State University, 2013).

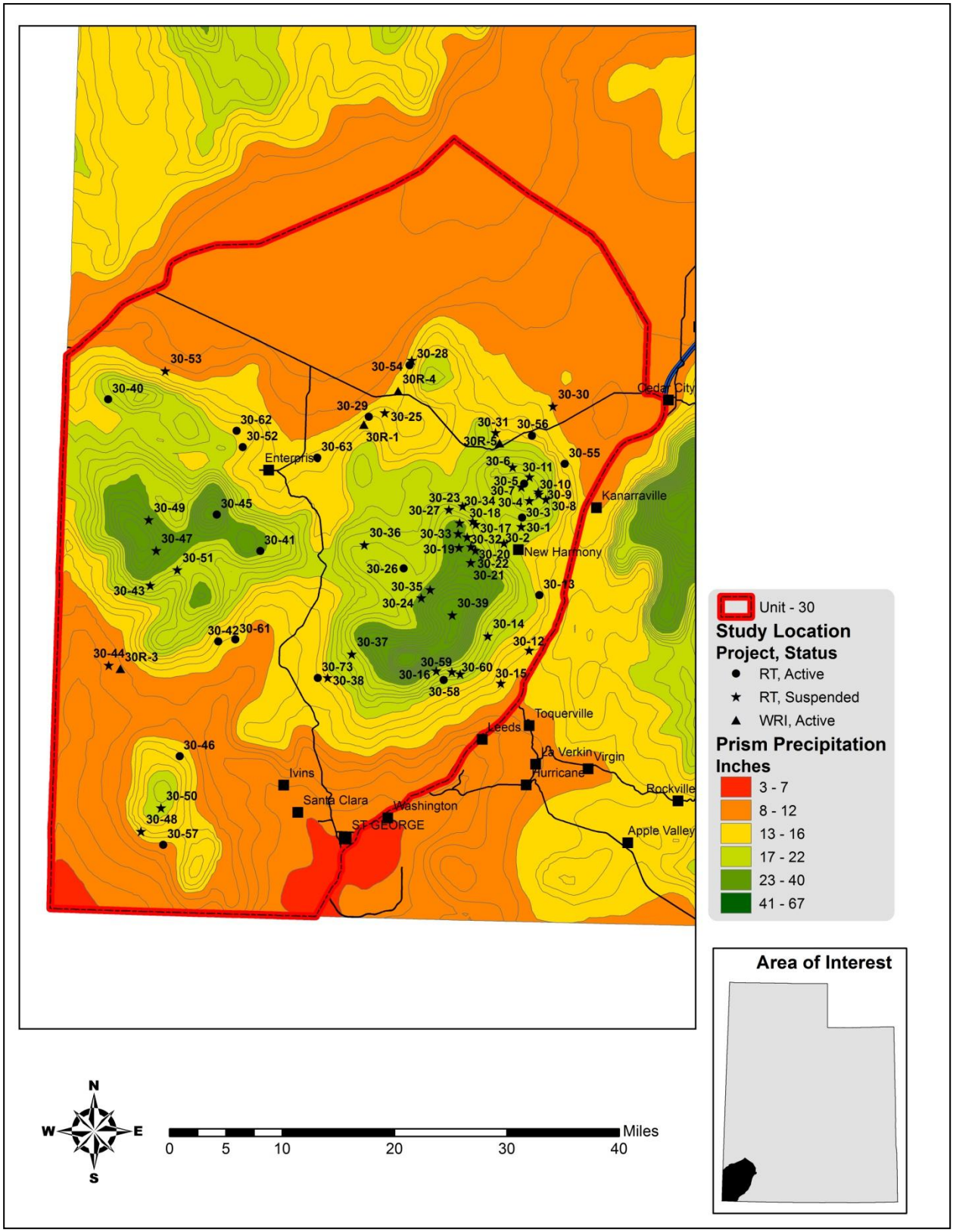
Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit were compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Western (Division 1), Dixie (Division 2), and South Central (Division 4) divisions.

The mean annual PDSI of the Western division displayed years of moderate to extreme drought from 1989-1990, 2000-2003, 2007-2008, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1993, 1995, 1997-1998, 2005, and 2011 (Figure 9.1a). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1991, 2000, 2002-2004, 2007-2008, and 2012-2013; and displayed years of moderate to extreme wet years in 1983-1986, 1993, 1995, 1998, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2001-2003, 2007-2008, and 2012; and displayed years of moderate to extreme wet years in 1982-1984, 1997-1998, and 2011 (Figure 9.1b) (Time Series Data, 2014).

The mean annual PDSI of the Dixie division displayed years of moderate to extreme drought from 1989-1990, 1996, 1999-2000, 2002-2003, 2006-2007, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1983, 1993, 1995, 1998, and 2005 (Figure 9.1c). The mean spring

(March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 1999-2000, 2002-2004, 2007, and 2012-2013; and displayed years of moderate to extreme wet years in 1983, 1992-1993, 1995, 1998, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 1999-2003, and 2006-2009; and displayed years of moderate to extreme wet years in 1983 and 1997-1998 (Figure 9.1d) (Time Series Data, 2014).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 1989-1990, 2002-2003, and 2012-2013. The mean annual PDSI displayed years of moderate to extreme wet years from 1982-1985, 1997-1998, 2005, and 2011 (Figure 9.1e). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1989-1990, 1996, 2002-2004, and 2013; and displayed years of moderate to extreme wet years in 1982-1985, 1993, 1995, 1999, 2001, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 1989-1990, 2002-2003, 2007, 2009 and 2012; and displayed years of moderate to extreme wet years in 1982-1985, 1997-1998, 2008 and 2011 (Figure 9.1f) (Time Series Data, 2014).



Map 9.1: The 1981-2010 PRISM Precipitation Model for WMU 30, Pine Valley (PRISM Climate Group, Oregon State University, 2013).

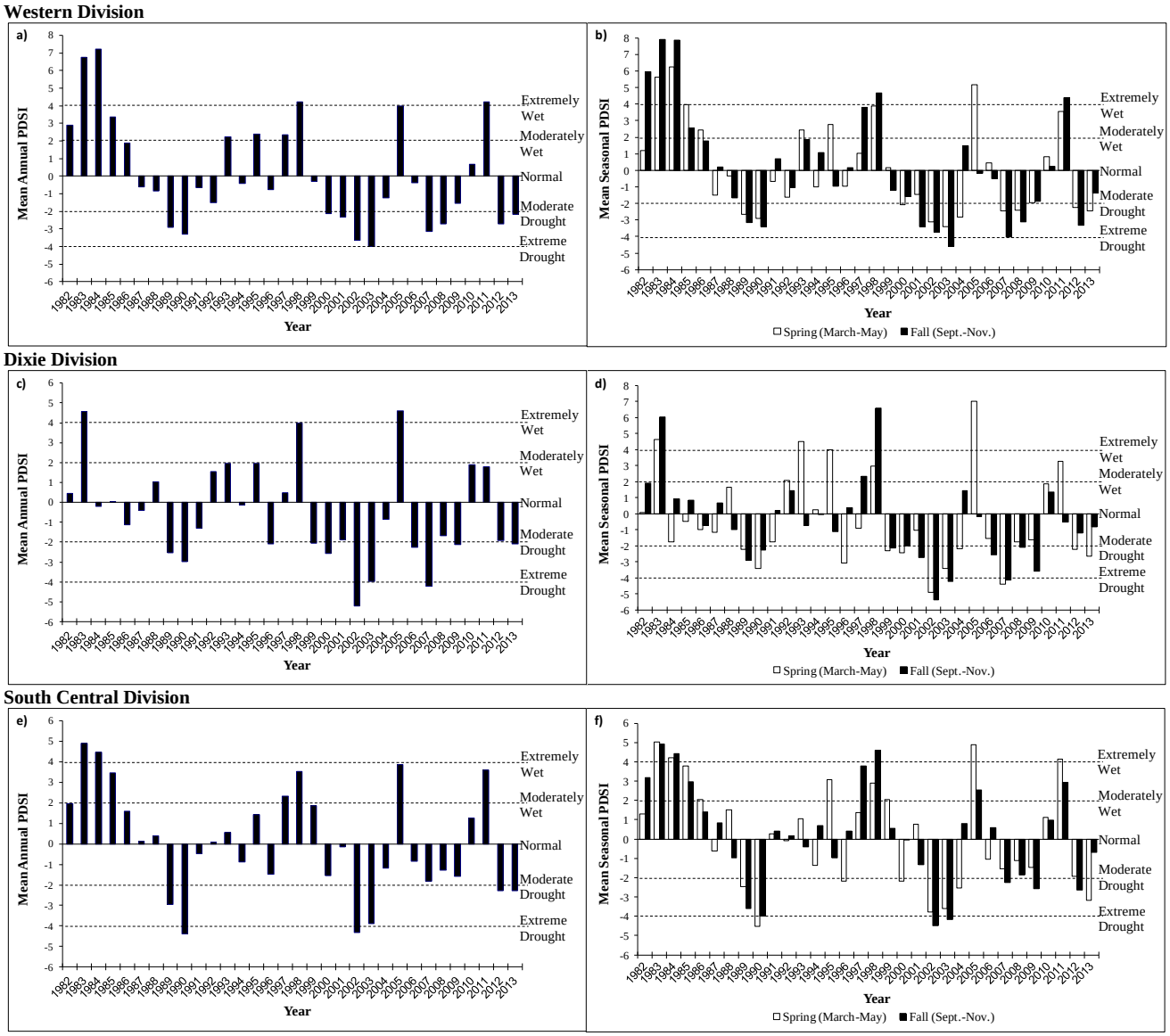


Figure 9.1: The 1982-2014 Palmer Drought Severity Index (PDSI) for the Western, Dixie, and South Central division (Divisions 1, 2, and 4). The PDSI is based on climate data gathered from 1895 to 2013. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to2.9 = Moderately Wet, 1.0 to 1.9 = Slightly Wet, 0.5 to 0.9 = Incipient Wet Spell, 0.4 to -0.4 = Normal, -0.5 to -.9 = Incipient Dry Spell, -1.0 to -1.9 = Mild Drought, -2.0 to -2.9 = Moderate Drought, -3.0 to -3.9 = Severe Drought and ≤-4.0 = Extreme Drought (Time Series Data 2014). a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2014).

Big Game Habitat

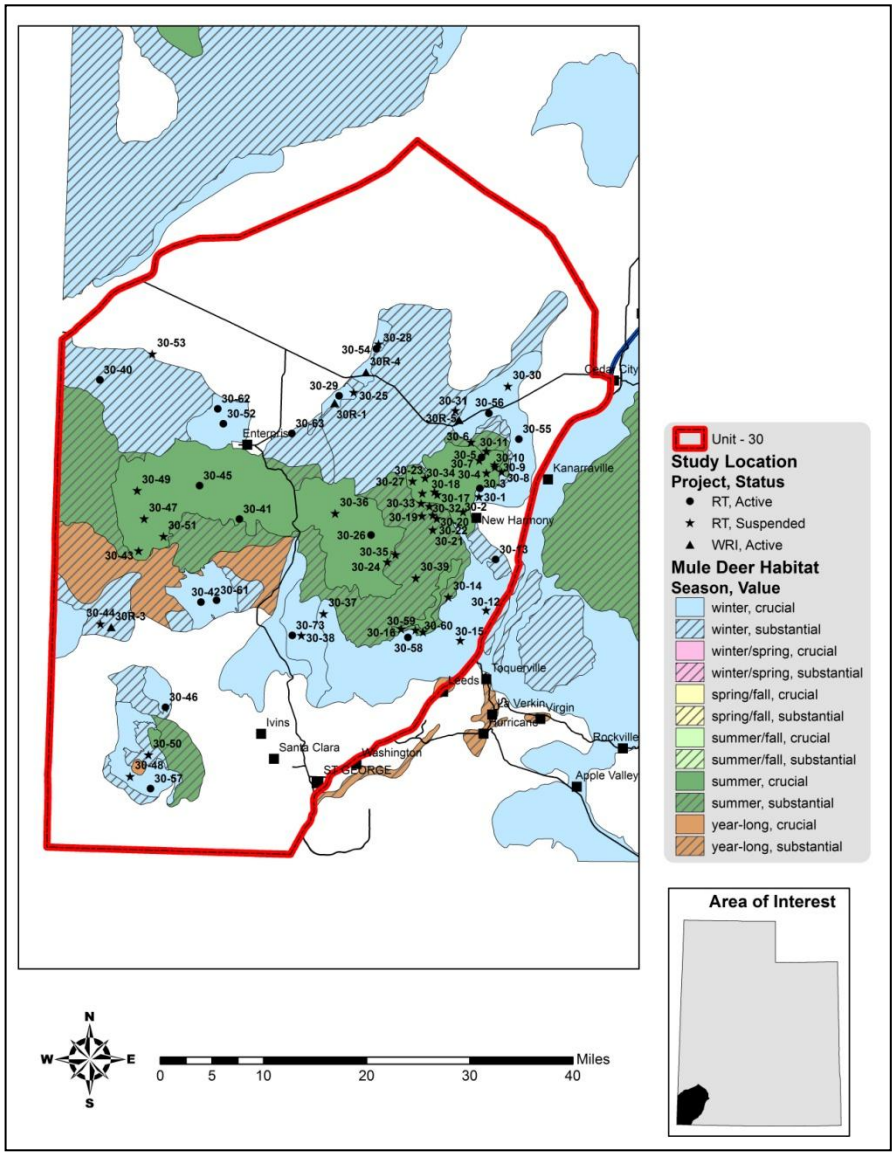
This unit was divided into 3 subunits; 30A West Pine Valley, 30B Comanche, and 30C Pine Valley/Browse prior to 1992. All subunits (A, B, and C) were combined for deer in 2001. Unit 30 contains approximately 339,899 acres of deer summer range, 82% of which in managed by the U.S. Forest Service as part of the Dixie National Forest. Deer winter range encompasses 466,936 acres, 37% of which occurs on Forest Service lands and 46% occurs on lands administered by the Bureau of Land Management. Elk habitat is not found within the Pine Valley unit (Table 9.1 and Map 9.2).

Summer range is confined to elevations above 6,000 to 6,500 feet on the New Harmony and Pine Valley Mountains. The summer range consists of dense conifers with a few aspen clones and dry meadows at higher elevations and mixed oak brush, mountain brush, southern desert shrub, and sagebrush-grass at lower elevations. Part of the summer range is within the officially designated wilderness area. The vegetation

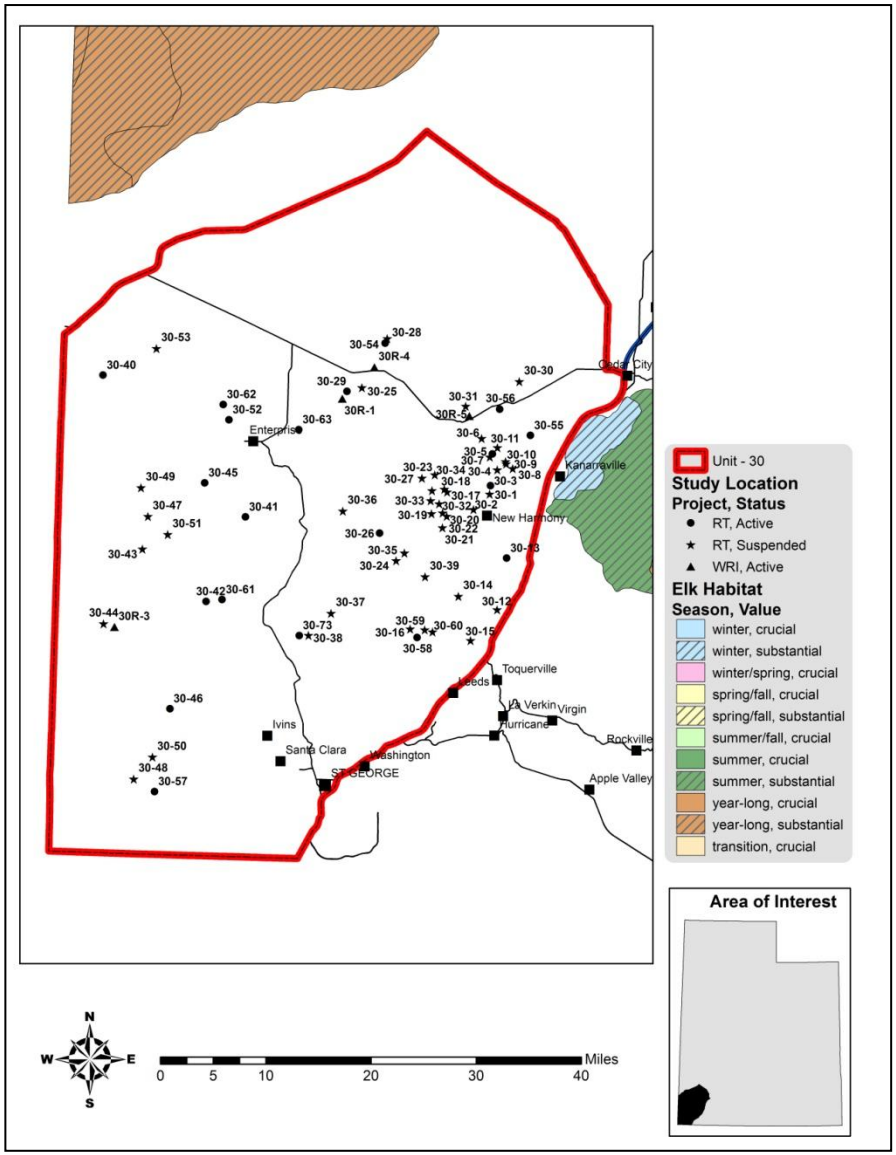
characteristics of the Harmony Mountain and lower slopes of Pine Valley are principally oak brush and mountain brush. Aspen and conifer are common on the higher portions of the Pine Valley Mountains, but much less prevalent on the Harmony Mountains. Sagebrush-grasslands and meadows can be found at the summit of the Harmony Mountains. These areas are important for deer during a short period in the summer months. However, these areas have been heavily impacted by cattle. Many similar sagebrush grasslands and meadows occur on the northern end of the Pine Valley Mountains. Summer deer concentrations are primarily on Harmony Mountain and the north end of the Pine Valleys. Relatively, few deer summer south of Big Point within unit 30.

Herd unit 30 winter range varies greatly, depending upon elevation. North of the Great Basin-Colorado River divide, pinyon-juniper and sagebrush-grass predominate. South of the divide, pinyon-juniper is still prevalent but there are increasing amounts of desert shrub dominated by shrub live oak (*Quercus turbinella*) and other browse species not often found in the north. Both areas possess important acreages of seeded range, most notably east of Pinto at Page Ranch, Woolsey Ranch, New Harmony and Pintura Bench. Deer tend to congregate in these areas, especially the latter three. Additional winter range in the Pine Valley unit can be found south of Pintura, but currently supports few deer. Winter range is extensive, but not uniformly utilized. Pinyon-juniper is the dominant vegetation type, but there are also other vegetation types that include large areas of sagebrush-grass, southern desert shrub, oak brush, and mountain brush. Important critical winter concentration areas include the area east of Central, the lower Pinto Creek drainage, the Antelope Range, Iron Mountain, the Shoal Creek drainage, Moody Creek, Tobin Bench, and the middle portion of the East Fork of Beaver Dam Wash. Only during the most severe winters do deer utilize the lower portions of the winter range, especially the Mojave Desert areas. During the spring, summer, and fall, crucial concentration areas include the higher elevations of the Bull Valley Mountains, Lost Peak, Maple Ridge, the slopes surrounding Pine Valley Reservoir, the meadows of the Whipple Valley area, and Flattop Mountains.

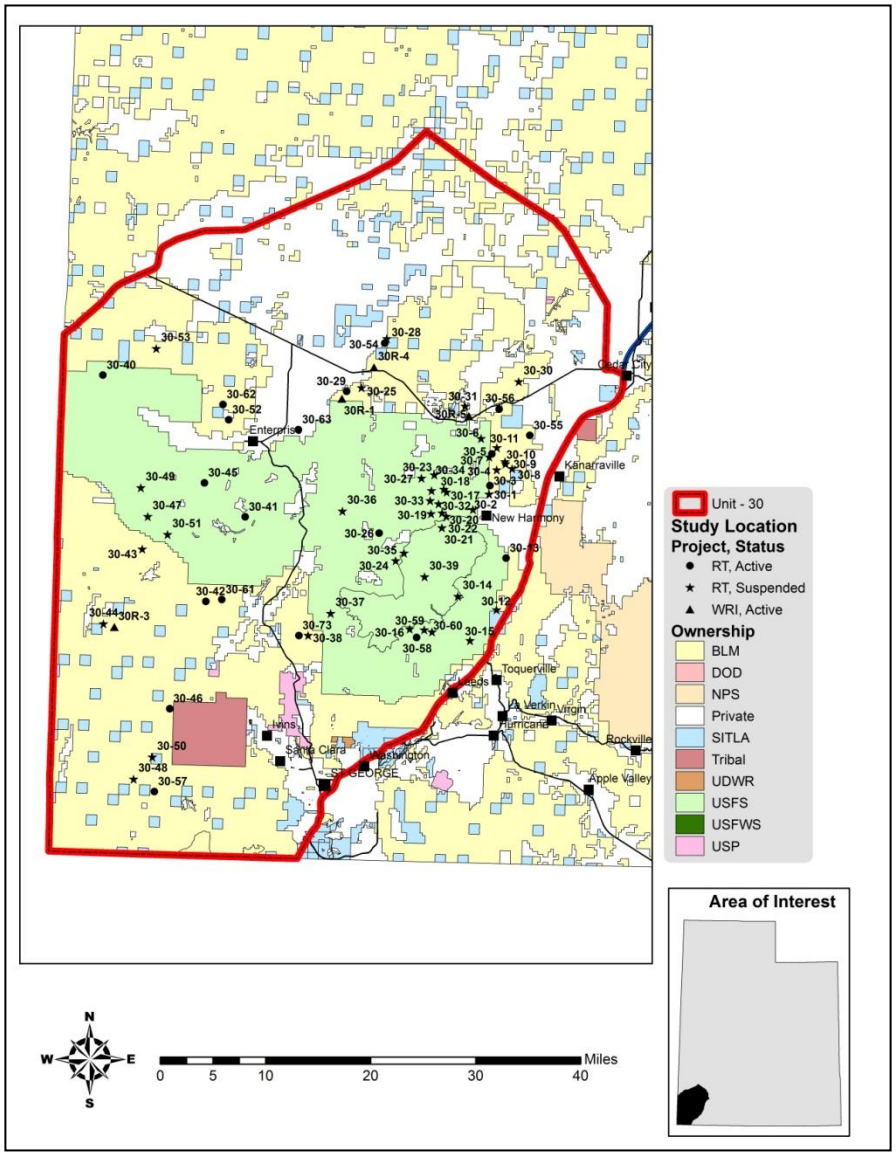
A comprehensive study conducted by the Southern Region of the Division of Wildlife Resources on deer population dynamics and habitat use, has contributed greatly to understanding of this herd unit. This study was especially helpful in identifying crucial areas for trend studies. For example, it is now evident that fawning and fawn rearing habitat are very critical for deer herd success in this unit. Accordingly, studies have been established at known fawning areas. In addition, winter range is now better defined and critical areas have been identified, with studies also sampling these areas.



Map 9.2: Estimated mule deer habitat by season and value for WMU 30, Pine Valley.



Map 9.3: Estimated elk habitat by season and value for WMU 30, Pine Valley.



Map 9.4: Land ownership for WMU 30, Pine Valley.

	Year-Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	60,766	7%	339,899	39%	466,936	54%
Elk	0	0%	0	0%	0	0%

Table 9.1: Estimated mule deer and elk habitat acreage by season for WMU 30, Pine Valley.

	Year-Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
USFS	13,020	21%	277,228	82%	170,930	37%
BLM	43,244	71%	37,331	11%	213,066	46%
SITLA	897	2%	1,338	<1%	21,056	5%
Tribal Land	0	0%	6,487	2%	141	<1%
Private	3,605	6%	17,516	5%	61,425	13%
USP	0	0%	0	0%	318	<1%
Total	**60,766**	**99%**	**339,899**	**100%**	**466,936**	**100%**

Table 9.2: Estimated mule deer habitat acreage by season and ownership for WMU 30, Pine Valley.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	224,768.56	13.48%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	112,989.30	6.78%	
	Mojave Mid-Elevation Mixed Desert Scrub	942,12.09	5.65%	
	Inter-Mountain Basins Greasewood Flat	73,926.38	4.43%	
	Great Basin Xeric Mixed Sagebrush Shrubland	49,394.93	2.96%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	44,691.73	2.68%	
	Sonora-Mojave Creosotebush-White Bursage Desert Scrub	40,794.94	2.45%	
	Coleogyne ramosissima Shrubland Alliance	23,312.50	1.40%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	12,930.24	0.78%	
	Inter-Mountain Basins Big Sagebrush Steppe	10,624.67	0.64%	
	Quercus gambelii Shrubland Alliance	8,671.61	0.52%	
	Artemisia tridentata ssp. vaseyana Shrubland Alliance	3,439.11	0.21%	
	Other Shrubland	22,614.41	1.36%	43.34%
Conifer	Great Basin Pinyon-Juniper Woodland	460,331.26	27.62%	
	Colorado Plateau Pinyon-Juniper Woodland	38,207.60	2.29%	
	Abies concolor Forest Alliance	7,694.63	0.46%	
	Southern Rocky Mountain Ponderosa Pine Woodland	6,489.92	0.39%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	4,916.48	0.29%	
	Other Conifer	5,835.85	0.35%	31.40%
Conifer-Hardwood	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	12,301.75	0.74%	0.74%
Grassland	Native Grassland	28,840.34	1.73%	1.73%
Exotic Herbaceous	Introduced Upland Vegetation-Annual Grassland	192,183.32	11.53%	
	Introduced Upland Vegetation-Annual and Biennial Forbland	35,200.16	2.11%	
	Introduced Upland Vegetation-Perennial Grassland and Forbland	3,023.68	0.18%	13.82%
Other	Hardwood	12,435.63	0.75%	
	Riparian	31,750.15	1.90%	
	Agricultural	58,432.38	3.51%	
	Developed	26,271.24	1.58%	
	Other	20,612.63	1.24%	8.97%
Total		1,666,897		

Table 9.3: LANDFIRE existing vegetation coverage (LANDFIRE: LANDFIRE 1.2.0, 2010) of deer winter range for WMU 30, Pine Valley.

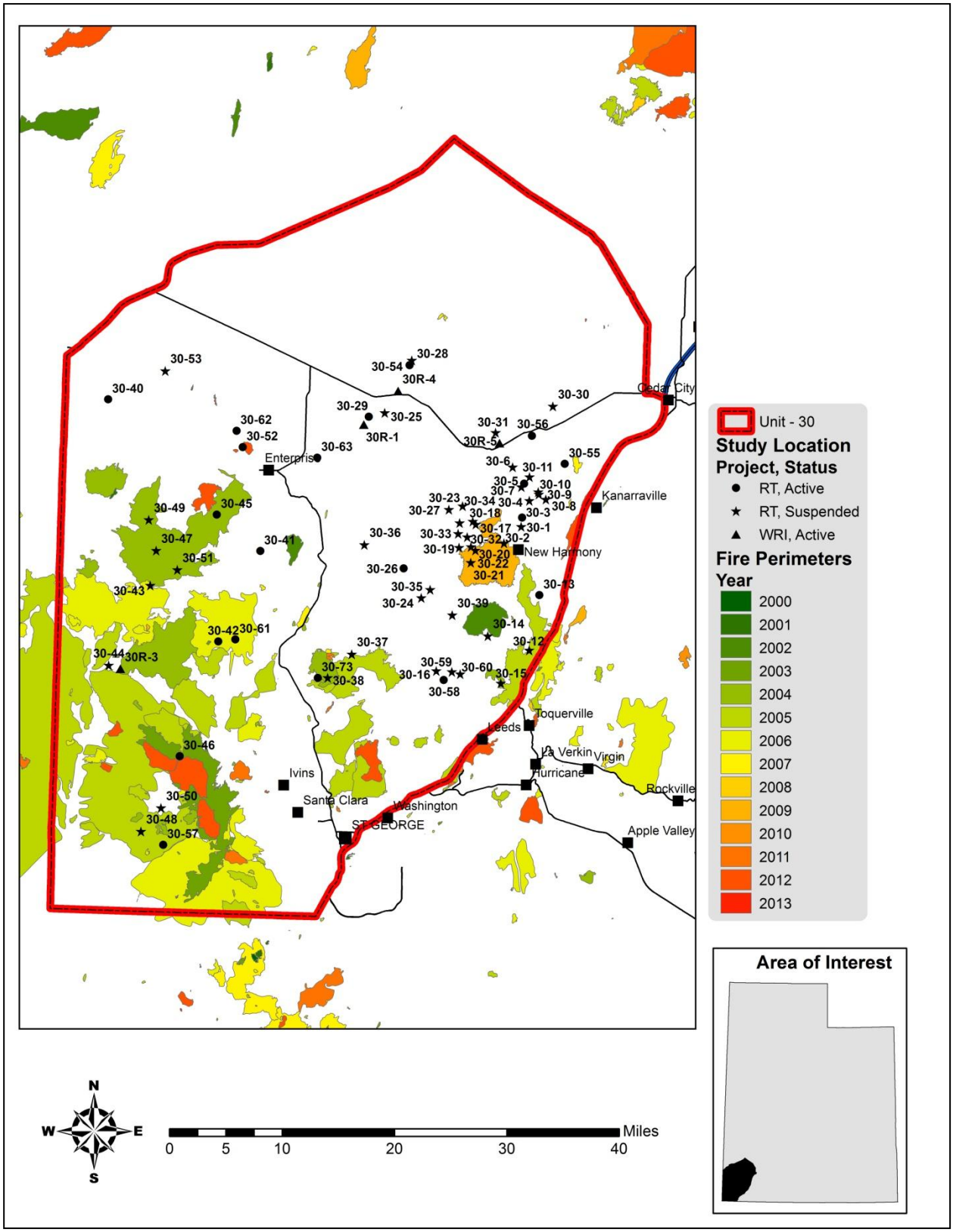
Limiting Factors to Big Game Habitat

Mortality of deer has been significant along I-15, SR-56, and SR-18. Deer proof fencing has been erected along I-15, impeding deer movement. Fencing may pose some barrier to deer migration to the wintering grounds.

Wildfire has had a significant impact on deer habitat in the southern and western portions of this unit in recent years. From 2000-2012, over 700,000 acres have burned in unit 30 in a variety of vegetative types. Where cheatgrass is prevalent, some locations have burned more than once during this time period. These wildfires have removed large expanses of important sagebrush and shrubland communities. While response to rehabilitation efforts has varied, available shrub forage remains highly reduced from pre-2000 levels. The abundance of cheatgrass, primarily within the lower elevation sagebrush communities, increases the threat of catastrophic wildfires within the unit (Balch, D'Antonio, & Gómez-Dans, 2013).

In addition to wildfire, severe flooding in January 2005 likely impacted deer habitat that drastically altered riparian communities along Moody Wash, Mogatsu Creek, Beaver Dam Wash, Santa Clara River, Virgin River, and neighboring drainages. Results of these events will likely impact deer use of these areas for several years.

Encroachment by pinyon-juniper woodland communities also poses a substantial threat to important sagebrush rangelands. Pinyon-juniper woodlands dominate the vegetation coverage within the deer winter range on WMU 30 (Table 9.3). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease the sagebrush and herbaceous components, and therefore decreases available forage for wildlife(Miller, Svejcar, & Rose, 2000).

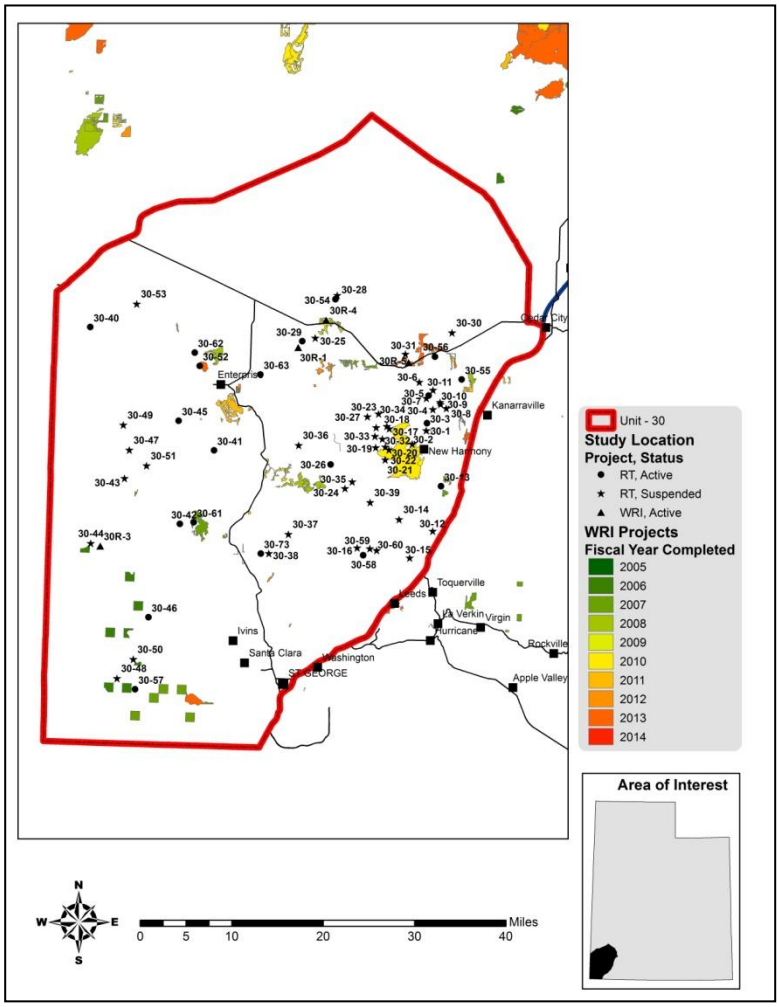


Map 9.5: Land coverage of fires by year from 2001-2013 for WMU 30, Pine Valley (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2014).

Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 40,535 acres have been treated within the Pine Valley unit since the WRI was implemented in 2004 (Map 9.6). Treatments frequently overlap one another bringing the total treatment acres to 40,535 acres for this unit (Table 9.4). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

The majority of treatment acreage, especially seeding, was done in conjunction with restoration efforts of wildfires within the unit. Treatments to reduce pinyon-juniper woodlands such as bullhog, chaining, and lop-and-scatter are the next most common management practices. Other common management treatments are those to rejuvenate sagebrush stands such as chaining and harrow treatments are common. Herbicide treatments within the unit are primarily used to control cheatgrass and restore other more desirable species (Table 9.4).



Map 9.6: WRI treatments by fiscal year completed for WMU 30, Pine Valley.

Treatment Action	Acres
Bullhog	8,186
Chaining	1,123
Greenstripping	264
Harrow	526
Herbicide application	816
PJ push	41
Road decommissioning	11
Seeding (primary)	26,406
Seeding (secondary/shrub)	1,933
Lop and Scatter	1,230
***Total Land Area Treated**	**22,566**
Total Treatment Acres	**40,535**

Table 9.4: WRI treatment action size (acres) for WMU 30, Pine Valley.
*Does not include overlapping treatments.

Range Trend Studies

Range Trend studies have been sampled within WMU 30 on a regular basis since 1982, with studies being added or suspended as was deemed necessary (Table 9.5). Several of the range trend studies have been suspended over the sample years. Due to changes in sampling methodologies, only data sampled following the 1998 sample year are included in this summary. Monitoring studies of WRI projects have been sampled since 2004. When possible, WRI monitoring studies are established prior to treatment and sampled on a regular basis following treatment. Due to the long-term nature of the studies, many of the Range Trend and WRI studies have had some sort of disturbance or treatment prior to or since study establishment (Table 9.6).

Range Trend studies that have not had recent disturbance or treatments are summarized in this report by ecological site or potential. Range Trend and WRI studies that have a disturbance or treatment during the reported sample period are summarized in this report by the disturbance or treatment type.

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
30-1	Lower Broad Hollow	RT	Suspended	-	Not Verified
30-2	Comanche Creek Ditch	RT	Suspended	‘82, ‘92	Not Verified
30-3	Upper Broad Hollow	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Upland Stony Loam (Shrub Liveoak)
30-4	Rock Spring	RT	Suspended	‘82	Not Verified
30-5	Harmony Mountain Summit	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Mountain Loam (Mountain Big Sagebrush)
30-6	Upper Duncan Canyon	RT	Suspended	‘82	Not Verified
30-7	Bumblebee Spring	RT	Suspended	‘82	Not Verified
30-8	Upper Groves Creek	RT	Suspended	‘82	Not Verified
30-9	Upper Lime Spring	RT	Suspended	‘82, ‘92, ‘98	Not Verified
30-10	Upper Bumblebee Spring	RT	Suspended	‘82, ‘92	Not Verified
30-11	Quichapa Canyon	RT	Suspended	‘82	Not Verified
30-12	Pintura Bench	RT	Suspended	‘82, ‘92, ‘98	Not Verified
30-13	Black Ridge	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Upland Loam (Mountain Big Sagebrush)
30-14	Browse	RT	Suspended	‘82	Not Verified
30-15	Wet Sandy Trail	RT	Suspended	‘82	Not Verified
30-16	Upper Leeds Creek	RT	Suspended	‘82, ‘86, ‘87, ‘92	Not Verified
30-17	Upper Grants Spring	RT	Suspended	‘82	Not Verified
30-18	Grants Ranch Trail	RT	Suspended	‘82, ‘92	Not Verified
30-19	Big Water Reservoir	RT	Suspended	‘82, ‘92	Not Verified
30-20	Upper Lone Pine Reservoir	RT	Suspended	‘82	Not Verified
30-21	Upper Comanche Canyon	RT	Suspended	‘82, ‘92	Not Verified
30-22	Sheep Pens	RT	Suspended	‘82	Not Verified
30-23	Grants Ranch	RT	Suspended	‘82	Not Verified
30-24	Water Canyon	RT	Suspended	‘82	Not Verified
30-25	New Castle Reservoir	RT	Suspended	‘82, ‘92	Not Verified
30-26	Grassy Flat Ridge	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Mountain Loam (Mountain Big Sagebrush)
30-27	Paradise	RT	Suspended	‘82, ‘92	Not Verified
30-28	Bullion Canyon	RT	Suspended	‘82	Not Verified
30-29	Southwest of Newcastle	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Semidesert Loam (Wyoming Big Sagebrush)
30-30	Swett Hills	RT	Suspended	‘82, ‘92	Not Verified
30-31	Oak Spring	RT	Suspended	‘82, ‘92	Not Verified
30-32	Whiterocks Reservior	RT	Suspended	‘82, ‘92	Not Verified
30-33	South Side Rencher Peak	RT	Suspended	‘82	Not Verified
30-34	West of Long Flat	RT	Suspended	‘82, ‘92	Not Verified
30-35	Deep Canyon	RT	Suspended	‘82, ‘92, ‘98, ‘03, ‘08	Not Verified
30-36	Atchinson Mountain	RT	Suspended	‘82, ‘92	Not Verified
30-37	Truman Bench	RT	Suspended	‘82, ‘92, ‘98	Not Verified
30-38	Wide Canyon	RT	Suspended	‘82, ‘92, ‘98, ‘03, ‘08	Not Verified
30-39	West Valley	RT	Suspended	‘82, ‘92	Not Verified
30-40	Telegraph Draw	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Upland Gravelly Loam (Wyoming Big Sagebrush)
30-41	Joe Spring	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Mountain Loam (Mountain Big Sagebrush)
30-42	Grapevine Spring	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Upland Stony Loam (Shrub Liveoak)
30-43	Dagget Flat	RT	Suspended	‘82	Not Verified
30-44	Motoqua	RT	Suspended	‘82, ‘92	Not Verified
30-45	Flat Top Mountain	RT	Active	‘82, ‘98, ‘03, ‘08, ‘13	Mountain Gravelly Loam (Oak)
30-46	Pahcoon Bench	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Upland Loam (Mountain Big Sagebrush)
30-47	Lost Peak	RT	Suspended	‘82, ‘98	Not Verified
30-48	Welcome Springs	RT	Suspended	‘82	Not Verified
30-49	Rattlesnake Spring	RT	Suspended	‘82, ‘92	Not Verified
30-50	Hell Hole Pass	RT	Suspended	‘82	Not Verified
30-51	Pinnacles	RT	Suspended	‘82, ‘92	Not Verified
30-52	Northwest of Enterprise	RT	Active	‘82, ‘92, ‘98, ‘03, ‘08, ‘13	Semidesert Loam (Wyoming Big Sagebrush)

Study #	Study Name	Project	Status	Year(s) Sampled	Ecological Site Description
30-53	Sevy Hollow	RT	Suspended	‘82, ‘98	Not Verified
30-54	Bullion Canyon	RT	Active	‘98, ‘03, ‘08, ‘13	Semidesert Gravelly Loam (Wyoming Big Sagebrush) South
30-55	Quichapa Canyon	RT	Active	‘98, ‘03, ‘08, ‘13	Upland Loam (Mountain Big Sagebrush)
30-56	Woolsey Reseed	RT	Active	‘98, ‘03, ‘08, ‘13	Upland Gravelly Loam (Bonneville Big Sagebrush)
30-57	Summit Spring	RT	Active	‘98, ‘03, ‘08, ‘13	*Semidesert (Desert Shrub)
30-58	Spirit Creek South Burned	RT	Active	‘86, ‘87, ‘92, ‘98, ‘03, ‘08, ‘13	Mountain Loam (Oak)
30-59	Upper Horse Creek	RT	Suspended	‘86, ‘87, ‘92, ‘98, ‘03	Not Verified
30-60	Jones Hollow	RT	Suspended	‘86, ‘87, ‘92, ‘98, ‘03	Not Verified
30-61	Tobin Bench	RT	Active	‘03, ‘08, ‘13	*Semidesert (Cliffrose)
30-62	North Hills	RT	Active	‘03, ‘08, ‘13	Semidesert Shallow Loam (Wyoming Big Sagebrush)
30-63	Holt Canyon	RT	Active	‘03, ‘08, ‘13	Semidesert Loam (Wyoming Big Sagebrush)
30-64	Horse Creek	RT	Suspended	-	Not Verified
30-65	Spirit Creek South Unburned	RT	Suspended	-	Not Verified
30-66	Jones Hollow II	RT	Suspended	-	Not Verified
30-67	North Horse Creek	RT	Suspended	-	Not Verified
30-68	Wet Sandy North	RT	Suspended	-	Not Verified
30-69	Wet Sandy South	RT	Suspended	-	Not Verified
30-70	Oak Grove	RT	Suspended	‘87	Not Verified
30-71	Pig Creek	RT	Suspended	‘87	Not Verified
30-72	Spirit Creek	RT	Suspended	‘87	Not Verified
30-73	Wide Canyon 2	RT	Active	‘13	Upland Shallow Loam (Mountain Big Sagebrush)
30R-1	Newcastle Bullhog	WRI	Active	‘04, ‘07, ‘12	Semidesert Loam (Wyoming Big Sagebrush)
30R-3	Square Fire Rehab	WRI	Active	‘06, ‘11	Semidesert Shallow Hardpan (Blackbrush)
30R-4	North Newcastle	WRI	Active	‘08, ‘11	Semidesert Shallow Loam (Black Sagebrush)
30R-5	Duncan Creek/Hwy 56	WRI	Active	‘12	Upland Loam (Shrub)

Table 9.5: Range trend and WRI project studies monitoring history and ecological site potential for WMU 30, Pine Valley.
*A defined Ecological Site Description was not defined for these sites.

Study #	Study Name	Type	Disturbance Name (if available)	Date	Size (acres)	WRI Project #
30-13	Black Ridge	Chain Unknown		Historic		
		Seed Unknown		Historic		
30-26	Grassy Flat Ridge	Seed Unknown		Historic		
29	Southwest of Newcastle	Lop and Scatter		1998-2003		
30-38	Wide Canyon	Wildfire	Dameron Complex	2004	10,027	
		Aerial Seed		Winter 2004-2005		
30-40	Telegraph Draw	Chain Unknown		Historic		
		Seed Unknown		Historic		
30-42	Grapevine Spring	Chain Unknown		Historic		
		Wildfire	Bull Complex	2006	41,500	
		Aerial Seed		2006		
30-45	Flat Top Mountain	Wildfire	Hawkins	2004	35,427	
30-46	Pahcoon Flat	Chain Unknown		1979		
		Seed Unknown		1979		
		Wildfire	Pahcoon	1998	6,363	
		Seed Unknown		1998		
		Wildfire	Apex	2003	29,933	
30-52	Northwest of Enterprise	Wildfire	Barn	1998	1,815	
		Aerial Seed		1998		
30-56	Woolsey Seeding	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Lop and Scatter		1998-2003		
30-57	Summit Spring	Wildfire	Westside Complex	2005	68,418	
		Aerial Seed		Winter 2005-2006		
30-58	Spirit Creek South	Wildfire		Jun. 1986		
		Seed Unknown		Jul. 1986		
30-61	Tobin Bench	Wildfire	Bull Complex	2006	41,500	
		Aerial Seed		2006		
30R-1	Newcastle Bullhog	Bullhog		Oct. 2004	900	PDB
30R-3	Square Fire Rehab	Wildfire	Square	2004	17,146	
		1-Way Chain	Square Fire Rehab	Fall 2004		PDB
		Aerial Before	Square Fire Rehab	Fall 2004	6,287	PDB
		Aerial After	Square Fire Rehab	Fall 2004	3,000	PDB
30R-4	North New Castle	Bullhog	North Newcastle	Dec. 2008-Jan. 2009	870	446
		Aerial Seed Before	North Newcastle	Oct. 2008	870	446
30R-5	Duncan Creek/Hwy 56	Bullhog	Duncan Creek/Hwy 56 Interface - Phase 1	Winter 2012-2013		2,303
		Aerial Seed Before	Duncan Creek/Hwy 56 Interface - Phase 1	Winter 2012-2013		2,303

Table 9.6: Range trend and WRI studies known disturbance history for WMU 30, Pine Valley.

Study Trend Summary (Undisturbed Sites)

Mountain (Mountain Big Sagebrush)

There are four studies [Harmony Mountain Summit (30-5), Grassy Flat Ridge (30-26), Joe Spring (30-41), and Spirit Creek South (30-58)] classified as Mountain (Mountain Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 9.5). The Harmony Mountain Summit study site occurs on the top of the Harmony Mountains. The Grassy Flat study site occurs on the west side of the Pine Valley Mountains, on the ridge to west of Grass Valley. The Spirit Creek South study site occurs on the east side of the Pine Valley Mountains near the head of Leads Creek and is located near the base of the steep rocky slopes. The Joe Spring study site occurs on north side of the Bull Valley Mountains on the south side of Ox Valley.

Shrubs/Trees: The primary browse on the Harmony Mountain study is a mixture of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and stickyleaf low rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*). The primary browse on the Joe Spring and Grassy Flat studies is mountain big sagebrush. The primary browse species on the Spirit Creek South study is Gambel oak (*Quercus gambelii*). Other preferred browse species are common on these sites, but occur at much lower cover than the sagebrush species. The

mean line-intercept cover of sagebrush is good on these sites ranging from 11% in 2003 to near 14% in 2013. The mean cover of sagebrush has been increasing since 2003 primarily due to continued recovery from a wildfire on the Spirit Creek South study that occurred in 1986. The mean cover of other preferred browse species has ranged from 8% to 12%, but with a decrease in 2008 (Figure 9.2a). The average height of the mountain big sagebrush ranges from one to two feet, making browse available through much of the year in mild winters, though the Harmony Mountain Summit and Grassy Flat studies are considered summer range. The demographics of the sagebrush population has been a mixture of mostly mature and young plants since 1998, but there has been a steady decrease in density since 2003, which can be attributed to the Harmony Mountain Summit site which has decreased in density since 2003 (Figure 9.2a).

Pinyon pine and Utah juniper are rare on these sites, and have only been sampled on the Grassy Flat study. Pinyon and juniper encroachment is considered to be in Phase I of woodland succession on the Grassy Flat study. Cover of pinyon pine has increased since 2003, but remains less than 2% (Figure 9.3b).

Herbaceous Understory: The study sites have a good herbaceous component dominated by perennial grass. However, the dominant grass species on two of the study sites, Spirit Creek South and Grassy Flat, are comprised of seeded species that are often considered aggressive at higher elevation and precipitation. These include intermediate wheatgrass (*Agropyron intermedium*), crested wheatgrass (*A. cristatum*), and smooth brome (*Bromus inermis*). This is particularly pronounced on the Spirit Creek South study site. Numerous native species also occur on the sites, but at much lower cover and frequency than the introduced species. Competition with these introduced grasses may limit the establishment of other desirable herbaceous species. Mean nested frequency of perennial grasses has fluctuated, but has remained relatively high since 1998 (Figure 9.4a). The mean cover of perennial grass decreased from 19% in 1998 to around 9%-15% in 2003 through 2013 (Figure 9.4b). The annual grass species cheatgrass is annual grass species is mainly found on the Joe Spring study and has been a major component of the study site over the sample years, though cover has decreased on the site since 2003.

Native perennial forb species composition is diverse with moderate nested frequency and cover. The mean nested frequency and cover of perennial forb species decreased from 1998 to 2008, but increased slightly in 2013 (Figure 9.4).

Occupancy: Pellet group transect data indicates that deer predominately occupy these studies. The mean abundance of deer pellet groups has ranged from a high of 80 days use/acre in 2008 to a low of 27 days use/acre in 2013. Deer occupancy has fluctuated across all the study sites. Elk pellet groups are rare and were only sampled on the Spirit Creek South study site in 2008. Livestock sign from cattle has been moderate to light over the sample years, and is more prominent on the Harmony Mountain Summit study (Figure 9.5).

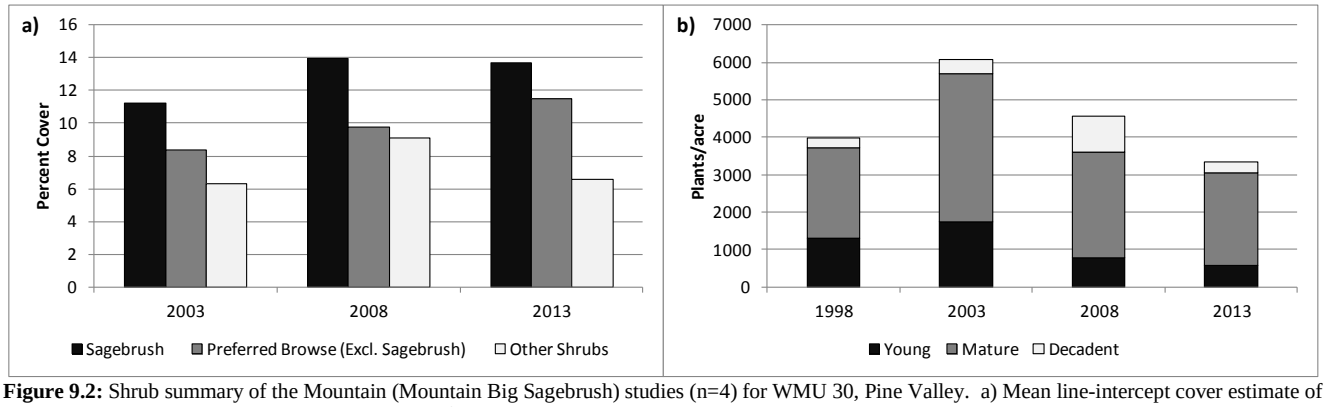


Figure 9.2: Shrub summary of the Mountain (Mountain Big Sagebrush) studies (n=4) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

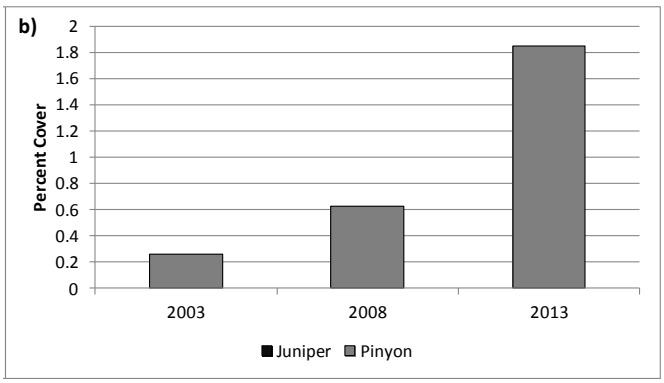


Figure 9.3: Tree summary of the Mountain (Mountain Big Sagebrush) studies (n=4) for WMU 30, Pine Valley. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

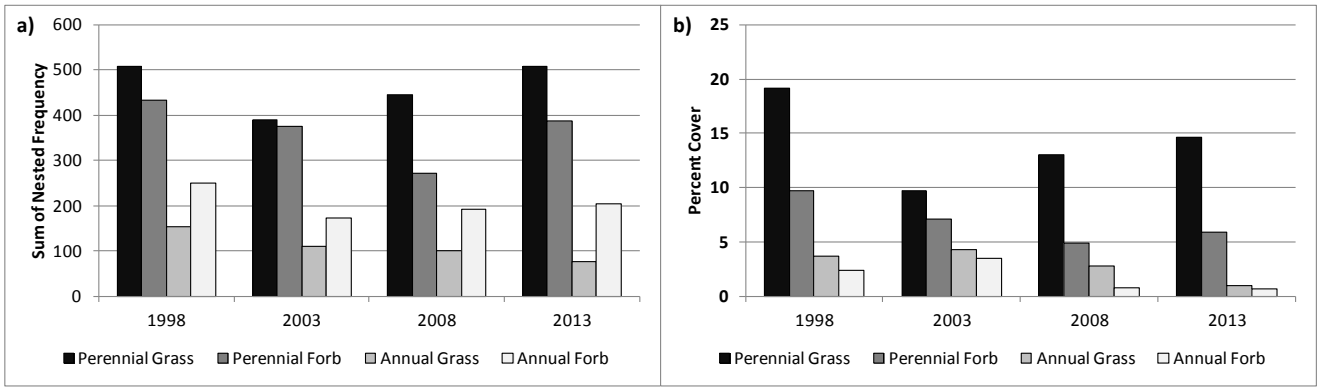


Figure 9.4: Herbaceous functional group summary of the Mountain (Mountain Big Sagebrush) studies (n=4) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

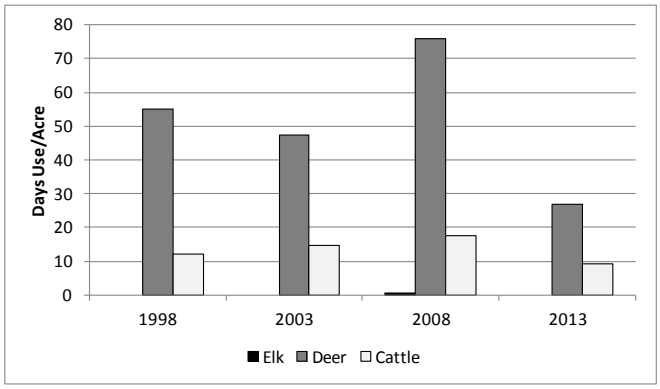


Figure 9.5: Mean pellet transect data for the Mountain (Mountain Big Sagebrush) studies (n=4) for WMU 30, Pine Valley.

Upland (Mountain Big Sagebrush)

There are three studies [Black Ridge (30-13), Quichapa Canyon (30-55), and Wide Canyon 2 (30-73)] classified as an Upland (Mountain Big Sagebrush) ecological site that remained undisturbed over the report period (Table 9.5). The Black Ridge study is located on the east side of the Pine Valley Mountain west of Ash Creek Reservoir. The Quichapa Canyon study is located on the northeast side of the Harmony Mountain and south of the mouth Quichapa Canyon. The Wide Canyon 2 study is located on the southwest side of Pine Valley Mountain north of Wide Canyon.

Shrubs/Trees: The primary browse on the study sites is mountain big sagebrush. The mean line-intercept cover of sagebrush is good on these sites with cover averaging 13-14% since 2013. The mean cover of other

preferred browse species, has ranged from 6% in 2003 to 8% in 2008 (Figure 9.6a). The average height of the mountain big sagebrush is approximately 1.5 feet making browse available throughout much of the year in mild winters. The demographics of these sagebrush populations have been generally comprised of mixture of young, mature, and decadent plants. Recruitment of young sagebrush plants has remained good within the population over the sample years with the exception of 2003 when recruitment was poor (Figure 9.6b).

Despite the good health of the browse community, encroachment from Utah juniper trees is a concern on these sites. Density and cover of pinyon-juniper trees has remained stable since 1998 (Figure 9.7a), though cover and density has steadily increased on the Black Ridge study since 2003 (Figure 9.7b). Although, the mean tree cover has remained stable, size and abundance of trees in photographs appear to have increased since 1982. These sites are classified as being in Phase I transitioning to Phase II of woodland succession. The study site is under threat of further encroachment by pinyon-juniper trees, which would result in decreased browse and forage species.

Herbaceous Understory: These study sites have a poor to fair perennial grass component. Mean nested frequency of perennial grasses has fluctuated, but overall has decreased since 1998 (Figure 9.8a). The mean cover of perennial grass decreased from 7% in 1998 to 2% in 2013 (Figure 9.8b). The annual grass species, cheatgrass (*Bromus tectorum*) is common on all three sites. Cheatgrass has decreased in nested frequency and cover on the Black Ridge and Quichapa Canyon studies since 1998, but will likely remain common on these sites. Additionally, it has the potential to become the dominant species on these sites following a major disturbance. The increase in annual grass in 2013 is from the addition of the Wide Canyon 2 study, which had a high abundance of cheatgrass sampled on the site (Figure 9.8)

Perennial forb species composition is lacking on these sites with low nested frequency and cover of all sampled species (Figure 9.8).

Occupancy: Pellet group transect data indicates that deer predominately occupy these studies. The mean abundance of deer pellet groups has ranged from a high of 35 days use/acre in 2008 to a low of 18 days use/acre in 2013. Elk and cattle pellet groups are typically sampled in low abundance on these study sites (Figure 9.9).

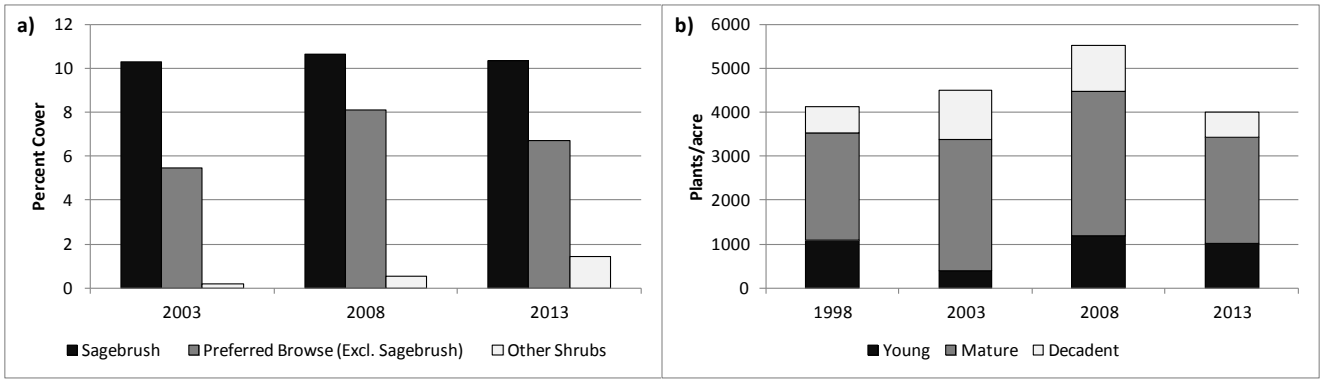


Figure 9.6: Shrub summary of the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

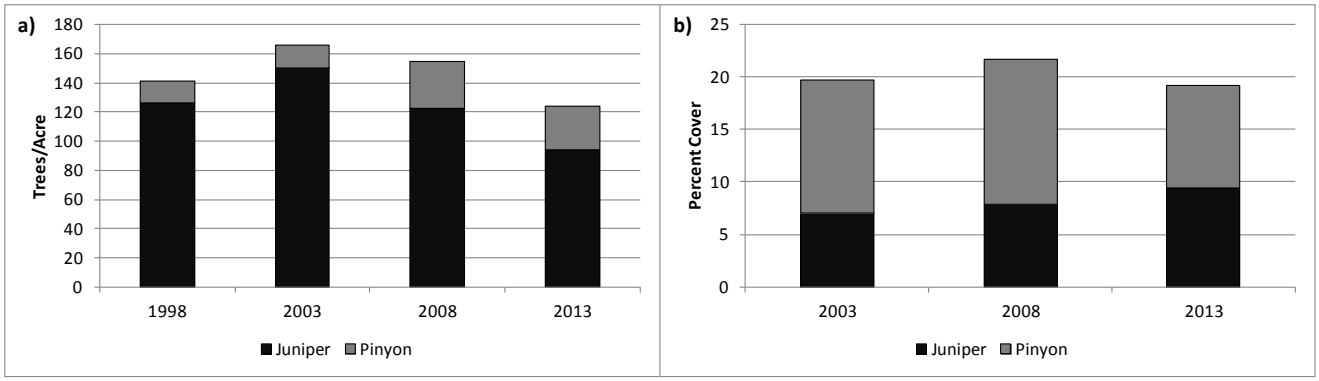


Figure 9.7: Tree summary of the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 30, Pine Valley. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

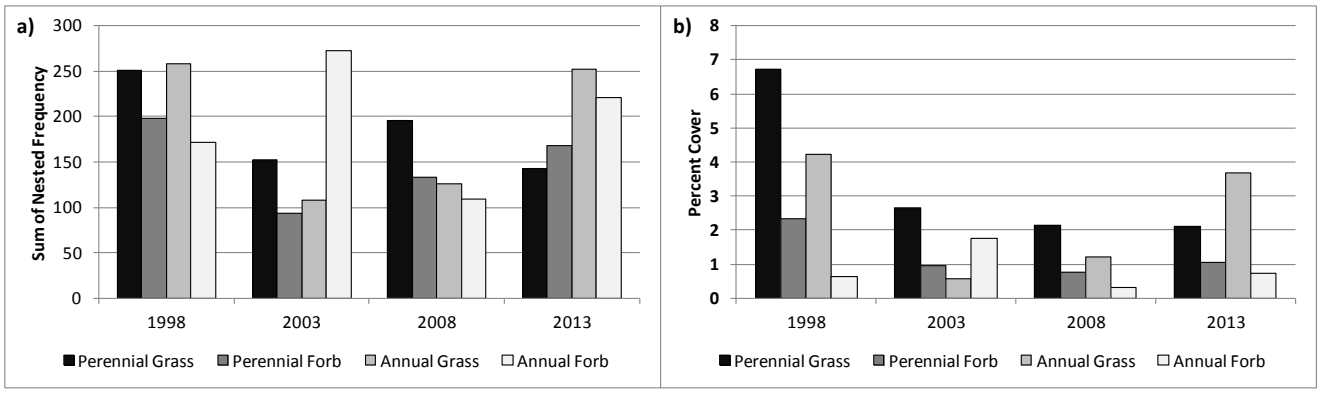


Figure 9.8: Herbaceous functional group summary of the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

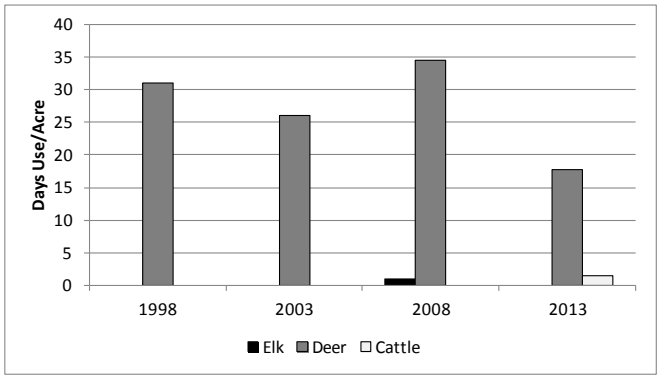


Figure 9.9: Mean pellet transect data for the Upland (Mountain Big Sagebrush) studies (n=3) for WMU 30, Pine Valley.

Upland (Wyoming Big Sagebrush)

There is one study [Telegraph Draw (30-40)] classified as an Upland (Wyoming Big Sagebrush) ecological site that remained undisturbed over the report period (Table 9.5). The Telegraph Draw study is located east of Crestline near the head of Telegraph Draw.

Shrubs/Trees: The primary browse on this study is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). The mean line-intercept cover of sagebrush is good on this site, and has steadily increased from 17% in 2003 to just over 21% in 2013. Antelope bitterbrush (*Purshia tridentata*) provides additional browse on this site and has remained similar at 5-7% cover over the sample period (Figure 9.10a). The average height of Wyoming big sagebrush this study is approximately nearly 2 feet tall, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have

generally been comprised of a mixture of mature, young, and decadent plants with recruitment of young plants comprising greater than 10% of the population on this study site since 1998. The mean density of sagebrush has steadily increased on these sites from 1998 to 2008, but density decreased substantially in 2013 (Figure 9.10b).

Encroachment from pinyon pine and Utah juniper trees is a concern on this site. The mean density of pinyon-juniper trees has fluctuated since 1998 (Figure 9.11a), but mean tree cover has increased substantially from 15% in 2003 to 22% in 2013 (Figure 9.11b). Density of pinyon and juniper has ranged from 181 trees/acre in 2003 to 225 trees/acre in 2008. Repeat photographs show trees increasing in size and density since study establishment of this study. The Telegraph Draw study is considered to be in Phase II encroachment of woodland succession. This study site is under threat of further encroachment by pinyon-juniper trees, which would result in decreases in valuable browse and forage species.

Herbaceous Understory: This study site has a fair to poor herbaceous component dominated primarily by native perennial grasses. Mean nested frequency of perennial grasses decreased in 2003 and 2013, but was moderate in 1998 and 2008. The mean cover of perennial grass decreased from 2% in 1998 to less than 1% in 2003, and 1% in 2008 and 2013. The annual grass species cheatgrass was moderately abundant on this site in 1998 and 2013, but has been sampled at much lower cover in other sample years (Figure 9.12). However, cheatgrass remains a threat to increased fire frequency.

Native perennial forb species composition is diverse on this study with moderate nested frequency and cover. Annual forb cover has been low across all years (Figure 9.12). No single forb species has been dominant over the sample years.

Occupancy: Pellet group transect data indicates that deer and horse almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 21 days use/acre in 1998 to a low of 1 days use/acre in 2013. The mean abundance of horse pellet groups has ranged from a high of 16 days use/acre in 1998 to 5 days use/acre in 2008 and 2013 (Figure 9.13).

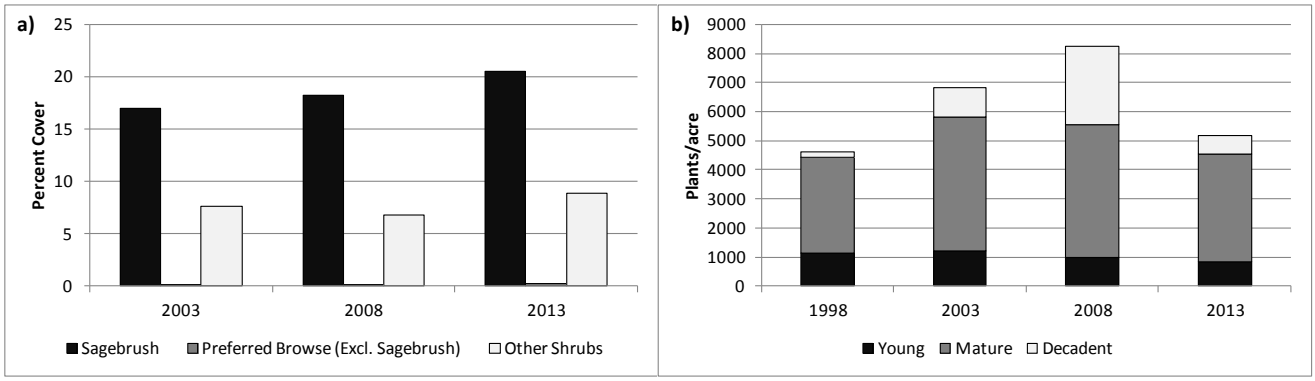


Figure 9.10: Shrub summary of the Upland (Wyoming Big Sagebrush) study (n=1) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

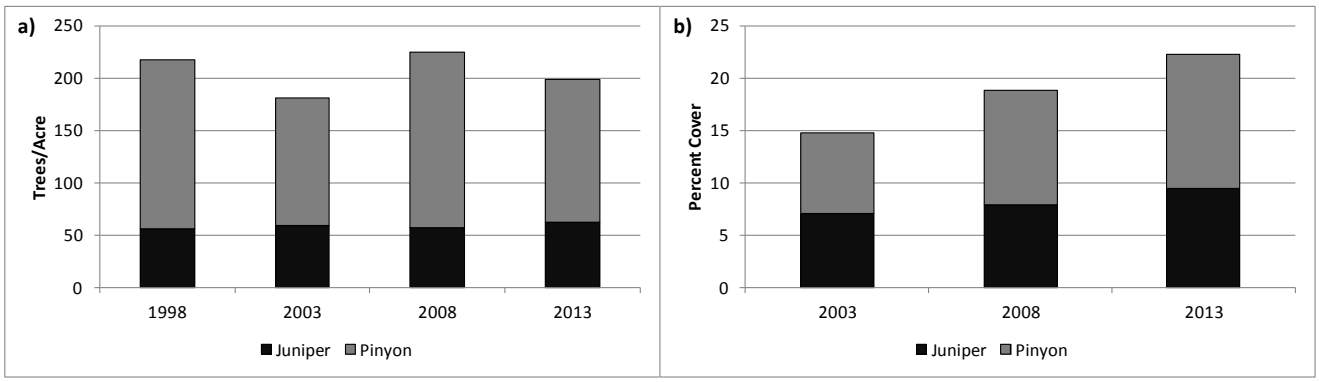


Figure 9.11: Tree summary of the Upland (Wyoming Big Sagebrush) study (n=1) for WMU 30, Pine Valley. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

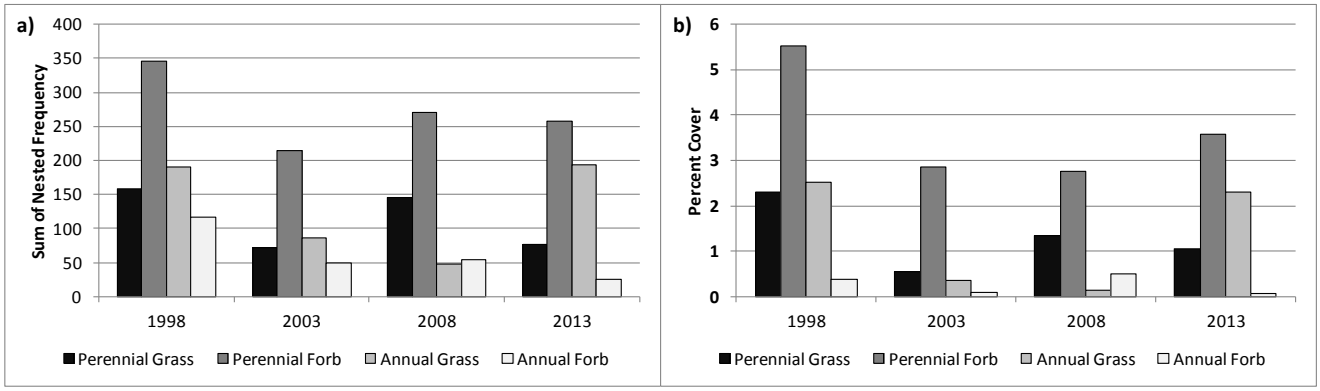


Figure 9.12: Herbaceous functional group summary of the Upland (Wyoming Big Sagebrush) study (n=1) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

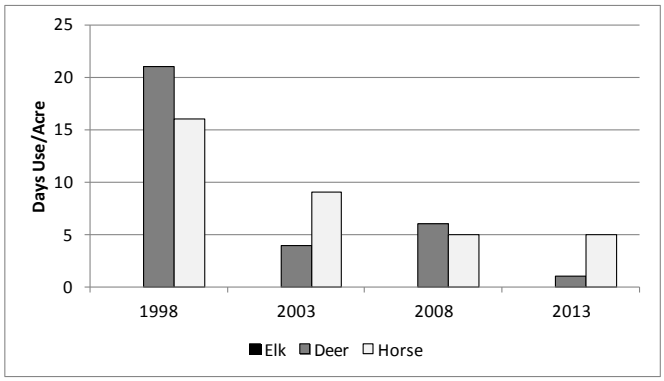


Figure 9.13: Mean pellet transect data for the Upland (Wyoming Big Sagebrush) study (n=1) for WMU 30, Pine Valley.

Upland (Shrub Liveoak)

There is one study [Upper Broad Hollow (30-3)] classified as Upland (Shrub Liveoak) ecological site that remained undisturbed over the report period (Table 9.5). The Upper Broad Hollow study is located north of New Harmony on the south slopes of Harmony Mountain.

Shrubs/Trees: The primary browse on this study is a mixture of mountain browse species consisting of Utah serviceberry (*Amelanchier utahensis*), antelope bitterbrush, and mountain big sagebrush. The mean line-intercept cover of sagebrush and other preferred browse species is good on this site. Sagebrush has steadily increased from 6% in 2003 to 9% in 2013. Other preferred browse species have increased from 17% cover in 2003 to 23% cover in 2013 (Figure 9.14a). The average height of mountain big sagebrush on this study is nearly 2 feet tall, making browse available through much of the year in normal winters. The demographics of

the sagebrush populations have generally been comprised of a mixture of mature and decadent plants with fluctuation in recruitment of young plants in 1998 and 2013 comprising greater than 10% of the population (Figure 9.14b).

Encroachment from pinyon pine and Utah juniper trees is a concern on this site. The mean density of pinyon-juniper trees has fluctuated since 1998 (Figure 9.15a), but mean tree cover increased slightly in 2013 (Figure 9.15b). Density of pinyon and juniper has ranged from 57 trees/acre in 1998 to 68 trees/acre in 2003, and cover has ranged from 12% in 2003 to 15% in 2013. Repeat photographs show trees increasing in size and density since study establishment. This study is classified as Phase I transitioning to Phase II of the woodland succession. This study site is under threat of further encroachment by pinyon-juniper trees, which would result in decreased valuable browse and forage species.

Herbaceous Understory: This study site has a good herbaceous component dominated primarily by native perennial grasses. The mean cover of perennial grass decreased from 15% in 1998 to 9% in 2003, and increased to 12% in 2013. The annual grass species cheatgrass was highly abundant on this site in 1998, but has been sampled at much lower cover in subsequent years (Figure 9.16). However, cheatgrass remains a fire threat on this site.

Native perennial forb species composition is diverse on this study with moderate nested frequency and cover (Figure 9.16). No single forb species has been dominant over the sample years.

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy this study site. The mean abundance of deer pellet groups has ranged from a high of 180 days use/acre in 2008 to a low of 68 days use/acre in 2013 (Figure 9.17).

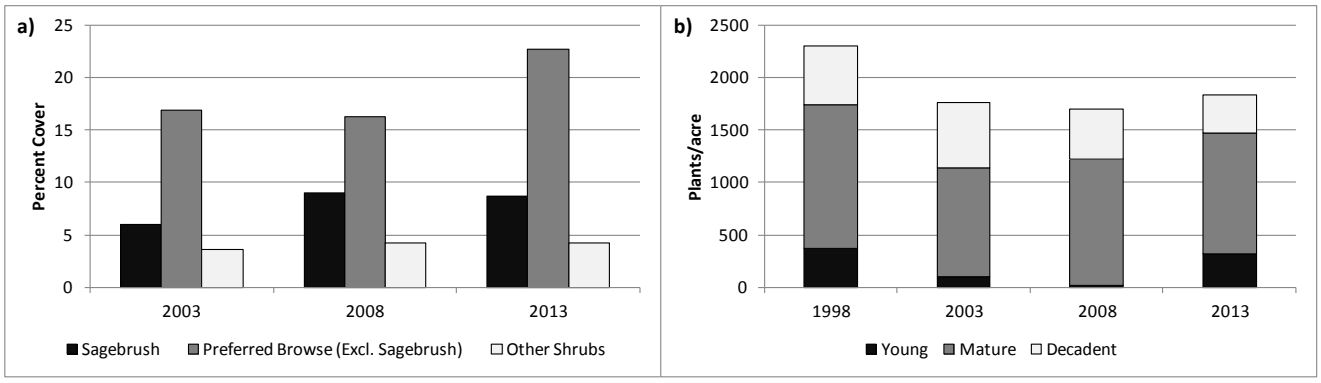


Figure 9.14: Shrub summary of the Upland (Shrub Liveoak) study (n=1) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

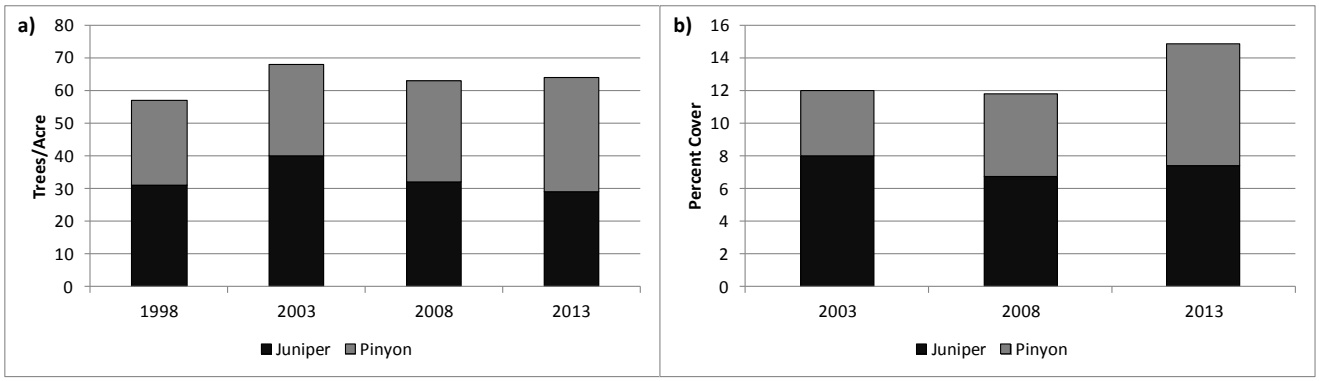


Figure 9.15: Tree summary of the Upland (Shrub Liveoak) study (n=1) for WMU 30, Pine Valley. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

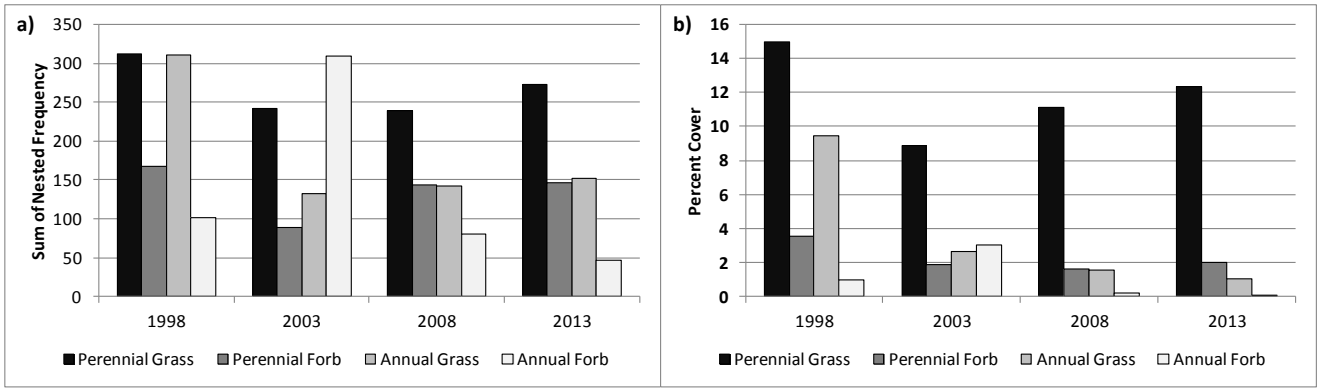


Figure 9.16: Herbaceous functional group summary of the Upland (Shrub Liveoak) study (n=1) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

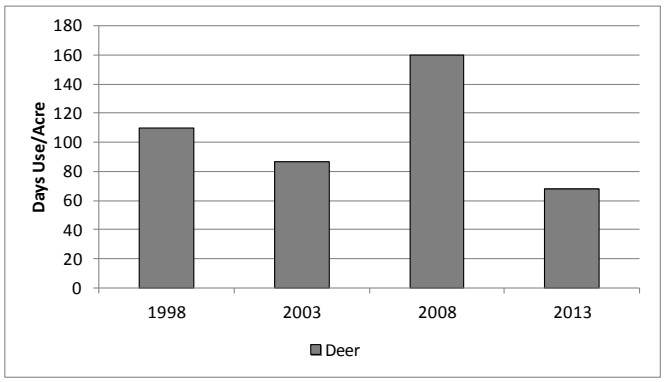


Figure 9.17: Mean pellet transect data for the Upland (Shrub Liveoak) study (n=1) for WMU 30, Pine Valley.

Semidesert (Wyoming Big Sagebrush)

There are three studies [Bullion Canyon (30-54), North Hills (30-62), and Holt Canyon (30-63)] classified as Semidesert (Wyoming Big Sagebrush) ecological sites that remained undisturbed over the report period (Table 9.5). The Bullion Canyon study is located on the west side of the Antelope Range south of Bullion Canyon. The Holt Canyon study is located on the east side of Enterprise near the mouth of Holt Canyon. The North Hills study is located in the foothills northwest of Enterprise.

Shrubs/Trees: The primary browse on all three studies is Wyoming big sagebrush with a few preferred browse species sampled in cover measurements. The mean line-intercept cover of sagebrush is good on these sites, and has remained similar at 14% to 17% since 2003 (Figure 9.18a). Trends in cover were similar on all three study sites with a slight increase in cover over the sample years. The average height of Wyoming big sagebrush on all of the studies is approximately 2 feet tall on the North Hills and Holt Canyon study, and 1 foot on the Bullion Canyon study, making browse available through much of the year in normal winters. The demographics of the sagebrush populations have generally been comprised of a mixture of mature and decadent plants with recruitment of young plants comprising less than 10% of the population on most of the study sites since 1998. Despite the stable trends of the mean cover of sagebrush, there has been a steady decrease in density on all three studies since 1998 (Figure 9.18b).

Encroachment from pinyon pine and Utah juniper trees is not a concern on Holt Canyon and North Hills, but is a concern on the Bullion Canyon study site (Figure 9.19). Repeat photographs show some encroachment of pinyon-juniper trees on the Holt Canyon and North Hills studies, but these studies are currently classified as being in Phase I of the woodland succession. The Bullion Canyon study is classified as Phase I transitioning to Phase II of woodland succession.

Herbaceous Understory: These study sites have a poor to fair herbaceous component dominated primarily by native or introduced perennial grasses. The mean nested frequency of perennial grasses decreased in 2003, and remained similar in 2008 and 2013. The mean cover of perennial grass remained similar at from 4% in 1998 and 2008 to 3% in 2003 and 2013. The annual grass species cheatgrass is very abundant on all three of these study sites, though cover and frequency have fluctuated over the sample years (Figure 9.20). Cheatgrass remains a threat for increased fire frequency on these studies.

Native perennial forb species composition is diverse on these studies, but with low nested frequency and cover of all sampled species (Figure 9.20).

Occupancy: Pellet group transect data indicates that deer almost exclusively occupy these study sites. The mean abundance of deer pellet groups has ranged from a high of 39 days use/acre in 2008 to a low of 6 days use/acre in 2013 (Figure 9.21). The Holt Canyon and North Hills studies typically have the highest abundance of pellet groups.

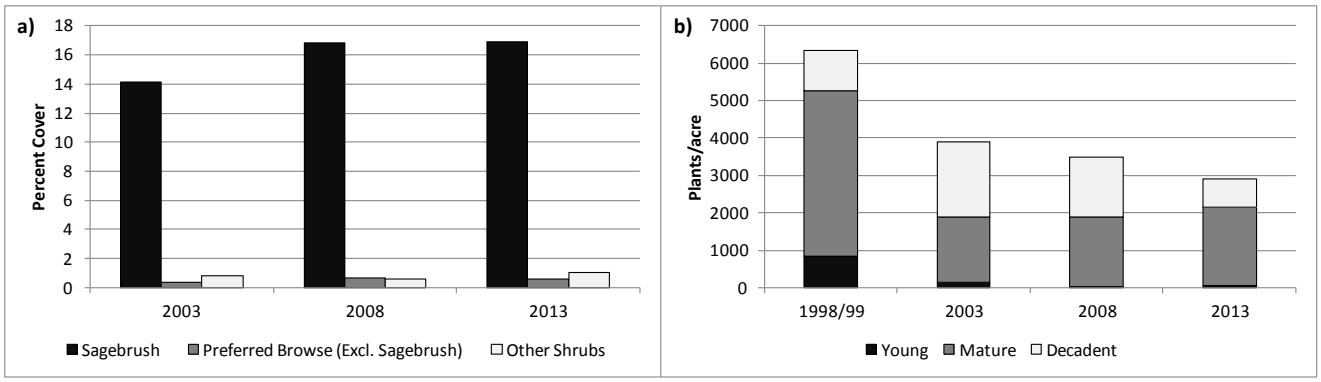


Figure 9.18: Shrub summary of the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

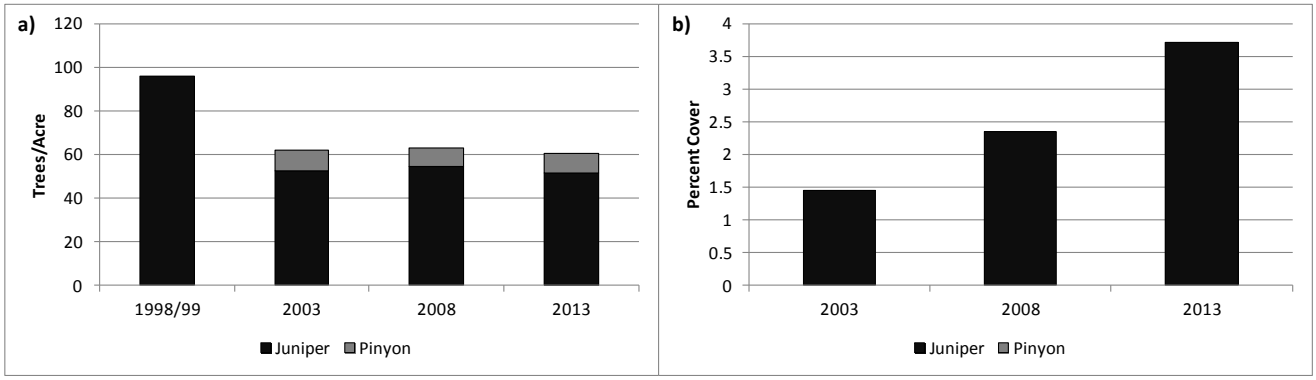


Figure 9.19: Tree summary of the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 30, Pine Valley. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

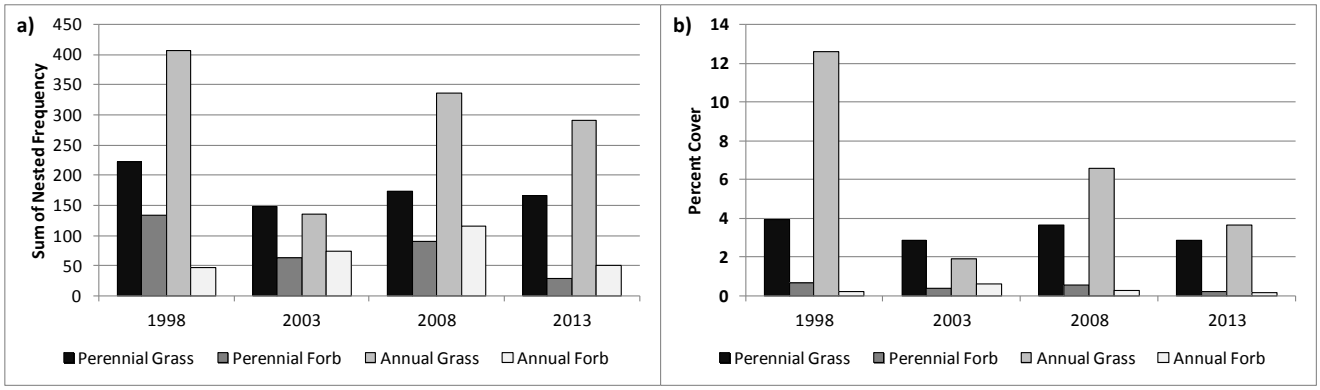


Figure 9.20: Herbaceous functional group summary of the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

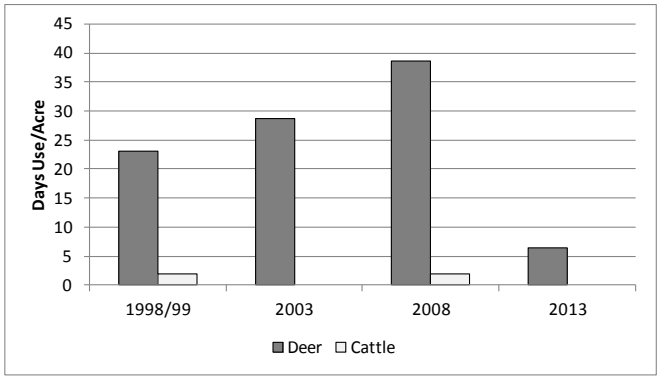


Figure 9.21: Mean pellet transect data for the Semidesert (Wyoming Big Sagebrush) studies (n=3) for WMU 30, Pine Valley.

Study Trend Summary (Treated/Disturbed Sites)

Bullhog

There are four studies [Woolsey Reseeding (30-56), Newcastle Bullhog (30R-1), North Newcastle Bullhog (30R-4), and Duncan Creek/Hwy 56 (30R-5)] that were treated with a bullhog during the report period (Table 9.6). All of the studies are located west of Cedar City along Highway 56 and Newcastle. The North Newcastle Bullhog and Newcastle Bullhog are located in the foothills east of Newcastle. The Woolsey Reseeding and Duncan Creek/Hwy 56 are located in the valley north of the Harmony Mountain and south of Swett Hills and Iron Mountain. The Woolsey Reseeding is classified as Upland (Mountain Big Sagebrush) ecological site, the Duncan Creek/Hwy 56 study is classified as an Upland (Shrub) ecological site, the North Newcastle Bullhog is classified as a Semidesert (Black Sagebrush), and the Newcastle bullhog is classified as a Semidesert (Wyoming Big Sagebrush) ecological site (Table 9.5). Generally, the target of the bullhog treatments was to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on all of the studies is a mixture of either mountain browse species, mountain big sagebrush or Wyoming big sagebrush. Sagebrush was being impacted by pinyon-juniper encroachment on these studies; the mean line-intercept cover of sagebrush was low on many of the sites. The mean cover of sagebrush increased following treatments from near 2% prior to treatment to just over 4% after treatment. The mean of cover of preferred browse, decreased slightly from 3% to 2% following treatment (Figure 9.22a). The mean density of sagebrush also increased from 820 plants/acre to 1,620 plants/acre. Additionally, changes in demographics of the sagebrush populations have been positive on most of the studies. Decadent and mature plants were co-dominant prior to treatment, but decadent plants became a minor component following treatment. The recruitment of young plants was 10% or less on all studies prior to

treatment, but recruitment of young plants was good following treatment (Figure 9.22b). It is expected that with the improved recruitment and health of the sagebrush following treatment that the sagebrush will continue to increase on most of the treatment sites.

The mean density and cover of pinyon pine and Utah juniper trees was high at 568 trees/acre and 17%, respectively. The mean density of pinyon-juniper trees decreased to 71 tree/acre and the mean cover decreased to 3% following treatment (Figure 9.23). Remaining density and cover of pinyon-juniper generally comes from trees that were intentionally left standing or small trees that were missed in the treatment.

Herbaceous Understory: The herbaceous component was generally lacking or poor prior to treatment on these studies, and there was an increase in perennial and annual grasses following treatment. Perennial forb and annual forb density and cover remained similar following the treatment at less than 1%. Perennial grass and annual grass species had the largest response increasing in mean cover from 6% to 17% and less than 1% to 17%, respectively (Figure 9.24). Cheatgrass is a threat for increased fire on all of these studies.

Occupancy: Pellet group transect data indicates that deer primarily occupy these study sites, but cattle are present on the Woolsey Reseeding and North Newcastle Bullhog studies. The mean abundance of pellet groups of deer has decreased from 34 days use/acre prior to treatment to 4 days use/acre 6-10 years following treatment. Most of the decrease in deer occupancy is from the Woolsey Reseeding and Newcastle Bullhog studies, which decreased substantially from 44 days use/acre and 72 days use/acre to 5 days use/acre and 3 days use/acre, respectively. Deer occupancy was low on the North Newcastle Bullhog and Duncan Creek/Hwy 56 studies (Figure 9.25).

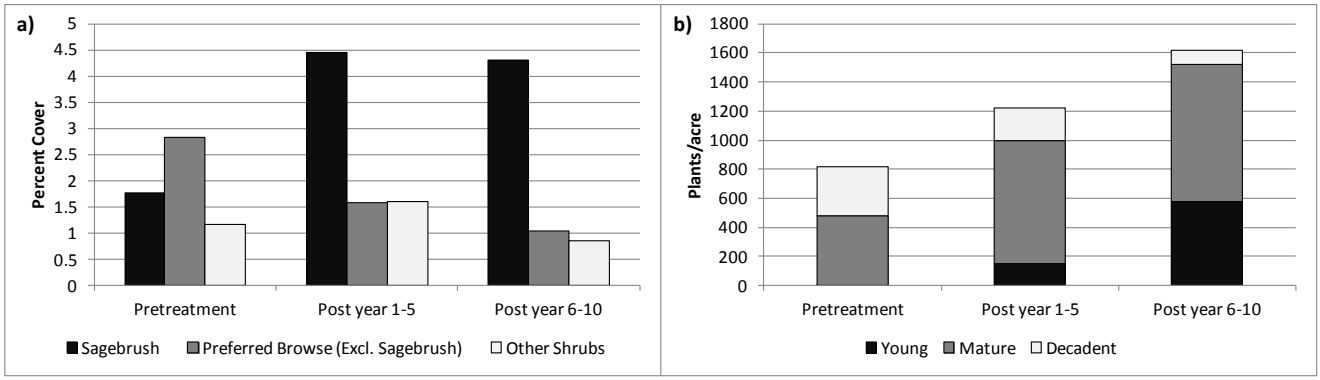


Figure 9.22: Shrub summary of the Bullhog treatment studies (n=4) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

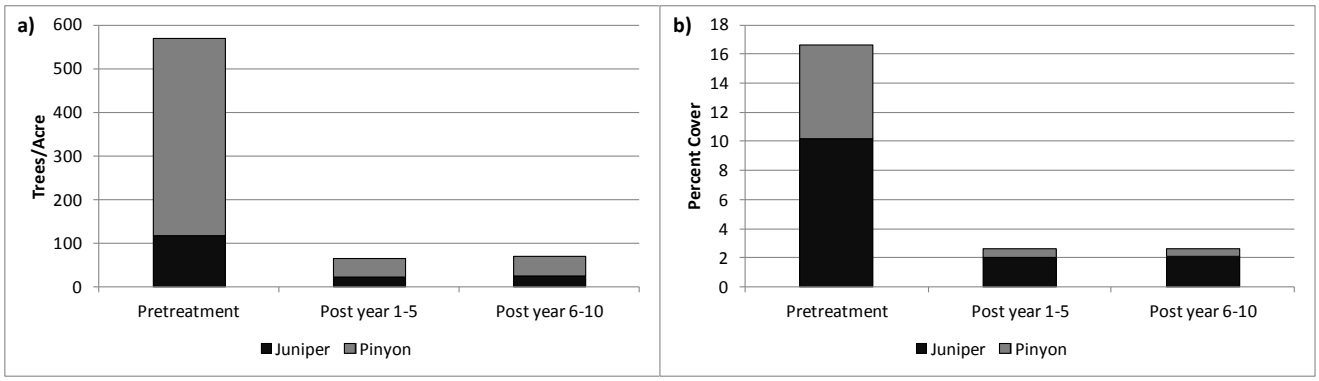


Figure 9.23: Tree summary of the Bullhog treatment studies (n=4) for WMU 30, Pine Valley. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

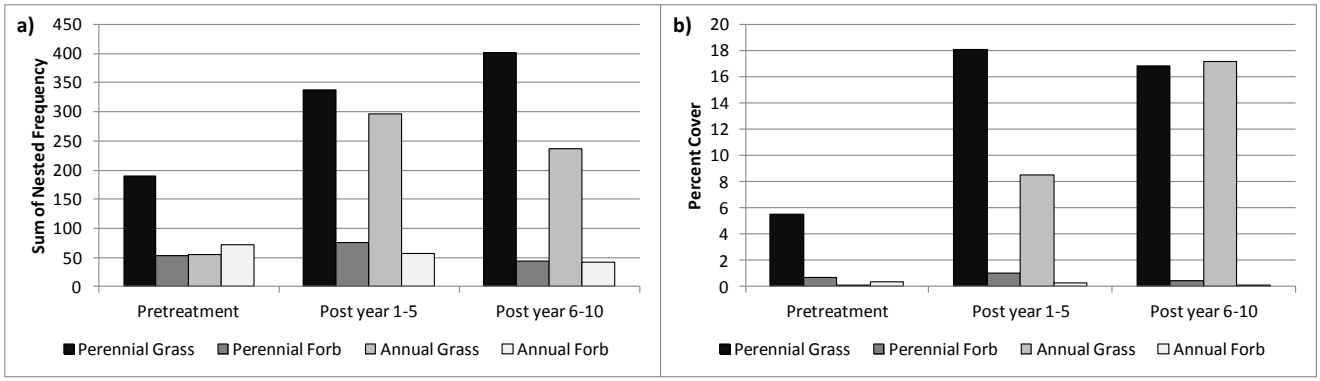


Figure 9.24: Herbaceous functional group summary of the Bullhog treatment studies (n=4) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

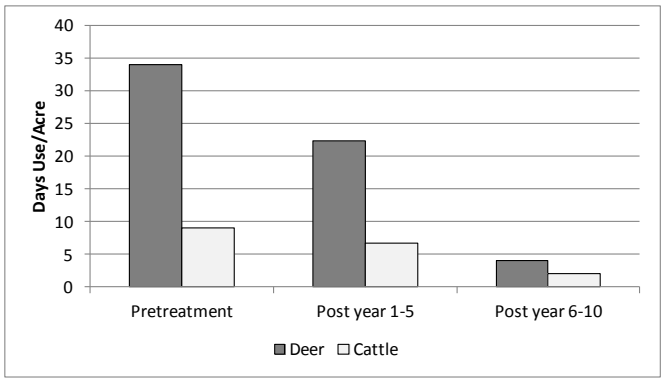


Figure 9.25: Mean pellet transect data for the Bullhog treatment studies (n=8) for WMU 30, Pine Valley.

Lop and Scatter

There is one study [Southwest of Newcastle (30-29)] that was treated with a lop and scatter during the report period (Table 9.6). The Southwest of Newcastle study is located in the foothills southwest of Newcastle. This study is classified as a Semidesert (Wyoming Big Sagebrush) ecological site (Table 9.5). Generally, the target of a lop and scatter treatment is to reduce pinyon-juniper tree cover in order to restore the sagebrush and herbaceous understory.

Shrubs/Trees: The primary browse on the Southwest of Newcastle study is Wyoming big sagebrush. The mean cover of sagebrush increased from near 1.5% prior to treatments to just over 10% following treatment. The other preferred browse species remained rare following treatment, but other shrub species have increased from 2% cover to 8% cover following treatment (Figure 9.26a). The mean density of sagebrush decreased following treatment. Decadent plants decreased substantially following treatment, while the mean density of mature plants increased markedly (Figure 9.26b).

Prior to treatment, the mean density and cover of pinyon pine and Utah juniper trees were moderately low at 88 trees/acre and 2%, respectively. Following treatment, the mean density of pinyon-juniper trees remained similar at 94 tree/acre and the mean cover decreased to 1% (Figure 9.27). Remaining density and cover is generally provided by young trees that were missed in the treatment.

Herbaceous Understory: This study site has a fair herbaceous component dominated by annual and perennial grasses. Initially, perennial grass had the largest response increasing in mean cover from 5% to 8% 1-5 years following treatment, but decreased to 4% 6-10 years post treatment. Annual grass species, primarily cheatgrass, increased from less than 1% cover to 17% cover following treatment. Cheatgrass poses a substantial threat for increased fire regimen for this site (Figure 9.28).

Occupancy: Pellet group transect data indicates that deer primarily occupy this study site. The mean abundance of pellet groups for deer initially increased from 85 days use/acre prior to treatment to 102 days use/acre 1-5 years post treatment, but decreased to 57 days use/acre 6-10 years post treatment (Figure 9.29).

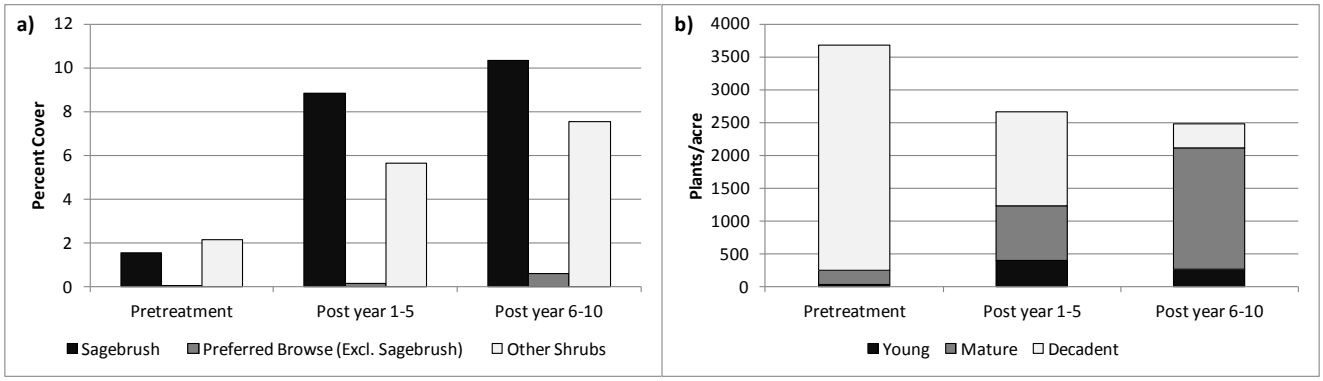


Figure 9.26: Shrub summary of the Lop and Scatter treatment study (n=1) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

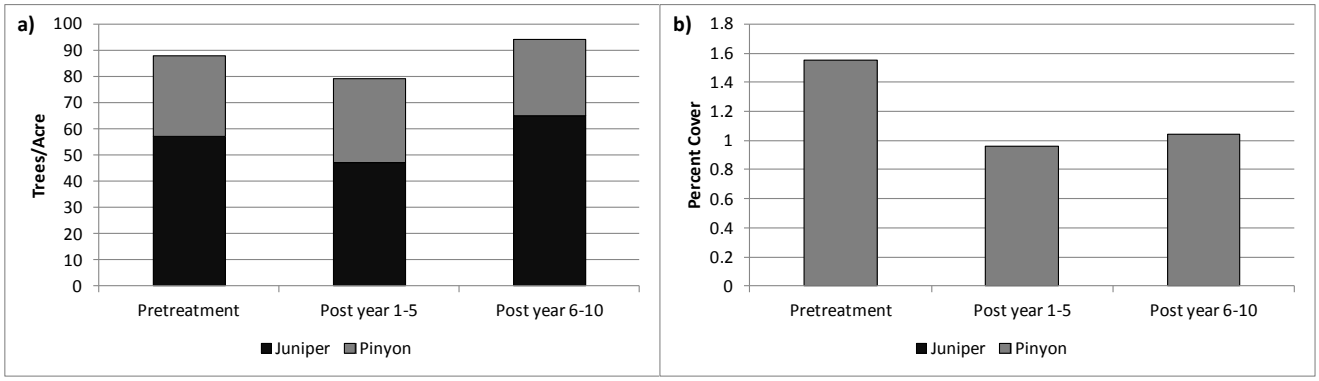


Figure 9.27: Tree summary of the Lop and Scatter treatment study (n=1) for WMU 30, Pine Valley. a) Mean point-quarter tree density estimates for pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). b) Mean line-intercept cover estimate for pinyon pine and Utah juniper.

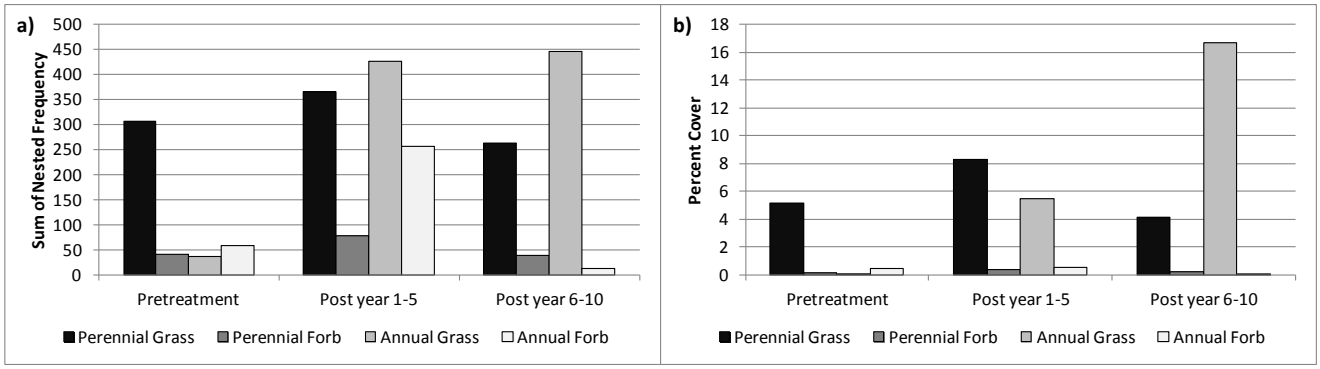


Figure 9.28: Herbaceous functional group summary of the Lop and Scatter treatment study (n=1) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

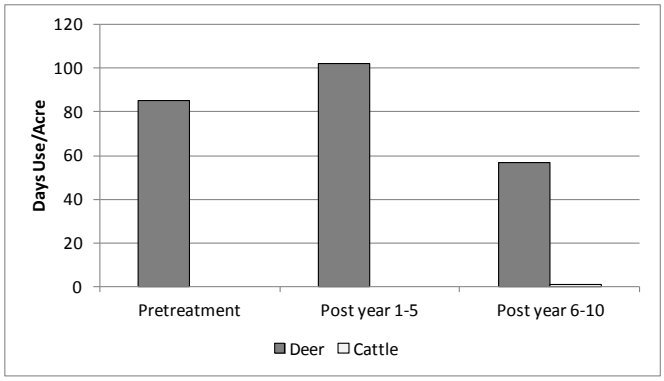


Figure 9.29: Mean pellet transect data for the Lop and Scatter treatment study (n=1) for WMU 30, Pine Valley.

Wildfire

There are seven studies [Grapevine Spring (30-42), Flat Top Mountain (30-45), Pahcoon Bench (30-46), Northwest of Enterprise (30-52), Summit Spring (30-57), Tobin Bench (30-61) and Square Fire Rehab (30R-2)] that were burned in wildfires during the report period (Table 9.6). For purposes of comparison, Flat Top Mountain was not included in the summary for studies that were burned by wildfire. The Grapevine Spring and Tobin Bench studies burned in the Bull Complex fire in 2006; the Flat Top Mountain study burned in the Hawkins fire in 2004; the Pahcoon Bench study burned in the Pahcoon and Apex fires in 1998 and 2003, respectively; the Northwest of Enterprise study burned in the Barn fire in 1998; the Summit Spring study burned in the Westside Complex fire in 2005; and the Square Fire Rehab study was established to monitor the rehabilitation of the Square fire that burned in 2004. The Northwest of Enterprise study is classified as Semidesert (Wyoming Big Sagebrush) ecological site, the Flat Top Mountain study is classified as an Mountain (Oak) ecological site, the Grapevine Spring study is classified as Upland (Shrub Liveoak) ecological site, the Pahcoon Bench study is classified as an Upland (Mountain Big Sagebrush) ecological site, and the Tobin Bench and Summit Spring studies did not have a defined ecological site description but are likely Semidesert (Cliffrose) and Semidesert (Desert Shrub), respectively (Table 9.5).

Shrubs/Trees: The primary browse is different for each of these sites, which include mountain big sagebrush, Wyoming big sagebrush, desert almond (*Prunus fasciculata*), blackbrush (*Coleogyne ramosissima*), threadleaf snakeweed (*Gutteriezia microcephala*), forage kochia (*Kochia prostrata*), and Stansbury cliffrose (*Cowania mexicana* spp. *stansburiana*). Prior to disturbance, sagebrush was sampled on three of the study sites Northwest of Enterprise, Pahcoon Bench, and Tobin Bench. However, only the Northwest of Enterprise study had sagebrush as the dominant browse species, on the other two sites sagebrush was co-dominant. Preferred browse species on all of the study sites provided a mean line-intercept of 11% prior to disturbance. Following the disturbance cover was 4% 1-5 years post treatment, 5% 6-10 years post treatment, and 4% 11-15 years post treatment(Figure 9.30a). Prior to disturbance the demographics of the sagebrush population was a mixture of decadent and mature plants with limited recruitment of young plants. Following the wildfires, the small populations of sagebrush have been comprised primarily of young plants, with minimal reestablishment (Figure 9.30b). Encroachment from pinyon pine and Utah juniper trees was minimal on most study sites except the Grapevine Spring and Northwest of Enterprise studies, so a summary of trees was therefore not included in this report.

Herbaceous Understory: The herbaceous component was mixed across the sites, but was generally dominated by annual grasses and forbs with the exception of Northwest of Enterprise study, which was dominated by perennial grasses. Perennial grass species have remained similar, with the exception of the Northwest of Enterprise and Pahcoon Bench studies. Perennial grass cover decreased on the Northwest of Enterprise study and perennial grass cover increased on the Pahcoon Bench study. Annual grasses decreased from 9% prior to wildfire to 4% 1-5 years following the wildfire, and then increased to 7% 6-10 years and 14% 11-15 years post

treatment (Figure 9.31). Cheatgrass remains a substantial threat for increased fire potential on all of these studies.

Occupancy: Pellet group transect data indicates that deer and cattle primarily occupied these study sites. The mean abundance of pellet groups of wildlife species have steadily decreased following the wildfires. The abundance of cattle sign has remained low on many of the sites (Figure 9.32).

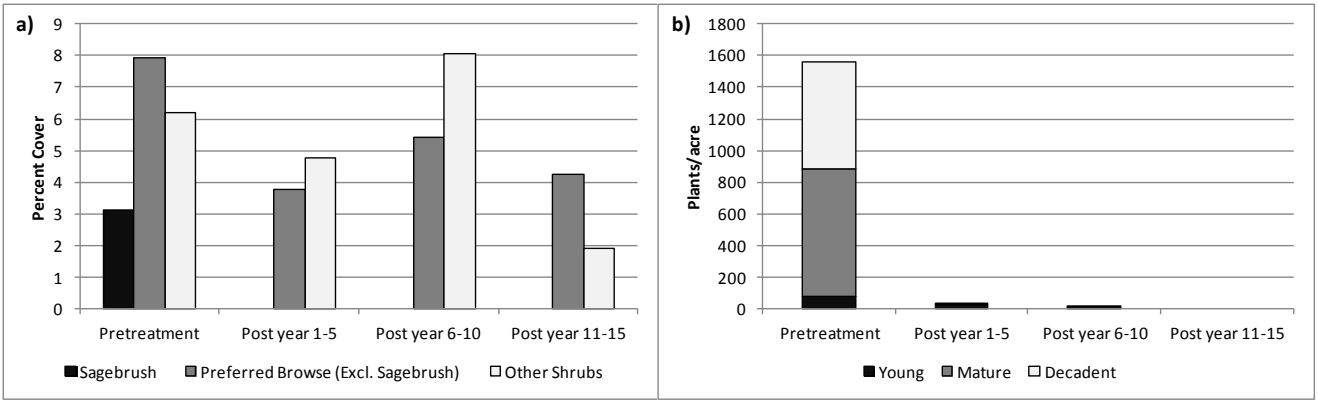


Figure 9.30: Shrub summary of the Wildfire disturbance studies (n=6) for WMU 30, Pine Valley. a) Mean line-intercept cover estimate of shrub groups. b) Mean density and demographics of sagebrush (*Artemisia spp.*) species.

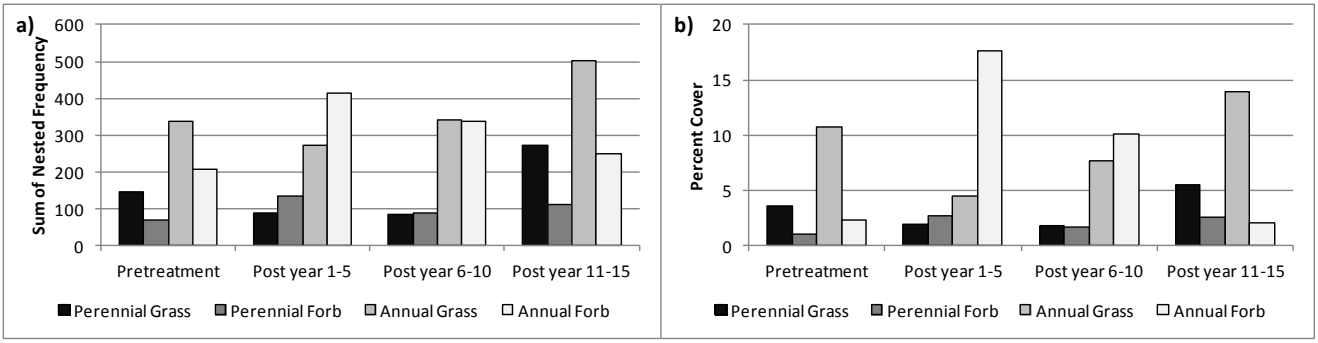


Figure 9.31: Herbaceous functional group summary of the Wildfire disturbance studies (n=6) for WMU 30, Pine Valley. a) Mean sum of nested frequency of herbaceous functional groups. b) Mean quadrat cover estimate of herbaceous functional groups.

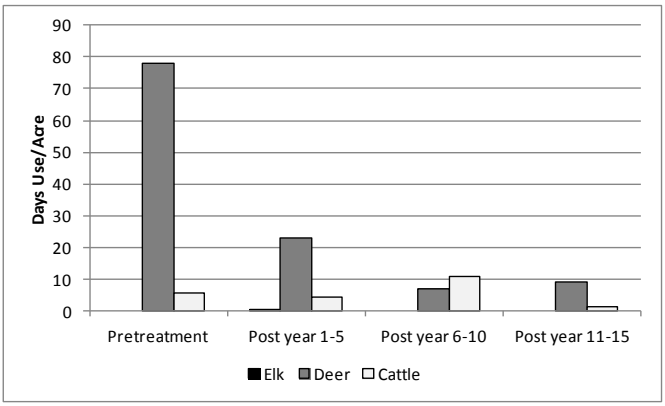


Figure 9.32: Mean pellet transect data for the Wildfire disturbance studies (n=7) for WMU 30, Pine Valley.

Deer Winter Range Condition Assessment

The condition of deer winter range on the untreated sites within the Pine Valley management unit has generally improved on the study sites sampled since 2003. The majority of sites sampled within the unit are considered to be in fair to good condition based on the most current sample data (Figure 9.33 and Figure 9.34). The two undisturbed study sites that are currently considered to be in very poor condition is the North Hills and Wide Canyon 2 studies, which have a poor herbaceous understory and are dominated by cheatgrass. The majority of disturbed or treated study sites ranked as being in poor or very poor condition after disturbance are those burned by wildfire or sites with high amounts of cheatgrass being sampled. These study sites generally are still lacking in available browse species, and/or typically have increased amounts of cheatgrass (Map 9.7 and Table 9.7).

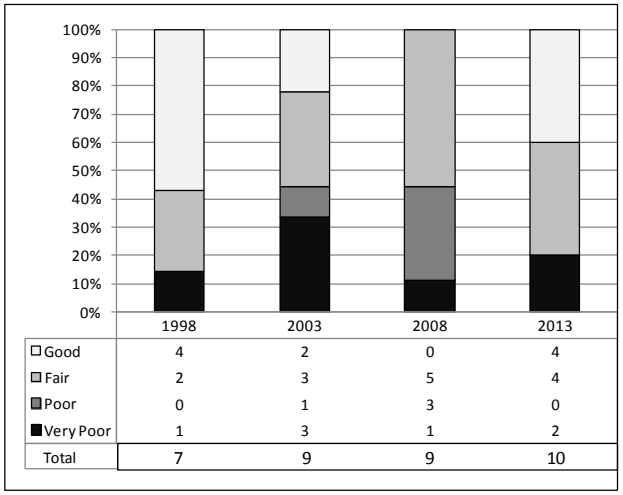


Figure 9.33: Deer winter range Desirable Components Index (DCI) summary by year of undisturbed sites for WMU 30, Pine Valley.

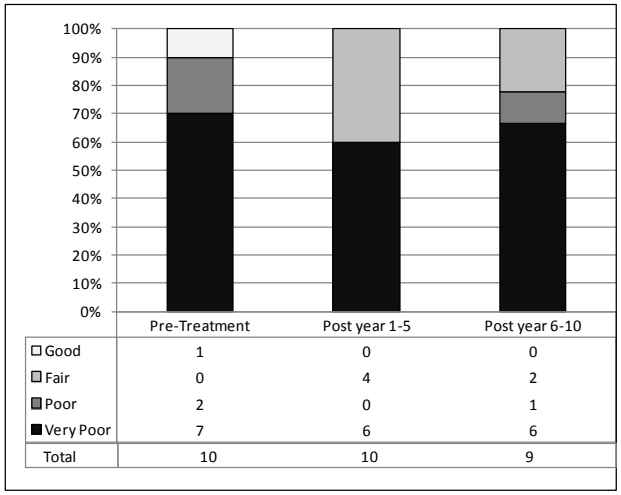
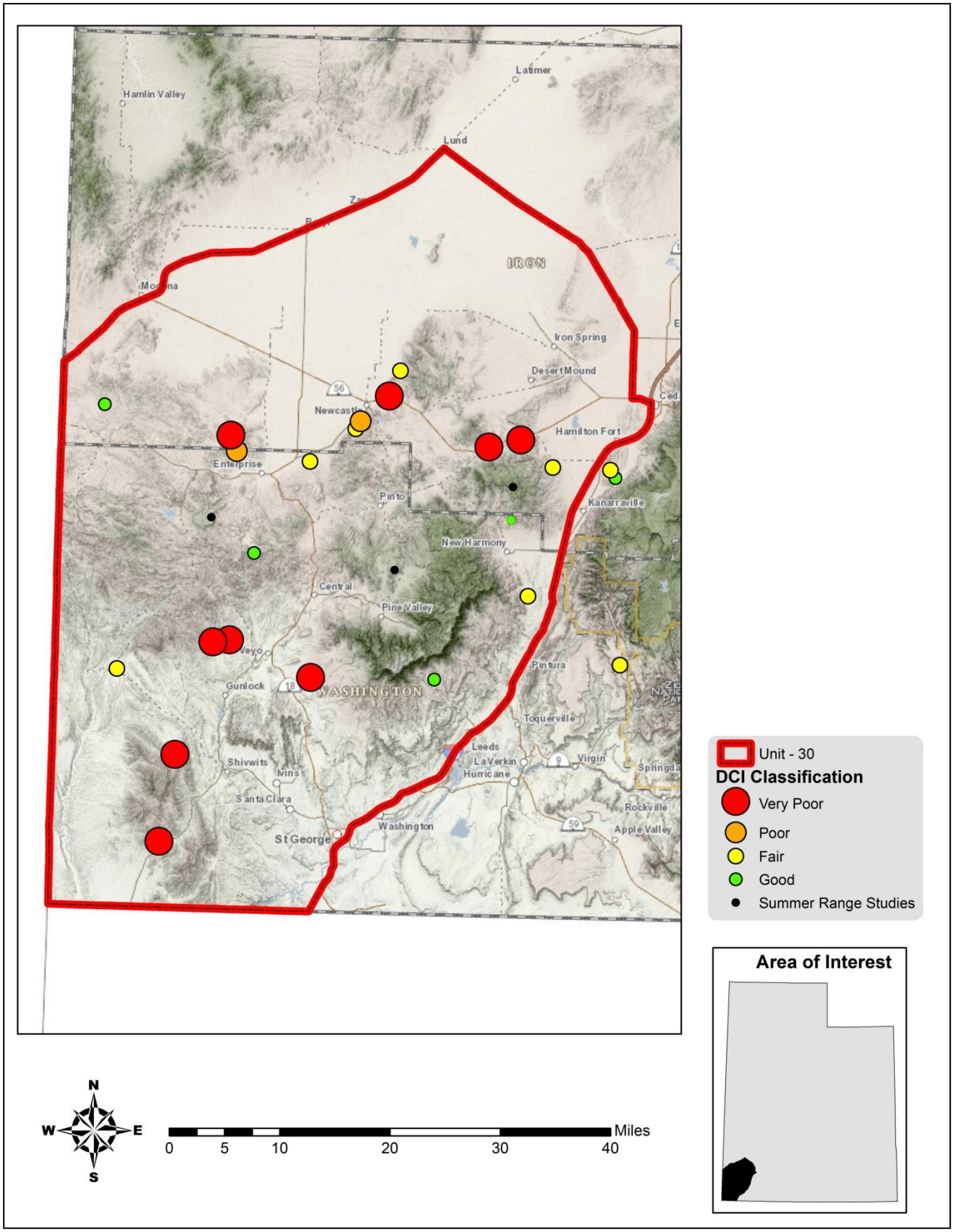


Figure 9.34: Deer winter range Desirable Components Index (DCI) summary by year of treated/disturbed sites for WMU 30, Pine Valley.



Map 9.7: Deer winter range Desirable Components Index (DCI) ranking distribution by study site of most current sample date as of 2013 for WMU 30, Pine Valley.

Study No.	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
30-3	Upper Broad Hollow	PJ Encroachment Annual Grass	Moderate Moderate	Reduced understory shrub and herbaceous vigor Increased fire potential
30-5	Harmony Mountain Summit	None Identified		
30-13	Black Ridge	PJ Encroachment Annual Grass	High Low	Reduced understory shrub and herbaceous vigor Increased fire potential
30-26	Grassy Flat Ridge	PJ Encroachment Introduced Perennial Grass	Low Moderate	Reduced understory shrub and herbaceous vigor Reduced diversity of desirable grass and forb species
30-29	Southwest of Newcastle	PJ Encroachment Annual Grass	Low High	Reduced understory shrub and herbaceous vigor Increased fire potential
30-40	Telegraph Draw	PJ Encroachment Annual Grass	High Low	Reduced understory shrub and herbaceous vigor Increased fire potential
30-41	Joe Spring	Annual Grass	High	Increased fire potential
30-42	Grapevine Spring	Annual Grass	Moderate	Increased fire potential
30-45	Flat Top Mountain	Annual Grass	Low	Increased fire potential
30-46	Pahcoon Bench	Annual Grass	High	Increased fire potential
30-52	Northwest of Enterprise	Annual Grass	High	Increased fire potential
30-54	Bullion Canyon	PJ Encroachment Annual Grass	Moderate Moderate	Reduced understory shrub and herbaceous vigor Increased fire potential
30-55	Quichapa Canyon	PJ Encroachment Annual Grass	Moderate Moderate	Reduced understory shrub and herbaceous vigor Increased fire potential
30-56	Woolsey Reseed	Introduced Perennial Grass Annual Grass	Moderate Low	Reduced diversity of desirable grass and forb species Increased fire potential
30-57	Summit Spring	Annual Grass	High	Increased fire potential
30-58	Spirit Creek South Burned	Introduced Perennial Grass Annual Grass	Moderate Low	Reduced diversity of desirable grass and forb species Increased fire potential
30-61	Tobin Bench	Annual Grass	Low	Increased fire potential
30-62	North Hills	Annual Grass	High	Increased fire potential
30-63	Holt Canyon	Annual Grass	High	Increased fire potential
30-73	Wide Canyon 2	PJ Encroachment Annual Grass	Moderate High	Reduced understory shrub and herbaceous vigor Increased fire potential
30R-1	Newcastle Bullhog	Annual Grass	High	Increased fire potential
30R-3	Square Fire Rehab	Annual Grass	High	Increased fire potential
30R-4	North New Castle	Annual Grass	High	Increased fire potential
30R-5	Duncan Creek/Hwy 56	Annual Grass	Low	Increased fire potential

Table 9.7: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 30, Pine Valley. All assessments are based off the most current sample date for each study site.

Discussion and Recommendations

Mountain (Oak)

The higher elevation mountain sites, which support Gambel oak communities, are generally considered to be in good condition for deer winter range habitat on the Pine Valley management unit. These communities support robust shrub populations that provide valuable browse in mild winters. While in generally good condition, these sites appear to be prone to wildfire with both of these sites having burned over the course of the sample years. In addition, introduced perennial grass is the dominant herbaceous component on the Spirit Creek South Burn site, which was seeded with introduced grass where as the Flat Top Mountain site was not seeded. While providing valuable forage, these grass species can often be aggressive at higher elevation and precipitation, and can reduce the abundance of other more desirable native grass and forb species.

It is recommended these communities be managed to maintain healthy browse and diverse herbaceous components. When reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species when possible.

Mountain and Upland (Mountain Big Sagebrush)

The higher elevation upland and mountain sites, which support mountain big sagebrush communities, are generally considered to be in good condition for deer winter range habitat on the Pine Valley management unit. With the exception being those sites that have been burned or have high abundance of cheatgrass with depleted herbaceous understory. These communities support robust shrub populations that provide valuable

browse in mild and moderate winters. While in generally good condition, these sites appear to be prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. In addition, introduced perennial grasses are often the dominant herbaceous component on these study sites. While providing valuable forage, these grass species can often be aggressive at higher elevation and precipitation and can reduce the abundance of other more desirable native grass and forb species.

It is recommended that work to reduce pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) should continue in these communities. When reseeding is necessary to restore the herbaceous understory, care should be taken in species selection and preference should be given to native grass species when possible.

Upland (Wyoming Big Sagebrush, Shrub, and, Shrub Liveoak)

The mid elevation upland Wyoming big sagebrush and shrub communities that have not been disturbed are generally considered to be in fair condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire and the study, which burned in 2006, is in very poor condition. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are prone to encroachment from pinyon-juniper trees, which can reduce understory shrub and herbaceous health if not addressed. Annual grass, primarily cheatgrass, can also be an issue within these communities. Increased amounts of cheatgrass can increase fuel loads and the threat of wildfire within these communities.

It is recommended that work to reduce pinyon-juniper encroachment should continue in these communities. Care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites. Work to diminish fuel loads and create firebreaks should continue in order to reduce the threat of catastrophic fire.

Semidesert (Wyoming Big Sagebrush and other browse)

The lower elevation semidesert Wyoming big sagebrush and other browse communities that have not been disturbed are generally considered to be in fair condition for deer winter range habitat on the unit. These communities support robust shrub populations that provide valuable browse in moderate to severe winters. However, these communities are prone to wildfire and those studies, which have burned since 1998, are in poor to very poor condition. If wildfire occurs within these communities, they lose most of their value as deer winter range and reestablishment of valuable browse species is typically slow. These communities are susceptible to invasion from annual grass, primarily cheatgrass. Increased amounts of cheatgrass can increase fuel loads and increase the threat of wildfire on within these communities. Encroachment from pinyon-juniper trees is not typically an issue within these communities.

It is recommended that work to diminish fuel loads and create firebreaks should continue within these communities in order to reduce the threat of catastrophic fire. Treatments to establish and increase browse species more rapidly following wildfire should also be implemented, and treatments to increase browse species on historic fires should be considered. If a treatment to rejuvenate sagebrush occurs, care should be taken in selecting treatment methods that will not increase annual grass loads. Treatments to reduce annual grass may be necessary on some sites.

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