UTAH BIG GAME RANGE TREND SUMMARIES 2021

WILDLIFE MANAGEMENT UNITS
1, 2, 3, 4, 5, 6, 7, 18A & 18B

PUBLICATION NUMBER 22-13
REPORT FOR FEDERAL AID PROJECT W-82-R-66

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

UTAH BIG GAME RANGE TREND UNIT SUMMARIES
2021
WILDLIFE MANAGEMENT UNITS
1, 2, 3, 4, 5, 6, 7, 18A & 18B

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Common Starlily (*Leucocrinum montanum*) by Jason Cox (2021)

Performance Report for Federal Aid Project W-82-R-66

Publication No. 22-13

UTAH DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife Resources
1594 West North Temple
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Reports for study sites, with accompanying photographs, are available online at http://wildlife.utah.gov/range-trend.html.

PROGRAM NARRATIVE

State: UTAH

Project Number: W-82-R-66

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 USBs, 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 2021 field season and reported in this publication involves the reading of interagency range trend studies in the DWR Northern Region. Most trend studies surveyed in these management units were established in the 1980s 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:

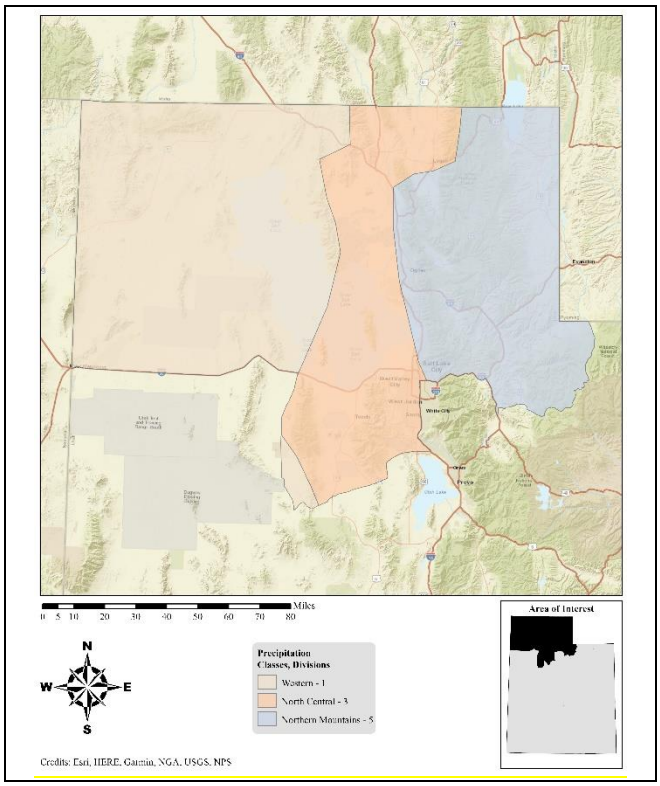
Bureau of Land Management
- Salt Lake Field Office

United States Forest Service
- Sawtooth National Forest
- Wasatch-Cache National Forest

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

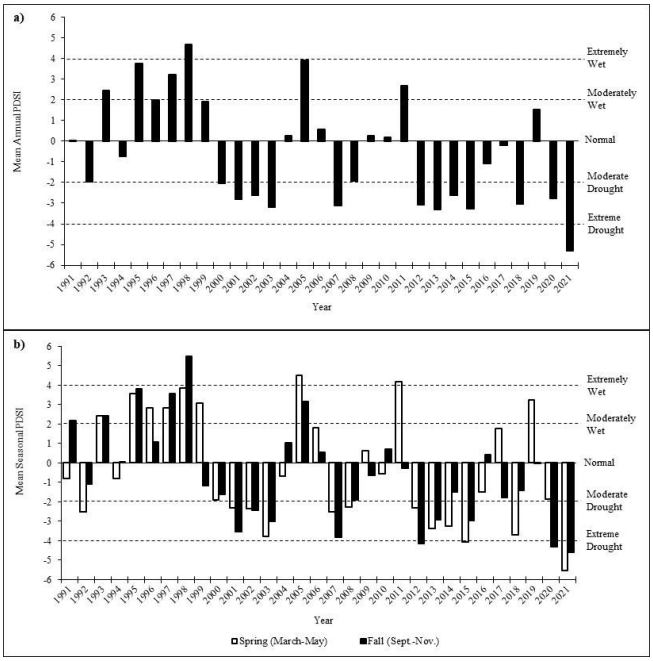
RANGE TREND UNIT SUMMARY OVERVIEW

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



Climate Data: The state of Utah is divided into seven climatic divisions for estimating the Palmer Drought Severity Index (PDSI) and the Northern Region occurs within three of these divisions: Western (Division 1), North Central (Division 3), and Northern Mountains (Division 5). 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 2021. The data reported in this summary covers the years over which these sites have been sampled (1991-2021). 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 to 2.9 = 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, 2022). 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 North Central region (Climate Prediction Center Internet Team, 2005).



Big Game Habitat: 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 big game animals show the seasonal ranges for year-long, winter, transitional, 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 big game animals to display estimated habitat acreage by season and ownership. If there was not habitat for a specific season (summer, winter, transitional, 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. Percentages of tree, shrub, and herbaceous canopy cover training data are generated using plot-level ground-based visual assessments. Once the training data is developed, relationships are then established separately for each functional group between the training data and a 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, n.d.).

The LANDFIRE data reported in this summary includes the major functional groups (shrubland, conifer, grassland, and others) and various subgroups of importance found within the unit boundaries. Acreage and percent of total acreage 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."

Limiting Factors to Big Game Habitat: This section discusses some of the major limiting factors for big game habitat in the given 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 management unit through the WRI program and a map of the fire history from 2000-2021 is available for each unit. A total acreage amount 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 1980s 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 (if available). Another table shows the disturbance history for those sites that have had a known disturbance that occurred on the site.

Study Trend Summary: 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, covers, and utilizations for shrubs and trees. Not all sites had shrubs or trees present: when this is the case, graphs are included with no data displayed. 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 are 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. In addition, 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 ESDs, which are lower in elevation; upland ESDs, which are mid-elevation; and mountain ESDs, which are higher elevation sites.

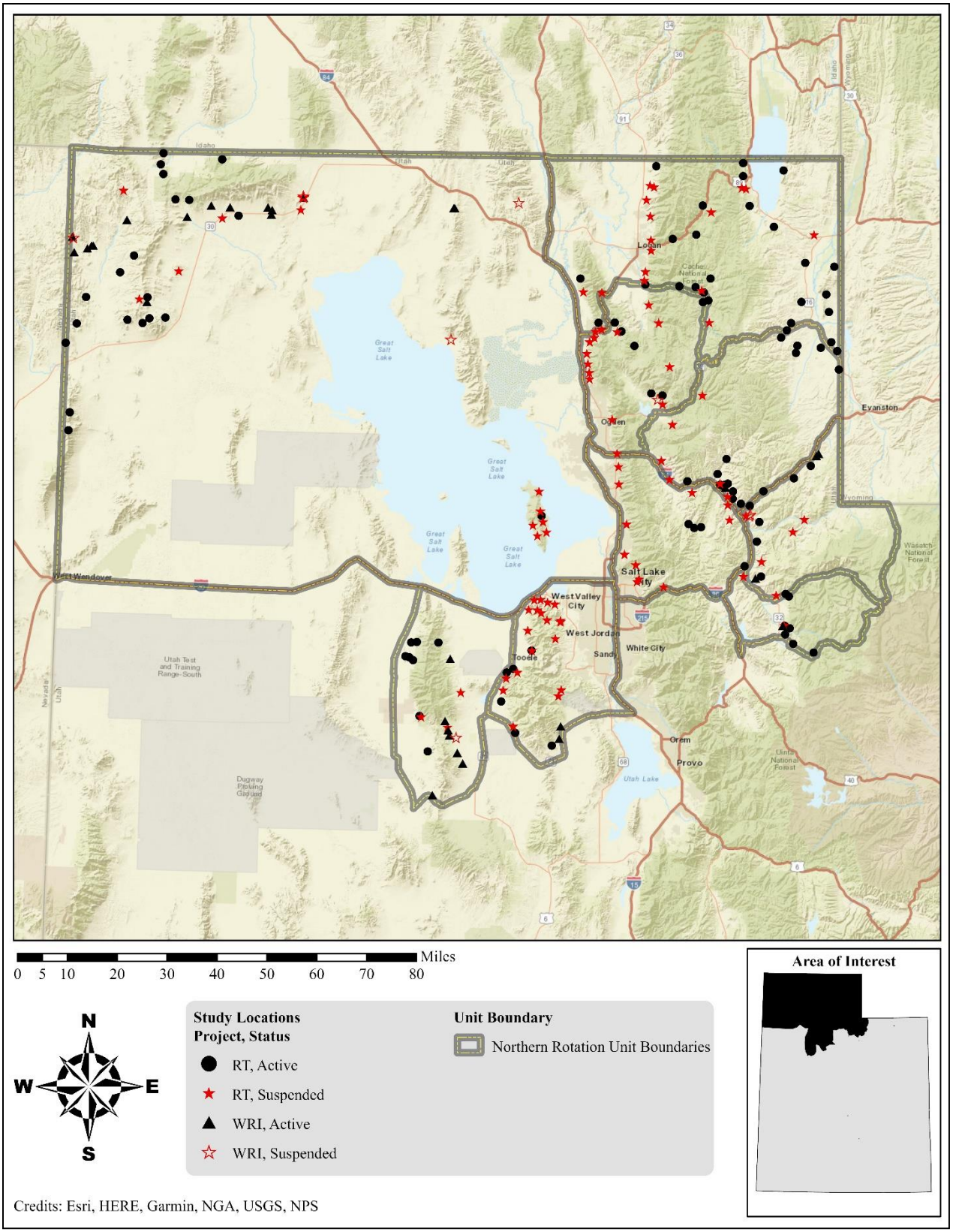
Deer Winter Range Condition Assessment: The desirable components index (DCI) for deer was created by Range Trend Program personnel as a tool to address condition and/or value of winter ranges for mule deer. This index is meant to be a companion to, and not a replacement for, the site-specific range trend 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, recruitment of young shrubs, 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 soil stability, hydrologic function, and other environmental factors into account, this index should not be used to assess a sites function and/or condition.

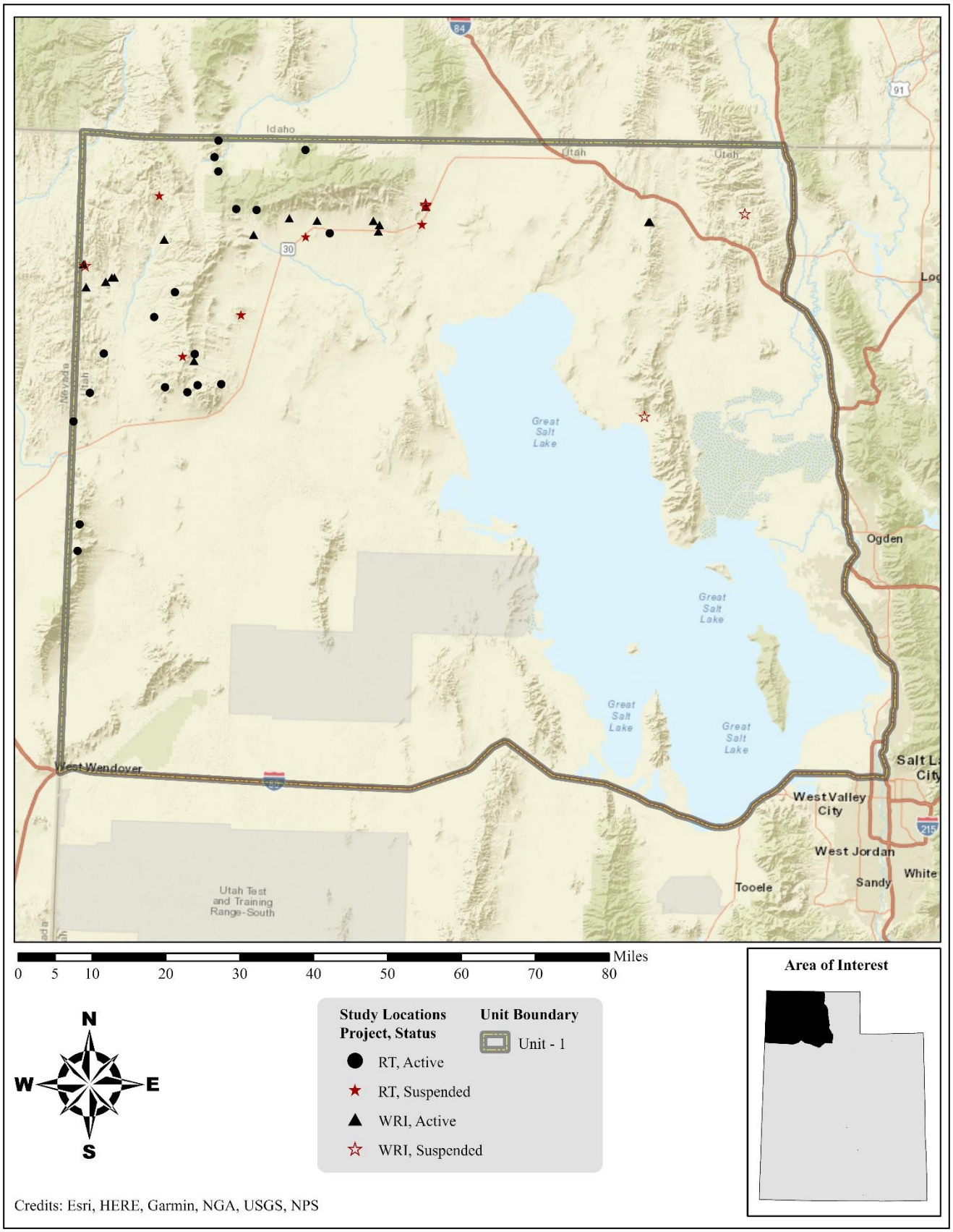
Changes in DCI over the sample years for both treated and untreated sites are included in the figures near the end of the summary. Care should be taken when interpreting these tables as the number of sites included in each year may vary. This could be misleading if the overall DCI seems to be improving, 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 are assessed for their overall threats based on species composition and cover. Common threats to these sites are pinyon-juniper encroachment and 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 1 – BOX ELDER



WILDLIFE MANAGEMENT UNIT 1 – BOX ELDER

Boundary Description

Box Elder, Tooele, Salt Lake, Davis, and Weber counties - Boundary begins at the Utah-Idaho state line and Interstate 15; west along this state line to the Utah-Nevada state line; south along this state line to Interstate 80; east on I-80 to I-15; north on I-15 to the Utah-Idaho state line.

Management Unit Description

Geography

The Box Elder Management Unit is one of the largest in the state, but big game range accounts for less than one-third of the unit. The Box Elder Subunit 1B (Promontory region) is located in the eastern portion of the WMU and consists primarily of private land that was considered unsuitable for permanent trend studies. The Pilot Mountain Subunit 1C is composed of the most southern portion of the unit and Pilot Mountain. Most of the permanent range trend studies have been established in the Raft River Subunit 1A, which is located in the western portion of the management unit. The land area of this subunit is comprised mostly of the Raft River, Grouse Creek, and Goose Creek Mountains. A majority of the land in this subunit is also privately owned, with 70% of what is considered "normal" winter range (King & Muir, 1971) arranged in a checkerboard pattern with public lands. Towns located within this area include Etna, Grouse Creek, Lynn, Yost, and Park Valley.

The Raft River Mountains run east-west, parallel to the Utah-Idaho border: slopes on this mountain range are moderately steep in the southern and eastern portions, and gentler to the north and west. The highest point in the unit is on Dunn Benchmark peak at the head of the Clear Creek drainage with an elevation of 9,925 feet. The Grouse Creek Mountains are relatively narrow and steep and run north-south; at 9,000 feet, Red Butte is the highest point in this mountain range. The topography of the Goose Creek Mountains is generally more nominal, with the highest point being 8,584 feet on Twin Peaks. Finally, the Dove Creek Mountains are rougher, but the terrain becomes gentler toward the Three Corners area.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 5 inches along portions of the Utah-Nevada border to 41 inches on the peaks of the Raft River Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within 10-23 inches of precipitation (**Map 1.1**) (PRISM Climate Group, Oregon State University, 2021).

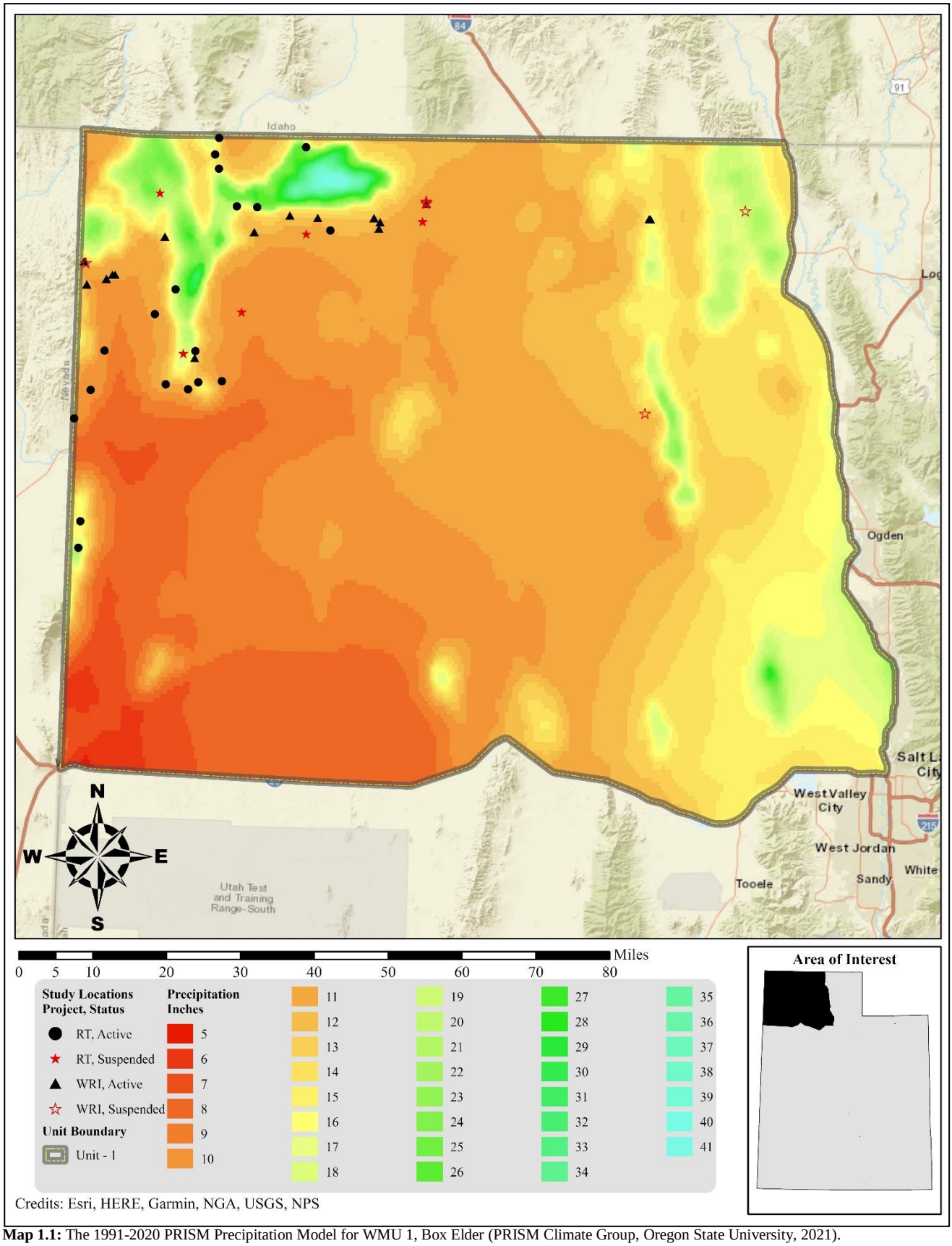
Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (Time Series Data, 2022) Physical Sciences Division (PSD) as part of the Western, North Central, and Northern Mountains divisions (Divisions 1, 3, and 5).

The mean annual PDSI of the Western division displayed years of moderate to extreme drought from 2000-2003, 2007-2008, 2012-2013, 2015, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1993, 1995, 1997-1998, 2005, 2011 and 2019 (**Figure 1.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 2000, 2002-2004, 2007-2008, 2012-2015, and 2021; moderately to extremely wet years were displayed in 1993, 1995, 1998, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2001-2003, 2007-2008, 2012, and 2020-2021; moderately to extremely wet years were displayed in 1997-1998, 2011, and 2019 (**Figure 1.1b).**

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought in 1992, 2000-2003, 2007, 2012-2015, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1993, 1995, 1997-1998, 2005, and 2011 (**Figure 1.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2001-2003, 2007, 2012-2013, 2015; and 2020-2021; moderately to extremely wet years were displayed in 1991, 1993, 1995, 1997-1998, and 2005 (**Figure 1.2b**).

The mean annual PDSI of the Northern Mountains division displayed years of moderate to extreme drought from 2000-2003, 2012-2013, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1995,

1997-1998, 2005, and 2011 (**Figure 1.3a**). The mean spring (March-May) PDSI displayed moderate to extreme drought in 1992, 2000-2004, 2012-2014, 2018, and 2021 ; moderately to extremely wet years were displayed from 1995-1996, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2013, and 2020-2021; moderately to extremely wet years were displayed in 1995 and 1997-1998 (**Figure 1.3b**) (Time Series Data, 2022).



Map 1.1: The 1991-2020 PRISM Precipitation Model for WMU 1, Box Elder (PRISM Climate Group, Oregon State University, 2021).

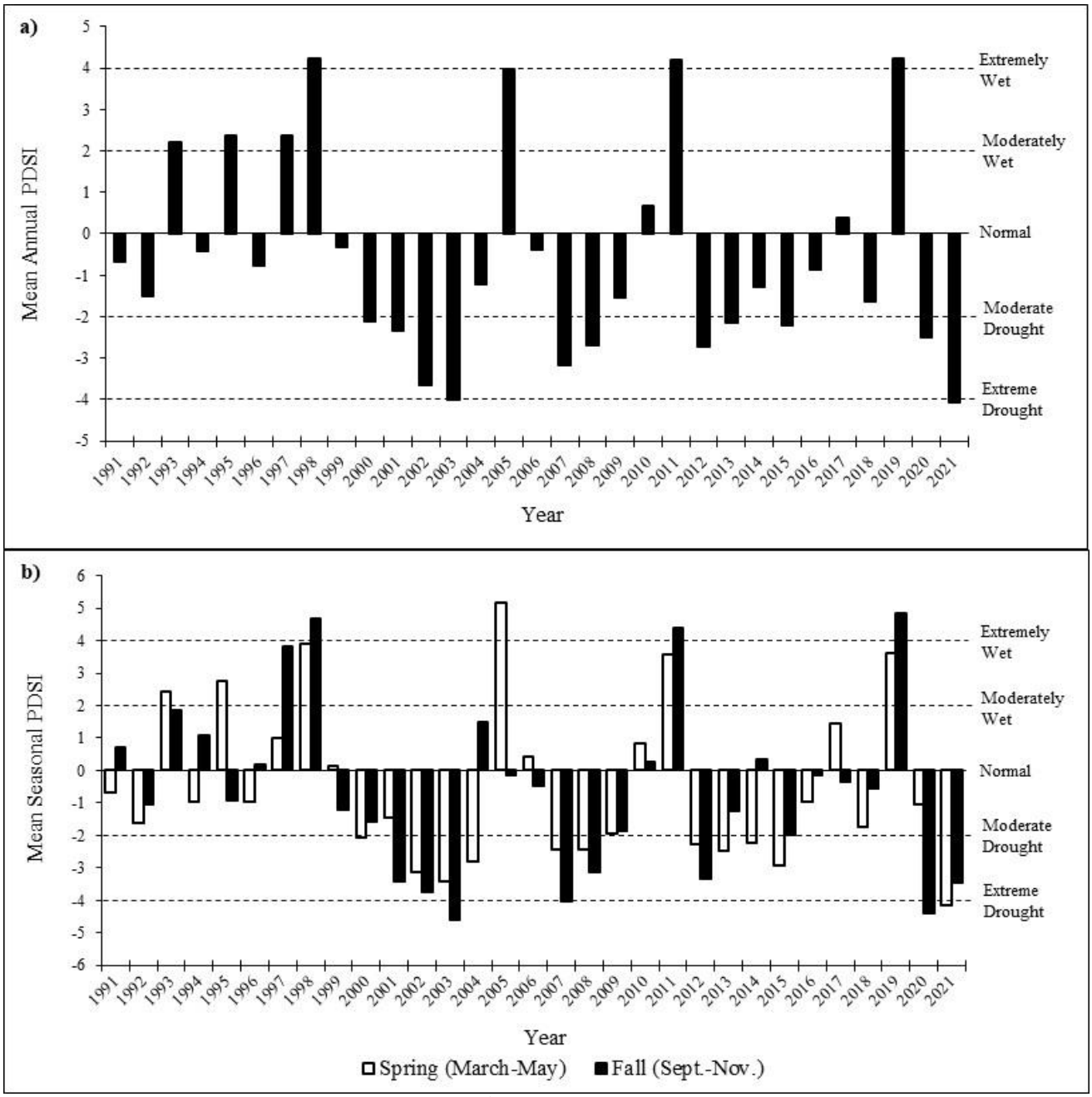


Figure 1.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Western division (Division 1). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

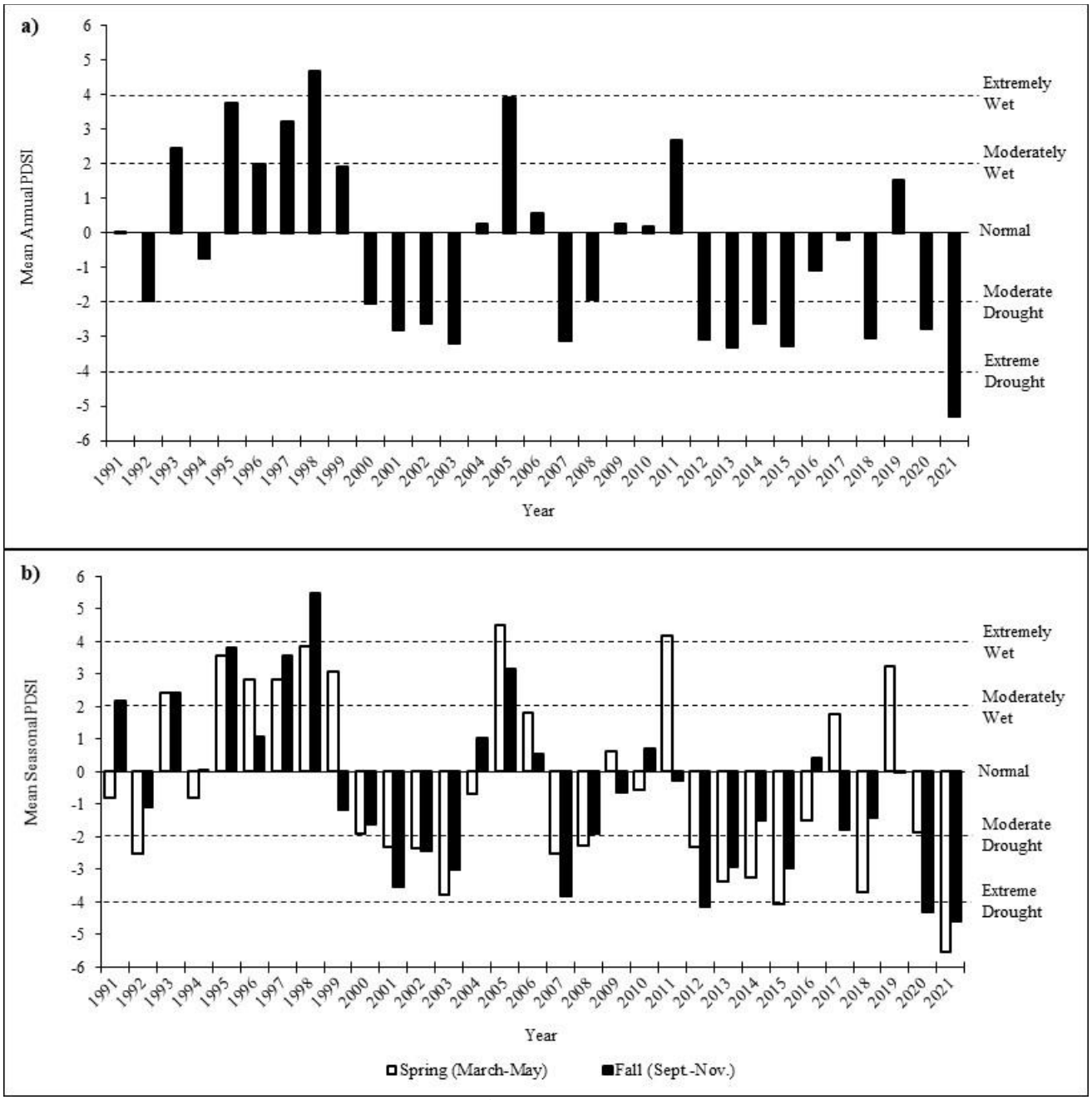


Figure 1.2: The 1991-2021 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

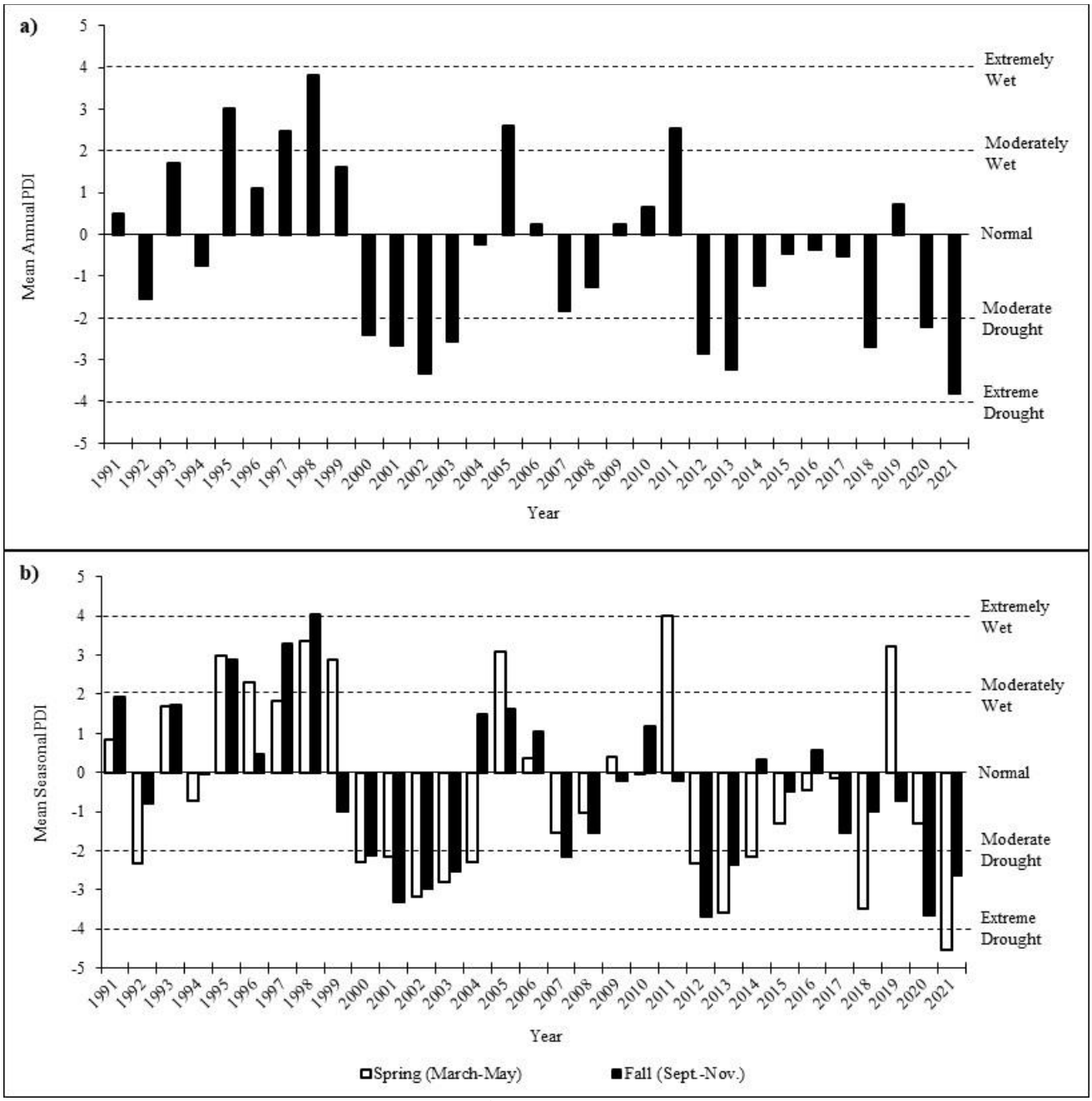


Figure 1.3: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

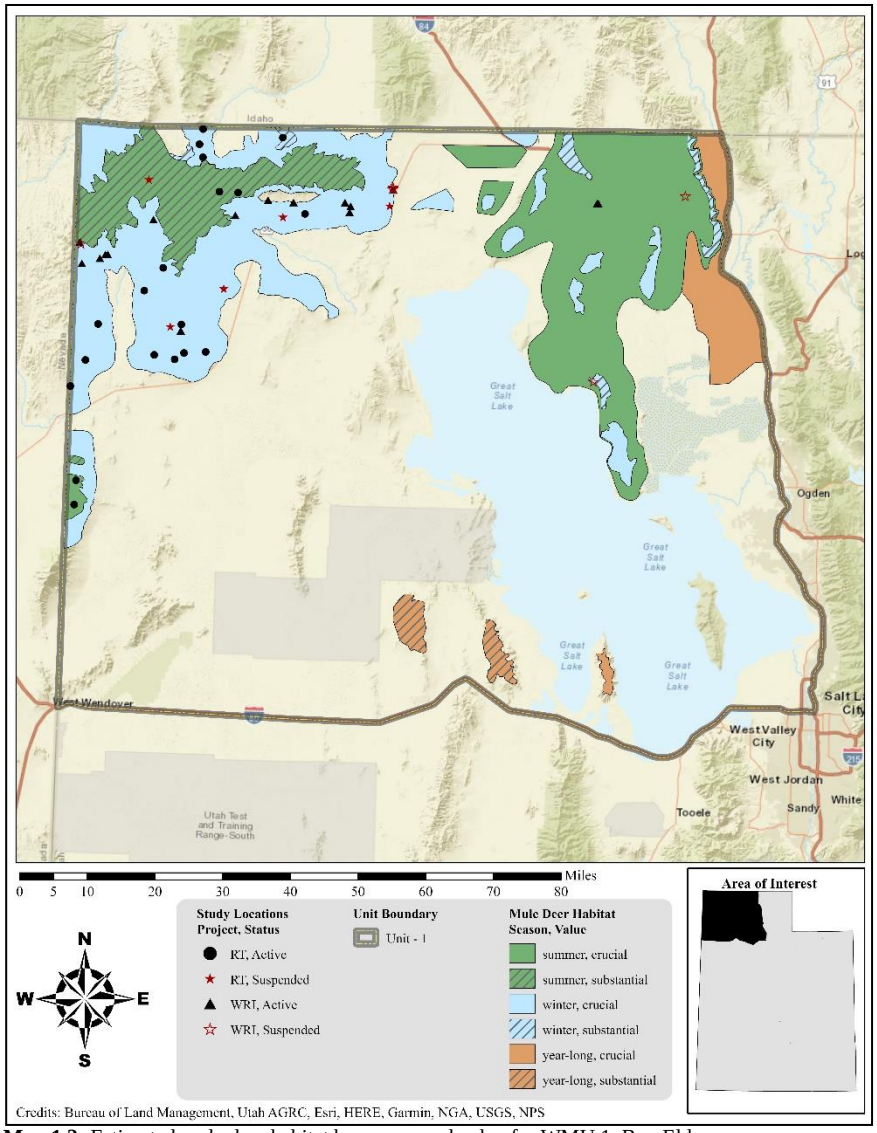
Big Game Habitat

Over 1,571,000 estimated acres are classified as deer range on Unit 1 with 41% considered to be winter range, 48% classified as summer range, and 11% classified as year-long range (**Table 1.1**, **Map 1.2**). Privately owned land comprises 53% of the winter range, 37% is managed by the Bureau of Land Management (BLM), 6% is administrated by the Utah School and Institutional Trust Lands Administration (SITLA), 4% is managed by the United States Forest Service (USFS), and the Utah Division of Wildlife Resources (UDWR) and Forestry, Fire and State Lands (FFSL) each manage less than 1% (**Table 1.2**, **Map 1.2**, **Map 1.7**). Of the elk winter range, 48% is administrated by the BLM, 31% is privately owned, the USFS manages 13%, and 8% is managed by SITLA (**Table 1.3**, **Map 1.3**, **Map 1.7**). The amount of privately held land on this unit presents several challenges to public land and wildlife managers. A majority of the summer range is on private land and hunting access is therefore limited.

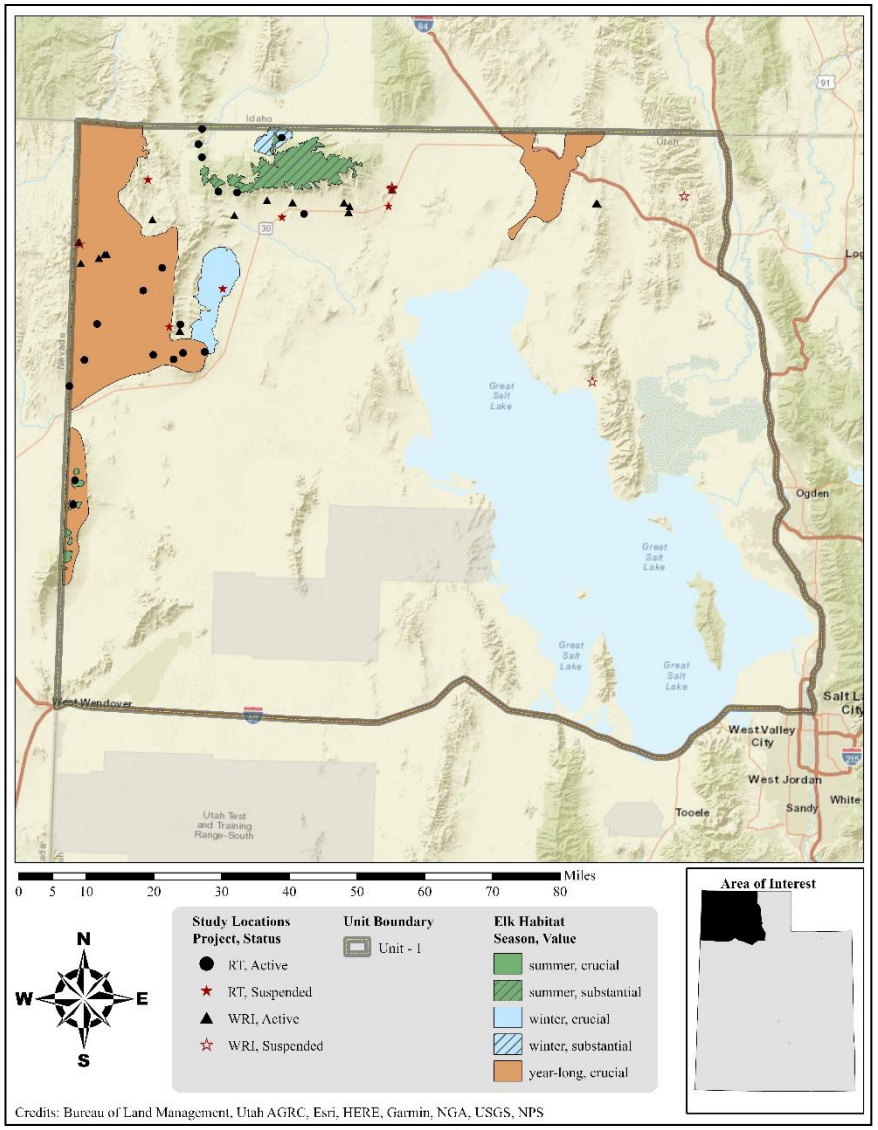
Deer winter range mainly follows the foothills of the major mountain ranges within the unit. The upper limit of normal deer winter range varies from 6,000 to 8,000 feet based on the mountain range on which it occurs. The lower range of normal deer winter range typically follows Highway 30 from Curlew Junction to the Nevada border, with further deer winter range occurring in Nevada and Idaho. This unit has a unique situation during severe winters: the limits for severe deer winter range are not only lowered at the upper limit, but are also raised at the lower limit. This is because the low-growing vegetation at the lower limits of normal deer winter range is easily covered by heavy snowfall, making them unavailable for big game use (King & Muir, 1971).

According to Landfire Existing Vegetation Coverage models, shrublands comprise 27% of the unit. Of the shrubland, combined sagebrush shrubland and steppe make up 17% of land coverage for this unit, a type which is considered key habitat for mule deer (**Table 1.8**).

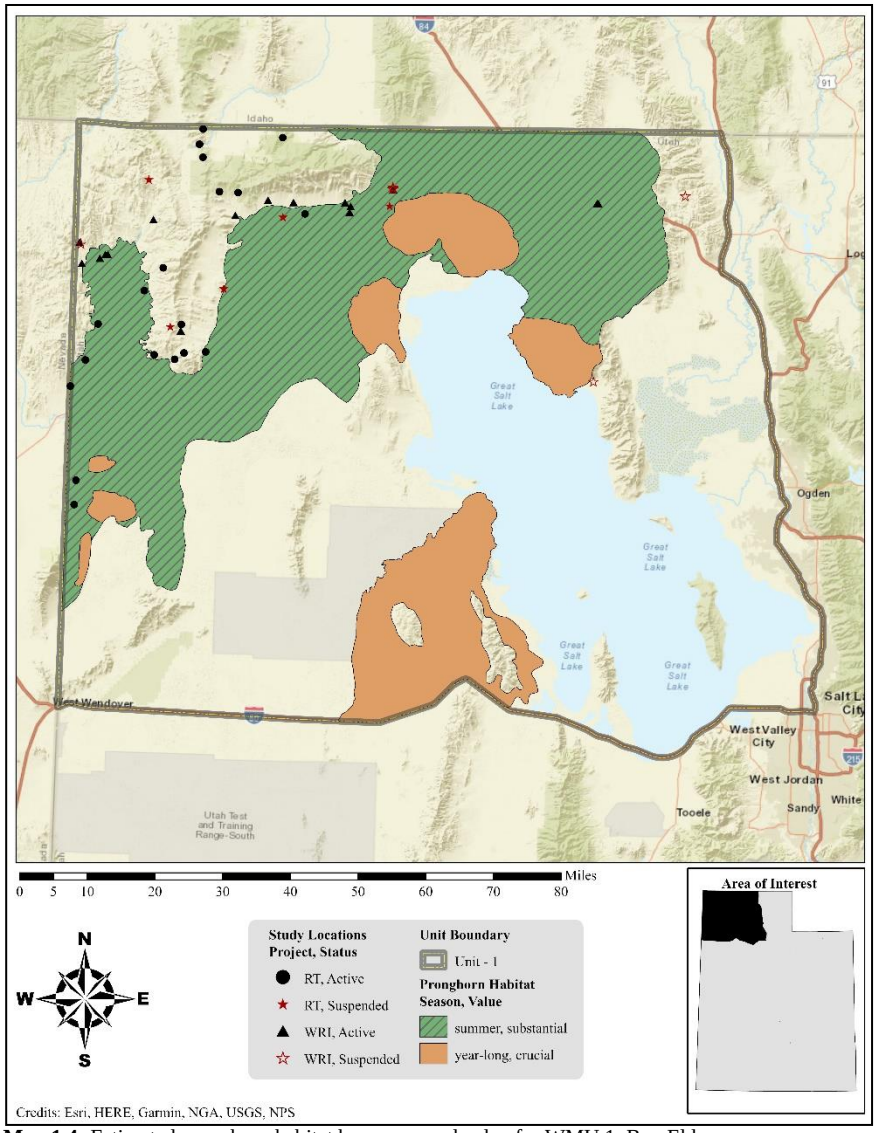
Sagebrush is a major vegetation component of both winter and summer ranges in this unit. Black sagebrush occupies ridge tops within the summer range and the upper reaches of the winter range; on summer range, black sagebrush communities have the highest abundance of grasses and forbs. Within the summer range, browse communities are dominated by curl-leaf mountain mahogany in drier areas and by maple on more mesic sites: this type provides a good variety of spring-fall forage, yet comprises a very minor portion of the winter range. Sagebrush-juniper and juniper communities are present in the winter range: in these ecological types, juniper trees are more important for thermal cover than for forage. Although small amounts of the aspen-timber and forb-grass types are found along the upper edges of winter range, their primary value is as summer range (King & Muir, 1971).



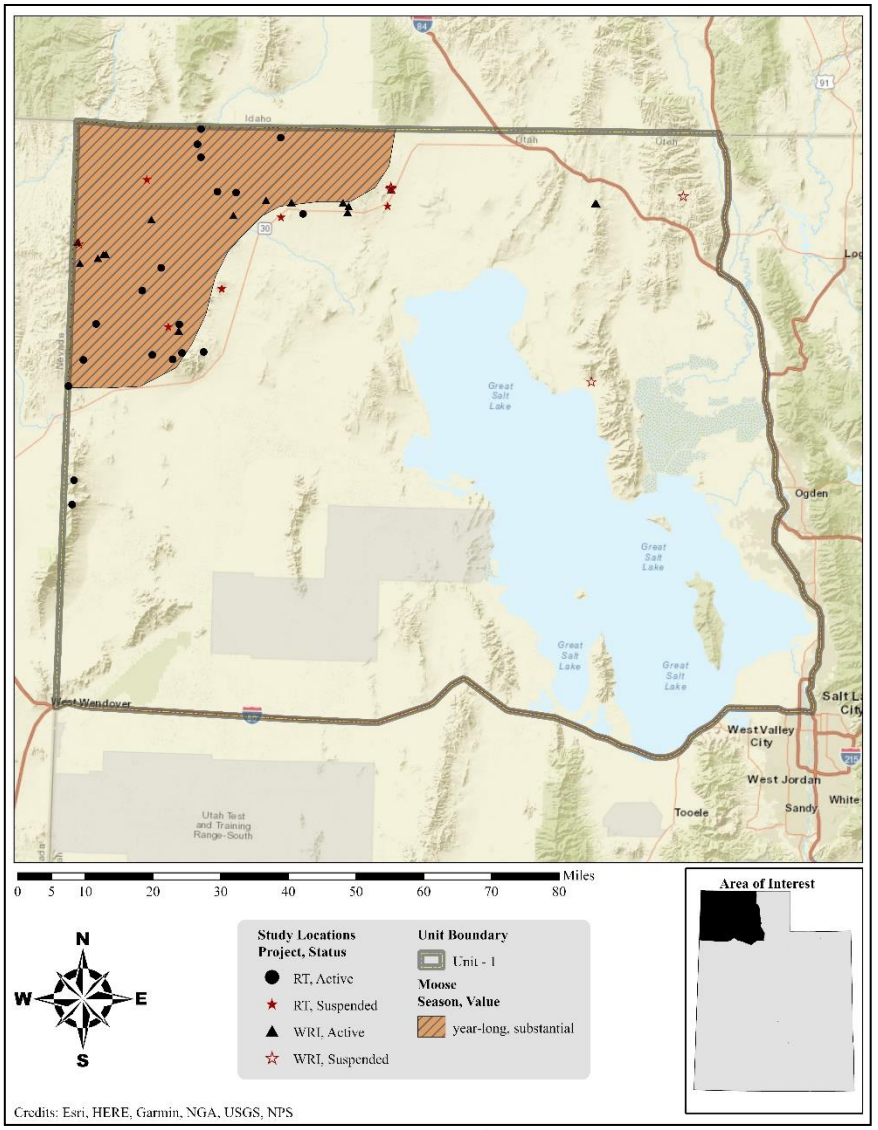
Map 1.2: Estimated mule deer habitat by season and value for WMU 1, Box Elder.



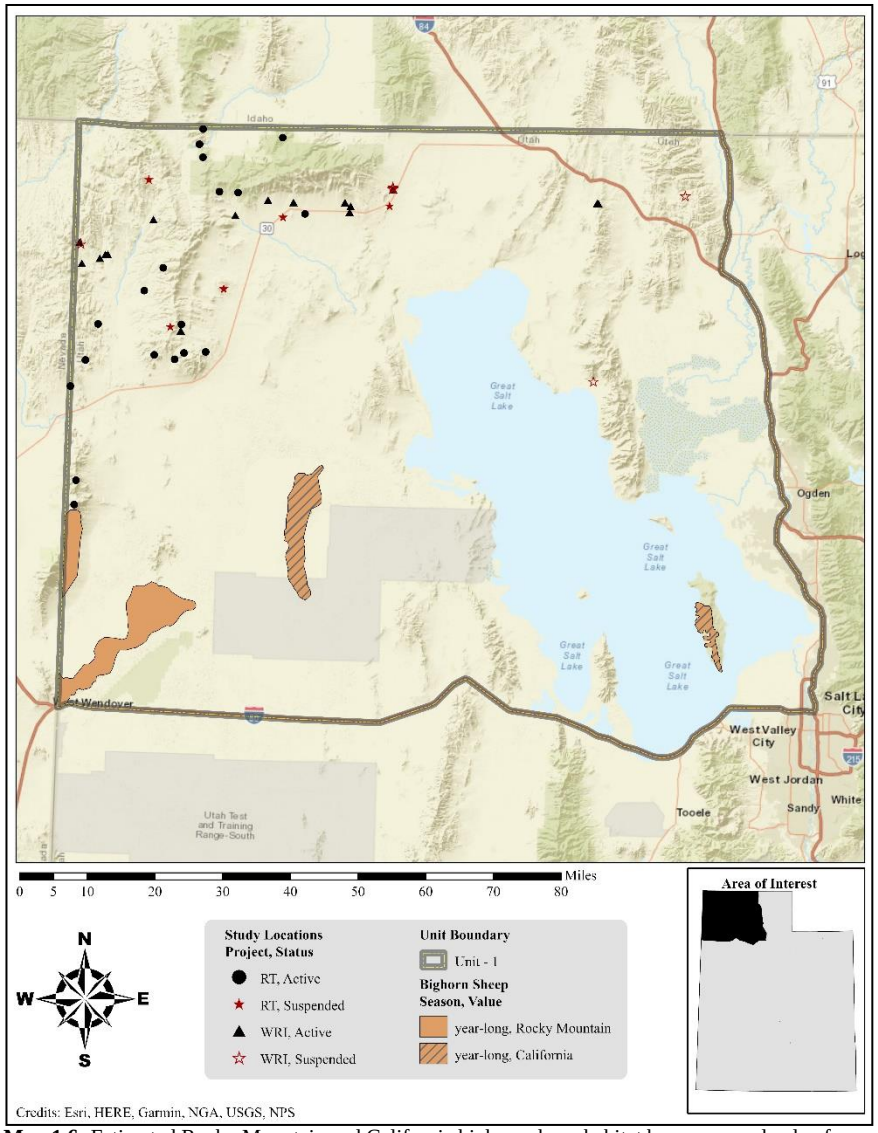
Map 1.3: Estimated elk habitat by season and value for WMU 1, Box Elder.



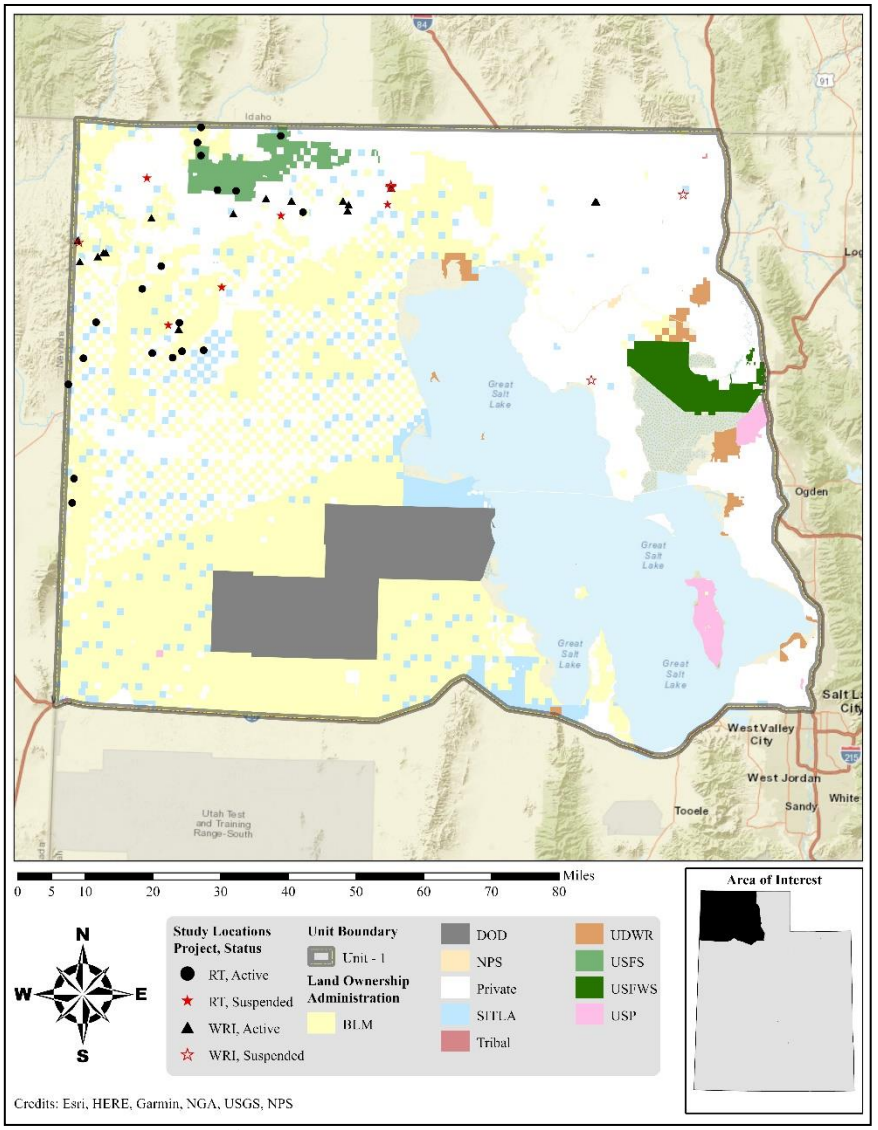
Map 1.4: Estimated pronghorn habitat by season and value for WMU 1, Box Elder.



Map 1.5: Estimated moose habitat by season and value for WMU 1, Box Elder.



Map 1.6: Estimated Rocky Mountain and California bighorn sheep habitat by season and value for WMU 1, Box Elder.



Map 1.7: Land ownership for WMU 1, Box Elder.

	Year Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
Mule Deer	164,697	11%	756,077	48%	650,983	41%
Elk	400,794	80%	55,404	11%	44,681	9%
Moose	691,016	100%	0	0%	0	0%
Pronghorn	561,230	29%	1,379,284	71%	0	0%
RMBHS	76,667	100%	0	0%	0	0%
CBHS	37,066	100%	0	0%	0	0%

Table 1.1: Estimated mule deer, elk, moose, pronghorn, Rocky Mountain bighorn sheep, and California bighorn sheep habitat acreage by season for WMU 1, Box Elder.

	Year Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	35,390	21%	53,229	7%	242,606	37%
Private	116,894	71%	639,819	85%	342,781	53%
SITLA	2,092	1%	13,282	2%	40,121	6%
Tribal	187	<1%	0	0%	0	0%
FFSL	3,431	2%	1,120	0%	19	<1%
UDWR	5,313	3%	2	<1%	<1	<1%
USFS	0	0%	46,410	6%	25,456	4%
USFWS	1,390	1%	0	0%	0	0%
NPS	0	0%	2,215	0%	0	0%
Total	164,697	**100%**	756,077	**100%**	650,983	**100%**

Table 1.2: Estimated mule deer habitat acreage by season and ownership for WMU 1, Box Elder.

	Year Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	190,357	47%	5,515	10%	21,530	48%
Private	183,626	46%	18,431	33%	13,803	31%
SITLA	26,810	7%	1,497	3%	3,443	8%
USFS	0	0%	29,961	54%	5,906	13%
Total	400,794	**100%**	55,404	**100%**	44,681	**100%**

Table 1.3: Estimated elk habitat acreage by season and ownership for WMU 1, Box Elder.

	Year Long Range	
Ownership	*Area (acres)*	*%*
BLM	225,279	33%
Private	359,922	52%
SITLA	33,943	5%
USFS	71,872	10%
Total	691,016	**100%**

Table 1.4: Estimated moose habitat acreage by season and ownership for WMU 1, Box Elder.

	Year Long Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	264,459	47%	458,279	33%
Private	134,879	24%	840,378	61%
SITLA	54,214	10%	69,365	5%
FFSL	4,570	1%	7,824	1%
UDWR	4,531	1%	1,134	<1%
NPS	127	<1%	2,088	<1%
DOD	98,297	18%	0	0%
USFS	0	0%	216	<1%
UDOT	152	<1%	0	0%
Total	561,230	**100%**	1,379,284	**100%**

Table 1.5: Estimated pronghorn habitat acreage by season and ownership for WMU 1, Box Elder.

	Year Long Range	
Ownership	*Area (acres)*	*%*
BLM	69,473	91%
Private	4,321	6%
SITLA	2,620	3%
USP	253	0%
Total	76,667	**100%**

Table 1.6: Estimated Rocky Mountain bighorn sheep habitat acreage by season and ownership for WMU 1, Box Elder.

	Year Long Range	
Ownership	*Area (acres)*	*%*
BLM	28,790	78%
Private	2,361	6%
SITLA	1,842	5%
FFSL	17	<1%
DOD	4,054	11%
USP	1	<1%
Total	37,066	**100%**

Table 1.7: Estimated California bighorn sheep habitat acreage by season and ownership for WMU 1, Box Elder.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Sparsely Vegetated	2,072,713	23.21%	
	Open Water	1,176,255	13.17%	
	Agricultural	791,431	8.86%	
	Developed	294,634	3.30%	
	Hardwood	181,575	2.03%	
	Riparian	159,703	1.79%	
	Conifer-Hardwood	25,730	0.29%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	1,964	0.02%	52.68%
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	797,973	8.94%	
	Inter-Mountain Basins Montane Sagebrush Steppe	447,881	5.02%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	398,517	4.46%	
	Great Basin Xeric Mixed Sagebrush Shrubland	274,810	3.08%	
	Inter-Mountain Basins Big Sagebrush Steppe	181,549	2.03%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	96,360	1.08%	
	Inter-Mountain Basins Greasewood Flat	87,931	0.98%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	70,443	0.79%	
	Other Shrubland	27,322	0.31%	
	Columbia Plateau Low Sagebrush Steppe	22,994	0.26%	
	Rocky Mountain Lower Montane-Foothill Shrubland	11,740	0.13%	
	Great Basin Semi-Desert Chaparral	8,256	0.09%	
	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	7,776	0.09%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Shrubland	378	0.00%	
	Inter-Mountain Basins Mat Saltbush Shrubland	123	0.00%	27.26%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	468,636	5.25%	
	Interior Western North American Temperate Ruderal Shrubland	135,161	1.51%	
	Interior West Ruderal Riparian Scrub	76,571	0.86%	
	Interior West Ruderal Riparian Forest	191	0.00%	7.62%
Exotic Herbaceous	Great Basin & Intermountain Introduced Annual Grassland	204,890	2.29%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	153,466	1.72%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	112,421	1.26%	
	Interior Western North American Temperate Ruderal Grassland	44,414	0.50%	5.77%
Conifer	Great Basin Pinyon-Juniper Woodland	334,207	3.74%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	31,008	0.35%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	23,880	0.27%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	19,771	0.22%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	18,430	0.21%	
	Colorado Plateau Pinyon-Juniper Woodland	7,156	0.08%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	6,930	0.08%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	2,591	0.03%	
	Other Conifer	2,077	0.02%	
	Inter-Mountain Basins Juniper Savanna	2,047	0.02%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	2,006	0.02%	
	Southern Rocky Mountain Ponderosa Pine Woodland	34	0.00%	
	Northern Rocky Mountain Subalpine Woodland and Parkland	13	0.00%	
	Rocky Mountain Lodgepole Pine Forest	10	0.00%	
	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	<1	0.00%	5.04%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	46,029	0.52%	
	Columbia Plateau Steppe and Grassland	42,399	0.47%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	24,628	0.28%	
	Other Grassland	16,941	0.19%	
	Southern Rocky Mountain Montane-Subalpine Grassland	15,385	0.17%	
	Rocky Mountain Alpine Turf	<1	0.00%	1.63%
Total		**8,929,353**	**100%**	**100%**

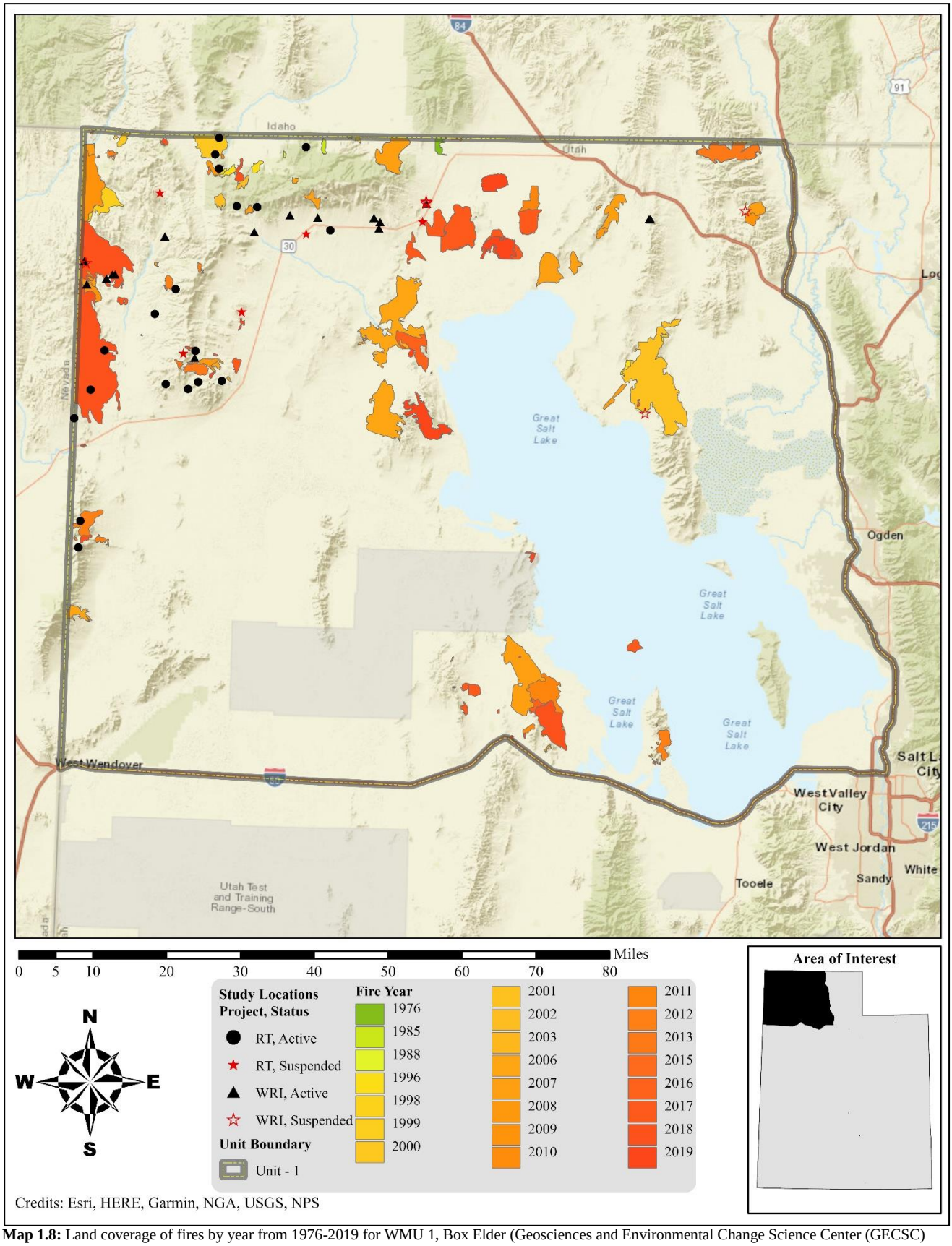
Table 1.8: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 1, Box Elder.

Limiting Factors to Big Game Habitat

Major human activities in the area include mining and grazing. Habitat degradation and loss, public land winter range availability, winter range forage condition, predation, and parasites and disease limit big game habitat in this unit. Continued range monitoring could maintain and protect ranges from further habitat loss and deterioration. Cooperation between federal, state, local, tribal governments, and private landowners could assist in maintaining and preserving crucial habitat through agreements with land management agencies, the use of conservation easements and the like on private lands, planning and evaluating resource use and developments that might affect habitat quality, and developing specific vegetation objectives to maintain the quality of important deer use areas. In addition, forage production could be maintained or improved through direct range improvements such as reseedings, controlled burns, water developments, tree removal, etc. Encroachment by pinyon-juniper woodland communities poses a threat to important sagebrush rangelands. According to current Landfire Existing Vegetation Coverage model, 3.82% of the Box Elder unit is comprised of pinyon-juniper woodlands (**Table 1.8**). Encroachment and invasion of these woodlands into sagebrush

communities has been shown to decrease sagebrush and herbaceous cover, thereby decreasing available wildlife forage (Miller, Svejcar, & Rose, 2000).

Other limiting factors to big game include introduced exotic herbaceous species, such as cheatgrass (*Bromus tectorum*). According to the current Landfire Existing Vegetation Coverage model, nearly 6% of the unit is comprised of exotic herbaceous species, with almost 4% being annual grasses (**Table 1.8**). Increased amounts of cheatgrass increase the risk for catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). The unit has had several large wildfires, resulting in loss of big game habitat (**Map 1.8**).



Map 1.8: Land coverage of fires by year from 1976-2019 for WMU 1, Box Elder (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

Treatments/Restoration Work

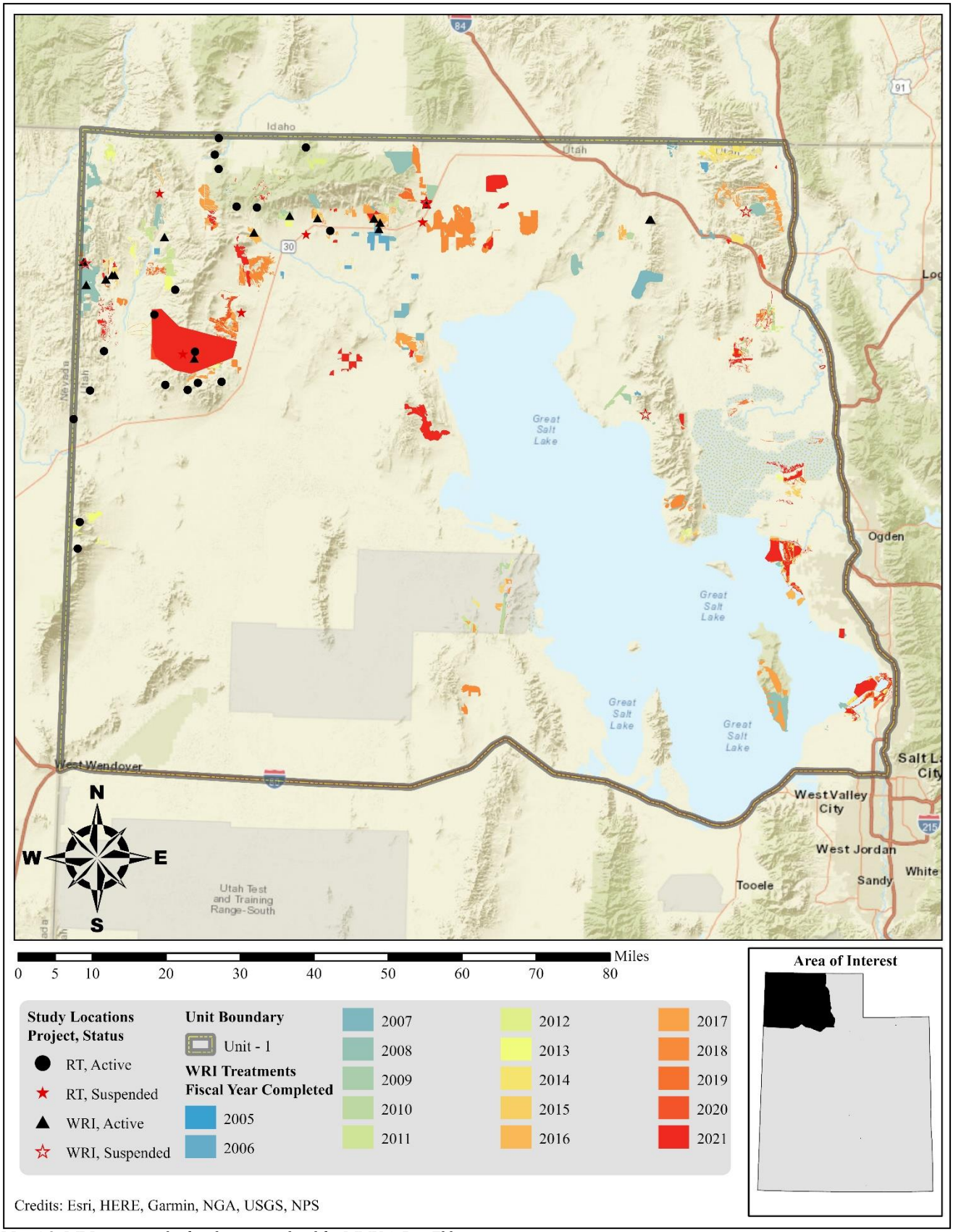
There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 192,538 acres of land have been treated within the Box Elder unit since the WRI was implemented in 2004 (**Map 1.9**). An additional 75,544 acres are currently being treated and treatments have been proposed for 3,586 acres. Treatments frequently overlap one another bringing the net total of completed treatment acres to 167,207 acres for this unit (**Table 1.9**, **Map 1.9**). 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.

Herbicide application to remove invasive species is the most common management practice in this unit. Seeding plants to augment the herbaceous understory is also very common. Other management practices include (but are not limited to) anchor chain, bullhog, disc use, and hand crews to remove pinyon and juniper. Other similar vegetation removal techniques are also frequently used (**Table 1.9**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Aerator	**882**	**0**	**0**	**882**
Double Drum (Two-Way)	494	0	0	494
Single Drum (One-Way)	388	0	0	388
Anchor Chain	**29,129**	**928**	**0**	**30,057**
Ely (One-Way)	18,181	163	0	18,344
Ely (Two-Way)	6,531	290	0	6,821
Smooth (One-Way)	3,673	0	0	3,673
Smooth (Two-Way)	745	474	0	1,219
Bulldozing	**1,595**	**148**	**0**	**1,742**
Tree Push	1,595	148	0	1,742
Bullhog	**16,274**	**1,572**	**2,544**	**20,389**
Full Size	15,249	1,572	2,544	19,365
Skid Steer	1,024	0	0	1,024
Chain Harrow	**927**	**311**	**0**	**1,238**
≤15 ft. (Two-Way)	927	0	0	927
>15 ft. (One-Way)	0	311	0	311
Disc	**13,099**	**0**	**76**	**13,175**
Off-Set (One-Way)	7,706	0	76	7,781
Off-Set (Two-Way)	2,770	0	0	2,770
Plow (One-Way)	1,501	0	0	1,501
Plow (Two-Way)	1,123	0	0	1,123
Forestry Practices	**101**	**0**	**0**	**101**
Ripping	101	0	0	101
Grazing Management/Changes	**5,001**	**1,106**	**0**	**6,108**
Greenstripping	**1,507**	**233**	**50**	**1,790**
Harrow	**829**	**266**	**628**	**1,724**
≤15 ft. (One-Way)	457	266	628	1,351
>15 ft. (One-Way)	373	0	0	373
Herbicide Application	**38,280**	**5,983**	**0**	**44,264**
Aerial (Fixed-Wing)	30,424	3,702	0	34,127
Aerial (Helicopter)	2,616	1,750	0	4,366
Ground	4,059	531	0	4,589
Spot Treatment	1,182	0	0	1,182
Mowing	**1,364**	**0**	**0**	**1,364**
Other	1,364	0	0	1,364
Planting/Transplanting	**263**	**0**	**0**	**263**
Container Stock	5	0	0	5
Other	258	0	0	258
Prescribed Fire	**1,868**	**89**	**0**	**1,957**
Pile Burn	0	89	0	89
Prescribed Fire	1,868	0	0	1,868
Roller Packer	**86**	**0**	**0**	**86**
Post-Seeding	86	0	0	86
Seeding (Primary)	**63,712**	**37,977**	**0**	**101,689**
Broadcast (Aerial-Fixed Wing)	24,488	19,042	0	43,530
Broadcast (Aerial-Helicopter)	8,972	0	0	8,972
Drill (Rangeland)	28,017	18,168	0	46,185
Drill (Truax)	0	571	0	571
Ground (Mechanical Application)	2,235	197	0	2,431

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Seeding (Secondary/Shrub)	**7,345**	**0**	**0**	**7,345**
Broadcast (Aerial-Fixed Wing)	6,843	0	0	6,843
Broadcast (Aerial-Helicopter)	469	0	0	469
Drill (Rangeland)	33	0	0	33
Vegetation Removal/Hand Crew	**10,274**	**26,855**	**288**	**37,417**
Lop (No Scatter)	31	0	0	31
Lop & Scatter	10,243	26,846	288	37,378
Lop-Pile-Burn	0	8	0	8
Other	**<1**	**76**	**0**	**76**
Road Decommissioning	0	76	0	76
Spring Development	<1	0	0	<1
Grand Total	**192,538**	**75,544**	**3,586**	**271,667**
***Total Land Area Treated**	**167,207**	**65,898**	**3,586**	**236,691**

Table 1.9: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 1, Box Elder. Data accessed on 02/09/2022.
*Does not include overlapping treatments.



Map 1.9: WRI treatments by fiscal year completed for WMU 1, Box Elder.

Range Trend Studies

Range Trend studies have been sampled within WMU 1 on a regular basis since 1984, with studies being added or suspended as was deemed necessary (**Table 1.10**). Due to changes in sampling methodologies, only data collected following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 1.11**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
01-1	Kelton	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
01-2	Rosette	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Loam (Wyoming Big Sagebrush)
01-3	Rosebud Hills	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
01-4	Chokecherry Springs	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Browse)
01-5	Devils Playground	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Gravelly Sandy Loam (Black Sagebrush)
01-6	Bovine Exclosure	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Browse)
01-7	South Side Emigrant Pass	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Shallow Loam (Black Sagebrush)
01-8	Mud Springs Basin	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Wyoming Big Sagebrush)
01-9	South West Rosette	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
01-10	Kilgore Basin	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Shallow Loam (Black Sagebrush)
01-11	Kimber Ranch	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Shallow Loam (Black Sagebrush)
01-12	Red Butte Exclosure	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Browse)
01-13	Raft River Narrows	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Gravelly Loam (Wyoming Big Sagebrush)
01-14	Broad Hollow	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Browse)
01-15	Cedar Hills	RT	Active	1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Wyoming Big Sagebrush)
01-16	Nut Pine Hills	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Browse)
01-17	Clarks Basin	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Shrub)
01-18	Bedke Spring	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Wyoming Big Sagebrush)
01-19	Bally Mountain	RT	Active	1996, 2001, 2006, 2011, 2016	Mountain Shallow Gravelly Ridge (Black Sagebrush)
01-20	Cotton Thomas	RT	Suspended	1996	Not Verified
01-21	Keg Spring	RT	Suspended	1996, 2001	Not Verified
01-22	Dake Pass	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Semidesert Shallow Loam (Black Sagebrush)
01-23	Patterson Pass	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
01-24	Sheep Range Spring	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
01R-1	White's Valley	WRI	Suspended	2004	Not Verified

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
01R-2	Rattlesnake Fire Seeded	WRI	Active	2004, 2007, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
01R-3	Rattlesnake Burn	WRI	Active	2004, 2007, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
01R-4	Coldwater 1	WRI	Active	2005, 2009, 2013, 2017	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
01R-5	Coldwater 2 (Reference)	WRI	Suspended	2005, 2009	Not Verified
01R-6	Hereford 1	WRI	Active	2005, 2008, 2013, 2017, 2021	Semidesert Loam (Wyoming Big Sagebrush)
01R-7	Hereford 2	WRI	Active	2005, 2010, 2013, 2017	Semidesert Shallow Loam (Black Sagebrush)
01R-8	Coldwater 3	WRI	Suspended	2005	Not Verified
01R-9	Coldwater 4	WRI	Suspended	2005	Not Verified
01R-10	Chokecherry	WRI	Active	2005, 2008, 2013, 2017	Upland Loam (Mountain Big Sagebrush)
01R-11	Lower Fort Ranch	WRI	Suspended	2007	Not Verified
01R-12	Dairy Valley GIP 1	WRI	Active	2008, 2009, 2011, 2016, 2021	Upland Loam (Wyoming Big Sagebrush)
01R-13	Dairy Valley GIP 2	WRI	Active	2008, 2011, 2016, 2021	Upland Loam (Wyoming Big Sagebrush)
01R-14	Morris GIP	WRI	Active	2008, 2013, 2017	Upland Shallow Loam (Black Sagebrush)
01R-15	Dairy Valley GIP Reference	WRI	Suspended	2009	Not Verified
01R-16	Kimbell Creek	WRI	Active	2010, 2013, 2017, 2021	Upland Loam (Bonneville Big Sagebrush)
01R-17	West Grouse Creek	WRI	Active	2013, 2016, 2021	Upland Shallow Loam (Black Sagebrush)
01R-18	Buckskin Spring	WRI	Active	2014, 2017, 2021	Semidesert Gravelly Sandy Loam (Black Sagebrush)
01R-19	Etna Reservoir	WRI	Active	2014, 2017, 2021	Semidesert Loam (Wyoming Big Sagebrush)
01R-20	Pine Creek	WRI	Active	2014, 2017	Upland Gravelly Loam (Bonneville Big Sagebrush)
01R-21	Indian Creek	WRI	Active	2014, 2017	Upland Stony Loam (Black Sagebrush)
01R-22	Dove Creek	WRI	Active	2017	Upland Loam (Mountain Big Sagebrush)

Table 1.10: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 1, Box Elder.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
01-2	Rosette	Lop and Scatter	Park Valley PJ Treatment Project Phase 2	December 2015-March 2016	680	3400
01-4	Chokecherry Springs	Lop and Scatter	Emigrant Pass Sagebrush Habitat Enhancement	Fall 2018	895	4359
01-5	Devils Playground	Chain Unknown		2014-2015		
01-8	Mud Springs Basin	Chain Unknown Seed Unknown		2014-2015 2014-2015		
01-10	Kilgore Basin	Rangeland Drill Wildfire	Goose Creek Fire Rehabilitation Goose Creek Fire	Between September 2018 and May 2021 July-August 2018	10,195 132,127	4758

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
01-11	Kimber Ranch	Wildfire	Goose Creek Fire	July 2018	132,127	
		Aerial Before	Goose Creek Fire Rehabilitation	November 2018	13,191	4758
		One-Way Ely Chain	Goose Creek Fire Rehabilitation	Between November 2018 and May 2021	13,191	4758
01-13	Raft River Narrows	Wildfire	City of Rocks	2000	17,573	
01-14	Broad Hollow	Wildfire		Prior to 1984		
		Wildfire		Between 1996 and 2001		
01-15	Cedar Hills	Wildfire	City of Rocks	2000	17,573	
		Aerial After	City of Rocks Emergency Fire Rehabilitation	Fall 2000	2,300	LTDL
01-18	Bedke Spring	Bullhog	Grouse Creek Bullhog Phase 2	Winter 2012	1,031	1938
01-19	Bally Mountain	Prescribed Fire	Bally Mountain Prescribed Fire	Fall 2003		
01R-2	Rattlesnake Fire	Wildfire	Rattle Snake Fire	2003		PDB
	Seeded	Rangeland Drill	Rattle Snake Fire	December 2003		PDB
01R-3	Rattlesnake Burn	Wildfire	Rattle Snake Fire	2003		PDB
01R-4	Coldwater 1	Prescribed	Coldwater Ranch-Dees Inc., M.O.	Fall 2007	1,944	163
		Plateau	Coldwater Ranch-Dees Inc., M.O.	Fall 2007	1,944	163
		Rangeland Drill	Coldwater Ranch-Dees Inc., M.O.	November-December 2007	1,944	163
01R-6	Hereford 1	Wildfire	Park Valley	July 2005	18,421	
		Rangeland Drill	Park Valley Burn Rehab	October-December 2005	3,152	348
		Aerial	Park Valley Burn Rehab	January 2006	3,152	348
01R-7	Hereford 2	Two-Way Ely Chain	Hereford Grazing Association	October 2005	600	250
		Rangeland Drill	Hereford Grazing Association	October-December 2005	1,240	250
		Aerial After	Hereford Grazing Association	January 2006	1,240	250
		Herbicide		Between 2013 and 2016		
		Unknown				
		Lop and Scatter	Cove Canyon Winter Habitat Juniper Removal	August 2016-May 2017	140	3864
01R-8	Coldwater 3	Prescribed Fire	Coldwater Ranch-Dees Inc., M.O.	2007	3,000	163
		Herbicide	Coldwater Ranch-Dees Inc., M.O.	2007	3,000	163
		Rangeland Drill	Coldwater Ranch-Dees Inc., M.O.	2007	3,000	163
01R-10	Chokecherry	Bullhog	Chokecherry Springs	March-June 2005	571	155
		Aerial Before	Chokecherry Springs	November 04	571	155
01R-12	Dairy Valley GIP	Wildfire	Winecup complex	2007	234,413	
	1	One-Way Ely Chain	Dairy Valley Fire Rehabilitation	June 2008	2,700	992
		Aerial Before	Dairy Valley Fire Rehabilitation	December 2007	6,900	992
		Wildfire	Goose Creek Wildfire	2018	132,230	
01R-13	Dairy Valley GIP	Wildfire	Winecup complex	2007	234,413	
	2	One-Way Ely Chain	Dairy Valley Fire Rehabilitation	June 2008	2,700	992
		Aerial Before	Dairy Valley Fire Rehabilitation	December 2007	6,900	992
01R-14	Morris GIP	Push	Morris Ranch	November-December 2008	797	1503
		Rangeland Drill	Morris Ranch	November-December 2008	797	1503
01R-16	Kimbell Creek	One-Way Chain	Kimball Creek Greater Sage Grouse Brood Rearing Habitat Enhancement	October 2010	106	1739
		Broadcast	Kimball Creek Greater Sage Grouse	Oct-10	106	1739
		Unknown	Brood Rearing Habitat Enhancement			
01R-17	West Grouse Creek	Rangeland Drill	Goose Creek Fire Rehabilitation	Between September 2018 and August 2021	10,195	4758
		Bullhog	West Grouse Creek Bullhog Phase 2	October-December 2013	1,079	2574
		Aerial Before	West Grouse Creek Bullhog Phase 2	October 2013	1,079	2574
		Wildfire	Goose Creek Wildfire	July-August 2018	132,230	
		Aerial	Etna Sage-grouse Habitat Restoration Phase 1	November 2020	701	4028
		Rangeland Drill	Goose Creek Fire Rehabilitation	Between September 2018 and August 2021	10,195	4758

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
01R-18	Buckskin Spring	Wildfire	Goose Creek Fire	July-August 2018	132,230	
		Aerial Before	West Grouse Creek Bullhog Phase 3	January 15	949	2900
		Bullhog	West Grouse Creek Bullhog Phase 3	January-April 2015	949	2900
		Rangeland Drill	Goose Creek Fire Rehabilitation	Between September 2018 and August 2021	10,195	4758
01R-19	Etna Reservoir	Plateau	Goose Creek Fire Rehabilitation	Spring 2019	534	4758
		Aerial Before	West Grouse Creek Bullhog Phase 3	Fall 2015	949	2900
		Bullhog	West Grouse Creek Bullhog Phase 3	January- April 2015	949	2900
		Wildfire	Goose Creek Wildfire	2018	132,230	
01R-20	Pine Creek	Aerial Before	Park Valley PJ Treatment Project Phase 1	October 2014	1,408	2874
		Bullhog	Park Valley PJ Treatment Project Phase 1	October 2014-June 2015	1,408	2874
01R-21	Indian Creek	Aerial Before	Park Valley PJ Treatment Project Phase 1	October 2014	707	2874
		Bullhog	Park Valley PJ Treatment Project Phase 1	October 2014-June 2015	1,408	2874
01R-22	Dove Creek	ATV Drill	Park Valley Winter Range Bullhog	Spring 2016	1,369	3441
01R-22	Dove Creek	Aerial Before	Park Valley Winter Range Bullhog	Winter 2015-2016	1,369	3441
01R-22	Dove Creek	Bullhog	Park Valley Winter Range Bullhog	January-June 2016	1,369	3441
01R-22	Dove Creek	Aerial	Park Valley Winter Range Bullhog	Spring 2016	1,369	3441

Table 1.11: Range Trend and WRI studies known disturbance history for WMU 1, Box Elder. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

There are two studies [Patterson Pass (01-23) and Sheep Range Spring (01-24)] classified as Mountain (Big Sagebrush) ecological sites. Patterson Pass is located in the Pilot Mountains. The Sheep Range Spring study site is also located in the Pilot Mountains north of the Patterson Pass site and just southeast of Mineral Mountain (**Table 1.10**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the most dominant preferred browse species, although other browse species such as black sagebrush (*A. nova*) contribute less cover. Average total shrub cover has slightly increased in total, as has that of sagebrush (**Figure 1.5**). Preferred browse demographic data indicates that the communities on these sites have been mainly comprised of mature individuals throughout the study period. Recruitment of young plants has fluctuated, but has exhibited a decreasing trend overall; mountain big sagebrush was the only preferred browse species on both study sites with young plants observed in density measurements in 2021. Total preferred browse density has remained similar over time (**Figure 1.15**). Preferred browse utilization has fluctuated from year to year, but has decreased overall. In 2016 and 2021, nearly 94% of plants exhibited little to no signs of hedging (**Figure 1.18**).

Trees contribute no cover on these study sites, but singleleaf pinyon (*Pinus monophylla*) was recorded on the Sheep Range Spring study site in low amounts in 2016 and 2021 density measurements (**Figure 1.9, Figure 1.12**).

Herbaceous Understory: These study sites have rich and abundant herbaceous understories mainly dominated by perennial grasses and forbs. Perennial grass and forb cover has exhibited a general increase over the years, while frequency has slightly decreased. Native grass species have generally contributed a majority of cover on both study sites. Annual grasses and forbs have been present in each study year, albeit with comparatively low cover and abundance; annual grass trends are entirely driven by the Sheep Range Spring study, as they have never been present on Patterson Pass (**Figure 1.21**, **Figure 1.24**).

Occupancy: Average pellet transect data indicates that occupancy has increased over the sample period and that the primary occupants have been elk. Elk pellet groups have had a mean abundance ranging from 23 days use/acre in 2016 to 37 days use/acre in 2021. Mean abundance of deer pellet groups has ranged from less than 1 days use/acre in 2016 to 7 days use/acre in 2021. Finally, cattle pellets had an average abundance of 1.5 days use/acre in 2006, but were not observed in any other sample year (**Figure 1.27**).

Mountain (Black/Low Sagebrush)

There is one study [Bally Mountain (01-19)] that is classified as a Mountain (Black/Low Sagebrush) ecological site: this study is located northeast of the town of Yost and just south of the Utah-Idaho border (**Table 1.10**).

Shrubs/Trees: The primary browse species on this site is black sagebrush (*Artemisia nova*) which contributed the most shrub cover in the 2006 and 2011 sample years; other preferred browse species such as mountain big sagebrush (*A. tridentata* ssp. *vaseyana*) and slender buckwheat (*Eriogonum microthecum*) have provided lesser amounts of cover. The cover of other shrub species has increased each study year, and broom snakeweed (*Gutierrezia sarothrae*) contributed the majority of the shrub cover in 2016 (**Figure 1.5**). Preferred demographic data indicates that mature individuals have comprised a majority of the population in all sample years except 2006, when decadent plants dominated, and 2016 when young plants were the major component. Total density decreased significantly between 2001 and 2006 due to a prescribed burn in 2003, but has increased overall since 2006 (**Figure 1.15)**. Preferred browse utilization has varied over time, but has decreased overall. Plants exhibited mainly moderate use in 1996 and 2011; usage has been mainly none to light in all other sample years (**Figure 1.18**).

Trees provide no cover on this study site, but 1996 and 2016 density measurements indicate that singleleaf pinyon (*Pinus monophylla*) has been present in low amounts (**Figure 1.9**, **Figure 1.12**).

Herbaceous Understory: This study site has remained dominated by perennial grasses and forbs in all study years. Cover and nested frequency for perennial grasses and forbs have increased overall, with bluebunch wheatgrass (*Pseudoroegneria spicata*) as the most abundant species in all years. Annual grass cover has remained minimal, with nested frequency increasing in greater amounts. Annual forbs have remained largely consistent in cover while frequency has increased slightly (**Figure 1.21**, **Figure 1.24**).

Occupancy: Pellet transect data shows that cattle have been the primary occupants of this site in most sample years, with the mean abundance of cattle pellet groups ranging from 0 days use/acre in 2006 to nearly 30 days use/acre in 2011. Deer pellet groups have had a mean abundance ranging from 0 days use/acre in 2016 to 6 days use/acre in 2001 (**Figure 1.27**).

Mountain (Shrub)

There is one study [Clarks Basin (01-17)] that is classified as a Mountain (Shrub) ecological site: this study is located in Clarks Basin north of Clarks Basin Creek (**Table 1.10**).

Shrubs/Trees: The primary browse species on this site are mountain snowberry (*Symphoricarpos oreophilus*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). However, a variety of other preferred browse species such as antelope bitterbrush (*Purshia tridentata*) and Utah serviceberry (*Amelanchier utahensis*) are also present, but provide lesser amounts of cover. Total shrub cover has fluctuated from year to year, but has exhibited a very slight increase overall mainly due to bitterbrush and other shrubs excluding preferred browse (**Figure 1.4**). Total preferred browse density increased steadily between 2001 and 2016, but exhibited a slight decrease in 2021. Average demographic data indicates that mature individuals have comprised a majority of the preferred browse population in all sample years. Decadence has exhibited a slight overall increase, while recruitment of young has decreased (**Figure 1.15**). Average preferred browse utilization has remained low, with less than 15% of plants being moderately or heavily used since 2001 (**Figure 1.18**).

Trees have not been observed on this study site in cover or density measurements in any sample year (**Figure 1.9**, **Figure 1.12**).

Herbaceous Understory: This study site has remained dominated by perennial grasses such as thickspike wheatgrass (*Elymus lanceolatus*) and Kentucky bluegrass (*Poa pratensis*) in all study years. Cover and nested frequency have fluctuated from year to year. However, cover has increased overall, while nested frequency has decreased. Annual grasses have generally remained rare: the exception to this is the 2016 sample year, when the introduced species cheatgrass (*Bromus tectorum*) contributed nearly 4% cover. The introduced perennial grass species bulbous bluegrass (*P. bulbosa*) has been observed in many years, but in low amounts (**Figure 1.21**, **Figure 1.24**).

Occupancy: Pellet transect data shows that total animal occupancy has increased overall and that deer have been the primary occupants in all sample years. Mean abundance of deer pellet groups has ranged from 19 days use/acre in 2011 to 37 days use/acre in 2006. Elk have also been present, with an average pellet group abundance as low as 0 days use/acre in 2001, 2006, and 2016 and as high as 3 days use/acre in 2021. Finally cattle pellet groups have had an average abundance fluctuating between 2 days use/acre in 2001 and 14.5 days use/acre in 2021 (**Figure 1.27**).

Upland (Big Sagebrush)

Four sites [Mud Springs Basin (01-8), Raft River Narrows (01-13), Cedar Hills (01-15), and Bedke Spring (01-18)] are classified as Upland (Big Sagebrush) ecological sites. Mud Springs Basin is found southwest of Rocky Pass Peak and Mud Basin, while the Raft River Narrows study is located just north of the Raft River and Lynn-Almo Road. Cedar Hills is located just south of the Utah-Idaho border and west of Lynn Road. Finally, the Bedke Spring study is found on the lower western slopes of the Grouse Creek Mountains (**Table 1.10**).

Shrubs/Trees: Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingesis*) is the dominant browse species on all study sites, although black sagebrush (*A. nova*) and forage kochia (*Bassia prostrata*) were co-dominant on Mud Springs Basin in 2021. Overall shrub cover increased between 2006 and 2016, but decreased in 2021: this recent decrease is largely due to the Mud Springs Basin, Cedar Hills, and Bedke Springs studies (**Figure 1.6**). Average preferred browse density has decreased over the study period, a trend which can partially be attributed to decreases in recruitment of young on the Bovine Exclosure and Red Butte Exclosure sites. Mature individuals have been the main shrub demographic in all sample years (**Figure 1.16**). Utilization of preferred browse has increased in total, but has remained low with less than 30% of plants being moderately to heavily hedged in all sample years (**Figure 1.19**).

Average tree cover on these study sites has remained low, with no cover observed in 2016 or 2021. Furthermore, the small amounts of cover that were observed in 2006 and 2011 can be entirely attributed to the Mud Springs Basin study (**Figure 1.10**). Tree density has also remained low, with the slight decrease between 2016 and 2021 largely being due to twoneedle pinyon (*Pinus edulis*) on the Raft River Narrows study (**Figure 1.13**).

Herbaceous Understory: The herbaceous understories of these study sites have generally increased in cover over time despite fluctuations from year to year. Average nested frequency has also varied between sample years, but has remained similar overall. Perennial grasses contributed the most cover in 1996, 2006, 2011, 2016, and 2021. However, annual grasses, primarily the introduced species cheatgtrass (*Bromus tectorum*), also contributed significant amounts of cover in 2001, 2006, and 2016. Annual and perennial forbs have generally been present with less cover and abundance than grasses in all years (**Figure 1.22**, **Figure 1.25**).

Occupancy: Average occupancy on these sites has exhibited an overall increase, with deer being the primary occupants in most study years: the exception to this is 2006 and 2021, when cattle were the primary occupants. Mean abundance of deer pellet groups has ranged from 3 days use/acre in 2021 to 12 days use/acre in 2011. Elk pellet groups have had an average abundance fluctuating between 0 days use/acre in 2021 and 2 days use/acre in 2016. Finally, the mean abundance of cattle pellet groups has been as low as 2 days use/acre in 2016 and as high as 18 days use/acre in 2021 (**Figure 1.28**).

Upland (Black/Low Sagebrush)

There is one study [South Side Emigrant Pass (01-7)] that is classified as an Upland (Black/Low Sagebrush) ecological site. South Side Emigrant Pass is found on the western slopes of the Bovine Mountains, southwest of the Bovine Exclosure study (**Table 1.10**).

Shrubs/Trees: Black sagebrush (*Artemisia nova*) has been the dominant browse species in all sample years; other preferred browse species such as shadscale saltbush (*Atriplex confertifolia*) and green molly (*Bassia americana*) have also been present, but with less cover. Total shrub cover has marginally decreased overall (**Figure 1.6**). Average preferred browse demographics indicate that density has only slightly decreased overall. A majority of the population has been comprised of mature plants in most sample years. Although density increased between 2016 and 2021, decadence also increased, and decadent individuals were the dominant demographic in 2021. Recruitment of young also displayed a slight increase between 2016 and 2021, but has remained low overall since 2001 (**Figure 1.16**). A majority of preferred browse plants were moderately or heavily browsed in 1996, but utilization has since decreased; a majority of plants exhibited no to light use in 2011, 2016, and 2021 (**Figure 1.19**).

Tree cover has remained low on this site, with Utah juniper (*Juniperus osteosperma*) contributing cover for the first time (albeit in low amounts) in 2021. Density has increased over time. However, it is important to note that although point-quarter measurements were only taken in 2016 and 2021, twoneedle pinyon (*Pinus edulis*) and/or Utah juniper have been recorded in shrub density strips in all years since 1996 (**Figure 1.10**, **Figure 1.13**).

Herbaceous Understory: Cover of the herbaceous understory has remained generally stable overall, but has been significantly less than that of other sites in this unit; frequency has exhibited a slight decrease. Perennial forbs and native perennial grasses have provided the most cover and have been the most abundant components in most study years. Cover of annual grasses and forbs has remained low (**Figure 1.22**, **Figure 1.25**).

Occupancy: Wildlife occupancy has displayed a general decrease over the sample period. Elk were the primary occupants of this site in 2001, and mean pellet group abundance has been as high as 71 days use/acre in 2001 and as low as 0 days use/acre in all other sample years. Deer have been the primary occupants in all years since 2001; average deer pellet group abundance has fluctuated between 5 days use/acre in 2001 and 27 days use/acre in 2006. Finally, mean abundance of cattle pellet groups has ranged from 0 days use/acre in 2001, 2016, and 2021 to 4 days use/acre in 2011 (**Figure 1.28**).

Upland (Browse)

There are five studies [Chokecherry Springs (01-4), Bovine Exclosure (01-6), Red Butte Exclosure (01-12), Broad Hollow (01-14), and Nut Pine Hills (01-16)] that are classified as Upland (Browse) ecological sites. The Chokecherry Springs study site is located northeast of Rocky Pass Peak and west of State Road 30, while the Bovine Exclosure study is situated northwest of the Bovine Mountains off of Immigrant Trail Road. The Red Butte Exclosure study is situated on the western slope of Red Butte Mountain, and the Broad Hollow site is about two miles south of the Raft River and Valley Lynn Road. Finally, Nut Pine Hills is situated in Nut Pine Hills, east of the Clark Basin study (**Table 1.10**).

Shrubs/Trees: These study sites generally tend to be dominated by different browse species including antelope bitterbrush (*Purshia tridentata*), mountain snowberry (*Symphoricarpos oreophilus*), and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), although other species have also been present to a lesser extent. Total shrub cover has decreased overall (**Figure 1.7**). Average preferred demographics indicate that although total density has varied between sample years, it has remained largely consistent over the study period as a whole. Demographics also show that the

majority of the shrub populations on these sites have been comprised of mature individuals. However, decadence has exhibited an overall increase; the number of decadent plants nearly doubled on all studies except Chokecherry Springs between 2016 and 2021. Recruitment of young has also decreased over time, a trend driven by Bovine Exclosure, Red Butte Exclosure, and Nut Pine Hills in the most recent sample years (**Figure 1.16**). Average preferred browse utilization has decreased overall, but has remained low throughout the study period: less than 25% of plants have displayed signs of moderate to heavy use in all sample years (**Figure 1.19**).

Tree cover has increased over time. Most of the tree cover has been contributed by Utah juniper (*Juniperus osteosperma*) on the Chokecherry Springs, Bovine Exclosure, and Nut Pine Hills study sites; the very small decrease in juniper cover between 2016 and 2021 can be directly attributed to a 2018 lop and scatter project that occurred on Chokecherry Springs. Increases in twoneedle pinyon cover (*Pinus edulis*) are mainly due to the Nut Pine Hills study (**Figure 1.10**). Average tree density measurements increased between 2006 and 2016 with juniper as the most abundant species. Tree density decreased between 2016 and 2021: this decrease is also a direct consequence of the lop and scatter treatment on the Chokecherry Springs study. However, density remains moderate overall, indicating that infilling may be a concern on these study sites in future sample years. The exception to these trends is the Broad Hollow study, on which density has remained very low and tree cover has been absent (**Figure 1.13**).

Herbaceous Understory: Overall cover of the herbaceous understories has generally increased with fluctuations from year to year. Composition has fluctuated, with perennial grasses contributing the most cover in 1996, 2001, 2011, and 2021, and annual grasses being (co-)dominant in 1996, 2001, and 2016. Average nested frequency has displayed less year-to-year fluctuation than cover, and has exhibited a slight decrease over time (**Figure 1.22**, **Figure 1.25**).

Occupancy: Deer have been the primary occupants of these study sites in all sample years; overall occupancy has slightly increased over time. Mean abundance of deer pellet groups has ranged from almost 18 days use/acre in 2021 to 32 days use/acre in 2006. Elk pellet groups have had an average abundance ranging from 0 days use/acre in 2006 to nearly 1 days use/acre in 2011. Finally, mean abundance of cattle pellet groups has been as low as 2 days use/acre in 2021 and as high as 10 days use/acre in 2006 (**Figure 1.28**).

Semidesert (Big Sagebrush)

One study [Rosette (01-2)] is considered to be a Semidesert (Big Sagebrush) ecological site, and is located just outside the town of Rosette, south of State Route 30 (**Table 1.10**).

Shrubs/Trees: Shrub cover on this site has fluctuated from year to year, but has remained similar overall. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) provides the most browse cover and other preferred browse is rare; much of the additional shrub cover has been provided by yellow rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus* var. *stenophyllus*) (**Figure 1.8**). Average preferred browse demographics show that mature plants have been the main component of the population in all study years except 1996, when young plants were the most prevalent. Recruitment of young has decreased over time, as has overall preferred browse density (**Figure 1.17**). Utilization of preferred browse has varied, but the percentage of plants that are moderately or heavily browsed has decreased since 2011 – over 90% of plants exhibited little to no use in 2016 and 2021 (**Figure 1.20**).

Utah juniper (*Juniperus osteosperma*) contributed cover in 2006 and 2011, but provided no cover in 2016 or 2021 due to a lop and scatter treatment in the winter/spring of 2015/2016. Density of trees has likewise exhibited an overall decrease, although it did increase between 2016 and 2021 (**Figure 1.11**, **Figure 1.14**).

Herbaceous Understory: Although native perennial grasses originally provided the most cover in the understory, annual grasses increased, becoming dominant on the site in 2011 and 2016. However, annual grass cover decreased in 2021 while that of perennial grasses increased, with perennial grasses again becoming dominant that year. Total cover has been variable, but has remained similar overall. Average nested frequency of the understory as a whole remained largely consistent between 1996 and 2016 with frequencies of individual components exhibiting slight fluctuations over time. However, total frequency decreased in 2021, largely due to annual grasses (**Figure 1.23**, **Figure 1.26**).

Occupancy: Average occupancy remained mostly consistent from 2001 to 2011, but has decreased since then. Deer/antelope have been the primary occupants in all years with mean abundance of pellet groups ranging from 11 days use/acre in 2021 to 26 days use/acre in 2001. Mean abundance of elk pellet groups has been as low as 0 days use/acre in 2001, 2006, 2011, and 2021 and as high as 0.7 days use/acre in 2016. Finally, cattle pellet groups have had a mean abundance ranging from 0 days use/acre in 2001 to 7 days use/acre in 2021 (**Figure 1.29**).

Semidesert (Black/Low Sagebrush)

There are four study sites [Devils Playground (01-5), Kilgore Basin (01-10), Kimber Ranch (01-11), and Dake Pass (01-22)] that are considered to be Semidesert (Black/Low Sagebrush) ecological sites. The Devils Playground study is located northeast of the Bovine Mountains near the Devils Playground rock formation. Kilgore Basin is found west of Grouse Creek, and the Kimber Ranch site is situated west of North Etna Road and north of Toms Cabin Creek. Finally, the Dake Pass study is located north of State Route 30 very near to the Utah-Nevada border (**Table 1.10**).

Shrubs/Trees: The dominant browse component on these sites has been black sagebrush (*Artemisia nova*) throughout the study period. However, Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) was the dominant browse species on Kimber Ranch in 2021. Other browse species are also often present on these sites to a lesser extent. Total shrub cover exhibited a significant decrease between 2016 and 2021. This decrease can be almost entirely attributed to the loss of black sagebrush on the Kimber Ranch and Kilgore Basin studies due to the Goose Creek wildfire in 2018 (**Figure 1.8**). Average preferred browse demographics also display a decrease in total density over the study period, a trend which can also be largely attributed to the Goose Creek wildfire. Mature individuals have been the dominant age demographic in these populations in all sample years. Recruitment of young increased between 2016 and 2021 due to the Kimber Ranch study; both Kimber Ranch and Kilgore Basin were seeded following the burn as part of fire rehabilitation efforts (**Figure 1.17**). Average preferred browse utilization has fluctuated over time. Less than 20% plants were moderately to heavily hedged in most sample years. The exceptions to this are the 1996 and 2011 sample years, when nearly 60% and 35% of plants (respectively) were moderately or heavily used (**Figure 1.20**).

Utah juniper (*Juniperus osteosperma*) has provided most of the cover on these sites which has generally decreased overall. Between 2011 and 2016, this decrease was largely influenced by the Devils Playground study, in which cover was reduced by over 10% by a chaining project. Tree cover decreased further between 2016 and 2021 due to the Goose Creek wildfire on the Kimber Ranch study site (**Figure 1.11**). Average tree density has decreased overall, with the loss of juniper between 2016 and 2021 again being due to the Goose Creek wildfire on Kimber Ranch. Density of pinyon (*Pinus sp.*), however, has increased: this can be entirely attributed to singleleaf pinyon (*P. monophylla*) on Devil's Playground (**Figure 1.14**).

Herbaceous Understory: The average herbaceous understories of these studies have varied from year to year, but cover has increased in total while nested frequency has generally remained stable overall. Composition has fluctuated over time. Perennial grasses contributed the most cover in 1996, 2011, 2016, and 2021. Annual grasses provided most of the cover in 2006, while perennial and annual grasses contributed equal amounts of cover in 2001. The large increase in annual grass cover in 2006 is likely due to the Dake Pass study, on which frequency and cover of the introduced species cheatgrass (*Bromus tectorum*) increased significantly between 2001 and 2006. Perennial grasses on these sites have been largely composed of native species (**Figure 1.23**, **Figure 1.26**).

Occupancy: Animal occupancy has generally increased, with deer and/or antelope being the main occupants in all study years. Mean abundance for deer and/or antelope pellet groups has been as low as 16 days/acre in 2001 and as high as nearly 24 days use/acre in 2016. Elk pellet groups have had an average abundance ranging from 2 days use/acre in 2016 to 8.5 days use/acre in 2011. Finally, the mean abundance of cattle pellet groups has ranged between 2 days use/acre in 2001 and 8 days use/acre in 2021 (**Figure 1.29**).

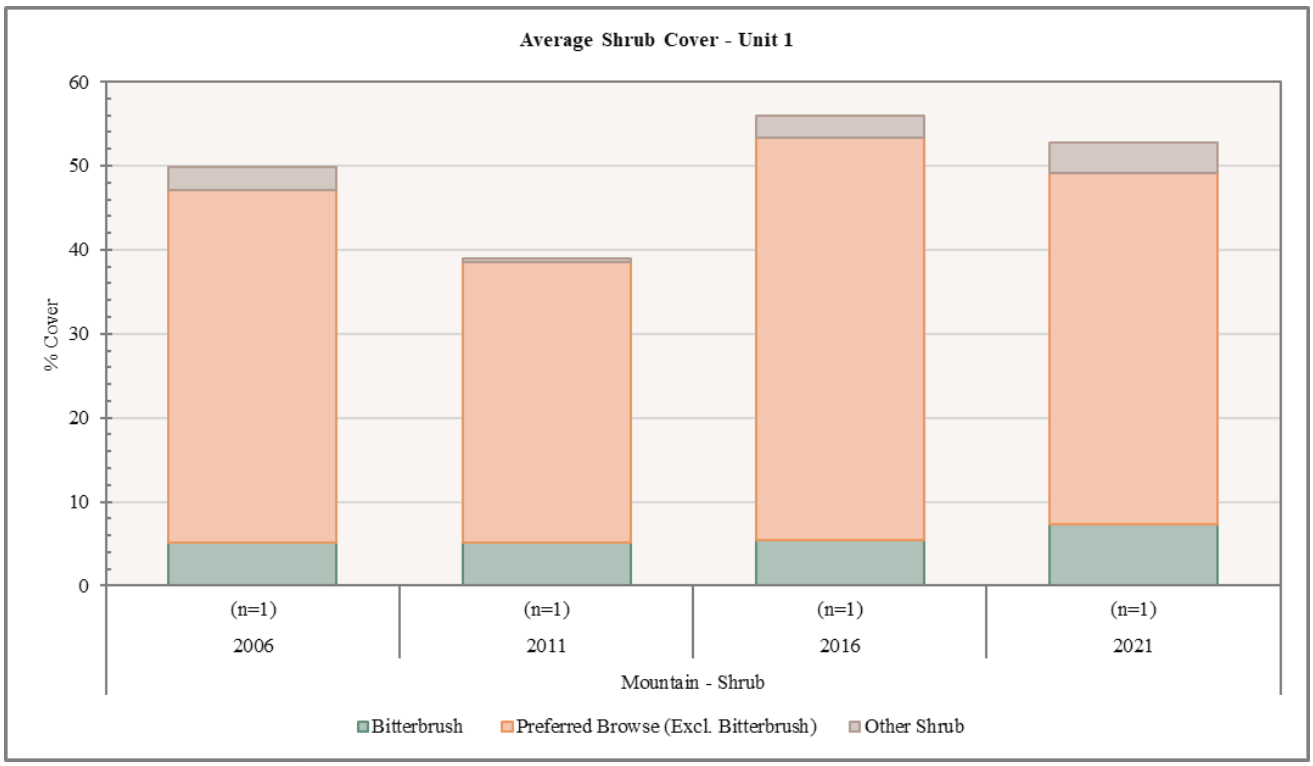


Figure 1.4: Average shrub cover for Mountain - Shrub study sites in WMU 1, Box Elder.

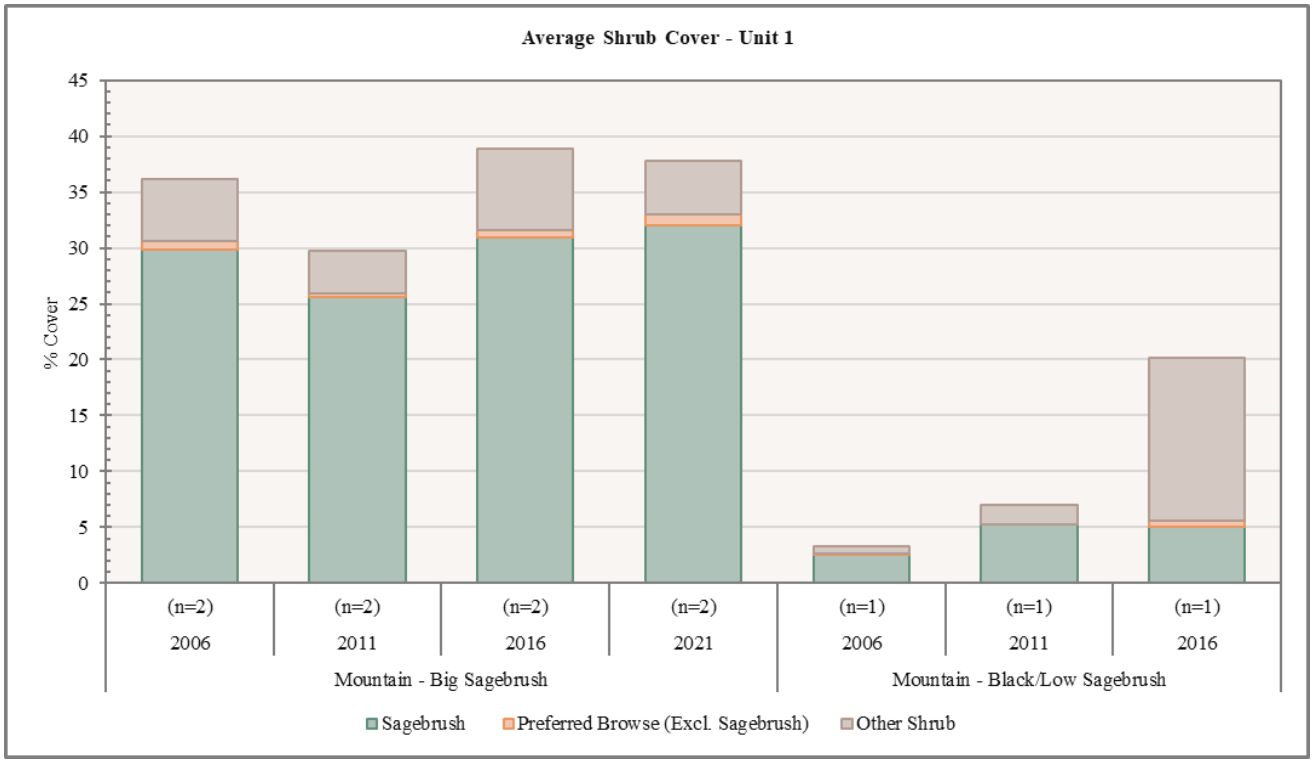


Figure 1.5: Average shrub cover for Mountain - Big Sagebrush and Mountain - Black/Low Sagebrush study sites in WMU 1, Box Elder.

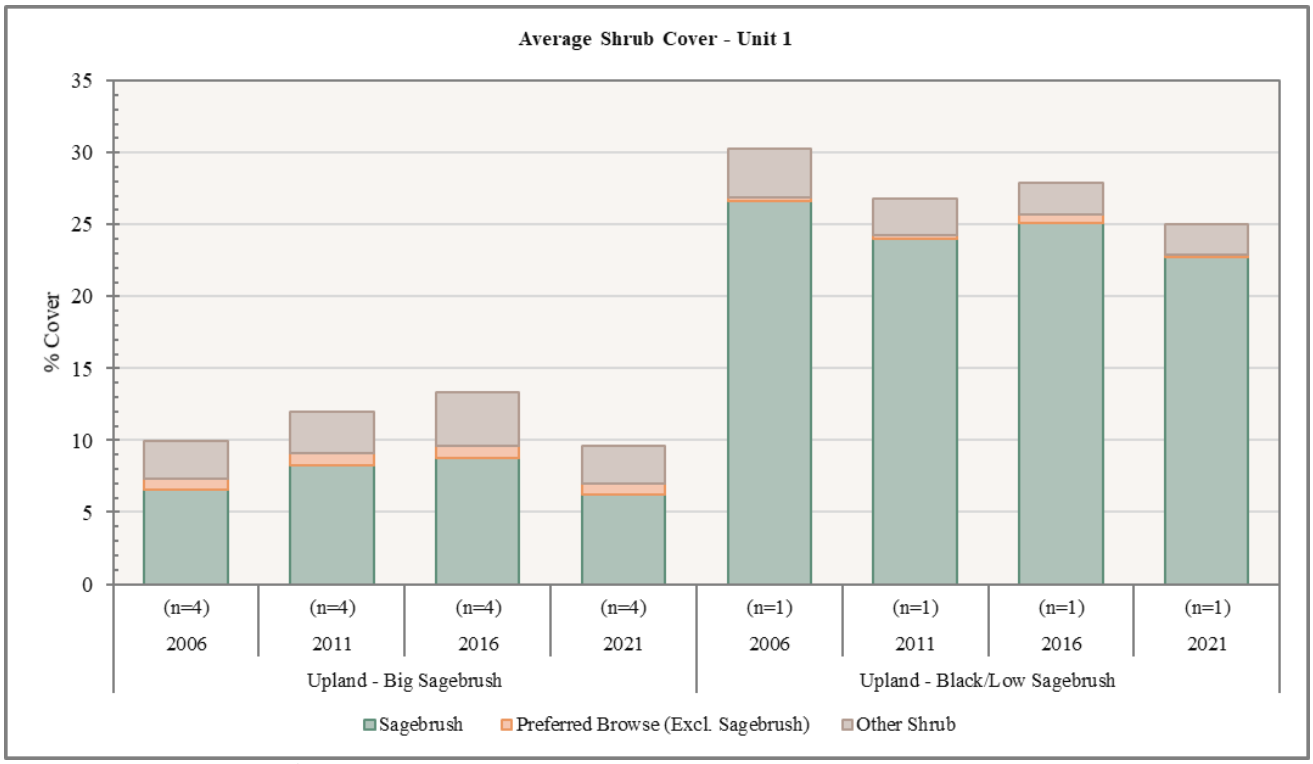


Figure 1.6: Average shrub cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 1, Box Elder.

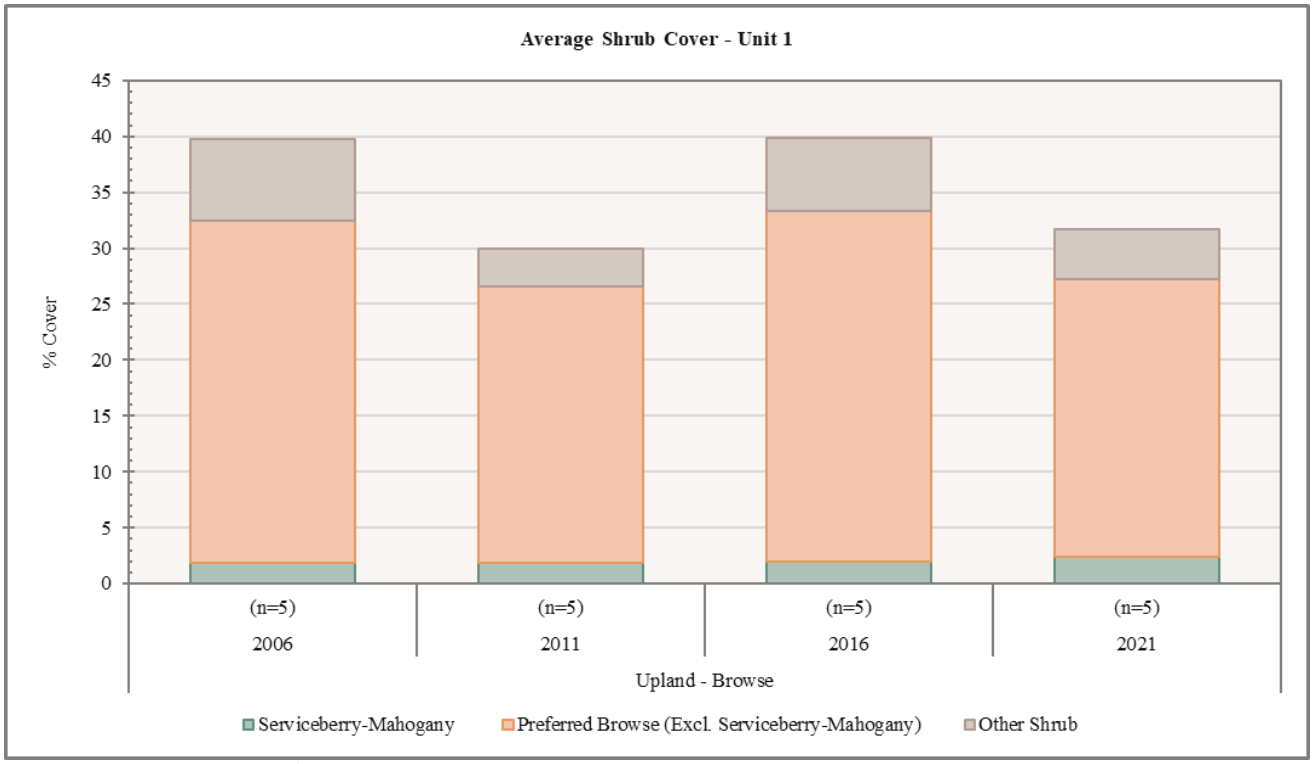


Figure 1.7: Average shrub cover for Upland - Browse study sites in WMU 1, Box Elder.

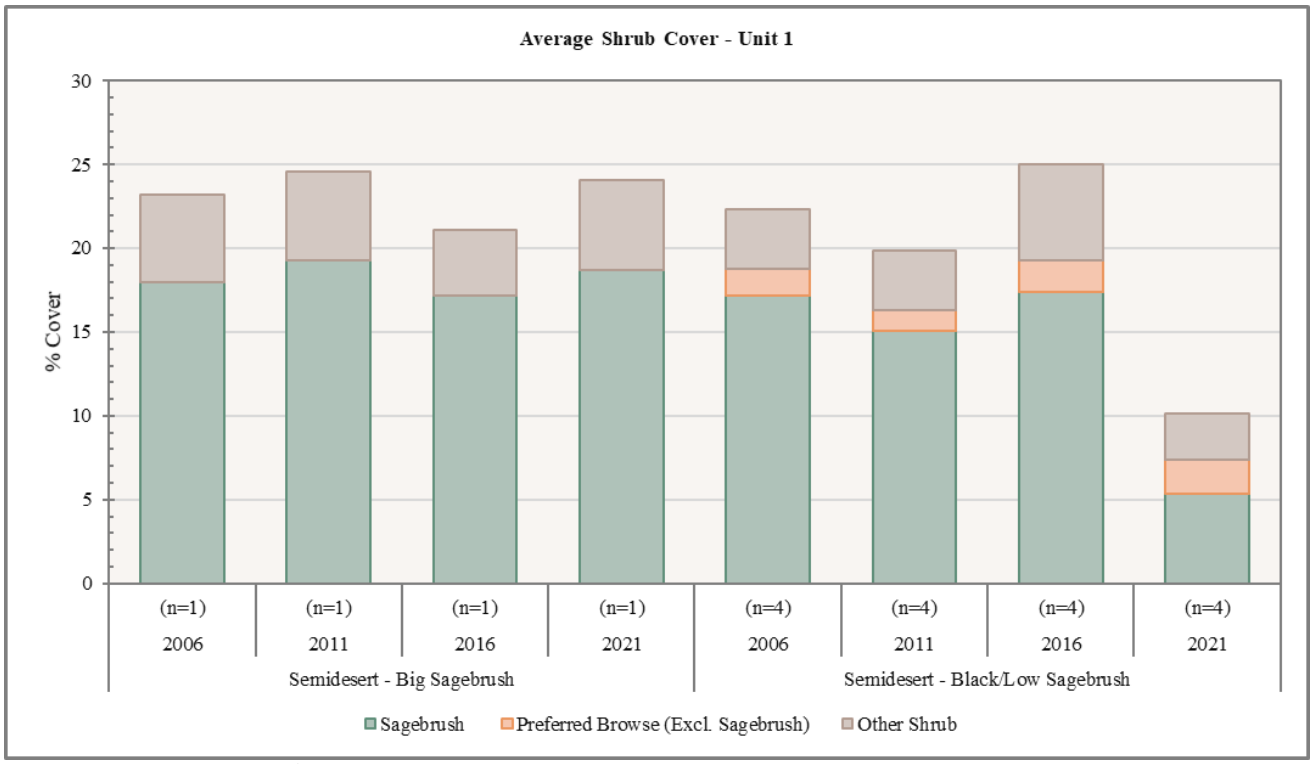


Figure 1.8: Average shrub cover for Semidesert - Big Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 1, Box Elder.

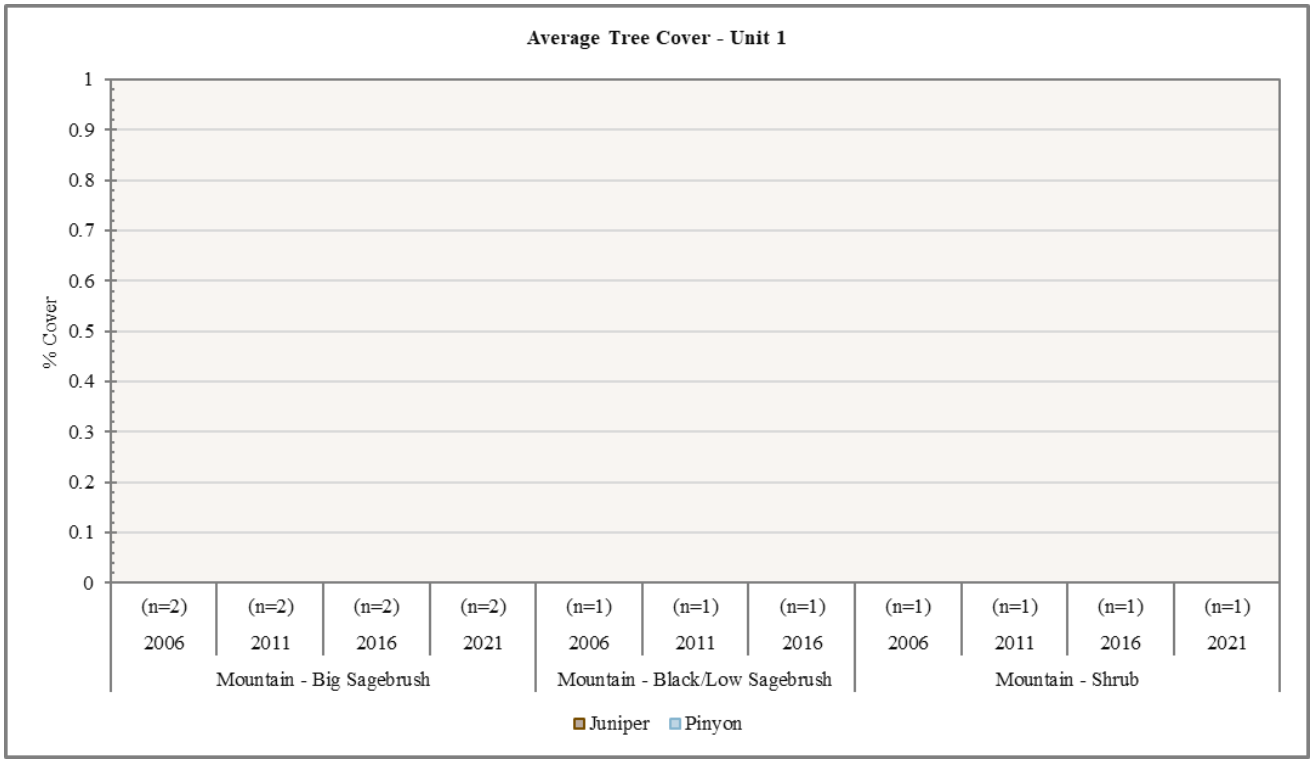


Figure 1.9: Average tree cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 1, Box Elder.

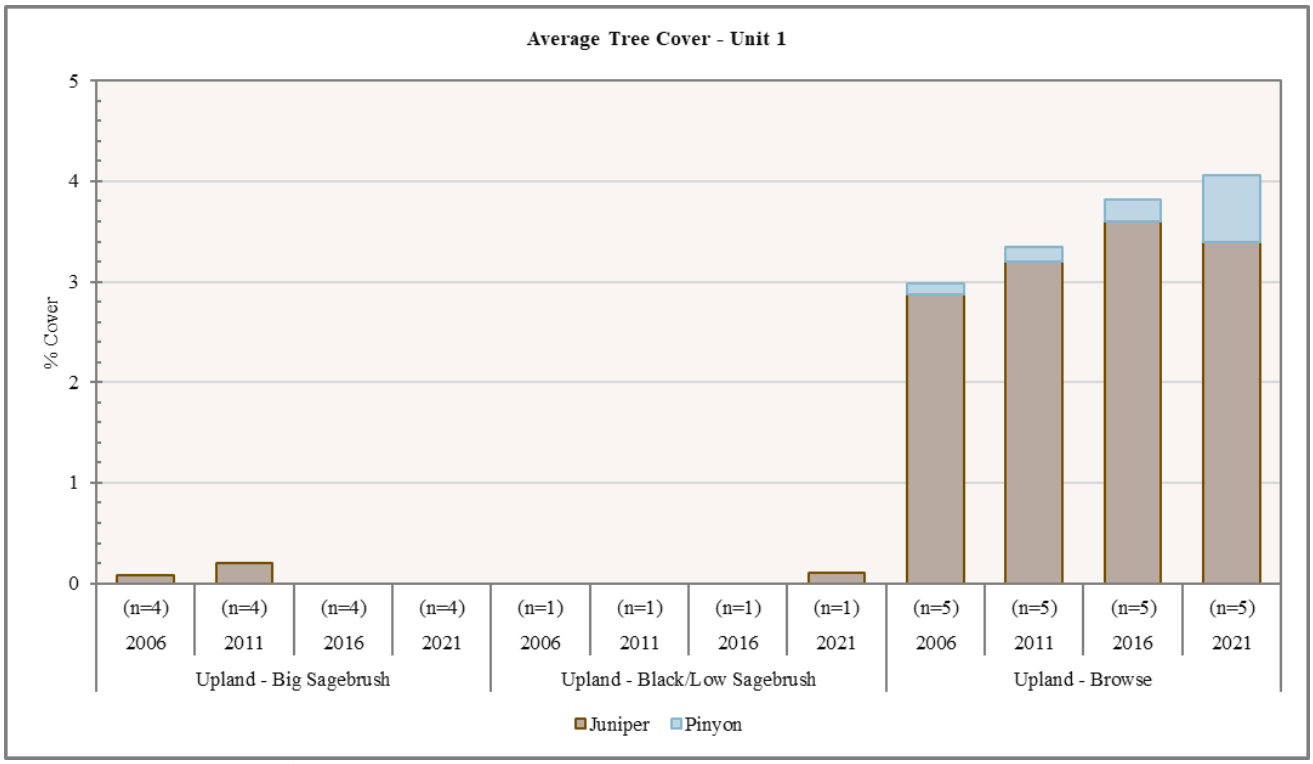


Figure 1.10: Average tree cover for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Browse study sites in WMU 1, Box Elder.

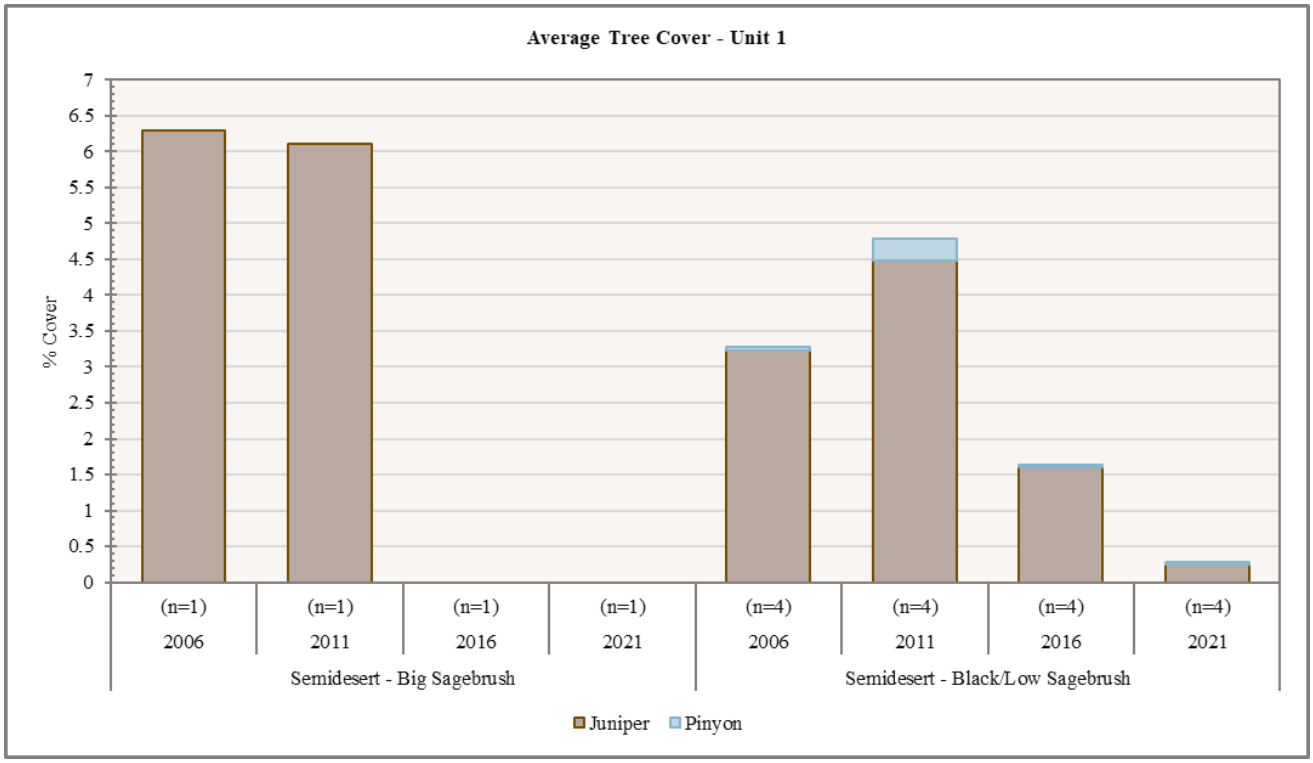


Figure 1.11: Average tree cover for Semidesert - Big Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 1, Box Elder.

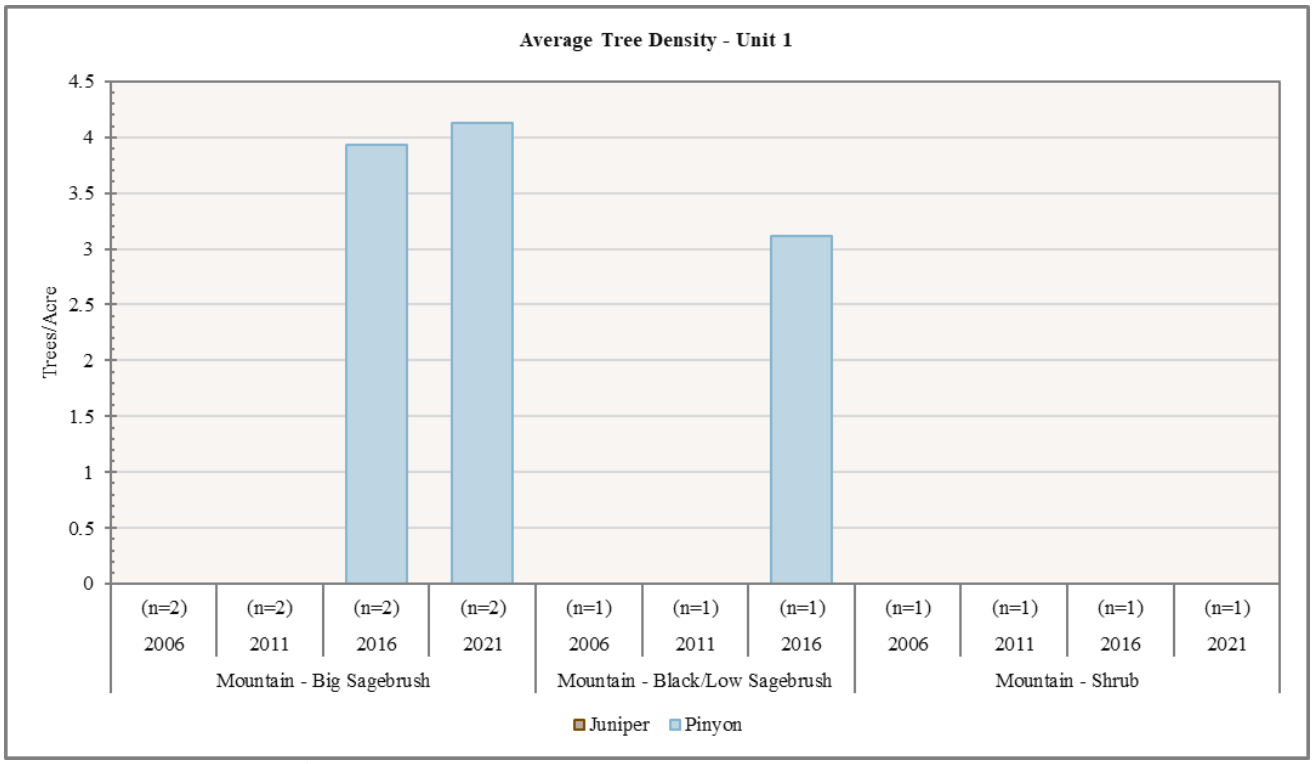


Figure 1.12: Average tree density for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 1, Box Elder.

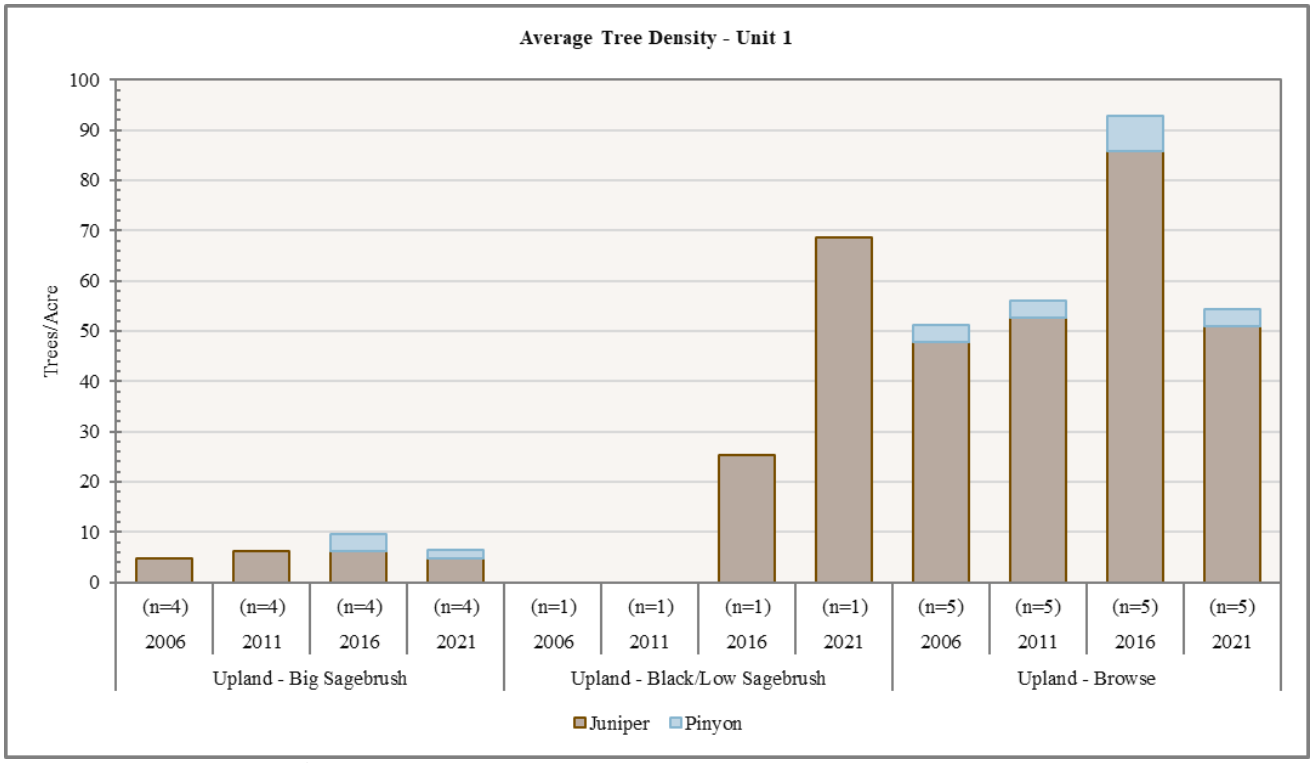


Figure 1.13: Average tree density for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Browse study sites in WMU 1, Box Elder.

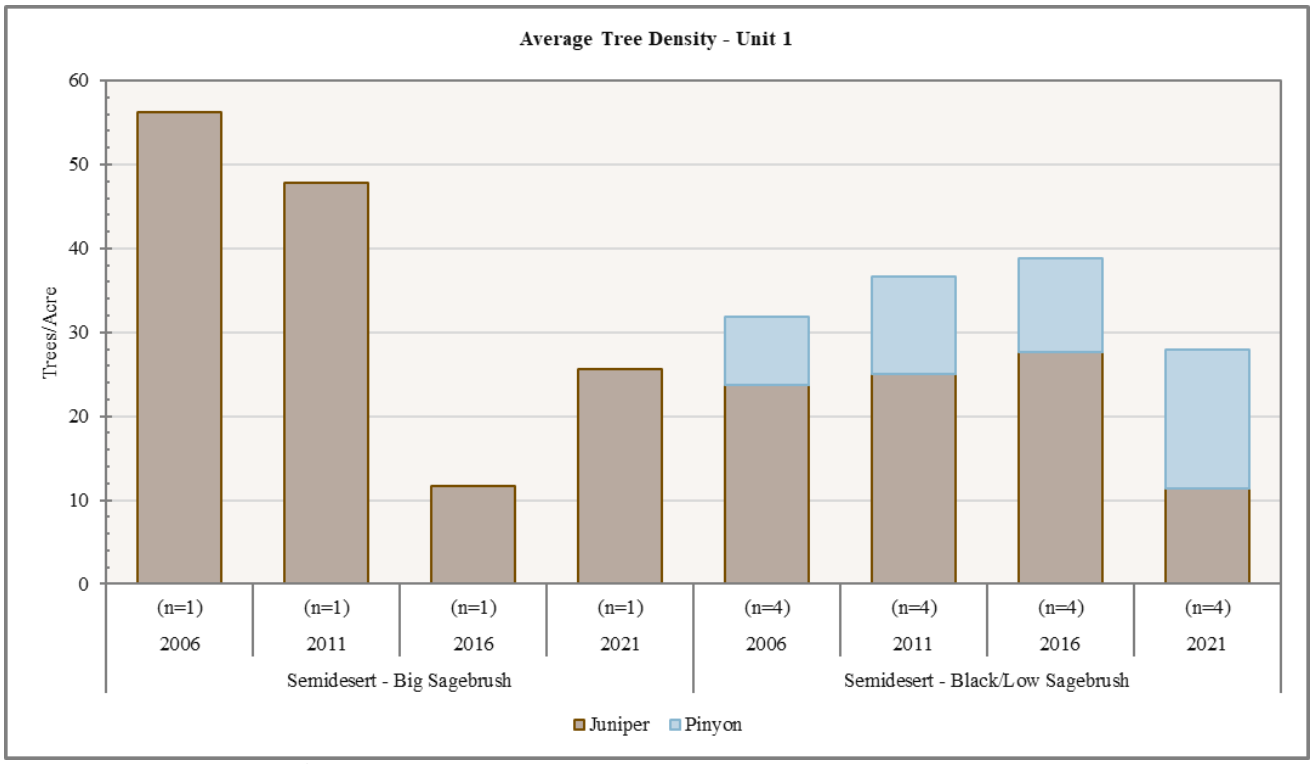


Figure 1.14: Average tree density for Semidesert - Big Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 1, Box Elder.

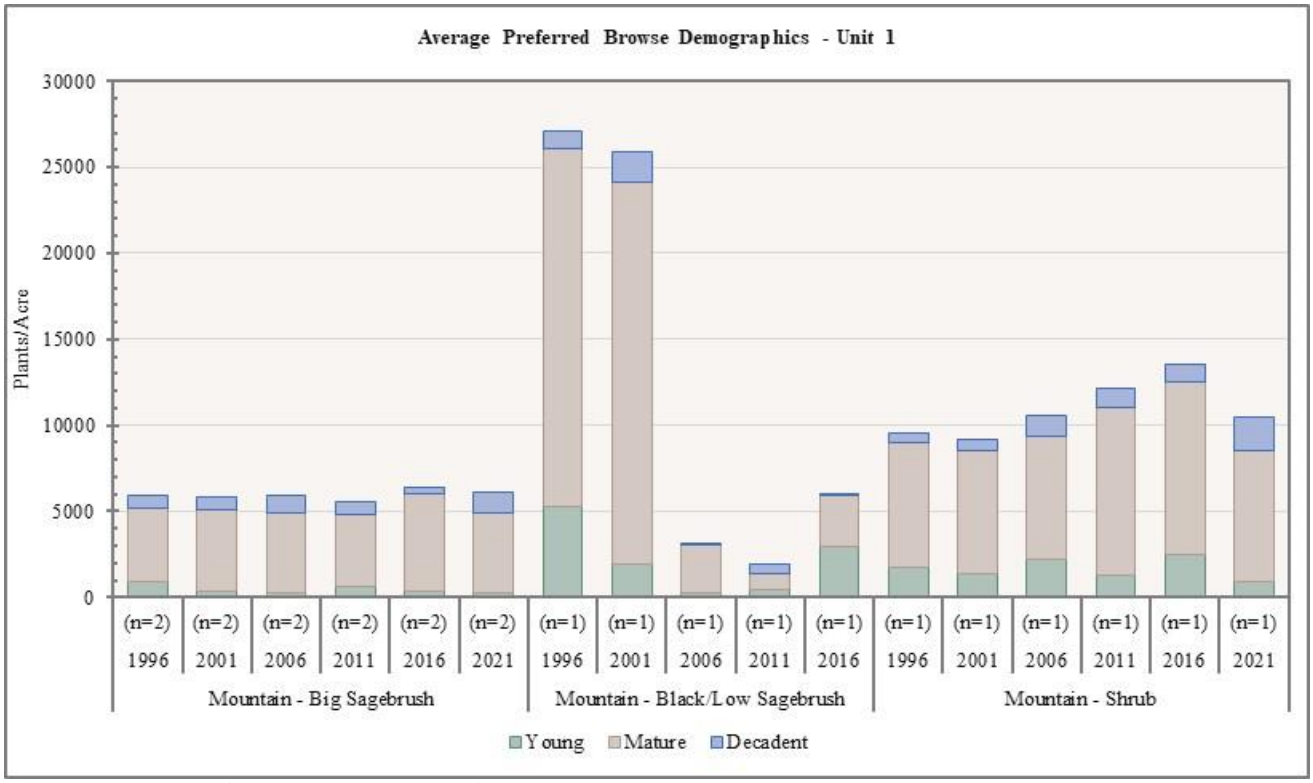


Figure 1.15: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 1, Box Elder.

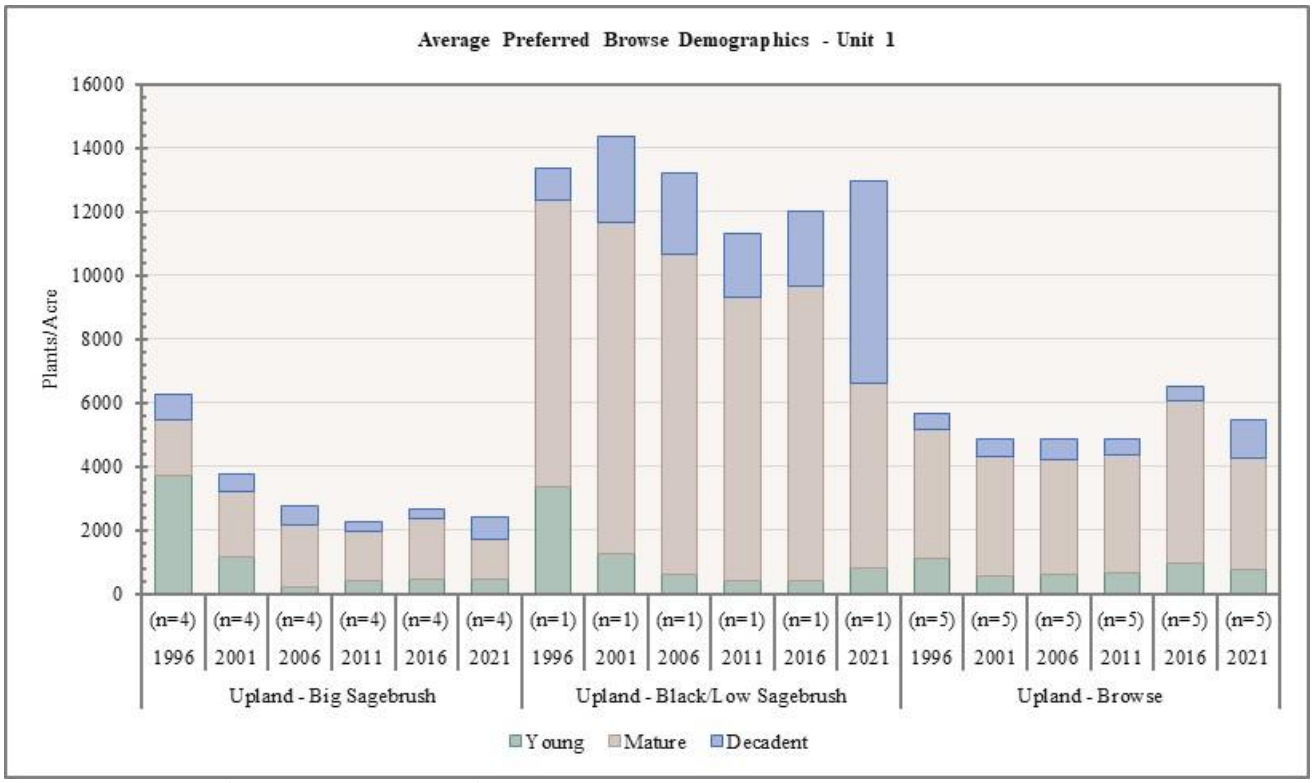


Figure 1.16: Average preferred browse demographics for Upland - Big Sagebrush, Upland - Black/Low Sagebrush and Upland - Browse study sites in WMU 1, Box Elder.

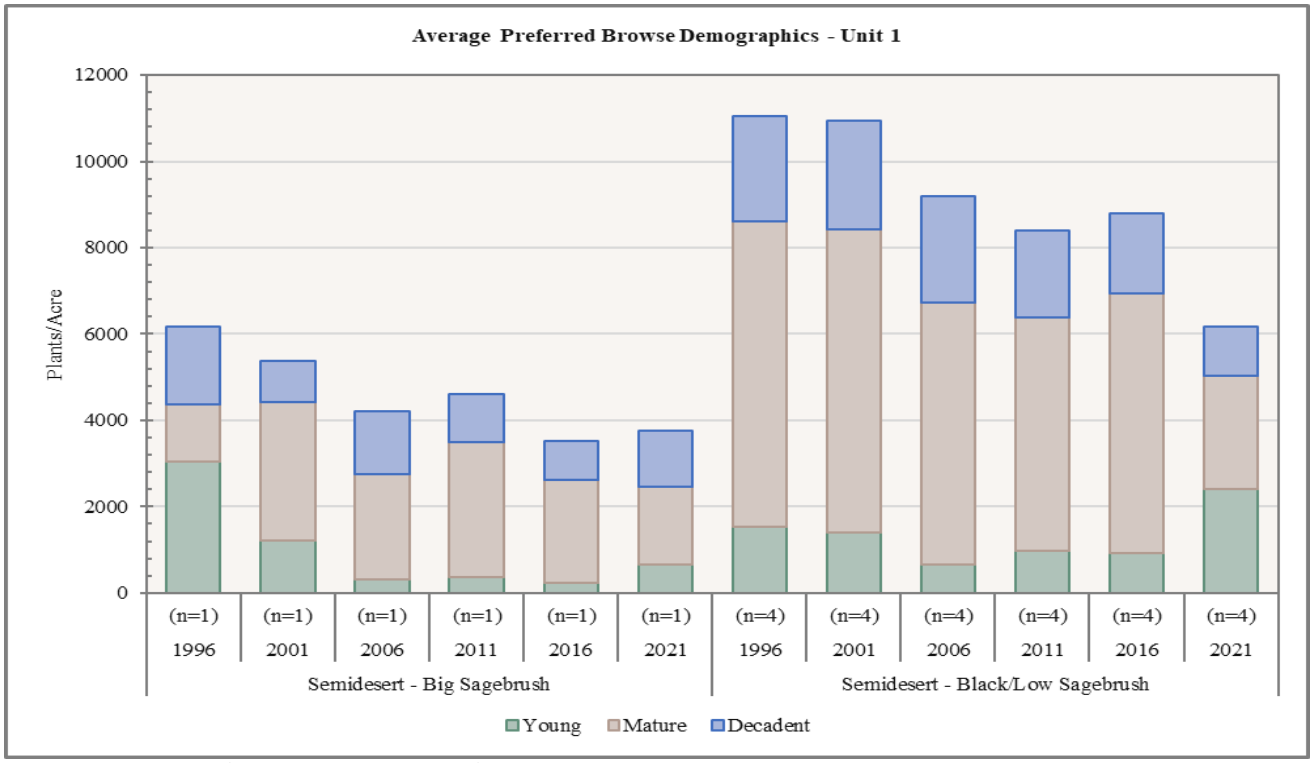


Figure 1.17: Average preferred browse demographics for Semidesert - Black/Low Sagebrush and Semidesert - Big Sagebrush study sites in WMU 1, Box Elder.

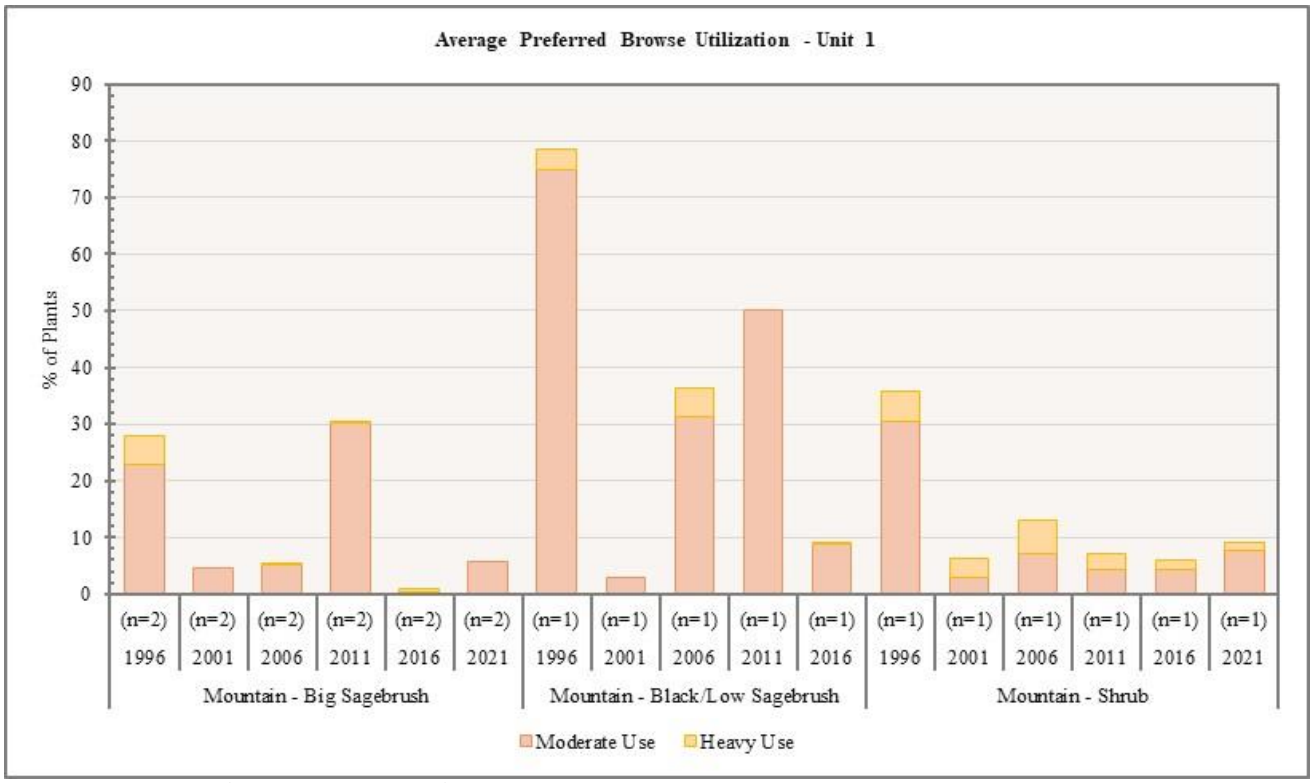


Figure 1.18: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 1, Box Elder.

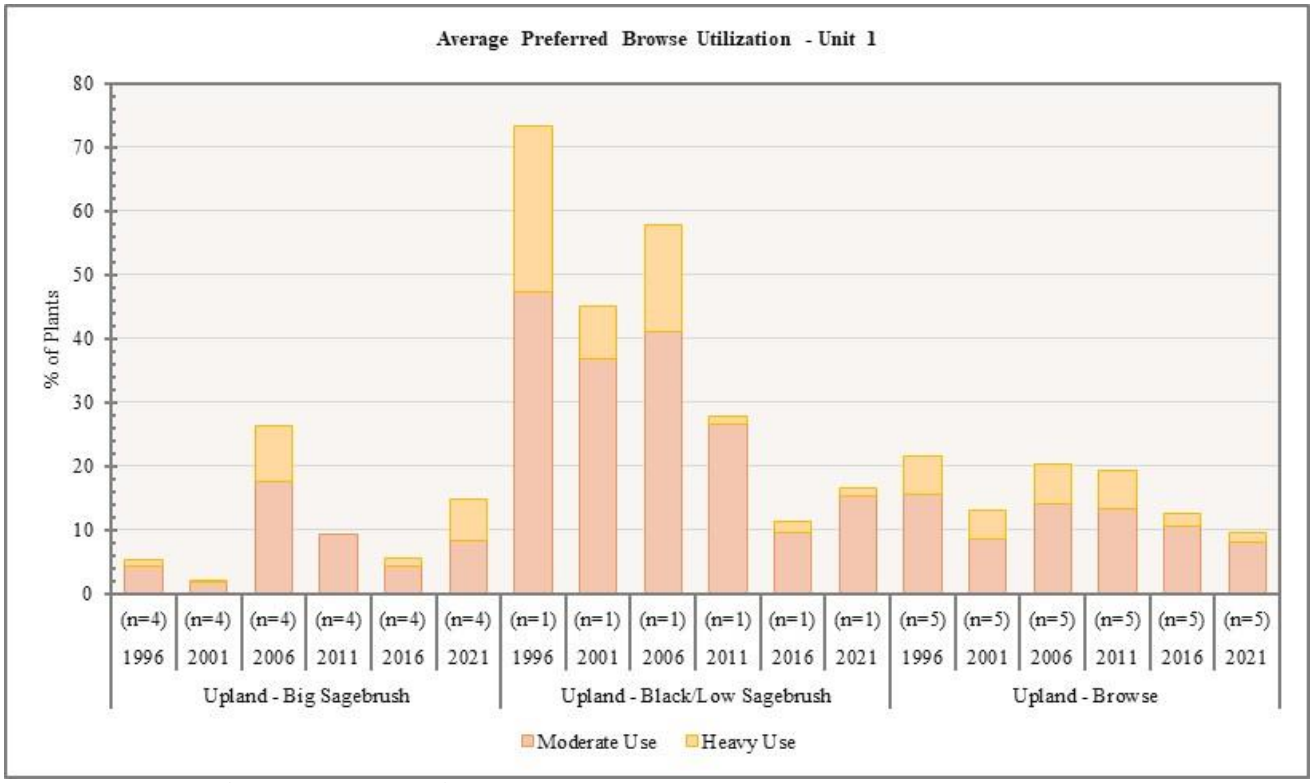


Figure 1.19: Average preferred browse utilization for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Browse study sites in WMU 1, Box Elder.

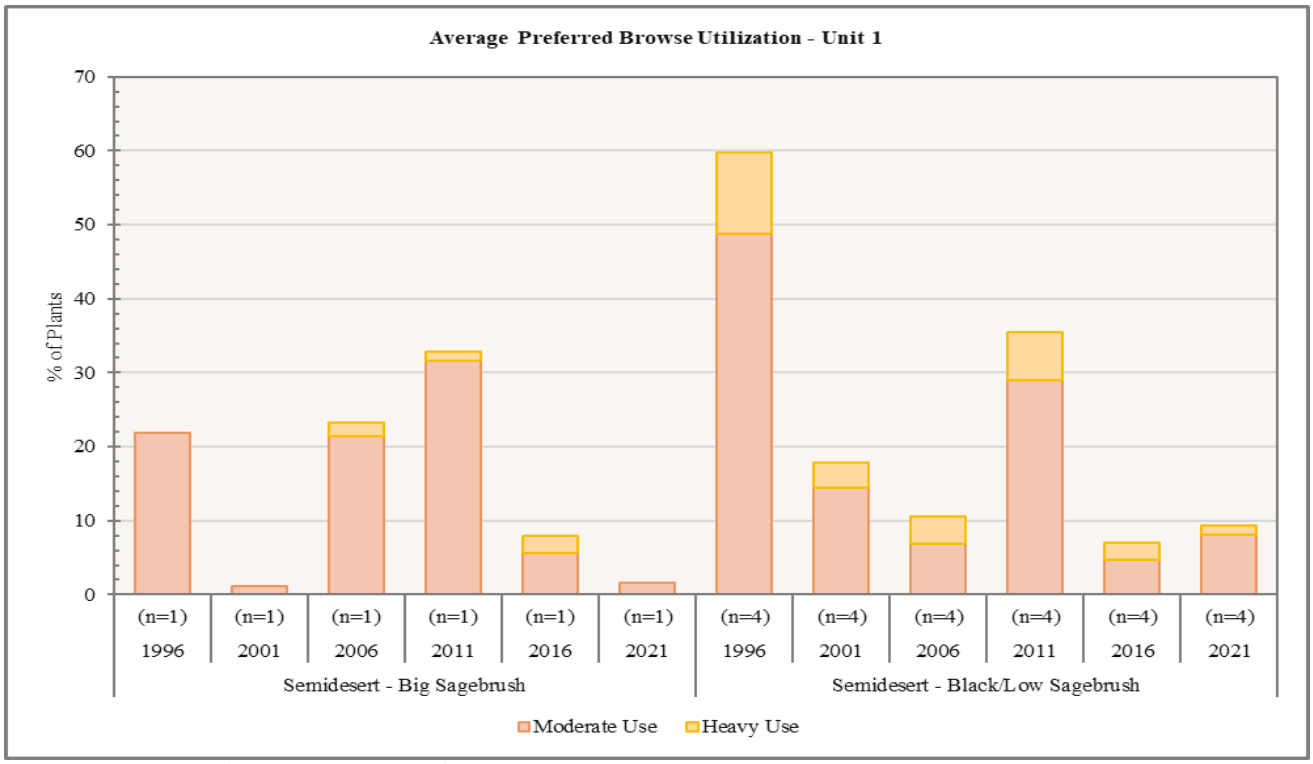


Figure 1.20: Average preferred browse utilization for Semidesert - Big Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 1, Box Elder.

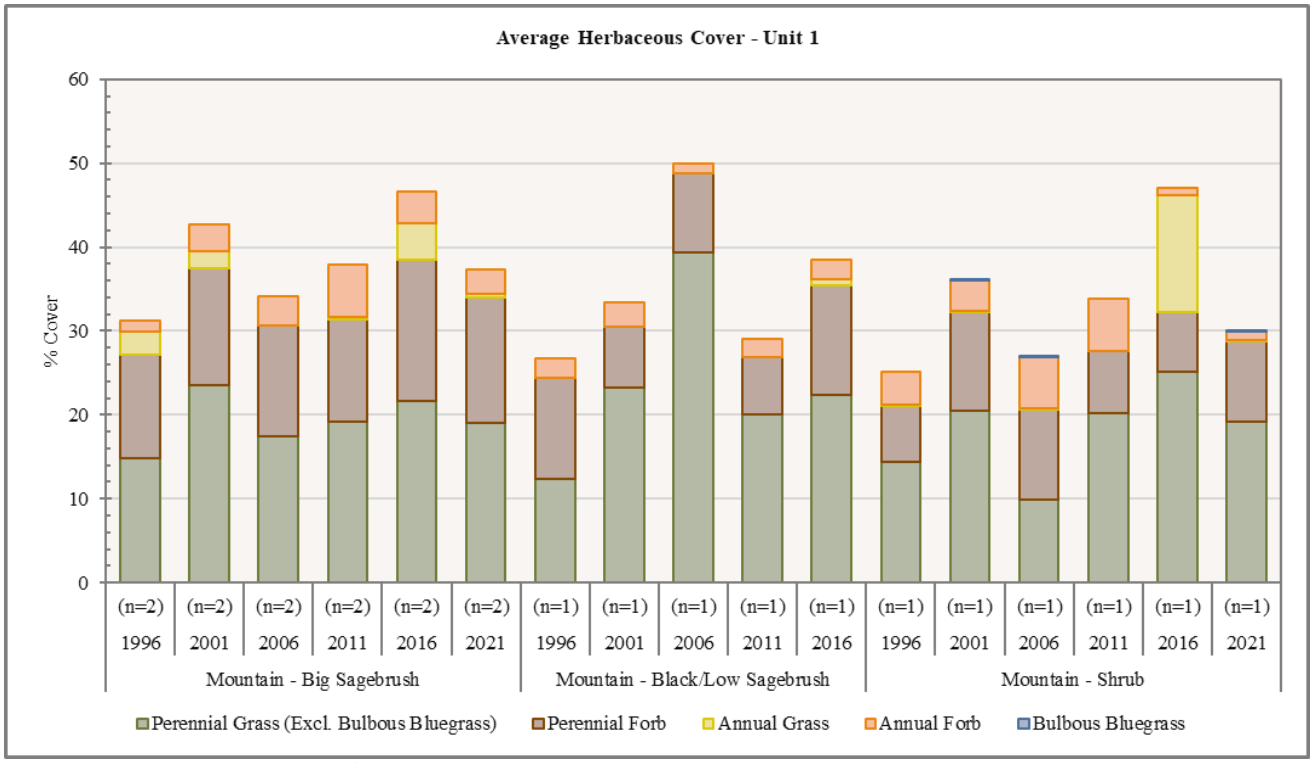


Figure 1.21: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 1, Box Elder.

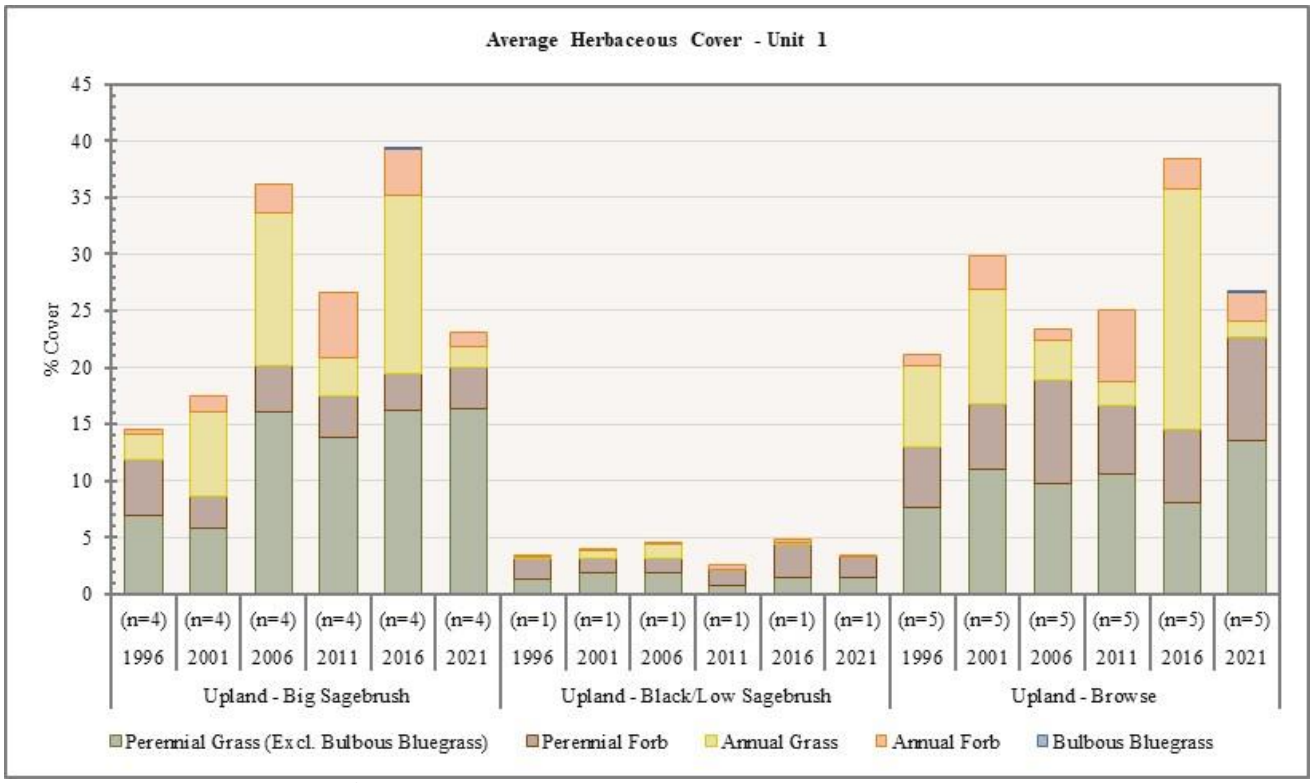


Figure 1.22: Average herbaceous cover for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Browse study sites in WMU 1, Box Elder.

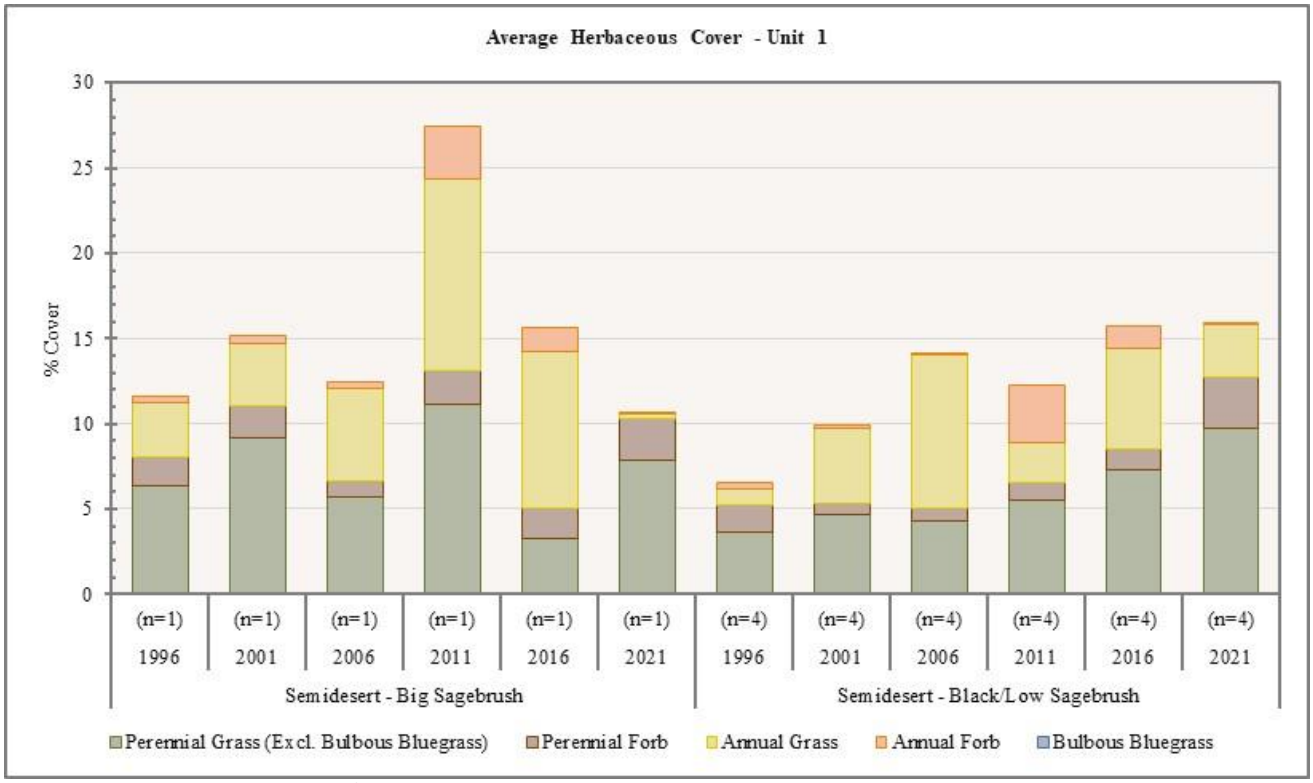


Figure 1.23: Average herbaceous cover for Semidesert - Big Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 1, Box Elder.

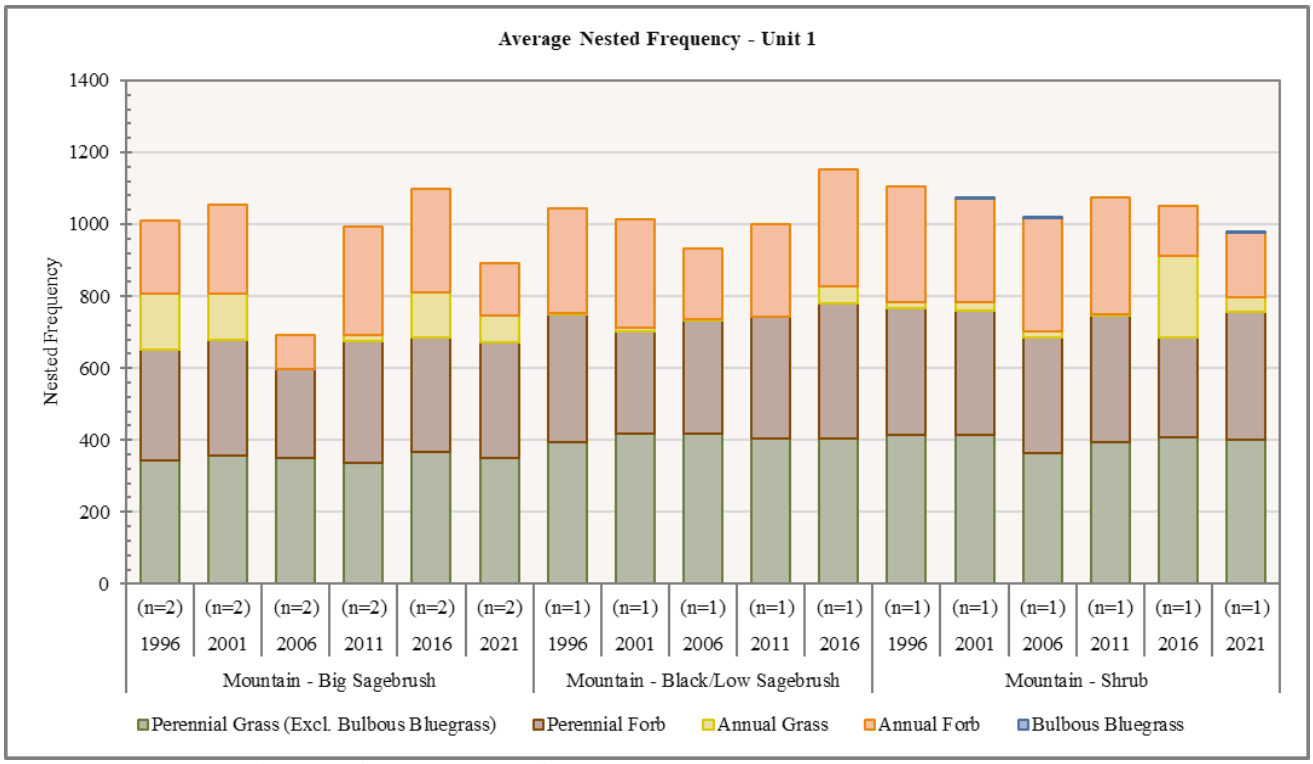


Figure 1.24: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 1, Box Elder.

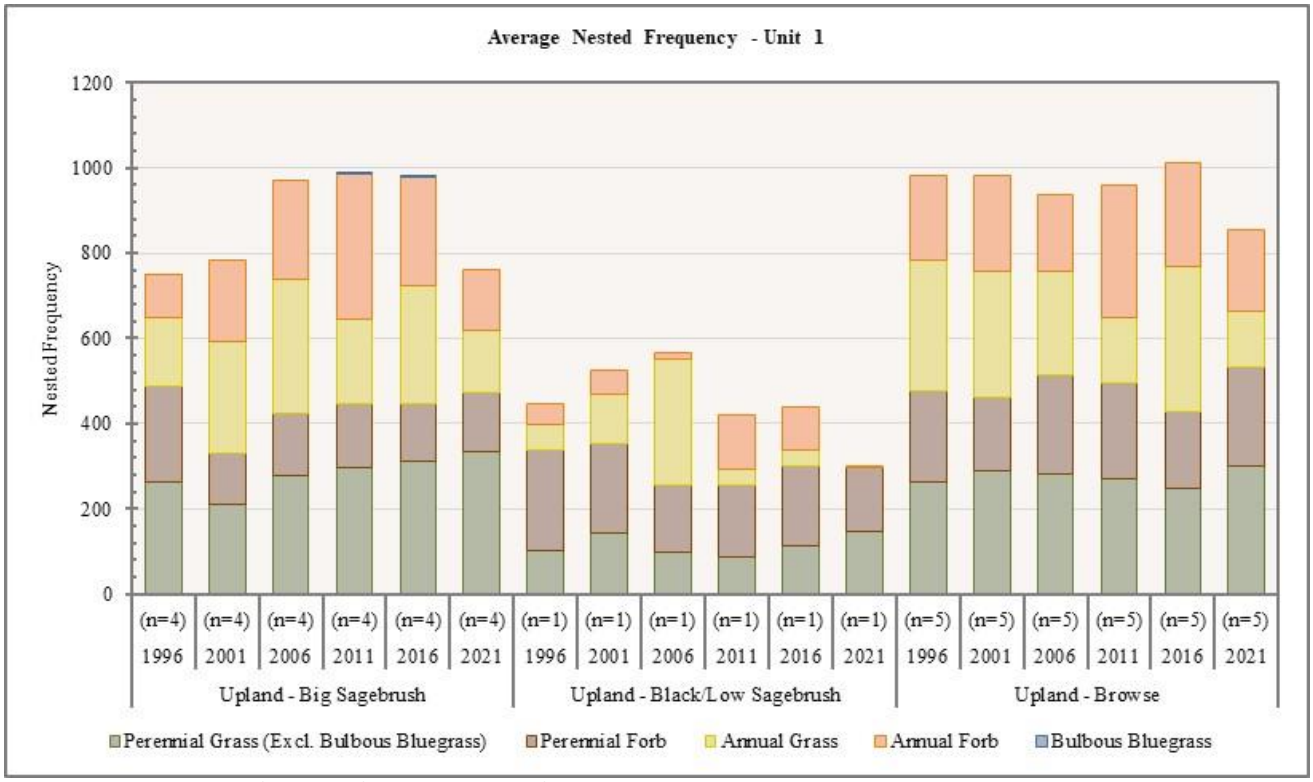


Figure 1.25: Average nested frequency of herbaceous species for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Browse study sites in WMU 1, Box Elder.

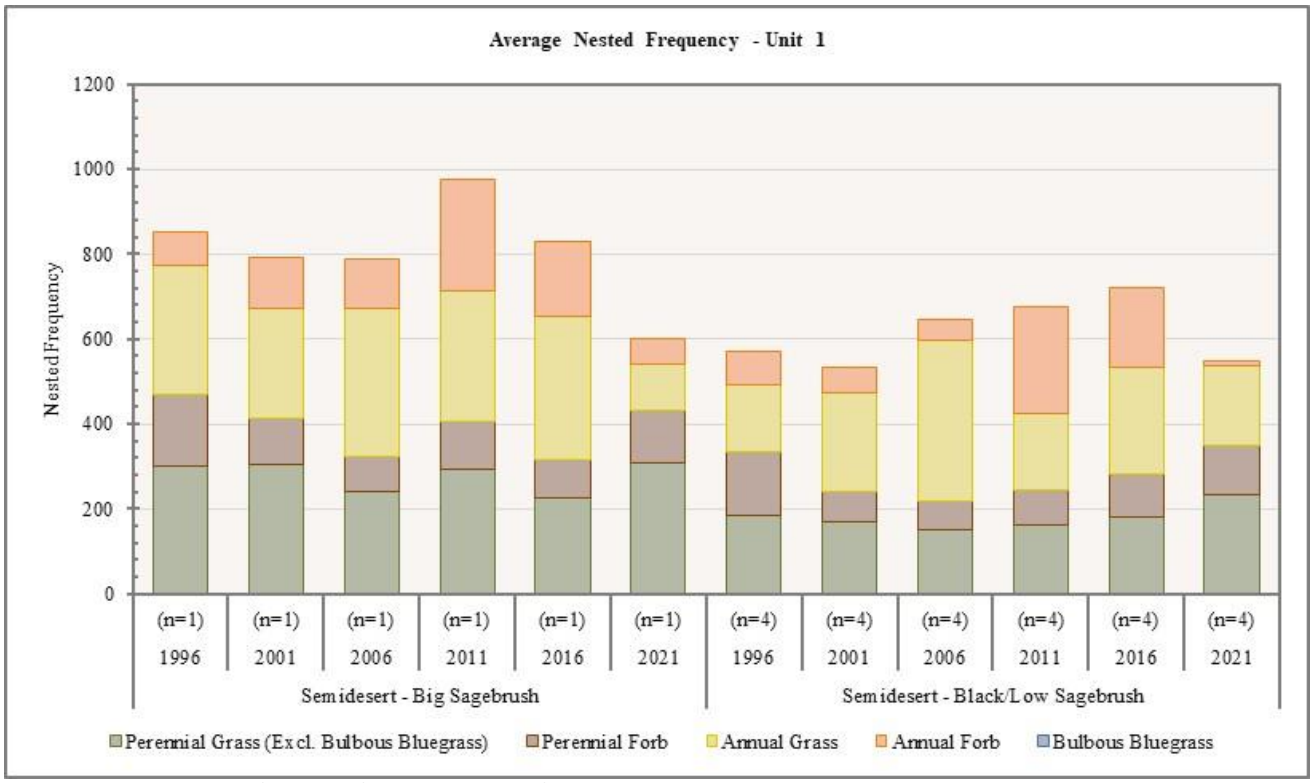


Figure 1.26: Average nested frequency of herbaceous species for Semidesert - Big Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 1, Box Elder.

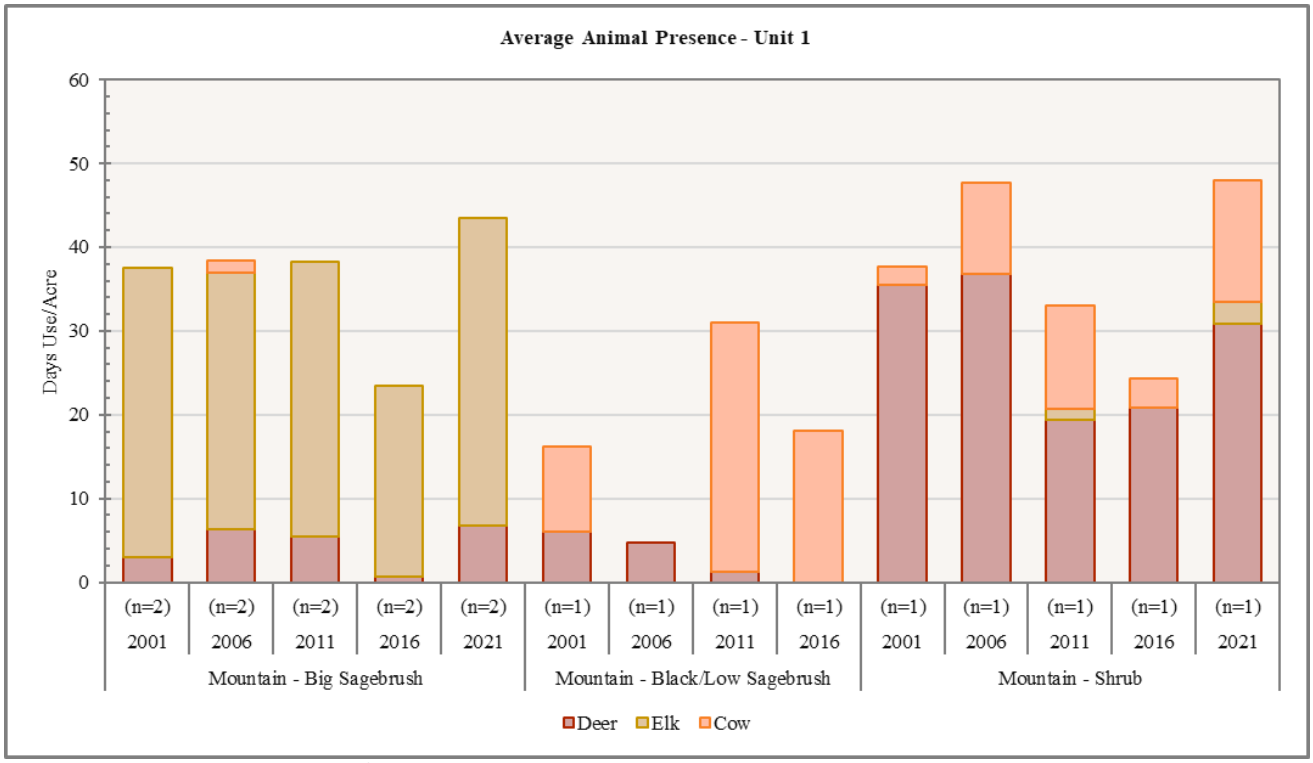


Figure 1.27: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 1, Box Elder.

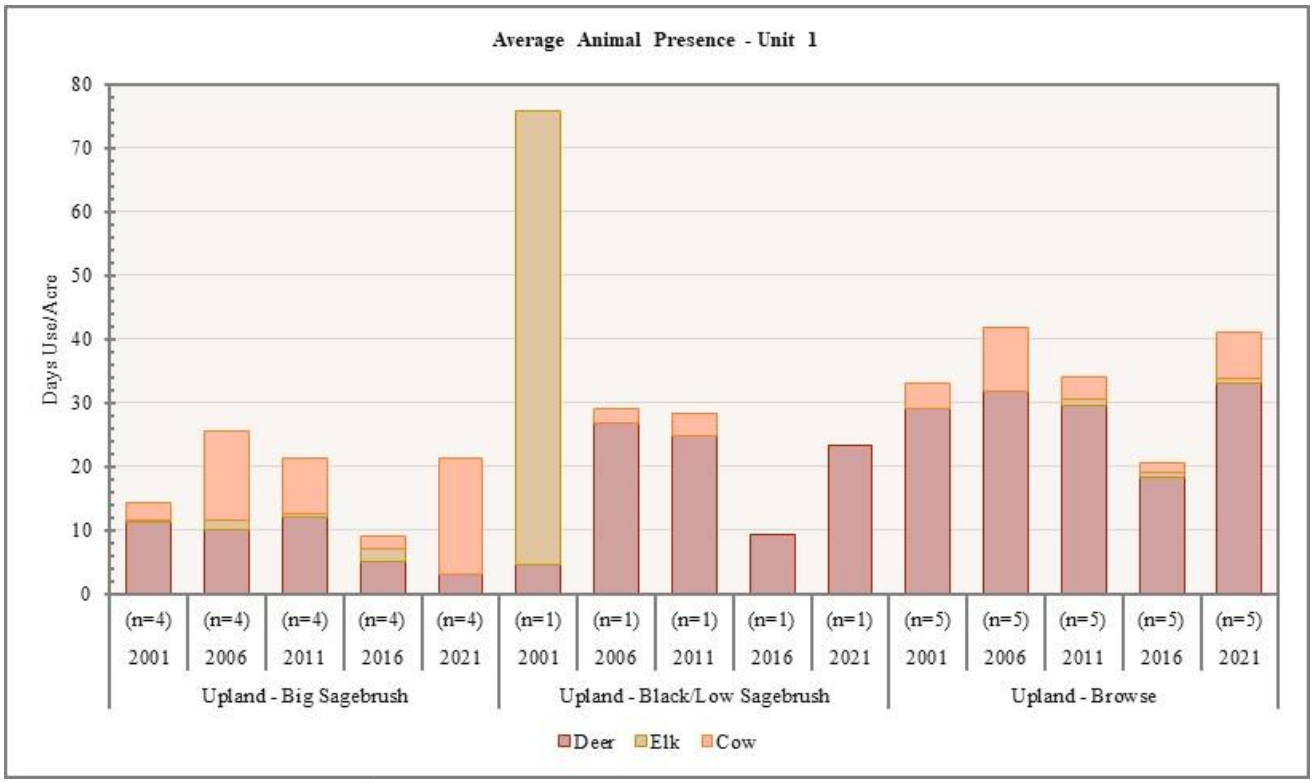


Figure 1.28: Average pellet transect data for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Browse study sites in WMU 1, Box Elder.

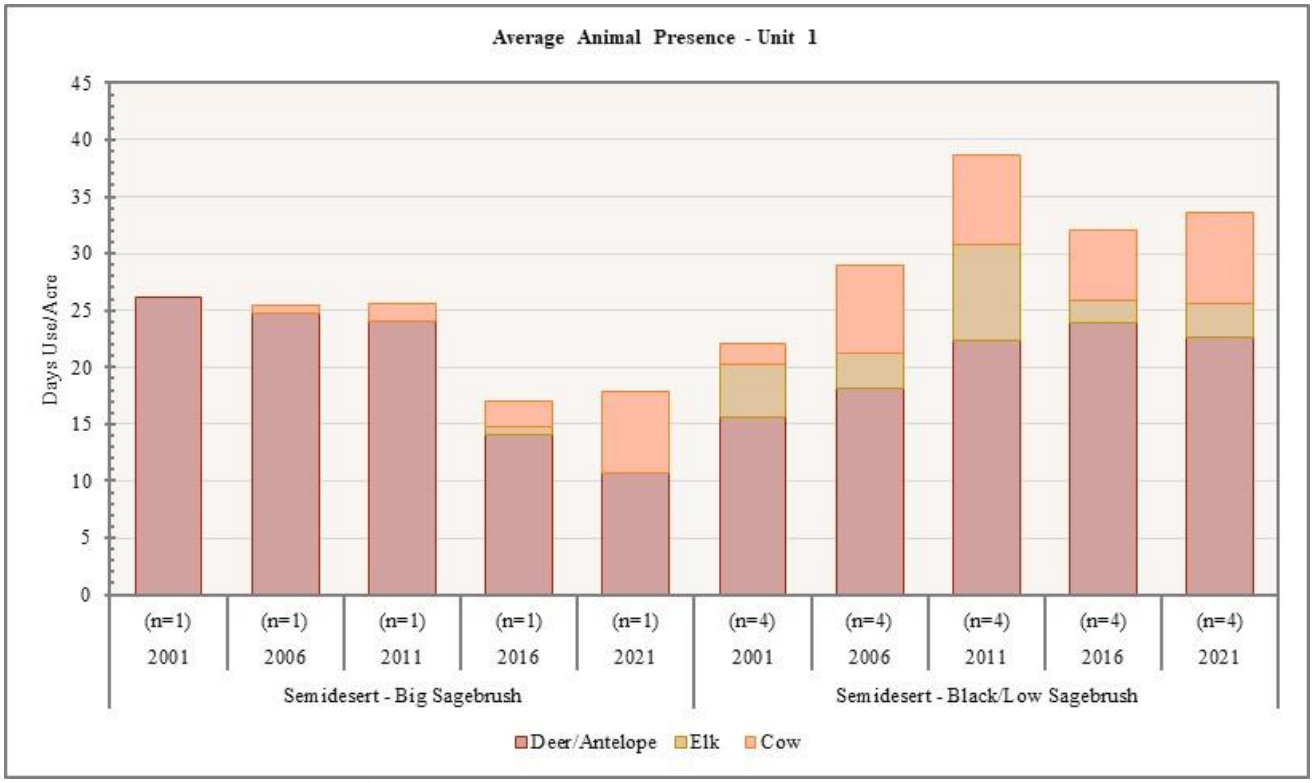
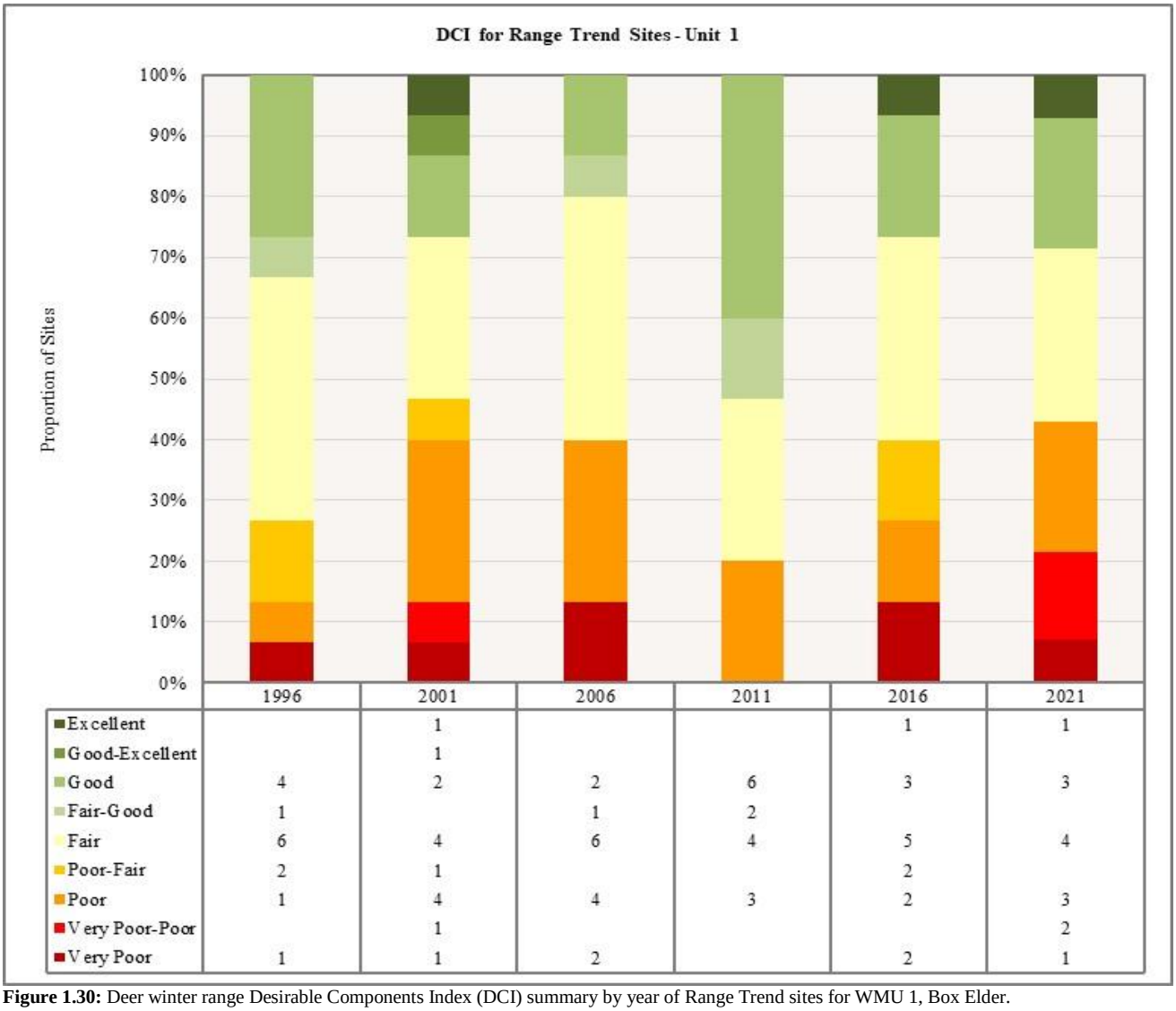


Figure 1.29: Average pellet transect data for Semidesert - Big Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 1, Box Elder.

Deer Winter Range Condition Assessment

The overall condition of deer winter range within the Box Elder management unit has remained stable and in poor-fair condition. Averaged unit conditions have declined slightly from fair in 1996 to poor-fair in 2021. Range Trend sites sampled within the unit that are considered consistently to be in poor condition include Bedke Spring, Cedar Hills, Mud Spring Basin, Raft River Narrows, and South Side Emigrant Pass. Factors contributing to very poor to poor winter conditions include the lack of browse cover and an undiversified age class structure among sagebrush. Bally Mountain, Chokecherry Springs, Devils Playground, Kimber Ranch, and Red Butte Exclosure are all sites with averaged conditions ranked as fair, and are the drivers for unit-wide conditions. Broad Hollow, Dake Pass, and Rosette consistently have good wintering conditions. Broad Hollow has had the highest degree of positive conditional change that followed a wildfire which allowed for increases in preferred browse and perennial grass covers (**Figure 1.30**, **Table 1.12**).



	1996	2001	2006	2011	2016	2021
Excellent		1			1	1
Good-Excellent		1				
Good	4	2	2	6	3	3
Fair-Good	1		1	2		
Fair	6	4	6	4	5	4
Poor-Fair	2	1			2	
Poor	1	4	4	3	2	3
Very Poor-Poor		1				2
Very Poor	1	1	2		2	1

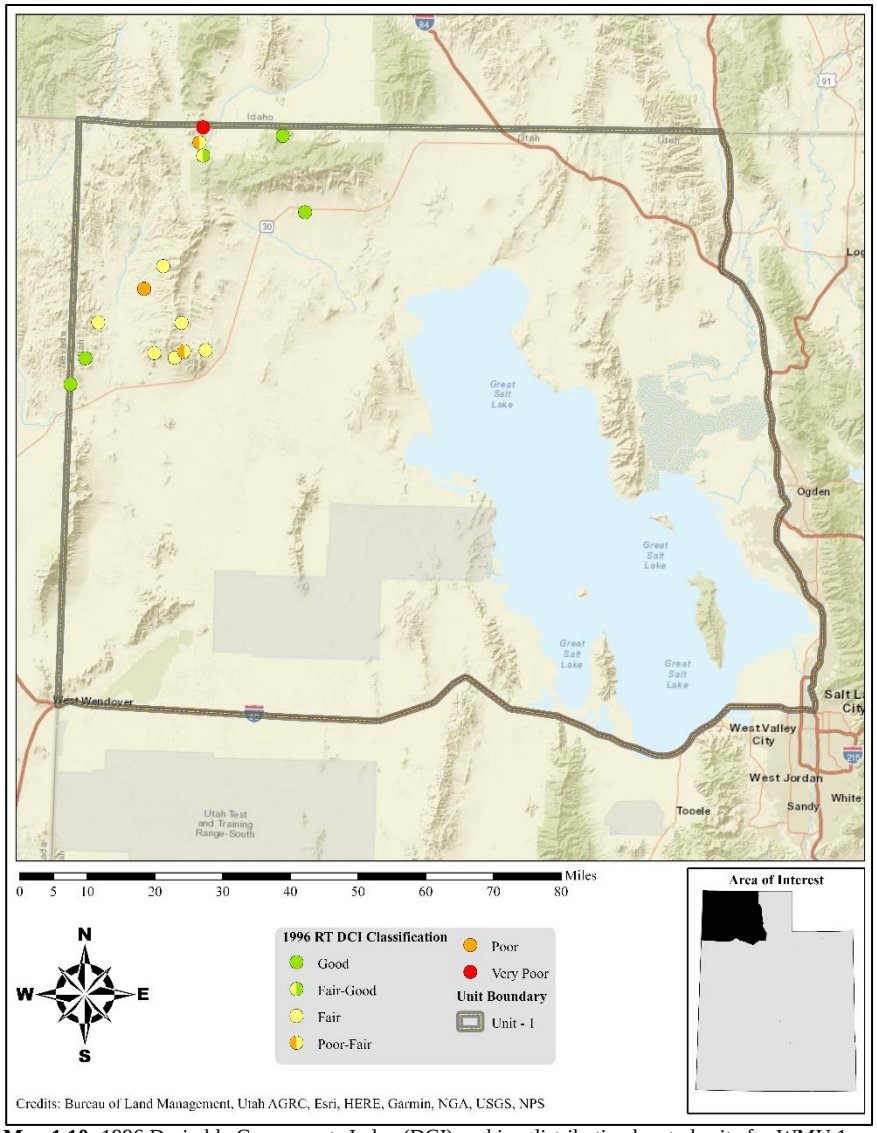
Figure 1.30: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 1, Box Elder.

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
01-2	1996	17.5	6.2	15	12.8	-2.4	3.4	0	**52.5**	**G**
01-2	2001	23	9.7	11.3	18.4	-2.7	3.7	0	**63.3**	**G-E**
01-2	2006	22.5	4.5	3.6	11.4	-4	1.9	0	**39.9**	**F**
01-2	2011	24.1	7.7	3.9	22.3	-8.5	3.8	0	**53.4**	**G**
01-2	2016	21.5	7.3	3.2	6.6	-6.9	3.5	0	**35.1**	**F**
01-2	2021	23.4	4.4	9	15.8	-0.2	4.7	0	**57**	**G**
01-4	1996	22.3	8.9	5.7	17.3	-4.6	10	-2	**57.6**	**F**
01-4	2001	30	10.2	1.7	17	-17.5	10	0	**51.4**	**P-F**
01-4	2006	30	7.1	2.5	26	-2.3	10	0	**73.3**	**G**
01-4	2011	30	9.9	1	29.8	-2.1	10	-2	**76.6**	**G**
01-4	2016	29.7	7.5	2.1	21.4	-14.7	10	-2	**53.9**	**F**
01-4	2021	26.6	7.5	6	29.5	-3.1	10	-2	**74.5**	**G**
01-5	1996	15.1	7.3	3.5	10.5	-0.4	2.1	0	**38.1**	**F**
01-5	2001	17	6.5	0.9	15.7	-4.3	1.7	0	**37.6**	**F**
01-5	2006	19	5.6	1	10.9	-6	0.3	0	**30.8**	**F**
01-5	2011	17.6	3.3	2.9	21.2	-2.2	3.3	0	**46.2**	**F-G**
01-5	2016	13.5	8.4	2.5	13.7	-11	1.7	0	**28.8**	**F**
01-5	2021	10.5	3.8	2.1	17.8	-0.3	0.7	0	**34.6**	**F**
01-6	1996	9.9	8.4	7.7	23.3	-1.7	4.2	0	**51.8**	**P-F**
01-6	2001	11	7.6	2.9	24.3	-7.1	5.6	0	**44.2**	**P**
01-6	2006	13.8	5.8	2	25.6	-2.8	9.4	0	**53.8**	**F**
01-6	2011	14.9	10.6	5.9	30	-1.1	10	0	**70.3**	**G**
01-6	2016	18.2	8.5	2.3	25	-3.6	10	0	**60.5**	**F**
01-6	2021	12.5	-0.8	0.4	27.7	-0.2	5.9	0	**45.4**	**P**
01-7	1996	23.1	12.5	12.1	2.7	-0.1	3.5	0	**53.8**	**F**
01-7	2001	25	9.2	2.9	3.9	-0.5	2.5	0	**43**	**P**
01-7	2006	30	8.3	1.8	3.7	-0.9	2.7	0	**45.5**	**P**
01-7	2011	30	9.6	1.7	1.4	-0.1	2.8	0	**45.4**	**P**
01-7	2016	30	8.7	1.4	2.9	-0.1	5.9	0	**48.8**	**P-F**
01-7	2021	28.6	-0.6	1.3	2.8	0	3.7	0	**35.9**	**VP-P**
01-8	1996	16.4	6	5.5	29.1	-4	6.7	0	**59.7**	**F**
01-8	2001	18.9	8.8	1.6	21.1	-9.6	2.1	0	**42.8**	**P**
01-8	2006	12	6.1	0.9	24.7	-20	2.2	0	**25.9**	**VP**
01-8	2011	18.3	8.7	3	26.2	-1.4	3.2	0	**57.8**	**F**
01-8	2016	8	4	2.3	22.1	-20	5.8	0	**22.2**	**VP**
01-8	2021	3.6	0	0	23.5	-1.3	0.8	0	**26.6**	**VP**
01-10	1996	30	7.4	6.3	3.3	-0.2	3.5	0	**50.3**	**G**
01-10	2001	26.6	8.4	5.2	2	-0.4	1.3	0	**43**	**F**
01-10	2006	30	6	2.6	2.5	-3.4	3.1	0	**40.8**	**F**
01-10	2011	22.3	7.5	7.4	3.9	-0.2	3.2	0	**44**	**F-G**
01-10	2016	30	7.2	6	7.9	-0.3	2.6	0	**53.3**	**G**
01-10	2021	1.7	0	0	28.7	-2	10	0	**38.4**	**F**
01-11	1996	19.8	10.5	7.5	3.4	-2.4	0.6	0	**39.4**	**F**
01-11	2001	20	8.1	7.9	2.5	-8.3	0.3	0	**30.5**	**F**
01-11	2006	19.6	5.8	4	8.2	-7.9	0.3	0	**30**	**F**
01-11	2011	18.3	9.2	2.4	5	-3.8	0.8	0	**31.8**	**F**
01-11	2016	21.5	7	1.4	8.5	-4	0.7	0	**35**	**F**
01-11	2021	5.4	0	0	22	-6.3	10	0	**31**	**F**
01-12	1996	28.6	11.2	9.7	10.9	-11.4	10	0	**59**	**F**
01-12	2001	30	8.2	4.7	11.1	-8	10	0	**55.9**	**F**
01-12	2006	30	12	5.8	9.6	-2.9	10	0	**64.6**	**F-G**
01-12	2011	30	12.9	10	16.2	-2	10	0	**77.1**	**G**
01-12	2016	30	13.7	5.5	3.4	-20	10	0	**42.6**	**P**
01-12	2021	30	6.1	2.4	27	-0.4	10	0	**75.1**	**G**
01-13	1996	18.2	13.8	15	3.9	-2.7	1.7	0	**49.9**	**P-F**
01-13	2001	12.1	12.9	15	4.1	-9.8	0.3	0	**34.6**	**VP-P**
01-13	2006	12	9.6	3.9	12.1	-12.4	1.6	0	**26.8**	**VP**
01-13	2011	13.6	13.8	14.1	7.2	-5.6	0.4	0	**43.4**	**P**
01-13	2016	20.6	11.9	2.9	7.4	-14	0.7	0	**29.4**	**VP**
01-13	2021	21.5	1.5	2.6	11.4	-2.7	0.3	0	**34.5**	**VP-P**

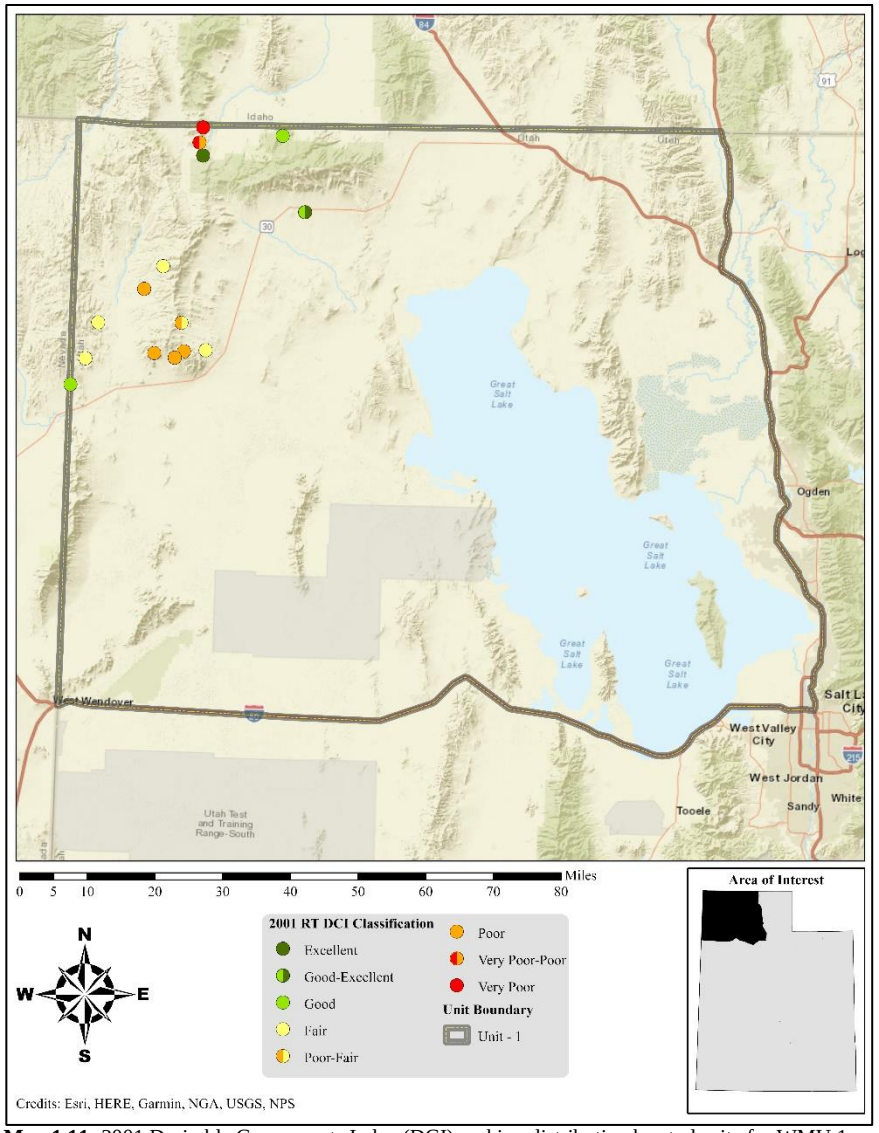
Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
01-14	1996	28.4	13.8	7.6	13	-9.2	9.9	0	**63.5**	**F-G**
01-14	2001	26.7	13.3	12.1	29.5	-4.8	10	0	**86.8**	**E**
01-14	2006	30	11.8	5.2	22.1	-5	10	0	**74**	**G**
01-14	2011	30	11.8	6.1	15.8	-2.4	7.8	0	**69.1**	**G**
01-14	2016	30	12.7	5.1	13.9	-20	9	0	**50.7**	**P-F**
01-14	2021	30	8.9	6.7	27.8	-0.9	10	0	**82.4**	**E**
01-15	1996	1.6	0	0	11	0	10	0	**22.6**	**VP**
01-15	2001	0	0	0	8.4	0	1	0	**9.4**	**VP**
01-15	2006	1.4	0	0	30	-2.5	9.6	0	**38.4**	**P**
01-15	2011	1.9	0	0	30	0	9	0	**40.8**	**P**
01-15	2016	8.1	14.6	15	30	-0.1	7.7	0	**75.2**	**G**
01-15	2021	3.6	0	0	30	0	10	0	**43.5**	**P**
01-18	1996	11.3	7.3	5.1	11	-0.2	10	0	**44.4**	**P**
01-18	2001	9.8	6.1	10	13.1	-2.6	10	0	**46.4**	**P**
01-18	2006	10.5	5.5	4	17.1	-5.3	10	0	**41.8**	**P**
01-18	2011	10.9	8.2	3.3	23.1	-3.2	10	0	**52.3**	**F**
01-18	2016	10.5	8.4	5.6	22.3	-12.6	10	0	**44.2**	**P**
01-18	2021	5.9	-0.9	1.3	30	-1.6	10	0	**44.6**	**P**
01-19	1996	17.9	13.8	9.6	24.6	0	10	0	**75.9**	**G**
01-19	2001	22.1	12.8	3.4	30	0	10	0	**78.3**	**G**
01-19	2006	3.4	0	0	30	0	10	0	**43.4**	**P**
01-19	2011	6.6	7.6	9.8	30	0	10	0	**63.9**	**F**
01-19	2016	7	12.8	15	30	-0.6	10	0	**74.2**	**G**
01-22	1996	23.3	7.1	7.4	12	0	6.3	0	**55.9**	**G**
01-22	2001	20.3	7.4	8	17	-0.2	1.6	0	**54**	**G**
01-22	2006	20.6	8.3	4.6	12.8	-9.6	2.3	0	**39.1**	**F**
01-22	2011	22.2	9	6.5	13.4	-0.7	1.3	0	**51.7**	**G**
01-22	2016	24.7	10.9	6	28.3	-2.4	4.4	0	**71.9**	**E**
01-22	2021	19.5	4.4	4.9	9.1	-0.6	1.7	0	**38.9**	**F**
01R-6	2005	18.6	4.5	2.6	15.2	-5.4	0.3	0	**35.8**	**F**
01R-6	2008	17.7	13.6	2.9	17.3	-0.7	2.2	0	**53**	**G**
01R-6	2013	26.2	14.9	15	21.6	-0.2	0.3	0	**77.8**	**E**
01R-6	2017	27.5	14.2	5.6	30	-2.4	0.3	0	**75.2**	**E**
01R-6	2021	25.9	13.1	12.9	30	0	0.5	0	**82.5**	**E**
01R-7	2005	11.5	2.7	5	3.2	-1.1	2.2	0	**23.4**	**P-F**
01R-7	2010	8.7	14.6	5.1	4.7	-9.1	10	0	**34.1**	**F**
01R-7	2013	7.6	15	15	1.8	-3	3.4	0	**39.8**	**F**
01R-7	2017	2.2	0	0	20.1	-14.6	0.1	0	**7.8**	**VP**
01R-10	2005	28.2	7.5	3.3	24	-3.2	5.3	0	**64.9**	**F-G**
01R-10	2008	23.5	-3.9	1	15.7	-0.1	2.9	0	**39.1**	**P**
01R-10	2013	27.3	10.4	7.5	21.4	-0.8	3.2	0	**69.1**	**G**
01R-10	2017	30	12.2	5.1	28.6	-15.9	6.8	0	**66.7**	**F-G**
01R-12	2008	5.5	0	0	15.1	-0.2	10	0	**30.4**	**VP**
01R-12	2009	10	0	0	30	-1.7	10	0	**48.3**	**P-F**
01R-12	2011	7.2	14.9	13.6	20.1	-0.1	10	0	**65.8**	**F-G**
01R-12	2016	23.5	14.7	9	29.3	-9	4.5	0	**72**	**G**
01R-12	2021	0.1	0	0	21.9	-0.2	3.8	0	**25.5**	**VP**
01R-13	2008	0	0	0	4.1	0	2.2	0	**6.2**	**VP**
01R-13	2011	0	0	0	17.6	-7.1	7.6	0	**18.2**	**VP**
01R-13	2016	0.4	0	0	30	-13.7	4.8	0	**21.5**	**VP**
01R-13	2021	0.6	0	0	30	-0.6	1.4	0	**31.3**	**VP**
01R-16	2010	30	14.8	15	26.1	-0.5	5.6	0	**91**	**E**
01R-16	2013	26.9	13.3	8.6	8.8	-0.4	7.3	0	**64.5**	**F-G**
01R-16	2017	30	13.5	3.8	25.6	-16	6.8	0	**63.6**	**F-G**
01R-16	2021	28.8	-2.8	2.1	21.7	-0.4	8.1	0	**57.4**	**F**
01R-17	2013	12	7.3	15	5.8	-0.1	1.9	-2	**39.9**	**P**
01R-17	2016	16	12.3	11.9	26.5	-5.7	9.1	0	**70**	**G**
01R-17	2021	2.3	0	0	30	0	1.4	0	**33.7**	**VP-P**

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
01R-18	2014	5.5	0	0	4.9	0	6.8	0	**17.1**	**P**
01R-18	2017	3.3	0	0	13.2	-5.7	10	0	**20.7**	**P**
01R-18	2021	9.7	14.9	14.1	21.1	-0.2	5	0	**64.7**	**G-E**
01R-19	2014	7.6	10.5	15	7.2	0	9.2	0	**49.6**	**G**
01R-19	2017	9	14	9.7	13.6	-4.2	10	0	**52.1**	**G**
01R-19	2021	7.1	11.4	15	14.1	-0.4	6.8	0	**54**	**G**
01R-21	2014	6.6	9.9	8.8	6	-0.2	3.2	0	**34.3**	**VP-P**
01R-21	2017	6.3	0	0	9.7	-10.3	10	0	**15.7**	**VP**
01R-22	2017	14.1	10.6	6.8	29.1	-7	10	0	**63.5**	**F-G**

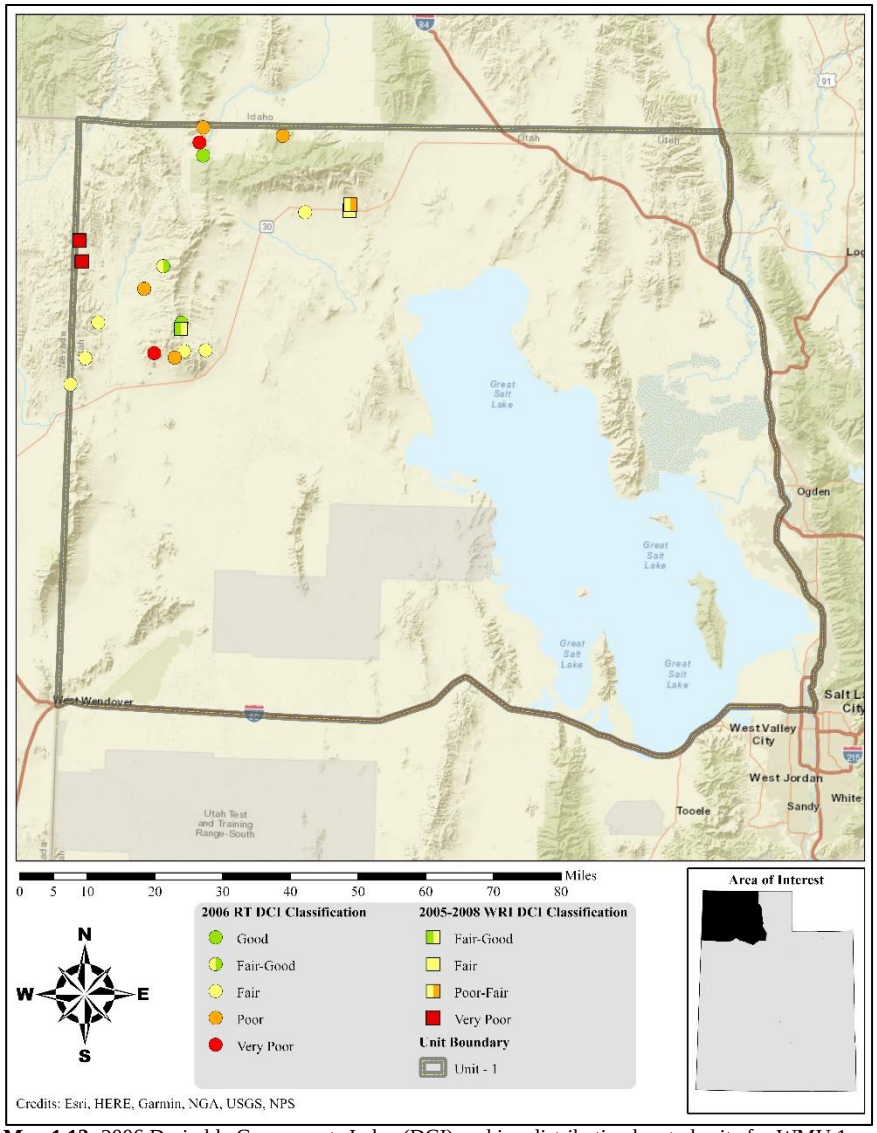
Table 1.12: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 1, Box Elder. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



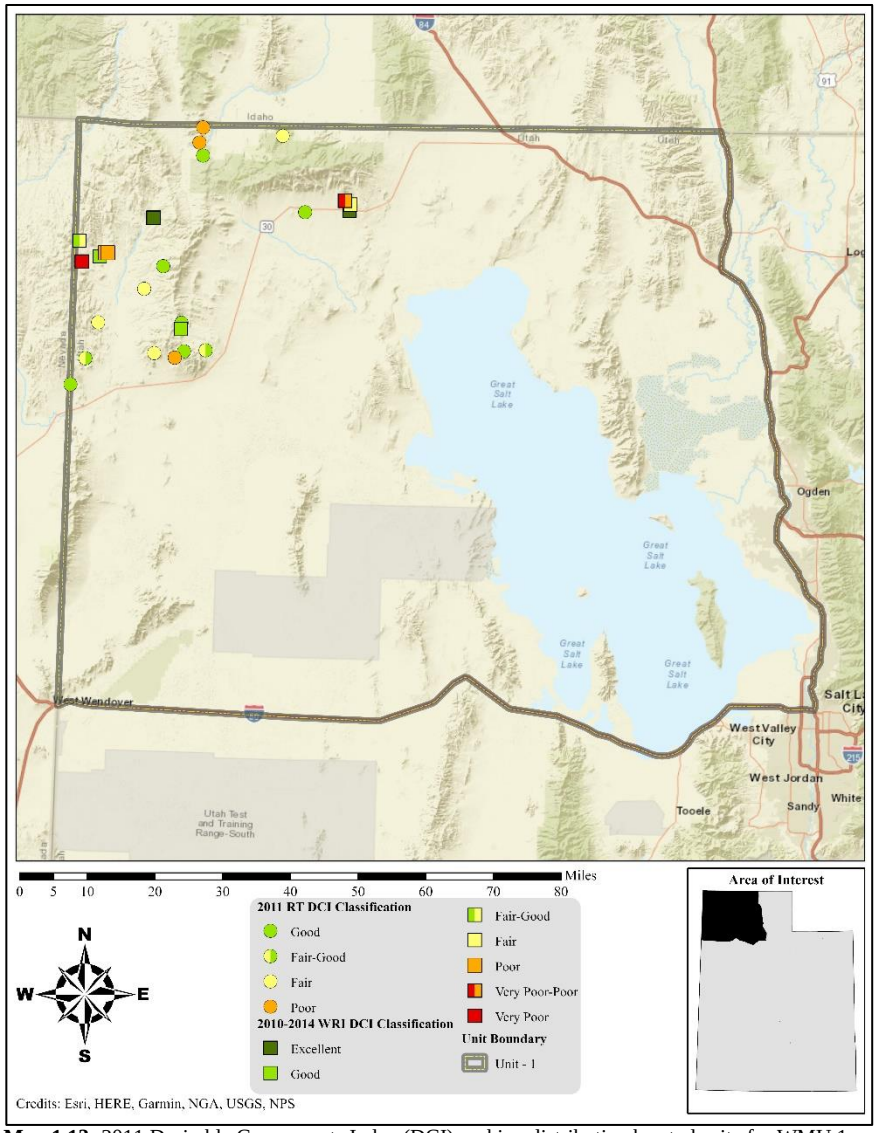
Map 1.10: 1996 Desirable Components Index (DCI) ranking distribution by study site for WMU 1, Box Elder.



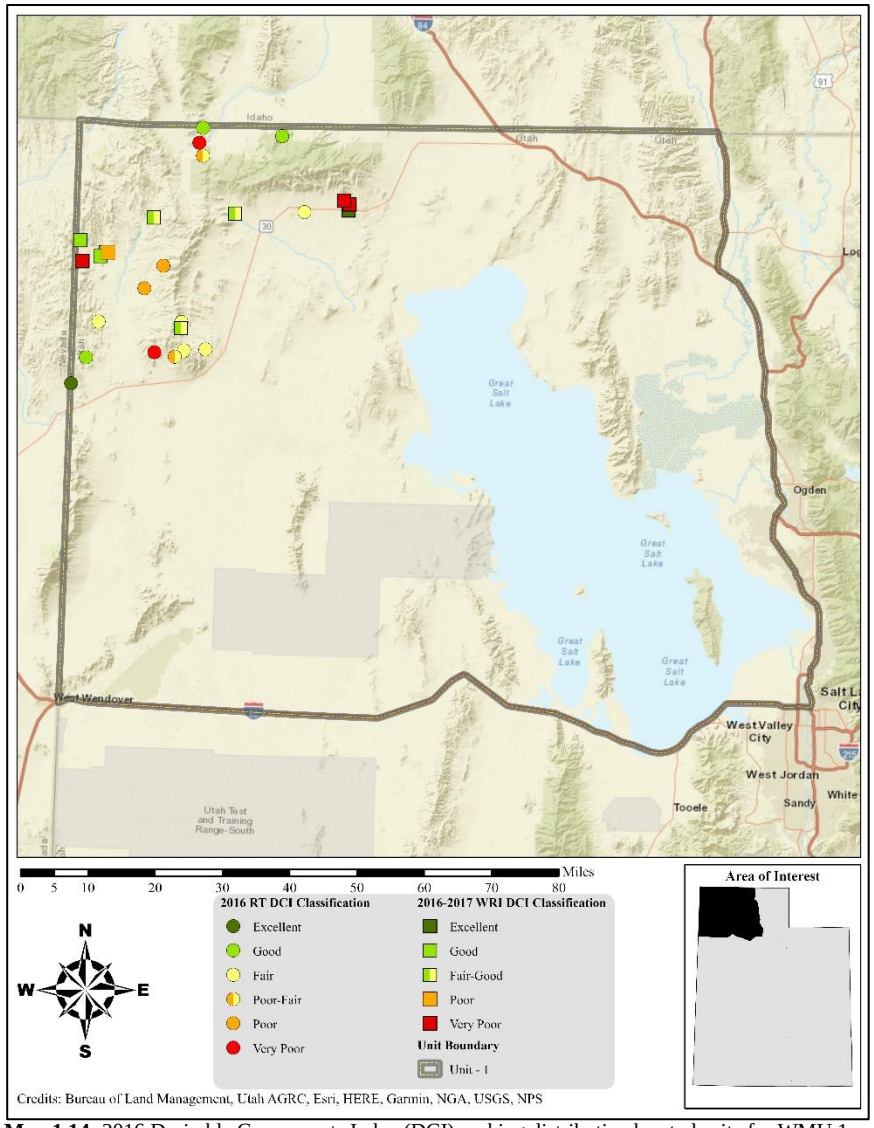
Map 1.11: 2001 Desirable Components Index (DCI) ranking distribution by study site for WMU 1, Box Elder.



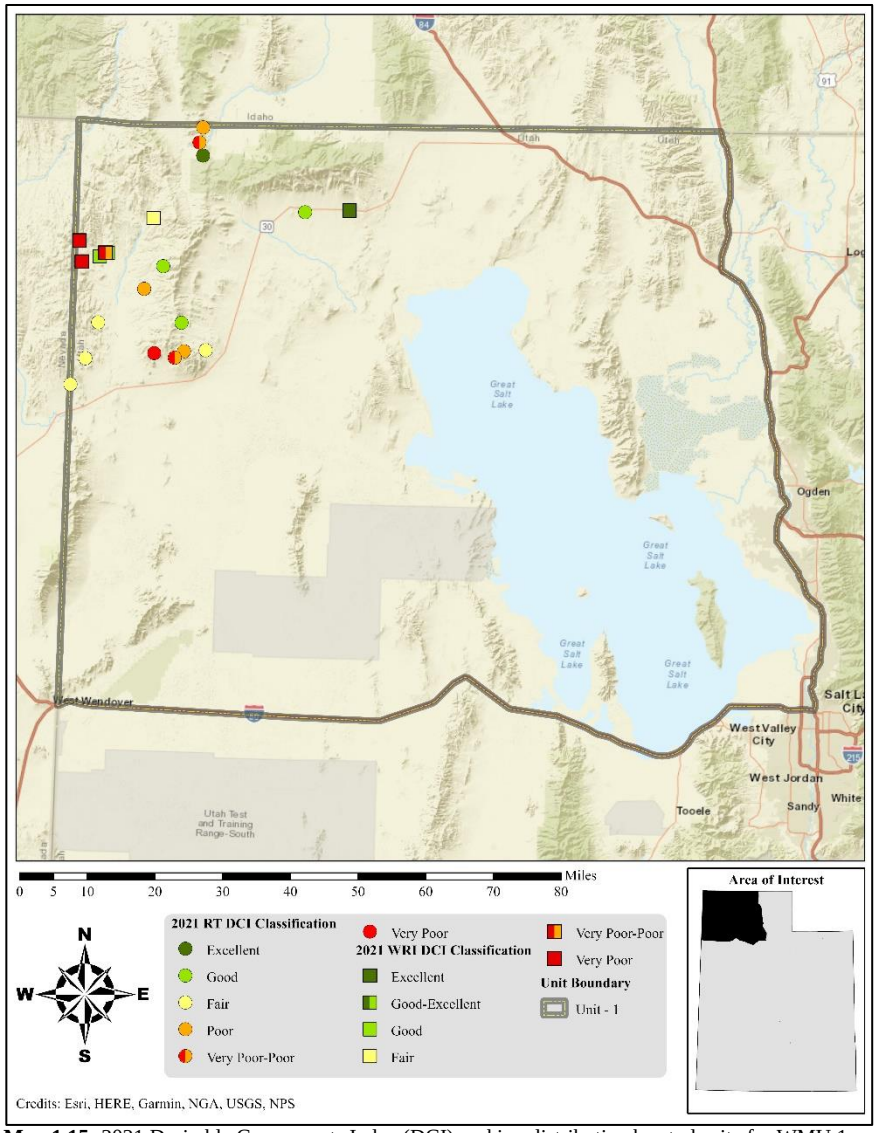
Map 1.12: 2006 Desirable Components Index (DCI) ranking distribution by study site for WMU 1, Box Elder.



Map 1.13: 2011 Desirable Components Index (DCI) ranking distribution by study site for WMU 1, Box Elder.



Map 1.14: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 1, Box Elder.



Map 1.15: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 1, Box Elder.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
01-2	Rosette	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-4	Chokecherry Springs	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
01-5	Devils Playground	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-6	Bovine Exclosure	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
01-7	South Side Emigrant Pass	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
01-8	Mud Springs Basin	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-10	Kilgore Basin	Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
01-11	Kimber Ranch	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
01-12	Red Butte Exclosure	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-13	Raft River Narrows	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-14	Broad Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-15	Cedar Hills	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
01-16	Nut Pine Hills	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-17	Clarks Basin	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
01-18	Bedke Spring	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
01-19	Bally Mountain	Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01-22	Dake Pass	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
01-23	Patterson Pass	None Identified		
01-24	Sheep Range Spring	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-2	Rattlesnake Fire Seeded	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-3	Rattlesnake Burn	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
01R-4	Coldwater 1	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
01R-6	Hereford 1	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-7	Hereford 2	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-10	Chokecherry	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
01R-12	Dairy Valley GIP 1	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
01R-13	Dairy Valley GIP 2	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
01R-14	Morris GIP	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-16	Kimbell Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
01R-17	West Grouse Creek	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
01R-18	Buckskin Spring	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
01R-19	Etna Reservoir	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-20	Pine Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-21	Indian Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
01R-22	Dove Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 1.13: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 1, Box Elder. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment**

Discussion and Recommendations

Mountain (Big Sagebrush)

The studies that are within the Mountain (Big Sagebrush) ecological sites are considered to generally be in good condition for deer summer range on the Box Elder Management Unit. These communities support good shrub populations that can provide valuable browse for wildlife. Annual grasses are not typical for this ecological type, particularly the introduced species cheatgrass (*Bromus tectorum*). However, cheatgrass is present on the Sheep Range Spring site, and poses a high-level threat. In high amounts, annual grasses increase fuel loads, exacerbate the risk of wildfire, and may alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). Encroachment of pinyon (*Pinus sp.*) and juniper (*Juniperus sp.*) is occurring in low amounts on the Sheep Range Spring study, and the site is considered to be within Phase I of woodland succession. Presence of pinyon and juniper trees can reduce shrub and herbaceous understory health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000).

Although annual grasses are present in moderate amounts as of 2021 and likely do not require immediate intervention, treatments such as herbicide application may be appropriate if they increase in cover and abundance over time. It is recommended that when necessary, work to prevent and reduce encroaching tree species should begin or continue, and care should be taken to select methods that will not increase annual grass cover.

Mountain (Black/Low Sagebrush)

The Mountain (Black/Low Sagebrush) ecological potential is represented by the Bally Mountain study, which is generally considered to be in good condition for deer winter range on the unit. This community supports sagebrush populations that provide vital browse for wildlife. The herbaceous understory is in good condition, with only a small amount of cheatgrass being noted. While currently in Phase I of woodland succession, the area is likely at low risk of future encroachment. If not addressed, elevated conifer presence can reduce shrub and herbaceous health and productivity (Miller, Svejcar, &

Rose, 2000). Pellet transect data indicates moderate use by cattle may be occurring on the on the Bally Mountain site, which may pose a medium-level threat. Overuse by livestock can lead to decreased vigor and diversity in the shrub and herbaceous understory (Butler, et al., 2003; Jornada & NRCS, 2022; Payne, Lane, & Cox, 2022).

While the conifer community at this particular study is currently small, it is recommended that work to prevent future pinyon encroachment (e.g. bullhog, chaining, lop and scatter, etc.) begin if and when necessary on these communities. Treatments to reduce annual grass loads are likely not needed for the Bally Mountain site and its surroundings. Finally, closer examination of the Bally Mountain study and surrounding areas is recommended to help determine if overuse by cattle may be occurring in the area.

Mountain (Shrub)

Currently, Clarks Basin represents the Mountain (Shrub) ecological potential, and is generally considered to be in poor condition for deer summer range on the unit. This area supports populations of mixed shrubs and a herbaceous community vital to wildlife. The herbaceous understory is in good condition, with only a single year where cheatgrass was noted to have a significant amount of cover. The potential for cheatgrass invasion is likely high, and may elevate the risk of wildfire and altered wildfire regimes in the future (Balch, D'Antonio, & Gómez-Dans, 2013). In addition, the effects of drought were observed on this study through increased shrub decadence and poor vigor in 2021. Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

Continued monitoring is needed to assess the annual grass population in this area. Annual grasses are present in low amounts as of 2021 and likely do not require intervention at this time. If cheatgrass becomes a dominant component, treatments such as herbicide application or changes in grazing management may be appropriate. Further monitoring of this study site is recommended for additional reasons: it may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife directly with water sources (e.g. guzzler or other catchment method, although springs are common throughout the area of Clarks Basin). It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003).

Upland (Big Sagebrush)

The studies within these mid-elevation sagebrush communities are generally considered to be in very poor to poor condition for deer winter range. These community types support sagebrush, which provide valuable browse for wildlife in winter. A few of the sites are currently at low risk of conifer encroachment, which can reduce shrub and herbaceous understory productivity (Miller, Svejcar, & Rose, 2000). There are currently introduced perennial grasses present on some sites, specifically crested wheatgrass on the Cedar Hills, Bedke Spring, and Mud Springs Basin studies. While they provide forage, introduced perennial grasses can be intrusive and reduce the prevalence and abundance of more desirable native grasses and forb species. In addition, introduced perennial grasses can outcompete establishing, young shrubs (Mack, et al., 2000). Introduced annual grasses are a concern on many of these studies, specifically Mud Springs Basin, Raft River Narrows, Broad Hollow, and Bedke Spring. The invasive annual grass species cheatgrass is a high-level threat and dominates the herbaceous understory on a majority of these sites. High amounts of cheatgrass can increase fuel loads and exacerbate the risk of wildfire (Mack, et al., 2000). Pellet transect data indicates that moderate use by cattle is occurring on the Mud Springs Basin study, posing a high-level threat. Overuse by livestock can lead to decreased vigor and diversity in the shrub and herbaceous understory (Butler, et al., 2003; Jornada & NRCS, 2022; Payne, Lane, & Cox, 2022). In addition, the effects of drought were observed on Bedke Spring study through increased shrub decadence and poor vigor in 2021. Prolonged periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

While the conifer community around the Cedar Hills site was removed by wildfire, it is still recommended that monitoring and work to reduce conifer presence continue in these communities that still remain at risk of encroachment. If reseeding is necessary to restore native species, care should be taken in species selection and preference should be given to native species when possible. The implementation of treatments to reduce annual grass loads is strongly recommended for these sites. Close examination of the Mud Springs Basin study and surrounding area is recommended to

help determine if overuse by cattle may be occurring within the Red Butte allotment and associated pastures. Further monitoring of the Bedke Spring study is recommended, as it may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife directly with water sources (e.g. guzzler or other catchment method). It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003).

Upland (Black/Low Sagebrush)

Currently, South Side Emigrant Pass represents the Upland (Black/Low sagebrush) ecological potential, and is generally considered to be in poor condition for deer winter range on the unit. Communities of this ecological type often support sagebrush populations that provide vital browse for wildlife. The herbaceous understory is also in poor condition, but with only a small amount of cheatgrass being observed. While currently only in Phase I of woodland succession, this study is at risk of encroachment in the future, which can reduce shrub and herbaceous health and productivity of the community if not addressed (Miller, Svejcar, & Rose, 2000). Finally, the effects of drought were observed on this study site in 2021. Long periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

While the conifer community at this particular study is currently small, it is recommended that work to prevent future pinyon-juniper encroachment (e.g. bullhog, chaining, lop and scatter, etc.) begin if necessary in these communities. Continued monitoring is also needed to assess the annual grass population. Although annual grasses are present in low amounts as of 2021 and likely do not require intervention at this time, treatments such as herbicide application or changes in grazing management may be appropriate if cheatgrass increases in cover and abundance. Further monitoring of this study site is recommended, as it may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife directly with water sources (e.g. guzzler or other catchment method). It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003).

Upland (Browse)

The studies within the mid-elevation sagebrush communities are generally considered to be in good condition for deer winter range. These site communities support large sagebrush populations which provide vital browse for wildlife in winter. All sites are at risk of conifer encroachment with Bovine Exclosure being most at risk, as it is considered to be transitioning from Phase I to Phase II of woodland succession. Conifer encroachment can reduce shrub and herbaceous understory productivity as it advances (Miller, Svejcar, & Rose, 2000). Introduced annual grasses are a concern on many of these studies, specifically Chokecherry Springs, Broad Hollow, and Red Butte Exclosure. Higher amounts of cheatgrass increase the fuel loads and heighten the risk of wildfire and community transition from a shrub dominated community to one dominated by annual grass (Balch, D'Antonio, & Gómez-Dans, 2013).

It is recommended that monitoring and work to reduce conifer encroachment continue in these communities. Further monitoring of annual grasses is likely necessary to determine extent of invasion in future sample years. Although annual grasses are present in low to moderate amounts as of 2021, future treatments such as herbicide application or changes in grazing management may be appropriate if they increase in cover and abundance in the future. When reseeding is necessary to restore native species, care should be taken in species selection and preference would be given to native species when possible. Although tree encroachment is likely not an immediate concern for most sites, the Bovine Exclosure study area is likely a good candidate for future treatments (e.g. bullhog) to manage pinyon and juniper encroachment.

Semidesert (Big Sagebrush)

The Rosette study represents the lower elevation semidesert ecotype that supports, or has the potential to support, Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) communities. This study is generally considered to be in good condition for deer wintering range habitat on the Box Elder management unit. Cheatgrass poses a high-level threat to community stability, as increased amounts of cheatgrass can intensify fuel loads and raise the potential for

wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). Although the threat level is low, this ecotype is prone to encroachment by pinyon and juniper trees, and the study itself is considered to be in Phase I of woodland succession. Presence of pinyon and juniper trees can reduce shrub and herbaceous understory health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000).

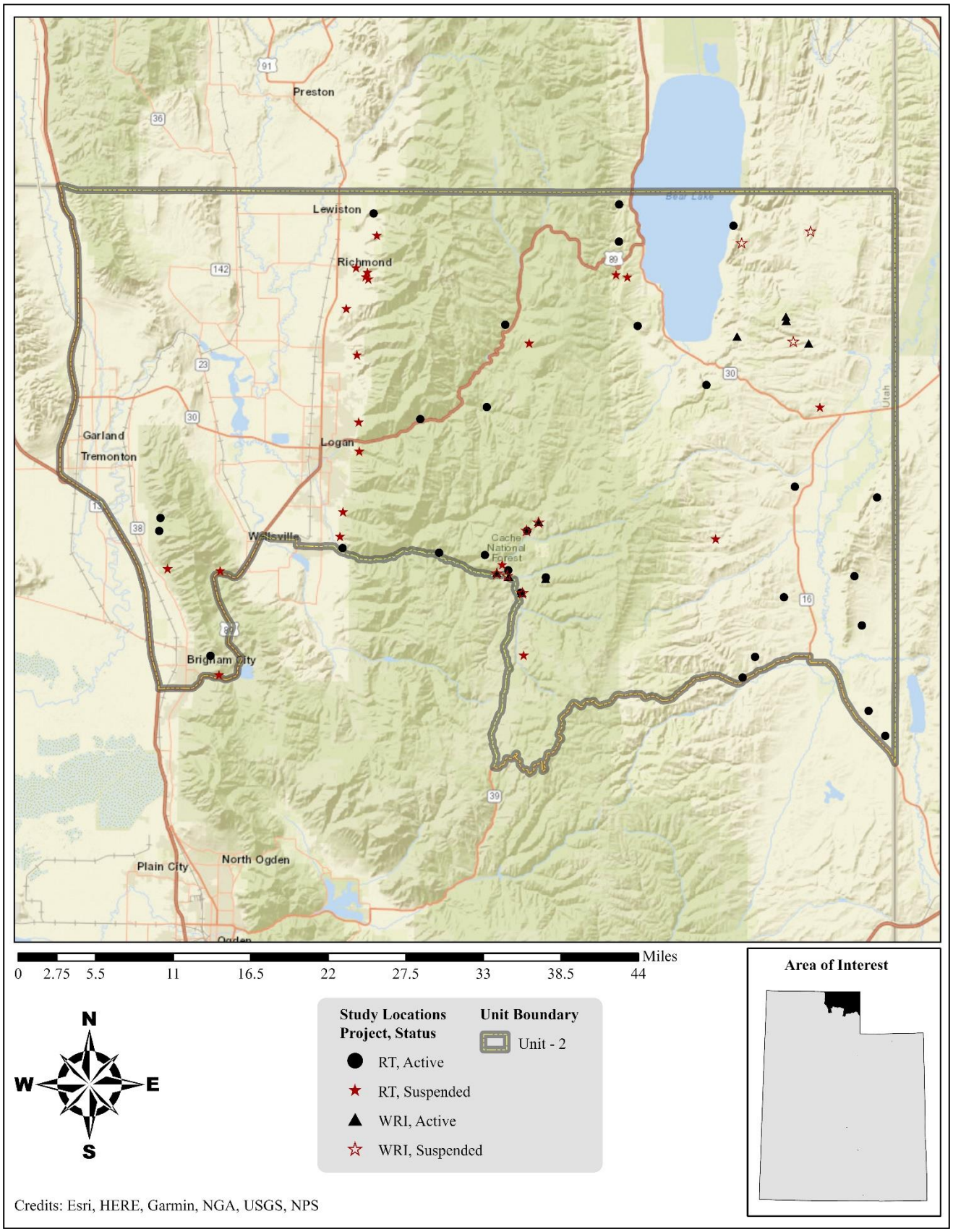
Treatments and considerations for this ecological type are few, but crucial in maintaining community function and avoiding subsequent ecological transition. It is strongly recommended that areas with high amounts of cheatgrass undergo treatments to reduce annual grass, which may include chemical control. Work to prevent and slow pinyon-juniper encroachment through bullhog, chaining, lop and scatter, etc. are needed should these communities continue to be encroached; care should be taken to select methods that will not increase annual grass loads.

Semidesert (Black/Low Sagebrush)

This lower elevation semidesert ecological type is represented by the Devils Playground, Kilgore Basin, Kimber Ranch, and Dake Pass sites, which have the potential to support robust black sagebrush and shadscale saltbush communities. These sites are considered to be in fair condition for deer wintering range habitat on this management unit. The herbaceous understories of these studies provide a fair amount of cover. However, most sites are dominated by the introduced annual grass species cheatgrass, and are therefore at high risk of increased fuel loads and wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). Introduced perennial grass species are also present in moderate amounts. These grass species provide valuable forage, but can be aggressive at higher elevations and may have the potential to lead to a reduction in prevalence and abundance of other more desirable native grass and forb species, in addition to competing with younger, establishing shrubs (Mack, et al., 2000). Due to wildfire, Kimber Ranch and Kilgore Basin have effectively had the pinyon-juniper cohort removed from their communities. The remaining study sites are considered to be in Phase I of woodland succession and are at low risk for future encroachment if left untreated. Pellet transect data indicates that moderate use by cattle is occurring on the Kilgore and Dake Pass studies, which poses a high-level threat. Overuse by livestock can lead to decreased vigor and diversity in the shrub and herbaceous understory (Butler, et al., 2003; Jornada & NRCS, 2022; Payne, Lane, & Cox, 2022). In addition, the effects of drought were observed on the Dake Pass study through increased shrub decadence and poor vigor in 2021. Long periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014).

Continued monitoring of this ecological site is recommended. It is strongly encouraged that areas with high amounts of cheatgrass undergo treatments to reduce annual grass, which may include chemical control. If reseeding should be necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native grass species if possible. Further tree-removing treatments (e.g. bullhog, chaining, lop and scatter, etc.) may be advisable on the Devils Playground and Dake Pass study areas if infilling increases in the future. Closer examination of the Kilgore Basin and Dake Pass studies and their surrounding areas is recommended to help determine if high cattle use may be occurring on the Kilgore allotment, and if cattle use may be approaching higher thresholds on the U & I allotment. Further monitoring of the Dake Pass study area is recommended, as it may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife directly with water sources (e.g. guzzler or other catchment method). It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003).

2. WILDLIFE MANAGEMENT UNIT 2 – CACHE



WILDLIFE MANAGEMENT UNIT 2 – CACHE

Boundary Description

Cache, Rich, Weber, and Box Elder counties - Boundary begins at the Utah-Idaho state line and I-15; south on I-15 to US-91; northeast on US-91 to SR-101; east on SR-191 to Hardware Ranch and USFS Road 054 (Ant Flat); south on USFS 054 to SR-39; east on SR-39 to SR-16; southeast on SR-16 to the Utah-Wyoming state line; north along this state line to the Utah-Idaho state line; west along this state line to I-15.

Management Unit Description

Geography

The Cache Management Unit can be divided into three main areas, which are isolated from one another to some extent. The first area is comprised of the Wellsville Mountains and their northern extension, Clarkston Mountain. The eastern half, mostly agricultural land in Cache Valley, does not receive much use by wintering deer. The second area consists of Cache Valley with its summer range on the Cache National Forest to the east; big game summer in the forest and use the winter ranges in the canyons and upper benches of the valley. The third and final area is Rich County, which includes a vast area of private and public rangeland on the east side of the Cache National Forest, extending to the Wyoming state line. Prior to 1993, these three areas were managed as separate deer herd units, but these were combined in 1993 to make Wildlife Management Unit 2 and are now managed as sub-units.

The Wellsville Mountains have remained relatively inaccessible because of steep topography; rising abruptly from the valley floor, the ridge of these mountains reaches over 9,300 feet in elevation. The upper limit for normal winter range is generally 7,000 feet, but during severe winters, that upper limit decreases to about 6,000-6,500 feet; in some canyons, the upper limit drops to 6,000 feet and excludes the north slopes. Box Elder Canyon reaches a low limit at 5,400 feet with the lower limit following an elevation of 4,400 feet. Most deer summer on the east side of the Wellsville Mountains and migrate to the west side each fall for winter range. Coldwater Canyon is the most notable concentration area for deer, and there is some migration from the Mantua-Willard herd unit. Most of the deer that winter on Clarkston Mountain range also summer on the Caribou National Forest in Idaho.

The majority of the deer range (along with the largest deer herd) is within the Cache County portion of the unit; most of this herd summers at higher elevations in the Wasatch-Cache National Forest west of the Wasatch Range summit. Most of the winter range is also on Forest Service land. The south-facing slopes of Blacksmith Fork, Logan, Dry, Providence, and Millville canyons are all important wintering areas.

The Rich County portion of the Cache deer herd unit, located on the eastern face of the Wasatch Range, is topographically similar to the western face. However, the drainages of Swan Creek, Garden City Canyon, Jebo Canyon, Cottonwood Canyon, and Temple Canyon are not as deep as those on the western face. Elevation in this portion ranges from 5,900 feet at Bear Lake to 9,114 feet on Swan Peak. Randolph and Woodruff are the principal municipalities located in Rich County: these towns are located on a strip of private land along the Bear River. Much of the lower country is privately owned and is grazed or farmed. The upper limit of the winter range begins at about 8,000 feet at the Idaho border and gradually descends to 6,000 feet at Cottonwood Canyon; the lower limit generally follows the 6,000-foot contour.

Climate Data

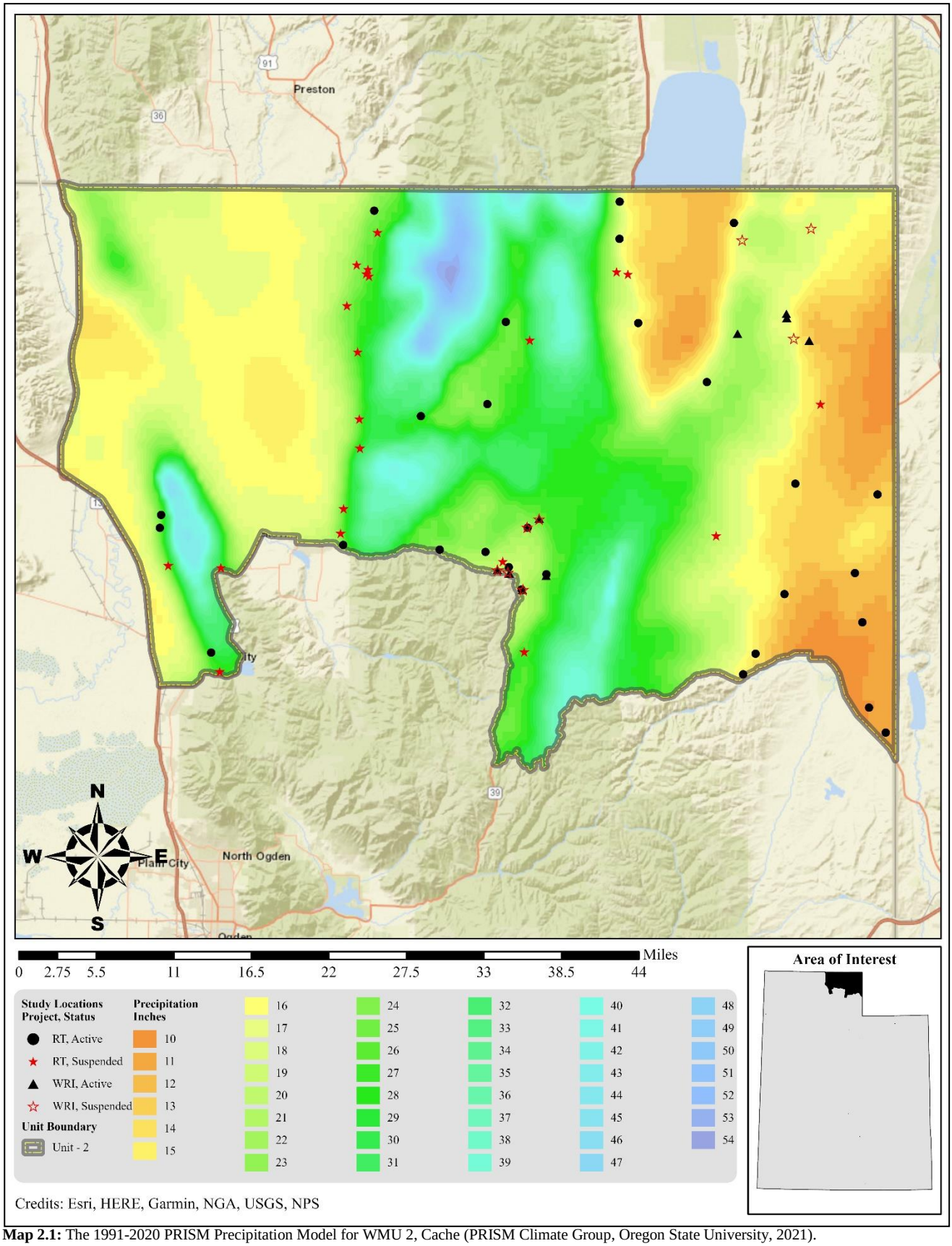
The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 10 inches along portions of the Utah-Wyoming border to 54 inches on the peaks of the Bear River Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within 11-26 inches of precipitation (**Map 2.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the North Central and Northern Mountains divisions (Divisions 3 and 5) (Time Series Data, 2022).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought in 1992, 2000-2003, 2007, 2012-2015, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1993,

1995, 1997-1998, 2005, and 2011 (**Figure 2.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2001-2003, 2007, 2012-2013, 2015; and 2020-2021; moderately to extremely wet years were displayed in 1991, 1993, 1995, 1997-1998, and 2005 (**Figure 2.1b**).

The mean annual PDSI of the Northern Mountains division displayed years of moderate to extreme drought from 2000-2003, 2012-2013, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1995, 1997-1998, 2005, and 2011 (**Figure 2.2a**). The mean spring (March-May) PDSI displayed moderate to extreme drought in 1992, 2000-2004, 2012-2014, 2018, and 2021; moderately to extremely wet years were displayed from 1995-1996, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2013, and 2020-2021; moderately to extremely wet years were displayed in 1995, and 1997-1998 (**Figure 2.2b**) (Time Series Data, 2022).



Map 2.1: The 1991-2020 PRISM Precipitation Model for WMU 2, Cache (PRISM Climate Group, Oregon State University, 2021).

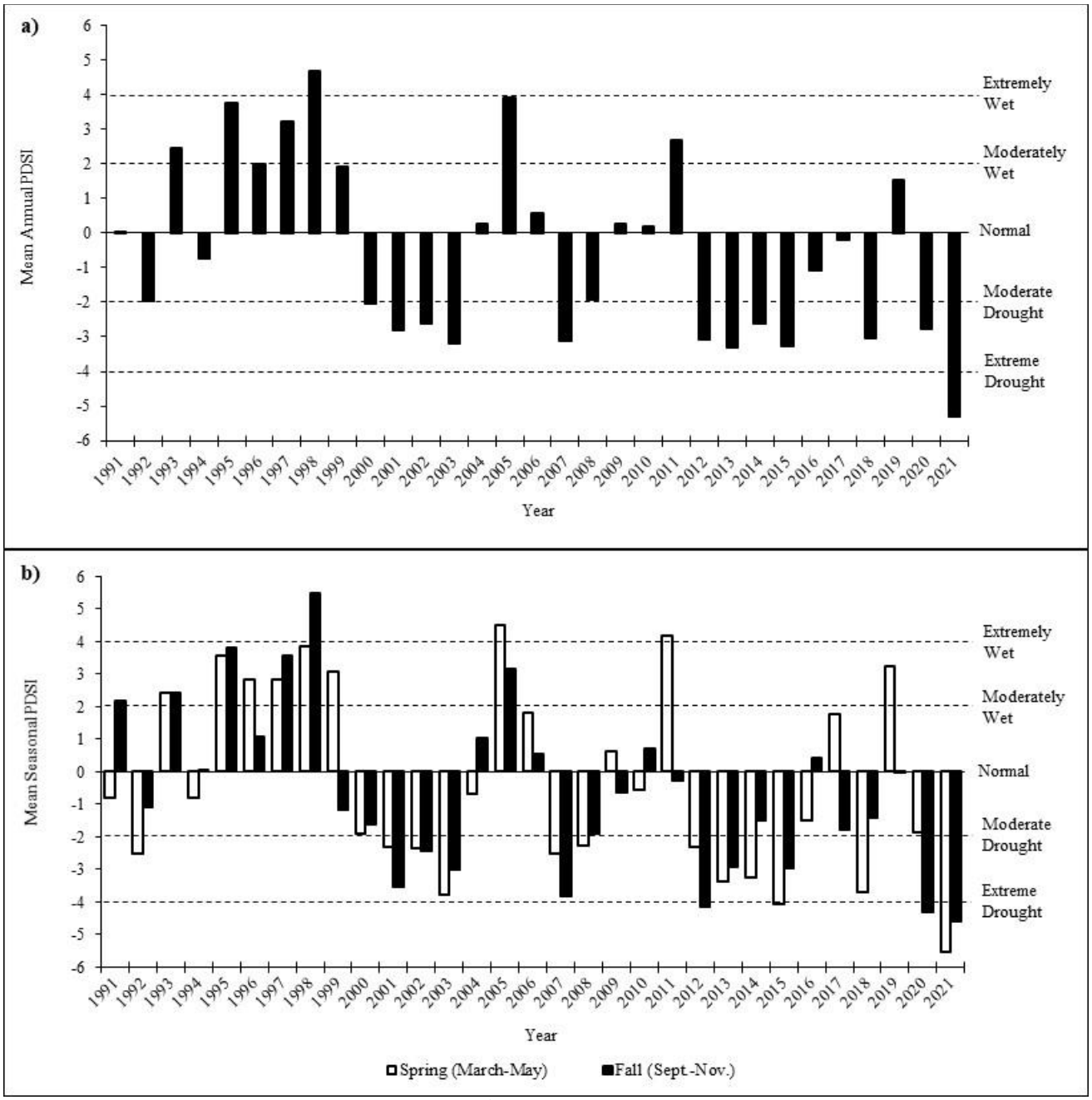


Figure 2.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

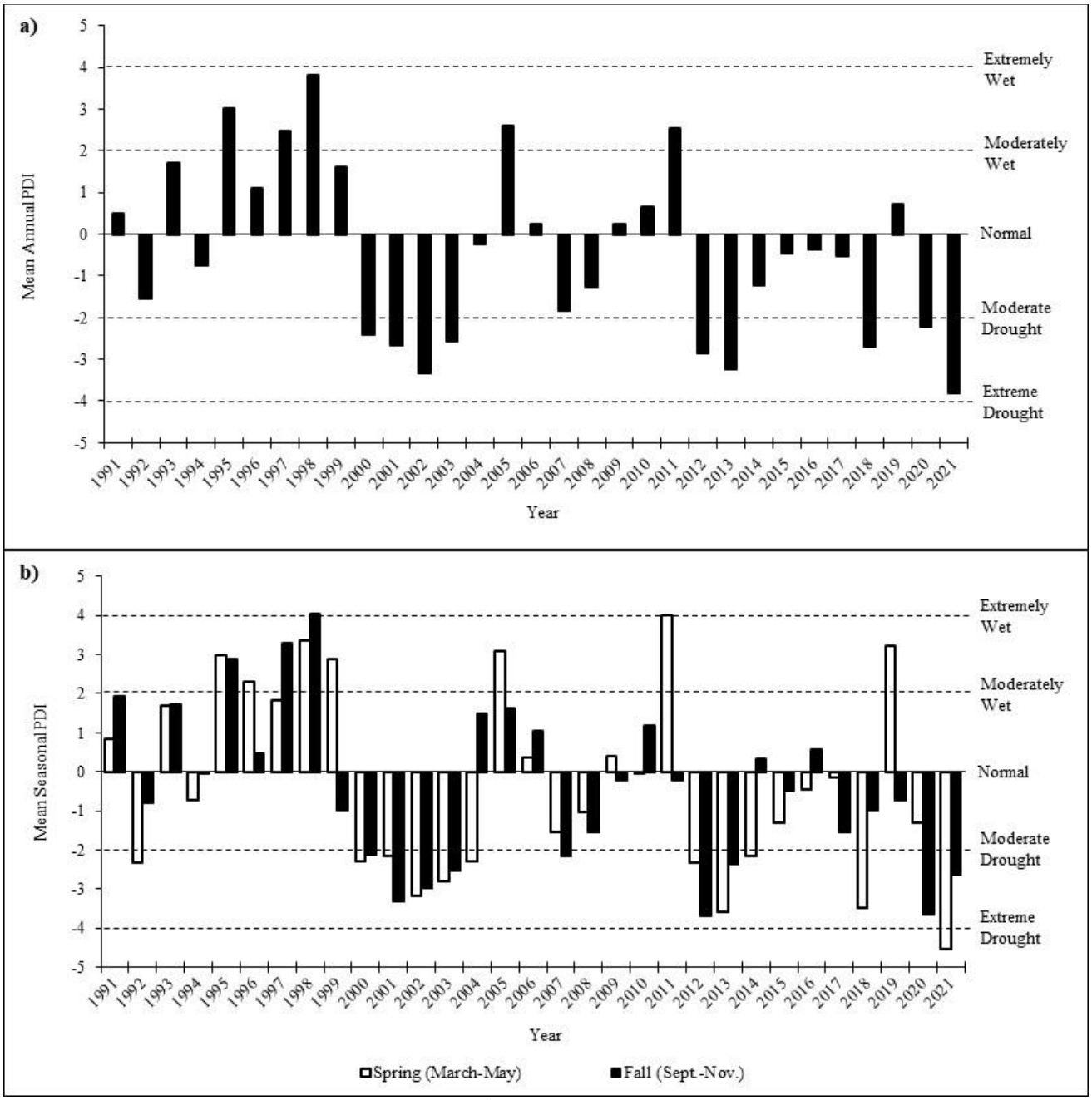
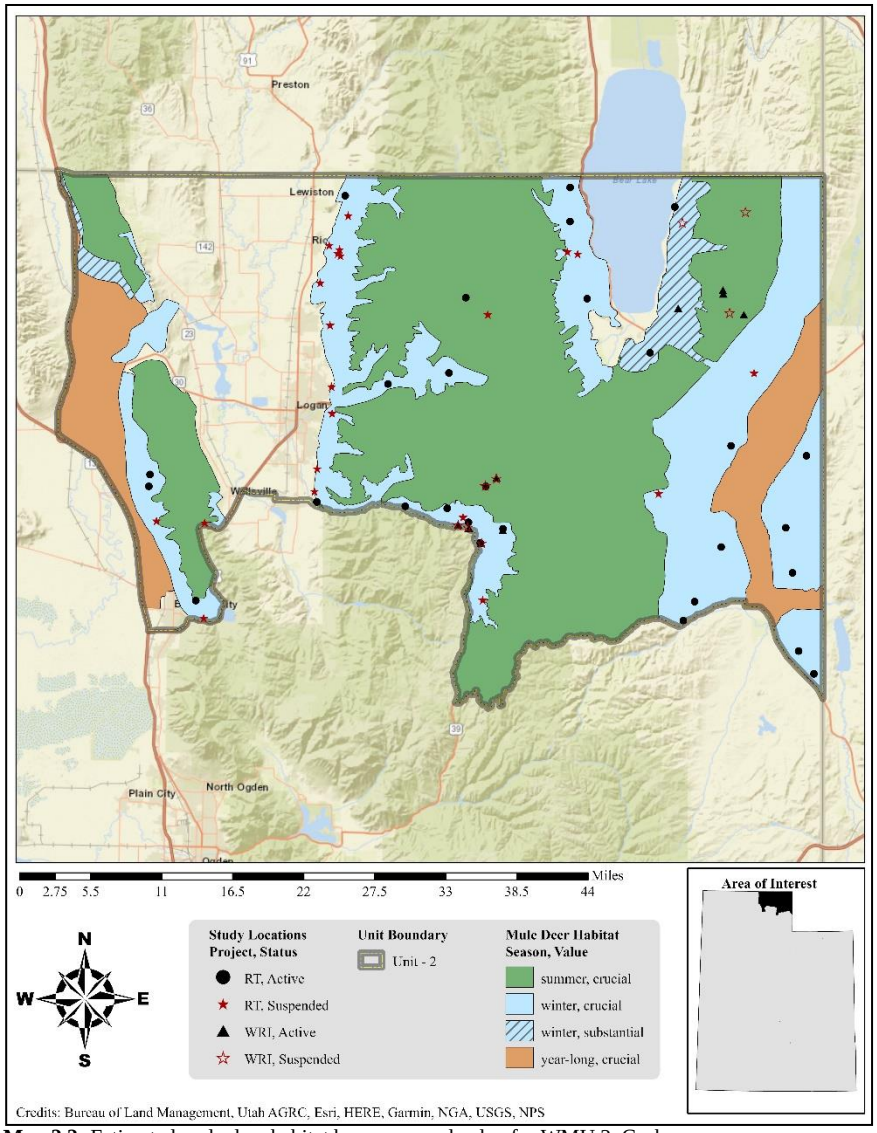


Figure 2.2: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

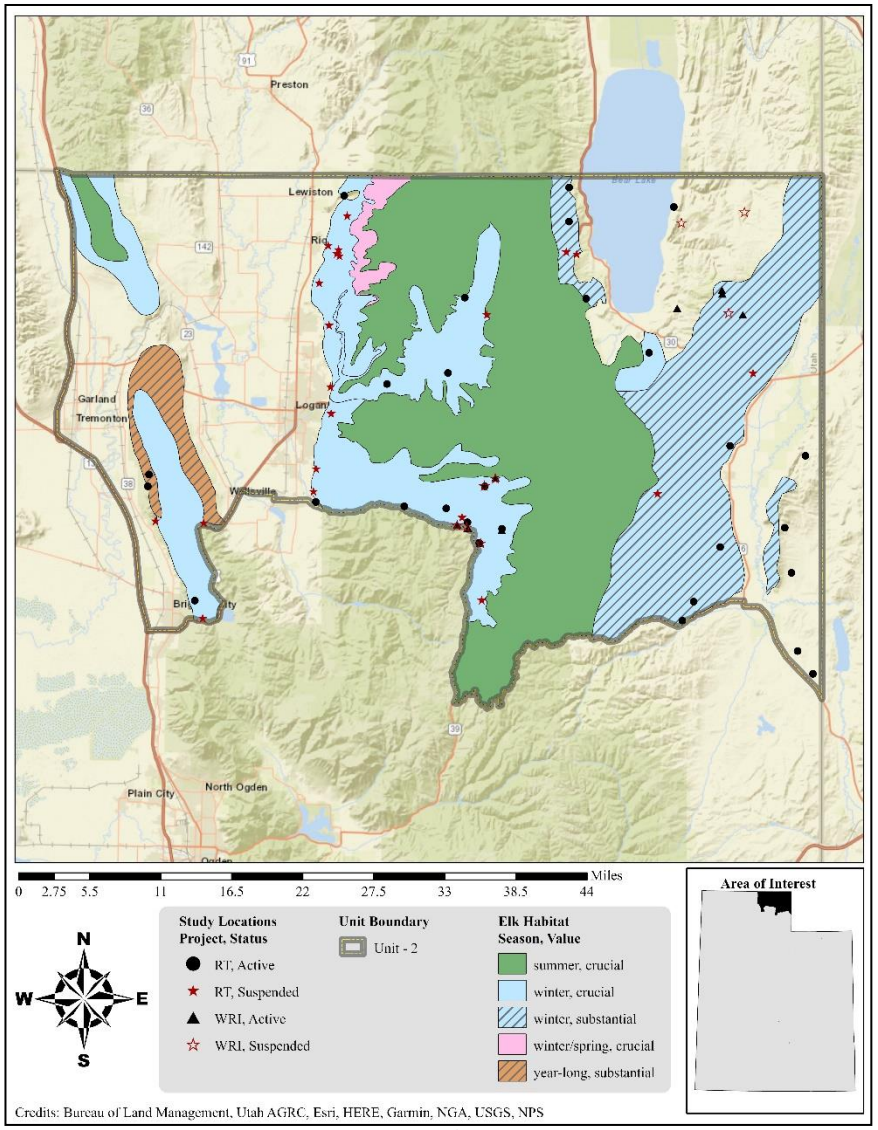
Big Game Habitat

Total mule deer range in this wildlife management unit is estimated at over 920,000 acres with 103,811 acres considered to be year-long range, 321,676 acres classified as winter range, and 495,437 acres classified as summer range (**Table 2.1**, **Map 2.2**). Total elk range is estimated at just over 701,000 acres with 22,374 acres classified as year-long range, 356,052 acres of this classified as winter range, 312,573 acres classified as summer range, and 10,264 classified as winter/spring range (**Table 2.3**, **Map 2.3**). Ninety-eight percent of mule deer year-long range is privately owned, 1% is administrated by Forestry, Fire and State Lands (FFSL), and the Bureau of Land Management (BLM), Utah School and Institutional Trust Lands Administration (SITLA), and the Utah Division of Wildlife Resources (UDWR) manage the remaining 1%. Much of the summer range (57%) is located on US Forest Service (USFS) land, 27% is privately owned, 10% is administrated by the BLM, 5% is managed by SITLA, and 1% is on land belonging to UDWR. Forty-one percent of the winter range is owned by private landowners, 29% is managed by the BLM, 17% belongs to the USFS, 8% is administrated by SITLA, 5% is owned by UDWR, and the remaining 1% is managed by Utah State Parks (USP) and FFSL (**Table 2.2**, **Map 2.2**, **Map 2.7**). Of the elk winter range, 33% is privately owned, 27% is managed by the BLM, the USFS administrates 30%, SITLA manages 5%, and 4% is administrated by UDWR (**Table 2.3**, **Map 2.3**, **Map 2.7**).

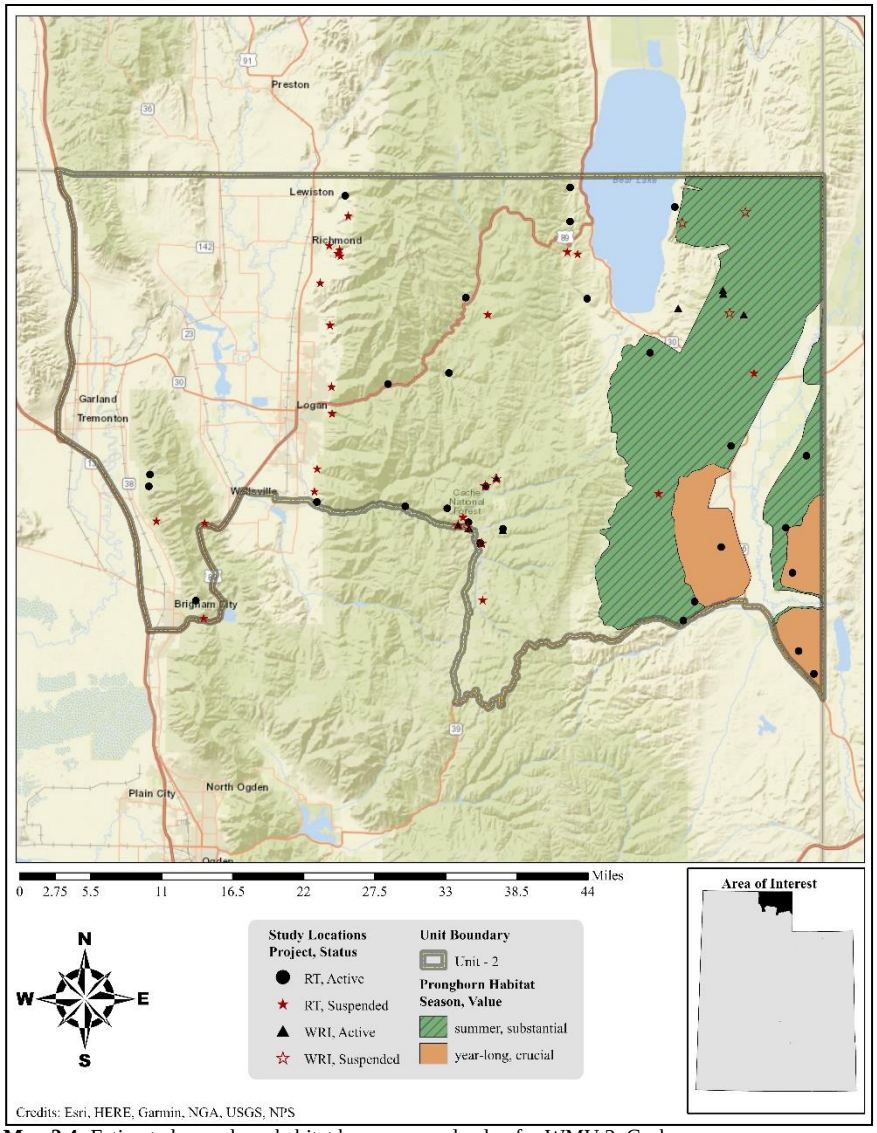
Landfire Existing Vegetation Coverage models suggest that shrublands comprise 32% of the unit, with approximately 28% of the land coverage consisting of sagebrush shrubland and steppe that is considered to be key habitat for mule deer (**Table 2.7**).



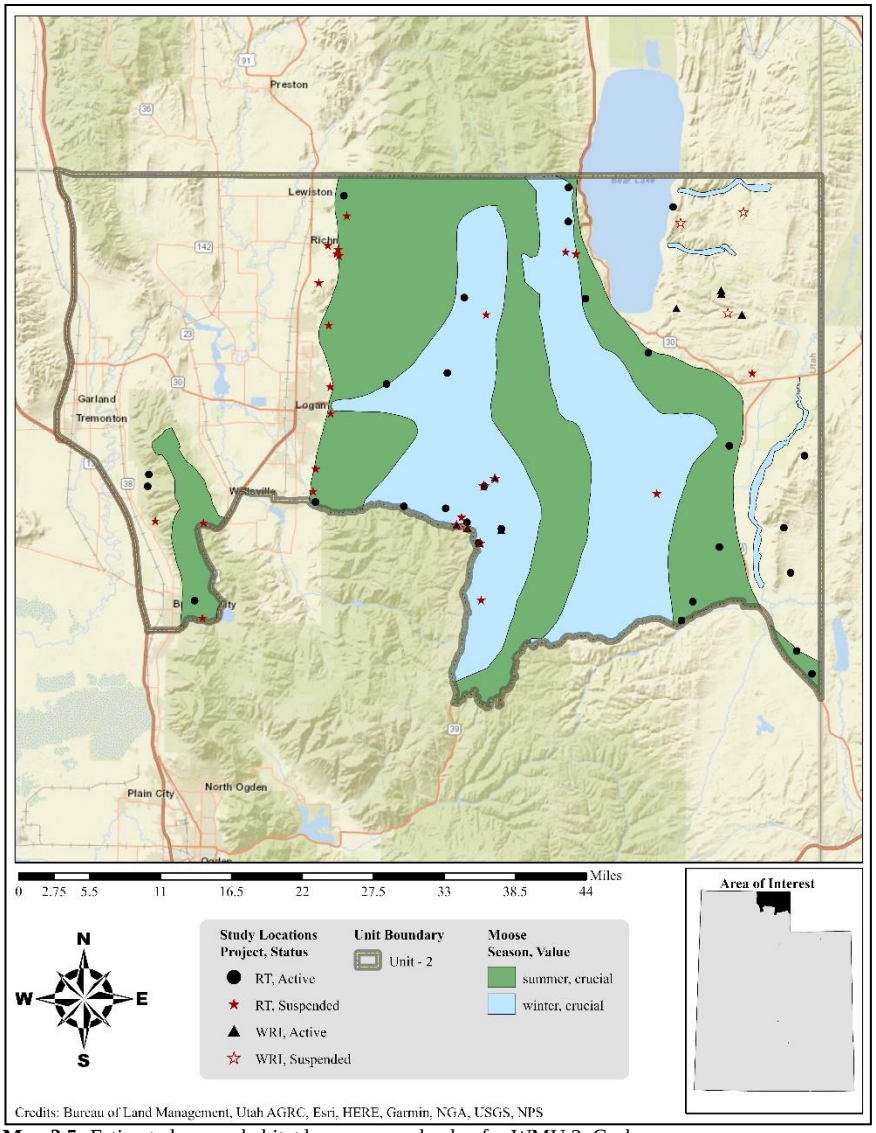
Map 2.2: Estimated mule deer habitat by season and value for WMU 2, Cache.



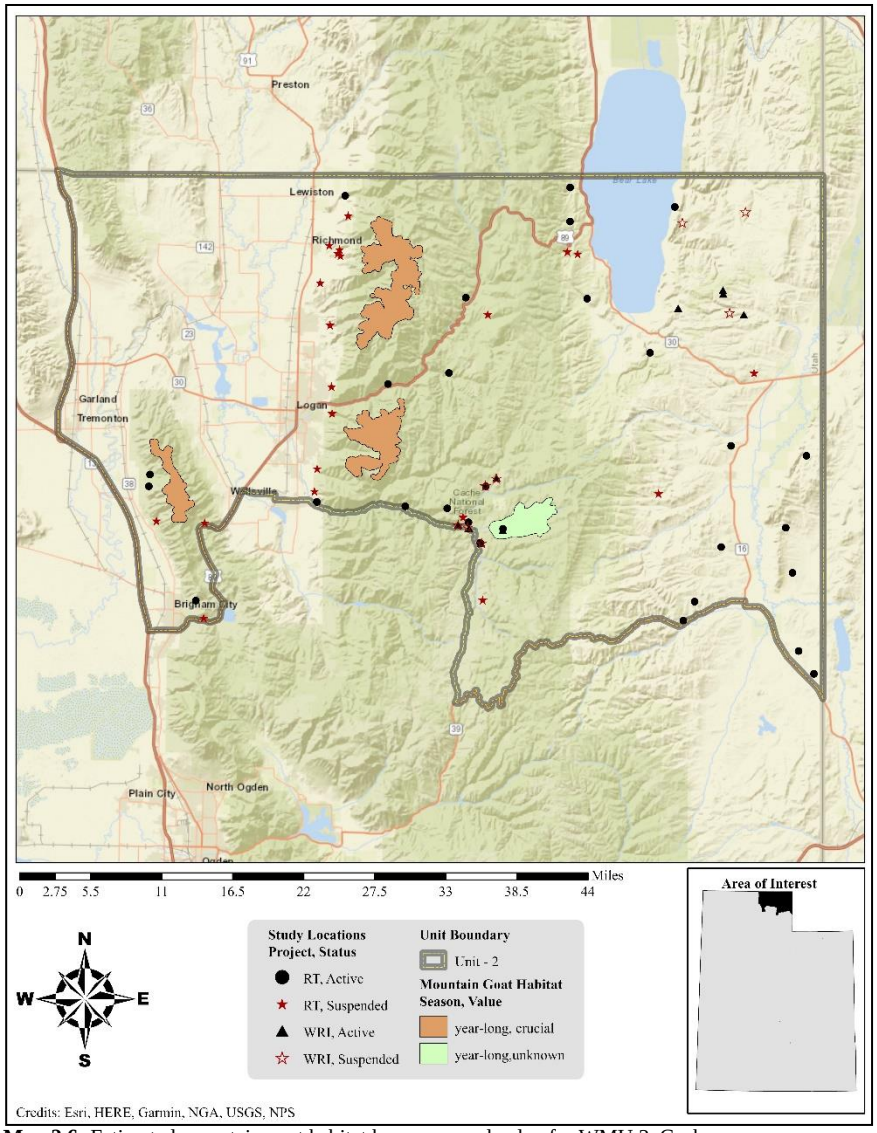
Map 2.3: Estimated elk habitat by season and value for WMU 2, Cache.



Map 2.4: Estimated pronghorn habitat by season and value for WMU 2, Cache.



Map 2.5: Estimated moose habitat by season and value for WMU 2, Cache.



Map 2.6: Estimated mountain goat habitat by season and value for WMU 2, Cache.

	Year Long Range		Summer Range		Winter Range		Winter/Spring Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
Mule Deer	103,811	11%	495,437	54%	321,676	35%	0	0%
Elk	22,374	3%	312,573	45%	356,052	51%	10,246	1%
Moose	0	0%	322,996	53%	281,832	47%	0	0%
Pronghorn	49,687	19%	215,360	81%	0	0%	0	0%
Mountain Goat	38,050	100%	0	0%	0	0%	0	0%

Table 2.1: Estimated mule deer, elk, pronghorn, and moose habitat acreage by season for WMU 2, Cache.

	Year Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	500	<1%	48,984	10%	94,084	29%
Private	101,885	98%	135,521	27%	131,522	41%
SITLA	44	<1%	25,022	5%	27,045	8%
FFSL	1,307	1%	0	0%	174	<1%
UDWR	76	<1%	4,866	1%	15,203	5%
USFS	0	0%	281,045	57%	53,340	17%
UDOT	0	0%	0	0%	2	<1%
USP	0	0%	0	0%	305	<1%
Total	103,811	**100%**	495,437	**100%**	321,676	**100%**

Table 2.2: Estimated mule deer habitat acreage by season and ownership for WMU 2, Cache.

	Year Long Range		Summer Range		Winter Range		Winter/Spring Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	0		16,527	5%	97,347	27%	0	0%
Private	15,403		72,840	23%	116,620	33%	65	1%
SITLA	0		13,433	4%	18,896	5%	0	0%
UDWR	630		1,185	0%	14,940	4%	39	<1%
USFS	6,341		208,588	67%	108,247	30%	10,142	99%
UDOT	0		0	0%	2	0%	0	0%
Total	22,374		312,573	**100%**	356,052	**100%**	10,246	**100%**

Table 2.3: Estimated elk habitat acreage by season and ownership for WMU 2, Cache.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	44,763	14%	46,522	17%
Private	73,279	23%	87,673	31%
SITLA	10,836	3%	9,759	3%
FFSL	49	<1%	0	0%
UDWR	6,067	2%	10,903	4%
USFS	187,978	58%	126,973	45%
UDOT	0	0%	2	<1%
USP	24	<1%	0	0%
Total	322,996	**100%**	281,832	**100%**

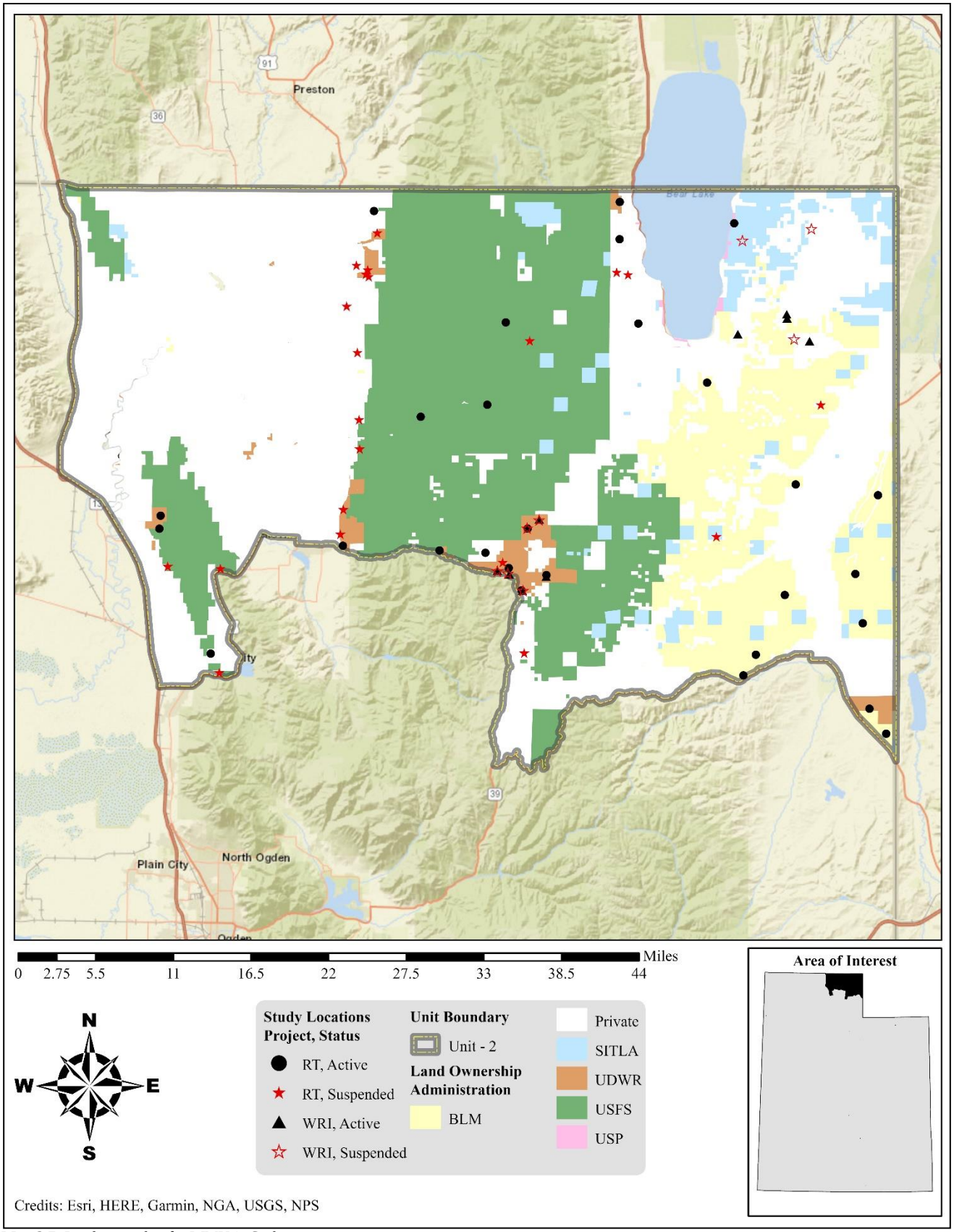
Table 2.4: Estimated moose habitat acreage by season and ownership for WMU 2, Cache.

	Year Long Range		Summer Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	31,349	63%	103,687	48%
Private	12,004	24%	81,026	38%
SITLA	3,438	7%	30,304	14%
UDWR	2,897	6%	0	0%
USFS	0	0%	343	<1%
Total	49,687	**100%**	215,360	**100%**

Table 2.5: Estimated pronghorn habitat acreage by season and ownership for WMU 2, Cache.

	Year Long Range	
Ownership	*Area (acres)*	*%*
Private	1,494	4%
SITLA	228	<1%
UDWR	2,123	6%
USFS	34,205	90%
Total	38,050	**100%**

Table 2.6: Estimated mountain goat habitat acreage by season and ownership for WMU 2, Cache.



Map 2.7: Land ownership for WMU 2, Cache.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Agricultural	445,312	21.20%	
	Hardwood	233,751	11.13%	
	Open Water	118,972	5.66%	
	Developed	88,796	4.23%	
	Conifer-Hardwood	62,249	2.96%	
	Riparian	39,589	1.88%	
	Sparsely Vegetated	19,402	0.92%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	117	0.01%	48.00%
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	313,639	14.93%	
	Inter-Mountain Basins Big Sagebrush Shrubland	128,009	6.09%	
	Inter-Mountain Basins Big Sagebrush Steppe	92,124	4.39%	
	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	61,986	2.95%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	44,730	2.13%	
	Rocky Mountain Lower Montane-Foothill Shrubland	13,298	0.63%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	12,254	0.58%	
	Inter-Mountain Basins Greasewood Flat	1,712	0.08%	
	Other Shrubland	1,637	0.08%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	1,320	0.06%	
	Inter-Mountain Basins Mat Saltbush Shrubland	692	0.03%	
	Great Basin Xeric Mixed Sagebrush Shrubland	338	0.02%	
	Great Basin Semi-Desert Chaparral	286	0.01%	
	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	234	0.01%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Shrubland	58	0.00%	
	Columbia Plateau Low Sagebrush Steppe	8	0.00%	32.01%
Conifer	Rocky Mountain Foothill Limber Pine-Juniper Woodland	78,945	3.76%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	65,555	3.12%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	40,265	1.92%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	37,398	1.78%	
	Rocky Mountain Lodgepole Pine Forest	21,848	1.04%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	17,742	0.84%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	16,622	0.79%	
	Colorado Plateau Pinyon-Juniper Woodland	13,608	0.65%	
	Great Basin Pinyon-Juniper Woodland	8,817	0.42%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	4,732	0.23%	
	Other Conifer	1,127	0.05%	
	Inter-Mountain Basins Juniper Savanna	140	0.01%	14.61%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	22,218	1.06%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	20,189	0.96%	
	Great Basin & Intermountain Introduced Annual Grassland	7,127	0.34%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	427	0.02%	2.38%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	29,682	1.41%	
	Southern Rocky Mountain Montane-Subalpine Grassland	7,759	0.37%	
	Other Grassland	6,116	0.29%	
	Inter-Mountain Basins Semi-Desert Grassland	4,681	0.22%	
	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	409	0.02%	
	Columbia Plateau Steppe and Grassland	169	0.01%	2.32%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	5,250	0.25%	
	Interior West Ruderal Riparian Scrub	5,097	0.24%	
	Interior Western North American Temperate Ruderal Shrubland	3,968	0.19%	
	Interior West Ruderal Riparian Forest	121	0.01%	0.69%
Total		**2,100,527**	**100%**	**100%**

Table 2.7: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 2, Cache.

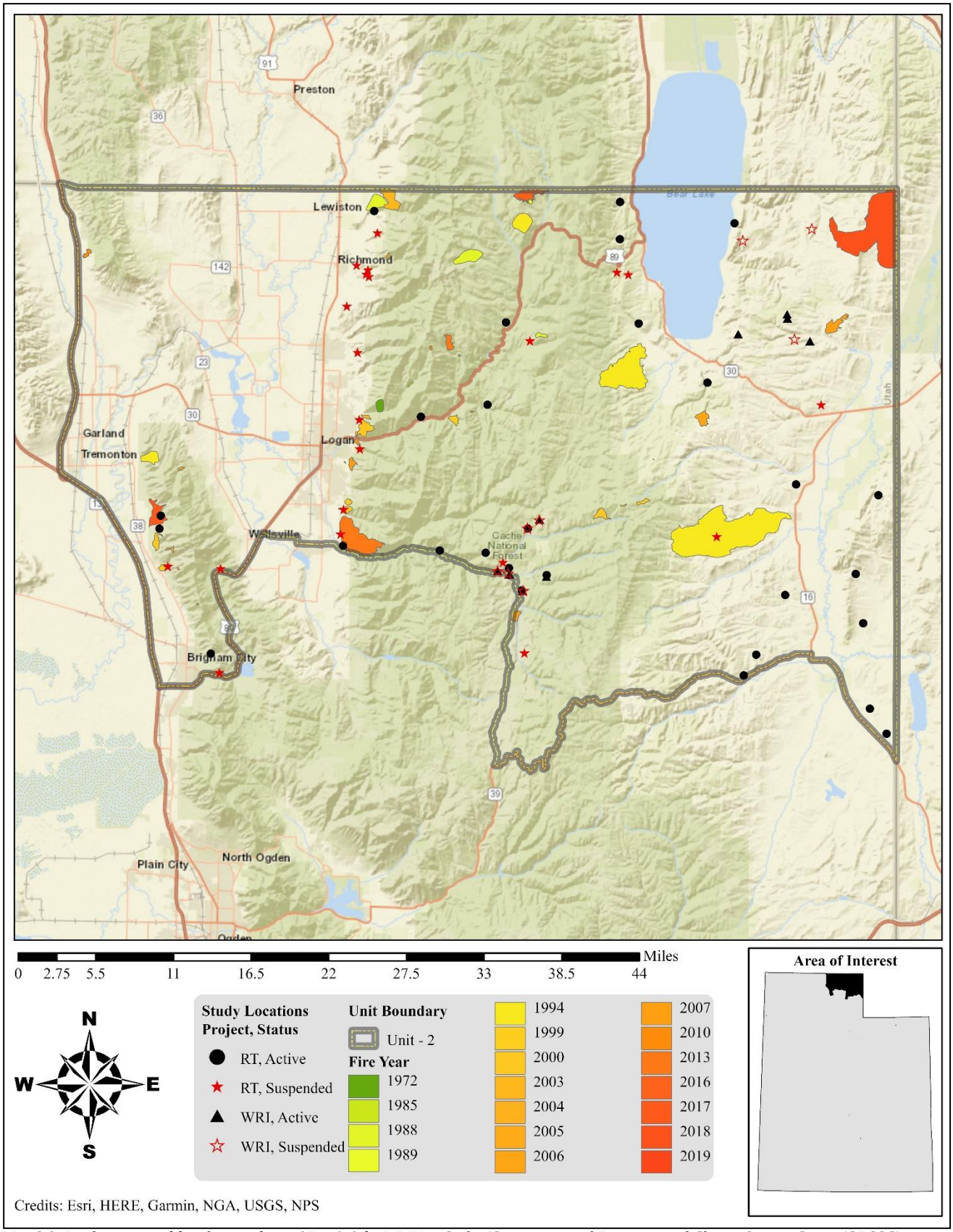
Limiting Factors to Big Game Habitat

The south-facing slopes of Blacksmith Fork, Logan, Dry, Providence, and Millville canyons are all important wintering areas. The lower winter range limits are restricted by the towns and cities of Cove, Richmond, Smithfield, Hyde Park, North Logan, Logan, Providence, Millville, Nibley, and Hyrum: these limits also include the deer-proof fence above agricultural land between Hyrum and Logan. Between Hyde Park and the Idaho border, the lower third of the winter range is located on private land and is threatened by increased cultivation and subdivision developments; the Landfire Existing Vegetation Coverage model indicates that 25% of the unit is developed or used for agricultural purposes (**Table 2.7**).

Other limiting factors to big game include introduced exotic herbaceous species, such as cheatgrass (*Bromus tectorum*). According to the current Landfire Existing Vegetation Coverage model, over 2% of the unit is comprised of exotic herbaceous species, with 0.3% being annual grasslands (**Table 2.7**); increased amounts of cheatgrass increases the risk for

catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). The unit has had some wildfires that have resulted in big game habitat loss, mainly near Hyrum and the Millville face (Miller, Svejcar, & Rose, 2000).

Finally, deer fences and crossings limiting range are a concern, but cooperation with the Utah Department of Transportation in constructing highway fences, passage structures, warning signs, etc. will continue in order to ensure proper access to habitat as well as deer and human safety.



Map 2.8: Land coverage of fires by year from 1972-2019 for WMU 2, Cache (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

Treatments/Restoration Work

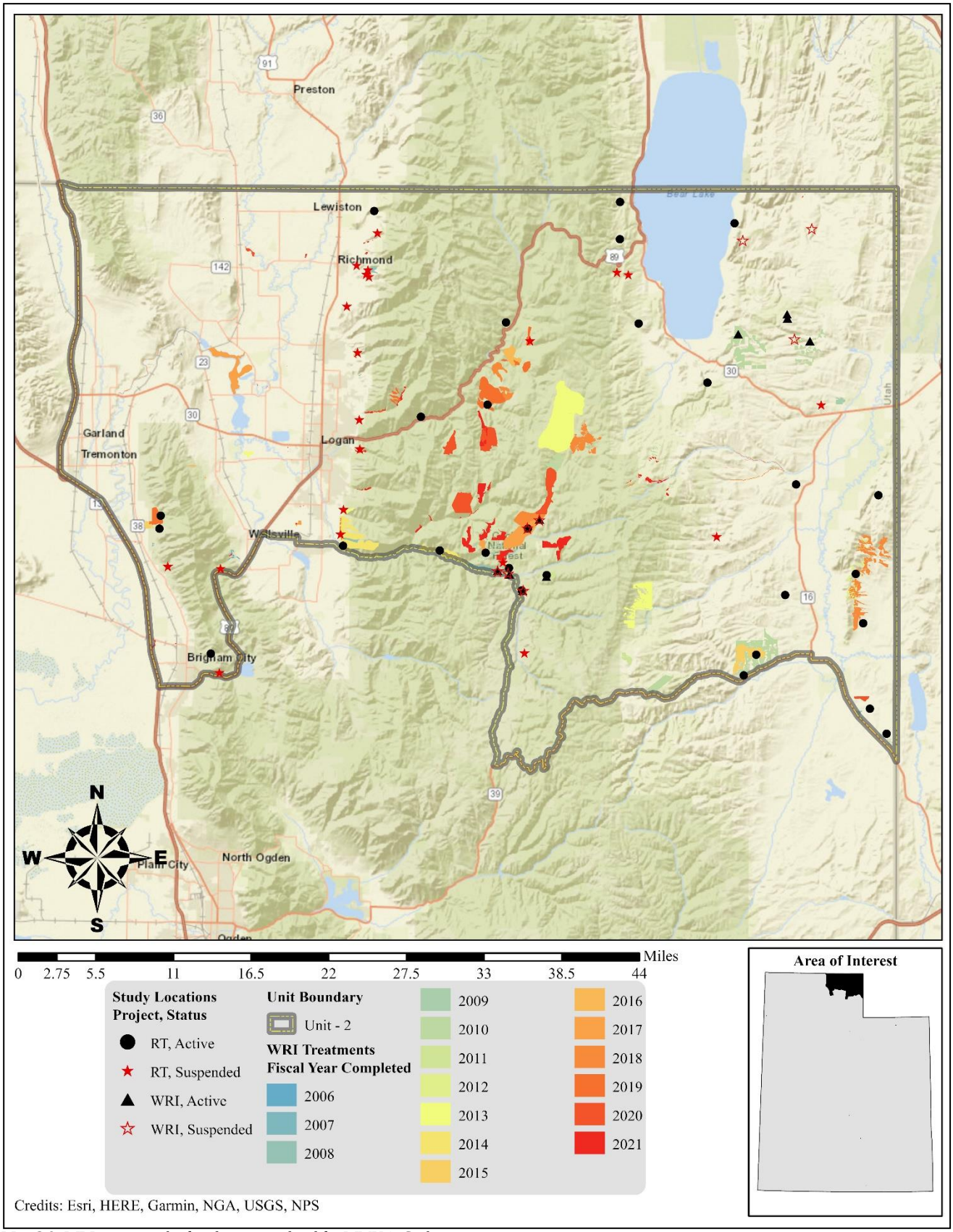
There has been some effort to address the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 39,215 acres of land have been treated within the Cache unit since the WRI was implemented in 2004 (**Map 2.9**). In addition, 21,876 acres are currently being treated and treatments have been proposed for 4,869 acres. Treatments frequently overlap one another bringing the net total of treatment acres to 35,157 acres for this unit (**Table 2.8**). 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.

Hand crew lop and scatter type treatments to reduce Utah juniper and twoneedle pine are the most common management practices in this unit. Herbicide application to remove invasive species is also very common. Other management practices include aerator use to improve the herbaceous understory, seeding desirable herbaceous species, harrow, bullhog (used to remove twoneedle pinyon and Utah juniper), and other similar vegetation removal techniques (**Table 2.8**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Aerator	**2,836**	**0**	**0**	**2,836**
Double Drum (One-Way)	2,732	0	0	2,732
Double Drum (Two-Way)	103	0	0	103
Anchor Chain	**207**	**0**	**0**	**207**
Ely (One-Way)	147	0	0	147
Ely (Two-Way)	60	0	0	60
Bullhog	**2,217**	**0**	**137**	**2,353**
Full Size	2,217	0	137	2,353
Chain Harrow	**2,309**	**0**	**0**	**2,309**
>15 ft. (Two-Way)	2,309	0	0	2,309
Disc	**41**	**0**	**0**	**41**
Off-Set (One-Way)	6	0	0	6
Off-Set (Two-Way)	7	0	0	7
Plow (Two-Way)	27	0	0	27
Forestry Practices	**31**	**1,003**	**0**	**1,034**
Thinning (Non-Commercial)	31	1,003	0	1,034
Greenstripping	**19**	**0**	**0**	**19**
Harrow	**212**	**0**	**0**	**212**
≤15 ft. (One-Way)	16	0	0	16
≤15 ft. (Two-Way)	124	0	0	124
>15 ft. (One-Way)	73	0	0	73
Herbicide Application	**3,650**	**464**	**72**	**4,185**
Aerial (Fixed-Wing)	1,162	0	18	1,180
Aerial (Helicopter)	2,125	0	0	2,125
Ground	363	464	0	826
Spot Treatment	0	0	54	54
Interseeding	**8**	**0**	**0**	**8**
Mowing	**76**	**16**	**0**	**92**
Brush Hog	0	16	0	16
Other	76	0	0	76
Planting/Transplanting	**365**	**0**	**0**	**365**
Container Stock	1	0	0	1
Other	364	0	0	364
Prescribed Fire	**9,917**	**13,454**	**0**	**23,371**
Prescribed Fire	9,917	13,454	0	23,371
Seeding (Primary)	**2,774**	**164**	**54**	**2,993**
Broadcast (Aerial-Fixed Wing)	355	0	0	355
Broadcast (Aerial-Helicopter)	1,931	0	0	1,931
Drill (Rangeland)	389	0	0	389
Ground (Mechanical Application)	66	0	0	66
Hand Seeding	33	164	54	251

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Seeding (Secondary/Shrub)	**150**	**150**	**1,214**	**1,514**
Broadcast (Aerial-Fixed Wing)	0	0	1,214	1,214
Ground (Mechanical Application)	150	150	0	300
Vegetation Removal/Hand Crew	**14,178**	**6,066**	**3,370**	**23,613**
Lop (No Scatter)	727	0	0	727
Lop & Scatter	12,932	6,066	3,370	22,368
Lop-Pile-Burn	518	0	0	518
Other	**226**	**560**	**23**	**808**
Road Decommissioning	226	200	0	425
Road/Parking Area Improvements	<1	360	23	383
Grand Total	**39,215**	**21,876**	**4,869**	**65,960**
***Total Land Area Treated**	**35,157**	**21,141**	**4,869**	**61,167**

Table 2.8: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 2, Cache. Data accessed on 02/09/2022. *Does not include overlapping treatments.



Map 2.9: WRI treatments by fiscal year completed for WMU 2, Cache.

Range Trend Studies

Range Trend studies have been sampled within WMU 2 on a regular basis since 1984, with studies being added or suspended as was deemed necessary (**Table 2.9**). Due to changes in sampling methodologies, only data collected following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 2.10**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
02-1	High Creek	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Stony Loam (Mountain Big Sagebrush)
02-2	Mouth of Blacksmith Fork	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Stony Loam (Mountain Big Sagebrush)
02-3	East of Richmond	RT	Suspended	1984	Not Verified
02-4	Crow Mountain	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
02-5	Smithfield Dry Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
02-6	Green Canyon Exclosure	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
02-7	Spawn Creek	RT	Suspended	1984, 1990, 1996	Not Verified
02-8	Millville Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
02-9	Beirdneau	RT	Active	1984. 1990. 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Antelope Bitterbrush)
02-10	Broad Hollow Flat	RT	Suspended	1984, 1990, 1996	Not Verified
02-12	Second Dam Blacksmith Fork	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Antelope Bitterbrush)
02-13	Hardware Plateau	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Very Steep Stony (Antelope Bitterbrush)
02-14	Dry Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
02-15	Lower Hodges Canyon	RT	Suspended	1984, 1990, 1996, 2001, 2006	Not Verified
02-16	Garden City Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Shallow Loam (Curl-leaf Mountain Mahogany)
02-17	Meadowville	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
02-18	Upper Hodges Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
02-19	Right Fork Logan Canyon	RT	Active	1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Antelope Bitterbrush)
02-20	Richmond WMA	RT	Suspended	1990, 1996, 2001	Not Verified
02-21	Swan Creek	RT	Active	1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Shallow Loam (Curl-leaf Mountain Mahogany)
02-22	Box Elder Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
02-23	Flat Bottom Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Shallow Loam (Mountain Big Sagebrush)
02-24	Calls Fort Canyon	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
02-25	Mouth of Two Jump Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Gravelly Loam (Mountain Big Sagebrush)
02-26	Wellsville Canyon	RT	Suspended	1990, 1996, 2001	Not Verified
02-27	Laketown Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Browse)
02-28	North Eden	RT	Active	1940, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Mountain Big Sagebrush)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
02-29	Woodruff Creek	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Wyoming Big Sagebrush)
02-30	State Line	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Loam (Wyoming Big Sagebrush)
02-31	South Crawford Mountains	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Shallow Loam (Wyoming Big Sagebrush)
02-32	Wood Pass	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Loam (Wyoming Big Sagebrush)
02-33	Brazier Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Stony Loam (Black Sagebrush)
02-34	Otter Creek	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
02-35	Higgins Hollow	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
02-36	Woodruff Co-op	RT	Active	1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Loam (Wyoming Big Sagebrush)
02-37	Rock Creek Riparian	RT	Suspended	1996, 2001, 2006	Not Verified
02-38	Twin Creek	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	High Mountain Loam (Mountain Big Sagebrush)
02-39	Pole Hollow Spring	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
02-40	Warrens Spring	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
02-41	Boundary Spring	RT	Suspended	1996, 2001	Not Verified
02-42	Hardware Gravel Pit	RT	Active	2011, 2016, 2021	Mountain Stony Loam (Mountain Big Sagebrush)
02-43	Woodruff Longhill	RT	Active	2009, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
02R-1	Austin's Rock	RT	Suspended	1997	Not Verified
02R-2	Randolph Burn	RT	Suspended	1997	Not Verified
02R-3	Richmond WMA-Seeded	RT	Suspended	1998	Not Verified
02R-4	Richmond WMA-Native	RT	Suspended	1998	Not Verified
02R-5	Coldwater WMA	RT	Active	1998, 2006, 2011, 2016, 2021	Mountain Gravelly Loam (Mountain Big Sagebrush)
02R-6	Duck Creek 3 Low	WRI	Active	2003, 2006, 2011, 2016	Upland Loam (Bonneville Big Sagebrush)
02R-7	Duck Creek 3 High	WRI	Suspended	2003	Not Verified
02R-8	Duck Creek 1	WRI	Active	2003, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
02R-9	Rabbit Creek Burn	WRI	Active	2004, 2007, 2012, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
02R-10	Rabbit Creek Burn Seeded	WRI	Active	2004, 2007, 2012, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
02R-11	Rattlesnake Knoll East	WRI	Active	2005, 2013, 2018	Mountain Shallow Loam (Low Sagebrush)
02R-12	Rattlesnake Knoll West	WRI	Suspended	2005, 2009	Not Verified
02R-13	Black Mountain East	WRI	Suspended	2005	Not Verified
02R-14	Black Mountain West	WRI	Suspended	2005	Not Verified
02R-15	Curtis Ridge Control	RT	Active	2006, 2011, 2021	Mountain Loam (Mountain Big Sagebrush)
02R-16	Curtis Ridge	WRI	Active	2006, 2013, 2021	Mountain Shallow Loam (Low Sagebrush)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
02R-17	Hardware Plateau Control	WRI	Suspended	2006, 2007	Not Verified
02R-18	Pole Hollow Control	WRI	Suspended	2006	Not Verified
02R-19	Squaw Flat South	WRI	Suspended	2006	Not Verified
02R-20	Squaw Flat North	WRI	Active	2006, 2013, 2018	Mountain Shallow Loam (Low Sagebrush)
02R-21	Hardware Plateau Grazed	WRI	Active	2007, 2013, 2018	Mountain Shallow Loam (Mountain Big Sagebrush)
02R-22	Blacksmith Fork Control	WRI	Suspended	2007	Not Verified
02R-23	Blacksmith Fork Grazed	WRI	Active	2007, 2013, 2018	Mountain Very Steep Stony Loam (Mountain Big Sagebrush)

Table 2.9: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 2, Cache.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
02-2	Mouth of Blacksmith Fork	Aerial	Millville WMA Fire Rehab	November 2013	410	2839
		Wildfire	Sleepy Hollow	2007	900	
		Plateau	Millville WMA Fire Rehabilitation Project	September 2007	792	972
		Aerial	Millville WMA Fire Rehabilitation Project	December 2007	792	972
		Transplant	Millville WMA Fire Rehabilitation Project	Spring 2008	792	972
		Wildfire	Millville	August 2013	2,864	
		Plateau	Millville WMA Fire Rehab	September 2013	410	2839
		Aerial	Millville WMA Fire Rehab	January 2014	410	2839
02-5	Smithfield Dry Canyon	Scalper	Weeks SFW Property	July-November 2013	8	2853
		Broadcast After	Weeks SFW Property	July-November 2013	8	2853
		Transplant	Weeks SFW Property	July-November 2013	8	2853
02-7	Spawn Creek	Lop and Scatter	Temple Fork Juniper Restoration 4	October 2018-June 2019	2,142	4420
02-8	Millville Canyon	Wildfire		2000		
02-10	Broad Hollow Flat	Wildfire	Millville WMA Fire	July 2007	900	
		Wildfire	Millville Fire	2013	2,864	
		Plateau	Millville WMA Fire Rehabilitation	September 2007	793	972
		Transplant	Millville WMA Fire Rehabilitation	April-May 2008	793	972
		Aerial After	Millville WMA Fire Rehabilitation	December 2007	793	972
02-12	Second Dam Blacksmith Fork	Lop and Scatter	UWC FS North Zone Watershed Improvements (Proposed)	2022	1,444	5548
		Lop and Scatter	Blacksmith Fork Juniper Thinning and Shrub Restoration	October-November 2013	1,200	2697
02-19	Right Fork Logan Canyon	Lop and Scatter	Temple Fork Juniper Restoration 4	October 2018 and June 2019	2,142	4420
02-20	Richmond WMA	Truax Drill	Richmond WMA	Fall 2007	161	64
		Roundup	Richmond WMA	Spring 2007	161	64
		Transplant	Richmond WMA	Spring 2008	161	64
02-32	Wood Pass	Bullhog	Crawford Mountain Sage-Grouse Habitat Enhancement	Fall 2016-Summer 2017	1,205	3867
		Bullhog	Crawford Mountain Bullhog	October 2011-August 2012	1,103	1936
02-34	Otter Creek	Herbicide Unknown		Prior to 1984		
		Rangeland Drill		Prior to 1984		
		Double Drum/Seed		Spring 2004	355	
02-36	Woodruff Co-op	Seed Unknown		Historic		
		Disc Unknown	Woodruff Co-op WMA	2003	173	
		Rangeland Drill	Woodruff Co-op WMA	2003	173	
02-39	Pole Hollow Spring	Lop and Scatter	Hardware Plateau Lop and Scatter	September-November 2016	2,143	3701
		Milestone	Hardware Ranch WMA Weed Abatement	July 2019-June 2020	269	4762
02-40	Warrens Spring	Lop and Scatter	Hardware Plateau Lop and Scatter	Fall 2016	2,143	3701

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
02-43	Woodruff Longhill	Lop and Scatter	Woodruff Longhill Sagebrush Improvement	Fall 2009	3,069	1477
		Rangeland Drill	Woodruff Seeding #2	Summer 1962-Winter 1963	2,381	LTDL
		Plow	Woodruff Seeding #2	Summer 1962-Winter 1963	2,381	LTDL
02R-5	Coldwater WMA	Plateau/Laramie /Roundup	Cold Water WMA Fire Rehab	Dec-17	491	4366
		Roundup	Cold Water WMA Fire Rehab	May-18	491	4366
		Aerial	Cold Water WMA Fire Rehab Phase II	Nov-18	473	4598
		Wildfire	Honeyville	Aug-17	856	
		Roundup	Cold Water WMA Fire Rehab	Mar-18	491	4366
02R-6	Duck Creek 3 Low	Double Drum/Seed	Duck Creek	2004	2,850	1321
02R-8	Duck Creek 1	Double Drum/Seed	Duck Creek	2004	2,850	1321
02R-9	Rabbit Creek Burn	Wildfire	East Bear	Fall 2003	887	PDB
02R-10	Rabbit Creek Burn Seeded	Wildfire	East Bear	Fall 2003	887	PDB
		Rangeland Drill	Rabbit Creek	Fall 2003	500	PDB
02R-11	Rattlesnake Knoll East	Intensive Grazing	Hardware Grazing Project	April-September 2005		PDB
02R-13	Black Mountain East	Fencing	Black Mountain Treatment			PDB
		Water Development	Black Mountain Treatment			PDB
		Disc Unknown	Black Mountain Treatment			PDB
		Aerator Unknown	Black Mountain Treatment			PDB
		Seed Unknown	Black Mountain Treatment			PDB
02R-14	Black Mountain West	Fencing	Black Mountain Treatment			PDB
		Water Development	Black Mountain Treatment			PDB
		Disc Unknown	Black Mountain Treatment			PDB
		Aerator Unknown	Black Mountain Treatment			PDB
		Seed Unknown	Black Mountain Treatment			PDB
02R-15	Curtis Ridge Control	Lop and Scatter	Curtis Ridge Lop and Scatter	2019	400	4730
02R-16	Curtis Ridge	Intensive Grazing	Hardware Grazing Project	2005		PDB
		Lop and Scatter	Curtis Ridge Lop and Scatter	2019	400	4730
02R-19	Squaw Flat South	Intensive Grazing	Hardware Grazing Project	2005		PDB
02R-20	Squaw Flat North	Intensive Grazing	Hardware Grazing Project	April-September 2005		PDB
02R-21	Hardware Plateau Grazed	Intensive Grazing	Hardware Grazing Project	April-September 2005		PDB
02R-22	Blacksmith Fork Control	Plateau	Hardware Ranch Plateau	August-September 2007	474	973
02R-23	Blacksmith Fork Grazed	Plateau	Hardware Ranch Plateau	August-September 2007	474	973
02R-23	Blacksmith Fork Grazed	Lop and Scatter		Between 2013 and 2018		
02R-23	Blacksmith Fork Grazed	Intensive Grazing	Hardware Grazing Project	April-September 2005		PDB
		Aerial	Hardware Ranch Seeding	April 2007	474	941

Table 2.10: Range Trend and WRI studies known disturbance history for WMU 2, Cache. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

There are nine studies [Coldwater WMA (02R-5), Curtis Ridge Control (02R-15), Meadowville (02-17), Flat Bottom Canyon (02-23), Mouth of Two Jump Canyon (02-25), Twin Creek (02-38), Pole Hollow Spring (02-39), Warrens Spring (02-40), and Hardware Gravel Pit (02-42)] that are considered to be Mountain (Big Sagebrush) ecological sites. The Coldwater WMA study is located at the mouth of Coldwater Canyon, while the Curtis Ridge Control study is found on Curtis Ridge on the Hardware Ranch WMA. The Meadowville study is located west of Bear Lake and north of

Meadowville. Flat Bottom Canyon is found on the south-facing slope of Flat Bottom Canyon, and the Mouth of Two Jump Canyon site is situated at the mouth of Two Jump Canyon. The Twin Creek study is located north of US-89 in Logan Canyon near Twin Creek. Pole Hollow Spring is situated north of Rock Creek, and Warrens Spring is found in North Cottonwood Canyon, northeast of Warrens Hollow. Finally, the Hardware Gravel Pit study site is situated north of SR-101 in Blacksmith Fork Canyon (**Table 2.9**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species on almost all sites as of 2021. The exceptions to this are the Curtis Ridge Control site, on which little sagebrush (*A. arbuscula*) co-dominates along with mountain big sagebrush, and Pole Hollow Spring, which is dominated by a mixture of preferred browse including antelope bitterbrush (*Purshia tridentata*), mountain snowberry (*Symphoricarpos oreophilus*), and mountain big sagebrush. Other preferred browse species that provide less cover are present on many study sites, such as chokecherry (*Prunus virginiana*) and Utah serviceberry (*Amelanchier utahensis*). Average shrub cover has exhibited an overall decrease over the study period. The decrease between 2016 and 2021 in particular can be largely attributed to the Coldwater WMA study: the Honeyville wildfire burned the area in 2017, removing a majority of the browse species. However, one should also note the differing number of studies (the 'n value') from year to year and consider the implications this variation may have on vegetation trends (**Figure 2.6**). Average preferred browse demographics indicate that density has fluctuated from year to year, but has increased in total. Mature individuals have been the dominant age class in these populations throughout the study period. However, decadence has increased; closer examination of the data shows that increases in decadent individuals happened on every site that was sampled in both 2016 and 2021. Recruitment of young has also increased in total. Again, these demographic trends are likely somewhat influenced by the differing number of studies each year. For example, data shows that increases in young plants between 2016 and 2021 occurred on the Coldwater WMA, Meadowville, Mouth of Two Jump Canyon, and Pole Hollow Spring studies. However, the Curtis Ridge Control study also had a large number of young plants, but was only sampled in 2021 and not in 2016 (**Figure 2.15**). Average preferred browse utilization has exhibited a general decrease over time, with more than 70% of the plants showing no to light use in all years (**Figure 2.18**).

Tree cover has increased very slightly over the sample period. This trend has been driven in some years by the Warrens Spring and Hardware Gravel Pit studies, but the inclusion of the Curtis Ridge Control study in 2021 (which was not sampled in 2016) largely influenced the most recent increase between 2016 and 2021 (**Figure 2.9**). Point-quarter data indicates that density has marginally decreased between 2016 and 2021. Although the graph shows that no tree density was observed in point-quarter measurements in 2006 or 2011, site-level data indicates that Rocky Mountain juniper (*Juniperus scopulorum*) was present in density strips on some sites during those years (**Figure 2.12**).

Herbaceous Understory: The herbaceous understories of these studies are generally diverse and although they have fluctuated from year to year, total cover and nested frequency have slightly decreased overall. Total cover of perennial grasses and forbs has marginally increased across the study period, while total nested frequency has remained similar. Both annual grass cover and frequency have decreased over time, and data suggests that perennial grasses and forbs were the dominant understory components in 2021. While the perennial grass component on many studies includes native species like bluebunch wheatgrass (*Psuedoroegneria spicata*), the invasive species bulbous bluegrass (*Poa bulbosa*) has increased as well: this trend is driven by the Mouth of Two Jump Canyon, Twin Creek, Flat Bottom Canyon, and Curtis Ridge Control studies. Although average annual grass cover has decreased over the study period, in some years species such as cheatgrass (*Bromus tectorum*) and field brome (*B. arvensis*) have contribute a significant amount of cover on many study sites (**Figure 2.21**, **Figure 2.24**).

Occupancy: Average pellet transect data shows that although there was an increase between 2016 and 2021, overall animal occupancy has decreased over time. Deer and/or sheep have been the primary occupants of these study sites in all sample years, with mean pellet group abundance ranging from just under 10.5 days use/acre in 2011 to 27 days use/acre in 2001. Average abundance of elk pellet groups has been as low as 4 days use/acre in 2016 and as high as just over 8 days use/acre in 2021. Finally, cattle pellet groups had a mean abundance fluctuating between 2 days use/acre in 2021 and 6.5 days use/acre in 2006 (**Figure 2.27**).

Mountain (Curl-leaf Mountain Mahogany)

Two study sites [Garden City Canyon (02-16) and Swan Creek (02-21)] are classified as Mountain (Curl-leaf Mountain Mahogany) ecological sites. The Garden City Canyon study is located on the south-facing slope of Garden City Canyon, west of Garden City. The Swan Creek study site is found east of Bear Lake on the Swan Creek WMA north of Swan Creek (**Table 2.9**).

Shrubs/Trees: Total shrub cover on study sites of this ecological type has exhibited a very slight increase overall, mainly due to increases in preferred browse other than curl-leaf mountain mahogany (*Cercocarpus ledifolius*) and shrubs other than preferred browse. The dominant browse species on both of these studies is curl-leaf mountain mahogany. However, mountain mahogany cover has decreased over time; in 2021, little sagebrush (*Artemisia arbuscula*) provided the most preferred browse cover of any species on the Garden City Canyon study (**Figure 2.5**). Average preferred browse demographics indicate that mature individuals have been the main component on these sites in all sample years. Both decadent plants and recruitment of young have exhibited very slight increases, but density as a whole has marginally decreased (**Figure 2.14**). Preferred browse utilization has fluctuated over the study period, and most plants have shown little to no use in most sample years (**Figure 2.17**).

Average tree cover has been entirely contributed by Rocky Mountain juniper (*Juniperus scopulorum*) and has increased overall: this is due to the Garden City Canyon study as juniper contributes no cover on the Swan Creek site. Density of juniper has increased overall according to point-quarter density data, a trend again driven by the Garden City Canyon study. Although juniper was not recorded in strip or point-quarter density prior to 2016, photos of Garden City Canyon show that trees have been present since study establishment (**Figure 2.8**, **Figure 2.11**).

Herbaceous Understory: The overall cover of the herbaceous understory has increased slightly over time, while nested frequency has marginally decreased when comparing 1996 with 2021 data. Perennial grasses have been the dominant component in most sample years and have largely been comprised of native species such as bluebunch wheatgrass (*Pseudoroegneria spicata*). Annual grasses have also been present with increased cover values, but cover decreased between 2016 and 2021. Average cover and frequency of the introduced perennial grass bulbous bluegrass (*Poa bulbosa*) have increased through the sample years: this increase is largely due to the Swan Creek study (**Figure 2.20**, **Figure 2.23**).

Occupancy: Following an initial increase in 2006, average animal occupancy has decreased each study year. Average pellet transect data indicates that deer have been the primary occupants in all sample years except 2006, when elk were the main occupants. Deer have had a mean abundance of pellet groups ranging from 29.5 days use/acre in 2021 to nearly 52 days use/acre in 2001. Average abundance of elk pellet groups has been as low as 14 days use/acre in 2021 and as high as 74 days use/acre in 2006. Moose have also been present with a mean abundance of pellet groups ranging from 0 days use/acre in 2001, 2011, and 2021 to 1 days use/acre in 2006 and 2016 (**Figure 2.26**).

Mountain (Browse)

There is one study [Laketown Canyon (02-27)] that is classified as a Mountain (Browse) ecological site: this study is located on the western-facing slope of Laketown Canyon, south of the town of Laketown (**Table 2.9**).

Shrubs/Trees: The dominant browse species on this study site are alderleaf mountain mahogany (*Cercocarpus montanus*) and black sagebrush (*Artemisia nova*), although many other browse species are present with less cover. Total average shrub cover has decreased overall. Shrubs other than preferred browse have contributed a majority of the cover in most sample years. In 2021, however, most of the cover was provided by other preferred browse species rather than serviceberry (*Amelanchier utahensis*) or mountain mahogany (*C. ledifolius* and/or *C. montanus*). Cover of serviceberry and/or mountain mahogany has decreased since 2006 (**Figure 2.3**). Average preferred browse demographic data shows that total density has decreased overall and that the population has been dominated by mature individuals in all sample years. Preferred browse decadence has increased, however, and decadent individuals were a co-dominant demographic in 2021. Recruitment of young has also increased over the study period (**Figure 2.14**). Average preferred browse utilization remained low through the 2016 year, with a majority of the plants showing signs of little to no browsing in each sample year. Utilization increased significantly in 2021, however, with 62% and 5% of plants showing respective signs of moderate and heavy usage (**Figure 2.17**).

Although it remains low and was not recorded in 2011, tree cover has increased and has been entirely contributed by Utah juniper (*Juniperus osteosperma*); point quarter data shows that density is moderate and has likewise increased. Although trees were not observed in point-quarter data prior to 2016, site-level examination reveals that juniper has been present in density strip data in all sample years (**Figure 2.8**, **Figure 2.11**).

Herbaceous Understory: As a whole, the understory on this study site has decreased in cover, with native perennial grasses as the main component in most sample years including 2021. However, annual grass increased in cover over time and was dominant in 2016. Although annual grass cover and frequency values decreased between 2016 and 2021, they have remained similar overall when compared to 1996 values. Perennial forb cover and frequency have decreased. However, cover and frequency of annual forbs have marginally increased, a trend driven in part by the introduced species desert madwort (*Alyssum desertorum*) (**Figure 2.20**, **Figure 2.23**).

Occupancy: Average pellet transect data shows that overall occupancy has increased over time. Deer have been the primary occupants in all sample years except 2006, when cattle pellets were the most abundant. Mean abundance of deer pellet groups has ranged from 5 days use/acre in 2006 to 63 days use/acre in 2021. Elk pellet groups have had a mean abundance as low as 0 days use/acre in 2001 and 2006, and as high as 3 days use/acre in 2011 and 2016. The mean abundance of cattle pellet groups has been as low as 0 days use/acre in 2001, 2011, and 2016, and as high as 5 days use/acre in 2006. Finally, mean abundance of moose pellet groups has ranged from 0 days use/acre in 2001, 2011, 2016, and 2021 to 2 days use/acre in 2006 (**Figure 2.26**).

Mountain (Shrub)

There are four studies [Beirdneau (02-9), Second Dam Blacksmith Fork (02-12), Hardware Plateau (02-13), and Right Fork Logan Canyon (02-19)] that are considered to be Mountain (Shrub) ecological sites. Beirdneau is located on a south-facing slope north of US-89 and Beirdneau Campground, and the Second Dam Blacksmith Fork study is situated east of Hyrum City Park and north of SR-101 in Blacksmith Fork Canyon. Hardware Plateau is found on a steep slope in the hills south of Hardware Ranch. Finally, the Right Fork Logan Canyon study is located east of US-89 on the slopes above Maughan Hollow (**Table 2.9**).

Shrubs/Trees: Antelope bitterbrush (*Purshia tridentata*) is the dominant browse species on all studies of this ecological type except for Hardware Plateau, where it is co-dominant with mountain snowberry (*Symphoricarpos oreophilus*) as of 2021. Other browse species such as mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) are also present on many sites, though they provide less cover. Overall, average shrub cover has marginally decreased over the sample years, with bitterbrush contributing a majority of this cover in most sample years. More specifically, the decrease in total shrub cover between 2016 and 2021 appears to mainly be driven by preferred browse other than bitterbrush (**Figure 2.4**). Average preferred browse demographics indicate that total shrub cover has varied between sample years, but has been largely consistent overall. In addition, mature individuals primarily comprise the populations on these study sites. Decadence has increased slightly overall, but so has recruitment of young plants. Furthermore, the increase of young between 2016 and 2021 in particular can largely be attributed to the Hardware Plateau site (**Figure 2.14**). More than half of preferred browse plants exhibited moderate to heavy browsing in 1996, but utilization has decreased over time. In the most recent sample year (2021), approximately 10% of plants were heavily used, 14% were moderately used, and the remaining majority showed little to no use (**Figure 2.17**).

Average tree cover has increased over the sample years: this trend is entirely driven by Rocky Mountain juniper (*Juniperus scopulorum*) on the Beirdneau study. Point-quarter measurements were only recorded in 2016 and 2021 on the Right Fork Logan Canyon and Beirdneau studies: tree density decreased slightly between those sample years mainly due to a 2018-2019 lop and scatter treatment on the Right Fork Logan Canyon study. However, site reports indicate that Rocky Mountain juniper has been recorded in density strips on the Beirdneau site in the past (**Figure 2.8**, **Figure 2.11**).

Herbaceous Understory: The herbaceous understory as a whole has increased in cover, but slightly decreased in frequency over the study years. Perennial and annual grasses have been the main components on these study sites in many years. However, annual grass cover decreased between 2016 and 2021 while that of perennial grasses increased. Cover and frequency of the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) have remained fairly consistent, with most of the grass found on the Right Fork Logan Canyon study. Perennial and annual forb cover has increased overall, a trend that is largely driven by the Beirdneau and Right Fork Logan Canyon studies; perennial forbs were dominant along with perennial grasses in 2021 due in part to an increase on the Hardware Plateau study site (**Figure 2.20**, **Figure 2.23**).

Occupancy: Average animal presence has decreased overall, although there was a significant increase between 2016 and 2021. Elk have been the primary occupants in all sample years, with average pellet group abundance ranging from 17 days use/acre in 2016 to 51 days use/acre in 2006. The mean abundance of deer pellet groups has been as low as 5.5 days use/acre in 2016, and as high as 21 days use/acre in 2001. Finally, cattle pellet groups have had a mean abundance ranging from 0 days use/acre in 2016 to 1.5 days use/acre in 2006 (**Figure 2.26**).

Upland (Big Sagebrush)

Seven studies [High Creek (02-1), Mouth of Blacksmith Fork (02-2), North Eden (02-28), Woodruff Creek (02-29), Otter Creek (02-34), Higgins Hollow (02-35), and Woodruff Longhill (02-43)] are considered to be Upland (Big Sagebrush) ecological sites. The High Creek study site is located on a south-facing slope north of Prater Hollow and High Creek and east of US-91. The Mouth of Blacksmith Fork study is situated at the mouth of Blacksmith Fork Canyon, north of SR-101. North Eden is found on a west-facing slope east of Bear Lake and North Cisco Road, and the Woodruff Creek study is situated east of Birch Creek Reservoirs above Woodruff Creek. The Otter Creek site is located north of the town of

Randolph and east of the Bear River, while the Higgins Hollow study is found in Higgins Hollow. Finally, Woodruff Longhill is located south of Dry Basin Reservoir and north of Woodruff Creek (**Table 2.9**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the primary browse species on all sites except Mouth of Blacksmith Fork, which is dominated by forage kochia (*Bassia prostrata*), and Woodruff Creek, on which Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) is dominant. Other preferred browse is present on select sites in lesser amounts, and includes species such as antelope bitterbrush (*Purshia tridentata*), black sagebrush (*A. nova*), and slender buckwheat (*Eriogonum microthecum*). Although it has fluctuated from year to year, the total average cover of sagebrush, preferred browse, and other shrubs has exhibited a very marginal increase overall. The total increase in sagebrush cover is likely at least partially driven by the Otter Creek, Higgins Hollow, Woodruff Longhill, and North Eden studies (**Figure 2.6**). Average preferred browse demographics indicate that density has fluctuated from year to year, but has increased in total. Mature plants have comprised a majority of the populations on these studies in most sample years. In 2021, however, decadent individuals were the dominant demographic. More specifically, the number of decadent plants increased on every site of this ecotype between 2016 and 2021. Trends in recruitment of young have partially been driven by the Otter Creek study, which has had the highest density of young plants in most sample years (**Figure 2.15**). Average preferred browse utilization has exhibited an overall decrease over the study period, with a majority of plants displaying no to light use. In 2021, only 24% of plants exhibited moderate to heavy hedging (**Figure 2.18**).

Tree cover on these study sites has increased each year since 2006, a trend which can be attributed to the North Eden and Woodruff Creek studies as line intercept cover of juniper (*Juniperus osteosperma*) was not recorded on any other site. Tree density has exhibited a slight increase since 2006. This density trend is entirely due to the High Creek, North Eden, Woodruff Creek, and Woodruff Longhill sites, as trees have remained absent on other studies (**Figure 2.9**, **Figure 2.12**).

Herbaceous Understory: Although total average herbaceous cover and frequency have fluctuated from year to year, both have remained nearly stable when comparing 1996 data to that of 2021. A majority of the understory cover has been contributed by annual grasses in most sample years. Furthermore, annual grass trends have likely been driven in part by the noxious weed jointed goatgrass (*Aegilops cylindrica*) and introduced species cereal rye (*Secale cereale*) on the Mouth of Blacksmith Fork study. However, annual grass cover decreased in 2021, making perennial grasses the dominant understory component in that year. On many sites, the perennial grass component is largely composed of species such as Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*), but the introduced species bulbous bluegrass (*Poa bulbosa*) has been present in fluctuating amounts in all study years on the High Creek and Mouth of Blacksmith Fork studies. Average cover of perennial and annual forbs has exhibited an overall increase over the study period, while frequency has remained similar when comparing 1996 and 2021 data (**Figure 2.21**, **Figure 2.24**).

Occupancy: Overall, animal presence has decreased over the study period, and deer and/or antelope have been the primary occupants in all sample years. Mean abundance of deer and/or antelope pellet groups has ranged from 25 days use/acre in 2011 to nearly 59 days use/acre in 2006. The average abundance of elk pellet groups has been as low as 0 days use/acre in 2001, and as high as just over 2 days use/acre in 2021. Finally, cattle pellet groups have had a mean abundance ranging from 3 days use/acre in 2021 to 9 days use/acre in 2016 (**Figure 2.27**).

Upland (Black/Low Sagebrush)

One study site [Brazier Canyon (02-33)] is classified as an Upland (Black/Low Sagebrush) ecological site: this study site is located in the Crawford Mountains in Brazier Canyon (**Table 2.9**).

Shrubs/Trees: Black sagebrush (*Artemisia nova*) is the dominant browse species on this site, with other preferred species such as mountain snowberry (*Symphoricarpos oreophilus*), winterfat (*Krascheninnikovia lanata*), and slender buckwheat (*Eriogonum microthecum*) providing less cover. Total shrub cover has marginally decreased over the study years, but that of sagebrush has slightly increased when comparing 2006 data to 2021 data (**Figure 2.7**). According to average demographic data, total density of preferred browse populations has increased over time. Mature individuals comprised a majority of the population from 1996 through 2016. However, decadence increased in 2021, making decadent plants the dominant demographic that year. Recruitment of young has increased overall (**Figure 2.15**). Preferred browse utilization has fluctuated from year to year, but a majority of plants have shown little to no use in all sample years (**Figure 2.18**).

Average tree cover has increased overall with Utah juniper (*Juniperus osteosperma*) providing all cover. Point-quarter data reveals that juniper density has also increased over the sample period (**Figure 2.9**, **Figure 2.12**).

Herbaceous Understory: The herbaceous understory on this site has exhibited an overall decrease in both cover and frequency with native perennial grasses, mainly bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass

(*Poa secunda*), as the main component. Annual grasses have fluctuated in cover and frequency from year to year, but have remained rare in comparison to perennial grasses. Perennial forbs have decreased overall, and annual forbs have remained rare (**Figure 2.21**, **Figure 2.24**).

Occupancy: Average pellet transect data shows that animal occupancy has varied from year to year, but has decreased overall. Deer have been the primary occupants in all sample years with mean abundance of pellet groups ranging from 27.5 days use/acre in 2021 to 78 days use/acre in 2006. Mean abundance of elk pellet groups has been as low as 0 days use/acre in 2011, 2016, and 2021, and as high as 8 days use/acre in 2006. Finally, cattle pellet groups have had a mean abundance ranging from 0 days use/acre in 2011 to 4 days use/acre in 2006 (**Figure 2.27**).

Semidesert (Big Sagebrush)

There are four studies [State Line (02-30), South Crawford Mountains (02-31), Wood Pass (02-32), and Woodruff Co-op (02-36)] that are classified as Semidesert (Big Sagebrush) ecological sites. The State Line study is located at the intersection of two dirt roads near the Utah-Wyoming border, and the South Crawford Mountains site is situated just east of the southern portion of the Crawford Mountains. The Wood Pass study is found on the lower eastern slopes of the Crawford Mountains, south of Wood Pass. Finally, Woodruff Co-op is located on the Woodruff Co-op Wildlife-Livestock WMA near the Utah-Wyoming border (**Table 2.9**).

Shrubs/Trees: The main browse species on a majority of sites is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), although fourwing saltbush (*Atriplex canescens*) contributes more cover on the Woodruff Co-op site. Total average shrub cover decreased between 2016 and 2021, but has increased overall; South Crawford Mountains and State Line have been the study sites with the most sagebrush cover (**Figure 2.6**). Average preferred browse demographics show that total density has increased overall. Mature plants were the most prominent age class from 1996 through 2016. However, decadence increased in 2021 (largely due to the State Line and South Crawford Mountains studies), and decadent plants were the dominant demographic in that year. Recruitment of young has remained comparatively low, but has increased overall over the study period (**Figure 2.16**). Average preferred browse utilization has decreased over the sample years; 12% and 18.5% of plants showed signs of moderate and heavy use, respectively, in 2021 (**Figure 2.19**).

Overall tree cover has decreased over the sample years, with the Wood Pass study being the only one to contribute tree cover. Density has also decreased throughout the years, with Wood Pass again being the sole contributor in most sample years. The exceptions to this are in 1996, when Woodruff Co-op also contributed tree density, and in 2021, when Utah juniper (*Juniperus osteosperma*) was observed on the South Crawford Mountains site. (**Figure 2.10**, **Figure 2.13**).

Herbaceous Understory: The average cover and frequency of the understories of these sites has varied from year to year, but have displayed decreasing trends when comparing 1996 data to 2021 data. Perennial grasses are, on average, the dominant herbaceous component and are largely comprised of species such as Sandberg bluegrass (*Poa secunda*): the exception to this is the Woodruff Co-op study, which is dominated by crested wheatgrass (*Agropyron cristatum*). The average cover and frequency of annual grass has remained low overall (**Figure 2.22**, **Figure 2.25**).

Occupancy: Average pellet transect data shows that overall animal presence has decreased over time and that deer were the primary occupants in all sample years except 2016, when most pellet groups were contributed by cattle. The mean abundance of deer pellet groups has been as low as 17 days use/acre in 2006 and as high as 42 days use/acre in 2011. Elk have also been present on this site, with an average pellet group abundance ranging from 0.3 days use/acre in 2016 to 13 days use/acre in 2006. Finally, the mean abundance of cattle pellet groups has ranged from 2 days use/acre in 2011 to 27 days use/acre in 2016 (**Figure 2.28**).

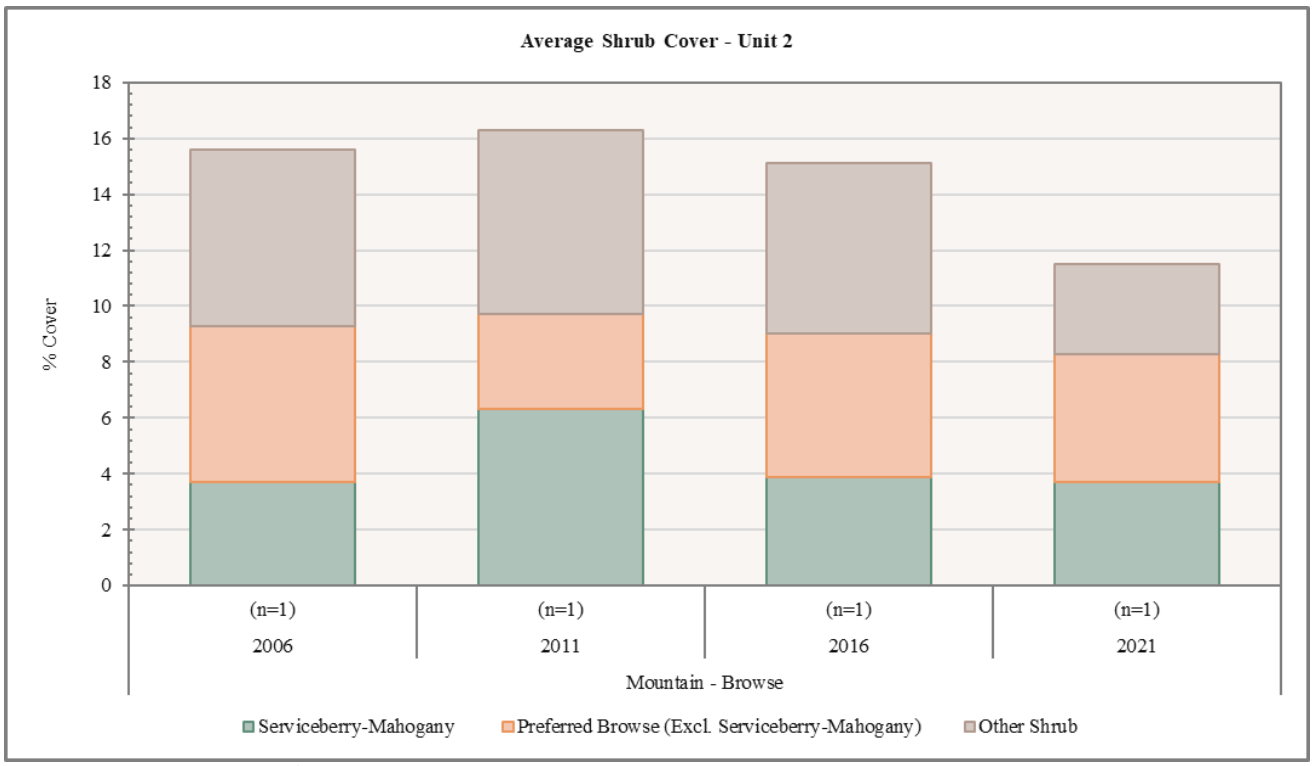


Figure 2.3: Average shrub cover for Mountain - Browse study sites in WMU 2, Cache.

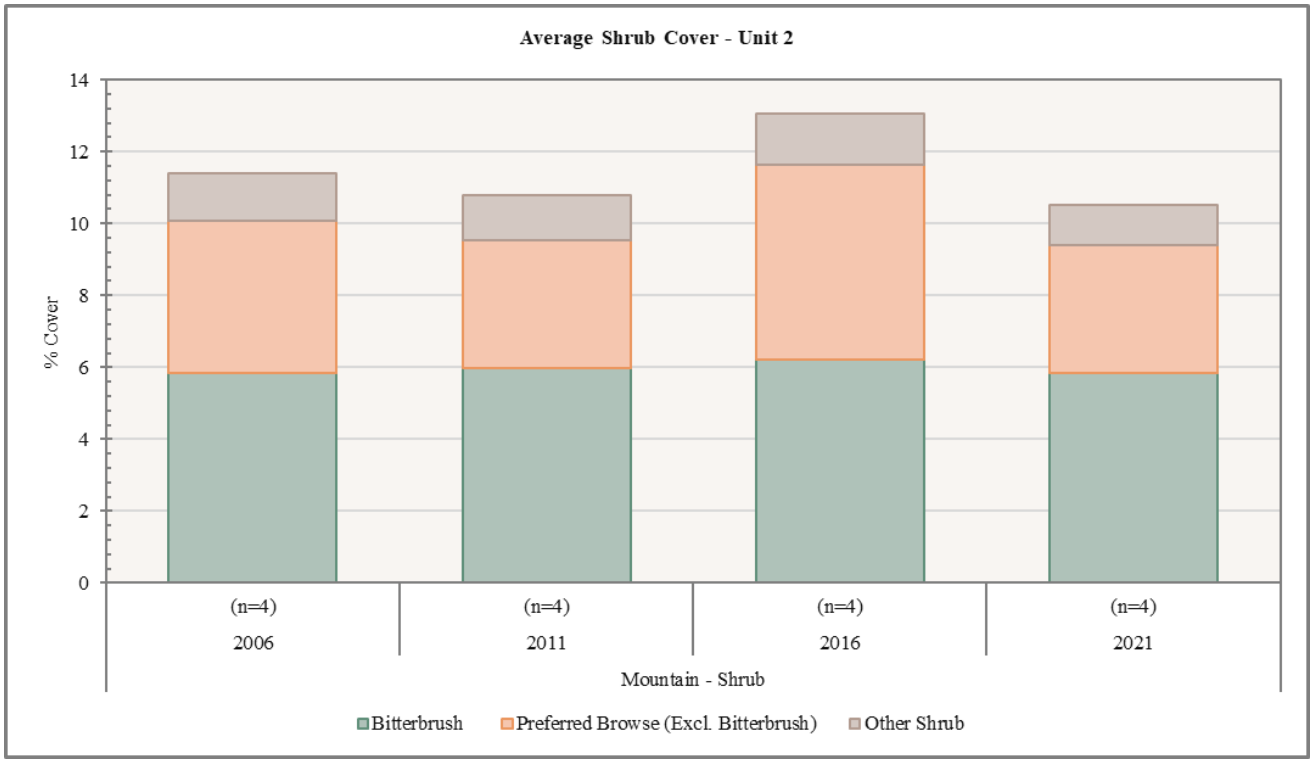


Figure 2.4: Average shrub cover for Mountain - Shrub study sites in WMU 2, Cache.

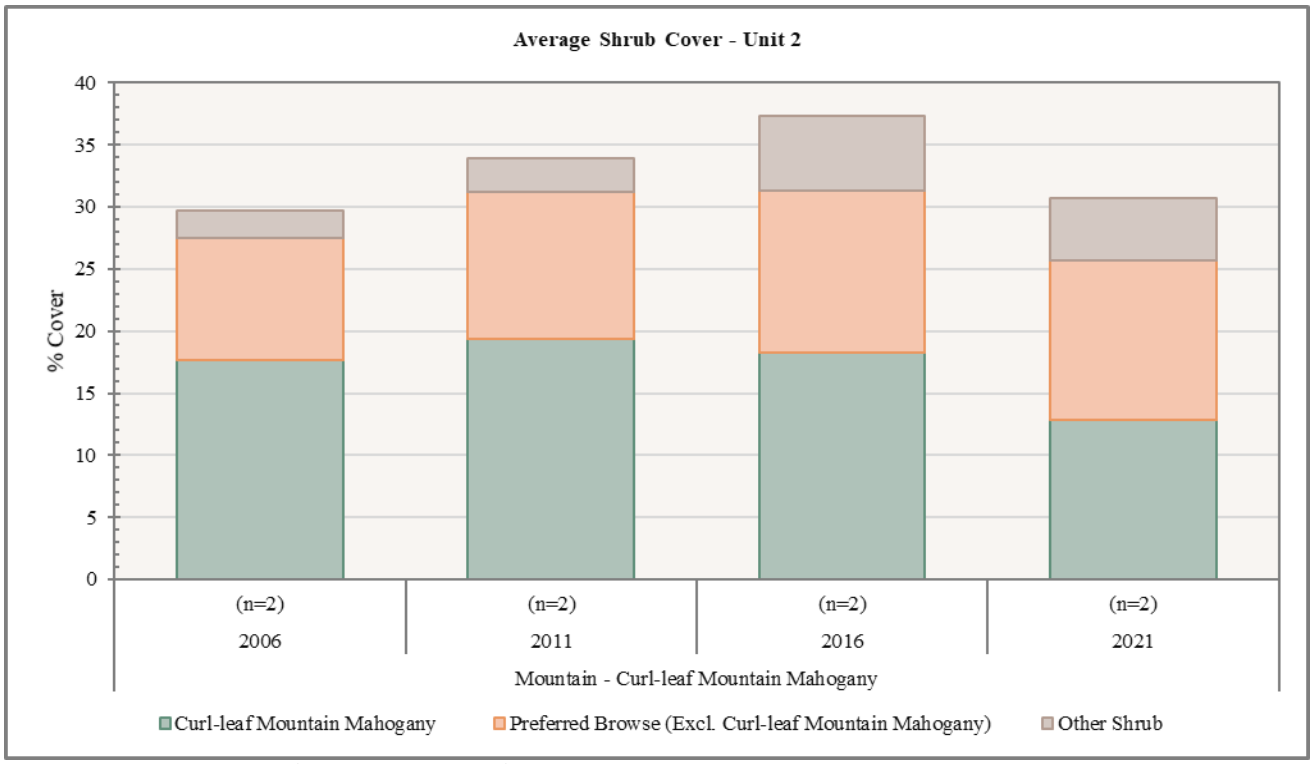


Figure 2.5: Average shrub cover for Mountain - Curl-Leaf Mountain Mahogany study sites in WMU 2, Cache.

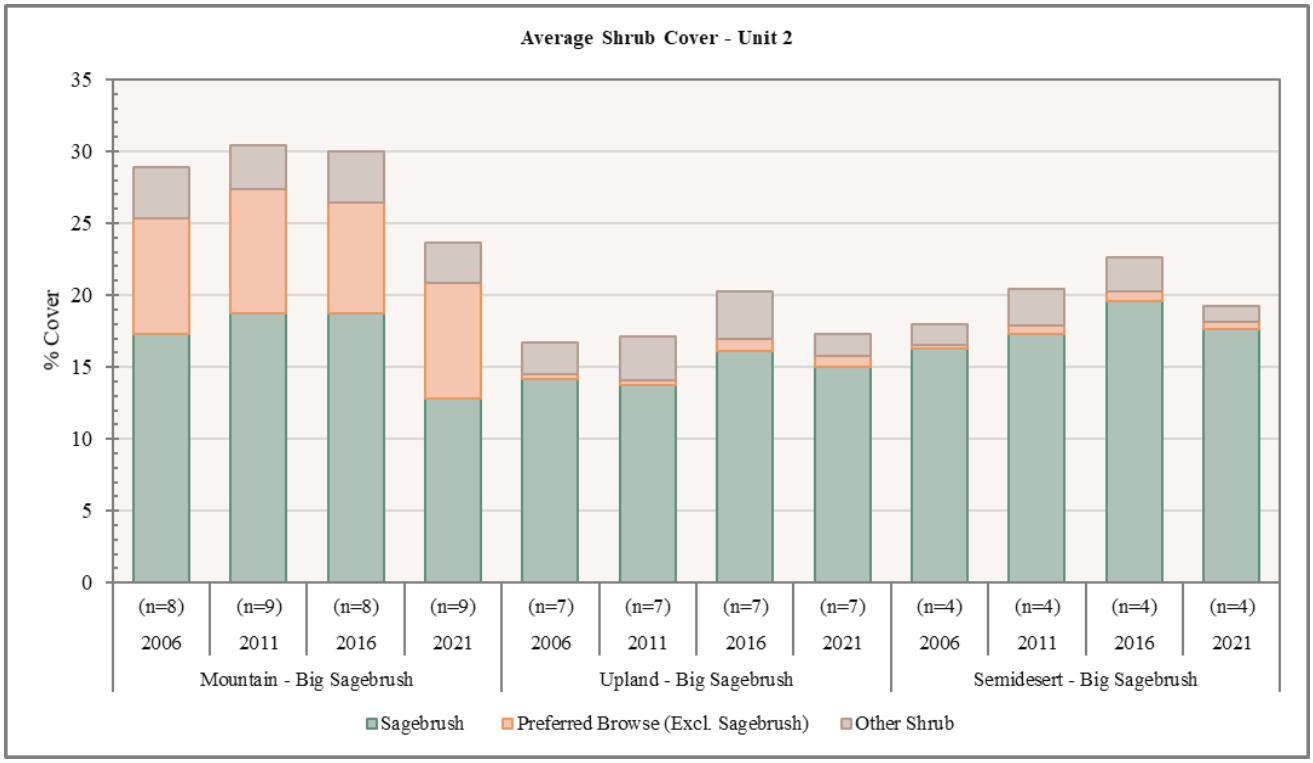


Figure 2.6: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 2, Cache.

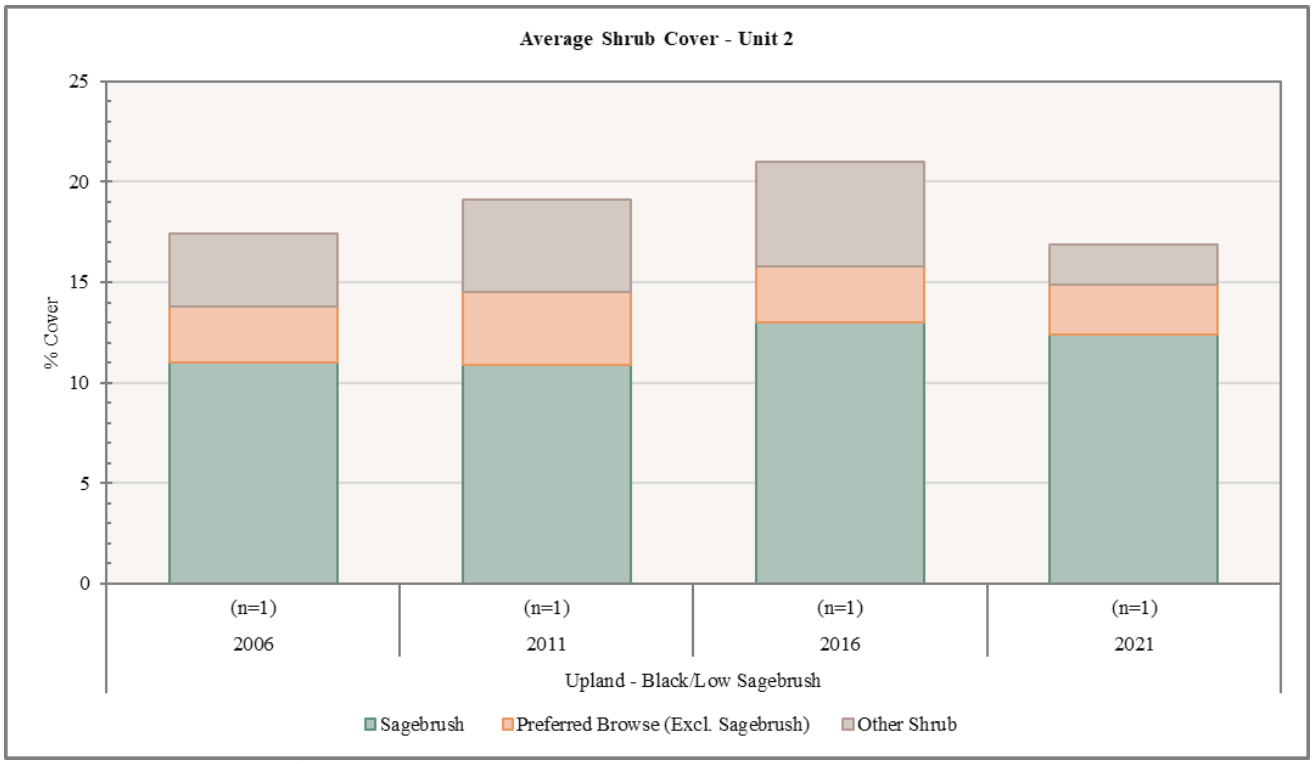


Figure 2.7: Average shrub cover for Upland - Black/Low Sagebrush study sites in WMU 2, Cache.

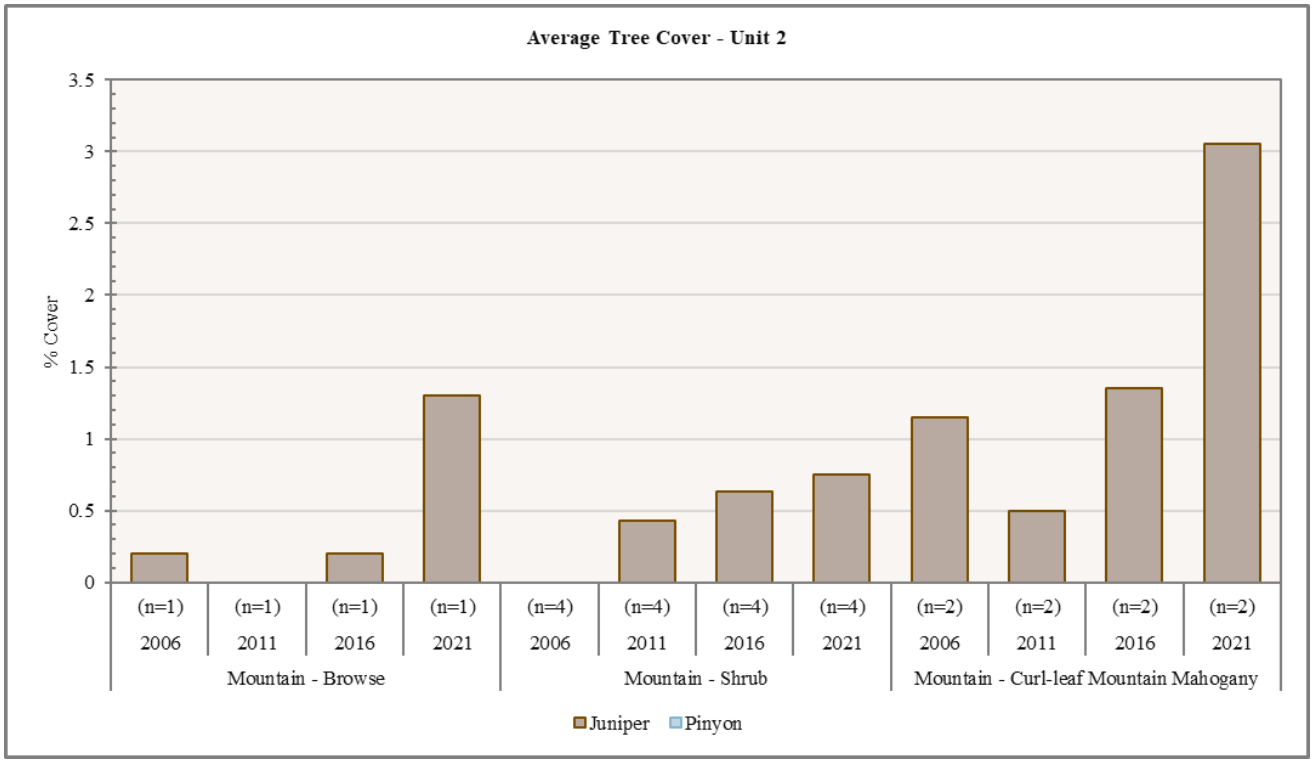


Figure 2.8: Average tree cover for Mountain - Browse, Mountain - Shrub, and Mountain - Curl-leaf Mountain Mahogany study sites in WMU 2, Cache.

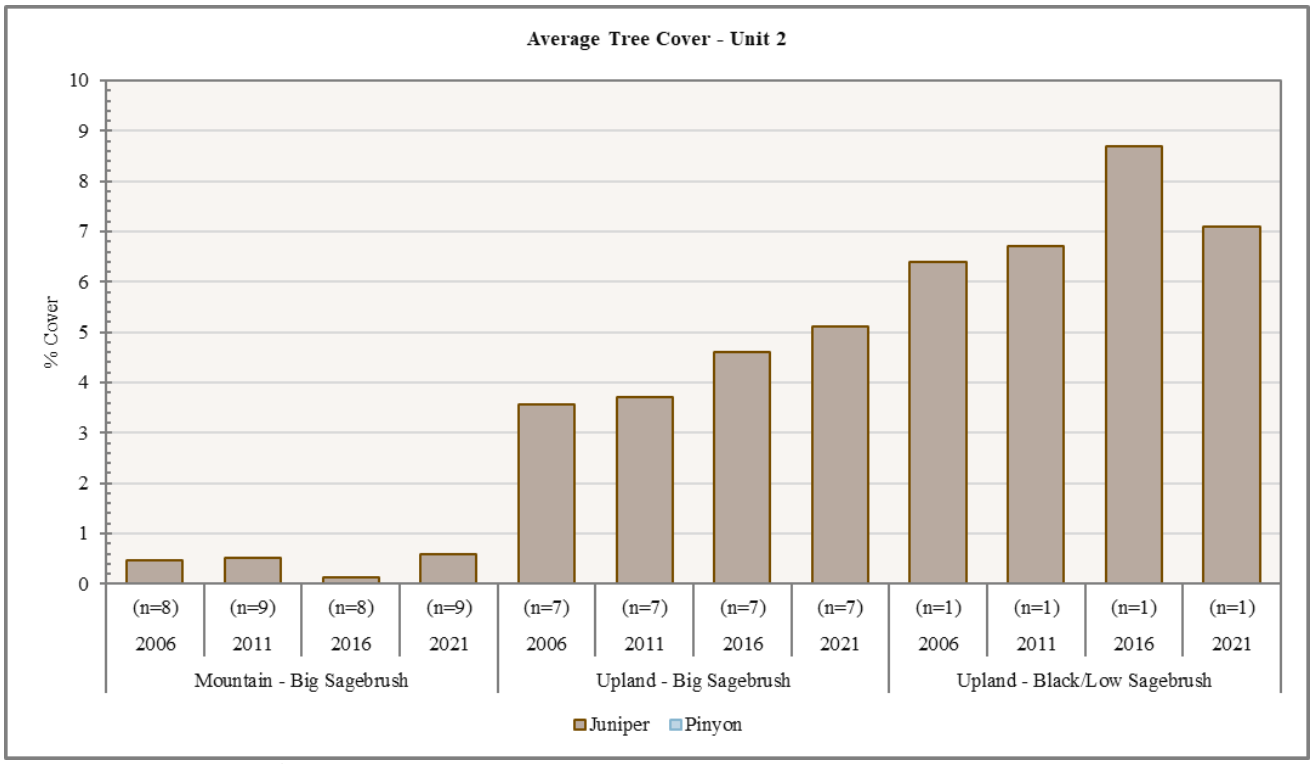


Figure 2.9: Average tree cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 2, Cache.

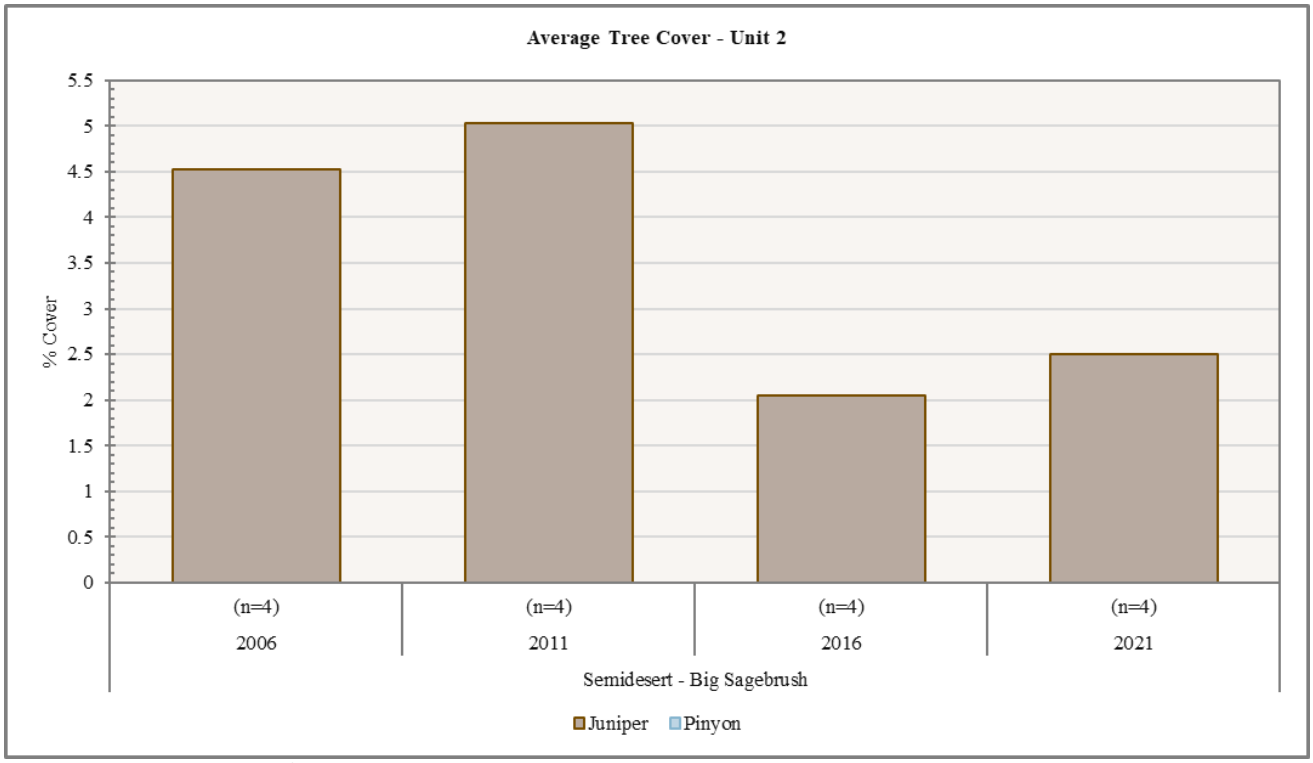


Figure 2.10: Average tree cover for Semidesert - Big Sagebrush study sites in WMU 2, Cache.

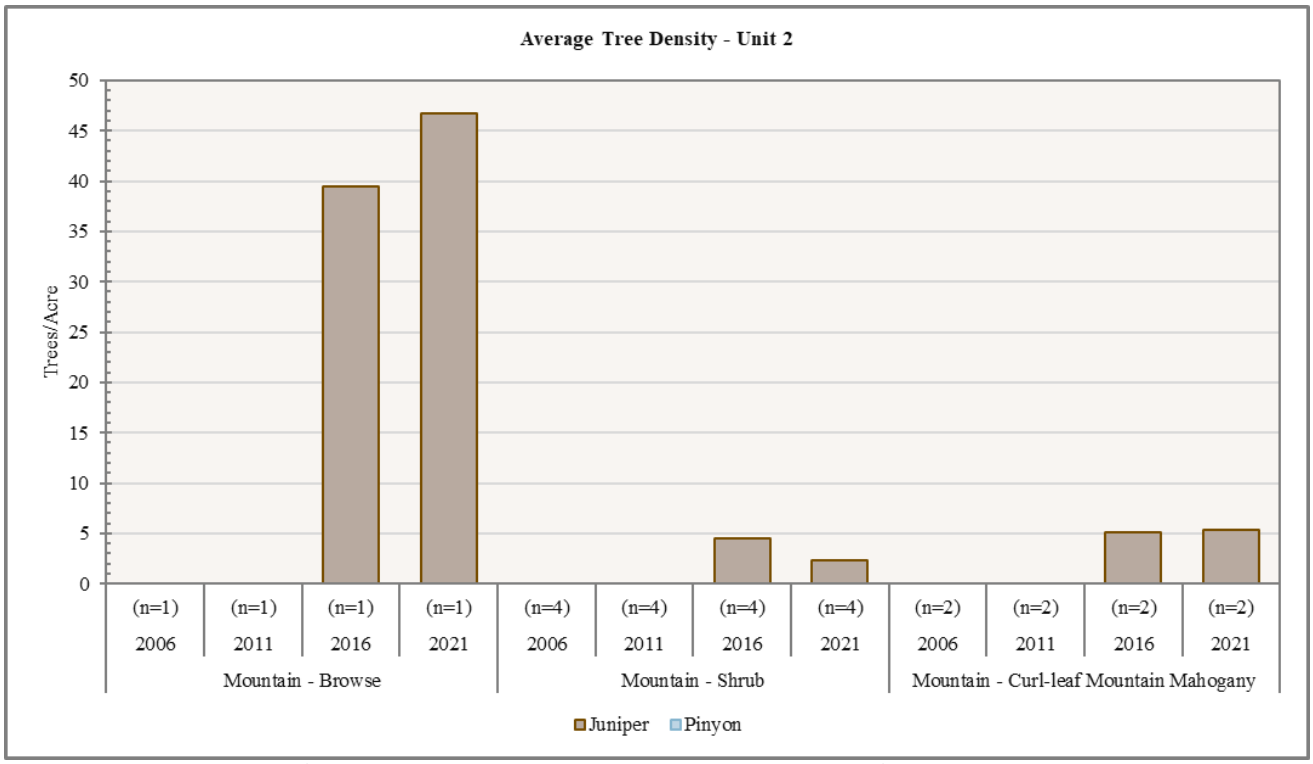


Figure 2.11: Average tree density for Mountain - Browse, Mountain - Shrub, and Mountain - Curl-leaf Mountain Mahogany study sites in WMU 2, Cache.

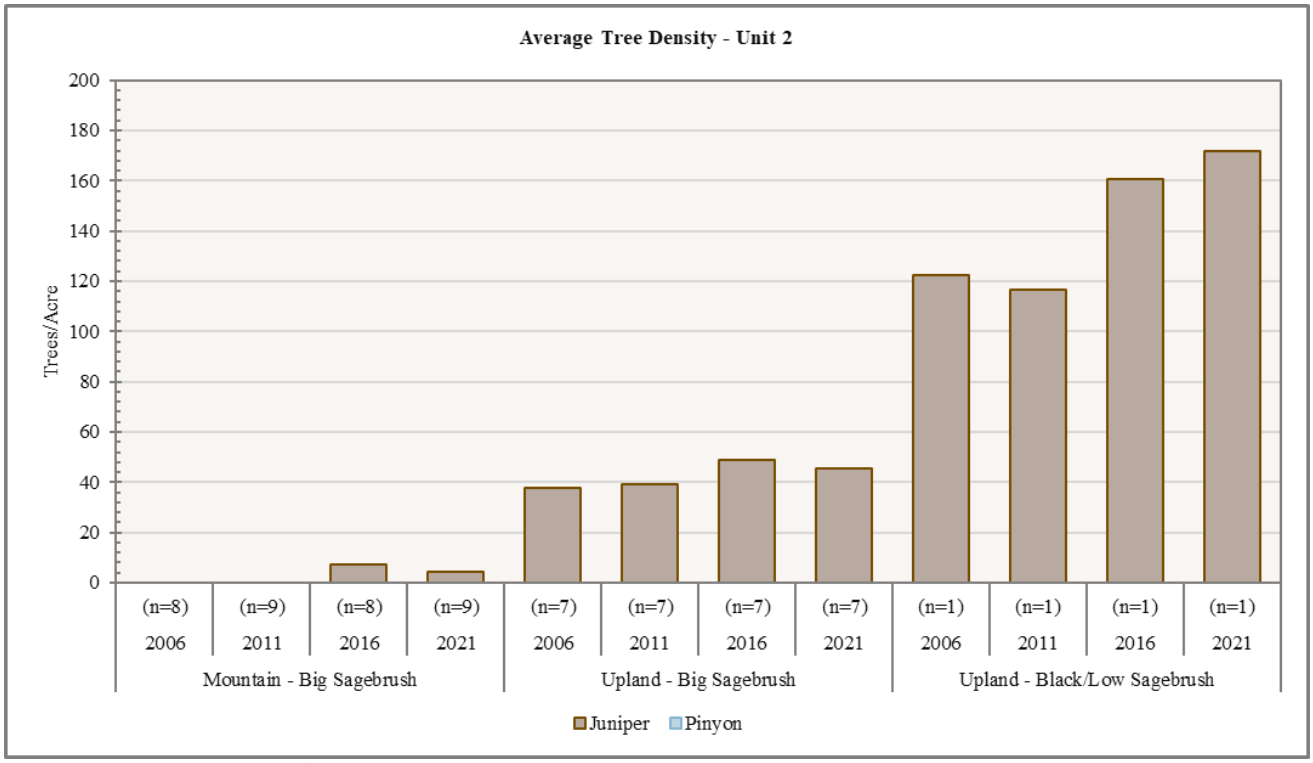


Figure 2.12: Average tree density for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 2, Cache.

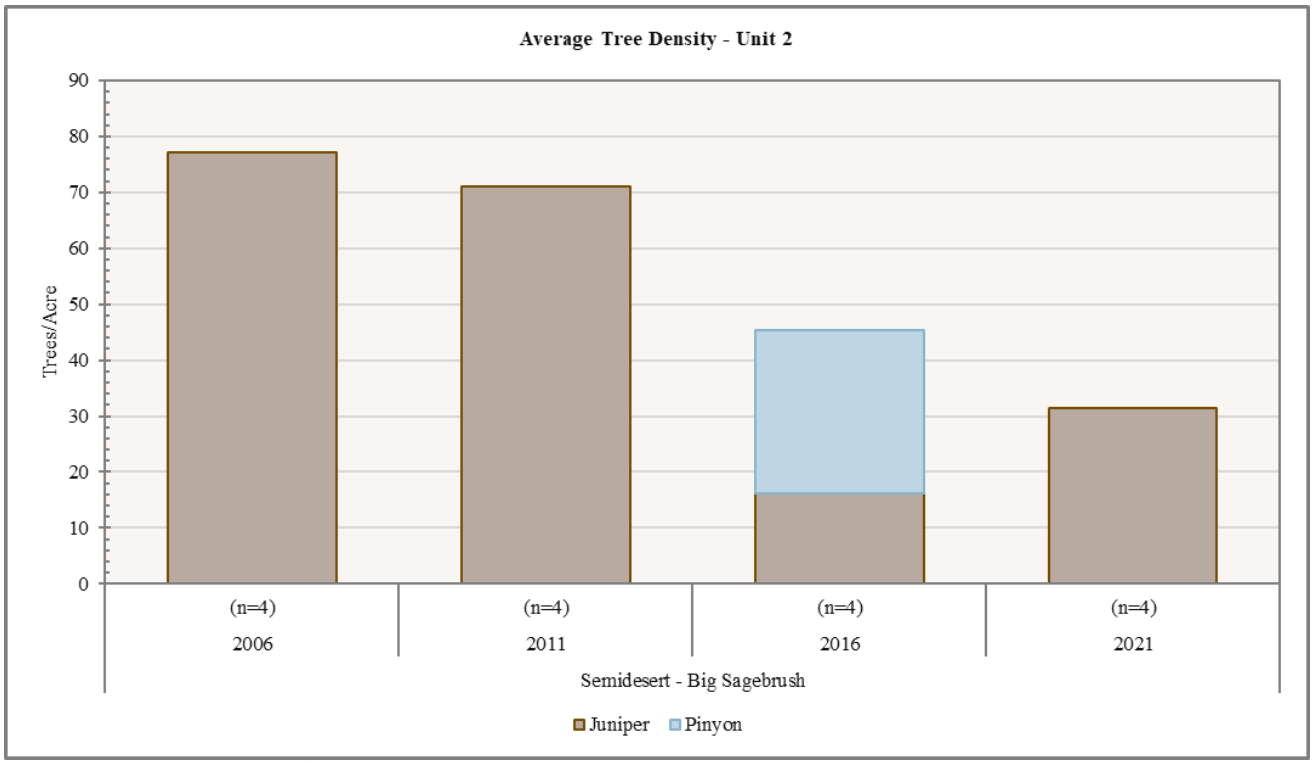


Figure 2.13: Average tree density for Semidesert - Big Sagebrush study sites in WMU 2, Cache.

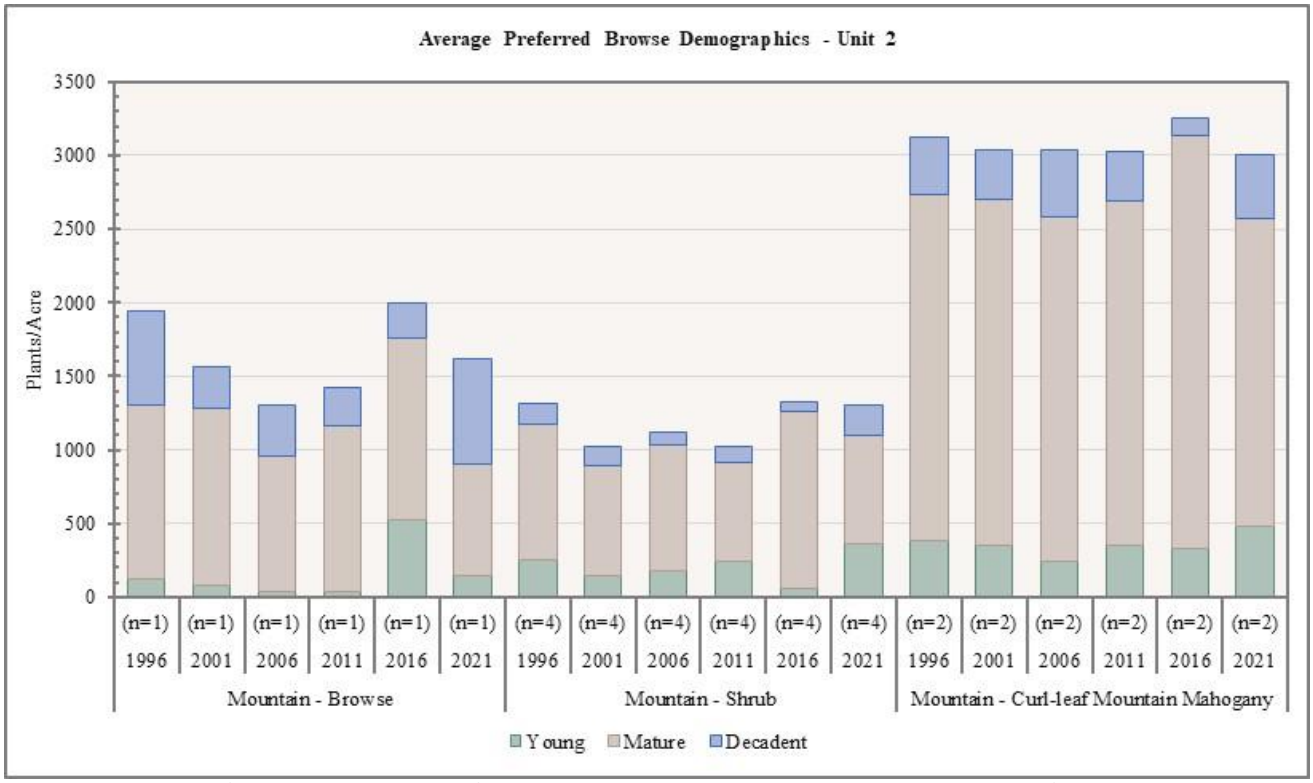


Figure 2.14: Average preferred browse demographics for Mountain - Browse, Mountain - Shrub, and Mountain - Curl-leaf Mountain Mahogany study sites in WMU 2, Cache.

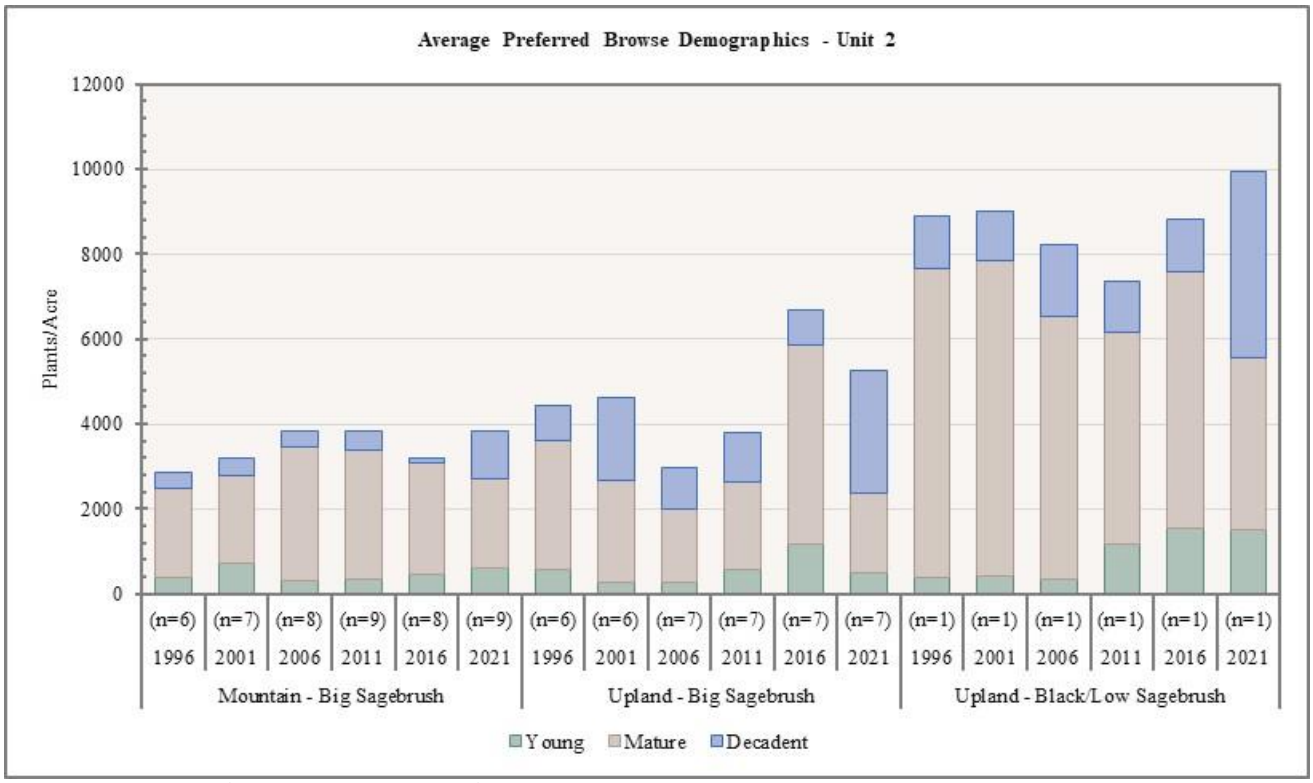


Figure 2.15: Average preferred browse demographics for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland –Black/Low Sagebrush study sites in WMU 2, Cache.

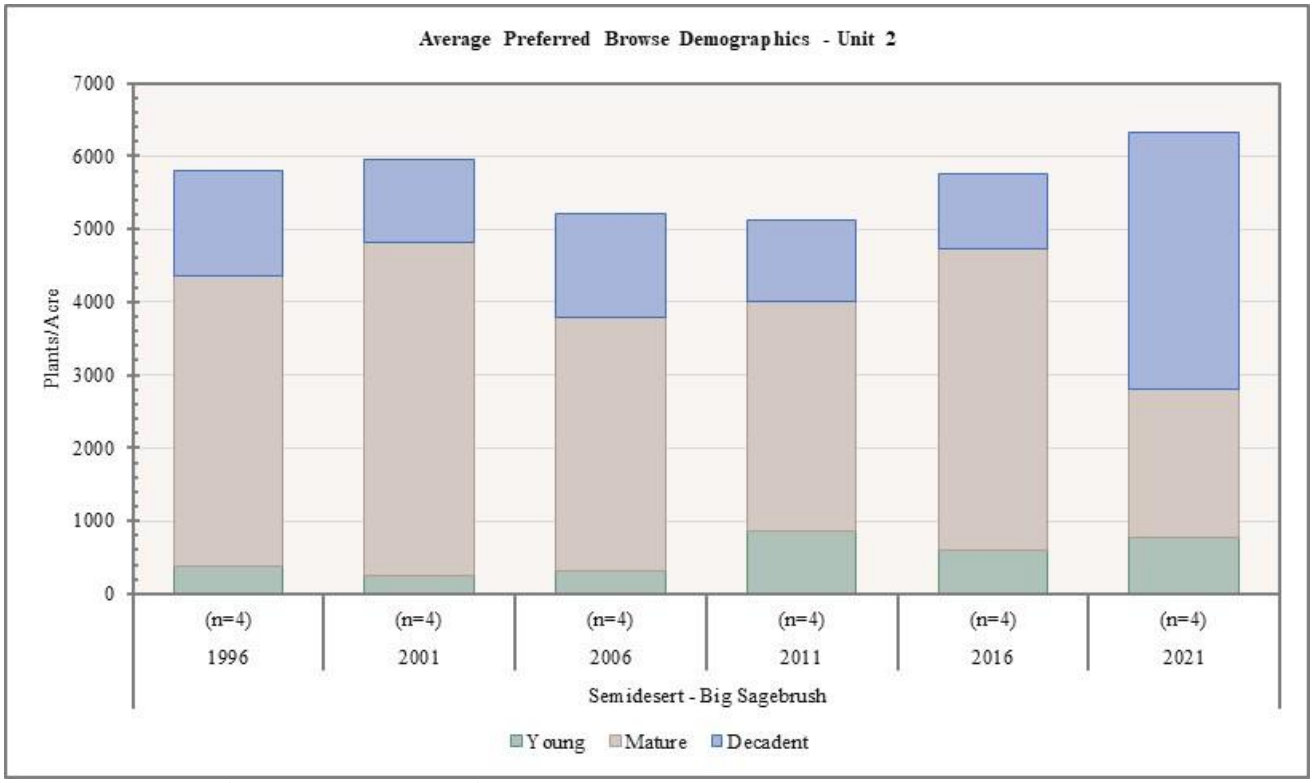


Figure 2.16: Average preferred browse demographics for Semidesert - Big Sagebrush study sites in WMU 2, Cache.

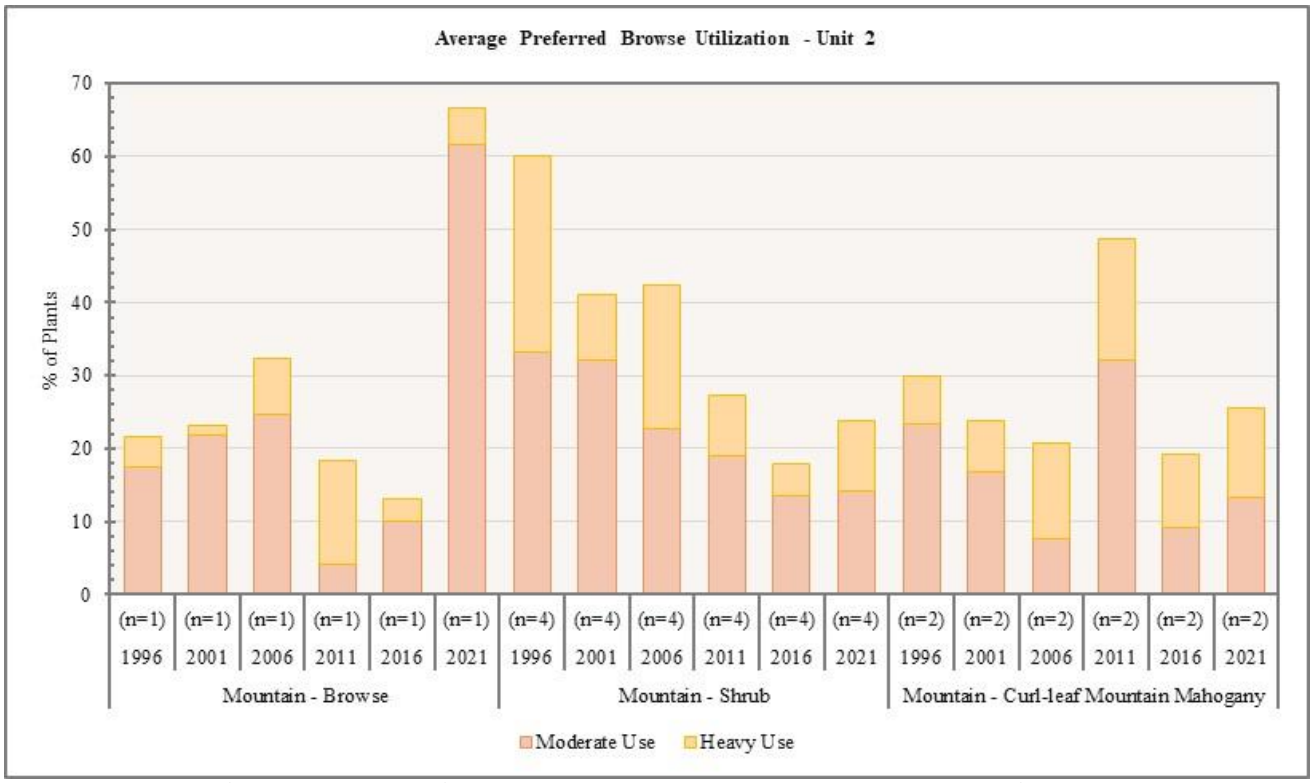


Figure 2.17: Average preferred browse utilization for Mountain - Browse, Mountain - Shrub, and Mountain - Curl-leaf Mountain Mahogany study sites in WMU 2, Cache.

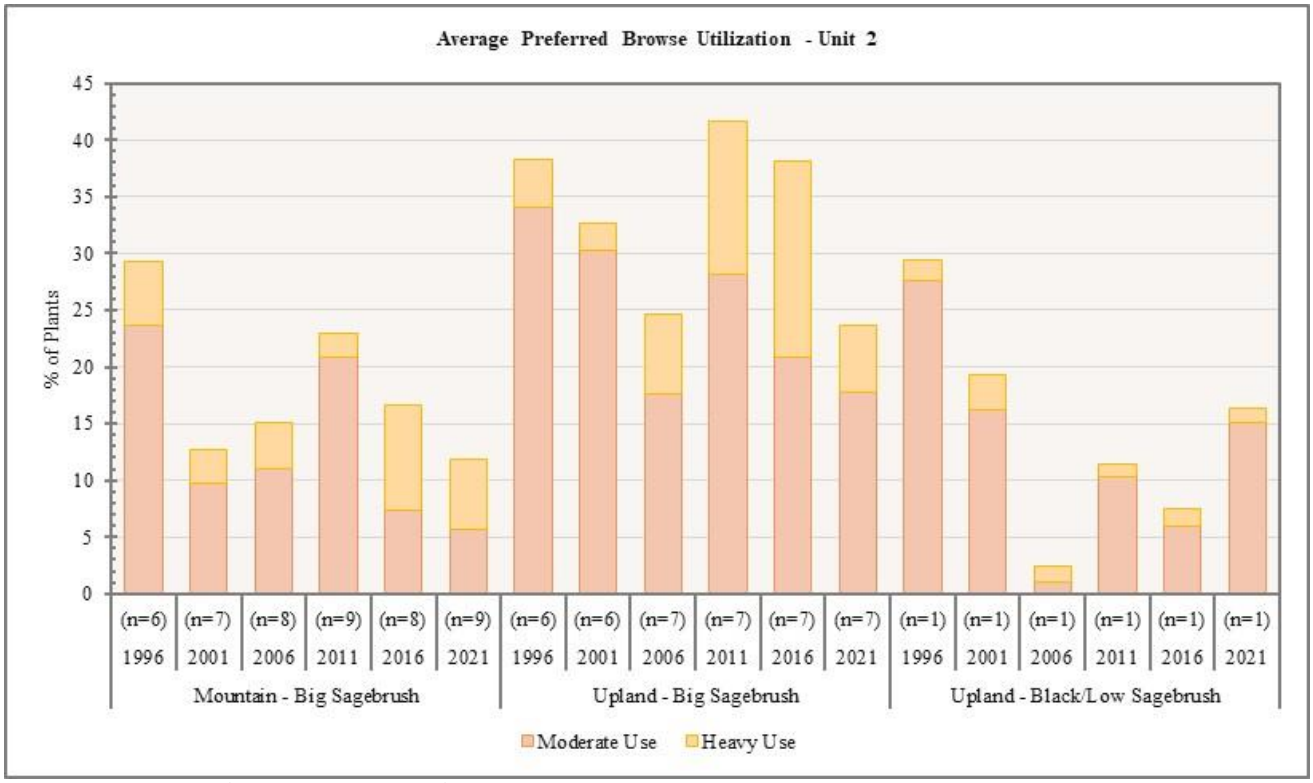


Figure 2.18: Average preferred browse utilization for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 2, Cache.

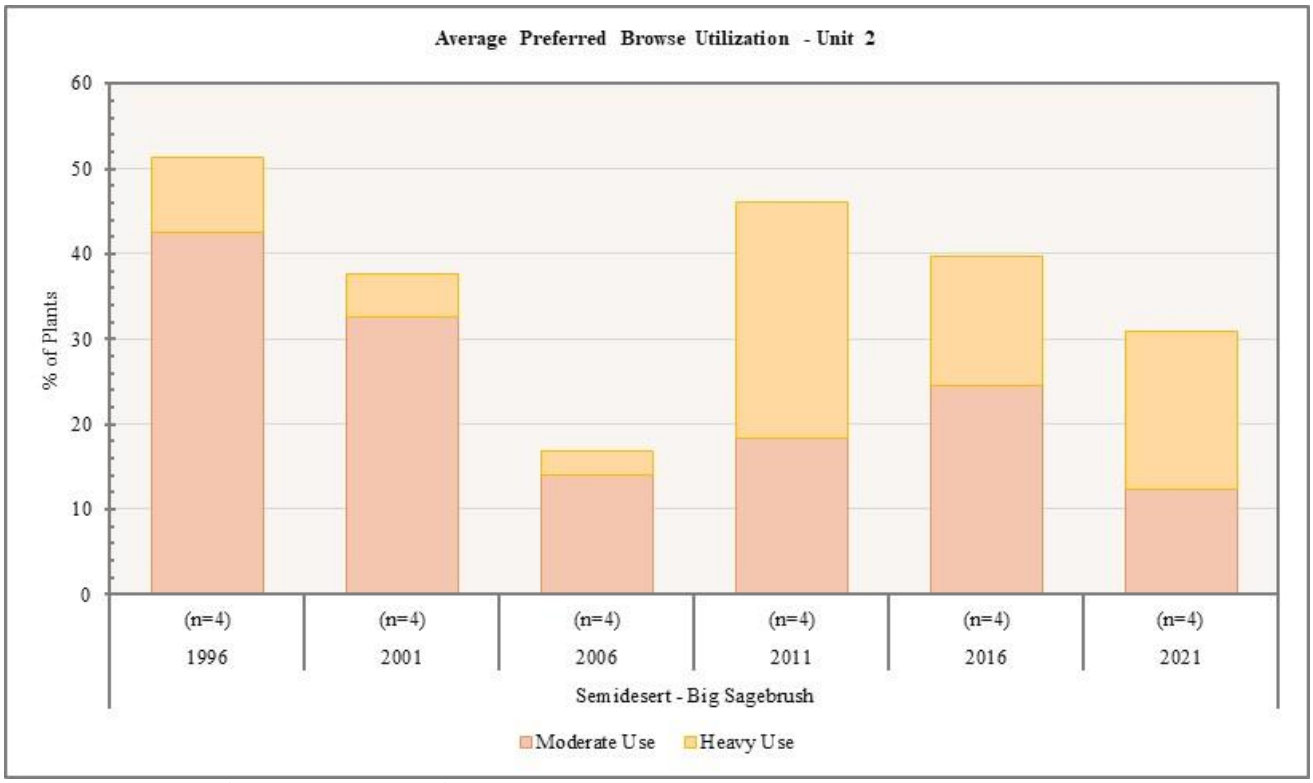


Figure 2.19: Average preferred browse utilization for Semidesert - Big Sagebrush study sites in WMU 2, Cache.

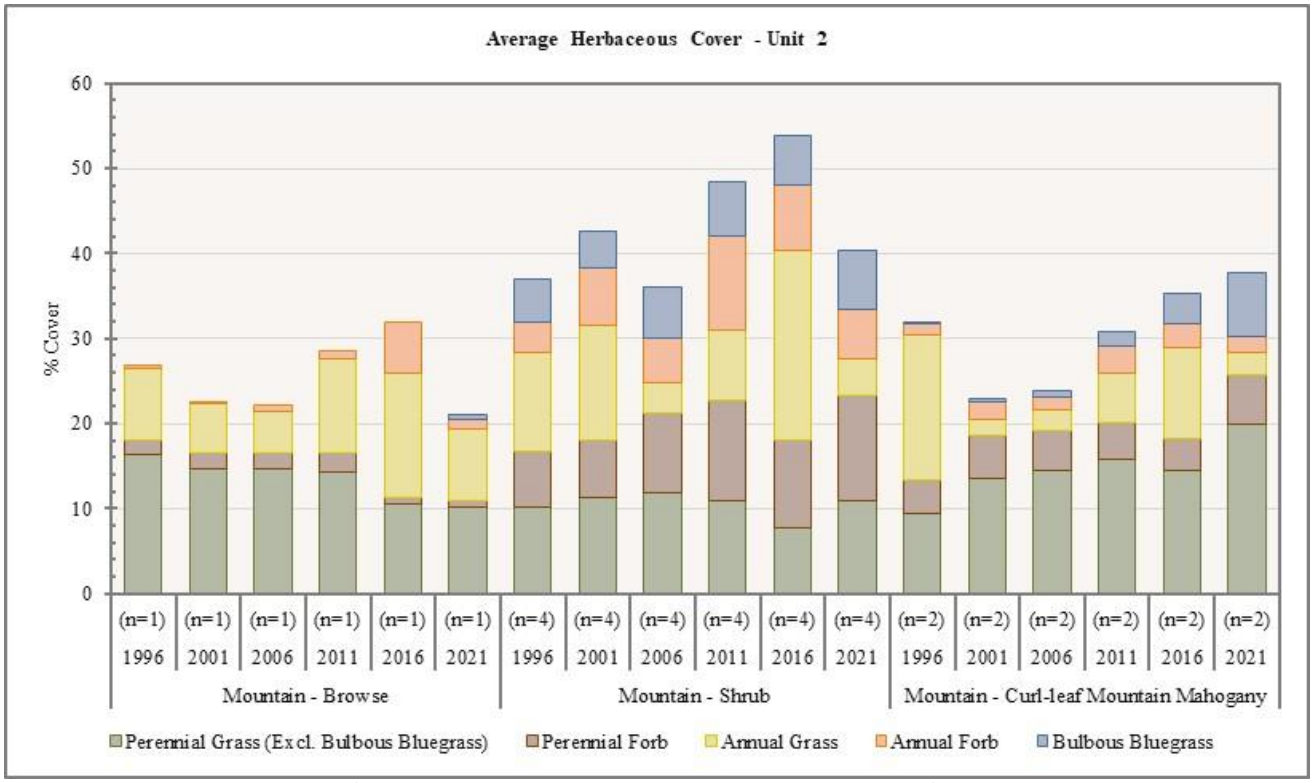


Figure 2.20: Average herbaceous cover for Mountain - Browse, Mountain - Shrub, and Mountain - Curl-leaf Mountain Mahogany study sites in WMU 2, Cache.

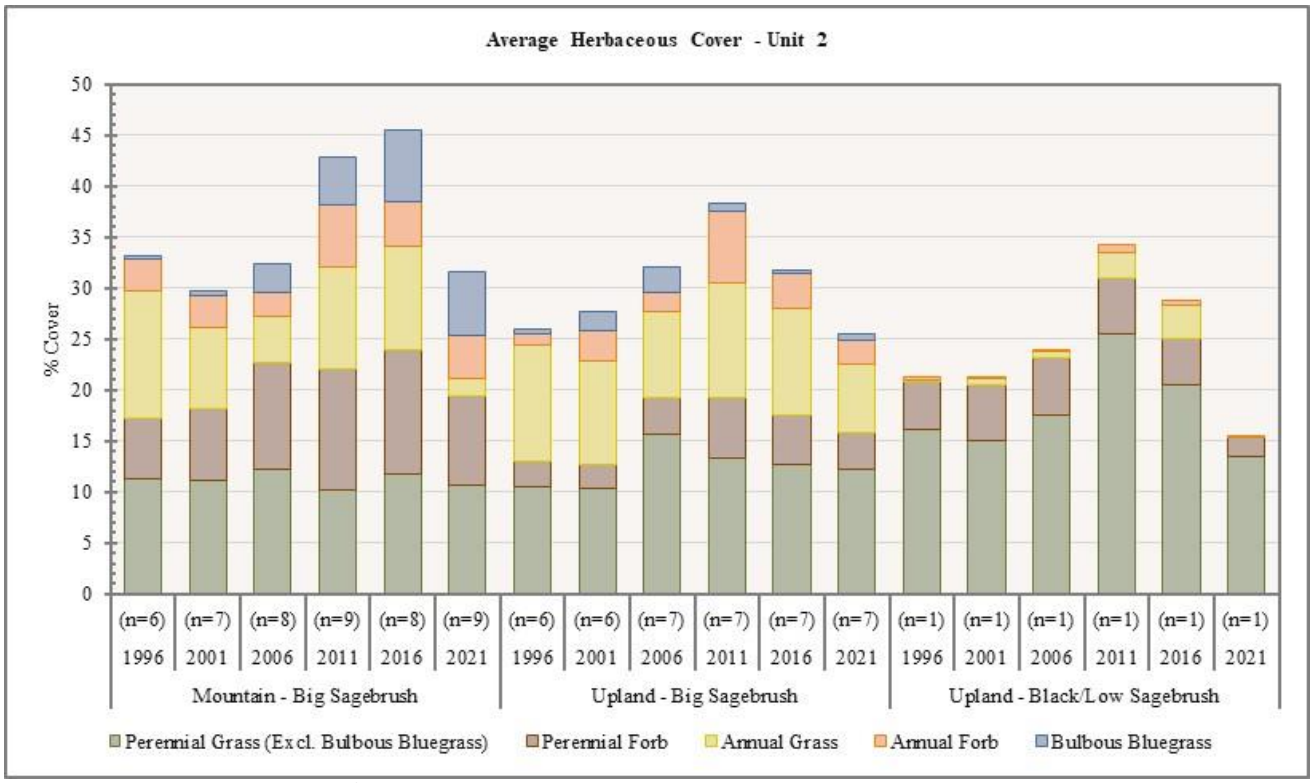


Figure 2.21: Average herbaceous cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 2, Cache.

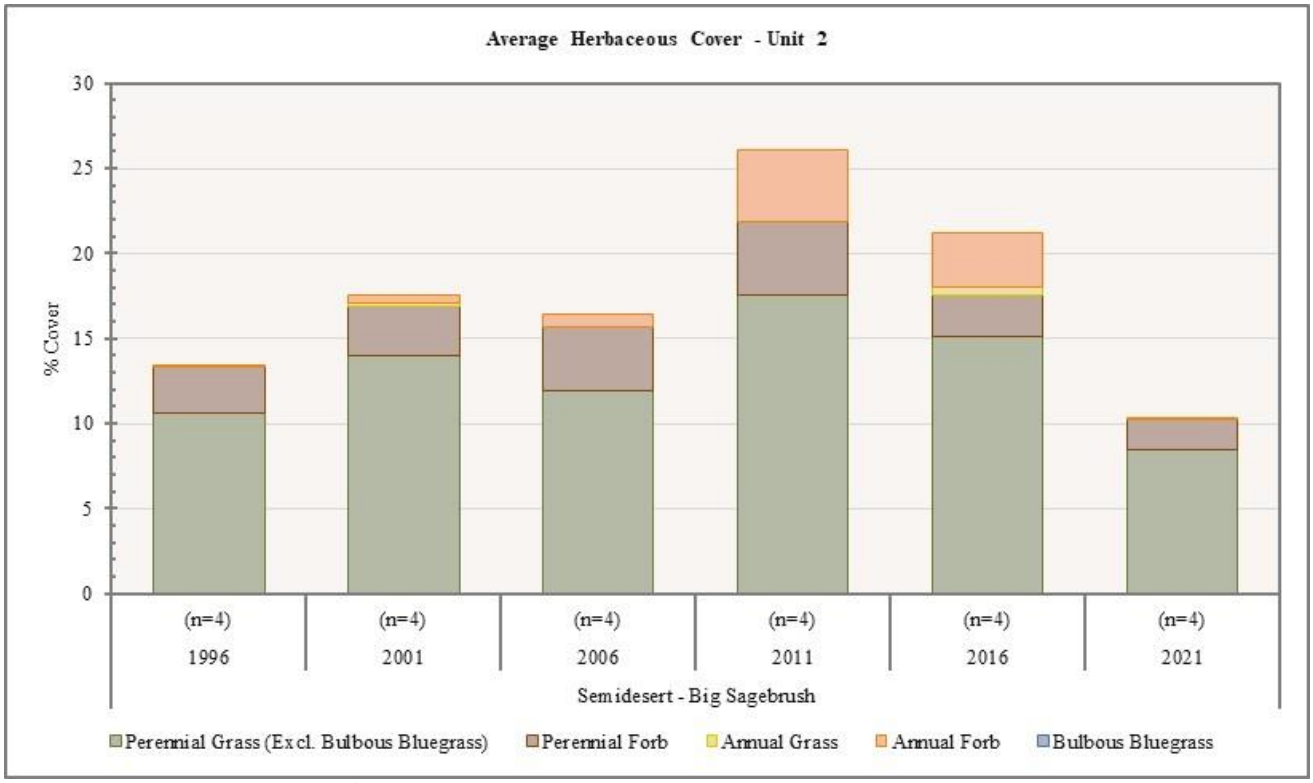


Figure 2.22: Average herbaceous cover for Semidesert - Big Sagebrush study sites in WMU 2, Cache.

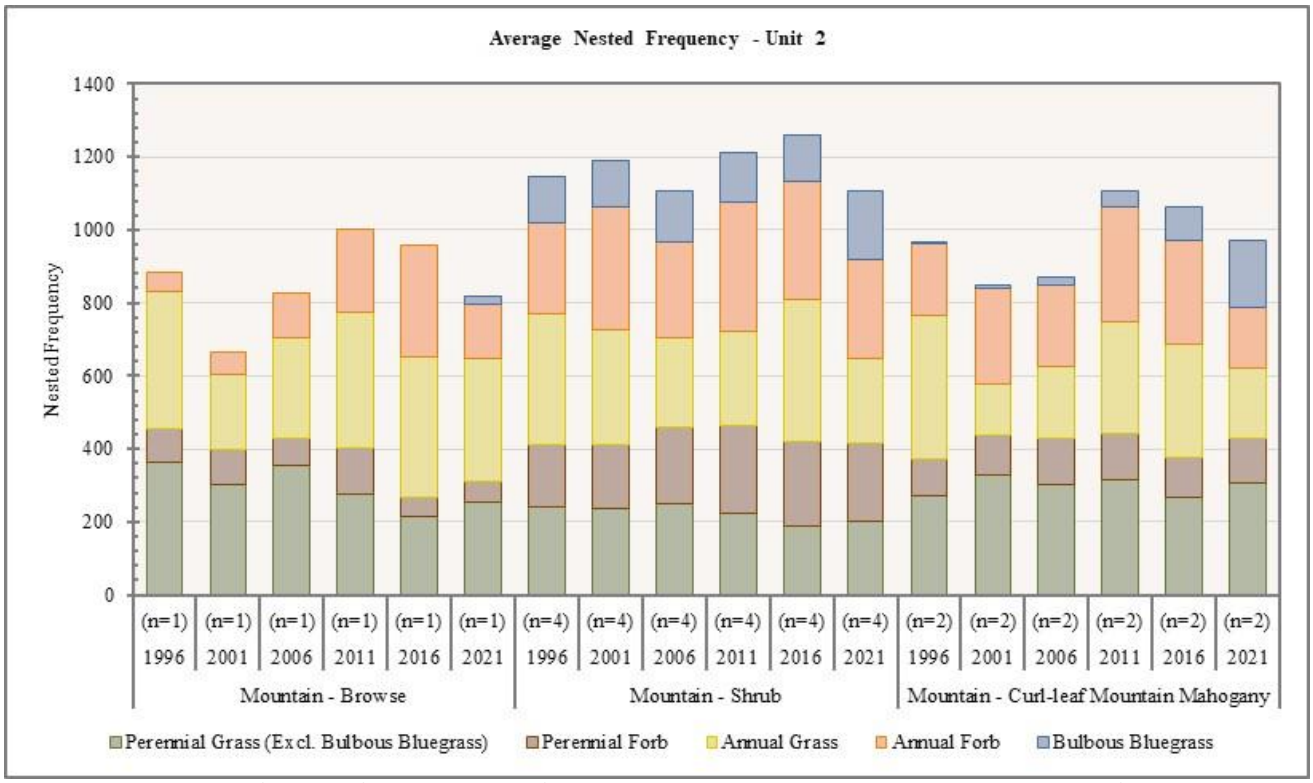


Figure 2.23: Average nested frequency of herbaceous species for Mountain - Browse, Mountain - Shrub, and Mountain - Curl-leaf Mountain Mahogany study sites in WMU 2, Cache.

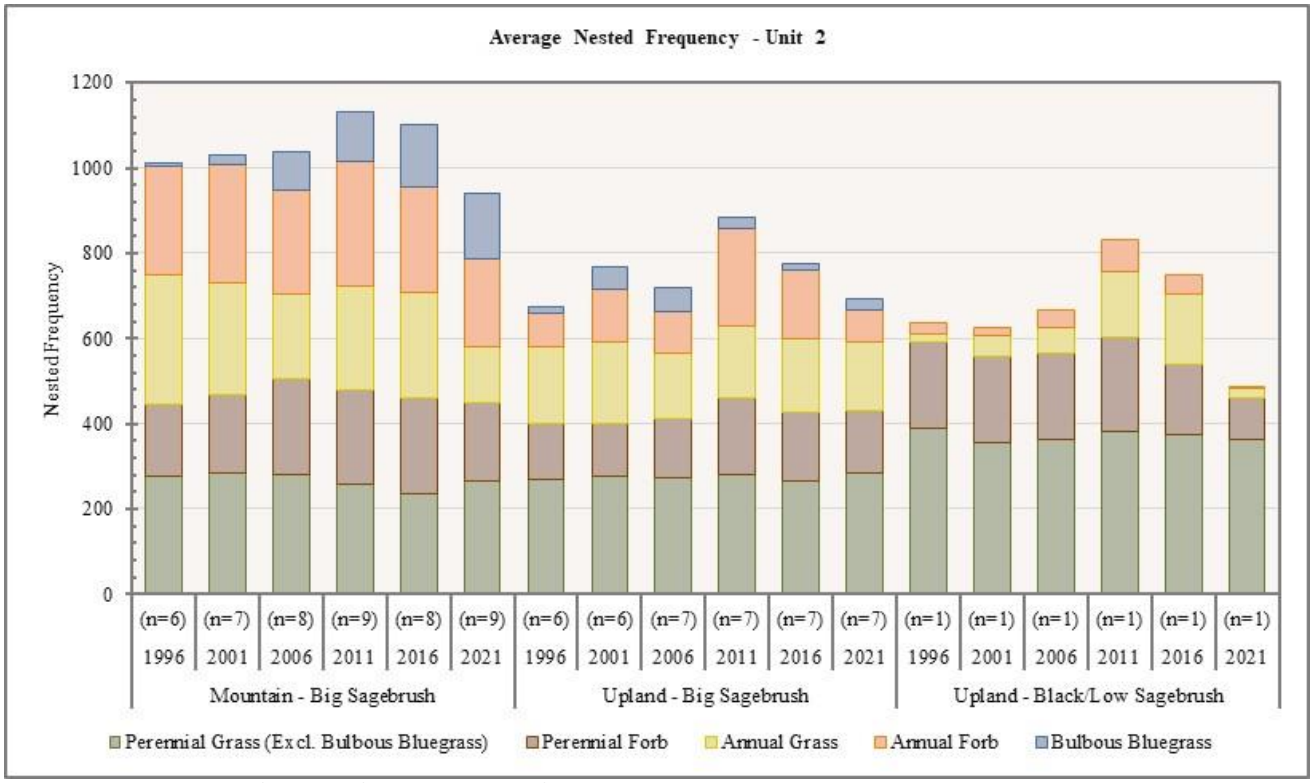


Figure 2.24: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 2, Cache.

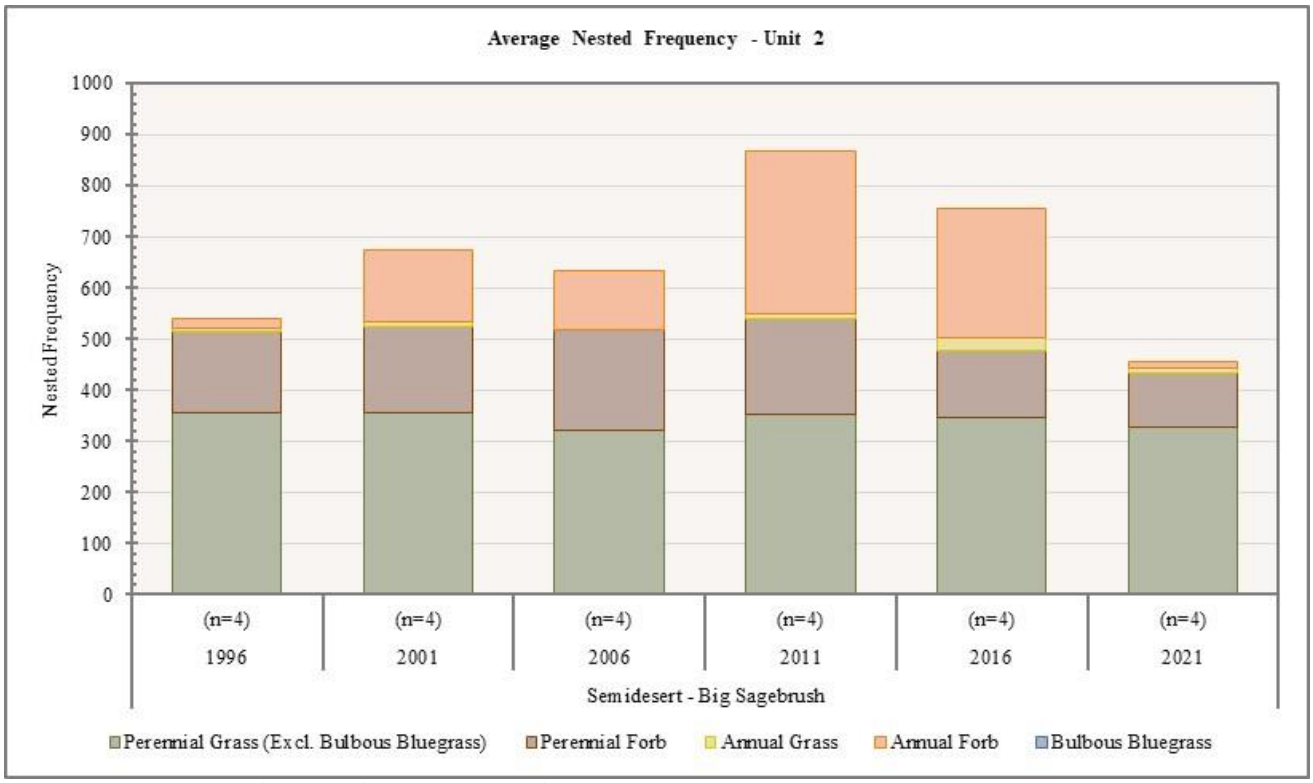


Figure 2.25: Average nested frequency of herbaceous species for Semidesert - Big Sagebrush study sites in WMU 2, Cache.

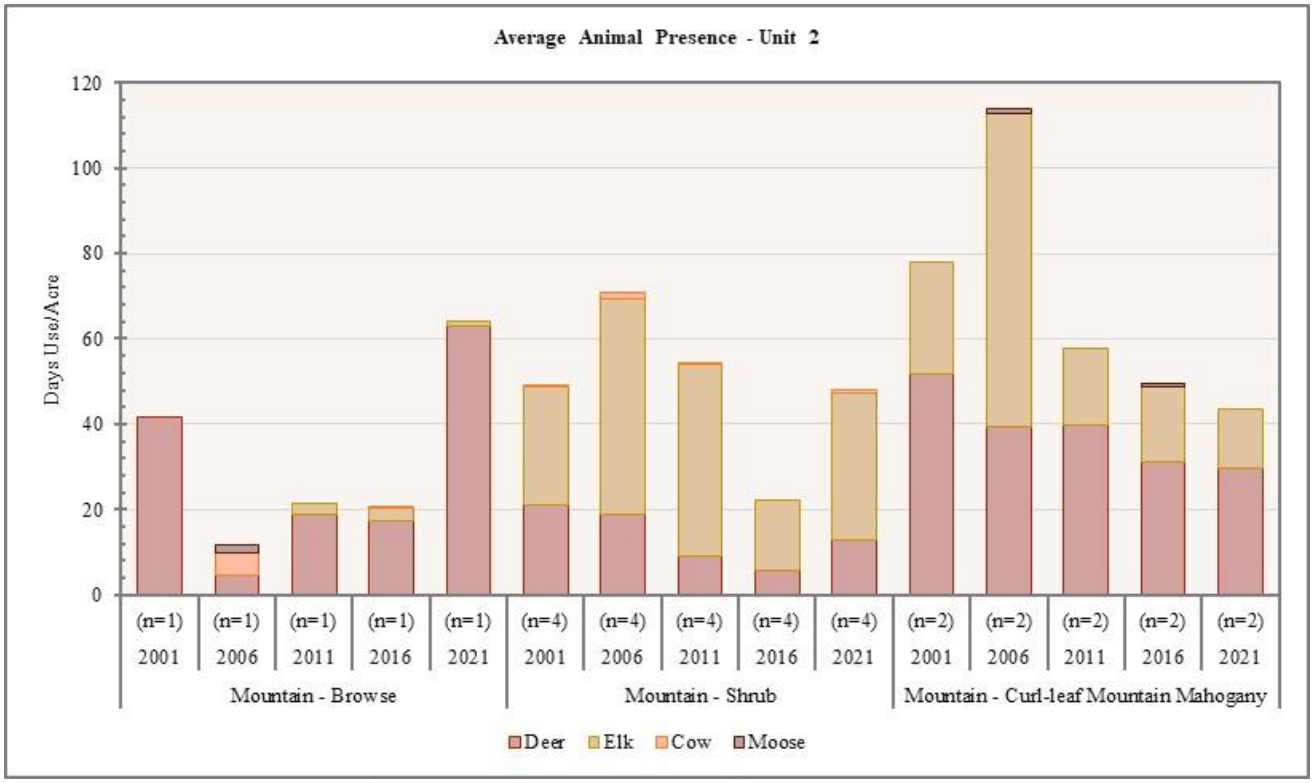


Figure 2.26: Average pellet transect data for Mountain - Browse, Mountain - Shrub, and Mountain - Curl-leaf Mountain Mahogany study sites in WMU 2, Cache.

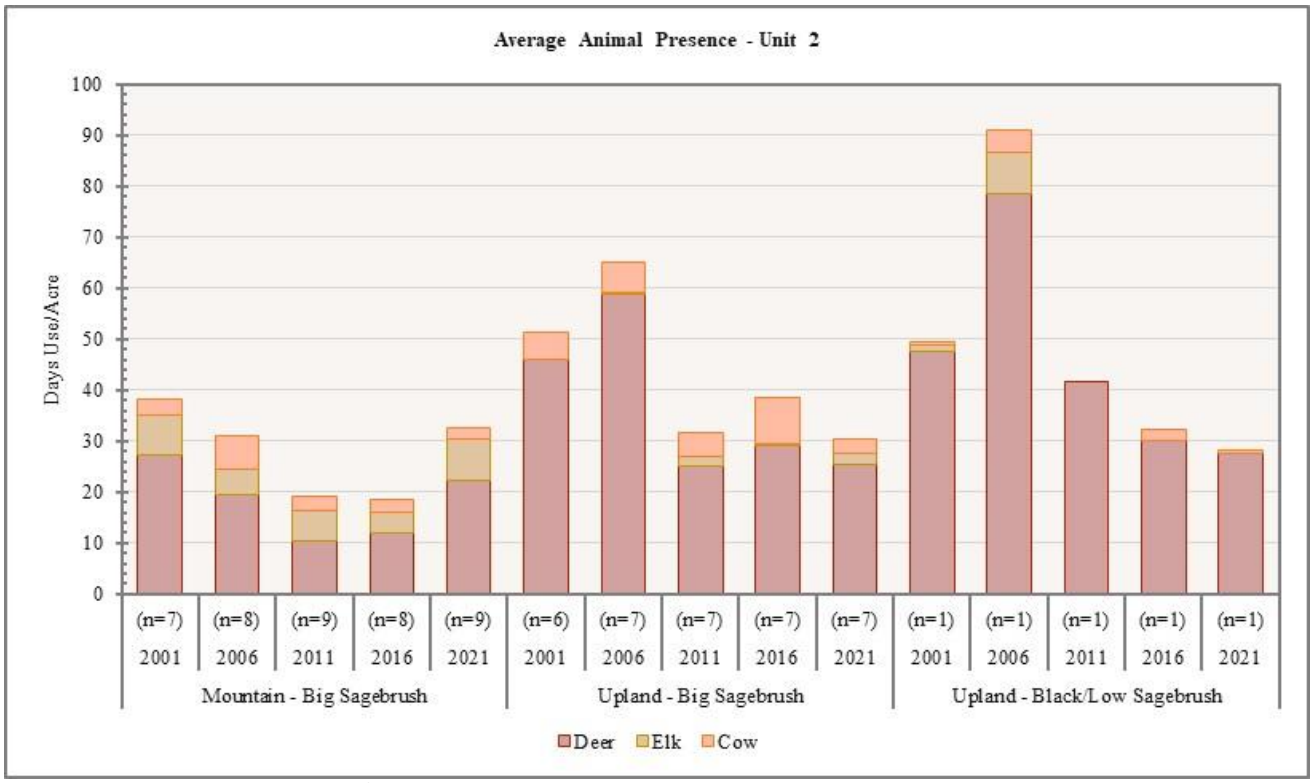


Figure 2.27: Average pellet transect data for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 2, Cache.

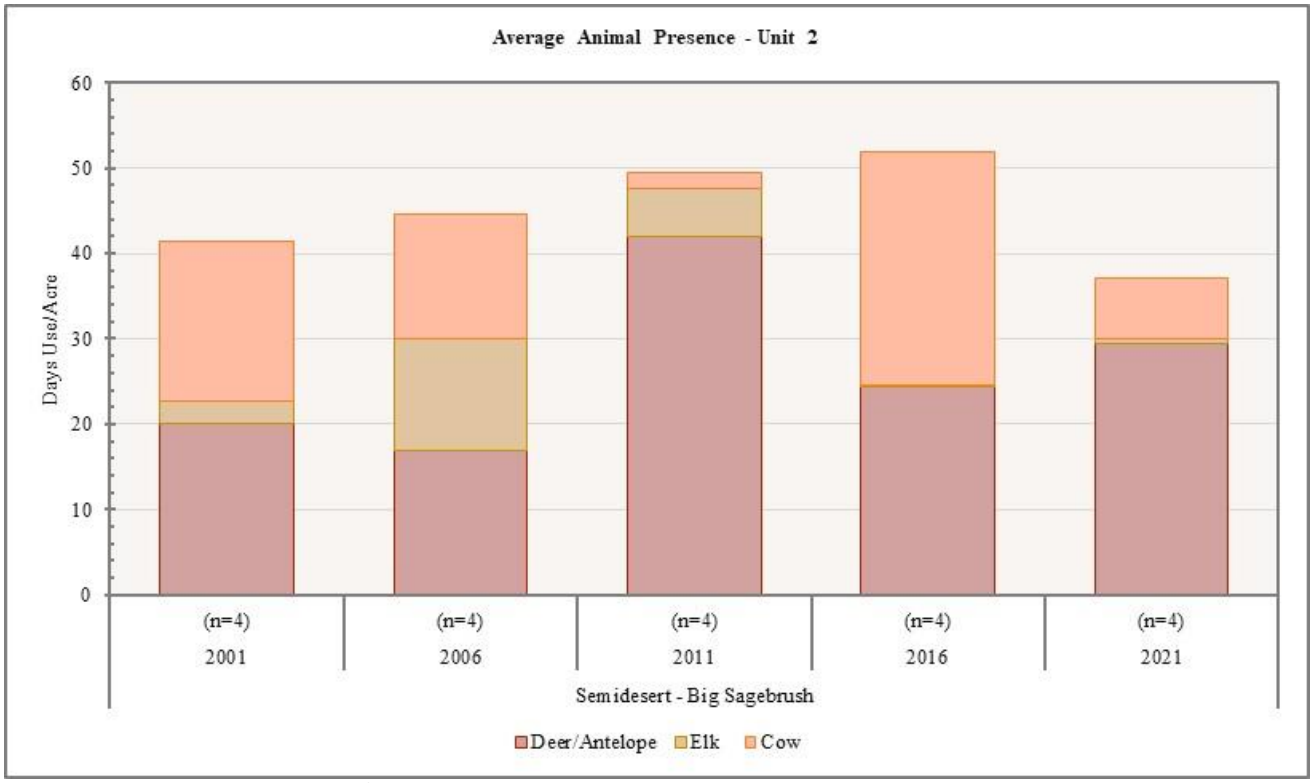
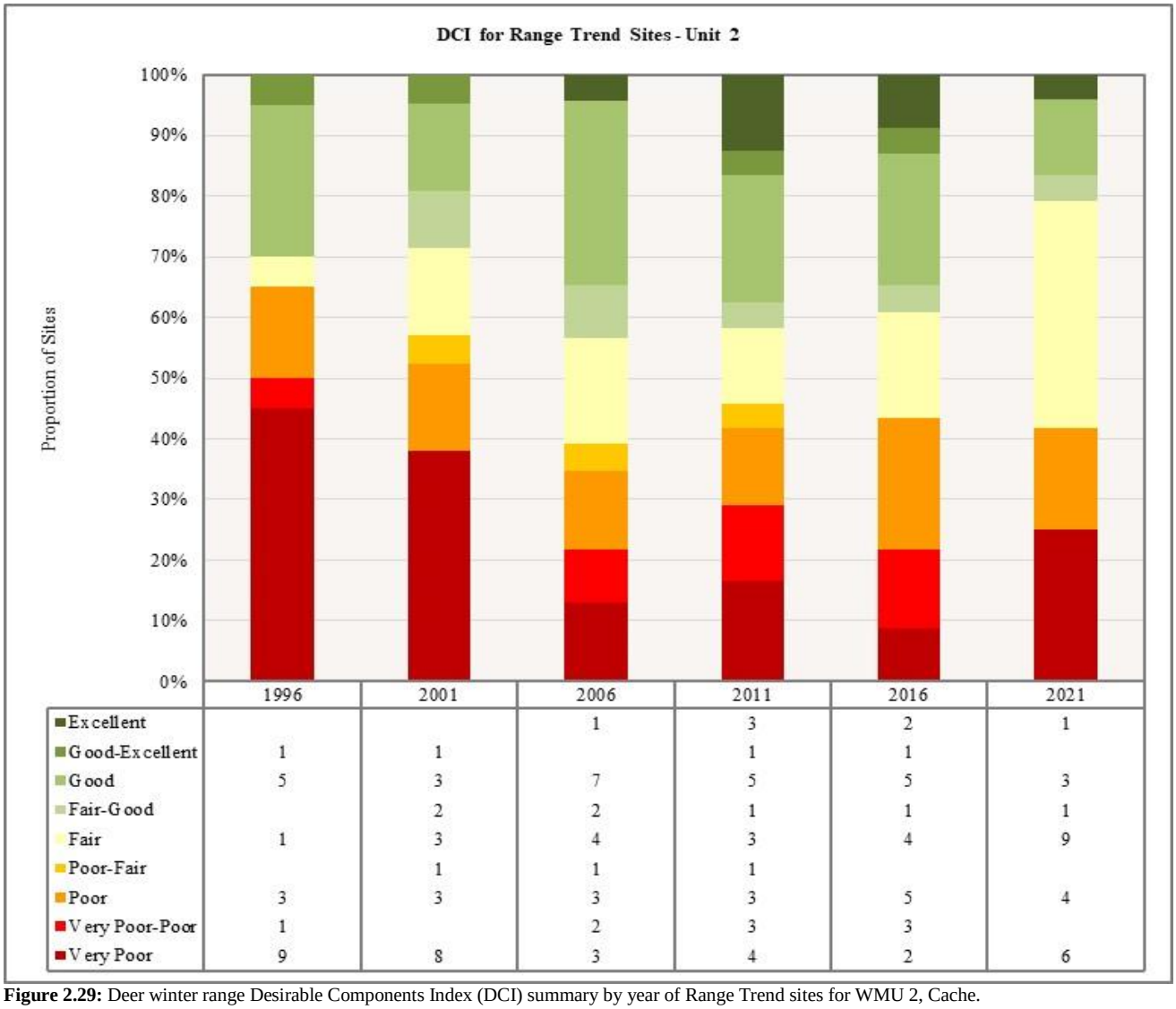


Figure 2.28: Average pellet transect data for Semidesert - Big Sagebrush study sites in WMU 2, Cache.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Cache management unit has had minimal improvement with average condition increasing from poor to poor-fair since 1996. Unit stability can be attributed to the Curtis Ridge (02R-15), State Line (02-30), South Crawford Mountains (02-31), Wood Pass (02-32), Brazier Canyon (02-33), Otter Creek (02-34), Higgins Hollow (02-35), Woodruff Co-op (02-36) and Warrens Spring (02-40) studies, which have been consistently considered to be in good condition. Range Trend sites that lower the overall deer winter range quality of the unit and/or have higher variability in quality from year to year include High Creek (02-1), Beirdneau (02-9), Second Dam Blacksmith Fork (02-12), Hardware Plateau (02-13), Meadowville (02-17), Flat Bottom Canyon (02-23), Mouth of Two Jump Canyon (02-25), Laketown Canyon (02-27), and Hardware Gravel Pit (02-42); these sites are considered to be in poor condition due to the amount of annual grass present, few perennial forbs, lack of recruitment within the preferred browse community, and/or a lack of preferred browse cover.

The overall deer winter range assessment in 2021 for WMU 2 remains fair. However, High Creek, Beirdneau, Second Dam Blacksmith Fork, Flat Bottom Canyon, and Laketown Canyon are currently considered to be in very poor condition. Eight sites were considered to be in fair condition in 2021, and four sites were considered to have good or excellent winter conditions. High Creek, Beirdneau, and Flat Bottom Canyon have very poor deer wintering conditions and experience very little change in quality, which may indicate a resistance to habitat improvement if implemented. However, sites with the largest degree of positive change in winter habitat for deer include Swan Creek, Otter Creek, and Hardware Gravel Pit. This variability may be indicative of community resilience and these sites may respond well to future habitat improvement projects (**Figure 2.29**, **Table 2.11**).



	1996	2001	2006	2011	2016	2021
Excellent			1	3	2	1
Good-Excellent	1	1		1	1	
Good	5	3	7	5	5	3
Fair-Good		2	2	1	1	1
Fair	1	3	4	3	4	9
Poor-Fair		1	1	1		
Poor	3	3	3	3	5	4
Very Poor-Poor	1		2	3	3	
Very Poor	9	8	3	4	2	6

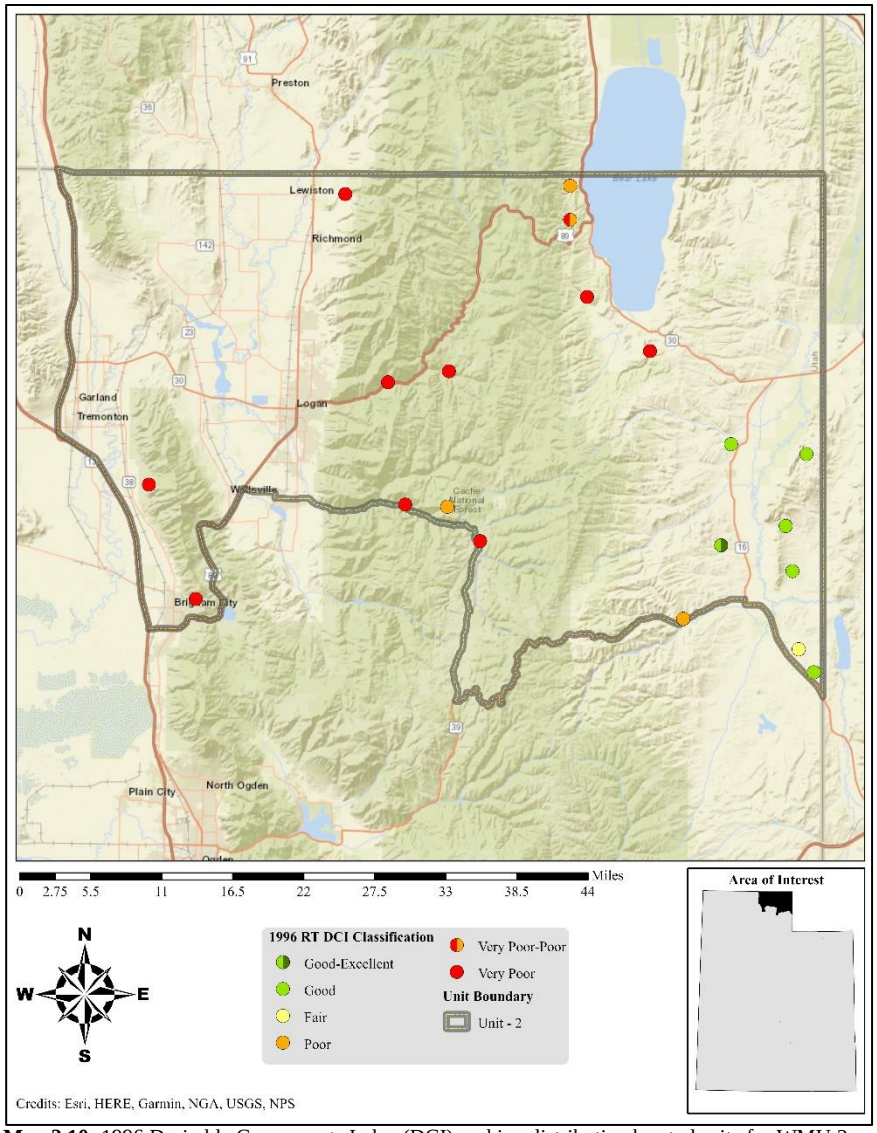
Figure 2.29: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 2, Cache.

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
02-1	1996	18	10.2	0.7	5.7	-20	2.9	0	**17.6**	**VP**
02-1	2001	18.1	8.9	0.5	3.2	-19.2	6.8	0	**18.3**	**VP**
02-1	2006	9.4	11.4	15	2.4	-14	10	-4	**30.3**	**VP**
02-1	2011	16.6	9	0	2.6	-8.7	10	-2	**27.5**	**VP**
02-1	2016	26.7	11.6	2.9	0.9	-11.4	8.1	-4	**34.7**	**VP-P**
02-1	2021	24.3	4	2.2	7.7	-9.2	5.5	-4	**30.4**	**VP**
02-9	1996	17.4	12.5	1.8	6.2	-19.4	10	-4	**24.4**	**VP**
02-9	2001	13.4	9.6	1.2	6.9	-19.8	10	-4	**17.3**	**VP**
02-9	2006	18.8	10.5	0	7.7	-2.6	10	-4	**40.4**	**VP-P**
02-9	2011	21	8.5	1.7	4.9	-1.9	10	-4	**40.1**	**VP-P**
02-9	2016	24.2	6.7	0	13.5	-11.1	10	-4	**39.2**	**VP-P**
02-9	2021	16.3	1.8	0	14.2	-8	10	-4	**30.2**	**VP**
02-12	1996	7.9	6.5	3.3	20.5	-7.2	3.6	-2	**32.7**	**VP**
02-12	2001	6.9	6.5	1.4	19	-15.4	6.3	0	**24.9**	**VP**
02-12	2006	12.7	10.9	0.2	27.9	-6.4	10	-2	**53.2**	**P-F**
02-12	2011	12.8	11.5	15	23.4	-19.5	8	-2	**49.2**	**P**
02-12	2016	11.6	8.5	0	11.9	-20	5.9	0	**17.9**	**VP**
02-12	2021	10	-2.3	0	16.7	-3.1	6.3	-2	**25.7**	**VP**
02-13	1996	4.5	0	0	30	-7.3	10	0	**37.3**	**VP**
02-13	2001	4.3	0	0	30	-4.5	10	-2	**37.8**	**VP**
02-13	2006	6.9	14.6	11.4	30	-0.8	10	-2	**70.1**	**F-G**
02-13	2011	6.3	0	0	30	-3.3	10	-2	**41**	**VP-P**
02-13	2016	12.8	14.8	1.7	23	-18.3	10	0	**44**	**P**
02-13	2021	10.9	12.1	6.3	30	-1	10	-2	**66.2**	**F**
02-16	1996	18.6	10.9	4	21	-15	1	0	**40.4**	**VP-P**
02-16	2001	20.4	9.9	1.4	30	-1.8	2.5	0	**62.4**	**F**
02-16	2006	30	11.9	0.3	29.7	-2	2.1	0	**72**	**G**
02-16	2011	30	10.7	7.9	30	-4.3	2.1	0	**76.5**	**G**
02-16	2016	30	14.2	6.6	30	-11.8	2.4	0	**71.4**	**F-G**
02-16	2021	30	10.7	6.5	30	-2.1	3.8	0	**78.9**	**G**
02-17	1996	7.4	0.3	6.9	23.7	-14.6	4.3	0	**28.1**	**VP**
02-17	2001	5.9	0	0	28.4	-5.1	5.8	0	**35**	**VP**
02-17	2006	5.8	0	0	30	-6.1	6.7	0	**36.4**	**VP**
02-17	2011	8.6	14.1	4.9	17.1	-17.4	5.5	0	**32.8**	**VP**
02-17	2016	16.6	15	4.3	18.1	-17.5	5.9	0	**42.3**	**P**
02-17	2021	18.5	11.1	4.7	16.9	-4.6	2.2	0	**48.9**	**P**
02-19	1996	6.4	0	0	20	-1	10	0	**35.4**	**VP**
02-19	2001	7.7	13.7	0	12.9	-1.1	10	0	**43.3**	**P**
02-19	2006	16.4	12.5	0.6	15.1	-0.6	10	-2	**51.9**	**P**
02-19	2011	12.1	4.9	0.4	12.7	-0.5	10	0	**39.5**	**VP-P**
02-19	2016	14.1	15	0	12.8	-9.4	10	0	**42.5**	**P**
02-19	2021	14.1	4.5	5.8	17.6	-0.7	10	0	**51.1**	**P**
02-21	1996	10.2	11.9	9.2	16.8	-10.3	10	0	**47.7**	**P**
02-21	2001	8.3	13.8	14.8	22.5	-1	10	0	**68.4**	**F-G**
02-21	2006	30	6	8.2	28.2	-1.6	10	0	**80.8**	**G**
02-21	2011	30	14.9	15	29.5	-4.3	10	0	**95.2**	**E**
02-21	2016	30	15	15	24.8	-4	10	0	**90.8**	**G-E**
02-21	2021	30	11.8	15	30	-1.9	10	0	**94.9**	**E**
02-23	1996	0.9	0	0	12.5	-13.8	10	-2	**7.6**	**VP**
02-23	2001	1.8	0	0	22.7	-10	4.7	-2	**17.1**	**VP**
02-23	2006	0.5	0	0	24.6	-6.5	10	-2	**26.6**	**VP**
02-23	2011	0	0	0	27.7	-14	8	-2	**19.8**	**VP**
02-23	2016	1.3	0	0	30	-5.4	10	-2	**33.8**	**VP**
02-23	2021	0.5	0	0	27	-2.4	6	-4	**27.1**	**VP**

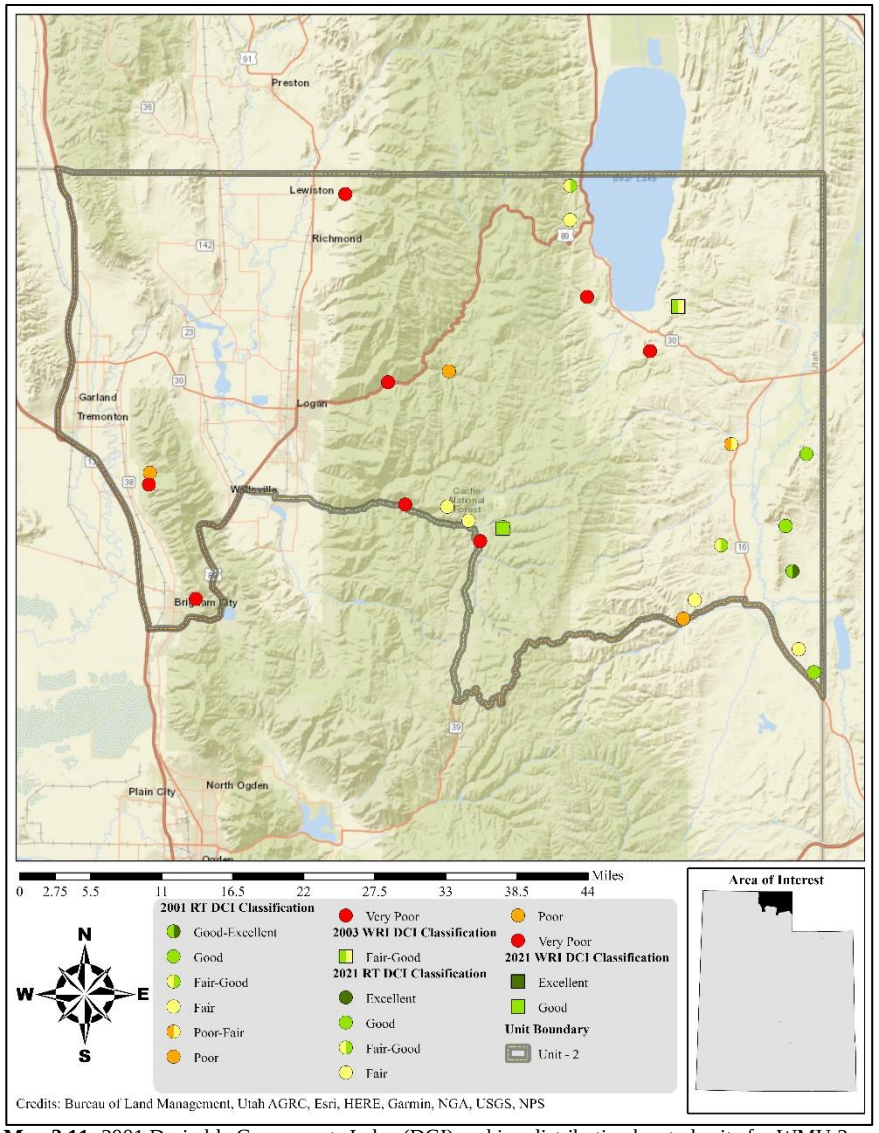
Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
02-25	1996	16.8	2.5	8.2	16.3	-20	10	0	**33.8**	**VP**
02-25	2001	9.4	-0.6	7.5	17.1	-12.8	10	0	**30.6**	**VP**
02-25	2006	11.3	7.7	3.1	17	-7.7	10	0	**41.3**	**VP-P**
02-25	2011	16.6	11.7	6.1	23	-5.8	10	-2	**59.6**	**F**
02-25	2016	19.4	14.3	1.8	16.1	-1.4	10	-2	**58.2**	**F**
02-25	2021	20	3.5	1.3	17.8	-0.6	10	0	**52**	**P**
02-27	1996	6.2	0	0	30	-6.4	3.3	0	**33.1**	**VP**
02-27	2001	4.8	0	0	29.5	-4.3	3.5	0	**33.6**	**VP**
02-27	2006	12.2	9.9	1.5	29.4	-3.7	3.6	0	**52.9**	**P**
02-27	2011	13.7	12.7	2.7	28.4	-8.3	4.5	0	**53.7**	**P-F**
02-27	2016	12.2	12.7	10	21.1	-10.9	1.7	0	**46.8**	**P**
02-27	2021	11	5.6	3.3	20.4	-6.4	1.4	0	**35.4**	**VP**
02-29	1996	7	3.1	0	19.9	-0.1	8.2	0	**38.1**	**P**
02-29	2001	6.8	-1.1	3.4	21.4	0	6.8	0	**37.3**	**P**
02-29	2006	5.1	0	0	24.1	0	9.9	0	**39.1**	**P**
02-29	2011	5.9	0	0	23.4	0	10	0	**39.2**	**P**
02-29	2016	7.9	5	4.4	25.6	0	10	0	**52.9**	**F**
02-29	2021	6.8	-1.9	8.8	30	-0.3	3.9	0	**47.2**	**P**
02-30	1996	29	5.4	0.7	9.5	0	6.2	0	**50.8**	**G**
02-30	2001	30	8.6	0.1	12.6	0	5.3	0	**56.7**	**G**
02-30	2006	30	5.9	1.8	10.2	0	4.3	0	**52.2**	**G**
02-30	2011	30	5.3	4.1	17.7	0	6.4	0	**63.5**	**G-E**
02-30	2016	30	7.7	6	14.6	0	4.1	0	**62.4**	**G**
02-30	2021	30	-3.9	2.9	15.5	0	5.1	0	**49.6**	**G**
02-31	1996	20.9	6.3	2.8	16.1	0	7.2	0	**53.2**	**G**
02-31	2001	27.6	9.3	1.6	17.4	0	8.3	0	**64.3**	**G-E**
02-31	2006	30	8.5	2.1	22.7	0	10	0	**73.3**	**E**
02-31	2011	30	9.5	8.6	24	0	10	0	**82**	**E**
02-31	2016	30	9.2	3.9	25.5	-0.1	8.9	0	**77.5**	**E**
02-31	2021	30	-4.6	3.2	13	0	7	0	**48.6**	**G**
02-32	1996	16.7	6.9	7	11.7	-0.1	6	0	**48.2**	**G**
02-32	2001	17.2	7.1	3.7	16.9	-0.3	8.3	-2	**50.8**	**G**
02-32	2006	17.5	3.4	2	15.2	0	8.9	0	**47**	**G**
02-32	2011	19.3	9.3	13.9	14	0	6.1	0	**62.5**	**G**
02-32	2016	18.8	12.2	5.2	13.8	-1.1	6.1	-6	**49**	**G**
02-32	2021	17.3	2.5	9.9	6.4	-0.1	1.6	0	**37.4**	**F**
02-33	1996	16.4	10.5	1.9	30	-0.2	9.3	0	**67.9**	**G**
02-33	2001	19.4	11	3.1	30	-0.5	10	0	**73**	**G**
02-33	2006	17.2	7.8	2.5	30	-0.4	10	0	**67.1**	**G**
02-33	2011	18.1	9.7	8	30	-1.8	10	0	**74**	**G**
02-33	2016	19.5	10.6	9.5	30	-2.5	9	0	**76.1**	**G**
02-33	2021	18.3	2.4	8.5	26.9	0	3.9	0	**59.9**	**F**
02-34	1996	20.2	12.4	7.7	30	0	2.7	0	**73**	**G**
02-34	2001	14.2	2.7	6	26.3	0	1.6	0	**50.8**	**P-F**
02-34	2006	9.8	8.7	3.6	30	0	8.2	0	**60.2**	**F**
02-34	2011	21.6	12.8	15	30	0	4.6	0	**84**	**E**
02-34	2016	25.5	13.6	15	25.6	0	4.3	0	**84**	**E**
02-34	2021	23.4	-2	6.5	26.5	0	4.7	0	**59**	**F**
02-35	1996	25.5	9.3	9.6	30	0	4.2	0	**78.6**	**G-E**
02-35	2001	30	0.8	1	30	0	4.4	0	**66.2**	**F-G**
02-35	2006	30	4.4	0.3	30	0	7	0	**71.7**	**G**
02-35	2011	30	4.4	1.1	30	0	10	0	**75.5**	**G**
02-35	2016	30	6.2	1.3	30	0	10	0	**77.5**	**G**
02-35	2021	30	-7	1.6	25.3	-0.1	3.2	0	**53**	**F**
02-36	1996	1.1	0	0	30	0	2.4	0	**33.5**	**F**
02-36	2001	1.9	0	0	30	0	1.7	0	**33.6**	**F**
02-36	2006	1	0	0	30	0	3.7	0	**34.7**	**F**
02-36	2011	2.6	0	0	30	0	10	0	**42.6**	**F**
02-36	2016	4.6	0	0	30	0	1	0	**35.6**	**F**
02-36	2021	4.8	0	0	30	0	0.2	0	**35**	**F**

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
02-40	1996	22.8	10.9	6.3	11	-4.4	8.1	-2	**52.6**	**P**
02-40	2001	30	10.9	2.4	10.1	-0.7	8	-2	**58.7**	**F**
02-40	2006	30	10.7	3.5	14.8	-0.7	10	0	**68.4**	**F-G**
02-40	2011	30	12.6	3.9	8.9	-1.3	10	-2	**62.2**	**F**
02-40	2016	30	11.2	3.5	16.3	-6.3	10	-2	**62.7**	**F**
02-40	2021	30	8.8	3.4	10.2	-0.3	10	-2	**60.1**	**F**
02-42	2011	30	1.7	1.4	4.7	-19	10	0	**28.9**	**VP**
02-42	2016	30	13.7	3.5	3.5	-19.8	10	0	**40.8**	**VP-P**
02-42	2021	30	2.3	2.5	16.3	-2.4	10	0	**58.7**	**F**
02-43	2009	29.8	0	0	30	0	1	0	**60.7**	**F**
02-43	2011	30	4.3	0.9	26.9	0	3	0	**65.1**	**F-G**
02-43	2016	29.6	9.5	2	30	0	2.3	0	**73.4**	**G**
02-43	2021	30	-3.8	2.1	30	0	1.7	0	**60**	**F**
02R-5	1998	22.8	13	6.7	5.5	-13.6	10	-2	**42.5**	**P**
02R-5	2006	30	9.9	0	16.7	-5.9	10	-2	**58.7**	**F**
02R-5	2011	30	10.7	0.3	1.7	-10	10	0	**42.8**	**P**
02R-5	2016	30	14.7	0.4	1.1	-9.4	10	0	**46.7**	**P**
02R-5	2021	0.5	0	0	20.1	-1.7	10	0	**28.9**	**VP**
02R-8	2003	30	5.9	2.9	19.3	0	10	0	**68**	**F-G**
02R-8	2006	12.5	8.7	5.5	30	0	10	0	**66.7**	**F**
02R-8	2011	28.1	11.9	7.2	30	0	10	0	**87.3**	**G**
02R-8	2016	30	14.4	14.1	30	0	10	0	**98.5**	**E**
02R-8	2021	30	7.5	15	30	0	10	0	**92.5**	**E**
02R-11	2005	10.3	14.8	0.1	21	-6.1	7.9	0	**48**	**P**
02R-11	2013	6.9	0	0	8.8	-7.9	10	0	**17.8**	**VP**
02R-11	2018	15.6	14.8	6.6	12.8	-19.6	10	-2	**38.2**	**VP-P**
02R-15	2006	30	11.4	6.4	27.1	0	10	0	**84.9**	**G**
02R-15	2011	30	11.2	6.1	20	0	10	0	**77.2**	**G**
02R-15	2021	25.6	0	8.7	24.9	0	10	0	**69.3**	**F-G**
02R-16	2006	30	10.1	4.3	18.1	0	10	0	**72.5**	**G**
02R-16	2013	30	13.2	5.2	16.5	0	10	0	**75**	**G**
02R-16	2021	30	1	7.4	26.5	0	10	0	**74.9**	**G**
02R-21	2007	0.1	0	0	30	-1.9	4	0	**32.2**	**VP**
02R-21	2013	0	0	0	30	-1.1	6.2	0	**35.1**	**VP**
02R-21	2018	0.1	0	0	30	-16	8.4	0	**22.5**	**VP**
02R-23	2007	1.6	0	0	1.3	-2.7	5	-4	**1.3**	**VP**
02R-23	2013	2.3	0	0	15.1	-18	9.6	-4	**5**	**VP**
02R-23	2018	8.3	14.2	10.8	13.4	-20	5.4	-4	**28**	**VP**

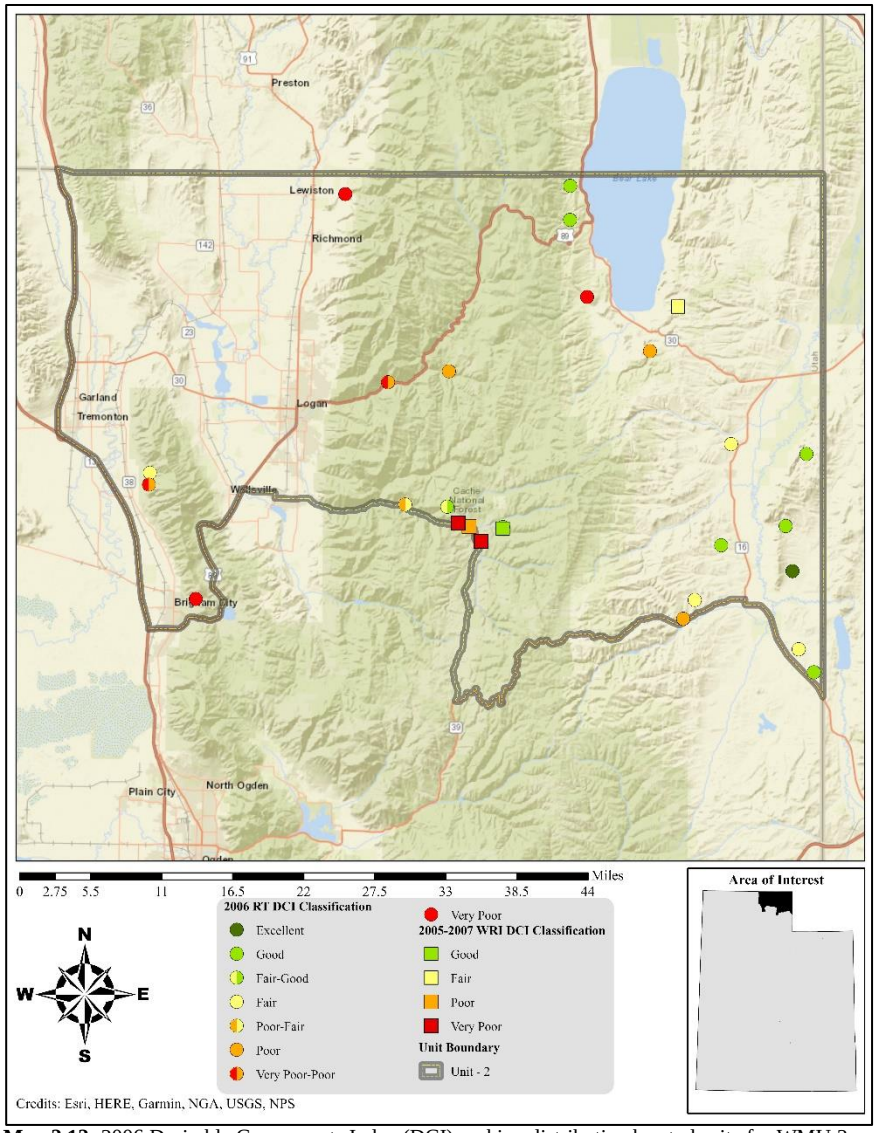
Table 2.11: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 2, Cache. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



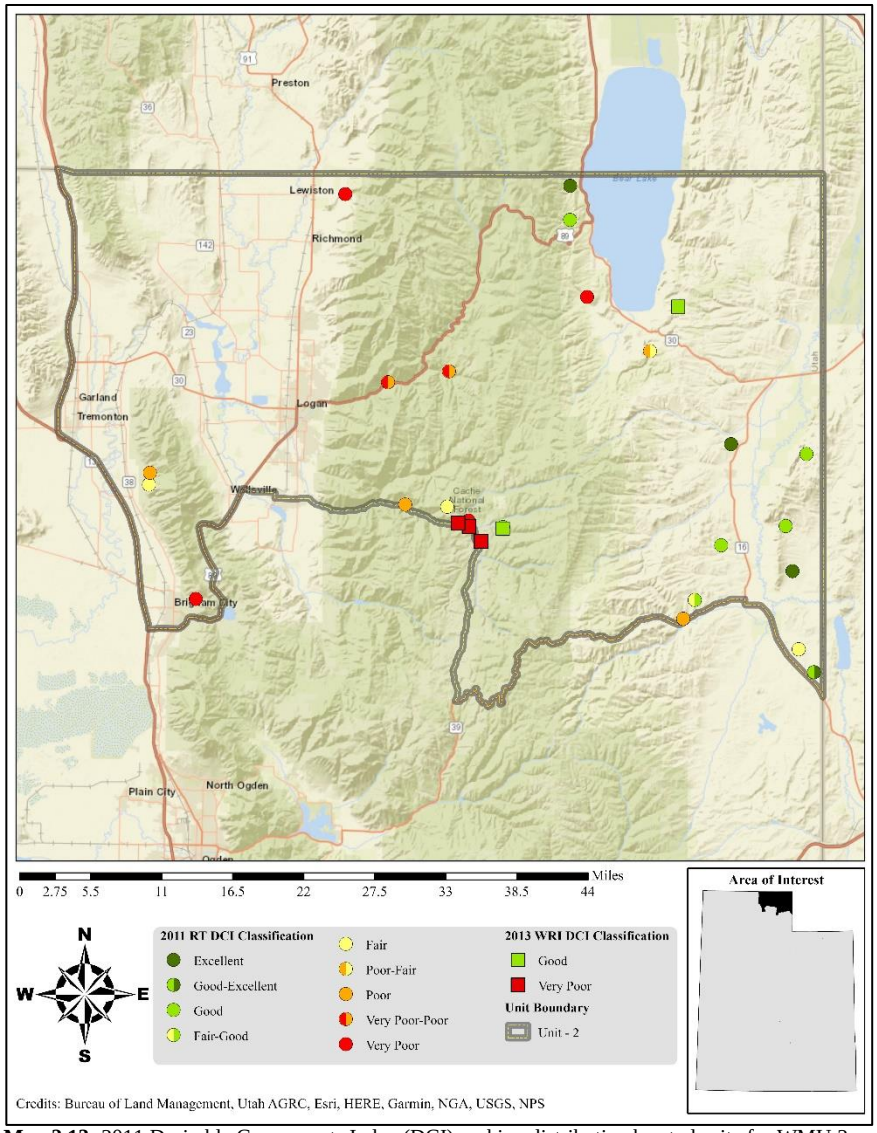
Map 2.10: 1996 Desirable Components Index (DCI) ranking distribution by study site for WMU 2, Cache.



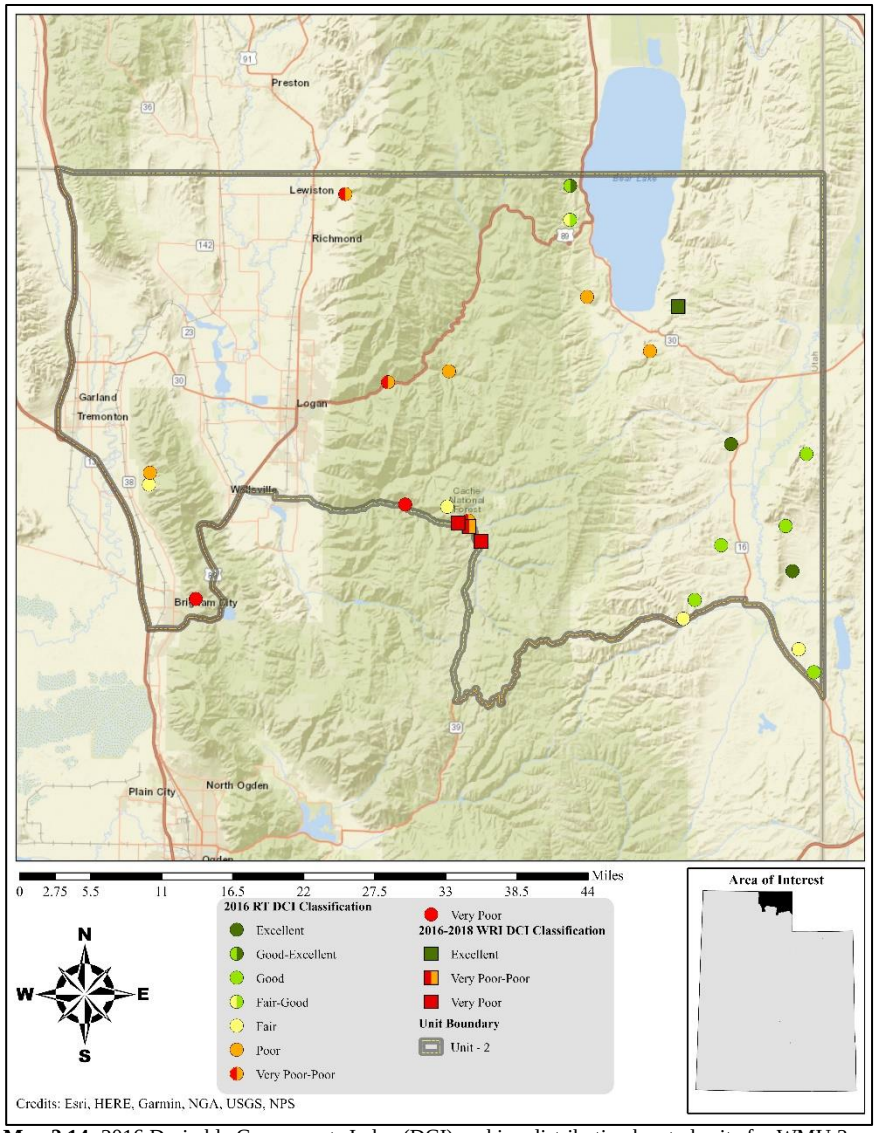
Map 2.11: 2001 Desirable Components Index (DCI) ranking distribution by study site for WMU 2, Cache



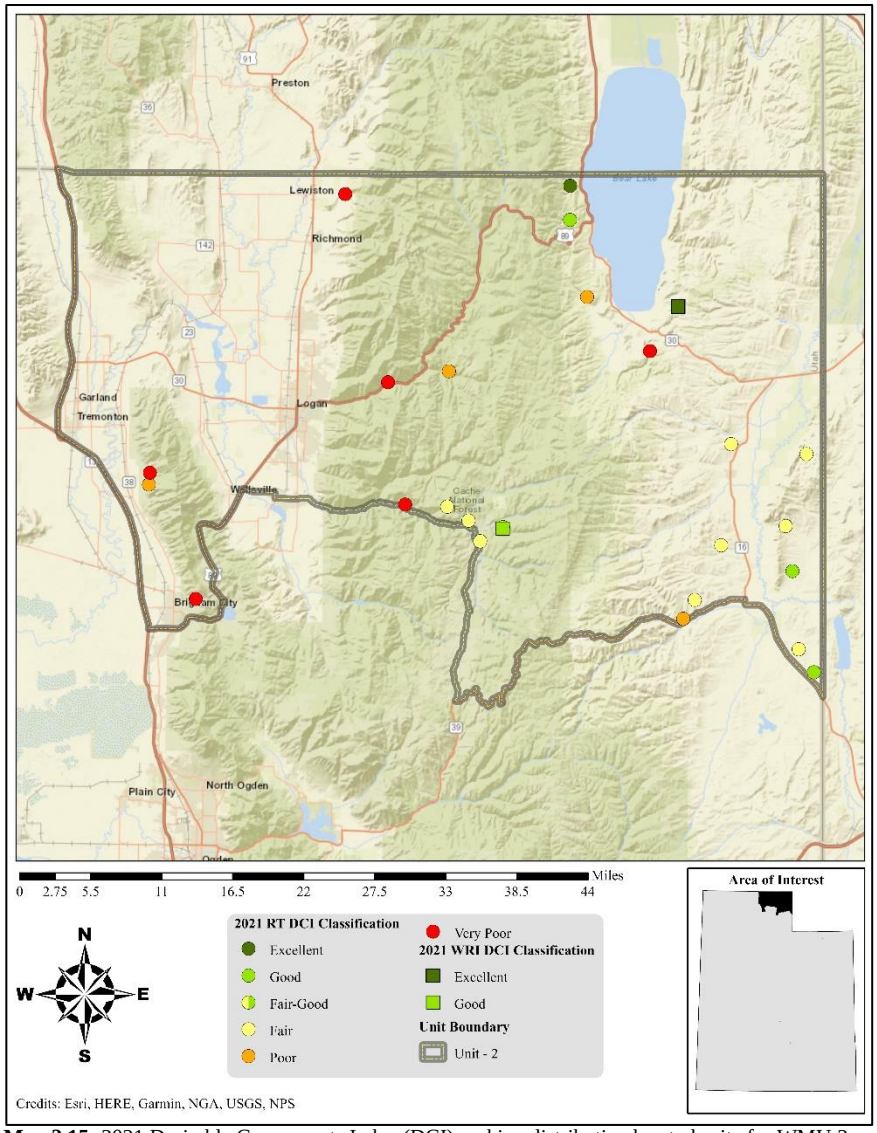
Map 2.12: 2006 Desirable Components Index (DCI) ranking distribution by study site for WMU 2, Cache



Map 2.13: 2011 Desirable Components Index (DCI) ranking distribution by study site for WMU 2, Cache.



Map 2.14: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 2, Cache.



Map 2.15: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 2, Cache.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
02-1	High Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-2	Mouth of Blacksmith Fork	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
02-9	Beirdneau	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-12	Second Dam Blacksmith Fork	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
02-13	Hardware Plateau	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
02-16	Garden City Canyon	Urban Development	High	Fragmentation and degradation/loss of habitat
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-17	Meadowville	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
02-19	Right Fork Logan Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-21	Swan Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
02-23	Flat Bottom Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
02-25	Mouth of Two Jump Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-27	Laketown Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-28	North Eden	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
02-29	Woodruff Creek	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
02-30	State Line	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
02-31	South Crawford Mountains	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
02-32	Wood Pass	Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
02-33	Brazier Canyon	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
02-34	Otter Creek	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
02-35	Higgins Hollow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
02-36	Woodruff Co-Op	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
02-38	Twin Creek	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-39	Pole Hollow Spring	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
02-40	Warrens Spring	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-42	Hardware Gravel Pit	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02-43	Woodruff Longhill	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
02R-5	Coldwater WMA	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
02R-6	Duck Creek 3 Low	Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
02R-8	Duck Creek 1	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
02R-9	Rabbit Creek Burn	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
02R-10	Rabbit Creek Burn Seeded	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
02R-11	Rattlesnake Knoll East	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02R-15	Curtis Ridge Control	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
02R-16	Curtis Ridge	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
02R-20	Squaw Flat North	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
02R-21	Hardware Plateau Grazed	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
02R-23	Blacksmith Fork Grazed	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 2.12: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 2, Cache. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment.**

Discussion and Recommendations

Mountain (Big Sagebrush)

The study sites on the Cache management unit that are classified as high elevation Mountain (Big Sagebrush) sites range from very poor to fair condition. This ecological type generally supports a diverse community with sagebrush and other browse species vital for big game winter ranges. In addition, there are shrub, grass and forb communities for big game summer range, which also appear to be in overall good habitat condition. A shared concern between all these sites is the presence of the invasive annual grass cheatgrass (*Bromus tectorum*), but to varying degrees. Meadowville, Flat Bottom Canyon, Mouth of Two Jump Canyon, Warrens Spring, and Hardware Gravel Pit all have, or have had, high amounts of cheatgrass and are considered to have a high-level threat to invasion. High amounts of cheatgrass can increase fuel loads and exacerbate the risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). Although the herbaceous understory is generally good, the introduced perennial grass bulbous bluegrass (*Poa bulbosa*) is present in varying amounts, and is a particular concern on Mouth of Two Jump Canyon, Flat Bottom Canyon, Curtis Ridge Control, and Coldwater WMA. Bulbous bluegrass can be aggressive and may have the potential to lead to a reduction in prevalence and abundance of other more desirable native grass and forb species (Mack, et al., 2000). It is important to note that the understory composition varies from site to site, and is likely due to the ecological site potential differences between high-mountain and mountain. Conifer encroachment is also occurring on most studies. Continued tree encroachment may lead to deteriorations in understory shrub and herbaceous health in the future if not addressed (Miller, Svejcar, & Rose, 2000).

Noxious weeds are present on the Flat Bottom Canyon, Mouth of Two Jump Canyon, Warrens Spring, and Coldwater WMA study sites, and include such species as medusahead (*Taeniatherum caput-medusae*) and Dyer's woad (*Isatis tincoria*) that pose a low-level threat. Although cover and abundance are very low as of 2021, these species can be aggressive, leading to reduced abundance and diversity of other desirable herbaceous species (Mack, et al., 2000). In addition, the effects of drought were observed on the Coldwater WMA and Curtis Ridge Control sites through increased shrub decadence and poor vigor in 2021. Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

Further monitoring of annual grasses is likely necessary to determine extent of invasion in future sample years. Although annual grasses are present in low to moderate amounts as of 2021, future treatments such as herbicide application or changes in grazing management may be appropriate if they increase in cover and abundance. On some sites, management of annual grasses might be presently necessary. Introduced perennial grasses, specifically bulbous bluegrass, may also need management through changes in grazing or introducing competitive native species. When reseeding, care should be taken in species selection, and preference should be given to native species when possible. It is recommended that work to reduce conifer encroachment (bullhog, chaining, lop and scatter, etc) continue or begin in these communities. Next, management of noxious weed species is recommended, an objective that may be met with methods such as spot application of herbicide. Further monitoring of the Coldwater WMA and Curtis Ridge Control study areas is recommended, as it may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife directly with water sources (e.g. guzzler or other catchment method). It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003).

Mountain (Curl-leaf Mountain Mayhogany)

This high-elevation ecological type generally supports curl-leaf mountain mahogany communities, and the study sites located in the Cache management unit are considered to be in good to excellent condition for winter range for deer. A shared concern between Garden City Canyon and Swan Creek is the presence of the invasive annual grass cheatgrass (*Bromus tectorum*). Both have high amounts of cheatgrass and are considered to have a high-level threat posed by invasion. High amounts of cheatgrass can increase fuel loads and exacerbate the risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) contributes significant cover on the Swan Creek study, but is a shared concern for both studies. While introduced perennial grasses may provide forage, they can be aggressive at higher elevations and may reduce the prevalence and abundance of other more desirable native grass and forb species through resource competition (Mack, et al., 2000). There is some conifer encroachment occurring that may reduce shrub and herbaceous understory as woodland succession continues (Miller, Svejcar, & Rose, 2000), but this is considered a low-level threat. The Garden City study may be threatened by urban development, as it is on private land directly adjacent to a house and other associated structures. Urban development often leads to fragmentation and loss of habitat as valuable shrub and herbaceous communities are often negatively impacted or removed entirely by construction, roads, etc (Forman & Alexander, 2000).

If needed, management of annual grasses may be necessary through herbicide application and/or establishment of competitive native perennial species. However, introduced perennial grasses may also need management through establishment of competitive species, especially with the introduction of bulbous bluegrass, which can be controlled through competitive native grasses. When reseeding, care should be taken in species selection and preference should be given to native species when possible. It is recommended that monitoring of this study site continue, as further monitoring will be needed to assess pinyon-juniper encroachment. If impacts from conifer infilling become apparent through understory shrub and herbaceous reduction, then it is recommended that work to reduce conifer trees (bullhog, chaining, lop and scatter, etc) continue or begin in these communities. With cooperation from private landowners, monitoring may be useful to determine what urban development factors (noise, traffic, pollutants, etc.) could be influencing wildlife in the area, and furthermore, if public awareness measures about human/wildlife interactions are needed to support wildlife.

Mountain (Browse)

The Laketown Canyon study site is classified as being of the Mountain (Browse) ecological type, and is considered to be in very poor condition for deer winter range. This site supports some perennial grasses and forbs. However, the herbaceous understory is generally dominated by introduced annual grasses, namely cheatgrass (*Bromus tectorum*) which

can reduce the abundance of more desirable native forbs and grasses (Mack, et al., 2000) and may exacerbate the risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). In addition, this representative study for this ecological type is currently in Phase I of woodland succession: this encroachment is not considered an immediate concern. Presence of Utah juniper (*Juniperus osteosperma*) trees can lead to reduced shrub and herbaceous understory health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000).

Management of annual grasses within this community type may be necessary through herbicide application and/or establishment of competitive perennial native species. Where and/or when needed within areas of this ecological type, it is recommended that work to reduce encroachment of pinyon and juniper (bullhog, chaining, lop and scatter, etc.) continue or begin.

Mountain (Shrub)

This high-elevation Mountain (Shrub) ecological type generally supports shrub and perennial grass communities. The study sites located in the Cache management unit for this ecological potential are considered to be between very poor to fair condition for deer winter range. A common high-level threat shared between all of these sites is the invasion by annual grasses, primarily cheatgrass (*Bromus tectorum*), which increases the fuel loads and the risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013) and has deleterious effects on herbaceous diversity (Mack, et al., 2000). Introduced perennial grasses are present on all sites, and are posing a high-level threat on Beirdneau and Righ Fork Logan Canyon studies: the understories of these studies are primarily composed of bulbous bluegrass (*Poa bulbosa*). Introduced perennial grasses can be aggressive and may outcompete other species for resources, therefore leading to reduced prevalence of more desirable native grasses and forbs (Mack, et al., 2000). Though a shared threat between all the sites to varying degrees, noxious weeds on the Beirdneau study has populations, Dyer's woad (*Isatis tinctoria*) and gypsyglower (*Cynoglossum officinale*), that pose a high-level threat. Like introduced perennial grass species, noxious weeds can be aggressive and will likely lead to reduced prevalence and abundance of native grass and forb species if they increase in the future (Mack, et al., 2000). Beirdneau and Right Fork Logan Canyon both have low-level threats posed by Rocky Mountain juniper (*Juniperus scopulorum*) encroachment, which can lead to reduced understory shrub and herbaceous production as woodland encroachment advances (Miller, Svejcar, & Rose, 2000).

Continued monitoring of these communities will likely prove valuable; data collected in the future will indicate whether the severity of current limiting factors (annual grasses, introduced perennial grasses, noxious weeds, etc.) is increasing. Should annual grass loads increase over time, treatments such as changes in grazing management or herbicide application may be advisable. If introduced perennial grasses and/or noxious weeds increase in the future, the implementation of reseeding efforts to restore biodiversity may be useful. However, caution should be taken when designing seed mixes, and native grass and forb species should be selected whenever possible. Although tree encroachment does not pose an immediate threat on the Beirdneau and Right Fork Logan Canyon sites, tree-removing treatments (bullhog, lop and scatter, chaining, etc.) may be advisable if monitoring shows a future increase in encroachment. If/when tree-removing treatments do occur, however, careful consideration should be made so as to select methods that will not increase annual grass loads.

Upland (Big Sagebrush)

There are several study sites that are designated as being of the Upland (Big Sagebrush) ecological potentials, but only a few are designated as deer winter range, including High Creek, Woodruff Creek, Higgins Hollow, and Woodruff Longhill. These sites are considered to be in very poor to fair condition for deer winter range on the Cache management unit. However, these communities support, or have the potential to support, shrub populations that provide browse forage in winter. Though annual grasses are a component of the understory on all of the study sites, High Creek, Mouth of Blacksmith Fork, and North Eden are considered to have a high-level threat posed by cheatgrass (*Bromus tectorum*). As an invasive, cheatgrass has the potential to increase fuel loads and exacerbate the risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). Non-native perennial grasses are also a concern on several study sites. Crested wheatgrass (*Agropyron cristatum*) poses a medium-level threat on the Woodruff Creek and Woodruff Longhill study sites, while bulbous bluegrass (*Poa bulbosa*) poses a medium-level threat on the High Creek and Mouth of Blacksmith Fork sites. At higher elevations in particular, introduced perennial grasses have the potential to be aggressive and can reduce understory diversity by outcompeting native species for resources (Mack, et al., 2000).The noxious weeds jointed goatgrass (*Aegilops cylindrica*) and Dyer's woad (*Isatis tinctoria)* have invaded the Mouth of Blacksmith Fork site: these respective grass and forb species threaten desirable native species by aggressively competing for resources. In addition, the noxious weeds field bindweed (*Convolvulus arvensis*) and Dyer's woad are present on the High Creek study, and present similar

impacts by increasing competition between native species (Mack, et al., 2000). There is some low-level conifer encroachment occurring on the High Creek, North Eden, and Woodruff Longhill sites, which may lead to reduced native understory species as woodland succession continues. Finally, the effects of drought were observed on the majority of sites through increased shrub decadence and poor vigor in 2021. Long periods of drought may result in reduced vigor and abundance in shrub populations and herbaceous species, and reduced resilience and resistance to ecosystem disturbances (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

Further monitoring of annual grasses is likely necessary to determine the extent of invasion in future sample years. Although annual grasses are present in low to moderate amounts as of 2021, future treatments such as herbicide application or altered grazing patterns may be appropriate if they increase in cover and abundance. If introduced perennial grasses and/or noxious weeds increase in the future, the implementation of reseeding efforts to restore biodiversity may be needed while spot herbicide spraying may be used for noxious weed control. Caution should be taken when developing seed mixes and an effort should be made to include native grass and forb species whenever possible. Work to reduce pinyon and juniper encroachment (bullhog, chaining, lop and scatter, etc) may eventually be needed on areas surrounding the High Creek, North Eden, and Woodruff Longhill studies. Care being taken to select methods that will not increase annual grass loads. Finally, further monitoring on the North Eden, Woodruff Creek, Higgins Hollow, and Woodruff Longhill may aid in determining the effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) that are occurring over a long periods of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife through water catchment systems. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003).

Upland (Black Sagebrush)

Brazier Canyon is considered to be a mid-elevation study that represents the Upland (Black/Low Sagebrush) ecological type, and is classified as being in fair condition for deer winter range on the Cache management unit. This community supports a population of black sagebrush and other browse species. The introduced annual grass species cheatgrass (*Bromus tectorum*) has been observed in the understory with low cover since 1996, posing a medium-level threat to the site. If cheatgrass increases in future sample years, it may increase potential fuel loads, exacerbate the risk of wildfire, and have the potential to negatively impact the resistance and resilience of the plant community on this site (Balch, D'Antonio, & Gómez-Dans, 2013). As a Phase I conifer-encroached community, Brazier Canyon is at low-level risk of reductions to the shrub and herbaceous understory, but the risk may increase as woodland succession progresses (Miller, Svejcar, & Rose, 2000). Lastly, effects of drought are evident on Brazier Canyon as observed through reduced vigor and increased decadence within the browse community. Periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

Continued monitoring of this study is recommended. Although annual grasses were present in low amounts in 2021 and likely do not require immediate intervention, treatments such as herbicide application may be appropriate if annual grasses increase in cover and abundance over time. It is recommended that observation and management of the conifer community (bullhog, chaining, lop and scatter, etc.) continue or begin. Finally, additional monitoring of the Brazier Canyon study may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over long periods of time. Consideration should be given to how drought may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife through water catchment systems. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003).

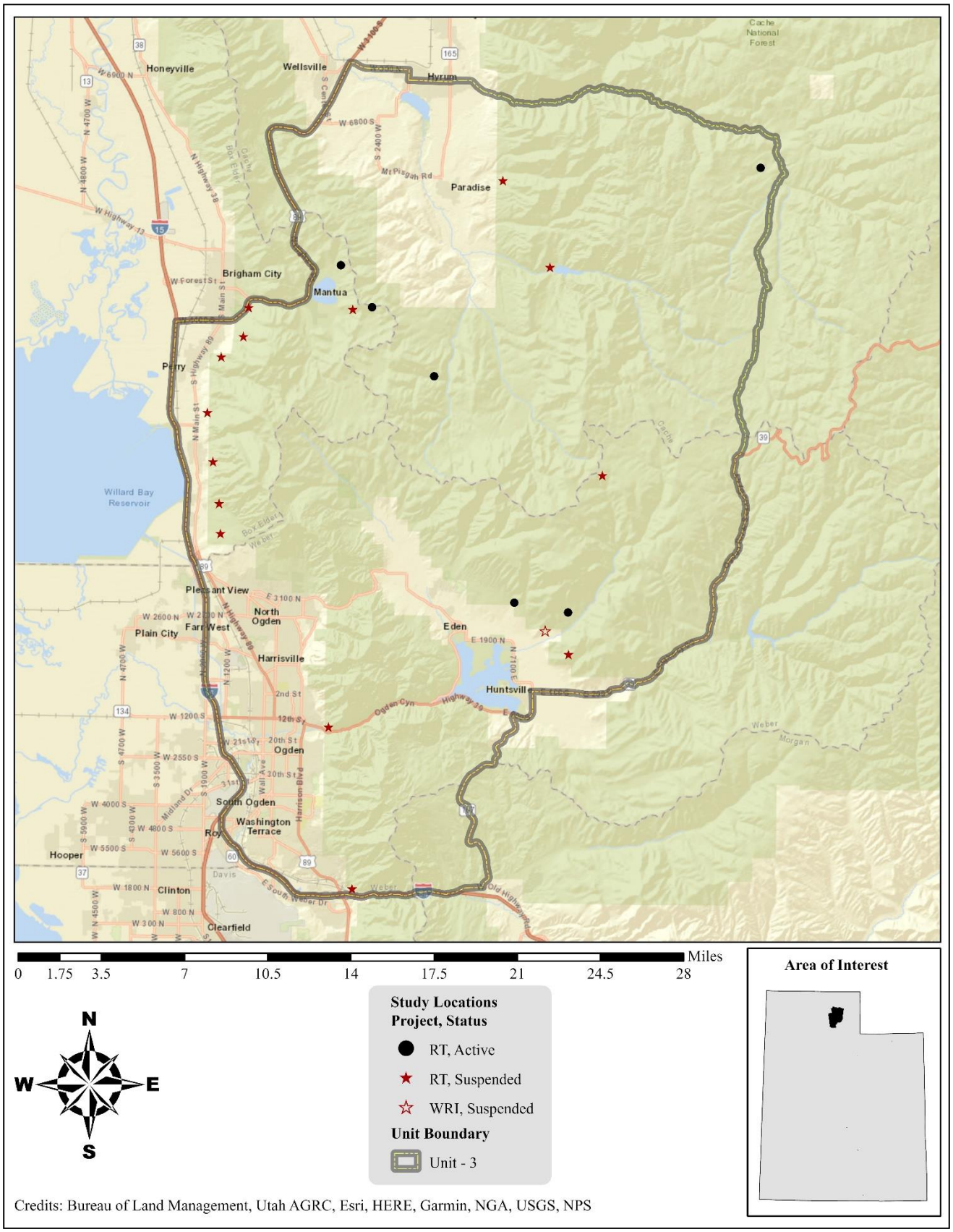
Semidesert (Big Sagebrush)

The study sites that are classified as being of the Semidesert (Big Sagebrush) ecological type are considered to be in fair to good condition for deer winter range on the Cache management unit. These communities support a mix of sagebrush and other browse species that can provide valuable browse in winter. Though it is consider a low-level threat, a common concern between all these sites is the presence of introduced annual grasses, which have the potential to invade some study sites. The presence of cheatgrass (*Bromus tectorum*) can exacerbate the risk of wildfire due to increased fuel loads (Balch, D'Antonio, & Gómez-Dans, 2013). Another shared concern between all these sites in this ecological potential are the effects of drought as observed through reduced vigor and increased decadence within the browse community. Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced

resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014). In addition, introduced perennial grasses are present on the Woodruff Co-op site; while they do provide valuable forage, these grass species can compete with other more desirable native forbs and grasses (Mack, et al., 2000). On Woods Pass, there is the noxious weed gypsyflower (*Cynoglossum officinale*) present; noxious weeds are aggressive and their presence can lead to reduced prevalence and abundance of native grass and forb species (Mack, et al., 2000). Finally, there is some conifer encroachment occurring by twoneedle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*), which has the potential to lead to reduced shrub and herbaceous understory vigor and presence as woodland succession continues (Miller, Svejcar, & Rose, 2000).

Due to the low-level threat that cheatgrass poses on these sites, the implementation of treatments to reduce annual grass loads is not recommended for these sites at this time. Instead, it is recommended that monitoring continue to track cheatgrass invasion and follow up with herbicide application if annual grasses become a dominant component in the understory. Additional monitoring of these sites is also recommended, as it may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how drought may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife directly with water sources (e.g. guzzler or other catchment method). More observation of introduced perennial grasses is suggested for the Woodruff Co-op site to determine whether native species are being suppressed. When reseeding in similar ecological conditions as the Woodruff Co-op site, preference should be given to native species. Noxious weeds on Woods Pass could be treated by spot application of herbicides either through preventative or reactive management. Observation of conifer encroachment should continue along with the coupling of reduction management methods of pinyon and juniper trees through bullhog, chaining, lop and scatter, and other means if/when needed.

3. WILDLIFE MANAGEMENT UNIT 3 – OGDEN



WILDLIFE MANAGEMENT UNIT 3 – OGDEN

Boundary Description

Weber, Box Elder, Cache, and Morgan counties - Boundary begins at Hyrum and SR-101; east on SR-101 to Ant Flat Road (at Hardware Ranch); south on this road to SR-39; west and south on SR-39 to SR-167 (Trappers Loop Road); south on SR-167 to SR-30 at Mountain Green; west along SR-30 to Interstate 84; west on I-84 to Interstate 15; north on I-15 to US-191; east and north on US-91 to SR-101; east on SR-101 to Hyrum.

Management Unit Description

Geography

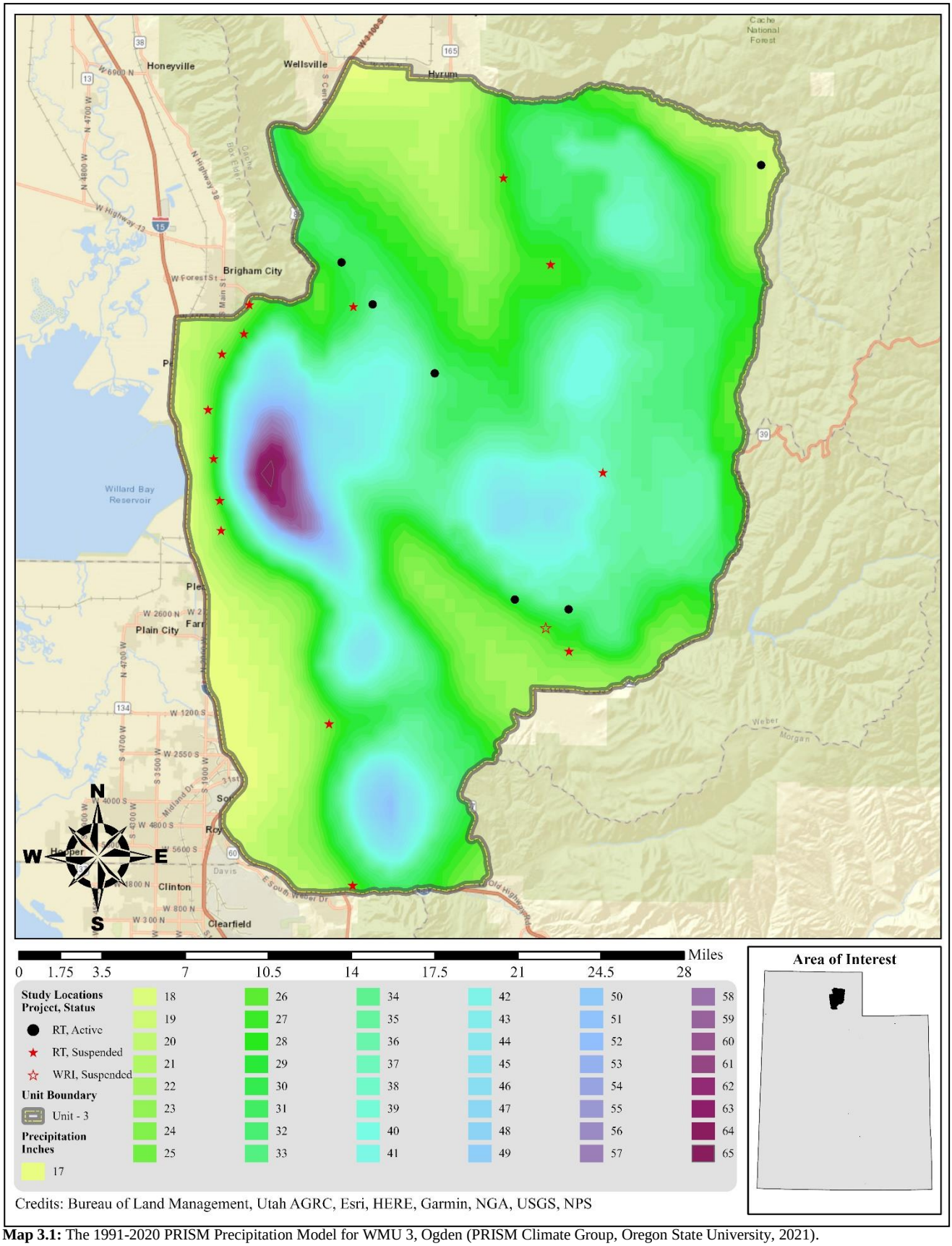
The Ogden Management Unit is located within Weber, Cache, Box Elder, and Morgan counties. Municipalities located within or along the unit boundaries include: Hyrum, Wellsville, Mantua, Perry, Willard, Ogden, Mountain Green, and Huntsville. The major drainages are the Little Bear River, Ogden River, and Box Elder Creek. Smaller drainages include Davenport Creek, Paradise Dry Canyon, Hyrum Dry Canyon, Hyrum Green Canyon, Perry Canyon, and Willard Canyon. The topography is steep and rough on the western face of the Wasatch Mountains above Willard, Perry, Ogden, and east of Avon and Paradise, and the topography is gentler in between. Elevation ranges from 4,400 feet near Willard to 9,764 feet on Willard Peak.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 18 inches on the southwestern edge near Ogden to 65 inches on Willard Peak. All of the Range Trend and WRI monitoring studies on the unit occur within 21-39 inches of precipitation (**Map 3.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Northern Mountains division (Division 5).

The mean annual PDSI of the Northern Mountains division displayed years of moderate to extreme drought from 2000-2003, 2012-2013, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1995, 1997-1998, 2005, and 2011 (**Figure 3.1a**). The mean spring (March-May) PDSI displayed moderate to extreme drought in 1992, 2000-2004, 2012-2014, 2018, and 2021 ; moderately to extremely wet years were displayed from 1995-1996, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2013, and 2020-2021; moderately to extremely wet years were displayed in 1995 and 1997-1998 (**Figure 3.1b**) (Time Series Data, 2022).



Map 3.1: The 1991-2020 PRISM Precipitation Model for WMU 3, Ogden (PRISM Climate Group, Oregon State University, 2021).

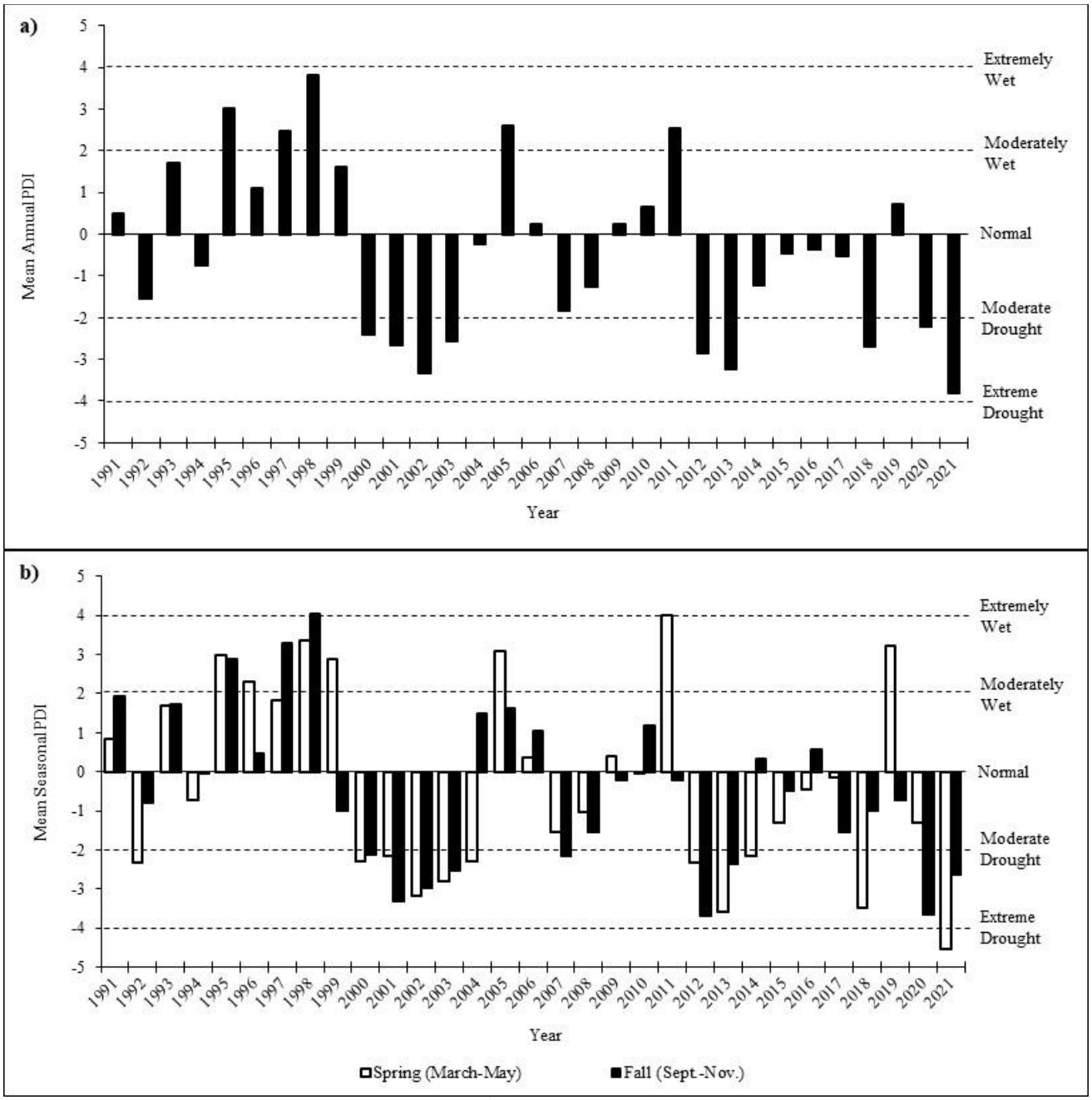


Figure 3.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

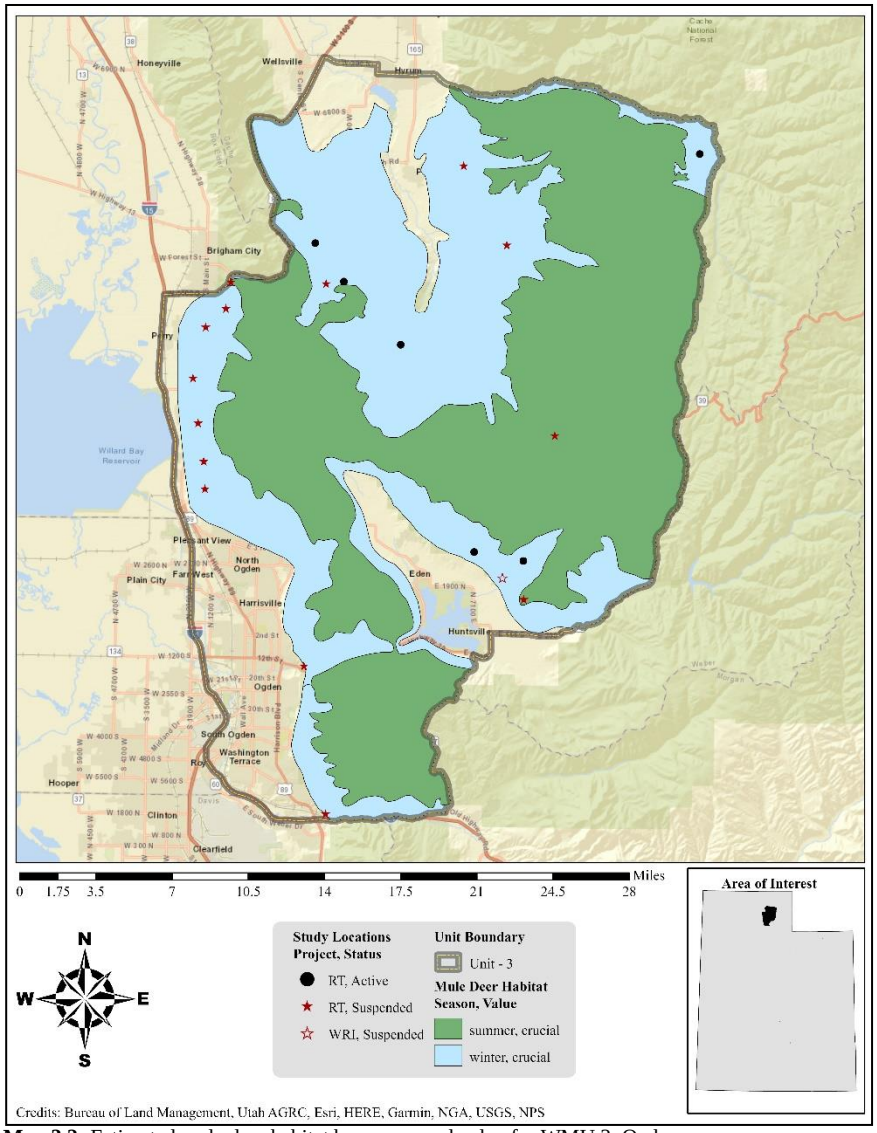
Big Game Habitat

There are approximately 140,000 acres in Unit 3 that are considered to be deer winter range and approximately 193,000 acres that are considered to be deer summer range (**Table 3.1**, **Map 3.2**).

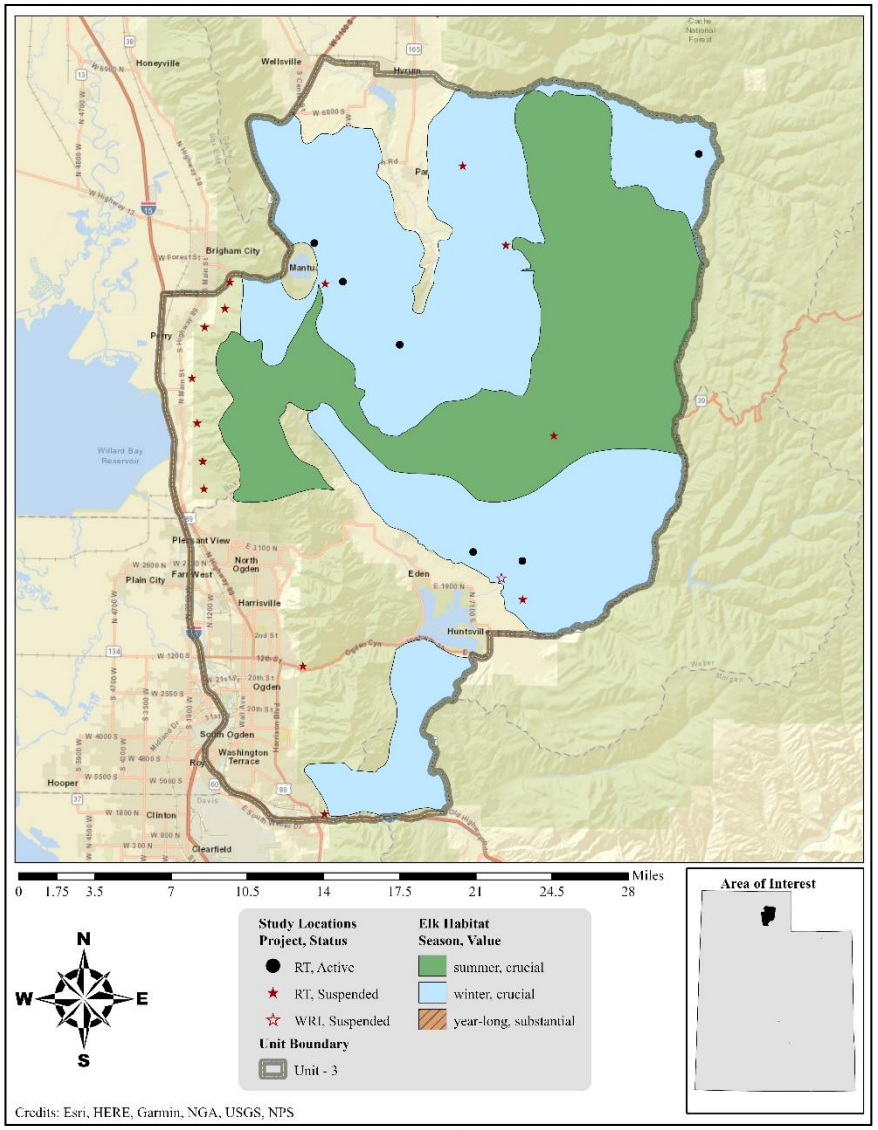
Seventy-eight percent of deer winter range is privately owned, 17% is managed by the US Forest Service (USFS), 6% is administered by the Utah Division of Wildlife Resources (UDWR), and less than 1% is owned by Utah State Parks (USP). A majority (65%) of the summer range is also privately owned, 24% is managed by the USFS, 7% is administrated by UDWR, and the Utah School and Institutional Trust Lands Administration (SITLA) owns the remaining 4% (**Table 3.2**, **Map 3.2** , **Map 3.6**). Like deer range, much of the elk winter range (77%) is privately owned, while 14% is administrated by the USFS and 9% is managed by UDWR. Of the elk summer range, 73% belongs to private landowners, 16% is managed by the USFS, SITLA administrates 8%, and the remaining 3% is managed by UDWR (**Table 3.3**, **Map 3.3**, **Map 3.6**).

Landfire Existing Vegetation Coverage modeling shows that shrublands make up approximately 24% of the Ogden unit with sagebrush shrubland and steppe contributing just over 14 percent of the unit's land coverage (**Table 3.6**). Sagebrush communities are considered to be key habitat for mule deer.

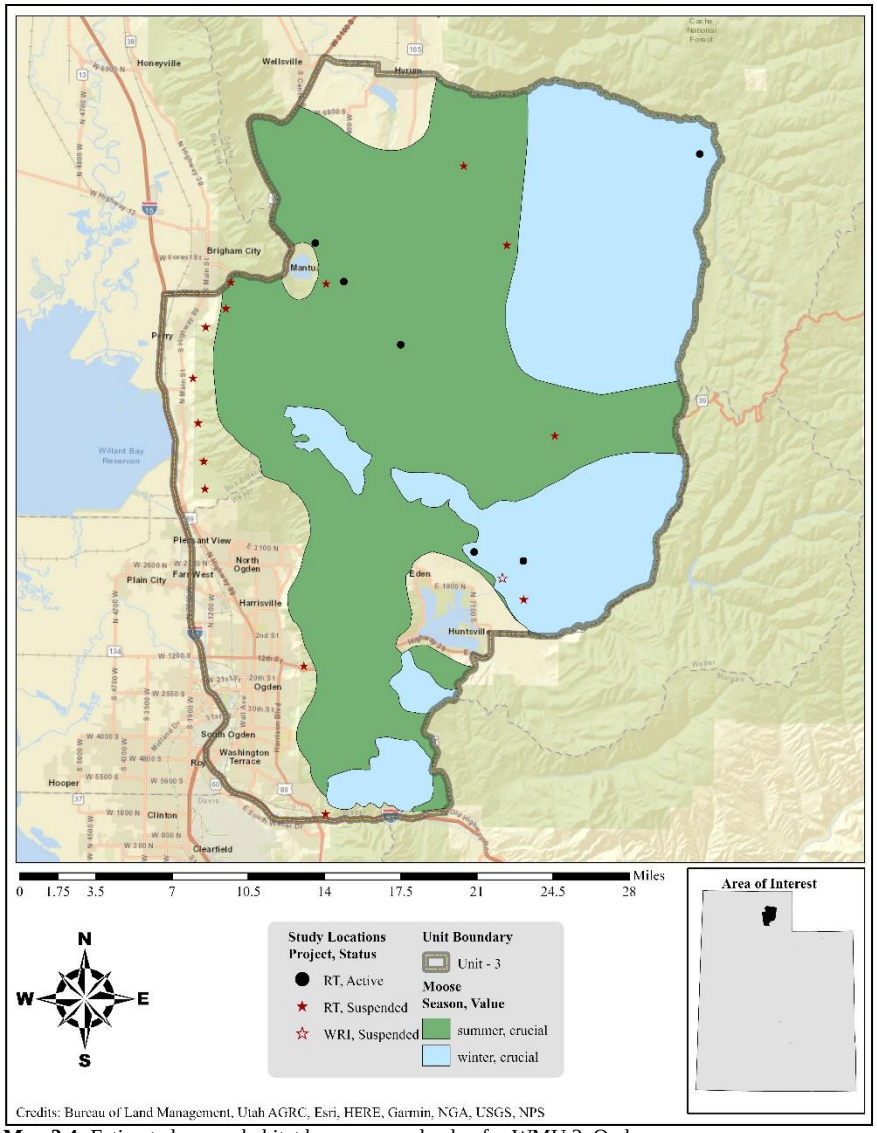
Deer wintering areas are found between 4,600 and 7,000 feet on the Wasatch face above Willard and Perry, between 5,100 and 7,000 feet north and east of Mantua Reservoir, from 5,600 to 7,000 feet in Threemile Canyon, and between 5,400 and 7,000 feet slopes on the southeast side of Cache Valley above Paradise and Avon. During severe winters, snow restricts deer use to Threemile Canyon, the East Fork of the Little Bear River, the area south of Porcupine Reservoir, Paradise Dry Canyon, Hyrum Dry Canyon, Perry Canyon, and the southeast corner of the unit south of Willard (King & Muir, 1971).



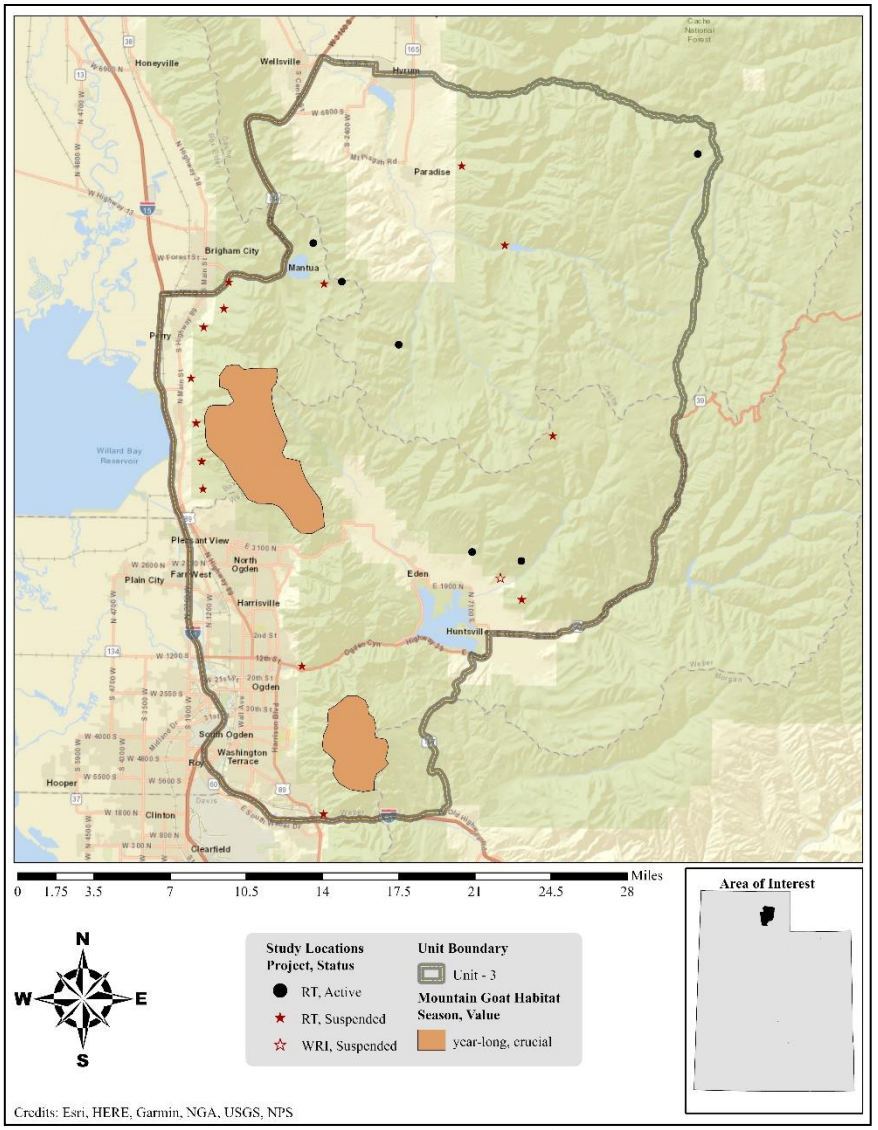
Map 3.2: Estimated mule deer habitat by season and value for WMU 3, Ogden.



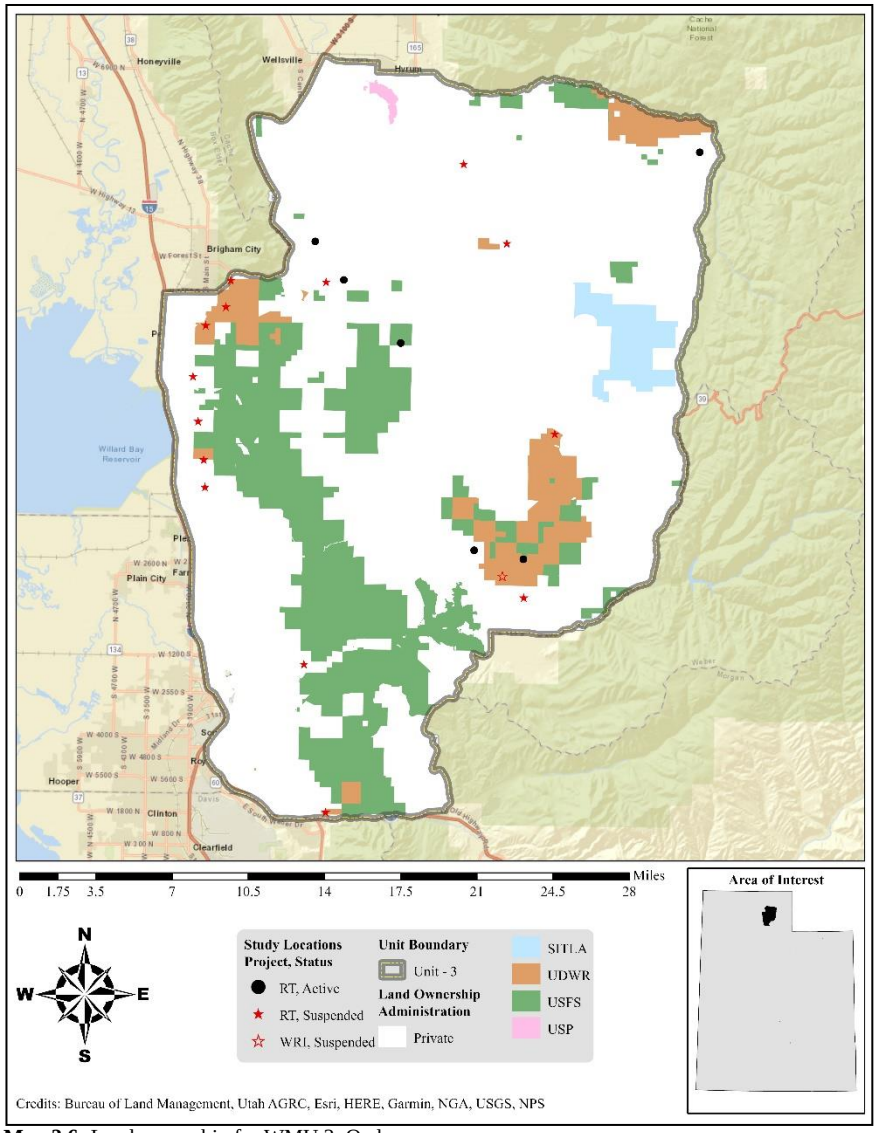
Map 3.3: Estimated elk habitat by season and value for WMU 3, Ogden.



Map 3.4: Estimated moose habitat by season and value for WMU 3, Ogden.



Map 3.5: Estimated mountain goat habitat by season and value for WMU 3, Ogden.



Map 3.6: Land ownership for WMU 3, Ogden.

	Year Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
Mule Deer	0	0%	193,561	58%	139,878	42%
Elk	8	<1%	104,507	39%	166,408	61%
Moose	0	0%	193,468	61%	123,411	39%
Mountain Goat	19,435	100%	0	0%	0	0%

Table 3.1: Estimated mule deer, elk, moose, and mountain goat habitat acreage by season for WMU 3, Ogden.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
Private	125,469	65%	108,767	78%
SITLA	8,113	4%	0	0%
UDWR	13,017	7%	7,976	6%
USFS	46,961	24%	23,125	17%
USP	0	0%	11	<1%
Total	193,561	**100%**	139,878	**100%**

Table 3.2: Estimated mule deer habitat acreage by season and ownership for WMU 3. Ogden

	Year Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
Private	8	100%	76,636	73%	127,706	77%
SITLA	0	0%	8,113	8%	0	0%
UDWR	0	0%	2,757	3%	15,679	9%
USFS	0	0%	17,001	16%	23,022	14%
Total	8	**100%**	104,507	**100%**	166,408	**100%**

Table 3.3: Estimated elk habitat acreage by season and ownership for WMU 3, Ogden.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
Private	137,632	71%	90,131	73%
SITLA	433	<1%	7,680	6%
UDWR	6,560	3%	13,130	11%
USFS	48,843	25%	12,471	10%
Total	193,468	**100%**	123,411	**100%**

Table 3.4: Estimated moose habitat acreage by season and ownership for WMU 3, Ogden.

	Year Long Range	
Ownership	*Area (acres)*	*%*
Private	2,083	11%
UDWR	129	<1%
USFS	17,223	89%
Total	19,435	**100%**

Table 3.5: Estimated mountain goat habitat acreage by season and ownership for WMU 3, Ogden.

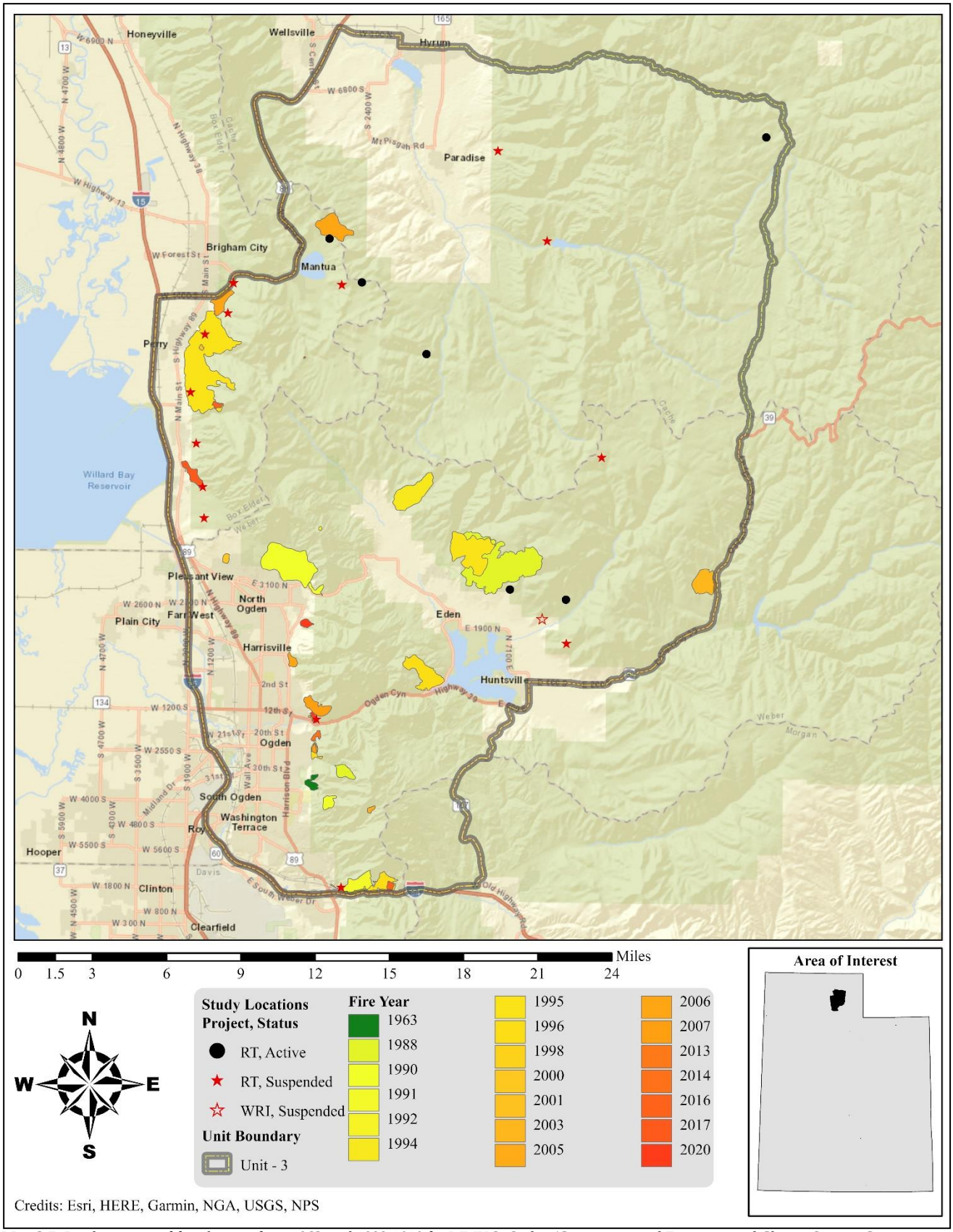
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Hardwood	162,912	21.11%	
	Agricultural	103,395	13.40%	
	Developed	88,431	11.46%	
	Conifer-Hardwood	22,343	2.89%	
	Open Water	20,786	2.69%	
	Riparian	16,442	2.13%	
	Sparsely Vegetated	9,454	1.22%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	235	0.03%	54.93%
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	80,127	10.38%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	65,289	8.46%	
	Inter-Mountain Basins Big Sagebrush Shrubland	23,733	3.07%	
	Inter-Mountain Basins Big Sagebrush Steppe	7,277	0.94%	
	Rocky Mountain Lower Montane-Foothill Shrubland	6,842	0.89%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	3,423	0.44%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	638	0.08%	
	Other Shrubland	529	0.07%	
	Inter-Mountain Basins Greasewood Flat	350	0.05%	
	Great Basin Xeric Mixed Sagebrush Shrubland	135	0.02%	
	Inter-Mountain Basins Mat Saltbush Shrubland	89	0.01%	
	Great Basin Semi-Desert Chaparral	86	0.01%	
	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	2	0.00%	24.42%
Conifer	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	22,631	2.93%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	17,820	2.31%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	15,161	1.96%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	14,962	1.94%	
	Colorado Plateau Pinyon-Juniper Woodland	7,699	1.00%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	6,194	0.80%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	2,564	0.33%	
	Great Basin Pinyon-Juniper Woodland	1,849	0.24%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	1,539	0.20%	
	Rocky Mountain Lodgepole Pine Forest	1,460	0.19%	
	Other Conifer	351	0.05%	
	Inter-Mountain Basins Juniper Savanna	7	0.00%	11.95%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	22,697	2.94%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	7,829	1.01%	
	Great Basin & Intermountain Introduced Annual Grassland	4,275	0.55%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	125	0.02%	4.53%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	21,925	2.84%	
	Southern Rocky Mountain Montane-Subalpine Grassland	5,700	0.74%	
	Inter-Mountain Basins Semi-Desert Grassland	412	0.05%	
	Other Grassland	279	0.04%	3.67%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	1,526	0.20%	
	Interior West Ruderal Riparian Scrub	1,340	0.17%	
	Interior Western North American Temperate Ruderal Shrubland	967	0.13%	
	Interior West Ruderal Riparian Forest	19	0.00%	0.50%
Total		**771,849**	**100%**	**100%**

Table 3.6: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 3, Ogden.

Limiting Factors to Big Game Habitat

Major human activities in the area include urbanization, grazing, and agriculture; the Landfire Existing Vegetation Coverage model suggests that 11% of the unit is developed, while 13% is used for agricultural purposes (**Table 3.6**). Habitat degradation and loss, winter range availability, winter range forage condition, and landowner acceptance limit big game habitat in this unit.

Other limiting factors to big game include introduced exotic herbaceous species, such as cheatgrass (*Bromus tectorum*). Increased amounts of cheatgrass exacerbate the risk of catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). According to the current Landfire Existing Vegetation Coverage model, over 4% of the unit is comprised of exotic herbaceous species (**Table 3.6**). Wildfires have occurred on this management unit, resulting in some loss of big game habitat (**Map 3.7**).



Map 3.7: Land coverage of fires by year from 1963, and 1988-2020 for WMU 3, Ogden (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

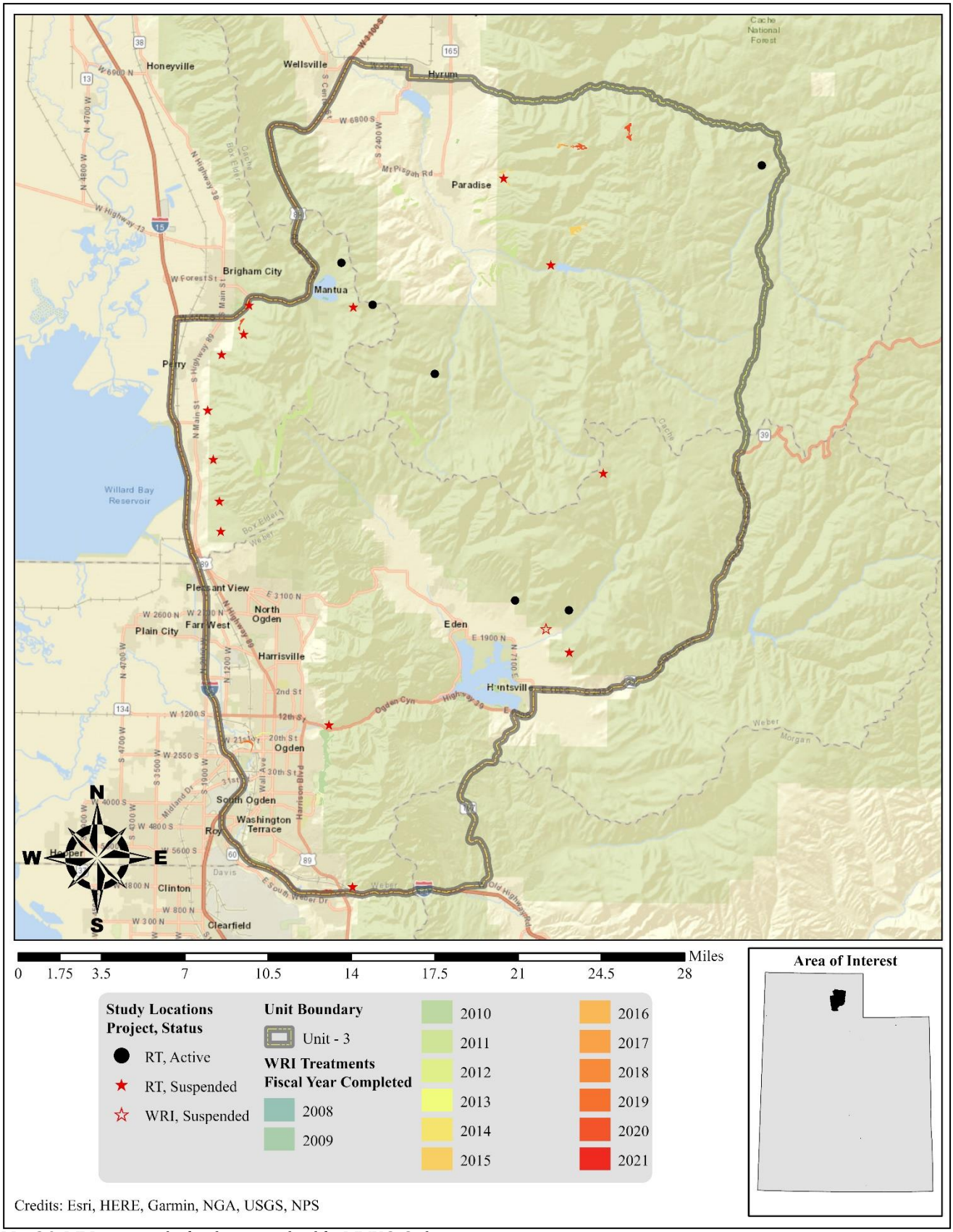
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 1,935 acres of land have been treated within the Ogden unit since the WRI was implemented in 2004 (**Map 3.8**). In addition, 212 acres are currently undergoing treatment and treatment projects are proposed for 473 acres. Treatments frequently overlap one another bringing the net total of completed treatment acres to 1,916 acres for this unit (**Table 3.7**). 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.

Herbicide application to remove unwanted vegetation is the most common management practice in this unit. Additional management practices include discing, logging, seeding desirable herbaceous species, and other vegetation management techniques (**Table 3.7**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Disc	**22**	**0**	**0**	**22**
Off-Set (One-Way)	4	0	0	4
Plow (One-Way)	7	0	0	7
Plow (Two-Way)	10	0	0	10
Forestry Practices	**148**	**138**	**134**	**420**
Group Selection Cuts	50	138	0	187
Thinning (Non-Commercial)	98	0	134	233
Greenstripping	**138**	**0**	**0**	**138**
Herbicide Application	**1,556**	**1**	**0**	**1,557**
Aerial (Helicopter)	924	0	0	924
Ground	632	0	0	632
Spot Treatment	0	1	0	1
Planting/Transplanting	**20**	**0**	**0**	**20**
Bareroot Stock	1	0	0	1
Other	19	0	0	19
Seeding (Primary)	**12**	**0**	**0**	**12**
Drill (Rangeland)	12	0	0	12
Seeding (Secondary/Shrub)	**27**	**72**	**0**	**99**
Ground (Mechanical Application)	27	72	0	99
Vegetation Removal/Hand Crew	**6**		**339**	**345**
Lop & Scatter	6		339	345
Other	**6**	**1**	**0**	**7**
Biological Control of Vegetation	5	0	0	5
Road Decommissioning	1	0	0	1
Excavating/Extraction	0	1	0	1
Grand Total	**1,935**	**212**	**473**	**2,620**
***Total Land Area Treated**	**1,916**	**212**	**473**	**2,600**

Table 3.7: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 3, Ogden. Data accessed on 02/09/2022. *Does not include overlapping treatments.



Map 3.8: WRI treatments by fiscal year completed for WMU 3, Ogden.

Range Trend Studies

Range Trend studies have been sampled within WMU 3 on a regular basis since 1984, with studies being added or suspended as was deemed necessary (**Table 3.8**). Due to changes in sampling methodologies, only data collected following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 3.9**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
03-1	East Mantua	RT	Suspended	1984, 1990, 2001	Not Verified
03-2	NE Mantua Reservoir	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Stony Loam (Wyoming Big Sagebrush)
03-3	Clay Valley	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
03-4	Anderson Ranch	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016	Mountain Loam (Shrub)
03-5	Mathias Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
03-6	White's Orchard	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
03-7	Mouth of Pearson's Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
03-8	Facer Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
03-9	Cook Canyon	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
03-10	Hyrum Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
03-11	Porcupine Dam	RT	Suspended	1984, 1990	Not Verified
03-12	Threemile Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Shrub)
03-13	Perry Basin	RT	Suspended	1984, 1990, 1996	Not Verified
03-14	Uintah Junction	RT	Suspended	1985, 1990, 1996	Not Verified
03-15	Odgen Canyon	RT	Suspended	1985, 1990, 1996	Not Verified
03-16	Maple Canyon	RT	Suspended	1985, 1990, 1996	Not Verified
03-17	Middle Fork	RT	Active	1985, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Shallow Loam (Low Sagebrush)
03-18	Geertsen Canyon	RT	Active	1985, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Mountain Big Sagebrush)
03-19	Brigham Face	RT	Suspended	1984, 1990, 1996	Not Verified
03R-1	Middle Fork Easement	RT	Suspended	1999	Not Verified
03R-2	Middle Fork Spray	WRI	Suspended	2006	Not Verified

Table 3.8: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 3, Ogden.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
03-2	NE Mantua Reservoir	Wildfire Wildfire	 Facer	1963 2006	 588	
03-4	Anderson Ranch	2,4-D		June 2011		
03-10	Hyrum Canyon	Lop and Scatter	West Coldwater Maple Thinning	Fall 2013-Fall 2015	126	2545
03-13	Perry Basin	Wildfire	Perry Fire	1994		
03R-2	Middle Fork Spray	Broadcast	Middle Fork WMA treatment	2008	6	1211

Table 3.9: Range Trend and WRI studies known disturbance history for WMU 3, Ogden. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

Two study sites [Clay Valley (03-3) and Geertsen Canyon (03-18)] are classified as Mountain (Big Sagebrush) ecological sites. The Clay Valley study is located east of Mantua Reservoir and north of Clay Valley, and the Geertsen Canyon study is found on the southwest-facing lower slopes near Geertsen Canyon (**Table 3.8**).

Shrubs/Trees: Total shrub cover has remained similar from year to year, and the dominant browse species on the Clay Valley and Geertsen Canyon studies is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Sagebrush cover follows a similar trend to the total cover trend with some variability in cover amounts each year, but increasing values overall (**Figure 3.3**). Average preferred browse demographics show that overall density has decreased over time and that mature plants make up the majority of the populations. Recruitment and density of young and decadent individuals has decreased overall (**Figure 3.8**). Average preferred browse utilization data shows that a majority of plants in most sample years have exhibited little to no use. Of the utilized plants, most are considered to be moderately hedged, except in 2016 when 16% were considered to be heavily hedged (**Figure 3.10**).

Average tree cover of juniper (*Juniperus* sp.) and bigtooth maple (*Acer grandidentatum*) has increased each study year: this is entirely due to the Clay Valley study as tree cover was not recorded on Geertsen Canyon (**Figure 3.4**). Point-quarter measurements of these species were only taken in 2016 with the values being attributed to the Clay Valley study (**Figure 3.6**).

Herbaceous Understory: Overall, the average herbaceous nested frequency has slightly decreased each sample year except for a slight increase between 2006 and 2011. In general, cover has increased over time, but exhibited a significant decrease between 2016 and 2021. In addition to bluebunch wheatgrass (*Pseudoroegneria spicata*) having a dominant influence on Clay Valley, the dominant component of the understory has been the introduced grass species bulbous bluegrass (*Poa bulbosa*) in most sample years. Although all sites of this ecological type in this unit have had bulbous bluegrass present in each sample year, cover has been highest on the Geertsen Canyon study throughout most of the study period. Average frequency of bulbous bluegrass has fluctuated, but has stayed fairly consistent overall. Cover of perennial annual forbs, and annual grasses have varied from year to year (**Figure 3.12**, **Figure 3.14**).

Occupancy: Despite a large decrease in usage in 2011, average pellet transect data shows that overall occupancy has remained similar and that deer have been the primary occupants in most sample years. Mean abundance of deer pellet groups has ranged from 4 days use/acre in 2011 to 38.5 days use/acre in 2021. Elk pellet groups have had a mean abundance as low as 3 days use/acre in 2006 and as high as 8 days use/acre in 2001. Average abundance of cattle pellet groups has been as low as nearly 2.5 days use/acre in 2001 and as high as 7 days use/acre in 2006. Finally, horse pellet groups have had a mean abundance ranging from 0 days use/acre in 2006 and 2016 to just over 2 days use/acre in 2011 (**Figure 3.16**).

Mountain (Black/Low Sagebrush)

There is one study [Middle Fork (03-17)] that is considered to be a Mountain (Low Sagebrush) ecological site: this study is situated on the south-facing slope north of Middle Fork Ogden River (**Table 3.8**).

Shrubs/Trees: The primary browse species on this study site is low sagebrush (*Artemisia arbuscula*); other shrubs contribute less cover. Shrub cover has fluctuated from year to year, but has remained fairly consistent overall (**Figure 3.3**). Mature plants have comprised most of the preferred browse population on this site, and density of decadent individuals exhibited a slight increase while recruitment of young plants decreased (**Figure 3.8**). Average preferred browse utilization have varied, but the majority of plants have shown signs of little to no use in all sample years (**Figure 3.10**).

Trees have not been recorded on this site in either cover or density measurements (**Figure 3.4**, **Figure 3.6**).

Herbaceous Understory: The herbaceous understory on this site has fluctuated from year to year, but cover has exhibited an overall increase over time while frequency has shown an overall decrease. The dominant component of the understory has been the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) in most sample years. Other perennial grasses include a number of introduced and native species with bluebunch wheatgrass (*Pseudoroegneria spicata*) providing much of the cover. Perennial forb cover and frequency has fluctuated, while annual forbs have remained relatively rare (**Figure 3.12**, **Figure 3.14**).

Occupancy: According to average pellet transect data, animal occupancy has generally increased over the study period with deer being the primary occupants in all study years; mean abundance of deer pellet groups has been as low as 13 days use/acre in 2006 and as high as nearly 35 days use/acre in 2016. Elk have also been present on this site, with pellet groups having an average abundance ranging from 7 days use/acre in 2001 to 20 days use/acre in 2016 (**Figure 3.16**).

Mountain (Shrub)

There are two studies [Anderson Ranch (03-4) and Threemile Canyon (03-12)] that are considered to be Mountain (Shrub) ecological sites. Anderson Ranch is situated west of Ant Flat Road near Hardware Ranch. The Threemile Canyon study is located on a south-facing slope above Threemile Creek (**Table 3.8**).

Shrubs/Trees: The primary browse species on these study sites are mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*); bitterbrush is more prevalent on Threemile Canyon. Shrub cover has fluctuated from year to year, but has remained fairly consistent overall. However, it is important to note that the 2021 sample year is not representative due to the Anderson Ranch study not being sampled (**Figure 3.2**). Mature plants have comprised most of the preferred browse populations on these sites, and density for all age classes appeared to remain constant between 1996 and 2016. Again, it is important to note that the 2021 is not representative; the density increase 2021 is likely inflated due to the differing "n values" (**Figure 3.8**). Though varied, overall utilization has decreased over time. More specifically, utilization values have decreased from 56% of the population being moderately to heavily hedged in 1996 to 39% of the population being hedged in 2016 (**Figure 3.10**).

Tree cover and density on these sites have been marginal to absent. Although recorded in density strips, point-quarter data for bigtooth maple (*Acer grandidentatum*) was only taken in 2016 (**Figure 3.4**, **Figure 3.6**).

Herbaceous Understory: The herbaceous understories on these sites have fluctuated from year to year, with cover exhibiting an increase over time and frequency remaining stable. The dominant component of the understories has been the native species with bluebunch wheatgrass (*Pseudoroegneria spicata*) in most sample years. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has increased in cover and frequency. Annual forb cover and frequency have also increased significantly while annual grasses have fluctuated over time (**Figure 3.12**, **Figure 3.14**).

Occupancy: According to average pellet transect data, animal occupancy has decreased overall during the course of the sampling with deer being the primary occupants in all study years; mean abundance of deer pellet groups has been as low as 16 days use/acre in 2016 and as high as nearly 93 days use/acre in 2001. Elk have also been present on this site, with pellet groups having an average abundance ranging from 9 days use/acre in 2021 to 26 days use/acre in 2011. Finally, cattle pellet groups show a small presence on this ecotype and have only been recorded on the Anderson Ranch site (**Figure 3.16**).

Upland (Big Sagebrush)

One study site [NE Mantua Reservoir (03-2)] is classified as an Upland (Big Sagebrush) ecological site. This study site is located northeast of Mantua Reservoir near Clappers Hollow (**Table 3.8**).

Shrubs/Trees: The dominant browse species on this study site is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), but other preferred browse species such as chokecherry (*Prunus virginiana*) are present to a lesser extent. Overall shrub cover has decreased due to a fire that burned the study site between 2006 and 2021. However, shrubs increased in cover in 2011 and 2016, suggesting that the site may recover in future sample years if climatic conditions improve (**Figure 3.3**). Average preferred browse demographic data shows that a majority of plants were mature in most sample years: the exception to this was in 2006 when decadent plants were most prevalent, and in 2016 when young plants were the most common. No decadent plants have been recorded since 2006 **(Figure 3.9**). Utilization has steadily increased. However, it is important to note that the population was considerably smaller following the fire, so the overall utilization percentage after 2006 is not comparable to the first three years of sampling (**Figure 3.11**).

Trees have not been recorded on this site in either cover or density measurements (**Figure 3.5**, **Figure 3.7**).

Herbaceous Understory: Both average cover and frequency of the herbaceous understory have exhibited a precipitous increase between 1996 and 2016, but decreased overall in 2021. The dominant components of annual grass and forbs have varied from year to year, but their overall cover has increased. This study site has been host to the noxious annual grass medusahead (*Teaniatherum caput-medusae*) in 2011 and 2006, and the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has been recorded in each sample year with increasing cover **(Figure 3.13**, **Figure 3.15**).

Occupancy: As expected, average pellet transect data indicates that animal occupancy decreased following the burn. Deer were the primary occupants in 2001 and 2006, and mean pellet group abundance has ranged from 0.7 days use/acre in both 2011 and 2016 to almost 27 days use/acre in 2006. Combined elk and deer use in 2021 was 26 day use/acre with deer being the primary occupants in 2021. Elk were the primary occupants in 2011 and 2016, and mean abundance of pellet groups has been as low as 0 days use/acre in 2001 and 2006 and as high as nearly 7.4 days use/acre in 2021 (**Figure 3.17**).

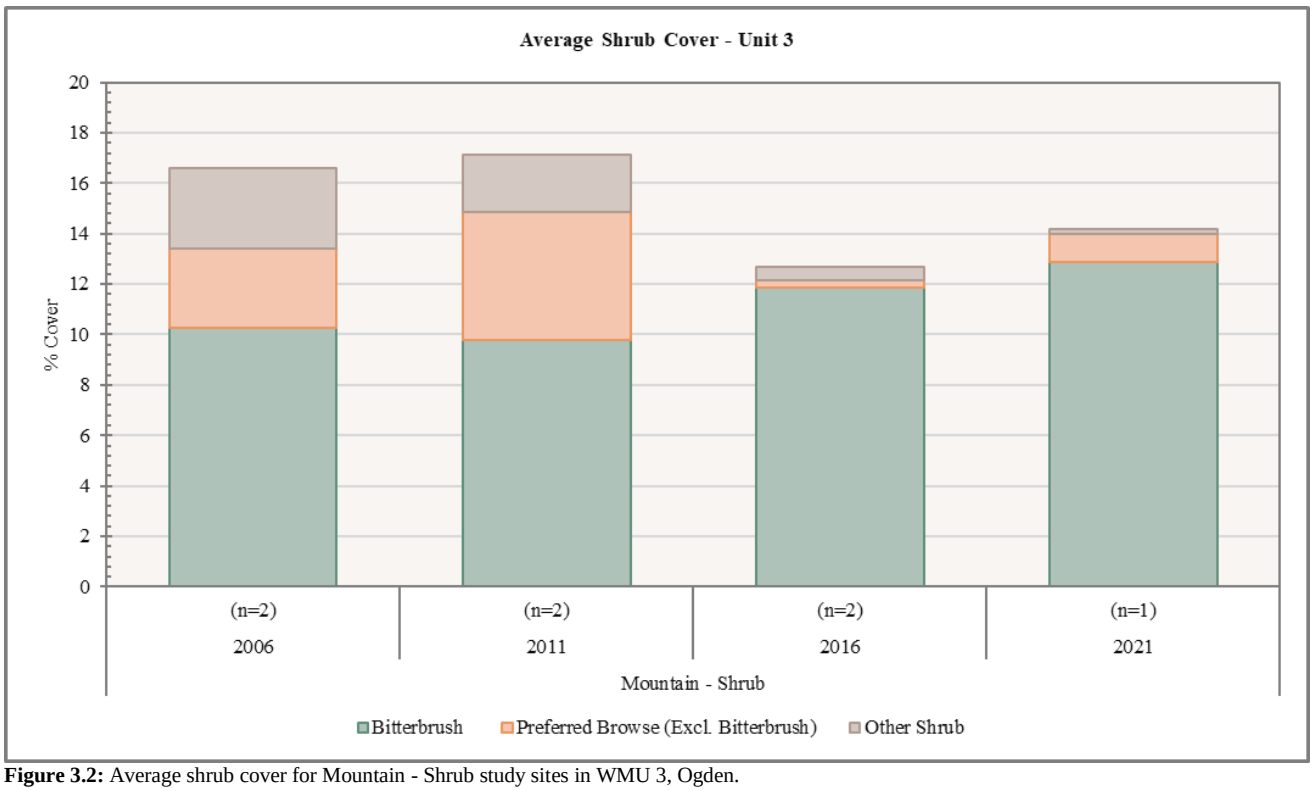


Figure 3.2: Average shrub cover for Mountain - Shrub study sites in WMU 3, Ogden.

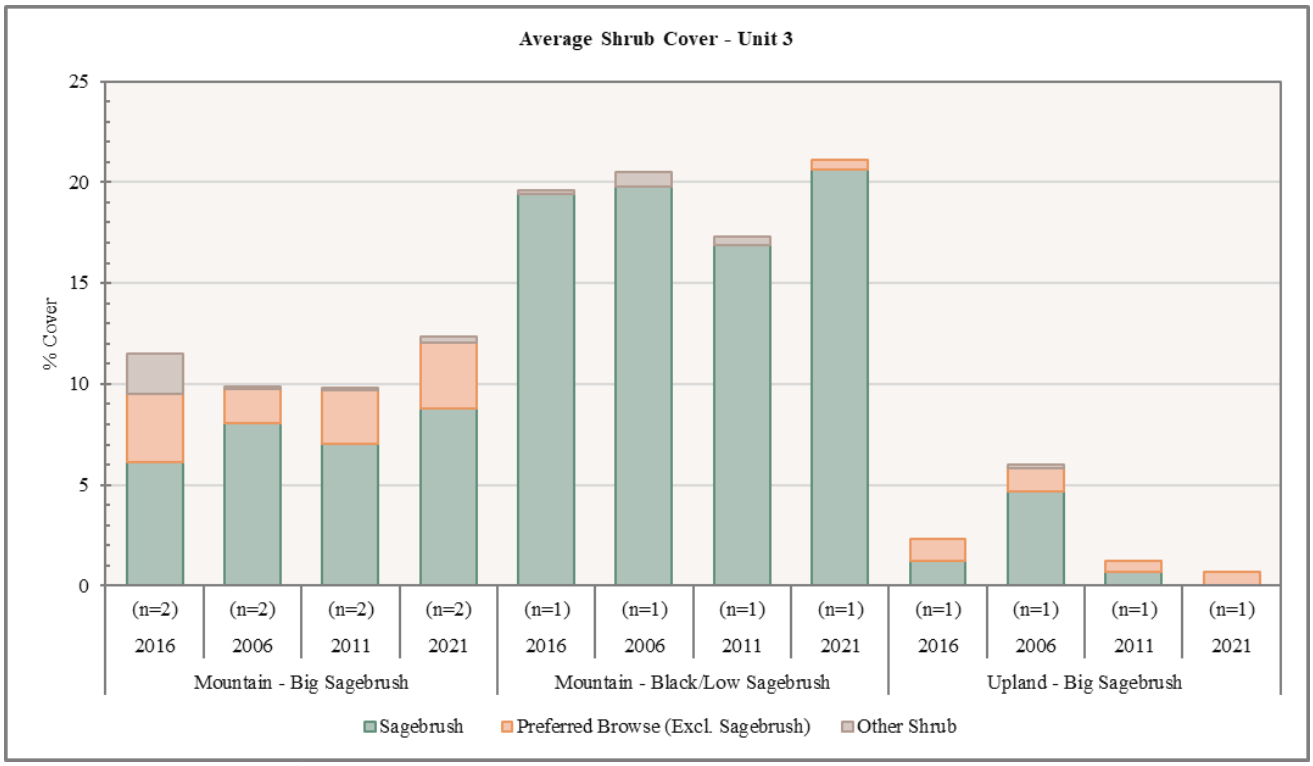


Figure 3.3: Average shrub cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Upland - Big Sagebrush study sites in WMU 3, Ogden.

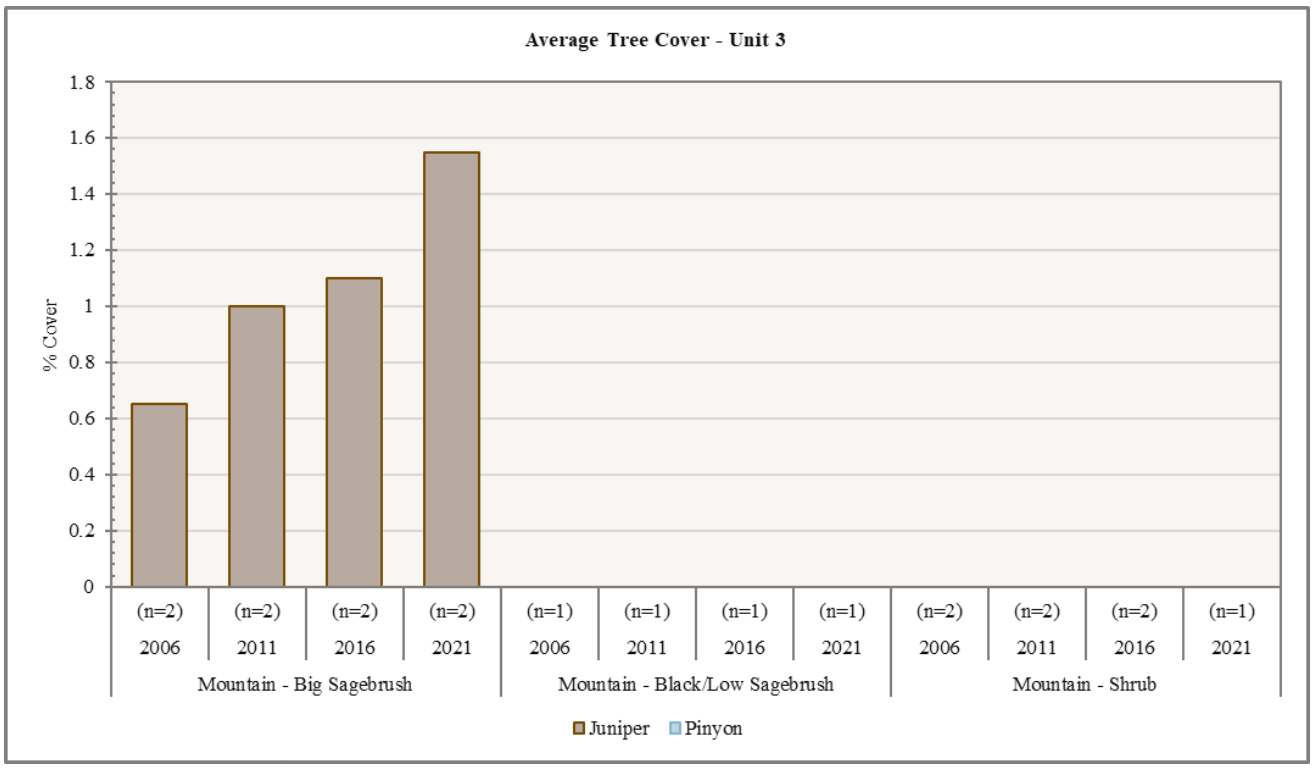


Figure 3.4: Average tree cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 3, Ogden.

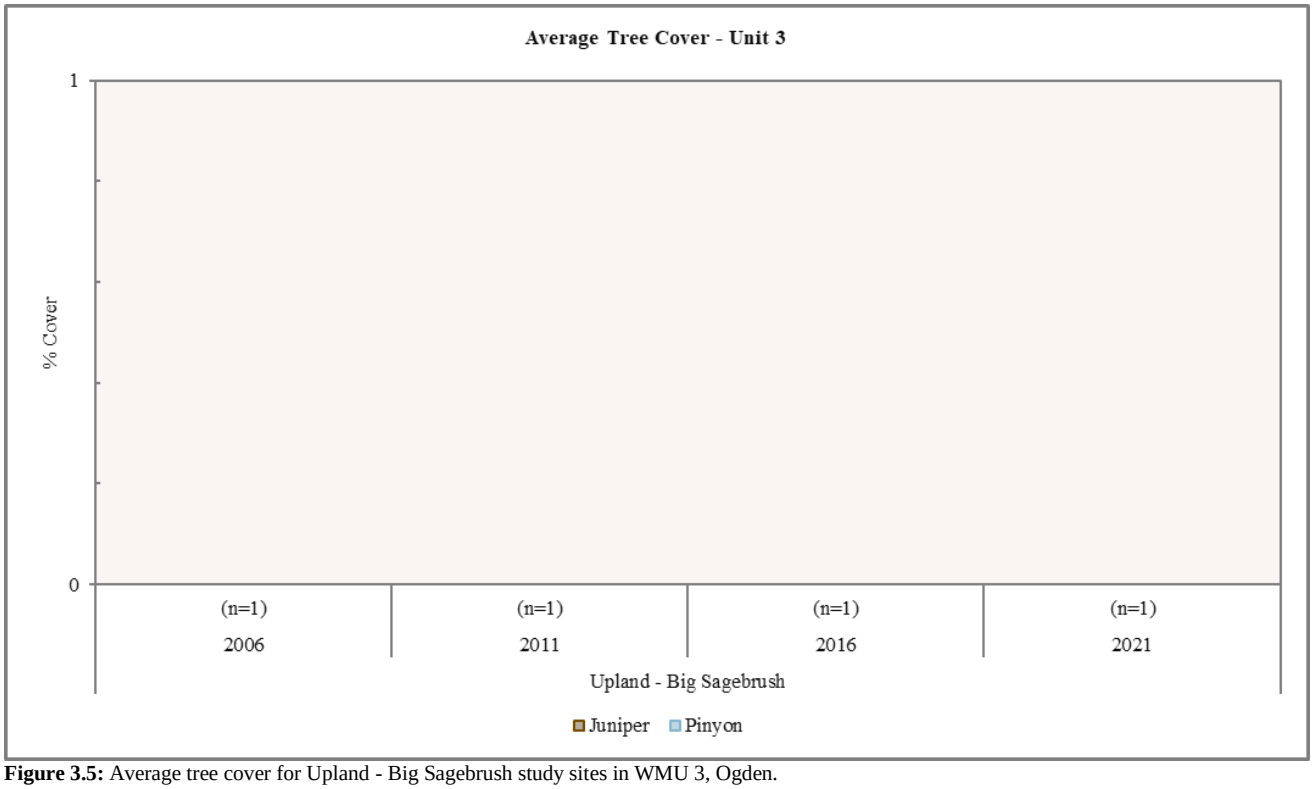


Figure 3.5: Average tree cover for Upland - Big Sagebrush study sites in WMU 3, Ogden.

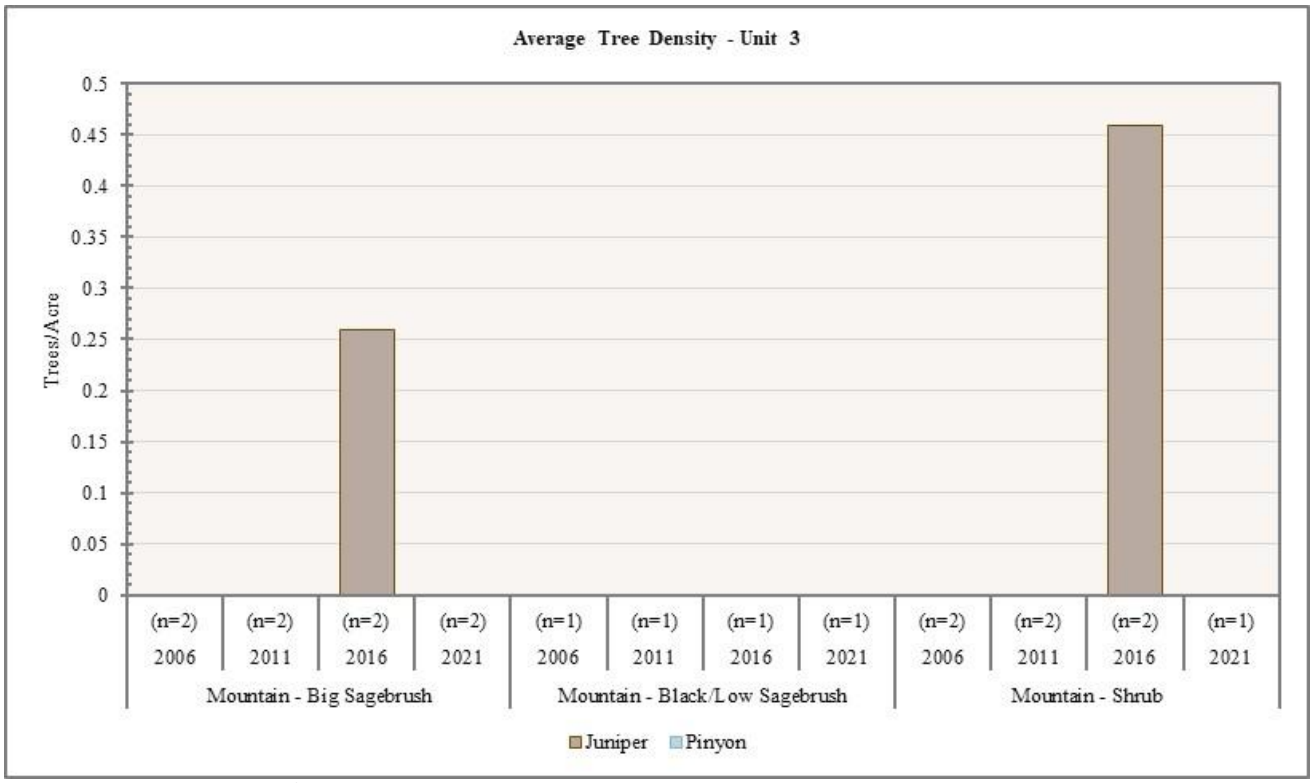


Figure 3.6: Average tree density for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 3, Ogden.

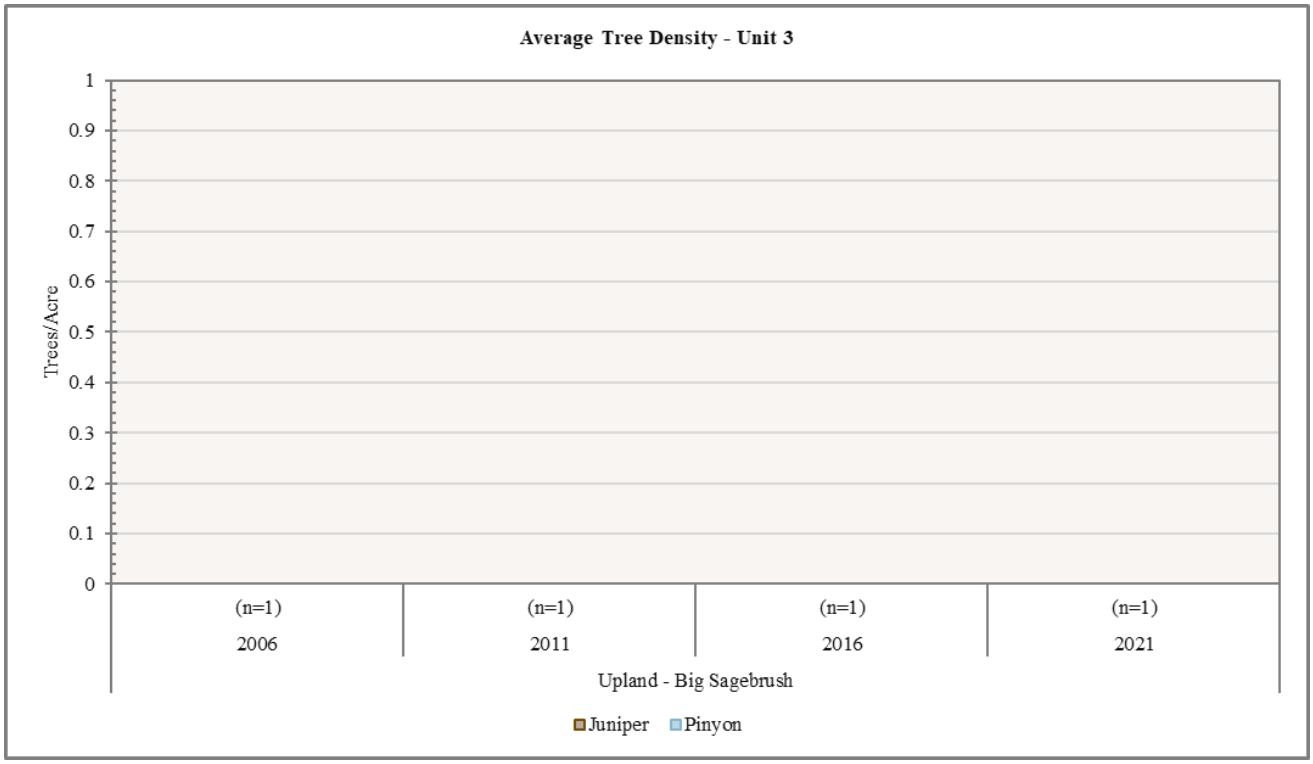


Figure 3.7: Average tree density for Upland - Big Sagebrush study sites in WMU 3, Ogden.

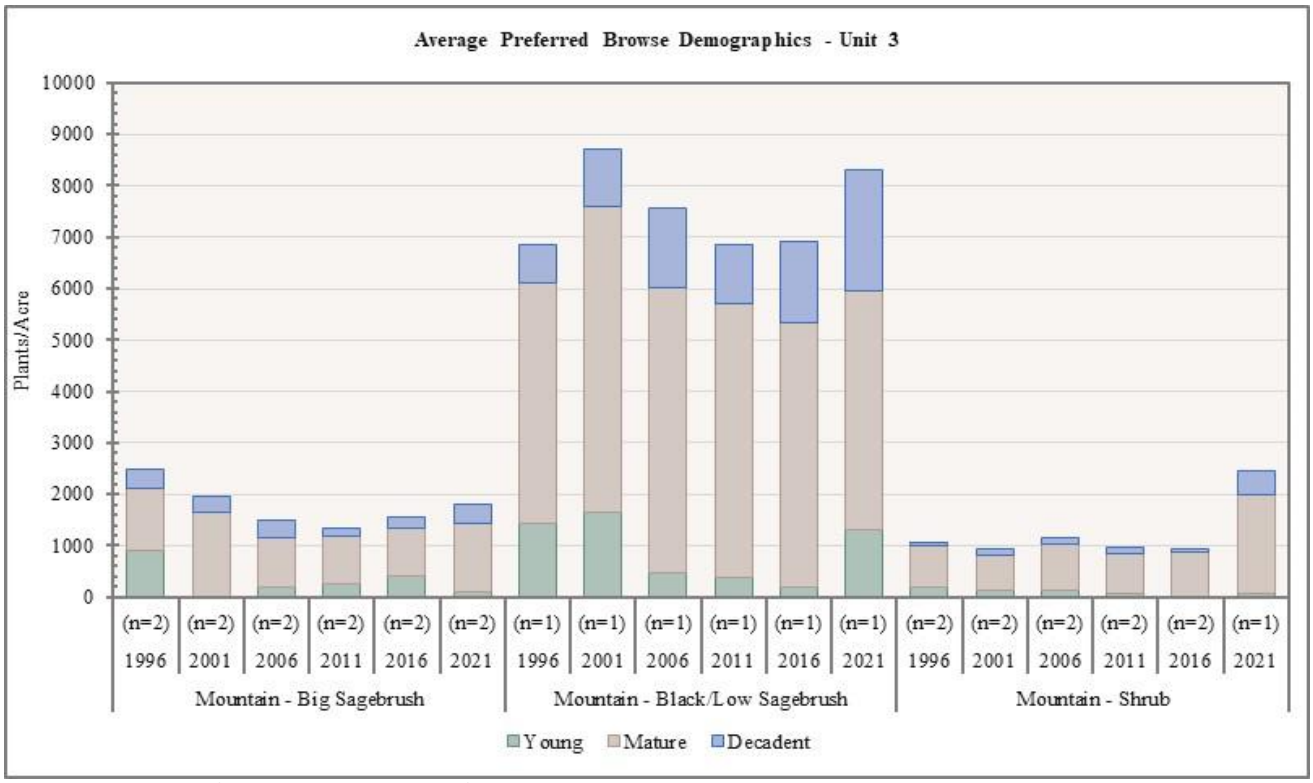


Figure 3.8: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 3, Ogden.

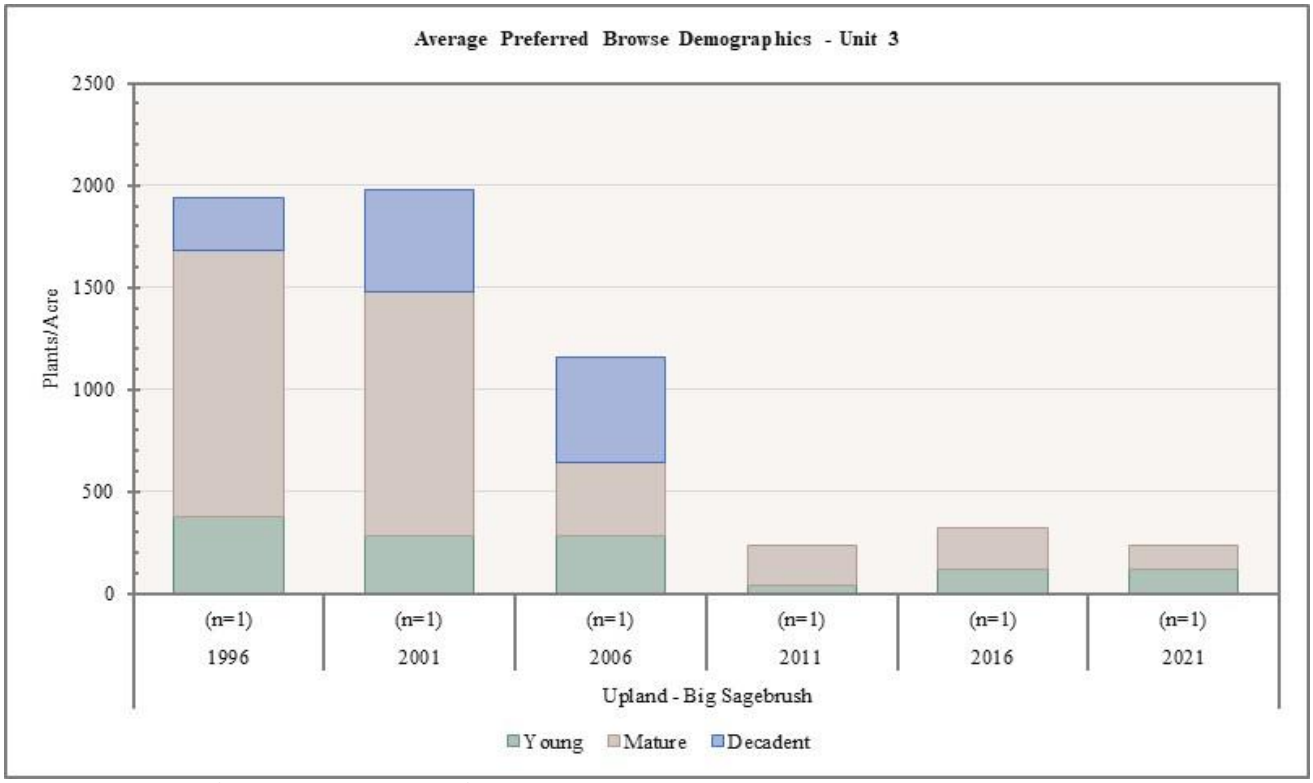


Figure 3.9: Average preferred browse demographics for Upland - Big Sagebrush study sites in WMU 3, Ogden.

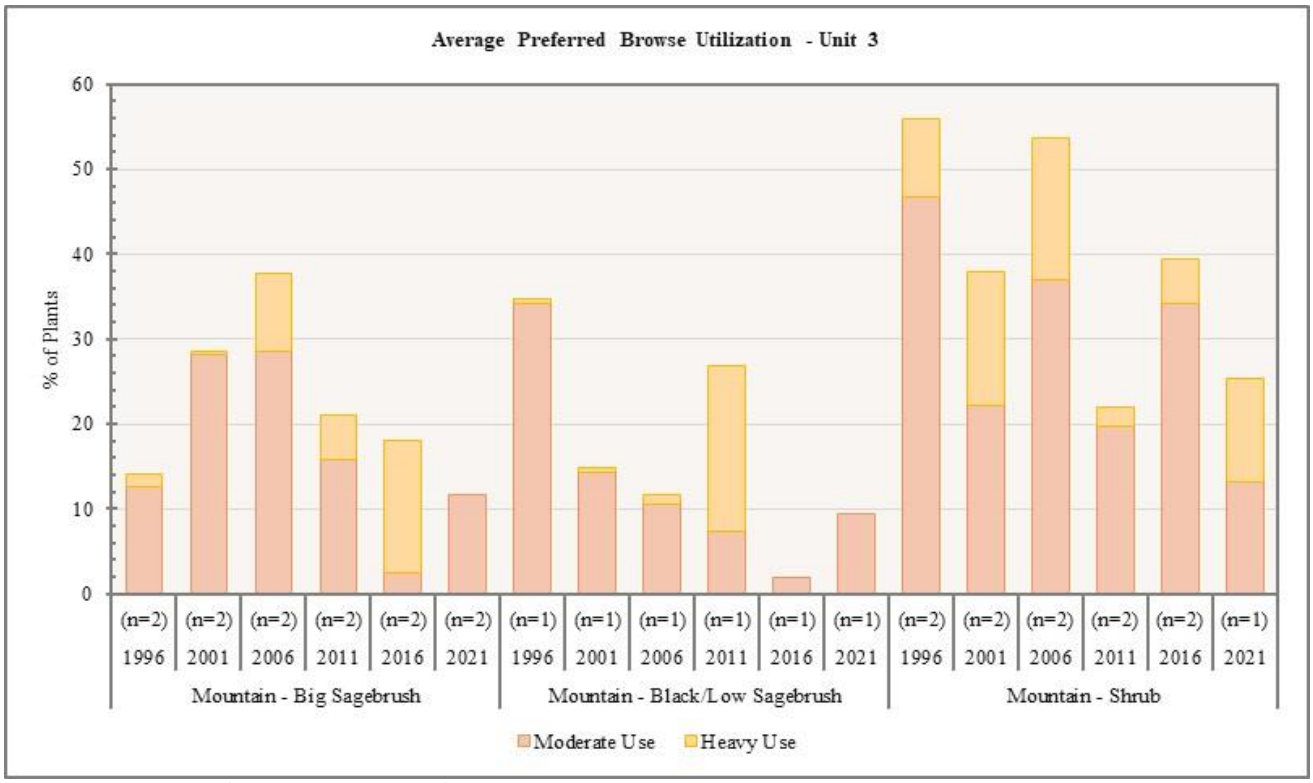


Figure 3.10: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 3, Ogden.

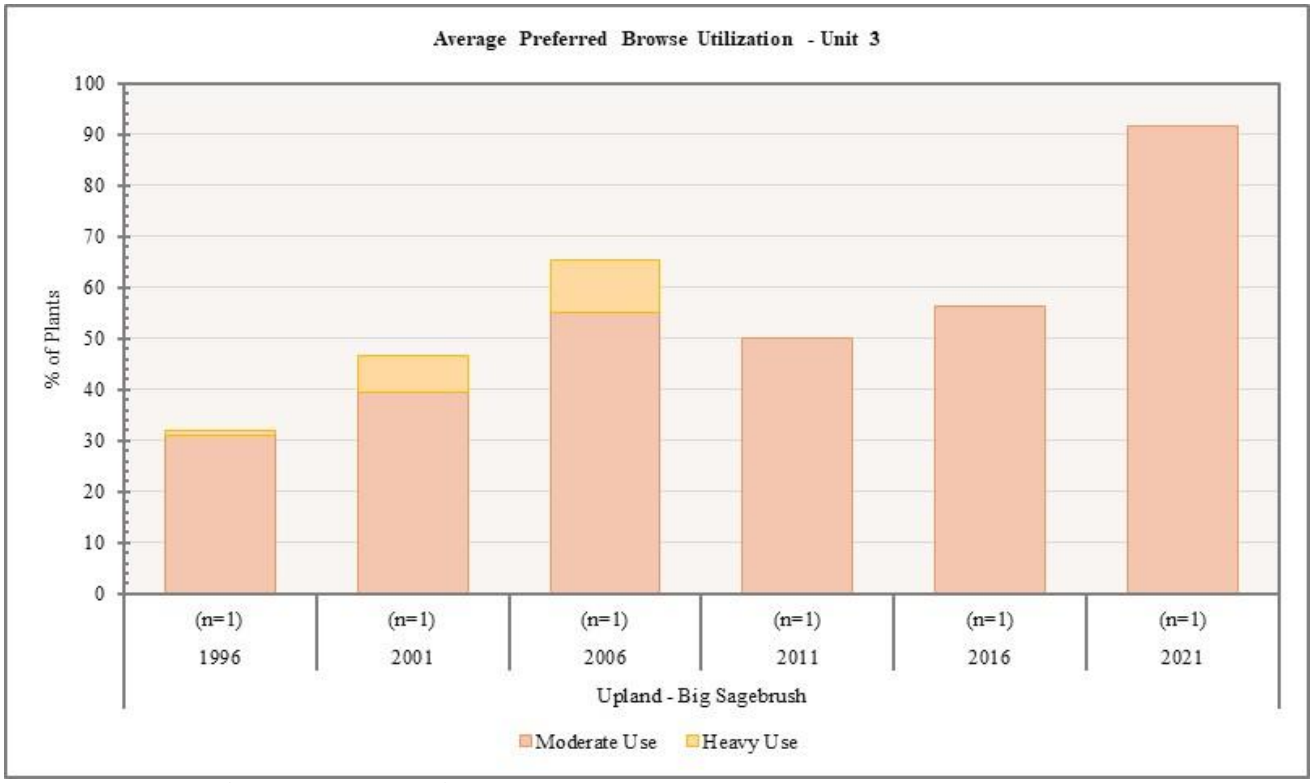


Figure 3.11: Average preferred browse utilization for Upland - Big Sagebrush study sites in WMU 3, Ogden.

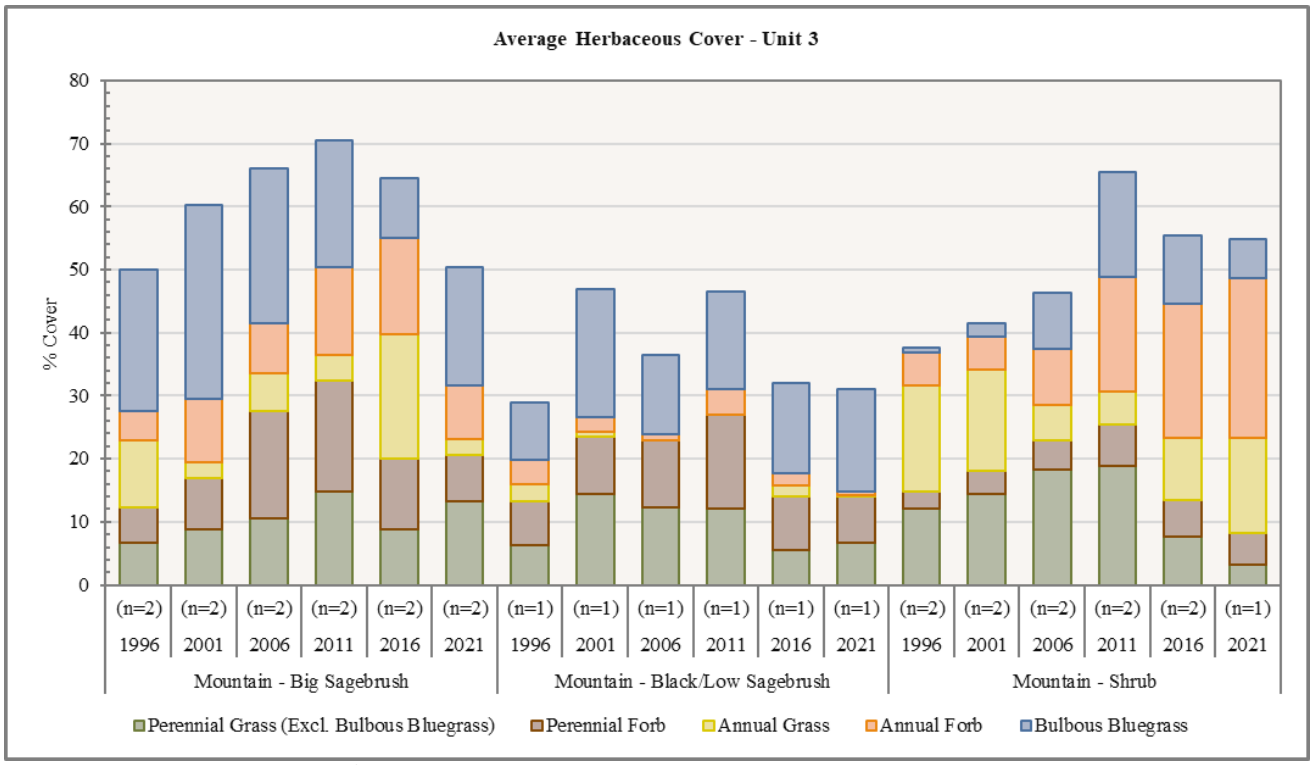


Figure 3.12: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 3, Ogden.

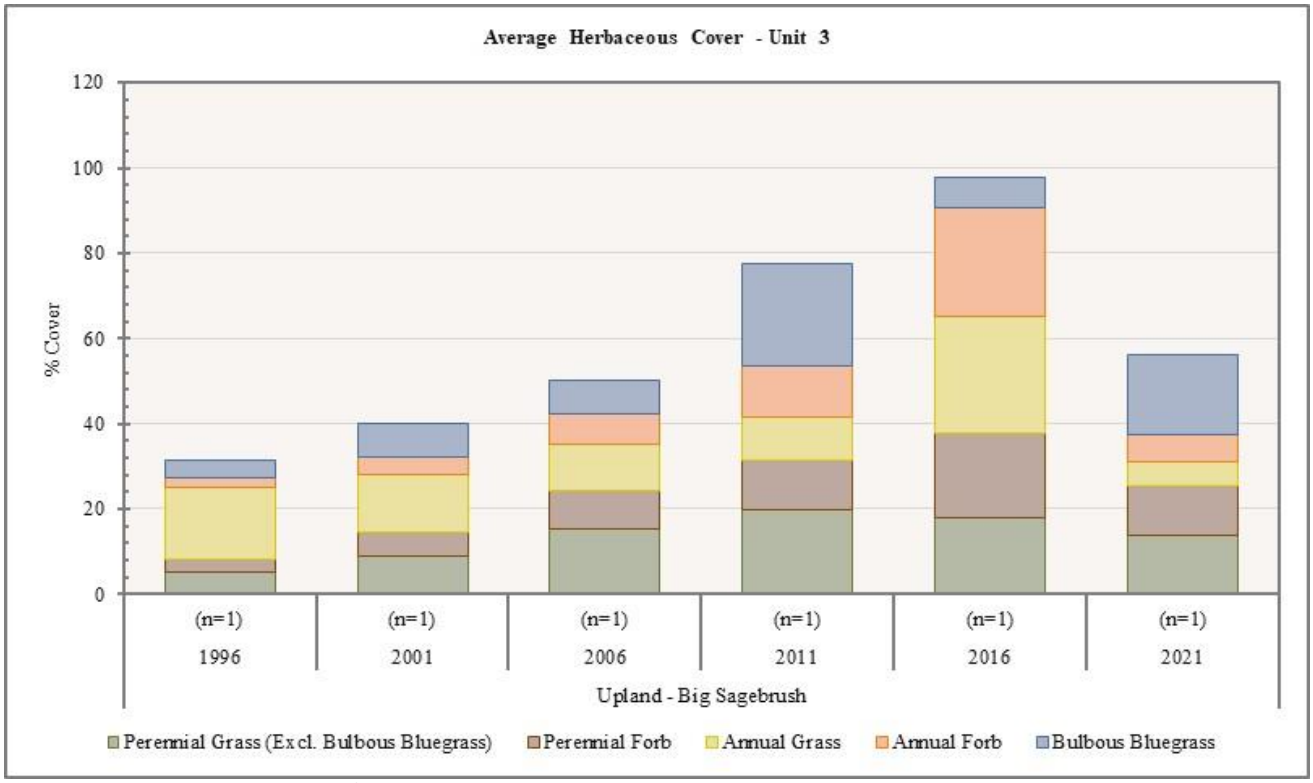


Figure 3.13: Average herbaceous cover for Upland - Big Sagebrush study sites in WMU 3, Ogden.

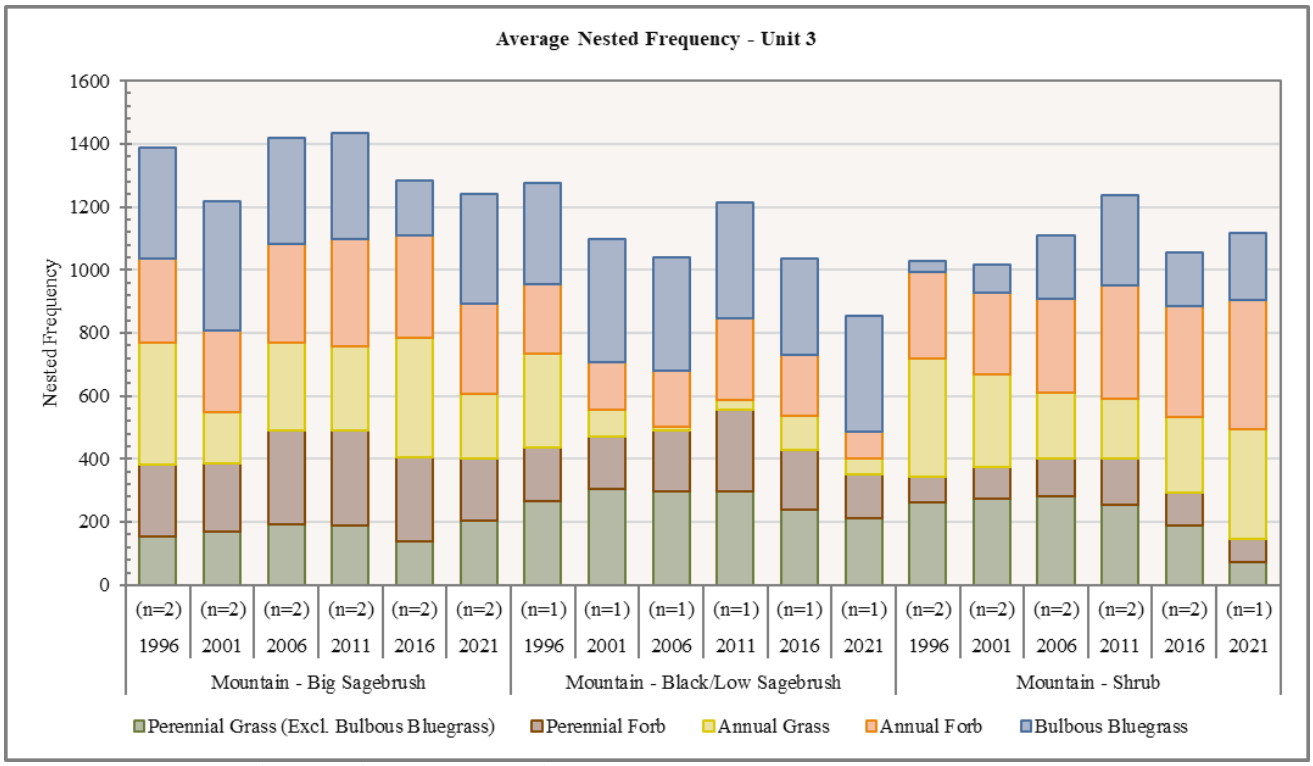


Figure 3.14: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 3, Ogden.

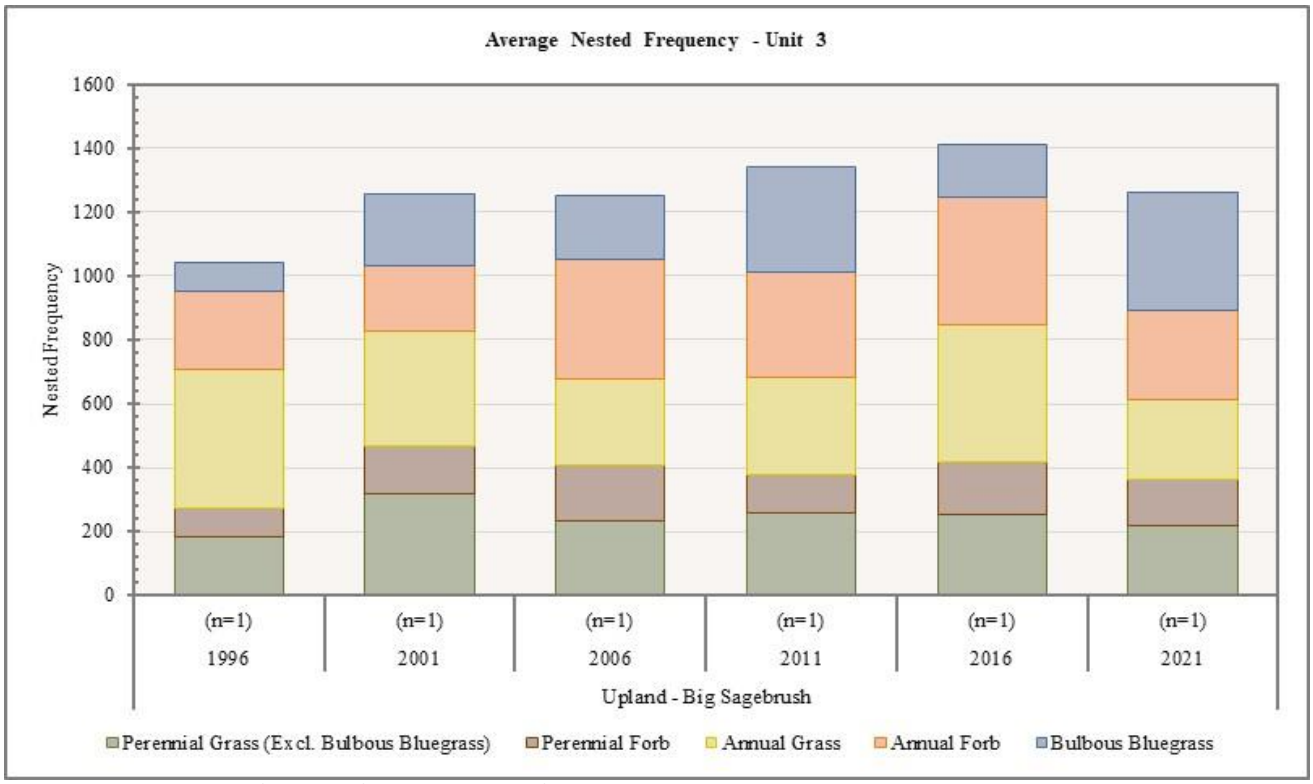


Figure 3.15: Average nested frequency of herbaceous species for Upland - Big Sagebrush study sites in WMU 3, Ogden.

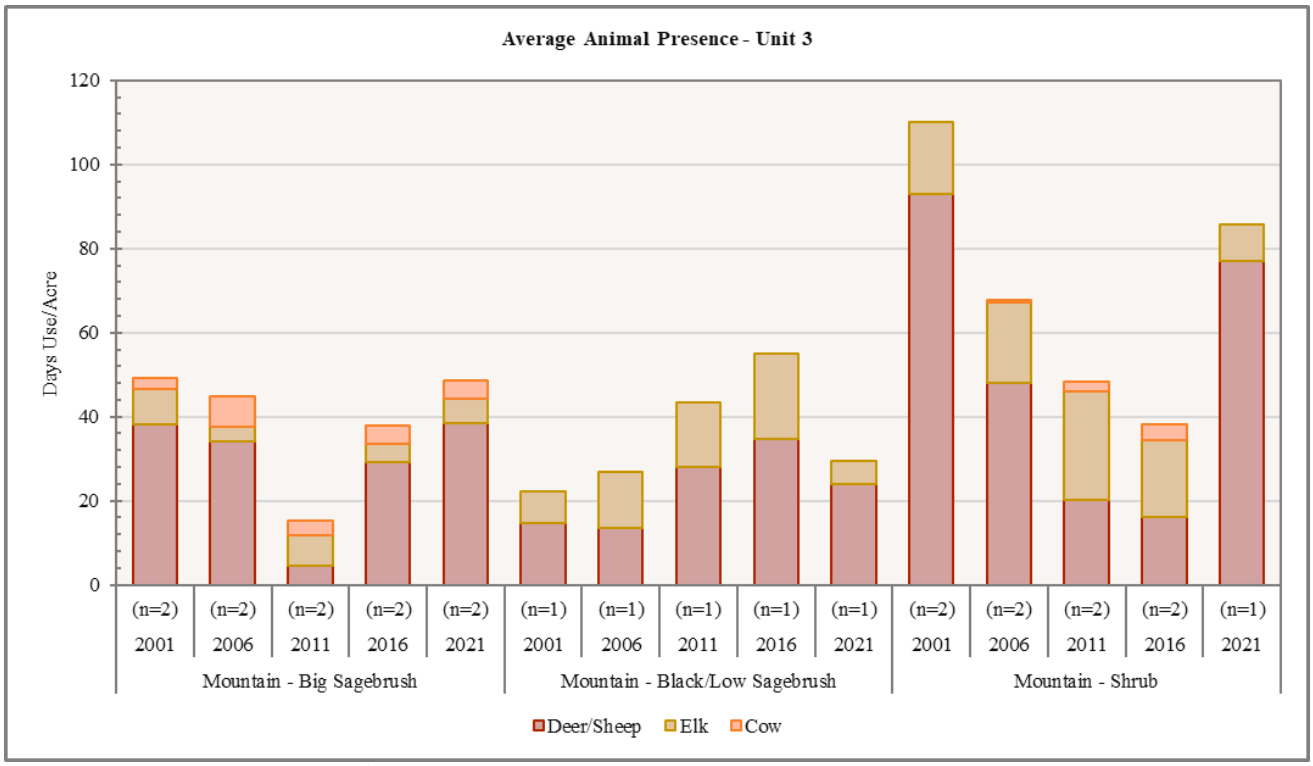


Figure 3.16: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 3, Ogden. *Mountain - Big Sagebrush and Mountain - Shrub deer pellet groups include deer/sheep.

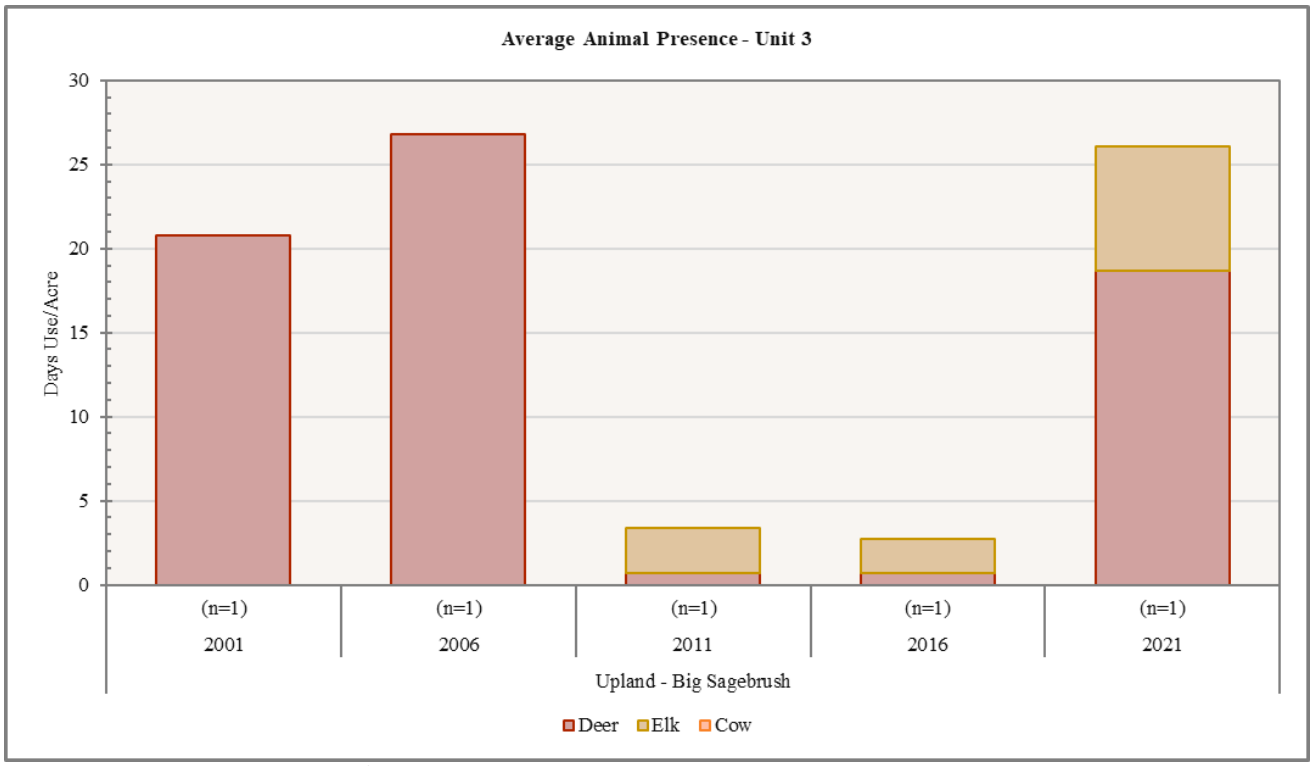
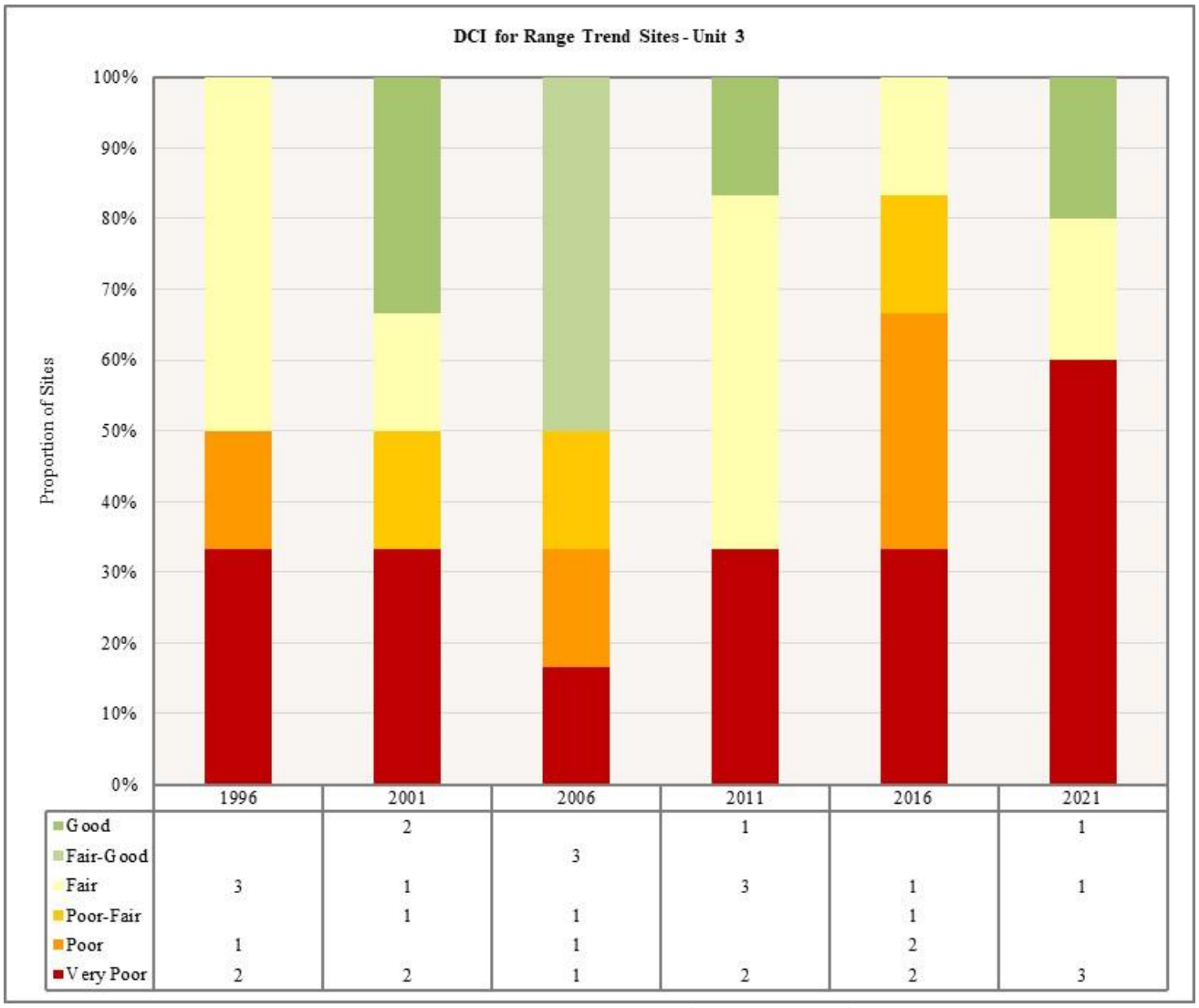


Figure 3.17: Average pellet transect data for Upland - Big Sagebrush study sites in WMU 3, Ogden.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Ogden management unit has generally remained poor condition since the 1996 sampling. The Range Trend sites in WMU 3 that have generally remained in fair condition are Clay Valley (03-3), Anderson Ranch (03-4), and Middle Fork (03-17), and are the main drivers for the unit's stability as fair to good deer winter range. Geertsen Canyon (03-18) has a proclivity to remain as very poor deer winter range while NE Mantua Reservoir (03-2) and Threemile Canyon (03-12) tend to also remain in very poor condition but with more variability as fair deer winter range: this variability may be an indicator that improvements in habitat can be made through rehabilitation.

The overall deer winter range assessment in 2021 for WMU 3 was poor. Geertsen Canyon remains in very poor condition due to an abundance of annual grass and a lack of preferred browse species. NE Mantua Reservoir lost much of its preferred browse in a wildfire in 2006 and is currently rated as very poor winter range. Of the sites in WMU 3, Clay Valley is the only site considered to be in good condition (**Figure 3.18**, **Table 3.10**).

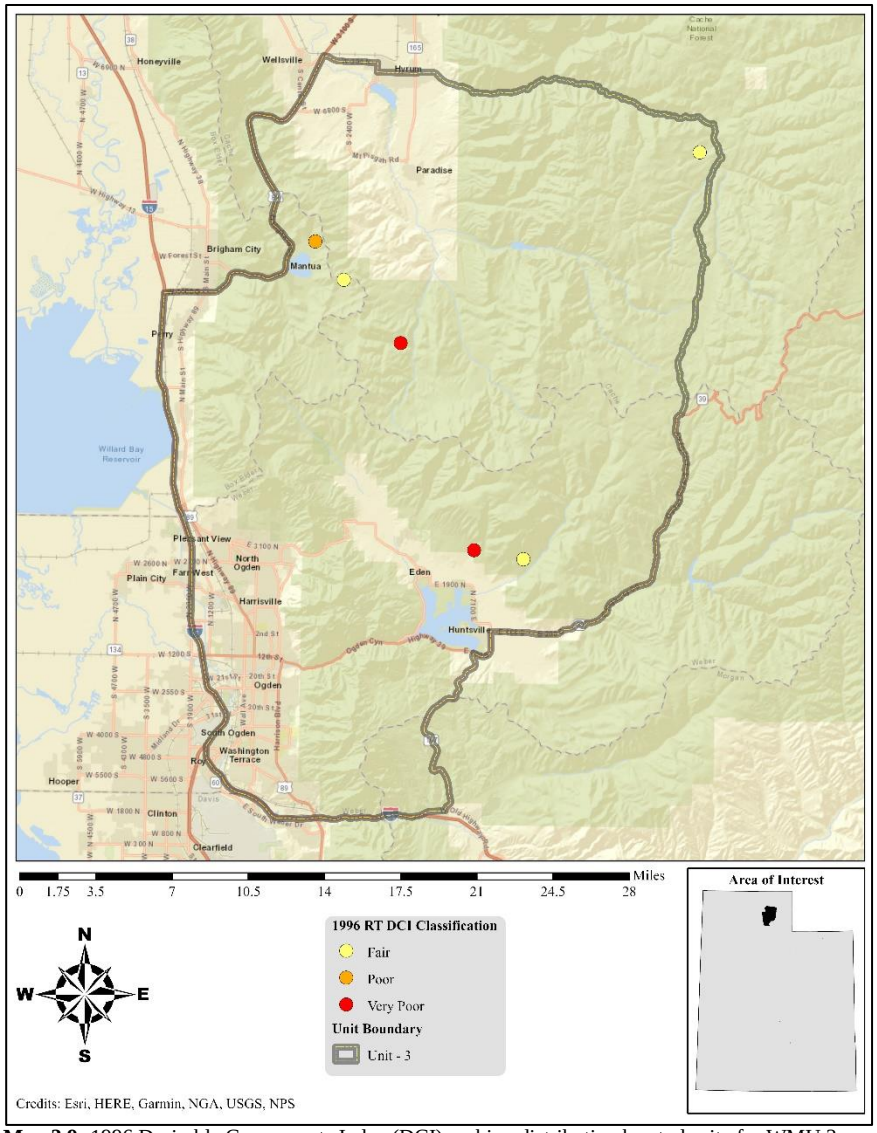


	1996	2001	2006	2011	2016	2021
Good		2		1		1
Fair-Good			3			
Fair	3	1		3	1	1
Poor-Fair		1	1		1	
Poor	1		1		2	
Very Poor	2	2	1	2	2	3

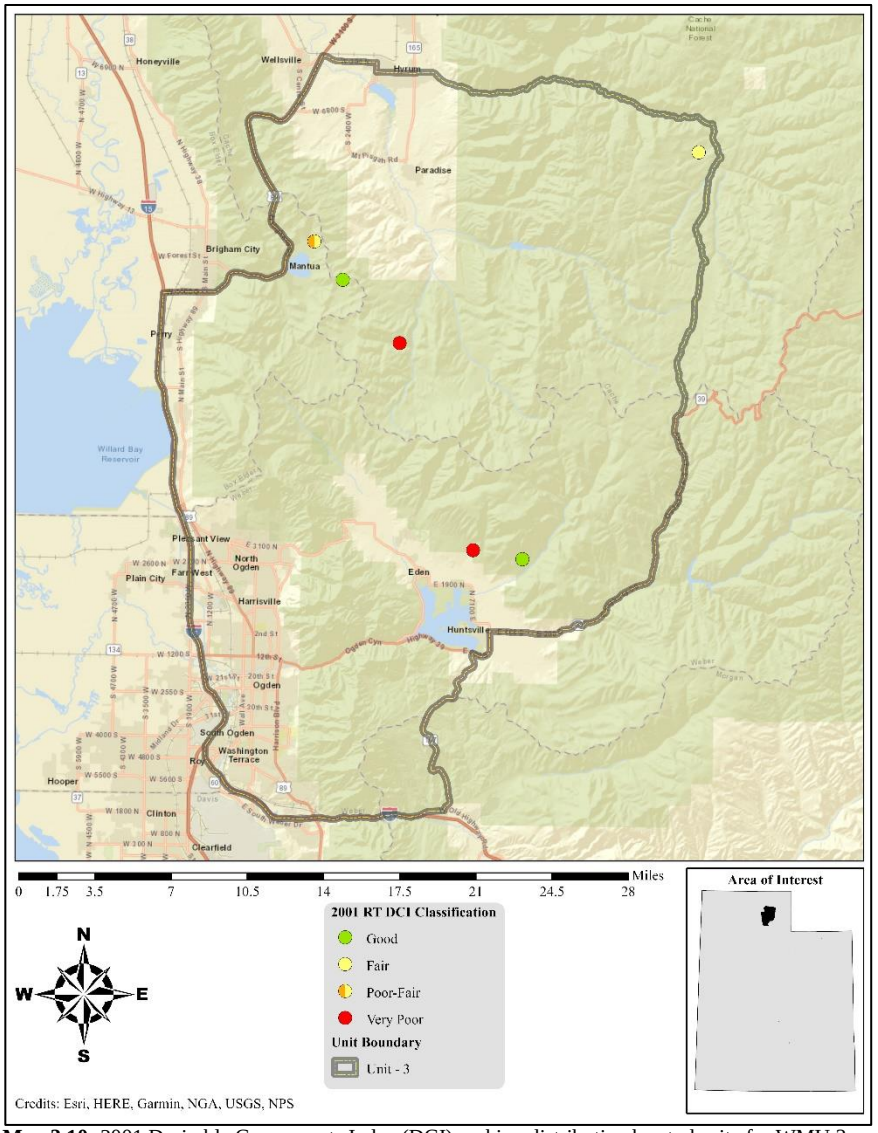
Figure 3.18: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 3, Ogden.

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
03-2	1996	21.3	11	8.3	10.6	-12.9	5.5	-2	**41.8**	**P**
03-2	2001	21	6.1	7.1	17.7	-10.2	10	-2	**49.7**	**P-F**
03-2	2006	7.5	1.6	4.3	30	-8.2	10	-2	**43.2**	**P**
03-2	2011	1.5	0	0	30	-7.5	10	-4	**30**	**VP**
03-2	2016	2.9	0	0	30	-15.7	10	-8	**19.2**	**VP**
03-2	2021	0.9	0	0	27.2	-1.6	10	-8	**28.5**	**VP**
03-3	1996	20.9	9.5	11.3	24.2	-9.6	2.9	-2	**57.1**	**F**
03-3	2001	30	10	0.7	30	-1.1	10	-2	**77.6**	**G**
03-3	2006	19	9.5	7.8	30	-4.8	10	-2	**69.4**	**F-G**
03-3	2011	17.9	12.5	11.2	30	-3.2	10	-2	**76.4**	**G**
03-3	2016	17.1	13.1	10.9	30	-11.6	10	-2	**67.6**	**F**
03-3	2021	25.9	8.5	2.5	30	-2.5	10	-2	**72.5**	**G**
03-4	1996	10.4	15	7.5	30	-5.8	2.1	0	**59.2**	**F**
03-4	2001	14.1	11.3	6.5	30	-1.2	1.3	0	**61.9**	**F**
03-4	2006	20.4	10	8	30	-0.8	3.5	0	**71.3**	**F-G**
03-4	2011	19	6.7	2.1	30	-0.7	5.9	0	**62.8**	**F**
03-4	2016	11.2	5.3	1.3	23.3	-6.4	10	0	**44.7**	**P**
03-12	1996	12.7	13	6.4	12.9	-19.6	8.8	-2	**32.2**	**VP**
03-12	2001	11.6	9.9	1.5	19.8	-20	10	-2	**30.8**	**VP**
03-12	2006	18.2	12.9	2.4	20.5	-7.8	10	-2	**54.2**	**P-F**
03-12	2011	23.1	15	2.3	21.4	-7	10	-2	**62.8**	**F**
03-12	2016	25.1	14.4	1	7	-8.3	10	-4	**45.2**	**P**
03-12	2021	20.8	2.4	0.1	6.3	-11.3	10	-6	**22.3**	**VP**
03-17	1996	16.5	11.9	10.1	12.7	-2	10	0	**59.2**	**F**
03-17	2001	16.6	11.2	9.5	28.6	-0.6	10	0	**75.4**	**G**
03-17	2006	24.8	8.8	2.9	24.6	0	10	0	**71**	**F-G**
03-17	2011	21.1	10	2.6	24.1	-0.1	10	0	**67.8**	**F**
03-17	2016	24.3	8.1	1.5	10.9	-1.3	10	0	**53.4**	**P-F**
03-17	2021	26.5	6.5	7.1	13.2	-0.1	10	0	**63.2**	**F**
03-18	1996	2.8	0	0	2.4	-6.2	10	-2	**7**	**VP**
03-18	2001	3.6	0	0	2.8	-2.6	10	0	**13.8**	**VP**
03-18	2006	4.6	0	0	4.2	-4.3	10	-2	**12.5**	**VP**
03-18	2011	5.1	0	0	5.4	-2.8	10	0	**17.7**	**VP**
03-18	2016	5.1	0	0	2.4	-18	10	0	**-0.5**	**VP**
03-18	2021	2.8	0	0	16.7	-1.2	10	0	**28.2**	**VP**

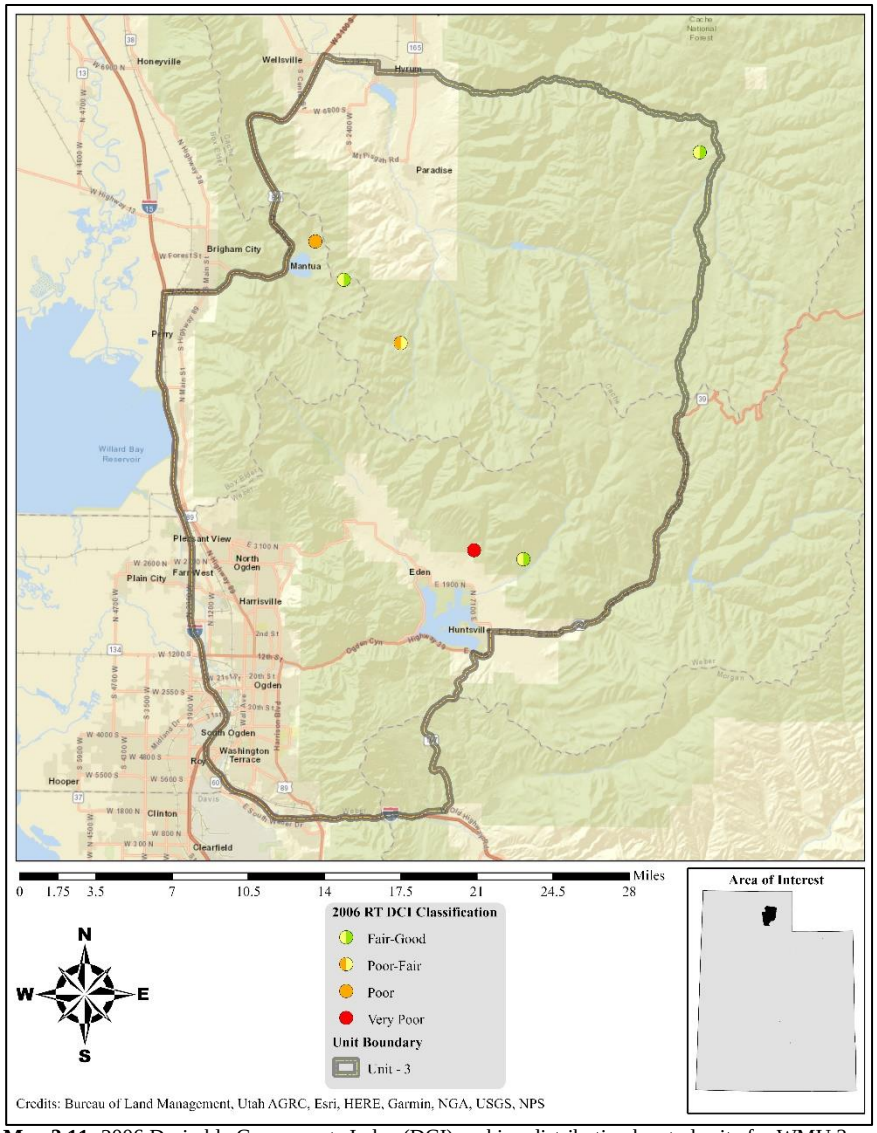
Table 3.10: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 3, Ogden. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



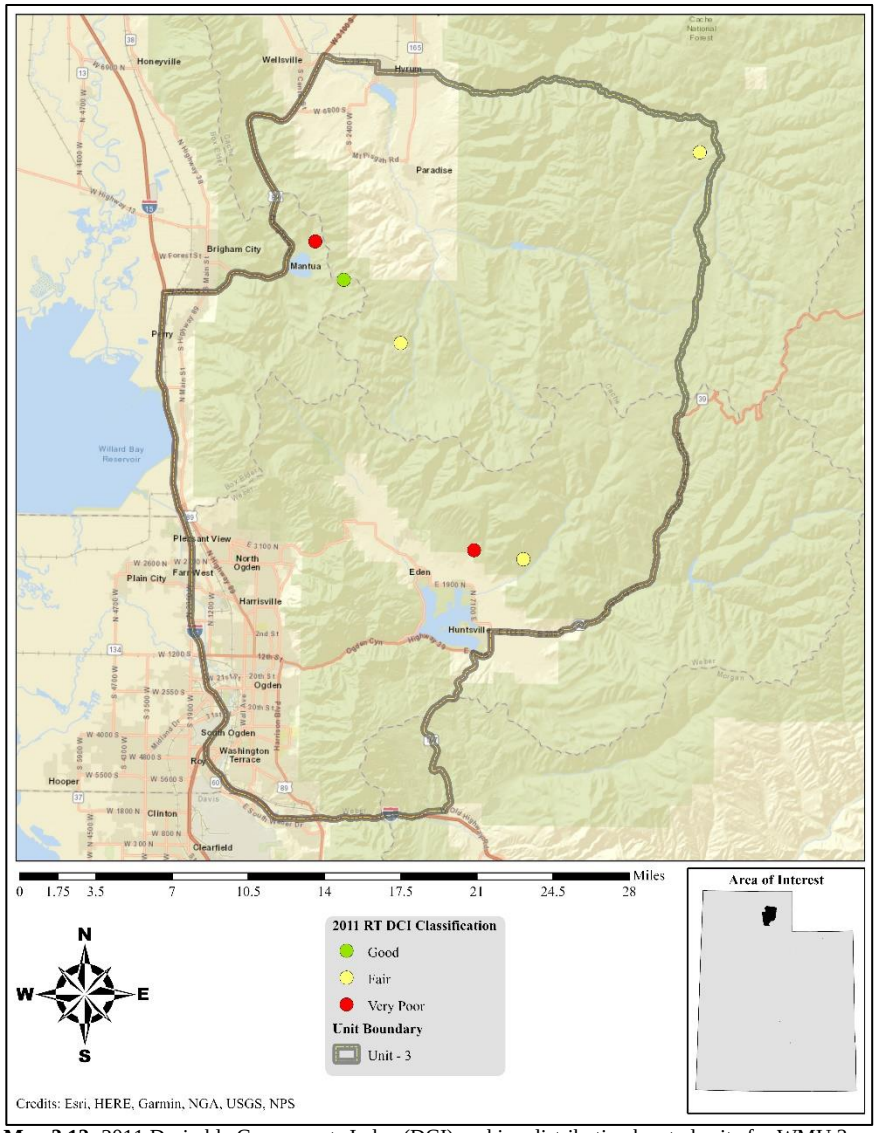
Map 3.9: 1996 Desirable Components Index (DCI) ranking distribution by study site for WMU 3, Ogden.



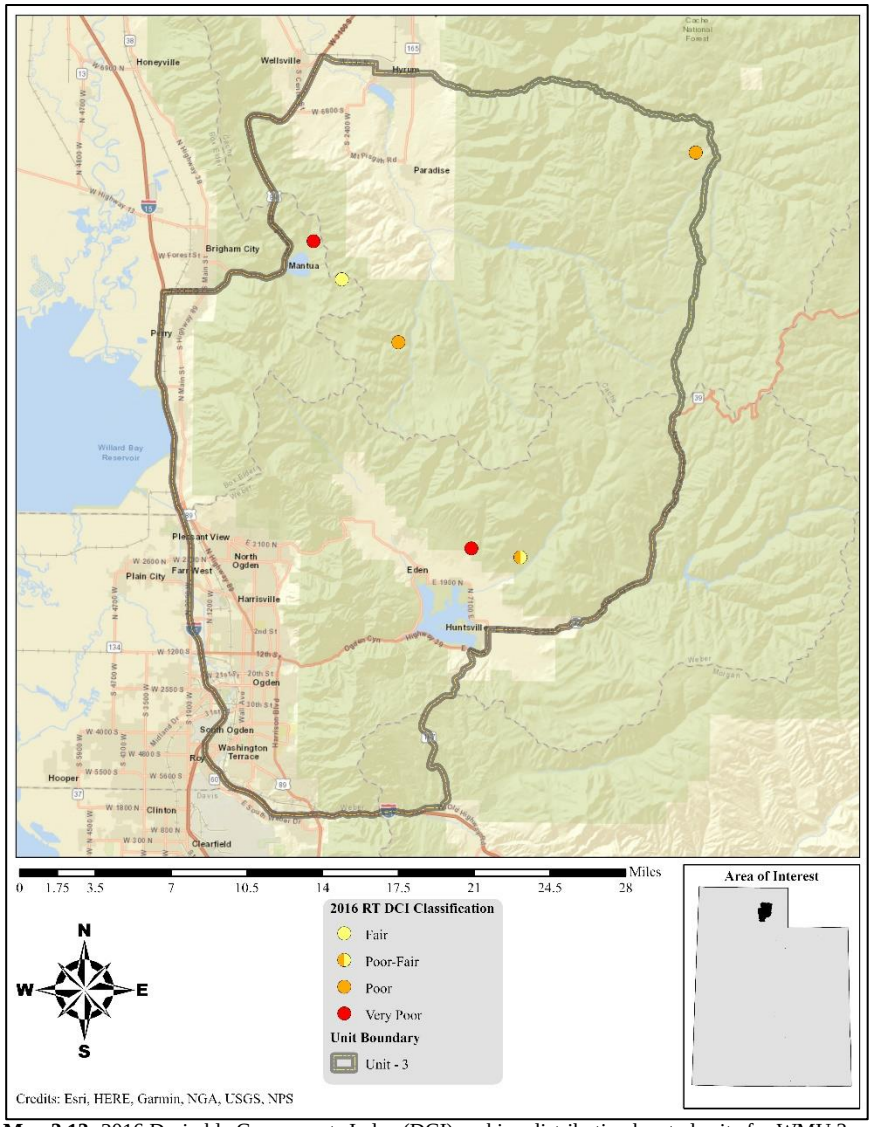
Map 3.10: 2001 Desirable Components Index (DCI) ranking distribution by study site for WMU 3, Ogden.



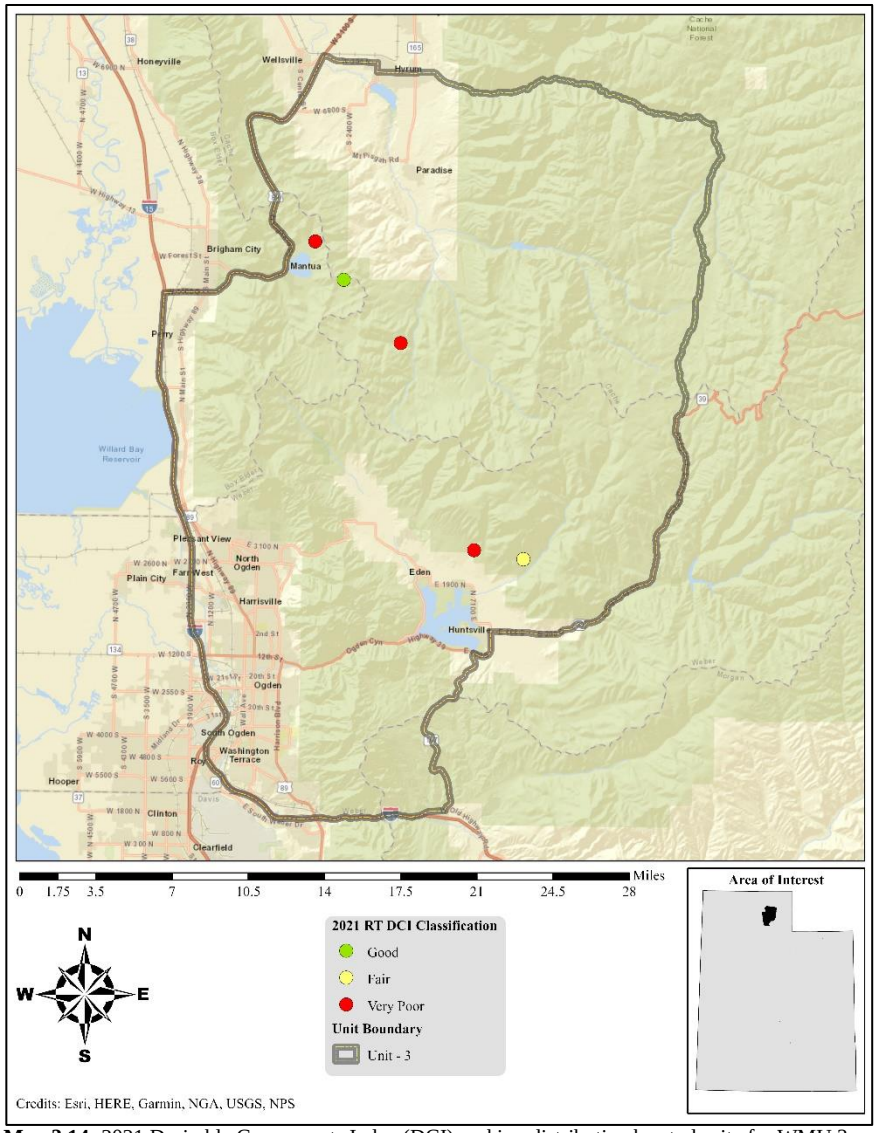
Map 3.11: 2006 Desirable Components Index (DCI) ranking distribution by study site for WMU 3, Ogden.



Map 3.12: 2011 Desirable Components Index (DCI) ranking distribution by study site for WMU 3, Ogden.



Map 3.13: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 3, Ogden.



Map 3.14: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 3, Ogden.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
03-2	NE Mantua Reservoir	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species
03-3	Clay Valley	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
03-4	Anderson Ranch	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
03-12	Threemile Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species
03-17	Middle Fork	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
03-18	Geertsen Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species

Table 3.11: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 3, Ogden. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment**.

Discussion and Recommendations

Mountain (Big Sagebrush)

The studies that are considered to be Mountain (Big Sagebrush) ecological sites are generally considered to be in very poor to good condition for deer winter habitat on the Ogden management unit. The herbaceous understories are generally fair in condition, but have been susceptible to invasion by significant amounts of annual grasses such as cheatgrass (*Bromus tectorum*) and field brome (*B. arvensis*) in previous sample years. Should annual grasses increase again in future years, they would exacerbate the threat of wildfire by amplifying fine fuel loads, and could alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013), and introduced species could lead to reduced herbaceous diversity (Mack, et al., 2000). Introduced perennial grasses are also present on both study sites, posing a high-level threat on Geertsen Canyon and a medium-level threat on Clay Valley. While introduced perennial grasses do provide forage, these species can be aggressive at higher elevations by competing for resources, leading to reduced prevalence and abundance of other more desirable native grass and forb species. Noxious weed species are present or have been present on both study sites. Like introduced perennial grasses, noxious weeds can be aggressive, outcompeting native grasses and forbs for resources and potentially leading to a reduction in understory diversity (Mack, et al., 2000). Finally, Utah juniper (*Juniperus osteosperma*) is present on the Clay Valley study site in low amounts. Although the site is only considered to be in Phase I of woodland succession, pinyon and juniper presence has the potential to lead to reduced understory shrub and herbaceous vigor as encroachment advances (Miller, Svejcar, & Rose, 2000).

Continuing to monitor these study sites would likely prove to be a worthwhile endeavor. If resurgences of annual grasses occur in the future, treatments such as changes in grazing management and herbicide application would be feasible to implement. Management of noxious weeds (whether preemptive or reactive) could be achieved through spot application of herbicides. Should reseeding be deemed necessary to restore herbaceous diversity in response to introduced perennial grasses, care should be taken in seed mix construction so that native grasses and forbs are selected whenever possible. Work to prevent further encroachment of pinyon and juniper (e.g. bullhog, chaining, lop and scatter, etc.) is not an immediate concern. If future monitoring indicates that encroachment is advancing, however, treatment may be wise. Before tree-removing treatments are implemented, caution should be taken to select methods that will not inadvertently amplify annual grass loads.

Mountain (Black/Low Sagebrush)

Middle Fork, the study site that is considered to be of this ecological type, supports a population of little sagebrush (*Artemisia arbuscula*) and is considered to be in fair condition for deer winter range for this unit. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) contributes significant cover in the herbaceous understory of this study. While introduced perennial grasses may provide forage, they can be aggressive and may reduce the prevalence and abundance of other more desirable native grass and forb species through competition for resources (Mack, et al., 2000). Introduced annual grasses such as cheatgrass (*Bromus tectorum*) and field brome (*B. arvensis*) are present on this site in low amounts. Although the threat posed is currently low, increased amounts of annual grasses in the future would amplify

fuel loads, therefore increasing the threat of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013), and introduced species could lead to reduced understory diversity (Mack, et al., 2000).

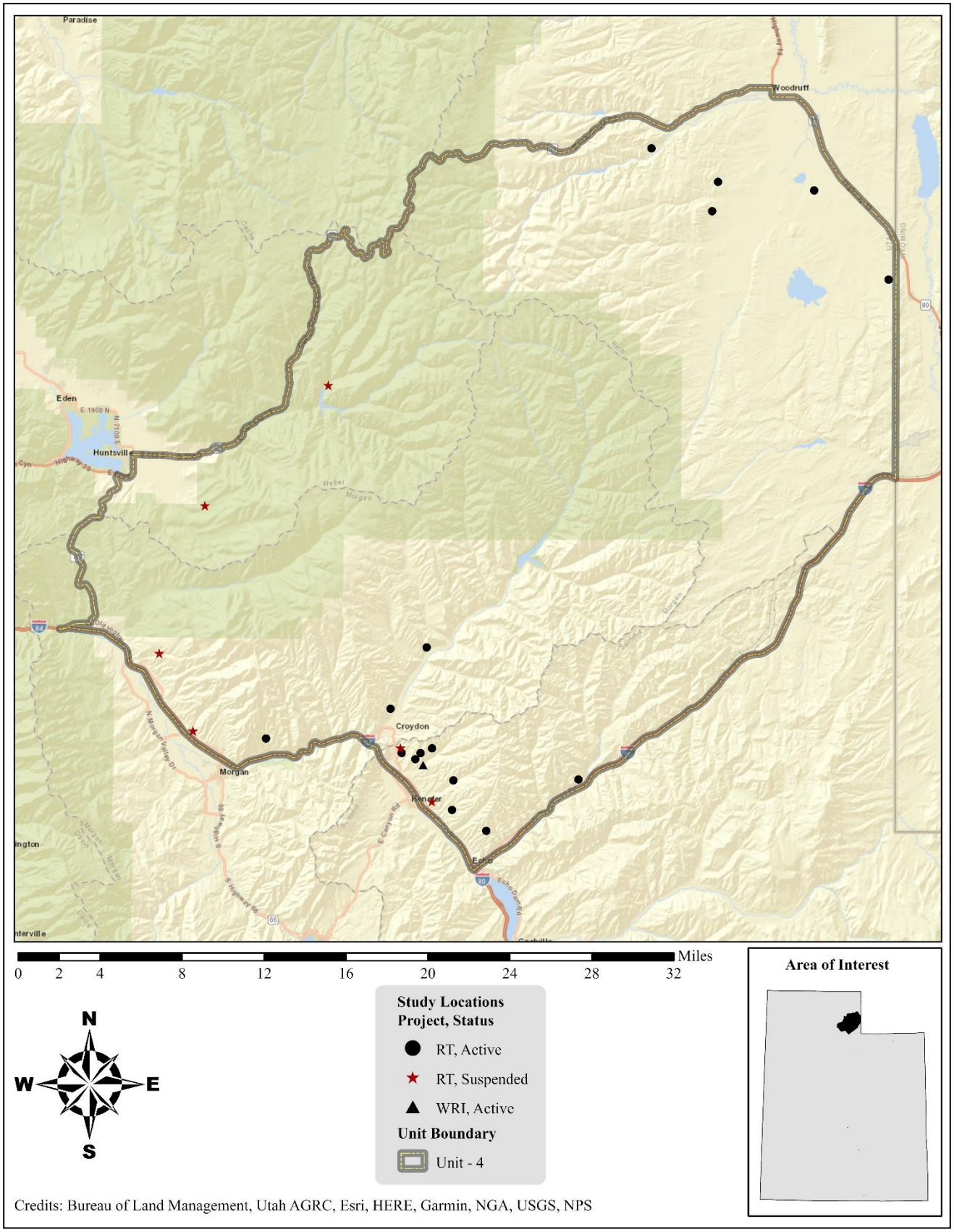
Should seeding be deemed necessary to restore the herbaceous diversity, care should be taken in species selection and preference should be given to native grasses and forbs whenever possible. Treatments to remove annual grasses are not immediately necessary. Should management be deemed prudent in the future, however, options could include grazing management and herbicide application.

Upland (Big Sagebrush)

The study that is considered to be an Upland (Big Sagebrush) ecological type, NE Mantua Reservoir, is considered to be in very poor condition for deer winter range within the Ogden management unit. The herbaceous understory of this study site is dominated by introduced perennial grass species, primarily bulbous bluegrass (*Poa bulbosa*). Introduced perennial grasses are often aggressive and compete well for resources: this in turn can lead to reduced prevalence and abundance of other, more desirable native grass and forb species (Mack, et al., 2000). Annual grasses such as field brome (*Bromus arvensis*) and cheatgrass (*B. tectorum*) have also been significant components of the understory in previous sample years. Although cover is moderate as of 2021, annual grasses in high amounts can boost fine fuel loads, exacerbate the risk of catastrophic wildfire, and alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013), and introduced species may lead to reduced herbaceous diversity (Mack, et al., 2000). Finally, the noxious weed species jointed goatgrass (*Aegilops cylindrica*), medusahead (*Taeniatherum caput-medusae*), and field bindweed (*Convolvulus arvensis*) are present and pose a high-level threat to the ecological integrity of the site. Like introduced perennial grasses, noxious weeds are often aggressive, outcompeting native herbaceous species for resources and therefore potentially leading to a reduction in herbaceous diversity (Mack, et al., 2000).

Diversification of the herbaceous understory through methods such as reseeding may be prudent. However, care must be taken in species selection with native grasses and forbs being used whenever possible and appropriate. In addition, treatments such as herbicide application and changes in grazing management may be appropriate if annual grass loads exhibit a resurgence in future sample years. Finally, management of noxious weed species is recommended, an objective that may be met with methods such as spot application of herbicide.

4. WILDLIFE MANAGEMENT UNIT 4 – MORGAN-SOUTH RICH



WILDLIFE MANAGEMENT UNIT 4 – MORGAN-SOUTH RICH

Boundary Description

Morgan, Rich, Summit, and Weber counties - Boundary begins at the junction of Interstate 80 and I-84 near Echo, Utah; northeast on I-80 to the Utah-Wyoming state line; north along this state line to SR-16; north on SR-16 to SR-39 near Woodruff; west along SR-39 to SR-167 (Trappers Loop Road); south on SR-167 to SR-30 at Mountain Green; west on SR-30 to I-84; east on I-84 to I-80 and the beginning point.

Management Unit Description

Geography

Management unit boundaries were changed in 1993 and the Morgan-South Rich Management Unit was created from parts of the old Units 5, 6, and 7. The new unit incorporates a section of Weber county southeast of Huntsville, the northern halves of Morgan and Summit counties, and the southern portion of Rich county southwest of Woodruff. Municipalities along the unit boundaries include Woodruff, Huntsville, Mountain Green, Croydon, and Echo.

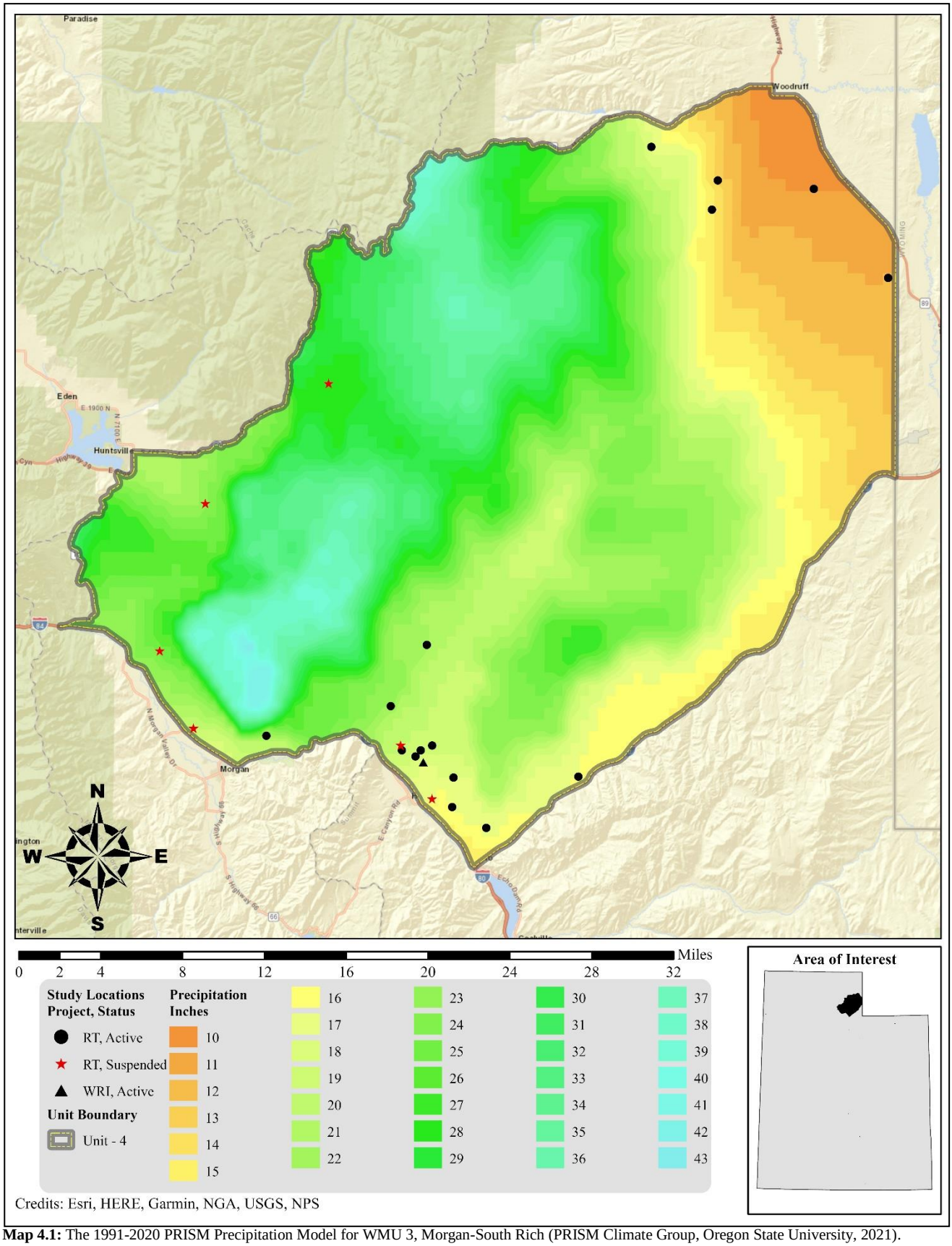
Interstate 80 and I-84, which run through Echo Canyon and along the Weber River, form the unit's southern boundary; there are several towns along the highways. The majority of the Lost Creek bottoms surrounding the town of Croydon have been converted to alfalfa fields. Lost Creek Reservoir, managed by the Division of Parks and Recreation, is primitively developed and the road is not maintained in the winter. However, snowmobilers, winter fishermen, and other recreationists use the facilities during winter months. Two areas of land in the unit are managed by the Division of Wildlife Resources. The Round Valley WMA is north of I-84, just east of Morgan. The Henefer-Echo WMA is located east of Henefer and is managed primarily as a big game habitat.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 10 inches along portions of the Utah-Wyoming border to 43 inches on the mountain tops north of Morgan. All of the Range Trend and WRI monitoring studies on the unit occur within 10-21 inches of precipitation (**Map 4.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Northern Mountains division (Division 5).

The mean annual PDSI of the Northern Mountains division displayed years of moderate to extreme drought from 2000-2003, 2012-2013, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1995, 1997-1998, 2005, and 2011 (**Figure 4.1a**). The mean spring (March-May) PDSI displayed moderate to extreme drought in 1992, 2000-2004, 2012-2014, 2018, and 2021 ; moderately to extremely wet years were displayed from 1995-1996, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2013, and 2020-2021; moderately to extremely wet years were displayed in 1995, and 1997-1998 (**Figure 4.1b**) (Time Series Data, 2022).



Map 4.1: The 1991-2020 PRISM Precipitation Model for WMU 3, Morgan-South Rich (PRISM Climate Group, Oregon State University, 2021).

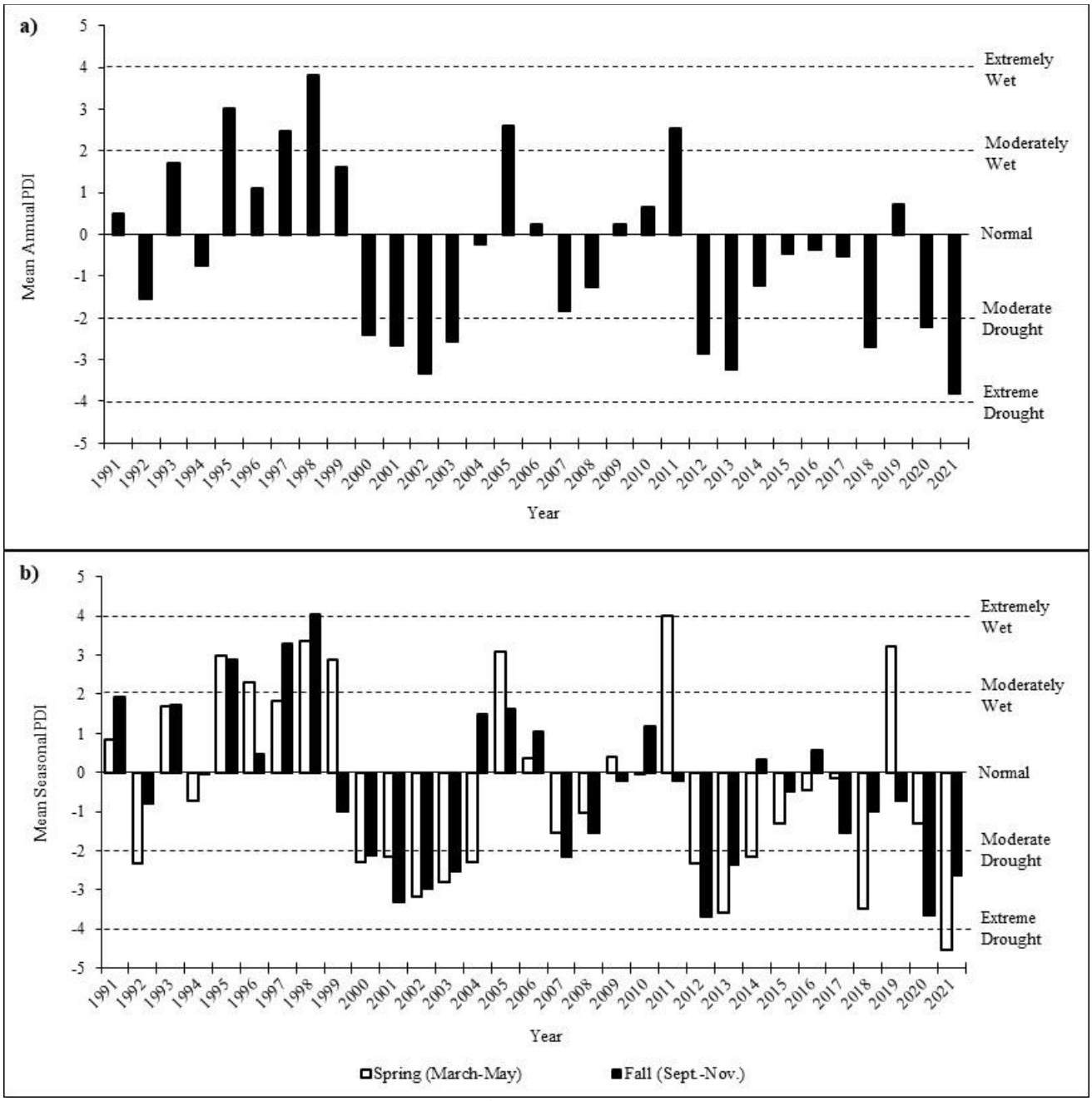


Figure 4.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

Big Game Habitat

The Morgan-South Rich unit contains over 588,000 acres of deer range with summer, winter, and year-long ranges making up 64%, 28%, and 8% of this area, respectively (**Table 4.1**, **Map 4.2**).

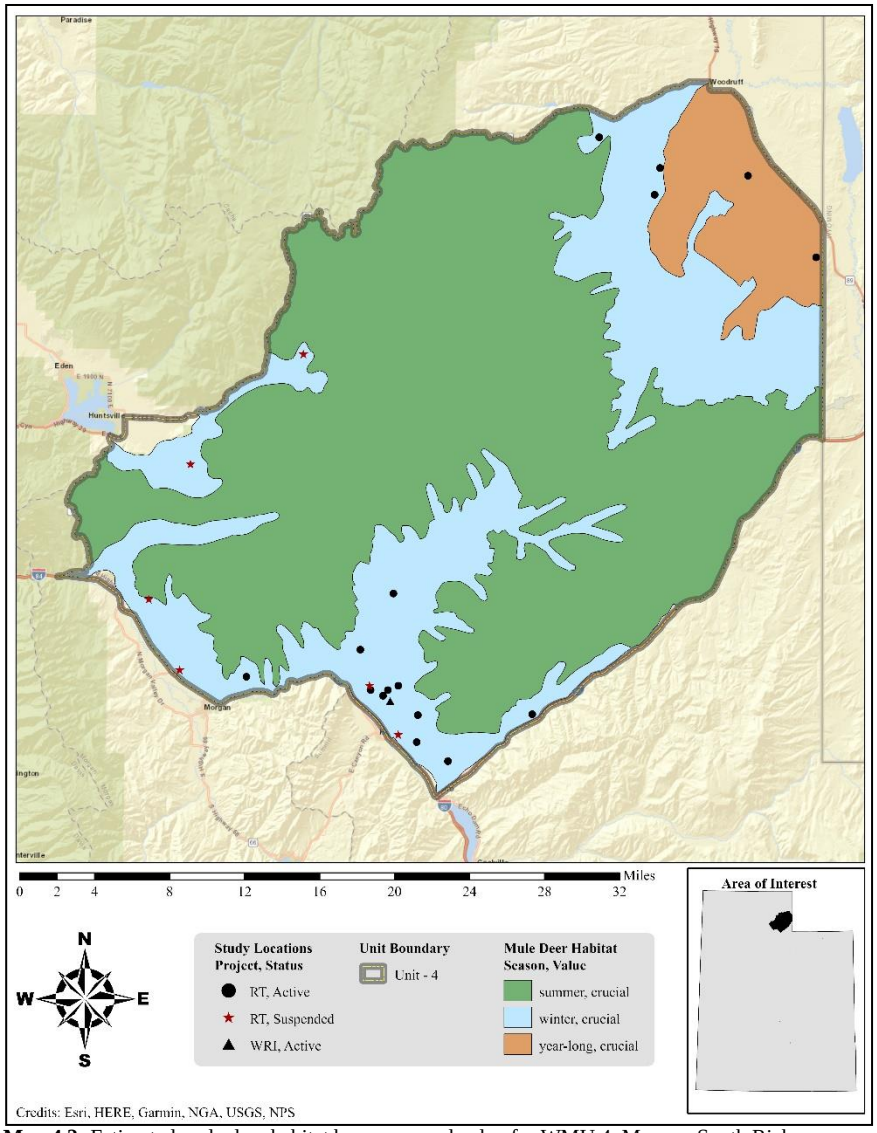
Most (81%) of the year-long range in this unit occurs in land owned by private landowners, while 18% is managed by the Bureau of Land Management (BLM). The remaining 1% is administrated by the Utah School and Institutional Trust Lands Administration (SITLA) and the Utah Division of Wildlife Resources (UDWR). 81% of the winter range is also privately owned. 9% is administrated by the BLM, 7% is managed by UDWR, and SITLA, the US Forest Service (USFS), and Utah State Parks (USP) each manage 1%. Finally, 88% of the summer range is privately owned, 8% is managed by the USFS, 2% is administrated by UDWR, 1% is owned by the BLM, and SITLA and USP each administrate less than 1% (**Table 4.2**, **Map 4.2**, **Map 4.6**).

Landfire Existing Vegetation Coverage modeling shows that shrublands make up over half (51%) of the Morgan-South Rich unit with sagebrush shrubland and steppe contributing just over 38% percent of the unit's land coverage (**Table 4.6**). Sagebrush shrublands are considered to be key habitat for mule deer.

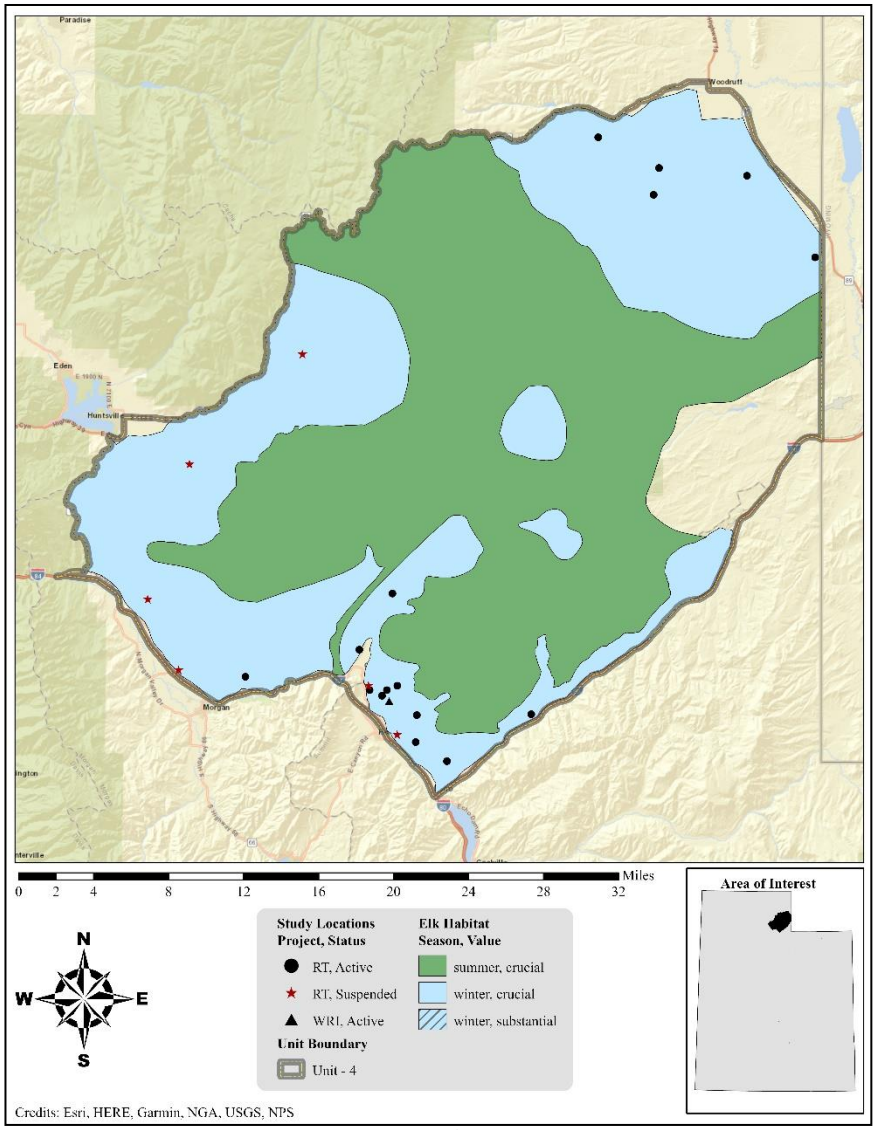
The Lost Creek, Weber River, and Echo Canyon areas are traditional deer wintering areas. There is considerable migration both from higher elevations in the unit and from other herd units to this area, especially during severe winters. The largest number of deer would likely come from the East Canyon Unit, where deer summer on the east side of the Wasatch Mountains. However, development in Morgan Valley is disrupting this migration route. Deer also come from the Ogden and Chalk Creek Units, which have adequate summer range, but limited winter range.

In severe winters, the area of available winter range is greatly reduced; the upper limit is 6,500 feet on most of the unit. The available acreage of all vegetation types (except agricultural land) is reduced during severe winters. All range trend studies in the unit were established on winter range, and most studies sample crucial and/or heavily-used areas.

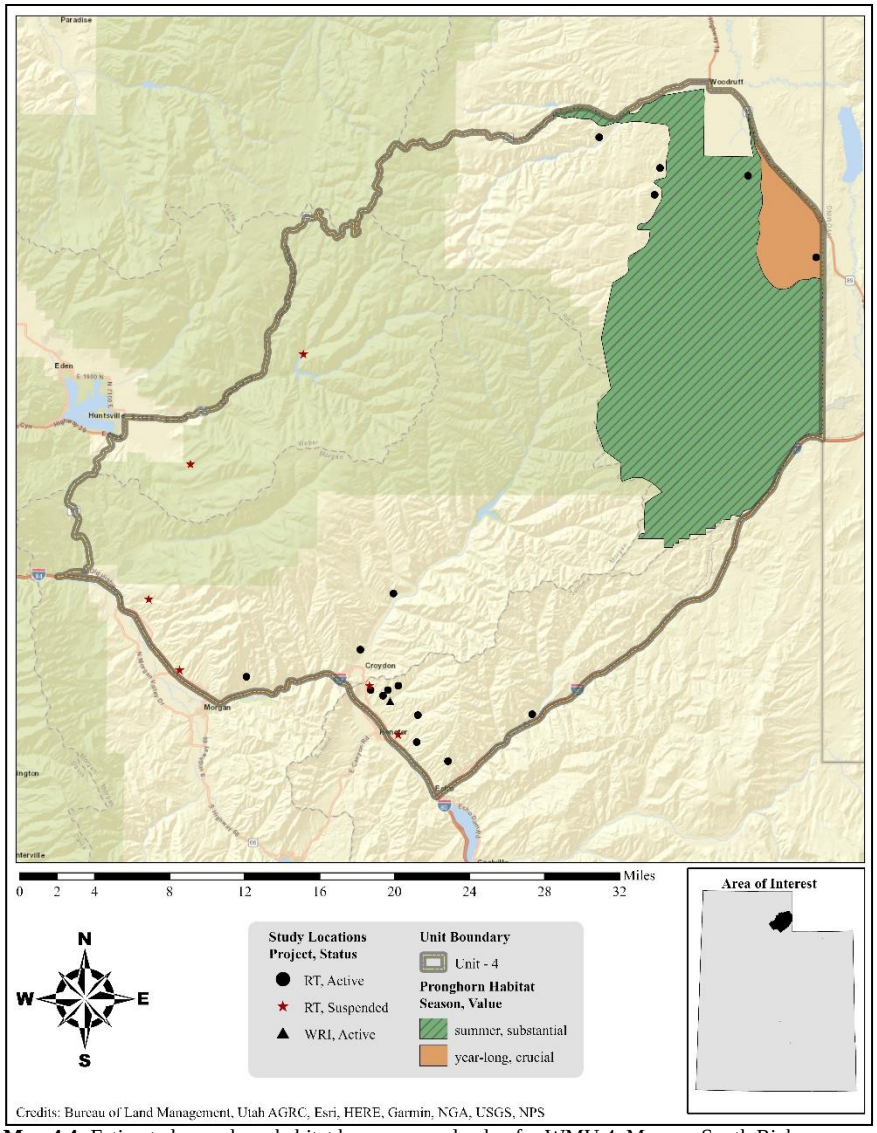
Earlier inventory studies described six vegetation types. The sagebrush type is most common and found over the whole area, forming part of a continuum (based on moisture conditions) between the mountain browse/sagebrush and mountain browse types. The lower elevation sagebrush and mountain browse/sagebrush types are productive and utilized heavily by deer, while the mountain browse type mainly provides cover and is unavailable in most winters. The other vegetation types occupy comparatively little land area, but have the potential to increase. A small population of mahogany is located in Cottonwood Canyon and is important to wintering deer. Scattered stands of juniper are also important for providing thermal cover, but are of little forage value.



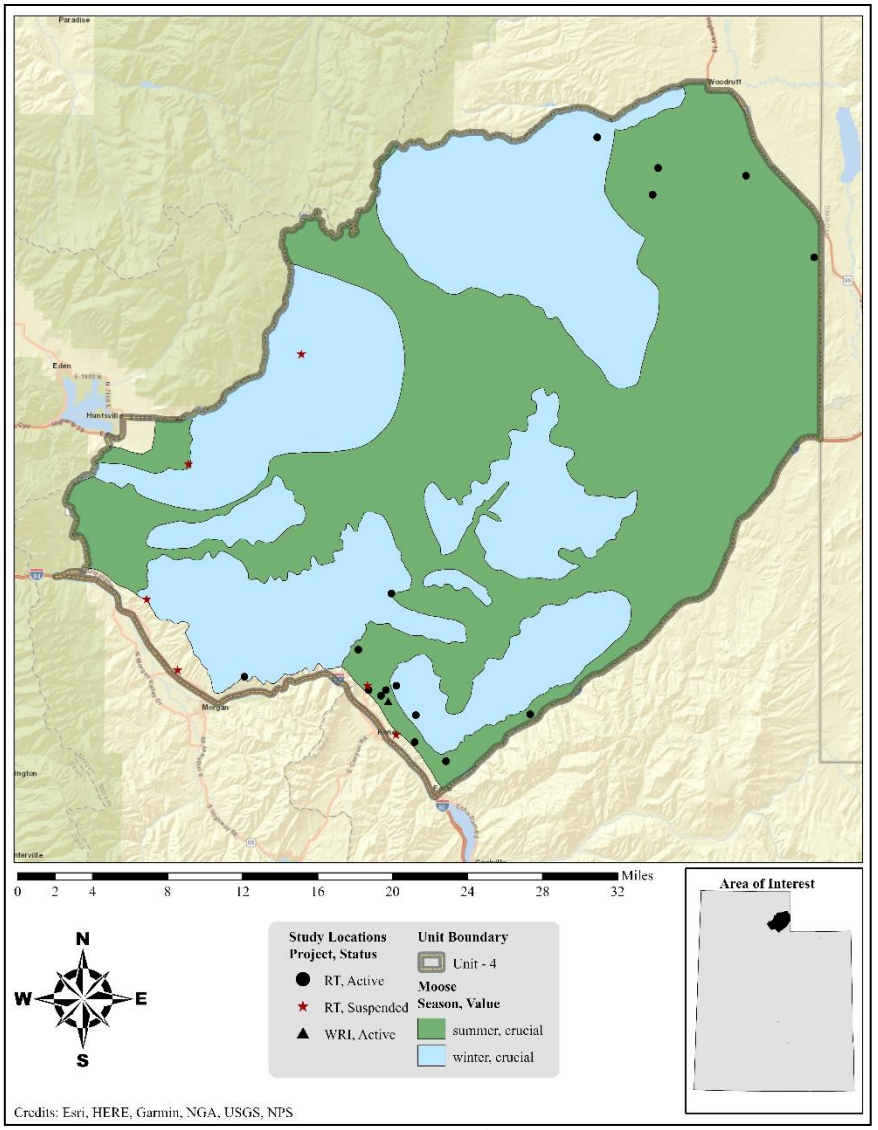
Map 4.2: Estimated mule deer habitat by season and value for WMU 4, Morgan-South Rich.



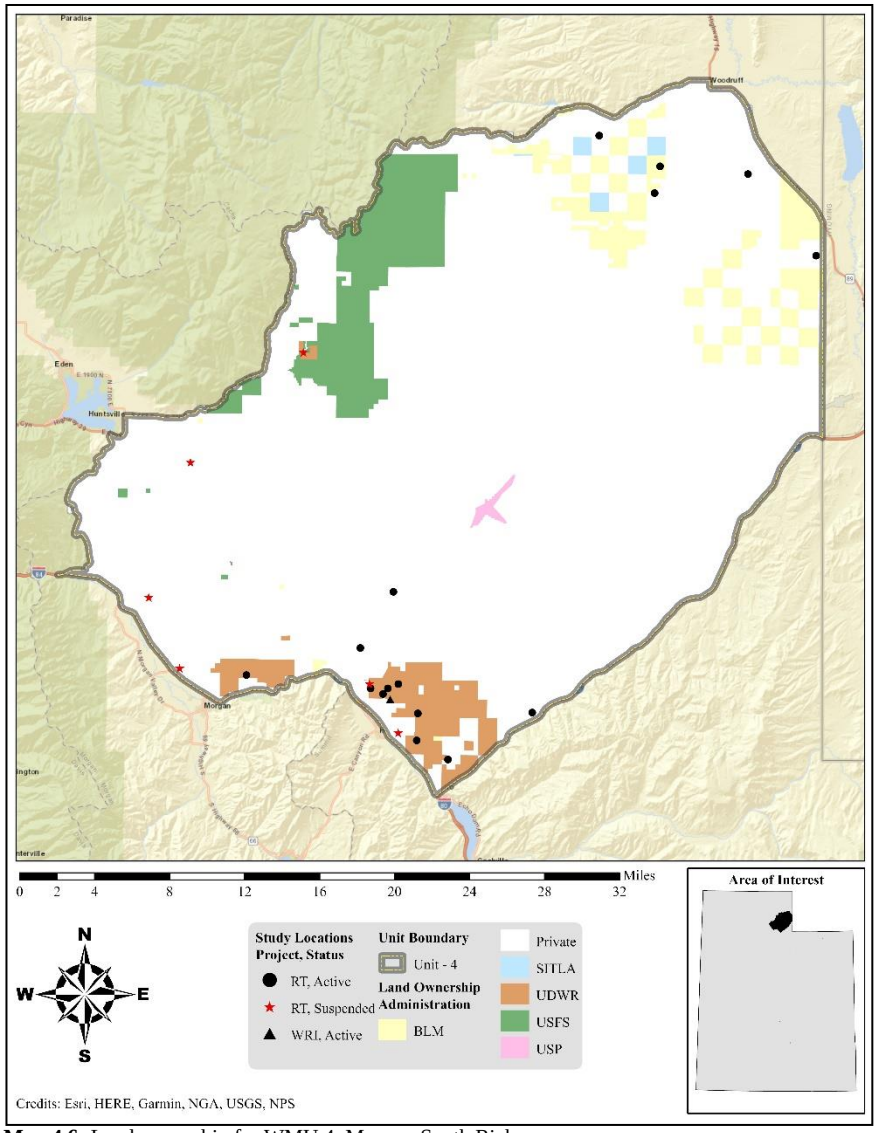
Map 4.3: Estimated elk habitat by season and value for WMU 4, Morgan-South Rich.



Map 4.4: Estimated pronghorn habitat by season and value for WMU 4, Morgan-South Rich.



Map 4.5: Estimated moose habitat by season and value for WMU 4, Morgan-South Rich.



Map 4.6: Land ownership for WMU 4, Morgan-South Rich.

	Year Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
Mule Deer	44,404	8%	375,990	64%	167,946	28%
Elk	0	0%	298,313	54%	251,678	46%
Moose	0	0%	315,140	54%	264,659	46%
Pronghorn	11,343	9%	117,687	91%	0	0%

Table 4.1: Estimated mule deer, elk, moose, and pronghorn habitat acreage by season for WMU 4, Morgan-South Rich.

	Year Long Range		Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	8,310	19%	4,620	1%	15,674	9%
Private	36,055	81%	331,798	88%	135,708	81%
SITLA	33	<1%	738	<1%	1,817	1%
UDWR	7	<1%	6,036	2%	11,659	7%
USFS	0	0%	32,783	9%	2,028	1%
USP	0	0%	14	<1%	1,060	1%
Total	44,404	**100%**	375,990	**100%**	167,946	**100%**

Table 4.2: Estimated mule deer habitat acreage by season and ownership for WMU 4, Morgan-South Rich.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	5,012	1%	22,451	9%
Private	267,343	90%	199,040	79%
SITLA	0	0%	2,589	1%
UDWR	5,145	2%	12,527	5%
USFS	19,746	7%	15,065	6%
USP	1,066	<1%	7	<1%
Total	298,313	**100%**	251,678	**100%**

Table 4.3: Estimated elk habitat acreage by season and ownership for WMU 4, Morgan-South Rich.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	19,263	6%	9,171	4%
Private	280,374	89%	215,638	81%
SITLA	1,284	<1%	1,318	<1%
UDWR	6,160	2%	10,699	4%
USFS	7,267	2%	27,544	10%
UDOT	7	<1%	0	0%
USP	785	<1%	288	<1%
Total	315,140	**100%**	264,659	**100%**

Table 4.4: Estimated moose habitat acreage by season and ownership for WMU 4, Morgan-South Rich.

	Year Long Range		Summer Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	4,888	43%	11,176	9%
Private	6,448	57%	106,511	91%
UDWR	7	<1%	0	0%
Total	11,343	**100%**	117,687	**100%**

Table 4.5: Estimated pronghorn habitat acreage by season and ownership for WMU 4, Morgan-South Rich.

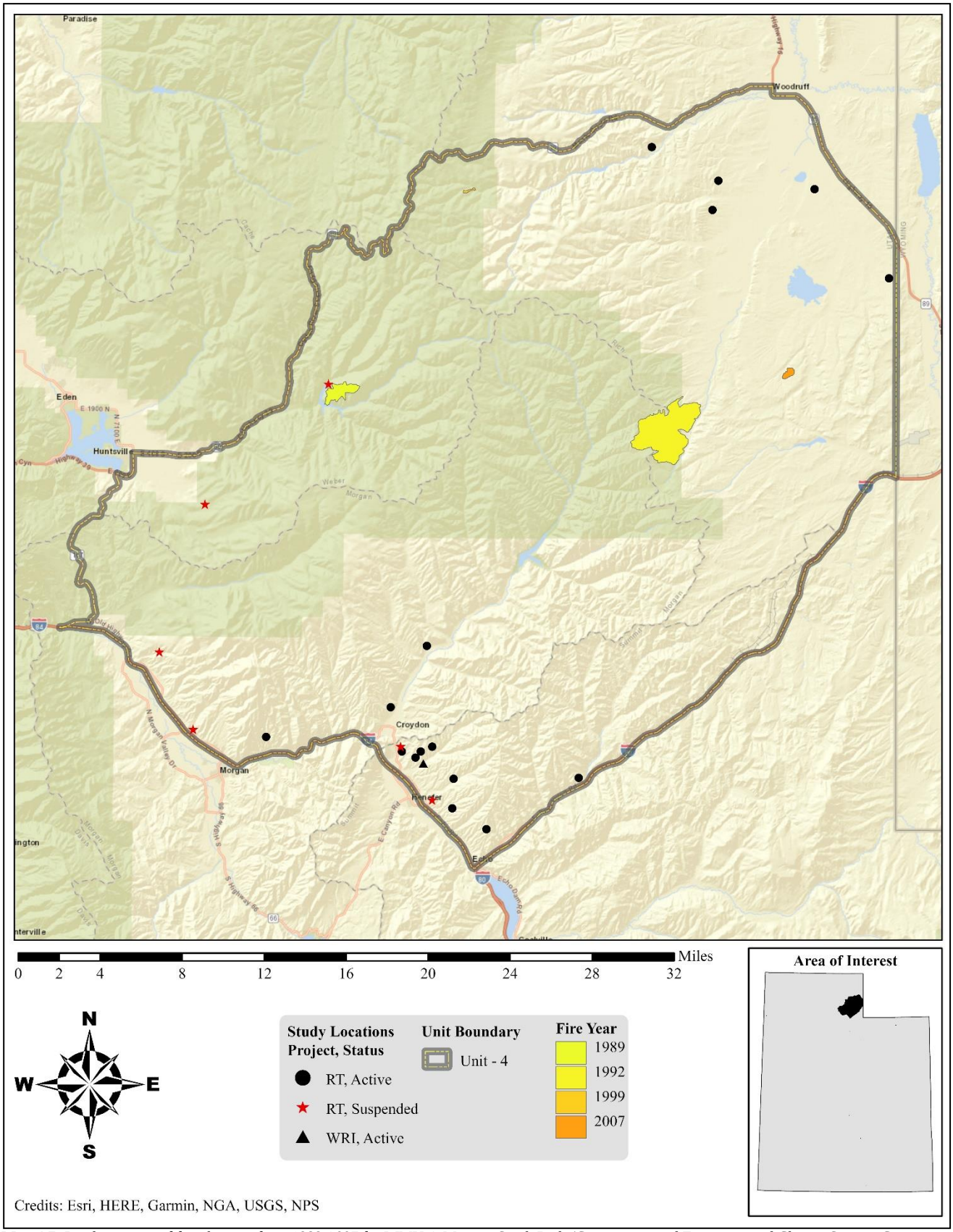
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	315,965	24.51%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	133,789	10.38%	
	Inter-Mountain Basins Big Sagebrush Shrubland	86,100	6.68%	
	Inter-Mountain Basins Big Sagebrush Steppe	52,183	4.05%	
	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	38,283	2.97%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	22,513	1.75%	
	Rocky Mountain Lower Montane-Foothill Shrubland	11,320	0.88%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	673	0.05%	
	Inter-Mountain Basins Greasewood Flat	624	0.05%	
	Inter-Mountain Basins Mat Saltbush Shrubland	563	0.04%	
	Other Shrubland	473	0.04%	
	Great Basin Semi-Desert Chaparral	1	0.00%	
	Great Basin Xeric Mixed Sagebrush Shrubland	<1	0.00%	51.38%
Other	Hardwood	233,221	18.09%	
	Agricultural	69,007	5.35%	
	Conifer-Hardwood	29,846	2.31%	
	Riparian	20,529	1.59%	
	Developed	20,047	1.55%	
	Open Water	8,732	0.68%	
	Sparsely Vegetated	3,860	0.30%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	352	0.03%	29.91%
Conifer	Rocky Mountain Foothill Limber Pine-Juniper Woodland	38,877	3.02%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	21,540	1.67%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	19,251	1.49%	
	Colorado Plateau Pinyon-Juniper Woodland	18,789	1.46%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	18,122	1.41%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	8,195	0.64%	
	Rocky Mountain Lodgepole Pine Forest	4,834	0.37%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	4,266	0.33%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	1,295	0.10%	
	Other Conifer	272	0.02%	
	Great Basin Pinyon-Juniper Woodland	97	0.01%	
	Southern Rocky Mountain Ponderosa Pine Woodland	3	0.00%	
	Inter-Mountain Basins Juniper Savanna	2	0.00%	10.51%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	38,684	3.00%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	14,714	1.14%	
	Great Basin & Intermountain Introduced Annual Grassland	3,456	0.27%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	131	0.01%	4.42%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	27,809	2.16%	
	Southern Rocky Mountain Montane-Subalpine Grassland	12,121	0.94%	
	Inter-Mountain Basins Semi-Desert Grassland	1,763	0.14%	
	Other Grassland	410	0.03%	3.27%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	4,126	0.32%	
	Interior Western North American Temperate Ruderal Shrubland	2,429	0.19%	
	Interior West Ruderal Riparian Scrub	5	0.00%	
	Interior West Ruderal Riparian Forest	1	0.00%	0.51%
Total		**1,289,274**	**100%**	**100%**

Table 4.6: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 4, Morgan-South Rich.

Limiting Factors to Big Game Habitat

Major human activities in the area include urbanization, grazing, and agriculture; the Landfire Existing Vegetation Coverage model indicates that just under 7% of the land in the Morgan-South Rich unit is developed or used for agricultural purposes (**Table 4.6**). Furthermore, habitat degradation and loss, public land winter range availability, winter range forage condition, and landowner acceptance limit big game habitat in this unit.

Other limiting factors to big game may include introduced exotic herbaceous species, such as cheatgrass (*Bromus tectorum*). Increased amounts of cheatgrass exacerbate the risk for catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). According to the current Landfire Existing Vegetation Coverage model, nearly 5% of the unit is comprised of exotic herbaceous species (**Table 4.6**).



Map 4.7: Land coverage of fires by year from 1989-2007 for WMU 4, Morgan-South Rich (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

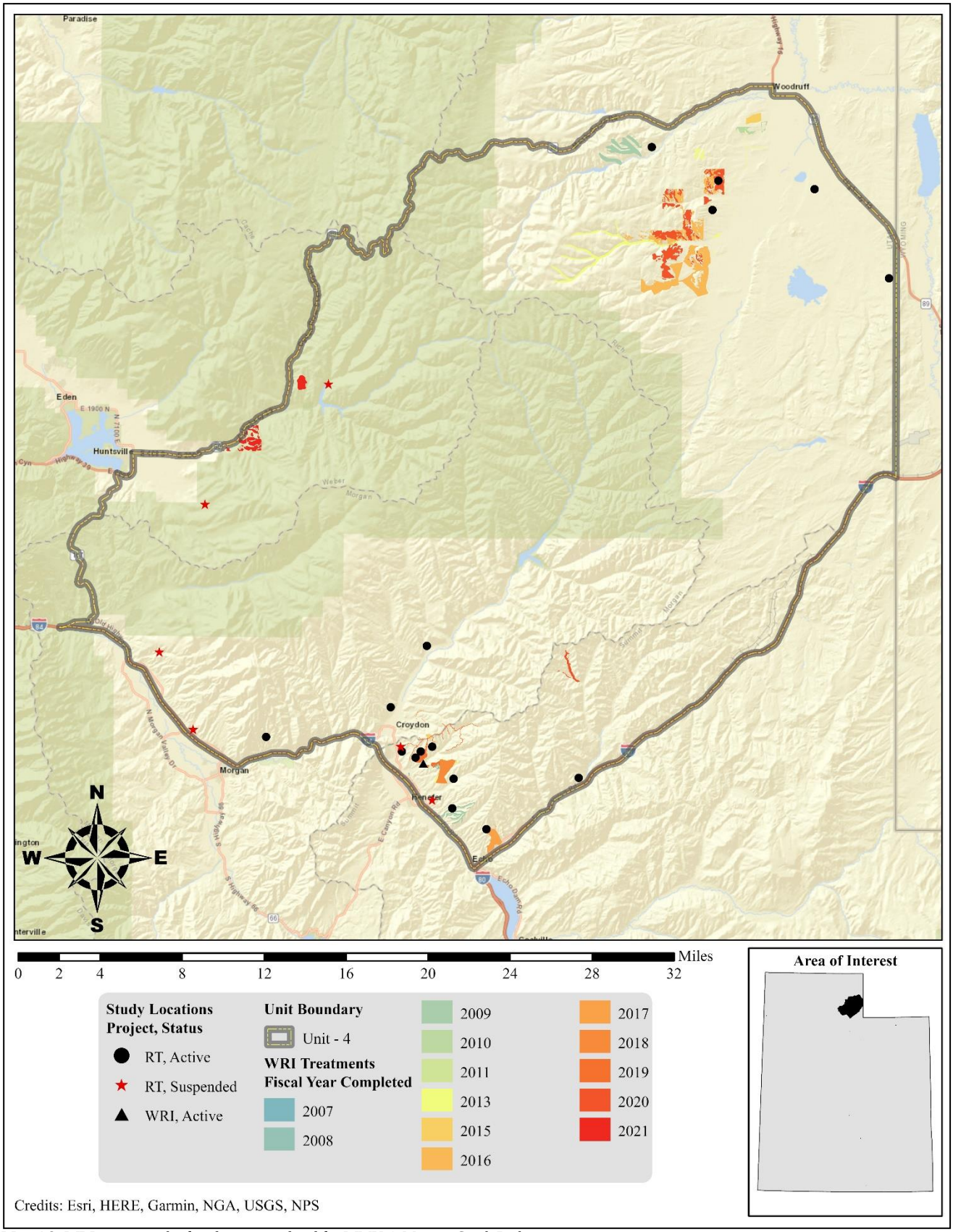
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 6,492 acres of land have been treated within the Morgan-South Rich unit since the WRI was implemented in 2004 (**Map 4.8**). An additional 1,336 acres are currently being treated and treatments have been proposed for 636 acres. Treatments frequently overlap one another bringing the net total of completed treatment acres to 6,282 acres for this unit (**Table 4.7**). 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.

Vegetation removal via hand crew to remove encroaching conifer is the most common management practice in this unit. Seeding to augment species diversity and desirability is also common. Other management practices include harrow, anchor chain, and bullhog to remove twoneedle pinyon and Utah juniper. In addition, discing and other vegetation removal techniques are also implemented (**Table 4.7**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**263**	**0**	**592**	**855**
Ely (One-Way)	2	0	0	2
Ely (Two-Way)	261	0	592	853
Bullhog	**235**	**0**	**0**	**235**
Full Size	235	0	0	235
Disc	**192**	**0**	**0**	**192**
Off-Set (One-Way)	6	0	0	6
Off-Set (Two-Way)	158	0	0	158
Plow (One-Way)	28	0	0	28
Greenstripping	**53**	**0**	**0**	**53**
Harrow	**640**	**0**	**0**	**640**
≤15 ft. (One-Way)	640	0	0	640
Herbicide Application	**134**	**0**	**44**	**178**
Aerial (Helicopter)	134	0	0	134
Spot Treatment	0	0	44	44
Planting/Transplanting	**611**	**0**	**0**	**611**
Bitterbrush Planter	594	0	0	594
Other	17	0	0	17
Seeding (Primary)	**1,382**	**665**	**0**	**2,048**
Broadcast (Aerial-Fixed Wing)	553	472	0	1,025
Broadcast (Aerial-Helicopter)	336	164	0	500
Drill (Rangeland)	357	0	0	357
Ground (Mechanical Application)	136	30	0	166
Vegetation Removal/Hand Crew	**2,982**	**671**	**0**	**3,652**
Lop & Scatter	2,982	671	0	3,652
Grand Total	**6,492**	**1,336**	**636**	**8,464**
***Total Land Area Treated**	**6,282**	**1,336**	**636**	**8,254**

Table 4.7: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 4, Morgan-South Rich. Data accessed on 02/09/2022. *Does not include overlapping treatments.



Map 4.8: WRI treatments by fiscal year completed for WMU 4, Morgan-South Rich.

Range Trend Studies

Range Trend studies have been sampled within WMU 4 on a regular basis since 1984, with studies being added or suspended as was deemed necessary (**Table 4.8**). Due to changes in sampling methodologies, only data collected following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 4.9**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
04-1	Heiner's Creek	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
04-2	Echo Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Stony Loam (Wyoming Big Sagebrush)
04-3	Tank Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04-4	Owen's Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04-5	Owen's Canyon Bench	RT	Suspended	1984, 1990	Not Verified
04-6	Harris Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Stony Loam (Mountain Big Sagebrush)
04-7	Croydon Access Road	RT	Suspended	1984, 1990	Not Verified
04-8	Shell Hollow	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04-9	Scott Rees Ranch	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Gambel Oak)
04-10	Big Hollow	RT	Suspended	1984, 1990	Not Verified
04-12	Bennett Creek	RT	Suspended	1990, 1996	Not Verified
04-13	Wheatgrass Hollow	RT	Active	1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Gravelly Loam (Bonneville Big Sagebrush)
04-14	Chapman Canal	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Semidesert Loam (Wyoming Big Sagebrush)
04-15	Woodruff Creek South	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04-16	Dry Hollow	RT	Suspended	1996, 2001	Not Verified
04-17	Above Toon Ranch	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04-18	Deseret Main Gate	RT	Active	1997, 2001, 2006, 2011, 2016, 2021	Semidesert Loam (Wyoming Big Sagebrush)
04-19	Deseret Burn	RT	Active	1997, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04R-3	Claypit North Slope	RT	Active	2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04R-4	Claypit South Slope	RT	Active	2006, 2011, 2016, 2021	Upland Stony Loam (Mountain Big Sagebrush)
04R-5	Croydon Cemetery	RT	Active	2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
04R-6	Harris Canyon Dixie	WRI	Active	2008, 2017, 2021	Mountain Gravelly Loam (Mountain Big Sagebrush)

Table 4.8: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 4, Morgan-South Rich.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
04-1	Heiner's Creek	Wildfire	Echo Canyon	1977		
04-2	Echo Canyon	Aerial After	Henefer Echo - Roadshed Fire, Rehab	November 2016	315	3895
		Wildfire	Echo Road Shed	August 2016	317	
04-3	Tank Canyon	Wildfire		1982		
		Seed Unknown		1982		
		Wildfire		1985	40	
		Aerial After	Henefer Echo WMA Project	December 2008	261	1212
		Two-Way Ely	Henefer Echo WMA Project	November-December 2008	261	1212
		Glyphosate	Henefer Echo WMA Fire Canyon Rehab	April-May 2021	43	5541
		Aerial After	Henefer Echo WMA Fire Canyon Rehab	October 2021	43	5541
04-4	Owen's Canyon	Wildfire	Eagle Canyon	1999	3,744	
04-13	Wheatgrass Hollow	Lop and Scatter	Home Ranch Bullhog	Winter 2019-2020	1,866	4025
04-19	Deseret Burn	Wildfire	Wheat Grass	August 96	630	
		One-Way Chain	Wheatgrass Hollow EFR	Fall 1996		LTDL
		Unknown				
		Aerial Before	Wheatgrass Hollow EFR	Fall 1996		LTDL
		Dribbler	Wheatgrass Hollow EFR	Fall 1996		LTDL
04R-3	Claypit North Slope	Aroga Moth	Aroga Moth Study	Approx. 2006		
04R-4	Claypit South Slope	Aroga Moth	Aroga Moth Study	Approx. 2006		
		Broadcast	Henefer WMA Browse Scalping and Pipeline Arc C	November 2018-January 2019	378	4590
		Dozer	Henefer WMA Browse Scalping and Pipeline Arc C	November 2018-January 2019	378	4590
04R-5	Croydon Cemetery	Aroga Moth	Aroga Moth Study	Approx. 2006		
04R-6	Harris Canyon	Aroga Moth		Approx. 2006		
	Dixie	One-Way Disc	Henefer-Echo WMA	September-October 2010	28	1471
		Rangeland Drill	Henefer-Echo WMA	September-October 2010	28	1471
		Broadcast	Henefer-Echo WMA	September-October 2010	28	1471

Table 4.9: Range Trend and WRI studies known disturbance history for WMU 4, Morgan-South Rich. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

One study [Heiner's Creek (04-1)] is considered to be a Mountain (Big Sagebrush) ecological site: this study is located in Echo Canyon north of Interstate 80 (**Table 4.8**).

Shrubs/Trees: The dominant browse species on this site is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), which has increased in cover each sample year; other preferred browse is less prevalent, but includes Utah serviceberry (*Amelanchier utahensis*), Woods' rose (*Rosa woodsii*), and antelope bitterbrush (*Purshia tridentata*) (**Figure 4.2**). Average sagebrush demographics show that mature plants have been the primary age class in all years except 2001, when young individuals dominated; recruitment of young has decreased since that sample year (**Figure 4.9**). Sagebrush on this site has been browsed in various amounts from year to year, but a majority of plants have exhibited little use in most sample years (**Figure 4.13**).

Trees are not present on this study site as of 2021 and therefore will not be discussed in this section (**Figure 4.4**, **Figure 4.7**).

Herbaceous Understory: Average herbaceous cover and frequency has fluctuated over time, but has decreased overall. Perennial grass has decreased in nested frequency each sequential year. Perennial grasses such as Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) have dominated the understory in 1996-97, 2001, and 2006, and have been co-dominant with perennial forbs in 2011, 2016, and 2021. Annual grasses and forbs have also fluctuated, but have remained relatively rare throughout the study years (**Figure 4.16**, **Figure 4.19**).

Occupancy: Average pellet transect data indicates that animal occupancy on this site has decreased each sample year between 2001 and 2016, but increased substantially in 2021. Deer have been the primary occupants in all sample years with a mean abundance of pellet groups ranging from 18 days use/acre in 2011 to 85 days use/acre in 2021. Elk have also been present on this site, with a mean abundance of pellet groups as low as 2 days use/acre in 2001 and as high as 16 days

use/acre in 2006. Mean abundance of cattle pellet groups has ranged from 1.5 days use/acre in 2016 to 7 days use/acre in 2011 (**Figure 4.22**).

Mountain (Oak)

One study site [Scott Rees Ranch (04-9)] is classified as a Mountain (Oak) ecological site. This study is situated north of Rees Ranch on the Morgan WMA (**Table 4.8**).

Shrubs/Trees: Average shrub cover data shows that cover has slightly increased overall: almost all of this cover is contributed by Gambel oak (*Quercus gambelii*), although mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*) are present in much lower amounts (**Figure 4.3**). Mature sagebrush plants have made up a majority of the population in most sample years. However, density of mature plants has decreased each sample year (**Figure 4.10**). Since 2001, most plants have shown little to no use (**Figure 4.13**).

Although trees contribute no cover on this site, Utah juniper (*Juniperus osteosperma*) was recorded in point-quarter measurements in low amounts in 2016 (**Figure 4.4**, **Figure 4.7**).

Herbaceous Understory: The herbaceous understory of this site has, on average, increased in overall cover through the sample years and decreased in frequency. However, annual grasses have been the dominant herbaceous component in all sample years except 2001 and 2006, and these grasses are the main driver in the overall increase in herbaceous cover. Perennial forb cover has increased through the study period with arrowleaf balsamroot (*Balsamorhiza sagittata*) and white sagebrush (*Artemisia ludoviciana*) as the most prevalent species. The introduced perennial grass bulbous bluegrass (*Poa bulbosa*) has been observed in each sample year since 2001, but is not common (**Figure 4.16**, **Figure 4.19**).

Occupancy: Although pellet transect data indicates that occupancy increased between 2001 and 2006, it has decreased each sample year since then. Deer have been the primary occupants in 2001, 2011, and 2021. Elk pellets have been most prevalent in 2006 and 2016. Deer pellet groups have had a mean abundance ranging from almost 7 days use/acre in 2021 to 56 days use/acre in 2006. Average abundance of elk pellet groups has been as low as 4 days use/acre in 2001 and 2021, and as high as 58 days use/acre in 2006 (**Figure 4.22**).

Upland (Big Sagebrush)

Nine study sites [Echo Canyon (04-2), Tank Canyon (04-3), Owen's Canyon (04-4), Harris Canyon (04-6), Shell Hollow (04-8), Wheatgrass Hollow (04-13), Woodruff Creek South (04-15), Above Toon Ranch (04-17), and Deseret Burn (04-19)] are classified as Upland (Big Sagebrush) ecological sites. The Echo Canyon study is located northeast of the intersection of Interstates 84 and 80, above Echo Canyon Road. Tank Canyon is found on the ridge between Tank Canyon and Bald Rock Canyon, and the Owen's Canyon study site is situated on the slopes on the northwest side of Owen's Canyon. The Harris Canyon site is found on the northwest slopes of Harris Canyon. Shell Hollow is located on the slopes above Lost Creek near Shells Hollow, and the Wheatgrass Hollow study is situated north of Wheatgrass Hollow and southwest of Halfway Spring. The Woodruff Creek South study is located on a south-facing slope north of Woodruff Creek. The Above Toon Ranch study site is found on a southeast-facing slope above Lost Creek Road and Toon Ranch. Finally, the Deseret Burn study is located south of Wheatgrass Hollow (**Table 4.8**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) or Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) are the dominant preferred browse species on all studies except Owen's Canyon, on which forage kochia (*Bassia prostrata*) has contributed the most cover. The overall shrub cover has exhibited a marginal increase each study year, except in 2021 where average shrub cover was recorded at it's lowest. The general increase in sagebrush cover is likely driven by the Shell Hollow and Wheatgrass Hollow studies which exhibited the largest increases in sagebrush cover. However, these same studies displayed a decrease in sagebrush cover in 2021 (**Figure 4.2**). Average preferred browse demographics show that mature plants have made up most of the populations on these sites in all sample years, while overall density has decreased over time. The demographic data also indicates that the density of decadent individuals has increased over the same period while recruitment of young has decreased (**Figure 4.11**). Average overall utilization has decreased throughout the study period, although with some variability. The majority of plants have shown signs of moderate use most sample years; the exception to this is in 2016, when just over half of the population was moderately to heavily hedged with most plants being heavily hedged (**Figure 4.14**).

Tree cover on these sites is contributed by Utah juniper (*Juniperus osteosperma*) and has decreased over time: this trend is driven by the Woodruff Creek South study. Average tree density has increased overall, a trend that is also largely driven by the previously-mentioned study (**Figure 4.5**, **Figure 4.8**).

Herbaceous Understory: Average cover and frequency of the herbaceous understory on these sites has increased over time, except in 2021 when there was a marked decrease in cover and nested frequency. Native perennial grasses such as crested wheatgrass (*Agropyron cristatum*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) have been the dominant component in most sample years. However, the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has significant populations on the Echo Canyon, Tank Canyon, and Owen's Canyon studies, and is considered to be increasing its presence on the unit. Annual grass cover and frequency have varied from year to year, but have exhibited a general decrease. Finally, perennial and annual forbs have demonstrated a steady presence in cover values over the study period **(Figure 4.17**, **Figure 4.20**).

Occupancy: Average pellet transect data shows that although animal occupancy has varied, it has decreased overall and that deer have been the primary occupants in all sample years. Mean abundance of deer pellet groups has ranged from 29 days use/acre in 2016 to 38 days use/acre in 2006. Elk pellet groups have had an average abundance as low as 8 days use/acre in 2016 and as high as almost 29 days use/acre in 2006. Mean abundance of cattle pellet groups has ranged from nearly 2 days use/acre in 2021 to just under 16 days use/acre in 2006 (**Figure 4.23**).

Semidesert (Big Sagebrush)

Two studies [Chapman Canal (04-14) and Deseret Main Gate (04-18)] are considered to be Semidesert (Big Sagebrush) ecological sites. The Chapman Canal study is located west of the Utah-Wyoming border and south of Chapman Canal, while Deseret Main Gate is situated north of Home Ranch Road and southeast of Blue Grass Pond (**Table 4.8**).

Shrubs/Trees: The dominant browse species on these sites is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Average shrub cover has generally increased over time, a trend which is driven by the Chapman Canal study through the overall increase of sagebrush and yellow rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus* var. *stenophyllus*) (**Figure 4.2**). Average sagebrush demographics indicate that mature plants have been the most abundant age class in all years except 2006, in which decadent individuals were dominant. Recruitment of young has fluctuated over the study years, but has exhibited a marginal increase overall (**Figure 4.12**). More than half of the sagebrush plants showed signs of moderate to heavy browsing in 1996-1997, while a majority of plants have been either not used or lightly used in other sample years (**Figure 4.15**).

Trees have not been observed in cover or point-quarter measurements in any sample year and will therefore not be discussed here (**Figure 4.6**, **Figure 4.9**).

Herbaceous Understory: The average cover and frequency of the herbaceous understories of these study sites have increased overall with the exception of 2021 when total nested frequency and cover decreased significantly. Perennial grasses are the dominant component on these sites. Perennial grass cover has increased on both studies. However, the general perennial grass trend is likely driven by the Deseret Main Gate study which had 40.2% cover in 2016, but that decreased to 13% in 2021. Furthermore, much of the perennial grass on that site was contributed by crested wheatgrass (*Agropyron cristatum*). Annual grasses and forbs and perennial forbs have remained rare throughout the study period. Annual grass cover and frequency have been provided solely by the Chapman Canal study in all sample years (**Figure 4.18**, **Figure 4.21**).

Occupancy: Animal occupancy has fluctuated over the years, but has decreased overall according to average pellet transect data. Cattle have been the primary occupants in all years except 2006 and 2021, when deer were the primary occupants. Deer pellet groups have had a mean abundance ranging from 11 days use/acre in 2016 to almost 69 days use/acre in 2006. Mean abundance of elk pellet groups has been as low as nearly 5 days use/acre in 2016 and as high as 39 days use/acre in 2006. Finally, cattle pellet groups have had an average abundance ranging from 20 days use/acre in 2021 to over 38 days use/acre in 2011 (**Figure 4.24**).

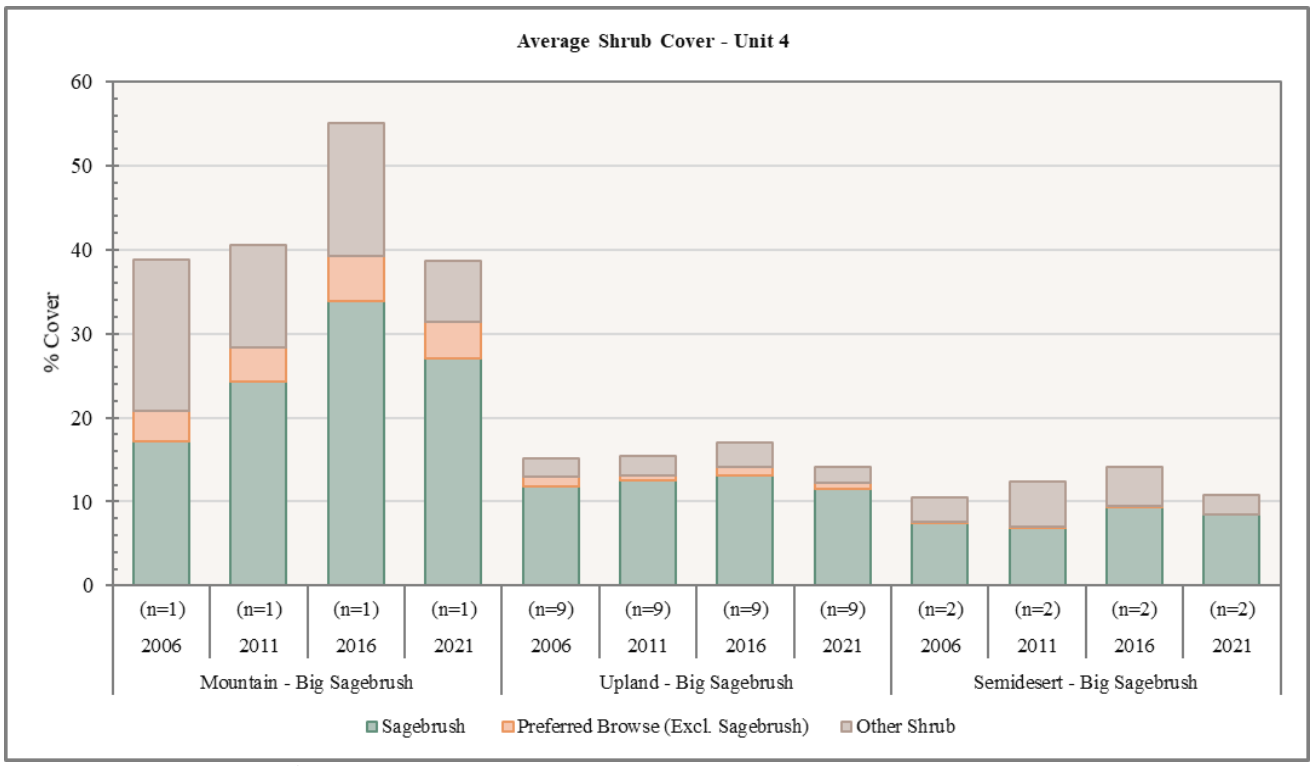


Figure 4.2: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

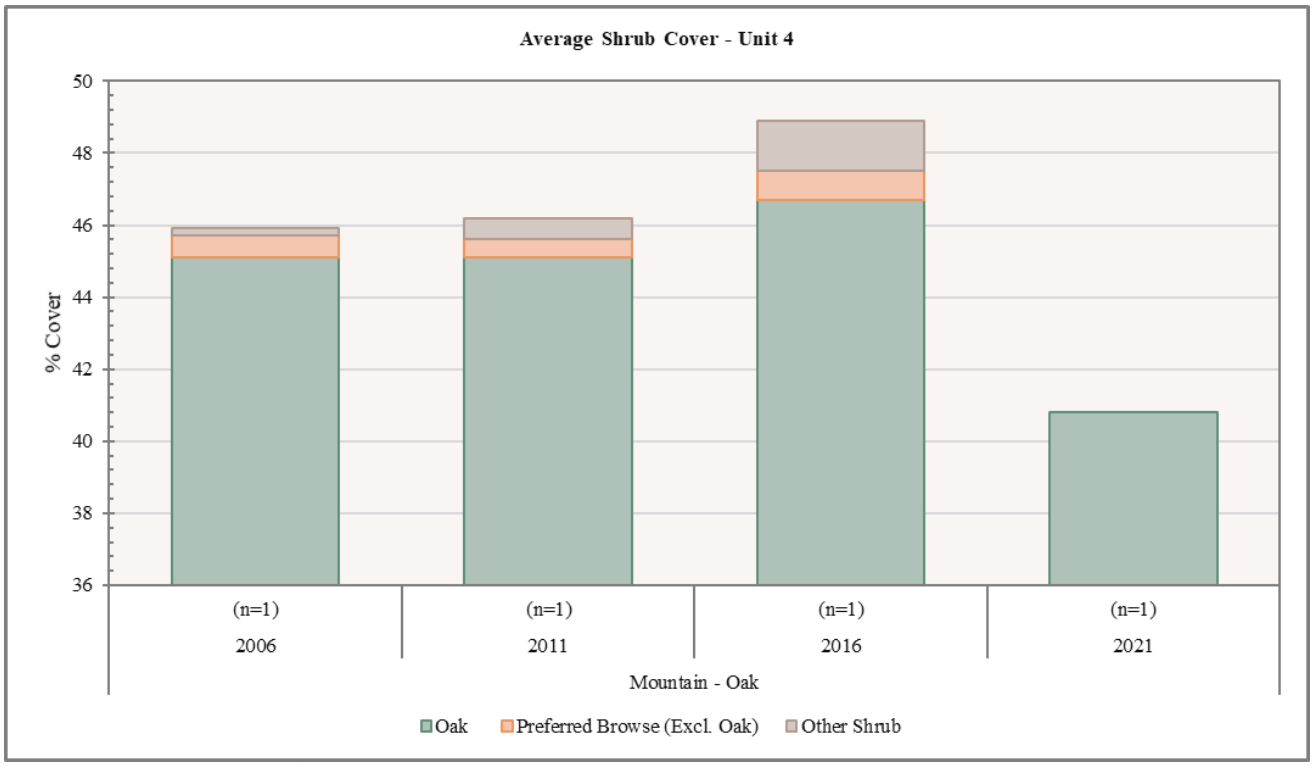


Figure 4.3: Average shrub cover for Mountain - Oak study sites in WMU 4, Morgan-South Rich.

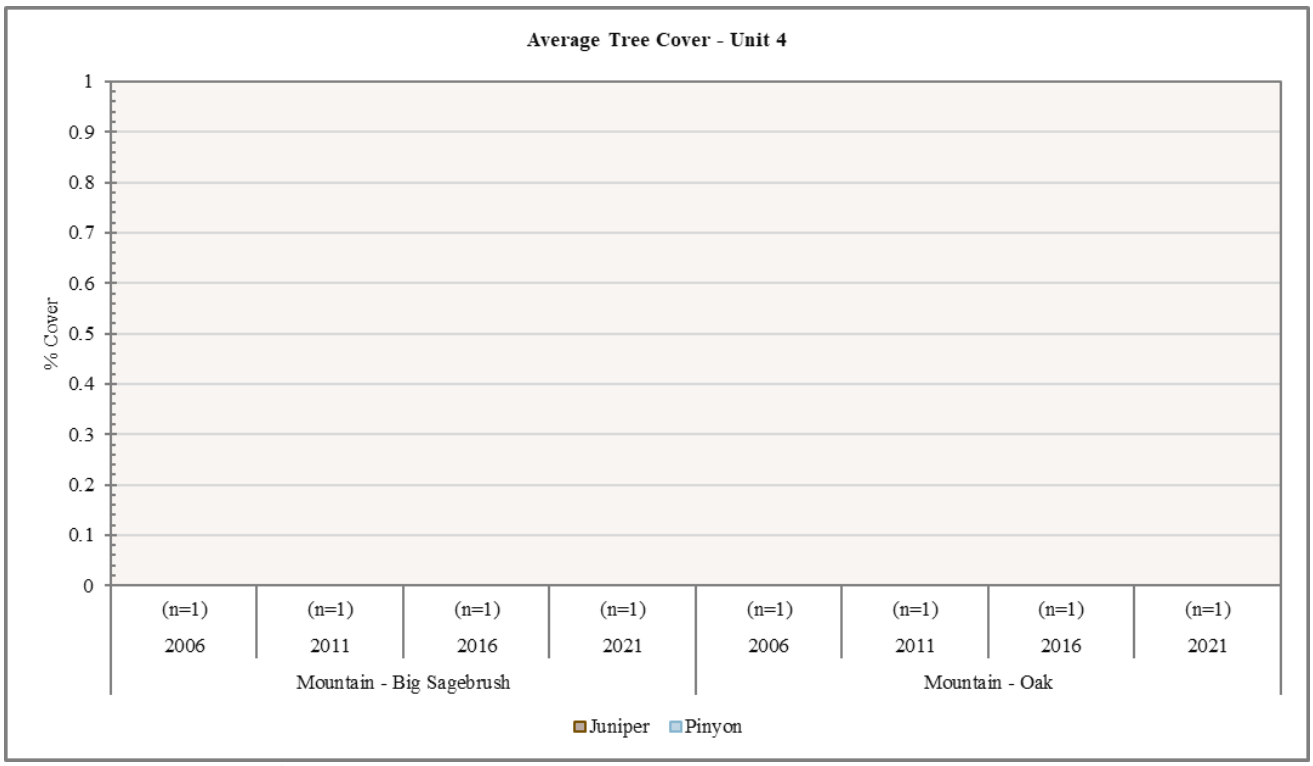


Figure 4.4: Average tree cover for Mountain - Big Sagebrush and Mountain - Shrub study sites in WMU 4, Morgan-South Rich.

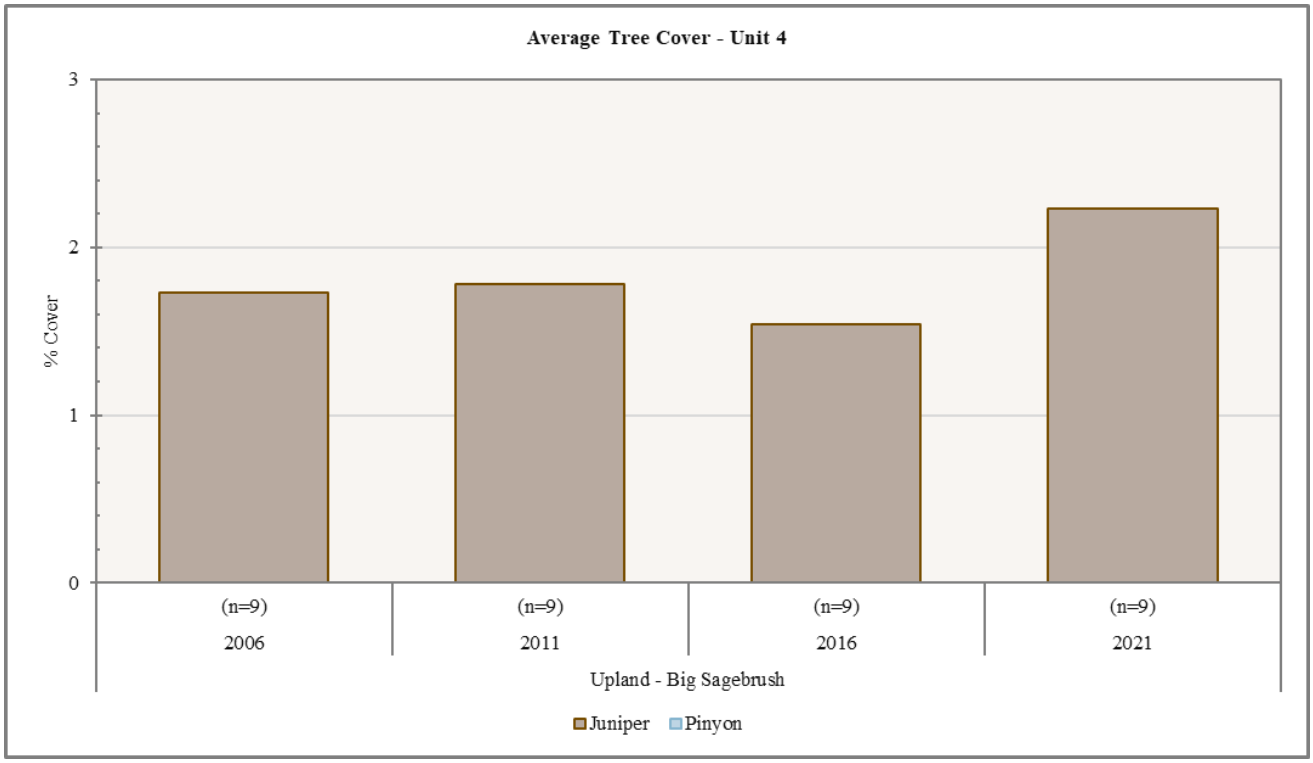


Figure 4.5: Average tree cover for Upland - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

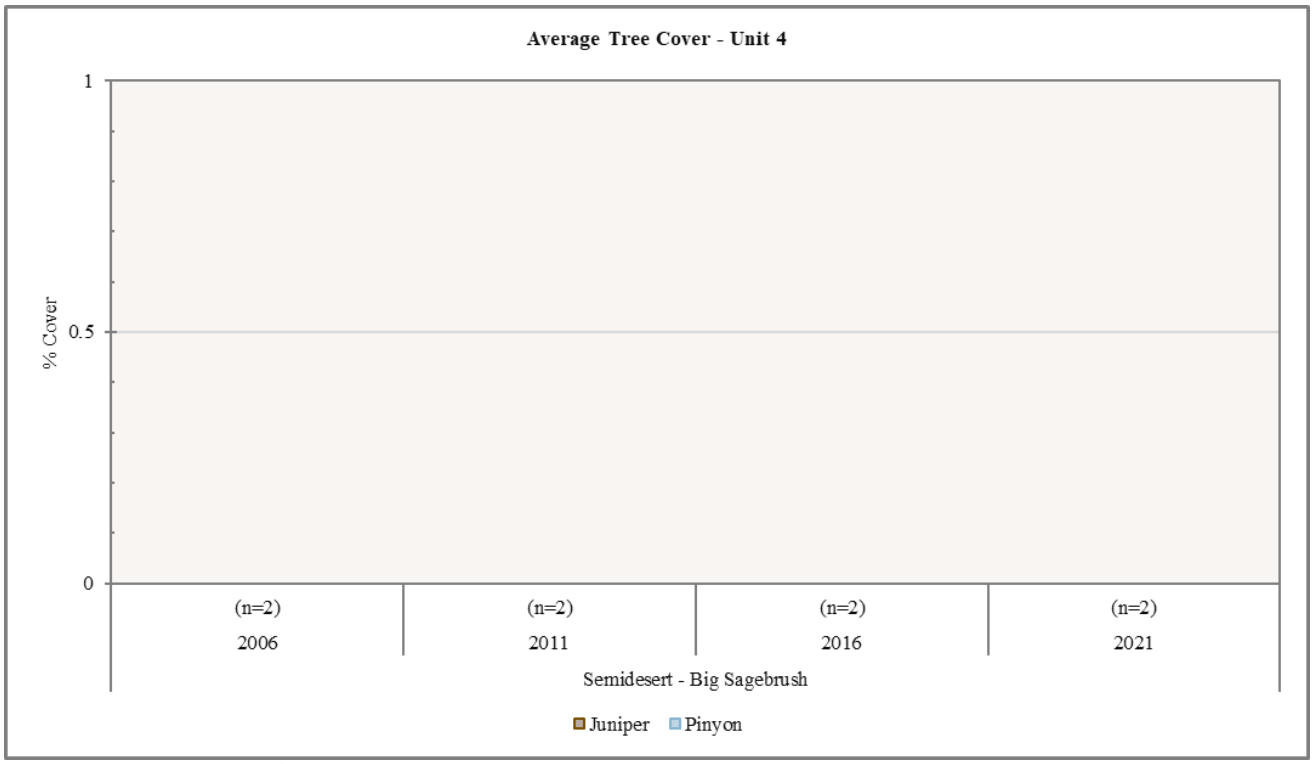


Figure 4.6: Average tree cover for Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

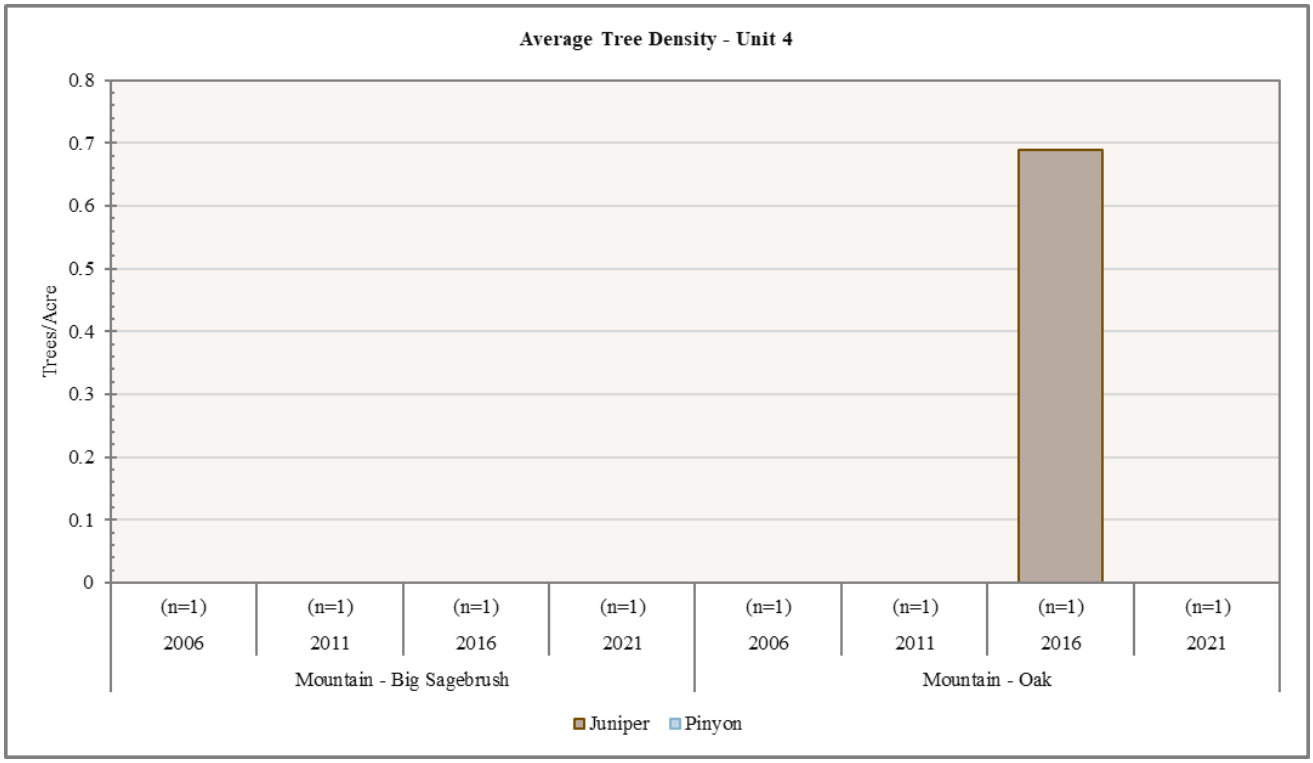


Figure 4.7: Average tree density for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 4, Morgan-South Rich.

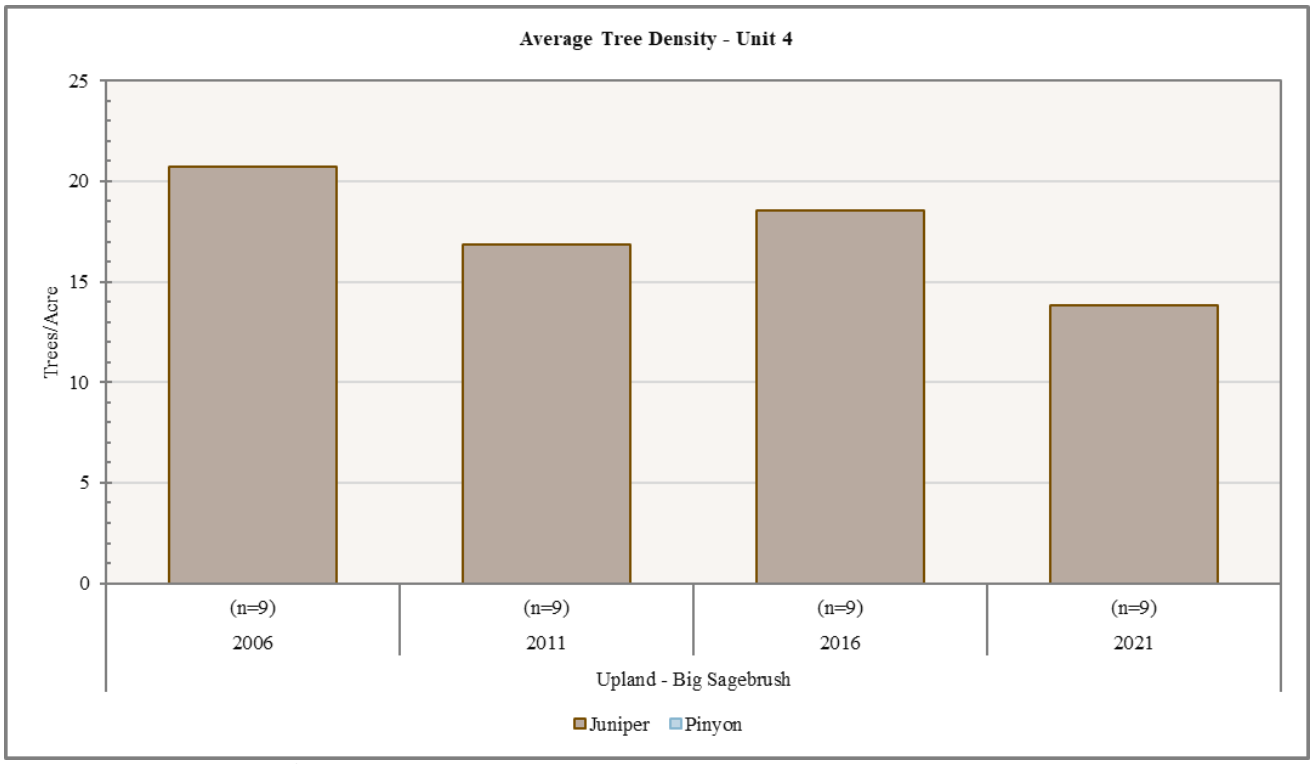


Figure 4.8: Average tree density for Upland - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

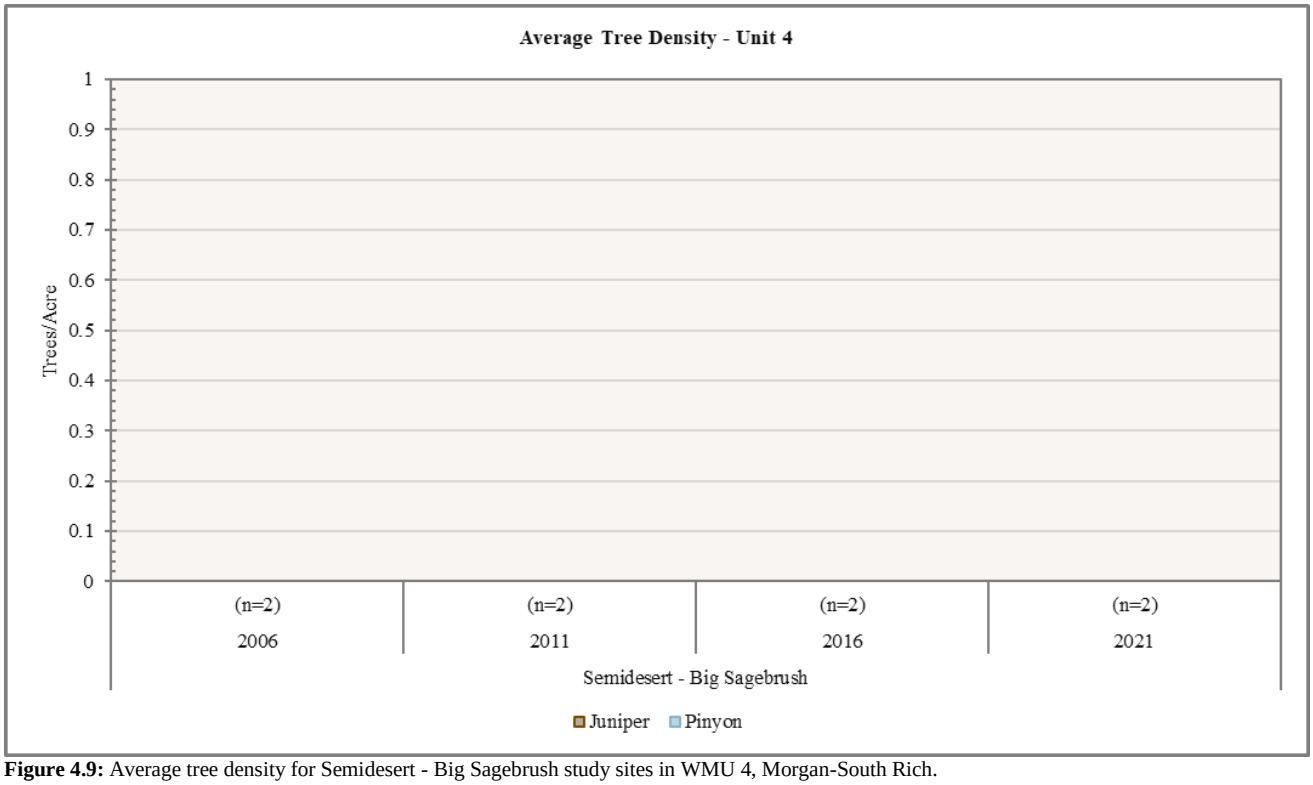


Figure 4.9: Average tree density for Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

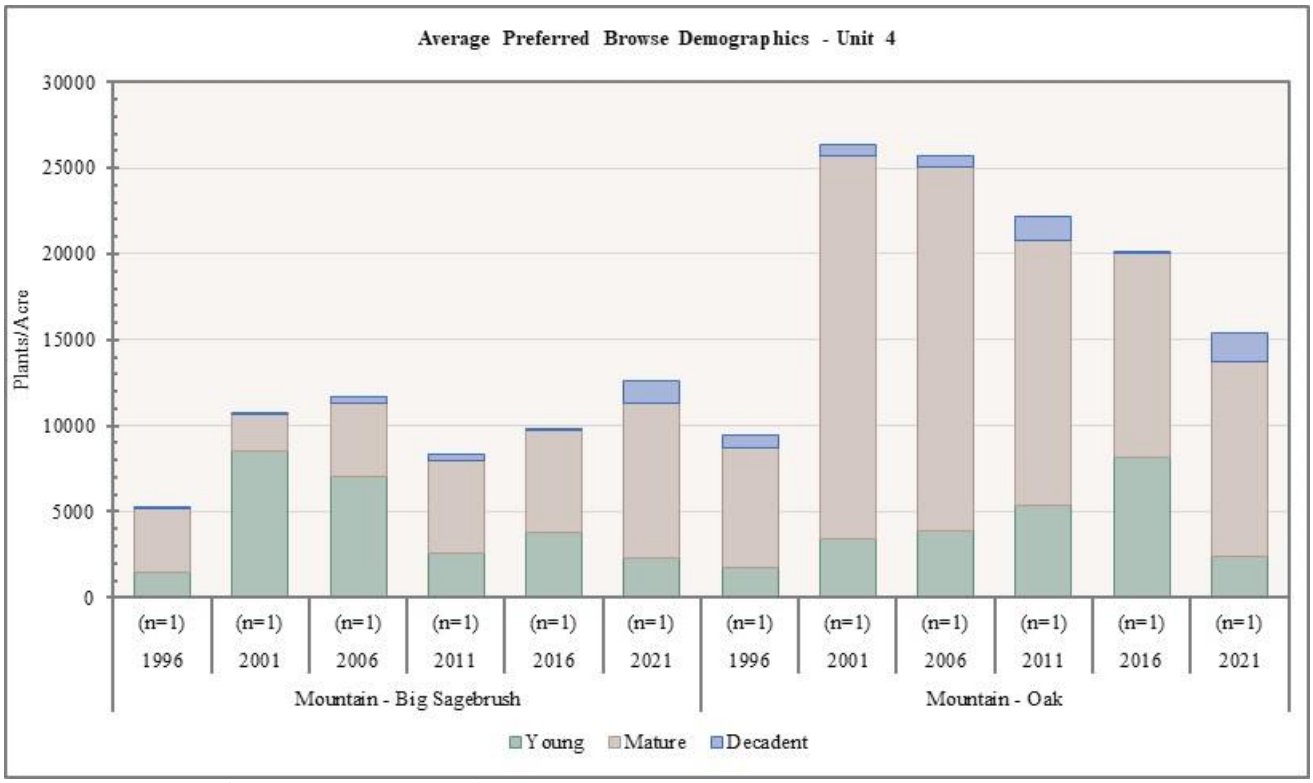


Figure 4.10: Average preferred browse demographics for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 4, Morgan-South Rich.

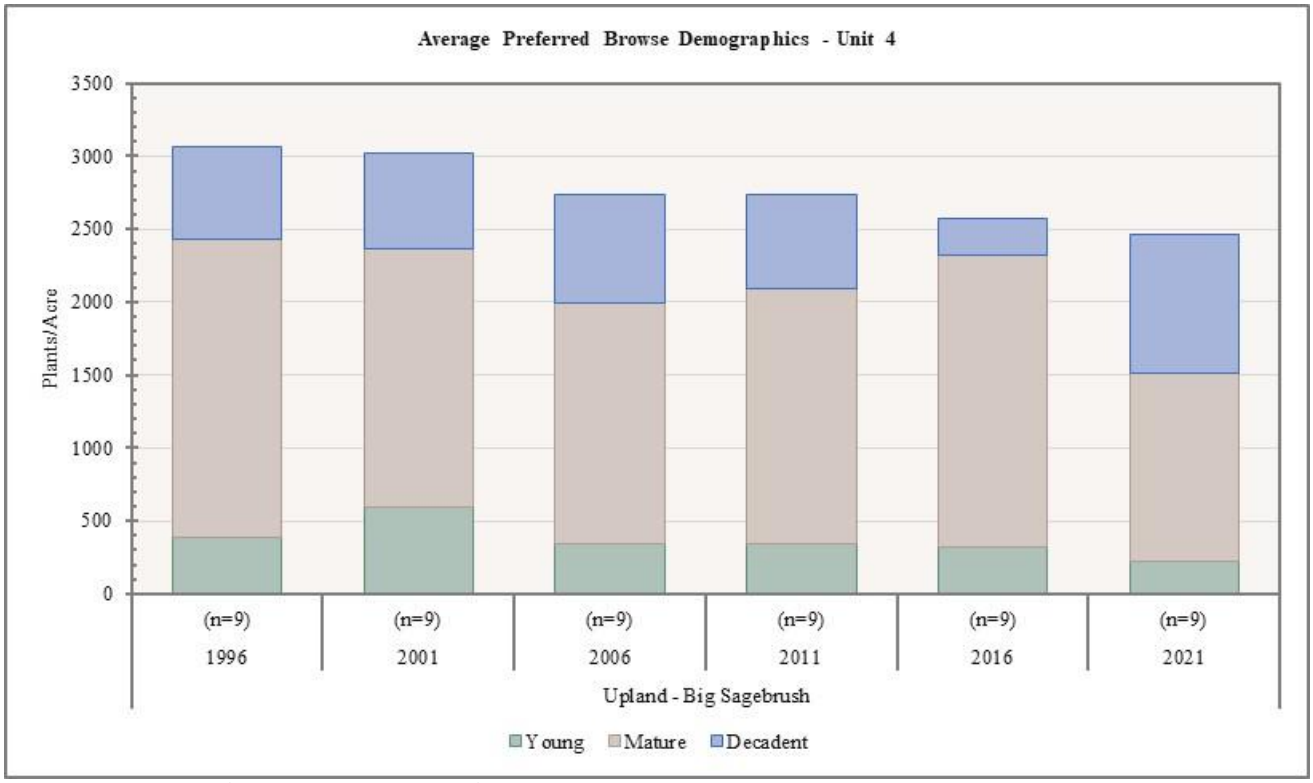


Figure 4.11: Average preferred browse demographics for Upland - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

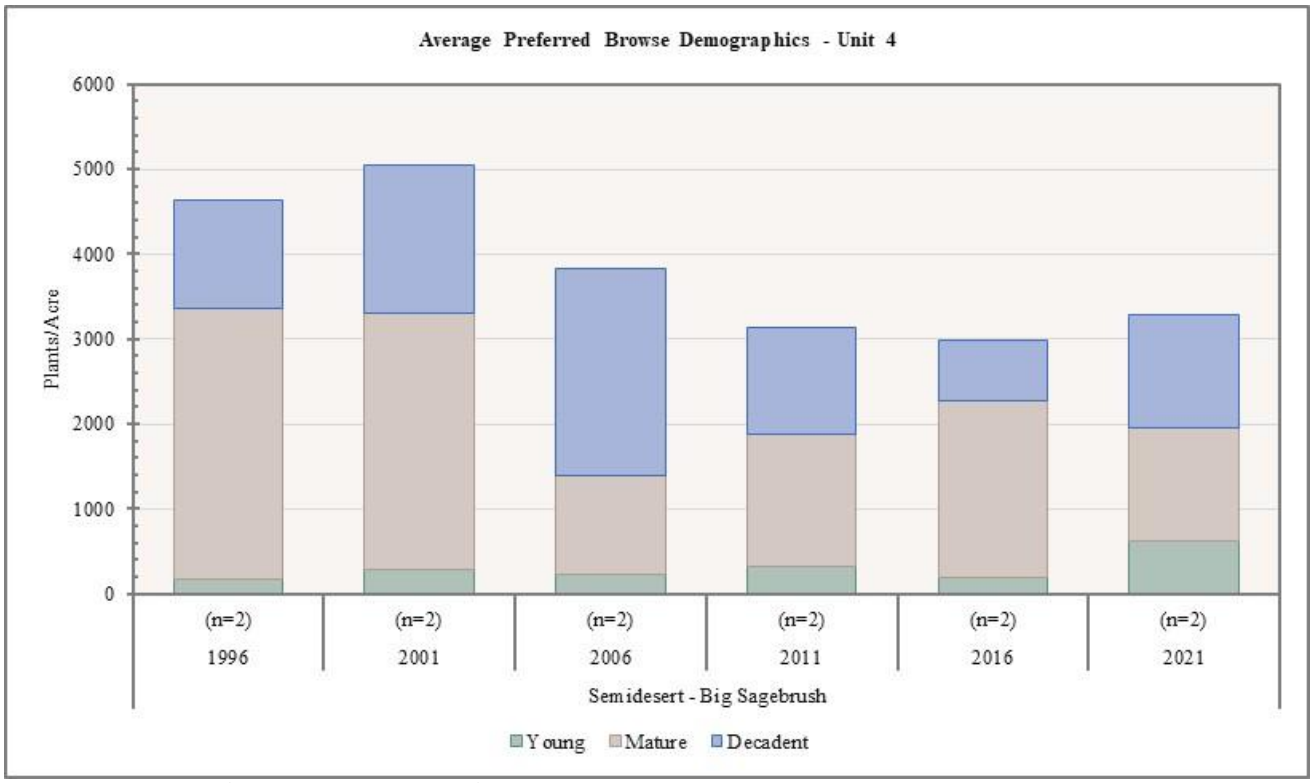


Figure 4.12: Average preferred browse demographics for Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

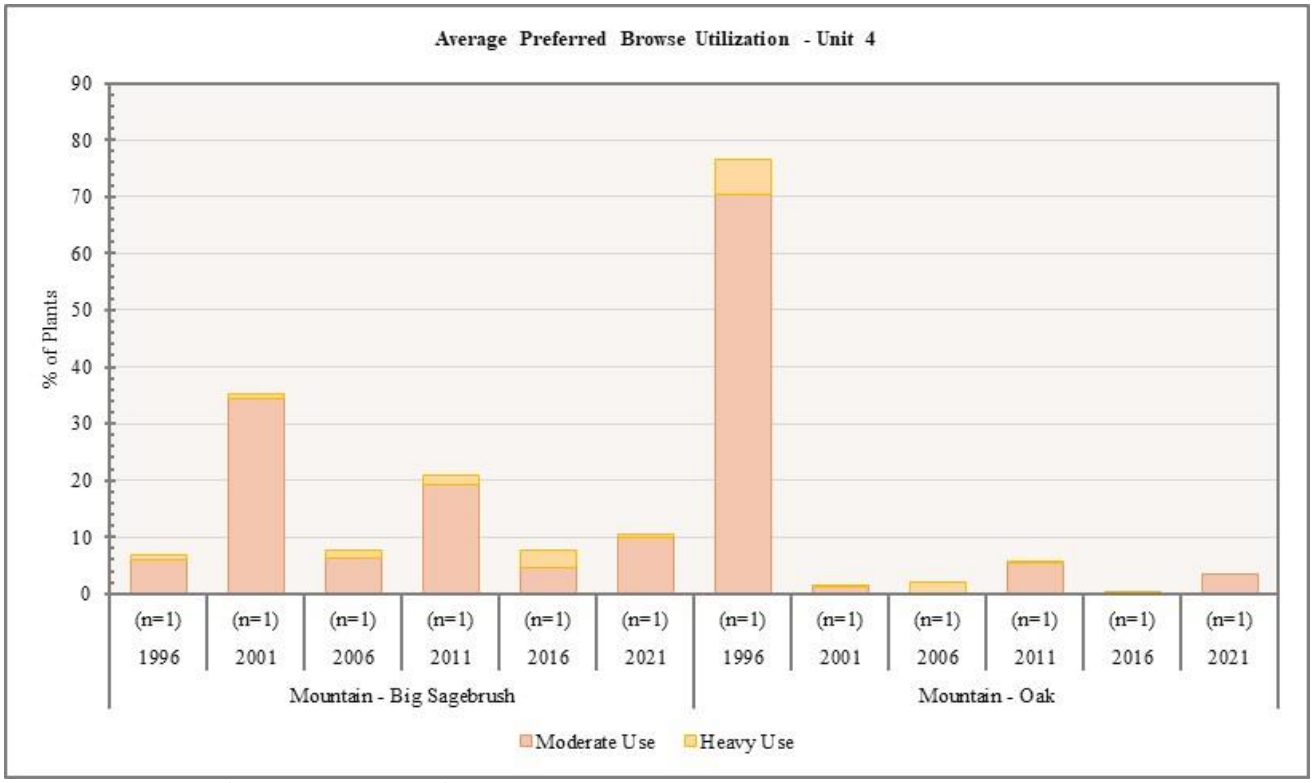


Figure 4.13: Average preferred browse utilization for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 4, Morgan-South Rich.

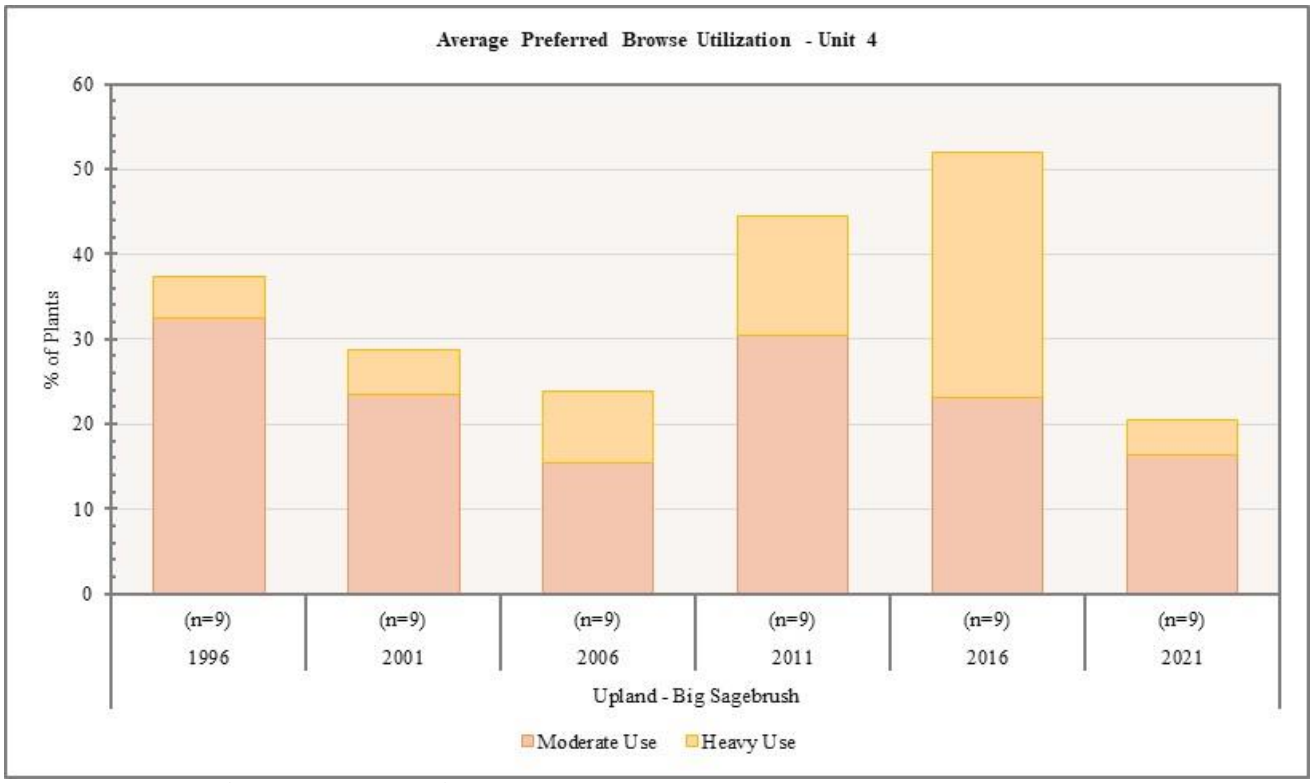


Figure 4.14: Average preferred browse utilization for Upland - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

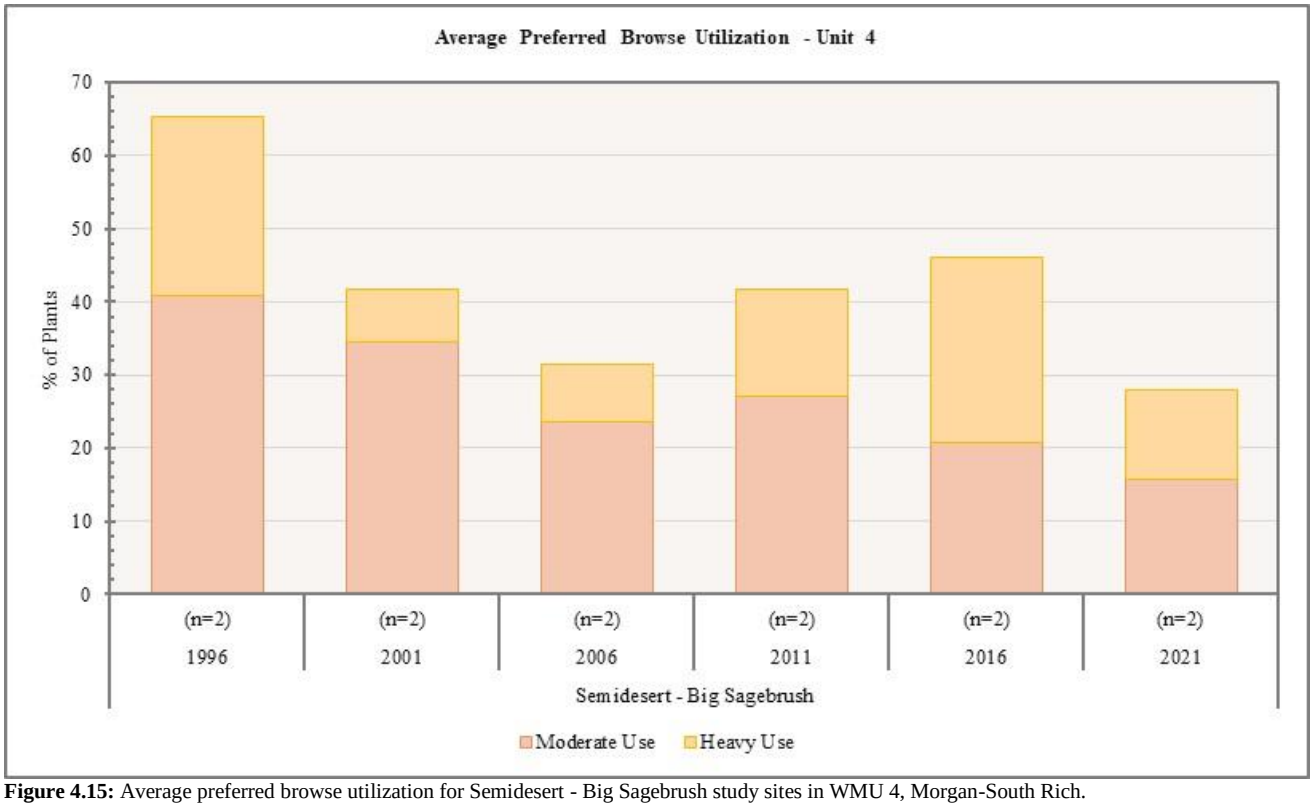


Figure 4.15: Average preferred browse utilization for Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

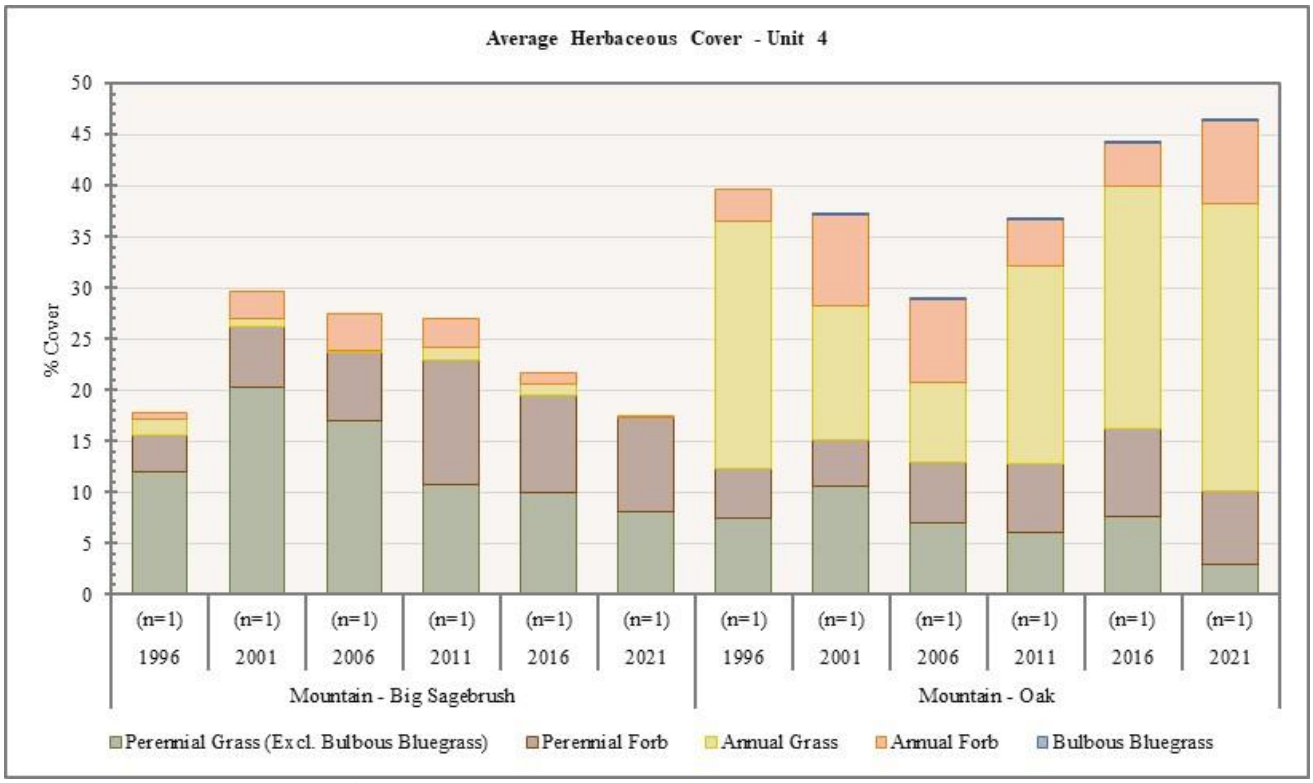


Figure 4.16: Average herbaceous cover for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 4, Morgan-South Rich.

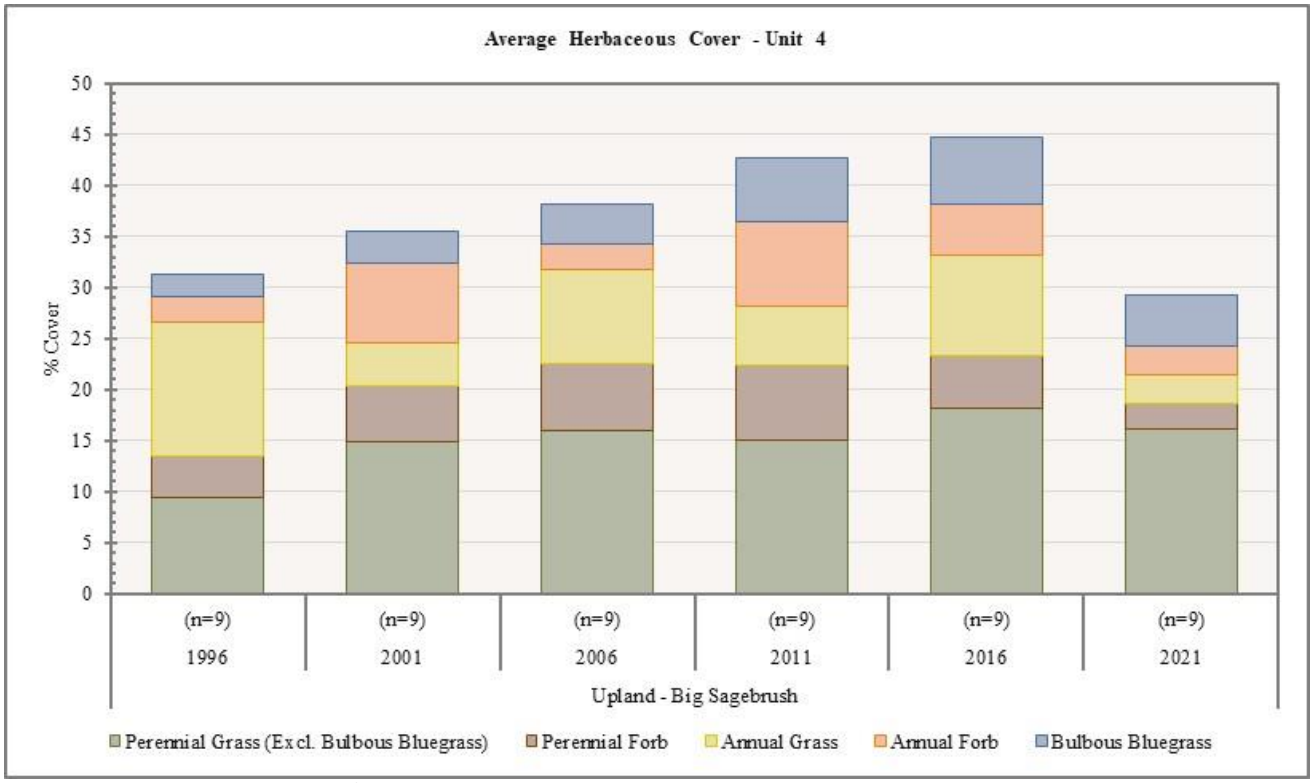


Figure 4.17: Average herbaceous cover for Upland - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

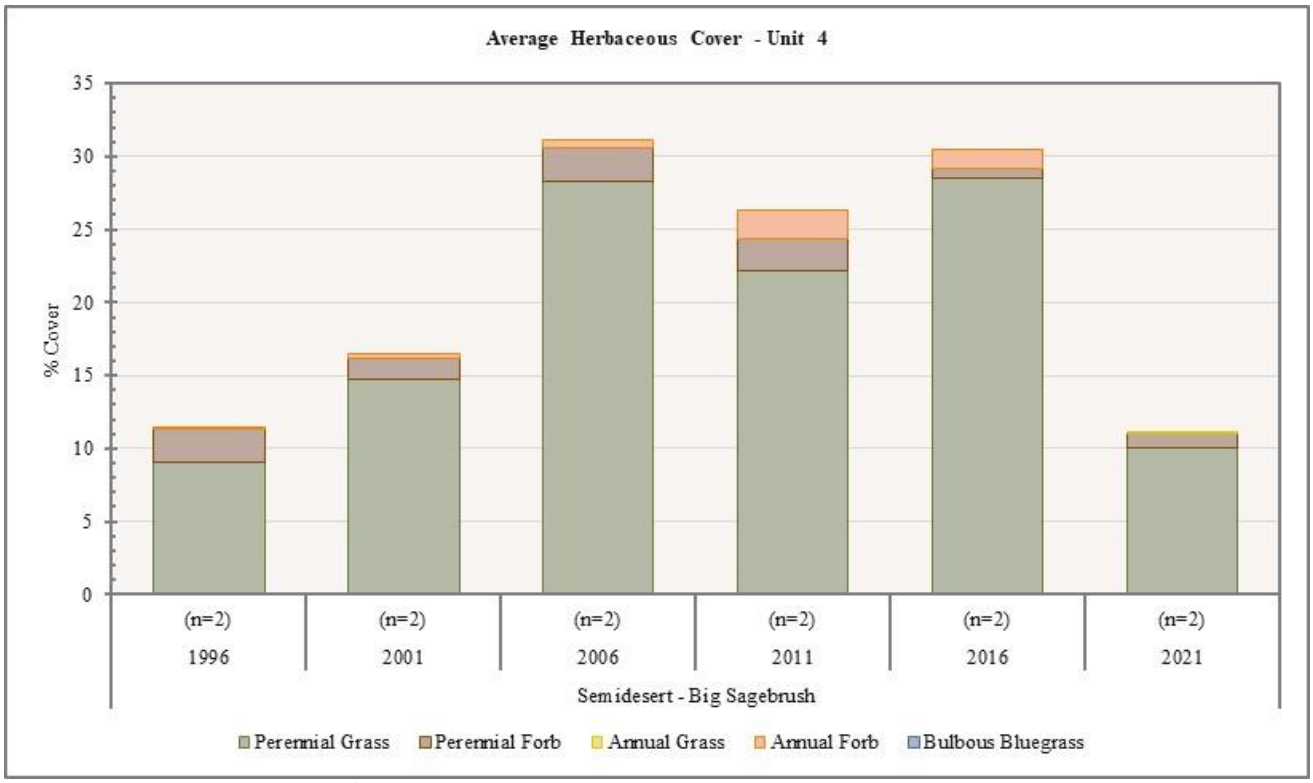


Figure 4.18: Average herbaceous cover for Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

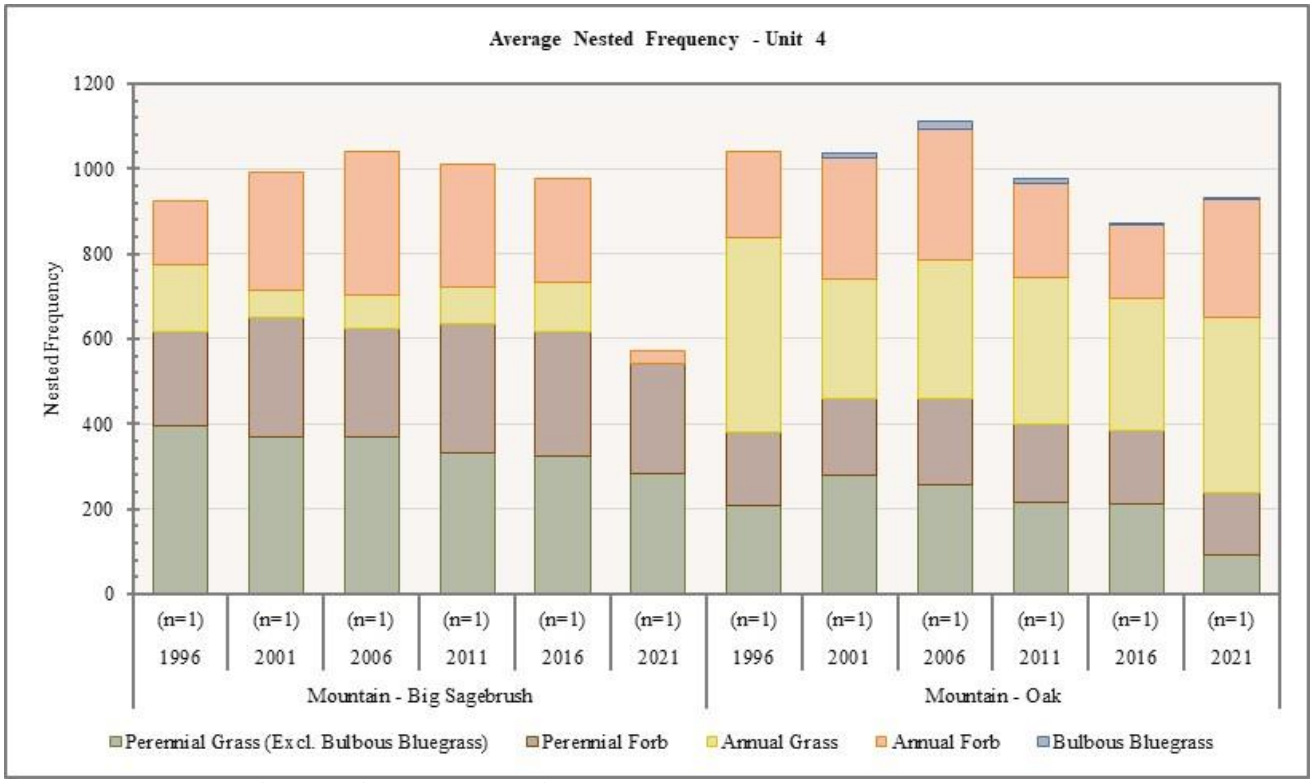


Figure 4.19: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 4, Morgan-South Rich.

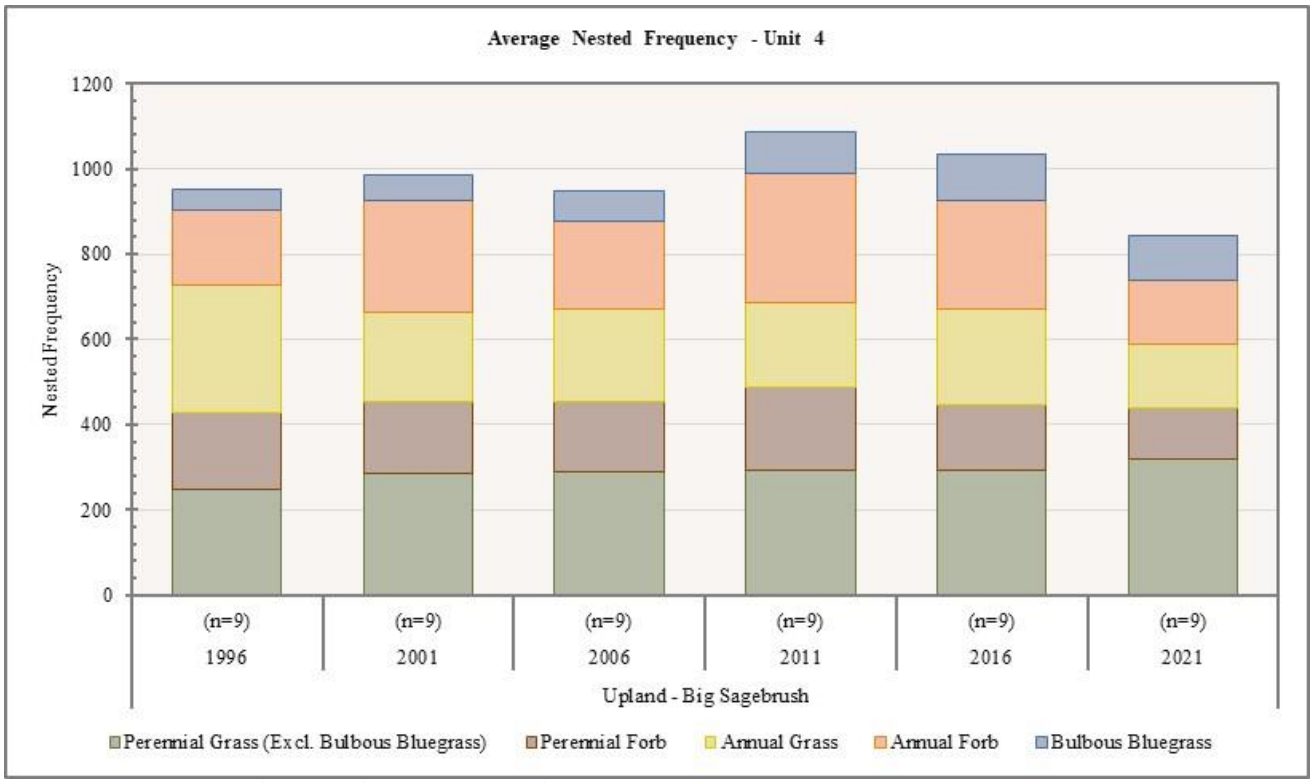


Figure 4.20: Average nested frequency of herbaceous species for Upland - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

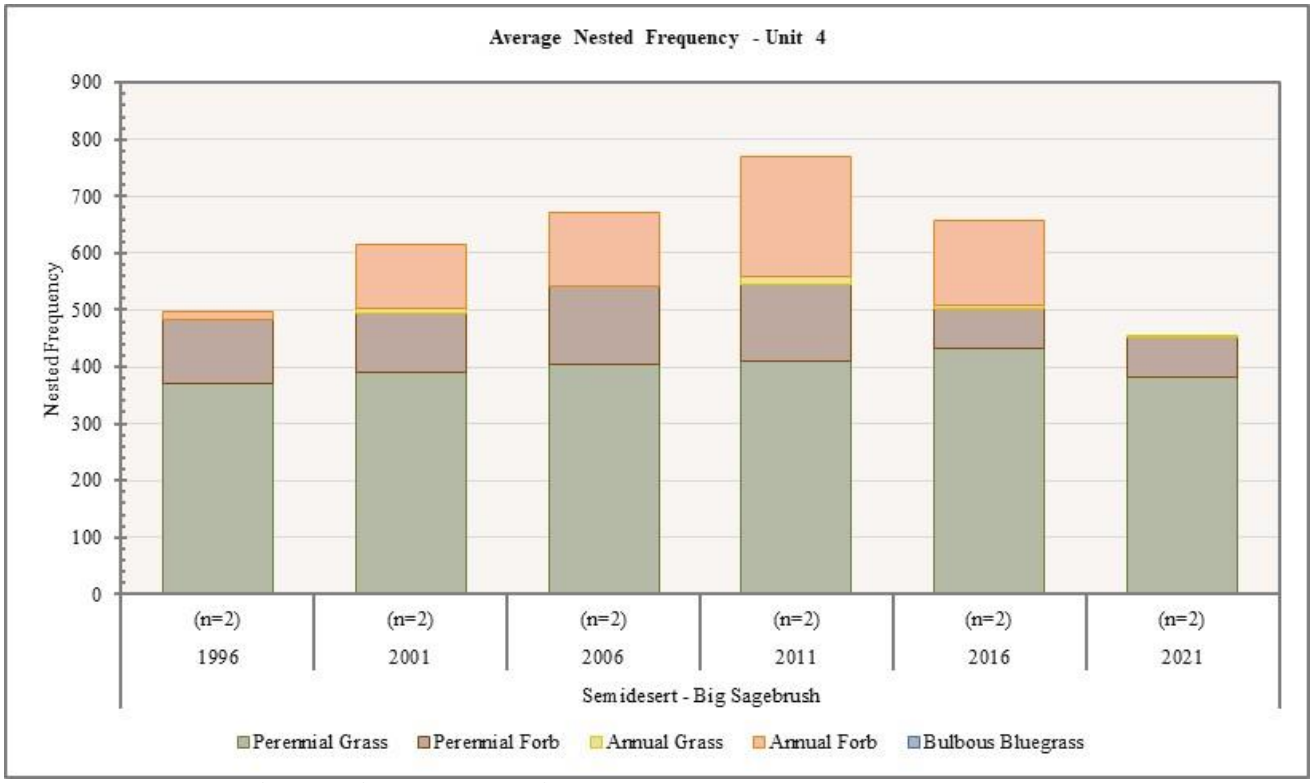


Figure 4.21: Average nested frequency of herbaceous species for Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

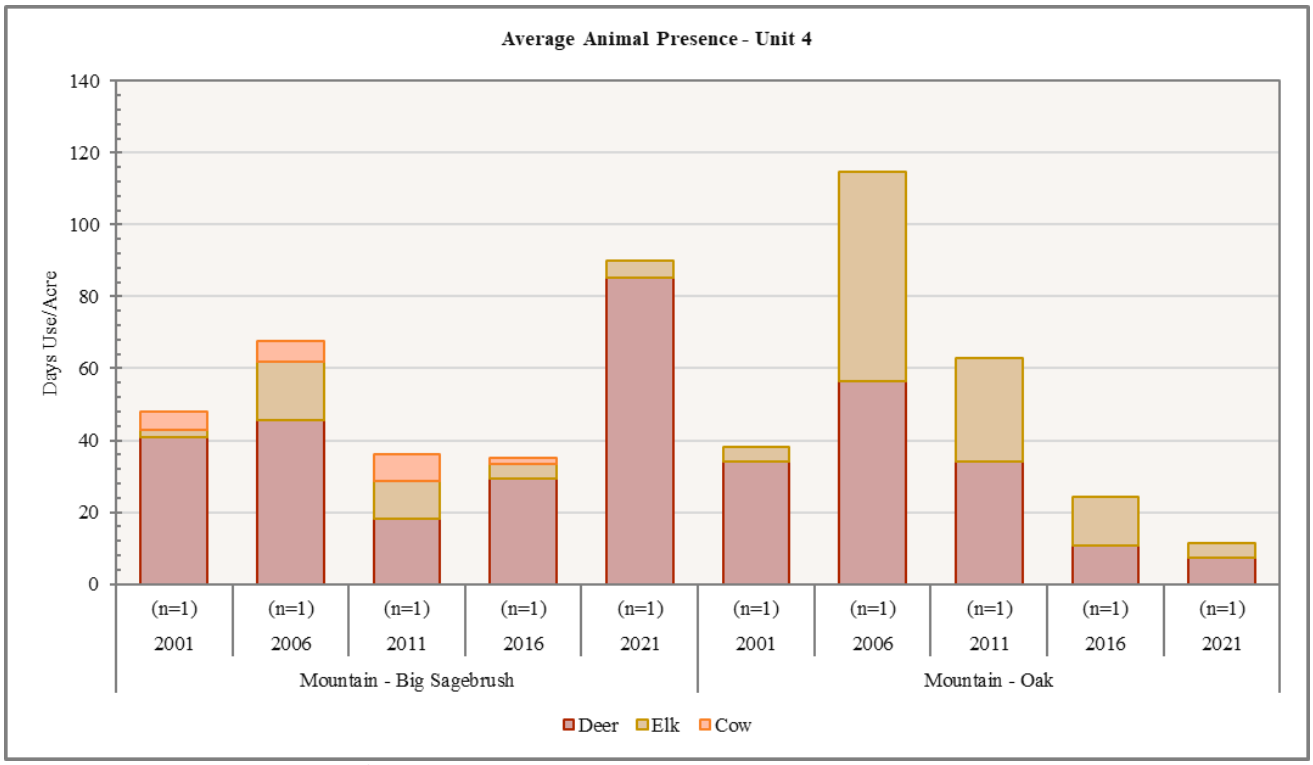


Figure 4.22: Average pellet transect data for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 4, Morgan-South Rich.

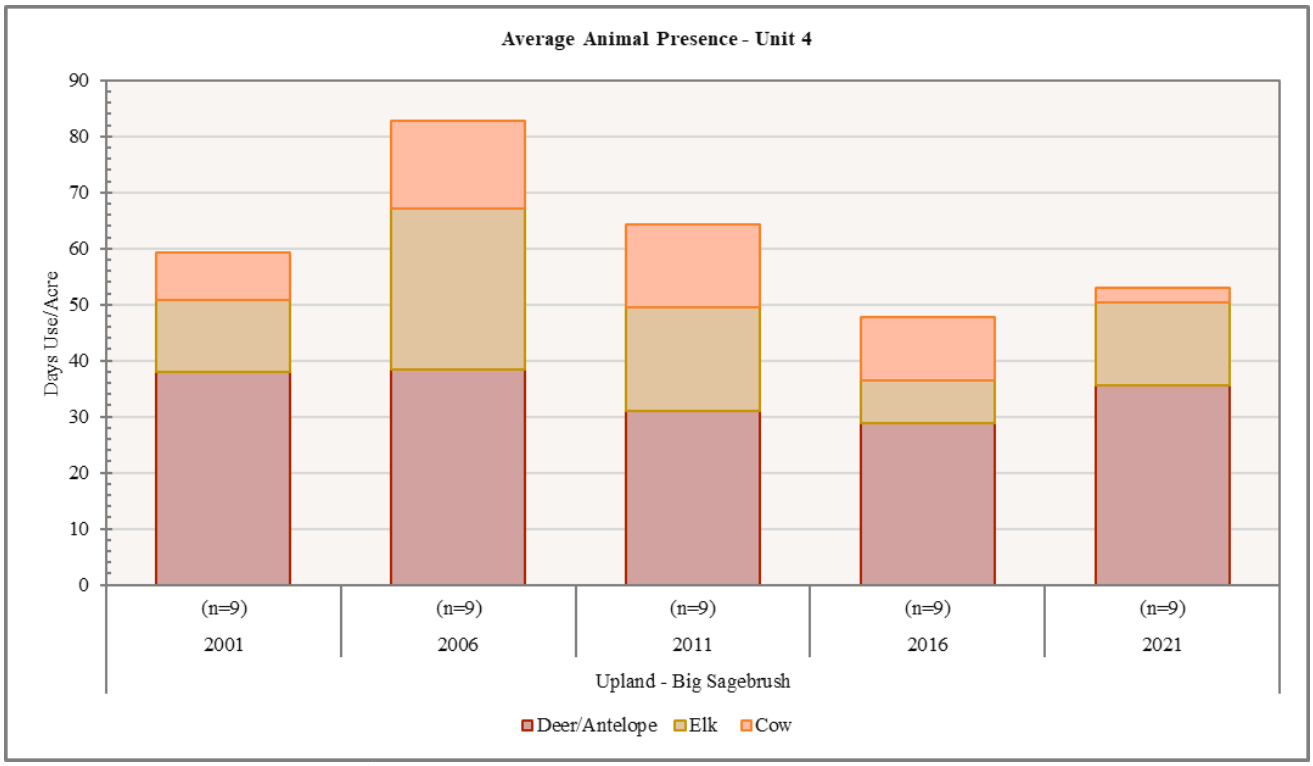


Figure 4.23: Average pellet transect data for Upland - Big Sagebrush study sites in WMU 4, Morgan-South Rich. *Upland - Big Sagebrush deer/antelope pellet groups include deer, antelope, and sheep pellets.

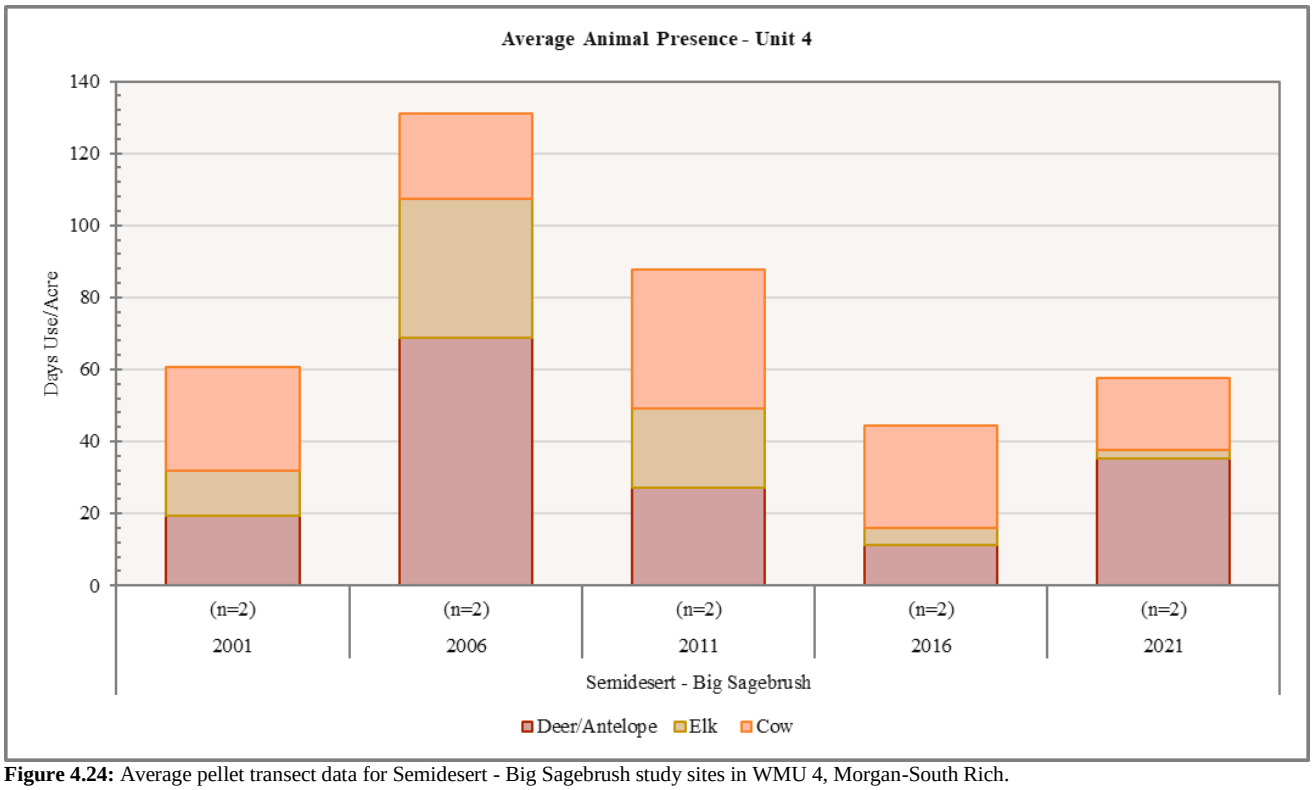
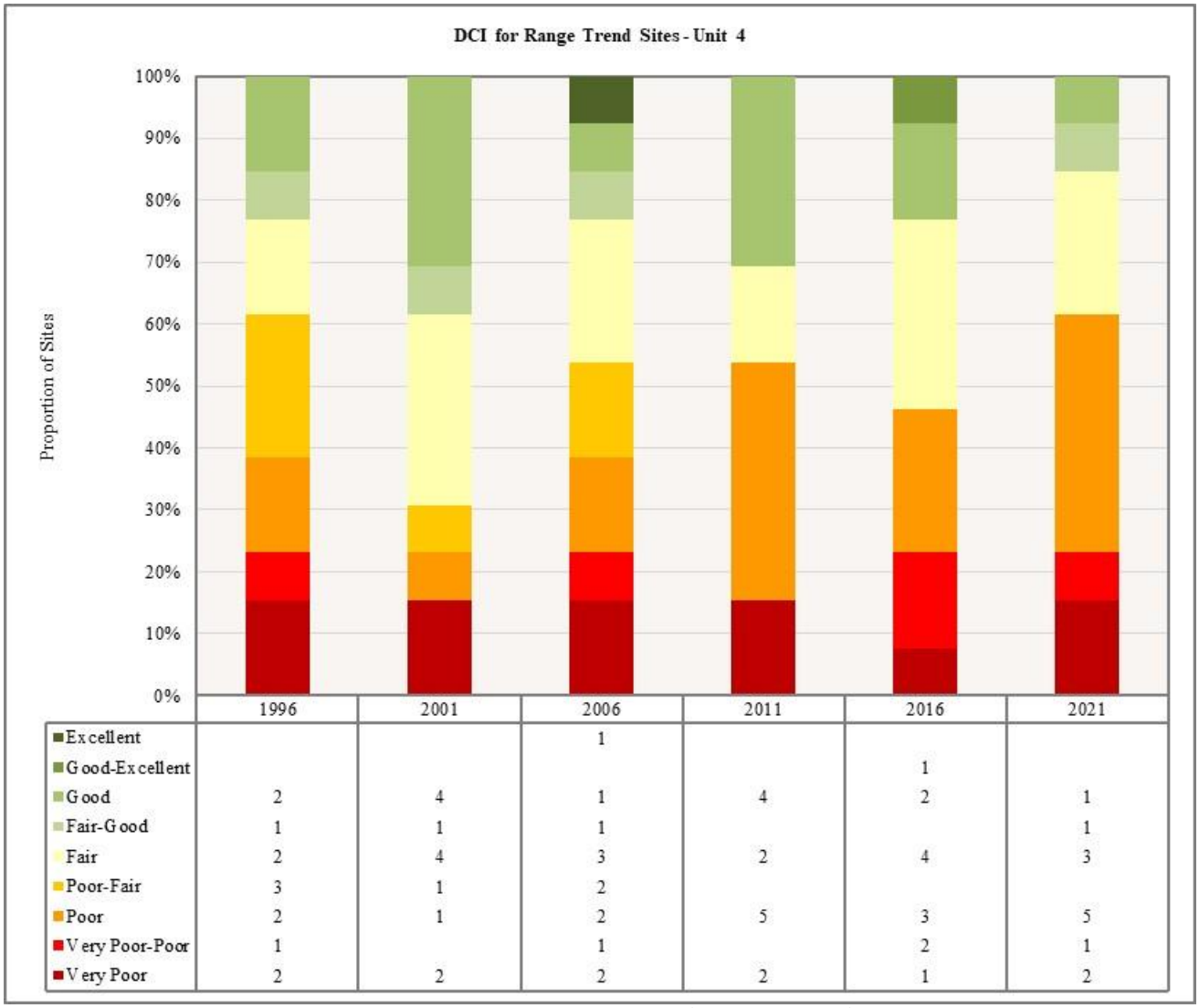


Figure 4.24: Average pellet transect data for Semidesert - Big Sagebrush study sites in WMU 4, Morgan-South Rich.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Morgan-South Rich management unit has generally remained stable since the 1996 sampling. Mean wintering conditions on WMU 4 have remained between very poor to fair condition from 1996 to 2021. Chapman Canal, Deseret Main Gate, Heiner's Creek, Scott Rees Ranch, and Wheatgrass Hollow are the main drivers for the unit's stability and average within good deer winter range conditions. Range Trend sites in WMU 4 tend to have low variability in deer winter habitat, meaning that sites experience little change in their respective habitat qualities from year to year.

The overall deer winter range assessment in 2021 for WMU 4 was that sites were in poor-fair condition. However, Heiner's Creek (04-1) and Claypit North Slope (04R-3) were considered to be in good condition due to an abundance of perennial grasses, forbs, and preferred browse cover. Deseret Burn, Owen's Canyon, and Tank Canyon rated as very poor to poor winter range in 2021 (**Figure 4.25**, **Table 4.10**).



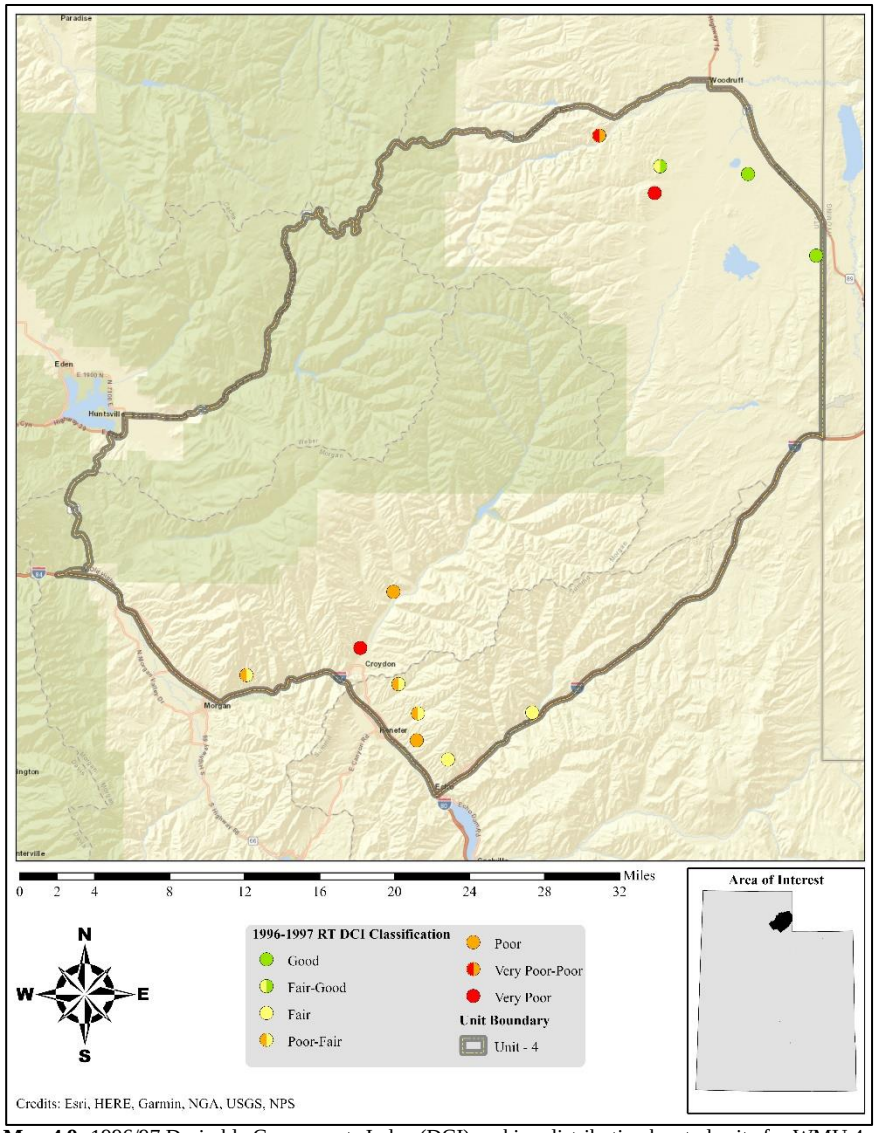
	1996	2001	2006	2011	2016	2021
Excellent			1			
Good-Excellent					1	
Good	2	4	1	4	2	1
Fair-Good	1	1	1			1
Fair	2	4	3	2	4	3
Poor-Fair	3	1	2			
Poor	2	1	2	5	3	5
Very Poor-Poor	1		1		2	1
Very Poor	2	2	2	2	1	2

Figure 4.25: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 4, Morgan-South Rich.

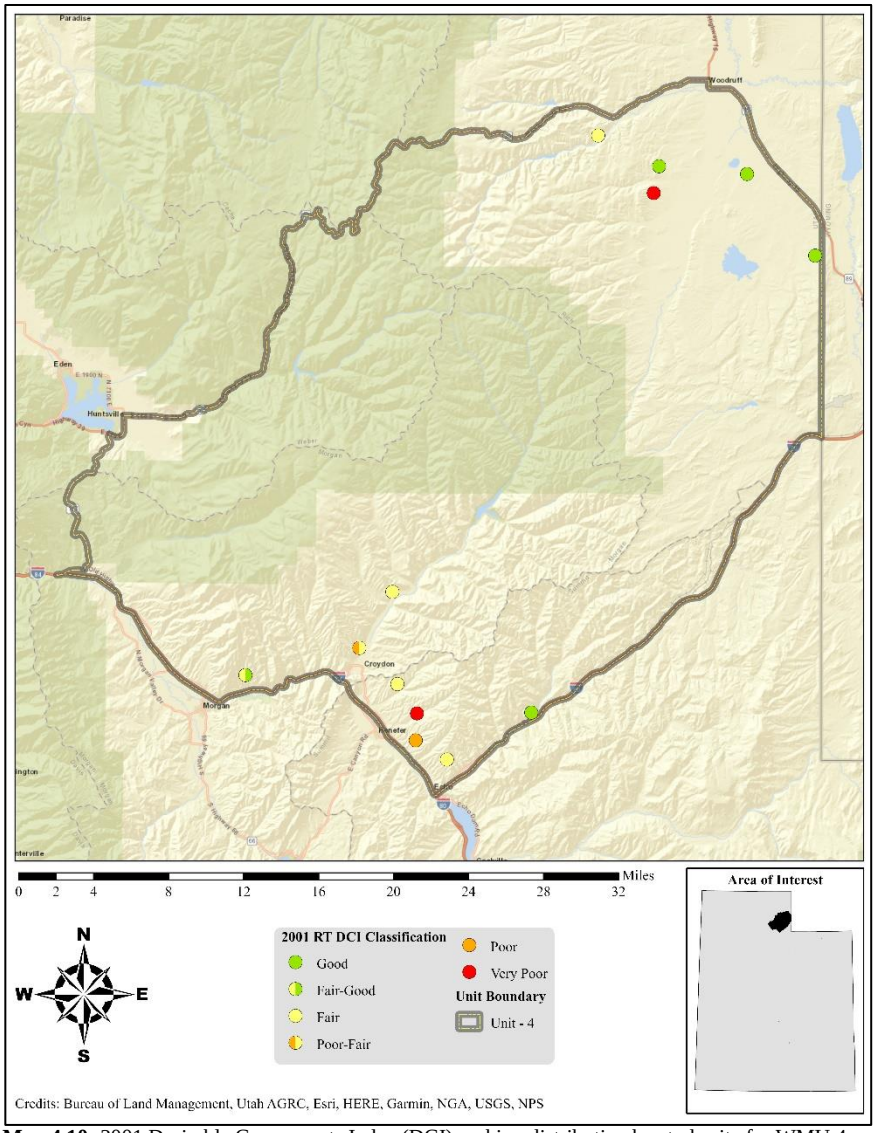
Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
04-1	1996	10.1	13.3	10.2	24.1	-1.2	7.1	0	**63.6**	**F**
04-1	2001	15	14.4	15	30	-0.6	10	0	**83.8**	**G**
04-1	2006	25.9	13.1	15	30	-0.2	10	0	**93.8**	**E**
04-1	2011	30	12.5	13.8	21.5	-1	10	0	**86.8**	**G**
04-1	2016	30	14.2	7.9	20	-0.7	10	0	**81.3**	**G**
04-1	2021	30	8.1	9.3	16.2	0	10	0	**73.5**	**G**
04-2	1996	17.9	9.2	8.6	19	-10.3	10	0	**54.5**	**F**
04-2	2001	18.7	5.7	0	30	-3.3	10	0	**61.1**	**F**
04-2	2006	16	2	0.5	30	-3.4	10	0	**55**	**F**
04-2	2011	8.9	-1.2	0.7	26.4	-3.5	10	0	**41.2**	**P**
04-2	2016	11.7	10	0.7	30	-5.8	10	-2	**54.6**	**F**
04-2	2021	4.6	0	0	30	-0.6	8.5	-2	**40.5**	**P**
04-3	1996	1.5	0	0	30	-0.2	10	0	**41.3**	**P**
04-3	2001	1.9	0	0	30	0	10	0	**41.9**	**P**
04-3	2006	1.4	0	0	30	0	10	0	**41.4**	**P**
04-3	2011	0.4	0	0	30	0	10	0	**40.4**	**P**
04-3	2016	0.8	0	0	30	0	10	0	**40.8**	**P**
04-3	2021	0.9	0	0	30	0	3.1	0	**34**	**VP-P**
04-4	1996	25.6	8.3	4.8	23.3	-14.7	1.8	0	**49.1**	**P-F**
04-4	2001	0.5	0	0	30	-1.9	4.4	-2	**31.1**	**VP**
04-4	2006	4.1	0	0	30	-7.5	3	0	**29.6**	**VP**
04-4	2011	3.3	0	0	30	-5.3	2.2	0	**30.3**	**VP**
04-4	2016	4	0	0	30	-1.2	1.1	-2	**32**	**VP**
04-4	2021	2	0	0	30	-1.1	1.2	-2	**30.1**	**VP**
04-6	1996	8.4	11.9	9.4	24.5	-7.2	3.8	-2	**48.8**	**P-F**
04-6	2001	16.8	7.3	3.2	27.1	-6.6	6.4	-2	**52.1**	**F**
04-6	2006	15.5	7.5	3.8	29.3	-13.9	9.3	-2	**49.6**	**P-F**
04-6	2011	6.8	4	4.6	25.1	-8.6	10	0	**41.8**	**P**
04-6	2016	10.6	11.2	4.4	30	-7.4	7	0	**55.8**	**F**
04-6	2021	11.3	5.8	0.4	30	-6.2	2.5	0	**43.8**	**P**
04-8	1996	29.9	7.8	4	3.8	-19.4	3	0	**29.1**	**VP**
04-8	2001	30	8.5	1.7	6	-1.6	5.6	0	**50.2**	**P-F**
04-8	2006	25	3.6	1.5	9.1	-19.2	10	0	**30**	**VP**
04-8	2011	30	6	0	5	-7.5	4.8	0	**38.3**	**P**
04-8	2016	30	11.6	6.5	6.8	-11.7	3.4	0	**46.6**	**P**
04-8	2021	30	1.7	1.8	6.2	-5.6	9.5	0	**43.5**	**P**
04-9	1996	28.5	12.6	9.4	14.9	-18.1	9.6	0	**56.9**	**P-F**
04-9	2001	30	14.4	6.4	21.1	-9.8	9.1	0	**71.2**	**F-G**
04-9	2006	30	14.2	7.6	14.1	-5.8	10	0	**70.2**	**F-G**
04-9	2011	30	13.2	12	12.2	-14.5	10	0	**62.8**	**F**
04-9	2016	30	14.6	15	15.3	-17.8	10	0	**67.1**	**F**
04-9	2021	30	11.7	7.7	5.8	-20	10	0	**45.2**	**P**
04-13	1996	29	7.6	5.4	20.3	0	4.1	0	**66.3**	**F-G**
04-13	2001	30	8.2	11.4	20.6	-0.1	3.3	0	**73.4**	**G**
04-13	2006	30	5.7	6.1	23.8	-0.1	5.9	0	**71.4**	**G**
04-13	2011	30	7.7	4.5	16.2	-0.1	4.1	0	**62.4**	**F**
04-13	2016	30	11.4	3	18.7	-0.6	5.1	0	**67.7**	**G**
04-13	2021	30	1.6	2.2	25.1	-0.3	4.5	0	**63**	**F-G**
04-14	1996	18.6	5.7	1	12.9	0	8.9	0	**47.1**	**G**
04-14	2001	22.7	7.3	0.7	21.7	0	5.3	0	**57.7**	**G**
04-14	2006	13.5	-11.3	0.8	30	0	8.3	0	**41.3**	**F**
04-14	2011	10.9	0.3	5.3	26	0	8.1	0	**50.4**	**G**
04-14	2016	20	7.2	3.8	30	0	2.4	0	**63.4**	**G-E**
04-14	2021	15.4	0	4.3	13.4	0	3.8	0	**36.8**	**F**
04-15	1996	13.5	5	9.1	18.6	-11.7	0.4	0	**34.8**	**VP-P**
04-15	2001	13.7	8.2	14.3	22.1	-1.2	0.6	0	**57.7**	**F**
04-15	2006	16.8	9.4	9.4	17.7	-5.7	1.6	0	**49**	**P-F**
04-15	2011	27.5	10	13.1	24.3	-8.6	1.4	0	**67.7**	**G**
04-15	2016	20.3	13.1	5.3	17.2	-17.4	0.9	0	**39.2**	**P**
04-15	2021	20.8	1.8	4.8	19.5	-0.3	0.4	0	**46.9**	**P**

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
04-17	1996	30	11.9	3.5	6.3	-20	10	0	**41.6**	**P**
04-17	2001	30	8.8	3.7	12	-8.6	10	0	**55.8**	**F**
04-17	2006	30	4.7	1.8	14	-13	10	0	**47.5**	**P**
04-17	2011	30	2.1	0	11.9	-6.1	10	0	**47.9**	**P**
04-17	2016	30	6.3	0	9	-20	10	0	**35.3**	**VP-P**
04-17	2021	21.5	2.1	3.7	16.9	-5.1	10	0	**49**	**P-F**
04-18	1997	14.4	7.1	2.1	23.5	0	0.3	0	**47.3**	**G**
04-18	2001	14.4	2.2	4.2	30	0	0.5	0	**51.3**	**G**
04-18	2006	5.4	0	0	30	0	1.1	0	**36.4**	**F**
04-18	2011	6.6	5.7	5.1	30	0	0.7	0	**48.1**	**G**
04-18	2016	3.6	0	0	30	0	0.1	0	**33.7**	**F**
04-18	2021	5.9	0	0	26.6	0	0.2	0	**32.7**	**F**
04-19	1997	0.1	0	0	20.2	-0.5	5.8	0	**25.6**	**VP**
04-19	2001	0.1	0	0	30	-4.7	3.2	0	**28.5**	**VP**
04-19	2006	0.8	0	0	30	-0.1	3.7	0	**34.3**	**VP-P**
04-19	2011	0.4	0	0	30	0	0.1	0	**30.5**	**VP**
04-19	2016	2.8	0	0	30	-0.6	1.2	0	**33.3**	**VP-P**
04-19	2021	1.6	0	0	30	-0.2	0.9	0	**32.3**	**VP**
04R-3	2006	18.5	5.6	3.1	30	0	7.6	0	**64.8**	**F-G**
04R-3	2011	22.4	2.1	1.5	30	0	10	0	**66**	**F-G**
04R-3	2016	25	3.1	5.7	30	-2.4	10	0	**71.4**	**G**
04R-3	2021	23.6	3.5	10.5	22.9	-0.3	5.7	0	**65.9**	**F-G**
04R-4	2006	7.4	1.5	2	28.6	-8.7	0.1	0	**30.7**	**VP**
04R-4	2011	6.5	3.9	1.6	30	-9.7	1.6	0	**33.8**	**VP-P**
04R-4	2016	8.3	2.2	0	30	-7.5	0.5	0	**33.4**	**VP-P**
04R-4	2021	6.9	12.1	15	14	-5.1	2.1	-2	**43**	**P**
04R-5	2006	19.6	-2.4	0.9	22.9	0	0	0	**41**	**P**
04R-5	2011	25.3	1	2.7	30	-0.2	0.2	0	**58.9**	**F**
04R-5	2016	30	0.7	4.1	24.8	0	0	0	**59.6**	**F**
04R-5	2021	17.9	0	9.3	7.6	-0.7	0.6	0	**34.6**	**VP-P**
04R-6	2008	9.5	-8.7	0.8	25.6	0	7.3	0	**34.6**	**VP**
04R-6	2017	5.3	0	0	26.3	-2.1	10	-2	**37.4**	**VP**
04R-6	2021	7.8	6.3	4	30	-0.3	10	0	**57.7**	**F**

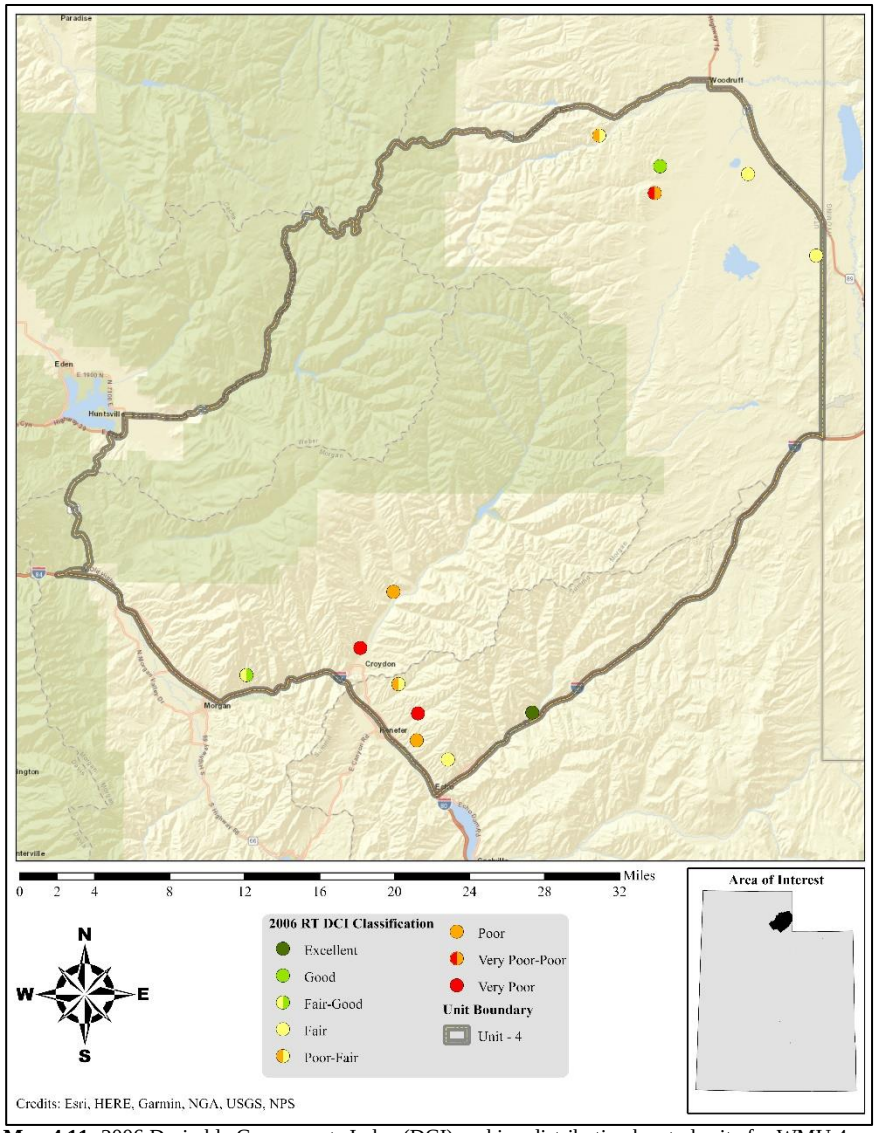
Table 4.10: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 4, Morgan-South Rich. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



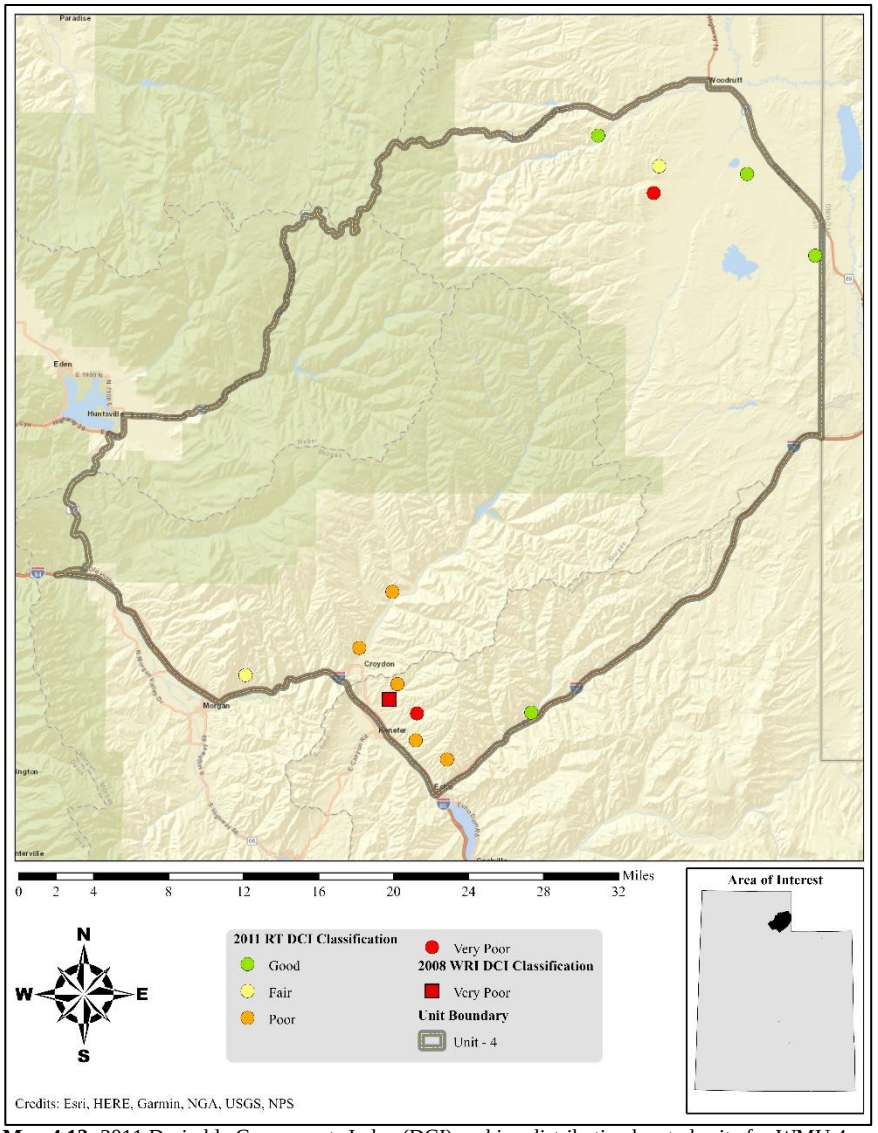
Map 4.9: 1996/97 Desirable Components Index (DCI) ranking distribution by study site for WMU 4, Morgan-South Rich.



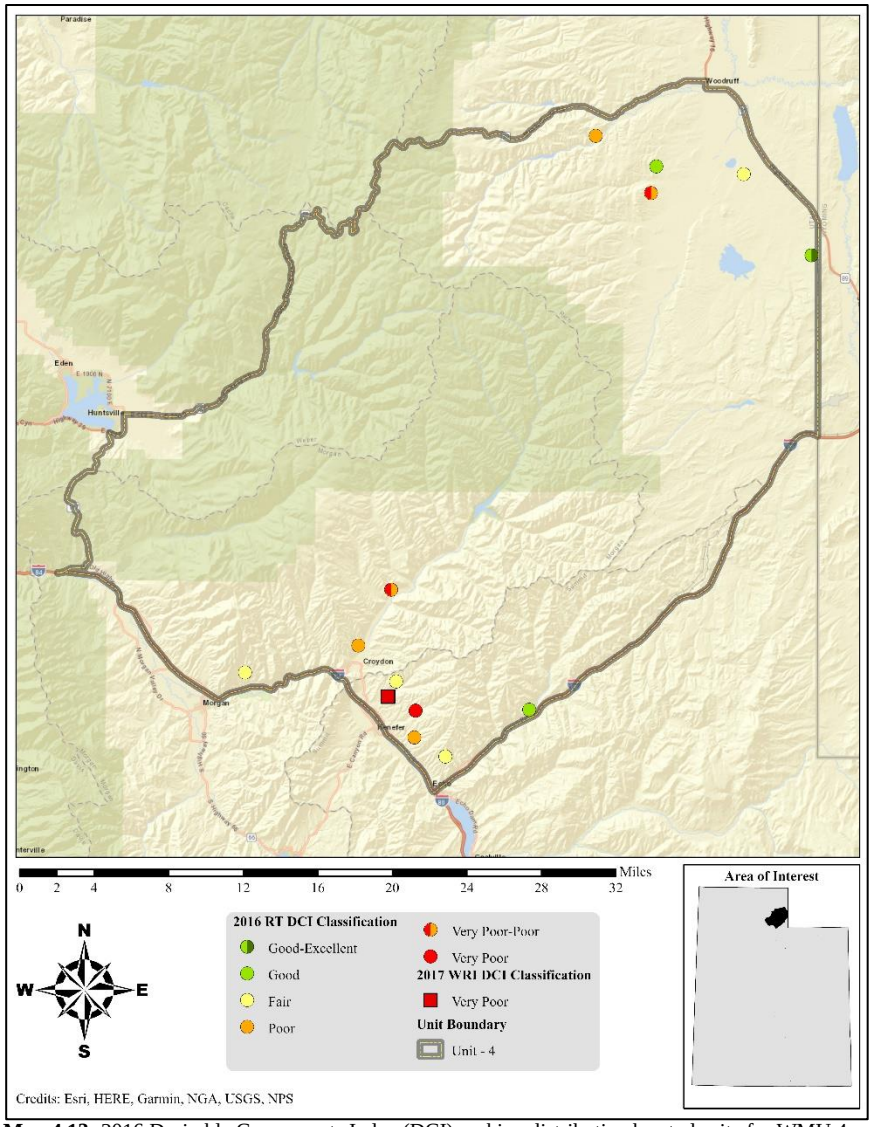
Map 4.10: 2001 Desirable Components Index (DCI) ranking distribution by study site for WMU 4, Morgan-South Rich.



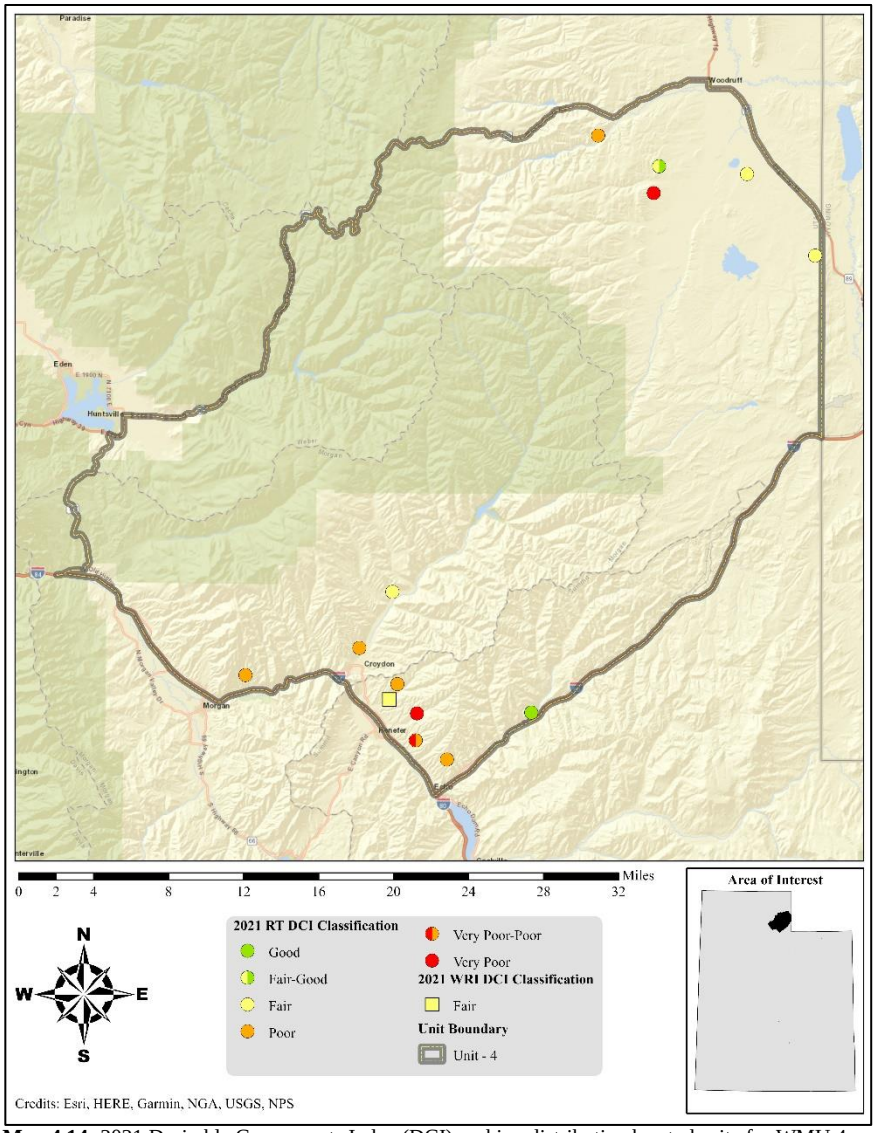
Map 4.11: 2006 Desirable Components Index (DCI) ranking distribution by study site for WMU 4, Morgan-South Rich.



Map 4.12: 2011 Desirable Components Index (DCI) ranking distribution by study site for WMU 4, Morgan-South Rich.



Map 4.13: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 4, Morgan-South Rich.



Map 4.14: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 4, Morgan-South Rich.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
04-1	Heiner's Creek	Animal Use – Deer	Medium	Reduced/less vigorous browse component
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
04-2	Echo Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Energy Development	Low	Fragmentation and degradation/loss of habitat
04-3	Tank Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
04-4	Owen's Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
04-6	Harris Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
04-8	Shell Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
04-9	Scott Rees Ranch	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
04-13	Wheatgrass Hollow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
04-14	Chapman Canal	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
04-15	Woodruff Creek South	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
04-17	Above Toon Ranch	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Deer/Sheep	Medium	Reduced/less vigorous browse component
04-18	Deseret Main Gate	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
04-19	Deseret Burn	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
04R-3	Claypit North Slope	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
04R-4	Claypit South Slope	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
04R-5	Croydon Cemetery	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
04R-6	Harris Canyon Dixie	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species

Table 4.11: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 4, Morgan-South Rich. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment**.

Discussion and Recommendations

Mountain (Big Sagebrush)

The study that is considered to be a Mountain (Big Sagebrush) ecological site, Heiner's Creek, supports a sagebrush community and is considered to be in good condition for deer winter range in the Morgan-South Rich management unit. This community supports a mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) community that provides valuable browse for wildlife. Pellet transect data indicates that moderate use by deer is occurring on this study site, posing a medium-level threat. Overuse by deer may lead to a reduced and/or less vigorous browse component (Butler, et al., 2003; Jornada & NRCS, 2022; Payne, Lane, & Cox, 2022; Côté, Rooney, Tremblay, Dussault, & Waller, 2004). The understory has generally remained in good condition, with perennial forbs and grasses as the main components. However, the introduced annual grass species cheatgrass (*Bromus tectorum*) has been present in previous sample years, albeit in low

amounts. If cheatgrass increases in the future, it will lead to boosted fine fuel loads, heightened risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013), and possibly reduced herbaceous diversity (Mack, et al., 2000).

It is recommended that monitoring of this community continue. Close examination of this study and the surrounding area would be prudent to help determine if overuse by deer may be occurring on the study site and adjacent areas. Treatments for annual grasses are not recommended at this time. If annual grasses increase in the future, however, options for treatment include changes in grazing management and herbicide application.

Mountain (Oak)

Scott Rees Ranch, the study that is considered to be of this ecological type supports a Gambel oak (*Quercus gambelii*) community and is considered to be in good condition for deer winter range. Annual grasses are present in the understory in significant amounts, posing a high-level threat to the ecological resilience and resistance of the site. High amounts of annual grasses increase fuel loads, exacerbate wildfire risk, and may alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013), and introduced annual grass species may have the potential to outcompete more desirable native species (Mack, et al., 2000). Utah juniper (*Juniperus osteosperma*) encroachment is also occurring on this study site, placing it in Phase I of woodland succession. Although the threat posed is currently low, presence of pinyon and juniper can result in reduced understory shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000).

Future monitoring of this community is advisable. In addition, treatments to remove annual grasses such as herbicide application are recommended. Tree-removing disturbances are not immediately recommended. However, if tree-removing treatments (lop and scatter, chaining, bullhog, etc.) are deemed necessary in future sample years, however, care should be taken to select methods that will not unintentionally increase annual grass loads.

Upland (Big Sagebrush)

The study sites that are classified as Upland (Sagebrush) ecological sites range in condition from very poor to fair-good for deer winter range in the Morgan-South Rich management unit. Some of the studies have transitioned into a perennial grass state with an abundant herbaceous understory, while others support big sagebrush populations. Introduced perennial grass species are a concern on the Echo Canyon, Tank Canyon, Owen's Canyon, Harris Canyon, and Deseret Burn studies. While they can provide forage for wildlife, introduced perennial grasses can be aggressive and may outcompete desirable native grass and forb species for resources. In turn, this can lead to reduced prevalence and abundance of native herbaceous species (Mack, et al., 2000). Annual grasses, primarily cheatgrass (*Bromus tectorum*) and field brome (*B. tectorum*), pose a threat to the ecological integrity of all study sites. When present in higher amounts, annual grasses exacerbate the risk of catastrophic wildfire by boosting fuel loads and may alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013), and introduced annual grass species have the potential to negatively affect herbaceous diversity (Mack, et al., 2000). In addition, Utah juniper (*Juniperus osteosperma*) encroachment is occurring on the Woodruff Creek South and Wheatgrass Hollow studies in medium and low amounts, respectively. Although the threats posed may not be immediate, pinyon and juniper presence has the potential to lead to decreased shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000).

The noxious weed and annual forb gypsyflower (*Cynoglossum officinale*) has been present in the past on the Harris Canyon site, while the noxious weed and perennial forb species common viber's bugloss (*Echium vulgare*) was present in recent sample years on the Echo Canyon study. The threat posed by noxious weeds is currently low on both sites as of 2021. However, noxious weeds have a similar effect to introduced perennial grasses when present in high amounts, as they are aggressive and can lead to reduced herbaceous diversity (Mack, et al., 2000). The Echo Canyon study is located next to a cell phone tower with a road that passes directly through the transect, placing the study at high risk of being affected by energy development. Construction of roads and structures associated with energy development can deleteriously affect or entirely remove valuable shrub and herbaceous components and may disturb nearby wildlife (Sawyer, F. Lindzey, McWhirter, & Andrews, 2002). In addition, effects of drought are evident on the Wheatgrass Hollow, Harris Canyon, and Woodruff Creek South studies. Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017). Finally, pellet transect data indicates that moderate use by deer and/or sheep is occurring on the Above Toon Ranch site, posing a medium-level threat. Overuse by deer and/or sheep can lead to a reduced and/or less vigorous browse component (Butler, et al., 2003; Jornada & NRCS, 2022; Payne, Lane, & Cox, 2022; Côté, Rooney, Tremblay, Dussault, & Waller, 2004).

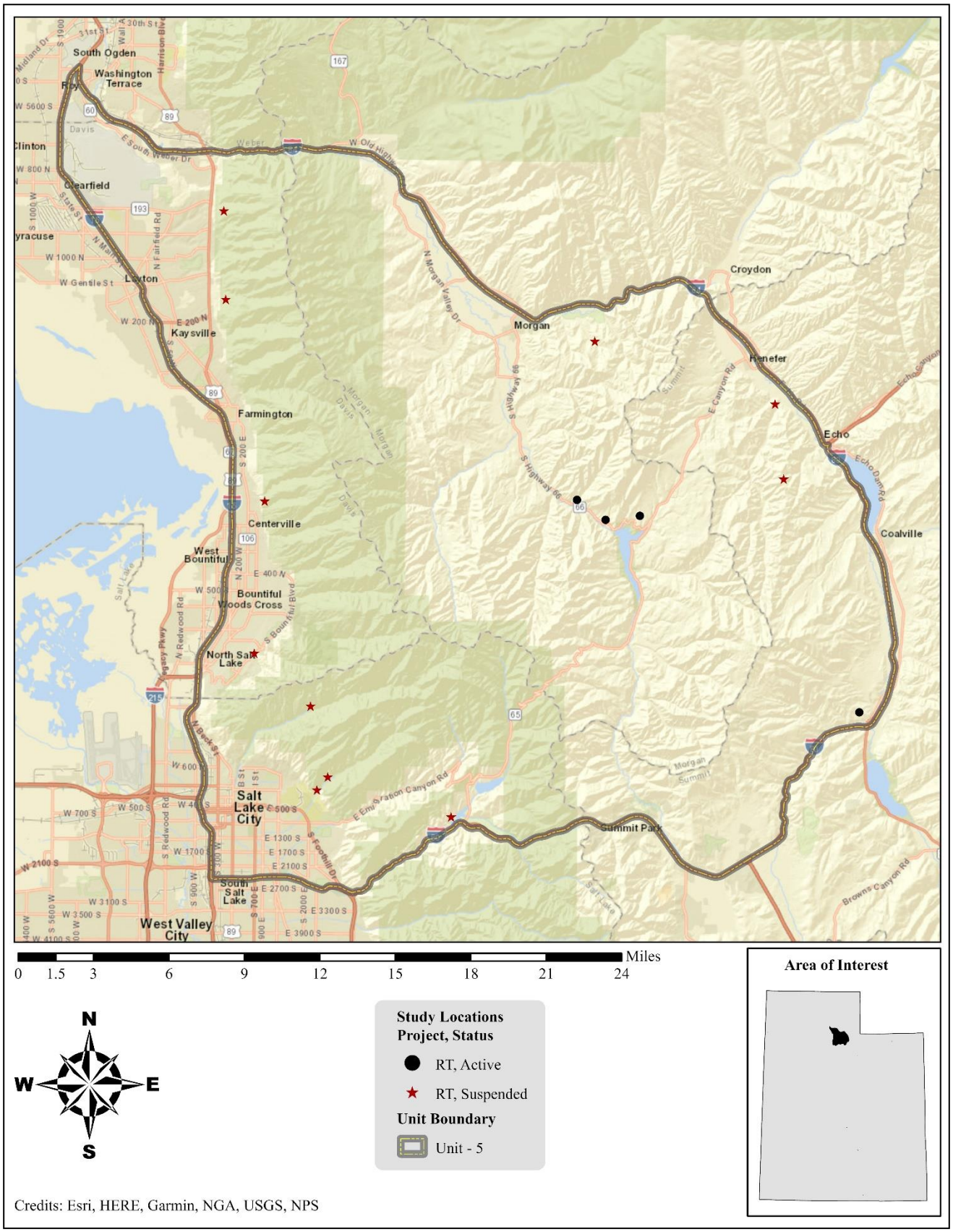
Sustained monitoring of these studies in the future is strongly recommended. More specifically, further monitoring on the Wheatgrass Hollow, Harris Canyon, and Woodruff Creek South studies may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003). Sites that have a high-level threat posed by introduced perennial grasses may see benefit from treatments done to diversify the herbaceous understories. If reseeding is opted for, care should be taken in species selection and preference should be given to native grass and forb species when possible. Areas with high amounts of annual grasses can be treated by herbicide application or through changes in grazing management. Pre-emptive or reactive management of noxious weeds on the appropriate studies could be achieved through spot application of herbicides. Noxious weed control may be necessary and would include herbicide application. Additional monitoring may be needed to determine what energy development factors (noise, traffic, pollutants, fugitive dust, etc.) could be influencing wildlife in the area, and furthermore, if mitigation measures are needed to support wildlife. Although they are likely not immediately necessary, tree-removal projects may be appropriate on the Woodruff Creek South and Wheatgrass Hollow studies in future sample years. However, care should be taken in method selection (lop and scatter, bullhog, chaining, etc.) to ensure that annual grass loads are not unintentionally amplified. Finally, a close examination of the Above Toon Ranch study and surrounding area is recommended to help determine if overuse by deer and/or sheep may be occurring in the area.

Semidesert (Big Sagebrush)

The sites classified as belonging to this lower-elevation semidesert sagebrush ecological type (Chapman Canal and Deseret Main Gate) are considered to be in fair condition for deer year-long range on this management unit. Pellet transect data indicates that high use by cattle is occurring on both study sites, posing a high-level threat. Overuse by livestock can lead to decreased vigor and diversity in the shrub and herbaceous understory. In addition, effects of drought are evident on both study sites. Long periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017). The herbaceous understory of the Deseret Main Gate study is dominated by the introduced perennial grass species crested wheatgrass (*Agropyron cristatum*). Introduced perennial grasses have the potential to outcompete native perennial forbs and grasses for resources, which may lead to reduced herbaceous diversity (Mack, et al., 2000). Finally, the introduced annual grass species cheatgrass (*Bromus tectorum*) is present on the Chapman Canal study in low amounts. If annual grasses increase in the future, they could lead to increased fine fuel loads, heightened risk of wildfire, and increased wildfire return interval (Balch, D'Antonio, & Gómez-Dans, 2013).

Continued monitoring of these study sites would be a valuable endeavor. Additional monitoring on both studies may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003). In addition, close examination of these study sites and surrounding areas is recommended to help determine if overuse by cattle may be occurring on the Deseret allotment and adjacent areas. If annual grasses increase on Chapman Canal in future sample years, treatments such as herbicide applications or changes to grazing management may be prudent to implement. Finally, if reseeding is deemed appropriate to restore herbaceous diversity on the Deseret Main Gate site, care should be taken in species selection and preference should be given to native grass and forb species when possible.

5. WILDLIFE MANAGEMENT UNIT 5 – EAST CANYON



WILDLIFE MANAGEMENT UNIT 5 – EAST CANYON

Boundary Description

Morgan, Summit, Salt Lake, and Davis counties – The boundary begins at the junction of Interstate 80 and Interstate 84 (Echo Junction); south and west on I-80 to Interstate 15; north on I-15 to I-84; east on I-84 to I-80.

Management Unit Description

Geography

The East Canyon Management Unit is located mostly on the eastern side of the Wasatch Mountains. The topography varies across the unit, ranging from fairly deep canyons and steep slopes in the western portion to more gentle open slopes and fewer cliffs in the east. Most of the unit is drained by the Weber River: several creeks (including the East Canyon Creek) along the north and east edges of the unit drain directly into the river. East Canyon Reservoir is located approximately in the center of the unit. The highest elevations in the management unit are along the western boundary on peaks of the Wasatch Range that reach above 9,500 feet. The lowest point is 4,800 feet in the northwestern corner where the Weber River flows out of the unit.

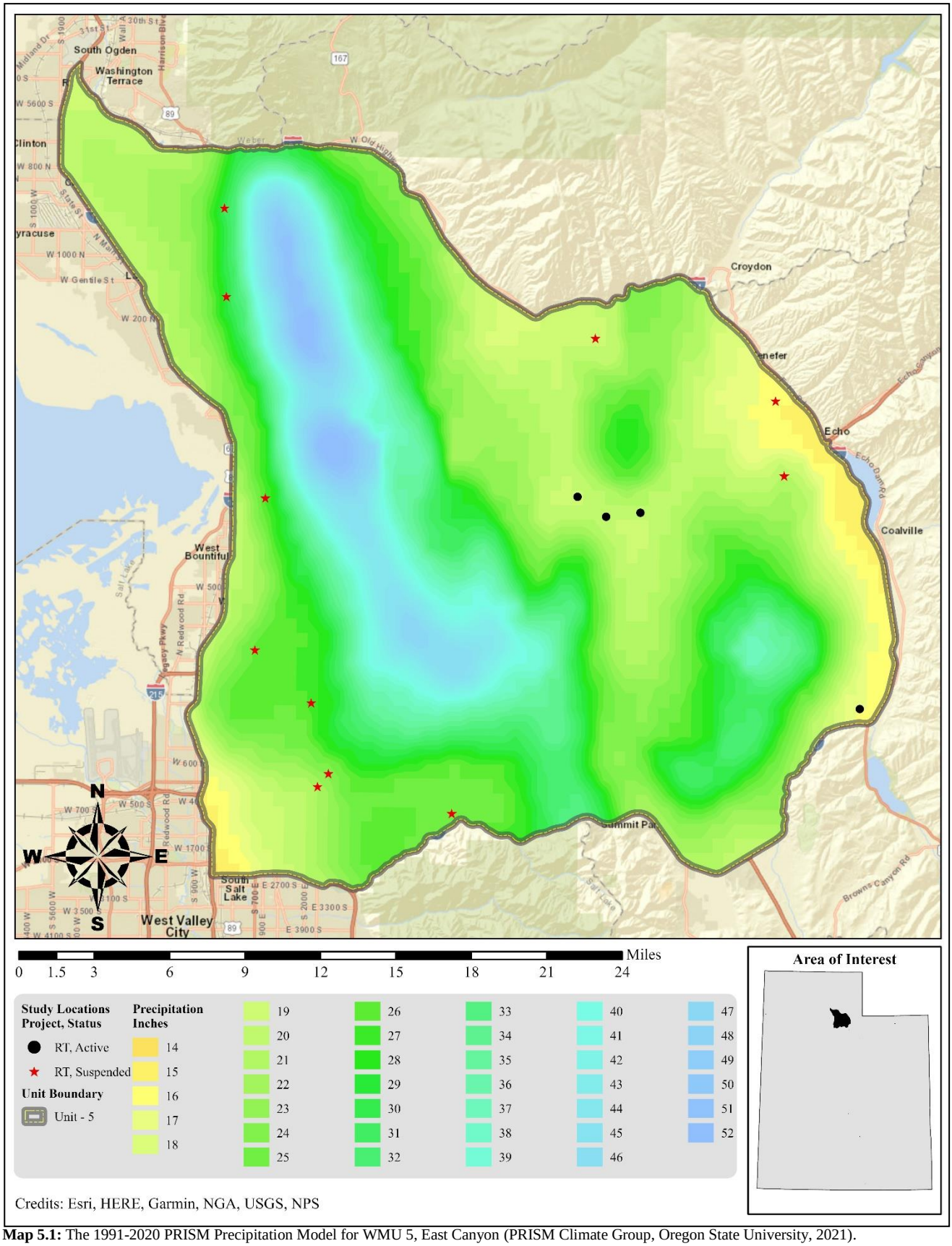
Climate Data

The 30 year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 14 inches on the extreme southwest corner to 52 inches on the peaks of the Sessions Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within 15-23 inches of precipitation (**Map 5.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the North Central and Northern Mountains divisions (Divisions 3 and 5).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought in 1992, 2000-2003, 2007, 2012-2015, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1993, 1995, 1997-1998, 2005, and 2011 (**Figure 5.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2001-2003, 2007, 2012-2013, 2015; and 2020-2021; moderately to extremely wet years were displayed in 1991, 1993, 1995, 1997-1998, and 2005 (**Figure 5.1b**).

The mean annual PDSI of the Northern Mountains division displayed years of moderate to extreme drought from 2000-2003, 2012-2013, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1995, 1997-1998, 2005, and 2011 (**Figure 5.2a**). The mean spring (March-May) PDSI displayed moderate to extreme drought in 1992, 2000-2004, 2012-2014, 2018, and 2021 ; moderately to extremely wet years were displayed from 1995-1996, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2013, and 2020-2021; moderately to extremely wet years were displayed in 1995, and 1997-1998 (**Figure 5.2b**) (Time Series Data, 2022).



Map 5.1: The 1991-2020 PRISM Precipitation Model for WMU 5, East Canyon (PRISM Climate Group, Oregon State University, 2021).

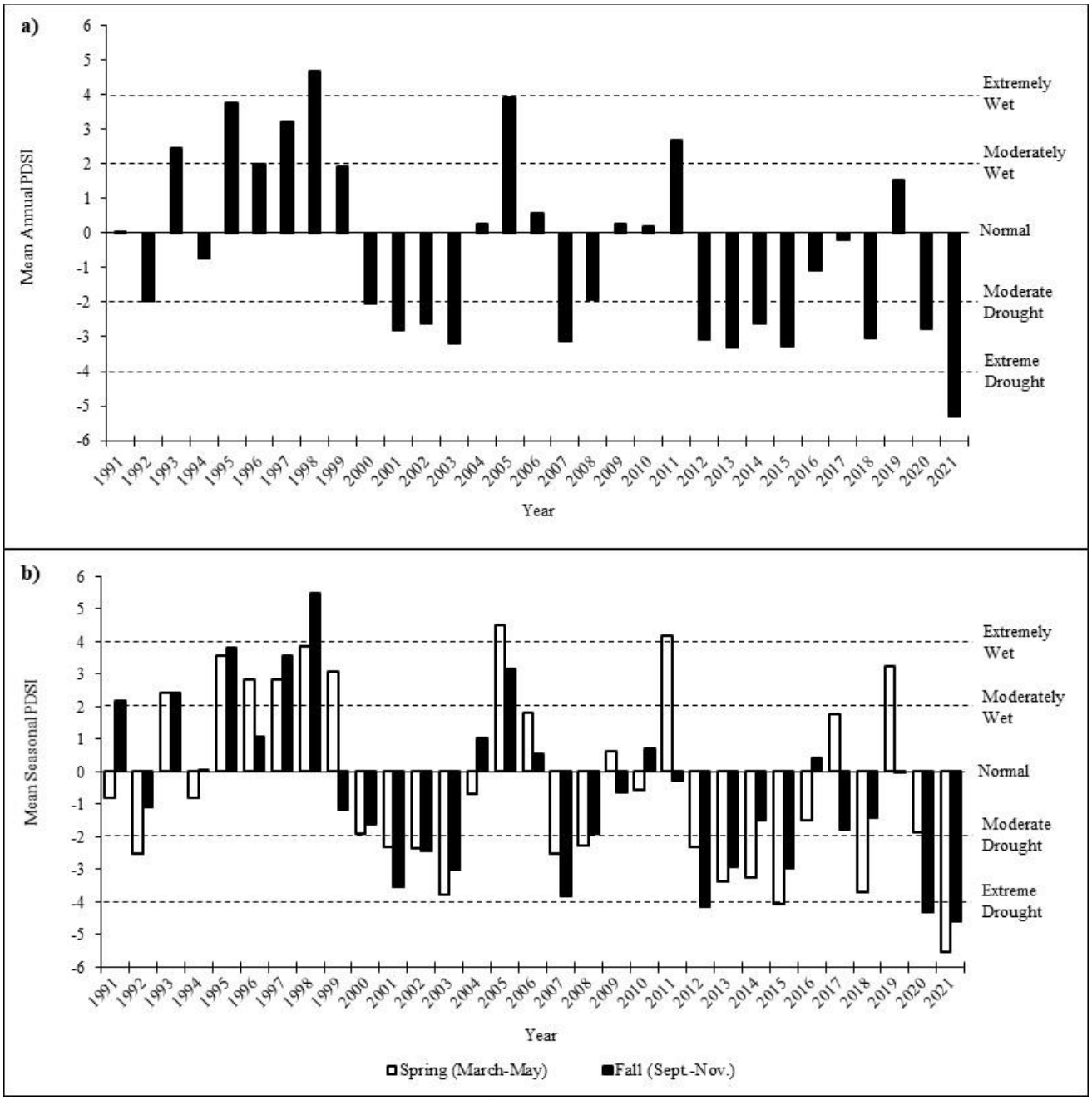


Figure 5.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

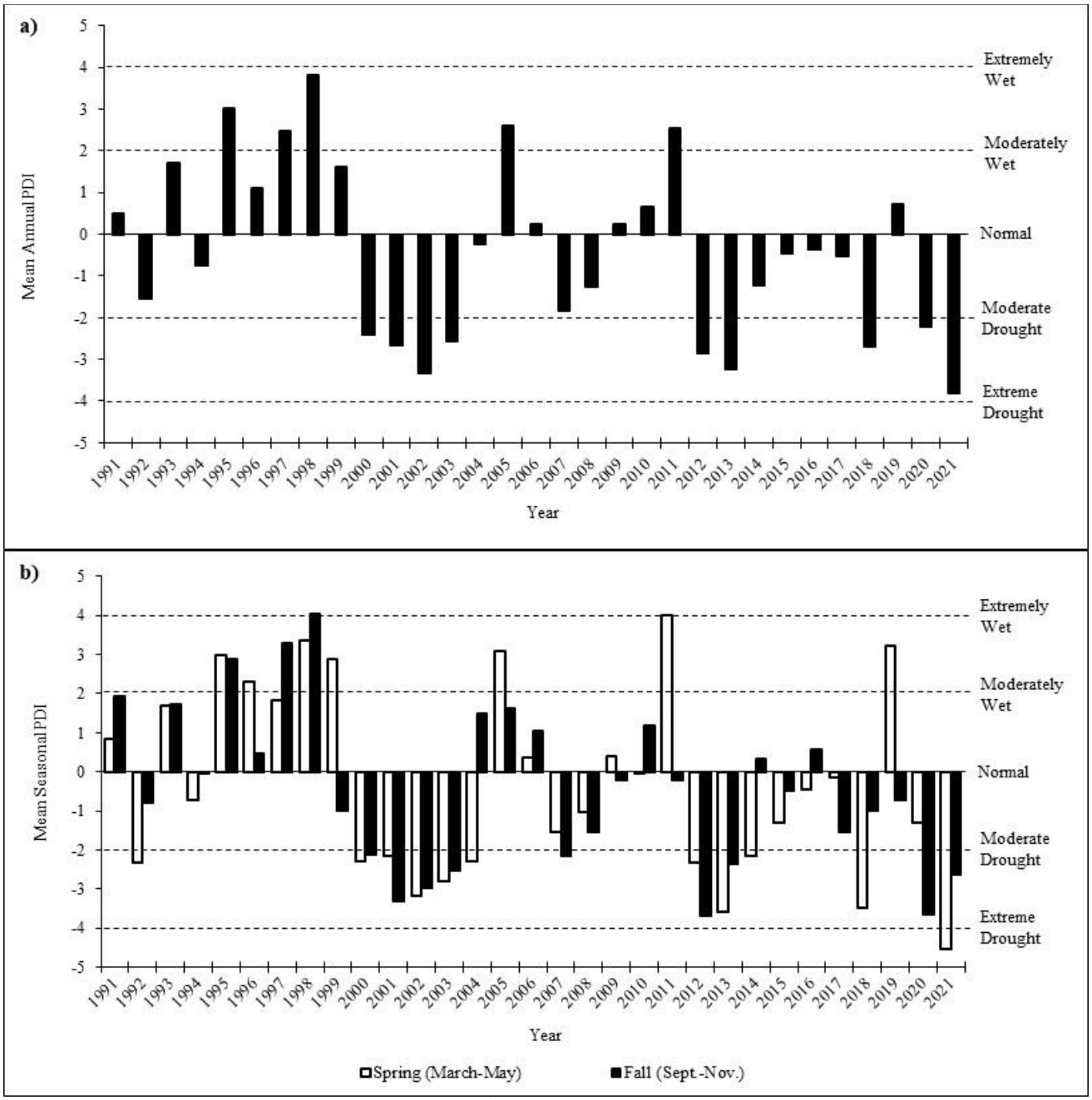
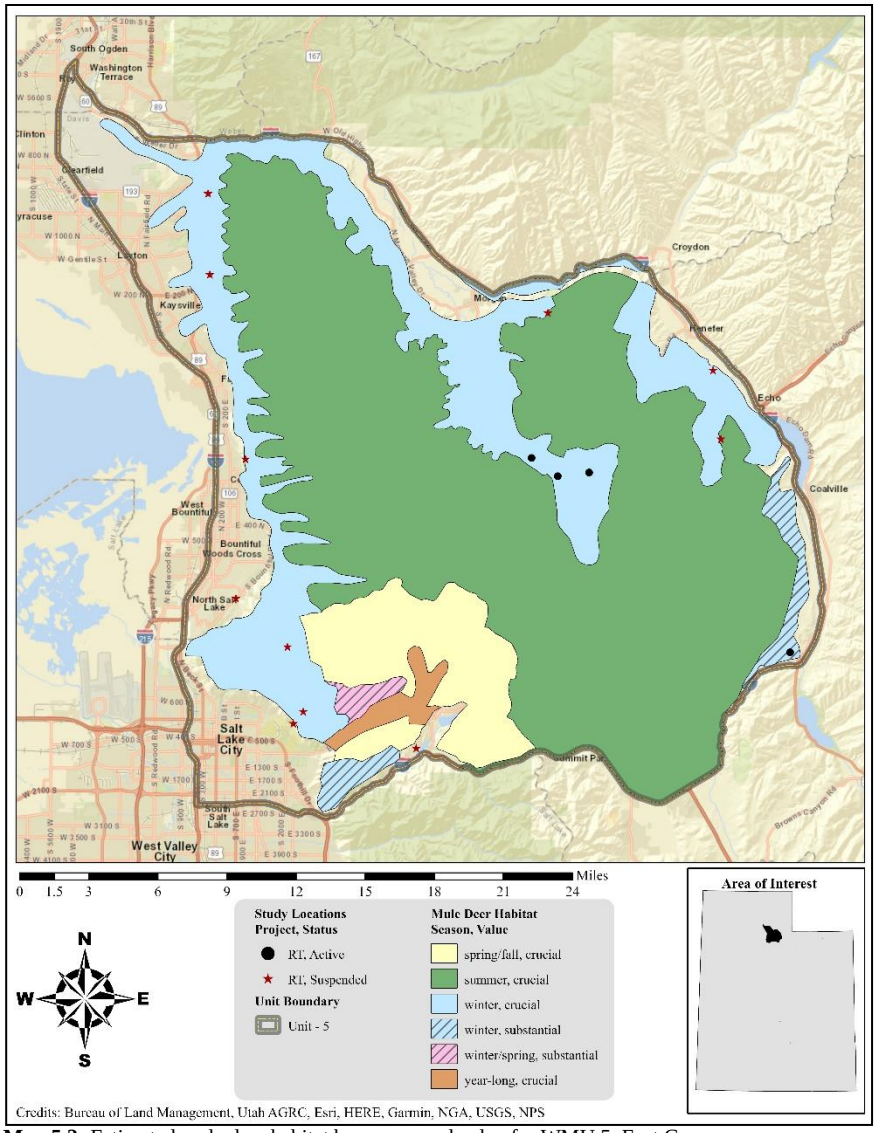


Figure 5.2: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

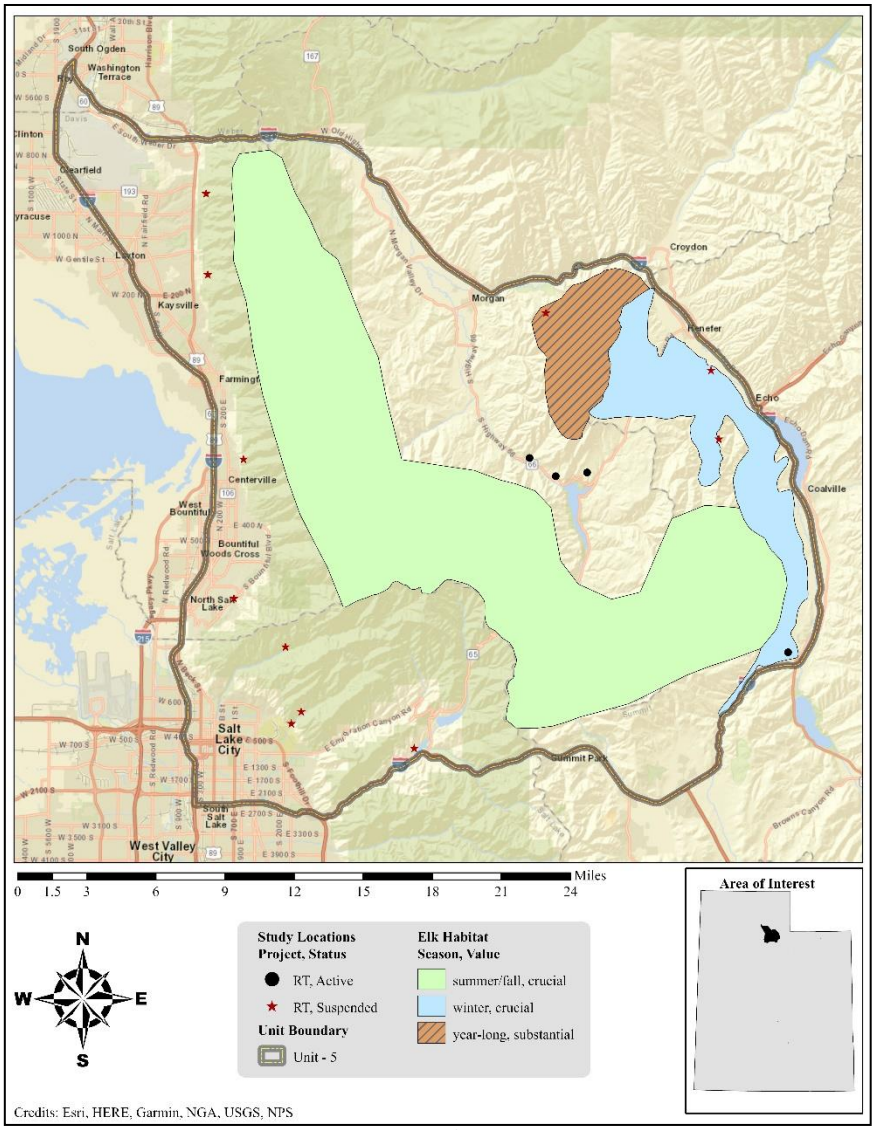
Big Game Habitat

Total mule deer range in this wildlife management unit is estimated at over 330,000 acres with 4,076 acres considered to be year-long range, 86,359 acres classified as winter range, 209,105 acres classified as summer range, 28,697 acres considered to be spring/fall range, and 2,015 acres classified as winter/spring range (**Table 5.1**, **Map 5.2**). Eighty-six percent of mule deer year-long range is privately owned and 14% is administrated by US Forest Service (USFS). Much of the summer range (80%) is also privately owned, 18% is managed by the USFS, the Utah Division of Wildlife Resources (UDWR) and Utah State Parks (USP) each administrate 1%, and less than 1% is managed by the Bureau of Land Management (BLM). Of the winter range, private landowners own 74%, 23% is managed by the USFS, 2% is administrated by UDWR, 1% is managed by USP, and the BLM, Bureau of Reclamation (BR), and Department of Defense (DOD) administrate the remaining 1%. The USFS manages over half (55%) of the winter/spring range, while 45% is privately owned. Finally, 60% of the spring/fall range is privately owned, the USFS administrates about 40%, and USP manages less than 1% (**Table 5.2**, **Map 5.2**, **Map 5.5**). Total elk range is estimated at just over 156,000 acres with 12,596 acres considered to be year-long range, 24,756 acres classified as winter range, and 118,679 acres classified as summer/fall range. Of the summer/fall range, 72% is privately owned, the USFS manages 27%, 1% is administrated by USP, and the BLM and UDWR manage the remaining 1%. A vast majority (99%) of elk winter range is owned by private landowners, and the BLM, UDWR, and BR each manage less than 1% (**Table 5.3**, **Map 5.3**, **Map 5.5**).

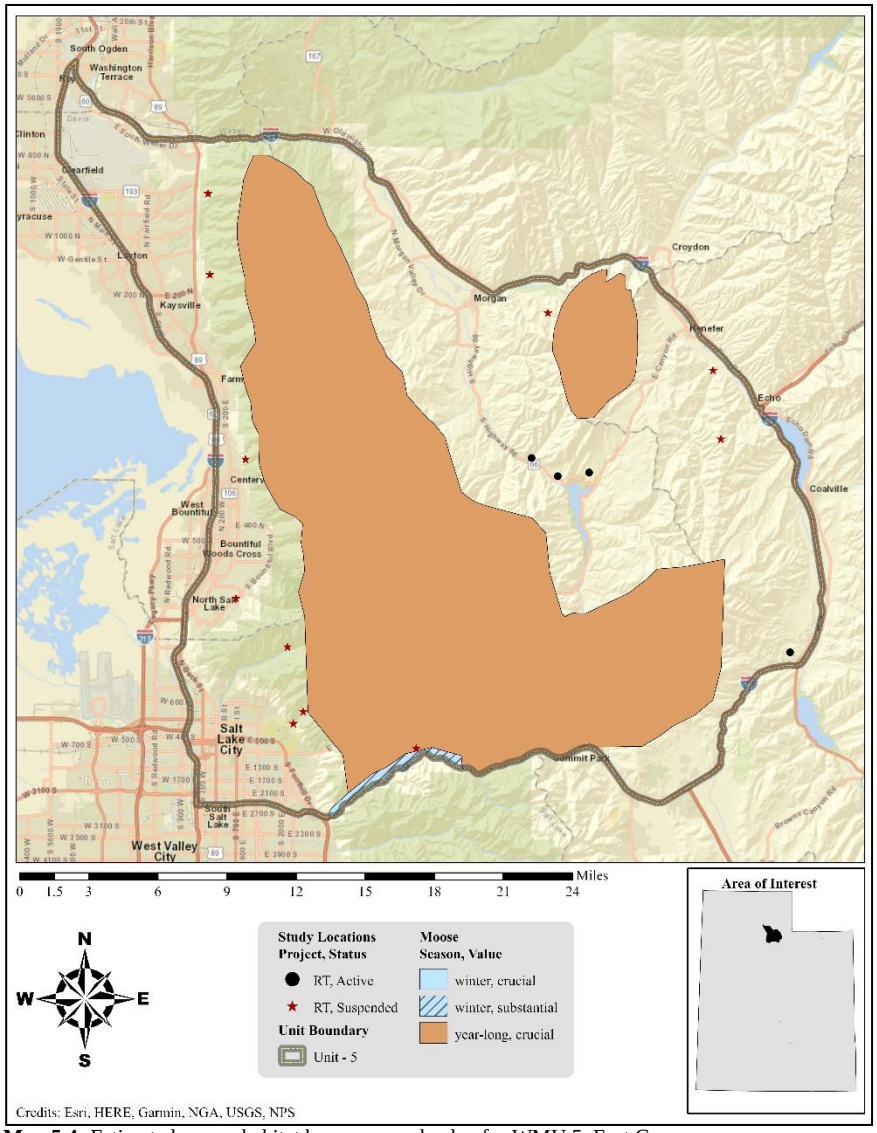
The upper limit of normal winter range is generally considered to be about 7,000 feet. Winter range is found in the major drainages and around East Canyon Reservoir. Most of the winter range is comprised of sagebrush range types. In the original inventory in 1972, King and Olson described almost three-quarters of the winter range as a mixture of black sagebrush on the ridge tops and big sagebrush down the slopes on the deeper soils; the sagebrush type has a good mix of browse species and can provide substantial forage for wintering deer. The browse type, which is 20% of the total range, is composed mainly of big sagebrush and Gambel oak. Other range types include agricultural lands and burns.



Map 5.2: Estimated mule deer habitat by season and value for WMU 5, East Canyon.



Map 5.3: Estimated elk habitat by season and value for WMU 5, East Canyon.



Map 5.4: Estimated moose habitat by season and value for WMU 5, East Canyon.

	Year Long Range		Summer Range		Summer/Fall Range		Winter Range		Winter/Spring Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	4,076	1%	209,105	63%	0	0%	86,359	26%	2,015	1%
Elk	12,596	8%	0	0%	118,679	76%	24,756	16%	0	0%
Moose	171,917	99%	0	0%	0	0%	1,603	1%	0	0%

	Spring/Fall Range	
Species	*Area (acres)*	*%*
Mule Deer	28,697	9%
Elk	0	0%
Moose	0	0%

Table 5.1: Estimated mule deer, elk, and moose habitat acreage by season for WMU 5, East Canyon.

	Year Long Range		Summer Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
BLM	0	0%	318	<1%	224	<1%	0	0%	0	0%
Private	3,499	86%	168,185	80%	63,515	74%	917	45%	17,211	60%
UDWR	0	0%	2,283	1%	1,393	2%	0	0%	0	0%
DOD	0	0%	0	0%	196	<1%	0	0%	0	0%
USFS	577	14%	37,203	18%	19,600	23%	1,099	55%	11,484	40%
USP	0	0%	1,115	1%	1,137	1%	0	0%	2	<1%
BR	0	0%	0	0%	293	<1%	0	0%	0	0%
Total	4,076	**100%**	209,105	**100%**	86,359	**100%**	2,015	**100%**	28,697	**100%**

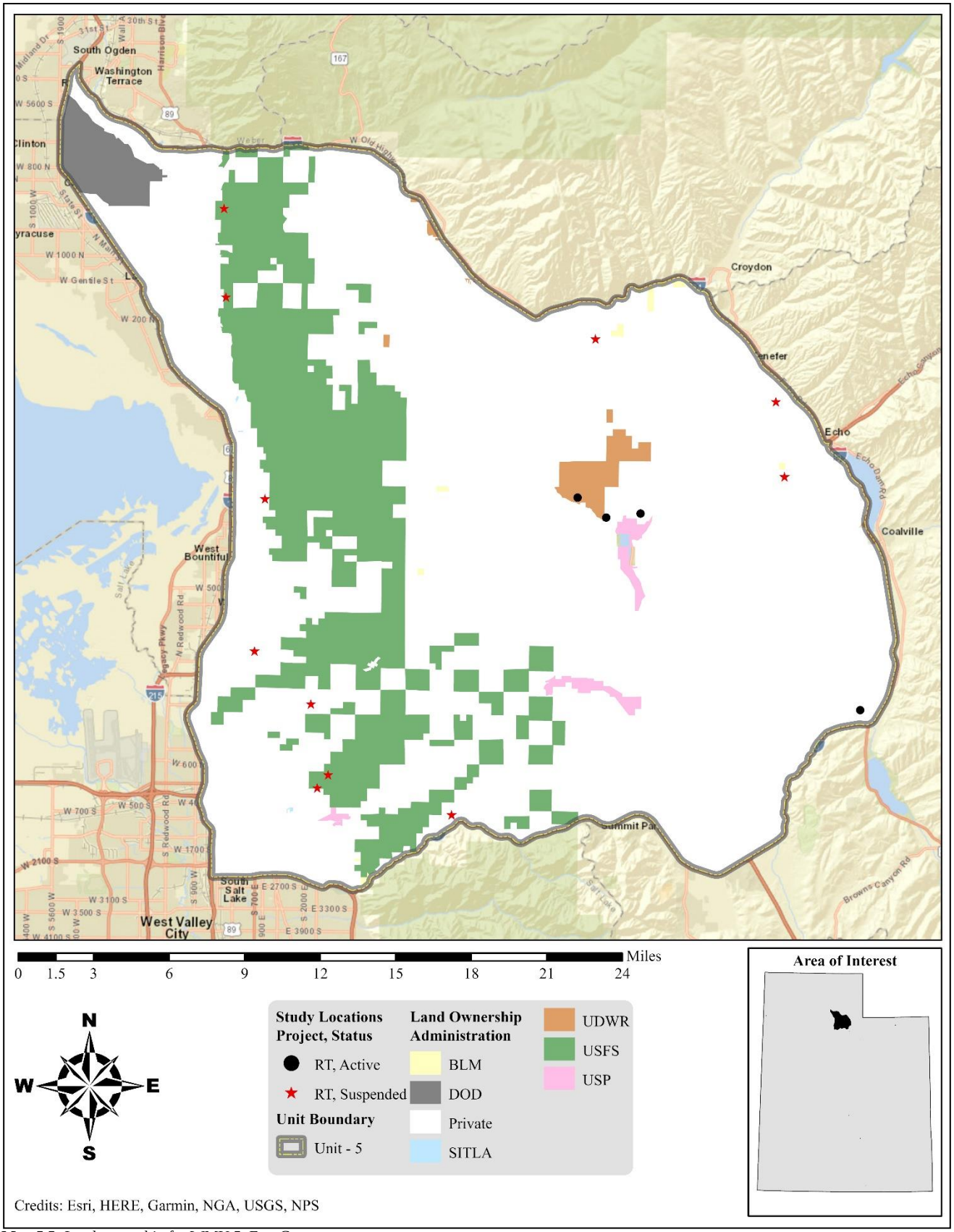
Table 5.2: Estimated mule deer habitat acreage by season and ownership for WMU 5, East Canyon.

	Year Long Range		Summer/Fall Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	198	2%	40	<1%	37	<1%
Private	11,279	89%	85,366	72%	24,631	99%
UDWR	1,118	9%	79	<1%	72	<1%
USFS	0	0%	32,080	27%	0	0%
USP	0	0%	1,114	1%	0	0%
BR	0	0%	0	0%	16	<1%
Total	12,596	**100%**	118,679	**100%**	24,756	**100%**

Table 5.3: Estimated elk habitat acreage by season and ownership for WMU 5, East Canyon.

	Year Long Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	325	<1%	72	4%
Private	117,236	68%	1,277	80%
UDWR	528	<1%	0	0%
USFS	52,712	31%	254	16%
USP	1,117	1%	0	0%
Total	171,917	**100%**	1,603	**100%**

Table 5.4: Estimated moose habitat acreage by season and ownership for WMU 5, East Canyon.



Map 5.5: Land ownership for WMU 5, East Canyon.

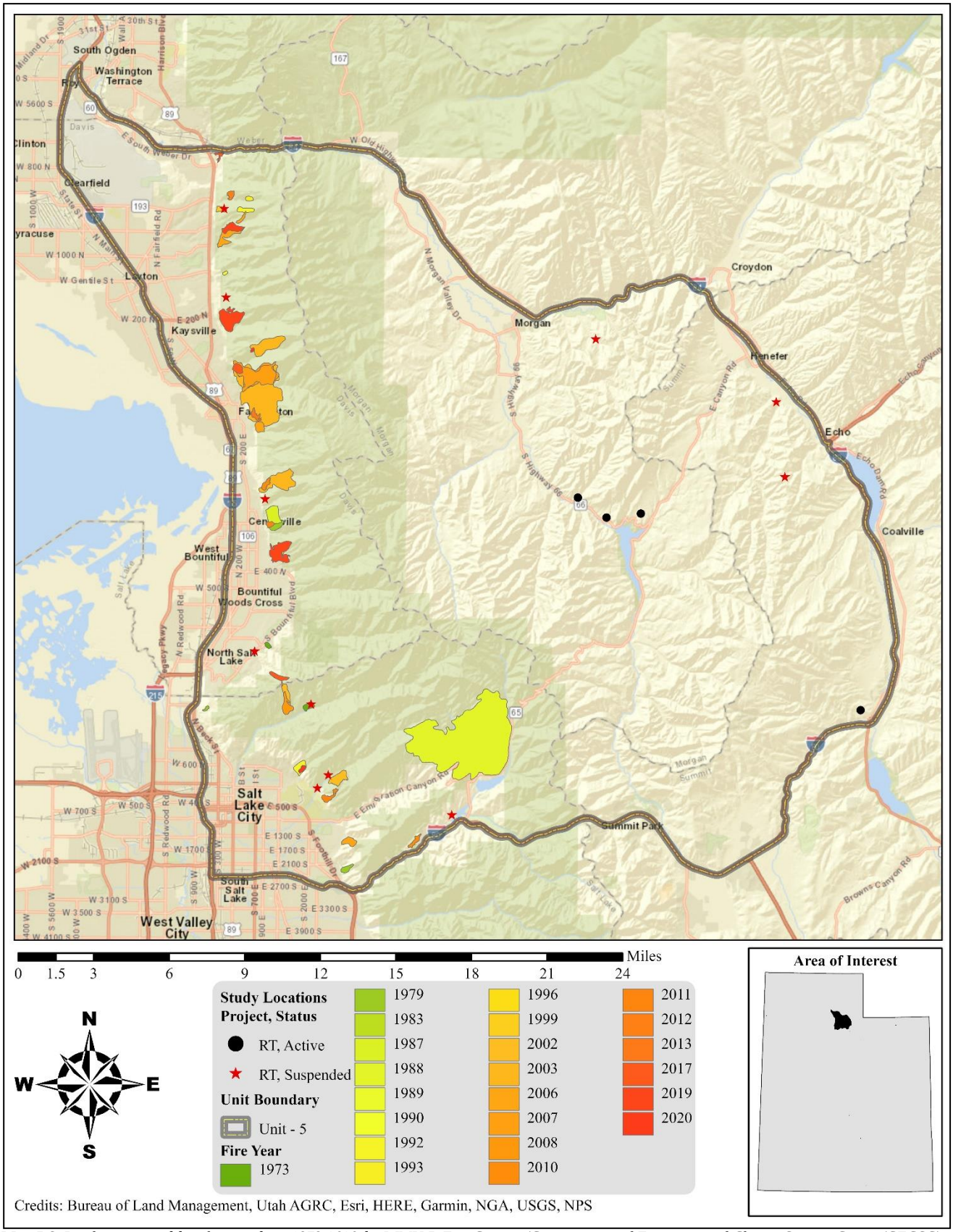
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Hardwood	180,407	19.63%	
	Developed	172,298	18.74%	
	Agricultural	59,233	6.44%	
	Riparian	34,351	3.74%	
	Open Water	24,973	2.72%	
	Sparsely Vegetated	16,506	1.80%	
	Conifer-Hardwood	10,237	1.11%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	644	0.07%	54.25%
Shrubland	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	125,260	13.63%	
	Inter-Mountain Basins Montane Sagebrush Steppe	70,918	7.72%	
	Inter-Mountain Basins Big Sagebrush Shrubland	33,808	3.68%	
	Inter-Mountain Basins Big Sagebrush Steppe	5,116	0.56%	
	Rocky Mountain Lower Montane-Foothill Shrubland	4,166	0.45%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	3,699	0.40%	
	Other Shrubland	854	0.09%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	694	0.08%	
	Inter-Mountain Basins Greasewood Flat	583	0.06%	
	Great Basin Xeric Mixed Sagebrush Shrubland	89	0.01%	
	Inter-Mountain Basins Mat Saltbush Shrubland	49	0.01%	
	Great Basin Semi-Desert Chaparral	48	0.01%	
	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	9	0.00%	26.69%
Conifer	Rocky Mountain Foothill Limber Pine-Juniper Woodland	22,395	2.44%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	20,299	2.21%	
	Colorado Plateau Pinyon-Juniper Woodland	16,268	1.77%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	14,937	1.63%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	7,767	0.84%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	5,332	0.58%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	1,366	0.15%	
	Great Basin Pinyon-Juniper Woodland	684	0.07%	
	Rocky Mountain Lodgepole Pine Forest	585	0.06%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	537	0.06%	
	Other Conifer	252	0.03%	
	Southern Rocky Mountain Ponderosa Pine Woodland	73	0.01%	
	Inter-Mountain Basins Juniper Savanna	2	0.00%	9.85%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	31,861	3.47%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	8,588	0.93%	
	Great Basin & Intermountain Introduced Annual Grassland	4,840	0.53%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	116	0.01%	4.94%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	21,502	2.34%	
	Southern Rocky Mountain Montane-Subalpine Grassland	6,089	0.66%	
	Other Grassland	603	0.07%	
	Inter-Mountain Basins Semi-Desert Grassland	59	0.01%	3.07%
Exotic Tree-Shrub	Interior West Ruderal Riparian Scrub	5,435	0.59%	
	Great Basin & Intermountain Ruderal Shrubland	2,988	0.33%	
	Interior Western North American Temperate Ruderal Shrubland	2,644	0.29%	
	Interior West Ruderal Riparian Forest	6	0.00%	1.20%
Total		**919,168**	**100%**	**100%**

Table 5.5: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 5, East Canyon.

Limiting Factors to Big Game Habitat

Recently, increased urbanization and deer have led to conflicts and degradation of the winter range. All of the valleys have been developed for agriculture and housing. The major canyons (Weber, East, and Main Canyons) contain housing developments and high-use roads. The northern, eastern, and southern boundaries are formed by Interstates 80 and 84, while other more narrow and higher-elevation canyons have seasonal roads; nearly 19% of the unit is developed according to the Landfire Existing Vegetation Coverage model (**Table 5.5**). Harvesting depredated deer is difficult due to access restrictions on private land; reducing the deer herd to within the carrying capacity of the winter range must be done with the cooperation and support of local interest groups.

Deer fences and crossings limiting range are also a concern. Although highway mortality occurs in this unit, it is not as high as in surrounding units. In addition, cooperation with the Utah Department of Transportation in construction of highway fences, passage structures, warning signs, etc. will continue in order to ensure proper access to habitat as well as deer and human safety.



Map 5.6: Land coverage of fires by year from 1979-2020 for WMU 5, East Canyon (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

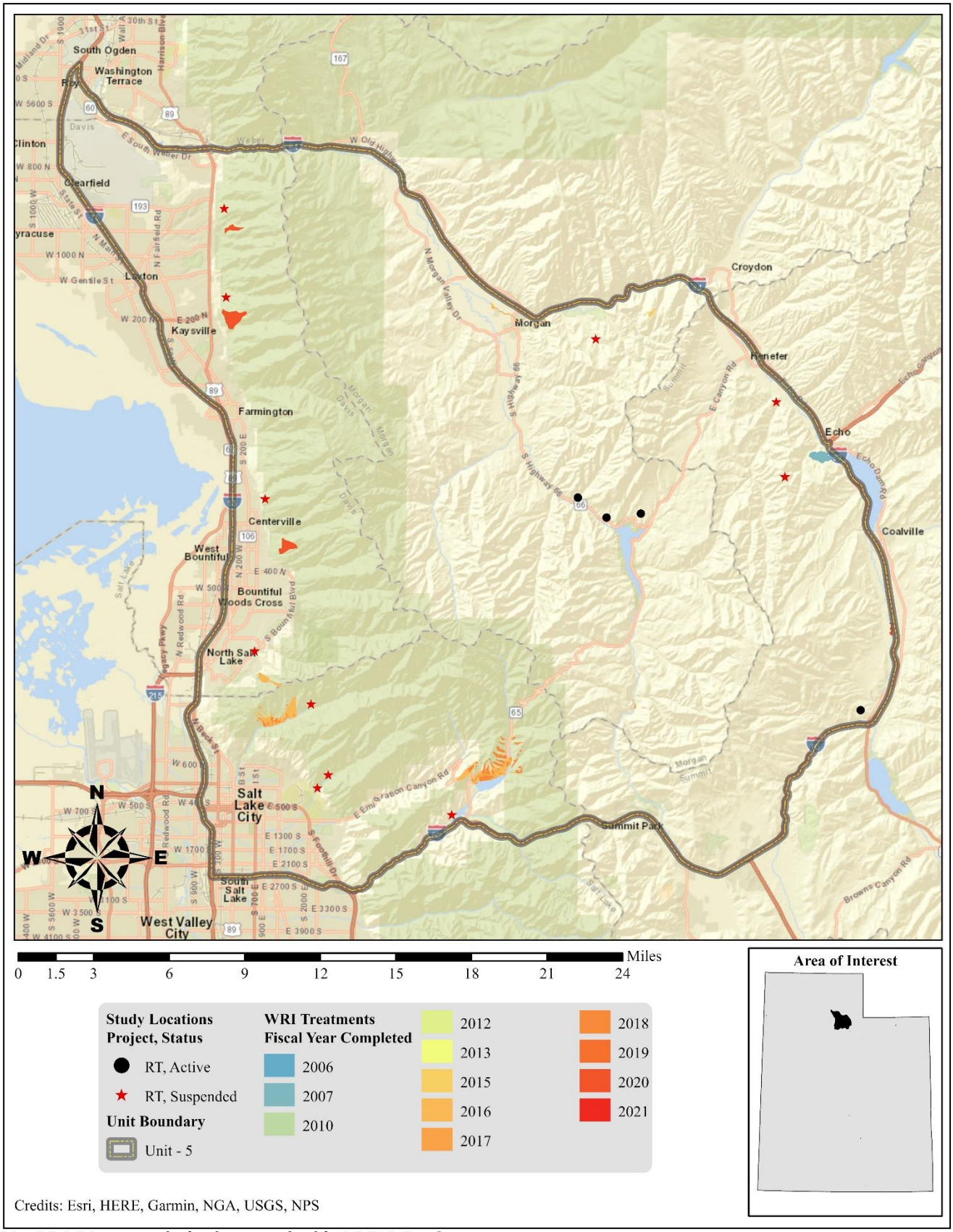
Treatments/Restoration Work

There have been efforts to address the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 2,216 acres of land have been treated within the East Canyon unit since the WRI was implemented in 2004 (**Map 5.7**). An additional 1,117 acres are currently being treated, and treatments are proposed for 1,142 acres. Treatments frequently overlap one another bringing the net total of completed treatment acres to 1,920 acres for this unit (**Table 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.

Herbicide application to remove unwanted vegetation is the most common management practice in this unit. Transplanting shrub species is also very common, and other management practices such as discing and seeding desirable herbaceous species are also implemented (**Table 5.6**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Bullhog	**0**	**0**	**<1**	**<1**
Full Size	0	0	<1	<1
Disc	**191**	**0**	**0**	**191**
Plow (One-Way)	191	0	0	191
Herbicide Application	**1,443**	**1,117**	**1,142**	**3,702**
Aerial (Helicopter)	40	0	0	40
Ground	53	0	0	53
Spot Treatment	1,350	1,117	1,142	3,609
Planting/Transplanting	**489**	**0**	**0**	**489**
Other	489	0	0	489
Seeding (Primary)	**35**	**0**	**0**	**35**
Drill (Rangeland)	35	0	0	35
Other	**59**	**0**	**0**	**59**
Biological Control of Vegetation	59	0	0	59
Grand Total	**2,216**	**1,117**	**1,142**	**4,476**
***Total Land Area Treated**	**1,920**	**1,117**	**1,142**	**4,179**

Table 5.6: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 5, East Canyon. Data accessed on 02/09/2022.
*Does not include overlapping treatments.



Map 5.7: WRI treatments by fiscal year completed for WMU 5, East Canyon.

Range Trend Studies

Range Trend studies have been sampled within WMU 5 on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 5.7**). Due to changes in sampling methodologies, only data sampled following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 2004; when possible, WRI monitoring studies are established prior to treatment and are 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 5.8**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
05-1	Geary Hollow	RT	Suspended	1984, 1990, 1996, 2001	Not Verified
05-2	Tucson Hollow	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
05-3	East Canyon Reservoir	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)
05-4	Wanship	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016	Upland Loam (Bonneville Big Sagebrush)
05-5	Upper Franklin Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
05-6	Franklin Canyon	RT	Suspended	1984, 1990, 1996	Not Verified
05-7	Baskin Spring	RT	Suspended	1990	Not Verified
05-8	Barnard Creek	RT	Suspended	1985, 1990, 1996, 2001, 2006, 2011	Not Verified
05-9	Davis County Rifle Range	RT	Suspended	1985, 1990, 2001, 2006	Not Verified
05-10	Junction 89-193	RT	Suspended	1985, 1990	Not Verified
05-11	Mountain Dell Reservoir	RT	Suspended	1983, 1990, 1996	Not Verified
05-12	Fort Douglas	RT	Suspended	1983	Not Verified
05-13	City Creek Canyon	RT	Suspended	1983	Not Verified
05-14	Red Butte Canyon	RT	Suspended	1983	Not Verified
05-15	Red Rock Canyon	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Mountain Big Sagebrush)

Table 5.7: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 5, East Canyon.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
05-4	Wanship	Wildfire		Between 1990 and 1995		
05-13	City Creek	Milestone	SL County Yellow Starthistle Mitigation	July 2018-June 2019	101	4595
	Canyon	Escort	SL County Yellow Starthistle Mitigation	July 2018-June 2019	101	4595
05-15	Red Rock	Wildfire		1992		
	Canyon	Seed Unknown	Redrock Burn	1992		

Table 5.8: Range Trend and WRI studies known disturbance history for WMU 5, East Canyon. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

There are three study sites [Tucson Hollow (05-2), East Canyon Reservoir (05-3), and Red Rock Canyon (05-15)] that are classified as Mountain (Big Sagebrush) ecological sites. The Tucson Hollow site is located northwest of East Canyon Reservoir near East Canyon Creek. The East Canyon Reservoir site is situated about ½ mile north of East Canyon Reservoir. Red Rock Canyon is located about 1.5 miles northeast of East Canyon Reservoir along East Canyon Creek (**Table 5.7**).

Shrubs/Trees: The main browse species on these sites is mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*). Antelope bitterbrush (*Purshia tridentata*) is present on the East Canyon Reservoir and Tucson Hollow sites, and provides additional beneficial browse. The total cover of shrub species has decreased through time, with the decrease of sagebrush being the primary contributor to the loss of preferred browse cover (**Figure 5.3**). The preferred browse populations on these sites are generally composed of mature individuals. However, mature plants have decreased over time and decadent plants were nearly equal to the number of mature plants in 2021 (**Figure 5.8**). Overall utilization has increased (with some variation) over time. The majority of the preferred browse has received moderate use which has generally remained consistent (**Figure 5.10**).

Pinyon and juniper encroachment is not an issue for this ecological type and is therefore not discussed in this section (**Figure 5.4**, **Figure 5.6**).

Herbaceous Understory: The herbaceous understories of these sites are in fair condition with high amounts of cover being present across the studies. The non-native annual grass species cheatgrass (*Bromus tectorum*) and perennial species bulbous bluegrass (*Poa bulbosa*) provide significant amounts of cover, reducing the overall condition of these sites. On the Red Rock Canyon study, the two co-dominant grasses are crested wheatgrass (*Agropyron cristatum*) and bulbous bluegrass. The grass component of the East Canyon Reservoir site is dominated by cheatgrass and bulbous bluegrass. On Tucson Hollow, the grass cover is mainly contributed by Sandberg bluegrass (*Poa secunda*), cheatgrass, and field brome (*Bromus arvensis*). In 2021, all sites were observed to have a reduction in cheatgrass and other herbaceous annual species. A mixture of perennial forbs has been present on these sites in amounts ranging from 18 percent in 2011 to nearly 9 percent in 2021. The cover of annual forbs has fluctuated between 8.5 percent in 2001 and 23 percent in 2016 (**Figure 5.12**, **Figure 5.14**).

Occupancy: Pellet group data displays fluctuations in usage from year to year, and indicates that mule deer are the primary occupants of these study sites. The 2006, 2016 and 2021 sample years show moderate use by cattle, while 2001 and 2011 show minimal cattle usage. Cattle usage was observed primarily on the Red Canyon site, with mean abundance of pellet groups decreasing from 42 to 11 days use/acre in 2006 and 2021, respectively. The usage of all sites by mule deer has fluctuated over time with a large decrease occurring in 2011. Deer used the sites at the highest rates of 56 and 50 days use/acre in 2001 and 2021, respectively; while the rate of 9 days use/acre in 2011 was the lowest. Usage of the sites by elk was minimal in 2001 with less than 1 day use/acre across the sites. Mean elk pellet group abundance increased to 30 days use/acre in 2006, followed by 4 days use/acre in 2011. 2016 and 2021 showed negligible use by elk with average pellet group abundance being less than 1 day use/acre (**Figure 5.16**).

Upland (Big Sagebrush)

There is one study [Wanship (05-4)] that is classified as an Upland (Big Sagebrush) ecological site: this site is located north of I-80 and Wanship near Rockport State Park (**Table 5.7**).

Shrubs/Trees: This study site does not have a significant shrub community as there was a fire in the early 1990s that removed much of the sagebrush community. Forage kochia (*Bassia prostrata*) did provide some cover after seeding, but that cover has decreased in recent years. The cover of sagebrush has been steadily decreasing through time and in 2016 became only a trace element of the species present on the site. Other preferred browse species are present as of 2016, but they have also decreased through time. Overall, the shrub community for this site has declined over the study period and the community has transitioned to a perennial grass state instead of a sagebrush-dominated plant community (**Figure 5.3**, **Figure 5.9**, **Figure 5.11**).

Conifer encroachment by Utah juniper (*Juniperus osteosperma*) and twoneedle pinyon (*Pinus edulis*) is not an issue on this study site (**Figure 5.5**, **Figure 5.7**).

Herbaceous Understory: The total herbaceous understory of this site has increased over time. The most common understory component is the non-native perennial grass species crested wheatgrass (*Agropyron cristatum*), although there has also been an increase in the presence of the non-native bulbous bluegrass (*Poa bulbosa*). Increases in cover for both species are the drivers for the increase in the total herbaceous cover. Perennial forbs are reasonably diverse, but remain a small component of the understory, while annual forbs provide the most forb cover with three percent cover being observed in 2016. (**Figure 5.13**, **Figure 5.15**).

Occupancy: The average pellet transect data has shown fluctuations in animal occupancy between 2001 and 2016. The mean abundance of elk pellet groups has generally increased from 24 days use/acre in 2001 to 90 days use/acre in 2016. The average abundance of mule deer pellet groups has decreased significantly: there were 64 days use/acre in 2001 and

15 days use/acre in 2016. There were cattle pellet groups observed on the site in the 2001 and 2006 sample years, but they were not present in 2011 or 2016 (**Figure 5.17**).

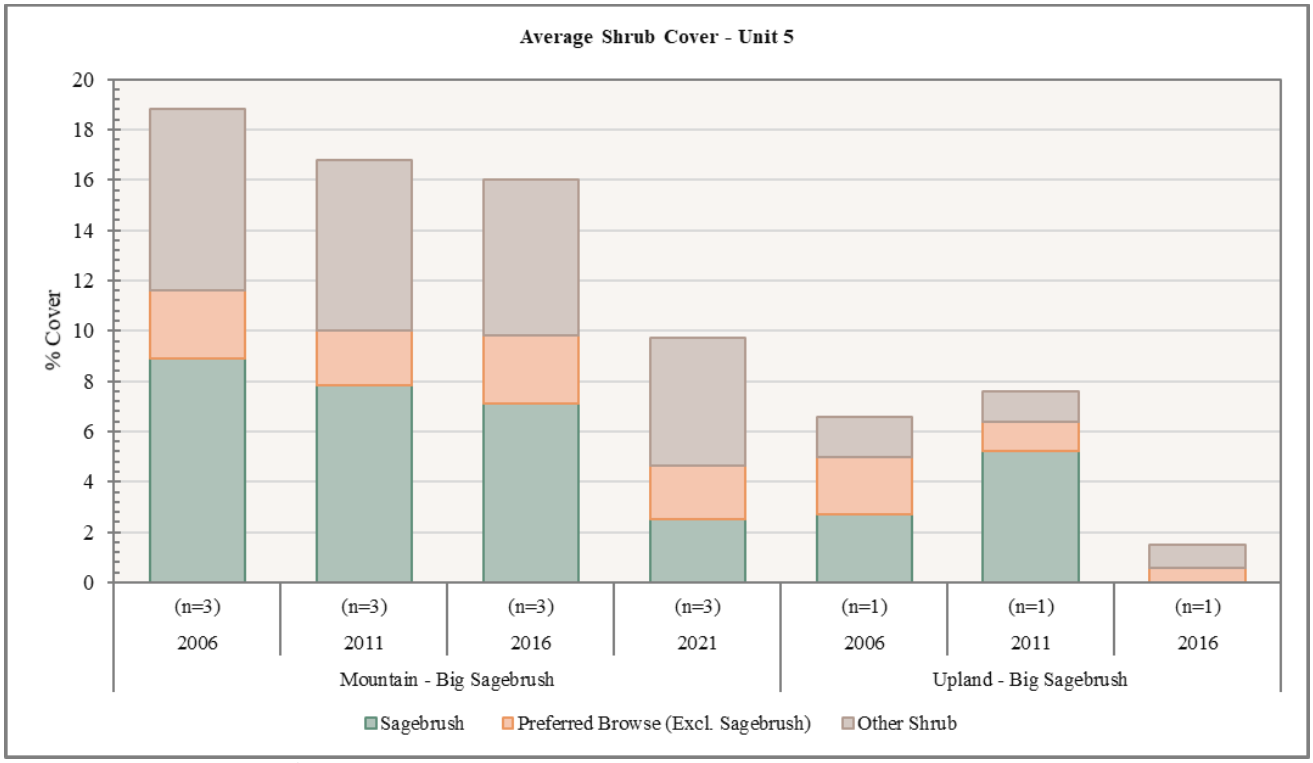


Figure 5.3: Average shrub cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 5, East Canyon.

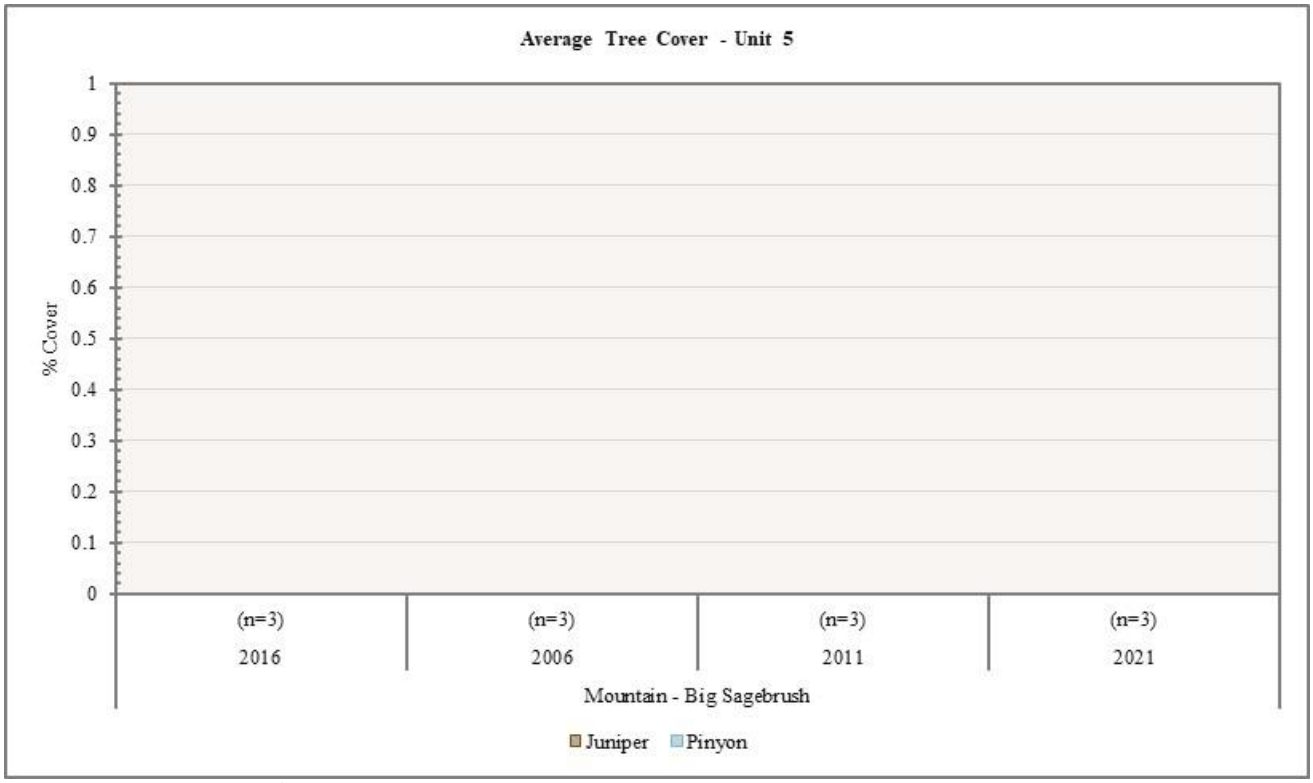


Figure 5.4: Average tree cover for Mountain - Big Sagebrush study sites in WMU 5, East Canyon.

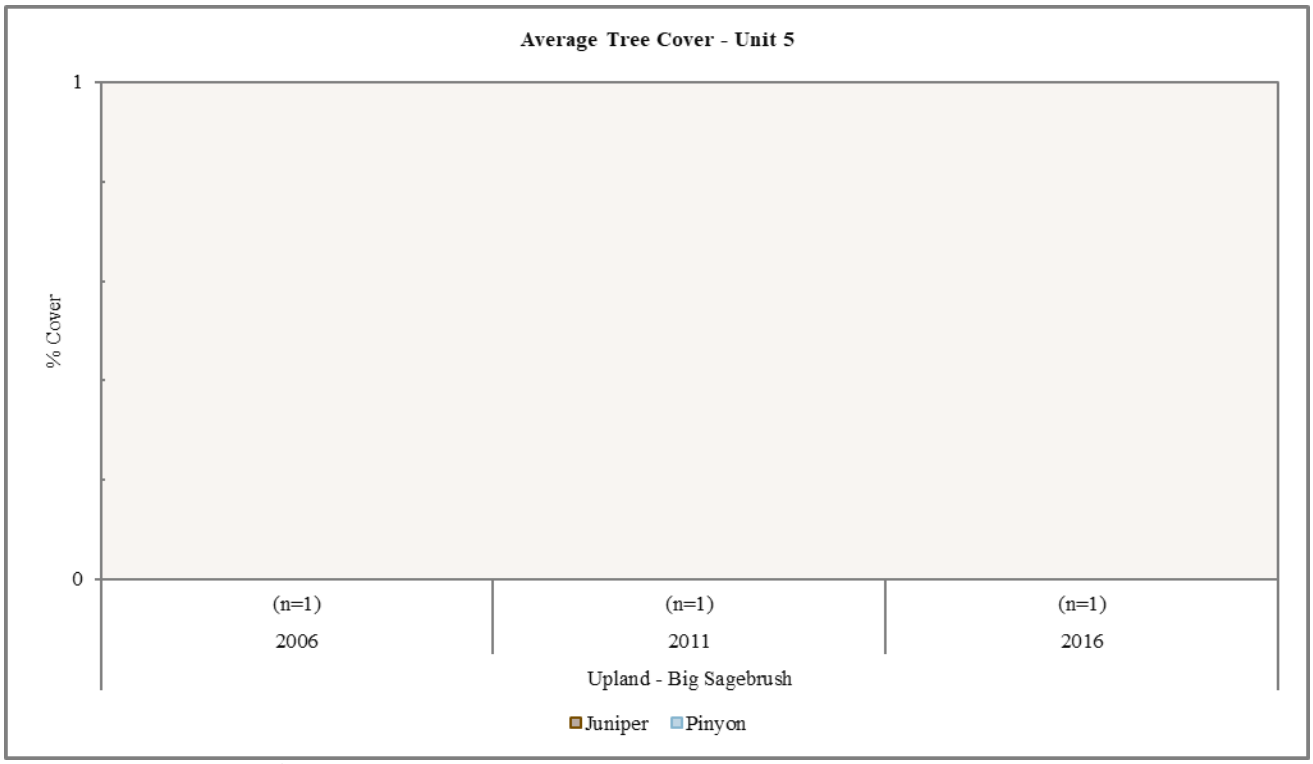


Figure 5.5: Average tree cover for Upland - Big Sagebrush study sites in WMU 5, East Canyon.

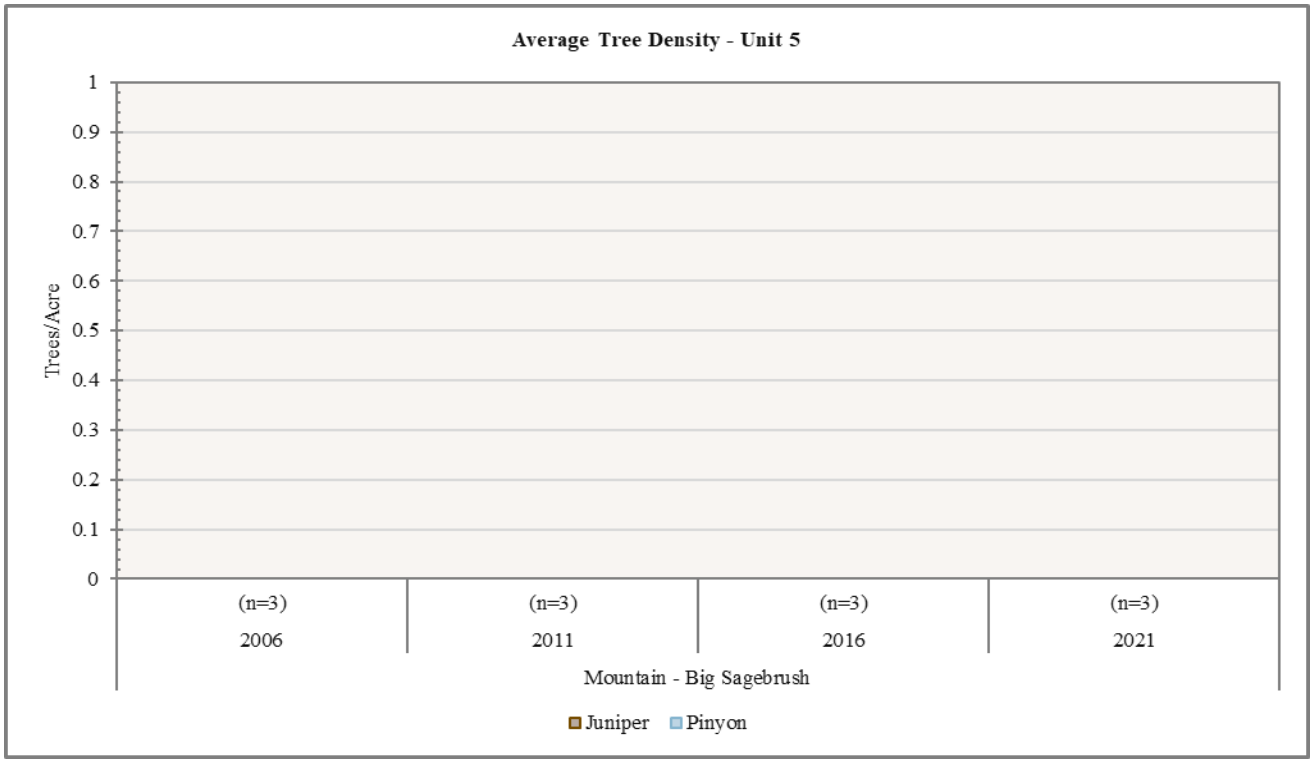


Figure 5.6: Average tree density for Mountain - Big Sagebrush study sites in WMU 5, East Canyon.

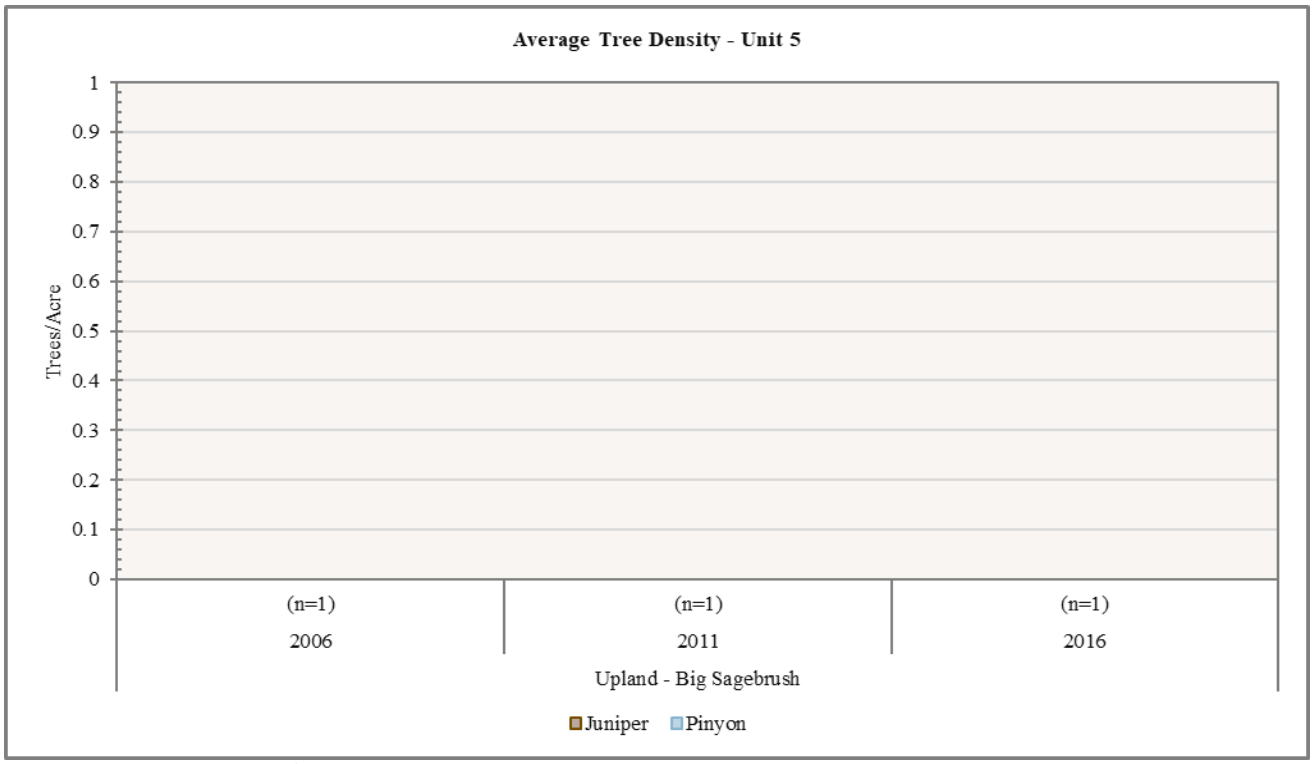


Figure 5.7: Average tree density for Upland - Big Sagebrush study sites in WMU 5, East Canyon.

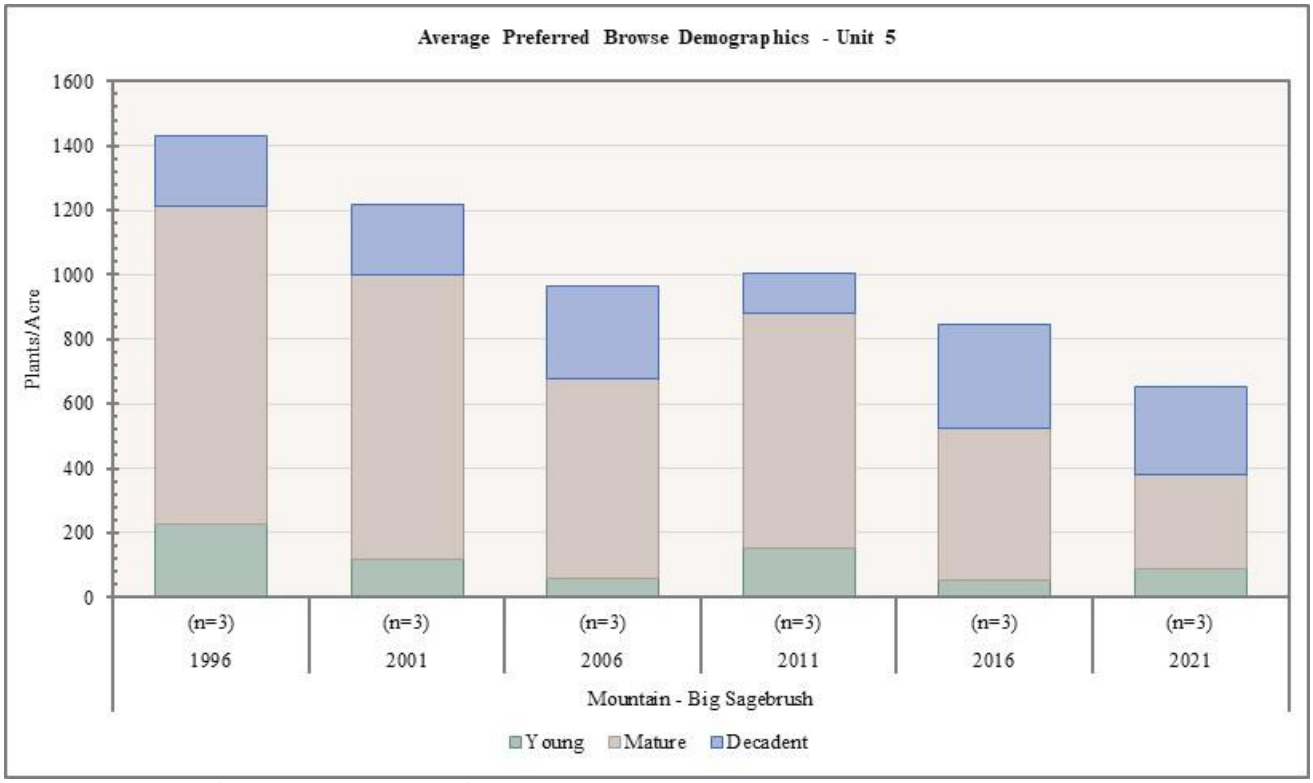


Figure 5.8: Average preferred browse demographics for Mountain - Big Sagebrush study sites in WMU 5, East Canyon.

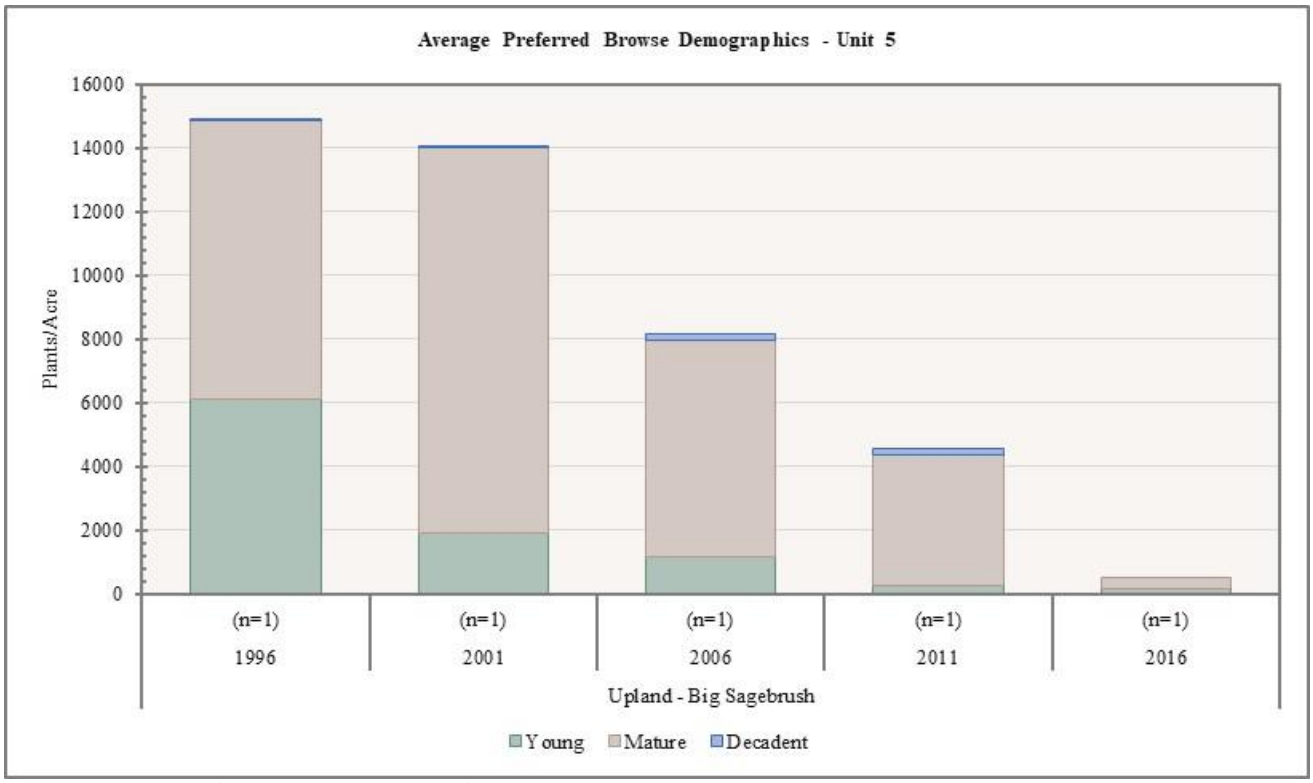


Figure 5.9: Average preferred browse demographics for Upland - Big Sagebrush study sites in WMU 5, East Canyon.

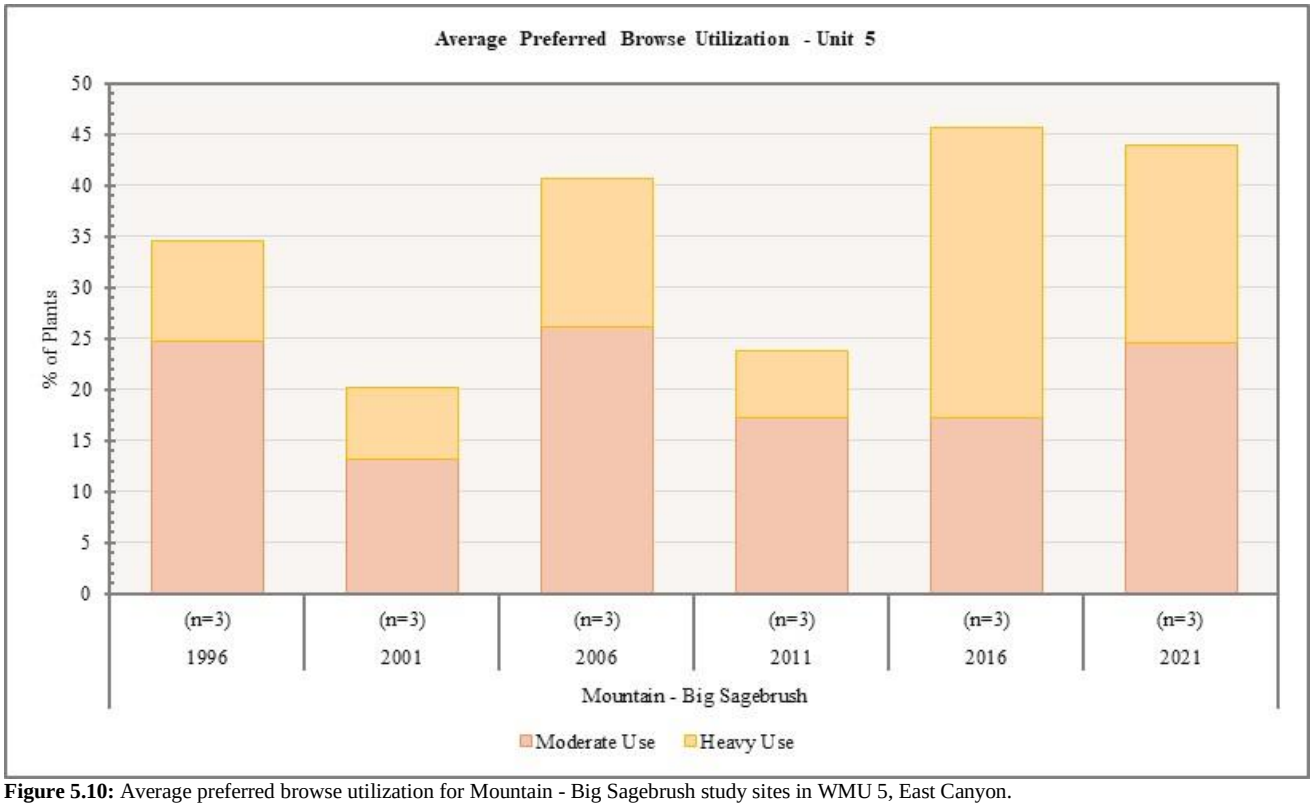


Figure 5.10: Average preferred browse utilization for Mountain - Big Sagebrush study sites in WMU 5, East Canyon.

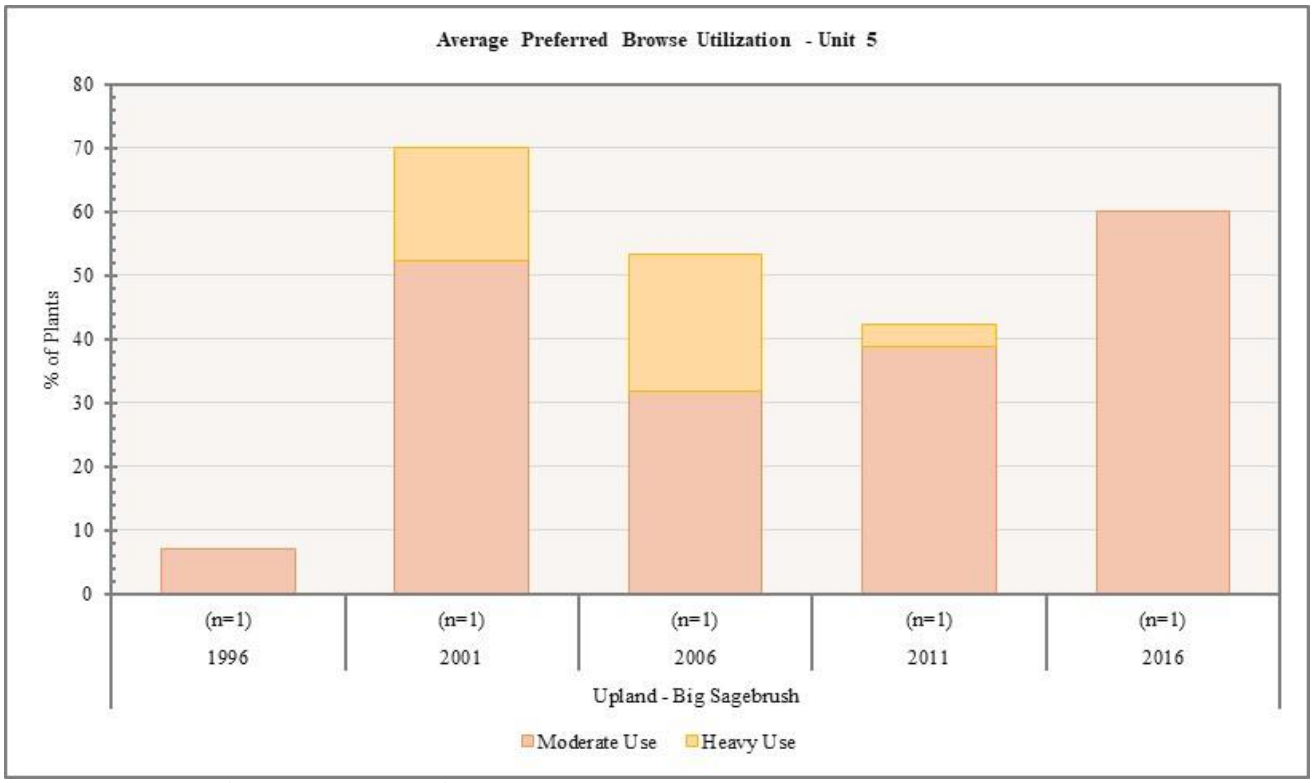


Figure 5.11: Average preferred browse utilization for Upland - Big Sagebrush study sites in WMU 5, East Canyon.

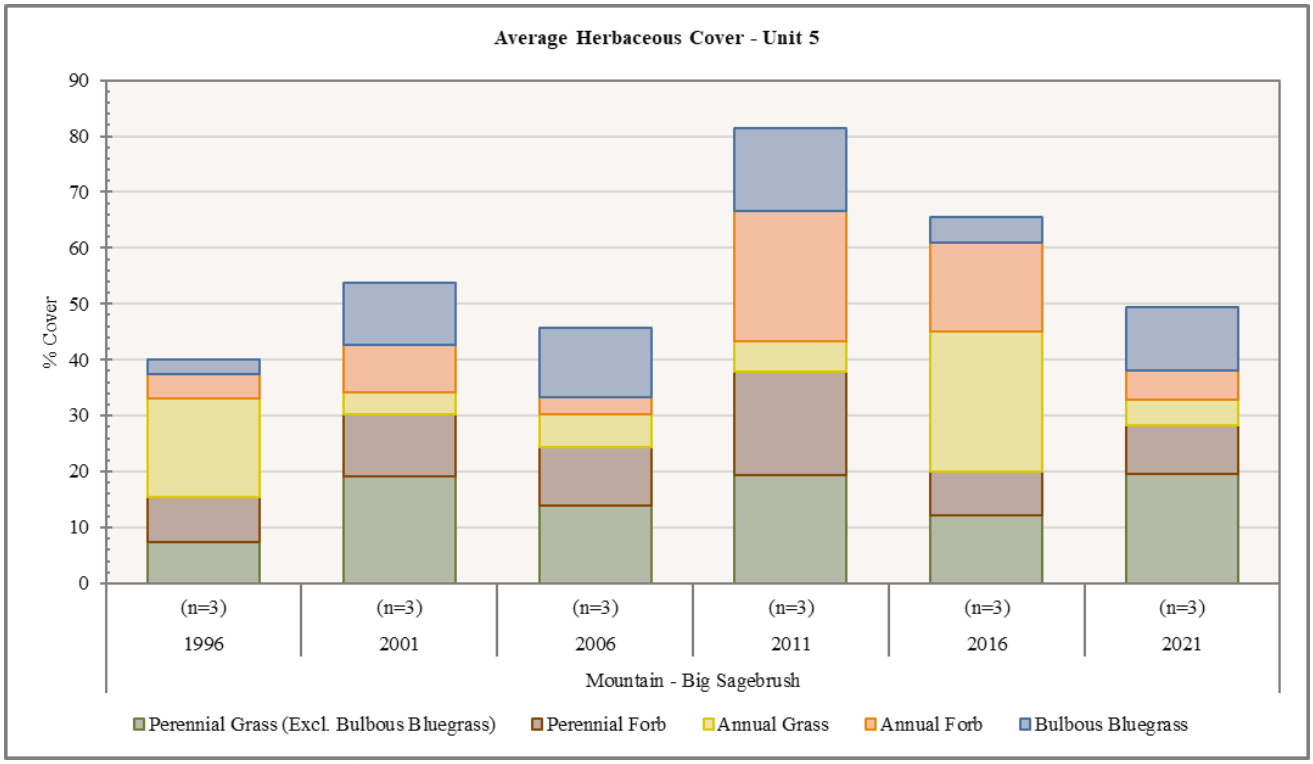


Figure 5.12: Average herbaceous cover for Mountain - Big Sagebrush study sites in WMU 5, East Canyon.

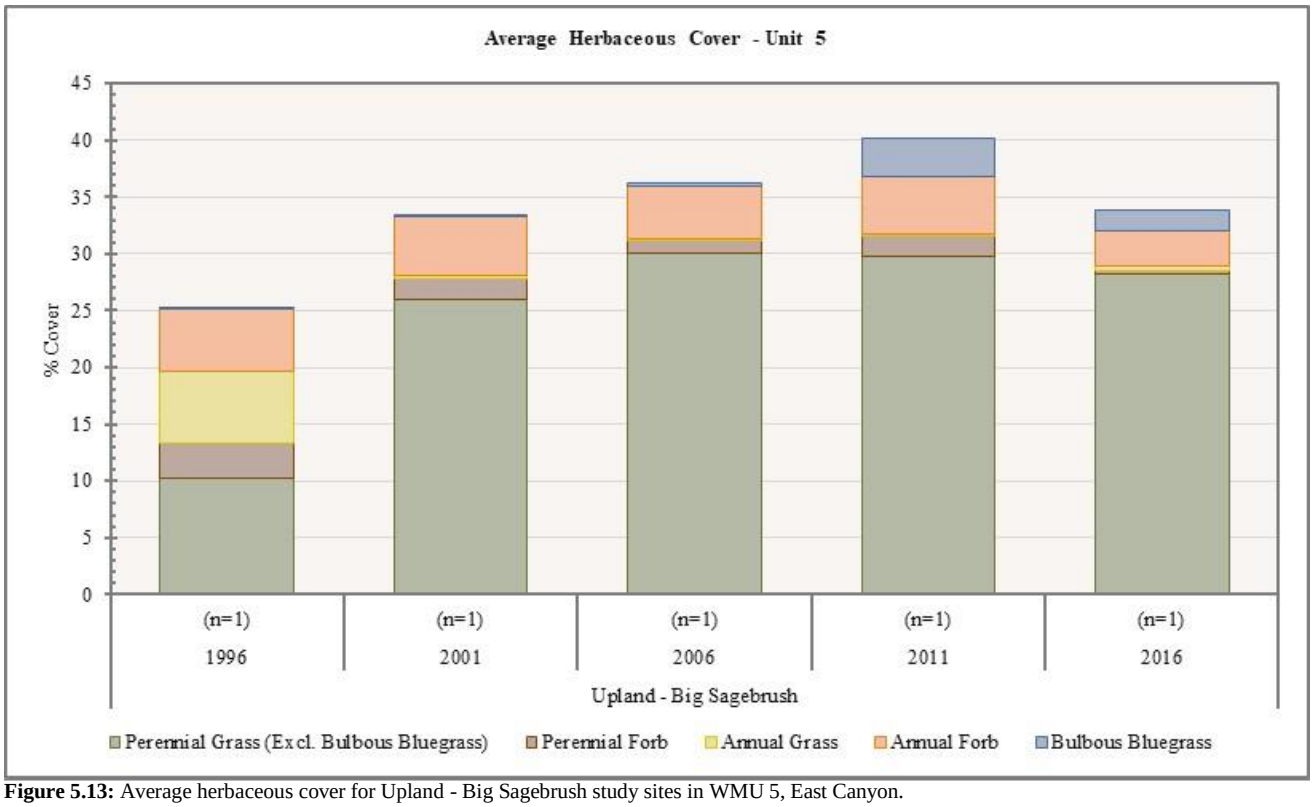


Figure 5.13: Average herbaceous cover for Upland - Big Sagebrush study sites in WMU 5, East Canyon.

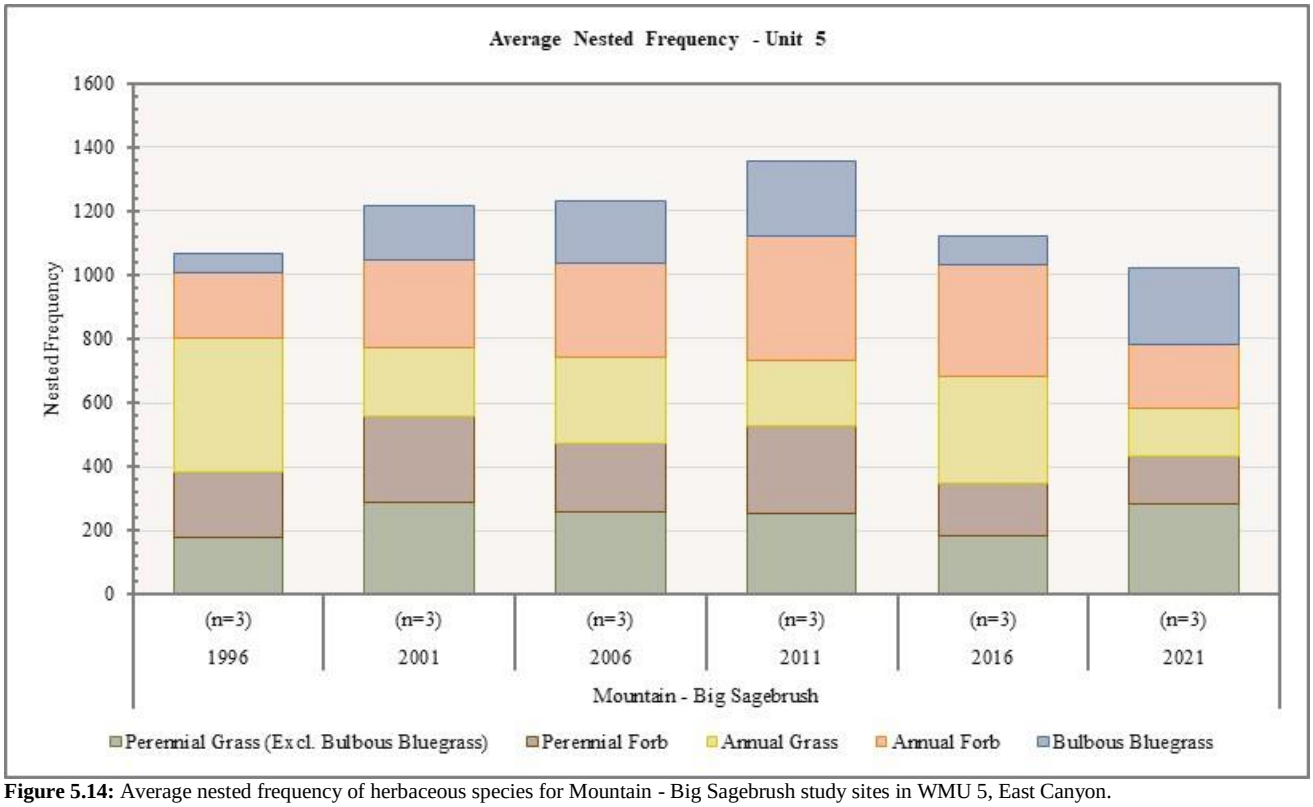


Figure 5.14: Average nested frequency of herbaceous species for Mountain - Big Sagebrush study sites in WMU 5, East Canyon.

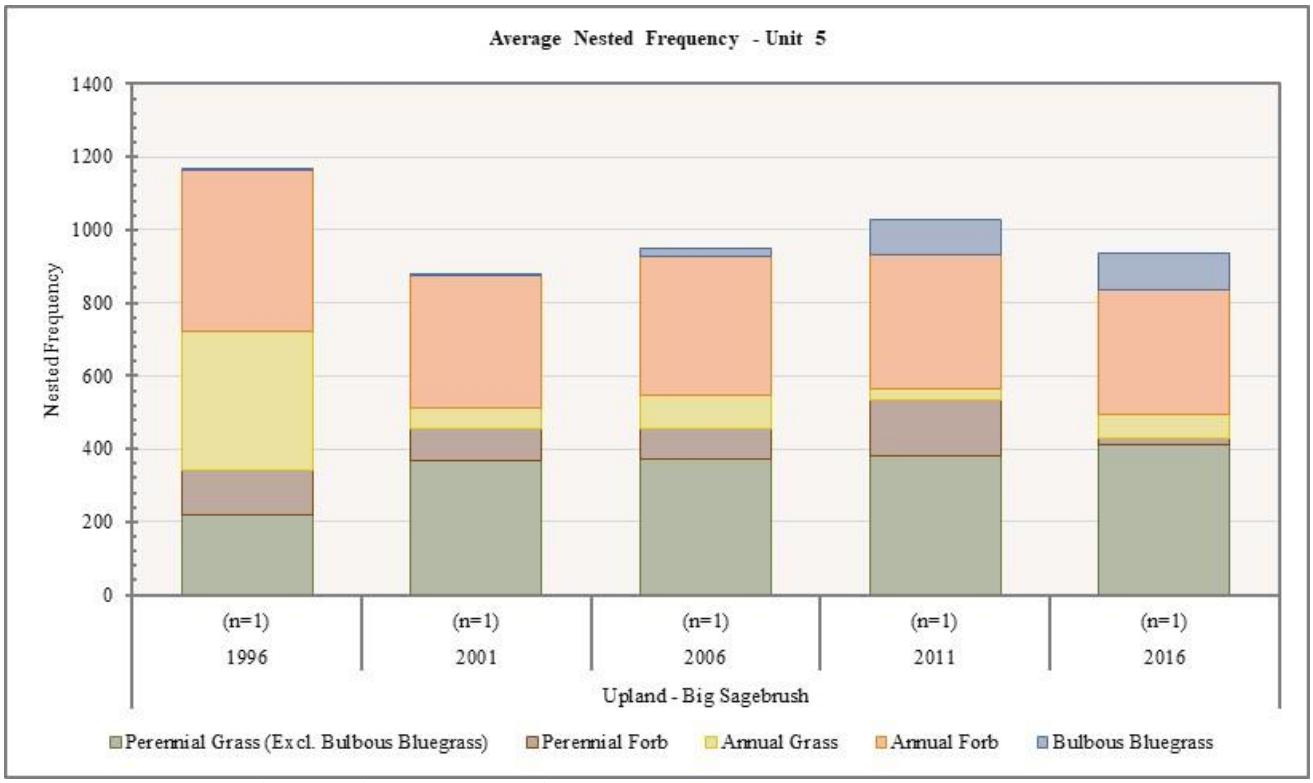


Figure 5.15: Average nested frequency of herbaceous species for Upland - Big Sagebrush study sites in WMU 5, East Canyon.

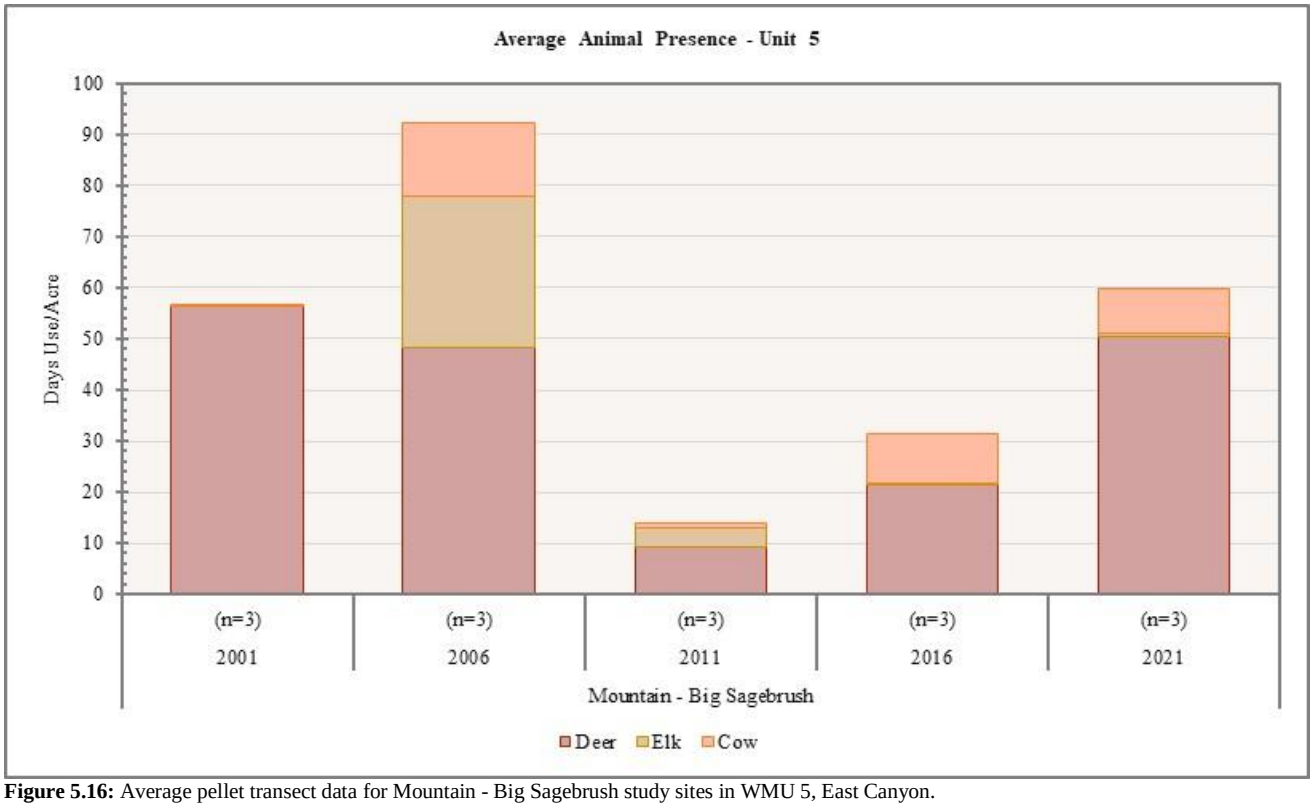


Figure 5.16: Average pellet transect data for Mountain - Big Sagebrush study sites in WMU 5, East Canyon.

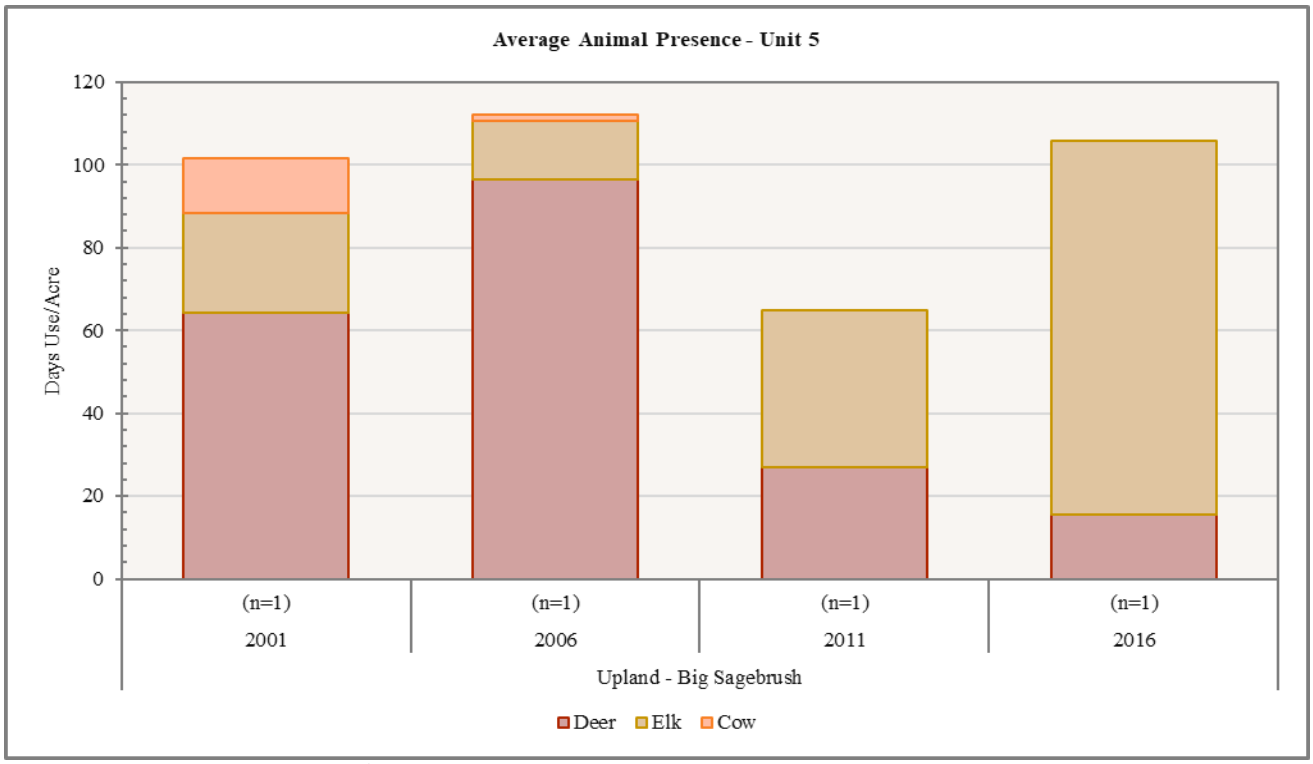


Figure 5.17: Average pellet transect data for Upland - Big Sagebrush study sites in WMU 5, East Canyon.

Deer Winter Range Condition Assessment

Deer winter range within the East Canyon management unit has generally remained in poor to fair condition since the 1996 sampling: the exception to this is 2011, when most sites were considered to be in fair condition. Of the few Range Trend sites in WMU 5, Wanship (05-4) has generally remained in fair condition. Tucson Hollow (05-2), East Canyon Reservoir (05-3), and Red Rock Canyon (05-15) are the main drivers for the unit's winter range condition as poor deer winter range. Wanship and East Canyon Reservoir display the most variability in deer winter range condition. This variability may be an indicator that improvements in habitat can be made through rehabilitation; however, East Canyon Reservoir shows a proclivity to remain in poor condition, and may not be the best candidate for rehabilitation. In addition, Red Rock Canyon may also show a resistance to habitat improvement.

The overall deer winter range assessment in 2021 for WMU 5 was very poor-poor. Much of the poor condition can be attributed to an abundance of annual grass, and a lack of preferred browse recruitment and age class diversity. Over the duration of the study, preferred browse species have been lacking on Red Rock Canyon with much of the winter condition benefiting only from an abundance of perennial grass. (**Table 5.9**, **Figure 5.18**).

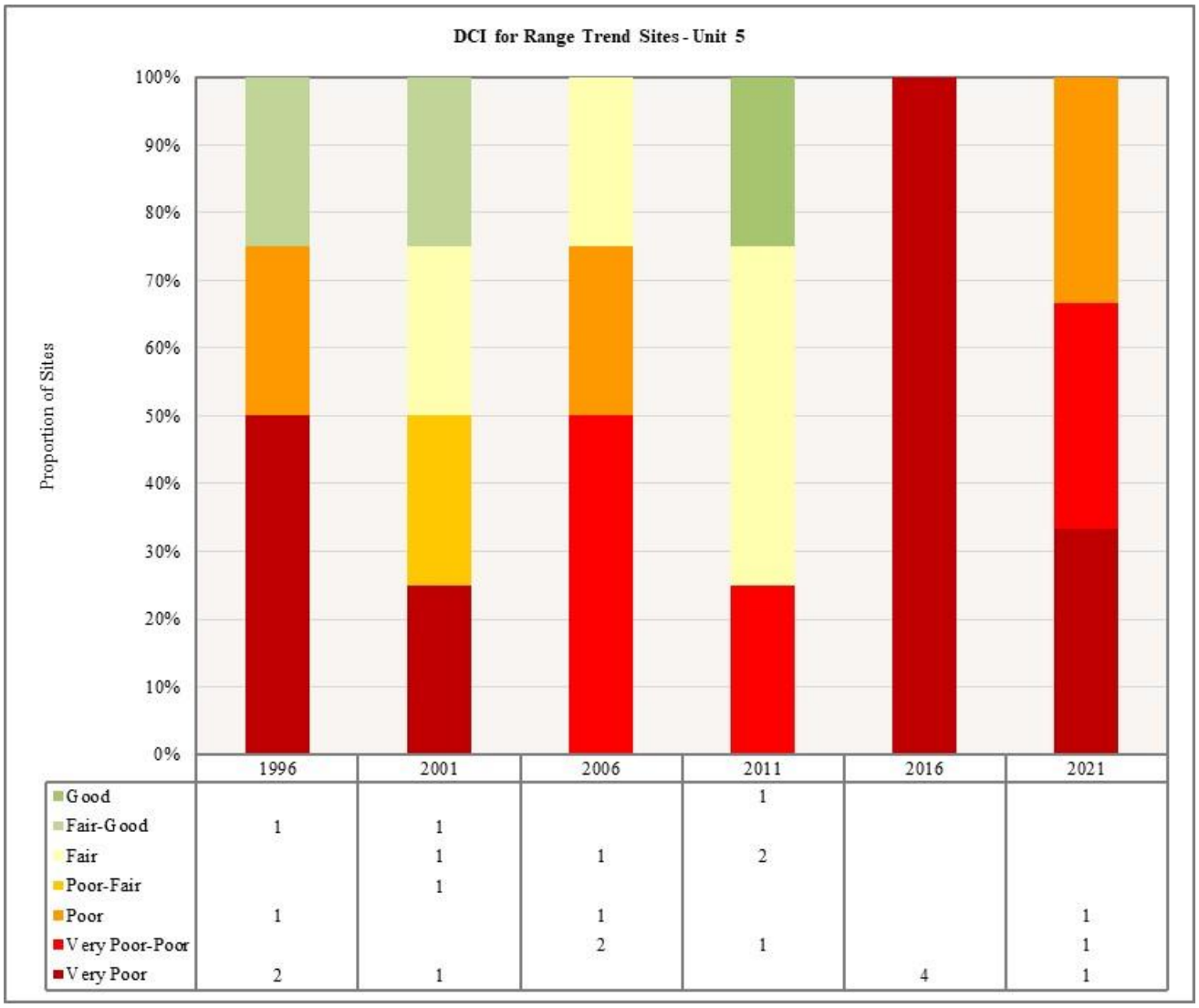
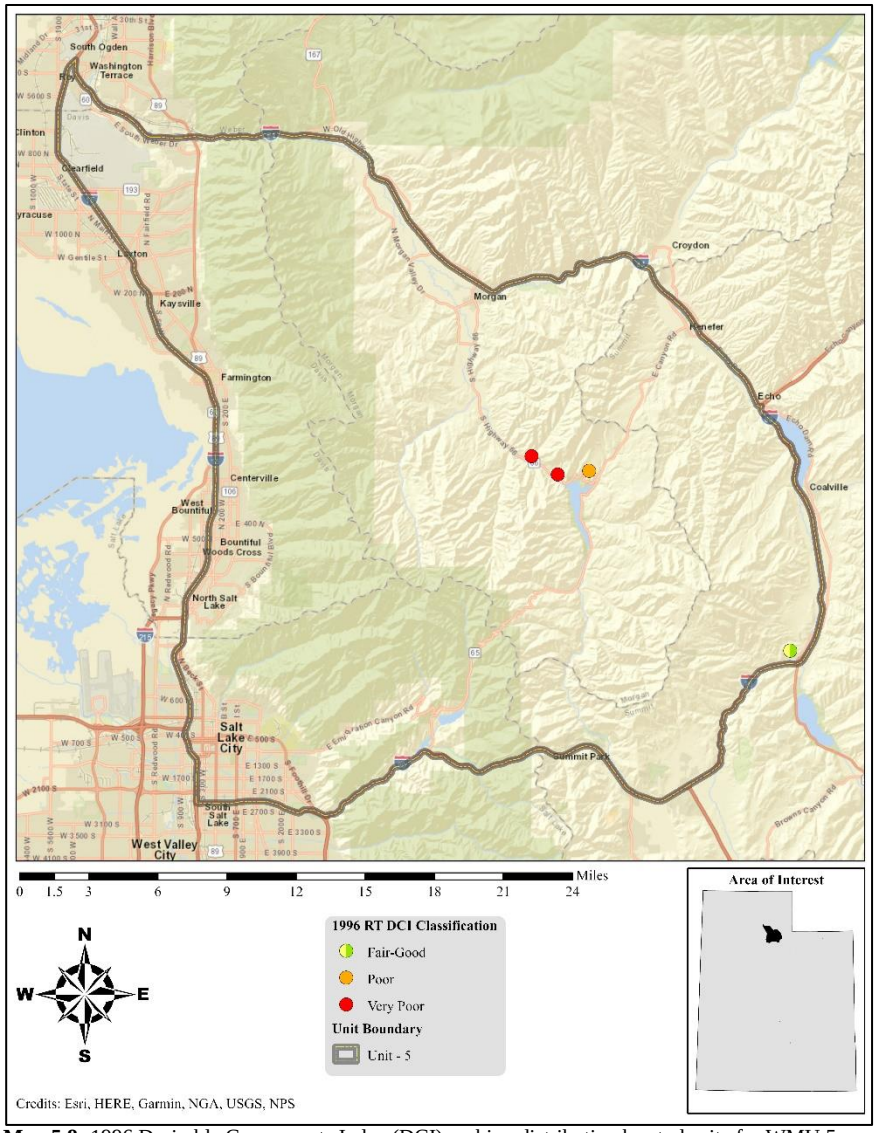


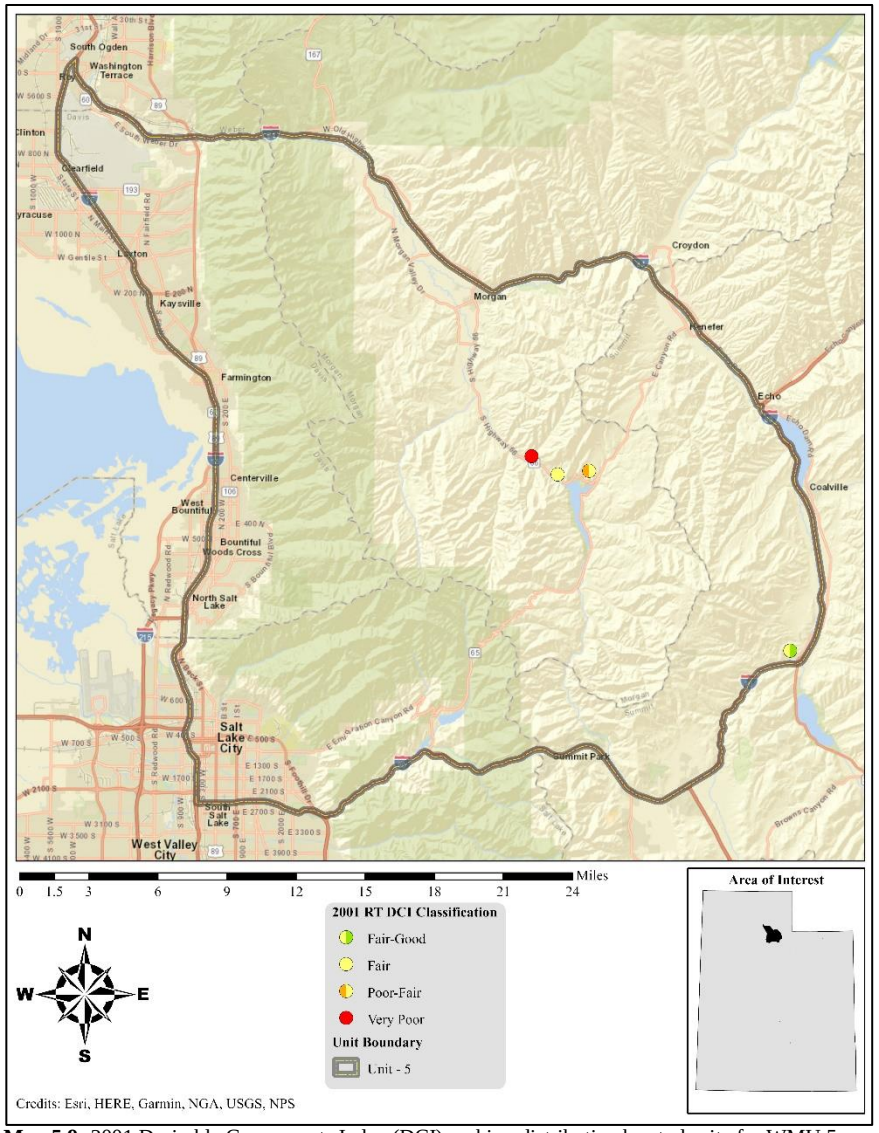
Figure 5.18: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 5, East Canyon.

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
05-2	1996	16.3	12	2.8	9	-14.4	10	-2	**33.7**	**VP**
05-2	2001	16.2	7.2	0	30	-2.1	10	-2	**59.2**	**F**
05-2	2006	22.4	9.1	5.5	28.9	-7.6	10	-2	**66.2**	**F**
05-2	2011	14.4	12.4	7	30	-7.6	10	0	**66.2**	**F**
05-2	2016	19.1	6.2	4.2	5.4	-20	10	-2	**22.8**	**VP**
05-2	2021	10.6	2	3.6	30	-2.8	10	-2	**51.3**	**P**
05-3	1996	21.4	9.6	6.3	10.8	-6.6	10	0	**51.5**	**P**
05-3	2001	25.4	8.3	2.9	15.6	-3.2	5.5	0	**54.5**	**P-F**
05-3	2006	20.2	-1.2	0.9	15.6	-1.9	8.2	0	**41.8**	**VP-P**
05-3	2011	20.9	10.2	6.1	30	-2.9	10	0	**74.3**	**G**
05-3	2016	16.5	-0.6	1.2	17.3	-13.3	7.9	0	**29.1**	**VP**
05-3	2021	5.7	0	0	29.3	-7	2.8	0	**30.7**	**VP**
05-4	1996	12.7	14.9	15	20.4	-4.7	6.3	0	**64.6**	**F-G**
05-4	2001	8.9	14.9	6.1	30	-0.2	3.7	0	**63.3**	**F-G**
05-4	2006	6.8	0	0	30	-0.2	2.1	0	**38.7**	**P**
05-4	2011	8.3	13	2.1	30	-0.1	3.7	0	**57.1**	**F**
05-4	2016	0.9	0	0	30	-0.3	0.5	0	**31.1**	**VP**
05-15	1996	0.5	0	0	24.3	-18.5	9.8	0	**16.2**	**VP**
05-15	2001	0.3	0	0	30	-3.6	10	0	**36.8**	**VP**
05-15	2006	2.1	0	0	30	-3.7	10	0	**38.3**	**VP-P**
05-15	2011	3	0	0	30	-2.1	10	0	**40.9**	**VP-P**
05-15	2016	2	0	0	30	-10	4.1	0	**26**	**VP**
05-15	2021	1.9	0	0	30	-0.4	10	0	**41.6**	**VP-P**

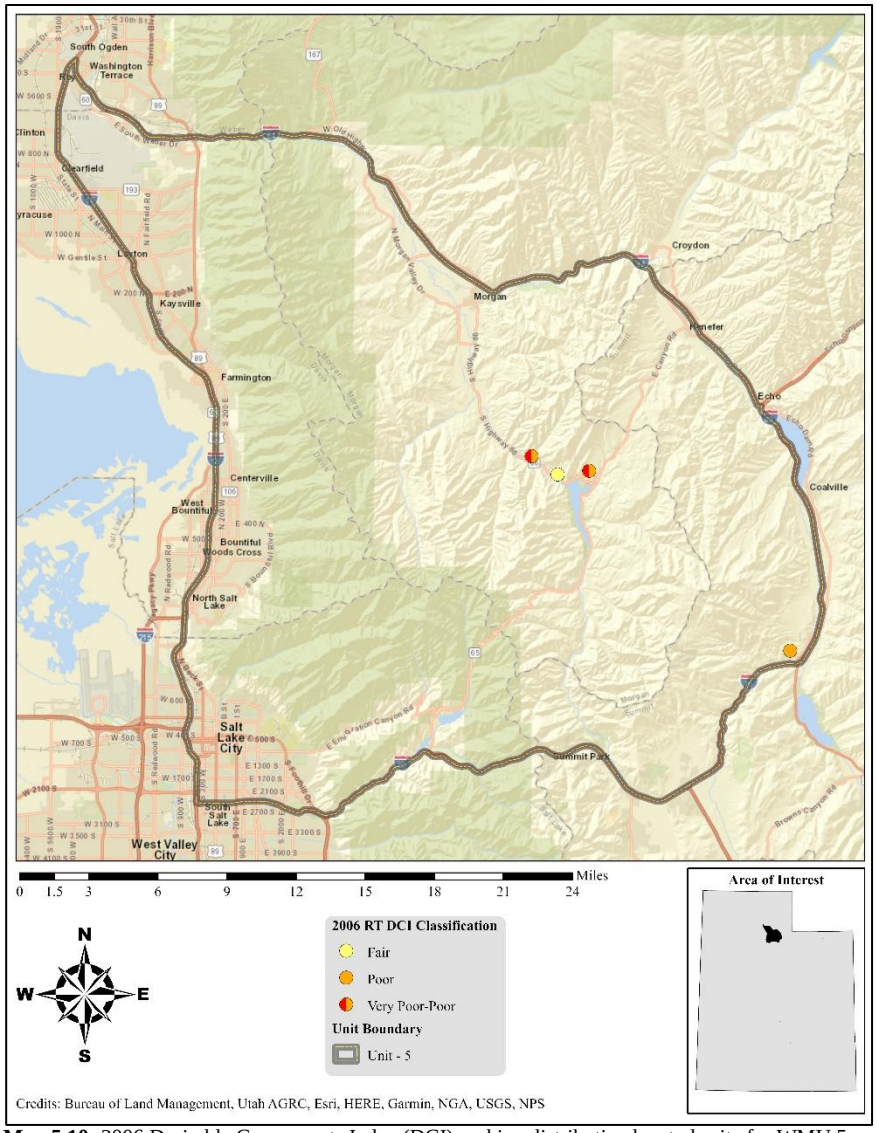
Table 5.9: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 5, East Canyon. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



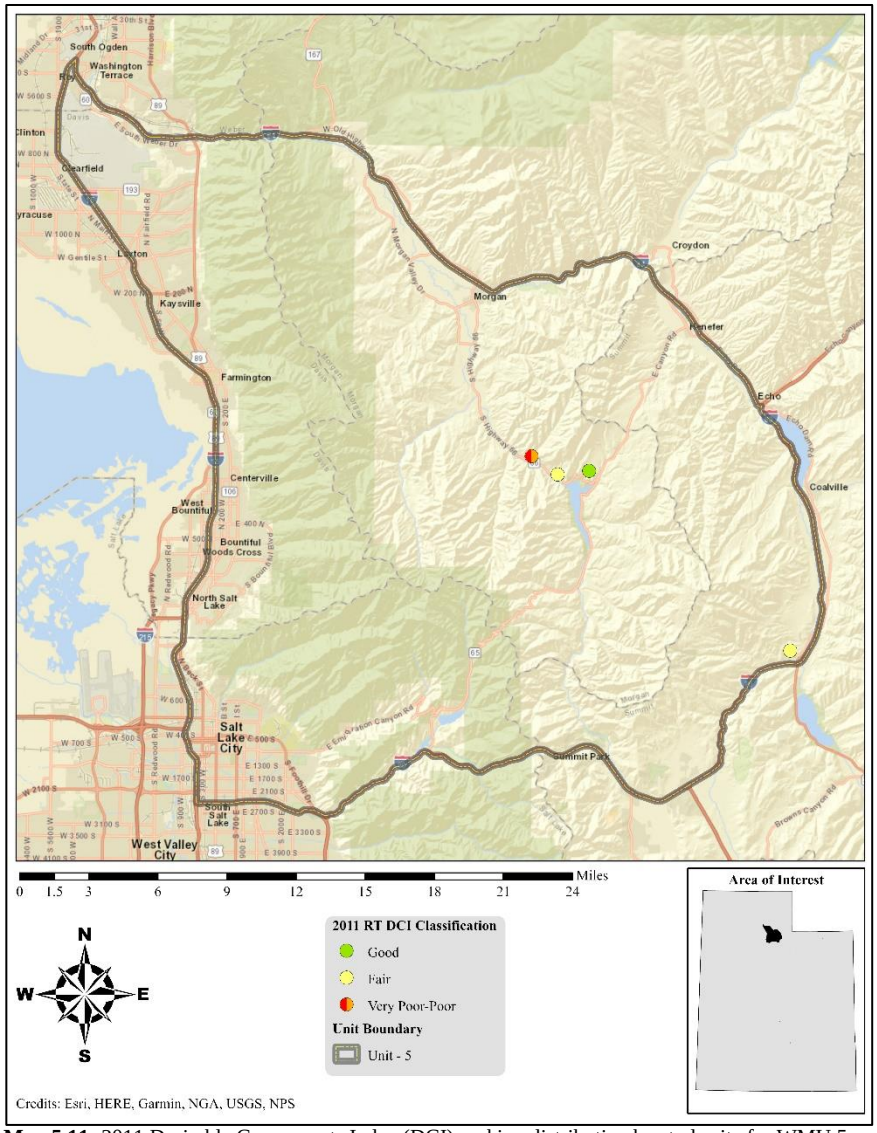
Map 5.8: 1996 Desirable Components Index (DCI) ranking distribution by study site for WMU 5, East Canyon.



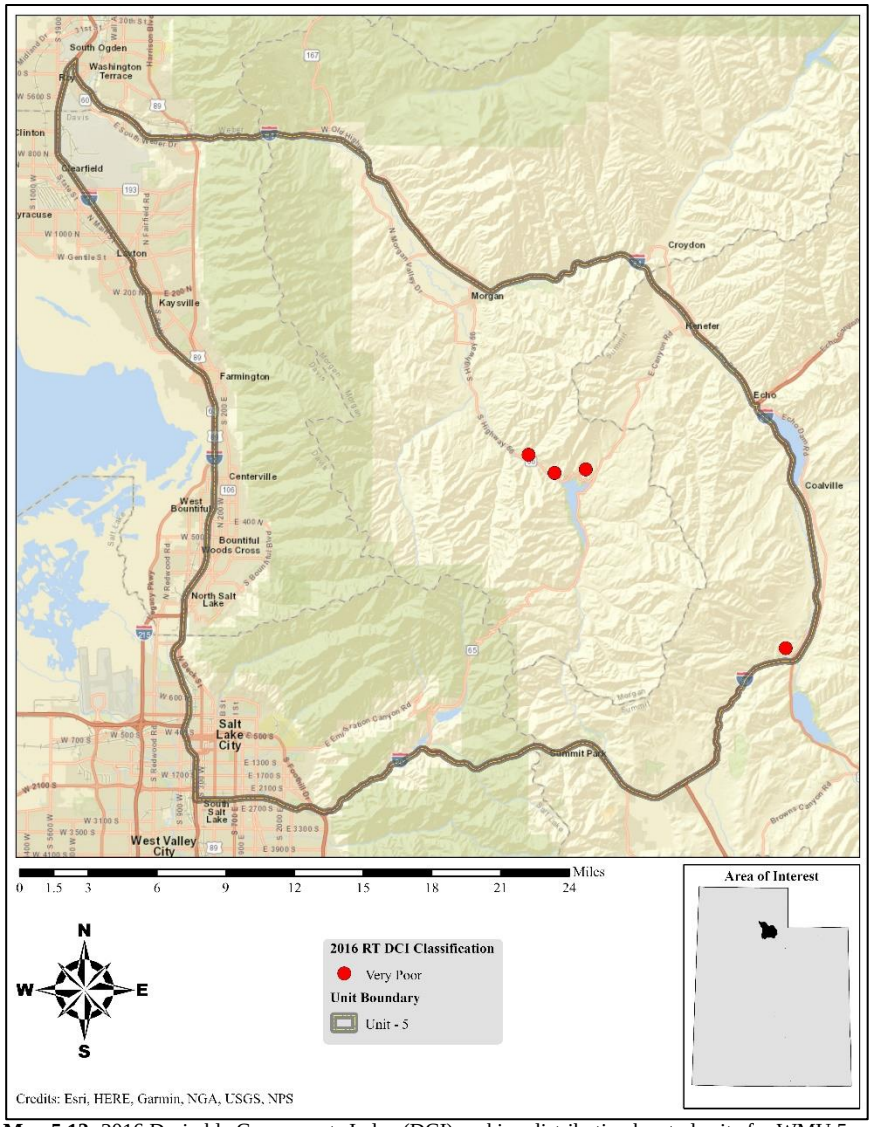
Map 5.9: 2001 Desirable Components Index (DCI) ranking distribution by study site for WMU 5, East Canyon.



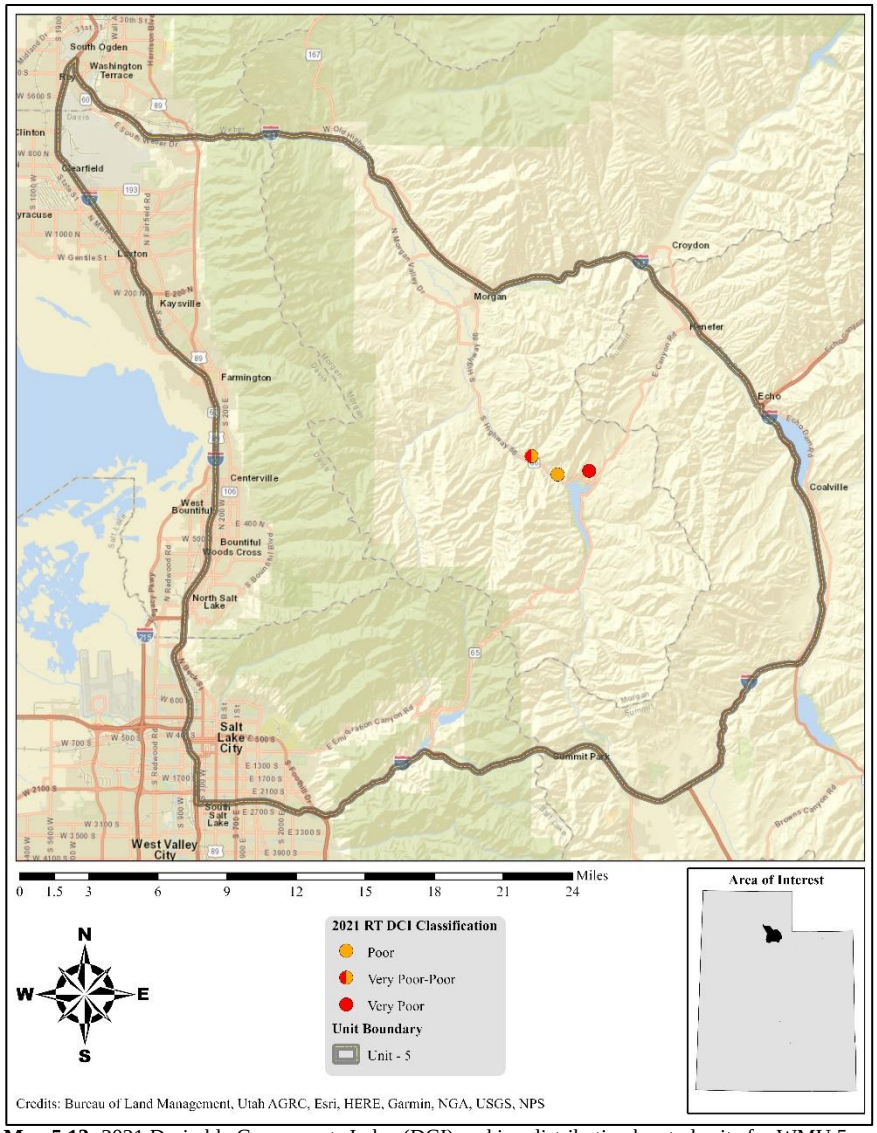
Map 5.10: 2006 Desirable Components Index (DCI) ranking distribution by study site for WMU 5, East Canyon.



Map 5.11: 2011 Desirable Components Index (DCI) ranking distribution by study site for WMU 5, East Canyon.



Map 5.12: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 5, East Canyon.



Map 5.13: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 5, East Canyon.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
05-2	Tucson Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
05-3	East Canyon Reservoir	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
05-4	Wanship	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Urban Development	High	Fragmentation and loss of habitat
		Animal Use – Elk	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
05-15	Red Rock Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity

Table 5.10: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 5, East Canyon. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment.**

Discussion and Recommendations

Mountain (Big Sagebrush)

The high elevation study sites that are considered to be Mountain (Big Sagebrush) ecological sites are considered to be in very poor to poor condition for deer winter range habitat on the East Canyon management unit. Although the herbaceous understories are abundant, annual grasses, namely cheatgrass (*Bromus tectorum*) or field brome (*B. arvensis*), are present or have been present in amounts that pose a high-level threat to the ecological integrities of all three study sites. In high amounts, annual grasses boost fuel loads, increase the risk of catastrophic wildfire, and alter wildfire return intervals (Balch, D'Antonio, & Gómez-Dans, 2013). Introduced perennial grass species are also present on these studies, posing a high-level threat on the East Canyon Reservoir and Red Rock Canyon studies and a medium-level threat on the Tucson Hollow site. At higher elevations, introduced perennial grasses are often aggressive and can outcompete native grasses and forbs for resources. This in turn results in decreased prevalence and abundance of more desirable species. Finally, the noxious weed species jointed goatgrass (*Aegilops cylindrica*) and gypsyflower (*Cynoglossum officinale*) are present or have been present in the past in low amounts on the Tucson Hollow study. Much like introduced perennial grass species under the right conditions, noxious weeds are also aggressive and can also lead to reduced herbaceous diversity when present in higher amounts (Mack, et al., 2000). In addition, evidence of drought is apparent on the East Canyon Reservoir study. Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

Continued monitoring of these communities is strongly recommended. More specifically, further monitoring on East Canyon Reservoir may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003). Herbicide treatments or changes in grazing management may be appropriate on all three studies, especially if large flushes of annual grass reoccur in future sample years. If reseeding is deemed necessary on sites where introduced grasses have led to reduced herbaceous diversity, care should be taken in species selection and preference should be given to native species whenever possible. Finally, noxious weeds could be treated by spot application of herbicides either through preventative or reactive management.

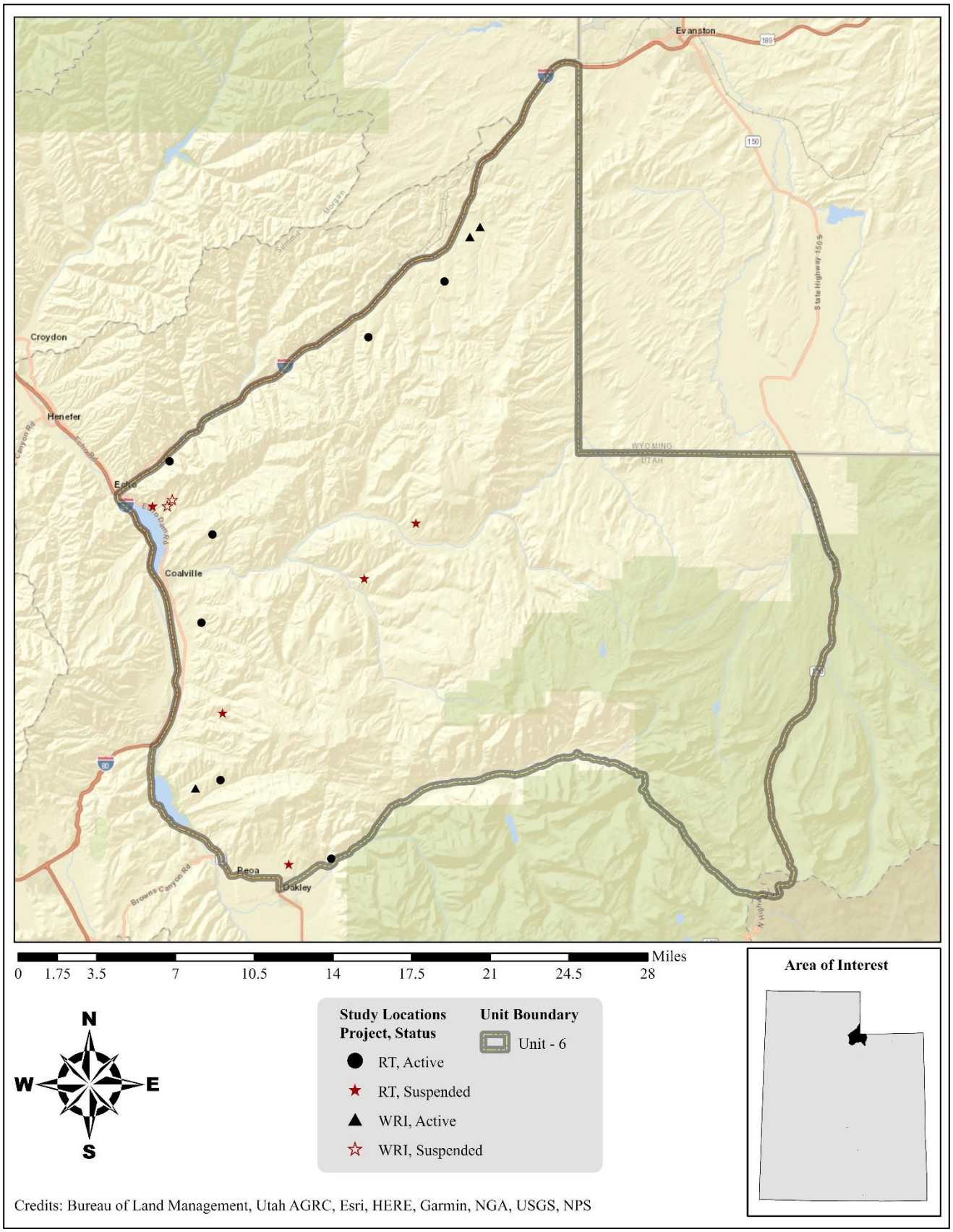
Upland (Big Sagebrush)

Wanship, the mid-elevation study site of this ecological type, is considered to be in very poor condition for deer winter range habitat on this unit. A sagebrush community was supported in the past, but the site now hosts an abundant herbaceous understory. Introduced perennial grasses such as crested wheatgrass (*Agropyron cristatum*) are present on this site in high amounts as of 2016, posing a high-level threat to the site's ecological integrity. Although they can provide valuable forage, introduced perennial grasses are often aggressive and can lead to reduced prevalence and abundance of other more desirable native grass and forb species by outcompeting them for resources (Mack, et al., 2000). The Wanship

study is also threatened by urban development, as it is on private land directly adjacent to a house and other associated structures. Urban development often leads to fragmentation and loss of habitat as valuable shrub and herbaceous communities are often negatively impacted or removed entirely by construction, roads, etc. (Forman & Alexander, 2000). In addition, pellet transect data taken in the most recent sample year (2016) indicates that moderate use by elk was occurring on this study, posing a medium-level threat. Overuse by elk can lead to decreased vigor in the shrub and herbaceous understory (Butler, et al., 2003; Jornada & NRCS, 2022; Payne, Lane, & Cox, 2022). Finally, the introduced annual grass species cheatgrass (*Bromus tectorum*) has been observed on this site in all sample years since 1996. Although cover has remained low during recent samplings, cheatgrass did contribute moderate cover in 1996, indicating that there may be the potential for a future resurgence of annual grasses. In high amounts, these grasses increase fine fuel loads, exacerbate the risk of wildfire, have the potential to alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013), and may lead to reduced herbaceous diversity (Mack, et al., 2000).

It is recommended that monitoring of this study site continue. With cooperation from private landowners, monitoring may be useful to determine what urban development factors (noise, traffic, pollutants, fugitive dust, etc.) could be influencing wildlife in the area, and furthermore, if mitigation measures are needed to support wildlife. If reseeding is deemed appropriate to diversify the herbaceous understory, species selection should be made with care with preference being given to native grass and forb species whenever possible. Although annual grasses likely do not require treatment at this time, herbicide application or other targeted treatments may be appropriate if monitoring shows an increase in future sample years. Finally, a close examination of this study site and surrounding area is recommended to help determine if overuse by elk is occurring within the area.

6. WILDLIFE MANAGEMENT UNIT 6 – CHALK CREEK



WILDLIFE MANAGEMENT UNIT 6 – CHALK CREEK

Boundary Description

Summit and Duchesne counties - Boundary begins at the junction of Interstates 84 and 80 near Echo; northeast on I-80 to the Utah-Wyoming state line; south and east along this state line to Highway SR-150; south on SR-150 to Pass Lake and the Weber River Trail; west to Holiday Park and Weber River Road; west on this road to Highway SR-32; north and west on SR-32 to I-80 and Wanship; north on I-80 to I-84 near Echo.

Management Unit Description

Geography

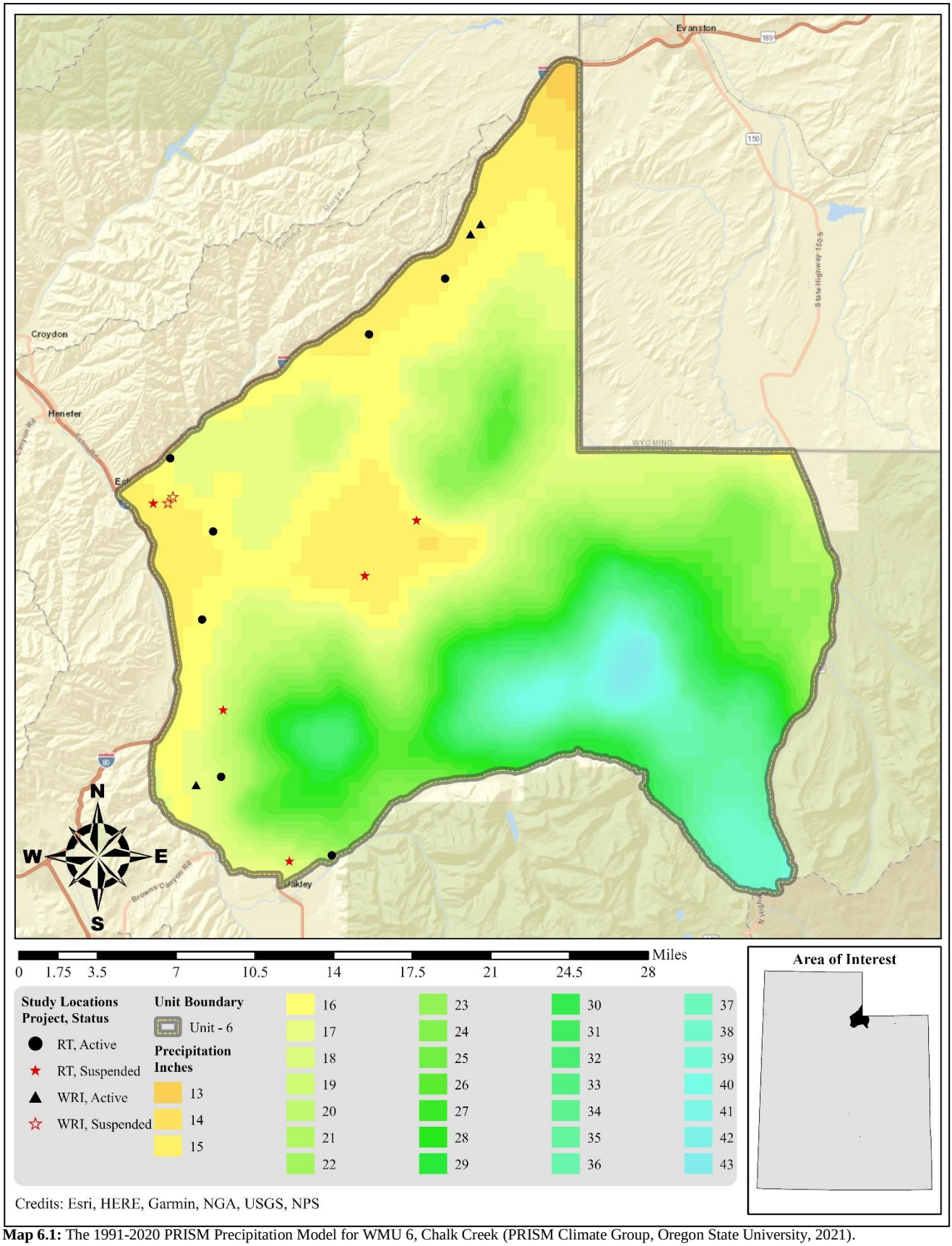
The topography of the Chalk Creek unit is influenced mainly by the Uinta Mountains to the east, with their drainages flowing through long, gradual slopes down into the Weber River Valley. Towns located in the valley along the Weber River include Oakley, Peoa, Wanship, Hoytsville, and Coalville. Echo and Rockport Reservoirs are located on the west side of the unit on the Weber River.

Climate Data

The 30 year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 13 inches along the northernmost portion of the unit near the Utah-Wyoming border to 43 inches on the peaks of the Uintas. All of the Range Trend and WRI monitoring studies on the unit occur within 15-21 inches of precipitation (**Map 6.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Northern Mountains division (Division 5).

The mean annual PDSI of the Northern Mountains division displayed years of moderate to extreme drought from 2000-2003, 2012-2013, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1995, 1997-1998, 2005, and 2011 (**Figure 6.1a**). The mean spring (March-May) PDSI displayed moderate to extreme drought in 1992, 2000-2004, 2012-2014, 2018, and 2021; moderately to extremely wet years were displayed from 1995-1996, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2000-2003, 2007, 2012-2013, and 2020-2021; moderately to extremely wet years were displayed in 1995 and from 1997-1998 (**Figure 6.1b**) (Time Series Data, 2022).



Map 6.1: The 1991-2020 PRISM Precipitation Model for WMU 6, Chalk Creek (PRISM Climate Group, Oregon State University, 2021).

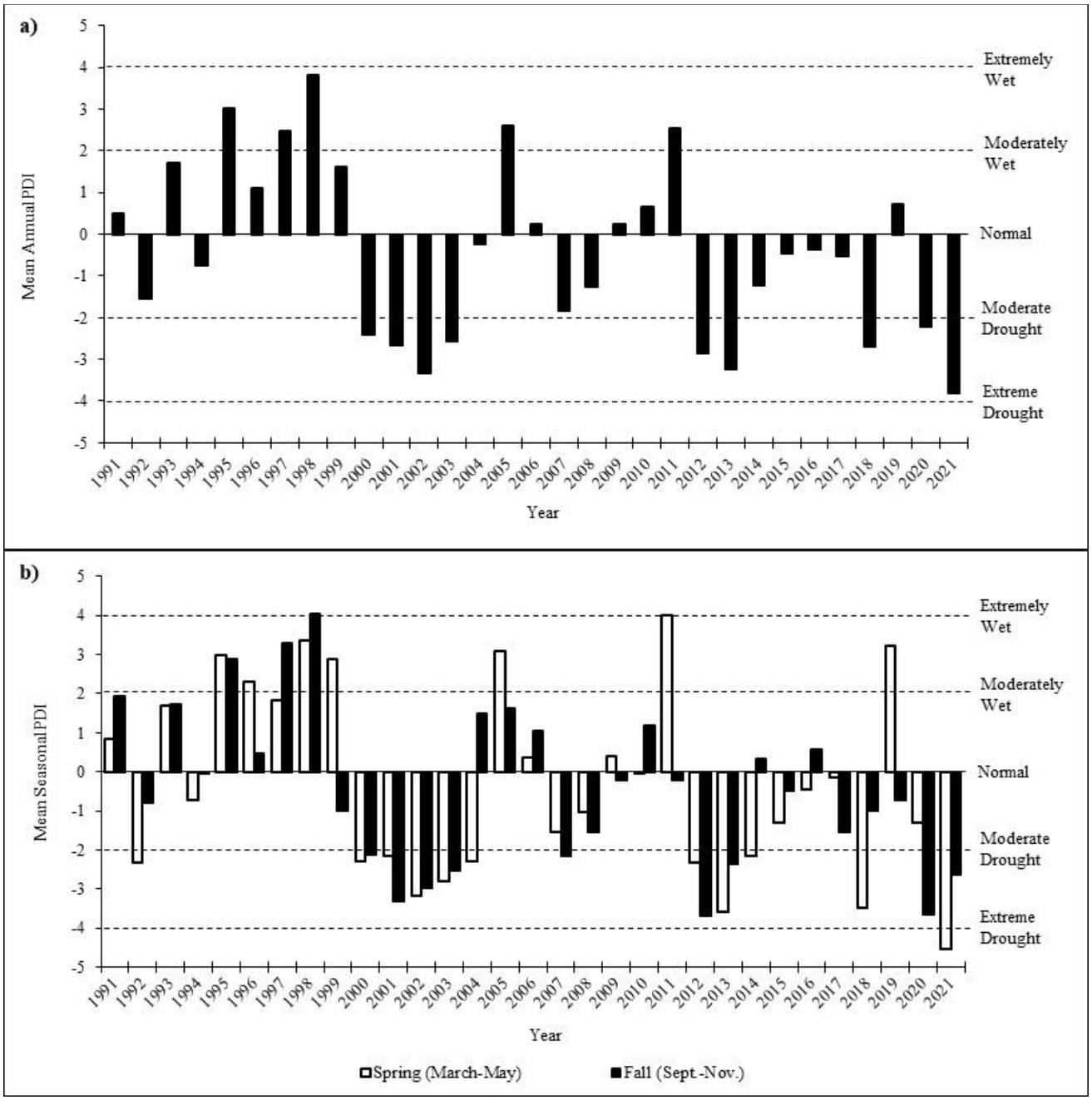


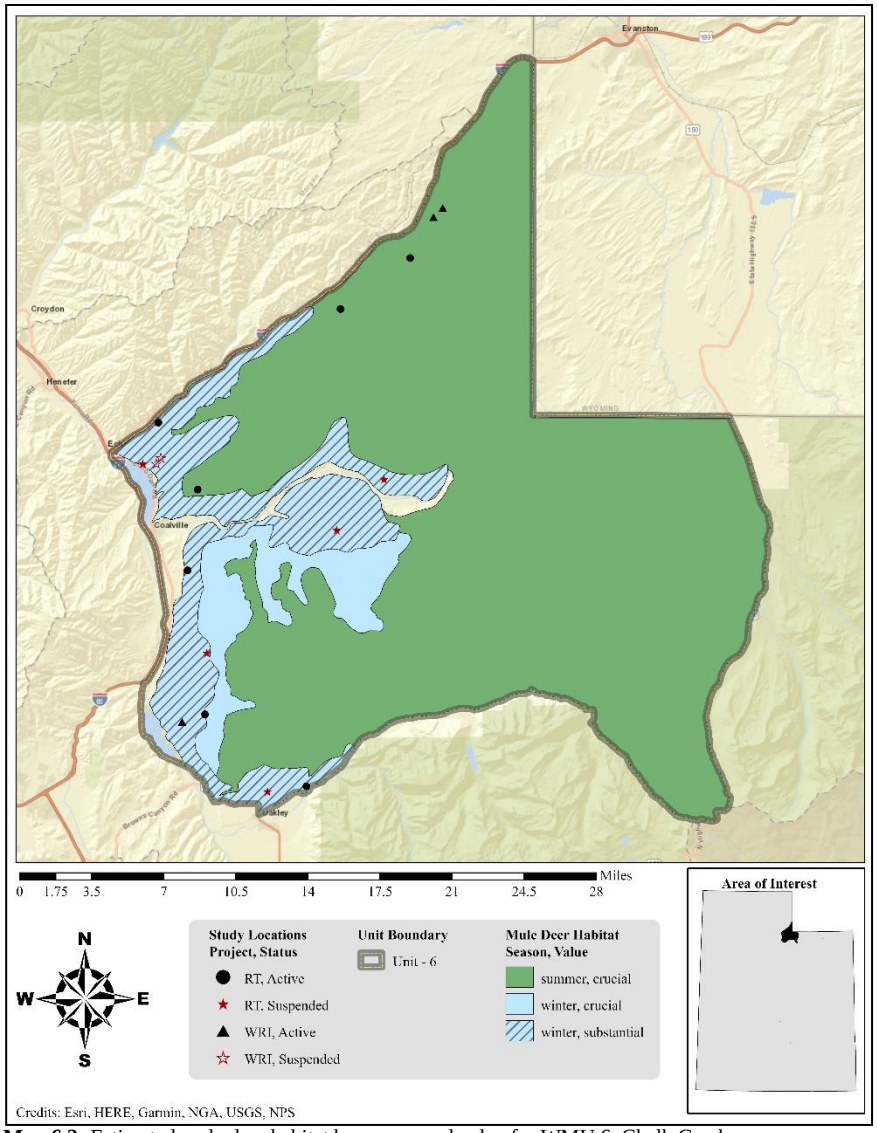
Figure 6.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

Big Game Habitat

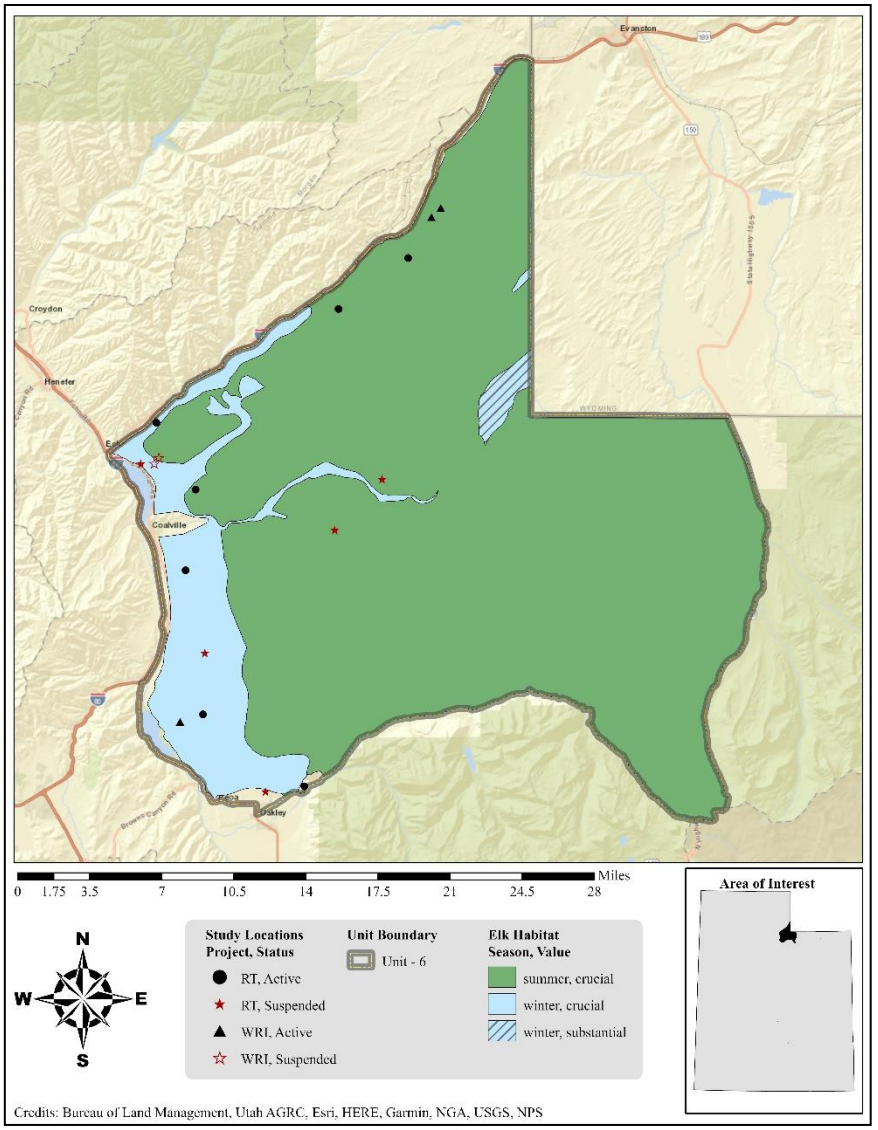
There are just over 380,000 acres classified as deer range on Unit 6 with 74,421 acres considered to be winter range and 306,970 acres classified as summer range (**Table 6.1**, **Map 6.2**). Privately owned land comprises 96% of the winter range, 3% is managed by the Utah Division of Wildlife Resources (UDWR), and the remaining 1% is administrated by the Bureau of Land Management (BLM), Bureau of Reclamation (BR), the Utah School and Institutional Trust Lands Administration (SITLA), the US Forest Service (USFS), Utah Department of Transportation (UDOT), and Utah State Parks (USP). Eighty-nine percent of the summer range is also privately owned, 11% is administrated by the USFS, and UDWR, SITLA, and the BLM manage the remaining 1% (**Table 6.2**, **Map 6.2**, **Map 6.6**). There are approximately 380,000 acres that are classified as elk range on the Chalk Creek management unit with 87% considered to be summer range and 13% classified as winter range. Of the elk summer range, 89% of land is privately owned, 10% is managed by the USFS, and the BLM, SITLA, and UDWR each administrate less than 1%. Ninety-four percent of elk winter range is privately owned, 5% is administrated by the UDWR, and the remaining 1% is managed by the BLM, SITLA, UDOT, USP, and BR (**Table 6.3**, **Map 6.3**, **Map 6.6**).

In the 1977 range inventory, the winter range was classified into 12 distinct vegetation types (Giunta, 1979). Of these vegetation types, seven of the larger, more important types were sampled: the sagebrush-grass and oak types were the most prevalent. The sagebrush-grass type is quite variable with basin big sagebrush, mountain big sagebrush, and Wyoming big sagebrush all occurring within the unit. This type is found on a variety of exposures, slopes, and elevations and is important on severe winter range. The oakbrush type is the most productive type, but is largely unavailable in severe winters. This type intergrades with the sagebrush-grass and other types. Other important types include juniper, which is especially important for thermal cover, and mountain brush.

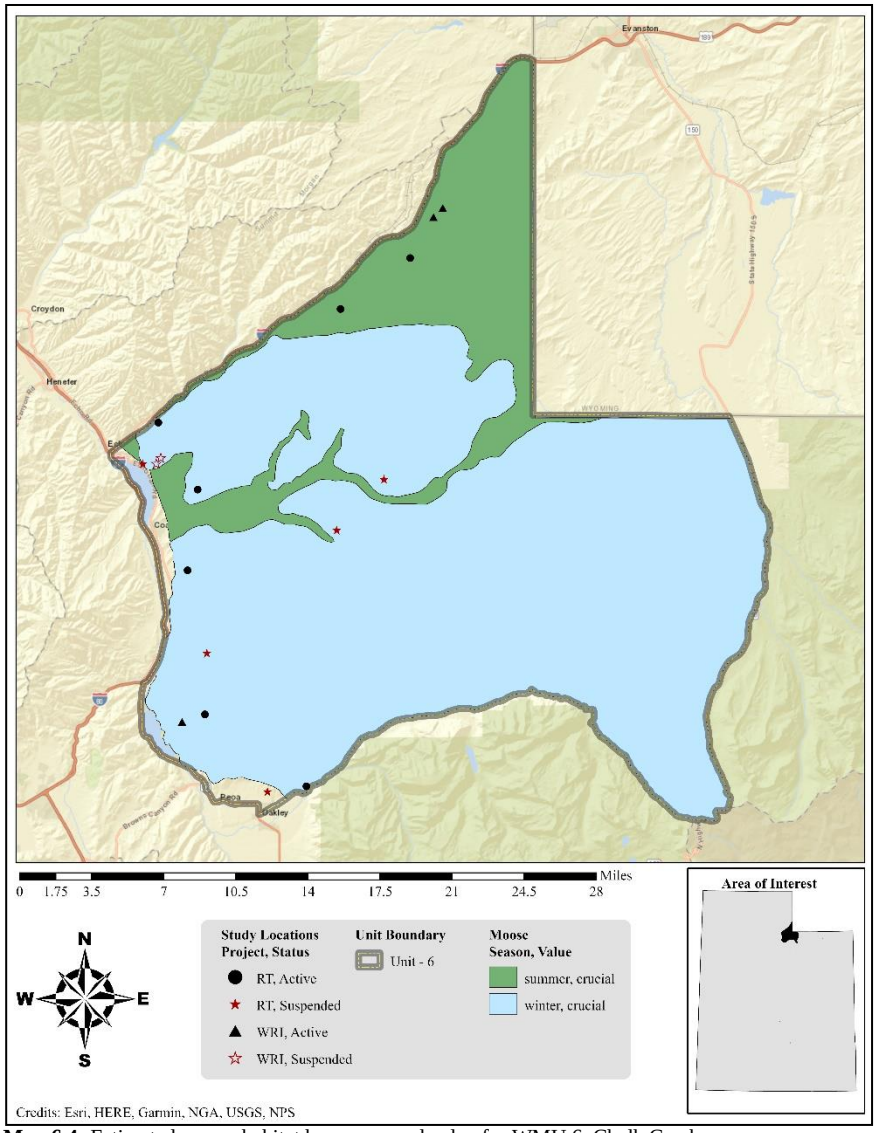
According to Landfire Existing Vegetation Coverage models, shrublands comprise approximately 43% of the unit. Of the shrubland cover, combined sagebrush shrubland and steppe vegetation types make up nearly 33% of the land cover, much of which is considered to be key mule deer habitat (**Table 6.6**).



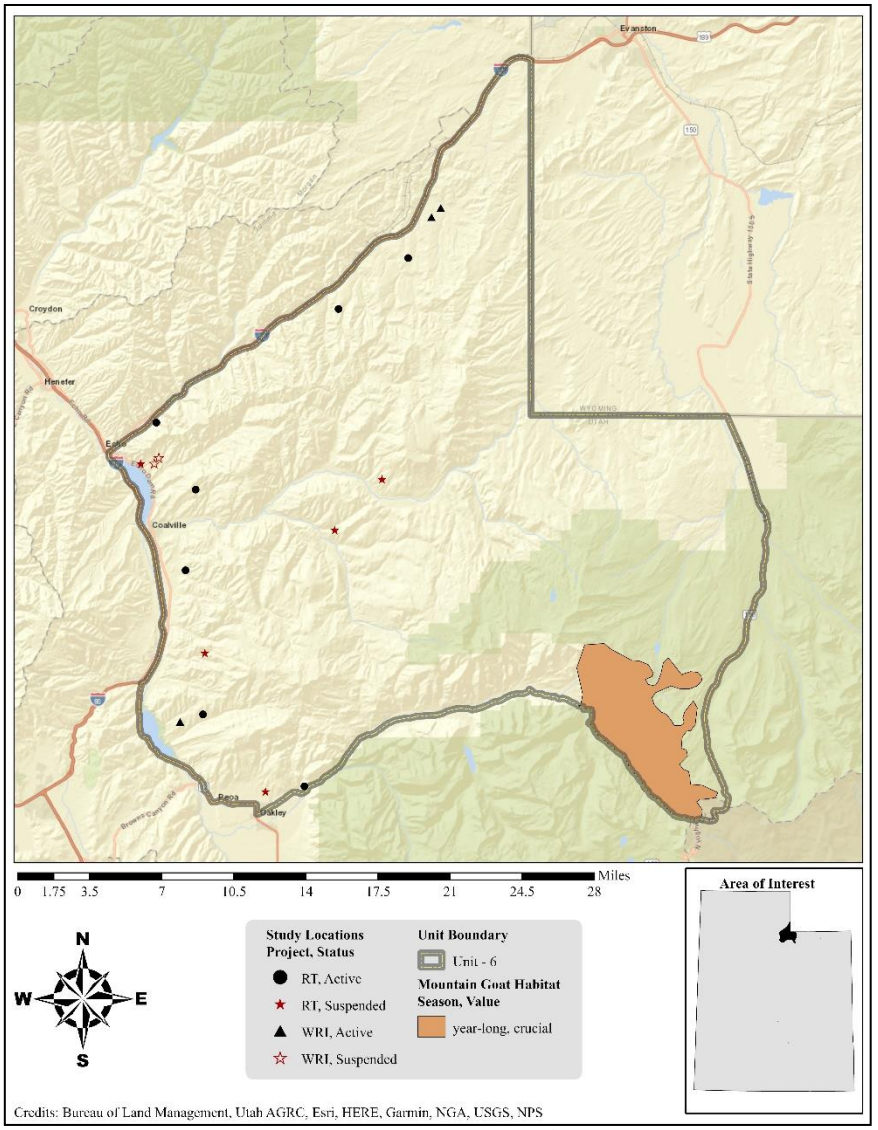
Map 6.2: Estimated mule deer habitat by season and value for WMU 6, Chalk Creek.



Map 6.3: Estimated elk habitat by season and value for WMU 6, Chalk Creek.



Map 6.4: Estimated moose habitat by season and value for WMU 6, Chalk Creek.



Map 6.5: Estimated mountain goat habitat by season and value for WMU 6, Chalk Creek.

	Year Long Range		Summer Range		Winter Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
Mule Deer	0	0%	306,970	80%	74,421	20%
Elk	0	0%	335,389	87%	48,010	13%
Moose	0	0%	73,342	19%	311,986	81%
Mountain Goat	17,965	100%	0	0%	0	0%

Table 6.1: Estimated mule deer, elk, moose, and mountain goat habitat acreage by season for WMU 6, Chalk Creek.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	88	<1%	331	<1%
Private	271,937	89%	71,296	96%
SITLA	237	<1%	213	<1%
UDWR	16	<1%	2,413	3%
USFS	34,693	11%	15	<1%
UDOT	0	0%	1	<1%
USP	0	0%	141	<1%
BR	0	0%	11	<1%
Total	306,970	**100%**	74,421	**100%**

Table 6.2: Estimated mule deer habitat acreage by season and ownership for WMU 6, Chalk Creek.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	160	<1%	232	<1%
Private	300,084	89%	45,205	94%
SITLA	237	<1%	213	<1%
UDWR	216	<1%	2,212	5%
USFS	34,693	10%	0	0%
UDOT	0	0%	1	<1%
USP	0	0%	128	<1%
BR	0	0%	20	<1%
Total	335,389	**100%**	48,010	**100%**

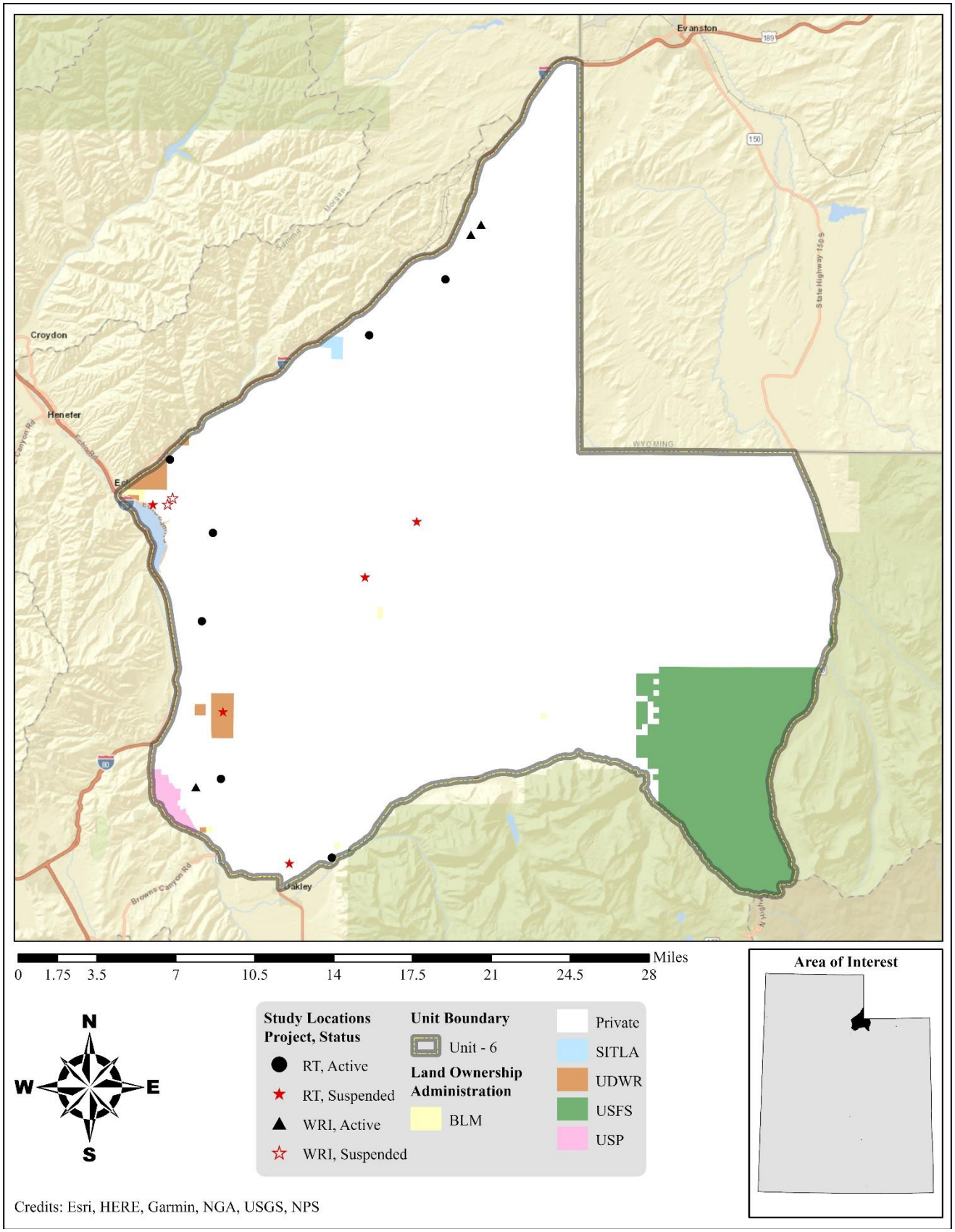
Table 6.3: Estimated elk habitat acreage by season and ownership for WMU 6, Chalk Creek.

	Summer Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	65	<1%	231	<1%
Private	72,480	99%	274,623	88%
SITLA	450	1%	0	0%
UDWR	296	<1%	2,128	1%
USFS	0	0%	34,708	11%
UDOT	12	<1%	0	0%
USP	0	0%	297	<1%
BR	38	<1%	0	0%
Total	73,342	**100%**	311,986	**100%**

Table 6.4: Estimated moose habitat acreage by season and ownership for WMU 6, Chalk Creek.

	Year Long Range	
Ownership	*Area (acres)*	*%*
Private	1,231	7%
USFS	16,734	93%
Total	17,965	**100%**

Table 6.5: Estimated mountain goat habitat acreage by season and ownership for WMU 6, Chalk Creek.



Map 6.6: Land ownership for WMU 6, Chalk Creek.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	262,599	26.30%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	84,310	8.44%	
	Inter-Mountain Basins Big Sagebrush Shrubland	34,710	3.48%	
	Inter-Mountain Basins Big Sagebrush Steppe	17,440	1.75%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	16,002	1.60%	
	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	13,172	1.32%	
	Rocky Mountain Lower Montane-Foothill Shrubland	7,073	0.71%	
	Rocky Mountain Alpine Dwarf-Shrubland	987	0.10%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	476	0.05%	
	Other Shrubland	468	0.05%	
	Inter-Mountain Basins Mat Saltbush Shrubland	160	0.02%	
	Inter-Mountain Basins Greasewood Flat	66	0.01%	43.81%
Other	Hardwood	167,845	16.81%	
	Agricultural	48,376	4.85%	
	Riparian	27,604	2.76%	
	Conifer-Hardwood	24,509	2.45%	
	Sparsely Vegetated	20,643	2.07%	
	Developed	20,474	2.05%	
	Open Water	6,564	0.66%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	89	0.01%	31.66%
Conifer	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	76,654	7.68%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	32,396	3.24%	
	Colorado Plateau Pinyon-Juniper Woodland	21,919	2.20%	
	Rocky Mountain Lodgepole Pine Forest	21,338	2.14%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	8,578	0.86%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	8,480	0.85%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	8,163	0.82%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	5,853	0.59%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	4,710	0.47%	
	Other Conifer	262	0.03%	
	Southern Rocky Mountain Ponderosa Pine Woodland	130	0.01%	18.88%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	15,731	1.58%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	8,759	0.88%	
	Great Basin & Intermountain Introduced Annual Grassland	919	0.09%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	115	0.01%	2.56%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	12,382	1.24%	
	Southern Rocky Mountain Montane-Subalpine Grassland	6,200	0.62%	
	Inter-Mountain Basins Semi-Desert Grassland	3,321	0.33%	
	Other Grassland	2,363	0.24%	
	Rocky Mountain Alpine Turf	243	0.02%	
	Rocky Mountain Alpine Fell-Field	229	0.02%	2.48%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	3,589	0.36%	
	Interior Western North American Temperate Ruderal Shrubland	2,542	0.25%	
	Interior West Ruderal Riparian Scrub	<1	0.00%	0.61%
Total		**998,441**	**100%**	**100%**

Table 6.6: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 6, Chalk Creek.

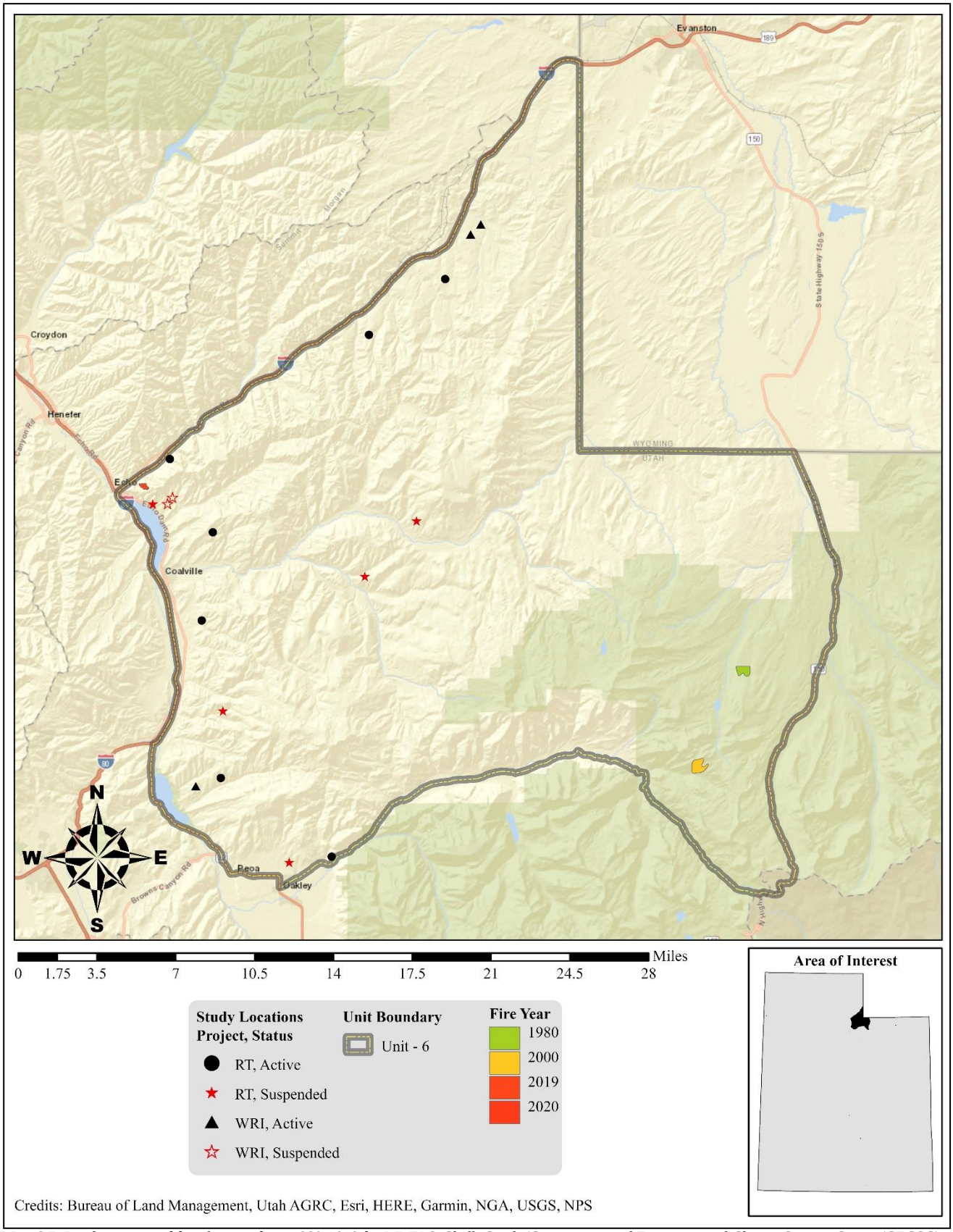
Limiting Factors to Big Game Habitat

Widespread private ownership has led to numerous management complications; unregulated development and loss of habitat are some of the biggest problems in this unit. The discovery, development, and removal of oil resources throughout the unit (especially the Chalk Creek area) has led to increased road and housing developments. Agricultural land makes up 5% of the unit according to the Landfire Existing Vegetation Coverage model (**Table 6.6**). More specifically, agricultural projects on crucial winter range continue to increase wildlife depredation problems and further decrease the available big game range. The establishment of hunting clubs has led to access that is strictly restricted for trophy hunting in large areas of the unit. Private landowners are also less likely to undertake extensive rehabilitation projects to improve the value of the remaining range.

The Landfire Existing Vegetation Coverage model also indicates that over 5% of the Chalk Creek unit is comprised of limber pine-juniper and pinyon-juniper woodlands (**Table 6.6**): Encroachment by these woodland communities poses a significant threat to important rangelands. Invasion of these woodlands into sagebrush communities has been shown to decrease sagebrush and herbaceous cover, therefore decreasing available forage for wildlife (Miller, Svejcar, & Rose, 2000). Lack of mule deer wintering range is also a limiting factor in this unit, with many deer migrating to the Morgan-South Rich unit during the winters.

Echo and Rockport Reservoirs, located on the west side of the unit on the Weber River, are both significant barriers to big game movement. I-80 through Echo Canyon also discourages big game movement and many deer deaths occur there during winter and spring. In addition, fires have destroyed large tracts of important range. Because of this habitat loss, increasing numbers of mule deer, elk, and moose tend to concentrate in the lower areas on agricultural land and at mouths of canyons, especially during severe winters.

Deer fences and crossings limiting range are also a concern. However, cooperation with the Utah Department of Transportation in construction of highway fences, passage structures, warning signs, etc. will continue in order to ensure proper access to habitat as well as deer and human safety.



Map 6.7: Land coverage of fires by year from 1980-2020 for WMU 6, Chalk Creek (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

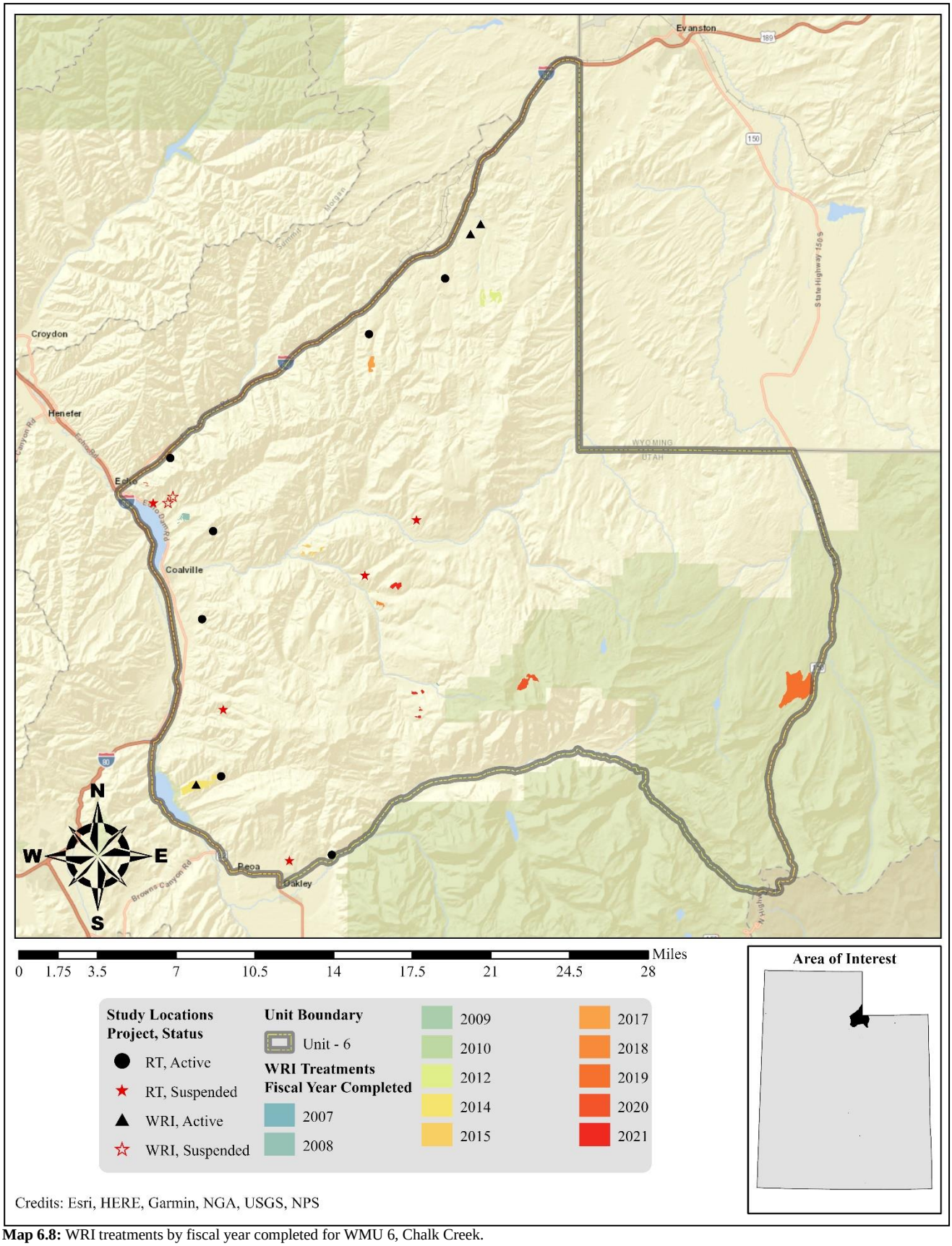
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 1,943 acres of land have been treated within the Chalk Creek unit since the WRI was implemented in 2004 (**Map 6.8**). An additional 114 acres are currently undergoing treatment projects, while 676 acres are proposed for additional projects. Treatments frequently overlap one another bringing the net total of completed treatment acres to 1,943 acres for this unit (**Table 6.7**). 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.

Prescribed fire is the most common management practice in this unit. Other management practices include seeding desirable herbaceous species, chaining, harrow, hand crews, and other treatments (**Table 6.7**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**354**	**0**	**0**	**354**
Ely (Two-Way)	354	0	0	354
Bullhog	**0**	**0**	**102**	**102**
Full Size	0	0	102	102
Forestry Practices	**0**	**46**	**573**	**619**
Coppice Cutting	0	46	0	46
Thinning (Non-Commercial)	0	0	573	573
Harrow	**75**	**0**	**0**	**75**
≤15 ft. (One-Way)	75	0	0	75
Interseeding	**7**	**0**	**0**	**7**
Planting/Transplanting	**172**	**0**	**0**	**172**
Container Stock	172	0	0	172
Prescribed Fire	**902**	**0**	**0**	**902**
Prescribed Fire	902	0	0	902
Seeding (Primary)	**332**	**0**	**0**	**332**
Broadcast (Aerial-Helicopter)	<1	0	0	<1
Drill (Rangeland)	101	0	0	101
Ground (Mechanical Application)	231	0	0	231
Hand Seeding	1	0	0	1
Skid-Steer Mounted Tree Cutter	**32**	**68**	**0**	**99**
Hydraulic Shears	32	68	0	99
Vegetation Removal/Hand Crew	**69**	**0**	**0**	**69**
Lop-Pile-Burn	69	0	0	69
Grand Total	**1,943**	**114**	**676**	**2,732**
***Total Land Area Treated**	**1,943**	**114**	**676**	**2,732**

Table 6.7: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 6, Chalk Creek. Data accessed on 02/09/2022.
*Does not include overlapping treatments.



Map 6.8: WRI treatments by fiscal year completed for WMU 6, Chalk Creek.

Range Trend Studies

Range Trend studies have been sampled within WMU 6 on a regular basis since 1984, with studies being added or suspended as was deemed necessary (**Table 6.8**). Due to changes in sampling methodologies, only data sampled following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 6.9**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
06-1	Anshutz Ranch	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
06-2	Echo Canyon Rest Area	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Shrub)
06-3	Spring Hollow Burn	RT	Active	1984, 1990, 2001, 2006, 2011, 2016	Mountain Loam (Mountain Big Sagebrush)
06-4	Echo Reservoir	RT	Suspended	1984, 1990, 1996, 2001, 2006, 2011	Not Verified
06-5	Spring Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2021	Mountain Loam (Mountain Big Sagebrush)
06-6	Hixon Canyon	RT	Suspended	1984, 1990, 1996, 2006	Not Verified
06-7	Crandall Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2017, 2021	Mountain Loam (Browse)
06-8	South Fork Chalk Creek	RT	Suspended	1990, 1996	Not Verified
06-9	North Oakley Bench	RT	Suspended	1984, 1990, 1996, 2001, 2006, 2011	Not Verified
06-10	Mahogany Hills	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Shrub)
06-12	Stag Canyon	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
06R-1	Cache Cave 1	WRI	Active	2004, 2007, 2012, 2017	Upland Loam (Basin Big Sagebrush)
06R-2	Cache Cave 2	WRI	Active	2004, 2007, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
06R-3	Grassy Valley Disking	WRI	Suspended	2007	Not Verified
06R-4	Grassy Valley Chaining	WRI	Suspended	2007	Not Verified
06R-5	Lower Crandall Canyon	WRI	Active	2014, 2017, 2021	Mountain Loam (Mountain Big Sagebrush)

Table 6.8: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 6, Chalk Creek.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
06-2	Echo Canyon Rest Area	Wildfire	Echo Fire	July 1998	40	
		Wildfire		Between June 2016 and July 2021		
		Herd Seeder	Tervels Fire Rehab	November 2018	19	4766
06-3	Spring Hollow Burn	Wildfire	Thirty Five Canyon Fire	July 1980		
		Seed Unknown		Historic		
06-12	Stag Canyon	Wildfire		Historic		
06R-1	Cache Cave 1	Double Drum	Cache Cave	Fall 2004	500	PDB
		Broadcast Before	Cache Cave	Fall 2004	500	PDB
06R-2	Cache Cave 2	Broadcast Before	Cache Cave	Fall 2004	500	PDB
		Double Drum	Cache Cave	Fall 2004	500	PDB
06R-5	Lower Crandall Canyon	Two-Way Ely	Crandall Canyon Juniper Thinning	October-November 2013	354	2360
		Aerial After	Crandall Canyon Juniper Thinning	December 2013	354	2360
		Drill	Crandall Canyon Juniper Thinning	November-December 2013		2360

Table 6.9: Range Trend and WRI studies known disturbance history for WMU 6, Chalk Creek. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Browse)

There is one study [Crandall Canyon (06-7)] that is classified as a Mountain (Browse) ecological site. The Crandall Canyon site is located 3.3 miles due east of Rockport State Park and Rockport Lake up Crandall Canyon (**Table 6.8**).

Shrubs/Trees: The primary browse species on this site include alderleaf mountain mahogany (*Cercocarpus montanus*), Utah serviceberry (*Amelanchier utahensis*), Gambel oak (*Quercus gambelii*), and mountain snowberry (*Symphoricarpos oreophilus*). There are lesser components of the shrub community that include antelope bitterbrush (*Purshia tridentata*) and mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*): both of these average 1 percent cover or less. The cover has remained relatively stable through the years (**Figure 6.2**). Average preferred browse demographics indicate that the population has been comprised of mainly mature individuals during most sample years, with that segment of the population remaining stable over the sample period. In addition, young plants have had considerable increases in 2016 and 2021 as compared to the beginning of the sample period. Decadent plants make up a small portion of the browse community. Overall, the browse population is increasing in density which may be largely driven by increases in the snowberry and oak populations (**Figure 6.9**). Preferred browse utilization has generally decreased over the sample period with heavy use becoming more evident from year to year (**Figure 6.11**).

Encroachment by Utah juniper (*Juniperus osteosperma*) with few occurrences of twoneedle pinyon (*Pinus edulis*) is occurring on Crandall Canyon. Cover of juniper has varied, but has generally decreased over the sample period. However, juniper density has steadily increased from 32 trees/acre in 2006 to 63 trees/acre in 2021 (**Figure 6.5**, **Figure 6.7**).

Herbaceous Understory: The herbaceous understory of this site is composed of a variety of perennial grasses and forbs, although there is a small contingent of introduced annual forbs and grasses. Thickspike wheatgrass (*Elymus lanceolatus*) and Indian ricegrass (*Achnatherum hymenoides*) are the primary native perennial grass species on site. Overall nested frequency in the herbaceous community has decreased over the sample period, which is mostly driven by decreases in perennial grasses and annual forbs. Total herbaceous cover increased from 1996 to 2011. However, the 2016 and 2021 sample years showed a dramatic decrease in perennial grass cover. Perennial grasses decreased from 18% cover in 2011 to 6% cover in 2016 and 2021: this decrease is due to the loss of bluebunch bluegrass (*Pseudoroegneria spicata*) (**Figure 6.13**, **Figure 6.15**).

Occupancy: Average pellet group transect data shows that occupancy was at its highest in 2001, but decreased considerably in 2006. Total use has steadily increased since 2006, however, with deer being the primary occupants each year. Mean abundance of mule deer pellet groups showed a high of 50 days use/acre in 2001 and a low of 9 days use/acre in 2011. Elk presence has ranged between 1 days use/acre in 2006 and 12 days use/acre in 2006. Cattle presence has remained low for this site (**Figure 6.17**).

Mountain (Shrub)

There are two studies [Echo Canyon Rest Area (06-2) and Mahogany Hills (06-10)] that are considered to be Mountain (Shrub) ecological sites. The Echo Canyon Rest Area site is located 2.75 miles northeast of the town of Echo on I-80. Mahogany Hills is 2.5 miles northeast of the town of Oakley off of Weber Canyon Road (**Table 6.8**).

Shrubs/Trees: The primary browse species on these sites include mountain snowberry (*Symphoricarpos oreophilus*) and Gambel oak (*Quercus gambelii*). Mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*) is a dominant species on the Mahogany Hills site, but has been a minor component on the Echo Canyon Rest Area study following the Echo wildfire in 1996. There are lesser components of the shrub community also present that include antelope bitterbrush (*Purshia tridentata*), Utah serviceberry (*Amelanchier utahesis*) and alderleaf mountain mahogany (*Cercocarpus montanus*). Mean cover for preferred browse species has remained relatively stable through the years, but total average shrub cover has slightly decreased since 2006 (**Figure 6.3**). Average preferred browse demographics indicate that the population has been comprised of mainly mature individuals during most sample years. Young plants within the population have generally increased in density over the sample period, with a considerable density increase occurring in 2021 (**Figure 6.9**). Total utilization was at its highest at 59% in 1996. Of the utilized shrubs in the population, most appear to be moderately used in most sample years. However, shrubs observed with herbivory were mostly categorized as being heavily used in 2016 and 2021 (**Figure 6.11**).

Conifer encroachment is not currently a concern for the sites of this ecological potential (**Figure 6.5**, **Figure 6.7**).

Herbaceous Understory: The herbaceous understory of the Echo Canyon Rest Area and Mahogany Hills sites are composed of a variety of perennial grasses and forbs. There is a small contingent of introduced annual forbs and grasses, but more so on the Echo Canyon site. Bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda*) are native species and are the primary perennial grasses on the Echo Canyon site, while the introduced species smooth brome (*Bromus inermis*) is the dominant perennial grass species on the Mahogany Hills study. There are many forbs present on these study sites, and many of them are native; American Vetch (*Vicia americana*) is the most common native forb and has an average cover of 3.2 percent, but has only been present on the Echo Canyon (**Figure 6.13**, **Figure 6.15**).

Occupancy: Average pellet group transect data shows animal presence to be variable, but that overall usage by both deer and elk have generally increased. Mean abundance of deer pellet groups showed a high of 38 days use/acre in 2006 and a low of 15 days use/acre in 2011. Average elk pellet group abundance has ranged between 11 days use/acre in 2016 and 48 days use/acre in 2006. Cattle have not appeared in transect data since 2001 (**Figure 6.17**).

Mountain (Big Sagebrush)

There are two studies [Spring Hollow Burn (06-3) and Spring Canyon (06-5)] that are classified as Mountain (Big Sagebrush) ecological sites. Spring Hollow Burn is 2.75 miles east of the town of Coalville. The Spring Canyon site is about one mile east of Hoytsville in Spring Canyon (**Table 6.8**). The Spring Canyon Study was not sampled in 2016 while Spring Hollow Burn was sampled, so averaged data is represented by Spring Hollow Burn in 2016. Conversely, the Spring Hollow Burn study was not read in 2021, so all averaged data for 2021 is represented by the Spring Canyon study.

Shrubs/Trees: The primary species present for preferred browse on the Spring Hollow Burn site are Utah serviceberry (*Amelanchier utahensis*) and mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), both of which are rare; the site has few desirable shrubs present. However, the primary shrubs on Spring Hollow Burn are broom snakeweed (*Gutierrezia sarothrae*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus ssp. viscidiflorus*). The cover for Spring Hollow Burn has remained stable over the study, with the exception being a spike in the cover of broom snakeweed (*Gutierrezia sarothrae*) in 2016. For the Spring Canyon site, the cover of preferred browse has remained negligible (**Figure 6.4**). The preferred browse populations on these sites are small, so trends are difficult to decipher. However, what little trend there is determined by the Spring Hollow Burn study (**Figure 6.9**). Due to Spring Hollow Burn being the only representative study containing preferred browse species, overall utilization for this ecotype is also represented by the Spring Hollow Burn site. Of the few plants observed, most were moderately utilized between the 2001 and 2016 sample years (**Figure 6.11**).

Juniper encroachment is not an issue on the Spring Hollow Burn study. Spring Canyon is considered to be in Phase III of woodland succession, and juniper cover has remained near or over 40 percent since 2006. Juniper density has varied, but remains high as of 2021 (**Figure 6.5**, **Figure 6.7**).

Herbaceous Understory: The herbaceous trend for this ecological type is driven by the Spring Hollow Burn study. Average total herbaceous cover for this ecological site was high between the 2001 and 2016 sample years. There are some native grasses present, but much of the perennial grass cover is provided by the introduced species crested wheatgrass (*Agropyron cristatum*), which is found on the Spring Hollow Burn study. Cover and nested frequency for the 2021 sample year substantially lower than in previous years, and is due to the Spring Hollow Burn study not being sampled (**Figure 6.13**, **Figure 6.15**).

Occupancy: Average pellet group data indicates that the overall utilization of the site has remained stable, and deer have remained the primary occupants. Deer have range from 31 days use/acre in 2001 to 49.6 days use/acre in 2006. Elk have ranged from 1.3 days use/acre in 2021 and 2016 to 15.4 days use/acre in 2011. Cattle are primarily found on Spring Hollow Burn and usage has varied from 8.0 days use/acre in 2011 and 2016 to a high of 21 days use/acre in 2001. (**Figure 6.17**).

Upland (Big Sagebrush)

There are two studies [Anshutz Ranch (06-1) and Stag Canyon (06-12)] that are considered to be Upland (Big Sagebrush) ecological sites. Anshutz Ranch is located 1.5 miles south of I-80 off Rees Creek. Stag Canyon is located 2 miles south of I-80 in Stag Canyon, which is off of Robinson Creek (**Table 6.8**).

Shrubs/Trees: Both of the sites surveyed have sagebrush species as their main shrub component. Stag Canyon is dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), while the Anshutz Ranch site is dominated by a mixture of little sagebrush (*Artemisia arbuscula*) and mountain big sagebrush. The cover percentage has remained stable (**Figure 6.4**), but the recruitment of young plants has decreased over time: this downward trend is driven by the sagebrush population found on the Stag Canyon site. Average preferred shrub demographics indicate that the populations of sagebrush are largely composed of mature individuals. Recruitment of young sagebrush has steadily diminished over the length of the sample years as previously mentioned, while decadence of sagebrush has largely increased (**Figure 6.10**). Utilization has been highly variable from year to year and a trend is difficult to determine, but it appears to be that moderate utilization is increasing. Moreover, each sample year the majority of plants received moderate use (**Figure 6.12**).

Encroachment of Utah juniper (*Juniperus osteosperma*) is occurring on the Stag Canyon study. Cover is currently nominal as of 2021, but it may become an issue in the future (**Figure 6.6**, **Figure 6.8**).

Herbaceous Understory: The herbaceous understory for the two sites is composed of a mix of perennial grasses and forbs. The most common perennial grasses include squirreltail (*Elymus elymoides*), thickspike wheatgrass (*Elymus lanceolatus*), needle and thread (*Hesperostipa comata*), and bluebunch wheatgrass (*Pseudoroegneria spicata*). There is a moderate annual grass component present on both sites. Perennial grass and forb cover have generally decreased through the sample years (**Figure 6.14**, **Figure 6.16**).

Occupancy: Average pellet group transect data for both sites show a generalized increasing trend for mule deer presence and a notable decreasing trend in usage for elk over time on the two sites. Elk averaged 54 days use/acre per site in 2001 and decreased to 1 days use/acre per site in 2021. The mean abundance of deer pellet groups was 9 days use/acre in 2001 and increased to 16 days use/acre in 2021. Thus, it appears that deer and elk have switched with deer being the primary occupants of the sites between 2001 and 2021. Mean abundance of cattle pellet groups has slightly increased from 7 days use/acre in 2001 to 10 days use/acre in 2021 (**Figure 6.18**).

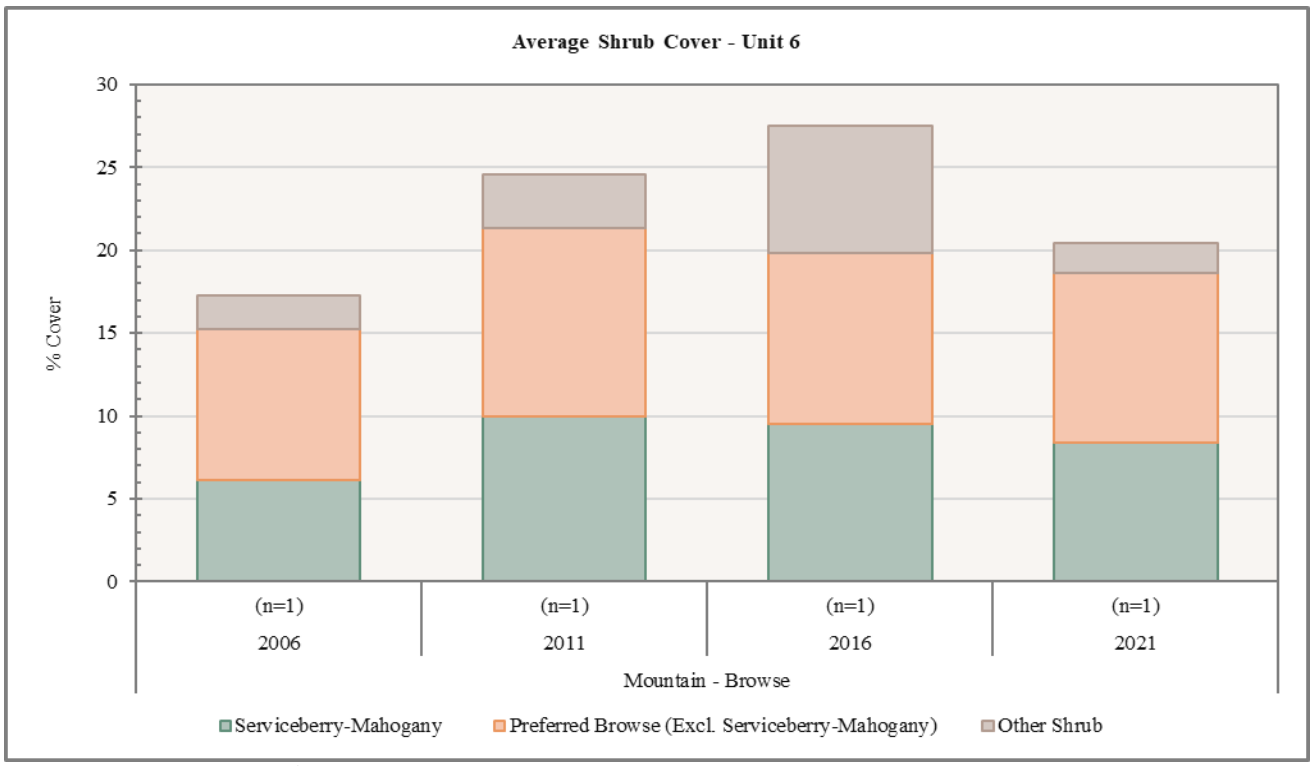


Figure 6.2: Average shrub cover for Mountain - Browse study sites in WMU 6, Chalk Creek.

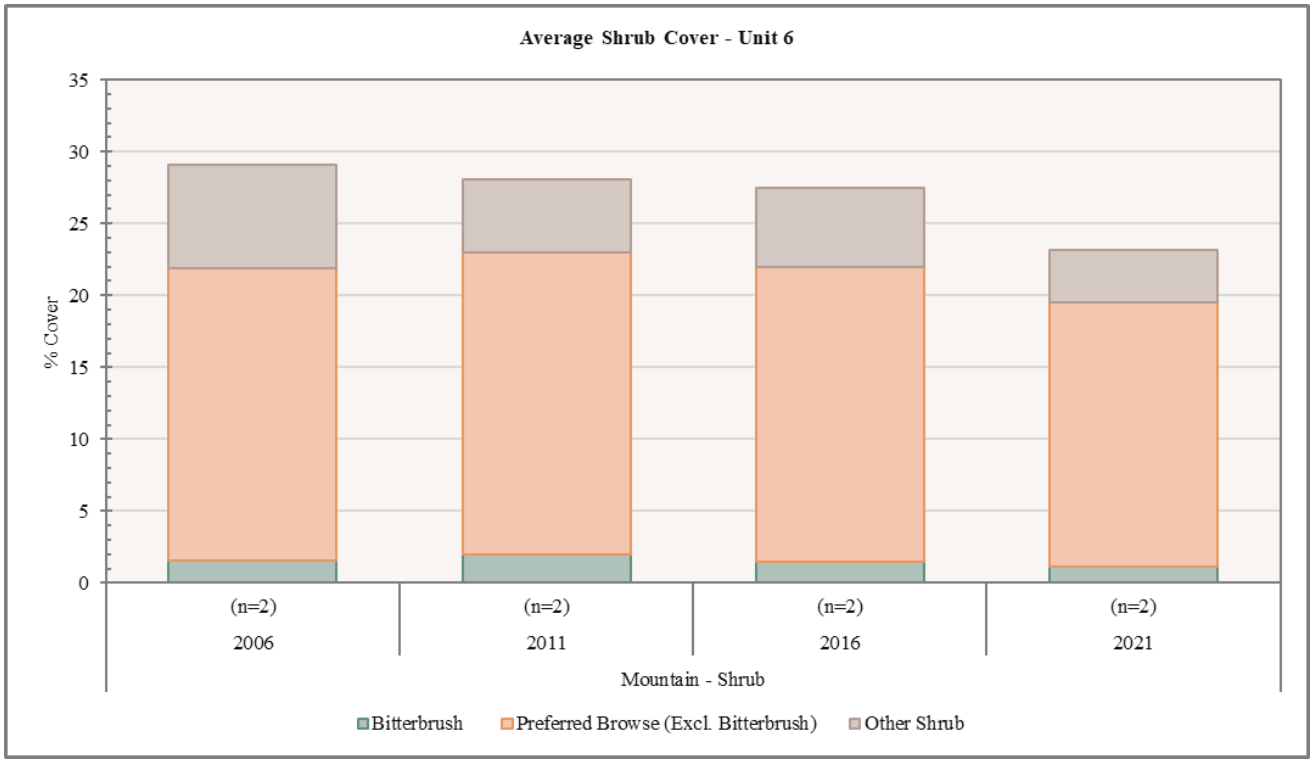


Figure 6.3: Average shrub cover for Mountain - Shrub study sites in WMU 6, Chalk Creek.

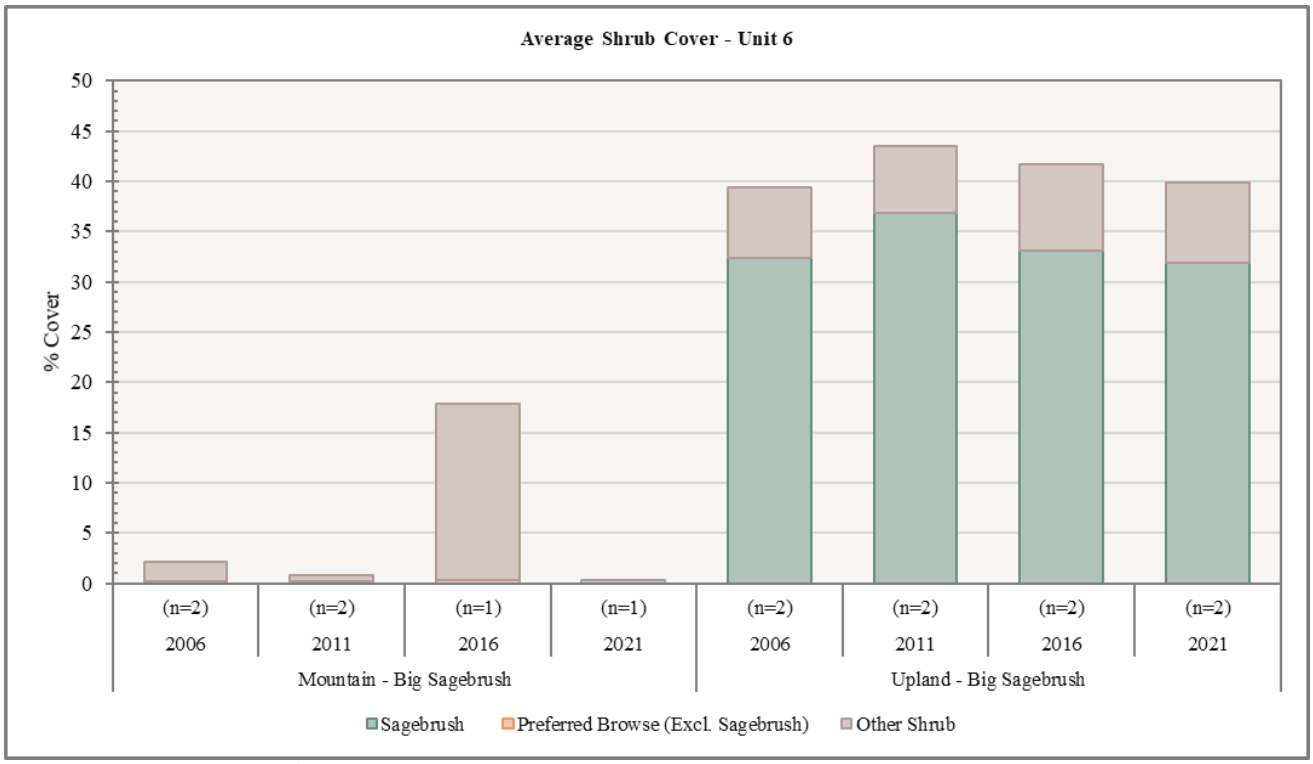


Figure 6.4: Average shrub cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

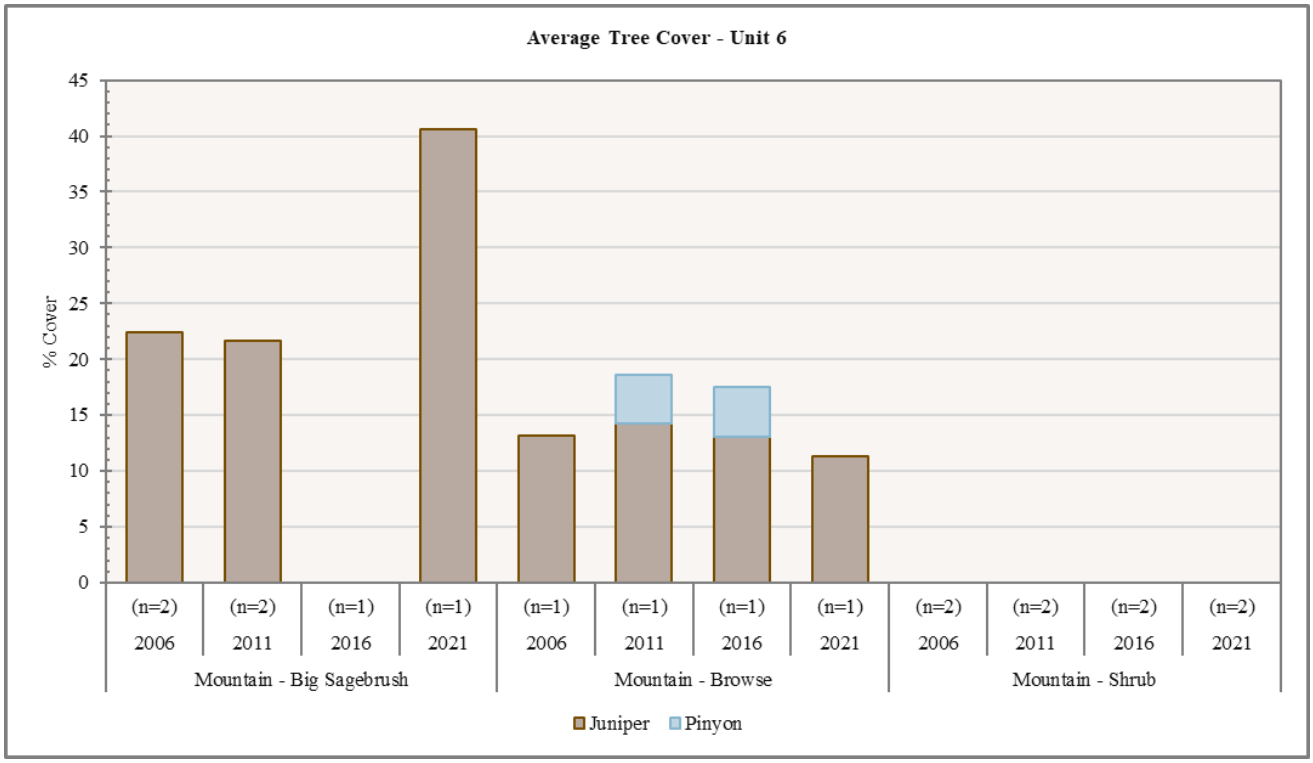


Figure 6.5: Average tree cover for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 6, Chalk Creek.

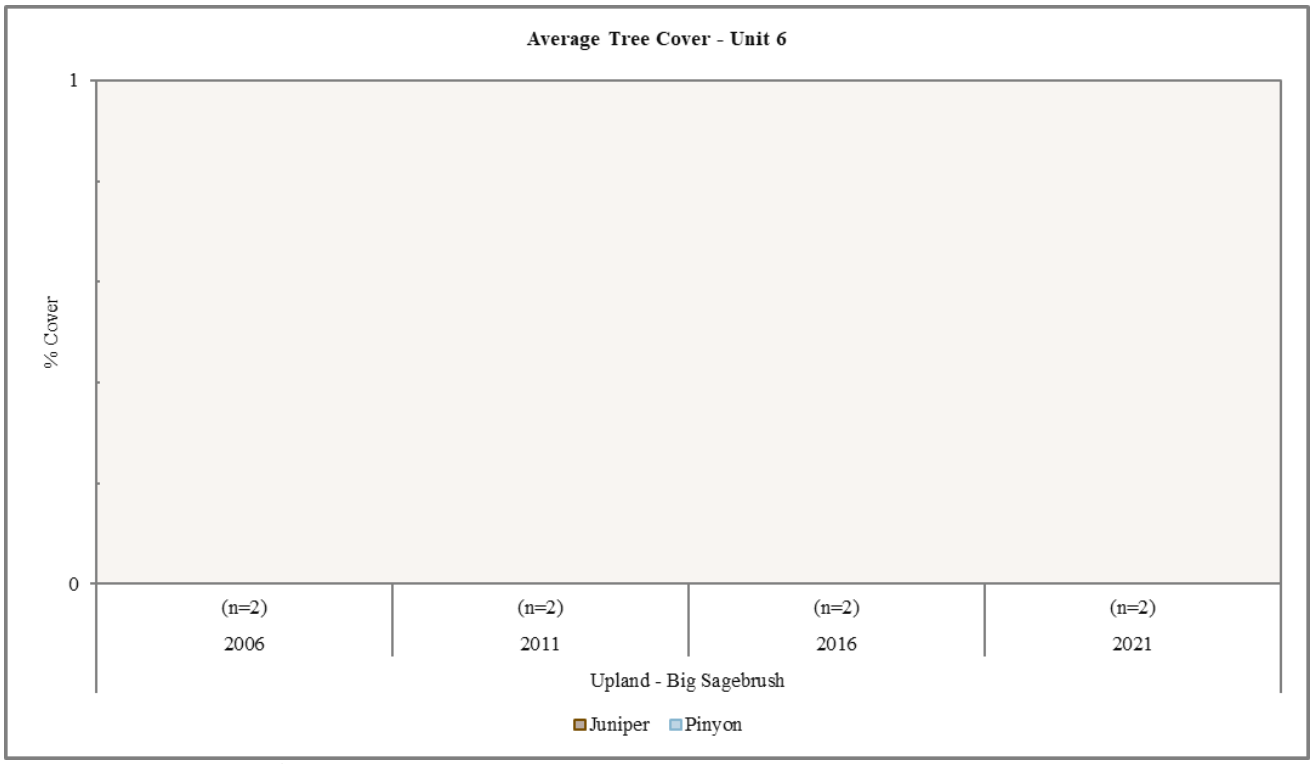


Figure 6.6: Average tree cover for Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

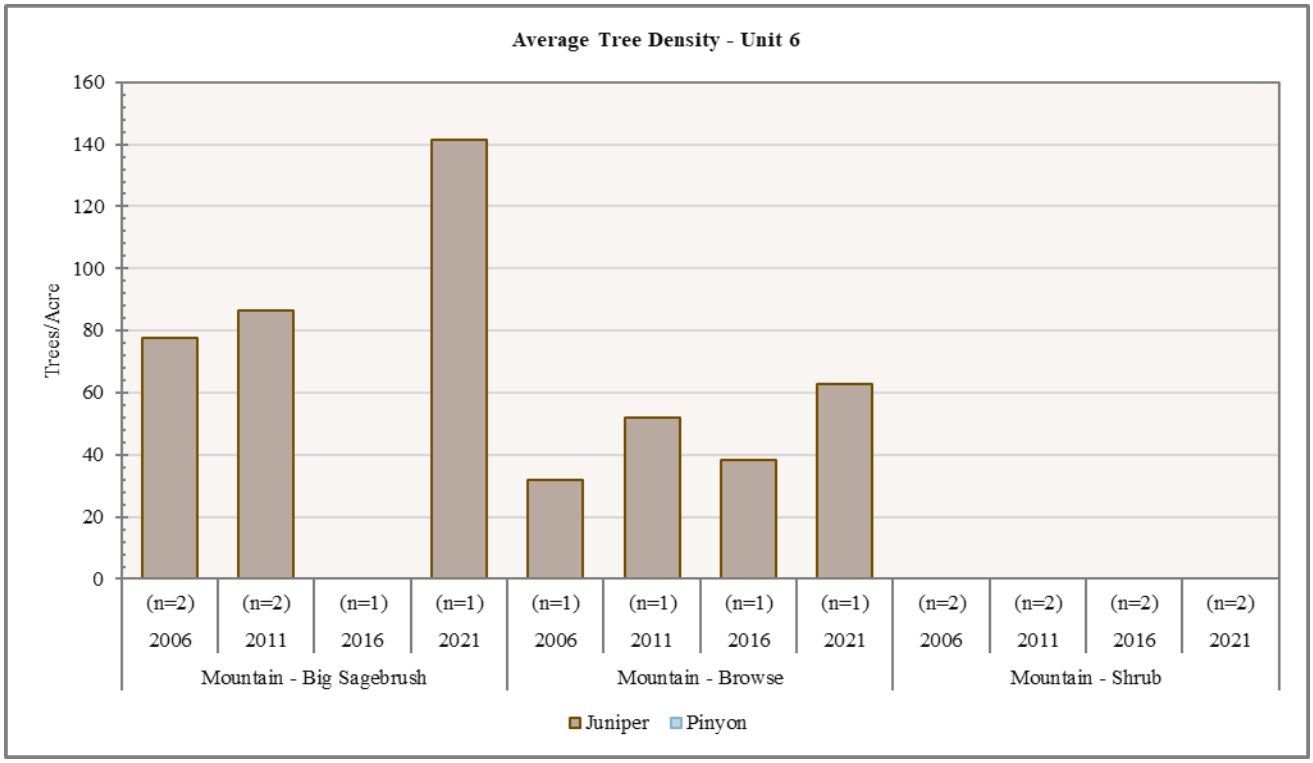


Figure 6.7: Average tree density for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 6, Chalk Creek.

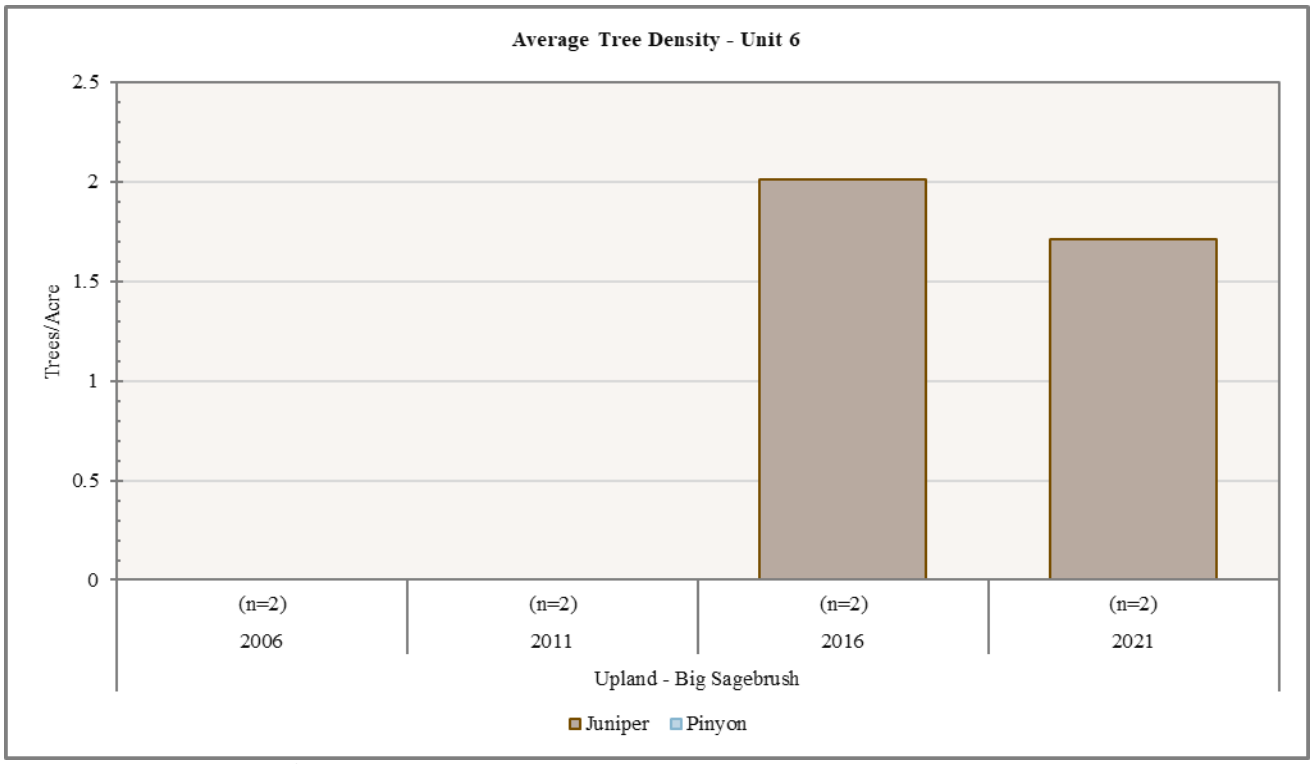


Figure 6.8: Average tree density for Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

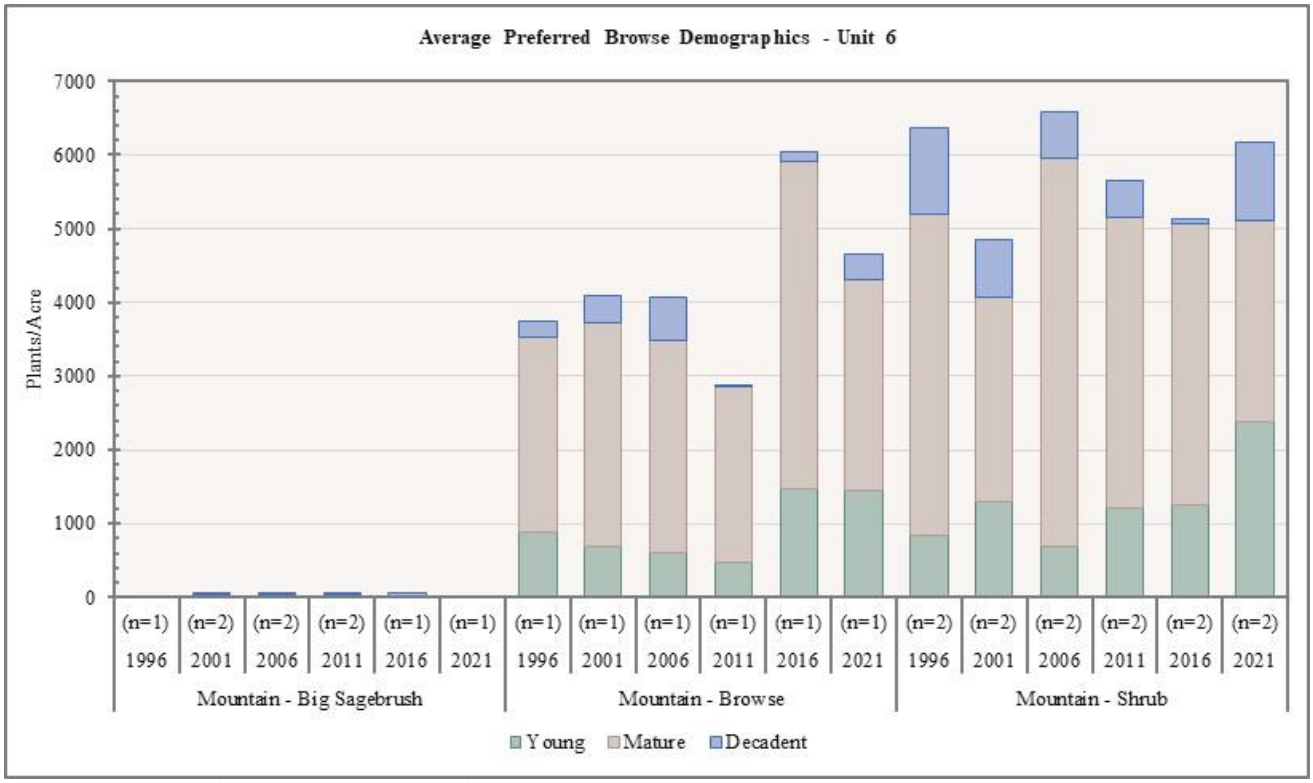


Figure 6.9: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 6, Chalk Creek.

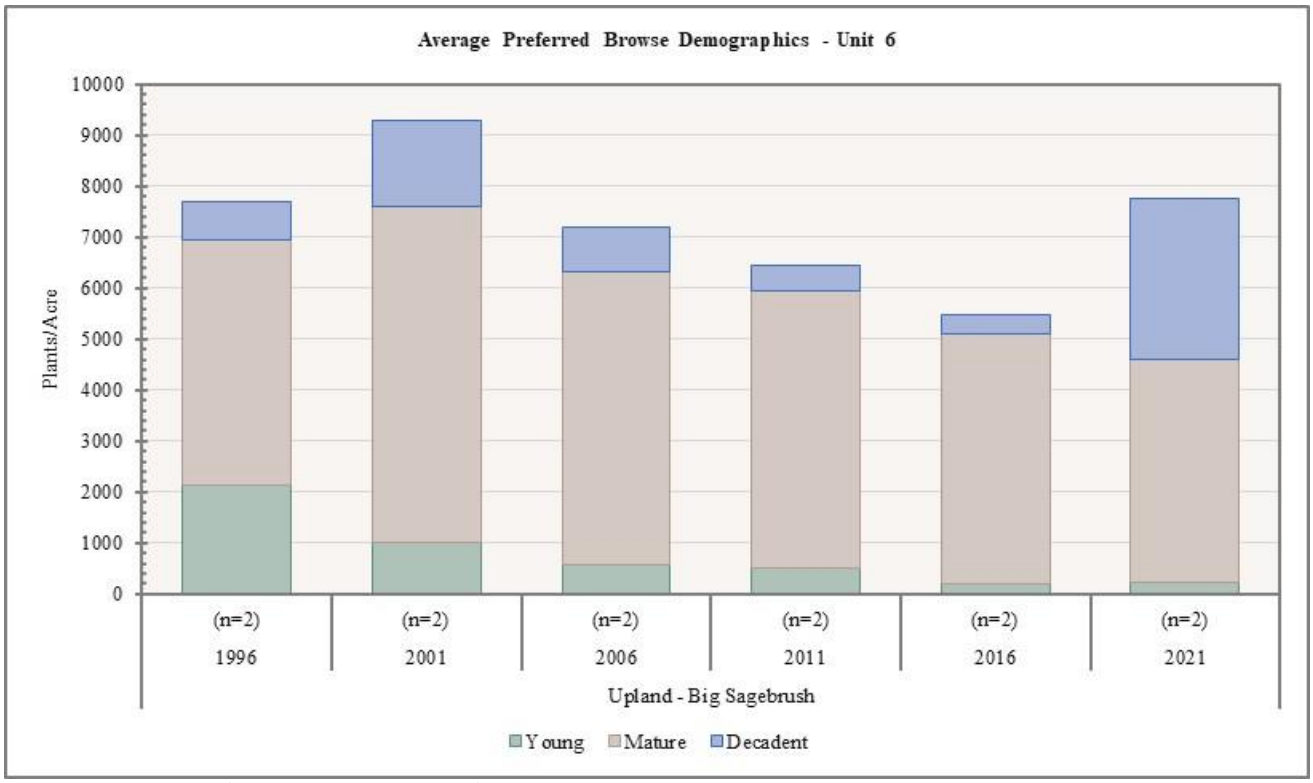


Figure 6.10: Average preferred browse demographics for Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

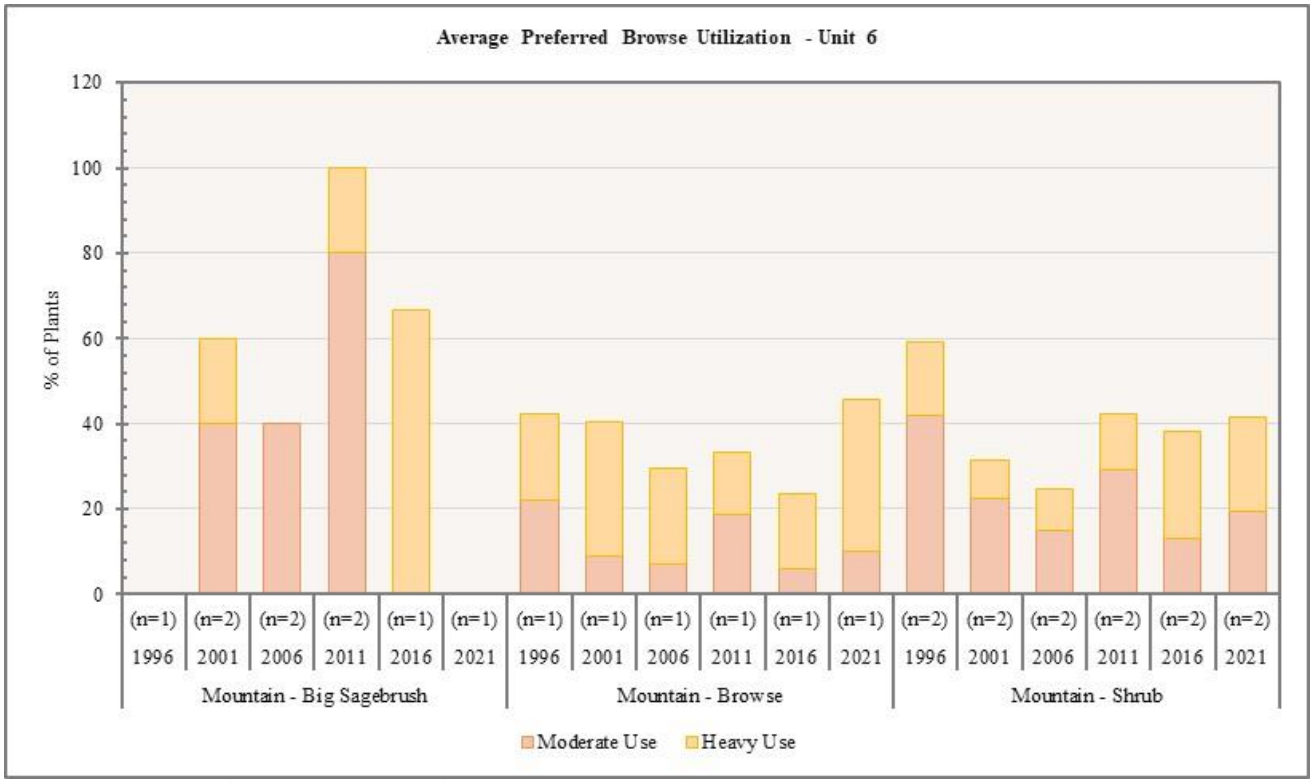


Figure 6.11: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 6, Chalk Creek.

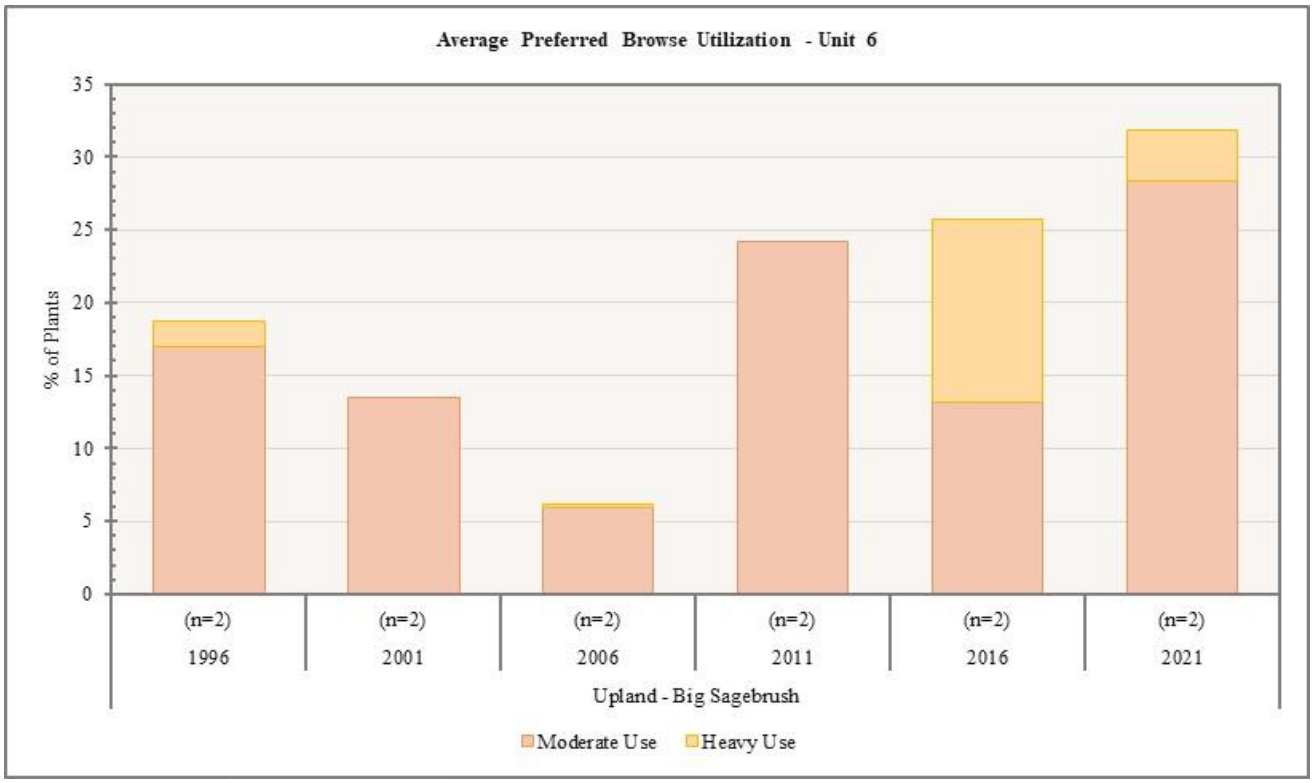


Figure 6.12: Average preferred browse utilization for Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

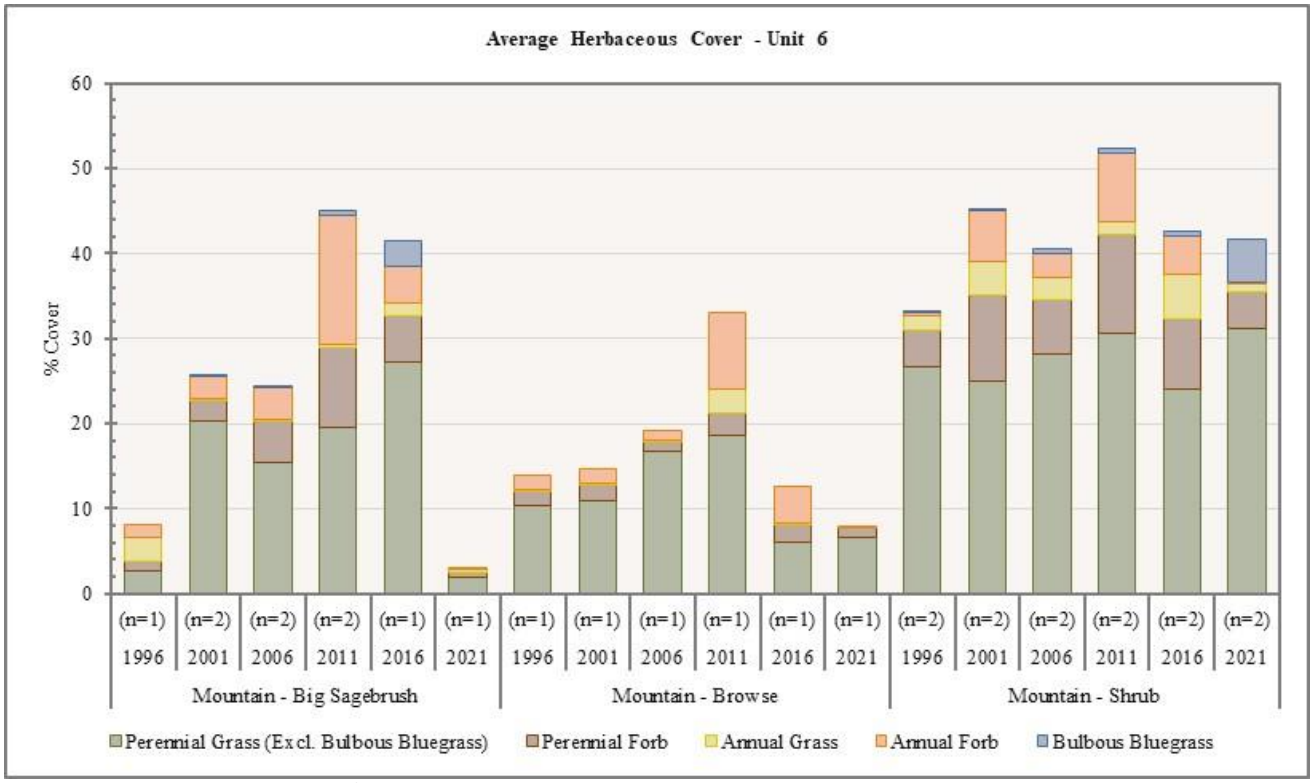


Figure 6.13: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 6, Chalk Creek.

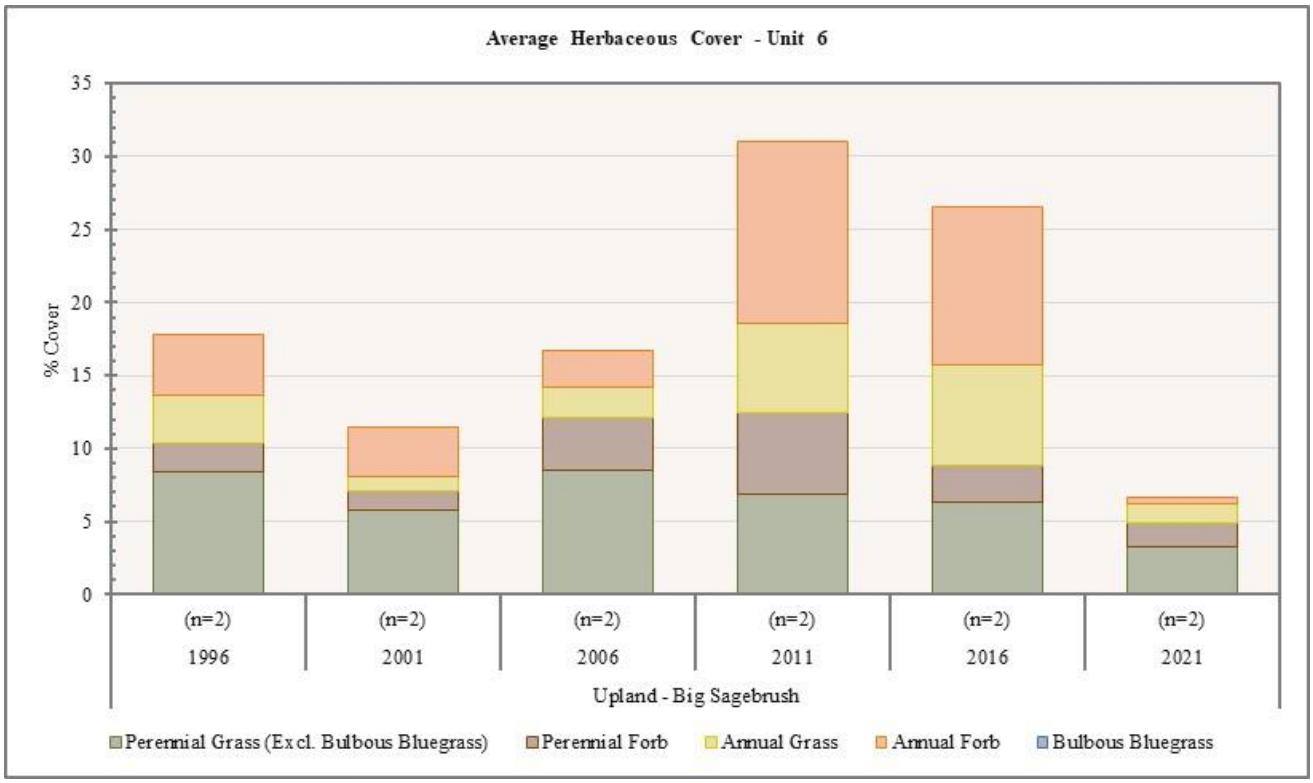


Figure 6.14: Average herbaceous cover for Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

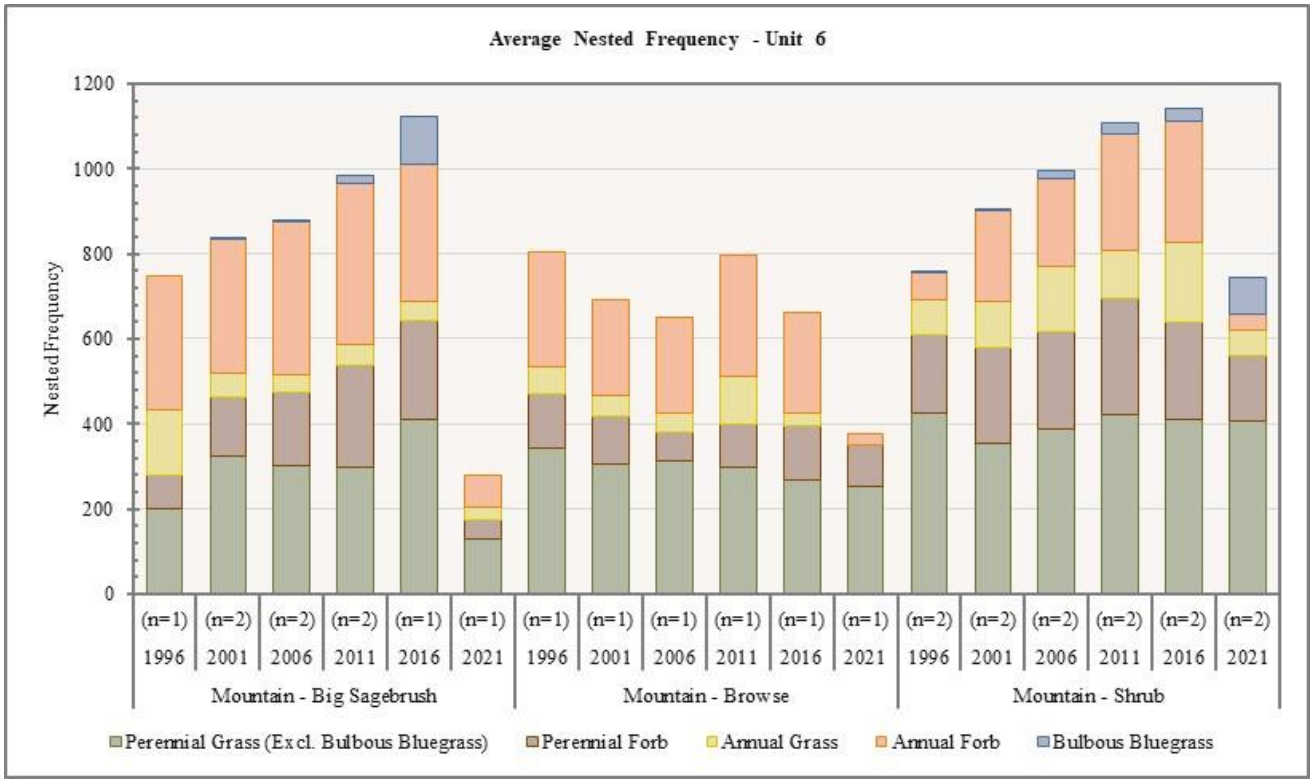


Figure 6.15: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 6, Chalk Creek.

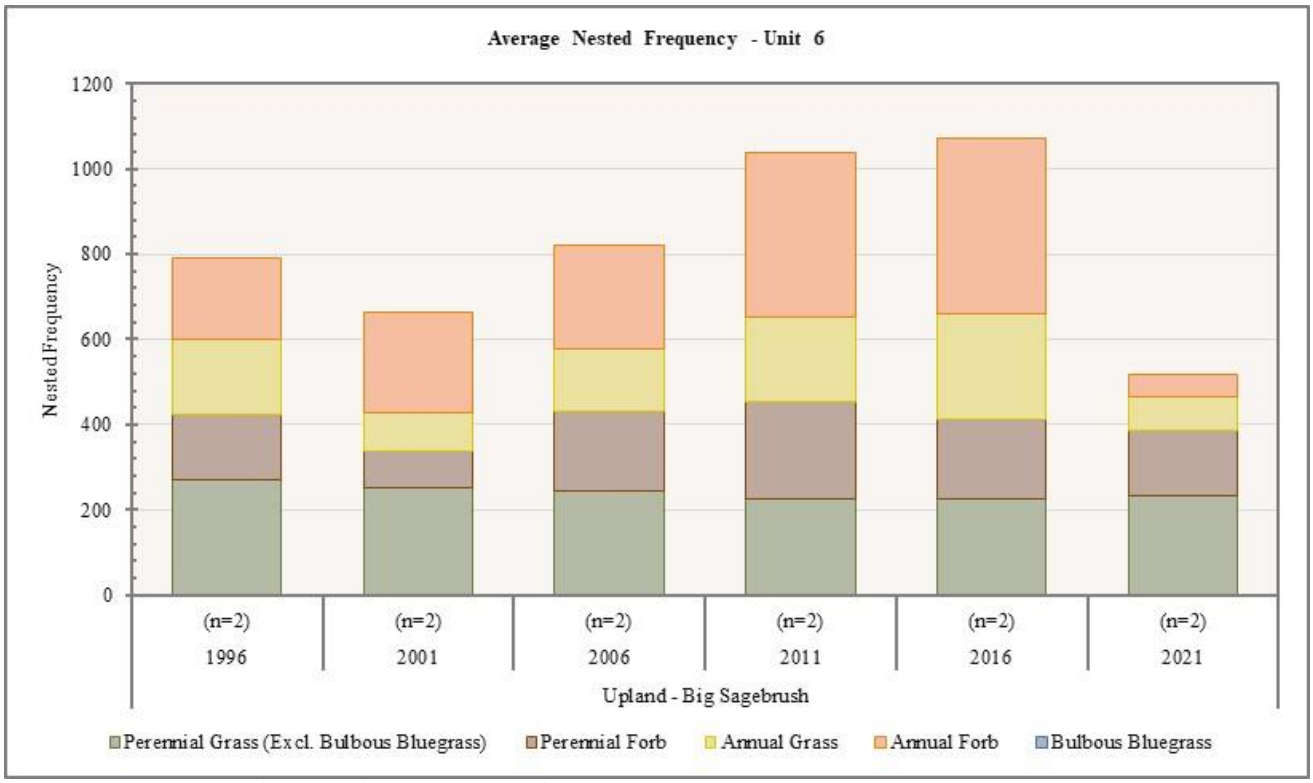


Figure 6.16: Average nested frequency of herbaceous species for Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

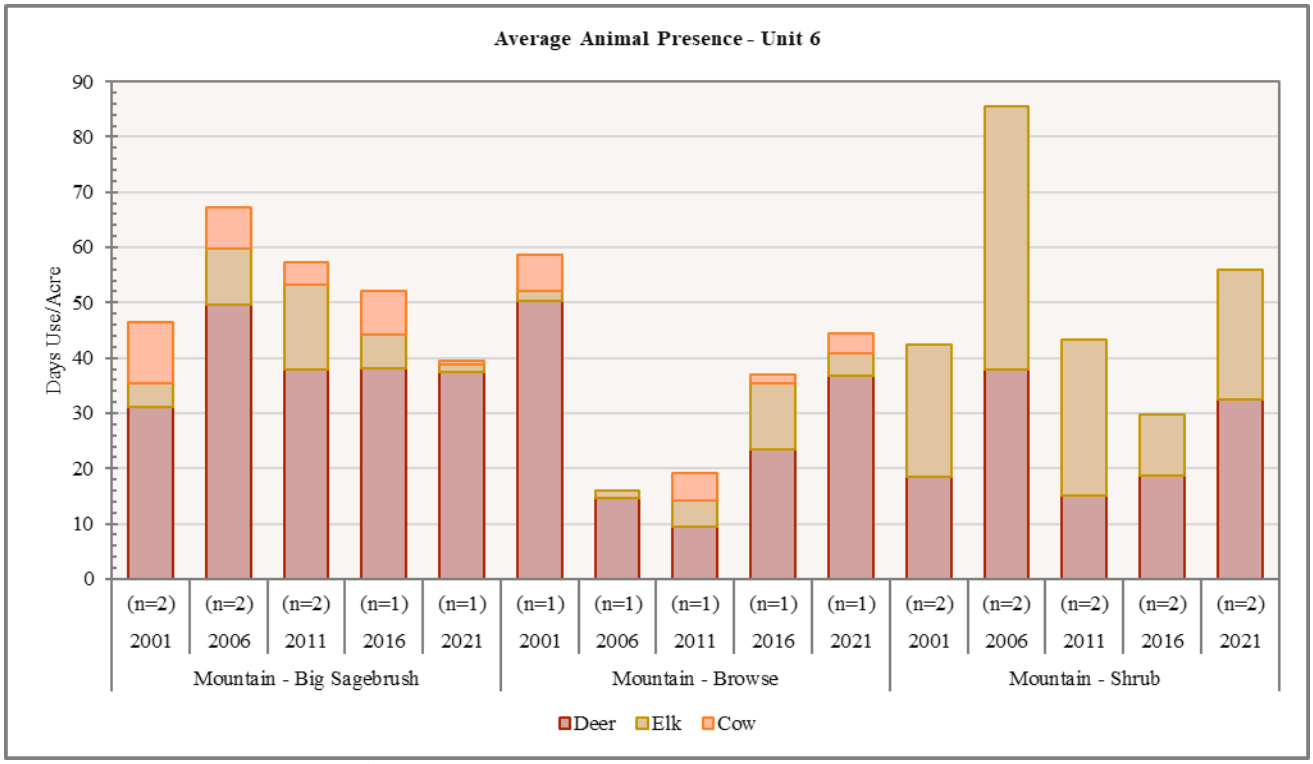


Figure 6.17: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 6, Chalk Creek.

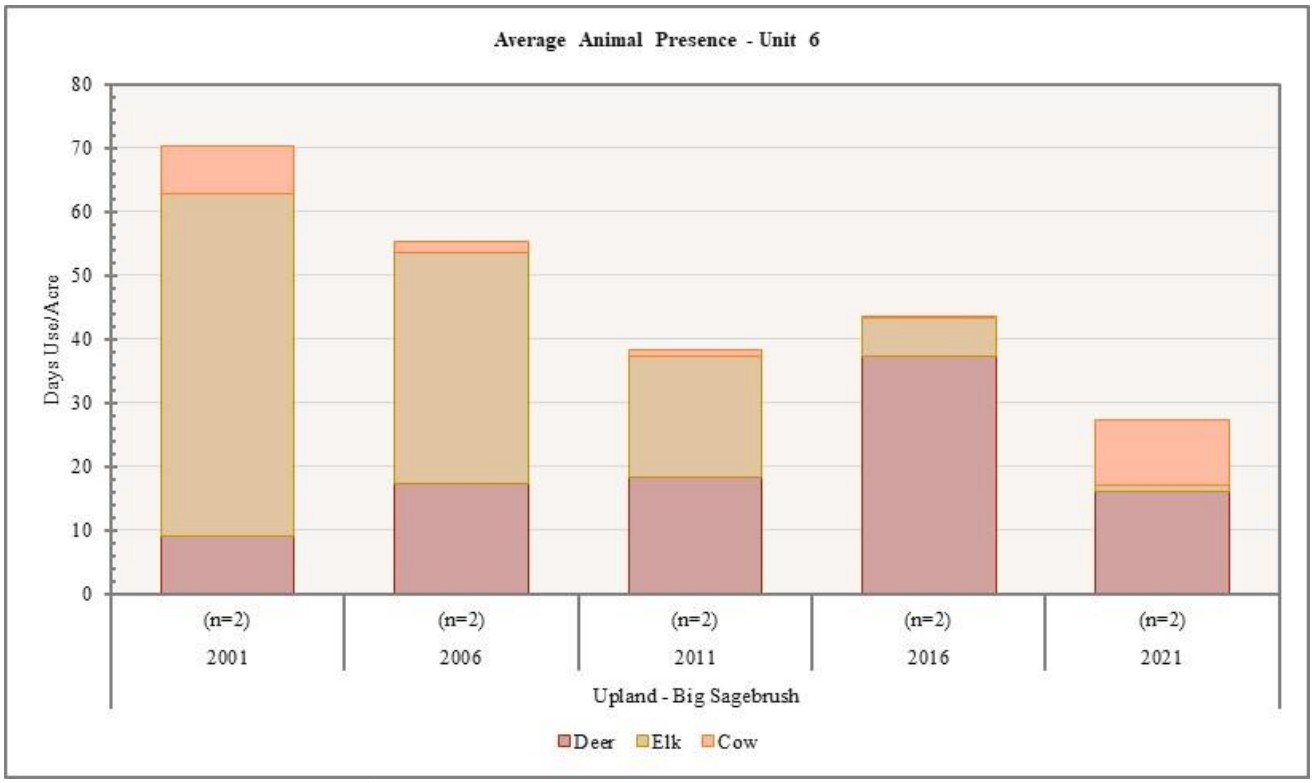


Figure 6.18: Average pellet transect data for Upland - Big Sagebrush study sites in WMU 6, Chalk Creek.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Chalk Creek management unit as a whole has generally remained fair since 1996. Of the few Range Trend sites in WMU 6, Spring Canyon (06-5) has remained in very poor condition since 1996 and suppresses the unit's mean habitat quality. Echo Canyon (06-2), Crandall Canyon (06-7), and Mahogany Hills Canyon (06-10) are the main drivers for the unit's condition as fair deer winter range. Additionally, these sites display a low amount of habitat conditional variability, and are consistently considered to be between fair and good winter habitat for mule deer. Due to the tendency for each site to remain in their evaluated winter conditions, there may be a certain implicit resistance to habitat improvement efforts. This suggests that any input to habitat improvement may be more effective in efforts to maintain current wintering conditions while avoiding any irreversible community or ecological transitions.

The overall deer winter range assessment in 2021 for WMU 6 was fair. Much of this can be attributed to the lack of preferred browse on the Spring Canyon site, which has been the case for the duration of the study (**Table 6.10**, **Figure 6.19**).

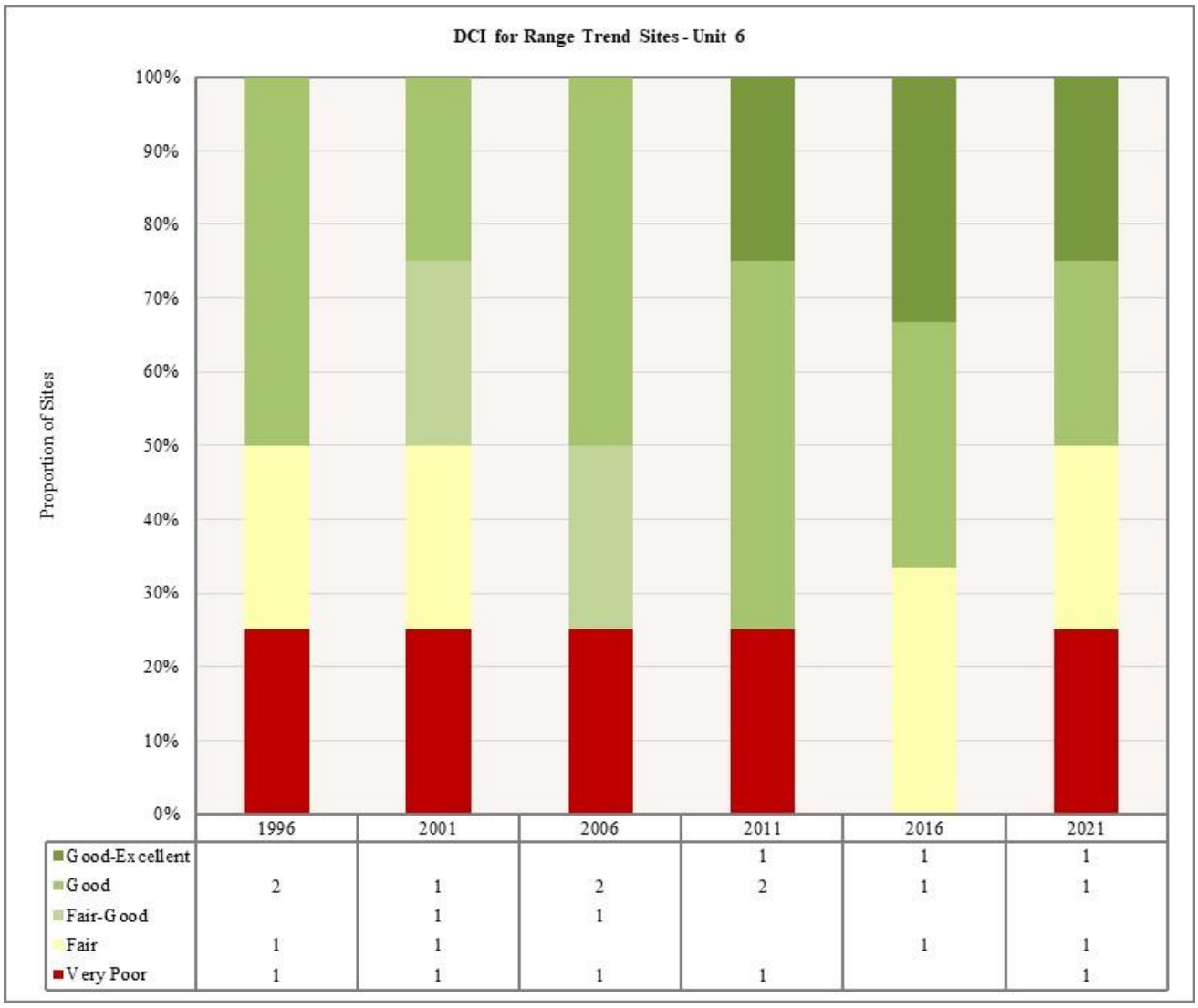
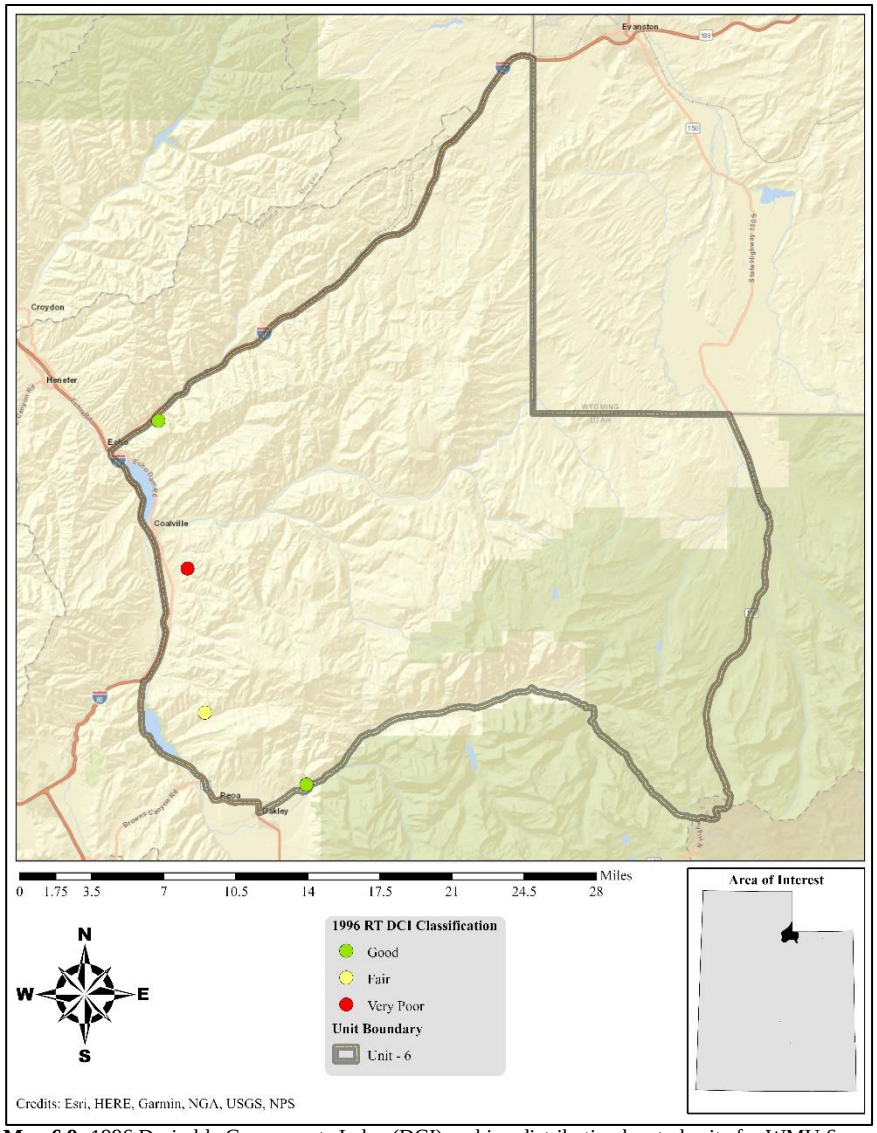


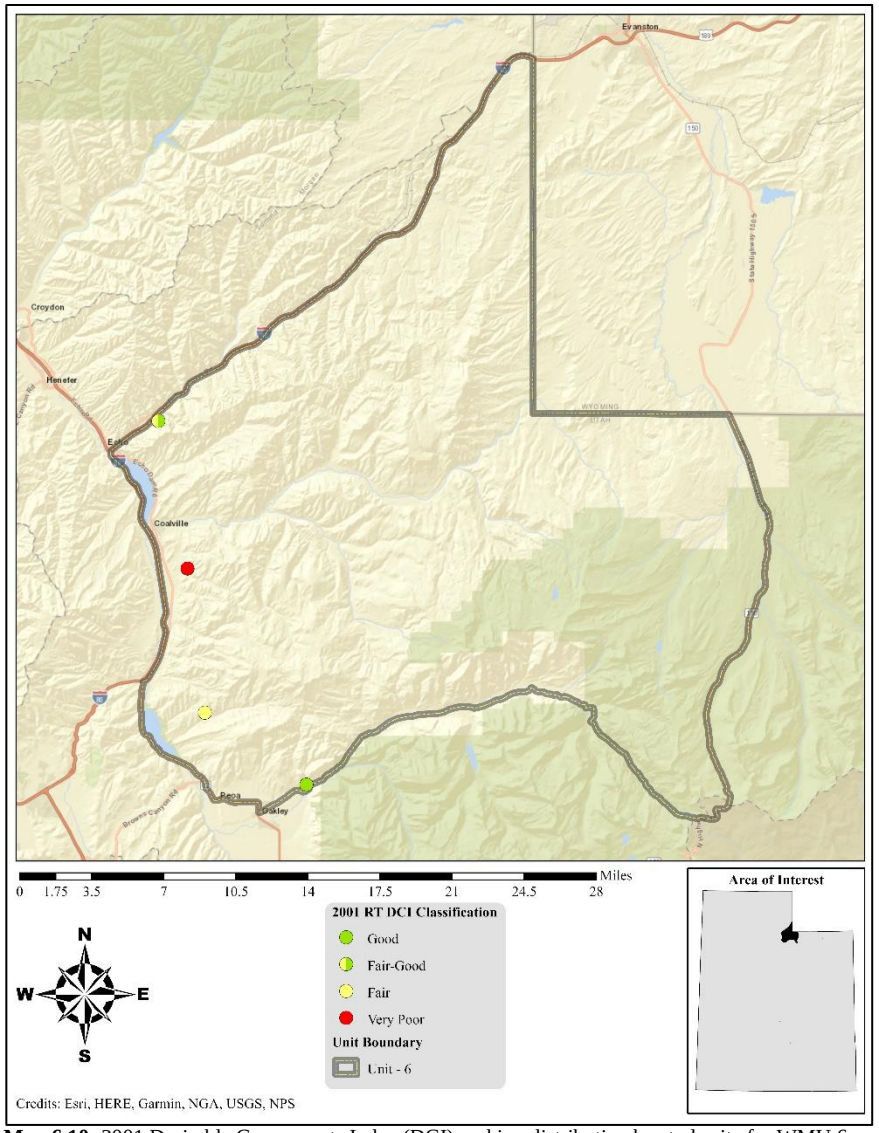
Figure 6.19: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 6, Chalk Creek.

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
06-2	1996	30	8.8	8.1	30	-2.5	6	0	**80.4**	**G**
06-2	2001	10.8	10.3	15	30	-5.9	10	0	**70.2**	**F-G**
06-2	2006	20	13.9	5.5	30	-3.7	9.3	0	**75**	**G**
06-2	2011	19.8	14.1	7.3	30	-2.3	10	0	**78.9**	**G**
06-2	2016	23.4	15	12.6	30	-8	10	0	**83**	**G**
06-2	2021	15.1	9.3	15	30	-1	7.3	0	**75.6**	**G**
06-5	1996	0	0	0	5.5	-2.1	2.3	0	**5.6**	**VP**
06-5	2001	0	0	0	9.7	-0.3	2.9	0	**12.3**	**VP**
06-5	2006	0	0	0	6.6	-0.5	3.6	0	**9.7**	**VP**
06-5	2011	0	0	0	10	-0.2	7.8	0	**17.7**	**VP**
06-5	2021	0	0	0	3.9	-0.3	1	0	**4.6**	**VP**
06-7	1996	17.7	12.8	10.9	20.9	-0.2	3.1	0	**65.1**	**F**
06-7	2001	15.2	12.1	7	21.9	-0.2	3.6	0	**59.7**	**F**
06-7	2006	18.8	11	7.9	30	-0.1	2	0	**69.7**	**F-G**
06-7	2011	27.2	14.8	8.6	30	-2.1	5.2	0	**83.8**	**G**
06-7	2017	25.3	14.3	11.6	12	-0.2	4.2	0	**67.1**	**F**
06-7	2021	23.4	13.1	15	13.1	0	2.5	0	**67.1**	**F**
06-10	1996	30	8.2	3.2	30	0	10	0	**81.5**	**G**
06-10	2001	27.8	7	1.5	30	0	9.5	0	**75.8**	**G**
06-10	2006	30	9.3	3.8	30	0	10	0	**83.1**	**G**
06-10	2011	30	11.4	9.1	30	0	10	0	**90.6**	**G-E**
06-10	2016	27.4	14.6	8.6	30	0	10	0	**90.7**	**G-E**
06-10	2021	30	6.7	15	30	-0.3	10	0	**91.3**	**G-E**
06R-5	2014	1.2	0	0	14.3	0	3.2	0	**18.6**	**VP**
06R-5	2017	3	0	0	30	-9.8	10	-2	**31.1**	**VP**
06R-5	2021	4.3	0	0	30	-0.6	10	-4	**39.6**	**VP-P**

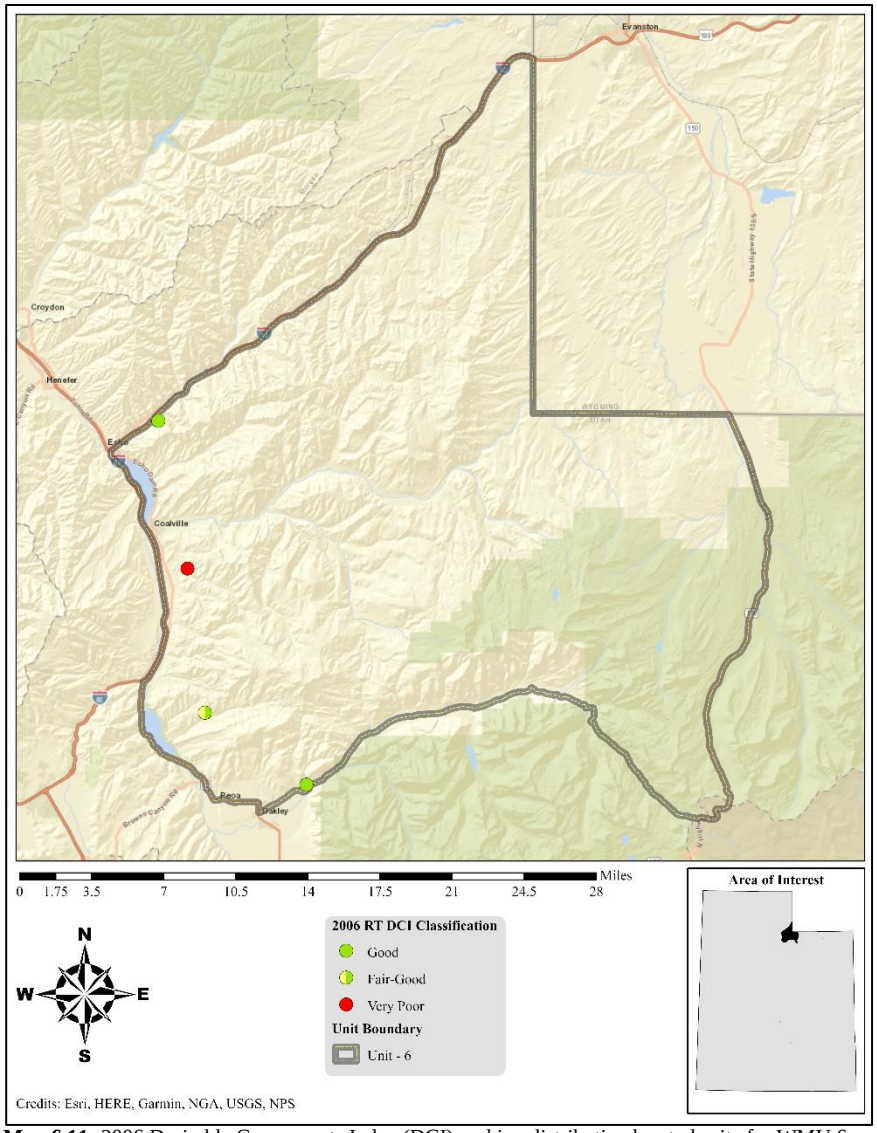
Table 6.10: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 6, Chalk Creek. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



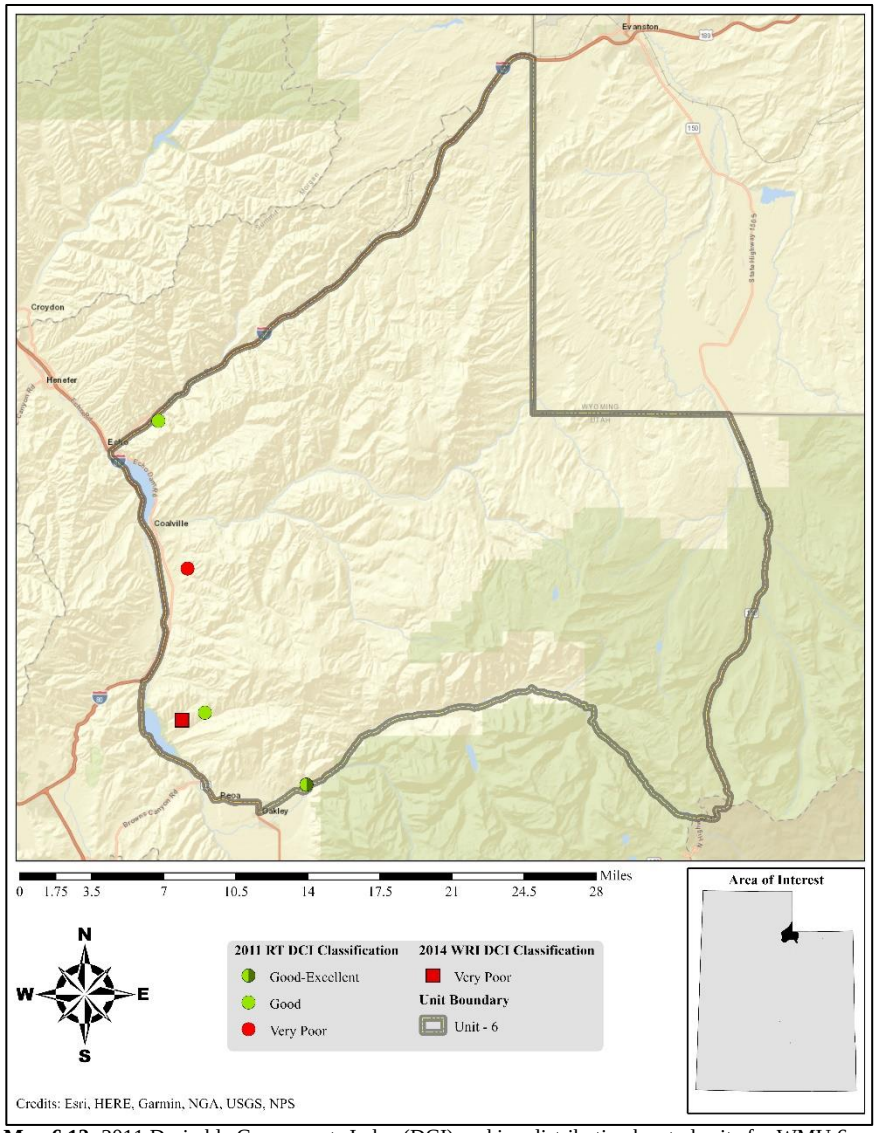
Map 6.9: 1996 Desirable Components Index (DCI) ranking distribution by study site for WMU 6, Chalk Creek.



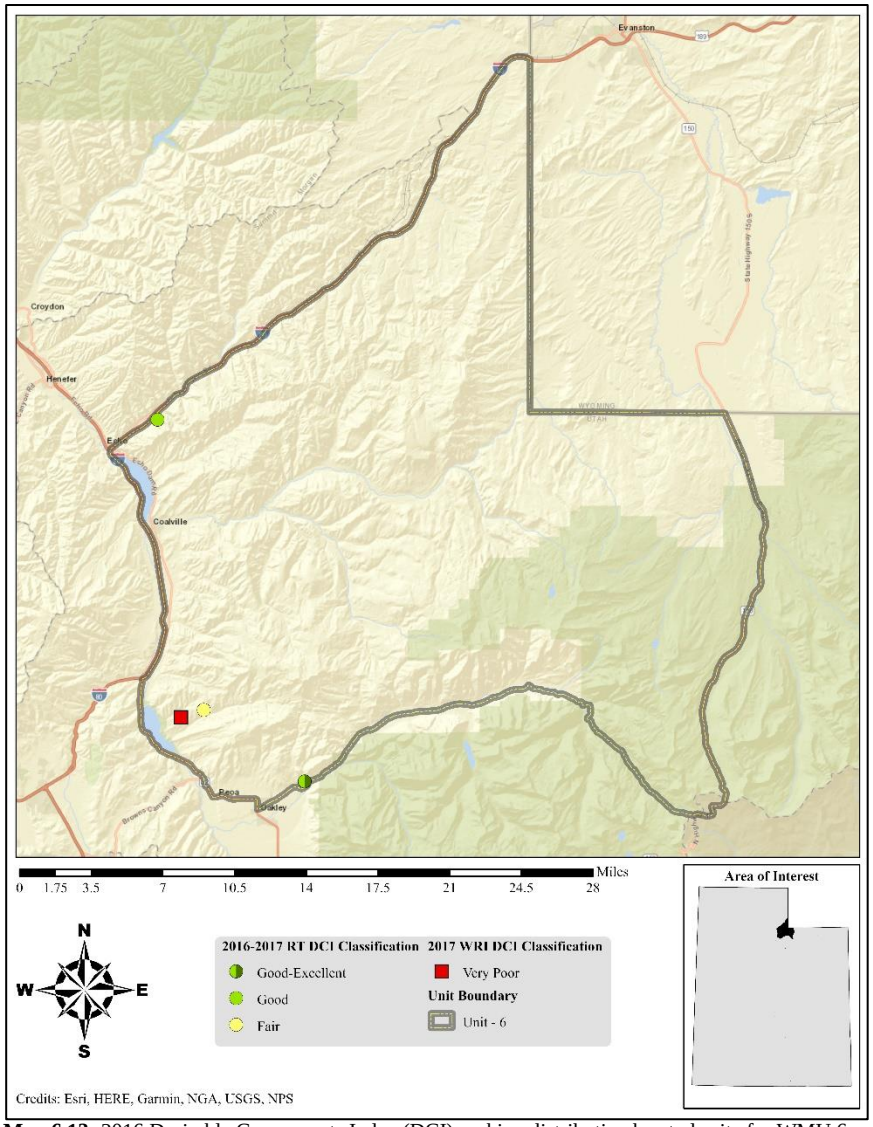
Map 6.10: 2001 Desirable Components Index (DCI) ranking distribution by study site for WMU 6, Chalk Creek.



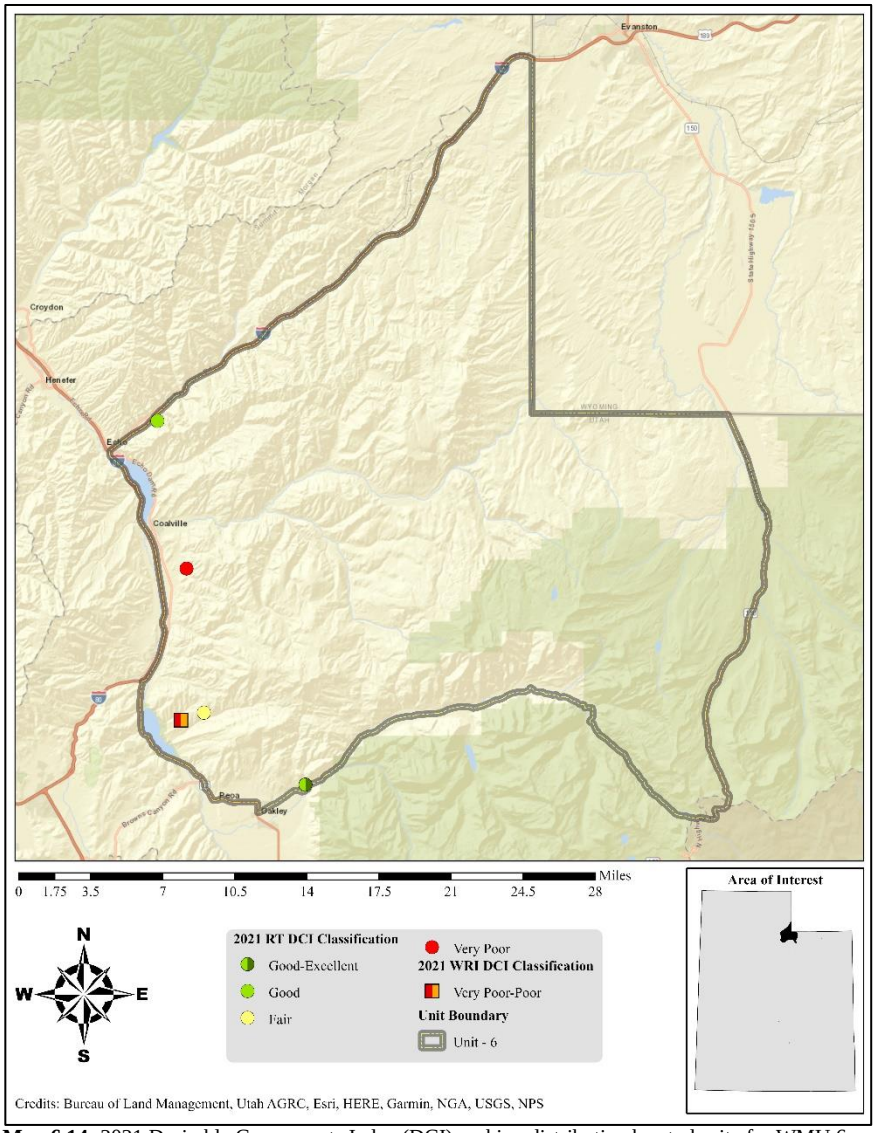
Map 6.11: 2006 Desirable Components Index (DCI) ranking distribution by study site for WMU 6, Chalk Creek.



Map 6.12: 2011 Desirable Components Index (DCI) ranking distribution by study site for WMU 6, Chalk Creek.



Map 6.13: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 6, Chalk Creek.



Map 6.14: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 6, Chalk Creek.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
06-1	Anshutz Ranch	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
06-2	Echo Canyon Rest Area	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
06-3	Spring Hollow Burn	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
06-5	Spring Canyon	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
06-7	Crandall Canyon	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
06-10	Mahogany Hills	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
06-12	Stag Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
06R-1	Cache Cave 1	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
06R-2	Cache Cave 2	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
06R-5	Lower Crandall Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 6.11: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 6, Chalk Creek. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment**.

Discussion and Recommendations

Mountain (Browse)

Crandall Canyon, the high-elevation study site that is designated as being of the Mountain (Browse) ecological type, is considered to be in fair condition for deer winter range in the Chalk Creek management unit. While these studies have abundant herbaceous understories, they are dominated by introduced perennial grasses. Although they were not observed in 2021, annual grasses such as cheatgrass (*Bromus tectorum*) and field brome (*B. arvensis*) have been present in low amounts in previous sample years. Should these grasses increase in the future, they could lead to increased fuel loads, exacerbated risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013), and negative effects on herbaceous biodiversity (Mack, et al., 2000). Twoneedle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) have also been present on this site. The study is currently classified as being within Phase I of woodland succession as of 2021; presence of pinyon and juniper trees can lead to reduced shrub and herbaceous understory health as woodland encroachment increases (Miller, Svejcar, & Rose, 2000).

Continued monitoring of this study site will likely prove valuable in the future. Treatments to address current limiting factors may not be immediately necessary. If monitoring indicates that treatment would be prudent in the future, methods such as herbicide application and grazing management could be used to target annual grasses, while treatments such as lop and scatter, chaining, bullhog, etc. would be options for removing trees.

Mountain (Shrub)

The high-elevation study sites of this ecological type are in good and good-excellent condition and support a communities of mixed browse species. The herbaceous understories of these study sites are diverse and abundant, but do present some threats to the ecological integrities of these sites. Annual grasses, primarily cheatgrass, are present on both study sites, posing a low-level threat on Mahogany Hills and a high-level threat on Echo Canyon Rest Area. Although cover is currently low, previous years' data shows that flushes have occurred in the past on the Echo Canyon Rest Area study. Should annual grass cover increase (again) in the future on either site, it would boost fuel loads, heighten the risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013), and could lead to lower herbaceous diversity (Mack, et al., 2000). Introduced perennial grasses such as bulbous bluegrass (*Poa bulbosa*) and/or smooth brome (*Bromus inermis*) have also been observed on both sites: the threat posed is low on the Echo Canyon Rest Area study and high on Mahogany Hills.

Introduced perennial grass species can be aggressive and often have the potential to outcompete more desirable native species for resources. In turn, this often leads to reduced herbaceous diversity (Mack, et al., 2000): this is of particular concern on the Mahogany Hills site, as smooth brome contributes nearly 20% cover as of 2021.

Monitoring of these communities should be continued in the future. If annual grasses increase on either study site, herbicide application or implantation of changes in grazing management may be appropriate. Should reseeding be selected to diversify the herbaceous understory on the Mahogany Hills study, care should be taken in seed selection and native species should be opted for whenever possible.

Mountain (Big Sagebrush)

The high-elevation study sites of the Upland (Sagebrush) ecological type (Spring Hollow Burn and Spring Canyon) are considered to be in very poor to fair condition for deer range habitat in the Chalk Creek management unit. Introduced perennial grasses are present on both sites, posing a high-level threat on Spring Hollow Burn and a low-level threat on Spring Canyon; the understory of the Spring Hollow Burn study is primarily composed of crested wheatgrass (*Agropyron cristatum*). Introduced perennial grasses can be aggressive and may outcompete other species for resources, therefore leading to reduced prevalence of more desirable native grasses and forbs (Mack, et al., 2000). The annual grass species cheatgrass (*Bromus tectorum*) is also present on these sites, albeit in low amounts. Although not an immediate threat as of 2021, increased annual grass presence in the future could result in exacerbated risk of catastrophic wildfire, increased fine fuel loads, potentially altered wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013), and deleterious effects on herbaceous diversity (Mack, et al., 2000). Finally, encroachment of Utah juniper (*Juniperus osteosperma*) is a significant concern on the Spring Canyon study, which is considered to be within Phase III of woodland succession. As is expected with an advanced stage of woodland encroachment (Miller, Svejcar, & Rose, 2000), the herbaceous and shrub understory of this site is very depauperate in both quantity and quality.

Continued monitoring of these study sites will likely prove to be a valuable endeavor. A tree-reducing treatment (bullhog, chaining, etc.) on the Spring Canyon study would likely prove to be highly beneficial, especially if accompanied by reseeding efforts to restore the understory components. However, careful consideration should be made so as to not a select a method that could unintentionally result in increased annual grass loads. If annual grasses are deemed to be a higher level threat in the future, treatments such as herbicide applications or changes to grazing management may be appropriate. Finally, reseeding may be advisable on the Spring Hollow Burn study to help diversify the herbaceous understory. Seed selection should be made with care however, with preference being given to native grass and forb species whenever possible and appropriate.

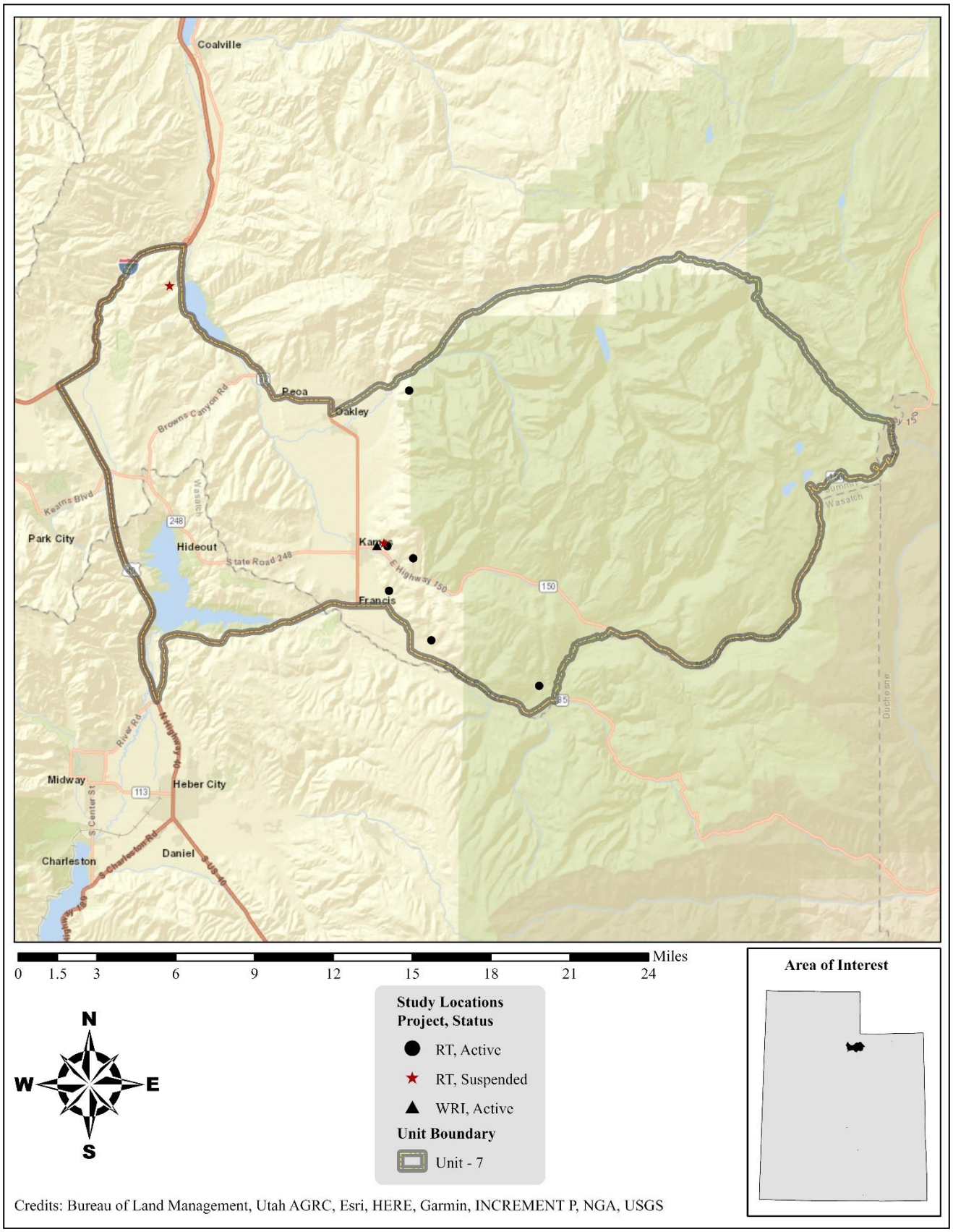
Upland (Big Sagebrush)

The mid-elevation study sites of the Upland (Sagebrush) ecological type are considered to be in fair to good condition for summer deer range habitat in the Chalk Creek management unit and are dominated by sagebrush populations that provide valuable browse. Introduced annual grasses, namely cheatgrass (*Bromus tectorum*), have been observed on both study sites, albeit with low cover in 2021. However, previous years' data indicates that cheatgrass flushes have occurred in the past on the Stag Canyon study, therefore posing a high-level threat to the ecological integrity of the plant community. Should annual grasses increase on either study site in future sample years, they could increase fuel loads, heighten the risk of wildfire, have an impact on wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013), and could lead to reduced herbaceous diversity (Mack, et al., 2000). Although not an immediate concern, encroachment of Utah juniper (*Juniperus osteosperma*) is occurring on the Stag Canyon study, placing it within Phase I of woodland succession. Presence of pinyon and juniper trees have the potential to lead to reduced shrub and herbaceous understory health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000). Finally, evidence of drought is apparent on both the Stag Canyon and Anshutz Ranch studies. Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

It is recommended that monitoring of these study sites continue. Further monitoring on both studies may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts are needed to support wildlife. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003). Treatments to remove annual grasses such as herbicide application or changes in grazing management may be advisable if

monitoring indicates that there are increases in the future. Work to reduce pinyon/juniper encroachment (e.g. bullhog, lop and scatter, chaining, etc.) may eventually be appropriate on the Stag Canyon study with care being taken to select methods that will not increase annual grass loads.

7. MANAGEMENT UNIT 7 – KAMAS



WILDLIFE MANAGEMENT UNIT 7 – KAMAS

Boundary Description

Summit and Wasatch counties - Boundary begins at the junction of I-80 and SR-32 (Wanship); south on SR-32 to the Weber Canyon Road at Oakley; east on this road to Holiday Park and the Weber River Trail; east on the Weber River Trail to SR-150 near Pass Lake; south on SR-150 to Soapstone Basin Road (USFS 037); south on this road to SR-35; west on SR-35 to Francis and SR-32; west on SR-32 to US-40 near Jordanelle; north on US-40 to I-80; north on I-80 to SR-32 and Wanship.

Management Unit Description

Geography

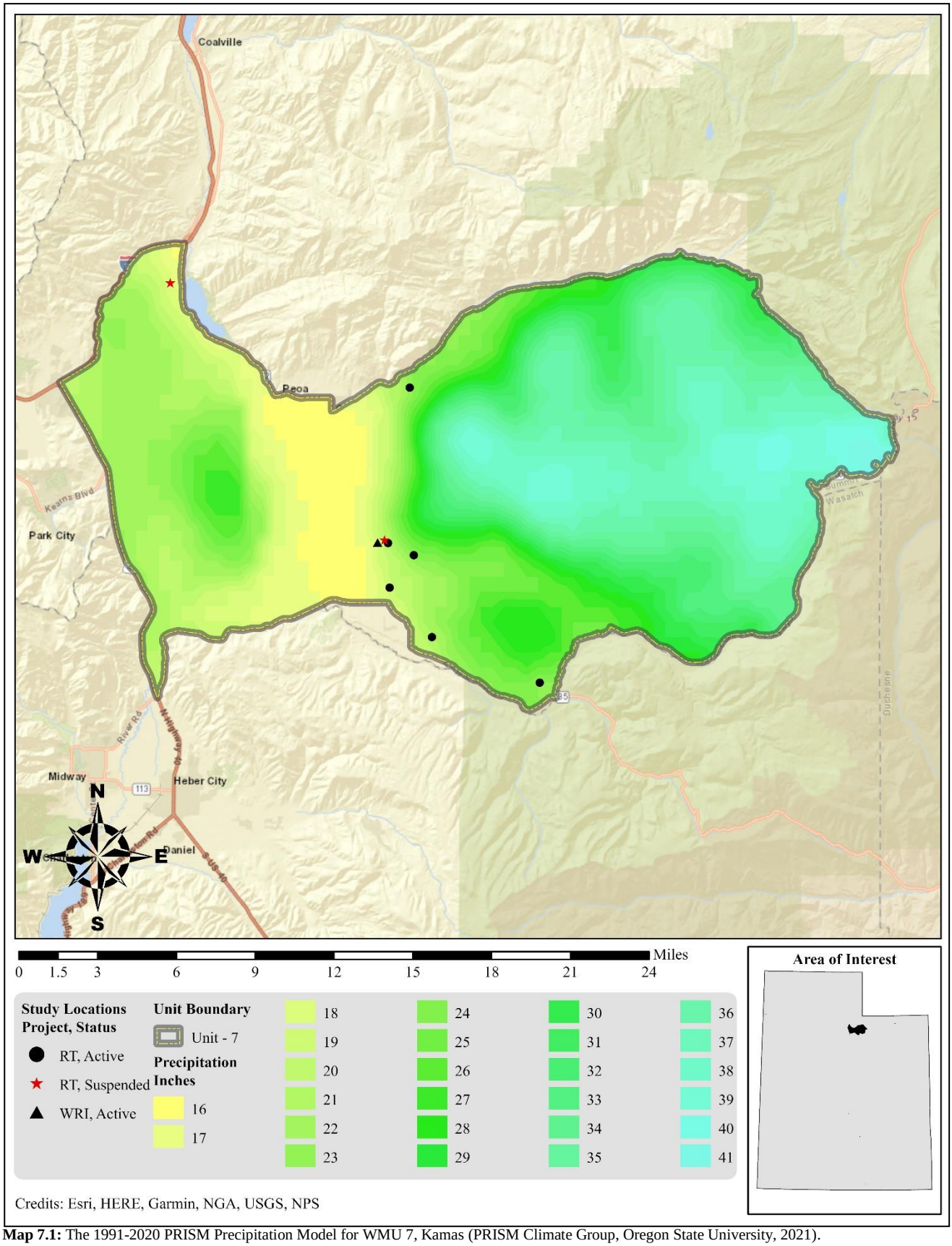
The Kamas management unit is located between the Uinta and Wasatch Mountains in the north-central part of the state. Boundary changes in 1985 reduced the total acreage and shifted a portion of the winter range north of the Weber River into the Chalk Creek management unit; there was another realignment of the herd unit boundaries again in 1996 and in 2004. The cities of Oakley, Kamas, and the town of Francis fall partially within the unit boundaries. The Uinta Mountains to the east contain the headwaters of the Weber and Provo Rivers, which flow west through the Rhodes and Heber Valleys.

Climate Data

The 30 year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 16 inches in the northernmost portion near Rockport State Park to 41 inches on the peaks of the Uintas. All of the Range Trend and WRI monitoring studies on the unit occur within 18-25 inches of precipitation (**Map 7.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Northern Mountains division (Divisions 5).

The mean annual PDSI of the Northern Mountains division displayed years of moderate to extreme drought from 2000-2003, 2012-2013, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1995, 1997-1998, 2005, and 2011 (**Figure 7.1a**). The mean spring (March-May) PDSI displayed moderate to extreme drought in 1992, 2000-2004, 2012-2014, 2018, and 2021; moderately to extremely wet years were displayed in 1995-1996, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2013, and 2020-2021; moderately to extremely wet years were displayed in 1995, and 1997-1998 (**Figure 7.1b**) (Time Series Data, 2022).



Map 7.1: The 1991-2020 PRISM Precipitation Model for WMU 7, Kamas (PRISM Climate Group, Oregon State University, 2021).

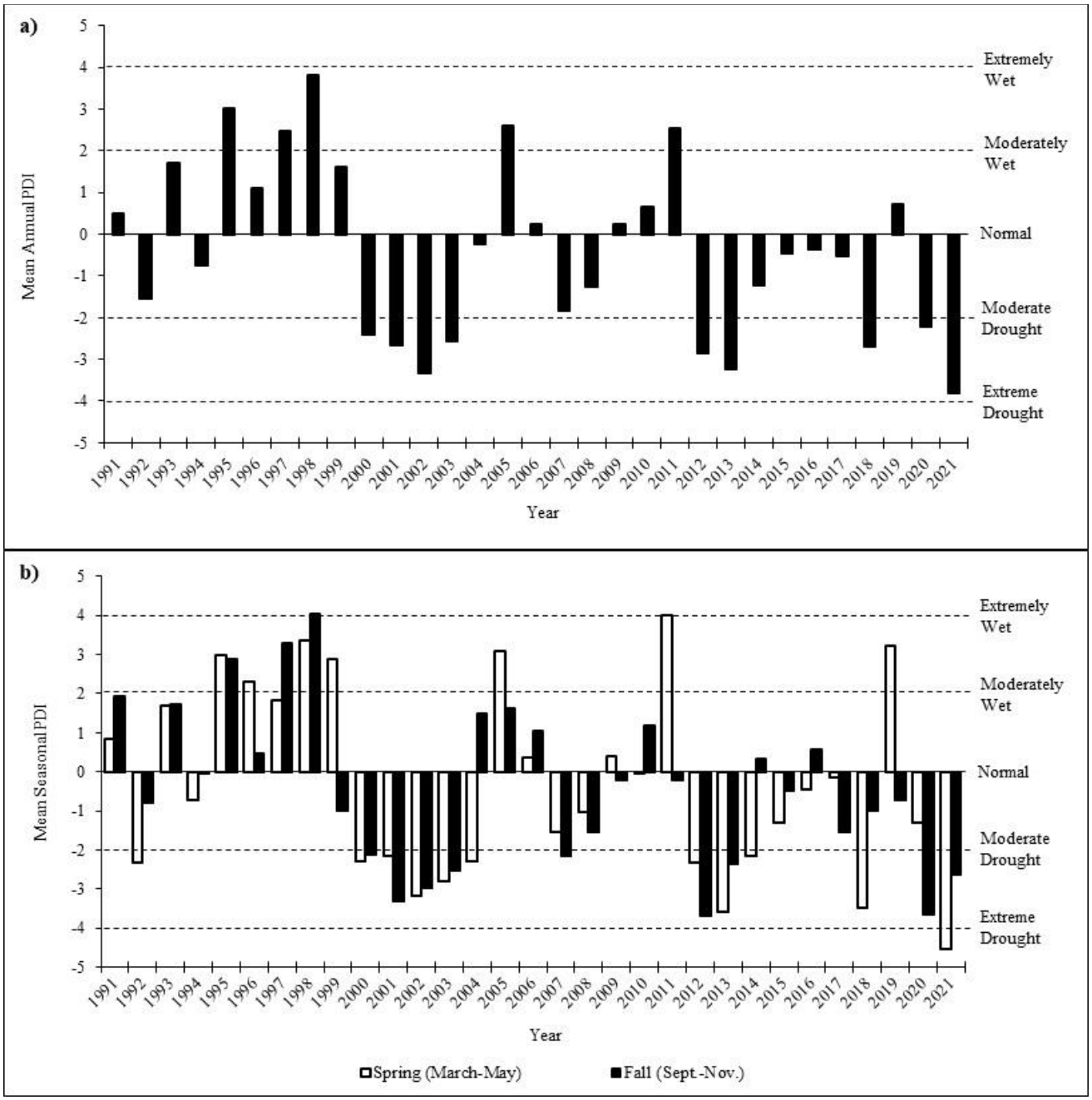


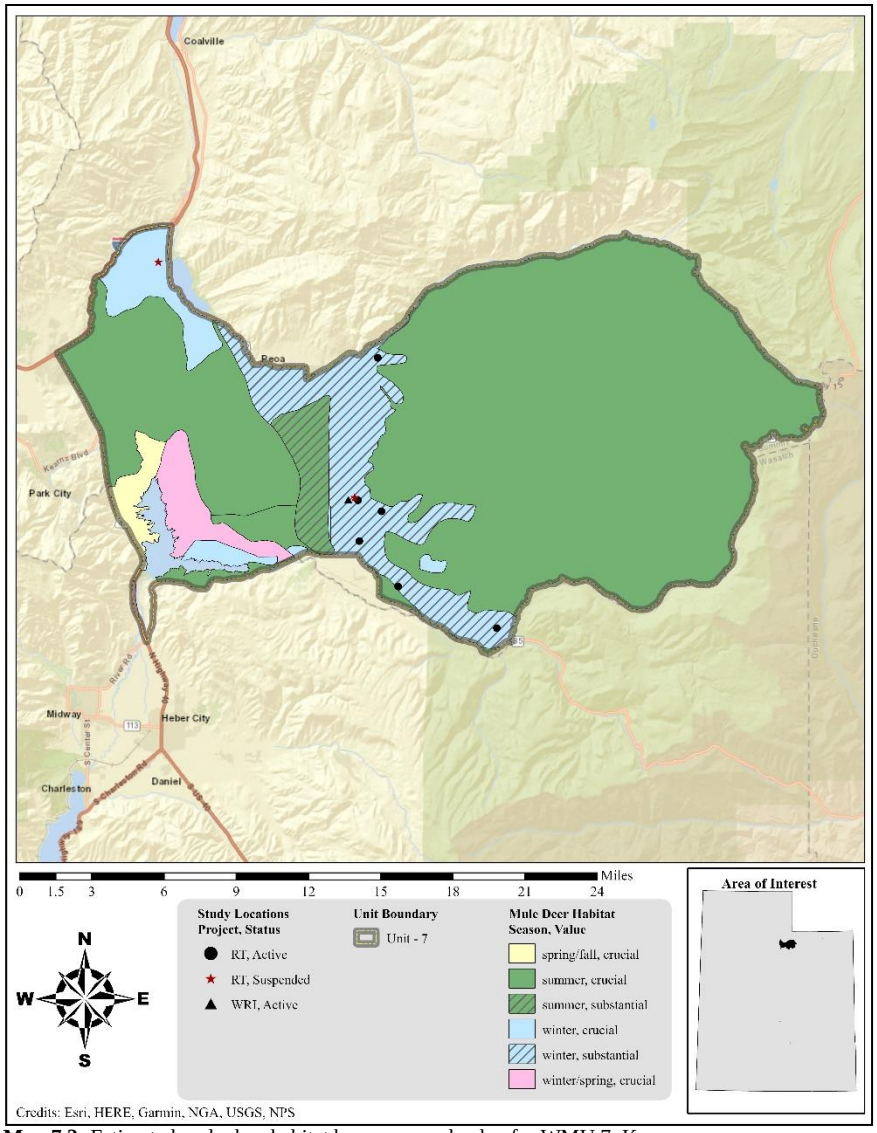
Figure 7.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

Big Game Habitat

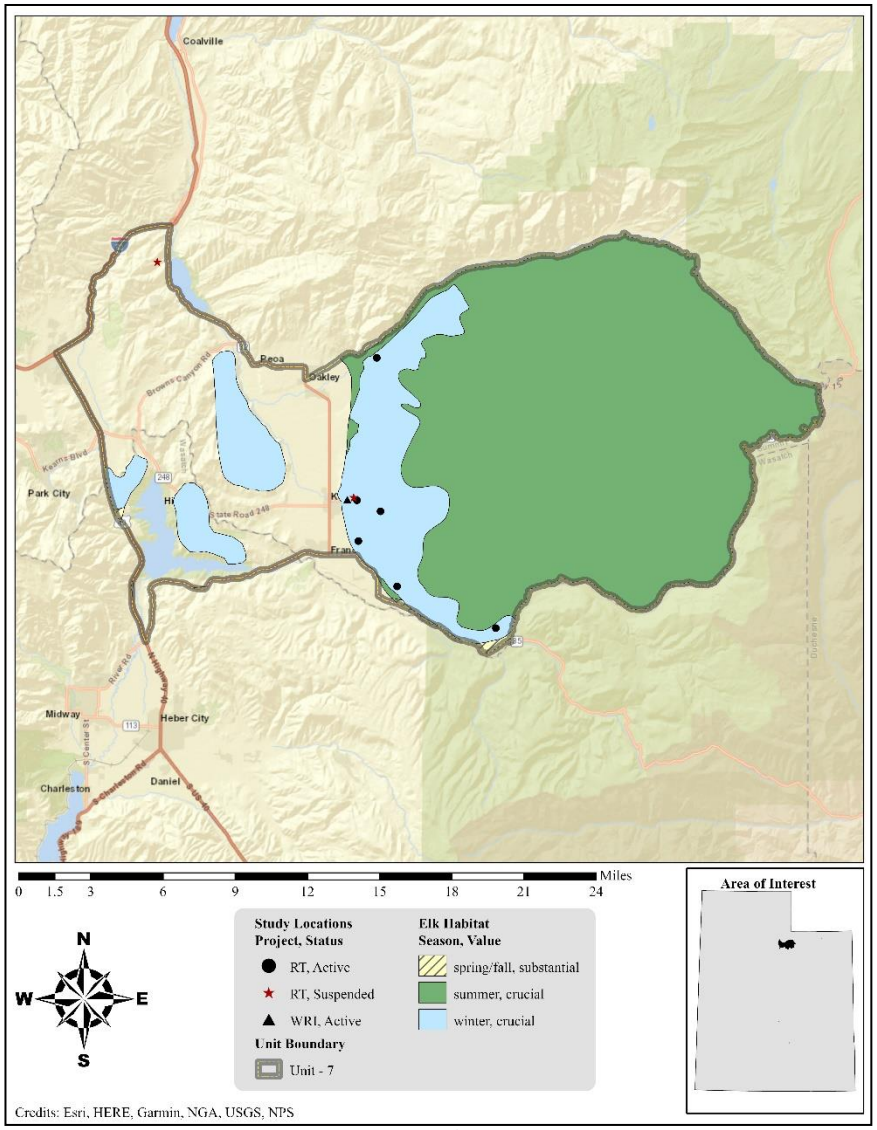
Total mule deer range in this wildlife management unit is estimated at over 215,000 acres with 172,686 acres classified as summer range, 33,014 acres classified as winter range, 6,037 acres classified as winter/spring range, and 3,272 acres classified as spring/fall range (**Table 7.1**, **Map 2.2**). Total elk range is estimated at just over 158,000 acres with 124,535 acres classified as summer range, 33,559 acres of this classified as winter range, and 532 classified as spring/fall range (**Table 7.1**, **Map 2.3**). Approximately 75% of mule deer winter range is privately owned, another 20% is administrated by the US Forest Service (USFS), 3% is owned by the Utah Division of Wildlife Resources (UDWR), and the remaining 2% is managed by Utah State Parks (USP). Much of the summer range (70%) is located on USFS land, and 29% is privately owned. Summer range managed by the BLM, SITLA, UDWR, and USP is all under 1% (**Table 7.2**, **Map 7.2**, **Map 7.6**).

Because of the varying topography, the deer winter range is separated into several distinct areas. The upper limits vary considerably, but lower limits generally follow the canyon bottoms, roads, and upper limits of cultivated lands. Wintering areas north of the Weber River (on the Kamas face, Beaver Creek, and the Provo River) have long been recognized as crucial to the deer herd on the western edge of the Uinta Mountains (Giunta, 1979).

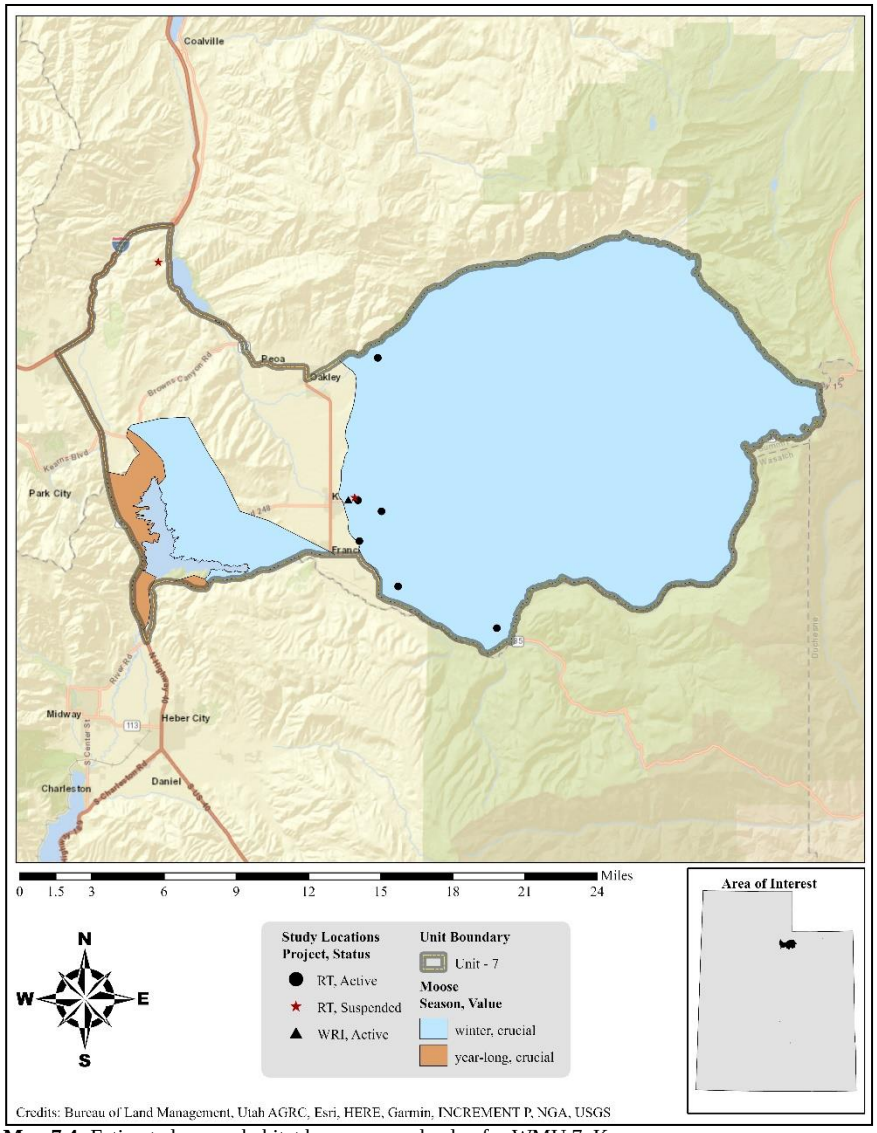
Fourteen different vegetation types were classified, but only nine of the more important types were sampled in the 1977 inventory. Of those, two emerge as the dominant and most valuable types. Together, the oakbrush and sagebrush-grass types occupied a majority of the normal winter range. The oakbrush type, dominated by Gambel oak (with big sagebrush, serviceberry, and snowberry as the subdominant associates) is often found at the more mesic, higher elevations; the oakbrush range condition was generally considered satisfactory and exhibited light to moderate deer use. Sagebrush-grass, the second most abundant type, often occurs interspersed with the oak type and normally occupies the lower, especially crucial portions of the winter range. Much of the lower areas have been converted to cropland or are heavily grazed by livestock. Other important types include the rather depleted sagebrush type and a significant mountain brush stand on the south-facing slope of Pinyon Canyon (**Table 7.6**).



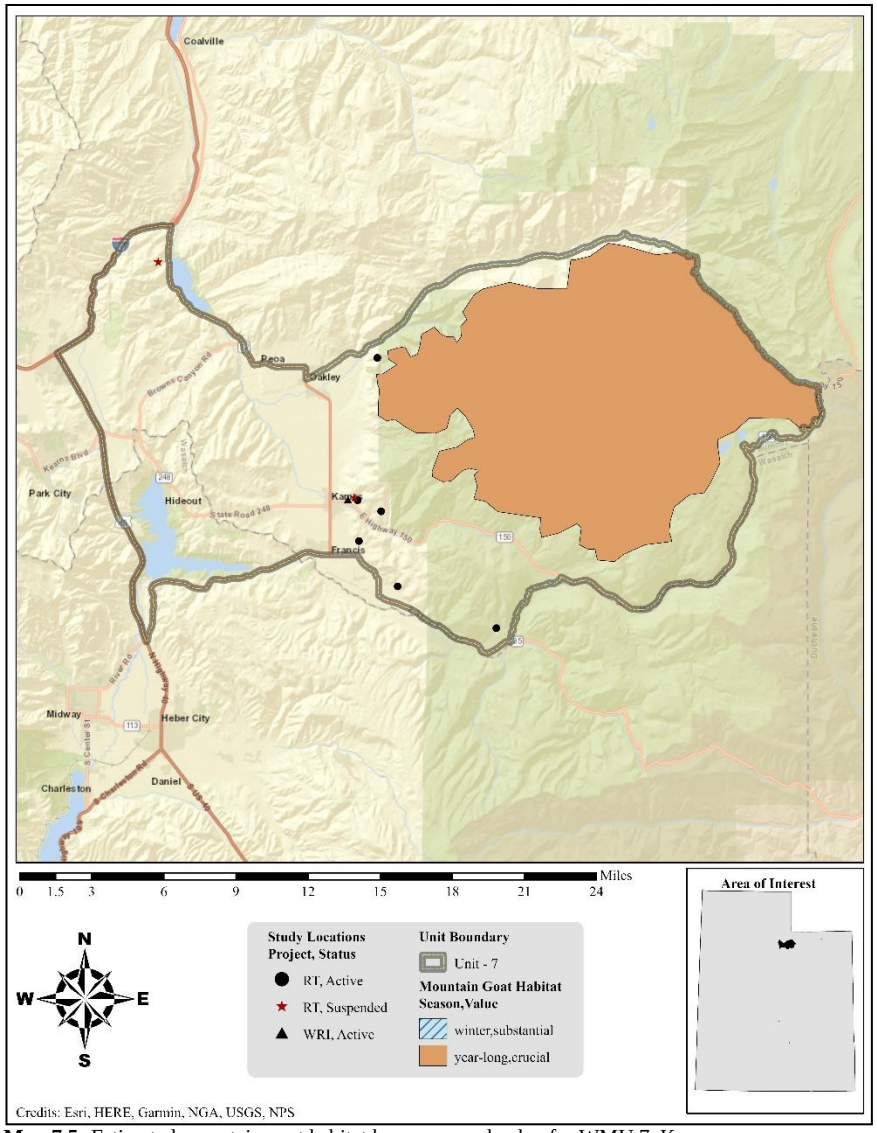
Map 7.2: Estimated mule deer habitat by season and value for WMU 7, Kamas.



Map 7.3: Estimated elk habitat by season and value for WMU 7, Kamas.



Map 7.4: Estimated moose habitat by season and value for WMU 7, Kamas.



Map 7.5: Estimated mountain goat habitat by season and value for WMU 7, Kamas.

	Year Long Range		Summer Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	0	0%	172,686	80%	33,014	15%	6,037	3%	3,272	2%
Elk	0	0%	124,535	79%	33,559	21%	0	0%	532	<1%
Moose	4,809	3%	0	0%	161,375	97%	0	0%	0	0%
Mountain Goat	87,500	100%	0	0%	<1	<1%	0	0%	0	0%

Table 7.1: Estimated mule deer, elk, moose, and mountain goat habitat acreage by season for WMU 7, Kamas.

	Summer Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	84	<1%	104	<1%	44	1%	0	0%
Private	50,540	29%	24,681	75%	4,824	80%	2,417	74%
SITLA	81	<1%	199	<1%	0	0%	0	0%
UDWR	704	<1%	926	3%	274	5%	0	0%
USFS	120,447	70%	6,528	20%	0	0%	0	0%
UDOT	0	0%	0	0%	22	<1%	3	<1%
USP	831	0%	540	2%	685	11%	822	25%
BR	0	0%	35	<1%	188	3%	30	1%
Total	172,686	**100%**	33,014	**100%**	6,037	**100%**	3,272	**100%**

Table 7.2: Estimated mule deer habitat acreage by season and ownership for WMU 7, Kamas.

	Summer Range		Winter Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	1	<1%	97	<1%	0	0%
Private	7,358	6%	22,013	66%	488	92%
SITLA	81	<1%	199	1%	0	0%
UDWR	0	0%	1,286	4%	0	0%
USFS	117,095	94%	9,828	29%	44	8%
USP	0	0%	95	<1%	0	0%
BR	0	0%	42	<1%	0	0%
Total	124,535	**100%**	33,559	**100%**	532	**100%**

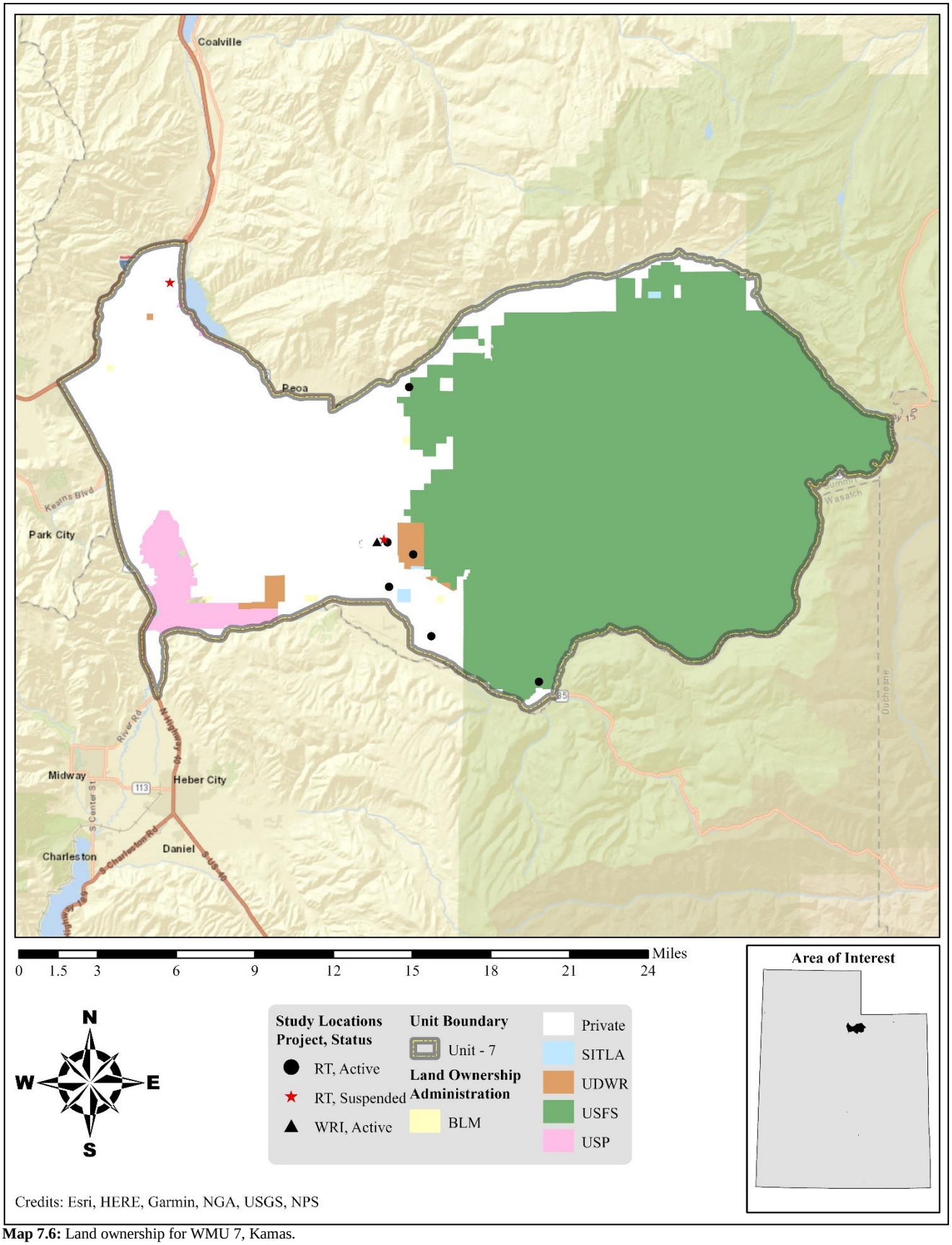
Table 7.3: Estimated elk habitat acreage by season and ownership for WMU 7, Kamas.

	Year Long Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	1	<1%	190	<1%
Private	3,531	73%	3,0602	19%
SITLA	0	0%	280	<1%
UDWR	0	0%	1,867	1%
USFS	0	0%	126,971	79%
UDOT	58	1%	0	0%
USP	1,106	23%	1,318	1%
BR	113	2%	149	<1%
Total	4,809	**100%**	161,375	**100%**

Table 7.4: Estimated moose habitat acreage by season and ownership for WMU 7, Kamas.

	Year Long Range		Winter Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	<1	<1%	0	0%
Private	1,505	2%	0	0%
SITLA	81	<1%	0	0%
USFS	85,914	98%	<1	100%
Total	87,500	**100%**	<1	**100%**

Table 7.5: Estimated mountain goat habitat acreage by season and ownership for WMU 7, Kamas.



Map 7.6: Land ownership for WMU 7, Kamas.

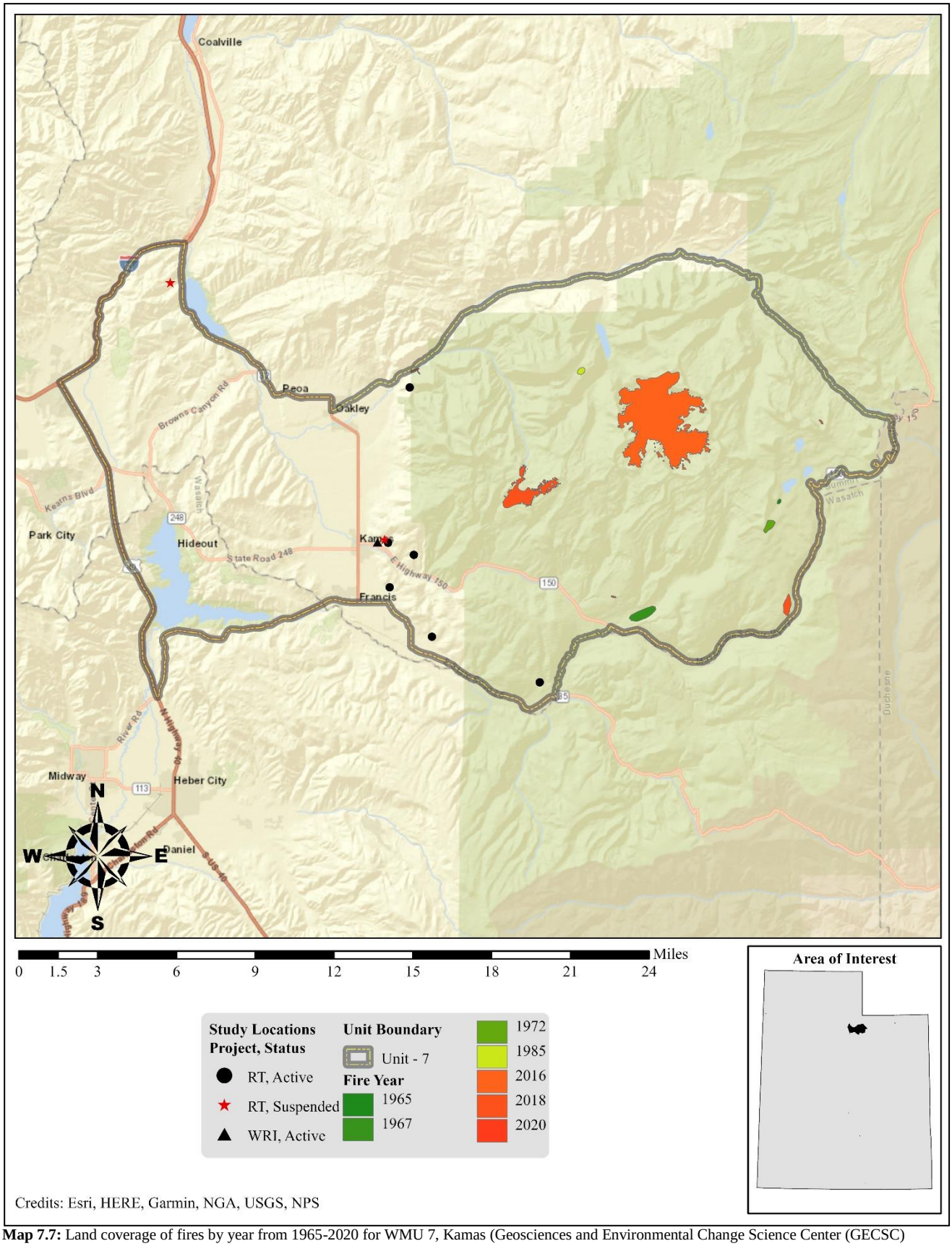
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Hardwood	87,000	17.60%	
	Developed	27,505	5.57%	
	Agricultural	23,244	4.70%	
	Conifer-Hardwood	23,158	4.69%	
	Sparsely Vegetated	15,599	3.16%	
	Riparian	9,873	2.00%	
	Open Water	6,800	1.38%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	264	0.05%	39.14%
Conifer	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	82,049	16.60%	
	Rocky Mountain Lodgepole Pine Forest	25,703	5.20%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	18,932	3.83%	
	Colorado Plateau Pinyon-Juniper Woodland	13,282	2.69%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	11,970	2.42%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	11,553	2.34%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	6,533	1.32%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	4,382	0.89%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	2,820	0.57%	
	Southern Rocky Mountain Ponderosa Pine Woodland	717	0.15%	
	Other Conifer	167	0.03%	36.04%
Shrubland	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	43,705	8.84%	
	Inter-Mountain Basins Montane Sagebrush Steppe	43,118	8.72%	
	Inter-Mountain Basins Big Sagebrush Shrubland	7,461	1.51%	
	Rocky Mountain Lower Montane-Foothill Shrubland	2,596	0.53%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	1,446	0.29%	
	Rocky Mountain Alpine Dwarf-Shrubland	916	0.19%	
	Other Shrubland	485	0.10%	
	Inter-Mountain Basins Big Sagebrush Steppe	283	0.06%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	101	0.02%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	1	0.00%	20.26%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	7,365	1.49%	
	Southern Rocky Mountain Montane-Subalpine Grassland	3,779	0.76%	
	Other Grassland	2,161	0.44%	
	Rocky Mountain Alpine Turf	217	0.04%	
	Rocky Mountain Alpine Fell-Field	127	0.03%	2.76%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	4,218	0.85%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	2,445	0.49%	
	Great Basin & Intermountain Introduced Annual Grassland	294	0.06%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	4	0.00%	1.41%
Exotic Tree-Shrub	Interior Western North American Temperate Ruderal Shrubland	1,117	0.23%	
	Great Basin & Intermountain Ruderal Shrubland	824	0.17%	0.39%
Total		**494,214**	**100%**	**100%**

Table 7.6: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 7, Kamas.

Limiting Factors to Big Game Habitat

The obvious limiting factor for big game in this management unit is the lack of adequate amounts of good quality winter range. The available range is reduced even further with severe winters; an example of this problem can be illustrated by the large winter deer losses which occurred during the winter of 1992-93. Furthermore, much of the lower winter range areas have been converted to cropland or are heavily grazed by livestock.

Most shrublands are considered to support vegetation typical of key habitat for big game. It is estimated that WMU 7 is comprised of just over 20% shrubland. Of the unit's shrubland, approximately 10% (50,800 acres) is considered to be big sagebrush steppe or shrubland, and approximately 9% of the unit's shrubland is comprised of Rocky Mountain Gambel Oak-Mixed Shrubland. As mentioned earlier, mixed oak and big sagebrush ecotypes are key areas of habitat for the unit. At an estimated 13,000 acers of land coverage, pinyon and juniper woodland communities may pose a threat by encroaching on crucial sagebrush shrublands. The presence of introduced annual grass on many study sites in this unit may limit effective recruitment of desirable species and increase fire frequency (**Table 7.6**) (Miller, Svejcar, & Rose, 2000).



Map 7.7: Land coverage of fires by year from 1965-2020 for WMU 7, Kamas (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

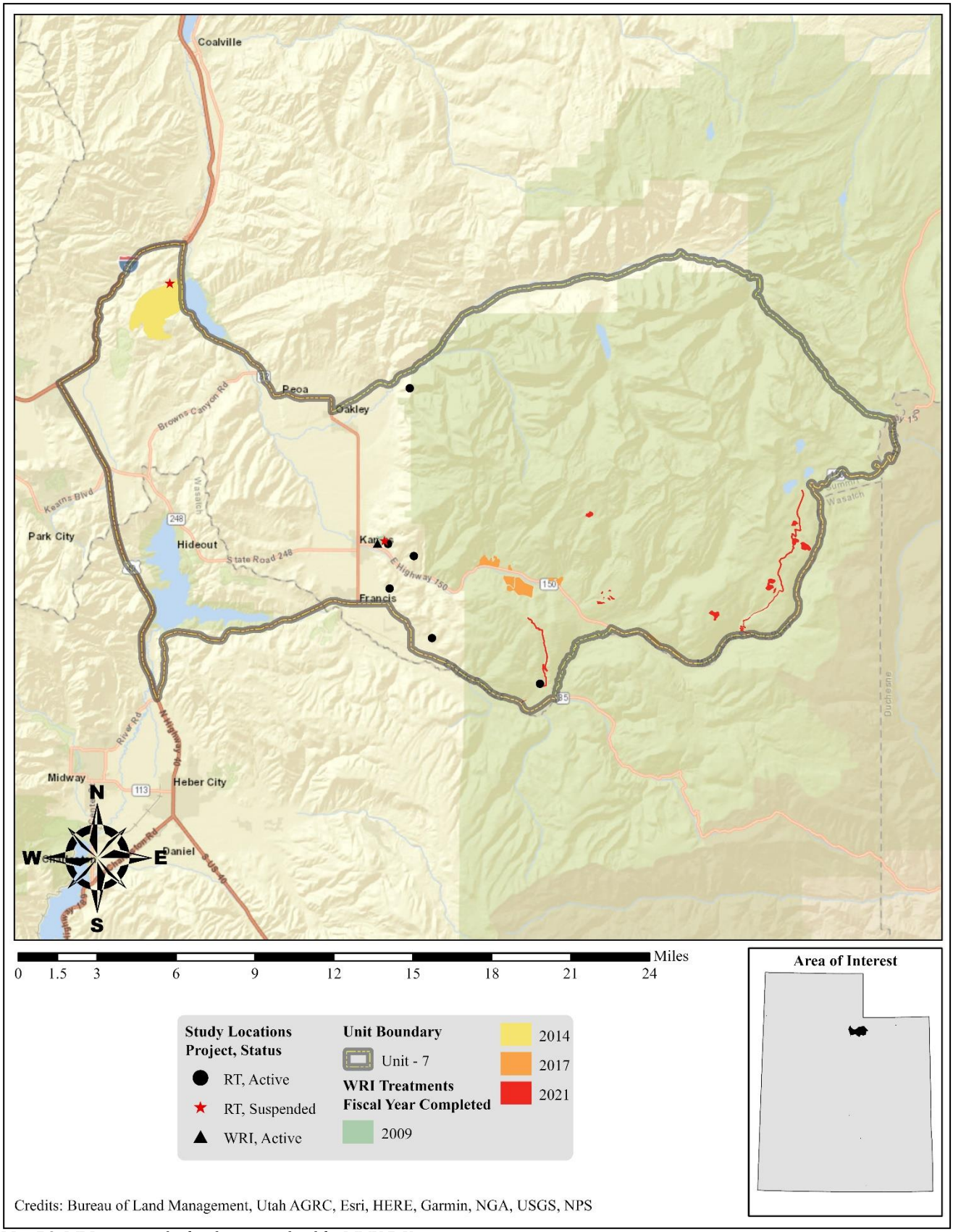
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 2,472 acres of land have been treated within the Kamas unit since the WRI was implemented in 2004 (**Map 7.8**). An additional 9,614 acres are currently undergoing a treatment project, and projects are proposed for 1,634 acres. Treatments frequently overlap one another bringing the net total of completed treatment acres to 2,472 acres for this unit (**Table 7.7**). 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.

Seeding to supplement the herbaceous understory is the most common management practice in this unit. Other management practices for completed, current, and proposed projects include bullhog use to remove twoneedle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*), prescribed fire, herbicide application to remove weeds, and vegetation removal by hand crews (**Table 7.7**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Bullhog	**625**	**1,966**	**343**	**2,934**
Full Size	625	1,966	343	2,934
Forestry Practices	**0**	**877**	**116**	**993**
Clearcutting	0	293	0	293
Group Selection Cuts	0	293	0	293
Thinning (Commercial)	0	0	83	83
Thinning (Non-Commercial)	0	291	33	325
Herbicide Application	**55**	**0**	**0**	**55**
Aerial (Fixed-Wing)	55	0	0	55
Prescribed Fire	**0**	**6,278**	**0**	**6,278**
Prescribed Fire	0	6,278	0	6,278
Seeding (Primary)	**1,791**	**0**	**0**	**1,791**
Broadcast (Aerial-Helicopter)	1,791	0	0	1,791
Vegetation Removal/Hand Crew	**0**	**494**	**1,174**	**1,668**
Lop & Scatter	0	494	0	494
Lop-Pile-Burn	0	0	1,174	1,174
Grand Total	**2,472**	**9,614**	**1,634**	**13,719**
***Total Land Area Treated**	**2,472**	**8,655**	**1,634**	**12,760**

Table 7.7: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 7, Kamas. Data accessed on 02/09/2022.
*Does not include overlapping treatments.



Map 7.8: WRI treatments by fiscal year completed for WMU 7, Kamas.

Range Trend Studies

Range Trend studies have been sampled within WMU 7 on a regular basis since 1984, with studies being added or suspended as was deemed necessary (**Table 7.8**). Due to changes in sampling methodologies, only data sampled following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 7.9**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
07-1	Stevens Hollow	RT	Suspended	1984, 1990, 1996	Not Verified
07-2	Pinyon Canyon	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Browse)
07-3	Foothill Drive	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016	Upland Stony Loam (Mountain Big Sagebrush)
07-4	Above Samak	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Gambel Oak)
07-5	Kamas Water Tanks	RT	Suspended	1984, 1990	Not Verified
07-6	Cedar Hollow	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Shrub)
07-9	Above Woodland	RT	Active	1984, 1990, 1996, 2001, 2006, 2011, 2016, 2021	Mountain Stony Loam (Browse)
07-10	Elder Hollow	RT	Active	1996, 2001, 2006, 2011, 2016, 2021	Mountain Loam (Shrub)
07R-2	Kamas SFH	WRI	Active	2006, 2011, 2017	Mountain Stony Loam (Mountain Big Sagebrush)

Table 7.8: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 7, Kamas.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
07-1	Stevens Hollow	Aerial After Wildfire	Rockport 5 Fire Rehab Rockport 5 Fire	Fall 2013 August 2013	1,789 3,347	2838
07-4	Above Samak	Wildfire Seed Unknown		1951 1951		
07R-2	Kamas SFH	Plateau Aerial	Kamas SFH Property Kamas SFH Property	September 2008 February 2009	55 55	1195 1195

Table 7.9: Range Trend and WRI studies known disturbance history for WMU 7, Kamas. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Browse)

There are two studies [Pinyon Canyon (07-2) and Above Woodland (07-9)] that are classified as Mountain (Browse) ecological sites. Pinyon Canyon is located a mile northeast of Oakley. The Above Woodland study is located in the hills directly north of Woodland on State Road 35 (**Table 7.8**).

Shrubs/Trees: The browse species on these sites are comprised of mixed browse components; cover is co-dominated by preferred browse species such as Saskatoon serviceberry (*Amelanchier alnifolia*), alderleaf mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), and Gambel oak (*Quercus gambelii*). In addition, mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is a co-dominant species on both sites. The overall trend for browse has varied from year to year, but is generally stable. Within this trend, however, sagebrush cover has increased over time on the Pinyon Canyon site, but has decreased on the Above Woodland study (**Figure 7.2**). Density of preferred browse species has exhibited a general decrease over time. Mature individuals have been the dominant demographic in the preferred browse populations in all years. Decadence has remained low, but has fluctuated. Recruitment of young plants has also remained low throughout the study period (**Figure 7.10**). Utilization of preferred browse has increased over time, with 6% of plants being heavily hedged in 1996 and 40% heavily hedged in 2021 (**Figure 7.12**).

Conifer encroachment is not a concern on these study sites. Tree cover is not detectable, but density of Rocky Mountain juniper (*Juniperus scopulorum*) is low and appears to be stable (**Figure 7.6**, **Figure 7.8**).

Herbaceous Understory: Understories of these studies are composed of several perennial forbs and grasses. Cover of annual grasses and introduced annual forbs have generally increased. Mean nested frequency for annual grasses has remained moderate, but variable. However, mean nested frequency of annual forbs has generally increased over time. The cover of perennial grasses has decreased overall on both sites. Pinyon Canyon maintains an established population of bluebunch wheatgrass (*Pseudoroegneria spicata*) with a lesser amount of cover contributed by annual bromes (*Bromus* sp.), while Above Woodland is generally dominated by annual bromes (**Figure 7.14**, **Figure 7.16**).

Occupancy: These sites have shown significant levels of occupancy by elk in the early part of the study period, but elk presence decreased significantly in the 2016 and 2021 sample years. Mean elk presence increased from 50 days use in 2001 to 86 days use/acre in 2011; average elk presence was estimated at 36 days use/acre in 2016 and 30 days use/acre in 2021 average deer presence has remained relatively low, decreasing steadily between 2001 (23 days use/acre) and 2016 (7 days use/acre). However, average abundance of deer pellet groups increased notably in 2021 to 30 days use/acre (**Figure 7.18**).

Mountain (Shrub)

There are two studies [Cedar Hollow (07-6) and Elder Hollow (07-10)] that are classified as Mountain (Shrub) ecological sites. Cedar Hollow is located 5 miles east of Woodland above the Provo River. Finally, the Elder Hollow Study is located a half mile east of Kamas off Highway 150 (**Table 7.8**).

Shrubs/Trees: The shrub component of these sites is composed of a mixture of species, with the primary browse species being mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Other species are present in lesser amounts and include the preferred browse species Utah serviceberry (*Amelanchier utahensis*) and antelope bitterbrush (*Purshia tridentata*); the Cedar Hollow site includes a significant component of Gambel Oak (*Quercus gambelii*) (**Figure 7.3**). Average sagebrush density has decreased overall. Mature plants are the primary age class in these populations, which have increased in the populations' overall composition over the duration of the studies. Density of decadent individuals and recruitment of young have fluctuated, but have decreased overall (**Figure 7.10**). Average utilization of sagebrush has also decreased, with less than half of the populations showing signs of moderate to heavy use in 2001, 2006, 2011, and 2016 (**Figure 7.12**).

Conifer encroachment is not a concern on these study sites. However, Rocky Mountain juniper (*Juniperus scopulorum)* is present but only has a small influence in the community (**Figure 7.6**, **Figure 7.8**).

Herbaceous Understory: The understories of these studies are composed of several perennial forbs and grasses. Cover of annual grasses and introduced annual forbs has either remained steady or has increased. However, there was a notable decrease in nested frequency and cover of annual grasses and introduced annual forbs in 2021: these decreases are likely due to the extreme drought that occurred that year (**Figure 7.1**). The cover of perennial grasses has generally remained stable on both sites. Cedar Hollow maintains a notable population of bluebunch wheatgrass (*Pseudoroegneria spicata*) with a lesser amount of cover contributed by perennial bromes, while Elder Hollow is dominated by annual bromes (*Bromus* sp.) (**Figure 7.14**, **Figure 7.16**).

Occupancy: These sites are primarily occupied by mule deer according to pellet transect data. Usage by deer has varied greatly with an overall trend that appears to be decreasing. Pellet group data ranges between 18 days use/acre in 2016 and 75 days use/acre in 2006 for mule deer. Elk occupancy has remained low over the years ranging between 0.3 days use/acre in 2016 and 6 days use/acre in 2001 (**Figure 7.18**)

Mountain (Oak)

There is one study [Above Samak (07-4)] that is classified as a Mountain (Oak) ecological site. The Above Samak study is located 2 miles east of Kamas in the Kamas WMA (**Table 7.8**).

Shrubs/Trees: The shrub component of the Above Samak site is a mixture of preferred browse species including Utah serviceberry (*Amelanchier utahensis*), antelope bitterbrush (*Purshia tridentata*), Gambel oak (*Quercus gambelii*), and mountain snowberry (*Symphoricarpos oreophilus*). There is also a significant mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) component to the browse available on this site. The cover percentage of sagebrush has decreased from 8.6 percent in 2011 to 4.6 percent in 2021. Gambel oak has increased from 6.9 percent in 2006 to 13.4 percent cover in 2021. The overall cover of preferred browse has slightly increased slightly or remained steady over the

study period (**Figure 7.4**). Average preferred browse demographics indicate that the population has been comprised of mainly mature individuals. In general, recruitment of young plants in the preferred browse community is low, but recruitment of Gambel oak has been high: the percentage of young Gambel oak plants has ranged from 23 percent of the population to 53 percent of the population in 2021 (**Figure 7.10**). Utilization of preferred browse decreased significantly over the length of the study. Serviceberry has received heavy utilization, while sagebrush has been moderately unitized (**Figure 7.12**).

Encroachment by conifer is not a concern on this study site (**Figure 7.6**, **Figure 7.8**).

Herbaceous Understory: The herbaceous understory of this site has generally remained stable over the study period. However, in 2011, bulbous bluegrass (*Poa bulbosa*) was detected in significant amounts on the site for the first time and cover has steadily increased since then. There is a diverse mix of perennial forbs on this site that has varied in cover from a low of 5.5 percent in 1996 to a high of 12.9 percent in 2011. Annual forbs have been present in amounts between 0.7 percent in 1996 and 4.6 percent in 2011.The herbaceous understory is dominated by the introduced perennial grasses crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), and intermediate wheatgrass (*Thinopyrum intermedium*). However, the native grasses muttongrass (*P. fendleriana*), bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda*) also provide cover to a lesser extent (**Figure 7.14**, **Figure 7.16**).

Occupancy: Average pellet group transect data shows that the site is primarily used by deer and/or cattle and that occupancy fluctuates by year. Elk pellet groups were sampled from 2001 to 2011 but were not sampled in 2016. For mule deer, there was a low of 7 days of use/acre in 2021 and a high of 46 days of use/acre in 2016. Cattle usage varied between 7 days use/acre in 2011 to 31 days use/acre in 2016. Mean abundance of elk pellet groups varied from 0 days use/acre in 2016 and 2021 to 23 days use/acre in 2001 (**Figure 7.18**).

Upland (Big Sagebrush)

There is one study [Foothill Drive (07-3)] that is classified as an Upland (Big Sagebrush) ecological site. The Foothill Drive site is located 2.25 miles south of Kamas near Foothill Drive (**Table 7.8**).

Shrubs/Trees: The browse component of this site is primarily composed of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). Other preferred browse species are present in the cover data, namely Utah serviceberry (*Amelanchier utahensis*) and Woods' rose (*Rosa woodsii*). Cover of sagebrush has remained relatively stable, along with cover of other preferred browse. Cover of other shrubs has slightly increased through the sample years (**Figure 7.5**). Average preferred browse demographics indicate that the browse populations on this study site are largely composed of mature and decadent individuals, and that overall density of mature plants has increased through the sample years. Recruitment of young plants has fluctuated, but has generally exhibited a decreasing trend over the sample period. However, decadence within these populations has remained stable over the same study period. Sagebrush recruitment has decreased slightly over time (**Figure 7.11**). Preferred browse utilization has generally remained low overall, but in 2001, just over 39% of plants were moderately browsed, and 15% were heavily browsed the same year (**Figure 7.13**).

Encroachment of conifer trees is not a concern on this site with no observed cover or density of trees to report (**Figure 7.7**, **Figure 7.9**).

Herbaceous Understory: The herbaceous understory for graminoids is primarily composed of annuals, namely cheatgrass (*Bromus tectorum*) and field brome (*B. arvensis*). Native perennial species include Sandberg bluegrass (*Poa secunda*), and bluebunch wheatgrass (*Pseudoroegneria spicata*): these native species are present in small amounts on the site. Perennial forb cover has varied, with cover amounts ranging from 3.1 to 9.2 percent. Annual forb cover has ranged from 4.9 to 17.3 percent over time (**Figure 7.15**, **Figure 7.17**).

Occupancy: The average pellet transect data shows that deer are the primary occupants of this site. In addition, the usage of the site by deer has generally decreased over the course of the study. There is a small amount of usage by domestic animals as of the most recent sample year: cattle had 3 days use/acre and horses showed 6 days use/acre in 2016. Average abundance of deer pellet groups had a high of 68 days use/acre in 2006 and a low of 36 days use/acre in 2016 (**Figure 7.19**).

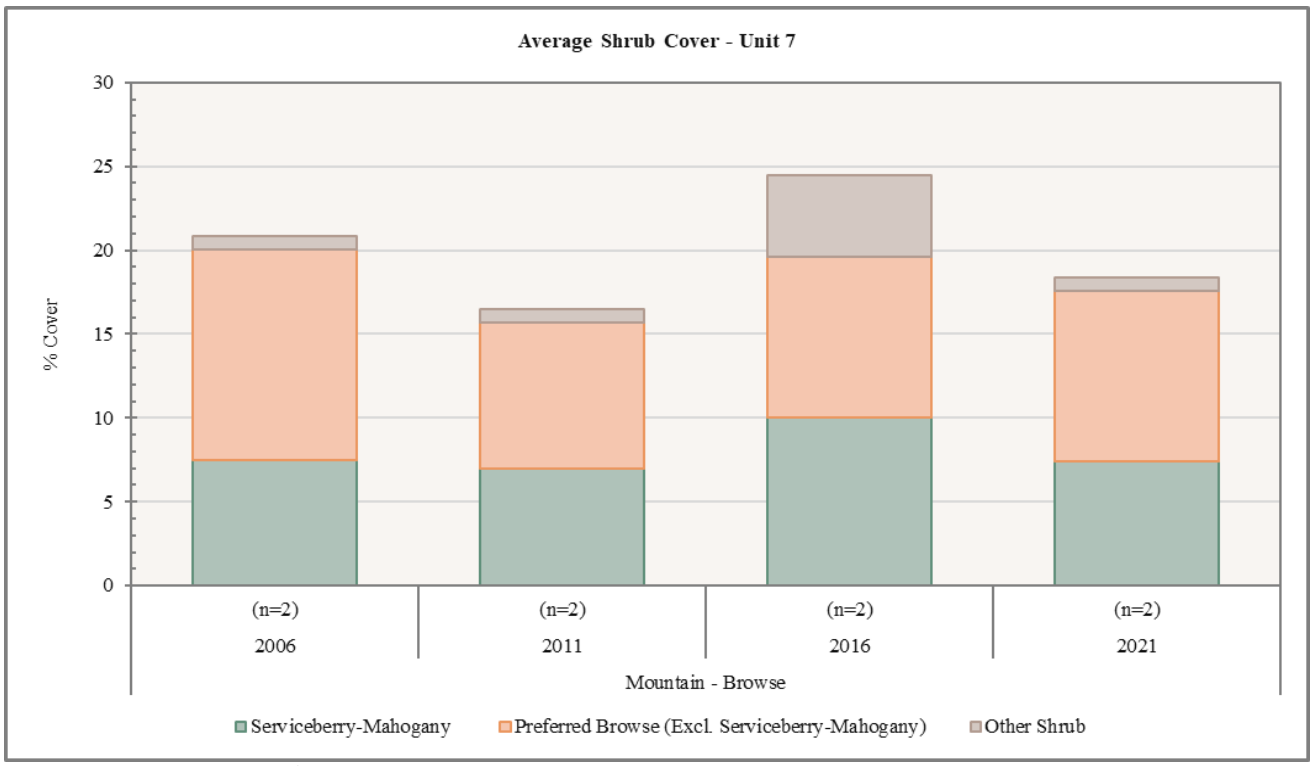


Figure 7.2: Average shrub cover for Mountain - Browse study sites in WMU 7, Kamas.

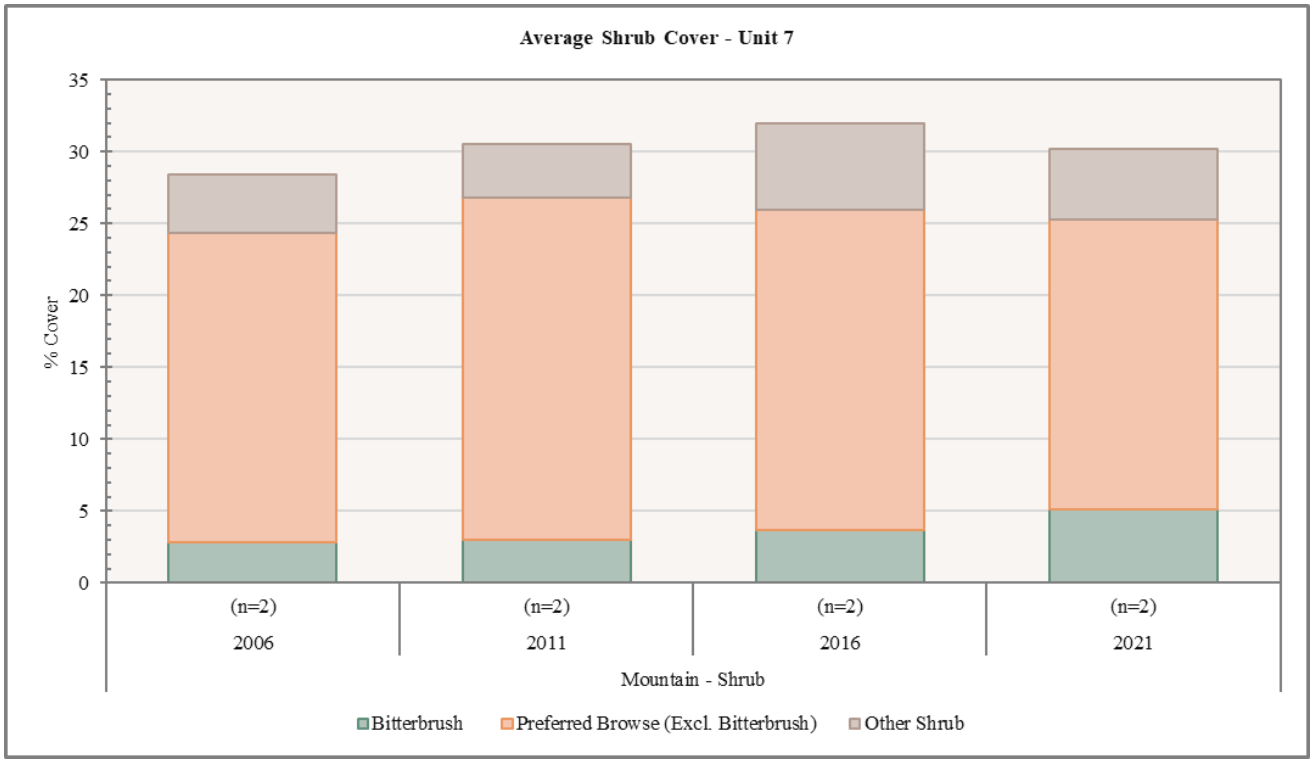


Figure 7.3: Average shrub cover for Mountain - Shrub study sites in WMU 7, Kamas.

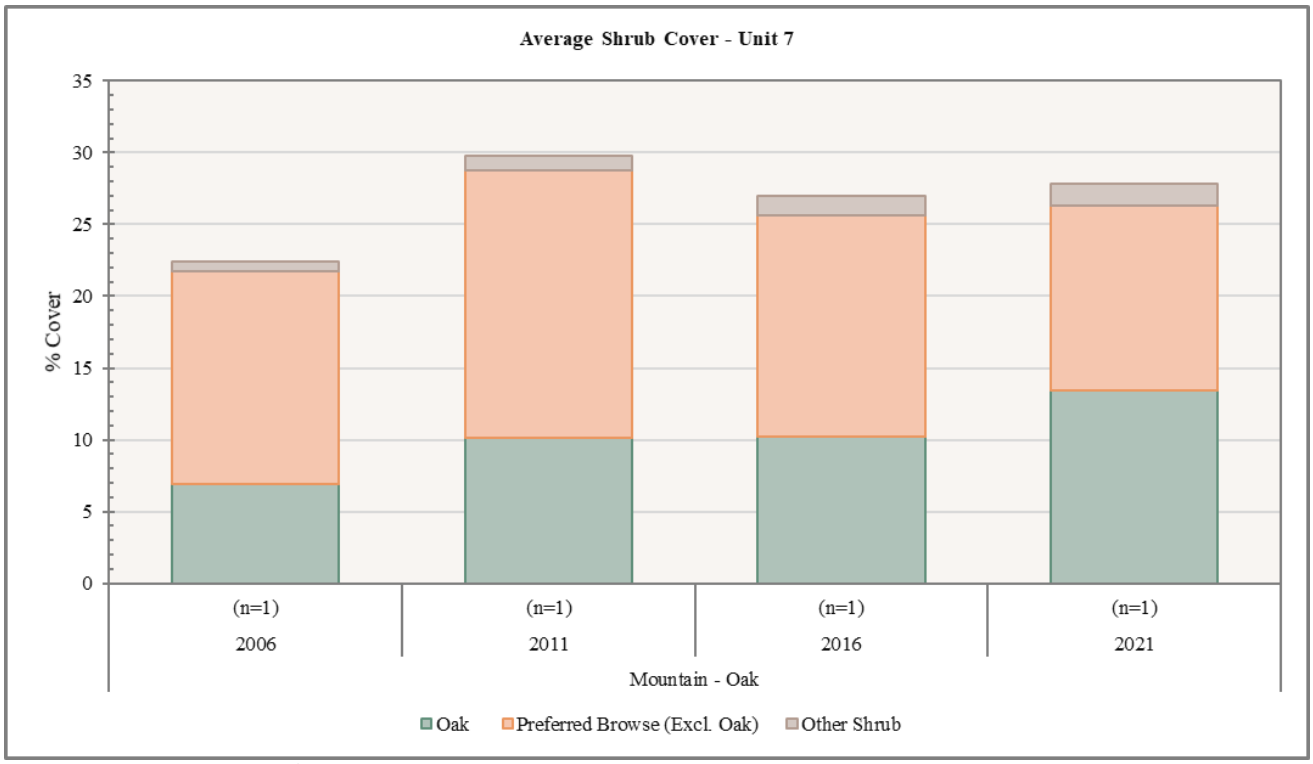


Figure 7.4: Average shrub cover for Mountain - Oak study sites in WMU 7, Kamas.

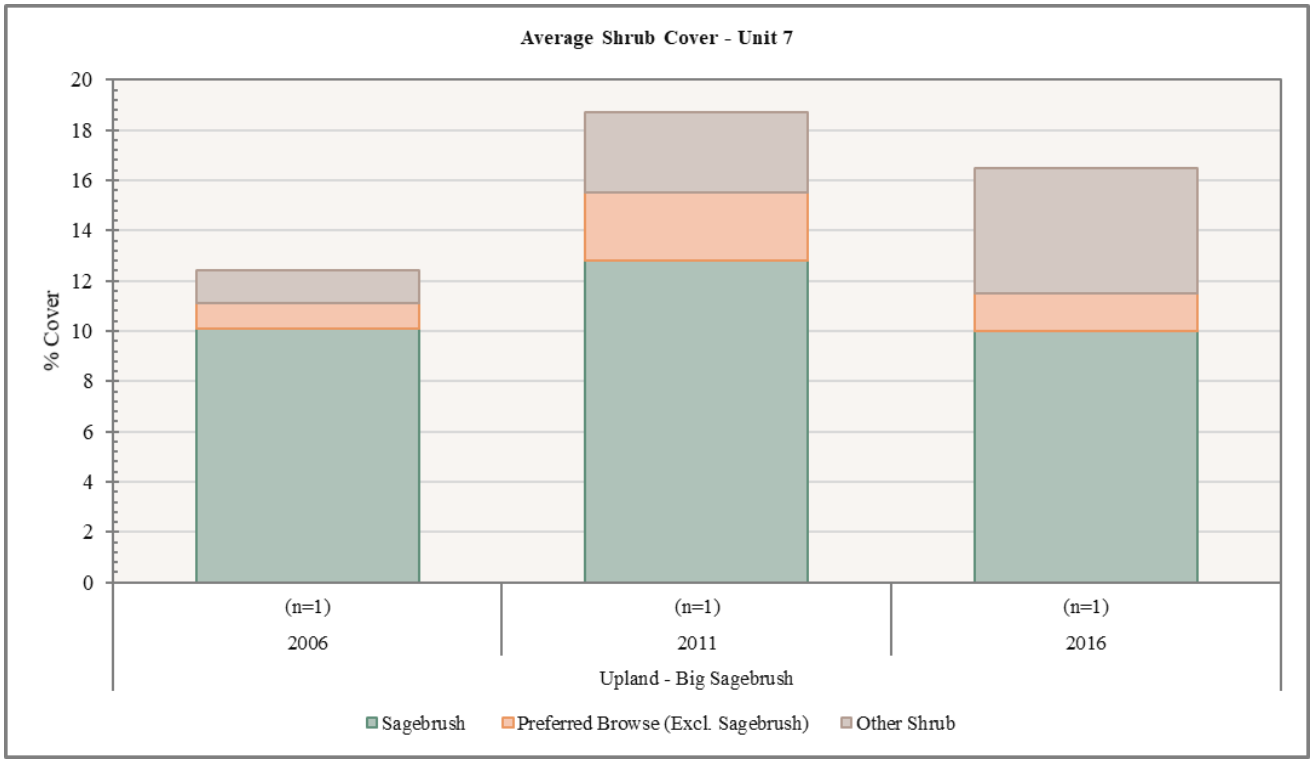


Figure 7.5: Average shrub cover for Upland - Big Sagebrush study sites in WMU 7, Kamas.

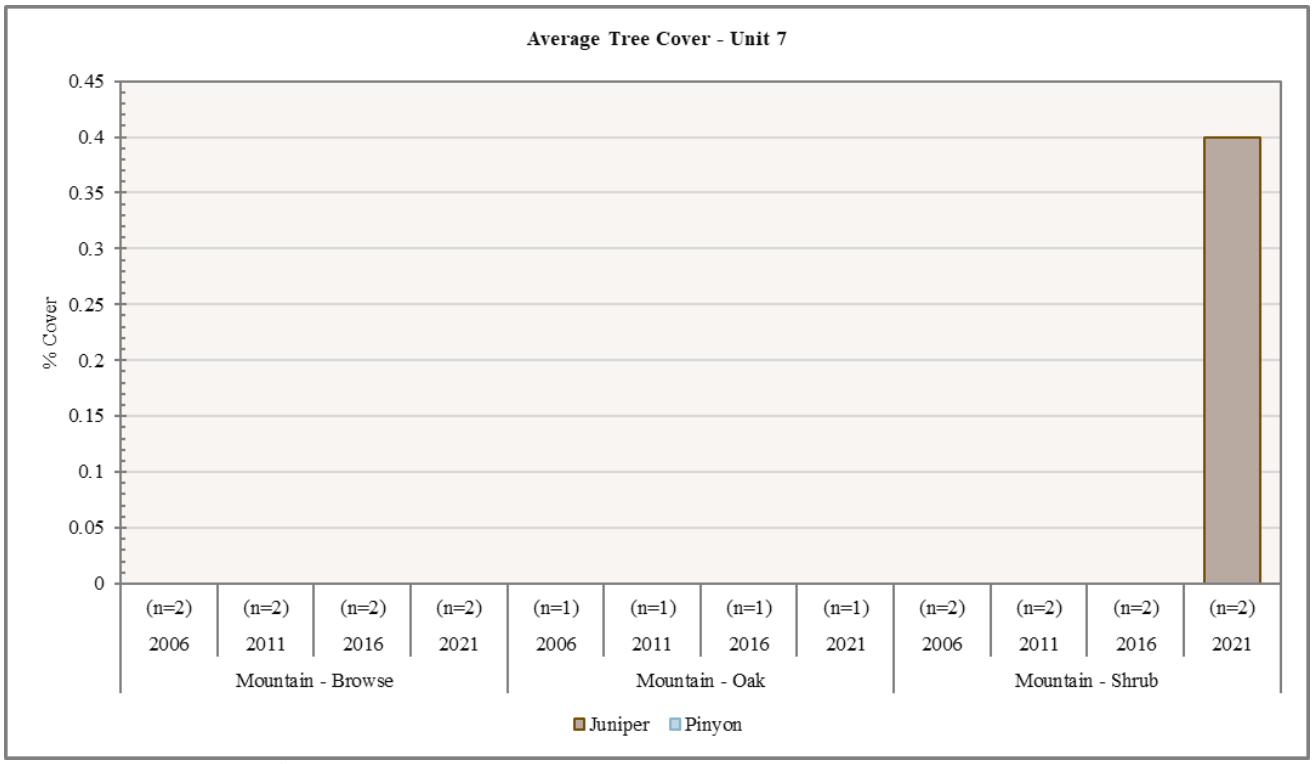


Figure 7.6: Average tree cover for Mountain - Browse, Mountain - Oak, and Mountain - Shrub study sites in WMU 7, Kamas.

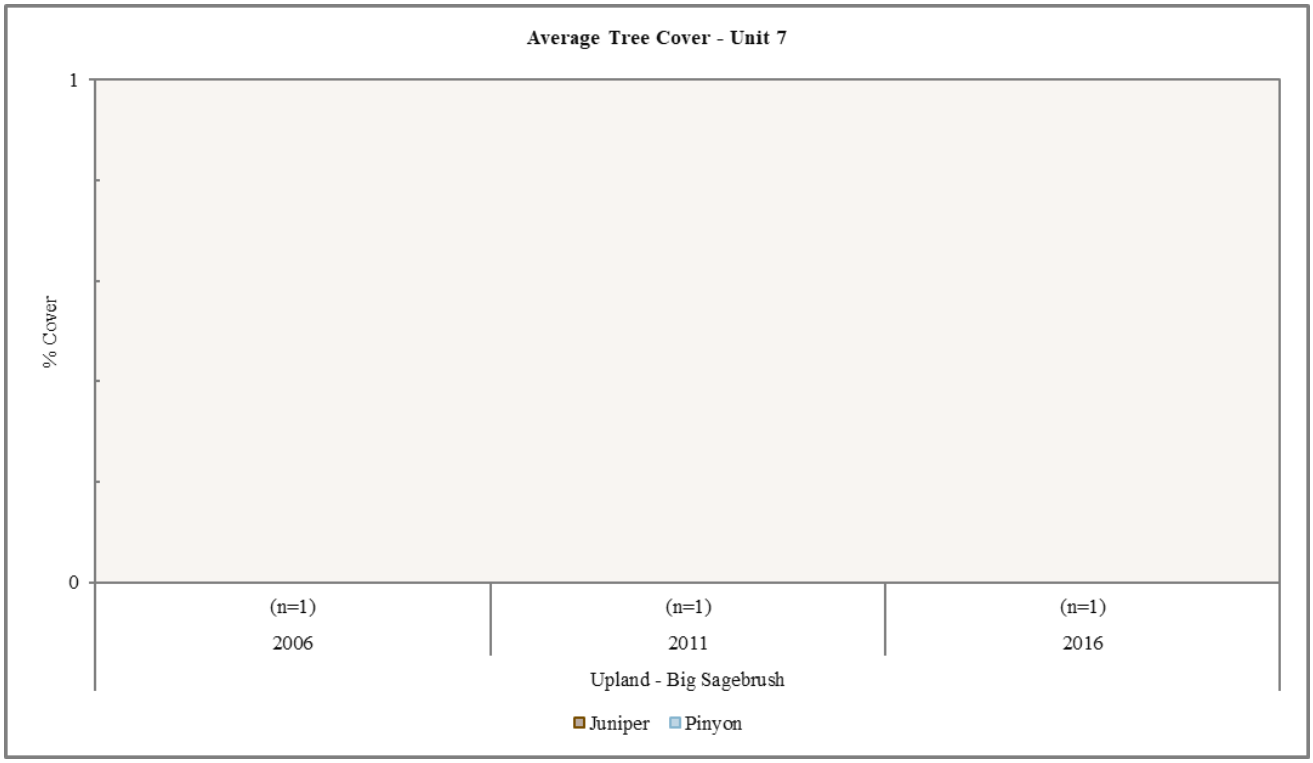


Figure 7.7: Average tree cover for Upland - Big Sagebrush study sites in WMU 7, Kamas.

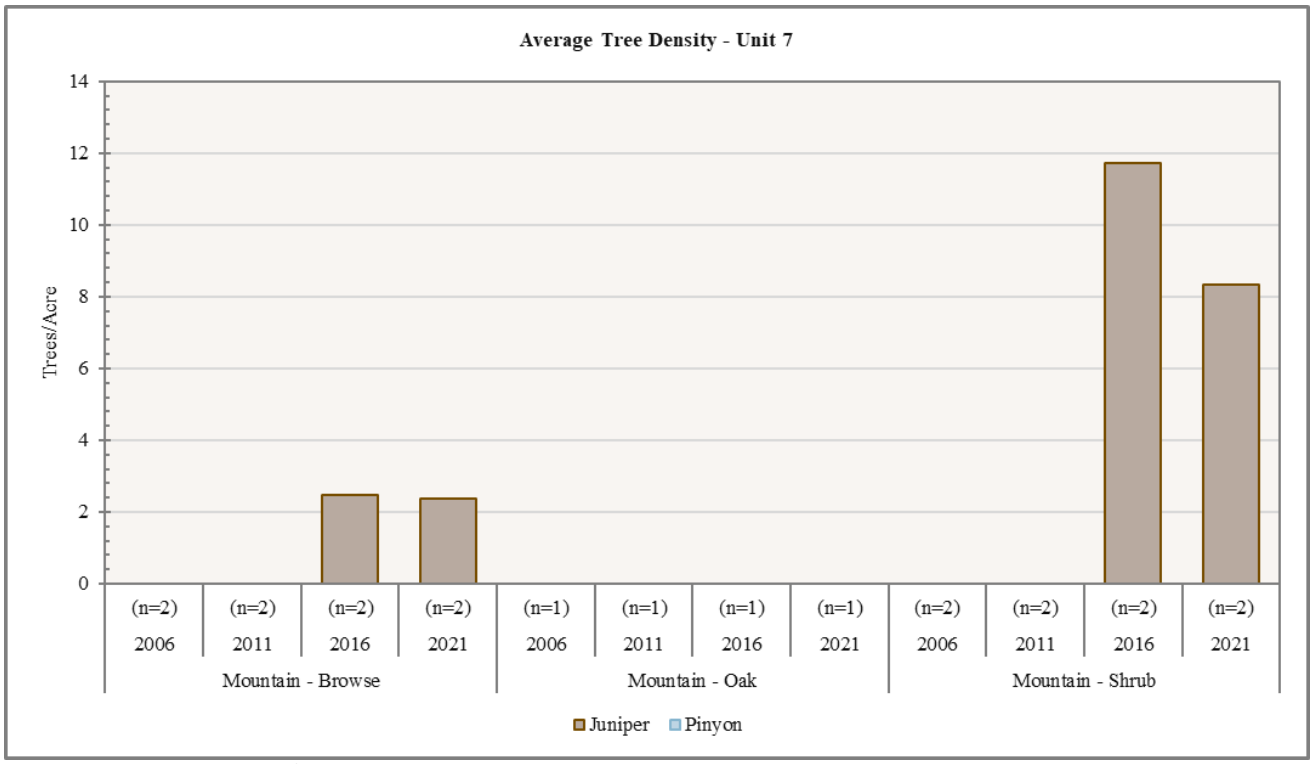


Figure 7.8: Average tree density for Mountain - Browse, Mountain - Oak, and Mountain - Shrub study sites in WMU 7, Kamas.

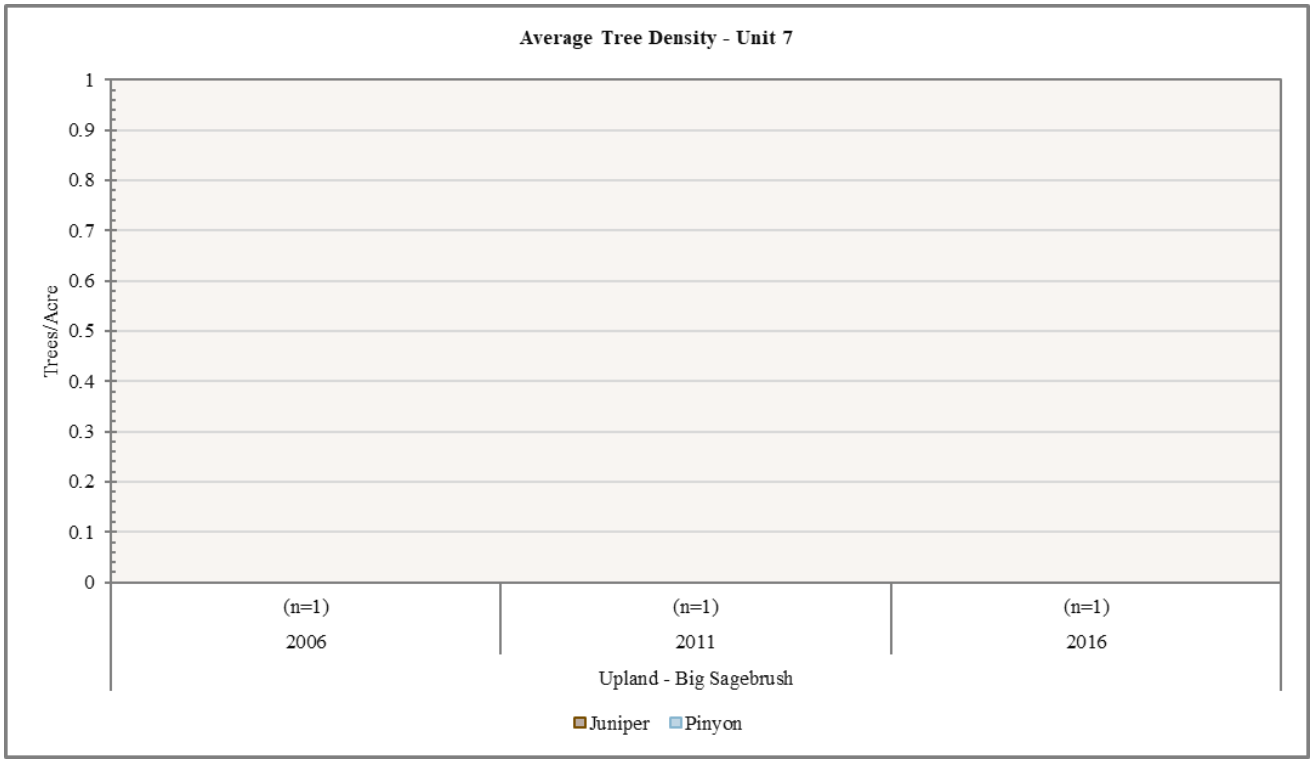


Figure 7.9: Average tree density for Upland - Big Sagebrush study sites in WMU 7, Kamas.

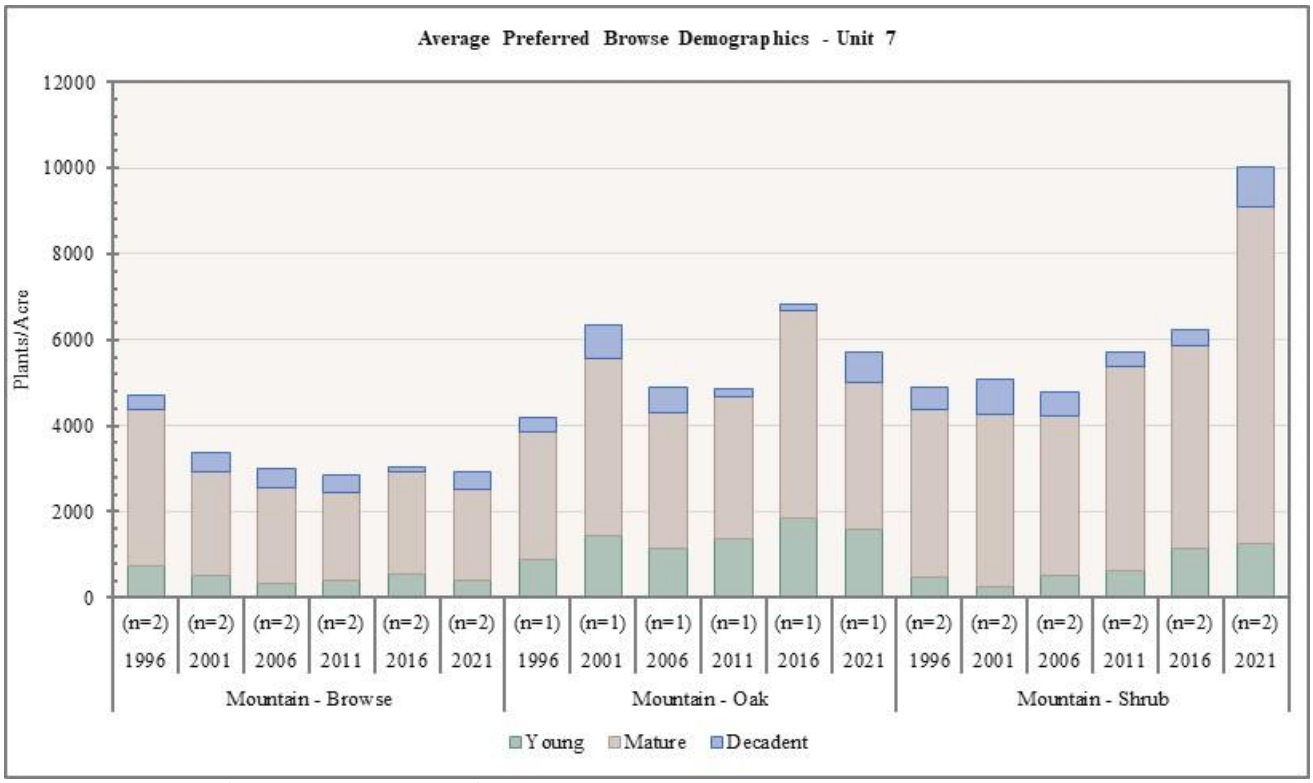


Figure 7.10: Average preferred browse demographics for Mountain - Browse, Mountain - Oak, and Mountain - Shrub study sites in WMU 7, Kamas.

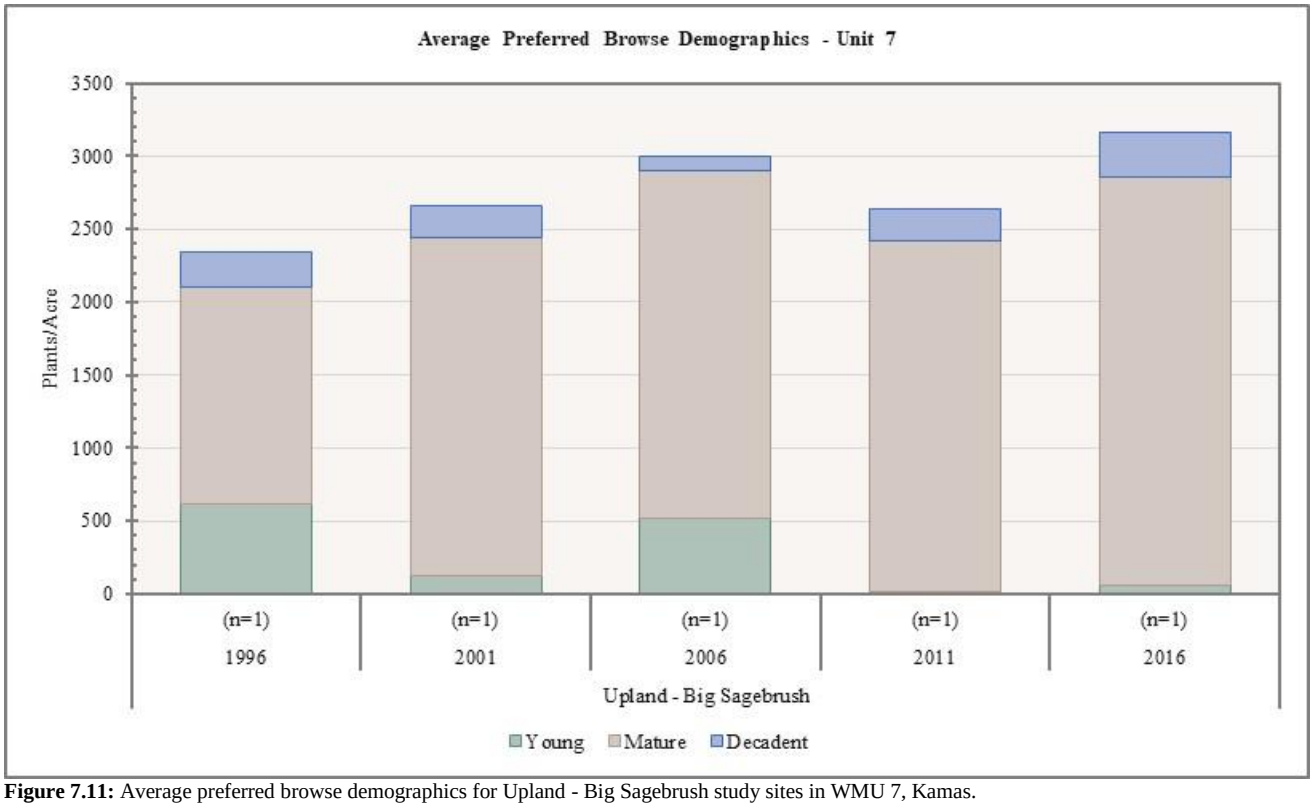


Figure 7.11: Average preferred browse demographics for Upland - Big Sagebrush study sites in WMU 7, Kamas.

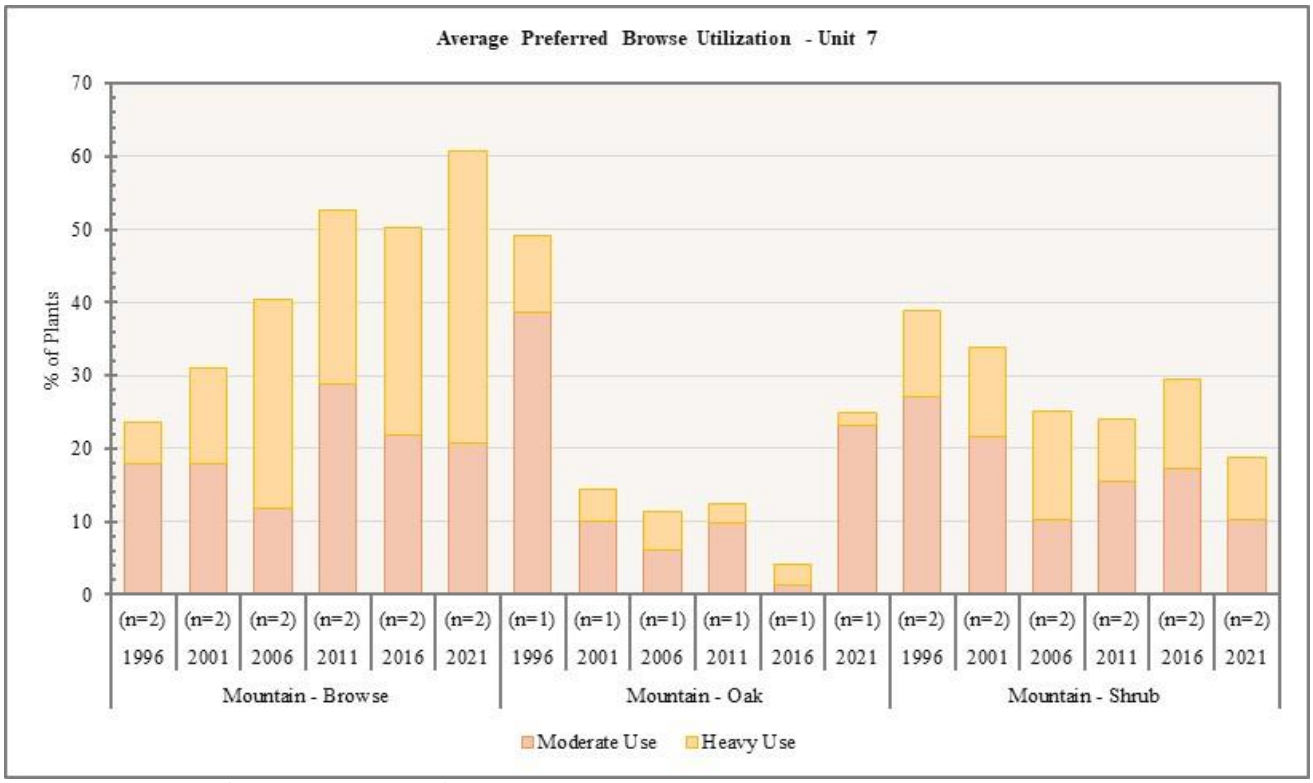


Figure 7.12: Average preferred browse utilization for Mountain - Browse, Mountain - Oak, and Mountain - Shrub study sites in WMU 7, Kamas.

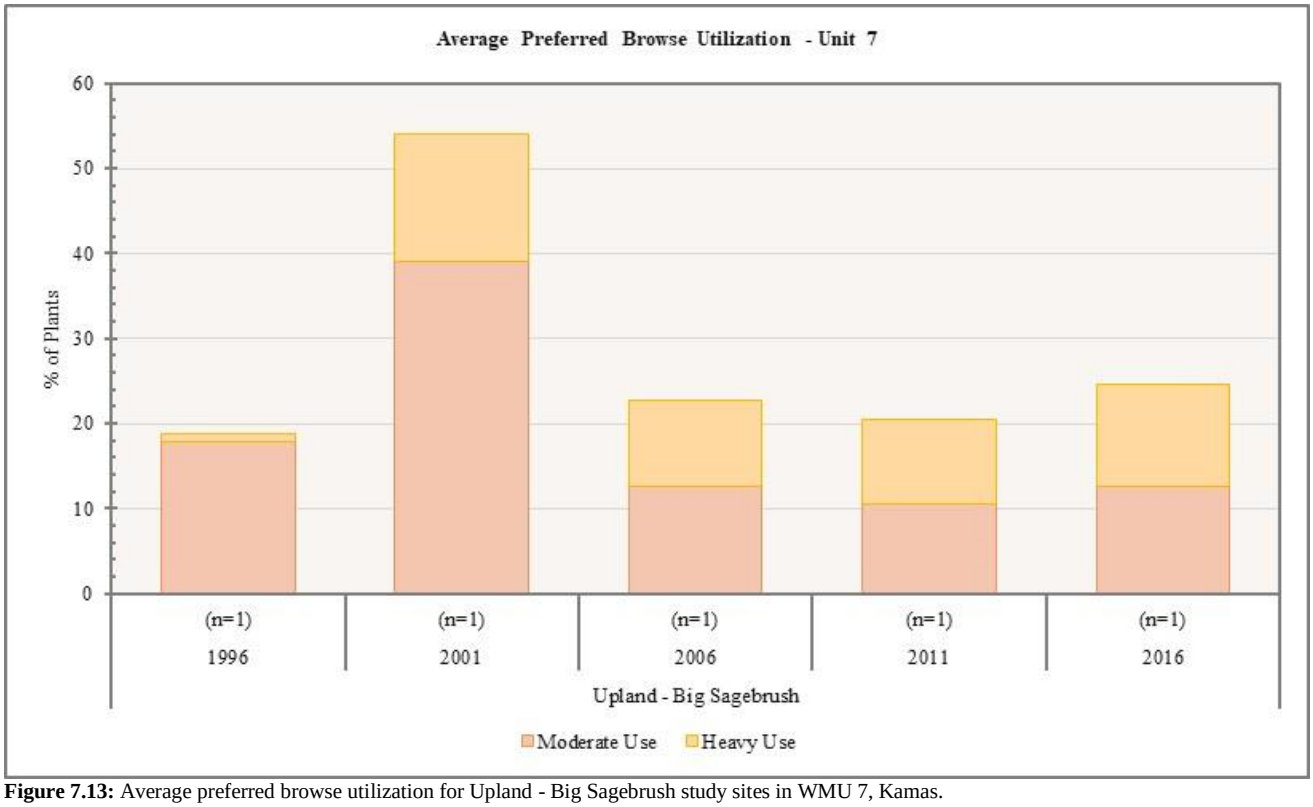


Figure 7.13: Average preferred browse utilization for Upland - Big Sagebrush study sites in WMU 7, Kamas.

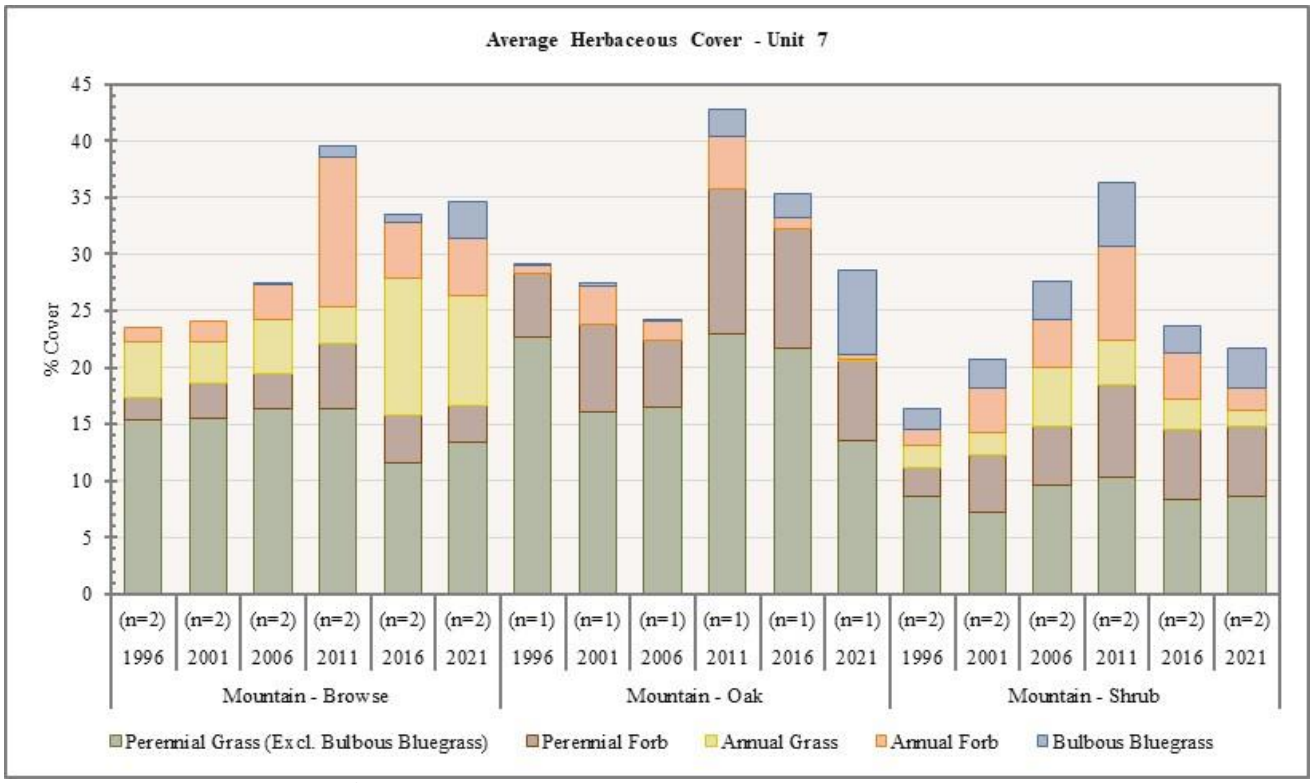


Figure 7.14: Average herbaceous cover for Mountain - Browse, Mountain - Oak, and Mountain - Shrub study sites in WMU 7, Kamas.

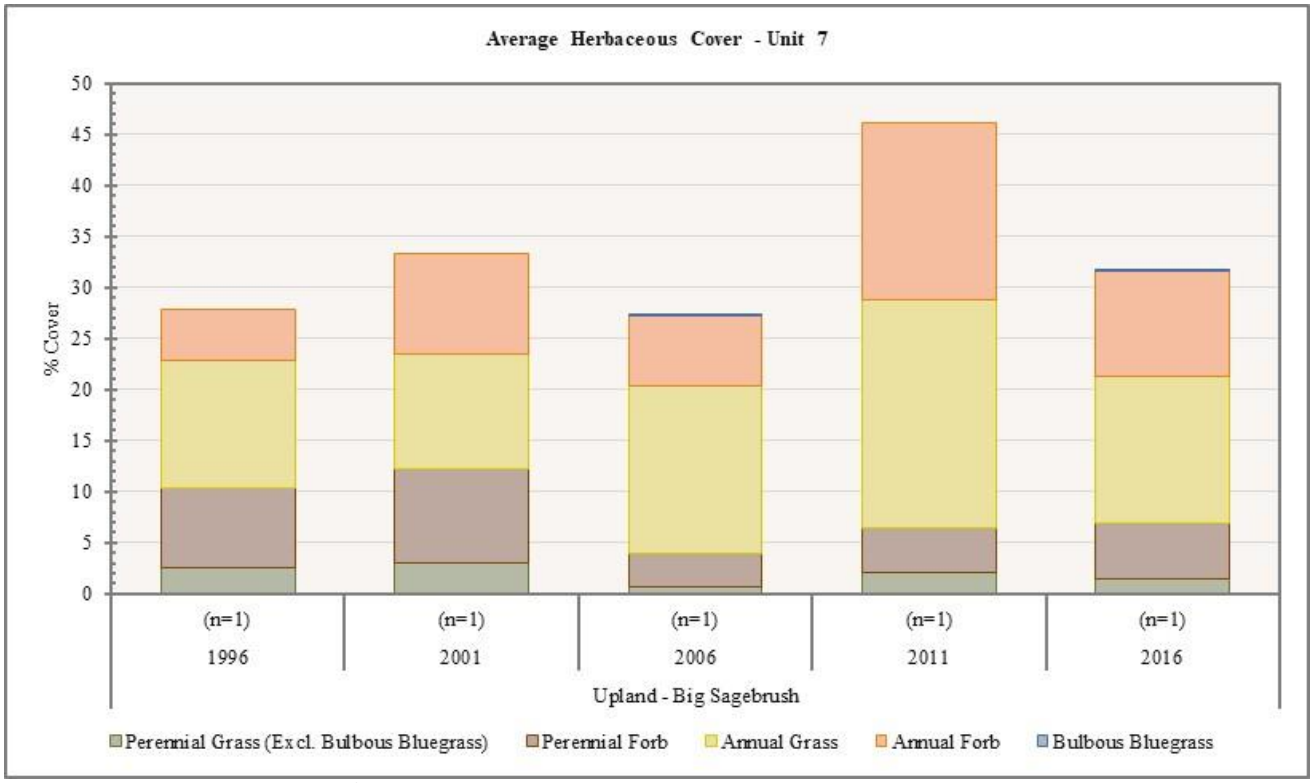


Figure 7.15: Average herbaceous cover for Upland - Big Sagebrush study sites in WMU 7, Kamas.

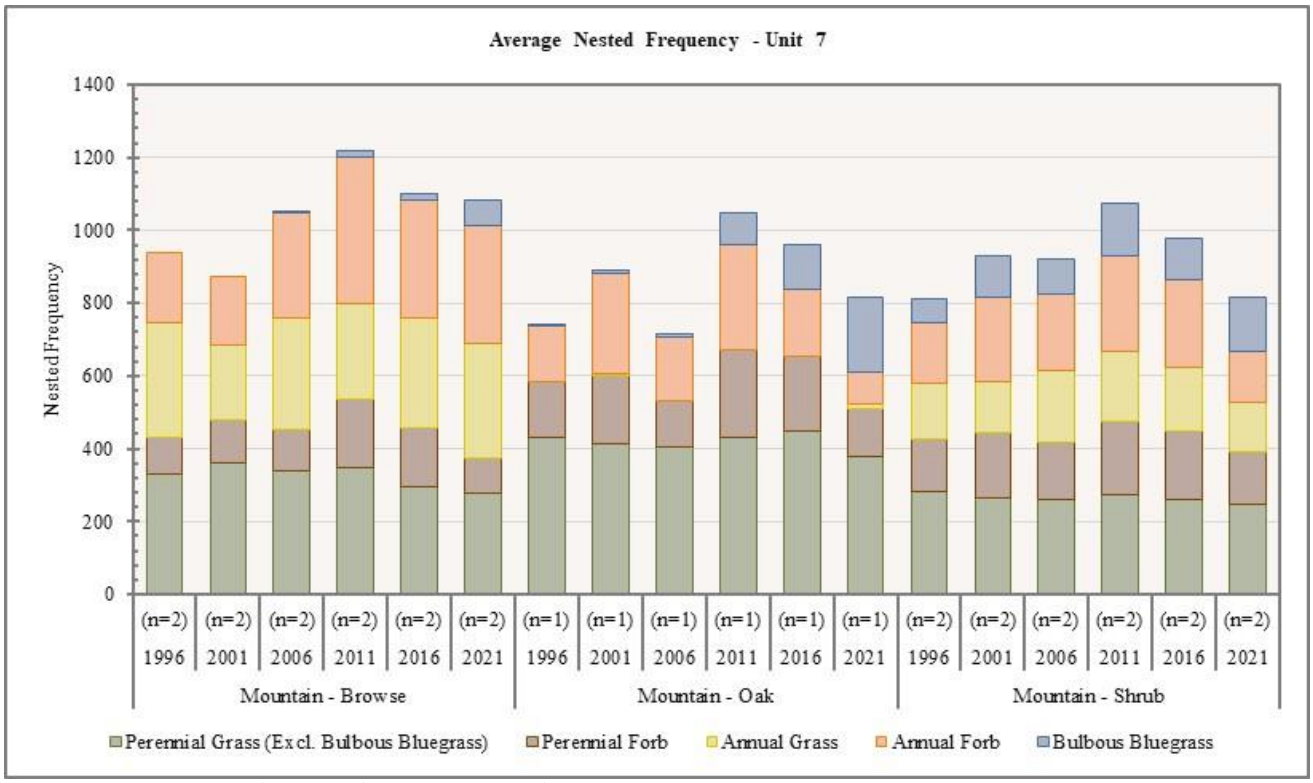


Figure 7.16: Average nested frequency of herbaceous species for Mountain - Browse, Mountain - Oak, and Mountain - Shrub study sites in WMU 7, Kamas.

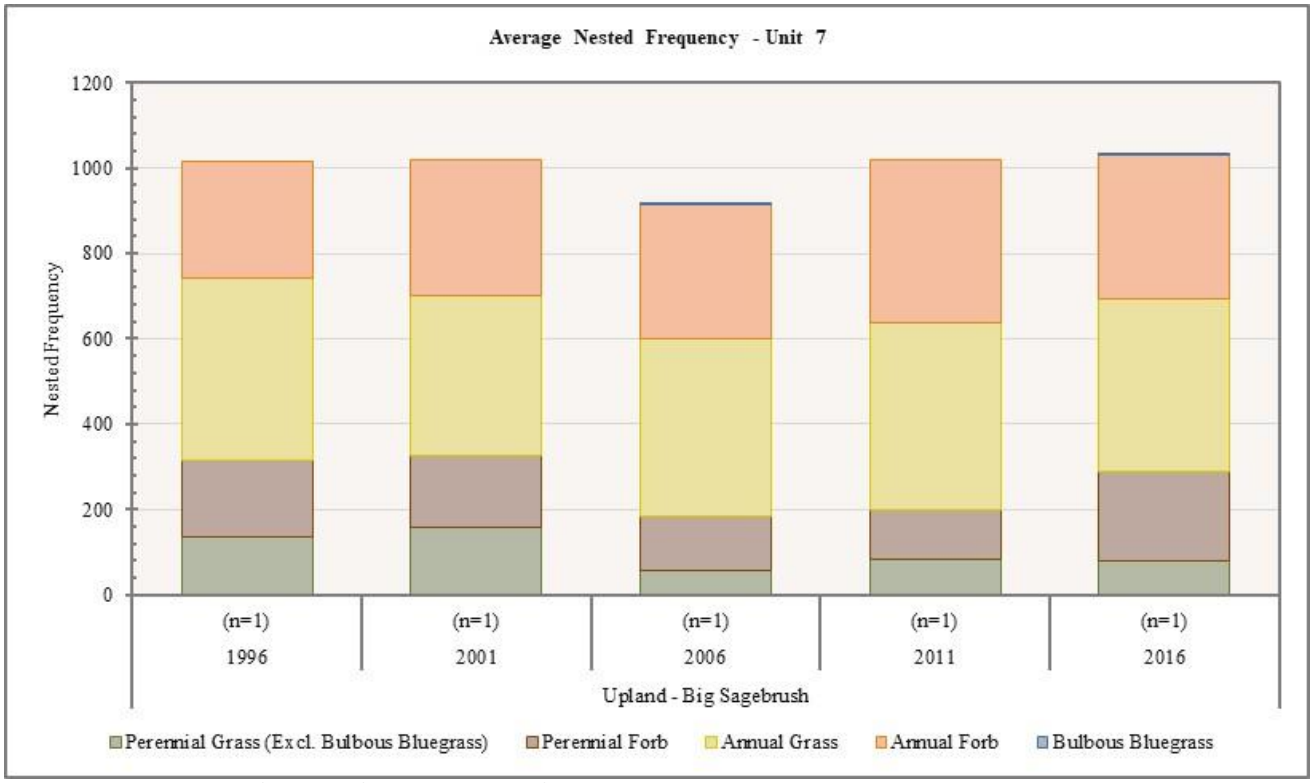


Figure 7.17: Average nested frequency of herbaceous species for Upland - Big Sagebrush study sites in WMU 7, Kamas.

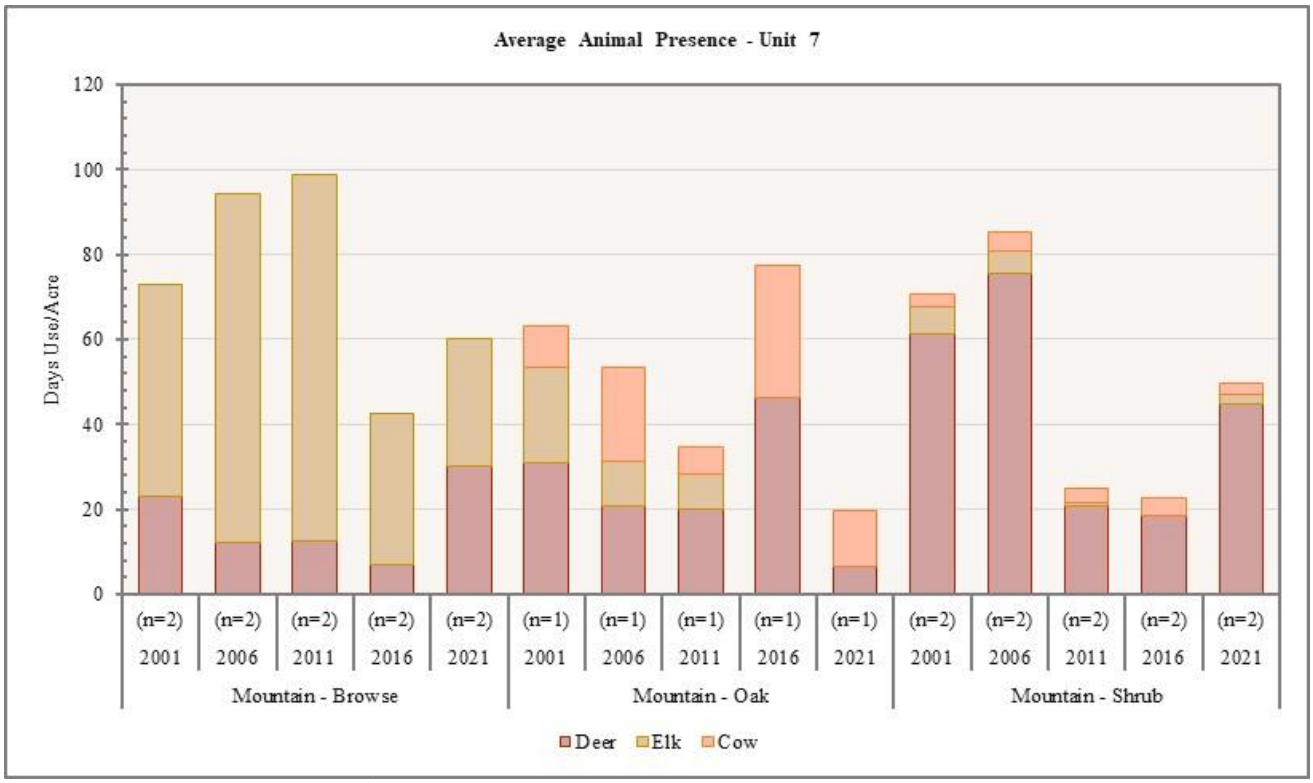


Figure 7.18: Average pellet transect data for Mountain - Browse, Mountain - Oak, and Mountain - Shrub study sites in WMU 7, Kamas.

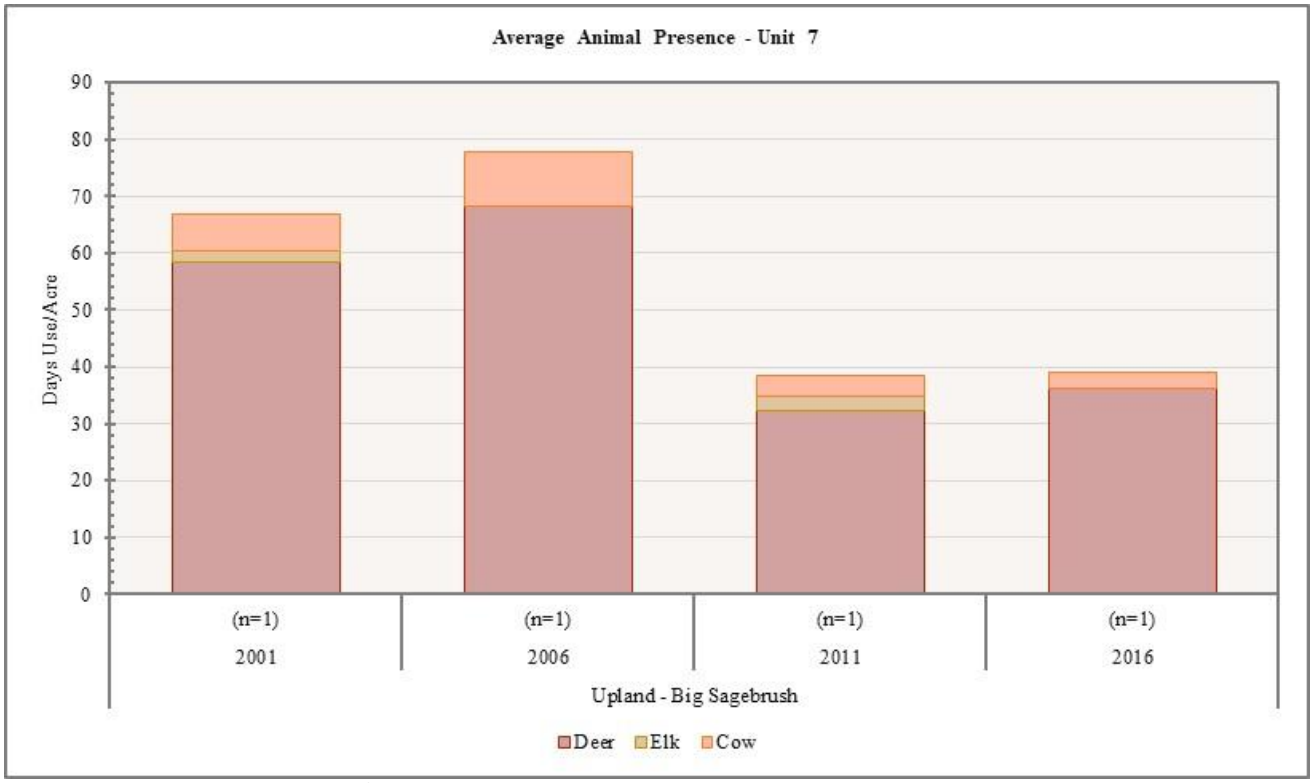
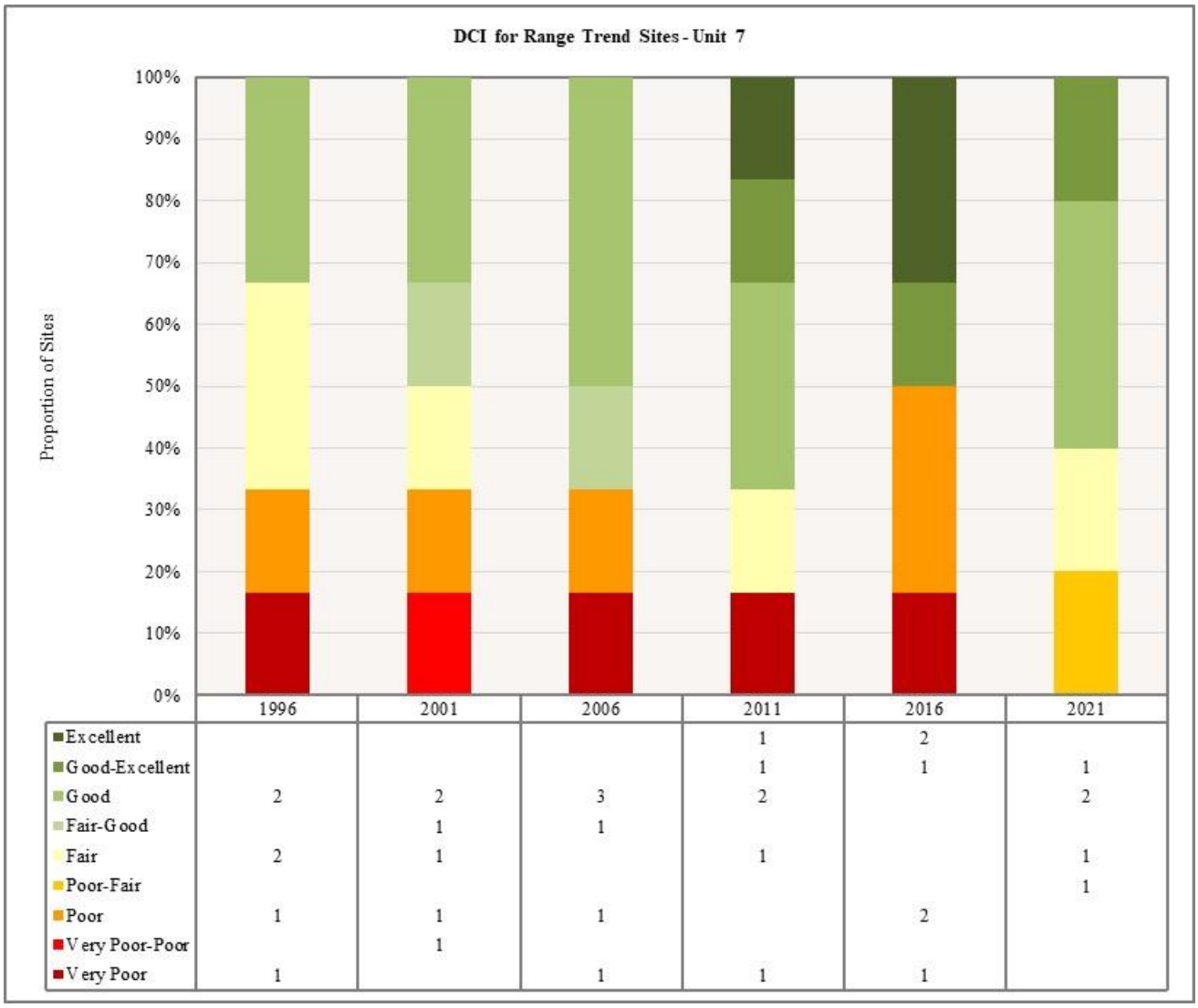


Figure 7.19: Average pellet transect data for Upland - Big Sagebrush study sites in WMU 7, Kamas.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Kamas management unit has generally improved from poor-fair averaged conditions in 1996 to fair-good averaged conditions in 2021. Pinyon Canyon (07-2), Above Samak (07-4), and Cedar Hollow (07-6) are the main drivers for the unit's wintering habitat stability and quality, and average between good and good-excellent deer winter range conditions. Foothill Drive (07-3) is considered to have very poor wintering habitat conditions consistently from year to year, and suppresses the unit's overall quality of winter habitat. Range Trend sites in WMU 7 that tend to have higher variability in deer winter habitat include Cedar Hollow and Above Woodland (07-9). Above Woodland appears to have the highest degree of potential winter range improvement.

The overall deer winter range assessment in 2021 for WMU 7 was in fair-good condition. However, Elder Hollow (07-10) was considered to be in poor-fair condition due to the presence of annual grass and low abundance of perennial grasses and forbs (**Figure 7.20**, **Table 7.10**).

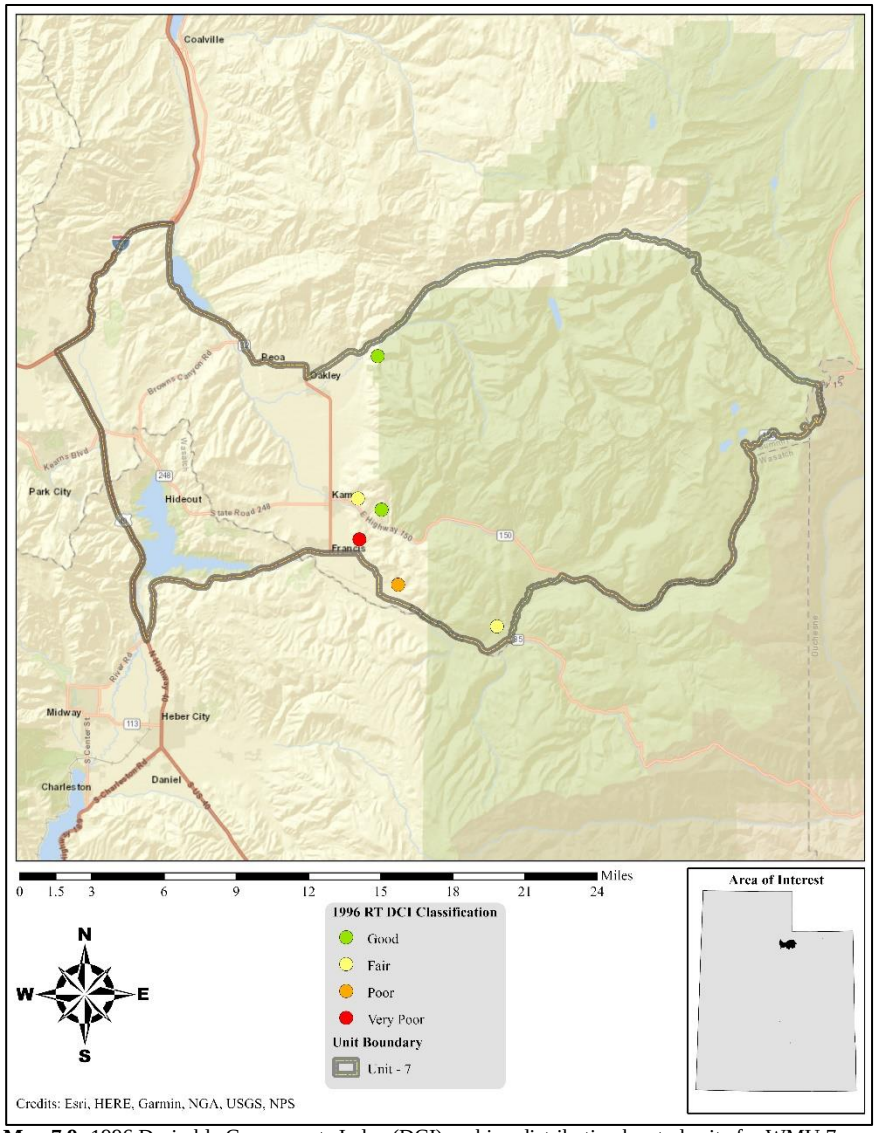


	1996	2001	2006	2011	2016	2021
Excellent				1	2	
Good-Excellent				1	1	1
Good	2	2	3	2		2
Fair-Good		1	1			
Fair	2	1		1		1
Poor-Fair						1
Poor	1	1	1		2	
Very Poor-Poor		1				
Very Poor	1		1	1	1	

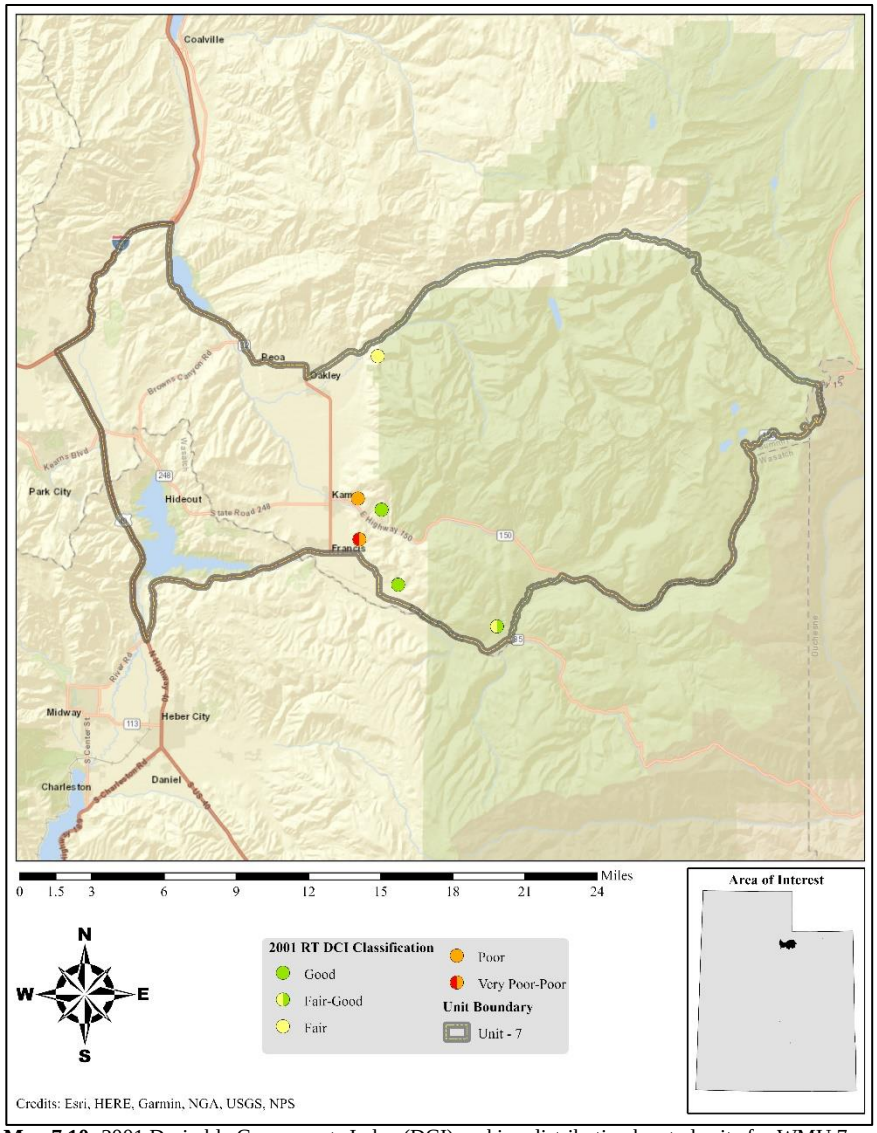
Figure 7.20: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 7, Kamas.

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
07-2	1996	13.3	14.1	14.4	30	-4.9	5.3	0	**72.2**	**G**
07-2	2001	16.8	12.9	4.4	30	-4.2	6.5	0	**66.3**	**F**
07-2	2006	22.1	11.2	6.9	30	-3	6.4	0	**73.5**	**G**
07-2	2011	19.3	9.4	7	29.6	-1.4	10	0	**73.9**	**G**
07-2	2016	25.8	14.4	10.1	30	-1.8	10	0	**88.5**	**G-E**
07-2	2021	24.9	13.2	10.4	27.2	-9.7	7.8	0	**73.7**	**G**
07-3	1996	8.2	9.6	6.6	5.2	-9.4	10	0	**30.3**	**VP**
07-3	2001	10.3	10.5	4.6	6	-8.4	10	0	**33**	**VP-P**
07-3	2006	13.9	12.3	3.8	1.5	-12.4	6.3	-2	**23.3**	**VP**
07-3	2011	19.5	9.1	0.9	4.2	-16.8	8.6	-2	**23.5**	**VP**
07-3	2016	14.4	7.7	1.6	2.9	-10.5	10	-2	**24.2**	**VP**
07-4	1996	17.3	12.5	8.7	30	0	10	0	**78.5**	**G**
07-4	2001	20.7	11.4	4.7	30	0	10	0	**76.7**	**G**
07-4	2006	24.3	10.8	10.3	30	0	10	0	**85.4**	**G**
07-4	2011	30	13.2	11.5	30	0	10	0	**94.7**	**E**
07-4	2016	28	14.1	13.4	30	0	10	0	**95.5**	**E**
07-4	2021	28.9	11.7	12.2	26.7	-0.1	10	0	**89.4**	**G-E**
07-6	1996	20.5	11.9	3.3	22.4	0	5	0	**63.1**	**F**
07-6	2001	26	10.8	0.8	21.5	0	10	0	**69.1**	**F-G**
07-6	2006	28.6	11.1	4.8	27.7	0	10	0	**82.2**	**G**
07-6	2011	30	14.2	4.8	30	0	10	0	**88.9**	**G-E**
07-6	2016	30	14.2	8.5	29.4	-0.1	10	0	**92**	**E**
07-6	2021	30	11.7	4.3	25	0	10	0	**80.9**	**G**
07-9	1996	20.6	11.7	4.3	14.4	-2.6	2.8	0	**51.2**	**P**
07-9	2001	30	10.1	3.2	29.5	-1.2	6.1	0	**77.6**	**G**
07-9	2006	30	9.5	3.7	25.1	-4.3	6.3	0	**70.2**	**F-G**
07-9	2011	23.4	9.7	2.7	30	-3.5	10	0	**72.2**	**G**
07-9	2016	27.9	13.7	7.5	12.8	-16.3	5.7	0	**51.3**	**P**
07-9	2021	22.8	7.7	4	26.4	-4.4	5.1	-2	**59.5**	**F**
07-10	1996	30	10.3	3.9	12.2	-2.9	5.1	0	**58.6**	**F**
07-10	2001	30	7.3	2.4	7.4	-3	10	-2	**52.1**	**P**
07-10	2006	29.4	8.8	3.2	10.6	-7.8	7.7	0	**51.9**	**P**
07-10	2011	30	10.8	5.4	10.5	-5.9	7.4	0	**58.1**	**F**
07-10	2016	29.6	10.4	3.8	3.8	-3.6	3.5	-2	**45.4**	**P**
07-10	2021	30	8.2	5.6	9.4	-2.1	2	0	**53**	**P-F**
07R-2	2006	0.9	0	0	3.3	-7.7	10	0	**6.5**	**VP**
07R-2	2011	0.8	0	0	2.9	-7.5	10	0	**6.1**	**VP**
07R-2	2017	1.5	0	0	1.1	-3.8	10	0	**8.9**	**VP**

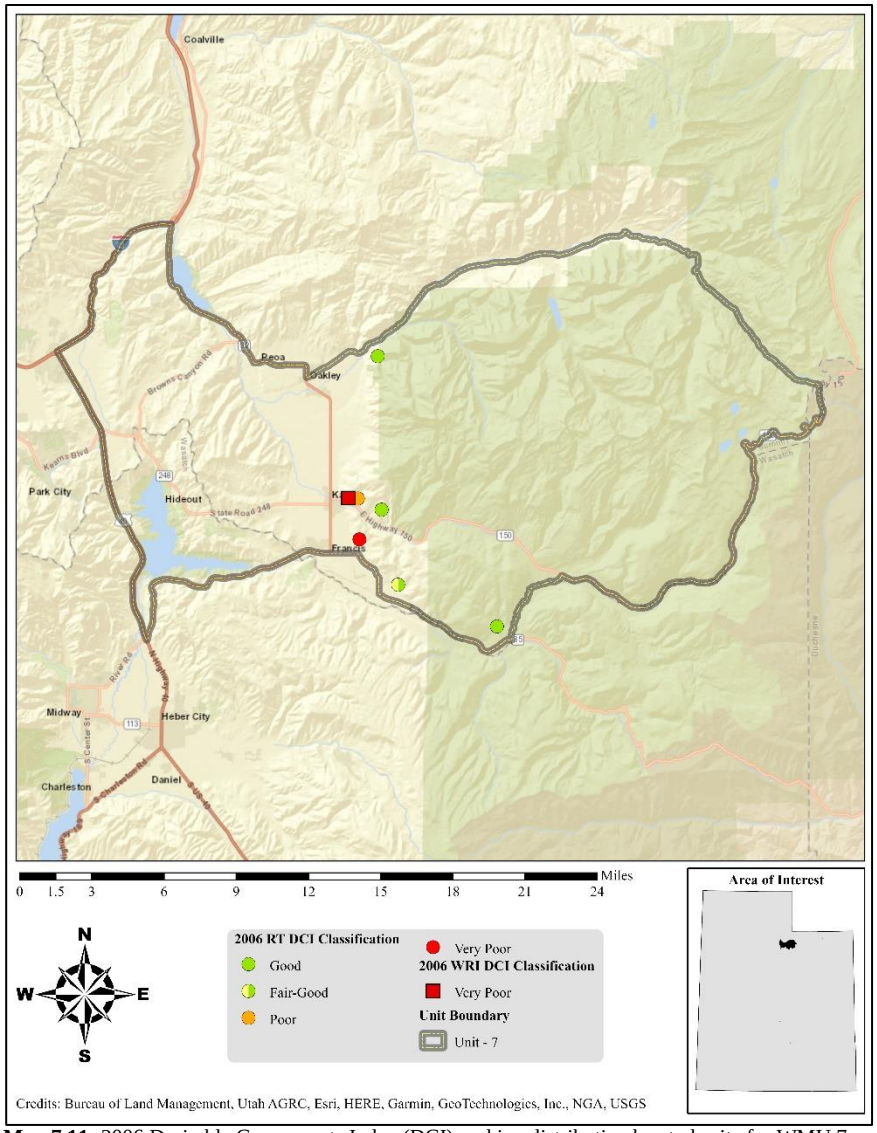
Table 7.10: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 7, Kamas. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



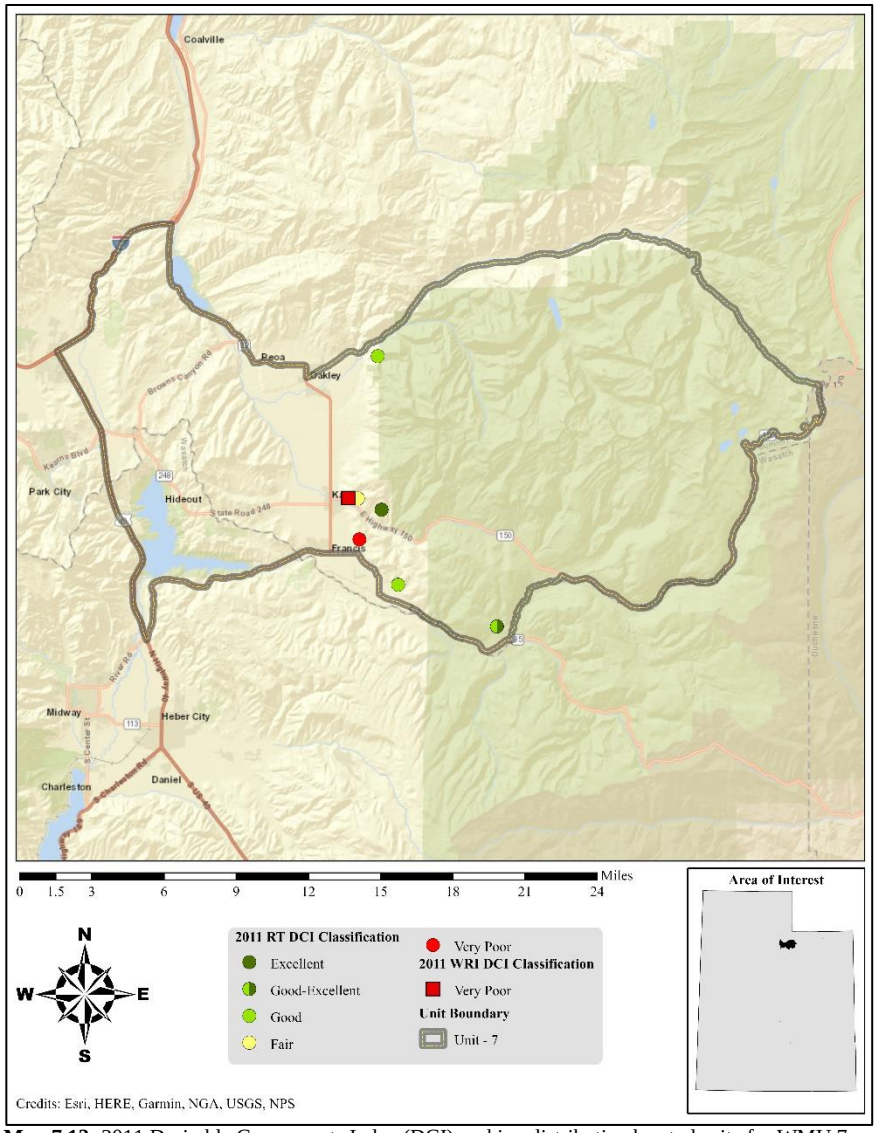
Map 7.9: 1996 Desirable Components Index (DCI) ranking distribution by study site for WMU 7, Kamas.



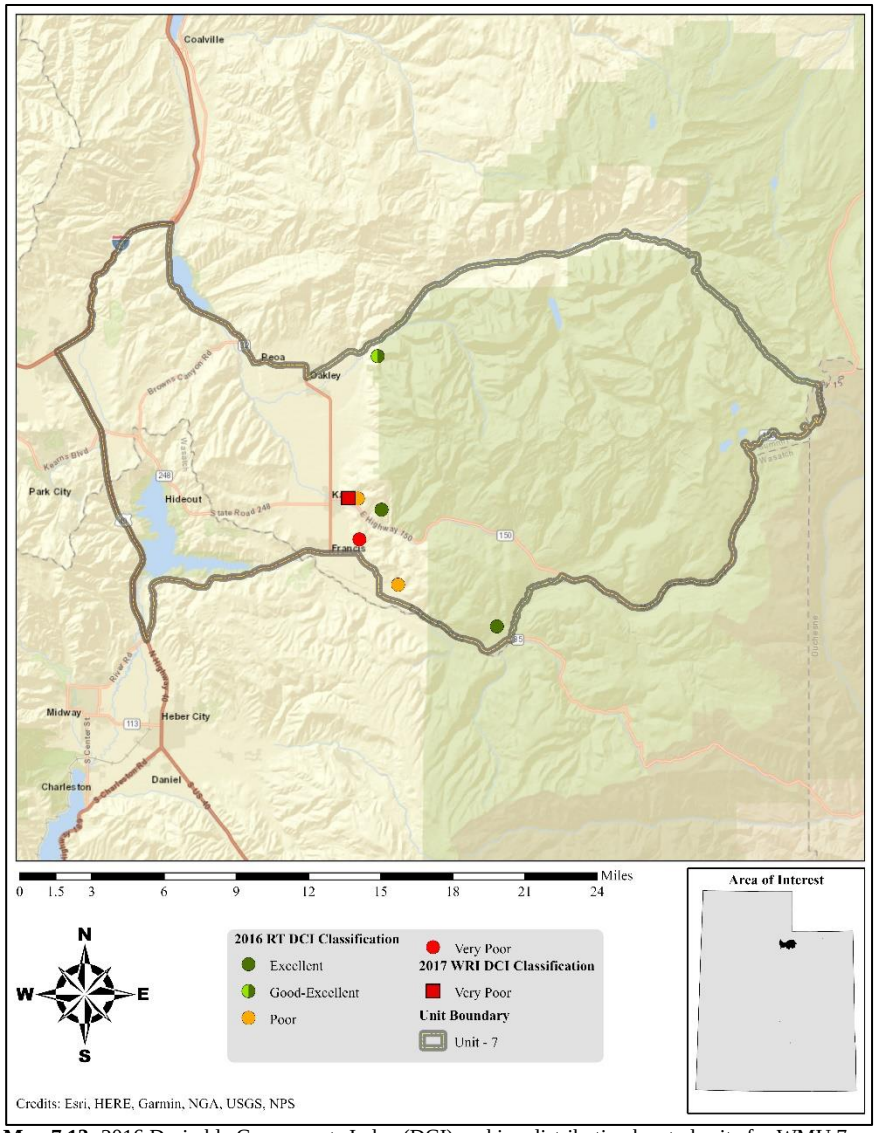
Map 7.10: 2001 Desirable Components Index (DCI) ranking distribution by study site for WMU 7, Kamas.



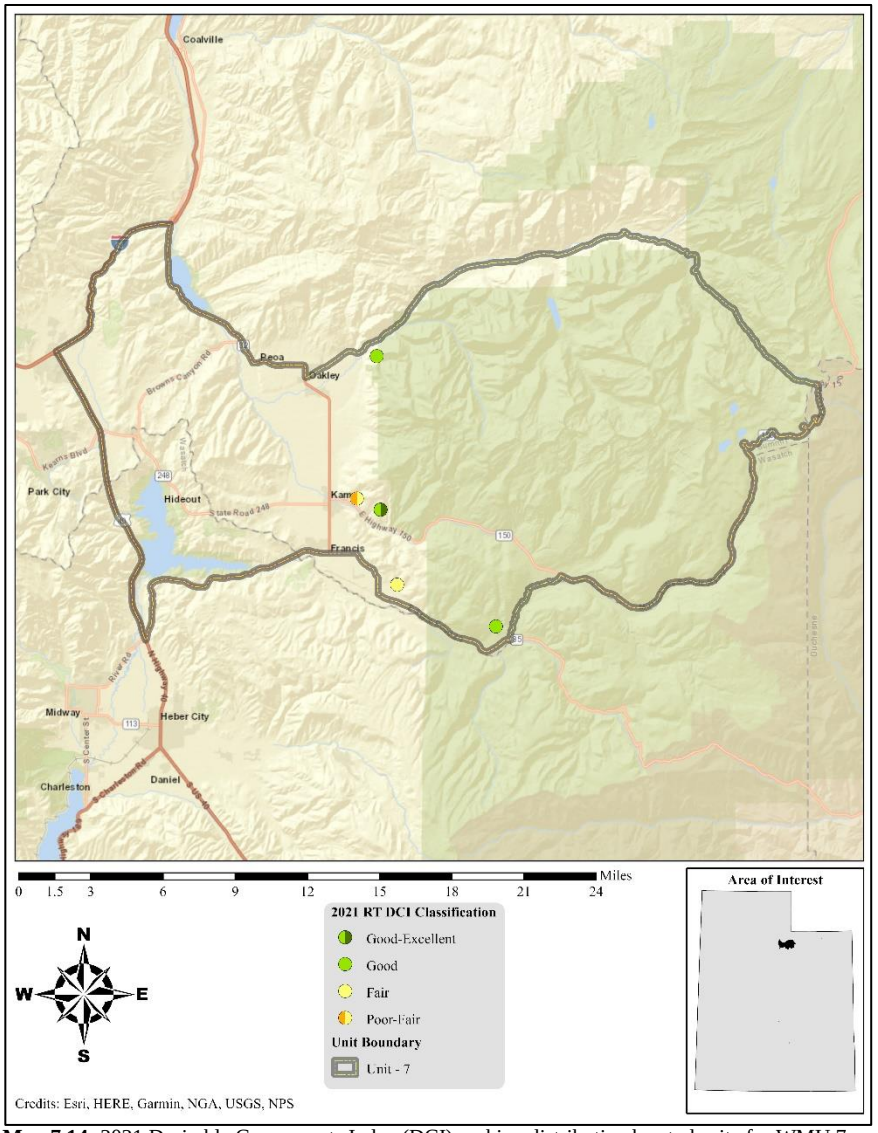
Map 7.11: 2006 Desirable Components Index (DCI) ranking distribution by study site for WMU 7, Kamas.



Map 7.12: 2011 Desirable Components Index (DCI) ranking distribution by study site for WMU 7, Kamas.



Map 7.13: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 7, Kamas.



Map 7.14: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 7, Kamas.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
07-2	Pinyon Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced understory shrub and herbaceous vigor
07-3	Foothill Drive	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
07-4	Above Samak	Introduced Perennial Grass	High	Reduced understory shrub and herbaceous vigor
07-6	Cedar Hollow	Introduced Perennial Grass	Medium	Reduced understory shrub and herbaceous vigor
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
07-9	Above Woodland	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced understory shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
07-10	Elder Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced understory shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
07R-2	Kamas SFH	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced understory shrub and herbaceous vigor

Table 7.11: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 7, Kamas. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment**.

Discussion and Recommendations

Mountain (Browse)

The high elevation study sites that are classified as Mountain (Browse) ecological sites that support sagebrush communities with a mix of other preferred browse species that are considered to be in fair to good condition for deer winter range on the Kamas management unit. Annual grasses, primarily cheatgrass (*Bromus tectorum*) pose high-level threats on both study sites. In high amounts, annual grasses exacerbate the risk of wildfire by boosting fuel loads and may alter wildfire return intervals (Balch, D'Antonio, & Gómez-Dans, 2013). Introduced perennial grass species are also present on both studies with low, but increasing cover. Introduced perennial grasses have the potential to be aggressive and can reduce understory diversity by outcompeting native species for resources. The noxious weed and perennial forb Dalmatian toadflax (*Linaria dalmatica*) was observed in low abundance on the Above Woodland site for the first time in 2021. Like introduced perennial grass species with the right conditions, noxious weeds are aggressive and will likely lead to reduced prevalence and abundance of native grass and forb species if they increase in the future (Mack, et al., 2000). In addition, pinyon and juniper encroachment is a potential threat on the Above Woodland site. Although the site is only in Phase I of woodland succession as of 2021, shrub and herbaceous health have the potential to be reduced if woodland succession progresses in the future (Miller, Svejcar, & Rose, 2000).

Continued monitoring would be advisable in the future. Treatments to reduce annual grass loads such as grazing management or herbicide application are advisable on these study sites to help mitigate fire risk and improve understory health. If introduced perennial grasses and/or noxious weeds increase in the future, the implementation of reseeding efforts to restore biodiversity may be prudent. However, caution should be taken when constructing seed mixes and native grass and forb species should be selected whenever possible. Although tree encroachment does not pose an immediate threat on the Above Woodland site, tree-removing treatments (bullhog, lop and scatter, chaining, etc.) may be advisable if future monitoring shows an increase in encroachment. If/when tree-removing treatments do occur, however, careful consideration should be made so as to select methods that will not increase annual grass loads.

Mountain (Shrub)

These high-elevation study sites that are considered to be Mountain (Shrub) ecological sites support mixed browse and sagebrush communities. These sites are generally considered to be in poor to good condition for deer winter range habitat on this unit. Annual grasses, particularly the introduced species cheatgrass (*Bromus tectorum*), have been present in all sample years in fluctuating amounts on the Elder Hollow study. Although cover was low in 2021, annual grasses could increase fuel loads, exacerbate the risk of wildfire, and alter wildfire regimes if they increase in the future (Balch,

D'Antonio, & Gómez-Dans, 2013). Introduced perennial grasses including (but not limited to) bulbous bluegrass (*Poa bulbosa*) are present in the understories of both study sites, posing a medium-level threat on the Cedar Hollow site and a high-level threat on Elder Hollow. Introduced perennial grasses are often aggressive and may outcompete desirable native forbs and grasses for resources: this made lead to reduced herbaceous biodiversity. The introduced and annual noxious weed species gypsyflower (*Cynoglossum officinale*) has also been recorded in past sample years on the Elder Hollow study, albeit in low amounts. Noxious weeds do not pose an immediate threat to the ecological integrity of the site. Like introduced perennial grass species, however, they are aggressive and lead to reduced herbaceous diversity when present in high amounts (Mack, et al., 2000). Finally, Rocky Mountain juniper (*Juniperus scopulorum*) is present on both study sites, placing them within Phase I of woodland succession. Presence of pinyon and juniper trees often has a deleterious effect on shrub and herbaceous understory health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000).

Continued monitoring of these communities will likely prove valuable; data collected in the future will indicate whether the severity of current limiting factors (tree encroachment, annual grasses, introduced perennial grasses, and noxious weeds) is increasing. Should annual grass loads increase over time, treatments such as changes in grazing management or herbicide application may be advisable. If 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. Finally, if/when tree-removing treatments (lop and scatter, bullhog, chaining, etc.) are deemed necessary to reduce woodland encroachment, care should be taken to select methods that will not increase annual grass loads.

Mountain (Oak)

Above Samak, the high-elevation site of the Mountain (Oak) ecological type, supports a mixed browse community dominated by Gambel oak (*Quercus gambelii*). This site is considered to be in good-excellent condition for deer winter range on the Kamas management unit. Although the herbaceous understory on this study site is plentiful, it is mainly composed of introduced perennial grasses such as smooth brome (*Bromus inermis*), bulbous bluegrass (*Poa bulbosa*), and intermediate wheatgrass (*Thinopyrum intermedium*). These grass species may provide forage, but they are often aggressive. Competition with introduced perennial grasses for resources can lead to reduced prevalence and abundance of other more desirable grass and forb species (Mack, et al., 2000).

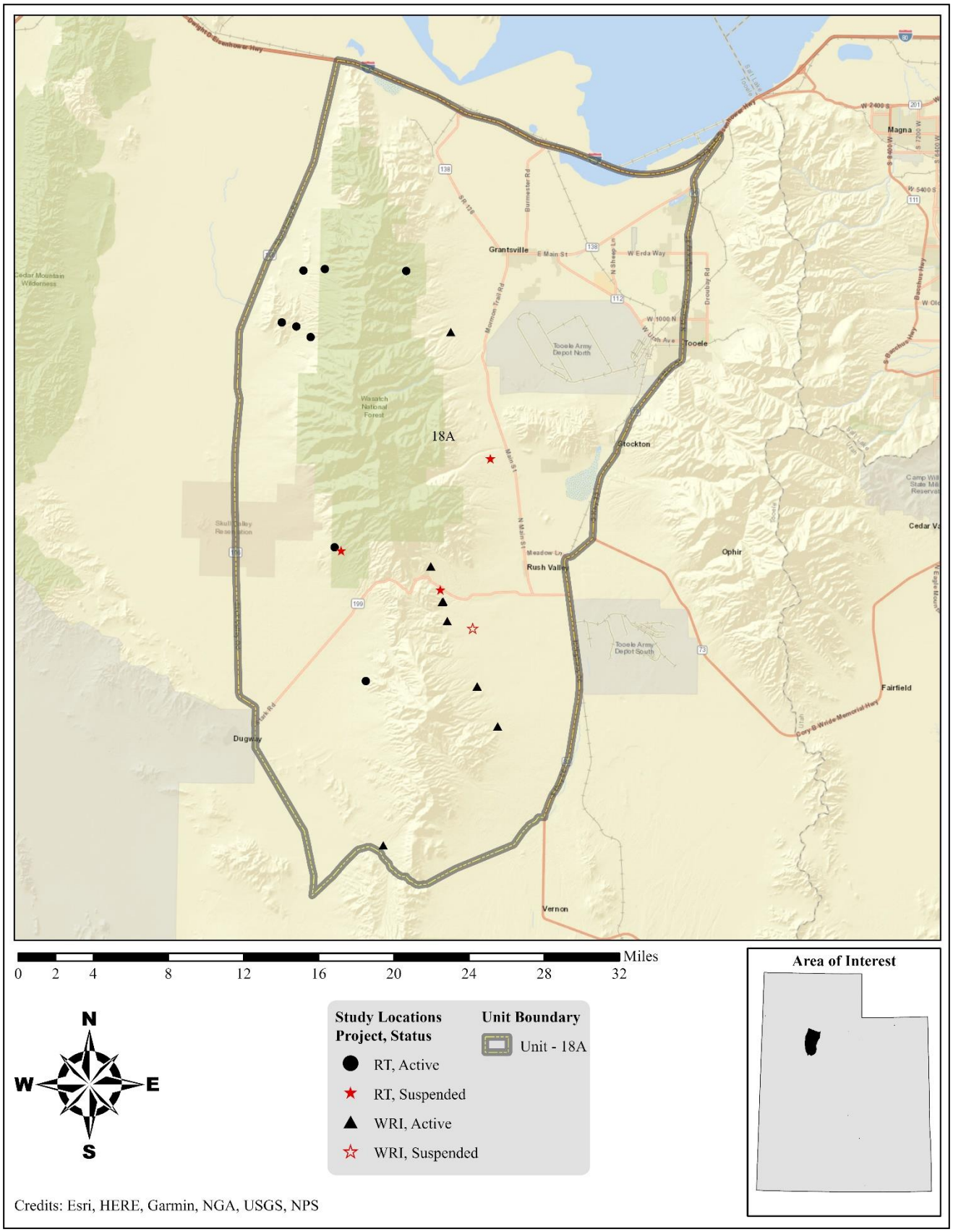
Reseeding to restore herbaceous biodiversity may be advisable on this site. If so, species should be selected carefully when constructing the seed mixes with native grass and forb species being given preference when possible and appropriate.

Upland (Big Sagebrush)

The mid elevation study site that is classified as an Upland (Big Sagebrush) ecological site, Foothill Drive, is dominated by sagebrush, which provides valuable browse for wildlife; this study site is considered to be in very poor condition for deer winter range. The introduced annual grass species cheatgrass (*Bromus tectorum*) dominated the herbaceous understory when the site was last sampled in 2016. High amounts of annual grasses increase fuel loads, exacerbating the risk of catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013), and can negatively affect herbaceous diversity. The introduced annual forb and noxious weed species nodding plumeless thistle (*Carduus nutans*) has also been present and poses a medium-level threat. In higher amounts, noxious weeds can outcompete native grasses and forbs for resources, leading to reduced herbaceous biodiversity (Mack, et al., 2000).

Treatments such as herbicide application may be needed to reduce annual grass cover on this site. Reseeding may also be deemed appropriate in the future to restore the herbaceous understory, with preference being given to native grass and forb species when possible.

8. WILDLIFE MANAGEMENT UNIT 18A – STANSBURY OQUIRRH-STANSBURY



WILDLIFE MANAGEMENT UNIT 18A – STANSBURY OQUIRRH-STANSBURY

Boundary Description

Tooele County - Boundary begins at Lake Point Junction on I-80; south on the Tooele/Salt Lake County boundary to Middle Canyon Road; west on Middle Canyon Road to SR-36; south on SR-36 to Pony Express Road located just south of Faust; west on this road to the Skull Valley-Dugway-Timpie Road; north on this road to I-80 at Rowley Junction; east on I-80 to Lake Point Junction and beginning point.

Management Unit Description

Geography

The Stansbury Oquirrh-Stansbury management unit is situated in the eastern portion of Tooele County. This unit encompasses the Stansbury Mountains, bounded by Skull Valley and Cedar Mountains to the west, the Great Salt Lake to the north, and the Oquirrh Mountains in the east. Drainages include Hickman Creek, which drains East Hickman Canyon, East Faust Creek, which drains East Faust Canyon, and numerous others. Elevation ranges from just over 4,000 feet near the Great Salt Lake to over 10,000 feet on the peaks of the Stansbury Mountains. Communities within the unit include (but are not limited to) portions of Tooele, Stockton, Grantsville, and Rush Valley.

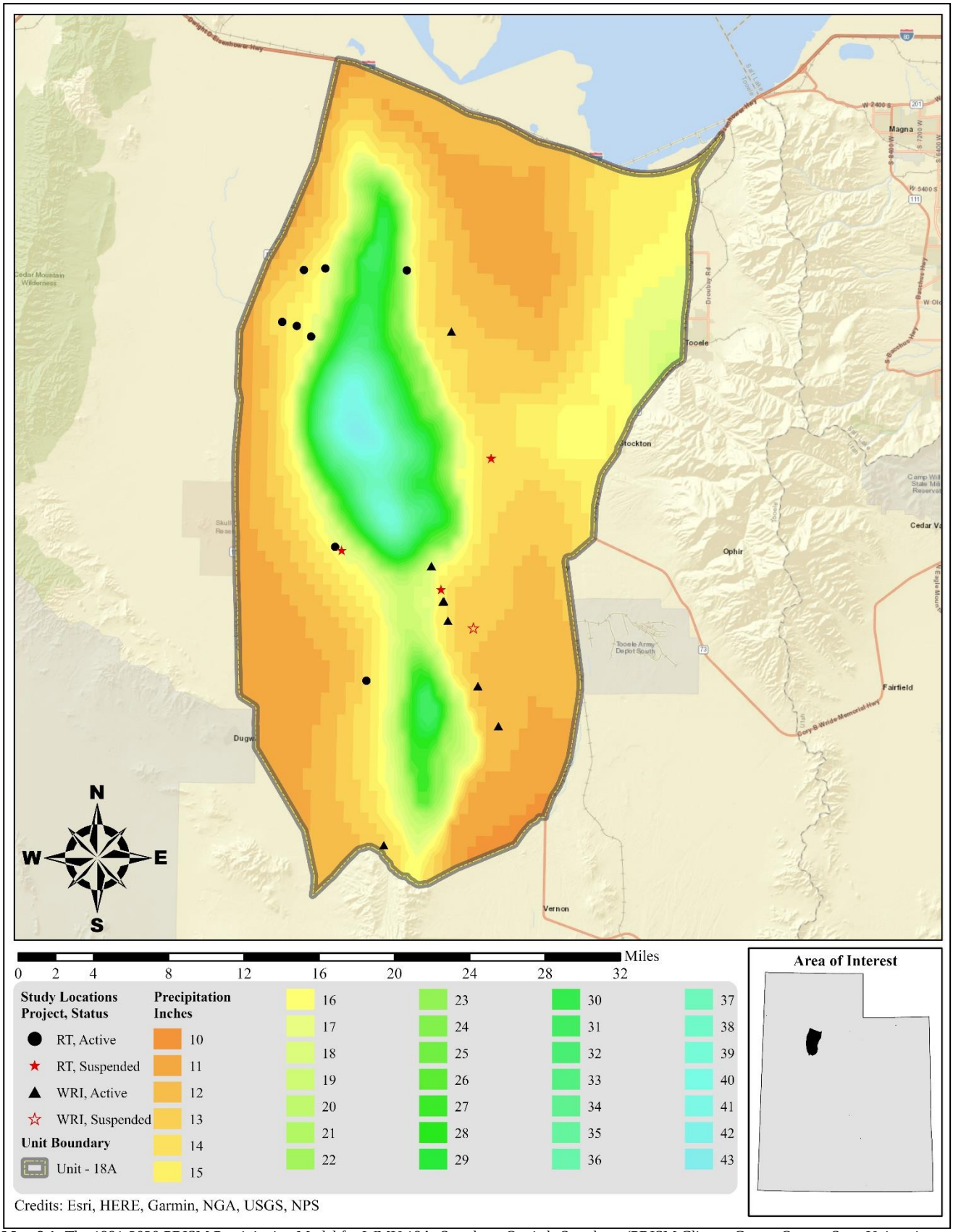
Climate Data

The 30 year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 10 inches along portions near the Great Salt Lake and Onaqui Mountains to 43 inches on the peaks of the Stansbury Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within 13-19 inches of precipitation (**Map 8.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Western and North Central divisions (Divisions 1 and 3).

The mean annual PDSI of the Western division displayed years of moderate to extreme drought from 2000-2003, 2007-2008, 2012-2013, 2015, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1993, 1995, 1997-1998, 2005, 2011 and 2019 (**Figure 8.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 2000, 2002-2004, 2007-2008, 2012-2015; and 2021; moderately to extremely wet years were displayed in 1993, 1995, 1998, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2001-2003, 2007-2008, 2012, and 2020-2021; moderately to extremely wet years were displayed from 1997-1998, 2011, and 2019 (**Figure 8.1b**).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought in 1992, 2000-2003, 2007, 2012-2015, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1993, 1995, 1997-1998, 2005, and 2011 (**Figure 8.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2001-2003, 2007, 2012-2013, 2015; and 2020-2021; moderately to extremely wet years were displayed in 1991, 1993, 1995, 1997-1998, and 2005 (**Figure 8.2b**) (Time Series Data, 2022).



Map 8.1: The 1991-2020 PRISM Precipitation Model for WMU 18A, Stansbury Oquirrh-Stansbury (PRISM Climate Group, Oregon State University, 2021).

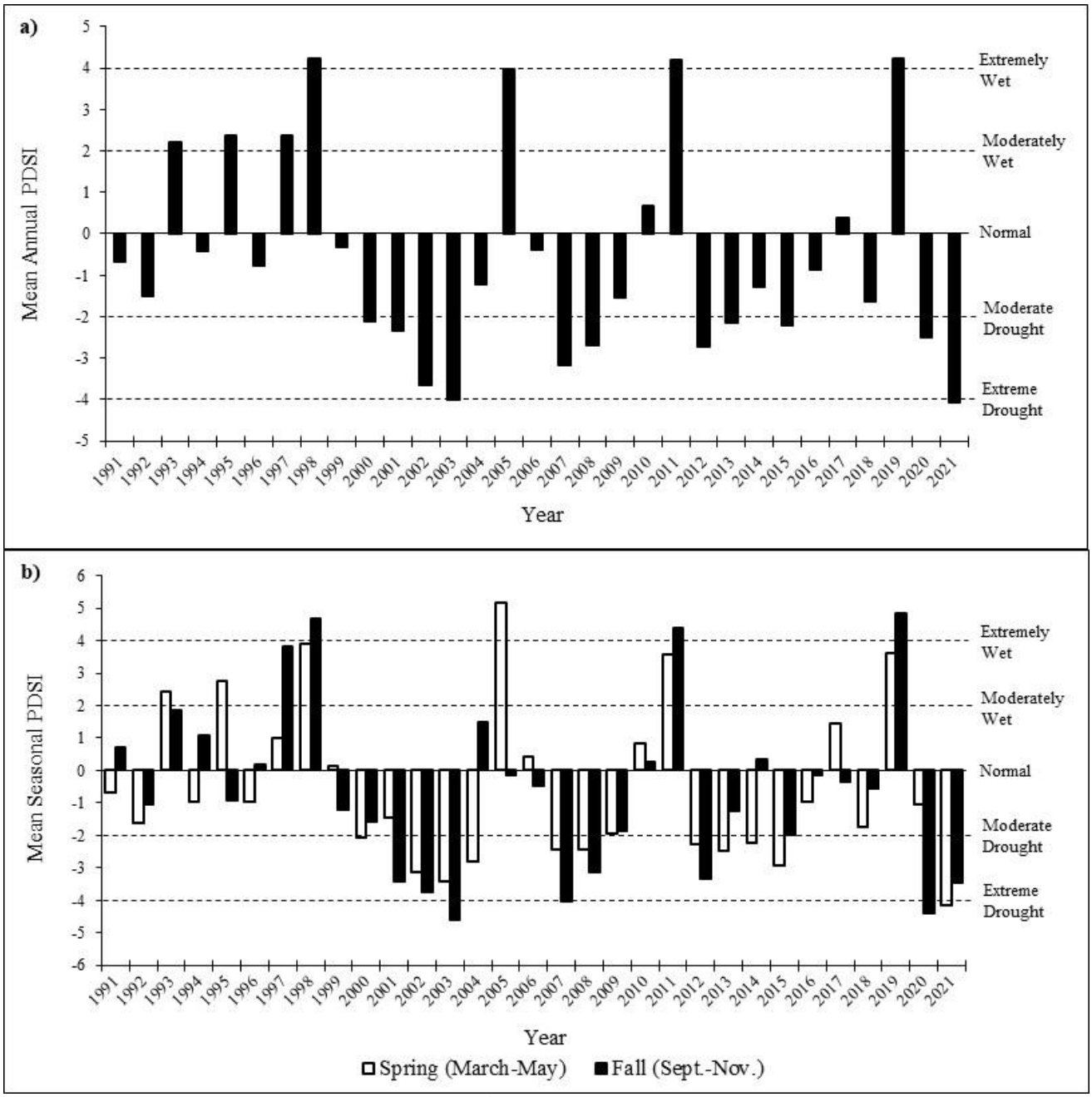


Figure 8.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the Western division (Division 1). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

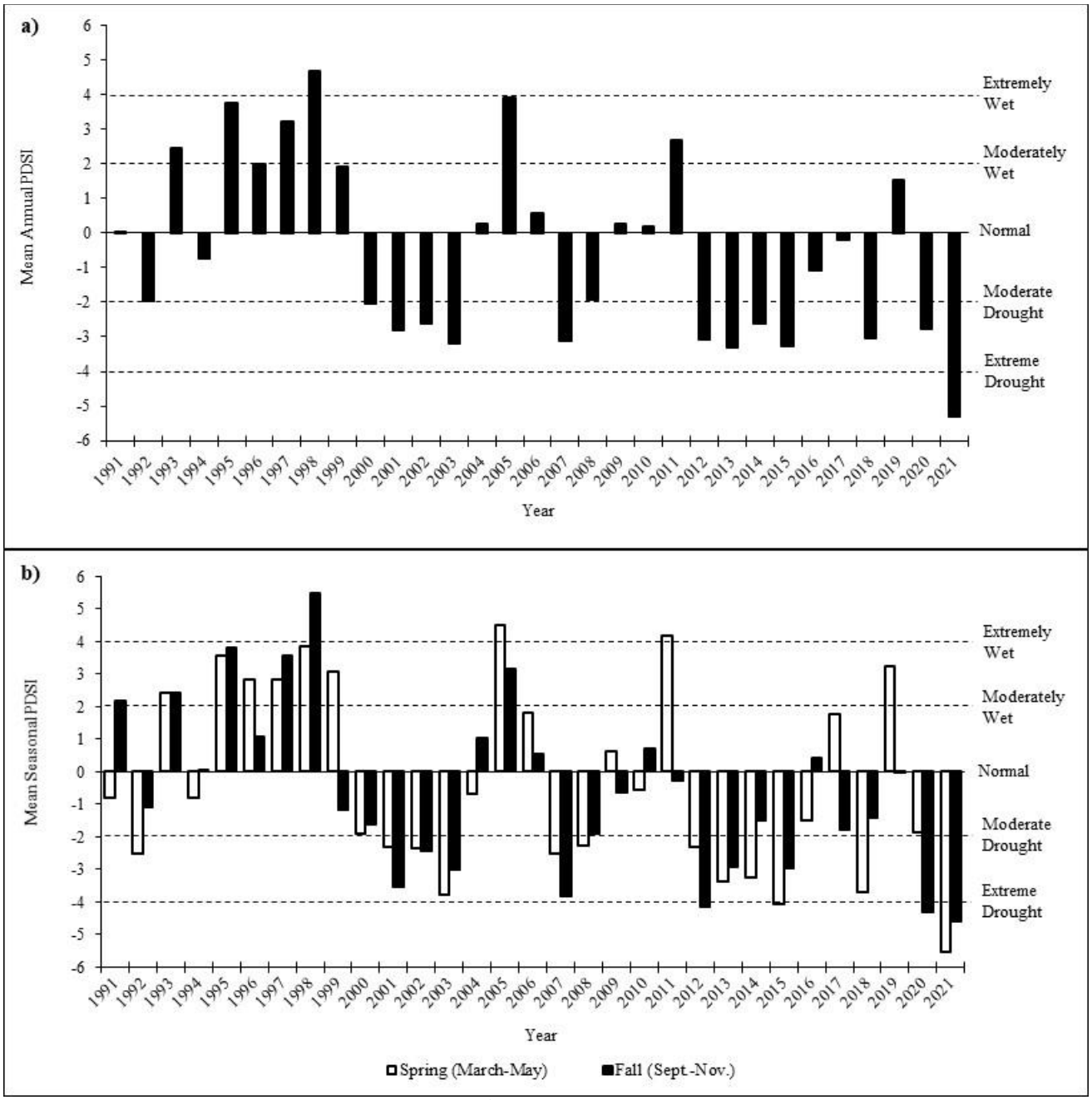
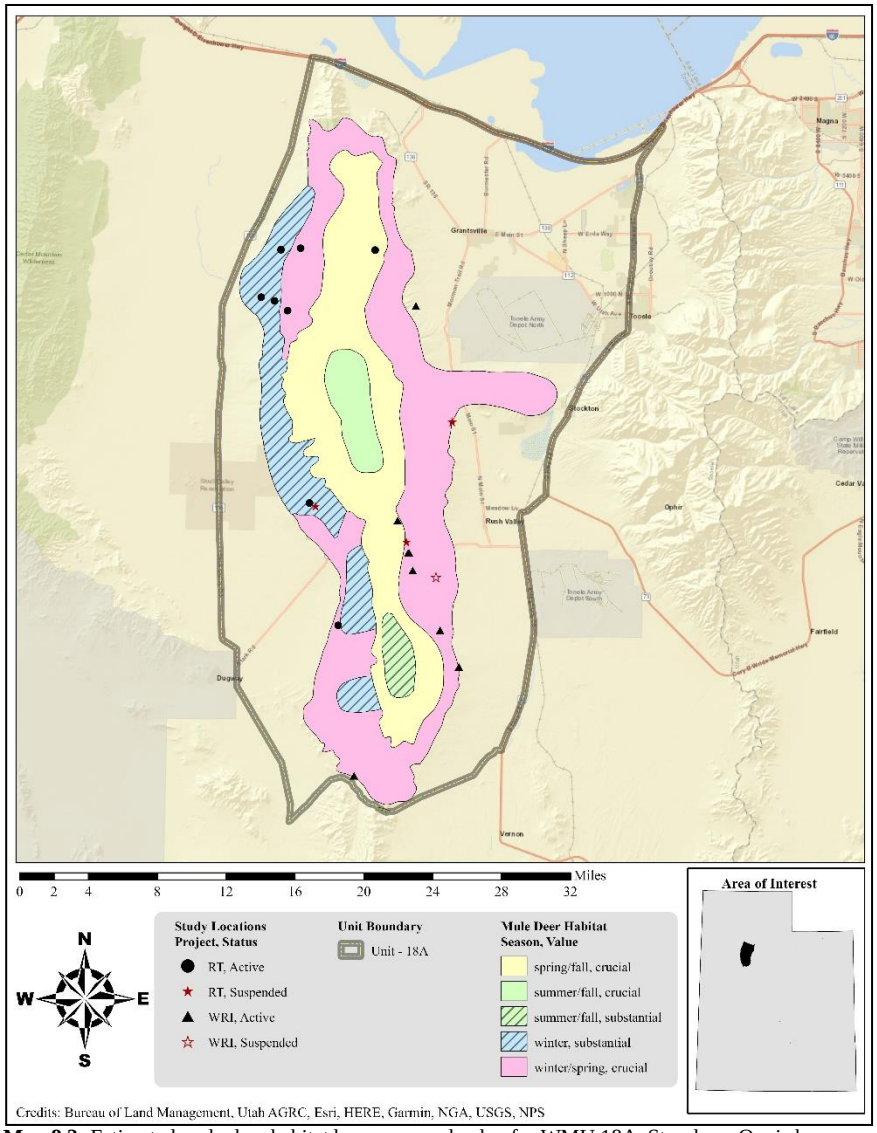


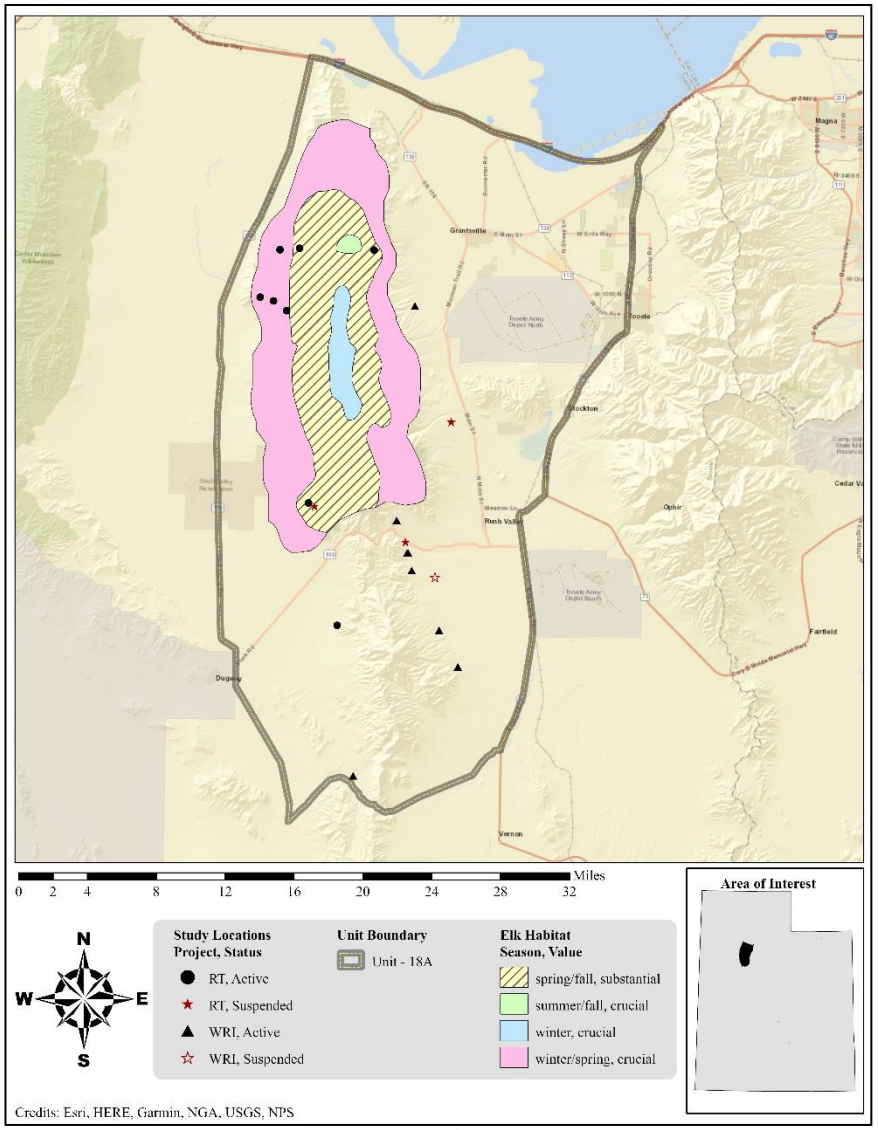
Figure 8.2: The 1991-2021 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

Big Game Habitat

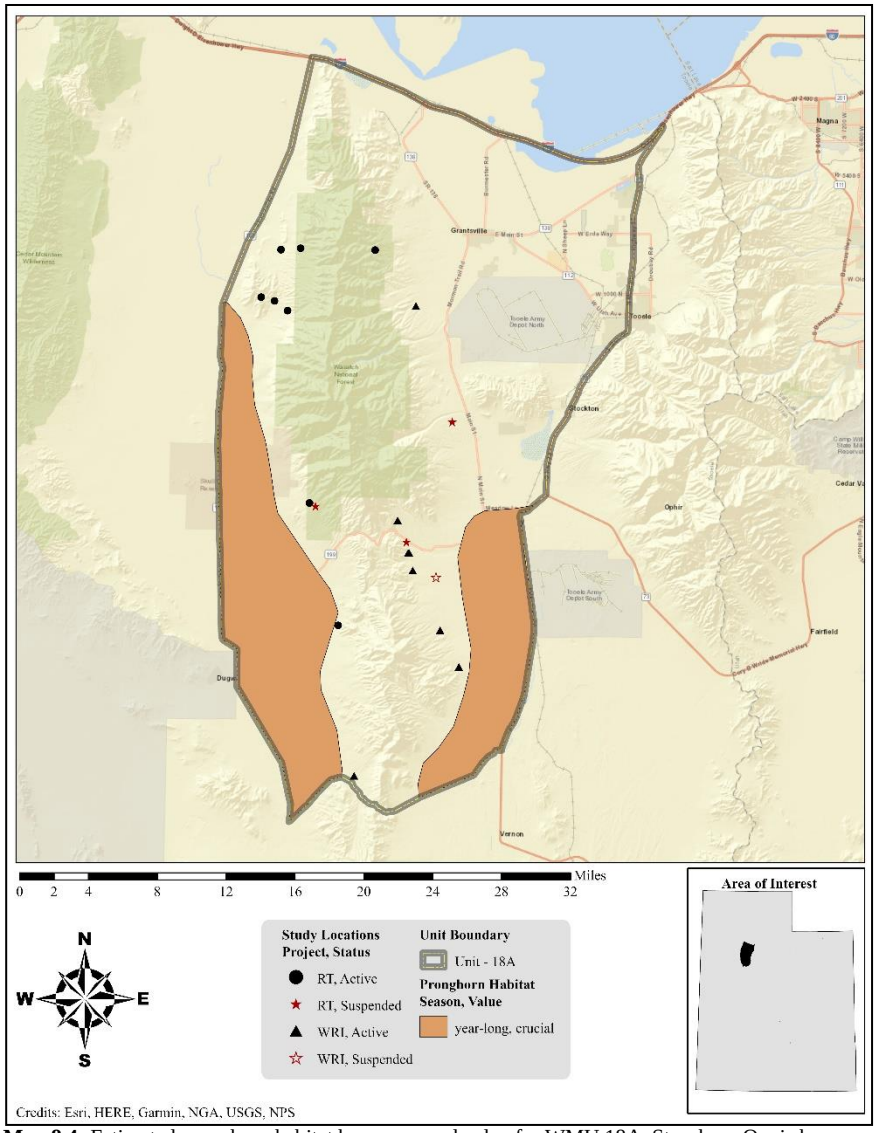
There are estimated to be over 206,000 acres classified as deer range on Unit 18A with 46% classified as winter/spring range, 32% as spring/fall range, 15% as winter range, and 7% is classified as summer/fall range (**Table 8.1**, **Map 8.2**). Bureau of Land Management (BLM)-managed land comprises 41% of the winter/spring range, 33% is privately owned, 15% is tribally owned by the Skull Valley Band of Goshute, and the Utah School and Institutional Trust Lands Administration (SITLA) administrates 11%. Fifty-nine percent of spring/fall range is owned by the US Forest Service (USFS), 34% is managed by the BLM, 4% is privately owned, SITLA administrates 3%, and less than 1% is tribally owned. The BLM administrates 56% of the winter range, 17% is managed by the USFS, private landowners own 15%, 10% is tribally owned, and 2% is administrated by SITLA. Finally, 67% of the summer/fall range is managed by the USFS, the BLM administrates 23%, 5% is managed by SITLA, and 5% is privately owned (**Table 8.2**, **Map 8.2**, **Map 8.6**). Winter/spring is the seasonality with the most land area of all elk range within the unit. Of the winter/spring range, 41% is managed by the BLM, 33% is privately owned, 15% is administrated by the USFS, and 11% is managed by SITLA (**Table 8.3**, **Map 8.3**, **Map 8.6**).



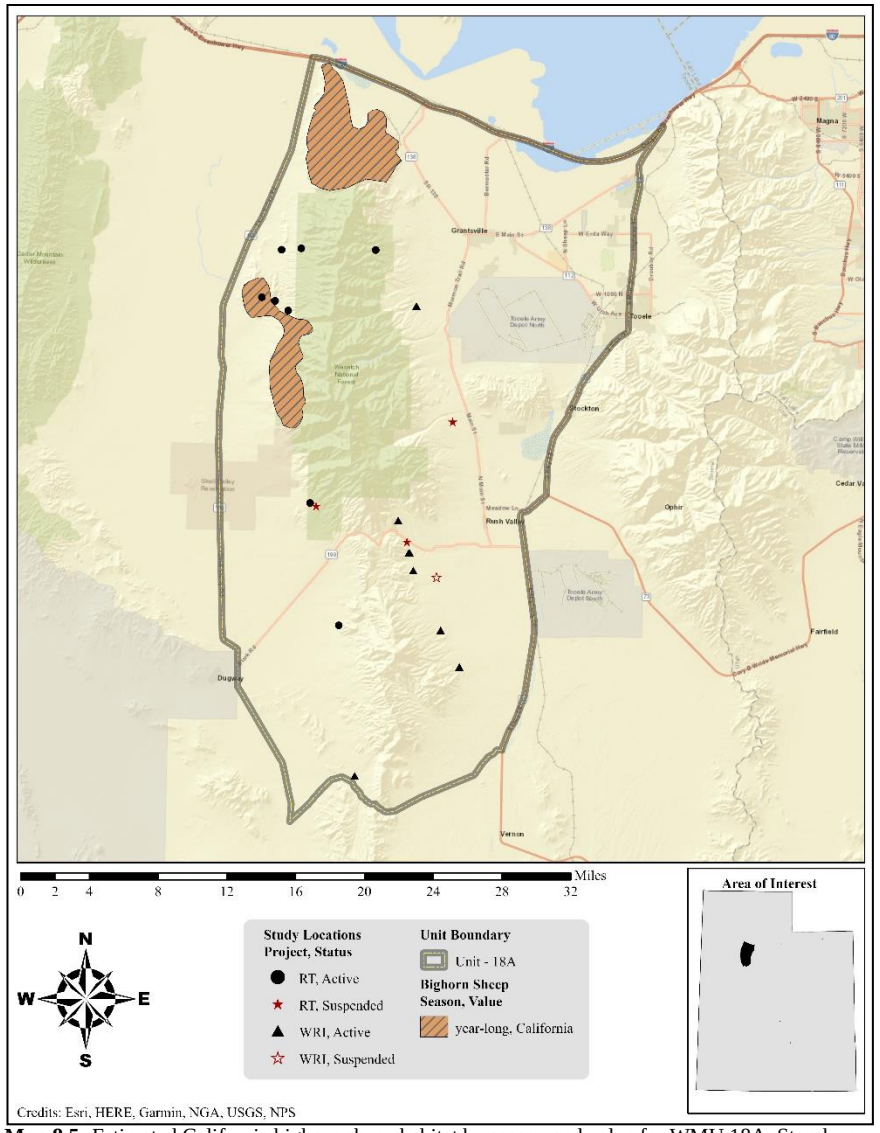
Map 8.2: Estimated mule deer habitat by season and value for WMU 18A, Stansbury Oquirrh-Stansbury.



Map 8.3: Estimated elk habitat by season and value for WMU 18A, Stansbury Oquirrh-Stansbury.



Map 8.4: Estimated pronghorn habitat by season and value for WMU 18A, Stansbury Oquirrh-Stansbury.



Map 8.5: Estimated California bighorn sheep habitat by season and value for WMU 18A, Stansbury Oquirrh-Stansbury.

	Year Long Range		Summer/Fall Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	0	0%	14,207	7%	30,976	15%	95,499	46%	66,131	32%
Elk	0	0%	807	<1%	5,695	5%	60,791	53%	48,215	42%
Pronghorn	105,366	100%	0	0%	0	0%	0	0%	0	0%
CBHS	23,558	100%	0	0%	0	0%	0	0%	0	0%

Table 8.1: Estimated mule deer, elk, pronghorn, and California bighorn sheep habitat acreage by season for WMU 18A, Stansbury Oquirrh-Stansbury.

	Summer/Fall Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	3,299	23%	17,300	56%	38,590	41%	22,680	34%
Private	643	5%	4,718	15%	31,361	33%	2,870	4%
SITLA	694	5%	488	2%	10,868	11%	1,766	3%
Tribal	0	0%	3,079	10%	0	0%	30	<1%
USFS	9,571	67%	5,391	17%	14,680	15%	38,785	59%
Total	14,207	**100%**	30,976	**100%**	95,499	**100%**	66,131	**100%**

Table 8.2: Estimated mule deer habitat acreage by season and ownership for WMU 18A, Stansbury Oquirrh-Stansbury.

	Summer/Fall Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	0	0%	0	0%	22,423	37%	6,029	13%
Private	0	0%	86	2%	12,616	21%	347	<1%
SITLA	0	0%	0	0%	2,747	4%	0	0%
Tribal	0	0%	0	0%	3,654	6%	0	0%
USFS	807	100%	5,610	98%	19,350	32%	41,839	87%
Total	807	**100%**	5,696	**100%**	60,791	**100%**	48,215	**100%**

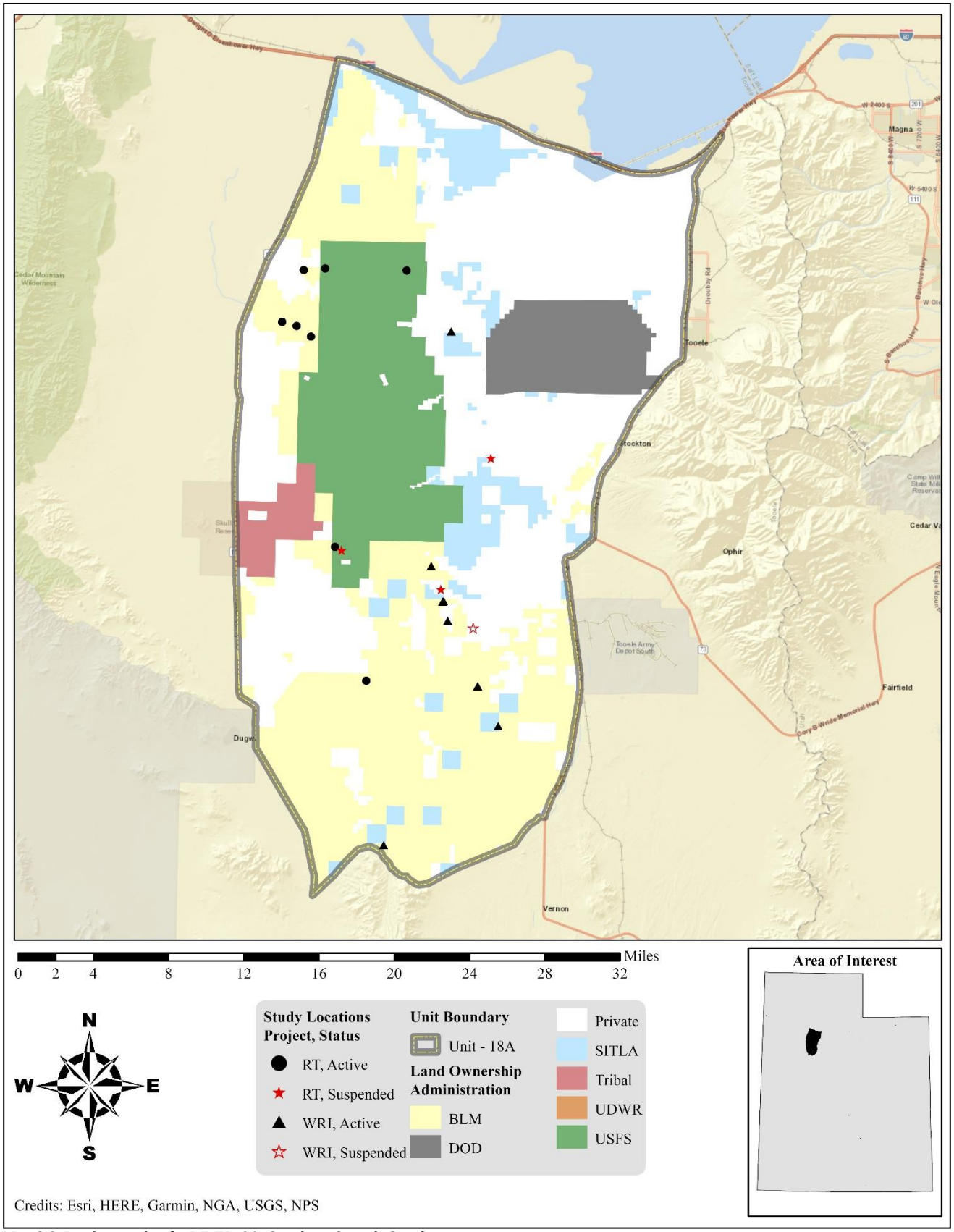
Table 8.3: Estimated elk habitat acreage by season and ownership for WMU 18A, Stansbury Oquirrh-Stansbury.

	Year Long Range	
Ownership	*Area (acres)*	*%*
BLM	50,625	48%
Private	47,101	45%
SITLA	976	1%
Tribal	6,584	6%
UDWR	60	<1%
DOD	9	<1%
UDOT	10	<1%
Total	105,366	**100%**

Table 8.4: Estimated pronghorn habitat acreage by season and ownership for WMU 18A, Stansbury Oquirrh-Stansbury.

	Year Long Range	
Ownership	*Area (acres)*	*%*
BLM	13,984	59%
Private	2,976	13%
SITLA	1,649	7%
Tribal	11	<1%
USFS	4,938	21%
Total	23,558	**100%**

Table 8.5: Estimated California bighorn sheep habitat acreage by season and ownership for WMU 18A, Stansbury Oquirrh-Stansbury.



Map 8.6: Land ownership for WMU 18A, Stansbury Oquirrh-Stansbury.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	212,727	21.29%	
	Inter-Mountain Basins Montane Sagebrush Steppe	37,731	3.78%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	20,131	2.01%	
	Great Basin Xeric Mixed Sagebrush Shrubland	19,835	1.98%	
	Other Shrubland	19,533	1.95%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	15,049	1.51%	
	Inter-Mountain Basins Greasewood Flat	14,966	1.50%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	14,313	1.43%	
	Great Basin Semi-Desert Chaparral	3,185	0.32%	
	Rocky Mountain Lower Montane-Foothill Shrubland	1,611	0.16%	
	Inter-Mountain Basins Big Sagebrush Steppe	1,133	0.11%	36.04%
Other	Sparsely Vegetated	85,872	8.59%	
	Agricultural	60,038	6.01%	
	Open Water	46,657	4.67%	
	Developed	19,417	1.94%	
	Riparian	18,249	1.83%	
	Hardwood	11,811	1.18%	
	Conifer-Hardwood	2,832	0.28%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	2,011	0.20%	24.70%
Conifer	Great Basin Pinyon-Juniper Woodland	104,181	10.42%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	10,580	1.06%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	8,610	0.86%	
	Colorado Plateau Pinyon-Juniper Woodland	4,400	0.44%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	4,346	0.43%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	4,288	0.43%	
	Other Conifer	3,282	0.33%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	1,548	0.15%	
	Inter-Mountain Basins Juniper Savanna	314	0.03%	14.16%
Exotic Herbaceous	Great Basin & Intermountain Introduced Annual Grassland	63,118	6.32%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	33,117	3.31%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	20,197	2.02%	
	Interior Western North American Temperate Ruderal Grassland	1,119	0.11%	11.76%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	92,257	9.23%	
	Interior West Ruderal Riparian Scrub	15,027	1.50%	
	Interior Western North American Temperate Ruderal Shrubland	6,347	0.64%	
	Interior West Ruderal Riparian Forest	125	0.01%	11.38%
Grassland	Southern Rocky Mountain Montane-Subalpine Grassland	7,891	0.79%	
	Inter-Mountain Basins Semi-Desert Grassland	6,815	0.68%	
	Other Grassland	4,445	0.44%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	254	0.03%	1.94%
Total		**999,363**	**100%**	**100%**

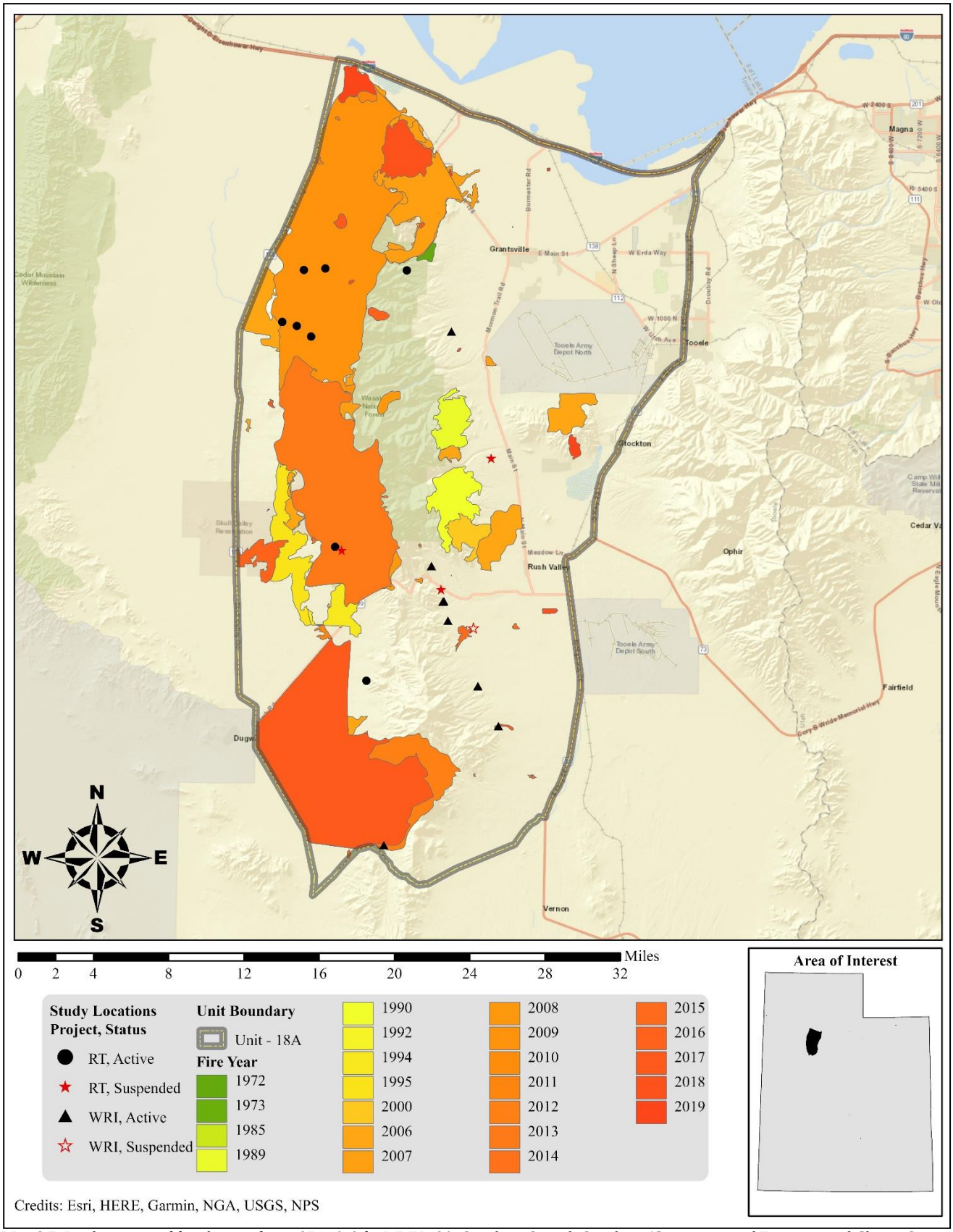
Table 8.6: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 18A, Stansbury Oquirrh-Stansbury.

Limiting Factors to Big Game Habitat

Limiting factors to big game habitat in this unit include habitat degradation and loss, summer range availability, and winter range forage condition. Continued range monitoring could maintain and protect ranges from further habitat loss and deterioration. Cooperation between federal, state, local governments, and private landowners could assist in maintaining and preserving crucial habitat through agreements with land management agencies, the use of conservation easements and the like on private lands, planning and evaluating resource use and developments that might affect habitat quality, and developing specific vegetation objectives to maintain the quality of important deer use areas. In addition, forage production could be maintained or improved through direct range improvements such as reseedings, controlled burns, water developments, tree removal, etc.

Encroachment by pinyon-juniper woodland may pose a substantial threat to important sagebrush rangelands. According to current Landfire Existing Vegetation Coverage models, over 10% of the Stansbury Oquirrh-Stansbury unit is comprised of pinyon-juniper woodlands (**Table 8.6**). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease sagebrush and herbaceous cover, therefore decreasing available wildlife forage (Miller, Svejcar, & Rose, 2000).

Finally, deer fences and crossings limiting range are a concern, but cooperation with the Utah Department of Transportation in constructing highway fences, passage structures, warning signs, etc. will continue in order to ensure proper access to habitat as well as deer and human safety.



Map 8.7: Land coverage of fires by year from 1974-2019 for WMU 18A, Stansbury Oquirrh-Stansbury (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

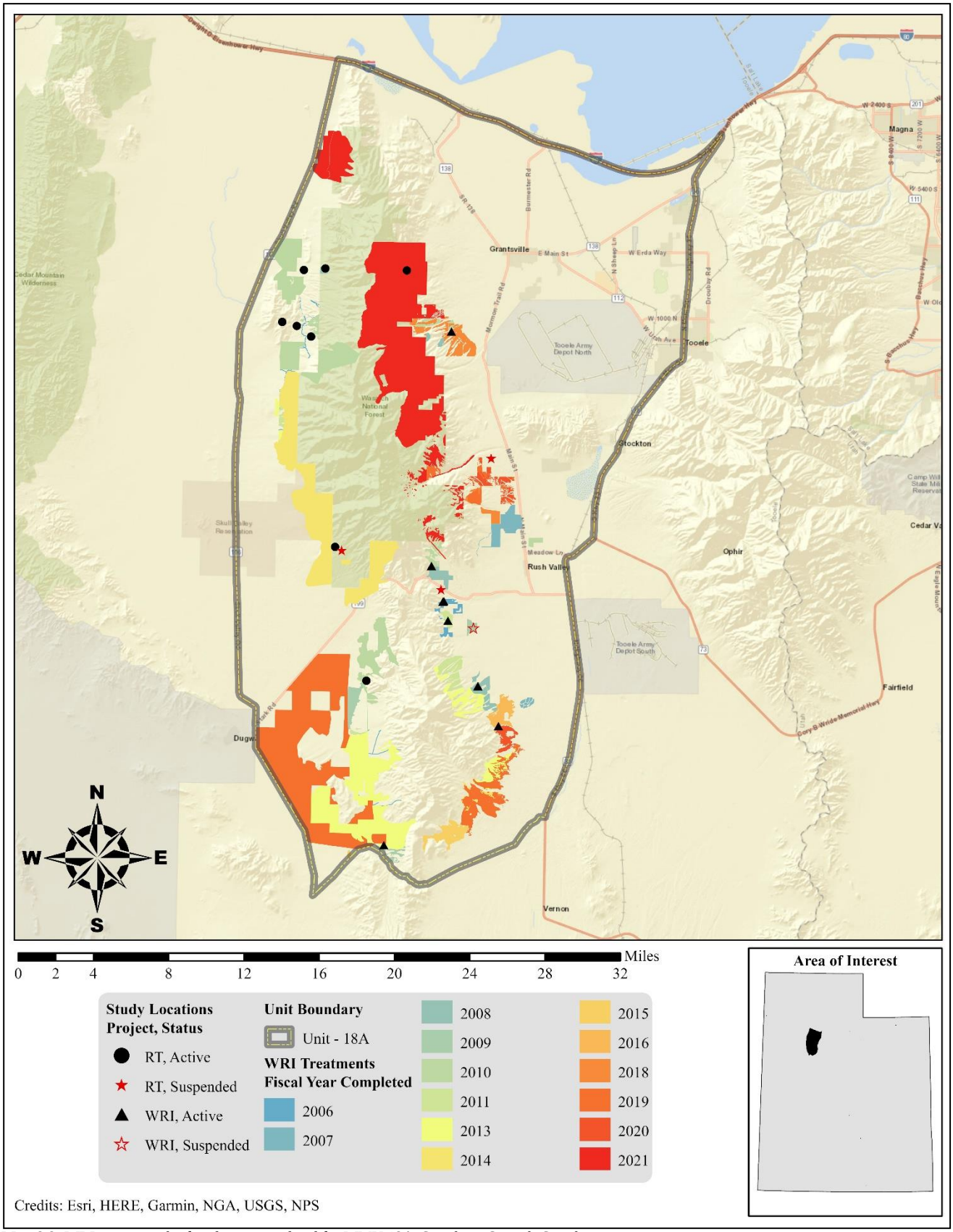
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 66,590 acres of land have been treated within the Stansbury Oquirrh-Stansbury unit since the WRI was implemented in 2004 (**Map 8.8**). An additional 10,653 acres are currently being treated, and treatment projects are proposed for 9,489 acers. Treatments frequently overlap one another bringing the net total of completed treatment acres to 59,552 acres for this unit (**Table 8.7**). 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.

Herbicide application to control weedy species is the most common management practice in this unit. Anchor chain and bullhog use is also very common. Other management practices include (but are not limited to) seeding desirable herbaceous species, harrow, hand removal of vegetation, and seeding of shrub species are also implemented (**Table 8.7**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**14,878**	**0**	**2,727**	**17,605**
Ely (One-Way)	14,024	0	0	14,024
Ely (Two-Way)	557	0	0	557
Smooth (Two-Way)	297	0	2,727	3,024
Bullhog	**14,210**	**3,674**	**0**	**17,884**
Full Size	14,132	3,674	0	17,805
Skid Steer	79	0	0	79
Chain Harrow	**0**	**68**	**0**	**68**
>15 ft. (Two-Way)	0	68	0	68
Greenstripping	**21**	**0**	**0**	**21**
Harrow	**159**	**0**	**0**	**159**
≤15 ft. (One-Way)	42	0	0	42
≤15 ft. (Two-Way)	117	0	0	117
Herbicide Application	**20,066**	**932**	**0**	**20,998**
Aerial (Fixed-Wing)	20,066	932	0	20,998
Planting/Transplanting	**0**	**0**	**6,585**	**6,585**
Container Stock	0	0	6,585	6,585
Seeding (Primary)	**10,818**	**1,677**	**0**	**12,495**
Broadcast (Aerial-Fixed Wing)	5,968	1,677	0	7,644
Broadcast (Aerial-Helicopter)	2,219	0	0	2,219
Drill (Rangeland)	2,578	0	0	2,578
Drill (Truax)	53	0	0	53
Seeding (Secondary/Shrub)	**1,230**	**0**	**0**	**1,230**
Broadcast (Aerial-Fixed Wing)	1,027	0	0	1,027
Ground (Mechanical Application)	203	0	0	203
Vegetation Removal/Hand Crew	**5,207**	**4,292**	**176**	**9,675**
Lop (No Scatter)	90	0	0	90
Lop & Scatter	4,041	4,292	0	8,333
Lop-Pile-Burn	1,076	0	176	1,252
Other	**0**	**9**	**0**	**9**
Road Decommissioning	0	4	0	4
Road/Parking Area Improvements	0	5	0	5
Grand Total	**66,590**	**10,653**	**9,489**	**86,731**
***Total Land Area Treated**	**59,552**	**10,622**	**9,489**	**79,663**

Table 8.7: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 18A, Stansbury Oquirrh-Stansbury. Data accessed on 02/09/2022. *Does not include overlapping treatments.



Map 8.8: WRI treatments by fiscal year completed for WMU 18A, Stansbury Oquirrh-Stansbury.

Range Trend Studies

Range Trend studies have been sampled within WMU 18A on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 8.8**). Due to changes in sampling methodologies, only data sampled following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 8.9**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
18A-23	South Palmer Point	RT	Active	1983, 1990, 1997, 2002, 2004, 2007, 2012, 2016, 2021	Upland Loam (Wyoming Big Sagebrush)
18A-24	Salt Mountain Stock Pond	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
18A-25	Below Chokecherry Spring	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
18A-26	Salt Mountain	RT	Active	1983, 1989, 2002, 2007, 2012, 2016, 2021	Upland Stony Loam (Cliffrose)
18A-27	South of Broons Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2016, 2021	Mountain Stony Loam (Antelope Bitterbrush)
18A-28	Condie Meadows	RT	Suspended	1983, 1989, 1997	Not Verified
18A-29	Deadman Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2016, 2021	Upland Gravelly Loam (Cliffrose)
18A-30	Hatch Ranch	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2016, 2021	Upland Gravelly Loam (Cliffrose)
18A-32	East Hickman Canyon	RT	Suspended	1997, 2002, 2007, 2012	Upland Loam (Mountain Big Sagebrush)
18A-33	Clover Creek	RT	Suspended	1997	Not Verified
18A-35	Magpie Canyon	RT	Active	2012, 2016, 2021	Mountain Stony Loam (Antelope Bitterbrush)
18R-1	East Onaqui	WRI	Active	2004, 2013, 2016	Upland Loam (Mountain Big Sagebrush)
18R-2	Clover Bullhog Drill	WRI	Active	2005, 2008, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
18R-3	Clover Bullhog Aerial	WRI	Active	2005, 2008, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
18R-4	Big Hollow Bullhog	WRI	Active	2006, 2010, 2014, 2018	Mountain Gravelly Loam (Mountain Big Sagebrush)
18R-5	Clover Creek Chaining	WRI	Suspended	2007, 2010	Upland Loam (Wyoming Big Sagebrush)
18R-6	Clover Creek Dry Farm	WRI	Active	2007, 2010, 2014, 2018	Upland Loam (Mountain Big Sagebrush)
18R-7	Grantsville Chaining	WRI	Active	2008, 2011, 2015, 2018	Upland Gravelly Loam (Wyoming Big Sagebrush)
18R-8	West Onaqui Bullhog	WRI	Active	2008, 2011, 2015, 2019	Upland Shallow Loam (Black Sagebrush)
18R-9	East Faust Creek	WRI	Active	2015, 2019	Upland Shallow Hardpan (Mountain Big Sagebrush)

Table 8.8: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 18A, Stansbury Oquirrh-Stansbury.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
18A-23	South Palmer Point	Bullhog	Round Canyon	November 2004	780	
		Aerial Before	Round Canyon	November 2004	780	
		Wildfire	Big Pole	August 2009	44,470	
		One-Way Ely	BLM-ESR	November 2009	9,500	
		Aerial Before	BLM-ESR	October 2009	9,808	
		Aerial After	BLM-ESR	Fall 2009	4,900	
		Harrow Unknown	Stansbury Mountains Winter Range Improvement and Solar Farm Mitigation (Proposed)	Fall 2021	6,747	5625
		Hand Transplant	Stansbury Mountains Winter Range Improvement and Solar Farm Mitigation (Proposed)	Fall 2021	6,747	5625
		Broadcast	Stansbury Mountains Winter Range Improvement and Solar Farm Mitigation (Proposed)	Fall 2021	6,747	5625
18A-24	Salt Mountain Stock Pond	Wildfire	Big Pole	August 2009	44,470	
		One-Way Ely Chain	BLM-ESR	November 2009	9,500	
		Aerial Before	BLM-ESR	October 2009	9,808	
		Aerial After	BLM-ESR	December 2009	4,900	
		Chain Unknown		Historic		
		Seed Unknown		Historic		
18A-25	Below Chokecherry Spring	Wildfire	Big Pole	August 2009	44,470	
		One-Way Ely Chain	BLM-ESR	November 2009	9,500	
		Aerial Before	BLM-ESR	October 2009	9,808	
		Aerial After	BLM-ESR	December 2009	4,900	
18A-26	Salt Mountain	Wildfire	Big Pole	August 2009	44,470	
		Aerial	BLM-ESR	October 2009	9,808	
		Aerial	BLM-ESR	December 2009	4,900	
18A-27	South of Broons Canyon	Wildfire	Big Pole	August 2009	44,470	
18A-28	Condie Meadows	Wildfire	Patch Springs	August 2013	31,010	
18A-29	Deadman Canyon	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Wildfire	Patch Springs	August 2013	31,010	
18A-30	Hatch Ranch	Bullhog	Terra East Juniper Thinning-Phase 2	October 2009-February 2010	2,190	1362
18A-32	East Hickman Canyon	Chain Unknown		1999		
		Seed Unknown		1999		
18R-1	East Onaqui	Aerial Before	East Onaqui Juniper Thinning and Seeding - Year 1	Aug 2007	332	353
		Bullhog	East Onaqui Juniper Thinning and Seeding - Year 1	September 2007-May 2008	418	353
18R-2	Clover Bullhog Drill	Bullhog	Clover Creek Juniper Thinning and Seeding--Year 2	October-December 2005	420	30
		Rangeland Drill	Clover Creek Juniper Thinning and Seeding--Year 2	October-December 2005	27	30
		Aerial After	Clover Creek Juniper Thinning and Seeding--Year 2	January 2006	420	30
18R-3	Clover Bullhog Aerial	Bullhog	Clover Creek Juniper Thinning and Seeding--Year 2	October-December 2005	420	30
		Aerial Before	Clover Creek Juniper Thinning and Seeding--Year 2	October-December 2005	400	30
		Aerial After	Clover Creek Juniper Thinning and Seeding--Year 2	January 2006	400	30
18R-4	Big Hollow Bullhog	Bullhog	Big Hollow Bullhog - Phase 2	April-August 2010	220	1380
18R-5	Clover Creek Chaining	Two-Way Smooth Chain	Clover Creek Habitat Enhancement	October 2007-April 2008	168	712
		Aerial Before	Clover Creek Habitat Enhancement	March 2008	168	712
18R-6	Clover Creek Dry Farm	Agriculture		Historic		
		Two-Way Ely Chain	Clover Creek Habitat Enhancement	September 2008	361	712
		Aerial Before	Clover Creek Habitat Enhancement	October 2008	408	712
		Plateau	Clover Creek Plateau	September 2010	220	1613
		Lop and Scatter		Between 2014 and 2018		
		One-Way Smooth Chain	Clover Creek Habitat Enhancement	November 2008	361	712

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
18R-7	Grantsville Chaining	Lop and Scatter	Grantsville Habitat and Grazing Improvement Project	October 2016-June 2018	765	3663
		Two-Way Ely Chain	Grantsville Chaining	October 2008	304	1117
		Aerial Before	Grantsville Chaining	October 2008	304	1117
		Dribbler	Grantsville Chaining	October 2008	304	1117
18R-8	West Onaqui Bullhog	Bullhog	West Onaqui Bullhog Phase III	March-April 2009	512	1133
		Aerial Before	Faust Fire ESR	December 2012	4,532	2484
		Plateau	Faust Fire ESR	September 2012	779	2484
		One-Way Ely	Faust Fire ESR	March-April 2013	4,068	2484
		Wildfire	Faust Fire	August 2012	22,045	
18R-9	East Faust Creek	Aerial Before	Onaqui East Bench Bullhog Phase III	October 2015	191	3249
	East Faust Creek	Wildfire	Two Springs	September 2017	84	
	East Faust Creek	Bullhog	Onaqui East Bench Bullhog Phase III	September 2015-March 2016	191	3249

Table 8.9: Range Trend and WRI studies known disturbance history for WMU 18A, Stansbury Oquirrh-Stansbury. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Shrub)

There are two studies [South of Broons Canyon (18A-27) and Magpie Canyon (18A-35)] that are classified as Mountain (Browse) ecological sites. South of Broons Canyon is located 1.5 miles north of Delle Ranch up Round Canyon Road. Magpie Canyon is located 6 miles west of Grantsville up Magpie Canyon (**Table 8.8**).

Shrubs/Trees: The dominant browse species on these study sites is antelope bitterbrush (*Purshia tridentata*) with mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) also present to a lesser extent. South of Broons Canyon burned completely in 2009, which removed the shrub component completely. Prior to the burn, however, the shrub community on the site was composed of these species. The fire accounts for the precipitous decrease in shrub cover in the combined cover between the years 2007 and 2012, with cover only present past 2007 because of the addition of the Magpie Canyon study (**Figure 8.3**). Average preferred browse density has decreased over time, with mature plants as the dominant age class in all sample years (**Figure 8.10**). Utilization of preferred browse has varied from sample year to sample year, but has decreased overall. In 2021, 13% of plants displayed signs of moderate use and none were heavily browsed (**Figure 8.12**).

Trees, specifically Utah juniper (*Juniperus osteosperma*), on the South of Broons Canyon study burned off in the 2009 fire and reduced the overall tree cover and density. Few trees are present on the Magpie Canyon site (**Figure 8.6**, **Figure 8.8**).

Herbaceous Understory: These study sites are not particularly diverse and have had high amounts of annual grass cover in most sample years. The perennial grass and forb components have remained comparatively limited. Cheatgrass (*Bromus tectorum*) is the dominant grass species overall, a trend driven by the South of Broons Canyon study; bluebunch wheatgrass (*Pseudoroegneria spicata*) contributes the most cover on Magpie Canyon as of 2021. In addition, bulbous bluegrass (*Poa bulbosa*) cover has increased over the study period. Perennial forb cover has fluctuated from year to year, but remained similar when comparing 1997 data to that of 2021. Annual forb cover has exhibited an overall increase. Overall nested frequency has decreased for all components except bulbous bluegrass and annual forbs (**Figure 8.14**, **Figure 8.16**).

Occupancy: The primary occupants on these sites have been mule deer, and mean abundance of deer pellet groups has ranged from 5 days use/acre in 2012 to 79 days use/acre in 2007. Elk pellet groups have had a mean abundance as low as 0 days use/acre in 2002 and 2021 and as high as 3 days use/acre in 2016. Cattle usage has varied from 0 days use/acre in 2002 and 2007 to 5 days use/acre in 2016 and 2021 (**Figure 8.18**).

Upland (Big Sagebrush)

Three studies [South Palmer Point (18A-23), Salt Mountain Stock Pond (18A-24), and Below Chokecherry Spring (18A-25)] are classified as Upland (Big Sagebrush) ecological sites. South Palmer Point is located 1 mile north of Delle Ranch. Salt Mountain Stock Pond is situated 2 miles south of Delle Ranch on Spring Pond Road. Finally, Below Chokecherry Spring can be found 2.25 miles southeast of Salt Mountain up Chokecherry Canyon (**Table 8.8**).

Shrubs/Trees: All of these studies were affected by the Big Pole wildfire in 2009, which removed most of the shrub component on all three studies. Total average shrub cover has increased in the sample years following the burn, but this is largely due to increases in shrubs other than preferred browse species. Broom snakeweed (*Gutierrezia sarothrae*) is the dominant shrub species on the South Palmer Point and Salt Mountain Stock Pond studies as of 2021, while yellow rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus* var. *viscidiflorus*) provides the most shrub cover of any single species on Below Chokecherry Spring. There are small, but increasing, amounts of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and rubber rabbitbrush (*Ericameria nauseosa* ssp. *nauseosa* var. *speciosa*) cover still found on South Palmer Point and Below Chokecherry Spring (**Figure 8.4**). Total average preferred browse density has decreased overall, but has increased in each sample year following the burn. Mature individuals have made up a majority of the preferred browse populations in most sample years. In 1997, however, young plants were the dominant demographic, largely due to the Below Chokecherry Spring site (**Figure 8.11**). Average utilization of preferred browse was low from 1997 through 2012. However, utilization has since increased, likely due in part to more concentrated browsing on the lower amount of shrubs that remain following the burn. In 2021, 6% and 52.5% of plants displayed signs of moderate and heavy usage (respectively) (**Figure 8.13**).

While there was some Utah Juniper (*Juniperus osteosperma*) present on all three studies, trees have provided no cover since the wildfire in 2009 (**Figure 8.7**). Average point-quarter density has increased since the burn, but remains low as of 2021 and is entirely due to the Salt Mountain Stock Pond study (**Figure 8.9**).

Herbaceous Understory: Total average cover and nested frequency of these herbaceous understories has fluctuated from year to year. When comparing 1997 data to 2021 data, however, nested frequency has decreased while cover has remained stable. Perennial grasses have contributed a majority of the herbaceous cover in all sample years. The introduced species crested wheatgrass (*Agropyron cristatum*) may limit diversity to some extent on some studies. However, other perennial grasses found include bluebunch wheatgrass (*Pseudoroegneria spicata*), slender wheatgrass (*Elymus trachycaulus*), and western wheatgrass (*Pascopyrum smithii*). The cover of annual grass has been high in multiple sample years, but is currently low as of 2021. However, the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has increased over time, particularly between 2016 and 2021: this trend is almost entirely driven by the Below Chokecherry Spring study. Perennial and annual forbs have fluctuated, but have generally provided less cover than annual and perennial grasses (**Figure 8.15**, **Figure 8.17**).

Occupancy: The primary occupants of these study were deer in 2002, but cattle were the main occupants in all other sample years. As of 2021, most of the cattle use appears to be on the Below Chokecherry Spring study; mean abundance of cattle pellet groups has been as low as 1 days use/acre in 2012 and as high as 25 days use/acre in 2007. Average deer pellet group abundance has ranged from 0.2 days use/acre in 2016 to 27 days use/acre in 2002. Finally, elk presence has fluctuated between 0 days use/acre in 2002, 2012, and 2016 and 9 days use/acre in 2007 (**Figure 8.19**).

Upland (Cliffrose)

There are three studies [Salt Mountain (18A-26), Deadman Canyon (18A-29), and Hatch Ranch (18A-30)] that are classified as Upland (Cliffrose) ecological sites. The Salt Mountain study is located 0.5 miles southeast of Salt Mountain. Deadman Canyon can be found about 4 miles north of the town of Terra, which is on SR-199. Finally, the Hatch Ranch site is situated about 3.75 miles south of the town of Terra (**Table 8.8**).

Shrubs/Trees: Total average shrub cover on these sites has decreased over time. The three studies have different vegetative characteristics, since Salt Mountain burned in 2009 and Deadman Canyon in 2013, significantly reducing the shrub communities on these sites. The Hatch Ranch study is dominated by Stansbury cliffrose (*Purshia stansburiana*) with Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) providing additional cover, but in significantly less amounts. On a site-specific level, cover of Stansbury cliffrose has generally increased overall as has the cover of Wyoming big sagebrush. In 2021, the only shrubs present on the Deadman Canyon and Salt Mountain studies were broom snakeweed (*Gutierrezia sarothrae*) and/or pricklypear (*Opuntia sp.*) (**Figure 8.5**). The preferred browse populations on these studies have mainly been composed of mature individuals and have decreased in density over time. Decadence has increased overall, while recruitment of young has decreased (**Figure 8.11**). Average preferred browse utilization has fluctuated, but more than half of plants have shown signs of little to no use in all sample years (**Figure 8.13**).

Conifers, specifically Utah juniper (*Juniperus osteosperma*) are the dominant trees on these site. Tree cover decreased initially between 2007 and 2012 due to the fire on the Salt Mountain study, then again in 2016 because of the burn on Deadman Canyon; tree cover has remained low since 2016 (**Figure 8.7**). Density of trees has also decreased overall.

However, tree density remains moderate as of 2021: this can be almost entirely attributed to the Hatch Ranch site (**Figure 8.9**).

Herbaceous Understory: The herbaceous understories of these sites have been composed of a mixture of annual and perennial grasses, with very few perennial forbs present. Cheatgrass (*Bromus tectorum*) is the most common annual grasses on all sites as of 2021. Bluebunch wheatgrass (*Pseudoroegneria spicata*) contributes the most perennial grass cover of any species on the Deadman Canyon and Salt Mountain studies, and is present in smaller amounts at the Hatch Ranch study. Deadman Canyon and Salt Mountain are in grassland states with little cover attributed to shrubs. Annual forb cover has fluctuated throughout the study, and they have made up a significant part of the understory in some years (**Figure 8.15**, **Figure 8.17**).

Occupancy: Average animal presence data indicates that occupancy has increased each year since 2012, but has decreased overall. Deer have been the primary occupants in all sample years, with most of the pellet groups occurring on the Hatch Ranch study in 2021. The mean abundance of deer pellet groups has varied from 4 days use/acre in 2012 to 48 days use/acre in 2002. Cattle pellet groups have had an average abundance as low as 0 days use/acre in 2002, 2007, and 2012 and as high as 3 days use/acre in 2021. Finally, elk have also been present with a mean abundance ranging from 0 days use/acre in 2002 and 2012 to 1 days use/acre in 2007 (**Figure 8.19**).

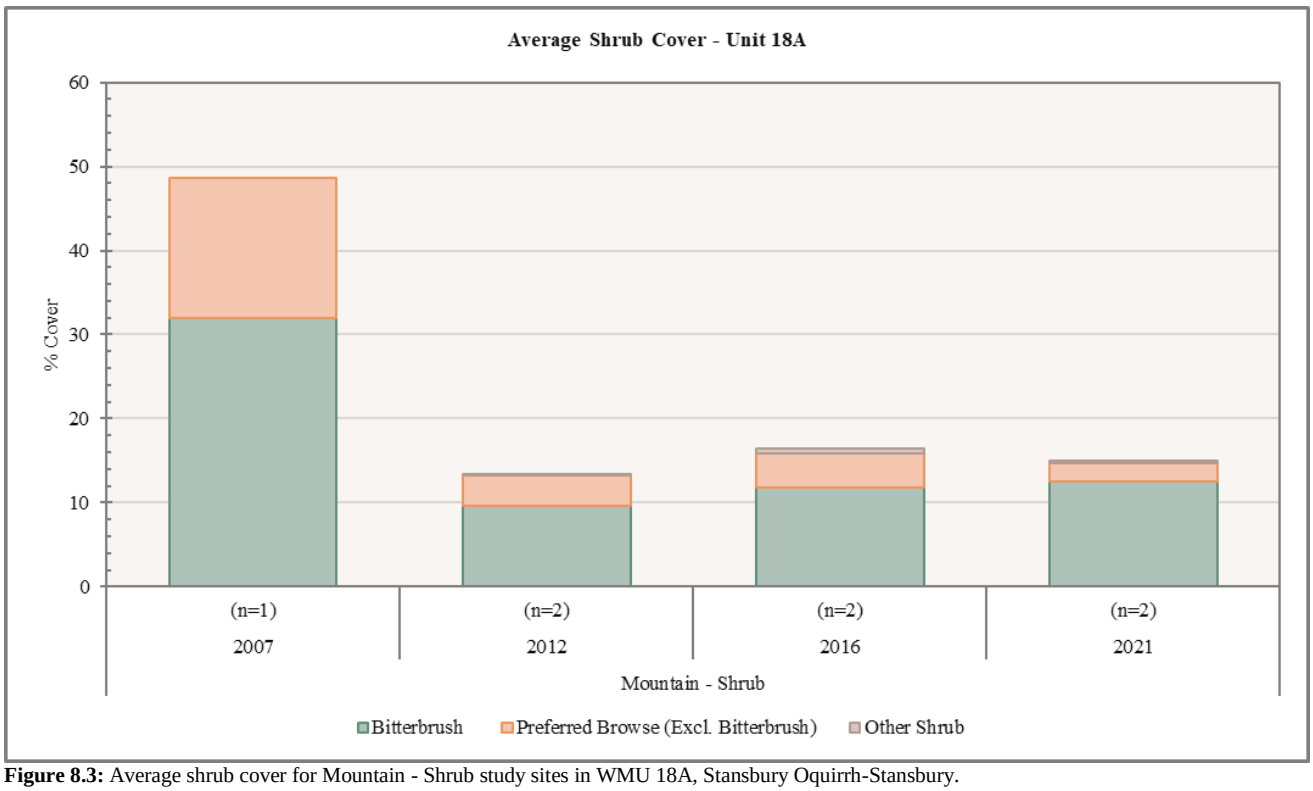


Figure 8.3: Average shrub cover for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

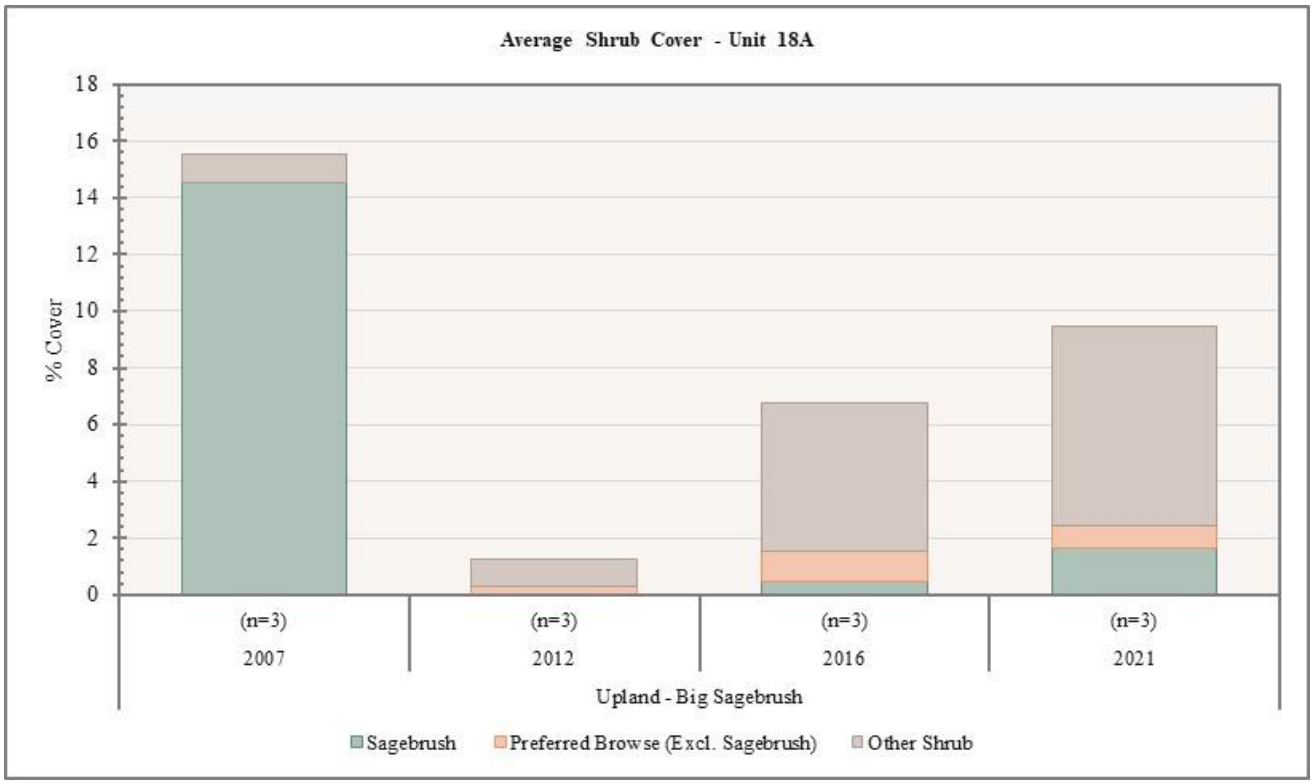


Figure 8.4: Average shrub cover for Upland - Big Sagebrush study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

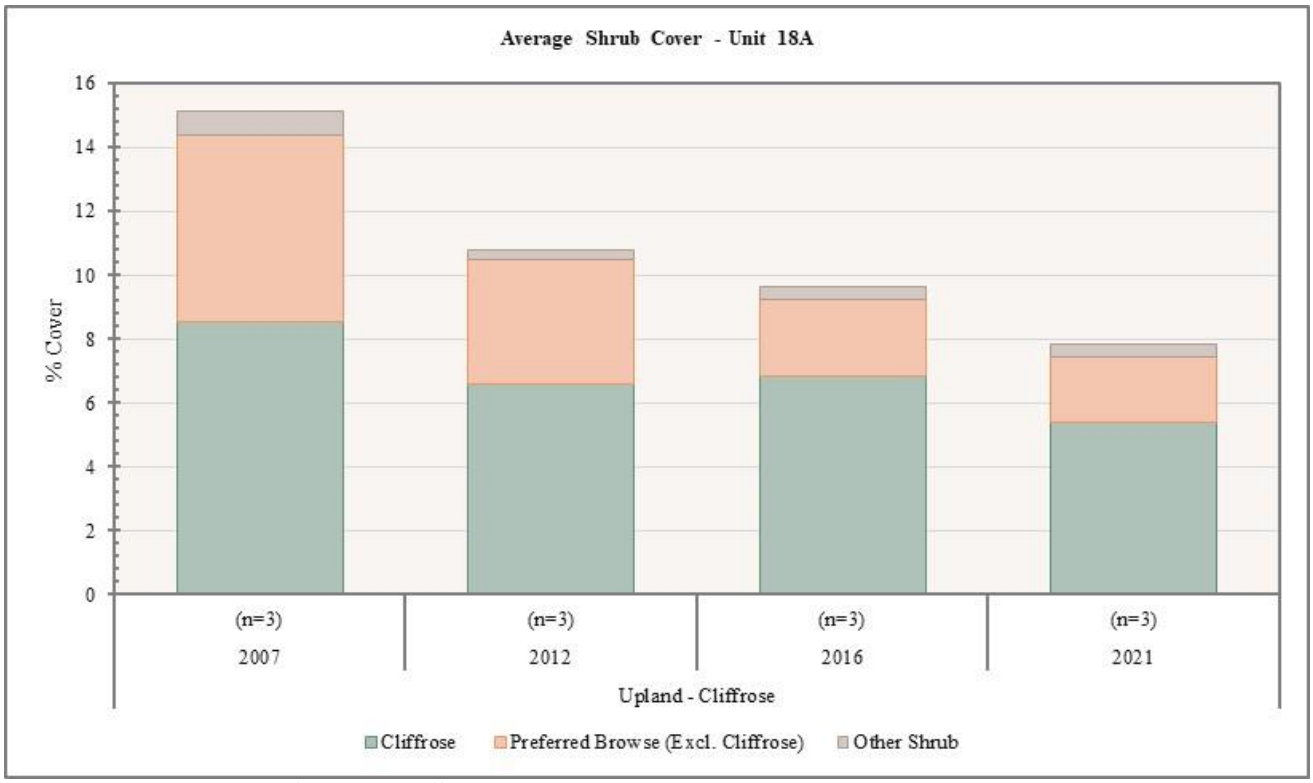


Figure 8.5: Average shrub cover for Upland - Cliffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

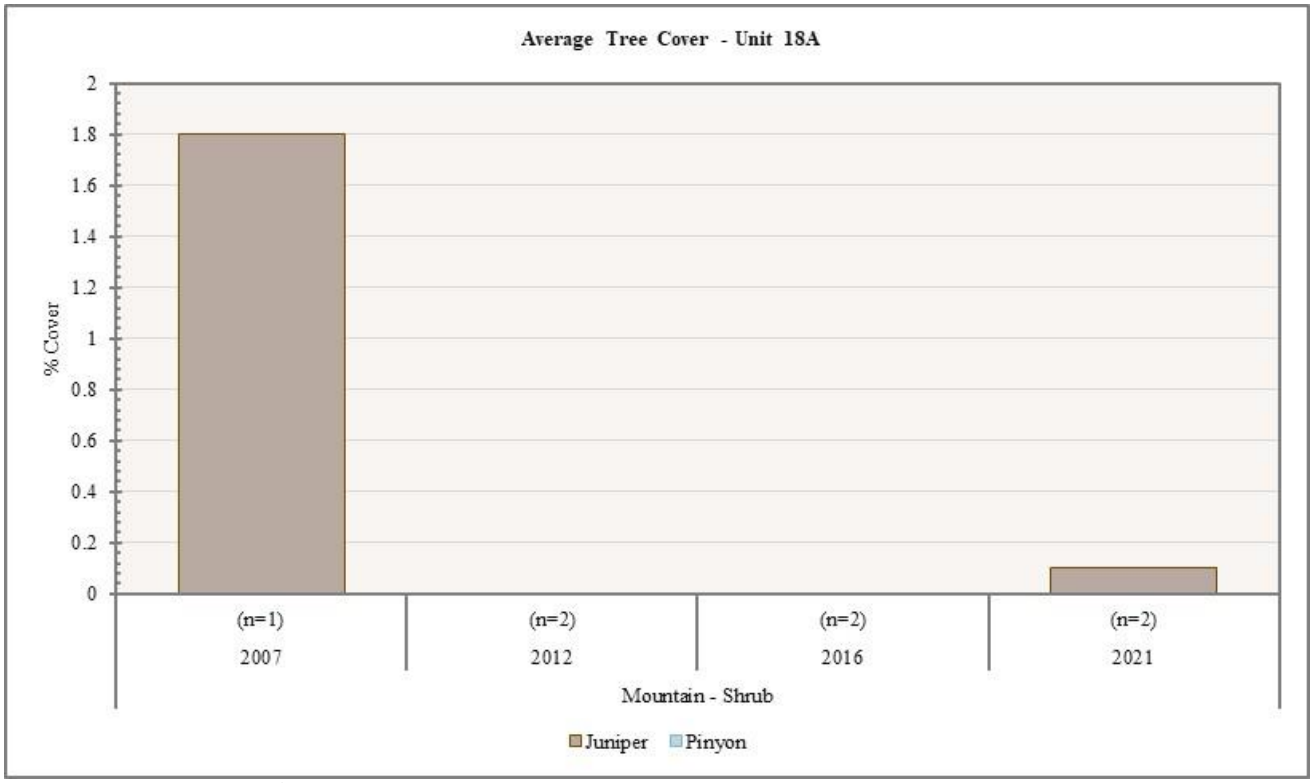


Figure 8.6: Average tree cover for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

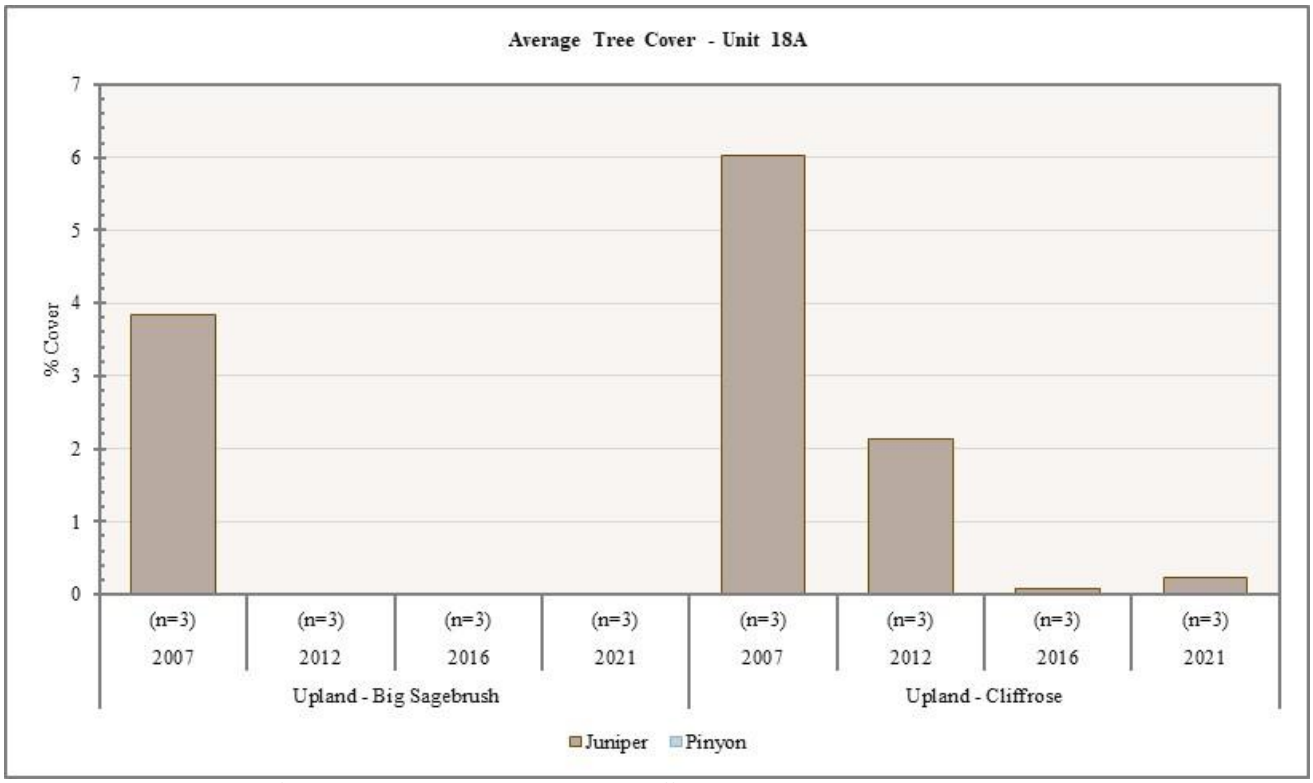


Figure 8.7: Average tree cover for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

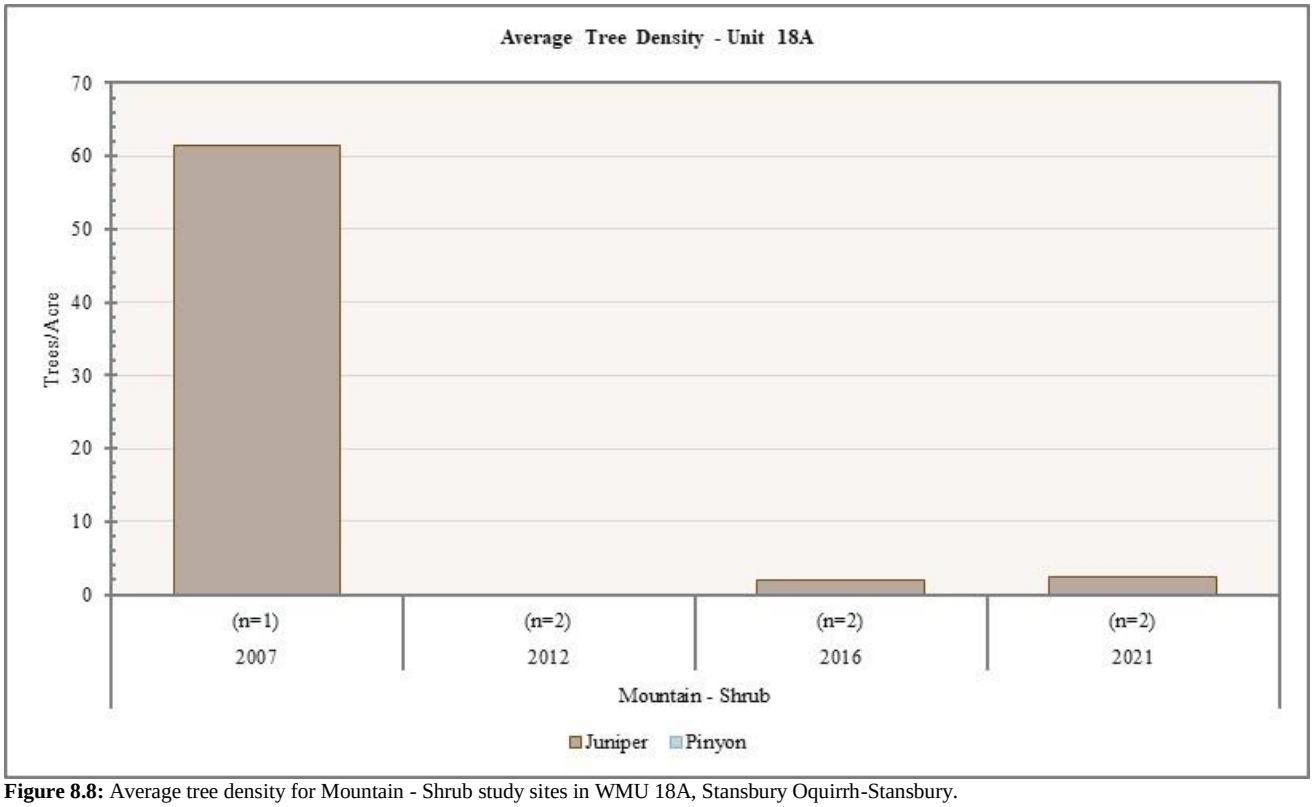


Figure 8.8: Average tree density for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

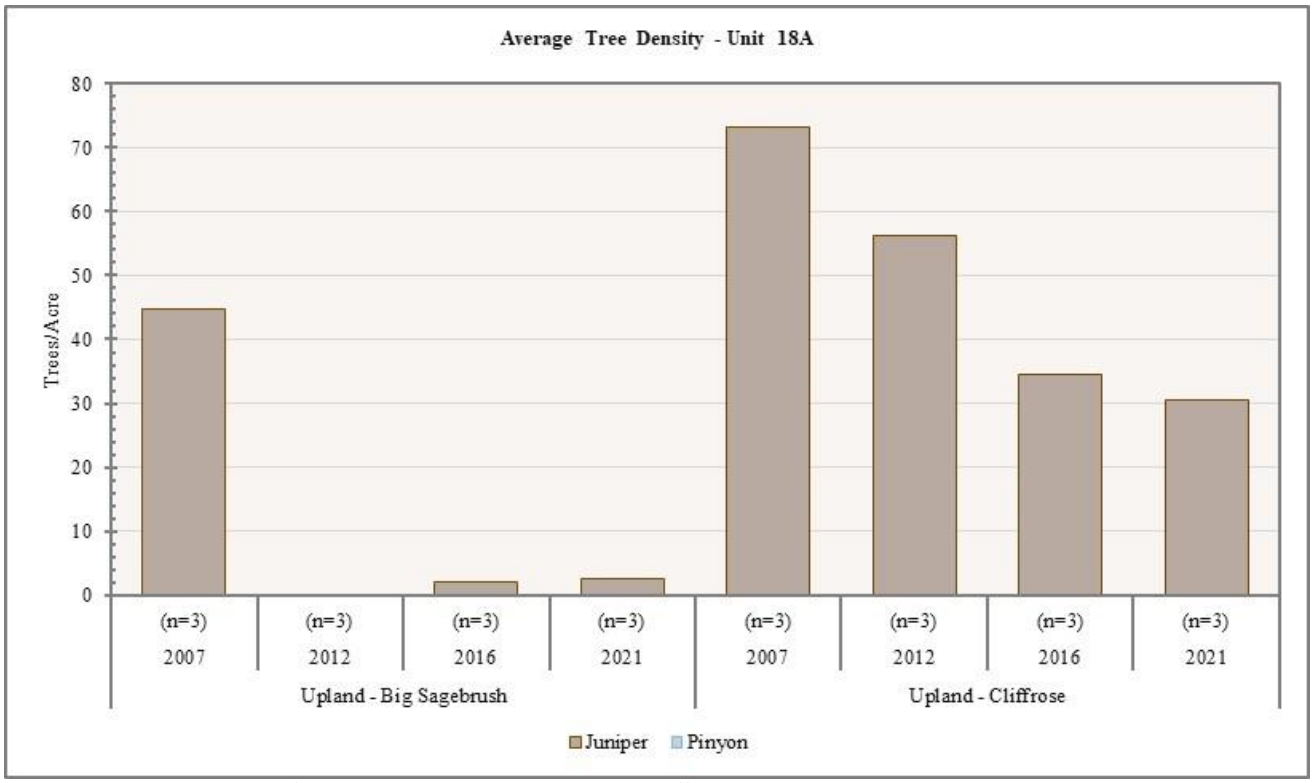


Figure 8.9: Average tree density for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

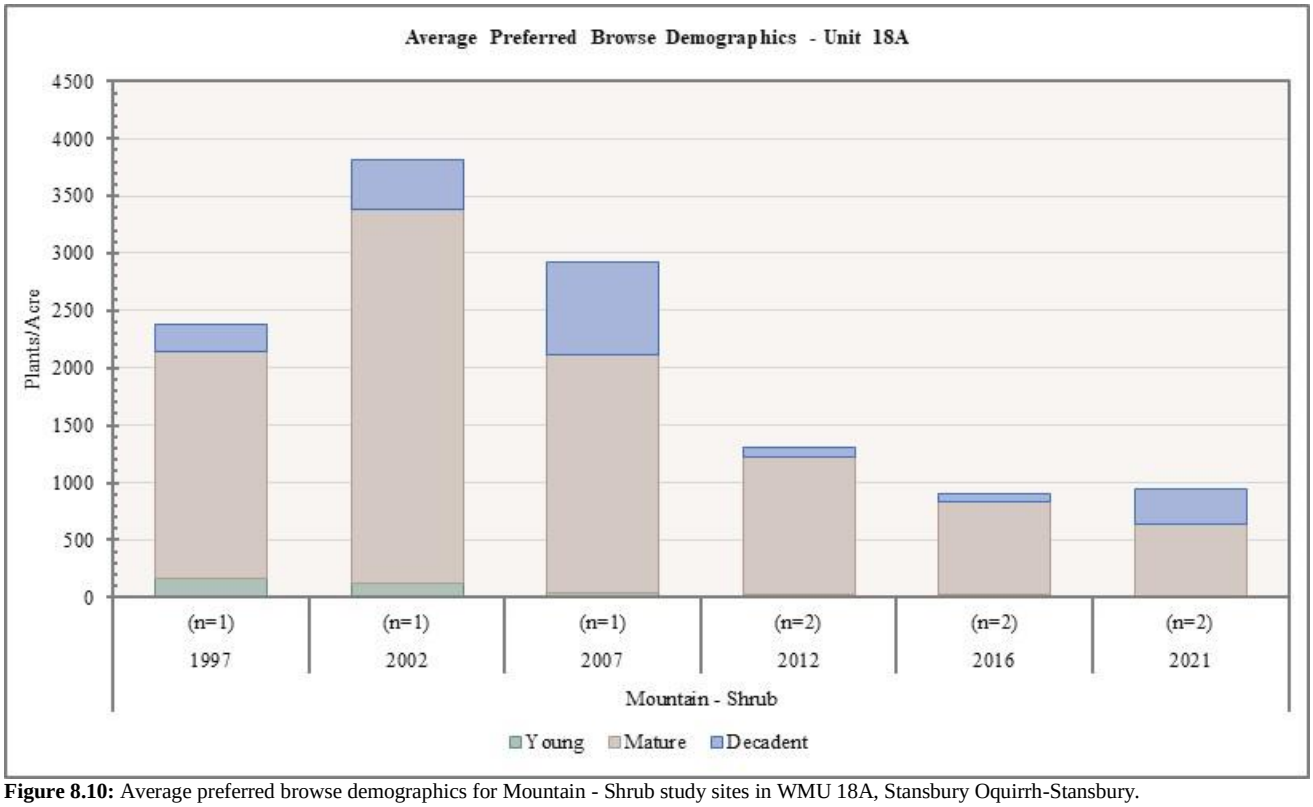


Figure 8.10: Average preferred browse demographics for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

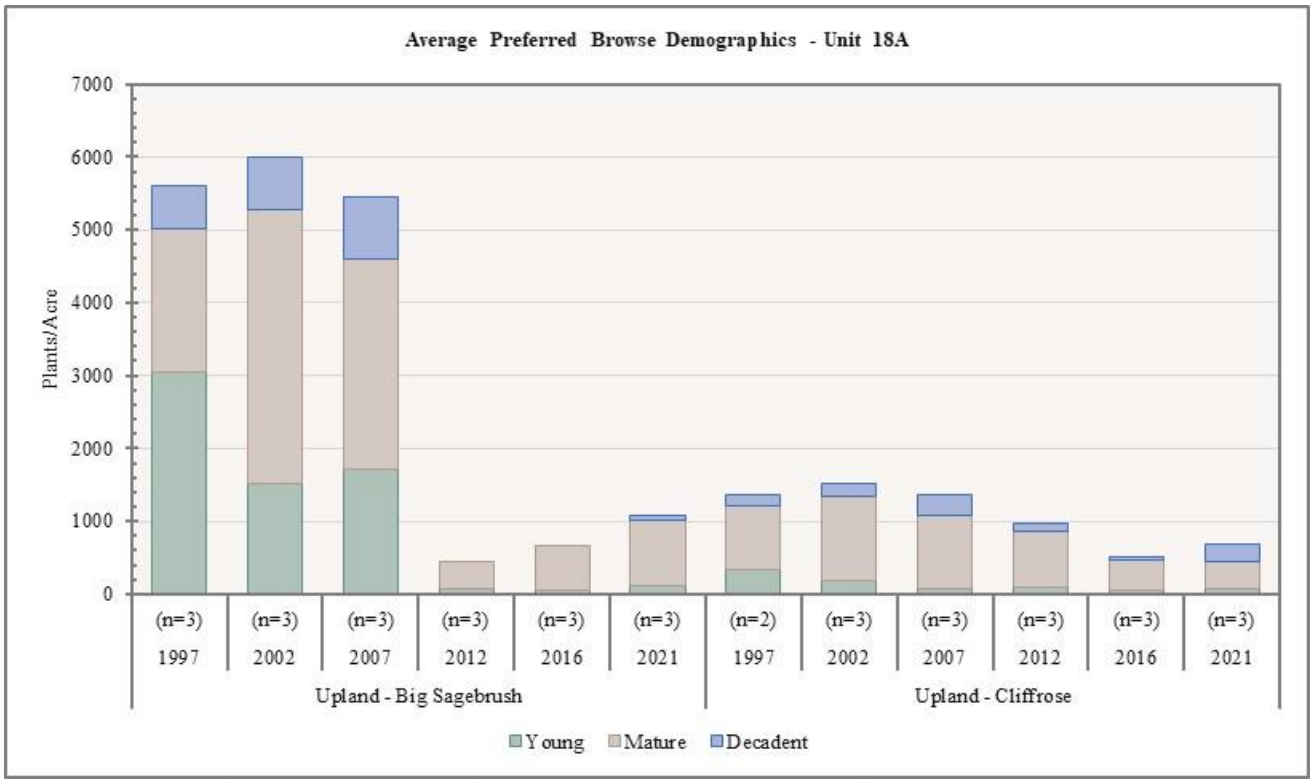


Figure 8.11: Average preferred browse demographics for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

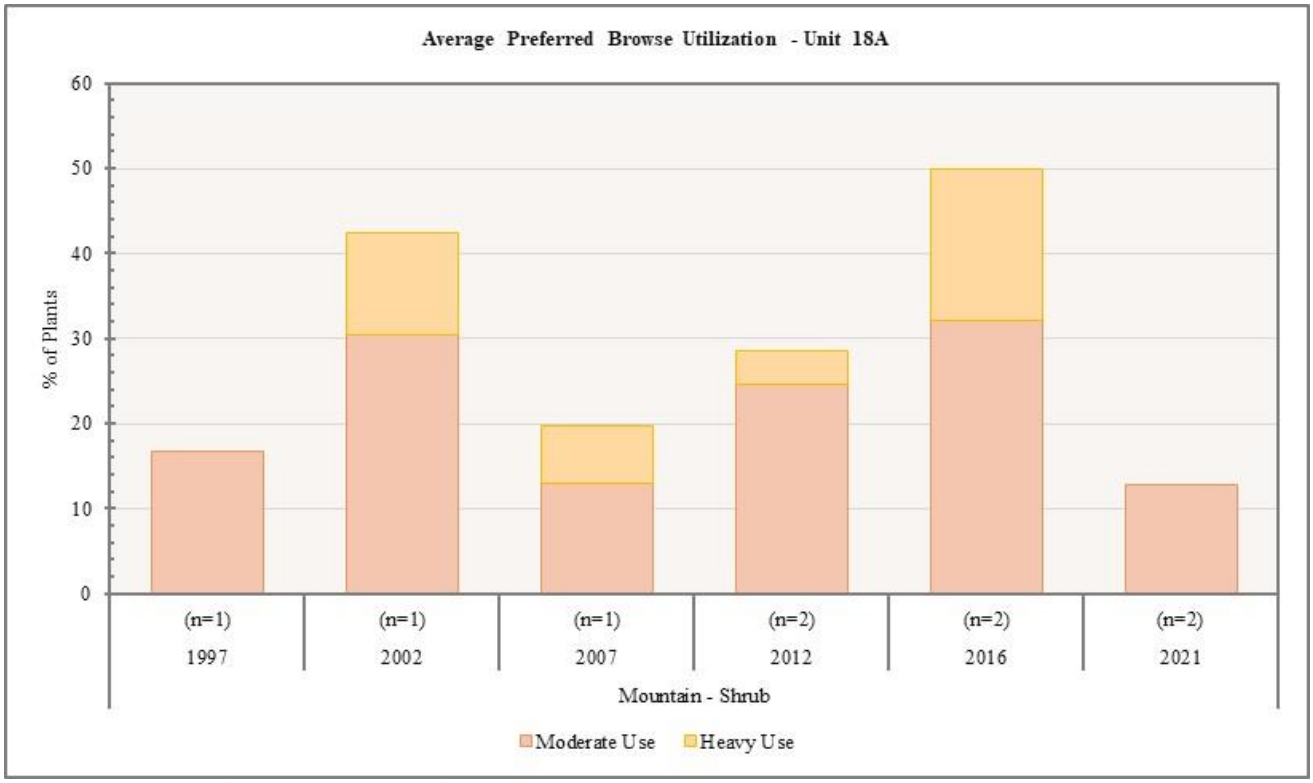


Figure 8.12: Average preferred browse utilization for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

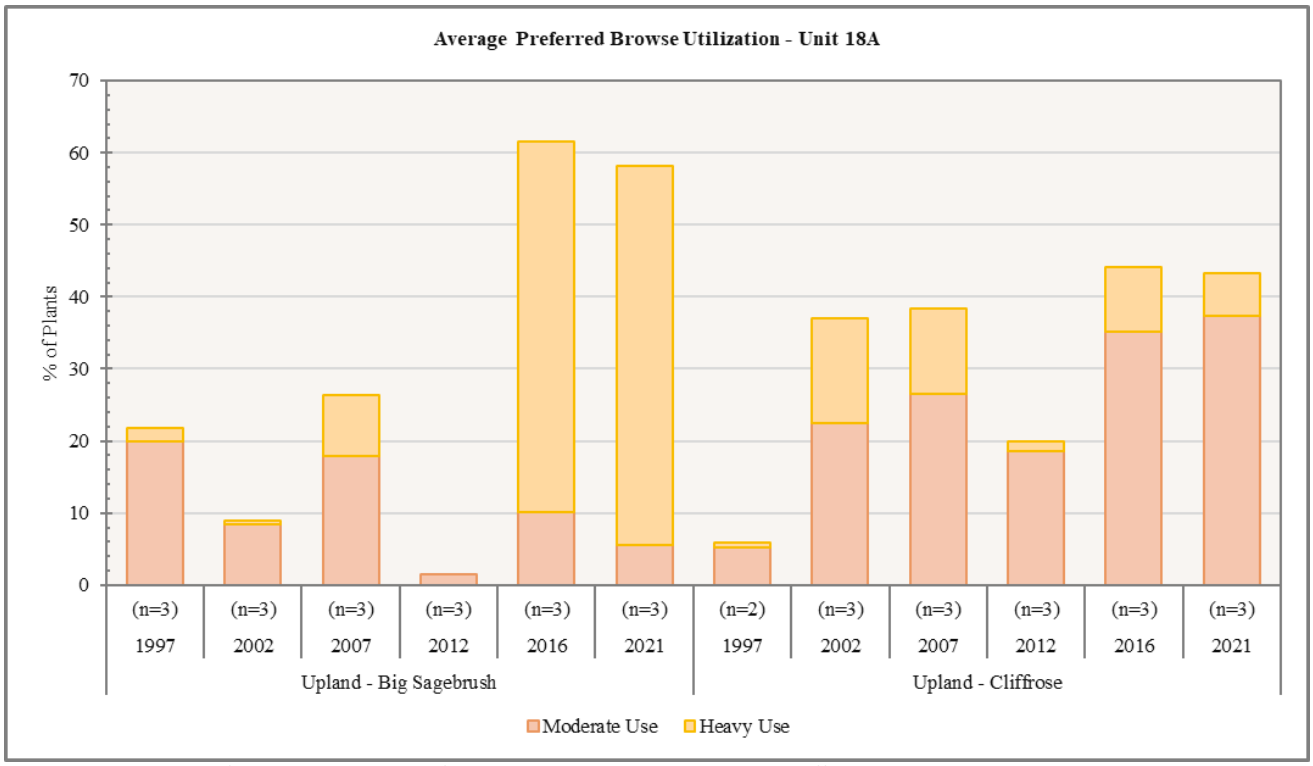


Figure 8.13: Average preferred browse utilization for Upland - Big Sagebrush and Upland- Clffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

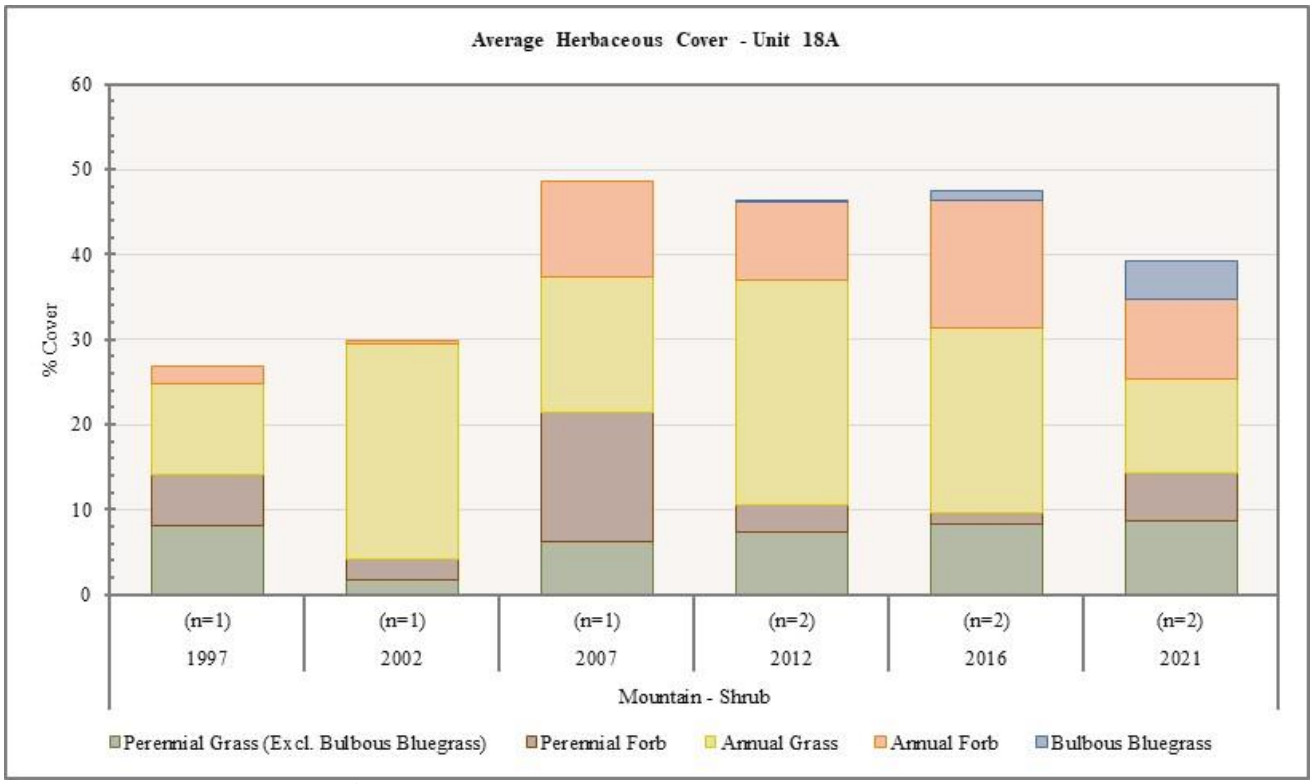


Figure 8.14: Average herbaceous cover for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

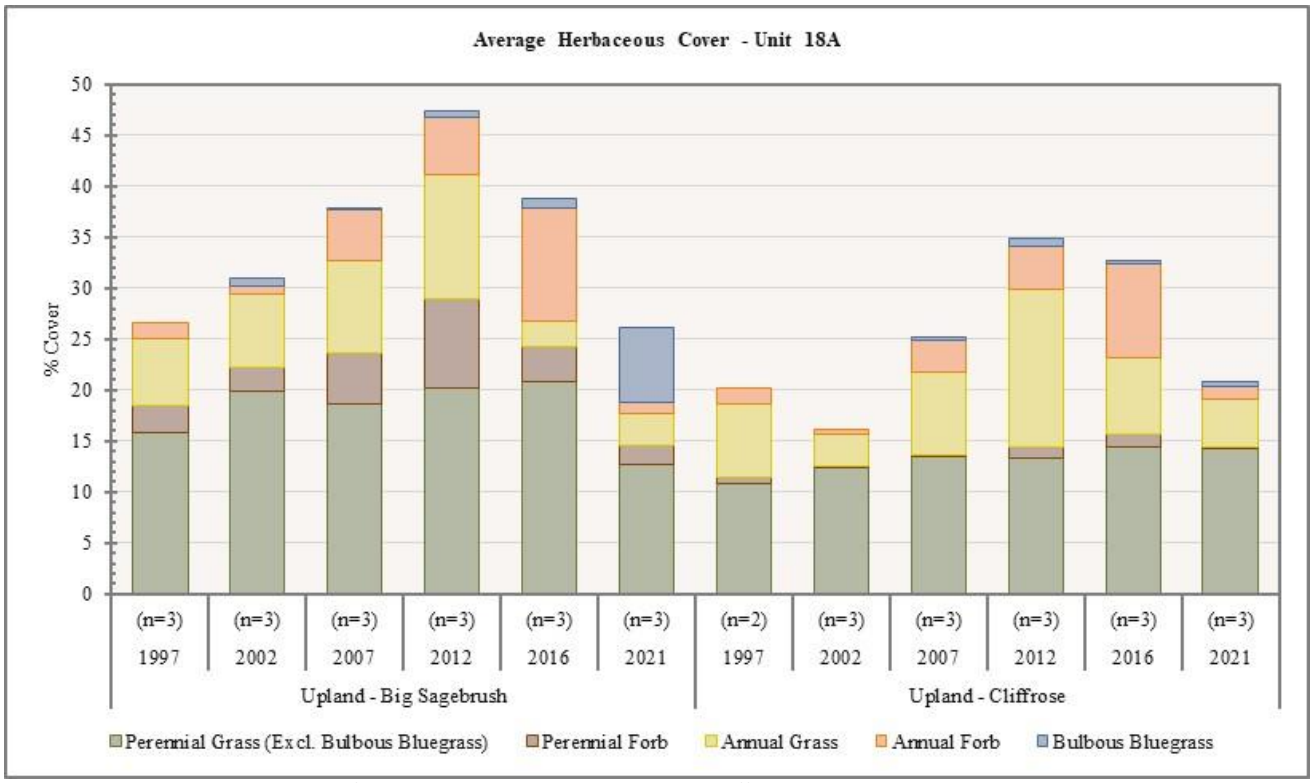


Figure 8.15: Average herbaceous cover for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

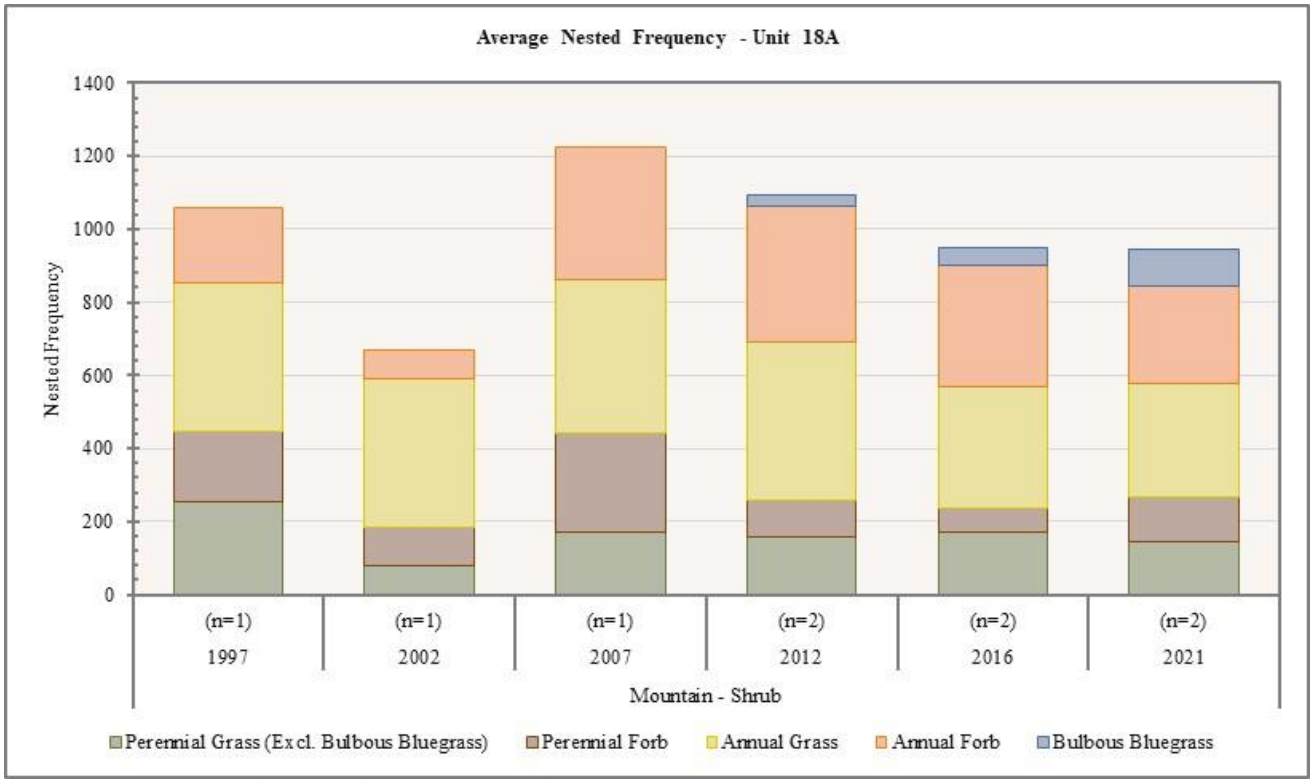


Figure 8.16: Average nested frequency of herbaceous species for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

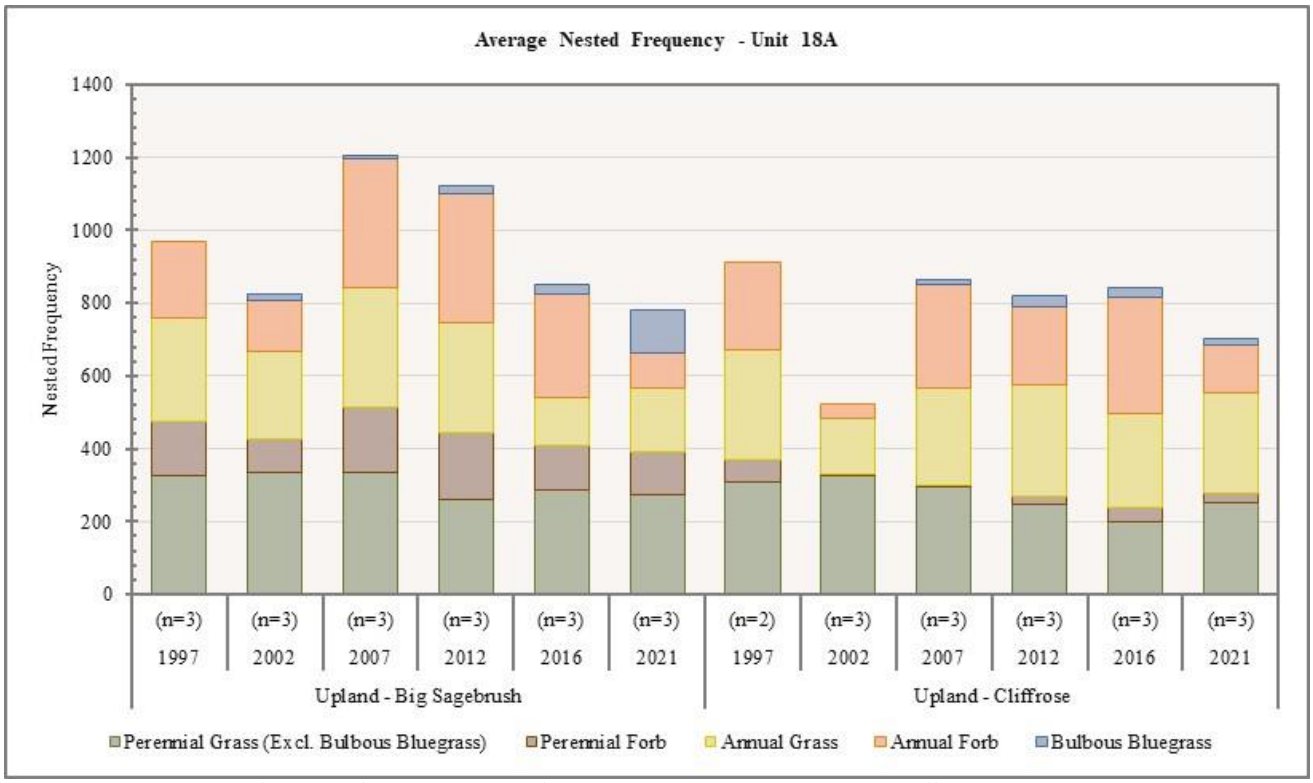


Figure 8.17: Average nested frequency of herbaceous species for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

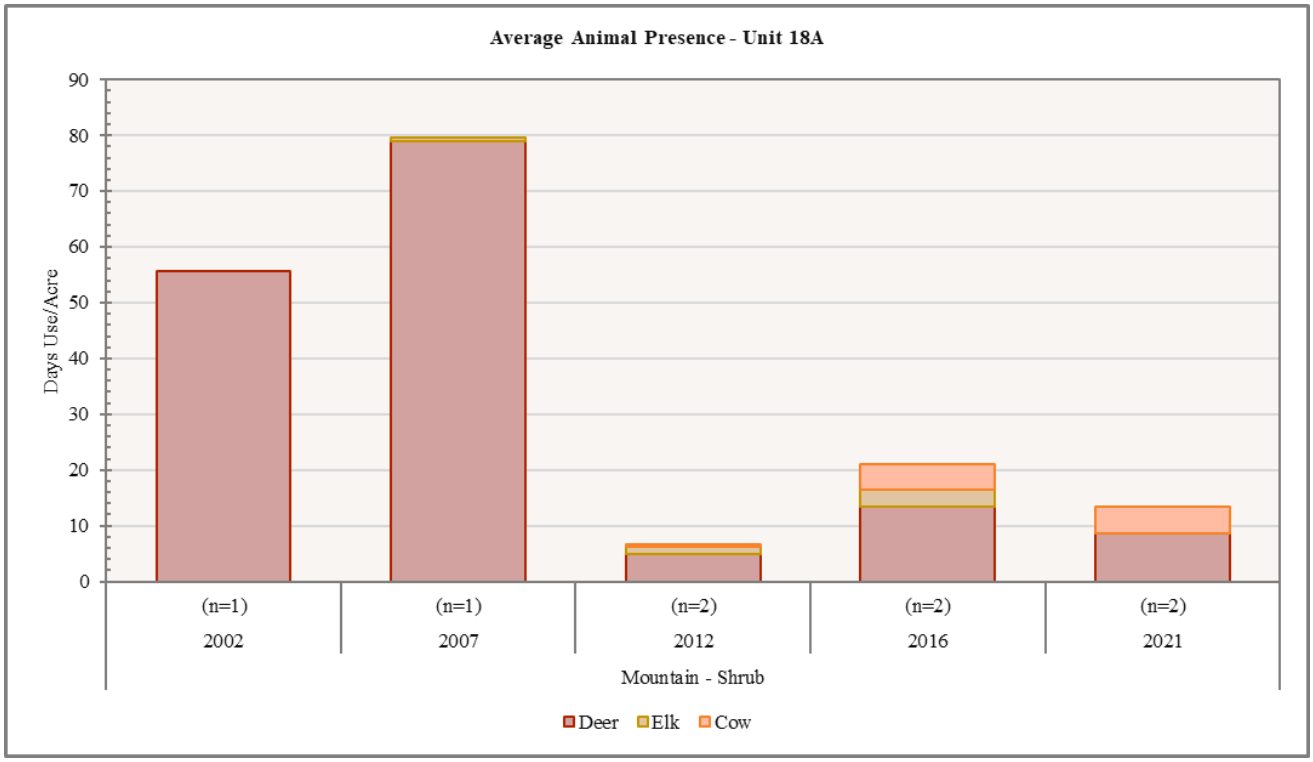


Figure 8.18: Average pellet transect data for Mountain - Shrub study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

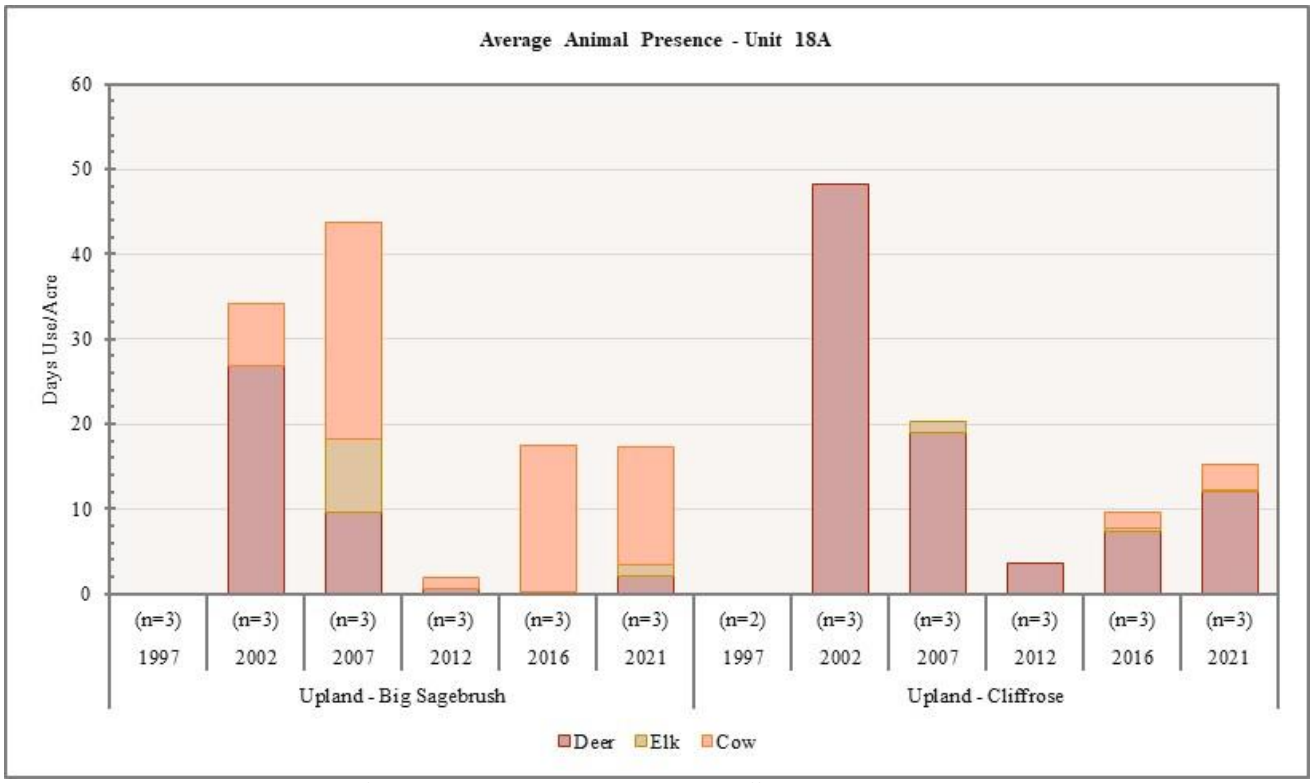
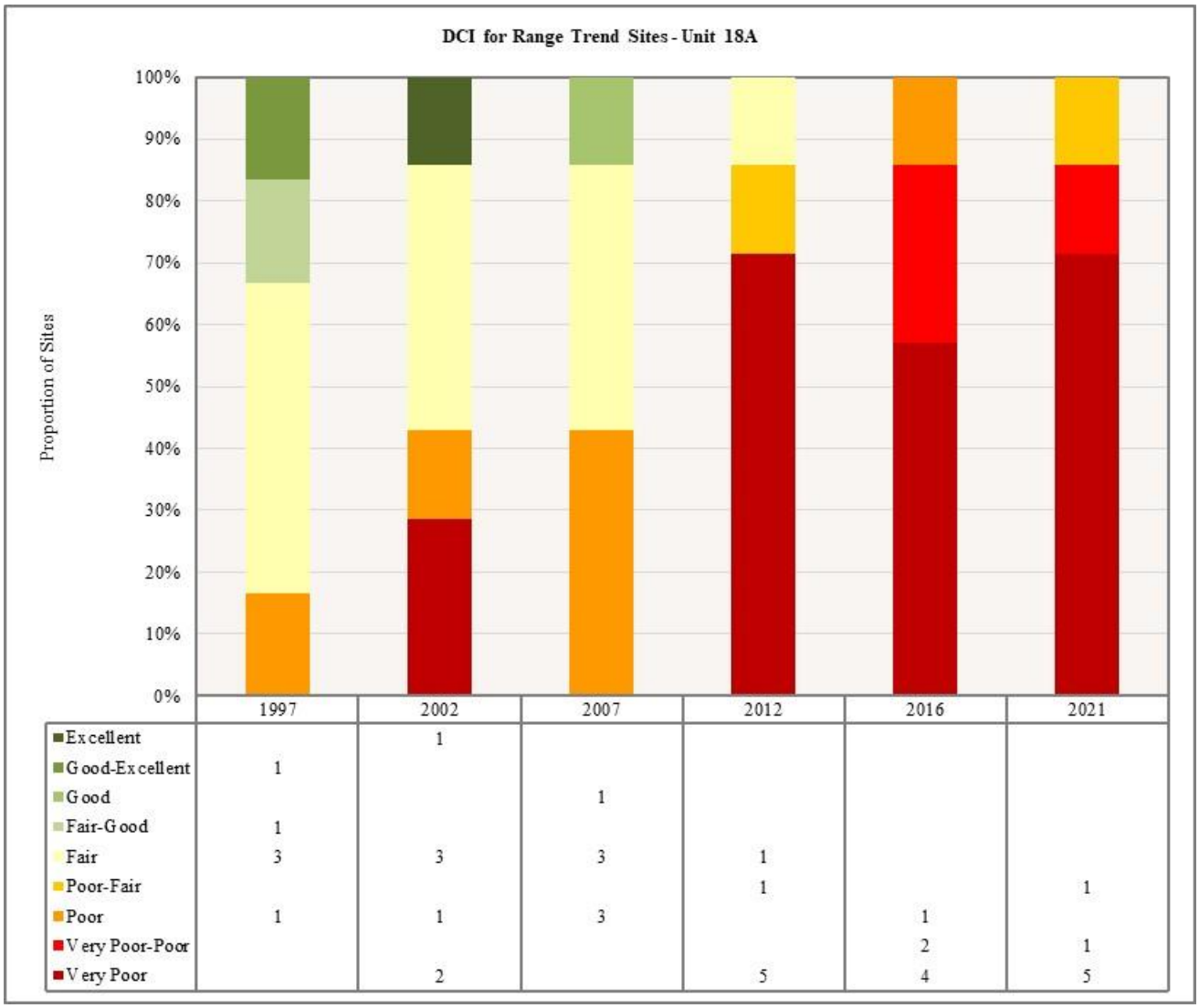


Figure 8.19: Average pellet transect data for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 18A, Stansbury Oquirrh-Stansbury.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Stansbury Oquirrh-Stansbury management unit, as a whole, has decreased from fair in 1997 to very poor wintering habitat in 2021. This decreasing trend was driven by the 2009 Big Pole wildfire with South Palmer Point (18A-23), Salt Mountain Stock Pond (18A-24), Below Chokecherry Spring (18A-25), Salt Mountain (18A-26), and South of Broons Canyon (18A-27) all being affected by the burn. Deadman Canyon (18A-29) was affected by the Patch Springs wildfire in 2013. Deer winter range on the east aspect of the Stansbury Mountains was negatively affected by the removal of much of the preferred browse populations. Some augmentation has been beneficial with the seeding of perennial grasses, but most sites have been negatively impacted by invasive annual grass. It is unclear as to whether these sites display any habitat conditional variability following the wildfires, so more time is needed to determine the responsiveness of these sites to winter range rehabilitation efforts.

The overall deer winter range assessment in 2021 for WMU 18A was very poor. Much of this can be attributed to the lack of preferred browse across the unit, with most of the sites sampling the west aspect of the Stansbury Mountains. Improvement to deer winter range will come with the addition of preferred browse species to the community. Despite the perceived benefits of perennial grasses to deer winter range, introduced species such as crested wheatgrass (*Agropyron cristatum*) and its other allies have the potential to suppress the establishment of young browse species which can complicate rehabilitation efforts (**Figure 8.20**, **Table 8.10**).



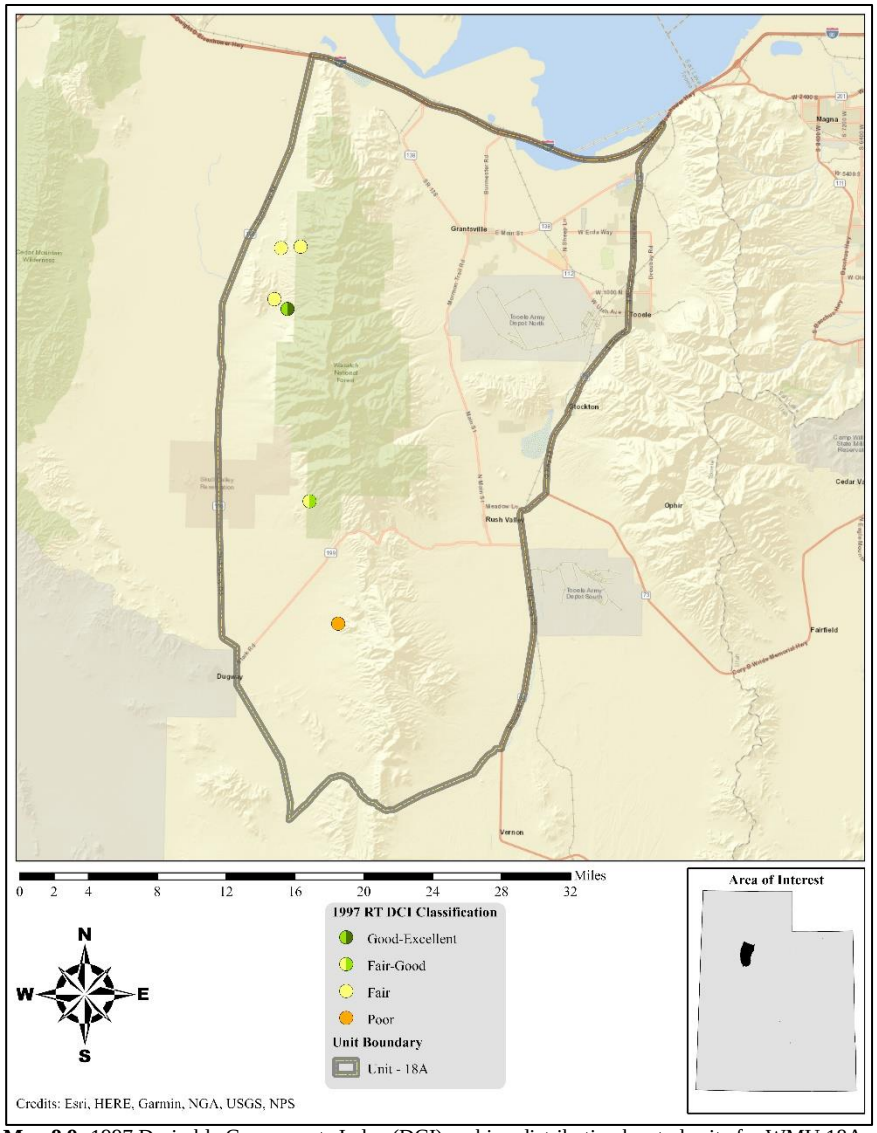
	1997	2002	2007	2012	2016	2021
Excellent		1				
Good-Excellent	1					
Good			1			
Fair-Good	1					
Fair	3	3	3	1		
Poor-Fair				1		1
Poor	1	1	3		1	
Very Poor-Poor					2	1
Very Poor		2		5	4	5

Figure 8.20: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 18A, Stansbury Oquirrh-Stansbury.

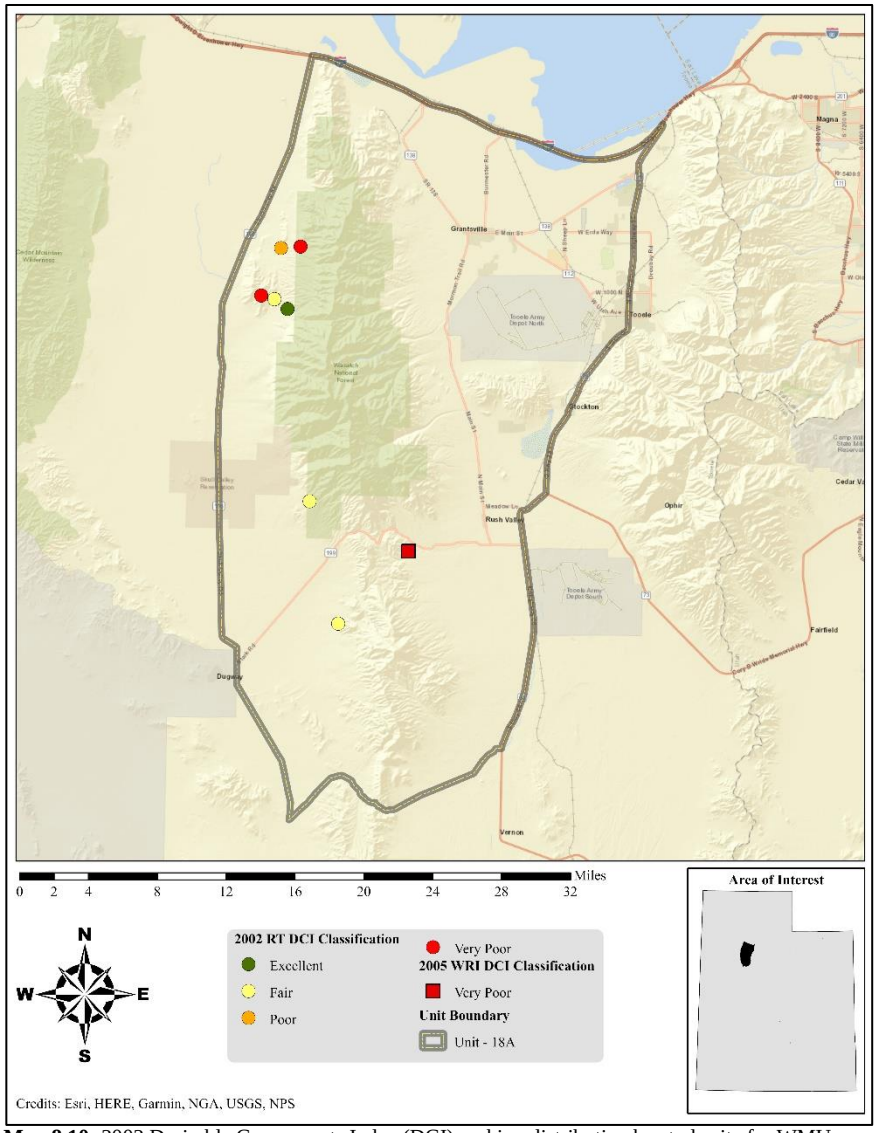
Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
18A-23	1997	14.7	9.1	15	17.1	-6.4	4.1	0	**53.5**	**F**
18A-23	2002	11.9	9.4	11.8	18.5	-9.5	0.9	0	**42.9**	**P**
18A-23	2004	12.8	6.6	3.4	13.7	-9.1	0.5	0	**27.9**	**VP**
18A-23	2007	15.6	12.8	15	17.6	-13.6	9.1	0	**56.5**	**F**
18A-23	2012	0.8	0	0	10.5	-12.7	10	-2	**6.6**	**VP**
18A-23	2016	5.1	0	0	10.5	-0.6	5.1	-4	**16.1**	**VP**
18A-23	2021	4.6	0	0	15.1	-4.9	3.4	-2	**16.2**	**VP**
18A-24	1997	12	5.2	9.1	30	-1.4	1.6	0	**56.4**	**F**
18A-24	2002	10	5.8	10.8	30	-1.7	0.1	0	**55.1**	**F**
18A-24	2007	10.9	4.4	3.7	30	-3.5	8.7	0	**54.2**	**F**
18A-24	2012	0	0	0	30	-2.7	4	0	**31.3**	**VP**
18A-24	2016	0	0	0	30	-0.1	4.1	0	**34**	**VP-P**
18A-24	2021	0	0	0	30	-1.9	2.4	0	**30.5**	**VP**
18A-25	1997	19.5	14.2	15	30	-7	9.8	0	**81.5**	**G-E**
18A-25	2002	23	13.7	13.3	30	-5	10	0	**85**	**E**
18A-25	2007	28	10	1.1	30	-3.1	10	0	**75.9**	**G**
18A-25	2012	0.5	0	0	30	-11.9	10	0	**28.6**	**VP**
18A-25	2016	1.5	0	0	30	-4.4	9.9	0	**37**	**VP-P**
18A-25	2021	4.9	0	0	24.7	-0.3	4.7	0	**33.9**	**VP-P**
18A-26	2002	4.7	0	0	23.8	-6.4	0	0	**22.2**	**VP**
18A-26	2007	10.5	12.1	8.1	23.2	-13.6	0	0	**40.2**	**P**
18A-26	2012	0	0	0	20.2	-19.6	3.8	0	**4.4**	**VP**
18A-26	2016	0	0	0	27.7	-1.6	5.5	0	**31.6**	**VP**
18A-26	2021	0	0	0	20.2	-6.1	0	0	**14.1**	**VP**
18A-27	1997	30	13.5	2.4	16.4	-8.1	10	0	**64.1**	**F**
18A-27	2002	30	11.9	1.1	3.4	-18.9	5.1	0	**32.6**	**VP**
18A-27	2007	30	9.6	0.9	12.4	-11.9	10	0	**51**	**P**
18A-27	2012	0	0	0	6.4	-20	5.7	0	**-7.9**	**VP**
18A-27	2016	0	0	0	8	-20	0.7	0	**-11.4**	**VP**
18A-27	2021	0.9	0	0	9.9	-11.4	5.6	0	**5**	**VP**
18A-29	1997	10.7	14.7	13.5	30	-4.7	2	0	**66.2**	**F-G**
18A-29	2002	10.3	13.2	3.7	30	0	0	0	**57.1**	**F**
18A-29	2007	16.4	2.3	0	30	-1.3	0.4	0	**47.8**	**P**
18A-29	2012	16.4	11.1	5.2	30	-1.3	0.5	0	**61.9**	**F**
18A-29	2016	0	0	0	30	-6.3	0.9	0	**24.7**	**VP**
18A-29	2021	0	0	0	30	-1.4	1.2	0	**29.8**	**VP**
18A-30	1997	17.8	10.8	9	12.2	-6	0.9	0	**44.6**	**P**
18A-30	2002	22	12	6	15.2	-0.4	0.7	0	**55.6**	**F**
18A-30	2007	30	9.9	2.2	17.5	-3.2	0.3	0	**56.7**	**F**
18A-30	2012	27.9	10.8	7	14.3	-13.8	2.2	0	**48.3**	**P-F**
18A-30	2016	30	11.9	4.7	4.1	-9.1	0.8	0	**42.3**	**P**
18A-30	2021	30	4.4	4.8	13.3	-3	0.2	0	**49.7**	**P-F**
18R-1	2004	1.5	0	0	11.7	0	0.9	0	**14**	**VP**
18R-1	2013	4.1	0	0	30	-1	4.9	0	**37.9**	**P**
18R-1	2016	9.6	15	10	30	-1.3	4.5	0	**67.7**	**G**
18R-2	2005	0.9	0	0	15.7	-0.1	0.7	0	**17.2**	**VP**
18R-2	2008	1.8	0	0	27.7	0	4.7	0	**34.1**	**VP-P**
18R-2	2012	2.5	0	0	30	-0.3	5.6	0	**37.8**	**P**
18R-2	2017	7.8	14.5	14.4	30	-0.3	3.9	0	**70.2**	**G**
18R-3	2005	2.7	0	0	24.3	-0.1	1.2	0	**28.1**	**VP**
18R-3	2008	0.8	0	0	28.1	0	2.1	0	**30.9**	**VP**
18R-3	2012	3.6	0	0	30	-0.1	3.7	0	**37.2**	**P**
18R-3	2017	6	0	0	30	0	8.7	0	**44.7**	**P**
18R-5	2007	0.9	0	0	16.2	-0.1	0.2	0	**17.2**	**VP**
18R-5	2010	0.3	0	0	30	-5	8	0	**33.3**	**VP-P**
18R-6	2007	16.2	-5.3	2.1	3.2	-2.1	0.7	0	**14.8**	**VP**
18R-6	2010	9.8	12.8	6.6	16.7	-20	1.6	0	**27.4**	**VP**
18R-6	2014	14.8	13.5	1.1	30	-3.9	3.9	0	**59.4**	**F**
18R-6	2018	17.1	8.4	1.9	30	-1.4	3.5	0	**59.4**	**F**

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
18R-8	2008	0	0	0	6.4	0	0.9	0	**7.3**	**VP**
18R-8	2011	0	0	0	27.8	-0.4	10	0	**37.4**	**P**
18R-8	2015	0	0	0	30	-7.3	2.1	0	**24.8**	**VP**
18R-8	2019	0	0	0	30	-11.5	7.4	0	**25.9**	**VP**

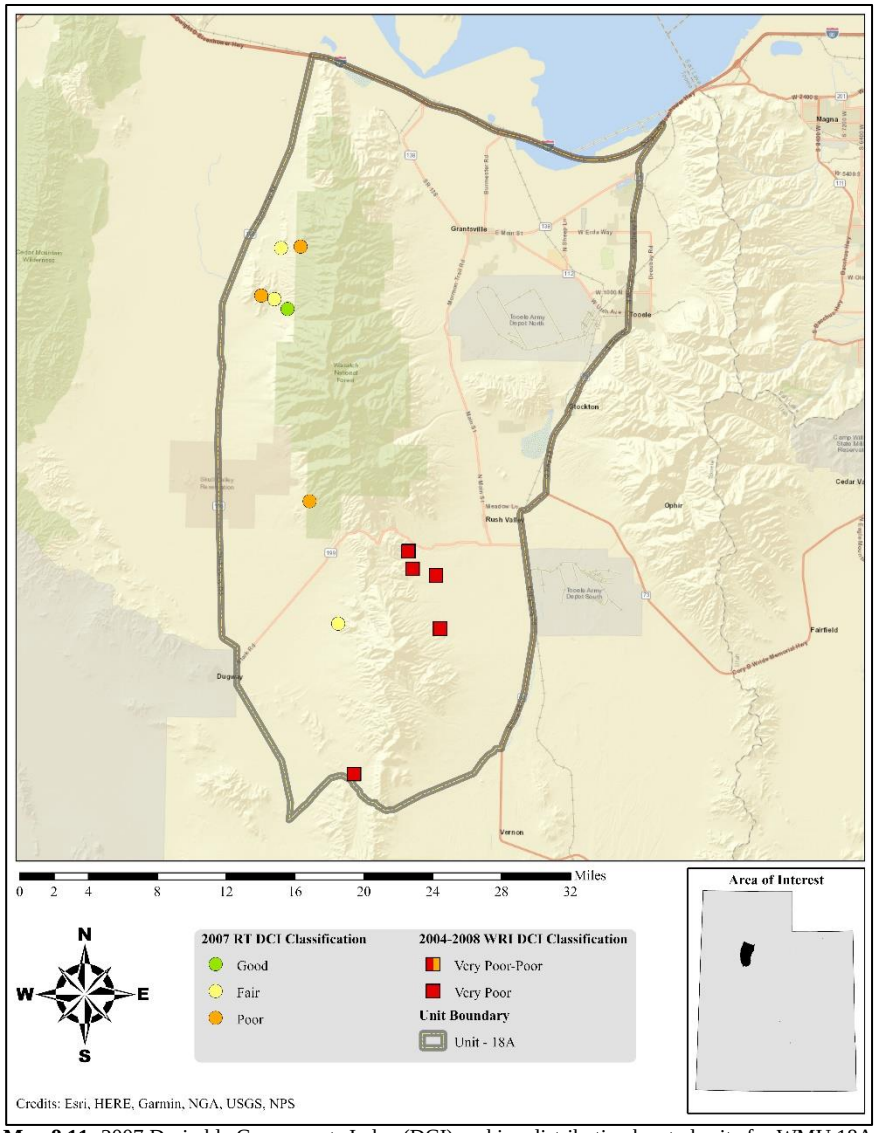
Table 8.10: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 18A, Stansbury Oquirrh-Stansbury. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



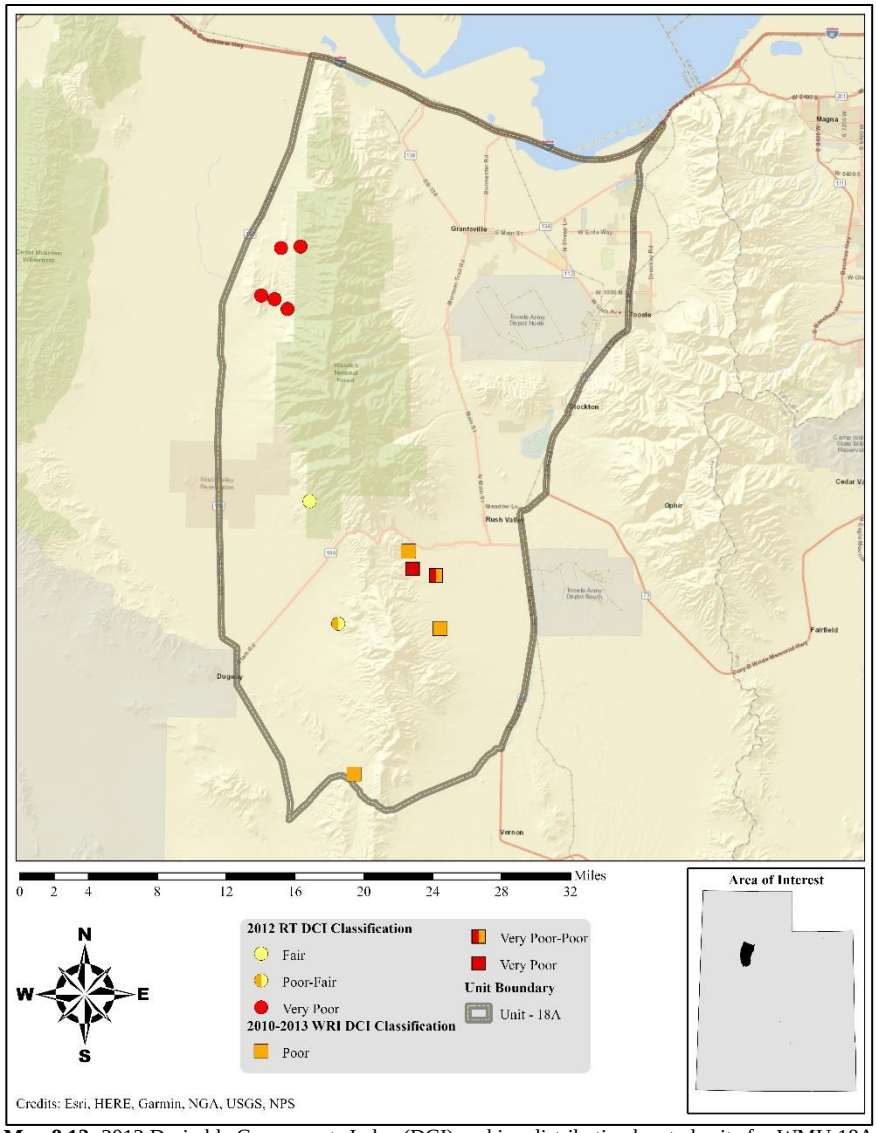
Map 8.9: 1997 Desirable Components Index (DCI) ranking distribution by study site for WMU 18A, Stansbury Oquirrh-Stansbury.



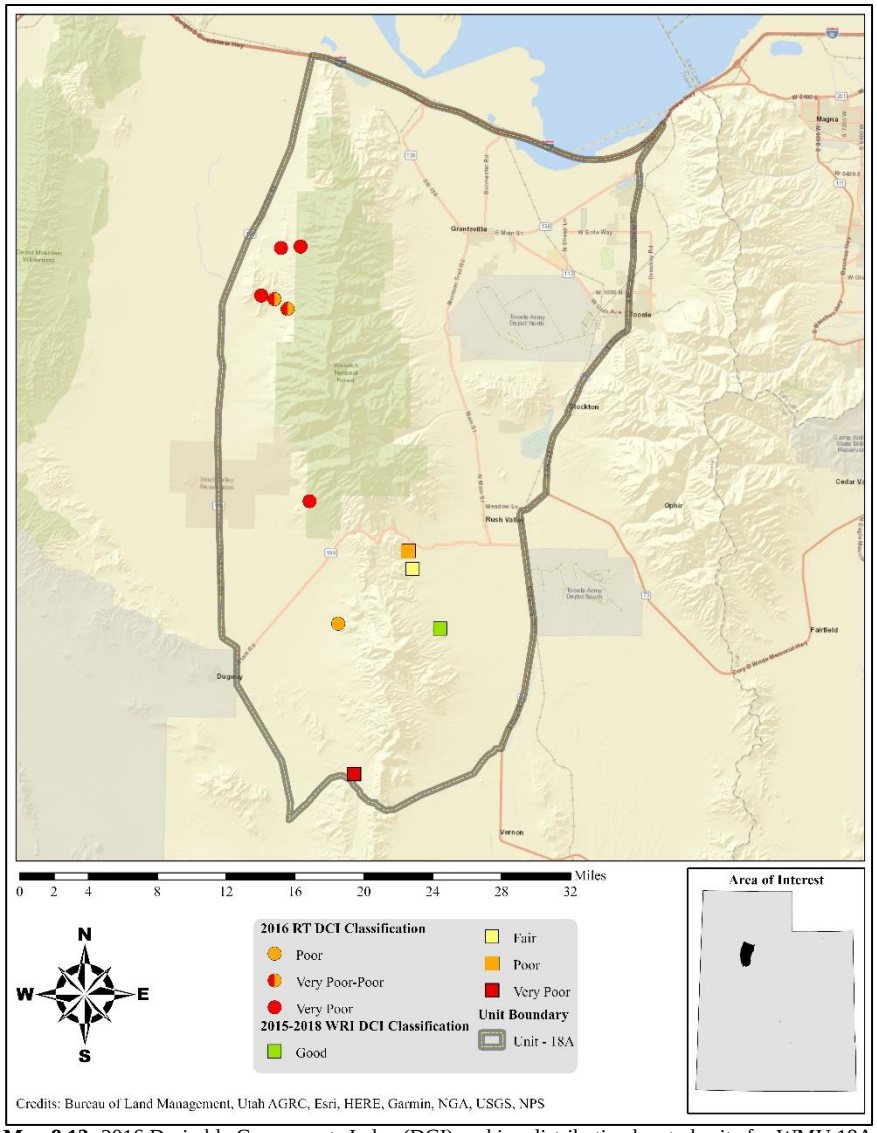
Map 8.10: 2002 Desirable Components Index (DCI) ranking distribution by study site for WMU 18A, Stansbury Oquirrh-Stansbury.



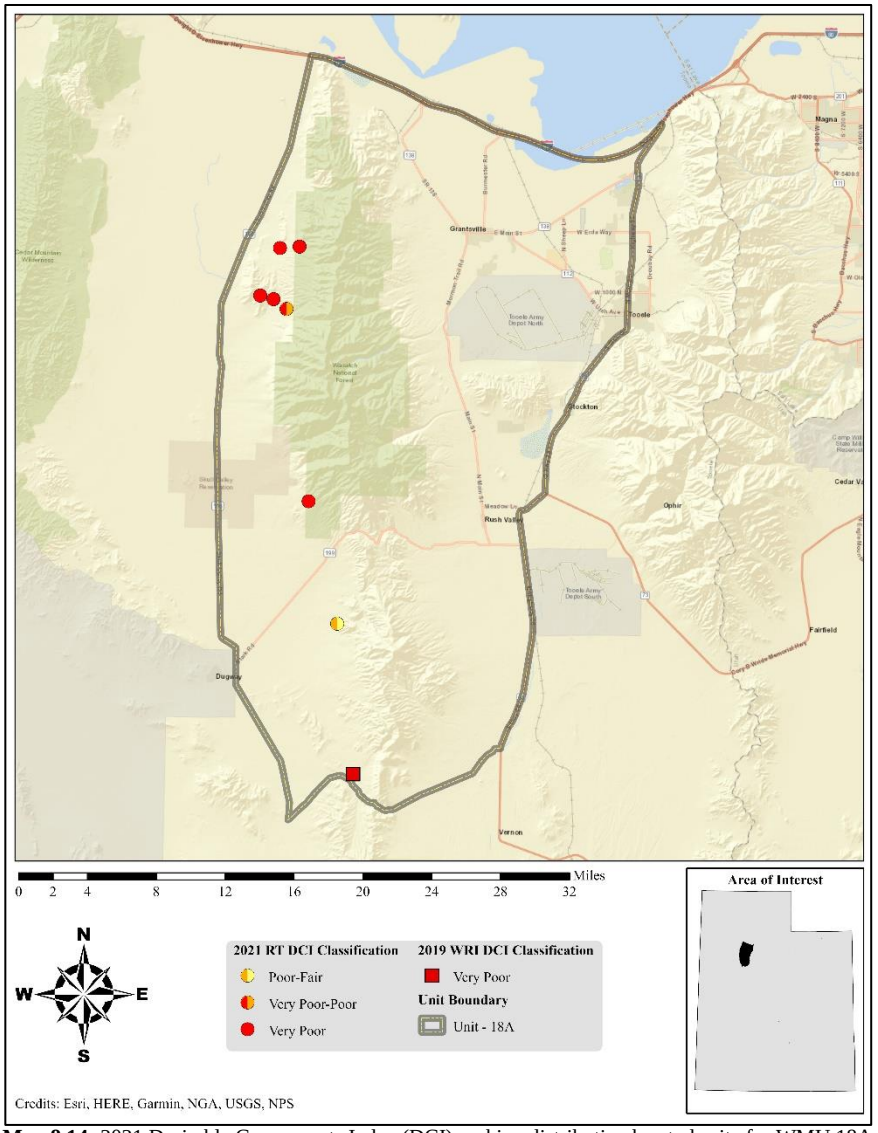
Map 8.11: 2007 Desirable Components Index (DCI) ranking distribution by study site for WMU 18A, Stansbury Oquirrh-Stansbury.



Map 8.12: 2012 Desirable Components Index (DCI) ranking distribution by study site for WMU 18A, Stansbury Oquirrh-Stansbury.



Map 8.13: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 18A, Stansbury Oquirrh-Stansbury.



Map 8.14: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 18A, Stansbury Oquirrh-Stansbury.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
18A-23	South Palmer Point	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
18A-24	Salt Mountain Stock Pond	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18A-25	Below Chokecherry Spring	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
18A-26	Salt Mountain	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18A-27	South of Broons Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
18A-29	Deadman Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
18A-30	Hatch Ranch	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18A-35	Magpie Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced understory shrub and herbaceous vigor
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
18R-1	East Onaqui	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced understory shrub and herbaceous vigor
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18R-2	Clover Bullhog Drill	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18R-3	Clover Bullhog Aerial	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18R-4	Big Hollow Bullhog	Introduced Perennial Grass	High	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18R-6	Clover Creek Dry Farm	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced understory shrub and herbaceous vigor
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18R-7	Grantsville Chaining	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced understory shrub and herbaceous vigor
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18R-8	West Onaqui Bullhog	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced understory shrub and herbaceous vigor
18R-9	East Faust Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 8.11: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 18A, Stansbury Oquirrh-Stansbury. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment**.

Discussion and Recommendations

Mountain (Shrub)

The high-elevation mountain study sites of this ecological type support or used to support mountain shrub communities and are generally considered to be in very poor to fair condition for deer habitat on the Stansbury Oquirrh-Stansbury management unit. Although a browse component is present on the Magpie Canyon study, a fire on the South of Broons Canyon study removed the shrub overstory. Annual grasses are present in significant amounts on these sites and pose a high-level threat on both study sites. High amounts of annual grasses increase fuel loads, heighten the potential for (additional) wildfire(s), and have the potential to alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). The

introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) is also present on both sites. Although the threat posed by introduced perennial grasses is currently medium, they are often aggressive in the herbaceous understory and may have the ability to outcompete native grasses and forbs for resources. This competition with introduced perennial grasses in turn can lead to reduced biodiversity and abundance of desirable native species (Mack, et al., 2000). Utah juniper (*Juniperus osteosperma*) is encroaching on the Magpie Canyon site, placing it in Phase I of woodland succession. The risk of reduced ecological integrity is low as of 2021, but pinyon and juniper trees can lead to reduced understory shrub and herbaceous health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000). Finally, the noxious weed species gypsyflower (*Cynoglossum officinale*) has been observed in previous sample years in low amounts. Although not present in 2021 data, a resurgence of noxious weeds in high enough amounts in the future could lead to reduced herbaceous diversity (Mack, et al., 2000).

Continued monitoring of these communities is recommended. Treatments to reduce annual grass loads such as herbicide, grazing management, etc. may be prudent, particularly on the South of Broons Canyon study. If reseeding is deemed necessary to restore herbaceous diversity, care should be taken in species selection and preference should be given to native grass and forb species when possible. Although tree encroachment is likely not an immediate concern, treatments to manage pinyon and juniper may be appropriate on the Magpie Canyon study if tree encroachment progresses in the future.

Upland (Big Sagebrush)

The mid-elevation study sites classified as being of the Upland (Big Sagebrush) ecological type are considered to be in very poor to poor condition for deer winter range. Prior to burning in the Big Pole fire in 2009, these sites supported sagebrush communities that provided valuable browse during the winter: much of the shrub cover was removed during the burn. Annual grasses, namely cheatgrass (*Bromus tectorum*), are a concern on all three study sites. Fluctuations over the sample period show that they have been observed with medium to high cover in the past. In high amounts, cheatgrass presence threatens ecological resilience and resistance, boosts fuel loads, exacerbates the risk of wildfire, and has the potential to alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). Introduced perennial grasses pose a high-level threat on the Salt Mountain Stock Pond study and a medium-level threat on the South Palmer Point and Below Chokecherry Spring sites. Introduced perennial grass species are often aggressive in the understory with the potential to outcompete native herbaceous species for resources: this increased competition can then result in reduced herbaceous diversity (Mack, et al., 2000). In higher amounts, noxious weed species are aggressive and have a similar effect as introduced perennial grasses, namely decreased understory biodiversity. Although abundance is low as of 2021, the noxious weed species field bindweed (*Convolvulus arvensis*) is present on the South Palmer Point study and may have deleterious effects should it increase in the future (Mack, et al., 2000). Finally, Utah juniper (*Juniperus osteosperma*) is present in low amounts on the Salt Mountain Stock Pond study. Although the study is only in Phase I of woodland succession as of 2021, pinyon and juniper presence can result in reduced understory shrub and herbaceous vigor as encroachment advances (Miller, Svejcar, & Rose, 2000).

Future monitoring of these study sites is strongly recommended. Treatment through grazing management, herbicide, etc. may be necessary if data indicates that annual grass loads have increased in future sample years. Reseeding may be advisable on the Below Chokecherry Spring and Salt Mountain Stock Pond studies to diversify the herbaceous understory. However, care should be taken in species selection when designing seed mixes and preference should be given to native species whenever possible. Tree encroachment is not an immediate concern on any site. If future monitoring indicates that encroachment has advanced and is negatively effecting the ecological integrity of the sites, treatments such as bullhogging and chaining may be advisable. However, consideration and care should be taken to select tree-removal methods that will not increase annual grass loads.

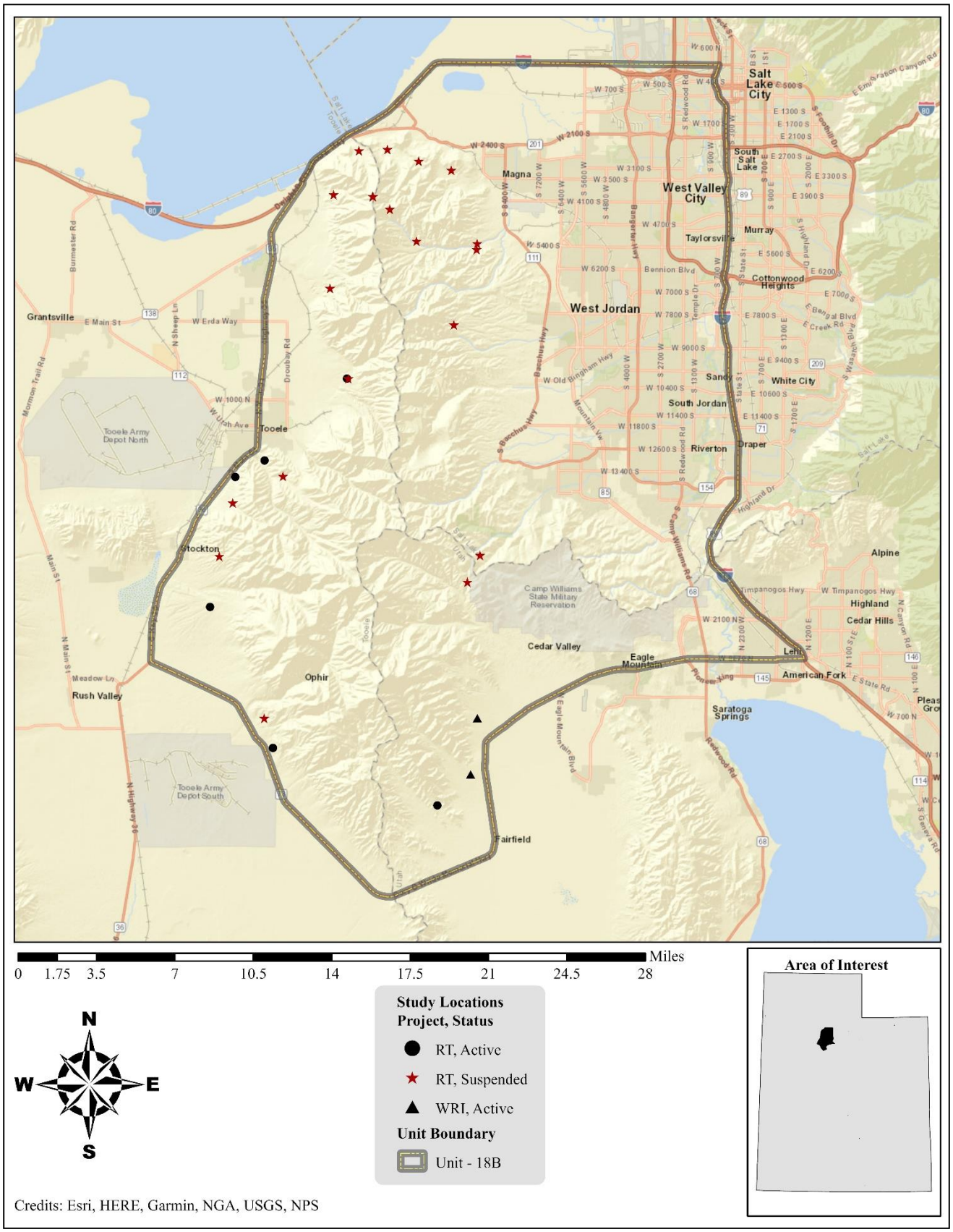
Upland (Cliffrose)

The mid-elevation study sites of the Upland (Cliffrose) ecological type are generally considered to be in very poor condition for deer winter range on the Stansbury Oquirrh-Stansbury management unit, although the Hatch Ranch site is classified as being in poor to fair condition. These studies support or supported shrub communities that provide(d) valuable browse for wildlife. Annual grasses, primarily cheatgrass and/or red brome (*Bromus tectorum* and/or *B. rubens*), are of high concern on these sites; data from previous years shows that annual grass cover has had flushes in the past. High amounts of annual grass boost fuel loads, exacerbate the risk of wildfire, and alter wildfire return intervals (Balch, D'Antonio, & Gómez-Dans, 2013). The herbaceous understory of the Salt Mountain study also contains the introduced perennial grasses species crested wheatgrass (*Agropyron cristatum*), albeit with low cover. In higher amounts, introduced

perennial grass species have the potential to be aggressive and reduce the prevalence and abundance of other, more desirable native grass and forb species (Mack, et al., 2000). Utah juniper (*Juniperus osteosperma*) is present on the Hatch Ranch and Salt Mountain studies, placing them in Phase I of woodland succession. Reduced herbaceous and shrub health is often a result of advanced encroachment, and could occur over time on these study sites if trees increase in the future (Miller, Svejcar, & Rose, 2000).

It is suggested that monitoring of these communities continue. Treatments to reduce annual grass cover such as herbicide application and changes in grazing management may be advisable in areas where annual grass flushes occur in the future. Although restoring herbaceous biodiversity may not be an immediate concern, if reseeding is deemed necessary in the future, care should be taken in species selection and preference should be given to native species whenever possible. Finally, further work to prevent and/or reduce infilling by pinyon and juniper (e.g. bullhog, chaining, lop and scatter, etc.) should begin on the Hatch Ranch and Salt Mountain studies when/if necessary; treatment methods should be selected with caution so as not to increase annual grass loads.

9. WILDLIFE MANAGEMENT UNIT 18B – OQUIRRH MOUNTAINS/STANSBURY



WILDLIFE MANAGEMENT UNIT 18B – OQUIRRH MOUNTAINS OQUIRRH-STANSBURY

Boundary Description

Salt Lake, Utah, and Tooele counties - Boundary begins at the junction of Interstates 15 and 80 in Salt Lake City; south on I-15 to SR-73; west on SR-73 to SR-36; north on SR-36 to Middle Canyon Road; east on Middle Canyon Road to the Tooele-Salt Lake county boundary; north along the Tooele-Salt Lake county boundary (Oquirrh Mountains ridge line) to Lake Point and I-80; east on I-80 to I-15 and beginning point.

Management Unit Description

Geography

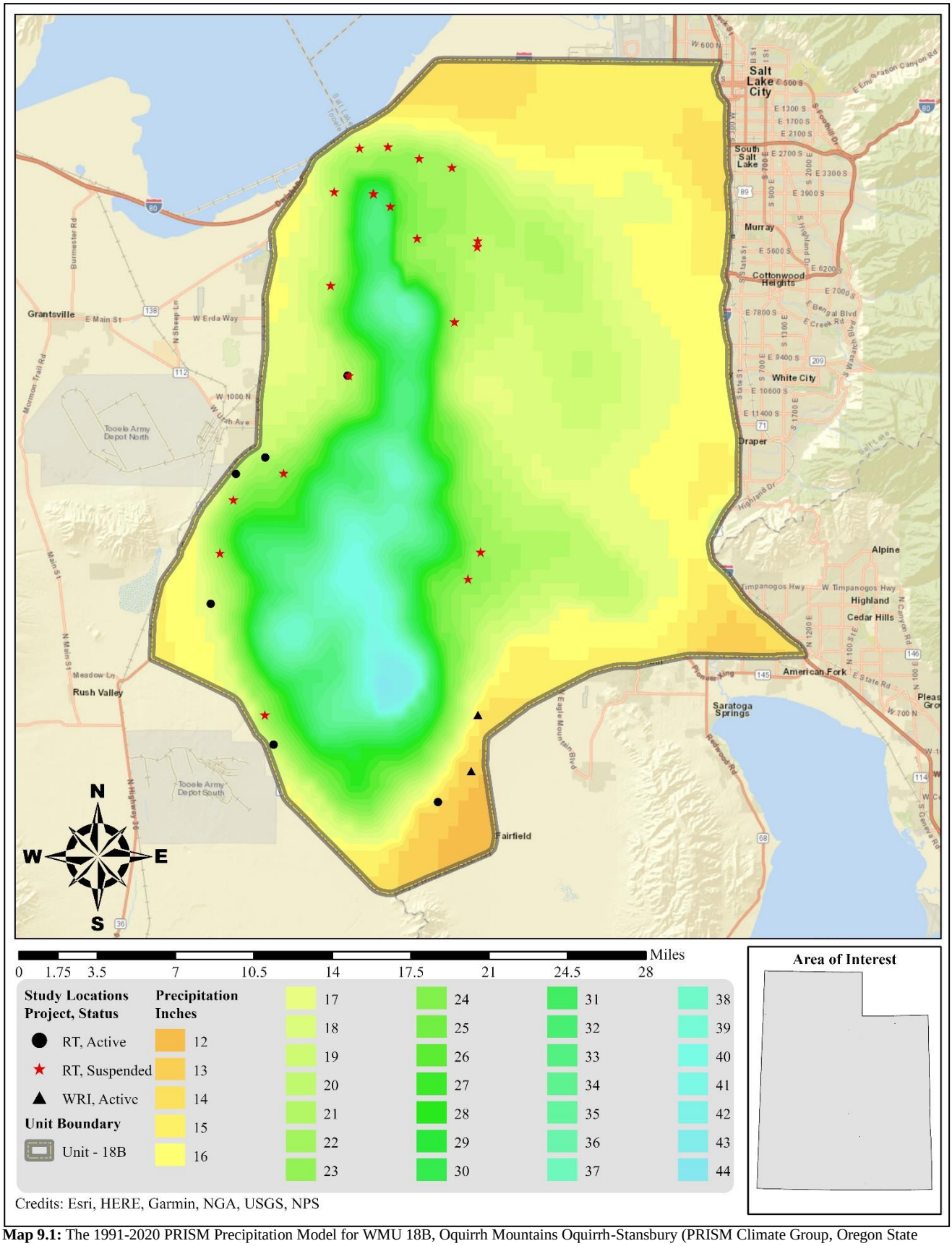
The Oquirrh Mountains Oquirrh-Stanbury management unit contains the easternmost portion of Tooele county, the western half of Salt Lake county, and the northwest corner of Utah county. This unit encompasses the Oquirrh Mountains with Tooele Valley to the west, the Great Salt Lake to the north, the Wasatch Mountains in the east, and Utah Lake and the Lake Mountains to the south. Major drainages include, but are not limited to, Soldier Creek, Ophir Creek, and West Canyon Wash. Elevation ranges from just over 4,000 feet near Salt Lake City and the surrounding area to over 10,000 feet on the peaks of the Oquirrh Mountains. Communities within the unit are numerous and include, among others, Cedar Fort and portions of Tooele, Stockton, Lehi, and Salt Lake City.

Climate Data

The 30 year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 12 inches near Fairfield to 44 inches on the southern peaks of the Oquirrh Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within 13-23 inches of precipitation (**Map 9.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the North Central division (Division 3).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought in 1992, 2000-2003, 2007, 2012-2015, 2018, and 2020-2021. The mean annual PDSI displayed moderately to extremely wet years in 1993, 1995, 1997-1998, 2005, and 2011 (**Figure 9.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought from 2001-2003, 2007, 2012-2013, 2015; and 2020-2021; moderately to extremely wet years were displayed in 1991, 1993, 1995, 1997-1998, and 2005 (**Figure 9.1b**) (Time Series Data, 2022).



Map 9.1: The 1991-2020 PRISM Precipitation Model for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury (PRISM Climate Group, Oregon State University, 2021).

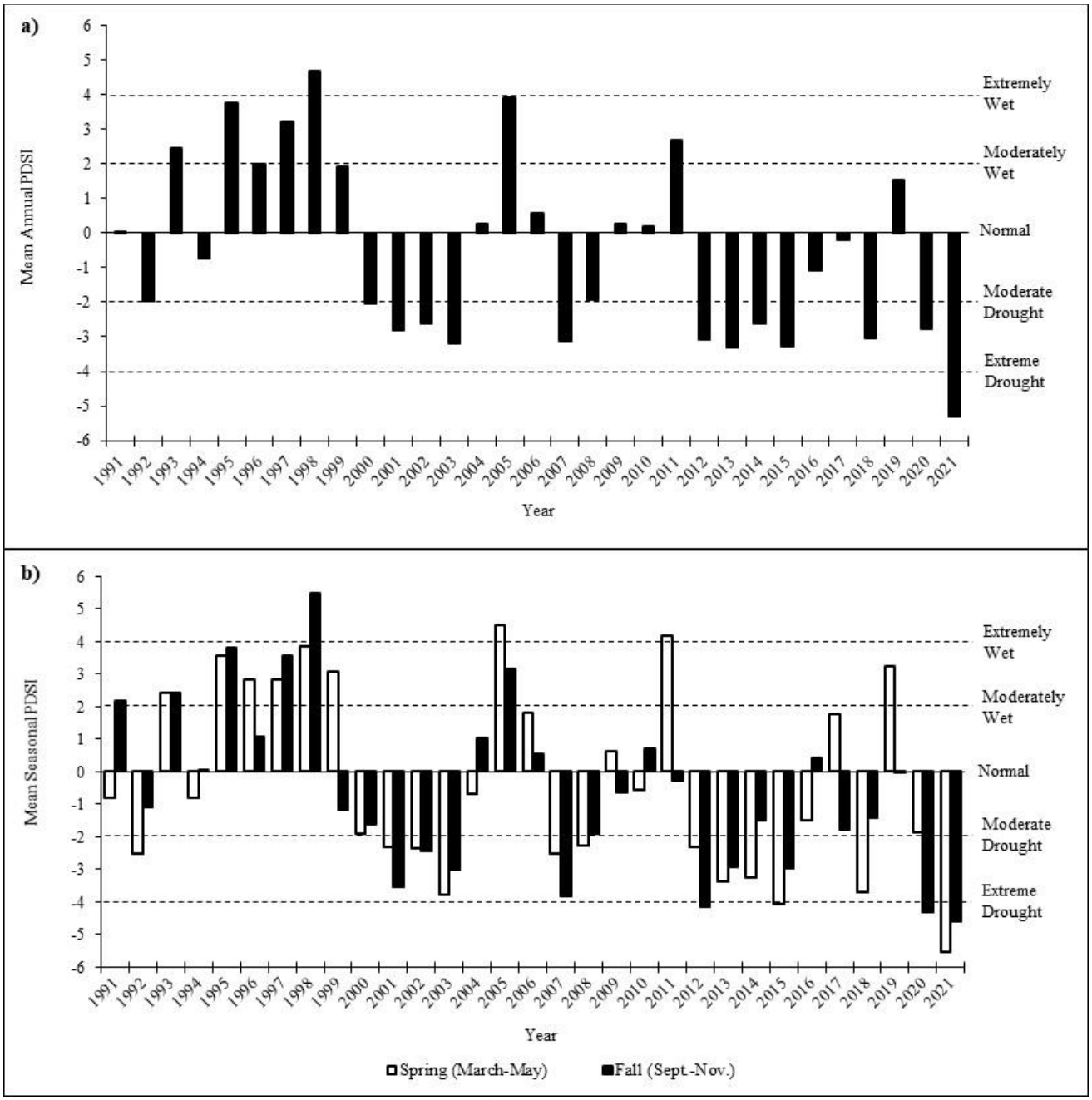
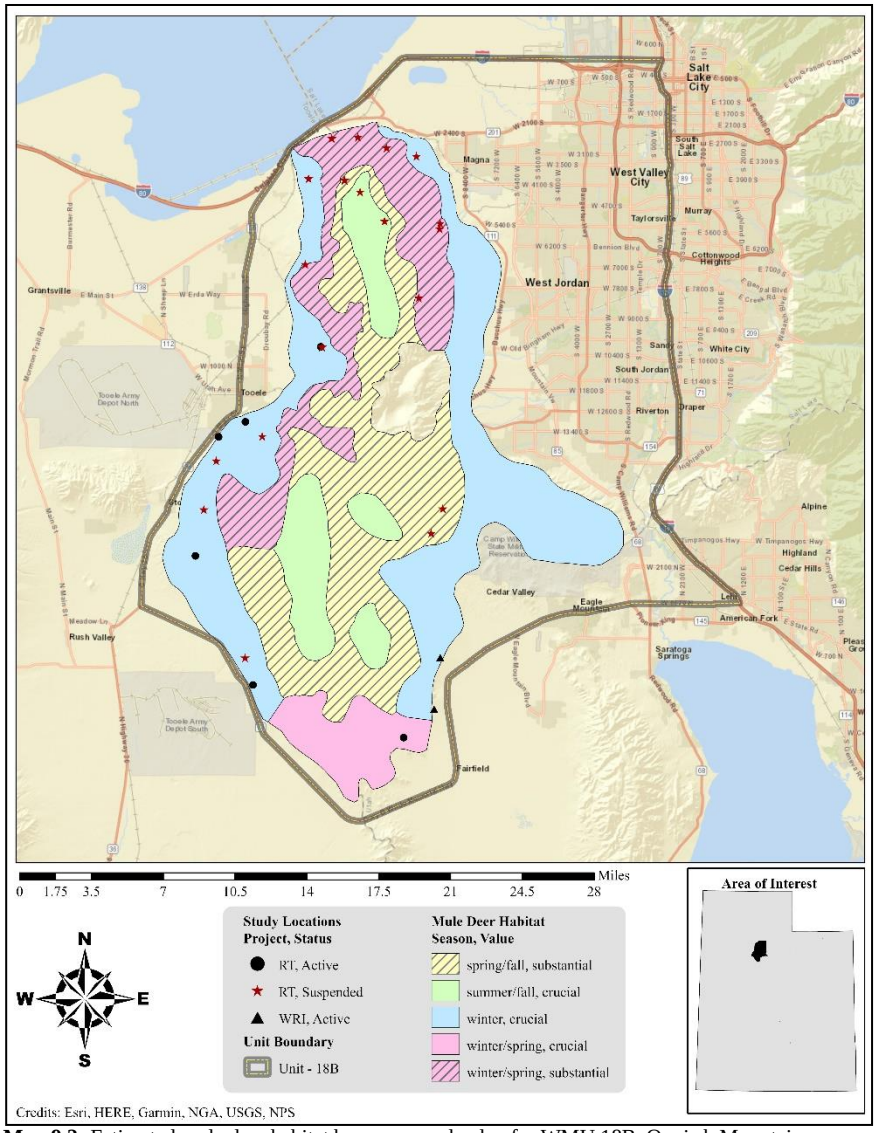


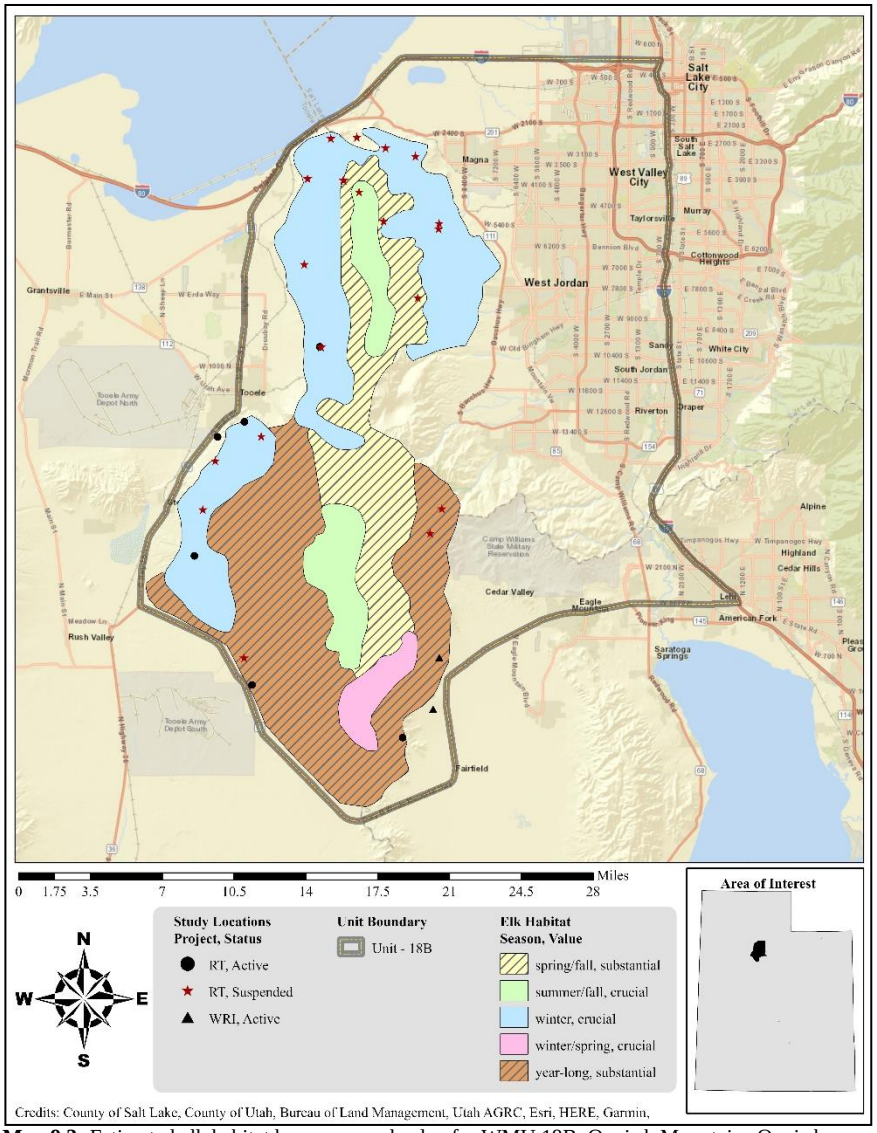
Figure 9.1: The 1991-2021 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2021. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is ≥4.0 = Extremely Wet, 3.0 to 3.9 = Very Wet, 2.0 to 2.9 = 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 -0.9 = 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. a) Mean annual PDSI. b) Mean spring (March-May) and fall (Sept.-Nov.) (Time Series Data, 2022).

Big Game Habitat

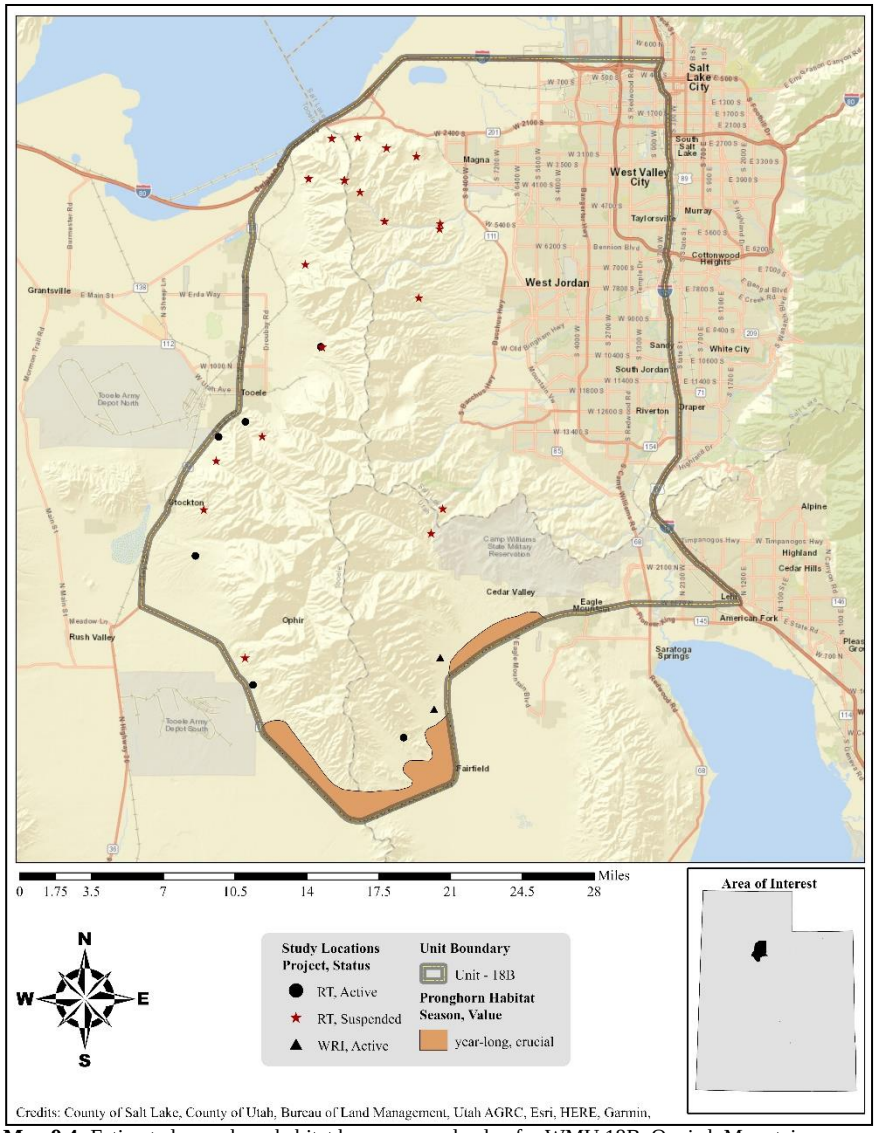
There are an estimated 216,000 acres classified as deer range on Unit 18B with 79,776 acres classified as winter range, 63,834 acres as spring/fall range, 49,291 as winter/spring range, and 24,007 acres as summer/fall range (**Table 9.1**, **Map 9.2**). Privately owned land comprises 56% of the winter range, the Bureau of Land Management (BLM) administrates 20%, 15 % is managed by the Department of Defense (DOD), the Utah School and Institutional Trust Lands Administration (SITLA) administrates 9%, and less than 1% is owned by Forestry, Fire & State Lands (FFSL). Of the spring/fall range, 70% is managed by private landowners, 25% by the BLM, 4% is owned by SITLA, and 1% is administrated by the DOD. Fifty-seven percent of the winter/spring range is privately owned, the BLM manages 36%, 7% is owned by SITLA, and less than 1% is administrated by FFSL. Finally, most (79%) of the summer/fall range is also privately owned, 18% is administrated by the BLM, and 3% is managed by SITLA (**Table 9.2**, **Map 9.2**, **Map 9.5**). Most of the year-long elk range in this unit occurs on land owned by private landowners at 49%, while the BLM manages 37%. 13% and 2% are administrated by SITLA and the DOD, respectively. A majority (64%) of elk winter range is also privately owned. In addition, the BLM administrates 39% while 6% is managed by SITLA (**Table 9.3**, **Map 9.3**, **Map 9.5**).



Map 9.2: Estimated mule deer habitat by season and value for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.



Map 9.3: Estimated elk habitat by season and value for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.



Map 9.4: Estimated pronghorn habitat by season and value for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

	Year Long Range		Summer/Fall Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Species	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
Mule Deer	0	0%	24,007	11%	79,776	37%	49,291	23%	63,834	29%
Elk	66,819	36%	16,709	9%	57,985	32%	5,949	3%	36,592	20%
Pronghorn	11,653	100%	0	0%	0	0%	0	0%	0	0%

Table 9.1: Estimated mule deer, elk, and pronghorn habitat acreage by season for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

	Summer/Fall Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*
BLM	4,392	18%	15,179	20%	17,698	36%	15,837	25%
Private	18,902	79%	44,427	56%	28,297	57%	44,677	70%
SITLA	712	3%	8,096	10%	3,270	7%	2,399	4%
FFSL	0	0%	23	<1%	25	<1%	0	0%
DOD	0	0%	12,051	15%	0	0%	921	1%
Total	24,007	**100%**	79,776	**100%**	49,291	**100%**	63,834	**100%**

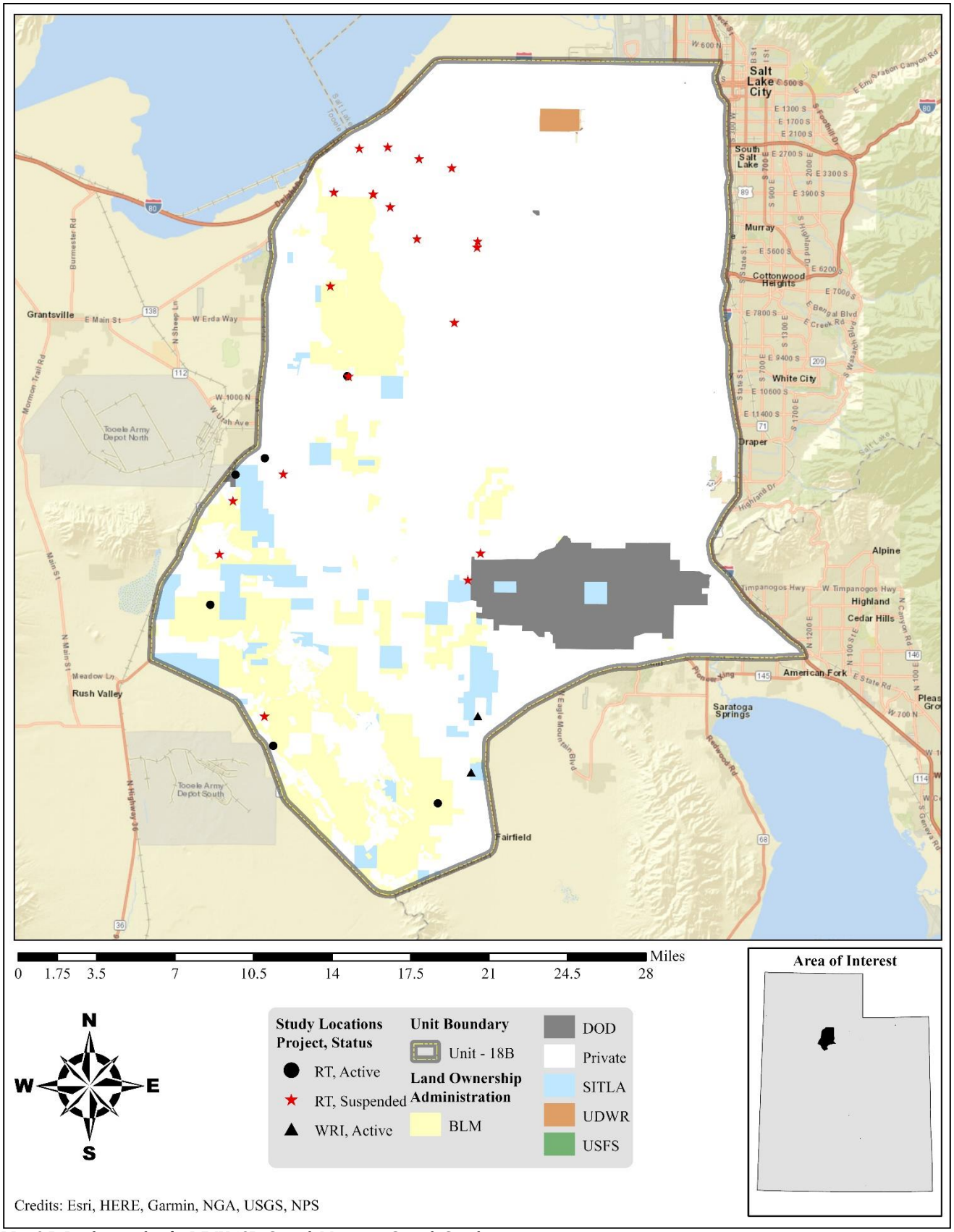
Table 9.2: Estimated mule deer habitat acreage by season and ownership for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

	Year Long Range		Summer/Fall Range		Winter Range		Winter/Spring Range		Spring/Fall Range	
Ownership	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (acres)*	*%*	*Area (Acres)*	*%*
BLM	24,441	37%	2,388	14%	17,350	30%	2,320	39%	5,336	15%
Private	32,468	49%	13,546	81%	37,044	64%	3,348	56%	30,447	83%
SITLA	8,566	13%	774	5%	3,591	6%	281	5%	808	2%
DOD	1,345	2%	0	0%	0	0%	0	0%	0	0%
Total	66,819	**100%**	16,709	**100%**	57,985	**100%**	5,949	**100%**	36,592	**100%**

Table 9.3: Estimated elk habitat acreage by season and ownership for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

	Year Long Range	
Ownership	*Area (acres)*	*%*
BLM	2,891	25%
Private	8,219	70%
SITLA	543	5%
UDOT	<1	<1%
Total	11,653	**100%**

Table 9.4: Estimated pronghorn habitat acreage by season and ownership for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.



Map 9.5: Land ownership for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Developed	210,996	22.97%	
	Agricultural	131,924	14.36%	
	Open Water	77,962	8.49%	
	Sparsely Vegetated	39,963	4.35%	
	Hardwood	31,886	3.47%	
	Riparian	23,060	2.51%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	12,020	1.31%	
	Conifer-Hardwood	3,381	0.37%	57.82%
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	106,755	11.62%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	41,840	4.55%	
	Inter-Mountain Basins Montane Sagebrush Steppe	21,012	2.29%	
	Great Basin Xeric Mixed Sagebrush Shrubland	8,944	0.97%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	8,646	0.94%	
	Inter-Mountain Basins Greasewood Flat	7,683	0.84%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	6,693	0.73%	
	Great Basin Semi-Desert Chaparral	4,242	0.46%	
	Other Shrubland	3,331	0.36%	
	Rocky Mountain Lower Montane-Foothill Shrubland	1,086	0.12%	
	Inter-Mountain Basins Big Sagebrush Steppe	733	0.08%	
	Inter-Mountain Basins Mat Saltbush Shrubland	30	0.00%	22.97%
Conifer	Great Basin Pinyon-Juniper Woodland	54,517	5.93%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	11,564	1.26%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	10,193	1.11%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	4,344	0.47%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	2,567	0.28%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	2,018	0.22%	
	Colorado Plateau Pinyon-Juniper Woodland	1,271	0.14%	
	Inter-Mountain Basins Juniper Savanna	388	0.04%	
	Other Conifer	355	0.04%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	285	0.03%	
	Southern Rocky Mountain Ponderosa Pine Woodland	18	0.00%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	11	0.00%	9.53%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	33,614	3.66%	
	Interior West Ruderal Riparian Scrub	6,681	0.73%	
	Interior Western North American Temperate Ruderal Shrubland	1,356	0.15%	
	Interior West Ruderal Riparian Forest	78	0.01%	4.54%
Exotic Herbaceous	Great Basin & Intermountain Introduced Annual Grassland	14,489	1.58%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	8,814	0.96%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	5,304	0.58%	
	Interior Western North American Temperate Ruderal Grassland	3,836	0.42%	3.53%
Grassland	Southern Rocky Mountain Montane-Subalpine Grassland	10,162	1.11%	
	Inter-Mountain Basins Semi-Desert Grassland	3,762	0.41%	
	Other Grassland	432	0.05%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	394	0.04%	1.61%
Total		**918,637**	**100%**	**100%**

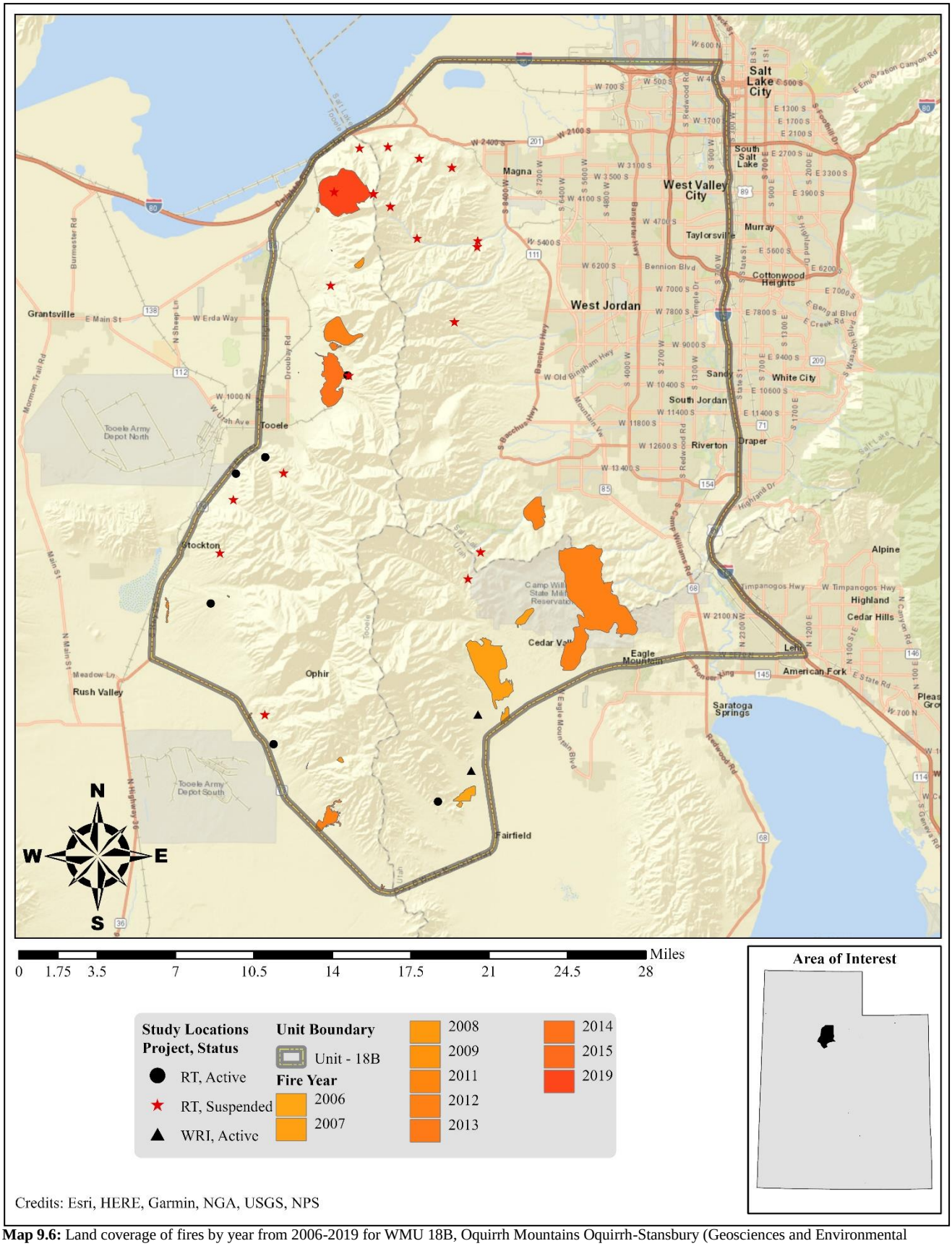
Table 9.5: LANDFIRE Existing Vegetation Coverage (LANDFIRE.US_140EVT, 2020) for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

Limiting Factors to Big Game Habitat

One of the major limiting factors in this management unit is habitat degradation and loss. Mining is a major human activity in the area, and the Bingham Canyon Open Pit Copper Mine is located on the eastern face of the Oquirrh Mountains. According to the current Landfire Existing Vegetation Coverage models, 23% of the Oquirrh Mountains Oquirrh-Stansbury subunit is developed, while 14% is used for agriculture. Other limiting factors include (but are not limited to) summer range availability and winter range forage condition. Continued range monitoring could maintain and protect ranges from further habitat loss and deterioration. Cooperation between federal, state, local governments, and private landowners could assist in maintaining and preserving crucial habitat through agreements with land management agencies, the use of conservation easements and the like on private lands, planning and evaluating resource use and developments that might affect habitat quality, and developing specific vegetation objectives to maintain the quality of important deer use areas. In addition, forage production could be maintained or improved through direct range improvements such as reseedings, controlled burns, water developments, tree removal, etc.

At an estimated 6% land coverage, pinyon and juniper woodland communities may pose a threat by encroaching on crucial sagebrush shrublands (Miller, Svejcar, & Rose, 2000). In addition, the Landfire Existing Vegetation Coverage model estimates that nearly 1.6% of the unit is comprised of annual grasslands (**Table 9.5**). More specifically, the presence of cheatgrass on many study sites in this unit may limit effective recruitment of desirable species and increase fire frequency (Balch, D'Antonio, & Gómez-Dans, 2013).

Finally, deer fences and crossings limiting range are a concern, but cooperation with the Utah Department of Transportation in constructing highway fences, passage structures, warning signs, etc. will continue in order to ensure proper access to habitat as well as deer and human safety.



Map 9.6: Land coverage of fires by year from 2006-2019 for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2021).

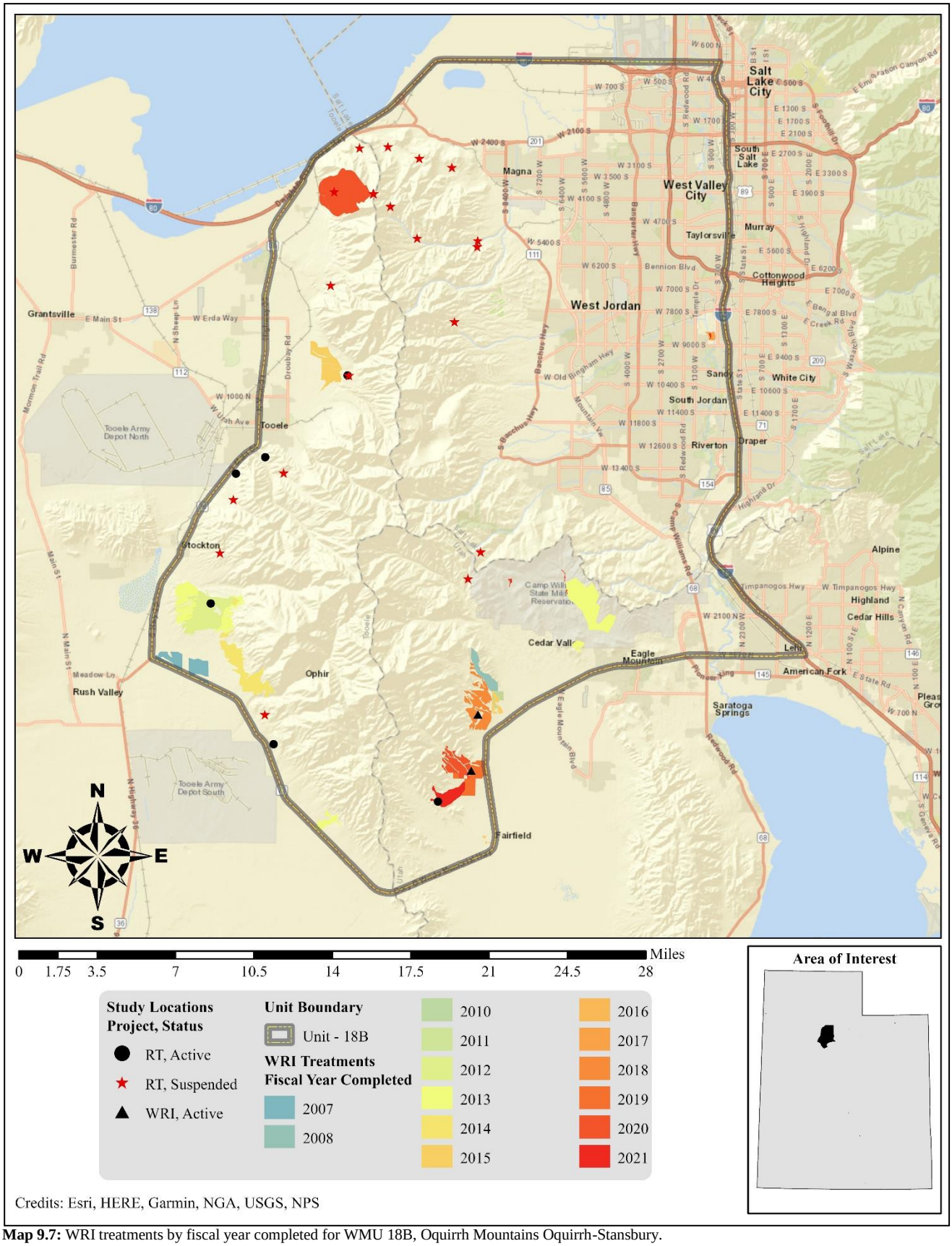
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 13,037 acres of land have been treated within the Oquirrh Mountains Oquirrh-Stansbury unit since the WRI was implemented in 2004 (**Map 9.7**). There are currently 487 acres being treated, and treatments frequently overlap one another bringing the total completed treatment acres to 12,923 acres for this unit (**Table 9.6**). 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.

Bullhog use to remove twoneedle pinyon and Utah juniper is the most common management practice in this unit. Seeding to supplement the herbaceous and shrub understory and herbicide application to remove weeds are also very common. Other management practices include anchor chaining and hand crews to remove pinyon and juniper and other similar vegetation removal techniques (**Table 9.6**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**1,119**	**0**	**0**	**1,119**
Ely (One-Way)	1,119	0	0	1,119
Bullhog	**4,439**	**0**	**0**	**4,439**
Full Size	4,439	0	0	4,439
Chain Harrow	**138**	**0**	**0**	**138**
>15 ft. (One-Way)	138	0	0	138
Disc	**839**	**0**	**0**	**839**
Off-Set (One-Way)	815	0	0	815
Off-Set (Two-Way)	23	0	0	23
Herbicide Application	**1,511**	**<1**	**0**	**1,511**
Aerial (Fixed-Wing)	1,230	<1	0	1,230
Aerial (Helicopter)	66	0	0	66
Ground	215	0	0	215
Interseeding	**30**	**0**	**0**	**30**
Planting/Transplanting	17	**0**	**0**	17
Other	17	0	0	17
Seeding (Primary)	**4,611**	**487**	**0**	**5,098**
Broadcast (Aerial-Fixed Wing)	3,959	487	0	4,446
Broadcast (Aerial-Helicopter)	122	0	0	122
Drill (Rangeland)	397	0	0	397
Ground (Mechanical Application)	132	0	0	132
Vegetation Removal/Hand Crew	**334**	**0**	**0**	334
Lop (No Scatter)	13	0	0	13
Lop & Scatter	322	0	0	322
Grand Total	**13,037**	**487**	**0**	**13,525**
***Total Land Area Treated**	**12,923**	**487**	**0**	**13,410**

Table 9.6: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury. Data accessed on 02/09/2022. *Does not include overlapping treatments.



Map 9.7: WRI treatments by fiscal year completed for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

Range Trend Studies

Range Trend studies have been sampled within WMU 18B on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 9.7**). Due to changes in sampling methodologies, only data collected following the 1992 sample year is included in this summary. Monitoring studies of WRI projects began in 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 9.8**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
18B-1	Barney Canyon	RT	Suspended	1983	Not Verified
18B-2	City Canyon	RT	Suspended	1983	Not Verified
18B-3	Manning Canyon	RT	Active	1983, 1990, 1997, 2002, 2007, 2012, 2016, 2021	Upland Gravelly Loam (Wyoming Big Sagebrush)
18B-4	Silverado Canyon	RT	Suspended	1983, 1989, 1997	Not Verified
18B-5	Big Dip Gulch	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2016, 2021	Upland Shallow Loam (Black Sagebrush)
18B-6	South of Soldier Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
18B-7	Calumet Mine	RT	Suspended	1983, 1989, 1997	Not Verified
18B-8	Silcox Canyon	RT	Suspended	1983, 1989	Not Verified
18B-9	Left Fork Settlement Canyon	RT	Suspended	1983, 1989, 1997	Not Verified
18B-10	Bates Canyon	RT	Suspended	1983, 1989, 1997	Not Verified
18B-11	Rose Canyon	RT	Suspended	1983	Not Verified
18B-12	Coon Canyon	RT	Suspended	1983, 1990	Not Verified
18B-13	Kressler Peak	RT	Suspended	1990	Not Verified
18B-14	Little Valley	RT	Suspended	1990, 1997	Not Verified
18B-15	Upper Kessler	RT	Suspended	1990, 1997, 2002, 2007	Not Verified
18B-16	Smelter	RT	Suspended	1990	Not Verified
18B-17	Deadman	RT	Suspended	1990	Not Verified
18B-18	Hogback	RT	Suspended	1990	Not Verified
18B-19	Black Rock West	RT	Suspended	1990, 1997, 2002	Not Verified
18B-20	Black Rock East	RT	Suspended	1990, 1997, 2002, 2007	Not Verified
18B-21	Black Rock Canyon	RT	Suspended	1990, 1997	Not Verified
18B-22	Rodgers Canyon	RT	Suspended	1990, 1997	Not Verified
18B-31	Carr Fork	RT	Suspended	1997, 2002, 2007	Not Verified
18B-34	Three O'Clock	RT	Active	2002, 2007, 2012, 2016, 2021	Upland Stony Loam (Bonneville Big Sagebrush)
18B-35	Settlement Canyon Reservoir	RT	Active	2002, 2007, 2012, 2016, 2021	Upland Stony Loam (Mountain Big Sagebrush)
18B-36	Carr Fork 2	RT	Active	2012, 2016, 2021	Mountain Stony Loam (Antelope Bitterbrush)
18R-10	Cedar Fort Bench	WRI	Active	2016, 2019	Upland Stony Loam (Wyoming Big Sagebrush)
18R-11	South of Cedar Fort	WRI	Active	2018, 2021	Upland Gravelly Loam (Bonneville Big Sagebrush)

Table 9.7: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
18B-3	Manning Canyon	Aerial	Pole Canyon Fire Rehabilitation	November 2020	487	5482
		Wildfire	Pole Canyon Fire	July 2020	487	
18B-6	South of Soldier Canyon	Broadcast	Russell Seeding-Browse	October 1968	1,300	LTDL
		Two-Way Ely Chain	Russell Chaining	September-October 1968	1,300	LTDL
		Aerial Before	Russell Seeding	September-October 1968	1,300	LTDL
		Bullhog	Stockton Bullhog	January-May 2012	1,561	1929
		Transplant	Stockton Bullhog	April 2012		1929
18B-34	Three O'Clock	Wildfire		Late 1980s		
18B-36	Carr Fork 2	Unknown		Fall 1986-Spring 1987		
		Rangeland Drill		Fall 1986-Spring 1987		
		Transplant		2002		
18R-10	Cedar Fort Bench	Plateau	Cedar Fort Chaining	September 2017	527	3662
		Aerial Before	Cedar Fort Chaining	October 2016	1,028	3662
		Two-Way Ely	Cedar Fort Chaining	October-December 2016	1,028	3662
		Dribbler After	Cedar Fort Chaining	October-December 2016	1,028	3662
		Aerial After	Cedar Fort Chaining	December 2016	1,028	3662
18R-11	South of Cedar Fort	Bullhog	Cedar Fort PJ Removal Phase 2	Fall 2018	703	4524
		Aerial Before	Cedar Fort PJ Removal Phase 2	September 2018	703	4524

Table 9.8: Range Trend and WRI studies known disturbance history for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod & Welty, Land Treatment Digital Library: U.S. Geological Survey Data Series 806., 2013).

Study Trend Summary (Range Trend)

Mountain (Shrub)

One study site [Carr Fork 2 (18B-36)] is classified as a Mountain (Shrub) ecological site: this study site is located north of Pine Creek and west of Leavetts Canyon (**Table 9.7**).

Shrubs/Trees: Antelope bitterbrush is the sole preferred browse species present on this study site and cover decreased from 26% to 12% between the 2012 and 2021 sample years. The only additional shrub species, broom snakeweed (*Gutierrezia sarothrae*), was observed for the first time in 2021 (**Figure 9.2**). Density of preferred browse species has increased over time. Mature individuals have been the dominant demographic in the population in all years. However, the number of decadent individuals has also increased, nearly doubling between 2016 and 2021. Recruitment of young has decreased, and there were no young plants observed in 2021 (**Figure 9.8**). Utilization of preferred browse increased between 2016 and 2021, but has decreased overall; 26.5% and 3% of plants were moderately and heavily used, respectively, in the most recent sample year (**Figure 9.10**).

Trees have not been recorded on this site and therefore will not be discussed in this section (**Figure 9.4**, **Figure 9.6**).

Herbaceous Understory: The herbaceous understory on this study has fluctuated in quantity and composition in each sample year. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) was the dominant component in 2012, but has since decreased in cover and frequency. Other perennial grasses and forbs were co-dominant in 2016, and perennial grasses were the sole dominant component in 2021. However, much of the cover was contributed by introduced grass species, such as intermediate wheatgrass (*Thinopyrum intermedium*) and orchardgrass (*Dactylis glomerata*); and forbs that are considered to be noxious weeds such as whitetop (*Cardaria draba*), field bindweed (*Convolvulus arvensis*), and Dalmatian toadflax (*Linaria dalmatica*) (**Figure 9.12**, **Figure 9.14**).

Occupancy: Average pellet transect data indicates that animal occupancy has increased over the sample years; no pellet groups were recorded in transect data in 2016. Deer, however, have been the sole occupants with a mean abundance of pellet groups of 13 days use/acre and 21 days use/acre in 2012 and 2021, respectively (**Figure 9.16**).

Upland (Big Sagebrush)

Four studies [Manning Canyon (18B-3), South of Soldier Canyon (18B-6), Three O'Clock (18B-34), and Settlement Canyon Reservoir (18B-35)] are considered to be Upland (Big Sagebrush) ecological sites. The Manning Canyon study is located in Manning Canyon, west of State Route 73. South of Soldier Canyon is situated south of Soldier Canyon and Soldier Creek, while Three O'Clock is found south of Tooele. Finally, the Settlement Canyon Reservoir study is located on a slope just northeast of Settlement Canyon Reservoir (**Table 9.7**).

Shrubs/Trees: The primary browse species on these study sites is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*); the exception to this is the Manning Canyon study, on which Wyoming big sagebrush (*A. tridentata* ssp.

wyomingensis) is the most abundant preferred browse species. Other browse species such as rubber rabbitbrush (*Ericameria nauseosa* ssp. *nauseosa* var. *speciosa*) are present on certain sites to a lesser extent. Average shrub cover has decreased overall since 2007, largely due to a decrease in sagebrush cover. The precipitous decrease in shrub cover between 2016 and 2021 is due to decreases on all four study sites. Furthermore, the decreasing trend was most apparent on the Manning Canyon site, which (as of 2021) had all shrub cover removed by the 2020 Pole Canyon Fire (**Figure 9.3**). Average preferred browse demographics indicate that total density has decreased over time; the decrease between 2016 and 2021 is again largely due to the Manning Canyon study. Mature plants have comprised a majority of the populations on these sites in most sample years. However, decadence has increased overall while the number of mature plants has decreased, and decadent individuals were a co-dominant demographic in 2021. Recruitment has remained very low in comparison, but did increase very marginally between 2016 and 2021 (**Figure 9.9**). Average preferred utilization has fluctuated from year to year. Over half of plants were moderately or heavily browsed in 2002, 2007, 2012, and 2016. However, a majority of the preferred browse plants showed signs of little to no use in 1997 and 2021 (**Figure 9.11**).

Tree cover and density have decreased overall, with Utah juniper (*Juniperus osteosperma*) as the most abundant tree species. These trends are entirely driven by the Manning Canyon and South of Soldier Canyon studies, as no trees were recorded on Three O'Clock or Settlement Canyon Reservoir in any sample year (**Figure 9.5**, **Figure 9.7**).

Herbaceous Understory: The herbaceous understories of these studies have exhibited overall increases in cover, but have decreased overall in nested frequency; the initial increases between 1997 and 2002 are at least in part due to the addition of the Three O'Clock and Settlement Canyon Reservoir studies. Perennial grasses have contributed the most cover of any single understory component in most sample years, and have generally been composed of native species such as bluebunch wheatgrass (*Pseudoroegneria spicata*). The cover of the introduced perennial grass bulbous bluegrass (*Poa bulbosa*) has fluctuated over time, and it was the dominant herbaceous component in 2002 and 2021: this trend is almost entirely due to the Three O'Clock and Settlement Canyon Reservoir studies (**Figure 9.13**, **Figure 9.15**).

Occupancy: Average pellet transect data indicates that animal occupancy has fluctuated over time, but has decreased overall. Deer have been the primary occupants in all sample years, with pellet groups having a mean abundance ranging from 17 days use/acre in 2012 to 60 days use/acre in 2007. Elk have also occupied this study site, with average pellet group abundance as low as 1 days use/acre in 2012 and as high as 21 days use/acre in 2007. Finally, mean abundance of cattle pellet groups has ranged from 0 days use/acre in 2012 to 3 days use/acre in 2002 (**Figure 9.17**).

Upland (Black/Low Sagebrush)

One study [Big Dip Gulch (18B-5)] is classified as an Upland (Black/Low Sagebrush) ecological site: this study site is located north of West Dip Gulch and just east of State Route 73 (**Table 9.7**).

Shrubs/Trees: The primary browse species on this study site is black sagebrush (*Artemisia nova*) which has decreased in cover overall; Stansbury cliffrose (*Purshia stansburiana*) provided the only other preferred browse cover for the first time in 2021 (**Figure 9.3**). Average preferred browse demographic data shows that total density has exhibited an overall decrease. Mature sagebrush plants have been the primary component of the sagebrush population in most sample years. However, decadence has increased over time, and in 2021 decadent individuals were the primary demographic on the Big Dip Gulch site. Recruitment of young has decreased (**Figure 9.9**). Preferred browse utilization has fluctuated from year to year and was particularly significant in 2012 and 2016, but has decreased overall. In 2021, 26% of plants were moderately used and less than 1% showed signs of heavy utilization (**Figure 9.11**).

Both tree cover and point-quarter density were not recorded in 2007, but have since increased with Utah juniper (*Juniperus osteosperma*) as the most abundant tree species, although singleleaf pinyon (*Pinus monophylla*) has also been present (**Figure 9.5**, **Figure 9.7**). Furthermore, site-level data shows that juniper has been present in density strip measurements in all sample years.

Herbaceous Understory: Perennial grasses such as Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) contribute the most cover of any herbaceous component and have increased overall; nested frequency has fluctuated, but has been decreased in total. Although cover has remained low, frequency values reveal that annual grasses and forbs have also been abundant in fluctuating amounts from year to year. Perennial forbs have remained rare (**Figure 9.13**, **Figure 9.15**).

Occupancy: Animal occupancy has fluctuated over time with a slight long-term increase; deer have been the sole occupants in all sample years with mean abundance of pellet groups ranging from 25 days use/acre in 2012 to 62 days use/acre in 2007 (**Figure 9.17**).

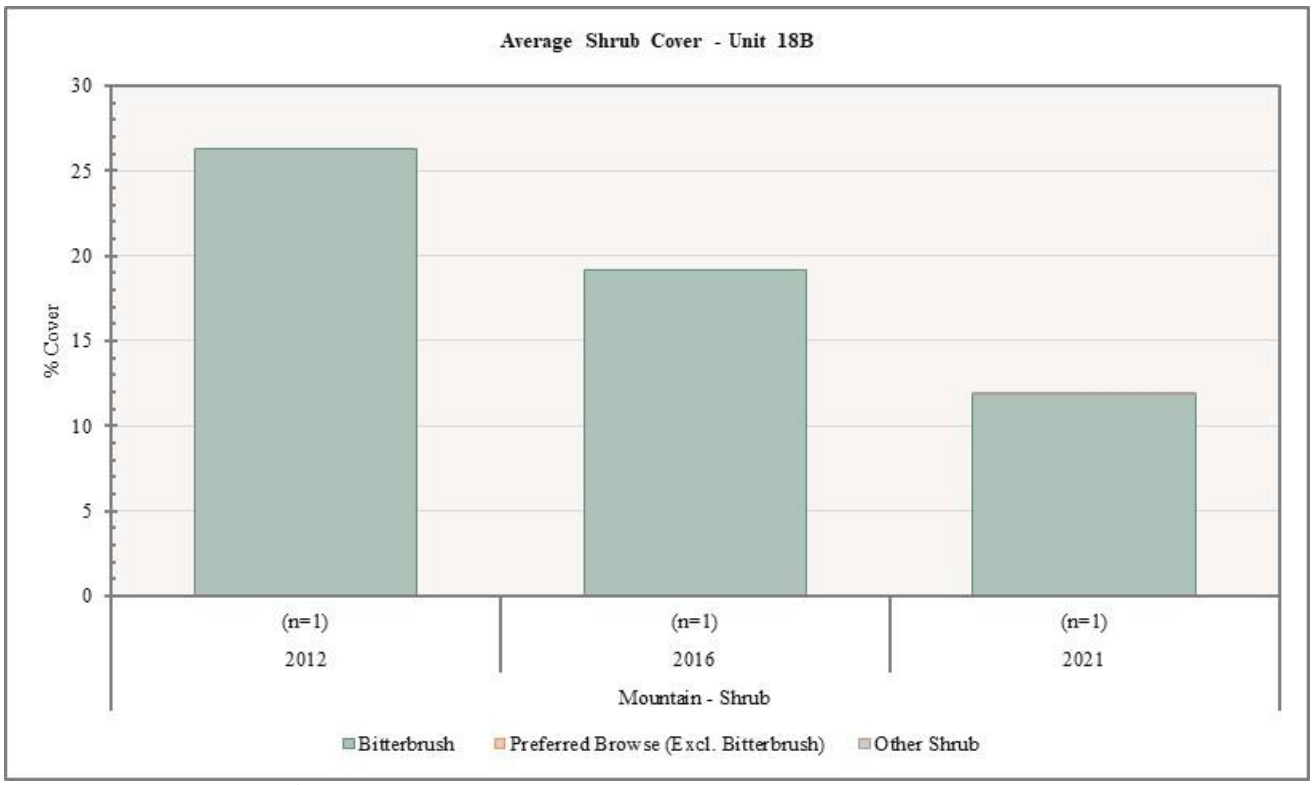


Figure 9.2: Average shrub cover for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

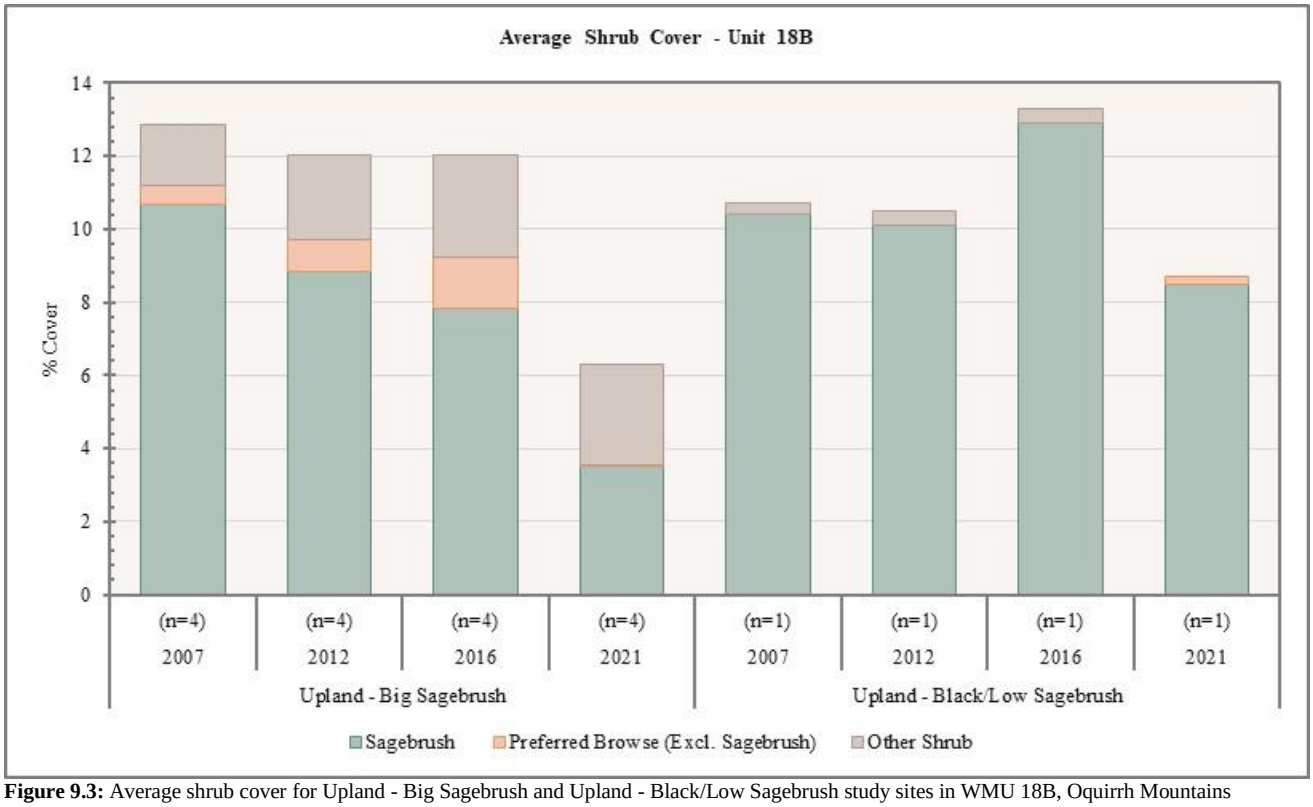


Figure 9.3: Average shrub cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

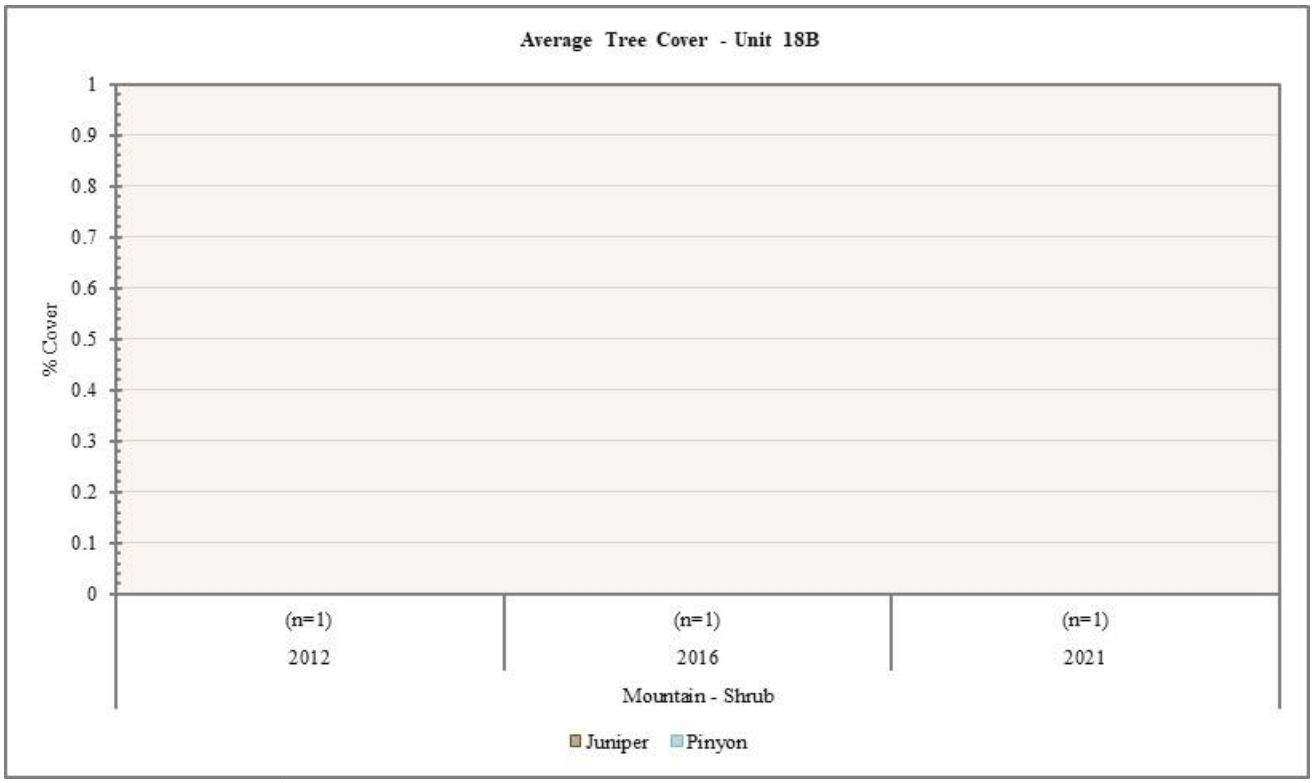


Figure 9.4: Average tree cover for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

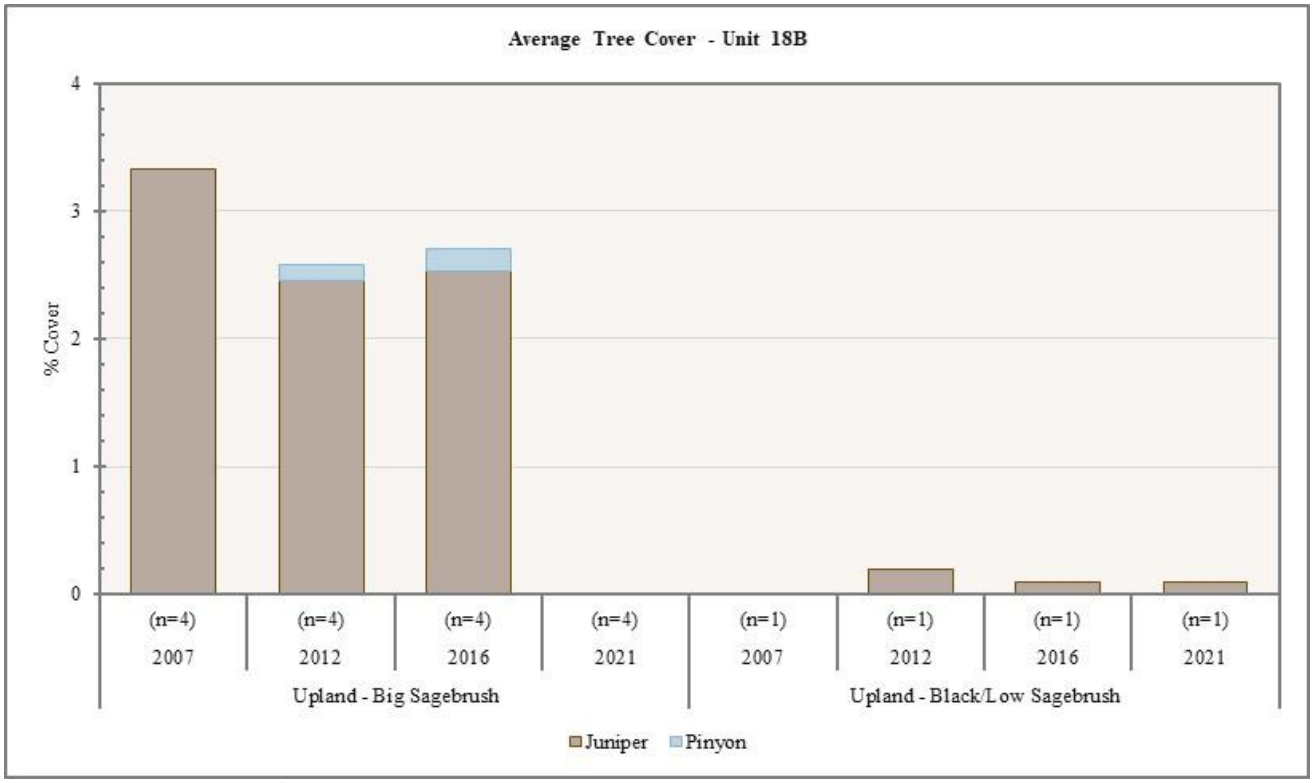


Figure 9.5: Average tree cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

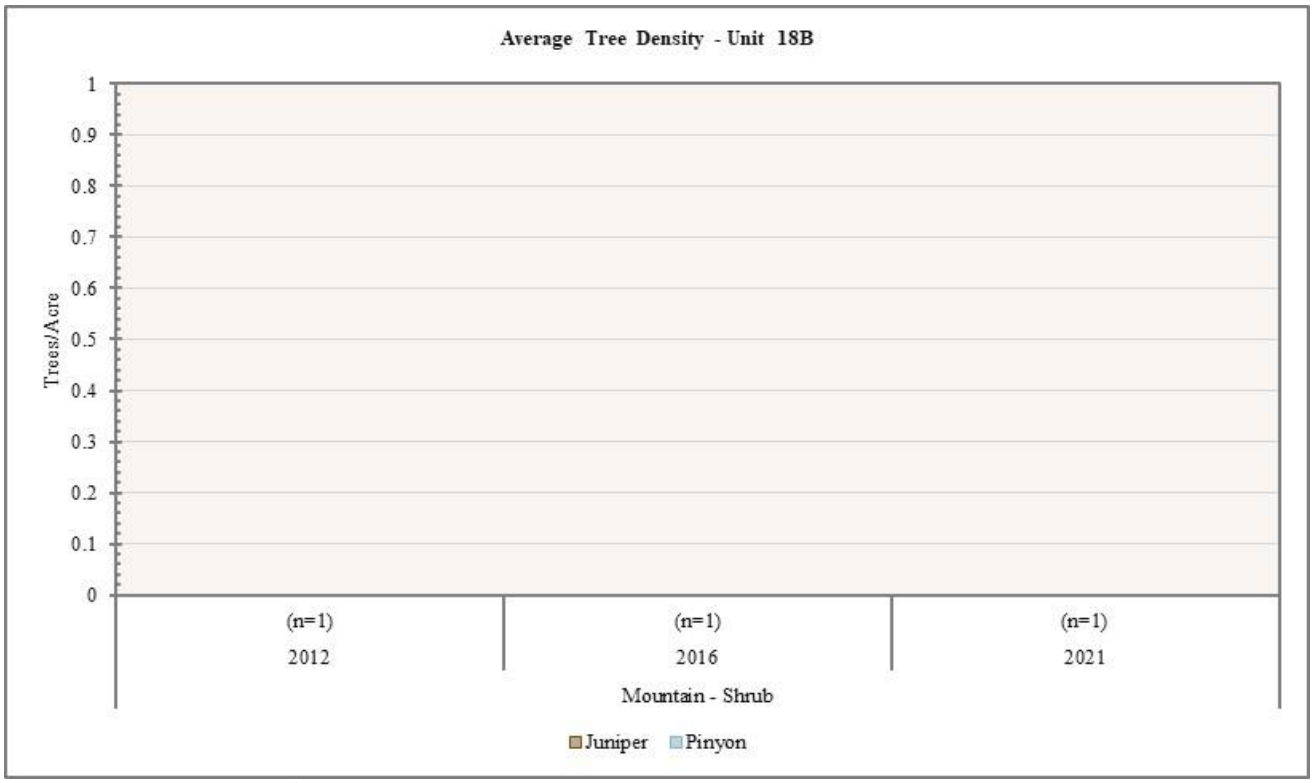


Figure 9.6: Average tree density for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

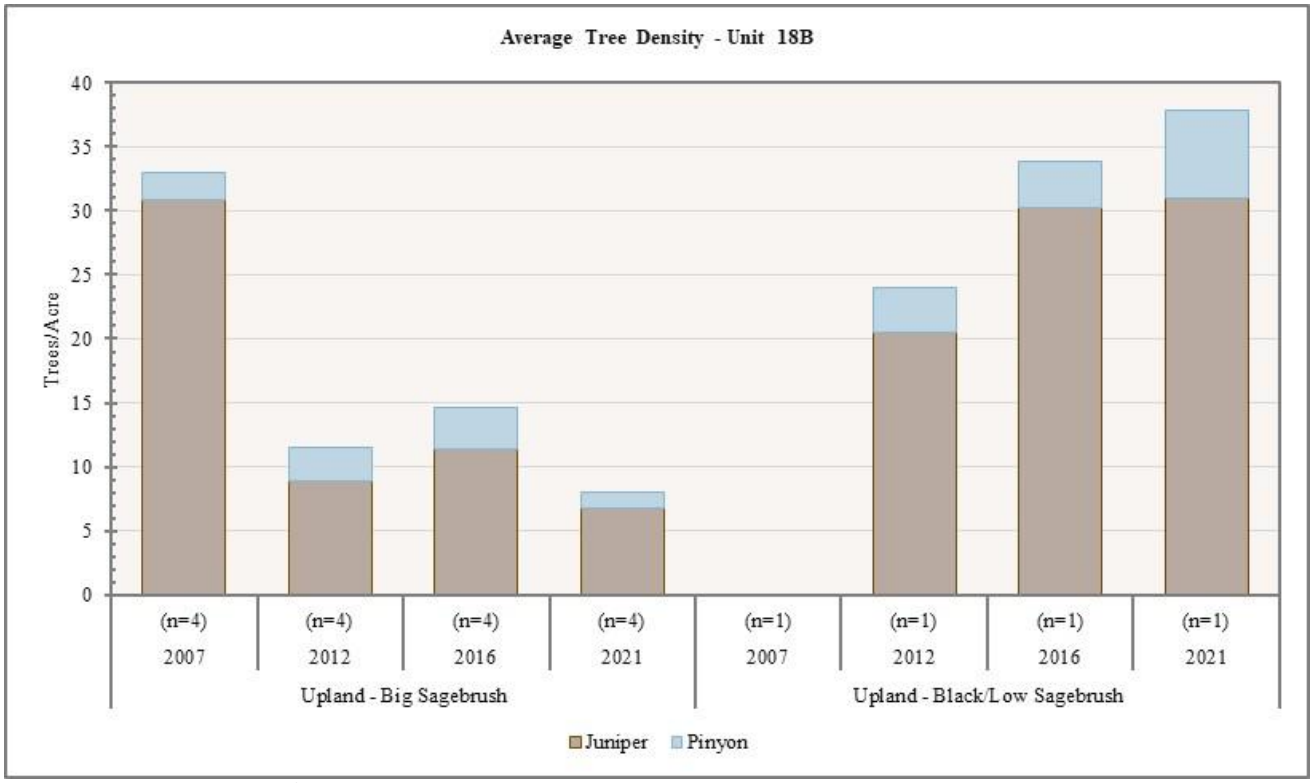


Figure 9.7: Average tree density for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

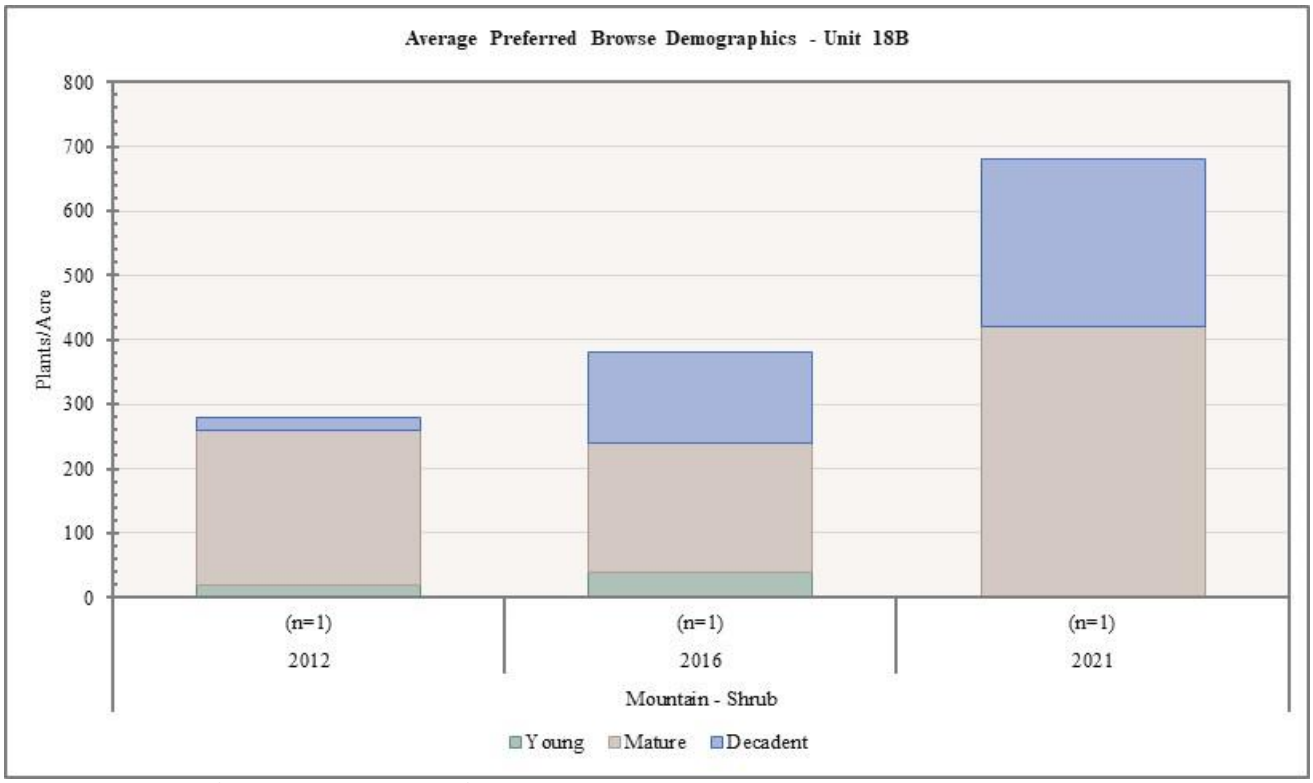


Figure 9.8: Average preferred browse demographics for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

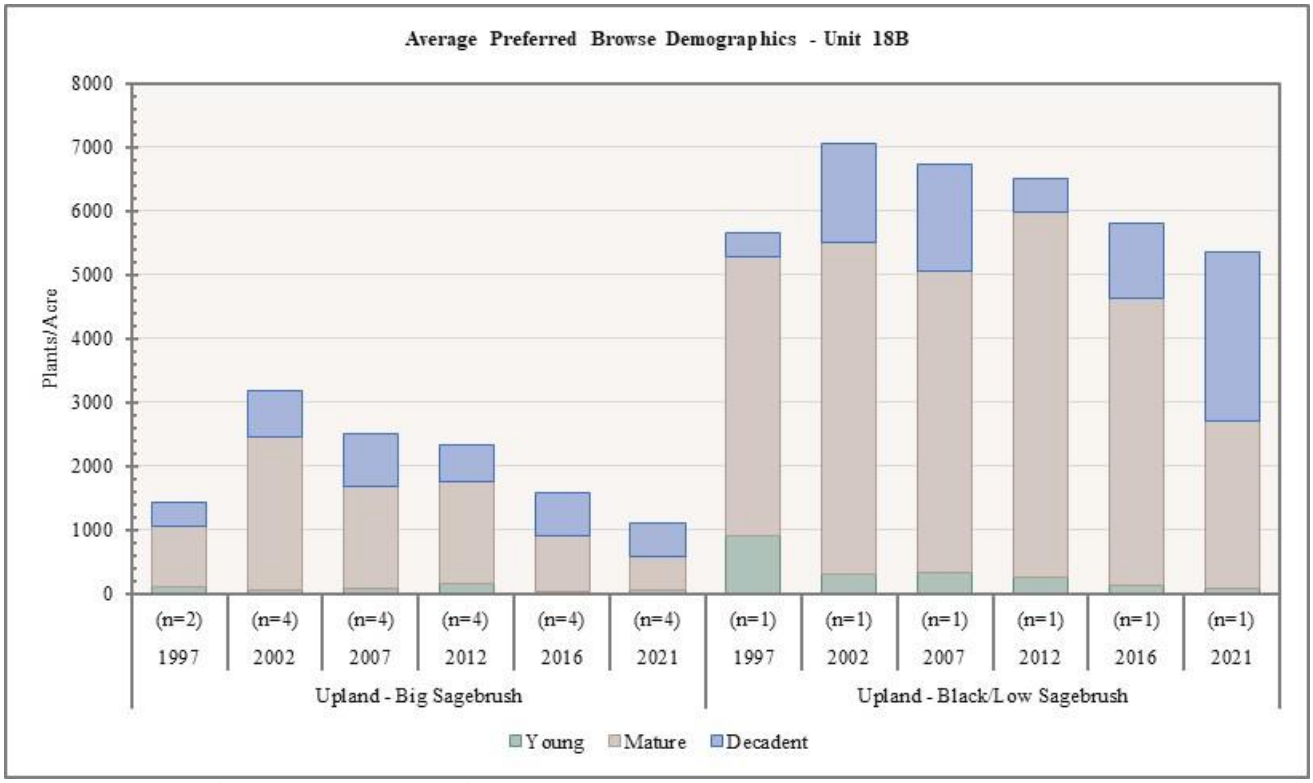


Figure 9.9: Average preferred browse demographics for Upland - Big Sagebrush and Upland - Black/Low Sagebrush Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

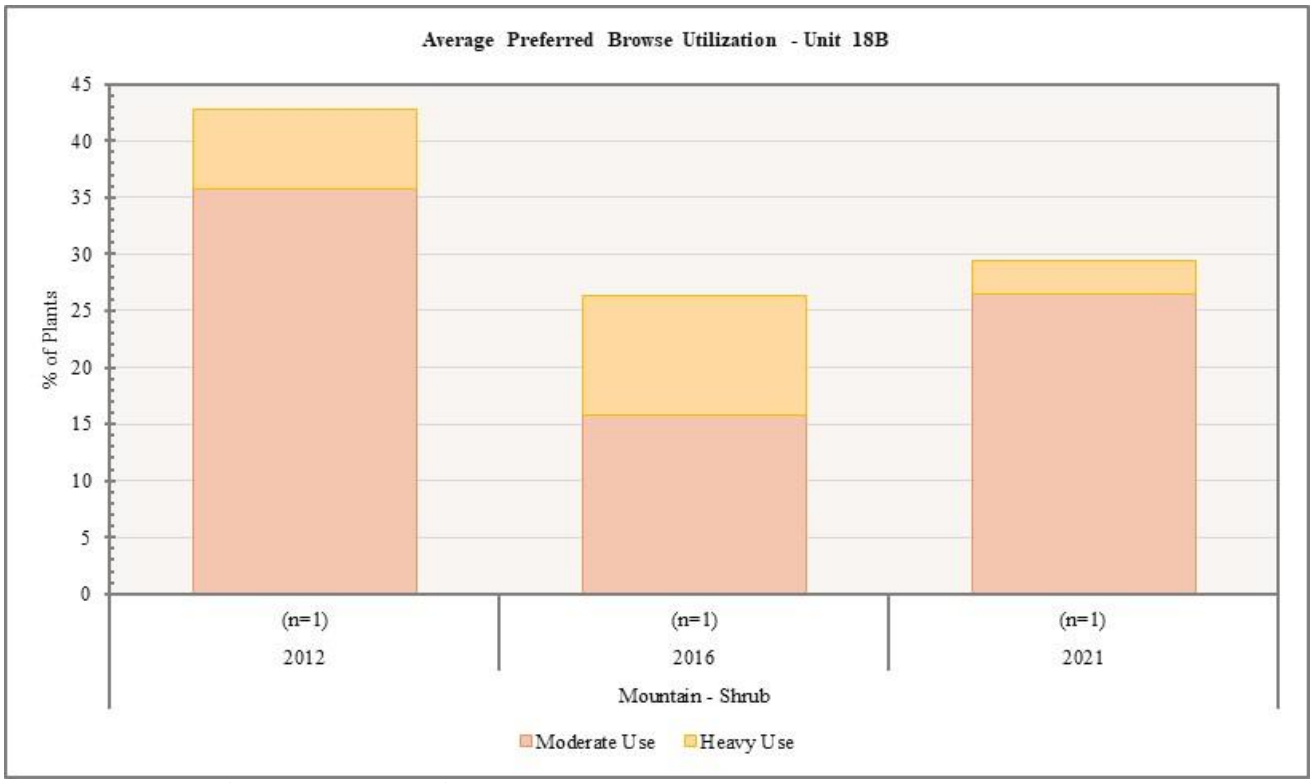


Figure 9.10: Average preferred browse utilization for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

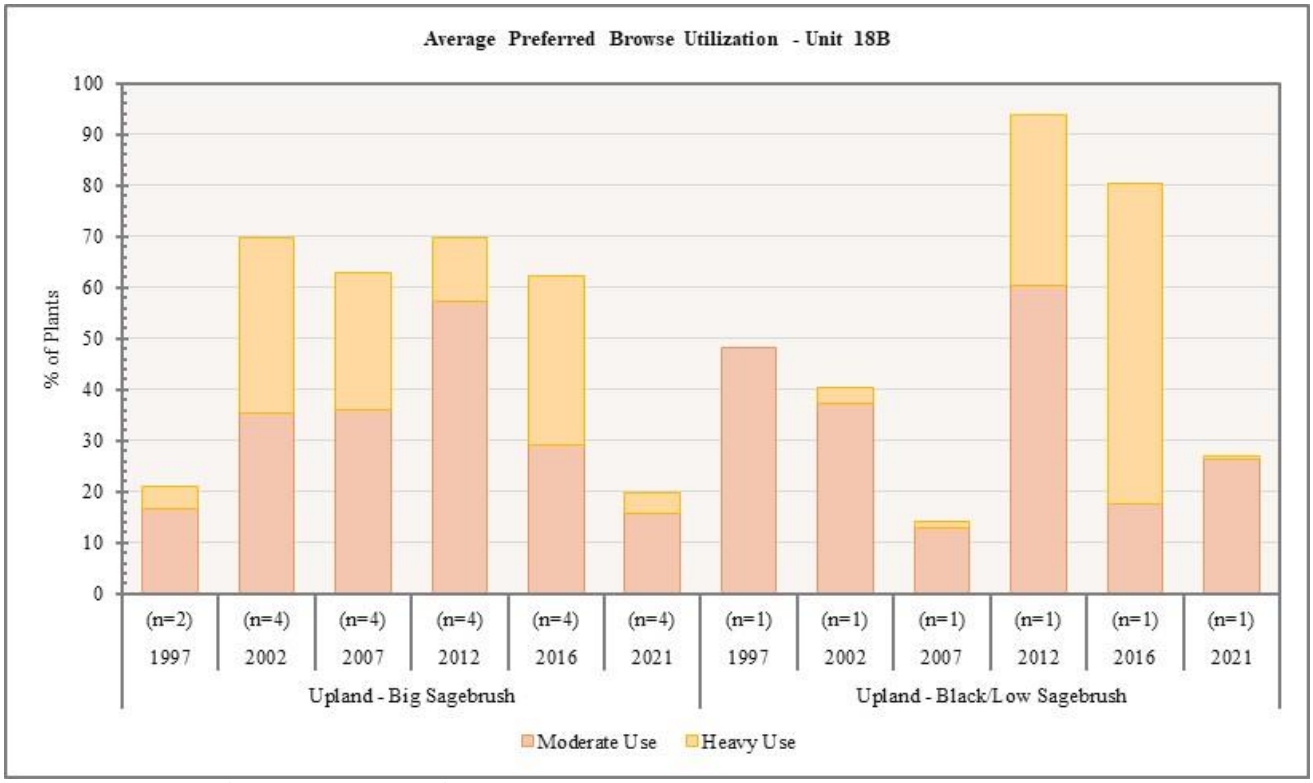


Figure 9.11: Average preferred browse utilization for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

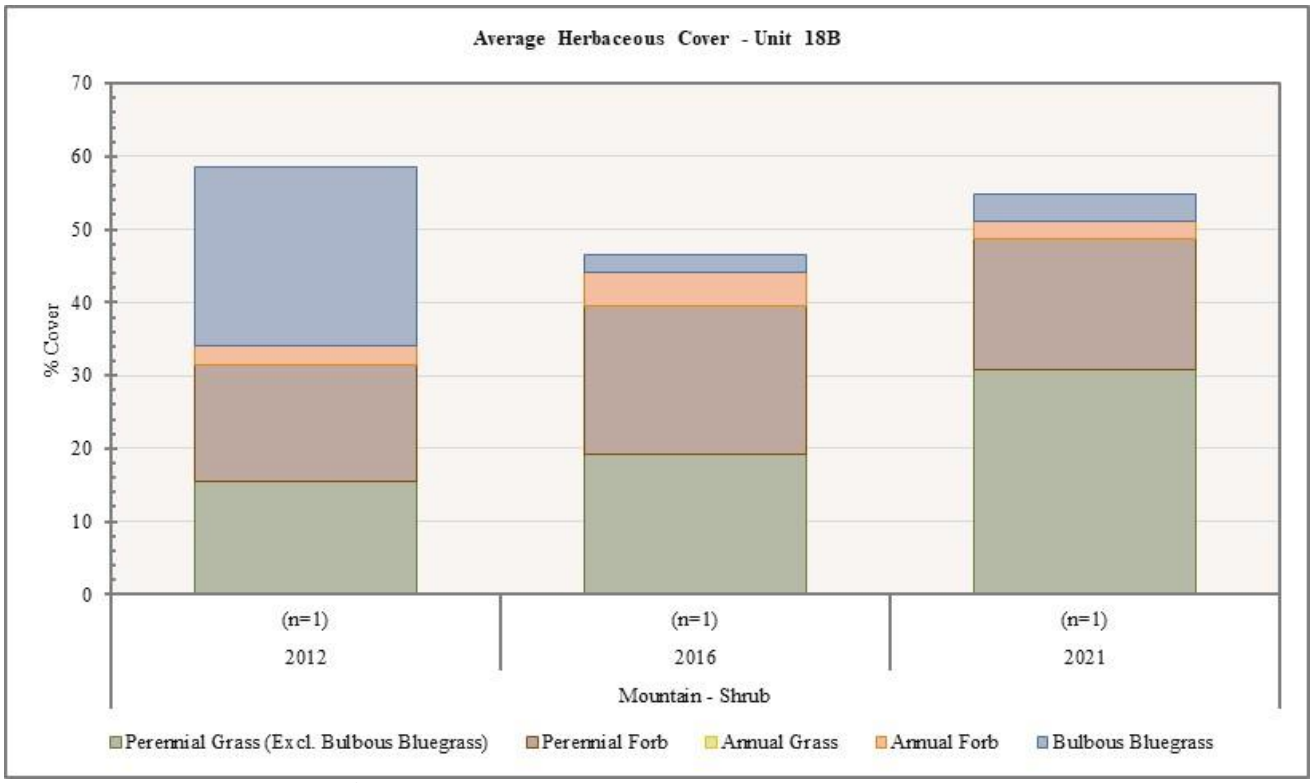


Figure 9.12: Average herbaceous cover for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

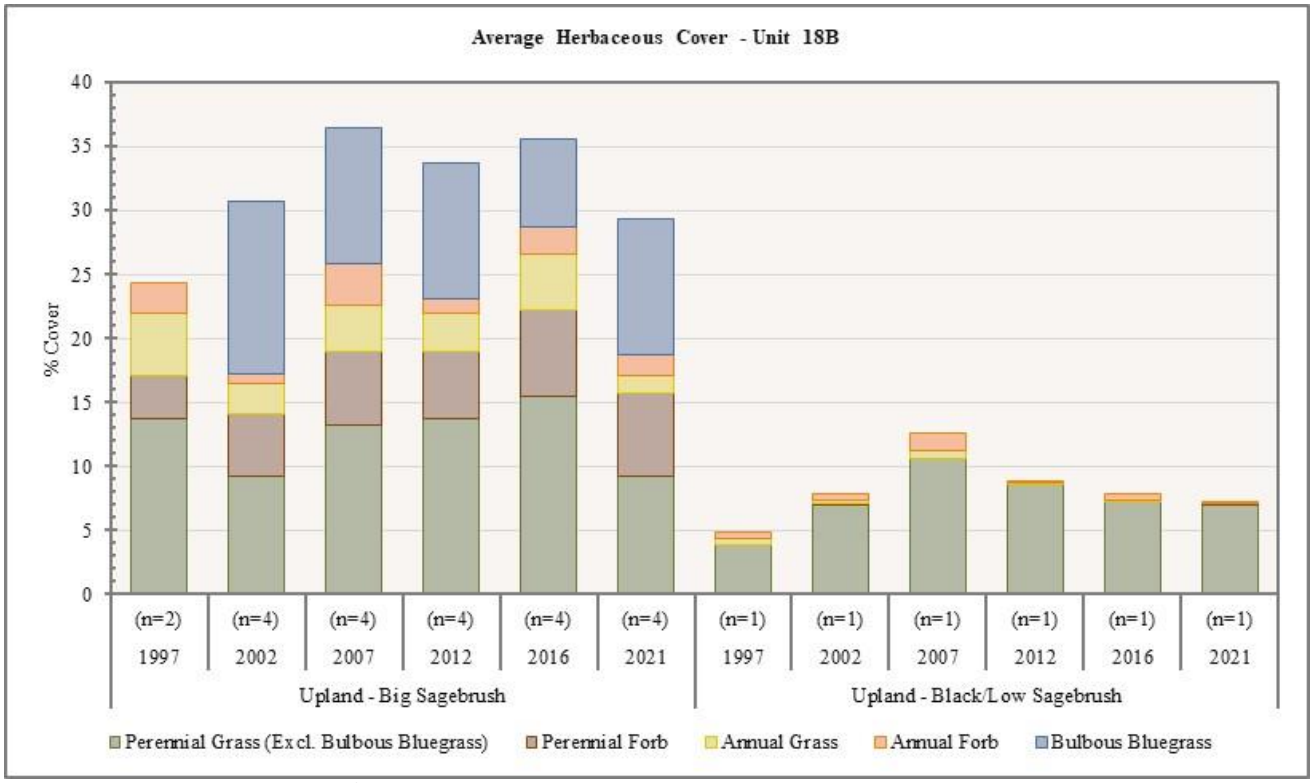


Figure 9.13: Average herbaceous cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

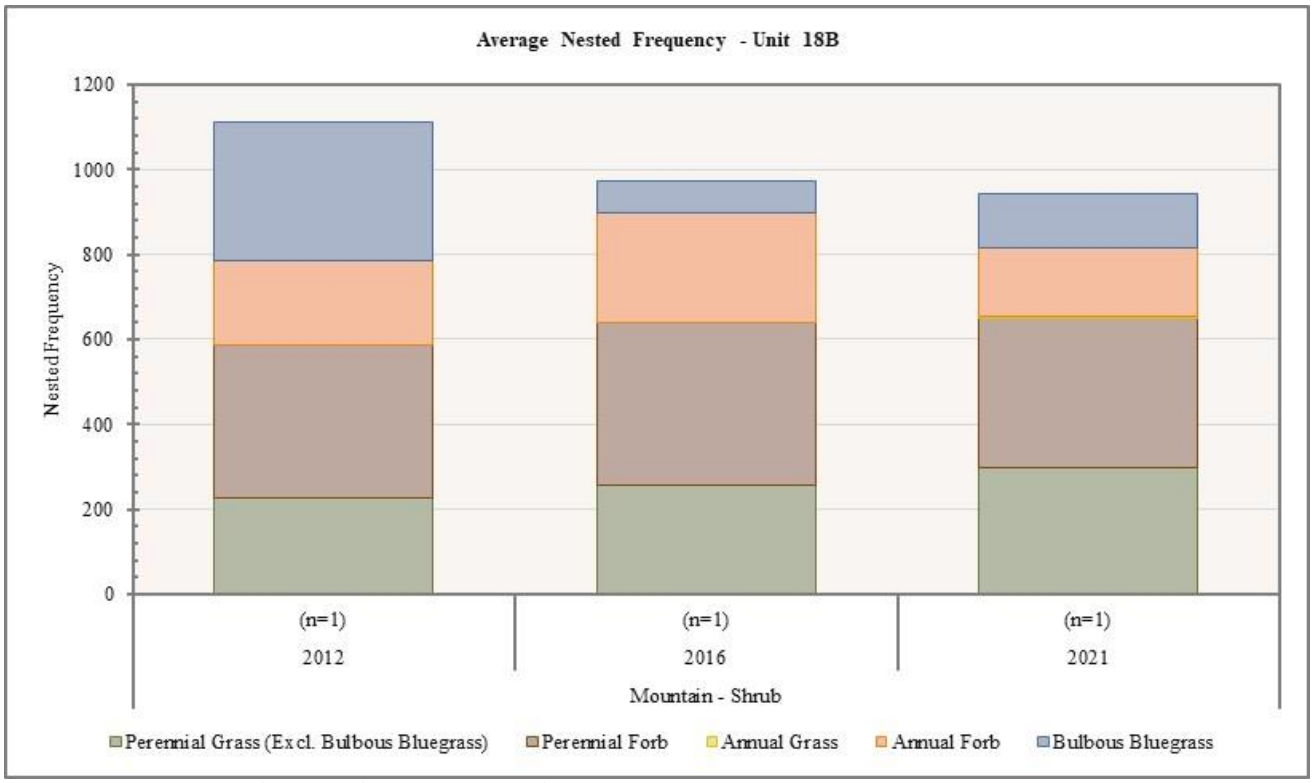


Figure 9.14: Average nested frequency of herbaceous species for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

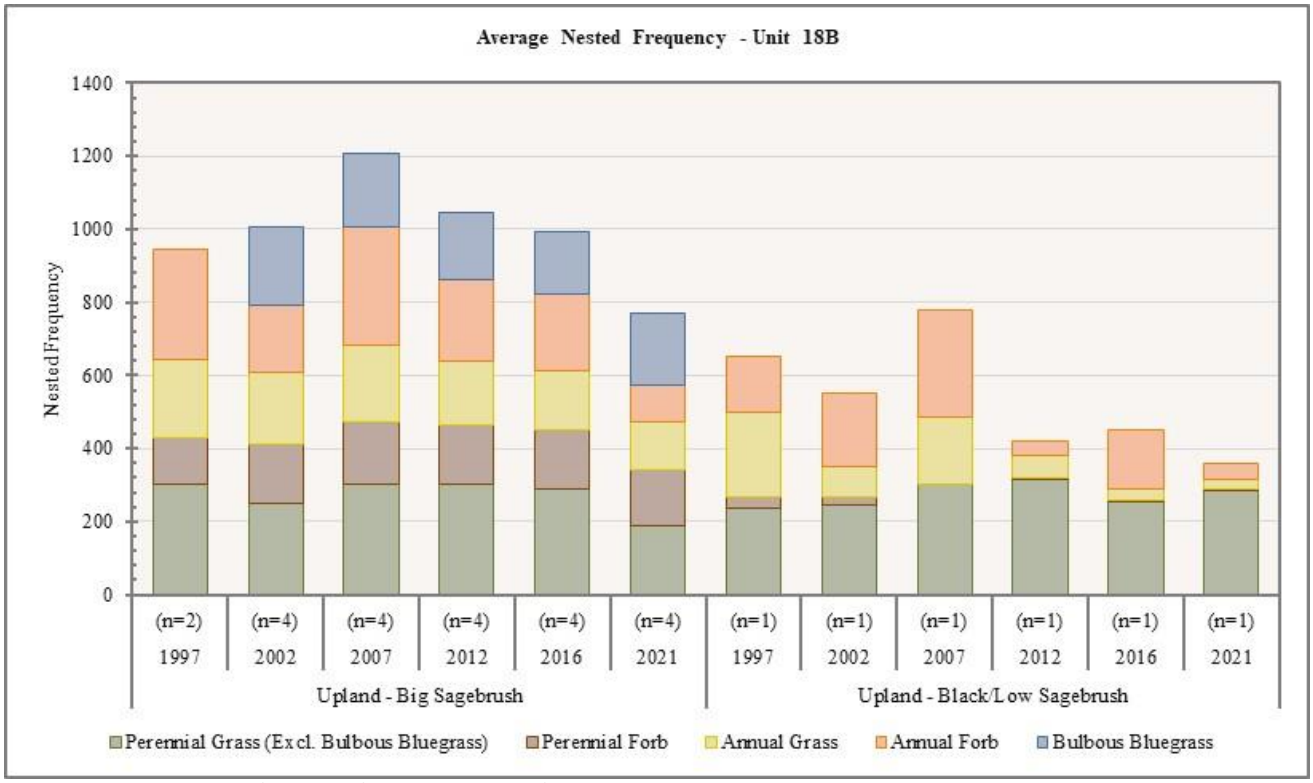


Figure 9.15: Average nested frequency of herbaceous species for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

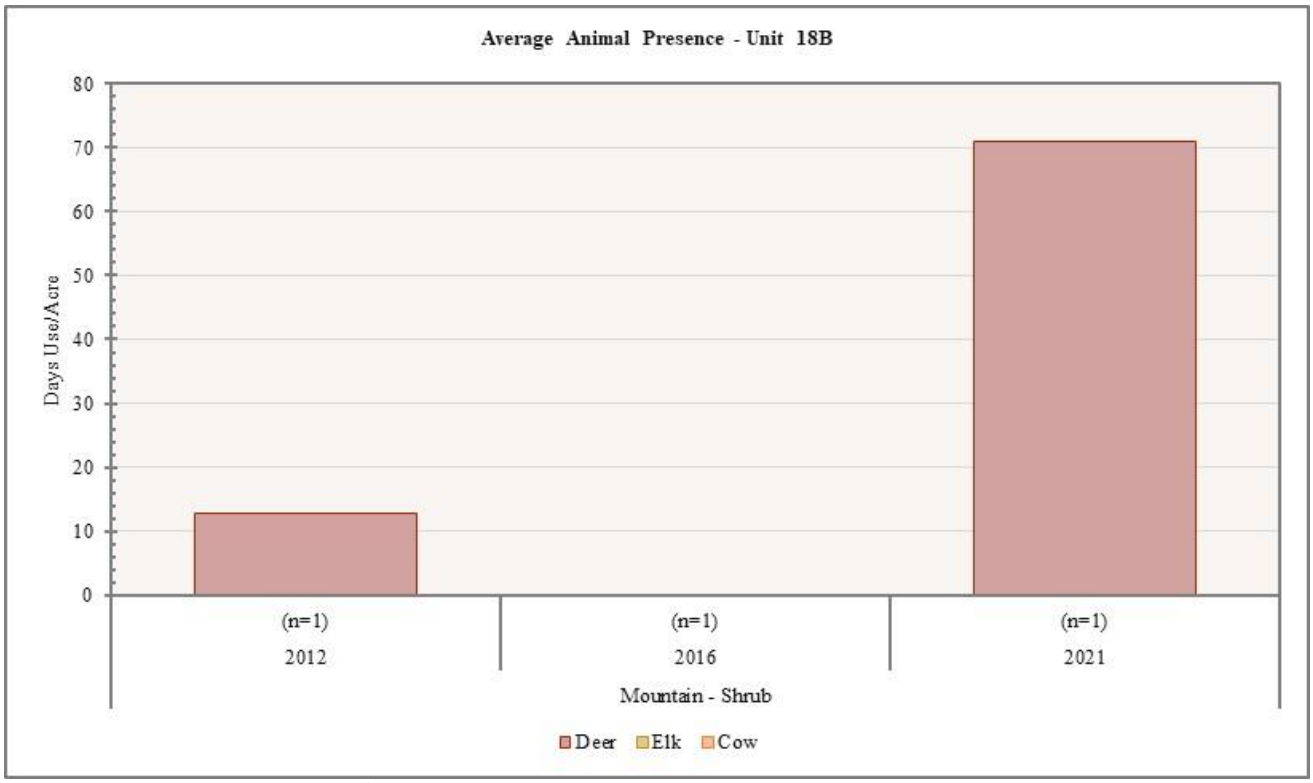


Figure 9.16: Average pellet transect data for Mountain - Shrub study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

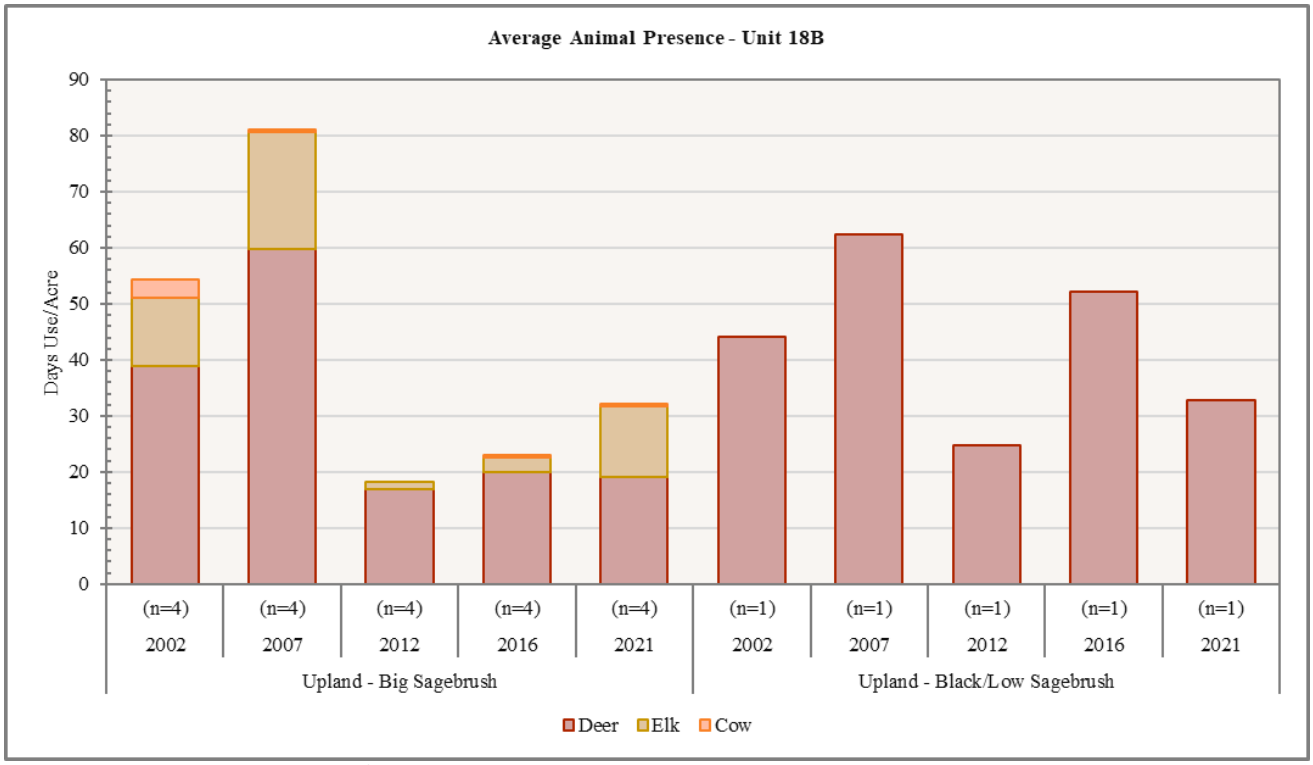


Figure 9.17: Average pellet transect data for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Oquirrh Mountains Oquirrh-Stansbury management unit has generally remained poor in most sample years, except in 2012, where average conditions were considered to be fair. Most Range Trend sites in WMU 18B, Manning Canyon (18B-3), Big Dip Gulch (18B-5), South of Soldier Canyon (18B-6), Three O'Clock (18B-34), and Settlement Canyon Reservoir (18B-35) have generally remained in poor condition and are considered to be the main drivers for the unit's overall winter condition. Contributing to the poor condition of these sites are deficient browse, and perennial grass and forb populations. Carr Fork 2 (18B-36) is a more recent study that was added to the sampling rotation in 2012, and has a tendency to be in states that are between fair and good condition for wintering deer: much of this favorable condition is due to a notable presence of antelope bitterbrush (*Purshia tridentata*), though cover has steadily decreased. Efforts to improve winter range on Carr Fork 2 should begin by preserving the browse community. Most sites show a proclivity to remain in poor condition and may not be the best candidates for rehabilitation.

The overall deer winter range assessment in 2021 for WMU 18B was very poor. Much of the poor condition can be attributed to a lack of preferred browse, perennial grasses, and forbs. The Pole Canyon wildfire is responsible for the decrease in deer wintering conditions on Manning Canyon, while climatic conditions may be responsible for deteriorating conditions for wintering deer for the remaining range trend studies (**Figure 9.18**, **Table 9.9**).

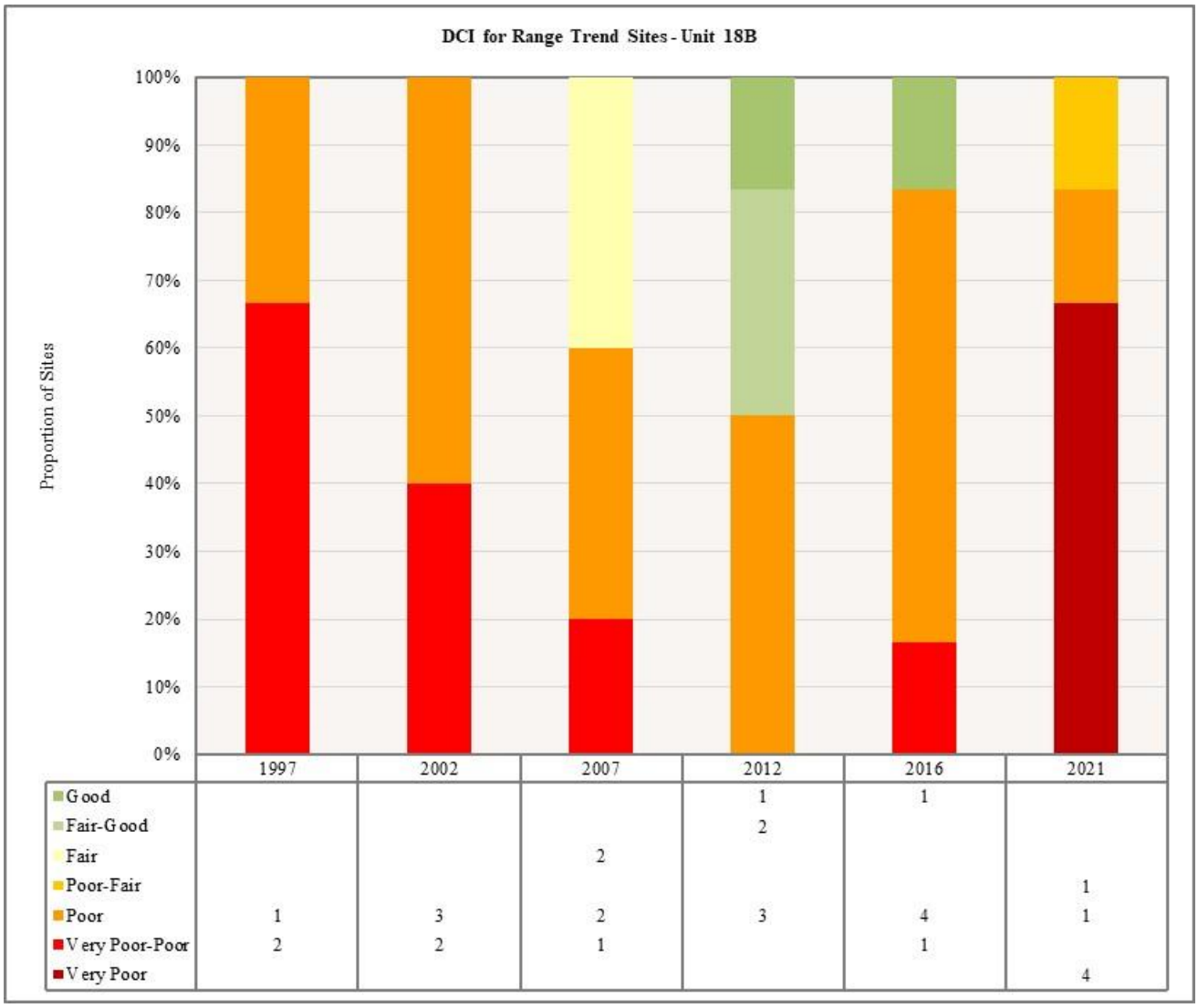
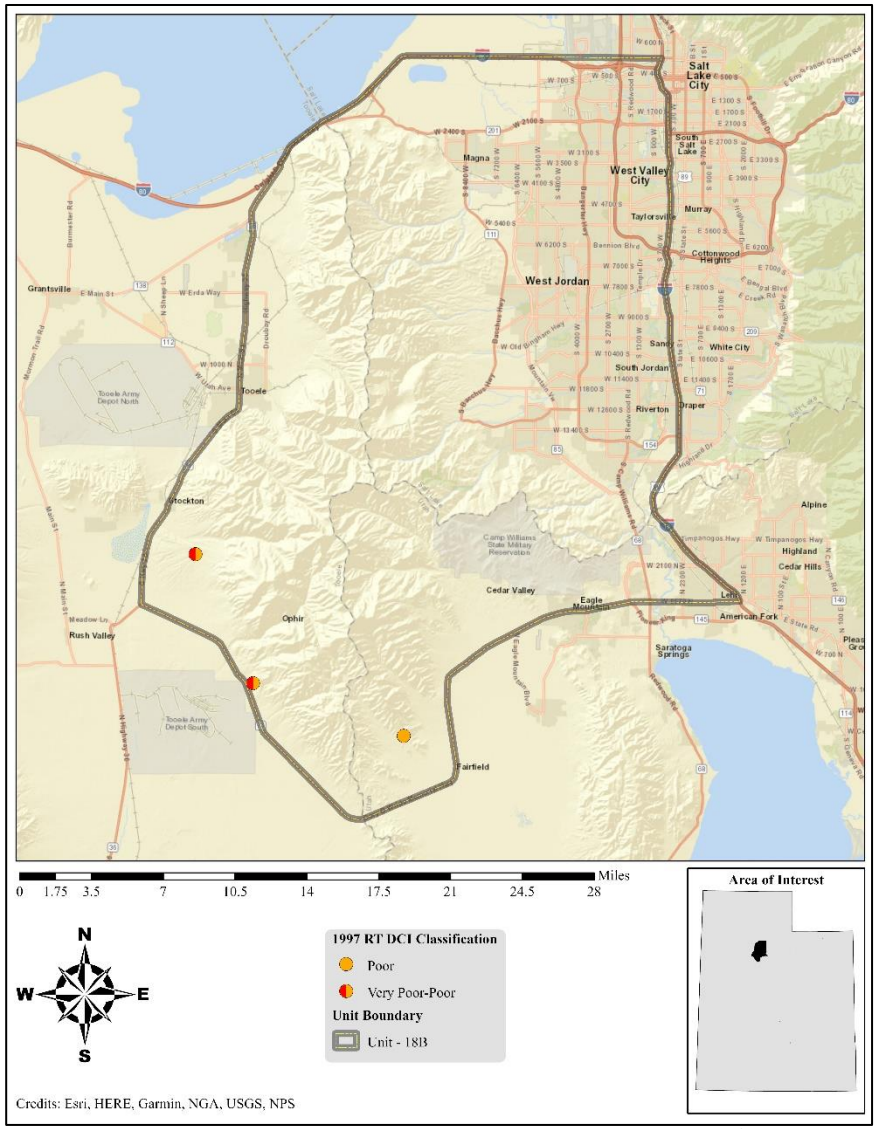


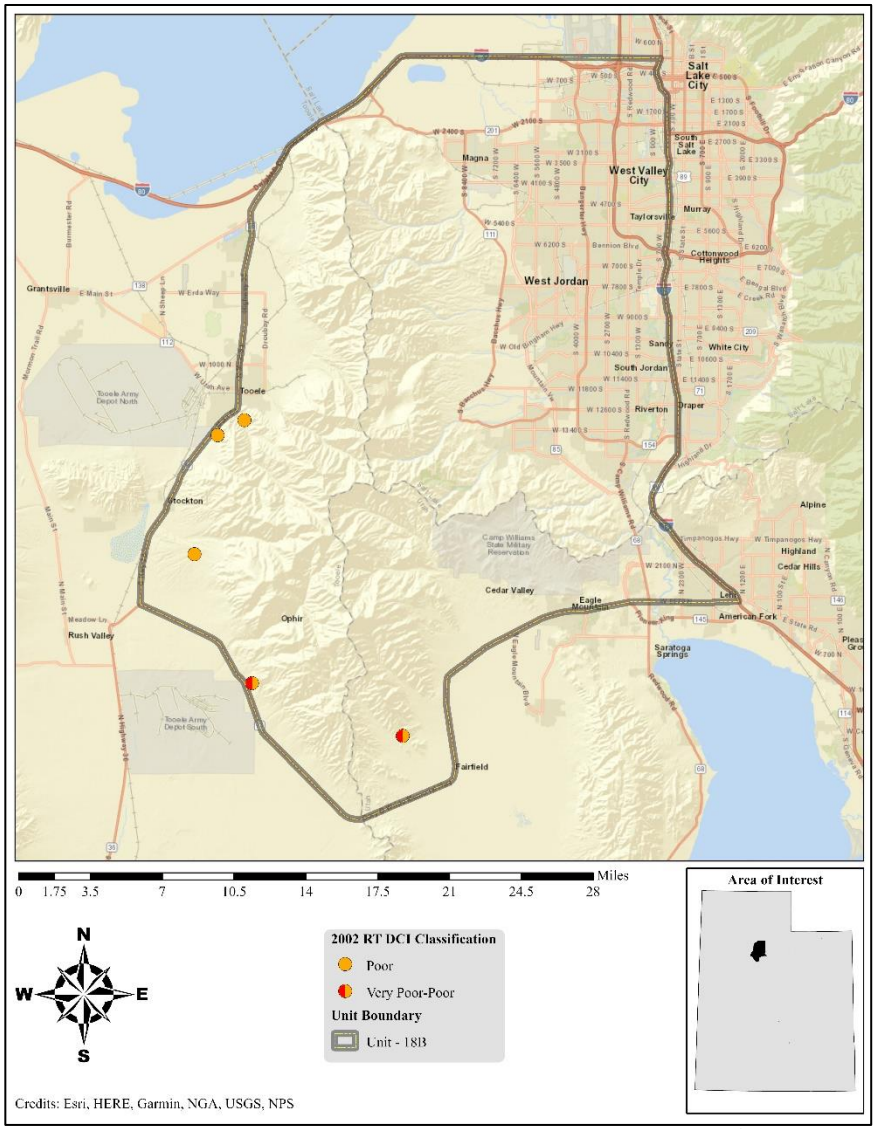
Figure 9.18: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

Study Number	Year	Preferred Browse Cover	Preferred Browse Decadence	Preferred Browse Young	Perennial Grass Cover	Annual Grass Cover	Perennial Forb Cover	Noxious Weeds	Total Score	Ranking
18B-3	1997	10.6	6.5	0.9	30	-5	3.5	0	**46.5**	**P**
18B-3	2002	11	1	1.3	23.4	-3.7	2.1	0	**35.2**	**VP-P**
18B-3	2007	12.5	2.4	5.1	21.5	-6.7	0.8	0	**35.5**	**VP-P**
18B-3	2012	13.9	10.7	14.8	29.3	-5.7	1.7	0	**64.7**	**F-G**
18B-3	2016	15.9	2.2	0.5	30	-2.4	1.6	0	**47.7**	**P**
18B-3	2021	0	0	0	3.2	-1.4	2.2	0	**3.9**	**VP**
18B-5	1997	8	13	7.8	7.6	-0.4	0.1	0	**36.1**	**VP-P**
18B-5	2002	10.1	8.3	2.2	14	-0.2	0.2	0	**34.7**	**VP-P**
18B-5	2007	13	7.5	2.6	21.1	-0.5	0	0	**43.7**	**P**
18B-5	2012	12.6	12.6	2	17.1	-0.1	0	0	**44.2**	**P**
18B-5	2016	16.1	8.9	1.2	14.5	-0.1	0	0	**40.7**	**P**
18B-5	2021	10.9	0.3	0.7	14	-0.1	0.1	0	**26**	**VP**
18B-6	1997	2.9	0	0	24.7	-2.4	9.8	0	**34.9**	**VP-P**
18B-6	2002	2.4	0	0	29.3	-1.3	9.7	0	**40**	**P**
18B-6	2007	2.6	0	0	30	-1.2	10	0	**41.4**	**P**
18B-6	2012	1.8	0	0	30	-0.1	7.4	0	**39.1**	**P**
18B-6	2016	5.8	0	0	30	-1.7	10	0	**44**	**P**
18B-6	2021	3.8	0	0	30	-0.1	6.6	0	**40.2**	**P**
18B-34	2002	18	12.9	0.6	4.2	-0.7	7.4	0	**42.3**	**P**
18B-34	2007	22.9	7.7	1	22	-0.7	9.7	0	**62.5**	**F**
18B-34	2012	21	8	2	26.1	-1.8	10	0	**65.3**	**F-G**
18B-34	2016	15.4	-0.7	0.4	20.4	-4.9	8.5	-4	**35**	**VP-P**
18B-34	2021	8.4	0.5	2	3.5	-2.1	10	-4	**18.5**	**VP**
18B-35	2002	15.2	3.7	1.5	17.2	-1.3	10	-2	**44.3**	**P**
18B-35	2007	17.9	2.9	2.1	25.3	-2.1	10	-2	**54**	**F**
18B-35	2012	12	6	1.7	19.4	-1.5	10	-2	**45.7**	**P**
18B-35	2016	9.1	2.9	1.2	18.2	-4	10	0	**37.4**	**P**
18B-35	2021	5.5	0	0	15.7	-0.5	10	-2	**28.6**	**VP**
18B-36	2012	30	12.9	3.6	30	0	10	-6	**80.4**	**G**
18B-36	2016	28.8	4	5.3	30	0	10	-6	**72**	**G**
18B-36	2021	17.9	3.5	0	30	0	8.3	-6	**53.7**	**P-F**
18R-10	2016	0.3	0	0	0.8	-0.1	0.5	0	**1.5**	**VP**
18R-10	2019	0.3	0	0	9.3	-0.9	10	-2	**16.6**	**VP**

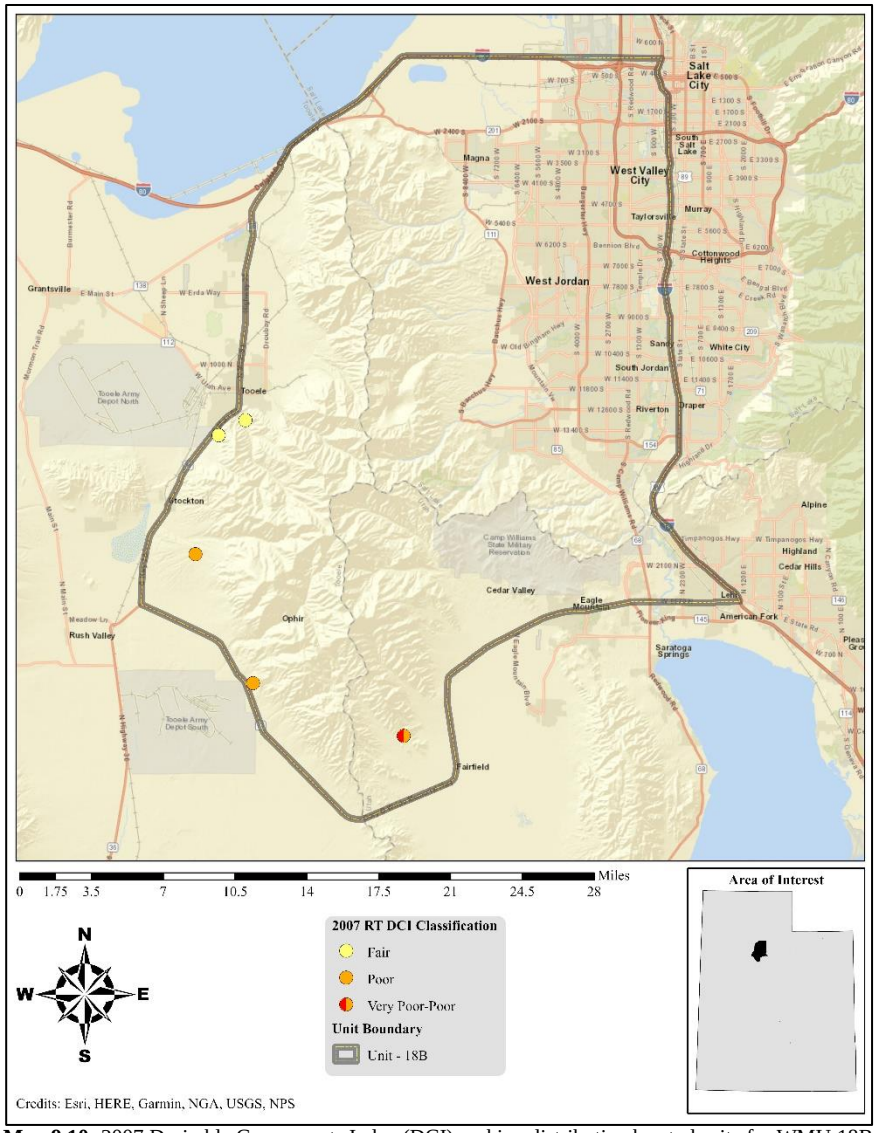
Table 9.9: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.



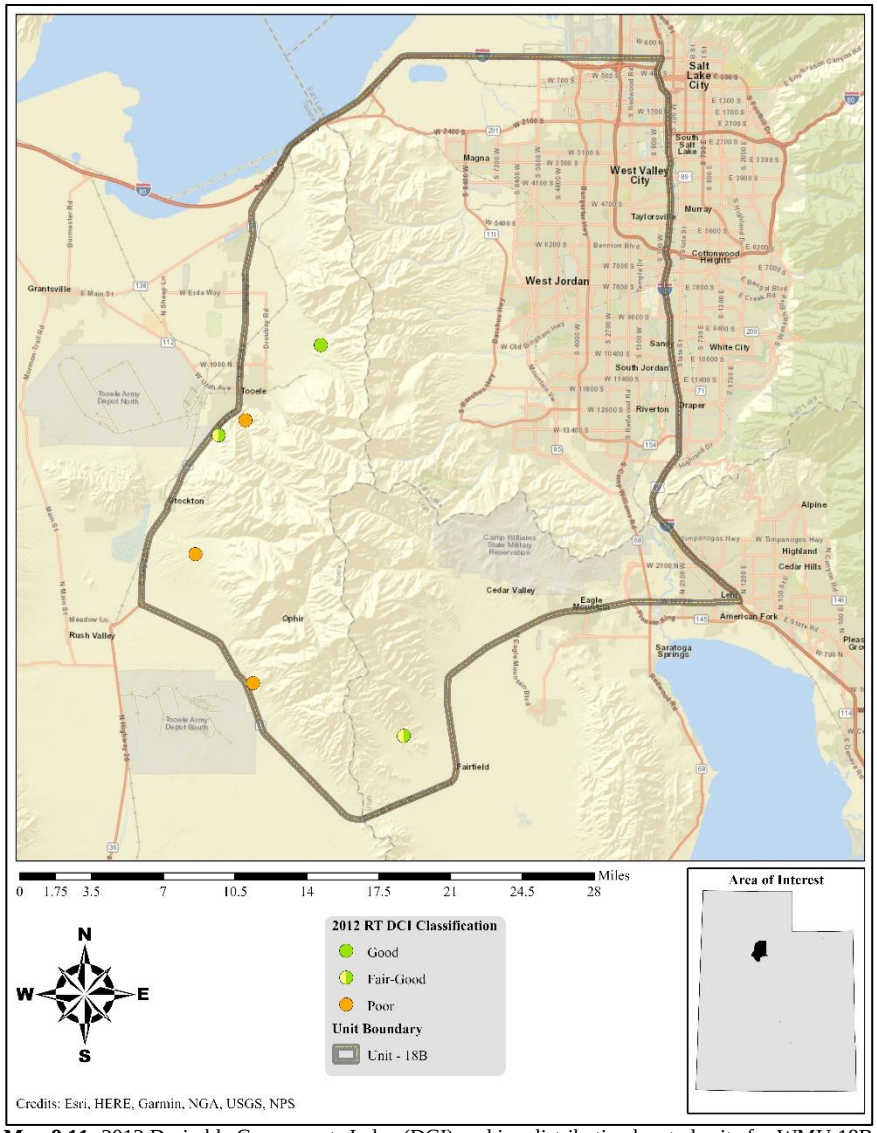
Map 9.8: 1997 Desirable Components Index (DCI) ranking distribution by study site for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.



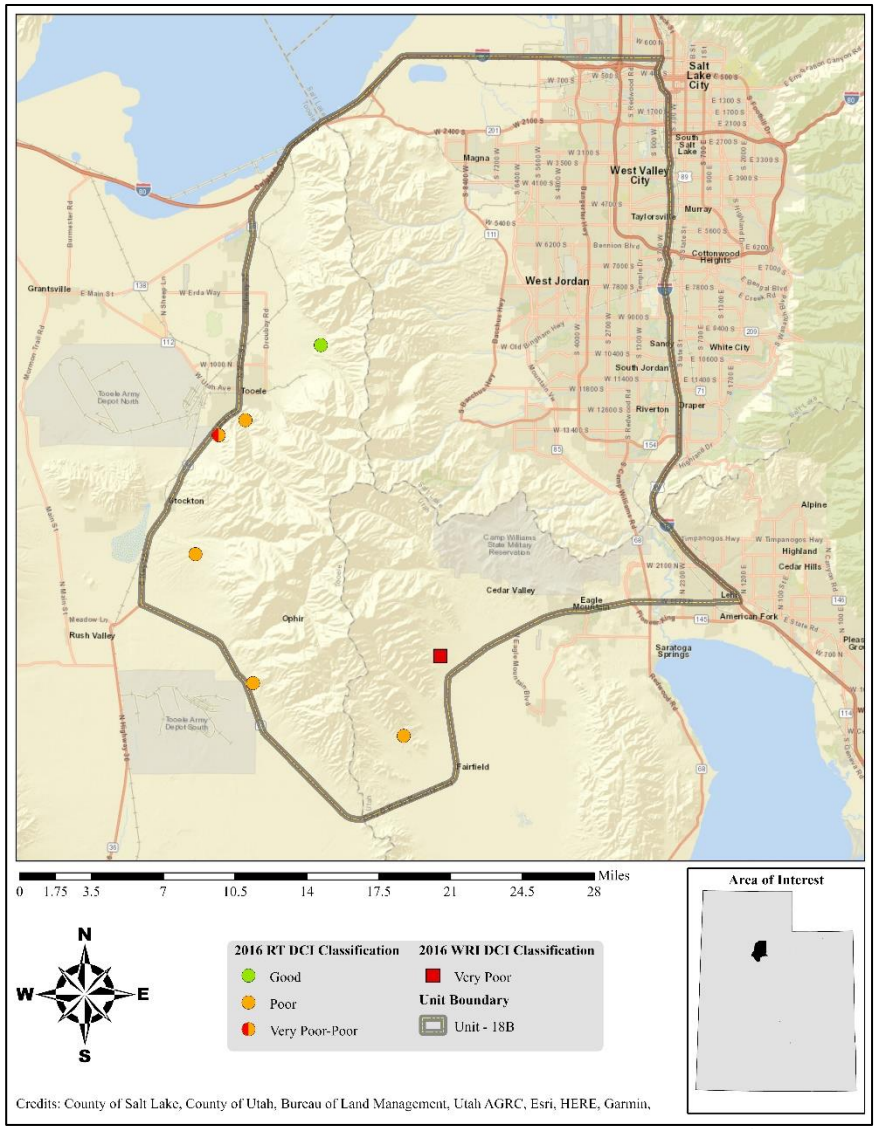
Map 9.9: 2002 Desirable Components Index (DCI) ranking distribution by study site for WMU18B, Oquirrh Mountains Oquirrh-Stansbury.



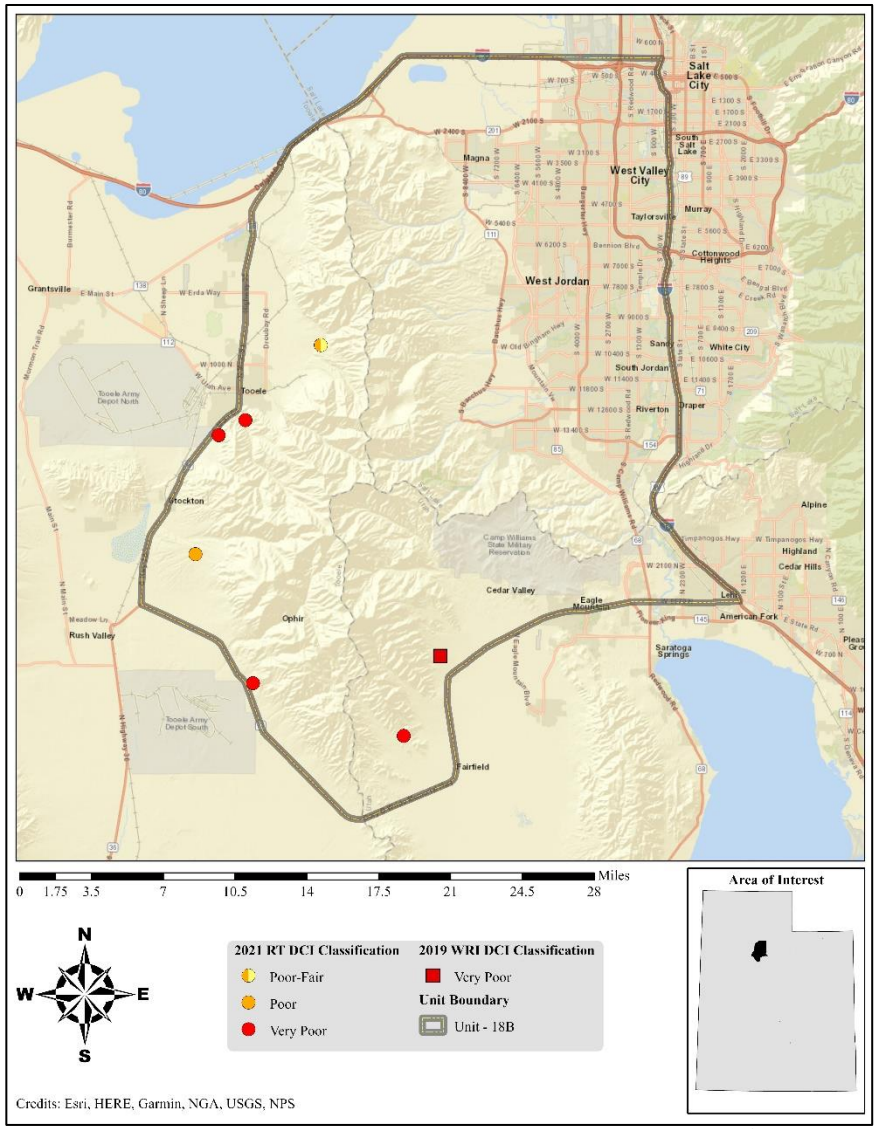
Map 9.10: 2007 Desirable Components Index (DCI) ranking distribution by study site for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.



Map 9.11: 2012 Desirable Components Index (DCI) ranking distribution by study site for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.



Map 9.12: 2016 Desirable Components Index (DCI) ranking distribution by study site for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.



Map 9.13: 2021 Desirable Components Index (DCI) ranking distribution by study site for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
18B-3	Manning Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18B-5	Big Dip Gulch	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
18B-6	South of Soldier Canyon	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
18B-34	Three O'Clock	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
18B-35	Settlement Canyon Reservoir	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
18B-36	Carr Fork 2	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
18R-10	Cedar Fort Bench	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
18R-11	South of Cedar Fort	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 9.10: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 18B, Oquirrh Mountains Oquirrh-Stansbury. All assessments are based off of the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A - Threat Assessment**.

Discussion and Recommendations

Mountain (Shrub)

This higher elevation study site, Carr Fork 2, is classified as being of the Mountain (Sagebrush) ecological type is considered to be in poor to fair condition for deer winter range on this management unit. A robust antelope bitterbrush (*Purshia tridentata*) population is present that provides valuable browse for wildlife. The introduced perennial grass species intermediate wheatgrass (*Thinopyrum intermedium*) and orchardgrass (*Dactylis glomerata*) are present on this site with high amounts of cover. Furthermore, the noxious weed Dalmatian toadflax (*Linaria dalmatica*) has been observed in all sample years and provided 6% cover in 2021. Both introduced perennial grasses and noxious weeds species pose a high-level threat to this study site. Introduced perennial grasses and noxious weeds have the potential to be aggressive and will likely lead to reduced prevalence and abundance of other more desirable native grass and forb species if they persist in the future (Mack, et al., 2000). The introduced annual grass species cheatgrass (*Bromus tectorum*) and field brome (*B. arvensis*) were observed in very low amounts for the first time in 2021. Although the threat is currently low, annual grasses can boost fuel loads, affect the ecological resiliency of the community, and will exacerbate the risk of wildfire if they increase in the future (Balch, D'Antonio, & Gómez-Dans, 2013).

Monitoring of this community should continue. If reseeding is necessary to restore the herbaceous understory, preference should be given to native grasses and forbs when possible and caution should be taken in species selection. If herbicide treatments are needed to address noxious weeds, caution should be used to not adversely affect the preferred browse population.

Upland (Big Sagebrush)

The mid-elevation study sites that are classified under this ecological type are considered to be in very poor to poor condition for deer winter range habitat on the Oquirrh Mountains Oquirrh-Stansbury management unit. These communities generally support sagebrush populations that provide valuable browse in mild to moderate winters. Introduced perennial grasses pose a medium to high-level threat on three of these study sites; bulbous bluegrass (*Poa*

bulbosa) is present with high cover on the Three O'Clock and Settlement Canyon Reservoir studies, while crested wheatgrass (*Agropyron cristatum*) provides 11% cover on South of Soldier Canyon. Introduced perennial grasses are often aggressive in the herbaceous understory and may have the ability to outcompete native grasses and forbs for resources. This competition with introduced perennial grasses in turn will likely lead to reduced biodiversity and abundance of desirable native species (Mack, et al., 2000). Annual grasses, particularly the introduced species cheatgrass (*Bromus tectorum*), are present on all study sites of this ecological type, posing a medium-level threat on most sites. However, cheatgrass on the Manning Canyon site has been recorded in high enough amounts in previous years to put the site at a high-level risk. In high amounts, annual grasses increase fuel loads, exacerbate the risk of wildfire, and alter wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). Encroachment of pinyon (*Pinus sp.*) and juniper (*Juniperus sp.*) is occurring in low amounts on the Manning Canyon and South of Soldier Canyon studies, and they are considered to be within Phase I of woodland succession. Presence of pinyon and juniper trees has the potential to lead to reduced shrub and herbaceous understory health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000). In addition, the Settlement Canyon Reservoir study is at low risk of the effects posed by tourism and/or recreation. Increased human use of an area can lead to reduced shrub and herbaceous vigor, and at high enough levels may result in localized habitat degradation (Cole, 2004). Finally, effects of drought are evident on South of Soldier Canyon and Settlement Canyon Reservoir. Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

Continued monitoring of all study sites is recommended. More specifically, further monitoring on the South of Soldier Canyon and Settlement Canyon Reservoir may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts such as water catchments are needed to support wildlife. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003). Further monitoring may also indicate whether or not annual grasses are present in high amounts in future sample years. Although annual grasses are present in moderate amounts as of 2021 and likely do not immediately require intervention, treatments such as herbicide application may be appropriate if they increase in cover and abundance over time. If reseeding is necessary to restore the herbaceous understories on the appropriate study sites, preference should be given to native grasses and forbs when possible and caution should be taken in species selection. Although tree encroachment is likely not an immediate concern, treatments to manage pinyon and juniper may be appropriate in future sample years on sites where tree encroachment progresses.

Upland (Black/Low Sagebrush)

The Big Dip Gulch study is classified as a mid-elevation Upland (Black/Low Sagebrush) ecological site and is considered to be in very poor condition for deer winter range on the Oquirrh Mountains Oquirrh-Stansbury management unit. The introduced annual grass species cheatgrass (*Bromus tectorum*) has been observed in the understory with low cover since 1997, posing a low-level threat to the site. If cheatgrass increases in future sample years, it would increase potential fuel loads, exacerbate the risk of wildfire, and have the potential to negatively impact the resistance and resilience of the plant community on this site (Balch, D'Antonio, & Gómez-Dans, 2013). Singleleaf pinyon (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) have been observed on this site, and the study is considered to be within Phase I of woodland succession. Presence of pinyon and juniper trees has the potential to lead to reduced shrub and herbaceous understory health as woodland encroachment advances (Miller, Svejcar, & Rose, 2000). Finally, the effects of drought were observed on this study site in 2021. Long periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced resilience and resistance of the ecosystem to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

Further monitoring of this study site is recommended, as it may aid in determining whether effects of drought (reduced shrub and herbaceous vigor, localized loss of browse populations, community transitions, etc.) are sustained over a longer period of time, how they may be affecting wildlife in the area, and whether mitigation efforts such as water catchments are needed to support wildlife. It is important to note that water enhancements should only occur in areas where forage availability and quality supports increased use by wildlife (Walkeling & Bender, 2003). Although tree encroachment is likely not an immediate concern, treatments to manage pinyon and juniper may be appropriate in future sample years on sites where tree encroachment progresses. Finally, continued monitoring may also indicate whether or not annual grasses are present in high amounts in future sample years. Although annual grasses are present in moderate amounts as of 2021 and likely do not immediately require intervention, treatments such as herbicide application may be appropriate if they increase in cover and abundance over time.

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APPENDIX A - THREAT ASSESSMENT

Annual Grass:

Species: *Bromus tectorum, B. rubens, Taeniatherum caput-medusae, Eremopyrum triticeum*
Low: If present, automatically a threat. Present-3% in ANY sample year.*
Medium: 3-7% cover in ANY sample year.*
High: >7% cover in ANY sample year.*

Potential impact*:* Increased fire potential and reduced herbaceous diversity.
*The study sites are not monitored yearly, so it cannot be said with absolute confidence that the seedbank has been depleted even if cover was low in the most sample year. As such, one should err on the side of what has already occurred and what is therefore possible.

Introduced Perennial Grasses:

Species: *Thinopyrum intermedium, Bromus inermis, Agropyron cristatum, Poa pratensis, Psathrostachys juncea, Poa bulbosa*
Low: 1% of actual cover has to be contributed by a single species AND ratio to total perennial grass cover has to be up to 20%.
Medium: 20-50% of total perennial grass cover is contributed by introduced species.
High: >50% of total perennial grass cover is contributed by introduced species.

Potential Impact: Reduced diversity of desirable grass and forb species.

Noxious Weeds:

Low: If present, automatically a threat. Present-1% in ANY sample year.*
Medium: 1-5% cover in ANY sample year.*
High: >5% cover in ANY sample year. *

Potential Impact: Reduced diversity of desirable grass and forb species.
*The study sites are not monitored yearly, so it cannot be said with absolute confidence that the seedbank has been depleted even if cover was low in the most sample year. As such, one should err on the side of what has already occurred and what is therefore possible.

PJ Encroachment:

Species: *Juniperus osteosperma, J. scopulorum, Pinus edulis, P. monophylla*
Low: Phase I.
Medium: Phase I transitioning to Phase II or Phase II.
High: Phase II transitioning to Phase III or Phase III.

Potential Impact: Reduced understory shrub and herbaceous vigor.

Urban Development:

Low: On private or SITLA property that may be developed in the future AND near a community (ex: house or building nearby).
Medium: Development occurring nearby including road improvements and new roads.
High: Development occurring within one mile of the study site.

Potential Impact: Fragmentation and loss of habitat.

Tourism/Recreation:

Ski areas, golf courses, county parks, campgrounds, mountain bike trails, trailheads, ATV trails
Low: Minimal evidence of recreation occurring (ex: recent ATV or bike tracks, recent camping, general recreational activity, clay pigeon and bullet shells).
Moderate: In the process of becoming a high-activity area (ex: fire ring, beginnings of a trail).
High: High-activity area/area developed for recreation (ex: definite trails, tent pads).

Potential Impact: Loss of habitat, reduced shrub and herbaceous vigor.

Energy Development:

Low: Must meet one of the following:
a.) Site located in a known oil and/or gas reserve (ex: sites near Price, Book Cliffs, etc.).
b.) Site is in the vicinity of a wind or solar farm AND could reasonably be developed in the future (ex: Milford Flat).
c.) Site is adjacent to powerline.
d.) Site is adjacent to pipeline.
Medium: Site located in a known oil and/or gas reserve with road developments/improvements occurring in the area.
NOTE: No 'medium' option applicable for powerlines, pipelines, or wind or solar farms.
High: Must meet one of the following:
a.) Oil and gas developments are active within one mile of the study site.
b.) Site is in immediate vicinity of/adjacent to solar or wind farm.
c.) Powerline is actually on site.
d.) Pipeline is actually on site.

Potential Impact: Fragmentation and degradation/loss of habitat.

Agriculture:

Low: Site located in former agricultural field, has potential to revert back to agricultural land.
High: Site is converted back to agricultural land.

Potential Impact: Fragmentation and degradation/loss of habitat.

Animal use:

Categories determined using calculations based on pellet group data compared to ESD annual production values. Threat level is based on most recent sample year only.

NOTE: 'Low' risk can be assumed with any animal on site without being explicitly stated.
Medium: 75-99% of total production is used.
High: 100% of total production is used.

Potential Impact: Reduced diversity of desirable grass and forb species.

Woodcutting (excluding intentional habitat treatments):

Firewood, fenceposts

Low: Evidence that woodcutting is occurring in the vicinity.
NOTE: No 'medium' option applicable.
High: Off-road truck traffic for access, large amounts of tree debris, intensive woodcutting occurring.

Potential Impact: Fragmentation and degradation/loss of habitat.

Climate Change:

NOTE: 'Low' risk can be assumed for the whole state without being explicitly stated. Risk is only assessed when visible changes are occurring.
Moderate: Localized, patchy community shifts beginning compared to the reference/invaded state in the ESD description. One indicator may be high decadence in shrub communities and decreasing shrub density (ex: Black Mesa before 2019/Harts Draw studies).
High: A shift in the community has occurred that one could attribute to climate change (ex: shrub die-off, Ruin Park/Alkali Flat studies).

Potential Impact: Plant community shifts, loss of habitat.

Drought:

NOTE: The "limiting factor or threat" of drought or long-term drought can be assumed for the whole State without being explicitly stated. However, to state that a site is limited or threatened is only assigned when visible changes are occurring, and annual and seasonal Palmer Drought Stress indexes for the specified division are considered to be in moderate drought or drier for multiple years.

Shrub poor vigor above 40% or above, decadence above 40%, and PDSI is negative (-2) or lower for multiple years.

Potential Impact: Lowered resilience and resistance to disturbance.