Wildlife Management Units 16A, 17A, 19A, 19B, 19C, 20, 21A, 21B & 23

Habitat Monitoring

UTAH BIG GAME RANGE TREND

RANGE TREND PROJECT REPORT

Publication Number 23-07 | Report for Federal Aid Project W-82-R-67

2022 Summary Report

Prepared by:

UTAH DIVISION OF WILDLIFE RESOURCES – GREAT BASIN RESEARCH CENTER

Utah Big Game Range Trend
Unit Summaries
2022
Wildlife Management Units
16A, 17A, 19A, 19B, 19C, 20, 21A, 21B & 23

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Performance Report for Federal Aid Project W-82-R-67

Publication No. 23-07

UTAH DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife Resources
1594 West North Temple
Salt Lake City, Utah 84114

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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-67

Grant Name: Utah Wildlife Habitat Research and Monitoring

Project Name: Utah Wildlife Habitat Monitoring

Need: The ability to detect changes in vegetation composition (range trend) on big game winter ranges is an important part of the Division’s 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 will be 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 BLM and USFS allotment management plans, and as one of several sources of information for revising deer and elk herd management unit plans. Range trend data may also be gathered where habitat information is necessary for other wildlife species such as Greater sage-grouse.

Purpose: Monitor, evaluate, and report range trend at designated key areas throughout the state, and inform Division 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 re-monitored every five years, and vegetation condition and trend assessments will be made for key areas. DWR 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 and use the information in the development of management plans. Annual reports will be readily available on the Division's website, digitally stored, and in hard copies located in DWR regional offices, BLM and USFS offices, and public libraries. Special studies (habitat project monitoring and big game/livestock forage utilization studies) will give DWR biologists and public land managers’ additional information to address local resource management problems.

REMARKS

The work completed during the 2022 field season and reported in this publication involves the reading of interagency Range Trend studies in the DWR Central 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:

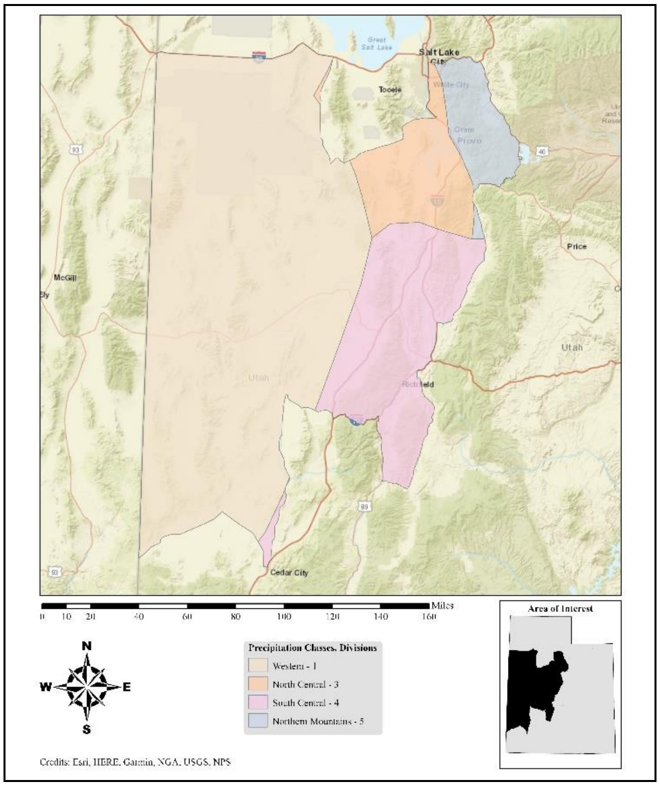
Bureau of Land Management
- Salt Lake Field Office
- Fillmore Field Office
- Richfield Field Office

United States Forest Service
- Uinta National Forest
- Fishlake National Forest

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

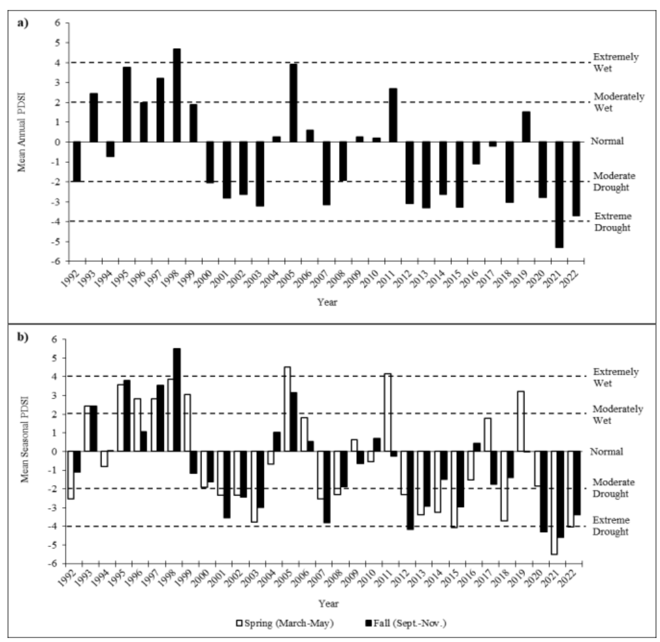
RANGE TREND UNIT SUMMARY OVERVIEW

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 Central Region occurs within three of these divisions: Western (Division 1), North Central (Division 3), South Central (Division 4), 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 2022. The data reported in this summary covers the years over which these sites have been sampled (1992-2022). 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, 2023). In the figure below, graph "a" represents the mean annual PDSI for the North Central region and graph "b" shows the mean PDSI by season, spring (March-May) and fall (Sept.-Nov.) for the same 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.

Rangeland Analysis Platform (RAP): Data from the Rangeland Analysis Platform was overlaid with precipitation data to create graphs representing vegetation changes by either biomass or percent cover based on deer winter or summer range habitat for each unit. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. In addition, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between Range Trend samplings.

Land Ownership: Land ownership information was used to create maps displaying ownership and study site location for each management unit.

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.US_140EVT, 2020).

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 at least 2000 through 2022 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.

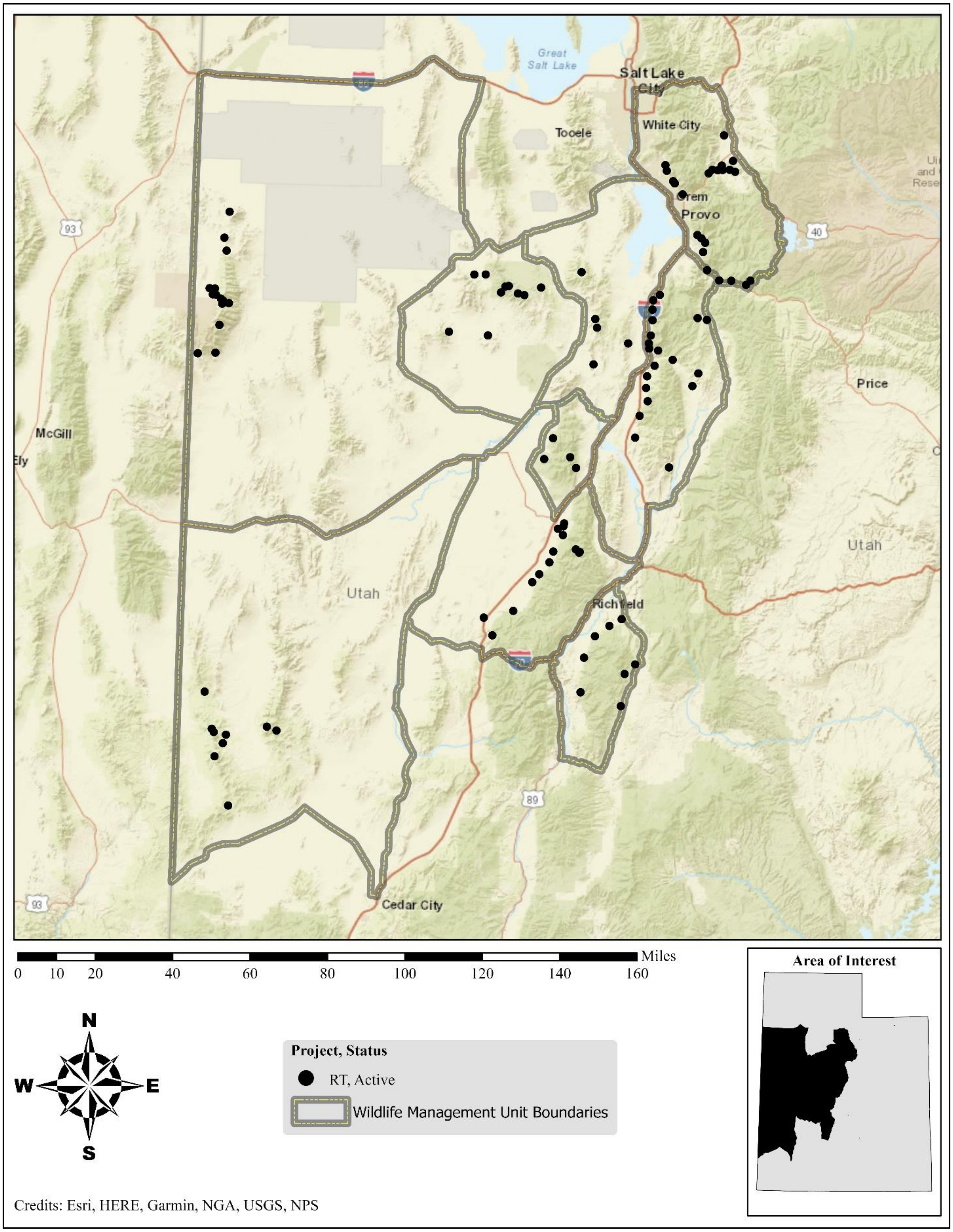
Deer Winter Range Condition Assessment: The desirable components index (DCI) for deer was created by Range Trend Program personnel as a tool to address condition and/or value of winter ranges for mule deer. This index is meant to be a companion to, and not a replacement for, the site-specific Range Trend 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.

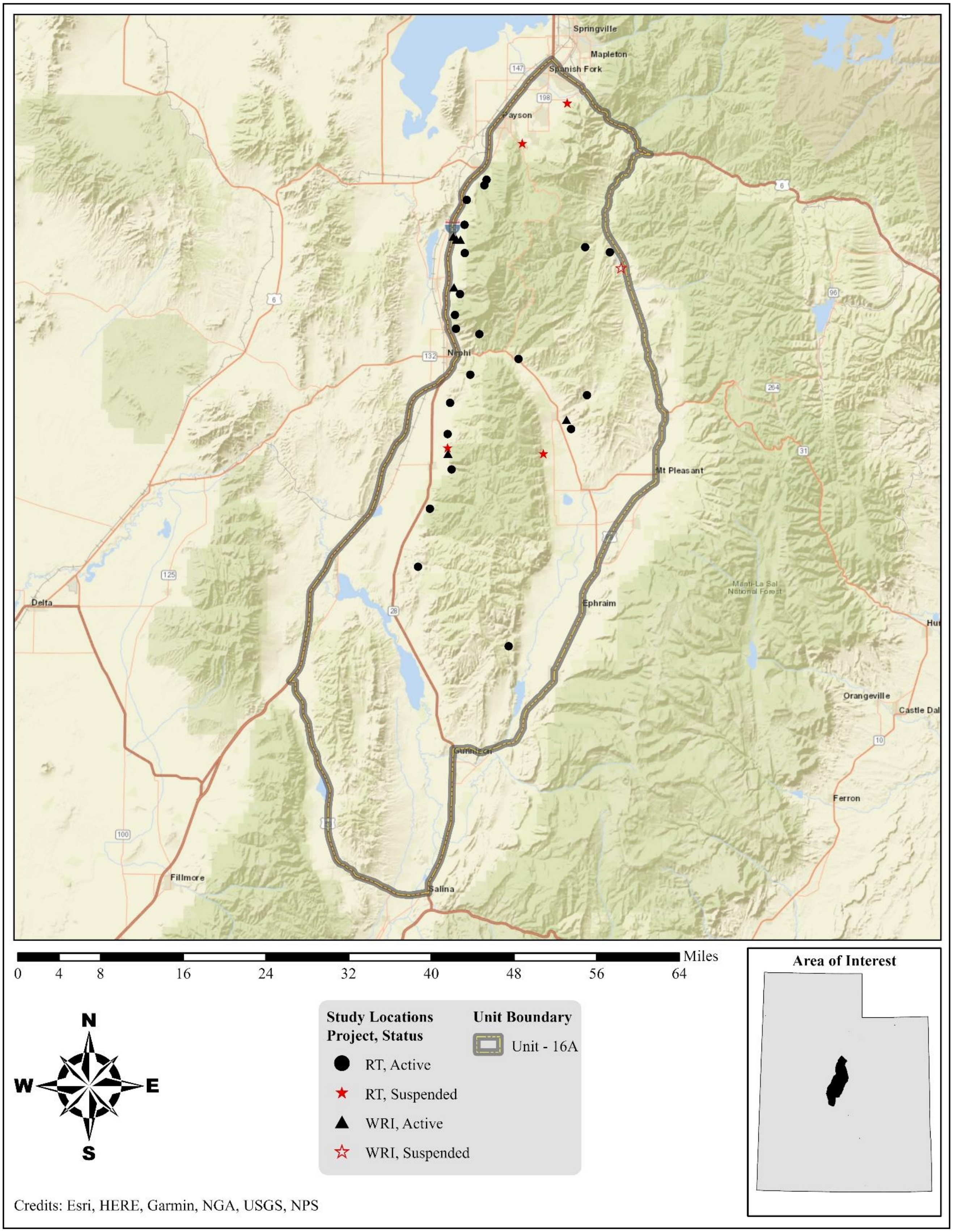
Changes in DCI over the sample years for both treated and untreated sites are included in the figures near the end of the summary. Care should be taken when interpreting these tables as the number of sites included in each year may vary. This could be misleading if the overall DCI seems to be improving, 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, among others. 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 any issues and were classified as "none identified."

UNIT SUMMARIES



1. WILDLIFE MANAGEMENT UNIT 16A – NEBO



WILDLIFE MANAGEMENT UNIT 16A – NEBO

Boundary Description

Utah, Juab, and Sanpete Counties – Boundary begins at the junction of I-15 and US-6 in Spanish Fork; southeast on US-6 to US-89 at Thistle Junction; south on US-89 to US-50 at Salina, northwest along US-50 to I-15 at Scipio; north along I-15 to US-6 in Spanish Fork.

Management Unit Description

Geography

This management unit incorporates most of the old North and South Nebo deer herd units and is approximately 943,923 acres in size. Nephi Canyon divides the northern and southern parts of the unit running east to west. A majority of the permanent Range Trend studies are placed on the western faces of the Wasatch and San Pitch Mountains. The northern section of the Nebo unit is dominated by high mountains such as Santaquin Peak, Bald Mountain, and Mount Nebo. Mount Nebo represents the southernmost extension of the Wasatch Range: this range is high and rugged, with steep slopes on the western portion and less steep slopes on the eastern portion of the mountain range. The San Pitch and Valley Mountains make up the majority of the southern portion of the unit. These mountains are lower in elevation and less steep than the northern part of the unit with shallow canyons throughout. Towns within this unit include Fountain Green, Moroni, Levan, Fayette, Payson, Chester, Wales and Salem. Towns partially included in the unit include Spanish Fork, Fairview, Mount Pleasant, Ephraim, and Manti.

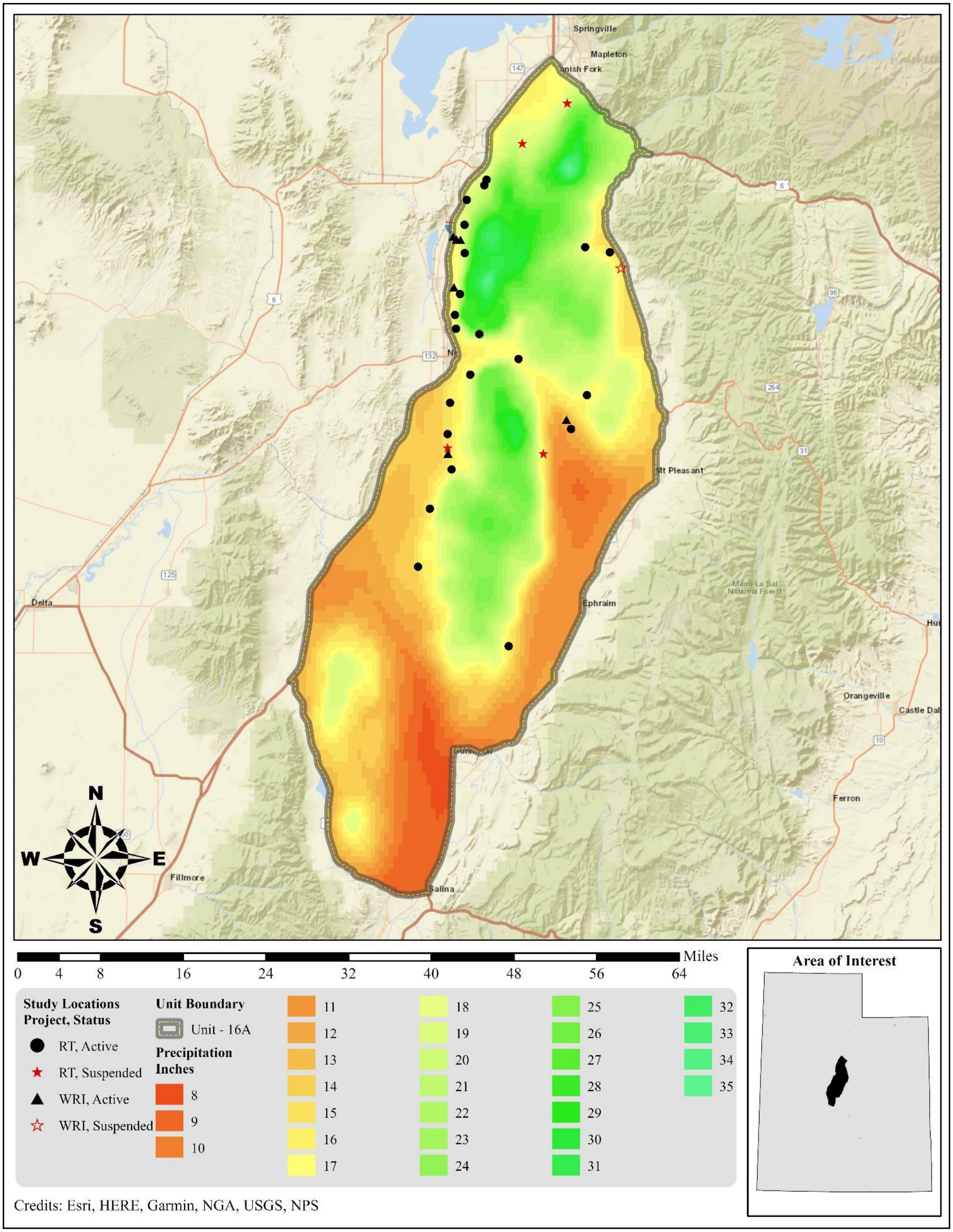
Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 8 inches in the Sanpete Valley and along the I-15 corridor near Yuba Reservoir to 35 inches on Mount Nebo. All of the Range Trend and WRI monitoring studies on the unit occur between 12 and 25 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 (NOAA) Physical Sciences Division (PSD) as part of the North Central, South Central, and Northern Mountain divisions (Divisions 3, 4, and 5).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2015, 2018, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995-1998, 2005, and 2011 (**Figure 1.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021-2022. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007, 2012-2013, 2015, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995, 1997-1998, and 2005 (**Figure 1.1b**).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 2002-2003, 2012-2014, 2018, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1997-1998, 2005, and 2011 (**Figure 1.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 2000, 2002-2004, 2007-2008, 2012-2014, 2018, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2002-2003, 2007, 2009, 2012, and 2020; moderately to extremely wet years were displayed in 1997-1998, 2005, and 2011 (**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; moderately to extremely wet years were displayed 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 2021-2022; 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 in 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, 2023).



Map 1.1: The 1991-2020 PRISM Precipitation Model for WMU 16A, Nebo (PRISM Climate Group, Oregon State University, 2021).

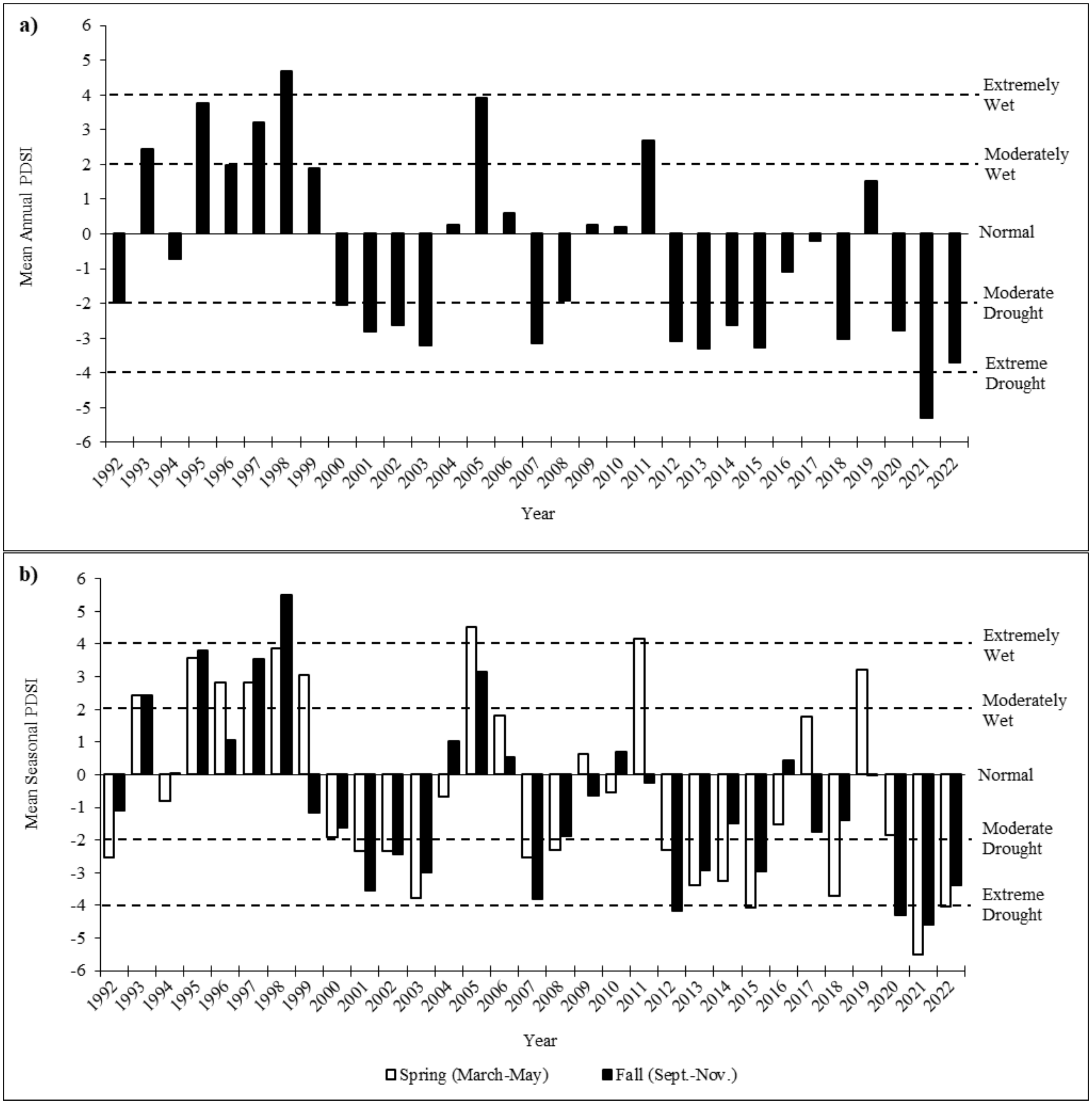


Figure 1.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

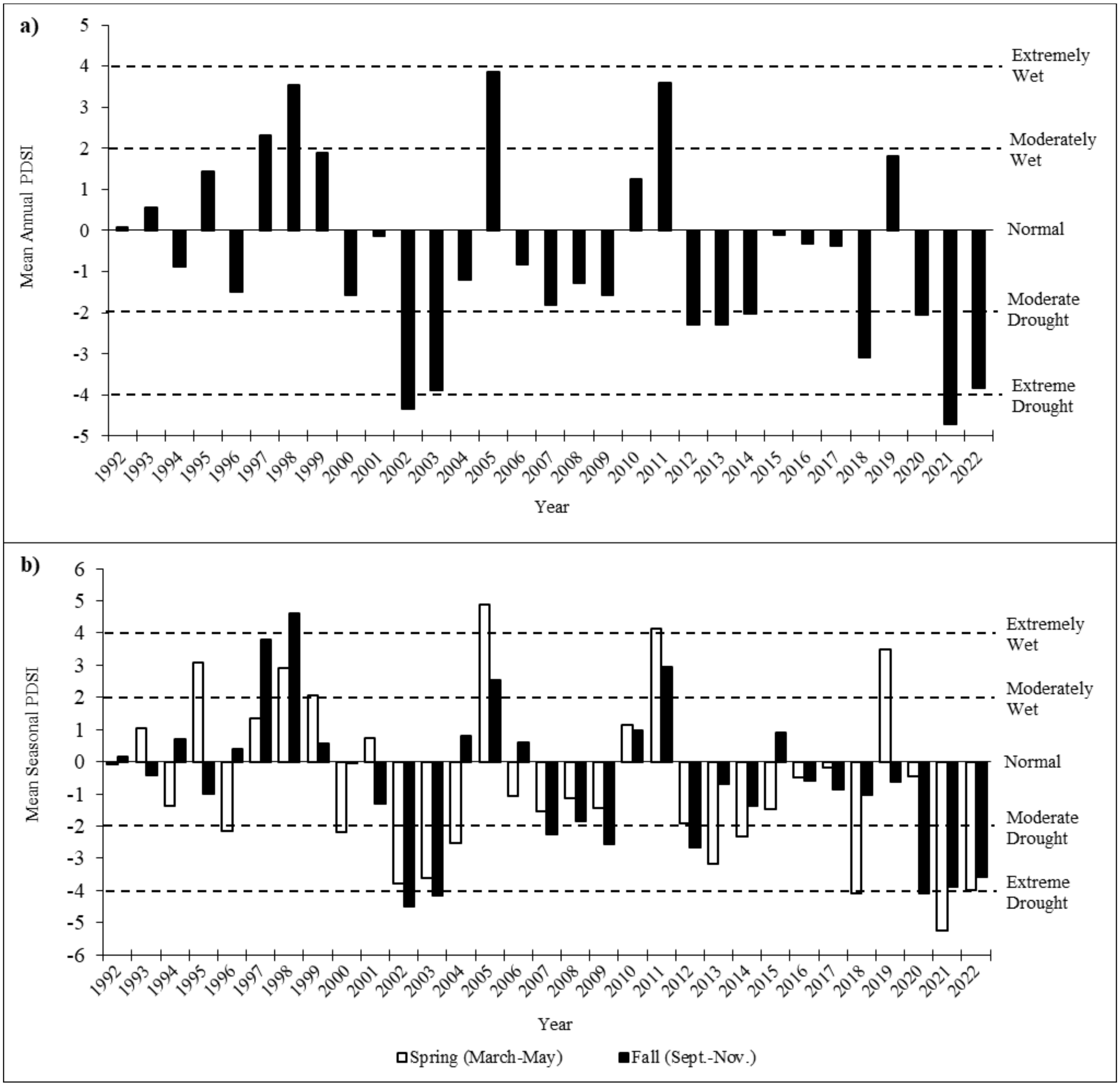


Figure 1.2: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

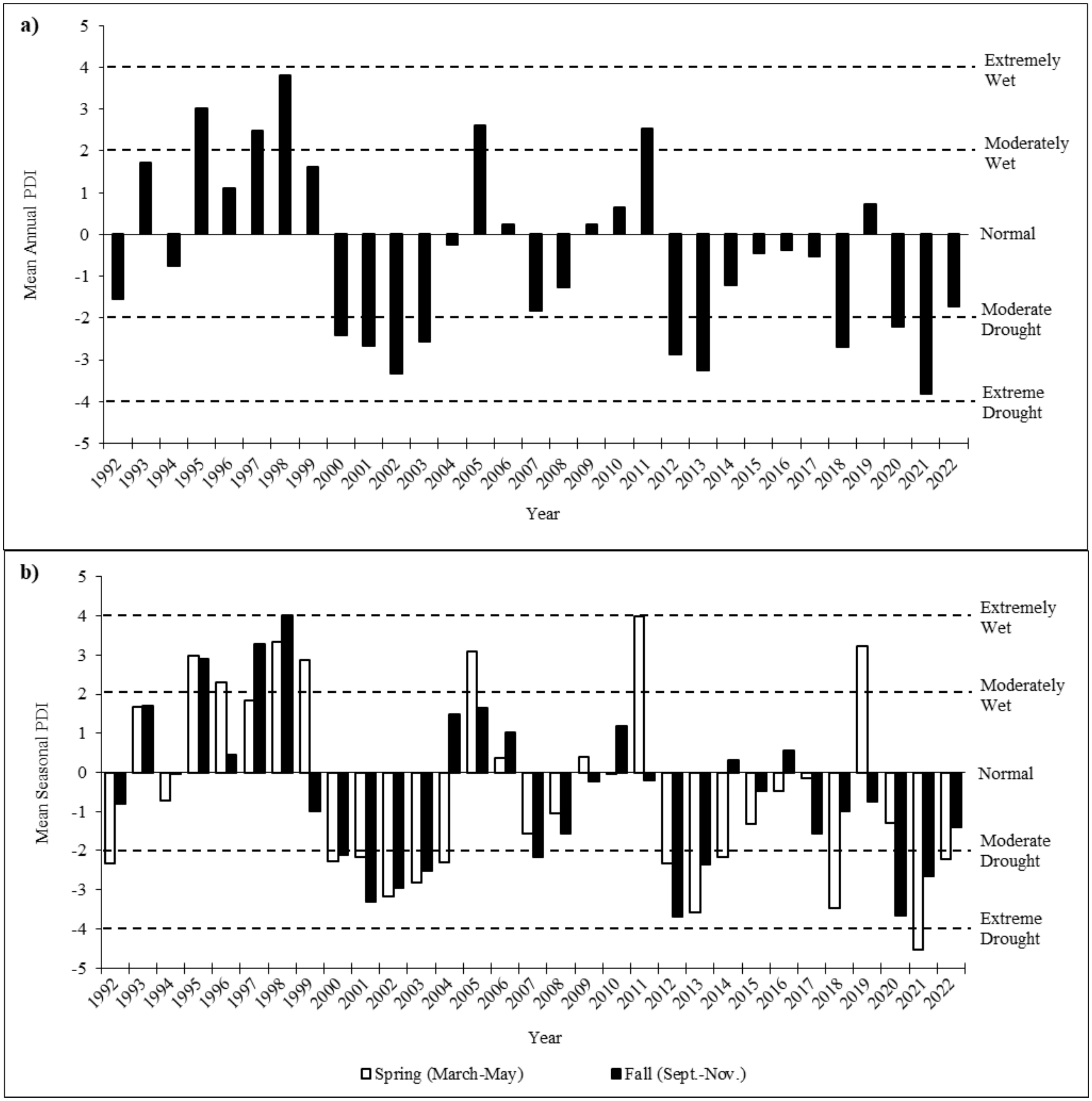


Figure 1.3: The 1992-2022 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

Big Game Habitat

Deer winter range is located mostly along the foothills of the ranges within the unit; the lower portions of deer winter range follow I-15 and US-89 north and south. This unit is limited by I-15 and associated fencing on the west side, which has hindered access to former winter range further west. During severe winters, this west side of the unit is limited by the small areas of crucial winter range, which are in some areas only a few hundred yards in size. The east side of the unit is not limited by crucial winter range to the same degree.

Both sagebrush and mixed mountain brush are major components of the winter range within this unit. Mountain big sagebrush occupies many of the lower flats and foothill regions. Mixed mountain brush communities, composed of Stansbury cliffrose, serviceberry, Gambel oak and mountain mahogany, occur within much of the winter ranges in the unit, often on the sides of foothill areas. There are pinyon-juniper communities present throughout the winter range, although many encroachment removal efforts have taken/are currently taking place across the unit. Residual tree cover can help provide thermal cover in wintering areas.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between Range Trend samplings.

The RAP data illustrates a peak in herbaceous cover and biomass in the early to mid-1990s that has slowly decreased to the present. Annuals showed a general increase in cover over this same time period with years of good precipitation correlating with large flushes of annuals: this is more pronounced on the winter habitats (**Figure 1.4**, **Figure 1.5**, **Figure 1.6**, **Figure 1.7**). The Range Trend data from 1997 to present shows a general increase in perennial cover, but annual cover has fluctuated (**Figure 1.22**, **Figure 1.23**). This fluctuation of annual cover is expected due to differences in timing and amounts of precipitation for each sample year read.

The RAP data for tree and shrub cover shows fluctuation over time, but cover has remained relatively stable for both trees and shrubs (**Figure 1.8**, **Figure 1.9**). Range Trend data displays general decreases in shrub and tree cover since 1997 (**Figure 1.10**, **Figure 1.11**, **Figure 1.12**, **Figure 1.13**, **Figure 1.14**, **Figure 1.15**).

RAP – Biomass by Deer Habitat

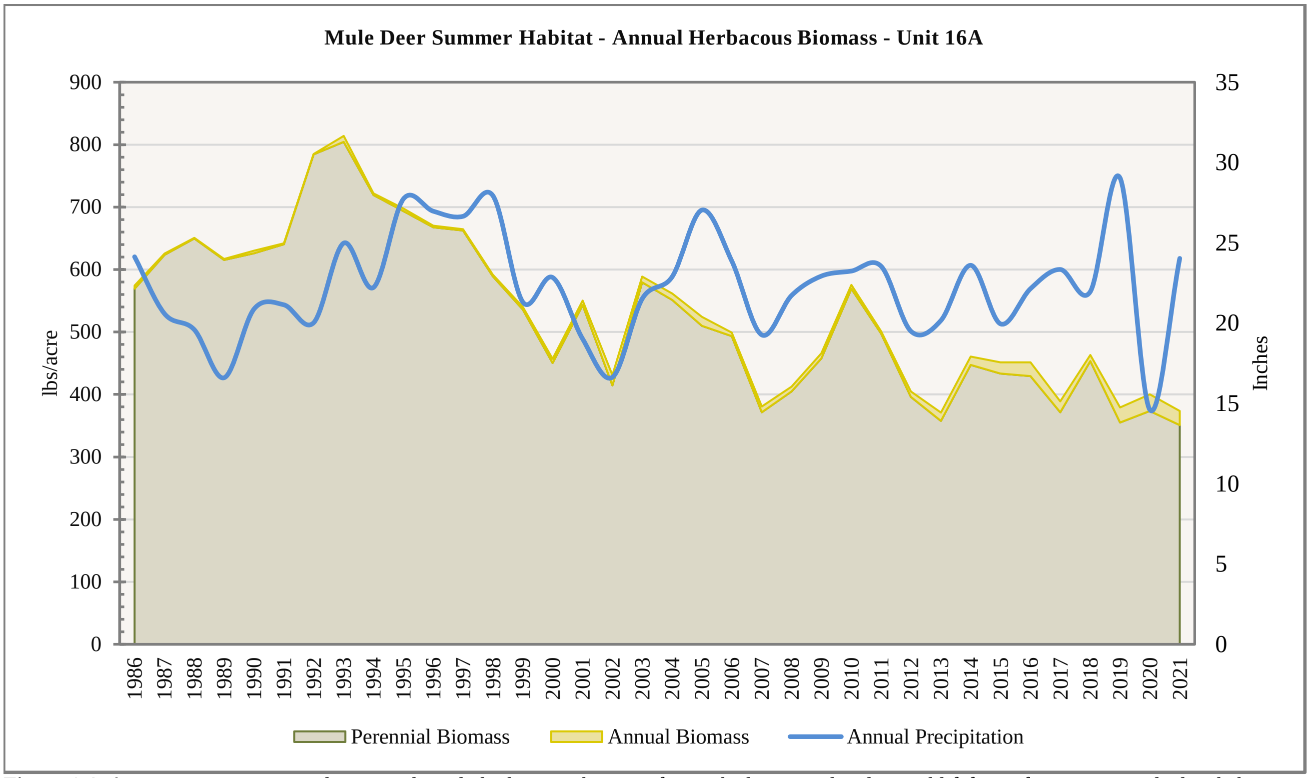


Figure 1.4: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 16A, Nebo (Rangeland Analysis Platform, 2023).

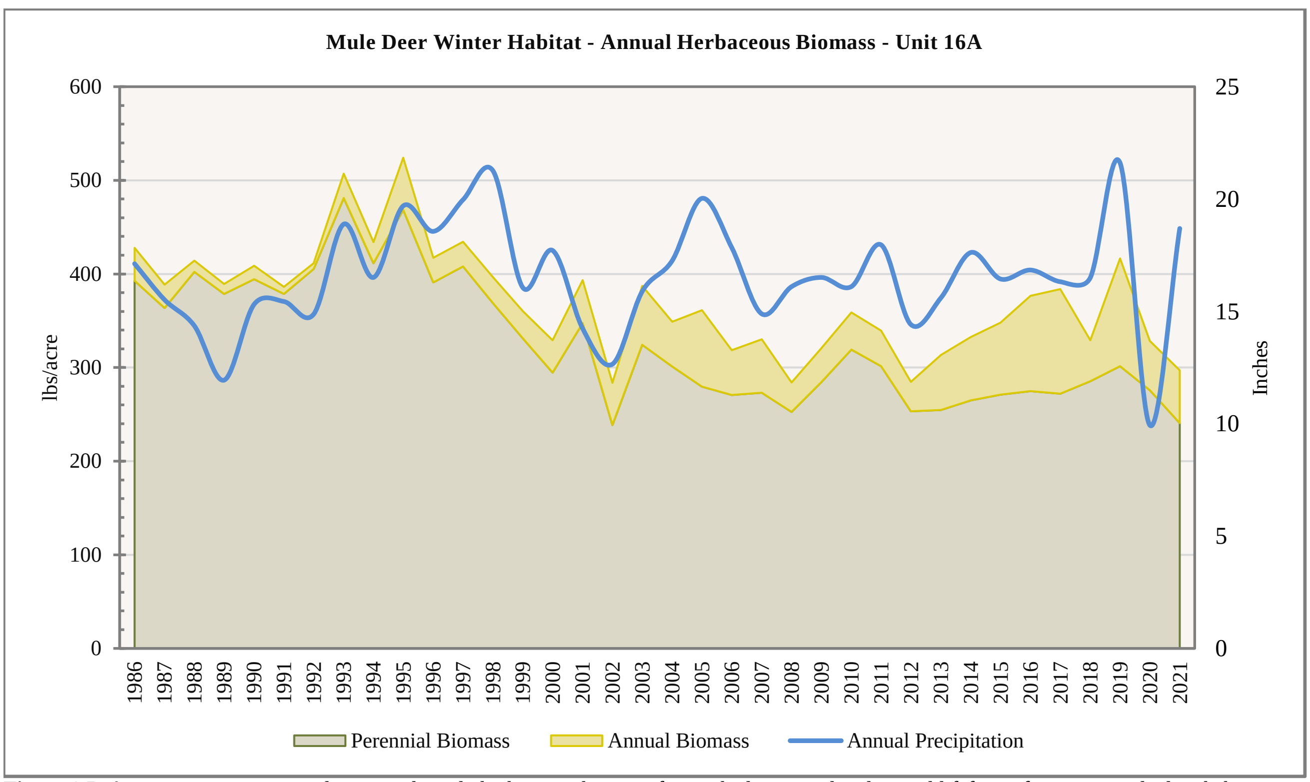


Figure 1.5: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 16A, Nebo (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

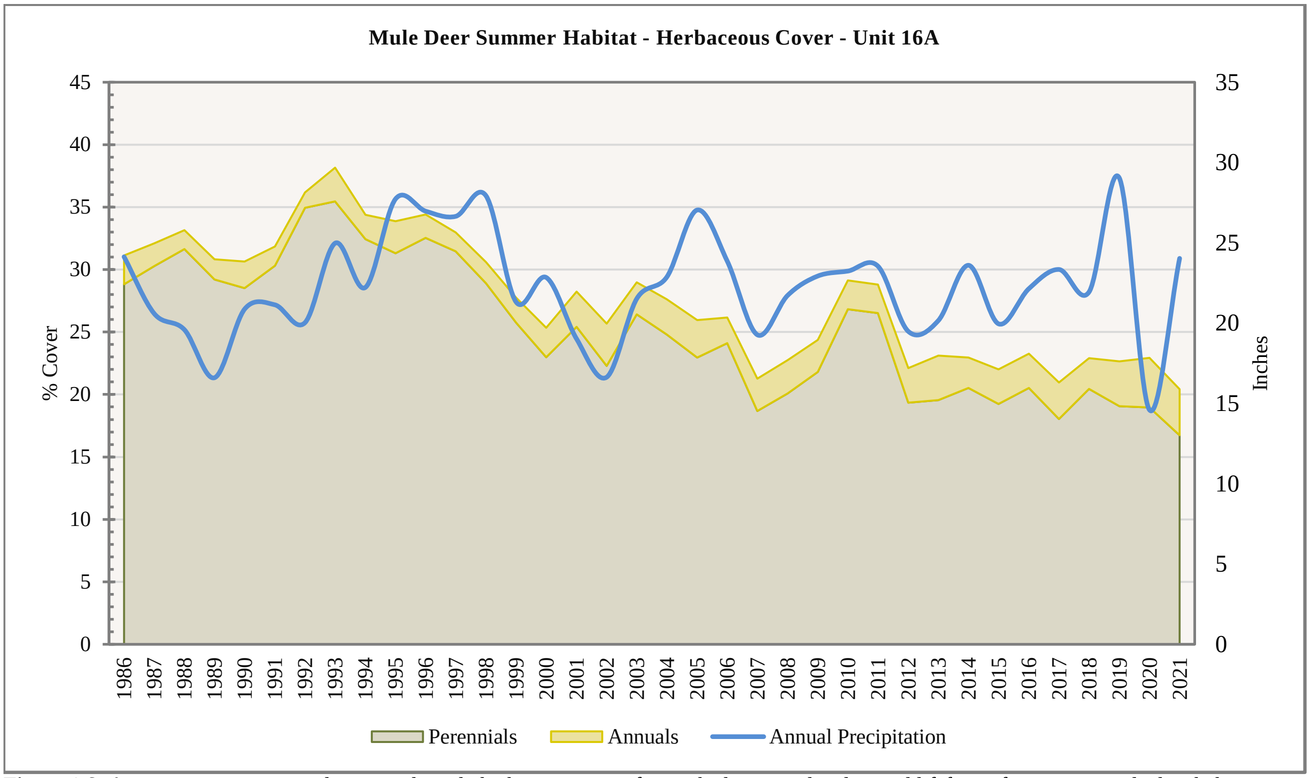


Figure 1.6: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 16A, Nebo (Rangeland Analysis Platform, 2023).

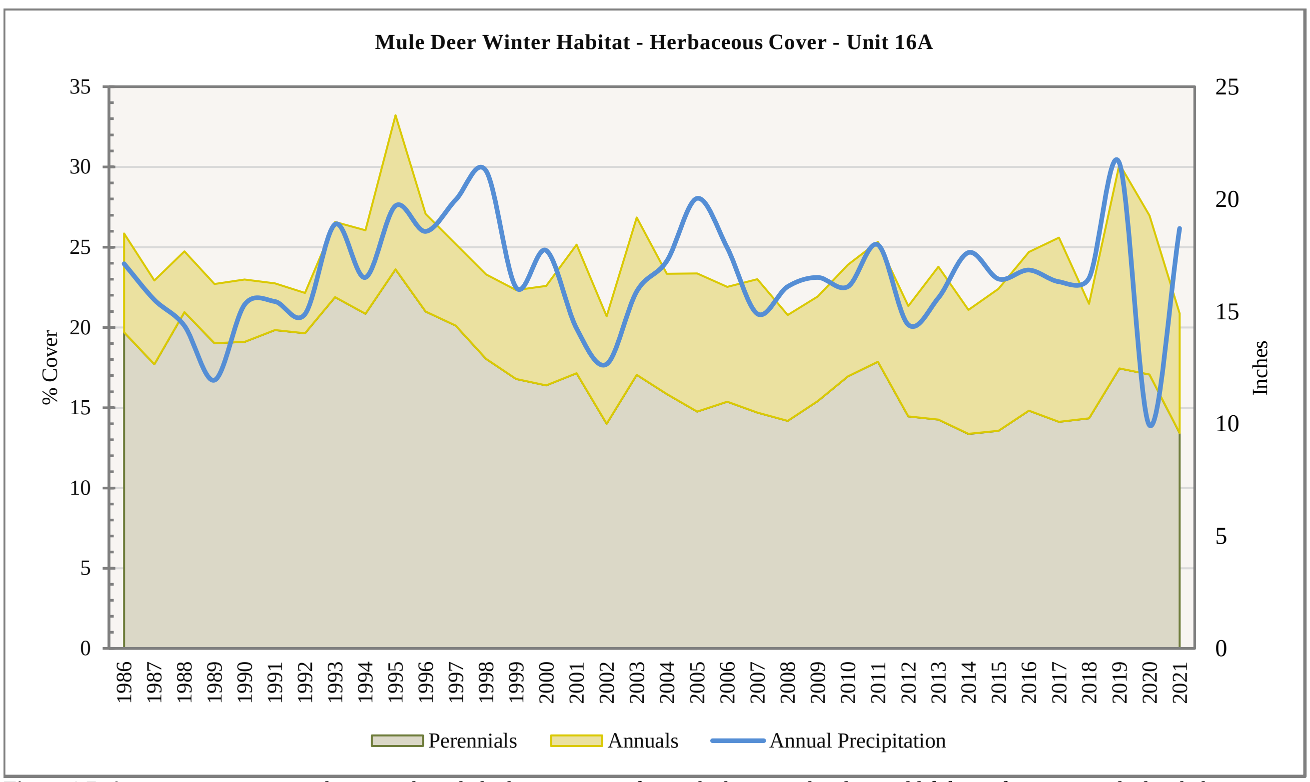


Figure 1.7: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 16A, Nebo (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

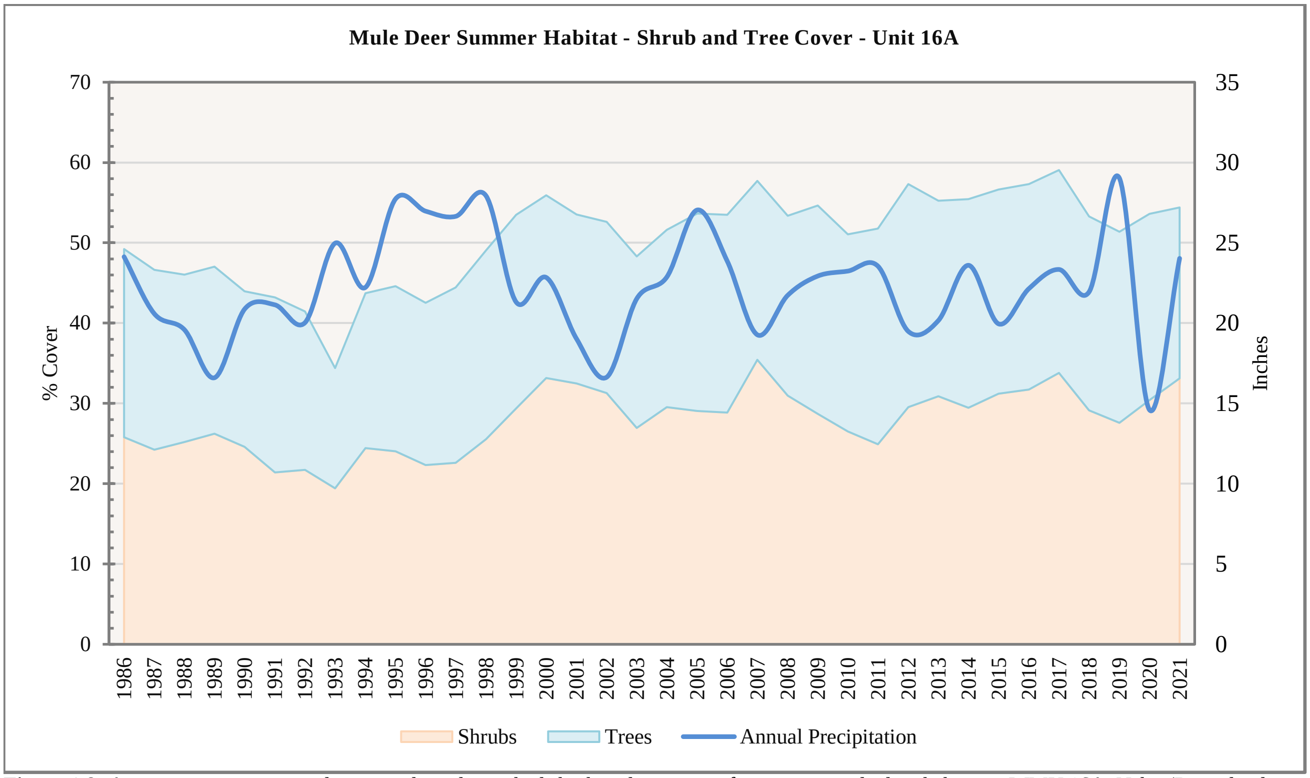


Figure 1.8: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 16A, Nebo (Rangeland Analysis Platform, 2023).

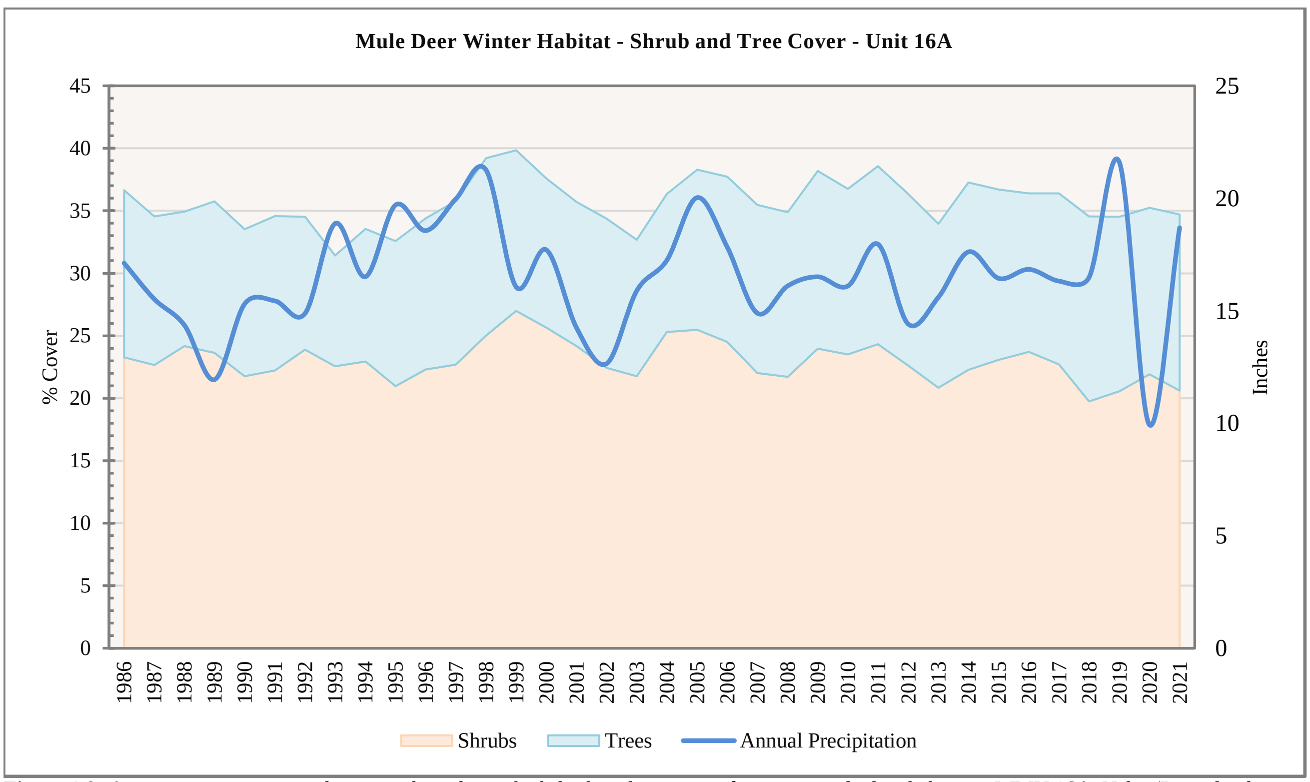
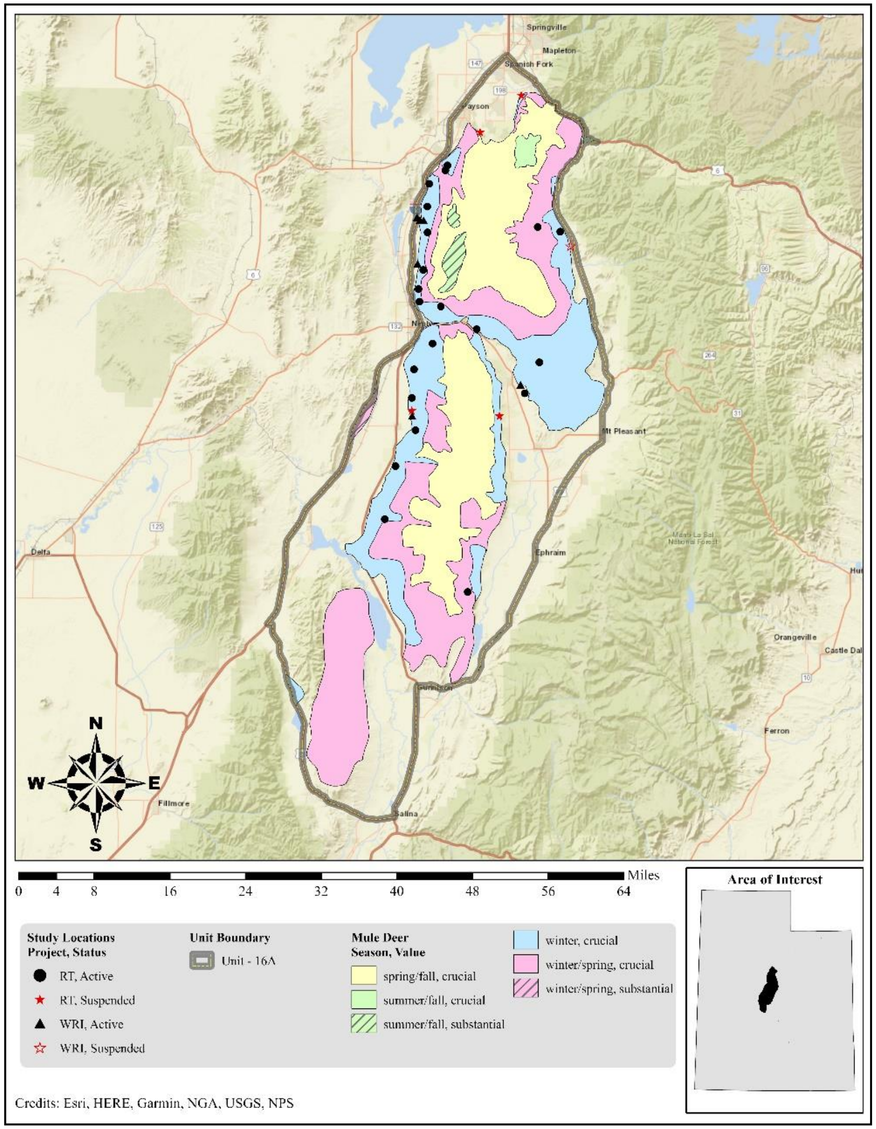
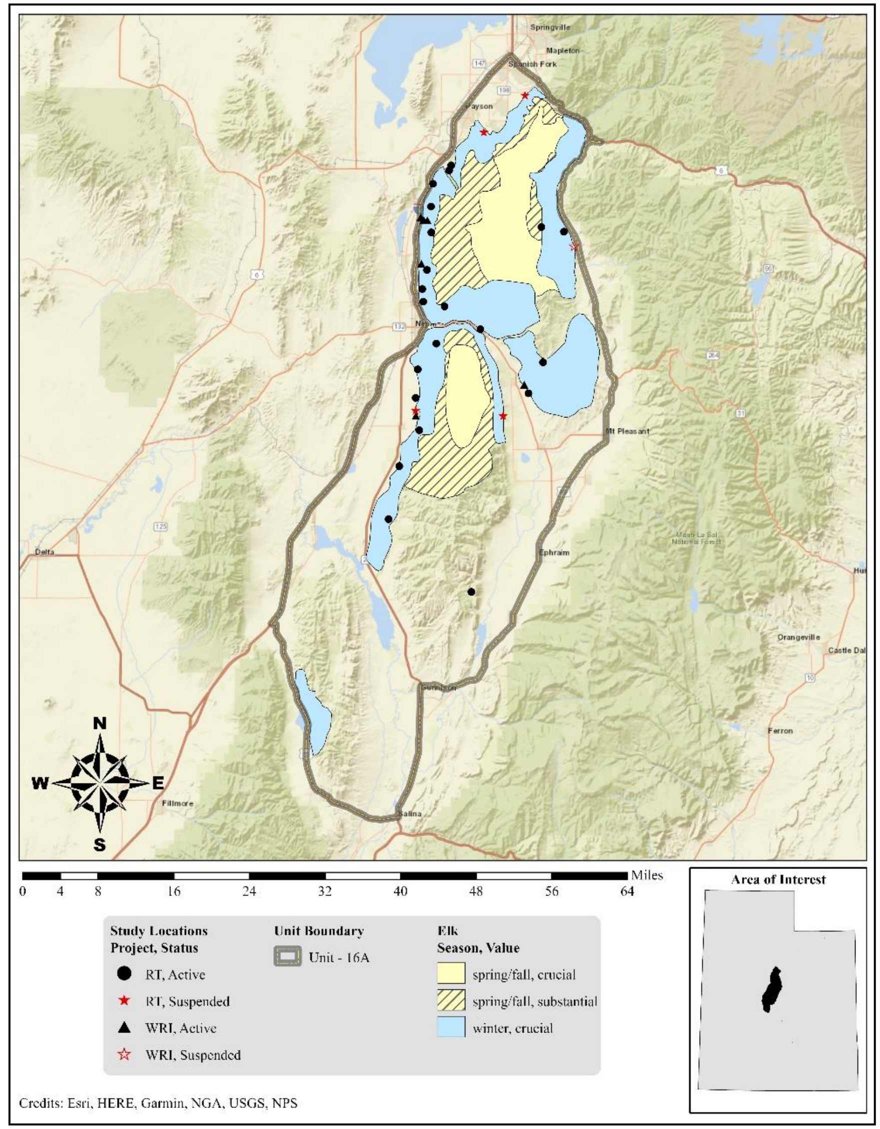


Figure 1.9: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 16A, Nebo (Rangeland Analysis Platform, 2023).



Map 1.2: Estimated mule deer habitat by season and value for WMU 16A, Nebo.



Map 1.3: Estimated elk habitat by season and value for WMU 16A, Nebo.

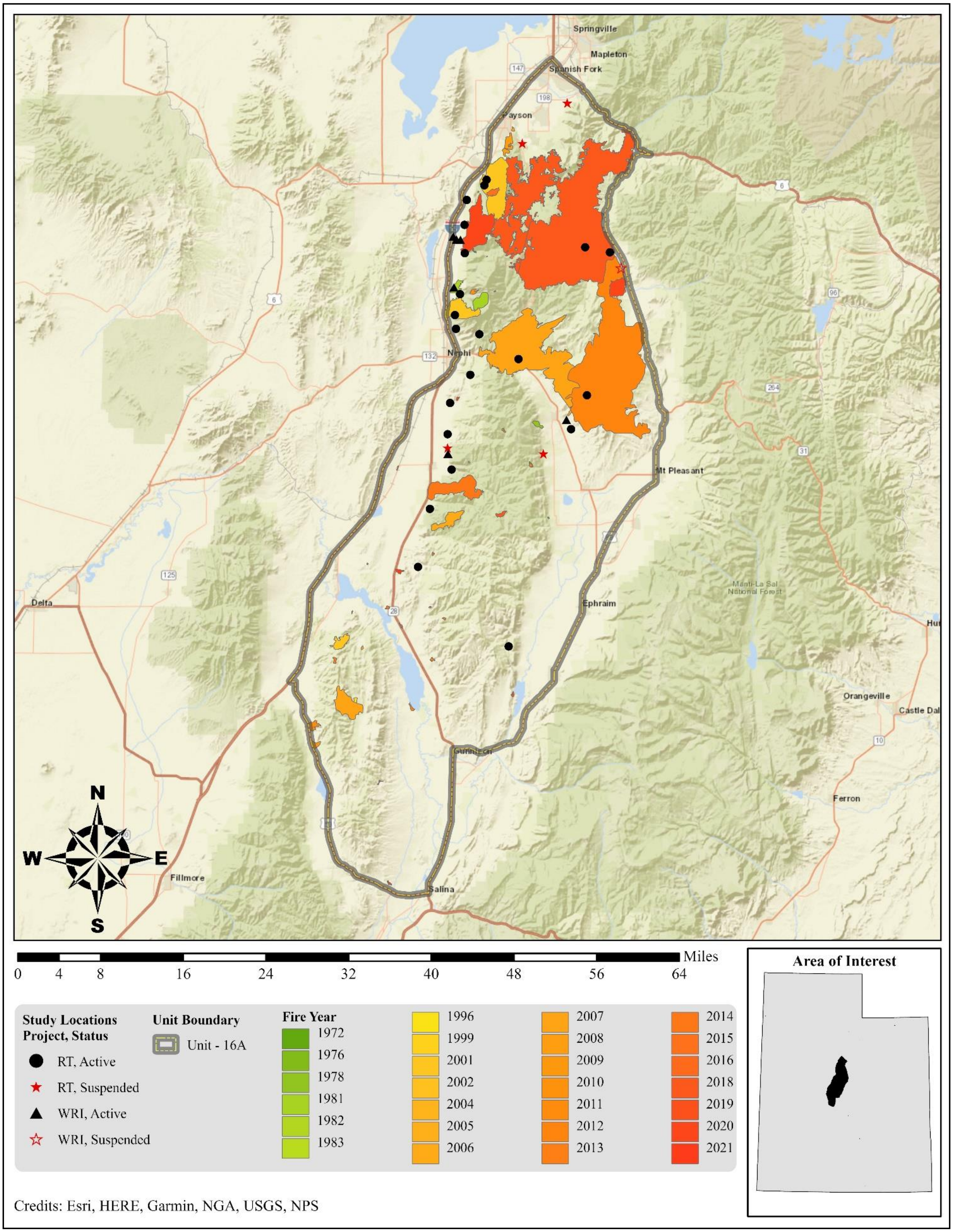
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	141,942	25.17%	
	Great Basin Pinyon-Juniper Woodland	30,729	5.45%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	19,953	3.54%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	15,151	2.69%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	6,400	1.13%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	6,163	1.09%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	3,091	0.55%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	2,942	0.52%	
	Southern Rocky Mountain Ponderosa Pine Woodland	835	0.15%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	575	0.10%	
	Inter-Mountain Basins Juniper Savanna	270	0.05%	40.44%
Shrubland	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	75,649	13.42%	
	Inter-Mountain Basins Big Sagebrush Shrubland	40,762	7.23%	
	Inter-Mountain Basins Montane Sagebrush Steppe	29,526	5.24%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	21,151	3.75%	
	Great Basin Xeric Mixed Sagebrush Shrubland	19,425	3.44%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	6,739	1.20%	
	Great Basin Semi-Desert Chaparral	1,896	0.34%	
	Rocky Mountain Lower Montane-Foothill Shrubland	1,462	0.26%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	898	0.16%	
	Rocky Mountain Alpine Dwarf-Shrubland	584	0.10%	
	Inter-Mountain Basins Big Sagebrush Steppe	36	0.01%	
	Inter-Mountain Basins Greasewood Flat	25	0.00%	
	Inter-Mountain Basins Mat Saltbush Shrubland	2	0.00%	35.14%
Other	Hardwood	55,862	9.91%	
	Sparsely Vegetated	10,203	1.81%	
	Conifer-Hardwood	8,861	1.57%	
	Agricultural	4,754	0.84%	
	Developed	3,897	0.69%	
	Riparian	1,253	0.22%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	414	0.07%	
	Open Water	87	0.02%	15.13%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	8,409	1.49%	
	Interior Western North American Temperate Ruderal Grassland	8,136	1.44%	
	Great Basin & Intermountain Introduced Annual Grassland	4,684	0.83%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	2,096	0.37%	4.14%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	9,038	1.60%	
	Inter-Mountain Basins Semi-Desert Grassland	2,967	0.53%	
	Southern Rocky Mountain Montane-Subalpine Grassland	2,932	0.52%	
	Rocky Mountain Alpine Fell-Field	259	0.05%	
	Rocky Mountain Alpine Turf	2	0.00%	2.70%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	11,958	2.12%	
	Interior Western North American Temperate Ruderal Shrubland	1,889	0.34%	2.46%
Total		**563,909**	**100%**	**100%**

Table 1.1: LANDFIRE Existing Vegetation Coverage For Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 16A, Nebo.

Limiting Factors to Big Game Habitat

The principal limiting factor and management concern in the Nebo management unit is the lack of winter range in good condition, especially crucial winter range on the west side of the unit. In the area from Spanish Fork Canyon south to Nephi, the normal winter range averages two miles or less in width. Crucial winter range is even narrower, ranging from a few hundred yards to 1.5 miles in width. However, the winter range on the east and south sides of the unit is more expansive and not nearly as critical.

Some of the major problems related to the limited winter range on the unit (especially low elevation crucial winter range) include restricted access to traditional wintering areas west of I-15, predominantly private ownership of critical ranges (57% of normal winter range), and agricultural depredation. To remedy the situation, the Utah Division of Wildlife Resources (DWR) has acquired approximately 12,800 acres of winter range in the unit (11% of total winter range) and has attempted treatments and rehabilitation projects in these critical areas. The available winter range, especially critical areas on the west side of the unit, remains threatened by urban development and a high fire hazard caused by the presence of significant amounts of cheatgrass (*Bromus tectorum*). As previously mentioned, a major threat to deer winter habitat is the development of winter range on private property. Most of the winter range on the north end of the Nebo unit is privately owned: there is continual expansion of new home construction in the higher elevations of winter range in the communities of Spanish Fork, Salem, Woodland Hills and Elk Ridge. The same is true on the central part of the Nebo unit, along Water Hollow and Big Hollow; the development there, however, is more for cabin lots and not for residential housing. Both of these areas have historically been very important winter ranges for large populations of mule deer. State-owned WMAs along the east and west side of the unit are important areas of protection. However, these WMAs may prove inadequate to sustain the deer population at the desired objective as private development continues in the future. Therefore, further habitat acquisition and rehabilitation are necessary to maintain adequate winter range in this management unit.



Map 1.4: Land coverage of fires by year from 1972-2021 for WMU 16A, Nebo (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

Treatments/Restoration Work

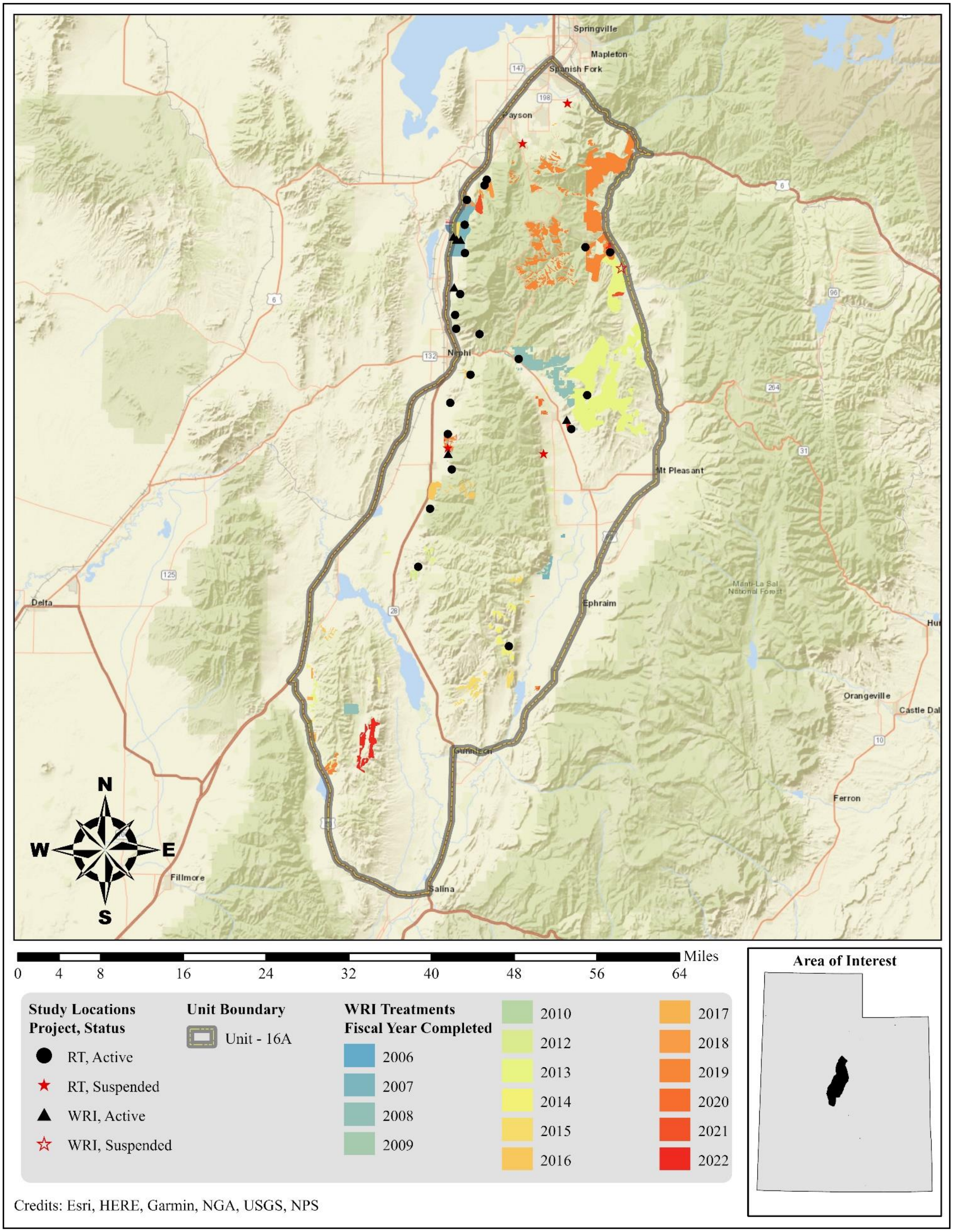
There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 77,064 acres of land have been treated within the Nebo unit since the WRI was implemented in 2004. An additional 4,489 acres are currently being treated and treatments have been proposed for 22,959 acres. Treatments frequently overlap one another, bringing the net total of completed treatment acres to 73,547 acres for this unit (**Table 1.2**, **Map 1.5**). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

Habitat restoration seedings to augment the herbaceous understory is the most common treatment type. Anchor chaining to remove pinyon and juniper trees is also very common. Herbicide application to remove invasive species is an effective tool to manage cheatgrass. Other management practices include (but are not limited to) bullhog, hand crews to remove pinyon and juniper, and shrub seedings (**Table 1.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**21,986**	**0**	**0**	**21,986**
Ely (One-Way)	17,382	0	0	17,382
Ely (Two-Way)	1,900	0	0	1,900
Smooth (One-Way)	2,704	0	0	2,704
Bullhog	**3,791**	**3,174**	**4,228**	**11,193**
Full Size	2,265	1,884	3,020	7,170
Skid Steer	1,526	1,289	1,208	4,023
Chain Harrow	**382**	**0**	**0**	**382**
≤ 15 ft. (One-Way)	354	0	0	354
≤ 15 ft. (Two-Way)	29	0	0	29
Excavating/Extraction	**0**	**0**	**0**	**0**
Other	0	0	0	0
Greenstripping	**0**	**15**	**0**	**15**
Greenstripping	0	15	0	15
Harrow	**285**	**0**	**0**	**285**
≤ 15 ft. (One-Way)	209	0	0	209
≤ 15 ft. (Two-Way)	76	0	0	76
Herbicide Application	**3,088**	**92**	**1,335**	**4,515**
Aerial (Fixed-Wing)	472	75	804	1,351
Aerial (Helicopter)	895	0	531	1,425
Ground	1,683	17	0	1,701
Spot Treatment	38	0	0	38
Interseeding	**26**	**0**	**0**	**26**
Interseeding	26	0	0	26
Mowing	**0**	**0**	**104**	**104**
Brush Hog	0	0	104	104
Planting/Transplanting	**61**	**112**	**473**	**646**
Bareroot Stock	5	0	0	5
Container Stock	47	112	473	632
Other	8	0	0	8
Prescribed Fire	**0**	**0**	**10,446**	**10,446**
Prescribed Fire	0	0	10,446	10,446
Other	**3**	**0**	**0**	**3**
Road/Parking Area Improvements	3	0	0	3
Seeding (Primary)	**41,178**	**65**	**3**	**41,246**
Broadcast (Aerial-Fixed Wing)	34,178	0	0	34,178
Broadcast (Aerial-Helicopter)	5,339	0	0	5,339
Drill (Rangeland)	356	0	3	359
Drill (Truax)	36	0	0	36
Ground (Mechanical Application)	1,136	65	0	1,201
Hand Seeding	134	0	0	134
Seeding (Secondary/Shrub)	**961**	**0**	**0**	**961**
Broadcast (Aerial-Fixed Wing)	945	0	0	945
Drill (Rangeland)	16	0	0	16

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Vegetation Removal/Hand Crew	**5,302**	**1,030**	**6,370**	**12,703**
Lop (No Scatter)	657	0	0	657
Lop & Chip	319	43	43	405
Lop & Scatter	4,327	987	6,327	11,641
Grand Total	**77,064**	**4,489**	**22,959**	**104,511**
***Total Land Area Treated**	**73,547**	**4,489**	**22,959**	**100,994**

Table 1.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 16A, Nebo. Data accessed on 01/23/2023. *Does not include overlapping treatments.



Map 1.5: WRI treatments by fiscal year completed for WMU 16A, Nebo.

Range Trend Studies

Range Trend studies have been sampled within WMU 16A on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 1.3**). 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 1.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
16A-1	Strawberry Highline Canal	RT	Suspended	1983, 1989, 1997	Mountain Stony Loam (Oak)
16A-2	Santaquin Bench	RT	Suspended	1983, 1989, 1997, 2002, 2007, 2012, 2017	Mountain Loam (Oak)
16A-3	Santaquin Hill	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Oak)
16A-4	Wash Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
16A-5	Nebo Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Gravelly Loam (Mountain Big Sagebrush)
16A-6	Hop Creek Browse	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
16A-7	Willow Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Very Steep Stony Loam (Cliffrose)
16A-8	Gardner Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Very Steep Stony Loam (Cliffrose)
16A-9	Birch Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Very Steep Stony Loam (Cliffrose)
16A-10	North Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Oak)
16A-11	Rees Flat	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Gravelly Loam (Oak)
16A-12	Tithing Mountain	RT	Suspended	1989, 1997, 2002, 2007, 2012	Mountain Stony Loam (Browse)
16A-13	Steele Ranch	RT	Active	1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Gravelly Loam (Oak)
16A-14	Big Hollow	RT	Active	1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
16A-15	Old Pinery	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
16A-16	Levan Farm Chaining	RT	Suspended	1983, 1997, 2002, 2007	Upland Loam (Mountain Big Sagebrush)
16A-17	Chicken Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Very Steep Loam (Cliffrose)
16A-18	Deep Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Loam (Birchleaf Mountain Mahogany)
16A-19	Flat Canyon	RT	Active	1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Gravelly Loam (Mountain Big Sagebrush)
16A-20	Triangle Ranch	RT	Active	1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
16A-21	Jerusalem	RT	Suspended	1989	Not Verified
16A-22	Levan North	RT	Active	2007, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
16A-23	Fountain Green Plateau	RT	Active	2007, 2012, 2017, 2022	Upland Loam (Wyoming Big Sagebrush)
16A-24	Maple Canyon	RT	Active	2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
16A-25	Santaquin Bench South	RT	Active	2022	Mountain Loam (Oak)
16R-9	Lasson CE	RT	Suspended	1999	Not Verified
16R-22	Levan Spray and Drill	WRI	Active	2006, 2010, 2017	Upland Loam (Mountain Big Sagebrush)
16R-26	Fountain Green Dixie and Plateau	WRI	Active	2007, 2010, 2015, 2019	Upland Loam (Basin Big Sagebrush)
16R-28	Willow Creek Dixie	WRI	Active	2008, 2011, 2017	Upland Loam (Mountain Big Sagebrush)
16R-40	Mona Bench	WRI	Active	2011, 2014, 2018, 2021	Upland Gravelly Loam (Bonneville Big Sagebrush)
16R-41	Mona Bench 2	WRI	Active	2011, 2014, 2018	Upland Gravelly Loam (Bonneville Big Sagebrush)
16R-51	North Canyon	WRI	Active	2013, 2018	Upland Gravelly Loam (Bonneville Big Sagebrush)
16R-58	Rocky Hollow Ridge	WRI	Active	2021, 2022	Mountain Stony Loam (Mountain Big Sagebrush)

Table 1.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 16A, Nebo.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
16A-2	Santaquin Bench	Seed Unknown		2002		
		Wildfire	Mollie Fire	August 2001	8,021	
16A-4	Wash Canyon	Aerial	Pole Creek/Bald Mountain Fire Rehabilitation	November 2018	1,823	4773
		Aerial	Pole Creek/Bald Mountain Fire Rehabilitation	January 2019	1,823	4773
		Wildfire	Pole Creek/Bald Mountain Fire Complex	August-October 2018	120,854	
16A-5	Nebo Creek	Wildfire	Pole Creek/Bald Mountain Fire Complex	August-October 2018	120,854	
		Wildfire	Nebo Creek	July 2001	4,378	
16A-6	Hop Creek Browse	Wildfire	Salt Creek	July-August 2007	25,913	
		One-Way Smooth	Salt Creek Wildfire Rehabilitation	December 2007	302	970
		Aerial Before	Salt Creek Wildfire Rehabilitation	November 2007	1,197	970
		Dribbler	Salt Creek Wildfire Rehabilitation	December 2007	302	970
16A-9	Birch Creek	Wildfire	Birch	September 2001	2,681	
16A-11	Rees Flat	Wildfire		Prior to 1983		
		Seed Unknown		Prior to 1983		
16A-14	Big Hollow	Wildfire	Salt Creek	July 2007	25,913	
		One-Way Ely	Salt Creek Wildfire Rehabilitation	November 2007	221	970
		Aerial Before	Salt Creek Wildfire Rehabilitation	November 2007	1,197	970
		Wildfire	Wood Hollow	June-July 2012	47,387	
		Aerial	Wood Hollow Fire	January 2013	301	2481
		Dribbler	Salt Creek Wildfire Rehabilitation	November 2007	221	970
		Chain Unknown		1964		
16A-15	Old Pinery	Chain Unknown		Early 1980s		
		Seed Unknown		Early 1980s		
16A-16	Levan Farm Chaining	Seed Unknown		Early 1970s		
		Chain Unknown		Early 1970s		
		Bullhog	Levan Wildlife Management Area Bullhog	2018	808	3954
		Lop and Scatter	Levan Farm WMA Habitat Improvement	Fall 2006	700	271
16A-19	Flat Canyon	Aerial Before	Chriss Creek PJ Removal Phase 2	October 2012	333	2223
		Bullhog	Chriss Creek PJ Removal Phase 2	December 2012-March 2013	333	2223
16A-20	Triangle Ranch	Dribbler	Triangle Ranch WMA Bullhog Project	Spring 2016	302	3447
		Bullhog	Triangle Ranch WMA Bullhog Project	July 2015-April 2016	302	3447
		Chain Unknown		Early 1970s		
		Seed Unknown		Early 1970s		
16A-22	Levan North	Chain Unknown		Early 1970s		
		Seed Unknown		Early 1970s		
		Lop and Scatter	Levan Farm WMA Habitat Improvement	Fall 2006	700	271
16A-22	Levan North	Dribbler	Levan Wildlife Management Area Bullhog	July 2017-June 2019	709	3954
		Bullhog	Levan Wildlife Management Area Bullhog	July 2017-June 2019	709	3954

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
16A-23	Fountain Green Plateau	Plateau	CRO WMA Upland Game Habitat Improvement - Phase II	June 2016	94	3461
		One-Way Chain	CRO WMA Upland Game Habitat Improvement - Phase II	October 2016	94	3461
		Broadcast Before	CRO WMA Upland Game Habitat Improvement - Phase II	October 2016	94	3461
		Plateau	Fountain Green WMA Habitat Improvement	September 2007	275	288
16A-24	Maple Canyon	Bullhog	Maple Canyon WMA Habitat Improvement	September 2012-October 2013	514	2352
		Two-Way Unknown	San Pitch Mountain Seeding	June-October 1969	392	LTDL
		Aerial Before	San Pitch Mountain Seeding	June-October 1969	392	LTDL
16A-25	Santaquin Bench South	Transplant	Central Region Shrub Restoration Projects FY2020	October 2020-March 2021	20	4812
		Wildfire	Mollie	2001	8,021	
16R-9	Lasson CE	Wildfire	Wood Hollow Fire	June-July 2012	47,387	
		Aerial Before	Wood Hollow Fire, North Rehabilitation Project	October 2012	4,202	2464
		One-Way Ely	Wood Hollow Fire, North Rehabilitation Project	October-November 2012	2,407	2464
		Aerial After	Wood Hollow Fire, North Rehabilitation Project	February 2013	2,725	2464
16R-22	Levan Spray and Drill	Agricultural Field		Historic		
		Plateau, Roundup, Paramount	Levan Farm WMA Habitat Improvement	Fall 2006	62	271
		Roundup	Levan Farm WMA Habitat Improvement	May 2007	62	271
		Plateau, Roundup	Levan Farm WMA Habitat Improvement	October 2007	62	271
		Rangeland Drill	Levan Farm WMA Habitat Improvement	October 2007	40	271
16R-26	Fountain Green Dixie and Plateau	Plateau	Fountain Green WMA Habitat Improvement	September 2007	240	288
		Two-Way Dixie	Fountain Green WMA Habitat Improvement	September 2007-April 2008	20	288
		Broadcast Before	Fountain Green WMA Habitat Improvement	April 2008	35	288
16R-28	Willow Creek Dixie	One-Way Dixie	Willow Creek Habitat Improvement	November-December 2008	52	1101
		Broadcast Before	Willow Creek Habitat Improvement	November-December 2008	52	1101
16R-40	Mona Bench	Milestone	Mona Bench Project	May 2011	62	1934
		Plateau	Mona Bench Project	November 2011	190	1934
		Two-Way Chain	Mona Bench Project	October 2011	190	1934
		Broadcast Before	Mona Bench Project	October 2011	190	1934
		Aerial After	Mona Bench Project	January 2012	190	1934
		Milestone	Mona Bench Project	May 2012	62	1934
16R-41	Mona Bench 2	Plateau	Mona Bench Project	November 2011	128	1934
		Two-Way Chain	Mona Bench Project	October 2011	128	1934
		Broadcast Before	Mona Bench Project	October 2011	128	1934
		Aerial After	Mona Bench Project	January 2012	128	1934
16R-51	North Canyon	Milestone	North Canyon Knapweed Project Phase I	August 2016	662	2688
		Milestone	North Canyon Knapweed Project Phase I	August 2013	662	2688
		Two-Way Chain	North Canyon Knapweed Project Phase I	October 2013	447	2688
		Broadcast Before	North Canyon Knapweed Project Phase I	October 2013	447	2688
		Plateau	North Canyon Knapweed Project Phase I	August 2014	447	2688
		Milestone	North Canyon Knapweed Project Phase I	August 2015	662	2688

Table 1.4: Range Trend and WRI studies known disturbance history for WMU 16A, Nebo. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

Five studies [Wash Canyon (16A-4), Nebo Creek (16A-5), Hop Creek Browse (16A-6), Big Hollow (16A-14), and Triangle Ranch (16A-20)] are classified as Mountain (Big Sagebrush) ecological sites. Wash Canyon and Nebo Creek are located in the foothills west of US-89 near Indianola. The Hop Creek Browse site is situated on the northern side of Nephi Canyon. Big Hollow can be found northeast of Fountain Green. Finally, the Triangle Ranch study site is located in the foothills southeast of Nephi **(Table 1.3**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the most dominant preferred browse species on these study sites. Average total shrub cover has steadily decreased, and sagebrush is the underlying driver of this overall decrease (**Figure 1.11**). 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 with no real net gain in the trend overall. Total preferred browse density has experienced a decrease each successive sample year due to wildfire events removing sagebrush (**Figure 1.18**). Preferred browse utilization has fluctuated from year to year, but has remained steady overall. Total hedging between 2002 to 2022 has decreased overall, and more than 50% of the plants exhibited little to no signs of hedging in all sample years (**Figure 1.20**). It is important to note that as one site has burned, average measurements have shifted to other sites of this potential as sagebrush is removed. In other words, the distribution of the average was weighted on all five sites in 1997, but the average in 2022 for these sites is mostly comprised of the measurements taken at Triangle Ranch.

Trees contribute little to no cover on these study sites. Utah juniper (*Juniperus osteosperma*) was recorded on the Triangle Ranch study in decreasing amounts between 2002 and 2022 in both density and cover measurements (**Figure 1.14, Figure 1.16**).

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 remained similar. Native grass species have generally contributed a large portion of cover on these study sites. However, bulbous bluegrass (*Poa bulbosa*) comprises the majority of the perennial grass cover on Nebo Creek, Triangle Ranch, and Wash Canyon, and is increasing. Annual grasses and forbs have been present in each study year in both cover and abundance measurements. Annual grass trends are driven by the Wash Canyon, Nebo Creek, Hop Creek Browse, and Big Hollow studies, but most notably by the Nebo Creek study (**Figure 1.22**, **Figure 1.24**).

Occupancy: Average pellet transect data indicates that occupancy has decreased over the sample period and that the primary occupants have been deer. Deer pellet groups have had a mean abundance ranging from 85 days use/acre in 2002 to 9 days use/acre in 2022. Mean abundance of elk pellet groups has ranged from 4 days use/acre in 2012 to 17 days use/acre in 2022. Finally, cattle pellets had an average abundance low of 3 days use/acre in 2002, and an average abundance high of 17 days use/acre in 2022 (**Figure 1.26**).

Mountain (Oak)

There are seven study sites [Strawberry Highline Canal (16A-1) (suspended), Santaquin Bench (16A-2) (suspended), Santaquin Hill (16A-3), North Canyon (16A-10), Rees Flat (16A-11), Steele Ranch (16A-13), and Santaquin Bench South (16A-25)] that are considered to be Mountain (Oak) ecological sites. The Strawberry Highline Canal study is located about a mile north of Flat Canyon on the slopes just above Strawberry Highline Canal. Santaquin Bench and Santaquin Hill are both located on the benches south of Santaquin along I-15, and the North Canyon study is situated at the base of the foothills that are northeast of Mona. The Rees Flat study is found along the hillsides near the mouth of Nephi Canyon. Steele Ranch is located east of I-15 near Mona. Finally, the Santaquin Bench South site is situated in the northern portion of the Santaquin WMA near the mouth of Santaquin Canyon (**Table 1.3**).

Shrubs/Trees: The primary browse species on this site are cohorts of Gambel oak (*Quercus gambelii*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), which contributed the most shrub cover between the 2007 and 2017 sample years. However, the 2022 sample year showed a notable decrease in cover for both shrub species. The decrease in oak is associated with the suspension of Santaquin Bench in 2022. The loss of sagebrush cover is due to a cumulative loss across all sites sampled in 2022, but is mostly driven by decreases in sagebrush cover on Rees Flat (**Figure 1.11**). Preferred browse demographic data indicates that mature individuals have comprised a majority of the population in all sample years except 2022, when young and mature plants were nearly equal in number. This is likely due the addition of Santaquin Bench South where young, preferred shrubs were recently transplanted as part of a shrub restoration project. Total density has steadily decreased between 2002 and 2022 (**Figure 1.18)**. Preferred browse utilization decreased between 1997 through 2012 and was considered low overall. However, total utilization increased between 2012 through 2022, increasing from 14% to 61%, respectively (**Figure 1.20**).

Few trees are found in this potential and they provide little to no cover, but 2017 and 2022 cover and density measurements indicate that Utah juniper (*Juniperus osteosperma*) has been present in low amounts. Santaquin Hill is the single study in this potential where juniper trees are observed (**Figure 1.14**, **Figure 1.16**).

Herbaceous Understory: These studies have remained dominated by perennial grasses and annual forbs in all study years. Cover and nested frequency for the herbaceous community have increased overall. Bluebunch wheatgrass (*Pseudoroegneria spicata*) is the most abundant species on Santaquin Hill, while introduced perennial grasses like intermediate wheatgrass (Thinopyrum intermedium) dominate the remaining studies. Bulbous bluegrass (*Poa bulbosa*) is common and abundant within this potential and is considered to be increasing. In addition, annual grass cover has remained minimal on most sites, and the trend is driven by the presence of cheatgrass (*Bromus tectorum*) on North Canyon and Steele Ranch, with nested frequency or cover increasing on these sites. Annual forbs have largely followed an increasing trend for cover, although frequency has remained consistent from year to year (**Figure 1.22**, **Figure 1.24**).

Occupancy: Pellet transect data shows that deer have been the primary occupants on these sites in all sample years, with the mean abundance of pellet groups ranging from 18 days use/acre in 2012 to 63 days use/acre in 2007. Elk pellet groups have had a mean abundance ranging from 3 days use/acre in 2012 to 8 days use/acre in 2007 and 2017 (**Figure 1.26**).

Upland (Big Sagebrush)

Six study sites [Old Pinery (16A-15), Levan Farm Chaining (16A-16) (suspended), Flat Canyon (16A-19), Levan North (16A-22), Fountain Green Plateau (16A-23), and Maple Canyon (16A-24)] are classified as Upland (Big Sagebrush) ecological sites. The Old Pinery study site is located along the western foothills of the San Pitch Mountains between Nephi and Levan. Levan Farm Chaining is found west of the mouth of Hartleys Canyon on the Levan WMA. The Flat Canyon site is situated in the northern portion of Flat Canyon and just northeast of Skinner Peaks. The Levan North study site is located along the San Pitch foothills near Levan. Fountain Green Plateau is situated southeast of Fountain Green along the base of Cedar Hills. The Maple Canyon study is located on the benches to the west of the town of Manti (**Table 1.3**).

Shrubs/Trees: The primary browse species on these sites is big sagebrush (*Artemisia tridentata*). A variety of other preferred browse species such as antelope bitterbrush (*Purshia tridentata*) are also present, but in most cases provide lesser amounts of cover. Total shrub cover had a notable increase in 2012 due to the addition of bitterbrush on Maple Canyon, but has exhibited an overall decrease due to a loss of sagebrush. More specifically, the most significant year for decreased sagebrush cover was 2022, mainly due to the Old Pinery study (**Figure 1.10**). Total preferred browse density has decreased overall between 2002 and 2022, but exhibited a slight increase in 2012. Average demographic data indicates that mature individuals have comprised a majority of the preferred browse population in all sample years. Decadence has exhibited some variability, but with a slight overall decrease, while recruitment of young has also decreased (**Figure 1.18**). Average preferred browse utilization appears to be variable or cyclic, with 25% of combined plants being moderately and heavily used since 1997, and increasing to 64% of total plants being hedged in 2007. This pattern was repeated again between 2012 and 2022 (**Figure 1.20**).

Due to treatments, Utah juniper (*Juniperus osteosperma*) cover has decreased over time on the majority of these sites. However, juniper has increased in cover on Old Pinery. The increase in cover and density in 2012 is due to the addition of Maple Canyon to the unit, and the reduction in both these measurements in 2017 can be attributed to a bullhog treatment that occurred on the same study site (**Figure 1.14**, **Figure 1.16**).

Herbaceous Understory: These studies site have remained dominated by annual forbs and grasses such as cheatgrass (*Bromus tectorum*) and desert madwort (*Alyssum desertorum*) in the majority of years sampled. Total cover and nested frequency have had slight fluctuations from year to year. However, cover has had an overall increase driven by increases in perennial and annual grasses, annual forbs, and bulbous bluegrass (*Poa bulbosa*). The introduced perennial grass species bulbous bluegrass has had notable increases in cover over the sample years: this trend is driven by the Old Pinery and Levan North sites (**Figure 1.22**, **Figure 1.24**).

Occupancy: Pellet transect data shows that total animal occupancy has varied over time, but has decreased overall. Deer have been the primary occupants in all sample years. Mean abundance of deer pellet groups has ranged from 18 days use/acre in 2012 to 50 days use/acre in 2007. Elk were also present in 2007 and 2022 with an average pellet group abundance of 1 days use/acre, but were absent in all other sample years. Finally, cattle pellet groups have had an average abundance fluctuating between 3 days use/acre in 2012 and 7 days use/acre in 2022 (**Figure 1.26**).

Upland (Cliffrose)

Five sites [Willow Creek (16A-7), Gardner Canyon (16A-8), Birch Creek (16A-9), Tithing Mountain (16A-12) (suspended), and Chicken Creek (16A-17)] are considered to be Upland (Cliffrose) ecological sites. Willow Creek is located up Water Hollow, east of Mona. Gardner Canyon is in the foothills northwest of Nephi, and the Birch Creek site is east of I-15 near Nortonville. The Tithing Mountain study is situated near the peak of Tithing Mountain, just west of the town of Elk Ridge. Finally, the Chicken Creek site is located approximately two miles east of Levan (**Table 1.3**).

Shrubs/Trees: Stansbury cliffrose (*Purshia stansburiana*) is the dominant browse species on all study sites, although Utah serviceberry (*Amelanchier utahensis*) and alderleaf mountain mahogany (*Cercocarpus montanus*) tend to be cohorts within this potential and are commonly found on these sites along with other preferred browse species. Total shrub cover decreased between 2012 and 2017 due to the suspension of the Tithing Mountain site, but cover has remained similar between 2017 and 2022 (**Figure 1.13**). Average preferred browse density decreased between the years of 1997 to 2012, but increased in 2017, also due to the suspension of Tithing Mountain; density also decreased between 2017 and 2022. Despite the decrease in density, a large proportion of young plants comprise these populations, suggesting that there should be increases in plant densities. It is important to note, however, that the trend in young is due to the amount of young plants found in the Gambel oak (*Quarcus gambelii*) populations. As such, the amount of young is due to regeneration more than new plants being added to the population, which would account for the overall loss in preferred browse density (**Figure 1.19**). Utilization of preferred browse decreased between 1997 to 2012, but spiked in 2017 with the suspension of Tithing Mountain. Of the plants utilized, the 1997 through 2007 sample years show that use was mostly heavy. Of the four sites sampled in 2017 and 2022, utilization was quite high with 78% and 80% of preferred plants being moderately to heavily hedged, respectively (**Figure 1.21**).

Average tree cover and density for this potential has remained low, with no cover observed being observed on most study sites. Chicken Creek is the study driving the trend for this potential and has a population of sparse, but older trees (**Figure 1.15, Figure 1.17**).

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 have gradually increased over time. However, annual grasses – primarily the introduced species cheatgrass (*Bromus tectorum*) – contribute the majority of the herbaceous cover for this ecotype. Annual forbs are abundant with the primary species being madworts (*Alyssum sp.*) and redstem stork's bill (*Erodium cicutarium*), while perennial forbs have generally been present with less cover and abundance (**Figure 1.23**, **Figure 1.25**).

Occupancy: Average occupancy on these sites has exhibited an overall decrease, with deer being the primary occupants in all study years. Mean abundance of deer pellet groups has ranged from 35 days use/acre in 2012 to 83 days use/acre in 2007. Elk pellet groups have had an average abundance fluctuating between 4 days use/acre in 2012 and 19 days use/acre in 2007. Finally, the mean abundance of cattle pellet groups has been as low as 0 days use/acre in 2002, 2012, and 2017; and as high as 7 days use/acre in 2022 (**Figure 1.27**).

Upland (Browse)

There is one study site [Deep Creek (16A-18)] that is classified as an Upland (Browse) ecological site: this study is located in the San Pitch Mountains south of Levan (**Table 1.3**).

Shrubs/Trees: Alderleaf mountain mahogany (*Cercocarpus montanus*) and Mormon tea (*Ephedra viridis*) have been the dominant browse species in all sample years; other preferred browse species such as Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and Stansbury cliffrose (*Purshia stansburiana*) have also been present, but with less cover. Total shrub cover has increased overall despite small decreases in 2017 and 2022. Mahogany in particular had a notable increase in cover between 2007 and 2012 (**Figure 1.12**). In 2007, decadent and mature plants were nearly equal in average density. However, average preferred browse demographics indicate that a majority of the population has been comprised of mature plants in most other sample years. Density has decreased overall and decadence has also decreased, although with some variability from year to year. Recruitment of young has generally remained low since site establishment (**Figure 1.19**). A majority of preferred browse plants were moderately or heavily browsed in 1997 and 2007, but utilization has since decreased; a majority of plants exhibited no to light use in 2012, 2017, and 2022 (**Figure 1.21**).

Tree cover has varied widely from year to year with Utah juniper (*Juniperus osteosperma*) contributing higher amounts in 2012 and 2021. Density has generally increased over time when considering quadrat sampling data. However, point-quarter data reveals that density of juniper has remained stable (**Figure 1.15**, **Figure 1.17**).

Herbaceous Understory: Cover of the herbaceous understory has had some variability over the sample period, most notably in the 2002 and 2022 sample years. Perennial grasses and forbs are generally stable in both cover and nested frequency. Drivers of the year-to-year variability are fluctuations in annual grasses and forbs. Total perennial grass cover has decreased slightly, while perennial forbs have increased in cover by the same proportion. Desert madwort (*Alyssum desertorum*) is responsible for the large increase in annual forb cover in 2022. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) was sampled for the first time in 2017 and had a slight increase in nested frequency in 2022 (**Figure 1.23**, **Figure 1.25**).

Occupancy: Wildlife occupancy is low and has displayed a general decrease over the sample period, although the 2022 sample year appears to be an outlier. Deer are the primary occupants of this site, and mean pellet group abundance has been as low as 3 days use/acre in 2017 and as high as 22 days use/acre in 2022. Elk and cattle pellet groups appear to be incidental with elk only being sampled in 2022 at 4 days use/acre, and cattle only being sampled in 2012 at 4 days use/acre (**Figure 1.27**).

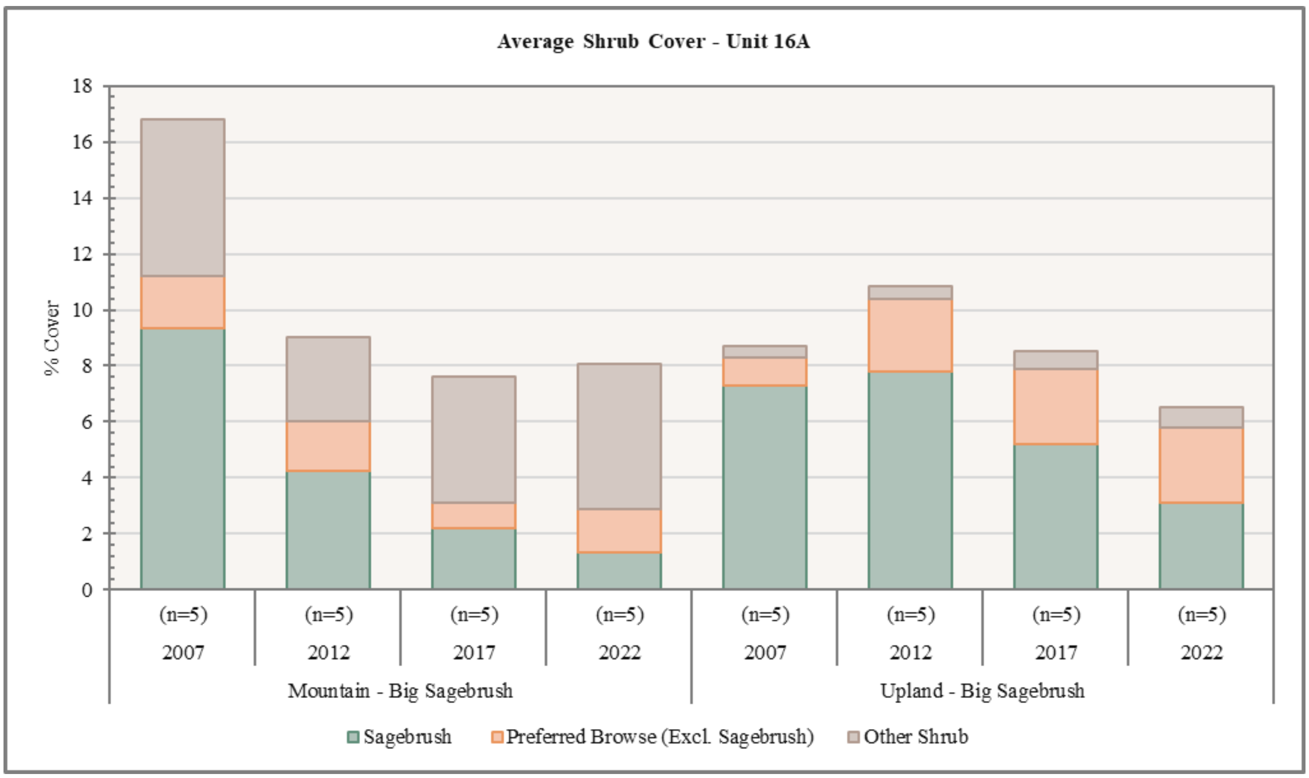


Figure 1.10: Average shrub cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 16A, Nebo.

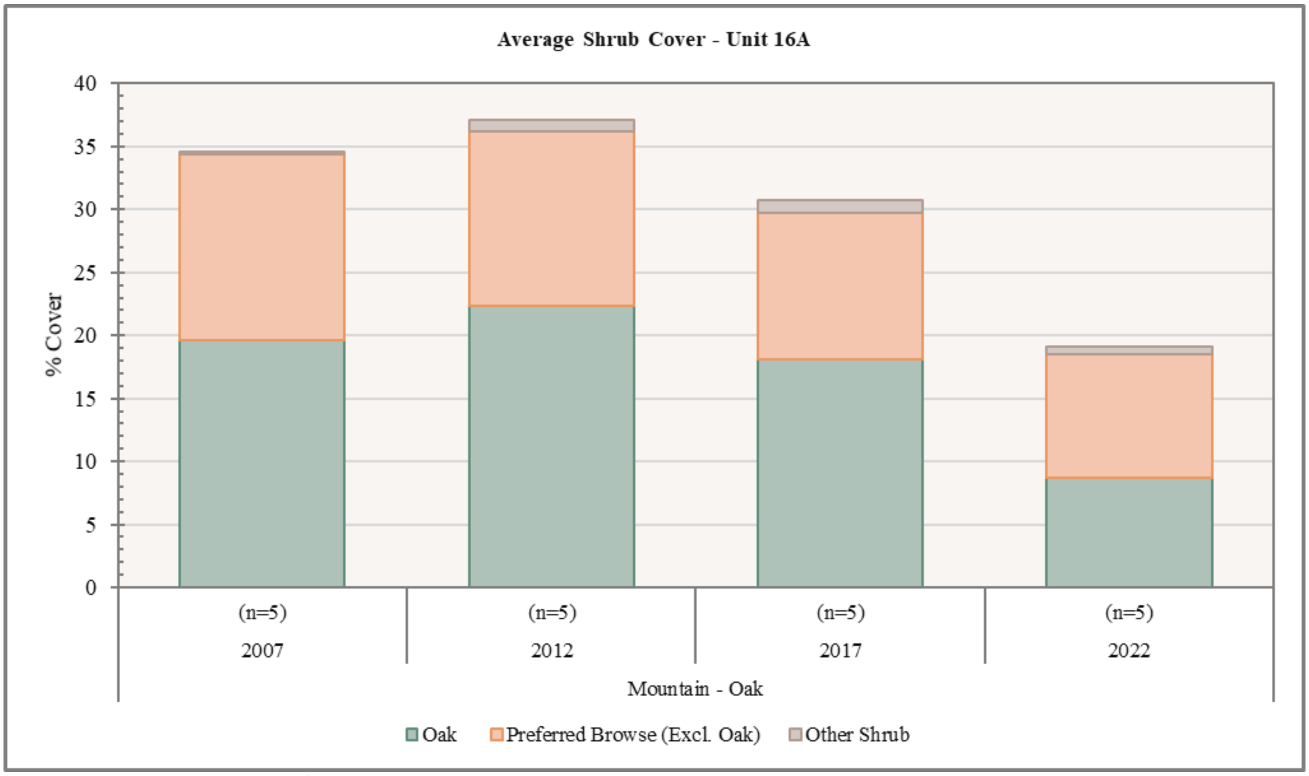


Figure 1.11: Average shrub cover for Mountain - Oak study sites in WMU 16A, Nebo.

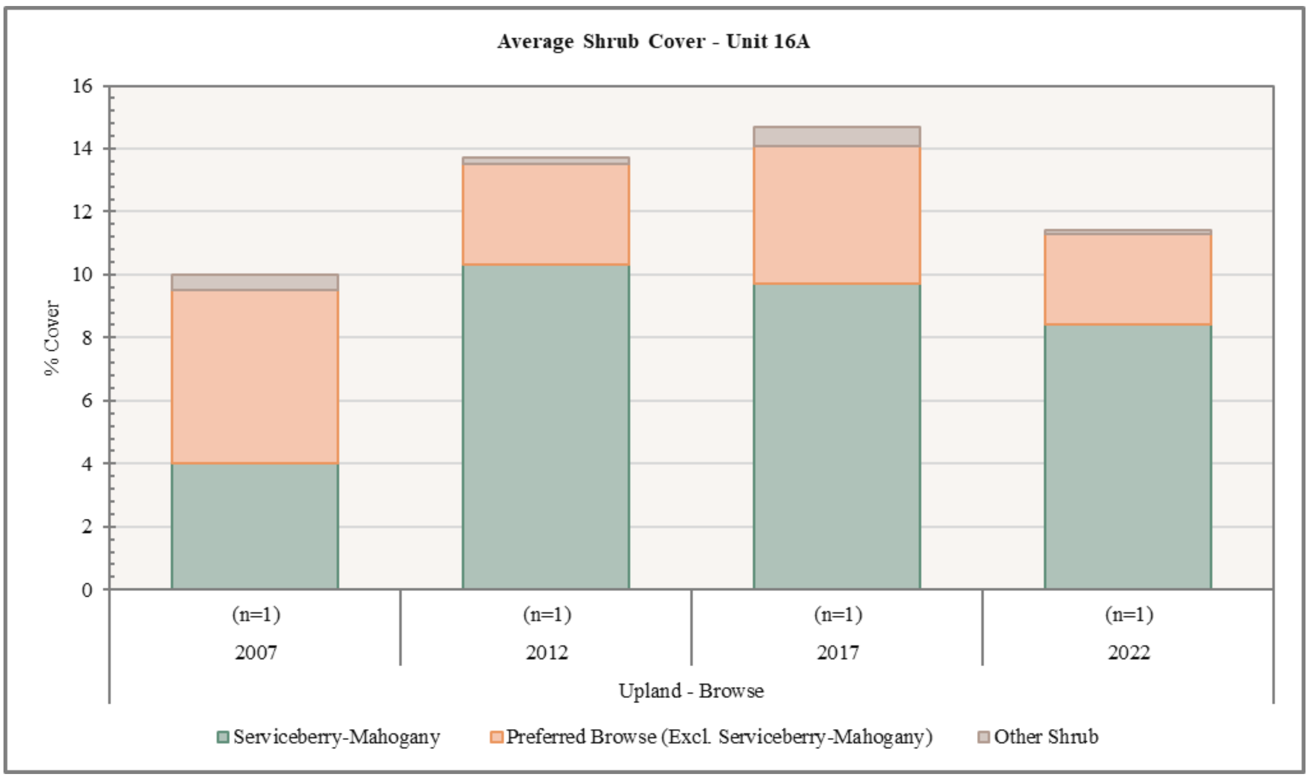


Figure 1.12: Average shrub cover for Upland - Browse study sites in WMU 16A, Nebo

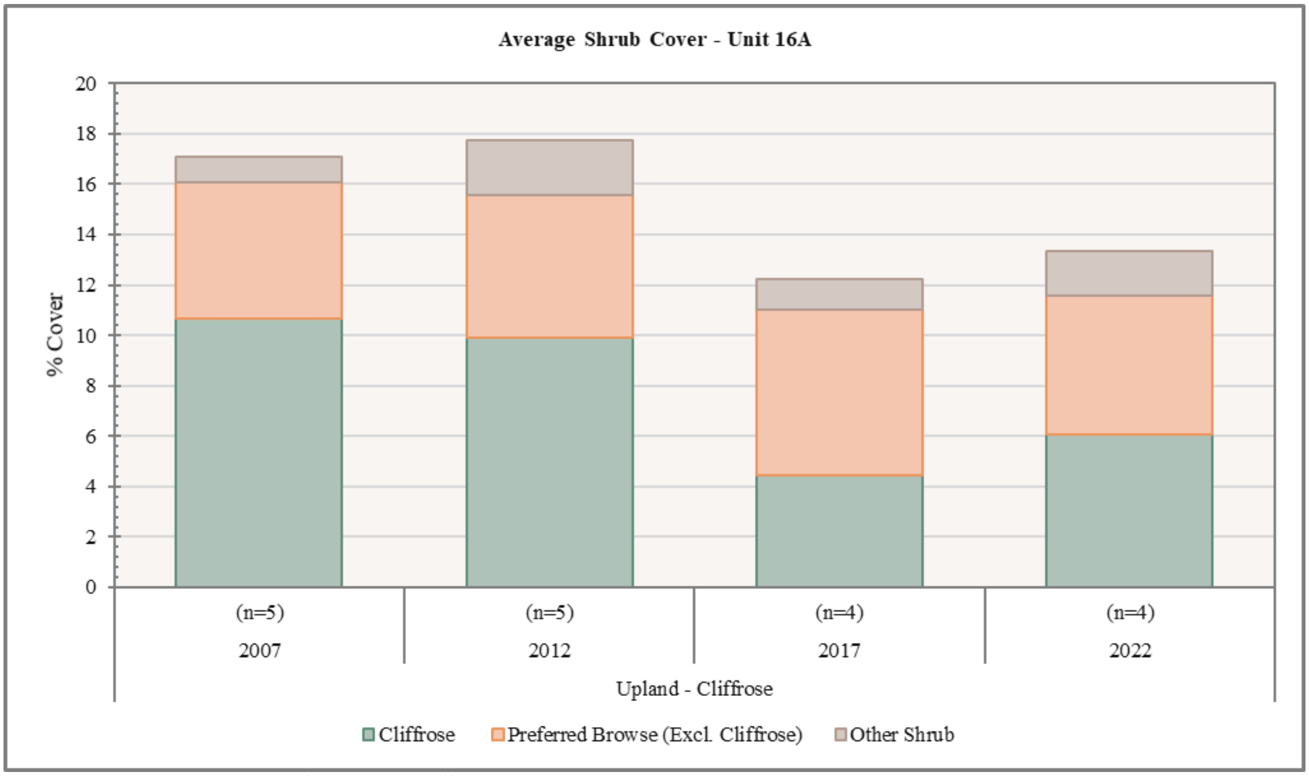


Figure 1.13: Average shrub cover for Upland - Cliffrose study sites in WMU 16A, Nebo.

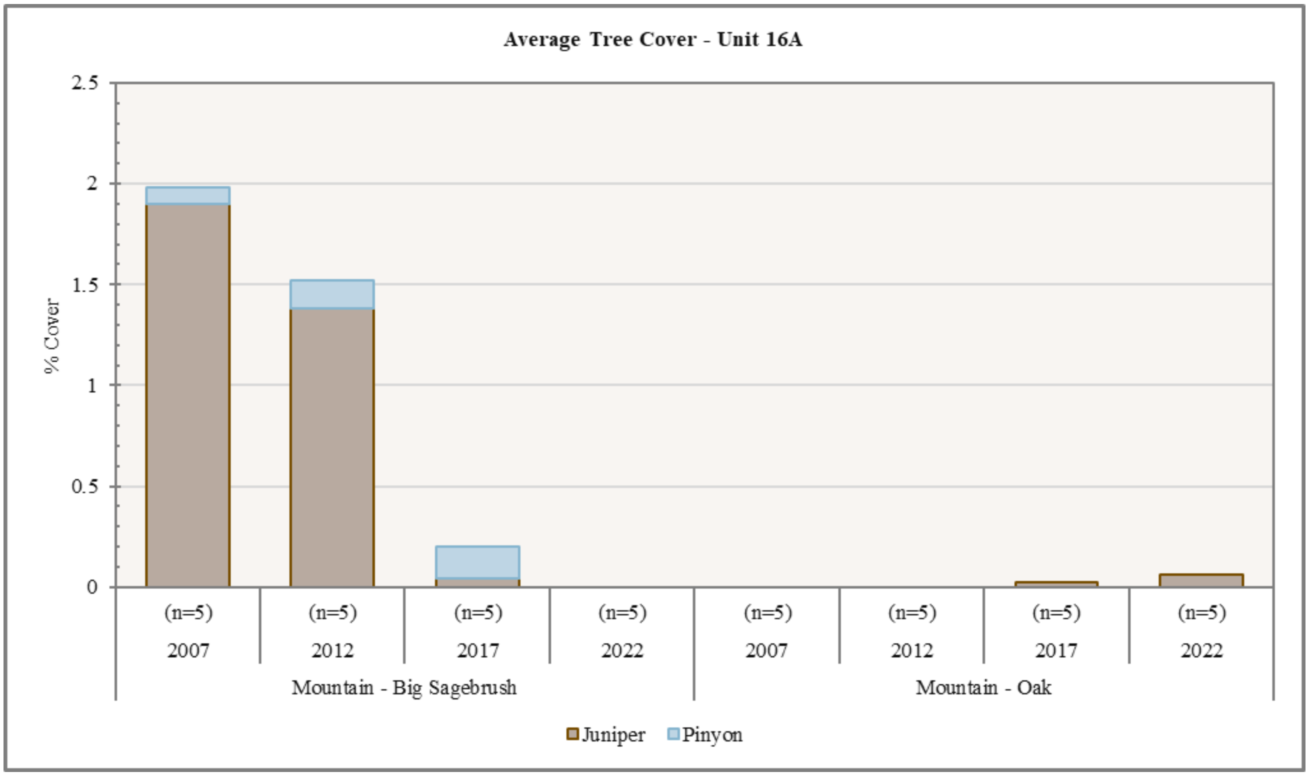


Figure 1.14: Average tree cover for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 16A, Nebo.

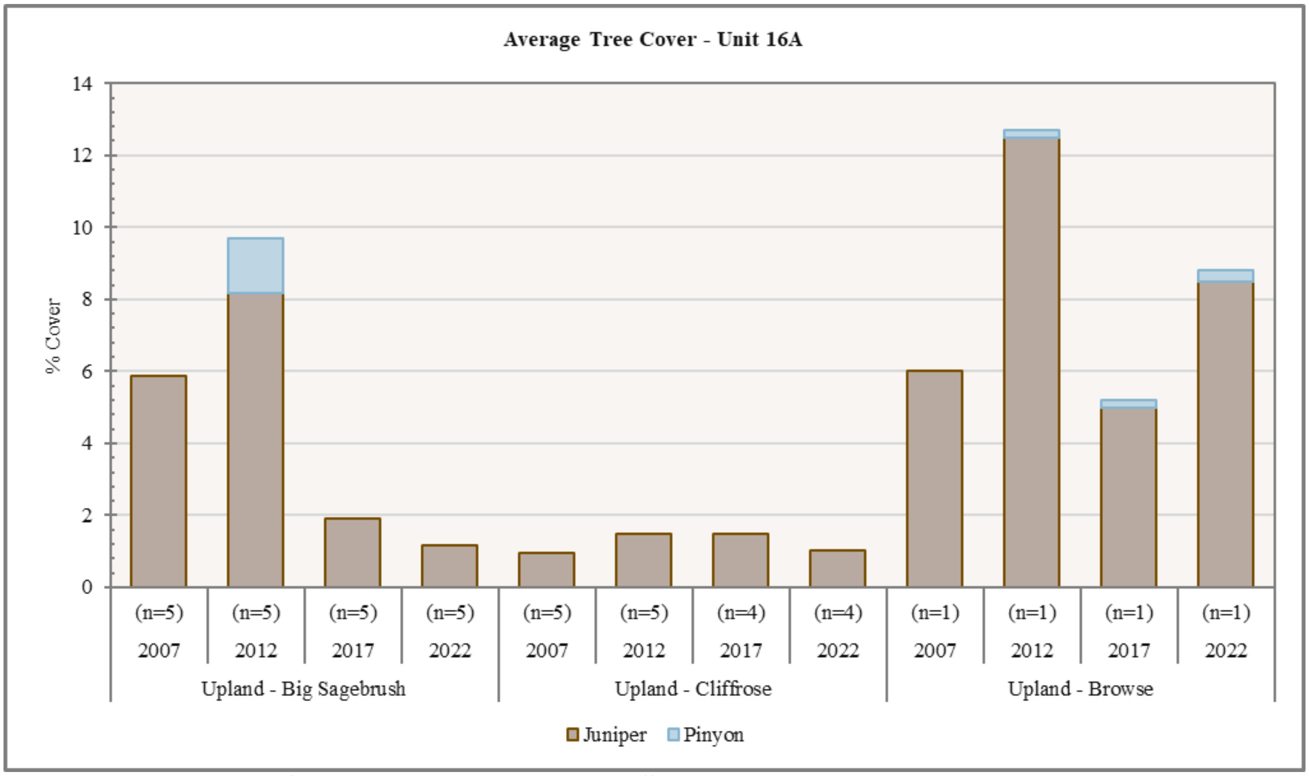


Figure 1.15: Average tree cover for Upland - Big Sagebrush, Upland - Cliffrose, and Upland - Browse study sites in WMU 16A, Nebo.

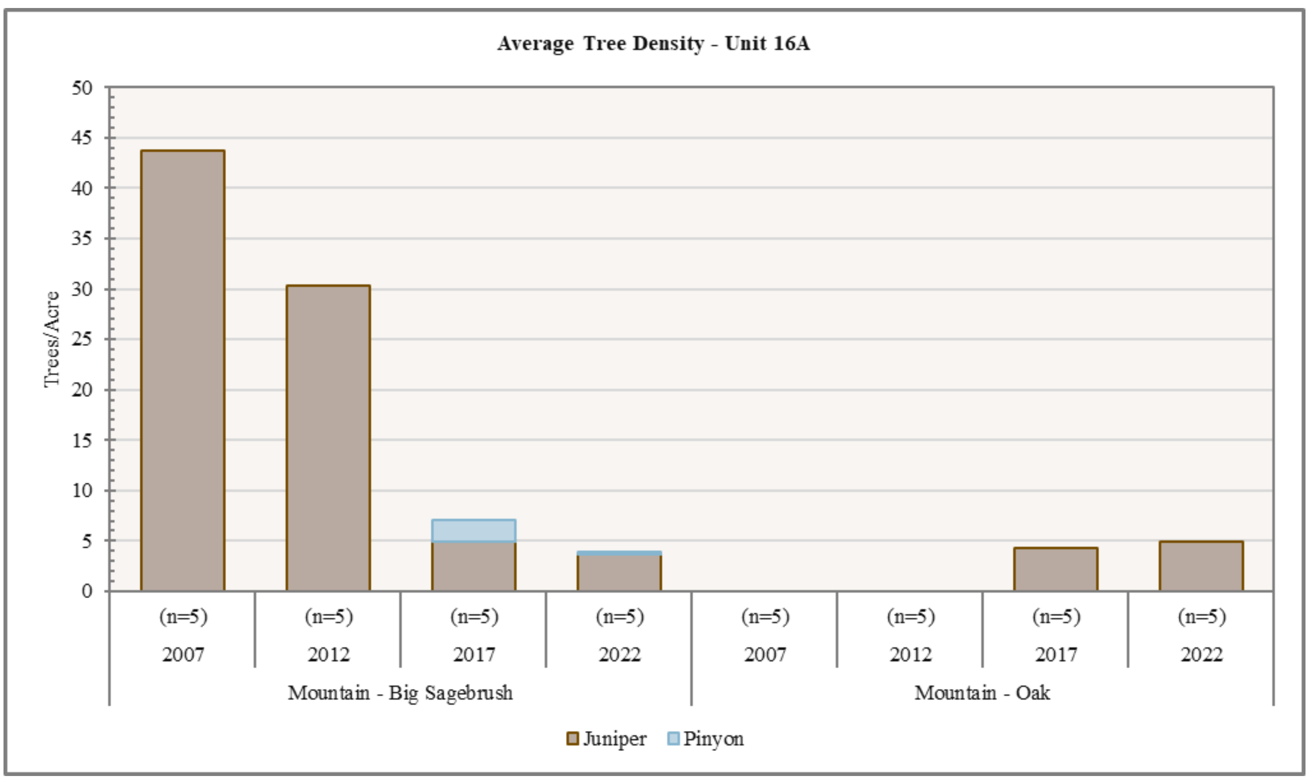


Figure 1.16: Average tree density for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 16A, Nebo.

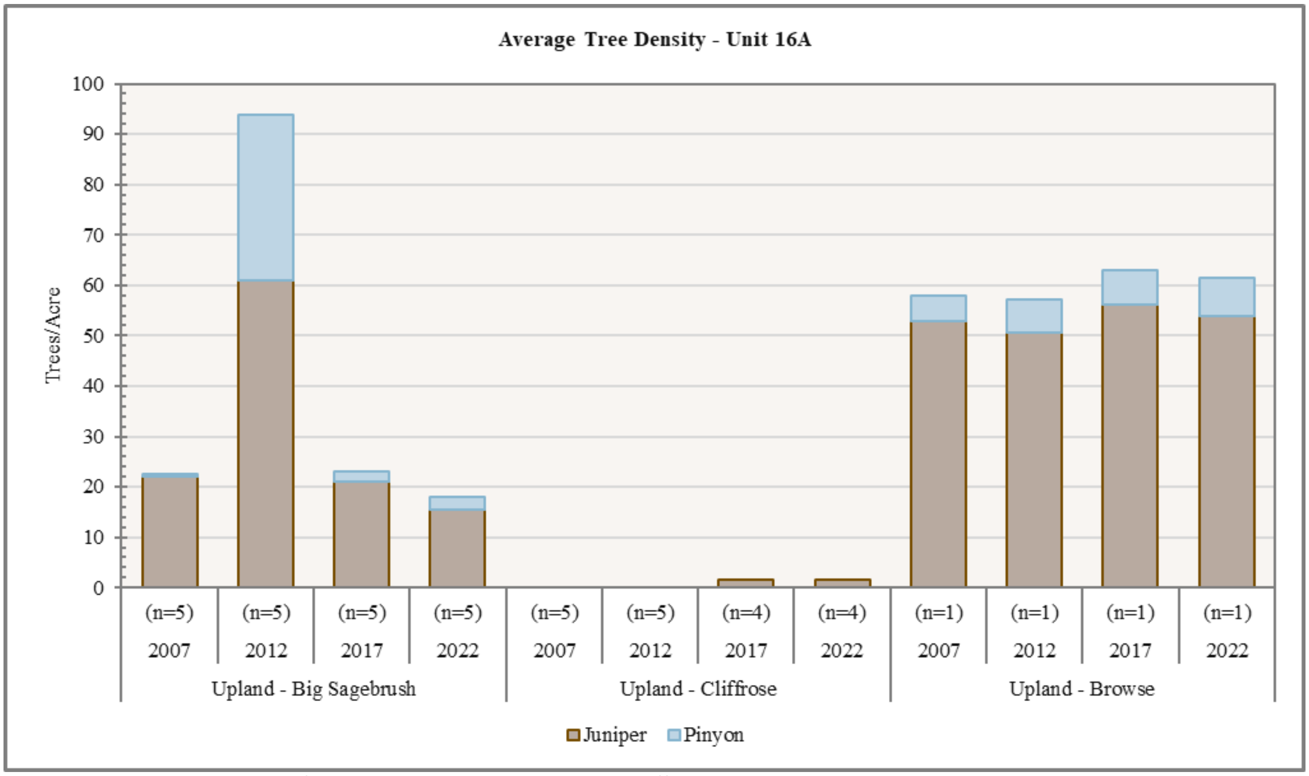


Figure 1.17: Average tree density for Upland - Big Sagebrush, Upland - Cliffrose, and Upland - Browse study sites in WMU 16A, Nebo.

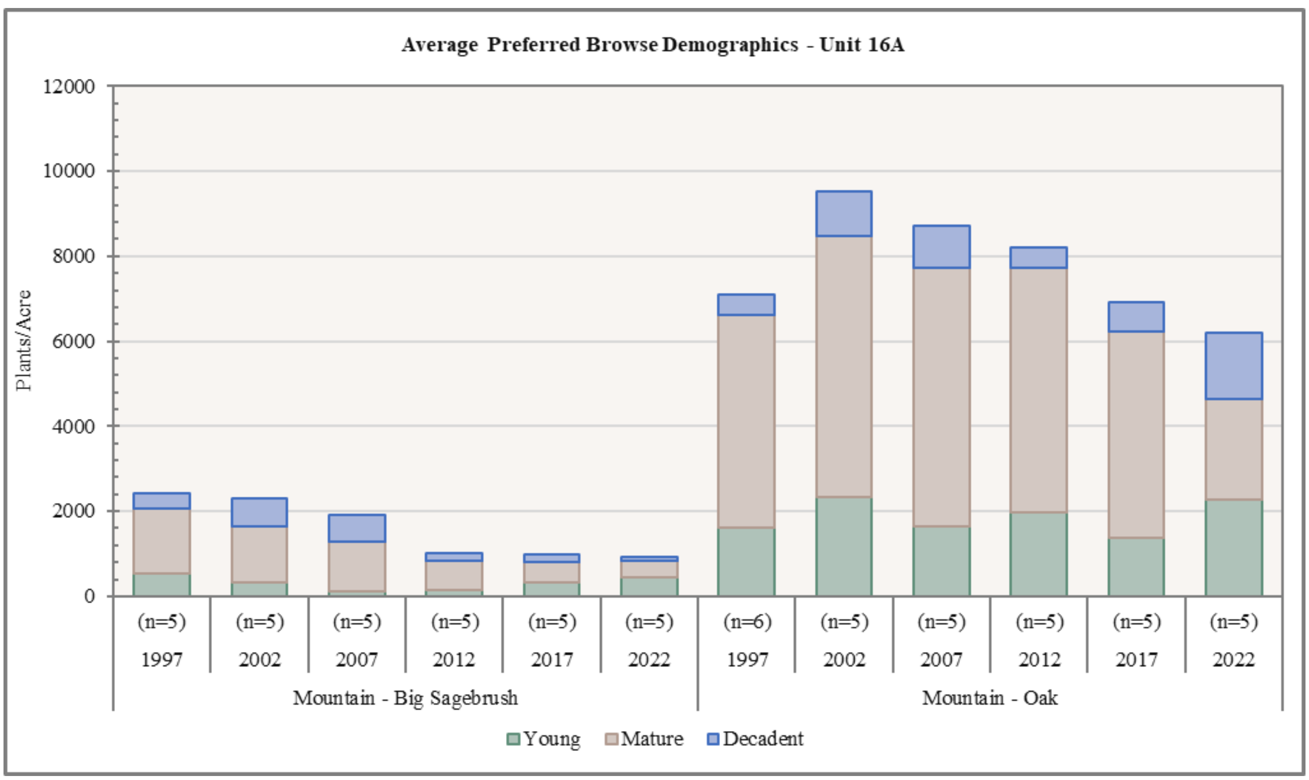


Figure 1.18: Average preferred browse demographics for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 16A, Nebo.

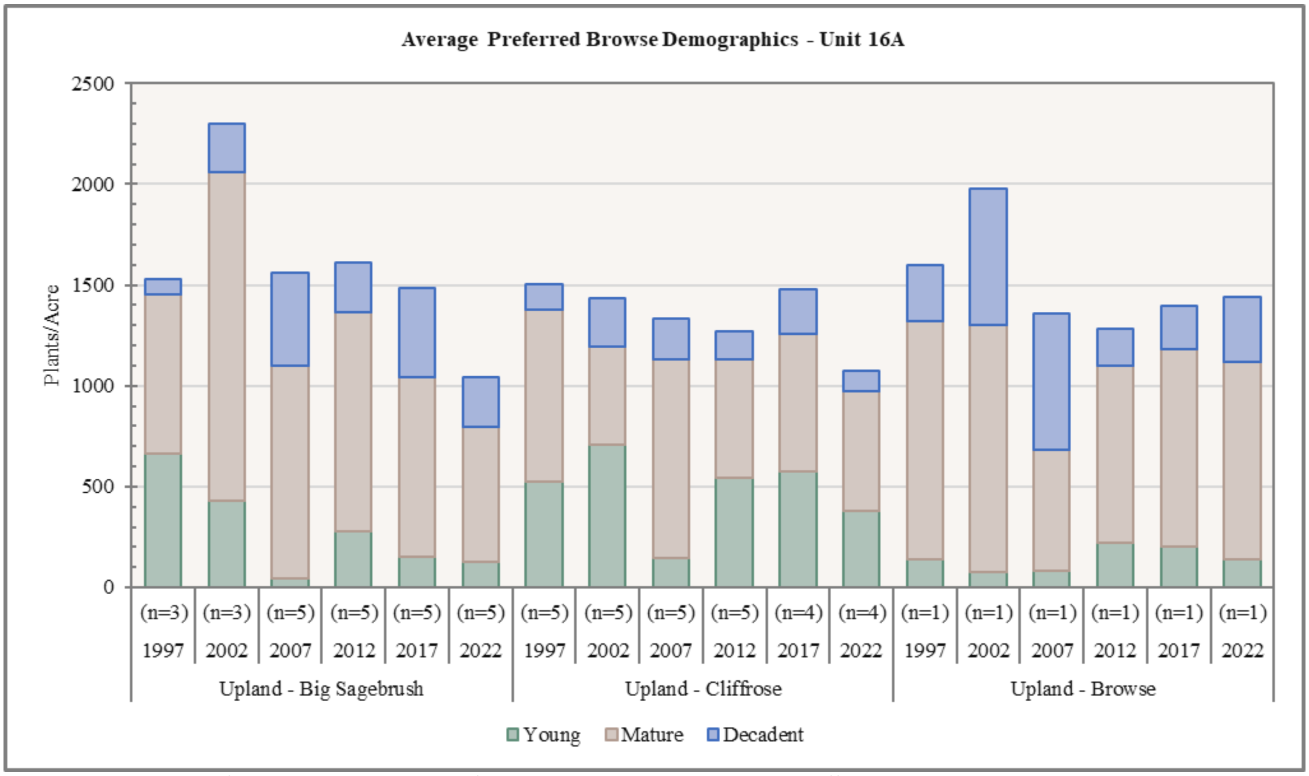


Figure 1.19: Average preferred browse demographics for Upland - Big Sagebrush, Upland - Cliffrose, and Upland - Browse study sites in WMU 16A, Nebo.

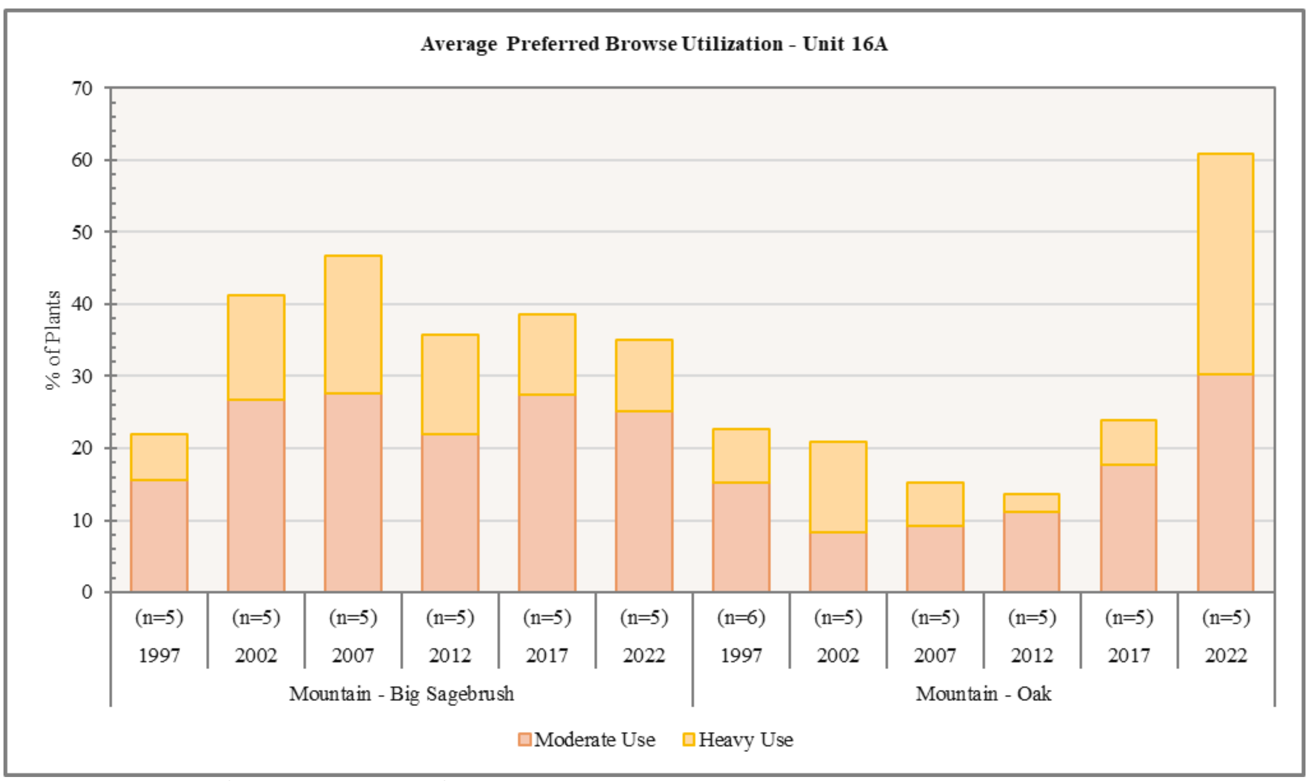


Figure 1.20: Average preferred browse utilization for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 16A, Nebo.

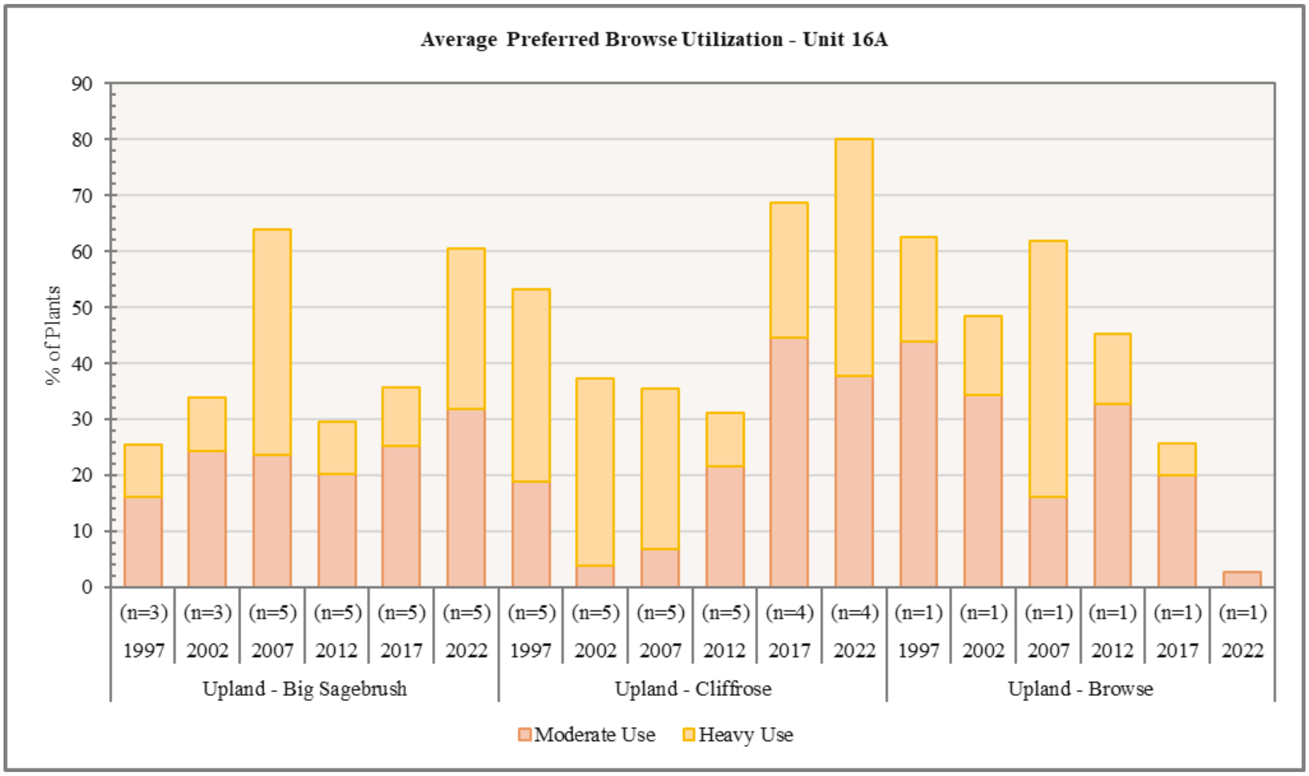


Figure 1.21: Average preferred browse utilization for Upland - Big Sagebrush, Upland - Cliffrose, and Upland - Browse study sites in WMU 16A, Nebo.

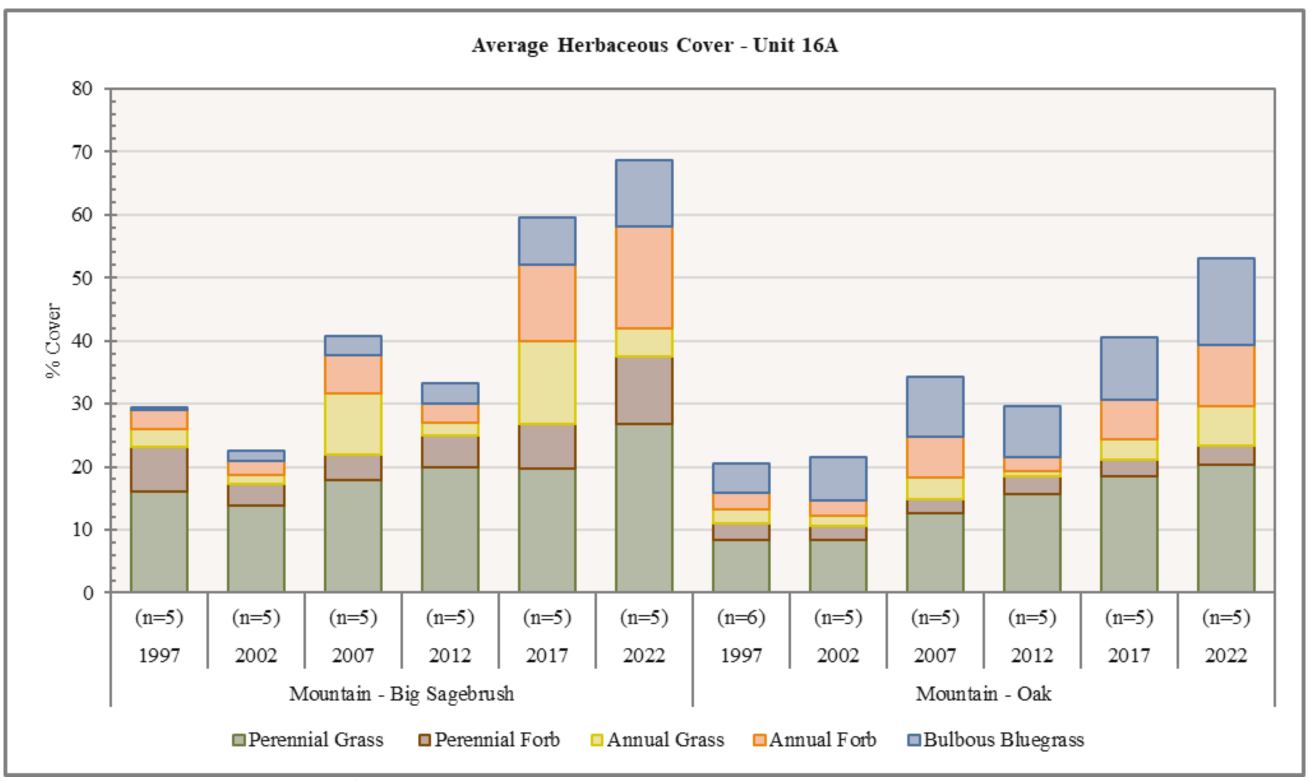


Figure 1.22: Average herbaceous cover for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 16A, Nebo.

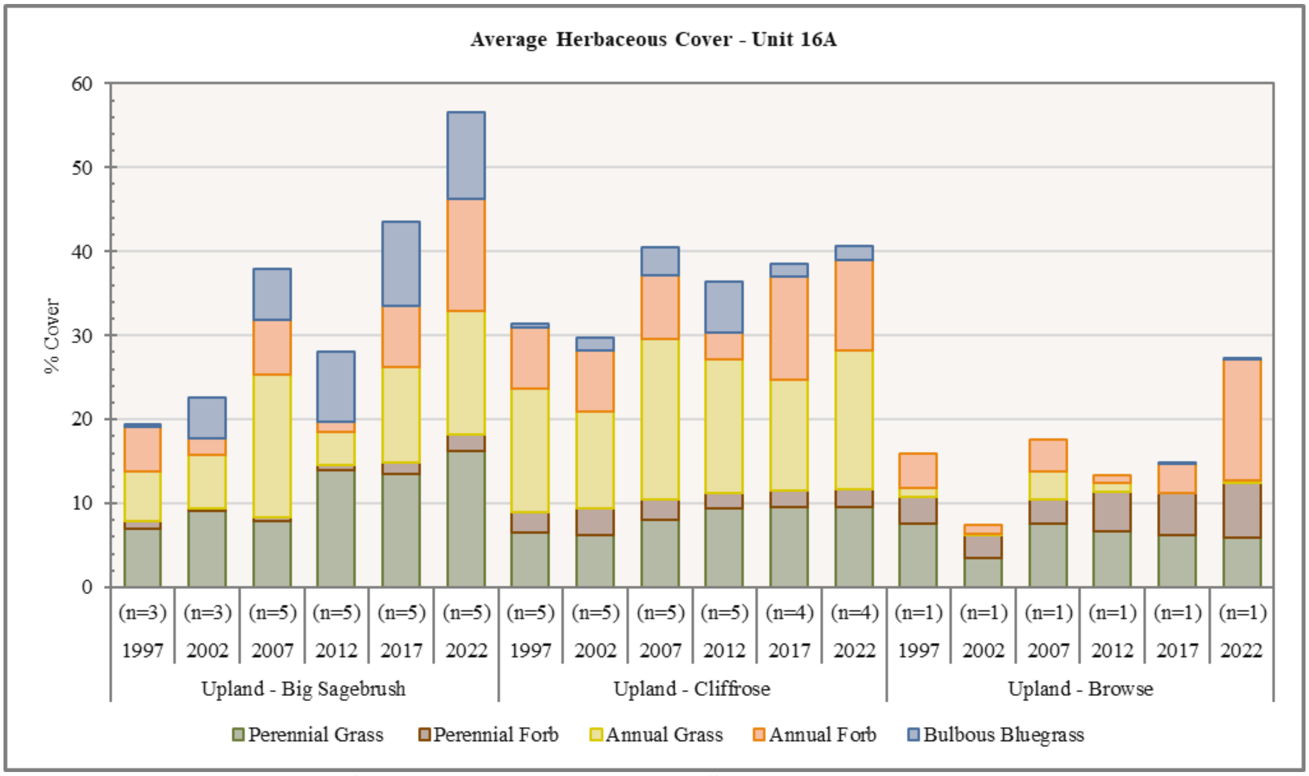


Figure 1.23: Average herbaceous cover for Upland - Big Sagebrush, Upland - Cliffrose, and Upland - Browse study sites in WMU 16A, Nebo.

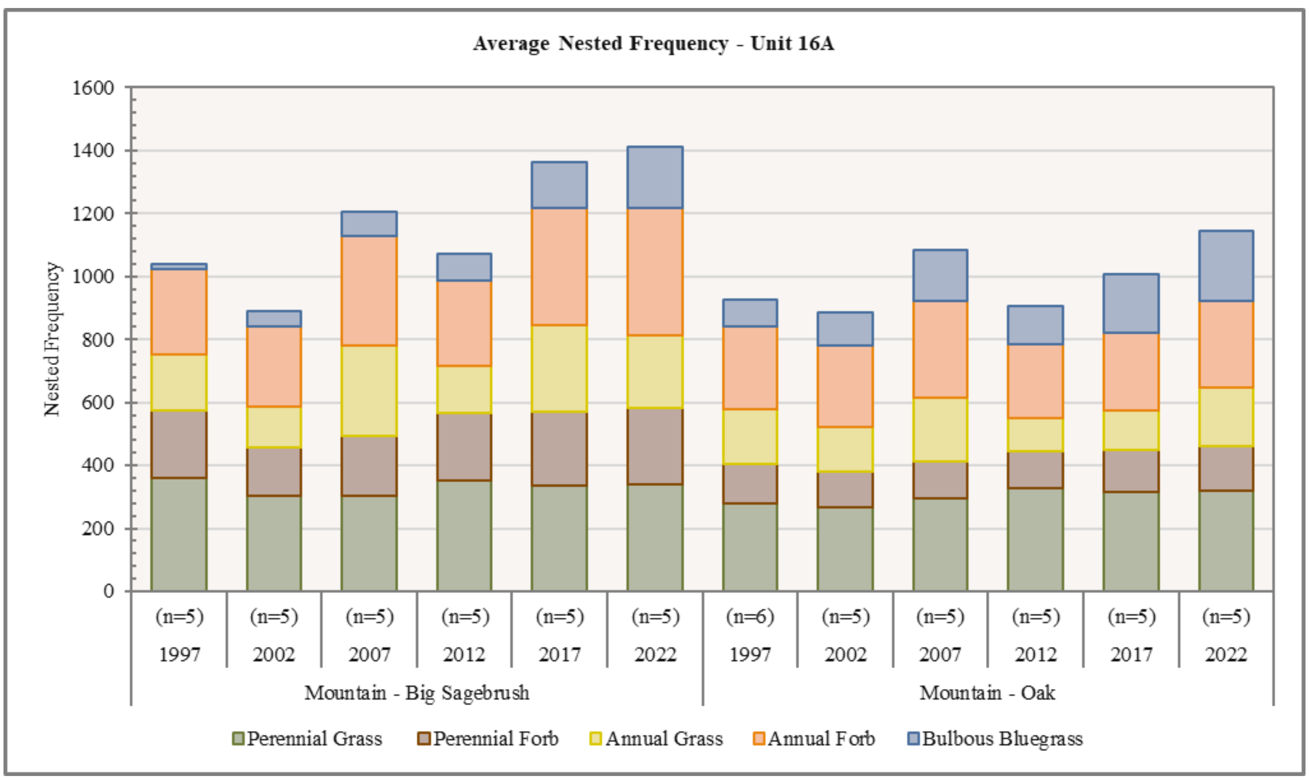


Figure 1.24: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 16A, Nebo.

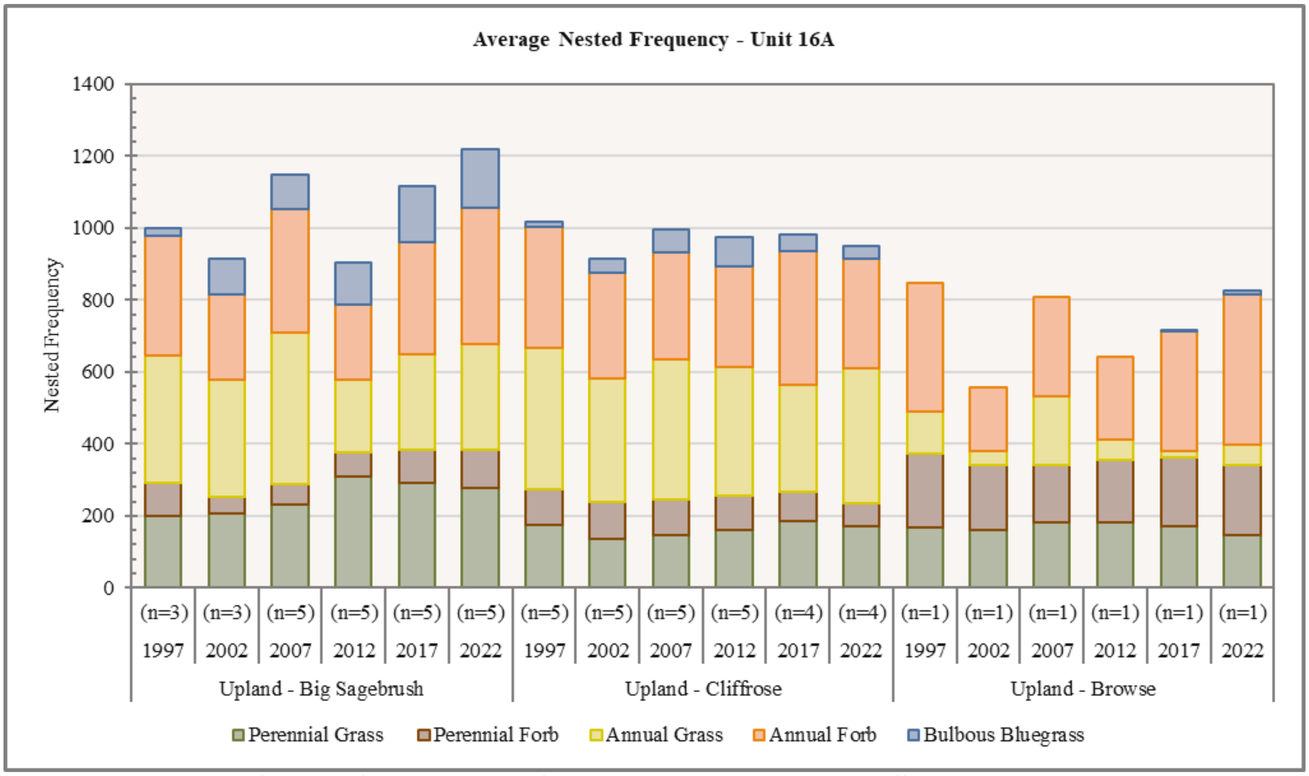


Figure 1.25: Average nested frequency of herbaceous species for Upland - Big Sagebrush, Upland - Cliffrose, and Upland - Browse study sites in WMU 16A, Nebo.

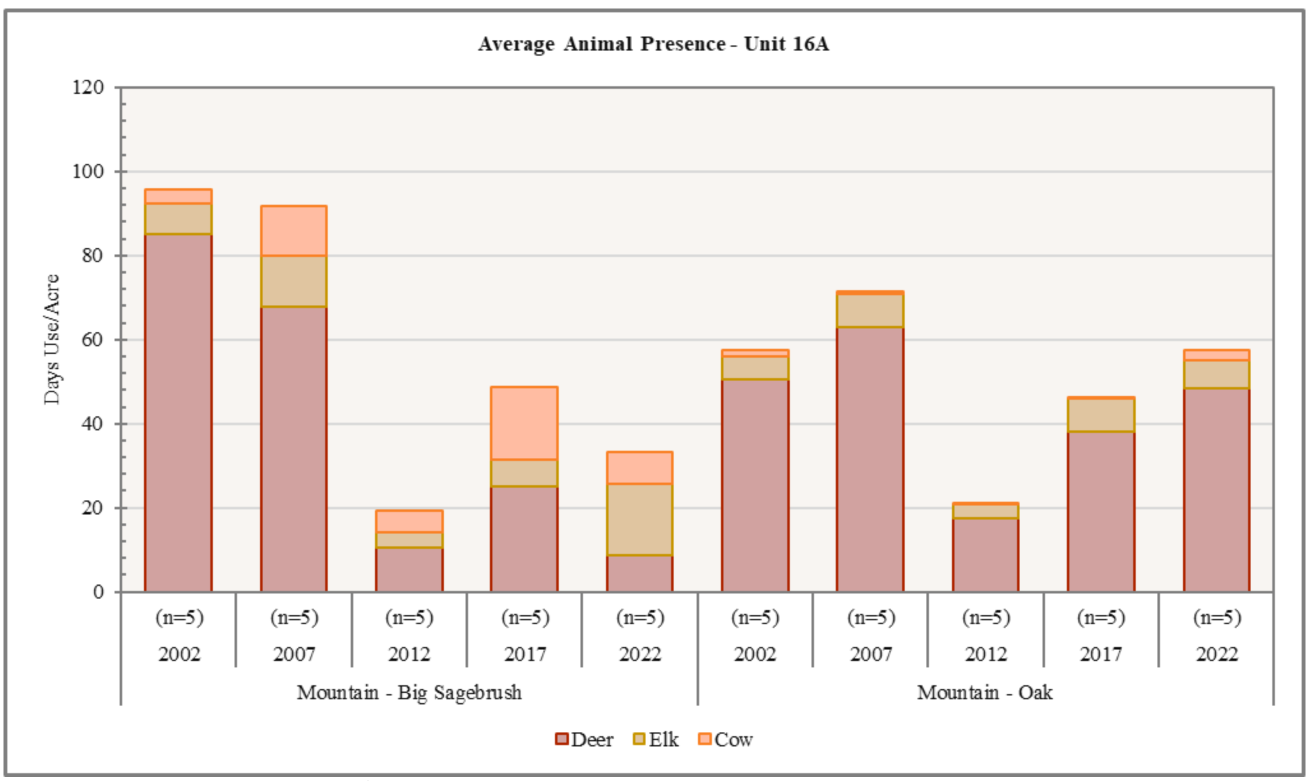


Figure 1.26: Average pellet transect data for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 16A, Nebo.

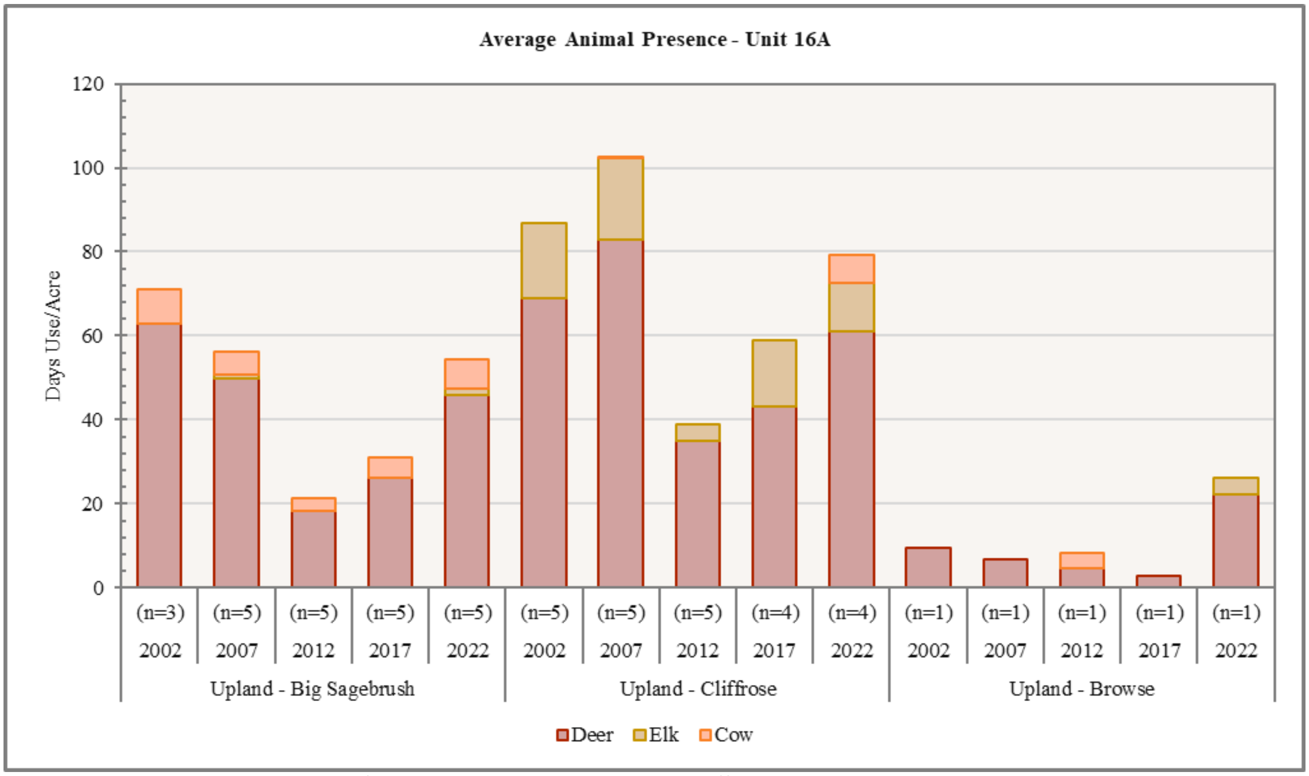
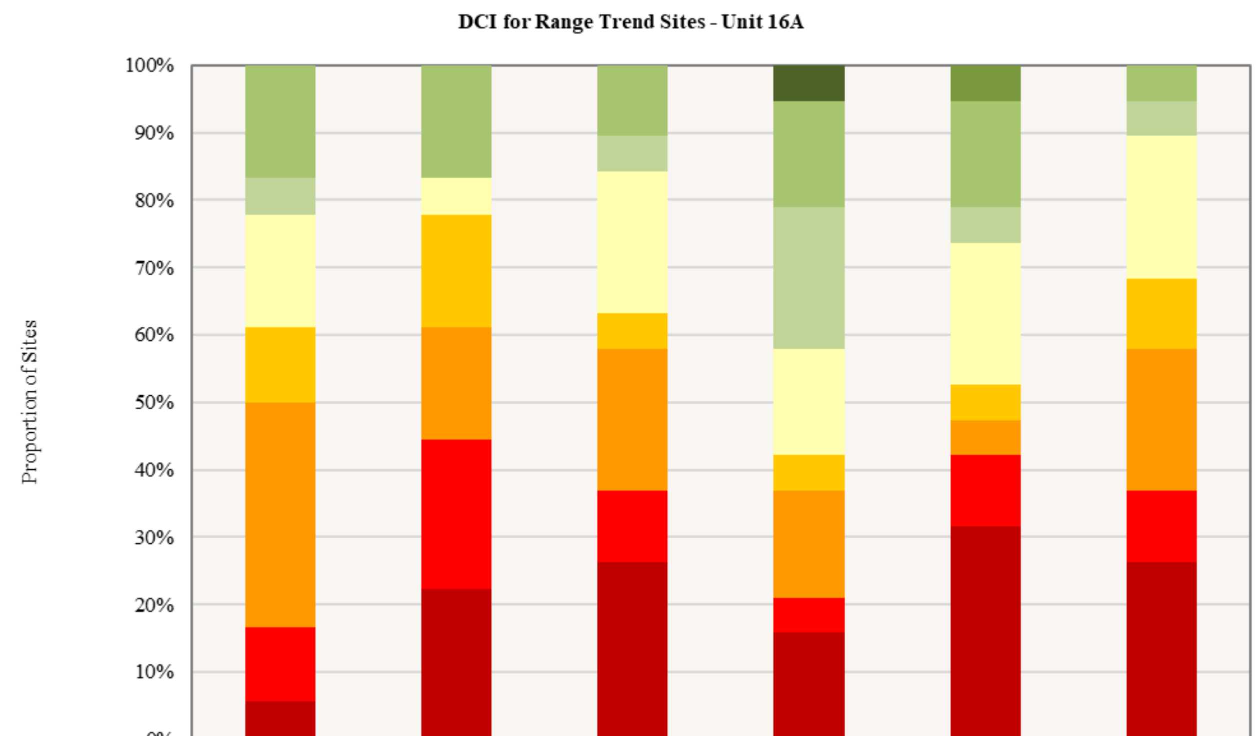


Figure 1.27: Average pellet transect data for Upland - Big Sagebrush, Upland - Cliffrose, and Upland - Browse study sites in WMU 16A, Nebo. *Upland - Big Sagebrush deer pellet groups include deer and sheep pellets.

Deer Winter Range Condition Assessment

The overall condition of deer winter range within the Nebo management unit has remained relatively stable, but in poor-fair condition. Averaged unit conditions have declined slightly from poor-fair in 1997 to poor in 2022. Range Trend sites sampled within the unit that are consistently considered to be in poor condition include Wash Canyon (16A-4), Willow Creek (16A-7), Gardner Canyon (16A-8), Birch Creek (16A-9), Big Hollow (16A-14), Levan Farm Chaining (16A-16), Levan North (16A-22), Maple Canyon (16A-24), and Santaquin Bench South (16A-25). Factors contributing to very poor to poor winter conditions include the lack of browse cover and an undiversified age class structure among preferred browse species. The presence of annual grasses also contributes to the poor conditions. It is probable that these sites represent their surrounding areas and likely point to areas of needed habitat rehabilitation topics of concern. Santaquin Bench (16A-2), Santaquin Hill (16A-3), North Canyon (16A-10), Rees Flat (16A-11), Steele Ranch (16A-13), Chicken Creek (16A-17), Deep Creek (16A-18), and Triangle Ranch (16A-20) are all sites with averaged conditions ranked between fair to good, and are the drivers for unit-wide conditions. Santaquin Bench, Rees Flat, and Triangle Ranch consistently have good wintering conditions. Santaquin Bench has had the highest degree of positive conditional change that followed a wildfire, which allowed for increases in preferred browse and perennial grass covers. However, Santaquin Bench was suspended in 2022 and no longer contributes to the unit's overall winter habitat conditions (**Figure 1.28**, **Table 1.5**).



	1997	2002	2007	2012	2017	2022
Excellent				1		
Good-Excellent					1	
Good	3	3	2	3	3	1
Fair-Good	1		1	4	1	1
Fair	3	1	4	3	4	4
Poor-Fair	2	3	1	1	1	2
Poor	6	3	4	3	1	4
Very Poor-Poor	2	4	2	1	2	2
Very Poor	1	4	5	3	6	5

Figure 1.28: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 16A, Nebo.

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
16A-2*	1997	24.9	12.6	10.8	30	-0.5	10	0	**87.8**	**G**
16A-2*	2002	2.7	0	0	9.2	-0.2	10	0	**21.7**	**VP**
16A-2*	2007	30	15	3	29.9	-4.3	10	-2	**81.6**	**G**
16A-2*	2012	30	14.9	14	30	-0.1	10	0	**98.7**	**E**
16A-2*	2017	27.4	13.6	7.8	30	-0.2	10	0	**88.6**	**G-E**
16A-3	1997	22.4	10.4	10.8	22.8	-2	0.9	0	**65.3**	**F**
16A-3	2002	16.2	7.4	2.1	22.8	-1.4	0.7	0	**47.8**	**P**
16A-3	2007	26.3	5.5	9.4	18.1	-4	1.9	-2	**55.1**	**P-F**
16A-3	2012	30	11.5	5.7	23.7	-1.1	3.3	0	**73**	**G**
16A-3	2017	21.9	10.7	8.1	30	-1.4	0.7	0	**70**	**F-G**
16A-3	2022	20.5	5.4	15	30	-7.8	1.3	0	**64.4**	**F**
16A-4	1997	10.1	7.4	9.5	18.4	-4.6	5.7	0	**46.5**	**P**
16A-4	2002	14.3	8.8	4.5	22.9	-0.5	3.3	0	**53.3**	**P-F**
16A-4	2007	14.3	8.7	7.9	17.1	-2.7	6.6	0	**52**	**P**
16A-4	2012	14.5	11	8.2	27.3	-0.3	10	0	**70.6**	**F-G**
16A-4	2017	10.8	6.6	7.9	29.1	-5.4	10	0	**58.9**	**F**
16A-4	2022	3.1	0	0	30	-5.4	10	0	**37.8**	**VP**
16A-5	1997	9.3	14.2	8.6	30	-1.9	10	-2	**68.2**	**F-G**
16A-5	2002	0	0	0	20.4	-0.4	10	0	**29.9**	**VP**
16A-5	2007	0	0	0	29.4	-18.2	10	-2	**19.1**	**VP**
16A-5	2012	0.3	0	0	30	-2.6	10	-2	**35.7**	**VP**
16A-5	2017	0.2	0	0	30	-20	10	-2	**18.2**	**VP**
16A-5	2022	0.4	0	0	30	-6.3	10	-2	**32.1**	**VP**
16A-6	1997	16	11.7	12.9	30	-0.5	10	0	**80**	**G**
16A-6	2002	16.6	6	13.5	30	-0.6	8.2	0	**73.7**	**G**
16A-6	2007	20.8	4.7	1.9	30	-4.9	10	0	**62.4**	**F**
16A-6	2012	0.5	0	0	30	-0.7	10	0	**39.7**	**VP-P**
16A-6	2017	1.3	0	0	30	-9.4	10	0	**31.9**	**VP**
16A-6	2022	2.5	0	0	30	-3	10	0	**39.5**	**VP-P**
16A-7	1997	23.3	14.1	0.4	8.6	-13	3.3	0	**36.7**	**VP-P**
16A-7	2002	24.1	7.1	2	11.3	-11.1	2.4	0	**35.8**	**VP-P**
16A-7	2007	30	7.9	4.5	14.9	-11.7	2.1	0	**47.7**	**P**
16A-7	2012	30	10.9	2.6	20.3	-13.7	2.9	0	**53.2**	**F**
16A-7	2017	18.7	0.8	1.2	13.6	-13.8	4.1	0	**24.6**	**VP**
16A-7	2022	26.9	8.2	1.2	15.8	-13.8	2	0	**40.2**	**P**
16A-8	1997	11.5	9.9	4.4	15.3	-8.5	1.8	0	**34.4**	**VP-P**
16A-8	2002	14	6.2	1.1	15.7	-7.1	4.3	0	**34.2**	**VP-P**
16A-8	2007	19.2	5.8	0	17.5	-8.9	3	0	**36.5**	**VP-P**
16A-8	2012	20.3	4.2	3	19.8	-6.2	3.5	0	**44.6**	**P**
16A-8	2017	13.2	9.8	0	17.3	-4.6	4.8	0	**40.5**	**P**
16A-8	2022	15.2	10.8	3.1	19.9	-15.5	5.8	0	**39.2**	**P**
16A-9	1997	10	11.8	6.8	14.3	-4.6	3.5	0	**41.7**	**P**
16A-9	2002	3.4	0	0	11	-7.4	1.6	0	**8.6**	**VP**
16A-9	2007	11.2	14.3	15	22.9	-12.9	2.3	0	**52.8**	**F**
16A-9	2012	7.6	14.5	8.7	21.9	-9.4	2.1	0	**45.3**	**P**
16A-9	2017	9.8	11.8	7	19	-15.3	2.3	0	**34.6**	**VP-P**
16A-9	2022	11.5	12.2	3.9	21.7	-15.3	3.9	0	**37.8**	**P**
16A-10	1997	27.6	12	5.4	7.6	-4.5	5.3	-2	**51.4**	**P**
16A-10	2002	29.2	1.6	3	21.2	-4.2	3.3	0	**54.2**	**P-F**
16A-10	2007	30	5.8	5.3	25.5	-4.5	3.8	-2	**63.9**	**F**
16A-10	2012	24.1	9.9	5.4	29.8	-1.7	3	0	**70.5**	**F-G**
16A-10	2017	23.7	8.9	2.4	29.9	-6.8	3.8	0	**61.8**	**F**
16A-10	2022	22.5	5.4	14.6	27.8	-7.6	3.3	0	**66**	**F**
16A-11	1997	12.9	14.6	15	15.2	-1.7	2.8	0	**58.8**	**F**
16A-11	2002	23.1	13.5	14.8	19.3	0	1.8	0	**72.5**	**G**
16A-11	2007	30	13.9	4	30	0	1.5	0	**79.5**	**G**
16A-11	2012	30	12.8	5.4	30	0	2.3	0	**80.4**	**G**
16A-11	2017	30	11.7	2.8	30	0	1.5	0	**76**	**G**
16A-11	2022	26	6.5	6.6	30	-0.3	3.9	0	**72.7**	**G**

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
16A-13	1997	30	12.3	5	6.8	-0.3	1.8	0	**55.6**	**P-F**
16A-13	2002	30	5.8	3.4	10.8	-0.5	2.3	0	**51.9**	**P**
16A-13	2007	30	9.6	15	12.9	-0.8	2.8	0	**69.5**	**F-G**
16A-13	2012	30	12.3	15	9.3	-0.4	1.8	0	**68**	**F-G**
16A-13	2017	30	12.2	14.2	7	-3.4	3.4	0	**63.6**	**F**
16A-13	2022	30	7.6	15	16.1	-7.2	5	0	**66.4**	**F**
16A-14	1997	22.1	7.2	6.2	10.4	-2.8	1.3	0	**44.5**	**P**
16A-14	2002	22.8	3.5	3.2	18.3	-3.7	1.4	0	**45.4**	**P**
16A-14	2007	19.9	0.1	0.6	17.3	-10	1.4	0	**29.3**	**VP**
16A-14	2012	7.6	10.3	0	30	-3.9	2	0	**45.9**	**P**
16A-14	2017	0	0	0	30	-8.5	2.6	0	**24.1**	**VP**
16A-14	2022	0.6	0	0	30	-1	1.5	0	**31.1**	**VP**
16A-15	1997	7.5	14.7	15	27.7	-5.8	1.7	-2	**58.7**	**F**
16A-15	2002	12.6	13.4	15	30	-2.6	0.7	0	**69**	**G**
16A-15	2007	20.5	13.7	1.8	8.9	-7.6	0.8	-2	**36.2**	**VP-P**
16A-15	2012	27.9	12.5	2.9	19.6	-1.4	0.7	0	**62.2**	**F**
16A-15	2017	17.9	0.3	0	18.5	-9.6	2.4	0	**29.6**	**VP**
16A-15	2022	4.6	0	0	23.3	-4.9	2.6	-2	**23.6**	**VP**
16A-16	1997	4.6	0	0	2.1	-3.1	0.8	-2	**2.4**	**VP**
16A-16	2002	7.4	11.9	1.3	2.2	-10.9	0.3	0	**12.2**	**VP**
16A-16	2007	11.3	8.6	1.5	5.8	-18.2	0.3	-2	**7.3**	**VP**
16A-17	1997	7.8	8.3	14.9	25.5	-7.7	2.9	0	**51.8**	**P-F**
16A-17	2002	7.1	1.1	7.7	23.5	-6.5	1.5	0	**34.4**	**VP-P**
16A-17	2007	13.8	8.9	1	25.6	-7.8	3.3	0	**44.9**	**P**
16A-17	2012	20.4	12.4	15	30	-5.1	4.3	-2	**75**	**G**
16A-17	2017	17.6	11.4	15	26.9	-5.8	3.8	0	**68.9**	**G**
16A-17	2022	11.7	13.2	15	19.4	-5.3	4.4	0	**58.3**	**F**
16A-18	1997	11.2	10.4	4.4	15.2	-0.8	6.4	0	**46.9**	**P**
16A-18	2002	14.3	4.7	2	6.9	-0.2	5.5	0	**33.2**	**VP-P**
16A-18	2007	12.9	1.2	4.7	15.1	-2.5	5.7	0	**37.1**	**P**
16A-18	2012	19.5	11.4	9.1	13.2	-0.8	9.5	0	**62**	**F**
16A-18	2017	20.1	10.1	8.4	12.5	0	9.8	0	**60.9**	**F**
16A-18	2022	16.2	9.8	3.7	11.8	-0.2	10	0	**51.4**	**P-F**
16A-19	1997	15.5	11.4	7	12.5	-4.3	2.1	0	**44.2**	**P**
16A-19	2002	19.7	9.1	2.7	20	-0.9	0.6	0	**51.2**	**P-F**
16A-19	2007	14.2	5.3	1.5	18.4	-9.2	1	0	**31.2**	**VP**
16A-19	2012	23.3	10.6	1	19.1	-3.1	0.8	0	**51.7**	**P-F**
16A-19	2017	25.2	12.5	2.3	17.8	-10.2	2.8	-2	**48.3**	**P-F**
16A-19	2022	23.2	12.2	4.8	19.1	-10.4	3.2	-2	**50**	**P-F**
16A-20	1997	15.9	12.2	13	30	-0.3	6.6	0	**77.4**	**G**
16A-20	2002	18.6	6.3	4.4	30	-0.1	7.5	0	**66.7**	**F**
16A-20	2007	15.5	5.2	3.3	30	-0.6	8.1	0	**61.5**	**F**
16A-20	2012	15	9.9	8.5	30	0	6.7	0	**70**	**F-G**
16A-20	2017	7.2	11.5	15	30	-0.1	10	0	**73.5**	**G**
16A-20	2022	11	5.7	15	30	-0.9	10	0	**70.8**	**F-G**
16A-22	2007	2.6	0	0	30	-8.2	0.5	-2	**22.9**	**VP**
16A-22	2012	4	0	0	30	-2.3	1.9	-2	**31.5**	**VP**
16A-22	2017	3	0	0	30	-3.2	2.2	-2	**30**	**VP**
16A-22	2022	3.6	0	0	30	-4.3	3.6	-2	**30.9**	**VP**
16A-24	2012	2.8	0	0	21.7	0	1.8	0	**26.3**	**VP**
16A-24	2017	3.9	0	0	30	-0.2	3.5	-2	**35.2**	**VP-P**
16A-24	2022	6	0	0	30	-0.1	5.2	-2	**39.1**	**P**
16A-25	2022	0.4	0	0	30	-0.5	10	0	**39.9**	**VP-P**

Table 1.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 16A, Nebo. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
16A-3	Santaquin Hill	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
16A-4	Wash Canyon	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
16A-5	Nebo 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	Low	Reduced diversity of desirable grass and forb species
16A-6	Hop Creek Browse	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Energy Development	Low	Fragmentation and degradation/loss of habitat
16A-7	Willow Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
16A-8	Gardner Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
16A-9	Birch Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
16A-10	North Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	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
16A-11	Rees Flat	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
16A-13	Steele Ranch	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
16A-14	Big Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
16A-15	Old Pinery	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	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
		Drought	-	Lowered resilience and resistance to disturbance
16A-17	Chicken Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
16A-18	Deep Creek	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
16A-19	Flat Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
16A-20	Triangle Ranch	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
16A-22	Levan North	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	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
16A-23	Fountain Green Plateau	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
16A-24	Maple Canyon	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
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
16A-25	Santaquin Bench South	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
16R-26	Fountain Green Dixie and Plateau	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
16R-40	Mona Bench	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
16R-41	Mona Bench 2	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species
16R-51	North Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
16R-58	Rocky Hollow Ridge	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous diversity

Table 1.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 16A, Nebo. 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

The condition of the deer wintering habitat within the Nebo unit appears to be deteriorating as a whole. More than half of the study sites are in very poor to poor condition as of 2022 while only seven studies were in this range in 2012. Factors contributing to the poor condition of these sites include (but are not limited to) lack of browse cover, an undiversified age class structure among preferred browse species, and the presence of annual grasses.

Of positive note within this unit are the study sites located in the canyons along the base of Mt. Nebo: Willow Creek Gardner Canyon, and Birch Creek. These study sites are host to valuable preferred browse populations that include varying amounts of species such as Utah serviceberry, alderleaf mountain mahogany, and Stansbury cliffrose, among others. Cover and density data indicate that the preferred browse components on these study sites have remained fairly stable between 2017 and 2022. All three sites are located within crucial deer winter range, and shrub populations such as those described above provide important browse for herds within the area. Additional positive aspects within the Nebo management unit include the improvements in habitat quality (pinyon-juniper reduction, browse diversification, amplification of the herbaceous understory, etc.) that have been observed during the post-treatment samplings of the Flat Canyon, Maple Canyon, and Santaquin Bench South studies.

A number of sites within the Nebo unit have burned within the last 20 years (Wash Canyon, Nebo Creek, Hop Creek Browse, and Big Hollow) and have exhibited the expected post-fire decreases in preferred browse cover and density. Furthermore, several large fires have occurred within the study period, particularly in the northern half of the unit near Mt. Nebo. These burns have generally been more continuous and larger in extent than many of those that have occurred along the Wasatch Front (**Map 1.4**, **Map 2.5)**. As such, these fires may have not only affected a larger range of contiguous habitats, but also an increased variety of habitat types. However, fire can play a key process in the function and structure of big game habitat (Pastro, Dickman, & Letnic, 2011). It is important to note that some of these burns (the 2018 Pole Hollow and Bald Mountain fires, for example) have occurred in higher-elevation summer habitat, on which fires may have the potential to be more beneficial than in lower elevation landscapes (Chambers, et al., 2013). There is the possibility of fire-driven regeneration and improvement in these areas, but current Range Trend studies do not monitor summer range that was burned by these fires.

Introduced perennial grasses are an additional concern in some areas. The Hop Creek Browse, Big Hollow, Nebo Creek, and Wash Canyon studies have burned in different fires over the study period, and a majority of the browse communities that were present have been removed. These sites have remained dominated by both native perennial grasses and introduced species such as crested wheatgrass, bulbous bluegrass, and intermediate wheatgrass in most post-fire sample years. While they provide forage, introduced perennial grasses can outcompete establishing, young shrubs (Mack, et al., 2000); the shrub populations on these sites have not returned in any significant capacity. Furthermore, almost no young preferred browse plants were observed in 2022, and recruitment of young is likely being at least partially impeded by the presence of these introduced perennial grass species. Sites that have not burned have also been deleteriously affected by introduced perennial grasses. Bulbous bluegrass has increased over time on the Old Pinery study, and contributed over 30% cover in 2022. In contrast, cover and density of mountain big sagebrush have exhibited a decreasing trend, with a significant decrease in both values between 2017 and 2022; recruitment of young was also very low in 2022. In addition, 59% of the sagebrush that does remain as of the most recent sampling is considered to be decadent. Although it is probable that a number of factors contribute to this reduction in sagebrush, recruitment of young is likely negatively affected by the presence of bulbous bluegrass.

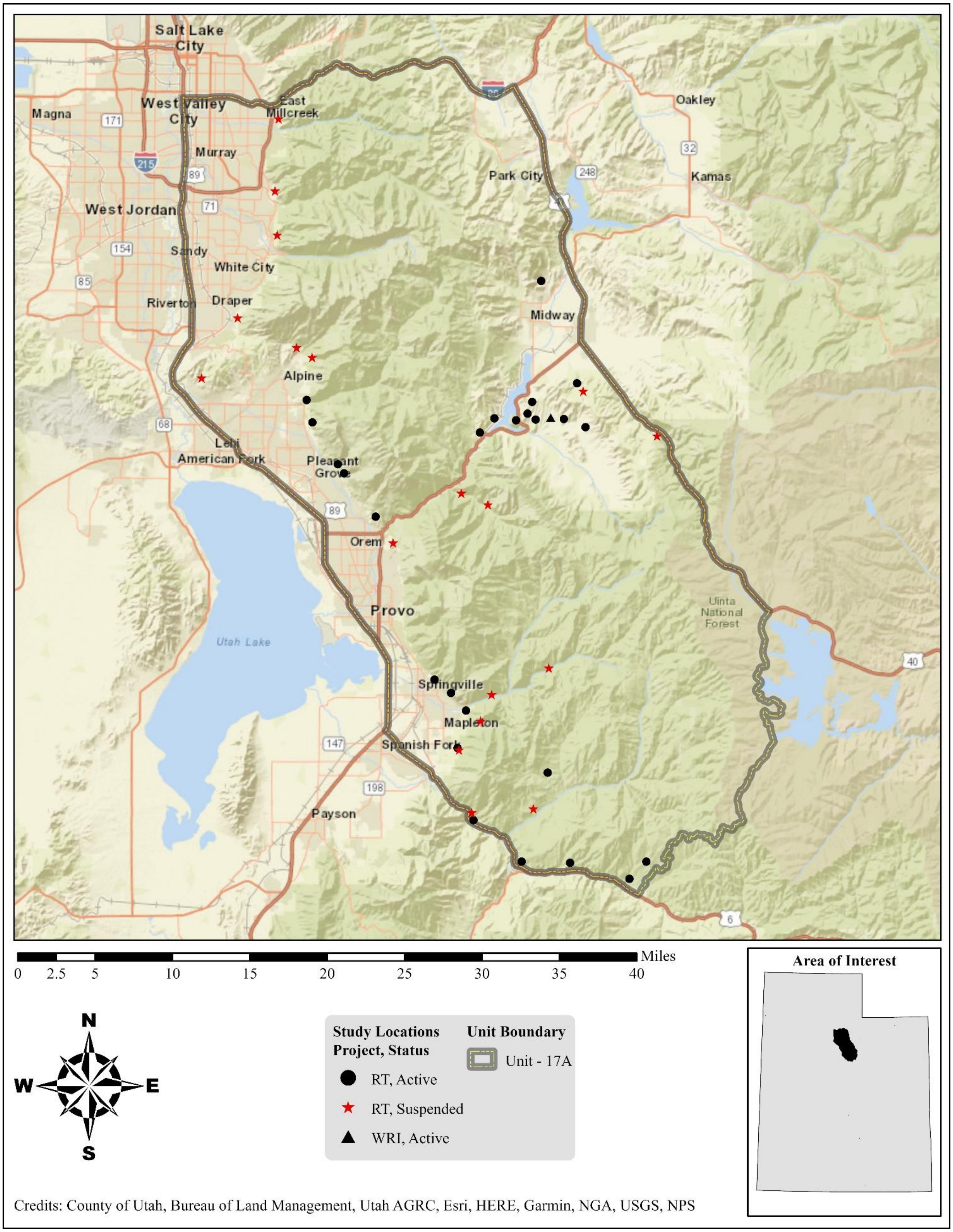
Annual grasses – primarily the introduced species cheatgrass (*Bromus tectorum*) – are present on many study sites in this management unit. Most of the lower-elevation study sites on the western side of Mt. Nebo had cheatgrass present in higher amounts in 2022. High amounts of cheatgrass can increase fuel loads, exacerbate the risk of wildfire (Balch, D'Antonio, & Gómez-Dans, 2013), and may outcompete more desirable and native species for resources (Mack, et al., 2000). However, these study sites have not exhibited the altered wildfire regimes influenced by cheatgrass like those that may be occurring on sites along the Provo Face. Noxious weeds have also been observed on many study sites in various sample years: these species are often aggressive and have the potential to lead to reduced herbaceous diversity through resource competition (Mack, et al., 2000). Although these noxious weeds have generally been present in low amounts, opportunities for greater establishment of these species could be created should fires occur in the future (Swartz & Smith, 2023; Jacobs & Sheley, 2003).

The expansion of urban sprawl poses additional threats to big game habitat within the Nebo management unit. New and continued development around communities within this unit and recreational activities may have unintended consequences including (but not limited to) a loss of preferred browse and herbaceous forage for wildlife, habitat fragmentation, disturbances of animals within the area through human-wildlife interactions, and degradation of habitat through the introduction of non-native species.

Other threats to wildlife habitat are occurring in localized portions of this unit, but will not be discussed in this section. These additional threats are specified by study site in the previous table (**Table 1.6**).

When trying to slow or alleviate the effects of habitat loss that is occurring within the Nebo unit, a variety of recommendations should be taken into consideration. Priority should be given to protecting and rehabilitating remaining areas of big game winter range and habitat in general in this unit: some of these areas may include the cliffrose communities near the base of Mt. Nebo along I-15. As available preferred browse and valuable forage continue to decrease, these remaining ranges will likely become increasingly important for deer herds in the area. Efforts to restore and/or rejuvenate remaining sagebrush habitat where feasible along the I-15 corridor would likely also prove to be beneficial. The shrub components on Range Trend sites that have burned on the northeastern portion of the unit near Indianola have generally not reestablished. As such, the implementation of restoration and rehabilitation methods focused specifically on shrub augmentation may be appropriate in these areas. A number of pinyon and juniper removal projects have occurred within this unit and have generally been effective. Treated and remaining untreated areas should continue to be evaluated and tree-removal projects (bullhog, lop and scatter, chaining, etc.) should be considered when and where appropriate. Finally, monitoring of both Range Trend studies and areas where rehabilitation projects have occurred should continue in the future. Periodic monitoring of these areas not only assesses the quality of big game habitat, but may also aid in the identification of threats as they appear over time.

2. WILDLIFE MANAGEMENT UNIT 17A – WASATCH MOUNTAINS, WEST



WILDLIFE MANAGEMENT UNIT 17A – WASATCH MOUNTAINS, WEST

Boundary Description

Salt Lake, Summit, Utah and Wasatch counties – Boundary begins at I-80 and I-15 in Salt Lake City; east on I-80 to US-40; south on US-40 to the Strawberry Bay Marina road; south on this road to USFS Road 042 (Indian Creek Road); south and west on this road to USFS Road 051; south on this road to US-6; west on US-6 to US-89; northwest on US-6 to I-15; north on I-15 to I-80 in Salt Lake City.

Management Unit Description

Geography

The Wasatch Mountains, West management unit is composed of the Wasatch Mountains, Wasatch Front, Heber Valley, and the areas surrounding Strawberry Reservoir. Towns within the boundary include Heber City, Park City, and the Wasatch Front Complex (Mapleton bordering the south and Millcreek bordering the north). Big game range occurs across a majority of the unit, although significant parts of historical winter range are no longer functional due to urbanization. The permanent Range Trend studies are located in Spanish Fork Canyon, along the Wasatch Front, and in Heber Valley.

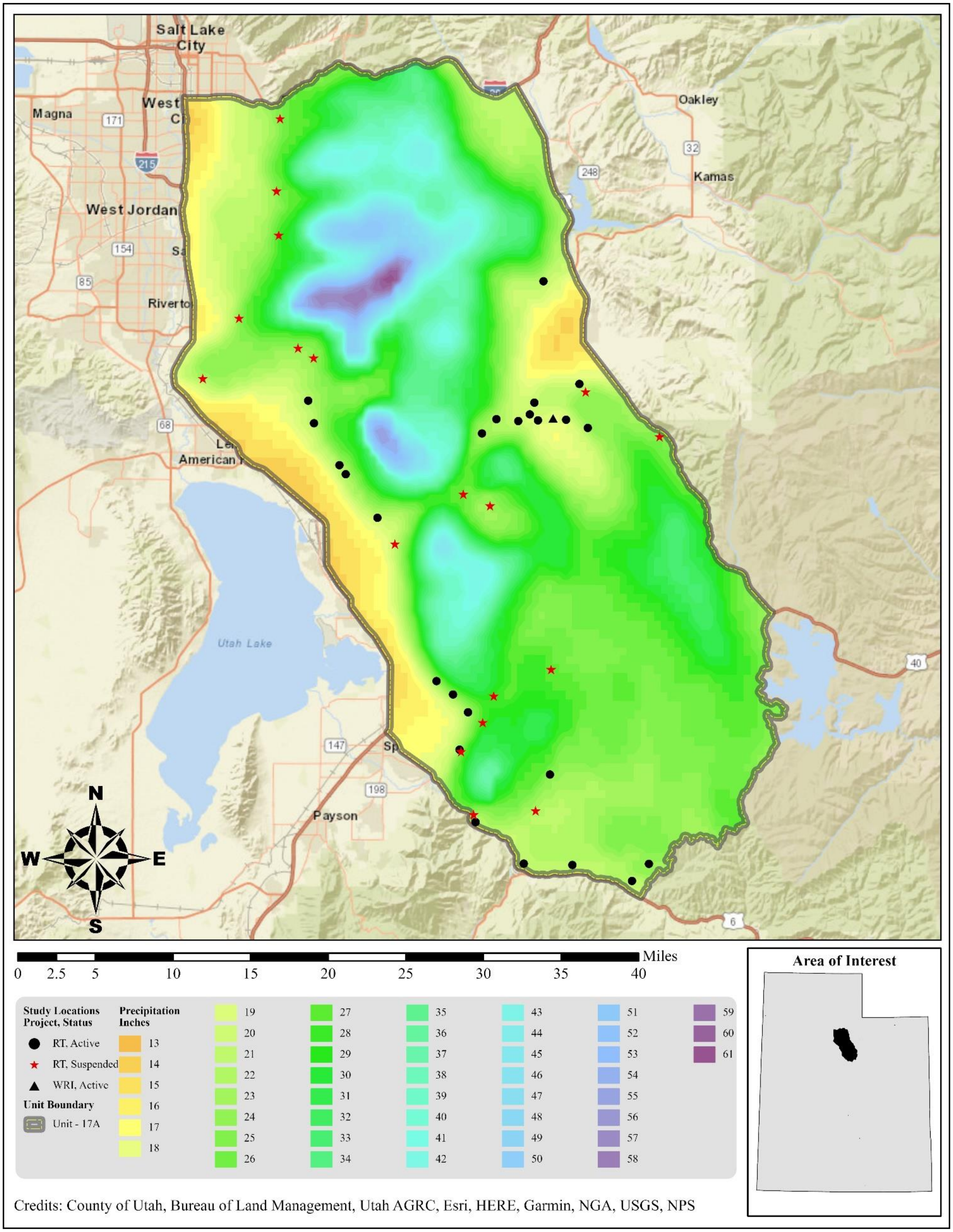
The Wasatch Mountains run north-south, with the Wasatch Front on the west side and Park City, Heber Valley, and Currant Creek Mountain bordering the east side. The Wasatch Mountains are generally tall with rugged terrain: the highest point is Mount Timpanogos at 11,752 feet. Willow Creek Ridge and Strawberry Ridge surrounding Strawberry Reservoir are less pronounced than the Wasatch Mountains, having gentler terrain.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 14 inches along portions of the Wasatch Front and Heber Valley to 61 inches on the peaks of Mt. Timpanogos and Twin Peaks. All of the Range Trend and WRI monitoring studies on the unit occur within 18-28 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 Mountain divisions (Divisions 3 and 5).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought from 1992, 2000-2003, 2007, 2012-2015, 2018, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995-1998, 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 2021-2022. 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 in 2001-2003, 2007, 2012-2013, 2015, and 2020-2022; moderately to extremely wet years were displayed in 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; moderately to extremely wet years were displayed 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 2021-2022; 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 in 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, 2023).



Map 2.1: The 1991-2020 PRISM Precipitation Model for WMU 17A, Wasatch Mountains, West (PRISM Climate Group, Oregon State University, 2021).

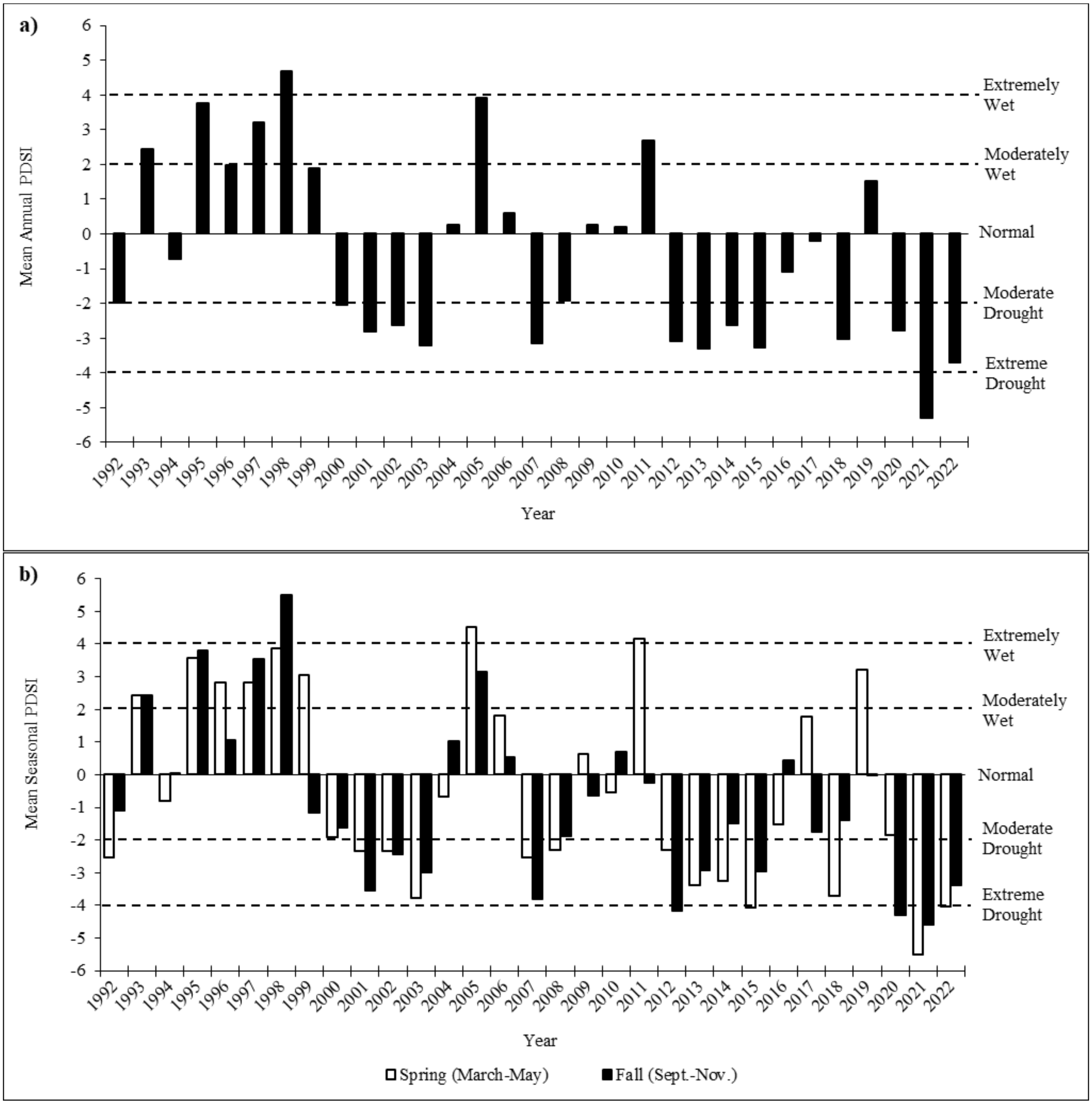


Figure 2.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

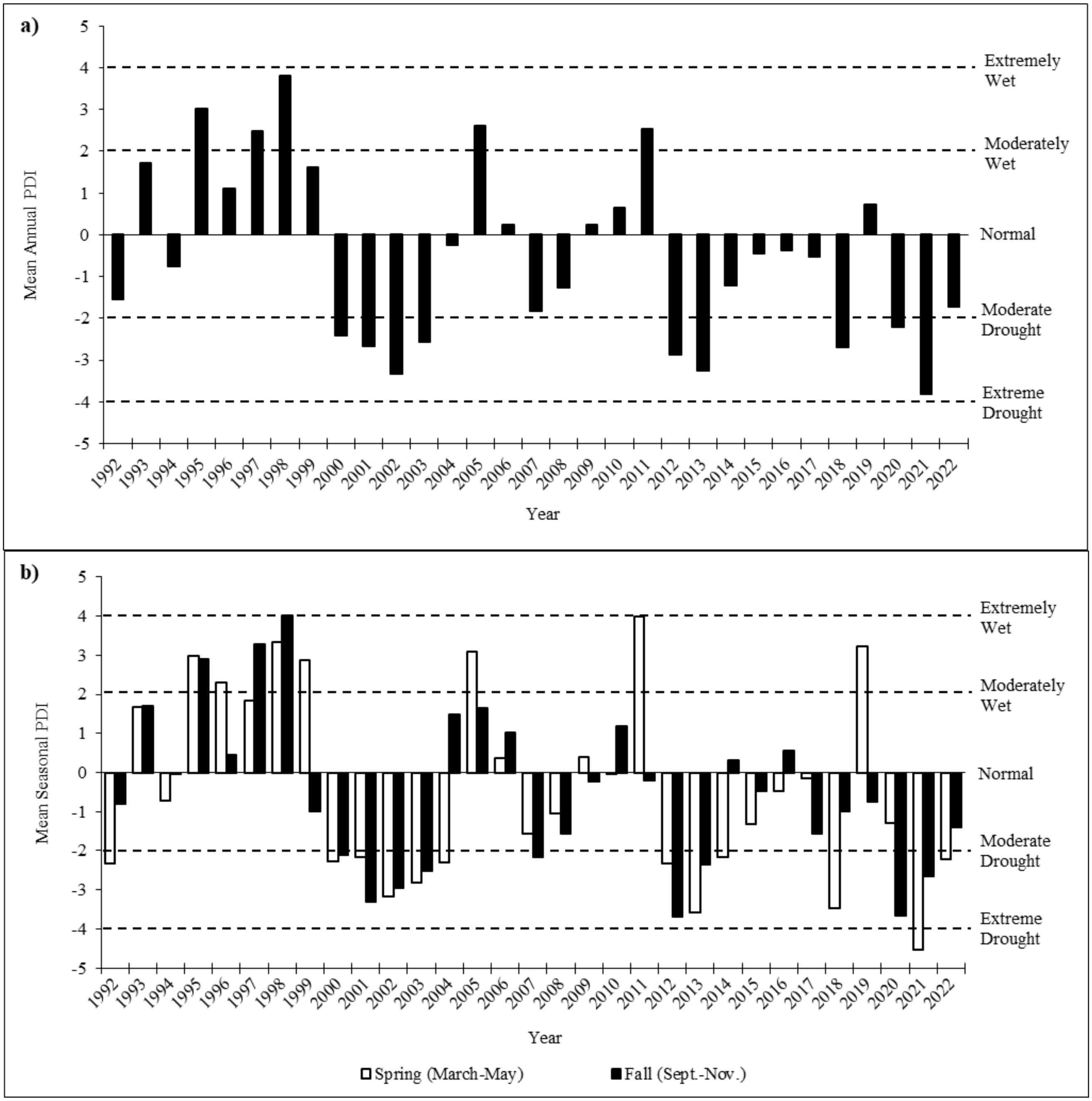


Figure 2.2: The 1992-2022 Palmer Drought Severity Index (PDSI) for the Northern Mountains division (Division 5). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

Big Game Habitat

The unit presents several challenges to public land and wildlife managers, with issues arising from the urbanization and degradation of winter range. Deer winter range throughout the unit is concentrated in Spanish Fork Canyon, Heber Valley and the Bonneville Shoreline. The deer winter range in Spanish Fork Canyon is higher in elevation and may not be heavily used in more severe winters.

Much of the winter range in the Heber Valley area (50%) is privately owned and development has been a continuing concern. Since the early 2000s, development has accelerated and some of the most critical range is being converted to housing. Division of Wildlife Resources, State Parks, and federal lands will likely be the key to the deer habitat into the future on this portion of the unit. Antelope bitterbrush, mixed mountain browse, mixed oakbrush/sagebrush, and mountain big sagebrush are some of the important vegetation types monitored.

Winter habitat along the Bonneville Shoreline is limited by quality and quantity in this area of the unit. A large portion of deer winter range is privately owned, making it susceptible to development. Housing developments in recent years have consumed much of this important winter range and will likely continue to do so in the future. Most winter range has been reduced to a narrow bench above the communities of Alpine, Pleasant Grove, Orem, Springville and Mapleton. Important vegetation types that are monitored include antelope bitterbrush, alderleaf mountain mahogany, mixed mountain browse, mixed oakbrush/sagebrush, and Stansbury cliffrose.

The majority of deer winter range in Spanish Fork Canyon is managed by the US Forest Service. These sites are typically higher elevation winter range and may not be used as heavily in more severe winters. Important vegetation types monitored include mixed mountain browse, mixed oakbrush/sagebrush, and sagebrush.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between range trend samplings.

The RAP data shows fluctuations of herbaceous biomass and cover on both deer summer and winter range. The highest values for both measurements were observed in the early 1990s, and have since decreased. Annual and perennial cover and biomass have followed precipitation trends in many years. However, a possible lag effect of a year or so appears to occur at different times (in 2017-2019, for example), and no apparent correlation is visible in other years. Increases and decreases in biomass and cover generally appear to be somewhat more pronounced on winter habitats than on summer range (**Figure 2.3**, **Figure 2.4**, **Figure 2.5**, **Figure 2.6**). As expected, some peaks and troughs in this herbaceous data can be correlated with Palmer Drought Severity Index (PDSI) data. For example, increased cover, biomass, and precipitation in 2019 correspond with PDSI values that show a wetter than normal year and a moderately wet spring and an extremely wet fall. While it is important to note yearly trends, the overall trend for biomass and cover for both winter and summer range has generally decreased since 1992, which seems to correspond with prolonged drought cycles beginning in the late 1990s as marked in the PDSI (**Figure 2.1a**, **Figure 2.1**, **Figure 2.2a**, **Figure 2.2b**). Fire may have influence in the increase and amount of annual species on winter range. Fire years that had significant impact on deer winter range occurred in 2003-2004 and 2017-2018 (**Map 2.5**).

Range Trend data for herbaceous cover from 1997 (and later) to present shows yearly variation in both perennial and annual lifeforms, but an overall cover increase occurred on most ecotypes (**Figure 2.25**, **Figure 2.26**, **Figure 2.27**). Year-to-year fluctuations can be expected due to differences in precipitation and the timing of data collection between sample years.

RAP data indicates that tree and shrub cover correlate with precipitation to some degree in many years and that these lifeforms have provided more cover on summer range than winter range. Total cover values have increased on both mule deer summer and winter habitat. Of particular interest is the decrease occurring from 1991 to 1993, which was more marked on summer habitat than winter range. Range Trend data for tree and shrub cover values has exhibited yearly fluctuations. However, the overall RAP data trend in cover for trees and shrubs for both summer and winter ranges appears to have increased overall (**Figure 2.7**, **Figure 2.8**), which does not compare to the overall negative trend occurring on many of the ecotypes sampled by Range Trend (**Figure 2.9**, **Figure 2.10**, **Figure 2.11**, **Figure 2.12**, **Figure 2.13**, **Figure 2.14**, **Figure 2.15**, **Figure 2.16**). This may be due to the low sample size or intentional placement of Range Trend studies in winter range, which therefore does not capture the full extent of tree and shrub cover for the Wasatch Mountains deer winter range. It is important to note that reductions in tree cover on Range Trend sites will not correspond with the overall increase in cover estimated by the RAP. This incongruence is due to the differences in dataset types: Range Trend data is site-specific and granular while RAP data is aggregated to the unit scale for deer habitat.

RAP – Biomass by Deer Habitat

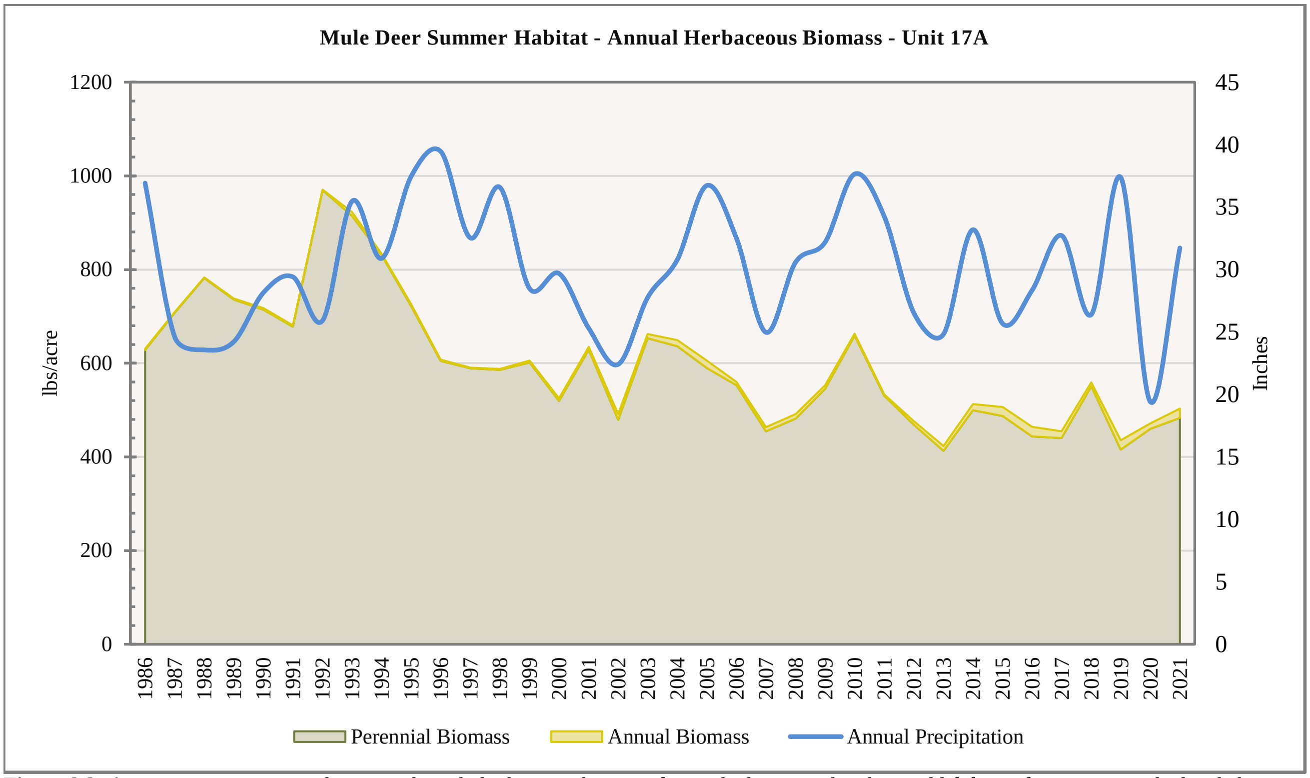


Figure 2.3: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 17A, Wasatch Mountains, West (Rangeland Analysis Platform, 2023).

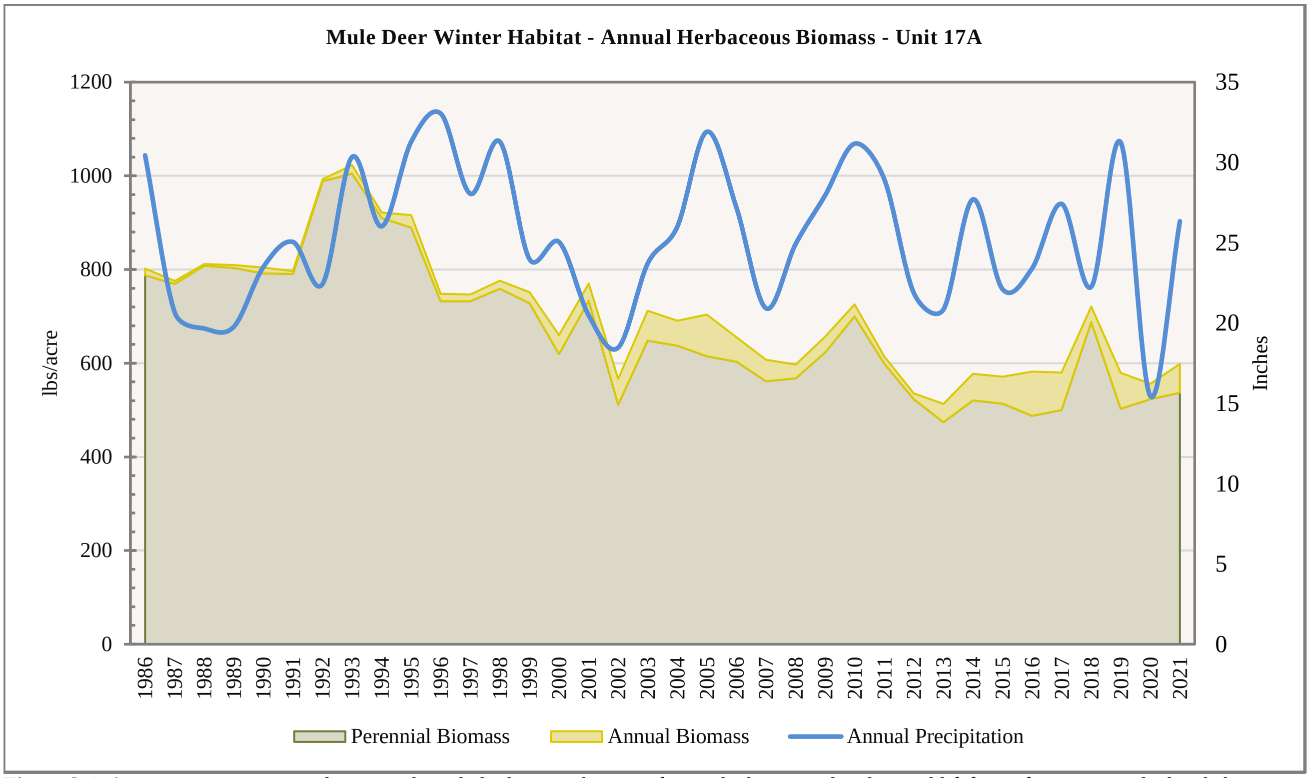


Figure 2.4: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 17A, Wasatch Mountains, West (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

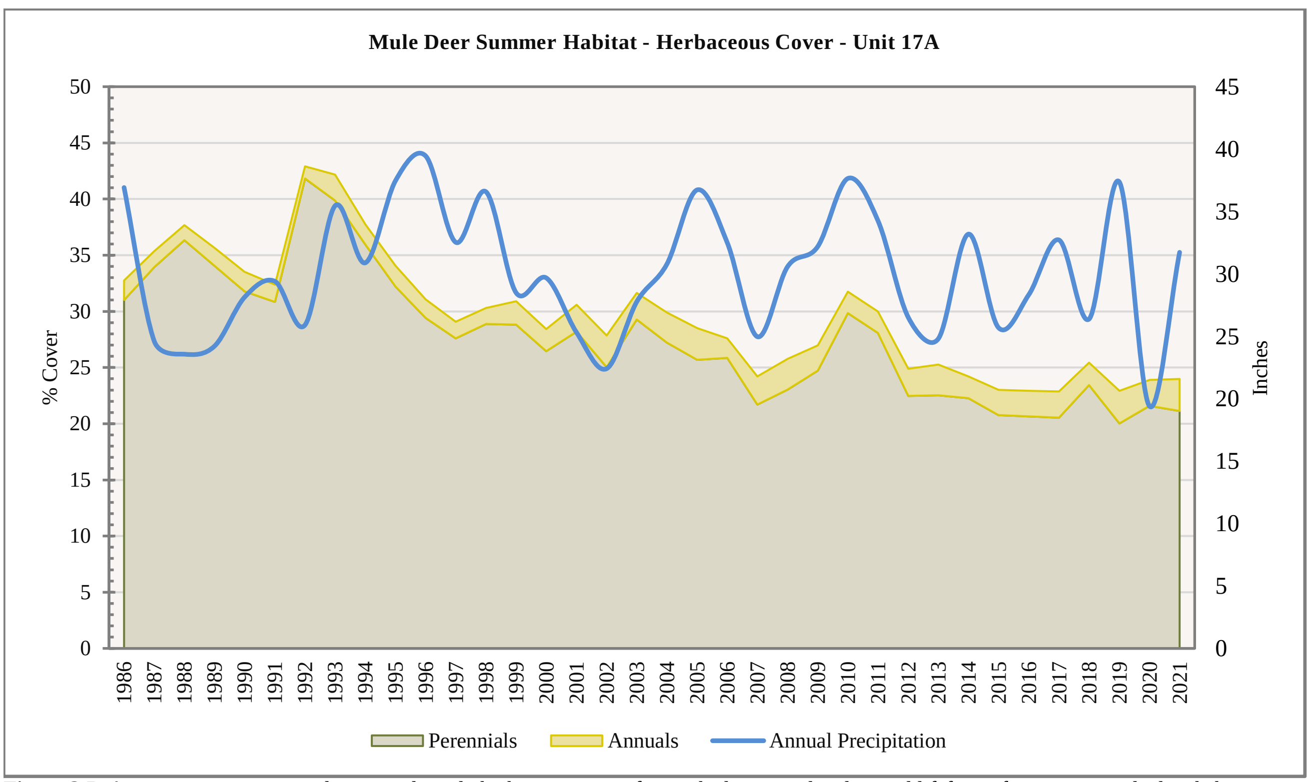


Figure 2.5: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 17A, Wasatch Mountains, West (Rangeland Analysis Platform, 2023).

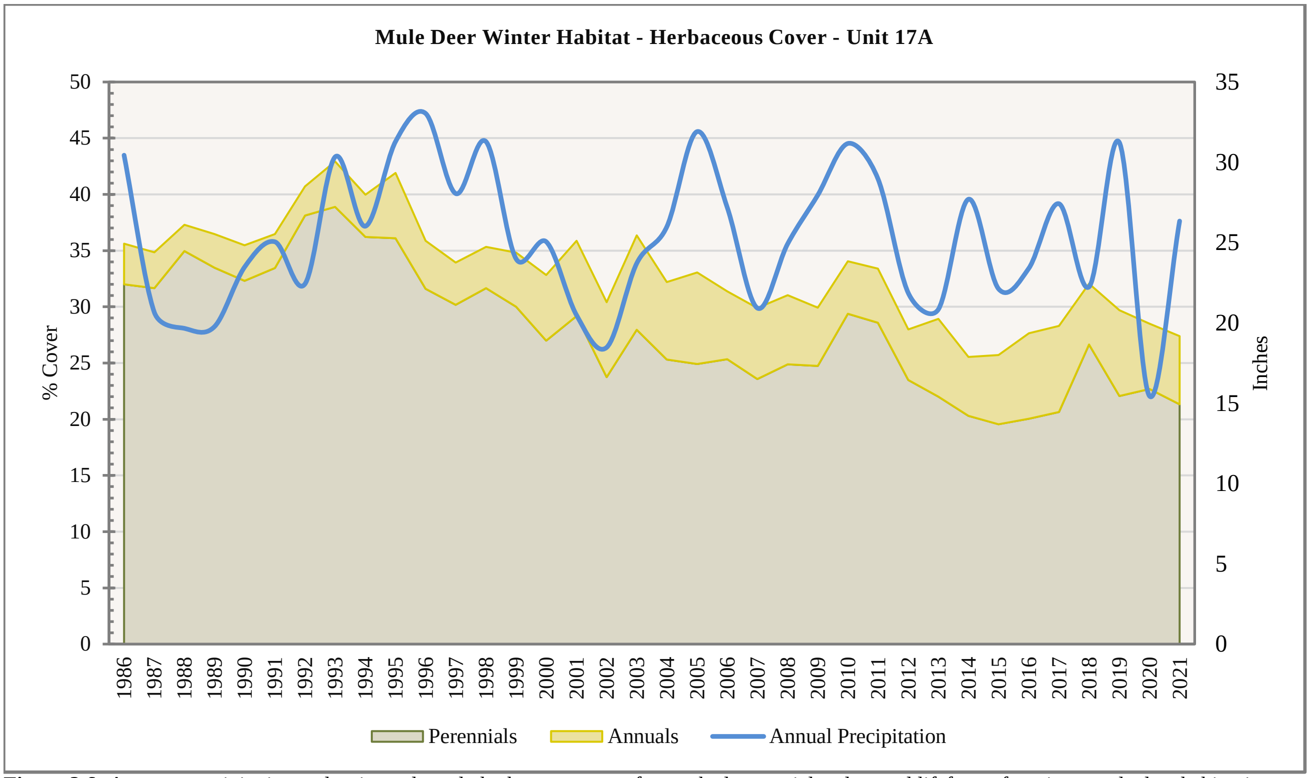


Figure 2.6: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 17A, Wasatch Mountains, West. (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

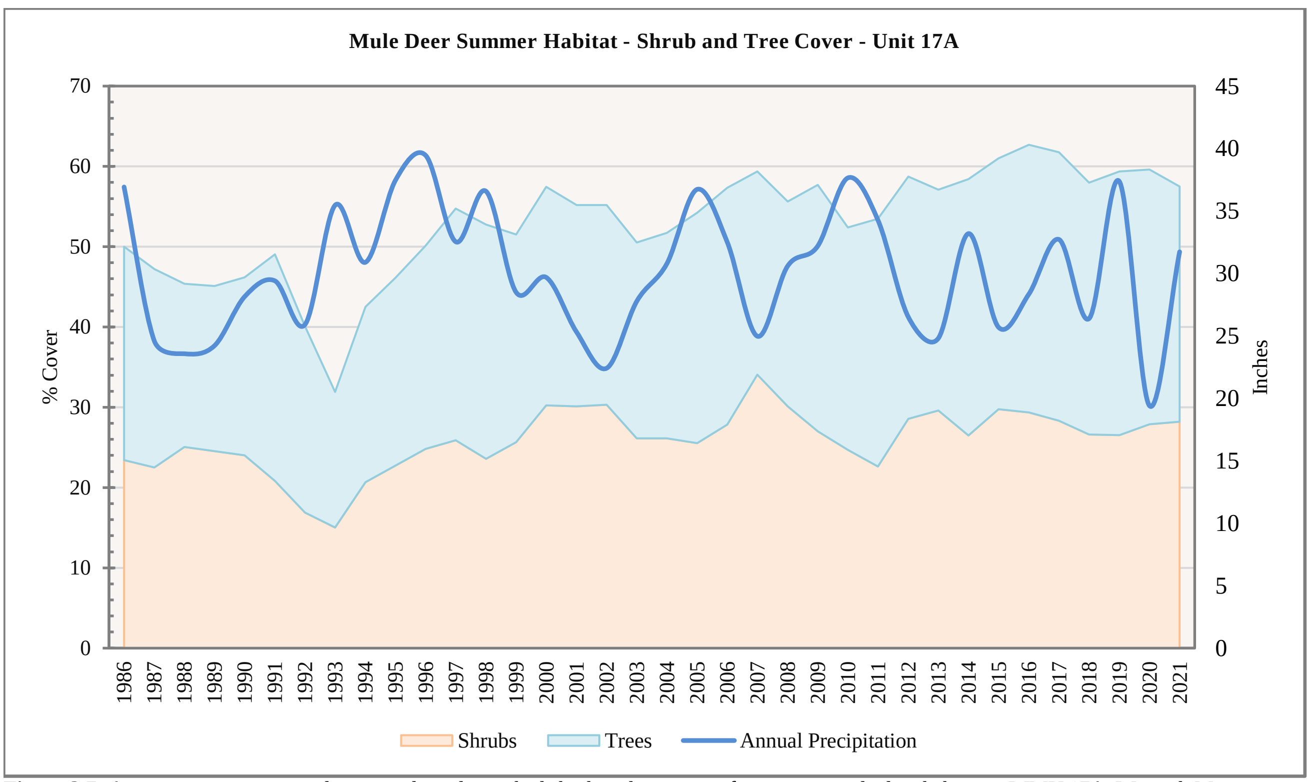


Figure 2.7: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 17A, Wasatch Mountains, West (Rangeland Analysis Platform, 2023).

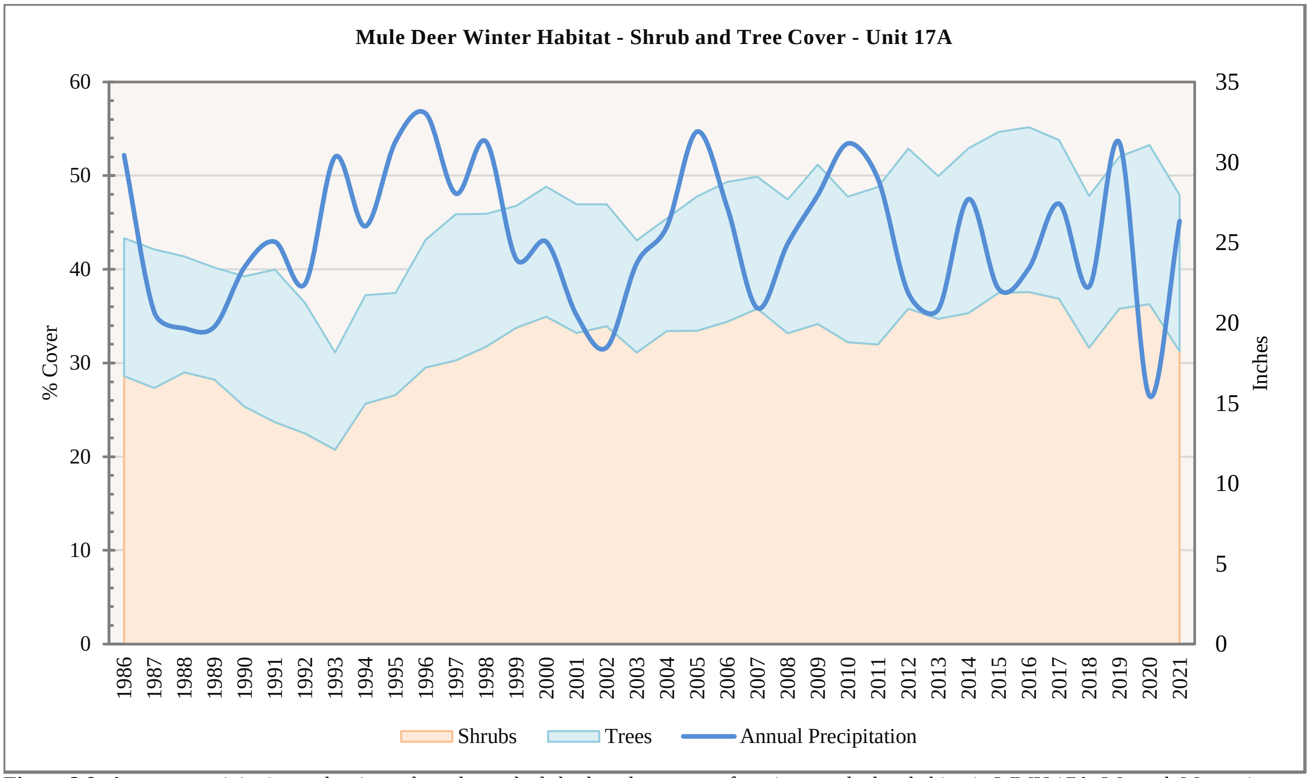
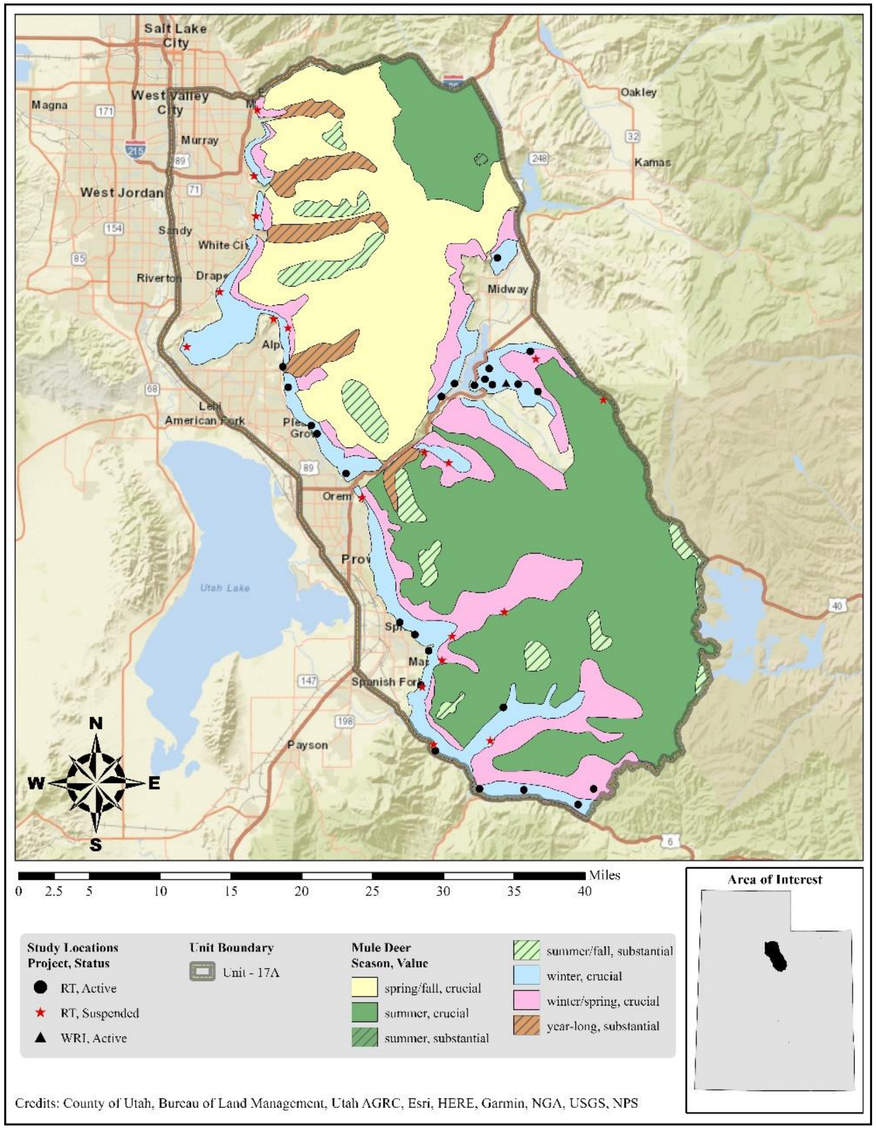
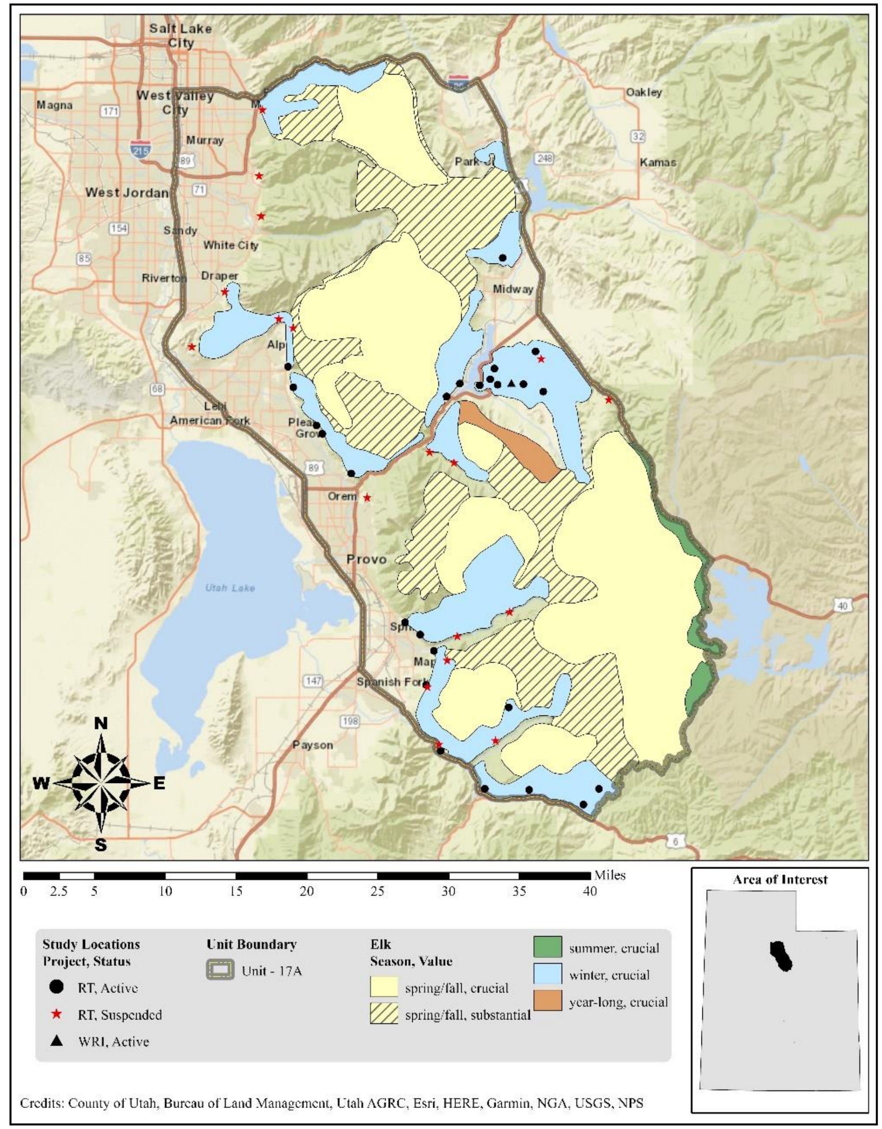


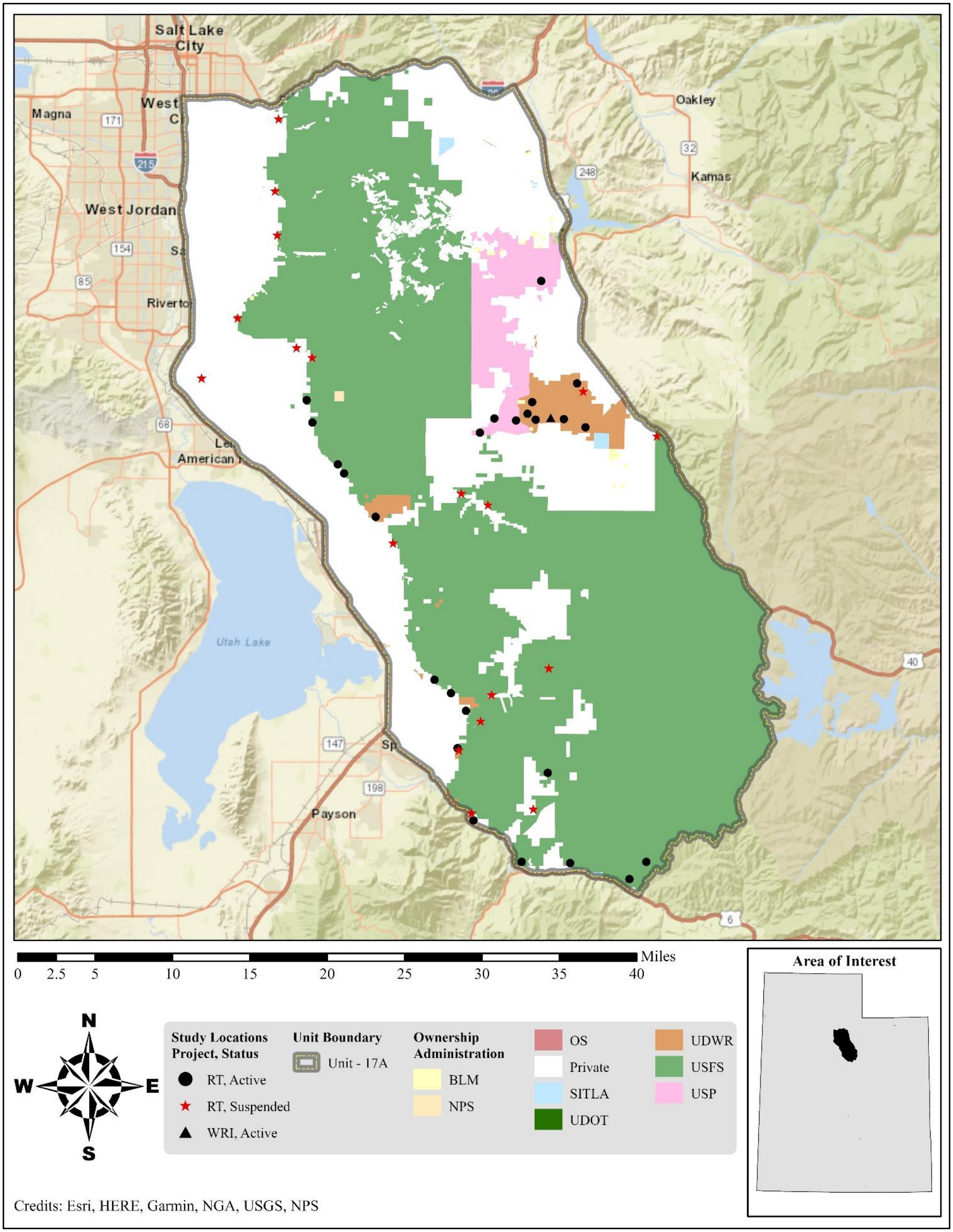
Figure 2.8: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 17A, Wasatch Mountains, West (Rangeland Analysis Platform, 2023).



Map 2.2: Estimated mule deer habitat by season and value for WMU 17A, Wasatch Mountains, West.



Map 2.3: Estimated elk habitat by season and value for WMU 17A, Wasatch Mountains, West.



Map 2.4: Land ownership for WMU 17A, Wasatch Mountains, West.

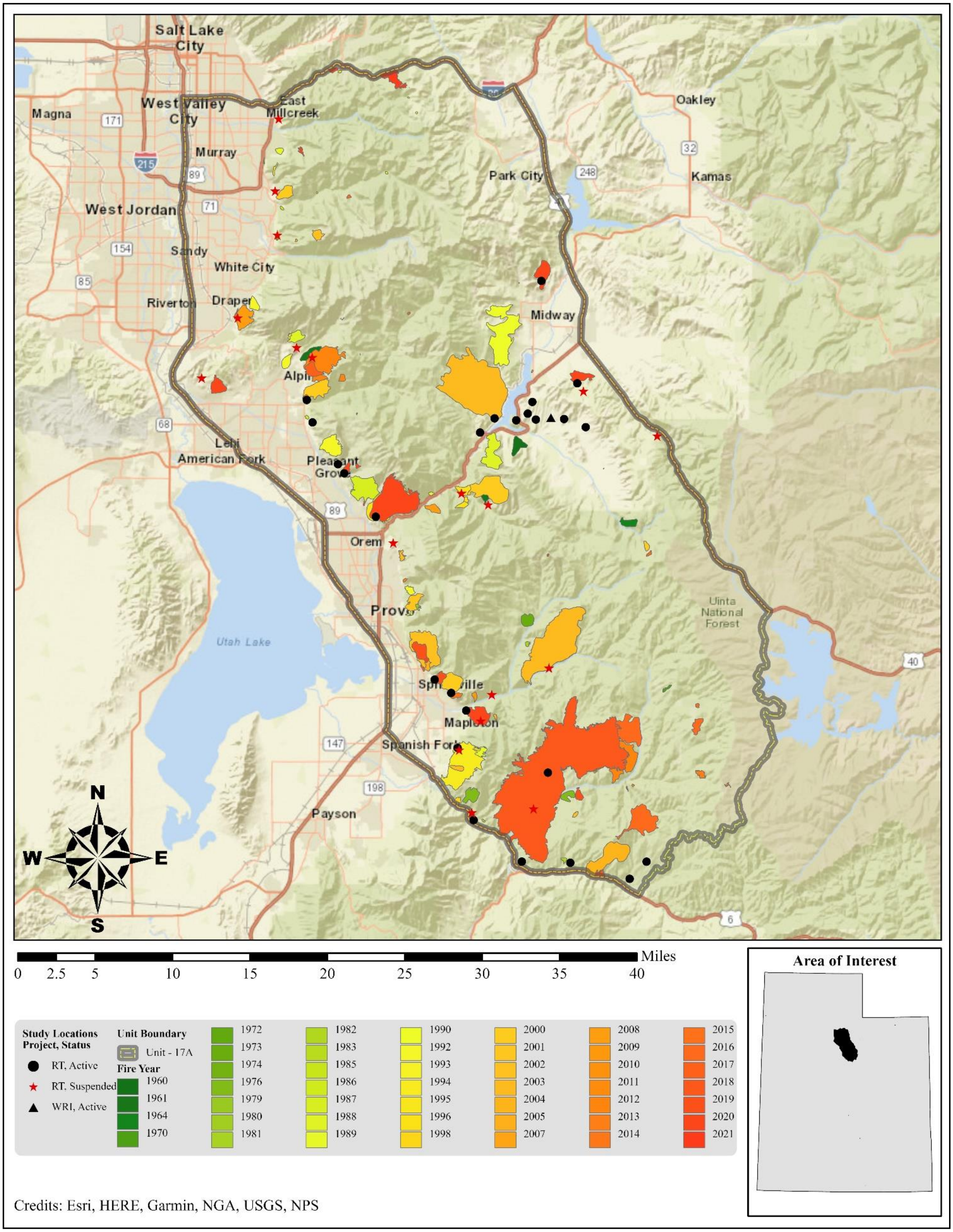
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Hardwood	189,243	30.67%	
	Developed	24,203	3.92%	
	Conifer-Hardwood	21,024	3.41%	
	Sparsely Vegetated	20,163	3.27%	
	Riparian	5,291	0.86%	
	Agricultural	4,065	0.66%	
	Open Water	364	0.06%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	39	0.01%	42.84%
Shrubland	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	128,933	20.89%	
	Inter-Mountain Basins Montane Sagebrush Steppe	23,895	3.87%	
	Inter-Mountain Basins Big Sagebrush Shrubland	10,127	1.64%	
	Rocky Mountain Lower Montane-Foothill Shrubland	4,745	0.77%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	2,840	0.46%	
	Rocky Mountain Alpine Dwarf-Shrubland	1,994	0.32%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	531	0.09%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	125	0.02%	
	Great Basin Semi-Desert Chaparral	67	0.01%	
	Great Basin Xeric Mixed Sagebrush Shrubland	57	0.01%	
	Inter-Mountain Basins Big Sagebrush Steppe	48	0.01%	
	Inter-Mountain Basins Mat Saltbush Shrubland	6	0.00%	
	Inter-Mountain Basins Greasewood Flat	<1	0.00%	28.09%
Conifer	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	30,069	4.87%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	28,080	4.55%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	25,378	4.11%	
	Colorado Plateau Pinyon-Juniper Woodland	22,499	3.65%	
	Rocky Mountain Foothill Limber Pine-Juniper Woodland	9,841	1.59%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	8,638	1.40%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	7,911	1.28%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	1,319	0.21%	
	Southern Rocky Mountain Ponderosa Pine Woodland	385	0.06%	
	Great Basin Pinyon-Juniper Woodland	303	0.05%	21.78%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	13,401	2.17%	
	Great Basin & Intermountain Introduced Annual Grassland	4,288	0.69%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	4,017	0.65%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	51	0.01%	3.53%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	16,511	2.68%	
	Southern Rocky Mountain Montane-Subalpine Grassland	4,297	0.70%	
	Rocky Mountain Alpine Fell-Field	212	0.03%	
	Rocky Mountain Alpine Turf	78	0.01%	
	Inter-Mountain Basins Semi-Desert Grassland	26	0.00%	3.42%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	1,136	0.18%	
	Interior Western North American Temperate Ruderal Shrubland	923	0.15%	0.33%
Total		**617,122**	**100%**	**100%**

Table 2.1: LANDFIRE Existing Vegetation Coverage For Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 17A, Wasatch Mountains, West.

Limiting Factors to Big Game Habitat

Major human activities within this unit include recreation and livestock grazing. Urban development is a primary concern and a significant factor in the loss of winter habitat. Public land winter range availability and winter range forage conditions are both major limiting factors to big game habitat on this unit.

The winter range within the Heber Valley and Spanish Fork Canyon areas of the subunit appears suitable to support planned deer population objectives. Winter range on the Bonneville Shoreline is more limited primarily due to development and poor quality habitat; deer will likely be forced to winter in an urban setting during more severe winters in this area. The abundance of bulbous bluegrass (*Poa bulbosa*) is a concern in all areas of the subunit. Once established, bulbous bluegrass populations persist and invade native plant communities (Kulmatiski, 2006): this introduced perennial species can form dense mats that may compete with other more desirable herbaceous species, seedlings, and young shrubs, potentially limiting the establishment of new plants into the population. The abundance of cheatgrass (*Bromus tectorum*) in the Heber Valley and Bonneville Shoreline areas of the unit is also a concern because this introduced annual species can increase fuel loads and the chance of a catastrophic fire event (Balch, D'Antonio, & Gómez-Dans, 2013). Cheatgrass may have been a factor in the conduction of fire in the most recent burns within the subunit. All Range Trend sites [excluding Little Diamond Fork (17A-39)] have had some level of cheatgrass abundance. According to the LANDFIRE Existing Vegetation Coverage model, 0.7% of the subunit’s mule deer winter range is comprised of annual grassland. In addition, LANDFIRE estimates that 3.7% of the subunit’s deer winter range is comprised of pinyon-juniper woodlands (**Table 2.1**). 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).



Map 2.5: Land coverage of fires by year from 1960-2021 for WMU 17A, Wasatch Mountains, West (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

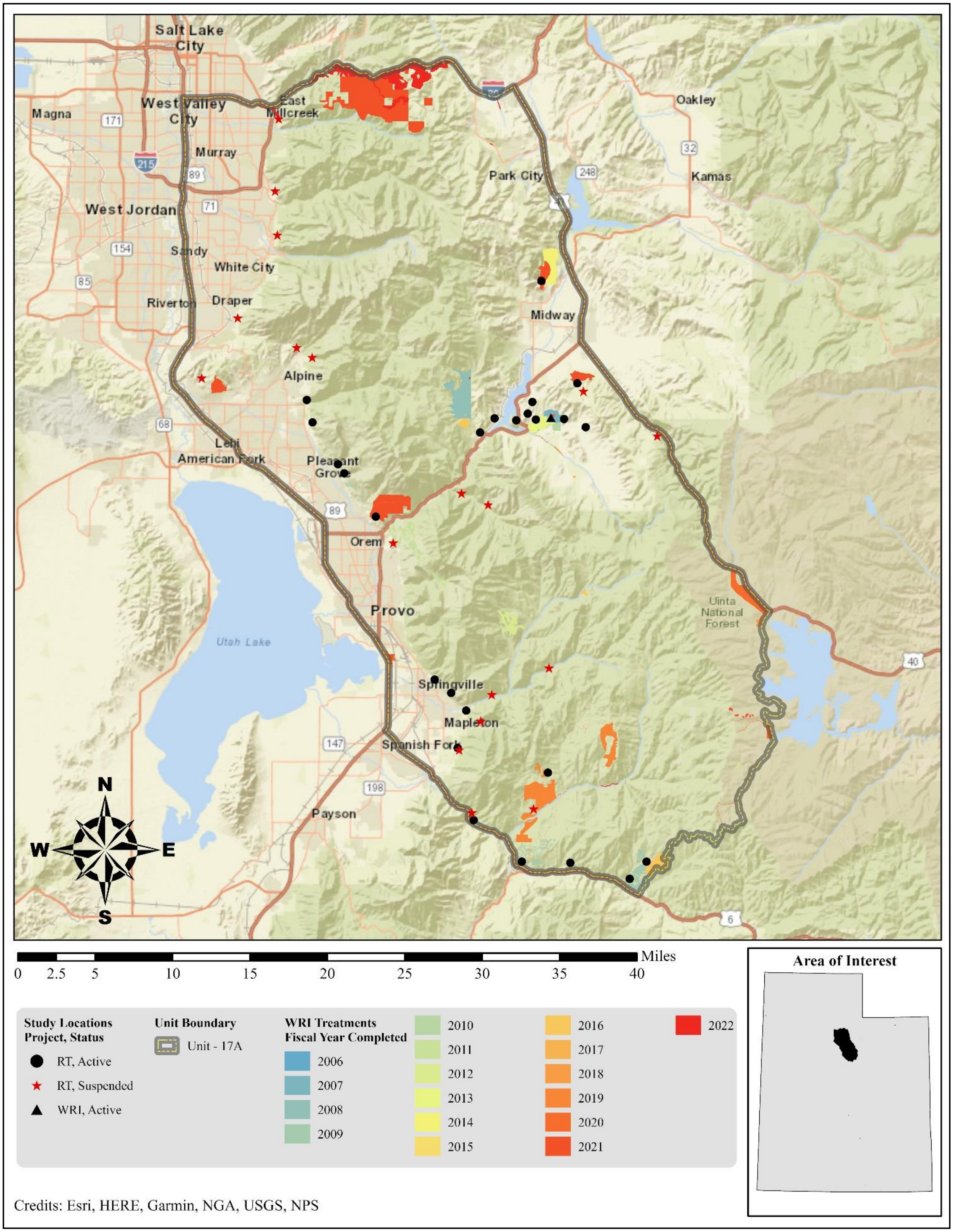
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 48,529 acres of land have been treated within the Wasatch Mountains, West subunit since the WRI was implemented in 2004 (**Map** 2.6: WRI treatments by **fiscal year completed for WMU** 17A, Wasatch Mountains, West.). An additional 40,437 acres are currently being treated and treatments have been proposed for 707 acres. Treatments frequently overlap one another bringing the total completed treatment acres to 44,524 acres for this unit (**Table 2.2**). 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 treatments to rejuvenate community diversity and health is the most common management practice in this subunit. Seeding and anchor chaining are also very common. Other management practices that are all used across the unit include (but are not limited to) bullhog, harrow, mowing, planting/transplanting to reestablish preferred browse, and hand vegetation removal (such as lop and scatter and lop-pile-burn) (**Table 2.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**8,062**	**0**	**0**	**8,062**
Ely (One-Way)	113	0	0	113
Ely (Two-Way)	7,949	0	0	7,949
Bullhog	**4,538**	**3,994**	**0**	**8,533**
Full Size	4,537	3,994	0	8,532
Skid Steer	1	0	0	1
Chain Harrow	**1,174**	**1,270**	**0**	**2,443**
> 15 ft. (Two-Way)	1,174	437	0	1,611
> 15 ft. (One-Way)	0	832	0	832
Greenstripping	**82**	**109**	**0**	**191**
Greenstripping	82	109	0	191
Harrow	**5,316**	**41**	**0**	**5,358**
≤ 15 ft. (One-Way)	2,323	0	0	2,323
≤ 15 ft. (Two-Way)	2,068	0	0	2,068
> 15 ft. (Two-Way)	176	0	0	176
> 15 ft. (One-Way)	749	41	0	791
Herbicide Application	**1,694**	**34**	**203**	**1,931**
Aerial (Fixed-Wing)	303	0	0	303
Aerial (Helicopter)	1,256	0	203	1,459
Ground	134	34	0	168
Mowing	**731**	**0**	**0**	**731**
Brush Hog	731	0	0	731
Prescribed Fire	**10,534**	**16,741**	**0**	**27,275**
Prescribed Fire	10,534	16,741	0	27,275
Seeding (Primary)	**7,768**	**14,525**	**89**	**22,382**
Broadcast (Aerial-Fixed Wing)	4,656	238	0	4,894
Broadcast (Aerial-Helicopter)	2,671	14,287	0	16,958
Drill (Rangeland)	287	0	89	376
Ground (Mechanical Application)	154	0	0	154
Seeding (Secondary/Shrub)	**1,536**	**0**	**0**	**1,536**
Broadcast (Aerial-Fixed Wing)	1,536	0	0	1,536
Vegetation Removal/Hand Crew	**7,093**	**3,723**	**414**	**11,231**
Lop (No Scatter)	910	1,672	0	2,582
Lop & Chip	0	4	0	4
Lop & Scatter	6,183	2,047	414	8,644
Grand Total	**48,529**	**40,437**	**707**	**89,673**
***Total Land Area Treated**	**44,524**	**45,155**	**707**	**90,385**

Table 2.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 17A, Wasatch Mountains, West. Data accessed on 01/23/2023 *Does not include overlapping treatments.



Map 2.6: WRI treatments by fiscal year completed for WMU 17A, Wasatch Mountains, West.

Range Trend Studies

Range Trend studies have been sampled within WMU 17A on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 2.3**). 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 2.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
17-5	Deer Creek Dam	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-6	Daniels Canyon	RT	Suspended	1983, 1996	Mountain Loam (Mountain Big Sagebrush)
17-7	Provo River Canyon	RT	Active	1984, 1990, 1996, 2001, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-9	Lower Big Hollow	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Oak)
17-10	Upper Big Hollow	RT	Suspended	1983, 1989, 1996	Mountain Loam (Oak)
17-11	Wallsburg Turn	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
17-12	North Wallsburg Reseeding	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Oak)
17-13	North Wallsburg	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
17-14	Hoovers Hollow	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
17-15	Island Boat Camp	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Shrub)
17-16	Rainbow Bay	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Shrub)
17-17	Dutch Canyon	RT	Active	1983, 1989, 1996, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Oak)
17-19	Coyote Canyon	RT	Suspended	1984, 1996, 2002, 2007, 2012, 2017	Mountain Loam (Mountain Big Sagebrush)
17-20	Lake Creek Road	RT	Suspended	1984, 1996, 2002	Mountain Stony Loam (Oak)
17-21	Box Elder Canyon	RT	Suspended	1983, 1989, 1997	Mountain Stony Loam (Oak)
17-22	Schoolhouse Springs	RT	Suspended	1983, 1989, 1997	Mountain Loam (Shrub)
17-23	Oak Hollow	RT	Suspended	1983, 1989, 1997	Mountain Stony Loam (Mountain Big Sagebrush)
17-24	Heisetts Hollow	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-25	North Battle Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Very Steep Stony Loam (Cliffrose)
17-26	Orem Water Tank	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Oak)
17-28	Spring Hollow	RT	Suspended	1983, 1989, 1997	Mountain Stony Loam (Oak)
17-29	Above Edgemont	RT	Suspended	1983, 1989, 1997	Mountain Loam (Mountain Big Sagebrush)
17-30	Spring Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Very Steep Stony Loam (Cliffrose)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
17-31	Round Peak	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Hackberry)
17-33	Maple Canyon	RT	Suspended	1983, 1989, 1997	Mountain Stony Loam (Oak)
17-34	Maple Mountain Face	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-35	Hobble Creek Golf Course	RT	Suspended	1983, 1989, 1997	Mountain Stony Loam (Oak)
17-36	Big Slide	RT	Suspended	1997	Mountain Loam (Mountain Big Sagebrush)
17-38	North Fork Diamond Canyon	RT	Suspended	1983, 1989, 1997	Mountain Loam (Mountain Big Sagebrush)
17-39	Little Diamond Fork	RT	Suspended	1983, 1989, 1997, 2002, 2007, 2012, 2017	Mountain Loam (Mountain Big Sagebrush)
17-40	Long Hollow	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Gravelly Loam (Mountain Big Sagebrush)
17-41	Upper Sheep Creek	RT	Active	1983, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Clay (Mountain Big Sagebrush)
17-42	Tank Hollow	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Browse)
17-43	Tie Fork	RT	Suspended	1983, 1989, 1997	Mountain Loam (Oak)
17-44	Billies Mountain	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Clay (Mountain Big Sagebrush)
17-45	North Bench	RT	Active	1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-46	Lower Tank Hollow	RT	Active	1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-47	Tie Fork East	RT	Suspended	1989, 1997, 2002, 2007, 2012	Mountain Stony Loam (Browse)
17-60	Center Creek	RT	Active	2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
17-61	American Fork Canyon	RT	Active	2002, 2007, 2012, 2017, 2022	Mountain Shallow Loam (Mountain Big Sagebrush)
17-62	Grove Creek	RT	Active	2002, 2007, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
17-63	Hobble Creek Bench	RT	Active	2002, 2012, 2017, 2022	Mountain Loam (Browse)
17-64	Water Hollow	RT	Active	2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-69	Zipline Hill	RT	Active	2017, 2022	Mountain Loam (Shrub)
17-70	Indian Creek Road	RT	Active	2017, 2022	Mountain Loam (Mountain Big Sagebrush)
17-71	Hailstone	RT	Suspended	1984, 1990, 1996, 2001	Mountain Loam (Mountain Big Sagebrush)
17R-1	West Hills WMA	RT	Suspended	1999	Mountain Loam (Mountain Big Sagebrush)
17R-40	Round Valley	WRI	Active	2018, 2021	Mountain Loam (Mountain Big Sagebrush)

Table 2.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 17A, Wasatch Mountains, West.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
17-4	Cherry Canyon	Wildfire	Corner Canyon	August 2008	763	
17-5	Deer Creek Dam	Powerline		Prior to 1989		
		Wildfire	Deer Creek Trail	June 2018		
		Wildfire	Deer Creek	July 2018		
17-9	Lower Big Hollow	Wildfire	Big Hollow	July-August 2020		
		Wildfire	Big Hollow	Summer 2019		
		Wildfire		1976		
		Seed Unknown		Fall 1976		
17-11	Wallsburg Turn	Wildfire		August 1976		
		Seed Unknown		Fall 1976		
17-12	North Wallsburg Reseeding	Wildfire		August 1976		
		Seed Unknown		Fall 1976		
17-14	Hoovers Hollow	Wildfire	Cascade 2	2003	7,834	
17-16	Rainbow Bay	Wildfire		Historic		
17-17	Dutch Canyon	Wildfire	Saddle	2020	683	
		Aerial	Saddle Fire Rehabilitation Project	November 2020	527	5466
17-21	Box Elder Canyon	Wildfire	Quail Fire	July 2012	2,220	
17-24	Heisetts Hollow	Wildfire	Cedar Hills	2013	6	
17-25	North Battle Creek	Wildfire	Battle Creek 2	2020	188	
17-26	Orem Water Tank	Wildfire	Range	2020	3,496	
		Aerial	Range Fire Rehabilitation Project	November 2020	1,966	5542
		Broadcast	Timpanogos WMA Fire Rehabilitation and Access Management Project (Proposed)	2022	145	5956
		Scalper	Timpanogos WMA Fire Rehabilitation and Access Management Project (Proposed)	2022	145	5956
		Seed Unknown		Historic		
		Wildfire	Orem Park	1960	604	
		Wildfire	Tank	1996	3,032	
17-32	Right Fork-Hobble Creek	Wildfire	Cherry Creek 2	2003	6,038	
17-34	Maple Mountain Face	Wildfire	Trojan II	1994	2,975	
		Seed Unknown		After 1994		
17-36	Big Slide	Wildfire		1994		
		Unknown		After 1994		
17-38	North Fork Diamond Canyon	Wildfire	Pole Creek/Bald Mountain Fire Complex	September-October 2018	120,854	
17-39	Little Diamond Fork	Wildfire	Pole Creek/Bald Mountain Fire Complex	August-October 2018	120,854	
		Chain Unknown	Lower Diamond Revegetation Project	1969	1,500	
		Aerial Unknown	Lower Diamond Revegetation Project	1969	1,500	
17-40	Long Hollow	Powerline		Prior to 1997		
17-41	Upper Sheep Creek	Wildfire	Tank Hollow	2017	11,067	
17-42	Tank Hollow	Lop and Scatter	Tank Hollow Habitat Improvement Project	July 2007-December 2008	1,117	658
		Broadcast	Sheepcreek (Wasatch Mtns Unit) Big Game Winter Habitat Improvement FY 23 (Proposed)	Spring-Fall 2023	2,981	5967
		Transplant	Sheepcreek (Wasatch Mtns Unit) Big Game Winter Habitat Improvement FY 23 (Proposed)	Fall 2023	2,981	5967
17-44	Billies Mountain	Lop and Scatter	Spanish Fork River Watershed Post Fire Restoration Phase III (Proposed)	2023	2,843	5969
17-45	North Bench	Milestone	Utah County CWMA Priority Weeds Treatment and Restoration-Phase I	2009	50	1116
17-46	Lower Tank Hollow	Broadcast	Sheepcreek (Wasatch Mtns Unit) Big Game Winter Habitat Improvement FY 23 (Proposed)	Spring-Fall 2023	2,981	5967
		Transplant	Sheepcreek (Wasatch Mtns Unit) Big Game Winter Habitat Improvement FY 23 (Proposed)	Fall 2023	2,981	5967
		Chain Unknown		1971		
		Seed Unknown		1971		
		Lop and Scatter	Tank Hollow Habitat Improvement Project	July 2007-December 2008	1,116	658

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
17-61	American Fork Canyon	Wildfire	Alpine Fire	June 2017	99	
		Wildfire	View Point	2020	20	
		Wildfire	Oak Hill	2000	911	
17-63	Hobble Creek Bench	Wildfire	Ether Hollow	September 2020	849	
17-64	Water Hollow	Two-Way Smooth		1990s	60	
		Seed Unknown		1990s		
17-69	Zipline Hill	Wildfire		Historic		
17-70	Indian Creek Road	Bullhog	Sheep Creek Phase 1	May 2014	552	2629
17R-40	Round Valley	One-Way	Wallsburg WMA Shrub Planting	October 2019	9	4556
		Broadcast	Wallsburg WMA Shrub Planting	October 2019	9	4556
		Hand Transplant	Wallsburg WMA Shrub Restoration Project	July 2020-June 2021	52	5618
		Hand Transplant	Wallsburg WMA Shrub Planting	November 2019	9	4556
		Unknown		Historic		

Table 2.4: Range Trend and WRI studies known disturbance history for WMU 17A, Wasatch Mountains, West. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

There are 21 studies [West Hills WMA (17R-1) (suspended), Deer Creek Dam (17-5), Daniels Canyon (17-6) (suspended), Provo River Canyon (17-7), Wallsburg Turn (17-11), North Wallsburg (17-13), Hoovers Hollow (17-14), Coyote Canyon (17-19) (suspended), Oak Hollow (17-23) (suspended), Heisetts Hollow (17-24), Above Edgemont (17-29) (suspended), Maple Mountain Face (17-34), Big Slide (17-36) (suspended), North Fork Diamond Canyon (17-39) (suspended), Little Diamond Fork (17-39), Long Hollow (17-40), Upper Sheep Creek (17-41), Billies Mountain (17-44), North Bench (17-45), Lower Tank Hollow (17-46), Center Creek (17-60), American Fork Canyon (17-61), Water Hollow (17-64), Indian Creek Road (17-70), and Hailstone (17-71) (suspended)] that are considered to be Mountain (Big Sagebrush) ecological sites.

The West Hills study is located above Provo River and east of Jordanelle Reservoir in the West Hills. The Deer Creek Dam site is situated southwest of Deer Creek Dam and the Daniels Canyon study can be found southeast of Heber City in Daniels Canyon. The Provo River Canyon study is situated west of the town of Francis and east of Jordanelle Reservoir. Wallsburg Turn is located northwest of the town of Wallsburg and east of Deer Creek Reservoir, and the North Wallsburg site can be found on a southwest-facing slope north of Wallsburg. The Hoovers Hollow site is located on a slope just west of the southwest portion of Deer Creek Reservoir. Coyote Canyon is situated in a present-day subdivision in Heber City. The Oak Hollow study is located up Oak Hollow in the Traverse Mountains, and Heisetts Hollow can be found north of Heisetts Hollow on the slopes facing the city of Cedar Hills. The Above Edgemont site is found in the foothills above Orem. Maple Mountain Face is located west of Middle Slide Canyon near the city of Mapleton. The Big Slide site is situated near the mouth of Big Slide Canyon, east of the city of Mapleton. North Fork Diamond Canyon can be found up Diamond Fork, which branches off Spanish Fork Canyon. The Little Diamond Fork study site is situated near a phosphate mining road north of Little Diamond Creek, and Long Hollow is located in Long Hollow, north of US Highway 6. The Upper Sheep Creek study is found on the slopes above Sheep Creek and south of Rays Valley Road. Billies Mountain is situated on the lower slopes of Billies Mountain about 0.5 miles west of the intersection of US Highways 6 and 89. The North Bench study site can be found on a bench between Joes Canyon and Sterling Hollow with Highway 6 to the east, and Lower Tank Hollow is found on the east slope of Knoll Hollow. The Center Creek study is located southwest of Heber City and north of a gravel pit. American Fork Canyon is situated on a bench that is at the mouth of American Fork Canyon and above a neighborhood in the city of Highland. The Water Hollow site is located southeast of Water Hollow and north of Highway 6, and Indian Creek Road can be found just north of Indian Creek Road and northeast of the Tie Fork Rest Area. Finally, the Hailstone study is located south of Murdock Hollow on the slopes above Jordanelle Reservoir (**Table 2.3**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant shrub species on many of these study sites as of 2022. Other preferred browse species such as antelope bitterbrush (*Purshia tridentata*) are codominant on some sites, while shrubs other than preferred browse contribute the most cover on other sites that have burned in the past. Average total shrub cover followed an upward trajectory through the 2017 sample year, a trend largely driven by shrub species that are not considered to be preferred browse. However, average shrub cover decreased between 2017 and 2022, mainly due to reductions in cover of sagebrush and other preferred browse species. This recent decrease is in part driven by the difference in study sites sampled between 2017 and 2022. Both the Coyote Canyon and Little

Diamond Fork studies had significant sagebrush cover that contributed to the total average, but these sites were suspended following the 2017 reading. In addition, the Deer Creek Dam and Upper Sheep Creek studies burned between sample years, with sagebrush cover on both sites exhibiting a corresponding precipitous decrease (**Figure 2.9**). Average preferred browse demographics indicate that total preferred browse density has decreased over time. As with other trends, one should take note of the different number of studies (the 'n value') sampled from year to year (particularly between 1997 and 2002) and consider the implications this may have on the data. A particularly significant decrease in preferred browse density occurred between 2017 and 2022: this trend can mainly be attributed to the same factors as those driving the recent decreasing shrub cover trend. Mature individuals have comprised a majority of the populations on these sites throughout the study period, while decadence and recruitment of young have remained comparatively low (**Figure 2.19**). Mean preferred browse utilization has fluctuated from year to year, but increased between 2017 and 2022. In 2022, 20.5% of plants were moderately hedged and 18% showed signs of heavy use (**Figure 2.22**).

Tree cover has exhibited a steady decrease over time, all of which has been contributed by Utah juniper (*Juniperus osteosperma*). More specifically, the cover decrease between 2017 and 2022 can in part be attributed to the American Fork Canyon and Upper Sheep Creek studies, both of which burned during this time period (**Figure 2.15**). Both juniper and twoneedle pinyon (*Pinus edulis*) have been observed in point-quarter density measurements. Average tree density has remained low and has been fairly stable overall despite very marginal fluctuations from year to year (**Figure 2.17**).

Herbaceous Understory: These studies have rich and abundant herbaceous understories that have fluctuated in composition from year to year; both average frequency and cover have increased overall. The introduced and weedy perennial grass species bulbous bluegrass (*Poa bulbosa*) provided the most herbaceous cover of any component in 2002, a trend largely driven by the Maple Mountain Face, Little Diamond Fork, and North Bench studies. Other, more desirable perennial grass species have been the dominant herbaceous components in other sample years. Annual grasses – namely the introduced species cheatgrass (*Bromus tectorum*) – have increased in cover and abundance over the sample period. Furthermore, site level data reveals that most recent annual grass increase is mainly due to cheatgrass on the American Fork Canyon study, which went from 0.2% cover in 2017 to 49% in 2022. Perennial forbs have displayed a slight overall decrease in both cover and frequency over the sample period. Finally, annual forb abundance and cover have increased over time. More specifically, the annual forb increase between the two most recent sample years can largely be attributed to introduced species on three sites: redstem stork's bill (*Erodium cicutarium*) on Deer Creek Dam; yellow salsify (*Tragopogon dubius*) on Billies Mountain; and redstem stork's bill, prickly Russian thistle (*Salsola tragus*), and tall tumblemustard (*Sisymbrium altissimum*) on American Fork Canyon (**Figure 2.25**, **Figure 2.28**).

Occupancy: Average pellet transect data shows that although there was an increase between 2012 and 2022, overall animal occupancy has generally decreased since 2002. Deer and/or bighorn sheep have been the primary occupants of these study sites in all sample years, with mean pellet group abundance ranging from 33 days use/acre in 2012 to 64.5 days use/acre in 2002. Average abundance of elk pellet groups has been as low 6 days use/acre in 2012 and as high as 33 days use/acre in 2007. Finally, cattle presence has fluctuated between 3.5 days use/acre in 2012 and 7 days use/acre in 2007 (**Figure 2.31**).

Mountain (Browse)

Three study sites [Tank Hollow (17-42), Tie Fork East (17-47) (suspended), and Hobble Creek Bench (17-63)] are classified as Mountain (Browse) ecological sites. The Tank Hollow study is found on the slopes between Knoll Hollow and Tank Hollow, and Tie Fork East is situated just east of Tie Fork in Spanish Fork Canyon. The Hobble Creek Bench study is located on the lower slopes of Rattlesnake Point and on a bench directly above a housing development in Mapleton (**Table 2.3**).

Shrubs/Trees: The shrub component of these study sites has generally been dominated by preferred browse species such as antelope bitterbrush (*Purshia tridentata*), mountain snowberry (*Symphoricarpos oreophilus*), and other species excluding Utah serviceberry (*Amelanchier utahensis*) and alderleaf mountain mahogany (*Cercocarpus montanus*). Total average shrub cover has exhibited a decrease overall, largely due to a reduction in preferred browse cover excluding serviceberry-mahogany. The significant decrease between 2017 and 2022 can mainly be attributed to the loss of antelope bitterbrush cover on the Hobble Creek Bench study, which burned in the 2020 Ether Hollow fire (**Figure 2.10**). Average preferred browse demographic data indicates that density of preferred browse plants has decreased over time. However, one should pay attention to the differing number of studies from year to year (the 'n value') and consider the implications this may have on the data; the studies sampled in 2017 and 2022 were Tank Hollow and Hobble Creek Bench. Like cover, the density decrease between the two most recent samplings can mainly attributed to the loss of preferred browse plants in the fire on Hobble Creek Bench. Mature individuals have been the dominant demographic in these populations throughout the study period. Decadence has generally remained low, as has the number of young individuals. However, a slight increase in recruitment of young occurred between 2017 and 2022: this is mainly due to Gambel oak (*Quercus gambelii*) on the Hobble Creek Bench site (**Figure 2.19**). Mean utilization of preferred browse species has also increased over time, with 15.5% of plants being moderately hedged and 55% being heavily used in 2022. Utilization in 2022 is entirely driven by the Tank Hollow study, as all plants on Hobble Creek Bench during that year exhibited signs of little to no browsing (**Figure 2.22**).

Average tree cover has mainly been provided by Utah and Rocky Mountain juniper (*Juniperus osteosperma* and *J. scopulorum*), with twoneedle pinyon (*Pinus edulis*) observed in 2007 and 2012 to a lesser extent. Despite a slight tree cover increase between 2017 and 2022, total cover has decreased overall: this is largely due to the suspension of the Tie Fork East study following the 2012 reading. Trees have never been observed on Hobble Creek Bench, so the slight increase in 2022 cover is entirely due to the Tank Hollow study (**Figure 2.15**). Tree density has also decreased over the sample period for the same reasons as cover, and density remains low as of 2022 (**Figure 2.17**).

<u>Herbaceous Understory</u>: The overall cover and nested frequency of the herbaceous understory have increased over time, while composition has fluctuated. Again, one should note the differing number of studies sampled each year and consider the implications this may have on the data. Perennial grasses have contributed the most cover of any herbaceous component in many sample years: much of this cover has been provided by the introduced species crested wheatgrass (*Agropyron cristatum*) on the Tank Hollow study. However, the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has increased over time and provided the most herbaceous cover in 2022. Trends in bulbous bluegrass are almost entirely driven by the Hobble Creek Bench study, as it has been observed with low cover on Tank Hollow and was not recorded at all on Tie Fork East. Annual forbs have had significant cover and abundance in 2017 and 2022: again, this is mainly due to Hobble Creek Bench and the introduced species redstem stork's bill (*Erodium cicutarium*). Annual grasses – namely the introduced species cheatgrass (*Bromus tectorum*) – have fluctuated, but have increased overall. Annual grass trends have largely been driven by the Hobble Creek Bench study, and they contribute moderate cover as of 2022. Perennial forbs provided significant cover in 1997, but remained relatively rare in other sample years (**Figure 2.25**, **Figure 2.28**).

<u>Occupancy</u>: Average animal occupancy increased between 2017 and 2022, but has decreased overall; again, one should pay attention to the 'n values' and consider implications on the data. Deer have been the primary occupants in all sample years, with mean pellet group abundance fluctuating between 32 days use/acre in 2017 and 97 days use/acre in 2022. Elk presence has been as low as under 1 days use/acre in 2022 and as high as 32 days use/acre in 2007. Average cattle pellet group abundance has ranged from 1 days use/acre in 2007 and 2017 to 3 days use/acre in 2022 (**Figure 2.31**).

Mountain (Shrub)

There are four study sites [Island Boat Camp (17-15), Rainbow Bay (17-16), Schoolhouse Springs (17-22) (suspended), and Zipline Hill (17-69)] that are considered to be Mountain (Shrub) ecological sites. Island Boat Camp is situated on the slopes above the eastern portion of Deer Creek Reservoir, while the Rainbow Bay site is found east of the southeastern portion of the reservoir. The Schoolhouse Springs study is located near Schoolhouse Springs, north of the city of Alpine. Finally, the Zipline Hill study site is found on the east-facing slope of a hill near the southeastern portion of Deer Creek Reservoir (**Table 2.3**).

<u>Shrubs/Trees</u>: The Schoolhouse Springs study was suspended prior to the implementation of line intercept cover and point-quarter density methodologies and therefore contributes no data to the shrub and tree cover and tree density trends. These study sites have generally remained dominated by a mixture of preferred browse species that may include antelope bitterbrush (*Purshia tridentata*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), and Utah serviceberry (*Amelanchier utahensis*), among others. Total average shrub cover has increased over the sample period, a trend mainly driven overall by increased bitterbrush cover and that of preferred browse species other than bitterbrush. However, the total cover increase between 2012 and 2017 is also due in part to shrubs other than preferred browse species. Site-level data indicates that the rise over this time period can be attributed to both the Island Boat Camp study and establishment of the Zipline Hill site, both of which had significant cover of other shrub species in 2017 (**Figure 2.12**). Average preferred browse demographic data indicates that density has decreased overall despite yearly fluctuations. One should note the differing number of study sites from year to year (the 'n value') and consider the implications that this may have on the data. The Schoolhouse Springs study was suspended after the 1997 sampling, while Zipline Hill was established in 2017; Island Boat Camp and Rainbow Bay provided all of the data from 2002 through 2012. Mature plants have been the most abundant demographic within these populations in all sample years, and decadence has remained low. Although the density of young plants has remained low throughout the study period, it has marginally increased since 2012. This increase is mainly due to the establishment of the Zipline Hill study and, to a lesser extent, increased recruitment of young on Island Boat Camp (**Figure 2.19**). Average preferred browse utilization decreased between 1997 and 2007, but has

increased since that time. In 2022, 20% of plants displayed signs of moderate hedging, while 43.5% were heavily used; much of the heavy utilization during the most recent sampling occurred on the Zipline Hill study (**Figure 2.22**).

Trees have not been observed in cover or point-quarter density measurements in any sample year on these study sites, and encroachment will therefore not be discussed in this section (**Figure 2.15**, **Figure 2.17**).

Herbaceous Understory: The herbaceous understories on these sites have, on average, exhibited general increases in cover and (to a lesser extent) nested frequency overall. Perennial grasses – namely the native species bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda*) – have contributed a majority of the herbaceous cover in many sample years and cover has increased over time. Perennial forb species provided moderate cover in most sample years, but were a codominant herbaceous component in 1997 mainly due to the Island Boat Camp and Rainbow Bay studies. Nested frequency of annual grasses has fluctuated, but cover has generally increased. In 2017, annual grasses contributed nearly as much cover as their perennial counterparts: cover of the introduced species cheatgrass (*Bromus tectorum*) exhibited a particularly significant increase on the Rainbow Bay study in that sample year. Annual forbs have been present with considerable frequency values in most years, but cover has generally remained moderate. This trend of high frequency and lower cover is likely due to the abundance of small annual forbs such as the introduced species desert madwort (*Alyssum desertorum*) and the native maiden blue eyed Mary (*Collinsia parviflora*) (**Figure 2.25**, **Figure 2.28**).

Occupancy: Average pellet transect data shows that overall occupancy decreased between 2002 and 2012, but has increased since that time. Deer have been the primary occupants in all sample years. Mean abundance of deer pellet groups has been as low as 42 days use/acre in 2012 and as high as 144.5 days use/acre in 2022; deer presence increased significantly between 2017 and 2022 on all three active study sites. Elk have also been present on these sites with an average pellet group abundance ranging from 0 days use/acre in 2022 to 29 days use/acre in 2002. Finally, mean cattle pellet group abundance has fluctuated between less than 1 days use/acre in 2002 and 2012 to 9 days use/acre in 2007 (**Figure 2.31**).

Mountain (Oak)

Eleven studies [Lower Big Hollow (17-9), Upper Big Hollow (17-10) (suspended), North Wallsburg Reseeding (17-12), Dutch Canyon (17-17), Lake Creek Road (17-20) (suspended), Box Elder Canyon (17-21) (suspended), Orem Water Tank (17-26), Spring Hollow (17-28) (suspended), Maple Canyon (17-33) (suspended), Hobble Creek Golf Course (17-35) (suspended), and Tie Fork (17-43) (suspended)] are classified as Mountain (Oak) ecological sites. The Lower Big Hollow study is located approximately halfway up Big Hollow, south of Heber City. Upper Big Hollow is found near the head of Big Hollow, south of the Lower Big Hollow study. The North Wallsburg Reseeding site is situated roughly two miles north of the town of Wallsburg, and Dutch Canyon is found north of Donkey Ridge near the city of Midway. The Lake Creek Road site is located approximately a mile and a half north of Lake Creek in a present-day subdivision in the eastern portion of Heber City. Box Elder Canyon is situated near the mouth of Box Elder Canyon, which is northeast of the city of Alpine. The Orem Water Tank study is located on the slopes above Orem City, northeast of the water tanks and the Orem City Rifle Range. The Spring Hollow site is found in South Fork off Provo Canyon, and Maple Canyon is found in Maple Canyon, south of Ether Peak. The Hobble Creek Golf Course study is located on the slopes just north of Hobble Creek Golf Course in Hobble Creek Canyon. Finally, the Tie Fork study is situated just north of the Tie Fork Rest Area (**Table 2.3**).

Shrubs/Trees: Shrub and tree cover and tree density values are provided by the Lower Big Hollow, North Wallsburg Reseeding, Dutch Canyon, and Orem Water Tank sites; all other study sites were suspended prior to the implementation of line intercept cover and point-quarter density methodology. These study sites have remained dominated by Gambel oak (*Quercus gambelii*) and/or other preferred browse species such as mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*). Total average shrub cover has decreased over time, with a significant decrease occurring between 2017 and 2022. Gambel oak cover did decrease during this time period, mainly due to the Range wildfire on the Orem Water Tank study. However, most of this recent cover reduction is primarily due to decreased preferred browse species other than oak: this in turn is driven by the Saddle fire on Dutch Canyon and the Big Hollow fire on the Lower Big Hollow study (**Figure 2.11**). Total preferred browse density has increased overall when comparing 1997 values with 2022. However, one should note the number of studies sampled (the 'n value') each year and consider the implications that this may have on the data. The density difference between 1997 and 2002 specifically is due to the suspension of seven studies, which left the 2002 value to be averaged between the four active sites (all of which exhibited density increases during that time period). Average preferred browse density has fluctuated between sample years since 2002, but has largely remained stable overall. Mature individuals have comprised a majority of these preferred browse populations in most sample years. Recruitment of young has steadily increased over time, however, and young plants were the most abundant demographic in 2022: this is primarily due to oak on the Orem Water Tank study.

Decadence has remained low throughout the study period (**Figure 2.20**). Average utilization of preferred browse species has exhibited yearly variations, but has increased overall. In 2022, 20% of plants displayed signs of moderate browsing while 2% were heavily used (**Figure 2.23**).

Trees have not been observed on the four active study sites in either cover or density measurements and will therefore not be discussed in this section (**Figure 2.15**, **Figure 2.17**).

Herbaceous Understory: The herbaceous understories of these sites have on average increased in cover and frequency over the study period. Perennial grasses provided the most herbaceous cover between 1997 and 2017 with both native and introduced species as the primary components. Annual grasses – mainly the introduced species cheatgrass (*Bromus tectorum*) – have been present throughout the study period, but contributed the most cover of any herbaceous component in 2022. Furthermore, site level detail indicates that much of the annual grass cover during the most recent sampling was observed on the Orem Water Tank, Dutch Canyon, and Lower Big Hollow studies. Perennial forb cover has exhibited a marginal increase overall, while frequency has largely remained stable. Although perennial forb cover has increased marginally as a whole, it would be prudent to note the increase in cover of the noxious weed and perennial forb species leafy spurge (*Euphorbia esula*) on the Dutch Canyon study from 4% in 2017 to over 13% in 2022. Cover of annual forbs has increased over time, as has abundance (albeit to a lesser extent than cover). The cover increase between 2017 and 2022 can largely be attributed to the Dutch Canyon study, which went from 2% to 32% annual forb cover between the two most recent samplings. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has been present throughout the duration of the study period and is present on all four active study sites as of 2022. Although cover and frequency of bulbous bluegrass remain low on average, values for both have increased between 2017 and 2022 on the Orem Water Tank and North Wallsburg Reseeding studies (**Figure 2.26**, **Figure 2.29**).

Occupancy: Average animal presence on these sites has exhibited an overall decrease over time, and deer have been the primary occupants in all sample years. Mean abundance of deer pellet groups has ranged from 18 days use/acre in 2012 to 55 days use/acre in 2002. Elk presence has been as low as 1 days use/acre in 2022 and as high as 33.5 days use/acre in 2007. Cattle pellet groups have not been observed in any sample year (**Figure 2.32**).

Mountain (Hackberry)

There is one study site [Round Peak (17-31)] that is considered to be a Mountain (Hackberry) ecological site: this study is located on the west-facing slopes above the Bonneville Shoreline Trail in Springville (**Table 2.3**).

Shrubs/Trees: This study site is dominated by netleaf hackberry (*Celtis laevigata* var. *reticulata*) and broom snakeweed (*Gutierrezia sarothrae*), although preferred browse species such as smooth sumac (*Rhus glabra*) and Gambel oak (*Quercus gambelii*) are also present. Total average shrub cover decreased between 2017 and 2022 (primarily due to reduced broom snakeweed and smooth sumac cover), but has increased overall when comparing 2007 with 2022 data (**Figure 2.13**). Average preferred browse demographic data indicates that density has exhibited a marginal overall decrease and that the preferred browse population has not been very abundant. Mature individuals have comprised a majority of the plant population in this site in all sample years, and both decadence and recruitment of young have remained low (**Figure 2.20**). Mean utilization of preferred browse species has fluctuated from year to year, but a large decrease was observed between the two most recent sample years. In 2017, 44.5% of plants were moderately used and 18.5% displayed signs of heavily utilization; in 2022, 0% and 3% of plants were moderately or heavily hedged (respectively) (**Figure 2.23**).

Trees contribute no cover or density on the Round Peak study and will therefore not be discussed in this section (**Figure 2.15**, **Figure 2.17**).

Herbaceous Understory: The herbaceous understory on this site has increased in cover, but frequency has remained generally stable despite yearly fluctuations. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) provided the most cover of any herbaceous component from 1997 through 2017. However, annual grasses – primarily the introduced species cheatgrass (*Bromus tectorum*) – contributed a majority of the cover in 2022. The annual grass and noxious weed species jointed goatgrass (*Aegilops cylindrica*) has also been observed in the understory since 2012, but in low amounts. The native perennial grass bluebunch wheatgrass (*Pseudoroegneria spicata*) is the only species driving the perennial grass trends, and cover has decreased over the sample period. Perennial forbs have been present throughout the study period with moderate cover and abundance. The noxious weed and perennial forb species Dalmatian toadflax (*Linaria dalmatica*) was observed for the first time in 2022, but in low amounts. Finally, annual forb cover has increased over the study period: this is largely due to increases in the introduced species redstem stork's bill (*Erodium cicutarium*) (**Figure 2.26**, **Figure 2.29**).

Occupancy: Average animal presence has decreased overall despite yearly fluctuations. Elk were the primary occupants in 2022, and presence has ranged from 5 days use/acre in 2022 to 36 days use/acre in 2007. Deer have been the main occupants in all other sample years, and mean pellet group abundance has been as low as 4 days use/acre in 2022 and as high as 74 days use/acre in 2007 (**Figure 2.32**).

Upland (Cliffrose)

Three studies [North Battle Creek (17-25), Spring Canyon (17-30), and Grove Creek (17-62)] are classified as Upland (Cliffrose) ecological sites. North Battle Creek is located north of Battle Creek on the west-facing slopes above the city of Pleasant Grove. The Spring Canyon study is situated on the steep south-facing slopes near the mouth of Spring Canyon, just east of the city of Springville. Finally, the Grove Creek study site is found just north of Grove Creek at the mouth of Grove Creek Canyon (**Table 2.3**).

Shrubs/Trees: Stansbury cliffrose (*Purshia stansburiana*) is the dominant browse species on these studies. Total average shrub cover has decreased over the sample period: this decrease is mainly due to cliffrose, the cover of which has exhibited an overall reduction since 2007 on all three study sites. On North Battle Creek specifically, cliffrose cover was nearly 13% in 2007 and only 3% in 2022. Other preferred browse species including (but not limited to) mountain/Wyoming big sagebrush (*Artemisia tridentata* ssp. *vaseyana* and *A. tridentata* ssp. *wyomingensis*) and Gambel oak (*Quercus gambelii*) have also been present, but have generally provided less cover than cliffrose (**Figure 2.14**). Average demographic data indicates that total density of preferred browse species has decreased over time, as has the number of decadent individuals. Mature plants have been the dominant age class in all sample years. Recruitment of young has increased over the study period, with the increase between 2017 and 2022 mainly being due to Gambel oak on the Spring Canyon study (**Figure 2.21**). Despite yearly fluctuations, mean utilization of preferred browse has decreased overall. In 2022, 33% of plants displayed signs of moderate hedging, while 12.5% had been heavily used (**Figure 2.24**).

Trees have not been observed in cover or density measurements on these study sites and will therefore not be discussed in this section (**Figure 2.16**, **Figure 2.17**).

Herbaceous Understory: Total average herbaceous cover has increased overall, while nested frequency has remained relatively stable. Dominant herbaceous components have varied over time. The weedy and introduced species bulbous bluegrass (*Poa bulbosa*) contributed most of the cover in 1997 and 2002, a trend mainly driven by the Spring Canyon study. Bulbous bluegrass cover has decreased since that time, but it is still present as of 2022. Annual grasses, primarily the introduced species cheatgrass (*Bromus tectorum*) and/or cereal rye (*Secale cereale*), have been a dominant or codominant herbaceous component in all sample years since 2002. In addition, the noxious weed and annual species jointed goatgrass (*Aegilops cylindrica*) was observed in 2017 and 2022 on North Battle Creek. Although cover of jointed goatgrass is low as of 2022, noxious weeds have the potential to be aggressive and abundance could increase in the future. Cover of the introduced annual forb redstem stork's bill (*Erodium cicutarium*) has increased over time on all three study sites, and annual forbs have been codominant herbaceous components since 2017. Both perennial forbs and grasses have remained scarce in comparison with their annual counterparts (**Figure 2.27**, **Figure 2.30**).

Occupancy: Average animal presence has slightly decreased overall despite yearly fluctuations. Deer and/or bighorn sheep have been the primary occupants in all sample years, and presence has ranged from 29 days use/acre in 2012 to 70 days use/acre in 2007. Elk pellet groups have been the only other species observed, and mean abundance has been as low as under 1 days use/acre in 2012 and as high as 21 days use/acre in 2007 (**Figure 2.33**).

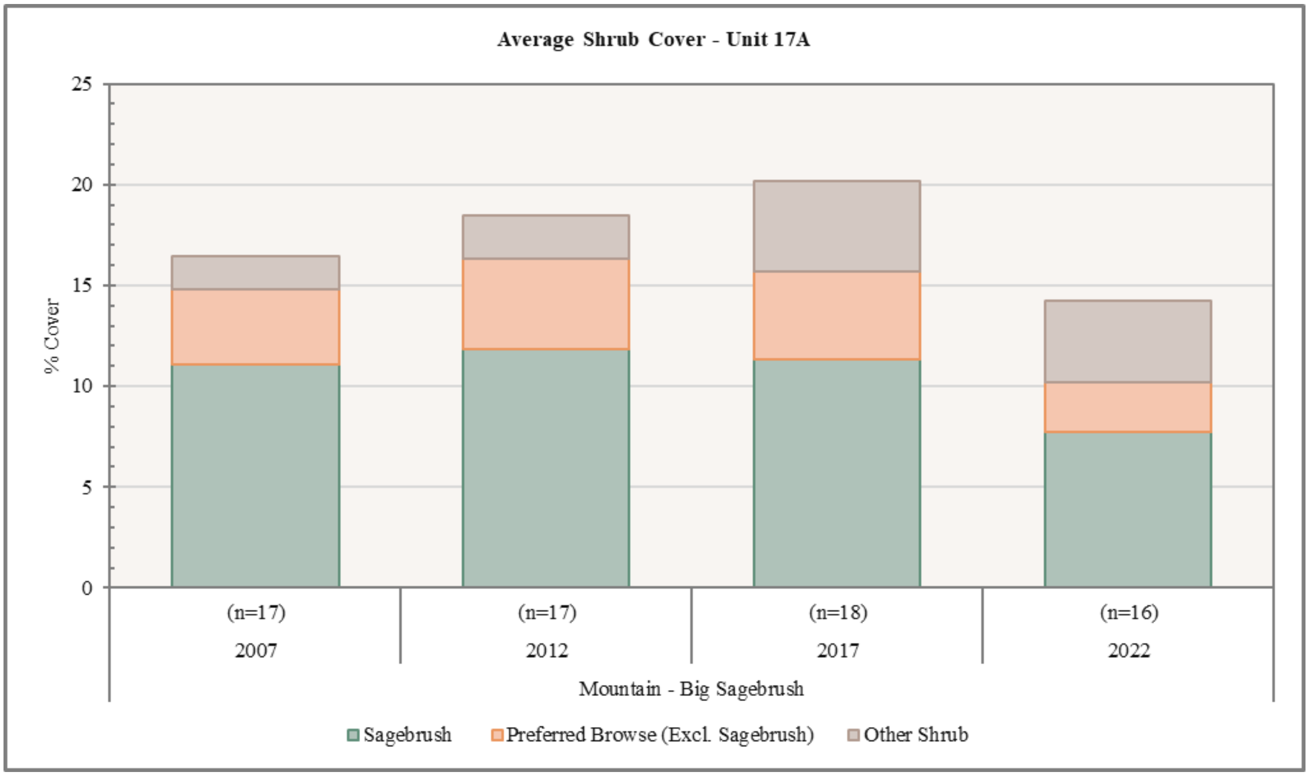


Figure 2.9: Average shrub cover for Mountain - Big Sagebrush study sites in WMU 17A, Wasatch Mountains, West.

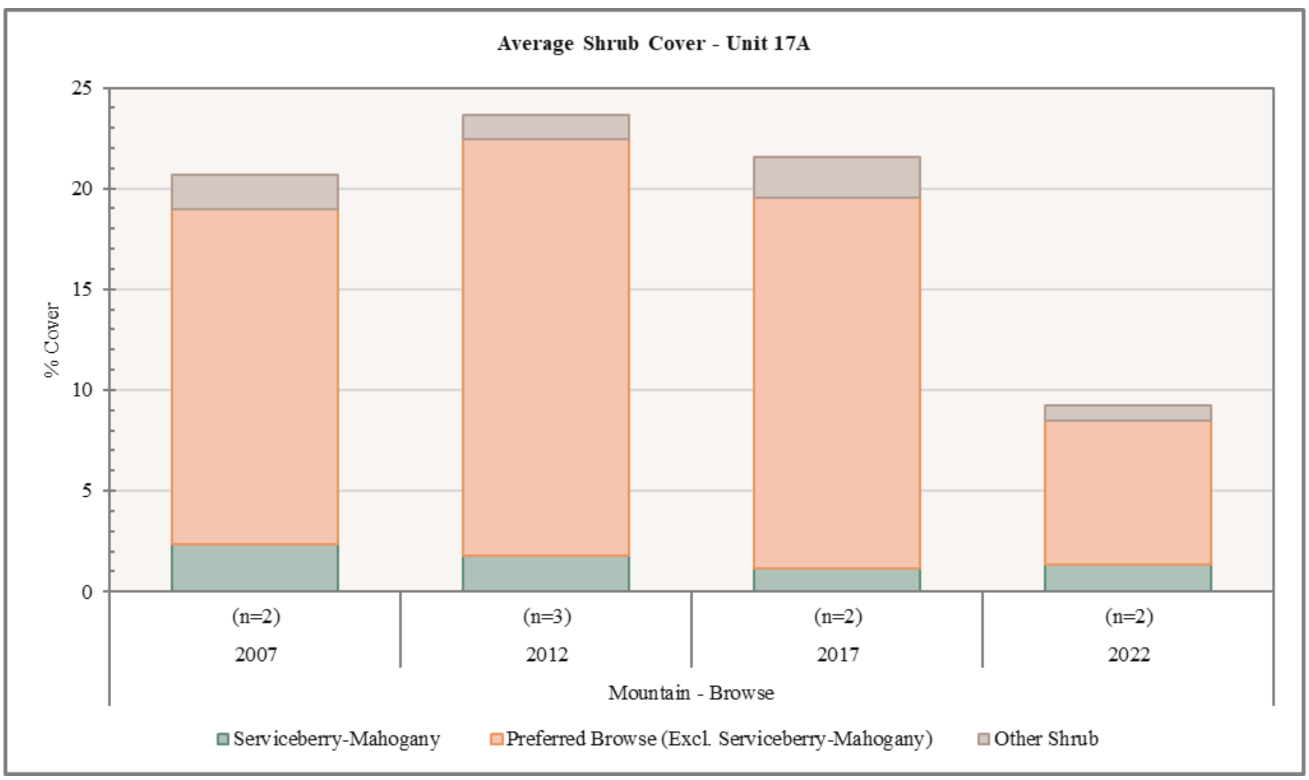


Figure 2.10: Average shrub cover for Mountain – Browse study sites in WMU 17A, Wasatch Mountains, West.

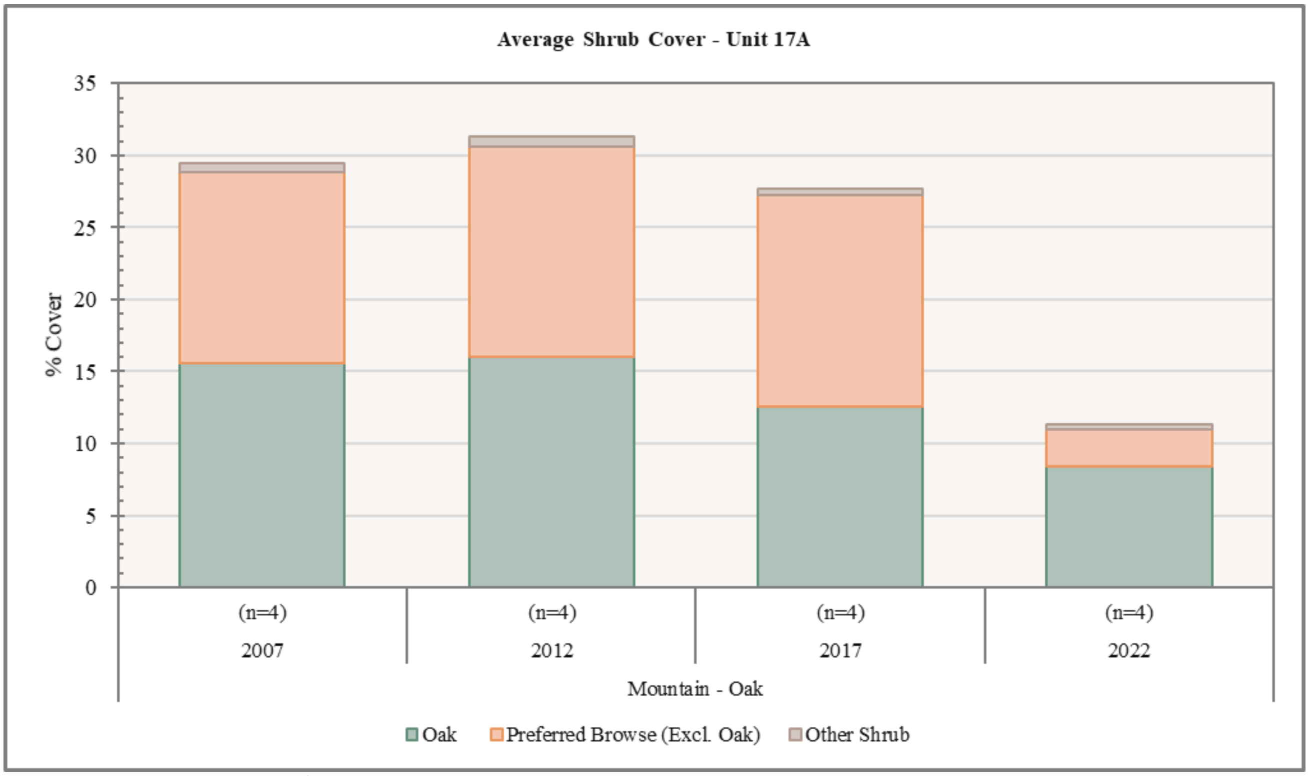


Figure 2.11: Average shrub cover for Mountain - Oak study sites in WMU 17A, Wasatch Mountains, West.

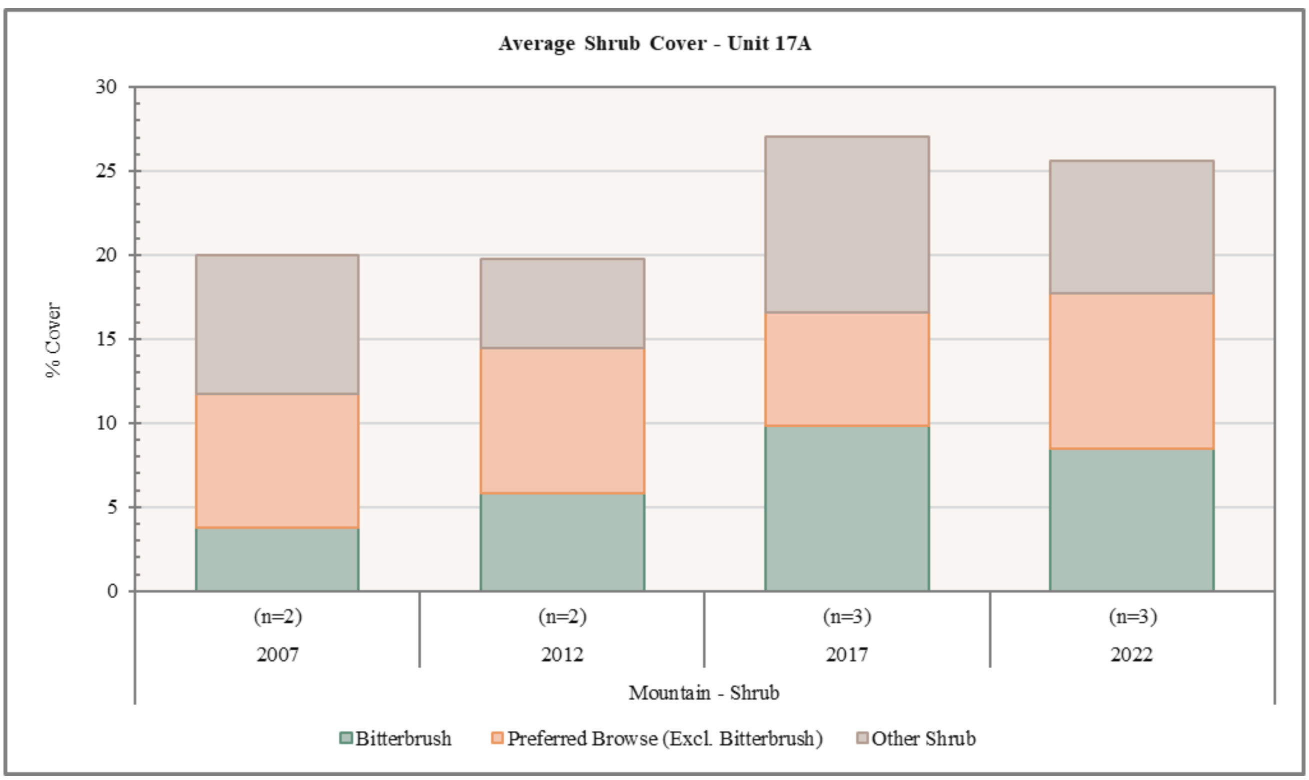


Figure 2.12: Average shrub cover for Mountain - Shrub study sites in WMU 17A, Wasatch Mountains, West.

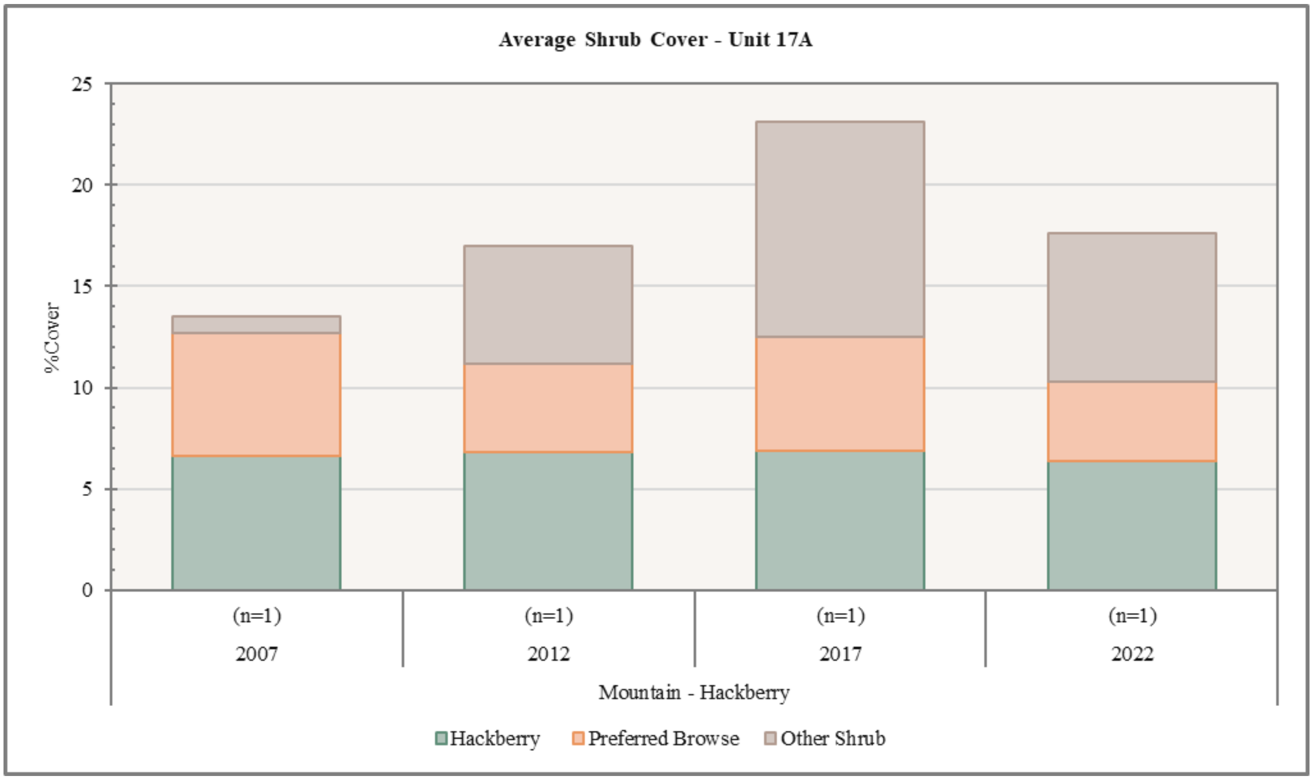


Figure 2.13: Average shrub cover for Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

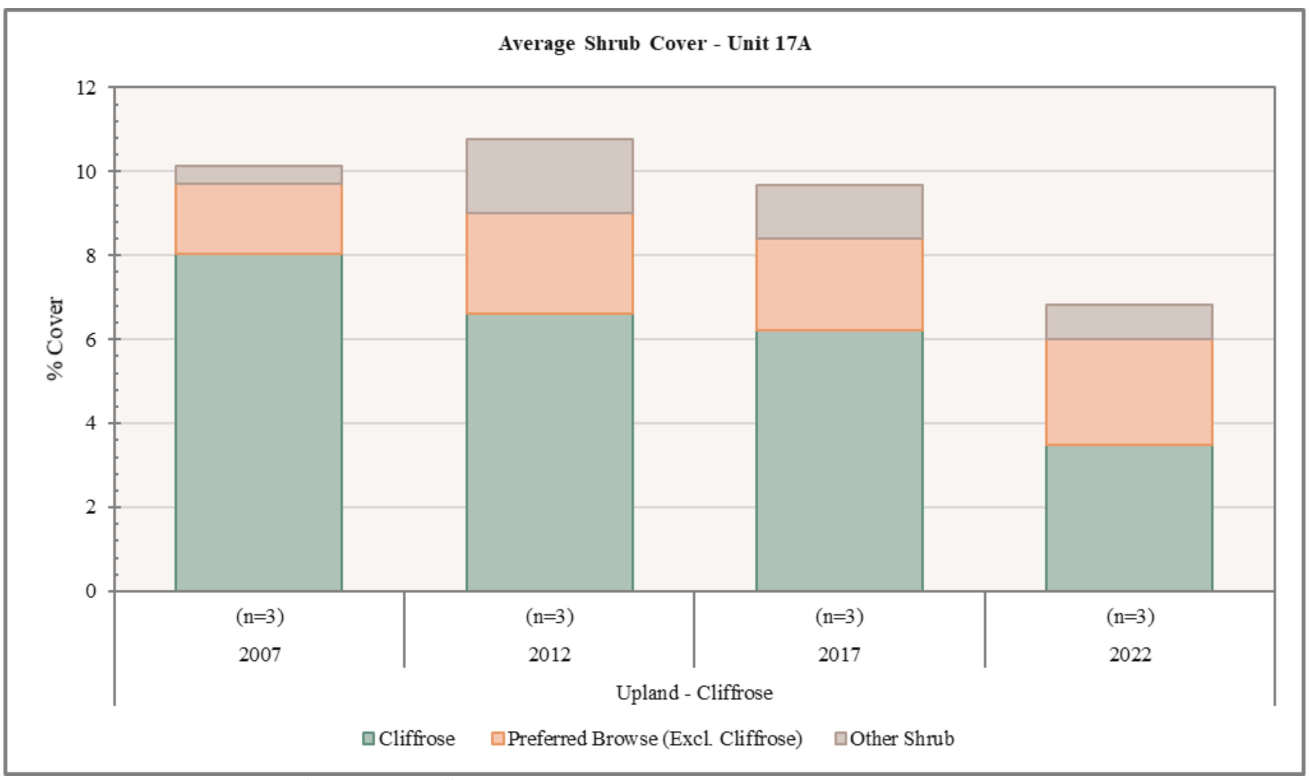


Figure 2.14: Average shrub cover for Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West.

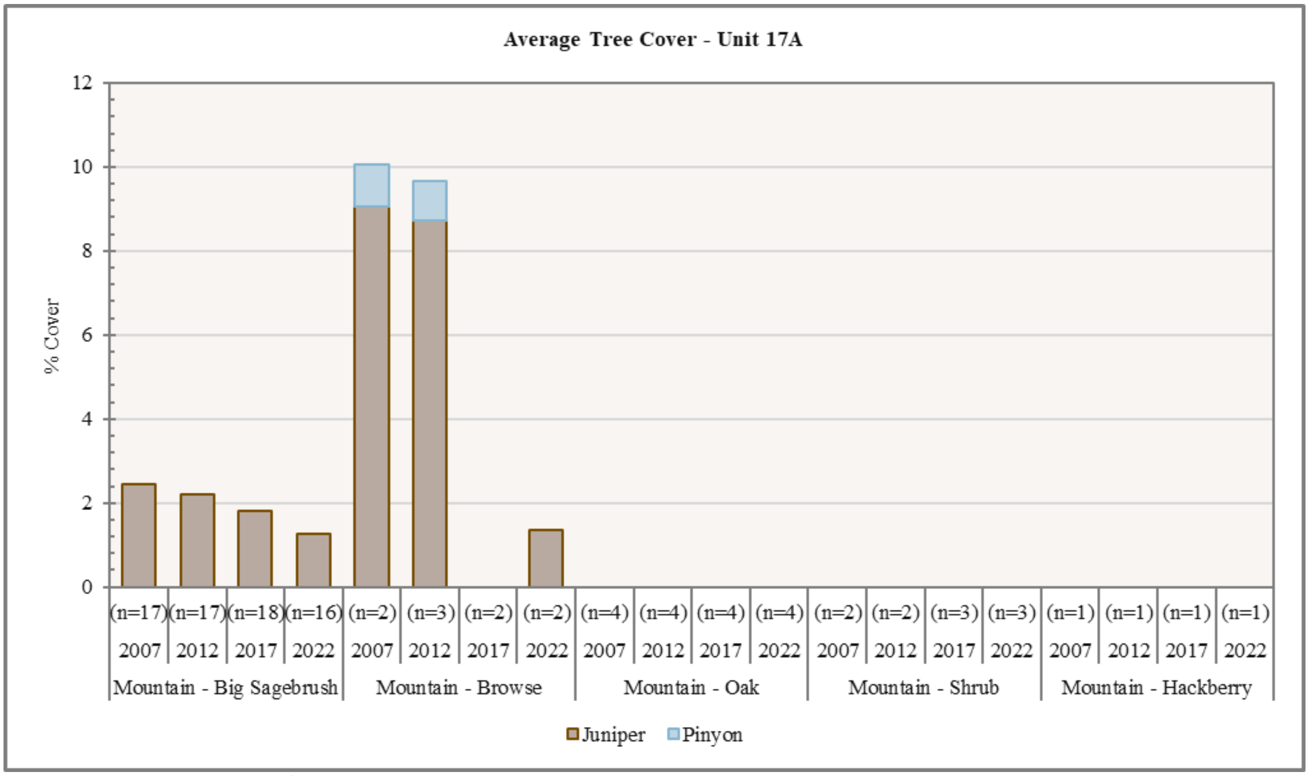


Figure 2.15: Average tree cover for Mountain - Big Sagebrush, Mountain - Browse, Mountain - Oak, Mountain - Shrub, and Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

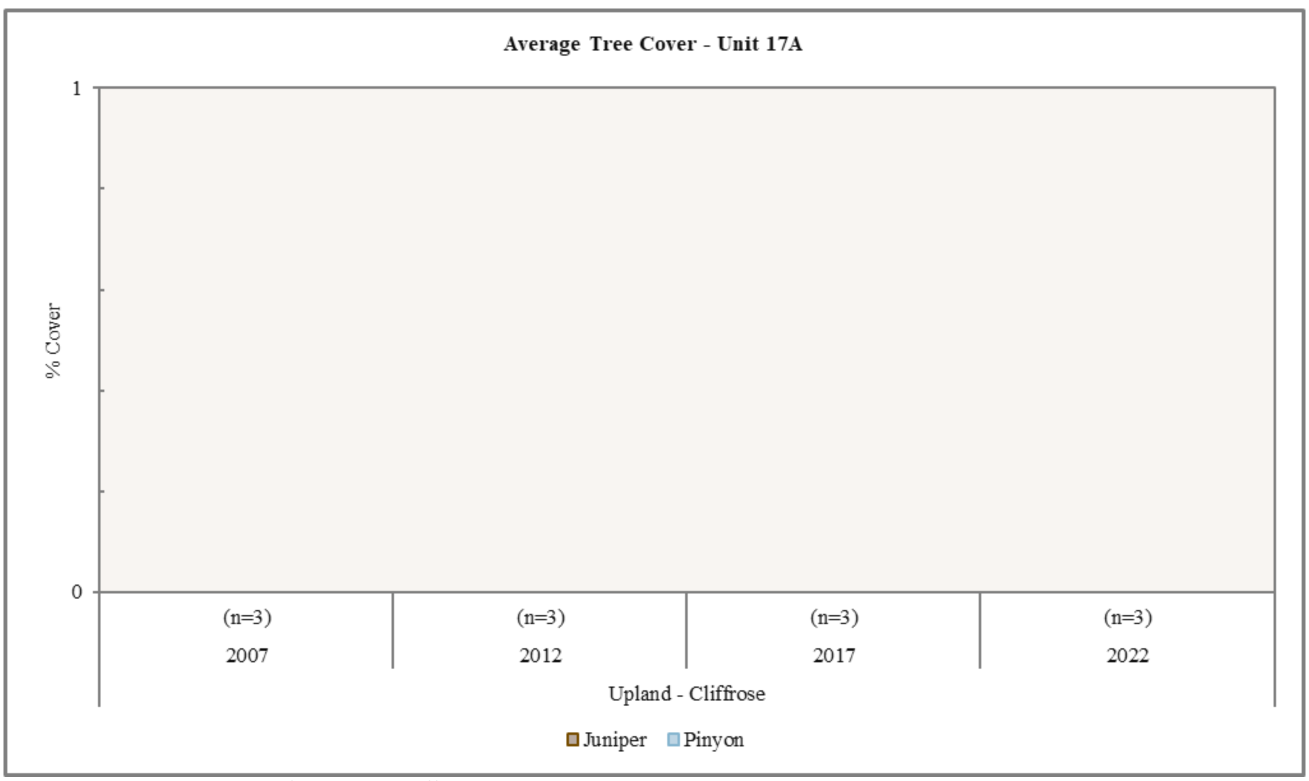


Figure 2.16: Average tree cover for Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West.

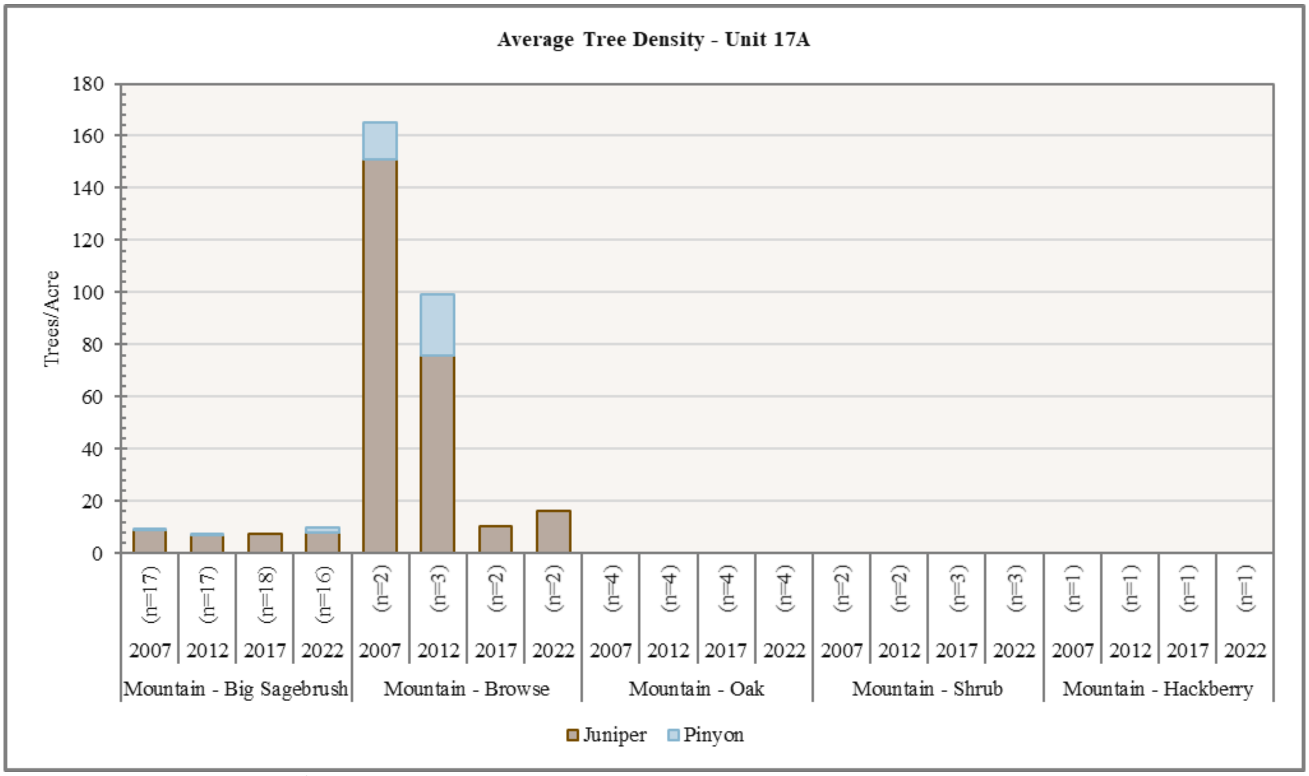


Figure 2.17: Average tree density for Mountain - Big Sagebrush, Mountain - Browse, Mountain - Oak, Mountain - Shrub, and Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

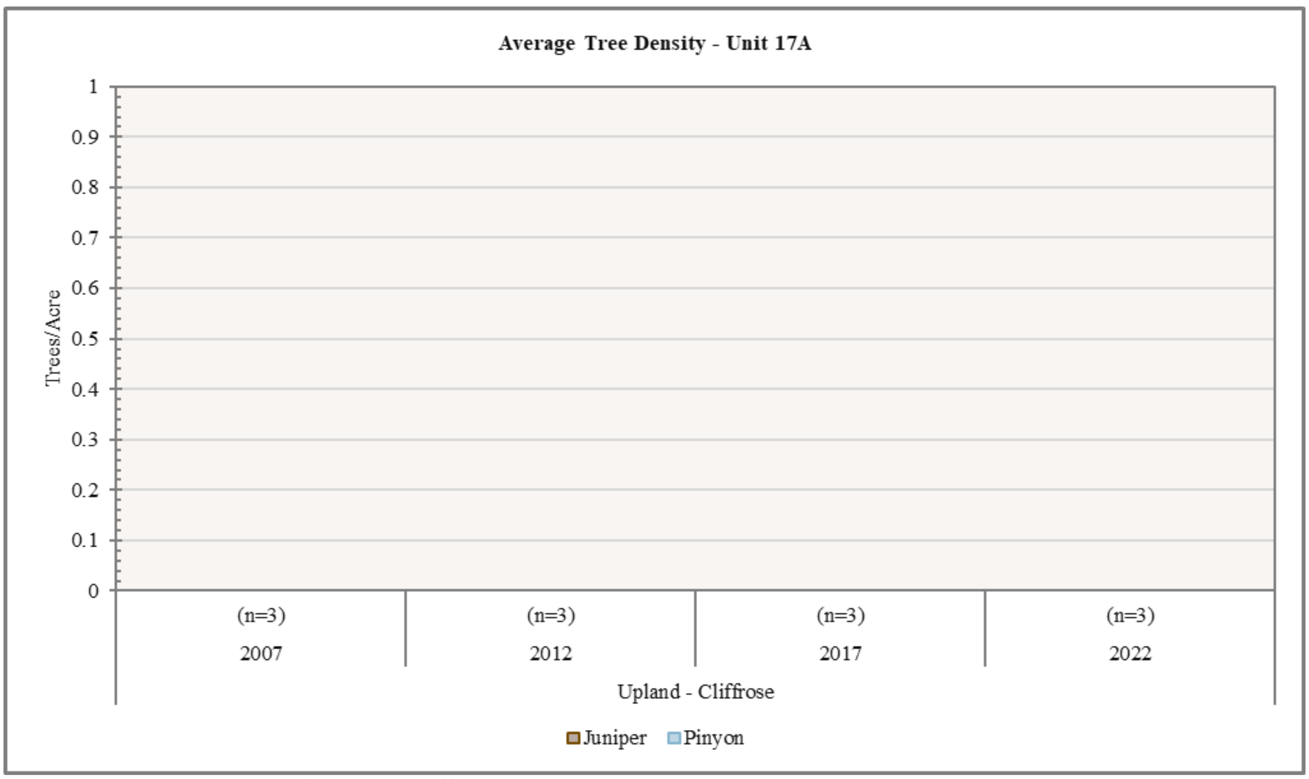


Figure 2.18: Average tree density for Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West.

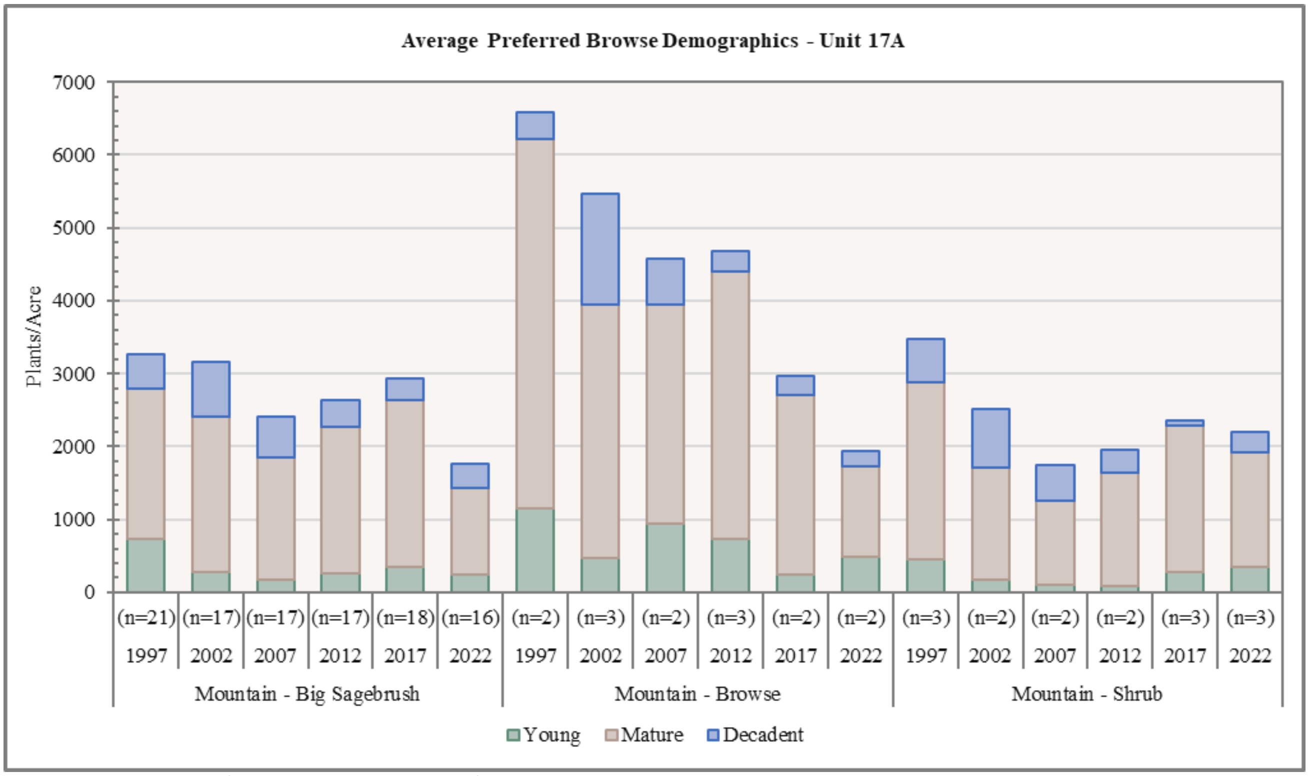


Figure 2.19: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 17A, Wasatch Mountains, West.

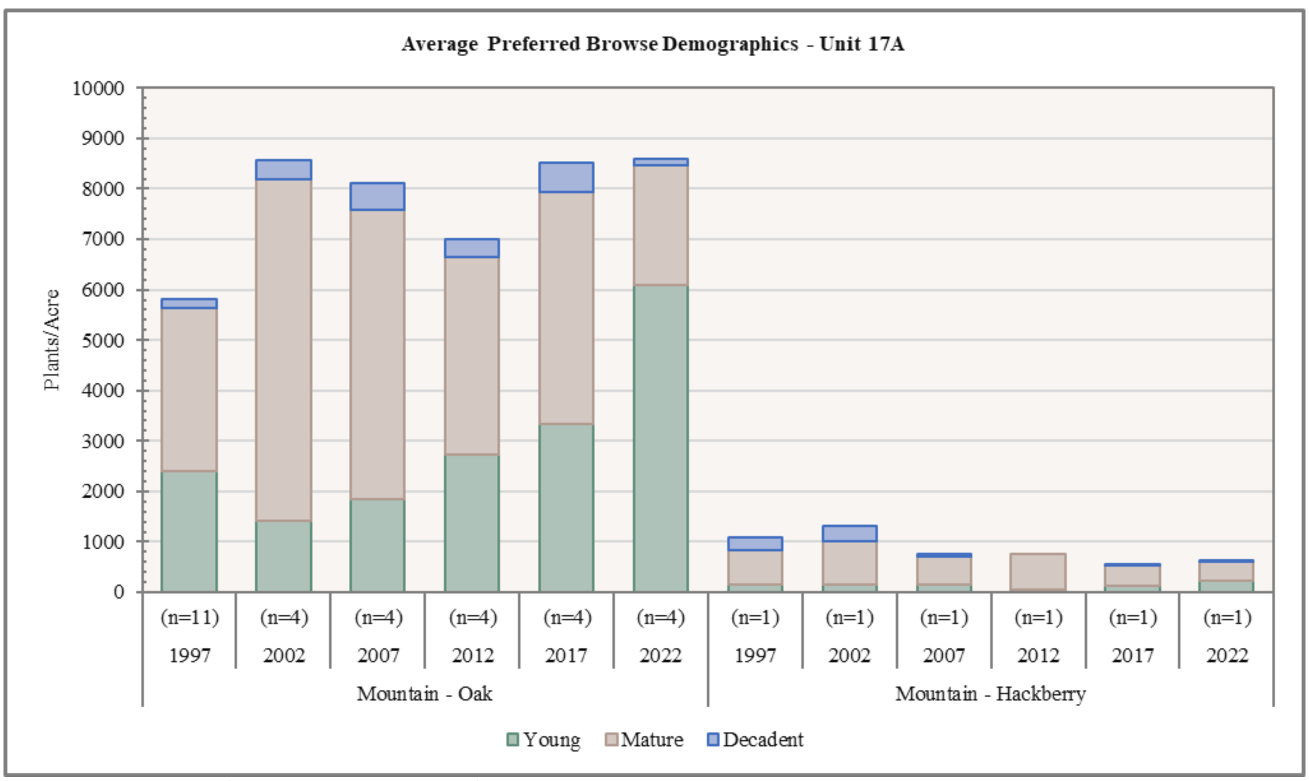


Figure 2.20: Average preferred browse demographics for Mountain - Oak and Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

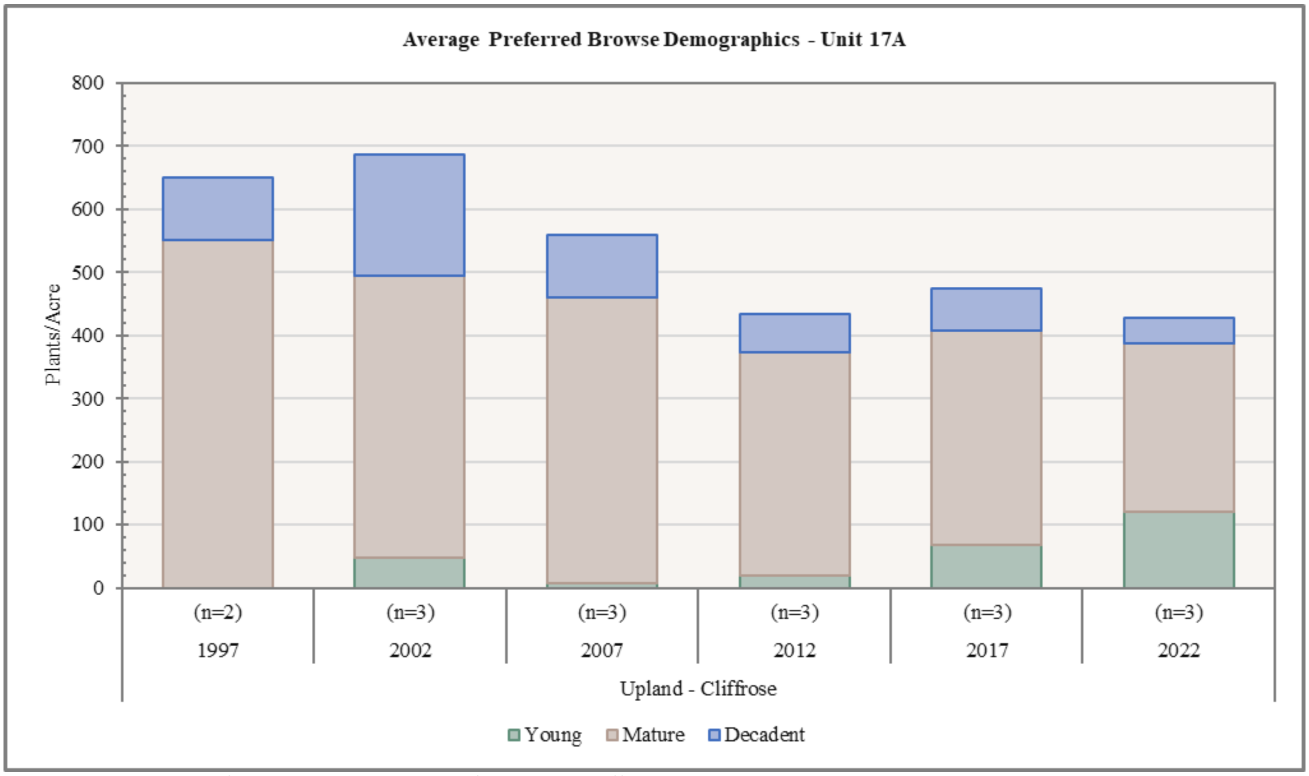


Figure 2.21: Average preferred browse demographics for Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West.

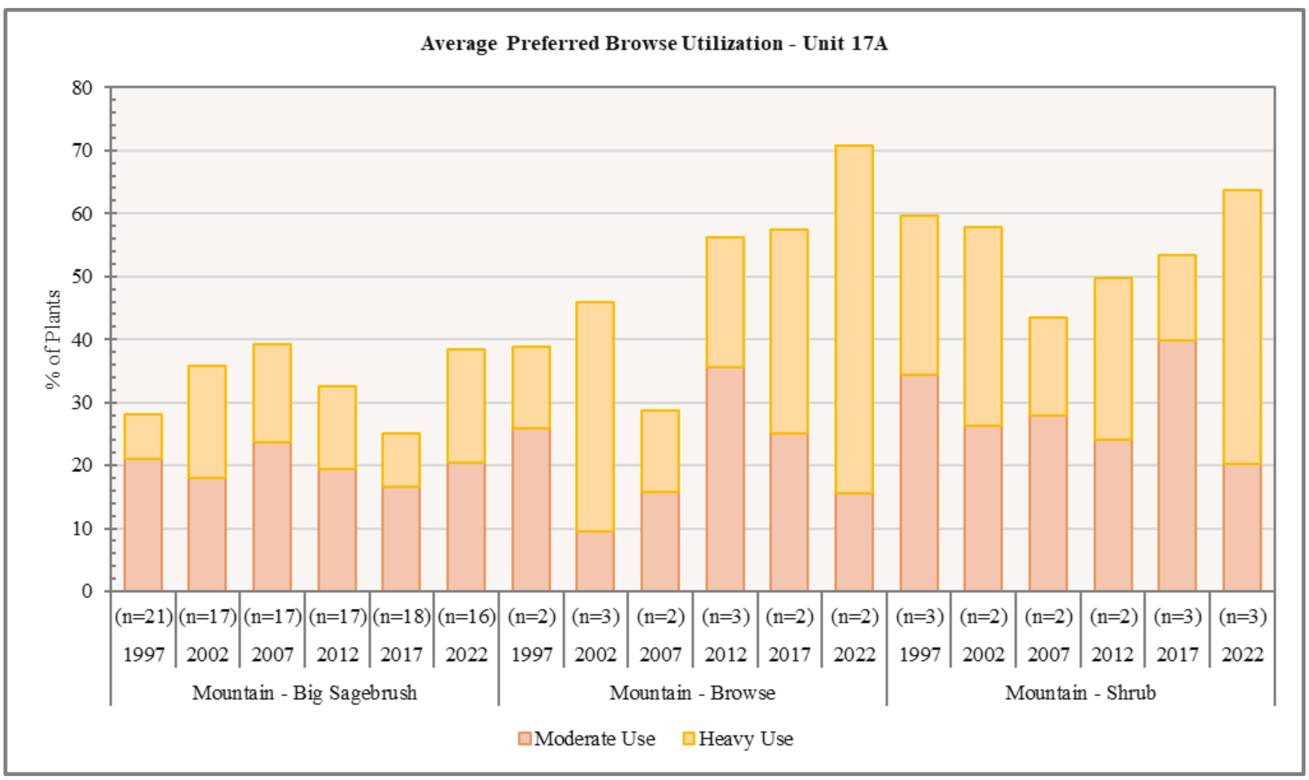


Figure 2.22: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 17A, Wasatch Mountains, West.

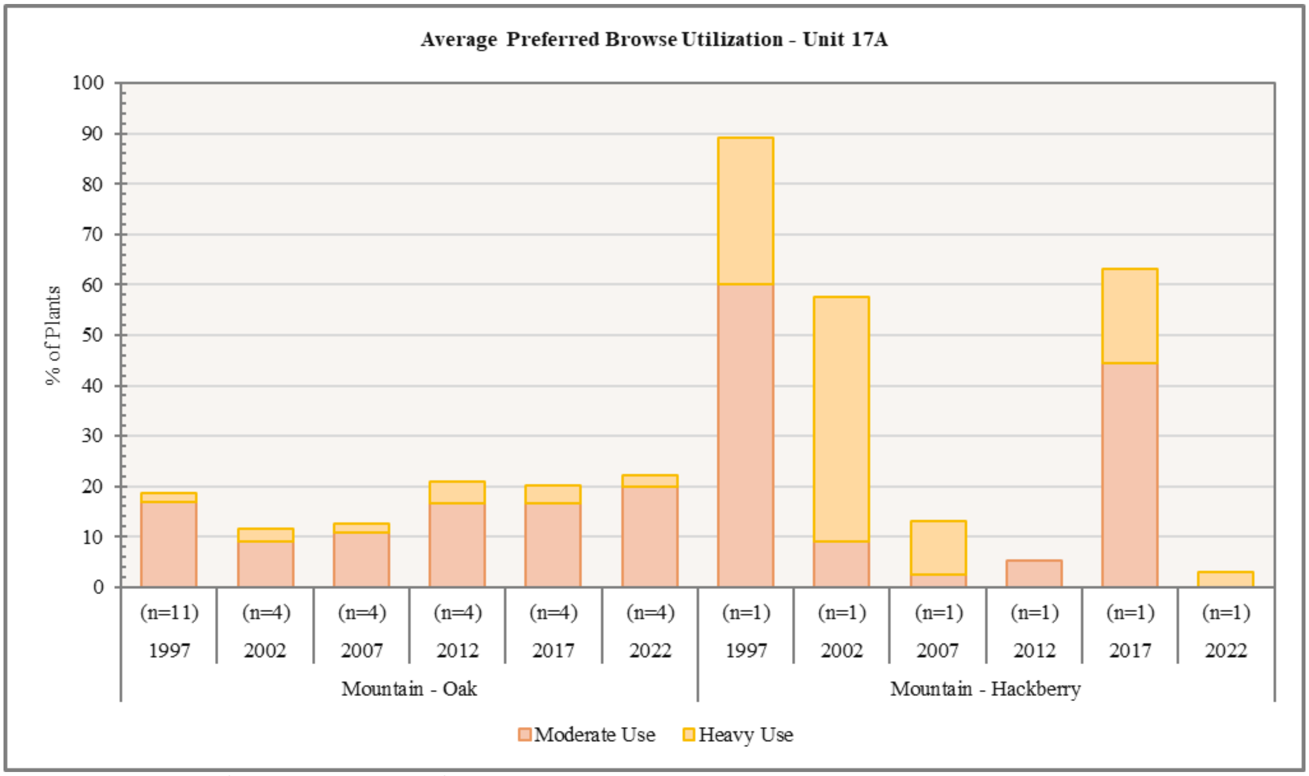


Figure 2.23: Average preferred browse utilization for Mountain - Oak and Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

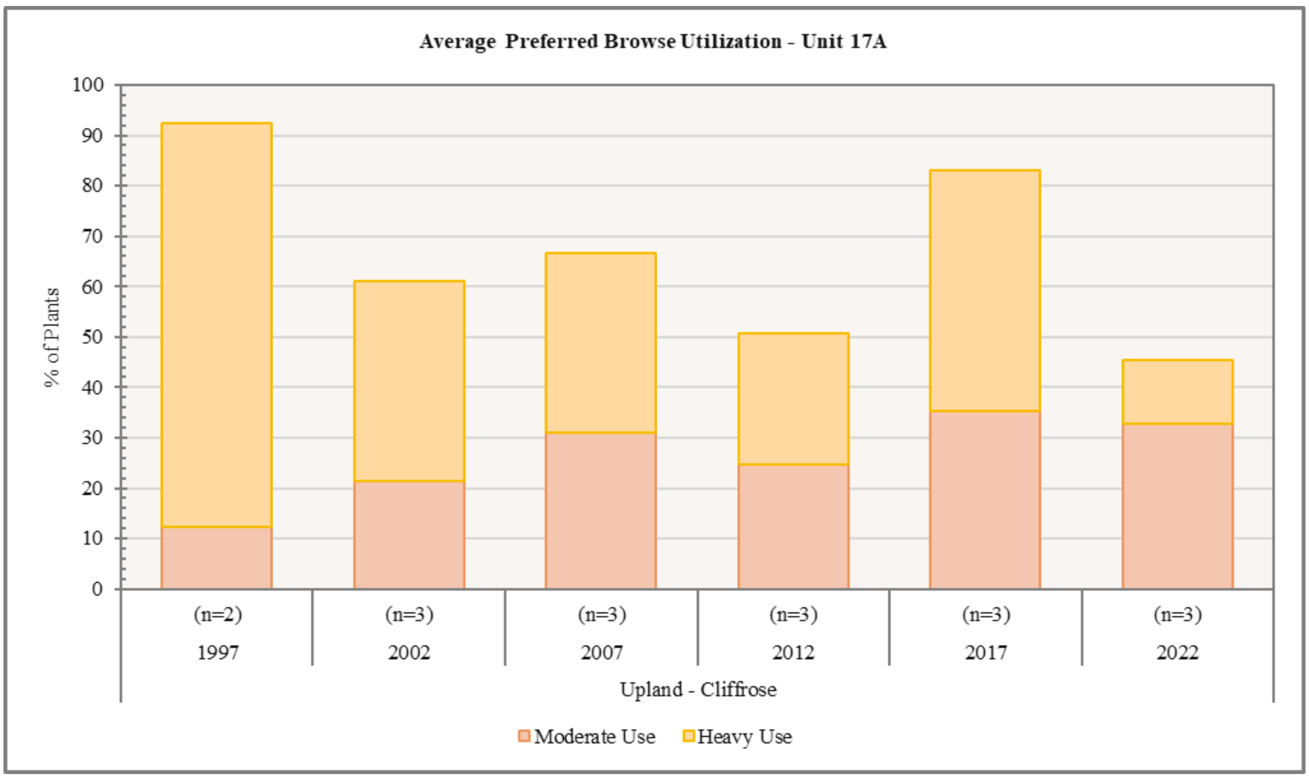


Figure 2.24: Average preferred browse utilization for Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West.

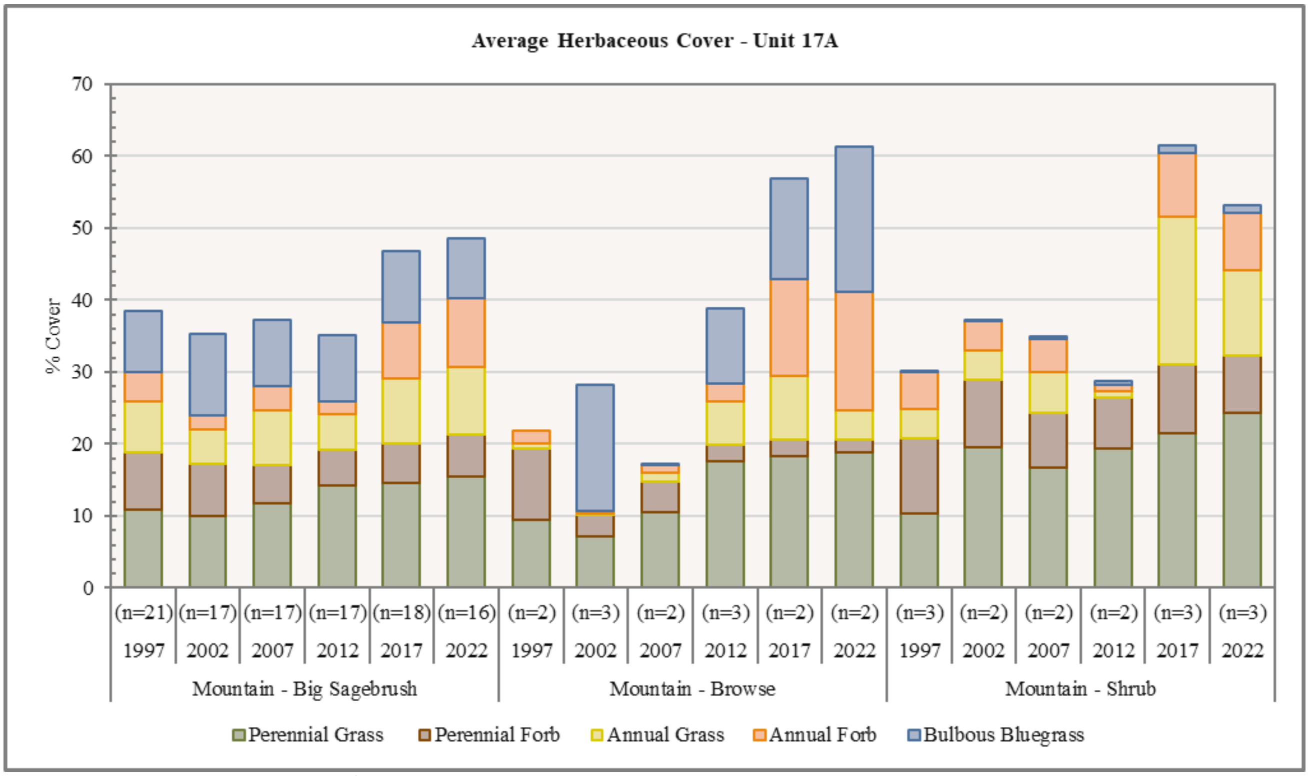


Figure 2.25: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 17A, Wasatch Mountains, West.

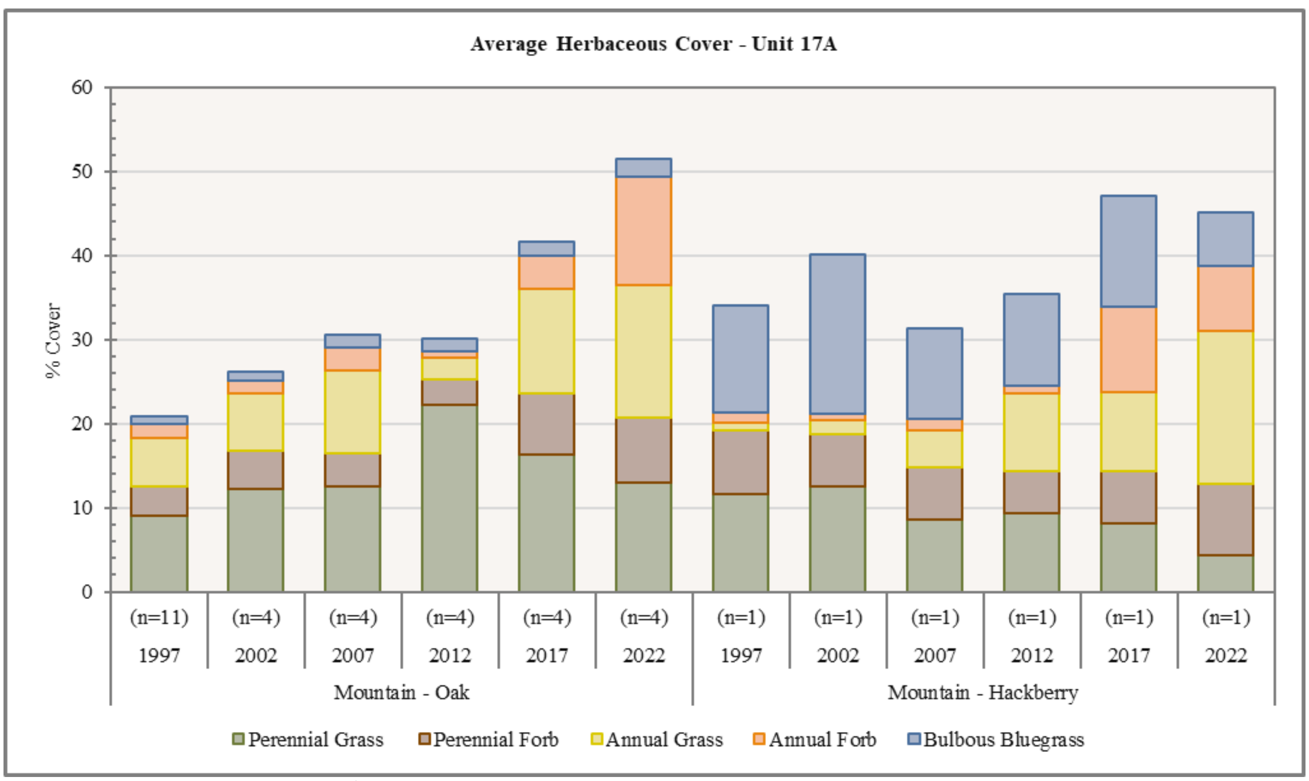


Figure 2.26: Average herbaceous cover for Mountain - Oak and Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

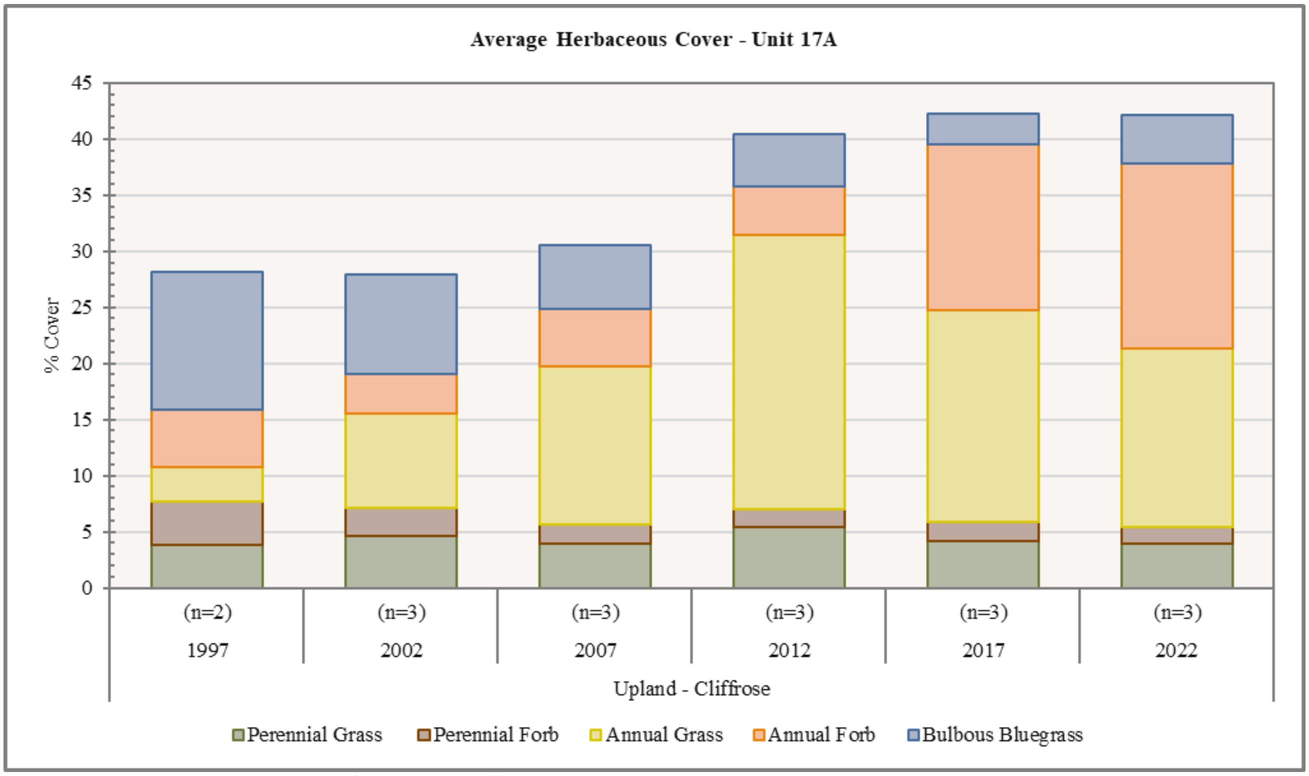


Figure 2.27: Average herbaceous cover for Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West.

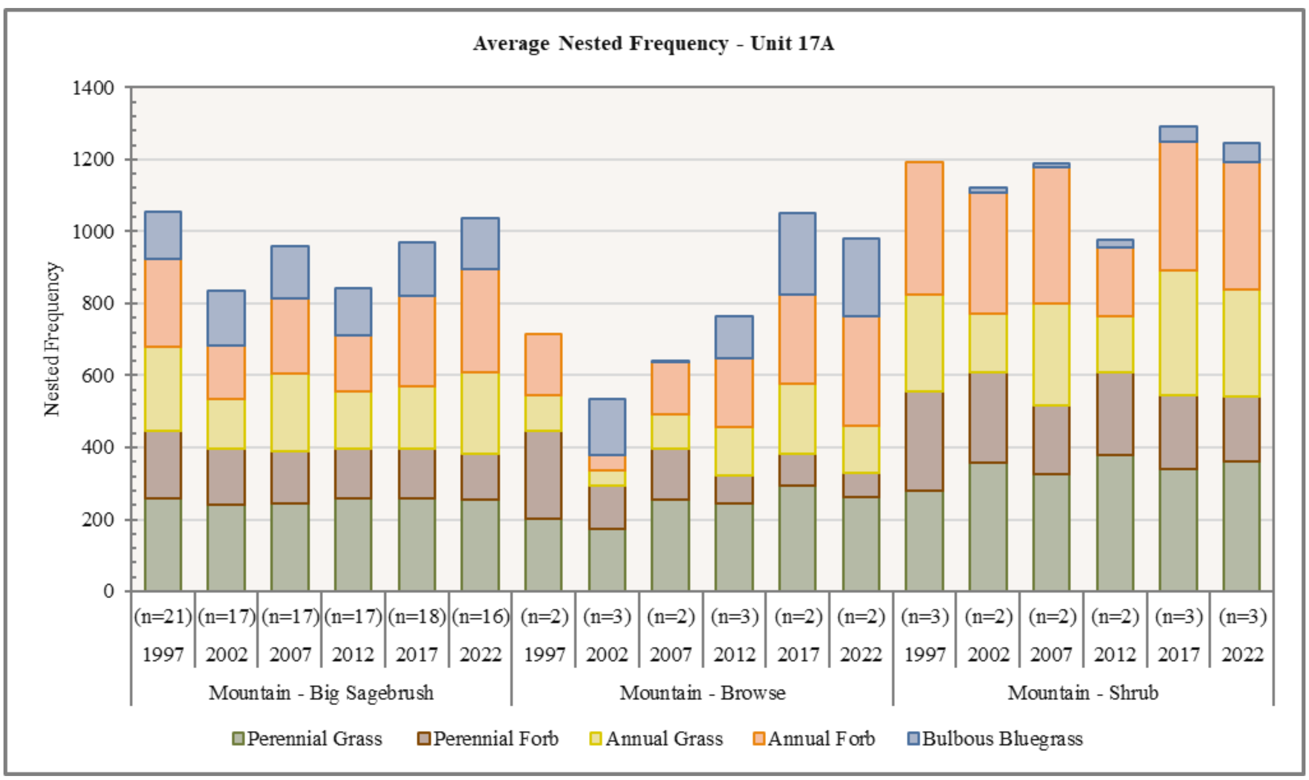


Figure 2.28: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 17A, Wasatch Mountains, West.

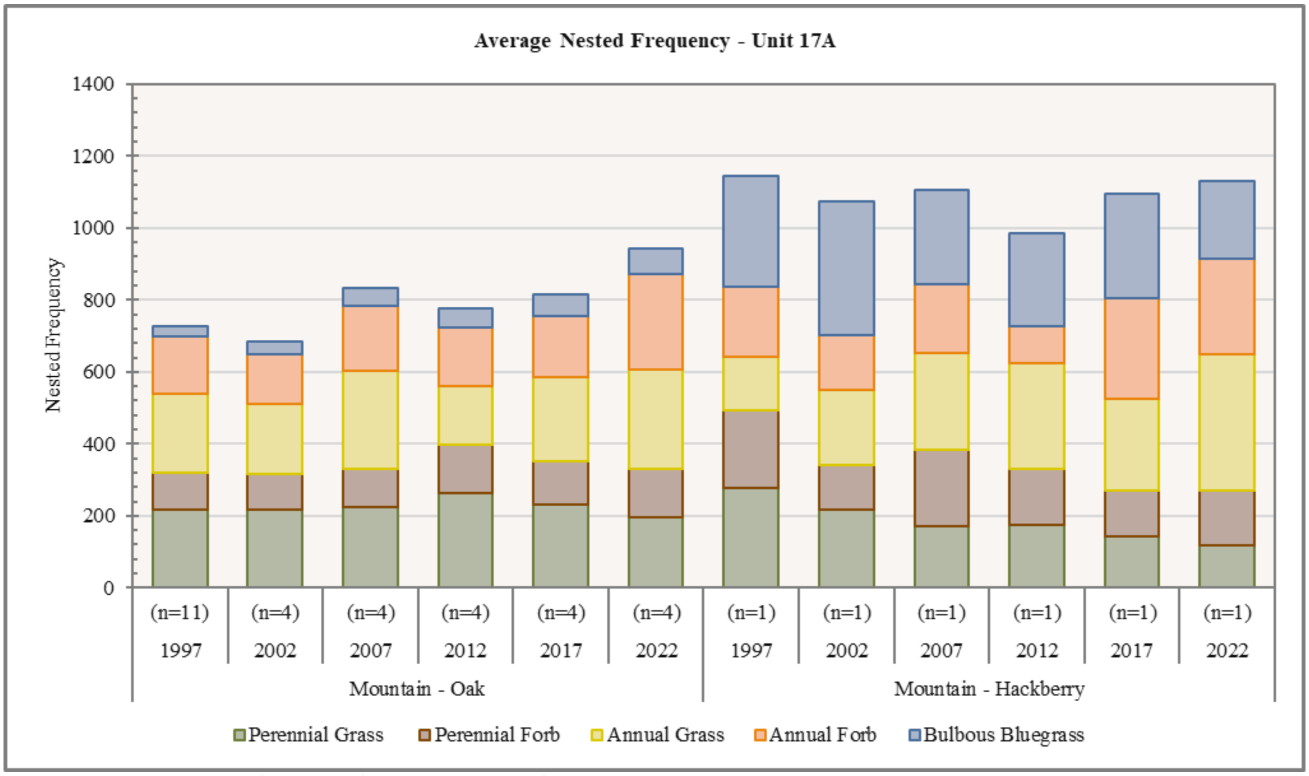


Figure 2.29: Average nested frequency of herbaceous species for Mountain - Oak and Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

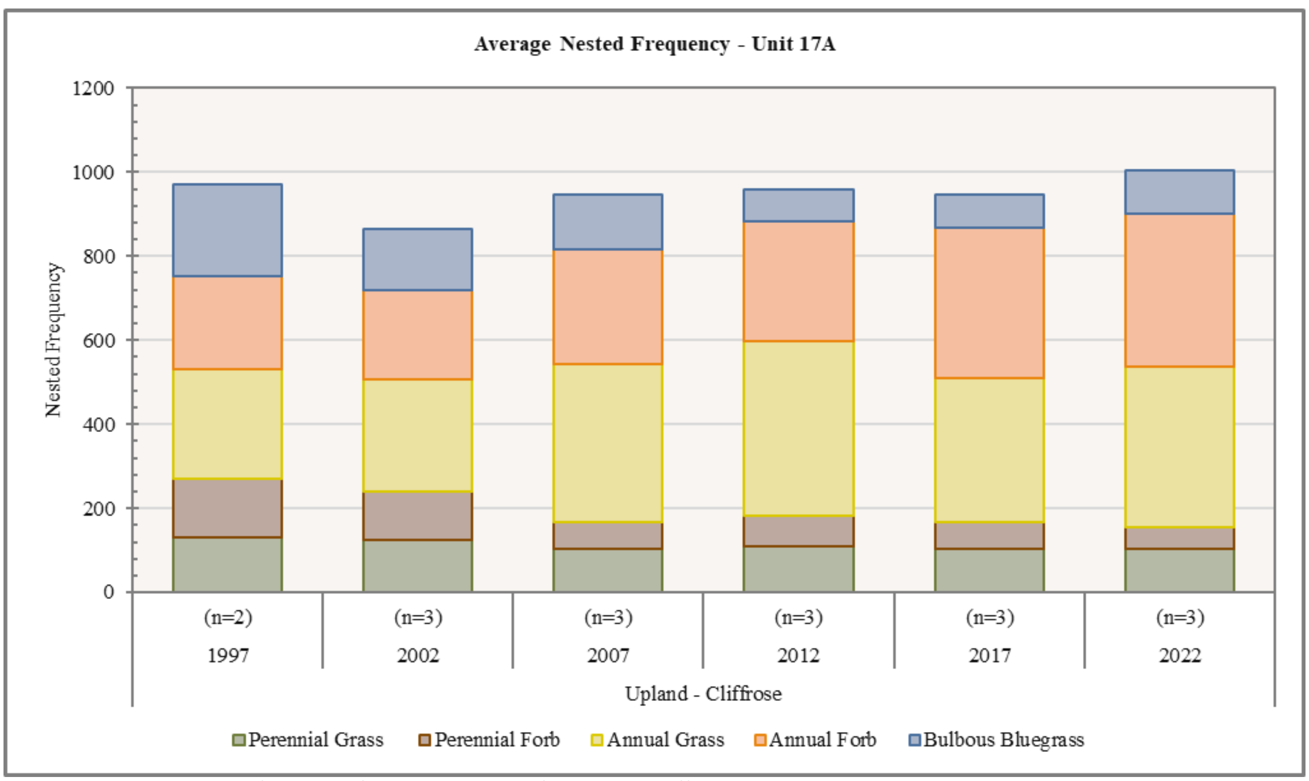


Figure 2.30: Average nested frequency of herbaceous species for Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West.

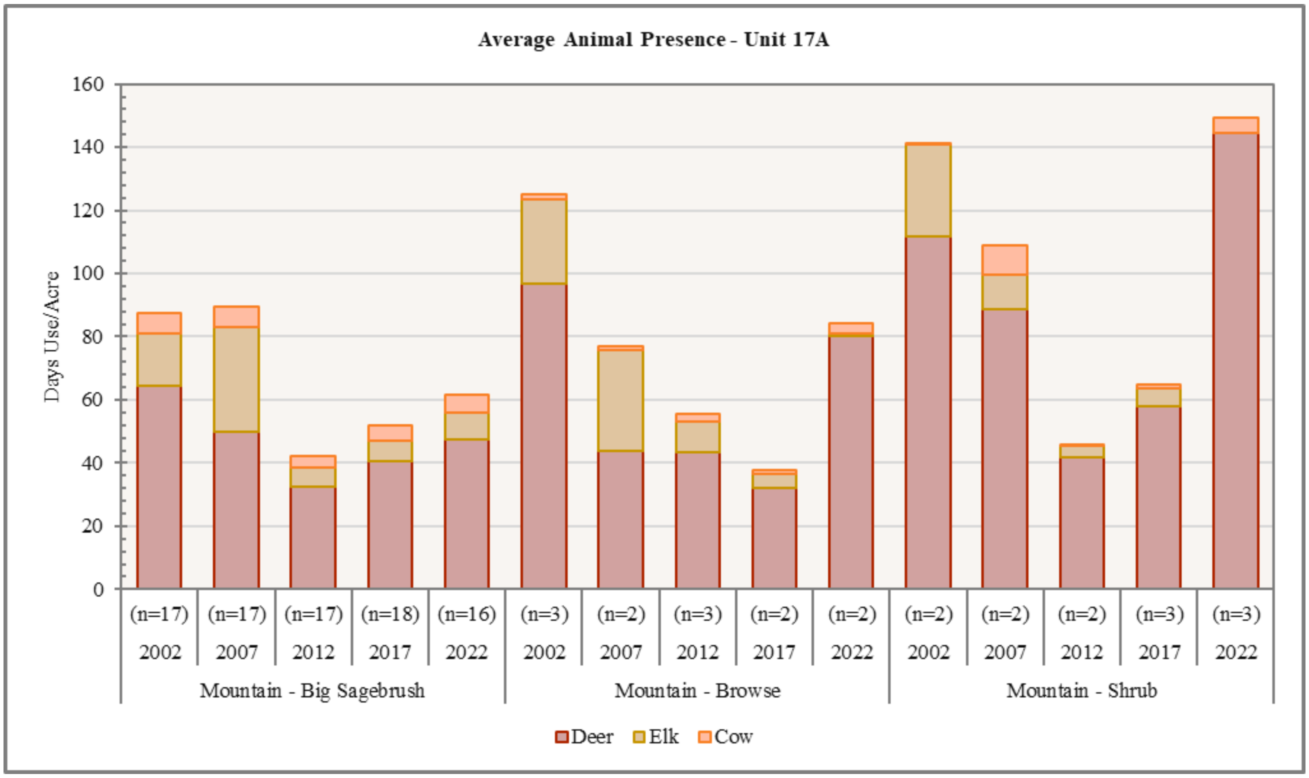


Figure 2.31: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 17A, Wasatch Mountains, West. *Mountain - Big Sagebrush deer pellet groups include deer and bighorn sheep pellets.

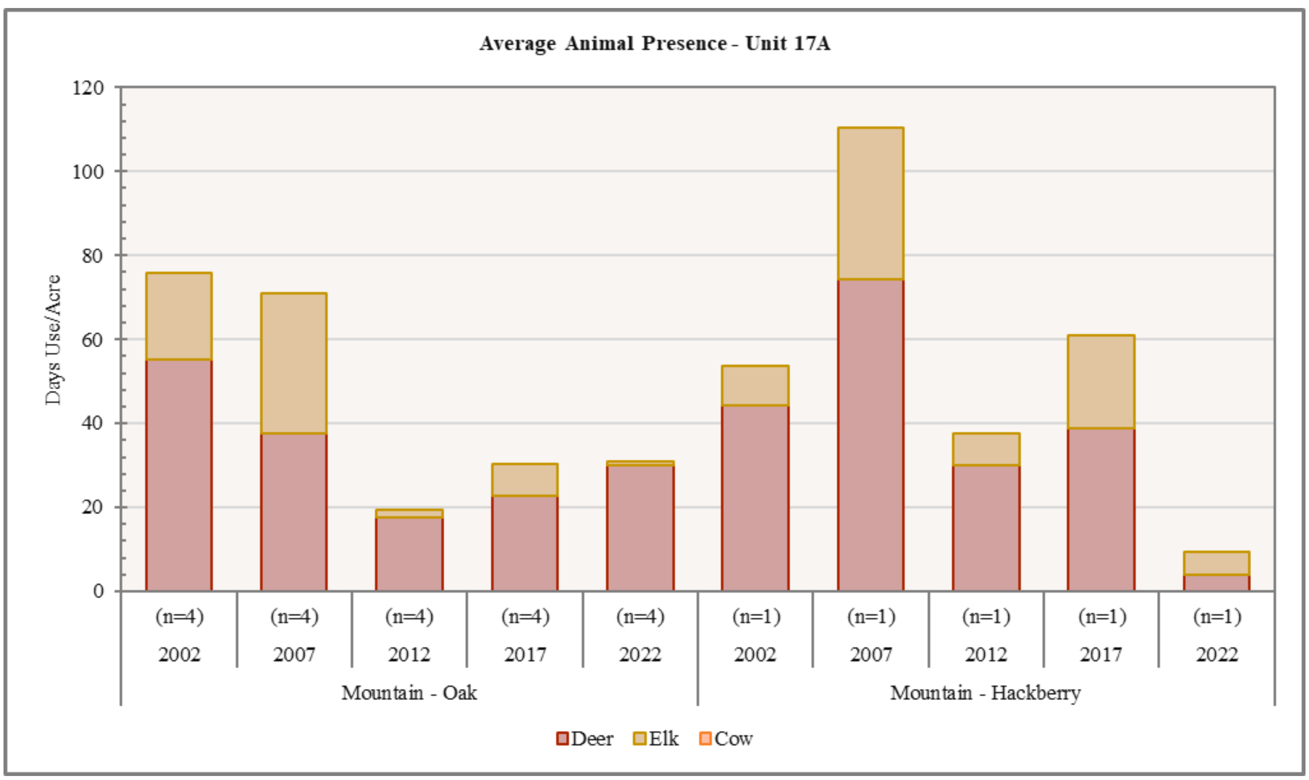


Figure 2.32: Average pellet transect data for Mountain - Oak and Mountain - Hackberry study sites in WMU 17A, Wasatch Mountains, West.

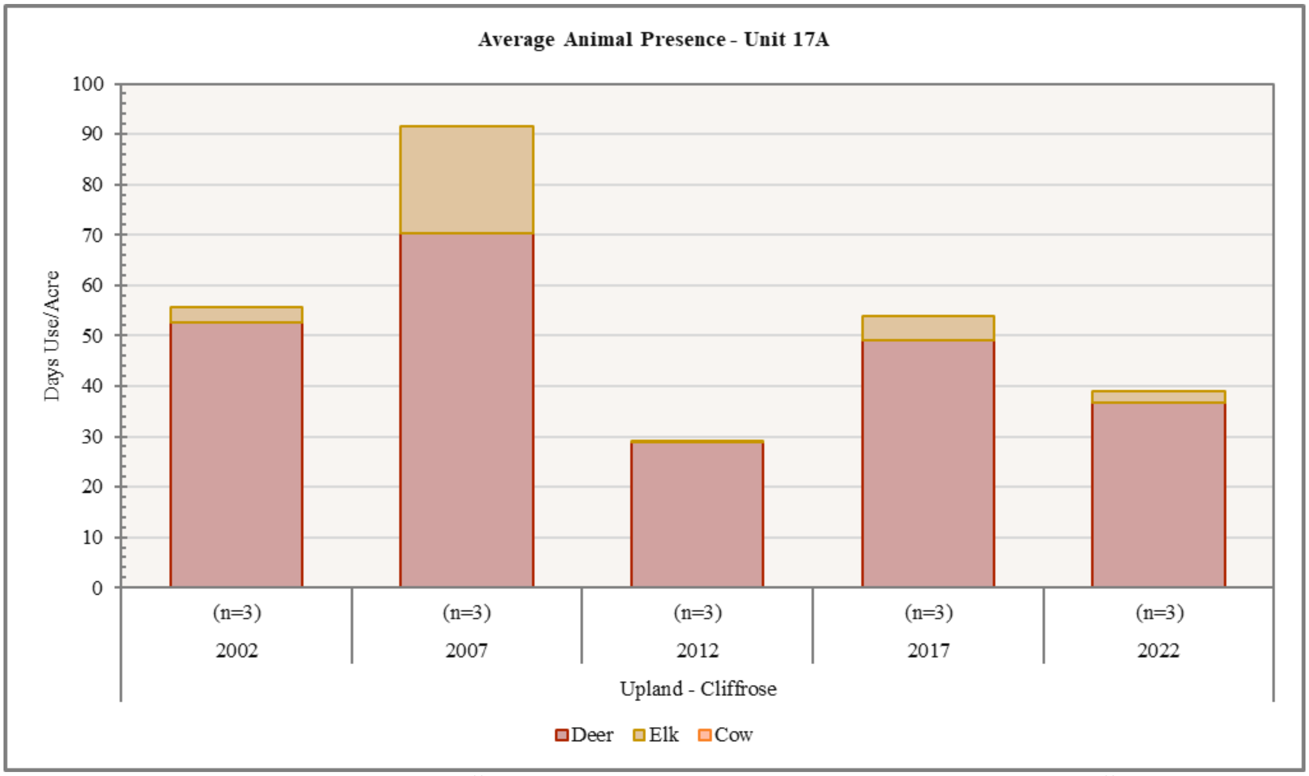
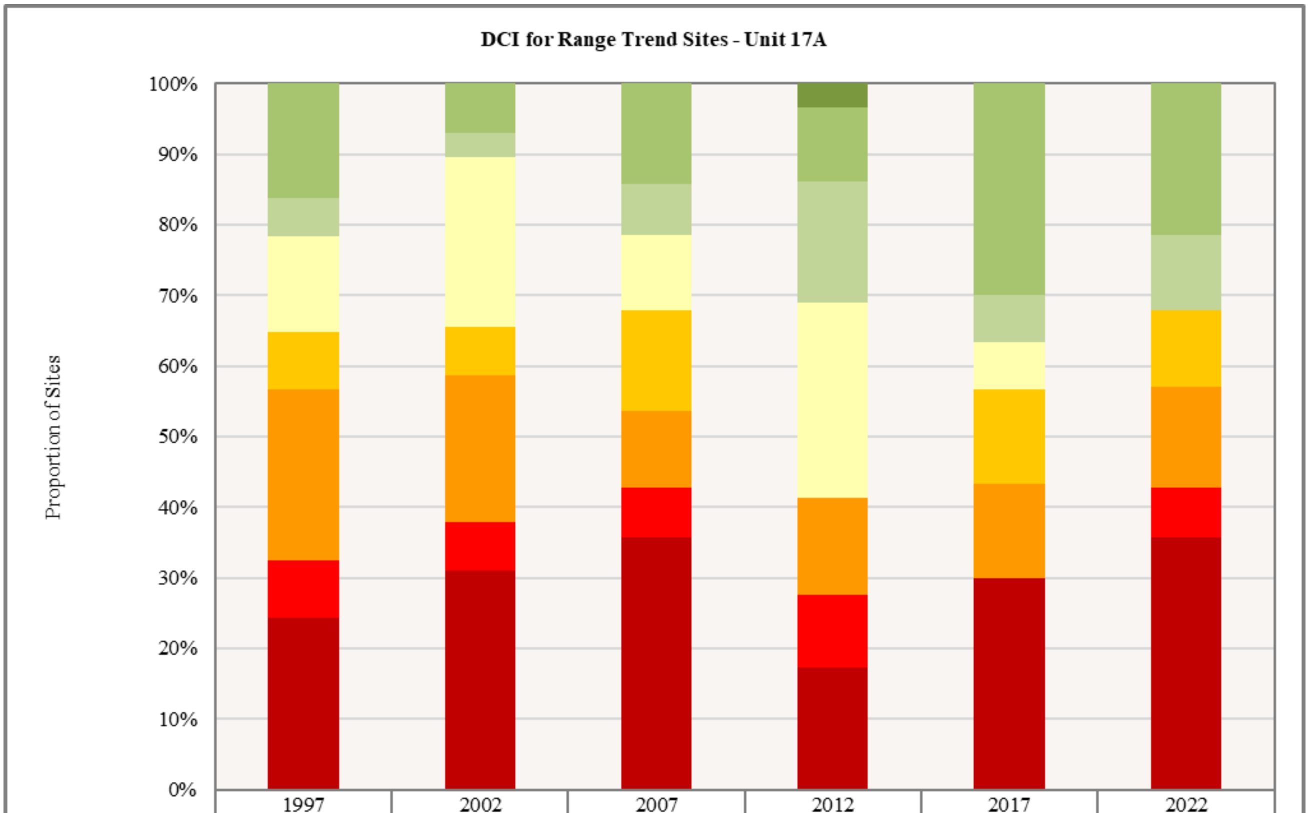


Figure 2.33: Average pellet transect data Upland - Cliffrose study sites in WMU 17A, Wasatch Mountains, West. *Upland - Cliffrose deer pellet groups include deer and bighorn sheep pellets.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Wasatch Mountain, West management unit has had minimal improvement with average condition increasing from poor to poor-fair since 1997. Unit stability can be attributed to the North Wallsburg Reseeding (17A-12), Island Boat Camp (17A-15), Orem Water Tank (17A-26), Little Diamond Fork (17A-39), Upper Sheep Creek (17A-41), Tank Hollow (17A-42), Billies Mountain (17A-44), North Bench (17A-45), and Zipline Hill (17A-69) 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 Deer Creek Dam (17A-5), Provo River Canyon (17A-7), Lower Big Hollow (17A-9), North Wallsburg (17A-13), Hoovers Hollow (17A-14), Dutch Canyon (17A-17), Coyote Canyon (17A-19), Heisetts Hollow (17A-24), North Battle Creek (17A-25), Spring Canyon (17A-30), Round Peak (17A-31), Maple Mountain Face (17A-34), Long Hollow (17A-40), Lower Tank Hollow (17A-46), Tie Fork East (17A-47), Center Creek (17A-60), Grove Creek (17A-62), Hobble Creek (17A-63), and Water Hollow (17A-64). These sites are considered to be in poor condition and the reasons for these poor conditions vary between high amounts of annual grass, few perennial forbs, lack of recruitment within the preferred browse community, and/or a lack of preferred browse cover. If any of these areas are to be considered for habitat rehabilitation, individual habitat concerns should be evaluated on a site-by-site basis. Provo River Canyon, Maple Mountain Face, and Lower Tank Hollow have had the highest degree of positive conditional change and may make good candidates for future habitat improvements. This variability may be indicative of community resilience and these sites may respond well to future habitat improvement projects. The remaining sites lack variability in conditional change and will likely be resistant to improvement inputs.

The overall deer winter range assessment in 2022 for WMU 17A is that the unit remains in poor-fair condition. Of the 28 sites sampled in 2022, just over half were evaluated to be between very poor to poor wintering habitat condition. Three sites were considered to be in poor-fair condition, and nine sites were considered to be between fair-good or good winter conditions (**Figure 2.34**, **Table 2.5**).



	1997	2002	2007	2012	2017	2022
Good-Excellent				1		
Good	6	2	4	3	9	6
Fair-Good	2	1	2	5	2	3
Fair	5	7	3	8	2	
Poor-Fair	3	2	4		4	3
Poor	9	6	3	4	4	4
Very Poor-Poor	3	2	2	3		2
Very Poor	9	9	10	5	9	10

Figure 2.34: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 17A, Wasatch Mountains, West.

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
17-5	1996	30	12.8	15	7	-14.3	8.1	-4	**54.5**	**P-F**
17-5	2002	30	10.2	6.4	6.3	-2.3	9.9	-4	**56.6**	**P-F**
17-5	2007	25.6	5	3.1	8.6	-7.2	9.9	-6	**38.9**	**VP-P**
17-5	2012	25.3	9.3	9.7	17	-2.1	10	-4	**65.2**	**F**
17-5	2017	30	12.9	8.5	8	-4	10	-6	**59.4**	**F**
17-5	2022	3	0	0	10.1	-11.5	8.8	-4	**6.4**	**VP**
17-7	1996	30	9	1.4	13.4	-5.6	0.5	0	**48.7**	**P**
17-7	2001	30	4.4	0.9	18	-1.1	7.6	0	**59.7**	**F**
17-7	2007	30	0.2	0.6	17.3	-14.6	1.3	0	**34.9**	**VP**
17-7	2012	30	3.5	0	30	-4.8	0.3	0	**58.9**	**F**
17-7	2017	30	6.6	1.2	27.7	-6.7	2.3	0	**61**	**F**
17-7	2022	30	9.7	4.6	30	-5.8	2.4	0	**70.9**	**F-G**
17-9	1996	26.8	11.7	9.8	11.6	-10.1	4.4	0	**54.2**	**P-F**
17-9	2002	27.4	9.8	6.3	13	-5.5	3.2	0	**54.1**	**P-F**
17-9	2007	28	11.3	1.3	13.1	-12.6	3.6	0	**44.6**	**P**
17-9	2012	30	12	8	17	-2.8	6.8	0	**70.9**	**F-G**
17-9	2017	30	11.8	3.6	18.8	-15.2	7	0	**56**	**P-F**
17-9	2022	12.9	14.3	6.6	18.1	-20	6.3	0	**38.2**	**VP-P**
17-10*	1996	18.5	14.4	13.5	30	0	5.8	0	**82.2**	**G**
17-11	1996	12.6	14.7	3.9	30	-0.4	10	0	**70.9**	**F-G**
17-11	2002	15.7	7.2	0.9	30	-0.5	10	0	**63.4**	**F**
17-11	2007	18.5	-0.8	0	30	-2.5	9.8	0	**54.9**	**P-F**
17-11	2012	19.6	8	3	30	-0.3	7.1	0	**67.3**	**F**
17-11	2017	15.3	7	1.1	30	-8.3	10	0	**55**	**P-F**
17-11	2022	14.9	0.8	0	30	-6.9	3.3	0	**42**	**P**
17-12	1996	9.7	13.5	7.6	30	-0.1	3	0	**63.8**	**F**
17-12	2002	14	13.5	6.6	30	-0.4	1.2	0	**65**	**F**
17-12	2007	16.4	8.5	12.5	30	-0.7	2.3	0	**68.9**	**F-G**
17-12	2012	20.8	12.9	15	30	-0.1	2.6	0	**81.2**	**G**
17-12	2017	17.6	13.2	15	30	-0.4	3.4	0	**78.7**	**G**
17-12	2022	19.4	12.9	15	30	-1	2.7	0	**79**	**G**
17-13	1996	13.6	6	7.6	8.5	-12	0.2	0	**23.9**	**VP**
17-13	2002	18.4	3.9	2.2	8.7	-3.9	0.1	0	**29.3**	**VP**
17-13	2007	24.4	1.3	1	8.4	-6.8	0.3	0	**28.6**	**VP**
17-13	2012	30	9.5	0.5	4.7	-5.4	0.1	0	**39.5**	**VP-P**
17-13	2017	24.4	7.5	1.1	2.8	-15.4	0.2	0	**20.6**	**VP**
17-13	2022	19.5	4	1.3	3.5	-9.9	0.1	0	**18.5**	**VP**
17-14	1996	2.7	0	0	14.7	-4.4	7	-2	**18**	**VP**
17-14	2002	3.8	0	0	14	-15.6	4.1	-2	**4.2**	**VP**
17-14	2007	0.5	0	0	13.7	-11	7.5	-2	**8.8**	**VP**
17-14	2012	0.7	0	0	26.5	-9.5	10	-2	**25.6**	**VP**
17-14	2017	0.6	0	0	6.4	-20	7.4	-2	**-7.7**	**VP**
17-14	2022	0.1	0	0	28.3	-10.5	5.7	-2	**21.7**	**VP**
17-15	1996	28.1	9.8	4.9	27.4	-0.5	10	-2	**77.6**	**G**
17-15	2002	30	6.4	2.6	30	0	10	0	**79**	**G**
17-15	2007	20.3	8	3.3	30	-1.8	10	0	**69.8**	**F-G**
17-15	2012	27	9.9	2.5	30	-0.2	10	0	**79.2**	**G**
17-15	2017	27.1	14.6	2.7	30	-8.3	10	-2	**74**	**G**
17-15	2022	30	10.6	3.7	30	-6.6	10	0	**77.7**	**G**
17-16	1996	17.2	3.7	2.9	26.4	-2.3	10	0	**57.9**	**F**
17-16	2002	17.4	6.1	1.6	30	-6	10	-2	**57.1**	**F**
17-16	2007	11.3	5.9	1.8	30	-6.8	10	0	**52.2**	**P**
17-16	2012	13.5	9.3	1.4	30	-1.1	10	-2	**61.2**	**F**
17-16	2017	17.2	13.6	0.4	26.6	-20	10	-2	**45.8**	**P**
17-16	2022	17.2	5.5	2.7	30	-16.6	10	-2	**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
17-17	1996	18.8	12	12.6	2.9	-6.1	2.6	0	**42.8**	**P**
17-17	2002	30	11	4.2	2.3	-6.7	1.4	-2	**40.2**	**VP-P**
17-17	2007	30	9.9	3	1.3	-4.2	1.8	-4	**37.8**	**VP**
17-17	2012	30	9.2	6.7	3.1	-1.8	1.8	-4	**45**	**P**
17-17	2017	30	10.6	1.9	4.5	-17	0.6	-2	**28.6**	**VP**
17-17	2022	9.3	13.8	14.1	1.1	-9.6	4.8	-4	**29.4**	**VP**
17-19*	1996	23.1	8.4	8.8	4.2	-15.9	1.2	0	**29.8**	**VP**
17-19*	2002	25.2	3.6	3.8	4.4	-2.1	0.1	0	**35**	**VP**
17-19*	2007	24.9	5.8	3.9	3.6	-14.8	0.4	0	**23.8**	**VP**
17-19*	2012	30	9.1	4	1.1	-5.2	0.2	0	**39.2**	**VP-P**
17-19*	2017	30	9.2	1.8	3.7	-20	2.5	0	**27.2**	**VP**
17-21*	1997	20.2	15	6.9	9.9	-1.8	2.7	0	**52.8**	**P**
17-23*	1997	18	11.9	15	8.1	-11.8	4.6	-2	**43.9**	**P**
17-24	1997	10.7	8.4	3.4	30	-1.1	3.1	0	**54.5**	**P-F**
17-24	2002	9.7	3.1	2.9	30	-0.1	2	0	**47.6**	**P**
17-24	2007	7.8	5.8	3.1	30	-1.2	5.3	0	**50.8**	**P**
17-24	2012	9.2	9.3	0	30	-1.9	2.7	-4	**45.3**	**P**
17-24	2017	2.4	0	0	28.2	-2.4	3.4	-2	**29.6**	**VP**
17-24	2022	0.6	0	0	28.6	-2.8	2.7	-4	**25.1**	**VP**
17-25	1997	13	10.2	0	7.4	-1.9	10	-4	**34.8**	**VP-P**
17-25	2002	14.5	6	1.3	7.8	-0.2	7.2	-4	**32.6**	**VP**
17-25	2007	20.8	13.3	1.4	2.9	-6.2	1.1	-4	**29.2**	**VP**
17-25	2012	16.7	9.4	0	3.2	-20	1.6	-2	**8.8**	**VP**
17-25	2017	12.6	9	0	1.7	-17.4	2.4	-6	**2.2**	**VP**
17-25	2022	4.5	0	0	2.3	-9.3	0.5	-6	**-8**	**VP**
17-26	1997	7.6	15	15	30	-2.5	10	-2	**73.1**	**G**
17-26	2002	16.5	15	7.8	30	-7.7	10	-2	**69.5**	**F-G**
17-26	2007	30	14.6	11.6	30	-12.2	10	-2	**81.9**	**G**
17-26	2012	30	14.1	15	30	-3	5.5	-2	**89.5**	**G-E**
17-26	2017	28.6	12.8	15	30	-4.7	10	-4	**87.6**	**G**
17-26	2022	5.7	15	15	30	-15.9	10	-4	**55.8**	**P-F**
17-28*	1997	4.5	0	0	16.2	-1.8	0.7	-2	**17.7**	**VP**
17-29*	1997	1.2	0	0	17.6	-5.1	7.2	0	**20.9**	**VP**
17-30	1997	5	0	0	8.1	-2.6	4.7	0	**15.2**	**VP**
17-30	2002	6.7	0	0	11.5	-4.5	5.6	0	**19.3**	**VP**
17-30	2007	12.1	10.7	0	12.2	-10.6	8.1	0	**32.5**	**VP**
17-30	2012	9	15	3.8	11.9	-16.9	4.4	0	**27.2**	**VP**
17-30	2017	10	8.6	12	11.3	-18.9	3.9	0	**27**	**VP**
17-30	2022	9.5	11.9	15	9.8	-11.8	6	0	**40.4**	**P**
17-31	1997	2.2	0	0	23.3	-0.6	10	0	**34.9**	**VP**
17-31	2002	1.8	0	0	25.2	-1.2	10	0	**35.8**	**VP**
17-31	2007	6.1	13.4	10.8	17.3	-3.3	10	0	**54.3**	**P-F**
17-31	2012	4.4	0	0	18.6	-6.9	10	-2	**24.1**	**VP**
17-31	2017	5.6	13.8	12.9	16.2	-6.9	10	-2	**49.6**	**P**
17-31	2022	3.9	0	0	8.7	-13.6	10	-4	**5.1**	**VP**
17-33*	1997	21.9	14.3	6.5	4.4	-18.4	10	0	**38.7**	**VP-P**
17-34	1997	1.8	0	0	8.9	-0.4	10	-2	**18.3**	**VP**
17-34	2002	5.1	0	0	4.2	-0.2	10	-2	**17.2**	**VP**
17-34	2007	18.5	13.3	7.5	9.7	-1.1	10	-2	**55.9**	**P-F**
17-34	2012	24.6	14.8	8.5	16.7	-2.5	10	-4	**68.1**	**F-G**
17-34	2017	24	13.7	7.2	30	-6.4	10	-4	**74.5**	**G**
17-34	2022	16.1	6.6	3.2	30	-8.4	10	-4	**53.5**	**P-F**
17-35*	1997	11.5	13.8	15	7.7	-2.9	2.5	0	**47.5**	**P**
17-36*	1997	4.3	0	0	4	-9.1	10	0	**9.2**	**VP**
17-38*	1997	3.3	0	0	30	-0.3	10	-2	**41**	**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
17-39*	1997	7.9	2.3	8.5	21.2	0	10	-2	**47.9**	**P**
17-39*	2002	11.5	10.5	3.1	28.3	0	10	-2	**61.4**	**F**
17-39*	2007	17.8	11.8	6.8	30	0	10	0	**76.4**	**G**
17-39*	2012	13.8	13.1	4.5	30	0	10	-2	**69.3**	**F-G**
17-39*	2017	25	11.9	5.2	30	0	8.2	0	**80.2**	**G**
17-40	1997	14.1	11.4	4.5	17.3	-5.9	10	-4	**47.3**	**P**
17-40	2002	13.3	-1.3	5.2	17.6	-0.5	10	-2	**42.3**	**P**
17-40	2007	10.9	8.1	1.1	30	-0.6	10	-4	**55.5**	**P-F**
17-40	2012	15	10.1	3	14.7	-0.4	10	-2	**50.4**	**P**
17-40	2017	10.6	8.7	0.8	13.8	-9	10	0	**34.9**	**VP**
17-40	2022	6.3	0	0	27.9	-3.9	10	0	**40.3**	**VP-P**
17-41	1997	30	13.2	4.7	23.6	0	10	0	**81.5**	**G**
17-41	2002	30	11.1	4.6	21.3	0	10	-2	**75**	**G**
17-41	2007	30	11.2	2.1	21.2	-0.1	10	0	**74.5**	**G**
17-41	2012	30	11	5.1	24.3	0	8.1	-2	**76.5**	**G**
17-41	2017	30	12.8	2.8	18.7	0	10	-2	**72.3**	**G**
17-41	2022	15.2	14.1	6.1	30	-0.4	10	-2	**73.1**	**G**
17-42	1997	30	10.4	5.2	22	-0.7	10	0	**76.9**	**G**
17-42	2002	23	-4.8	3.1	23.6	-0.2	5.8	0	**50.5**	**P**
17-42	2007	15.2	5.8	6.6	30	-1.1	6.1	0	**62.6**	**F**
17-42	2012	24.9	11.1	3.5	30	-0.2	2.3	0	**71.5**	**F-G**
17-42	2017	25	11.1	2.1	30	-0.3	4.3	0	**72.2**	**G**
17-42	2022	22.2	10.8	8.2	30	-0.1	2.2	0	**73.2**	**G**
17-43*	1997	8.9	14.4	12	16.9	-0.1	10	0	**62.2**	**F**
17-44	1997	10.9	5.7	7	30	-0.6	10	-2	**60.9**	**F**
17-44	2002	11.9	4.9	5.5	30	0	10	-2	**60.2**	**F**
17-44	2007	14.3	8.4	4	30	-0.4	10	0	**66.3**	**F**
17-44	2012	9.6	12.7	5.8	30	-0.2	10	-2	**65.8**	**F**
17-44	2017	12	13.5	10.5	30	-0.7	10	-2	**73.4**	**G**
17-44	2022	10.5	11.2	10.1	30	-0.7	10	-2	**69**	**F-G**
17-45	1997	11	12.4	15	28.9	-0.1	10	-2	**75.1**	**G**
17-45	2002	16.4	8.7	5.6	30	0	10	-4	**66.7**	**F**
17-45	2007	23.5	10.9	0.9	29.5	0	10	-2	**72.8**	**G**
17-45	2012	13.5	7.7	8.1	30	0	10	-2	**67.3**	**F**
17-45	2017	24.6	13.4	6.5	30	-0.5	10	-2	**82**	**G**
17-45	2022	25.4	9	5.3	30	-0.2	10	-2	**77.5**	**G**
17-46	1997	5.4	0	0	30	-0.4	10	-2	**43**	**P**
17-46	2002	7.8	-1.3	1.6	30	0	3.4	-2	**39.5**	**VP-P**
17-46	2007	6.3	0	0	30	-0.1	3.8	-2	**38.1**	**VP-P**
17-46	2012	10.3	13.4	0.9	30	0	3.5	0	**58**	**F**
17-46	2017	12.5	14.4	4.3	30	0	7.4	0	**68.6**	**F-G**
17-46	2022	13	12.2	11.7	30	0	4.6	-2	**69.4**	**F-G**
17-47*	1997	18.6	14	8	16	-0.4	7.4	-4	**59.6**	**F**
17-47*	2002	18.2	12.6	3	10.6	0	6.7	-4	**47.1**	**P**
17-47*	2007	28.2	12.8	5.1	10.3	-0.9	10	-4	**61.5**	**F**
17-47*	2012	24.5	13.8	8.7	13.1	-0.8	4.2	-2	**61.4**	**F**
17-60	2002	27.8	6.7	1.2	7.7	-3.3	3.7	0	**43.7**	**P**
17-60	2007	23.4	5.4	0.5	6	-7.7	1.3	0	**28.9**	**VP**
17-60	2012	30	10	0.5	10.9	-5.9	3.1	0	**48.6**	**P**
17-60	2017	30	5.2	1.9	14.2	-10.7	6.2	0	**46.7**	**P**
17-60	2022	26.2	3.8	5	17.2	-12.1	3	0	**43**	**P**
17-62	2002	8	7	11.4	8.4	-14.4	1.1	0	**21.5**	**VP**
17-62	2007	8.9	7.1	0	8.4	-15	0.7	-4	**6.1**	**VP**
17-62	2012	12.2	14.1	8.9	17.3	-15.7	3.3	-6	**34**	**VP-P**
17-62	2017	12.9	14.3	6.3	12.1	-5.9	3.3	-2	**41.1**	**P**
17-62	2022	10.1	11.8	1.1	11.6	-14.1	1.8	-2	**20.2**	**VP**
17-63	2002	23.5	10.9	1.8	8.7	-0.4	5.2	0	**49.6**	**P**
17-63	2012	30	13.1	6.6	24.6	-12.5	7.3	0	**69**	**F-G**
17-63	2017	29.8	13	3.4	17.2	-13.1	4.9	0	**55.2**	**P-F**
17-63	2022	1.1	0	0	11.6	-6.1	4.4	0	**11**	**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
17-64	2002	0.8	0	0	30	0	0.7	-2	**29.4**	**VP**
17-64	2007	2.4	0	0	30	-0.5	0.9	0	**32.7**	**VP**
17-64	2012	3	0	0	30	-0.1	0.2	0	**33.1**	**VP**
17-64	2017	2.9	0	0	30	-0.4	0.6	-2	**31.1**	**VP**
17-64	2022	2.9	0	0	30	-0.5	0	0	**32.4**	**VP**
17-69	2017	26.4	14.2	6.9	30	-13.9	10	-2	**71.5**	**F-G**
17-69	2022	24.7	12.3	10.5	30	-3.5	10	-2	**82**	**G**
17-70	2017	6.7	13.3	2.3	30	-0.9	2.4	0	**53.8**	**P-F**
17-70	2022	8.1	12.4	6.7	29	-1.2	0.7	-2	**53.5**	**P-F**

Table 2.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 17A, Wasatch Mountains, West. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
17-5	Deer Creek Dam	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
17-7	Provo River Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
		Urban Development	Low	Fragmentation and loss of habitat
17-9	Lower Big Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
17-11	Wallsburg Turn	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
17-12	North Wallsburg Reseeding	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
17-13	North Wallsburg	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
17-14	Hoovers Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
17-15	Island Boat Camp	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
17-16	Rainbow Bay	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Drought	Low	Lowered resilience and resistance to disturbance
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
17-17	Dutch Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
		Noxious Weeds	High	Reduced diversity of desirable grass and forb species
17-24	Heisetts Hollow	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	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
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
17-25	North Battle Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
17-26	Orem Water Tank	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
17-30	Spring Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
17-31	Round Peak	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
17-34	Maple Mountain Face	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Urban Development	Low	Fragmentation and loss of habitat
		Noxious Weeds	Medium	Reduced diversity of desirable grass and forb species
17-40	Long Hollow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Drought	Low	Lowered resilience and resistance to disturbance
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
17-41	Upper Sheep Creek	Introduced Perennial Grass	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

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
17-42	Tank Hollow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
17-44	Billies Mountain	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	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
17-45	North Bench	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
17-46	Lower Tank Hollow	Introduced Perennial Grass	Low	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
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
17-60	Center Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Animal Use	Medium	Reduced diversity of desirable grass and forb species
17-61	American Fork Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
17-62	Grove Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
17-63	Hobble Creek Bench	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
17-64	Water Hollow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	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
17-69	Zipline Hill	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
17-70	Indian Creek Road	Annual Grass	Medium	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
		Animal Use	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
17R-40	Round Valley	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species

Table 2.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 17A, Wasatch Mountains, West. 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

As of 2022, two-thirds of the study sites that fall within deer winter range are classified as being in very poor to poor-fair condition. The drivers behind these poor conditions vary between high amounts of annual grass, few perennial forbs, lack of recruitment within the preferred browse community, and/or a lack of preferred browse cover.

Many sites near Deer Creek Reservoir and in the Heber Valley area have experienced wildfires between 2017 and 2022, while multiple areas across the Wasatch Front have also burned in the last decade. Data gathered in the Deer Creek Reservoir and Heber Valley areas during 2022 confirms precipitous decreases in shrub cover and density on the burned study sites. The loss of preferred browse communities to wildfire translates to less available forage and browse for deer in the area, which in turn emphasizes the importance of habitat that does remain. As such, a positive aspect of sampled habitat within the management unit was observed in the Wallsburg area. The desirable components index of study sites in this area ranges from very poor to good. However, a majority of these sites (specifically Wallsburg Turn, North Wallsburg Reseeding, North Wallsburg, Island Boat Camp, and Zipline Hill) have preferred browse communities that have largely remained stable between the two most recent samplings.

Although the browse components vary in abundance and cover between the study sites along Highway 6 (Long Hollow, Tank Hollow, Billies Mountain, North Bench, Lower Tank Hollow, Water Hollow, and Indian Creek Road), they also appear to have remained fairly stable between 2017 and 2022. The exception to this is the Upper Sheep Creek study, which saw a substantial decrease in the browse population and the removal of trees due to the 2017 Tank Hollow fire. However, 2022 data indicates that the recruitment of young Utah serviceberry and mountain snowberry plants is occurring on this site, suggesting that the preferred browse component may continue to return over time.

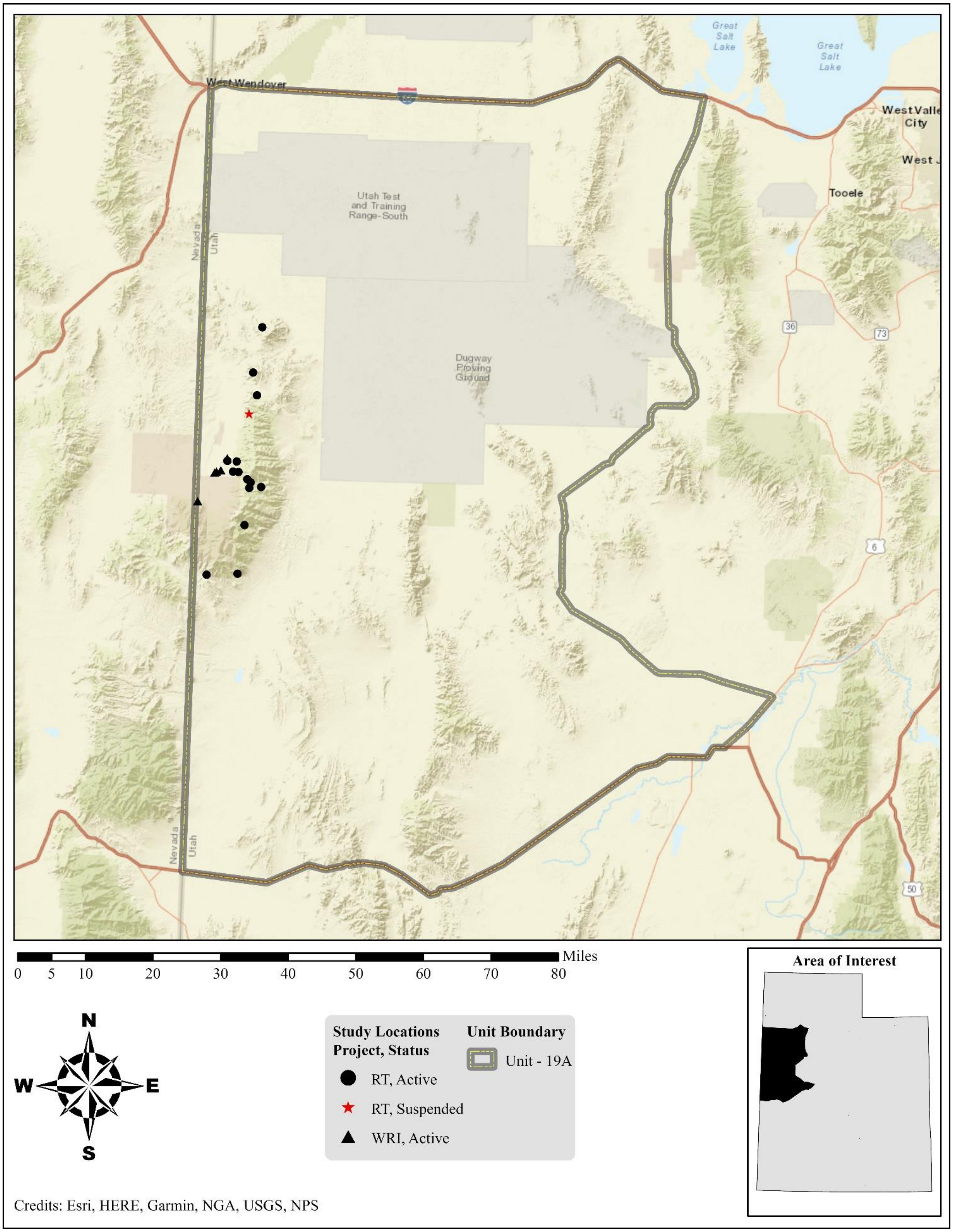
A number of study sites in this management unit have burned at some point during the study period. To expand upon the fires mentioned earlier in this discussion, many sites along the benches of the Wasatch Front in particular have burned within the past 10 years (Heisetts Hollow, North Battle Creek, Orem Water Tank, American Fork Canyon, and Hobble Creek Bench). Furthermore, the Orem Water Tank and American Fork Canyon studies have burned more than once over a 30-year period. The shrub populations on these sites have exhibited significant post-fire losses: this equates to even less preferred browse being available for deer in an area where habitat is already fragmented and affected by urban development and human presence. All of the previously mentioned studies have had annual grasses – particularly the introduced species cheatgrass – present in varying amounts throughout the study period both prior to and following the fires. As was also briefly mentioned earlier in this discussion, fires have also occurred on sites near Deer Creek Reservoir and Heber Valley, including Deer Creek Dam, Lower Big Hollow, Hoovers Hollow, and Dutch Canyon. Furthermore, all of these sites except Hoovers Hollow burned within the last five years. Like the study sites that have burned along the Provo face, the sites in this area have exhibited precipitous post-fire decreases in preferred browse cover and density. Cheatgrass has also been present in the understories of the burned study sites in this area throughout the study period, and contributed significant cover in 2022. Although a number of factors may have influenced how and why these study sites burned, the presence of annual grasses can increase fine fuel loads, exacerbate the risk of wildfire, and may even result in altered wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). The noxious perennial forbs field bindweed and Dalmatian toadflax were observed during the most recent sampling on the Deer Creek Dam study; the cover and abundance of Dalmatian toadflax in particular increased between 2017 and 2022. Noxious weeds are often aggressive and may lead to reduced understory diversity by outcompeting desirable grass and forb species for resources (Mack, et al., 2000). Furthermore, the 2018 wildfire that occurred on this site may have contributed to the 2022 increase in Dalmatian toadflax (Jacobs & Sheley, 2003).

A number of additional concerns and threats to wildlife habitat are associated with the increased urban development and human activity occurring within the Wasatch Mountains management unit. For example, satellite imagery shows the large extent of single and two-track trail systems along the Bonneville Shoreline and the foothills in the Heber Valley area. Recreational trails such as these may have unintended consequences when located within traditional big game habitat, including (but not limited to) a loss of preferred browse and herbaceous forage for wildlife, disturbances of animals within the area through human-wildlife interactions, and degradation of habitat through the introduction of non-native species. In addition, human activities along the Wasatch Front have led to fires and the associated loss of valuable browse populations – an unattended campfire ring ignited the 2017 Alpine fire that burned the American Fork Canyon study. Housing and energy developments are also actively occurring in this unit and have led to fragmentation and loss of habitat; a powerline project in the Tie Fork area had destroyed portions of the Water Hollow transect when it was read in 2022, and the Coyote Canyon study had been converted to a housing development in the same year.

Other threats to wildlife habitat are occurring in localized portions of this unit, but will not be discussed in this section. These additional threats are specified by study site in the previous table (**Table 2.6**).

A number of recommendations should be taken into consideration when trying to mitigate or slow the effects of big game habitat loss in the Wasatch Mountains management unit. Priority should be given to protecting and rehabilitating remaining areas of big game winter range and habitat in general in this unit. As available preferred browse and valuable forage continue to decrease, these remaining ranges will likely become increasingly important for deer herds in the vicinity. In addition, areas that would benefit from the reestablishment of shrub communities should be identified and projects to achieve this should be considered. If seeding is used as a method of reestablishment of shrub or herbaceous components, care should be taken in seed selection. Preference should be given to native species whenever possible when creating seed mixes, as some introduced species may have the potential to be aggressive in certain ecological potentials. Efforts to reduce the creation of illegal trails should also be considered, and may involve such methods as cooperation with local municipalities, public outreach, and/or posted signage where appropriate. Finally, monitoring of both Range Trend studies and areas where rehabilitation projects have occurred should continue in the future. Periodic monitoring of these areas not only assesses the quality of big game habitat, but may also aid in the identification of threats as they appear over time.

3. WILDLIFE MANAGEMENT UNIT 19A – WEST DESERT - DEEP CREEK



WILDLIFE MANAGEMENT UNIT 19A – WEST DESERT - DEEP CREEK

Boundary Description

Juab, Millard and Tooele counties – Boundary begins at the Utah-Nevada state line and I-80 in Wendover; east on I-80 to Exit 77 and SR-196; south on SR-196 to Government Creek Road near Dugway; south on this road to the Pony Express road: southwest on this road to 14-mile road (Dugway Valley road); south on this road to SR-174; east on SR-174 to US-6; south on US6 to US-6/50; west on US-6/50 to the Utah-Nevada state line; north on this state line to I-80 in Wendover. Excludes all Native American trust lands within this boundary.

Management Unit Description

Geography

The West Desert-Deep Creek subunit is located in the West Desert along the Nevada border. The Bonneville Salt Flats and Dugway Proving Ground make up significant portions of the subunit. The land area of this subunit consists of the Deep Creek Mountains, Cedar Mountains, and the House Range. All of the Range Trend sites in the unit are located on the Deep Creek mountain range. A significant amount of the winter range occurs on tribal land, but most of the summer range in the unit is publicly held. Towns in this unit include Wendover, Delta, and Ibapah.

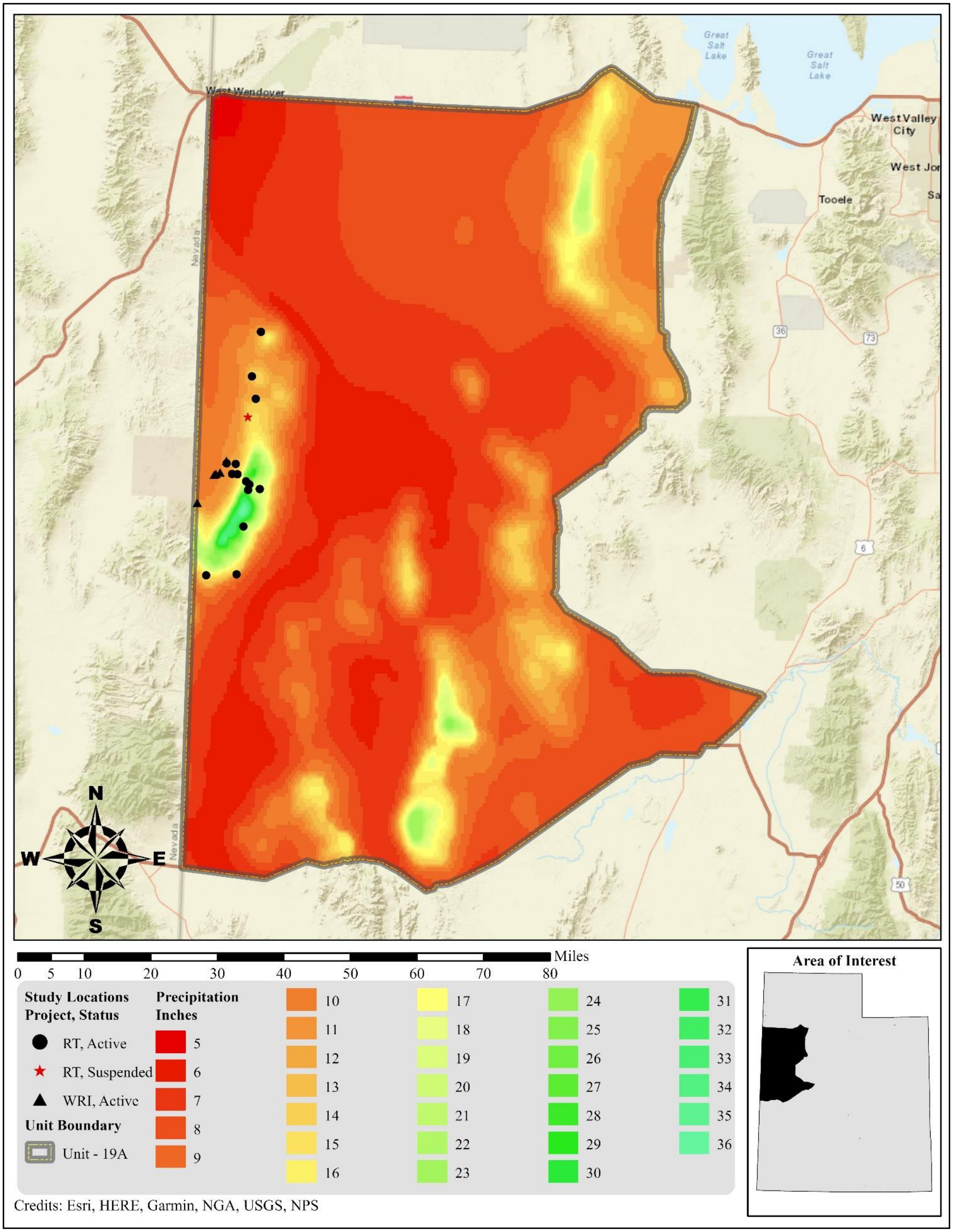
The Deep Creek Mountains run north-south along the Nevada border; the Cedar Mountains and House Range run north-south as well. The Cedar Mountains are south of I-80 near Skull Valley, and the House Range is south of Dugway Proving Grounds. The highest point is Ibapah Peak at 12,087 feet, and the lowest point is on the Bonneville Salt Flats at around 4,200 feet. The Deep Creeks are the most prominent range in the unit and are steep, with many deep canyons leading up to the peaks.

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 near Wendover to 36 inches on the peaks of the Deep Creek Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within 10-24 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 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 2020-2022. The mean annual PDSI displayed moderately to extremely wet years in 1993, 1995, 1997-1998, 2005, 2011, and 2019 (**Figure 3.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 2000, 2002-2004, 2007-2008, 2012-2015, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1995, 1998, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007-2008, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2011, and 2019 (**Figure 3.1b**).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2015, 2018, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995-1998, 2005, and 2011 (**Figure 3.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021-2022. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007, 2012-2013, 2015, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995, 1997-1998, and 2005 (**Figure 3.2b**) (Time Series Data, 2023).



Map 3.1: The 1991-2020 PRISM Precipitation Model for WMU 19A, West Desert - Deep Creek (PRISM Climate Group, Oregon State University, 2021).

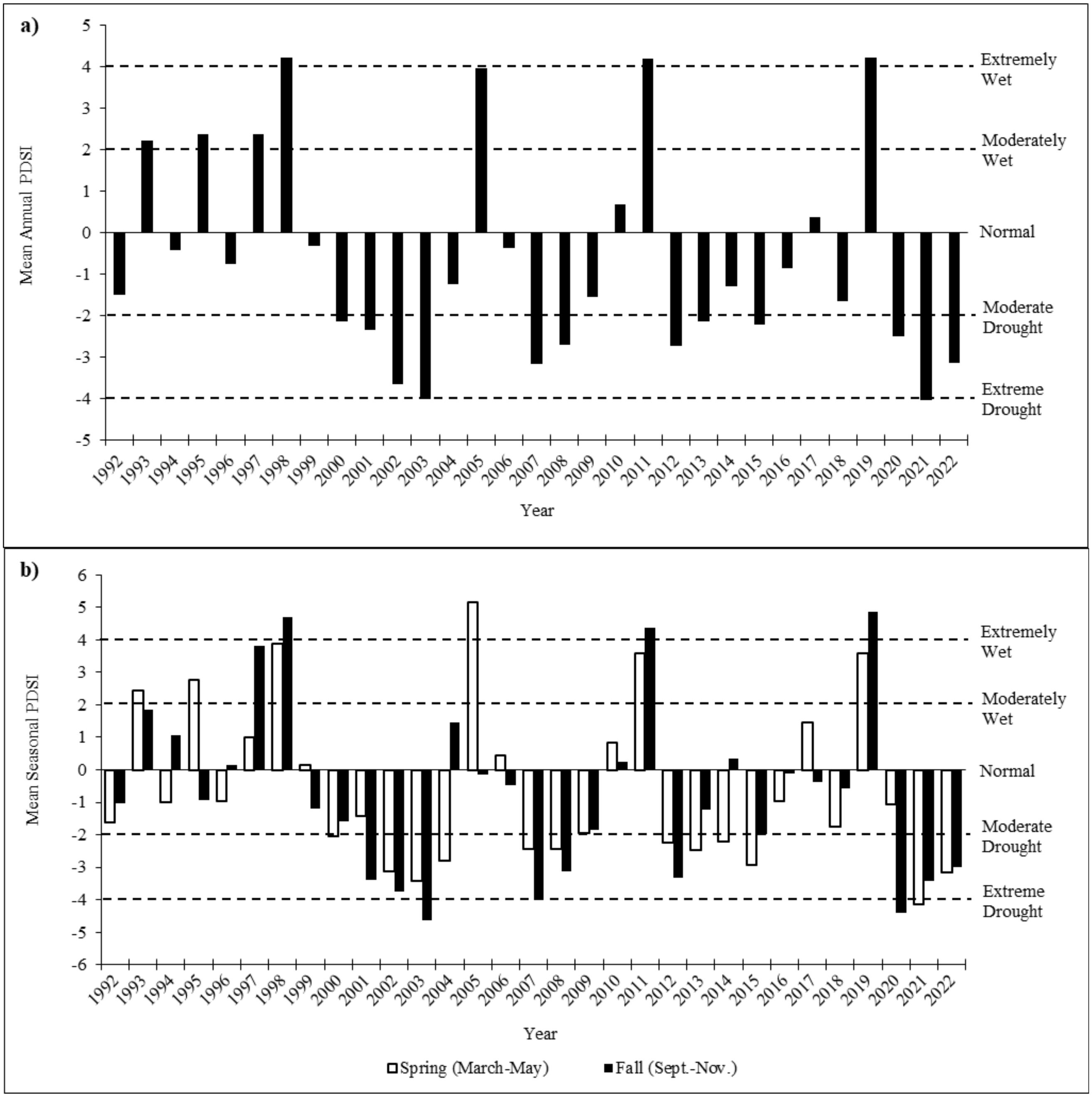


Figure 3.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the Western division (Division 1). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

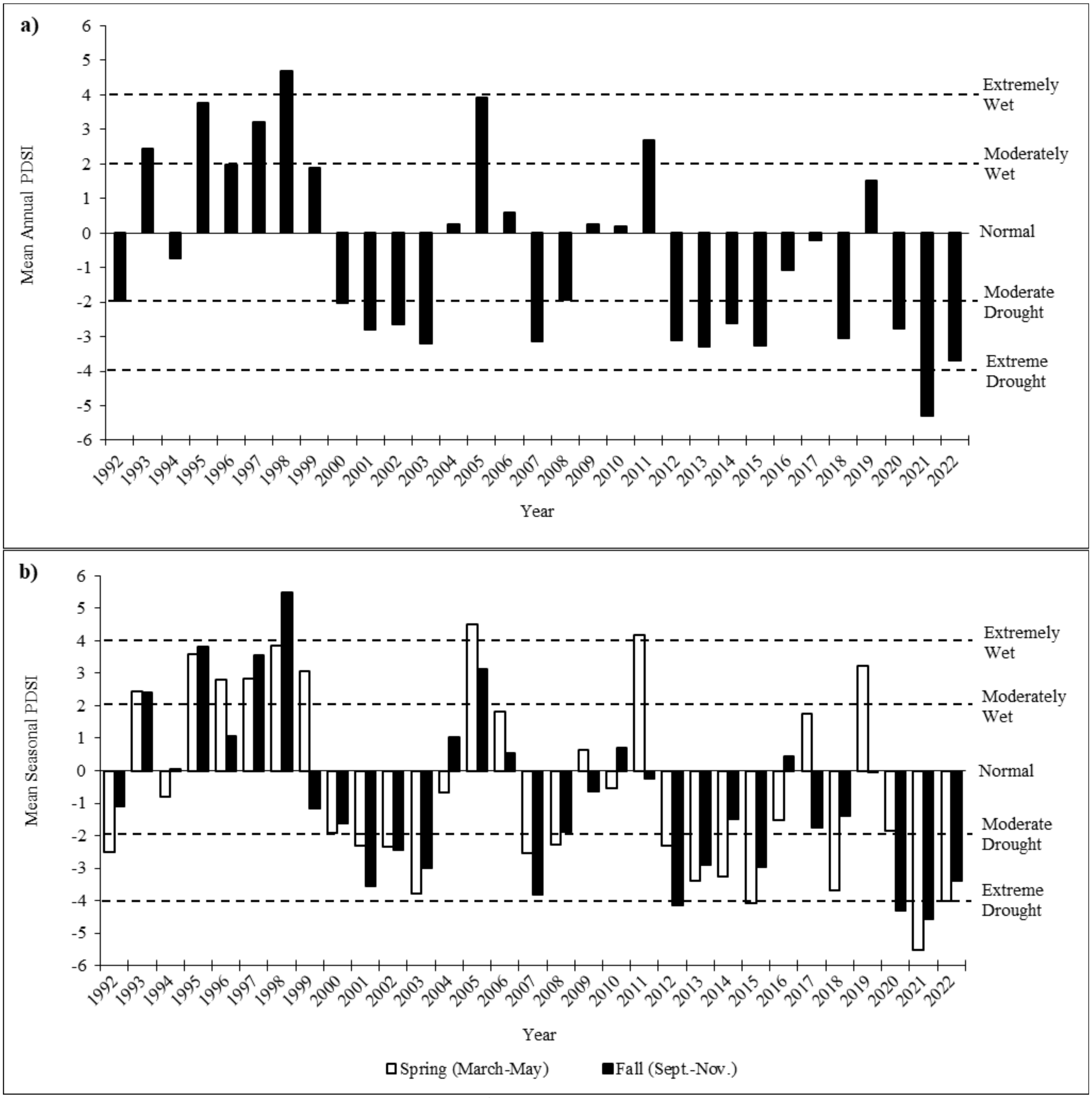


Figure 3.2: The 1992-2022 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

Big Game Habitat

This unit is limited by quality summer range: the Deep Creek Mountains are the only feature in the unit that provides significant amounts of summer range. The Deep Creek Range contains winter habitat along the lower edges of the range, but is limited at the lower elevations by transition into the expanses of barren salt flats and unsuitable salt desert scrub. The House Range and Cedar Mountains also contain some winter habitat, but they do not have significant summer habitat.

Deer winter range around the Deep Creeks typically follows the base of the mountains and extends to the foothills northwest of the mountains. It is possible that some wintering deer would move out to the Ferber Hills in Nevada depending on the year.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between Range Trend samplings.

The RAP data illustrates a peak in total herbaceous cover and biomass in 2019; there are a few other notable peaks in total herbaceous biomass and cover in 1995 and 2006. These peaks are largely due to sharp increases in annual species within the respective deer ranges and appear to follow the high precipitation trend. For both summer and winter ranges, annuals have generally shown an increase in biomass and cover as perennials have generally decreased over the same time period. This degree of separation between annual and perennial life forms is more pronounced in RAP cover estimations (**Figure 3.3**, **Figure 3.4**, **Figure 3.5**, **Figure 3.6**). The Range Trend data from 1997 to present shows a general increase of perennial cover, but annual cover has fluctuated (**Figure 3.27**, **Figure 3.28**, **Figure 3.29**). This fluctuation of annual cover is expected due to differences in timing and amounts of precipitation for each sample year read.

RAP estimations for tree and shrub cover show minor fluctuations over time that appear to correspond with variations in precipitation, and are naturally less pronounced due to the slower growth in woody species. Cover has remained relatively stable for both trees and shrubs (**Figure 3.7**, **Figure 3.8**). Range Trend data shows a variation in trends for shrub and tree cover since 1997 among the different potentials (**Figure 3.9**, **Figure 3.10**, **Figure 3.11**, **Figure 3.12**).

RAP – Biomass by Deer Habitat

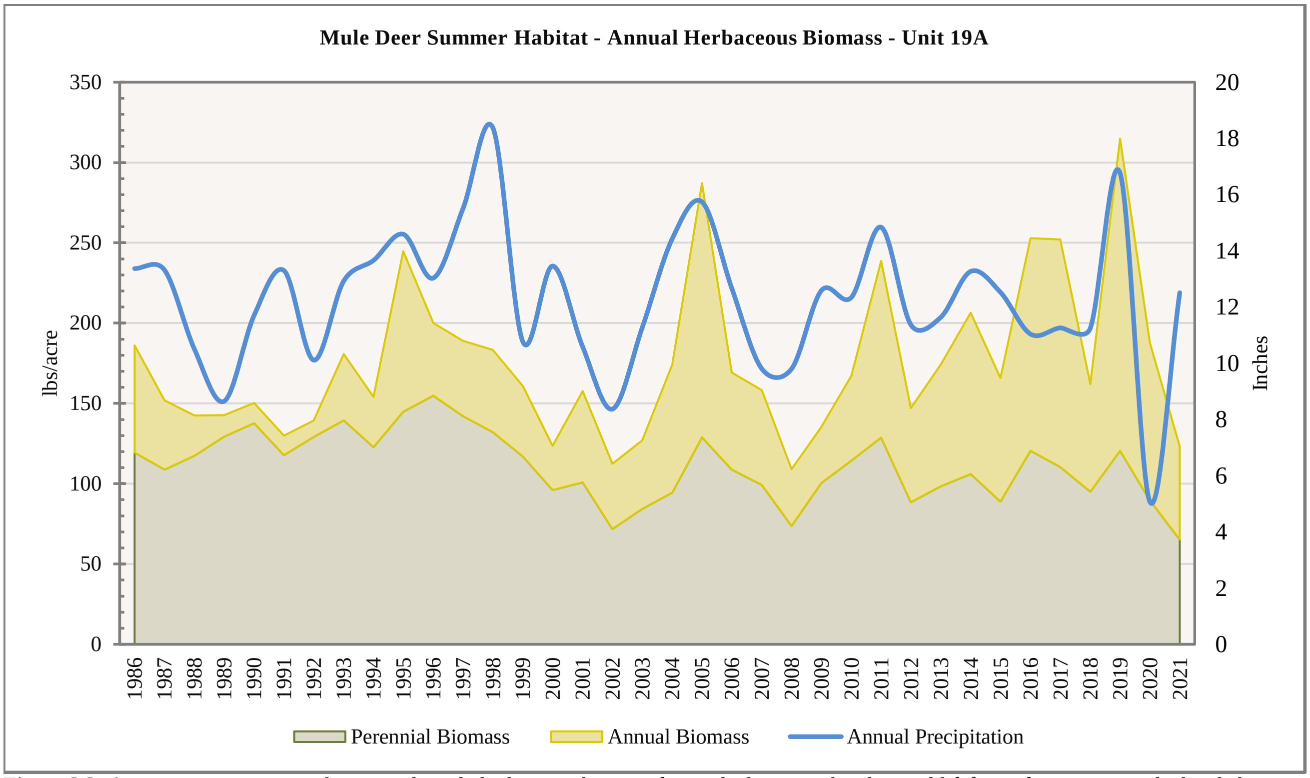


Figure 3.3: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 19A, West Desert - Deep Creek (Rangeland Analysis Platform, 2023).

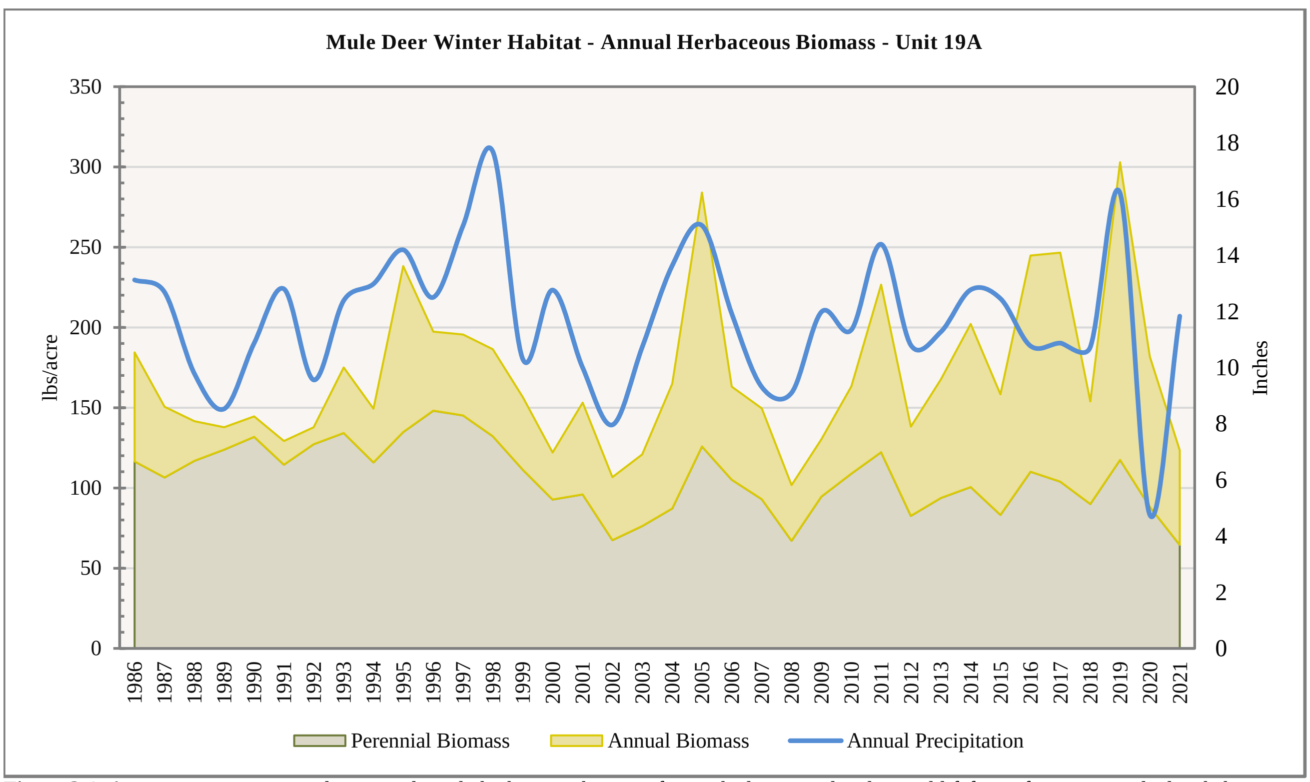


Figure 3.4: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 19A, West Desert - Deep Creek (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

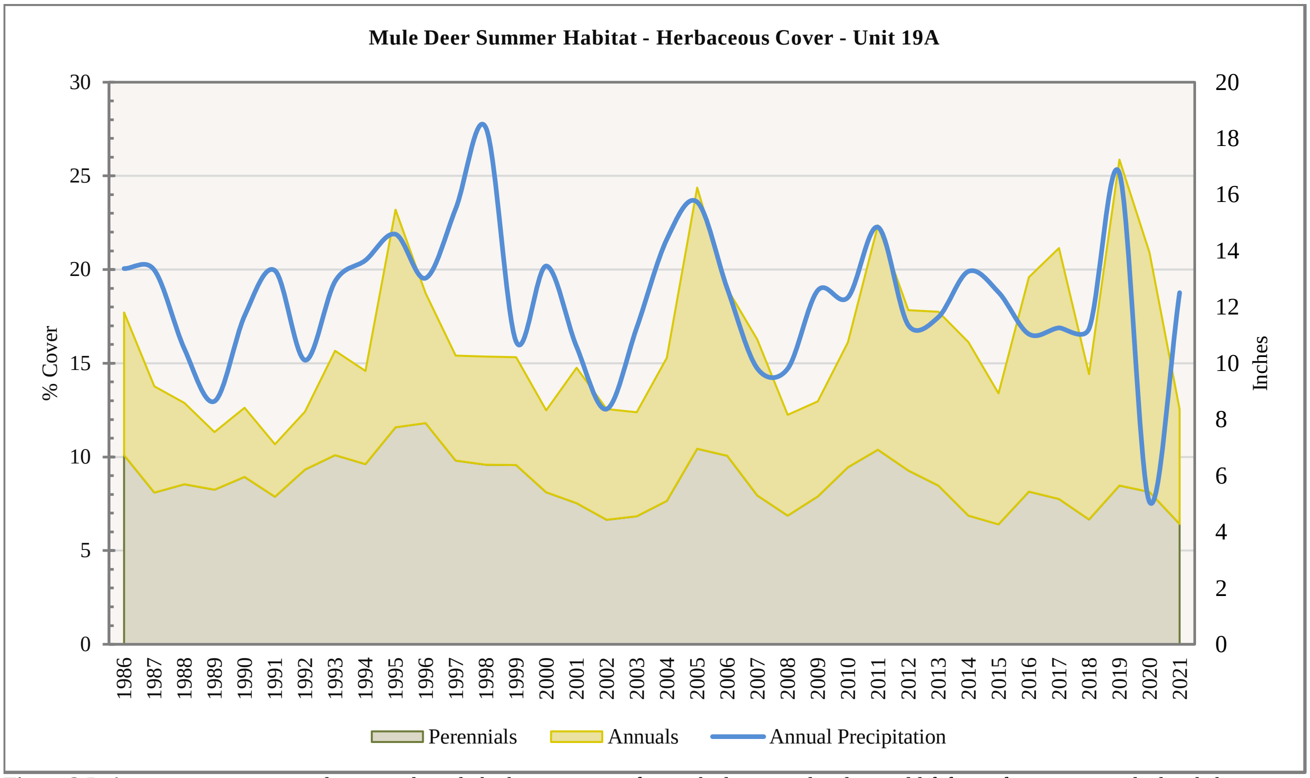


Figure 3.5: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 19A, West Desert - Deep Creek (Rangeland Analysis Platform, 2023).

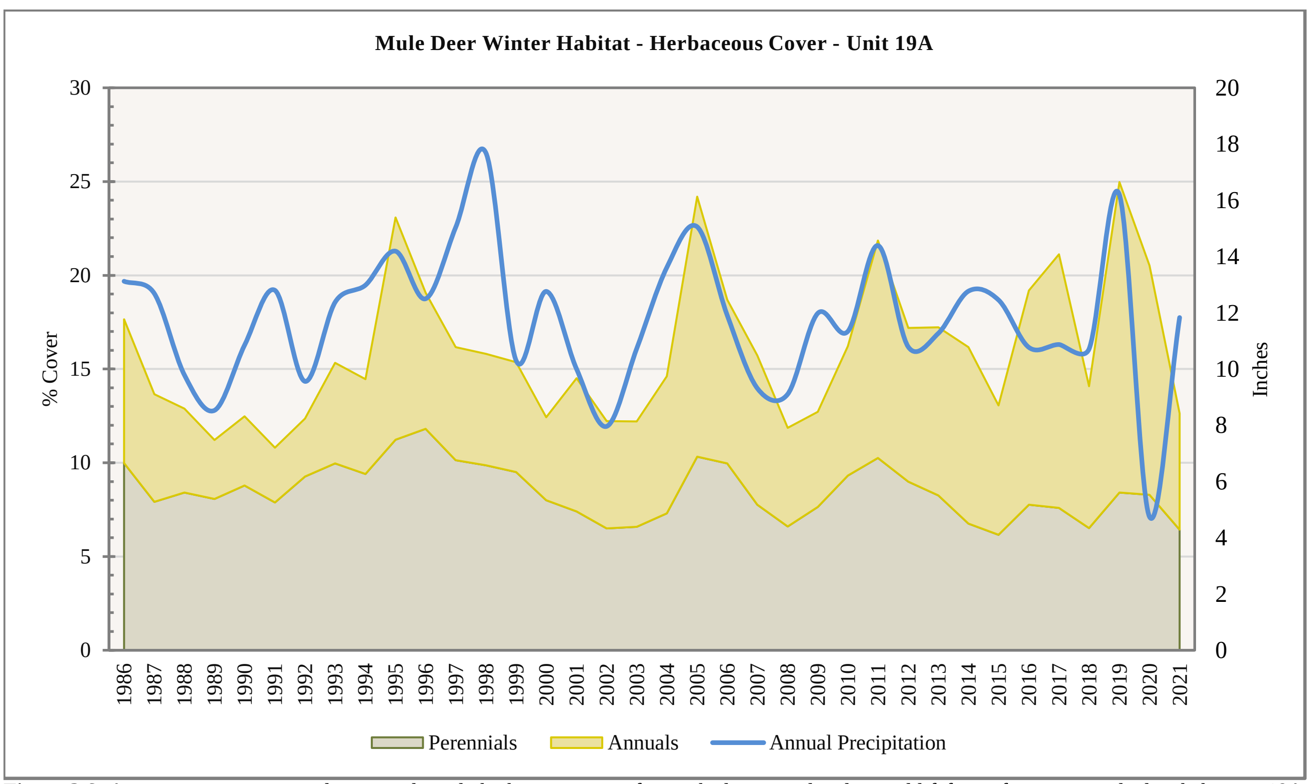


Figure 3.6: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in 19A, West Desert - Deep Creek (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

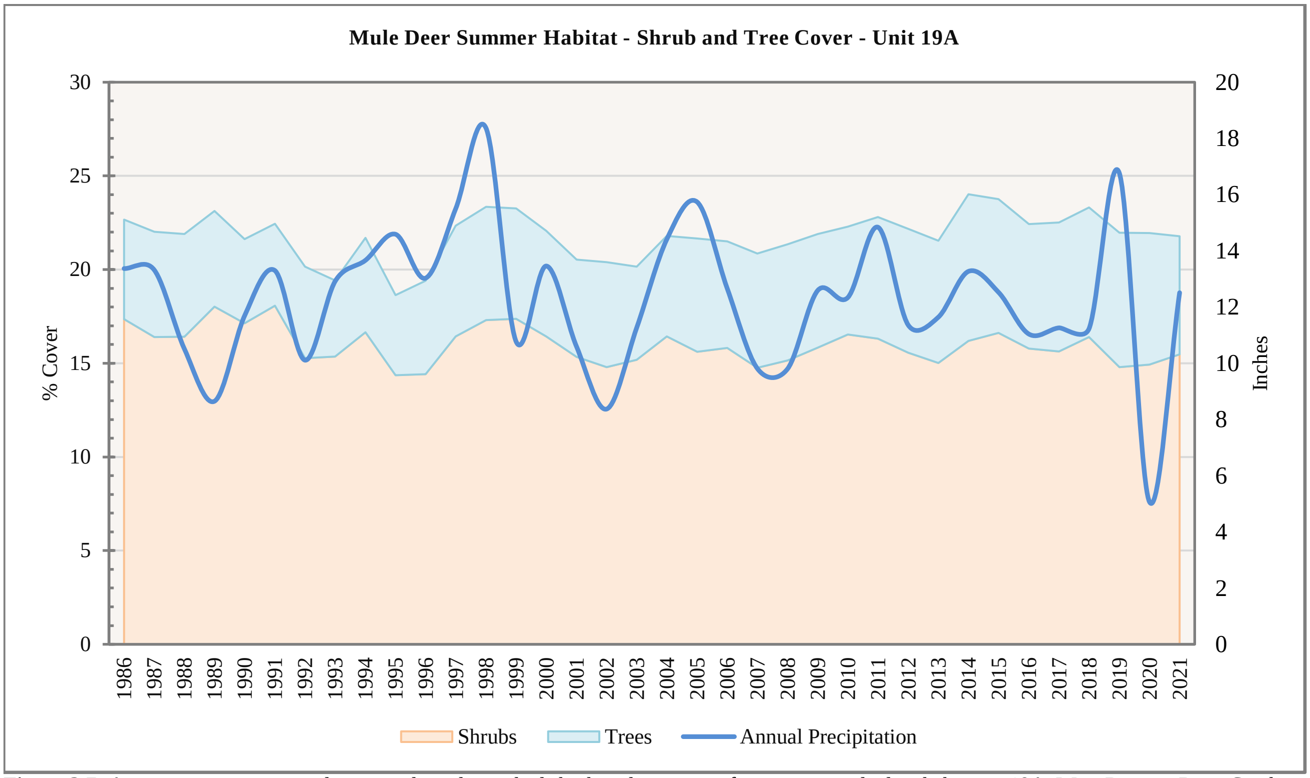


Figure 3.7: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in 19A, West Desert - Deep Creek (Rangeland Analysis Platform, 2023).

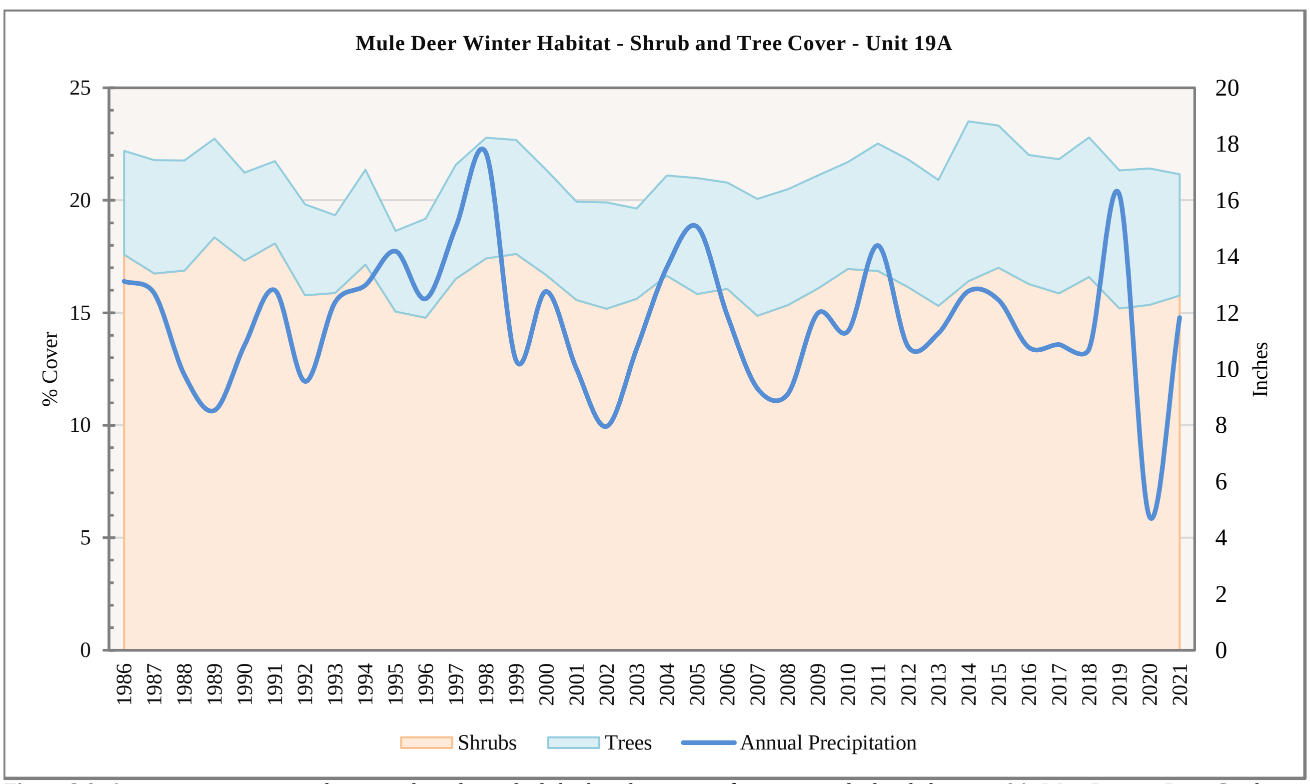
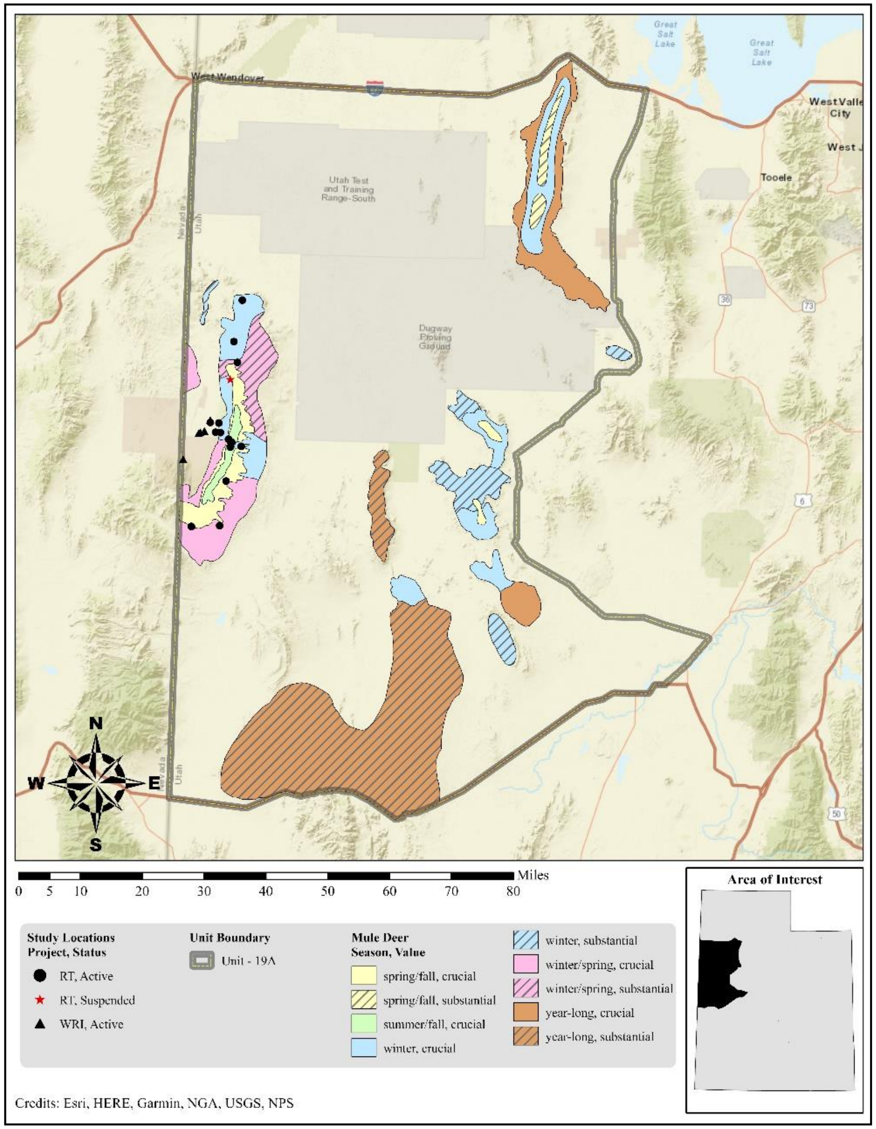
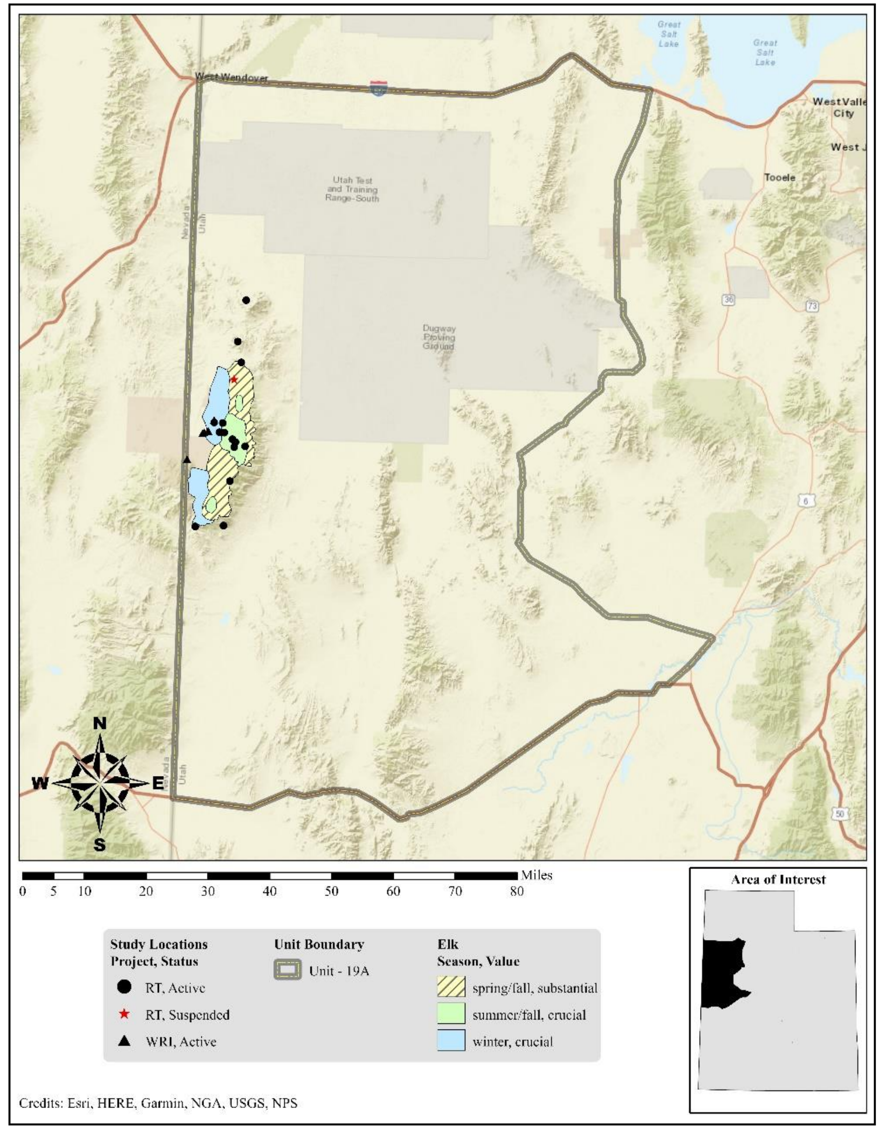


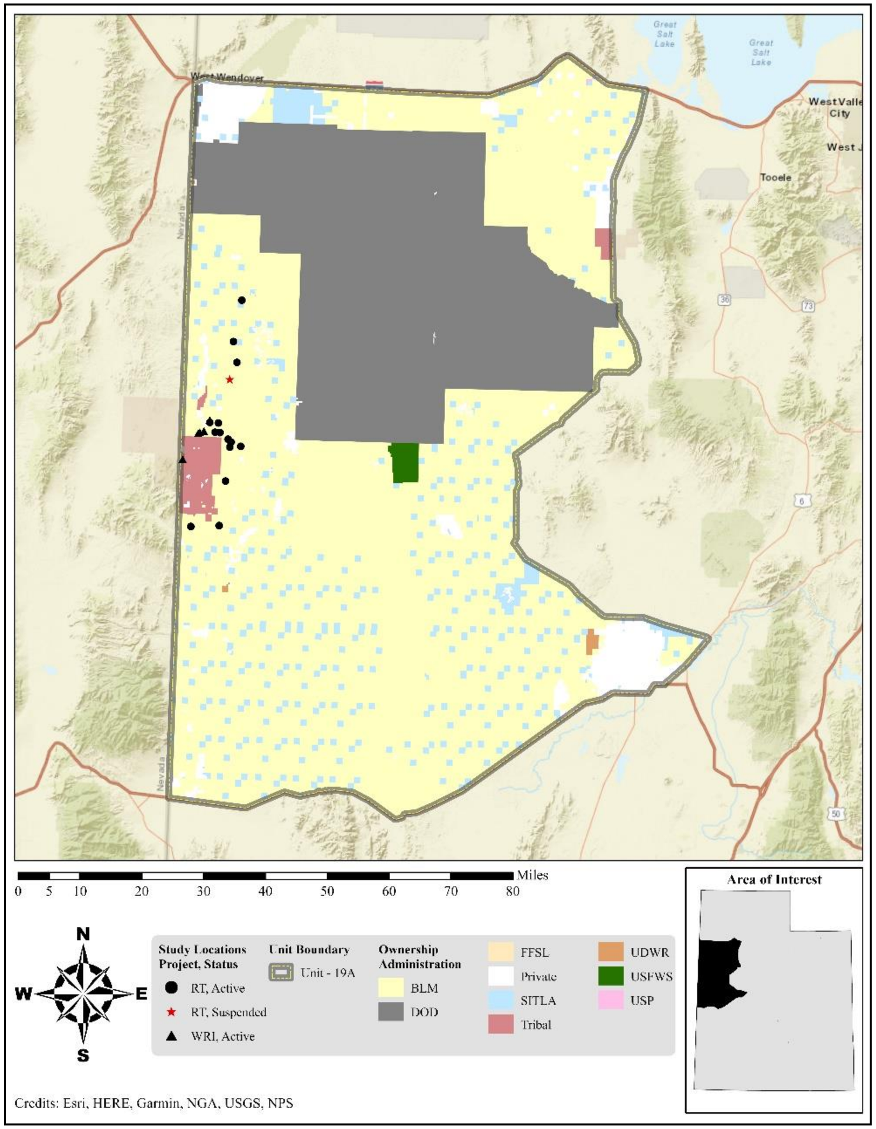
Figure 3.8: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in 19A, West Desert - Deep Creek (Rangeland Analysis Platform, 2023).



Map 3.2: Estimated mule deer habitat by season and value for WMU 19A, West Desert - Deep Creek.



Map 3.3: Estimated elk habitat by season and value for WMU 19A, West Desert - Deep Creek.



Map 3.4: Land ownership for WMU 19A, West Desert - Deep Creek.

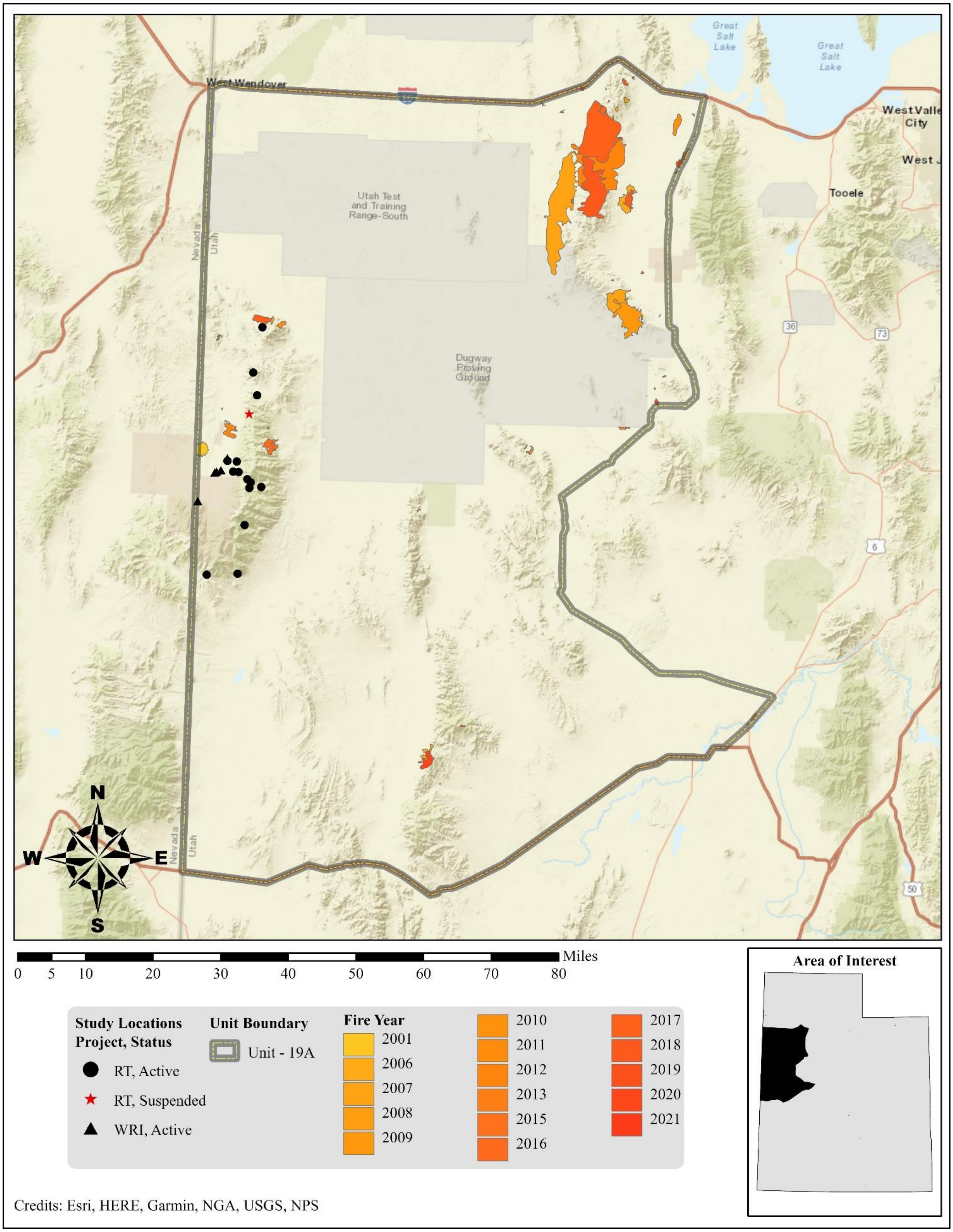
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Great Basin Xeric Mixed Sagebrush Shrubland	288,383	29.24%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	134,326	13.62%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	84,265	8.54%	
	Inter-Mountain Basins Big Sagebrush Shrubland	59,329	6.01%	
	Great Basin Semi-Desert Chaparral	33,978	3.44%	
	Inter-Mountain Basins Montane Sagebrush Steppe	21,718	2.20%	
	Desert Scrub	14,278	1.45%	
	Inter-Mountain Basins Greasewood Flat	4,500	0.46%	
	Inter-Mountain Basins Big Sagebrush Steppe	1,368	0.14%	
	Rocky Mountain Lower Montane-Foothill Shrubland	1,214	0.12%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	2	0.00%	65.22%
Conifer	Great Basin Pinyon-Juniper Woodland	169,046	17.14%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	13,367	1.36%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	11,833	1.20%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	7,142	0.72%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	4,401	0.45%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	3,271	0.33%	
	Inter-Mountain Basins Juniper Savanna	386	0.04%	
	Southern Rocky Mountain Ponderosa Pine Woodland	174	0.02%	
	Colorado Plateau Pinyon-Juniper Woodland	66	0.01%	21.26%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	63,588	6.45%	
	Interior Western North American Temperate Ruderal Shrubland	4,972	0.50%	6.95%
Other	Sparsely Vegetated	17,702	1.79%	
	Conifer-Hardwood	6,630	0.67%	
	Developed	4,707	0.48%	
	Riparian	857	0.09%	
	Hardwood	577	0.06%	
	Agricultural	563	0.06%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	209	0.02%	
	Snow-Ice	76	0.01%	
	Open Water	34	0.00%	3.18%
Exotic Herbaceous	Great Basin & Intermountain Introduced Annual Grassland	9,124	0.92%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	7,106	0.72%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	5,704	0.58%	
	Interior Western North American Temperate Ruderal Grassland	76	0.01%	2.23%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	9,595	0.97%	
	Southern Rocky Mountain Montane-Subalpine Grassland	1,743	0.18%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	82	0.01%	
	Rocky Mountain Alpine Turf	34	0.00%	1.16%
Total		**771,849**	**100%**	**100%**

Table 3.1: LANDFIRE Existing Vegetation Coverage For Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 19A, West Desert - Deep Creek.

Limiting Factors to Big Game Habitat

The major human activities in the area consist of mining, livestock grazing, and off-road recreation. Habitat degradation and loss, water availability, summer range availability, and winter range forage conditions are factors affecting big game habitat. Significant portions of the winter range for elk occur on tribal lands and are therefore outside of the Utah Division of Wildlife Resources' (DWR) management. Encroachment of pinyon-juniper woodland communities is a threat to the sagebrush communities in the area, and treatments should concentrate on the north and west slopes of the Deep Creek Mountains.

A significant limiting factor in the unit is the presence of exotic introduced grasses such as cheatgrass (*Bromus tectorum*). According to the LANDFIRE Exisiting Vegetation Coverage model, 2.23% of the unit's mule deer habitat is comprised of exotic herbaceous species (**Table 3.1**). Increased amounts of cheatgrass exacerbate the risk of catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). The unit has suffered from several wildfires, particularly in the Cedar Mountains. As mentioned above, pinyon-juniper encroachment is a factor in habitat degradation or loss with 17% of the unit's mule deer habitat being comprised of pinyon and juniper woodlands: these existing woodlands play a role as a source for pinyon-juniper expansion (**Table 3.1**).



Map 3.5: Land coverage of fires by year from 2001-2021 for WMU 19A, West Desert - Deep Creek (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

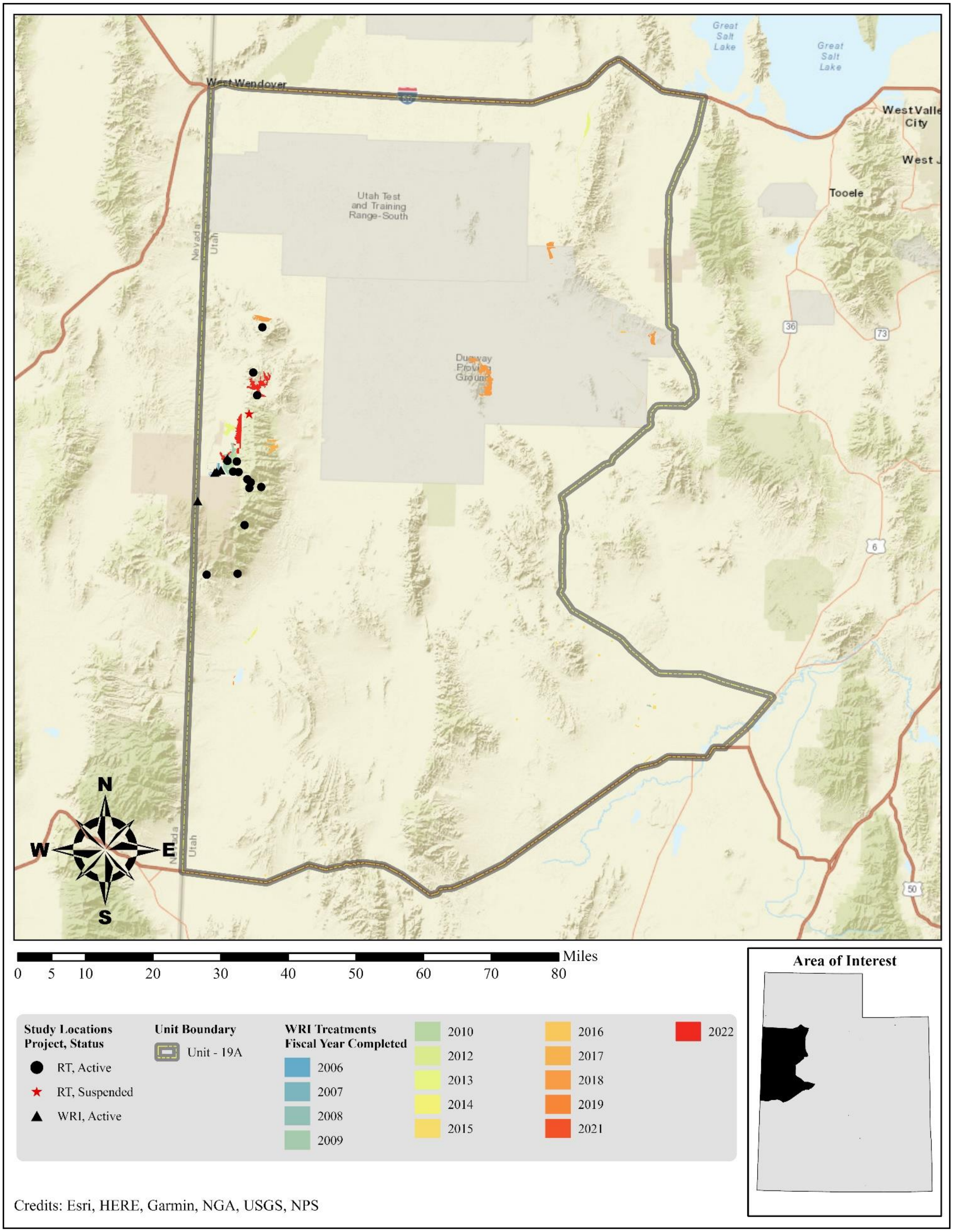
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 15,642 acres of land have been treated within the West Desert-Deep Creek unit since the WRI was implemented in 2004 (**Map 3.6**). An additional 9,378 acres are currently being treated. Treatments frequently overlap one another, bringing the net total of completed treatment acres to 16,116 acres for this unit (**Table 3.2**). 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 plants to augment the herbaceous understory is the most common method for habitat rehabilitation, and is used in conjunction with other treatment types. Herbicide application to treat undesirable plants is the second most common treatment type. Bullhog and lop and scatter treatments for pinyon-juniper removal are also often employed across the unit. Other management practices include (but are not limited to) anchor chaining, bulldozing, greenstripping, harrowing, prescribed fire, and manual vegetation removal (**Table 3.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**440**	**0**	**0**	**440**
Ely (One-Way)	440	0	0	440
Bullhog	**1,723**	**1,041**	**0**	**2,763**
Full Size	1,723	1,041	0	2,763
Greenstripping	**38**	**0**	**0**	**38**
Greenstripping	38	0	0	38
Harrow	**445**	**0**	**0**	**445**
≤ 15 ft. (Two-Way)	445	0	0	445
Herbicide Application	**3,855**	**0**	**0**	**3,855**
Aerial (Fixed-Wing)	1,312	0	0	1,312
Ground	2,425	0	0	2,425
Spot Treatment	119	0	0	119
Planting/Transplanting	**34**	**147**	**0**	**182**
Container Stock	34	147	0	182
Prescribed Fire	**86**	**0**	**0**	**86**
Prescribed Fire	86	0	0	86
Other	**9**	**0**	**0**	**9**
Road/Parking Area Improvements	9	0	0	9
Seeding (Primary)	**7,472**	**2,824**	**0**	**10,296**
Broadcast (Aerial-Fixed Wing)	0	2,824	0	2,824
Broadcast (Aerial-Helicopter)	6,005	0	0	6,005
Drill (Rangeland)	1,420	0	0	1,420
Ground (Mechanical Application)	47	0	0	47
Vegetation Removal/Hand Crew	**1,538**	**5,365**	**0**	**6,904**
Lop & Scatter	1,538	5,365	0	6,904
Grand Total	**15,642**	**9,378**	**0**	**25,019**
***Total Land Area Treated**	**16,116**	**9,378**	**473**	**25,494**

Table 3.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 19A, West Desert - Deep Creek. Data accessed on 01/23/2023. *Does not include overlapping treatments.



Map 3.6: WRI treatments by fiscal year completed for WMU 19A, West Desert - Deep Creek

Range Trend Studies

Range Trend studies have been sampled within WMU 19A on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 3.3**). 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 3.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
19A-1	Trail Gulch	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Shallow Loam (Cliffrose)
19A-2	Ochre Mountain	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Gravelly Loam (Bonneville Big Sagebrush)
19A-3	Sevy Mountain	RT	Suspended	1983, 1989, 1997	Upland Stony Loam (Black Sagebrush)
19A-4	Durse Canyon	RT	Active	1983, 1989, 1997, 2002, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
19A-5	Chokecherry Springs	WRI	Suspended	1983, 1989, 1997	Mountain Stony Loam (Mountain Big Sagebrush)
19A-6	Granite Creek	RT	Active	1983, 1989, 1997, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
19A-7	Wood Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Semidesert Stony Loam (Black Sagebrush)
19A-8	The Basin	RT	Active	1989, 1997, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
19A-9	Rocky Canyon	RT	Active	2002, 2007, 2012, 2017	Mountain Shallow Loam (Mountain Big Sagebrush)
19A-10	Rocky Spring	RT	Active	2002, 2007, 2012, 2017, 2022	Upland Stony Loam (Mountain Big Sagebrush)
19A-11	Ibapah Harrow	RT	Active	2007, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
19A-12	Clifton Flat	RT	Active	2022	Upland Stony Loam (Black Sagebrush)
19A-13	Dry Canyon	RT	Active	2022	Upland Stony Loam (Black Sagebrush)
19A-14	Big Canyon	RT	Active	2022	High Mountain Loam (Mountain Big Sagebrush)
19A-15	Chimney Rock	RT	Active	2022	High Mountain Stony Loam (Aspen)
19A-16	South Rocky Peak	RT	Active	2022	High Mountain Loam (Aspen)
19R-2	Deep Creek Aerator	WRI	Suspended	2005, 2008, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
19R-3	Deep Creek Drill	WRI	Suspended	2005, 2008, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
19R-5	Goshute Chaining	WRI	Suspended	2006, 2012, 2017	Upland Shallow Loam (Black Sagebrush)
19R-14	Ibapah Harrow	WRI	Suspended	2008, 2012, 2017	Upland Loam (Mountain Big Sagebrush)
19R-20	East Pasture Harrow	WRI	Suspended	2007, 2012	Semidesert Loam (Wyoming Big Sagebrush)

Table 3.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 19A, West Desert - Deep Creek.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
19A-11	Ibapah Harrow	Two-Way Dixie	Ibapah Sagebrush Improvement - Year 1	October-November 2007	166	730
		Broadcast Before	Ibapah Sagebrush Improvement - Year 1	October-November 2007	166	730
		Lop and Scatter	Ibapah Sagebrush Improvement - Year 2	October 2008-April 2009	1,540	1104
19A-12	Clifton Flat	Lop and Scatter	Clifton Flat Sagebrush Habitat Enhancement (Proposed)	2023	2,300	6047
19R-2	Deep Creek Aerator	Double Drum	Deep Creek Valley Sagebrush Improvement - Year 2	October-December 2005	194	24
		Truax Drill	Deep Creek Valley Sagebrush Improvement - Year 2	October-December 2005	444	24
		Aerial After	Deep Creek Valley Sagebrush Improvement - Year 2	Dec-05	194	24
19R-3	Deep Creek Drill	Truax Drill	Deep Creek Valley Sagebrush Improvement - Year 2	October-December 2005	389	24
		Aerial After	Deep Creek Valley Sagebrush Improvement - Year 2	December 2005	389	24
19R-5	Goshute Chaining	Two-Way Ely	Discretionary Seed for Goshute Reservation Pinyon Juniper Chaining Project	May-December 2006	776	354
		Aerial Before	Discretionary Seed for Goshute Reservation Pinyon Juniper Chaining Project	November 2006	776	354
		Dribbler	Discretionary Seed for Goshute Reservation Pinyon Juniper Chaining Project	December 2006	776	354
19R-14	Ibapah Harrow	Two-Way Dixie	Ibapah Sagebrush Improvement - Year 2	October 2008	134	1104
		Broadcast Before	Ibapah Sagebrush Improvement - Year 2	October 2008	134	1104
19R-20	East Pasture Harrow	Two-Way Dixie	Deep Creek East Pasture Habitat Enhancement	November 2007	145	662
		Broadcast Before	Deep Creek East Pasture Habitat Enhancement	November 2007	145	662

Table 3.4: Range Trend and WRI studies known disturbance history for WMU 19A, West Desert - Deep Creek. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

Four study sites [Granite Creek (19A-6), The Basin (19A-08), Rocky Canyon (19A-9), and Big Canyon (19A-14)] are classified as Mountain (Big Sagebrush) ecological sites. The Granite Creek site is located up Granite Canyon to the east of Ibapah Peak. The Basin is found in Big Canyon on the eastern slopes of the Deep Creek Range. The Rocky Canyon study site is situated on the western slopes of the mountain range near Rocky Peak. Finally, the Big Canyon study is located just south of Tom’s Creek, which is south of Scotts Basin (**Table 3.3**).

Shrubs/Trees: When analyzing trends for this ecotype, one should consider the differing number of studies from year to year (the ‘n value’) and consider the implications that this may have on data. More specifically, The Basin and Granite Creek studies only provide data from 2017 onward, as they were not sampled between then and the last reading in 1997. Rocky Canyon provides the data for 2002-2017, but was not sampled in 2022. Finally, Big Canyon was only established in 2022 and thus has no data available for any other sample year. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species on all study sites except for The Basin. The Basin transect crosses two ecological types, one of which is dominated by mountain big sagebrush and the other by low sagebrush (*A. arbuscula*). As such, low sagebrush is the primary species on The Basin. Total average shrub cover has increased over time. This overall cover increase is due to preferred browse species other than sagebrush and other shrub species; sagebrush cover alone has exhibited a marginal decrease in total. The large increase in preferred browse cover other than sagebrush between 2017 and 2022 can mainly be attributed to the establishment of the Big Canyon study, as cover of these species was 18.5% in 2022 (**Figure 3.9**). Average preferred browse density on these sites has increased overall. Again, one should pay attention to the differing number of studies each year and consider the impact that this may have on the relevant trends. Mature plants have comprised a majority of these browse populations in all sample years, while decadence and young plants have remained comparatively low. In 2022, recruitment of young was highest on the Big Canyon study, while The Basin had the most decadent individuals (**Figure 3.21**). The average utilization of preferred browse species has also exhibited an overall increase. Utilization was higher in 2022 than any other sample year, with

18% of plants being moderately hedged and 17% being heavily used: this is largely due to utilization on Big Canyon and The Basin (**Figure 3.24**).

Average tree cover and density decreased between 2017 and 2022, but have increased overall when 2007 and 2022 data are directly compared. As has been mentioned previously, this is mainly due to the different studies that have been sampled from year to year. More specifically, the decreases between 2017 and 2022 can be largely attributed to the inclusion or exclusion of two study sites: Rocky Canyon and Big Canyon. Rocky Canyon has had density and cover data for singleleaf pinyon (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) observed in some study years, but the site was not sampled in 2022. In addition, Big Canyon does not have pinyon or juniper present, and study establishment in 2022 led to reduced averages for both cover and density. As such, all tree data for 2022 is provided by singleleaf pinyon on the Granite Creek and The Basin study sites (**Figure 3.13**, **Figure 3.17**).

<u>Herbaceous Understory</u>: The average herbaceous understory for this ecotype has increased overall in cover, and to a lesser extent, nested frequency. Composition has fluctuated depending on year and which sites were sampled. However, perennial grasses and/or forbs have been the dominant herbaceous components in each sample year; tuber starwort (*Pseudostellaria jamesiana*) on the Granite Creek site contributed the most cover of any single herbaceous species in 2022. Annual forbs have been present throughout the study period with less cover and frequency than their perennial counterparts, while annual grasses have remained scarce. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) was observed with increasing frequency and cover between 2002 and 2017, but was absent in 2022. This recent decrease in bulbous bluegrass is due to the fact that it has only been observed on the Rocky Canyon study, which was not sampled in 2022 (**Figure 3.27**, **Figure 3.30**).

<u>Occupancy</u>: Despite yearly fluctuations, average pellet group abundance data indicates that total animal occupancy has remained similar when comparing 2002 with 2022 data. The primary occupants have shifted over time for the different studies that have been sampled each year. Elk were the main occupants between 2002 and 2012, when Rocky Canyon was the only study site sampled; elk pellet group abundance has ranged from 1 days use/acre in 2022 to 28 days use/acre in 2007. Deer were the species with the most abundant pellet groups in 2017 and 2022, and presence has been as low as 0 days use/acre in 2012 and as high as 35 days use/acre in 2022. Finally, mean abundance of cattle pellet groups has fluctuated between less than 1 days use/acre in 2007 and 11 days use/acre in 2022 (**Figure 3.33**).

Mountain (Aspen)

Two study sites [Chimney Rock (19A-15) and South Rocky Peak (19A-16)] are considered to be Mountain (Aspen) ecological sites. The Chimney Rock study is located about 1½ miles south of Rocky Peak in Scotts Basin, while South Rocky Peak can be found less than a mile northwest and upslope of the Chimney Rock study (**Table 3.3)**.

<u>Shrubs/Trees</u>: Trends over time are not yet available for this ecotype, as both study sites were established in 2022 and do not have data for other years. The primary preferred browse species on these study sites is mountain snowberry (*Symphoricarpos oreophilus*), although most of the shrub cover is contributed by creeping barberry (*Mahonia repens*) on the Chimney Rock study (**Figure 3.10**). Average preferred browse demographics indicate that mature individuals comprise a majority of the populations on these sites and that decadence is low. In addition, recruitment of young is significant as of 2022: this can be attributed to mountain snowberry on Chimney Rock (**Figure 3.21**). Seventeen percent of preferred browse plants in 2022 showed signs of moderate use, while 12% were heavily browsed (**Figure 3.24**).

Quaking aspen (*Populus tremuloides*) trees contribute a majority of the cover and density values on these sites. Conifer trees such as subalpine fir (*Abies lasiocarpa*), limber pine (*Pinus flexilis*), and Douglas-fir (*Pseudotsuga menziesii*) are also present, but to a much lesser extent than aspen (**Figure 3.14**, **Figure 3.18**).

<u>Herbaceous Understory</u>: The herbaceous understories on these sites are plentiful and primarily comprised of perennial grasses and forbs. Native perennial forb species such as silvery lupine (*Lupinus argenteus*), tuber starwort (*Pseudostellaria jamesiana*), and/or western sweetroot (*Osmorhiza occidentalis*) provide a majority of the cover on these sites. Perennial grasses are mainly native, but the introduced species Kentucky bluegrass (*Poa pratensis*) is present on both sites. The weedy introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) is also present on the Chimney Rock study, but with low cover and abundance. Annual forbs are relatively rare, and annual grasses have not been observed in the understories of either site (**Figure 3.27**, **Figure 3.30**).

<u>Occupancy</u>: Elk are the primary occupants of these study sites, and mean pellet group abundance is 27.5 days use/acre as of 2022. Mean abundance of deer pellet groups is 4 days use/acre, and that of cattle is just under 4 days/use acre (**Figure 3.33**).

Upland (Big Sagebrush)

There are three studies [Ochre Mountain (19A-2), Rocky Spring (19A-10), and Ibapah Harrow (19A-11)] that are considered to be Upland (Big Sagebrush) ecological sites. The Ochre Mountain study is situated between Deep Creek Valley and Clifton Flat. The Rocky Spring site is found near the mouth of Rocky Canyon on the lower western slopes below Rocky Peak. Finally, the Ibapah Harrow study is located in the Deep Creek Valley south of Ibapah (**Table 3.3**).

Shrubs/Trees: The Rocky Spring and Ochre Mountain studies are dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), while Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) is the primary browse species on Ibapah Harrow. Total average shrub cover has decreased since 2007; all three studies have exhibited reductions in sagebrush cover when comparing 2007 data with 2022 data. The most recent decrease between 2017 and 2022 can largely be attributed to the Ochre Mountain study, during which time sagebrush cover decreased by more than half from nearly 17% to 8%. However, this decrease was due to error in site setup, so cover values might increase during the next sampling (**Figure 3.9**). Total average preferred browse density has exhibited minor fluctuations from year to year, but has remained fairly stable overall. However, it is important to note the different number of studies (the 'n value') that have been sampled each year. For example, Ochre Mountain was the sole study sampled in 1997, while both Rocky Spring and Ochre Mountain provide data for 2002. All three study sites drive the browse trends for 2007-2022. Mature plants have comprised most of the preferred browse populations on these sites throughout the study period. Decadence has fluctuated from year to year as has recruitment of young, but densities of both are comparatively low as of 2022 (**Figure 3.22**). Average preferred browse utilization increased between 1997 and 2007 (again, it is important to consider the differing 'n values,') but has decreased since that time. In 2022, 3% of plants were moderately used and 0.4% were heavily browsed: this can mainly be attributed to utilization decreases on the Ochre Mountain and Rocky Spring study sites (**Figure 3.25**).

Tree cover has displayed extremely marginal increases over time, but has remained very low overall. Utah juniper (*Juniperus osteosperma*) was observed in cover measurements on the Ochre Mountain study in 2012 and 2017, but was not present in 2022. Juniper has provided low cover on Rocky Spring since 2017, and singleleaf pinyon (*Pinus monophylla*) has been present with increasing cover since 2002. Density of pinyon and juniper has increased very slightly over time, but has also remained low: density trends are mainly driven by the Rocky Spring study. Trees have not been observed in cover or density measurements on Ibapah Harrow (**Figure 3.15**, **Figure 3.19**).

Herbaceous Understory: The herbaceous understories on these sites have fluctuated from year to year, with both cover and nested frequency increasing overall. Again, however, one should consider the differing 'n values' in 1997, 2002, and 2007 and consider the impact that this may have on the trends for those years. The introduced annual grass species cheatgrass (*Bromus tectorum*) has provided significant cover and frequency values in the understories of all sites, and annual grasses have been the dominant herbaceous component since 1997. Perennial grasses such as the native species bluebunch wheatgrass (*Pseudoroegneria spicata*), Sandberg bluegrass (*Poa secunda*), and the introduced species crested wheatgrass (*Agropyron cristatum*) have contributed good cover on these study sites. In addition, perennial forb cover and frequency have generally been moderate; annual forbs have been scarce in most sample years, but had moderate cover and abundance in 2022. Finally, the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has been observed in the understories of the Rocky Spring and Ibapah Harrow sites, but with low cover and frequency (**Figure 3.28**, **Figure 3.31**).

Occupancy: According to average pellet transect data, animal occupancy has decreased over time on these study sites, and primary occupancy has varied between deer, elk, and cattle. Deer were the primary occupants in 2002 and 2022, and presence has fluctuated between 5 days use/acre in 2017 and 55 days use/acre in 2022. Elk were the species with the most abundant pellet groups in 2007 with 27 days use/acre, although abundance has been as low as 4 days use/acre in 2022. Cattle have been the primary occupants in all other sample years, and average abundance of pellet groups has varied between 2 days use/acre in 2007 and 14 days use/acre in 2017 (**Figure 3.34**).

Upland (Black/Low Sagebrush)

Three study sites [Sevy Mountain (19A-3) (suspended), Clifton Flat (19A-12), and Dry Canyon (19A-13)] are classified as Upland (Black/Low Sagebrush) ecological sites. The Sevy Mountain study is located in Sevy Canyon in the northern portion of the Deep Creek Range. Clifton Flat is situated just north of Uiyabi Canyon and on the western portion of Clifton Flat. The Dry Canyon site is found on the lower southern slopes of the Deep Creek Range near the mouth of Dry Canyon (**Table 3.3**).

Shrubs/Trees: Black sagebrush (*Artemisia nova*) contributes a majority of the cover on these sites, and other shrub species provide very little cover. The Sevy Mountain study was suspended prior to the implementation of line intercept cover methodology and thus provides no data for the average shrub cover values. In addition, Clifton Flat and Dry Canyon were established in 2022, so a trend over time for cover cannot yet be determined (**Figure 3.12**). Average preferred browse demographic data indicates that total preferred browse density has increased over time. However, one must consider the differing number of studies (the 'n value') between 1997 and 2022 and consider the implications that this may have on trends. More specifically, Sevy Mountain is the only site providing data for 1997, while Clifton Flat and Dry Canyon contribute the 2022 data: comparing between the two sample years therefore compares different studies. Mature plants were the dominant demographic in 1997, while decadent individuals were most abundant in 2022. Recruitment of young plants has remained low throughout the study period (**Figure 3.22**). Average preferred browse utilization has also increased over time. Again, however, directly comparing between 1997 and 2022 compares different studies. In 2022, 19% of plants were moderately used while 18% were heavily hedged (**Figure 3.25**).

The Sevy Mountain study was suspended before point-quarter density and line intercept cover data were collected and will therefore not be discussed in this section. A majority of the tree cover and density is provided by singleleaf pinyon (*Pinus monophylla*) which is present on both sites, but Utah juniper (*Juniperus osteosperma*) is also present on the Clifton Flat study in lower amounts. Trends over time for trees cannot be determined at this time as both the Clifton Flat and Dry Canyon studies were installed in 2022 and do not yet have additional data available (**Figure 3.15**, **Figure 3.19**).

Herbaceous Understory: Both average cover and frequency of the herbaceous understory have decreased over time. As was mentioned in the shrub/trees section, however, directly comparing 1997 with 2022 data compares different sites. Sevy Mountain provides all data for 1997 while Dry Canyon and Clifton Flat contribute the same for 2022. Perennial grasses and forbs were the dominant herbaceous components in 1997; bluebunch wheatgrass (*Pseudoroegneria spicata*) provided most of the perennial grass cover while Bonneville Pea (*Lathyrus brachycalyx*) was the prominent perennial forb. Perennial grasses, mainly the native species bluebunch wheatgrass and Sandberg bluegrass (*Poa secunda*), dominated the understory in 2022. The introduced annual grass species cheatgrass (*Bromus tectorum*) has been observed on all study sites, but in low amounts; annual forb presence has also remained low. Finally, the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) was present in the understory of Clifton Flat in 2022, but with minimal cover and abundance (**Figure 3.28**, **Figure 3.31**).

Occupancy: The Sevy Mountain study was suspended before pellet group sampling methodology was implemented and will therefore not be discussed in this section. In addition, animal presence trends over time are not yet available as only 2022 data is available for Clifton Flat and Dry Canyon. Deer are the primary occupants of these sites, with mean abundance of pellet groups being 22 days use/acre in 2022. Elk presence was nearly as high as that of deer, however, having an average pellet group abundance of 21 days use/acre in the same year. Cattle pellet groups were not sampled on these sites (**Figure 3.34**).

Upland (Cliffrose)

There are two studies [Trail Gulch (19A-1) and Durse Canyon (19A-4)] that are considered to be Upland (Cliffrose) ecological sites. The Trail Gulch site is located east of Dutch Mountain near Gold Hill, while the Durse Canyon study can be found in the Deep Creek Valley on the western side of the Deep Creek Range (**Table 3.3**).

Shrubs/Trees: Stansbury cliffrose (*Purshia stansburiana*) has been the dominant browse species on these sites throughout the duration of the study period. Additional preferred browse and other shrub species have also been present, but have provided less cover than cliffrose. Total average shrub cover has fluctuated from year to year, but has increased overall. However, it is important to note the differing number of studies (the 'n value') sampled between 2007 and subsequent years. Trail Gulch was the only study sampled in 2007, whereas data was gathered on both sites from 2012 onwards. Although it increased in 2017, total shrub cover displayed a marginal decrease between 2012 and 2022 mainly due to a reduction in the cover of preferred browse species other than cliffrose (**Figure 3.11**). Average demographic data indicates that total preferred browse density has also exhibited yearly variations, but has slightly decreased in general. Mature plants have comprised a majority of the preferred browse populations on these sites, and decadence has remained comparatively low. Recruitment of young individuals has decreased over time, a trend that is in large part due to the Durse Canyon study (**Figure 3.22**). Less than 30% of preferred browse plants have been moderately to heavily hedged in nearly every sample year: the exception to this is 2007, when 20% of plants were moderately used and 57% were heavily hedged. This outlier can be attributed to the fact that Trail Gulch was the only study sampled that year, and utilization has generally been higher on that site than on Durse Canyon. In 2022, 16% of plants showed signs of moderate browsing while 11% were heavily used (**Figure 3.25**).

Both tree cover and density have increased overall. Like with shrub cover, 2007 data is contributed entirely by the Trail Gulch study while both sites were sampled in subsequent years: one should consider the implications this may have on the data and associated trends. Utah juniper (*Juniperus osteosperma*) has provided similar cover on both sites, while singleleaf pinyon (*Pinus monophylla*) cover has been higher on Durse Canyon than Trail Gulch. Total average tree density has remained high since 2012: although pinyon-juniper are present on both sites, density has been significantly higher on the Durse Canyon study (**Figure 3.15**, **Figure 3.19**).

Herbaceous Understory: The understories of these study sites are typical of rocky landscapes with low precipitation. Cover and frequency of perennial grasses and forbs and annual forbs have remained similar over time, with almost all perennial grasses on both sites being native species. The Trail Gulch site drives the trend for annual grasses, as Durse Canyon has consistently been host to low amounts of these species. Cover of annual grasses – primarily the introduced species cheatgrass (*Bromus tectorum*) – has fluctuated from year to year, but was high as of 2022 (**Figure 3.28**, **Figure 3.31**).

Occupancy: Average pellet transect data indicates that animal occupancy has decreased over time. Deer have been the primary occupants in all sample years, and mean pellet group abundance has been as low as 0.3 days use/acre in 2017 and as high as 28 days use/acre in 2002. Elk have also been present, with an average pellet group abundance fluctuating between 0 days use/acre in 2017 and 3 days use/acre in 2002. Cattle pellet groups have not been observed in any sample year (**Figure 3.34**).

Semidesert (Black/Low Sagebrush)

One study site [Wood Canyon (19A-7)] is classified as a Semidesert (Black/Low Sagebrush) ecological site: this study is located on the eastern side of the mountains at the southern end of the Deep Creek Range (**Table 3.3**).

Shrubs/Trees: Preferred browse species other than sagebrush – primarily Nevada jointfir (*Ephedra nevadensis*) – were the primary browse components of this site in 2017 and 2022. Other shrub species, mainly broom snakeweed (*Gutierrezia sarothrae*), have dominated in other years and were codominant in 2017. Total average shrub cover has exhibited yearly fluctuations, but has decreased overall (**Figure 3.12**). Total preferred browse density has increased over time, with mature plants being the dominant demographic in most sample years. However, the amount of decadent individuals increased significantly in 2022, surpassing the density of mature plants in that year. Recruitment of young also increased during the most recent sampling, and site-level data indicates that this is largely due to young Nevada jointfir and green molly (*Bassia americana*) specifically (**Figure 3.23**). Average preferred browse utilization increased between 2017 and the most recent sample year, but has decreased overall. In 2022, 13% of preferred browse plants were moderately hedged, while less than 1% displayed signs of heavy utilization (**Figure 3.26**).

Trees have not been recorded on this site in either cover or density measurements and will therefore not be discussed in this section (**Figure 3.16**, **Figure 3.20**).

Herbaceous Understory: Both average cover and frequency of the herbaceous understory have increased overall despite variations from year to year. The primary understory components have fluctuated over time. Annual forbs provided the most herbaceous cover in 2022, but a majority of this cover was contributed by the introduced species redstem stork's bill (*Erodium cicutarium*). Perennial grasses have exhibited yearly variations in cover (and abundance to a lesser extent), and cover noticeably decreased between 2017 and 2022. However, all perennial grasses observed have been native species throughout the study period. Annual grasses – namely the introduced species cheatgrass (*Bromus tectorum*) – have also fluctuated between sample years, but provided as much cover as perennial grasses in 2022. Fluctuations in annual grasses could potentially be a result of certain precipitation amounts and timings. Perennial forbs have remained very scarce in all years (**Figure 3.29**, **Figure 3.32**).

Occupancy: Average animal presence has remained stable over time despite exhibiting variations from year to year. Deer were the primary occupants in from 2002 through 2012, and mean pellet group abundance has ranged from 2 days use/acre in 2017 to 14 days use/acre in 2002. Elk were the primary occupants in 2017 and 2022, and presence has been as low as less than 1 days use/acre in 2002 and as high as 16 days use/acre in 2022. Finally, cattle have also been present on the Wood Canyon site with an average pellet group abundance fluctuating between 0 days use/acre in 2017 and 8 days use/acre in 2002 (**Figure 3.35**).

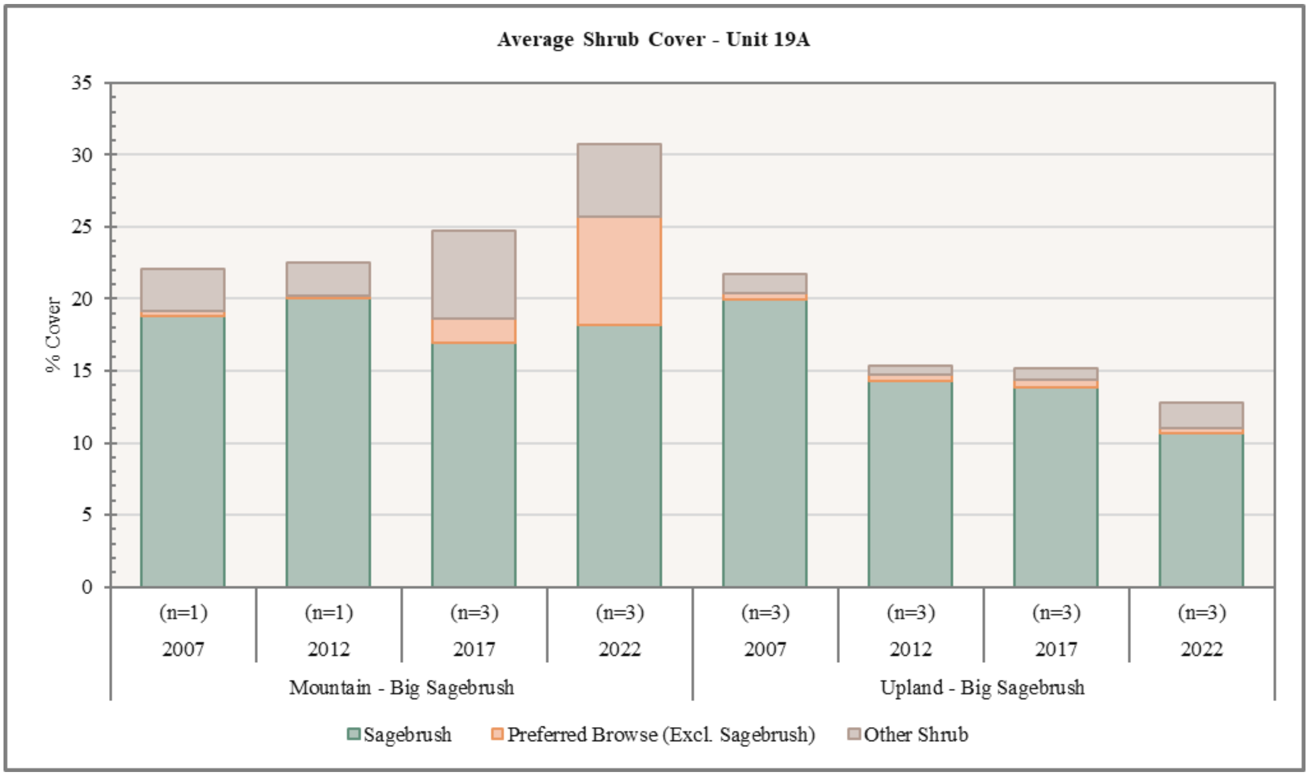


Figure 3.9: Average shrub cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

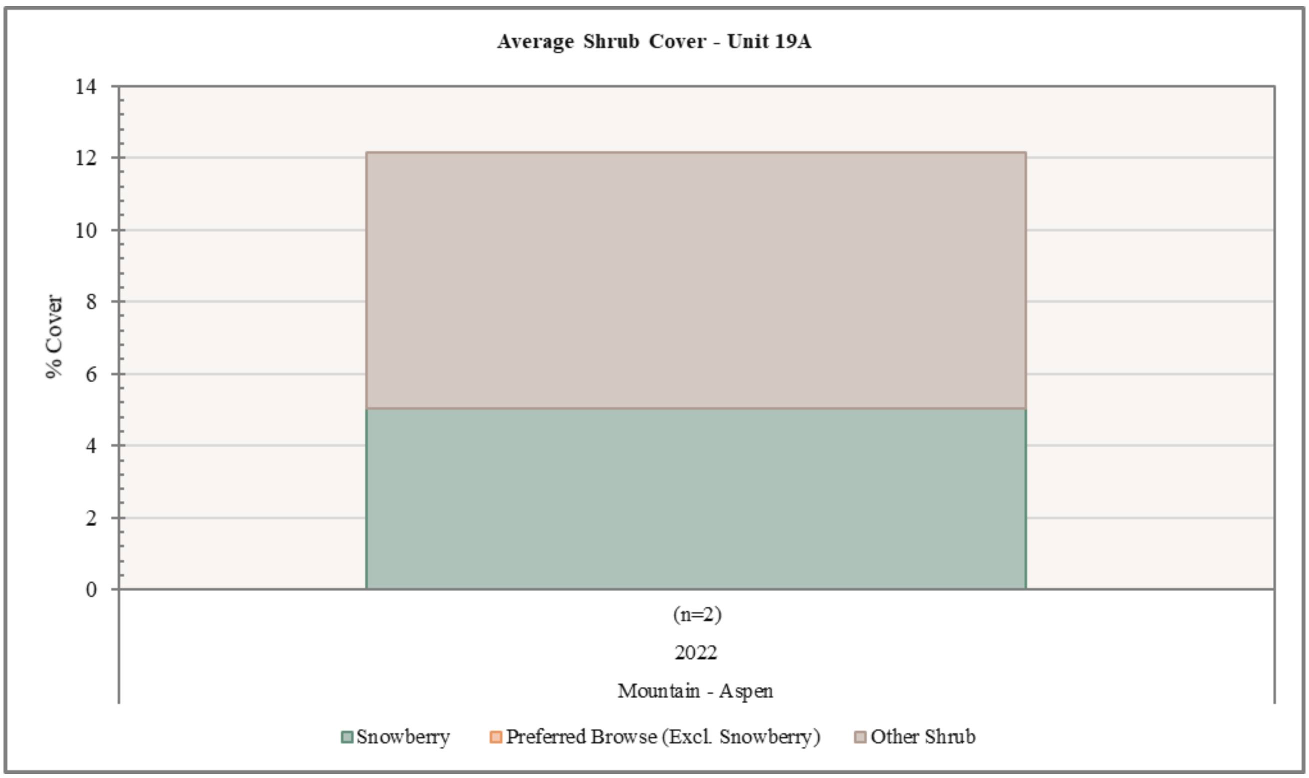


Figure 3.10: Average shrub cover for Mountain - Aspen study sites in WMU 19A, West Desert - Deep Creek.

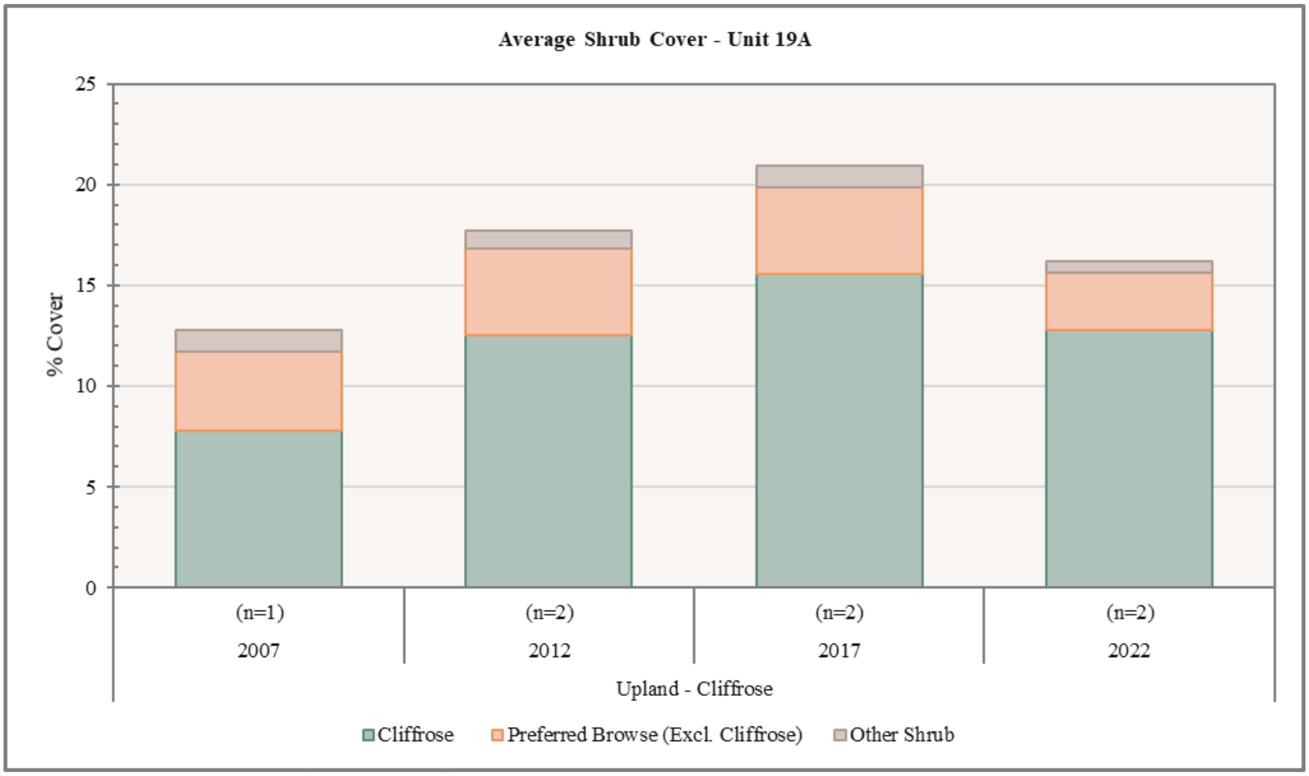


Figure 3.11: Average shrub cover for Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

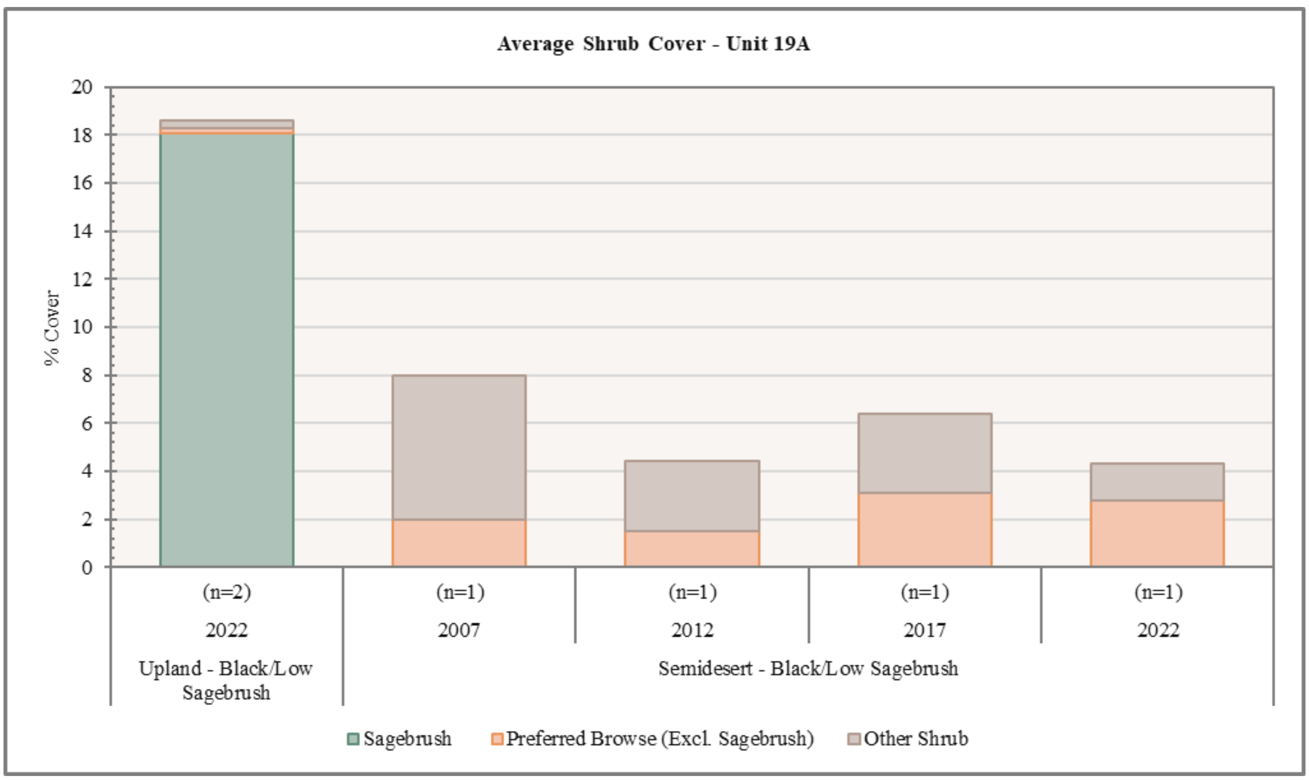


Figure 3.12: Average shrub cover for Upland - Black/Low Sagebrush and Semidesert - Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

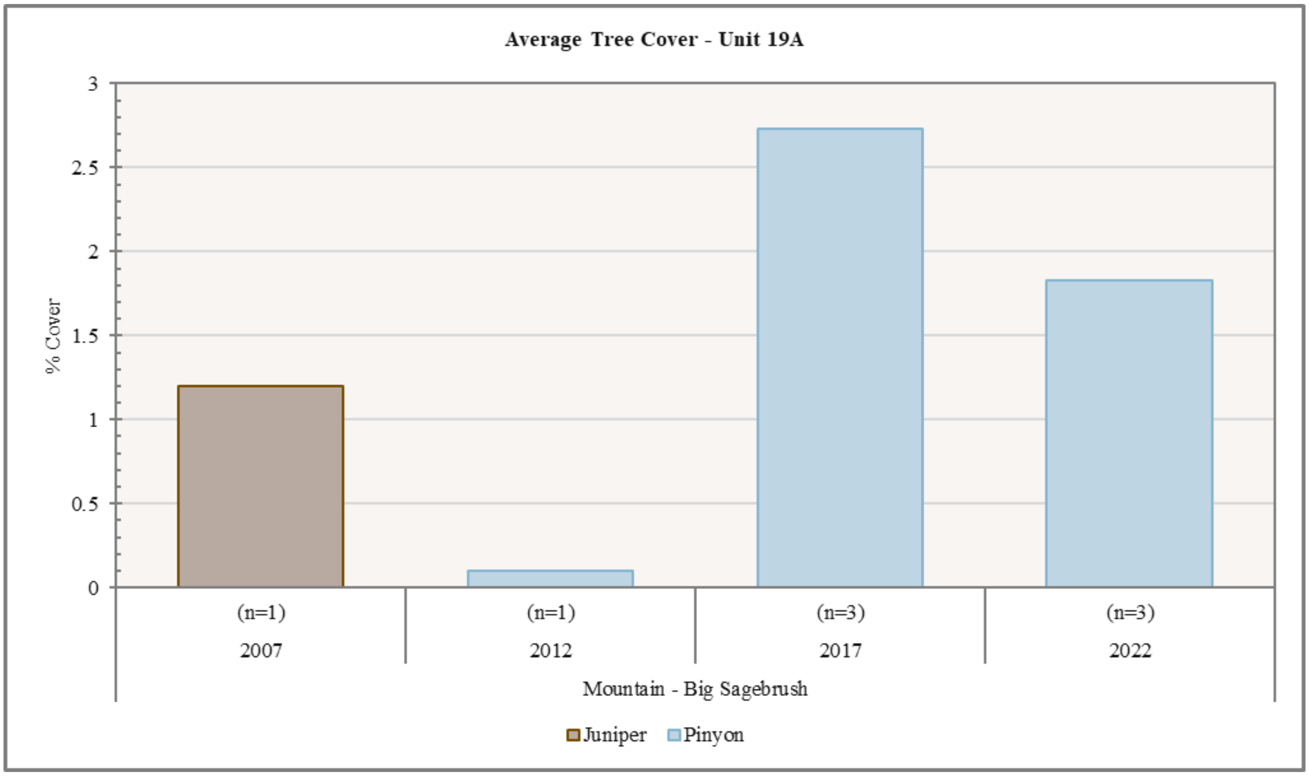


Figure 3.13: Average tree cover for Mountain - Big Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

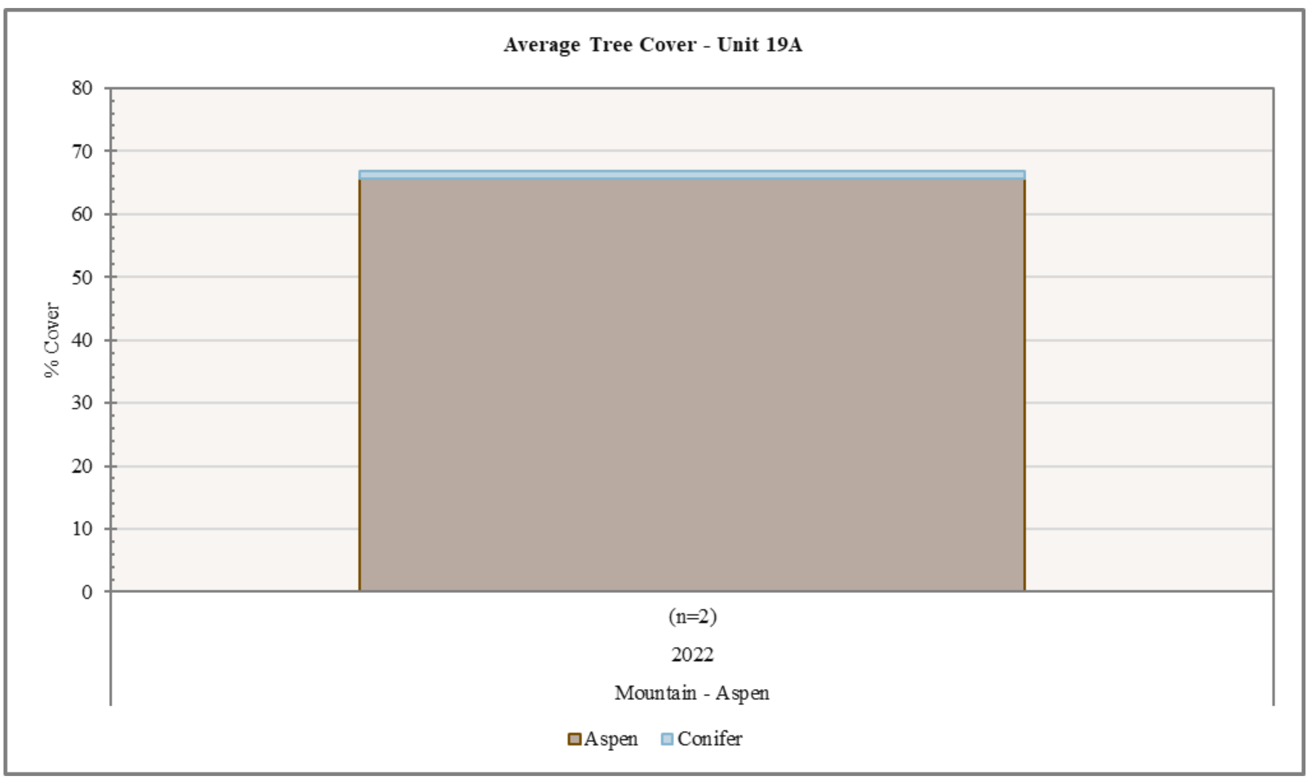


Figure 3.14: Average tree cover for Mountain - Aspen study sites in WMU 19A, West Desert - Deep Creek.

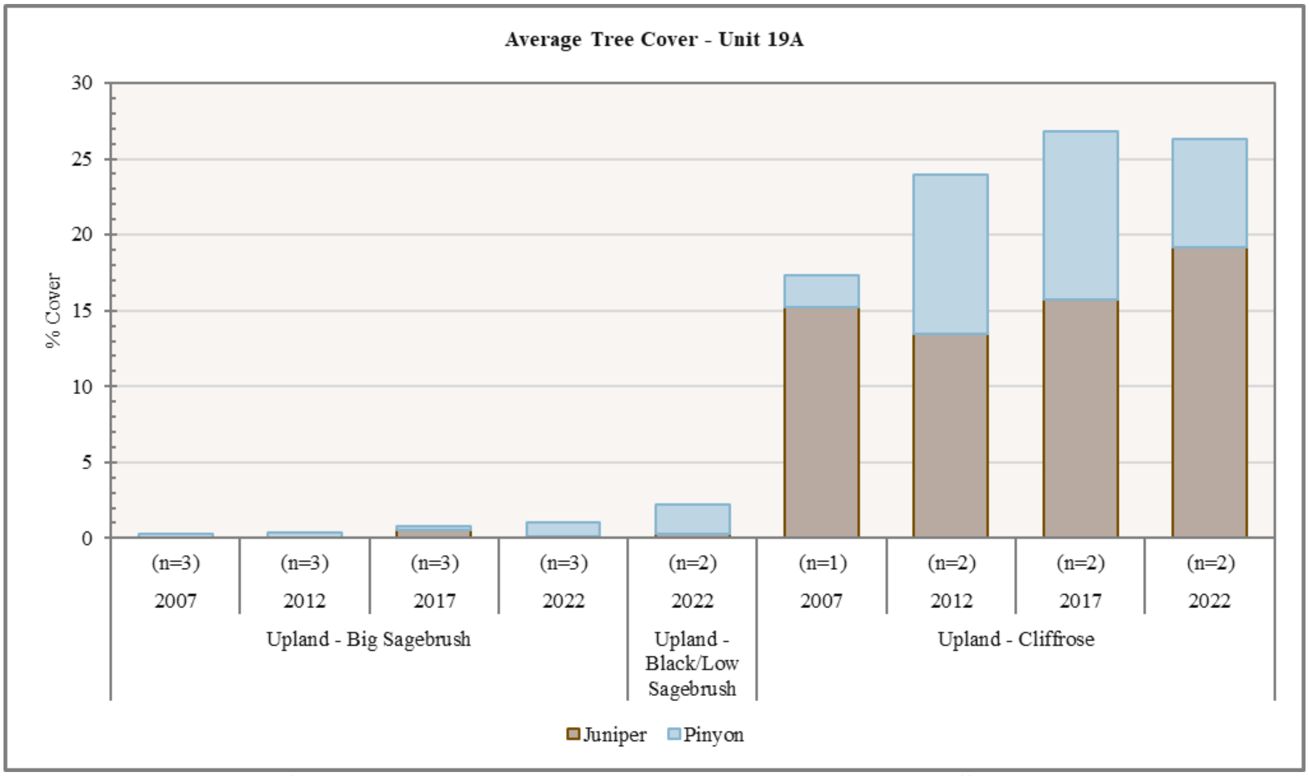


Figure 3.15: Average tree cover for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

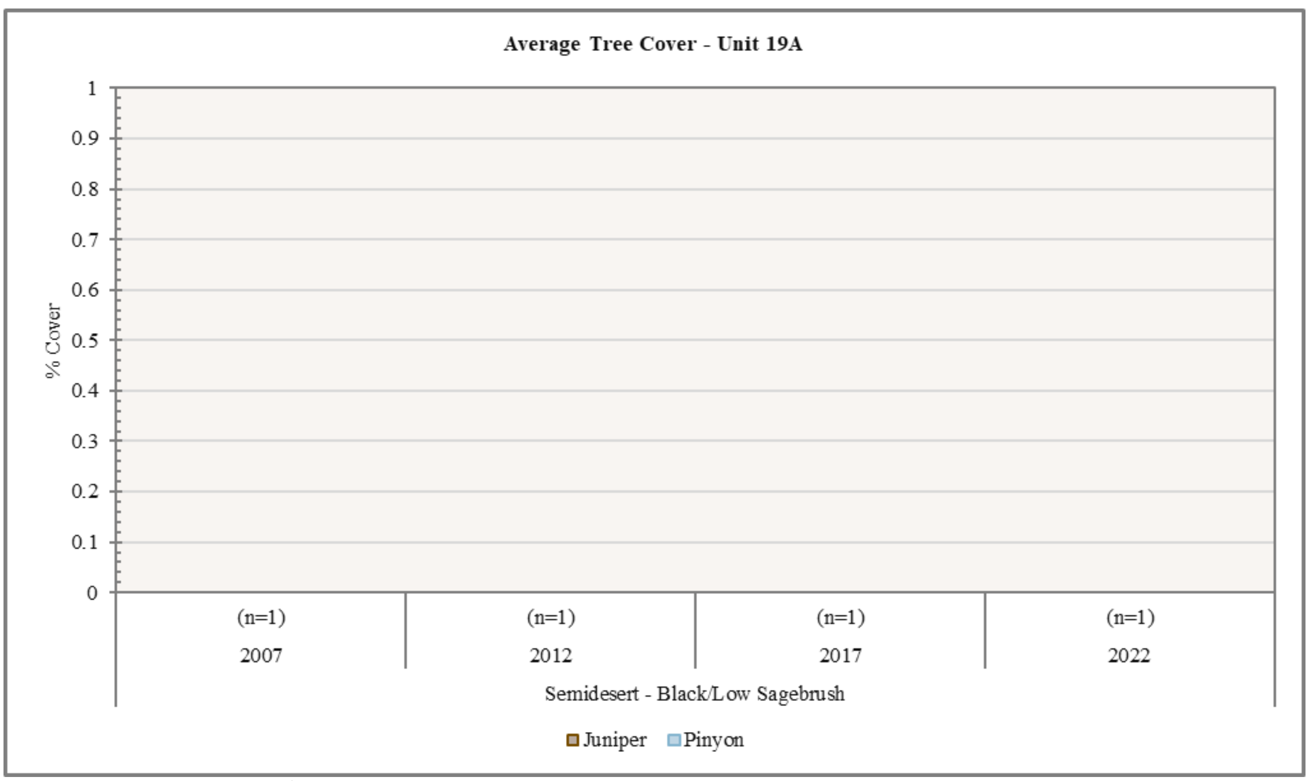


Figure 3.16: Average tree cover for Semidesert - Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

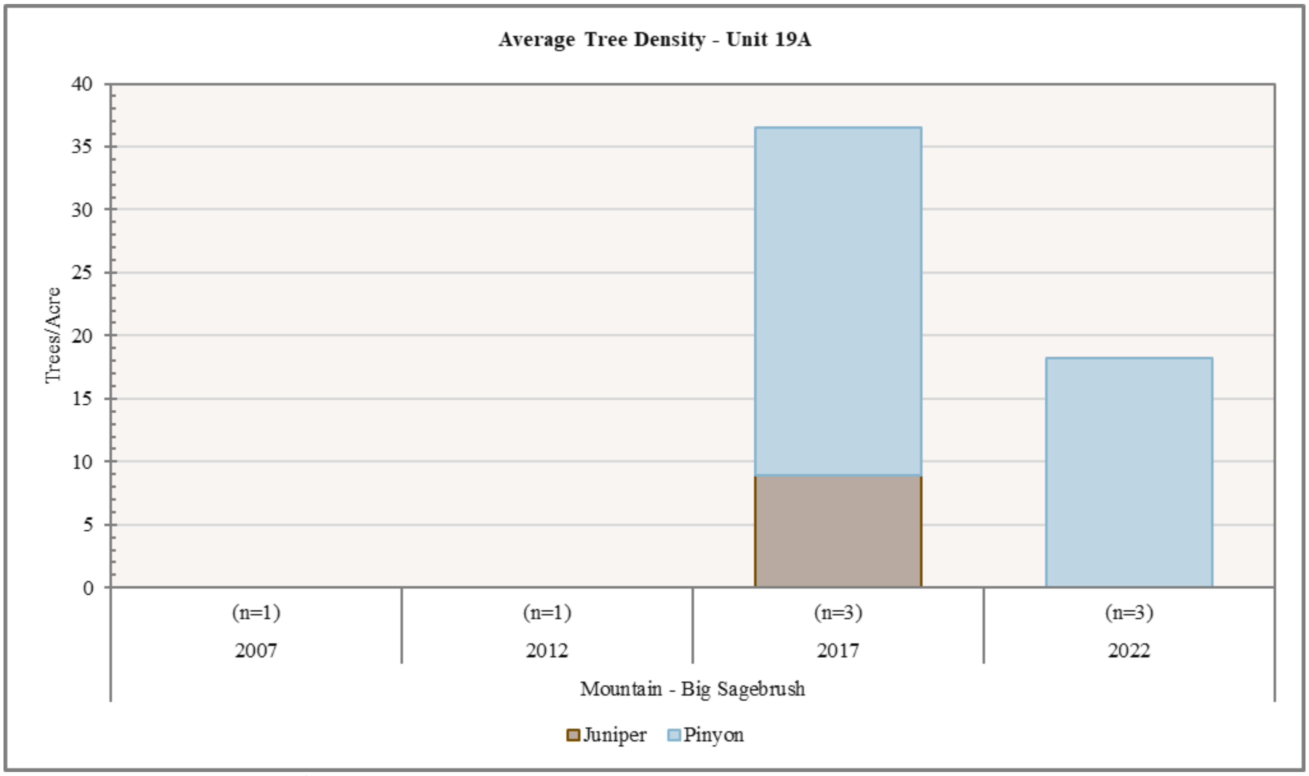


Figure 3.17: Average tree density for Mountain - Big Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

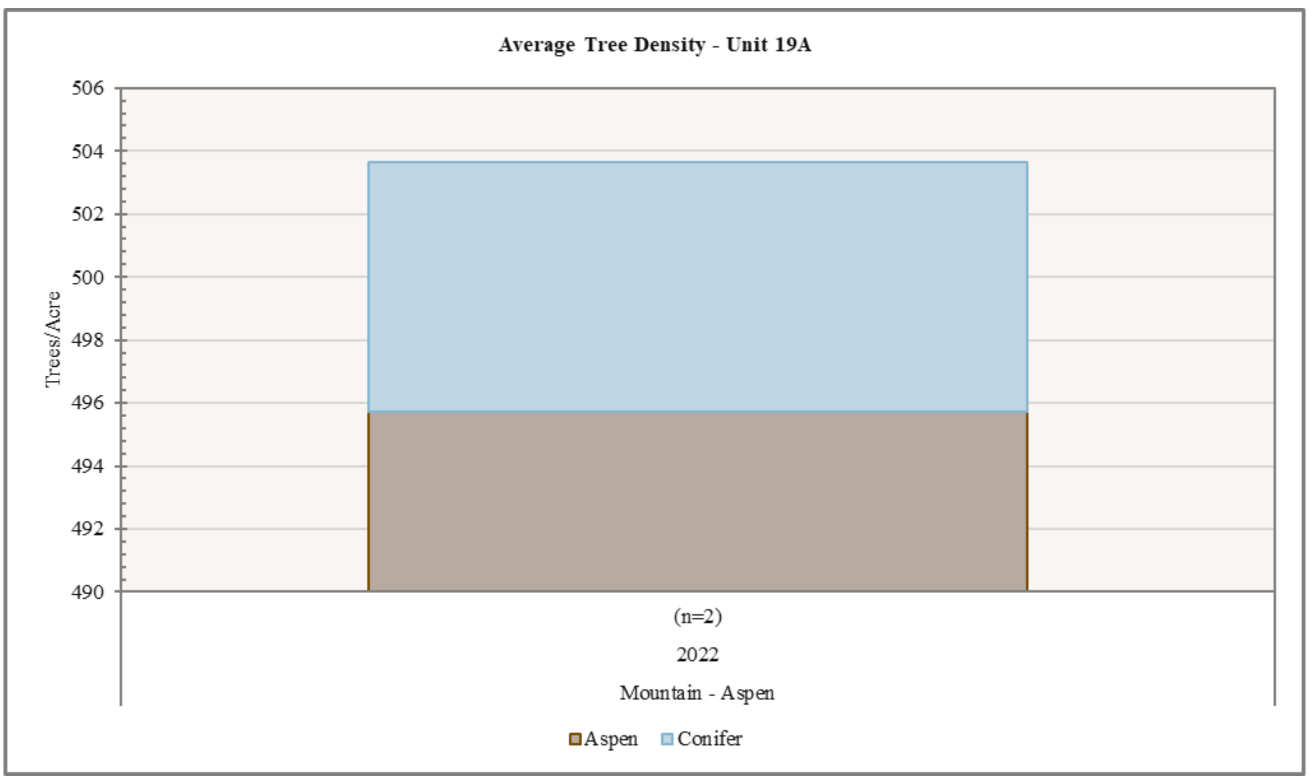


Figure 3.18: Average tree density for Mountain - Aspen study sites in WMU 19A, West Desert - Deep Creek.

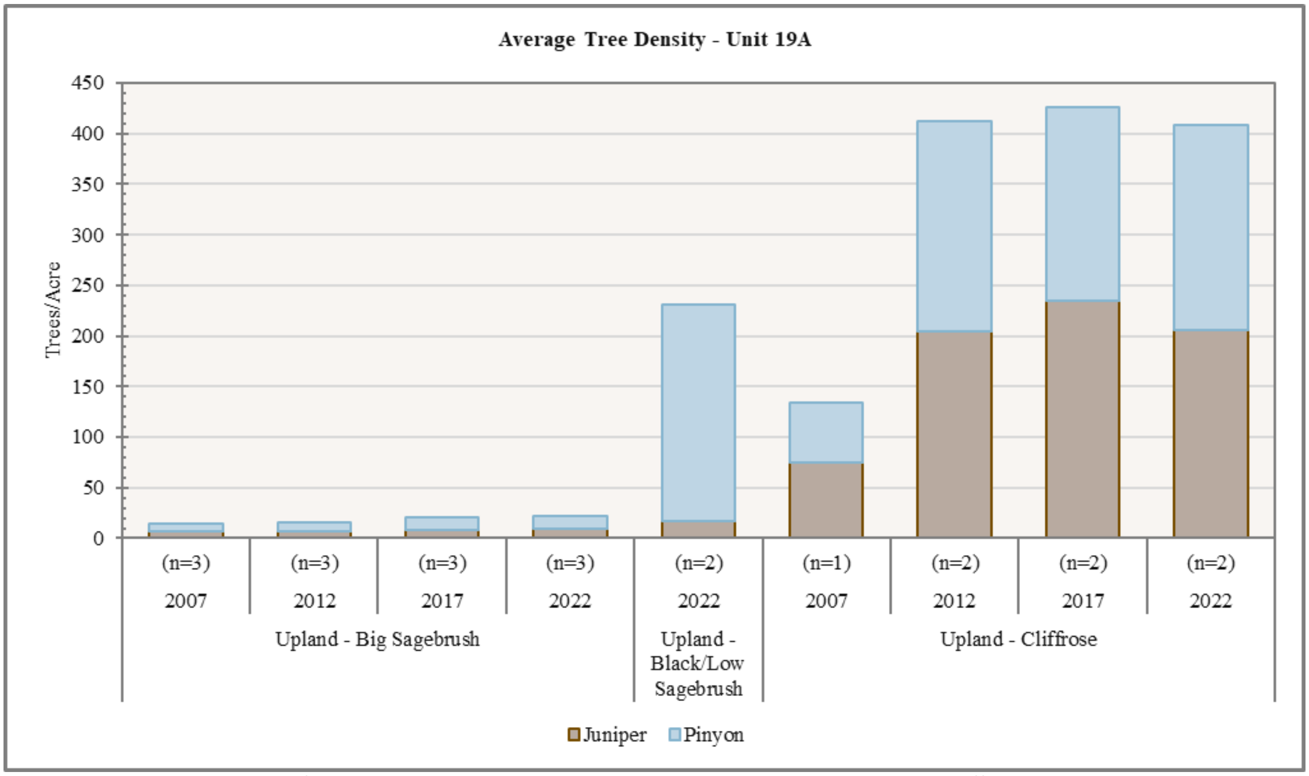


Figure 3.19: Average tree density for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

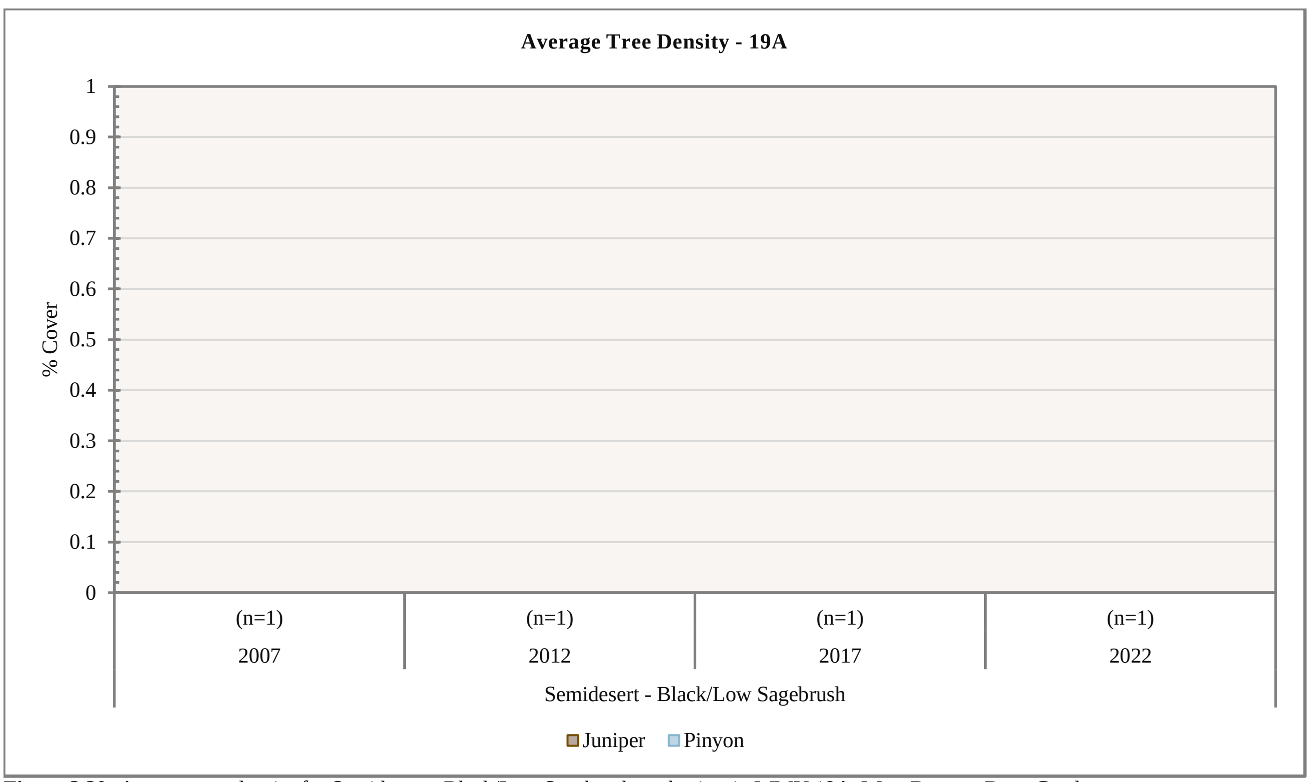


Figure 3.20: Average tree density for Semidesert - Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

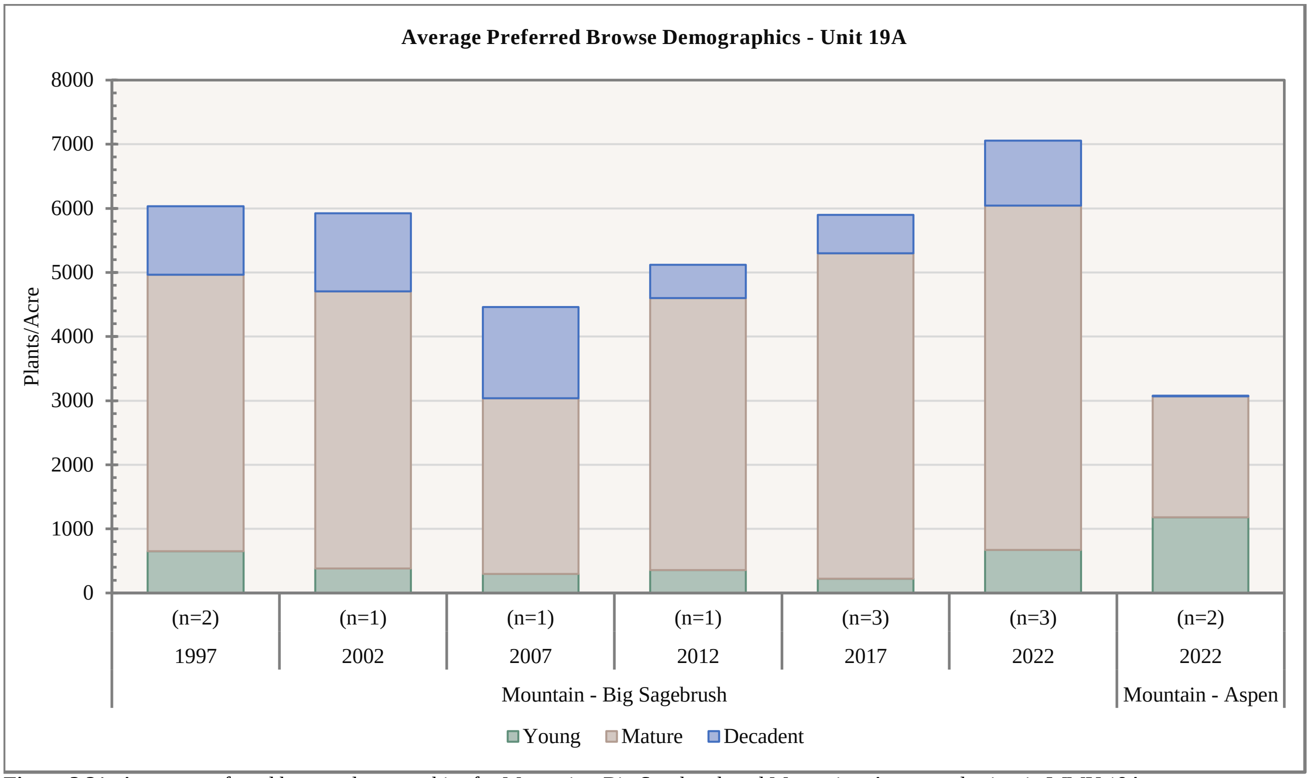


Figure 3.21: Average preferred browse demographics for Mountain - Big Sagebrush and Mountain - Aspen study sites in WMU 19A, West Desert - Deep Creek.

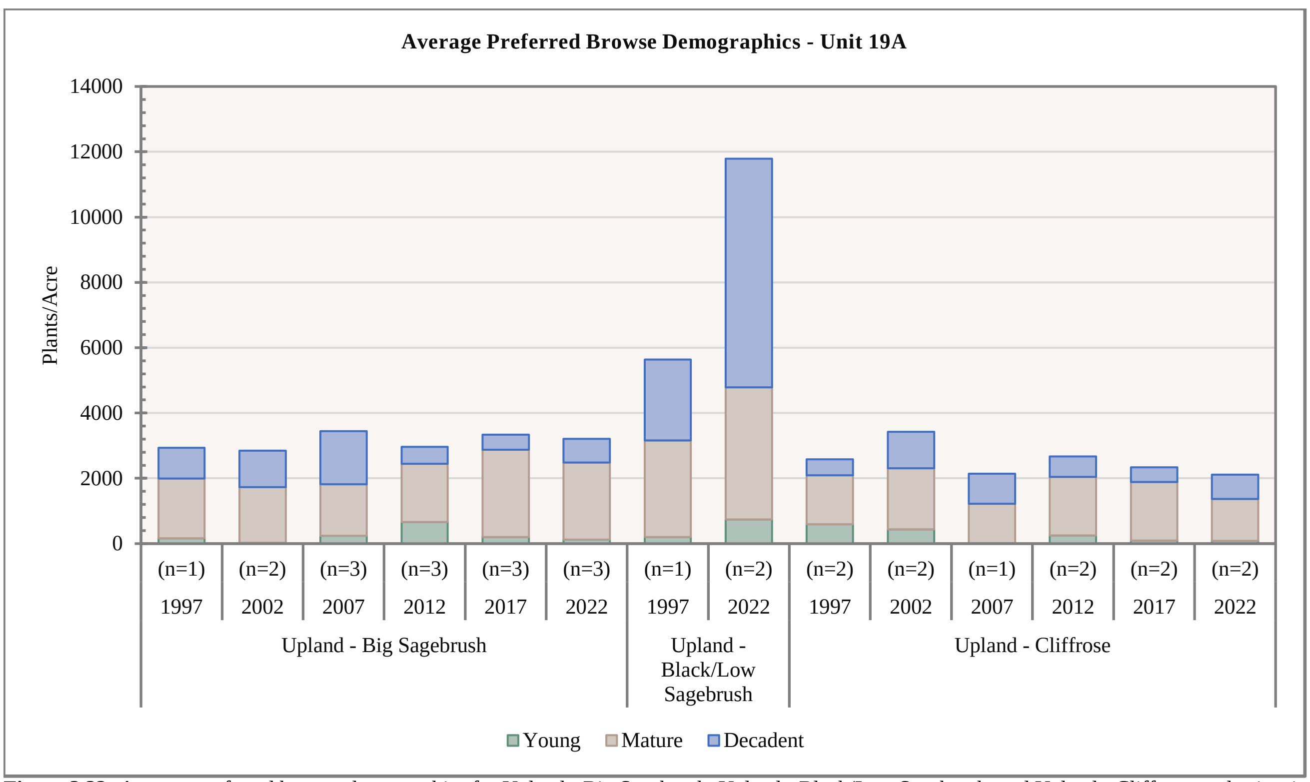


Figure 3.22: Average preferred browse demographics for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

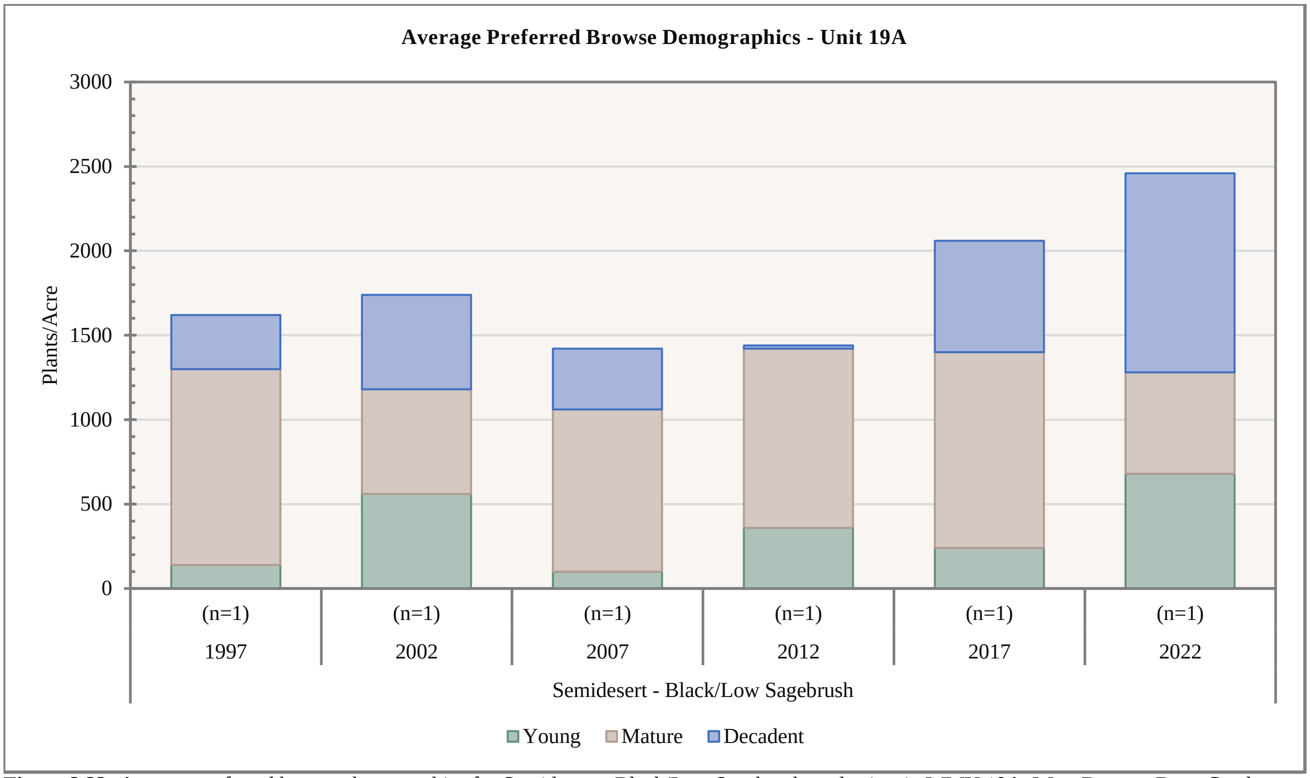


Figure 3.23: Average preferred browse demographics for Semidesert - Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

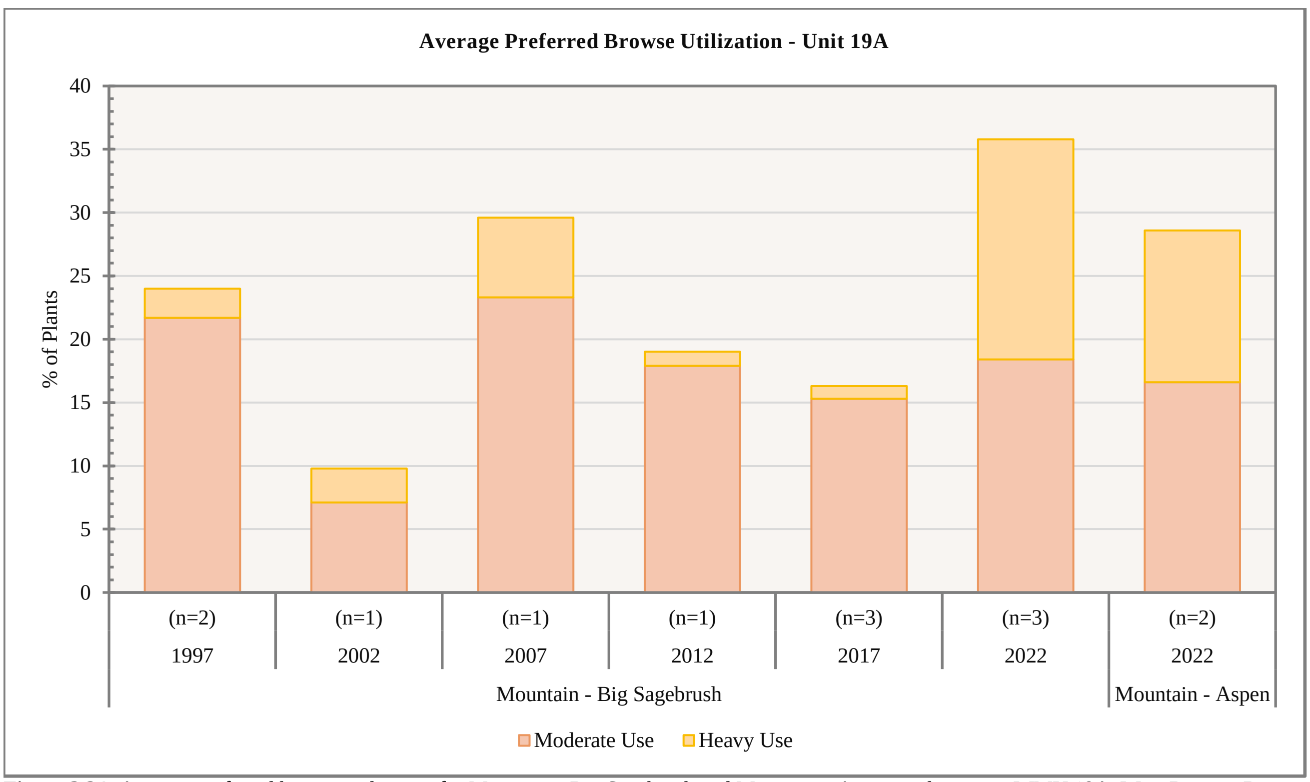


Figure 3.24: Average preferred browse utilization for Mountain - Big Sagebrush and Mountain - Aspen study sites in WMU 19A, West Desert - Deep Creek.

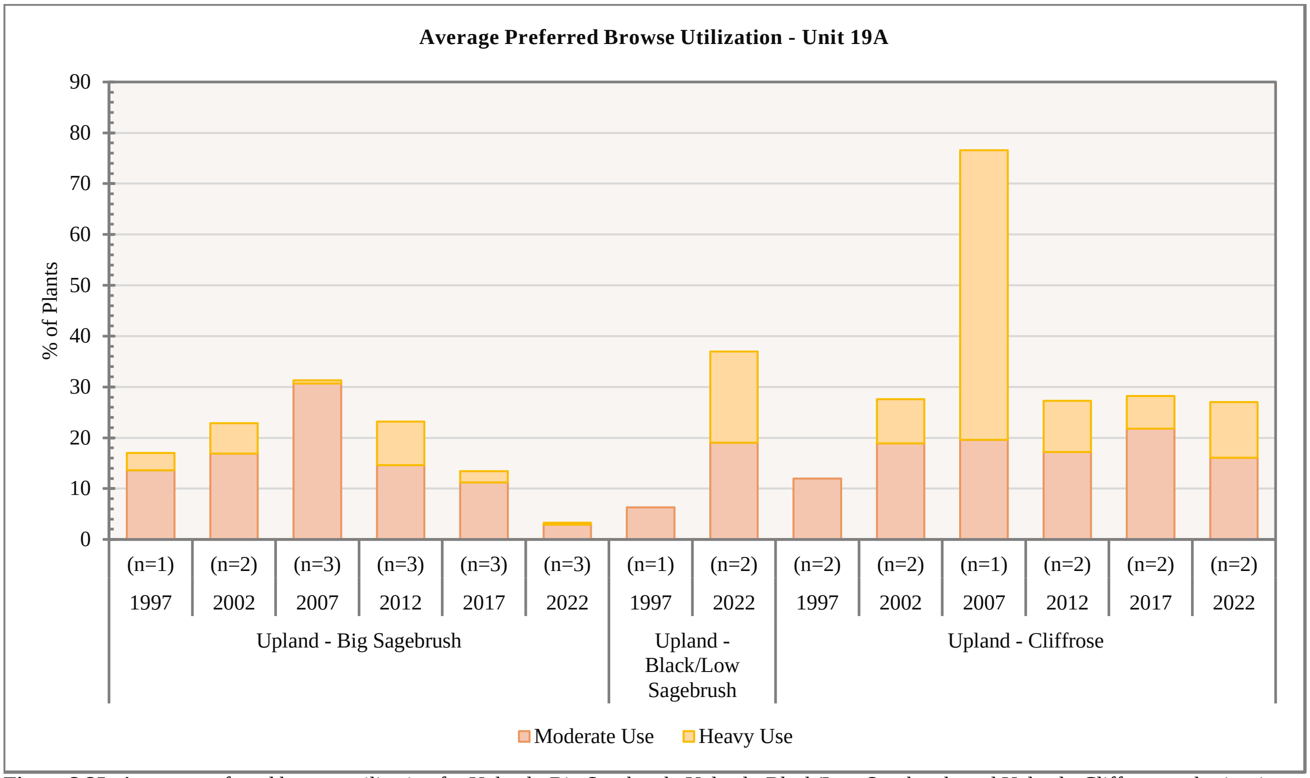


Figure 3.25: Average preferred browse utilization for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

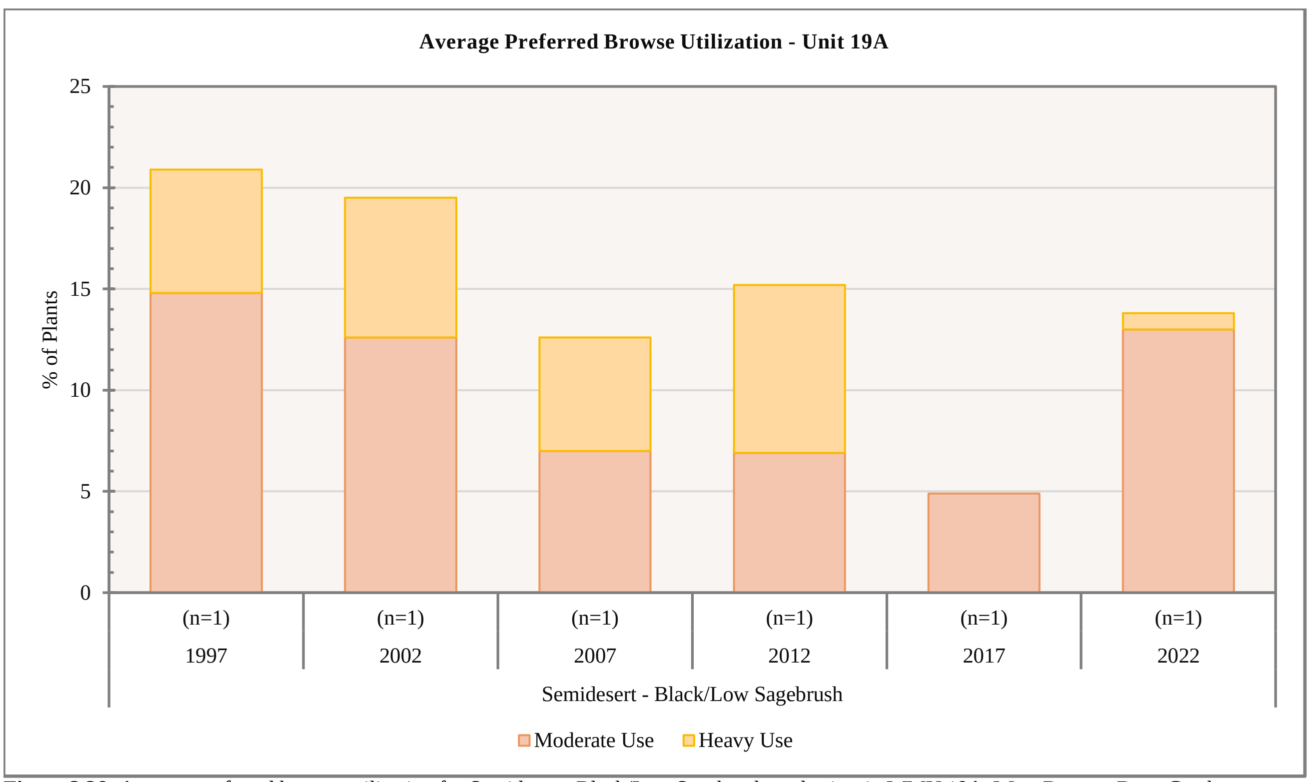


Figure 3.26: Average preferred browse utilization for Semidesert -Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

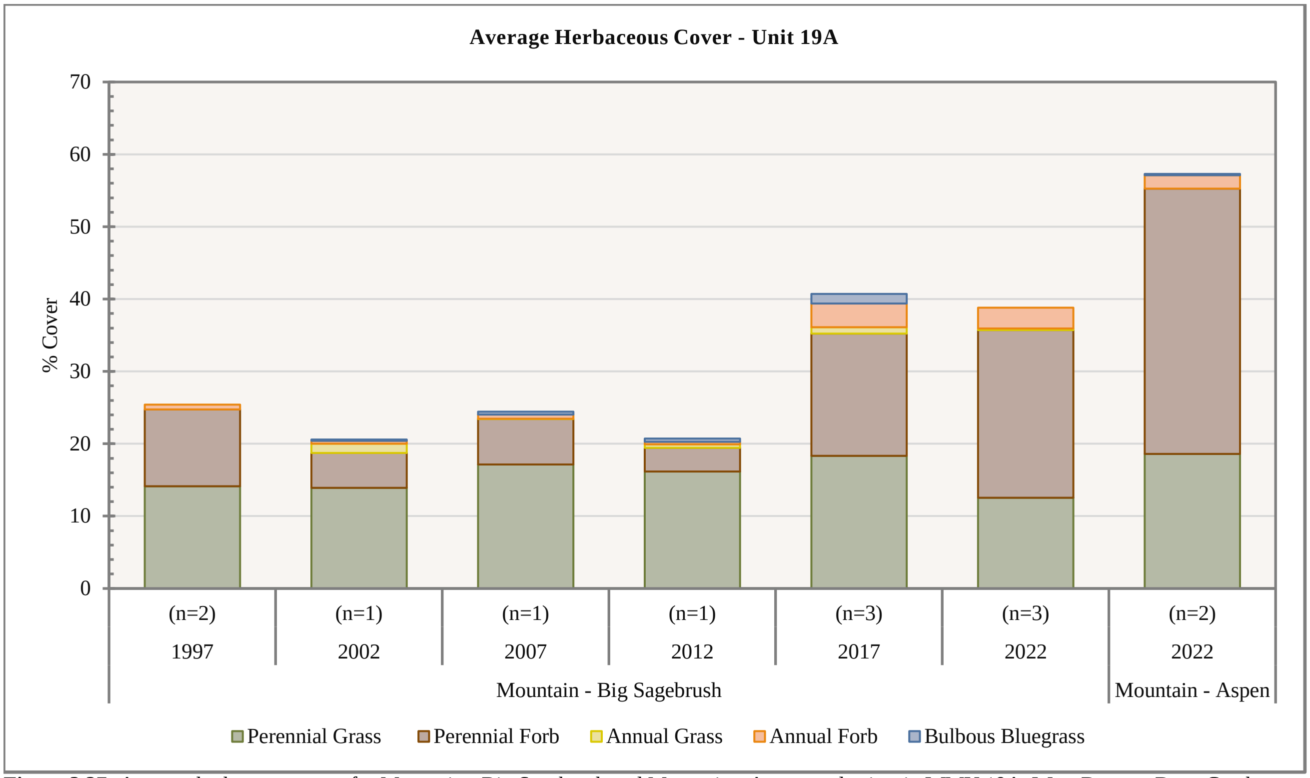


Figure 3.27: Average herbaceous cover for Mountain - Big Sagebrush and Mountain - Aspen study sites in WMU 19A, West Desert - Deep Creek.

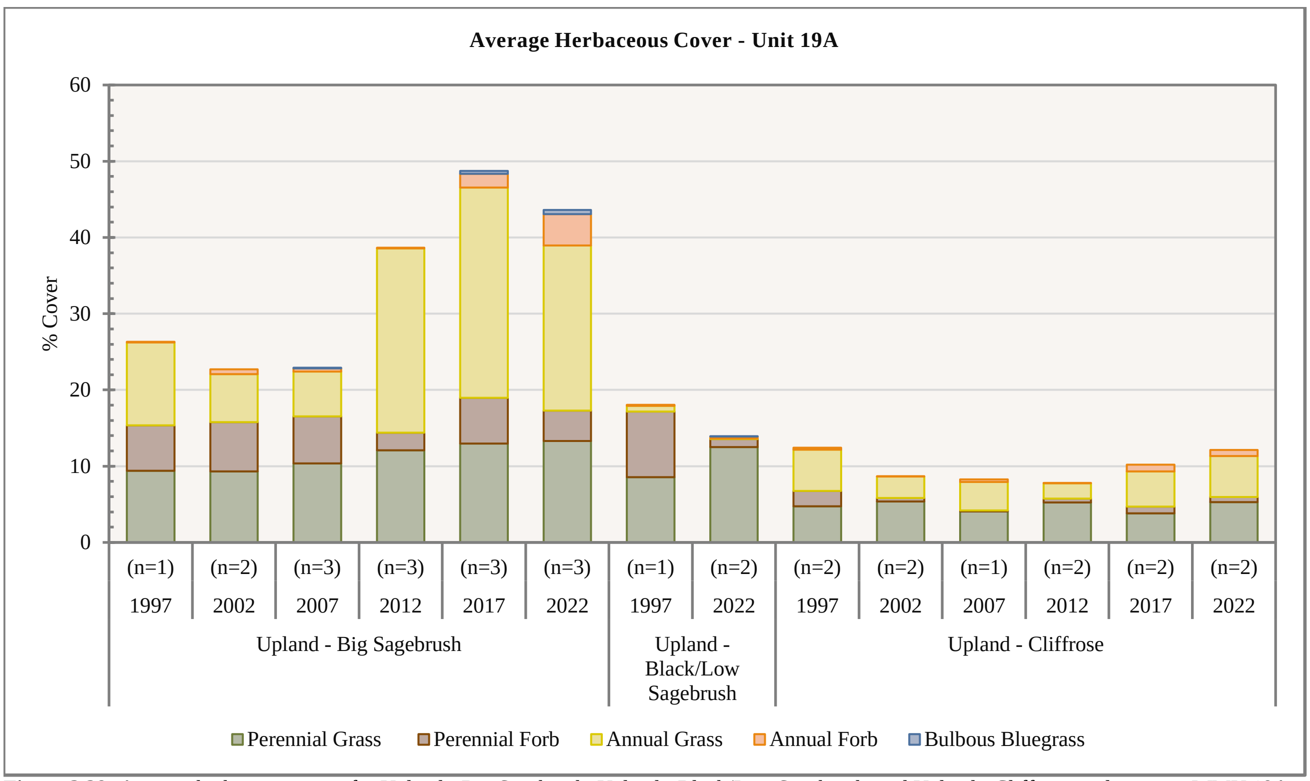


Figure 3.28: Average herbaceous cover for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

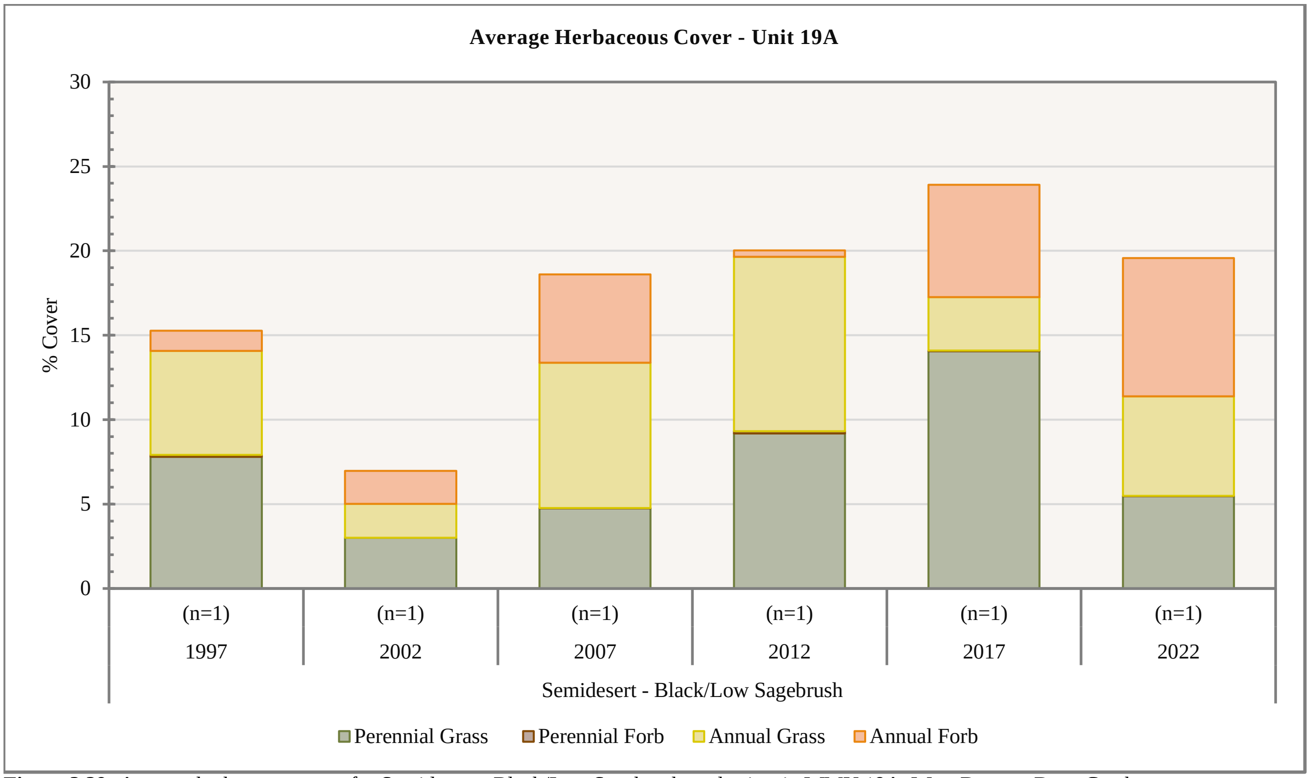


Figure 3.29: Average herbaceous cover for Semidesert - Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

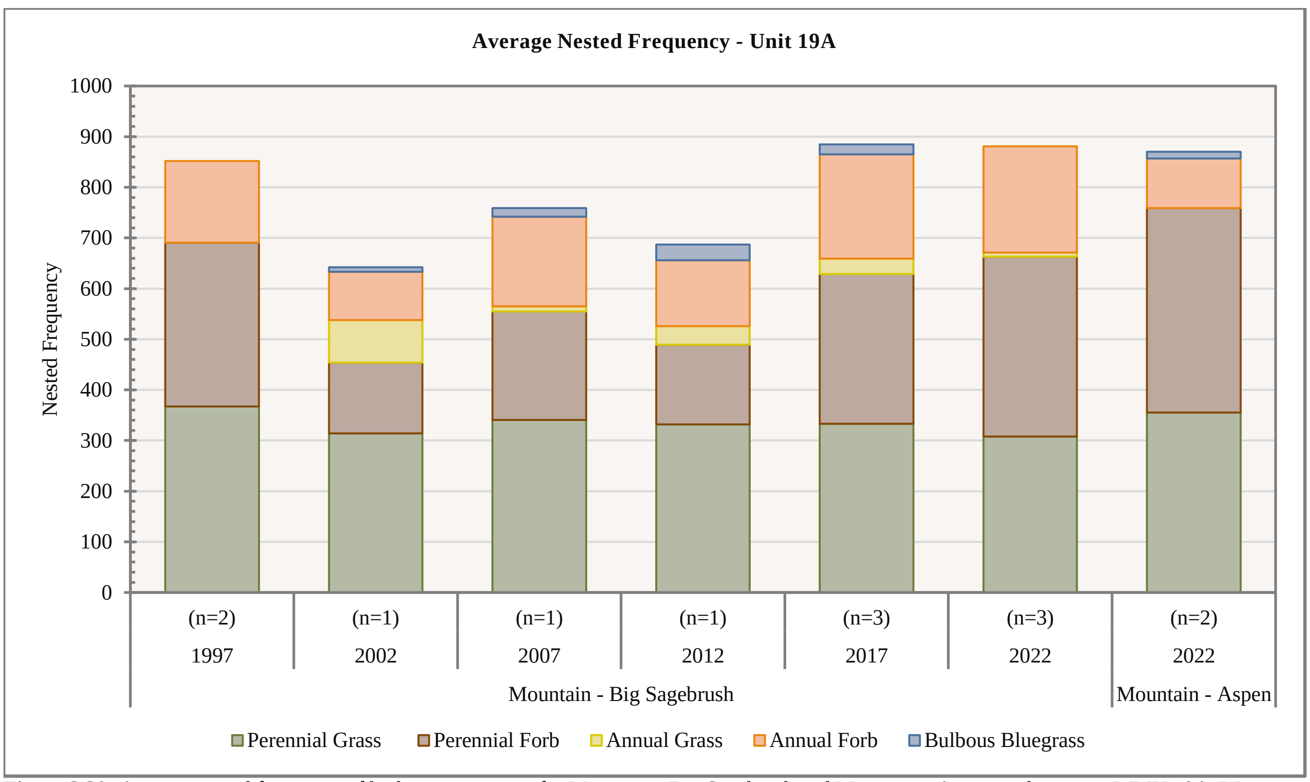


Figure 3.30: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Mountain - Aspen study sites in WMU 19A, West Desert - Deep Creek.

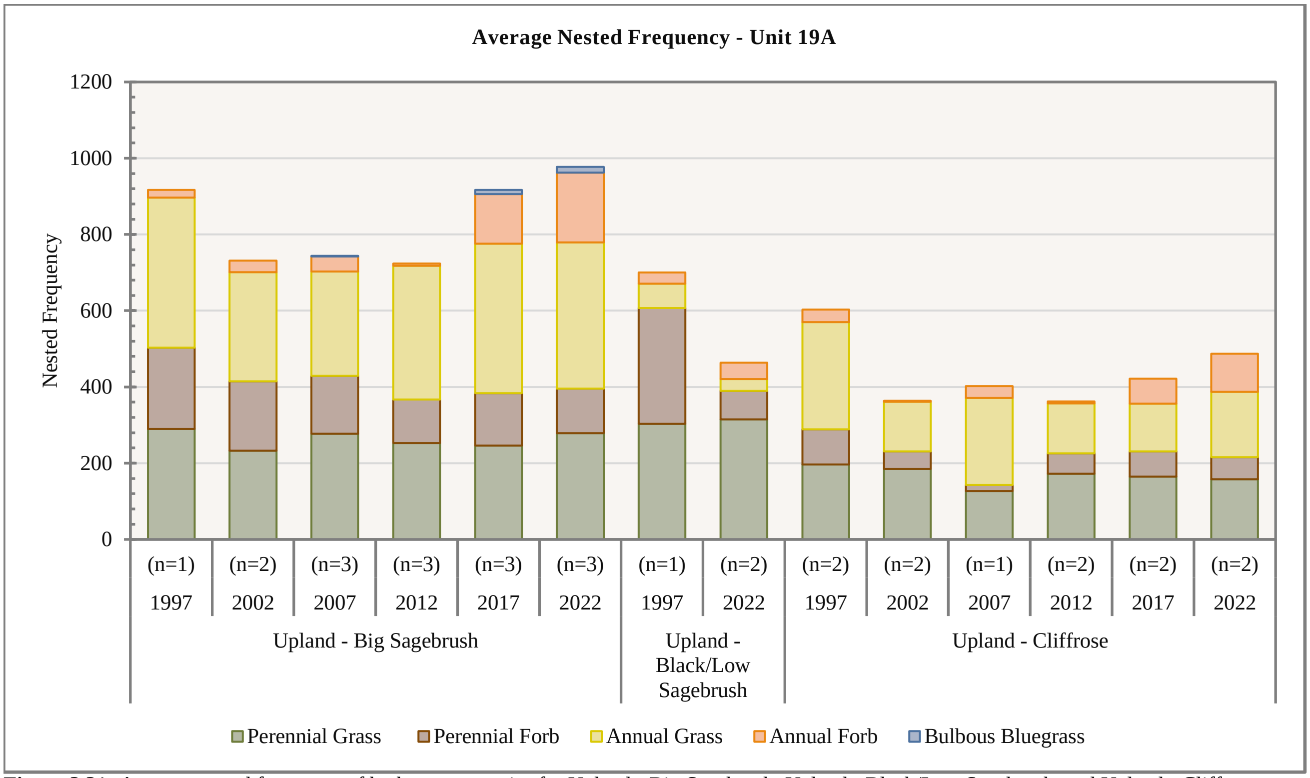


Figure 3.31: Average nested frequency of herbaceous species for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

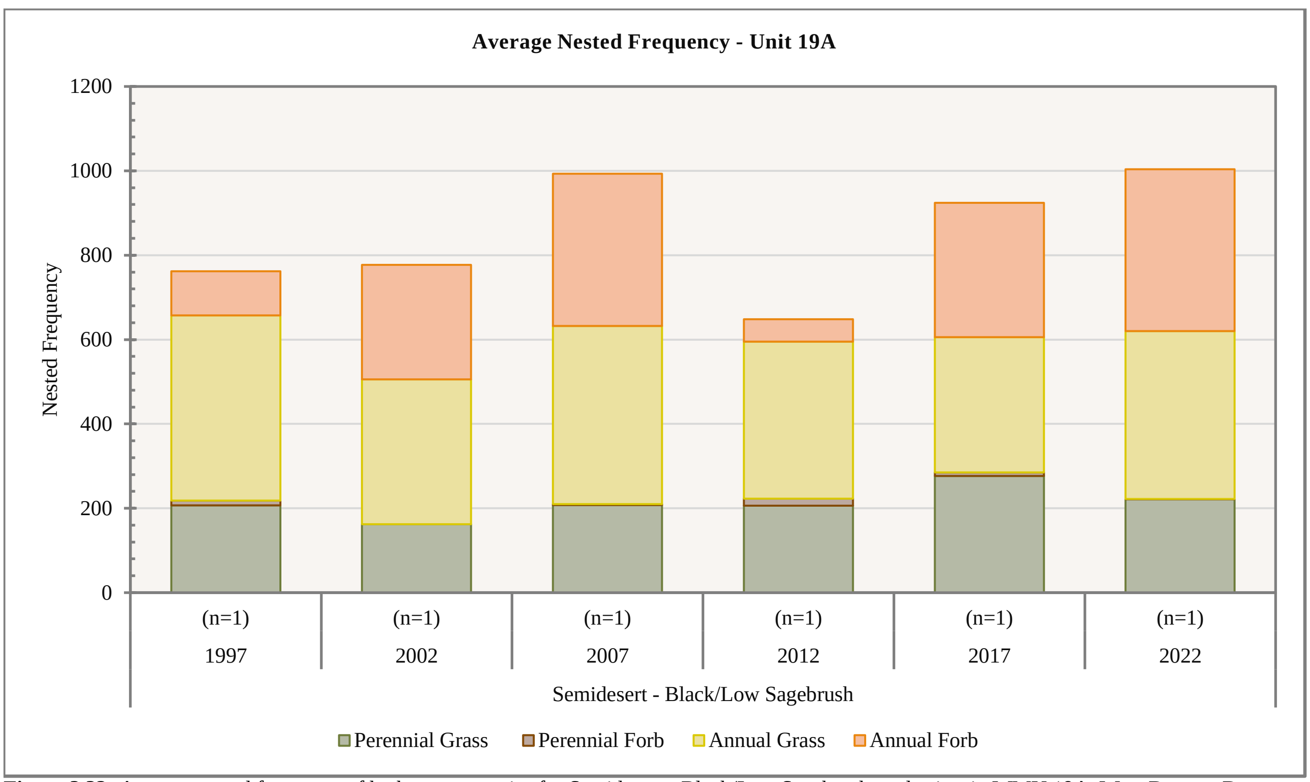


Figure 3.32: Average nested frequency of herbaceous species for Semidesert - Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

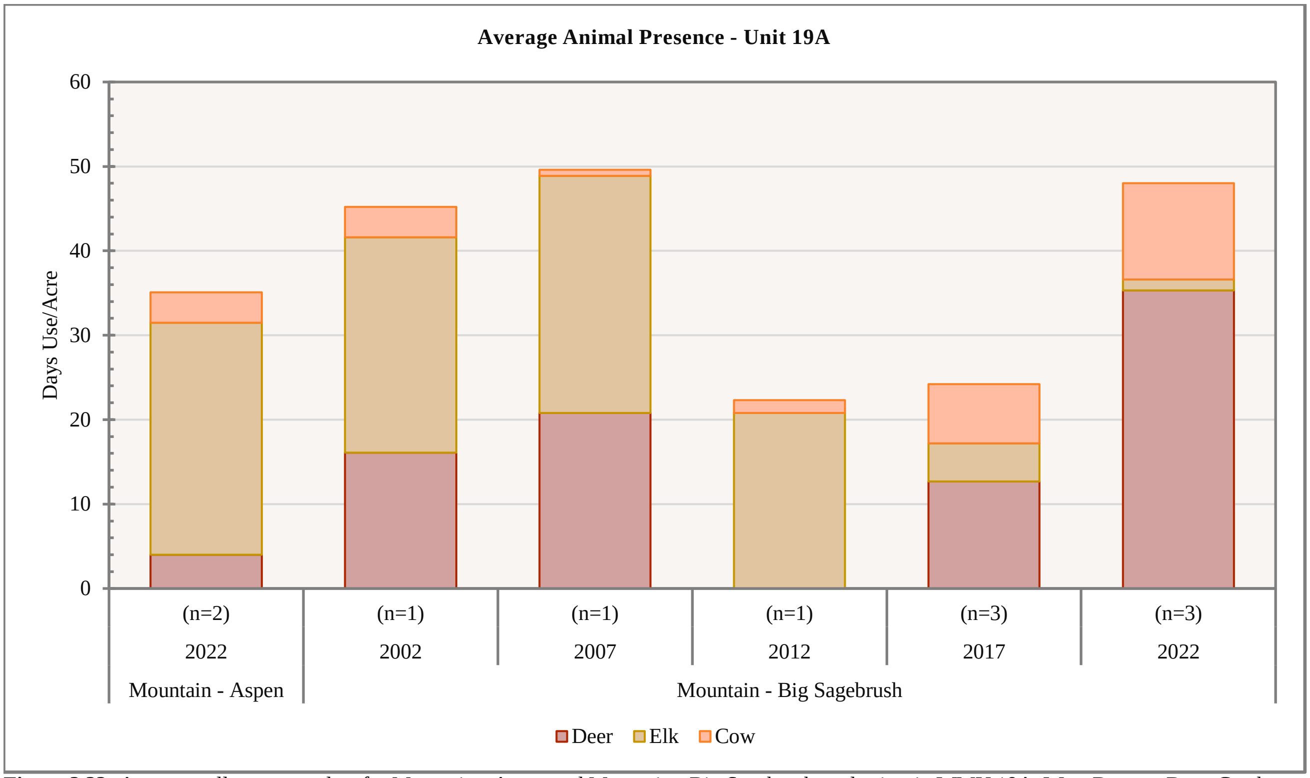


Figure 3.33: Average pellet transect data for Mountain - Aspen and Mountain - Big Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

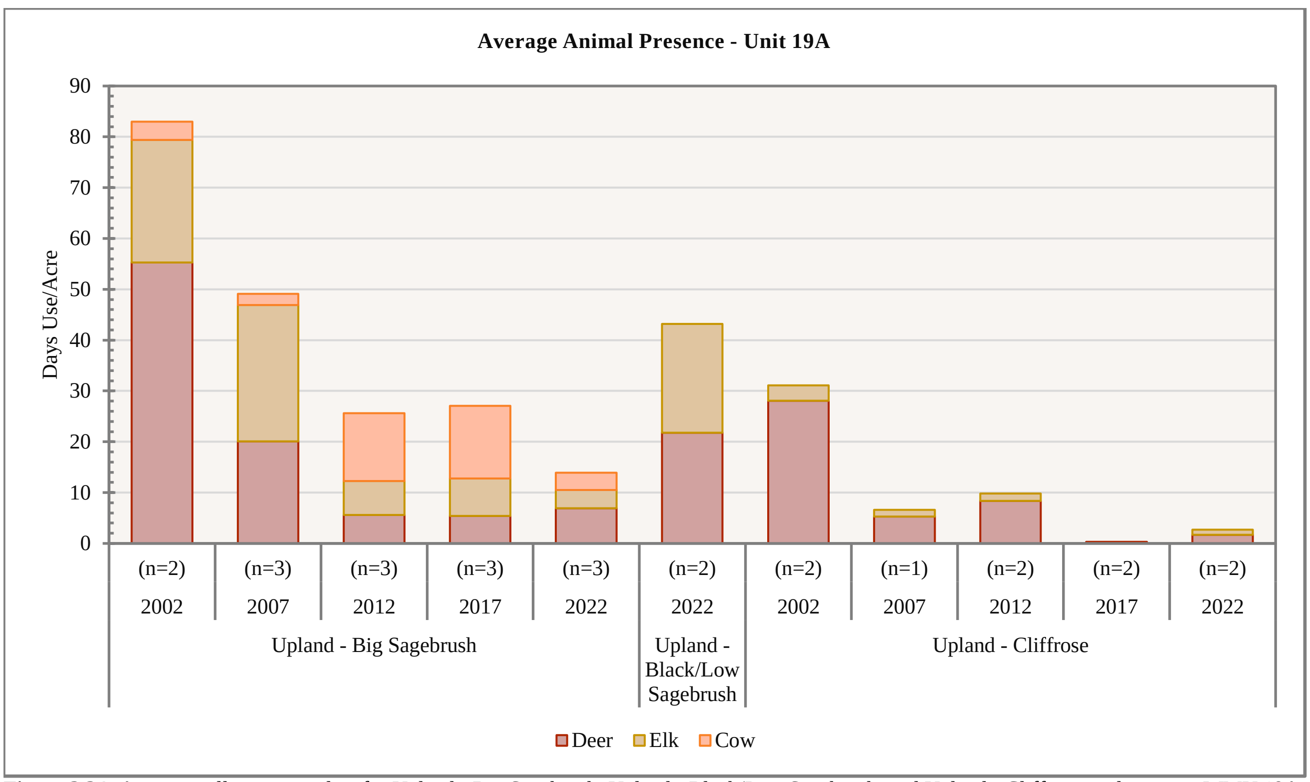


Figure 3.34: Average pellet transect data for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Cliffrose study sites in WMU 19A, West Desert - Deep Creek.

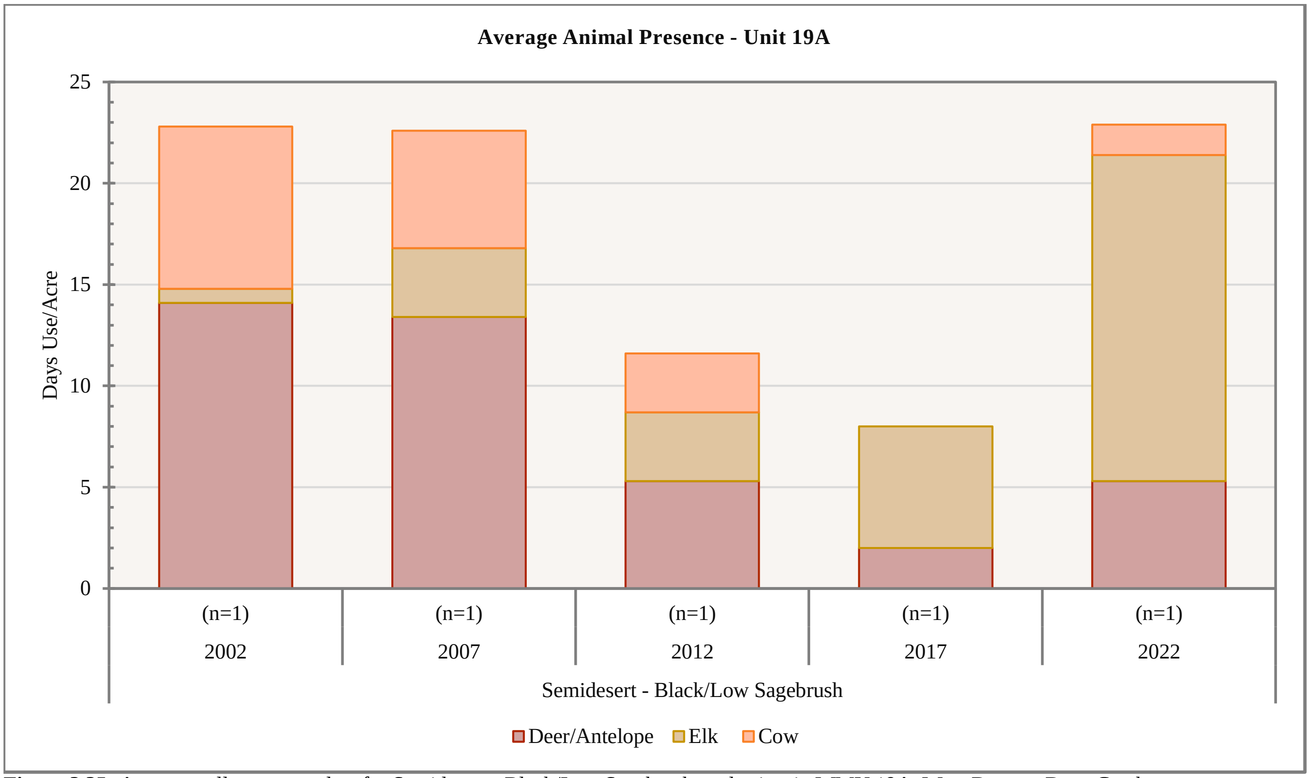
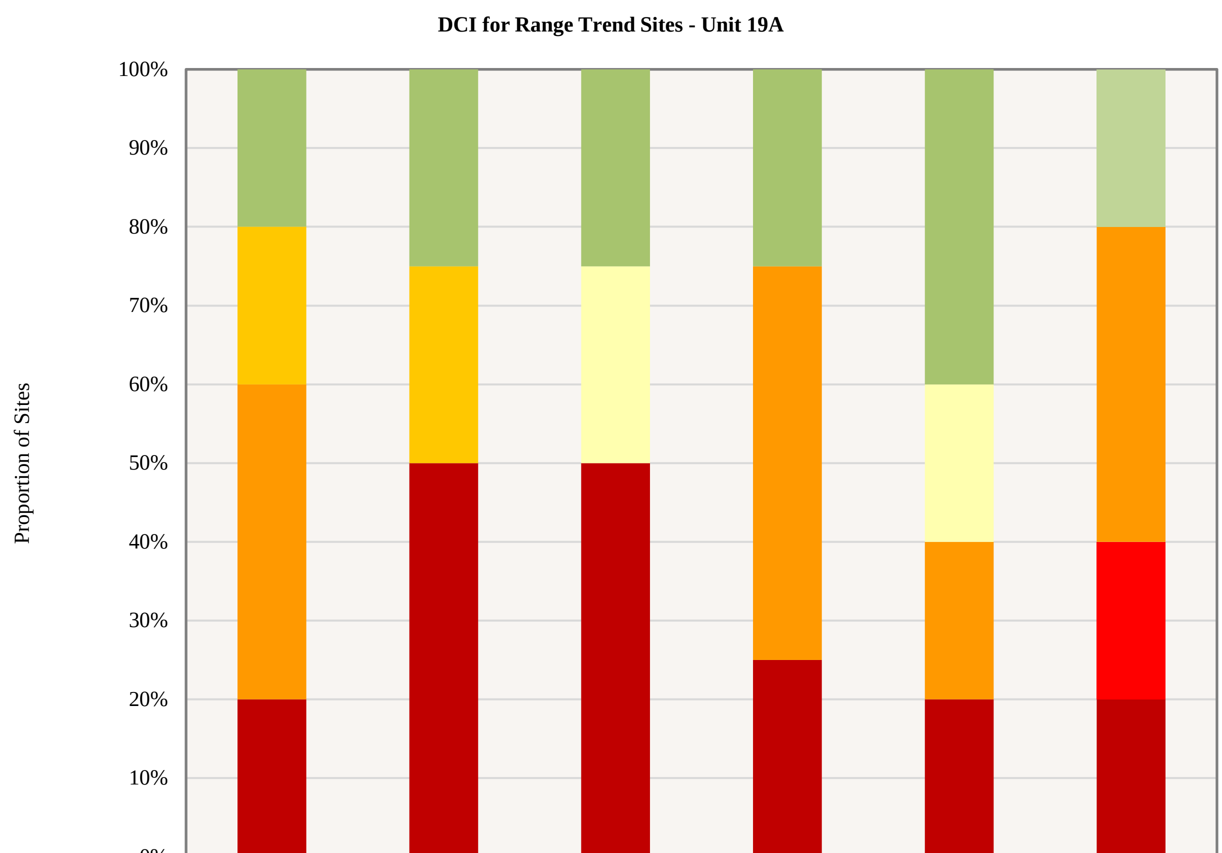


Figure 3.35: Average pellet transect data for Semidesert - Black/Low Sagebrush study sites in WMU 19A, West Desert - Deep Creek.

Deer Winter Range Condition Assessment

The averaged condition of deer winter range within the Deep Creek management unit has generally remained poor since the 1997 sampling. The Range Trend sites in WMU 19A that have generally remained in good condition are The Basin (19A-8) and Rocky Canyon (19A-9), and are the main drivers for the unit's stability as good deer winter range. Trail Gulch (19A-1), Ochre Mountain (19A-2), Sevy Mountain (19A-3), Wood Canyon (19A-7), and Clifton Flat (19A-12) all have a proclivity to remain as very poor to poor deer winter range. Of these sites, Ochre Mountain and Wood Canyon have more variability in deer winter range condition: this variability may be an indicator that these sites may respond well to future habitat improvement projects.

The overall deer winter range assessment in 2022 for WMU 19A was that the unit was in poor condition; all sites except for The Basin were ranked as poor or worse. These conditions are mainly driven by an abundance of annual grass and a lack of preferred browse and/or a lack of diversity in preferred shrub age classes. Ochre Mountain and its surroundings would benefit the most from habit improvements made in these areas (**Figure 3.36**, **Table 3.5**).



	1997	2002	2007	2012	2017	2022
Good	1	1	1	1	2	
Fair-Good						1
Fair			1		1	
Poor-Fair	1	1				
Poor	2			2	1	2
Very Poor-Poor						1
Very Poor	1	2	2	1	1	1

Figure 3.36: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 19A, West Desert - Deep 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
19A-1	1997	13.2	9.8	4.5	8.2	-5.4	0.2	0	**30.6**	**VP**
19A-1	2002	11.7	7.7	1.7	9.9	-4	0.1	0	**27**	**VP**
19A-1	2007	16.6	4.9	0.3	8.2	-2.8	0.2	0	**27.3**	**VP**
19A-1	2012	15.7	4.8	4.2	7.6	-2.6	0	0	**29.8**	**VP**
19A-1	2017	19.1	12.4	0	6.3	-6.4	0.1	0	**31.5**	**VP**
19A-1	2022	17.9	10.4	2.3	15.7	-7.5	0.3	0	**39**	**P**
19A-2	1997	20.8	5.2	2.9	18.8	-8.1	10	0	**49.5**	**P-F**
19A-2	2002	20.7	-0.1	0	24.4	-5.7	10	0	**49.3**	**P-F**
19A-2	2007	22.5	2.4	4.6	27.4	-9.4	10	0	**57.5**	**F**
19A-2	2012	24.9	4.3	1.8	27.4	-17.6	6.1	0	**46.7**	**P**
19A-2	2017	21	8.6	0.7	23.6	-20	10	0	**43.9**	**P**
19A-2	2022	10.5	-0.9	0	27.3	-20	10	0	**26.9**	**VP**
19A-3*	1997	14.9	1.1	1.8	17.1	-0.6	10	0	**44.4**	**P**
19A-7	1997	3.3	0	0	15.6	-4.6	0.2	0	**14.5**	**P**
19A-7	2002	2.3	0	0	6	-1.5	0	0	**6.8**	**VP**
19A-7	2007	2.3	0	0	9.5	-6.5	0	0	**5.4**	**VP**
19A-7	2012	1.8	0	0	18.4	-7.7	0.2	0	**12.6**	**P**
19A-7	2017	3.8	0	0	28.1	-2.4	0.1	0	**29.6**	**F**
19A-7	2022	3.5	0	0	10.9	-4.4	0	0	**10**	**VP-P**
19A-8	1997	18.1	10.9	5.9	28.8	0	10	0	**73.8**	**G**
19A-8	2017	24.3	12.2	3.1	30	-0.2	10	0	**79.5**	**G**
19A-8	2022	18.9	7.8	5	30	-0.4	10	0	**71.2**	**F-G**
19A-9	2002	27	8.6	3.2	27.8	-1	9.7	0	**75.3**	**G**
19A-9	2007	24	5	3.6	30	0	10	0	**72.6**	**G**
19A-9	2012	25.3	11.9	3.5	30	-0.4	6.5	0	**76.8**	**G**
19A-9	2017	29.6	11.2	0	30	-1.8	10	0	**79**	**G**
19A-12	2022	12.4	-6.5	4.4	30	-0.1	4	0	**44.3**	**P**

Table 3.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 19A, West Desert - Deep Creek. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
19A-1	Trail Gulch	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
19A-2	Ochre Mountain	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19A-4	Durse Canyon	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
19A-6	Granite Creek	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19A-7	Wood Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
19A-8	The Basin	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19A-10	Rocky 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
19A-11	Ibapah Harrow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
19A-12	Clifton Flat	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
19A-13	Dry Canyon	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
19A-14	Big Canyon	None Identified	-	-
19A-15	Chimney Rock	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
19A-16	South Rocky Peak	Animal Use – Elk	High	Reduced understory shrub and herbaceous vigor
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species

Table 3.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 19A, West Desert – Deep 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

Most study sites in the West Desert - Deep Creek unit that are classified as deer winter range are considered to be in very poor to poor condition. These conditions are mainly driven by an abundance of annual grass, a lack of preferred browse cover, and/or undiversified age classes among the preferred browse populations. In contrast, the Big Canyon, Chimney Rock, and South of Rocky Peak study sites are considered to be in good condition for deer summer range. These conditions can be attributed to high cover of perennial forbs and grasses on all three study sites and the presence of the quaking aspen communities on South of Rocky Peak and Chimney Rock.

Of positive note in this unit is that plant communities on established study sites have generally remained stable. More specifically, the shrub components on these sites have not exhibited decreases in cover or density to a degree that would cause the associated plant communities to shift into a different ecological state. In addition, ecological improvements have occurred on Ibapah Harrow in the time following treatment. Not only have the grass and forb communities diversified on this site, but in addition, the shrub component is returning with a slightly diversified age class structure.

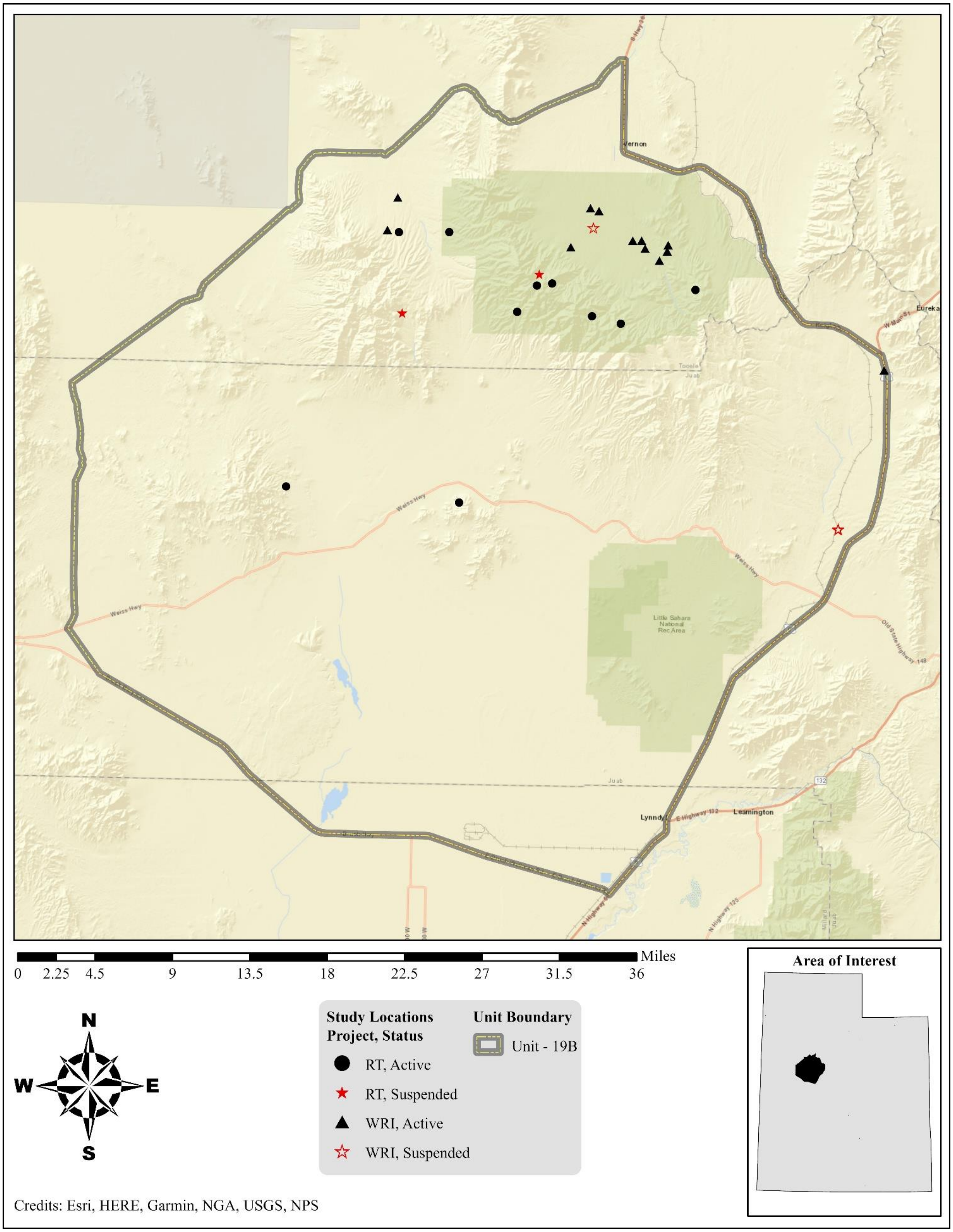
A number of events are occurring that may have negative effects on big game habitat within the West Desert - Deep Creek management unit. Palmer Drought Severity Index (PDSI) data indicates that this unit experienced moderate to extreme drought conditions in 2020, 2021, and 2022 (**Figure 3.1a, Figure 3.2a**). 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). Some of these drought effects including reduced shrub vigor can be observed on a number of lower elevation Range Trend studies (**Table 3.6**). These effects may be more widespread and may include lower potential areas in general, but this cannot be confirmed by site-specific data.

Pinyon-juniper encroachment is steadily increasing over time on sites that have not experienced disturbance such as Trail Gulch and Durse Canyon (the latter of which is in a Wilderness Study Area and is thus unable to be treated). Pinyon and juniper presence has the potential to lead to decreased shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000). These effects can be observed on the Durse Canyon study in particular: both cover and density of preferred browse have exhibited decreases over time, and the herbaceous understory was scarce in 2022. Conifer encroachment into aspen stands in higher elevation summer range is also occurring, mainly in areas outside of The Basin such as Tom's Creek, etc. Increased conifer presence in these communities can lead to deterioration of existing aspen stands and reduced shrub and herbaceous production (Stam, Malechek, Bartos, Bowns, & Godfrey, 2008). An additional threat in this unit is posed by the prevalence of annual grasses on some of the mountain range’s south-facing slopes. 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).

Other threats to wildlife habitat are occurring in localized portions of this unit, but will not be discussed in this section. These additional threats are specified by study site in the previous table (**Table 3.6**).

When trying to slow habitat loss or alleviate detrimental effects caused by the threats previously mentioned, a number of recommendations should be taken into consideration. Monitoring of Range Trend studies, areas where rehabilitation projects have occurred, and areas around the Wilderness Study Area should continue in the future. Periodic monitoring of these areas not only assesses the quality of big game habitat, but may also aid in the identification of threats as they appear over time. Cooperation with private landowners and the Confederated Tribes of the Goshutes is recommended to implement habitat improvement projects where possible, including on summer range. In higher elevations, methods that will promote aspen rejuvenation should be considered. When and where appropriate, efforts to address infilling or encroachment of pinyon and juniper should implemented; tree-removal projects may be especially appropriate on the southern end of the mountain range near Dry Canyon, on the northern end near Clifton Flat, and outside of the Wilderness Study Area near Trail Gulch. Care should be should be taken in method selection (lop and scatter, bullhog, chaining, etc.) to ensure that annual grass loads are not unintentionally amplified.

4. WILDLIFE MANAGEMENT UNIT 19B – WEST DESERT - VERNON



WILDLIFE MANAGEMENT UNIT 19B – WEST DESERT - VERNON

Boundary Description

Juab, Millard and Tooele counties – Boundary begins at SR-36 and the Pony Express road; south on SR-36 to US-6; southwest on US-6 to SR-174 (the IPP road); northwest on SR-174 to the Dugway Valley road (14-Mile Road); north on this road to the Pony Express road; northeast on this road to SR-36.

Management Unit Description

Geography

The West Desert - Vernon unit has a variety of terrain with a small amount of the unit being suitable big game habitat. Most of the unit is publicly managed, with the United States Forest Service (USFS) managing most of the spring/fall range and the Bureau of Land Management (BLM) managing most of the winter range. Most of the public land in the Sheeprock range is managed by the USFS, while the BLM manages most of the West Tintic and Simpson Mountains.

The Sheeprock and Tintic Mountains run north-south on the northern end of the unit. The highest point is Black Crook Peak at 9,264 feet. The Simpson Mountains sit on the northwest part of the unit between 7,000 and 8,000 feet. The Simpson and West Tintic Mountains have mostly gentle topography and are shallowly sloped at the base. The Sheeprock Mountains are more rugged with steeper canyons running to the peaks. Towns located within the management unit include Lynndyl and Vernon.

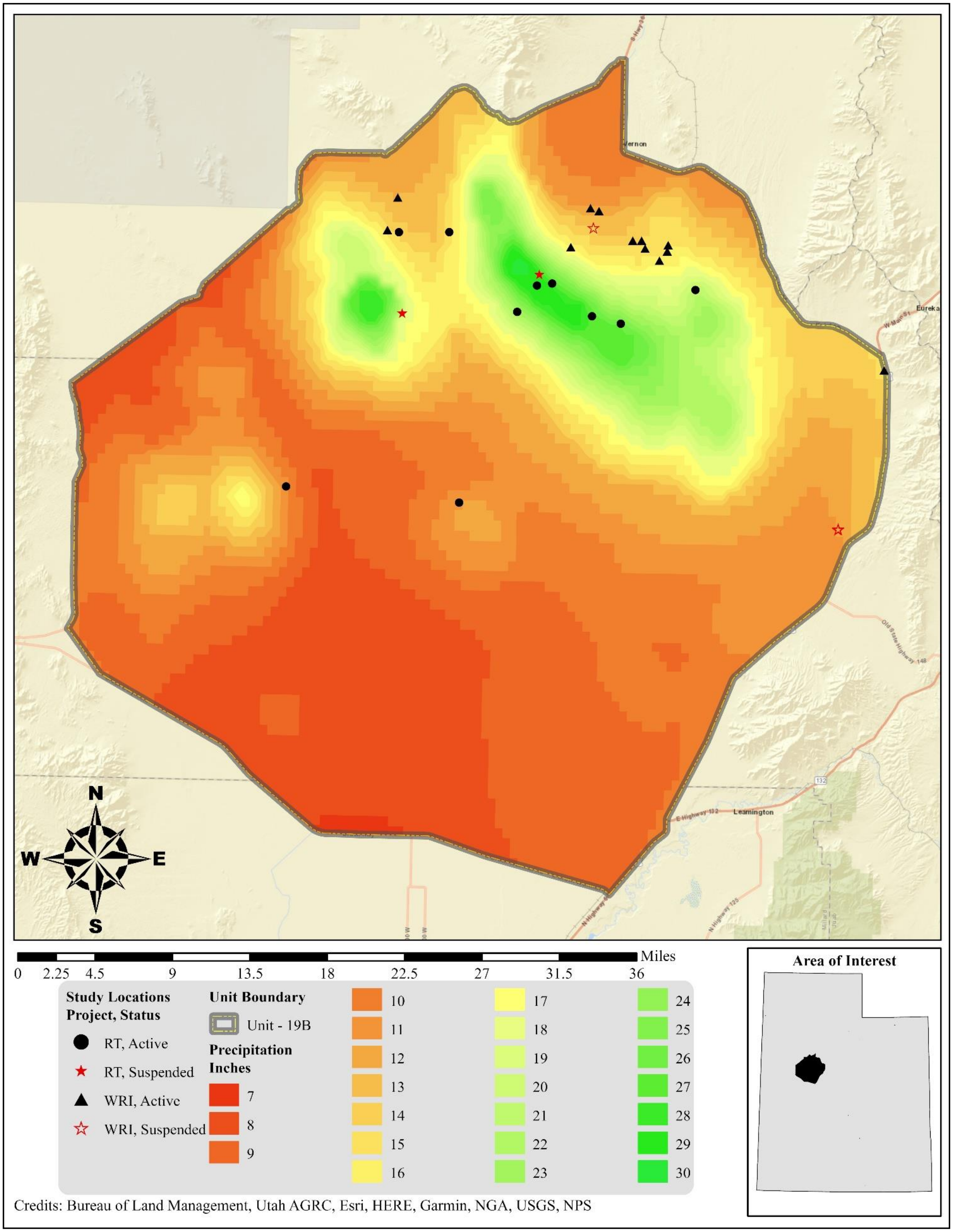
Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 7 inches near Delta and Crater Bench Reservoir to 30 inches on the peaks of the Simpson and Sheeprock Mountains. All of the Range Trend and WRI monitoring studies on the unit occur between 11-29 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 Western, North Central, and South Central Mountains divisions (Divisions 1, 3, and 4).

The mean annual PDSI of the Western division displayed years of moderate to extreme drought from 2000-2003, 2007-2008, 2012-2013, 2015, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1993, 1995, 1998-1999, 2005, 2011, and 2019 (**Figure 4.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 2000, 2002-2004, 2007-2008, 2012-2015, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1995, 1998, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007-2008, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2011, and 2019 (**Figure 4.1b**).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2015, 2018, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995-1998, 2005, and 2011 (**Figure 4.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1992, 2001-2003, 2007-2008, 2012-2015, 2018, and 2021-2022. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007, 2012-2013, 2015, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995, 1997-1998, and 2005 (**Figure 4.2b**).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 2002-2003, 2012-2014, 2018, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1997-1998, 2005, and 2011 (**Figure 4.3a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 2000, 2002-2004, 2007-2008, 2012-2014, 2018, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2002-2003, 2007, 2009, 2012, and 2020; moderately to extremely wet years were displayed in 1997-1998, 2005, and 2011 (**Figure 4.3b**) (Time Series Data, 2023).



Map 4.1: The 1991-2020 PRISM Precipitation Model for WMU 19B, West Desert - Vernon (PRISM Climate Group, Oregon State University, 2021).

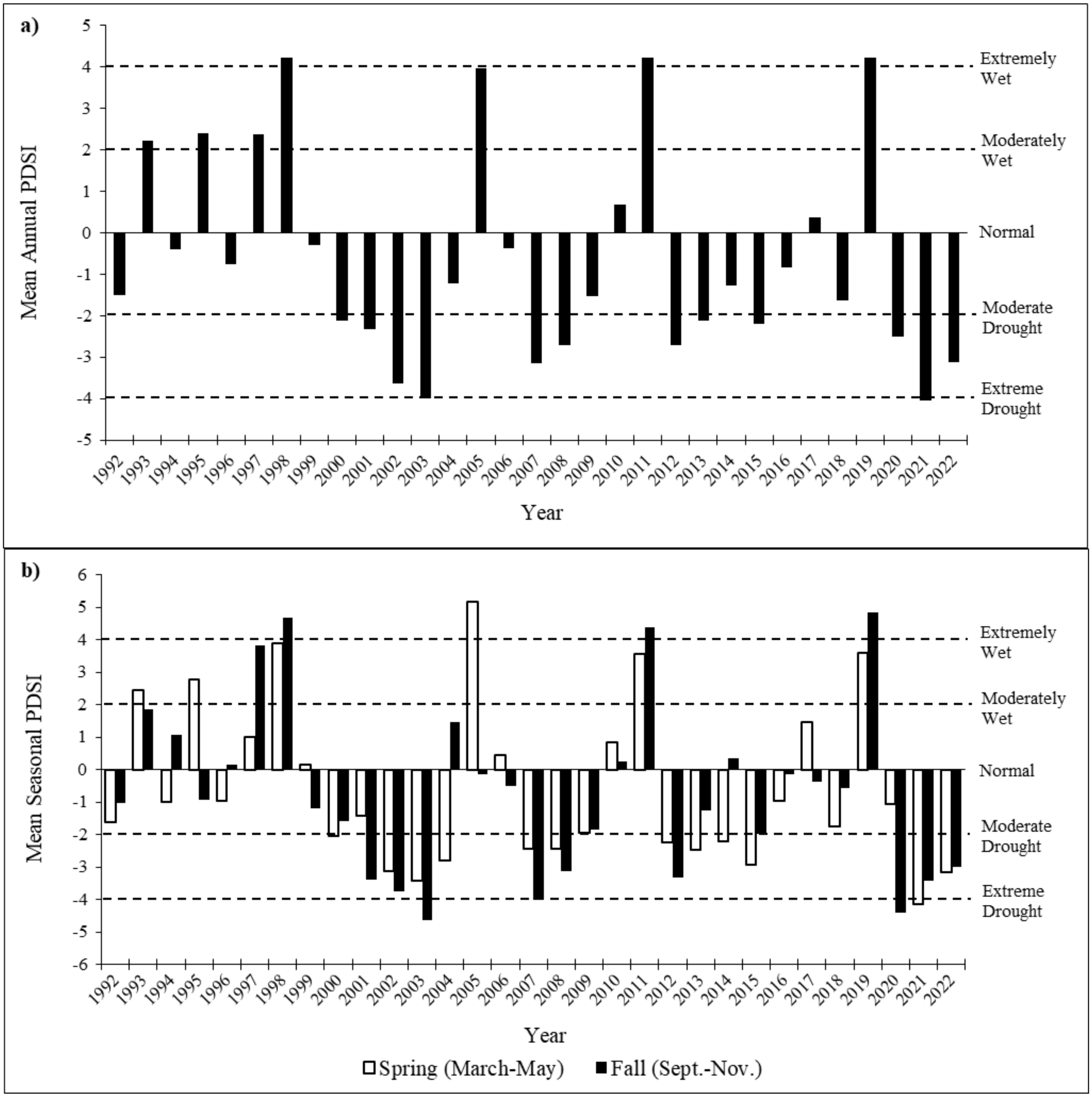


Figure 4.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the Western division (Division 1). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

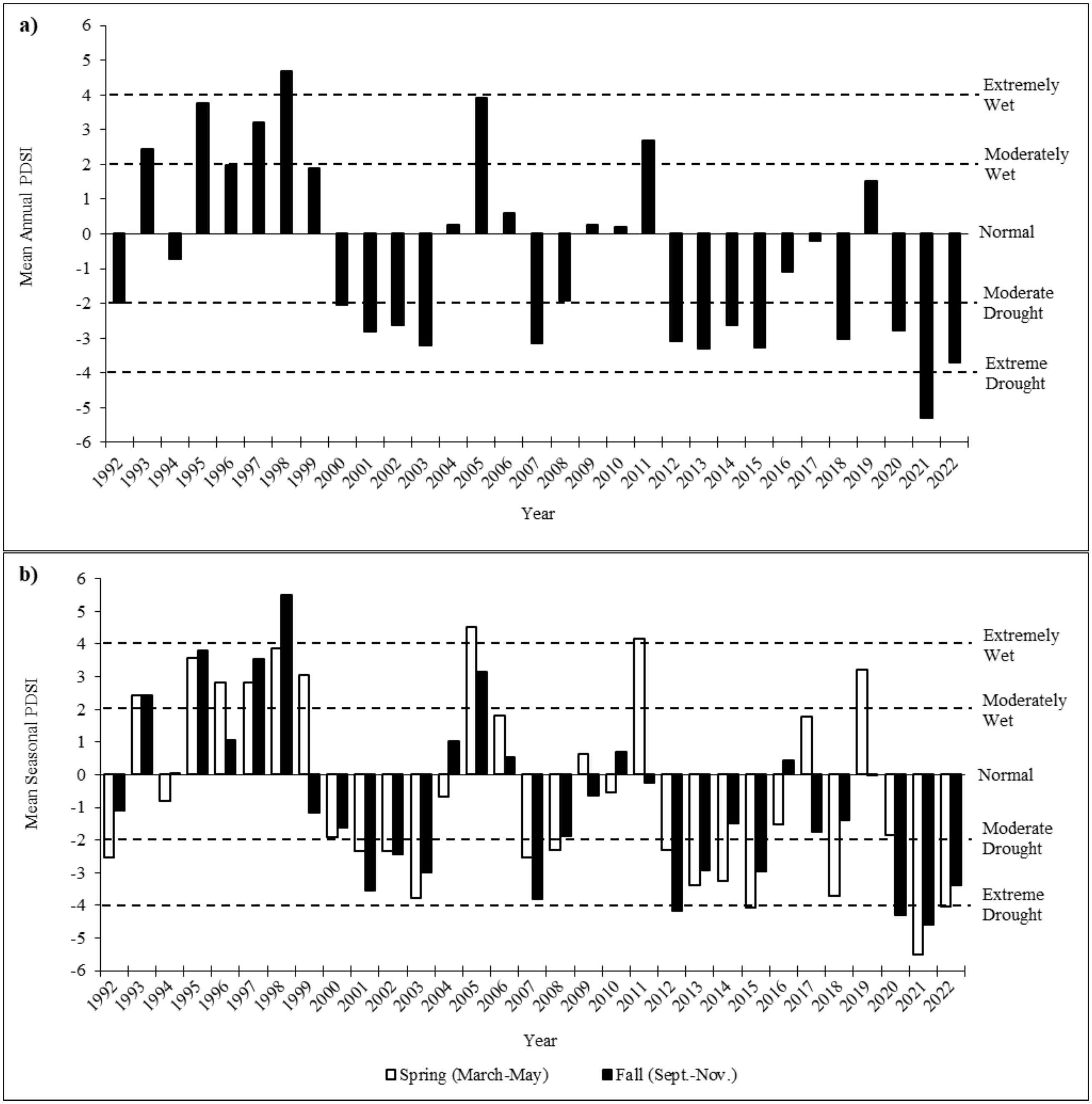


Figure 4.2: The 1992-2022 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

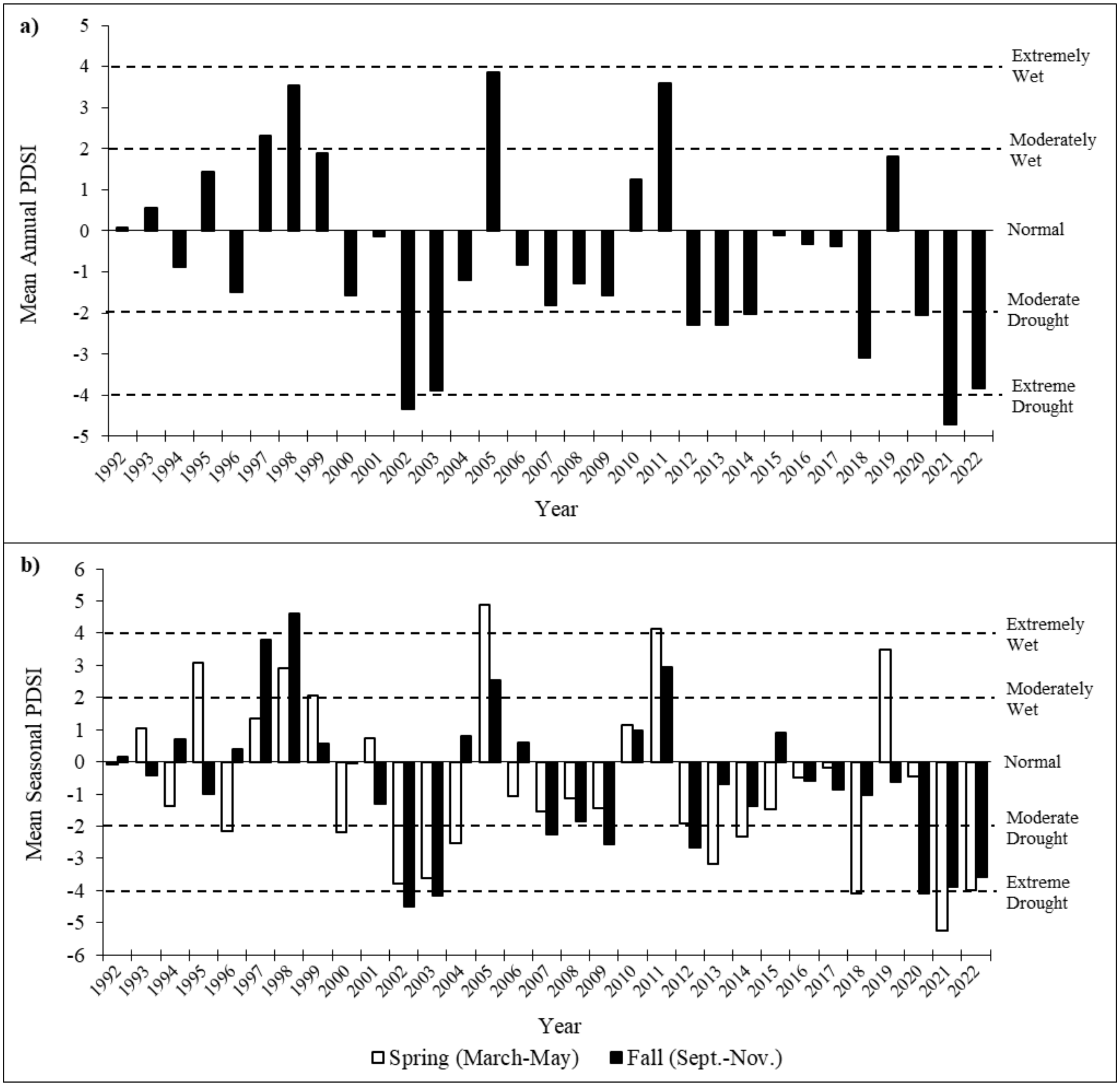


Figure 4.3: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

Big Game Habitat

Deer winter range mainly follows the foothills of the Sheeprock and Simpson Mountains, with a stretch of winter habitat near Keg Mountain. The upper limit of normal deer winter range is around 7,000 feet and the lower limit is around 5,500 feet. The unit is limited at the low elevation portions of the unit where the vegetation switches to less palatable salt desert vegetation.

This unit contains mixed mountain brush and aspen communities at higher elevations that are summer and fall ranges: these communities support diverse understories, which are crucial for these ranges. However, this unit does not have significant amounts of summer range. Sagebrush-juniper and juniper communities are present at the edges of the winter range on this unit. In these lower elevation ecological types, juniper trees do provide thermal cover, but they also pose a threat of encroachment.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, “[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances” (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between Range Trend samplings.

The RAP data shows fluctuations of herbaceous biomass and cover on both summer and winter deer winter range; the highest values for both measurements have mainly been observed in the early-mid 1990s and late 2010s. Both annual and perennial cover and biomass have generally followed precipitation trends, with a tighter correlation present with biomass data. Increases and decreases in biomass and cover are more pronounced on the winter habitats (**Figure 4.4**, **Figure 4.5**, **Figure 4.6**, **Figure 4.7**). As expected, some peaks and troughs in this herbaceous data can be correlated with Palmer Drought Severity Index (PDSI) data. For example, increased cover and biomass in 2019 correspond with PDSI values that show wetter than normal years and a moderately to extremely wet spring and/or fall depending on division (**Figure 4.1a**, **Figure 4.1b**, **Figure 4.2a**, **Figure 4.2b**, **Figure 4.3a**, **Figure 4.3b**). Of additional interest is the increasing difference in biomass and cover between annual and perennial lifeforms observed in the mid-1990s. The GECSC fire map indicates that larger fires took place within the Vernon unit in 1994 and 1996 (**Map 4.5**), which may correlate with this initial divergence.

Range Trend data for herbaceous cover from 1997 to present shows fluctuations in both perennial and annual lifeforms, but an overall increase occurred on many ecotypes (**Figure 4.23**, **Figure 4.24**). Year-to-year fluctuations can be expected due to differences in precipitation and the timing of data collection between sample years.

RAP data indicates that shrub and tree cover on mule deer summer and winter range shows less variability than that of herbaceous lifeforms. Tree and shrub cover also tracks with precipitation in many years, but more loosely so than herbaceous cover and biomass. Cover values for mule deer summer habitat have displayed more overall stability than those of winter habitat (**Figure 4.8**, **Figure 4.9**). Range Trend data for tree and shrub cover values differ between ecotypes. Sites in some upland and mountain potentials have exhibited overall shrub cover decreases since 2012, while trends over time are not available for other ecotypes (**Figure 4.10**, **Figure 4.11**, **Figure 4.12**, **Figure 4.13**, **Figure 4.14**, **Figure 4.15**)

RAP – Biomass by Deer Habitat

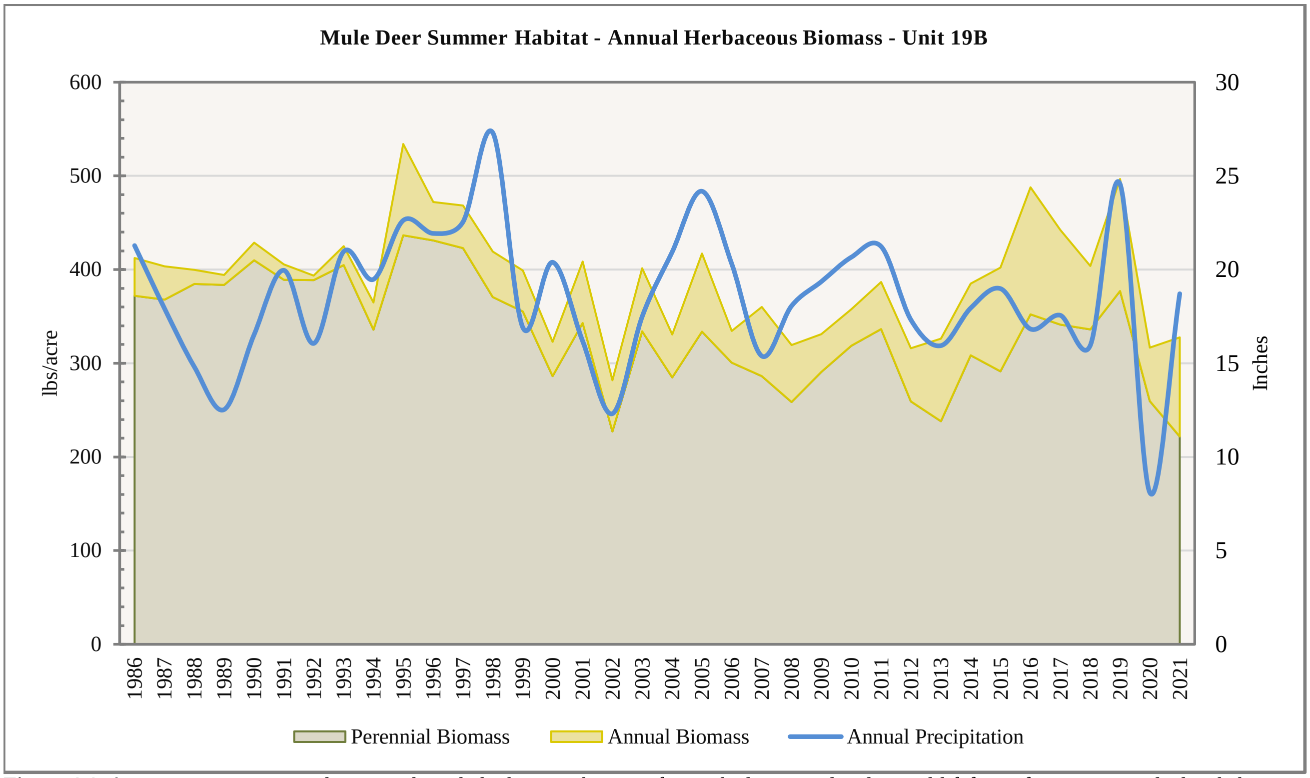


Figure 4.4: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 19B, West Desert - Vernon (Rangeland Analysis Platform, 2023).

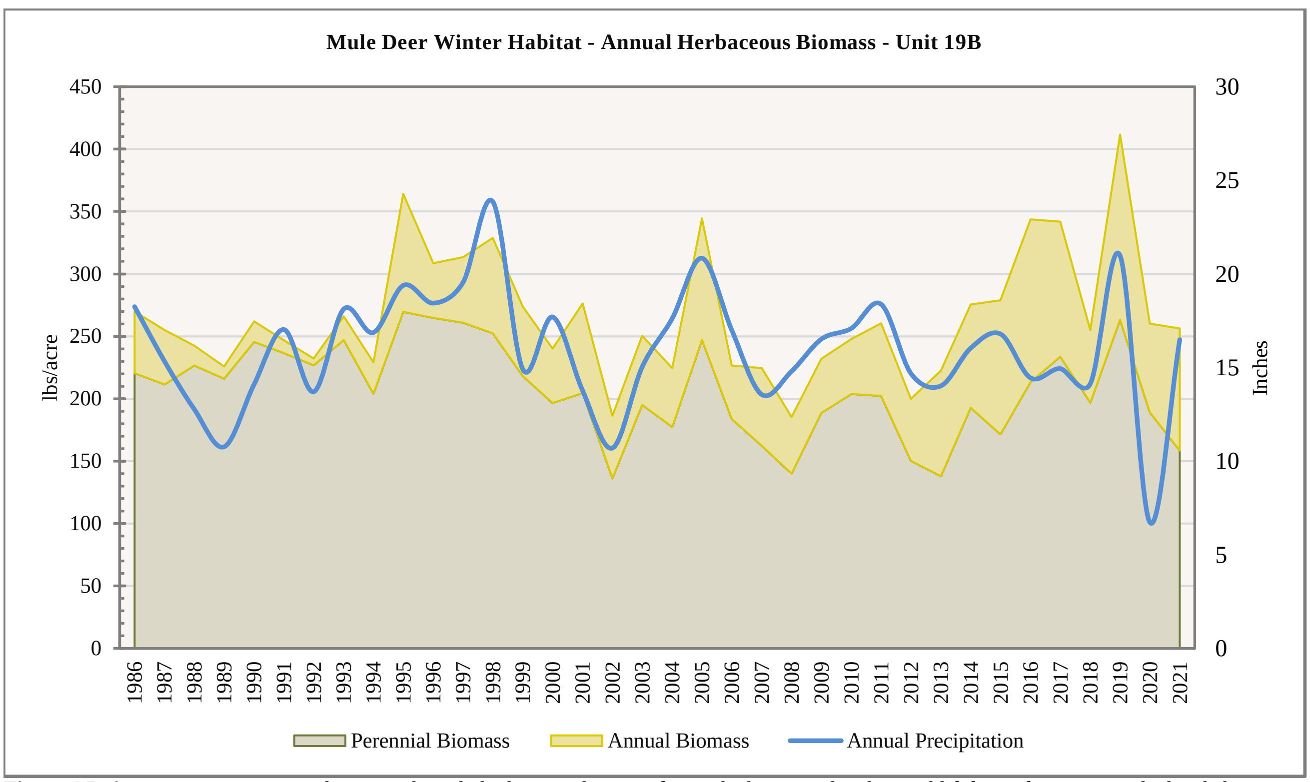


Figure 4.5: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 19B, West Desert - Vernon (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

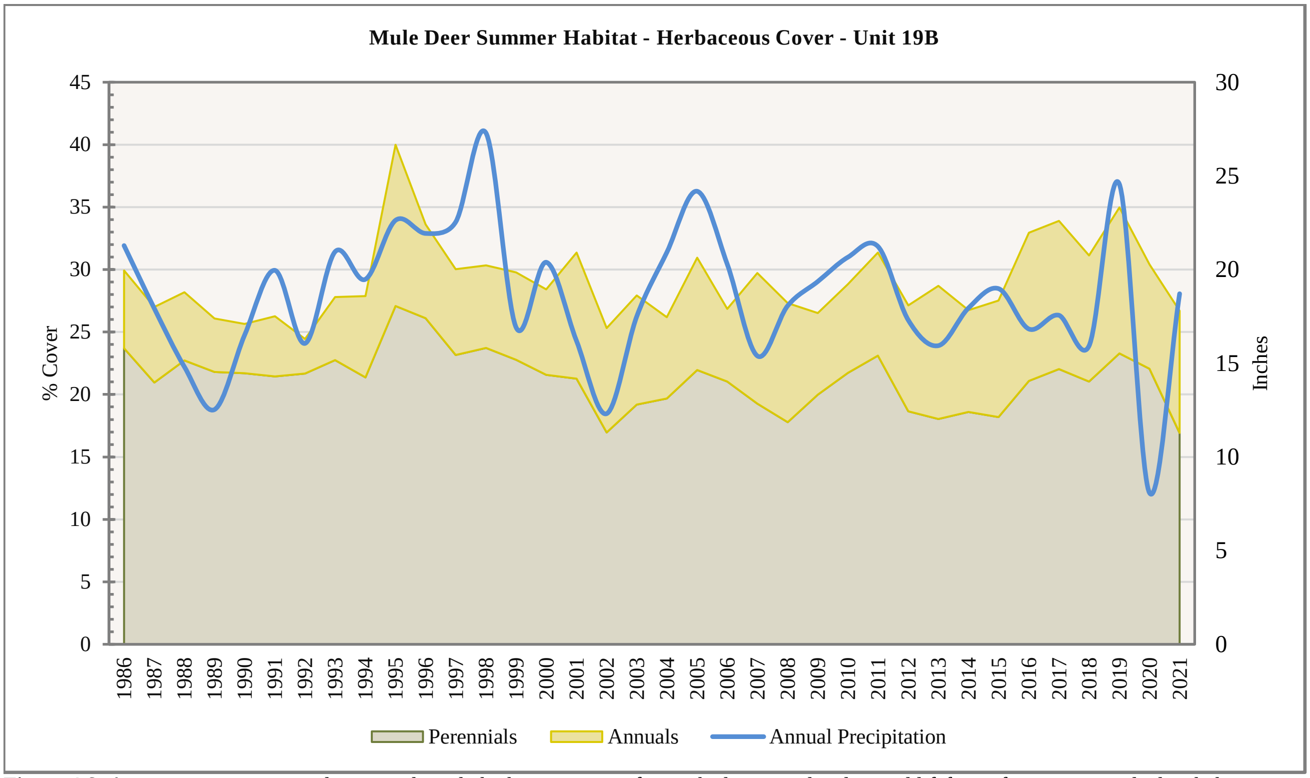


Figure 4.6: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 19B, West Desert - Vernon (Rangeland Analysis Platform, 2023).

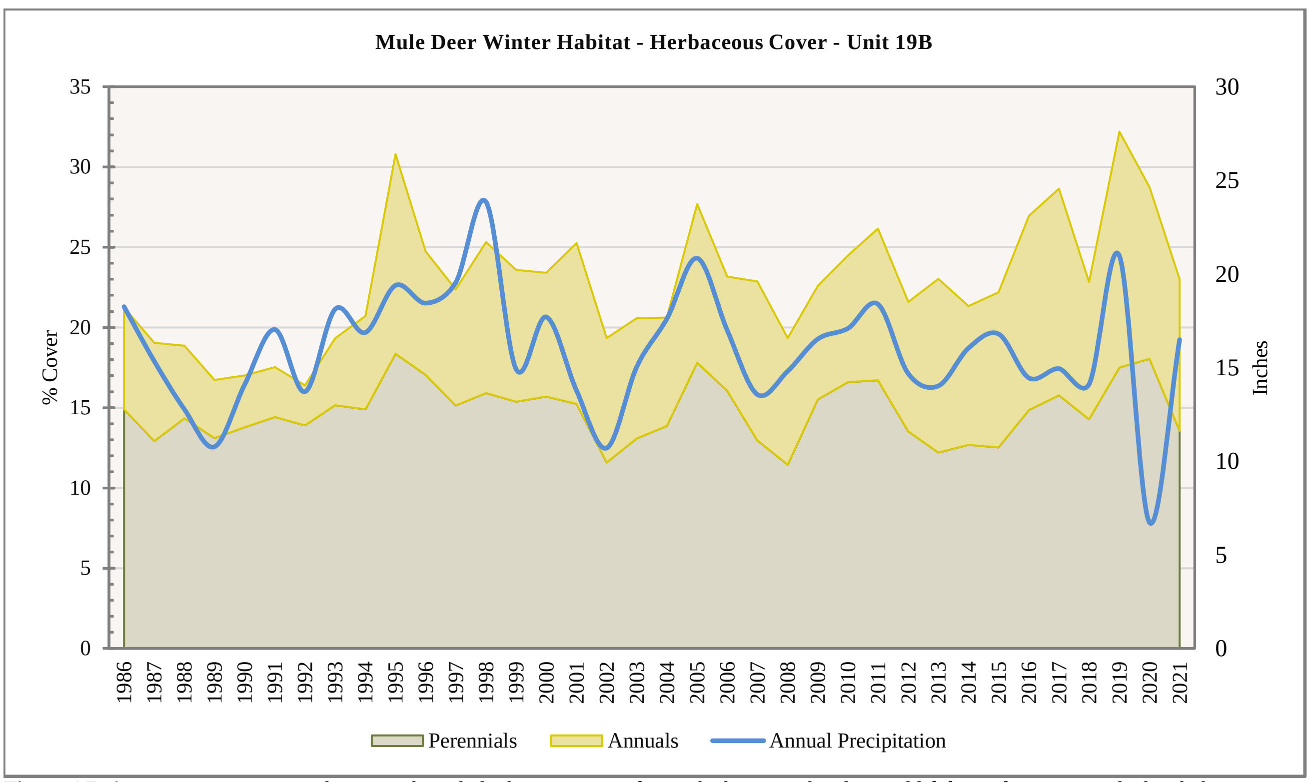


Figure 4.7: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 19B, West Desert - Vernon (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

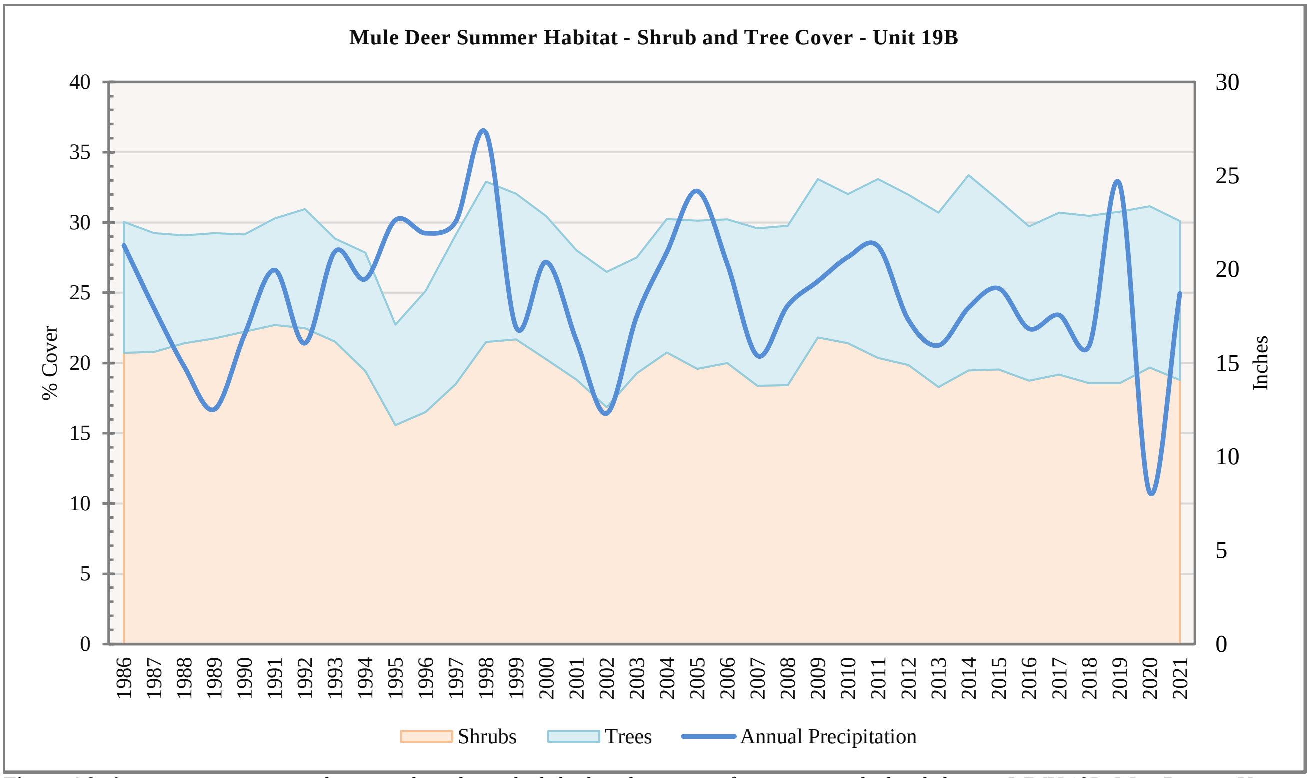


Figure 4.8: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 19B, West Desert - Vernon (Rangeland Analysis Platform, 2023).

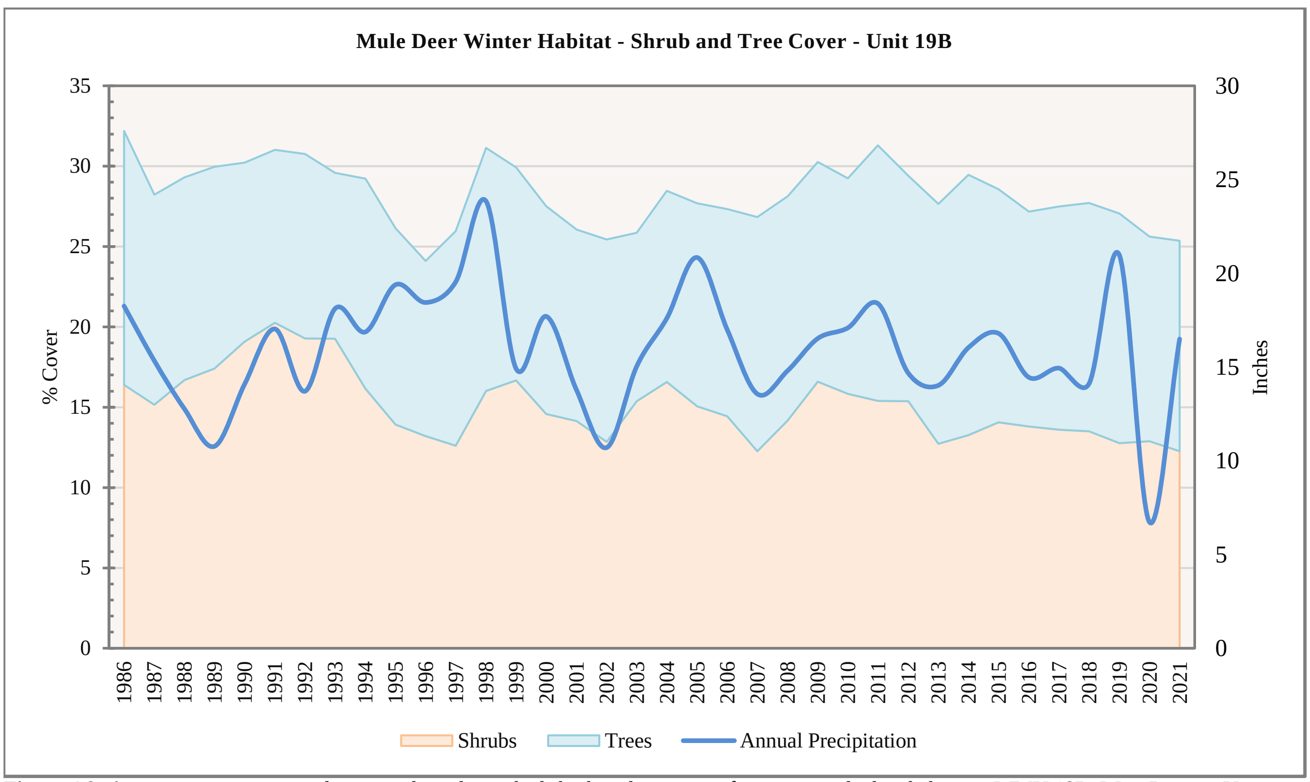
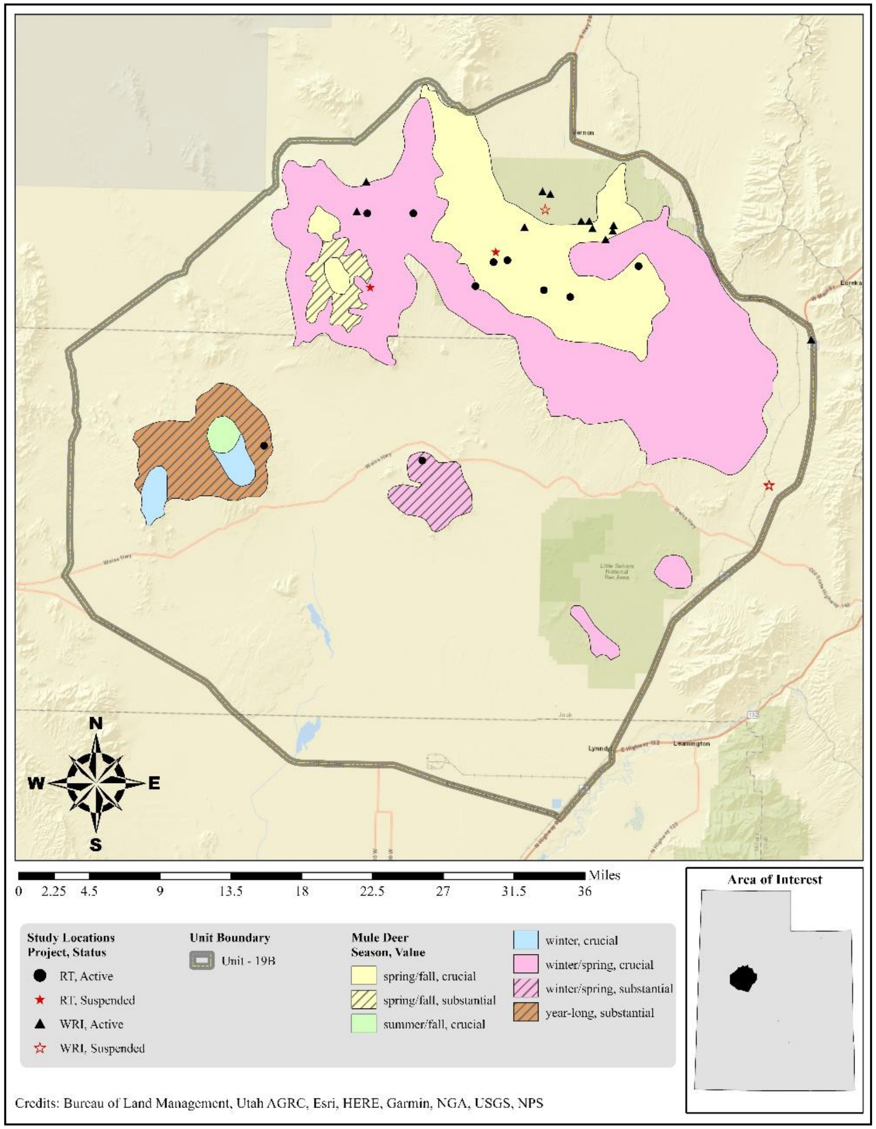
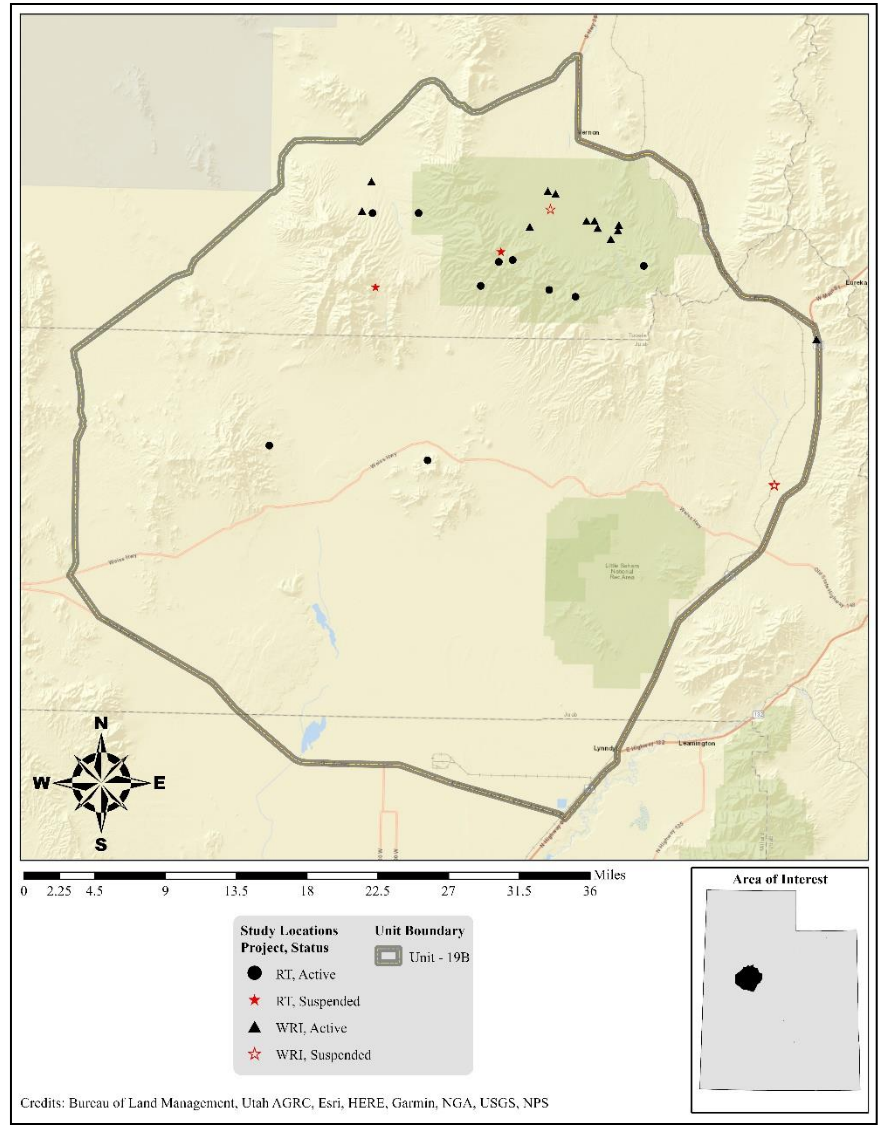


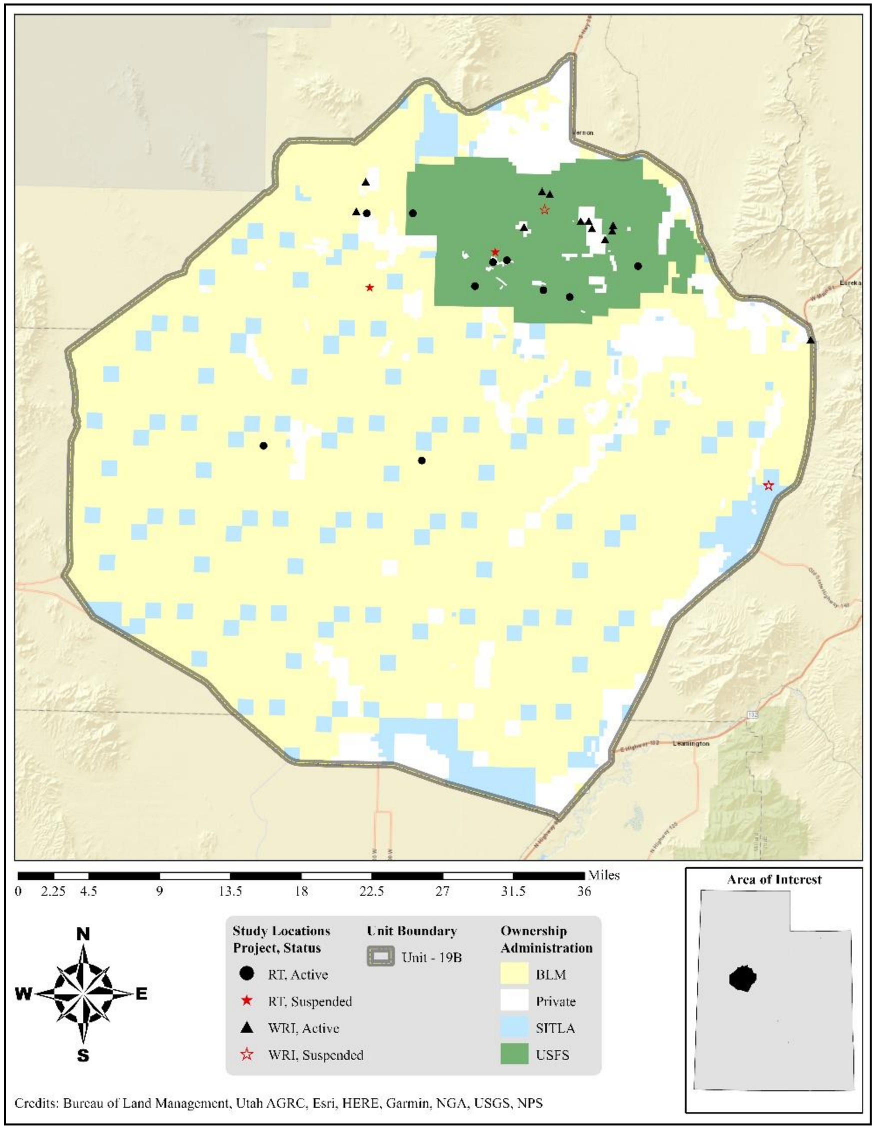
Figure 4.9: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 19B, West Desert - Vernon (Rangeland Analysis Platform, 2023).



Map 4.2: Estimated mule deer habitat by season and value for WMU 19B, West Desert - Vernon.



Map 4.3: Estimated elk habitat by season and value for WMU 19B, West Desert - Vernon.



Map 4.4: Land ownership for WMU 19B, West Desert - Vernon.

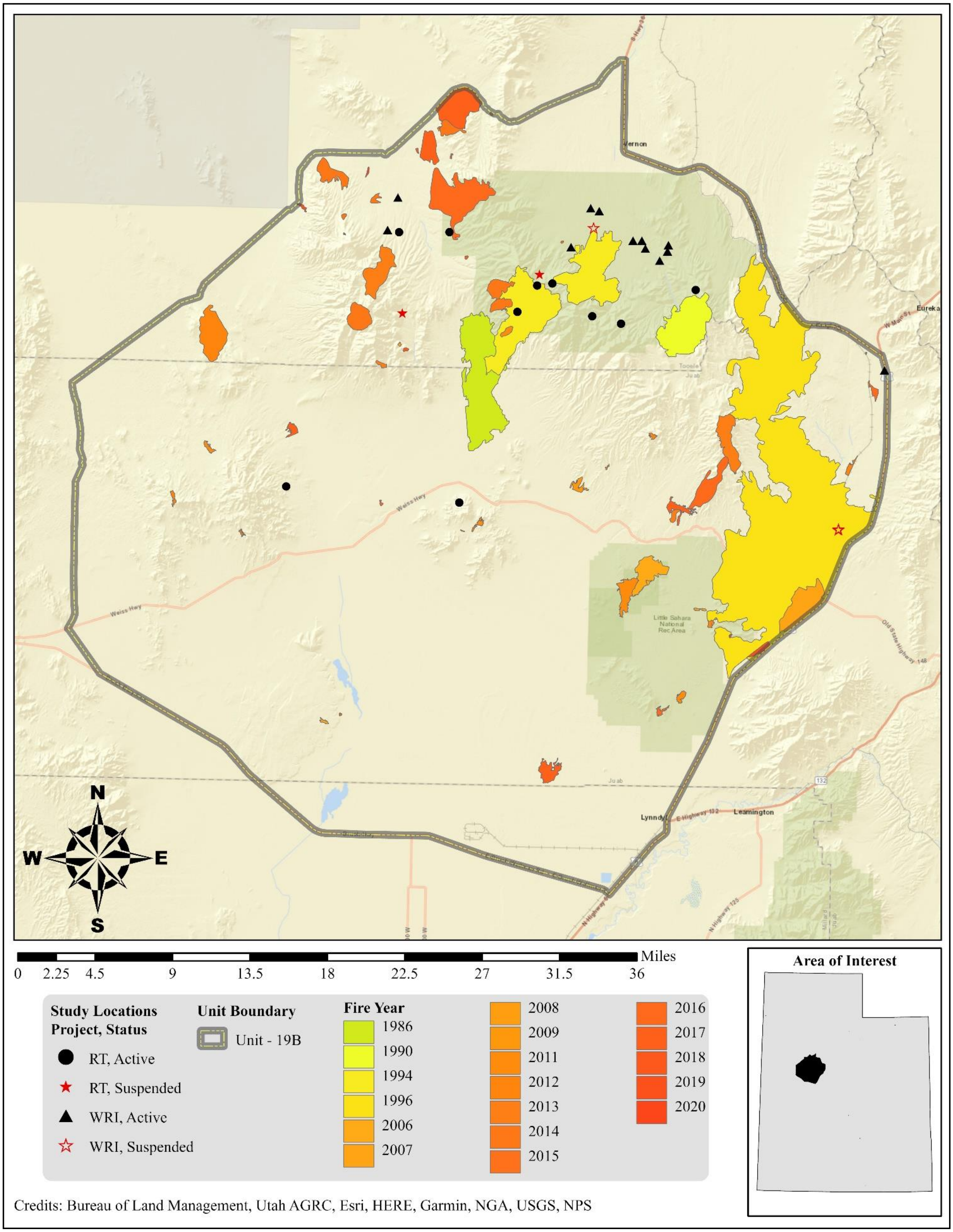
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	58,779	20.78%	
	Inter-Mountain Basins Montane Sagebrush Steppe	43,652	15.43%	
	Great Basin Xeric Mixed Sagebrush Shrubland	23,383	8.27%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	6,073	2.15%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	3,350	1.18%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	3,185	1.13%	
	Inter-Mountain Basins Big Sagebrush Steppe	1,055	0.37%	
	Great Basin Semi-Desert Chaparral	953	0.34%	
	Rocky Mountain Lower Montane-Foothill Shrubland	841	0.30%	
	Desert Scrub	278	0.10%	
	Inter-Mountain Basins Greasewood Flat	42	0.01%	50.05%
Conifer	Great Basin Pinyon-Juniper Woodland	104,684	37.00%	
	Colorado Plateau Pinyon-Juniper Woodland	13,174	4.66%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	2,358	0.83%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	847	0.30%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	288	0.10%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	74	0.03%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	42	0.01%	
	Inter-Mountain Basins Juniper Savanna	26	0.01%	42.94%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	5,953	2.10%	
	Interior Western North American Temperate Ruderal Shrubland	5	0.00%	2.11%
Other	Hardwood	1,582	0.56%	
	Developed	1,159	0.41%	
	Riparian	925	0.33%	
	Sparsely Vegetated	726	0.26%	
	Conifer-Hardwood	451	0.16%	
	Agricultural	287	0.10%	
	Open Water	40	0.01%	1.83%
Exotic Herbaceous	Great Basin & Intermountain Introduced Annual Grassland	2,022	0.71%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	1,942	0.69%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	491	0.17%	
	Interior Western North American Temperate Ruderal Grassland	137	0.05%	1.62%
Grassland	Southern Rocky Mountain Montane-Subalpine Grassland	2,194	0.78%	
	Inter-Mountain Basins Semi-Desert Grassland	1,642	0.58%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	265	0.09%	1.45%
Total		**282,905**	**100%**	**100%**

Table 4.1: LANDFIRE Existing Vegetation Coverage For Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 19B, West Desert - Vernon.

Limiting Factors to Big Game Habitat

Major human activities in the area include livestock grazing, off-road recreation, and some agriculture. In addition, encroachment by pinyon-juniper woodland communities poses a threat to important sagebrush rangelands. There has been significant work in this unit to reduce tree cover in order to improve sage grouse habitat. According to the current LANDFIRE Existing Vegetation Coverage model, 41.66% of the Vernon subunit's mule deer habitat is comprised of pinyon-juniper woodlands. 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).

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, 1.45% of the unit's mule deer habitat is comprised of exotic herbaceous species (**Table 4.1**). Increased amounts of cheatgrass increase the risk for catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013)



Map 4.5: Land coverage of fires by year from 1986-2020 for WMU 19B, West Desert - Vernon (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

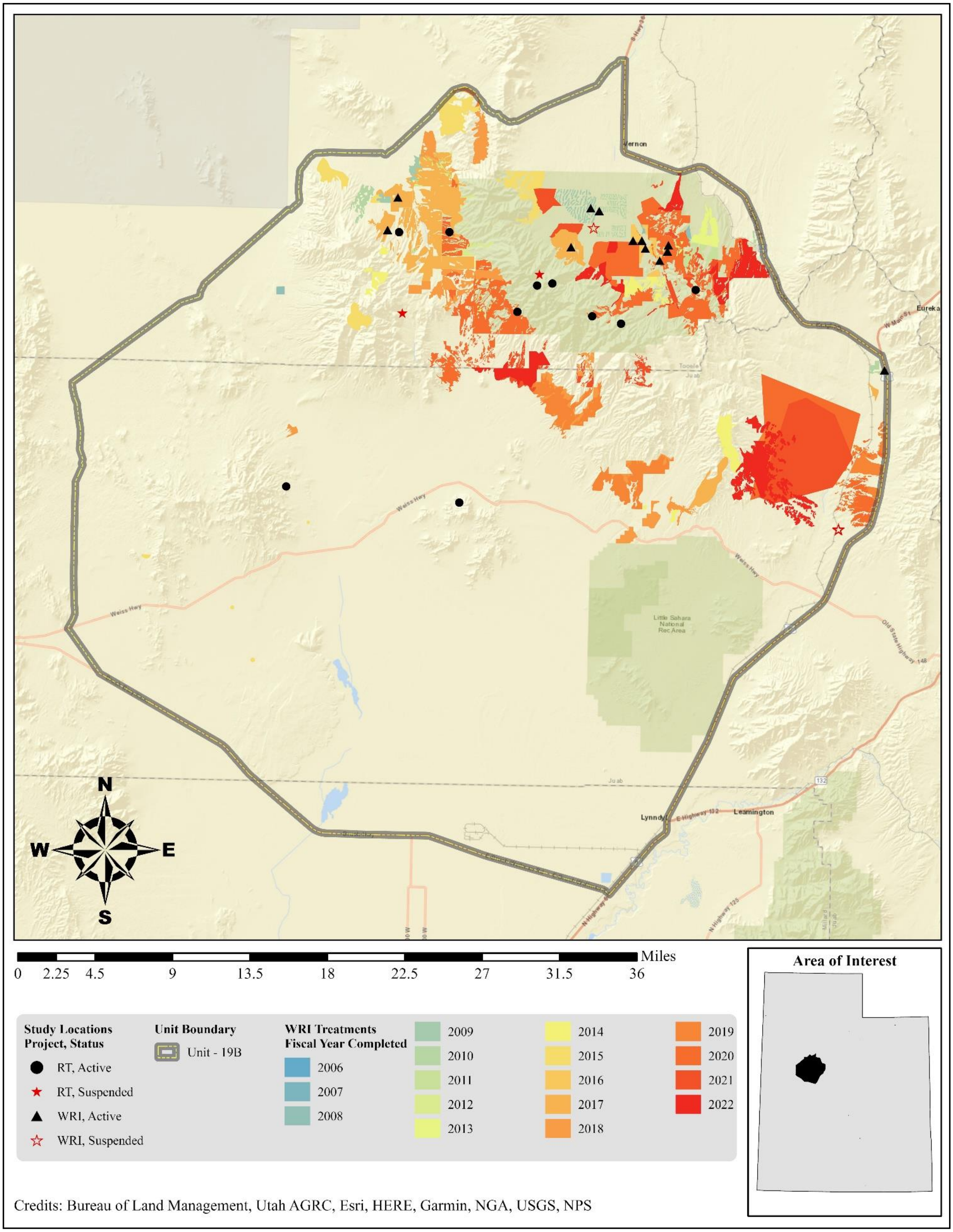
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 92,647 acres of land have been treated within the Vernon subunit since the WRI was implemented in 2004 (**Map 4.6**). An additional 7,409 acres are currently being treated and treatments have been proposed for 5,221 acres. Treatments frequently overlap one another, bringing the net total of completed treatment acres to 80,600 acres for this unit (**Table 4.2**). 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.

Lop and scatter as well as bullhog treatments are common treatment types across the unit. Anchor chaining is also often used. Seeding to supplement the herbaceous understory is frequently combined with some of the conifer removal projects. Other treatments include (but are not limited to) harrow, herbicide application, and mowing (**Table 4.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**5,666**	**0**	**0**	**5,666**
Ely (One-Way)	4,496	0	0	4,496
Ely (Two-Way)	1,170	0	0	1,170
Bullhog	**22,514**	**78**	**2,591**	**25,183**
Full Size	21,704	78	2,591	24,373
Skid Steer	810	0	0	810
Harrow	**2,092**	**0**	**0**	**2,092**
≤ 15 ft. (One-Way)	117	0	0	117
≤ 15 ft. (Two-Way)	162	0	0	162
> 15 ft. (Two-Way)	1,813	0	0	1,813
Herbicide Application	**1,254**	**0**	**0**	**1,254**
Aerial (Fixed-Wing)	877	0	0	877
Ground	377	0	0	377
Mowing	**30**	**0**	**0**	**30**
Other	30	0	0	30
Planting/Transplanting	**199**	**2,544**	**158**	**2,901**
Container Stock	199	2,544	158	2,901
Seeding (Primary)	**18,299**	**695**	**56**	**19,051**
Broadcast (Aerial-Fixed Wing)	9,714	0	0	9,714
Broadcast (Aerial-Helicopter)	7,102	695	56	7,854
Drill (Rangeland)	1,096	0	0	1,096
Drill (Truax)	387	0	0	387
Vegetation Removal/Hand Crew	**42,593**	**4,092**	**2,416**	**49,100**
Lop (No Scatter)	3,841	0	0	3,841
Lop & Scatter	38,752	4,092	2,416	45,260
Grand Total	**92,647**	**7,409**	**5,221**	**105,278**
***Total Land Area Treated**	**80,600**	**7,337**	**5,221**	**93,158**

Table 4.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 19B, West Desert - Vernon. Data accessed on 01/23/2023 *Does not include overlapping treatments.



Map 4.6: WRI treatments by fiscal year completed for WMU 19B, West Desert - Vernon.

Range Trend Studies

Range Trend studies have been sampled within WMU 19B on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 4.3**). 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 4.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
19B-1	Sabie Mountain	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
19B-2	Upper Little Valley	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Browse)
19B-3	Bennion Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Browse)
19B-4	Harker Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017	Mountain Loam (Browse)
19B-5	West Government Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
19B-6	Lee’s Creek	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
19B-7	Judd Creek	RT	Suspended	1989, 1997, 2002, 2007	Mountain Stony Loam (Antelope Bitterbrush)
19B-8	South Pine Canyon	RT	Active	1983, 1989, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
19B-9	North Oak Brush Canyon	RT	Suspended	1989, 1997	Mountain Stony Loam (Oak)
19B-10	Keg Mountain	RT	Active	2022	Upland Shallow Loam (Black Sagebrush)
19B-11	Desert Mountain	RT	Active	2022	Semidesert Bouldery Loam (Wyoming Big Sagebrush)
19B-12	Hilltop Mine	RT	Active	2022	High Mountain Stony Loam (Mountain Big Sagebrush)
19B-21	Jericho State Section	WRI	Suspended	1998, 2002, 2007	Not Verified
19B-22	Jericho BLM	WRI	Suspended	1998, 2002, 2007, 2012	Semidesert Loam (Wyoming Big Sagebrush)
19R-1	West Lee's Creek	WRI	Active	2004, 2007, 2012, 2017, 2022	Mountain Stony Loam (Antelope Bitterbrush)
19R-4	Bennion Chaining	WRI	Active	2005, 2010, 2015, 2019	Upland Gravelly Loam (Wyoming Big Sagebrush)
19R-6	Sage Valley Dixie	WRI	Active	2006, 2008, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
19R-7	Bennion Sagebrush Chaining	WRI	Active	2006, 2010, 2014, 2018	Upland Loam (Mountain Big Sagebrush)
19R-8	Bennion Spike 1	WRI	Suspended	2006, 2010, 2014, 2018	Upland Loam (Mountain Big Sagebrush)
19R-9	Bennion Spike 2	WRI	Suspended	2006, 2010, 2014, 2018	Upland Loam (Mountain Big Sagebrush)
19R-10	Tintic Knapweed Control	WRI	Suspended	2008, 2011, 2015	Upland Loam (Wyoming Big Sagebrush)
19R-11	James Ranch Bullhog	WRI	Active	2008, 2011, 2015, 2018	Upland Loam (Mountain Big Sagebrush)
19R-13	Diagonal/Electric Harrow	WRI	Active	2008, 2009, 2010, 2014, 2018	Upland Loam (Mountain Big Sagebrush)
19R-15	Benmore Reference	WRI	Suspended	2009	Not Verified
19R-16	Benmore Harrow	WRI	Active	2009, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
19R-22	East Vernon Bullhog	WRI	Active	2012, 2015, 2018	Upland Gravelly Loam (Bonneville Big Sagebrush)
19R-23	Lion Hill	WRI	Active	2015, 2018	Upland Loam (Mountain Big Sagebrush)

Table 4.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 19B, West Desert - Vernon.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
19B-1	Sabie Mountain	Lop and Scatter	Vernon Ecosystem Phase 4	May-August 2019	7,938	4900
19B-5	West Government Creek	Lop and Scatter	Western Sheeprock Sage Grouse Habitat Improvement	July 2019-June 2020	5,059	4939
		Chain Unknown		Late 1960s		
		Seed Unknown		Late 1960s		
		Lop and Scatter	West Government	July 2011-May 2012	1,613	2024
19B-6	Lee's Creek	Two-Way Unknown	James Seeding	August-December 1970	1,500	
		Aerial Before	James Seeding	August-December 1970	1,500	
19B-7	Judd Creek	Wildfire	Sheeprock	June 1996	9,280	
19B-8	South Pine Canyon	Wildfire	East Harker (Vernon Complex)	1994	8,197	
19B-12	Hilltop Mine	Wildfire	East Harker (Vernon Complex)	1994	8,197	
19B-21	Jericho State Section	Wildfire	Leamington Burn Complex	August 1996	138,340	
		Aerial		October 1996	1,200	
19B-22	Jericho BLM	Wildfire	Leamington Burn Complex	August 1996	138,340	
		One-Way Ely Chain		October 1996	2,131	
		Aerial Before		October 1996	2,131	
		Dribbler		October 1996	2,131	
19R-1	West Lee's Creek	Two-Way Chain Unknown	James Seeding	June-December 1970	1,500	
		Aerial Before	James Seeding	June-December 1970	1,500	
		Bullhog	Lee Canyon HFR	November 2004-April 2005	700	PDB
		Aerial Before	Lee Canyon HFR	November 2004	700	PDB
		Bullhog	Lee Canyon HFR	May 2009	720	PDB
		Bullhog	Government Creek GRSG Habitat Improvement	September 2016-February 2017	5,746	3635
19R-4	Bennion Chaining	Lop and Scatter	Bennion Ranch Lop and Scatter	May 2016	1,047	3408
		Two-Way Smooth	Bennion Ranch Sage Grouse Demonstration Year 1	September-December 2006	450	55
		Aerial Before	Bennion Ranch Sage Grouse Demonstration Year 1	December 2006	450	55
		Dribbler	Bennion Ranch Sage Grouse Demonstration Year 1	September-December 2006	450	55
		Aerial After	Bennion Ranch Sage Grouse Demonstration Year 1	January 2007	450	55
19R-6	Sage Valley Dixie	Two-Way Dixie	Sage Valley/Vernon sagebrush enhancement-Year 1	October-November 2006	162	291
		Broadcast Before	Sage Valley/Vernon sagebrush enhancement-Year 1	October-November 2006	162	291
		Lop and Scatter	Vernon Ecosystem Phase 4	May-August 2019	7,938	4900
19R-7	Bennion Sagebrush Chaining	Lop and Scatter	Bennion Ranch Lop and Scatter	May 2016	1,047	3408
		Two-Way Ely	Bennion Ranch Sage Grouse Demonstration Year 2	November-December 2006	192	396
		Aerial Before	Bennion Ranch Sage Grouse Demonstration Year 2	December 2006	192	396
		Dribbler	Bennion Ranch Sage Grouse Demonstration Year 2	December 2006	192	396
19R-8	Bennion Spike 1	Spike	Bennion Ranch Sage Grouse Demonstration Year 2	September 2006	158	396
		Lop and Scatter	Bennion Ranch Lop and Scatter	May 2016	1,047	3408
19R-9	Bennion Spike 2	Mower		May-June 2018		
		Spike	Bennion Ranch Sage Grouse Demonstration Year 2	September 2006	158	396
19R-10	Tintic Knapweed Control	2-4D	Tintic Junction Knapweed Control and Habitat Improvement Project	April-July 2008	55	1102
		Prescribed Fire	Tintic Junction Knapweed Control and Habitat Improvement Project	October 2008	55	1102
		Rangeland Drill	Tintic Junction Knapweed Control and Habitat Improvement Project	November 2008	55	1102
		Plateau	Tintic Junction Knapweed Control and Habitat Improvement Project	September 2009	53	1348
		Milestone	Tintic Junction Knapweed Control and Habitat Improvement Project	April-July 2010	53	1348
19R-11	James Ranch Bullhog	Bullhog	James Ranch Juniper Bullhog	February-March 2009	473	1131

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
19R-13	Diagonal/Electric Harrow	Two-Way Dixie	Diagonal-Electric Sagebrush Improvement	November 2008-March 2009	993	659
		Broadcast Before	Diagonal-Electric Sagebrush Improvement	November 2008-March 2009	993	659
19R-16	Benmore Harrow	Two-Way Chain	Benmore Pastures Dixie Harrow Project	October-December 2009	731	1361
		Broadcast Before	Benmore Pastures Dixie Harrow Project	October-December 2009	731	1361
19R-22	East Vernon Bullhog	Bullhog	East Vernon Habitat Restoration	September 2012-January 2013	413	2292
		Lop and Scatter	Vernon Ecosystem Phase 4 (Proposed)	August 2019	7,023	4900
19R-23	Lion Hill	Push	West Vernon Phase 5: Lion Hill	May 2016	285	3236
		Plateau	West Vernon Phase 5: Lion Hill	May 2016	285	3236
		One-Way Ely	West Vernon Phase 5: Lion Hill	April 2016	285	3236
		Aerial Before	West Vernon Phase 5: Lion Hill	November 2016	285	3236

Table 4.4: Range Trend and WRI studies known disturbance history for WMU 19B, West Desert - Vernon. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

Three studies [Sabie Mountain (19B-1), South Pine Canyon (19B-8), and Hilltop Mine (19B-12)] are considered to be Mountain (Big Sagebrush) ecological sites. The Sabie Mountain study is located in the West Tintic Mountains southeast of Vernon, and South Pine Canyon is in the Sheeprock Mountains south of Erickson Pass. The Hilltop Mine study is located approximately one mile southeast of Black Crook Peak and downslope from the old Hilltop Mine in the Sheeprock Mountains (**Table 4.3**).

<u>Shrubs/Trees</u>: The dominant preferred browse on these sites is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), although mountain snowberry (*Symphoricarpos oreophilus*) is co-dominant on the Sabie Mountain site. Total average shrub cover increased between 2002 and 2017, but decreased in 2022: this decrease can mainly be attributed to two factors. Firstly, preferred browse cover decreased on the Sabie Mountain site by 11% between 2017 and 2022. Secondly, the Hilltop Mine study site was established in 2022 and had just under 17% preferred browse cover, leading to a decreased cover value when averaged with values from the other study sites (**Figure 4.10**). Total preferred browse density initially decreased between 1997 and 2002 due to the installation of the South Pine Canyon study, but exhibited a general increase through 2017. A reduction in density was observed in 2022, mainly due to both a decrease on South Pine Canyon and the establishment of the Hilltop Mine site. Mature plants have comprised a majority of the browse populations on these sites in all sample years, and decadence has remained low. Recruitment of young has fluctuated from year to year, and a majority of the young individuals was observed on the Sabie Mountain study in 2022 (**Figure 4.19**). Average preferred browse utilization increased overall through 2017, but decreased in 2022; 2.5% of plants were moderately used and 0.4% were heavily hedged during the most recent sample year (**Figure 4.21**).

Tree cover and density trends are entirely driven by Utah juniper (*Juniperus osteosperma*) and singleleaf pinyon (*Pinus monophylla*) on the Sabie Mountain study, as pinyon-juniper are not present on the other sites. Trees were observed with moderate cover and density through the 2017 year, but data for both measurements decreased in 2022: this is due to a lop and scatter treatment that occurred between May and August of 2019 (**Figure 4.13**, **Figure 4.16**).

<u>Herbaceous Understory</u>: Average herbaceous cover and frequency decreased between 1997 and 2002 due to decreases on the Sabie Mountain site and the installation of the South Pine Canyon study. However, total frequency and cover have increased since 2002. Annual grasses were the dominant herbaceous component in 2002 and 2007; annual grass trends for sites of this ecotype are almost entirely driven by the introduced species cheatgrass (*Bromus tectorum*) on the South Pine Canyon study. Native perennial forbs have been the dominant component in all other sample years: this is mainly due to the Sabie Mountain study, as well as the establishment of the Hilltop Mine site in 2022. Annual forbs have increased over time on South Pine Canyon, and to a lesser extent, Sabie Mountain. Perennial grasses contribute good cover as of 2022 largely due to the Hilltop Mine and Sabie Mountain studies. The introduced species rescuegrass (*Bromus catharticus*) provided most of the perennial grass cover on the Hilltop Mine site in 2022, while the native species muttongrass (*Poa fendleriana*) and Sandberg bluegrass (*P. secunda*) contributed most of the cover on Sabie Mountain. The introduced perennial grass species bulbous bluegrass (*P. bulbosa*) has been observed in the understories of the South Pine Canyon and Sabie Mountain studies, but in low amounts (**Figure 4.23**, **Figure 4.25**).

<u>Occupancy</u>: Average pellet transect data indicates that animal occupancy on these sites decreased between 2002 and 2012, but has increased each year since then; the increase between 2017 and 2022 can largely be attributed to the establishment of the Hilltop Mine study. Deer have been the primary occupants in all sample years with a mean

abundance of pellet groups ranging from 7 days use/acre in 2012 to 42 days use/acre in 2022. Elk have also been present with a mean abundance of pellet groups as low as 0 days use/acre in 2002 and 2012 and as high as 8 days use/acre in 2007. Mean abundance of cattle pellet groups has ranged from 1 days use/acre in 2022 to 6 days use/acre in 2002 (**Figure 4.27**).

Mountain (Oak)

One study site [North Oak Brush Canyon (19B-9) (suspended)] is considered to be a Mountain (Oak) ecological site: this study is located up North Oak Brush Canyon in the Sheeprock Mountains (**Table 4.3**).

<u>Shrubs/Trees</u>: The dominant browse species on the North Oak Brush Canyon study was Gambel oak (*Quercus gambelii*), although mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) also contributed significant quadrat cover. Because this study site was suspended before line intercept cover methodology was implemented, data and an associated graph are not available and will not be discussed in this subsection. In addition, data for average preferred browse demographics is only available for 1997, so a trend over time cannot be determined. Mature plants were the dominant demographic in the browse population, and decadence was low. Recruitment of young was also significant, with Gambel oak contributing many of the juvenile individuals (**Figure 4.19**). Like demographic data, average preferred browse utilization data was only recorded in 1997, in which 9% of plants were moderately used and less than 1% were heavily hedged (**Figure 4.21**).

The point-quarter density and line intercept cover methodology were also implemented after the suspension of the North Oak Brush Canyon study. As such, tree density and cover data are not available for this site.

<u>Herbaceous Understory</u>: This study site was suspended following the 1997 sample year, and thus cover and frequency trends over time cannot be determined. Perennial grasses and forbs were the primary components of this site in 1997; the native species spike fescue (*Leucopoa kingii*) and muttongrass (*Poa fendleriana*) provided most of the perennial grass cover while much of the perennial forb cover was contributed by the native species mule-ears (*Wyethia amplexicaulis*). Native annual forbs were present, but in moderate abundance and with little cover. The introduced annual grass species cheatgrass (*Bromus tectorum*) was also observed, but in very low amounts (**Figure 4.23**, **Figure 4.25**).

<u>Occupancy</u>: Average pellet transect data is not available for the North Oak Brush Canyon study site as the associated method was not utilized until after the study was suspended.

Mountain (Browse)

Three studies [Upper Little Valley (19B-2), Bennion Creek (19B-3), and Harker Canyon (19B-4)] are classified as Mountain (Browse) ecological sites: all three of these study sites are located south of Vernon in the Sheeprock Mountains (**Table 4.3**).

<u>Shrubs/Trees</u>: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), mountain snowberry (*Symphoricarpos oreophilus*), and additional preferred browse species other than Utah serviceberry (*Amelanchier utahensis*) and mountain mahogany (*Cercocarpus sp.*) have been the dominant shrub component on these sites in each sample year. Total average shrub cover increased between 2002 and 2017, but decreased in 2022. This reduced average shrub cover is due to a nearly 9% decrease in preferred browse cover on Upper Little Valley site between 2017 and 2022 and the fact that the Harker Canyon study was not sampled in 2022 (**Figure 4.11**). Average density of preferred browse species increased between 2007 and 2017, but decreased in 2022: this recent decrease can be attributed to both a density decrease on Bennion Creek, and again, Harker Canyon not being sampled in 2022. Mature plants have comprised a majority of the browse populations on these sites in all years, and both decadence and recruitment of young have remained low in comparison (**Figure 4.19**). Average preferred browse utilization has fluctuated from year to year, but increased between 2017 and 2022, in which 14% of plants were moderately browsed and 1% were heavily hedged (**Figure 4.21**).

Trees contribute no cover or density on these study sites and will therefore not be discussed in this section (**Figure 4.13**, **Figure 4.16**).

<u>Herbaceous Understory</u>: Average herbaceous cover and frequency on these sites have displayed yearly fluctuations, but have increased overall. Perennial forbs such as lupine (*Lupinus sp.*) and ballhead waterleaf (*Hydrophyllum capitatum*) have provided a majority of the cover in most sample years. However, annual forbs contributed almost the same amount of cover as perennial species in 2022. This increase in mean annual forb cover can be attributed to both Harker Canyon not being sampled in the most recent year and a significant increase in cover of the introduced species desert madwort (*Alyssum desertorum*) on the Upper Little Valley site. Perennial grasses have also been a prominent understory

component throughout the study period, with mainly native species including oniongrass (*Melica bulbosa*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) providing much of the cover. Annual grasses have increased in both cover and frequency throughout the study period, a trend largely driven by the introduced species cheatgrass (*Bromus tectorum*) on Upper Little Valley. Abundance and cover of the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has also increased over time. The highest amounts of bulbous bluegrass are present on Bennion Creek as of 2022, but it has been present on all three sites during their most recent samplings (**Figure 4.23**, **Figure 4.25**).

Occupancy: Although pellet transect data indicates that occupancy increased between 2017 and 2022 (largely due to the Upper Little Valley study), it has exhibited a decrease overall. Deer have been the primary occupants in all sample years, and presence has ranged from 12 days use/acre in 2012 to 31 days use/acre in 2002. Elk have also been present, with a mean pellet group abundance as low as 0 days use/acre in 2022 and as high as 7 days use/acre in 2007. Finally, average abundance of cattle pellet groups has fluctuated between 1.7 days use/acre in 2012 and 13 days use/acre in 2002 (**Figure 4.27**).

Mountain (Shrub)

Judd Creek [(19B-7) (suspended)] is the single study site that is considered to be a Mountain (Shrub) ecological site: this site is located near Judd Creek in the Simpson Mountains (**Table 4.3**).

Shrubs/Trees: Antelope bitterbrush (*Purshia tridentata*) was the dominant browse species on this site prior to site suspension, although Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) was also present to a slightly lesser extent. A diverse number of other shrub species provided additional cover. Line intercept cover data on this site was only recorded in 2007, and thus a trend over time is not available for shrub cover (**Figure 4.12**). Average preferred browse demographics show that total density fluctuated, but increased overall between 1997 and 2007. Young plants were the primary age class through the 2002 sampling, but mature individuals were the dominant demographic in 2007. Decadence remained low over the study period (**Figure 4.19**). Average preferred browse utilization increased over time, with a significant increase occurring between 2002 and 2007; in 2007, 36% of plants were moderately browsed and 26% were heavily hedged (**Figure 4.21**).

Tree cover and density data for this study site are only available for 2007, and trends over time can therefore not be determined. Utah juniper (*Juniperus osteosperma*) provided moderate cover in 2007, but no trees were observed in point-quarter density measurements (**Figure 4.13**, **Figure 4.16**).

Herbaceous Understory: Average herbaceous cover and frequency exhibited an initial decrease between 1997 and 2002, but had increased as of the 2007 sampling. Perennial forbs such as western stoneseed (*Lithospermum ruderale*), bastard toadflax (*Comandra umbellata*), and longleaf phlox (*Phlox longifolia*) provided a majority of the herbaceous cover in 1997. Perennial grasses – namely the native species bluebunch wheatgrass (*Pseudoroegneria spicata*) and the introduced species crested wheatgrass (*Agropyron cristatum*) – increased in cover in 2002, becoming the dominant herbaceous component in that year. Annual forbs were also present with generally moderate cover and frequency, and annual grasses were scarce (**Figure 4.23**, **Figure 4.25**).

Occupancy: Average pellet transect data indicates that cattle were the primary occupants of the Judd Creek study site and that total animal presence increased between 2002 and 2007. Average cattle pellet group abundance was 56 days use/acre in 2007 and 58 days use/acre in 2002. Elk pellet groups were observed in 2007 with a mean abundance of 3 days use/acre, but were absent in 2002. Finally, deer presence was 9 days use/acre in 2002 and 21 days use/acre in 2007 (**Figure 4.27**).

Upland (Big Sagebrush)

Two study sites [West Government Creek (19B-5) and Lee's Creek (19B-6)] are classified as Upland (Big Sagebrush) ecological sites. The West Government Creek study is located on the foothills of the Sheeprock Mountains north of Erickson Pass. Lee's Creek is located at the base of the Simpson Mountains north of Erickson Pass (**Table 4.3**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species on both studies, although antelope bitterbrush (*Purshia tridentata*) is present to a much lesser extent. Total average shrub cover has slightly decreased over time, a trend mainly driven by decreases in sagebrush cover on both sites (**Figure 4.10**). Total preferred browse density has shown a general marginally decreasing trend over time. Mature plants have comprised a majority of the browse populations on these study sites throughout the sample period. However, decadence has increased overall while recruitment of young has decreased (**Figure 4.20**). Average utilization of preferred browse has decreased since 2007, with a significant decrease occurring between 2017 and 2022. In 2022, both moderate and heavy utilization were under 2% each: this is largely due to the Lee's Creek site, on which 0% of plants showed signs of moderate to heavy browsing (**Figure 4.22**).

Tree cover on these sites is entirely contributed by Utah juniper (*Juniperus osteosperma*) and has remained stable over time; much of the tree cover can be attributed to the Lee's Creek study (**Figure 4.14**). Juniper has also been present in point-quarter density measurements, with the highest amounts being observed on Lee's Creek. Average density has fluctuated, but has exhibited an overall decrease when comparing 2007 with 2022 data. Much of this total decrease is due to 2011-2012 and 2019-2020 lop and scatter treatments on the West Government Creek site and a general density reduction on the Lee's Creek study (**Figure 4.17**).

Herbaceous Understory: Perennial grasses, particularly the introduced species crested wheatgrass (*Agropyron cristatum*), have been the primary herbaceous component on sites of this ecotype throughout the duration of the studies. Both nested frequency and cover have increased over time. Perennial forbs have contributed good cover during the past two sample years, with much of that cover being provided by the native species browse milkvetch (*Astragalus cibarius*) on both studies. Although annual forb cover has remained low, frequency data indicates that abundance has remained high in most sample years: this is largely due to the presence of the introduced species desert madwort (*Alyssum desertorum*). The introduced annual grass species cheatgrass (*Bromus tectorum*) has been present in the understories of both studies, but with low cover and frequency. Finally, the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) was observed on both studies in 2022. Although bulbous bluegrass cover remains low as of the most recent sampling, it doubled on the West Government Creek site between 2017 and 2022. Increased amounts of bulbous bluegrass in future sample years could lead to reduced understory diversity (**Figure 4.24**, **Figure 4.26**).

Occupancy: Average animal presence on these sites has fluctuated, but has decreased overall when comparing 2002 with 2022 data; primary occupancy has also varied from year-to-year. Cattle were the primary occupants in 2002 and 2017, and mean abundance of pellet groups has been as low as 0 days use/acre in 2012 and as high as 35 days use/acre in 2017. Deer and/or antelope were the primary occupants in all other years, with an average pellet group abundance varying between 2 days use/acre in 2012 and 17 days use/acre in 2007. Finally, elk pellet groups were observed in 2007 and 2022 with a mean abundance of 1.3 days use/acre and 1 days use/acre (respectively), but were absent in other sample years (**Figure 4.28**).

Upland (Black/Low Sagebrush)

One study [Keg Mountain (19B-10)] is classified as an Upland (Black/Low Sagebrush) ecological site: this study site is situated on a hill near the eastern base of Keg Mountain (**Table 4.3**).

Shrubs/Trees: Black sagebrush (*Artemisia nova*) is the dominant browse species on the Keg Mountain study site and contributes a majority of the shrub cover as of 2022. Other preferred browse species such as Stansbury cliffrose (*Purshia stansburiana*), Nevada jointfir (*Ephedra nevadensis*), and shadscale saltbush (*Atriplex confertifolia*) are also present, but to a much lesser extent than sagebrush. Because the study was established in 2022, data from other sample years is not available and thus trends over time cannot be determined (**Figure 4.10**). Average preferred browse demographics indicate that mature individuals are the main demographic in the browse population on this site. Decadence is low, but the number of decadent individuals is higher than the number of young plants recruited **(Figure 4.20**). In 2022, 14% of preferred browse plants were moderately hedged, while 16.5% were heavily browsed (**Figure 4.22**).

Average tree cover and density data indicate that encroachment by Utah juniper (*Juniperus osteosperma*) and singleleaf pinyon (*Pinus monophylla*) is occurring on the Keg Mountain study site, albeit in relatively low amounts (**Figure 4.14**, **Figure 4.17**).

Herbaceous Understory: The herbaceous understory of this study site is present with moderate abundance and cover. Perennial grasses, particularly the native species Sandberg bluegrass (*Poa secunda*), are the dominant understory component. The introduced annual grass species red brome (*Bromus rubens*) and cheatgrass (*B. tectorum*) are present, but with low cover and abundance. The forb component is lacking in diversity, and both annual and perennial species are scarce (**Figure 4.24**, **Figure 4.26**).

Occupancy: Deer are the primary occupants of this study site, and mean pellet group abundance in 2022 was 7 days use/acre. Elk pellet groups were also observed with an average abundance of 3 days use/acre (**Figure 4.28**).

Semidesert (Big Sagebrush)

One study site [Desert Mountain (19B-11)] is considered to be a Semidesert (Big Sagebrush) ecological site. The Desert Mountain study is located in the foothills on the northern portion of Desert Mountain (**Table 4.3**).

Shrubs/Trees: The Desert Mountain study site was established in 2022 and does not have data for any other sample years available. As such, trends over time for study site cannot be determined at this time. Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) contributes the most cover of any shrub species on this site, although the preferred species Nevada jointfir (*Ephedra nevadensis*) and Mormon tea (*E. viridis*) also provide moderate cover (**Figure 4.10**). Decadent plants are the most abundant age class in the preferred browse population as of 2022, mainly due to Wyoming big sagebrush. Mature plants are slightly less abundant than decadent individuals, and recruitment of young is low (**Figure 4.20**). Preferred browse utilization data shows that 27% of plants were moderately hedged and 21% were heavily browsed in 2022 (**Figure 4.22**).

Trees contribute no cover on this site. Utah juniper (*Juniperus osteosperma*) was observed in point-quarter density measurements, but in very low amounts (**Figure 4.15**, **Figure 4.18**).

Herbaceous Understory: The herbaceous understory of this study site contributes high amounts of total cover and frequency. The introduced annual grass species cheatgrass (*Bromus tectorum*) provides the most cover of any single herbaceous species, and annual grasses are the dominant understory component. Native perennial grasses such as James' galleta (*Pleuraphis jamesii*) and Sandberg bluegrass (*Poa secunda*) contribute moderate amounts of cover, as does the introduced annual forb species redstem stork's bill (*Erodium cicutarium*). Perennial forbs are depauperate in both cover and diversity (**Figure 4.24**, **Figure 4.26**).

Occupancy: Mule deer and/or pronghorn are the primary occupants of the Desert Mountain study, with a mean pellet group abundance of 34 days use/acre in 2022. Elk sign was also observed, and 2022 presence was estimated at 6 days use/acre (**Figure 4.28**).

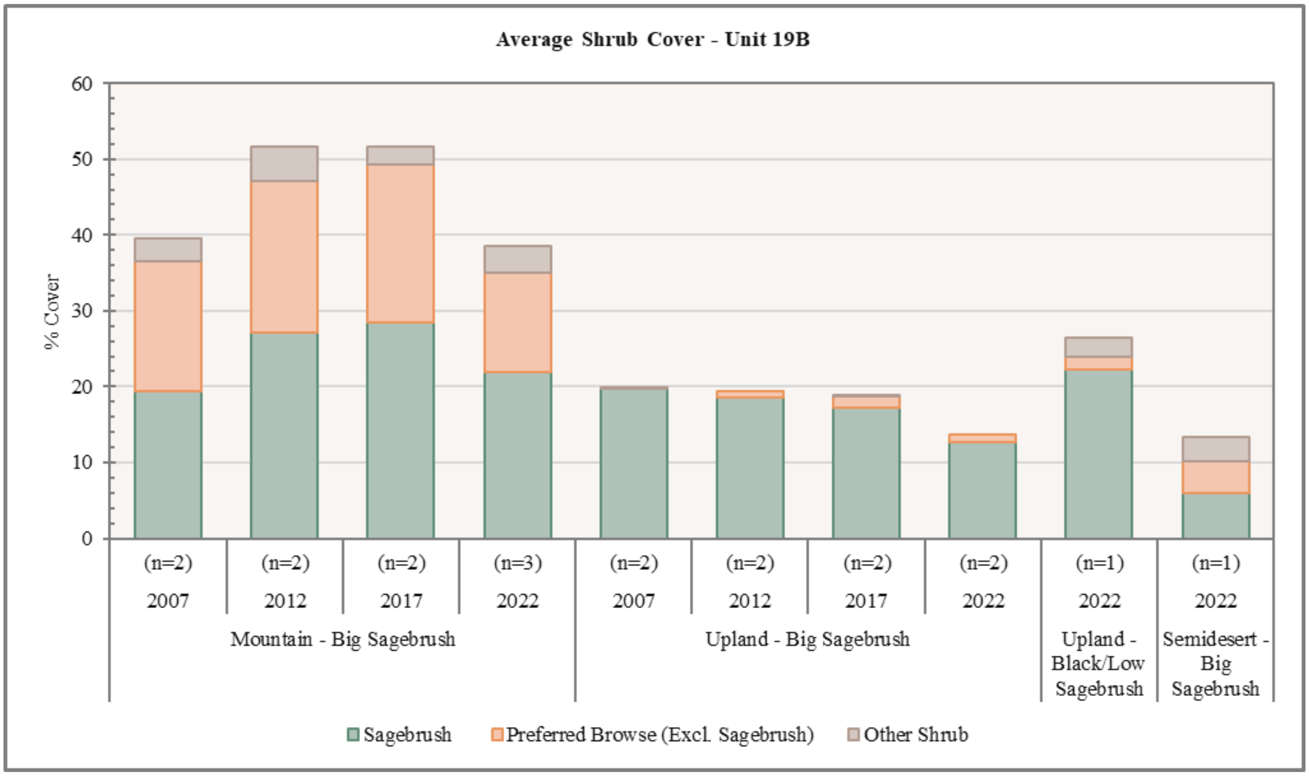


Figure 4.10: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 19B, West Desert - Vernon.

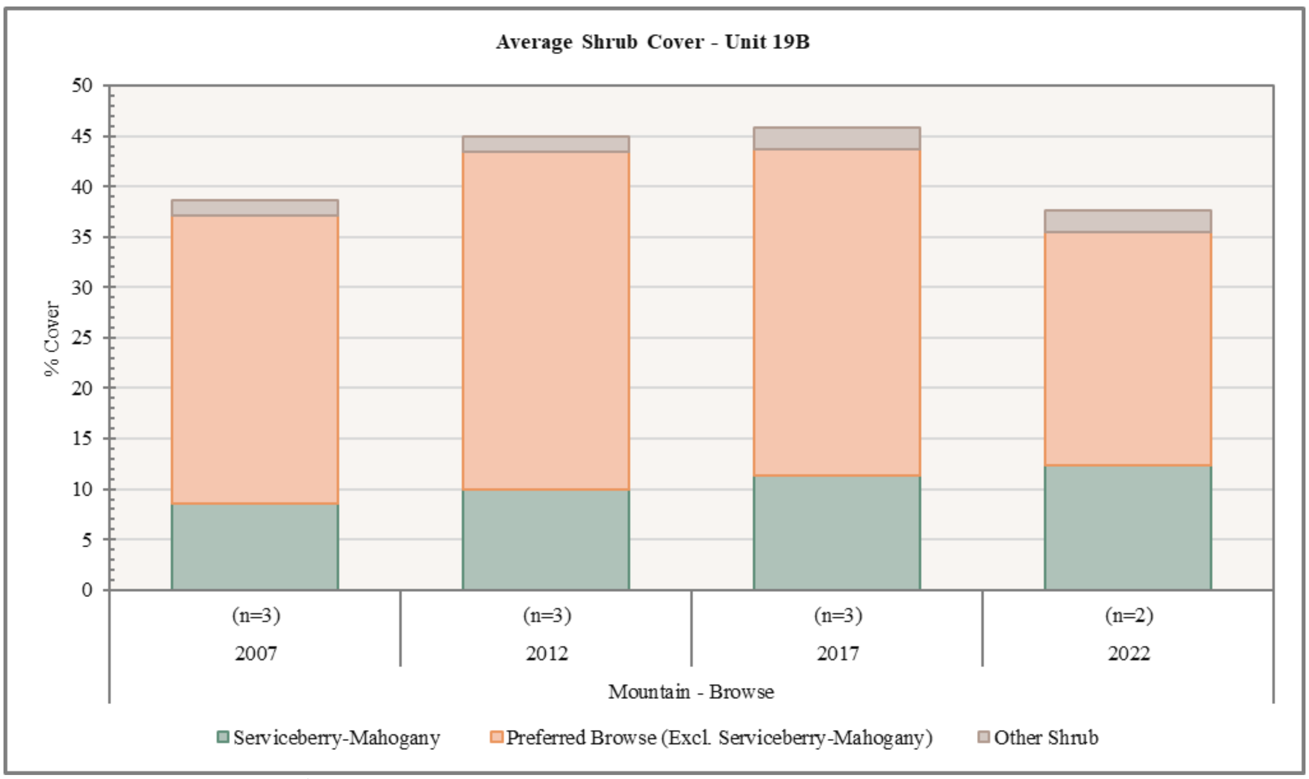


Figure 4.11: Average shrub cover for Mountain - Browse study sites in WMU 19B, West Desert - Vernon.

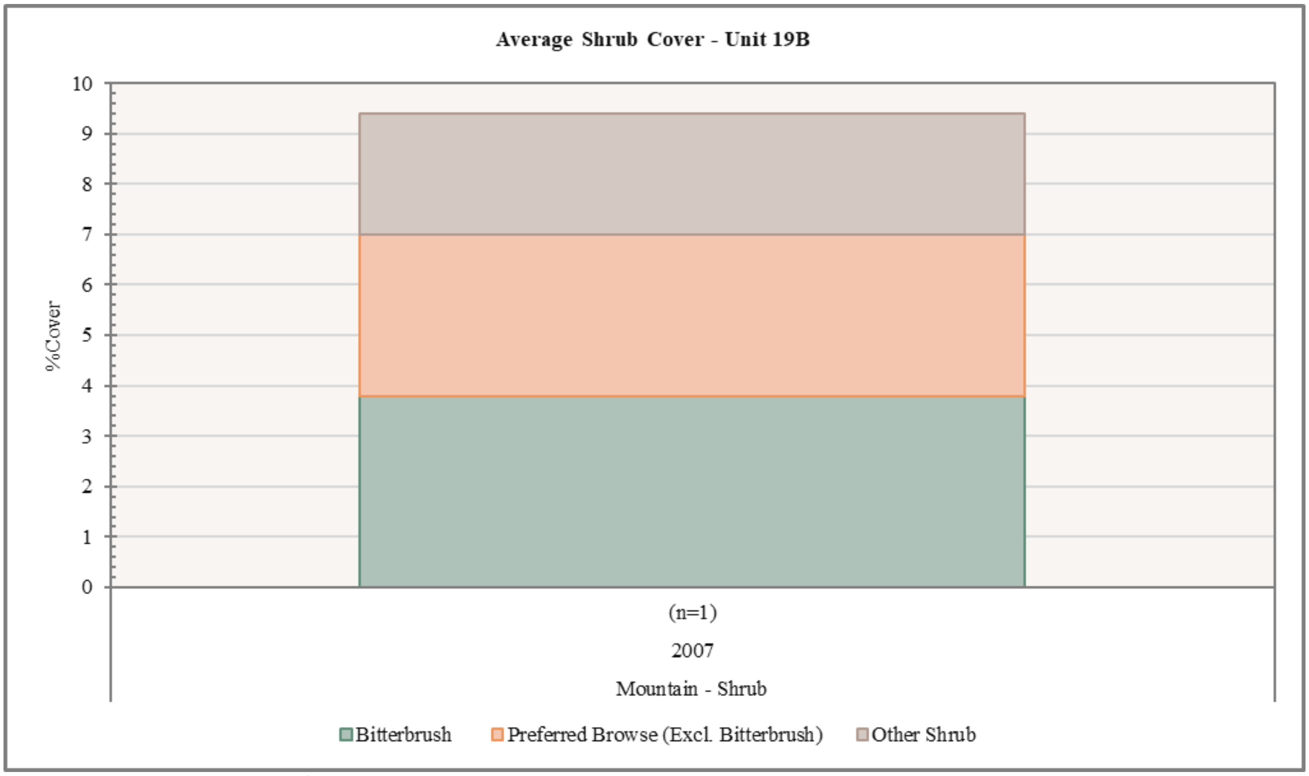


Figure 4.12: Average shrub cover for Mountain - Shrub study sites in WMU 19B, West Desert - Vernon.

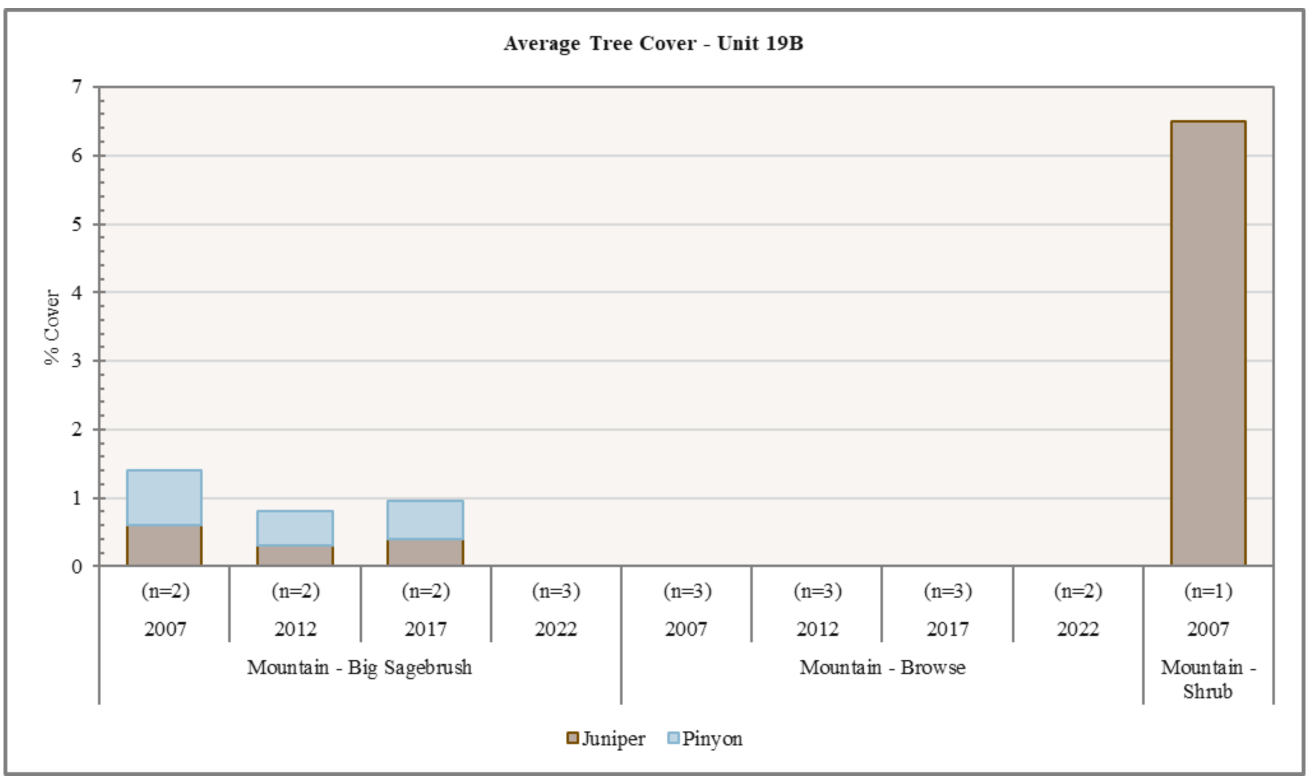


Figure 4.13: Average tree cover for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 19B, West Desert - Vernon.

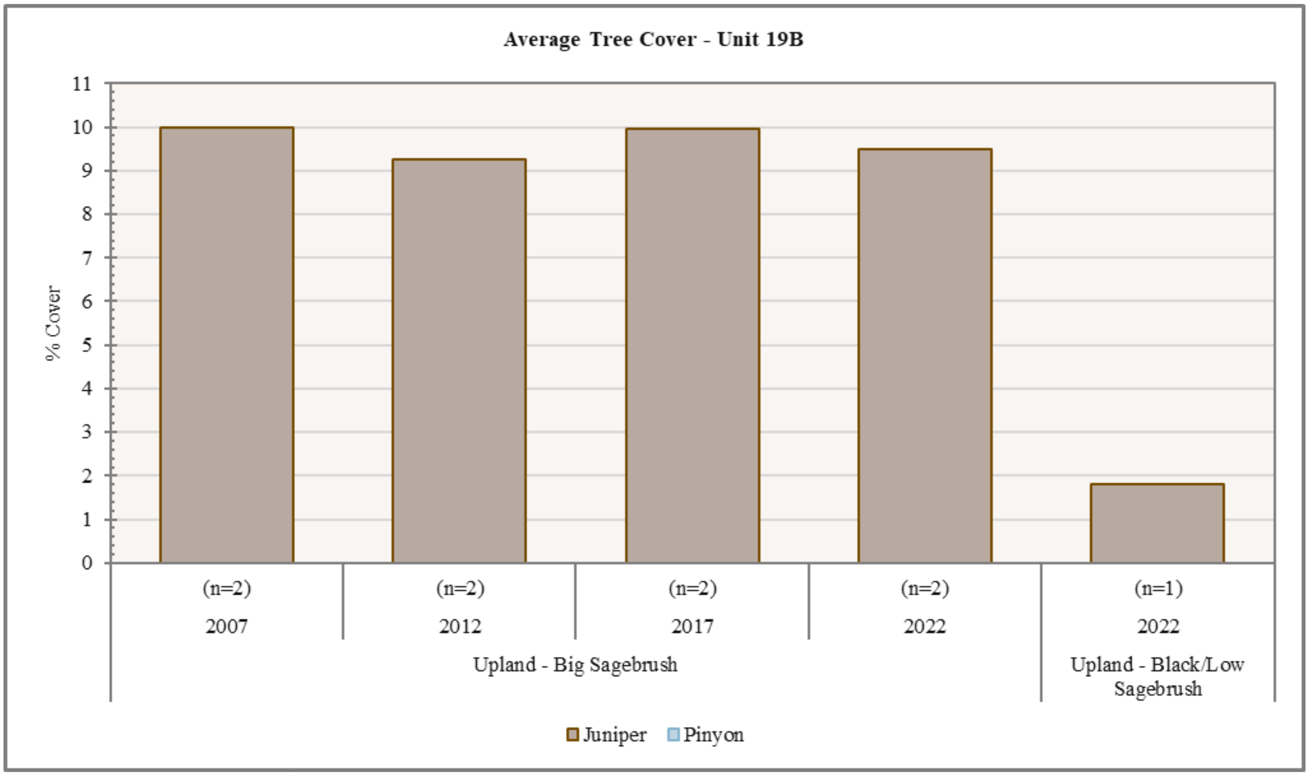


Figure 4.14: Average tree cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 19B, West Desert - Vernon.

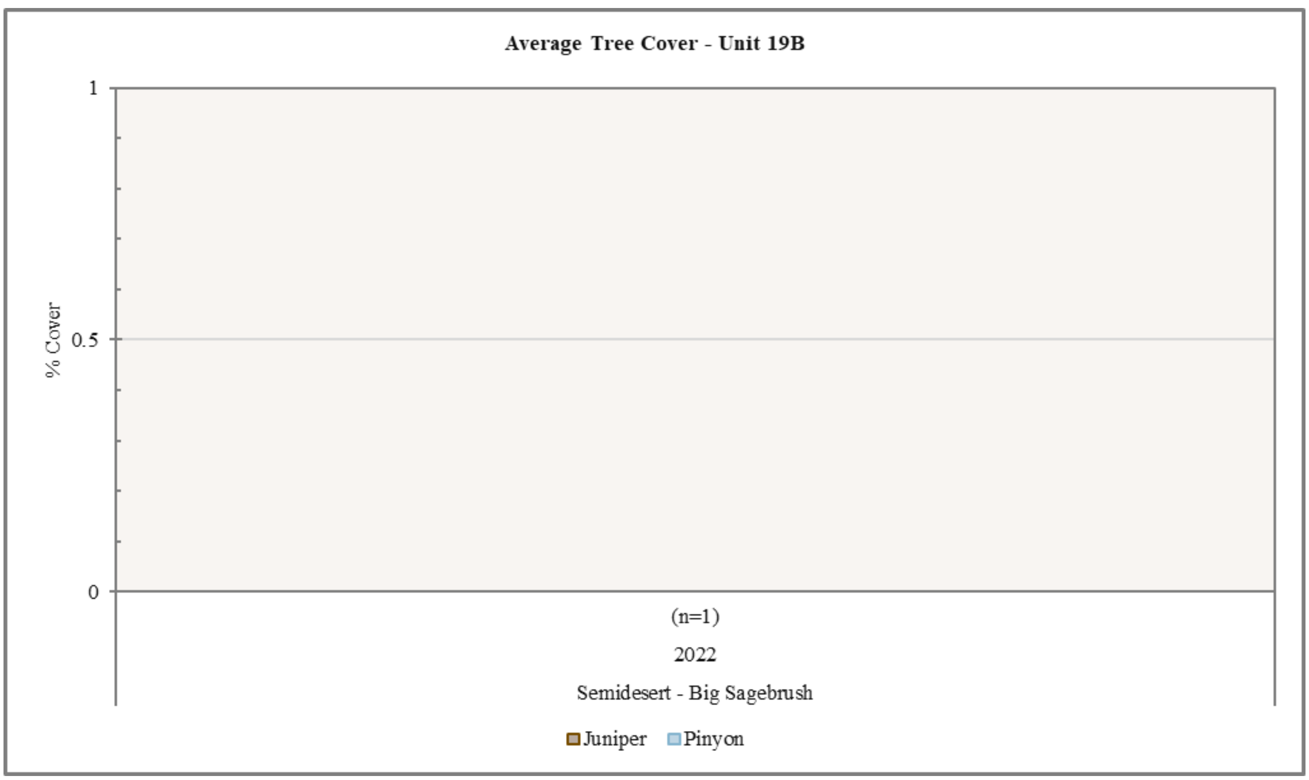


Figure 4.15: Average tree cover for Semidesert - Big Sagebrush study sites in WMU 19B, West Desert - Vernon.

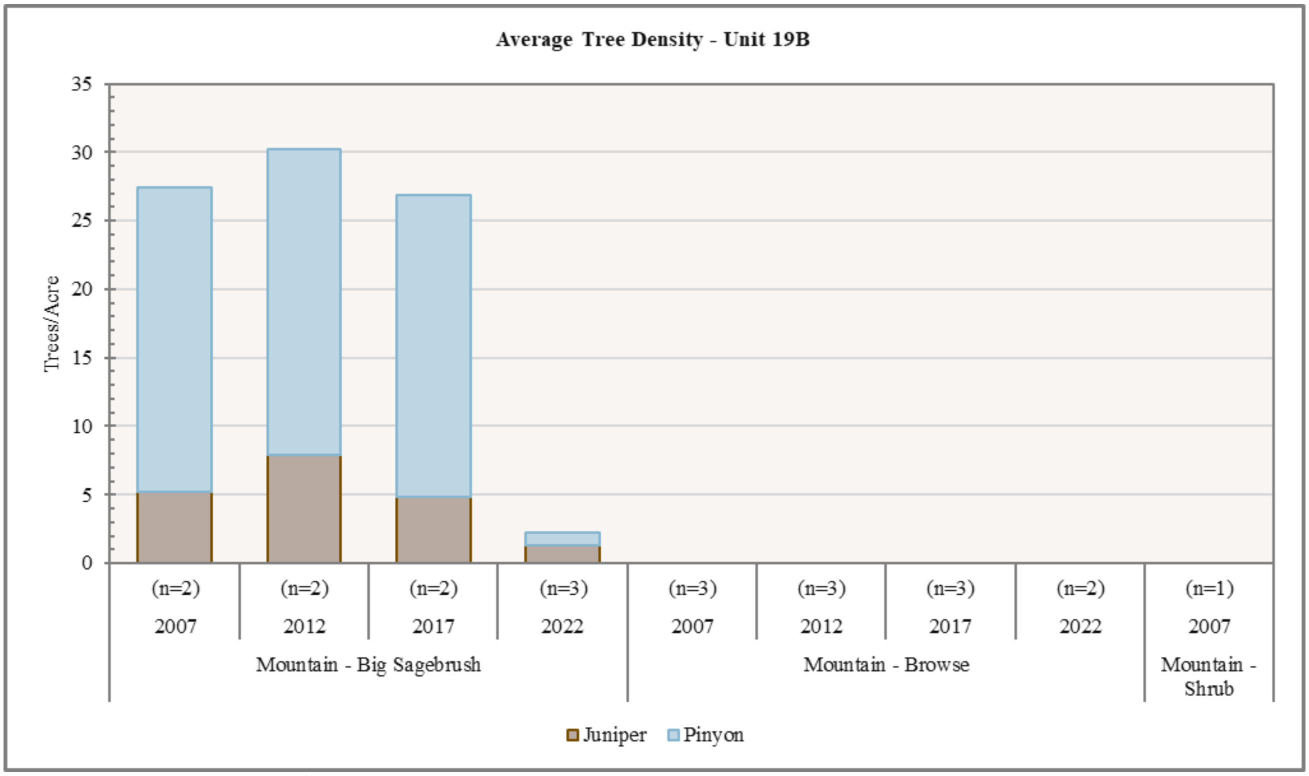


Figure 4.16: Average tree density for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 19B, West Desert - Vernon.

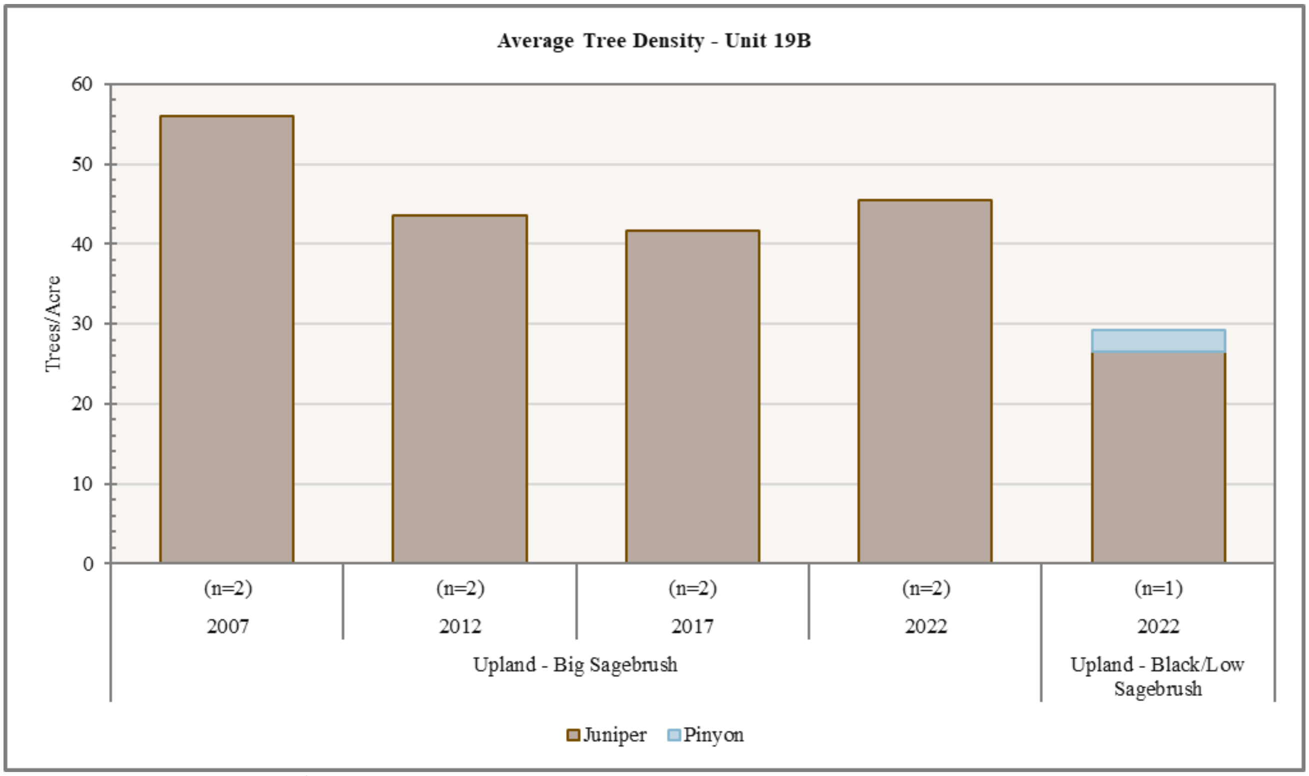


Figure 4.17: Average tree density for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 19B, West Desert - Vernon.

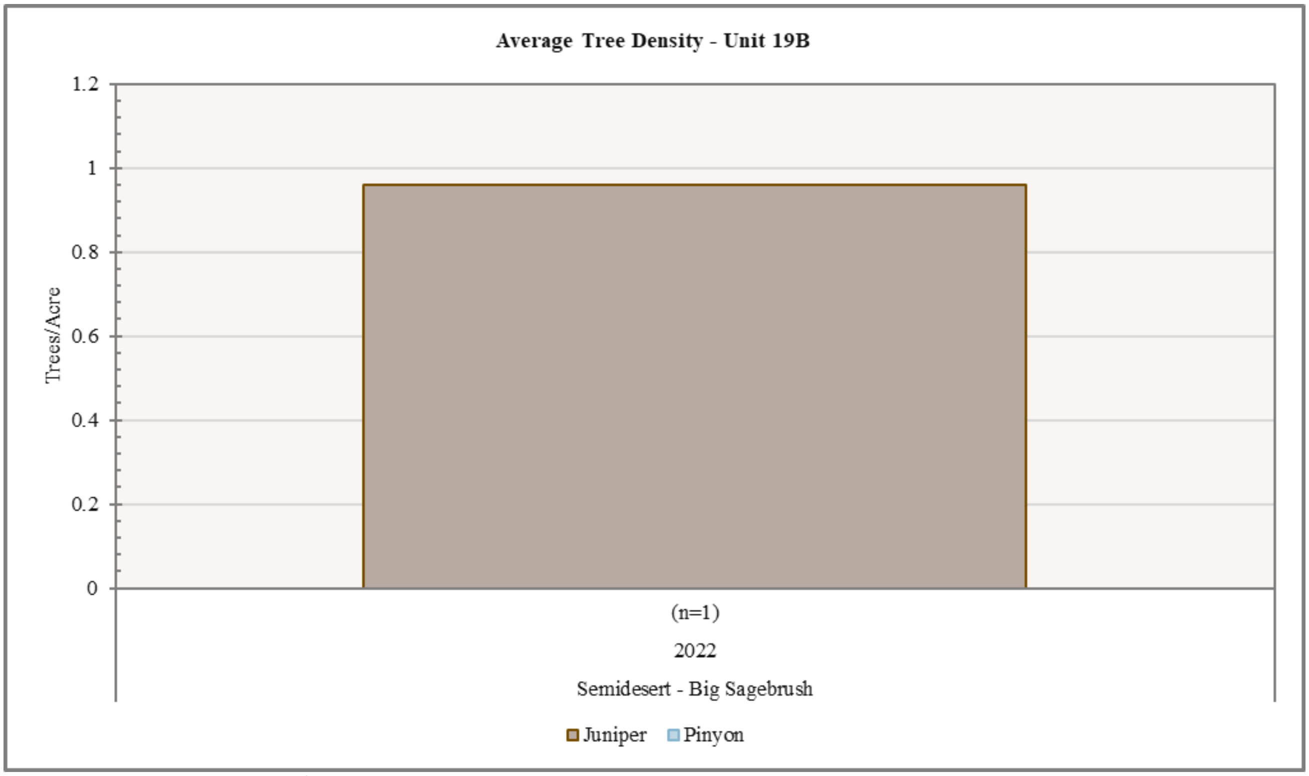


Figure 4.18: Average tree density for Semidesert - Big Sagebrush study sites in WMU 19B, West Desert-Vernon.

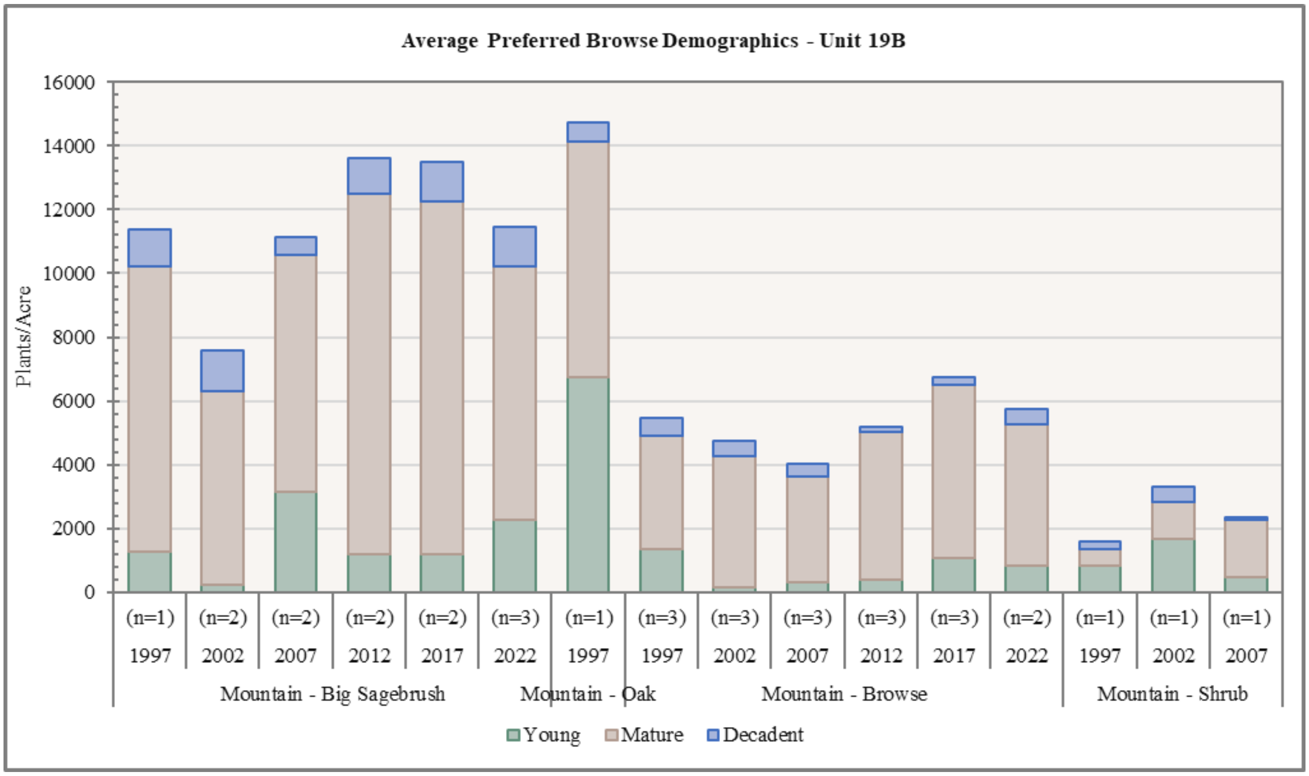


Figure 4.19: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Oak, Mountain - Browse, and Mountain - Shrub study sites in WMU 19B, West Desert - Vernon.

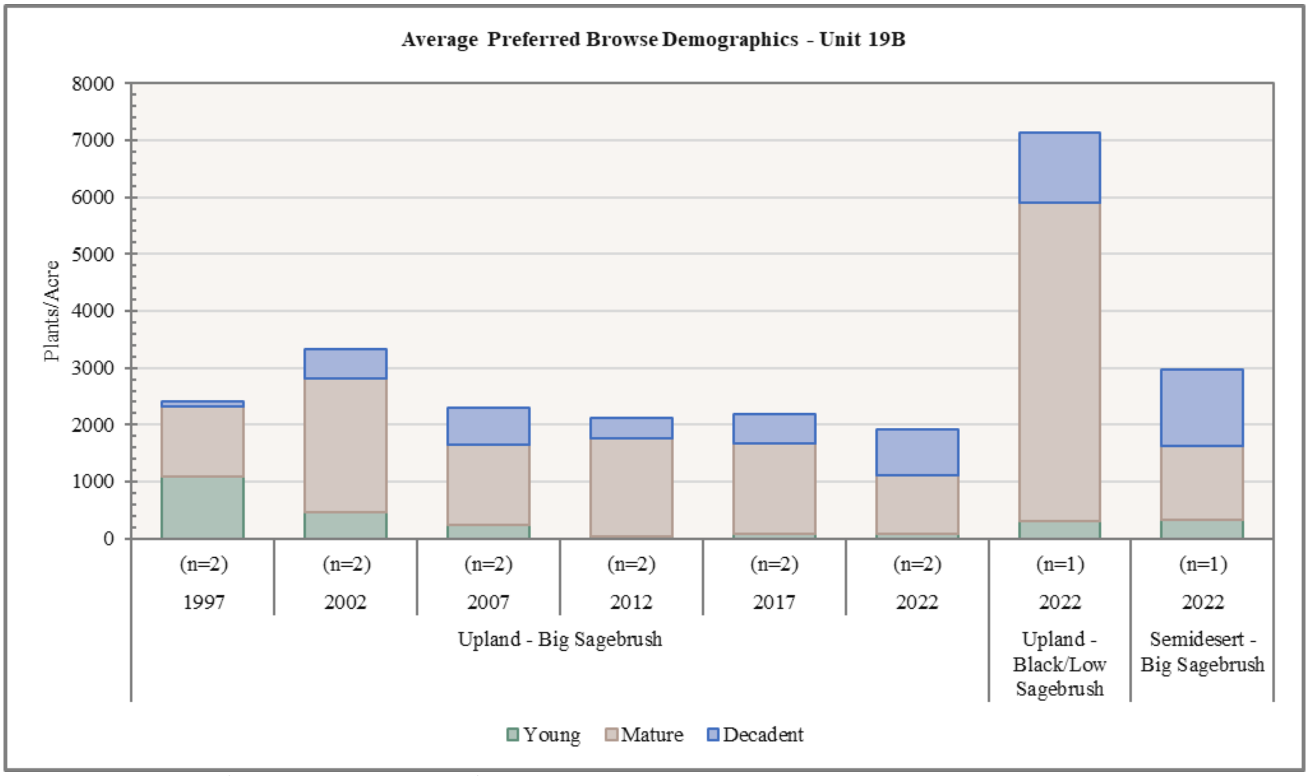


Figure 4.20: Average preferred browse demographics for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 19B, West Desert - Vernon.

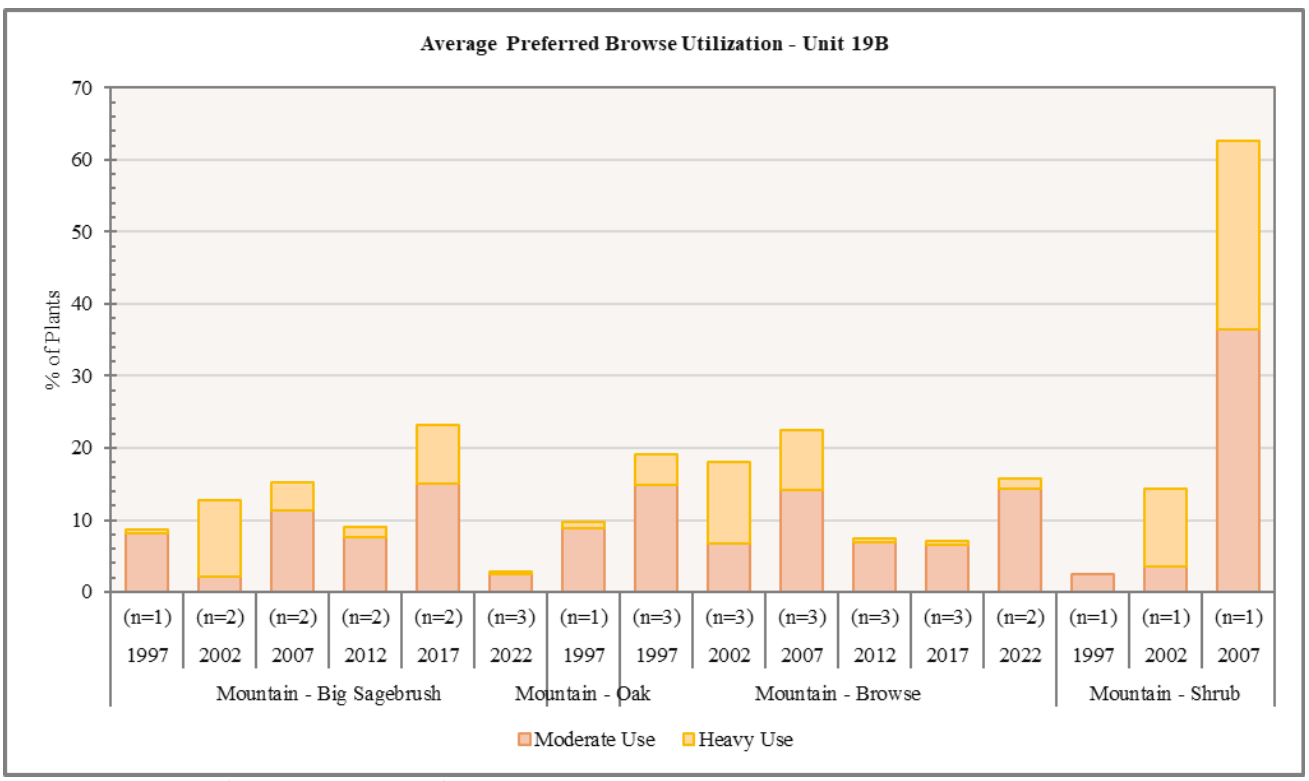


Figure 4.21: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Oak, Mountain - Browse, and Mountain - Shrub study sites in WMU 19B, West Desert - Vernon.

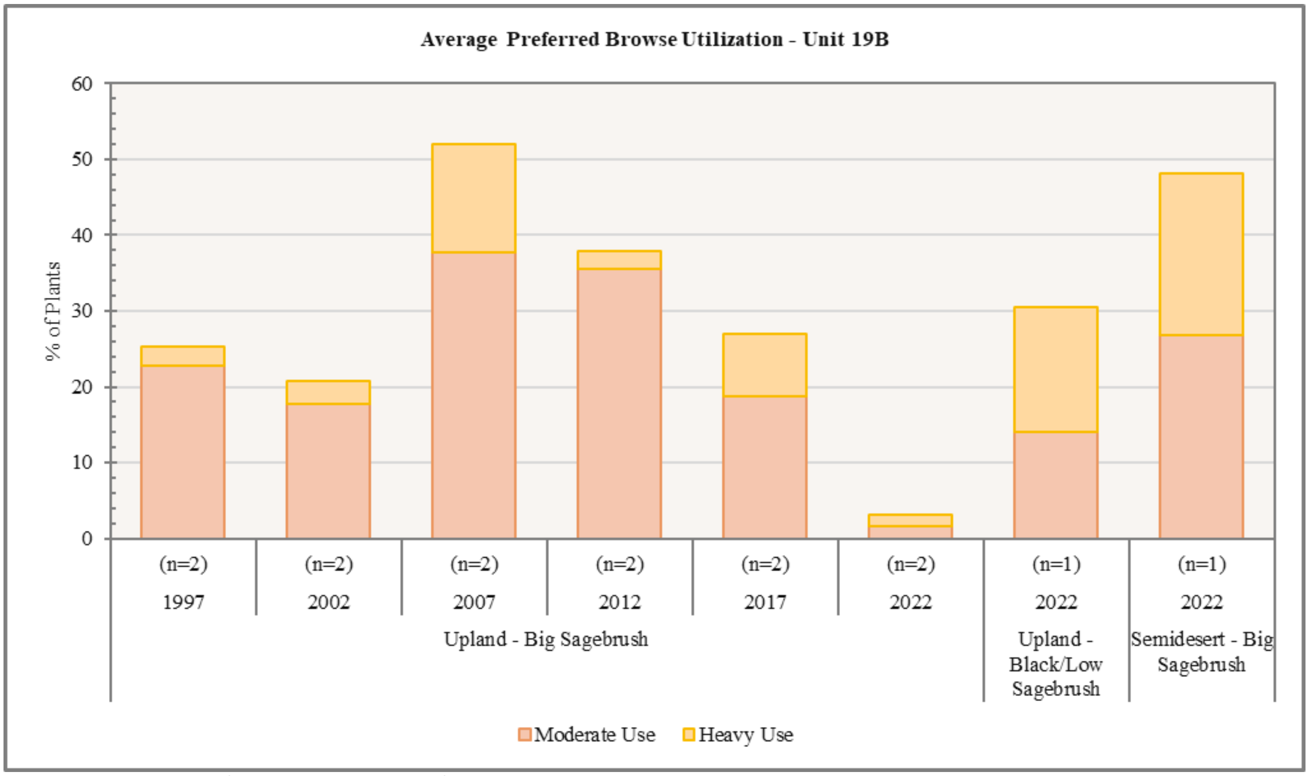


Figure 4.22: Average preferred browse utilization for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 19B, West Desert-Vernon.

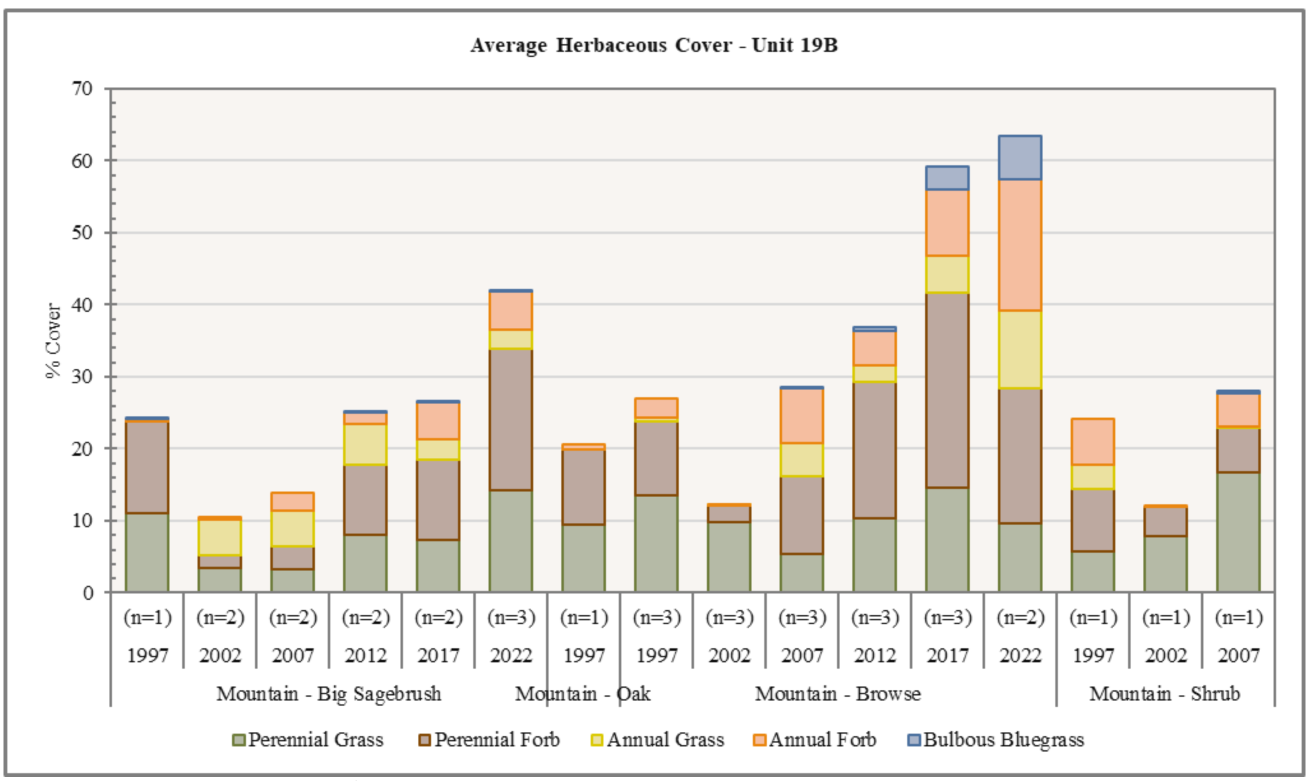


Figure 4.23: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Oak, Mountain - Browse, and Mountain - Shrub study sites in WMU 19B, West Desert - Vernon.

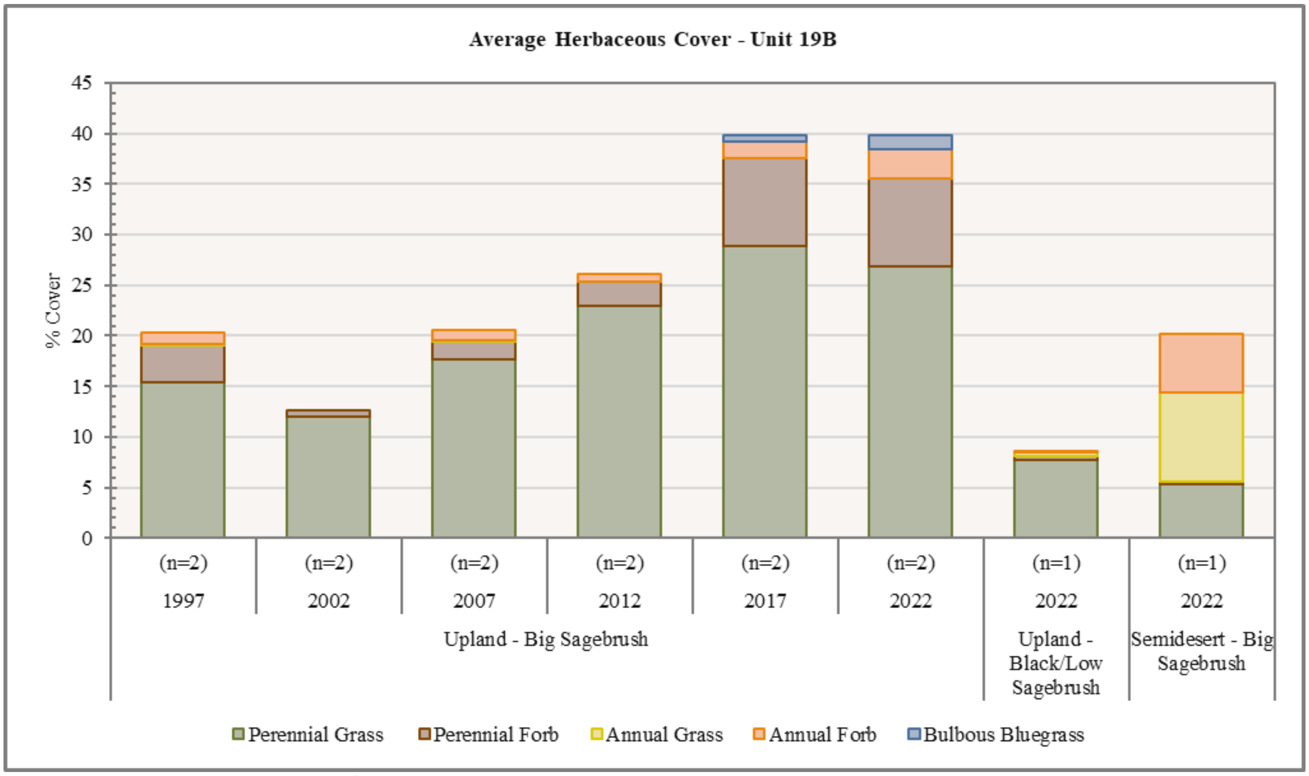


Figure 4.24: Average herbaceous cover for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 19B, West Desert - Vernon.

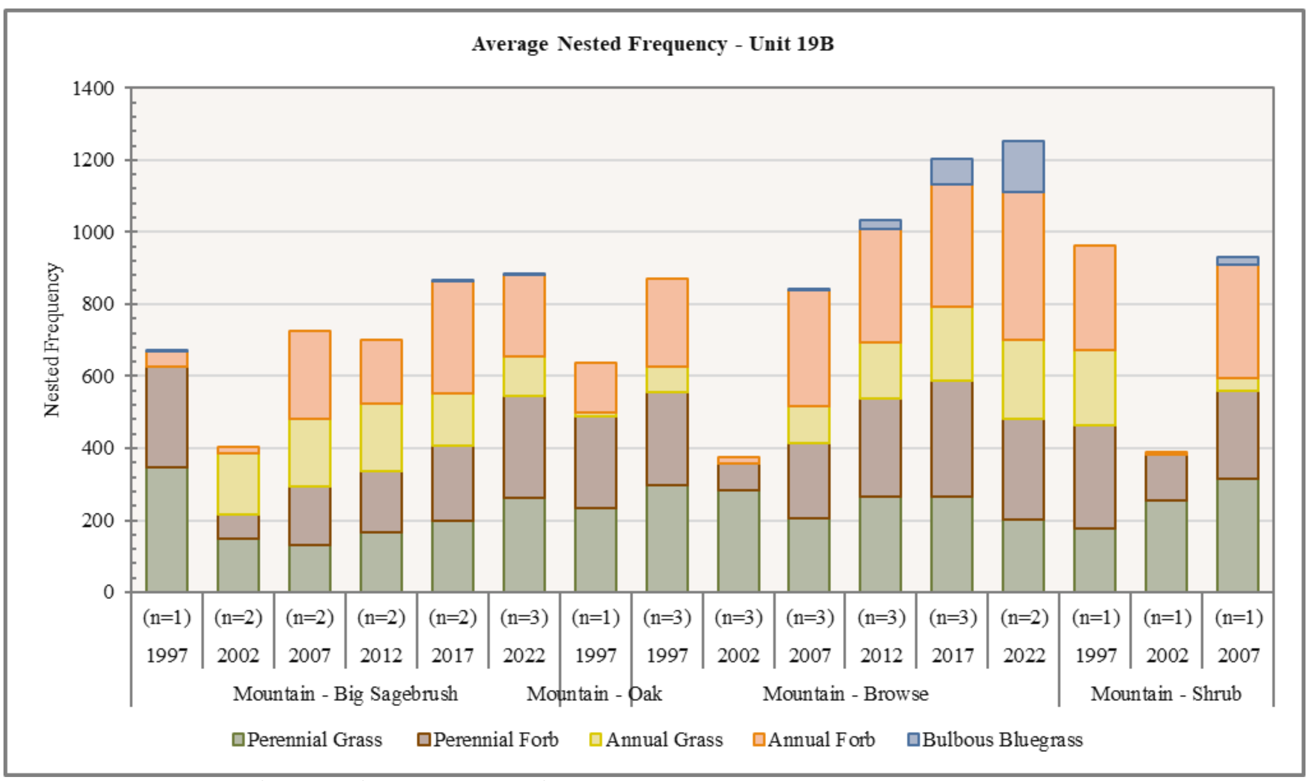


Figure 4.25: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Oak, Mountain - Browse, and Mountain - Shrub study sites in WMU 19B, West Desert - Vernon.

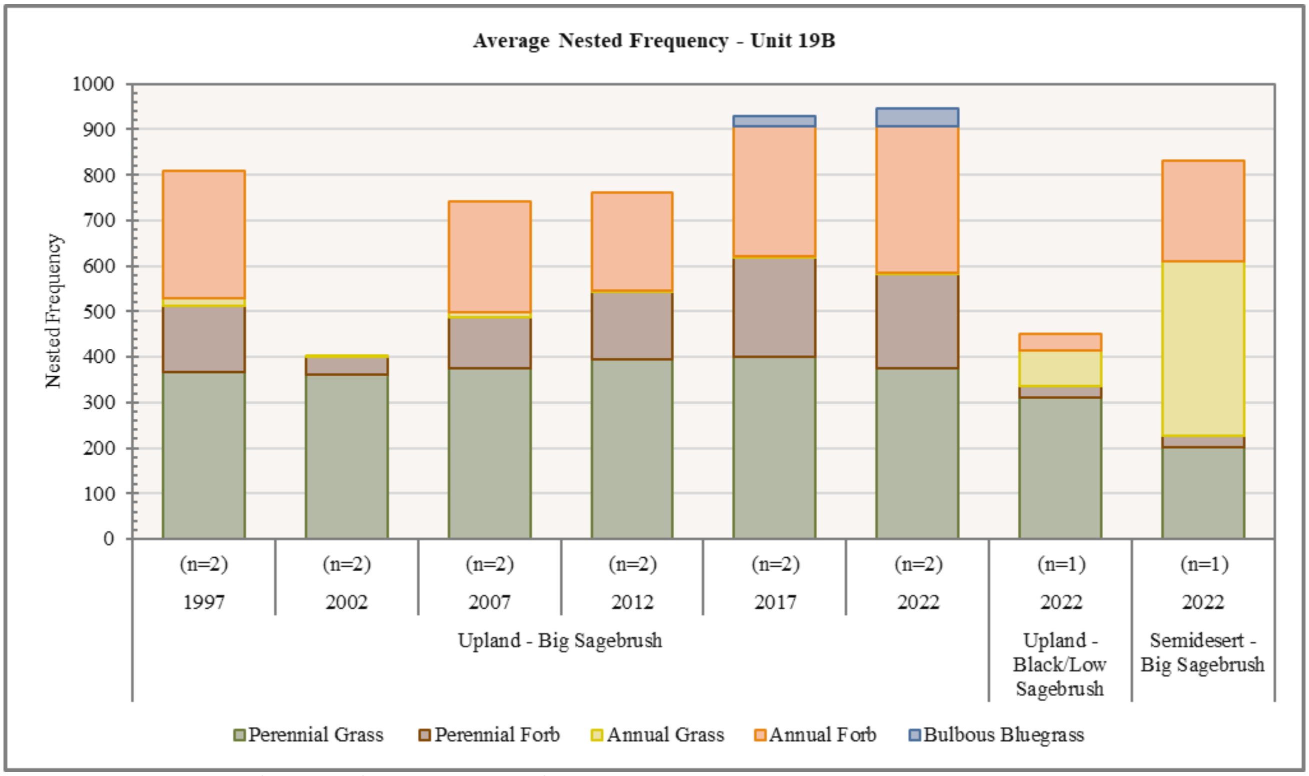


Figure 4.26: Average nested frequency of herbaceous species for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 19B, West Desert-Vernon.

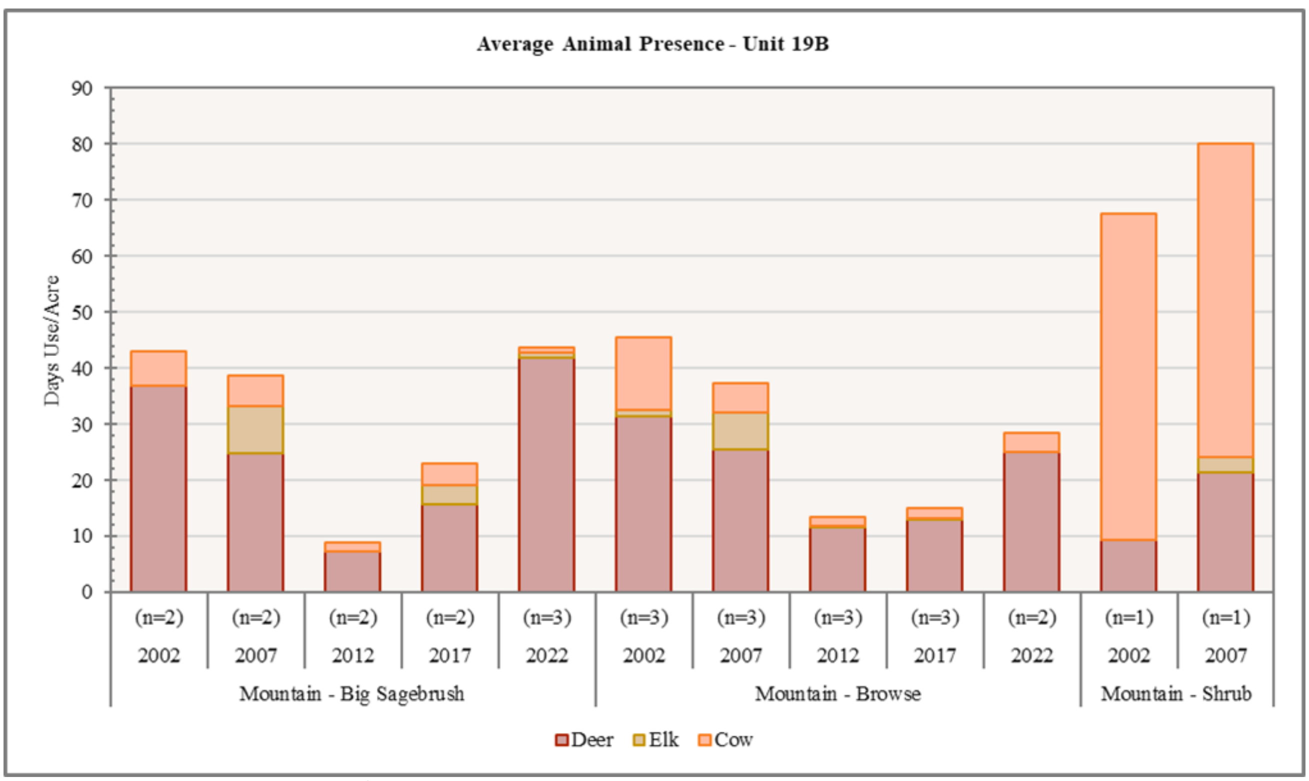


Figure 4.27: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 19B, West Desert-Vernon.

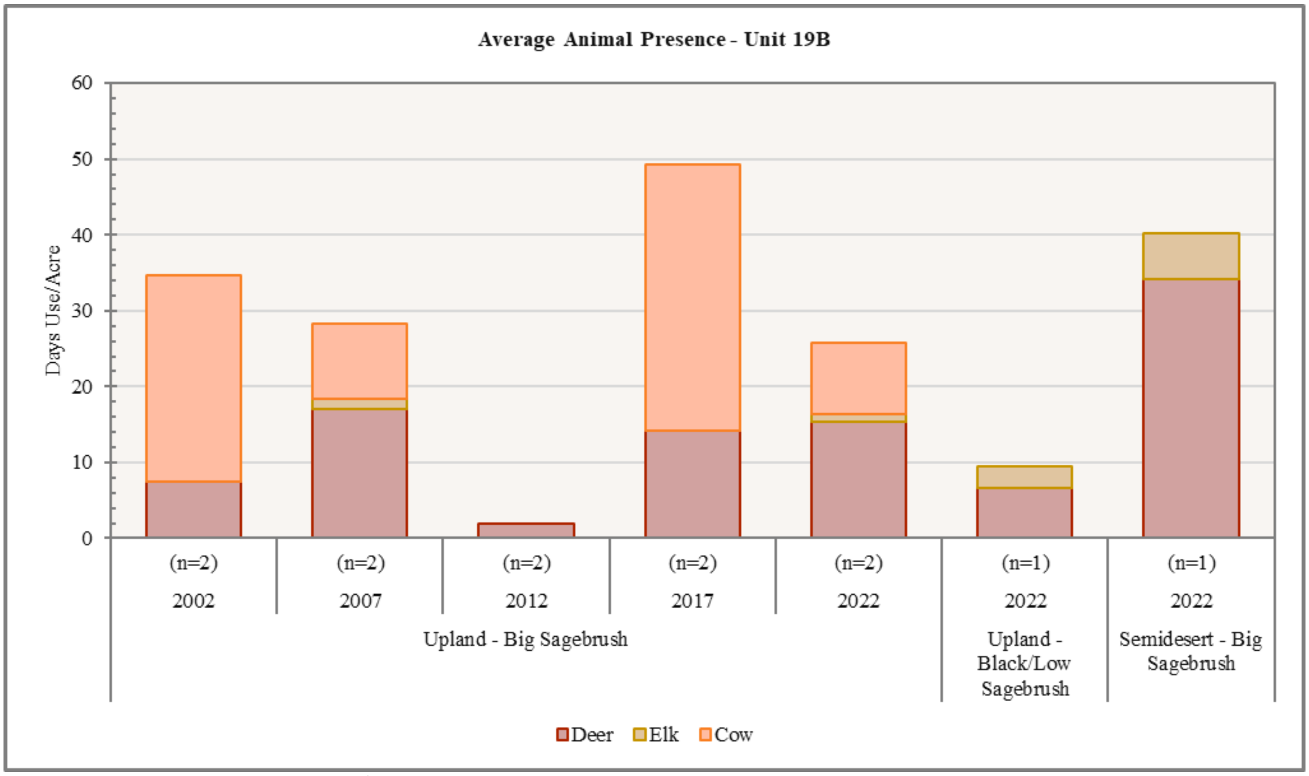
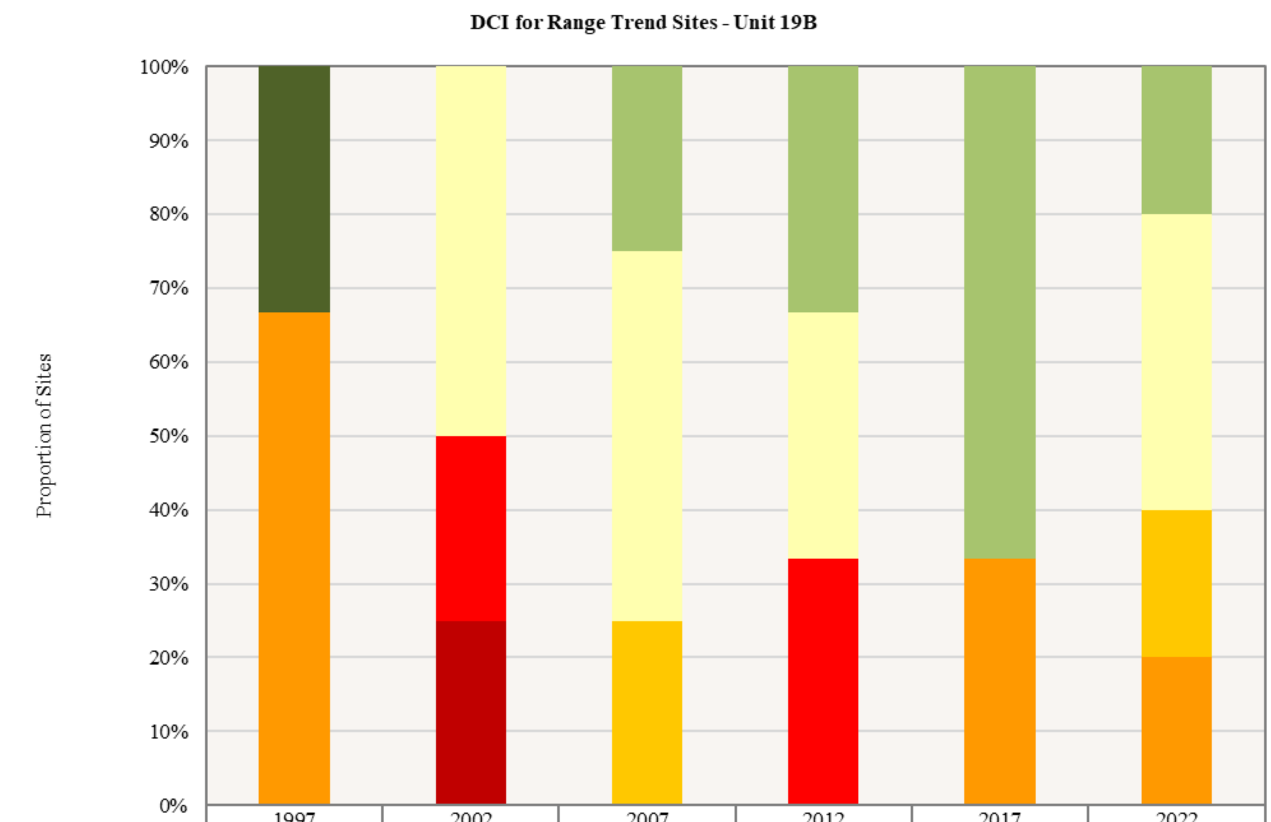


Figure 4.28: Average pellet transect data for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 19B, West Desert-Vernon. *Upland - Big Sagebrush deer pellet groups include deer and antelope pellets.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Vernon management unit has generally remained stable since the 1997 sampling. Mean wintering conditions on WMU 19B have remained between poor-fair to fair condition from 1997 to 2022. West Government Creek (19B-5) and Lee's Creek (19B-6) are the main drivers for the unit's stability and average within good and fair deer winter range conditions, respectively. Range Trend sites in this WMU 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 2022 for WMU 19B was that sites were in poor-fair condition. However, West Government Creek was considered to be in good condition due to an abundance of perennial grasses, forbs, and preferred browse cover. A suggested habitat improvement that would address deer winter range condition on this site would be diversifying the age class component for preferred shrubs by decreasing decadence and increasing young populations. South Pine Canyon (19A-8) and the newly added Keg Mountain (19B-10) site are rated, respectively, as poor and fair winter range in 2022. Concerns identified are reduced perennial grass and forb abundance, and preferred browse, but annual grass is an additional issue. Addressing these areas as a focus for habitat rehabilitation would improve winter conditions for deer (**Figure 4.29**, **Table 4.5**).



	1997	2002	2007	2012	2017	2022
Excellent	1					
Good			1	1	2	1
Fair		2	2	1		2
Poor-Fair			1			1
Poor	2				1	1
Very Poor-Poor		1		1		
Very Poor		1				

Figure 4.29: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 19B, West Desert - Vernon.

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
19B-5	1997	23	12.5	7.9	30	0	10	0	**83.3**	**E**
19B-5	2002	26.7	7.8	1.7	23.8	0	0.7	0	**60.6**	**F**
19B-5	2007	30	3.5	0.4	30	0	6	0	**69.8**	**G**
19B-5	2012	30	8.2	0	30	0	7.5	0	**75.7**	**G**
19B-5	2017	30	6	0	30	0	10	0	**76**	**G**
19B-5	2022	26.5	3.9	0	30	0	10	0	**70.3**	**G**
19B-6	1997	5.8	0	0	29	-0.2	3.8	0	**38.4**	**P**
19B-6	2002	6.4	12.8	11.7	24.3	0	1.7	0	**56.9**	**F**
19B-6	2007	13.3	9.3	9.6	28.5	0	1.1	0	**61.6**	**F**
19B-6	2012	10.9	12.8	2.4	30	0	2	0	**58.1**	**F**
19B-6	2017	11.8	11.4	4.8	30	0	9.1	0	**67**	**G**
19B-6	2022	8.4	0.8	6.3	30	0	7.6	0	**53**	**F**
19B-7*	1997	8.8	8.2	9.5	11.6	-2.5	10	0	**45.6**	**P**
19B-7*	2002	7.6	5	5	15.6	0	8.1	0	**41.3**	**VP-P**
19B-7*	2007	9.8	12.2	3.6	30	-0.2	10	0	**65.3**	**F**
19B-8	2002	3.1	0	0	3.5	-7.4	0.6	0	**-0.1**	**VP**
19B-8	2007	27.1	13.9	15	1.9	-7.6	2.8	0	**53**	**P-F**
19B-8	2012	30	12.4	0.9	1.7	-8.4	2.6	0	**39.1**	**VP-P**
19B-8	2017	30	10.5	3.4	4.1	-4.5	3.3	0	**46.7**	**P**
19B-8	2022	30	10.7	1.7	5.3	-5.8	1.4	0	**43.3**	**P**
19B-10	2022	30	9.7	2.1	15.3	-0.3	0.8	0	**57.6**	**F**
19B-11	2022	12.8	2.1	6.2	10.5	-6.6	0.6	0	**25.5**	**P-F**

Table 4.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 19B, West Desert - Vernon. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
19B-1	Sabie Mountain	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
19B-2	Upper Little Valley	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
19B-3	Bennion Creek	Annual Grass	Low	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
19B-4	Harker Canyon	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
19B-5	West Government Creek	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
19B-6	Lee's Creek	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
19B-8	South Pine Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
19B-10	Keg Mountain	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19B-11	Desert Mountain	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
19B-12	Hilltop Mine	None Identified	-	-
19R-1	West Lee's Creek	Annual Grass	Medium	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
19R-6	Sage Valley Dixie	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19R-7	Bennion Sagebrush Chaining	Annual Grass	Medium	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
19R-11	James Ranch Bullhog	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19R-13	Diagonal/Electric Harrow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
19R-16	Benmore Harrow	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
19R-22	East Vernon Bullhog	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19R-23	Lion Hill	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species

Table 4.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 19B, West Desert - Vernon. 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

Study sites in deer wintering habitat on the Vernon management unit are generally in poor to fair condition as of 2022. Factors that negatively affect habitat condition within this unit include (but are not limited to): lack of preferred browse cover, undiversified age classes and decadence among preferred browse, and presence of annual grasses.

Of positive, study sites that have not been disturbed have generally remained stable. More specifically, the shrub components on these sites have not exhibited decreases in cover or density to a degree that would cause the associated plant communities to shift into a different ecological state. An additional positive aspect is that many projects to remove pinyon and juniper have taken place on encroached areas of the Sheeprock Mountains. These tree-removing treatments have likely created opportunities for reinvigoration and diversification of shrub and herbaceous components in areas where they have occurred. Furthermore, WRI sites that have undergone restoration efforts generally appear to be responding well and improving in condition. Finally, the South Pine Canyon study burned in the 1994 East Harker (Vernon Complex) wildfire. However, shrub cover has increased in the years following the burn, suggesting that the preferred browse component on this site is returning to pre-disturbance conditions.

Although much of the Sheeprock Mountains have been treated to remove pinyon and juniper, tree encroachment remains a concern on the southern portion of this range and on the Keg and Simpson Mountains. Presence of pinyon and juniper can result in reduced understory shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000).

Annual grasses, particularly the introduced species cheatgrass, are or have been present in varying amounts on many sites and pose a threat to the ecological resiliency of the communities they have invaded. 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).

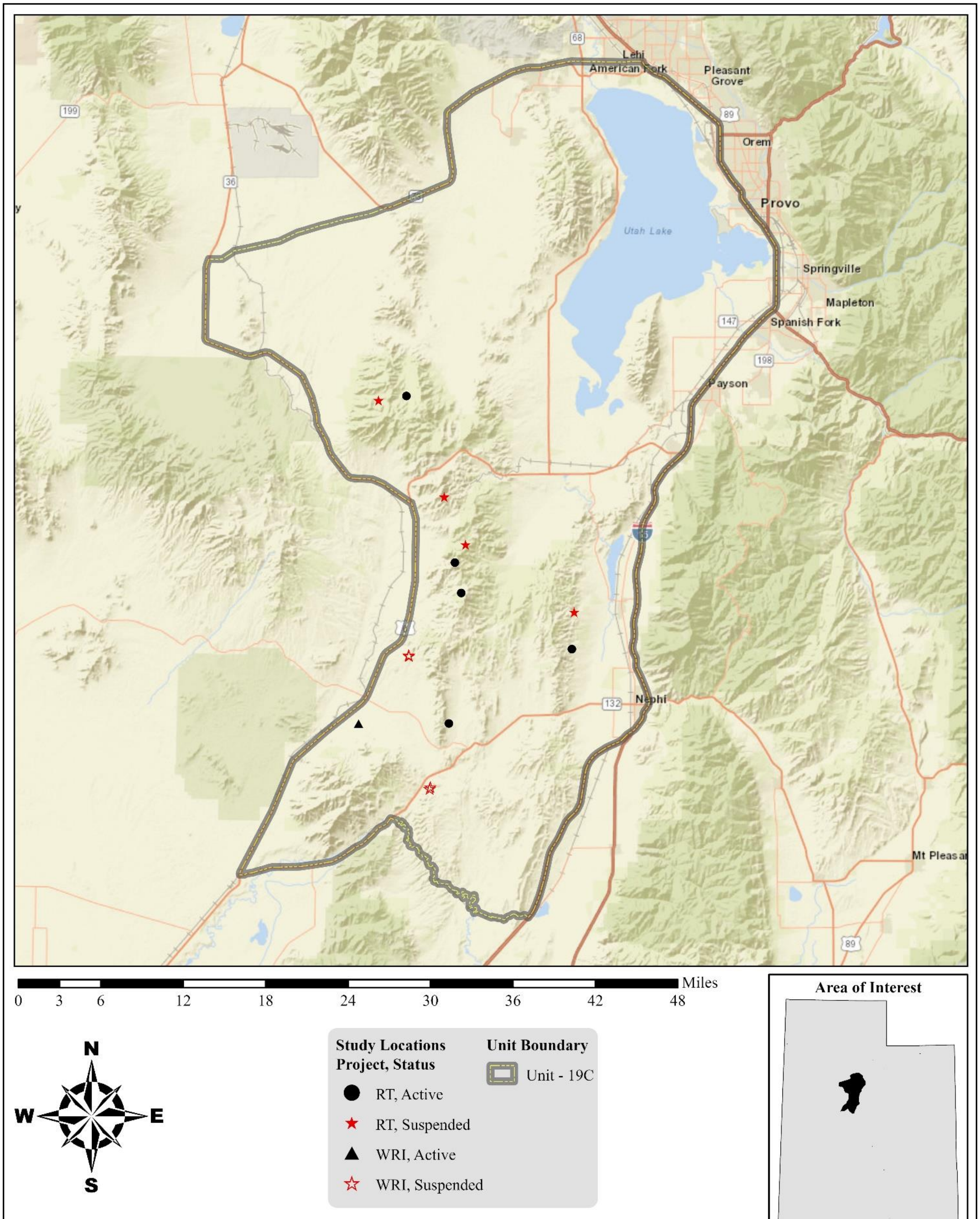
Study sites on this unit also appear to exhibit visibly pronounced vegetation effects when drought occurs. When compared with photos from other years, for example, 2002 photos of the Upper Little Valley and Bennion Creek studies show browse components with poor vigor and scant herbaceous understories; moderate to extreme drought years occurred on these sites between 2000 and 2003 (**Figure 4.1a**). Extended periods of drought may result in reduced vigor and abundance of shrub and herbaceous species and reduced community resilience and resistance to disturbance (Shafer, Bartlein, & Thompson, 2001; Schlaepfer, Lauenroth, & Bradford, 2014; Karban & Pezzola, 2017).

A number of fires have also burned a significant portion of this unit over time (**Map 4.5**). Fires can have negative effects through the removal of preferred browse species and herbaceous understories, such as opening up ecological niches that can be filled by undesirable species. Positive effects are also possible, and include (but are not limited to) the rejuvenation of quaking aspen stands and removal of undesirable (Swartz & Smith, 2023). Because these fires have mostly occurred in areas without established study sites, it is not possible to use Range Trend data to determine whether or not these fires have had an overall positive or negative effect on big game habitat in this unit.

Other threats to wildlife habitat are occurring in localized portions of this unit, but will not be discussed in this section. These additional threats are specified by study site in the previous table (**Table 4.6**).

There are a few suggestions to consider for improving big game habitat within the West Desert - Vernon management unit. A considerable portion of this unit has been treated for tree encroachment. When and where appropriate, efforts to address infilling or encroachment of pinyon and juniper in both previously treated and untreated areas should be continued or implemented. Care should be should be taken in method selection (lop and scatter, bullhog, chaining, etc.) to ensure that annual grass loads are not unintentionally amplified. When considering treatments for annual grass reduction, herbicide application or changes in grazing management may be appropriate in areas where high annual grass loads are present. Finally, it is highly recommended that monitoring should continue in the future for both Range Trend studies and rehabilitation projects. Periodic monitoring of these areas not only assesses the quality of big game habitat, but may also aid in the identification of threats as they appear over time.

5. WILDLIFE MANAGEMENT UNIT 19C – WEST DESERT - TINTIC



Credits: County of Utah, Bureau of Land Management, Utah AGRC, Esri, HERE, Garmin, NGA, USGS, NPS

WILDLIFE MANAGEMENT UNIT 19C – WEST DESERT - TINTIC

Boundary Description

Tooele, Juab, Utah and Millard counties – Boundary begins at I-15 and SR-73 in Lehi; south on I-15 to Exit 207 and Mills Road; west on this road to the Sevier River; north along this river to SR-132; west on SR-132 to US-6; north on US-6 to SR-36; north on SR-36 to SR-73; east on SR73 to I-15 in Lehi. Excludes all CWMUs.

Management Unit Description

Geography

The West Desert-Tintic unit has mule deer habitat congregated around the East Tintic and Lake Mountains. A majority of the unit outside of the mountains is considered to be pronghorn habitat.

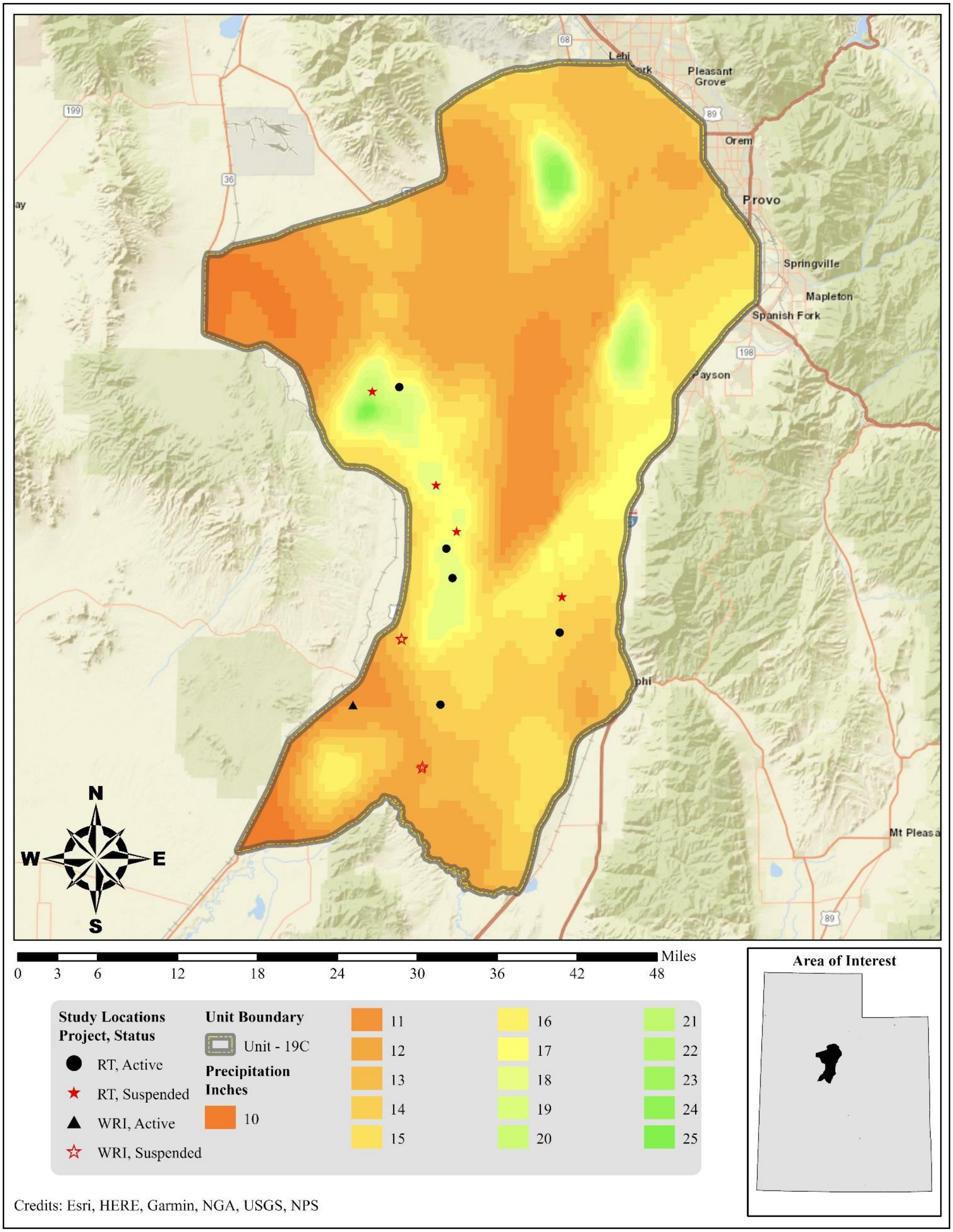
A significant portion of this unit is covered by Utah Lake. The primary geographic features in this subunit are the East Tintic Mountains and the Lake Mountains: both ranges are fairly wide, with gradual slopes. The highest point in the East Tintic Mountains is Boulter Peak at 8,312 feet and the Lake Mountains top out at 7,655 feet. Champlin Peak is the highest point in the Gilson Mountains at 7,510 feet. Finally, the tallest peak in the East Tintic Mountains is Tintic Mountain with an elevation of 8,223 feet.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 10 inches along portions of Rush and Cedar Valley to 25 inches on the peaks of the East Tintic and Lake Mountains. All of the Range Trend and WRI monitoring studies on the unit occur within 11-20 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 4).

The mean annual PDSI of the North Central division displayed years of moderate to extreme drought from 2000-2003, 2007, 2012-2015, 2018, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995-1998, 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 2021-2022. Moderately to extremely wet years for this time period were displayed in 1993, 1995-1999, 2005, and 2011. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007, 2012-2013, 2015, and 2020-2022; moderately to extremely wet years were displayed in 1993, 1995, 1997-1998, and 2005 (**Figure 5.1b**).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 2002-2003, 2012-2014, 2018, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1997-1998, 2005, and 2011 (**Figure 5.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1996, 2000, 2002-2004, 2013-2014, 2018, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2002-2003, 2007, 2009, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2005, and 2011 (**Figure 5.2b**) (Time Series Data, 2023).



Map 5.1: The 1991-2020 PRISM Precipitation Model for WMU 19C, West Desert - Tintic (PRISM Climate Group, Oregon State University, 2021).

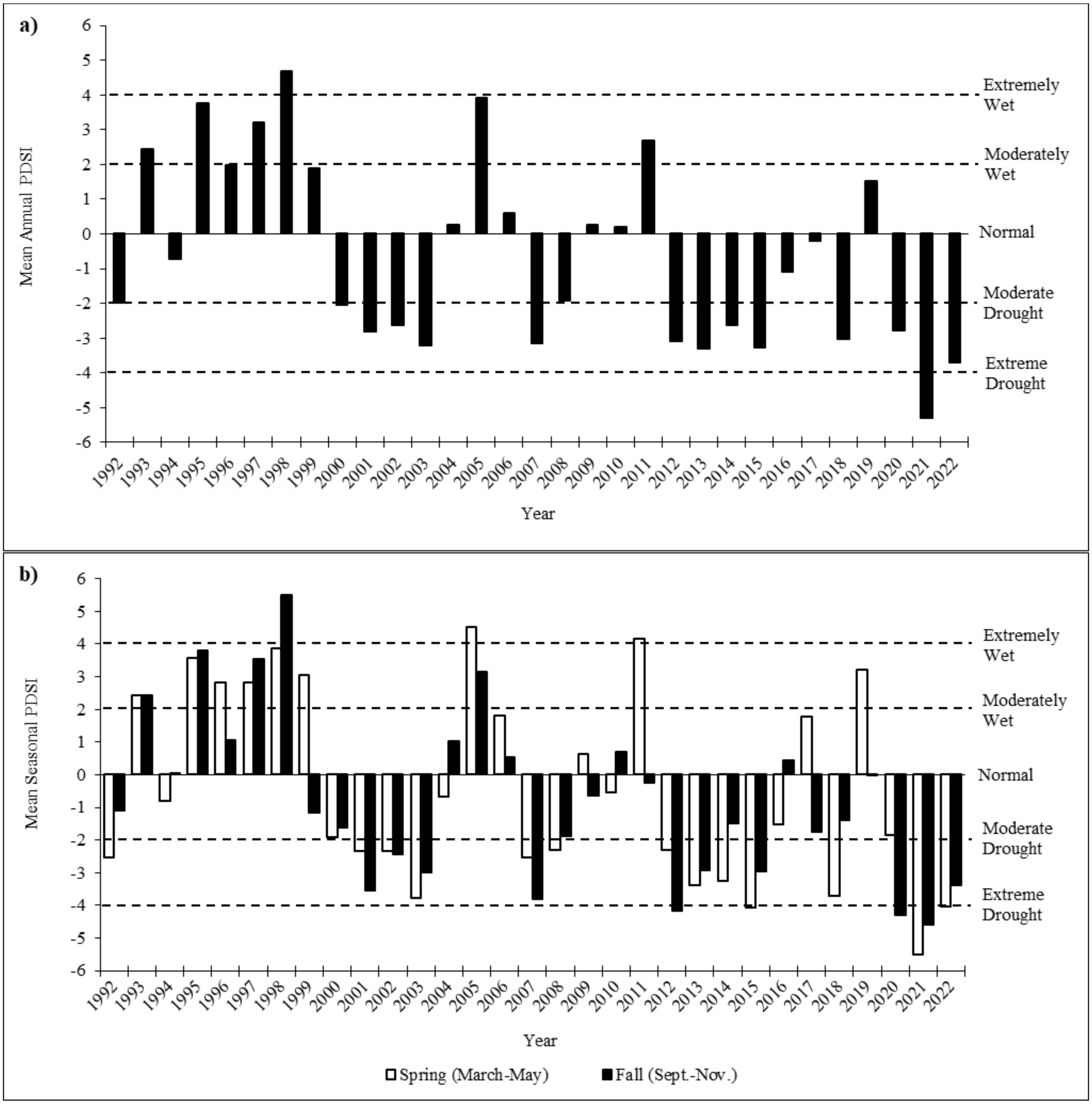


Figure 5.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the North Central division (Division 3). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

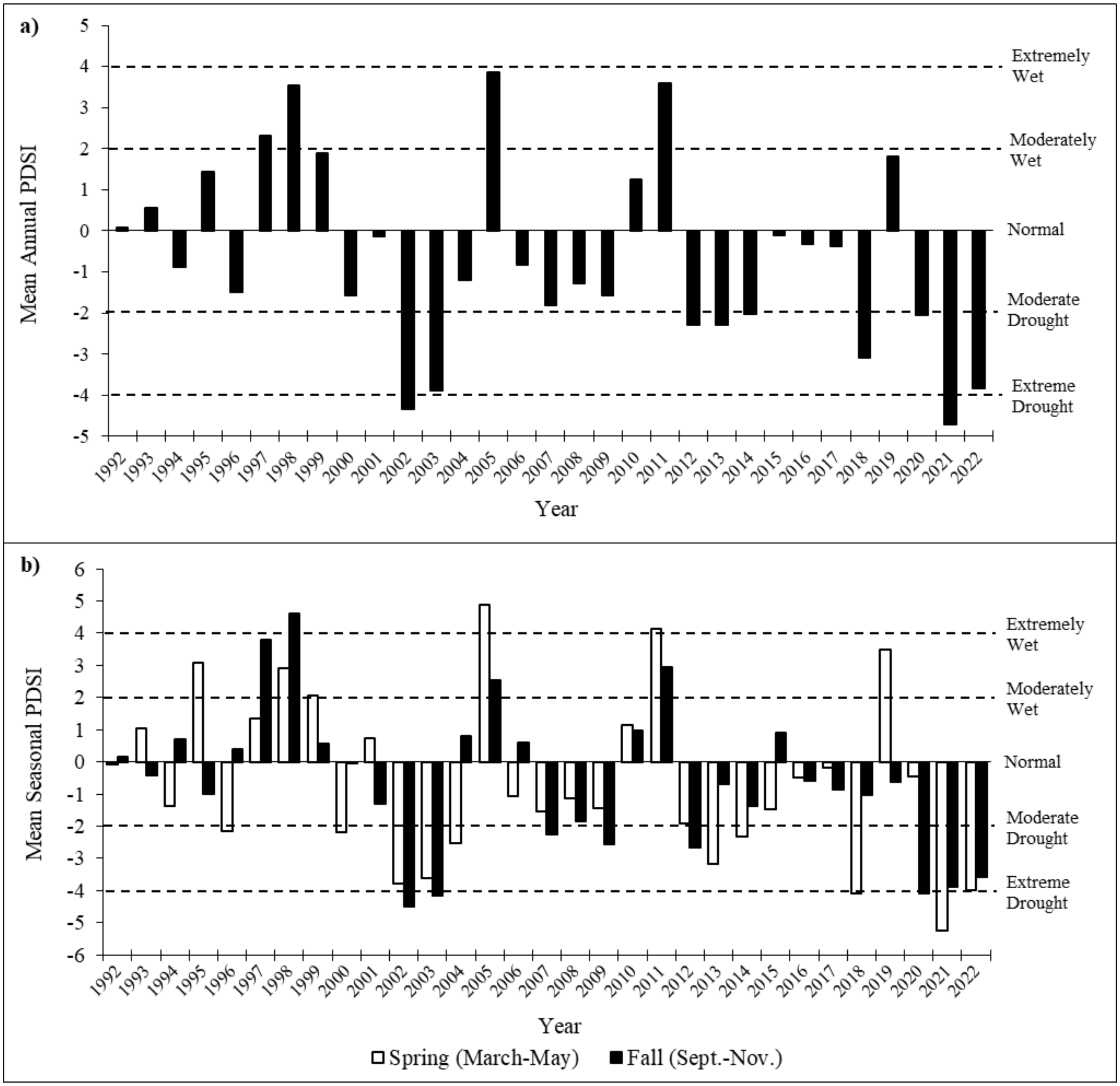


Figure 5.2: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

Big Game Habitat

Deer winter range mainly follows the lower elevation areas of the mountain ranges within the unit; the upper limit of normal deer winter range varies from 5,200 to 7,300 feet based on the mountain range on which it occurs. The lower range of normal deer winter range typically follows the lower elevations into the Tintic and Cedar Valleys.

Within the summer range, the browse species consist of sagebrush in the drier areas and mixed mountain brush communities in some of the more mesic locations. Sagebrush-PJ and pinyon-juniper communities are present on both the winter and summer range. Within these areas, pinyon and juniper trees can encroach on the browse communities, which often leads to reduced productivity (Miller, Svejcar, & Rose, 2000).

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between range trend samplings.

The RAP data shows fluctuations of herbaceous biomass and cover on both summer and winter deer winter range; the highest values for both measurements have mainly been observed in the mid-1990s, mid-2000s, and late 2010s. Annual and perennial cover and biomass have followed precipitation trends in many years. However, a possible lag effect of a year or so appears to occur at different times (in 2007-2008, for example), and no apparent correlation is visible in other years. Increases and decreases in biomass and cover generally appear to be somewhat more pronounced on winter habitats than on summer range (**Figure 5.3**, **Figure 5.4**, **Figure 5.5**, **Figure 5.6**). As expected, some peaks and troughs in this herbaceous data can be correlated with Palmer Drought Severity Index (PDSI) data. For example, increased cover, biomass, and precipitation in 2019 correspond with PDSI values that show wetter than normal years and a moderately wet spring (**Figure 5.1a**, **Figure 5.1b**, **Figure 5.2a**, **Figure 5.2b**).

Range Trend data for herbaceous cover from 1997 to present shows fluctuations in both perennial and annual lifeforms, but an overall increase occurred on sites of both ecotypes (**Figure 5.14**). Year-to-year fluctuations can be expected due to differences in precipitation and the timing of data collection between sample years.

RAP data indicates that tree and shrub cover correlates with precipitation in many years, but more loosely so than herbaceous cover and biomass. Cover values have decreased on both mule deer summer and winter habitat, but have done so to a more marked degree on winter range (**Figure 5.7**, **Figure 5.8**). Range Trend data for tree and shrub cover values has exhibited yearly fluctuations. In contrast with RAP data, however, cover values for these lifeforms appear to have increased overall (**Figure 5.9**, **Figure 5.10**).

RAP – Biomass by Deer Habitat

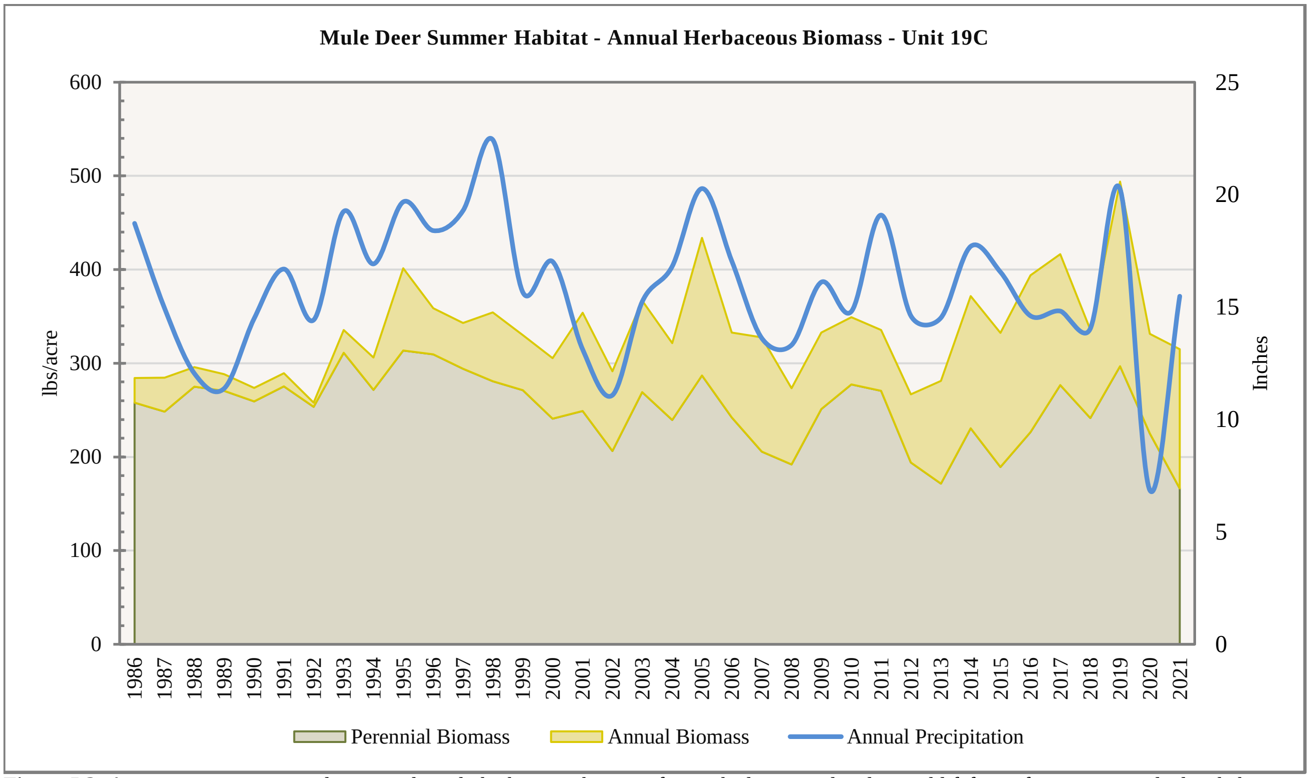


Figure 5.3: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 19C, West Desert - Tintic (Rangeland Analysis Platform, 2023).

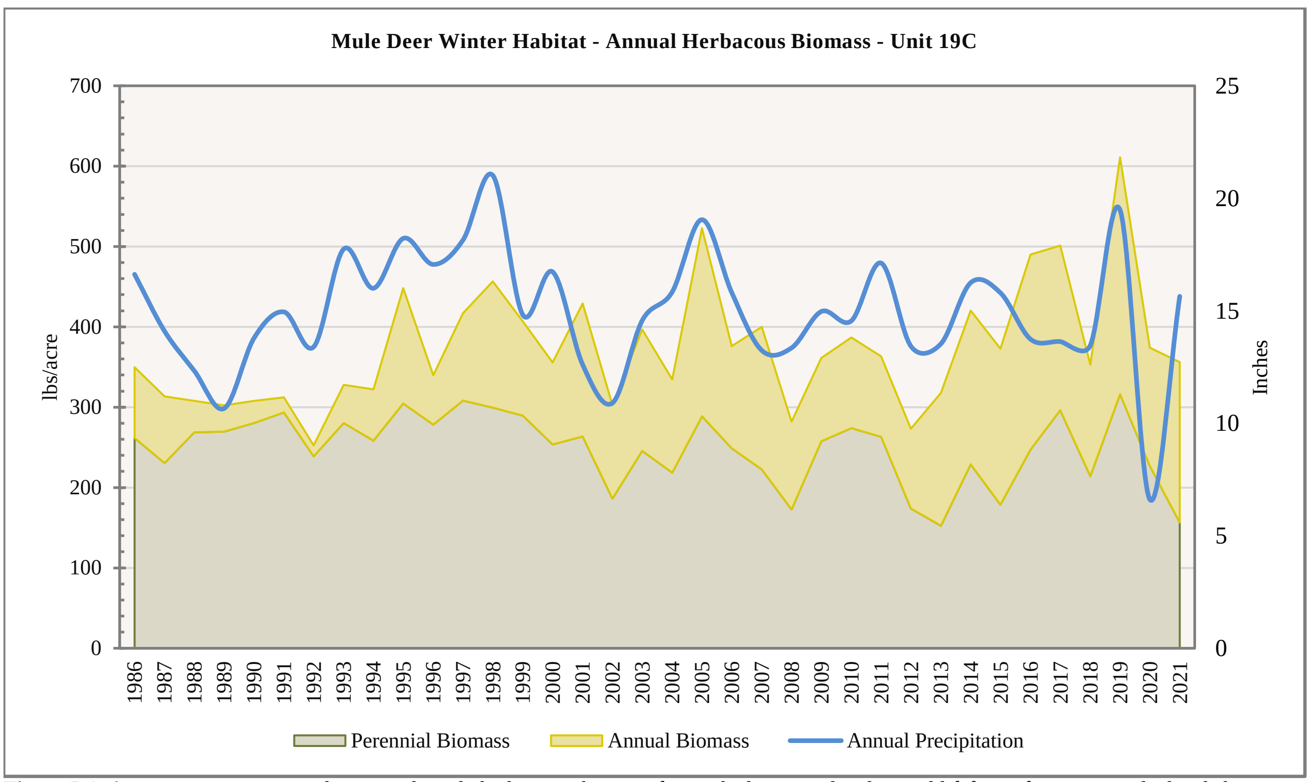


Figure 5.4: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 19C, West Desert - Tintic (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

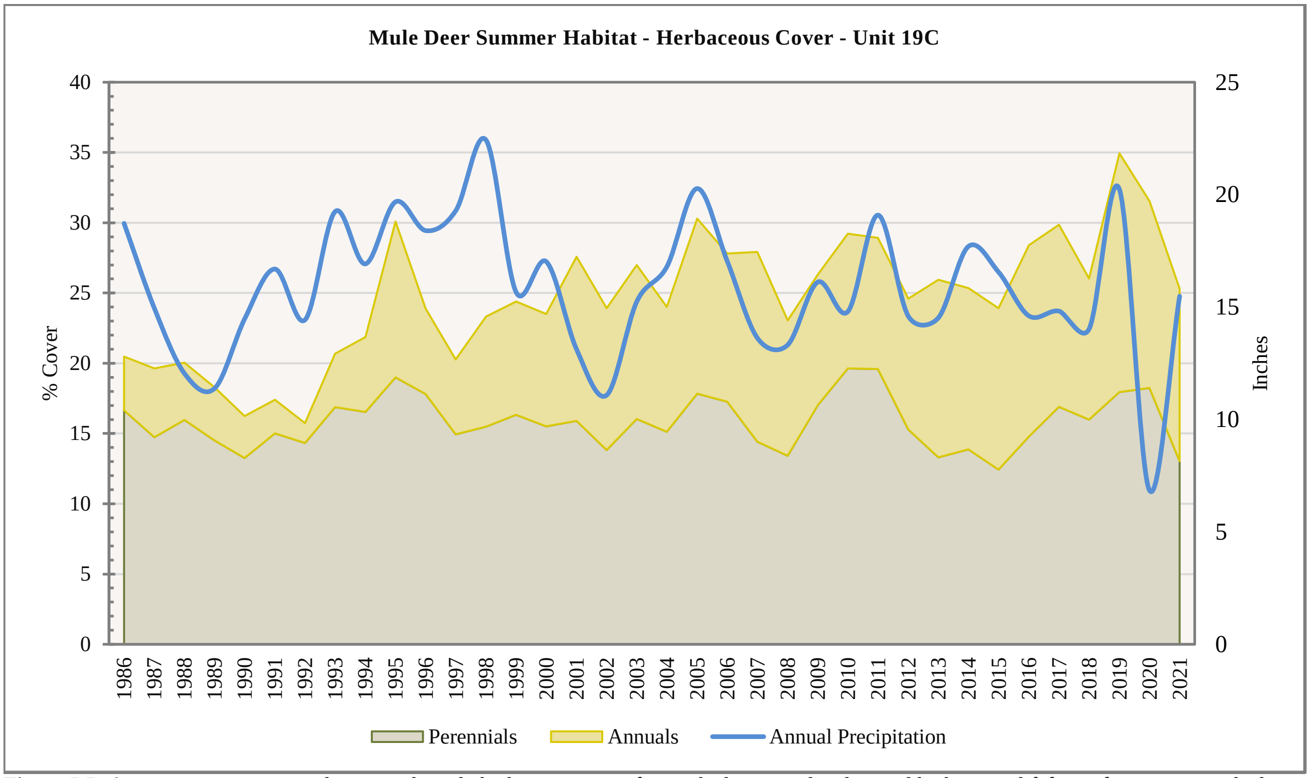


Figure 5.5: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual herbaceous lifeforms for summer mule deer habitat in WMU 19C, West Desert - Tintic (Rangeland Analysis Platform, 2023).

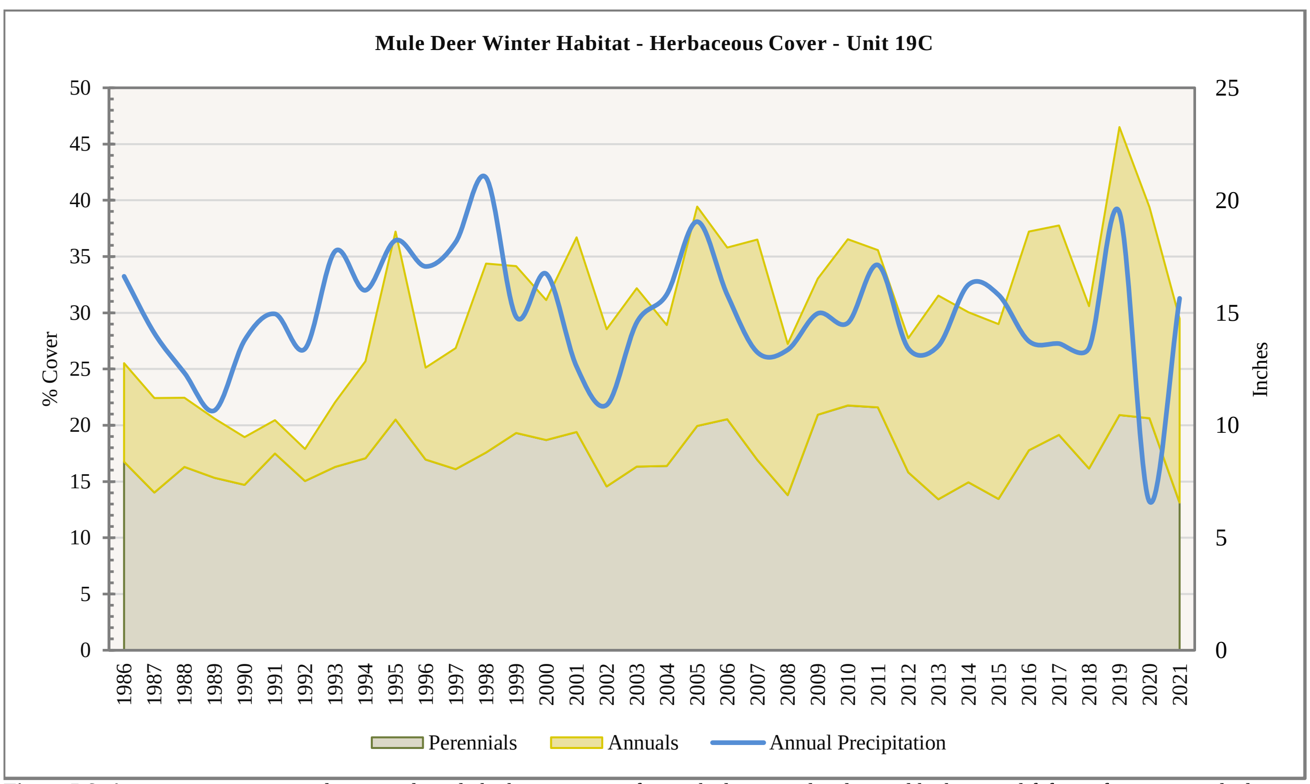


Figure 5.6: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual herbaceous lifeforms for winter mule deer habitat in WMU 19C, West Desert - Tintic (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

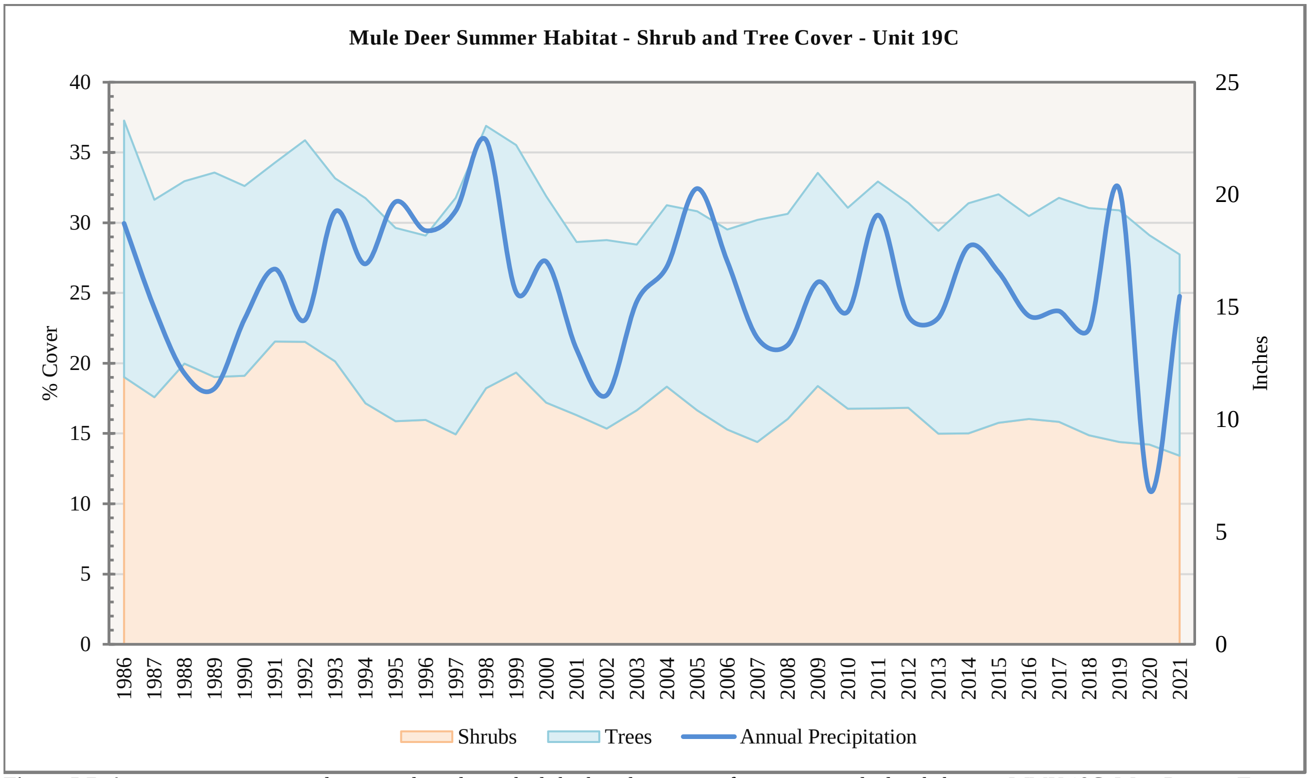


Figure 5.7: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 19C, West Desert - Tintic (Rangeland Analysis Platform, 2023).

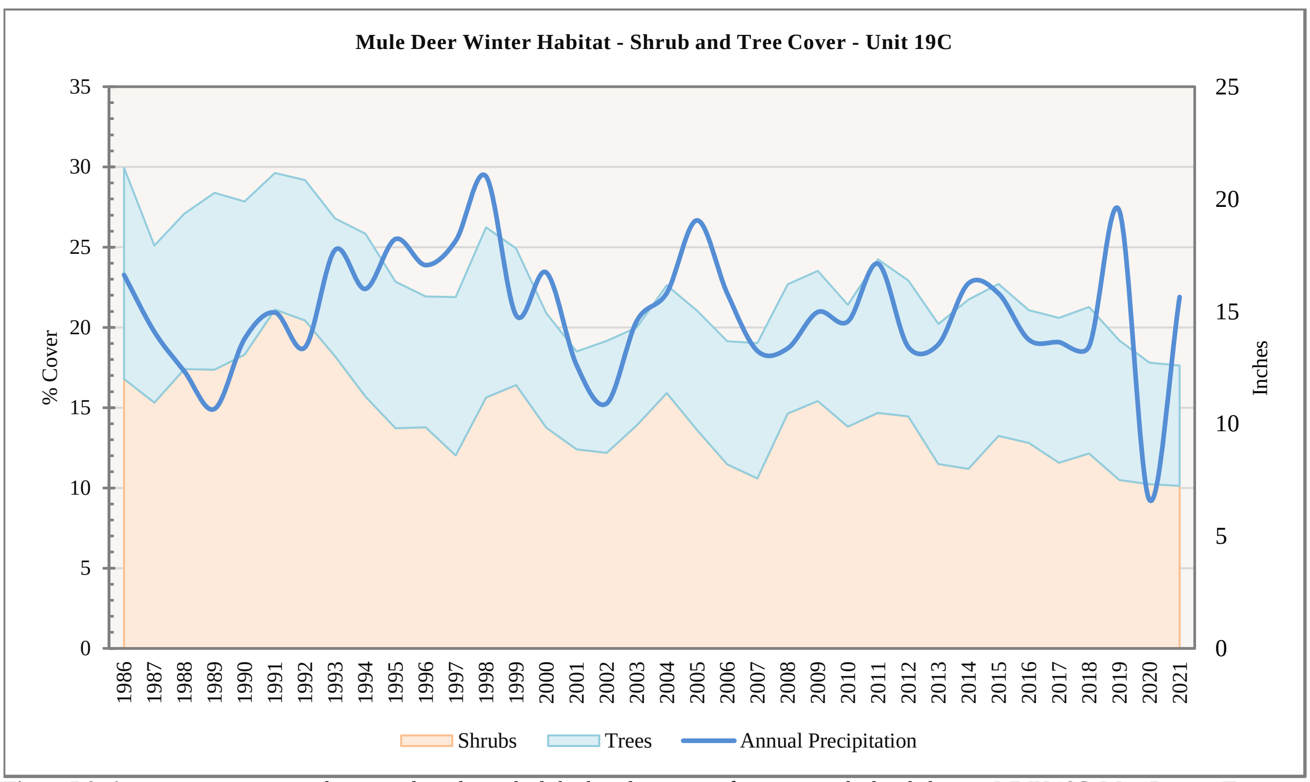
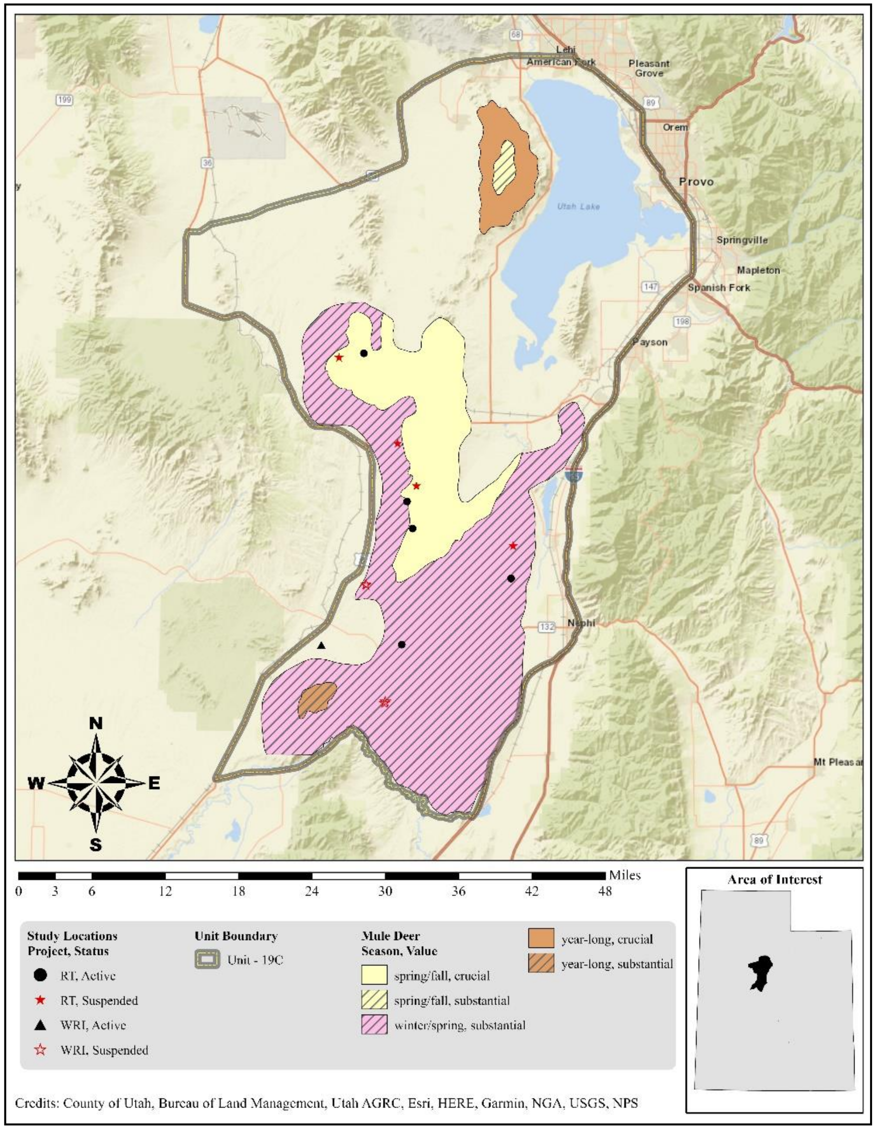
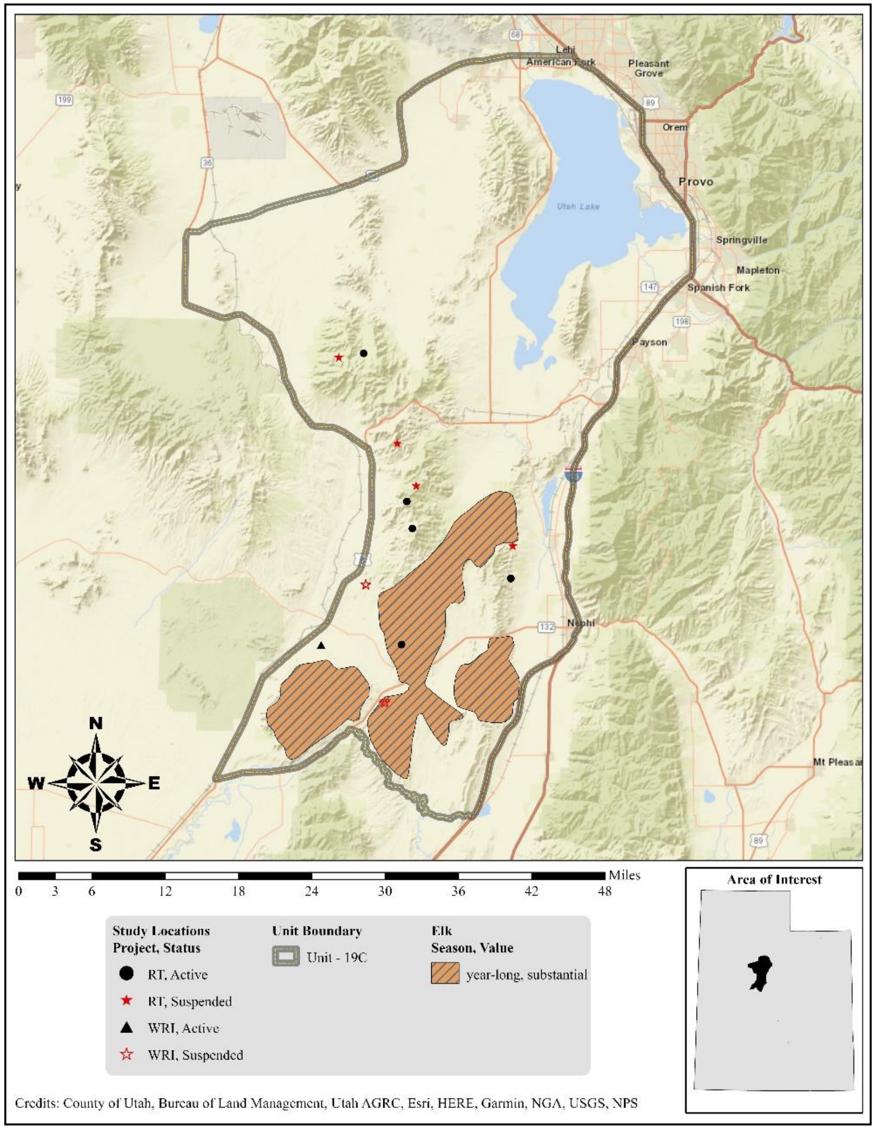


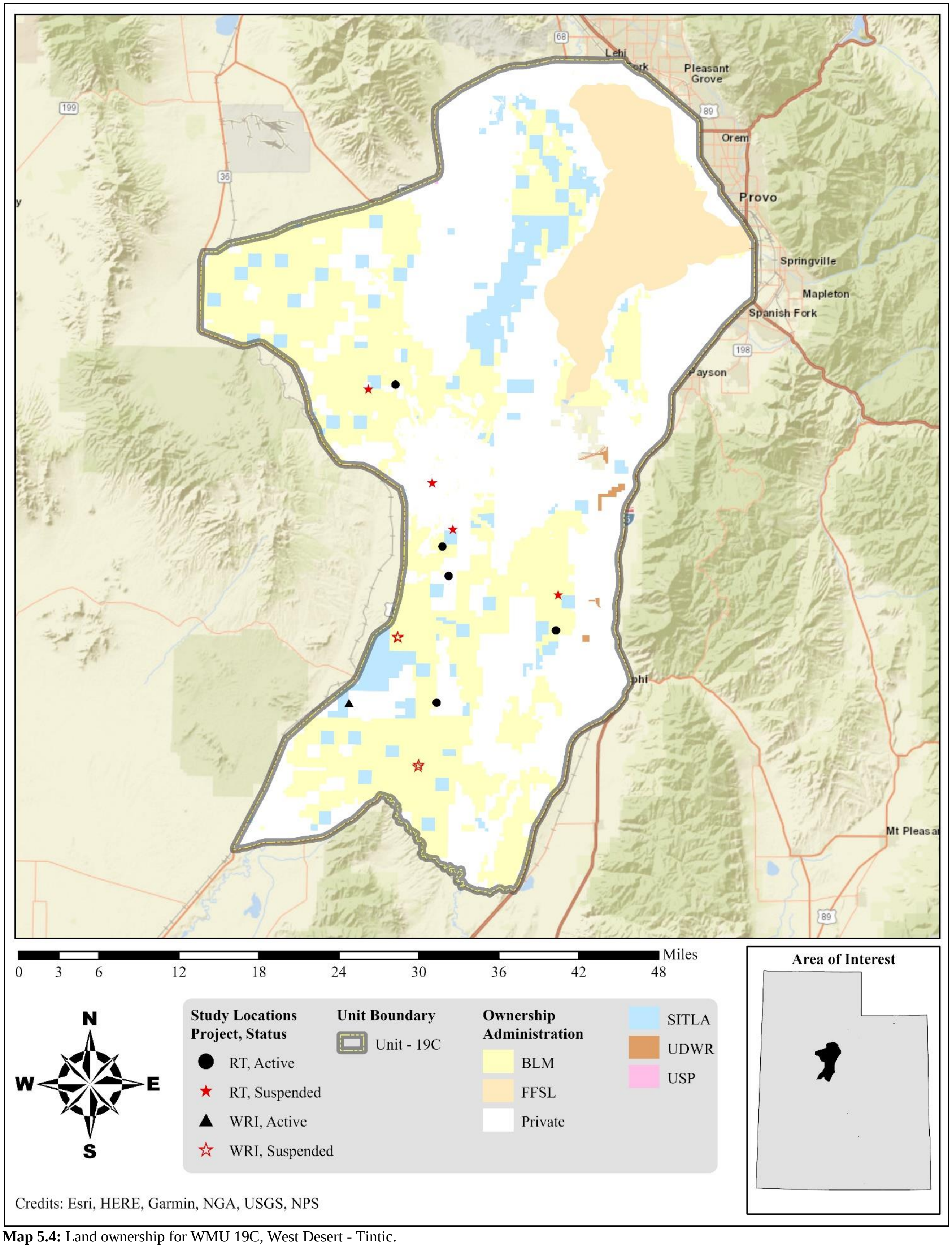
Figure 5.8: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 19C, West Desert - Tintic (Rangeland Analysis Platform, 2023).



Map 5.2: Estimated mule deer habitat by season and value for WMU 19C, West Desert - Tintic.



Map 5.3: Estimated elk habitat by season and value for WMU 19C, West Desert - Tintic.



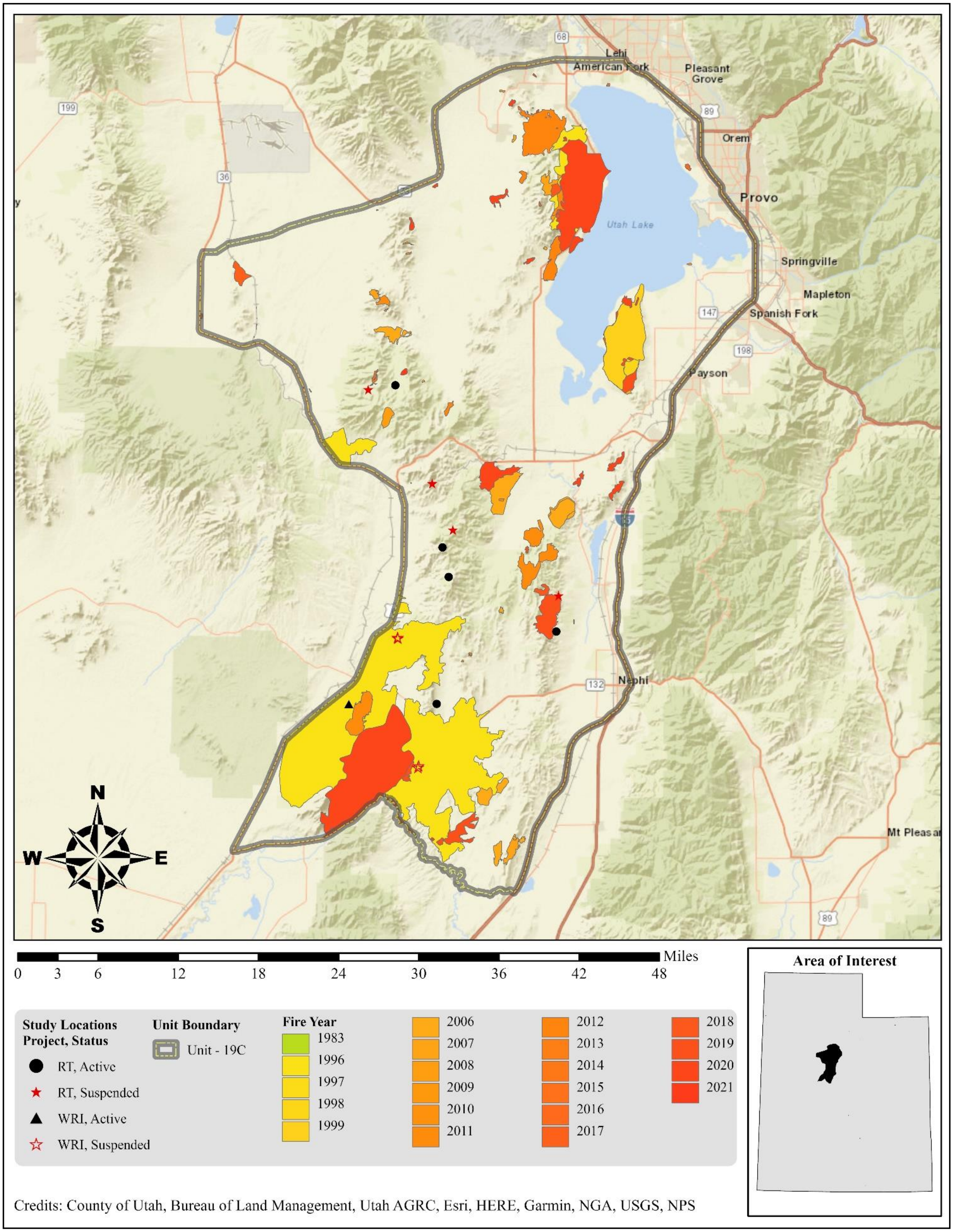
Map 5.4: Land ownership for WMU 19C, West Desert - Tintic.

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	109,041	30.40%	
	Inter-Mountain Basins Montane Sagebrush Steppe	33,827	9.43%	
	Great Basin Xeric Mixed Sagebrush Shrubland	24,340	6.79%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	6,430	1.79%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	5,243	1.46%	
	Great Basin Semi-Desert Chaparral	1,395	0.39%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	1,369	0.38%	
	Inter-Mountain Basins Big Sagebrush Steppe	1,305	0.36%	
	Rocky Mountain Lower Montane-Foothill Shrubland	1,164	0.32%	
	Inter-Mountain Basins Greasewood Flat	200	0.06%	
	Desert Scrub	3	0.00%	51.38%
Conifer	Great Basin Pinyon-Juniper Woodland	99,060	27.62%	
	Colorado Plateau Pinyon-Juniper Woodland	15,797	4.40%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	3,398	0.95%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	1,703	0.47%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	896	0.25%	
	Inter-Mountain Basins Juniper Savanna	302	0.08%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	2	0.00%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	<1	0.00%	33.78%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	11,929	3.33%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	5,812	1.62%	
	Great Basin & Intermountain Introduced Annual Grassland	5,471	1.53%	
	Interior Western North American Temperate Ruderal Grassland	22	0.01%	6.48%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	13,880	3.87%	
	Interior Western North American Temperate Ruderal Shrubland	19	0.01%	3.87%
Other	Agricultural	5,698	1.59%	
	Developed	3,993	1.11%	
	Hardwood	666	0.19%	
	Sparsely Vegetated	344	0.10%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	262	0.07%	
	Riparian	241	0.07%	
	Conifer-Hardwood	60	0.02%	
	Open Water	49	0.01%	3.15%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	4,469	1.25%	
	Southern Rocky Mountain Montane-Subalpine Grassland	291	0.08%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	17	0.00%	1.33%
Total		**358,698**	**100%**	**100%**

Table 5.1: LANDFIRE Existing Vegetation Coverage For Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 19C, West Desert - Tintic.

Limiting Factors to Big Game Habitat

Major human activities in the area include agriculture, livestock grazing, recreation, and urban development. Limiting factors on this unit include habitat degradation and loss, winter range availability on public land, winter range forage condition, predation, and parasites and disease. In addition, encroachment by pinyon-juniper woodland communities poses a threat to important sagebrush rangelands. According to the current LANDFIRE Existing Vegetation Coverage model, 32.1% of the Tintic subunit's deer winter range is comprised of pinyon-juniper woodlands (**Table 5.1**). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease sagebrush and herbaceous cover, therefore negatively impacting the availability of wildlife forage (Miller, Svejcar, & Rose, 2000). Finally, this unit has had several wildfires, notably the Canal Wildfire and the Leamington Complex, resulting in loss of big game habitat (**Map 5.5**).



Map 5.5: Land coverage of fires by year from 1983-2021 for WMU 19C, West Desert - Tintic (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

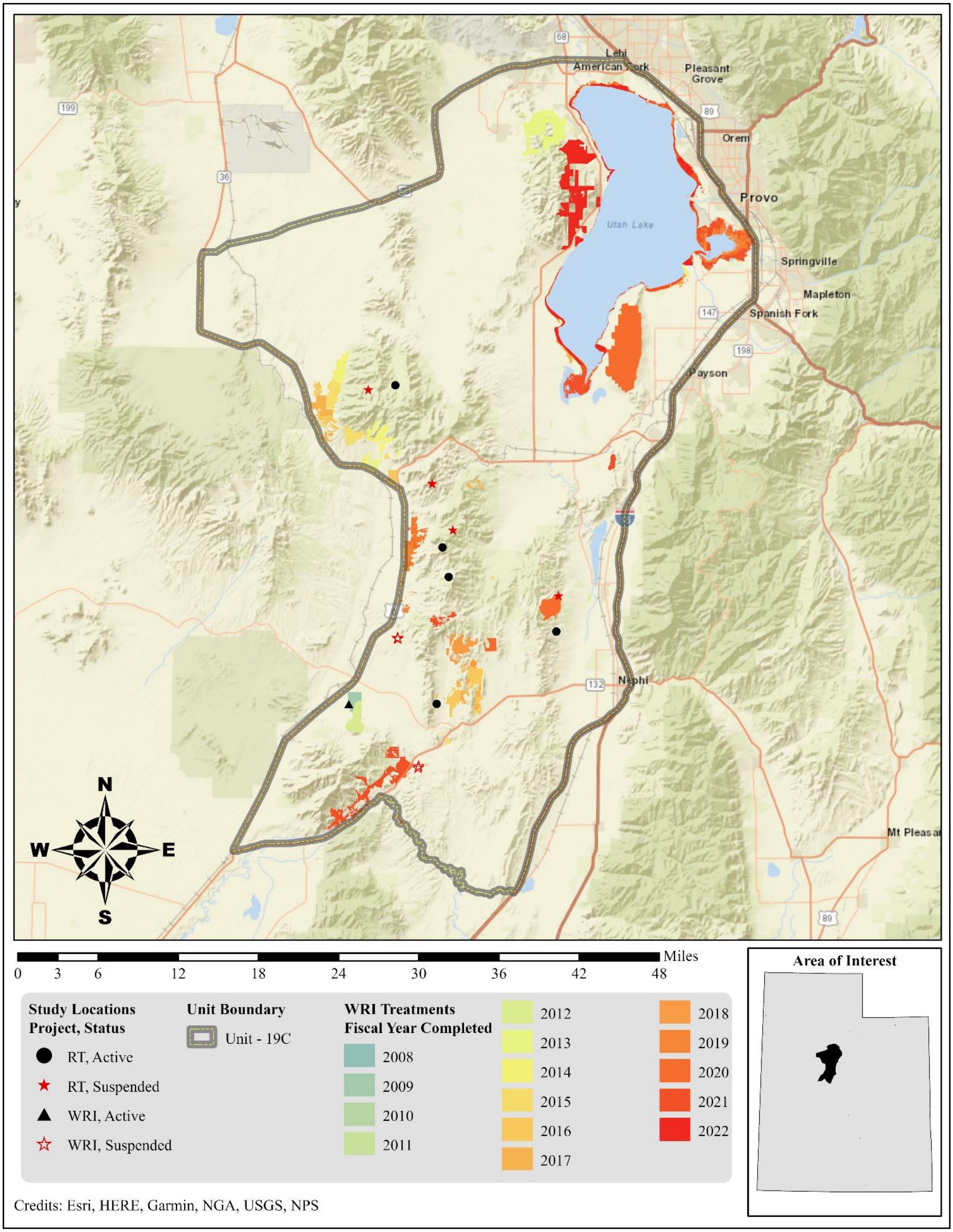
Treatments/Restoration Work

There has been an active effort to address the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 48,309 acres of land have been treated within the Tintic subunit since the WRI was implemented in 2004 (**Map 5.6**). Treatments frequently overlap one another; bringing the net total of completed acres to 46,624 acres for this unit (**Table 5.2**). 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 augment the herbaceous understory is the primary treatment type in this subunit and is often used in conjunction with other treatments for habitat improvement. Bullhog treatment to remove pinyon and juniper is also a common management practice in this subunit, with anchor chaining as well as lop and scatter treatments being implemented less often. Prescribed fire has also been used, but to a lesser extent (**Table 5.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**1,458**	**0**	**0**	**1,458**
Ely (One-Way)	669	0	0	669
Ely (Two-Way)	594	0	0	594
Smooth (Two-Way)	195	0	0	195
Bullhog	**7,210**	**0**	**0**	**7,210**
Full Size	7,210	0	0	7,210
Harrow	**509**	**0**	**0**	**509**
> 15 ft. (One-Way)	509	0	0	509
Herbicide Application	**9,603**	**195**	**0**	**9,798**
Aerial (Fixed-Wing)	71	195	0	266
Aerial (Helicopter)	6,167	0	0	6,167
Ground	1,402	0	0	1,402
Spot Treatment	1,963	0	0	1,963
Mowing	**773**	**0**	**0**	**773**
Other	773	0	0	773
Planting/Transplanting	**0**	**42**	**499**	**542**
Container Stock	0	42	499	542
Prescribed Fire	**112**	**0**	**0**	**112**
Prescribed Fire	112	0	0	112
Seeding (Primary)	**26,071**	**0**	**0**	**26,071**
Broadcast (Aerial-Fixed Wing)	18,927	0	0	18,927
Broadcast (Aerial-Helicopter)	5,646	0	0	5,646
Drill (Rangeland)	1,178	0	0	1,178
Ground (Mechanical Application)	320	0	0	320
Vegetation Removal/Hand Crew	**2,573**	**94**	**1**	**2,669**
Lop (No Scatter)	12	0	0	12
Lop & Chip	1	0	0	1
Lop & Scatter	2,560	0	1	2,562
Lop-Pile-Burn	0	94	0	94
Grand Total	**48,309**	**332**	**501**	**49,142**
***Total Land Area Treated**	**46,624**	**332**	**501**	**47,456**

Table 5.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 19C, West Desert - Tintic. Data accessed on 01/23/2023. *Does not include overlapping treatments.



Map 5.6: WRI treatments by fiscal year completed for WMU 19C, West Desert - Tintic.

Range Trend Studies

Range Trend studies have been sampled within WMU 19C on a regular basis since 1983, with studies being added or suspended as was deemed necessary (**Table 5.3**). 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 5.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
19C-10	Sioux Pass	RT	Suspended	1989, 1997, 2002	Mountain Stony Loam (Mountain Big Sagebrush)
19C-11	Water Canyon	RT	Suspended	1989, 1997	Mountain Stony Loam (Mountain Big Sagebrush)
19C-12	Sunrise Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
19C-13	Dennis Spring	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
19C-14	Black Rock Canyon	RT	Suspended	1989, 1997	Mountain Stony Loam (Browse)
19C-15	Upper Broad Canyon	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Mountain Stony Loam (Mountain Big Sagebrush)
19C-16	Nephi Dump	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Stony Loam (Mountain Big Sagebrush)
19C-18	Furner Valley	RT	Active	1983, 1989, 1997, 2002, 2007, 2012, 2017, 2022	Upland Loam (Mountain Big Sagebrush)
19C-19	Paul Bunyan Burn	WRI	Suspended	1998, 1999, 2002, 2007	Upland Loam (Wyoming Big Sagebrush)
19C-19	Paul Bunyan Burn	WRI	Suspended	1998, 1999, 2002, 2007	Upland Loam (Wyoming Big Sagebrush)
19C-20	Paul Bunyan Burn and Chain	WRI	Suspended	1998, 1999, 2002, 2007, 2012	Upland Gravelly Loam (Wyoming Big Sagebrush)
19C-21	Leamington Burn and Chain	WRI	Suspended	1997, 1998, 1999, 2002, 2007, 2012	Upland Shallow Hardpan (Pinyon-Utah Juniper)
19C-22	Leamington Burn	WRI	Suspended	1997, 1998, 1999, 2002, 2007	Upland Loam (Wyoming Big Sagebrush)
19R-21	Gilson Mountain Sage-grouse	WRI	Active	2008, 2011, 2016, 2021	Semidesert Loam (Wyoming Big Sagebrush)

Table 5.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 19C, West Desert - Tintic.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
19C-13	Dennis Spring	Wildfire	Mona West	July 2001	33,852	
19C-14	Black Rock Canyon	Aerial After Wildfire	Blackrock Fire Blackrock Fire	December 2003 July-August 2003	393 502	LTDL
19C-18	Furner Valley	Mower or Aerator Unknown		Between 2002 and 2007		
19C-19	Paul Bunyan Burn	Wildfire Aerial	Leamington Burn Complex	August 1996 October 1996	138,340 3,779	
19C-20	Paul Bunyan Burn and Chain	Wildfire One-Way Ely Aerial Before Dribbler	Leamington Burn Complex	August 1996 October 1996 October 1996 October 1996	138,340 3,779 3,779 3,779	
19C-21	Leamington Burn and Chain	Wildfire One-Way Ely Aerial Before Dribbler	Leamington Burn Complex	August 1996 October 1996 October 1996 October 1996	138,340 3,765 3,765 3,765	
19C-22	Leamington Burn	Wildfire Aerial	Leamington Burn Complex	August 1996 October 1996	138,340 3,765	
19R-21	Gilson Mountain Sage-grouse	Wildfire Plateau Rangeland Drill Rangeland Drill	 Gilson Mountain Sage-grouse Habitat Improvement Gilson Mountain Sage-grouse Habitat Improvement Gilson Mountain Sage-grouse Habitat Improvement	1996 September 2008 November-December 2008 March 2009	 657 657 657	 1103 1103 1103

Table 5.4: Range Trend and WRI studies known disturbance history for WMU 19C, West Desert - Tintic. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

There are five study sites [Sioux Pass (19C-10) (suspended), Water Canyon (19C-11) (suspended), Sunrise Canyon (19C-12), Dennis Spring (19C-13), and Upper Broad Canyon (19C-15)] that are classified as Mountain (Big Sagebrush) ecological sites. The Sioux Pass study is found in the East Tintic Mountains, south of Mammoth Peak near Sioux Pass. The Water Canyon site is situated on the north-facing slopes above Water Canyon in the same mountain range. Sunrise Canyon is found near Volcano Ridge, while the Dennis Spring study is located near Tintic Mountain: both study sites are situated in the East Tintic Mountains. Finally, the Upper Broad Canyon study is also in the East Tintic Mountain Range, specifically up Broad Canyon (**Table 5.3**).

<u>Shrubs/Trees</u>: The main browse species on these study sites is mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), although the Sunrise Canyon study is also host to a robust population of little sagebrush (*A. arbuscula*). Other species such as antelope bitterbrush (*Purshia tridentata*) and mountain snowberry (*Symphoricarpos occidentalis*) are also present on these sites in lesser amounts, providing additional beneficial browse. The Sioux Pass and Water Canyon studies were suspended prior to the implementation of line-intercept cover and point-quarter density methodologies. As such, data for these study sites is only included in this section in the context of browse demographic and utilization trends. Total average shrub cover increased each sample year between 2007 and 2017. Although cover remained significant, a decrease occurred in 2022: this increase and subsequent decrease can largely be attributed the Dennis Spring study. Site-level data reveals that mountain big sagebrush on Dennis Spring provided 36% cover in 2007, 66% in 2017, and 58% in 2022 (**Figure 5.9**). Average preferred browse demographic density indicates that although total shrub density has increased overall, a steadily decreasing trend has occurred since 2012. Recruitment of young exhibited an initial increase between 1997 and 2002, but has decreased during each subsequent sample year. Both of these trends are again largely due to the Dennis Spring study site, with the 2002 increase in young driven by recruitment following the 2001 Mona West fire. Average decadence within these browse populations has remained low, and mature individuals have been the primary demographic throughout the study period (**Figure 5.12**). Overall utilization increased (with some variation) between 1997 and 2017; 22% of plants were moderately hedged and 7% were heavily used in 2017. However, significantly reduced utilization was observed in 2022, when only 10% and 2% of plants displayed signs of moderate and heavy browsing (respectively). Closer examination of site-level data shows that this recent decrease is mainly due to the Sunrise Canyon study (**Figure 5.13**).

Average tree cover and density data indicate that continued, increased encroachment of both singleleaf pinyon (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) is occurring in this ecotype. However, both of these trends are exclusively driven by the Upper Broad Canyon study as trees are absent in cover and density measurements on the Sunrise Canyon and Dennis Spring sites (**Figure 5.10**, **Figure 5.11**).

<u>Herbaceous Understory</u>: Total average herbaceous frequency and cover have increased over time on these study sites. Perennial grasses have contributed the most cover and have been the most abundant of any single herbaceous component throughout the sample period. More specifically, much of the perennial grass cover was provided by the native species bluebunch wheatgrass (*Pseudoroegneria spicata*) on the Sunrise Canyon and Upper Broad Canyon studies in 2017 and 2022. Perennial forbs are also a significant understory component, with silver lupine (*Lupinus argenteus*) on the Sunrise Canyon site contributing much of the cover. Annual forb cover and frequency have increased over the sample period. Site-specific data indicates that the significant increase in annual forb cover between 2017 and 2022 can mainly be attributed to the introduced species jagged chickweed (*Holosteum umbellatum*), desert madwort (*Alyssum desertorum*), and curveseed butterwort (*Ceratocephala testiculata*) on the Upper Broad Canyon site. The non-native annual grass species cheatgrass (*Bromus tectorum*) has been observed on all study sites, but with generally low cover. Cover remains low as of 2022, but the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has been present in increasing amounts since 2012. Trends in bulbous bluegrass cover and frequency are primarily driven by the Upper Broad Canyon study (**Figure 5.14**, **Figure 5.15**).

<u>Occupancy</u>: Pellet group data displays fluctuations in usage from year to year. Primary occupancy has varied over the sample period: deer pellet groups were most abundant in 2002 and 2022, while sheep were the primary occupants in 2007, 2012, and 2017. Deer presence has ranged from 3 days use/acre in 2017 to 29 days use/acre in 2002. Elk have had a mean pellet group abundance as low as 0 days use/acre in 2002 and 2017 and as high as 3 days use/acre in 2022. Cattle pellets were observed in 2022 with an average abundance of 5 days use/acre, but were absent in all other years. Finally, mean abundance of sheep pellet groups has fluctuated between 8 days use/acre in 2002 and 32 days use/acre in 2007 (**Figure 5.16**).

Upland (Big Sagebrush)

Two study sites [Nephi Dump (19C-16) and Furner Valley (19C-18)] are considered to be Upland (Big Sagebrush) ecological sites. The Nephi Dump site is on Long Ridge on the foothills west of Nephi. The Furner Valley site is located at the southern edge of the East Tintic Mountains between Tintic and Juab Valleys (**Table 5.3**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant preferred browse species on these sites; antelope bitterbrush (*Purshia tridentata*) also contributes significant cover on Furner Valley. Total average shrub cover has exhibited a slight increase over time. This increasing cover trend is mainly driven by sagebrush on the Furner Valley site, as sagebrush cover on Nephi Dump increased by only 0.8% when comparing 2007 with 2022 data (**Figure 5.9**). Total preferred browse density has remained largely stable since 2012, but an overall decrease occurred during the study period: this is due to total density decreases on both studies. Mature plants have been the dominant age class in these populations in all sample years. Decadence and recruitment of young have decreased over time (**Figure 5.12**). At least 25% of preferred browse plants were moderately to heavily hedged between 1997 and 2017. In 2022, however, 8% each were moderately or heavily browsed, a trend driven by decreasing utilization on both study sites. (**Figure 5.13**).

Conifer encroachment by Utah juniper (*Juniperus osteosperma*) is occurring on these study sites. Tree cover has increased overall since 2007. However, a slight decrease occurred between 2017 and 2022: this small reduction in tree cover is largely due to the Furner Valley site. Tree density has exhibited minor year-to-year fluctuations, but has remained stable overall (**Figure 5.10**, **Figure 5.11**).

Herbaceous Understory: The total average herbaceous understory of these sites has increased overall in cover and frequency. Perennial grasses have contributed the most cover of any herbaceous component in most sample years, although annual forbs provided nearly the same amount of cover in 2022. However, nested frequency data indicates that annual forbs such as desert madwort (*Alyssum desertorum*) and curveseed butterwort (*Ceratocephala testiculata*) have been the most abundant herbaceous component in many years. Cover and abundance of the introduced annual grass species cheatgrass (*Bromus tectorum*) has varied over time, but it exhibited an increase on both study sites between 2017 and 2022. Perennial forbs have remained rare (**Figure 5.14**, **Figure 5.15**).

Occupancy: Average pellet transect data has shown an overall decrease in animal presence over the study period. Deer, antelope, and/or sheep were the primary occupants in 2002 and 2017, but cattle pellets were most abundant in all other sample years. Deer, antelope, and/or sheep presence has been as low as 2 days use/acre in 2012 and as high as 33.5 days use/acre in 2002. Elk pellet groups were present in 2017 with a mean abundance of 0.3 days use/acre, but were absent otherwise. The average abundance of cattle pellet groups has ranged from 2 days use/acre in 2017 to 28 days use/acre in 2012. Finally, sheep pellet groups were present on the Furner Valley study in 2002 with a mean abundance of 2 days use/acre. However, sheep pellet sign has not been observed in other sample years (**Figure 5.16**).

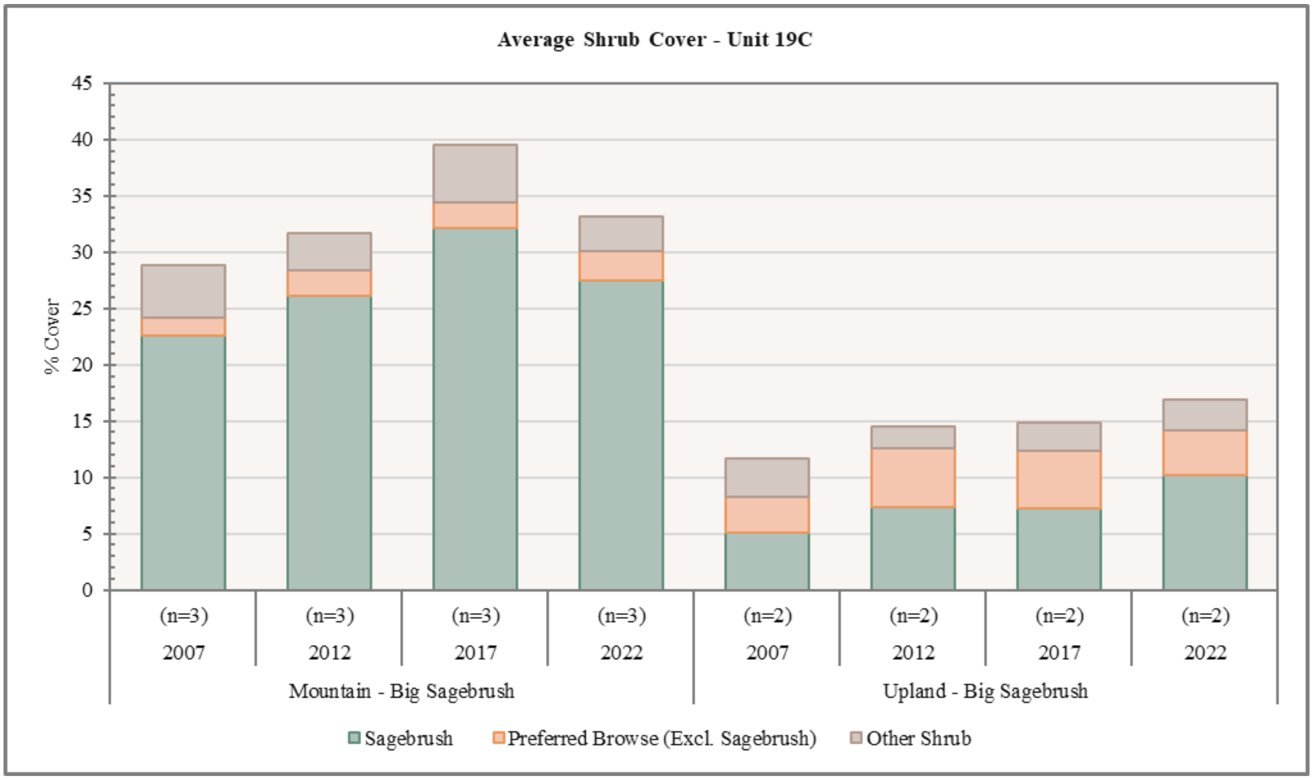


Figure 5.9: Average shrub cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, West Desert - Tintic.

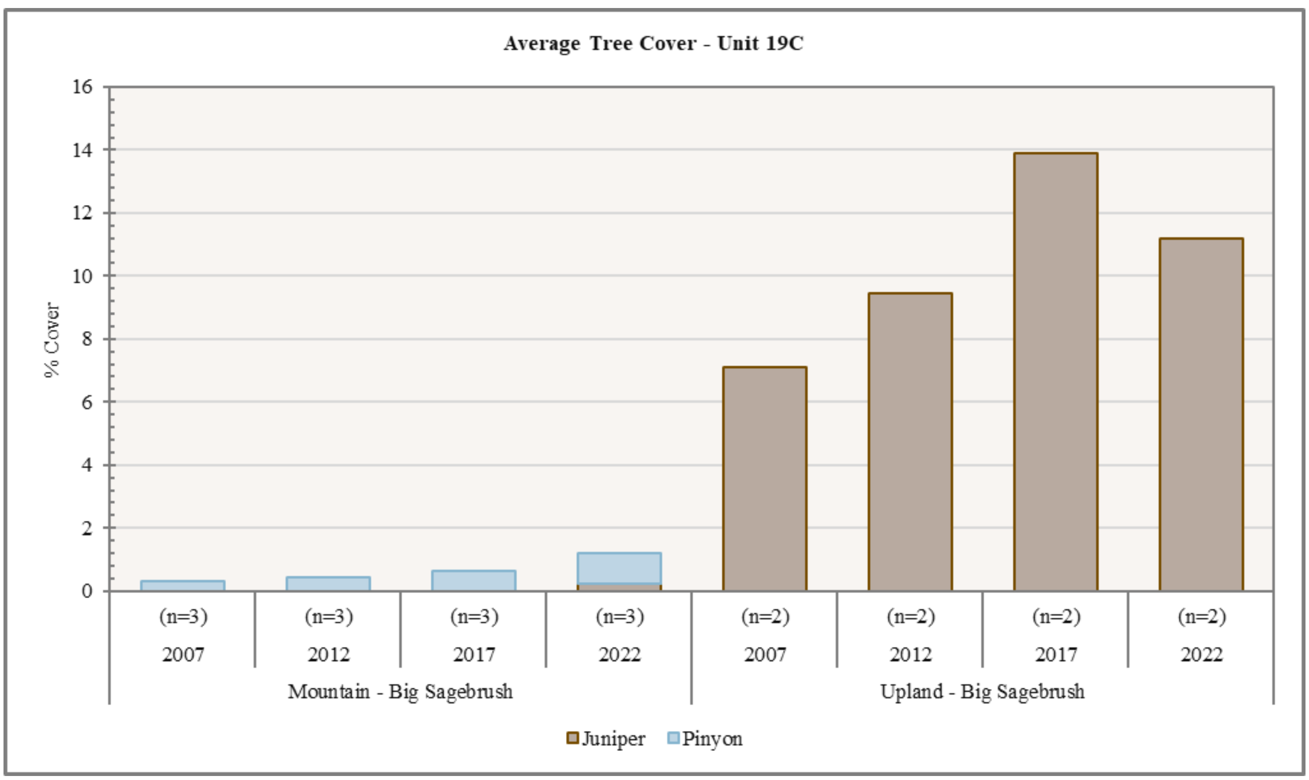


Figure 5.10: Average tree cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, West Desert - Tintic.

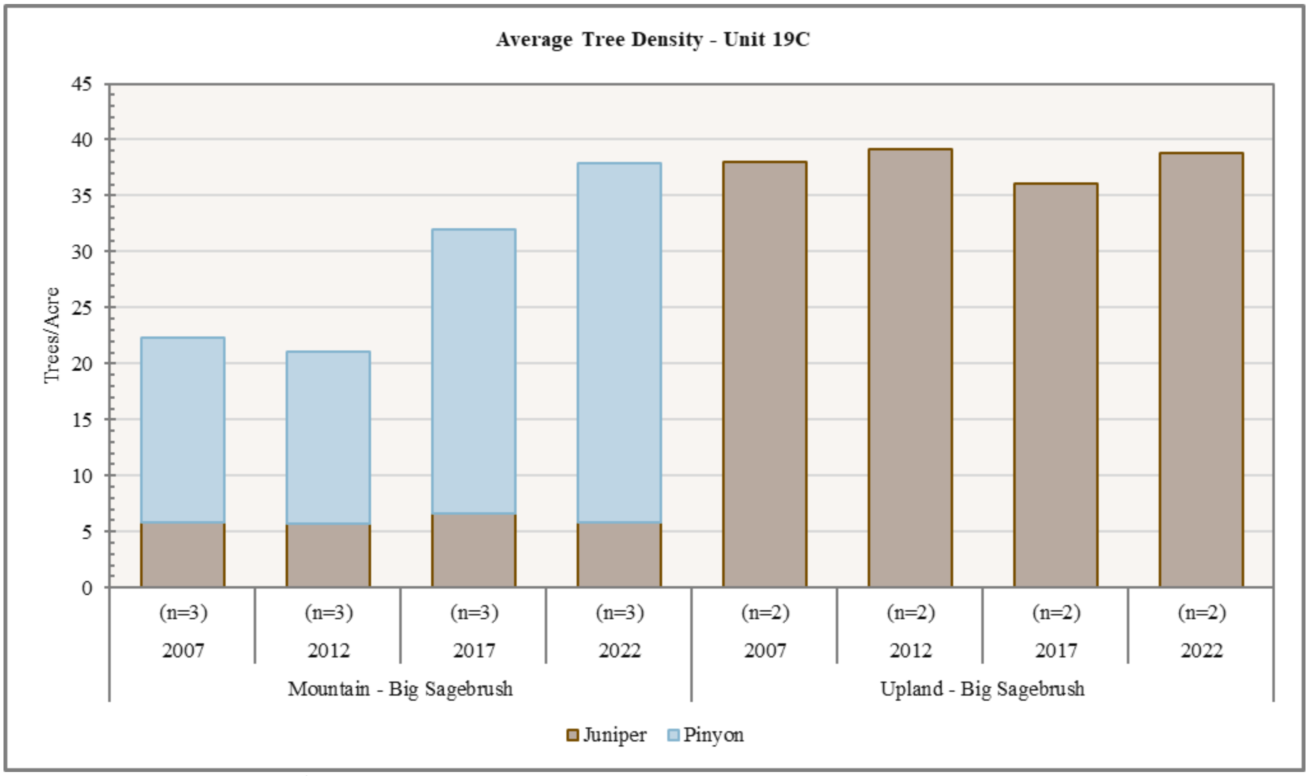


Figure 5.11: Average tree density for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, West Desert - Tintic.

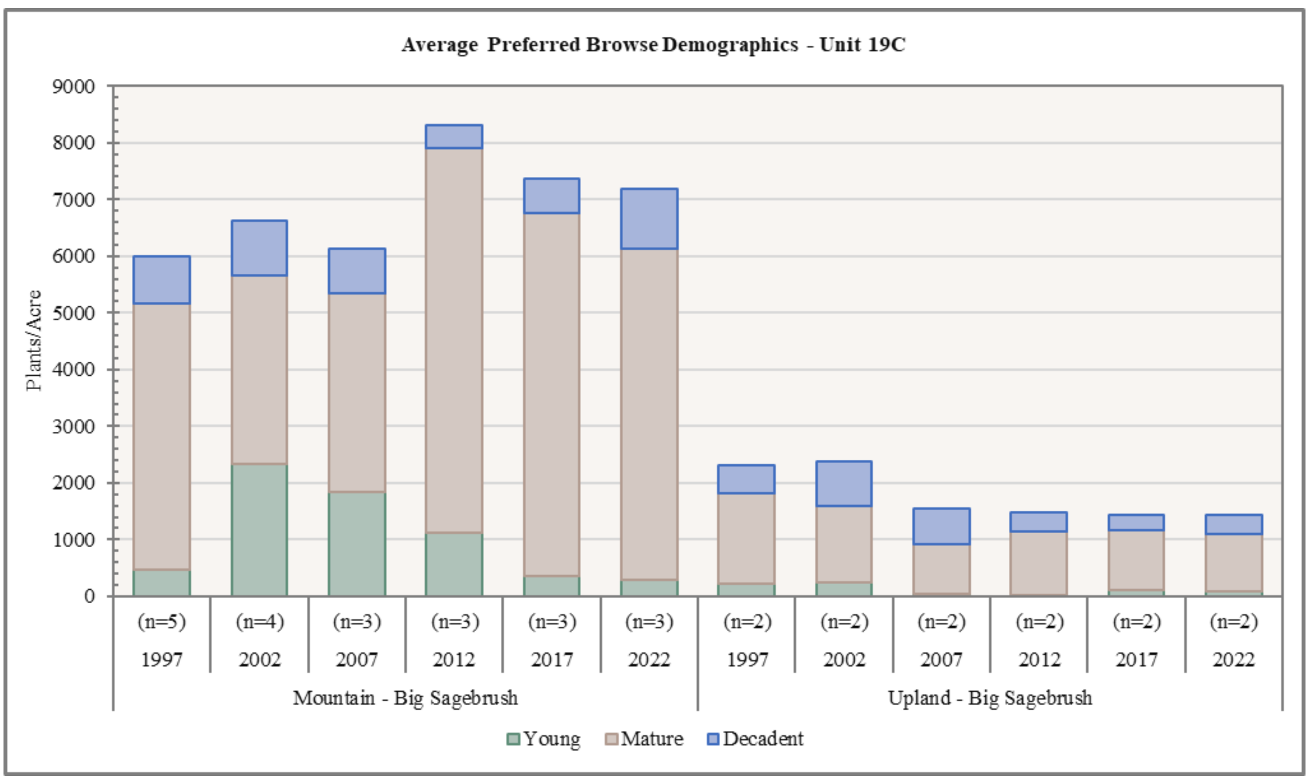


Figure 5.12: Average preferred browse demographics for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, West Desert - Tintic.

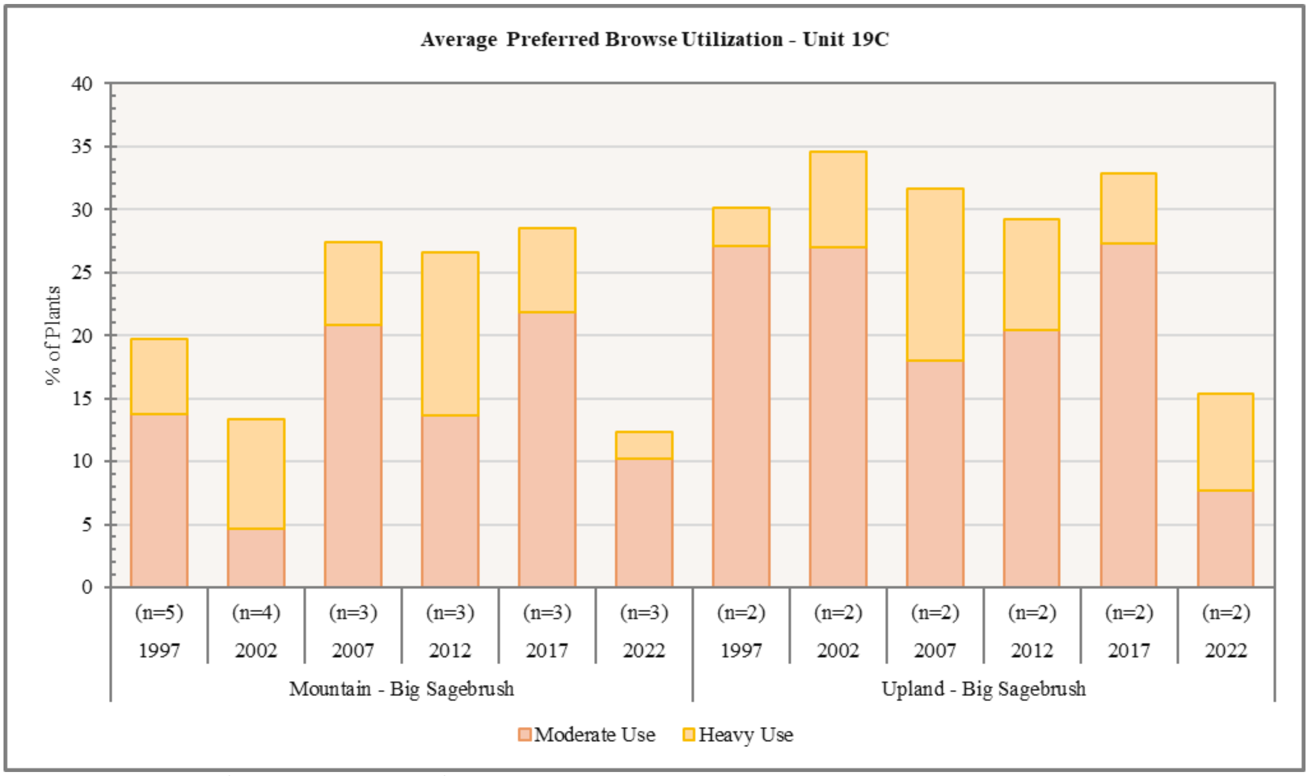


Figure 5.13: Average preferred browse utilization for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, West Desert - Tintic.

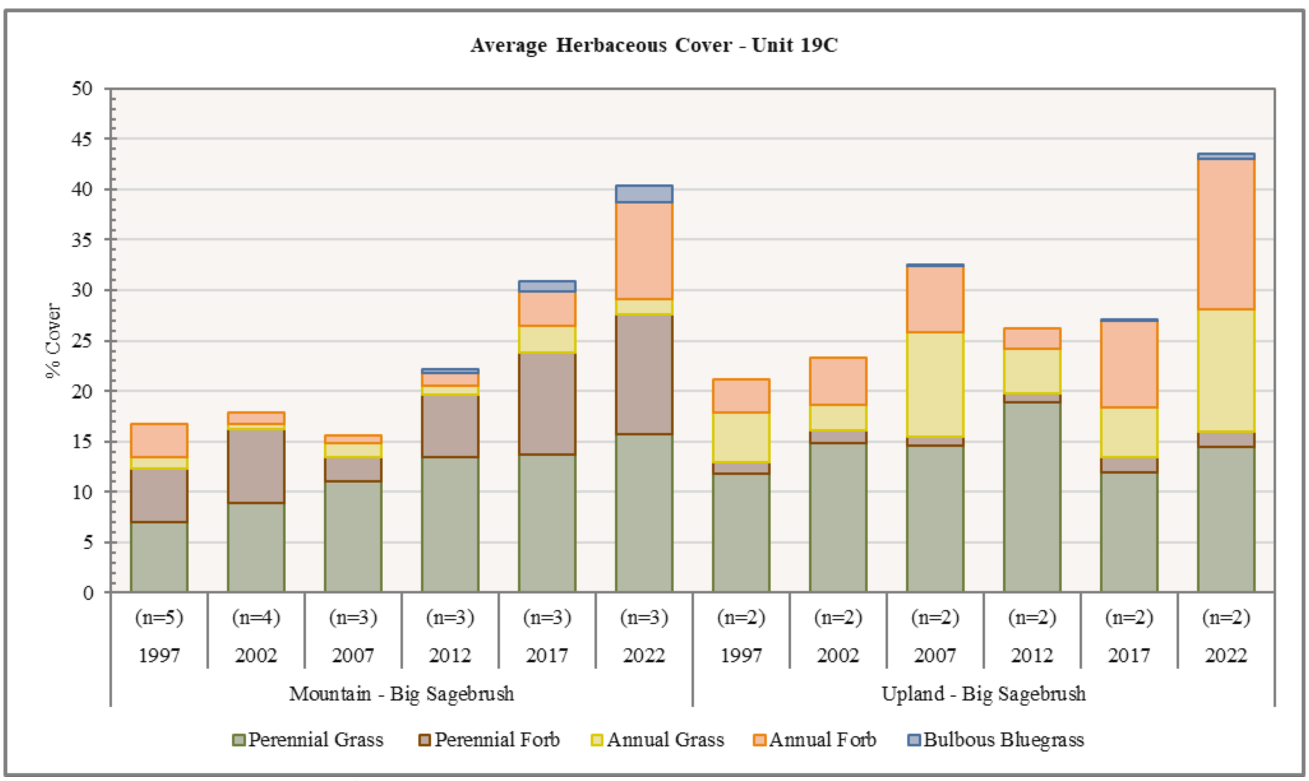


Figure 5.14: Average herbaceous cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, Tintic - West Desert.

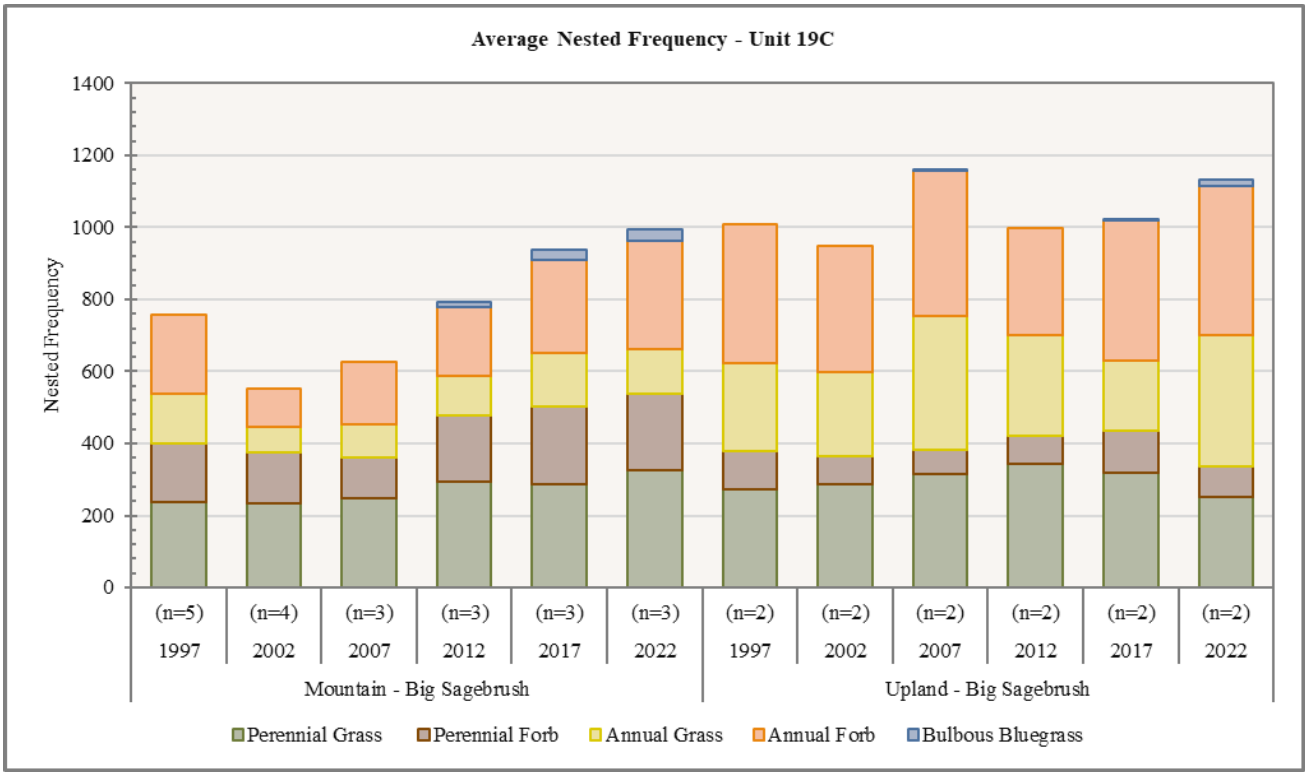


Figure 5.15: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, West Desert - Tintic.

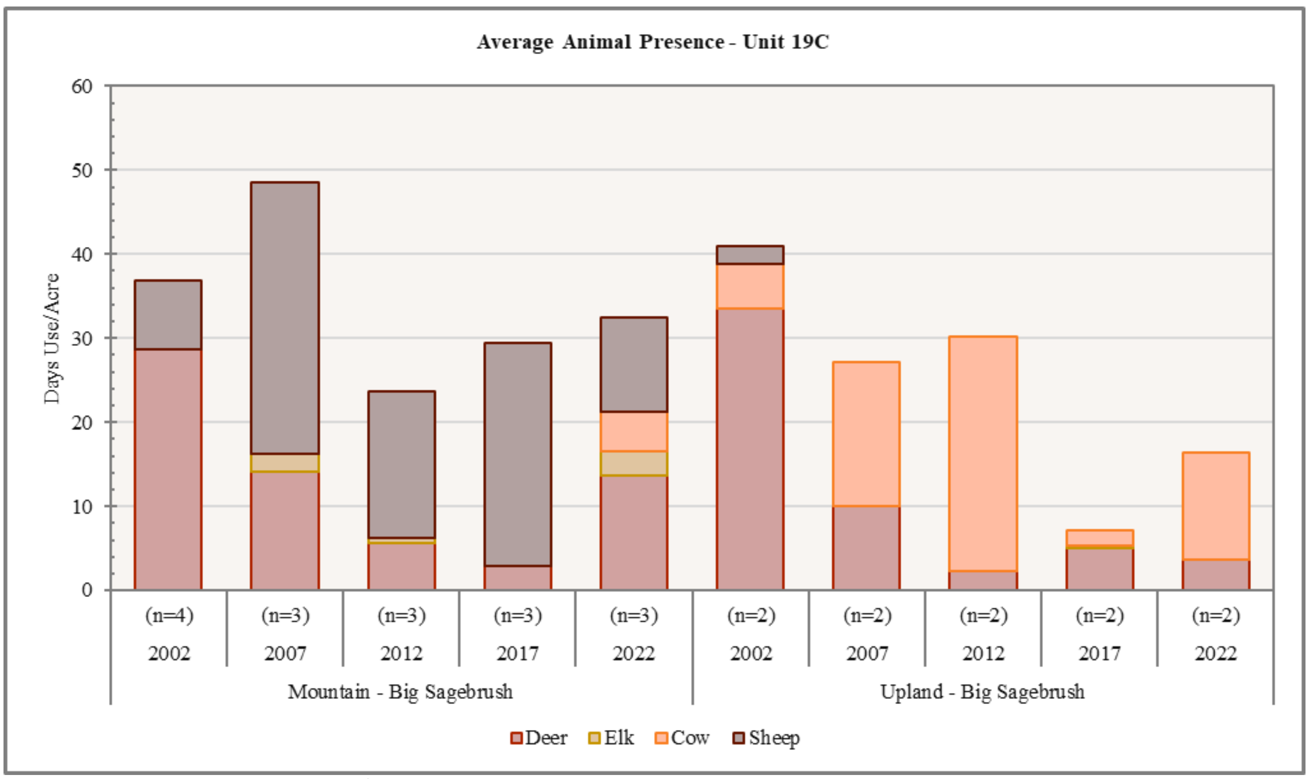
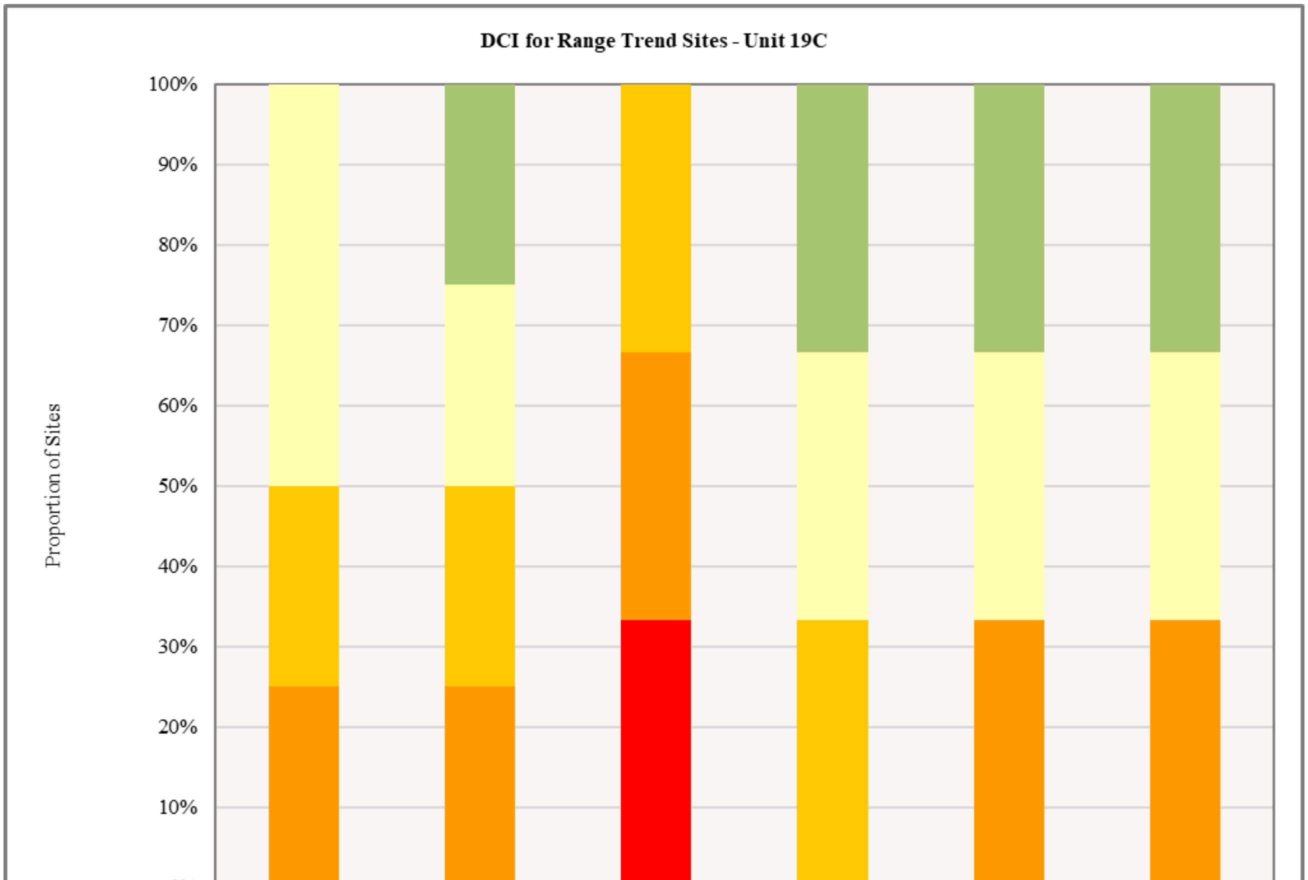


Figure 5.16: Average pellet transect data for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 19C, West Desert - Tintic. *Upland - Big Sagebrush deer pellet groups include deer, antelope, and sheep pellets.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Tintic management unit has modestly improved overall from very poor-fair averaged conditions in 1997 to fair averaged conditions in 2022. Sunrise Canyon (19C-12) is the main driver for the unit's wintering habitat stability and quality, and averages between fair and good for deer winter range conditions. Sioux Pass (19C-10), Nephi Dump (19C-16), and Furner Valley (19C-18) are considered to have poor conditions consistently from year to year, which suppresses the unit's overall quality of winter habitat; as of 2007, however, Sioux Pass has not influenced the winter range conditional trend. Furner Valley tends to have higher variability in deer winter habitat, and appears to have the highest degree of potential winter range improvement: the immediate area may benefit and respond the most to improvement projects. Areas of improvement may include a reduction in pinyon and juniper tree cover, and/or cheatgrass.

The overall deer winter range assessment in 2022 was that WMU 19C was in fair condition. Factors contributing to fair conditions are the presence of annual grass, low abundance of perennial grasses and forbs, and a lack of preferred shrub recruitment. However, Nephi Dump has a notable perennial grass community present (**Table 5.5**, **Figure 5.17**).



	1997	2002	2007	2012	2017	2022
Good		1		1	1	1
Fair	2	1		1	1	1
Poor-Fair	1	1	1	1		
Poor	1	1	1		1	1
Very Poor-Poor			1			

Figure 5.17: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 19C, West Desert - Tintic.

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
19C-10*	1997	30	10.4	0.8	8.1	-1.7	2.2	-2	**47.8**	**P**
19C-10*	2002	30	8.6	3.1	12.4	-0.9	1.8	0	**55**	**P-F**
19C-12	1997	30	9.2	3	11.8	0	10	-2	**62**	**F**
19C-12	2002	30	8.8	4.9	14.4	0	10	-2	**66.1**	**F**
19C-12	2007	30	7	4.2	5.4	0	9.1	0	**55.7**	**P-F**
19C-12	2012	30	12.7	9.1	19.1	-1.4	10	-2	**77.5**	**G**
19C-12	2017	30	12.3	4.2	30	-1.2	10	0	**85.4**	**G**
19C-12	2022	27.7	10.3	2.5	30	-1.6	10	0	**78.8**	**G**
19C-16	1997	14.8	8.5	2.4	29.4	-3.4	0.6	0	**52.2**	**F**
19C-16	2002	11.2	1.8	0.5	30	-2.1	3.2	0	**44.5**	**P**
19C-16	2007	9.5	0.9	0	30	-7.8	2.9	0	**35.5**	**VP-P**
19C-16	2012	12.1	5.9	0	30	-1.8	2.8	0	**48.9**	**P-F**
19C-16	2017	10.6	10.1	4.1	30	-1	4.5	0	**58.3**	**F**
19C-16	2022	10.5	3.9	2.2	30	-6.5	3.9	0	**44**	**P**
19C-18	1997	21	8.5	6.2	18.1	-3.9	3.6	-2	**51.4**	**P-F**
19C-18	2002	24.9	10	6.2	27.5	-1.8	1.6	0	**68.5**	**G**
19C-18	2007	12.9	9.8	1.6	23.1	-7.7	0.5	0	**40.3**	**P**
19C-18	2012	21.8	12.6	2.2	30	-4.8	0.7	0	**62.5**	**F**
19C-18	2017	22.7	8.8	1.6	14.3	-6.4	1.3	-2	**40.4**	**P**
19C-18	2022	27	12.1	3.2	22.9	-11.8	2.1	0	**55.6**	**F**

Table 5.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 19C, West Desert - Tintic. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
19C-12	Sunrise Canyon	Annual Grass	Low	Increased Fire Potential
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19C-13	Dennis Spring	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
19C-15	Upper Broad Canyon	Annual Grass	Medium	Increased Fire Potential
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	Low	Lowered resilience and resistance to disturbance
19C-16	Nephi Dump	Introduced Perennial Grass	Medium	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
19C-18	Furner Valley	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
19R-21	Gilson Mountain Sage-grouse	Annual Grass	High	Increased Fire Potential
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species

Table 5.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 19C, West Desert - Tintic. 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

Since 2012, the study sites that fall within deer winter range have been classified as being in very poor to good condition. The drivers behind the two sites (Furner Valley and Nephi Dump) exhibiting poor conditions vary from high amounts of annual grass, few perennial forbs, lack of recruitment within the preferred browse community, browse decadence, and/or a lack of preferred browse cover.

The actively monitored study sites in this unit have generally remained stable. Most study sites have good browse components that provide big game forage during winter months. The herbaceous understories are robust. The mountain ecological potential sites provide high diversity and cover of perennial forbs while the lower potential sites show continued encroachment of conifer trees.

Although there have been treatments to address pinyon and juniper tree encroachment, it remains a concern on the unit. Presence of pinyon and juniper can result in reduced understory shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000). Annual grasses, particularly the introduced species cheatgrass, are or have been present in varying amounts on many sites and pose a threat to the ecological resiliency of the communities they have invaded. The lower potential upland sites have higher abundance and greater degrees of fluctuation in cheatgrass. 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).

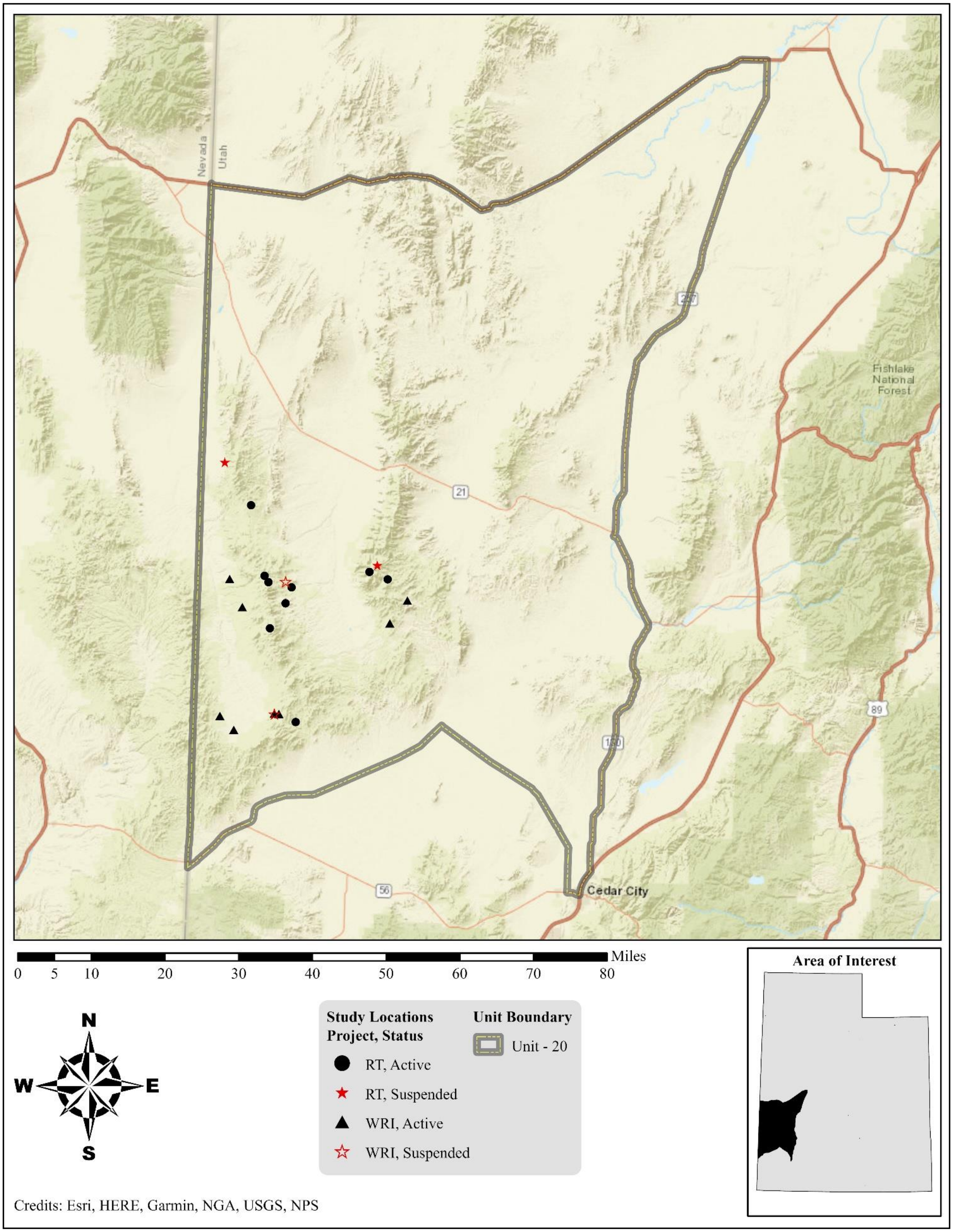
A number of fires have also burned a significant portion of this unit over time (**Map 5.5**). Fires can have negative effects through the removal of preferred browse species and herbaceous understories, such as opening up ecological niches that can be filled by undesirable species. However, fire can play a key process in the function and structure of big game habitat (Pastro, Dickman, & Letnic, 2011). Two sets of comparison studies were established in 1998 (Leamington Burn and Chain, Leamington Burn, Paul Bunyan Burn and Chain and Paul Bunyan Burn) following the Leamington Burn Complex fire to monitor rehabilitation work done after the burn. These sites had good herbaceous response to the seeding efforts. To help combat cheatgrass following the fires, introduced perennial grasses were seeded. While they provide forage and help reduce the presence of annual grasses, introduced perennial grasses can outcompete and impede establishment of young shrubs and seedlings (Mack, et al., 2000). Range Trend data indicates a slow response by preferred browse returning to these sites. Another example of the effects of fire on a mountain potential site is Dennis Spring, which burned as part of the Mona West fire: no active restoration was done on this study following the burn. However, this study site showed a strong resilience and within 10 years, the site returned to pre-fire conditions.

The expansion of urban sprawl poses additional threats to big game habitat within the Tintic management unit, particularly in areas surrounding Lake Mountain and Santaquin. New and continued development around these communities, along with recreational activities, may have unintended consequences that include (but are not limited to): a loss of preferred browse and herbaceous forage for wildlife, habitat fragmentation, disturbances to animals through human-wildlife interactions, and degradation of habitat through the introduction of non-native species. In addition, mining has had an historical impact on big game habitat, particularly around the mountains near Eureka. Although active mining has since decreased, it still poses additional threats through the expansion of existing mines and mine tailings (Boulanger, Poole, Gunn, & and Wierzchowski, 2011).

Other threats to wildlife habitat are occurring in localized portions of this unit, but will not be discussed in this section. These additional threats are specified by study site in the previous table (**Table 5.6**).

A number of recommendations should be taken into consideration for improving big game habitat within the Tintic - West Desert management unit. A number of pinyon and juniper removal projects have occurred within this unit. When and where appropriate, however, efforts to address infilling or encroachment of pinyon and juniper in both previously treated and untreated areas should be continued or implemented. Care should be should be taken in method selection (lop and scatter, bullhog, chaining, etc.) to ensure that annual grass loads are not unintentionally amplified. Treatments such as herbicide application or changes in grazing management may be appropriate in areas where high annual grass loads are present. Work to alleviate effects from urbanization and other human impacts such as mining and recreation should focus on conservation of crucial big game habitat and corridors. Finally, it is highly recommended that monitoring of both Range Trend studies and areas where rehabilitation projects have occurred should continue in the future. Considerations for adding monitoring sites in remaining habitat on Lake Mountain is suggested if there is need for better information on habitat trends in that portion of the unit. Periodic monitoring of these areas not only assesses the quality of big game habitat, but may also aid in the identification of threats as they appear over time.

6. WILDLIFE MANAGEMENT UNIT 20 – SOUTHWEST DESERT



WILDLIFE MANAGEMENT UNIT 20 – SOUTHWEST DESERT

Boundary Description

Beaver, Iron and Millard counties – Boundary begins at the Utah-Nevada state line and US-6/50; east on US-6/50 to SR-257; south on SR-257 to SR-21; south on SR-21 to SR-130; south on SR-130 to I-15; south on I-15 to SR-56; west on SR-56 to the Lund highway; northwest on this highway to Lund and the Union Pacific railroad tracks; southwest along these tracks to the Utah-Nevada state line; north on this state line to US-6/50. Excludes all CWMUs.

Management Unit Description

Geography

The Southwest Desert management unit encompasses the Indian Peaks and Sevier Desert area; significant amounts of this unit serve as big game range. The permanent Range Trend studies are primarily located on the Indian Peak Range and the Wah Wah Mountains: many of these sites are located on the summer range as this unit is summer-limited. Towns located within this unit include Modena, Garrison, Beryl, Milford and Minersville as well as parts of Cedar City, Hinckley, and Enoch.

The topographic features of this unit include the Indian Peak, Needle, House, Confusion, and Mountain Home Ranges as well as the Wah Wah Mountains. The highest peak in the unit is Indian Peak at 9,765 feet.

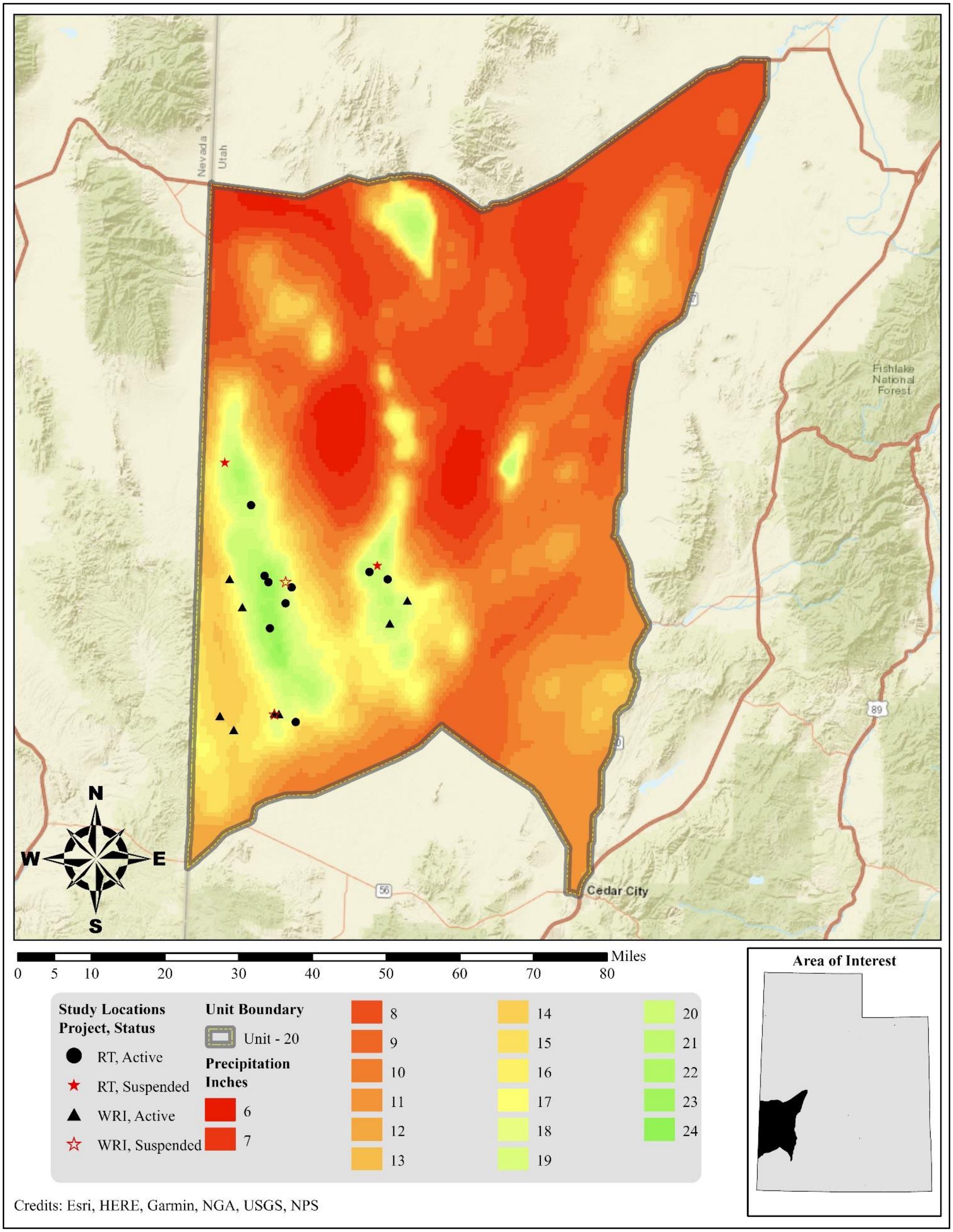
Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 6 inches along portions of upper Wah Wah Valley and Upper Pine Valley to 24 inches on the top of Indian Peak and Twin Peaks. All of the Range Trend and WRI monitoring studies on the unit occur between 14-23 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 Western and South Central Mountains divisions (Divisions 1 and 4).

The mean annual PDSI of the Western division displayed years of moderate to extreme drought from 2000-2003, 2007-2008, 2012-2013, 2015, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1993, 1995, 1998-1999, 2005, 2011, and 2019 (**Figure 6.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 2000, 2002-2004, 2007-2008, 2012-2015, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1995, 1998, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007-2008, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2011, and 2019 (**Figure 6.1b**).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 2002-2003, 2012-2014, 2018, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1997-1998, 2005, and 2011 (**Figure 6.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1996, 2000, 2002-2004, 2013-2014, 2018, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2002-2003, 2007, 2009, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2005, and 2011 (**Figure 6.2b**) (Time Series Data, 2023).



Map 6.1: The 1991-2020 PRISM Precipitation Model for WMU 20, Southwest Desert (PRISM Climate Group, Oregon State University, 2021).

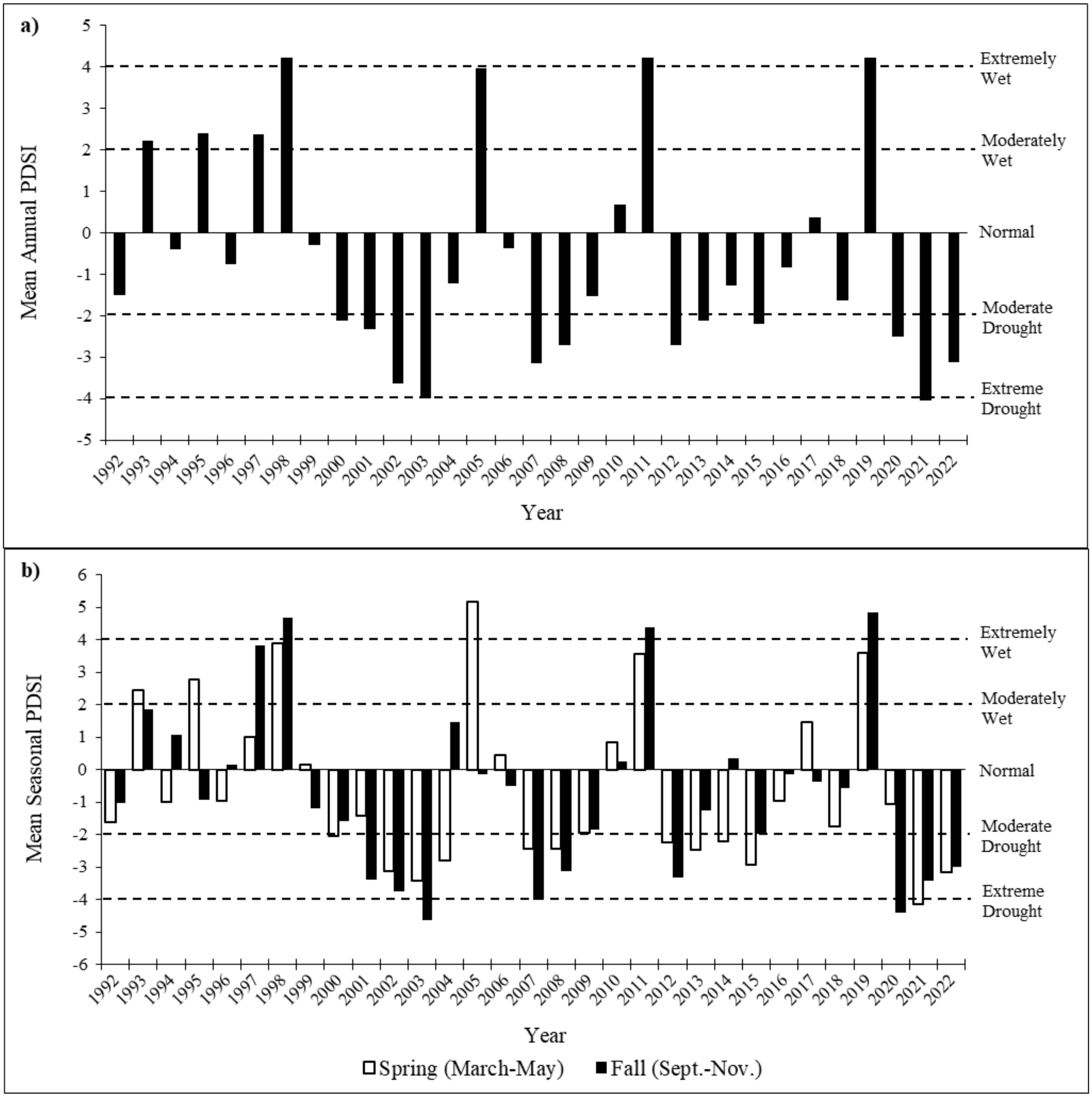


Figure 6.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the Western division (Division 1). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

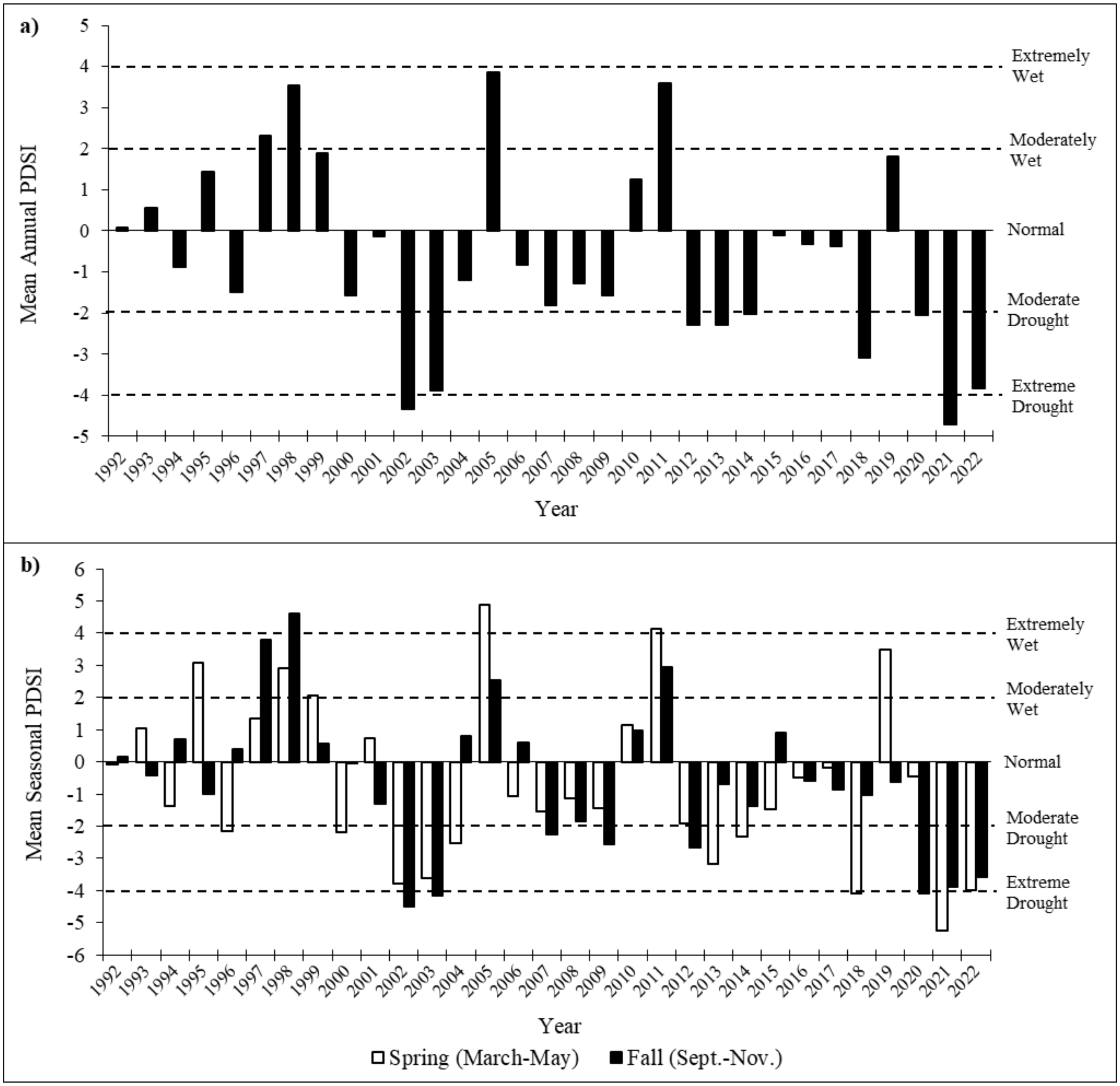


Figure 6.2: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

Big Game Habitat

This unit is similar to other desert units in that it is primarily limited by the lack of quality summer range for both deer and elk. The winter range for deer in this unit consists of the areas around the Indian Peak Range and the Wah Wah Mountains. Elevations for this winter range vary from 5,200 feet to 8,000 feet.

Much of the summer range in Indian Peaks is in mixed mountain brush communities and aspen/conifer communities. Some of the rocky upper elevation sites are dominated by curl-leaf mountain mahogany. A significant portion of the winter range is composed of sagebrush: the shallow sites are often comprised of black sagebrush and the deeper soils are mostly mountain big sagebrush. Much of the winter range in the Southwest Desert unit borders the edge of pinyon-juniper communities. These tree communities provide thermal cover for animals, but also pose a risk for encroachment.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between Range Trend samplings.

The RAP data for the Southwest Desert unit shows fluctuations of herbaceous biomass and cover on both summer and winter deer ranges; the highest values for both measurements have generally been observed in the mid-1990s and/or late 2010s. Annual and perennial cover and biomass have followed precipitation trends in many years. However, a possible lag effect of a year or so appears to occur at different times (e.g. 1988-1989 for biomass and 1998-2000 for all herbaceous data). Increases and decreases in biomass and cover appear to be slightly more pronounced at times on winter habitats than on summer range (**Figure 6.3**, **Figure 6.4**, **Figure 6.5**, **Figure 6.6**). As expected, some highs and lows in this herbaceous data can be correlated with Palmer Drought Severity Index (PDSI) data. For example, increased cover, biomass, and precipitation in 2019 correspond with PDSI values that show wetter than normal years and a moderately to extremely wet spring and/or fall depending on division (**Figure 6.1a**, **Figure 6.1b**, **Figure 6.2a**, **Figure 6.2b**).

Range Trend data for herbaceous cover from 1997 to present shows fluctuations in both perennial and annual lifeforms, with overall decreases or increases occurring depending on ecotype (**Figure 6.20**, **Figure 6.21**). Year-to-year fluctuations are commonplace and expected due to differences in precipitation and the timing of data collection between sample years.

RAP data indicates that tree and shrub cover correlates with precipitation in many years, but with less marked fluctuations than herbaceous cover and biomass. Cover values have remained fairly stable on winter mule deer habitat, but have decreased overall on summer range (**Figure 6.7**, **Figure 6.8**). Range Trend data for tree and shrub cover value trends varies, but cover values have remained similar or have increased on sites of many ecotypes (**Figure 6.9**, **Figure 6.10**, **Figure 6.11**, **Figure 6.12**, **Figure 6.13**).

RAP – Biomass by Deer Habitat

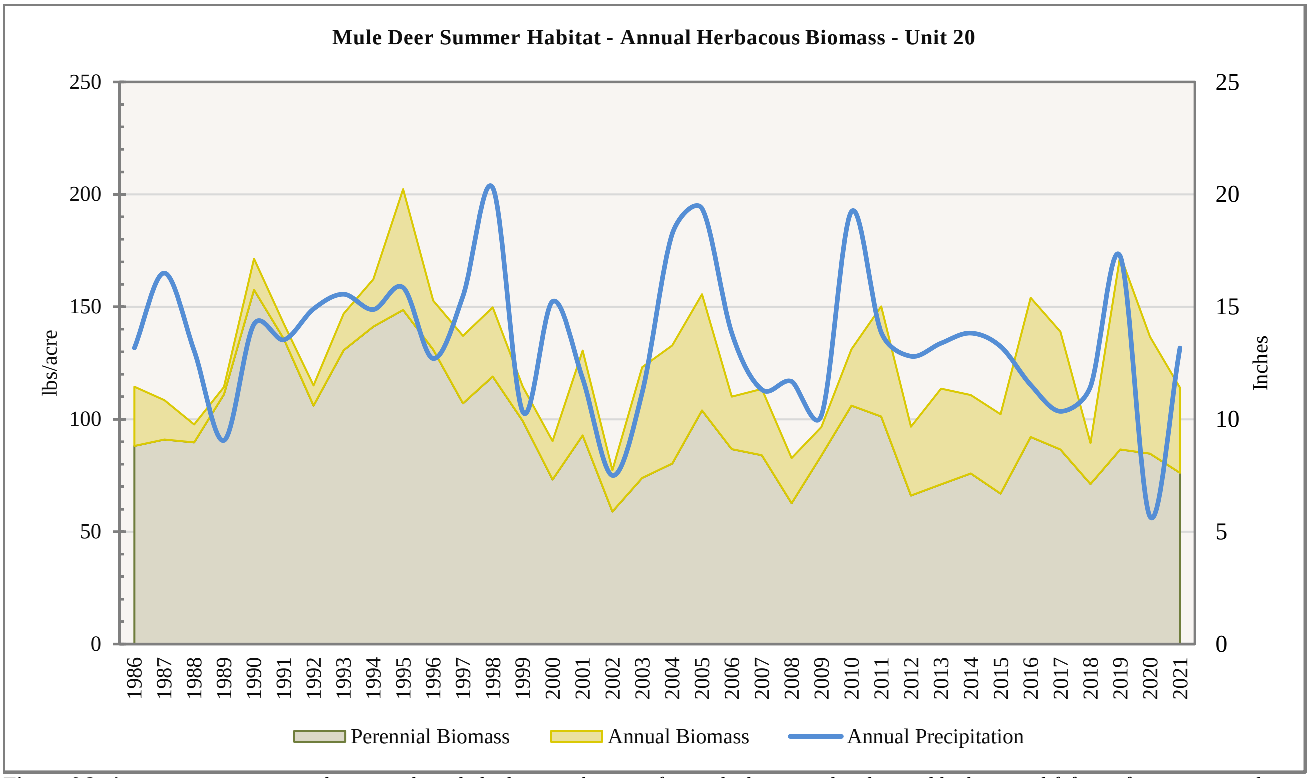


Figure 6.3: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual herbaceous lifeforms for summer mule deer habitat in WMU 20, Southwest Desert (Rangeland Analysis Platform, 2023).

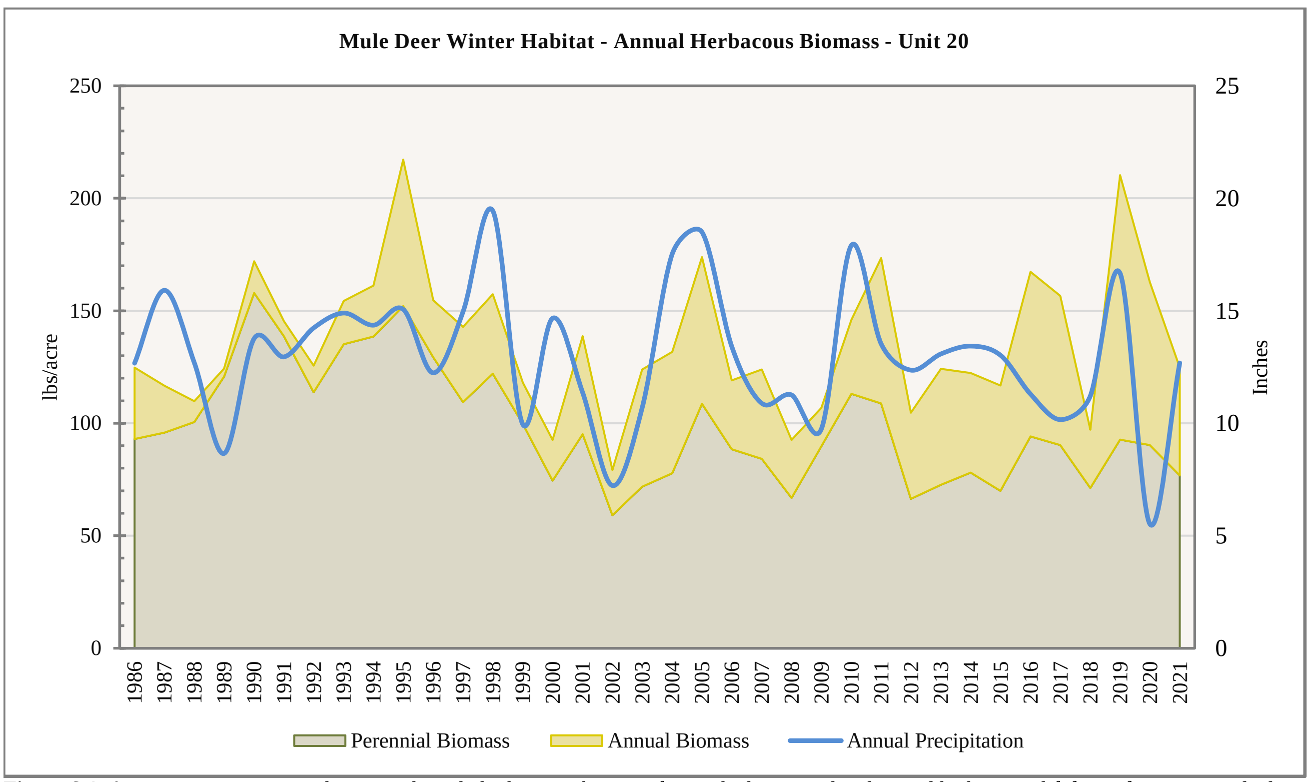


Figure 6.4: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual herbaceous lifeforms for winter mule deer habitat in WMU 20, Southwest Desert (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

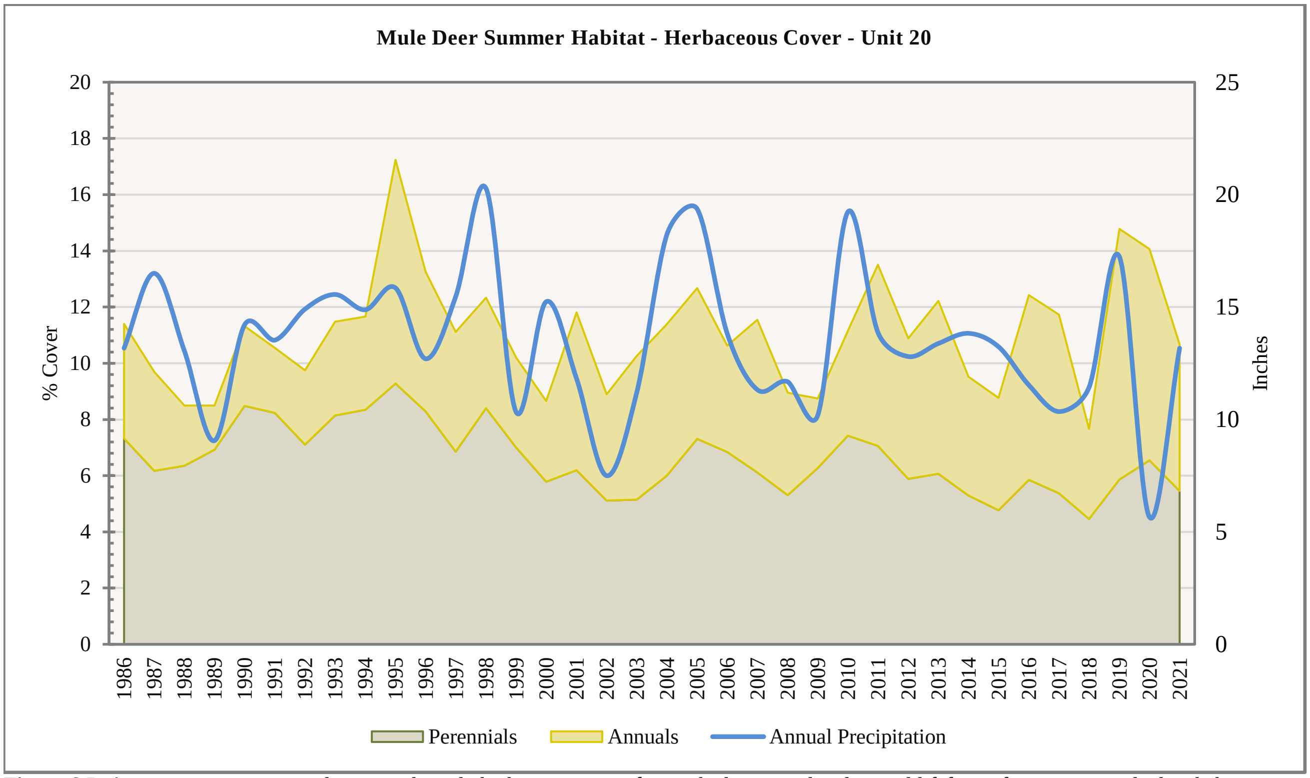


Figure 6.5: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 20, Southwest Desert (Rangeland Analysis Platform, 2023).

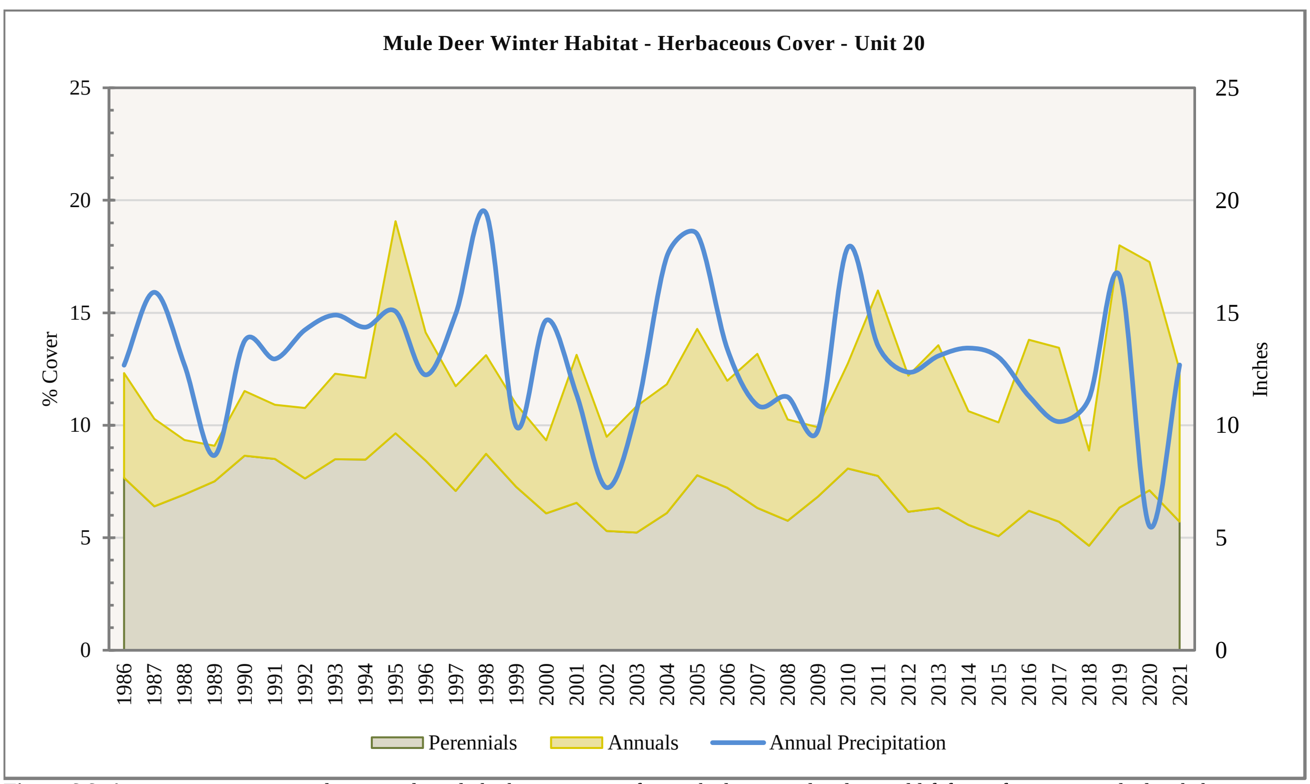


Figure 6.6: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 20, Southwest Desert (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

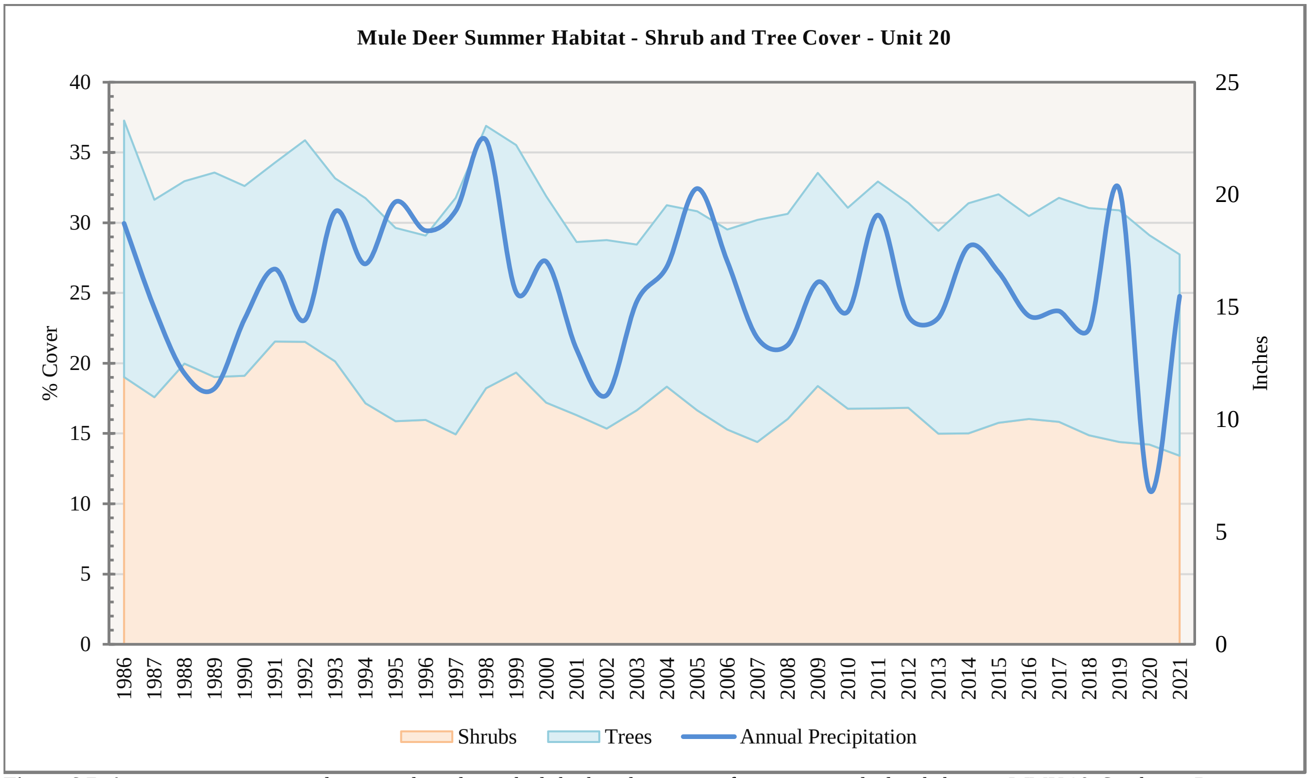


Figure 6.7: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 20, Southwest Desert (Rangeland Analysis Platform, 2023).

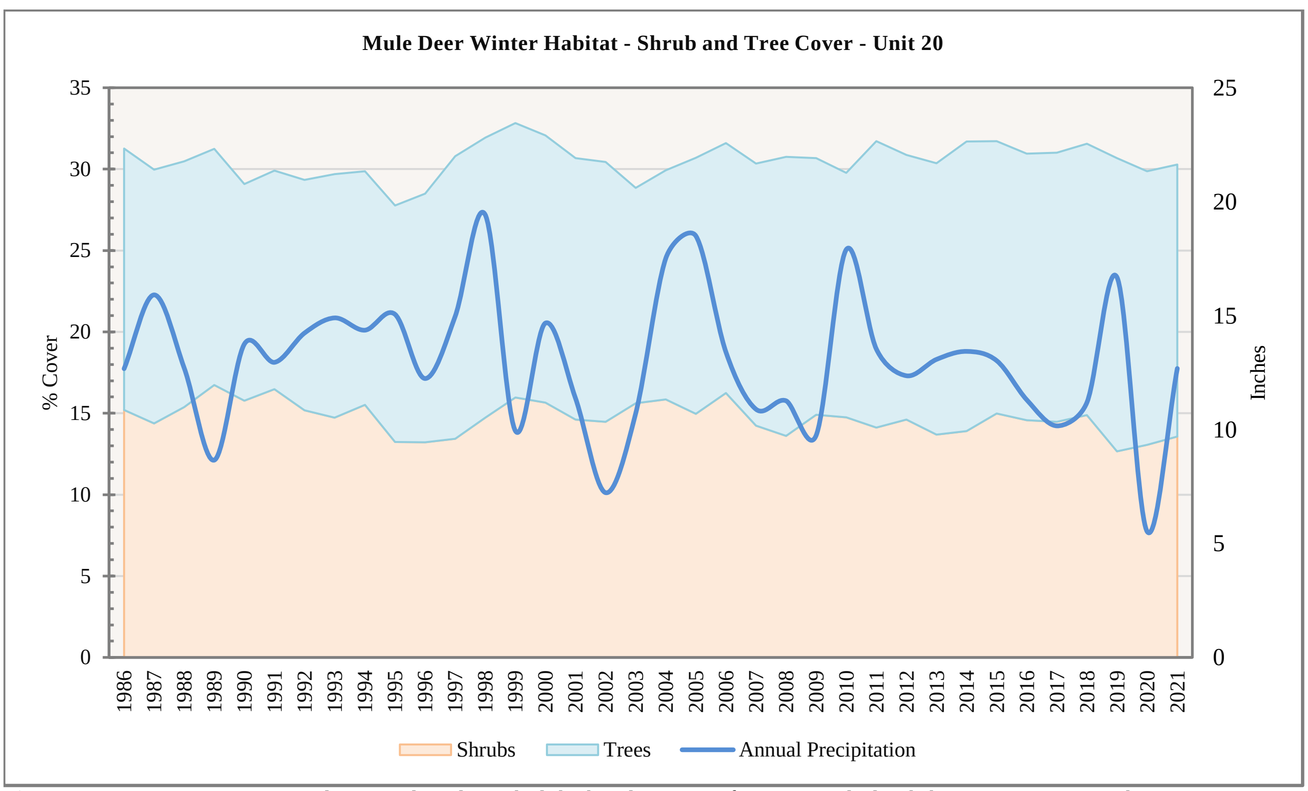
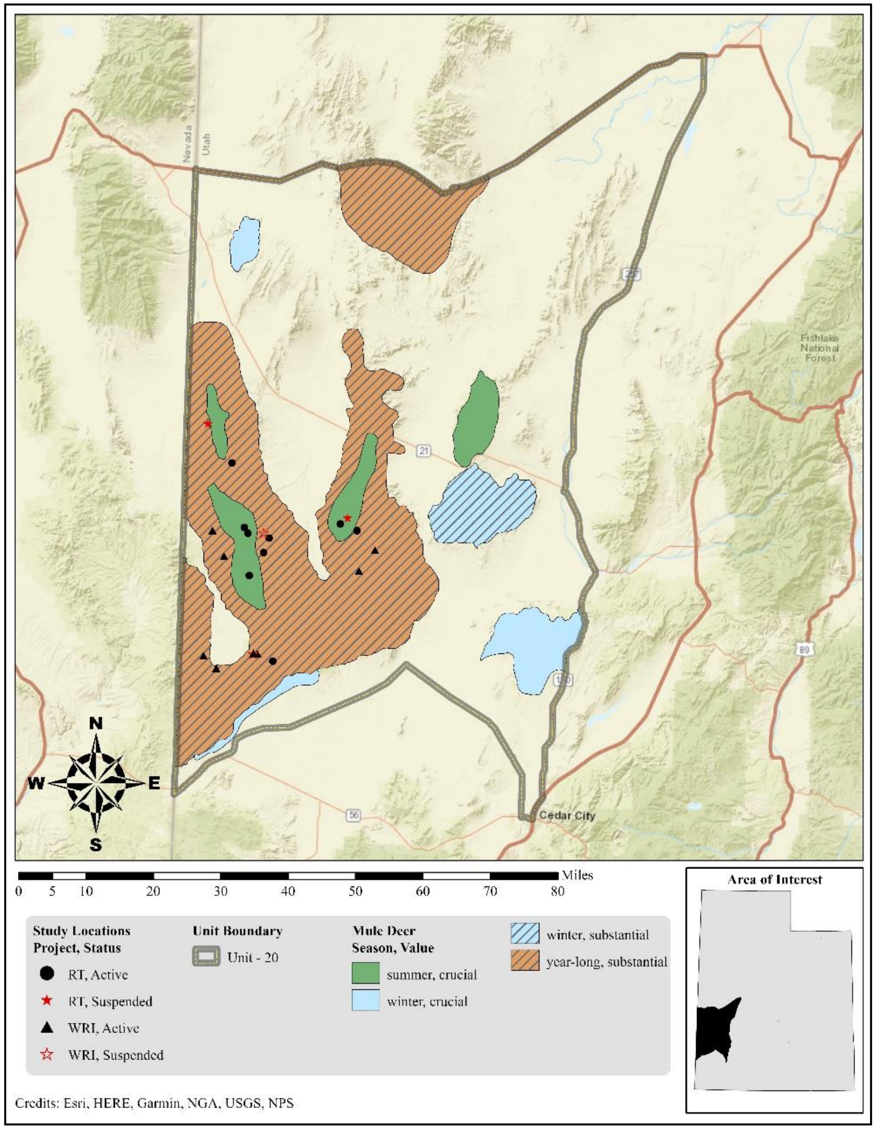
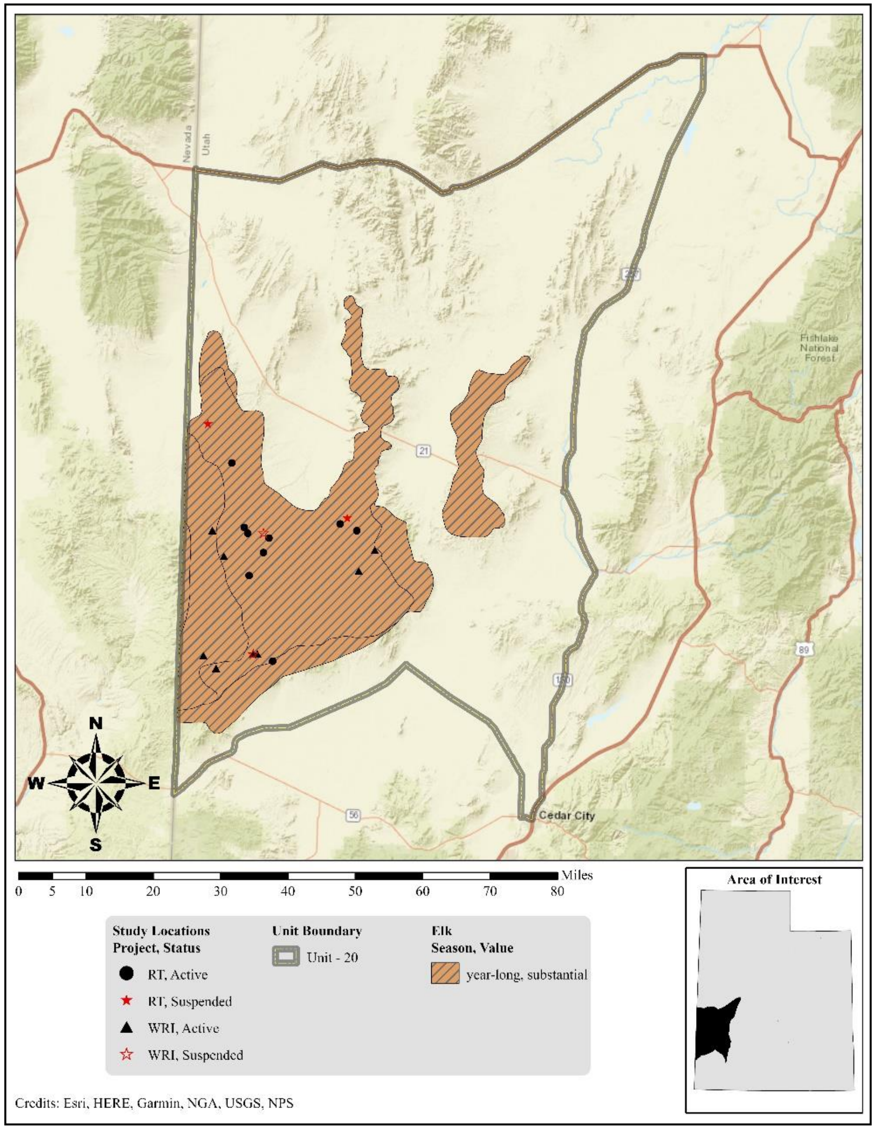


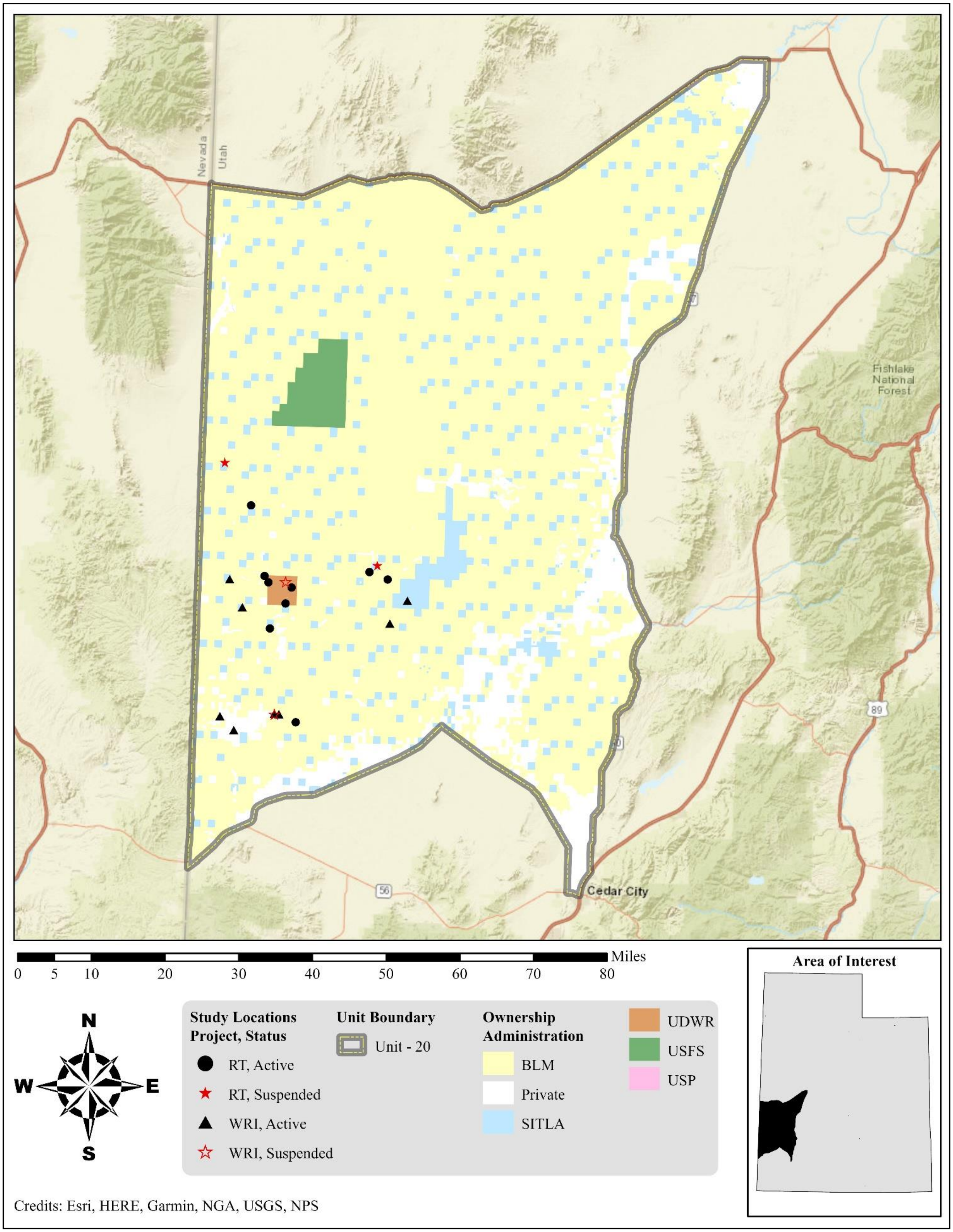
Figure 6.8: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 20, Southwest Desert (Rangeland Analysis Platform, 2023).



Map 6.2: Estimated mule deer habitat by season and value for WMU 20, Southwest Desert.



Map 6.3: Estimated elk habitat by season and value for WMU 20, Southwest Desert.



Map 6.4: Land ownership for WMU 20, Southwest Desert.

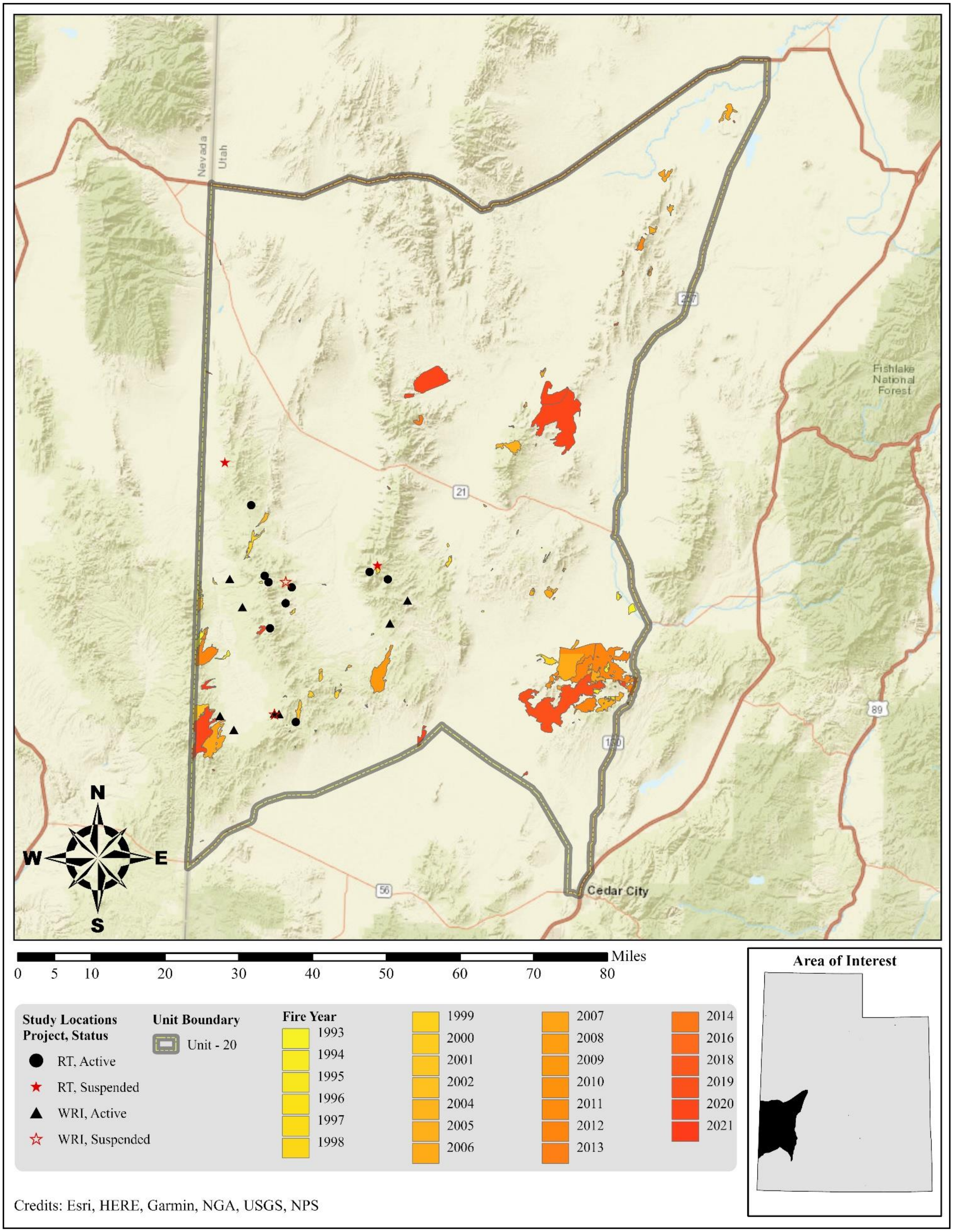
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Great Basin Pinyon-Juniper Woodland	665,264	55.23%	
	Colorado Plateau Pinyon-Juniper Woodland	25,051	2.08%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	12,484	1.04%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	6,425	0.53%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	1,459	0.12%	
	Southern Rocky Mountain Ponderosa Pine Woodland	612	0.05%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	511	0.04%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	366	0.03%	
	Inter-Mountain Basins Juniper Savanna	8	0.00%	59.13%
Shrubland	Great Basin Xeric Mixed Sagebrush Shrubland	161,206	13.38%	
	Inter-Mountain Basins Big Sagebrush Shrubland	157,183	13.05%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	38,934	3.23%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	38,762	3.22%	
	Great Basin Semi-Desert Chaparral	23,546	1.95%	
	Inter-Mountain Basins Montane Sagebrush Steppe	13,661	1.13%	
	Desert Scrub	6,910	0.57%	
	Inter-Mountain Basins Big Sagebrush Steppe	893	0.07%	
	Rocky Mountain Lower Montane-Foothill Shrubland	886	0.07%	
	Inter-Mountain Basins Greasewood Flat	503	0.04%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	301	0.02%	36.76%
Exotic	Great Basin & Intermountain Ruderal Shrubland	22,616	1.88%	
Tree-Shrub	Interior Western North American Temperate Ruderal Shrubland	975	0.08%	1.96%
Other	Developed	6,615	0.55%	
	Sparsely Vegetated	6,358	0.53%	
	Riparian	1,282	0.11%	
	Conifer-Hardwood	508	0.04%	
	Agricultural	202	0.02%	
	Hardwood	51	0.00%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	23	0.00%	
	Open Water	17	0.0%	1.25%
Exotic	Great Basin & Intermountain Introduced Annual Grassland	3,315	0.28%	
Herbaceous	Great Basin & Intermountain Introduced Annual and Biennial Forbland	2,789	0.23%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	2,745	0.23%	
	Interior Western North American Temperate Ruderal Grassland	37	0.00%	0.74%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	1,554	0.13%	
	Southern Rocky Mountain Montane-Subalpine Grassland	417	0.03%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	42	0.00%	0.17%
Total		**1,204,510**	**100%**	**100%**

Table 6.1: LANDFIRE Existing Vegetation Coverage for Mule Deer Habitat for WMU 20, Southwest Desert (LANDFIRE.US_140EVT, 2020).

Limiting Factors to Big Game Habitat

Major human activities in the area include grazing, mining, agriculture, and recreation. Habitat degradation and loss, lack of summer habitat, non-game ungulate competition for forage, and winter range conditions limit big game habitat in this unit. Encroachment by pinyon-juniper woodland communities poses a threat to important sagebrush rangelands. According to the current LANDFIRE Existing Vegetation Coverage model, 57.31% of the Southwest Desert unit's mule deer habitat is comprised of pinyon-juniper woodlands. In comparison to sagebrush, however, these woodlands are significant in size with sagebrush shrublands comprising 26.5% of mule deer habitat (**Table 6.1**). Encroachment and invasion of these woodlands into sagebrush communities has been shown to decrease sagebrush and herbaceous cover, therefore negatively impacting the availability of wildlife forage (Miller, Svejcar, & Rose, 2000). Feral horses are a significant problem across the unit, with many sites showing extremely high occupancy by horses. In large numbers, horses can degrade range conditions through overutilization and trampling (Davies, Collins, & Boyd, 2014; Eldridge, Ding, & Travers, 2020; Baur, Schoenecker, & Smith, 2017).

Other limiting factors to big game include introduced exotic herbaceous species such as cheatgrass (*Bromus tectorum*). The current LANDFIRE Existing Vegetation Coverage model indicates that 0.28% of mule deer habitat is comprised of annual grasslands (**Table 6.1**): this is more troublesome on the lower elevation sites. Increased amounts of cheatgrass can exacerbate the risk for catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013).



Map 6.5: Land coverage of fires by year from 1993-2021 for WMU 20, Southwest Desert (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

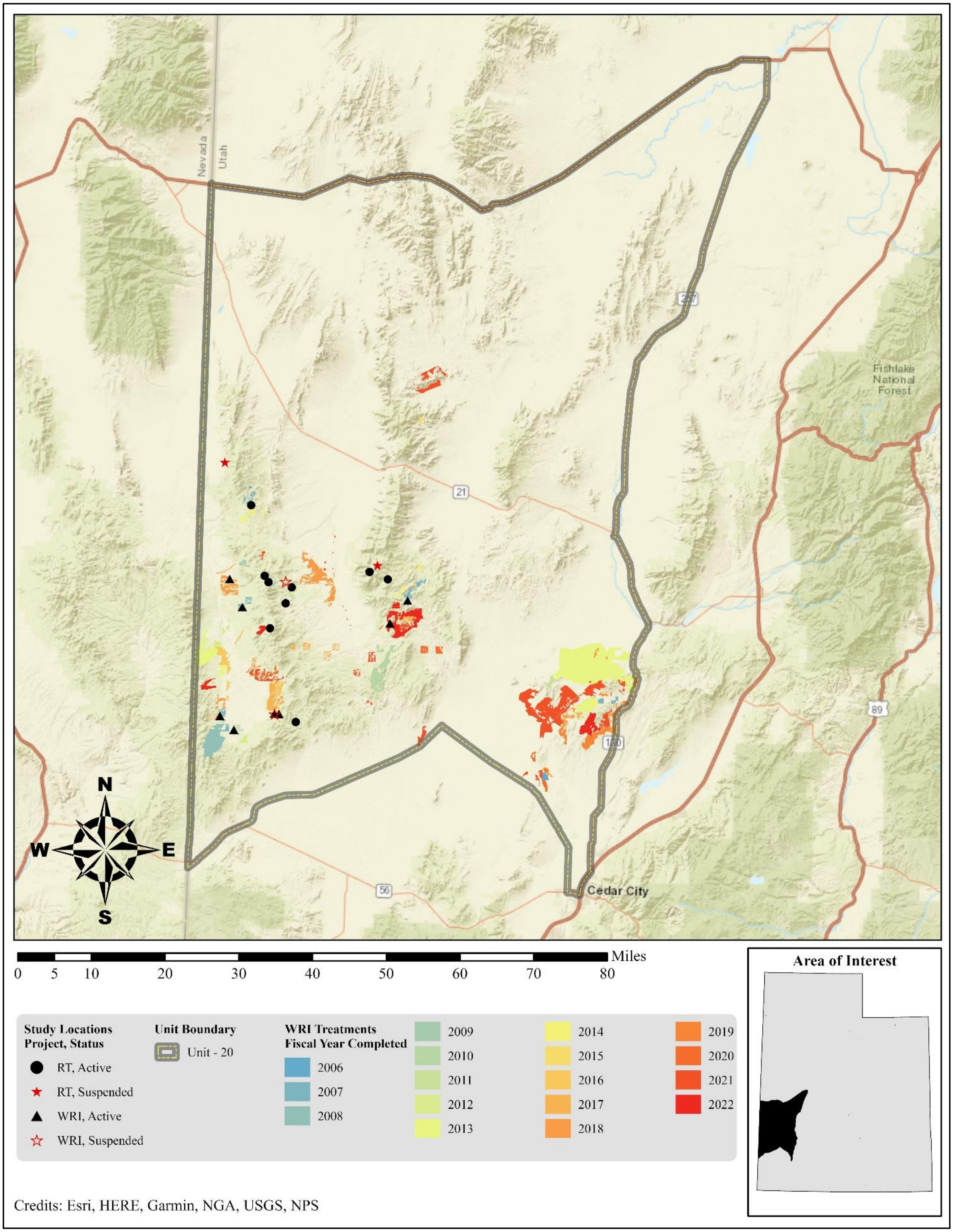
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 124,393 acres of land have been treated within the Southwest Desert unit since the WRI was implemented in 2004 (**Map 6.6**). An additional 29,661 acres are currently being treated and treatments have been proposed for 3,219 acres. Treatments frequently overlap one another, bringing the net total of treated land area to 114,124 acres for this unit (**Table 6.2**). 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.

Anchor chaining to remove pinyon and juniper is the most common management practice in this unit. Seeding plants to augment the herbaceous understory is also often used. Other management practices include (but are not limited to) bullhog, lop and scatter, harrowing, discing, herbicide application, and mowing (**Table 6.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**64,825**	**1,679**	**0**	**66,504**
Ely (One-Way)	50,667	0	0	50,667
Ely (Two-Way)	14,158	1,679	0	15,837
Bullhog	**10,873**	**108**	**706**	**11,686**
Full Size	10,802	108	706	11,616
Skid Steer	70	0	0	70
Harrow	**3,400**	**0**	**0**	**3,400**
≤ 15 ft. (One-Way)	746	0	0	746
≤ 15 ft. (Two-Way)	1,028	0	0	1,028
> 15 ft. (Two-Way)	560	0	0	560
> 15 ft. (One-Way)	1,066	0	0	1,066
Herbicide Application	**1,537**	**0**	**0**	**1,537**
Aerial (Fixed-Wng)	1,456	0	0	1,456
Aerial (Helicopter)	80	0	0	80
Interseeding	**252**	**0**	**0**	**252**
Interseeding	252	0	0	252
Mowing	**25**	**0**	**0**	**25**
Other	25	0	0	25
Planting/Transplanting	**0**	**341**	**0**	**341**
Container Stock	0	157	0	157
Other	0	184	0	184
Prescribed Fire	**0**	**0**	**2,238**	**2,238**
Prescribed Fire	0	0	2,238	2,238
Seeding (Primary)	**19,544**	**26,713**	**0**	**46,256**
Broadcast (Aerial-Fixed Wing)	18,907	16,153	0	35,060
Drill (Rangeland)	633	10,560	0	11,193
Hand Seeding	3	0	0	3
Seeding (Secondary/Shrub)	**3,380**	**820**	**0**	**4,200**
Broadcast (Aerial-Fixed Wing)	2,594	0	0	2,594
Hand Seeding	786	820	0	1,606
Vegetation Removal/Hand Crew	**20,560**	**0**	**275**	**20,835**
Lop & Scatter	20,560	0	275	20,835
Grand Total	**124,393**	**29,661**	**3,219**	**157,273**
***Total Land Area Treated**	**114,124**	**29,503**	**3,219**	**146,846**

Table 6.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 20, Southwest Desert. Data accessed on 01/23/2023 *Does not include overlapping treatments.



Map 6.6: WRI treatments by fiscal year completed for WMU 20, Southwest Desert.

Range Trend Studies

Range Trend studies have been sampled within WMU 20 on a regular basis since 1985, with studies being added or suspended as was deemed necessary (**Table 6.3**). 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 6.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
20-1	Upper Indian Peak	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Mountain Stony Loam (Browse)
20-2	Lower Indian Peak	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Black Sagebrush)
20-3	Mountain Home Seeding	RT	Active	1998, 2003, 2005, 2008, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
20-4	Merrill’s Camp	RT	Active	2012, 2017, 2022	Mountain Stony Loam (Browse)
20-5	Upper Hamblin Valley	RT	Suspended	1998, 2003, 2008, 2012	Mountain Shallow Loam (Curlleaf Mountain Mahogany)
20-6	Wah Wah Pass	RT	Suspended	1998, 2003, 2008, 2012	Mountain Shallow Loam (Curlleaf Mountain Mahogany)
20-7	South Spring	RT	Active	1999, 2003, 2008, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
20-8	Greens Canyon	RT	Active	2017, 2022	Mountain Loam (Browse)
20-9	Burnt Stump Canyon	RT	Active	2017, 2022	Mountain Shallow Loam (Low Sagebrush)
20-10	Lamerdorf Canyon	RT	Active	2017, 2022	Mountain Stony Loam (Browse)
20-11	Mustang Spring	RT	Active	2017, 2022	Upland Loam (Mountain Big Sagebrush)
20R-2	Indian Peaks Willow	WRI	Suspended	1999	Not Verified
20R-3	Bowler Chaining	WRI	Active	2006, 2011, 2015, 2022	Upland Loam (Wyoming Big Sagebrush)
20R-4	Blawn Wash Dixie	WRI	Active	2006, 2011, 2015, 2019	Upland Gravelly Loam (Bonneville Big Sagebrush)
20R-5	Salt Cabin	WRI	Active	2006, 2011, 2015, 2019	Upland Loam (Wyoming Big Sagebrush)
20R-6	Hamlin Valley Harrow	WRI	Active	2008, 2011, 2015, 2022	Upland Loam (Wyoming Big Sagebrush)
20R-7	Spanish George Spring	WRI	Active	2015, 2019	Upland Loam (Mountain Big Sagebrush)
20R-8	Spanish George Spring 2	WRI	Suspended	2016	Upland Loam (Mountain Big Sagebrush)
20R-9	Miners Cabin Wash	WRI	Active	2017, 2022	Upland Gravelly Loam (Black Sagebrush)
20R-10	Spanish George Spring 2T	WRI	Active	2019	Upland Loam (Mountain Big Sagebrush)
20R-11	The Tetons	WRI	Active	2021	Mountain Gravelly Loam (Mountain Big Sagebrush)

Table 6.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 20, Southwest Desert.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
20-2	Lower Indian Peak	Chain Unknown		1959	100	
		Rangeland Drill		1959	100	
		Lop and Scatter	Indian Peaks WMA Lop and Scatter	May-June 2011	930	1784
		Lop and Scatter	Indian Peaks WMA Mule Deer Habitat Improvement Project	November 2018-October 2019	991	4818
20-3	Mountain Home Seeding	Prescribed Fire	Mountain Home Habitat Improvement 1988	1989	1,066	
		Two-Way Chain Unknown	Mountain Home Habitat Improvement 1988	1989	1,066	
		Aerial Before	Mountain Home Habitat Improvement 1988	1989	1,066	
		One-Way Dixie	Mountain Home Habitat Improvement	Fall 2005	746	226
		Broadcast Before	Mountain Home Habitat Improvement	Fall 2005	746	226
20-7	South Spring	Chain Unknown		1960s		
		Seed Unknown		1960s		
		Prescribed Fire	Indian Peak Prescribed Fire	1999		
20-11	Mustang Spring	Bullhog	Mustang Spring Bullhog	2005		
20R-3	Bowler Chaining	Two-Way Ely	Bowler Chaining	October-November 2006	854	563
		Aerial Before	Bowler Chaining	November 2006	854	563
20R-4	Blawn Wash Dixie	Chain Unknown	Blawn Wash Seeding 1964	1964-1965		
		Seed Unknown	Blawn Wash Seeding 1964	1964-1965		
		One-Way Dixie	Blawn Wash Seeding Restoration	October 2006-January 2007	1,067	391
		Broadcast Before	Blawn Wash Seeding Restoration	October 2006-January 2007	1,067	391
20R-5	Salt Cabin	Two-Way Ely	Salt Cabin Reseed	October-November 2006	733	479
		Aerial Before	Salt Cabin Reseed	November 2006	733	479
20R-6	Hamlin Valley Harrow	Two-Way Dixie	Hamlin Valley Flinspach	October 2009	320	1185
		Broadcast Before	Hamlin Valley Flinspach	October 2009	320	1185
20R-7	Spanish George Spring	Aerial After	Hamlin Valley Habitat Restoration Project - Sagebrush Restoration Year I	January-February 2016	1,423	2076
		Bullhog	Hamlin Valley Habitat Restoration Project - Sagebrush Restoration Year I	October 2015-February 2016	1,423	2076
		Aerial Before	Hamlin Valley Habitat Restoration Project - Sagebrush Restoration Year I	October 2015	1,423	2076
20R-8	Spanish George Spring 2	Aerial Before	Hamlin Valley Habitat Restoration Project - Sagebrush	November 2016	4,086	3686
		Two-Way Ely	Hamlin Valley Habitat Restoration Project - Sagebrush	October-November 2016	4,086	3686
20R-9	Miners Cabin Wash	Aerial Before	Indian Peak/Spanish George (Hamlin Valley Habitat Restoration Project-Sagebrush (Year 3))	October 2017	2,264	3934
		Chain Unknown	Indian Peak/Spanish George (Hamlin Valley Habitat Restoration Project-Sagebrush (Year 3))	October-December 2017	2,264	3934
20R-10	Spanish George Spring 2T	Bullhog	Hamlin Valley Habitat Restoration Project - Sagebrush Restoration Year 2	October 2016-June 2017	848	3686
		Aerial Before	Hamlin Valley Habitat Restoration Project - Sagebrush Restoration Year 2	January 2017	848	3686
20R-11	The Tetons	Aerial Before	Blawn Mountain Wildlife Habitat and Watershed Enhancement Phase I (Proposed)	Fall 2021	3,474	5669
		Two-Way Ely Chaining	Blawn Mountain Wildlife Habitat and Watershed Enhancement Phase I (Proposed)	Fall 2021	3,474	5669

Table 6.4: Range Trend and WRI studies known disturbance history for WMU 20, Southwest Desert. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

There are two studies [Mountain Home Seeding (20-3) and South Spring (20-7)] that are classified as Mountain (Big Sagebrush) ecological sites. The Mountain Home Seeding site is located at the south end of the Mountain Home Range, while South Spring is found in the Indian Peak Range in the foothills near Pine Valley (**Table 6.3**).

<u>Shrubs/Trees</u>: Rubber rabbitbrush (*Ericameria nauseosa* and *E. nauseosa* ssp. *nauseosa* var. *hololeuca*) contributed a majority of the browse cover on these study sites through the 2012 sample year. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) increased in cover each sample year, however, and it has been the dominant browse species

since 2017 (**Figure 6.10**). Average preferred browse data shows that total density decreased between 2017 and 2022, but has increased overall when comparing 1998 to 2022 data. Mature individuals have comprised a majority of the populations on these sites, and decadence has remained comparatively low. Recruitment of young has decreased since 2012 (**Figure 6.16**). Preferred browse utilization has exhibited an overall decrease, but has increased each sample year since 2012. In 2022, nearly 18% of plants were moderately browsed while 4.5% showed signs of heavy utilization (**Figure 6.18**).

Trees contribute no cover on these study sites. Density remains low as of 2022, but has increased over the study period: this can be attributed to both Utah juniper (*Juniperus osteosperma*) and singleleaf pinyon (*Pinus monophylla*) on the Mountain Home Seeding study (**Figure 6.12**, **Figure 6.14**).

Herbaceous Understory: The herbaceous understories of these study sites have fluctuated, but cover has shown an overall decreasing trend; total nested frequency has increased slightly when 1998 data is compared to that of 2022. The introduced annual grass species cheatgrass (*Bromus tectorum*) has been a significant understory component in many sample years, particularly on the South Spring study site. Average perennial grass cover and frequency have both exhibited a general decrease. Introduced species such as crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), and intermediate wheatgrass (*Thinopyrum intermedium*) have provided most of the perennial grass cover throughout the study period. Annual and perennial forbs have remained scarce in comparison with grasses (**Figure 6.20**, **Figure 6.22**).

Occupancy: Average pellet transect data shows that the primary occupants of these study sites have fluctuated from year to year. Horses were the main occupants in 1998 and 2017, and presence has ranged from 9 days use/acre in 2012 to 29 days use/acre in 2008. The primary occupants in 2003, 2008, and 2012 were elk, and mean pellet group abundance has been as low as 8 days use/acre in 2017 and as high as 64 days use/acre in 2003. Deer were the main occupants in 2022, and average abundance of pellet groups has fluctuated between 1 days use/acre in 2012 and 38 days use/acre in 2022. Finally, cattle have also been present on these sites with presence ranging from 0 days use/acre in 1998, 2008, and 2017 to 1.5 days use/acre in 2003 and 2022 (**Figure 6.24**).

Mountain (Black/Low Sagebrush)

There is one study [Burnt Stump Canyon (20-9)] that is considered to be a Mountain (Black/Low Sagebrush) ecological site: this site is located at the head of Burnt Stump Canyon in the Wah Wah Mountains (**Table 6.3**).

Shrubs/Trees: The primary browse species on this study site is little sagebrush (*Artemisia arbuscula*), although other species such as slender buckwheat (*Eriogonum microthecum*) and mountain snowberry (*Symphoricarpos oreophilus*) are also present to a lesser extent. Total shrub cover decreased between 2017 and 2022, mainly due to reduced little sagebrush cover (**Figure 6.9**). However, density of preferred browse has increased over the study period: this trend can largely be attributed to recruitment of young sagebrush. Mature plants have been the dominant demographic in both sample years, and decadence has remained low (**Figure 6.16**). Preferred browse utilization increased slightly over time, but remains low; in 2022, 9% of plants were moderately hedged and nearly 10% were heavily utilized (**Figure 6.18**).

Pinyon and juniper encroachment is not currently a concern for this study site (**Figure 6.12**, **Figure 6.14**).

Herbaceous Understory: Total herbaceous cover and frequency on the Burnt Stump Canyon site have both increased between 2017 and 2022. The perennial grass component has remained abundant throughout the study period, and was a co-dominant understory component in 2017. The native species muttongrass (*Poa fendleriana*) provided a majority of the perennial grass cover in both sample years. Perennial forbs have also been a dominant herbaceous component, with much of the cover being contributed by the native species silvery lupine (*Lupinus argenteus*), Watson’s penstemon (*Penstemon watsonii*), and littleleaf pussytoes (*Antennaria microphylla*). Annual forbs have remained scarce, and annual grasses have not been observed in either sample year (**Figure 6.20**, **Figure 6.22**).

Occupancy: Average pellet group transect data indicates that animal presence has increased over time, but the primary occupants have varied between sample years. Horses were the primary occupants in 2017, and mean abundance of pellet groups has ranged from just under 6 days use/acre in 2017 to over 10 days use/acre in 2022. Elk had the most abundant pellet groups in 2022 at 27 days use/acre, and use was 5 days use/acre in 2017. Mean abundance of deer pellet groups was 4 days use/acre in 2017 and 9 days use/acre in 2022. Cattle pats were not observed in 2017, but mean abundance was 3 days use/acre in 2022 (**Figure 6.24**).

Mountain (Browse)

Four study sites [Upper Indian Peak (20-1), Merrill's Camp (20-4), Greens Canyon (20-8), and Lamerdorf Canyon (20-10)] are classified as Mountain (Browse) ecological sites. Upper Indian Peak is located on the Indian Peak WMA at the base of Indian Peak. The Merrill's Camp site is situated near Twin Peaks in the Indian Peak Range, while Green's Canyon is located on a ridge approximately one mile north of Indian Peak. Finally, the Lamerdorf Canyon study is found up Rose Spring Canyon in the Wah Wah Mountains (**Table 6.3**).

<u>Shrubs/Trees</u>: The primary species on these study sites include (but are not limited to) species such as Utah serviceberry (*Amelanchier utahensis*), black sagebrush (*Artemisia nova*), mountain big sagebrush (*A. tridentata* ssp. *vaseyana*), alderleaf mountain mahogany (*Cercocarpus montanus*), curl-leaf mountain mahogany (*C. ledifolius*), and antelope bitterbrush (*Purshia tridentata*). Total shrub cover has exhibited an increase over the sample period, although mean serviceberry and mahogany cover has decreased overall. Increases in preferred browse cover other than serviceberry-mahogany drive the overall shrub cover trend. Closer examination of the data indicates that the number of studies sampled (the 'n value') has changed from year to year, affecting the trends observed on study sites of this ecotype. The rise in the cover of other preferred browse species is not only due to increases on the Indian Peak site, but to the 2017 establishment of the Greens Canyon and Lamerdorf Canyon studies as well (**Figure 6.10**). Average preferred browse demographic data shows that total shrub density increased between 1998 and 2008, but decreased in 2012 in part due to the establishment of the Merrill's Camp study. The abundance of shrubs has since increased: this trend is again driven by both the Upper Indian Peak study and the installation of Greens Canyon and Lamerdorf Canyon. Mature plants have been the dominant demographic in these browse populations, while decadence has remained low (**Figure 6.16**). Utilization of preferred browse has exhibited yearly fluctuations, but moderately and heavily used plants have remained below 50% throughout the study period. In 2022, 14% of preferred browse plants showed signs of moderate usage, while nearly 20% were heavily hedged (**Figure 6.18**).

Increasing tree cover and density trends beginning in 2017 are driven by singleleaf/twoneedle pinyon (*Pinus monophylla* and *P. edulis*) and/or Utah/Rocky Mountain juniper (*Juniperus osteosperma* and *J. scopulorum*) on the Lamerdorf Canyon, Merrill's Camp, and Upper Indian Peak studies (**Figure 6.12**, **Figure 6.14**).

<u>Herbaceous Understory</u>: These sites support mainly native herbaceous communities with plentiful perennial forbs and grasses; perennial forbs have contributed a majority of the herbaceous cover throughout the sample period. The introduced annual grass species cheatgrass (*Bromus tectorum*) has been observed with moderate to high frequency values on the Merrill's Camp study during all three samplings. Cheatgrass has also been sampled on the Lamerdorf Canyon site, but with very low frequency and cover. Total herbaceous frequency and cover have exhibited yearly fluctuations, but have decreased overall. These herbaceous trends can largely be attributed to consistent decreases in perennial grass and forb cover on the Upper Indian Peak study combined with the differing number of studies (the 'n value') sampled from year to year (**Figure 6.20**, **Figure 6.22**).

<u>Occupancy</u>: Average pellet group data indicates that elk have been the primary occupants in all sample years except 2022, when deer pellet groups were the most abundant. Elk presence has ranged from 17 days use/acre in 2022 to 60 days use/acre in 2003. Mean abundance of deer pellet groups has been as low as 2 days use/acre in 2003 and as high as just over 23 days use/acre in 2022. Cattle pellet groups were observed in 1998 and 2017 with an average abundance of 3.6 and 0.2 days use/acre, respectively, but were absent in all other years. Finally, horse presence has fluctuated between 0 days use/acre in 1998 and 2003 and 13 days use/acre in 2017 (**Figure 6.24**).

Mountain (Curlleaf Mountain Mahogany)

There are two studies [Upper Hamblin Valley (20-5) (suspended) and Wah Wah Pass (20-6) (suspended)] that are classified as Mountain (Curlleaf Mountain Mahogany) ecological sites. The Upper Hamblin Valley study is located on the lower west-facing slopes of the Mountain Home Range, which is on the eastern side of Hamlin Valley. The Wah Wah Pass site is s located east of Burnt Stump Canyon in the Wah Wah Mountains (**Table 6.3**).

<u>Shrubs/Trees</u>: The primary preferred browse species on these study sites was curl-leaf mountain mahogany (*Cercocarpus ledifolious*), although other species such as mountain snowberry (*Symphoricarpos oreophilus*) and sagebrush (*Artemisia sp.*) were also observed. Curl-leaf mountain mahogany cover decreased each sample year on the Wah Wah Pass site, driving the marginally decreasing trend displayed by the total average cover data (**Figure 6.11**). Total preferred density fluctuated from year to year, but remained similar over the study period. Mature individuals were the dominant preferred browse demographic in all sample years. Decadence among the preferred browse community decreased over time. However, this reduction in the number of older plants was also accompanied by an overall decrease in the recruitment of

young individuals (**Figure 6.16**). Average utilization of preferred browse species also exhibited yearly fluctuations, but less than 25% of plants were moderately or heavily hedged throughout the duration of the studies (**Figure 6.18**).

Tree cover on these sites displayed a very marginal increase over time, mainly due to singleleaf pinyon (*Pinus monophylla*) on the Upper Hamblin Valley study. However, tree density decreased over the same time period, a trend also largely driven by singleleaf pinyon on Upper Hamblin Valley (**Figure 6.12**, **Figure 6.14**).

Herbaceous Understory: Total herbaceous frequency exhibited an initial decrease between 1998 and 2003 which was mainly driven by annual forbs on the Upper Hamblin Valley study. However, total nested frequency increased slightly during each subsequent sample year until the study sites were suspended. Cover displayed yearly fluctuations, but remained similar when comparing 1998 with 2012 data. Perennial forbs were the dominant herbaceous component throughout the duration of the study period, with cover and frequency trends largely influenced by the native species rock goldenrod (*Petradoria pumila*) on the Upper Hamblin Valley site. Annual grasses remained rare (**Figure 6.20**, **Figure 6.22**).

Occupancy: Total animal utilization of this study site decreased significantly between 2008 and 2012, but remained nearly stable when comparing 2008 with 2012 data. Elk were the primary occupants in most sample years, with mean pellet group abundance ranging from 10 days use/acre in 1998 to 29.5 days use/acre in 2003. Deer were the main occupants in 2008, mainly due to the Wah Wah Pass study. Deer presence has been as low as 8 days use/acre in 1998 and as high as 38 days use acre in 2008. Average abundance of horse pellet groups has fluctuated between 0.3 days use/acre in 2012 and 7 days use/acre in 2003. Finally, cattle pats were also observed with an average abundance ranging from 4 days use/acre in 2012 to 9 days use/acre in 2003 (**Figure 6.24**).

Upland (Big Sagebrush)

One study site [Mustang Spring (20-11)] is considered to be an Upland (Big Sagebrush) ecological site: this study is located at the south end of Hamlin Valley between Spanish George Spring and the town of Beryl (**Table 6.3**).

Shrubs/Trees: Total shrub cover has increased on this study site between 2017 and 2022. A vast majority of the shrub cover has been provided by preferred browse species other than sagebrush in both sample years, mainly rubber rabbitbrush (*Ericameria nauseosa* ssp. *nauseosa* var. *hololeuca*) (**Figure 6.9**). Total preferred browse density, however, decreased between 2017 and 2022. Young individuals were the dominant demographic in 2017. However, recruitment of young lessened in 2022, contributing to the overall decrease in density; mature plants comprised a majority of the population in 2022 (**Figure 6.17**). All preferred browse plants showed signs of little to no usage in 2017. In 2022, however, less than 1% of plants were moderately hedged and nearly 2% were heavily browsed (**Figure 6.19**).

Trees provide no cover on the Mustang Spring site. Utah juniper (*Juniperus osteosperma*) has been observed in increasing amounts in point-quarter data, but density remains low as of 2022 (**Figure 6.13**, **Figure 6.15**).

Herbaceous Understory: The herbaceous understory has decreased in both cover and frequency on this study site between 2017 and 2022. Annual forbs, particularly the weedy species prickly Russian thistle (*Salsola tragus*) and common mullein (*Verbascum thapsus*) contributed most of the herbaceous cover in 2017. Annual forbs decreased in 2022 while the introduced annual grass species cheatgrass (*Bromus tectorum*) increased; annual grasses were the dominant herbaceous component in the most recent sample year. Perennial grasses, primarily the introduced species crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*Thinopyrum intermedium*), contributed moderate cover in 2017, but cover was minimal in 2022. Perennial forbs have remained rare in comparison with other herbaceous components (**Figure 6.21**, **Figure 6.23**).

Occupancy: Horses were the primary occupants of this study site in both sample years, and total animal occupancy decreased between 2017 and 2022. Mean abundance of horse pellet groups was 42 days use/acre in 2017 and 23 days use/acre in 2022. Elk have also been present with an average pellet group abundance of 1 days use/acre in both sample years. Finally, deer pellet groups were observed in 2017 with an abundance of 5 days use/acre, but were absent in 2022 (**Figure 6.25**).

Upland (Black/Low Sagebrush)

There is one study [Lower Indian Peak (20-2)] that is classified as an Upland (Black/Low Sagebrush) ecological site. The Lower Indian Peak study is located south of Indian Creek at the edge of Pine Valley (**Table 6.3**).

Shrubs/Trees: Black sagebrush (*Artemisia nova*) has been the dominant preferred browse species on the Lower Indian Peak study in all sample years. Other species such as mountain big sagebrush (*A. tridentata* ssp. *vaseyana*), mormon tea (*Ephedra viridis*), and antelope bitterbrush (*Purshia tridentata*) have also been observed to a lesser extent than black sagebrush. Total preferred browse cover has exhibited yearly fluctuations, but has remained nearly stable overall (**Figure 6.9**). Average preferred browse demographic data shows that density of preferred browse species on this study site has also remained largely stable. Mature individuals have been the dominant demographic of the browse population on the Lower Indian Peak study; decadence and recruitment of young have remained low (**Figure 6.17**). Utilization of preferred browse species increased through the 2012 sample year, but has decreased during each subsequent sampling. In 2022, 20% of plants showed signs of moderate browsing and 8% were heavily hedged (**Figure 6.19**).

Encroachment of Utah juniper (*Juniperus osteosperma*) and singleleaf pinyon (*Pinus monophylla*) is occurring on this study site. Tree cover increased between 2003 and 2008, but has remained low following lop and scatter treatments that occurred in 2011 and 2018; pinyon has not contributed any cover from 2012 onwards (**Figure 6.13**). Tree density has decreased every sample year (**Figure 6.15**).

Herbaceous Understory: Herbaceous cover and frequency decreased between 1998 and 2003, but have generally increased in subsequent sample years. Perennial grasses, namely the introduced species crested wheatgrass (*Agropyron cristatum*), have provided a majority of the herbaceous cover throughout the study period. The introduced annual grass species cheatgrass (*Bromus tectorum*) is also a prominent component of the herbaceous community, and both cover and frequency have increased over time. Bulbous bluegrass (*Poa bulbosa*), another introduced perennial grass species, has also been present with fluctuating cover. Annual and perennial forbs have remained scarce (**Figure 6.21**, **Figure 6.23**).

Occupancy: Average pellet group transect data shows that overall occupancy has fluctuated from year to year. Elk were the primary occupants in all sample years except 2012, when deer were the main occupants. Mean abundance of elk pellet groups has ranged from 7 days use/acre in 2017 to 44 days use/acre in 2003. Deer presence has been as low as 5 days use/acre in 2022 and as high as 22 days use/acre in 2017. Cattle pellet groups have also been present on the Lower Indian Peak study, with an average abundance fluctuating between 0 days use/acre in 2003, 2008, and 2017 and 6 days use/acre in 1998. Finally, the mean abundance of horse pellet groups ranged from 0 days use/acre in 2003, 2008, and 2012 to 2 days use/acre in 2017 (**Figure 6.25**).

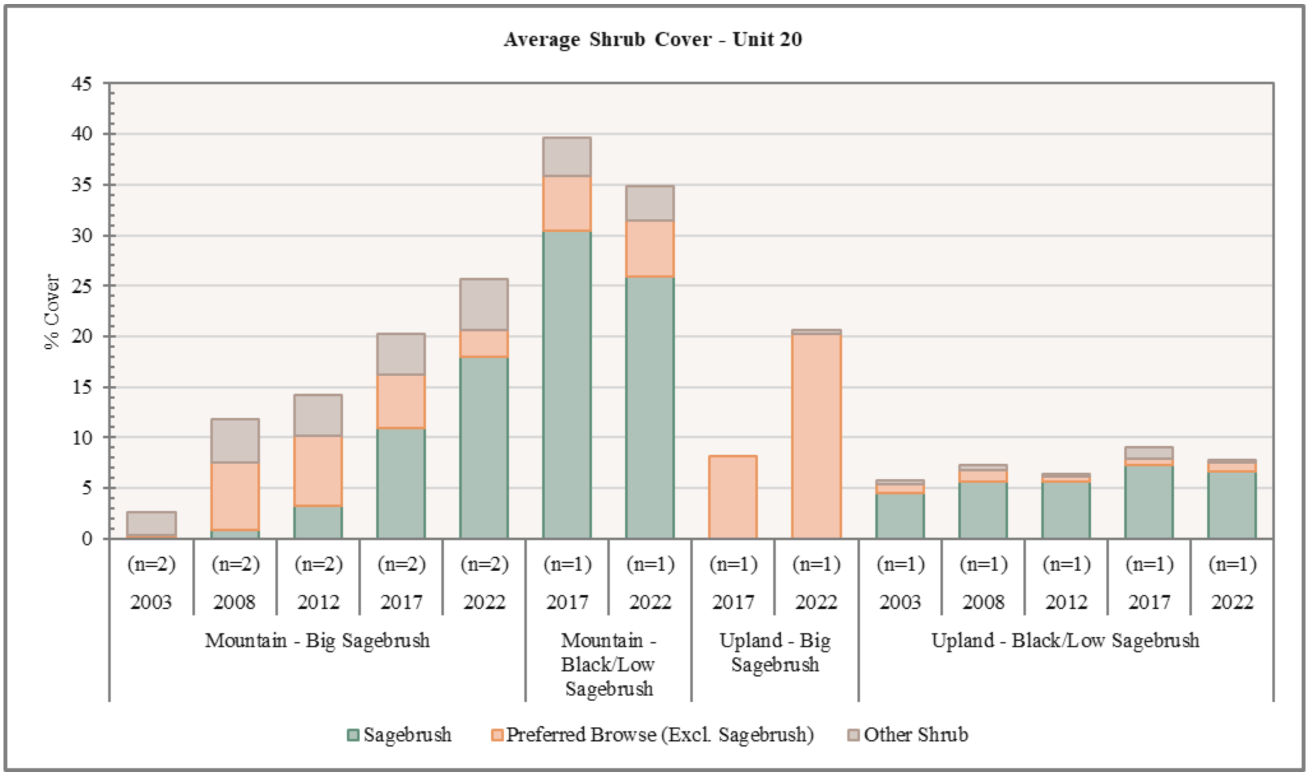


Figure 6.9: Average shrub cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

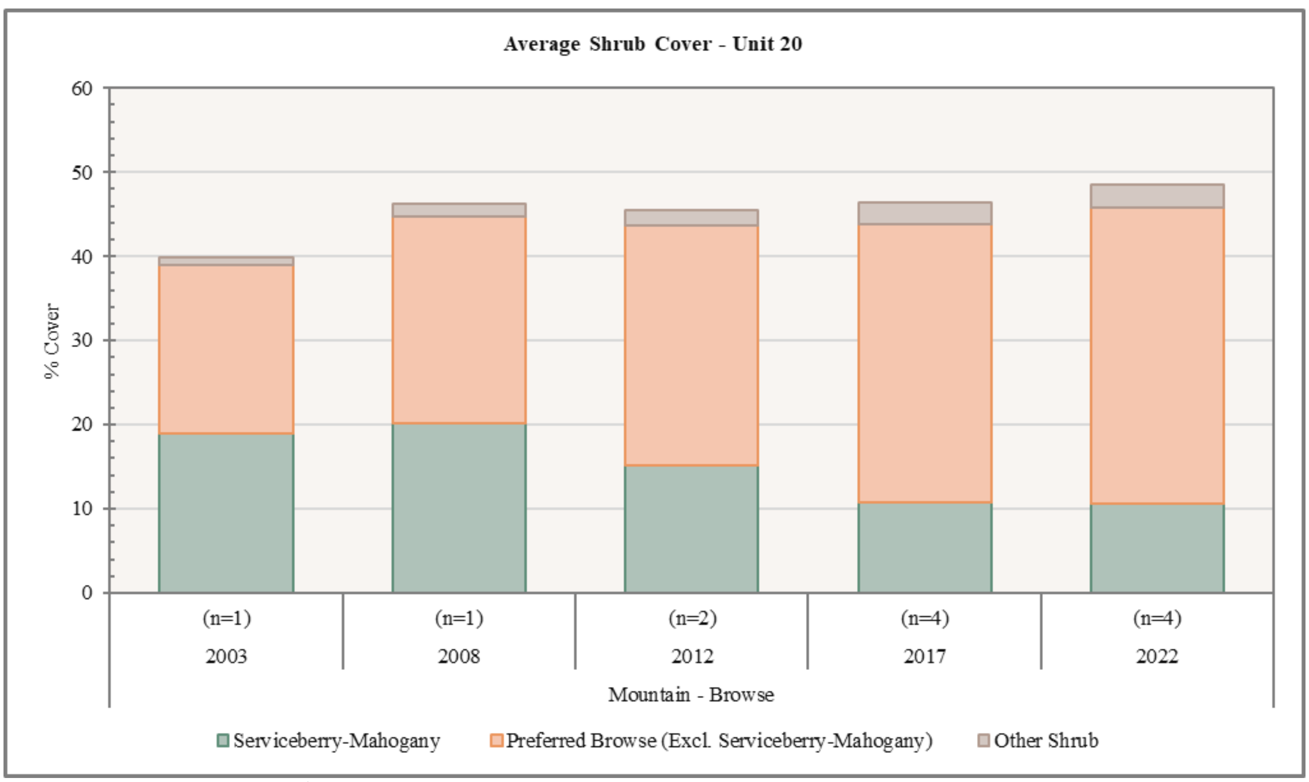


Figure 6.10: Average shrub cover for Mountain - Browse study sites in WMU 20, Southwest Desert.

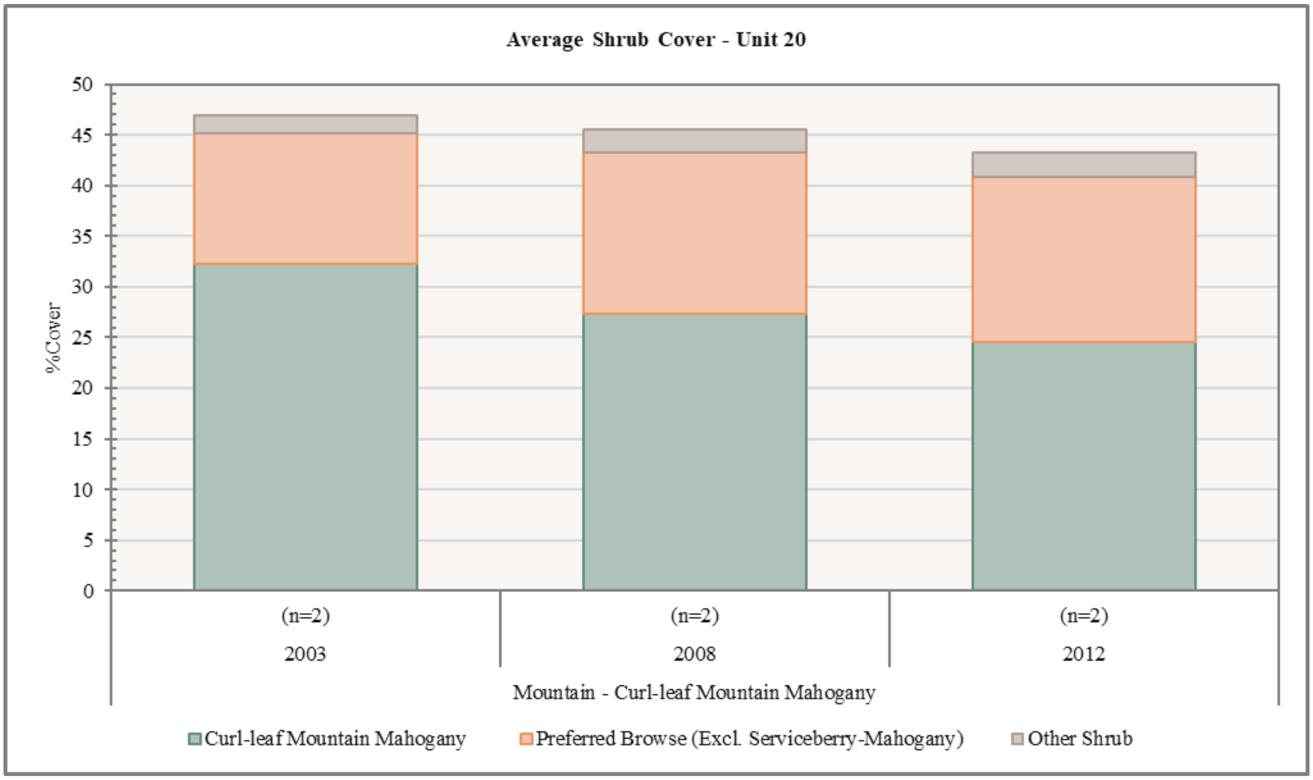


Figure 6.11: Average shrub cover for Mountain - Curl-leaf Mountain Mahogany study sites in WMU 20, Southwest Desert.

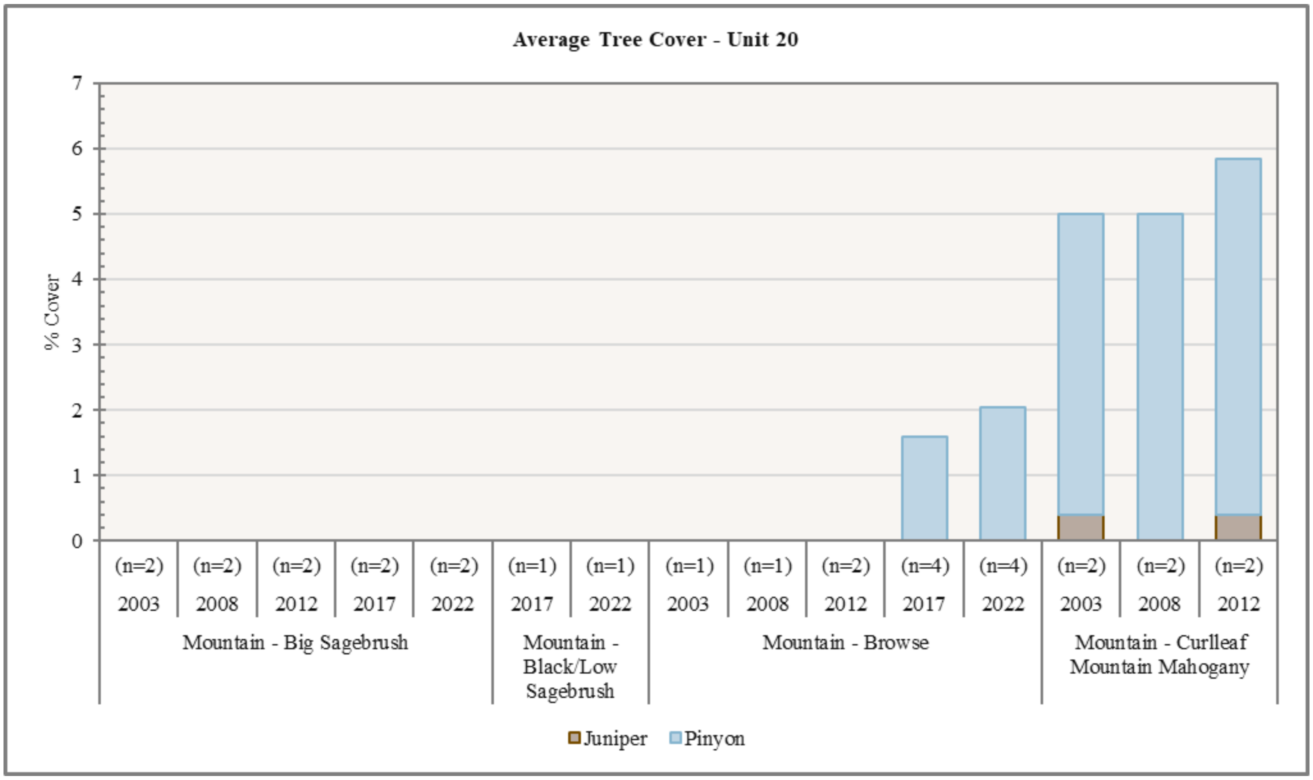


Figure 6.12: Average tree cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, Mountain - Browse, and Mountain - Curlleaf Mountain Mahogany study sites in WMU 20, Southwest Desert.

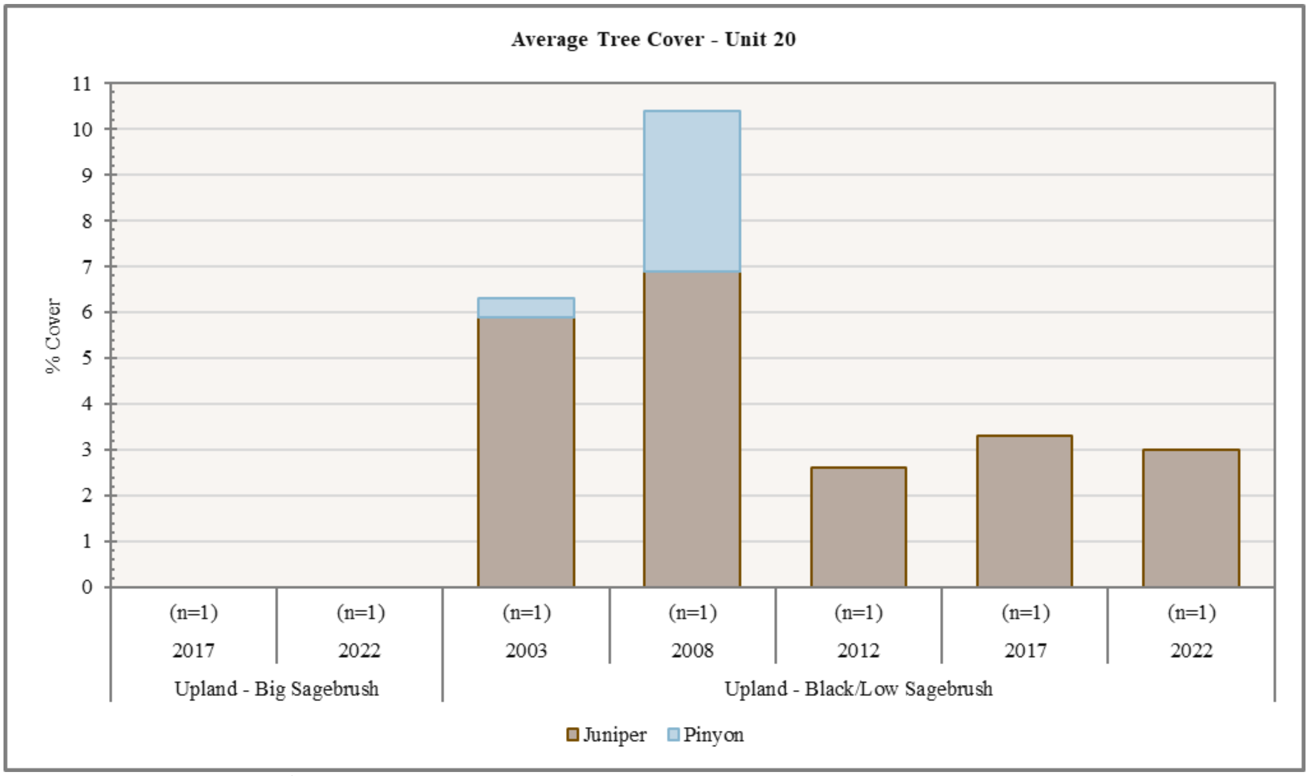


Figure 6.13: Average tree cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

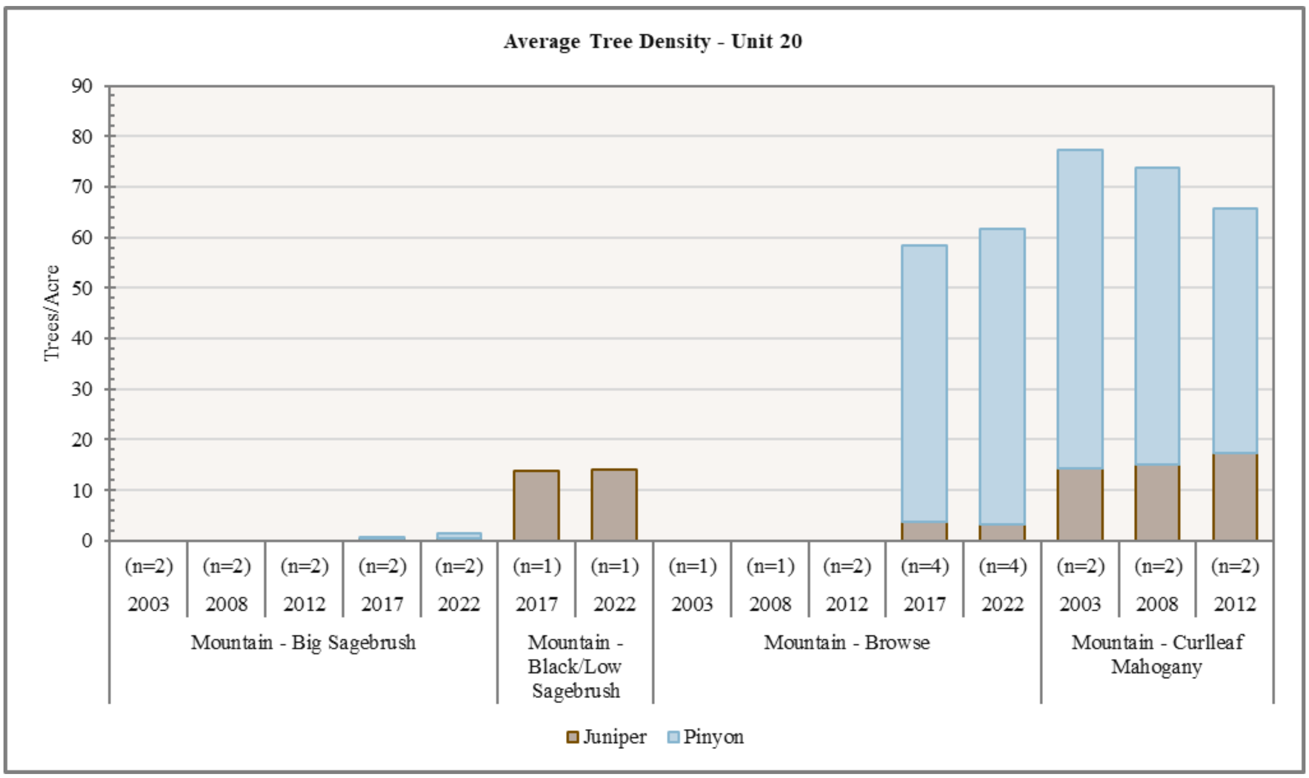


Figure 6.14: Average tree density for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, Mountain - Browse, and Mountain - Curlleaf Mahogany study sites in WMU 20, Southwest Desert.

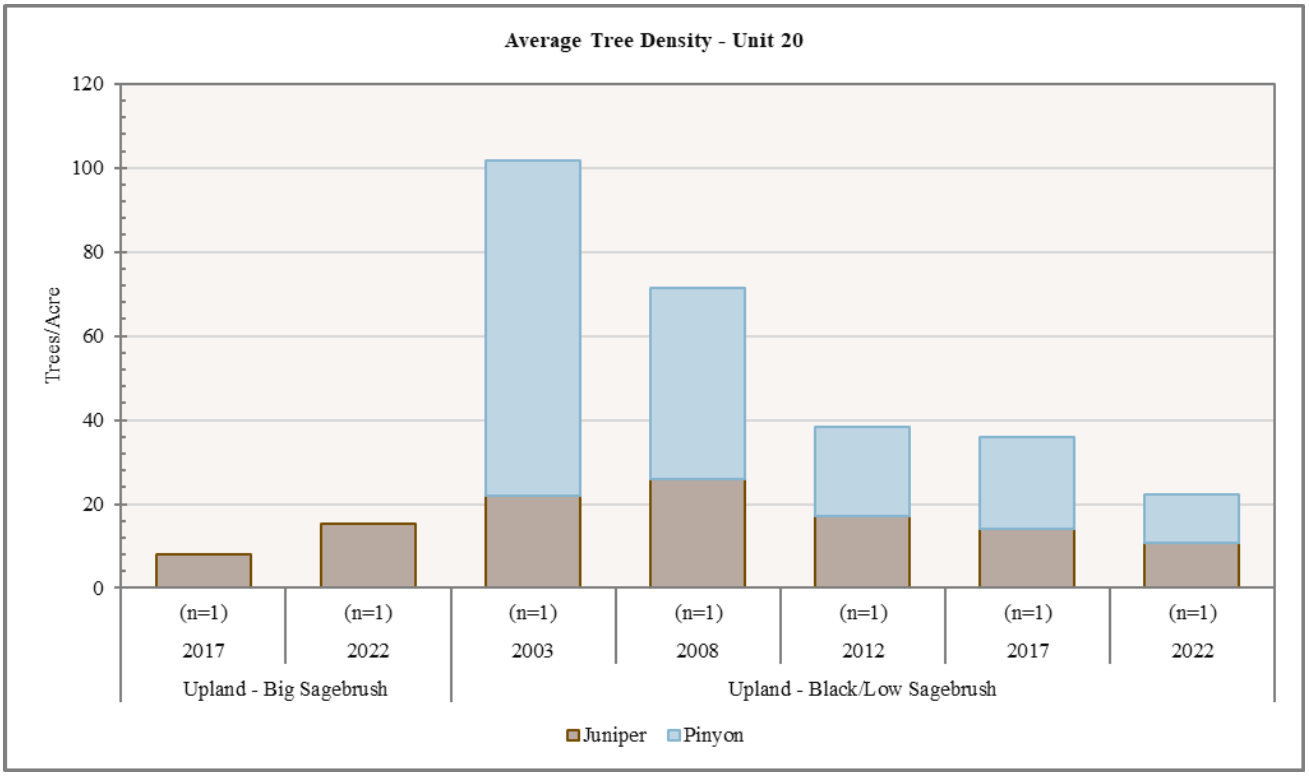


Figure 6.15: Average tree density for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

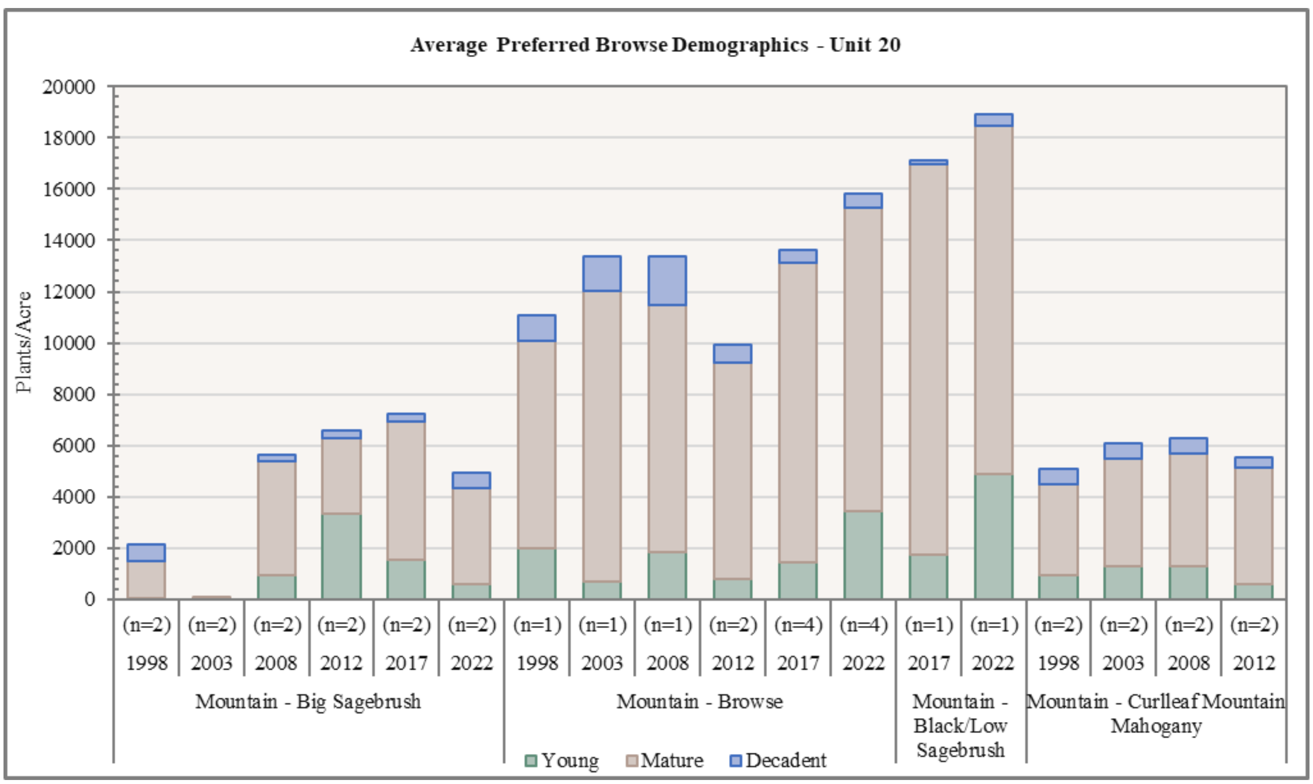


Figure 6.16: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Browse, Mountain - Black/Low Sagebrush, and Mountain - Shrub study sites in WMU 20, Southwest Desert.

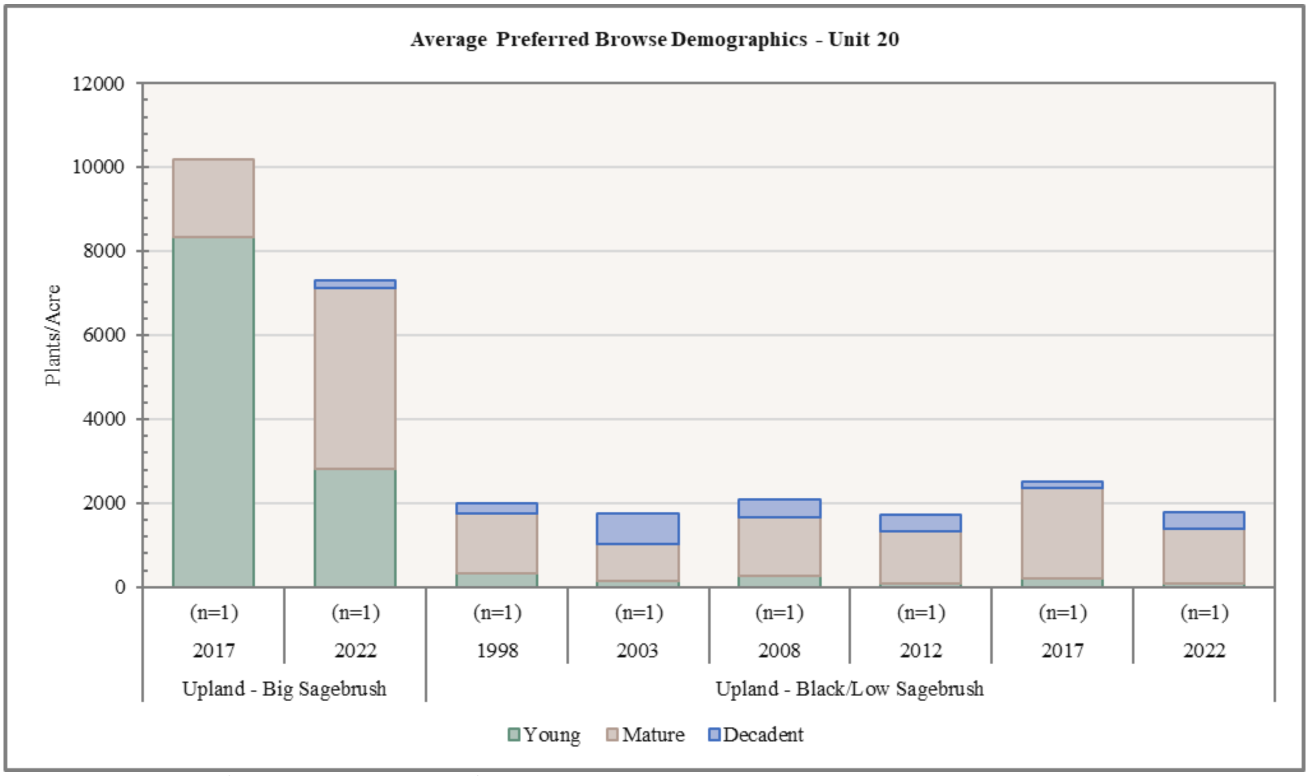


Figure 6.17: Average preferred browse demographics for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

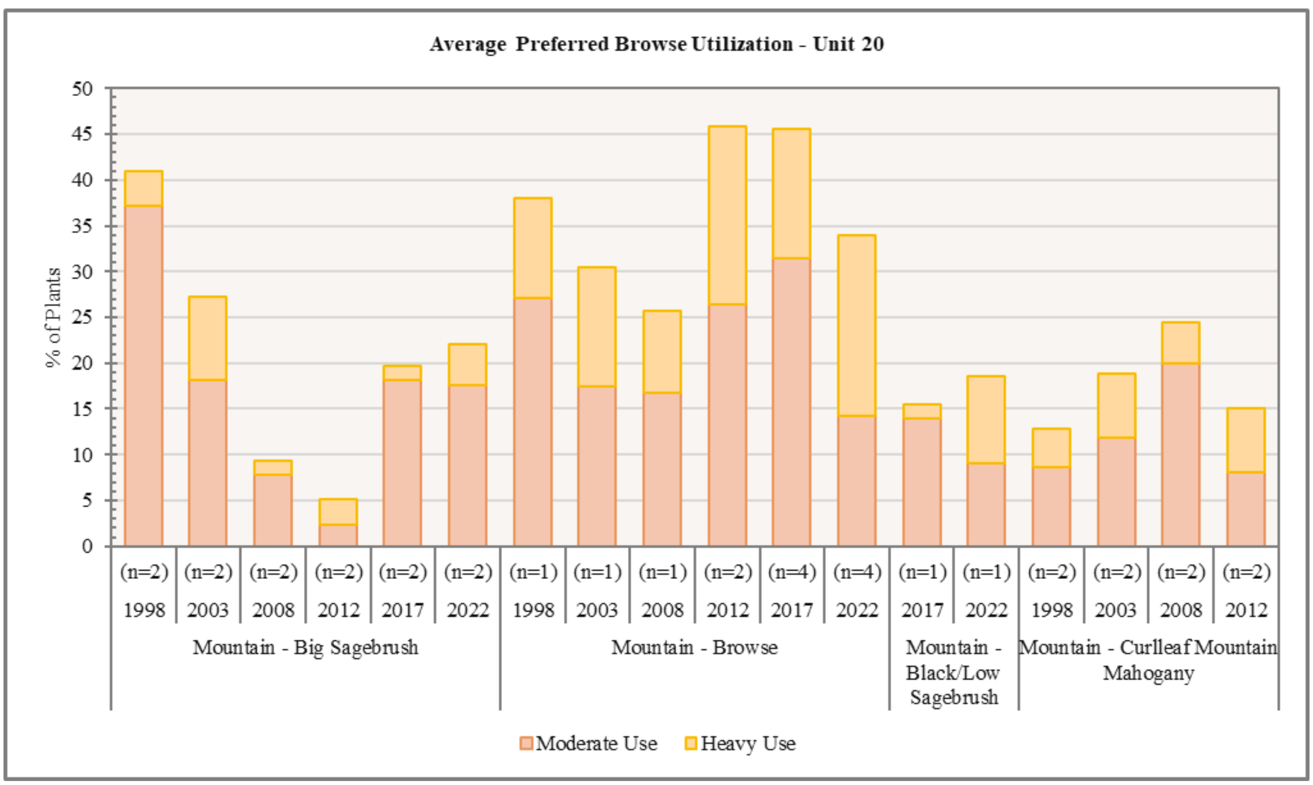


Figure 6.18: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Browse, Mountain - Black/Low Sagebrush, and Mountain - Curlleaf Mountain Mahogany study sites in WMU 20, Southwest Desert.

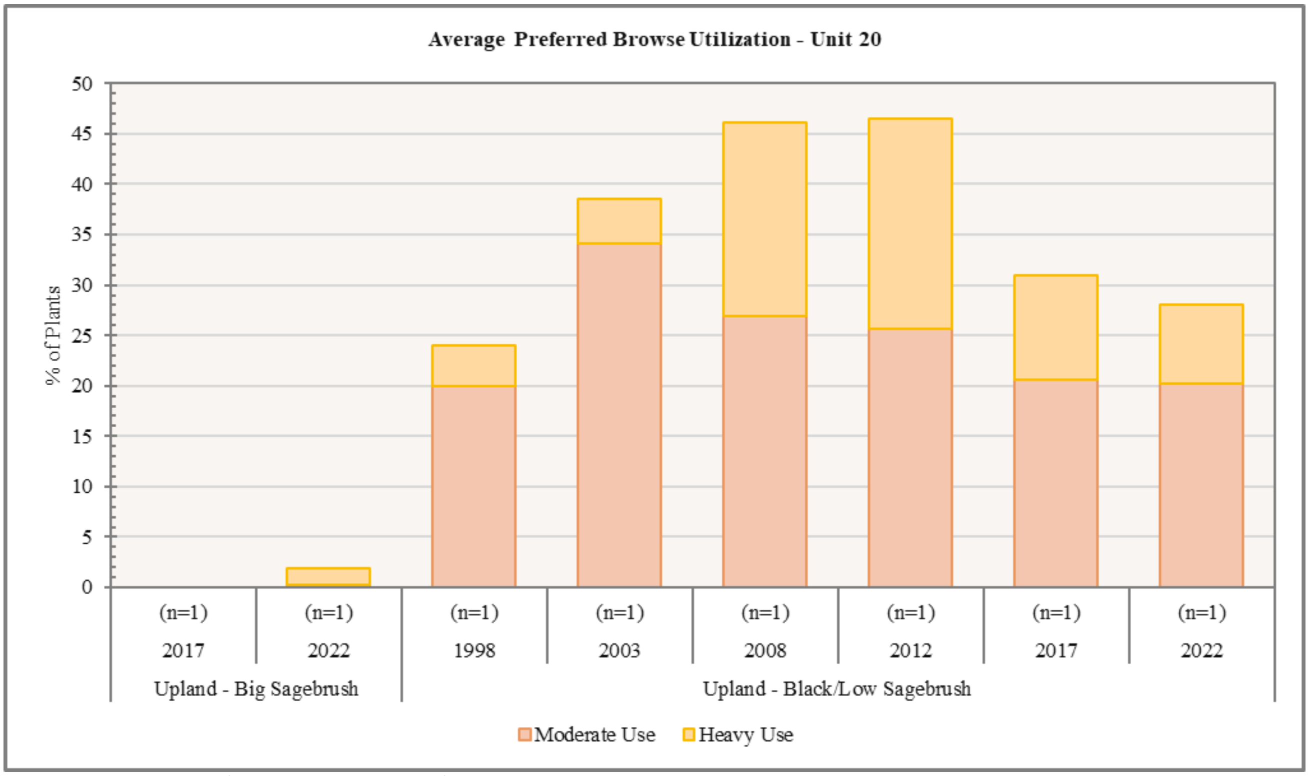


Figure 6.19: Average preferred browse utilization for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

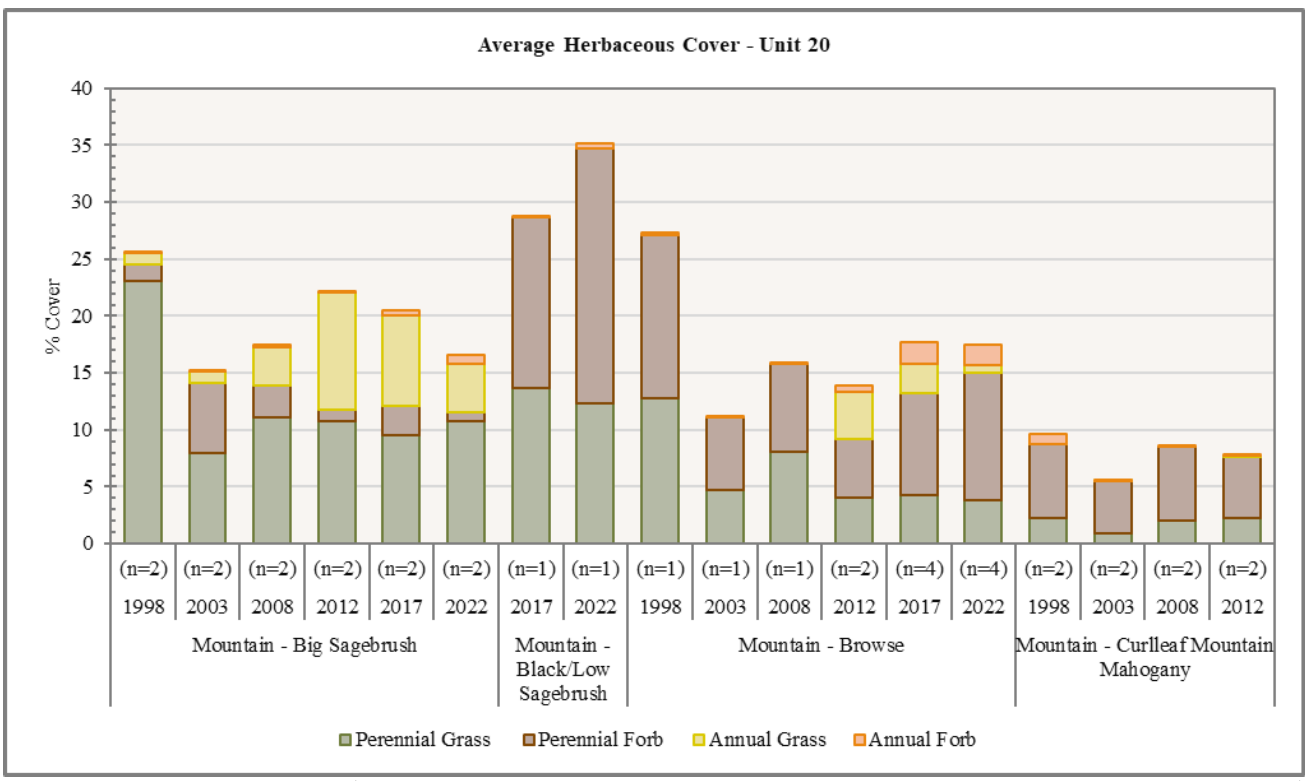


Figure 6.20: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, Mountain - Browse, and Mountain - Curlleaf Mountain Mahogany study sites in WMU 20, Southwest Desert.

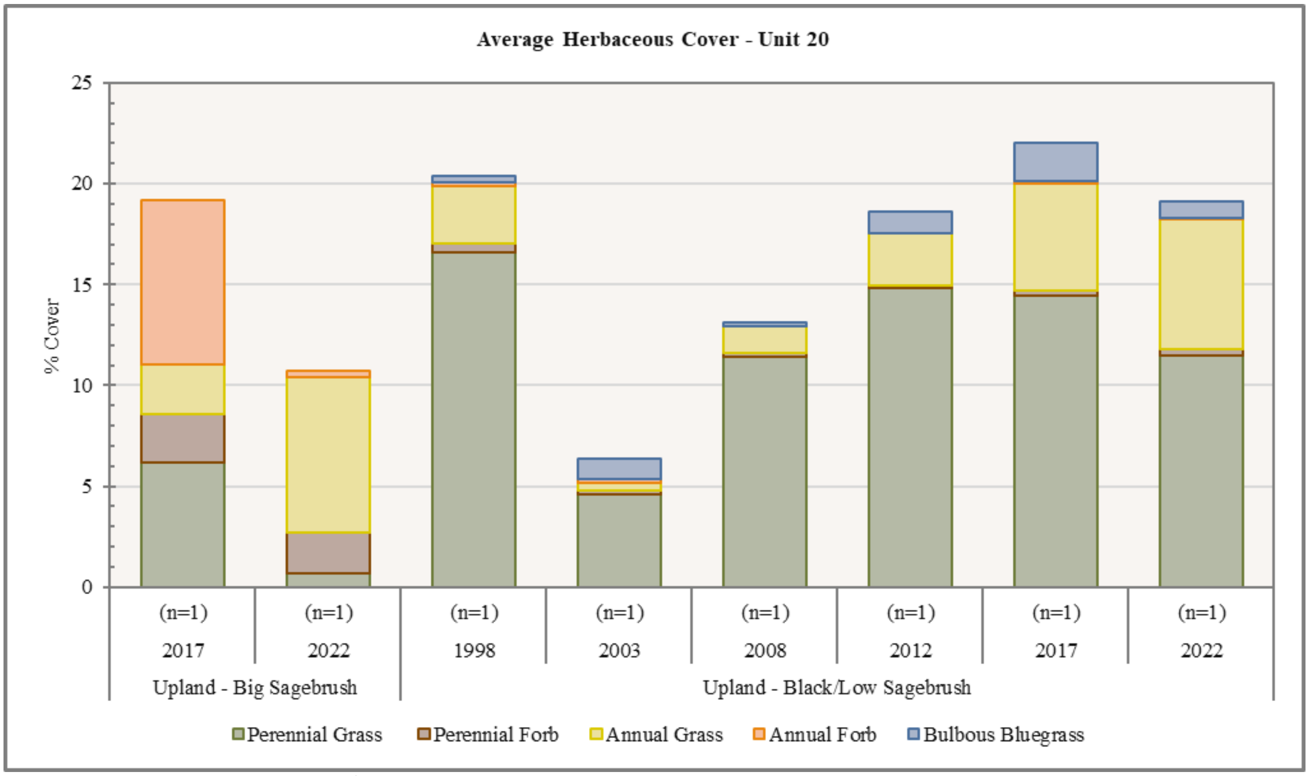


Figure 6.21: Average herbaceous cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

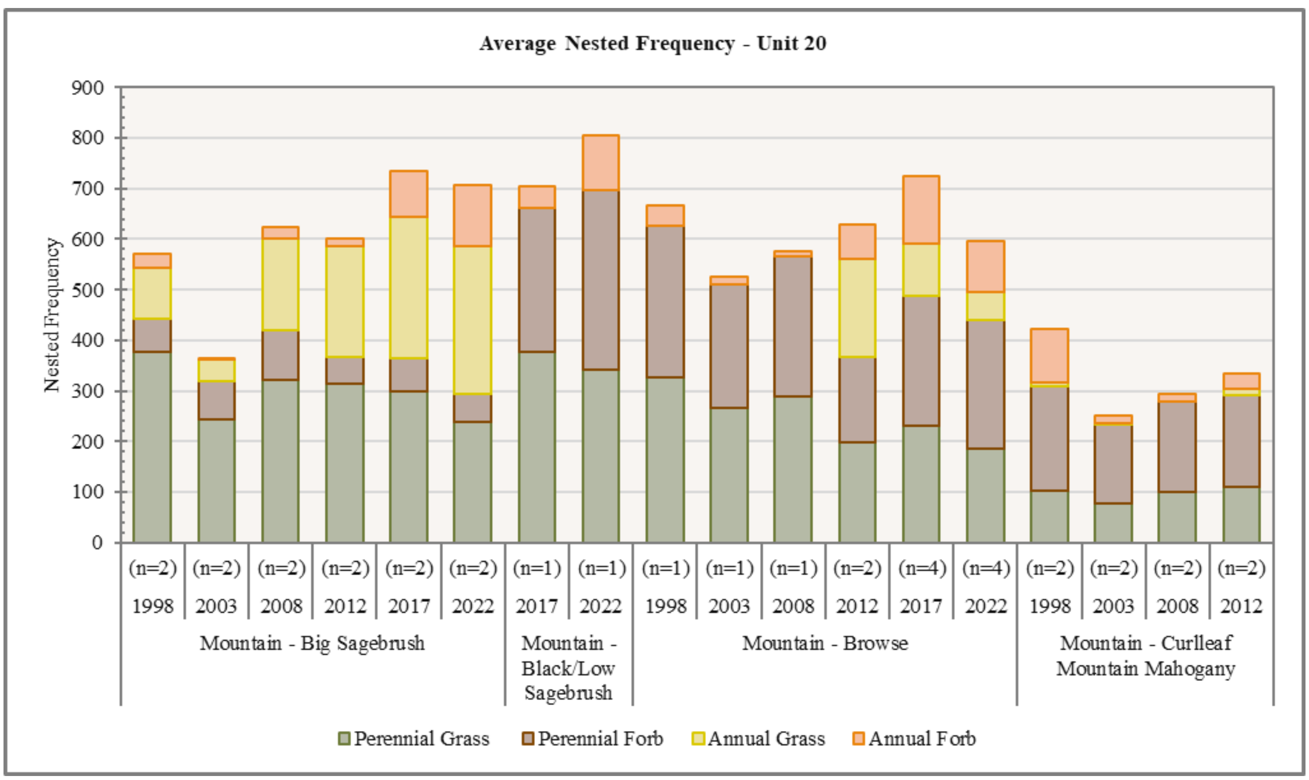


Figure 6.22: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, Mountain - Browse, and Mountain - Curlleaf Mountain Mahogany study sites in WMU 20, Southwest Desert.

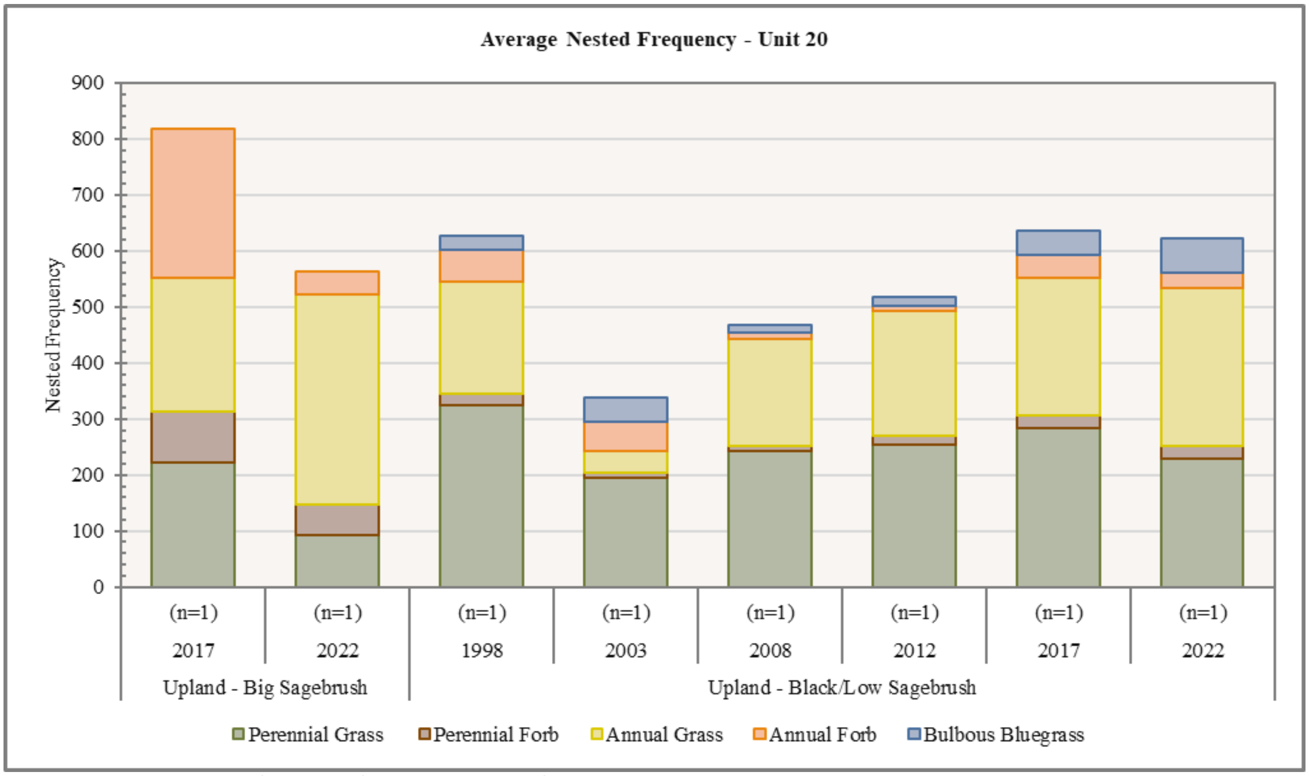


Figure 6.23: Average nested frequency of herbaceous species for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

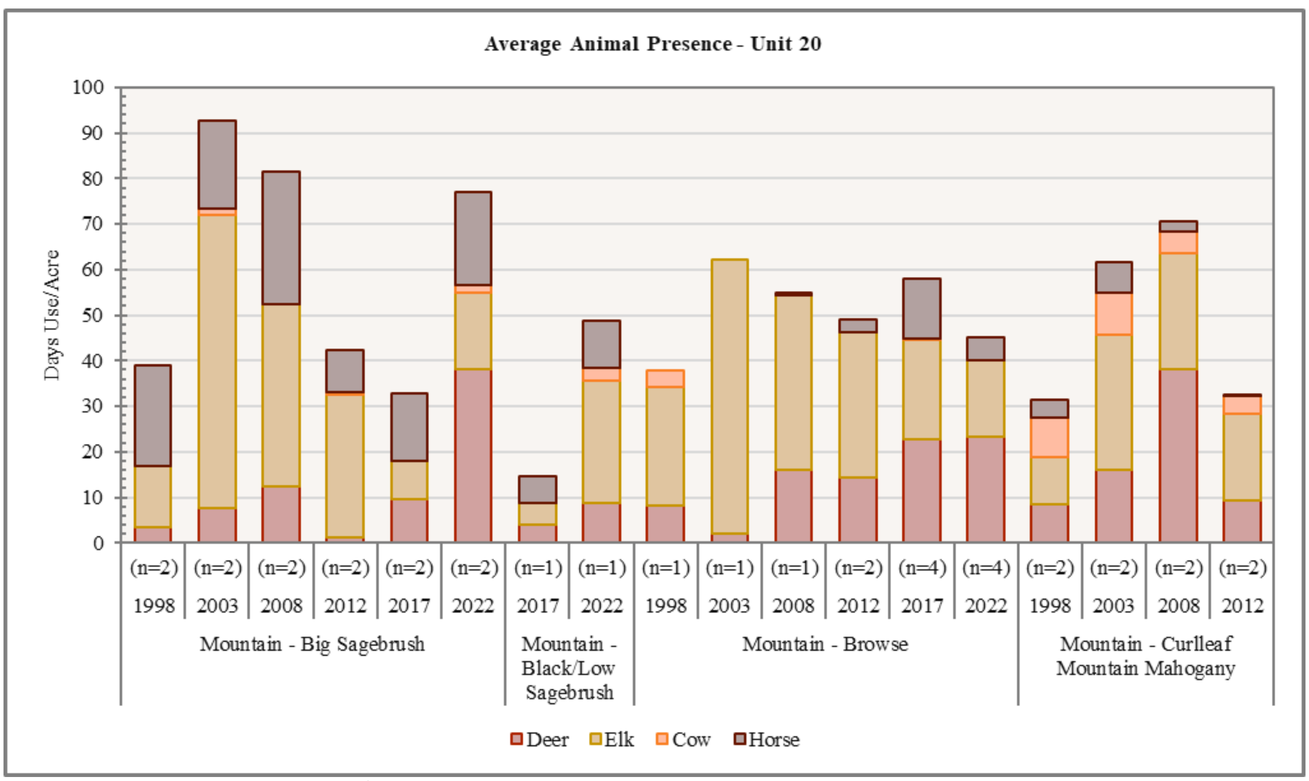


Figure 6.24: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Black/Low Sagebrush, Mountain - Browse, and Mountain - Curlleaf Mountain Mahogany study sites in WMU 20, Southwest Desert.

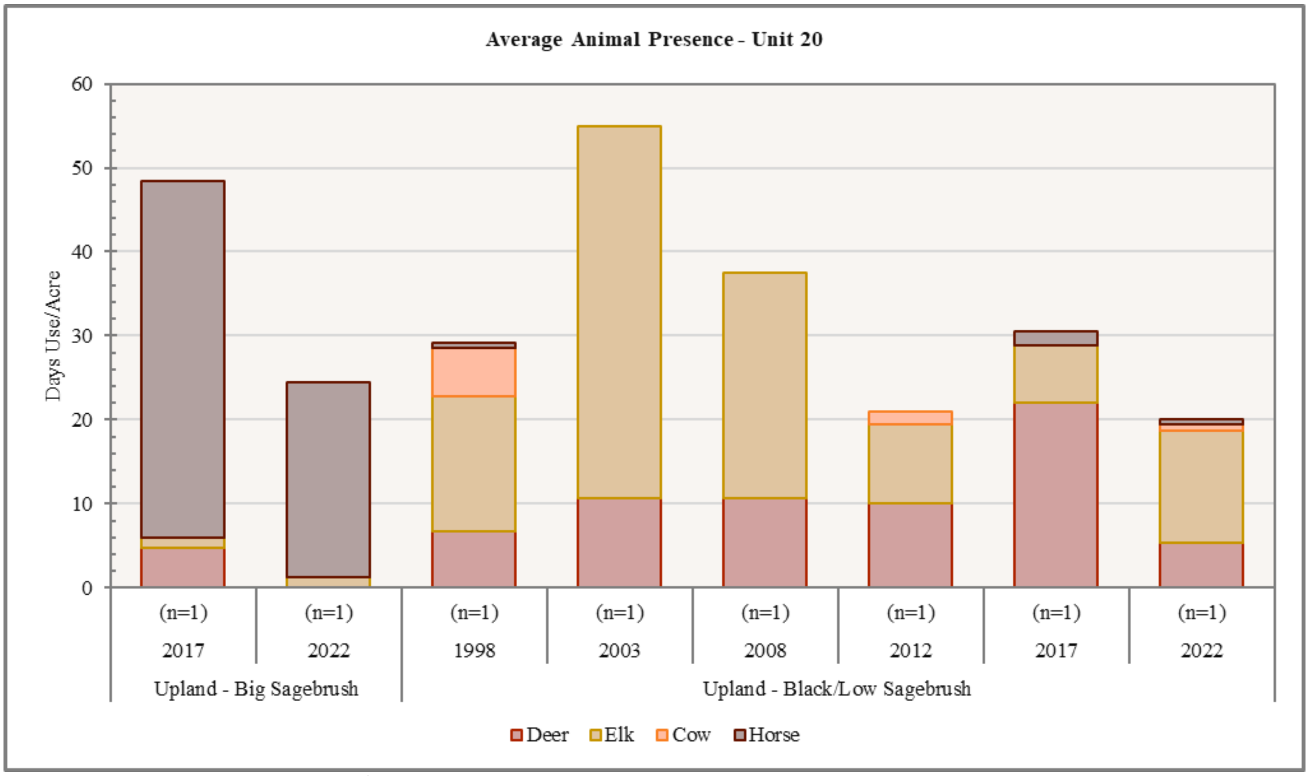
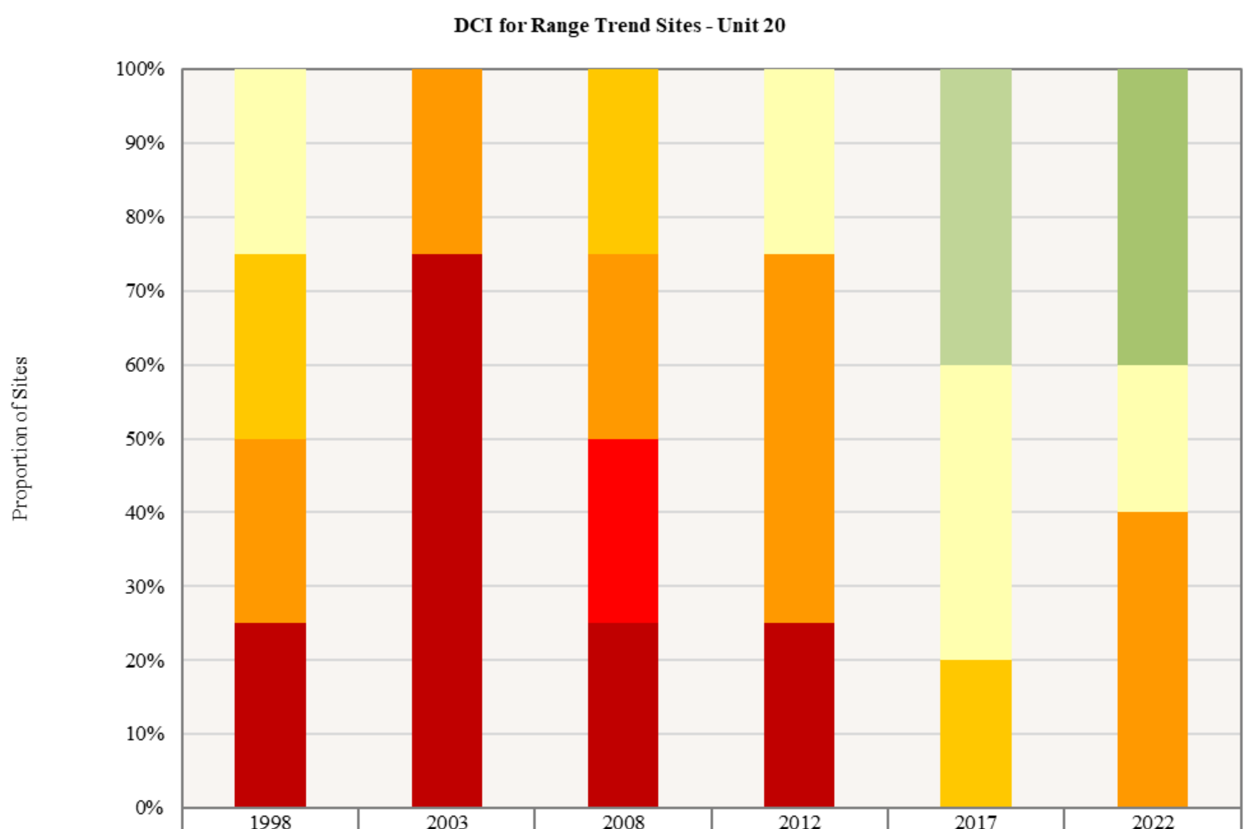


Figure 6.25: Average pellet transect data for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 20, Southwest Desert.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Southwest Desert management unit has generally improved from very poor-poor averaged conditions in 1998 to fair averaged conditions in 2022. South Spring (20-7), Lamerdorf Canyon (20-10), and Mustang Canyon (20-11) are the main drivers for the unit's wintering habitat stability or quality, and average between poor-fair to fair-good deer winter range conditions. It is important to note that Lamerdorf Canyon and Mustang Canyon study sites were not added to the unit until recently and have only contributed to the unit's improvement in wintering conditions since 2017. Lower Indian Peak (20-2), Mountain Home Seeding (20-3), and Upper Hamblin Valley (20-5), are considered to have very poor to poor wintering habitat conditions consistently from year to year and suppress the unit's overall winter habitat quality. The Range Trend site in this unit that tends to have higher variability in deer winter habitat is South Spring. This variability may suggest the site has a higher capacity for winter range improvement, and may benefit and respond the most from additional improvement projects.

The overall deer winter range assessment in 2022 for WMU 20 was that the unit was in fair condition. A factor contributing to this fair condition is that the majority of the sites have a notable presence preferred browse, although Lower Indian Peak is lacking. Perennial grasses and forbs are limited on most of these sites: addressing these components would greatly improve winter range habitat conditions for mule deer (**Table 6.5**, **Figure 6.26**).



	1998	2003	2008	2012	2017	2022
Good						2
Fair-Good					2	
Fair	1			1	2	1
Poor-Fair	1		1		1	
Poor	1	1	1	2		2
Very Poor-Poor			1			
Very Poor	1	3	1	1		

Figure 6.26: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 20, Southwest Desert.

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
20-2	1998	8.4	9	4.9	30	-2.1	0.9	0	**51**	**P-F**
20-2	2003	6.9	0.8	4.6	9.2	-0.3	0.4	0	**21.7**	**VP**
20-2	2008	8.6	8.3	6	22.8	-1	0.4	0	**45.1**	**P**
20-2	2012	7.7	7.8	2.4	29.7	-1.9	0.2	0	**45.9**	**P**
20-2	2017	9.9	13.4	3.8	28.9	-4	0.5	0	**52.6**	**F**
20-2	2022	9.5	9.9	2.9	23	-4.8	0.6	0	**41.1**	**P**
20-3	1998	0.5	0	0	30	-0.5	0.8	0	**30.8**	**VP**
20-3	2003	0.4	0	0	18.6	-0.1	0.4	0	**19.3**	**VP**
20-3	2005	2.6	0	0	30	0	0.6	0	**33.2**	**VP**
20-3	2008	4.3	0	0	26.3	0	0.7	0	**31.2**	**VP**
20-3	2012	10.6	12.5	15	24.5	0	0.5	0	**63.1**	**F**
20-3	2017	15.6	14.7	14.3	9.3	-1.3	2.3	0	**54.9**	**P-F**
20-3	2022	24.4	10.7	9.5	5	-3.3	0.6	0	**46.9**	**P**
20-5*	1998	14.6	10.6	6.1	4.4	0	10	0	**45.6**	**P**
20-5*	2003	17.7	13.5	1.8	2.3	0	10	0	**45.3**	**P**
20-5*	2008	17.2	5.1	1.3	4.5	0	10	0	**38**	**VP-P**
20-5*	2012	15	6.7	2.4	3.8	0	10	0	**37.9**	**VP**
20-7	1999	17.1	6.2	0.5	30	-0.9	5.2	0	**58.1**	**F**
20-7	2003	0.4	0	0	13	-1.4	10	0	**22**	**VP**
20-7	2008	14.5	14.3	2.9	18.1	-5.1	10	0	**54.7**	**P-F**
20-7	2012	14.9	14.1	8.9	18.3	-15.5	3.5	0	**44.2**	**P**
20-7	2017	25	12.6	6.7	29	-10.7	7.6	0	**70.1**	**F-G**
20-7	2022	27.1	13.6	2.5	30	-3.2	2.5	0	**72.6**	**G**
20-10	2017	30	14.3	9	5.9	0	10	0	**69.1**	**F-G**
20-10	2022	30	14.1	15	8.6	0	10	0	**77.7**	**G**
20-11	2017	10.3	15	15	12.3	-1.8	4.9	0	**55.6**	**F**
20-11	2022	25.3	14.2	15	1.3	-5.8	4.1	0	**54.1**	**F**

Table 6.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 20, Southwest Desert. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
20-1	Upper Indian Peak	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20-2	Lower Indian Peak	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20-3	Mountain Home Seeding	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20-4	Merrill's Camp	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20-7	South Spring	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
20-8	Greens Canyon	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20-9	Burnt Stump Canyon	Animal Use - Horse	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20-10	Lamerdorf Canyon	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20-11	Mustang 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
20R-3	Bowler Chaining	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
20R-4	Blawn Wash Dixie	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
20R-5	Salt Cabin	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
20R-6	Hamblin Valley Harrow	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Animal Use - Cow	High	Reduced diversity of desirable grass and forb species
20R-7	Spanish George Spring	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
20R-9	Miners Cabin Wash	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
20R-10	Spanish George Spring 2T	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
20R-11	The Tetons	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor

Table 6.6: 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

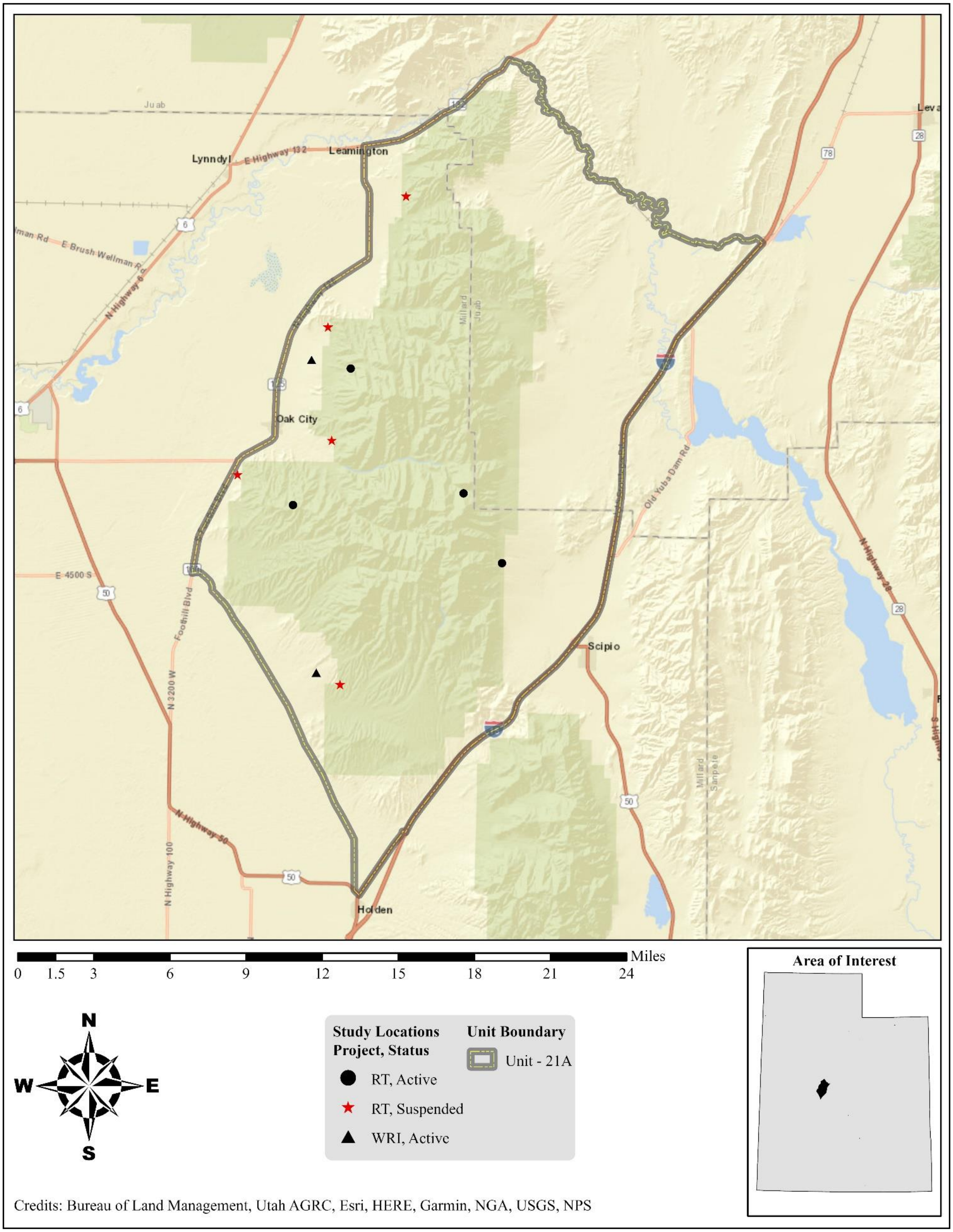
As mentioned above, the overall deer winter range assessment in 2022 for WMU 20 was that the unit was in fair condition. South Spring, Lamerdorf Canyon, and Mustang Springs are all sites responsible for the overall stable condition due to the high amounts of preferred browse cover and the well diversified age classes within these populations. The remaining sites, Mountain Home Seeding and Lower Indian Peak, are in poor condition, and have very little perennial forb cover and have annual grass established. Mountain Home has a good amount of shrub cover, but there is not a sufficient herbaceous understory. The inverse is true on Lower Indian Peak, where there is not much browse cover, but only perennial grass provides sufficient cover in the understory.

There are a number of factors that contribute to the unit's habitat health. Due to the area's relative isolation there are not many people in the area; urban development and high-use recreation is less likely. With reduced traffic, habitat is preserved in a number of ways, including (but not limited to): a reduced potential for invasive species like cheatgrass to spread, human-caused wildfire, and direct impacts to habitat through expansion of recreational roads or trails. Sites in summer habitat have stable shrub populations, despite the high amount of wildlife use/presence on most of these sites. Winter range sites also have good browse components in general, while the age class structures are fairly diversified (specifically on Lamerdorf Canyon and Mustang Spring). Monitored Watershed Restoration Initiative (WRI) treatments appear to be responding well to rehabilitation efforts. A number of WRI projects have occurred on the southern end of the Wah Wah Mountains, Hamlin Valley, and the Indian Peak WMA. For the most part, sites within these project areas reveal that the habitats are fairly stable and are undergoing some improvements. Also notable are the few fires that have occurred on the unit as a whole. Some areas south of Minersville have burned, but there is a lack of Range Trend monitoring in this area and therefore data concerning recovery of this crucial winter habitat is absent. Finally, much of the land outside of Hamlin Valley, and the unit as a whole, is public, which allows for easier coordination and implantation of treatment projects.

Despite the good condition of the preferred browse component on Mustang Spring, one of the more prominent issues is the amount of wild horse presence and use in the area. Feral horse presence has affected the herbaceous understory: this is made evident by the reduction in the perennial grass species intermediate and crested wheatgrass, and high horse pellet counts. In addition, the summer range sites with mountain browse communities also appear to have higher use by and presence of wildlife. There are many treatments occurring on winter range habitat that are currently being sampled to monitor the effects of pinyon and juniper removal. However, there are few land treatments that have occurred on the summer range, and it has been noted that much of this summer range is within Phase III of woodland succession. Presence of pinyon and juniper can result in reduced understory shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000). As this is a summer-limited unit, future tree treatments would likely expand available habitat. The threat of cheatgrass is mixed among the sampled sites, but there are a few hot spots (like South Spring and Mustang Spring) that likely require some attention as increases in annual grass abundance and cover could become an issue if left unchecked.

As mentioned earlier, this unit appears to be summer range limited and there are few habitat improvement projects that have occurred. With the amount of pinyon and juniper encroachment taking place, more work is recommended in summer range to improve habitat through tree removal. Similar to the issue of pinyon and juniper encroachment happening in winter and summer ranges, many aspen stands are conifer-encroached and could benefit from tree-removal projects. As with all treatment types, careful consideration should be made so as to not select a method that could unintentionally result in increased annual grass loads. Moreover, if aspen rejuvenation efforts occur, care should also be taken regarding ungulate use in the presence of aspen seedlings, as the aspen stands are limited within the unit. Treatments to reduce annual grasses through the use of herbicide application or changes in grazing management could be effective tools in annual grass control. However, areas where the threat of annual grasses is moderate to low need future monitoring to aid in identifying when and where increases in fuel loads may be occurring. Should these grasses increase in the future, the risk of wildfire may be exacerbated (Balch, D'Antonio, & Gómez-Dans, 2013). Consideration should also be given to monitoring the rehabilitation efforts in the burned areas near Minersville. Following wildfires, community types can transition away from more resistant and resilient systems to communities that are less resistant to fire disturbances as a result of increased fuel loads from annual species. Without studies in the Minersville area, community compositions and their potential behavior to disturbance are less predictable. Likewise, data on community composition is also needed for future project development to aid in improving this crucial winter range habitat.

7. MANAGEMENT UNIT 21A – OAK CREEK



WILDLIFE MANAGEMENT UNIT 21A – OAK CREEK

Boundary Description

Juab and Millard counties – Boundary begins at SR-50 and I-15 near Holden; north on I-15 to the Mills Road; west on this road to Leamington Pass Road, west along Leamington Pass Road to the Sevier River; north along this river to SR-132; west on SR-132 to SR-125 (300 East in Leamington); south on SR-125 to McCormick Road (CR-4549); south on this road to Whiskey Creek Road; southeast on this road to SR-50 in Holden; north on SR-50 to I-15. Excludes all CWMUs.

Management Unit Description

Geography

The Oak Creek Unit sits on the transition area between the Wasatch Front and the West Desert geographic features. Mountains within this unit include the Canyon Mountains and Church Mountains. The majority of study sites are located on the western aspect of the Canyon Mountains. The towns within this unit include Mills, Scipio, Holden, Oak City, and Leamington.

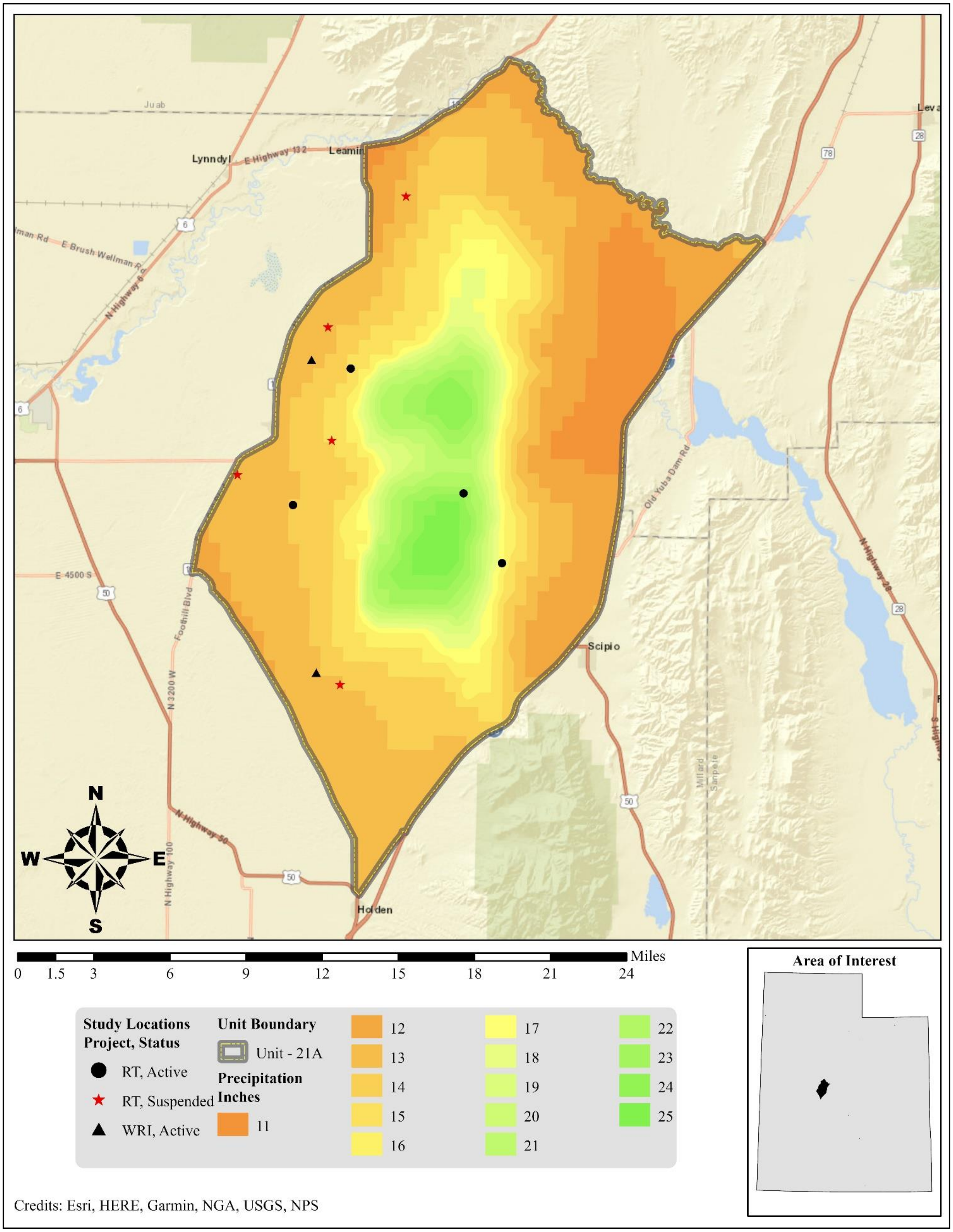
The Canyon Mountains are oriented north to south. They are shallowly sloped, with some moderate slopes and canyons present. The tallest peak in the Canyon Mountains is Fool Creek Peak at 9,712 feet.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 8 inches in the Sevier Desert near Delta to 25 inches on the peaks of Blue Mountain and Partridge Mountain. All of the Range Trend and WRI monitoring studies on the unit occur within 9-22 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 South Central division (Division 4).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 2002-2003, 2012-2014, 2018, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1997-1998, 2005, and 2011 (**Figure 7.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1996, 2000, 2002-2004, 2013-2014, 2018, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2002-2003, 2007, 2009, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2005, and 2011 (**Figure 7.1b**) (Time Series Data, 2023).



Map 7.1: The 1991-2020 PRISM Precipitation Model for WMU 21A, Oak Creek (PRISM Climate Group, Oregon State University, 2021).

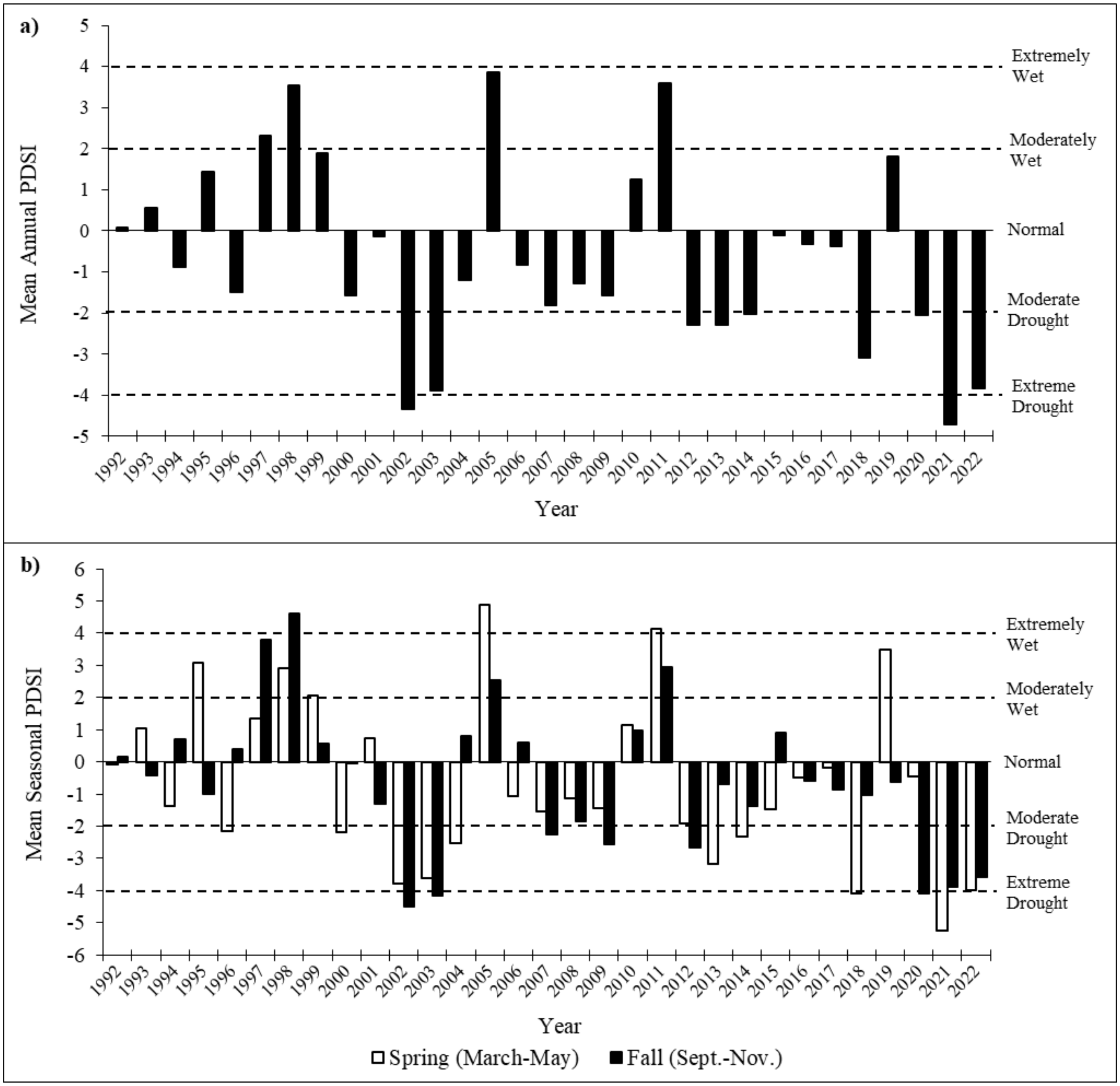


Figure 7.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is $\geq$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 $\leq$-4.0 = Extreme Drought. **a)** Mean annual PDSI. **b)** Mean spring (March-May) and fall (Sept.-Nov.) PDSI (Time Series Data, 2023).

Big Game Habitat

Deer winter range on the Oak Creek unit consists of the foothills around the Canyon Mountains and in Furner Valley. The lower and upper limits of normal deer winter range vary from approximately 4,800 to 6,800 feet, dependent upon the location.

The plant communities on the winter range are varied and the composition depends on the location. Much of the winter range consists of either sagebrush or cliffrose/sagebrush communities. There are some mountain brush communities, although large amounts of this habitat type burned in past fires (**Map 7.5**). As such, many of these mountain brush communities have transitioned into perennial grass-dominated sites.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between range trend samplings.

The RAP data shows fluctuations of herbaceous biomass and cover on both deer summer and winter range. The highest values for both measurements have mostly been observed in the late 2010s, although biomass on summer habitat was also significant in the early 1990s. Annual and perennial cover and biomass have followed precipitation trends in many years. However, a possible lag effect of a year or so appears to occur at different times (in 1999-2000/2001, for example), and no apparent correlation is visible in other years. Increases and decreases in biomass and cover generally appear to be somewhat more pronounced on winter habitats than on summer range (**Figure 7.2**, **Figure 7.3**, **Figure 7.4**, **Figure 7.5**). As expected, some peaks and troughs in this herbaceous data can be correlated with Palmer Drought Severity Index (PDSI) data. For example, increased cover, biomass, and precipitation in 2019 correspond with PDSI values that show a wetter than normal year and a moderately wet spring (**Figure 7.1a**, **Figure 7.1b**).

Range Trend data for herbaceous cover from 1998 (and later) to present shows yearly variation in both perennial and annual lifeforms, but an overall cover increased occurred on Upland (Big Sagebrush) study sites (**Figure 7.15**). Year-to-year fluctuations can be expected due to differences in precipitation and the timing of data collection between sample years.

RAP data indicates that tree and shrub cover correlate with precipitation to some degree in many years and that these lifeforms have provided more cover on summer range than winter range. Cover values have decreased on both mule deer summer and winter habitat. Of particular interest is the decrease between 2012 and 2013, which was more marked on summer habitat than winter range. The GECSC fire map for the Oak Creek unit shows that a large fire (the Clay Springs fire) occurred in 2012 and that a significant portion of the burn affected mountainous terrain (**Map 7.5**). The timing and extent of this fire correlate with the previously mentioned decreases in shrub and tree cover (**Figure 7.6**, **Figure 7.7**). Range Trend data for tree and shrub cover values has exhibited yearly fluctuations. Cover values for shrubs appear to have increased overall on many ecotypes (**Figure 7.8**, **Figure 7.9**, **Figure 7.10**).

RAP – Biomass by Deer Habitat

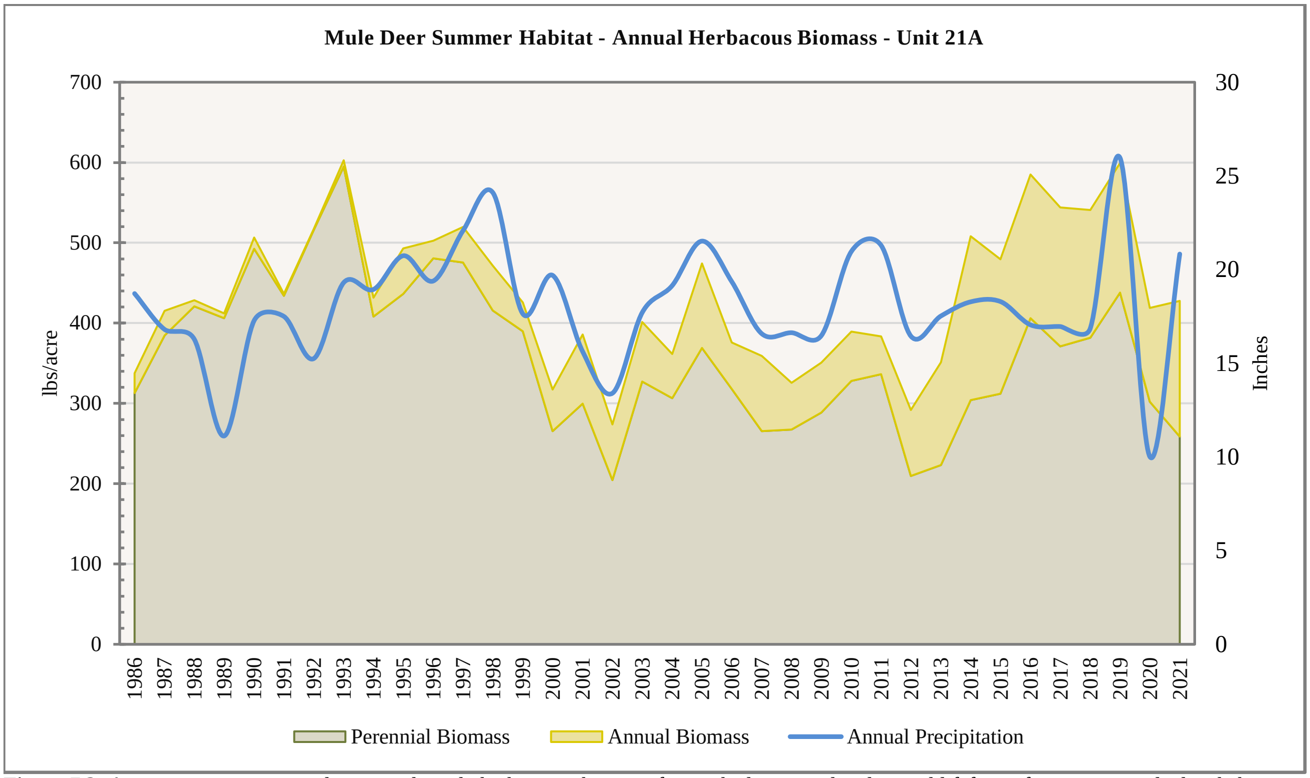


Figure 7.2: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 21A, Oak Creek (Rangeland Analysis Platform, 2023).

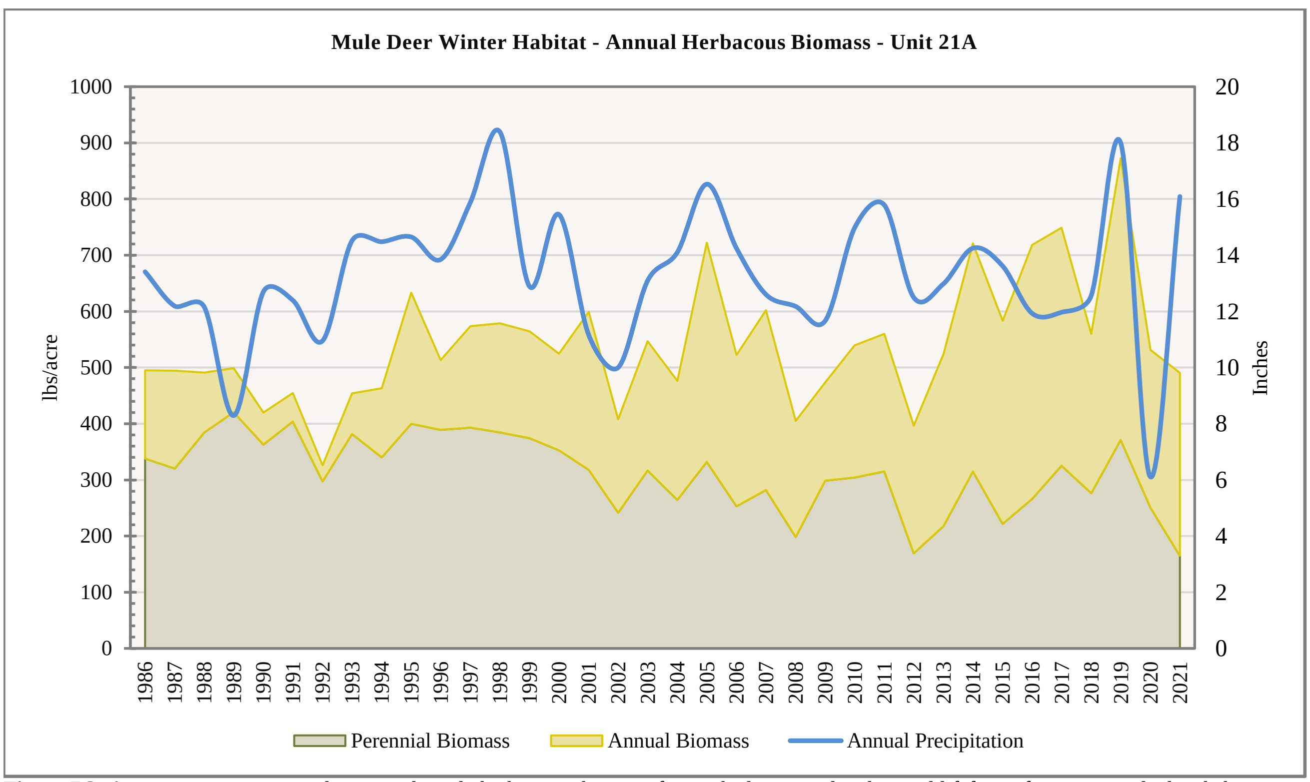


Figure 7.3: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 21A, Oak Creek (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

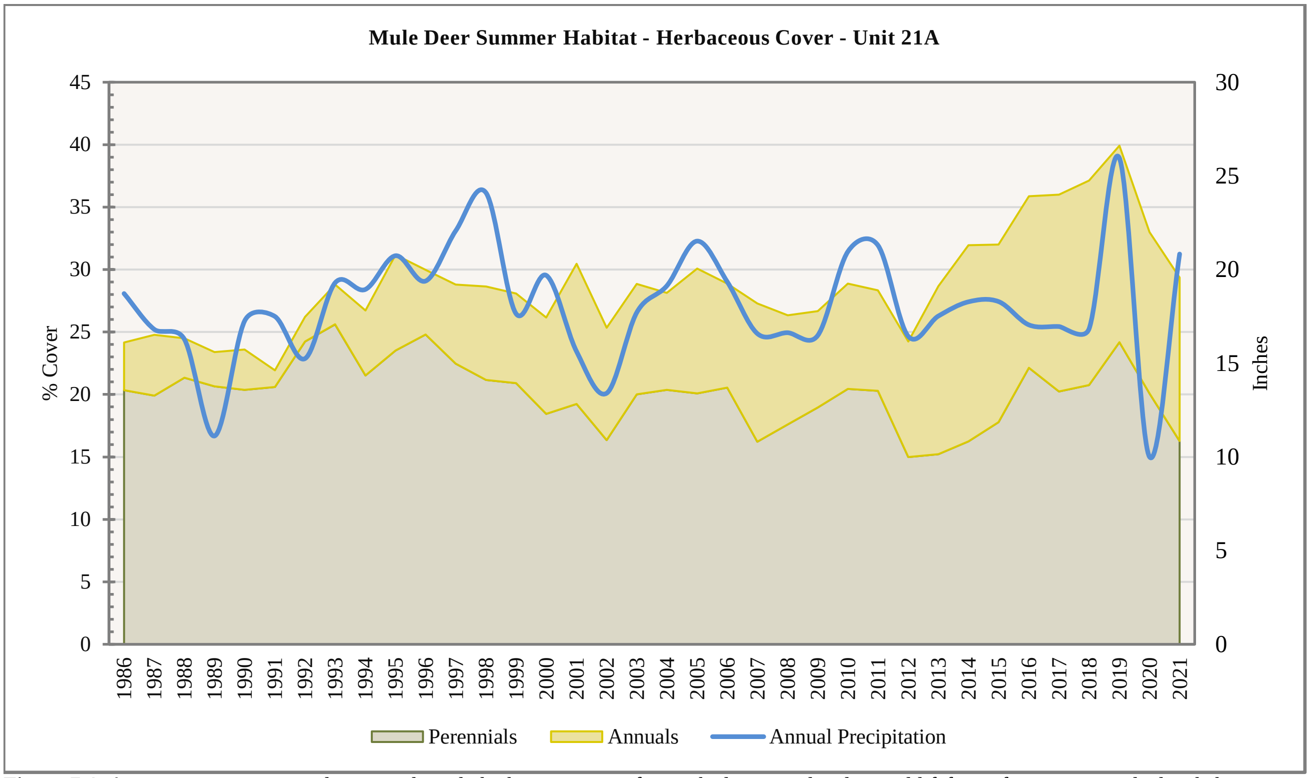


Figure 7.4: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 21A, Oak Creek (Rangeland Analysis Platform, 2023).

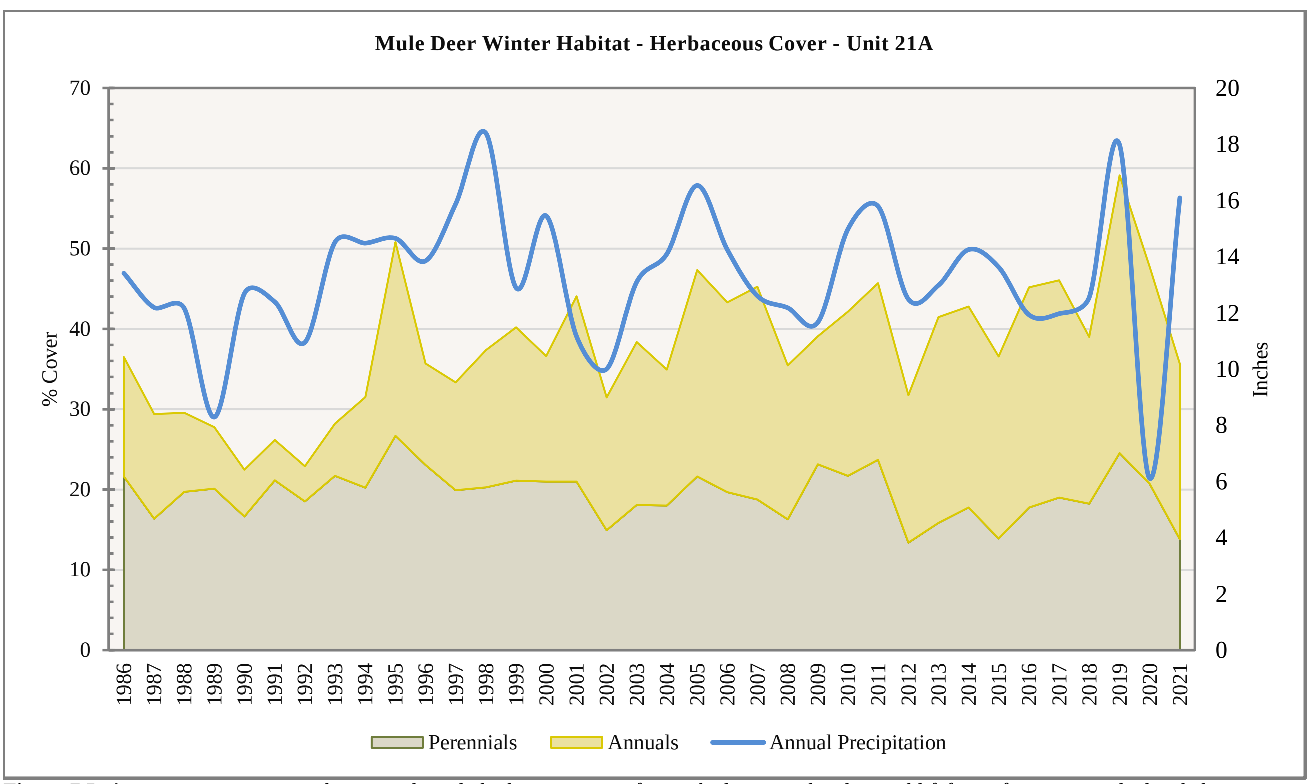


Figure 7.5: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 21A, Oak Creek (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

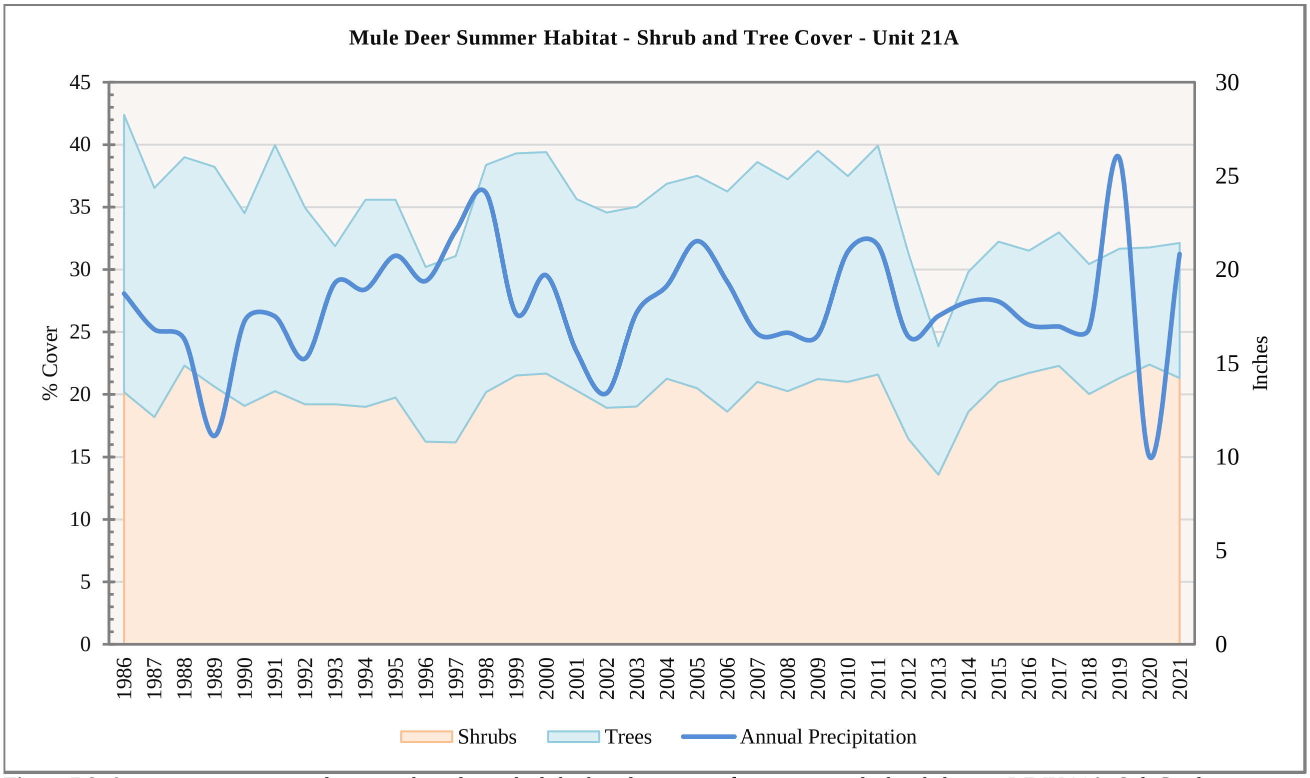


Figure 7.6: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 21A, Oak Creek (Rangeland Analysis Platform, 2023).

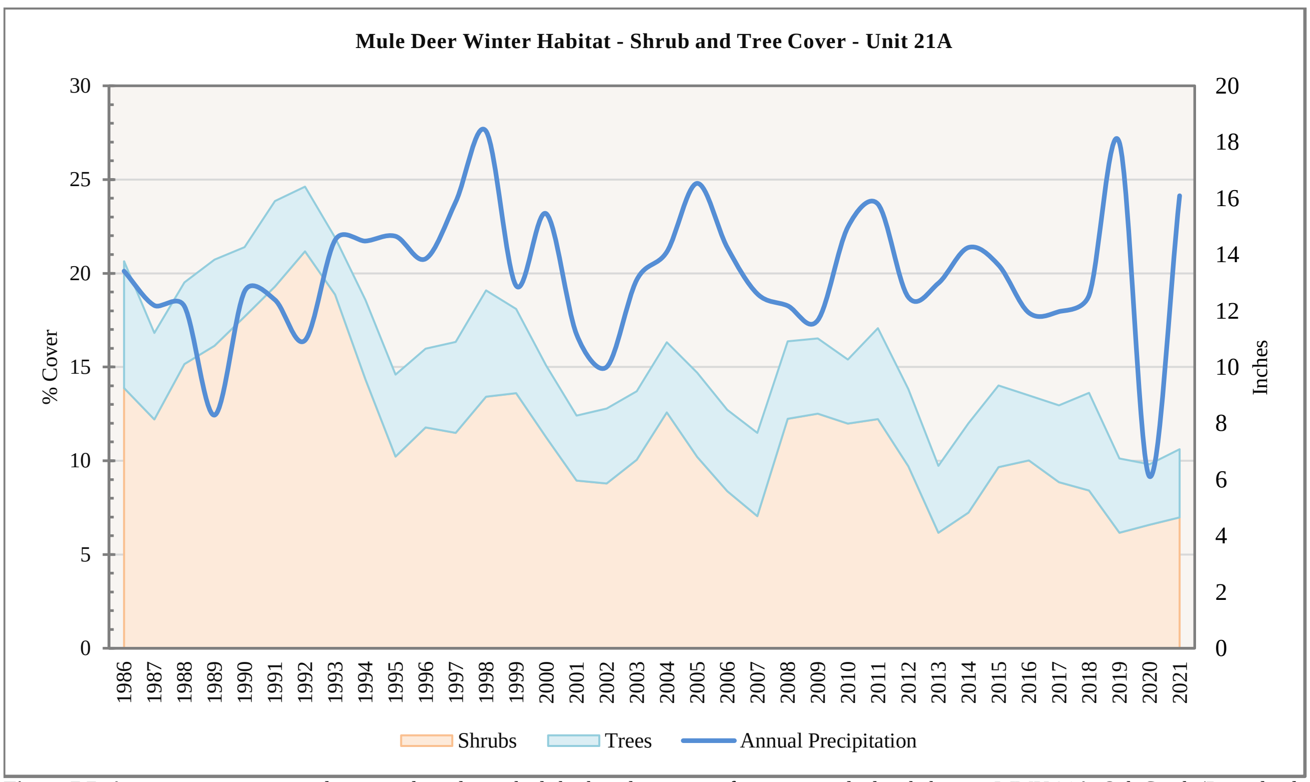
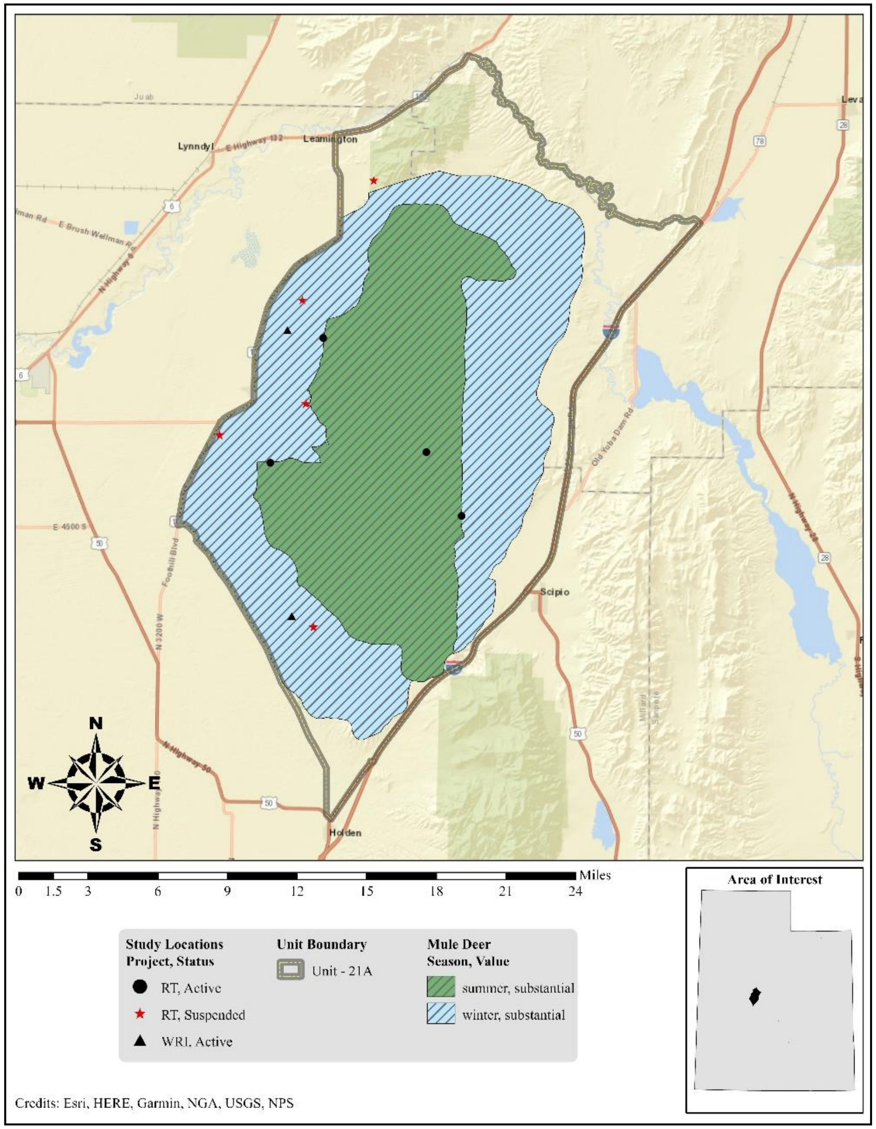
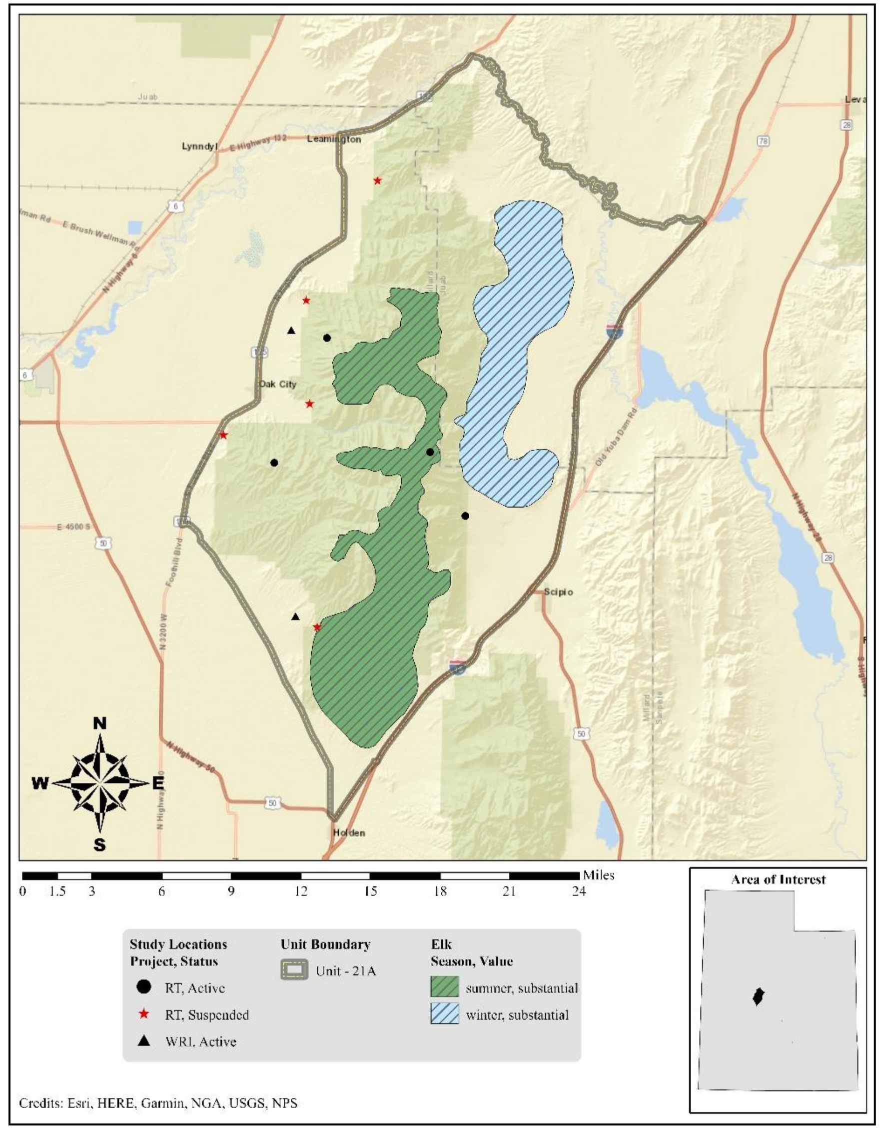


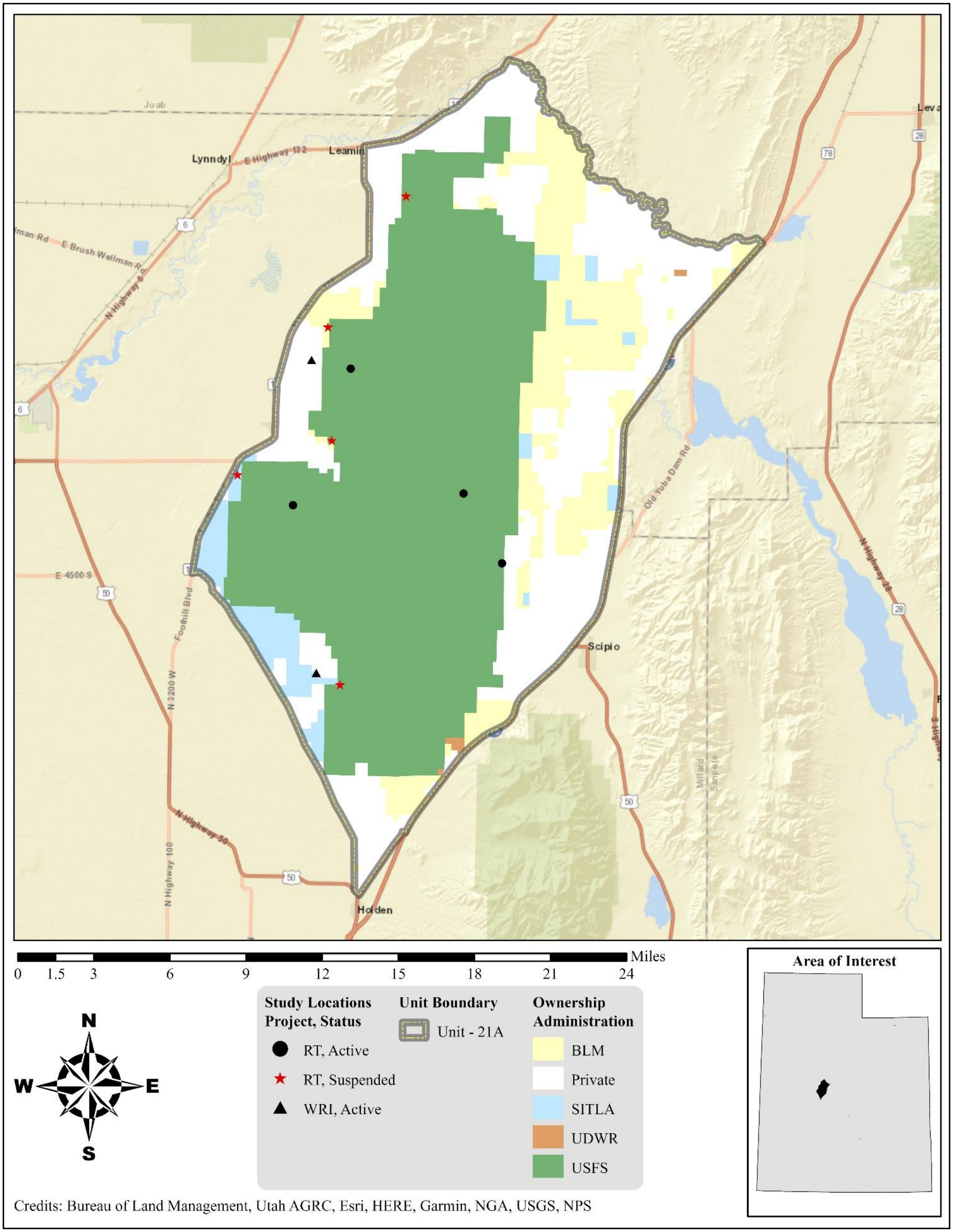
Figure 7.7: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 21A, Oak Creek (Rangeland Analysis Platform, 2023).



Map 7.2: Estimated mule deer habitat by season and value for WMU 21A, Oak Creek.



Map 7.3: Estimated elk habitat by season and value for WMU 21A, Oak Creek.



Map 7.4: Land ownership for WMU 21A, Oak Creek.

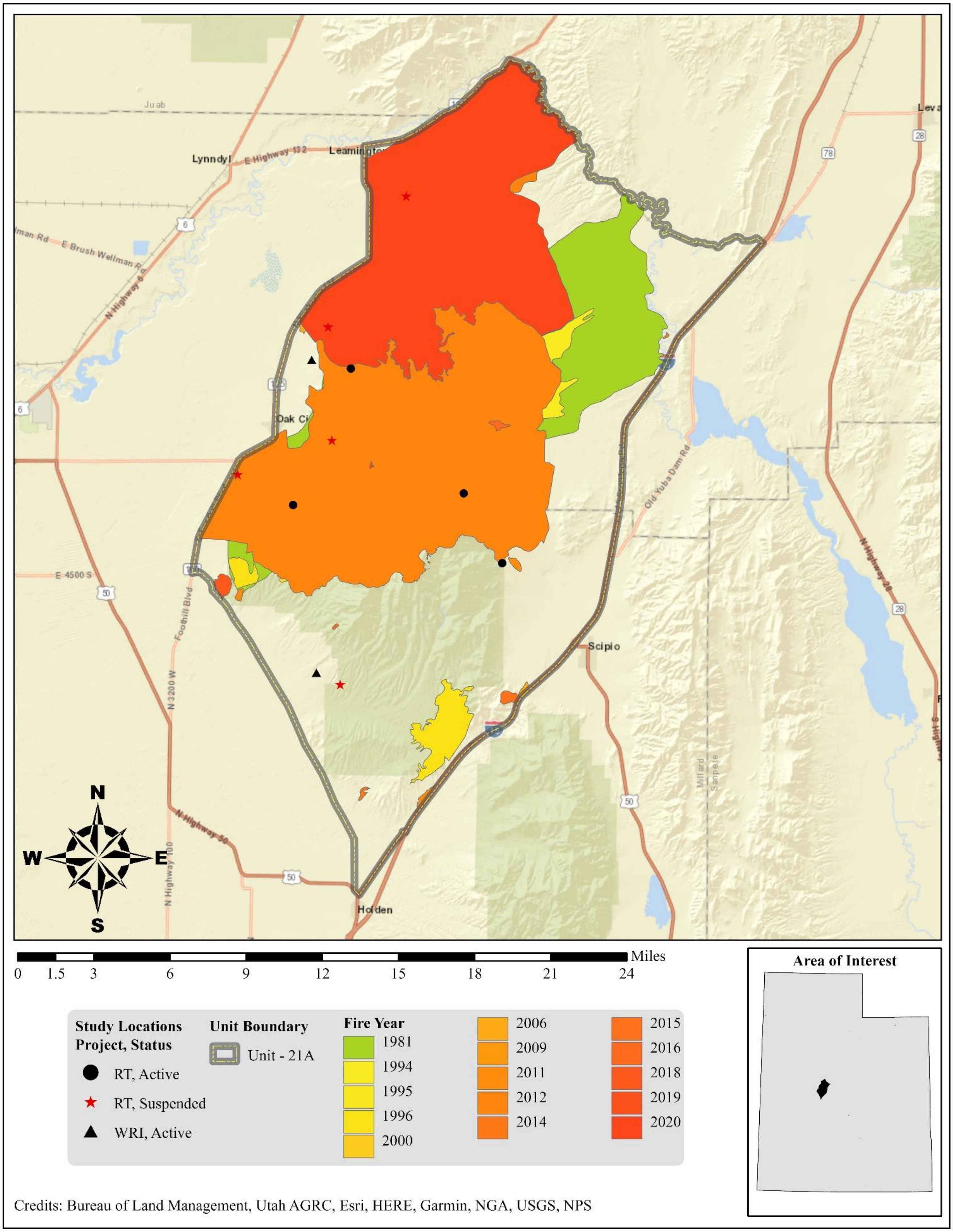
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	34,783	20.25%	
	Inter-Mountain Basins Montane Sagebrush Steppe	16,890	9.83%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	16,210	9.44%	
	Great Basin Xeric Mixed Sagebrush Shrubland	10,692	6.22%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	8,904	5.18%	
	Rocky Mountain Lower Montane-Foothill Shrubland	1,390	0.81%	
	Great Basin Semi-Desert Chaparral	941	0.55%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	468	0.27%	
	Inter-Mountain Basins Big Sagebrush Steppe	423	0.25%	
	Inter-Mountain Basins Greasewood Flat	60	0.03%	
	Desert Scrub	4	0.00%	52.83%
Conifer	Great Basin Pinyon-Juniper Woodland	22,541	13.12%	
	Colorado Plateau Pinyon-Juniper Woodland	7,205	4.19%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	7,130	4.15%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	1,700	0.99%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	503	0.29%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	174	0.10%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	143	0.08%	
	Inter-Mountain Basins Juniper Savanna	48	0.03%	22.96%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	11,179	6.51%	
	Great Basin & Intermountain Introduced Annual Grassland	6,187	3.60%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	3,963	2.31%	
	Interior Western North American Temperate Ruderal Grassland	114	0.07%	12.48%
Other	Sparsely Vegetated	2,183	1.27%	
	Agricultural	2,020	1.18%	
	Hardwood	1,816	1.06%	
	Developed	1,766	1.03%	
	Conifer-Hardwood	454	0.26%	
	Riparian	225	0.13%	
	Open Water	3	0.00%	4.93%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	7,136	4.15%	
	Interior Western North American Temperate Ruderal Shrubland	126	0.07%	4.23%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	2,964	1.73%	
	Southern Rocky Mountain Montane-Subalpine Grassland	1,431	0.83%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	19	0.01%	2.57%
Total		**171,794**	**100%**	**100%**

Table 7.1: LANDFIRE Existing Vegetation Coverage For Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 21A, Oak Creek.

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. Encroachment by pinyon-juniper woodland communities poses a threat to important sagebrush rangelands. According to the current LANDFIRE Existing Vegetation Coverage model, 17.31% of the Oak Creek mule deer habitat is comprised of pinyon-juniper woodlands (**Table 7.1**). 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).

This unit has been heavily impacted by fire and much of the winter range has seen a conversion of the browse component to annual and perennial grasses. With the large expanse of area affected by wildfires within this unit, winter range is in poor condition across much of the unit (**Map 7.5**). Other limiting factors to big game include introduced exotic herbaceous species such as cheatgrass (*Bromus tectorum*). The current LANDFIRE Existing Vegetation Coverage model indicates that 12.48% of the unit mule deer habitat is comprised of exotic herbaceous species (**Table 7.1**). High amounts of cheatgrass increase the risk for severe wildfire occurrence (Balch, D'Antonio, & Gómez-Dans, 2013). The presence of the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) on many sites is another limiting factor to this unit. Once established, bulbous bluegrass populations persist and invade native plant communities (Kulmatiski, 2006), often leading to reduced understory productivity and species diversity. In addition, large wildfires that have occurred in this unit have resulted in a loss of big game habitat (**Map 7.5**). The Milford Flat fire burned a very large portion of the winter range west of I-15, and loss of this habitat may have consequences in the event of a very severe winter.



Map 7.5: Land coverage of fires by year from 1981-2020 for WMU 21A, Oak Creek (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

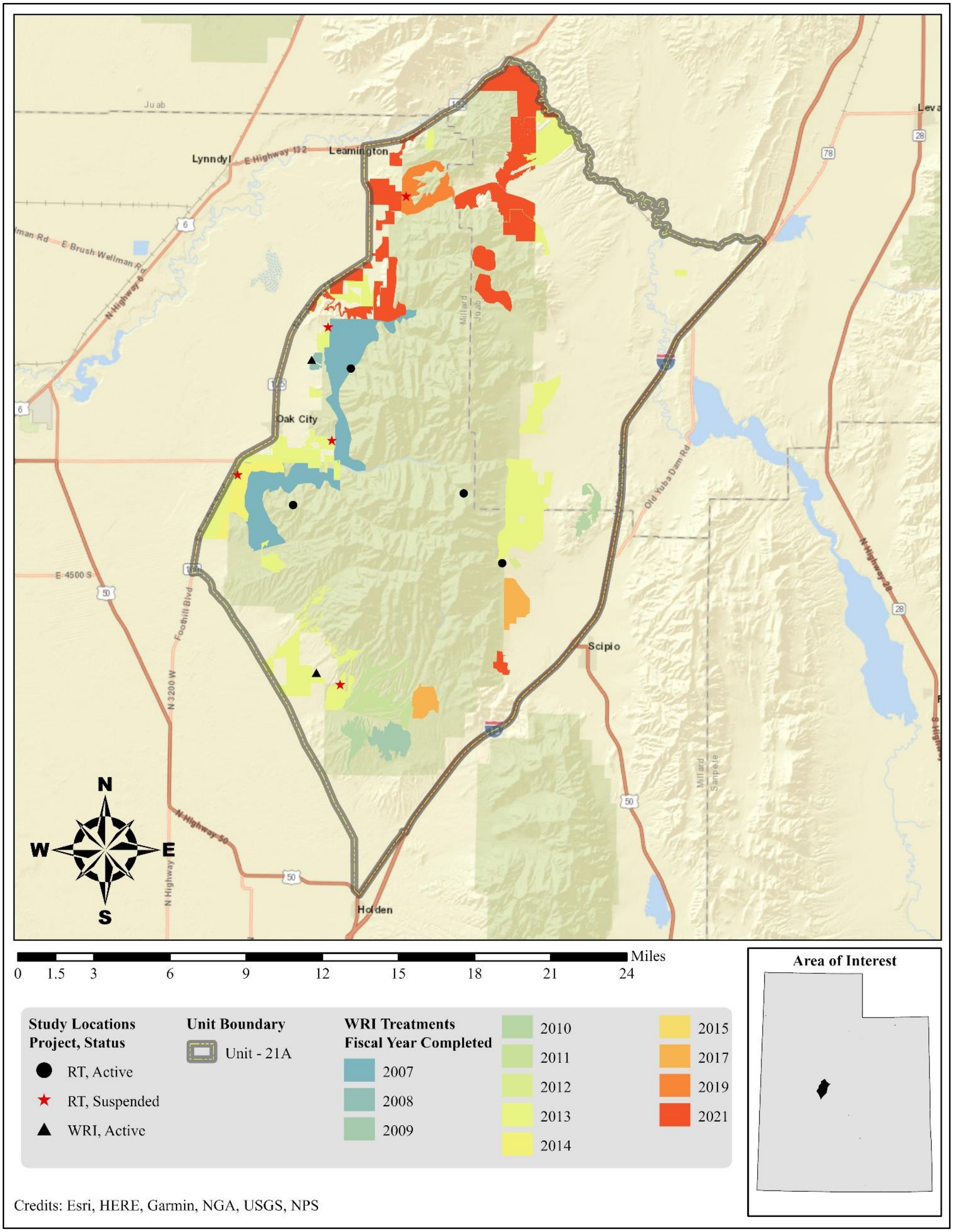
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 44,943 acres of land have been treated within the Oak Creek subunit since WRI was implemented in 2004 (**Map 7.6**). An additional 3,840 acres are currently being treated. Treatments frequently overlap one another bringing the net total of treatment acres to 38,951 acres for this unit (**Table 7.2**). 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.

Anchor chaining to remove pinyon and juniper is the most common management practice in this unit. Seeding plants to augment the herbaceous understory is also very common and frequently occurs together with chainings. Other management practices include (but are not limited to) bullhog and hand crew removal for pinyon-juniper trees (**Table 7.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**9,998**	**0**	**0**	**9,998**
Ely (One-Way)	8,468	0	0	8,468
Ely (Two-Way)	1,530	0	0	1,530
Bullhog	**5,211**	**3,840**	**0**	**9,051**
Skid Steer	5,211	3,840	0	9,051
Greenstripping	**1,041**	**0**	**0**	**1,041**
Greenstripping	1,041	0	0	1,041
Harrow	**660**		**0**	**660**
≤ 15 ft. (One-Way)	494	0	0	494
> 15 ft. (One-Way)	166	0	0	166
Prescribed Fire	**1**	**0**	**0**	**1**
Prescribed Fire	1	0	0	1
Seeding (Primary)	**22,594**	**0**	**0**	**22,594**
Broadcast (Aerial-Fixed Wing)	20,462	0	0	20,462
Drill (Rangeland)	1,972	0	0	1,972
Ground (Mechanical Application)	159	0	0	159
Seeding (Secondary/Shrub)	**1,281**	**0**	**0**	**1,281**
Hand Seeding	1,281	0	0	1,281
Vegetation Removal/Hand Crew	**4,158**	**0**	**0**	**4,158**
Lop & Scatter	3,543	0	0	3,543
Lop-Pile-Burn	615	0	0	615
Grand Total	**44,943**	**3,840**	**0**	**48,783**
***Total Land Area Treated**	**38,951**	**3,840**	**0**	**42,791**

Table 7.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 21A, Oak Creek. Data accessed on 01/23/2023.
*Does not include overlapping treatments.



Map 7.6: WRI treatments by fiscal year completed for WMU 21A, Oak Creek.

Range Trend Studies

Range Trend studies have been sampled within WMU 21A on a regular basis since 1985, with studies being added or suspended as was deemed necessary (**Table 7.3**). 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 7.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
21A-1	Long Canyon	RT	Suspended	1998, 2003	Upland Stony Loam (Cliffrose)
21A-2	Lovell Hollow	RT	Suspended	1985, 1991, 1998, 2003, 2007	Upland Loam (Wyoming Big Sagebrush)
21A-3	Cascade Spring	RT	Suspended	1985, 1991, 1998, 2003, 2007	Upland Loam (Wyoming Big Sagebrush)
21A-4	Horse Hollow	RT	Suspended	1985, 1991, 1998, 2003, 2007, 2017	Upland Gravelly Loam (Wyoming Big Sagebrush)
21A-5	Wood Canyon	RT	Suspended	1998	Upland Loam (Wyoming Big Sagebrush)
21A-6	Bridge Canyon	RT	Active	2017, 2022	Upland Stony Loam (Wyoming Big Sagebrush)
21A-7	Rocky Ridge Canyon	RT	Active	2017, 2022	Mountain Stony Loam (Browse)
21A-8	Williams Canyon	RT	Active	2017, 2022	Upland Stony Loam (Mountain Big Sagebrush)
21A-9	Ox Hollow	RT	Active	2022	High Mountain Stony Loam (Mountain Big Sagebrush)
21R-6	Anderson Dixie	WRI	Active	2007, 2010, 2011, 2016	Semidesert Loam (Wyoming Big Sagebrush)
21R-15	Duggins Creek	WRI	Active	2012, 2015, 2019	Upland Gravelly Loam (Wyoming Big Sagebrush)

Table 7.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 21A, Oak Creek.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
21A-2	Lovell Hollow	Wildfire	Clay Springs	September 1986	2,390	
		Aerial Before	Clay Springs Fire Rehab (1987)	February 1987	735	LTDL
		One-Way Unknown	Clay Springs Fire Rehab (1987)	March-April 1987	735	LTDL
		One-Way Ely	Clay Springs Fire Rehab (2012)	November 2012	747	2454
		Aerial Before	Clay Springs Fire Rehab (2012)	November 2012	747	2454
		Aerial After	Clay Springs Fire Rehab (2012)	February 2013	747	2454
		Hand Planter	Browse Seeding on FY13 Fires	July 2013-June 2014	2,066	2707
21A-3	Cascade Spring	Wildfire	Clay Springs Fire	June-August 2012	107,847	
		Wildfire	Devils Den Fire	August 2006	14,371	
		Aerial After	Devils Den	December 2006	7,852	660
21A-4	Horse Hollow	Wildfire	Clay Springs Fire	June-August 2012	107,847	
		Wildfire	Devils Den Fire	August 2006	14,371	
		Wildfire	Canal Fire	June 2020	78,023	
		Aerial After	Devils Den	December 2006	7,852	660
21A-5	Wood Canyon	Aerial After	Wood Canyon Fire Rehab Project	November 2018-February 2019	2,021	4750
		Wildfire	Wood Canyon Fire	July 2018	2,050	
21A-6	Bridge Canyon	Wildfire	Clay Springs Fire	June-August 2012	107,847	
		Wildfire	Devils Den Fire	August 2006	14,371	
		Wildfire	Clay Springs Fire	1981	15,840	
		Aerial After	Devils Den Fire Rehab	December 2006	3,976	660
21A-7	Rocky Ridge Canyon	Wildfire	Clay Springs Fire	June-August 2012	107,847	
		Wildfire	Clay Springs Fire	1981	15,840	
21A-8	Williams Canyon	Aerial Before	Clay Springs Fire Rehab	Fall 2012	13,505	2454
21A-9	Ox Hollow	Wildfire	Clay Springs	2012	107,767	
21R-6	Anderson Dixie	One-Way Dixie	D. Anderson Dixie Harrow	October 2007	166	797
21R-6	Anderson Dixie	Broadcast Before	D. Anderson Dixie Harrow	October 2007	166	797
21R-15	Duggins Creek	Chain Unknown		Early 1980s		
		Seed Unknown		Early 1980s		
		Lop and Scatter	Whiskey Creek Lop n Scatter Project Phase I	July-August 2012	1,902	2197

Table 7.4: Range Trend and WRI studies known disturbance history for WMU 21A, Oak Creek. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

One study site [Ox Hollow (21A-9)] is classified as a Mountain (Big Sagebrush) ecological site. The Ox Hollow study is located on the slopes above Ox Hollow, which splits off from Lyman Canyon in the Canyon Mountains (**Table 7.3**).

Shrubs/Trees: The preferred browse species mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and Woods' rose (*Rosa woodsii*) and shrub species creeping barberry (*Mahonia repens*) provide nearly equal amounts of what little shrub cover was observed on this site in 2022. As only one year of data is available for the Ox Hollow study, trends over time cannot yet be determined (**Figure 7.8**). Density of preferred browse species is low, with 160 mature plants/acre and 20 young plants/acre observed in 2022; decadent individuals were absent (**Figure 7.13**). Finally, 44% of preferred browse plants were found to have been heavily browsed upon study establishment (**Figure 7.14**).

Tree cover and density are absent on this study site and will therefore not be discussed in this section (**Figure 7.11**, **Figure 7.12**).

Herbaceous Understory: The understory of this study site is primarily composed of perennial forbs and grasses; as was discussed in the shrubs section, trends over time cannot yet be established as there is only one year of data available. The native perennial grass species Sandberg bluegrass (*Poa secunda*) and the introduced perennial forb species alfalfa (*Medicago sativa*) contributed much of the herbaceous cover. The introduced annual grass species cheatgrass (*Bromus tectorum*) was observed in the understory, but in very low amounts. Annual forbs were comparatively scarce (**Figure 7.15**, **Figure 7.16**).

Occupancy: Deer are the primary occupants of this study site, with an average pellet group abundance of 96.5 days use/acre in 2022. Elk pellet groups were also observed, with a mean abundance of 8 days use/acre. Finally, cattle were present in 2022 with an average pellet group abundance of 0.7 days use/acre (**Figure 7.17**).

Mountain (Browse)

There is one study site [Rocky Ridge Canyon (21A-7)] that is classified as a Mountain (Browse) ecological site: this study is located in the Canyon Mountains south of Oak City (**Table 7.3**).

Shrubs/Trees: The dominant preferred browse species on this site is alderleaf mountain mahogany (*Cercocarpus montanus*), although Gambel oak (*Quercus gambelii*) and mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) are present to a lesser extent. Total average shrub cover has increased over the study period: this trend is entirely driven by alderleaf mountain mahogany, which increased from nearly 10% cover in 2017 to 16% cover in 2022 (**Figure 7.9**). Total preferred browse density increased between 2017 and 2022. This density increase is mainly due to recruitment of young and, although the amount is still low overall, higher numbers of decadent plants. Mature individuals have comprised a majority of this browse population in both sample years (**Figure 7.13**). Utilization of preferred browse increased significantly over the sample period. In 2022, nearly 28% of plants displayed signs of heavy browsing, while 46% were heavily hedged (**Figure 7.14**).

Trees contribute no cover on these sites, but Utah juniper (*Juniperus osteosperma*) has been observed in density measurements with low values in both sample years (**Figure 7.11**, **Figure 7.12**).

Herbaceous Understory: Total herbaceous cover and frequency exhibited slight decreases between 2017 and 2022. Perennial grasses, particularly the native species bluebunch wheatgrass (*Pseudoroegneria spicata*), were the dominant herbaceous component in both years. Introduced annual grasses such as field brome (*Bromus arvensis*) and cheatgrass (*B. tectorum*) have also contributed significant cover, as has the native perennial forb species arrowleaf balsamroot (*Balsamorhiza sagittata*) (**Figure 7.15**, **Figure 7.16**).

Occupancy: Total animal occupancy remained nearly stable between 2017 and 2022, and deer have been the primary occupants of this study site in both sample years. Mean abundance of deer pellet groups has ranged from 20.8 days use/acre in 2022 to 21.4 days use/acre in 2017. Elk were present in 2017 with a presence of 2 days use/acre, but pellet groups were not observed in 2022. Finally, cattle pellet groups were not present in 2017, but had an average abundance of 1.5 days use/acre in 2022 (**Figure 7.17**).

Upland (Big Sagebrush)

Six study sites [Lovell Hollow (21A-2) (suspended), Cascade Spring (21A-3) (suspended), Horse Hollow (21A-4) (suspended), Wood Canyon (21A-5) (suspended), Bridge Canyon (21A-6), and Williams Canyon (21A-8)] are classified as Upland (Big Sagebrush) ecological sites. The Lovell Hollow study is situated south of the mouth of Lovell Hollow on the eastern side of Pahvant Valley. Cascade Spring is found near the mouth of Oak Creek Canyon, east of Oak City. The Horse Hollow and Bridge Canyon studies are located north of Oak City on the eastern slopes of the Canyon Mountains. Wood Canyon is found on the northeastern portion of Fools Creek Flat between Pass Canyon and Wood Canyon. Finally, the Williams Canyon site is situated at the base of the Canyon Mountains on the western side near Scipio (**Table 7.3**).

Shrubs/Trees: Total shrub cover has increased over the sample period, with a particularly significant increase occurring between 2007 and 2017. Although the number of study sites sampled (the 'n value') has remained similar over time, examination of site-level data reveals that the studies driving the trends have differed over the sample period. The initial decrease in sagebrush cover between 2003 and 2007 can largely be attributed to the 2006 Devils Den fire on the Horse Hollow study, which effectively removed all of the Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Preferred browse cover was rare on the Lovell Hollow and Cascade Spring studies, which had been suspended by the 2017 sample year. The Bridge Canyon and Williams Canyon sites were established in 2017. The comparatively large amount of sagebrush and other preferred browse cover observed since 2017 is mainly due to the Williams Canyon study, which had 15% cover of mountain big sagebrush (*A. tridentata* ssp. *vaseyana*) and 10% antelope bitterbrush (*Purshia tridentata*) cover in 2022 (**Figure 7.8**). Average preferred browse demographics indicate that these populations have been comprised of mainly mature individuals in most sample years. Total density of preferred browse has increased over the study period. Again, this increasing trend can be attributed to the suspension and establishment of different study sites; the Williams Canyon site contributed all preferred browse density in 2017 and 2022. Decadence and recruitment of young have remained low, although there was a slight increase in the number of decadent plants in 2022 (**Figure 7.13**). Less than 50% of plants have been moderately or heavily hedged during recent samplings. More specifically, 25% of plants showed signs of moderate use and 12.5% were heavily browsed in 2022 (**Figure 7.14**).

Utah juniper (*Juniperus osteosperma*) contributed no cover in 2022, but provided low amounts in previous years. In recent sample years, this tree cover trend can be attributed to the suspension of the Horse Hollow study and a decrease in juniper cover on Williams Canyon. Average tree density follows a similar trend as cover for the same reasons, and juniper is present on the Williams Canyon site in low amounts as of 2022 (**Figure 7.11**, **Figure 7.12**).

Herbaceous Understory: Average herbaceous cover and frequency have both increased over time, again a consequence of the different study sites sampled each year. Between 1998 and 2007, the understory was primarily comprised of annual grasses. More specifically, Lovell Hollow had the most annual grass cover of any site in 2003, while Cascade Spring drove the trend in 2007; both sites and Wood Canyon were suspended by the 2017 sample year. Understory composition shifted with the establishment of Bridge Canyon and Williams Canyon, and annual grasses and forbs were the dominant herbaceous components in 2017 and 2022. Perennial grasses have increased over time, with the increases in recent years driven by the Williams Canyon and Bridge Canyon studies. The cover and frequency of the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) have also grown over time. Site-level data reveals that the increase in bulbous bluegrass between 2017 and 2022 can be attributed to the suspension of the Horse Hollow site (from which the species was absent) and increases in cover and frequency on Williams Canyon. Perennial forbs have remained rare throughout the sample period (**Figure 7.15**, **Figure 7.16**).

Occupancy: Average pellet group transect data shows that cattle have primarily used these sites in all years except 2022, when deer were the main occupants. Cattle pellet groups had an average abundance ranging from 5 days use/acre in 2003 to nearly 30 days use/acre in 1998. Elk pellet groups were sampled in 1998 and 2003 with abundances of 0.2 and 0.4 days use/acre (respectively), but have not been observed from 2007 onwards. Finally, mean abundance of deer pellet groups has been as low as nearly 3 days use/acre in 2003 and as high as 18 days use/acre in 2022 (**Figure 7.17**).

Upland (Cliffrose)

There is one study [Long Canyon (21A-1) (suspended)] that is classified as an Upland (Cliffrose) ecological site. The Long Canyon site is located south of Long Canyon on the southern portion of the Canyon Mountains (**Table 7.3**).

Shrubs/Trees: Line intercept cover data was only collected on the Long Canyon study site in 2003, and as such, an associated trend over time cannot be established. Stansbury cliffrose (*Purshia stansburiana*) provided a majority of the preferred browse cover on the Long Canyon study, although other species such as Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and black sagebrush (*A. nova*) were also present to a lesser extent (**Figure 7.10**). Total preferred browse density increased marginally between 1998 and 2003, but this was largely due to an increase in the number of decadent Wyoming big sagebrush and cliffrose plants. No young individuals were recruited into the population in 2003 (**Figure 7.13**). Seventeen percent of plants were moderately browsed in 1998, and in 2003 less than 15% of the preferred browse population was moderately or heavily hedged (**Figure 7.14**).

Utah juniper (*Juniperus osteosperma*) provided just under 3% cover in 2003, and density was over 200 trees/acre in the same sample year. Tree cover and density trends over time cannot be determined as the study was suspended following the 2003 sample year (**Figure 7.11**, **Figure 7.12**).

Herbaceous Understory: Herbaceous cover and frequency exhibited a slight decrease between 1998 and 2003. Perennial grasses, particularly the native species Sandberg bluegrass (*Poa secunda*), were the dominant herbaceous component in both sample years. The introduced annual grass species cheatgrass (*Bromus tectorum*) contributed moderate cover in 1998, but decreased significantly in 2003. Perennial and annual forbs were rare in comparison with grasses (**Figure 7.15**, **Figure 7.16**).

Occupancy: Cattle were the primary occupants of the Long Canyon study site in both sample years, with a mean pellet group abundance of nearly 3 days use/acre in 2003 and 24 days use/acre in 1998. Deer were also present, with pellet groups having an average abundance of 1 days use/acre in 2003 and 10 days use/acre in 1998 (**Figure 7.17**).

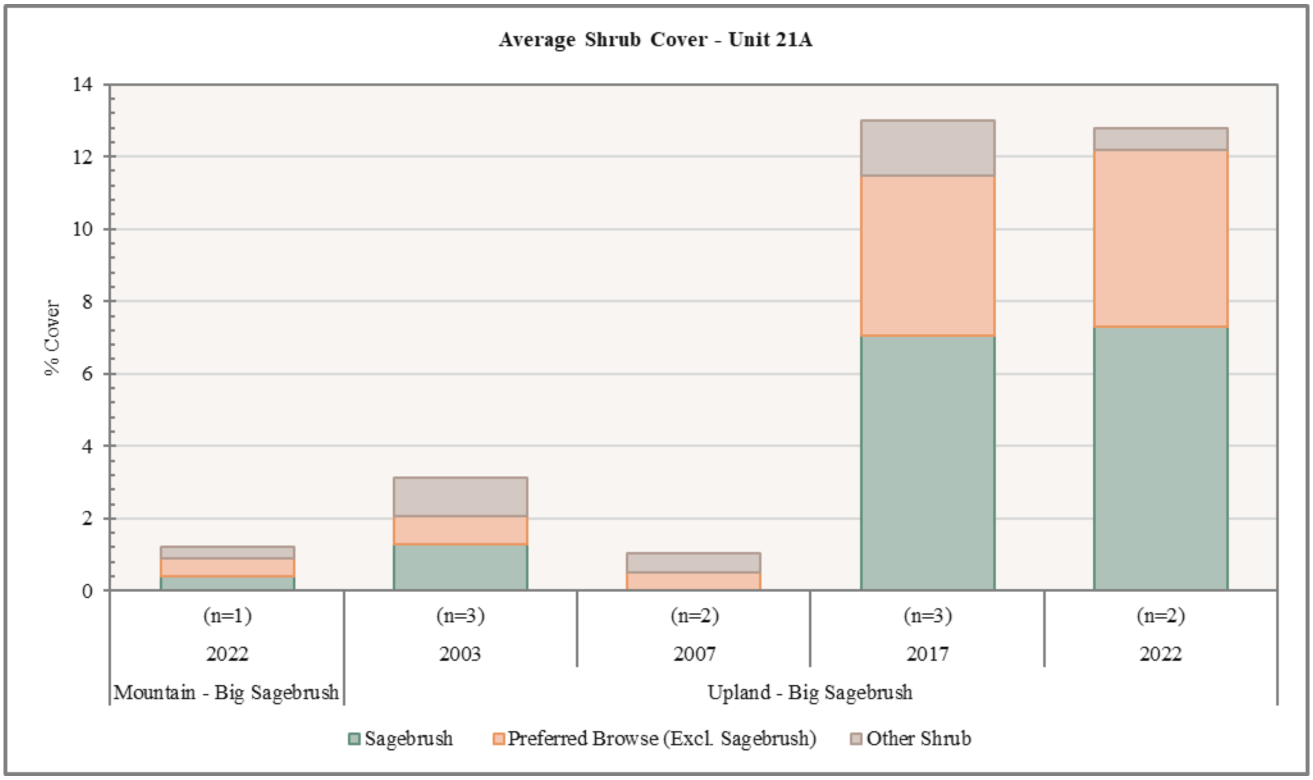


Figure 7.8: Average shrub cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 21A, Oak Creek.

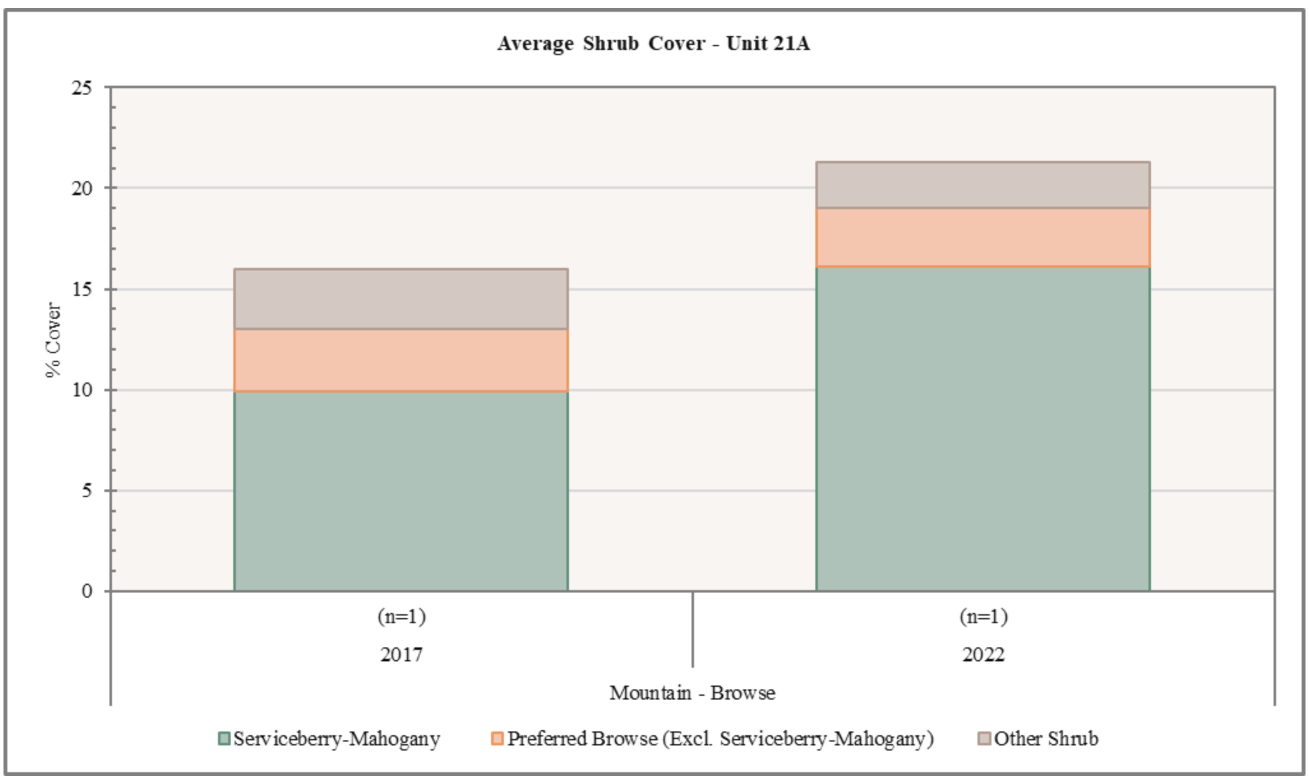


Figure 7.9: Average shrub cover for Mountain - Browse study sites in WMU 21A, Oak Creek.

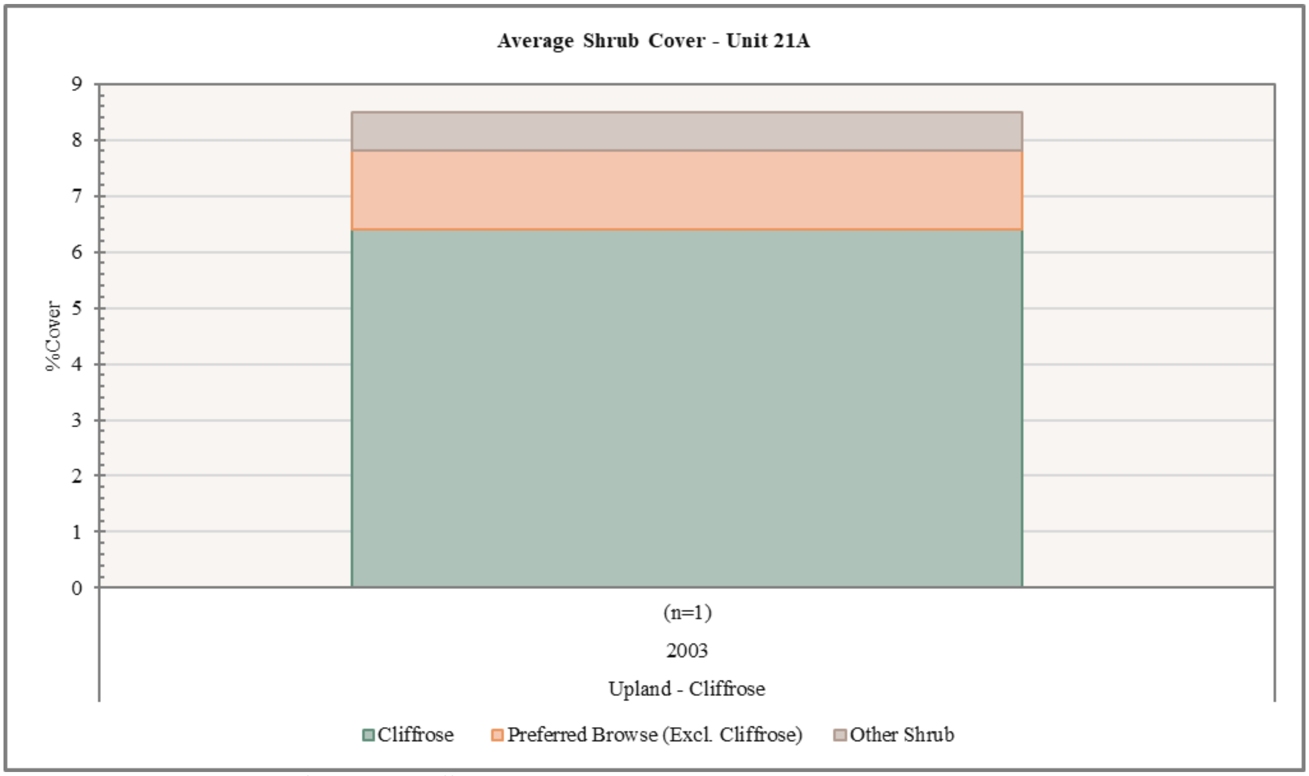


Figure 7.10: Average shrub cover for Upland - Cliffrose study sites in WMU 21A, Oak Creek.

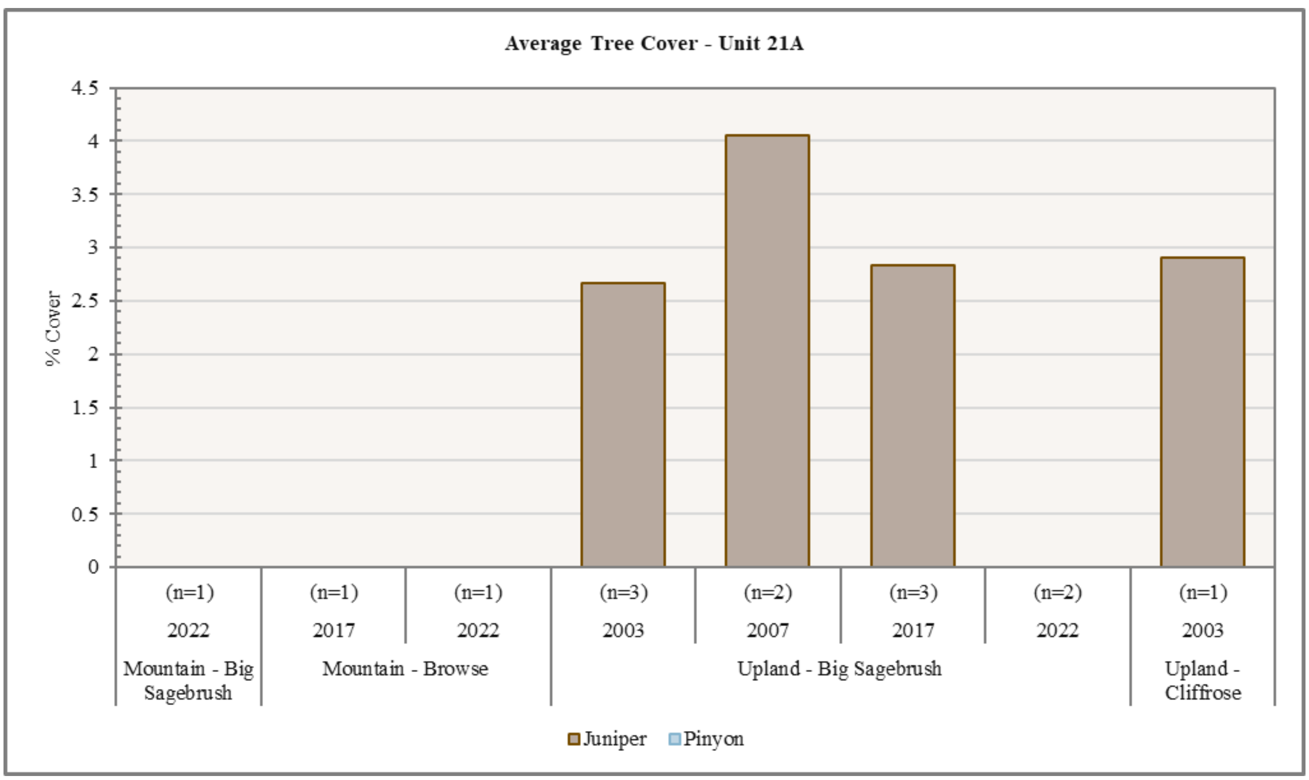


Figure 7.11: Average tree cover for Mountain - Big Sagebrush, Mountain - Browse, Upland - Big Sagebrush, and Upland - Cliffrose study sites in WMU 21A, Oak Creek.

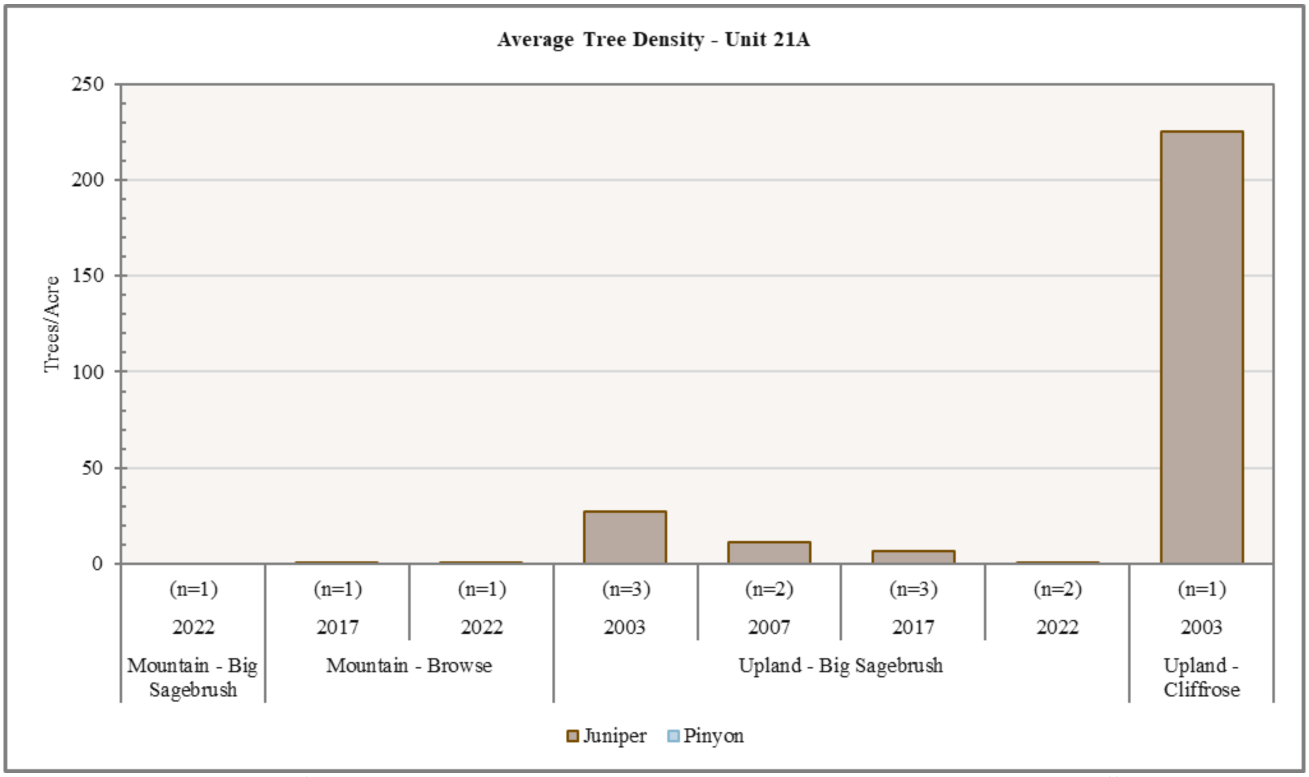


Figure 7.12: Average tree density for Mountain - Big Sagebrush, Mountain - Browse, Upland - Big Sagebrush, and Upland - Cliffrose study sites in WMU 21A, Oak Creek.

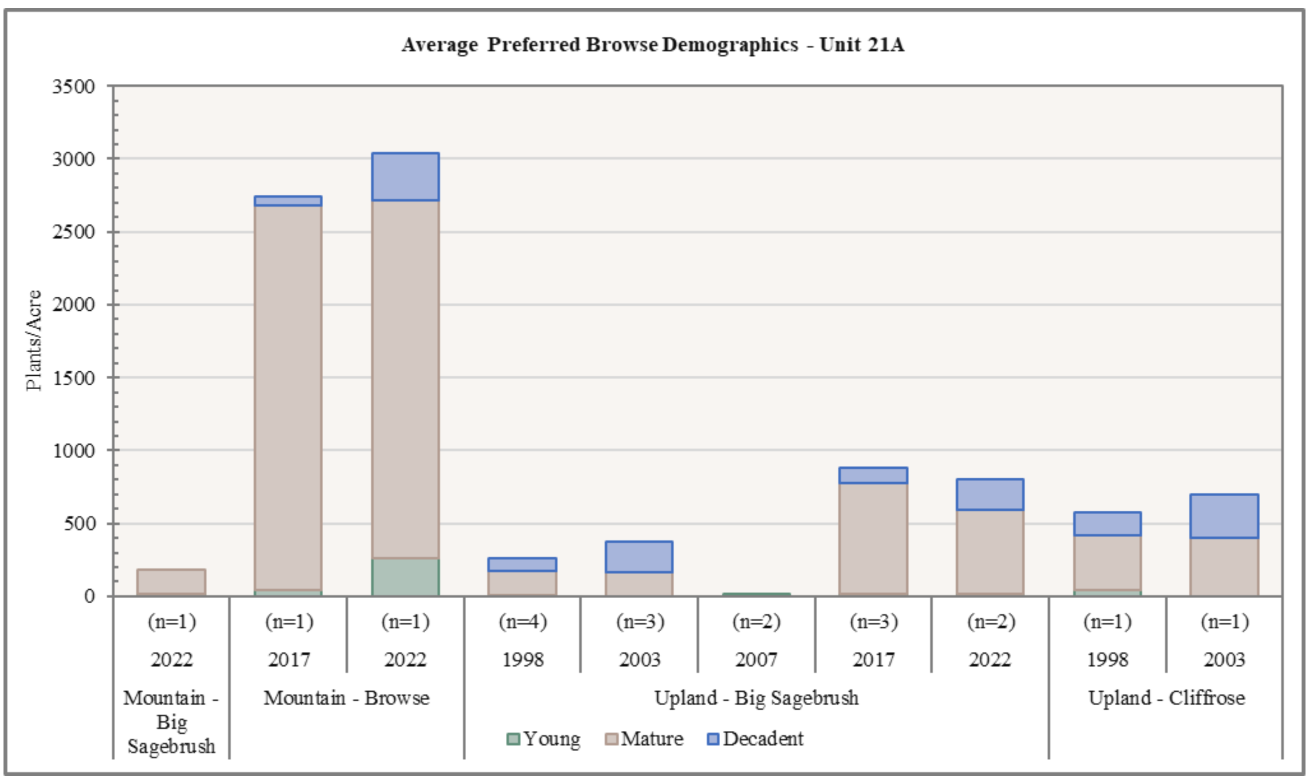


Figure 7.13: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Browse, Upland - Big Sagebrush, and Upland - Cliffrose study sites in WMU 21A, Oak Creek.

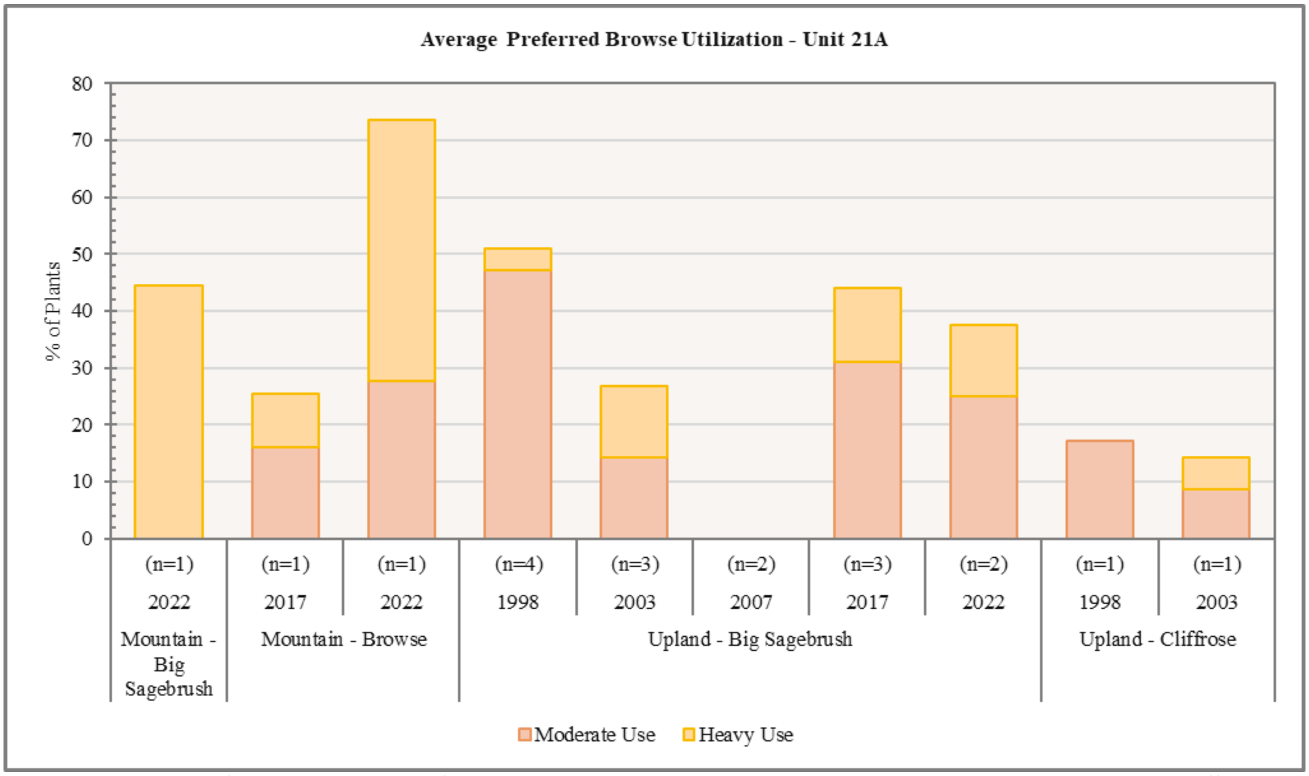


Figure 7.14: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Browse, Upland - Big Sagebrush, Upland - Cliffrose study sites in WMU 21A, Oak Creek.

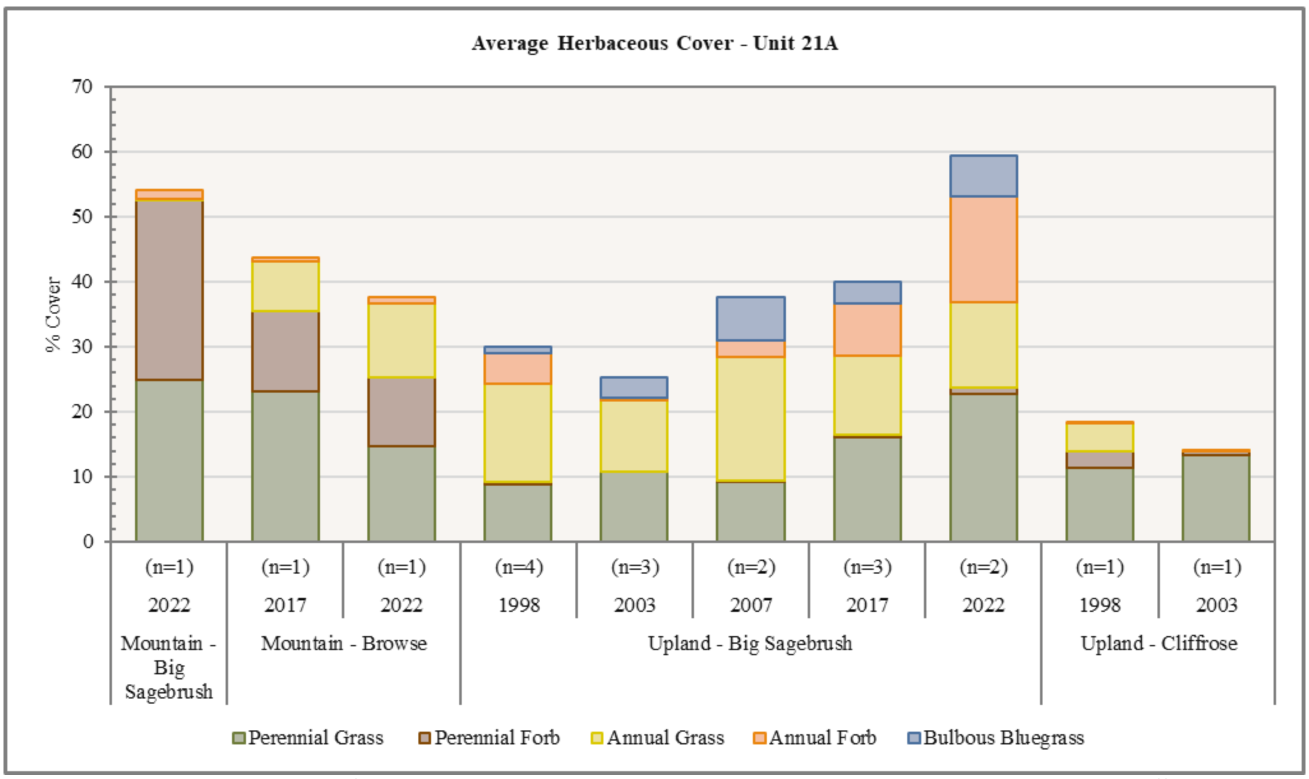


Figure 7.15: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Browse, Upland - Big Sagebrush, and Upland - Cliffrose study sites in WMU 21A, Oak Creek.

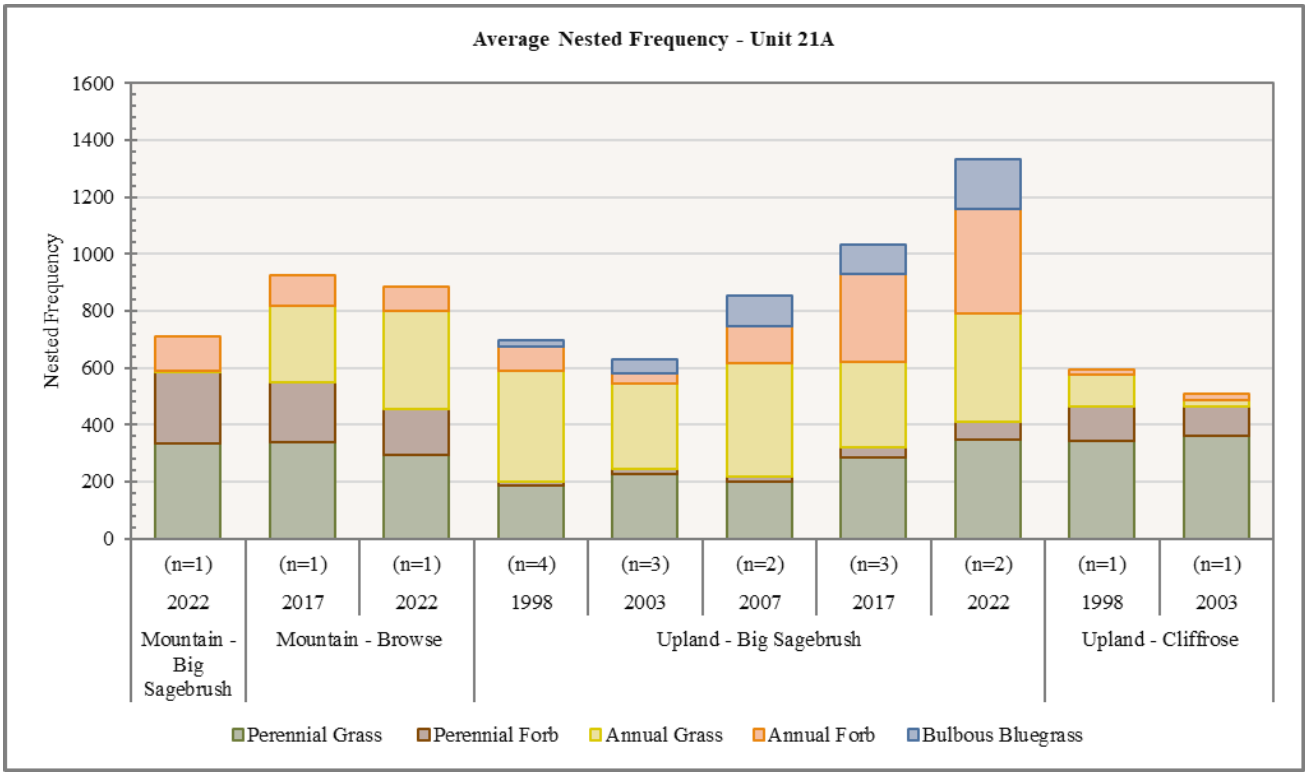


Figure 7.16: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Browse, Upland - Big Sagebrush, and Upland - Cliffrose study sites in WMU 21A, Oak Creek.

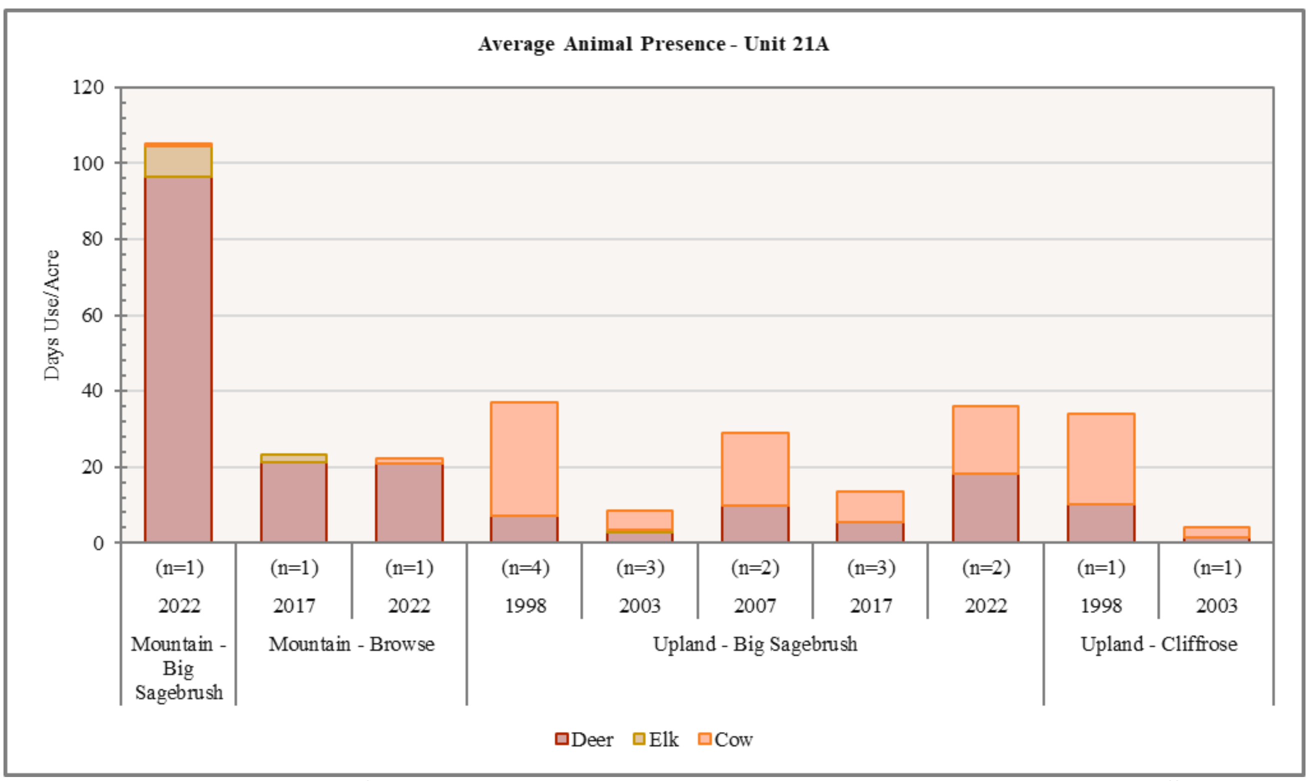


Figure 7.17: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Browse, Upland - Big Sagebrush, and Upland - Cliffrose study sites in WMU 21A, Oak Creek.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Oak Creek management unit has generally improved from very poor averaged conditions in 1998 to poor averaged conditions in 2022. This trend is largely driven by the replacement of sites with consistently very poor conditions with the Bridge Canyon (21A-6) and Williams Canyon (21A-8) studies. The addition of Williams Canyon is the main driver for the unit's wintering habitat stability and quality, and this site has been consistently ranked as having fair deer winter range conditions in 2017 and 2022. Conversely, Bridge Canyon (21A-6) has been considered to have very poor conditions consistently over the same period. More study sites are needed to obtain a more comprehensive view of winter range conditions on the Oak Creek management unit.

The overall deer winter range assessment in 2022 for WMU 21A was that the unit was in poor condition. However, as mentioned above, Williams Canyon was in fair condition while Bridge Canyon was in very poor condition. Winter range conditions would likely improve if preferred browse and forb species were established on Bridge Canyon; browse recruitment and a reduction in annual grass would improve condition on Williams Canyon (**Figure 7.18**, **Table 7.5**)

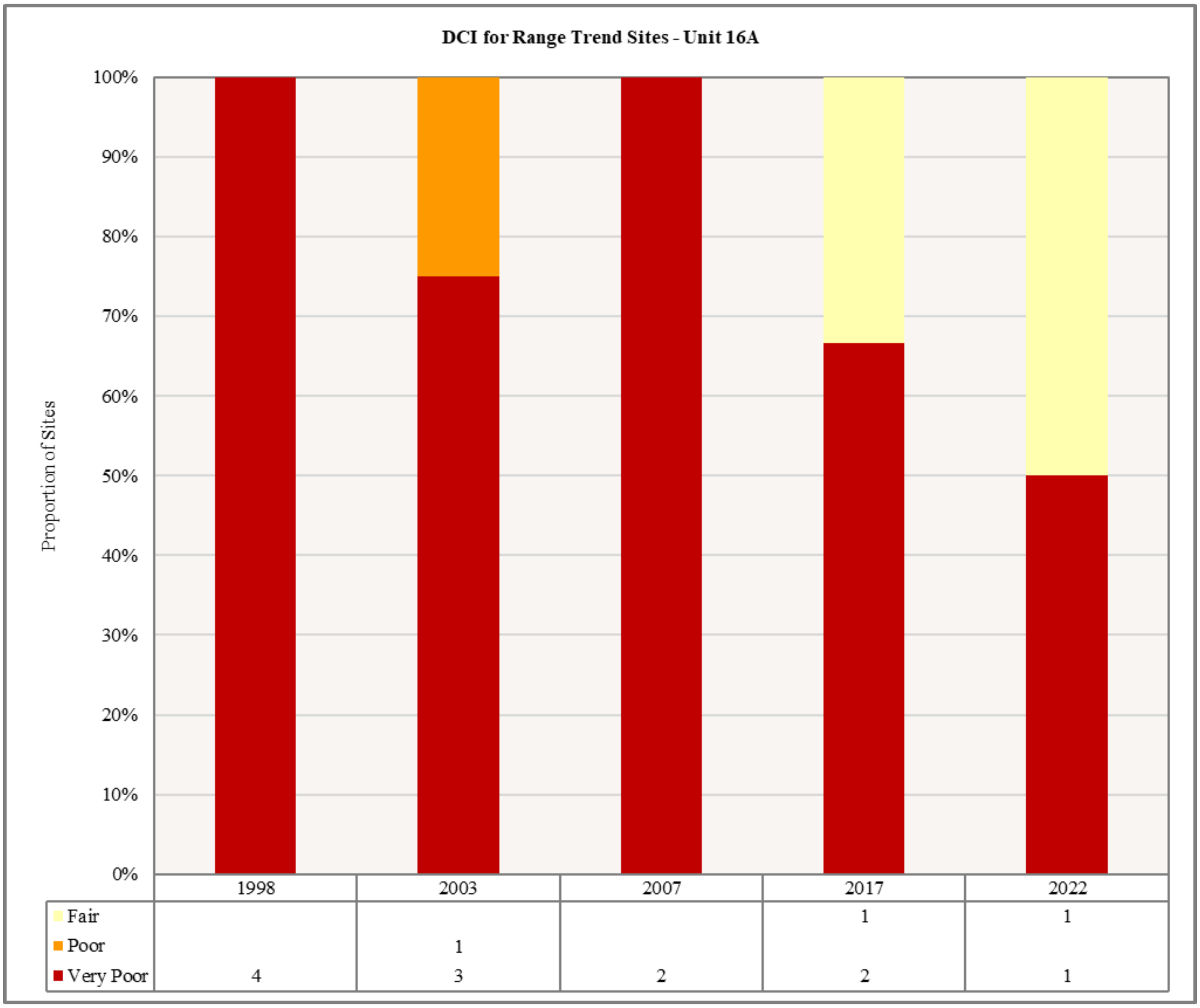


Figure 7.18: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 21A, Oak Creek.

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
21A-1*	1998	7.1	0	0	22.7	-3.2	5.3	0	**31.9**	**VP**
21A-1*	2003	11.4	1.1	0	26.8	0	1.1	0	**40.2**	**P**
21A-2*	1998	2.8	0	0	9.6	-13.5	0.4	0	**-0.7**	**VP**
21A-2*	2003	0.8	0	0	11.9	-18.1	0.2	0	**-5.2**	**VP**
21A-3*	1998	0	0	0	30	-4	0.1	0	**26.1**	**VP**
21A-3*	2003	0	0	0	30	-4.1	0	-2	**24**	**VP**
21A-3*	2007	0	0	0	30	-18.1	0.5	-2	**10.3**	**VP**
21A-4*	1998	3.8	0	0	6	-9.5	0.1	0	**0.4**	**VP**
21A-4*	2003	7	-0.2	0	10.5	-2.6	0.1	0	**14.7**	**VP**
21A-4*	2007	1.3	0	0	3.6	-10.3	0.1	0	**-5.4**	**VP**
21A-4*	2017	2.5	0	0	19.3	-7.8	1	0	**14.9**	**VP**
21A-6	2017	0	0	0	30	-2.2	0.1	0	**27.9**	**VP**
21A-6	2022	0	0	0	30	-7	0.9	0	**23.9**	**VP**
21A-8	2017	30	11.5	0.9	27.8	-17.1	2	0	**55**	**F**
21A-8	2022	30	8.6	0.9	30	-12.9	3.1	0	**59.7**	**F**

Table 7.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 21A, Oak Creek. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
21A-6	Bridge Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
21A-7	Rocky Ridge Canyon	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
21A-8	Williams Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21A-9	Ox Hollow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
21R-6	Anderson Dixie	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21R-15	Duggins Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 7.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 21A, Oak 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

In most sample years, nearly all of the study sites that fall within deer winter range have been classified as being in very poor condition. The drivers behind these poor conditions vary between high amounts of annual grass, few perennial forbs, lack of recruitment within the preferred browse community, and/or a lack of preferred browse cover.

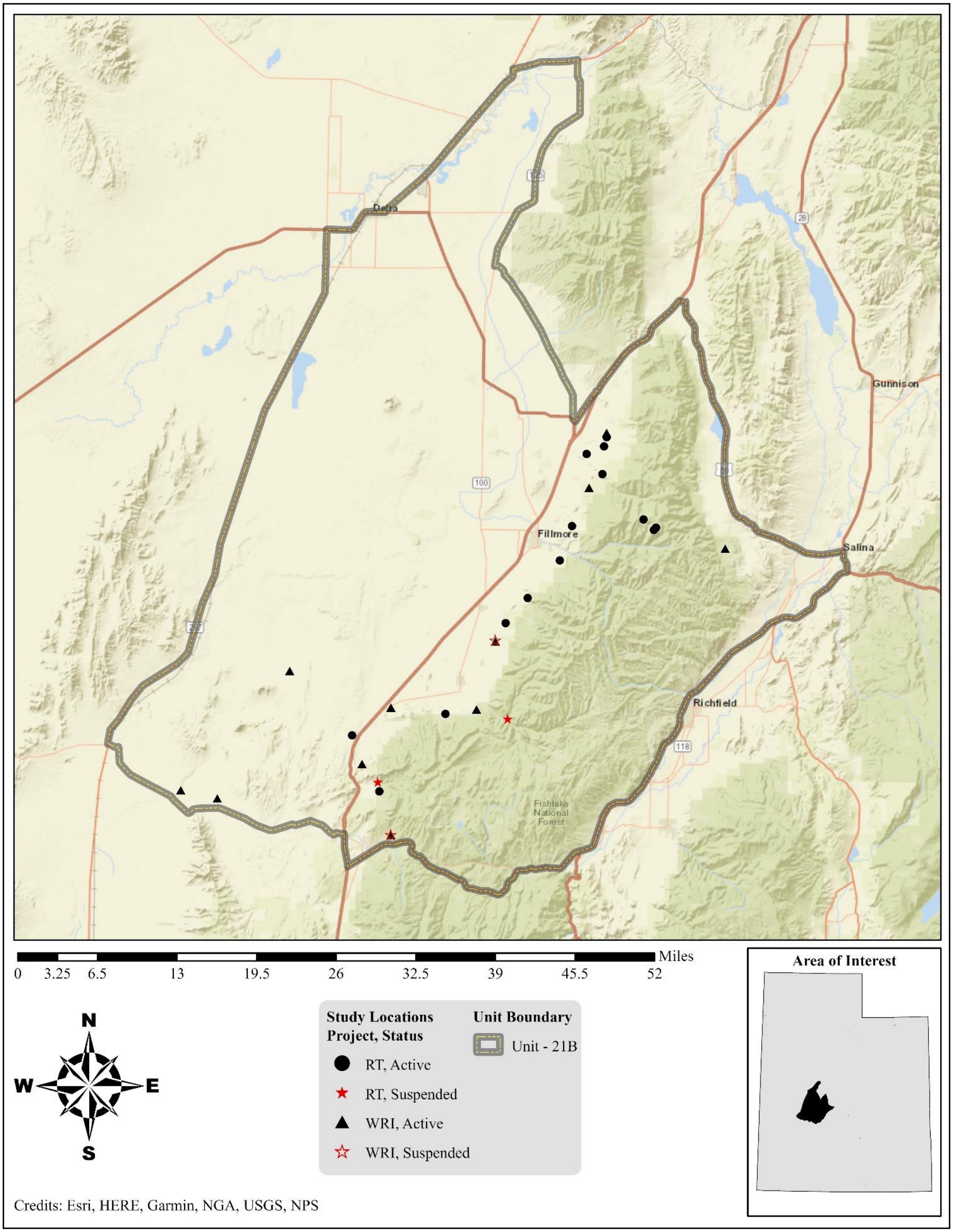
Nearly two-thirds of the unit has burned since 1981, and many of these burned areas have burned multiple times. These fires have altered the winter habitat in the northern two-thirds of the unit, effectively converting much of the browse component to an introduced perennial/annual grass plant community. The loss of preferred browse on the winter range to wildfire translates to less available forage and browse for deer in the area, which in turn emphasizes the importance of winter habitat that does remain. The effects of wildfire have influenced nearly all of the Range Trend study sites in the unit. As a result, the study sites originally established to monitor big game habitat were all suspended and replaced by the 2017 sample year due to low use by deer and/or persistent lack of browse component (Lovell Hollow, Cascade Spring, and Horse Hollow). Consequently, new study sites were established in 2017 and 2022 to monitor isolated patches of remnant browse populations that persist within the burned areas on the winter range or to gather summer range trends. Study sites that monitor these persistent browse populations show a stable to decreasing trend in cover of preferred browse (Williams Canyon, Rocky Ridge Canyon, and Anderson Dixie). Cheatgrass has also been present and a major component in the understories of most the study sites (suspended and active) on this unit throughout the study period. The presence of annual grasses can increase fine fuel loads, exacerbate the risk of wildfire, and may even result in altered wildfire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). Following the fires, introduced perennial grasses were seeded to help combat the invasion of cheatgrass. While they provide forage and help reduce the presence of annual grasses, introduced perennial grasses can outcompete establishment of young shrubs and seedlings (Mack, et al., 2000). An example of this is the suspended site Cascade Spring, which had high cover of introduced perennial grasses and no recruitment of preferred browse over the study period.

However, fire can play a key process in the function and structure of big game habitat (Pastro, Dickman, & Letnic, 2011). The higher-elevation summer range habitat may have benefitted from the fires that have occurred on the Oak Creek unit; much of the summer range has transitioned to an early seral state. There is the possibility of fire-driven regeneration and improvement in these areas, although only one study, Ox Hollow, monitors summer range. Preliminary data from the Ox Hollow study show an herbaceous understory with good diversity and cover.

Other threats to wildlife habitat are occurring in localized portions of this unit, but will not be discussed in this section. These additional threats are specified by study site in the previous table (**Table 7.6**).

A number of recommendations should be taken into consideration when trying to mitigate or slow the effects of big game habitat loss in the Oak Creek management unit. Priority should be given to protecting and rehabilitating affected areas of big game winter range and habitat in general in this unit. Areas that would benefit from the reestablishment of shrub communities should be identified and projects to achieve this should be considered, such as in areas where wildlife have shown a historical presence. Because of a lack of forage, many deer end up in the agricultural lands outside of Oak City. Consider desirable forb and browse rehabilitation efforts on the winter range around Oak City to alleviate use on agricultural fields. If seeding is used as a method of reestablishment of shrub or herbaceous components, care should be taken in seed selection. Preference should be given to native species whenever possible when creating seed mixes, as some introduced species may have the potential to be aggressive in certain ecosystems. In addition, treatments such as herbicide application and changes in grazing management may be appropriate in areas where annual grass flushes occur in the future. Finally, monitoring of both Range Trend studies and areas where rehabilitation projects have occurred should continue in the future. Periodic monitoring of these areas not only assesses the quality of big game habitat, but may also aid in the identification of threats as they appear over time.

8. MANAGEMENT UNIT 21B – FILLMORE - PAHVANT



WILDLIFE MANAGEMENT UNIT 21B – FILLMORE - PAHVANT

Boundary Description

Juab, Millard, and Sevier counties – Boundary begins at SR-132 and SR-125 (300 E in Leamington); west on SR132 to US-6; south on US-6 to US-50 (Delta, Main Street); west on US-50 (US-6) to SR-257 (4000 West in Hinckley); south on SR-257 to the Black Rock Road; east on this road to I-15; south on I-15 to I-70; east and north on I-70 to US-89; north on US-89 to US-50 in Salina; north on US-50 to I-15 near Scipio; south on I-15 to Exit 178 and US-50; south on US-50 to Whiskey Creek Road; north on this road to McCormick Road (CR-4549); north on this road to SR-125; north on SR-125 to SR-132 in Leamington. Excludes all Native American trust lands and CWMUs within this boundary.

Management Unit Description

Geography

The Fillmore - Pahvant management unit sits in between the Sevier Desert and Central Valley. This unit consists of the Pahvant Range and associated winter habitat areas surrounding it. Range Trend studies are mostly on the western side of the mountain range in the winter range, with three high-elevation summer range sites located in the northern section of the unit.

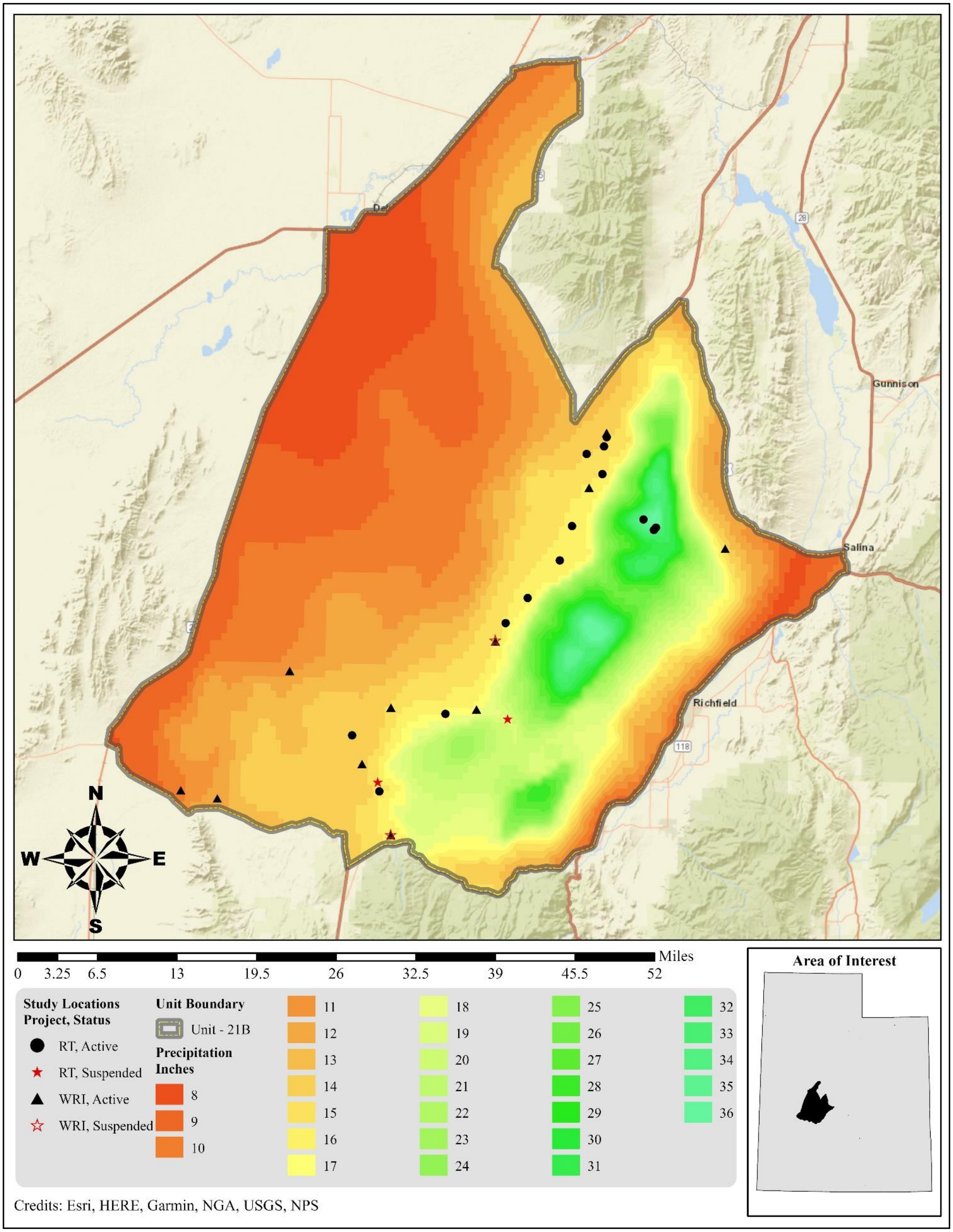
The Pahvant Range is the primary geographic feature within the unit. This mountain range runs north and south, parallel with I-15. Mine Camp Peak is the tallest peak in the range at 10,225 feet tall. There are many wide and moderately sloped canyons on both the eastern and western sides of the range. The range generally becomes lower in elevation towards the southern end of the unit with sagebrush flats and valleys as the main topography instead of high elevation peaks. Towns within this management unit include Kanosh, Fillmore, Meadow, and Aurora.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 8 inches in areas near Joseph up to 35 inches on the top of the Pahvant Range. All of the Range Trend and WRI monitoring studies on the unit occur within 13-35 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 Central and South Central divisions (Divisions 1 and 4).

The mean annual PDSI of the Western division displayed years of moderate to extreme drought from 2000-2003, 2007-2008, 2012-2013, 2015, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1993, 1995, 1998-1999, 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 2021-2022; moderately to extremely wet years were displayed in 1995, 1995, 1998, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2001-2003, 2007-2008, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2011, and 2019 (**Figure 8.1b**).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 2002-2003, 2012-2014, 2018, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1997-1998, 2005, and 2011 (**Figure 8.2a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1996, 2000, 2002-2004, 2013-2014, 2018, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2002-2003, 2007, 2009, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2005, and 2011 (**Figure 8.2b**) (Time Series Data, 2023).



Map 8.1: The 1991-2020 PRISM Precipitation Model for WMU 21B, Fillmore - Pahvant (PRISM Climate Group, Oregon State University, 2021).

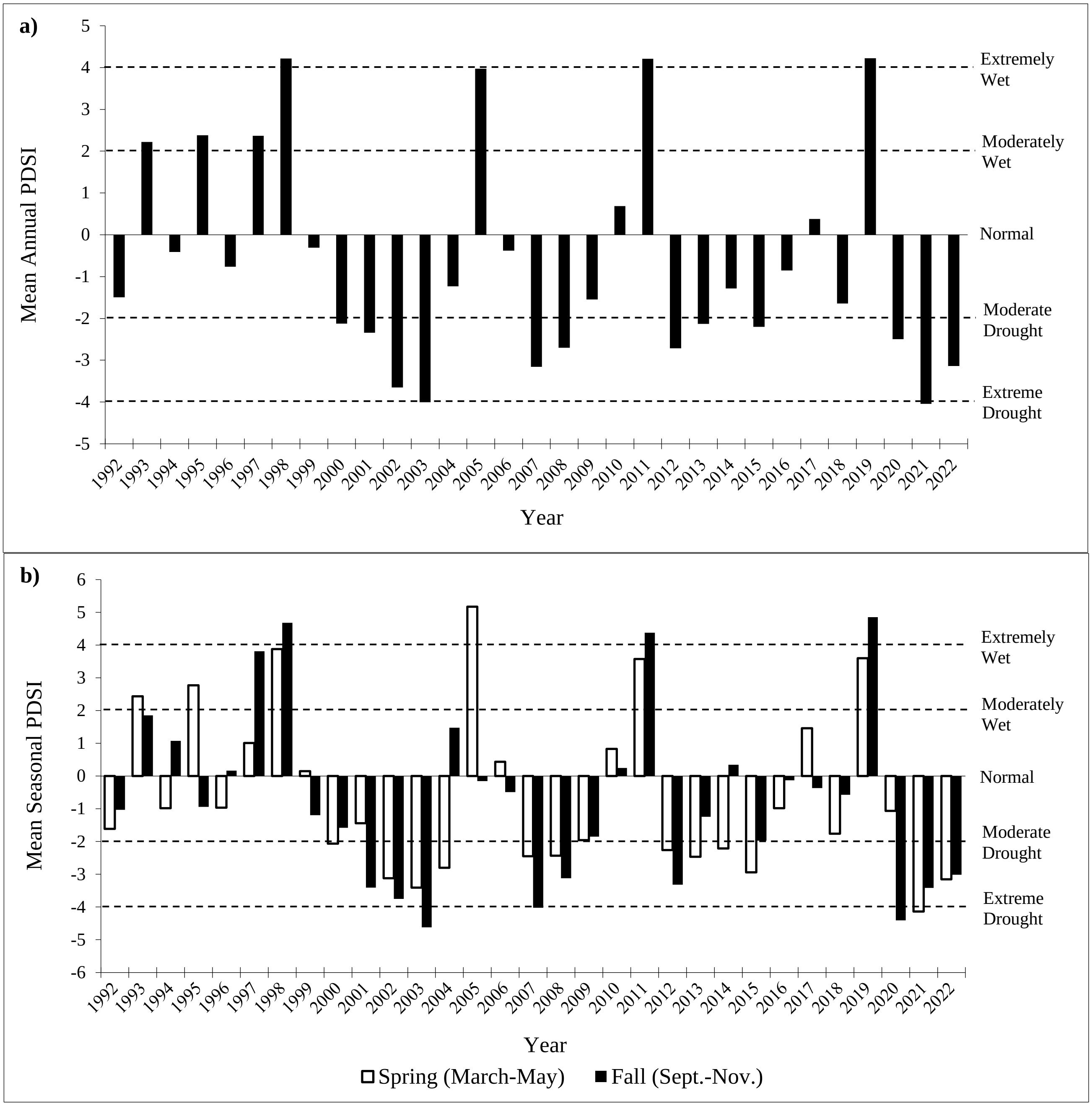


Figure 8.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 1). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023).

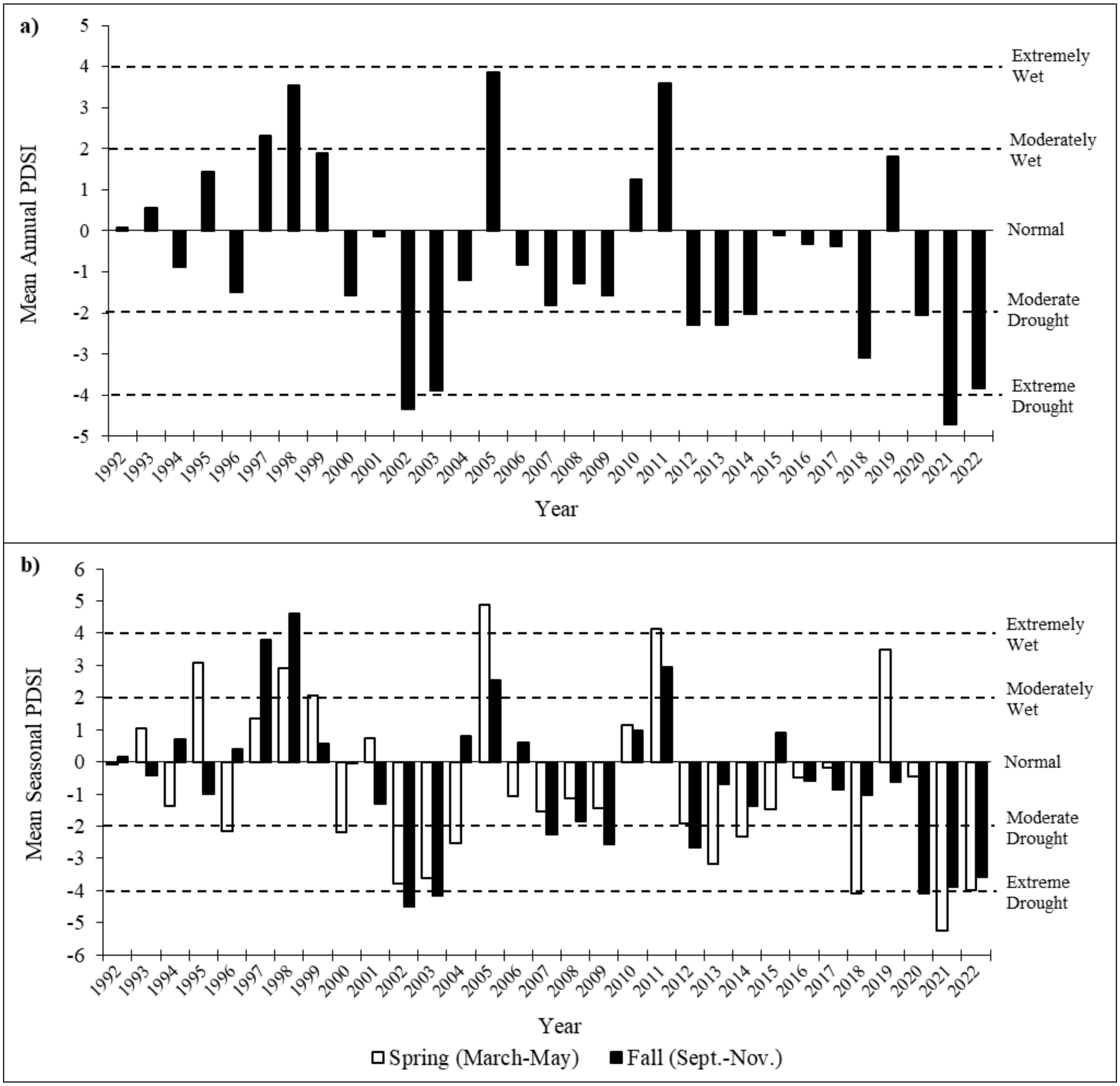


Figure 8.2: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification of the scale is $\geq$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 $\leq$-4.0 = Extreme Drought. **a)** Mean annual PDSI. **b)** Mean spring (March-May) and fall (Sept.-Nov.) PDSI (Time Series Data, 2023).

Big Game Habitat

Deer winter range roughly follows the base of the Pahvant Range at elevations between approximately 5,100 and 7,500 feet. This winter range is bordered on the west by I-15, on the east by I-70, and on the north by US-50. There are still good amounts of winter habitat at the lower elevations of the unit. The Milford Flat fire burned significant areas of former winter range and I-15 acts as a barrier to migration into previously-used desert wintering areas. This unit has significant amounts of winter range that are privately owned, which can present management issues with crop depredation (**Map 8.4**).

Much of the winter range on this unit is host to shrub communities composed of a mixture of Stansbury cliffrose, mountain big sagebrush, and other browse species. While many of the Range Trend sites show good populations of browse species, many of these sites have depleted understories with remnant shrub communities. Both cheatgrass and bulbous bluegrass are very common across the range. Significant amounts of aspen-timber and subalpine meadow plant communities that are used for summer range can be found at higher elevation.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

A number of factors determine quality wildlife forage. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and/or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. According to the RAP website, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to help illustrate the year-to-year fluctuations or changes that may occur between Range Trend samplings.

The RAP data shows fluctuations of herbaceous biomass and cover on both summer and winter deer winter range; the highest values for both measurements have mainly been observed in the mid-1990s for deer summer range; however, total biomass and cover on winter range increased and was at its highest 2019 primarily due to increases in annuals. The mid-2000s, and late 2010s display strong peaks that correspond or follow high precipitation years. Additionally, annual and perennial cover and biomass have generally followed precipitation trends. However, no apparent correlation is discernable in other years (in 1988-1989 and 2015-2017, for example), with biomass and precipitation displaying some degree of independence. Yearly increases and decreases in biomass and cover generally appear to be more pronounced on winter range than on summer range (**Figure 8.3**, **Figure 8.4**, **Figure 8.5**, **Figure 8.6**). As expected, some peaks and troughs in this herbaceous data can be correlated with Palmer Drought Severity Index (PDSI) data. For example, increased cover, biomass, and precipitation in 2019 correspond with PDSI values that show a wetter than normal year, a moderately wet spring, and an extremely wet fall. While it is important to note yearly trends, the overall trend for biomass and cover for both winter and summer range has generally decreased since 1992, which seems to correspond with prolonged drought cycles beginning in the late 1990s as marked in the PDSI (**Figure 8.1a**, **Figure 8.1b**, **Figure 8.2a**, **Figure 8.2b**). Fire may have influence in the increase and amount of annual species on winter range. Fire years that had significant impact on deer winter range occurred in 1996, 2006-2007, 2012, 2016, and 2020 (**Map 8.5, Figure 8.4, Figure 8.6**).

Range Trend data for herbaceous cover from 1997 to present show fluctuations in both perennial and annual lifeforms. An overall increase occurred on most mountain and upland ecotypes, but cover remained relatively stable on upland cliffrose sites, which is the most commonly sampled ecotype on deer winter range (**Figure 8.11**). Year-to-year fluctuations can be expected due to differences in precipitation and the timing of data collection between sample years.

RAP data indicates that tree and shrub cover correlate with precipitation in many years, but more loosely so than herbaceous cover and biomass. Tree and shrub cover values have increased on mule deer summer range, but estimated shrub cover using RAP appears to show a gradual decrease in winter range (**Figure 8.7**, **Figure 8.8**). Conversely, the majority of Range Trend sites that fall within winter range display an overall increase for tree cover, but that cover is decreasing on upland sagebrush sites. Cover values for shrubs show an increasing trend on all ecotypes that is more pronounced on upland ecological types (**Figure 8.11**, **Figure 2.20**).

RAP – Biomass by Deer Habitat

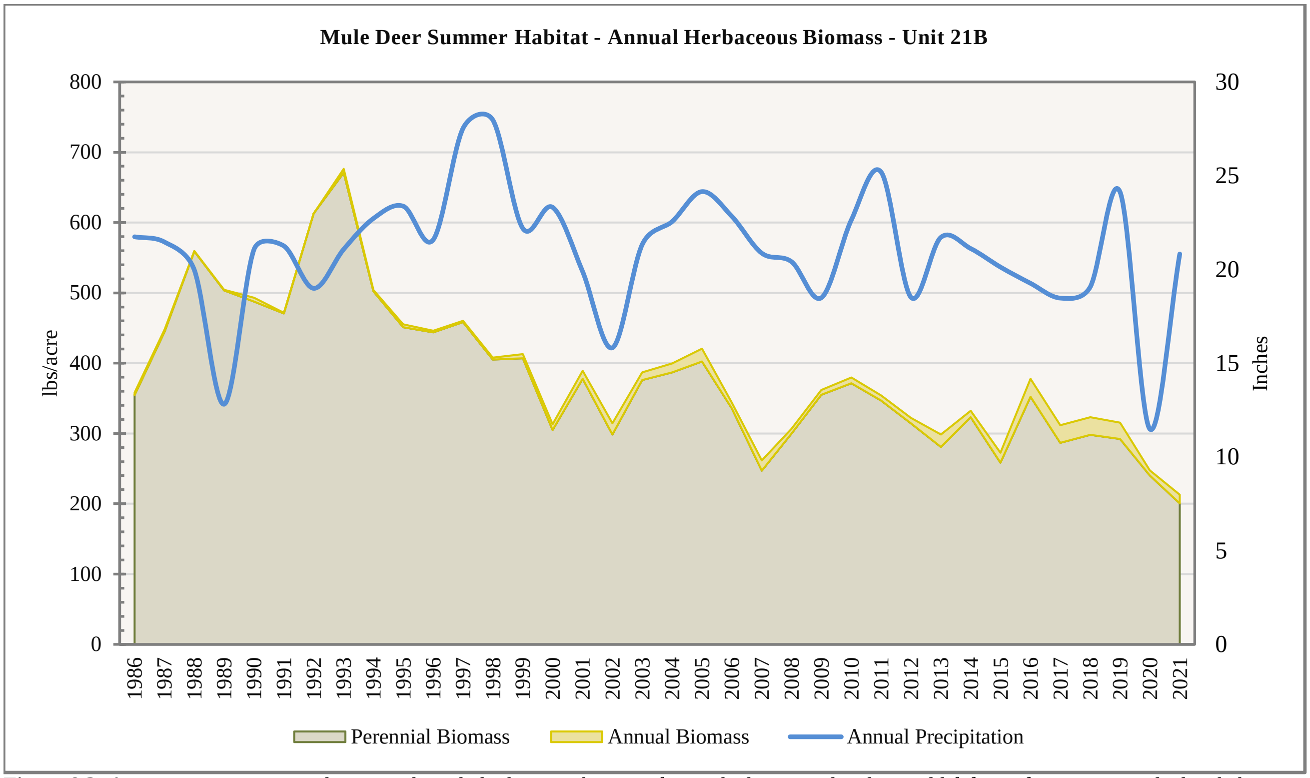


Figure 8.3: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 21B, Fillmore - Pahvant (Rangeland Analysis Platform, 2023).

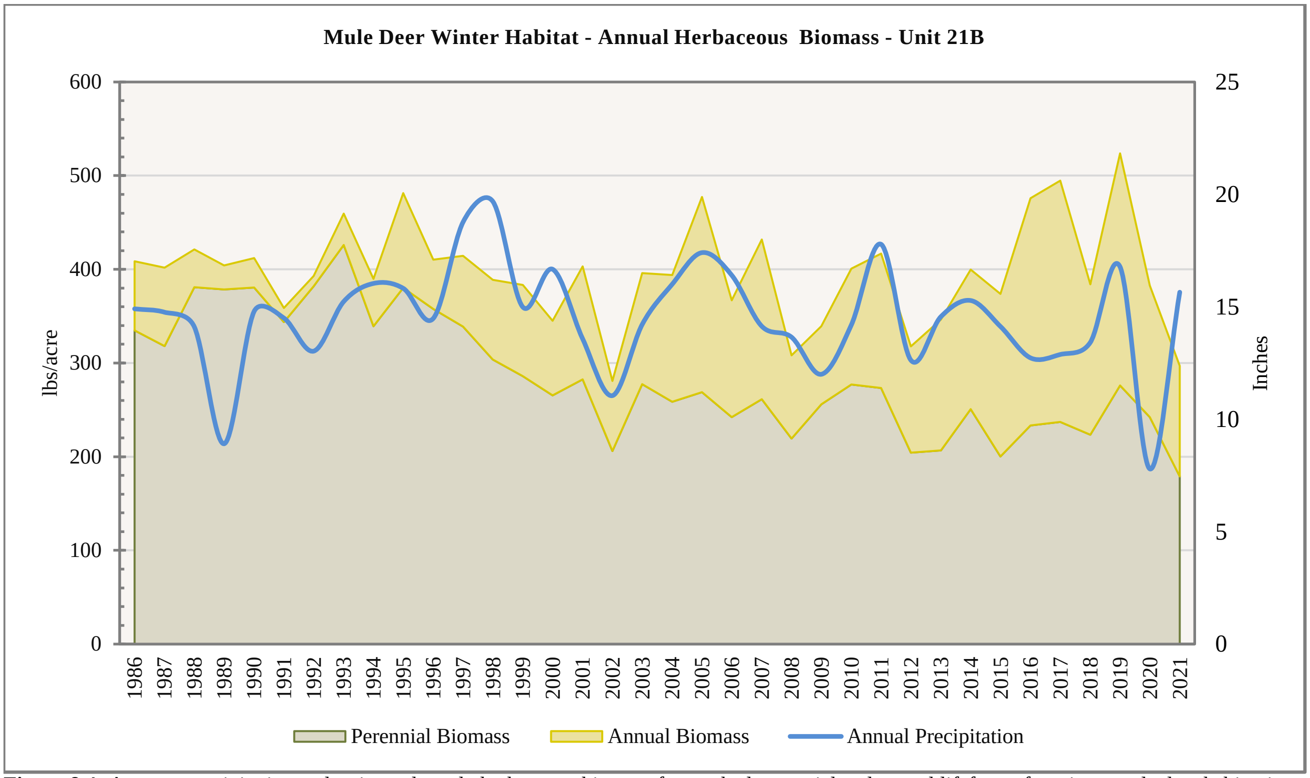


Figure 8.4: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 21B, Fillmore - Pahvant (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

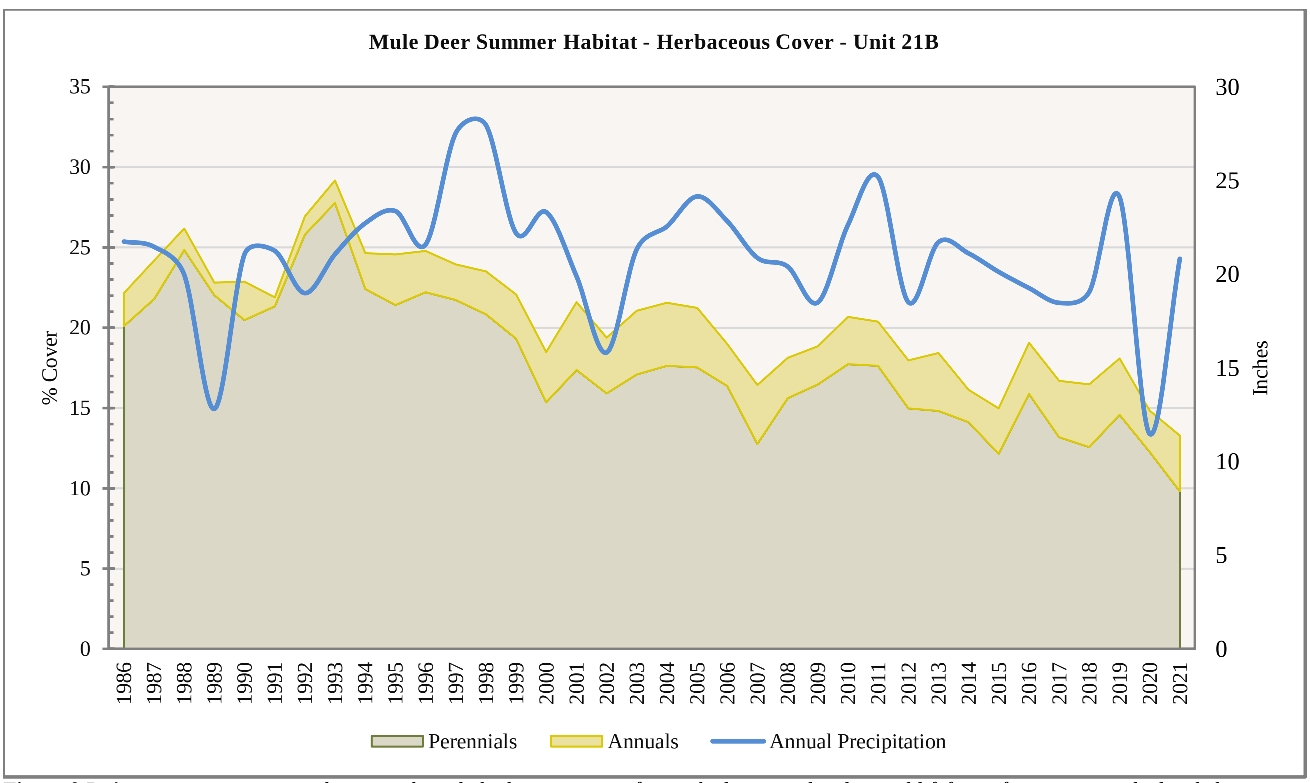


Figure 8.5: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 21B, Fillmore - Pahvant (Rangeland Analysis Platform, 2023).

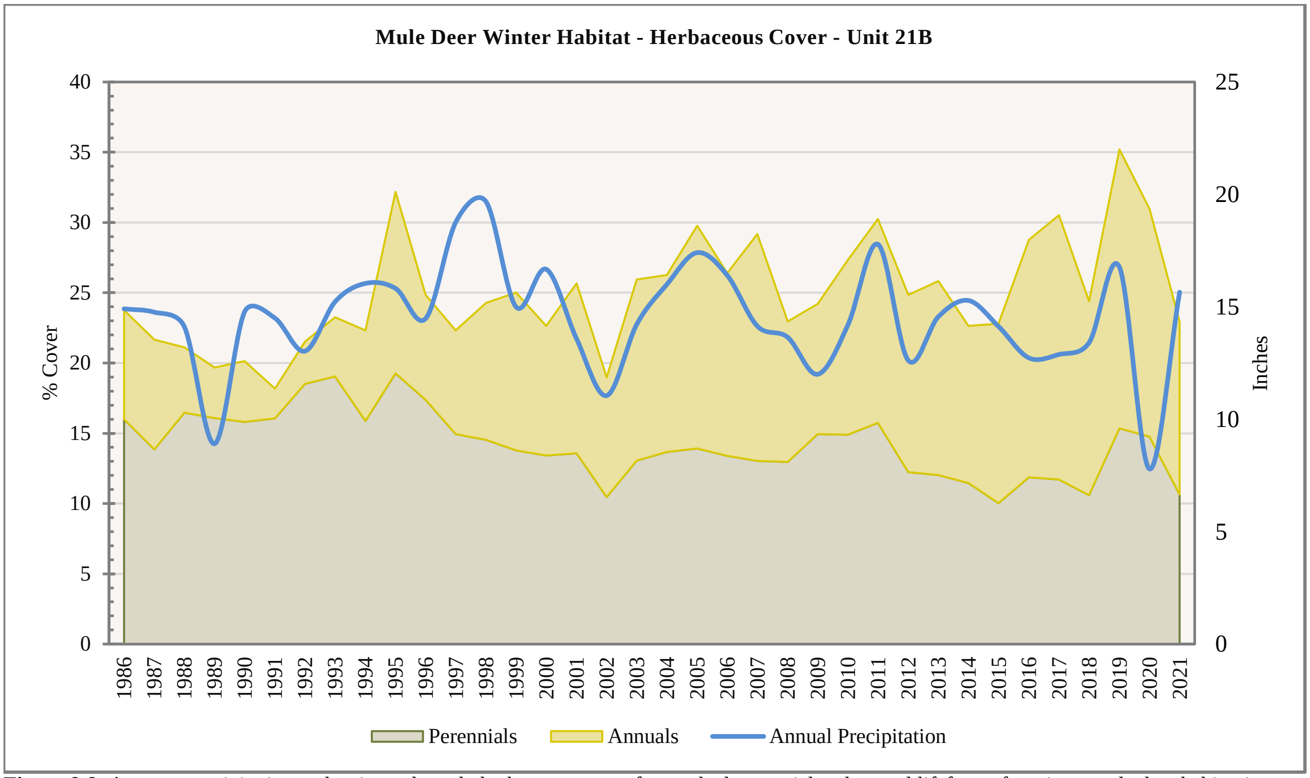


Figure 8.6: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 21B, Fillmore - Pahvant (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

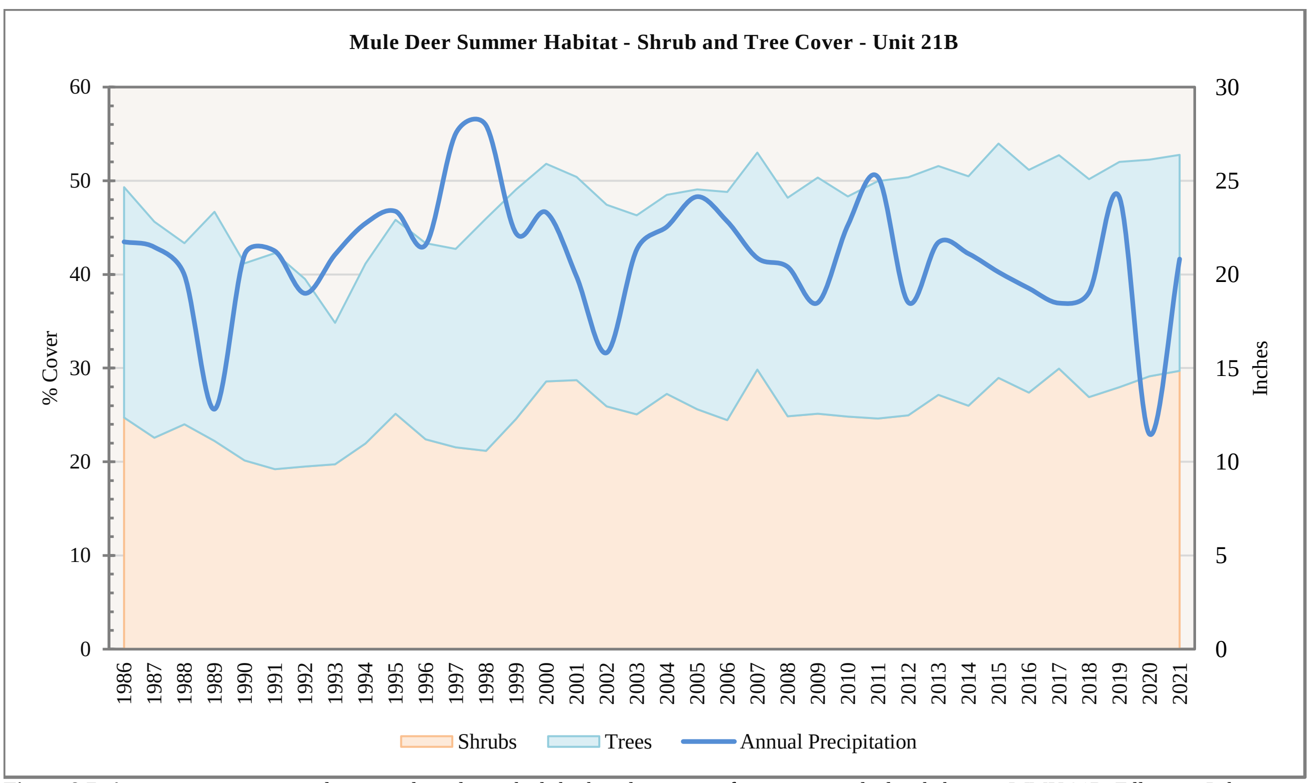


Figure 8.7: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 21B, Fillmore - Pahvant (Rangeland Analysis Platform, 2023).

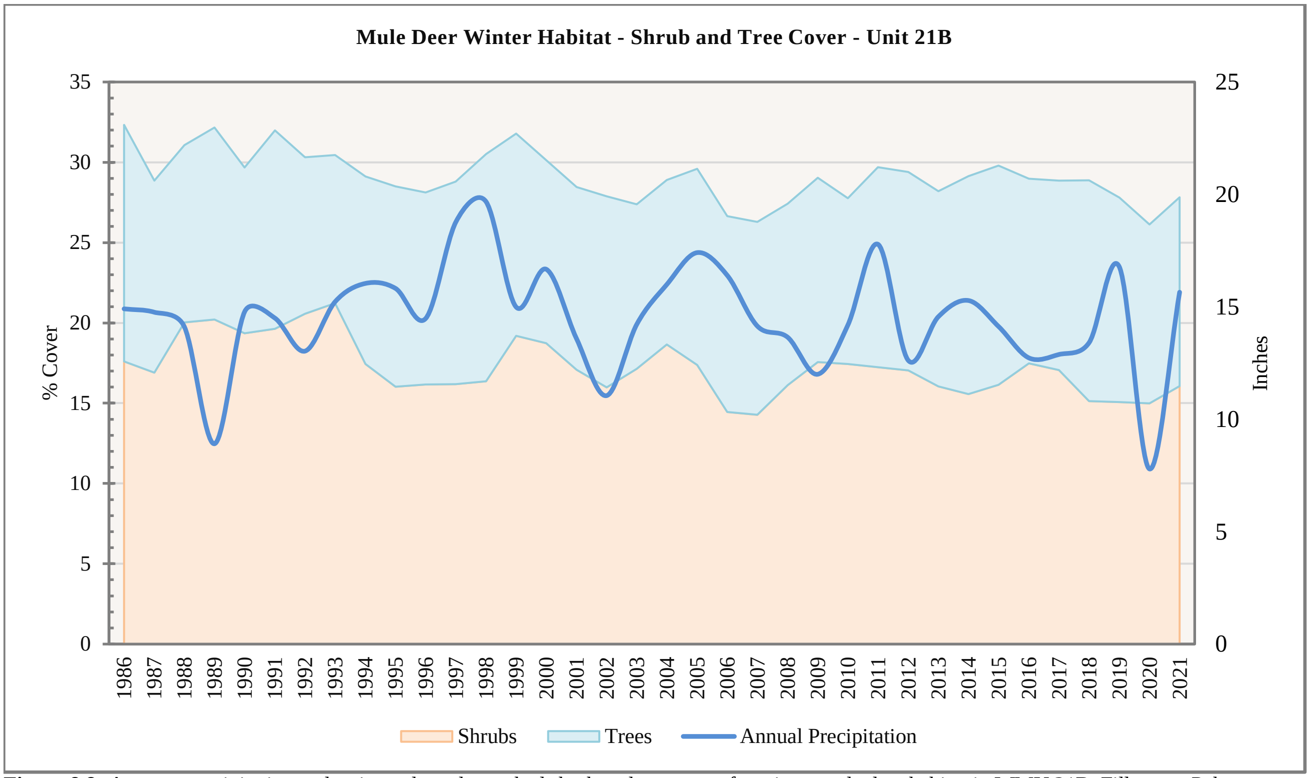
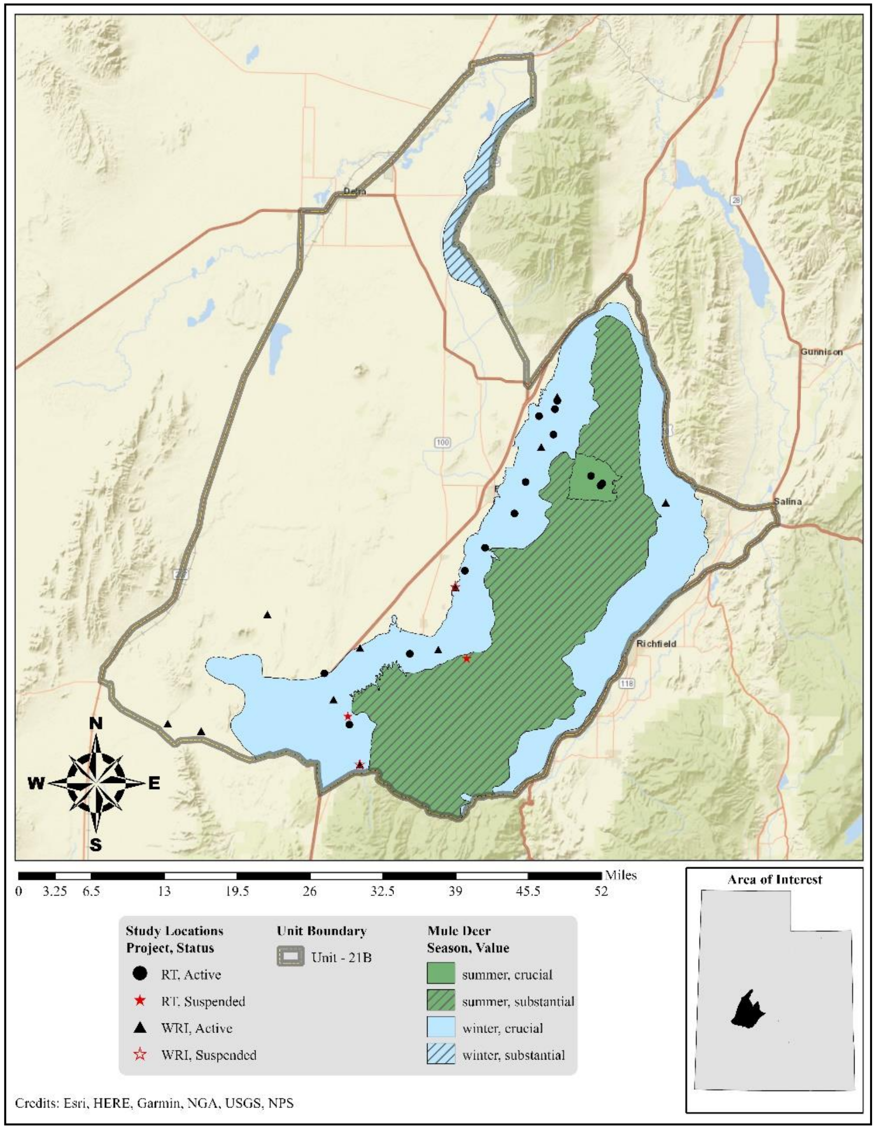
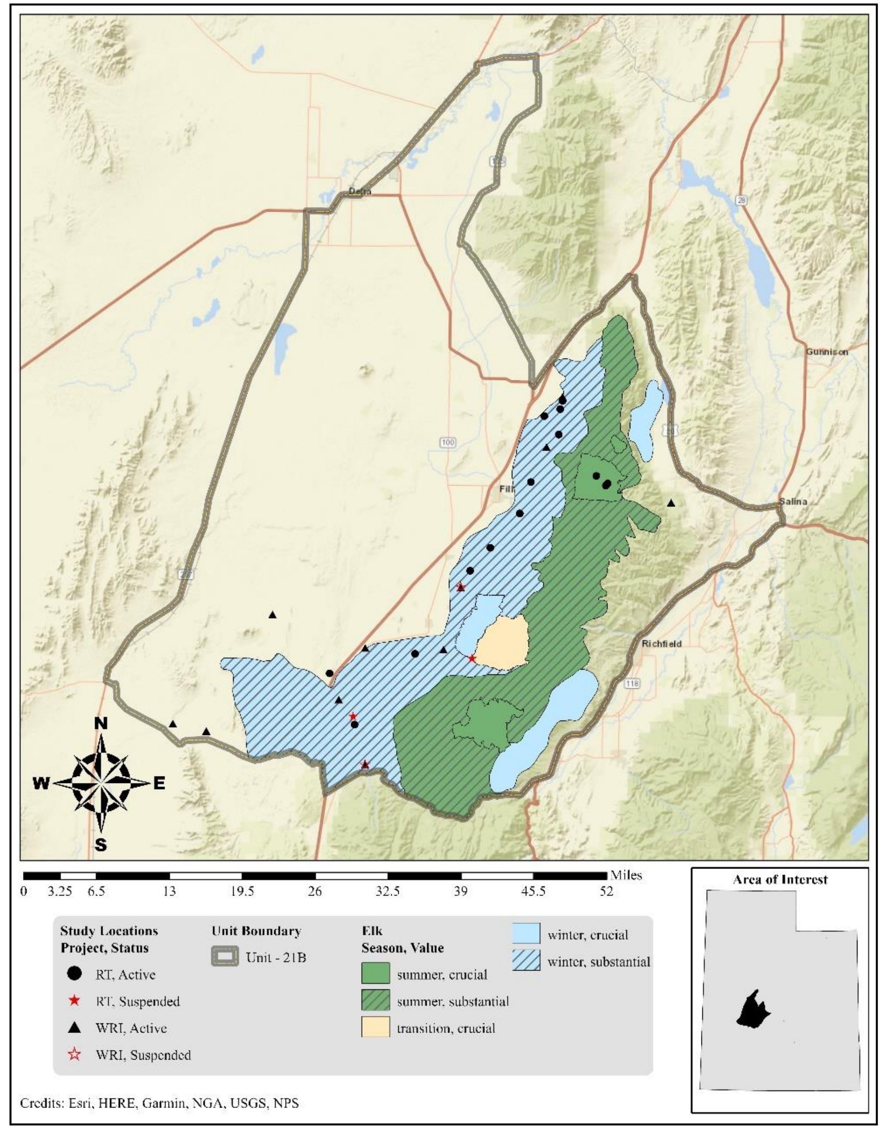


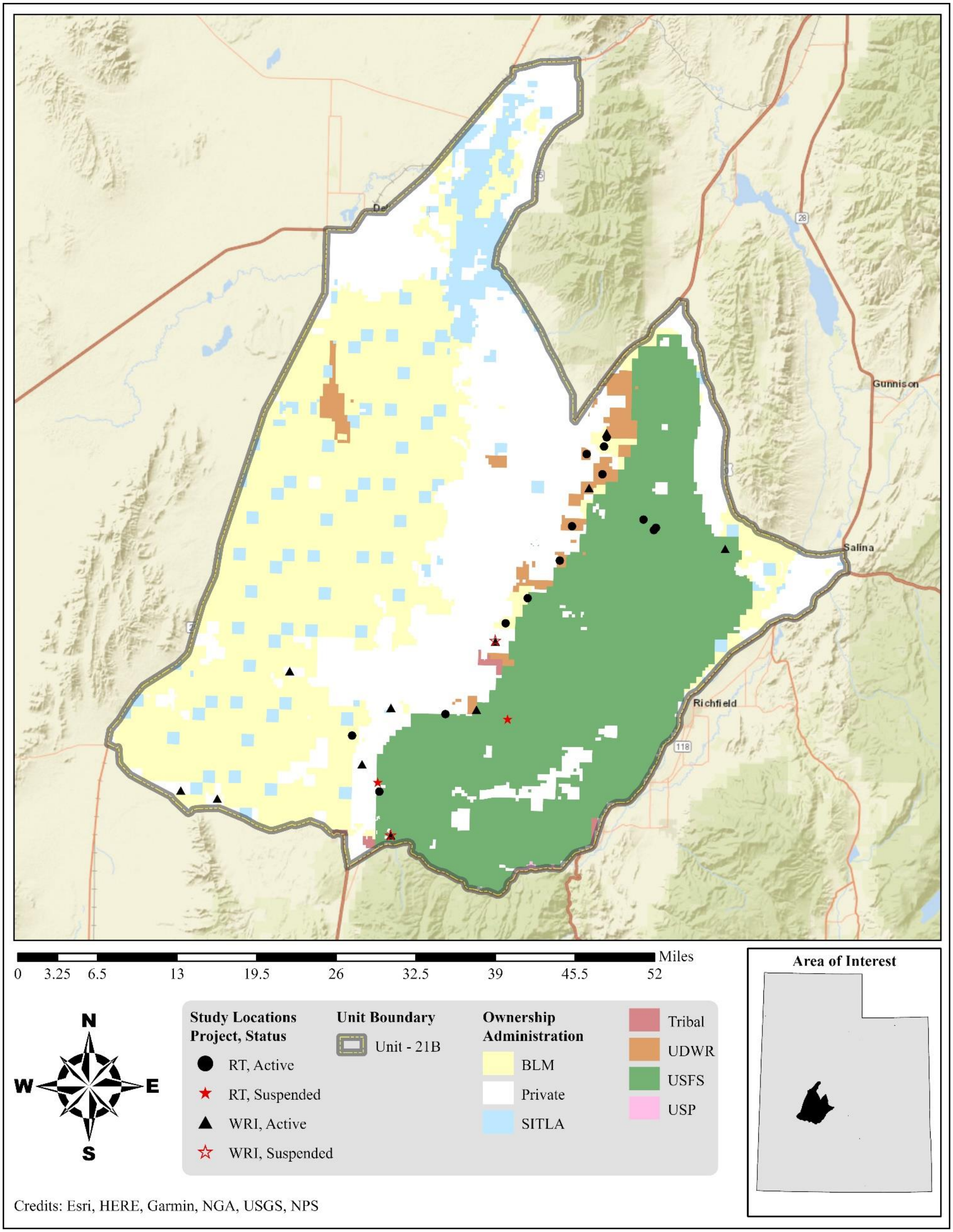
Figure 8.8: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 21B, Fillmore - Pahvant (Rangeland Analysis Platform, 2023).



Map 8.2: Estimated mule deer habitat by season and value for WMU 21B, Fillmore - Pahvant.



Map 8.3: Estimated elk habitat by season and value for WMU 21B, Fillmore - Pahvant.



Map 8.4: Land ownership for WMU 21B, Fillmore - Pahvant.

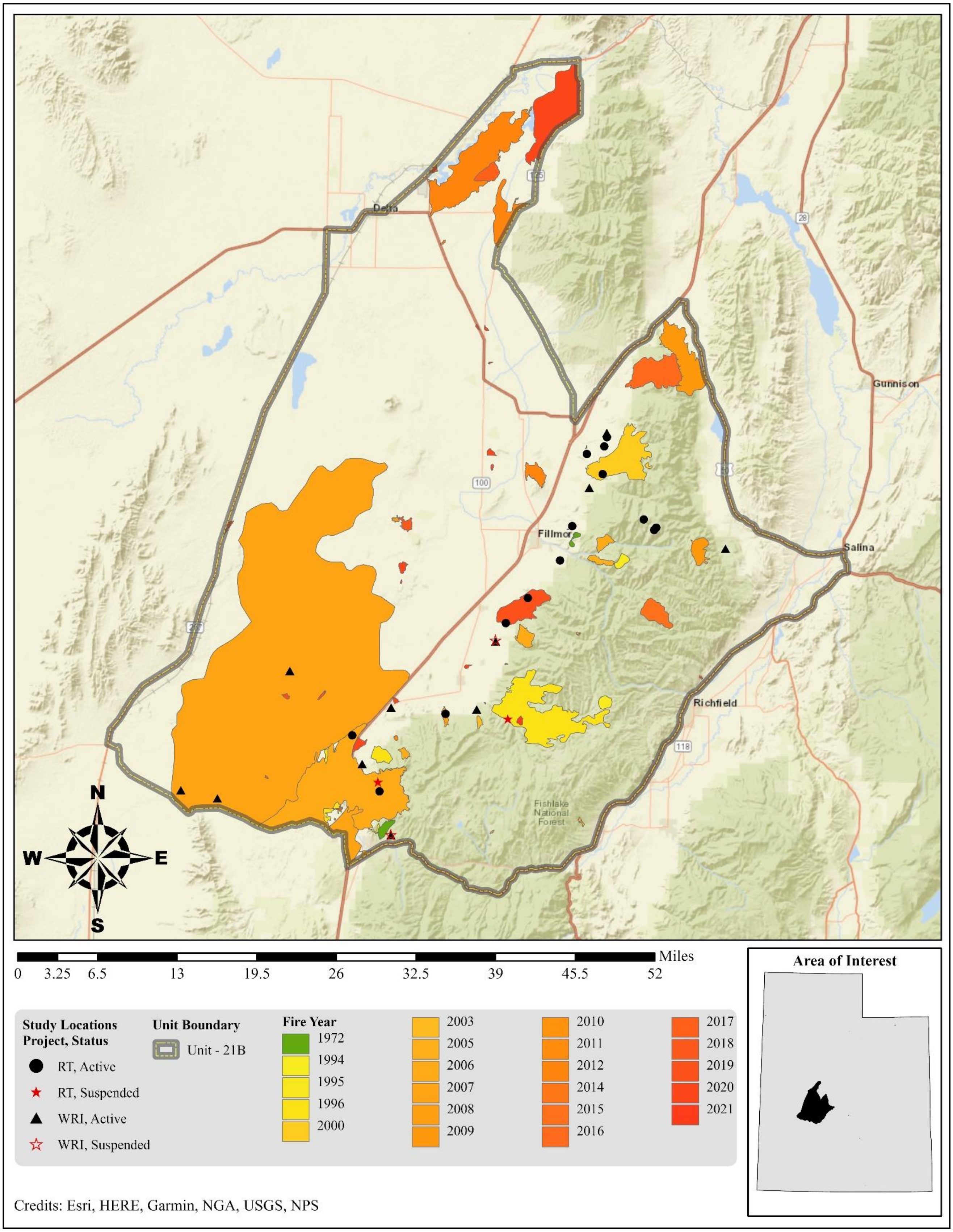
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	167,853	31.20%	
	Great Basin Pinyon-Juniper Woodland	34,743	6.46%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	29,484	5.48%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	18,252	3.39%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	17,087	3.18%	
	Southern Rocky Mountain Ponderosa Pine Woodland	4,660	0.87%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	1,435	0.27%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	1,284	0.24%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	449	0.08%	
	Inter-Mountain Basins Juniper Savanna	15	0.00%	51.17%
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	55,897	10.39%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	37,219	6.92%	
	Great Basin Xeric Mixed Sagebrush Shrubland	17,234	3.20%	
	Inter-Mountain Basins Montane Sagebrush Steppe	13,983	2.60%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	12,381	2.30%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	2,842	0.53%	
	Rocky Mountain Lower Montane-Foothill Shrubland	827	0.15%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	756	0.14%	
	Great Basin Semi-Desert Chaparral	540	0.10%	
	Inter-Mountain Basins Greasewood Flat	264	0.05%	
	Inter-Mountain Basins Big Sagebrush Steppe	140	0.03%	
	Desert Scrub	41	0.01%	26.42%
Other	Hardwood	34,522	6.42%	
	Developed	9,140	1.70%	
	Sparsely Vegetated	7,277	1.35%	
	Agricultural	6,526	1.21%	
	Conifer-Hardwood	6,439	1.20%	
	Riparian	2,059	0.38%	
	Open Water	246	0.05%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	91	0.02%	12.32%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	11,837	2.20%	
	Great Basin & Intermountain Introduced Annual Grassland	8,380	1.56%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	6,209	1.15%	
	Interior Western North American Temperate Ruderal Grassland	2,326	0.43%	5.34%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	14,337	2.66%	
	Interior Western North American Temperate Ruderal Shrubland	1,480	0.28%	2.94%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	5,714	1.06%	
	Southern Rocky Mountain Montane-Subalpine Grassland	2,440	0.45%	
	Inter-Mountain Basins Semi-Desert Grassland	1,577	0.29%	1.81%
Total		**537,985**	**100%**	**100%**

Table 8.1: LANDFIRE Existing Vegetation Coverage For Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 21B, Fillmore - Pahvant.

Limiting Factors to Big Game Habitat

Major human activities in this area include agriculture, grazing, and mining. Some of the limiting factors to this unit include habitat fragmentation, habitat degradation and loss, and winter range conditions. Due to the amounts of cropland adjacent to winter ranges, there are issues with private land depredation. In addition, I-15 and I-70 are restrictive to natural migration patterns and are barriers to movement in both winter and summer habitats. Pinyon-juniper encroachment is a threat to the browse communities in the unit; according to the current LANDFIRE Exisiting Vegetation Coverage model, 37.66% of mule deer habitat is composed of pinyon-juniper woodlands (**Table 8.1**). Encroachment and invasion of these woodlands into sagebrush communities has been shown to lead to decreased sagebrush and herbaceous cover, therefore decreasing available wildlife forage (Miller, Svejcar, & Rose, 2000).

Other limiting factors to big game include introduced exotic herbaceous species, such as cheatgrass (*Bromus tectorum*). The current LANDFIRE Existing Vegetation Coverage model indicates that 1.56% of mule deer habitat is comprised of annual exotic herbaceous species (**Table 8.1**). 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 8.5**).The presence of bulbous bluegrass (*Poa bulbosa*) on many sites is also a limiting factor to this unit. Once established, bulbous bluegrass populations can persist and invade native plant communities (Kulmatiski, 2006). The presence of this introduced grass often leads to reduced understory productivity and species diversity.



Map 8.5: Land coverage of fires by year from 1972-2021 for WMU 21B, Fillmore - Pahvant (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

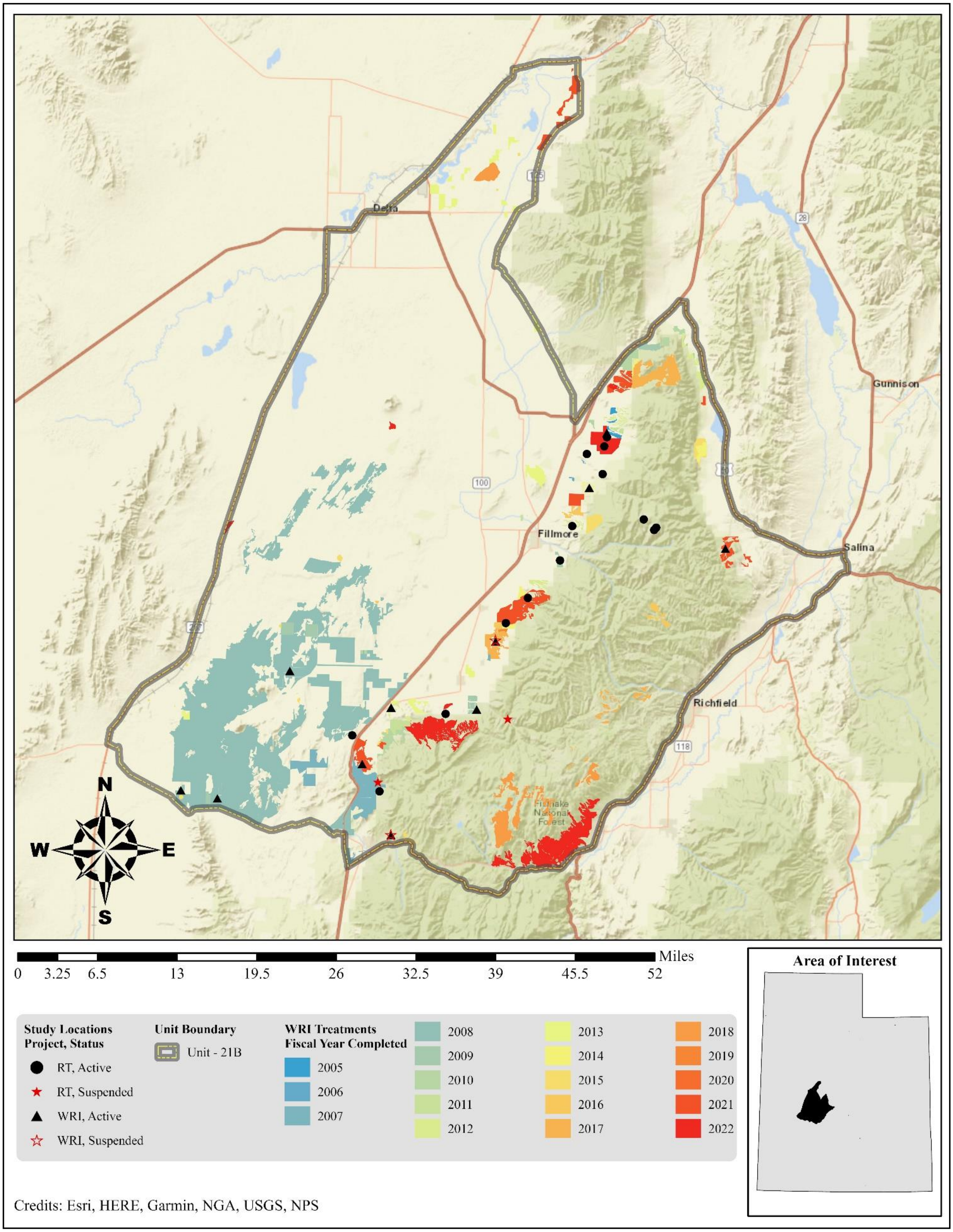
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 166,932 acres of land have been treated within the Fillmore - Pahvant unit since the WRI was implemented in 2004 (**Map 8.6**). An additional 12,762 acres are currently being treated and treatments have been proposed for 19,086 acres. Treatments frequently overlap one another, bringing the net total of treatment acres to 157,239 acres for this unit (**Table 8.2**). Other treatments have occurred outside of the WRI through independent agencies and landowners, but WRI projects comprise the majority of work done on deer winter ranges throughout the state of Utah.

Anchor chaining to remove pinyon and juniper is the most common management practice in this unit. Seeding plants to augment the herbaceous understory is also often used and frequently occurs together with chainings. Other management practices include (but are not limited to) bullhog and hand crew removal for pinyon-juniper trees, disking, harrow, herbicide application, and prescribed fire (**Table 8.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**65,524**	**1,091**	**1,329**	**67,944**
Ely (One-Way)	59,186	1,091	374	60,651
Ely (Two-Way)	5,719	0	956	6,675
Smooth (One-Way)	618	0	0	618
Bullhog	**5,823**	**0**	**1,031**	**6,853**
Full Size	488	0	0	488
Skid Steer	5,335	0	1,031	6,365
Chain harrow	**5,698**	**0**	**251**	**5,950**
≤ 15 ft. (One-Way)	0	0	251	251
> 15 ft. (Two-Way)	5,698	0	0	5,698
Greenstripping	**744**	**0**	**0**	**744**
Greenstripping	744	0	0	744
Harrow	**338**	**0**	**0**	**338**
> 15 ft. (One-Way)	338	0	0	338
Herbicide application	**3,650**	**0**	**0**	**3,650**
Aerial (Fixed-Wing)	3,265	0	0	3,265
Aerial (Helicopter)	357	0	0	357
Ground	29	0	0	29
Planting/Transplanting	**69**	**0**	**0**	**69**
Other	69	0	0	69
Prescribed fire	**633**	**0**	**0**	**633**
Prescribed Fire	633	0	0	633
Seeding (primary)	**63,584**	**5,155**	**1,135**	**69,874**
Broadcast (aerial-fixed wing)	17,697	5,155	1,135	23,988
Broadcast (aerial-helicopter)	651	0	0	651
Drill (rangeland)	44,804	0	0	44,804
Drill (truax)	234	0	0	234
Ground (mechanical application)	197	0	0	197
Seeding (secondary/shrub)	**2,804**	**0**	**0**	**2,804**
Broadcast (Aerial-Fixed Wing)	2,291	0	0	2,291
Ground (Mechanical Application)	389	0	0	389
Hand seeding	124	0	0	124
Vegetation Removal/Hand Crew	**18,065**	**6,516**	**15,340**	**39,921**
Lop (No Scatter)	1,261	0	0	1,261
Lop & Scatter	16,118	6,516	4,809	27,443
Lop-Pile-Burn	685	0	10,531	11,216
Grand Total	**166,932**	**12,762**	**19,086**	**198,780**
***Total Land Area Treated**	**157,239**	**12,762**	**19,086**	**189,087**

Table 8.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 21B, Fillmore - Pahvant. Data accessed on 01/23/2023. *Does not include overlapping treatments.



Map 8.6: WRI treatments by fiscal year completed for WMU 21B, Fillmore - Pahvant.

Range Trend Studies

Range Trend studies have been sampled within WMU 21B on a regular basis since 1985, with studies being added or suspended as was deemed necessary (**Table 8.3**). 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 8.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
21B-6	M Hill	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Mountain Loam (Oak)
21B-7	Bennett Field	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
21B-8	Smiths Ridge	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
21B-9	Wide Canyon BLM	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
21B-10	Wide Canyon DWR	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
21B-11	Dog Valley	RT	Suspended	1985, 1991, 1998, 2003, 2008, 2012, 2017	Upland Stony Loam (Cliffrose)
21B-12	Dameron Canyon	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
21B-13	Walker Creek	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
21B-14	Meadow Creek	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Stony Loam (Cliffrose)
21B-15	Fillmore Cemetery East	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Mountain Loam (Oak)
21B-17	Pioneer Peak	RT	Active	1997, 2003, 2012, 2017, 2022	High Mountain Loam (Mountain Big Sagebrush)
21B-18	Teeples Ridge	RT	Active	1997, 2003, 2012, 2017, 2022	High Mountain Loam (Mountain Big Sagebrush)
21B-19	Teeples Terrace	RT	Active	1997, 2003, 2012, 2017, 2022	High Mountain Loam (Mountain Big Sagebrush)
21B-20	Dog Valley Creek	RT	Active	2017, 2022	Upland Loam (Mountain Big Sagebrush)
21B-23	Baker Canyon	RT	Active	1998, 2003, 2008, 2012, 2017, 2022	Upland Loam (Wyoming Big Sagebrush)
21R-1	Corn Creek	RT	Suspended	1997, 2003, 2012	Mountain Shallow Loam (Mountain Big Sagebrush)
21R-2	Wide Canyon Bullhog	WRI	Active	2004, 2008, 2013, 2017, 2021	Upland Loam (Wyoming Big Sagebrush)
21R-3	Dry Creek	WRI	Suspended	2004, 2008	Not Verified
21R-4	Dry Creek Chaining	WRI	Suspended	2008, 2009, 2010, 2015	Upland Stony Loam (Mountain Big Sagebrush)
21R-8	A&F Aerial Seeding	WRI	Suspended	2008, 2011, 2017	Semidesert Loam (Wyoming Big Sagebrush)
21R-9	A&F Aerial Seeding 2	WRI	Suspended	2008, 2011, 2017	Semidesert Loam (Wyoming Big Sagebrush)
21R-10	A&F Drill 3	WRI	Suspended	2008, 2011, 2017	Desert Loam (Shadscale)
21R-11	Kanosh Lop and Scatter	WRI	Active	2008, 2011, 2014, 2019	Upland Stony Loam (Wyoming Big Sagebrush)
21R-12	Water Canyon	WRI	Active	2009, 2012, 2016, 2021	Upland Loam (Bonneville Big Sagebrush)
21R-13	Water Canyon Reference	WRI	Suspended	2009	Not Verified
21R-14	Wide Mouth Canyon	WRI	Active	2011, 2014, 2019	Upland Loam (Wyoming Big Sagebrush)
21R-16	Wide Mouth Canyon 2	WRI	Active	2013, 2016, 2021	Upland Gravelly Loam (Wyoming Big Sagebrush)
21R-17	Pioneer Creek	WRI	Active	2013, 2016, 2021	Mountain Loam (Oak)
21R-18	Ezra Flat	WRI	Active	2013, 2016, 2021	Upland Stony Loam (Black Sagebrush)

Table 8.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 21B, Fillmore - Pahvant.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
21B-6	M Hill	Chain Unknown		Historic		
21B-7	Bennett Field	Chain Unknown		1958		
21B-8	Smiths Ridge	Chain Unknown		Late 1950s or early 1960s		
		Wildfire	Swains Fire	August 2000	7,898	
		Aerial	Fire Rehabilitation-Swains Fire Q-619	2001	1,000	
21B-9	Wide Canyon BLM	Two-Way Unknown	Holden Seeding	1965	2,668	
		Aerial Before	Holden Seeding	1965	2,668	
		Bullhog	BLM Project	2006	1,500	
21B-10	Wide Canyon DWR	Chain Unknown		1950s		
		Seed Unknown		1950s		
		Chain Unknown		1998-2003		
21B-11	Dog Valley	Wildfire	Dog Valley Peak	July 1996	217	
		Wildfire	Dog Valley	July-August 2006	28,664	
21B-12	Dameron Canyon	Wildfire	Dry Wash	July 2008	324	
		Chain Unknown		1985		
21B-13	Walker Creek	Push	Meadow Creek Seeding	1966	270	
		Prescribed Burn	FFO Meadow Phase 2	March 2016	243	3075
21B-14	Meadow Creek	Aerial Before	Meadow Creek Fire Rehabilitation and Stabilization Project	November 2019-January 2020	1,444	5148
		Aerial After	Meadow Creek Fire Rehabilitation and Stabilization Project	January 2020-June 2021	1,444	5148
		Dribbler/Broadcast Before	Meadow Creek Seeding	1966	1,770	
		Two-Way Unknown	Meadow Creek Seeding	1966	1,770	
		Aerial Before	Meadow Creek Seeding	1966	1,770	
21B-15	Fillmore Cemetery East	Chain Unknown		1973		
		Seed Unknown		1973		
		One-Way Dixie	Fillmore WMA Juniper Thinning	November 2008	156	408
		Broadcast Before	Fillmore WMA Juniper Thinning	November 2008	156	408
		Plateau	Fillmore WMA Juniper Thinning	November-December 2008	156	408
21B-17	Pioneer Peak	Contour Trench		Historic		
		Seed Unknown		Historic		
21B-18	Teeples Ridge	Seed Unknown		Historic		
21B-19	Teeples Terrace	Contour Trench		Historic		
		Seed Unknown		Historic		
21B-20	Dog Valley Creek	Wildfire	Dog Valley	July-August 2006	28,664	
		Wildfire	Dog Valley Peak	July 1996	217	
21B-23	Baker Canyon	Rangeland Drill	Horse Hollow Seeding	1967	2,200	
		Prescribed Fire		Prior to 1991		
		Plow	Horse Hollow Seeding	1967	2,200	
21R-1	Corn Creek	Wildfire	Adelaide	1996	15,706	
21R-2	Wide Canyon Bullhog	Chain Unknown		Late 1950s		
		Seed Unknown		Historic		
		Bullhog	Fillmore WMA Bullhog	March-April 2005	488	85
21R-4	Dry Creek Chaining	Two-Way Ely	Dry Creek Chaining	December 2006-February 2007	847	86
		Aerial Before	Dry Creek Chaining	January 2007	847	86
		Lop and Scatter	Dry Creek Meadow Canyon Phase II Restoration Project	September-October 2016	1,402	3699
21R-8	A&F Aerial Seeding	Wildfire	Milford Flat	July 2007	363,052	
		Rangeland Drill	Milford Flat Fire Rehabilitation - Missouri Flat	January 2008	7,925	1007
21R-9	A&F Aerial Seeding 2	Wildfire	Milford Flat	2007	363,052	
		Aerial	Milford Flat Fire Rehabilitation - JK	January-February 2008	265	1010
21R-10	A&F Drill 3	Wildfire	Milford Flat	July 2007	363,052	
		Rangeland Drill	Milford Flat Fire Rehabilitation - BG	November 2007	2,896	1006
		Wildfire	Twin Peaks Fire	July 1986	19,840	
21R-11	Kanosh Lop and Scatter	Chain Unknown		1960s		
		Seed Unknown		1960s		
		Lop and Scatter	Fillmore WMA Juniper thinning	May 2008	575	408

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
21R-12	Water Canyon	Bullhog	Cancelled (Water Canyon Forage Enhancement WRI #1493)	Spring 2009		USFS
		Prescribed		Fall 2012-Spring 2013		
21R-13	Water Canyon Reference	Unknown		Historic		
		Unknown		Historic		
21R-14	Wide Mouth Canyon	Two-Way Ely	Wide Mouth Canyon Chaining Phase III Project	August 2011-February 2012	237	1972
		Plateau	Wide Mouth Canyon Chaining Phase III Project	August 2011-February 2012	237	1972
		Aerial Before	Wide Mouth Canyon Chaining Phase III Project	August 2011-February 2012	237	1972
		Dribbler	Wide Mouth Canyon Chaining Phase III Project	August 2011-February 2012	237	1972
		Aerial After	Wide Mouth Canyon Chaining Phase III Project	February 2012	237	1972
21R-16	Wide Mouth Canyon 2	Lop and Scatter	Central Utah Chaining Maintenance Project Phase II	May-June 2021	5,219	5761
		Two-Way Ely	Widemouth Canyon Chaining Phase V	September-October 2013	1,155	2727
		Aerial Before	Widemouth Canyon Chaining Phase V	September-October 2013	1,155	2727
		Aerial After	Widemouth Canyon Chaining Phase V	February 2014	1,155	2727
		Dribbler	Widemouth Canyon Chaining Phase V	September-October 2013	1,155	2727
21R-17	Pioneer Creek	Two-Way Ely	Pioneer WMA Bullhog	November 2013-March 2014	102	2665
		Aerial Before	Pioneer WMA Bullhog	November 2013	102	2665
21R-18	Ezra Flat	Unknown		Historic	1,100	
		Bullhog	Ezra Flat Winter Range Restoration	November 2013-April 2014	1,048	2623
		One-Way Ely Chaining	Red Canyon Habitat Restoration Project Phase I	Fall 2019	470	4625
		Aerial Before	Red Canyon Habitat Restoration Project Phase I	Fall 2019	470	4625
		Aerial After	Red Canyon Habitat Restoration Project Phase I	Fall 2019	470	4625
		Spike	Red Canyon Habitat Restoration Project Phase I	Spring 2021	177	4625

Table 8.4: Range Trend and WRI studies known disturbance history for WMU 21B, Fillmore - Pahvant. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

There are three study sites [Pioneer Peak (21B-17), Teeples Ridge (21B-18), and Teeples Terrace (21B-19)] that are classified as Mountain (Big Sagebrush) ecological sites. The Pioneer Peak study is located on the east side of Pioneer Peak on the Pahvant Range. The Teeples Ridge and Teeples Terrace studies are located on Teeples Ridge in the Pahvant Range east of Fillmore (**Table 8.3**).

Shrubs/Trees: The browse component on the Teeples Terrace and Teeples Ridge study sites is dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), while shrubs have remained rare on Pioneer Peak. Average sagebrush cover has increased each sample year (mainly due to the Teeples Terrace study), but has remained under 2% throughout the study period. Other shrubs have not been observed in cover measurements in any sample year (**Figure 8.9**). Average preferred browse demographics show that total density remains low as of 2022, but has increased overall. Mature plants have comprised a majority of the browse populations on these sites in most years, but young individuals were the dominant age class in 1998 and 2017. Recruitment of young and decadence have otherwise remained low (**Figure 8.16**). Average preferred browse utilization remains low, but has increased over time; just over 10% of plants exhibited signs of moderate use in 2022 (**Figure 8.18**).

Trees have not been observed in either cover or density measurements in any sample year and will therefore not be discussed in this section (**Figure 8.12**, **Figure 8.14**).

Herbaceous Understory: Average herbaceous cover and frequency values on these sites have increased over time. Introduced perennial grasses such as smooth brome (*Bromus inermis*) and intermediate wheatgrass (*Thinopyrum intermedium*) have been the primary herbaceous component on these studies in all sample years; although they contribute less cover, native perennial grass species are also present. Native perennial forbs provide significant amounts of cover on all three study sites. Annual forbs have remained comparatively rare, and annual grasses have not been observed in any sample year (**Figure 8.20**, **Figure 8.22**).

Occupancy: Elk were the primary occupants of these study sites in 2012 and 2017, while cattle had the highest presence in 2003 and 2022. Mean abundance of elk pellet groups has ranged from 5 days use/acre in 2022 to nearly 24 days use/acre in 2012. Cattle have had an average pellet group abundance as low as 4 days use/acre in 2017 and as high as 21.5 days use/acre in 2003. Finally, deer presence has varied between 0 days use/acre in 2017 and just over 3 days use/acre in 2022 (**Figure 8.24**).

Mountain (Oak)

Two studies [M Hill (21B-6) and Fillmore Cemetery East (21B-15)] are considered to be Mountain (Oak) ecological sites. The M Hill study is located in the foothills east of Fillmore, while Fillmore Cemetery East is situated in the foothills southeast of Fillmore (**Table 8.3**).

Shrubs/Trees: Browse species on these sites include (but are not limited to): alderleaf mountain mahogany (*Cercocarpus montanus*), Gambel oak (*Quercus gambelii*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), antelope bitterbrush (*Purshia tridentata*), and Stansbury cliffrose (*P. stansburiana*). Average oak cover has exhibited a marginal general increase, while that of other preferred browse species has fluctuated from year to year (**Figure 8.10**). Total preferred browse density has increased overall, with mature plants as the dominant age class in most sample years. Recruitment of young has decreased each year since 2012, but has slightly increased when comparing 1998 to 2022 data. Decadence has remained low (**Figure 8.16**). Utilization of preferred browse increased over the sample period; in 2022, nearly 28% of plants were moderately browsed and 8% were heavily hedged (**Figure 8.18**).

Utah juniper (*Juniperus osteosperma*) is present on both study sites. Tree cover and density (to a lesser extent) have increased over time, with M Hill being more encroached than the Fillmore Cemetery East study (**Figure 8.12**, **Figure 8.14**).

Herbaceous Understory: The understories of these studies are mixed, with both introduced and native plant species present. Annual grasses and forbs contributed most of the herbaceous cover in 1998 and 2017, while perennial grasses dominated in most other years. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) increased in cover, however, and was considered to be the dominant herbaceous component in 2022. Perennial forbs have generally remained scarce (**Figure 8.20**, **Figure 8.22**).

Occupancy: These sites are primarily occupied by mule deer according to pellet transect data, and total animal occupancy has increased over time. Mean abundance of deer pellet groups has been as low as nearly 19 days use/acre in 2017 and as high as 72 days use/acre in 2022. Elk presence has varied between 1 days use/acre in 2017 and 4 days use/acre in 2003. Cattle pellet groups have had a mean abundance fluctuating between 0 days use/acre in 2008, 2012, and 2017 and 3 days use/acre in 1998 (**Figure 8.24**).

Upland (Big Sagebrush)

There are two study sites [Dog Valley Creek (21B-20) and Baker Canyon (21B-23)] that are classified as Upland (Big Sagebrush) ecological sites. The Dog Valley Creek study is found at the base of Dog Valley Mountain near I-15. The Baker Canyon site is located north of Baker Canyon at the base of the northern portion of the Pahvant Range (**Table 8.3**).

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the primary browse species on the Dog Valley Creek study, while Baker Canyon has been dominated by Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*). Other preferred browse species such as Nevada jointfir (*Ephedra nevadensis*) and rubber rabbitbrush (*Ericameria nauseosa* ssp. *nauseosa* var. *hololeuca*) are present on the Baker Canyon study, but contribute less cover than sagebrush. Sagebrush cover has increased over time on these sites, with a particularly significant increase occurring between 2012 and 2017: site-level data indicates that this increase was largely driven by the establishment of the Dog Valley Creek study (**Figure 8.9**). Preferred browse density has also increased over the study period, with mature plants as the dominant demographic in most sample years. However, young plants were the primary age class in 2017, with the large recruitment increase (and subsequent 2022 decrease) mainly being due to the Dog Valley Creek site. Decadence has remained comparatively low (**Figure 8.17**). Preferred browse utilization has fluctuated from year to year, but has decreased overall. In 2022, moderate and heavy utilization were observed on 24% and 4% of plants (respectively) (**Figure 8.19**).

Tree cover and density trends are mainly driven by Utah juniper (*Juniperus osteosperma*) on the Baker Canyon study. However, the decreases observed in 2017 and 2022 are in part due to the establishment of the Dog Valley Creek site: trees are absent on this study, and their absence has caused total average cover and density to decrease (**Figure 8.13**, **Figure 8.15**).

Herbaceous Understory: Both average herbaceous cover and frequency have increased over time on these sites. Understory composition has fluctuated over the study period. Perennial grasses, particularly the native species bluebunch wheatgrass (*Pseudoroegneria spicata*), provided the most cover of any single component through the 2012 sample year. The introduced annual grass species cheatgrass (*Bromus tectorum*) exhibited a flush on both the newly-established Dog Valley Creek site and existing Baker Canyon study in 2017, but decreased again in 2022. However, the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) increased in cover in 2022 on Dog Valley Creek, becoming the dominant herbaceous component in that year. Annual forbs have generally provided moderate amounts of cover, and perennial forbs have consistently been the least abundant herbaceous lifeform over the sample period (**Figure 8.21**, **Figure 8.23**).

Occupancy: These study sites have been primarily used by cattle in most sample years except 1998, when deer were the primary occupants. Cattle presence has varied between less than 1 days use/acre in 2012 and nearly 47 days use/acre in 2017. Mean abundance of deer pellet groups has been as low as 0.7 days use/acre in 2003 and 2017 and as high as 19 days use/acre in 1998. Finally, elk pellet groups were observed on the Dog Valley Creek study in 2017 and 2022 with a mean abundance of 0.7 and nearly 2 days use/acre, respectively (**Figure 8.25**).

Upland (Cliffrose)

Eight study sites [Bennett Field (21B-7), Smiths Ridge (21B-8), Wide Canyon BLM (21B-9), Wide Canyon DWR (21B-10), Dog Valley (21B-11) (suspended), Dameron Canyon (21B-12), Walker Creek (21B-13), and Meadow Creek (21B-14)] are considered to be Upland (Cliffrose) ecological sites. The Bennett Field study is located southeast of the town of Holden, and Smiths Ridge is southeast of Holden near the base of Pioneer Canyon. The Wide Canyon BLM and Wide Canyon DWR sites are situated east of Holden on the flats near Wide Canyon. Dog Valley is found at the base of Dog Valley Mountain near I-15. The Dameron Canyon study is about two miles south of the town of Kanosh, and the Walker Creek site is situated approximately two miles southeast of the town of Meadow. Finally, Meadow Creek is located roughly 2.5 miles northeast of Meadow near Halfway Hill (**Table 8.3**).

Shrubs/Trees: The browse components of these sites are mainly comprised of preferred species other than cliffrose (*Purshia stansburiana*). Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) provides most of the cover on many study sites. Total average shrub cover decreased in 2008 mainly due to a fire that occurred that year on the Dameron Canyon study. Shrub cover has increased each year since 2008, however, a trend that is largely driven by smooth sumac (*Rhus glabra*) on Dameron Canyon. Cliffrose cover has generally remained stable over time (**Figure 8.11**). Average preferred browse demographic data indicates that density of these populations has slightly decreased over the sample period. The amount of decadence has remained similar over time, although yearly fluctuations have occurred; the increase in decadence between 2017 and 2022 can largely be attributed to the Walker Creek and Smiths Ridge studies. Mature plants have comprised a majority of the populations on these sites, and recruitment of young has remained low in most sample years (**Figure 8.17**). Preferred browse utilization has fluctuated from year to year, but more than 50% of plants have been lightly browsed or not used at all in most sample years. In 2022, 18% of plants were moderately hedged and nearly 7% were heavily hedged (**Figure 8.19**).

Utah juniper (*Juniperus osteosperma*) is present on sites of this ecotype, and both cover and density have increased over time. These tree trends are in large part driven by the Meadow Creek study, although smaller increases in density and cover have also occurred on other sites (**Figure 8.13**, **Figure 8.15**).

Herbaceous Understory: The herbaceous understories of these sites have been mainly comprised of annual grasses – namely cheatgrass (*Bromus tectorum*) and field brome (*B. arvensis*) – and/or forbs throughout the study period. Site-level data reveals that particularly high annual grass cover has been observed in many years on the Walker Creek, Dameron Canyon, Dog Valley, Wide Canyon BLM, and Bennett Field studies. In addition, weedy species such as redstem stork's bill (*Erodium cicutarium*) and desert madwort (*Alyssum desertorum*) have contributed much of the annual forb cover on these sites. Cover and frequency of the introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) have increased over time; more specifically, bulbous bluegrass contributed over 10% understory cover in 2022 on all studies except Meadow Creek and Walker Creek. Perennial grasses other than bulbous bluegrass have exhibited fluctuations in cover and abundance from year to year, but have generally remained stable. Perennial forbs have remained rare throughout the sample period (**Figure 8.21**, **Figure 8.23**).

Occupancy: Average pellet transect data shows that animal presence has decreased over time and that deer are the primary occupants of these study sites. Mean abundance of deer pellet groups has fluctuated between 37 days use/acre in 2017 and nearly 136 days use/acre in 2003. Elk have also been present, with an average pellet group abundance as low as 1.5 days use/acre in 2003 and as high as nearly 5 days use/acre in 1998. Finally, the average abundance of cattle pellet groups has varied between just over 2 days use/acre in 2022 and 4 days use/acre in 2008 and 2012 (**Figure 8.25**).

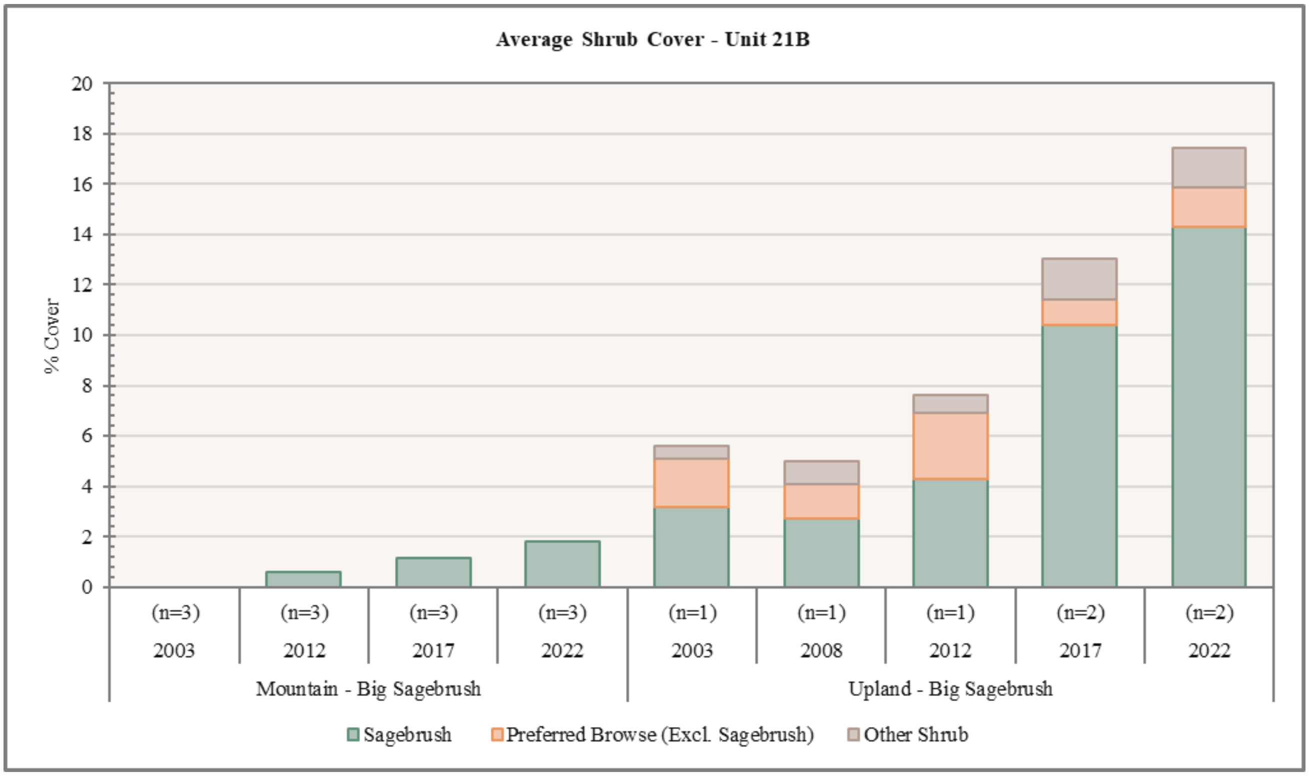


Figure 8.9: Average shrub cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 21B, Fillmore - Pahvant.

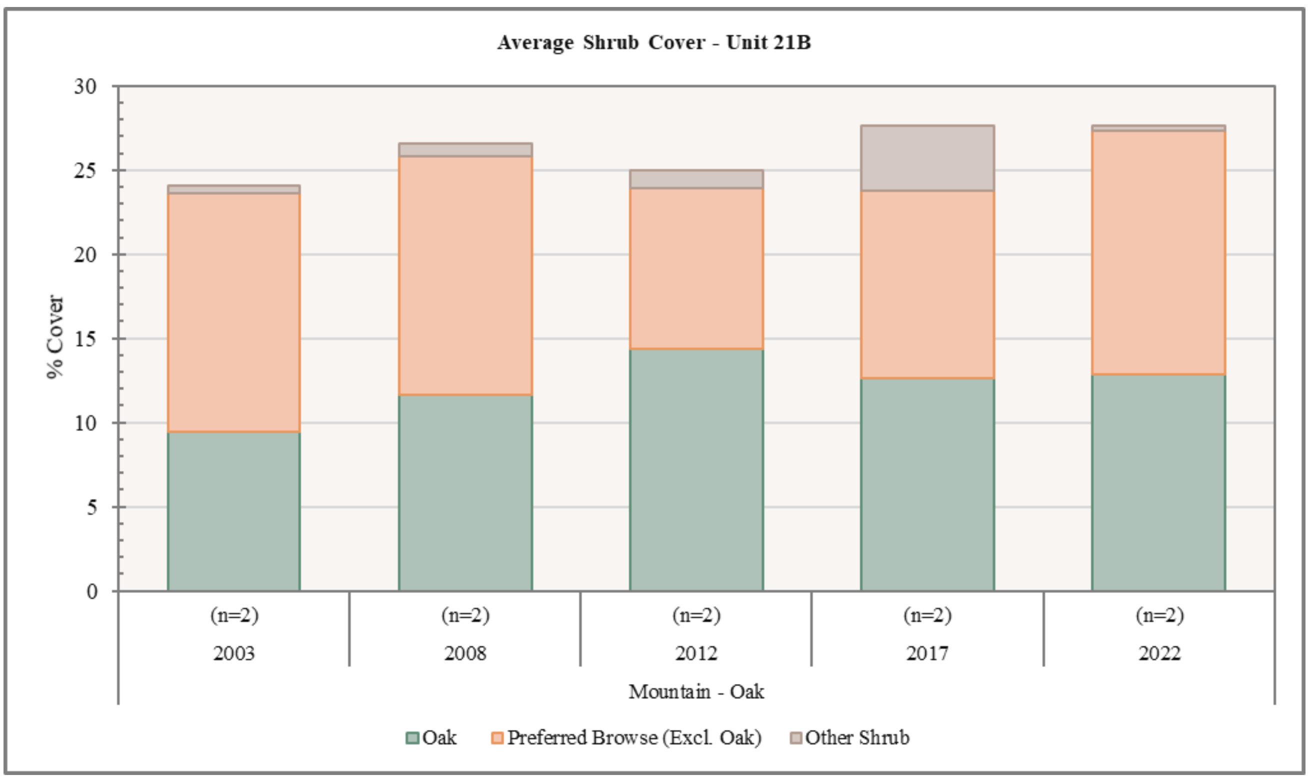


Figure 8.10: Average shrub cover for Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

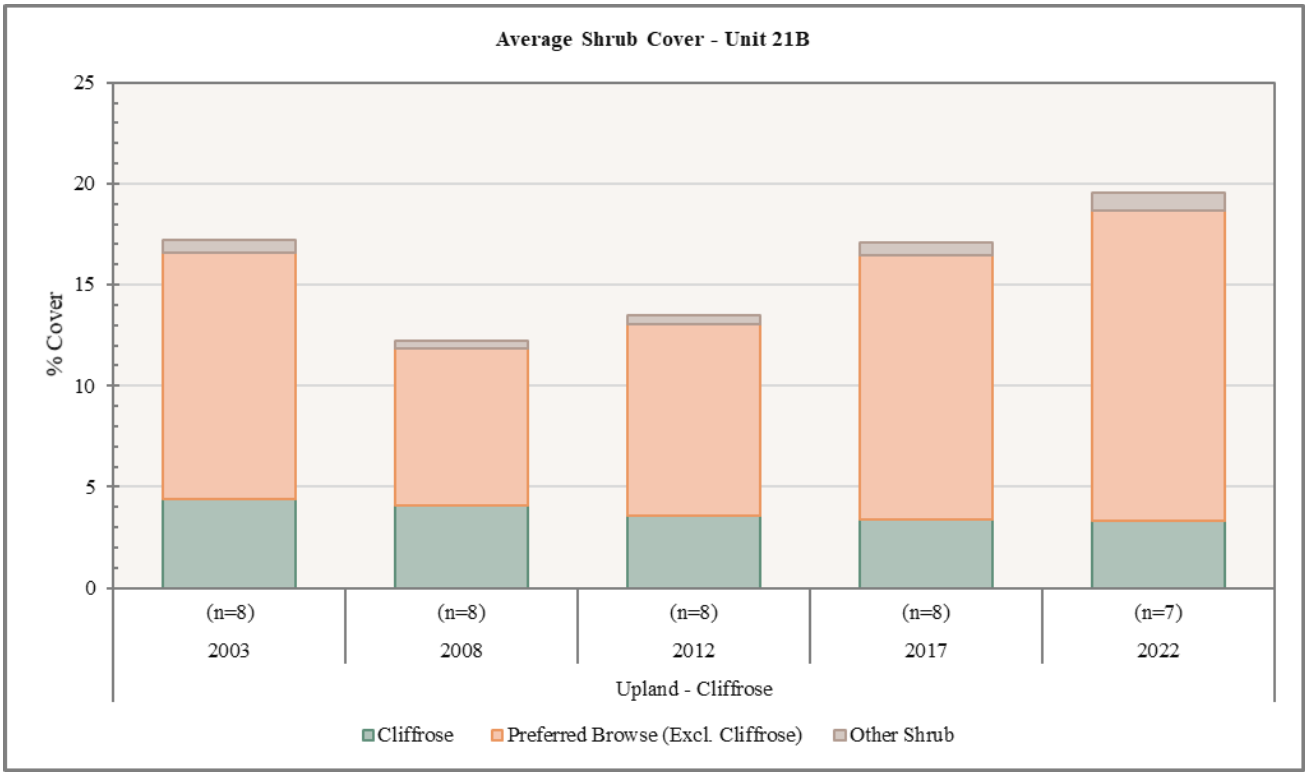


Figure 8.11: Average shrub cover for Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

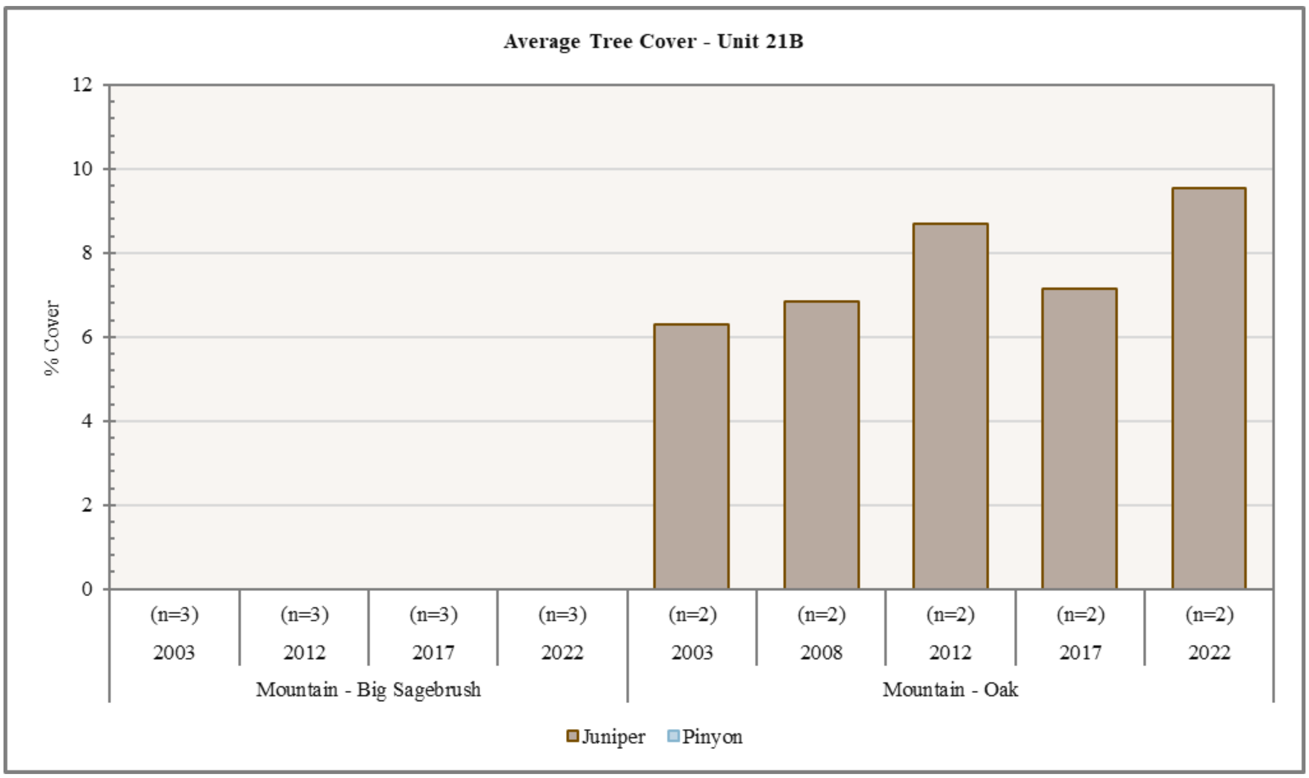


Figure 8.12: Average tree cover for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

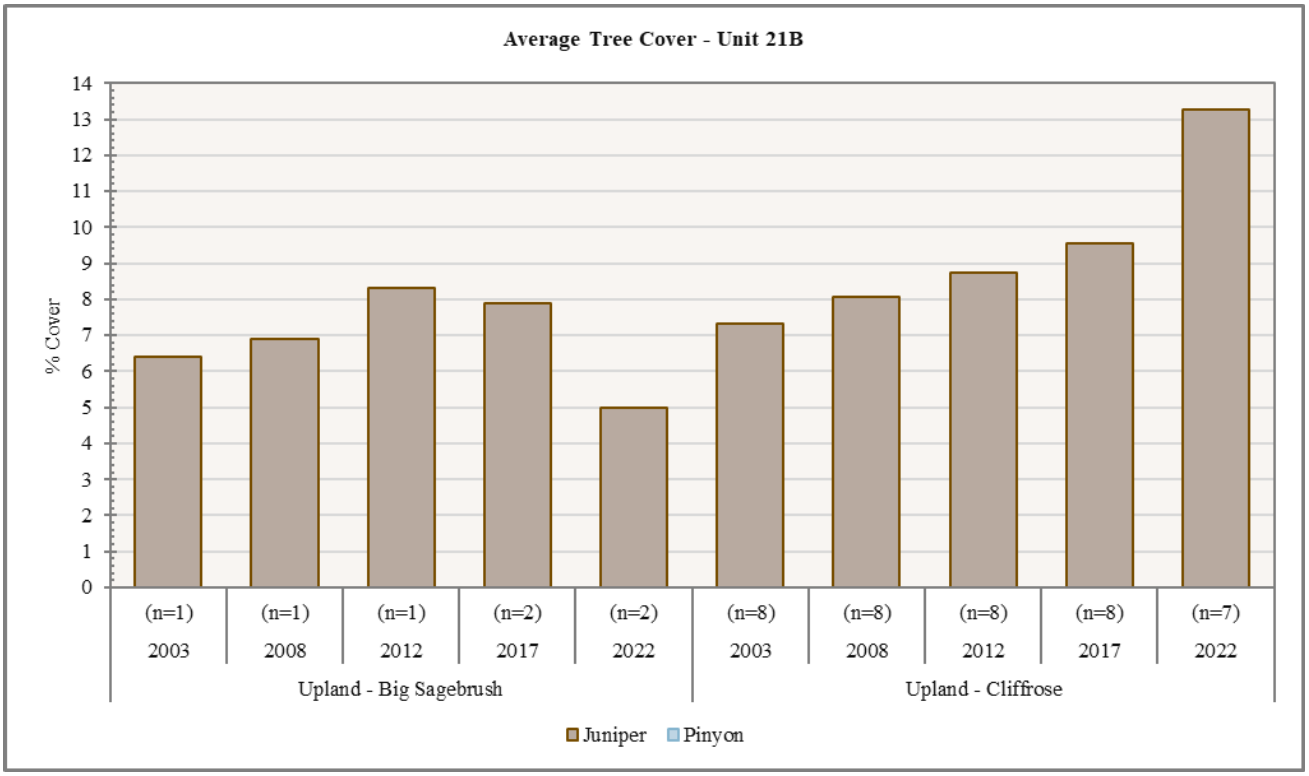


Figure 8.13: Average tree cover for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

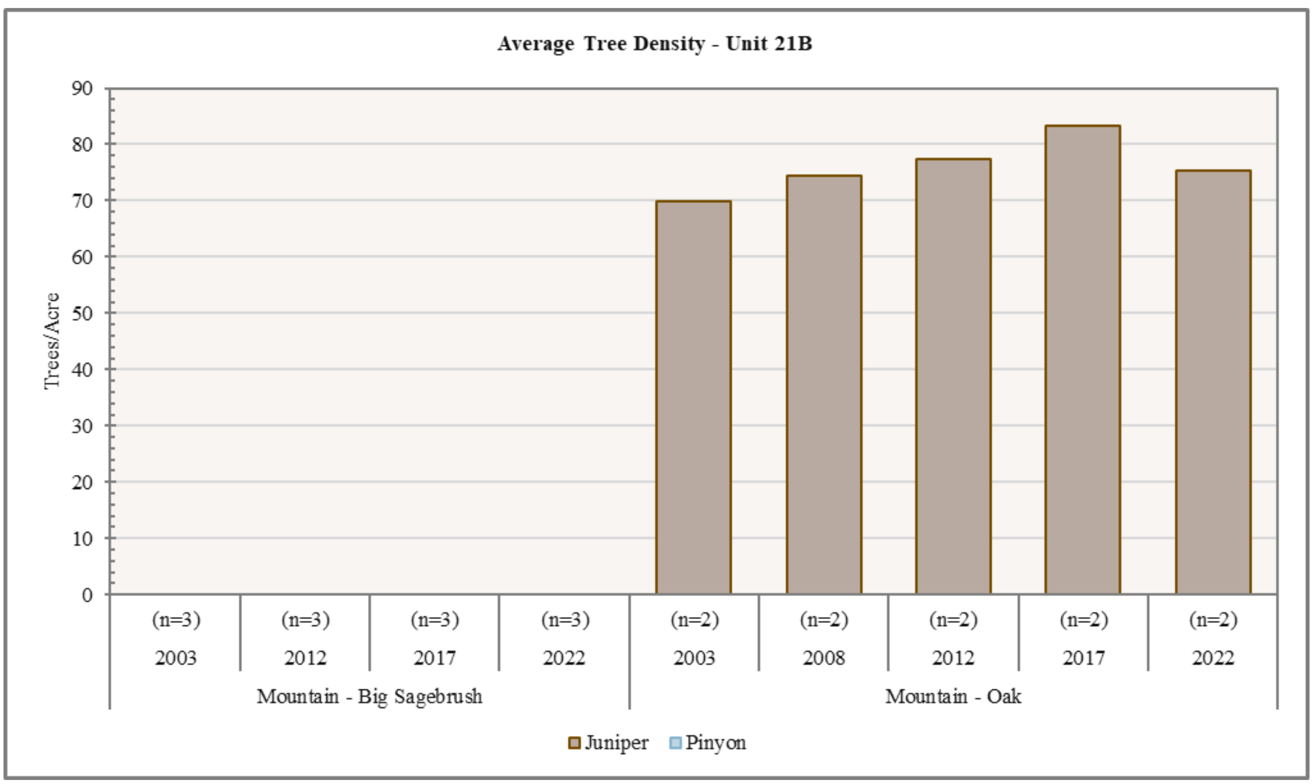


Figure 8.14: Average tree density for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

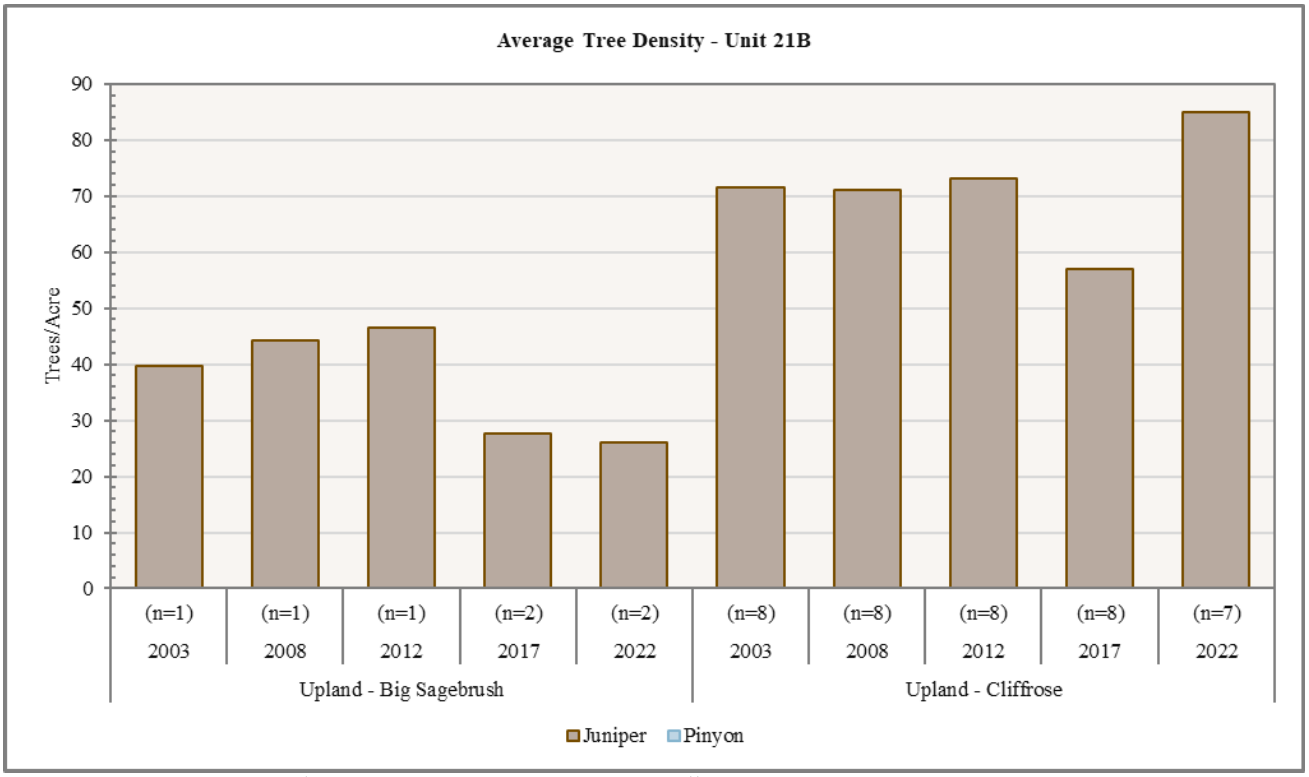


Figure 8.15: Average tree density for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

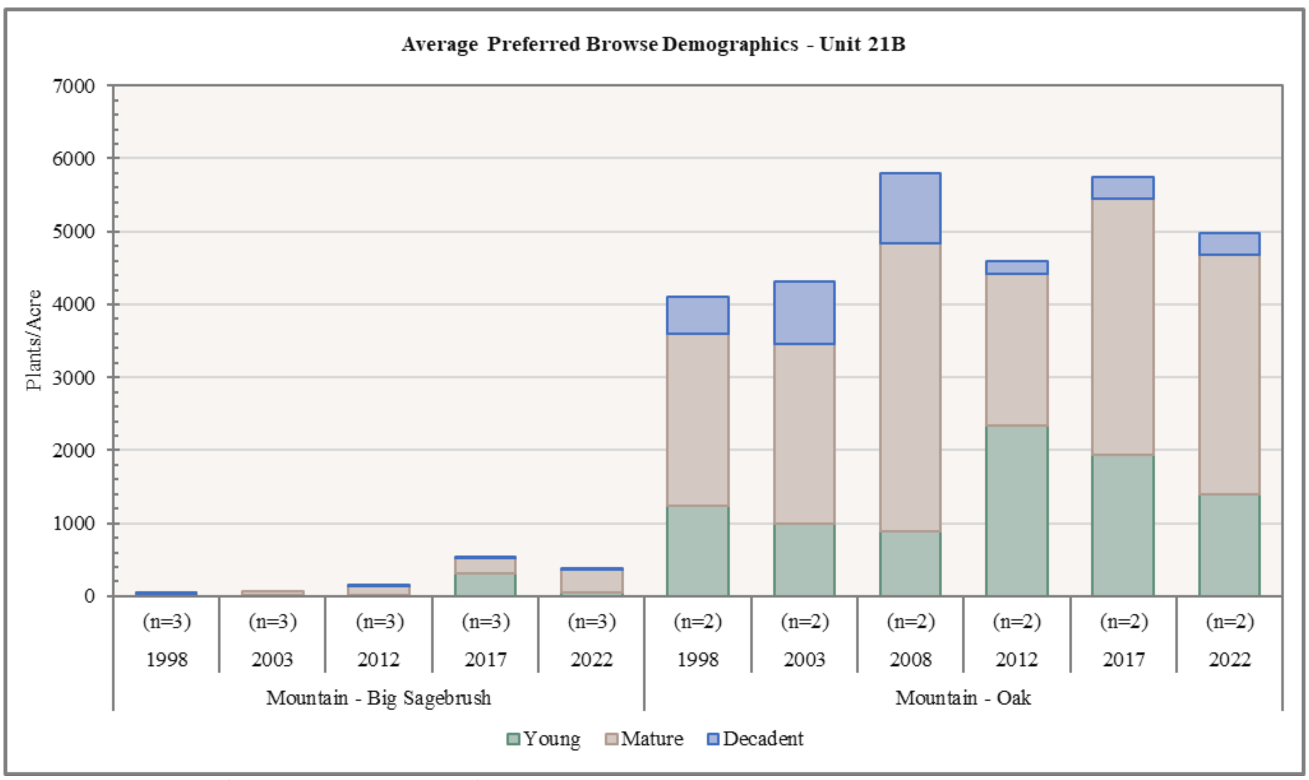


Figure 8.16: Average preferred browse demographics for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

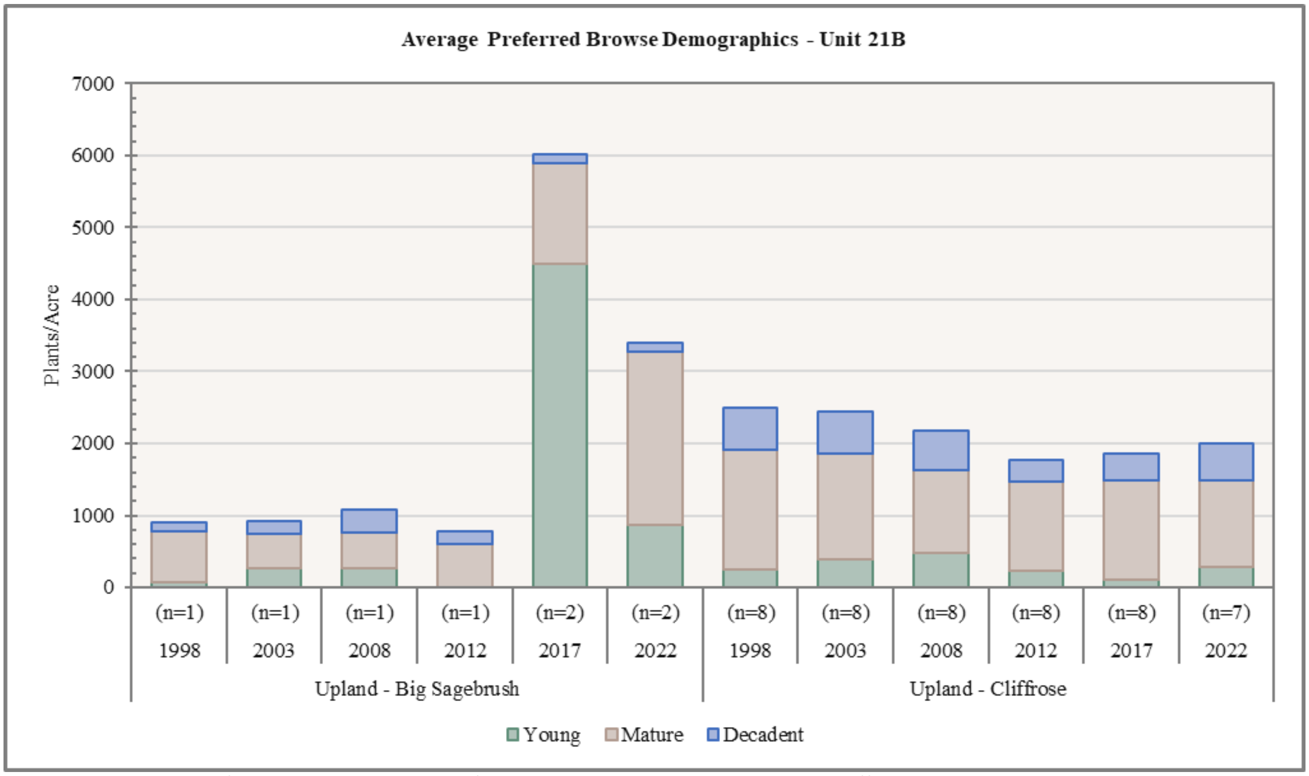


Figure 8.17: Average preferred browse demographics for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

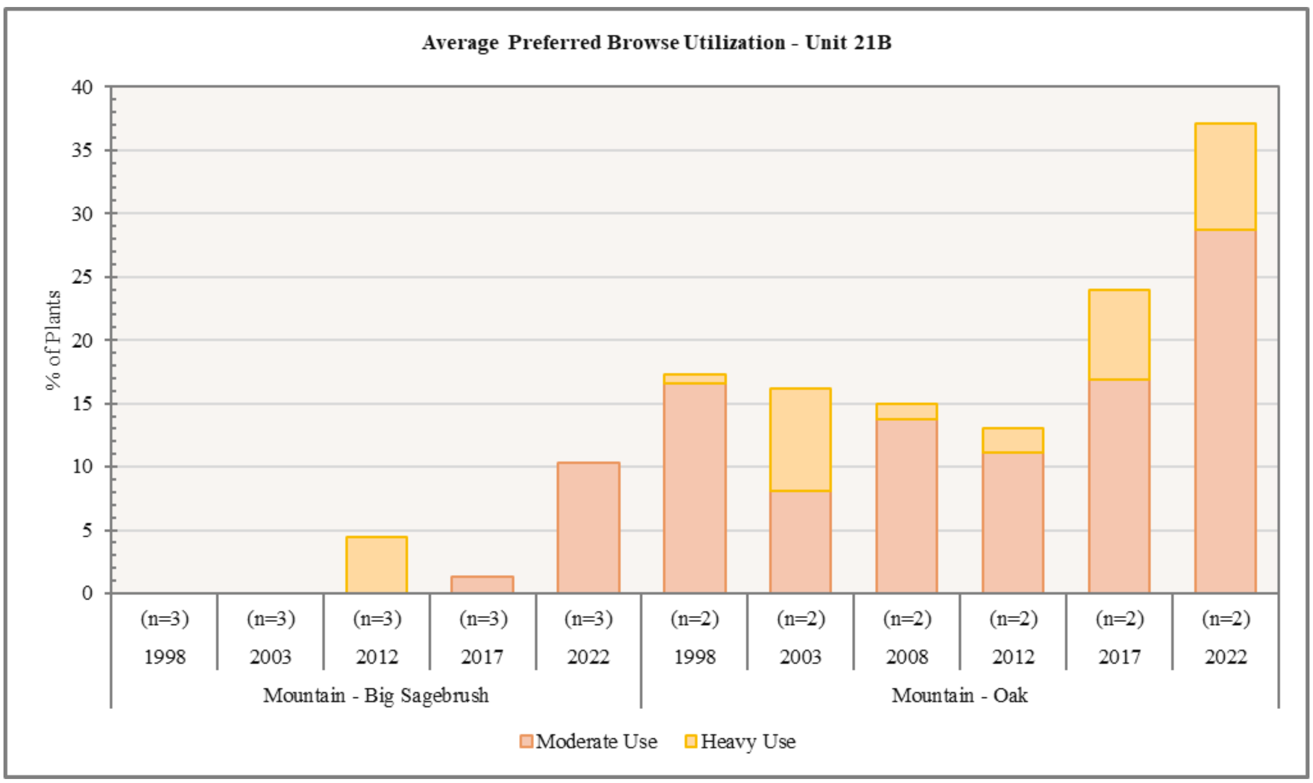


Figure 8.18: Average preferred browse utilization for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

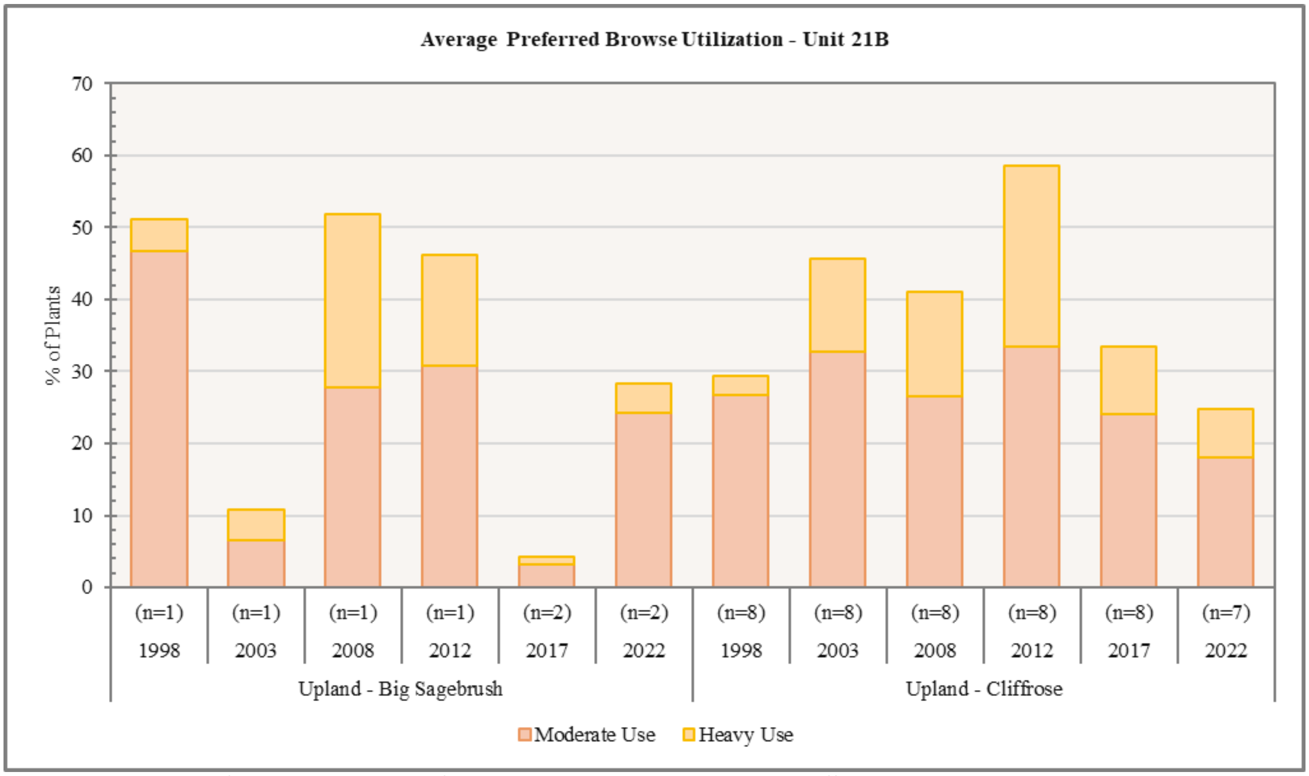


Figure 8.19: Average preferred browse utilization for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

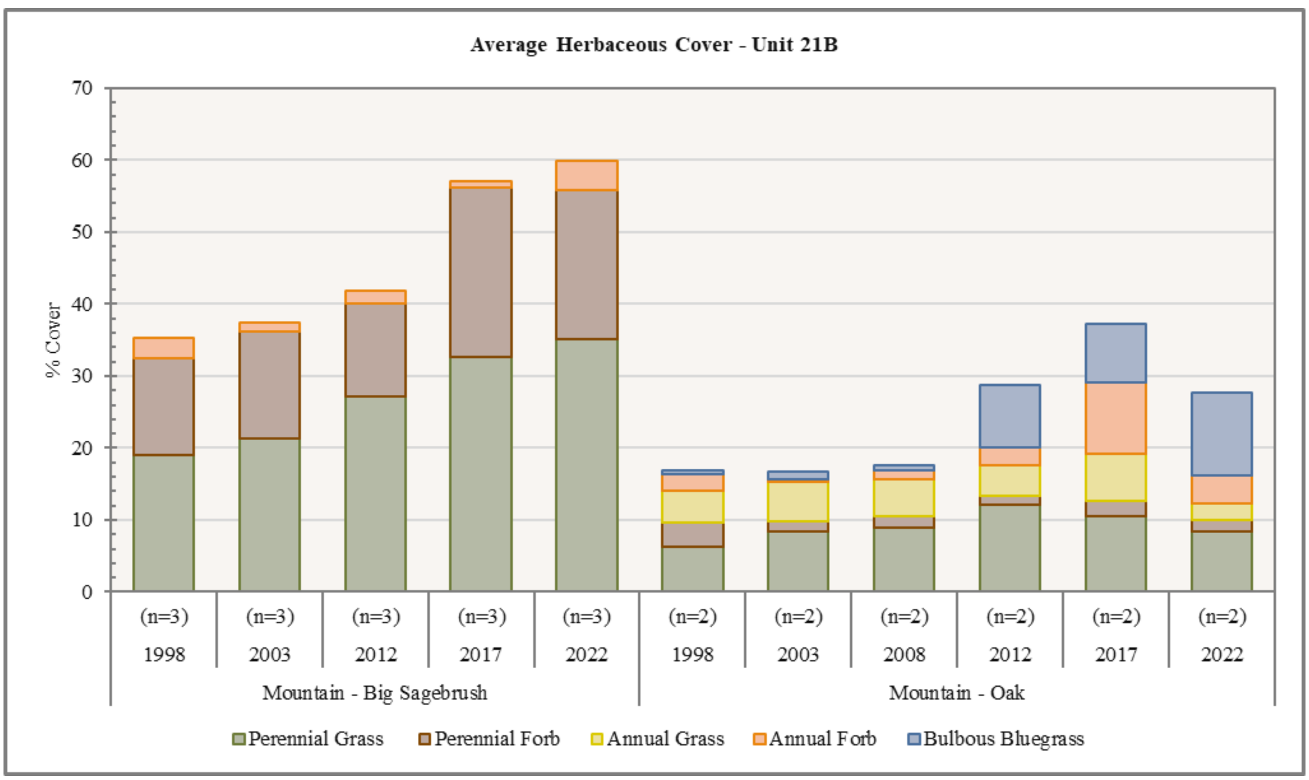


Figure 8.20: Average herbaceous cover for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

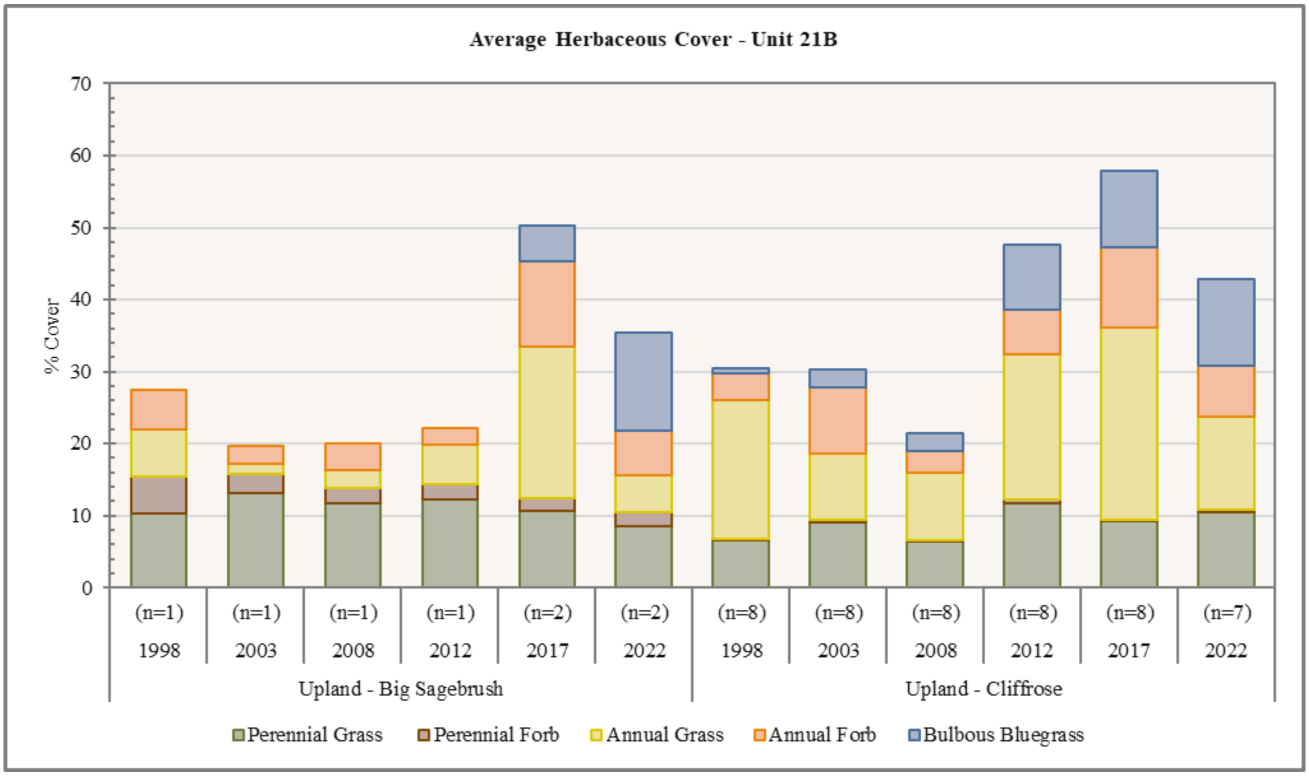


Figure 8.21: Average herbaceous cover for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

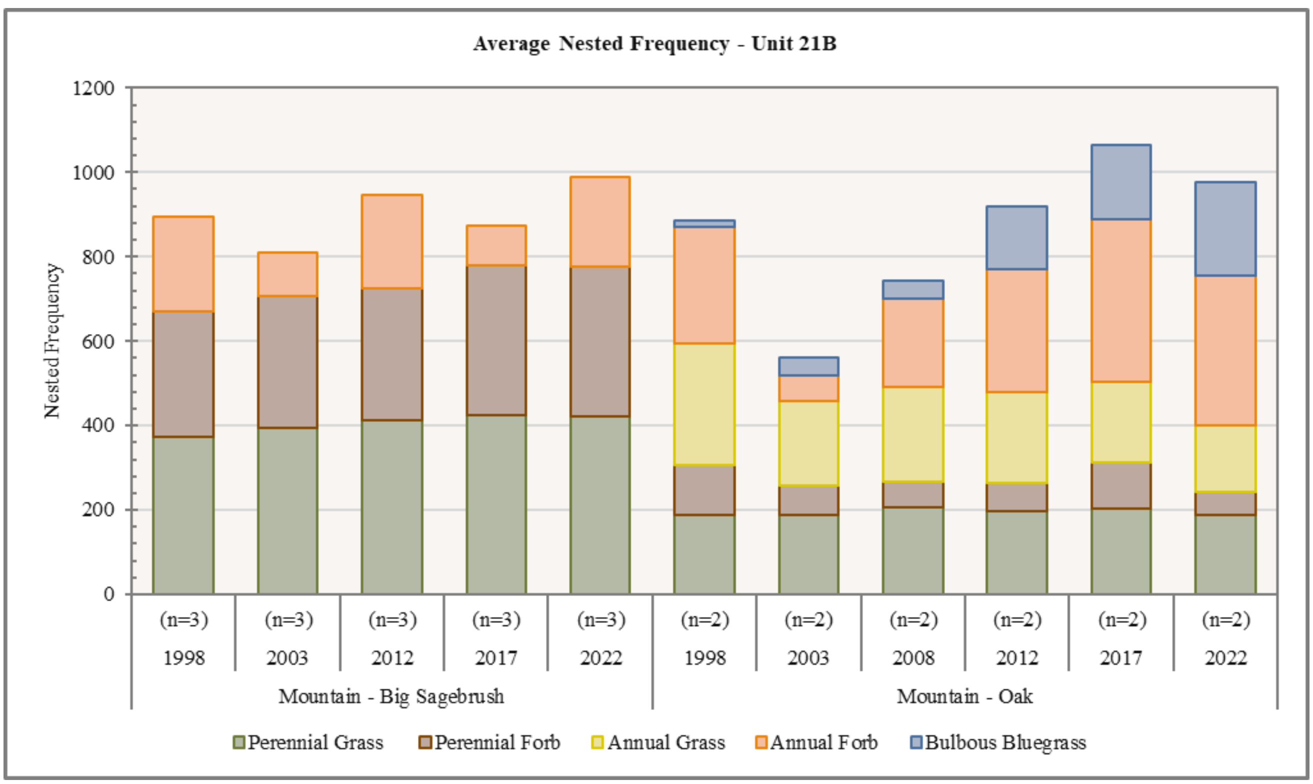


Figure 8.22: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

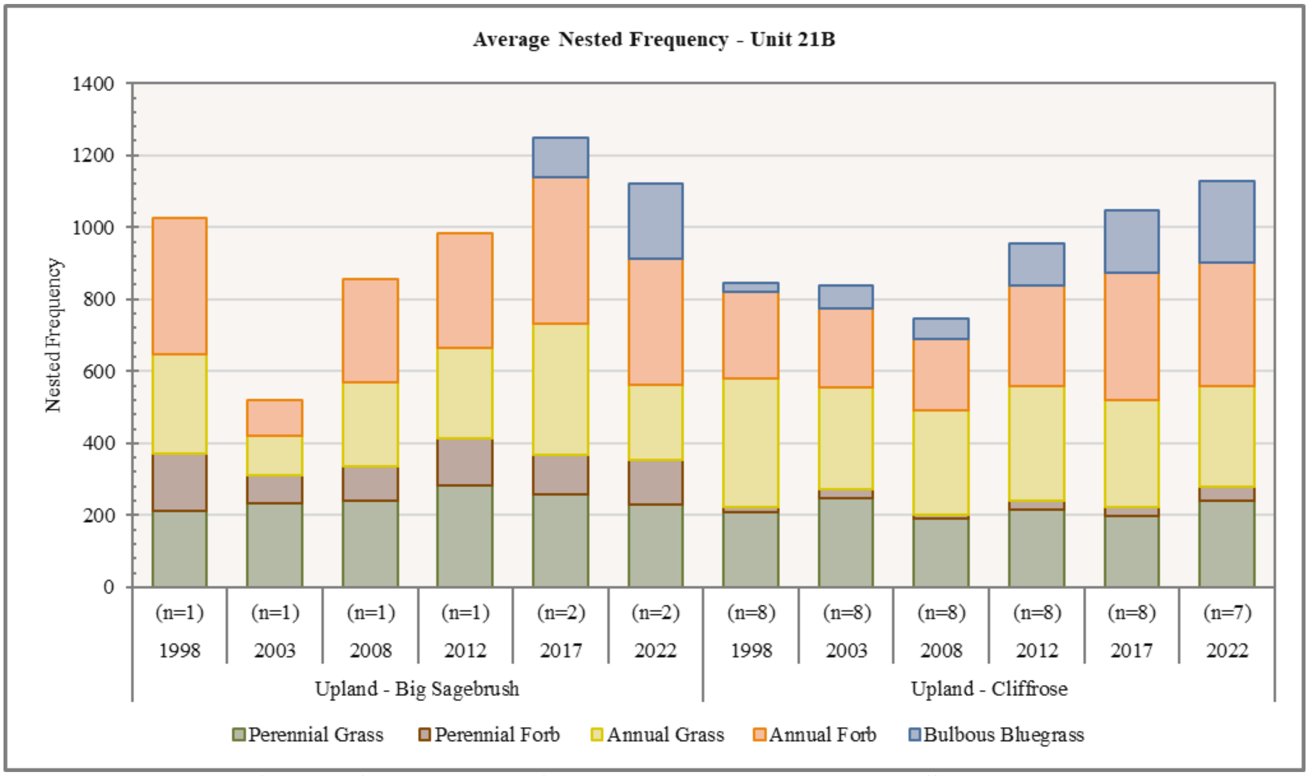


Figure 8.23: Average nested frequency of herbaceous species for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

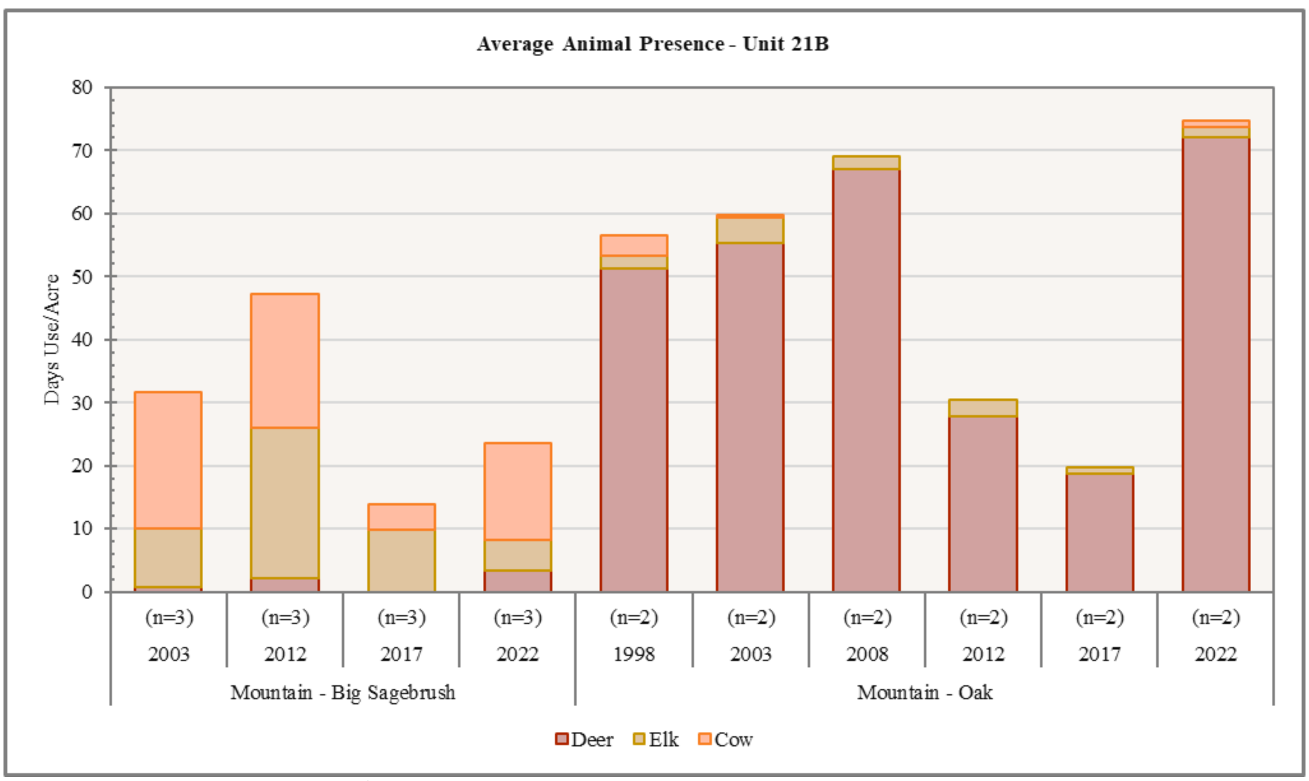


Figure 8.24: Average pellet transect data for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 21B, Fillmore - Pahvant.

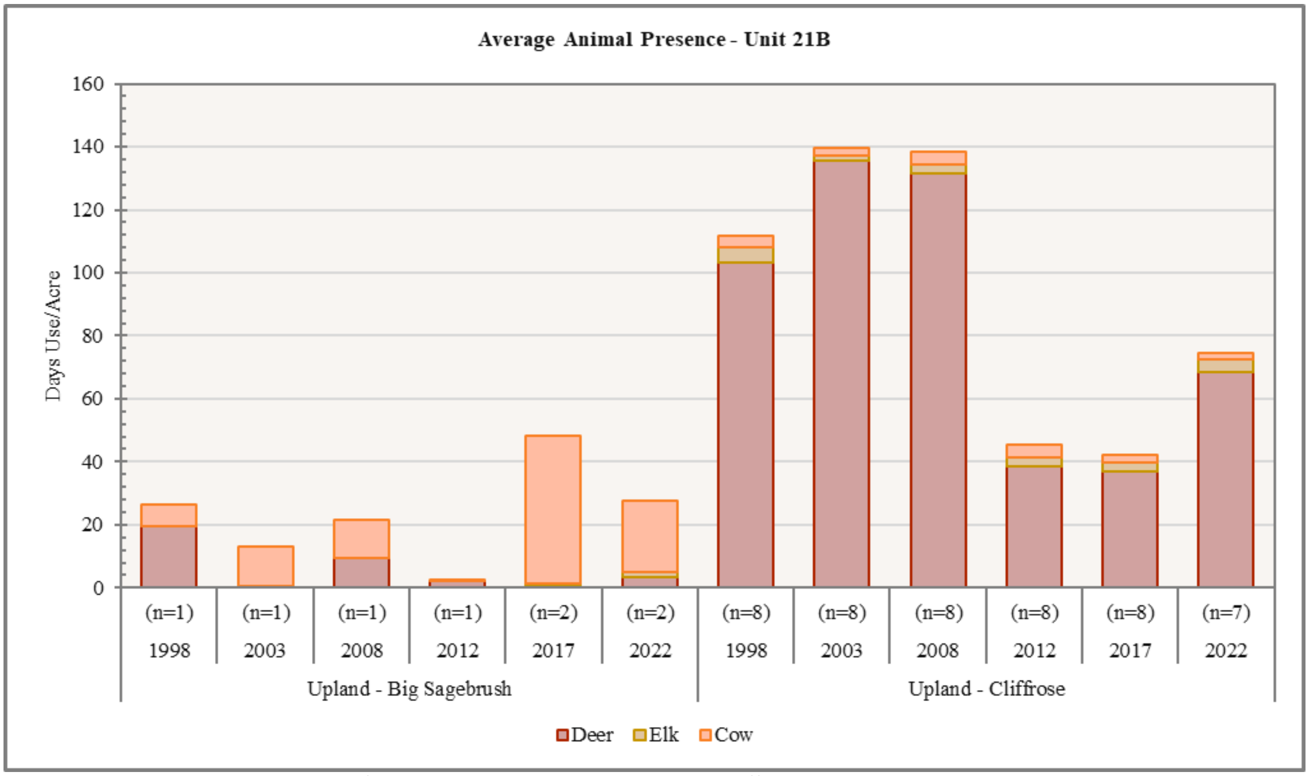
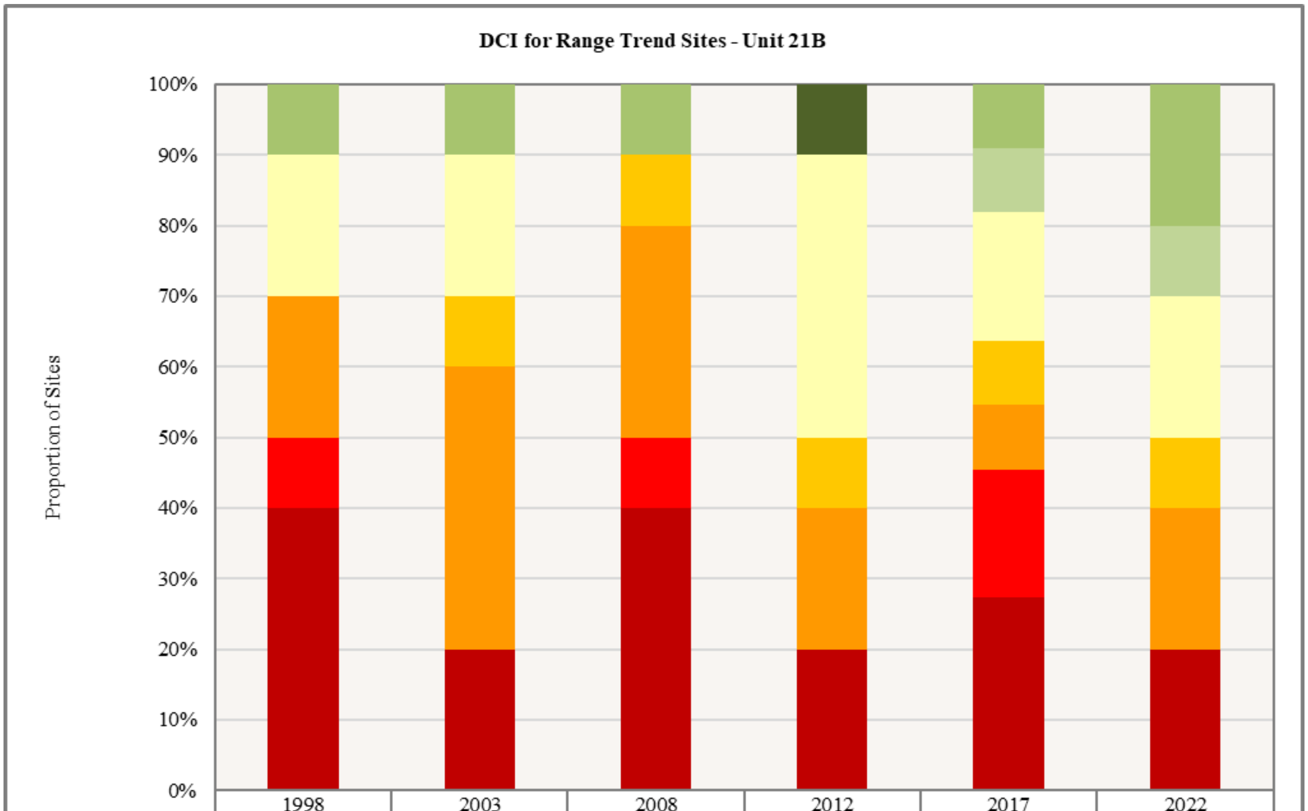


Figure 8.25: Average pellet transect data for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 21B, Fillmore - Pahvant.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Fillmore-Pahvant management unit has generally improved from an average of very poor-poor in 1998 to poor-fair averaged conditions in 2022. M-Hill (21B-6) and Wide Canyon (21B-10) are the main drivers for the unit's wintering habitat stability and quality, and average between good and fair deer winter range conditions, respectively. However, juniper encroachment on M-Hill is an issue: with tree reduction there will likely be improvement in shrub production and health. Bennett Field (21B-7), Wide Canyon (21B-9), Dog Valley (21B-11), Dameron Canyon (21B-12), Walker Creek (21B-13), and Meadow Creek (21B-14) are consistently considered to have very poor to poor wintering habitat conditions from year to year, which suppresses the unit's overall quality of winter habitat. Range Trend sites in WMU 21B that tend to have higher variability in deer winter habitat include Wide Canyon DWR (21B-10) and Smiths Ridge (21B-8). Both studies appear to have the highest degree of potential winter range improvement, and may benefit and respond the most to improvement projects.

The overall deer winter range assessment in 2022 for WMU 21B was that the unit was in poor-fair condition. Factors contributing to this poor-fair condition are the presence of annual grass, low abundance of perennial grasses and forbs, and a lack of preferred shrub recruitment (**Figure 8.26**, **Table 8.5**).



	1998	2003	2008	2012	2017	2022
Excellent				1		
Good	1	1	1		1	2
Fair-Good					1	1
Fair	2	2		4	2	2
Poor-Fair		1	1	1	1	1
Poor	2	4	3	2	1	2
Very Poor-Poor	1		1		2	
Very Poor	4	2	4	2	3	2

Figure 8.26: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 21B, Fillmore - Pahvant.

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
21B-6	1998	17.6	12.8	15	18.5	-1.6	10	0	**72.3**	**G**
21B-6	2003	24	10.3	14.4	24	-0.1	4.6	0	**77.1**	**G**
21B-6	2008	23.5	11.4	6.2	26.4	-0.2	5.5	0	**72.8**	**G**
21B-6	2012	30	14	15	30	-0.2	4.3	0	**93.1**	**E**
21B-6	2017	24.4	14	15	30	-1.6	5.6	0	**87.4**	**G**
21B-6	2022	30	13.9	13.7	20.1	-0.2	4.2	0	**81.7**	**G**
21B-7	1998	19	5.2	2.9	9	-20	1.4	0	**17.5**	**VP**
21B-7	2003	30	1.7	0.3	19.4	-9.7	1.2	0	**42.8**	**P**
21B-7	2008	27.8	-2.5	4.8	12.9	-11.1	0.1	0	**31.9**	**VP**
21B-7	2012	29.1	5.5	0.5	30	-16.5	0.7	0	**49.3**	**P-F**
21B-7	2017	27.6	3.2	1.9	16.2	-14.4	0.5	0	**35**	**VP-P**
21B-7	2022	29.9	2.1	0	24.1	-7.5	1	0	**49.6**	**P-F**
21B-8	1998	28.8	13.4	5.1	17.1	-7	0.3	0	**57.7**	**F**
21B-8	2003	7.6	11.9	12.7	15.4	-8.9	3.5	0	**42.1**	**P**
21B-8	2008	9.7	10.1	15	18.1	-4.8	0	0	**48**	**P**
21B-8	2012	12.2	13.7	3.4	28.8	-2	0.9	0	**56.9**	**F**
21B-8	2017	17.8	12.5	8.3	27	-0.9	1	0	**65.7**	**F-G**
21B-8	2022	15.2	6	1.3	22	-2.1	1.4	0	**43.7**	**P**
21B-9	1998	18.2	10.2	8.9	5.2	-11.3	0.3	0	**31.5**	**VP**
21B-9	2003	30	11.4	0.7	15	-14.2	0.3	0	**43.2**	**P**
21B-9	2008	30	7.3	15	8.1	-13.1	0	0	**47.3**	**P**
21B-9	2012	23.3	10.4	5.1	23.5	-16.3	0.1	0	**46.1**	**P**
21B-9	2017	30	10	1.8	15	-20	0.4	0	**37.1**	**P**
21B-9	2022	30	7.1	1.6	27.8	-12	0.1	0	**54.7**	**F**
21B-10	1998	13.4	-1	0.9	30	-0.1	0.4	0	**43.6**	**P**
21B-10	2003	15.3	5.7	1.5	30	-0.6	0.5	0	**52.2**	**F**
21B-10	2008	14.9	2.6	2.5	30	-0.9	0.1	0	**49.3**	**P-F**
21B-10	2012	13.6	7.7	4.8	30	0	0.1	0	**56.2**	**F**
21B-10	2017	15.1	2.3	6.5	30	-0.5	0.4	0	**53.8**	**F**
21B-10	2022	13.8	9.5	13.2	30	0	0.6	0	**67.1**	**G**
21B-11*	1998	0	0	0	2.7	-20	1.3	0	**-16**	**VP**
21B-11*	2003	1.2	0	0	0.9	-6.5	0.1	-2	**-6.4**	**VP**
21B-11*	2008	0	0	0	1.3	-15.4	0.2	-2	**-16**	**VP**
21B-11*	2012	0	0	0	4.3	-20	0.3	-2	**-17.4**	**VP**
21B-11*	2017	1.4	0	0	8.1	-20	0.3	-4	**-14.2**	**VP**
21B-12	1998	25.7	10.7	4.4	9.9	-14.9	0.2	0	**35.9**	**VP-P**
21B-12	2003	30	8.5	0.5	28.9	-6.2	0	0	**61.7**	**F**
21B-12	2008	0	0	0	1	0	0	0	**1**	**VP**
21B-12	2012	3.9	0	0	0.8	-20	4.4	0	**-11**	**VP**
21B-12	2017	29.7	15	2.8	1.3	-20	0.1	0	**28.8**	**VP**
21B-12	2022	27.4	14.7	5.2	3.7	-20	0.8	0	**31.8**	**VP**
21B-13	1998	30	10.2	1.6	7.4	-20	0.3	0	**29.5**	**VP**
21B-13	2003	30	4.5	0.9	20.8	-7.5	0	0	**48.8**	**P-F**
21B-13	2008	30	2.4	1.2	12.9	-10.1	0.6	0	**37**	**VP-P**
21B-13	2012	30	9.8	5.3	30	-15.4	0.2	0	**59.9**	**F**
21B-13	2017	30	6.1	2	17.3	-20	0.7	-2	**34.1**	**VP-P**
21B-13	2022	27.6	-2	2.1	14	-20	1	0	**22.7**	**VP**
21B-14	1998	18.1	9.1	8.7	21.7	-2	0.4	0	**56**	**F**
21B-14	2003	13.6	0	2.8	11.3	-1	0.1	0	**26.8**	**VP**
21B-14	2008	9.9	3.2	8.8	12	-1.4	0.3	0	**32.7**	**VP**
21B-14	2012	11	6.7	7	23.1	-2.3	0.2	0	**45.7**	**P**
21B-14	2017	8.7	5.9	0.3	15.1	-0.7	0.3	0	**29.6**	**VP**
21B-14	2022	11.7	6.6	15	14.4	-3.2	0.2	0	**44.7**	**P**
21B-15	1998	30	8.5	6.6	6.6	-5.1	0.9	0	**47.6**	**P**
21B-15	2003	30	7.9	4.3	9.6	-8	1.2	0	**45.1**	**P**
21B-15	2008	30	7.1	5.3	9.1	-7.5	1.4	0	**45.4**	**P**
21B-15	2012	24.1	13.9	15	10.2	-5.9	0.9	0	**58.1**	**F**
21B-15	2017	30	13.5	4.8	11	-8.1	3	0	**54.3**	**P-F**
21B-15	2022	30	12.9	9.3	13.9	-3.3	1.6	-2	**62.3**	**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
21B-20	2017	21.4	14.9	15	29.4	-19.4	2.5	-2	**61.7**	**F**
21B-20	2022	29.4	14.9	13.8	8.1	-0.2	3.1	-2	**67**	**F-G**

Table 8.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 21B, Fillmore - Pahvant. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
21B-6	M Hill	PJ Encroachment	Medium	Reduced understory shrub and herbaceous diversity
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
21B-7	Bennett Field	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
21B-8	Smiths Ridge	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
21B-9	Wide Canyon BLM	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21B-10	Wide Canyon DWR	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
21B-12	Dameron Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21B-13	Walker 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
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
21B-14	Meadow Creek	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
21B-15	Fillmore Cemetery East	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	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
21B-17	Pioneer Peak	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
21B-18	Teeples Ridge	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
21B-19	Teeples Terrace	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
21B-20	Dog Valley Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
21B-23	Baker Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21R-2	Wide Canyon Bullhog	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
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
21R-11	Kanosh Lop and Scatter	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21R-12	Water Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21R-14	Wide Mouth Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
21R-16	Wide Mouth Canyon 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
21R-17	Pioneer 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
21R-18	Ezra Flat	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
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species

Table 8.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 21B, Fillmore - Pahvant. 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

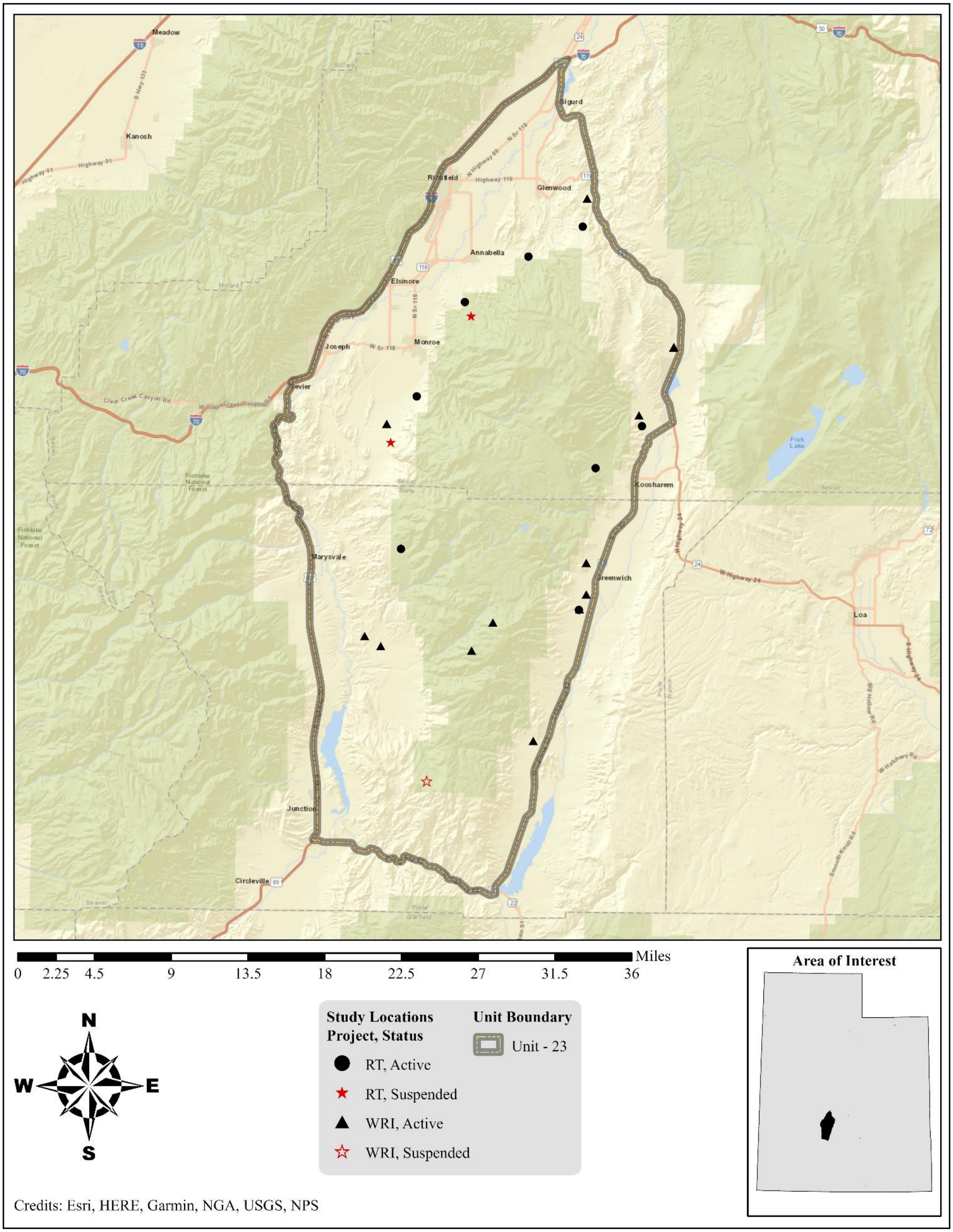
As of 2022, half of the study sites that fall within deer winter range are classified as being in very poor to poor-fair condition. The drivers behind these poor conditions vary between high amounts of annual grass, few perennial forbs, lack of recruitment within the preferred browse community, and/or a lack of preferred browse cover. A few sites are in good condition and help stabilize the overall poor-fair winter condition for this unit (**Table 8.5**). Studies contributing to better wintering conditions include M Hill, Wide Canyon, and Dog Valley Creek: these sites all have lower amounts of annual grass, recruitment of preferred browse, and high amounts of browse or perennial grass cover.

Several wildfires have impacted the Fillmore unit. However, a majority of these burns have been localized to the southwest corner of the unit in Dog Valley, Baker Canyon, and the valley bottoms of Clear Spot Flat, where the Milford Flat wildfire occurred. The concentration of large fires to the west of I-15 has left the east side of the unit, where much of the deer winter and summer habitats are located, largely untouched. The unburned portions of winter range on the west side of the Pahvant mountain range has allowed relic populations of preferred browse to persist, despite their decadence and degraded understories. Wildfires that have occurred in deer and elk winter range have been patchy and non-contiguous. Moreover, ecological responses to these fires have had an element of unpredictability. For example, Smiths Ridge and Dog Valley Creek have had increases in preferred browse cover and have shown some elements of recovery following fire, while the trajectory at Dameron Canyon has been unexpected with sagebrush stands being replaced by smooth sumac. The summer range sites, namely Teeples Ridge and Pioneer Peak, have abundant herbaceous understories with mixtures of both native and introduced perennial grasses, and a diverse community of perennial forbs.

Unfortunately when these winter range sites burn (especially cliffrose communities), much of the browse component is lost and the stands are replaced by other communities. Dameron Canyon and the Dog Valley studies display this replacement without any signs of the past browse communities returning. Due to the lack of return, it is expected that significant inputs will be needed in order for cliffrose and other preferred browse species to return and function as a recovered ecological system. As a result of wildfire, the understories have had openings that have allowed for the sites to be invaded by high amounts of annual grass. The high presence of cheatgrass may alter the fire regime (Balch, D'Antonio, & Gómez-Dans, 2013) with increased frequency of wildfire and a continuation and expansion of browse removal in the future. A similar regime is occurring on the Oak City side of the unit. In the Milford Flat and Cove Fort areas, rehabilitation efforts on the winter range have used seeded perennial grass species as a tool to compete with the potential invasion of cheatgrass and thereby avoid a detrimental fire cycle. However, presence of introduced perennial grasses can suppress the establishment of preferred browse species and native perennial grasses and forbs (Mack, et al., 2000). It has been noted that browse is not returning; these seeded perennial grasses are likely impeding recruitment of young browse plants. Near Richfield, there appears to be active solar farm construction occurring on the winter range: this may contribute to habitat loss in the area. Concerning the unit as a whole, shrub communities on lower potential winter range are drought-stressed. Sites particularly affected by drought seem to fall within Stansbury cliffrose ecological types; sagebrush and cliffrose have experienced poor vigor and decadence within their respective populations.

Continued efforts to protect extant cliffrose populations should be made by various means. First, reductions in annual grasses and bulbous bluegrass should be attempted. Treatments to reduce annual grass loads such as grazing management or herbicide application are advisable on the associated study sites to help mitigate fire risk and improve understory health. However, each site should be treated on a case-by-case basis. 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 along the Fillmore face, care should be taken to select methods that will not increase annual grass loads. Reducing annual grass and bulbous bluegrass while also removing juniper along this front would likely free resources for cliffrose to reestablish (Roundy, et al., 2014). These efforts should not only continue in areas of current restoration, but should also be considered on historic winter range with additional efforts placed on shrub rehabilitation similar to those occurring along the Wasatch Front.

9. MANAGEMENT UNIT 23 – MONROE



WILDLIFE MANAGEMENT UNIT 23 – MONROE

Boundary Description

Piute and Sevier Counties – Boundary begins at I-70 and US-89 north of Sigurd; south on US-89 to SR-24; south on SR-24 to SR-62; south and west on SR-62 to US-89; north on US-89 to I-70 near Sevier; north on I-70 to US-89 north of Sigurd. Excludes all Native American trust lands within this boundary

Management Unit Description

Geography

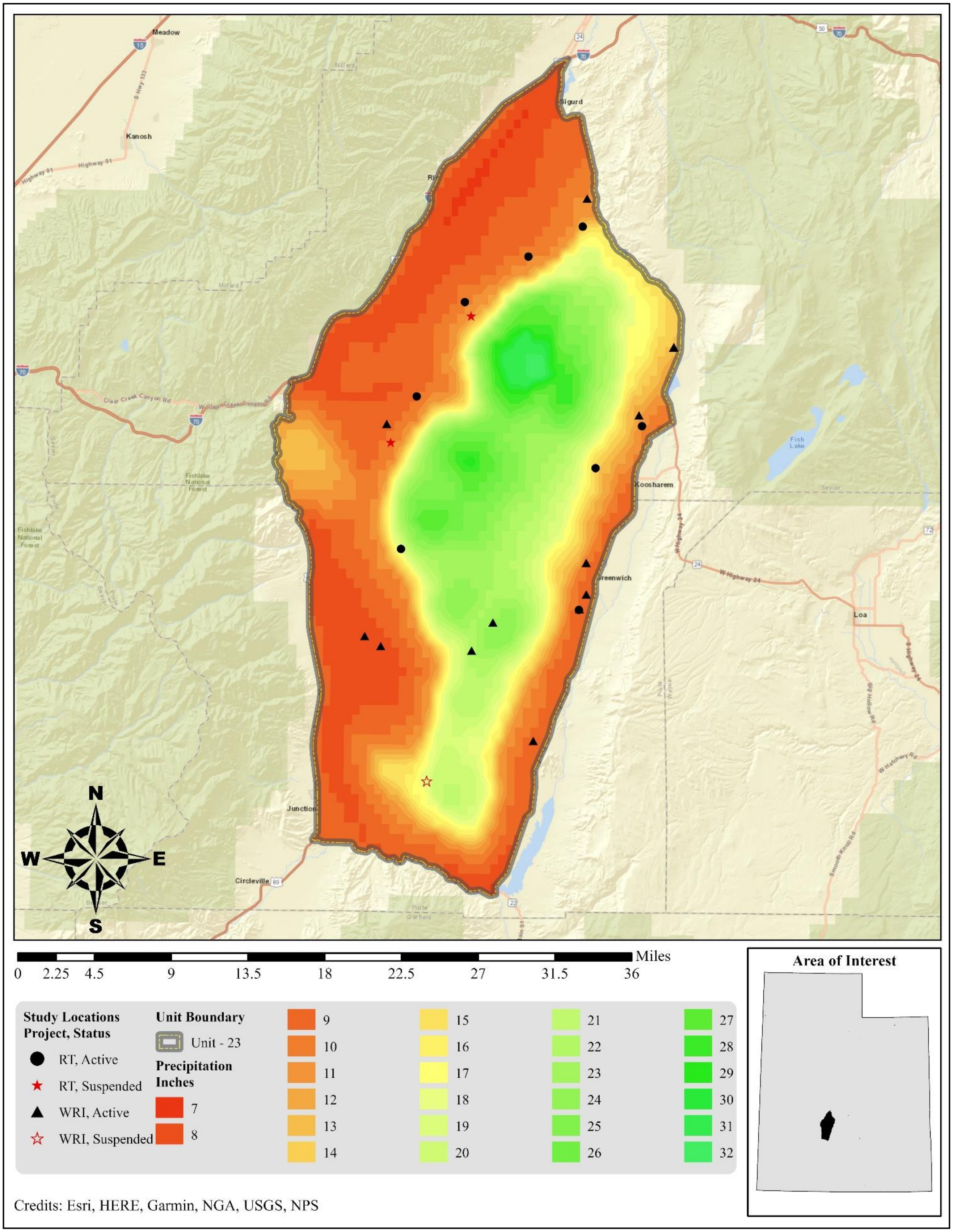
The Monroe Management Unit is almost entirely considered to be big game habitat, with the exception of the desert areas and some of the incorporated townships. A majority of this unit is publicly managed on both winter and summer ranges. Permanent Range Trend studies have been established on both sides of the Sevier Plateau in both Central Valley and the areas between Otter Creek Reservoir and Koosharem. Towns within this unit include Richfield, Monroe, Glenwood, Annabella, Koosharem, and Marysvale.

The primary geographic feature on this unit is the Sevier Plateau, with the highest point being Glenwood Mountain at 11,208 feet. The lowest part of the unit is in the Central Valley near Richfield at approximately 5,300 feet. The mountains are not particularly rough, with the large plateau averaging between 9,000 to 10,000 feet; a majority of the summer habitat for this unit exists on the plateau.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 7 inches in areas near Richfield, Joseph, and areas around Piute Reservoir up to 39 inches on Glenwood Mountain. All of the Range Trend and WRI monitoring studies on the unit occur within 9-22 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 South Central division (Division 4).

The mean annual PDSI of the South Central division displayed years of moderate to extreme drought from 2002, 2012-2014, 2018, and 2020-2022. The mean annual PDSI displayed moderately to extremely wet years from 1997-1998, 2005, and 2011 (**Figure 9.1a**). The mean spring (March-May) PDSI displayed years of moderate to extreme drought in 1996, 2000, 2002-2004, 2013-2014, 2018, and 2021-2022; moderately to extremely wet years were displayed in 1995, 1998-1999, 2005, 2011, and 2019. The mean fall (Sept.-Nov.) PDSI displayed years of moderate to extreme drought in 2002-2003, 2007, 2009, 2012, and 2020-2022; moderately to extremely wet years were displayed in 1997-1998, 2005, and 2011 (**Figure 9.1b**) (Time Series Data, 2023).



Map 9.1: The 1991-2020 PRISM Precipitation Model for WMU 23, Monroe (PRISM Climate Group, Oregon State University, 2021).

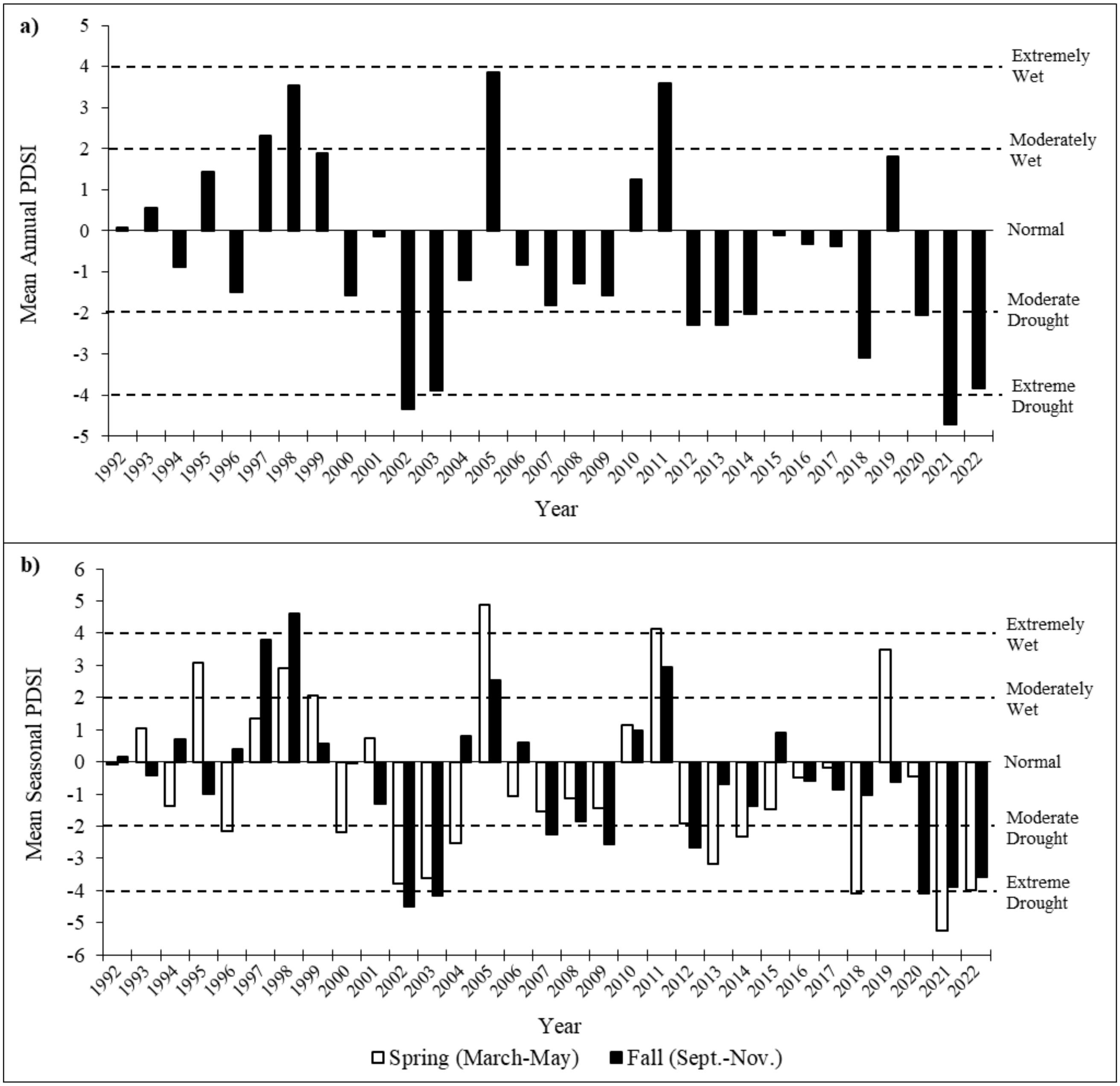


Figure 9.1: The 1992-2022 Palmer Drought Severity Index (PDSI) for the South Central division (Division 4). The PDSI is based on climate data gathered from 1895 to 2022. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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.) PDSI (Time Series Data, 2023)

Big Game Habitat

Deer winter range is mostly located around the lower-elevation edges of the Sevier Plateau between 5,500 and 8,200 feet. The winter range is bounded on the lower edge by Highway 89 on the west and Highways 24 and 62 on the east. On the northern portion of the mountains, the winter range is limited in size. As a result, there is potential for conflicts with animals using agricultural areas in the winter because of their proximity to traditional winter ranges. Most of the summer range for deer is on Forest Service land and provides good access for hunting.

Significant amounts of the winter range consist of sagebrush, with smaller amounts being host to mixed mountain brush communities. Many of the sagebrush communities are composed of mountain big sagebrush. There are some issues with excessive shrub decadence and mortality in some portions of this unit, particularly those with low precipitation. Significant amounts of pinyon-juniper are present at the lower elevations, which can pose a threat to the integrity and productivity of the sagebrush ecosystems. At the higher elevations, some of the aspen stands are being encroached by conifer trees, which can lower the quality of summer habitat.

Rangeland Analysis Platform (RAP) – Biomass and Cover by Deer Habitat

Quality wildlife forage is determined by a number of factors. Diversity of species and life forms, age class and vigor of shrubs, timing of vegetative stages of grasses and forbs, and the abundance of palatable vegetation all contribute to a quality habitat for mule deer. Site-level (Range Trend sites) data addresses species composition, age composition, and health of communities in winter habitat. However, due to the small number and or placement of Range Trend sites, it is difficult to get a true estimation of vegetation abundance. Trend study sites are placed strategically in key areas for mule deer to assess both quantity and quality of forage, but due to limited sampling sites cannot accurately predict the overall abundance of forage available to mule deer in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer by providing a value for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for, but does not fully address the quality of forage the way that Range Trend data does. The intent of the RAP dataset is to supplement Range Trend data and local knowledge to inform managers of general habitat trends. Additionally, "[RAP] data can be used to evaluate resources in concert with site-specific information about the area under investigation, such as past land management practices, vegetation treatments, conservation efforts, or natural disturbances" (Rangeland Analysis Platform, 2022, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter or summer range habitat. Range Trend data is collected on a 5-year interval and the intent of the RAP data is to also help illustrate the year-to-year fluctuations or changes that may occur between Range Trend samplings.

The RAP data shows fluctuations of herbaceous biomass and cover on both summer and winter deer winter range; the highest values for both measurements have mainly been observed in the mid-1990s. However, the mid-2000s and late 2010s display strong peaks that correspond or follow high precipitation years. In addition, annual and perennial cover and biomass have generally followed precipitation trends. However, no apparent correlation is discernable in other years (in 2013-2015, for example), with biomass and precipitation displaying some degree of independence. Yearly increases and decreases in biomass and cover generally appear to be more pronounced on winter range than on summer range (**Figure 9.2**, **Figure 9.3**, **Figure 9.4**, **Figure 9.5**). As expected, some peaks and troughs in this herbaceous data can be correlated with Palmer Drought Severity Index (PDSI) data. For example, increased cover, biomass, and precipitation in 2019 correspond with PDSI values that show wetter than normal years and a moderately wet spring. While it is important to note yearly trends, the overall trend for biomass and cover for both winter and summer range has generally decreased since 1997, which seems to correspond with prolonged drought cycles beginning in the late 1990s as marked in the PDSI (**Figure 9.1a**, **Figure 9.1b**). Fire may have influence in the increase and amount of annual species on winter range. Burns that had significant impact on deer winter range occurred in 1997, 2006, 2012, 2016, and 2018 (**Map 9.5, Figure 9.2, Figure 9.5**).

Range Trend data for herbaceous cover from 1997 to present show fluctuations in both perennial and annual lifeforms. However, an overall increase occurred on sites of upland ecotypes, which comprise the majority of sites on deer winter range (**Figure 9.22**). Year-to-year fluctuations can be expected due to differences in precipitation and the timing of data collection between sample years.

RAP data indicates that tree and shrub cover correlate with precipitation in many years, but more loosely so than herbaceous cover and biomass. Tree cover values have remained stable on both mule deer summer and winter ranges, but have been more variable on summer range. Estimated shrub cover using RAP appears to show a gradual decrease (**Figure 9.6**, **Figure 9.7**). Range Trend data for tree cover values have decreased overall which is primarily due to tree removal projects. In contrast, cover values for shrubs appear to be increasing on the majority of ecotypes, while decreasing on semidesert ecological types (**Figure 9.8**, **Figure 9.9**, **Figure 9.10**, **Figure 9.11**, **Figure 9.12**, **Figure 9.13**).

RAP – Biomass by Deer Habitat

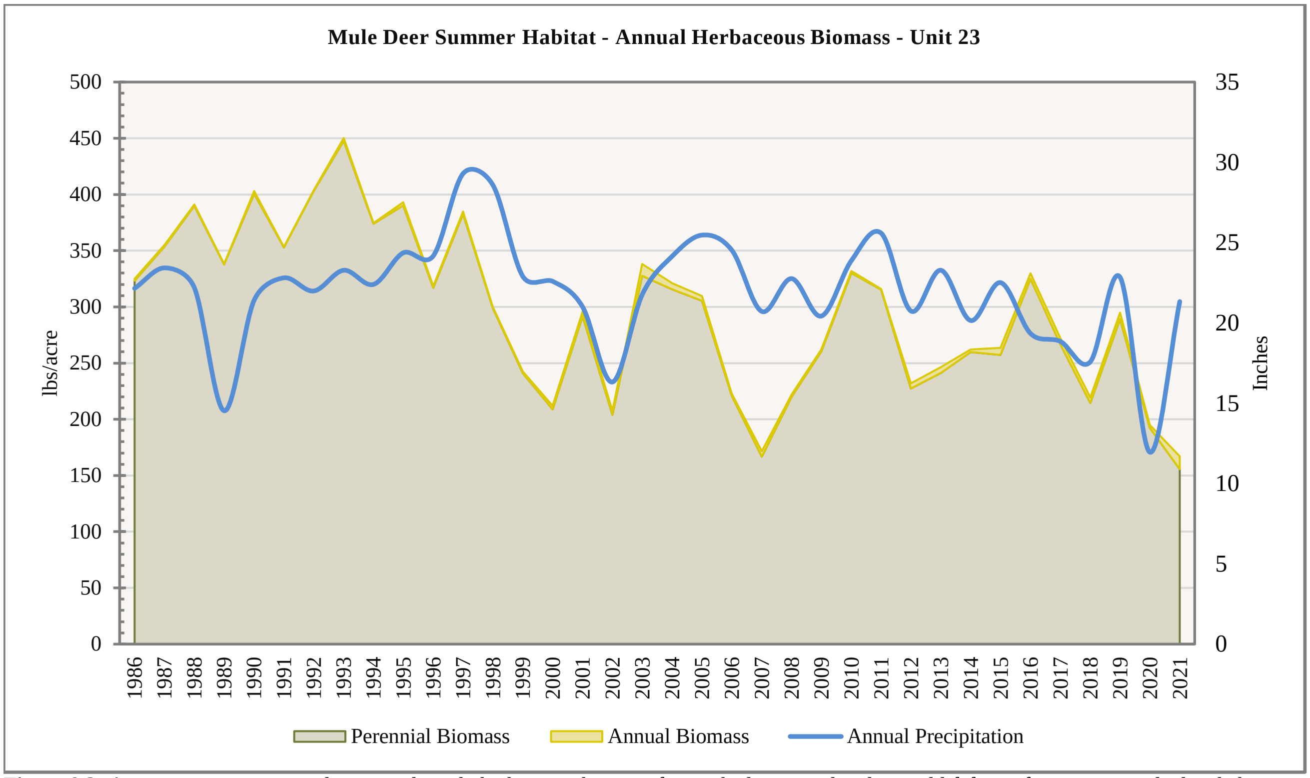


Figure 9.2: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 23, Monroe (Rangeland Analysis Platform, 2023).

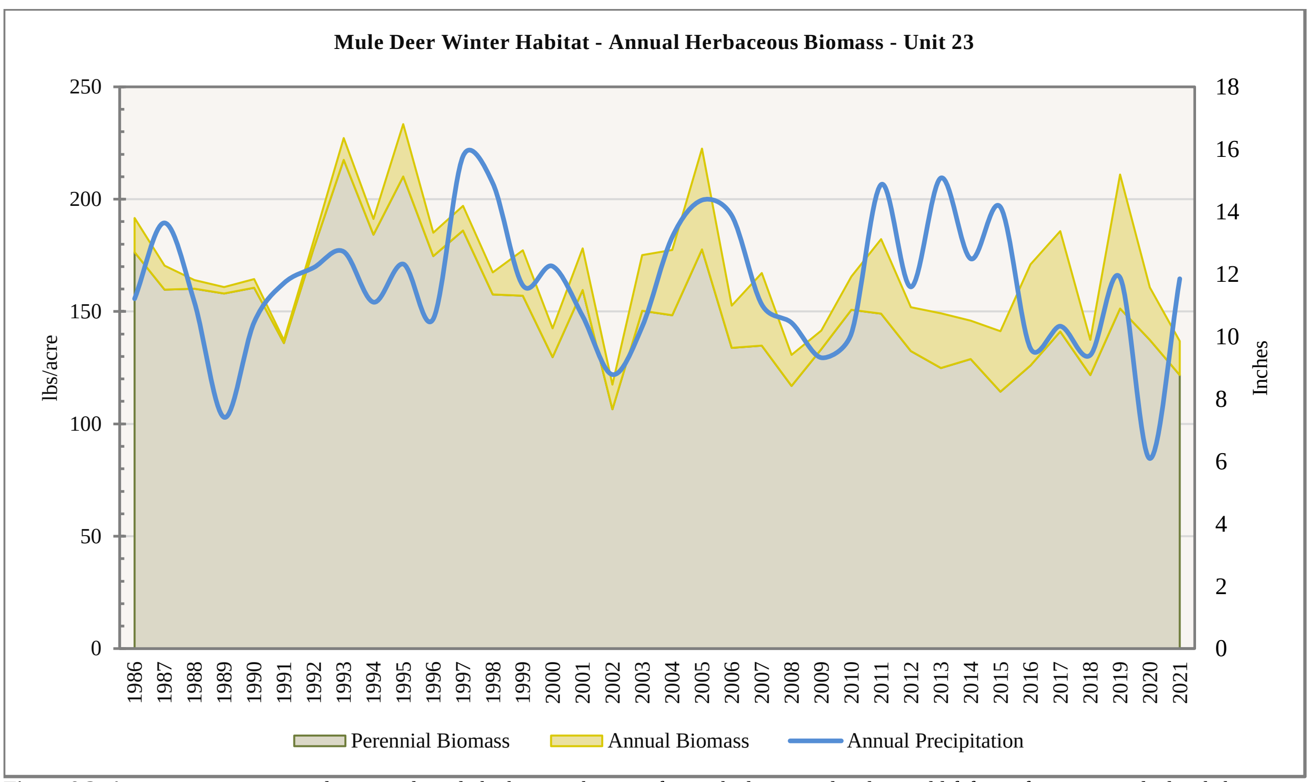


Figure 9.3: Average precipitation and estimated yearly herbaceous biomass for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 23, Monroe (Rangeland Analysis Platform, 2023).

RAP – Herbaceous Cover by Deer Habitat

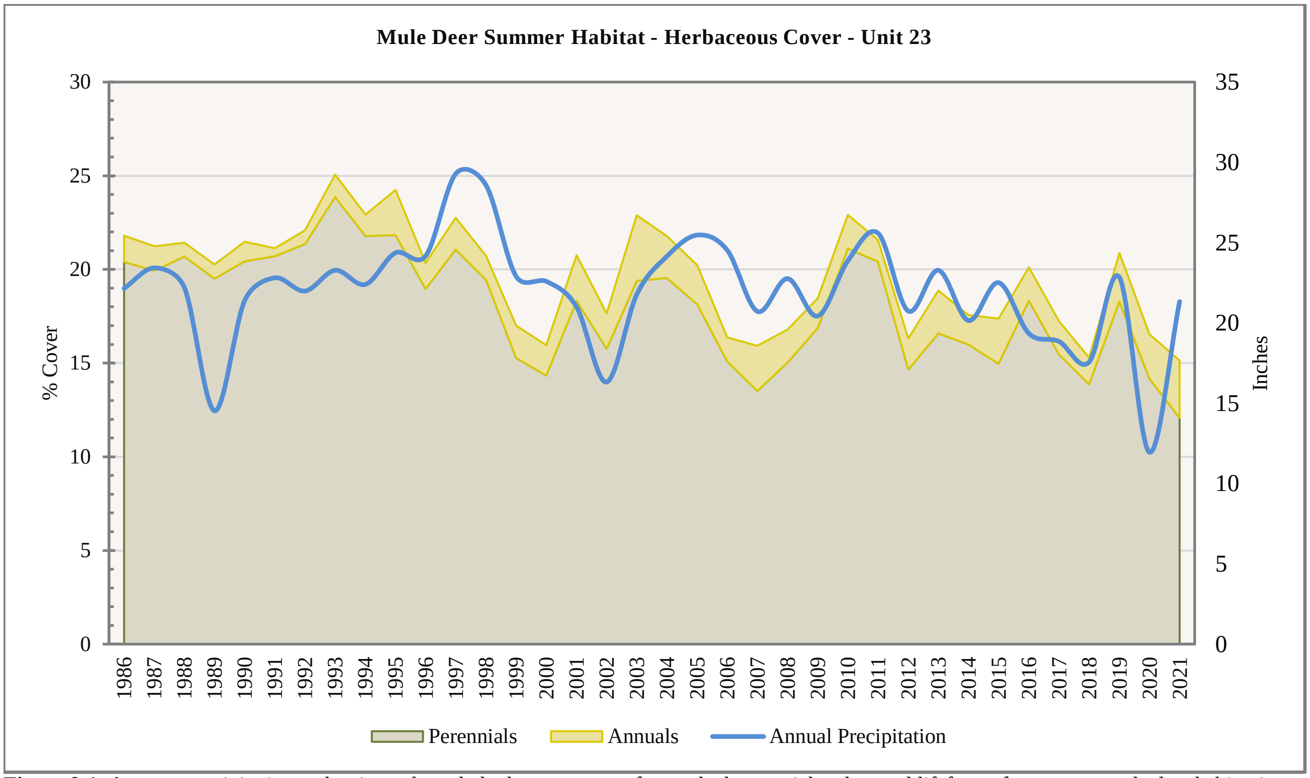


Figure 9.4: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for summer mule deer habitat in WMU 23, Monroe (Rangeland Analysis Platform, 2023).

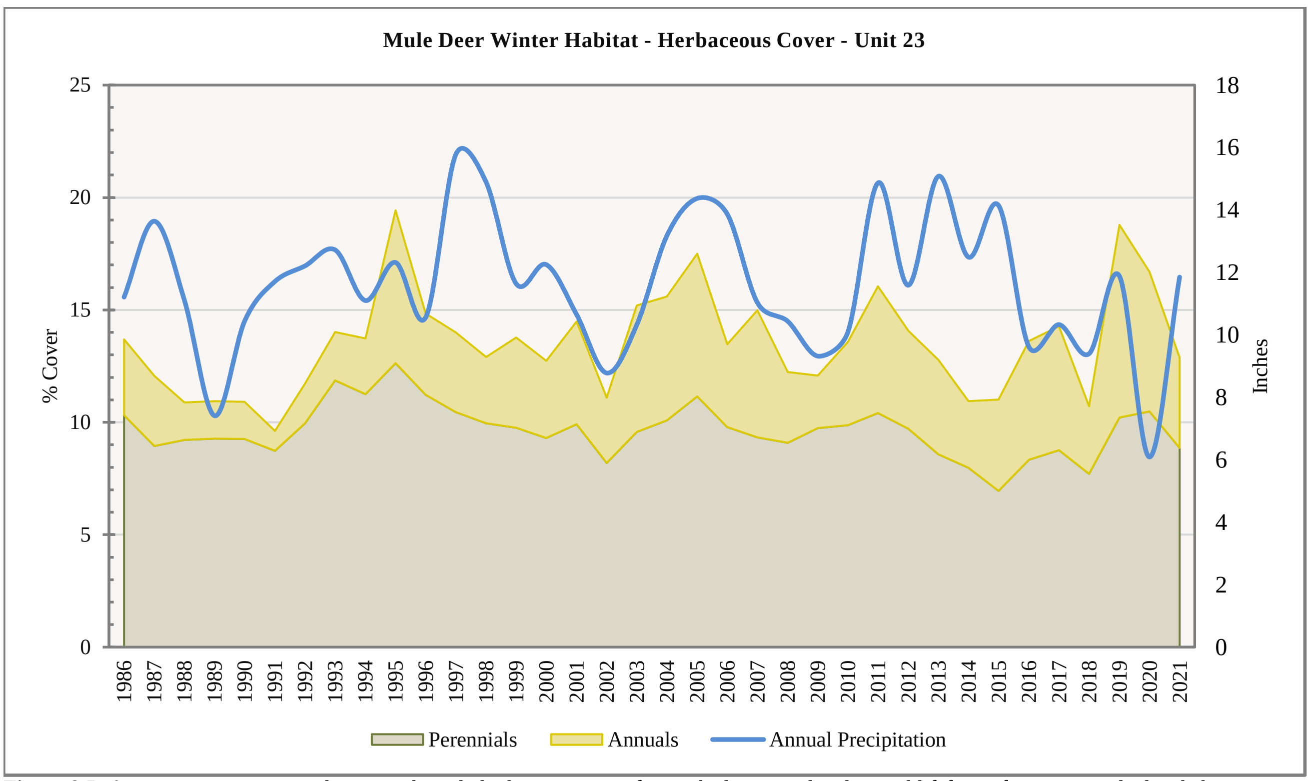


Figure 9.5: Average precipitation and estimated yearly herbaceous cover for stacked perennial and annual lifeforms for winter mule deer habitat in WMU 23, Monroe (Rangeland Analysis Platform, 2023).

RAP – Shrub and Tree Cover by Deer Habitat

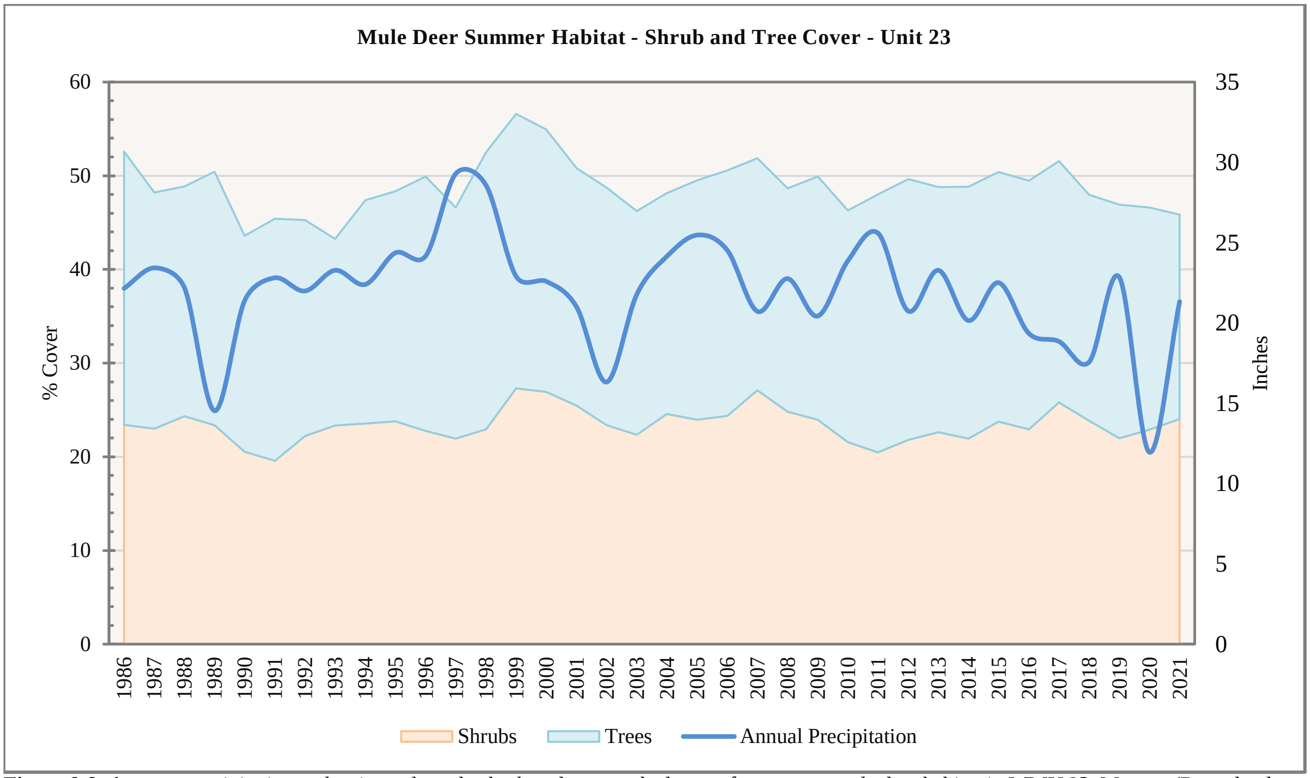


Figure 9.6: Average precipitation and estimated yearly shrub and tree stacked cover for summer mule deer habitat in WMU 23, Monroe (Rangeland Analysis Platform, 2023).

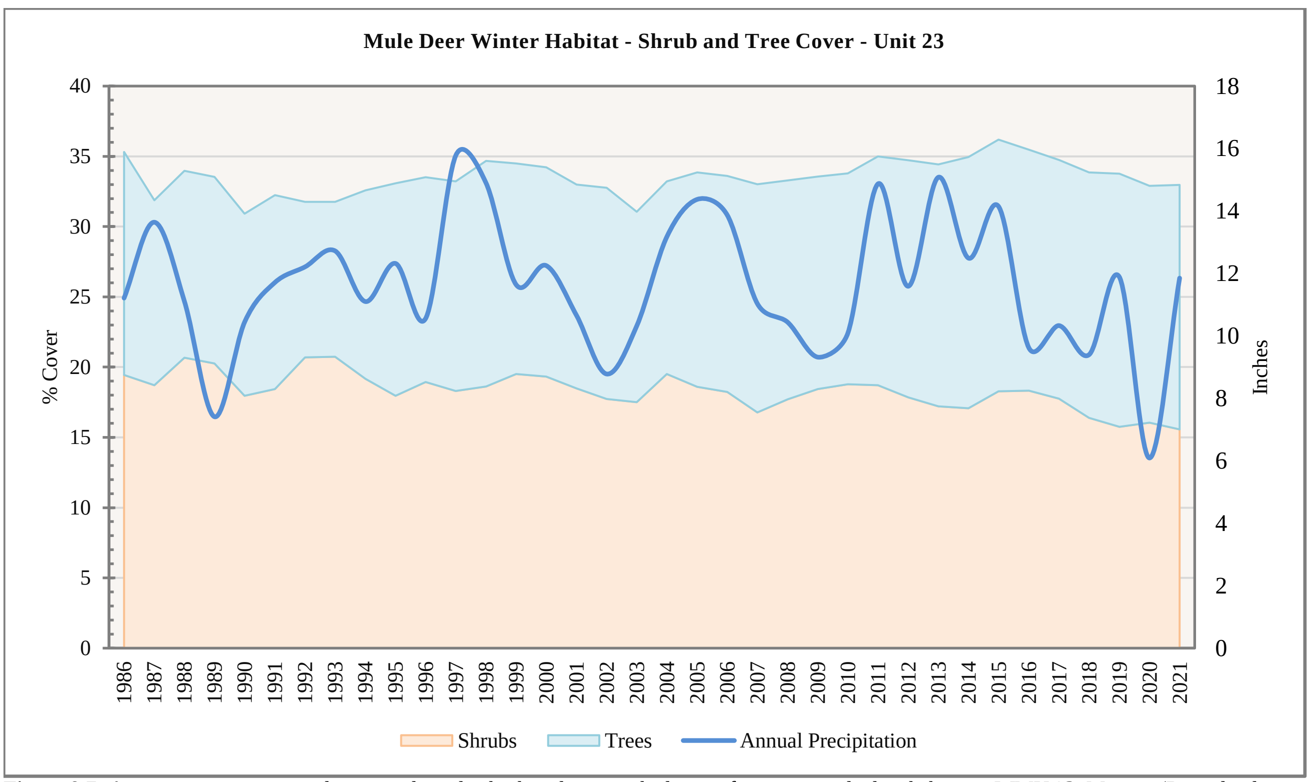
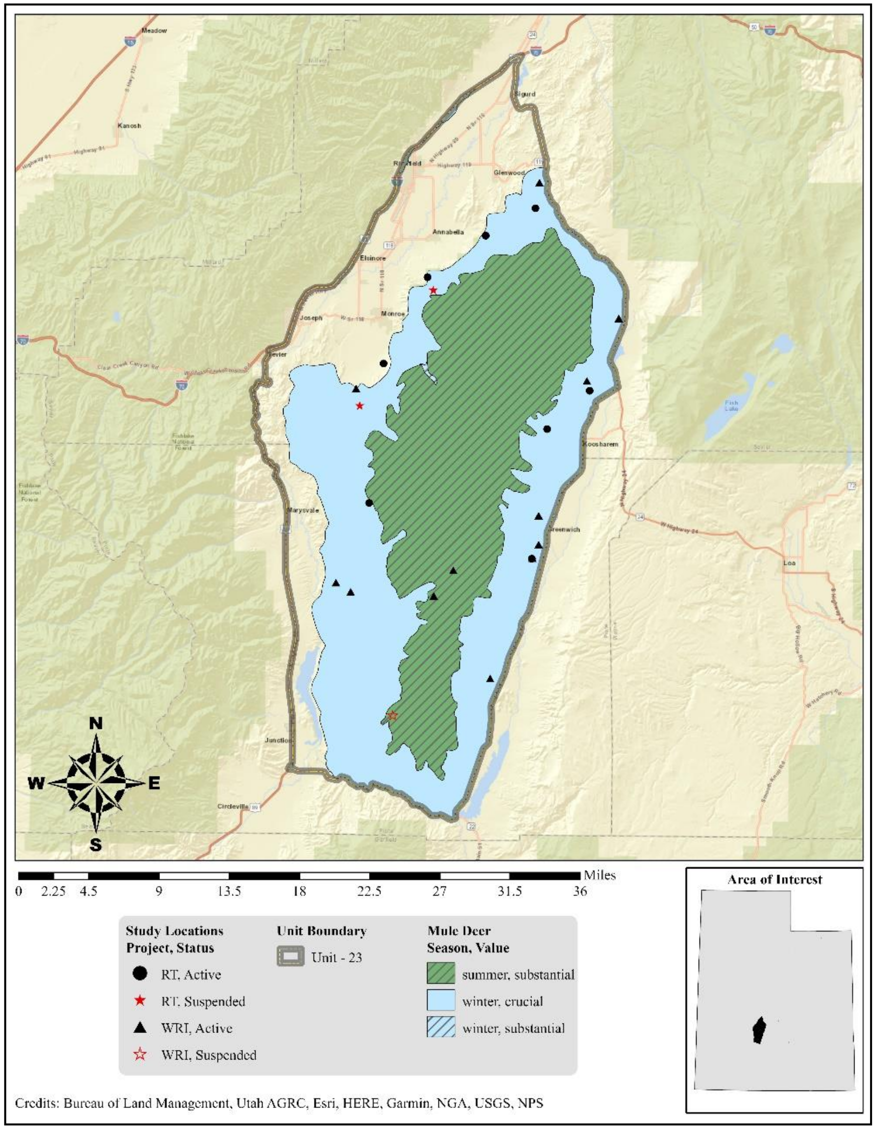
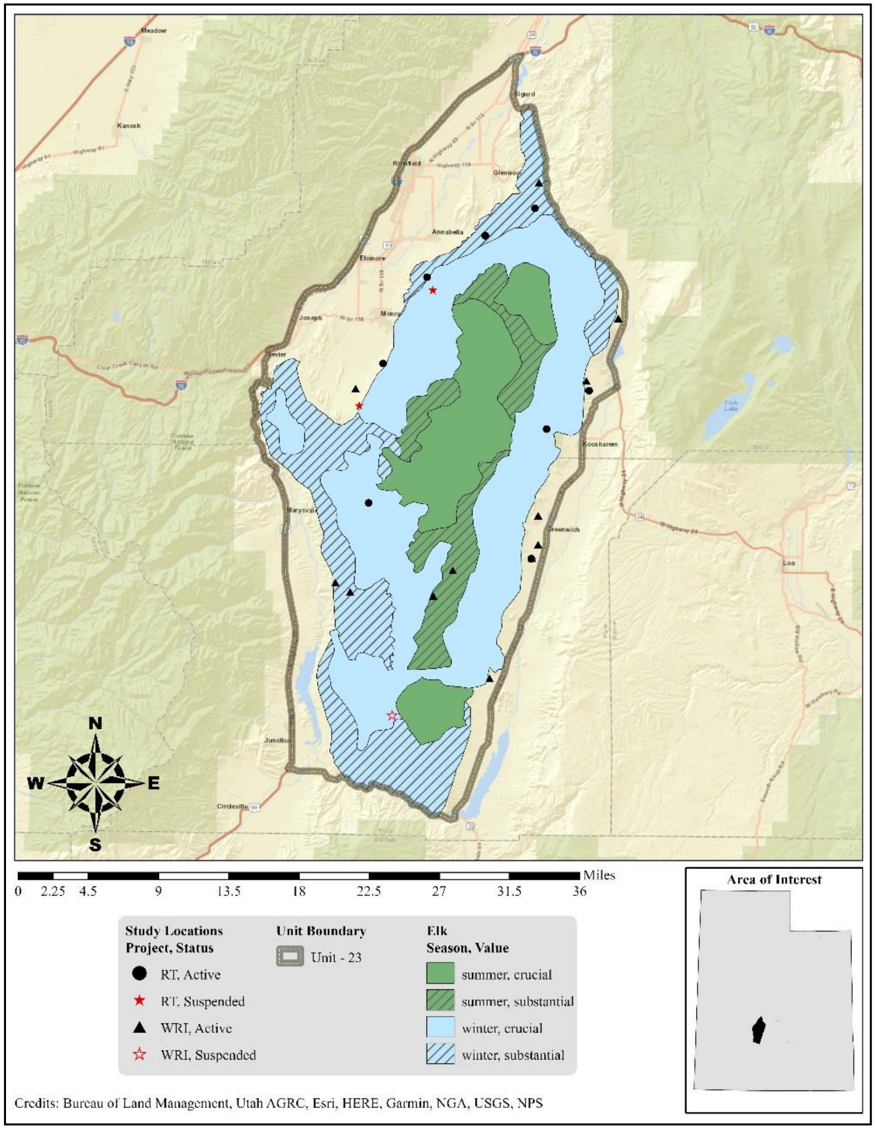


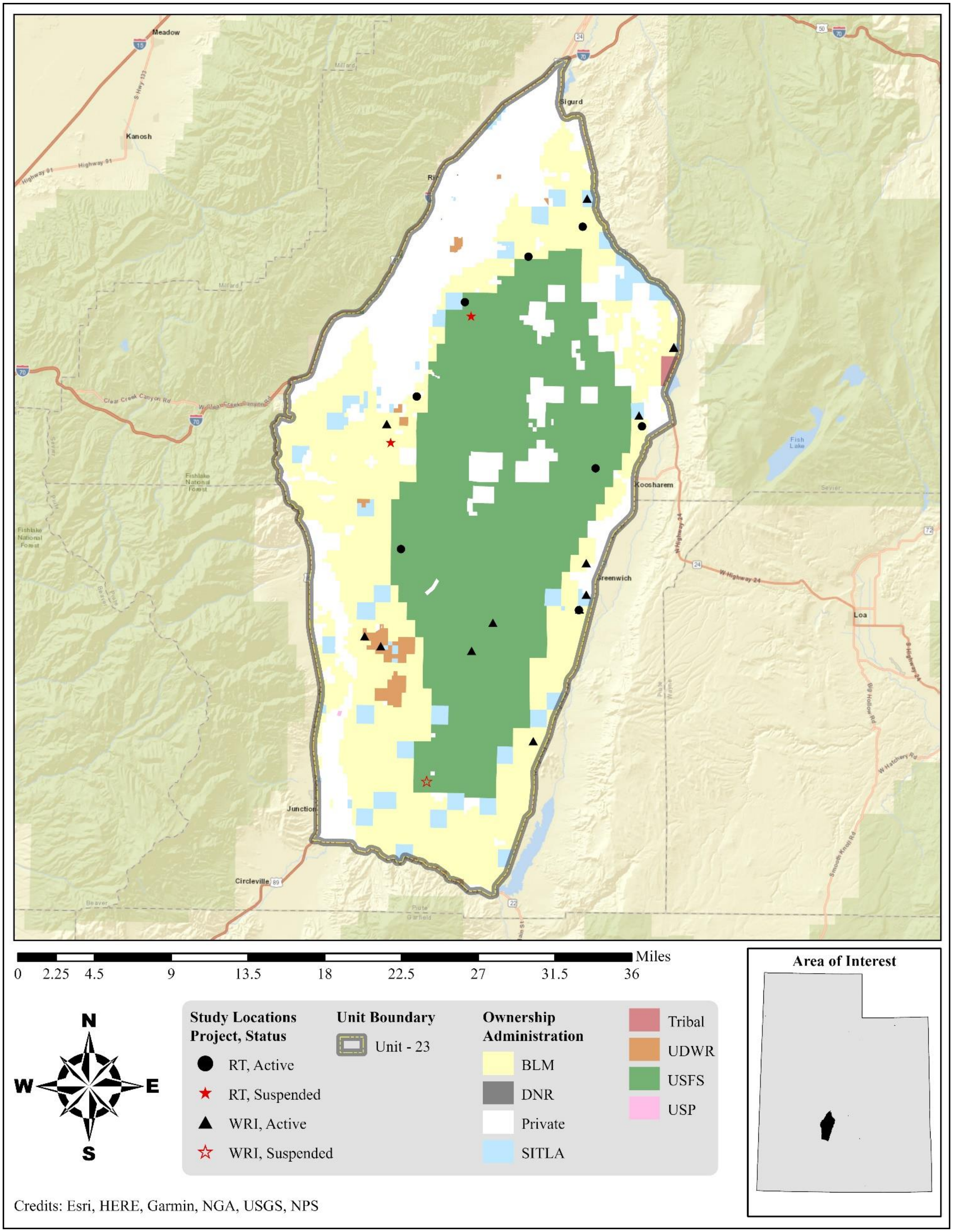
Figure 9.7: Average precipitation and estimated yearly shrub and tree stacked cover for winter mule deer habitat in WMU 23, Monroe (Rangeland Analysis Platform, 2023).



Map 9.2: Estimated mule deer habitat by season and value for WMU 23, Monroe.



Map 9.3: Estimated elk habitat by season and value for WMU 23, Monroe.



Map 9.4: Land ownership for WMU 23, Monroe.

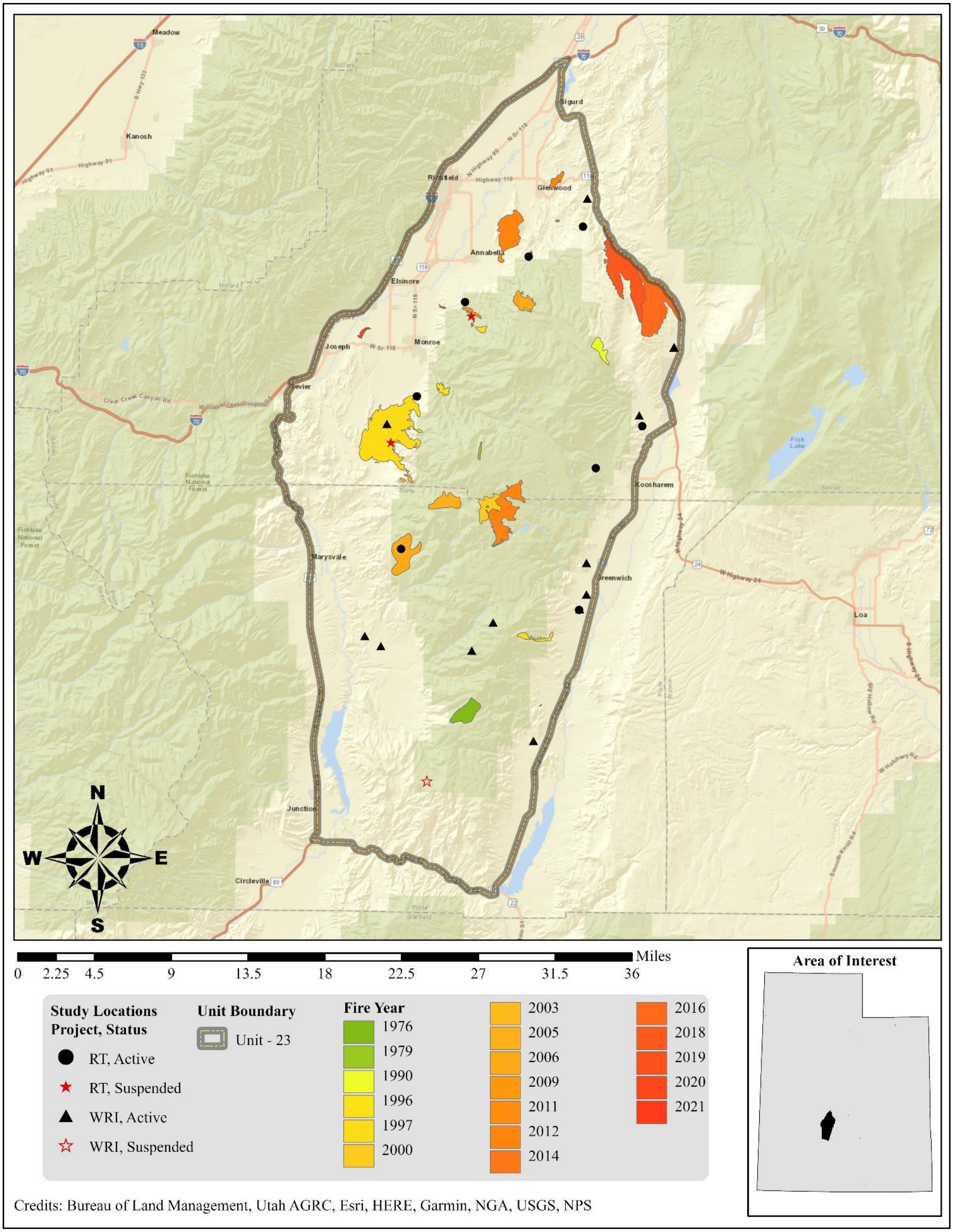
Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	100,805	30.84%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	21,228	6.49%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	11,017	3.37%	
	Southern Rocky Mountain Ponderosa Pine Woodland	7,575	2.32%	
	Great Basin Pinyon-Juniper Woodland	6,974	2.13%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	5,441	1.66%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	3,885	1.19%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	2,638	0.81%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	614	0.19%	49.01%
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	42,255	12.93%	
	Inter-Mountain Basins Big Sagebrush Shrubland	40,436	12.37%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	6,773	2.07%	
	Great Basin Xeric Mixed Sagebrush Shrubland	3,617	1.11%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	2,173	0.66%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	2,086	0.64%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	1,651	0.51%	
	Rocky Mountain Lower Montane-Foothill Shrubland	131	0.04%	
	Rocky Mountain Alpine Dwarf-Shrubland	105	0.03%	
	Great Basin Semi-Desert Chaparral	102	0.03%	
	Inter-Mountain Basins Big Sagebrush Steppe	50	0.02%	
	Inter-Mountain Basins Greasewood Flat	2	0.00%	30.40%
Other	Conifer-Hardwood	22,179	6.79%	
	Hardwood	15,194	4.65%	
	Developed	10,157	3.11%	
	Sparsely Vegetated	4,012	1.23%	
	Agricultural	1,982	0.61%	
	Riparian	1,552	0.47%	
	Open Water	382	0.12%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	205	0.06%	
	Snow-Ice	12	0.00%	17.03%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	3,315	1.01%	
	Southern Rocky Mountain Montane-Subalpine Grassland	2,046	0.63%	
	Inter-Mountain Basins Semi-Desert Grassland	789	0.24%	
	Rocky Mountain Alpine Turf	100	0.03%	
	Rocky Mountain Alpine Fell-Field	1	0.00%	1.91%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	3,887	1.19%	
	Interior Western North American Temperate Ruderal Shrubland	112	0.03%	1.22%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	472	0.14%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	327	0.10%	
	Great Basin & Intermountain Introduced Annual Grassland	322	0.10%	
	Interior Western North American Temperate Ruderal Grassland	254	0.08%	0.42%
Total		**326,861**	**100%**	**100%**

Table 9.1: LANDFIRE Existing Vegetation Coverage for Mule Deer Habitat (LANDFIRE.US_140EVT, 2020) for WMU 23, Monroe.

Limiting Factors to Big Game Habitat

A few factors limit mule deer habitat in the Monroe unit. Pinyon-juniper woodlands account for nearly 33% of the unit's mule deer habitat (**Table 9.1**). Conifer encroachment into sagebrush communities has been shown to decrease sagebrush and herbaceous cover, therefore decreasing available wildlife forage (Miller, Svejcar, & Rose, 2000). An additional limiting factor is the encroachment of conifer into high elevation summer ranges; prescribed fires have been used to reduce conifer cover and to regenerate aspen stands in these areas.

Other limiting factors to mule deer habitat include introduced exotic herbaceous species such as cheatgrass (*Bromus tectorum*). According to the current LANDFIRE Existing Vegetation Coverage model, 0.42% of the mule deer habitat is comprised of exotic herbaceous species (**Table 9.1**). Increased amounts of cheatgrass exacerbate the risk for catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). The unit has had several wildfires, resulting in loss of big game habitat (**Map 9.5**). The Poverty Flat area suffered from a wildfire in 1997, and recovery of browse species has been slow. Some of the drier portions of the unit have experienced sagebrush die-off from drought, which also often occurs in crucial winter habitat.



Map 9.5: Land coverage of fires by year from 1976-2021 for WMU 23, Monroe (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

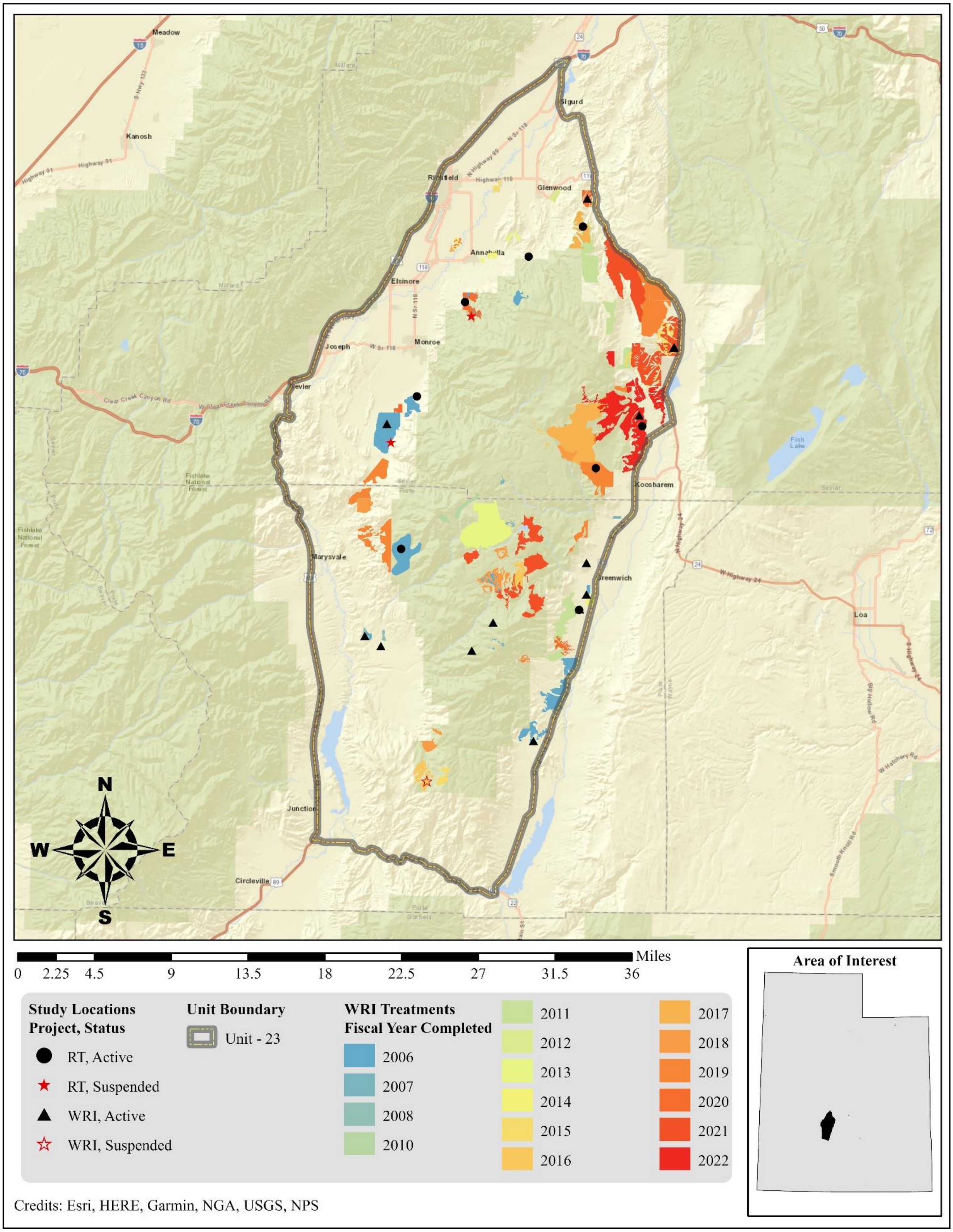
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 89,673 acres of land have been treated within the Monroe unit since the WRI was implemented in 2004 (**Map 9.6**). An additional 40,437 acres are currently being treated and treatments have been proposed for 707 acres. Treatments frequently overlap one another, bringing the net total of treatment acres to 90,385 acres for this unit (**Table 9.2**). 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. Seeding to augment the herbaceous understory is also frequently used in the unit. In addition, tree removal through treatment methods such as anchor chaining, bullhog, and hand crews such as lop and scatter are also common. Other management practices include (but are not limited to) chain harrows, harrows, mowing, herbicide application, and forest thinning (**Table 9.2**).

Type	Completed Acreage	Current Acreage	Proposed Acreage	Total Acreage
Anchor Chain	**8,062**	**0**	**0**	**8,062**
Ely (One-Way)	113	0	0	113
Ely (Two-Way)	7,949	0	0	7,949
Bullhog	**4,538**	**3,994**	**0**	**8,533**
Full Size	4,537	3,994	0	8,532
Skid Steer	1	0	0	1
Chain Harrow	**1,174**	**1,270**	**0**	**2,443**
> 15 ft. (Two-Way)	1,174	437	0	1,611
> 15 ft. (One-Way)	0	832	0	832
Greenstripping	**82**	**109**	**0**	**191**
Greenstripping	82	109	0	191
Harrow	**5,316**	**41**	**0**	**5,358**
≤ 15 ft. (One-Way)	2,323	0	0	2,323
≤ 15 ft. (Two-Way)	2,068	0	0	2,068
> 15 ft. (Two-Way)	176	0	0	176
> 15 ft. (One-Way)	749	41	0	791
Herbicide Application	**1,694**	**34**	**203**	**1,931**
Aerial (Fixed-Wing)	303	0	0	303
Aerial (Helicopter)	1,256	0	203	1,459
Ground	134	34	0	168
Mowing	**731**	**0**	**0**	**731**
Brush Hog	731	0	0	731
Prescribed Fire	**10,534**	**16,741**	**0**	**27,275**
Prescribed Fire	10,534	16,741	0	27,275
Seeding (Primary)	**7,768**	**14,525**	**89**	**22,382**
Broadcast (Aerial-Fixed wing)	4,656	238	0	4,894
Broadcast (Aerial-Helicopter)	2,671	14,287	0	16,958
Drill (Rangeland)	287	0	89	376
Ground (Mechanical Application)	154	0	0	154
Seeding (Secondary/Shrub)	**1,536**	**0**	**0**	**1,536**
Broadcast (Aerial-Fixed Wing)	1,536	0	0	1,536
Vegetation Removal/Hand Crew	**7,093**	**3,723**	**414**	**11,231**
Lop (No Scatter)	910	1,672	0	2,582
Lop & Chip	0	4	0	4
Lop & Scatter	6,183	2,047	414	8,644
Grand Total	**48,529**	**40,437**	**707**	**89,673**
***Total Land Area Treated**	**44,524**	**45,155**	**707**	**90,385**

Table 9.2: WRI treatment action size (acres) for completed, current, and proposed projects for WMU 23, Monroe. Data accessed on 01/23/2023.
*Does not include overlapping treatments.



Map 9.6: WRI treatments by fiscal year completed for WMU 23, Monroe.

Range Trend Studies

Range Trend studies have been sampled within WMU 23 on a regular basis since 1985, with studies being added or suspended as was deemed necessary (**Table 9.3**). 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 9.4**). Range Trend studies are summarized in this report by ecological site.

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
23-1	Bear Ridge	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Mountain Stony Loam (Antelope Bitterbrush)
23-2	Saul Meadow	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Upland Loam (Bonneville Big Sagebrush)
23-3	Thompson Basin	RT	Suspended	1985, 1991, 1998, 2003, 2008, 2012	Upland Stony Loam (Mountain Big Sagebrush)
23-4	Poverty Flat	RT	Suspended	1985, 1991, 1998, 2003, 2008, 2012	Upland Stony Loam (Mountain Big Sagebrush)
23-5	Smith Canyon	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Mountain Loam (Mountain Big Sagebrush)
23-6	Koosharem Canyon	RT	Active	1985, 1991, 1998, 2003, 2008, 2012, 2017, 2022	Mountain Loam (Browse)
23-7	Thompson Creek	RT	Active	2017, 2022	Upland Loam (Bonneville Big Sagebrush)
23-8	Burrville Cemetery	RT	Active	2017, 2022	Upland Loam (Mountain Big Sagebrush)
23-9	Corner Spring Canyon	RT	Active	2017, 2022	Semidesert Loam (Wyoming Big Sagebrush)
23R-1	Greenwich Disking	WRI	Active	1997, 2003, 2004, 2008, 2012, 2019	Semidesert Loam (Wyoming Big Sagebrush)
23R-2	Greenwich Native	RT	Active	1997, 2003, 2004, 2008, 2012, 2017, 2022	Semidesert Loam (Wyoming Big Sagebrush)
23R-1	Greenwich Disking	WRI	Active	1997, 2003, 2004, 2008, 2012, 2019	Semidesert Loam (Wyoming Big Sagebrush)
23R-3	Plateau Harrow	WRI	Active	1999, 2003, 2008, 2012, 2018	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
23R-4	Plateau Native	WRI	Active	1999, 2003, 2012, 2018	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
23R-5	Elbow Ranch 1	WRI	Active	2004, 2012, 2017	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
23R-6	Elbow Ranch 2	WRI	Active	2004, 2012, 2017	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
23R-7	South Narrows	WRI	Active	2004, 2007, 2012, 2016, 2020	Semidesert Loam (Wyoming Big Sagebrush)
23R-8	Browns Canyon Drill	WRI	Active	2004, 2007, 2012, 2016, 2020	Semidesert Loam (Wyoming Big Sagebrush)
23R-9	Poverty Dixie	WRI	Active	2005, 2010, 2013, 2017, 2022	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
23R-10	Twin Peaks Dixie	WRI	Suspended	2006	Not Verified
23R-11	Box Creek Dixie	WRI	Active	2006, 2011, 2016, 2020	Semidesert Loam (Wyoming Big Sagebrush)
23R-12	Glenwood Chaining	WRI	Active	2011, 2014, 2018	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
23R-13	Tuft Reservoir	WRI	Active	2018, 2022	High Mountain Loam (Aspen)
23R-14	Langdon Mountain	WRI	Active	2018, 2021	High Mountain Loam (Aspen)
23R-15	Wood Hollow	WRI	Active	2020	Upland Loam (Wyoming Big Sagebrush)

Table 9.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 23, Monroe.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
23-1	Bear Ridge	Two-Way Ely	North Cove Vegetation Treatment	October-November 2010	3,000	1880
		Aerial Before	North Cove Vegetation Treatment	October-November 2010	1,500	1880
		Lop (No Scatter)	North Cove Maintenance and Guzzlers	October 2016	1,500	3150
23-2	Saul Meadow	Broadcast Before	Maple Creek Seeding	May 1965	540	
		Lop and Scatter	Sauls Meadow Thinning	April 2003	331	
		Two-Way Unknown	Maple Creek Seeding	May 1965	540	
		Aerial Before	Maple Creek Seeding	May 1965	540	
23-3	Thompson Basin	Wildfire		Historic		
23-4	Poverty Flat	Wildfire	Flats Fire	July 1997	5,425	LTDL
			Flat Fire Rehabilitation Aerial Seeding	November 1997	3,400	LTDL
23-5	Smith Canyon	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Wildfire	Blackbird Mine WFU	June 2006	1,464	
		Aerial Unknown	Monroe Mountain Burn Stabilization	July 2006	1,468	598
23-6	Koosharem Canyon	Lop and Scatter	Pine Canyon to Koosharem Creek Wildlife Habitat Improvement Project - Phase 2	Between June 2017 and February 2019	1,409	3868
23-7	Thompson Creek	Dixie	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	2005	1,115	216
		Chain Unknown		Historic		
23-8	Burrville Cemetery	Lop and Scatter	Burrville Collaboration Ecosystem Restoration Project	July 2020-June 2022	538	5232
		Dixie		Between 2006 and 2009		
		Seed Unknown		Between 2006 and 2009		
23R-1	Greenwich Disking	Aerial Unknown	Narrows Project	December 2004	1,650	PDB
		Unknown		Fall 1996		PDB
		Seed Unknown		Fall 1996		PDB
		One-Way Dixie	Narrows Project	November 2004	3,600	PDB
		Broadcast Before	Narrows Project	November 2004	3,600	PDB
23R-2	Greenwich Native	Two-Way Dixie	Narrows Project	November 2004	3,600	PDB
		Broadcast Before	Narrows Project	November 2004	3,600	PDB
		Aerial Unknown	Narrows Project	December 2004	1,650	PDB
23R-3	Plateau Harrow	Two-Way Unknown	Plateau Brush Control #2	July-October 1966	1,200	LTDL
		Two-Way Dixie		1999		
		Unknown		1999		
23R-4	Plateau Native	Two-Way Unknown	Plateau Brush Control #2	July-October 1966	1,200	LTDL
23R-5	Elbow Ranch 1	One-Way Dixie	Elbow Ranch WMA Habitat Improvement	Fall 2007	129	800
		Broadcast	Elbow Ranch WMA Habitat Improvement	Fall 2007	132	800
		Cropland		Historic		
		One-Way Dixie	Elbow Ranch Drill	November 2005	170	2835
		Rangeland Drill	Elbow Ranch Drill	November 2005	170	2835
		Broadcast	Elbow Ranch Drill	November 2005	170	2835
		Rangeland Drill	Elbow Ranch WMA Habitat Improvement	Fall 2007	126	800
23R-6	Elbow Ranch 2	Cropland		Historic		
23R-7	South Narrows	Two-Way Dixie		1996		PDB
		Unknown		1996		PDB
		Two-Way Dixie	South Narrows Dixie Harrow - West Side	September-November 2005	1,740	210
		Broadcast Before	South Narrows Dixie Harrow - West Side	November 2005	1,740	210
		Aerial Unkown	South Narrows Dixie Harrow - West Side	December 2005	2,300	210

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
23R-8	Browns Canyon Drill	Rangeland Drill	Grass Valley/Rocky Knoll Phase II	November 2013	172	2256
		Aerial After	Greenwich Disking	December 2003	275	PDB
		Unknown		Fall 1996		PDB
		Unknown		Fall 1996		PDB
		Truax Drill	Greenwich Disking	October 2003	275	PDB
23R-9	Poverty Dixie	Wildfire	Flat	July 1997	5,425	LTDL
		Rangeland Drill	Flat Fire Rehabilitation	November-December 1997	3,400	LTDL
		Aerial	Flat Fire Rehabilitation	November 1997	3,000	LTDL
		One-Way Dixie	Poverty Flat	November 2005	2,108	139
		Broadcast After	Poverty Flat	November 2005	2,108	139
		Aerial After	Poverty Flat	December 2005	2,108	139
		Aerial	Flat Fire Rehabilitation	November 1997	400	LTDL
23R-10	Twin Peaks Dixie	Two-Way Chain	Dixie and Chain Harrow Retreat	August-November 2015	3,337	3076
23R-11	Box Creek Dixie	Two-Way Dixie	BLM Project	Fall 2006		BLM
		Broadcast Before	BLM Project	Fall 2006		BLM
		Aerial After	BLM Project	Fall 2006		BLM
23R-12	Glenwood Chaining	Two-Way Ely	Glenwood Habitat Enhancement	November 2011	303	1941
		Aerial Before	Glenwood Habitat Enhancement	November 2011	303	1941
		Dribbler	Glenwood Habitat Enhancement	November 2011	303	1941
		Aerial After	Glenwood Habitat Enhancement	Feburary 2012	303	1941
		Lop and Scatter	Central Utah Chaining Maintenance Project Phase I (Proposed)	2019	4,776	4582
23R-13	Tuft Reservoir	Prescribed	Monroe Mountain Aspen Ecosystems Restoration Project Phase 3	May 2018	4,611	4396
23R-14	Langdon Mountain	Prescribed	South Monroe Rx	January 2019	13,114	4777
23R-15	Wood Hollow	Bullhog	Burrville Collaboration Ecosystem Restoration Project (Proposed)	Fall 2020	312	5232
		Aerial Before	Burrville Collaboration Ecosystem Restoration Project (Proposed)	Fall 2020	312	5232

Table 9.4: Range trend and WRI studies known disturbance history for WMU 23, Monroe. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

One study site [Smith Canyon (23-5)] is classified as a Mountain (Big Sagebrush) ecological site: this study is located approximately four miles east of the town of Marysvale at the base of Marysvale Peak (**Table 9.3**).

<u>Shrubs/Trees</u>: Mountain big sagebrush (*Artemisia tridentate* ssp. *vaseyana*) is the dominant browse species present on this study site, and other preferred browse species have contributed little cover over time. Sagebrush cover exhibited an initial decrease in 2008 following a 2006 fire. Cover has increased each subsequent sample year, however, and has since surpassed the levels observed prior to the burn (**Figure 9.8**). Average preferred browse demographics data shows that there was a significant increase in preferred browse density between 2008 and 2012: this trend was almost entirely driven by recruitment of young sagebrush plants. Density has since decreased, with the most recent decrease between 2017 and 2022 due to the loss of mature plants. Decadence has remained low over the sample period (**Figure 9.17**). Preferred browse utilization was high in 1998 in 2003, but has remained low in the following sample years; less than 12% of plants were moderately or heavily browsed in 2022 (**Figure 9.19**).

Conifer encroachment is not a concern on this study site, with neither cover nor density being observed in any sample year (**Figure 9.11**, **Figure 9.14**).

<u>Herbaceous Understory</u>: The herbaceous understory of this site is depauperate, with the introduced annual grass species cheatgrass (*Bromus tectorum*) as the dominant component in all sample years. Annual grasses contributed significant cover in previous years, but decreased in 2022. Perennial grasses and forbs have remained comparatively rare throughout the study period. Forbs, however, have shown high levels of biodiversity (**Figure 9.21**, **Figure 9.23**).

<u>Occupancy</u>: This site displayed high levels of occupancy by deer in the early part of the study period, but deer presence decreased significantly following the 2003 sample year. Mean abundance of deer pellet groups has been as low as 8 days use/acre in 2022 and as high as 139 days use/acre in 2003. Elk have also been present, with average pellet group abundance ranging from under 1 days use/acre in 1998 to nearly 9 days use/acre in 2008. Finally, cattle have also been

present on this site, with presence fluctuating between 0 days use/acre in 2017 and 18 days use/acre in 2012 (**Figure 9.25**).

Mountain (Browse)

There is one study [Koosharem Canyon (23-6)] that is considered to be a Mountain (Browse) ecological site. The Koosharem Canyon site is situated approximately 2.5 miles northwest of the town of Koosharem up Koosharem Canyon (**Table 9.3**).

<u>Shrubs/Trees</u>: 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*) – which contributes the most intercept cover – and alderleaf mountain mahogany (*Cercocarpus montanus*). Other preferred browse species present in lesser amounts include (but are not limited to): mountain snowberry (*Symphoricarpos oreophilus*), Gambel oak (*Quercus gambelii*), and antelope bitterbrush (*Purshia tridentata*). Total shrub cover on this site has fluctuated from year to year, but has generally increased over time (**Figure 9.9**). Total preferred browse density has exhibited a small overall increase. Mature plants are the primary age class in this population, with mountain big sagebrush contributing most of the individual plants. Density of decadent and young individuals has remained low in most sample years (**Figure 9.17**). The proportion of preferred browse that has been moderately to heavily utilized has remained above 30% throughout the duration of the study. Utilization displayed a significant decrease between 2017 and 2022, however: this can be attributed to a decrease in heavy browsing on antelope bitterbrush, and to a lesser extent, Gambel oak (**Figure 9.19**).

Both Utah juniper (*Juniperus osteosperma*) and twnoeedle pinyon (*Pinus edulis*) are present on the Koosharem Canyon study. Tree cover displayed an upward trend through 2017, but was absent in 2022 following a lop and scatter treatment that occurred between 2017 and 2019. Density of pinyon and juniper has decreased since 2012, but remains moderate as of the 2022 sample year (**Figure 9.11**, **Figure 9.14**).

<u>Herbaceous Understory</u>: The understory of this study site has exhibited yearly fluctuations in both cover and nested frequency, but has remained similar overall between 1998 and 2022. Perennial grasses, particularly the native species muttongrass (*Poa fendleriana*), are the dominant understory components. Although diverse, perennial and annual forbs have been comparatively scarce. The introduced annual grass species cheatgrass (*Bromus tectorum*) was observed in 2003, 2017, and 2022, but in low amounts (**Figure 9.21**, **Figure 9.23**).

<u>Occupancy</u>: Deer have been the primary occupants of this study site, although usage decreased significantly between 2017 and 2022. Mean abundance of deer pellet groups has varied between 63 days use/acre in 1998 and 231 days use/acre in 2017. Elk have also been present on this site, with an average pellet group abundance as low as under 1 days use/acre in 2017 and as high as nearly 31 days use/acre in 1998. Cattle usage has fluctuated between 0 days use/acre in 2017 and 5 days use/acre in 1998 (**Figure 9.25**).

Mountain (Shrub)

One study site [Bear Ridge (23-1)] is classified as a Mountain (Shrub) ecological site: this study can be found approximately three miles southeast of Glenwood (**Table 9.3**).

<u>Shrubs/Trees</u>: Antelope bitterbrush (*Purshia tridentata*) contributes a majority of the preferred browse cover on the Bear Ridge site, although other species such as black sagebrush (*Artemisia nova*) and mountain big sagebrush (*A. tridentata* ssp. *vaseyana*) have been present to a lesser extent. Total shrub cover has increased over time (**Figure 9.10**). Total preferred browse density has fluctuated from year to year, but has remained largely stable when comparing 1998 to 2022 data. Decadent plants comprised a majority of the browse population on this site in 2003 and 2008. Decadence has remained low since 2012, however, and mature individuals have been the dominant demographic in all other sample years. Recruitment of young has remained low (**Figure 9.17**). More than 50% of plants have shown signs of little to no browsing in all sample years except 2008. In 2022, the percentages of heavily and moderately used plants were nearly 15% each (**Figure 9.19**).

Twoneedle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) contributed significant cover and density measurements in 2003 and 2008. However, a chaining treatment in 2010 and lop and scatter in 2016 significantly reduced the tree component. Tree cover remains low as of 2022 while density is moderate, having increased from the 2017 sample year (**Figure 9.11**, **Figure 9.14**).

<u>Herbaceous Understory</u>: The herbaceous understory of this site has increased in cover over time, while abundance has remained similar when comparing the 1998 sample year with 2022. Perennial grasses have been the dominant component

throughout the duration of the study; the native species bluebunch wheatgrass (*Pseudoroegneria spicata*) has contributed the most cover of any single perennial grass species in all sample years. The introduced annual grass species cheatgrass (*Bromus tectorum*) has been observed throughout the study period, but has provided little cover. Forbs have generally remained scarce in comparison with perennial grasses, but have been diverse (**Figure 9.21**, **Figure 9.23**).

Occupancy: Deer have been the primary occupants on this study site in all years except 2022, when elk presence was highest. Average abundance of deer pellet groups has been as low as 16 days use/acre in 2017 and as high as 54 days use/acre in 2003. Elk pellet groups have had a mean abundance ranging from just over 1 days use/acre in 2003 and 2008 to 87 days use/acre in 2022. Cattle pellet groups were not sampled in 1998, 2012, or 2017, but had a mean abundance of under 1 days use/acre in 2003 and 2008 and 8 days use/acre in 2022 (**Figure 9.25**).

Upland (Big Sagebrush)

Five study sites [Saul Meadow (23-2), Thompson Basin (23-3) (suspended), Poverty Flat (23-4) (suspended), Thompson Creek (23-7), and Burrville Cemetery (23-8)] are classified as Upland (Big Sagebrush) ecological sites. The Saul Meadow site is located approximately 2.5 miles east of Annabella near Water Creek. Thompson Basin is found roughly three and a half miles south of Annabella near Thompson Creek, and the Poverty Flat site is situated south of the town of Monroe on the eastern edge of Poverty Flat. The Thompson Creek study is located approximately three miles south of Annabella up Thompson Basin Road. Finally, the Burrville Cemetery site is located about one-half of a mile north of Burrville on the foothills above town (**Table 9.3**).

Shrubs/Trees: Total average shrub cover has increased over time on sites of this ecotype. Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species on all studies. The exception to this is Poverty Flat, which had Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) as the sagebrush subspecies, and blue elderberry (*Sambucus nigra* ssp. *cerulea*) and forage kochia (*Bassia prostrata*) as the dominant preferred browse species during the most recent sampling. Although the number of study sites sampled (the ‘n value’) has remained consistent over time, examination of site-specific data reveals that the studies driving the trends have differed over the sample period. Data on the Saul Meadow site has been gathered in all years, while the Thompson Basin and Poverty Flat studies were only sampled through 2012 and then suspended. The Thompson Creek and Burrville Cemetery studies were established in 2017, and have contributed data along with Saul Meadow since that year. Sagebrush has contributed more cover on the Saul Meadow, Thompson Creek, and Burrville Cemetery studies than on those that were suspended: this drives the slight increase displayed between 2012 and 2017 (**Figure 9.8**). Average density of preferred browse species has increased over time, a trend also driven by the shift in the specific study sites sampled. Mature individuals have comprised a majority of the populations throughout the duration of the sample periods. Recruitment of young increased between 1998 and 2012, but decreased in 2017: this is due to the suspension of the Poverty Flat study. Decadence has remained low in most years (**Figure 9.18**). Preferred browse utilization has fluctuated from year to year. More specifically, moderate and heavy utilization decreased from nearly 70% in 2017 to under 30% between 2017 and 2022: this can largely be attributed to a decrease in moderate utilization on the Burrville Cemetery study (**Figure 9.20**).

Cover and density of twoneedle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) have decreased over time, again largely due to the shift in study sites sampled between 2012 and 2017. As of 2022, all juniper cover can be attributed to the Burrville Cemetery study, and trees were present in density data on Saul Meadow and Burrville Cemetery in the same year (**Figure 9.12**, **Figure 9.15**).

Herbaceous Understory: The herbaceous understories of these sites have increased over time in both frequency and cover: like for shrubs and trees, these trends are at least in part driven by the suspension and establishment of different studies over time. Annual grasses, primarily the introduced species cheatgrass (*Bromus tectorum*), have been the dominant herbaceous component in most sample years. Furthermore, the significant increase in annual grass cover between 2012 and 2017 is largely due to both the Saul Meadow study and the establishment of the Thompson Creek site. Perennial grass cover in 2017 and 2022 has mainly been contributed by the native species bluebunch wheatgrass (*Pseudoroegneria spicata*) on the Burrville Cemetery study. Annual forbs have increased over time, again largely due to both the Saul Meadow study and the establishment of the Burrville Cemetery and Thompson Creek sites. Perennial forbs have remained rare (**Figure 9.22**, **Figure 9.24**).

Occupancy: The average pellet transect data shows that deer and/or sheep have been the primary occupants of these study sites throughout the study period, with a mean pellet group abundance ranging from nearly 17 days use/acre in 2017 to 47 days use/acre in 2003. Elk have also been present, with average abundance of pellet groups as low as 8 days use/acre in 2003 and as high as 17 days use/acre in 2012. Finally, cattle presence has varied between 0 days use/acre in 2012 and nearly 2 days use/acre in 2008 (**Figure 9.26**).

Semidesert (Big Sagebrush)

There are two studies [Greenwich Native (23R-2) and Corner Spring Canyon (23-9)] that are classified as Semidesert (Big Sagebrush) ecological sites. Greenwich Native is located approximately two miles south of Greenwich near the mouth of Browns Canyon. The Corner Spring Canyon study is situated about two miles south of Monroe at the base of Monroe Mountain (**Table 9.3**).

Shrubs/Trees: The preferred browse component of these sites is almost entirely composed of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*); the only other shrub species contributing any line intercept cover in 2022 was plains pricklypear (*Opuntia polyacantha*) on the Corner Spring Canyon site. Total average shrub cover increased marginally between 2017 and 2022, but has decreased overall. Site-level data reveals that this decrease is due to the establishment of the Corner Spring Canyon study in 2017. More specifically, line intercept cover of sagebrush has increased from nearly 17% in 2017 to over 23% in 2022 on the Greenwich Native study, but decreased from 2.4% to 1.6% over the same time period on Corner Spring Canyon (**Figure 9.8**). Average preferred browse demographics indicate that preferred browse density has decreased over time, mainly driven by Corner Spring Canyon. Mature individuals have been the primary age class in most sample years. However, decadent plants comprised a majority of the population on Greenwich Native in 2003, possibly due to the significant drought that occurred in 2002. Recruitment of young individuals has decreased over time, with young plants observed almost entirely on the Greenwich Native study (**Figure 9.18**). Utilization of preferred browse species has fluctuated, but more than 50% of plants have exhibited little to no browsing in most sample years. In 2022, 13% of plants were moderately hedged and 2% were heavily hedged (**Figure 9.20**).

Trees contribute no cover on these sites. Density of Utah juniper (*Juniperus osteosperma*) remains low, but has increased over time: this trend is entirely driven by the establishment of the Corner Spring Canyon study as trees are absent on Greenwich Native (**Figure 9.13**, **Figure 9.16**).

Herbaceous Understory: The average herbaceous understory on sites of this ecotype was sparse and primarily composed of perennial grasses between 1998 and 2012. Both cover and abundance increased significantly in 2017 due to the establishment of the Corner Spring Canyon site. However, understory composition has shifted with the addition of said study: the introduced annual grass species cheatgrass (*Bromus tectorum*) and weedy annual forb redstem stork's bill (*Erodium cicutarium*) are the main herbaceous components as of 2022 (**Figure 9.22**, **Figure 9.24**).

Occupancy: Elk were the primary occupants of sites of this ecotype in 1998, 2003, and 2008 with a mean pellet group abundance ranging from 1 days use/acre in 2003 to nearly 10 days use/acre in 2022. Deer have been the primary occupants following the establishment of the Corner Spring Canyon study in 2017. Deer pellet groups have had an average abundance ranging from 0 days use/acre in 2003 and 2008 to nearly 57 days use/acre in 2022. Finally, cattle have been present on these sites with presence as low as 0 days use/acre in 2003 and as high as over 4 days use/acre in 2012 and 2022 (**Figure 9.26**).

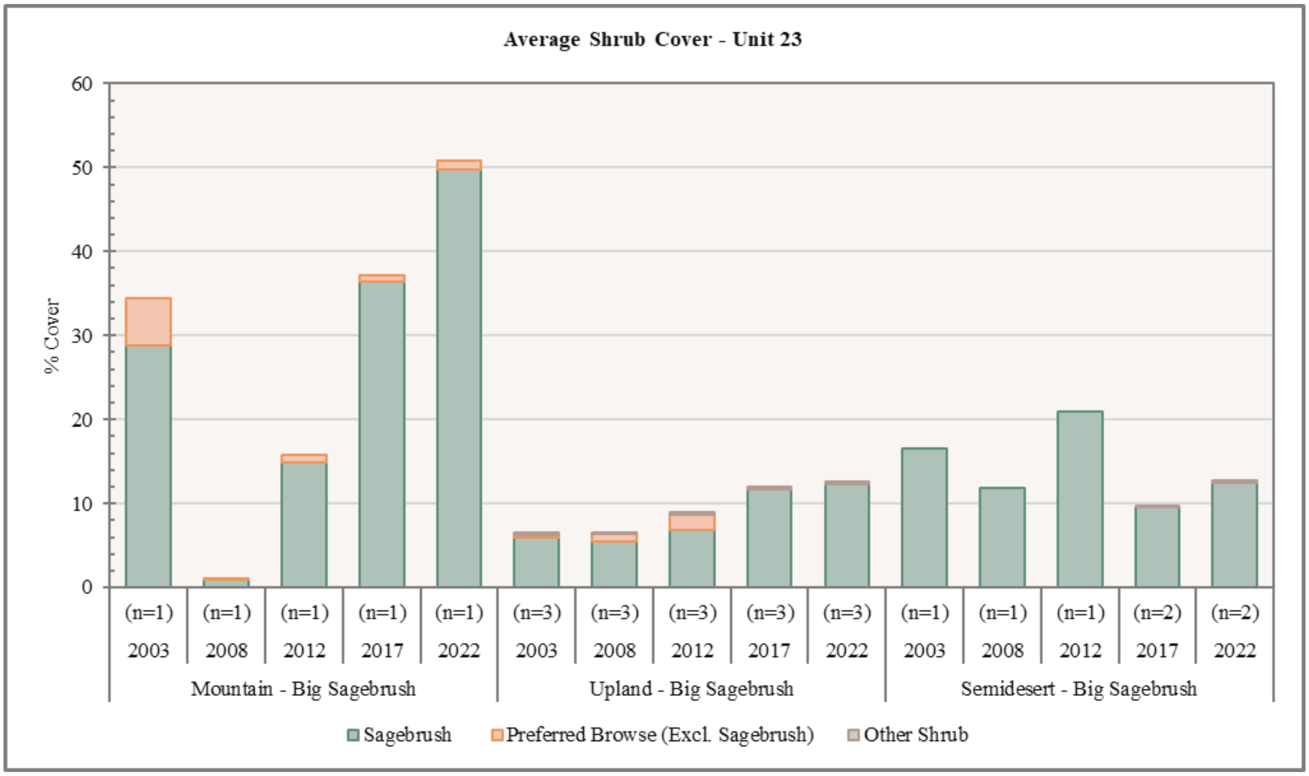


Figure 9.8: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 23, Monroe.

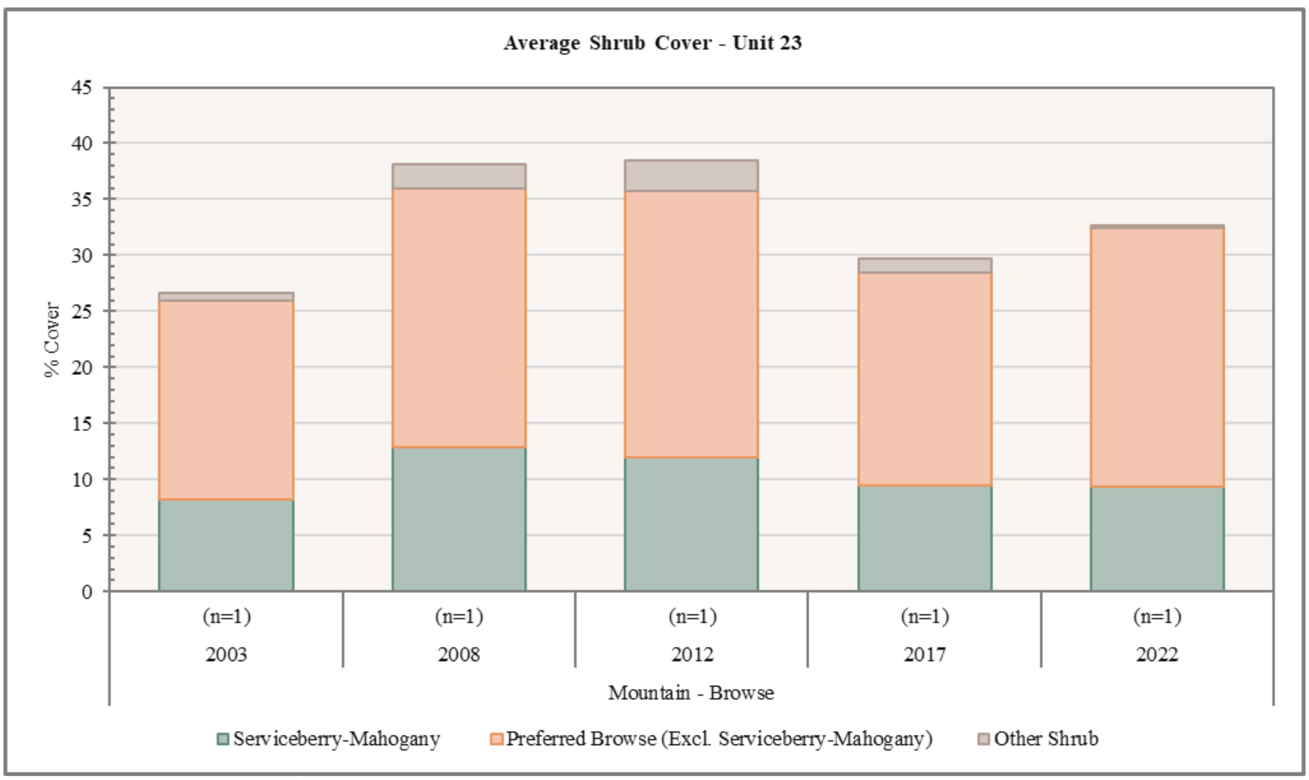


Figure 9.9: Average shrub cover for Mountain - Browse study sites in WMU 23, Monroe.

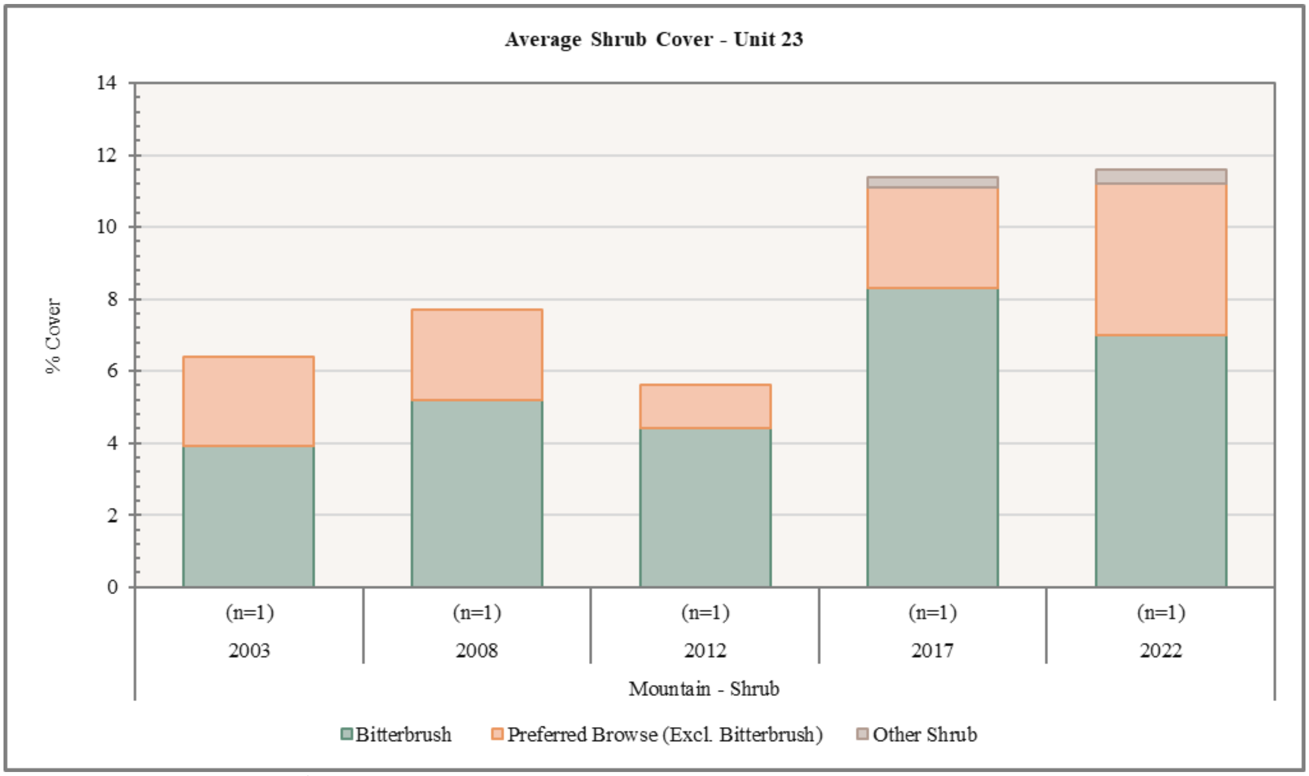


Figure 9.10: Average shrub cover for Mountain - Shrub study sites in WMU 23, Monroe.

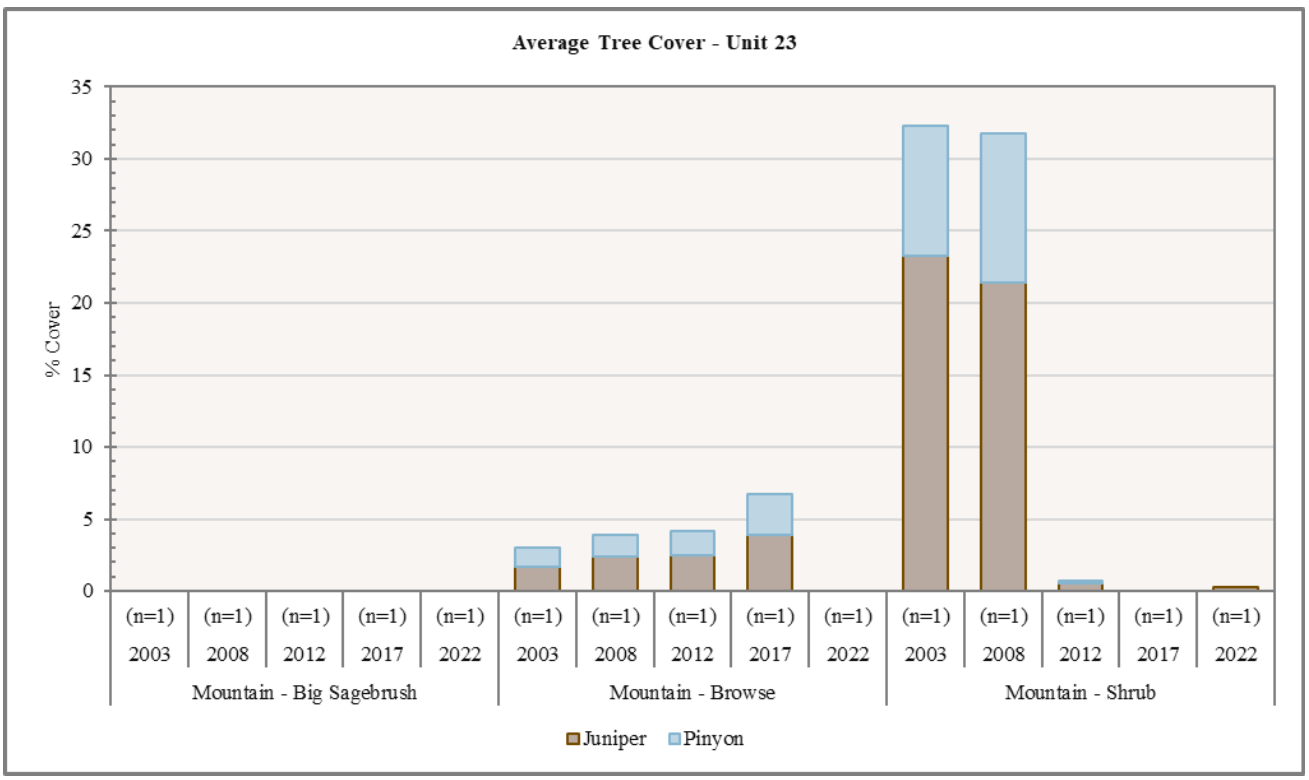


Figure 9.11: Average tree cover for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 23, Monroe.

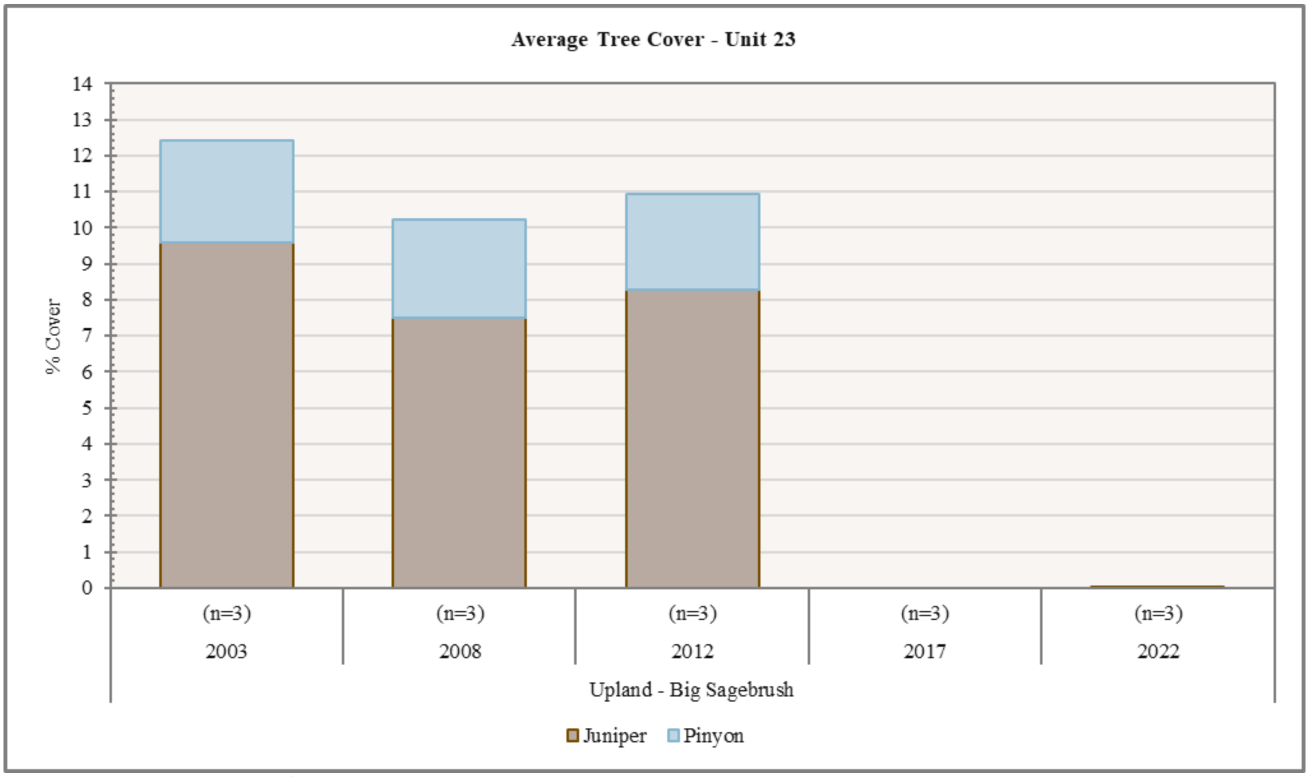


Figure 9.12: Average tree cover for Upland - Big Sagebrush study sites in WMU 23, Monroe.

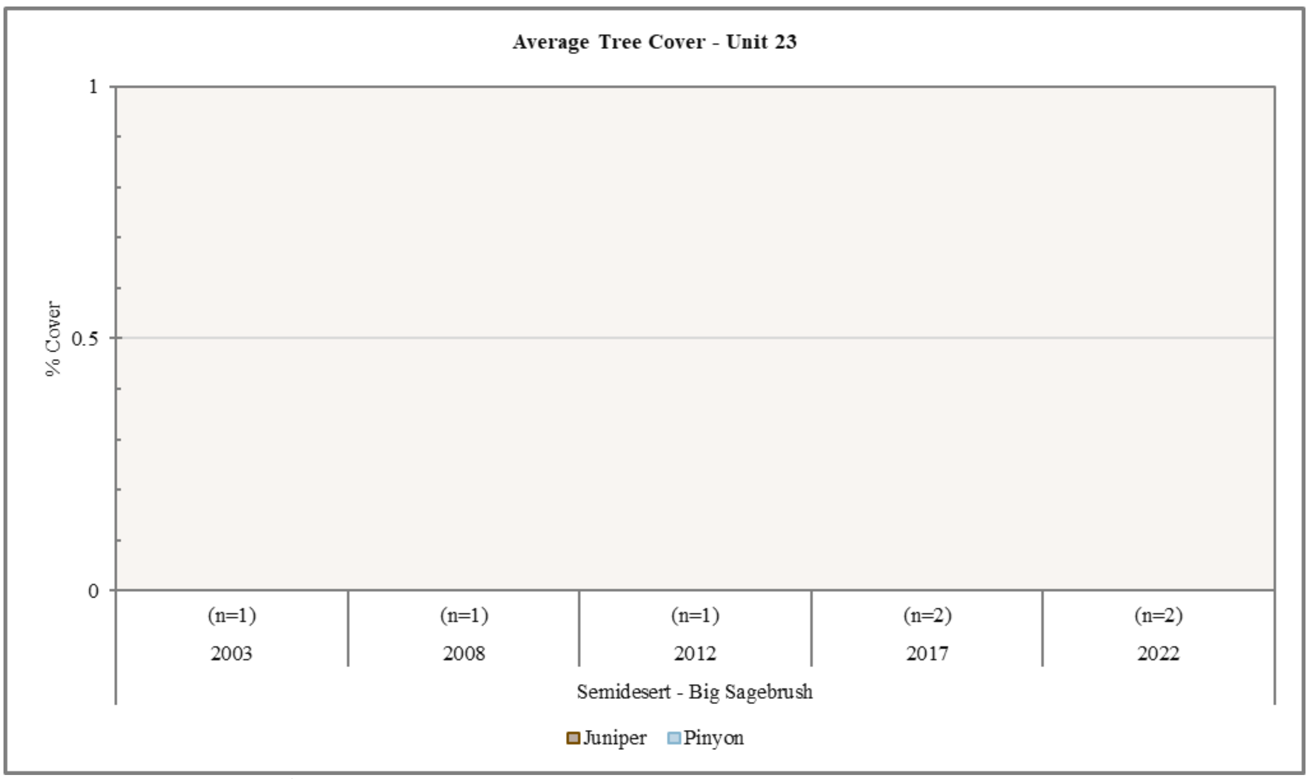


Figure 9.13: Average tree cover for Semidesert - Big Sagebrush study sites in WMU 23, Monroe.

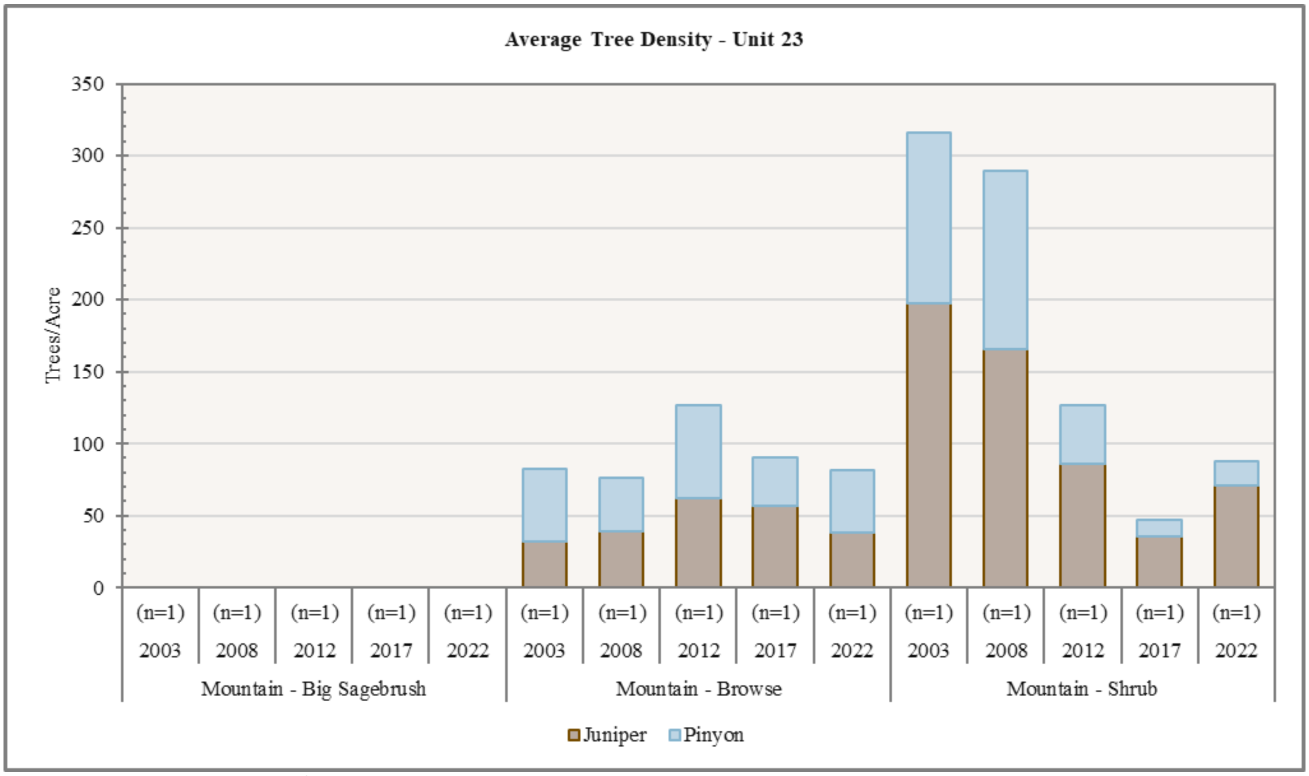


Figure 9.14: Average tree density for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 23, Monroe.

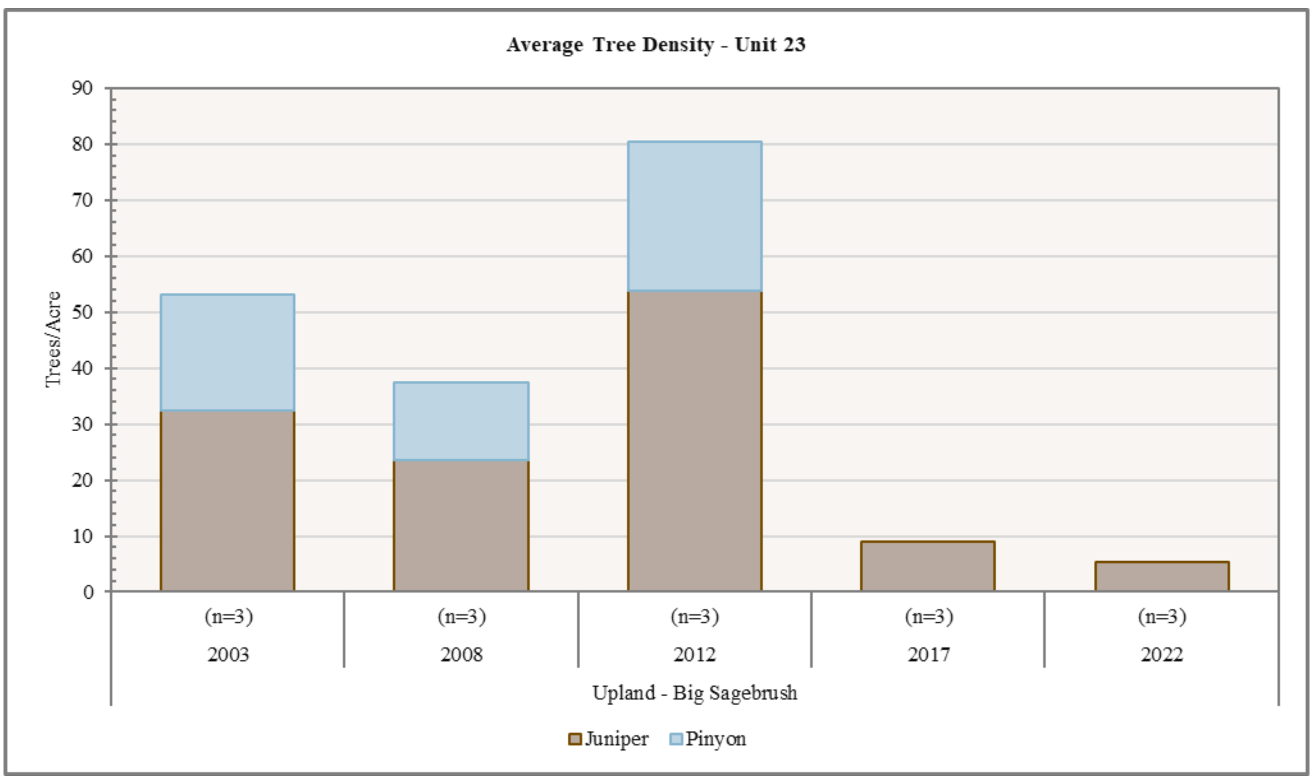


Figure 9.15: Average tree density for Upland - Big Sagebrush study sites in WMU 23, Monroe.

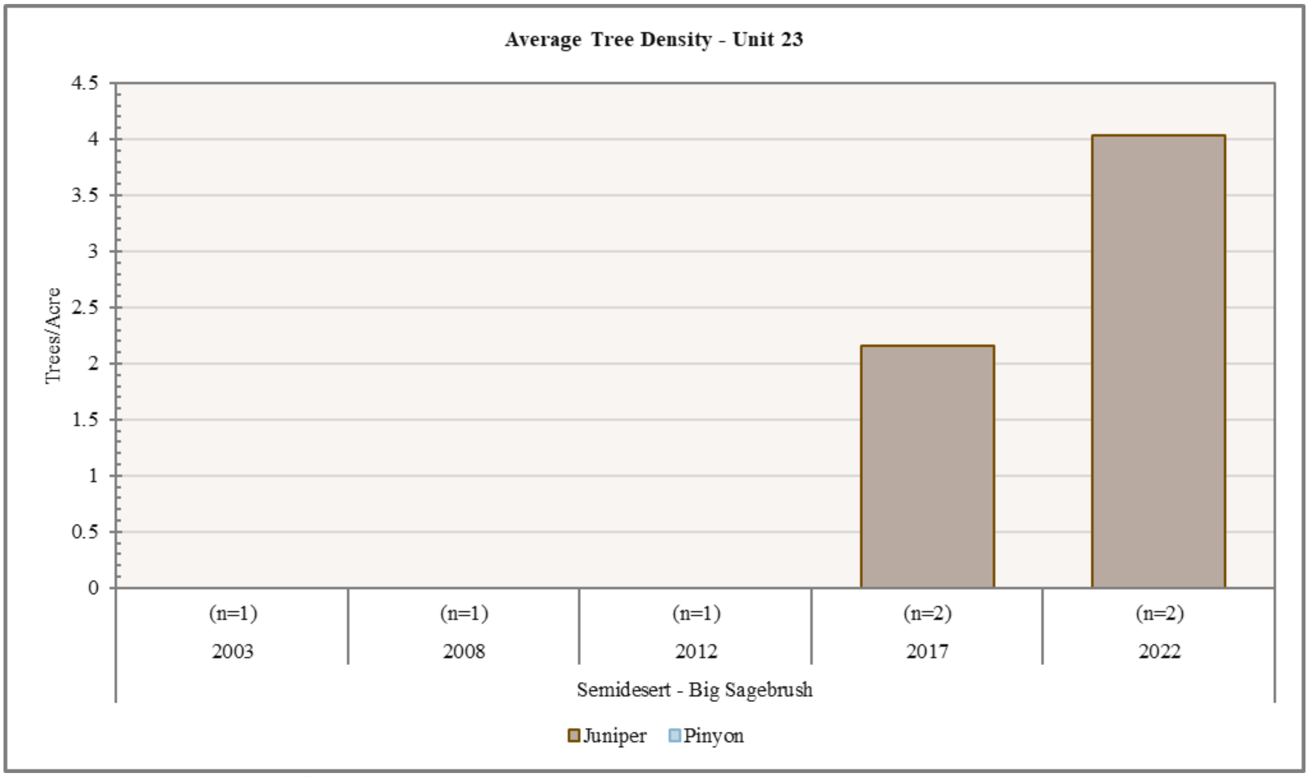


Figure 9.16: Average tree density for Semidesert - Big Sagebrush study sites in WMU 23, Monroe.

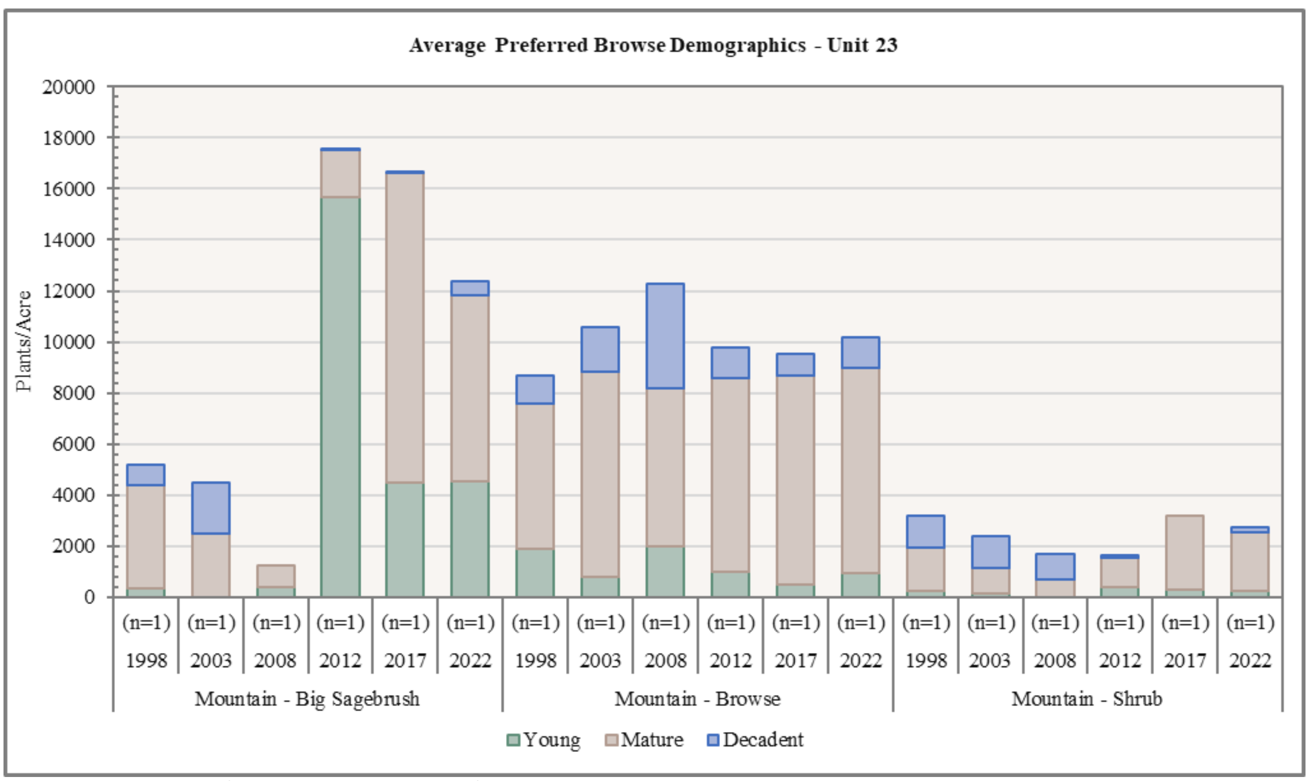


Figure 9.17: Average preferred browse demographics for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 23, Monroe.

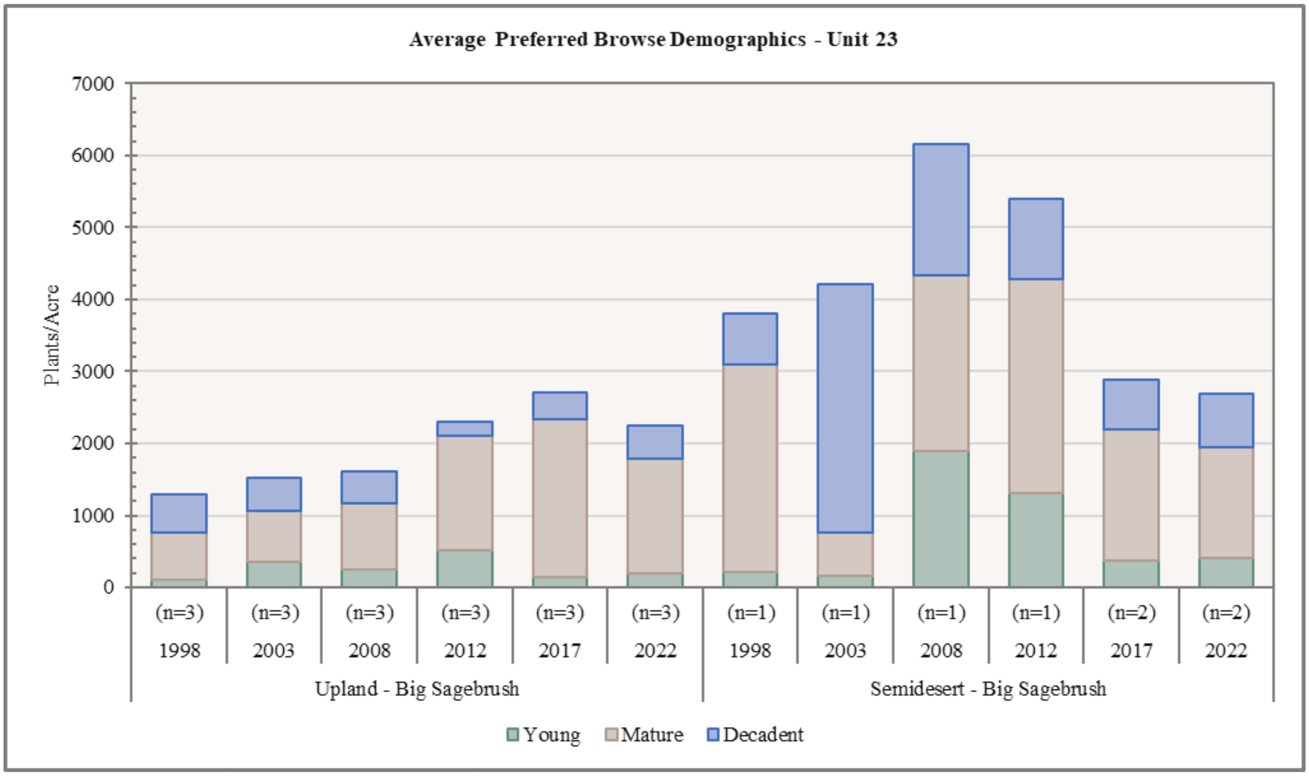


Figure 9.18: Average preferred browse demographics for Upland - Big Sagebrush and Semidesert - Big Sagebrush study sites in WMU 23, Monroe.

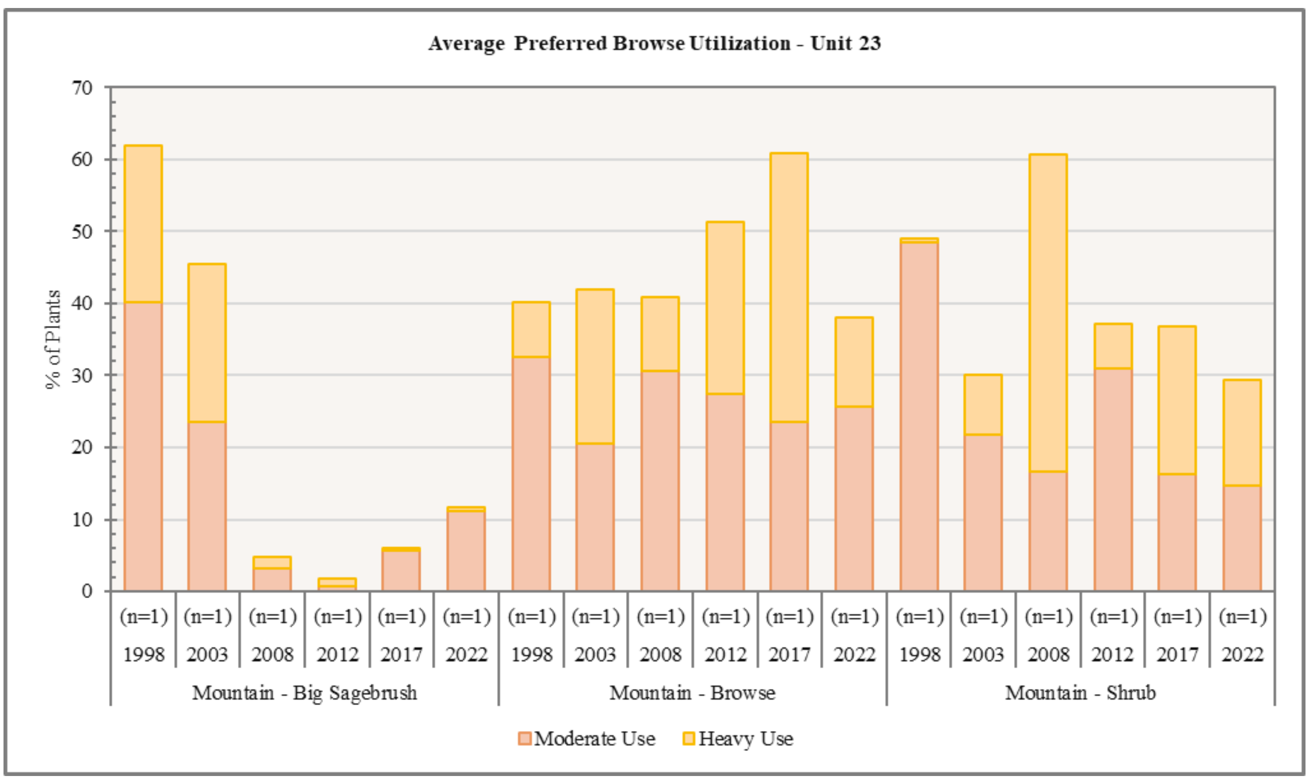


Figure 9.19: Average preferred browse utilization for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 23, Monroe.

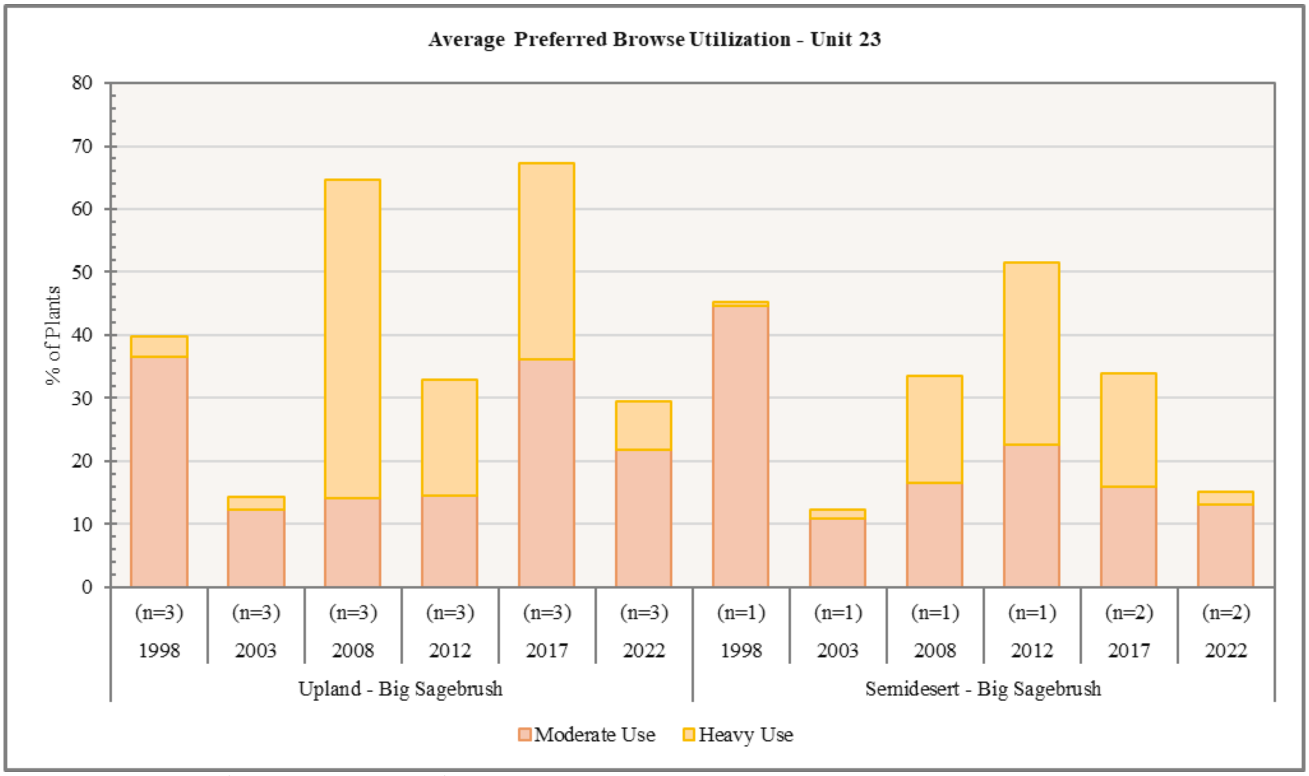


Figure 9.20: Average preferred browse utilization for Upland - Big Sagebrush and Semidesert - Big Sagebrush study sites in WMU 23, Monroe.

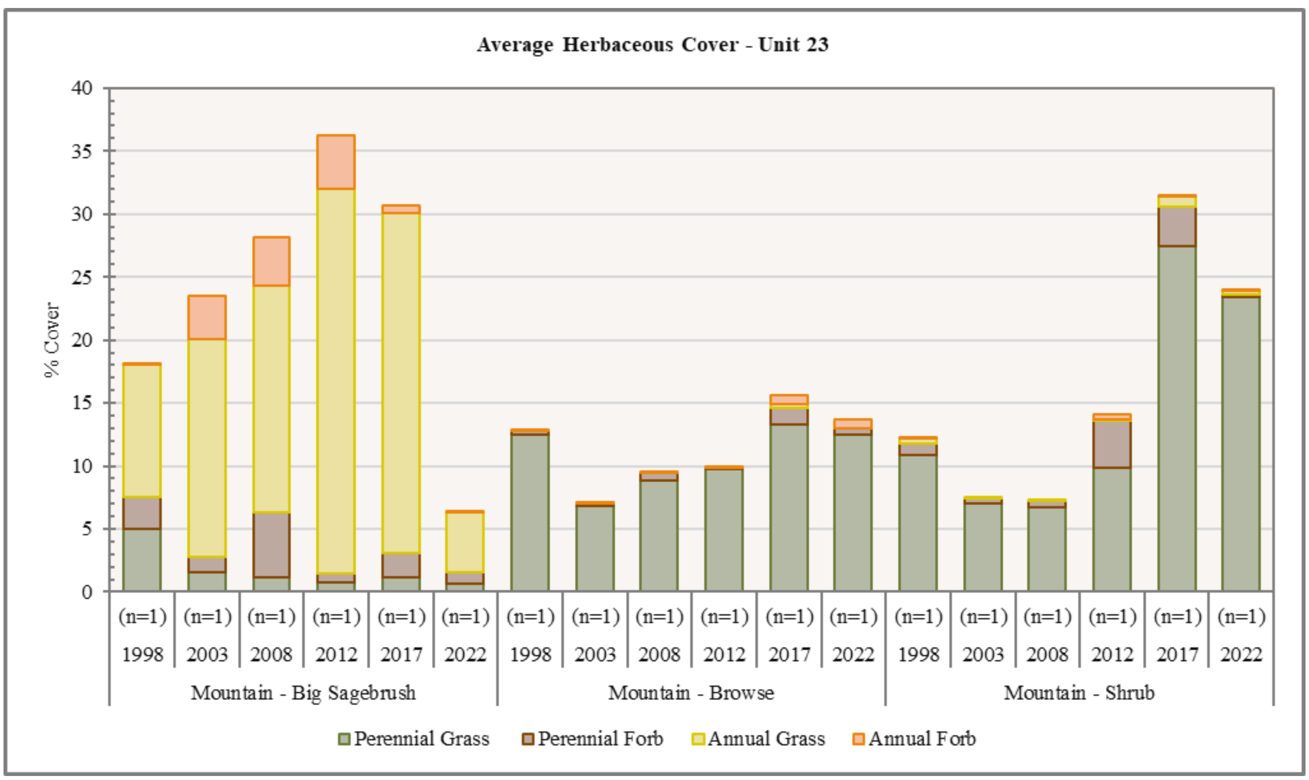


Figure 9.21: Average herbaceous cover for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 23, Monroe.

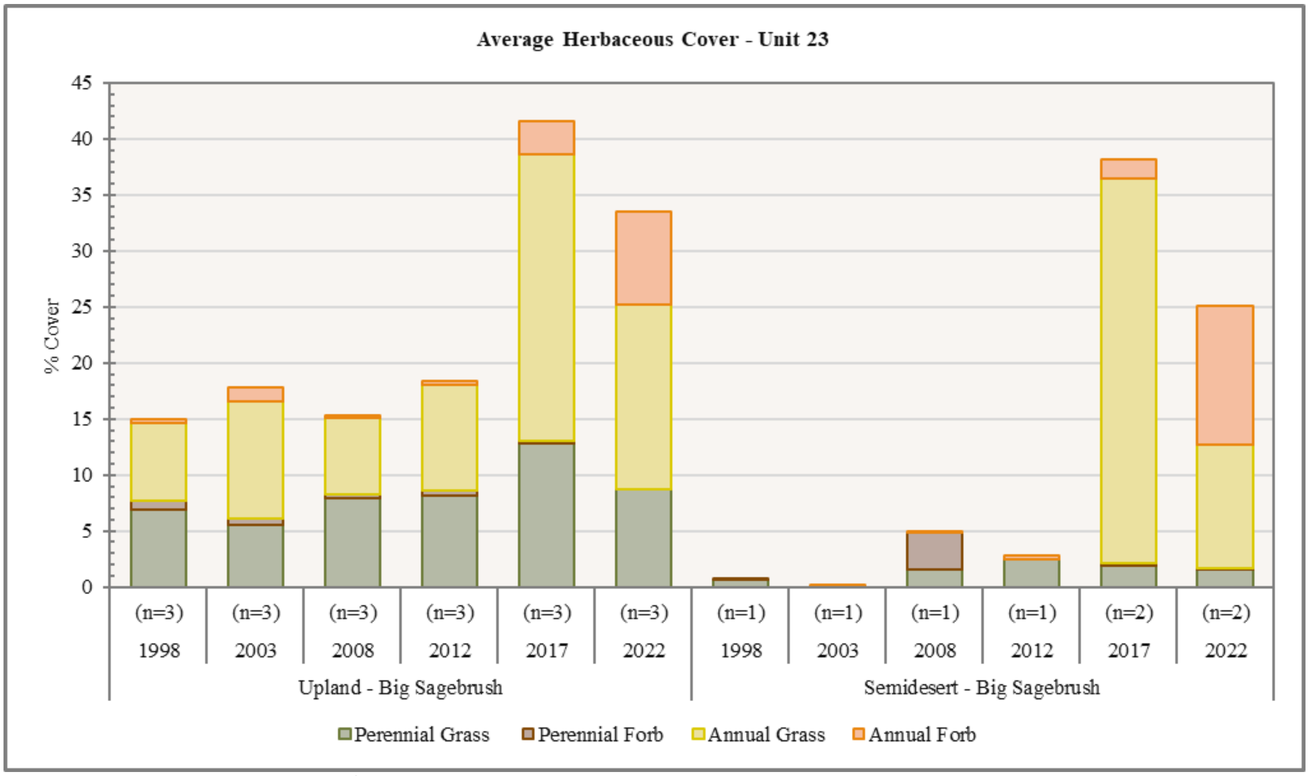


Figure 9.22: Average herbaceous cover for Upland - Big Sagebrush and Semidesert - Big Sagebrush study sites in WMU 23, Monroe.

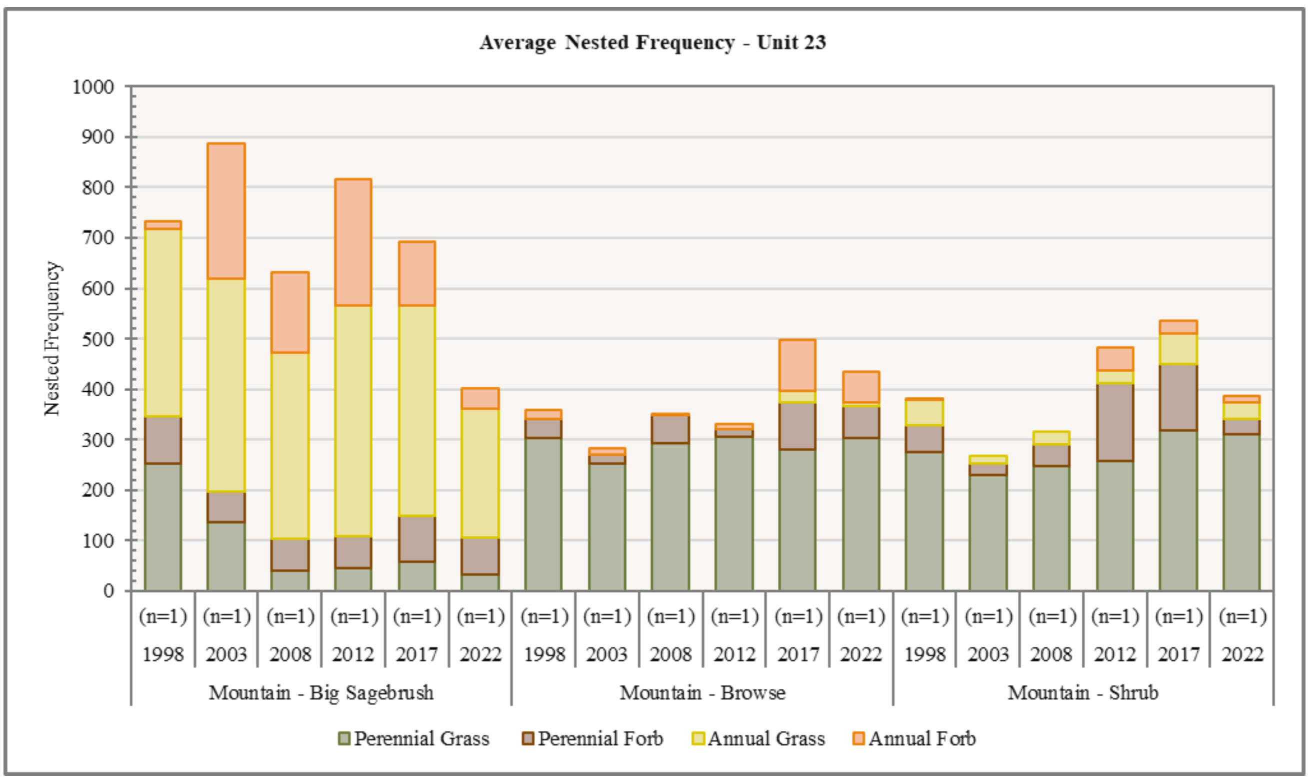


Figure 9.23: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 23, Monroe.

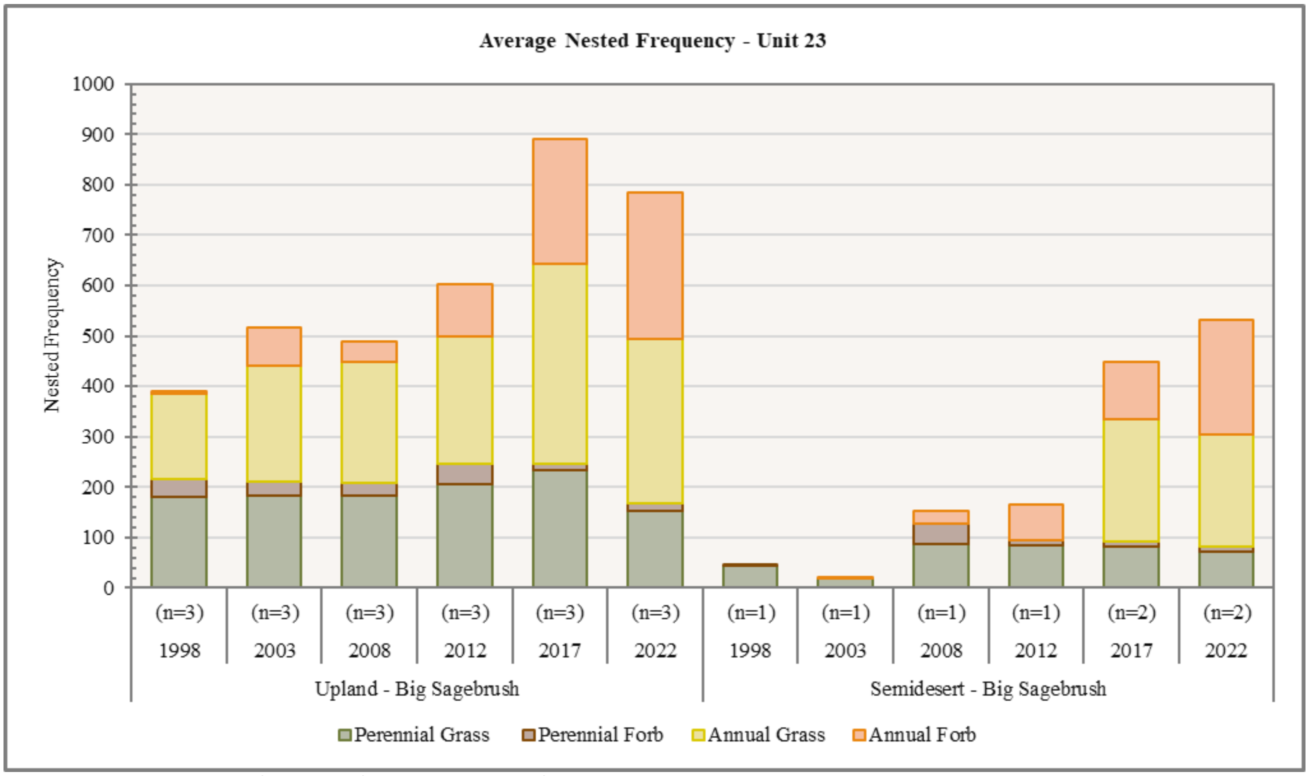


Figure 9.24: Average nested frequency of herbaceous species for Upland - Big Sagebrush and Semidesert - Big Sagebrush study sites in WMU 23, Monroe.

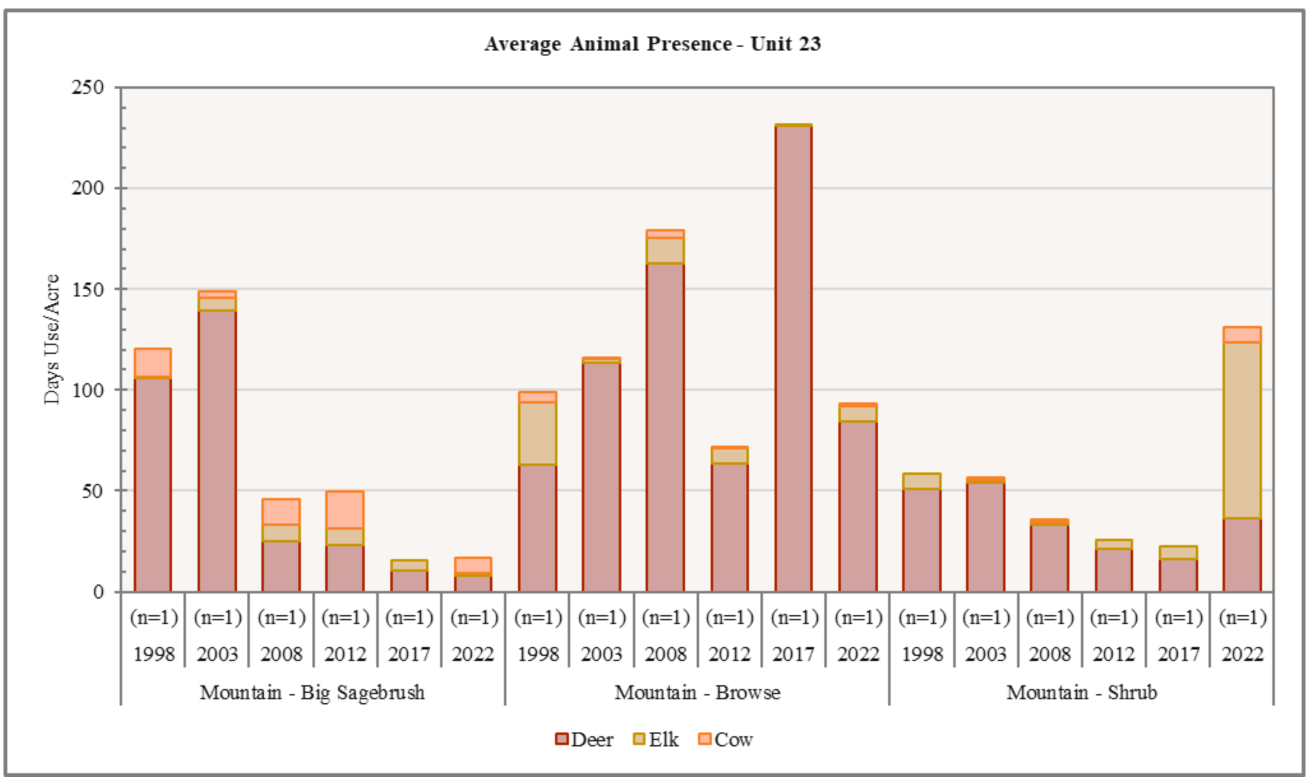


Figure 9.25: Average pellet transect data for Mountain - Big Sagebrush, Mountain - Browse, and Mountain - Shrub study sites in WMU 23, Monroe.

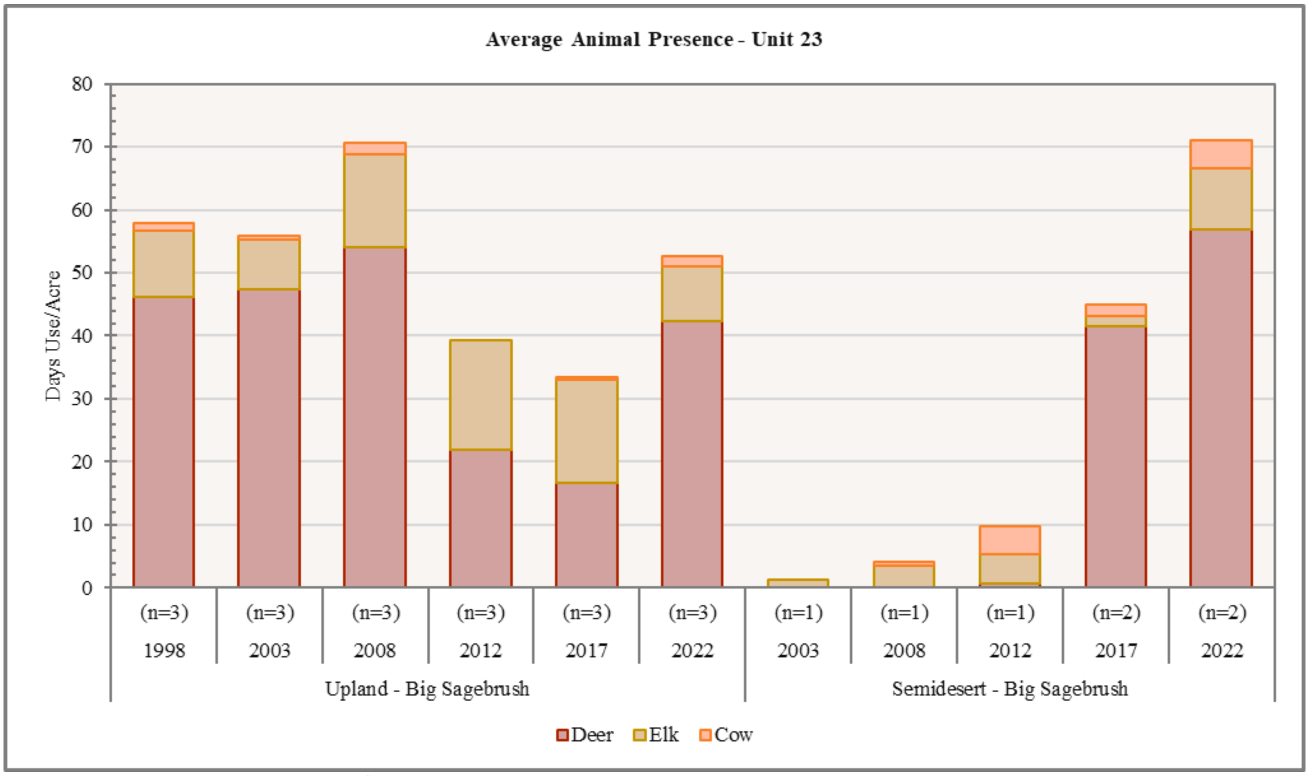
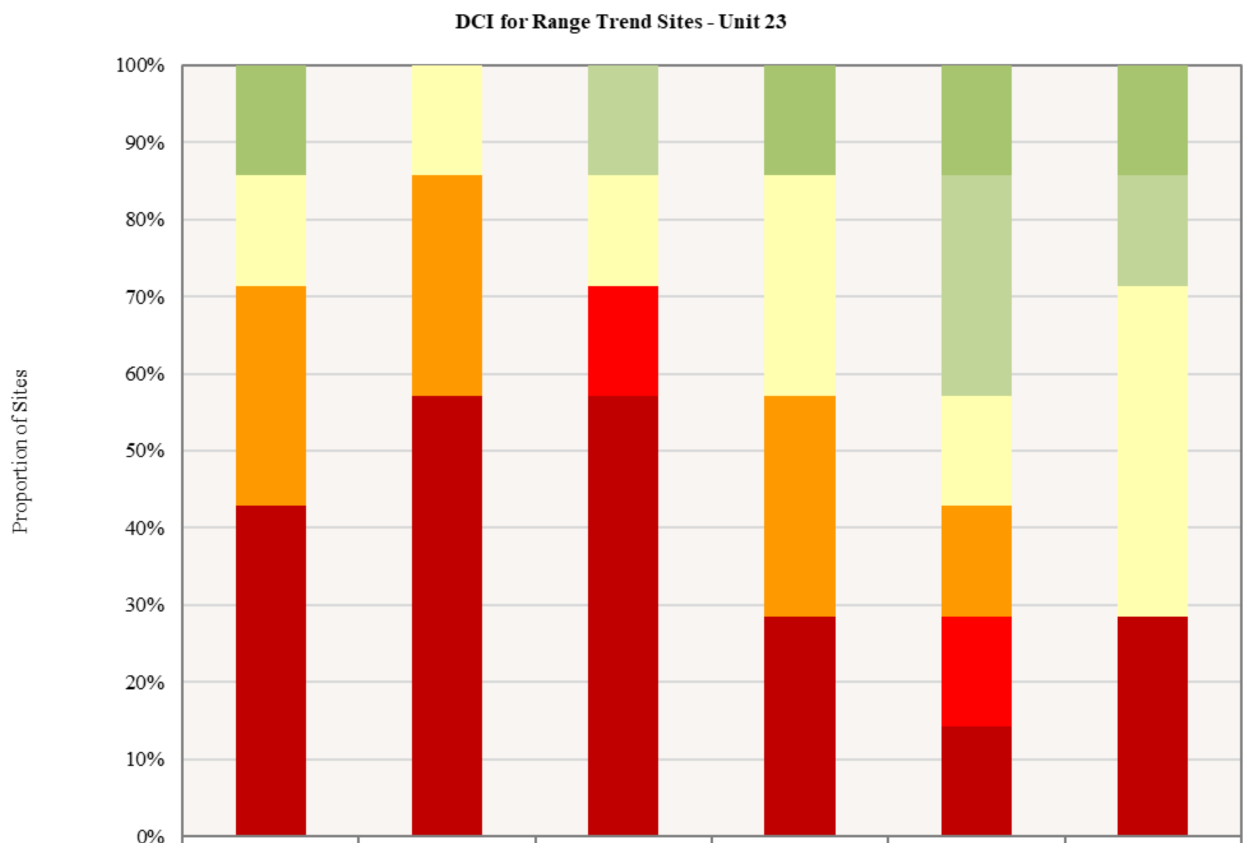


Figure 9.26: Average pellet transect data for Upland - Big Sagebrush and Semidesert - Big Sagebrush study sites in WMU 23, Monroe. *Upland - Big Sagebrush deer pellet groups include deer and sheep pellets.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Monroe management unit has generally improved from very poor-poor averaged conditions in 1998 to poor-fair averaged conditions in 2022. Koosharem Canyon (23-6) and Greenwich Native (23R-2) are the main drivers for the unit's wintering habitat stability and quality, and average as fair deer winter range conditions for both sites. The establishment of Burrville Cemetery (23-8) in 2017 has added some stability to monitored deer wintering range conditions and the site is considered to average as fair. Saul Meadow (23-2), Thompson Basin (23-3) (suspended), Poverty Flat (23-4) (suspended), Smith Canyon (23-5), and Thompson Creek (23-7) (added in 2017) are considered to have very poor wintering habitat conditions consistently from year to year: these poor conditions suppress the unit's overall quality of winter habitat. However, Thompson Basin and Poverty Flat are no longer monitored and do not contribute to the unit's current overall habitat quality for mule deer. Range Trend sites in WMU 23 that tend to have higher winter habitat variability include Bear Ridge (23-1) and Smith Canyon, which suggests a higher potential for winter range improvement.

The overall deer winter range assessment in 2022 for WMU 23 was that the unit was in poor-fair condition with most sites ranging between fair to good condition. However, Saul Meadow and Thompson Creek were considered to be in very poor condition due to the presence of annual grass and a lack of perennial grasses and forbs (**Figure 9.27**, **Table 9.5**).



	1998	2003	2008	2012	2017	2022
Good	1			1	1	1
Fair-Good			1		2	1
Fair	1	1	1	2	1	3
Poor	2	2		2	1	
Very Poor-Poor			1		1	
Very Poor	3	4	4	2	1	2

Figure 9.27: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 23, Monroe.

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
23-1	1998	10.7	4.8	3.4	21.8	-0.3	1.7	0	**42.1**	**P**
23-1	2003	9	4	2.4	14.1	0	0.7	0	**30.2**	**VP**
23-1	2008	10.9	4.8	0	13.4	-0.1	0.9	0	**30.1**	**VP**
23-1	2012	8.1	14.6	9.9	19.6	-0.1	7.5	0	**59.7**	**F**
23-1	2017	16	15	2.5	30	-0.6	6.3	0	**69.1**	**F-G**
23-1	2022	15.8	12.7	1.7	30	-0.2	0.4	0	**60.4**	**F**
23-2	1998	15.9	1.7	4.3	14.9	-8.7	0	0	**28.1**	**VP**
23-2	2003	15	6.6	15	14.3	-4.4	0	0	**46.5**	**P**
23-2	2008	15	4.1	4.8	16	-4.2	0	0	**35.6**	**VP-P**
23-2	2012	20.8	9.5	1.9	16.9	-7.7	0	0	**41.3**	**P**
23-2	2017	16.8	7.3	0.9	6.1	-20	0	0	**11**	**VP**
23-2	2022	18.1	7.8	3.7	6	-12.2	0.1	0	**23.5**	**VP**
23-3*	1998	5.2	0	0	23.5	-0.1	2.6	0	**31.2**	**VP**
23-3*	2003	5.4	0	0	10.6	-0.1	3.7	0	**19.6**	**VP**
23-3*	2008	5.3	0	0	12.3	-0.3	2.4	0	**19.7**	**VP**
23-3*	2012	5.1	0	0	14	-0.3	2.6	0	**21.5**	**VP**
23-4*	1998	0	0	0	2.9	-6.7	2.1	0	**-1.7**	**VP**
23-4*	2003	3.1	0	0	8	-18.8	0	0	**-7.8**	**VP**
23-4*	2008	4.1	0	0	19.1	-10.7	0	0	**12.5**	**VP**
23-4*	2012	7.9	13.6	14.6	18.1	-13.2	0.1	0	**41.2**	**P**
23-5	1998	30	10.3	3	10	-7.9	5.1	0	**50.5**	**P**
23-5	2003	30	1.9	0.3	3	-13	2.4	0	**24.6**	**VP**
23-5	2008	1.4	0	0	2.4	-13.5	10	0	**0.3**	**VP**
23-5	2012	19.9	15	15	1.4	-20	1.5	0	**32.9**	**VP**
23-5	2017	30	15	13.4	2.4	-20	3.8	0	**44.6**	**P**
23-5	2022	30	13.5	15	1.3	-3.6	1.8	0	**58.1**	**F**
23-6	1998	30	9.5	7.5	25.1	0	0.5	0	**72.7**	**G**
23-6	2003	30	9.4	4	13.7	0	0.2	0	**57.4**	**F**
23-6	2008	30	3.1	7.9	17.7	0	1.2	0	**59.9**	**F**
23-6	2012	30	10.9	4.8	19.6	0	0.2	0	**65.4**	**F**
23-6	2017	30	11.4	2	26.6	-0.2	2.7	0	**72.5**	**G**
23-6	2022	30	11.3	4.1	25.1	0	0.8	0	**71.3**	**F-G**
23-7	2017	16.9	7.8	0.6	29.9	-20	0.3	0	**35.4**	**VP-P**
23-7	2022	15.9	8.9	2.8	5.8	-20	0.2	0	**13.4**	**VP**
23-8	2017	10.2	14.5	5	30	-3.2	0.7	0	**57.2**	**F**
23-8	2022	12.3	8.6	6.5	30	-0.7	0.2	0	**56.9**	**F**
23R-2	1997	22.4	9.5	2.9	1.2	0	0.1	0	**36**	**F**
23R-2	2003	20.8	-9.6	1.9	0.3	0	0	0	**13.3**	**P**
23R-2	2004	26.8	-2	1.9	0.1	0	0	0	**26.8**	**P-F**
23R-2	2008	14.9	6.2	15	3.2	0	6.5	0	**45.7**	**F-G**
23R-2	2012	26.3	8.8	12.2	5	0	0.1	0	**52.3**	**G**
23R-2	2017	21	9.2	6.9	5.4	0	0.8	0	**43.3**	**F-G**
23R-2	2022	29.1	7.1	7.7	5.4	0	0.1	0	**49.3**	**G**

Table 9.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend and WRI studies for WMU 23, Monroe. VP = Very Poor, P = Poor, F = Fair, G = Good, E = Excellent. *Studies with an asterisk have been suspended.

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
23-1	Bear Ridge	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Animal Use – Elk	Medium	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
23-2	Saul Meadow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
23-5	Smith Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
23-6	Koosharem Canyon	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Animal Use – Deer	Medium	Reduced/less vigorous browse component
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
23-7	Thompson Creek	Annual Grass	High	Increased fire potential and reduced herbaceous vigor
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
23-8	Burrville Cemetery	Annual Grass	Medium	Increased fire potential and reduced herbaceous vigor
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
23-9	Corner Spring Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous vigor
		Animal Use – Deer	Medium	Reduced/less vigorous browse component
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
23R-1	Greenwich Disking	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
23R-2	Greenwich Native	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
23R-3	Plateau Harrow	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
23R-4	Plateau Native	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
23R-7	South Narrows	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
23R-8	Browns Canyon Drill	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
23R-9	Poverty Dixie	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
23R-11	Box Creek Dixie	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
23R-12	Glenwood Chaining	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
23R-13	Tuft Reservoir	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
23R-14	Langdon Mountain	None Identified	-	-
23R-15	Wood Hollow	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor

Table 9.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 23, Monroe. 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

Most winter range sites in this unit are in overall poor-fair condition. However, winter range condition varies from site to site: three sites are considered to be in very poor condition while the remaining sites are fair-good. The sites that are in poor condition are all on the northwest side of the mountain, while the majority of sites that are in fair or good condition are found on the east side of Monroe Mountain. Shared among the sites ranked as fair or good are adequate amounts of preferred browse and/or perennial grass available to wildlife.

The lack of wildfire on the unit as a whole has generally resulted in higher elevation habitats remaining intact, which is made evident through GIS and satellite imagery exercises. The low frequency and the small size of wildfires that have occurred on the Monroe unit have potentially been beneficial to wildlife by diversifying summer habitat. Because wildfires have been infrequent, major work has been done and is currently occurring on the Monroe unit to improve summer range, and reduce the risk of crown fires. WRI sites that are in these summer areas have been treated by controlled burns and have data showing that aspen are regenerating and benefiting habitat. Also noteworthy on these higher elevation habitats are fire mitigation efforts that have cleared conifer around the cabin communities, which has likely improved the summer range for both deer and elk. Only a few significant fires have occurred on lower elevation winter range habitat in this unit, primarily the Flat wildfire in Poverty Flat. Sites in the Poverty Flat area have remained dominated by cheatgrass with a depauperate herbaceous community. Fortunately, other fires within the winter range have been limited in scope, and threats have been limited to conifer encroachment. Many different methods have been and are being used to control and remove pinyon-juniper from winter range habitat: this allows for sagebrush recovery and other preferred browse to regenerate. Along with browse regeneration, these treated areas have generally had increases in perennial grasses and forbs that have further diversified these communities and improved their health.

There are various concerns for the Monroe unit that are currently being addressed or need attention in the future. Sagebrush in the winter range is decreasing in the Poverty Flat area, which is a result of the 1997 Flat wildfire that burned approximately 5,500 acres. Current and historical data show that sagebrush populations have been slow to recover in the area; there are a number of factors that contribute to this trend. First, annual grass has become a major component in the understories where or near where wildfires have occurred. Annual grasses, primarily cheatgrass, pose high-level threats on both study sites in Poverty Flat [Corner Spring Canyon (23-9) and Poverty Dixie (23R-9)]. 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). This particular effect has not become evident due to the low frequency of wildfire on the unit. However, in high abundance, cheatgrass, competes with establishing native and seeded plants for water and nutrient resources that prevent these more desirable plants from maturing and establishing in restoration projects, which is particularly evident on the Corner Spring Canyon study (Stevens & Monsen, 2004). These two factors negatively impact this localized winter range by preventing sagebrush and their associated communities from reestablishing and providing sufficient forage for wildlife.

Winter range habitat in areas of lower potential in this unit as a whole tends to show signs of drought stress. Drought lowers the resilience and resistance of these communities to disturbance that can lead to loss of habitat and slow recoveries of plant communities when disturbances occur. Sites near the town of Greenwich that have been treated have herbaceous understories that did not respond to treatment despite improvements in the browse component; the exception to this is South Narrows where browse and herbaceous components failed to respond. Although cheatgrass presence is low on these sites, future improvement projects should use caution when treating these lower potential areas to avoid releasing cheatgrass further into the habitat.

Pinyon and juniper encroachment is actively occurring in areas monitored for deer winter range throughout this unit, but especially on the eastern side. Current and historic work has been successful in reducing the impact of tree encroachment. However, there remains a considerable amount of tree cover within these areas, and range between Phase I and Phase III 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).

There are a few islands (albeit clustered) of private land on top of the Sevier Plateau near Monroe Meadows. Naturally, there is potential for further human development in what is considered to be substantial and crucial summer habitat for deer and elk, respectively. Increased development within this habitat can have direct deleterious effects to both habitat and wildlife through habitat fragmentation, human-wildlife interactions on roadways, and increased potential for invasive plant introduction, among other effects.

There are a number of recommendations to mitigate or slow the effects of habitat loss in the Monroe management unit. As habitat is impacted in the future, continued habitat improvement projects will be needed to mitigate the effects of further human development. More specifically, as cabin and road developments occur, improvement projects will be needed to provide “buffering” in areas immediately around private land development and replace habitat as it is lost. Loss of preferred browse and community diversity increases strain on wildlife through forage loss in their respective winter and summer ranges. To relieve this strain, there are several rejuvenation project types occurring on this unit that are directed at sagebrush and aspen ecosystems. Common within the Monroe unit is conifer removal; revitalization methodologies like bullhog, lop and scatter, chaining, and controlled burns are essential tools in alleviating pressures of encroachment and enhancing forage on winter and summer ranges. It is recommended that these methods should continue to be appropriately selected according to the needs of each area. Additionally, many of these treatments use seed mixes to augment or restore depleted understories. If seeding is used as a method of reestablishment of shrub or herbaceous components, care should be taken in seed selection. Preference should be given to native species whenever possible when creating seed mixes, as some introduced species may have the potential to be aggressive in certain ecological potentials. Continued monitoring of the communities in the winter range will prove valuable; data collected in the future will indicate whether the severity of current limiting factors (tree encroachment, annual grasses, introduced perennial grasses, and drought) is increasing, and what actions are needed to mitigate these identified potential threats to habitat and wildlife.

REFERENCES

Balch, J. K., D'Antonio, B. A., & Gómez-Dans, C. M. (2013). Introduced annual grass increases regional fire activity across the arid western USA (1980–2009). *Global Change Biology, 19*(1), 173-183.

Baur, L. E., Schoenecker, K. A., & Smith, M. D. (2017). Western North American Naturalist. *Effects of Feral Horse Herds on Rangeland Plant Communities across a Precipitation Gradient, 77*(4), pp. 526-539. Retrieved from https://discovery-ebsco-com.ezproxy.uvu.edu/c/er7pa4/viewer/pdf/oi2nilknpz

Boulanger, J., Poole, K. G., Gunn, A., & and Wierzchowski, J. (2011, November 21). Wildlife Biology. *Estimating the Zone of Influence of Industrial Developments on Wildlife: a migratory caribou Rangifer tarandus groenlansicus and diamond mine case study*, pp. 164-179.

Chambers, J. C., Bradley, B. A., Brown, C. S., D'Antonio, C., Germino, M. J., Grace, J. B., . . . Pyke, D. A. (2013, November 14). Ecosytems. *Resilience to Stress and Disturbance, and Resistance to Bromus tectorum L. Invasion in Cold Desert Shrublands of Western North America, 17*, pp. 360-375. doi:https://doi.org/10.1007/s10021-013-9725-5

Climate Prediction Center Internet Team. (2005). *Climate Prediction Center*. Retrieved February 12, 2019, from National Weather Service: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/palmer_drought/wpdanote.shtml

Davies, K. W., Collins, G., & Boyd, C. S. (2014, October). Ecosphere. *Effects of feral free-roaming horses on semi-arid rangeland ecosystems: an example from the sagebrush steppe, 5*(10), pp. 1-17. doi:https://doi.org/10.1890/ES14-00171.1

Eldridge, D. J., Ding, J., & Travers, S. K. (2020, January). Biological Conservation. *Feral horse activity reduces environmental quality in ecosystems globally, 241*. doi:https://doi.org/10.1016/j.biocon.2019.108367

Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets. (2023). *US Historic Fire Perimeters*. U.S. Department of the Interior, Geological Survey. Retrieved 2023, from http://rmgsc.cr.usgs.gov/outgoing/GeoMAC/historic_fire_data/

Jacobs, J. S., & Sheley, R. L. (2003, March). Prescribed Fire Effects on Dalmation Toadflax. *Journal of Range Management, 56*(2), 193-197. doi:10.2307/4003904

Karban, R., & Pezzola, E. (2017). Effects of Multi-year Drought on a Drought-adapted Shrub, Artemisia tridentata. *Plant Ecology*, 547-554.

Kulmatiski, A. (2006). Plant Ecology. *Exotic plants establish persistent communities, 187*, pp. 261-275. doi:DOI 10.1007/s11258-006-9140-5

LANDFIRE.US_140EVT. (2020). *LANDFIRE Existing Vegetation Type*. Sioux Falls, SD, US: Wildland Fire Science, Earth Resources Observation and Science Center, U.S. Geological Survey. Retrieved December 6, 2020, from http://landfire.cr.usgs.gov/viewer/

Mack, R. N., Simberloff, D., Lonsdale, W. M., Evans, H., Clout, M., & Bazzaz, F. A. (2000). Biotic Invasions: Causes, Epidemiology, Global Consequences, and Control. *Ecological Applications*, 689-710.

Miller, R. F., Svejcar, T. J., & Rose, J. A. (2000). Impacts of western juniper on plant community composition and structure. *Journal of Range Management*, 574-585.

Pastro, L. A., Dickman, C. R., & Letnic, M. (2011, December). Ecological Applications. *Burning for Biodiversity or Burning Biodiversity? Prescribed Burn vs. Wildfire Impact On Plants, Lizards, and Mammals, 21*(8), pp. 3238-3253.

Pilliod, D., Welty, J., & Jefferies, M. (2019). *Land Treatment Digital Library: U.S. Geological Survey Data Series 806.* (U.S. Geological Survey) doi:https://doi.org/10.5066/P98OBOLS

PRISM Climate Group, Oregon State University. (2021). *1991-2020 Climatology Normals*. Retrieved February 2022, from https://prism.oregonstate.edu/normals/

Rangeland Analysis Platform. (2022, September 26). *Products*. Retrieved March 14, 2023, from Rangeland Analysis Platform: https://rangelands.app/products/

Rangeland Analysis Platform. (2023, March 6). Retrieved from Rangeland Analysis Platform: https://rangelands.app/

Roundy, B., Young, K., Cline, N., Hulet, A., Miller, R., Tausch, R., . . . Rau, B. (2014). Management, Rangeland Ecology. *Pinyon–Juniper Reduction Increases Soil Water Availability of the Resource Growth Pool, 67*, pp. 495-505.

Schlaepfer, D. R., Lauenroth, W. K., & Bradford, J. B. (2014). Natural Regeneration Processes in Big Sagebrush (Artemisia tridentata). *Rangland Ecology Management*, 344-357.

Shafer, S. L., Bartlein, P. J., & Thompson, R. S. (2001). Potential Changes in the Distributions of Western North America Tree and Shrub Taxa under Future Climate Scenarios. *Ecosystems*, 200-215.

Stam, B. R., Malechek, J. C., Bartos, D. L., Bowns, J. E., & Godfrey, E. B. (2008, January). Rangeland Ecology Management. *Effects of Conifer Encroachment Into Aspen Stands on Understory Biomass, 61*, pp. 93-97.

Stevens, R., & Monsen, S. B. (2004). Guildlines for restoration and rehabilitation of principal plant communities. In S. B. Monsen, R. Stevens, & N. L. Shaw, *Restoring western ranges and wildlands, vol. 1* (pp. 199-294). Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. doi:https://doi.org/10.2737/RMRS-GTR-136-V1

Swartz, K., & Smith, H. (2023, March 20). *Office of Wildland Fire*. Retrieved from U.S. Department of the Interior: https://www.doi.gov/wildlandfire/teaming-take-double-threat-invasives-and-wildfires#:~:text=Invasive%20plants%20such%20as%20cheatgrass,invade%20or%20even%20re%2Dinvade.

Time Series Data. (2023). *National Oceanic and Atmospheric Administration Earth System Research Laboratory Physical Science Division*. Boulder, CO. Retrieved February 14, 2023, from http://www.esrl.noaa.gov/psd/data/timeseries/

APPENDIX A - THREAT ASSESSMENT

Annual Grass:

Species: *Bromus tectorum, B. arvensis, 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 recent 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 introduced perennial 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 recent 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.

Drought:

> **NOTE:** The "limiting factor or threat" of drought or long-term drought can assigned 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.