Wildlife Management Units 22, 24, 25A, 25B, 25C, 27, 28, 29 & 30

Habitat Monitoring

UTAH BIG GAME RANGE TREND

RANGE TREND PROJECT REPORT

Publication Number 24-10 | Report for Federal Aid Project W-82-R-68

2023 Summary Report

Prepared by:

UTAH DIVISION OF WILDLIFE RESOURCES – GREAT BASIN RESEARCH CENTER

Utah Big Game Range Trend
Unit Summaries
2023
Wildlife Management Units
22, 24, 25A, 25B, 25C, 27, 28, 29 & 30

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Cover Photo Credit

Woollypod Milkvetch (*Astragalus purshii*) by Jason Cox (2023)

Performance Report for Federal Aid Project W-82-R-68

Publication No. 24-10

UTAH DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife Resources
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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-68

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. Study sites for all tasks will be located throughout Utah in the Great Basin, Central Basin and Range, and the Colorado Plateau Ecoregions.

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 2023 field season and reported in this publication involves the reading of interagency Range Trend studies in the DWR Southern Region. Most trend studies surveyed in these management units were established in the 1980s and reread at five-year intervals.

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

Bureau of Land Management

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

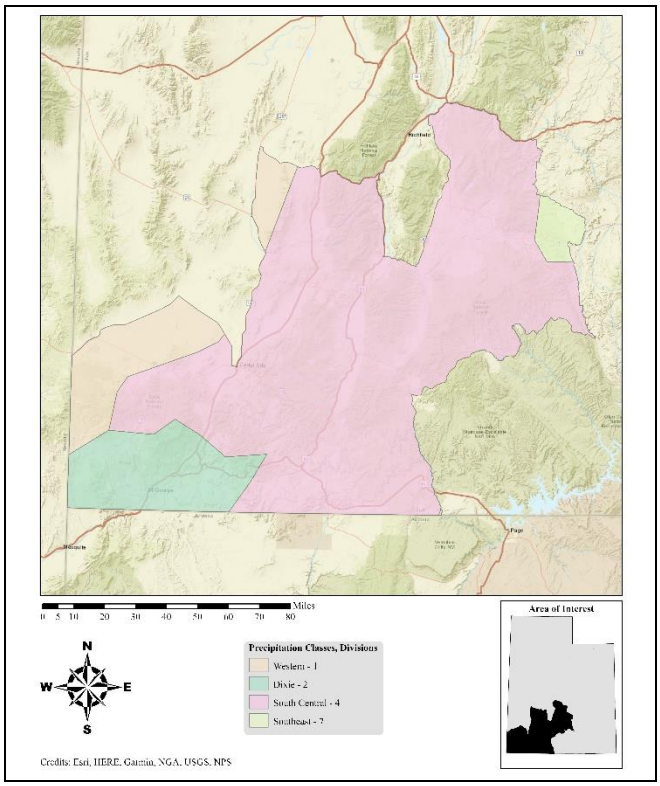
United States Forest Service

- Dixie National Forest
- Fishlake National Forest

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

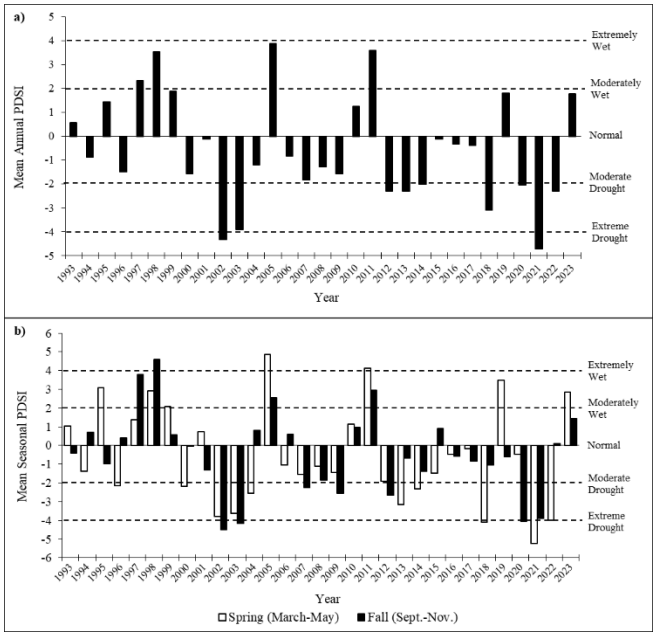
RANGE TREND UNIT SUMMARY OVERVIEW

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 Southern Region occurs within three of these divisions: Western (Division 1), Dixie (Division 2), and South Central (Division 4). 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 2023. The data reported in this summary covers a majority of the years over which these sites have been sampled (1993-2023). 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 -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 (Time Series Data, 2024). In the figure below, graph "a" represents the mean annual PDSI for the South Central Division and graph "b" shows the mean PDSI by season, spring (March-May) and fall (Sept.-Nov.) for the same division (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. 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 structure, 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 the limited number of sampling sites, Range Trend cannot accurately predict the overall abundance of forage available in the entire extent of mule deer range. The RAP may aid in the estimation of forage quantity within mule deer habitat by providing values for biomass and cover for perennial, annual, and browse lifeforms that Range Trend sites cannot account for. However, RAP data 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. 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, 2023, para. 6). The following graphs represent vegetation changes by either biomass or percent cover based on deer winter, summer, or year-long range habitat. Range Trend data is collected on a five-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 Type for Mule Deer Habitat: The Existing Vegetation Type (EVT) layer represents the terrestrial ecological systems that are distributed across the landscape. According to the LANDFIRE Existing Vegetation Type website (2022, paras. 2-4):

> A terrestrial ecological system is defined as a group of plant community types (associations) that tend to co-occur with landscapes with similar ecological processes, substrates, and/or environmental gradients. […] EVT also includes ruderal or semi-natural vegetation types within the U.S. National Vegetation Classification. […] EVT is mapped using decision tree models, field data, Landsat imagery, elevation, and biophysical gradient data.

The LANDFIRE data reported in this summary includes the major functional groups (shrubland, conifer, grassland, and others) and various subgroups of importance found on mule deer habitat 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."

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 2023 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 numerous 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 studies 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.

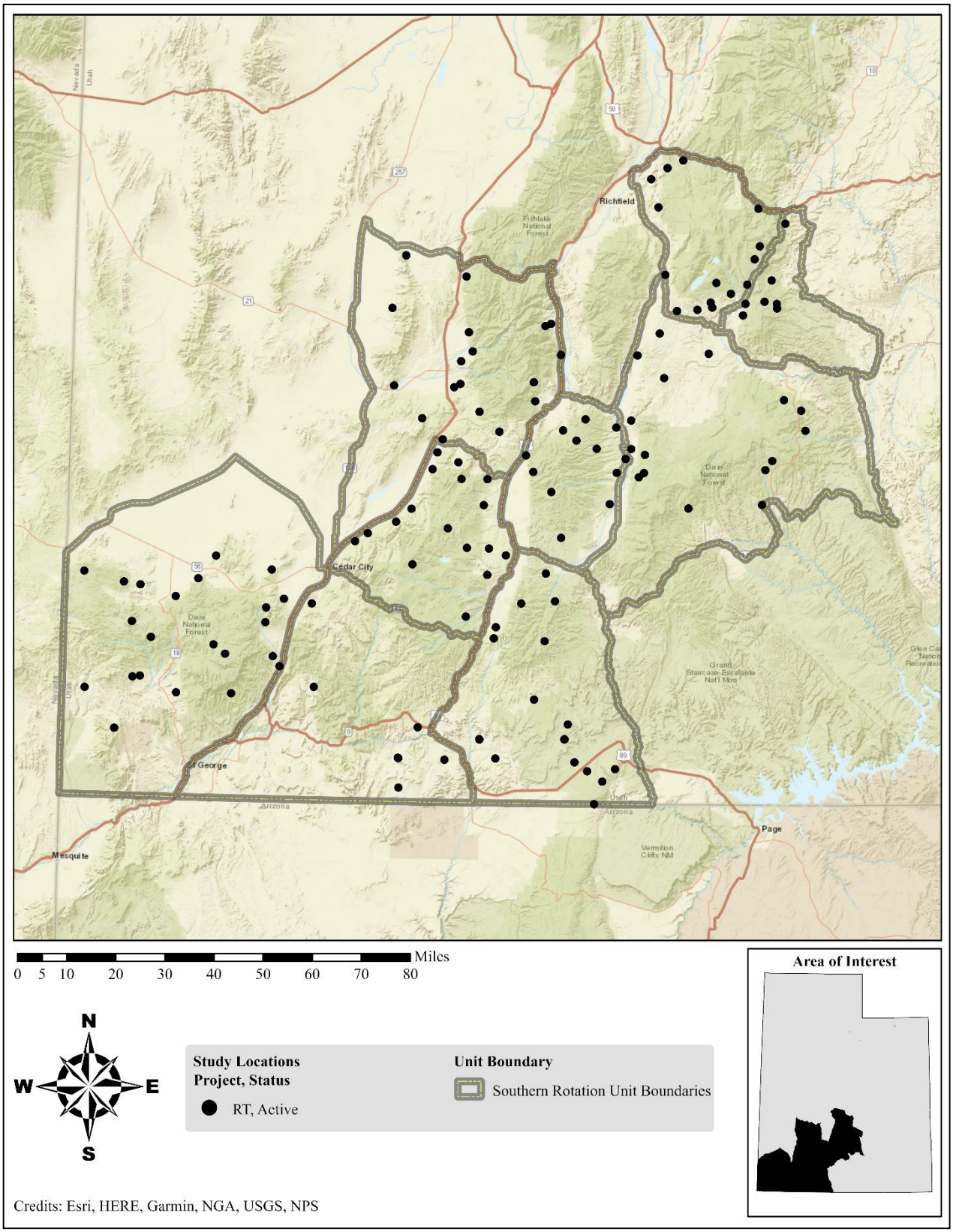
Deer Winter Range Condition Assessment: The desirable components index (DCI) for deer was created by Range Trend Program personnel as a tool to address condition and/or value of winter ranges for mule deer. This index is meant to be a companion to, and not a replacement for, the site-specific Range Trend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

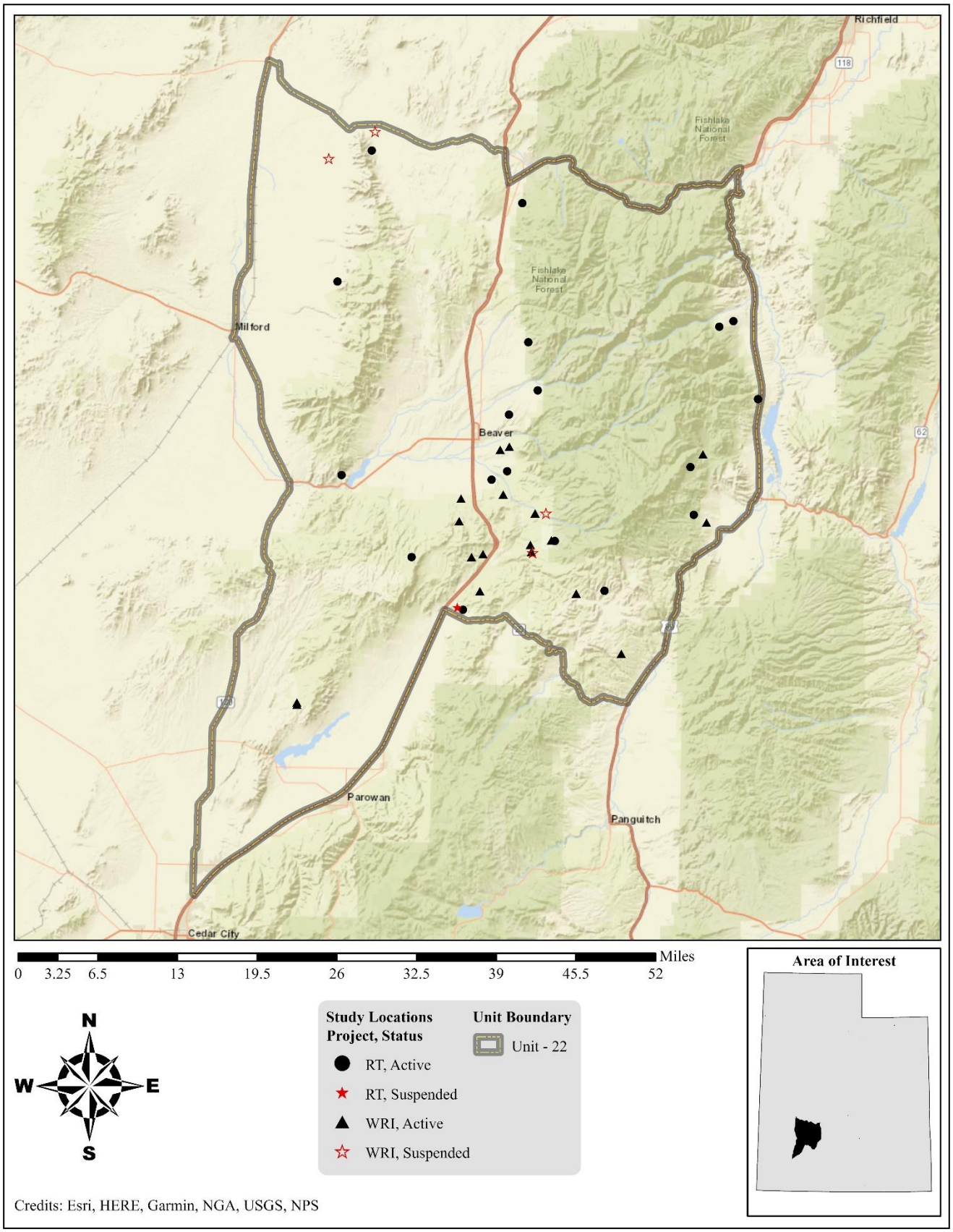
Changes in DCI over the sample years for both treated and untreated sites are included in the figures near the end of the unit summary. Care should be taken when interpreting these tables as the number of sites included in each year may vary. This could be misleading if the overall DCI seems to be improving, 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 (but are not limited to) 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 22 – BEAVER



WILDLIFE MANAGEMENT UNIT 22 – BEAVER

Boundary Description

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

Management Unit Description

Geography

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

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

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

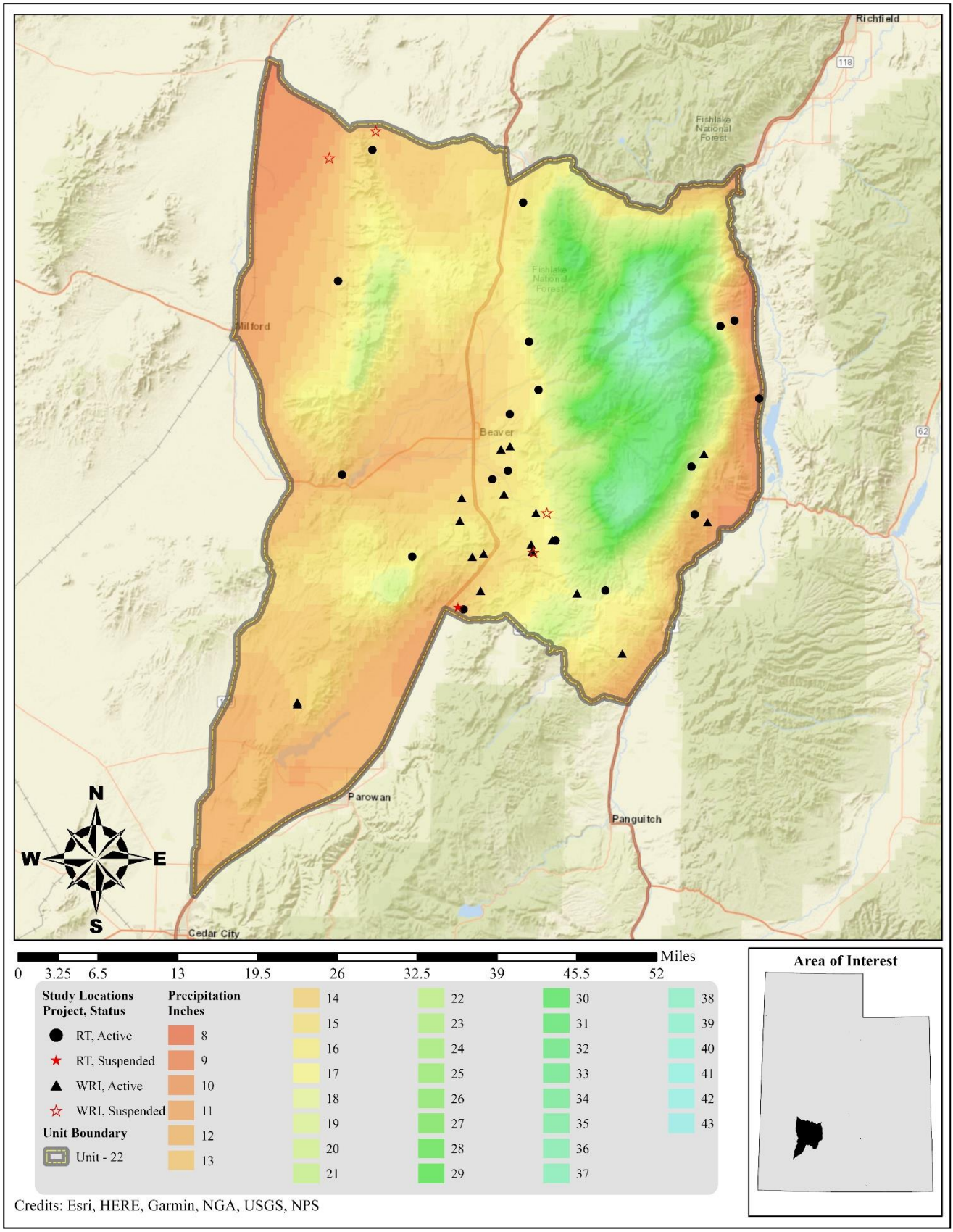
Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation on this unit ranges from 8 inches near Beaver Bottoms and Marysvale to 43 inches on Mount Belknap. All of the active Range Trend and Watershed Restoration Initiative (WRI) monitoring studies in this unit occur between 9 and 21 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 South Central Division (Division 4).

The mean annual PDSI of the South Central Division, which the Beaver unit is a part of, has experienced some form of drought most years since 1993. Moreover, this climate division has been considered to be in some form of drought nearly 68% of the time since 1993. Of the drought years, nearly 43% are considered to be either moderate or extreme droughts. Also remarkable about this climate division is that drought is experienced over multiple years and is generally interrupted by a single wet year event. The most notable wet years occur in 2005 and 2011, which were both considered moderately wet (**Figure 1.1a**). The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI. These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September to May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and

spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 1.1b**). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 1.3**). Years that were moderately wet occur in 1999 and 2023, but years where drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 1.1a, Figure 1.1b**) (Time Series Data, 2024).



Map 1.1: The 1991-2020 PRISM Precipitation Model for WMU 22, Beaver (PRISM Climate Group, Oregon State University, 2021).

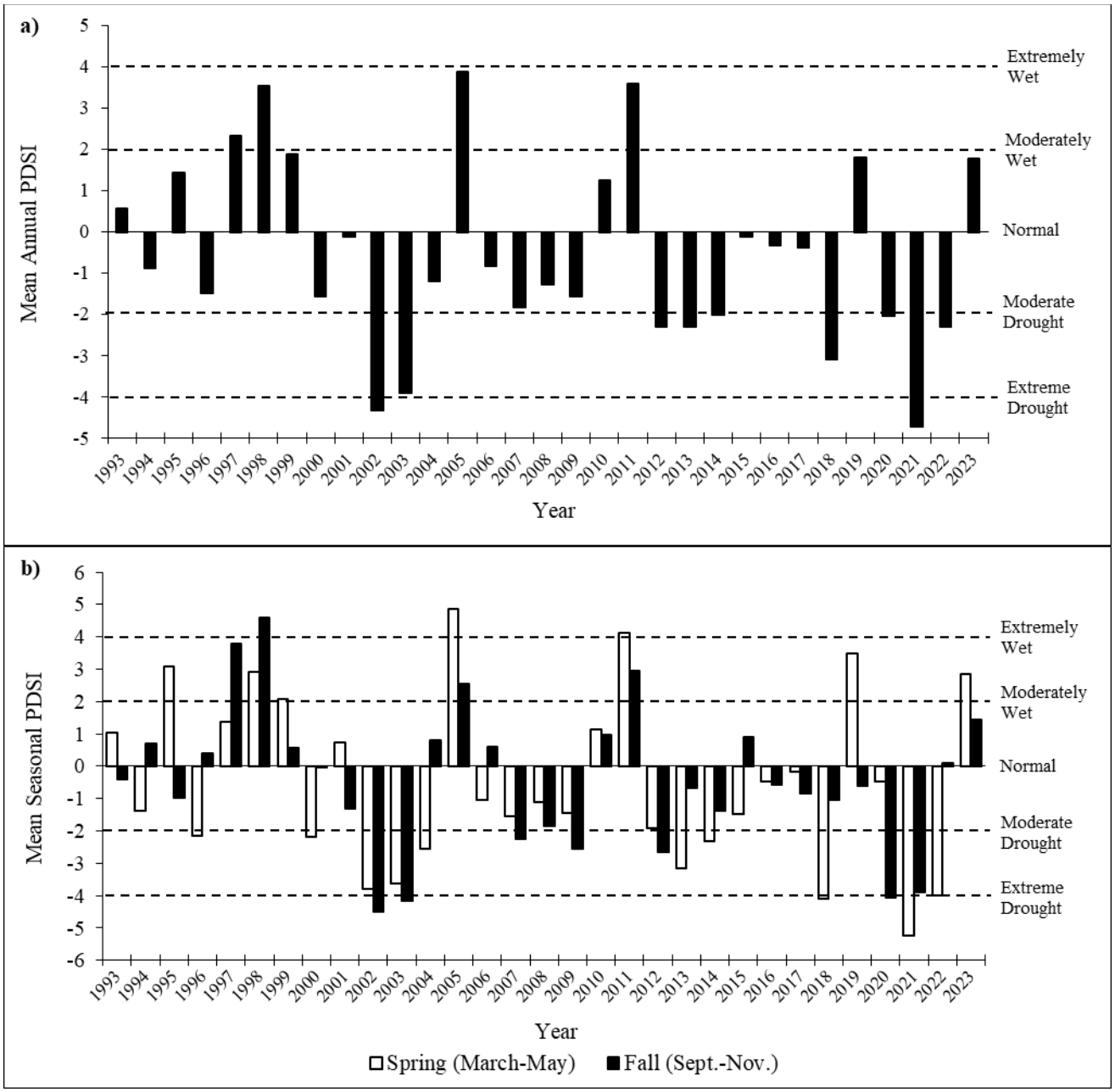


Figure 1.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

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

The Tushar Mountains are more typical of the high-elevation mountains of central and southern Utah and contain good summer range for deer and elk. The Tushars have many small lakes and perennial streams. The western slopes of the Tushar Mountains are more gradual and receive sufficient precipitation to create substantial summer range for deer. On the east side of the Tushar Mountains, the normal winter range boundaries range from 6,200 feet on the valley floor to 8,500 feet in the upper basins. Oak Basin often winters deer up to the 8,600-foot level. The upper limit along the steeper portions of the east face of Tushar Mountains is 7,200 feet. Winter deer concentrations are found on south- and southeast-facing slopes. Minor migrations from the summer ranges of Units 23 - Monroe and 24 - Mt. Dutton onto Unit 22 winter ranges occur each year. However, the major movement is along an elevation gradient with deer migrating from summer to winter range within the unit itself (**Map 1.2**, **Map 1.3**).

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

The RAP data shows fluctuations of herbaceous biomass and cover on both deer summer and winter range. The highest values for biomass of perennial lifeforms occurred in the early 1990s, and both values have decreased overall despite year-to-year variation. Annual and perennial cover and biomass have correlated with precipitation trends in many years. However, a possible lag effect of a year or so appears to occur at different times (in 2012-2017 on summer range, 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, particularly for annual lifeforms (**Figure 1.2**, **Figure 1.3**, **Figure 1.4**, **Figure 1.5**). 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 and 2023 correspond with PDSI values that show wetter than normal years. In contrast, the PDSI displays years of moderate to extreme drought from 2020 to 2022; biomass and cover values over the same period were lower than in 2019 or 2023 (**Figure 1.1a**, **Figure 1.1b**).

Range Trend data for herbaceous cover from 1998 to present shows yearly variation in both perennial and annual lifeforms. Year-to-year fluctuations can be expected due to differences in precipitation and the timing of data collection between sample years. However, annual grasses and forbs have contributed notable cover on upland and semidesert study sites (**Figure 1.13**): this correlates with RAP data for herbaceous cover of annual lifeforms on mule deer winter habitat (**Figure 1.5**).

RAP data indicates that tree and shrub cover correlate with precipitation to some degree in many years and that both lifeforms have generally provided more cover on summer habitat than on winter range. However, shrub cover on summer range in 2023 was less than that on winter range, having decreased each year since 2020 (**Figure 1.6**, **Figure 1.7**). Range Trend data for tree and shrub cover values have exhibited yearly fluctuations and correlations with RAP data are not readily apparent (**Figure 1.8**, **Figure 1.9**). This may be due to low sample size on summer range or intentional placement of Range Trend studies in winter range, which therefore do not capture the full extent of tree and shrub cover for the Beaver management unit. It is important to note that variations in cover on Range Trend sites will not always correspond with the fluctuations 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 – Herbaceous Biomass by Deer Habitat

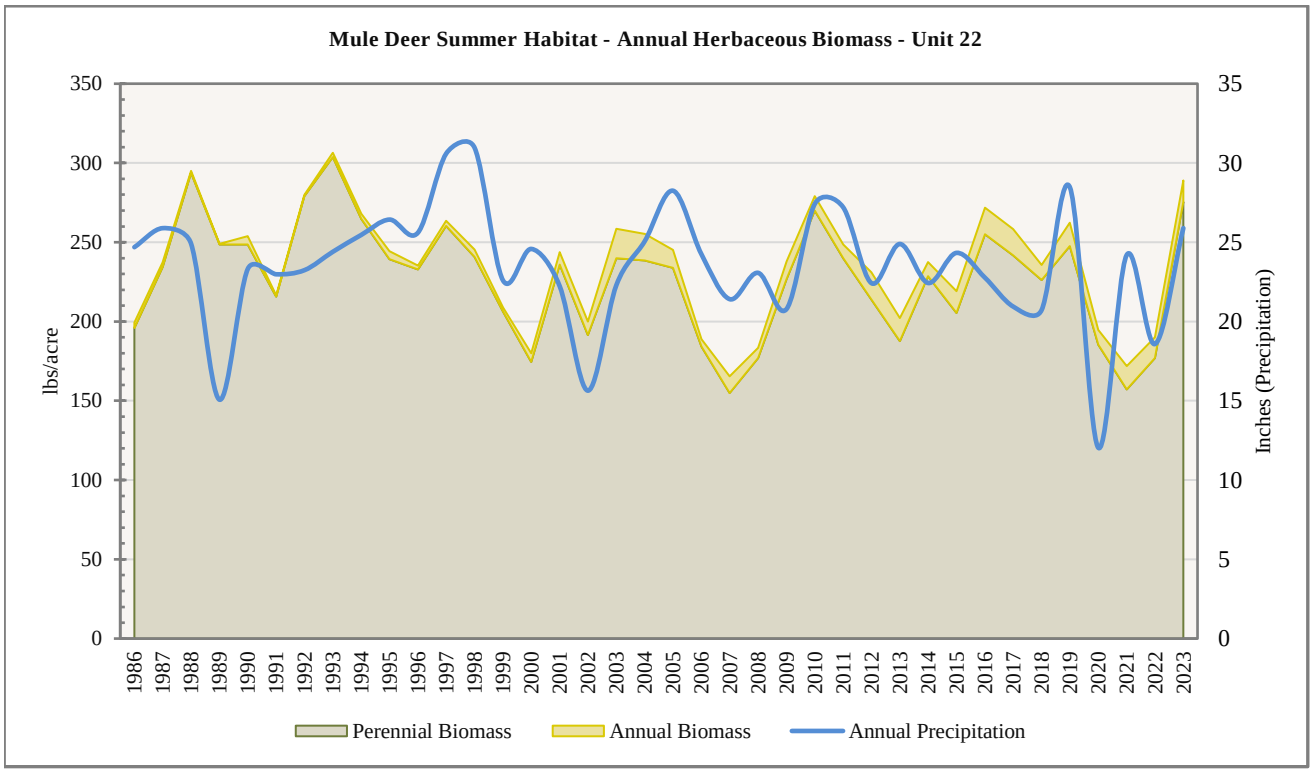


Figure 1.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 22, Beaver (Rangeland Analysis Platform, 2024).

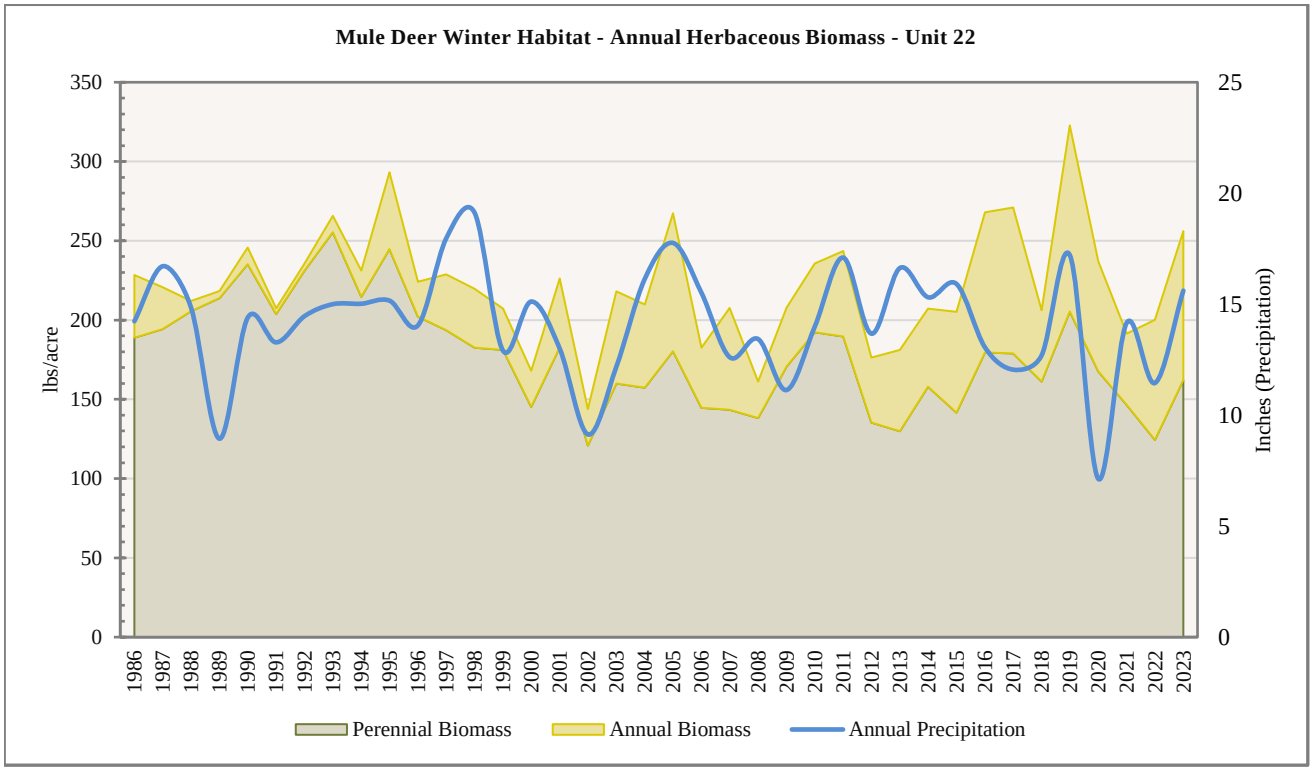


Figure 1.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 22, Beaver (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

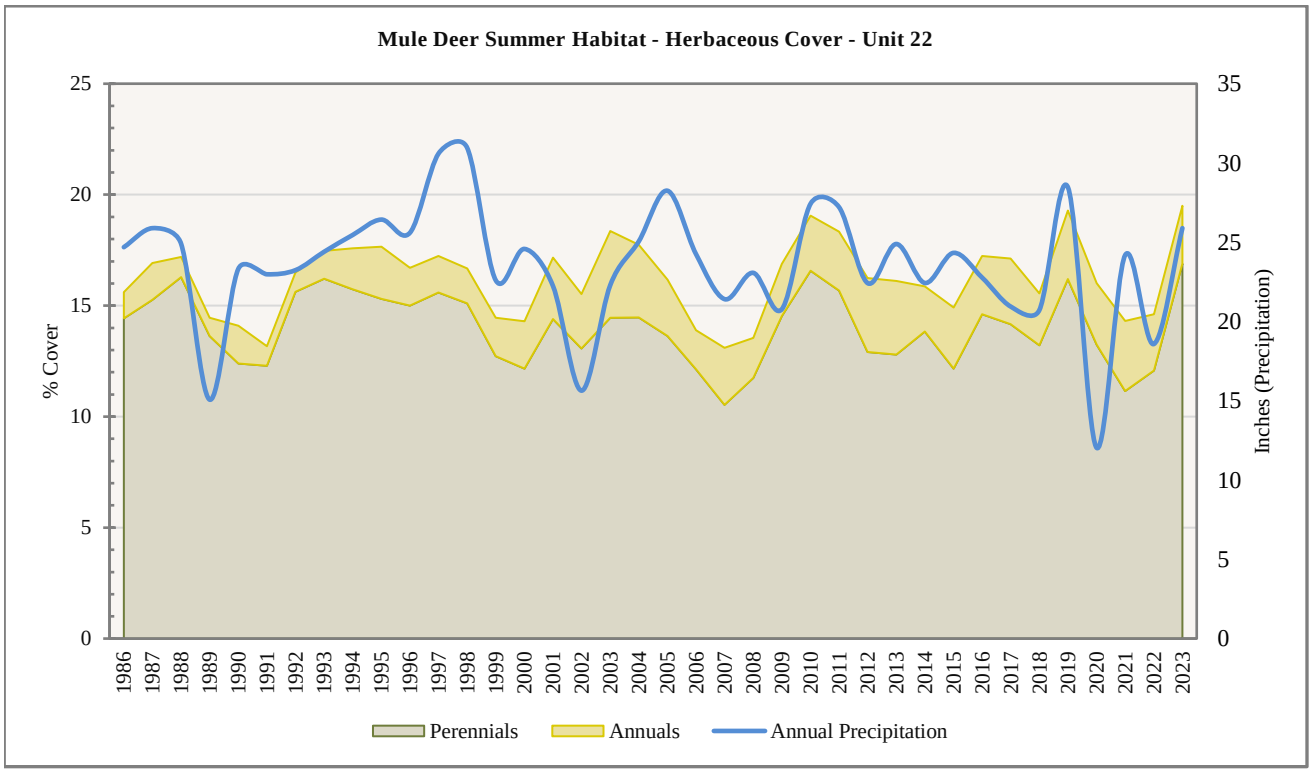


Figure 1.4: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 22, Beaver (Rangeland Analysis Platform, 2024).

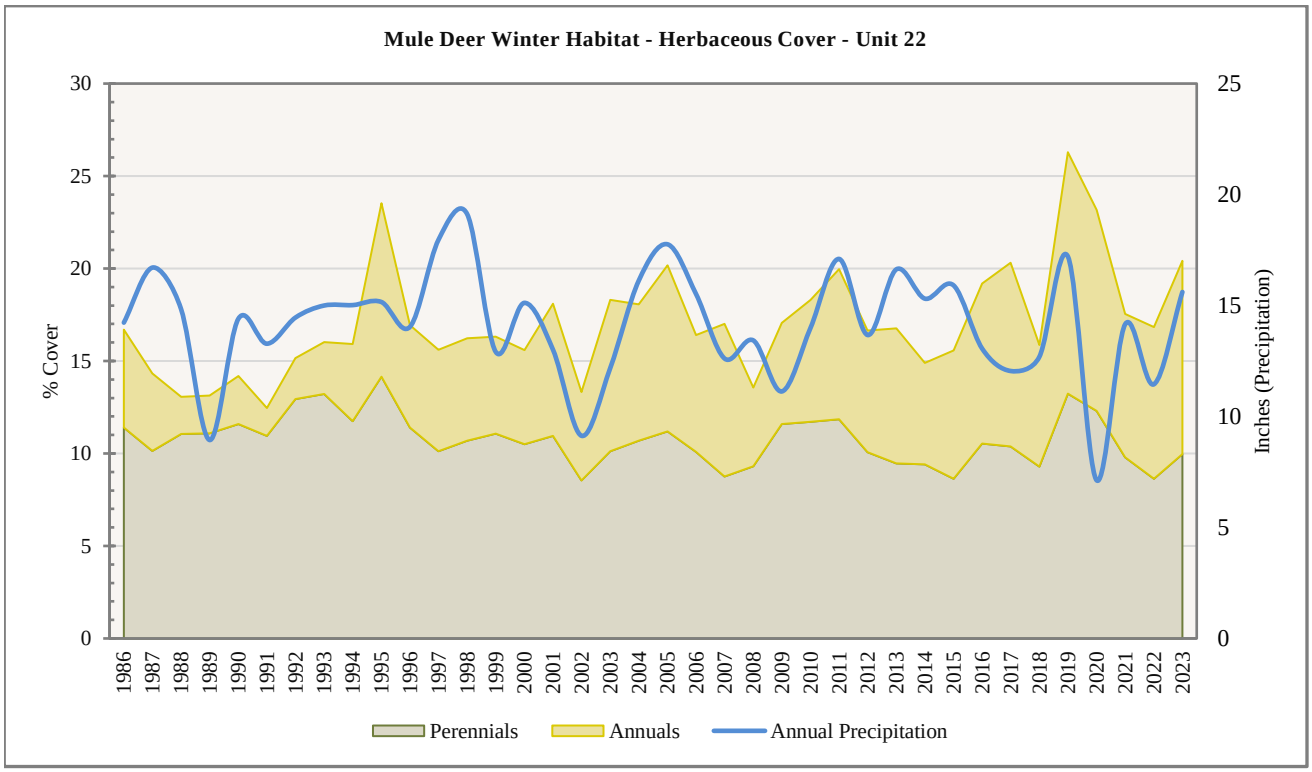


Figure 1.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 22, Beaver (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

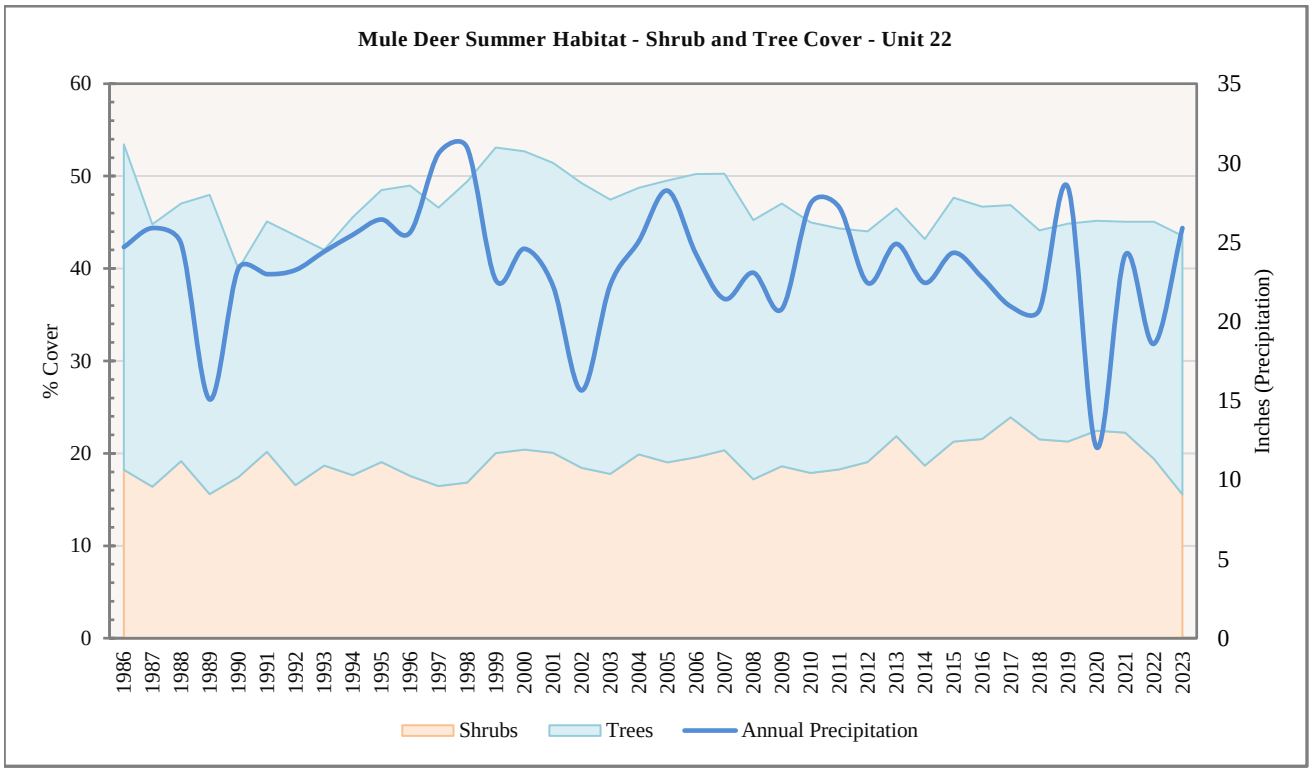


Figure 1.6: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 22, Beaver (Rangeland Analysis Platform, 2024).

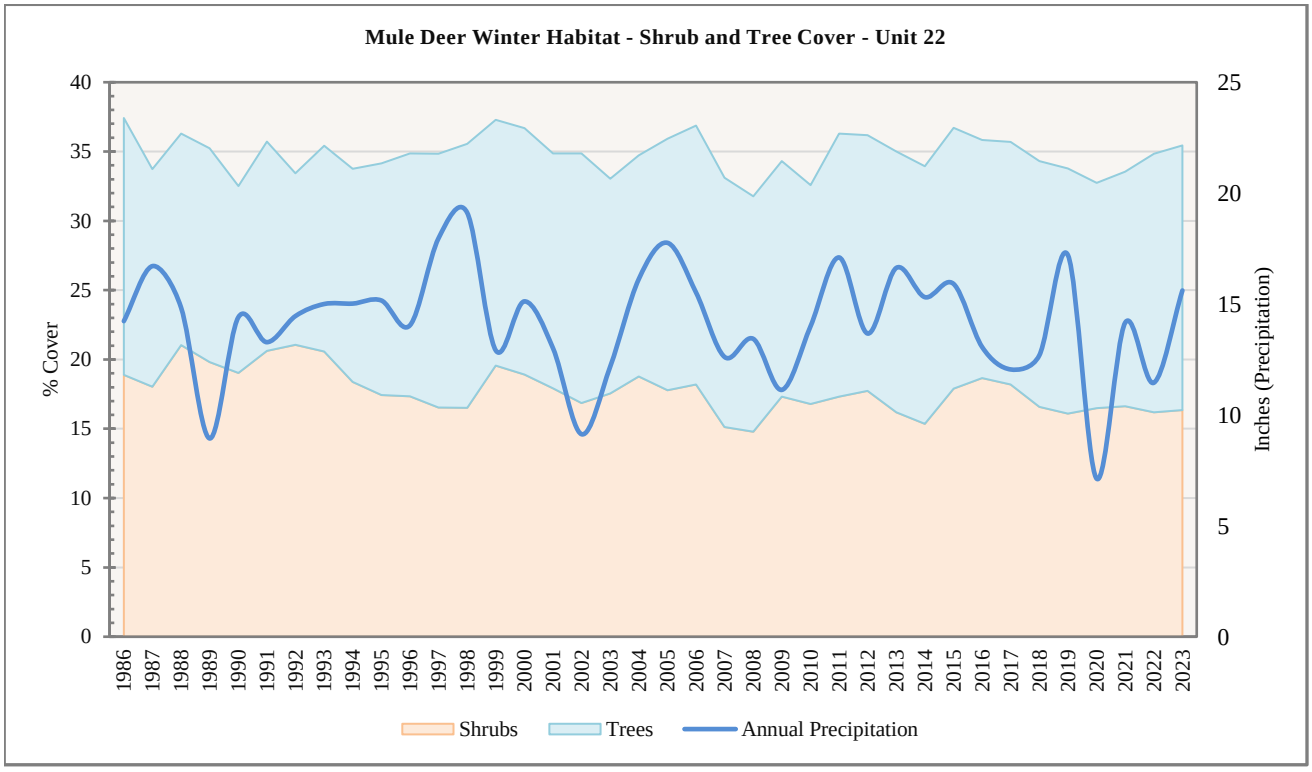
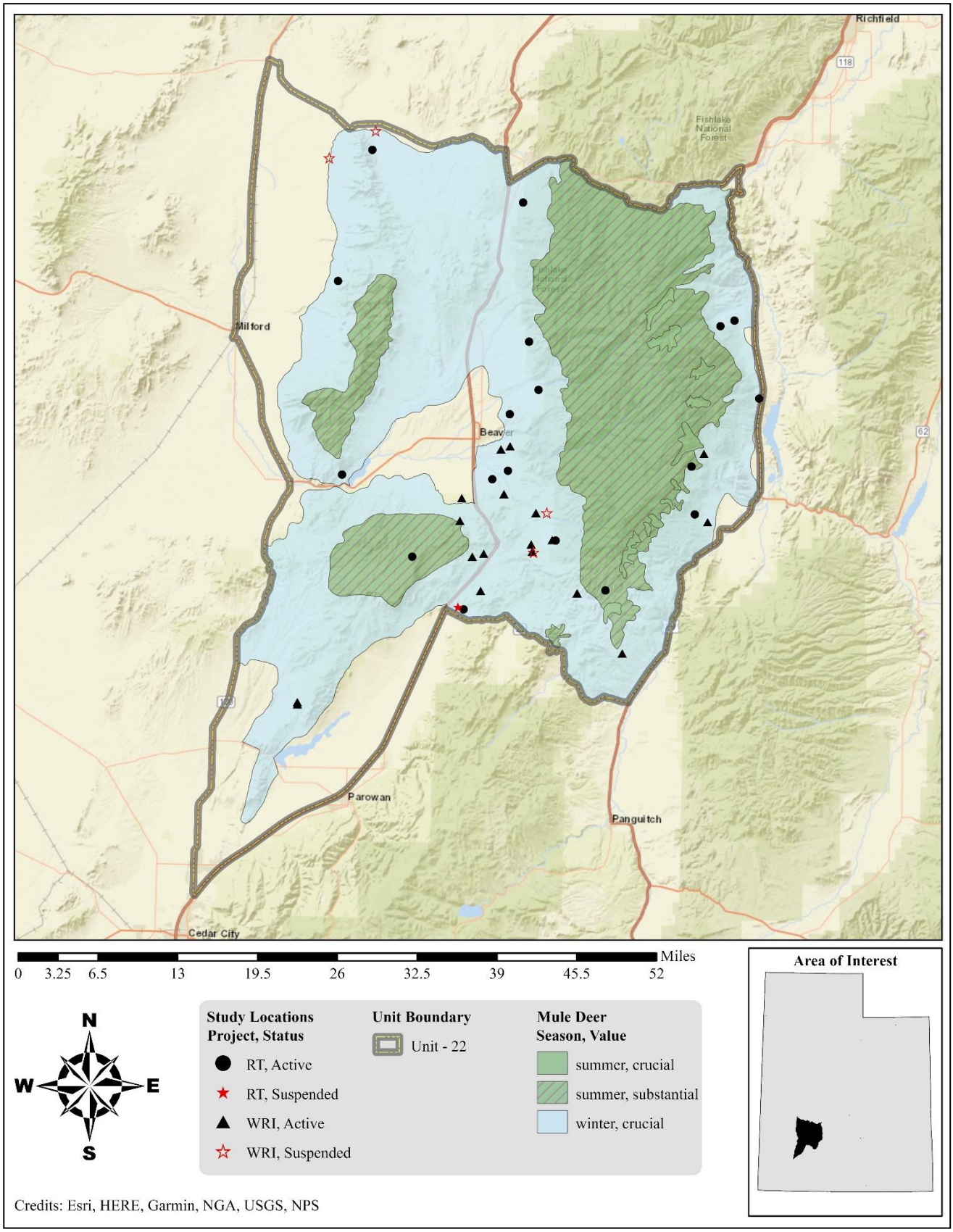
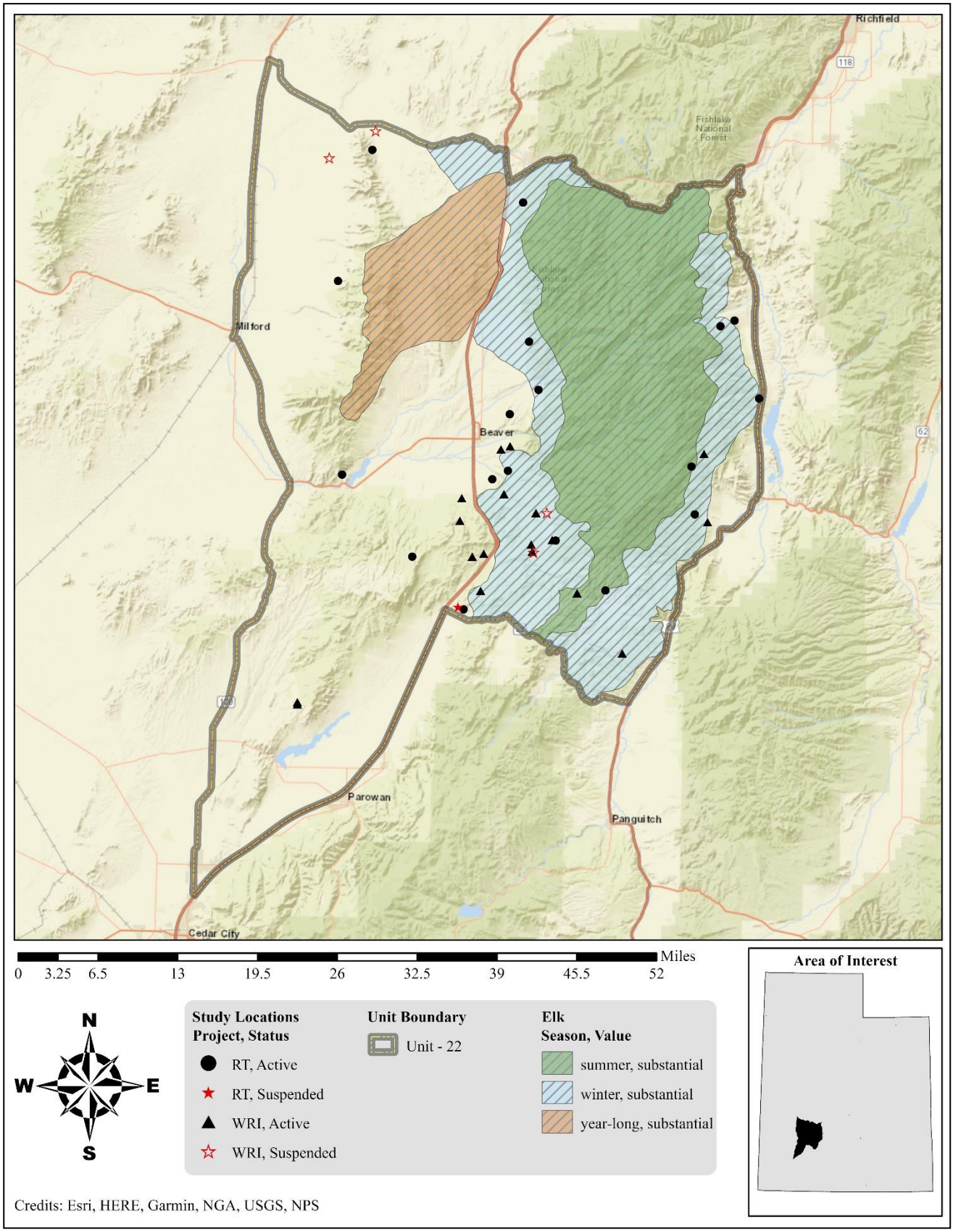


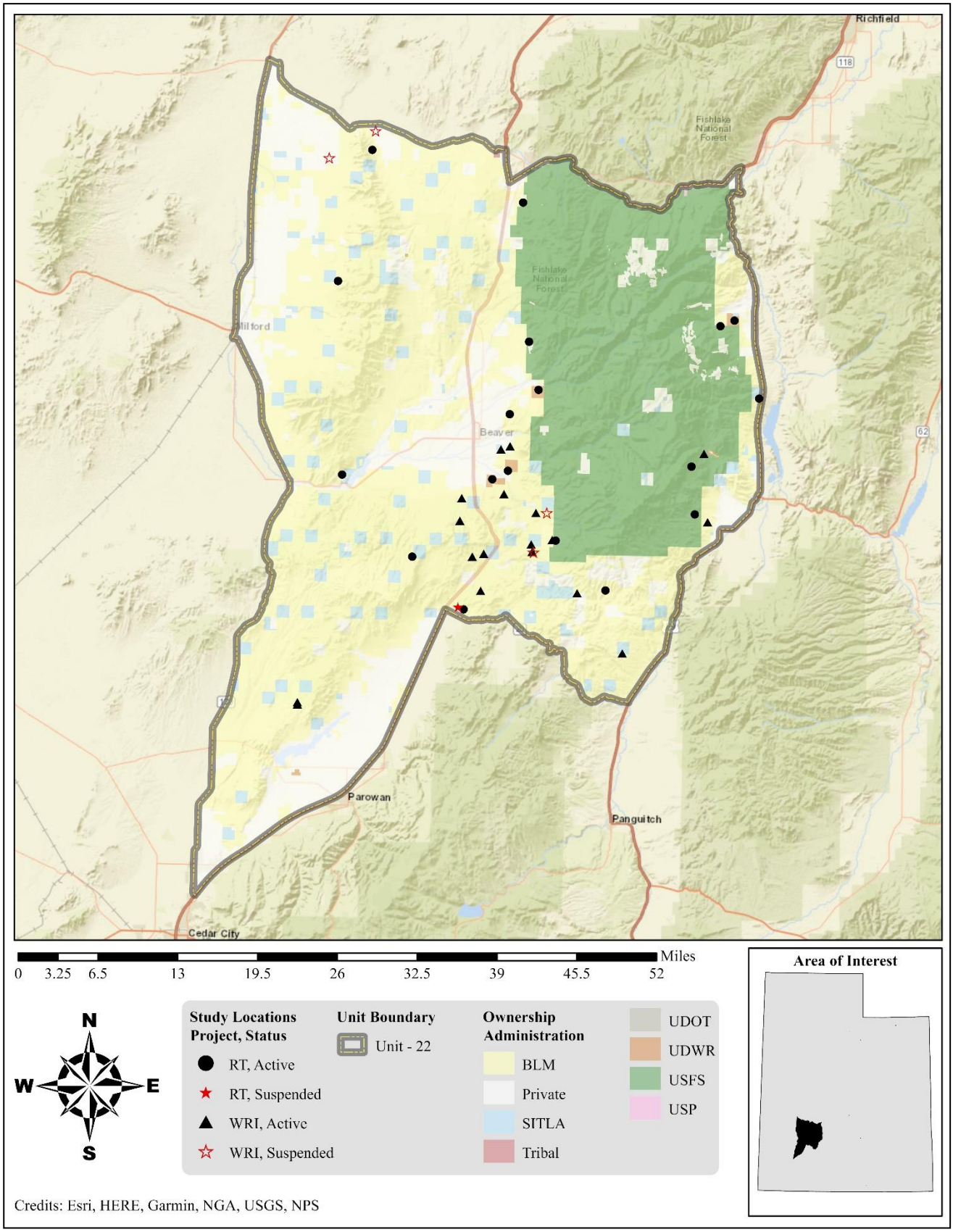
Figure 1.7: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 22, Beaver (Rangeland Analysis Platform, 2024).



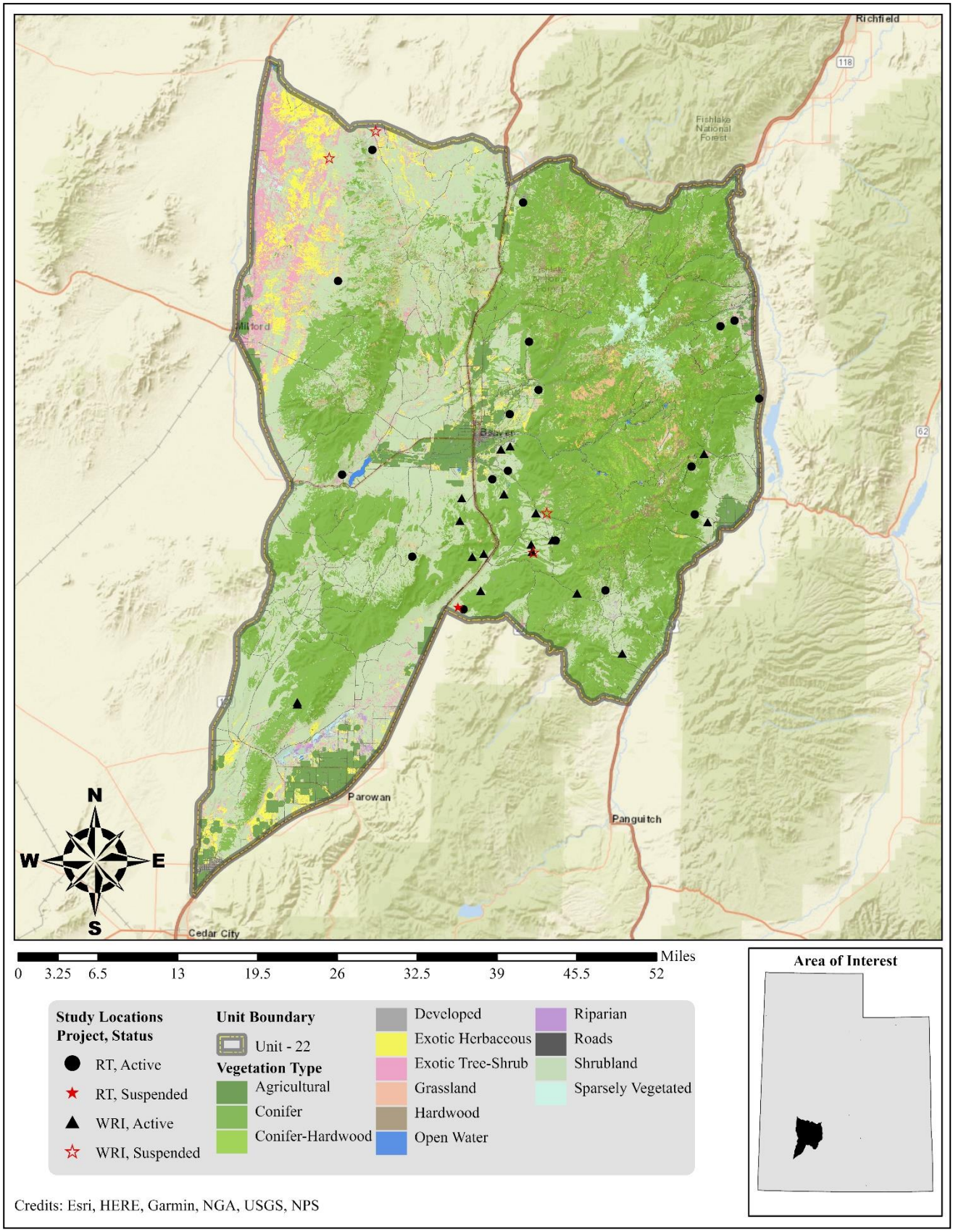
Map 1.2: Estimated mule deer habitat by season and value for WMU 22, Beaver.



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



Map 1.4: Land ownership for WMU 22, Beaver.



Map 1.5: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 22, Beaver.

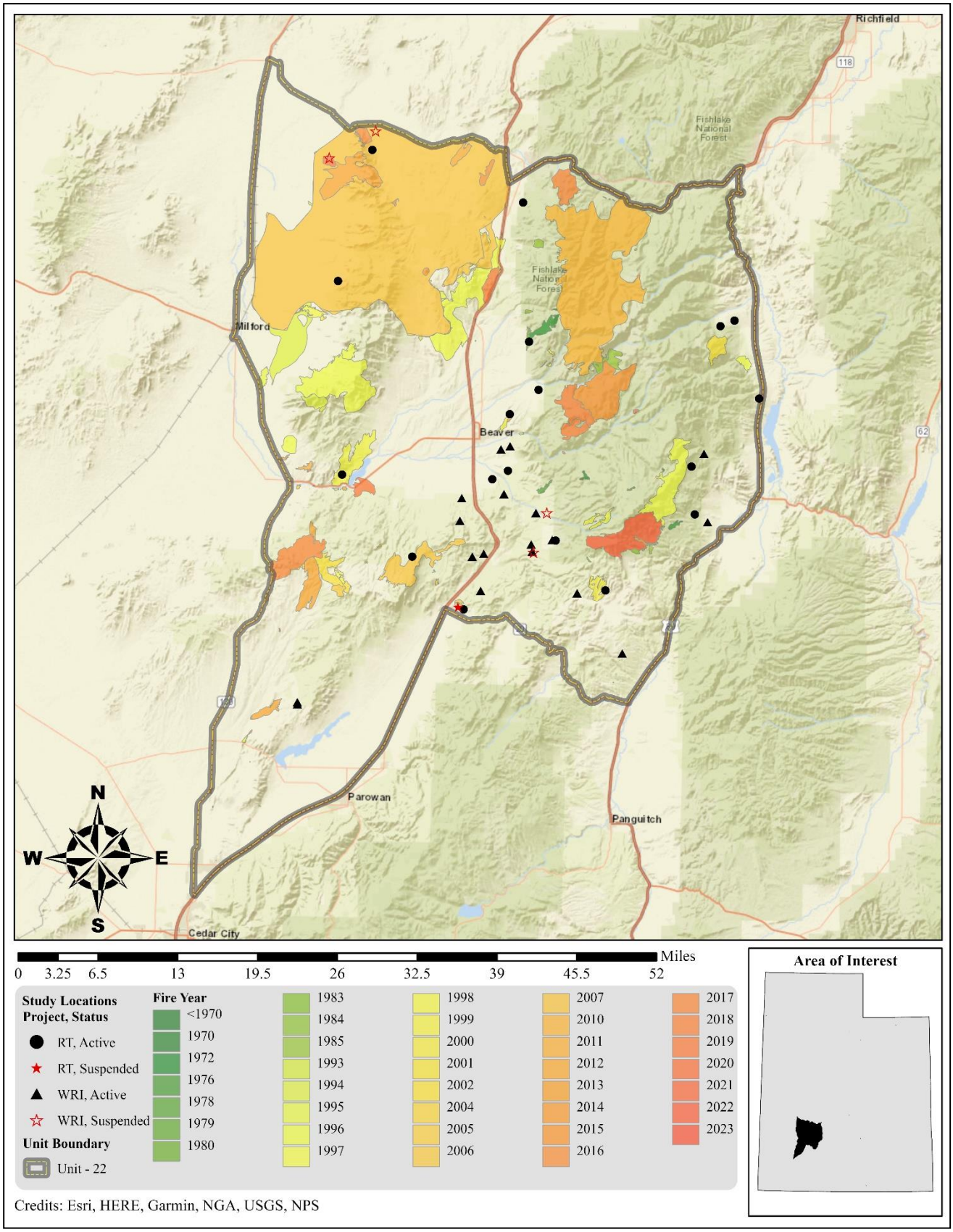
LANDFIRE Existing Vegetation Types on Mule Deer Habitat

According to the current LANDFIRE Existing Vegetation Type model, pinyon-juniper woodland vegetation types comprise 38% of the mule deer habitat in WMU 22 (**Table 1.1**). These woodlands can be located in low to middle-high elevations and may be associated with understory browse species known to be beneficial to mule deer, although abundance can vary widely. Widespread encroachment of pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) into sagebrush (*Artemisia spp.*) shrublands has been observed. However, it is likely that some historical sagebrush types within this unit have been identified as pinyon-juniper woodland types due to their departure from the reference vegetation conditions. When pinyon and juniper encroach on existing shrublands, they can lead to decreased sagebrush and herbaceous components (Miller, Svejcar, & Rose, 2000), therefore decreasing available forage for wildlife.

The model also indicates that sagebrush steppe and shrublands make up approximately 27% of the Beaver unit's mule deer habitat (**Table 1.1**). These biophysical sites can be found at elevations ranging from low (semidesert) to high (mountain and subalpine). Sagebrush species typically dominate these biophysical sites across the elevation gradient, and may provide valuable browse for deer when they are present on winter range. However, other preferred browse species may be present in lesser amounts. At higher elevations, these biophysical sites are often host to abundant herbaceous understories, and pinyon and juniper may be present at lower to middle elevations. A variety of other vegetation types comprise the rest of the mule deer habitat within the Beaver management unit (**Table 1.1**), but will not be discussed here. Descriptions for these additional vegetation types can be found on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	225,046	25.46%	
	Great Basin Pinyon-Juniper Woodland	111,317	12.59%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	33,149	3.75%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	31,112	3.52%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	25,327	2.87%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	20,680	2.34%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	17,138	1.94%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	15,794	1.79%	
	Southern Rocky Mountain Ponderosa Pine Woodland	10,494	1.19%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	5,866	0.66%	
	Inter-Mountain Basins Juniper Savanna	2	0.00%	56.11%
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	147,578	16.70%	
	Inter-Mountain Basins Montane Sagebrush Steppe	60,238	6.82%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	30,321	3.43%	
	Great Basin Xeric Mixed Sagebrush Shrubland	26,634	3.01%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	10,668	1.21%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	1,848	0.21%	
	Rocky Mountain Lower Montane-Foothill Shrubland	1,420	0.16%	
	Great Basin Semi-Desert Chaparral	1,043	0.12%	
	Inter-Mountain Basins Big Sagebrush Steppe	1,037	0.12%	
	Rocky Mountain Alpine Dwarf-Shrubland	789	0.09%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	563	0.06%	
	Inter-Mountain Basins Greasewood Flat	296	0.03%	
	Mojave Mid-Elevation Mixed Desert Scrub	112	0.01%	31.97%
Other	Developed	22,382	2.53%	
	Sparsely Vegetated	15,085	1.71%	
	Agricultural	7,328	0.83%	
	Riparian	1,712	0.19%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	511	0.06%	
	Open Water	336	0.04%	5.36%
Hardwood	Rocky Mountain Aspen Forest and Woodland	12,880	1.46%	
	Rocky Mountain Bigtooth Maple Ravine Woodland	5,156	0.58%	2.04%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	8,450	0.96%	
	Southern Rocky Mountain Montane-Subalpine Grassland	4,821	0.55%	
	Inter-Mountain Basins Semi-Desert Grassland	1,538	0.17%	
	Rocky Mountain Alpine Turf	422	0.05%	
	Rocky Mountain Alpine Fell-Field	90	0.01%	1.73%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	12,749	1.44%	
	Interior Western North American Temperate Ruderal Shrubland	234	0.03%	1.47%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	6,240	0.71%	
	Great Basin & Intermountain Introduced Annual Grassland	3,118	0.35%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	1,635	0.18%	
	Interior Western North American Temperate Ruderal Grassland	686	0.08%	1.32%
Total		**883,844**	**100%**	**100%**

Table 1.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 22, Beaver.



Map 1.6: Land coverage of fires by year from prior to 1970-2023 for WMU 22, Beaver (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

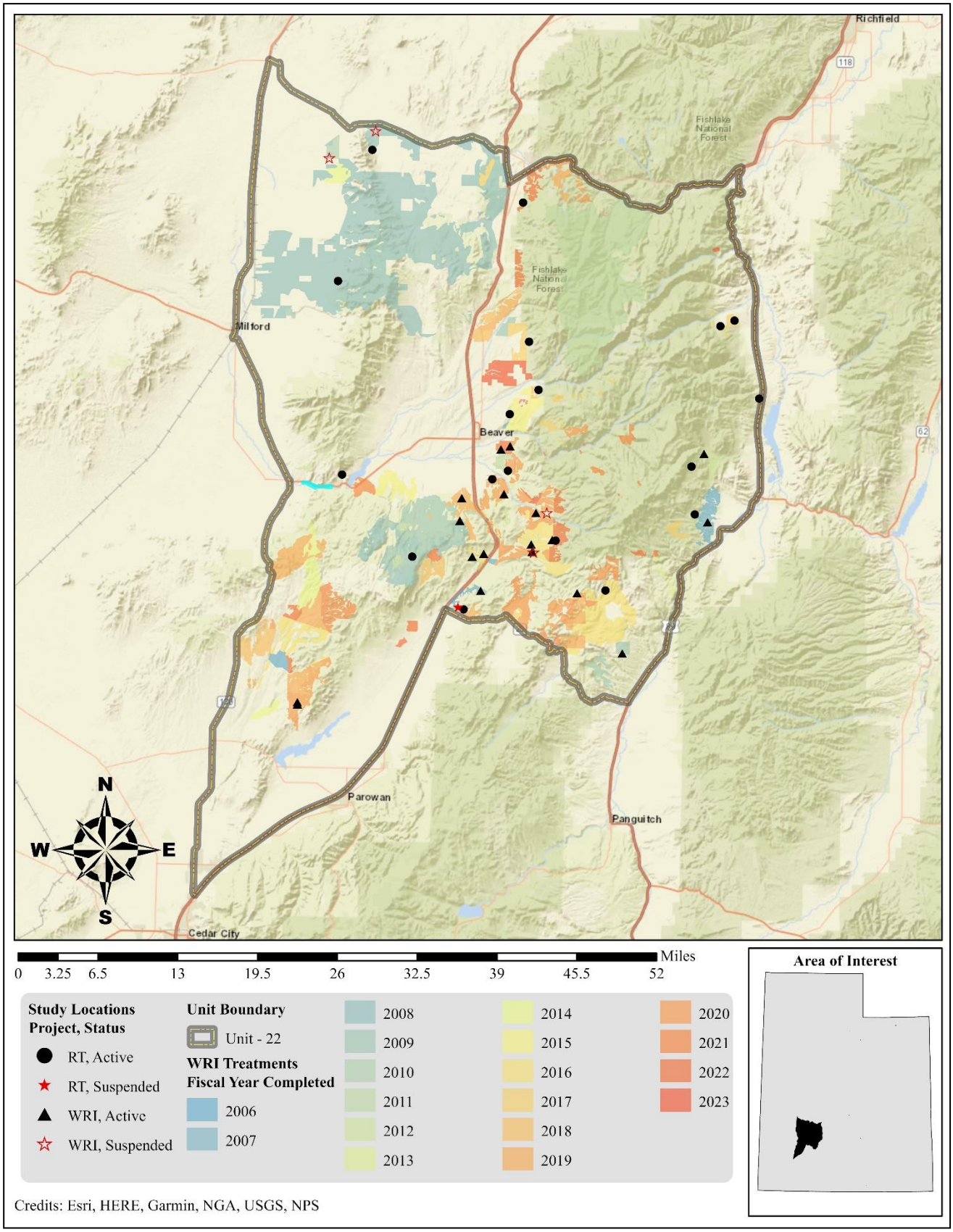
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 265,952 acres of land have been treated within the Beaver unit since the WRI was implemented in 2004. Treatments frequently overlap one another, bringing the net total of completed treatment acres to 247,112 for this unit (**Table 1.2**, **Map 1.7**). Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

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

Type	Total Completed Acreage
Anchor Chain	**50,595**
Ely (One-Way)	34,100
Ely (Two-Way)	15,756
Smooth (One-Way)	740
Bulldozing	**36**
Tree Push	36
Bullhog	**20,394**
Full Size	20,009
Skid Steer	385
Chain Harrow	**514**
≤ 15 ft. (Two-Way)	93
> 15 ft. (One-Way)	307
> 15 ft. (Two-Way)	114
Disc	**158**
Off-Set (Two-Way)	158
Forestry Practices	**889**
Thinning (Commercial)	542
Thinning (Non-Commercial)	348
Harrow	**4,477**
≤ 15 ft. (One-Way)	75
≤ 15 ft. (Two-Way)	2,270
> 15 ft. (One-Way)	1,646
> 15 ft. (Two-Way)	486
Herbicide Application	**2,093**
Aerial (Fixed-Wing)	1,805
Aerial (Helicopter)	288
Mowing	**183**
Other	183
Planting/Transplanting	**1,087**
Container Stock	30
Other	1,057
Prescribed Fire	**1,003**
Prescribed Fire	1,003
Seeding (Primary)	**132,798**
Broadcast (Aerial-Fixed Wing)	119,662
Drill (Rangeland)	11,840
Drill (Truax)	1,068
Ground (Mechanical Application)	93
Hand Seeding	136
Seeding (Secondary/Shrub)	**195**
Hand Seeding	195
Skid-Steer Mounted Tree Cutter	**1,751**
Hydraulic Brush Saw	1,751
Vegetation Removal/Hand Crew	**48,993**
Lop (No Scatter)	5,076
Lop & Scatter	43,913
Lop-Pile-Burn	5
Other	**786**
Road Decommissioning	786
Grand Total	**265,952**
***Total Land Area Treated**	**247,112**

Table 1.2: WRI treatment action size (acres) of completed projects for WMU 22, Beaver. Data accessed on 02/07/2024.
*Does not include overlapping treatments



Map 1.7: Terrestrial WRI treatments by fiscal year completed for WMU 22, Beaver.

Range Trend Studies

Range Trend studies have been sampled within WMU 22 on a regular basis since 1985, with studies being added or suspended as was deemed necessary (**Table 1.3**). 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
22-01	Deer Flat	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Stony Loam (Mountain Big Sagebrush)
22-02	Piute Reservoir	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Semidesert Shallow Loam (Wyoming Big Sagebrush)
22-03	Oak Basin	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Stony Loam (Mountain Big Sagebrush)
22-04	Wades Canyon	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
22-05	Bone Hollow	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
22-06	Beaver Table	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
22-07	Sheep Rock	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
22-08	Muley Point	RT	Suspended	1985, 1991, 1998, 2003, 2008, 2013	Semidesert Loam (Wyoming Big Sagebrush)
22-09	Rocks Reseeding	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
22-10	Doubleup Hollow	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Bonneville Big Sagebrush)
22-11	B Hill	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
22-12	Big Cedar Cove	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)
22-13	Minersville Reservoir	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Semidesert Loam (Wyoming Big Sagebrush)
22-14	Antelope Mountain	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)
22-15	South Creek	RT	Active	1998, 2003, 2008, 2013, 2018, 2023	Semidesert Loam (Wyoming Big Sagebrush)
22-16	Brady Creek	RT	Active	2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
22R-03	Marysvale WMA	RT	Active	1998, 2018, 2023	Upland Stony Loam (Wyoming Big Sagebrush)
22R-04	Above Fremont Wash	RT	Active	1999, 2003, 2008, 2013, 2018, 2023	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
22R-05	Black Mountain	WRI	Active	2004, 2007, 2012, 2016, 2020	Upland Loam (Wyoming Big Sagebrush)
22R-06	Greenville Bullhog	WRI	Active	2004, 2007, 2012, 2016, 2020	Upland Loam (Wyoming Big Sagebrush)
22R-07	Sulphurdale	RT	Active	2005, 2008, 2013, 2017, 2021, 2023	Upland Loam (Bonneville Big Sagebrush)
22R-08	P-Hill Dixie	WRI	Active	2005, 2008, 2013, 2017, 2022	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
22R-09	South Beaver Dixie Reference	WRI	Suspended	2006	Not Verified
22R-10	South Beaver Bullhog	WRI	Active	2006, 2010, 2014, 2018, 2023	Upland Loam (Bonneville Big Sagebrush)
22R-11	South Beaver SITLA Chaining	WRI	Active	2007, 2010, 2014, 2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
22R-12	South Beaver Bullhog 2	WRI	Active	2007, 2010, 2015, 2018, 2023	Upland Loam (Bonneville Big Sagebrush)
22R-13	Greenville Bench Bullhog 2	WRI	Active	2007, 2011, 2015, 2019	Upland Loam (Mountain Big Sagebrush)
22R-14	South Beaver Rocky Wash	WRI	Active	2008, 2011, 2015, 2019	Upland Loam (Mountain Big Sagebrush)
22R-15	South Beaver Bullhog Year 4	WRI	Active	2008, 2011, 2015, 2019	Upland Loam (Mountain Big Sagebrush)
22R-16	Spry Sagebrush Restoration	WRI	Active	2008, 2011, 2015, 2020	Upland Stony Loam (Mountain Big Sagebrush)
22R-17	Beaver Easement Harrow	WRI	Active	2008, 2011, 2015, 2019	Upland Loam (Mountain Big Sagebrush)
22R-18	A&F Drill 1	WRI	Suspended	2008, 2011, 2017	Semidesert Loam (Wyoming Big Sagebrush)
22R-19	A&F Drill 2	WRI	Suspended	2008, 2011, 2017	Semidesert Loam (Wyoming Big Sagebrush)
22R-20	South Beaver Year 5	WRI	Active	2010, 2013, 2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-21	South Beaver Year 5 Reference	WRI	Suspended	2010	Not Verified
22R-22	South Beaver Dixie	WRI	Active	2010, 2014, 2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-23	South Beaver Year 7	WRI	Active	2012, 2015, 2019	Upland Gravelly Loam (Bonneville Big Sagebrush)
22R-24	City Creek	WRI	Active	2011, 2014, 2018, 2023	Mountain Stony Loam (Mountain Big Sagebrush)
22R-25	Fremont Pass	WRI	Active	2018, 2022	Upland Stony Loam (Black Sagebrush)
22R-26	Jackrabbit Mountain	WRI	Active	2019, 2022	Upland Loam (Bonneville Big Sagebrush)
22R-27	Jackrabbit Mountain 2	WRI	Active	2019, 2022	Upland Loam (Mountain Big Sagebrush)

Table 1.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 22, Beaver.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
22-01	Deer Flat	Chain Unknown Seed Unknown		1968 1968		
22-03	Oak Basin	Dixie Harrow Unknown Seed Unknown Wildfire		1965 1965 Between 1985 and 1991	600 600	
22-05	Bone Hollow	Aerial Before Two-Way Ely	Indian Creek Indian Creek	October 2014 November 2014-February 2015	3,160 2,790	3001 3001
22-06	Beaver Table	Cable Unknown Seed Unknown Lop and Scatter		1957 1957 Between 2003 and 2008		
22-07	Sheep Rock	Two-Way Chain Unknown Seed Unknown Wildfire Bullhog		Fall 1981 Fall 1981 Between 1981 and 1984 Between 2009 and 2011		
22-08	Muley Point	Wildfire Aerial	Lee's Wash Lee's Wash Reseeding	2005 2005	195 193	
22-09	Rocks Reseeding	Dixie Harrow Unknown Seed Unknown		1962 1962		
22-10	Doubleup Hollow	Wildfire Aerial	Greenville Fire Greenville Bench Aerial Seeding	May-July 2007 December 2007-January 2008	14,716 11,048	 993
22-11	B Hill	Chain Unknown Aerial Lop and Scatter	 Project Maintenance - South Beaver Phase II	1959 1959 May-June 2019	 6,241	 4831

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
22-12	Big Cedar Cove	Wildfire	Milford Flat	July 2007	356,665	
		One-Way Ely	Milford Flat Fire Rehabilitation and Contracting	Fall 2007	76,454	1218
		Aerial Before	Milford Flat Fire Rehabilitation and Contracting	Fall 2007	76,454	1218
		Aerial After	Milford Flat Fire Rehabilitation and Contracting	Fall 2007	76,454	1218
22-13	Minersville Reservoir	Wildfire	Minersville	July 1998	4,052	
		One-Way Smooth	Minersville Fire Rehabilitation	October 1998	1,522	
		Aerial Before	Minersville Aerial Seeding	October 1998	2,626	
22-14	Antelope Mountain	Wildfire		1996		
		Chain Unknown		1996		
		Seed Unknown		1996		
		Wildfire	Milford Flat	July 2007	356,665	
22R-03	Marysvale WMA	Lop and Scatter	Deer Flat Lop and Scatter Project	May-June 2017	724	3775
22R-04	Above Fremont Wash	Lop and Scatter		Between 2008 and 2013		
22R-05	Black Mountain	Aerial	Black Mountain	September-December 2004		PDB
		Lop and Scatter		Between 2004 and 2007		
		Two-Way Dixie	Beaver Easement Property Treatment	September-December 2008	205	1294
		Broadcast Before	Beaver Easement Property Treatment	November 2008	205	1294
		Aerial After	Beaver Easement Property Treatment	January 2009	205	1294
		Transplant	SR Shrub Seedlings Year 2	January-June 2007	238	469
		Transplant	SR Shrub Seedlings	January-June 2006	238	81
22R-06	Greenville Bullhog	Bullhog	Greenville Bench	August-December 2004	1,500	PDB
		Truax Drill	Greenville Bench	November 2004	1,500	PDB
		Aerial After	Greenville Bench	November 2004	1,500	PDB
		Lop and Scatter	Bone Hollow and Greenville Bench Project Maintenance	September-December 2018	3,368	4513
22R-07	Sulphurdale	Chain Unknown	Pine Creek Chaining	1983-1984	2,800	
		Seed Unknown	Pine Creek Chaining	1983-1984	2,800	
		Lop and Scatter	Sulphurdale	Fall 2005		
22R-08	P-Hill Dixie	Two-Way Dixie	P-Hill One-way Harrow	October 2005-February 2006	1,784	119
		Broadcast After	P-Hill One-way Harrow	October 2005-February 2006	1,784	119
22R-09	South Beaver Dixie Reference	Two-Way Unknown	Coyote Bench Seeding	July 1964-November 1965	2,905	LTDL
		Aerial Unknown	Coyote Bench Seeding	July 1964-November 1965	2,905	LTDL
		Bullhog	South Beaver Vegetation Enhancement Year 6	November 2011-February 2012	1,506	1994
		Aerial Before	South Beaver Vegetation Enhancement Year 6	November 2011	1,506	1994
		Lop and Scatter	Project Maintenance - South Beaver	September-October 2015	4,251	3296
22R-10	South Beaver Bullhog	Bullhog	South Beaver Vegetation Enhancement Yr 4	Fall 2008-Summer 2009	1,520	1224
		Aerial Before	South Beaver Vegetation Enhancement Yr 4	December 2008	1,358	1224
		Lop and Scatter	Project Maintenance - South Beaver	September-October 2015	4,251	3296
22R-11	South Beaver SITLA Chaining	Two-Way Ely	South Beaver SITLA vegetation enhancement	November-December 2008	402	918
		Aerial Before	South Beaver SITLA vegetation enhancement	December 2008	402	918
		Dribbler	South Beaver SITLA vegetation enhancement	December 2008	402	918
		Lop (No Scatter)	Panguitch Creek/South Beaver Dedicated Hunter Habitat Projects maintenance	April-June 2011	402	1801
		Lop and Scatter	Project Maintenance - South Beaver	September-October 2015	4,251	3296

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
22R-12	South Beaver Bullhog 2	Rangeland Drill	South Beaver Vegetation Enhancement Project Year 3	August 2007-March 2008	385	895
		Bullhog	South Beaver Vegetation Enhancement Project Year 3	August 2007-March 2008	385	895
		Aerial After	South Beaver Vegetation Enhancement Project Year 3	February-March 2008	385	895
22R-13	Greenville Bench Bullhog 2	Bullhog	BLM Project	2008 or 2009		
		Aerial	Greenville Bench Aerial Seeding	December 2007	11,048	993
		Hand Crew	Bone Hollow and Greenville Bench Project Maintenance	November 2018	1,939	4513
22R-14	South Beaver Rocky Wash	Lop and Scatter	Project Maintenance - South Beaver	September-October 2015	4,251	3296
		Bullhog	South Beaver Vegetation Enhancement Yr 4	July 2008-August 2009	1,520	1224
		Aerial Before	South Beaver Vegetation Enhancement Yr 4	December 2008	1,358	1224
22R-15	South Beaver Bullhog Year 4	Lop and Scatter	Project Maintenance - South Beaver	September-October 2015	4,251	3296
		Bullhog	South Beaver Vegetation Enhancement Yr 4	July 2008-August 2009	1,520	1224
		Aerial Before	South Beaver Vegetation Enhancement Yr 4	December 2008	1,358	1224
22R-16	Spry Sagebrush Restoration	Chain Unknown	Hawkins Wash Seeding	Fall 1966		
		Seed Unknown	Hawkins Wash Seeding	Fall 1966		
		Lop and Scatter	Spry Sagebrush Restoration	April-June 2009	1,745	1173
		Tebuthiuron	Hawkins Wash Seeding Maintenance	1992	640	LTDL
22R-17	Beaver Easement Harrow	Aerial Unknown		Historic		
		Two-Way Dixie	Beaver Easement Property Treatment	September 2008-January 2009	205	1294
		Broadcast Before	Beaver Easement Property Treatment	November 2008-January 2009	205	1294
		Aerial After	Beaver Easement Property Treatment	January 2009	205	1294
22R-18	A&F Drill 1	Wildfire	Milford Flat	July 2007	356,665	
		Rangeland Drill	Milford Flat Fire Rehabilitation - Missouri Flat	October 2007-February 2008	7,925	1007
22R-19	A&F Drill 2	Wildfire	Milford Flat	July 2007	356,665	
		Rangeland Drill	Milford Flat Fire Rehabilitation - JK	September-December 2007	520	1010
22R-20	South Beaver Year 5	Bullhog	South Beaver Vegetation Enhancement Year 5	October 2010-January 2011	1,761	1711
		Aerial Before	South Beaver Vegetation Enhancement Year 5	October 2010	1,761	1711
		Lop and Scatter	Project Maintenance - South Beaver Phase II	May-June 2019	6,241	4831
22R-22	South Beaver Dixie	Two-Way Unknown	Coyote Bench Seeding	July 1964-November 1965	2,905	LTDL
		Aerial Unknown	Coyote Bench Seeding	July 1964-November 1965	2,905	LTDL
		One-Way Dixie	South Beaver Vegetation Enhancement Project Year 1	December 2005-March 2006	1,646	104
		Broadcast Before	South Beaver Vegetation Enhancement Project Year 1	December 2005-March 2006	1,646	104
		Lop and Scatter	Project Maintenance - South Beaver Phase II	May-June 2019	6,241	4831
22R-23	South Beaver Year 7	Aerial Before	South Beaver Vegetation Enhancement Year 7	September 2014	1,366	2227
		Bullhog	South Beaver Vegetation Enhancement Year 7	August-November 2014	1,366	2227
		Lop and Scatter	Project Maintenance - South Beaver Phase II	May-June 2019	6,241	4831
22R-24	City Creek	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Bullhog	City Creek Sagebrush-steppe Enhancement Year 1	September 2011-June 2012	1,080	1995
22R-25	Fremont Pass	Lop and Scatter	Little Bear Valley to Fremont Canyon Sagebrush Steppe Habitat Restoration	Winter 2018-August 2019	1,856	4402
22R-26	Jackrabbit Mountain	Lop and Scatter	Chipman Peak-Benson Vegetation Treatment	Fall 2019	873	4786

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
22R-27	Jackrabbit Mountain 2	Aerial Before	Chipman Peak-Benson Vegetation Treatment	Fall 2019	1,692	4786
		Bullhog	Chipman Peak-Benson Vegetation Treatment	January-June 2020	1,496	4786

Table 1.4: Range Trend and WRI studies known disturbance history for WMU 22, Beaver. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Big Sagebrush)

Two study sites [Deer Flat (22-01) and Oak Basin (22-03)] are classified as Mountain (Big Sagebrush) ecological sites. The Deer Flat study site is located southwest of Marysvale up Bullion Canyon, and the Oak Basin site is located in the foothills northwest of Circleville.

Shrubs/Trees: Average preferred browse cover on these sites has increased over the sample period, with the increase between 2018 and 2023 mostly driven by the Oak Basin study (**Figure 1.8**). The dominant browse species are black sagebrush (*Artemisia nova*) and mountain big sagebrush (*A. tridentata* ssp. *vaseyana*); the other preferred shrub that is present on these sites is Gambel oak (*Quercus gambelii*). Average preferred browse density has also generally increased. Demographic data shows that mature individuals have comprised a majority of the preferred browse populations on these sites in most sample years. In addition, recruitment of young plants has decreased each sample year since 2013: site-level data indicates that this trend is largely driven by the Oak Basin site (**Figure 1.11**). Browse utilization has fluctuated over the study years. In 2023, 27% of preferred browse plants were moderately used and 26% were heavily browsed (**Figure 1.12**).

Tree cover on these sites decreased significantly between 2013 and 2018 with the lop and scatter treatment on Deer Flat likely being a significant driver of this decrease; trees contributed no cover in 2023. Tree density did not change drastically with treatment, but a slight decrease did occur between 2018 and 2023 (**Figure 1.9**, **Figure 1.10**).

Herbaceous Understory: The herbaceous understories of these sites have increased slightly over the years, with mainly introduced perennial grasses as the dominant component. Annual grasses have remained rare, with low cover and frequency observed throughout the study period. Nested frequency and cover of perennial forbs exhibited a slight increase between 2018 and 2023, but both measurements remain low in comparison with those of perennial grasses. Abundance of annual forbs also increased between the two most recent samplings, which can largely be attributed to native species (**Figure 1.13**, **Figure 1.14**).

Occupancy: Pellet transect data shows that deer are the primary occupants of these study sites and that pellet group abundance has varied from a low of 14 days use/acre in 2018 to a high of 98 days use/acre in 2003. Cattle have also been present on these sites and average pellet group abundance has ranged between 6.5 days use/acre in 2023 and 42.5 days use/acre in 1998. Finally, average abundance of elk pellet groups has fluctuated between 3 days use/acre in 2023 and 21 days use/acre in 2003 (**Figure 1.15**).

Upland (Big Sagebrush)

There are 12 studies [Wades Canyon (22-04), Bone Hollow (22-05), Beaver Table (22-06), Sheep Rock (22-07), Rocks Reseeding (22-09), Doubleup Hollow (22-10), B Hill (22-11), Big Cedar Cove (22-12), Antelope Mountain (22-14), Brady Creek (22-16), Marysvale WMA (22R-03), and Sulphurdale (22R-07)] that are classified as Upland (Big Sagebrush) ecological sites. The Wades Canyon study site is situated in the foothills west of Circleville. Bone Hollow and Beaver Table are located northeast of Beaver along the foothills. Sheep Rock is situated east of I-15 at the foothills near Last Chance Bench. Rocks Reseeding can be found on Coyote Bench between the city of Beaver and Buckskin Valley. Doubleup Hollow is situated south of Greenville Bench near Little Valley. B Hill is located south of Beaver near Kane Canyon. Big Cedar Cove can be found in the Mineral Mountains northeast of Milford. Antelope Mountain is located at the northern end of the Mineral Mountains directly west of the junction of I-70 and I-15. Brady Creek is located in the north end of Dog Valley between US-89 and I-15, and the Marysvale WMA study is situated southeast of the town of Marysvale on Marysvale WMA. Finally, Sulphurdale site is located southeast of the intersection of I-15 and I-70.

Shrubs/Trees: Average preferred browse cover on these sites has fluctuated over time, with a decrease in 2008 that can be attributed to fires on both Doubleup Hollow and Big Cedar Cove; shrub cover has remained stable otherwise (**Figure 1.8**). The primary species of preferred browse on these study sites is mountain big sagebrush. However, lesser amounts of

other preferred browse species such as antelope bitterbrush (*Purshia tridentata*) are found on some studies. Average preferred browse density has exhibited an overall decrease, with the decrease between 2003 and 2008 also largely driven by the previously mentioned fires (**Figure 1.11**). Utilization has increased overall. Thirty three percent of preferred browse plants were heavily browsed and 23% were moderately used in 2023 (**Figure 1.12**).

Tree cover on these sites is provided by both twoneedle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). Average cover has shown fluctuations, but a significant decrease in 2018 was driven by a treatment on the Bone Hollow study site. In addition, a lop and scatter treatment on the Rocks Reseeding study contributed to a further slight decrease between 2018 and 2023 (**Figure 1.9**). Density of trees has also decreased: Bone Hollow, Beaver Table, Sheep Rock, and Rocks Reseeding were the primary drivers of this trend (**Figure 1.10**).

Herbaceous Understory: The understories of these studies are primarily comprised of perennial grass species, with cover generally increasing between 2008 and 2023. Annual grass cover has fluctuated between sample years, although cover has increased each year since 2008: this trend has largely been driven by the Big Cedar Cove and Antelope Mountain studies, both of which burned in 2007 (**Figure 1.13**, **Figure 1.14**). Site-level data indicates that perennial grass cover for Sheep Rock, Rocks Reseeding, Doubleup Hollow, B Hill, and Sulphurdale is primarily contributed by introduced species; namely intermediate wheatgrass (*Thinopyrum intermedium*) and smooth brome (*Bromus inermis*).

Occupancy: Pellet transect data shows that deer and/or antelope are the main occupants on these sites and that pellet group abundance has fluctuated between 23 days use/acre in 2013 and 2018 and 54 days use/acre in 2008. Elk have also been present, and utilization has been as low as under 1 days use/acre in 1998 and as high as 6 days use/acre in 2008. Finally, pellet group abundance of cattle has varied between 5 days use/acre in 2008 and 15 days use/acre in 2003 (**Figure 1.15**).

Semidesert (Big Sagebrush)

Five study sites [Piute Reservoir (22-02), Muley Point (22-08) (suspended), Minersville Reservoir (22-13), South Creek (22-15), and Above Fremont Wash (22R-04)] are classified as Semidesert (Big Sagebrush) ecological sites. Piute Reservoir is located on the west side of US-89 near the north end of Piute Reservoir. The Muley Point site can be found just northeast of the intersection of I-15 and SR-20. Minersville Reservoir is situated north of SR-21 in the Mineral Mountains near the west edge of Minersville Reservoir. The South Creek study site is located in the foothills west of I-15 near Beaver. Finally, the Above Fremont Wash site is located just north of SR-20 and east of I-15 and the Muley Point study.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, the Piute Reservoir, Above Fremont Wash, Minersville Reservoir, and South Creek studies have provided data each sample year since 1998. Muley Point, however, only contributed data from 1998 through 2013.

Shrubs/Trees: The primary browse species on these sites is mountain big sagebrush or Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*), with lesser amounts of cover contributed by other species. The Minersville Reservoir site has not hosted a significant browse population since it burned in 1998. In addition, a 2005 wildfire removed most of the browse component on the Muley Point study (which was suspended in 2018). Preferred browse cover has exhibited a slight increase overall (**Figure 1.8**). Site-level data indicates that the increase in preferred browse cover between the two most recent sample years is almost entirely due to the Piute Reservoir site, on which mountain big sagebrush cover increased by over 9% between 2018 and 2023. Preferred browse density has fluctuated from year to year, but has remained fairly stable when comparing 1998 data with that from 2023. However, one should note the different number of studies sampled each year and consider the implications that this may have on the data. For example, the Muley Point study burned in 2005, leading to a decrease in preferred browse density in 2008; the study was suspended in 2018. Total preferred browse density increased between 2013 and 2018, a trend that was likely in part driven by the suspension of the Muley Point study in addition to a substantial increase on the Minersville Reservoir site. Preferred browse demographics indicate that mature plants have comprised a majority of the populations on these sites throughout the study period. In addition, the number of decadent individuals and recruitment of young exhibited slight decreases between the two most recent sample years (**Figure 1.11**). Utilization of preferred browse has fluctuated over time, but increased between the two most recent samplings. In 2023, 16% of plants showed signs of moderate use and 29.5% were heavily browsed (**Figure 1.12**).

Trees sampled on these sites include both Utah juniper and twoneedle pinyon. Tree presence remains low as of 2023. However, cover has increased each sample year since 2013, a trend that can be entirely attributed to the Piute Reservoir

study. Tree density has exhibited an overall increase, with the Above Fremont Wash and Piute Reservoir studies as the trend drivers. More specifically, the increase between 2013 and 2018 coincides with point-quarter density being sampled for the first time in 2018 on the Piute Reservoir site and the suspension of the Muley Point study, which had no tree density (**Figure 1.9**, **Figure 1.10**).

Herbaceous Understory: Annual grasses – primarily the introduced species cheatgrass (*B. tectorum*) – have been the dominant component in the herbaceous understories of many of these sites throughout the study period. Annual grass cover and frequency have fluctuated from sample year to sample year, but have generally remained high. In 2023, abundance and cover of cheatgrass were highest on the Above Fremont Wash and Minersville Reservoir studies, and lowest on the Piute Reservoir site (which had a sparse herbaceous understory in general). However, mainly native perennial grass species contributed significant cover on most studies during the most recent sampling. Both perennial and annual forbs have provided little cover over the study years, but site-level data shows that increases in both cover and abundance of annual species occurred on all active studies between 2018 and 2023 (**Figure 1.13**, **Figure 1.14**).

Occupancy: Total animal occupancy has generally decreased overall since 1998. Pellet transect data shows that deer have been the primary occupants of these sites throughout the study period. Average deer pellet group abundance has ranged from 28 days use/acre in 2018 to 47 days use/acre in 2008. Mean abundance of elk pellet groups has fluctuated between 0 days use/acre from 2008 through 2018 and 1 days use/acre in 2003. Finally, cattle have also been present on these sites with an average pellet group abundance as low as 6.5 days use/acre in 2008 and as high as 14.5 days use/acre in 2018 (**Figure 1.15**).

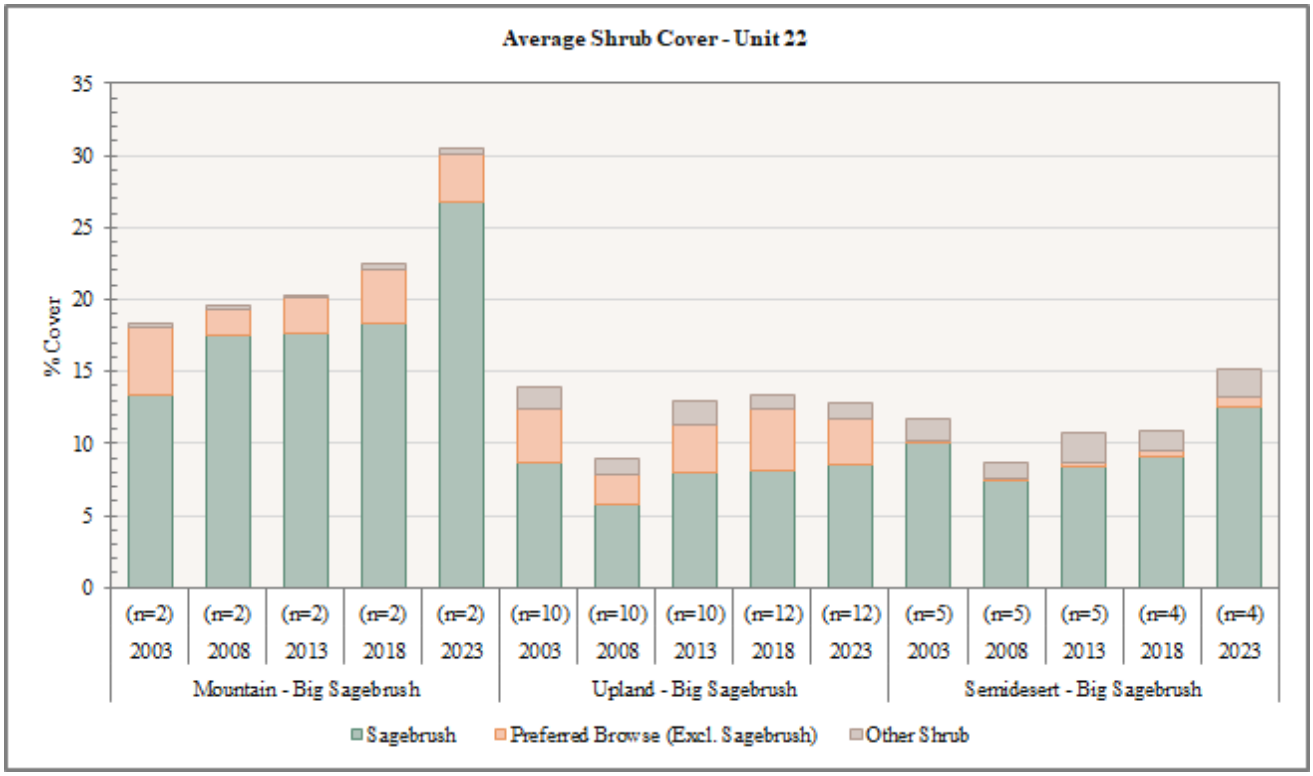


Figure 1.8: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver.

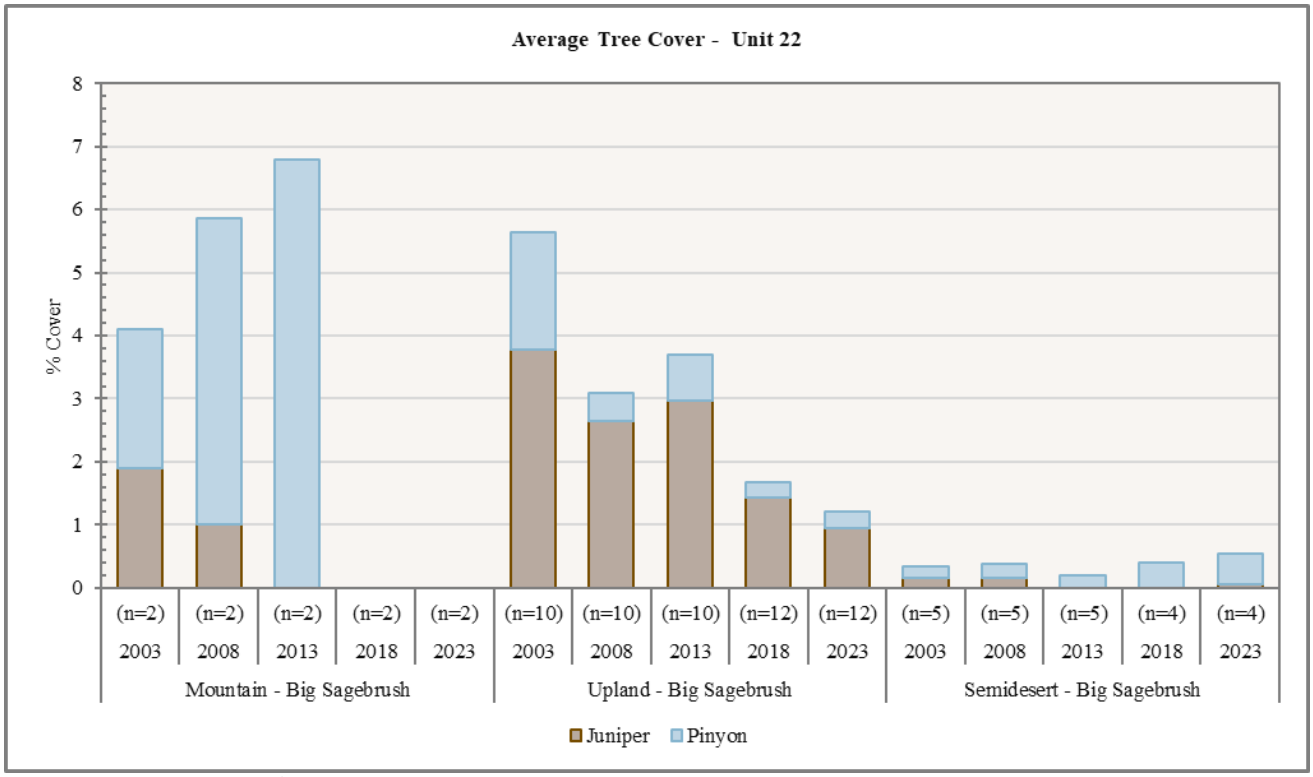


Figure 1.9: Average tree cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver.

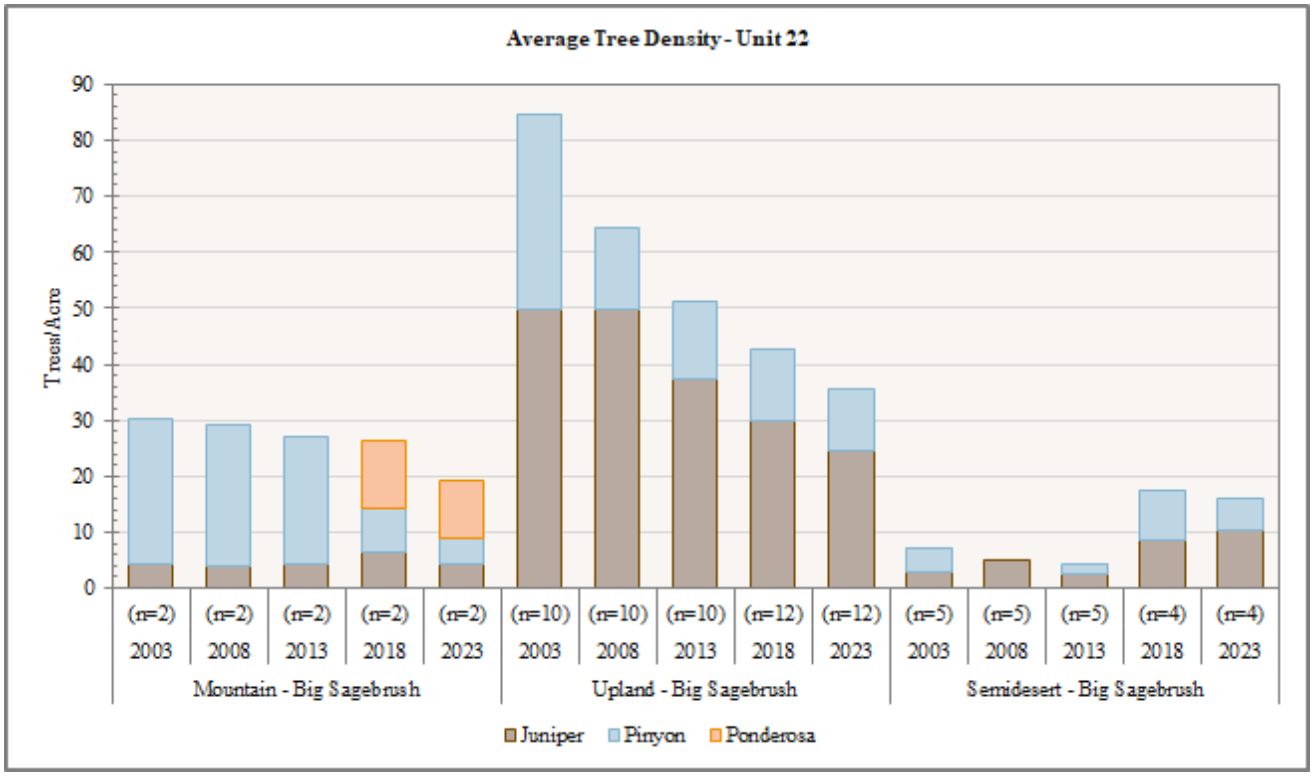


Figure 1.10: Average tree density for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver.

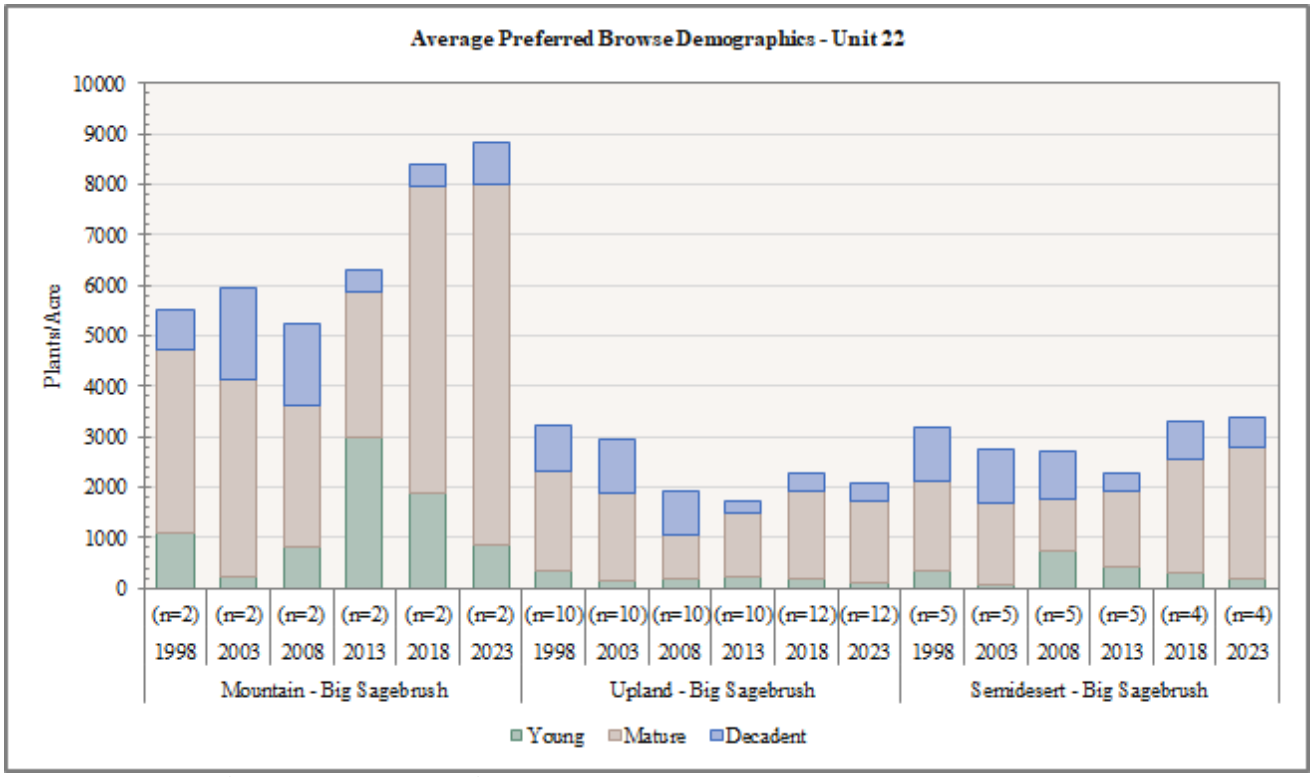


Figure 1.11: Average preferred browse demographics for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver.

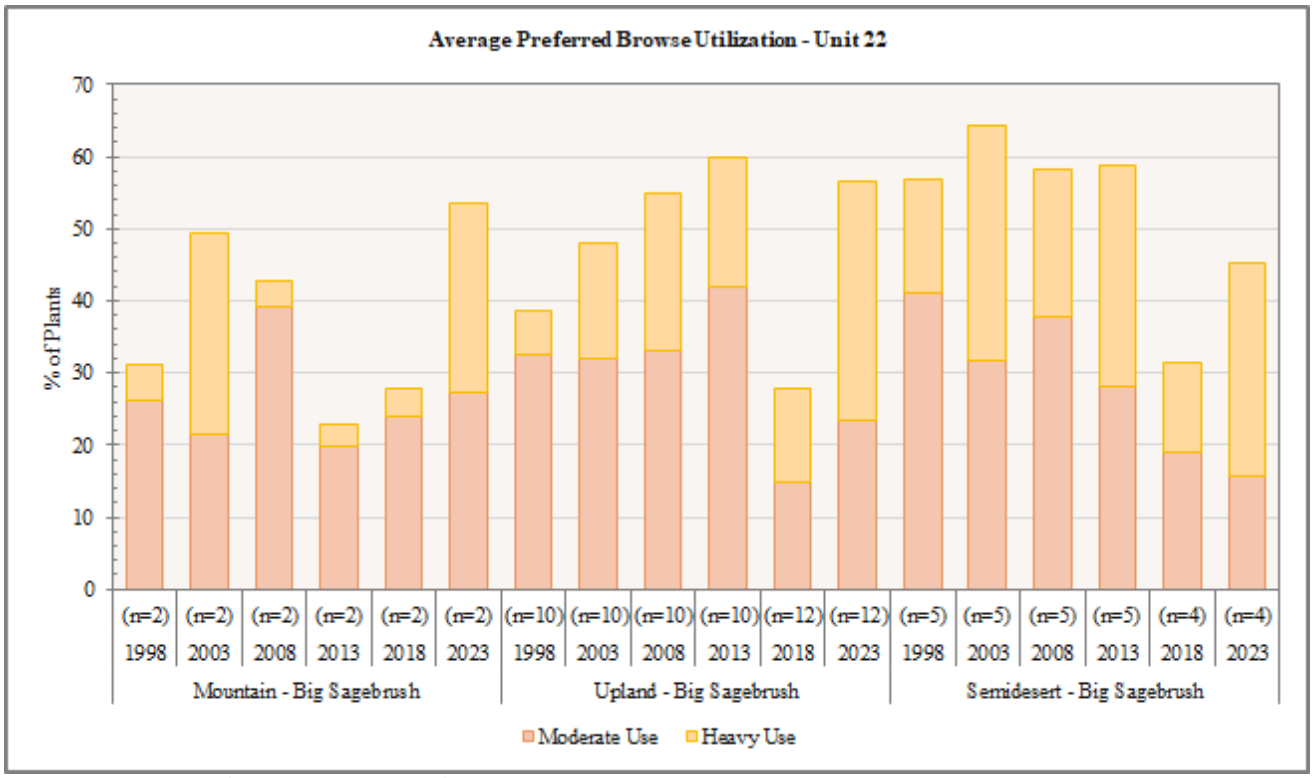


Figure 1.12: Average preferred browse utilization for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver.

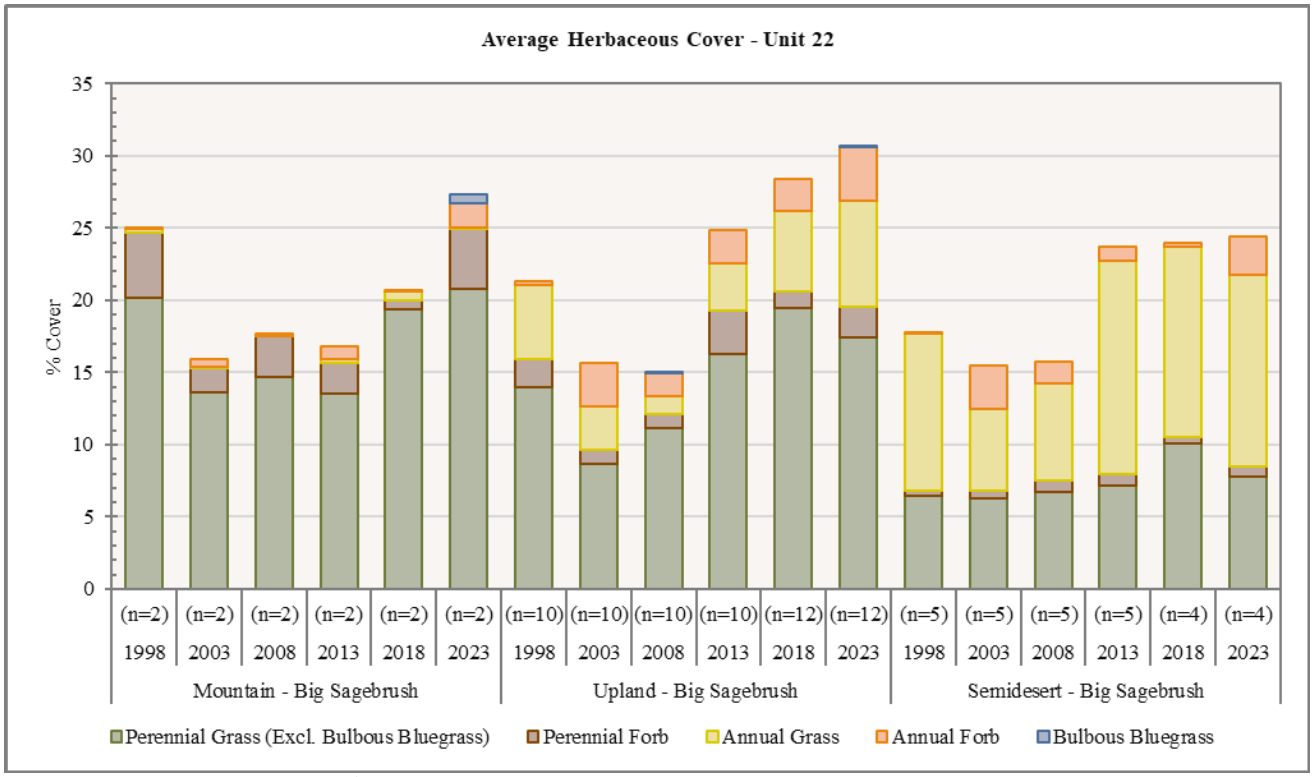


Figure 1.13: Average herbaceous cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver.

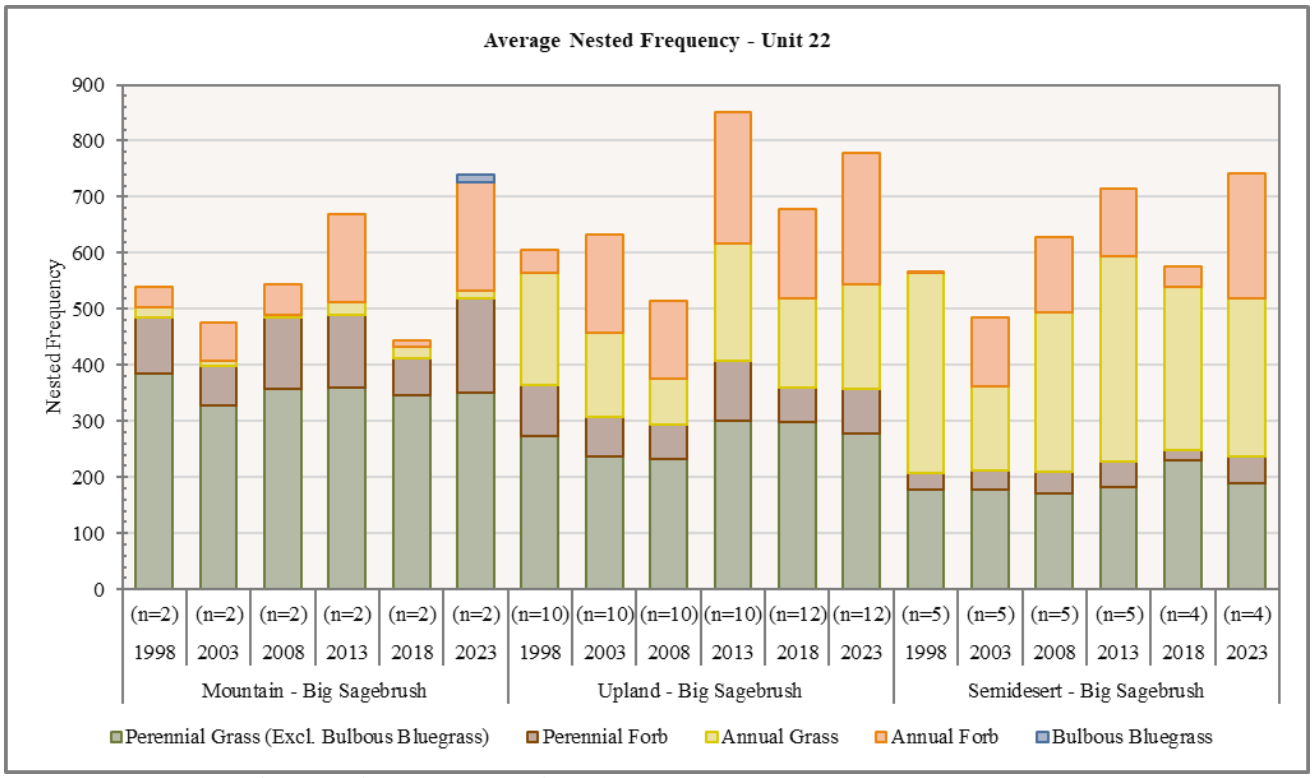


Figure 1.14: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver.

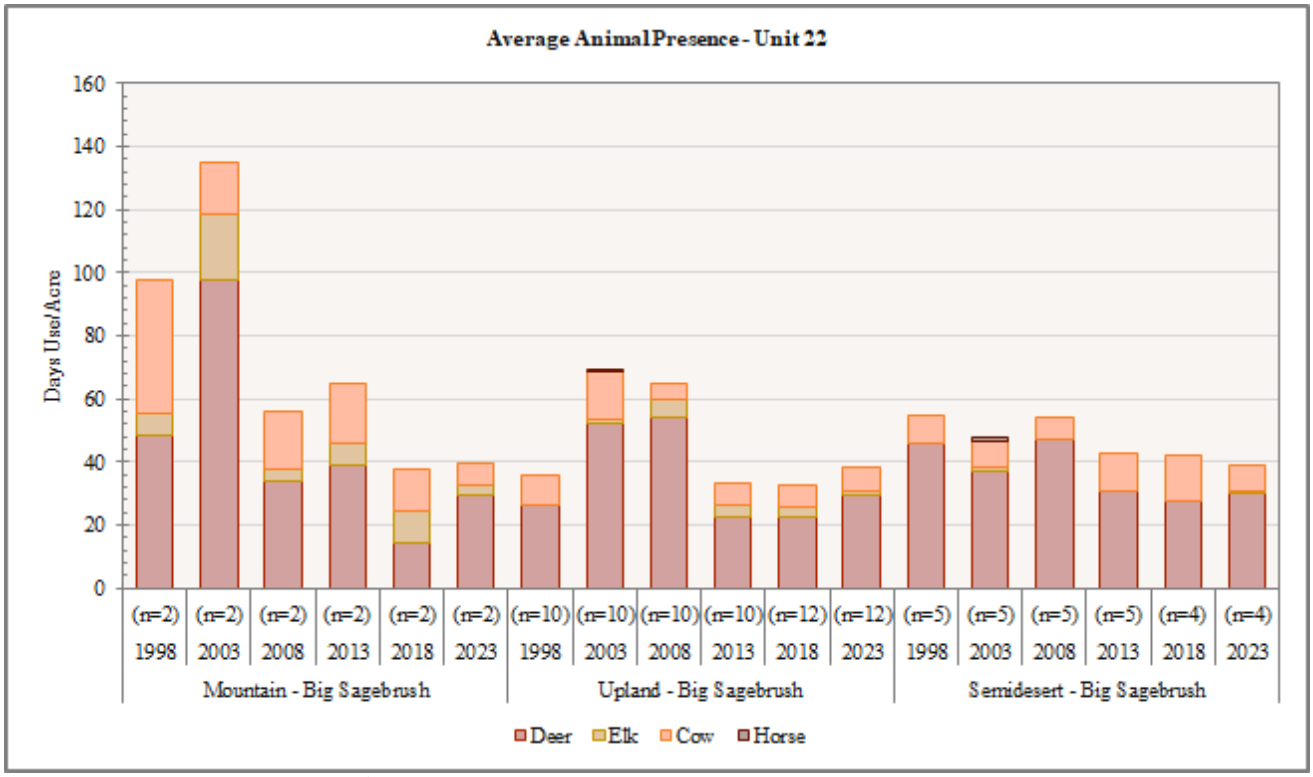
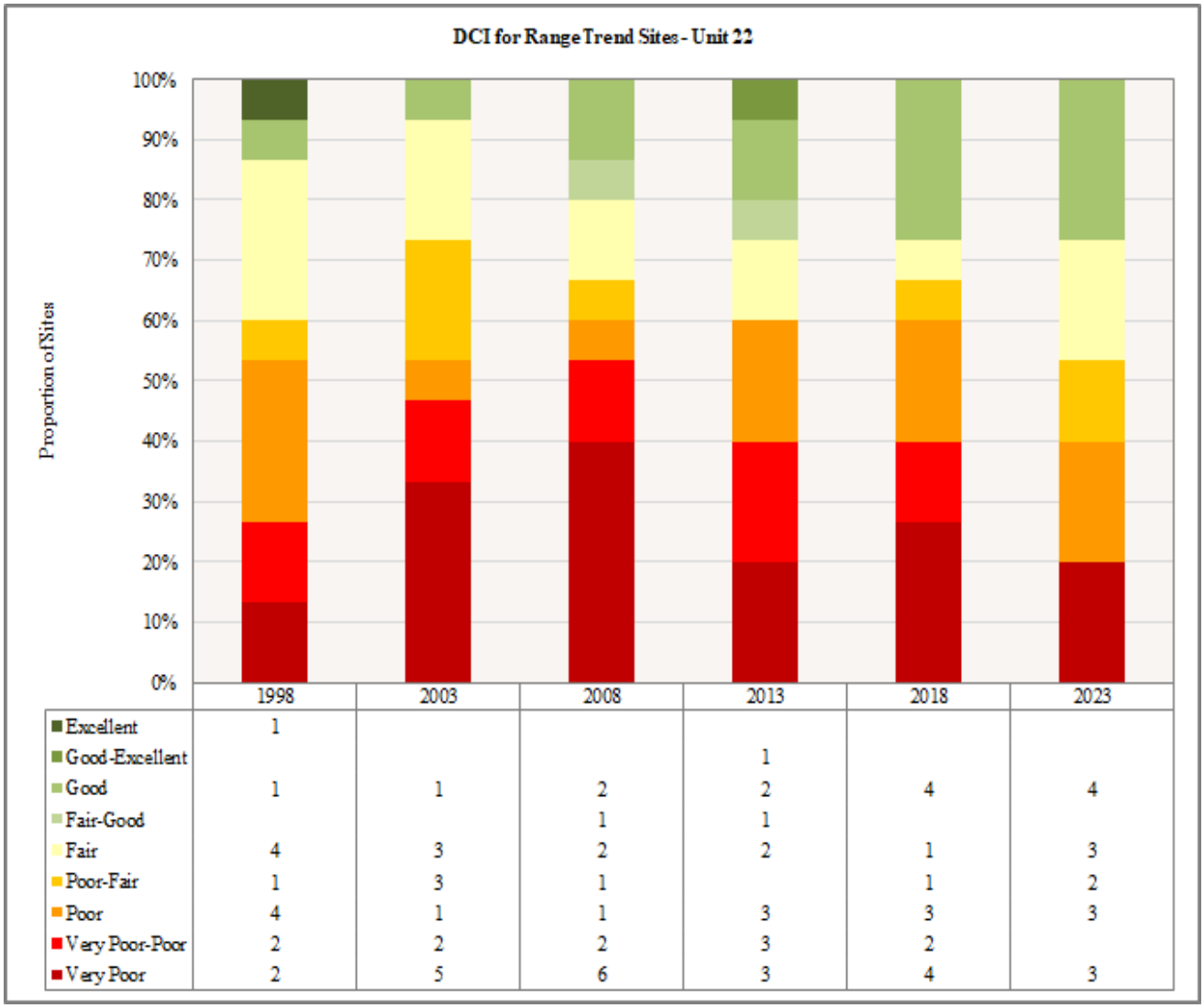


Figure 1.15: Average pellet transect data for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 22, Beaver. *Upland - Big Sagebrush deer pellets include deer and sheep pellet groups.

Deer Winter Range Condition Assessment

The overall condition of deer winter range within the Beaver management unit has remained similar from year to year with sites averaging from poor to fair condition since 1998. Deer Flat (22-01), Piute Reservoir (22-02) , Rocks Reseeding (22-09), South Creek (22-15), and Sulphurdale (22R-07) are the main drivers for the unit's wintering habitat stability and quality, and deer winter range condition for these sites averages as fair to good. Bone Hollow (22-05), Sheep Rock (22-07), B Hill (22-11), Big Cedar Cove (22-12), Antelope Mountain (22-14), and Above Fremont Wash (22R-04) are considered to have very poor to poor wintering habitat conditions consistently from year to year: these poor conditions suppress the unit's overall winter range quality. Range Trend sites in WMU 22 that tend to have higher winter habitat variability include Bone Hollow and Muley Point (22-08) (suspended); this may suggest a higher potential for winter range improvement, especially on Bone Hollow where winter range has been improving.

The overall deer winter range assessment in 2023 for WMU 22 is that the unit is in poor-fair condition with most sites ranging between very poor and fair condition. However, Deer Flat, Rocks Reseeding, South Creek, and Sulphurdale were considered to be in good condition due to high cover of preferred browse and perennial grass, but these sites would benefit from a reduction in annual grass and increased perennial forb cover (**Figure 1.16**, **Table 1.5**).



	1998	2003	2008	2013	2018	2023
Excellent	1					
Good-Excellent				1		
Good	1	1	2	2	4	4
Fair-Good			1	1		
Fair	4	3	2	2	1	3
Poor-Fair	1	3	1		1	2
Poor	4	1	1	3	3	3
Very Poor-Poor	2	2	2	3	2	
Very Poor	2	5	6	3	4	3

Figure 1.16: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 22, Beaver.

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
22-01	1998	30	10.1	7	28	-0.4	3.7	0	**78.4**	**G**
22-01	2003	30	5	2.6	13.9	0	1.9	0	**53.4**	**P-F**
22-01	2008	29.2	2.3	5.5	24.2	0	5.5	0	**66.7**	**F**
22-01	2013	29	11.1	8.1	20.3	-0.4	1.5	0	**69.6**	**F-G**
22-01	2018	27.8	10.9	11.3	30	-0.8	1.1	0	**80.3**	**G**
22-01	2023	30	11.5	5.1	30	-0.1	6.2	0	**82.7**	**G**
22-02	1998	22.9	6.4	7	3.3	0	0.6	0	**40.2**	**F**
22-02	2003	22	3	0.7	0.9	0	0.1	0	**26.7**	**P-F**
22-02	2008	21.5	1.6	1.7	1	0	0.3	0	**26.1**	**P-F**
22-02	2013	24.9	10.3	2.8	3.2	0	0.2	0	**41.4**	**F**
22-02	2018	24.1	6.4	0.5	0.9	0	0.7	0	**32.7**	**F**
22-02	2023	30	4.5	0.2	0.5	0	0.1	0	**35.3**	**F**
22-04	1998	14.1	-3.3	4.1	25.8	0	7.7	0	**48.4**	**P**
22-04	2003	7.8	0.8	2.4	10.7	0	1.1	0	**22.7**	**VP**
22-04	2008	11	-2.6	2.1	14.9	0	0.6	0	**25.9**	**VP**
22-04	2013	13.4	9.4	2.4	19.3	-0.1	2.1	0	**46.3**	**P**
22-04	2018	13.4	8.4	3.5	19.6	0	0.9	0	**45.7**	**P**
22-04	2023	17.5	10.4	1.4	18.8	-0.2	0.3	0	**48.2**	**P-F**
22-05	1998	21.6	4.6	2.2	9	-15.1	1.6	0	**23.9**	**VP**
22-05	2003	14.9	1.1	0	10	-2.1	0.6	0	**24.5**	**VP**
22-05	2008	12.4	-2.6	1.6	12.4	0	0.8	0	**24.5**	**VP**
22-05	2013	13.5	8.1	4.6	15.7	-3	1.7	0	**40.6**	**P**
22-05	2018	4.5	0	0	28.9	-6.2	3.6	0	**30.8**	**VP**
22-05	2023	10.1	14.3	2.4	30	-7.6	4.5	0	**53.7**	**F**
22-06	1998	21.9	3.4	4.3	14.8	-8.4	2.2	0	**38.2**	**P**
22-06	2003	27.8	5.9	0.1	6	-0.5	1.6	0	**41**	**P**
22-06	2008	30	0.9	1.4	6.7	-0.1	0.5	0	**39.4**	**P**
22-06	2013	30	9.5	3.5	8.3	-0.2	3.3	0	**54.5**	**F**
22-06	2018	30	8.5	2.8	8.3	-0.1	1.3	0	**50.8**	**P-F**
22-06	2023	26.3	3.6	0.4	16.7	-1.1	3.9	0	**49.9**	**P-F**
22-07	1998	2.6	0	0	30	-8.6	5.2	0	**29.2**	**VP**
22-07	2003	2.6	0	0	26.1	-1	4.1	0	**31.8**	**VP**
22-07	2008	2.4	0	0	30	-0.7	5.2	0	**36.9**	**VP-P**
22-07	2013	3.1	0	0	30	-1.5	2.6	0	**34.2**	**VP-P**
22-07	2018	4.2	0	0	30	-0.7	0.9	0	**34.4**	**VP-P**
22-07	2023	5.9	0	0	30	-2.4	10	0	**43.6**	**P**
22-08*	1998	18.3	3.9	5.7	9.1	-10	2.3	0	**29.3**	**F**
22-08*	2003	17.4	3.3	0.7	9.4	-3.4	1.6	0	**28.9**	**F**
22-08*	2008	1.3	0	0	1.7	-11.9	4.1	0	**-4.9**	**VP**
22-08*	2013	1.8	0	0	4.4	-18.5	4.9	0	**-7.4**	**VP**
22-09	1998	30	12.3	8.7	30	0	1.7	0	**82.7**	**E**
22-09	2003	30	4.2	4.5	30	0	0.6	0	**69.3**	**G**
22-09	2008	28.1	0.2	4.5	30	0	0.5	0	**63.3**	**F-G**
22-09	2013	30	11.4	7.4	30	0	1.3	0	**80.1**	**G-E**
22-09	2018	30	7.5	1.2	30	0	0.4	0	**69**	**G**
22-09	2023	21.9	9.3	10.1	30	-0.1	1.9	0	**73**	**G**
22-11	1998	3.8	0	0	30	-0.3	1.7	0	**35.2**	**VP-P**
22-11	2003	2.9	0	0	30	0	0.9	0	**33.8**	**VP-P**
22-11	2008	3	0	0	30	0	1.2	0	**34.2**	**VP-P**
22-11	2013	4	0	0	30	0	1.7	0	**35.7**	**VP-P**
22-11	2018	3.5	0	0	30	0	2.6	0	**36.1**	**VP-P**
22-11	2023	4.3	0	0	30	0	3.6	0	**37.9**	**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
22-12	1998	21.4	4.2	1.6	14.4	-3.4	1.7	0	**39.8**	**P**
22-12	2003	22.6	0.3	0.4	11	-3.4	1	0	**31.9**	**VP**
22-12	2008	0.2	0	0	7.8	-2.4	1	0	**6.5**	**VP**
22-12	2011	1.5	0	0	0	0	0	0	**1.5**	**VP**
22-12	2013	3	0	0	30	-6	1.8	0	**28.9**	**VP**
22-12	2018	3.4	0	0	19.9	-14.2	0.1	0	**9.1**	**VP**
22-12	2023	5.8	0	0	15.8	-20	0.5	0	**2.1**	**VP**
22-13	1998	11	-0.3	2.5	14.2	-11.3	0	0	**16.1**	**P**
22-13	2003	0.3	0	0	27.4	-0.4	2.7	0	**30**	**F**
22-13	2008	0.1	0	0	30	-2	0.5	0	**28.6**	**F**
22-13	2013	1.4	0	0	30	-9.6	0.5	0	**22.3**	**P**
22-13	2018	2.4	0	0	30	-10.2	0.2	0	**22.4**	**P**
22-13	2023	4.3	0	0	28.9	-13.9	1.7	0	**20.9**	**P**
22-14	1998	0	0	0	30	-0.3	10	0	**39.7**	**P**
22-14	2003	0.4	0	0	23.9	-8.9	1.5	0	**16.8**	**VP**
22-14	2008	0.1	0	0	30	-0.7	1.4	0	**30.9**	**VP**
22-14	2013	0	0	0	30	-5.9	10	0	**34.1**	**VP-P**
22-14	2018	0.4	0	0	30	-18	0.8	0	**13.1**	**VP**
22-14	2023	0	0	0	30	-20	1.3	0	**11.3**	**VP**
22-15	1998	11.1	5.2	6.9	21	-9.6	0.7	0	**35.4**	**F**
22-15	2003	13.5	2.2	3	15.1	0	0.9	0	**34.6**	**F**
22-15	2008	18.1	9.2	15	10.3	-2.7	2.2	0	**52.1**	**G**
22-15	2013	21.3	11.7	14.7	16	-11.4	1.3	0	**53.5**	**G**
22-15	2018	17.4	7	6.8	25.9	-8.1	2.3	0	**51.2**	**G**
22-15	2023	22.4	11.6	2	19.5	-5.8	2	0	**51.7**	**G**
22R-03	1998	8.1	12.3	15	26.3	-1.6	0.4	0	**60.4**	**F**
22R-03	2018	11.6	4.1	0.7	30	-2.3	1.1	0	**45.2**	**P**
22R-03	2023	13.3	8.8	3.3	30	-3.4	3.9	0	**55.8**	**F**
22R-04	1999	4.7	0	0	16.8	-9.8	0.2	0	**11.9**	**VP-P**
22R-04	2003	10.3	6	0.7	9.8	-17.3	0.4	0	**9.9**	**VP-P**
22R-04	2008	5.9	0	0	8.9	-8.7	0.9	0	**6.9**	**VP**
22R-04	2013	4.9	0	0	13.9	-15.6	0.6	0	**3.7**	**VP**
22R-04	2018	3.8	0	0	12.1	-20	0	0	**-4.1**	**VP**
22R-04	2023	4.3	0	0	13.6	-20	1.7	0	**-0.4**	**VP**
22R-07	2005	11.9	13.6	9.5	15	-6	6.6	0	**50.6**	**P-F**
22R-07	2008	13.3	13.7	10.9	26.9	-5.1	8.1	0	**67.8**	**G**
22R-07	2013	21.6	14.7	14.3	23.5	-3.2	6.9	0	**77.7**	**G**
22R-07	2017	24	14	8.5	30	-7.1	6.5	0	**75.7**	**G**
22R-07	2021	27.3	10.1	8.5	21.7	-2.7	3.8	0	**68.7**	**G**
22R-07	2023	24.6	11.1	5.1	25.9	-1.6	8.4	0	**73.4**	**G**

Table 1.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 22, Beaver. 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 Impact	Potential Impact
22-01	Deer 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
22-02	Piute Reservoir	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
22-03	Oak Basin	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
22-04	Wades Canyon	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat

Study #	Study Name	Limiting Factor and/or Threat	Level of Impact	Potential Impact
22-05	Bone Hollow	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
22-06	Beaver Table	Animal Use – Deer	Medium	Reduced/less vigorous browse component
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
22-07	Sheep Rock	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
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
22-09	Rocks Reseeding	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22-10	Doubleup Hollow	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
22-11	B Hill	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
22-12	Big Cedar Cove	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
22-13	Minersville Reservoir	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	Medium	Reduced diversity of desirable grass and forb species
		Energy Development	Low	Fragmentation and degradation/loss of habitat
22-14	Antelope Mountain	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
22-15	South Creek	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22-16	Brady Creek	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-03	Marysvale WMA	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
22R-04	Above Fremont Wash	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-05	Black Mountain	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-06	Greenville Bullhog	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
22R-07	Sulphurdale	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
22R-08	P-Hill Dixie	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
22R-10	South Beaver Bullhog	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
22R-11	South Beaver SITLA Chaining	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-12	South Beaver Bullhog 2	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
22R-13	Greenville Bench Bullhog 2	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
22R-14	South Beaver Rocky Wash	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

Study #	Study Name	Limiting Factor and/or Threat	Level of Impact	Potential Impact
22R-15	South Beaver Bullhog Year 4	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
22R-16	Spry Sagebrush Restoration	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
22R-17	Beaver Easement Harrow	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-20	South Beaver Year 5	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
22R-22	South Beaver Dixie	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
22R-23	South Beaver Year 7	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
22R-24	City Creek	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-25	Fremont Pass	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-26	Jackrabbit Mountain	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
22R-27	Jackrabbit Mountain 2	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 1.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 22, Beaver. All assessments are based off the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A – Threat Assessment**.

Discussion and Recommendations

Deer winter range condition on the Beaver management unit averages as poor to fair unit-wide as of 2023; despite slight variations, year-to-year conditions have remained similar since 1998. However, four study sites have remained in good condition primarily due to high preferred browse and perennial grass cover: Deer Flat, Rocks Reseeding, South Creek, and Sulphurdale. Factors contributing to the poorer conditions of other studies generally vary between a lack of preferred browse cover, the presence of annual grasses, and undiversified age class structures among the preferred browse communities (**Figure 1.16**, **Table 1.5**).

Of positive note within this unit is that many of the Range Trend sites along stretches of US-89 and I-15 have browse components that have persisted. Almost all of these studies (Deer Flat, Piute Reservoir, Wades Canyon, Bone Hollow, Beaver Table, Rocks Reseeding, Marysvale WMA, and Sulphurdale) are located on mule deer winter range, with only one (Oak Basin) that is considered to be summer range (**Map 1.2**). Many of these studies have undergone treatments for pinyon-juniper removal that have generally been effective. Furthermore, any disturbances that may have occurred on these sites have not caused the plant communities to irreversibly transition to a degraded ecological state. An additional highlight on this unit is the Big Cedar Cove study, which burned in the Milford Flat fire of 2007 and underwent a rehabilitation treatment later that year (**Table 1.4**). The site remains dominated by the introduced annual grass species cheatgrass (*Bromus tectorum*) as of 2023. However, photos show that a notable increase in sagebrush (*Artemisia tridentata*) plants occurred across the study area between the two most recent sample years. Density data for 2023 did not capture this increase or any recruitment of young (Cox, Lane, & Payne, 2023), but it is possible that sagebrush will continue to return over time on this site. Other restoration projects have occurred across the unit, and improvements in habitat quality (pinyon-juniper reduction, augmentation of the herbaceous understory, browse diversification, etc.) have been observed following treatment on many Range Trend and Watershed Restoration Initiative (WRI) sites. Habitat treatment projects have also been and continue to be implemented in areas not monitored by the Range Trend program; nearly 266,000 treatment acres have been completed through the WRI as of February 2024 (**Table 1.2**, **Map 1.7**).

Numerous fires have occurred in the Beaver management unit, some of which have been in higher elevations (**Map 1.6**). In some circumstances, fire can play a key process in the structure and function of big game habitat (Pastro, Dickman, & Letnic, 2011). Fires have the potential to be beneficial, and more so in higher-elevation summer habitat than on lower elevation landscapes (Chambers, et al., 2013). However, habitat change fueled by fire can rely on multiple variables. A single fire can have both negative and positive impacts depending on localized factors: such is the case with the Twitchell Canyon fire, which burned within unit boundaries on Fishlake National Forest in 2010. The United States Forest Service (USFS) documented some detrimental effects of the burn in an environmental assessment for the Twitchell Fire Salvage Sale project. For example, an outbreak of mountain pine beetles was observed in ponderosa pine (*Pinus ponderosa*) trees within the perimeters of the project area: these pines had been damaged by the fire and already had reduced vigor, which can affect whether or not a tree survives an insect infestation. However, the same assessment also noted the occurrence of significant aspen (*Populus tremuloides*) regeneration and stated, "it is likely that the Twitchell Fire will result in numerous long term forest health benefits" (United States Department of Agriculture, 2013); this fire caused some conifer-encroached aspen stands to transition back to early-successional phases. How this fire burned may have also been advantageous. According to Wan, Rhodes, & St. Clair (2014), much of the Twitchell Canyon fire was considered high severity. Data gathered two years after the burn showed density of aspen saplings to be greater in mid- to high severity burn areas than in low-severity or unburned plots. Furthermore, the level of anti-herbivory defense compounds were significantly greater in high severity burn areas, and an inverse relationship was observed between deer pellet group abundance and burn severity. This combination of high sapling density and increased defense compounds in more severely burned areas may be beneficial for the survival of these seral communities.

The condition of aspen stands in some areas of higher elevation summer range that have not burned, however, is a concern on this unit. Range Trend data does not address specific and detailed conditions of these areas, as aspen communities are not and have not been sampled by any active or suspended study sites (**Table 1.3**). However, the LANDFIRE Vegetation Departure model indicates that aspen ecotypes at higher elevations throughout the management unit have departed from reference conditions to a greater degree than those at lower elevations (LC22_VDEP_230, 2022). In many areas that have not burned, satellite imagery shows that these departed systems are experiencing significant levels of conifer encroachment. These late successional stages are likely the result of decades-long fire management and policy, which have allowed for fir (*Abies spp.*) and spruce (*Picea spp.*) to accumulate over time.

Although fire may have served as an agent of positive change at higher elevations, it has had deleterious effects in other portions of the unit. The condition of deer winter range in many lower elevation areas west of I-15 is a concern. Numerous wildfires have burned this area over the past 30 years (many of which occurred in the mid-2000s) (**Table 1.4**, **Map 1.6**), removing shrub communities that were valuable for wildlife. Browse components on the Minersville Reservoir and Antelope Mountain studies exhibited significant post-fire losses and remain diminished as of 2023. In addition, pellet transect data for these sites shows that deer presence has generally decreased from pre-fire levels (Cox, Lane, & Payne, 2023). Furthermore, some fire effects can be observed even without study sites to monitor on-the-ground conditions. A comparison of current and historic satellite imagery of the northern half of the Mineral Mountains shows the removal of large areas of vegetation, presumably by the 2007 Milford Flat fire. Some burned areas (some of which fall within the perimeters of the Minersville and Greenville Bench fires, for example) have been known to host higher densities of wintering deer than other places in the western portion of this unit. Fire has likely had different effects depending on specific location; however, the loss of shrubs in these areas means less browse available for wildlife. In some places, this could possibly translate to the inability of these areas to sustain wintering deer densities similar to those that have used these ranges in the past.

Diminished browse communities are also present in other localized parts of the Beaver unit. As of 2023, the Sheep Rock, B Hill, and Above Fremont Wash studies are considered to be within very poor to poor-fair condition for deer winter range. Negative drivers for these conditions common to all three studies include low amounts of preferred browse cover and a lack of age class diversity in the preferred browse communities (**Table 1.5**). Site-level data shows that density of preferred browse species has decreased over time on B Hill and Above Fremont Wash; Sheep Rock has remained dominated by perennial grasses with a sparse browse component throughout the study period (Cox, Lane, & Payne, 2023). The actual extent of the affected areas cannot be determined from the available data, but the preferred browse trends observed on the B Hill and Above Fremont Wash studies may have implications for browse communities in the surrounding area.

Introduced annual grasses (namely cheatgrass) are present in many areas unit-wide. These grasses pose a medium to high-level threat on a number of Range Trend and WRI sites at lower elevations (**Table 1.6**); in 2023, cheatgrass contributed over 10% cover on the Minersville Reservoir, Big Cedar Cove, Antelope Mountain, Bone Hollow, and Above Fremont Wash studies. The presence of annual grasses can increase fine fuel loads, exacerbate the risk of wildfire, and may even result in altered fire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). This in turn can perpetuate and expand the removal of valuable reestablishing or extant browse communities. Should the affected sites burn, they may be at risk for the release of even greater amounts of cheatgrass and the increased fire frequency associated with annual grasses (Bradley, 2018).

Increased human presence may also pose a threat to wildlife and wildlife habitat in the Beaver management unit. Satellite imagery shows the presence of wind and solar energy structures west of the Mineral Mountains. These specific installations do not overlap mule deer winter habitat as defined by the Division, but are adjacent to the peripheral edges of currently specified winter range (**Map 1.2**). Although existing renewable energy installations do not currently affect habitat, the potential for future development remains. According to the Bureau of Land Management (2024), interest in developing solar projects on publicly managed lands throughout the west is ongoing. Geothermal power plants are also present in this unit and are located on deer winter range near the base of the Mineral Mountains and adjacent to Sulphurdale. Although the largest direct impacts on the loss and fragmentation of deer habitat were likely due to construction of these plants, noise pollution caused by operational activities may still have an impact on local wildlife. The actual impacts on animals around these locations are unknown to the authors of this report. However, human-caused noise can negatively affect wildlife in general in terms of foraging, wildlife presence, body condition and reproductive success (Shannon, et al., 2016).

There are a few islands of privately owned land in the Tushar Mountains (**Map 1.4**), one of which is near Puffer Lake and includes the Eagle Point Ski Resort. Satellite imagery over time shows construction of new mountain homes and additions to recreational features in this area, which is considered to be substantial summer range for both deer and elk. Naturally, there is the potential for further human development in this habitat, which 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 others. However, the extent of potential development is likely very limited as this island of privately owned property is surrounded by publicly managed land.

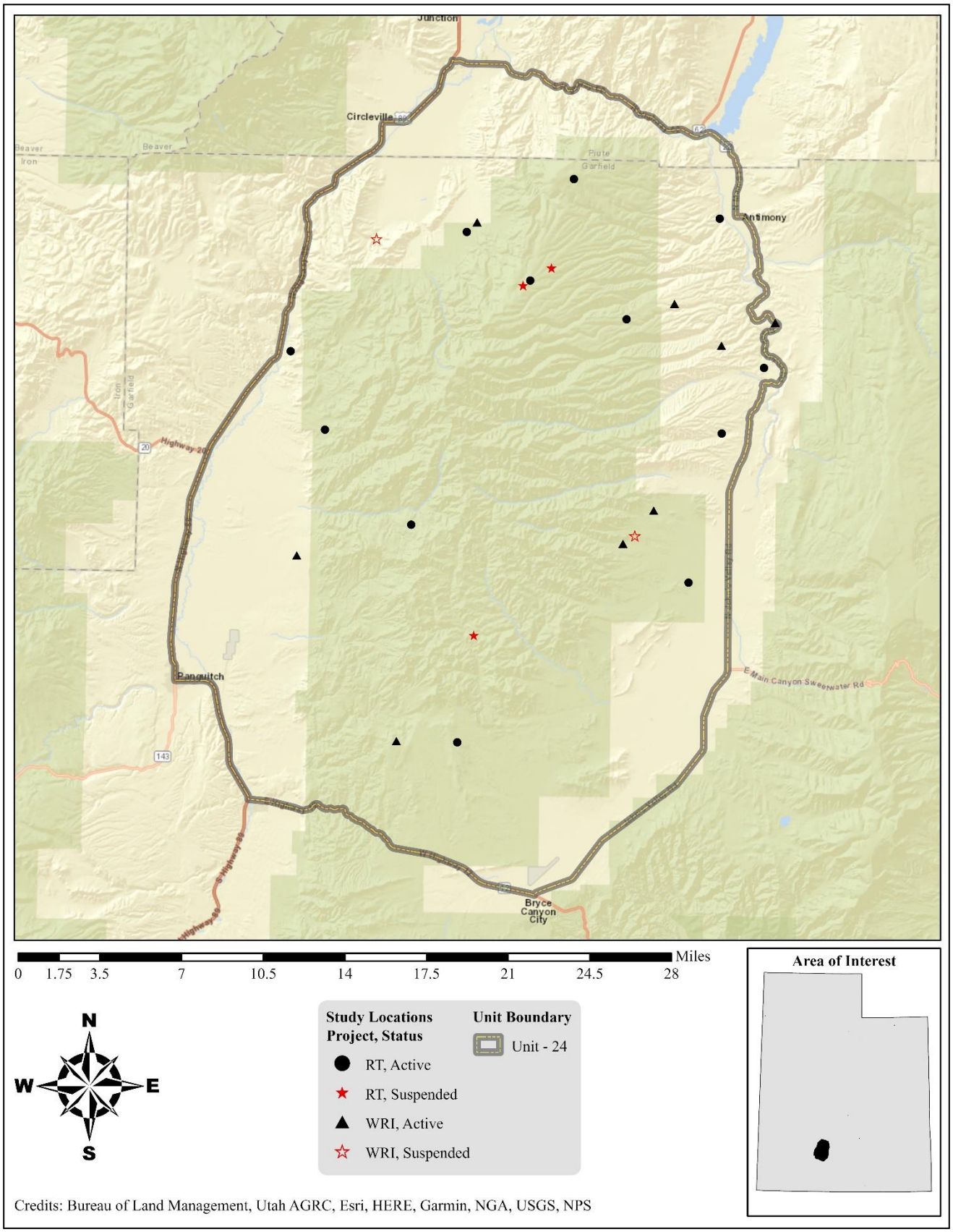
The Beaver management unit also experiences human presence through recreation and travel. A number of major roads are contained within or on the boundaries of this management unit including I-15, I-70, US-89, and SR-20, among others. According to data provided by the Utah Department of Transportation (UDOT), notable areas of vehicular travel occur on I-15 between Cove Fort and just north of Cedar City, where average annual daily traffic in 2019 was up to 27,000 vehicles per day depending on location. On SR-20 between I-15 and US-89, average annual daily traffic during the same year was 2,300 vehicles per day. Finally, US-89 between I-70 and SR-20 averaged less, but still significant traffic at up to 1,600 vehicles daily (Annual Average Daily Traffic, 2019). Utah Roadkill Reports reflect the high traffic densities on these roads. Roadkill pick-up reports from 2018 to 2024 appear to be concentrated along I-15 in intermittent stretches between Cove Fort and Cedar City; on SR-20; along a small stretch of SR-21 east of Minersville; and along unit boundaries on US-89 (Utah Division of Wildlife Resources, 2024). However, efforts have been made to mitigate highway mortality and migratory restrictions. More specifically, four wildlife crossings have been installed along I-15 and one on I-70. In addition, mesh wire exclusionary fencing has been constructed along sections of the same interstates. Furthermore, the 2020 deer management plan for this unit states that there will be continued cooperation with UDOT to install additional fencing, crossings, and/or signage when and where they are deemed necessary (Utah Division of Wildlife Resources, 2024).

In addition to well-traveled highways and roadways, the unit is also host to numerous trails open to bikes, hikers, horseback riding, and off-highway vehicles (OHVs): a vast majority of these are located on the Fishlake National Forest in the Tushar Mountains. OHV use in particular remains a popular form of recreation throughout the state of Utah: there were over 200,000 in-state registrations and over 23,000 out-of-state permits were issued between January and August of 2023 (Utah Division of Outdoor Recreation, 2023). Education on best practices required by state law and guidelines issued by federal land management agencies likely help mitigate some of the negative outcomes that might otherwise result from OHV recreation. However, deleterious effects on wildlife and wildlife habitat are always a possibility. Threat levels vary between and do not affect all locations equally, but auditory

disturbances to wildlife, physical damage to habitat, and the introduction of non-native plant species can all result from improperly managed OHV recreation.

There are some recommendations for improving big game habitat within the Beaver management unit. A considerable portion of this unit has already been treated for tree encroachment. Over 120,000 acres have been bullhogged, chained, or treated by hand crews (**Table 1.2**), and these treatments have generally been effective. 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. Habitat projects in general should also continue to help restore and maintain historic and current sagebrush stands. When these projects do take place, 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. This unit should also continue to be proactively monitored for annual grasses and appropriate action (herbicide application, changes in grazing management, etc.) taken if flushes of annual grass occur in the future. If reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native species whenever possible. Finally, both Range Trend studies and areas where rehabilitation projects have occurred should continue to be monitored. Data collected in the future will indicate whether the severity of current limiting factors is increasing, and may provide guidance on what actions are needed to mitigate these identified potential threats to habitat and wildlife.

2. WILDLIFE MANAGEMENT UNIT 24 – MT. DUTTON



WILDLIFE MANAGEMENT UNIT 24 – MT. DUTTON

Boundary Description

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

Management Unit Description

Geography

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

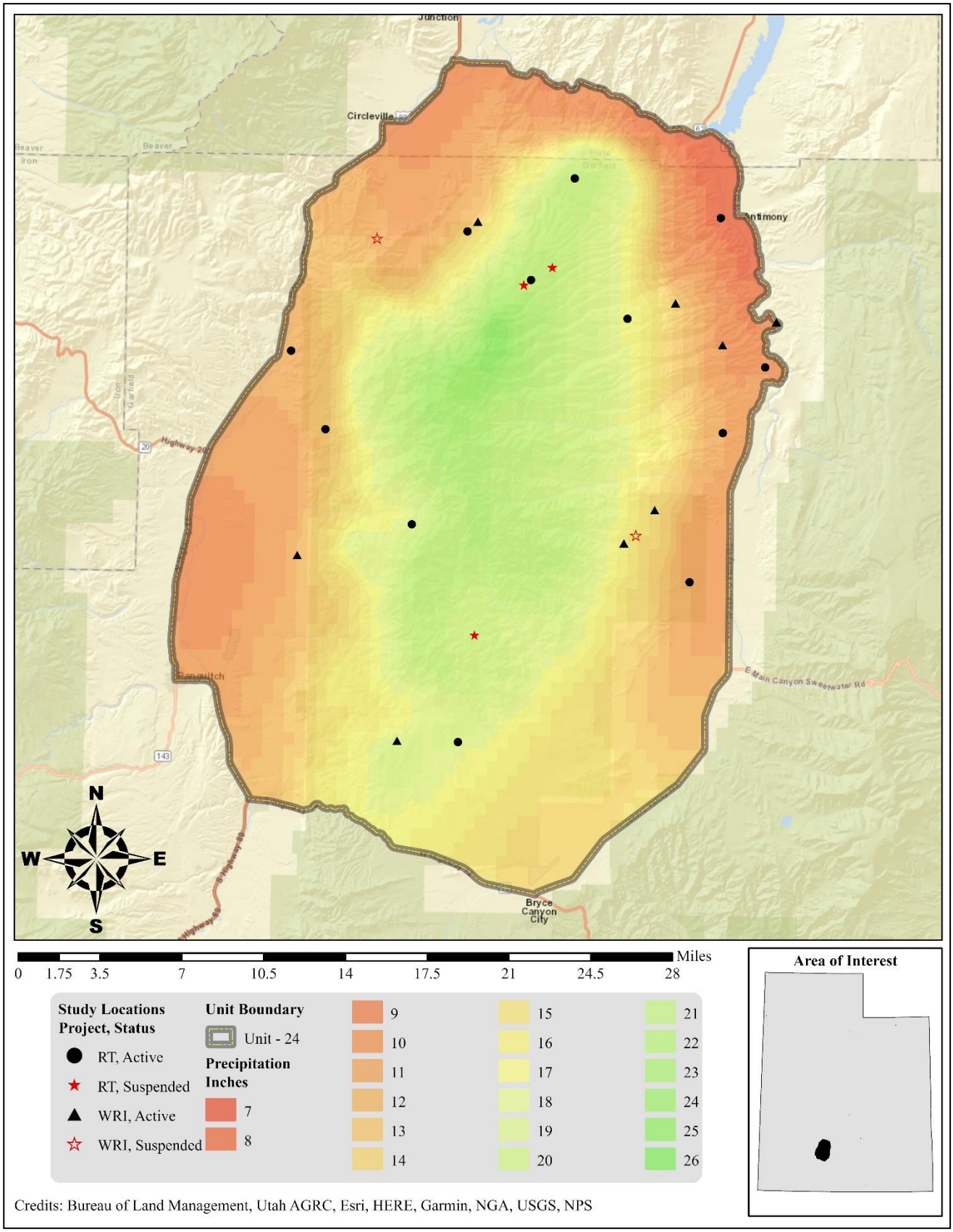
The east side of Mt. Dutton is comprised of many drainages that empty into the East Fork of the Sevier River. The major tributaries are Hoodle Creek, Forest Creek, Pine Creek, Deer Creek, Cow Creek, Cottonwood Creek, Rock Creek, North Fork Prospect Creek, and South Fork Prospect Creek. Drainages on the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

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 7 inches in the far northeast portion of the unit near Antimony to 26 inches on the peaks of Mt. Dutton. All of the active Range Trend and WRI monitoring studies on the unit occur within 7-22 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 South Central Division (Division 4).

The mean annual PDSI of the South Central Division has displayed some form of drought most years since 1993. Moreover, this climate division has been considered to be in some form of drought nearly 68% of the time since 1993. Of the drought years, nearly 43% are considered to be either moderate or extreme droughts. Also remarkable about this climate division is that drought is experienced over multiple years and is generally interrupted by a single wet year event; the most notable wet years occur in 2005 and 2011, which were both considered moderately wet years (**Figure 2.1a**). The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI (**Figure 2.1b**). These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September and May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 2.1b**). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 2.3**). Years that were moderately wet occur in 1999 and 2023, but years where drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 2.1a, Figure 2.1b**) (Time Series Data, 2024).



Map 2.1: The 1991-2020 PRISM Precipitation Model for WMU 24, Mt. Dutton (PRISM Climate Group, Oregon State University, 2021).

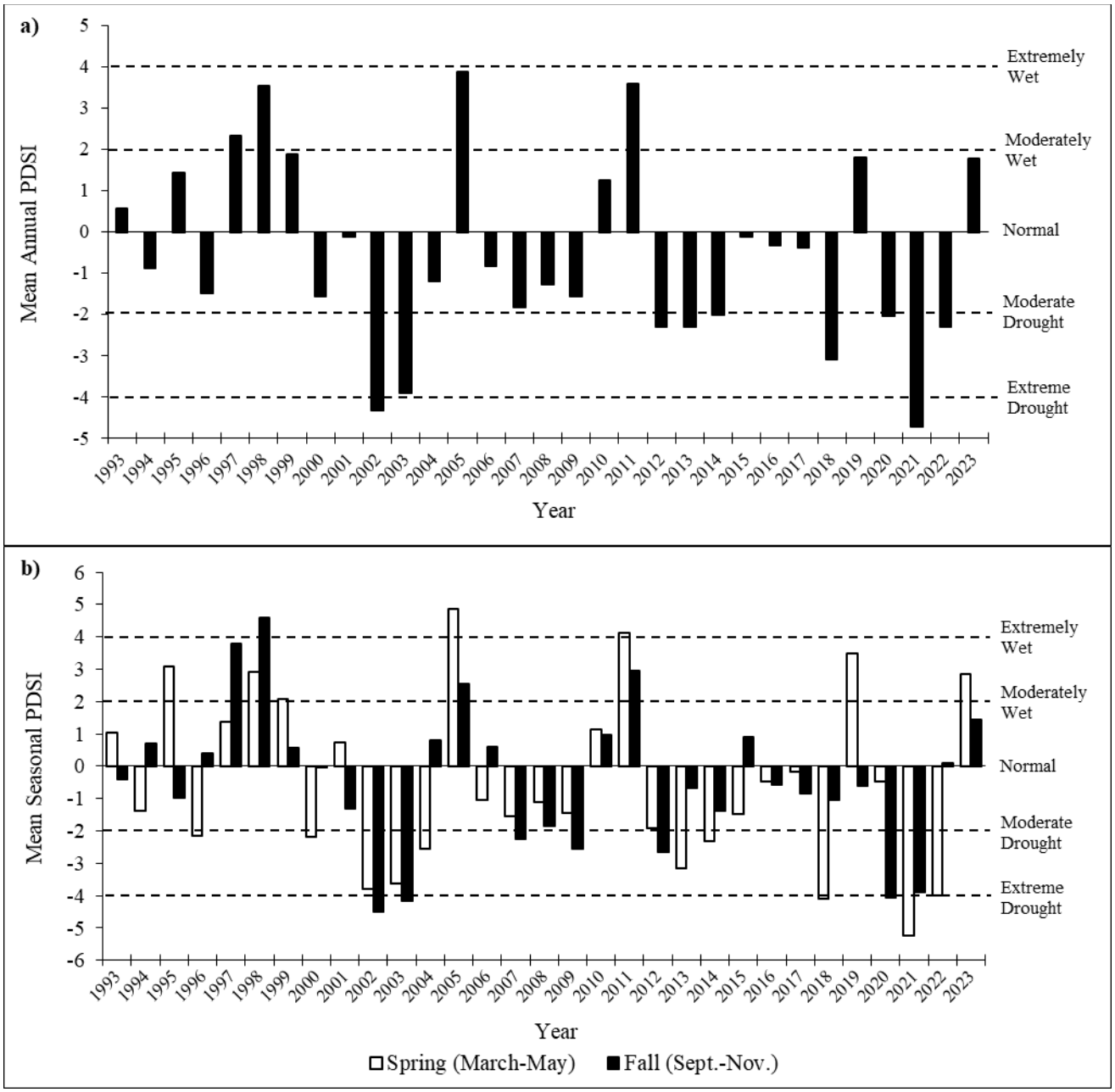


Figure 2.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

The wildlife unit encompasses Mt. Dutton with its surrounding foothills and valleys. Mt. Dutton is typical of the mesic, high mountain plateaus of southern Utah. Deer summer range is centrally located within the unit, while much of the winter range surrounds the high mountain plateaus of Mt. Dutton and Table Mountain (**Map 2.2**). Much of the elk range is considered year-long and centrally located on the plateaus and benches of Mt. Dutton and Table Mountain, while elk winter range is restricted to the higher benches and foothills on the eastern portion of the unit. Furthermore, a substantial part of the elk summer range is limited to the high-elevation aspen (*Populus tremuloides*) and mixed conifer communities. This summer range extends from Table Mountain in the north to the southern end of the unit, encompassing the ponderosa (*Pinus ponderosa*) parks along the upper tributaries of Casto Canyon, Losee Canyon, and Red Canyon (**Map 2.3**).

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

The RAP data illustrates fluctuations in herbaceous cover and biomass on mule deer winter, summer, and year-long range. Years showing the highest values for biomass and cover vary between ranges of different seasonality, but peaks have generally occurred in early to mid-1990s, the mid-2000s, early 2010s, and late 2010s/early 2020s. Annual and perennial cover and biomass have followed precipitation trends in many years, although lag effects of a year or so have occurred at other times (**Figure 2.2**, **Figure 2.3**, **Figure 2.4**, **Figure 2.5**, **Figure 2.6**, **Figure 2.7**).

The RAP data for tree and shrub cover shows fluctuations from year to year, but values have remained similar overall. Values for both correlate with precipitation in some years, but more loosely so than herbaceous cover and biomass. On mule deer summer habitat, RAP data shows that tree and shrub cover have slightly decreased overall when comparing 1986 data with that from 2023. Shrub cover has marginally decreased on winter range over the same period while tree cover has increased. On year-long range, values for both have exhibited an overall increase (**Figure 2.8**, **Figure 2.9**, **Figure 2.10**). Range Trend data displays general increases in shrub cover since 2003. Tree cover has only been sampled on studies with an upland potential and has decreased overall (**Figure 2.11**, **Figure 2.12**). It is important to note that variations in cover on Range Trend sites will not always correspond with the fluctuations 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; Range Trend sites are often associated with targeted vegetation treatments (e.g. pinyon-juniper removal).

RAP – Herbaceous Biomass by Deer Habitat

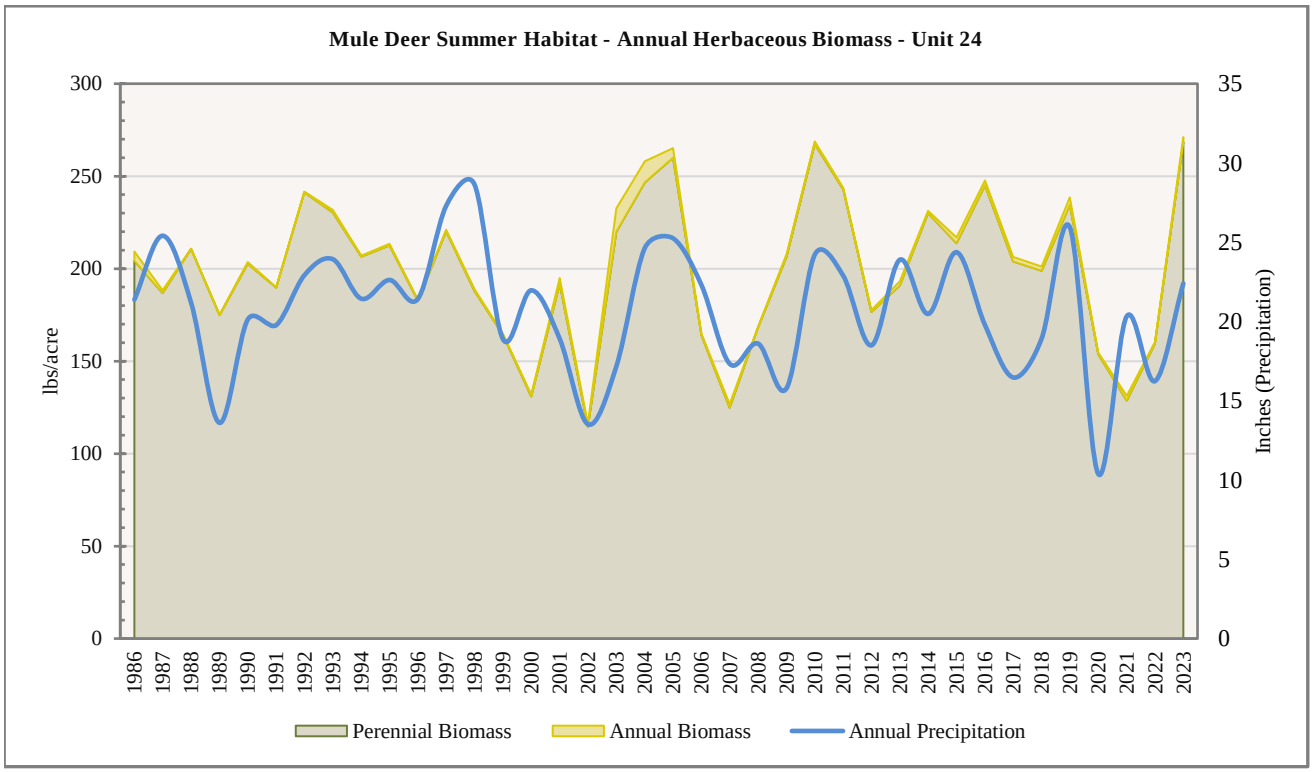


Figure 2.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).

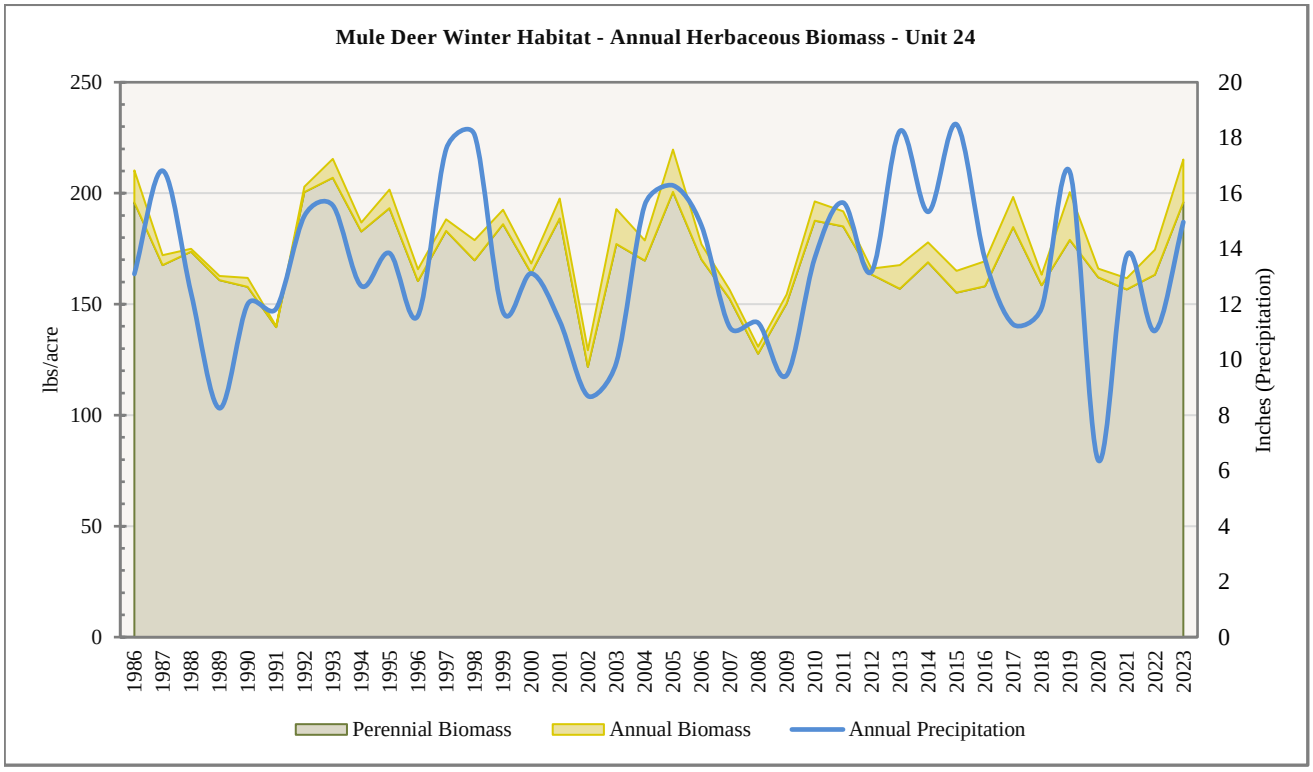


Figure 2.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).

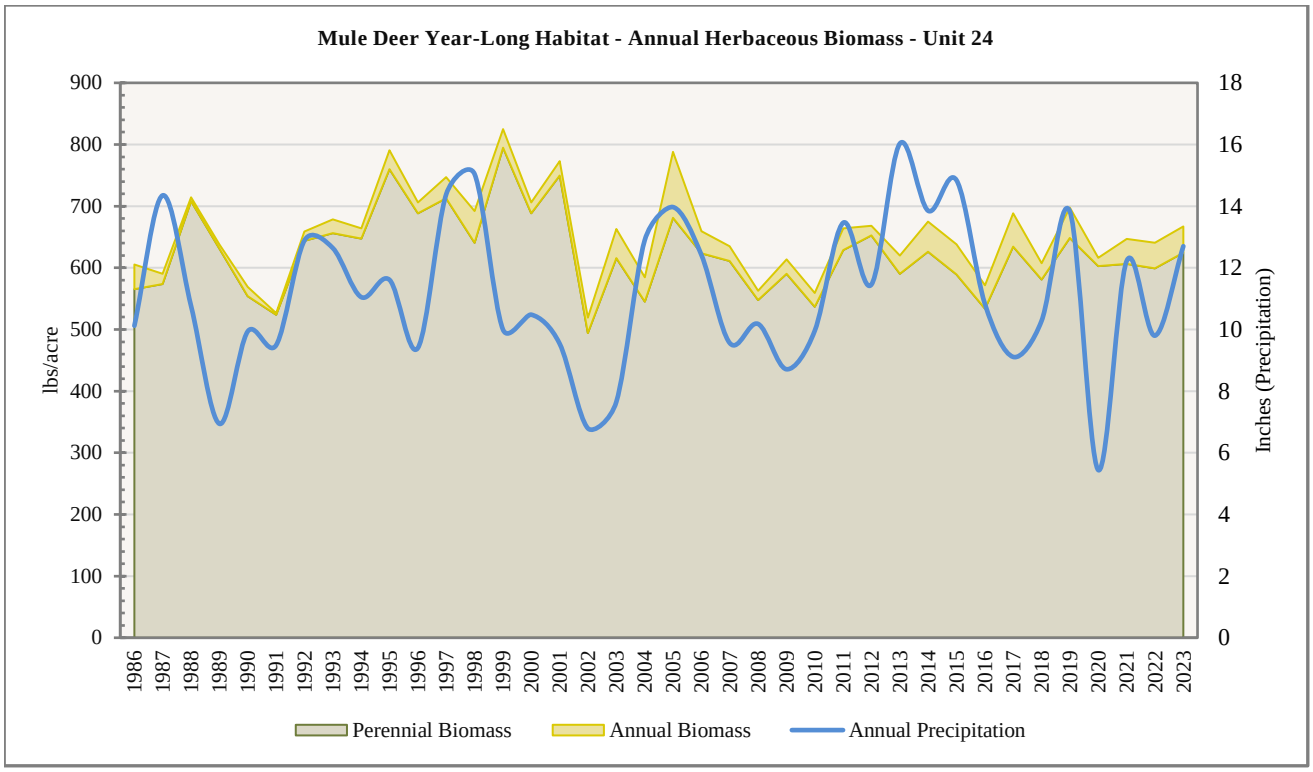


Figure 2.4: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

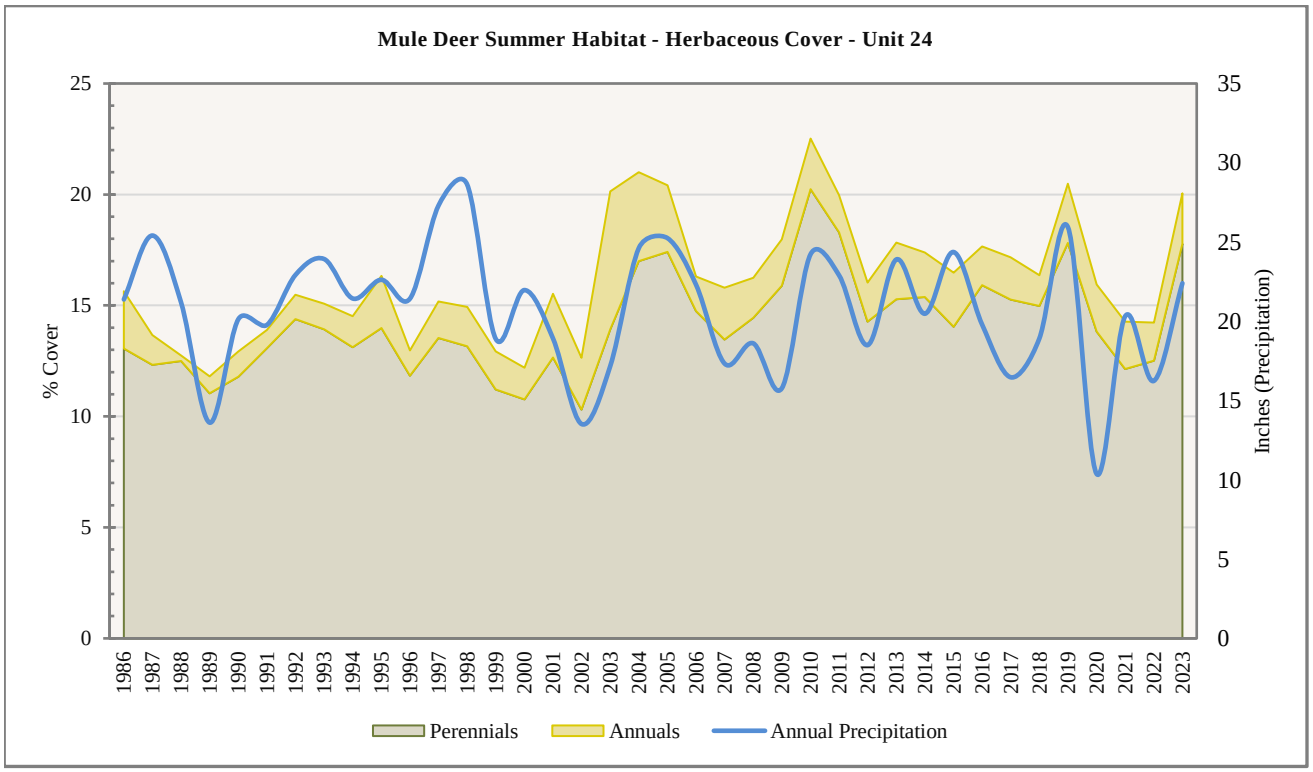


Figure 2.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2023).

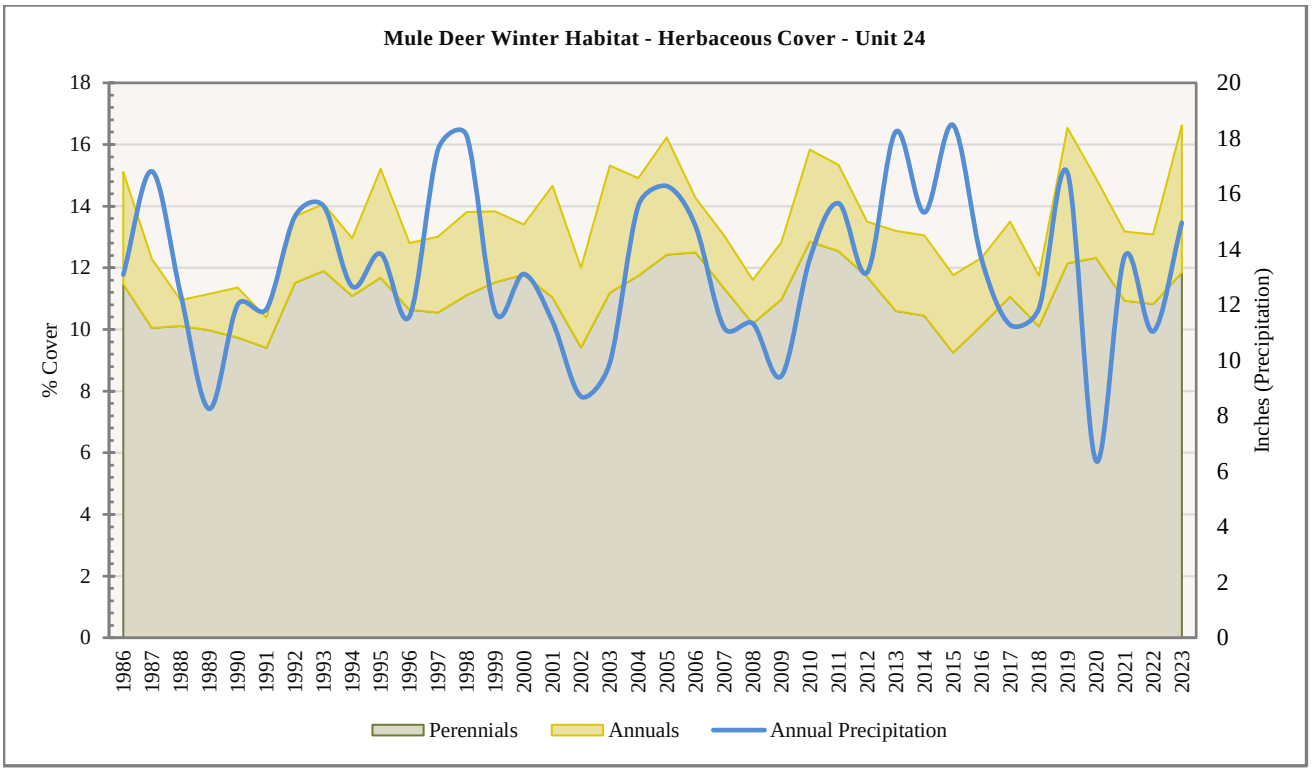


Figure 2.6: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).

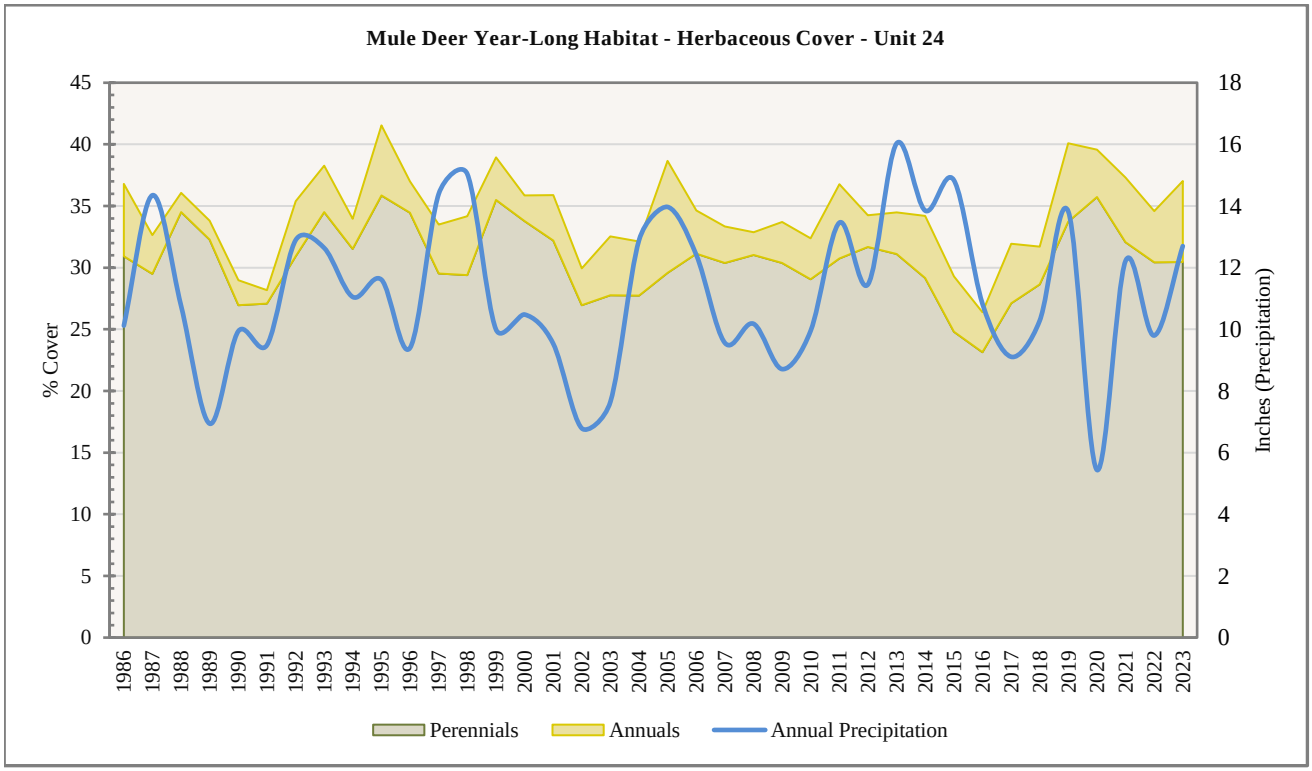


Figure 2.7: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

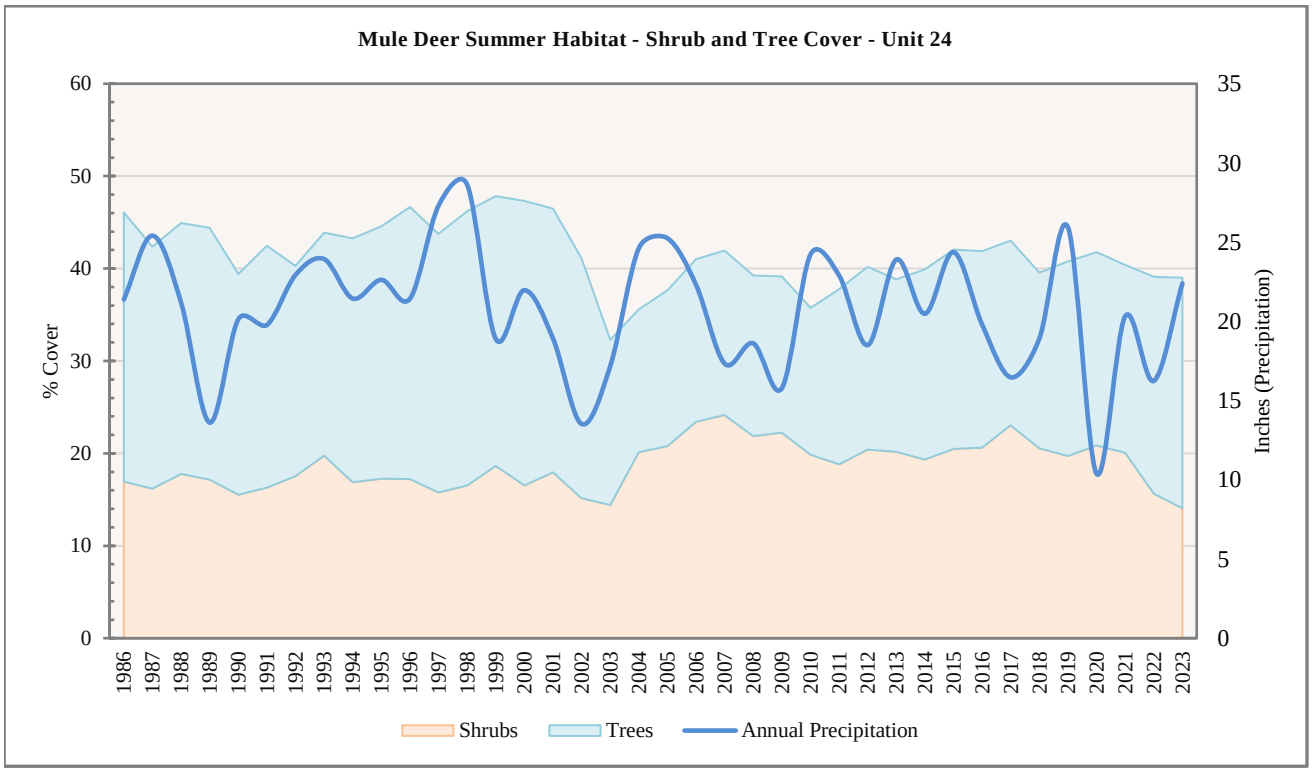


Figure 2.8: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).

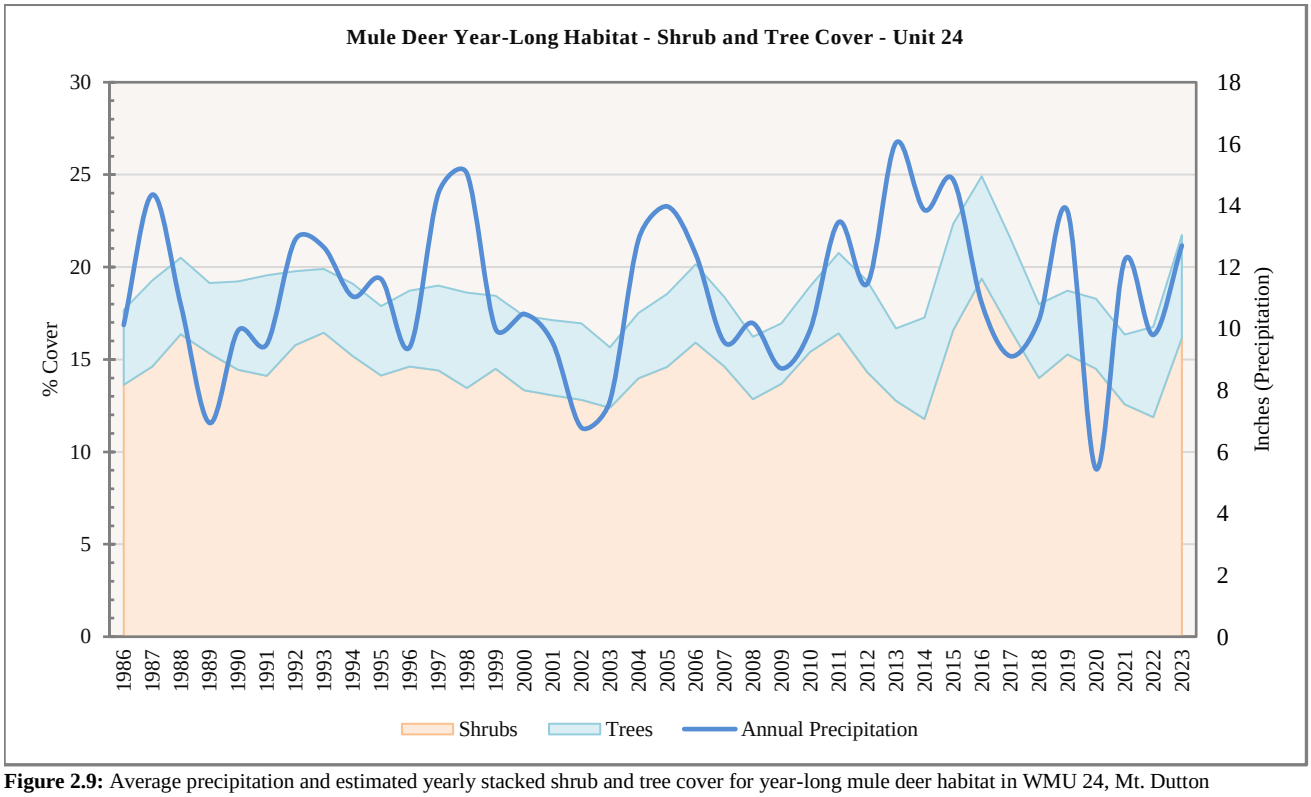


Figure 2.9: Average precipitation and estimated yearly stacked shrub and tree cover for year-long mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).

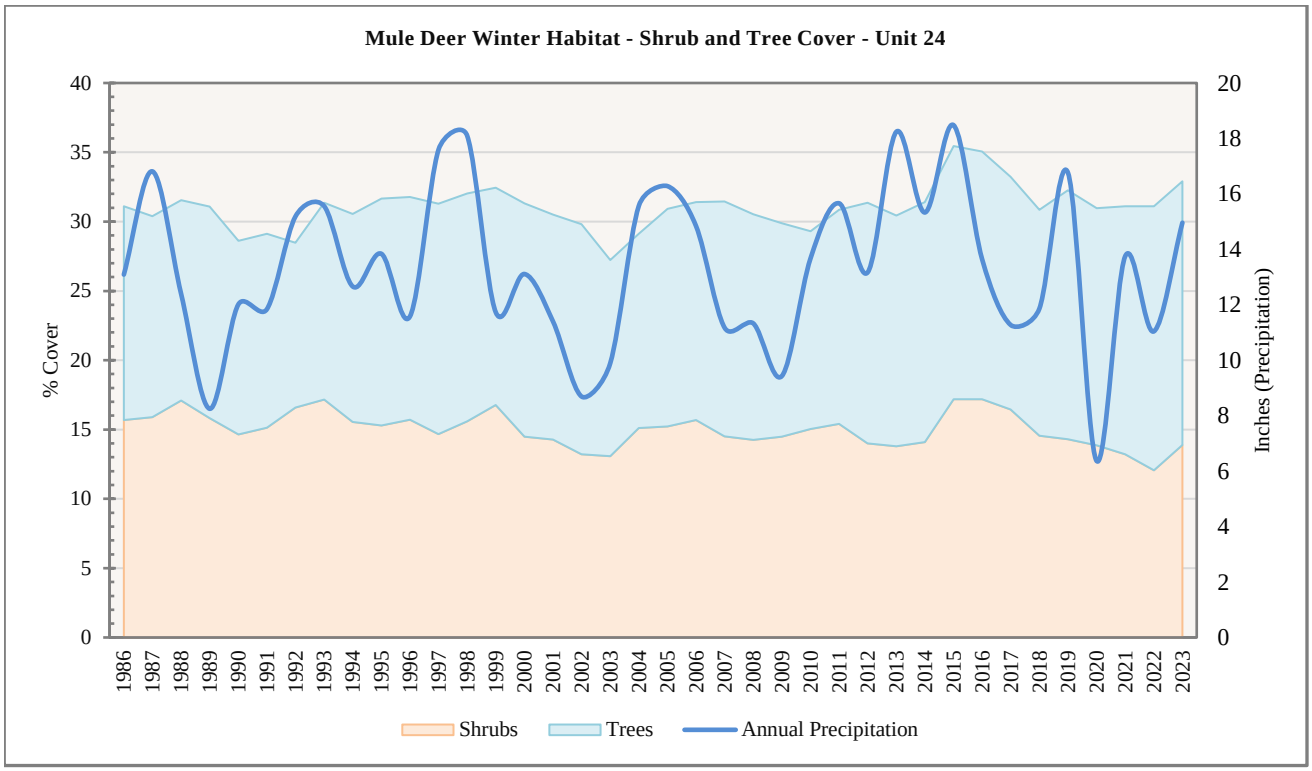
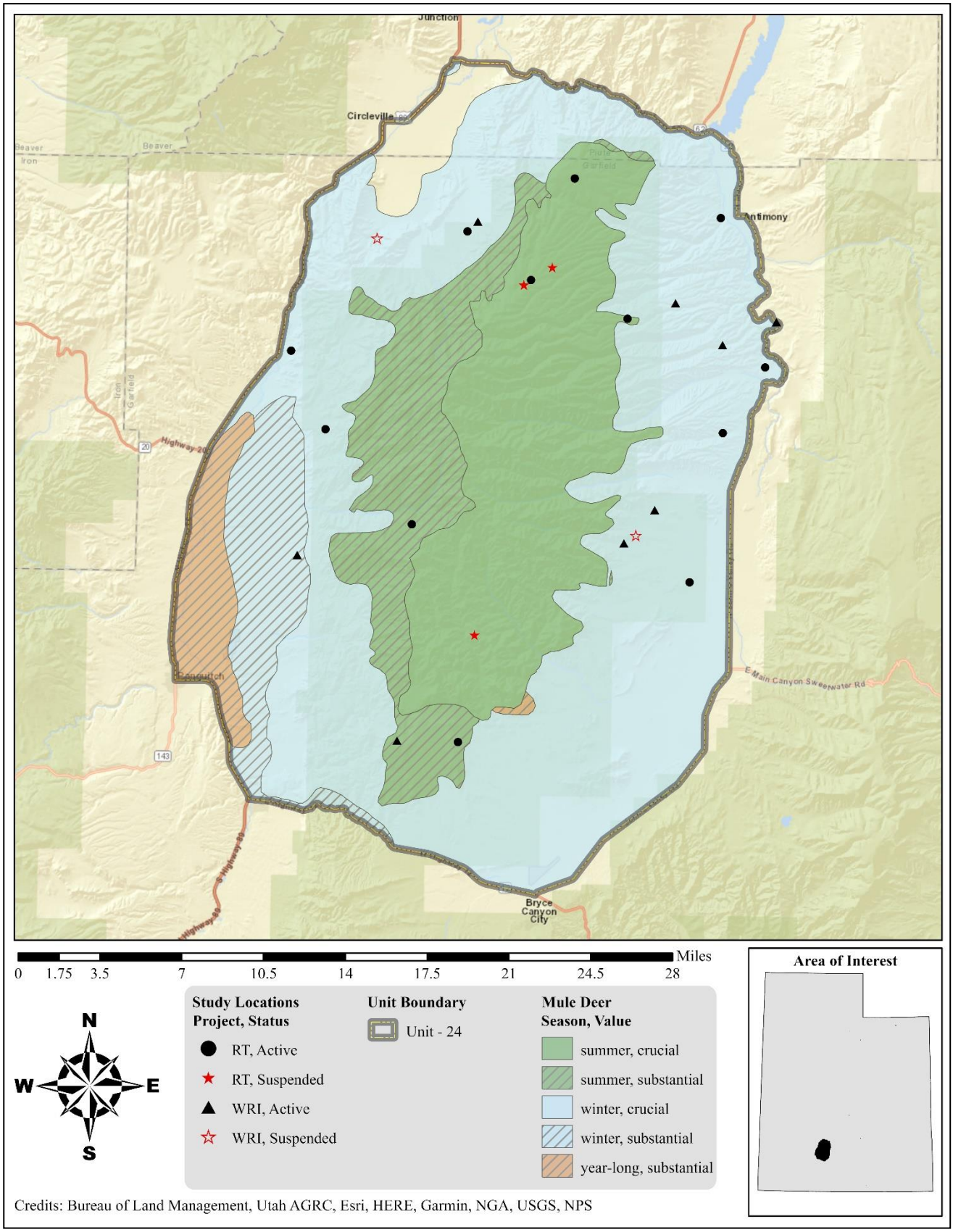
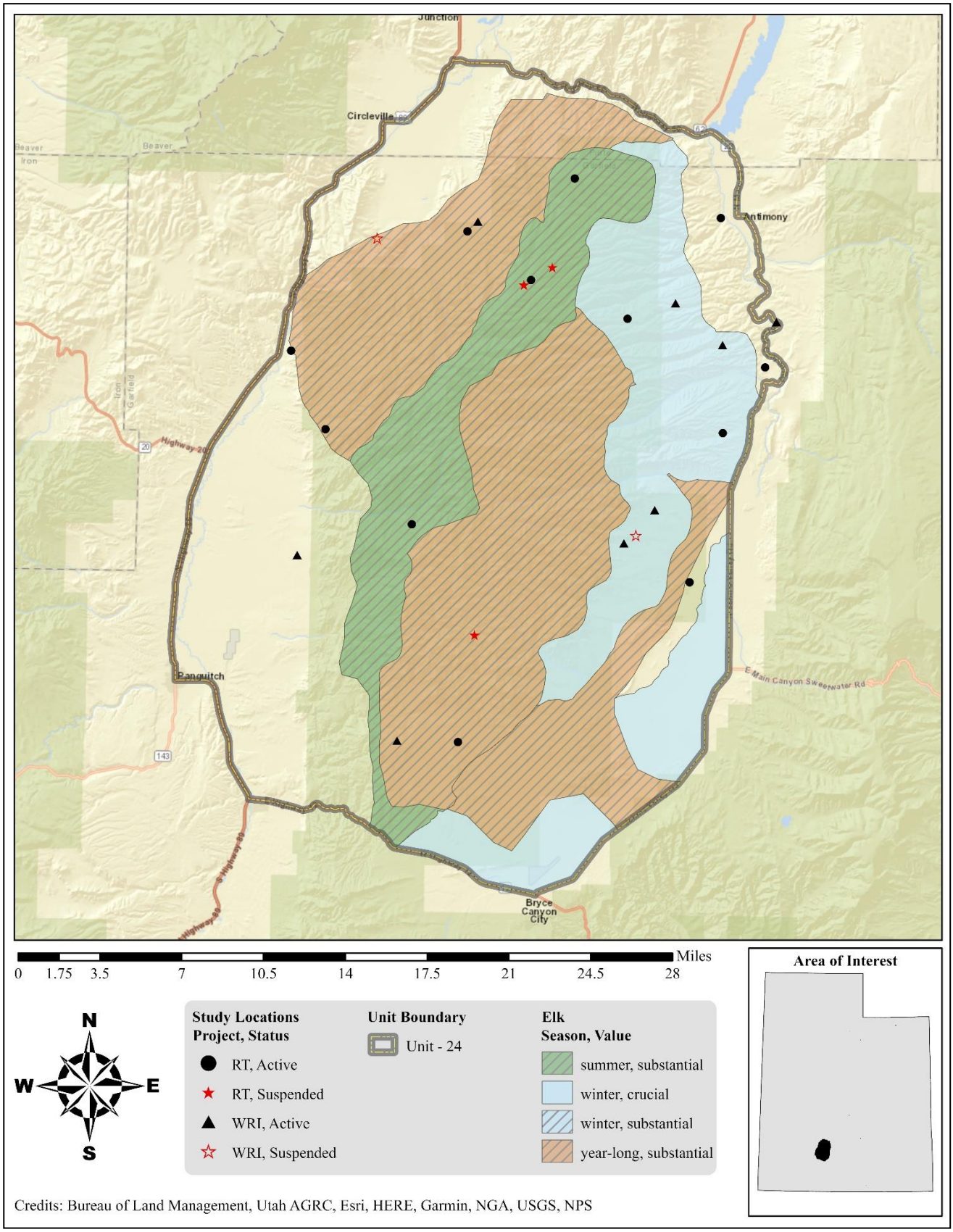


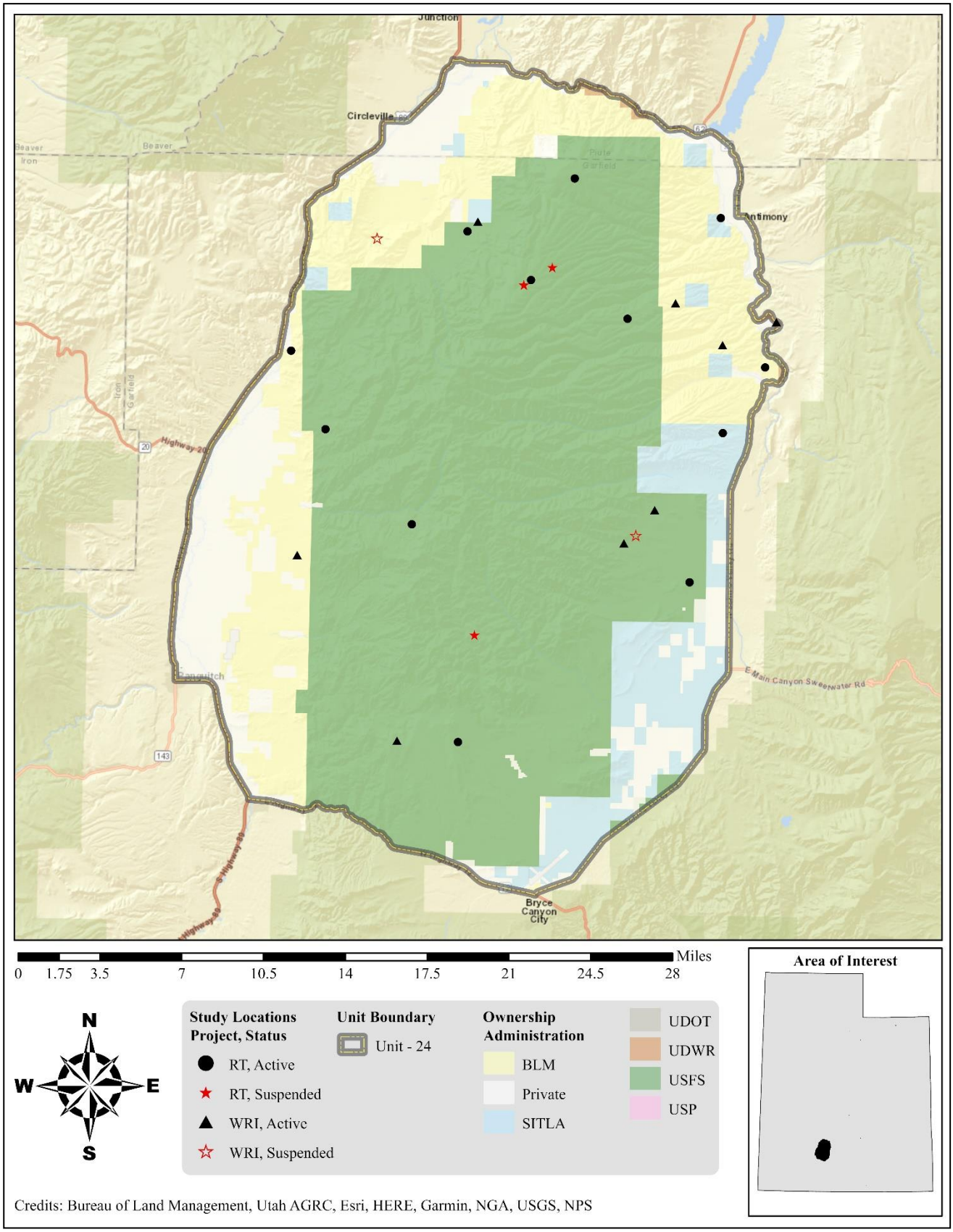
Figure 2.10: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 24, Mt. Dutton (Rangeland Analysis Platform, 2024).



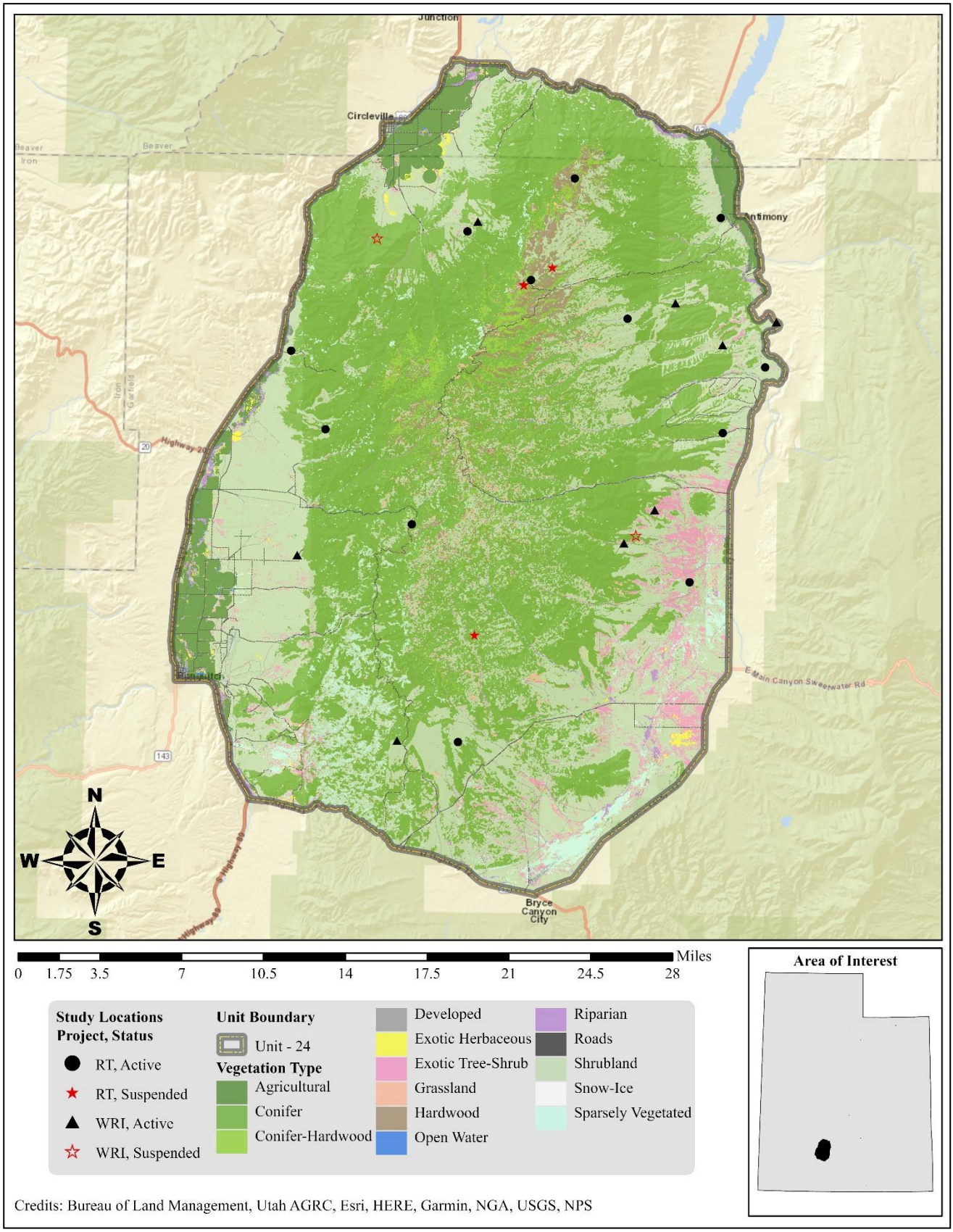
Map 2.2: Estimated mule deer habitat by season and value for WMU 24, Mt. Dutton.



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



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



Map 2.5: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 24, Mt. Dutton.

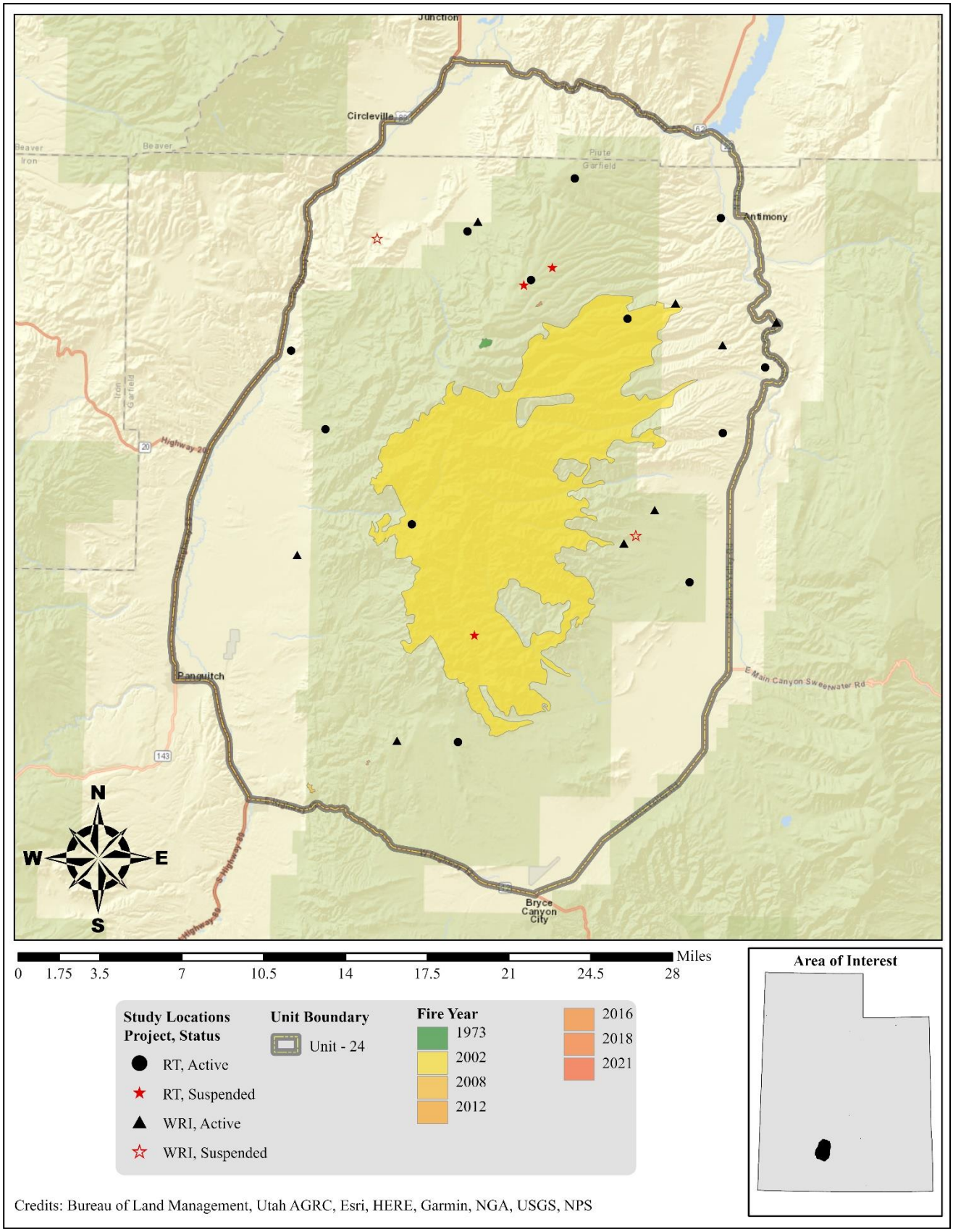
LANDFIRE Existing Vegetation Types on Mule Deer Habitat

The current LANDFIRE Existing Vegetation Type model shows that just over 33% of mule deer habitat in the Mt. Dutton management unit is comprised of biophysical sites that are dominated by pinyon-juniper woodlands (**Table 2.1**). These woodlands are often located in lower elevations and may be associated with understory browse species known to be beneficial to mule deer, although abundance may vary widely. When pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) encroach on existing shrublands, they have been shown to lead to decreased sagebrush (*Artemisia spp.*) and herbaceous components (Miller, Svejcar, & Rose, 2000), thereby decreasing available forage for wildlife.

According to the model, montane sagebrush steppe biophysical sites make up 13% of the unit's mule deer habitat (**Table 2.1**) and are typically found at higher elevations. Although sagebrush dominates these biophysical sites, other preferred browse species may be present in lesser amounts. In addition, sites of this type typically have abundant understories that could valuable forage for mule deer during the summer months. These biophysical sagebrush sites can be negatively impacted by conifer encroachment, insect infestation, drought, winterkill, and herbivory, among others. An additional biophysical type of interest includes big sagebrush shrubland, which makes up just over 7% of the unit's mule deer habitat (**Table 2.1**). These sites are found at lower to middle elevations, are dominated by Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*), and may have juniper and pinyon present. A number of other vegetation types comprise the rest of the mule deer habitat within the Mt. Dutton management unit (**Table 2.1**), but will not be discussed here. Descriptions for these additional vegetation types can be found on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	137,579	33.47%	
	Southern Rocky Mountain Ponderosa Pine Woodland	19,295	4.69%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	14,199	3.45%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	12,522	3.05%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	8,395	2.04%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	7,240	1.76%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	5,326	1.30%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	2,580	0.63%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	350	0.09%	50.47%
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	54,158	13.18%	
	Inter-Mountain Basins Big Sagebrush Shrubland	29,662	7.22%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	25,552	6.22%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	18,501	4.50%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	10,082	2.45%	
	Rocky Mountain Lower Montane-Foothill Shrubland	609	0.15%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	606	0.15%	
	Rocky Mountain Alpine Dwarf-Shrubland	4	0.00%	33.86%
Other	Sparsely Vegetated	13,005	3.16%	
	Agricultural	12,026	2.93%	
	Developed	7,903	1.92%	
	Riparian	3,728	0.91%	
	Open Water	73	0.02%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	27	0.01%	
	Snow-Ice	4	0.00%	8.94%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	13,085	3.18%	
	Interior Western North American Temperate Ruderal Shrubland	266	0.06%	3.25%
Hardwood	Rocky Mountain Aspen Forest and Woodland	9,743	2.37%	
	Rocky Mountain Bigtooth Maple Ravine Woodland	32	0.01%	2.38%
Grassland	Southern Rocky Mountain Montane-Subalpine Grassland	1,782	0.43%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	1,112	0.27%	
	Inter-Mountain Basins Semi-Desert Grassland	232	0.06%	
	Rocky Mountain Alpine Turf	10	0.00%	0.76%
Exotic Herbaceous	Introduced Perennial Grassland and Forbland	1,061	0.26%	
	Interior Western North American Temperate Ruderal Grassland	216	0.05%	
	Great Basin & Intermountain Introduced Annual Grassland	52	0.01%	
	Introduced Annual and Biennial Forbland	50	0.01%	0.34%
Total		**411,064**	**100%**	**100%**

Table 2.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 24, Mt. Dutton.



Map 2.6: Land coverage of fires by year from 1973-2021 for WMU 24, Mt. Dutton (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

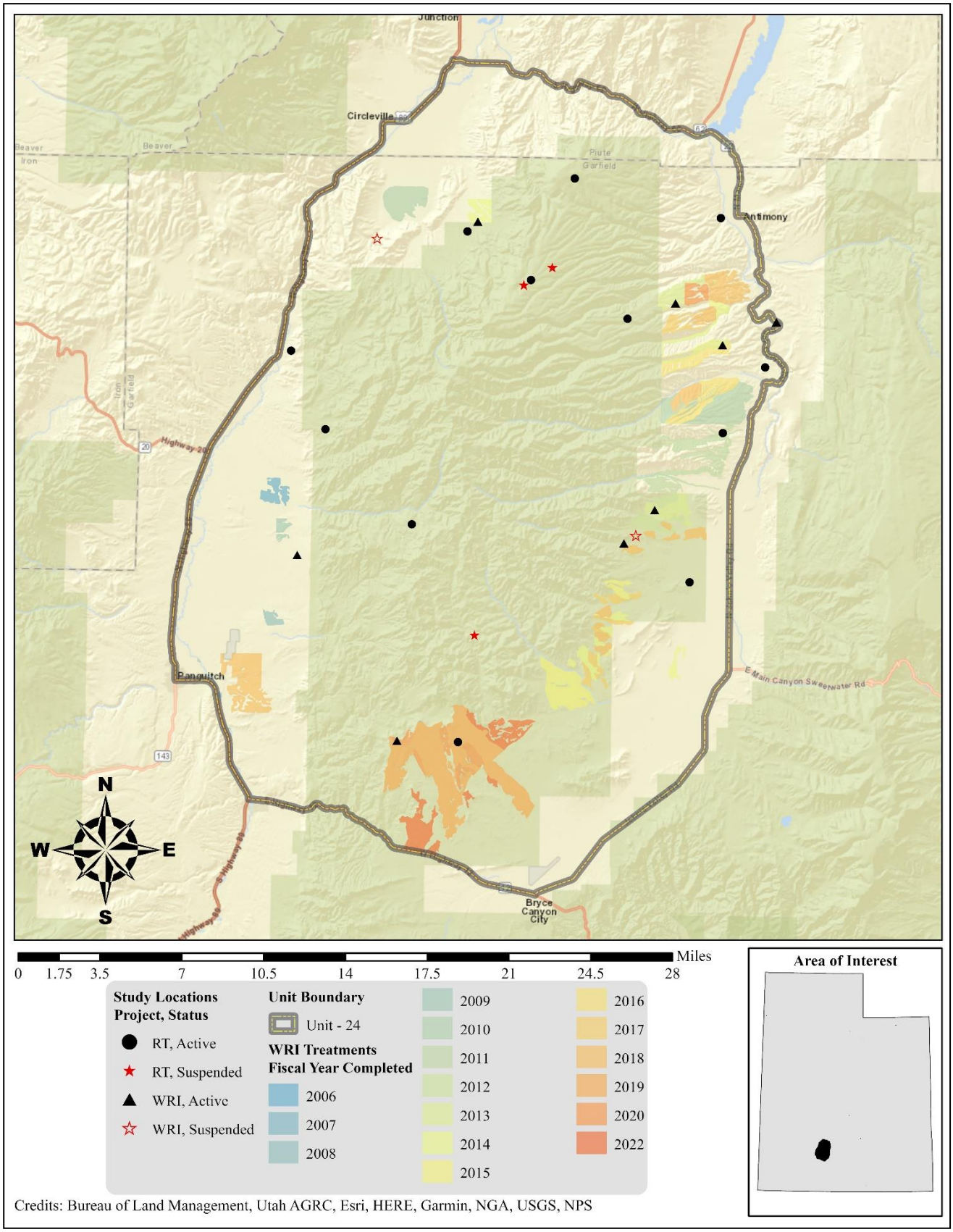
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 34,960 acres of land have been treated within the Mt. Dutton unit since the WRI was implemented in 2004 (**Map 2.7**) Treatments frequently overlap one another bringing the net total of completed treatment acres to 31,392 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.

The most common management practice in this unit is vegetation removal by hand (using methods such as lop and scatter) to remove pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) trees. Additional techniques to remove pinyon and juniper such as anchor chaining and bullhog treatments are also very common. Other management practices including (but not limited to) seeding species to augment the herbaceous understory, harrowing, mowing, and chain harrowing are all used across the unit (**Table 2.2**).

Type	Total Completed Acreage
Anchor Chain	**6,258**
Ely (One-Way)	596
Ely (Two-Way)	5,662
Bullhog	**7,144**
Full Size	5,880
Skid Steer	1,264
Chain Harrow	**991**
≤ 15 ft. (One-Way)	991
Disc	**193**
Plow (One-Way)	193
Harrow	**1,424**
≤ 15 ft. (One-Way)	732
> 15 ft. (One-Way)	692
Mowing	**24**
Other	24
Prescribed Fire	**586**
Prescribed Fire	586
Seeding (Primary)	**4,087**
Broadcast (Aerial-Fixed Wing)	126
Drill (Rangeland)	63
Ground (Mechanical Application)	3,898
Vegetation Removal/Hand Crew	**14,253**
Lop & Scatter	14,102
Lop-Pile-Burn	150
Other	**<1**
Road Decommissioning	<1
Grand Total	**34,960**
***Total Land Area Treated**	**31,392**

Table 2.2: WRI treatment action size (acres) of completed projects for WMU 24, Mt. Dutton. Data accessed on 02/07/2024. *Does not include overlapping treatments.



Map 2.7: Terrestrial WRI treatments by fiscal year completed for WMU 24, Mt. Dutton.

Range Trend Studies

Range Trend studies have been sampled within WMU 24 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (**Table 2.3**). 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
24-1	North Pole Canyon	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
24-2	Deer Creek Bench	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Semidesert Loam (Black Sagebrush)
24-3	North Bull Rush	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
24-4	Mud Spring Chaining	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
24-5	Suicide	RT	Suspended	1987, 1991, 1992, 1997	High Mountain Loam (Mountain Big Sagebrush)
24-6	Table Mountain	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	High Mountain Loam (Mountain Big Sagebrush)
24-7	Cow Creek	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
24-8	Prospect Seeding	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
24-9	Mud Spring	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Upland Gravelly Loam (Black Sagebrush)
24-10	Barnhurst Ridge	RT	Suspended	1987, 1991, 1997	Upland Stony Loam (Mountain Big Sagebrush)
24-12	Marshall Basin	RT	Active	1987, 1991, 1997, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
24-13	Jones Corral	RT	Active	2003, 2008, 2013, 2018, 2023	High Mountain Loam (Mountain Big Sagebrush)
24-14	Pine Canyon	RT	Active	2013, 2018, 2023	Mountain Windswept Ridge (Black Sagebrush)
24R-1	Sanford	RT	Active	1998, 2003, 2008, 2013, 2018, 2023	High Mountain Loam (Aspen)
24R-2	Jones Corral Cattle Exc.	RT	Suspended	1998	High Mountain Loam (Aspen)
24R-3	Jones Corral Outside	RT	Suspended	1998	High Mountain Loam (Aspen)
24R-4	Jones Corral Wildlife Exc.	RT	Suspended	1998	High Mountain Loam (Aspen)
24R-5	Jones Corral Total Exc.	RT	Suspended	1998	High Mountain Loam (Aspen)
24R-6	Panguitch East Bench Harrow	WRI	Active	2004, 2007, 2012, 2016, 2020	Semidesert Loam (Wyoming Big Sagebrush)
24R-7	Horse Valley Burn	WRI	Suspended	2005	Not Verified
24R-8	Johns Valley	WRI	Active	2011, 2015, 2019	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
24R-9	Johns Valley 2	WRI	Active	2012, 2015, 2019	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
24R-10	Antimony Lop and Scatter	WRI	Active	2012, 2015, 2019	Upland Stony Loam (Mountain Big Sagebrush)
24R-11	Antimony PJ Reduction	WRI	Active	2012, 2015, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
24R-12	Johns Valley 3	WRI	Suspended	2013	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
24R-13	Circleville	WRI	Active	2013, 2016, 2022	Upland Stony Loam (Mountain Big Sagebrush)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
24R-14	Black Canyon WMA	WRI	Active	2016, 2019	Upland - Interzonal Loamy Bottom (Basin Wildrye)
24R-15	Horse Bench	WRI	Active	2019, 2022	Mountain Gravelly Loam (Ponderosa Pine)

Table 2.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 24, Mt. Dutton.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
24-4	Mud Spring	Chain Unknown		Historic		
	Chaining	Seed Unknown		Historic		
		Lop and Scatter		Between 2003 and 2008		
24-6	Table Mountain	Prescribed Fire		Prior to 1987		
24-7	Cow Creek	Disk Unknown		Prior to 1987		
		Rangeland Drill		Prior to 1987		
		Lop and Scatter	Cow and Cottonwood Creek Lop and Scatter	November 2011	2,100	1794
24-8	Prospect Seeding	Disc Unknown		1968		
		Seed Unknown		1968		
24-9	Mud Spring	One-Way Dixie	Sevier Plateau Dixie Harrow	Fall 2006	500	461
		Seed Unknown	Sevier Plateau Dixie Harrow	Fall 2006	500	461
		Hand Crew	Powell - Mud Springs Phase I	May-July 2019	7,161	4635
24-12	Marshall Basin	Chain Unknown		Fall 1984	900	
		Seed Unknown		Fall 1984	900	
		Wildfire		1996		
24-14	Pine Canyon	Prescribed Fire	Sanford	2002	60,740	
24R-1	Sanford	Wildfire	Sanford	April-July 2002	60,740	
24R-2	Jones Corral Cattle Exc.	Wildfire		Mid 1990s		
24R-3	Jones Corral Outside	Wildfire		Mid 1990s		
24R-4	Jones Corral Wildlife Exc.	Wildfire		Mid 1990s		
24R-5	Jones Corral Total Exc.	Wildfire		Mid 1990s		
24R-6	Panguitch East Bench Harrow	One-Way Dixie	Panguitch East Bench	October 2004	300	PDB
		Broadcast Before	Panguitch East Bench	October 2004	300	PDB
		Aerial After	Panguitch East Bench	December 2004	300	PDB
24R-8	Johns Valley	Bullhog	2012 John's Valley Sage-Steppe Restoration	January-July 2013	1,236	2055
		Chain Unknown		Historic	7,685	
		Seed Unknown		Historic	7,685	
24R-9	Johns Valley 2	Chain Unknown		Historic	7,685	
		Seed Unknown		Historic	7,685	
		Bullhog		2012		
24R-10	Antimony Lop and Scatter	Lop and Scatter	Antimony Fuels Reduction and Habitat Improvement FY14	November 2014-February 2015	587	2597
		Prescribed Fire	Antimony Fuels Reduction and Habitat Improvement FY14	November 2014-February 2015	736	2597
24R-11	Antimony PJ Reduction	Bullhog	Antimony PJ Reduction and Riparian Improvement (Phase V)	Fall 2012	1,005	2239
		Aerial Before	Antimony PJ Reduction and Riparian Improvement (Phase V)	Fall 2012	1,005	2239
24R-13	Circleville	Dribbler Before	Circleville Vegetation Enhancement	October 2013	459	2706
		Aerial After	Circleville Vegetation Enhancement	February 2014	459	2706
		Two-Way Ely	Circleville Vegetation Enhancement	October 2013	459	2706
		Aerial Before	Circleville Vegetation Enhancement	October 2013	459	2706
24R-14	Black Canyon WMA	Unknown		Historic		
		Tordon	Black Canyon WMA Rabbitbrush Removal Phase 2	October-November 2016	24	3069
		Mower	Black Canyon WMA Rabbitbrush Removal Phase 2	October-November 2016	24	3069
24R-15	Horse Bench	Bullhog	Powell District Mud Springs phase II	August-October 2019	895	4993

Table 2.4: Range Trend and WRI studies known disturbance history for WMU 24, Mt. Dutton. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Ecotypes represented by only one study site throughout most or all of the sample period are not discussed in this section. These ecotypes include:

- Mountain (Aspen) - Sanford (24R-01) and Jones Corral Outside (24R-03) (suspended)
- Mountain (Black/Low Sagebrush) - Pine Canyon (24-14)
- Upland (Black/Low Sagebrush) - Mud Spring (24-09)
- Semidesert (Black/Low Sagebrush) - Deer Creek Bench (24-02)

Trend summaries and/or data for these ecotypes are available in the corresponding site reports.

Mountain (Big Sagebrush)

There are three studies [Suicide (24-05) (suspended), Table Mountain (24-06), and Jones Corral (24-13)] that are classified as Mountain (Big Sagebrush) ecological sites. The Suicide study can be found south of Table Mountain and roughly a mile northeast of the Jones Corral site. The Table Mountain site is located south of Kingston Canyon on Table Mountain. The Jones Corral site is situated south of Table Mountain up the Jones Corral Draw.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, data for the 1992 year was solely contributed by the Suicide study, while the 1997 data was provided by both the Suicide and Table Mountain studies. Finally, the data since 2003 has been provided by the Table Mountain and Jones Corral studies.

Shrubs/Trees: The dominant preferred browse species on these study sites has been a codominant mixture of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and mountain snowberry (*Symphoricarpos oreophilus*) with lesser cover also contributed by species such as whisky currant (*Ribes cereum* var. *pedicellare*), and Woods' rose (*Rosa woodsii*). Total preferred browse cover has fluctuated from year to year, but has increased overall since 2003. Browse composition and cover trends are entirely driven by the Table Mountain study, as line intercept cover has not been observed on the Jones Corral site in any sample year (**Figure 2.11**). Shrub demographic data shows that preferred browse density has decreased overall between 1992 and 2023. Preferred browse density has decreased since 2008, but an overall increase occurred when comparing 2003 data with that from 2023. Mature individuals have comprised the majority of the browse populations on these sites since 2003 and recruitment of young has remained low during the past three samplings: these trends are again almost entirely due to the Table Mountain study (**Figure 2.14**). Average utilization of preferred browse has been low in all years except 2003, when approximately 43% of plants were moderately or heavily hedged. In 2023, 3% of plants were heavily used and 11% showed signs of moderate browsing (**Figure 2.15**).

No tree cover or density data have been observed in any sample year on these study sites and will therefore not be discussed for this ecological type (**Figure 2.12**, **Figure 2.13**).

Herbaceous Understory: Total average cover and frequency of the herbaceous understories on these sites have shown generally increasing trends. Again, data for the 1992 and 1997 sample years is provided by the Suicide and Table Mountain studies, while Table Mountain and Jones Corral have contributed data since 2003. Perennial grasses and forbs have been codominant herbaceous components on these sites throughout the study period, with Letterman's needlegrass (*Achnatherum lettermanii*), needle and thread (*Hesperostipa comata*), muttongrass (*Poa fendleriana*), and Sandberg bluegrass (*Poa secunda*) as the most common native species. However, introduced perennial grasses such as smooth brome (*Bromus inermis*) and timothy (*Phleum pratense*) have also been present, but mainly on the Jones Corral site. Perennial forbs have increased in both cover and abundance since 2003. In 2023, silvery lupine (*Lupinus argenteus*) provided the most cover of any perennial forb species on the Table Mountain study, while hollyleaf clover (*Trifolium gymnocarpon*) provided the most cover on the Jones Corral site. Annual grasses have not been observed in cover or frequency measurements in any year, and annual forbs have remained rare in comparison with perennial grasses and forbs (**Figure 2.16**, **Figure 2.17**).

Occupancy: Primary occupancy has fluctuated from year to year. Deer were the main occupants of these sites in 2003, and mean pellet group abundance has ranged from 3 days use/acre in 2018 to 51 days use/acre in 2003. The primary occupants were elk in 2008, and average abundance of pellet groups has been as low as 3 days use/acre in 2023 and as high as 47 days use/acre in 2008. Finally, cattle have been the primary occupants of these sites since 2013; mean cattle pellet group abundance has fluctuated between 9 days use/acre in 2023 and 27 days use/acre in 2008 (**Figure 2.18**).

Upland (Big Sagebrush)

There are five studies [North Bull Rush (24-03), Mud Spring Chaining (24-04), Cow Creek (24-07), Barnhurst Ridge (24-10) (suspended), and Marshall Basin (24-12)] that are classified as Upland (Big Sagebrush) ecological sites. The North Bull Rush site is located at the south end of Circleville Canyon off US-89. The Mud Spring Chaining site is situated southeast of Circleville near Burnt Hollow. The Cow Creek site is located between the town of Antimony and John's Valley on the west side of John's Valley Road. The Barnhurst Ridge study is located just east of and above West Fork Hunt Creek on Barnhurst Ridge. Finally, the Marshall Basin site can be found east of the junction between US-89 and SR-20 near Smith Canyon.

When discussing the data for these study sites, it is important to note that the Barnhurst Ridge study only provides data for the 1997 study year, whereas the remaining studies contribute data spanning all sample years.

Shrubs/Trees: The dominant shrub species on most of these sites is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*). However, rubber rabbitbrush (*Ericameria nauseosa* ssp. *nauseosa* var. *hololeuca*) has provided a majority of the shrub cover on the Marshall Basin study since 2003. Sagebrush and total shrub cover have exhibited an overall increase: these trends can be attributed to the North Bull Rush, Mud Spring Chaining, and Cow Creek studies (**Figure 2.11**). Total preferred browse density has decreased over time. More specifically, the decrease between 1997 and 2003 was likely partially driven by the suspension of the Barnhurst Ridge study, which had over 4800 preferred browse plants/acre in 1997. The overall decrease in subsequent years can mainly be attributed to the North Bull Rush, Cow Creek, and Marshall Basin studies, as preferred browse densities on these sites decreased when comparing 2003 data with that from 2023. Mature individuals have comprised a majority of the preferred browse populations on these sites in most years. In 2008, however, decadent plants were the most abundant demographic: this is largely due to the North Bull Rush and Cow Creek studies. Recruitment of young has exhibited yearly fluctuations, but has remained low throughout the sample period (**Figure 2.14**). Average preferred browse utilization has also varied from year to year, but has increased in total. Forty two percent of plants were heavily used and 16% were moderately hedged in 2023 (**Figure 2.15**).

Utah juniper (*Juniperus osteosperma*) and/or twoneedle pinyon (*Pinus edulis*) have been present on some of these sites. Average tree cover and density have decreased since 2003. Site-level data shows that these decreasing trends are mainly attributed to lop and scatter treatments that occurred on the Cow Creek study prior to 2008 and the Mud Spring Chaining study in 2011 (**Figure 2.12**, **Figure 2.13**).

Herbaceous Understory: Average cover of the herbaceous understories on these sites has increased while frequency has generally remained stable overall. Native and/or introduced perennial grasses have been the dominant herbaceous component in all sample years. Annual grasses and forbs and perennial forbs have remained rare on all sites throughout the study period (**Figure 2.16**, **Figure 2.17**).

Occupancy: Deer were the primary occupants of these study sites in 2003, and mean pellet group abundance has ranged from 9 days use/acre in 2013 to 15 days use/acre in 2003. Cattle were the main occupants in 2008, and average abundance of cattle pellet groups has been as low as 3 days use/acre in 2018 and as high as 15 days use/acre in 2008. Elk were the primary occupants in all other sample years, and mean pellet group abundance has fluctuated between 2.5 days use/acre in 2008 and just over 16 days use/acre in 2018 (**Figure 2.18**).

Semidesert (Big Sagebrush)

There are two study sites [North Pole Canyon (24-01) and Prospect Seeding (24-08)] that are classified as Semidesert (Big Sagebrush) ecological sites. The North Pole Canyon study site is located west of Antimony on the benches above the East Fork Sevier River. The Prospect Seeding site is located at the north end of John's Valley between Bryce Canyon City and Antimony.

Shrubs/Trees: Sagebrush is the dominant preferred browse species on both study sites, with mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) present on North Pole Canyon and Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) on the Prospect Seeding study. Other preferred browse species have not been found in any abundance on either study site. Cover of sagebrush exhibited a slight decrease between 2013 and 2018 due to the North Pole Canyon study. However, cover has increased overall between 2003 and 2023 (**Figure 2.11**). Average preferred browse density has fluctuated from year to year, but has increased since 2013. Site-level data shows that the increase of preferred browse density between the two most recent sample years was mainly driven by the Prospect Seeding study: 620 plants/acre were sampled on this site in 2018, and 3460 plants/acre were observed in 2023. Demographic data shows that the populations

of these sites have primarily been comprised of mature individuals in most sample years, but decadent plants were the main demographic in 2003. Recruitment of young has increased since 2013, with North Pole Canyon driving the trend in 2018 and Prospect Seeding as the driver in 2023 (**Figure 2.14**). Average preferred browse utilization increased through 2018. However, utilization decreased in 2023; twenty two percent of plants were heavily hedged and 11% were moderately used during the most recent sample year (**Figure 2.15**).

Trees have not been observed in cover or density measurements in any sample year on these sites and will therefore not be discussed in this subsection (**Figure 2.12**, **Figure 2.13**).

Herbaceous Understory: Total average herbaceous cover and frequency have fluctuated from year to year, but have increased overall. Perennial grasses have been the primary herbaceous component on both sites throughout the study period, with introduced species dominant on Prospect Seeding and native species dominating the understory of North Pole Canyon. Perennial forbs have remained sparse, and annual grasses have not been observed. Annual forbs have been rare in most sample years, but were somewhat common in 1997 and 2023 due to the North Pole Canyon study (**Figure 2.16**, **Figure 2.17**).

Occupancy: Pellet transect data shows that average occupancy of these sites has decreased overall despite yearly fluctuations. Cattle were the primary occupants in 2008 and 2013, with a mean pellet group abundance as low as 4 days use/acre in 2018 and as high as 40 days use/acre in 2008. Deer were the main occupants in all other sample years, and average abundance of deer pellet groups has ranged from 5 days use/acre in 2013 to 23.5 days use/acre in 2003. Finally, elk have also been present on these sites with a mean pellet group abundance as low as 0 days use/acre in 2013 and 2023 and as high as 7 days use/acre in 2003 (**Figure 2.18**).

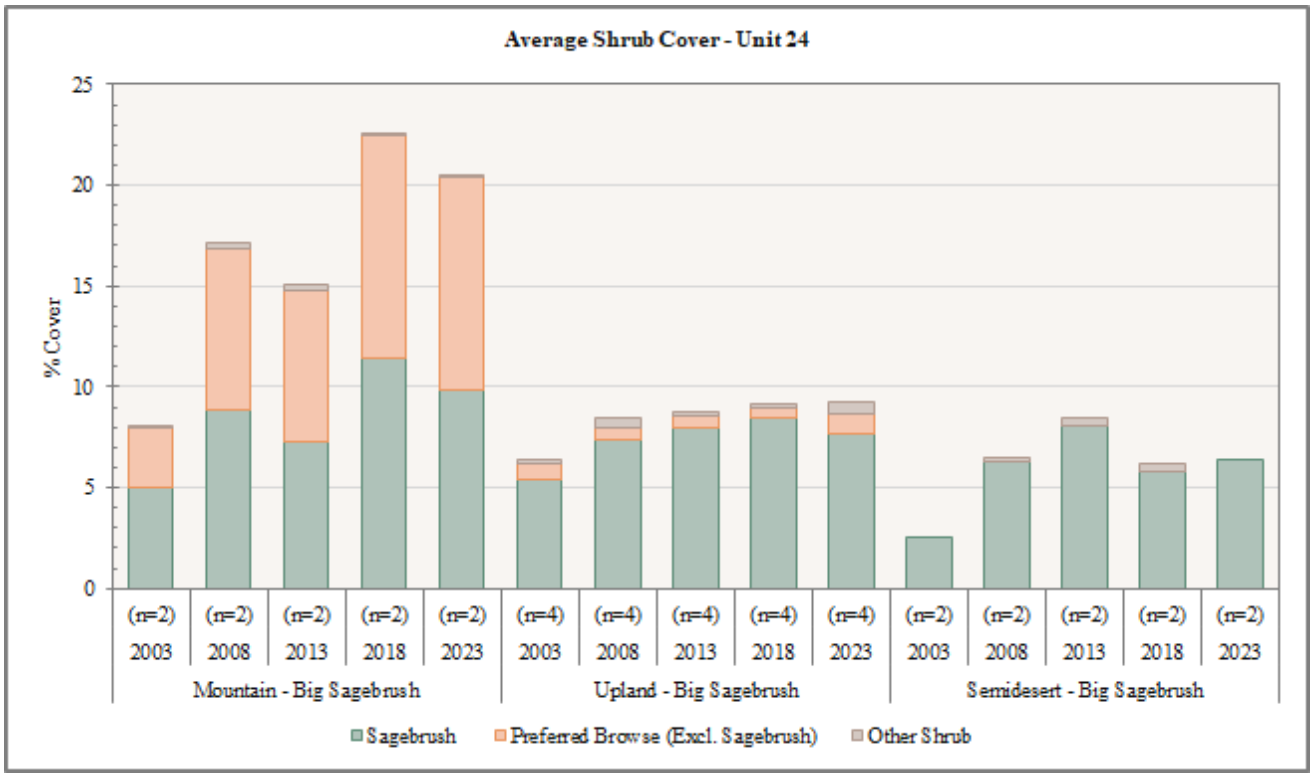


Figure 2.11: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 24, Mt. Dutton.

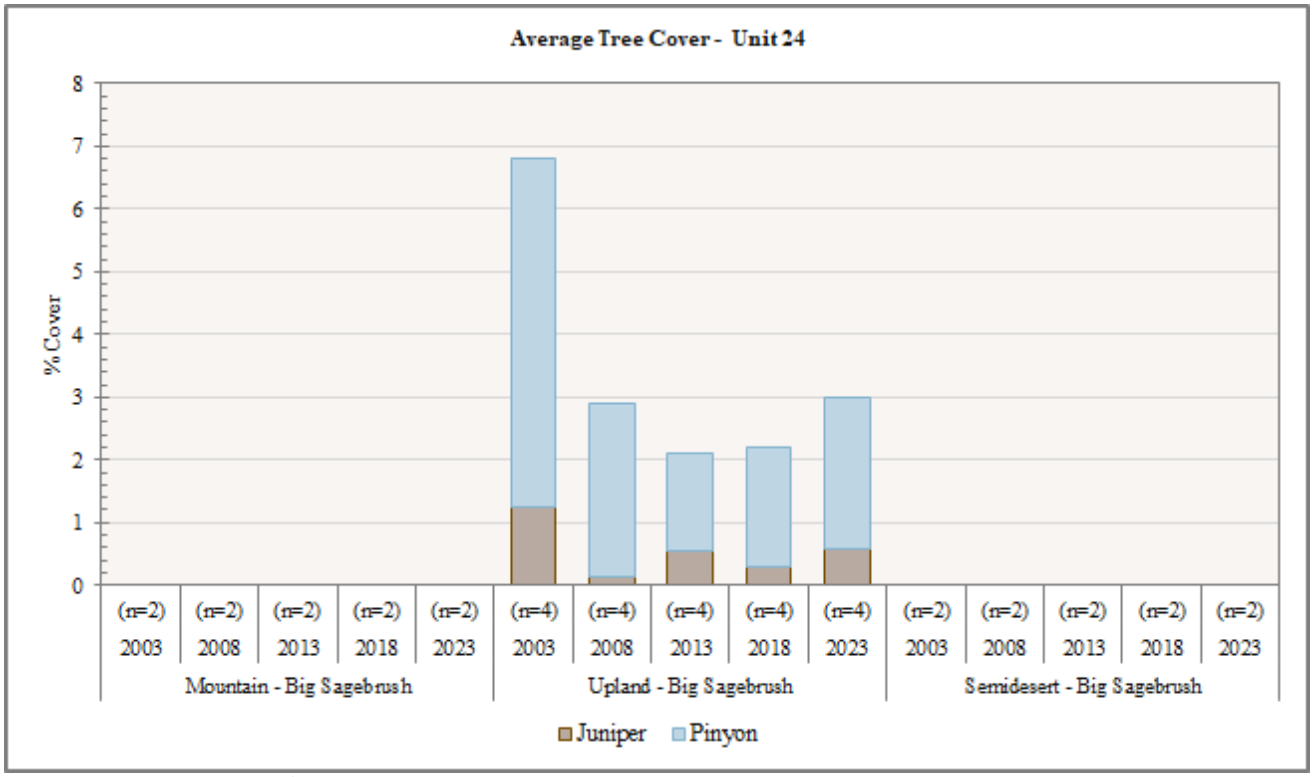


Figure 2.12: Average tree cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 24, Mt. Dutton.

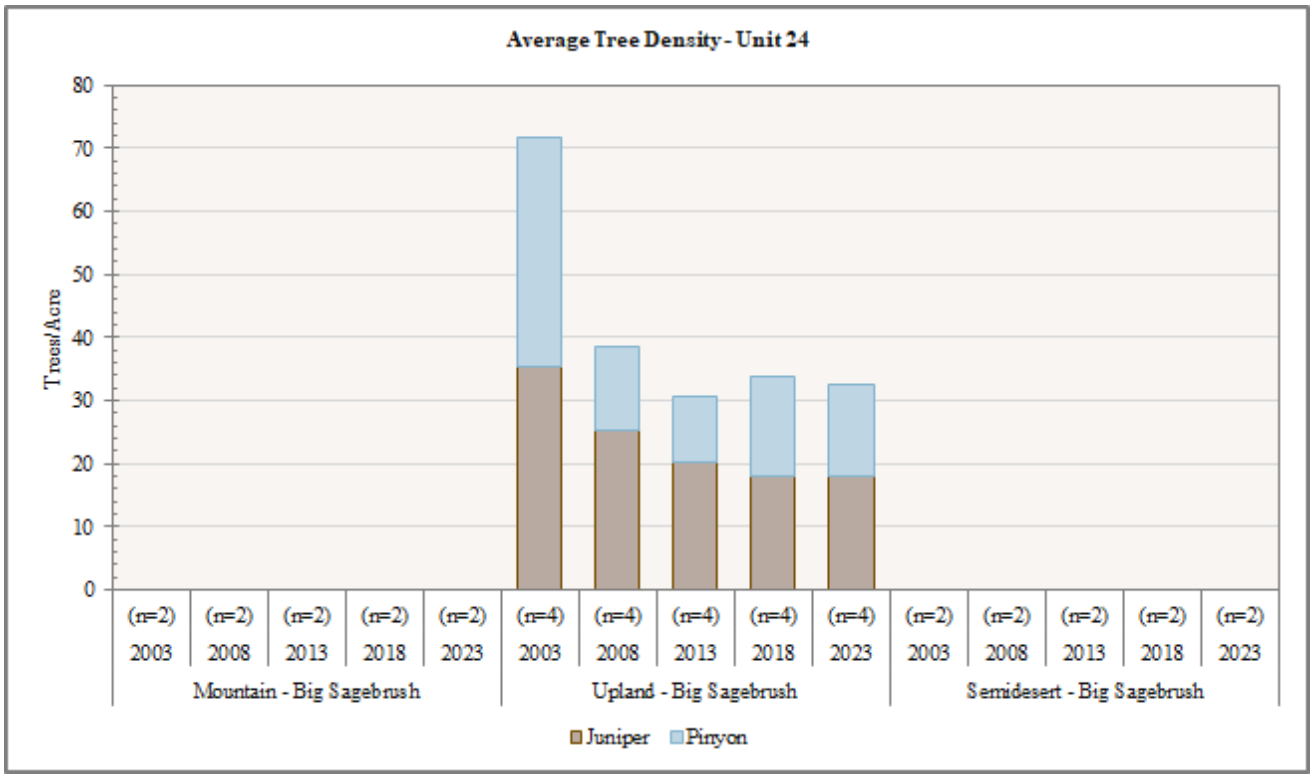


Figure 2.13: Average tree density for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 24, Mt. Dutton.

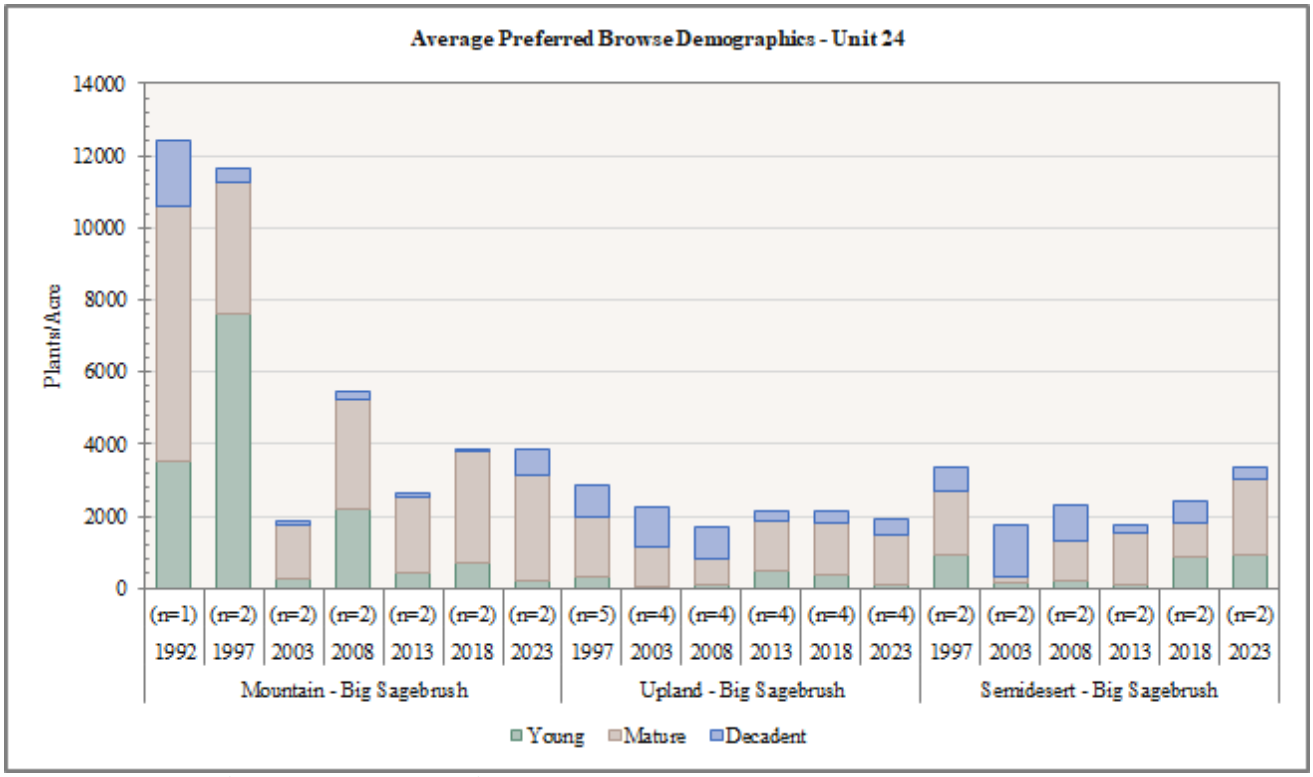


Figure 2.14: Average preferred browse demographics for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 24, Mt. Dutton.

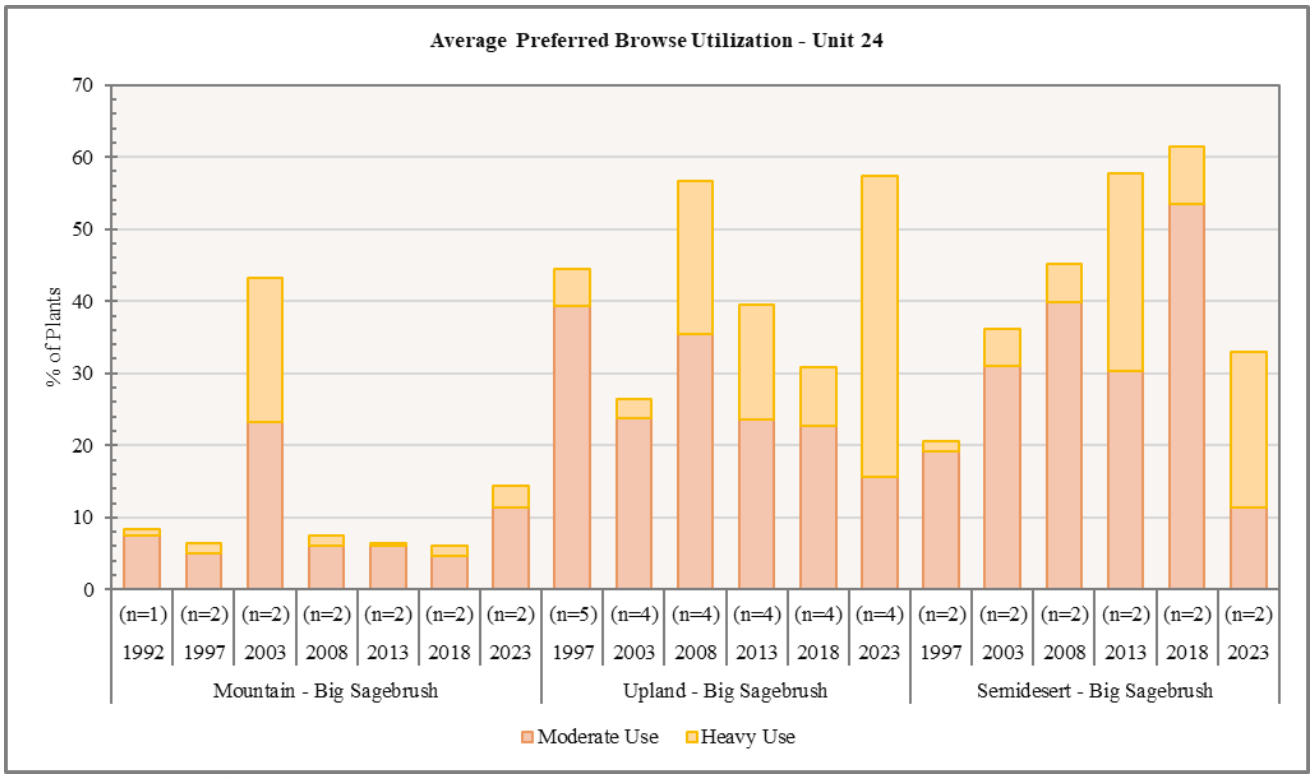


Figure 2.15: Average preferred browse utilization for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 24, Mt. Dutton.

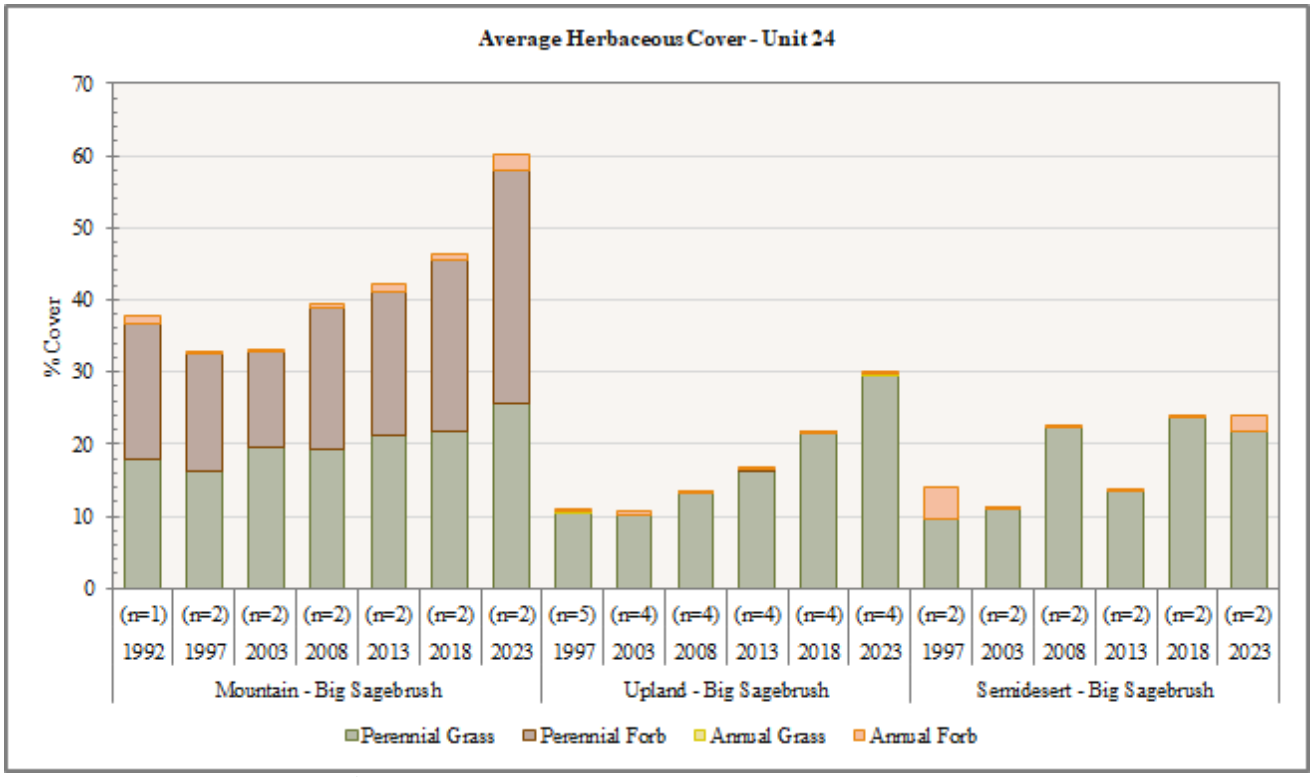


Figure 2.16: Average herbaceous cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 24, Mt. Dutton.

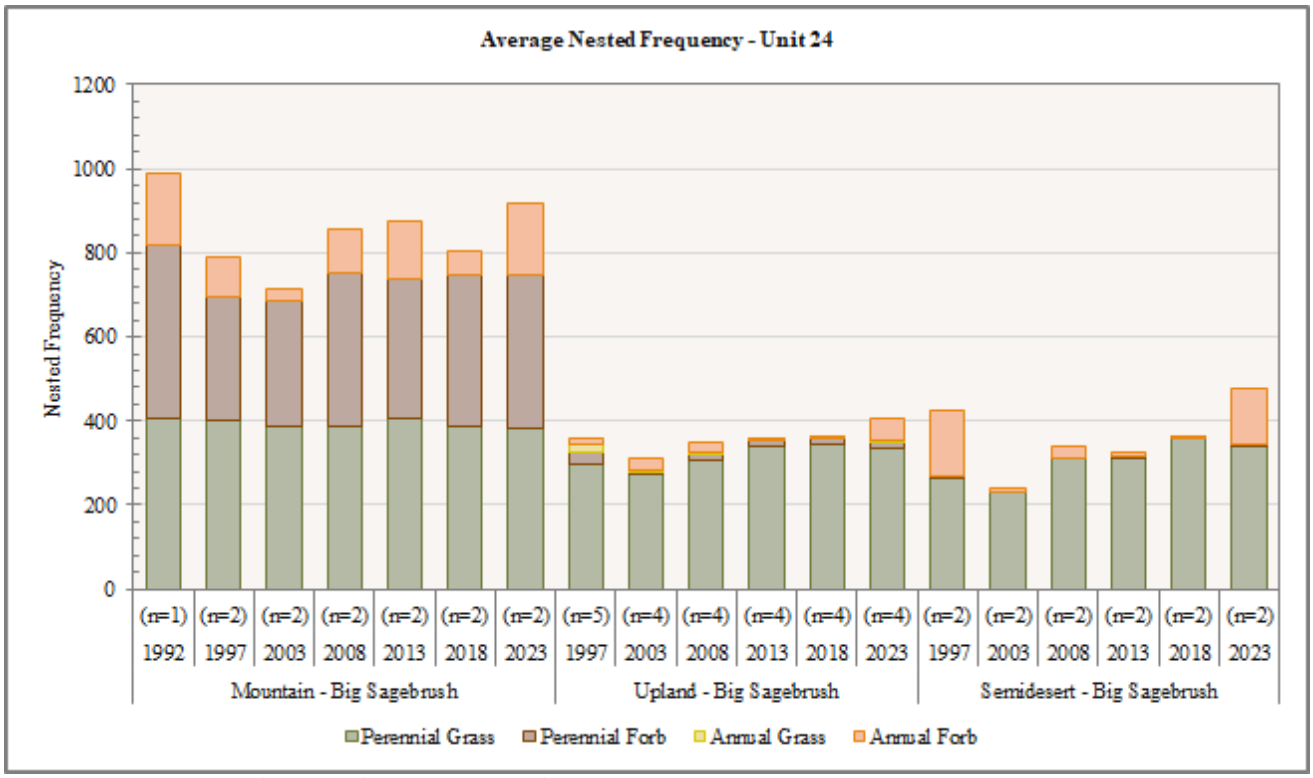


Figure 2.17: Average nested frequency of herbaceous species for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush study sites in WMU 24, Mt. Dutton.

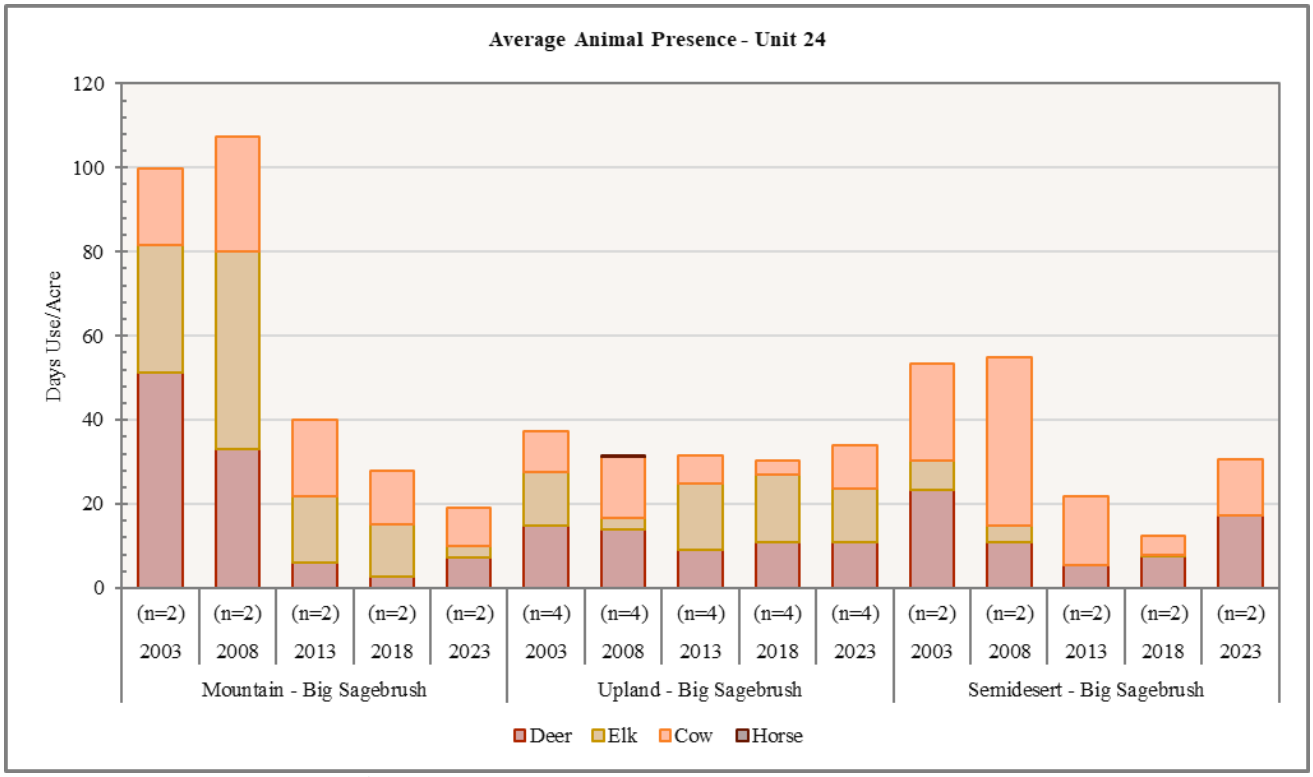
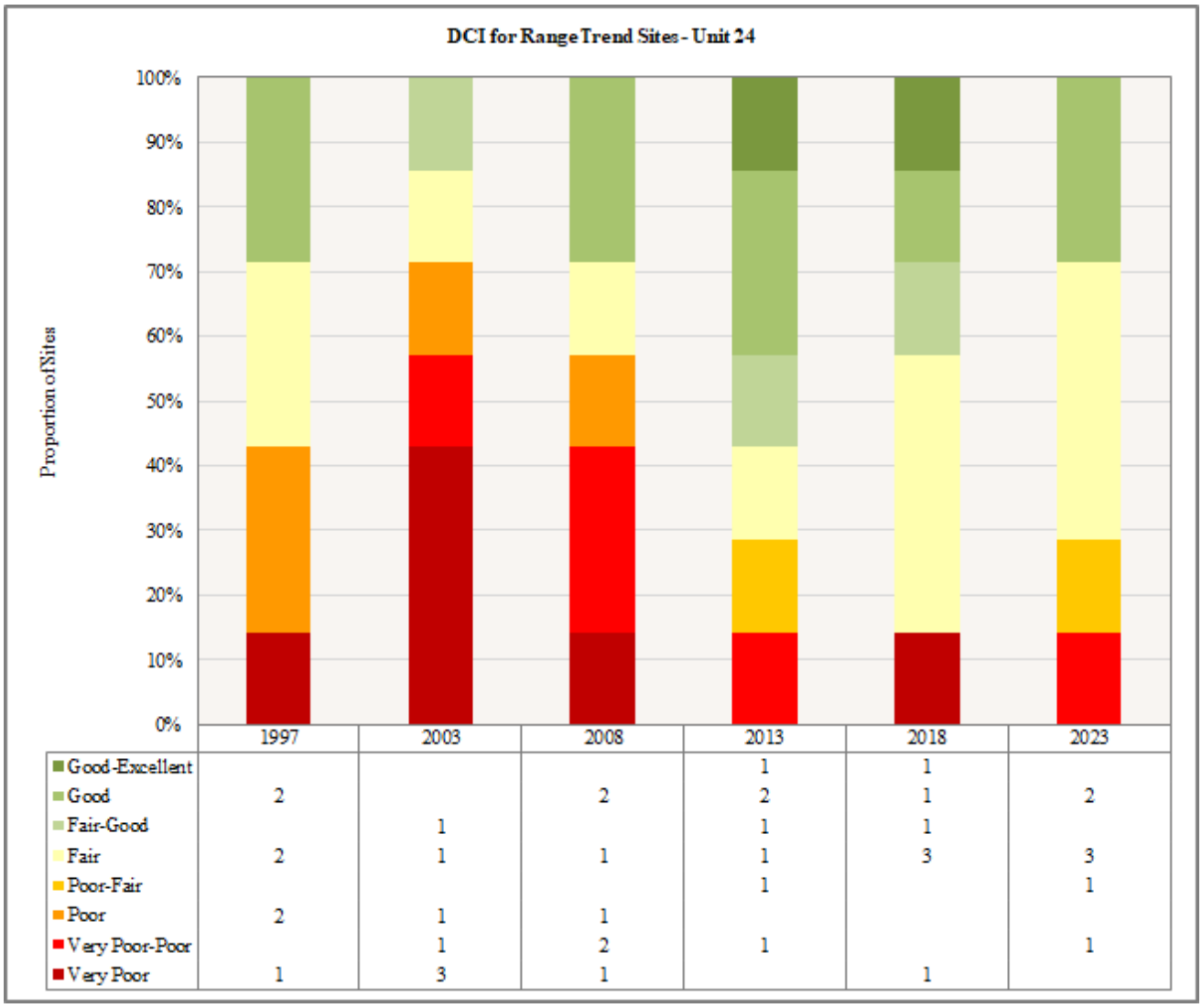


Figure 2.18: Average pellet transect data for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Semidesert - Big Sagebrush, study sites in WMU 24, Mt. Dutton. *Mountain - Big Sagebrush deer pellets include deer and sheep pellet groups.

Deer Winter Range Condition Assessment

The overall condition of deer winter range within the Mt. Dutton management unit has improved slightly since 1997, but there was a notable decease in range condition in 2003. Since 2003, however, deer winter range conditions have recovered from averaged unit conditions at very poor-poor in 2003 to fair in 2023. Marshall Basin (24-12) is the only Range Trend site that is consistently considered to be in very poor condition, which is due to the lack of preferred browse and perennial forbs. One factor beneficial to the overall winter range health on all Range Trend sites in this unit is lack of annual grass; however, most sites could benefit by increasing preferred browse and perennial forb cover while diversifying these components in their respective communities. It is probable that these sites represent their surrounding areas and likely point to areas of needed habitat rehabilitation topics of concern, namely the need to increase preferred browse on Marshall Basin and increases in perennial forbs as a whole. North Pole Canyon (24-01), Deer Creek Bench (24-02), North Bull Rush (24-03), Mud Spring Chaining (24-04), and Prospect Seeding (24-08) are all sites with averaged conditions ranked between fair and good, and are the drivers for unit-wide conditions. Though considered to be in fair condition, North Bull Rush tends to have higher variability in deer winter habitat, and may 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 (*Pinus spp.*) and juniper (*Juniperus spp.*) tree cover, and/or cheatgrass (*Bromus tectorum*), and increase preferred browse cover.

The overall deer winter range assessment in 2023 was that WMU 24 is in fair condition. Factors contributing to fair conditions are the lack of preferred shrub cover and recruitment. However, all sites have notable perennial grass communities present (**Figure 2.19**, **Table 2.5**).



	1997	2003	2008	2013	2018	2023
Good-Excellent				1	1	
Good	2		2	2	1	2
Fair-Good		1		1	1	
Fair	2	1	1	1	3	3
Poor-Fair				1		1
Poor	2	1	1			
Very Poor-Poor		1	2	1		1
Very Poor	1	3	1		1	

Figure 2.19: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 24, Mt. Dutton.

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
24-01	1997	8	11.5	15	14	0	0	0	**48.6**	**G**
24-01	2003	6.3	0	0	30	0	0.1	0	**36.3**	**F**
24-01	2008	13.4	0.3	3.9	30	0	0	0	**47.5**	**G**
24-01	2013	16.9	10	3.8	30	0	0	0	**60.6**	**G**
24-01	2018	11.4	8.1	15	30	0	0	0	**64.5**	**G-E**
24-01	2023	11.5	8.9	8.6	30	0	0.1	0	**59.2**	**G**
24-02	1997	22.1	10.7	6.4	7.9	0	1.1	0	**48.3**	**G**
24-02	2003	22.6	7.8	0.6	13.8	0	0.9	0	**45.6**	**F-G**
24-02	2008	25.5	3.9	1.8	17.6	0	1.4	0	**50.2**	**G**
24-02	2013	24	10.9	3.4	22.5	0	2.4	0	**63.3**	**G-E**
24-02	2018	14.5	8	3.5	23.9	-0.1	1.4	0	**51.2**	**G**
24-02	2023	11.4	6.9	5.1	30	-1.4	2.1	0	**54**	**G**
24-03	1997	17	0.6	1.5	20.4	0	0.1	0	**39.6**	**P**
24-03	2003	12.3	-1.2	0	24.3	0	0	0	**35.3**	**VP-P**
24-03	2008	11.9	-5.7	0.3	30	0	0	0	**36.5**	**VP-P**
24-03	2013	17.1	9.9	9.8	30	0	0	0	**66.8**	**F-G**
24-03	2018	15	8	9.2	30	0	0	0	**62.2**	**F**
24-03	2023	14.5	6.5	4.7	30	0	0.1	0	**55.7**	**F**
24-04	1997	7.7	12.6	13.4	22.6	0	0.5	0	**56.9**	**F**
24-04	2003	6.4	6.2	8.2	16.6	0	0.1	0	**37.4**	**P**
24-04	2008	11.5	10.4	0	25.6	0	0.2	0	**47.7**	**P**
24-04	2013	12.5	13.7	7.3	27	0	0.4	0	**60.9**	**F**
24-04	2018	17.1	12	6.8	30	0	0.6	0	**66.5**	**F-G**
24-04	2023	13.8	12.4	0.6	30	0	0.4	0	**57**	**F**
24-07	1997	8.2	4.8	4	22.9	0	1.4	0	**41.2**	**P**
24-07	2003	7.9	-2.8	0.5	24.7	0	0.1	0	**30.4**	**VP**
24-07	2008	13.6	-5.7	1.4	24.8	0	1.2	0	**35.3**	**VP-P**
24-07	2013	10.3	12	15	30	0	0.6	0	**67.9**	**G**
24-07	2018	10	11.9	8.6	30	0	1	0	**61.4**	**F**
24-07	2023	9.8	9.6	0	30	0	1.3	0	**50.6**	**P-F**
24-08	1997	3.5	0	0	24.4	0	0	0	**27.9**	**F**
24-08	2003	0.1	0	0	7	0	0	0	**7.1**	**VP**
24-08	2008	2.3	0	0	30	0	0	0	**32.3**	**F**
24-08	2013	3.3	0	0	23.2	0	0	0	**26.5**	**P-F**
24-08	2018	3.1	0	0	30	0	0	0	**33.1**	**F**
24-08	2023	4.5	0	0	30	0	0	0	**34.5**	**F**
24-12	1997	0.4	0	0	23.5	-1.1	0.1	0	**22.9**	**VP**
24-12	2003	4.3	0	0	16.1	0	0	0	**20.3**	**VP**
24-12	2008	2.6	0	0	17.1	0	0.5	0	**20.2**	**VP**
24-12	2013	2.9	0	0	30	0	0.2	0	**33**	**VP-P**
24-12	2018	2.5	0	0	30	0	0	0	**32.5**	**VP**
24-12	2023	5.4	0	0	30	-0.1	0.1	0	**35.4**	**VP-P**

Table 2.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 24, Wasatch Mountains. 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 Impact	Potential Impact
24-01	North Pole Canyon	None Identified		
24-02	Deer Creek Bench	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
24-03	North Bull Rush	Animal Use – Cattle	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
24-04	Mud Spring	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
	Chaining	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
24-06	Table Mountain	Drought	-	Lowered resilience and resistance to disturbance.
24-07	Cow Creek	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Study #	Study Name	Limiting Factor and/or Threat	Level of Impact	Potential Impact
24-08	Prospect Seeding	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
24-09	Mud Spring	None Identified		
24-12	Marshall Basin	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
24-13	Jones Corral	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
24-14	Pine Canyon	Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
24R-01	Sanford	Conifer Encroachment	Medium	Reduced understory shrub, aspen stand, and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
24R-06	Panguitch East Bench Harrow	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
24R-08	Johns Valley	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
24R-09	Johns Valley 2	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
24R-10	Antimony Lop and Scatter	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
24R-11	Antimony PJ Reduction	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
24R-13	Circleville	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
24R-14	Black Canyon WMA	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
24R-15	Horse Bench	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Table 2.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 24, Mt. Dutton. All assessments are based off the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A – Threat Assessment**.

Discussion and Recommendations

Deer winter range within the Mt. Dutton management unit averages as being in fair condition as of the 2023 sample year. A lack of preferred browse cover and recruitment of young negatively contribute to these conditions. In contrast, the presence of notable perennial grass communities on all studies positively influences the condition of winter range in this unit (**Figure 2.19**, **Table 2.5**).

A positive aspect of the Mt. Dutton unit is that the browse components have persisted on a majority of the sites that are considered to be within mule deer winter range (North Pole Canyon, Deer Creek Bench, North Bull Rush, Mud Spring Chaining, and Cow Creek) (**Map 2.2**). 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 (and possibly degraded) ecological state. Of additional positive note, improvements in habitat quality (pinyon-juniper reduction, augmentation of the herbaceous understory, browse diversification, etc.) have been observed on some treated Range Trend sites (e.g. Cow Creek) and many WRI studies. Furthermore, habitat treatment projects have been and continue to be implemented in areas not monitored by the Range Trend program; nearly 35,000 total treatment acres have been completed in this management unit through the WRI as of February 2024 (**Table 2.2**, **Map 2.7**).

The Sanford wildfire burned 73,342 acres on top of the Sevier Plateau in 2002 after two separate prescribed burns escaped control and merged. Fire can act as an agent of negative change in some situations depending on where and how it occurs, and it is likely that localized detrimental effects occurred on portions of the plateau burned by the Sanford fire. However, fire can also serve as a catalyst for habitat improvement in other circumstances, and the Sanford wildfire appears to have acted as such in some ways. Smith et al. (2011) studied aspen (*Populus tremuloides*) regeneration on plots within the burn perimeter and found high levels of aspen regeneration through suckering; even stands that were moderately encroached by conifer prior to the burn had notable amounts of aspen regeneration. The study also found a small positive relationship between aspen sucker height and soil altered by fire,

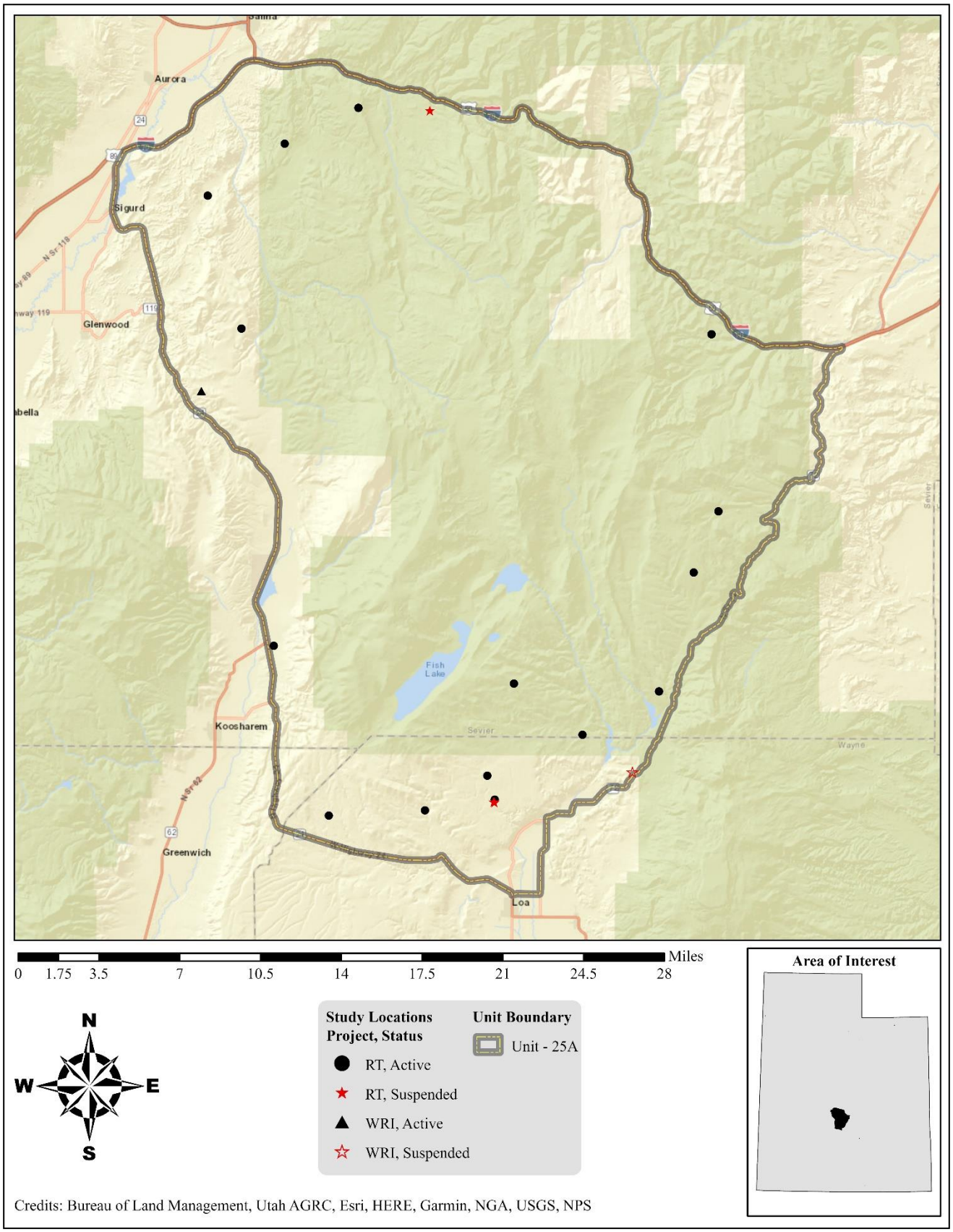
suggesting that soil nutrient and chemical changes precipitated by the burn may have been slightly beneficial for regeneration. Although limited to only one study site (Sanford), comparison of pre- and post-disturbance data gathered by the Range Trend program also demonstrates positive changes resulting from the burn. Pictures of this site from 1998 show an aspen community with notable conifer encroachment, and species-level data indicates the presence of a moderately diverse and abundant herbaceous understory. Although conifers were present in 2023 according to point-quarter density data, photos suggest their presence is at levels less than those observed prior to the burn. In addition, photos and aspen characteristic data show that aspen has regenerated and that the site has transitioned from a conifer-encroached state to an aspen community. Furthermore, herbaceous cover, abundance, and diversity have exhibited overall increases following the fire (Cox, Lane, & Payne, 2023).

Drought is a concern on the Mt. Dutton management unit as it may pose a threat to the condition of the unit's wildlife habitat. Considerable leader growth of browse species was observed on study sites sampled during the 2023 field season, likely due to increased precipitation. However, Palmer Drought Severity Index (PDSI) data for the South Central Division (in which Unit 24 is located) shows that 2020-2022 were considered to be years of moderate to extreme drought. Possible holdover effects from these drought years were observed on some sites in 2023, including partial crown death on some shrubs. In addition, deer winter range Desirable Components Index (DCI) scores did not improve overall between 2018 and 2023, despite 2018 being a drought year (**Figure 2.1a**, **Figure 2.1b**). Furthermore, condition of three sites (North Pole Canyon, Mud Spring Chaining, and Cow Creek) slightly deteriorated between the two most recent samplings. Closer examination of the DCI score at site level shows that although other variables partially affected scores on two sites, the most negatively influential factor was the same on all three studies: a lack of young plants in the preferred browse communities (**Figure 2.19**, **Table 2.5**). Campbell and Harris (1977, as cited in Karban & Pezzola, 2017) suggested that smaller big sagebrush (*Artemisia tridentata*) plants may be more greatly affected by drought due to their shallow root systems and relatively limited access to soil moisture when compared to larger plants with deeper-reaching roots. Because Range Trend study sites are not monitored every year, densities of seedlings and young plants and observations about inflorescence production are not available for the 2020-2022 period. However, it is possible that most of the seedlings and/or young plants that may have established on these three sites in between sample years were unable to survive the drought.

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**).

There are a few suggestions to consider for maintaining or improving big game habitat within the Mt. Dutton management unit. Broadly speaking, and when necessary, habitat improvement projects should continue to be implemented within this unit. More specifically, a considerable portion of this unit has been treated for tree encroachment (**Table 2.2**). When and where appropriate, efforts to address infilling or encroachment of pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) in both previously treated and untreated areas should be continued or implemented. Care should be taken in method selection (lop and scatter, bullhog, chaining, etc.) to ensure that annual grass loads are not unintentionally amplified. Although annual grasses are generally not considered a high-level threat within this unit, they are present in the understories of many study sites; proactive monitoring of annual grass loads is advisable. Treatments to control annual grass loads may be prudent following future disturbances, as annual grasses – particularly cheatgrass (*Bromus tectorum*) – often behave opportunistically and increase when resources are released. Finally, monitoring of both Range Trend studies and areas where rehabilitation projects have occurred should continue into 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 25A – FISHLAKE PLATEAU



WILDLIFE MANAGEMENT UNIT 25A – FISHLAKE PLATEAU

Boundary Description

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

Management Unit Description

Geography

The Fishlake Plateau Wildlife Management Unit is part of the larger management unit, 25 – Plateau. Unit 25 is divided into three sub-units: Fishlake Plateau (25A), Thousand Lakes Plateau (25B), and Boulder Plateau (25C).

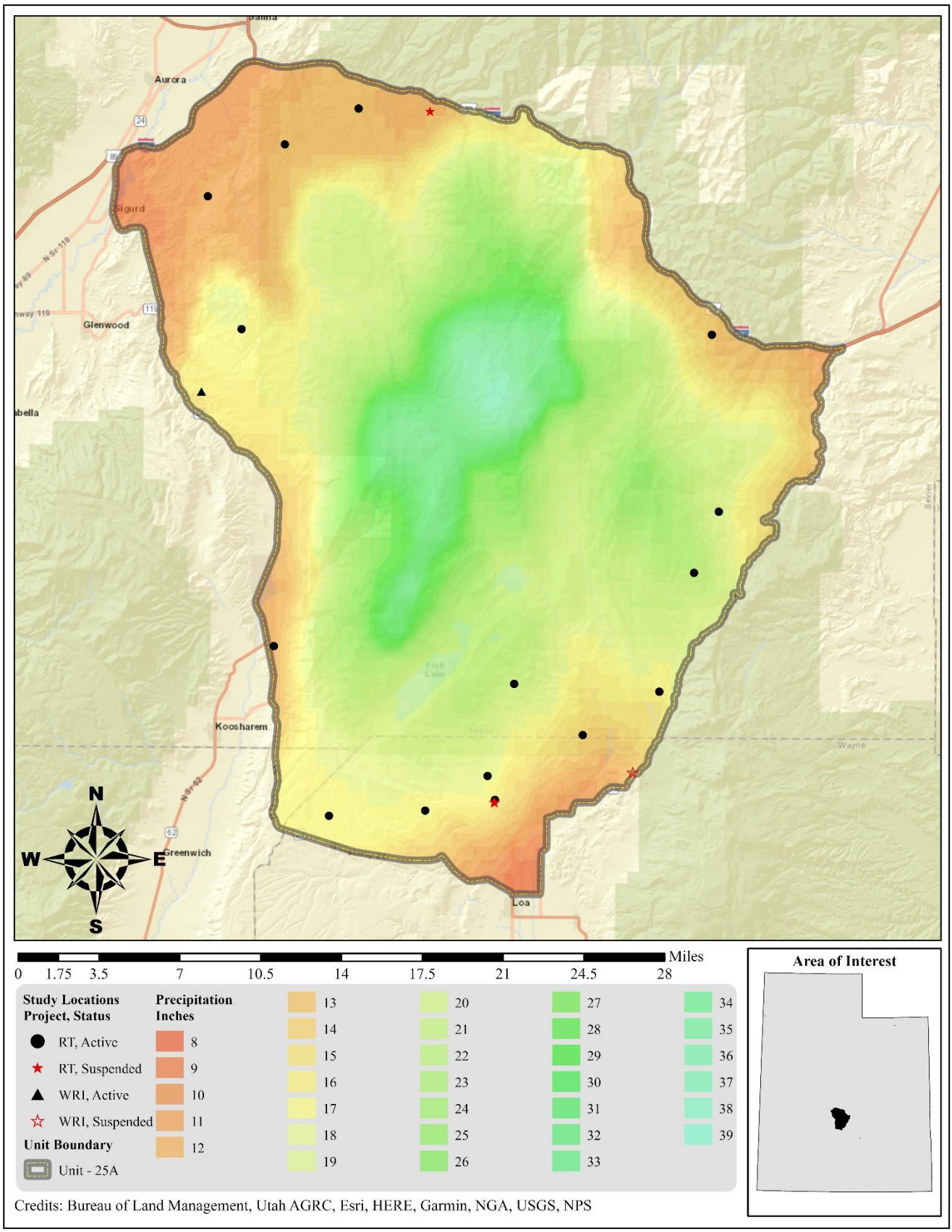
The Fishlake Plateau unit includes the Fish Lake Mountains and the associated drainages: Otter Creek to the west and the Fremont River with its major tributaries, 7-mile Creek and UM Creek, to the east. Some steep, relatively rough areas exist in the drainage heads along the northwestern side, but most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

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation on this unit ranges from 8 inches near Sigurd and in the southeast portion of the unit near Loa to 48 inches just north of the high-elevation peak of Mt. Terrill. All of the active Range Trend and WRI monitoring studies in this unit occur within 11-22 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 South Central Division (Division 4).

The mean annual PDSI of the South Central Division, which the Fishlake Plateau unit is a part of, has experienced some form of drought most years since 1993. Moreover, this climate division has been considered to be in drought nearly 68% of the time since 1993. Of the drought years, nearly 43% are considered to be either moderate or extreme droughts. Also remarkable about this climate division is that drought is experienced over multiple years and is generally interrupted by a single wet year event; the most notable wet years occur in 2005 and 2011, which were both considered moderately wet (**Figure 3.1a**). The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI. These seasonal precipitation events can play a crucial role in the timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September and May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although overall annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 3.1b**). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 3.3**). Years that were moderately wet occur in 1999 and 2023, but years where drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 3.1a, Figure 3.1b**) (Time Series Data, 2024).



Map 3.1: The 1991-2020 PRISM Precipitation Model for WMU 25A, Fishlake Plateau (PRISM Climate Group, Oregon State University, 2021).

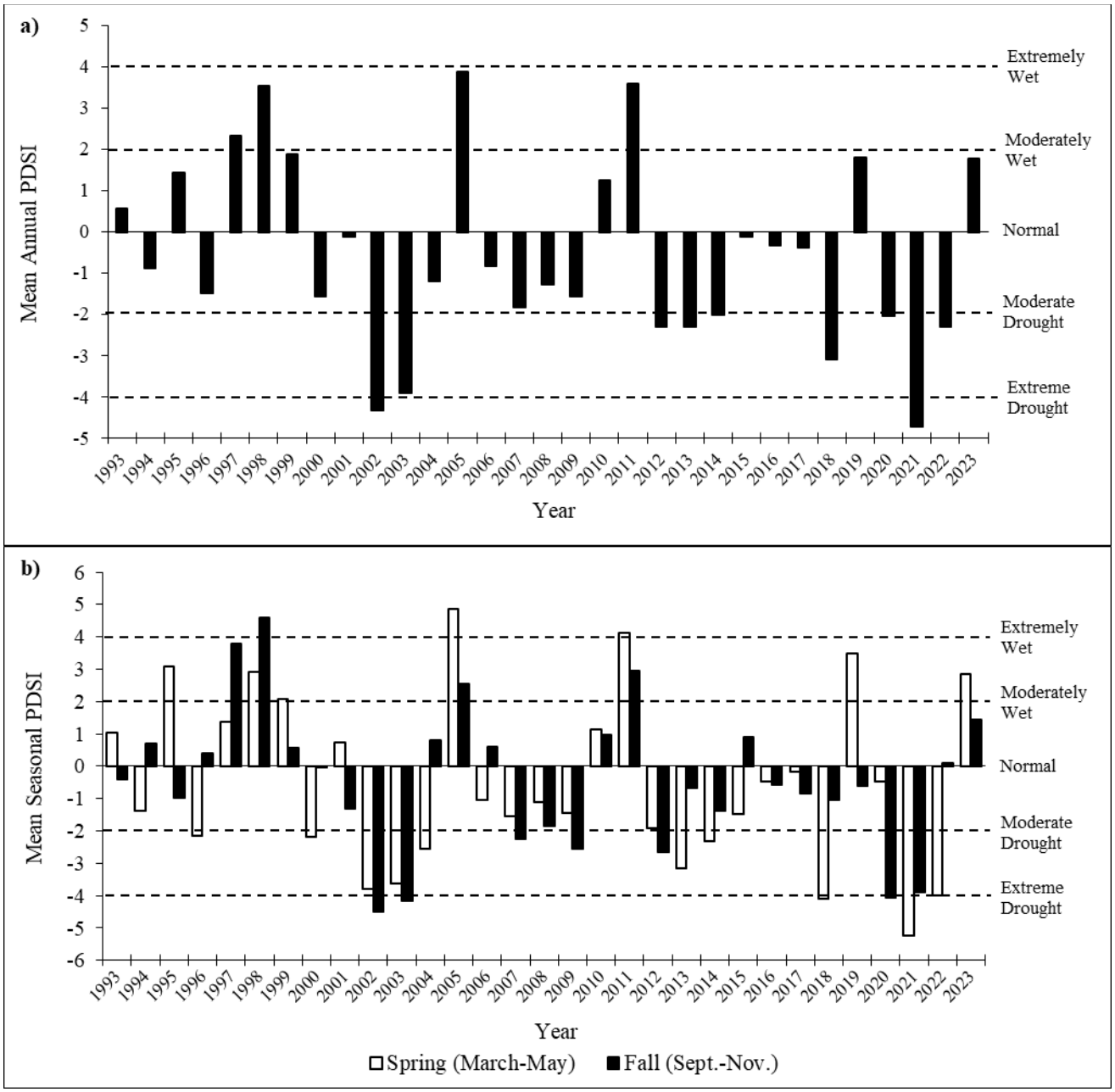


Figure 3.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

The northern two-thirds of the Fishlake Plateau unit include the high-elevation Fish Lake Mountains, which constitute summer range for deer and elk. Winter range is primarily confined to the lower elevations of the northern third of the unit and the sagebrush (*Artemisia spp.*) benches on the west side above Highway 24. Antelope are also present and are normally found in the more open areas of the deer and elk winter range (**Map 3.2**, **Map 3.3**). Excessive accumulations of snow during severe winters confine deer below the 8,600-foot contour. Pinyon-juniper on both normal and severe wintering areas provide extremely important protective cover for elk and deer, while the closely associated sagebrush type produces the bulk of the required forage.

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

The RAP data for both summer and winter deer habitat illustrates a peak in herbaceous cover and biomass during the late 1980s that has slowly decreased to the present, though with some notable fluctuations. These fluctuations in biomass and cover typically follow the fluctuations in precipitation. Annual biomass is minimal on deer summer range and tightly fluctuates with the perennial biomass yearly trend. Annuals show some variability in cover over this same period, with years of good precipitation correlating with large flushes of annuals: this is more pronounced on the winter habitats (**Figure 3.2**, **Figure 3.3**, **Figure 3.4**, **Figure 3.5**). The Range Trend data from 1999 to present shows a general stability in perennial cover; annual cover has generally increased on all ecological sites, but with some variability (**Figure 3.13**, **Figure 3.14**). 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 combined tree and shrub cover on deer summer range show fluctuations over time with no discernable trend, but shrub cover has decreased overall with an abrupt decrease beginning in 2021. This decrease in shrub cover follows a drought year in 2020 that may be related to said decrease in cover. Tree and shrub cover for deer winter range follows a similar trend (**Figure 3.6**, **Figure 3.7**). Range Trend data displays an increase in shrub cover, but tree cover has decreased since 2004 (**Figure 3.8**, **Figure 3.9**).

RAP – Herbaceous Biomass by Deer Habitat

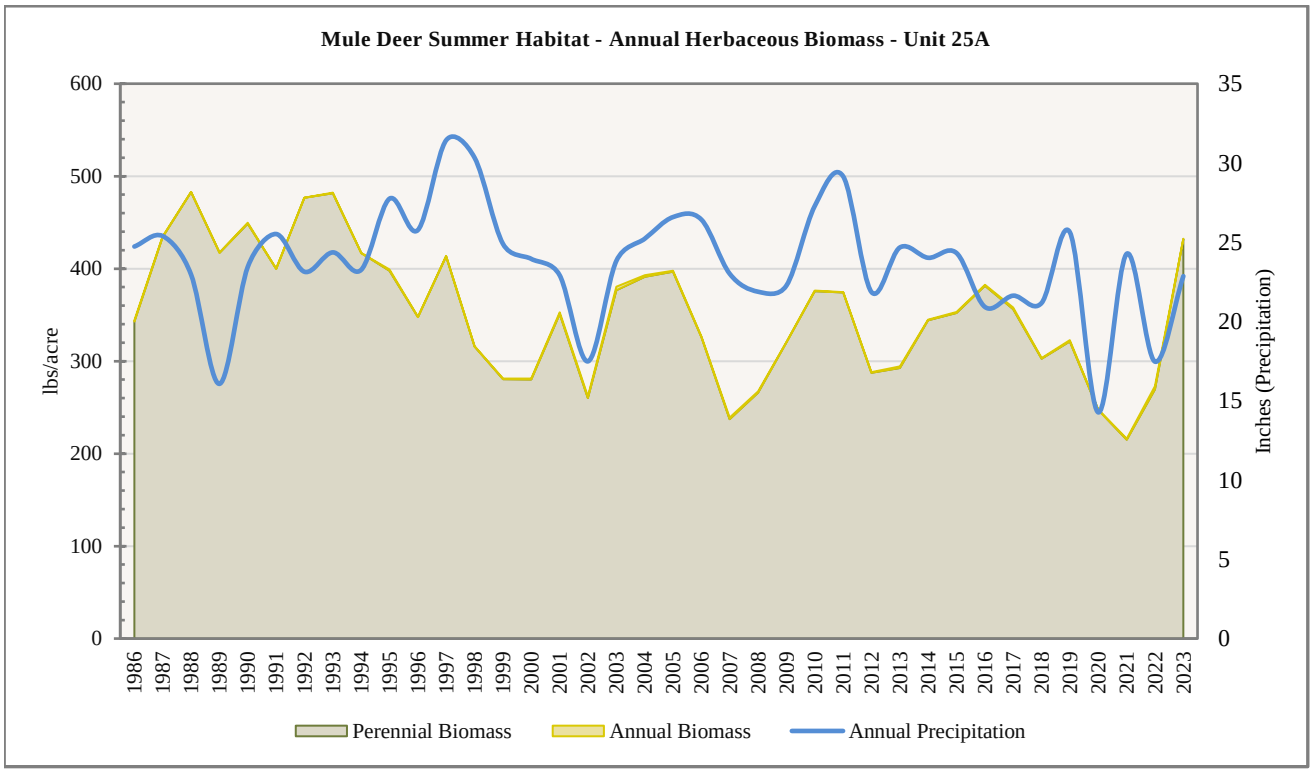


Figure 3.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 25A, Fishlake Plateau (Rangeland Analysis Platform, 2024).

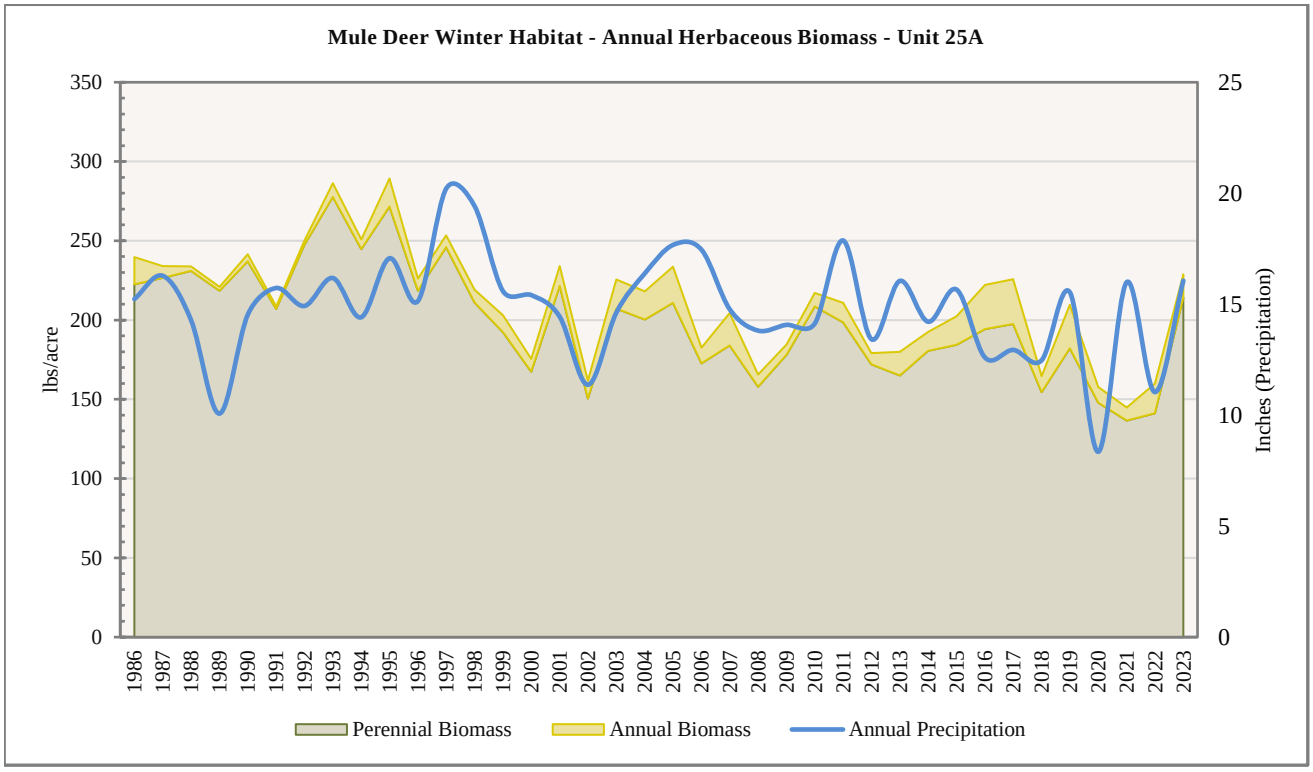


Figure 3.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 25A, Fishlake Plateau (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

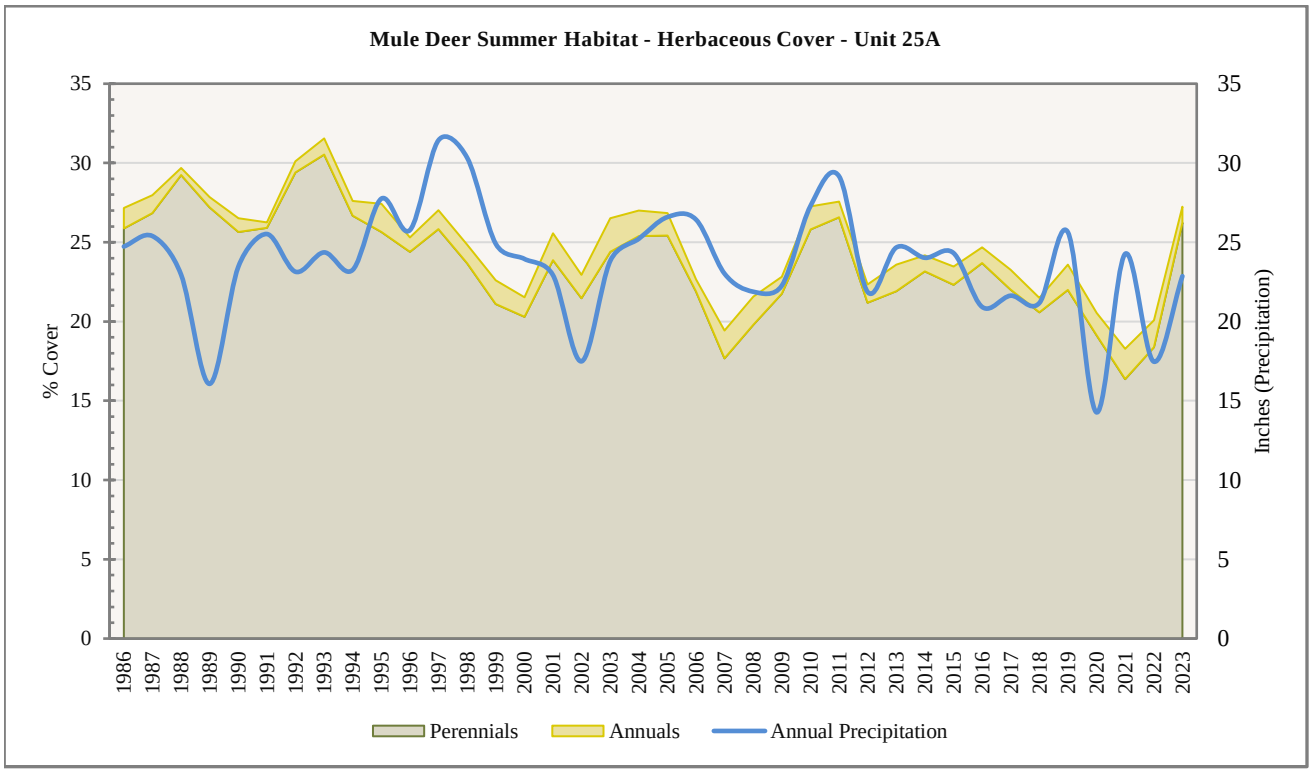


Figure 3.4: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 25A, Fishlake Plateau (Rangeland Analysis Platform, 2024).

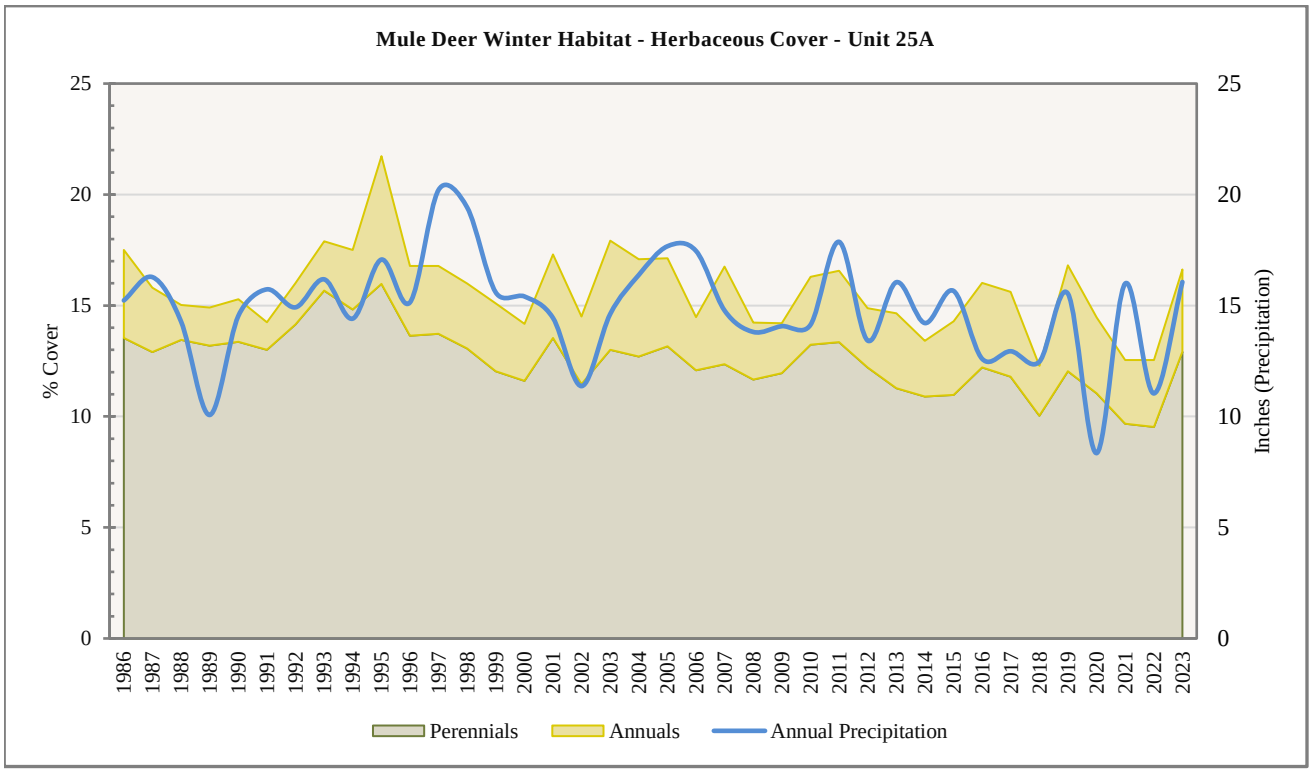


Figure 3.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 25A, Fishlake Plateau (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

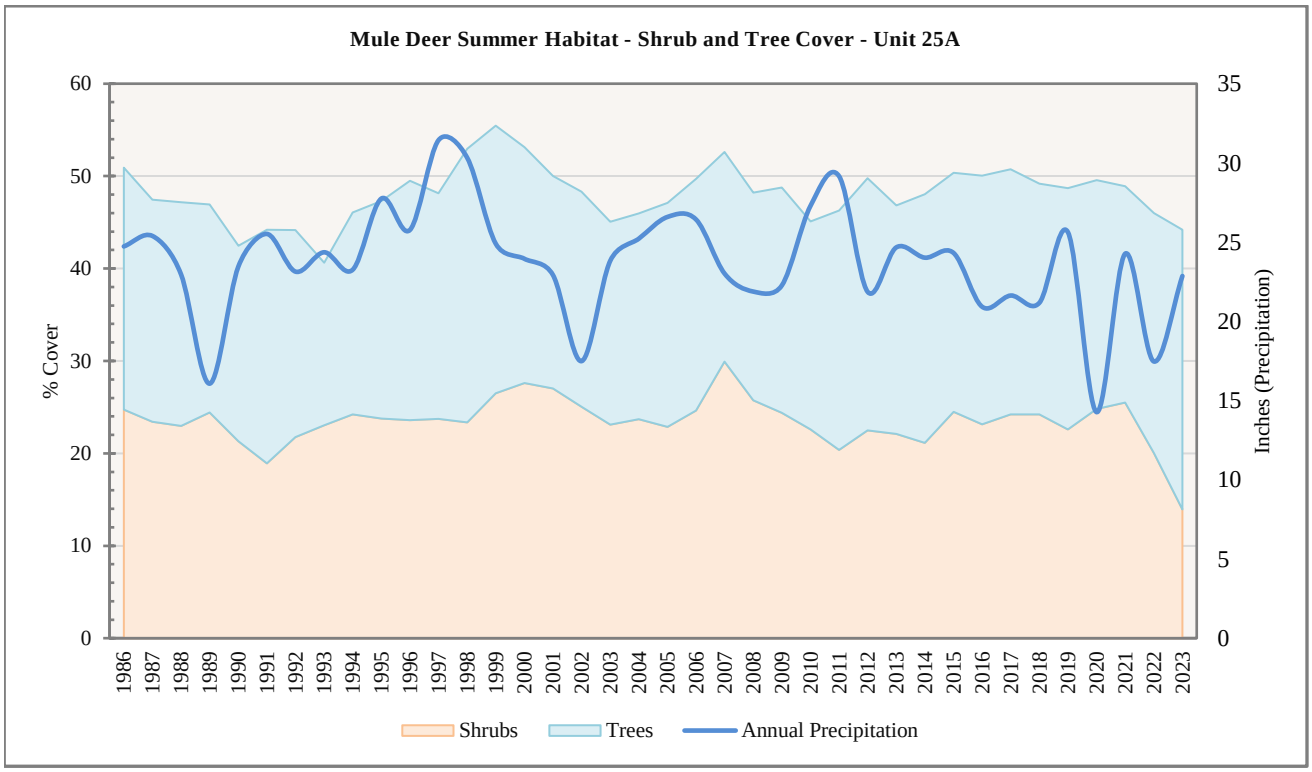


Figure 3.6: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 25A, Fishlake Plateau (Rangeland Analysis Platform, 2024).

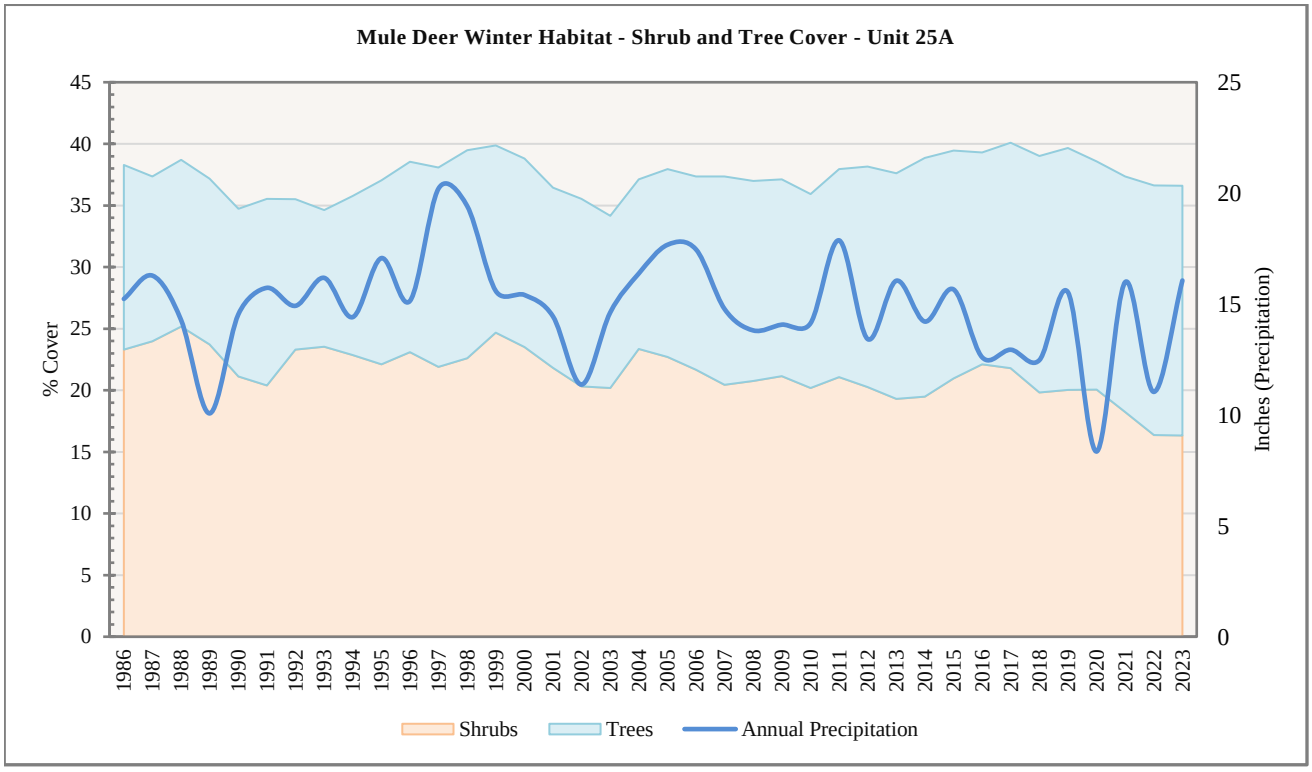
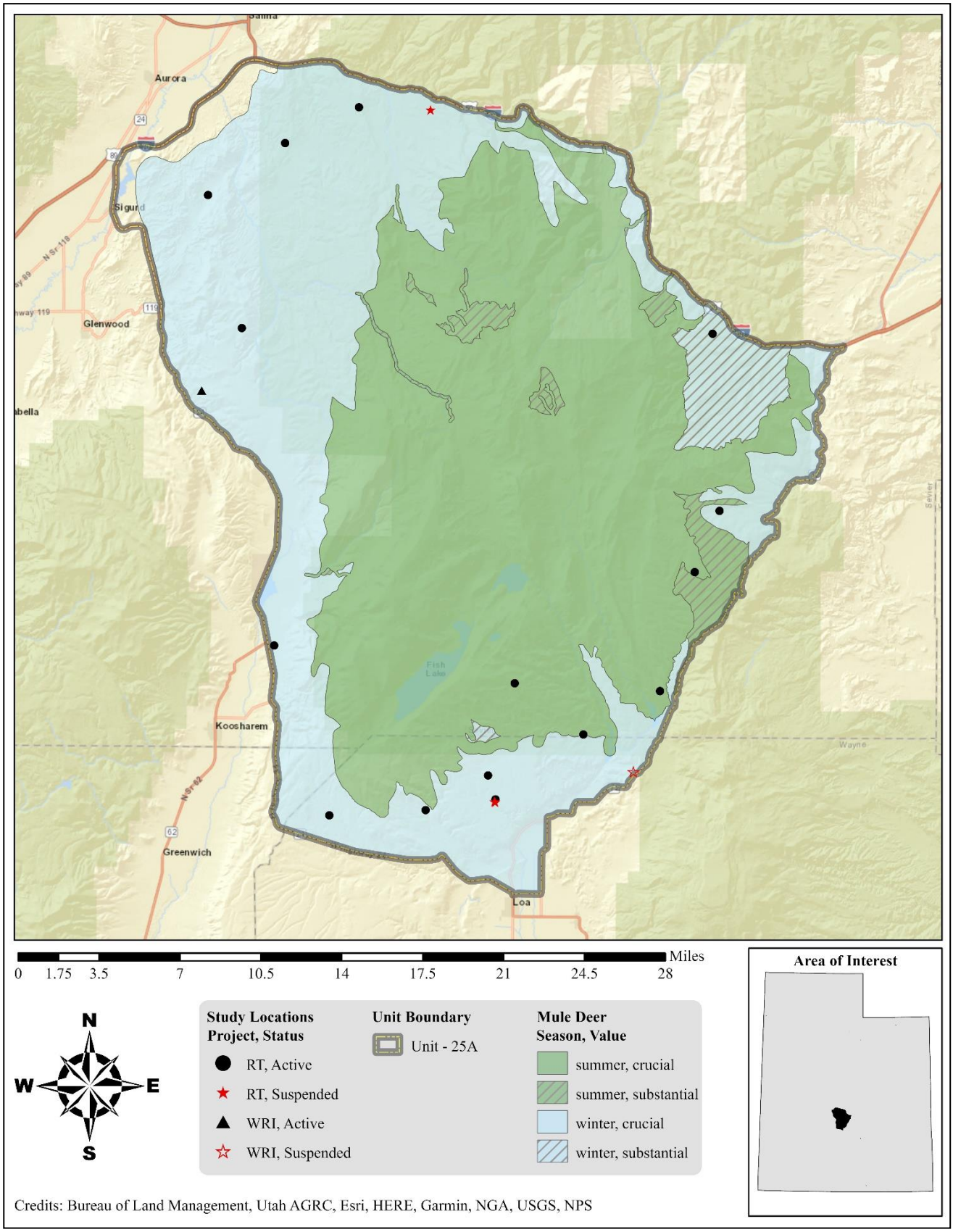
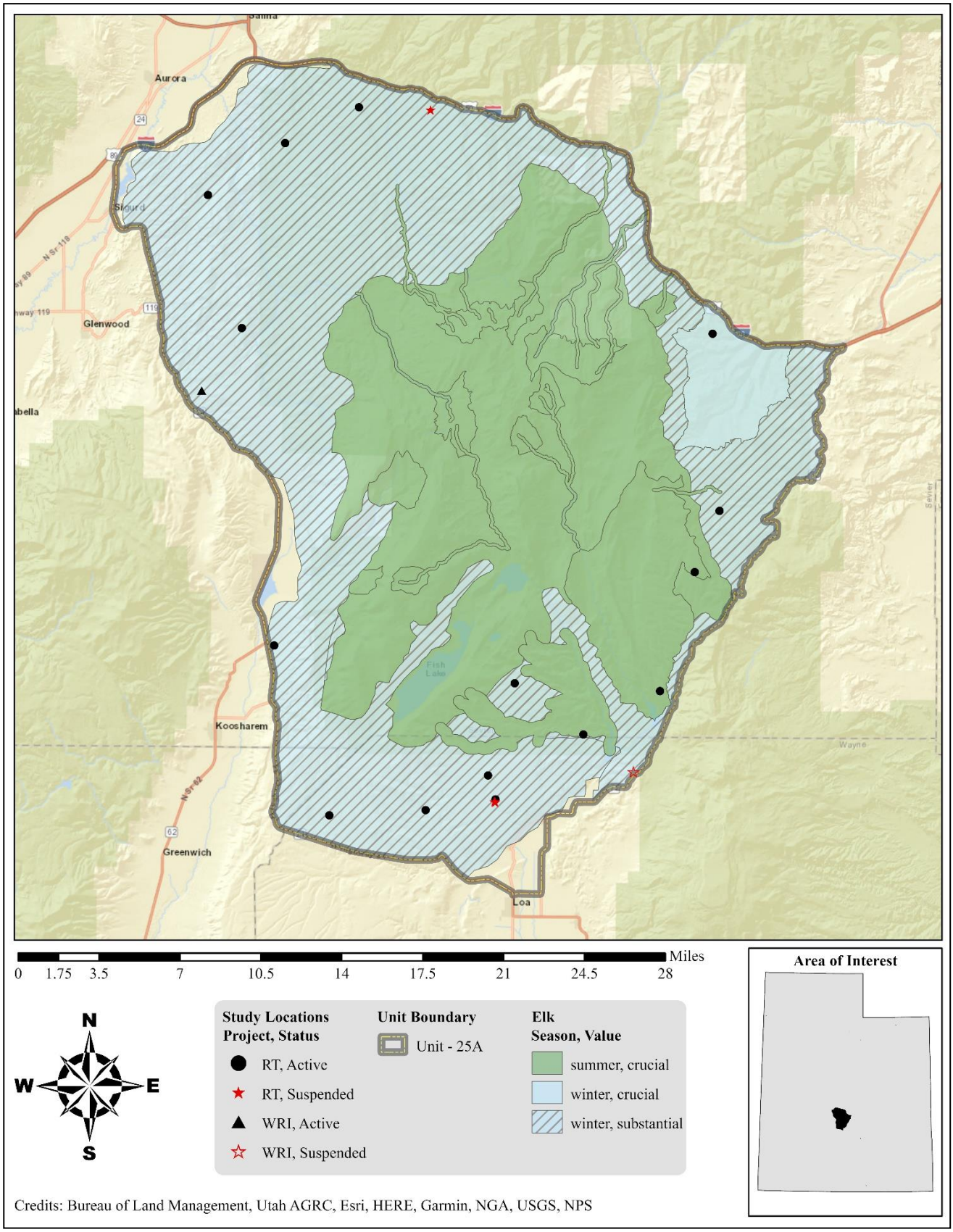


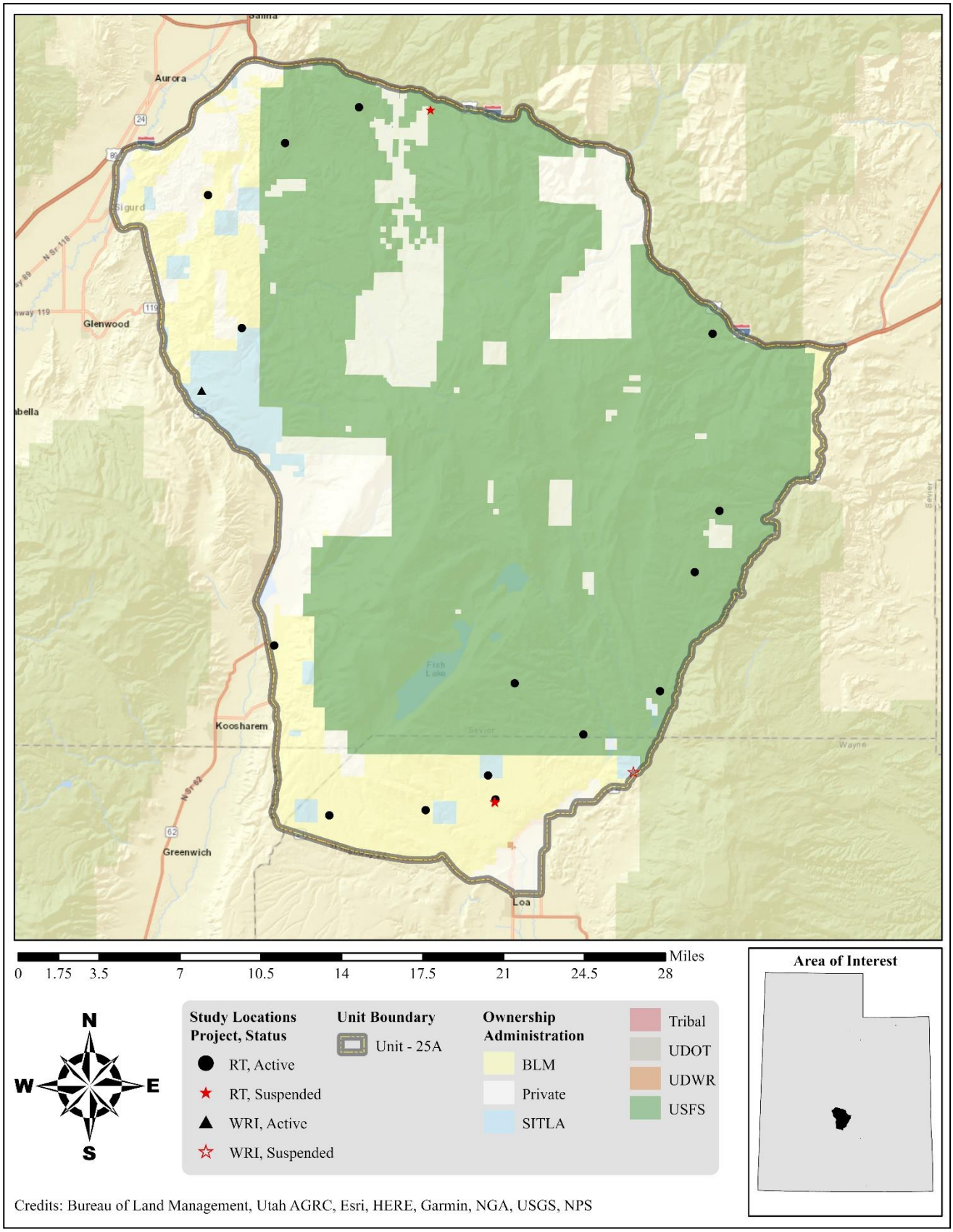
Figure 3.7: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 25A, Fishlake Plateau (Rangeland Analysis Platform, 2024).



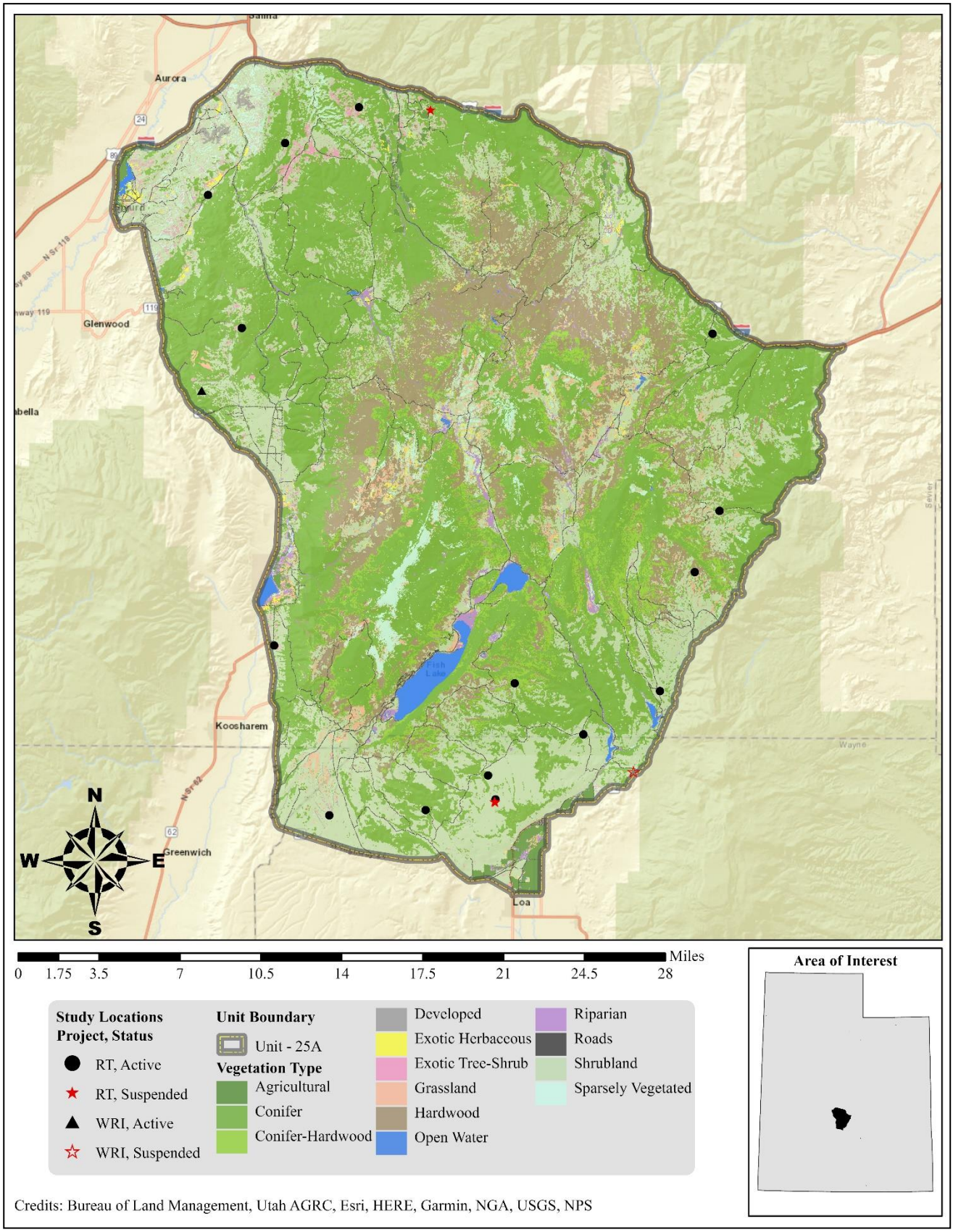
Map 3.2: Estimated mule deer habitat by season and value for WMU 25A, Fishlake Plateau.



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



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



Map 3.5: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 25A, Fishlake Plateau.

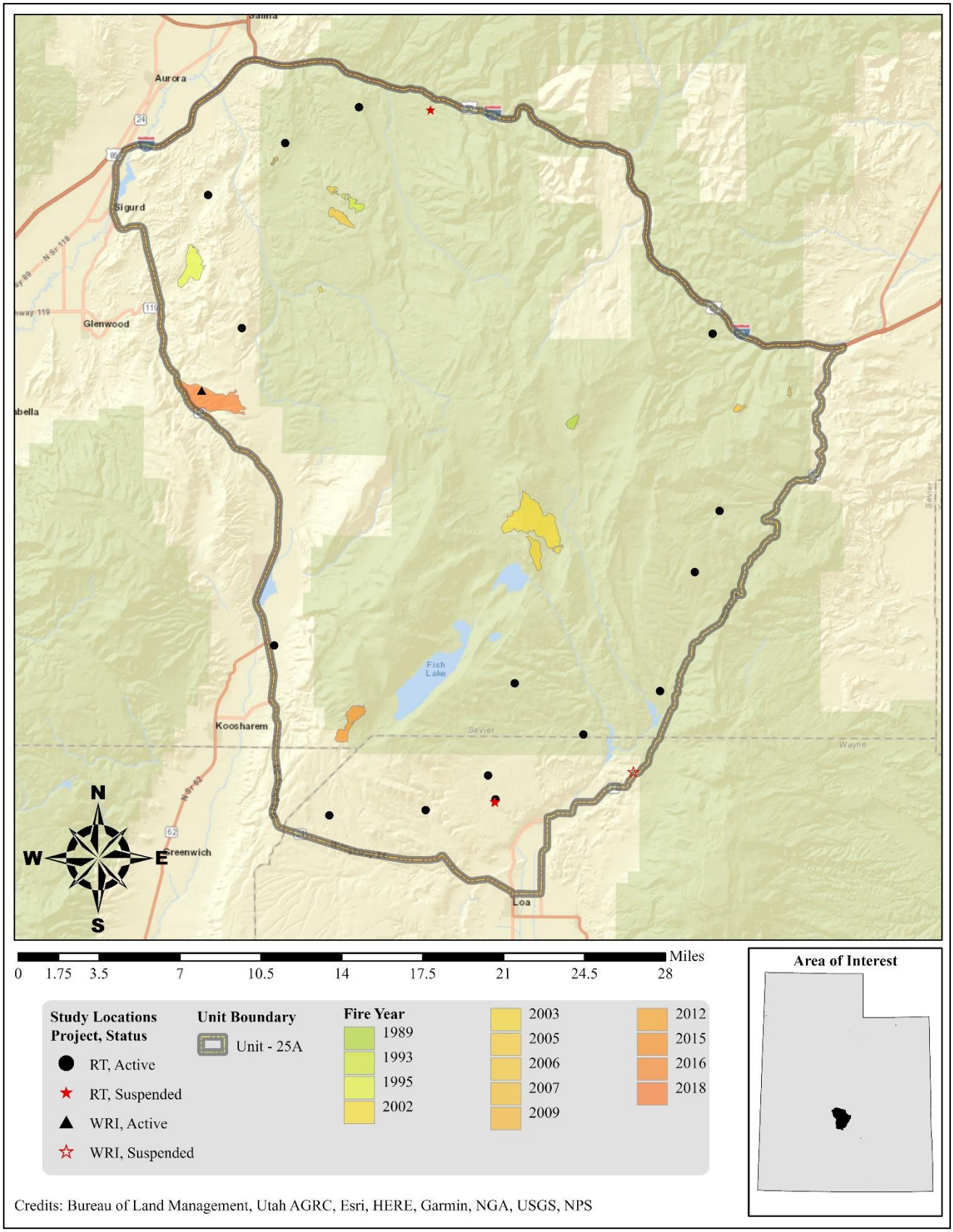
LANDFIRE Existing Vegetation Types on Mule Deer Habitat

Pinyon-juniper woodlands make up 26% of the mule deer habitat in the Fishlake Plateau management unit according to the current LANDFIRE Existing Vegetation Type model (**Table 3.1**). These woodlands are usually located at lower elevations and may be associated with understory browse species known to be beneficial to mule deer, although abundance can vary widely. Pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) woodlands may provide valuable escape and thermal cover for wildlife. When these trees encroach on existing shrublands, however, they can lead to decreased sagebrush (*Artemisia spp.*) and herbaceous components (Miller, Svejcar, & Rose, 2000), therefore decreasing available forage for wildlife.

The model also indicates that sagebrush steppe and shrublands make up just over 21% of the unit's mule deer habitat (**Table 3.1**). These biophysical sites can be found at elevations ranging from low (semidesert) to high (mountain and subalpine). Sagebrush species typically dominate these biophysical sites across the elevation gradient, and may provide valuable browse for deer when they are present on winter range. However, other preferred browse species may be present in lesser amounts. At higher elevations, these biophysical sites are often host to abundant herbaceous understories and pinyon and juniper may be present at lower to middle elevations. Approximately 7% of the unit's mule deer habitat is made up of types that may have little to no value for mule deer, including developed land, sparsely vegetated areas, open water, agricultural land, and energy developments. The rest of the mule deer habitat within the Fishlake Plateau management unit is comprised of a number of other vegetation types (**Table 3.1**), but those will not be discussed here. Descriptions for these additional vegetation types are available on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	112,542	26.23%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	37,063	8.64%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	23,711	5.53%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	9,684	2.26%	
	Southern Rocky Mountain Ponderosa Pine Woodland	7,534	1.76%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	5,896	1.37%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	5,736	1.34%	
	Great Basin Pinyon-Juniper Woodland	4,563	1.06%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	2,317	0.54%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	2,294	0.53%	49.26%
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	75,100	17.50%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	10,740	2.50%	
	Inter-Mountain Basins Big Sagebrush Shrubland	8,580	2.00%	
	Great Basin Xeric Mixed Sagebrush Shrubland	7,746	1.81%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	4,543	1.06%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	1,980	0.46%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	607	0.14%	
	Rocky Mountain Alpine Dwarf-Shrubland	371	0.09%	
	Rocky Mountain Lower Montane-Foothill Shrubland	192	0.04%	
	Great Basin Semi-Desert Chaparral	116	0.03%	
	Inter-Mountain Basins Big Sagebrush Steppe	22	0.01%	
	Inter-Mountain Basins Greasewood Flat	9	0.00%	25.64%
Hardwood	Rocky Mountain Aspen Forest and Woodland	55,016	12.82%	
	Rocky Mountain Bigtooth Maple Ravine Woodland	3,012	0.70%	13.52%
Other	Developed	12,350	2.88%	
	Sparsely Vegetated	11,187	2.61%	
	Riparian	5,239	1.22%	
	Open Water	4,190	0.98%	
	Agricultural	2,634	0.61%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	257	0.06%	8.36%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	4,177	0.97%	
	Southern Rocky Mountain Montane-Subalpine Grassland	3,736	0.87%	
	Rocky Mountain Alpine Turf	254	0.06%	
	Inter-Mountain Basins Semi-Desert Grassland	39	0.01%	
	Rocky Mountain Alpine Fell-Field	18	0.00%	1.92%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	3,066	0.71%	
	Interior Western North American Temperate Ruderal Shrubland	198	0.05%	0.76%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	1,327	0.31%	
	Introduced Perennial Grassland and Forbland	653	0.15%	
	Great Basin & Intermountain Introduced Annual Grassland	206	0.05%	
	Introduced Annual and Biennial Forbland	163	0.04	0.55%
Total		**429,067**	**100%**	**100%**

Table 3.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 25A, Fishlake Plateau.



Map 3.6: Land coverage of fires by year from 1989-2018 for WMU 25A, Fishlake Plateau (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

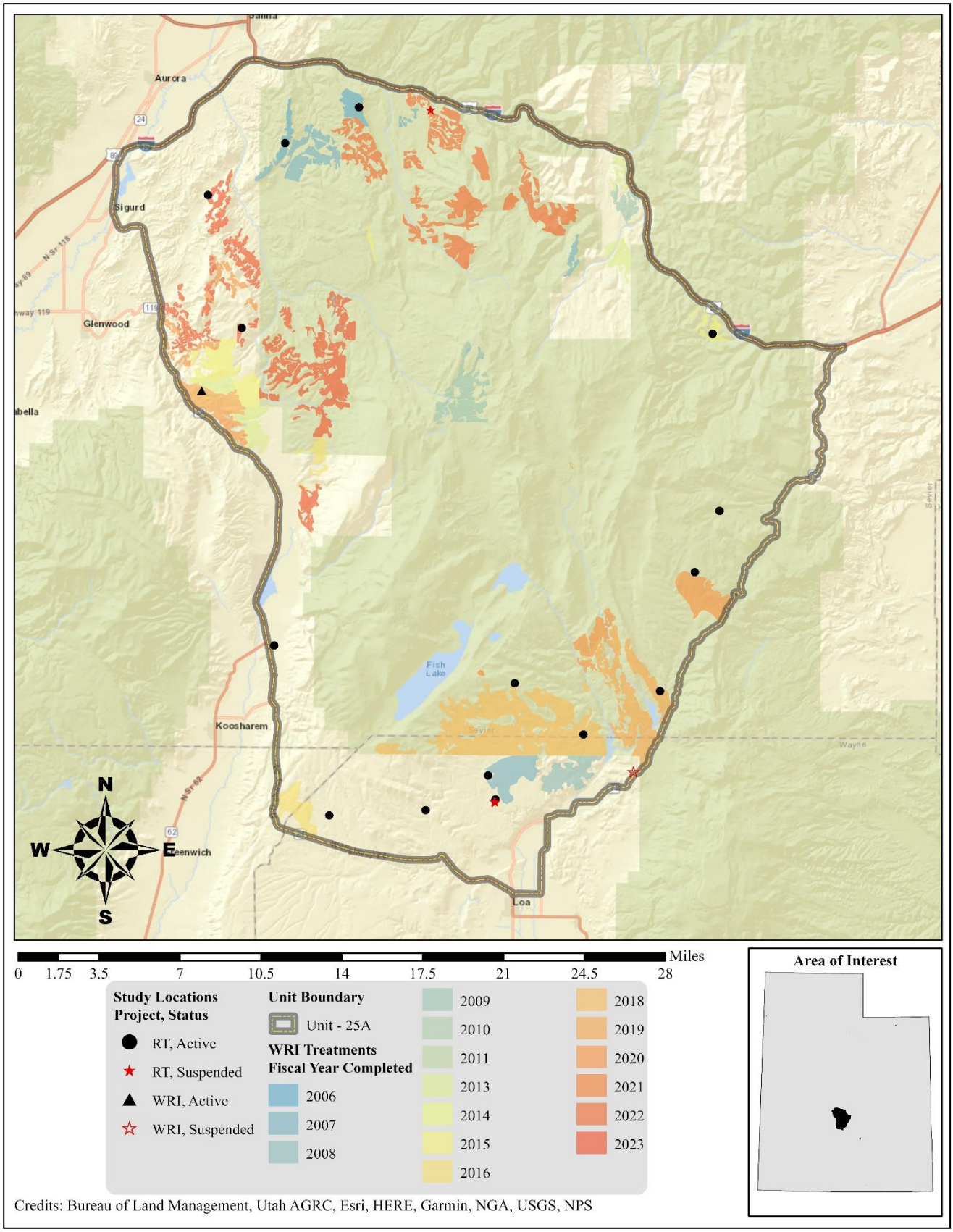
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 50,677 acres of land have been treated within the Fishlake Plateau unit since the WRI was implemented in 2004 (**Map 3.7**). Treatments frequently overlap one another bringing the net total of completed treatment acres for this unit to 47,843. 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.

Manual vegetation removal (lop and scatter, etc.) to treat pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) trees is the most common management practice by acreage in this unit. Harrow treatments are also common, as are bullhog and chaining for tree removal. Other management practices include (but are not limited to) seeding to augment herbaceous components, mowing, and herbicide application (**Table 3.2**).

Type	Total Completed Acreage
Anchor Chain	**3,698**
Ely (One-Way)	526
Ely (Two-Way)	3,172
Bullhog	**4,885**
Full Size	2,214
Skid Steer	2,671
Chain Harrow	**426**
> 15 ft. (Two-Way)	426
Forestry Practices	**52**
Clearcutting	52
Harrow	**6,959**
≤ 15 ft. (Two-Way)	4,050
> 15 ft. (One-Way)	112
> 15 ft. (Two-Way)	2,797
Herbicide Application	**657**
Aerial (Fixed-Wing)	645
Aerial (Helicopter)	11
Mowing	**2,214**
Brush Hog	2,214
Seeding (Primary)	**2,829**
Broadcast (Aerial-Fixed Wing)	1,899
Broadcast (Aerial-Helicopter)	876
Hand Seeding	54
Seeding (Secondary/Shrub)	**58**
Broadcast (Aerial-Fixed Wing)	58
Vegetation Removal/Hand Crew	**28,888**
Lop (No Scatter)	7,995
Lop & Scatter	20,893
Other	**2**
Road Decommissioning	1
Road/Parking Area Improvements	1
Grand Total	**50,667**
***Total Land Area Treated**	**47,843**

Table 3.2: WRI treatment action size (acres) of completed projects for WMU 25A, Fishlake Plateau. Data accessed on 02/07/2024.
*Does not include overlapping treatments.



Map 3.7: Terrestrial WRI treatments by fiscal year completed for WMU 25A, Fishlake Plateau.

Range Trend Studies

Range Trend studies have been sampled within WMU 25A on a regular basis since 1985, with studies being added or suspended as was deemed necessary (**Table 3.3**). 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
25A-01	Triangle Mountain	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Black Sagebrush)
25A-02	Black Mountain	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Black Sagebrush)
25A-03	Sage Flat	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Semidesert Gravelly Loam (Wyoming Big Sagebrush)
25A-04	Durfee Homestead	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Mountain Stony Loam (Mountain Big Sagebrush)
25A-05	Praetor Slope	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-07	Evans Reservoir	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Mountain Loam (Mountain Big Sagebrush)
25A-08	Lower Dog Flat	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
25A-09	Row of Pines	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-10	Cedarless Flat	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-11	Forsyth Reservoir	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Gravelly Loam (Black Sagebrush)
25A-12	East Tidwell	RT	Active	1991, 1999, 2004, 2009, 2013, 2018, 2023	High Mountain Loam (Mountain Big Sagebrush)
25A-13	Ox Spring	RT	Active	1991, 1999, 2004, 2009, 2013, 2018, 2023	High Mountain Loam (Mountain Big Sagebrush)
25A-14	Row of Pines Exclosure	RT	Active	1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
25A-16	Tommy Hollow	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-18	Elk Camp	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Mountain Stony Loam (Mountain Big Sagebrush)
25A-19	Row of Pines Livestock Exclosure	RT	Suspended	1999, 2004, 2009	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25A-20	Row of Pines Total Exclosure	RT	Suspended	1999, 2004, 2009	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25R-01	Gooseberry	RT	Suspended	1997, 2004, 2009	Upland Loam (Black Sagebrush)
25R-06	North Fremont Dixie	WRI	Suspended	2007, 2010	Not Verified
25R-09	Sand Ledges	WRI	Active	2012, 2016, 2020	Mountain Stony Loam (Mountain Big Sagebrush)

Table 3.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 25A, Fishlake Plateau.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
25A-01	Triangle Mountain	Chain Unknown		1970		
		Seed Unknown		1970		
		Two-Way Dixie	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	Fall 2005	4,079	216
		Broadcast	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	Fall 2005	1,600	216
25A-02	Black Mountain	Bullhog		Between 1999 and 2004		
		Chain Unknown		1984		
		Seed Unknown		1984		
		Two-Way Dixie	Fishlake NF PJ Maintenance-Sagebrush Enhancement - Year 1	Fall 2005	4,079	216
25A-04	Durfee Homestead	Chain Unknown		1983		
		Seed Unknown		1983		
		Prescribed Fire	Gypsum Sandledge Prescribed Fire	August-September 1985	1,000	LTDL
		Aerial Unknown	Gypsum Sandledge Prescribed Fire	October 1985	1,000	LTDL
25A-05	Praetor Slope	Chain Unknown	Praetor Slopes Reseeding	May 1963	1,400	LTDL
		Rangeland Drill	Praetor Slopes Reseeding	Spring 1964	1,440	LTDL
		Two-Way Dixie		2002	3,000	PDB
		Seed Unknown		2002	3,000	PDB
25A-07	Evans Reservoir	Two-Way Dixie		Fall 1999		PDB
		Seed Unknown		Fall 1999		PDB
25A-08	Lower Dog Flat	Chain Unknown		1980		
		Seed Unknown		1980		
		Two-Way Dixie	Seven Mile Dixie Harrow 2006	October-December 2006	4,275	LTDL
		Broadcast Before	Seven Mile Dixie Harrow 2006	November-December 2006	4,275	LTDL
		Aerial Unknown	Seven Mile Dixie Harrow 2006	January 2007	2,000	LTDL
25A-10	Cedarless Flat	Chain Unknown		1987		
		Seed Unknown		1987		
		Lop and Scatter	Mytoge-Tidwell Sage Grouse Habitat Improvement Phase 1	August 2017-July 2018	7,964	3995
25A-11	Forsyth Reservoir	Lop and Scatter	Mytoge-Tidwell Sage Grouse Habitat Improvement Phase 2	July 2018-June 2021	3,504	4604
25A-13	Ox Spring	Prescribed Fire		1989 or 1990		
25A-14	Row of Pines Exclosure	Two-Way Unknown	Roe Pine Bench Chaining and Seeding 1983	August-November 1983	2,345	LTDL
		Aerial Unknown	Roe Pine Bench Chaining and Seeding 1983	August-November 1983	2,345	LTDL
		Two-Way Dixie	Seven Mile Dixie Harrow 2006	October-December 2006	4,275	LTDL
		Broadcast Before	Seven Mile Dixie Harrow 2006	November-December 2006	4,275	LTDL
		Aerial Unknown	Seven Mile Dixie Harrow 2006	January 2007	2,000	LTDL
25A-18	Elk Camp	Lop and Scatter	Last Chance Habitat Improvement Project Phase 1	2023	6,650	5197
		Prescribed Fire		1990		
25A-19	Row of Pines Livestock Exclosure	Two-Way Unknown	Roe Pine Bench Chaining and Seeding 1983	August-November 1983	2,345	LTDL
		Aerial Unknown	Roe Pine Bench Chaining and Seeding 1983	August-November 1983	2,345	LTDL
25A-20	Row of Pines Total Exclosure	Two-Way Unknown	Roe Pine Bench Chaining and Seeding 1983	August-November 1983	2,345	LTDL
		Aerial Unknown	Roe Pine Bench Chaining and Seeding 1983	August-November 1983	2,345	LTDL
25R-01	Gooseberry	Chain Unknown		Fall 1997		
		Seed Unknown		Fall 1997		
25R-09	Sand Ledges	Unknown	Sand Ledges Chaining 1983	July-November 1983	1,980	LTDL
		Aerial Unknown	Sand Ledges Chaining 1983	July-November 1983	1,980	LTDL
		Lop and Scatter	Sandledges Lop and Scatter Project Phase II	June 2013	2,275	2334
		Wildfire	Willow Patch Fire	June-July 2018	4,583	
		Plateau	Willow Patch Fire Rehabilitation Project	Fall 2018	1,674	4739
		Aerial Before	Willow Patch Fire Rehabilitation Project	Winter 2019	1,674	4739
		One-Way Ely	Willow Patch Fire Rehabilitation Project	Winter 2019-June 2021	1,674	4739

Table 3.4: Range Trend and WRI studies known disturbance history for WMU 25A, Fishlake Plateau. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

The Semidesert (Big Sagebrush) ecotype is represented by only one study site [Sage Flat (25A-03)] and is not discussed in this section. Trend summaries and data for this ecotype are available in the corresponding site report.

Mountain (Big Sagebrush)

Five studies [Durfee Homestead (25A-04), Evans Reservoir (25A-07), East Tidwell (25A-12), Ox Spring (25A-13), and Elk Camp (25A-18) are classified as Mountain (Big Sagebrush) ecological sites. The Durfee Homestead study site is about four miles east of SR-24 on Cedar Mountain. The Evans Reservoir study is located south of Fish Lake between the south side of the lake and SR-24. The East Tidwell study is located on the Tidwell Slopes approximately five miles north of Forsyth Reservoir. The Ox Spring study can be found in the Mytoge Mountains approximately three miles east of Fish Lake. Finally, the Elk Camp study is located around five miles north of the Tidwell Slopes along South Last Chance Creek.

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant preferred browse species on most of these study sites as of 2023; the exception to this is the East Tidwell study, on which black sagebrush (*A. nova*) is the dominant preferred browse species. Other preferred browse is also present on some sites, including species such as mountain snowberry (*Symphoricarpos oreophilus*), antelope bitterbrush (*Purshia tridentata*), Gambel oak (*Quercus gambelii*), and Woods' rose (*Rosa woodsii*). Total average shrub cover on these sites has increased over time. This trend can largely be attributed to overall increases in sagebrush cover on all sites except Durfee Flat. Cover of shrubs other than preferred browse species exhibited an initial decrease between 2004 and 2009, but has increased since that time: this is mainly due to the Ox Spring and Elk Camp studies (**Figure 3.8**). Average preferred browse density has fluctuated from year to year, but has increased in total. More specifically, site-level data shows that browse density has exhibited significant increases since 2004 on the Evans Reservoir, East Tidwell, and Ox Spring studies. Demographic data shows that mature plants have comprised a majority of the browse populations on these sites since study establishment. Demographic data also indicates that decadence has decreased overall while recruitment of young has slightly increased (**Figure 3.11**). Browse utilization has displayed yearly fluctuations, but has generally decreased over time; 6% of plants were moderately browsed and 19% showed signs of heavy use in 2023 (**Figure 3.12**).

Twoneedle pinyon (*Pinus edulis*) and Rocky Mountain and/or Utah juniper (*Juniperus scopulorum* and/or *J. osteosperma*) have been present on the Elk Camp and Durfee Homestead studies throughout the sample period. Tree cover has decreased over time, primarily due to a 2023 lop and scatter treatment on the Elk Camp site (**Figure 3.9**). Tree density appears to have increased since 2004. However, site photos indicate that trees were present on these studies in 2004, but point-quarter density measurements were not taken. Density increased between 2009 and 2018, but decreased in 2023: again, this is mainly due to the lop and scatter treatment on Elk Camp (**Figure 3.10**).

Herbaceous Understory: The herbaceous understories of these study sites are rich, abundant, and primarily composed of perennial grasses. Total average herbaceous cover and abundance have fluctuated from year to year, but both values have remained similar when comparing 1999 data with that from 2023. Perennial forbs have also contributed notable cover throughout the study period, but that provided by their annual counterparts has remained low. The introduced annual grass species cheatgrass (*Bromus tectorum*) and/or field brome (*B. arvensis*) have been present on some of these study sites, but with very low cover and abundance (**Figure 3.13**, **Figure 3.15**).

Occupancy: Average pellet transect data shows an overall decreasing trend in animal presence. Elk have been the primary occupants on these sites in all sample years, and mean pellet group abundance has ranged from 14.5 days use/acre in 2023 to 54.5 days use/acre in 1999. Average abundance of deer and/or antelope pellet groups has been as low as 5 days use/acre in 2013 and as high as 46 days use/acre in 2009. Cattle have also been present on these sites, and mean pellet group abundance has fluctuated between 1 days use/acre in 2018 and 11 days use/acre in 1999 (**Figure 3.17**).

Upland (Big Sagebrush)

Six studies [Praetor Slope (25A-05), Lower Dog Flat (25A-08), Row of Pines (25A-09), Cedarless Flat (25A-10), Row of Pines Exclosure (25A-14), and Tommy Hollow (25A-16)] are classified as Upland (Big Sagebrush) ecological sites. The Praetor Slope site is located about one mile south of Koosharem Reservoir. The Lower Dog Flat study site can be found between Loa and Fish Lake near Black Ridge. Row of Pines is situated northwest of Fremont on the Row of Pines Bench. The Cedarless Flat site can be found about a mile west of Mill Meadow Reservoir. The Row of Pines Exclosure study is also located northwest of Fremont on the Row of Pines Bench. Finally, the Tommy Hollow study site is located near the top of Emigrant Pass south of I-70.

Shrubs/Trees: Mountain big sagebrush is the dominant preferred browse species on these studies, with lesser amounts of black sagebrush present on many sites. Other preferred browse species such as antelope bitterbrush and winterfat (*Krascheninnikovia lanata*) have also been present, but mainly on the Tommy Hollow study site. Average shrub cover has generally increased over the sample period. Furthermore, site-level data shows that sagebrush cover has increased overall on most studies when comparing 2004 data with that from 2023: this in turn has largely driven the overall increase in total shrub cover (**Figure 3.8**). Preferred browse demographic data has indicated an increasing number of plants per acre over time, and a majority of individual preferred browse plants have been classified as mature in all sample years. Recruitment of young plants has exhibited an overall increase, while decadence has generally remained low (**Figure 3.11**). Average preferred browse utilization has fluctuated from year to year. In 2023, 19% of plants were moderately hedged and 25% showed signs of heavy browsing: most of this use occurred on the Lower Dog Flat, Row of Pines, and Row of Pines Exclosure studies (**Figure 3.12**).

Trees – particularly Utah juniper, Rocky Mountain juniper, and/or twoneedle pinyon – have been observed on many of these study sites. Tree cover has remained low throughout the sample period, and no cover was observed in 2023. Tree density has increased overall. However, a decrease in point-quarter density occurred between 2018 and 2023 mainly due to the Row of Pines and Tommy Hollow studies (**Figure 3.9**, **Figure 3.10**).

Herbaceous Understory: Cover and abundance of the herbaceous understories of these study sites have remained similar when comparing 1999 data with that from 2023. Yearly fluctuations have occurred, however, and total herbaceous cover decreased between 2018 and 2023: this was primarily due to decreases in perennial grass cover on all studies except Praetor Slope. Perennial grasses such as blue grama (*Bouteloua gracilis*) and muttongrass (*Poa fendleriana*) have been the dominant herbaceous component on these sites throughout the sample period. Perennial and annual forbs have been present on these sites, but have provided little cover overall. Annual grasses have remained rare throughout the sample period and were not observed on any study site in 2023 (**Figure 3.13**, **Figure 3.15**).

Occupancy: Average pellet transect data indicates that occupancy of these sites has fluctuated from year to year, but has decreased overall. Deer, antelope, and/or sheep have been the primary occupants of these sites throughout the study period; mean abundance of deer, antelope, and/or sheep pellet groups has ranged from nearly 15 days use/acre in 2013 and 2023 to 29 days use/acre in 1999. Average elk pellet group abundance has been as low as 4 days use/acre in 2018 and as high as 23 days use/acre in 2009. Finally, cattle have been present on one or more of these sites in all years and mean pellet group abundance has fluctuated between 4 days use/acre in 2004 and 9 days use/acre in 2023 (**Figure 3.17**).

Upland (Black/Low Sagebrush)

There are three studies [Triangle Mountain (25A-01), Black Mountain (25A-02), and Forsyth Reservoir (25A-11)] classified as Upland (Black/Low Sagebrush) ecological sites. The Triangle Mountain site is located between Salina and Gooseberry Road south of I-70. The Black Mountain site is situated about five miles south of the town of Salina. The Forsyth Reservoir study can be found about one half mile north of Forsyth Reservoir near the Tidwell Slopes.

Shrubs/Trees: Black sagebrush is the dominant preferred browse species on sites of this ecotype. Average sagebrush cover has increased over time: this trend is mainly driven by the Forsyth Reservoir study, as sagebrush provides little cover on Triangle Mountain and Black Mountain. Preferred browse species excluding sagebrush and shrubs other than preferred browse have contributed relatively small amounts of cover throughout the study period (**Figure 3.8**). Average preferred browse density data displays a decrease between 1999 and 2004, but density has increased in subsequent years: again, this is primarily due to the Forsyth Reservoir study. Mature plants have comprised a majority of the browse populations on these sites in all years. In addition, decadence has decreased since 2004 while recruitment of young has increased (**Figure 3.11**). Average utilization of preferred browse has exhibited fluctuations, but has decreased each sample year since 2013. In 2023, 9% of plants were moderately used and 5% displayed signs of heavy utilization (**Figure 3.12**).

Utah juniper and/or twoneedle pinyon have been present on these sites in all sample years. Tree cover and density displayed increasing trends between 2004 and 2018. However, both values decreased in 2021, primarily due to a lop and scatter treatment that occurred on the Forsyth Reservoir study between 2018 and 2021 (**Figure 3.9**, **Figure 3.10**).

Herbaceous Understory: The herbaceous understories of these study sites have mainly been composed of perennial grasses. Total herbaceous cover increased between 1999 and 2013, but has decreased since that time: this trend can largely be attributed to decreases in perennial grass cover on all three study sites. Total average nested frequency of herbaceous species has varied over the study years, but has remained stable when comparing 1999 data with that from 2023. However, abundance of individual lifeforms has fluctuated. Perennial grasses have remained abundant over the

sample years, but annual forbs were also common in 2023 due to increases on the Black Mountain and Triangle Mountain sites. Both perennial forbs and annual grasses have remained rare in comparison with perennial grasses and annual forbs (**Figure 3.14**, **Figure 3.16**).

Occupancy: Pellet transect data shows that total animal presence has decreased over time and that primary occupancy has fluctuated from year to year. Deer were the main occupants in 2004 and 2023, and average pellet group abundance has been as low as 8 days use/acre in 2013 and as high as 34 days use/acre in 1999. Elk have been the primary occupants in all other sample years, and mean abundance of pellet groups has ranged from 14 days use/acre in 2023 to 50 days use/acre in 1999. Finally, cattle have also been present on these sites with an average pellet group abundance fluctuating between 7 days use/acre in 2004 and 28 days use/acre in 2009 (**Figure 3.18**).

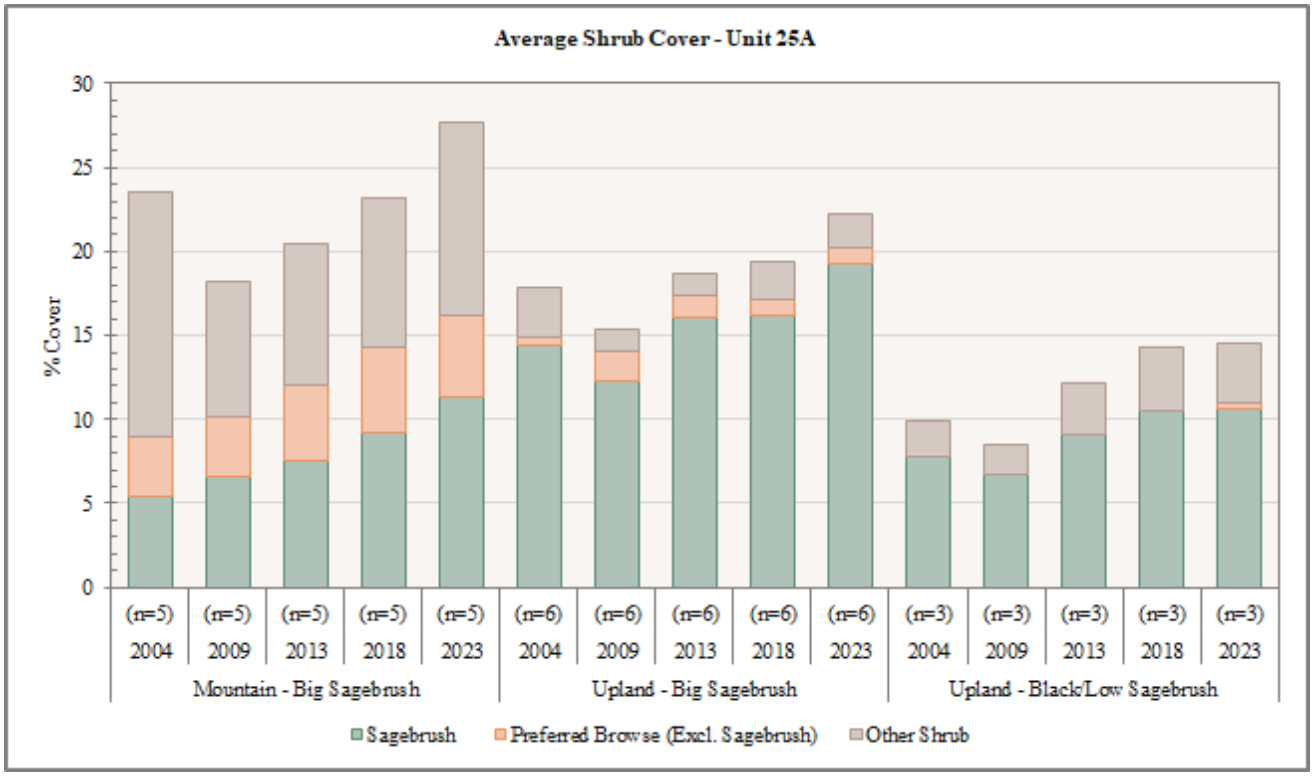


Figure 3.8: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

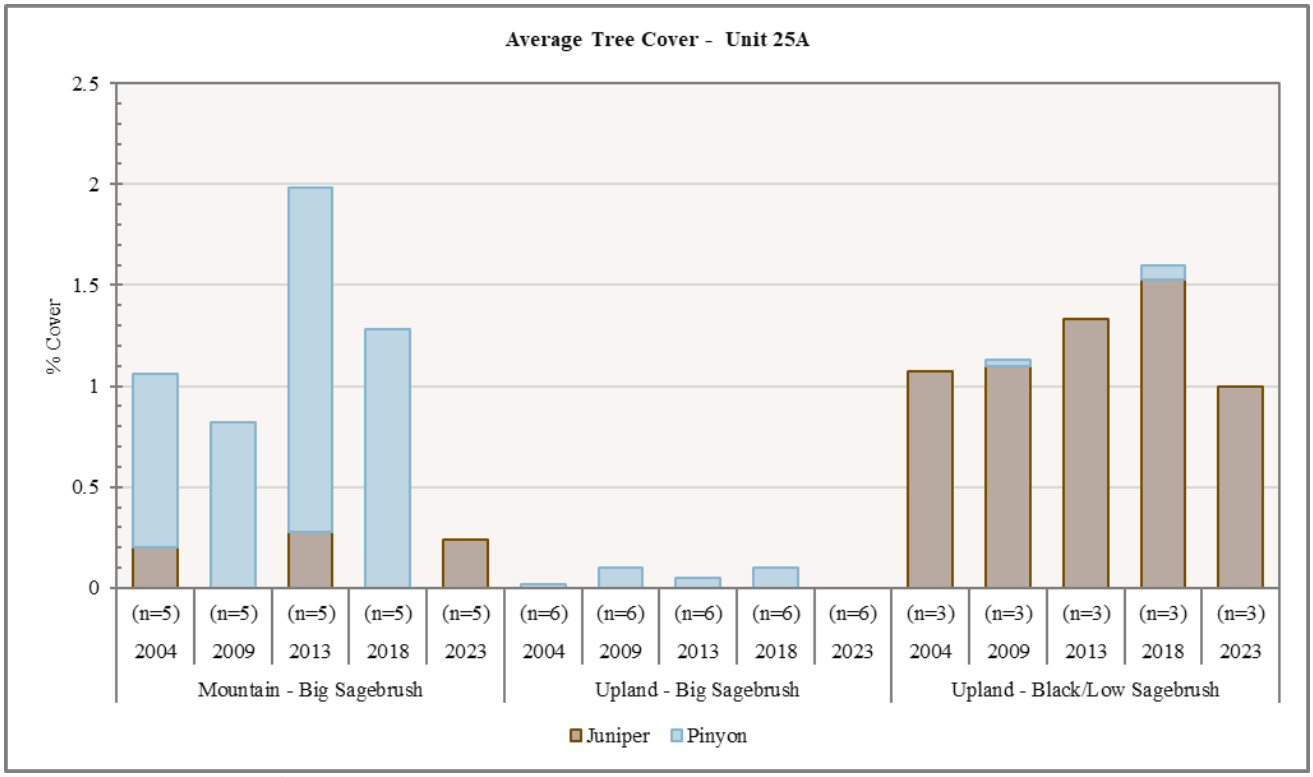


Figure 3.9: Average tree cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

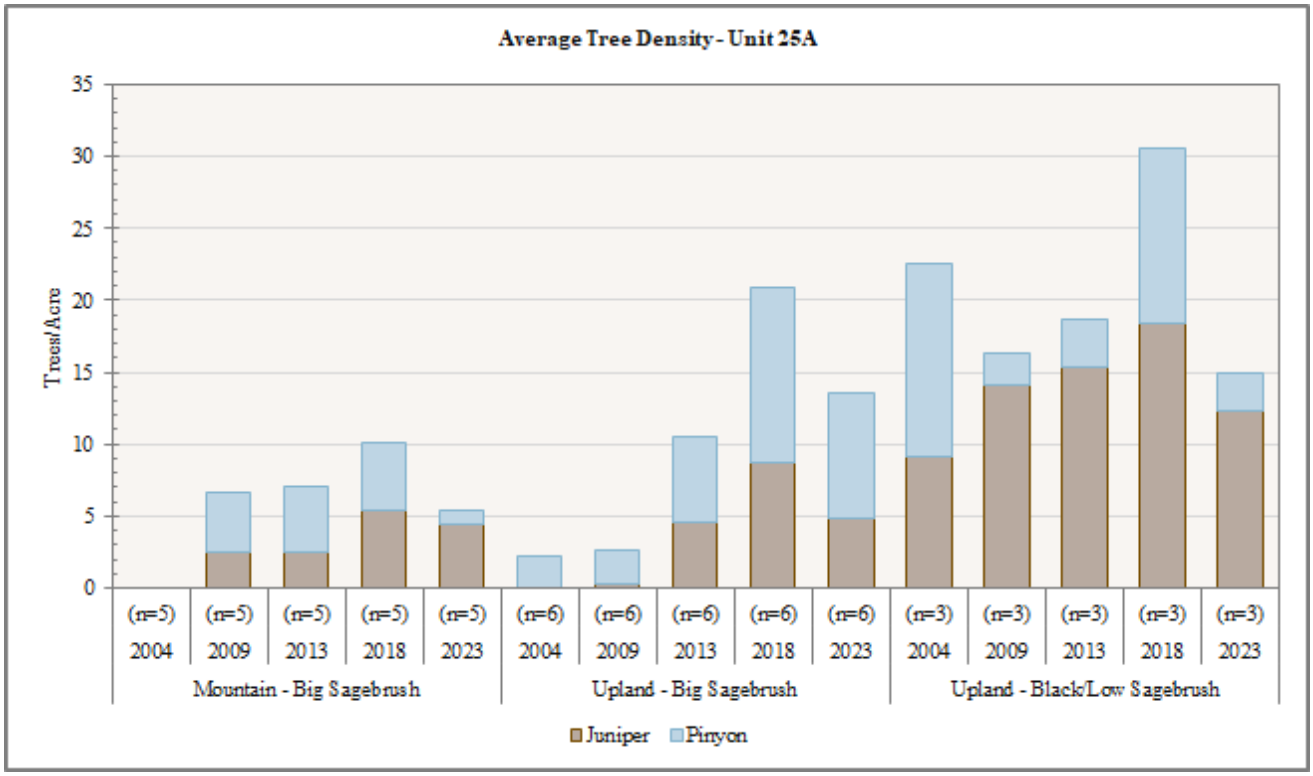


Figure 3.10: Average tree density for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

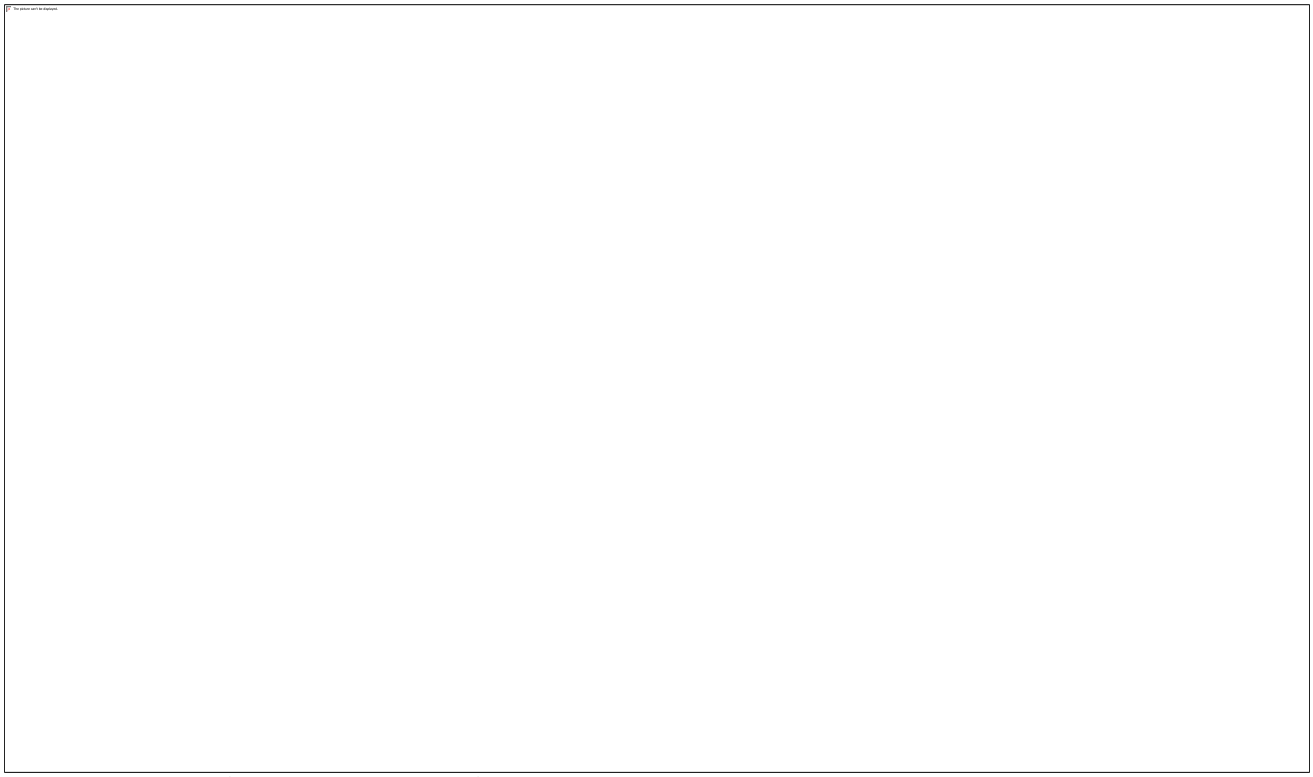


Figure 3.11: Average preferred browse demographics for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

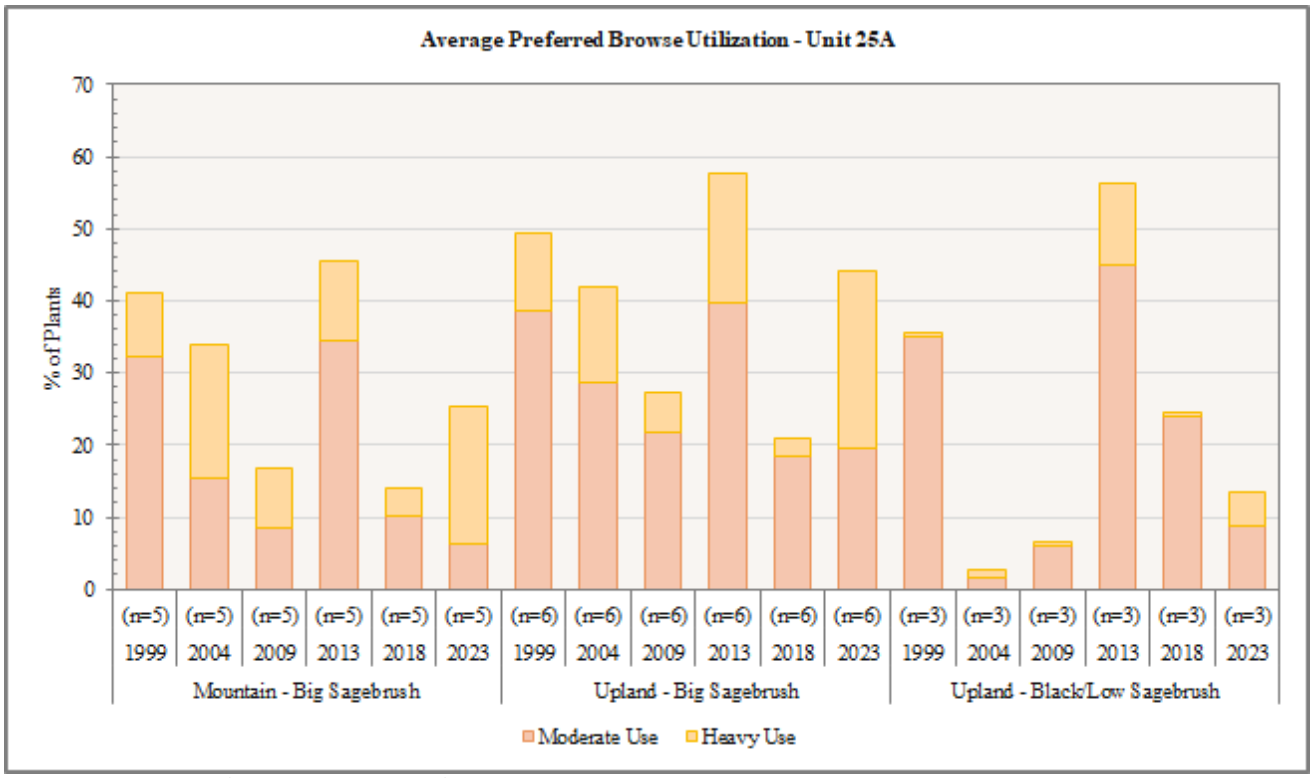


Figure 3.12: Average preferred browse utilization for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

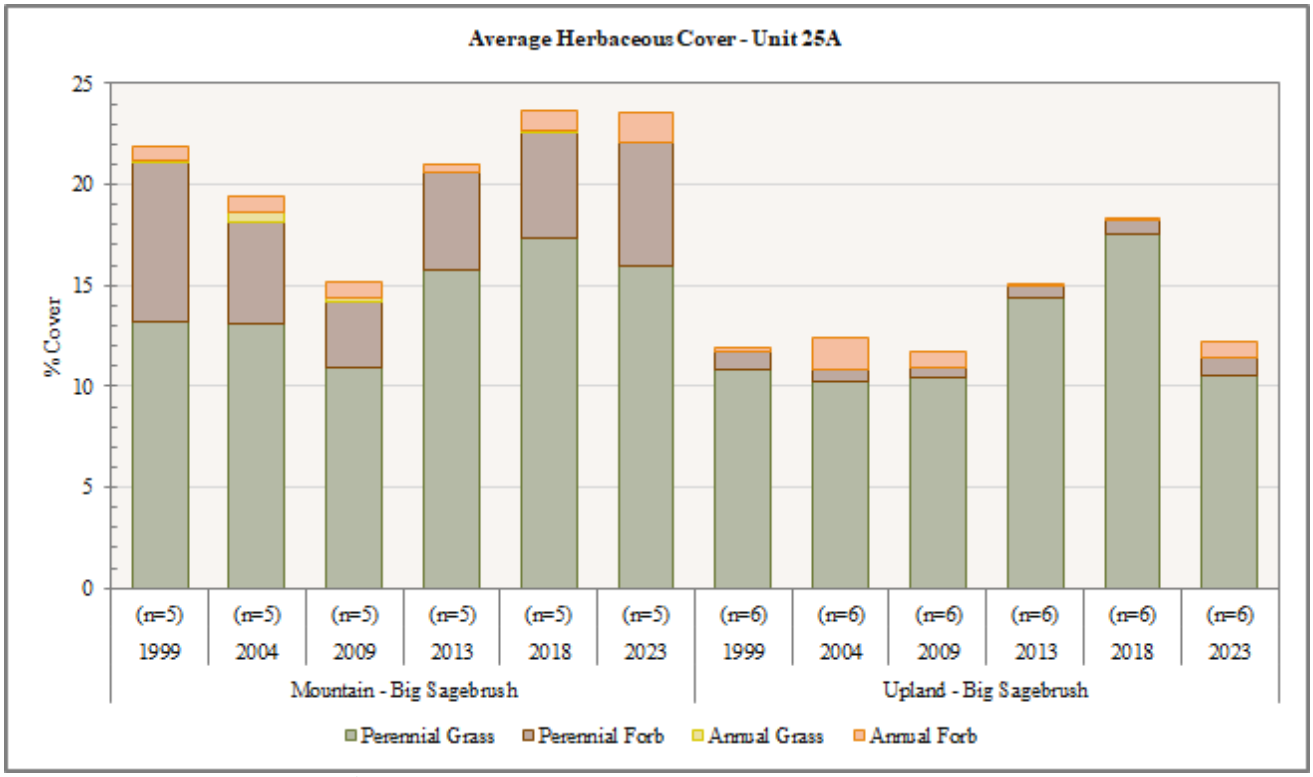


Figure 3.13: Average herbaceous cover for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 25A, Fishlake Plateau.

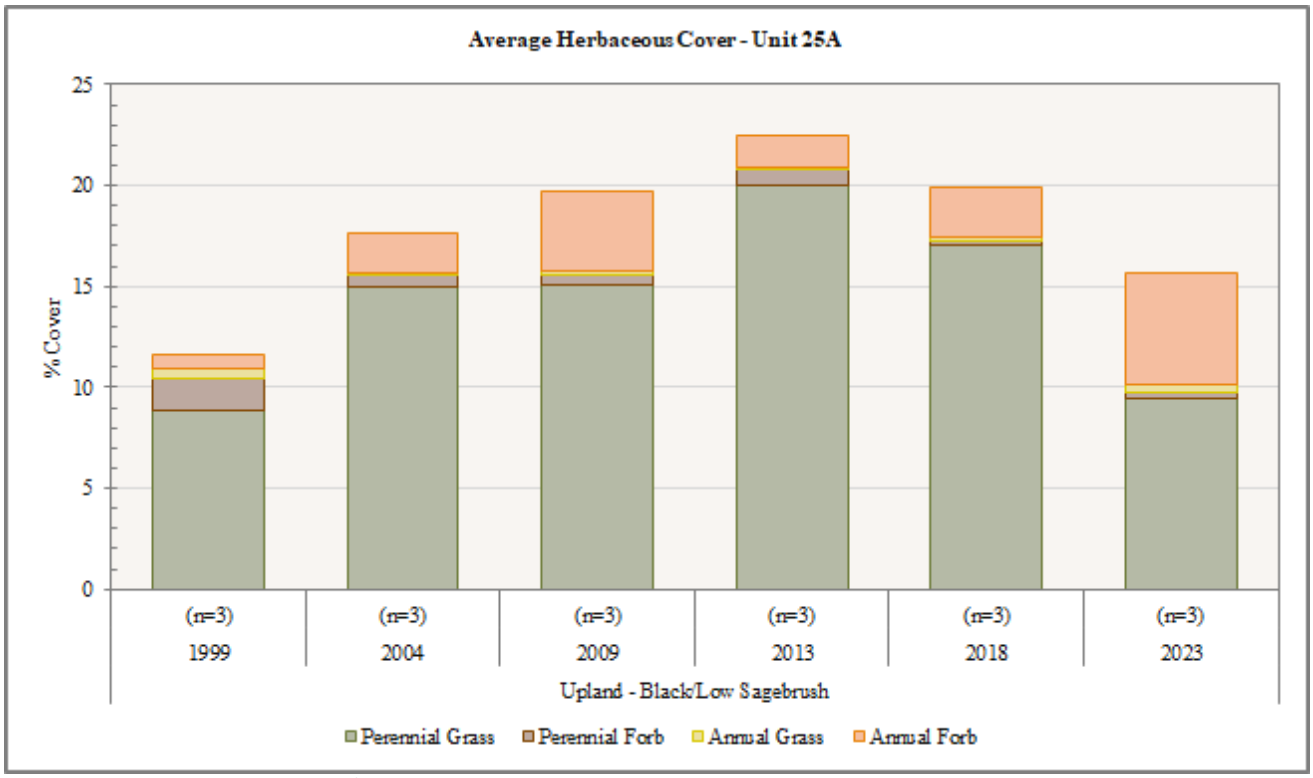


Figure 3.14: Average herbaceous cover for Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

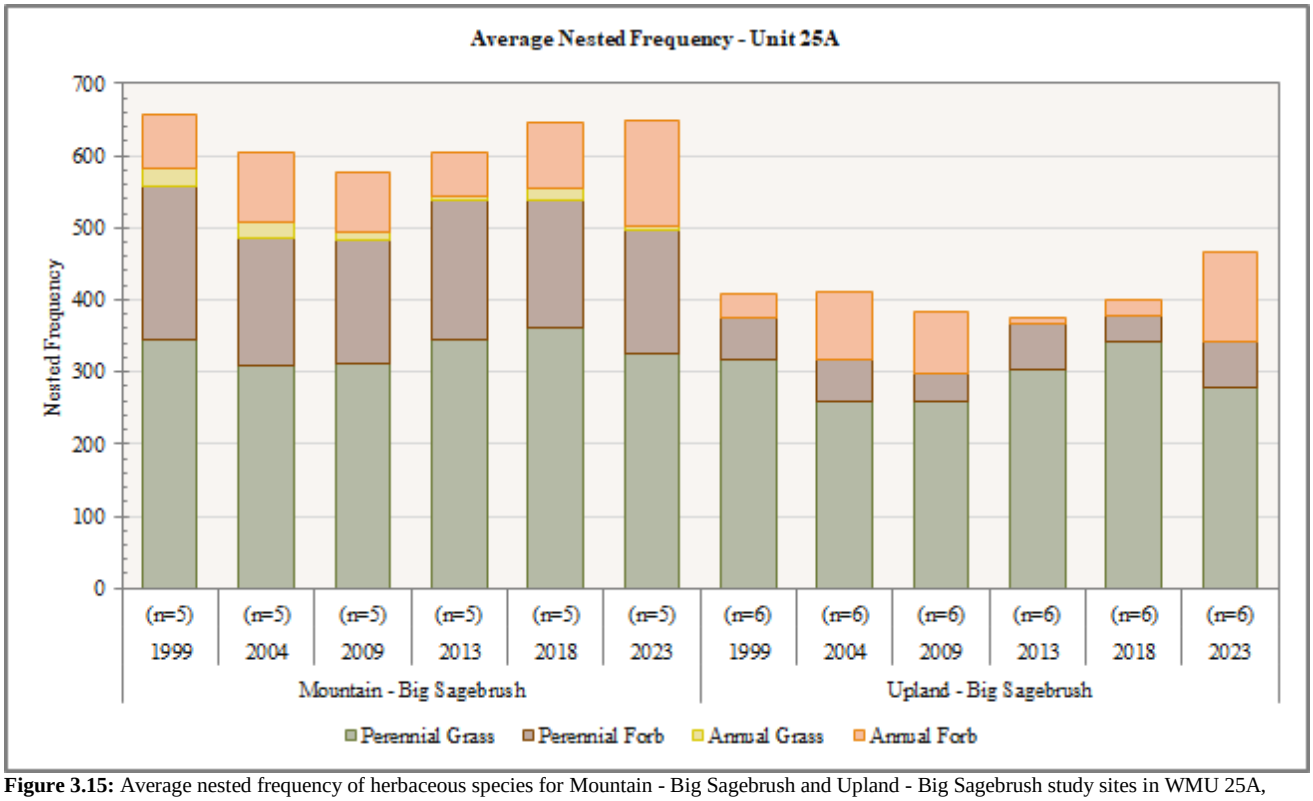


Figure 3.15: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 25A, Fishlake Plateau.

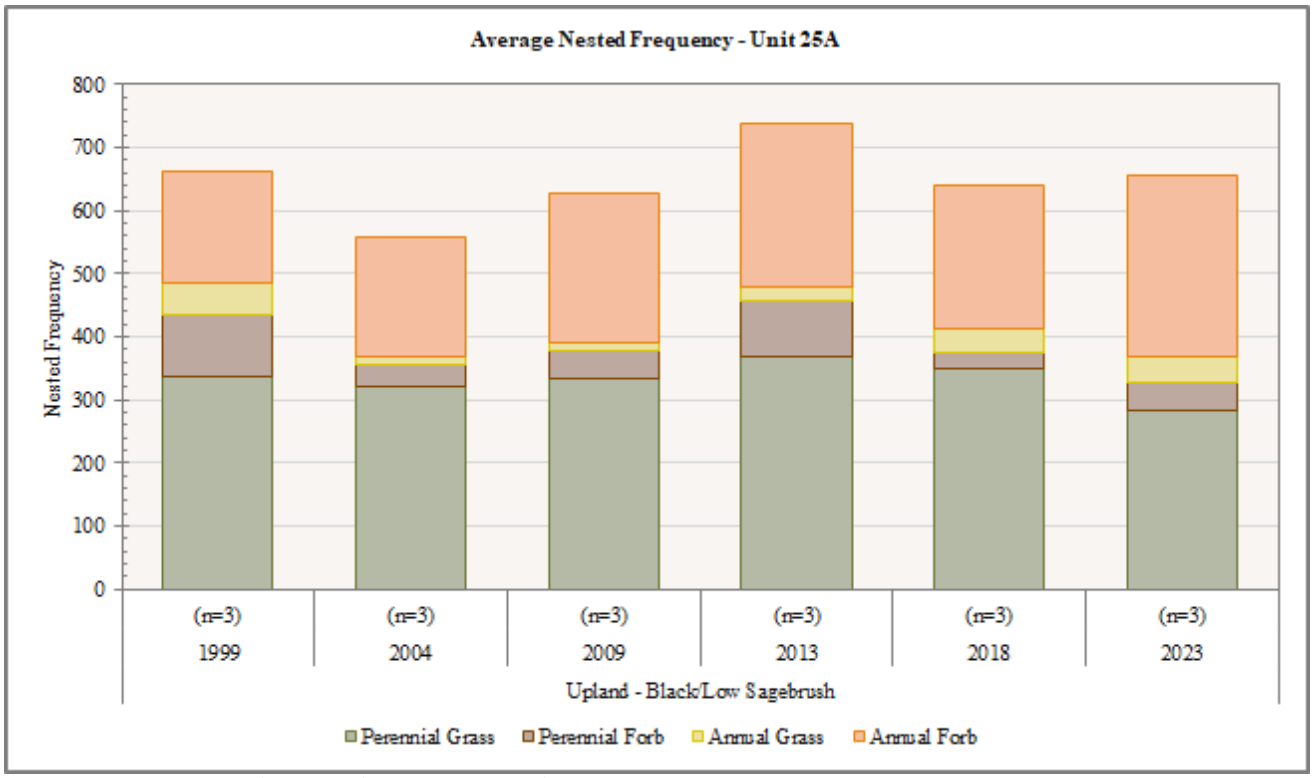


Figure 3.16: Average nested frequency of herbaceous species for Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

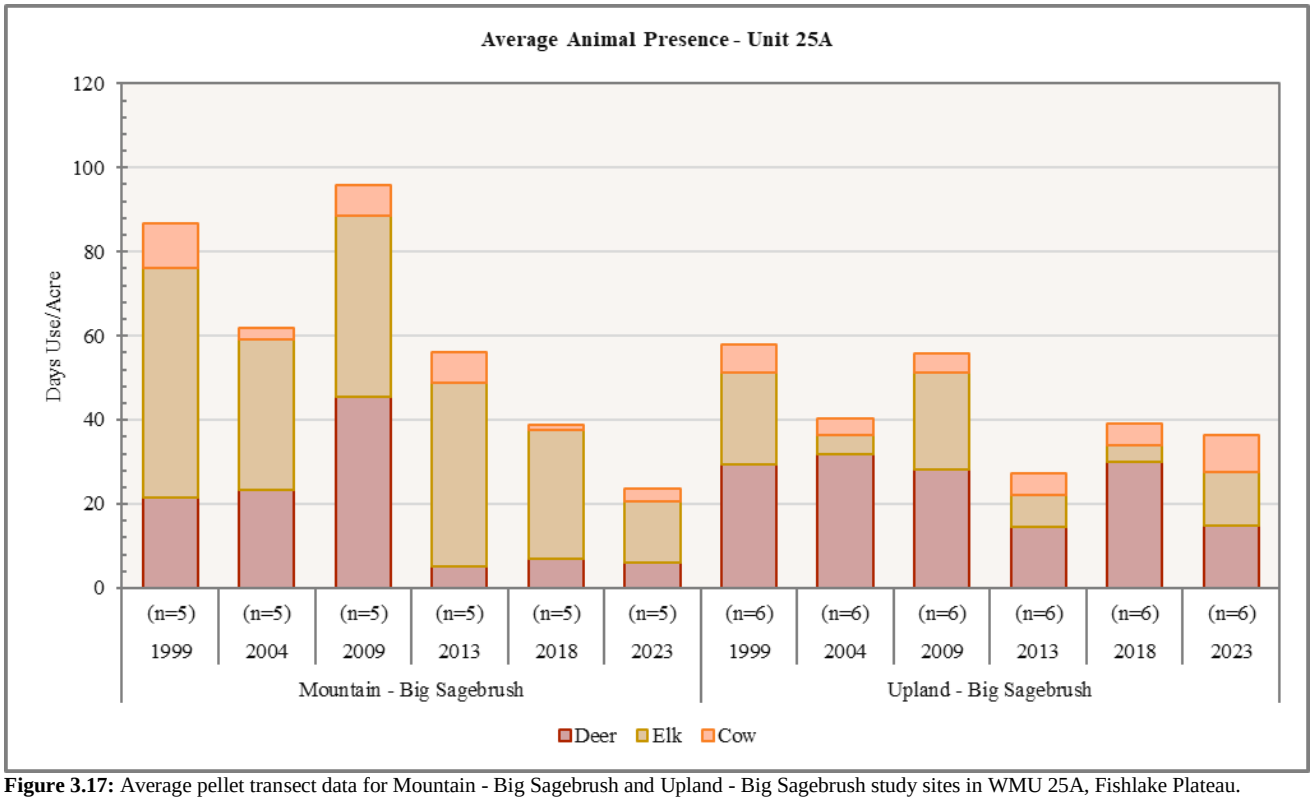


Figure 3.17: Average pellet transect data for Mountain - Big Sagebrush and Upland - Big Sagebrush study sites in WMU 25A, Fishlake Plateau. *Mountain - Big Sagebrush deer pellets include deer and antelope pellet groups. Upland - Big Sagebrush deer pellets include deer, antelope, and sheep pellet groups.

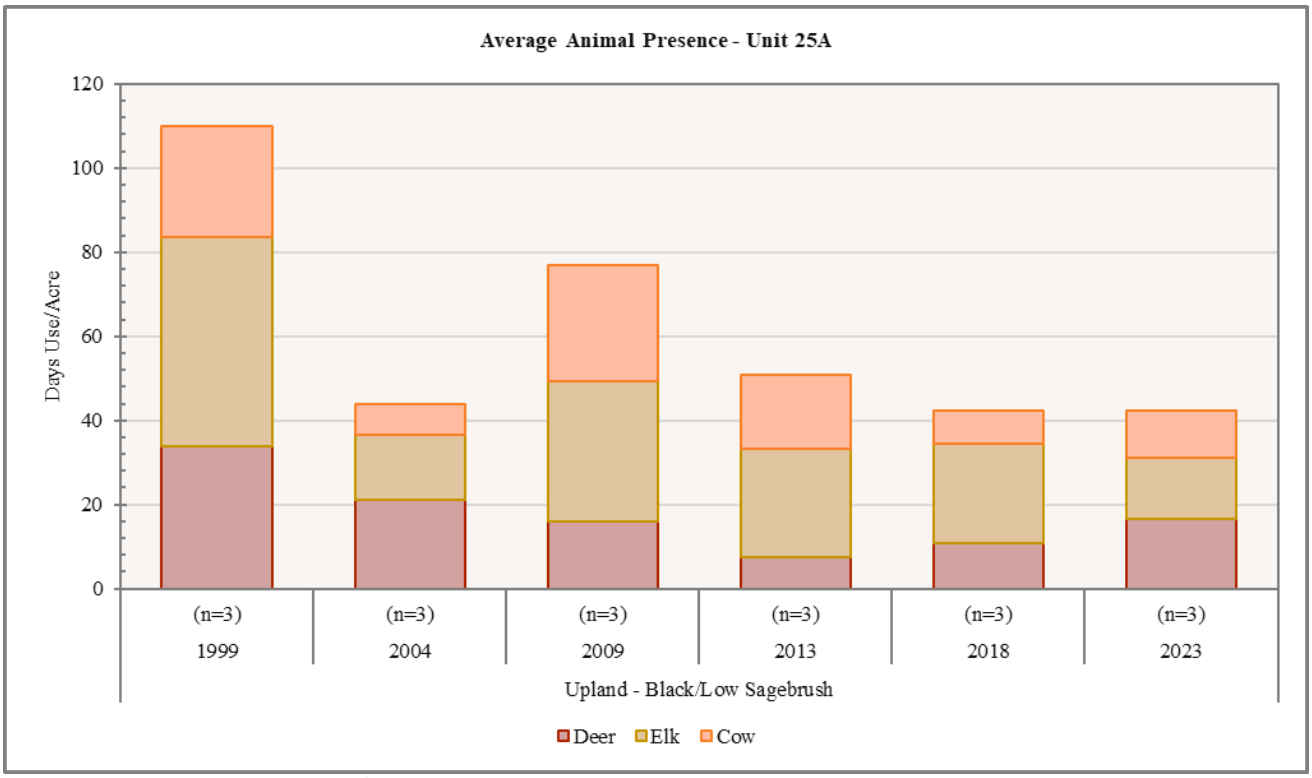
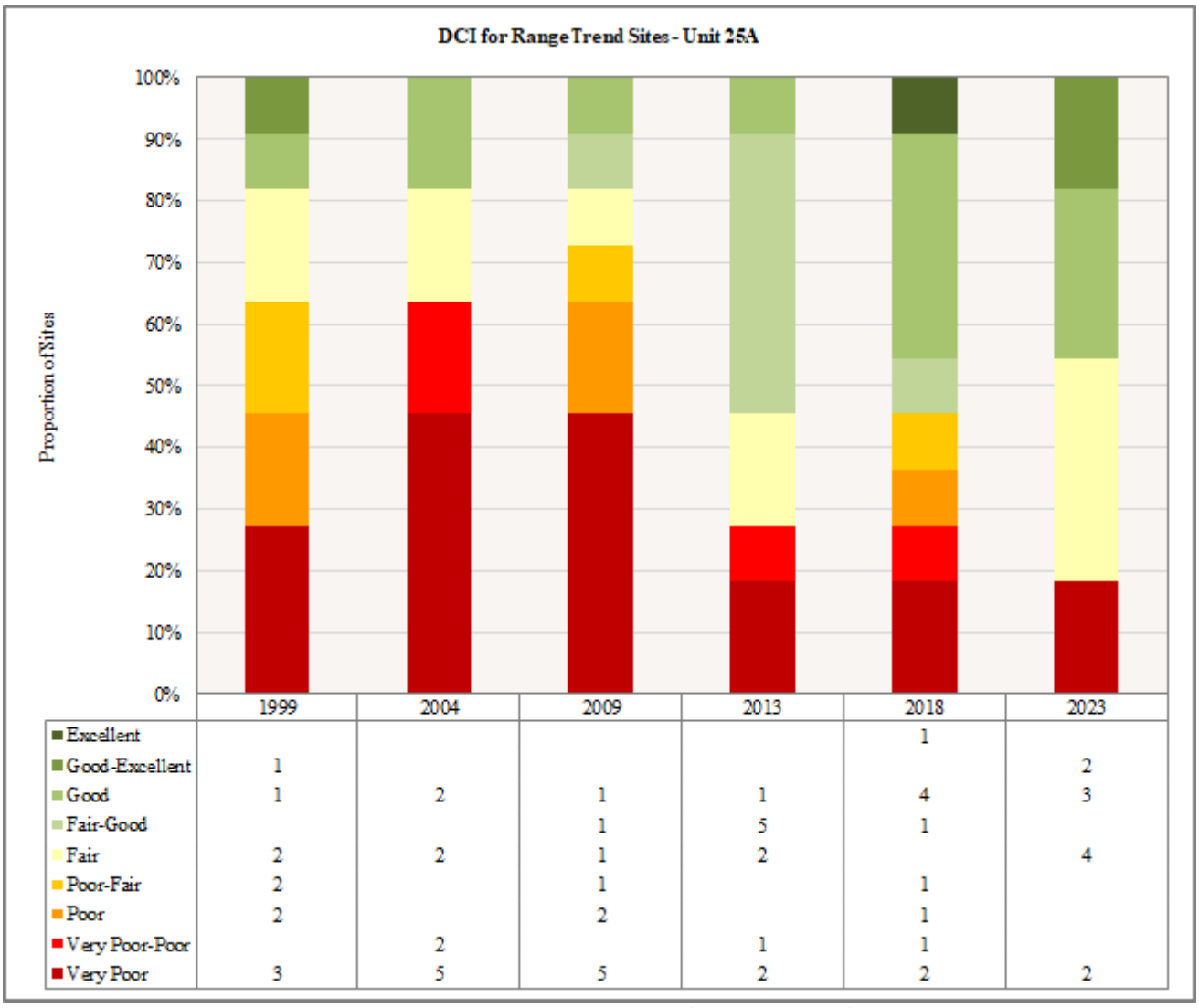


Figure 3.18: Average pellet transect data for Upland - Black/Low Sagebrush study sites in WMU 25A, Fishlake Plateau.

Deer Winter Range Condition Assessment

Overall condition of deer winter range on the Fishlake Plateau management unit has improved from poor averaged conditions in 1999 to fair averaged conditions in 2023. Evans Reservoir (25A-07), Lower Dog Flat (25A-08), Tommy Hollow (25A-16), and Elk Camp (25A-18) are the main drivers for the unit's wintering habitat stability and quality, and deer winter range condition averages between fair and good. Triangle Mountain (25A-01), Black Mountain (25A-02), Sage Flat (25A-03), Durfee Homestead (25A-04), and Praetor Slope (25A-05) are considered to have very poor and poor wintering habitat conditions consistently from year to year: these poor conditions suppress the unit's overall quality of winter habitat. Range Trend sites in WMU 25A that tend to have higher winter habitat variability include Sage Flat, Durfee Homestead, Praetor Slope, and Row of Pines Exclosure (25A-14). This may suggest a higher potential for winter range improvement, but may also suggest some instability in each community's resistance and resilience to state transitions. However, all of these sites appear to exhibit improvement in winter habitat and may experience the most success out of all study sites if treatments are applied in these areas.
The overall deer winter range assessment in 2023 for WMU 25A is that the unit is in fair condition with most sites ranging between fair to good-excellent conditions. However, Triangle Mountain and Black Mountain remain in very poor condition due to the lack of preferred browse and perennial forbs; perennial grass cover is lacking on Black Mountain (**Figure 3.19**, **Table 3.5**).



	1999	2004	2009	2013	2018	2023
Excellent					1	
Good-Excellent	1					2
Good	1	2	1	1	4	3
Fair-Good			1	5	1	
Fair	2	2	1	2		4
Poor-Fair	2		1		1	
Poor	2		2		1	
Very Poor-Poor		2		1	1	
Very Poor	3	5	5	2	2	2

Figure 3.19: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 25A, Fishlake Plateau.

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
25A-01	1999	0	0	0	23.2	0	7.3	0	**30.5**	**VP**
25A-01	2004	1.1	0	0	30	-0.1	1.1	0	**32.1**	**VP**
25A-01	2009	1	0	0	30	0	2	0	**32.9**	**VP**
25A-01	2013	1.1	0	0	30	0	1.3	0	**32.4**	**VP**
25A-01	2018	0.8	0	0	30	-0.2	0.6	0	**31.2**	**VP**
25A-01	2023	1.1	0	0	30	-0.2	0.8	0	**31.7**	**VP**
25A-02	1999	2.1	0	0	16.1	-1	0.2	0	**17.5**	**VP**
25A-02	2004	1.9	0	0	24.5	-0.1	0	0	**26.2**	**VP**
25A-02	2009	1.4	0	0	21	-0.4	0.3	0	**22.3**	**VP**
25A-02	2013	2	0	0	30	-0.3	0.3	0	**32**	**VP**
25A-02	2018	2.5	0	0	22.8	-0.5	0	0	**24.9**	**VP**
25A-02	2023	2.9	0	0	5.1	-0.8	0.1	0	**7.3**	**VP**
25A-03	1999	18.5	5.7	5.7	0.4	-11.2	0	0	**19.1**	**P**
25A-03	2004	20.4	3.6	1.3	0.1	-20	0	0	**5.3**	**VP**
25A-03	2009	13.4	-0.2	0	0	-20	0	0	**-6.9**	**VP**
25A-03	2013	29.3	9.4	4.9	0.2	-14.6	0	0	**29.1**	**F**
25A-03	2018	15.3	2.5	2.1	0	-7.6	0	0	**12.2**	**P**
25A-03	2023	20	10.7	3.9	0	-2.9	0.1	0	**31.8**	**F**
25A-04	1999	3.5	0	0	17.1	-0.7	5.5	0	**25.4**	**VP**
25A-04	2004	5.8	0	0	19.2	-1.9	5.3	0	**28.4**	**VP**
25A-04	2009	9.9	14.4	1	23.7	-0.7	5.5	0	**53.7**	**P-F**
25A-04	2013	11	15	4.9	30	-0.1	4.2	0	**65**	**F**
25A-04	2018	13.1	15	1.2	20.9	-0.5	5.5	0	**55.1**	**P-F**
25A-04	2023	11.9	14.5	1.6	30	-0.1	7.5	0	**65.4**	**F**
25A-05	1999	15	5.9	0.7	30	0	0	0	**51.6**	**P-F**
25A-05	2004	0.4	0	0	30	0	3.8	0	**34.2**	**VP-P**
25A-05	2009	0.8	0	0	30	0	0.4	0	**31.1**	**VP**
25A-05	2013	3.9	0	0	30	0	1.2	0	**35.1**	**VP-P**
25A-05	2018	3.9	0	0	30	0	0.2	0	**34.1**	**VP-P**
25A-05	2023	16	15	15	30	0	2.2	0	**78.2**	**G-E**
25A-07	1999	20.8	0.3	4.1	26	0	10	0	**61.3**	**F**
25A-07	2004	11.1	8	3.3	30	0	6.8	0	**59.2**	**F**
25A-07	2009	11.8	7.1	4.5	30	0	5.5	0	**58.8**	**F**
25A-07	2013	12.5	11	8.9	30	0	7.6	0	**70**	**F-G**
25A-07	2018	15.9	14	14.2	30	0	10	0	**84.1**	**G**
25A-07	2023	20.5	11.2	3	30	0	8.9	0	**73.6**	**G**
25A-08	1999	22	10.4	6.2	17.4	0	0.5	0	**56.5**	**F**
25A-08	2004	26.9	8.7	1.7	15.7	0	0.1	0	**53**	**F**
25A-08	2009	19.8	9.8	0.8	8.8	0	0.1	0	**39.2**	**P**
25A-08	2013	26.1	12.5	15	11.6	0	0.1	0	**65.3**	**F-G**
25A-08	2018	24.1	10.4	15	26.9	0	0.1	0	**76.5**	**G**
25A-08	2023	25.5	10.9	9.2	12.8	0	0.4	0	**58.8**	**F**
25A-09	1999	30	2.9	2.9	11.2	0	1.1	0	**48.1**	**P-F**
25A-09	2004	26	0.6	0.8	5.8	0	0.5	0	**33.7**	**VP-P**
25A-09	2009	26	3.1	5.9	4.8	0	0.1	0	**39.9**	**P**
25A-09	2013	30	10.4	14.9	8.1	0	0.6	0	**63.9**	**F-G**
25A-09	2018	30	7.5	9	19.5	0	0.2	0	**66.1**	**F-G**
25A-09	2023	30	9.4	8	10.8	0	0.3	0	**58.5**	**F**
25A-14	1999	16.3	6.3	3.1	17.6	0	1.2	0	**44.5**	**P**
25A-14	2004	12	2.5	0.9	11.4	0	0.4	0	**27.1**	**VP**
25A-14	2009	5.4	0	0	20.6	0	0.1	0	**26**	**VP**
25A-14	2013	11.6	14.1	9.9	30	0	0.4	0	**65.9**	**F-G**
25A-14	2018	15	13.2	15	30	0	0	0	**73.3**	**G**
25A-14	2023	21.3	13.5	13.8	19.8	0	0.2	0	**68.6**	**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
25A-16	1999	26.5	8.9	13.5	24.8	0	7.9	0	**81.6**	**G-E**
25A-16	2004	30	5.8	2.8	26.1	0	3	0	**67.7**	**G**
25A-16	2009	30	9.3	1.9	21.3	0	5.5	0	**68**	**G**
25A-16	2013	30	9.7	4.9	28.4	0	4.8	0	**77.8**	**G**
25A-16	2018	30	11.5	4.1	30	0	6.8	0	**82.4**	**E**
25A-16	2023	30	9.4	4.8	23.2	0	8.1	0	**75.6**	**G**
25A-18	1999	28.8	11.4	9.4	24	0	4.9	0	**78.4**	**G**
25A-18	2004	30	10.8	5	22.5	0	4.8	0	**73.1**	**G**
25A-18	2009	30	13.5	9.5	15.5	0	2.2	0	**70.7**	**F-G**
25A-18	2013	30	10	8.7	17.5	0	2.2	0	**68.4**	**F-G**
25A-18	2018	30	13.3	5	29.3	0	7.3	0	**84.9**	**G**
25A-18	2023	30	12.6	7.5	28.3	0	10	0	**88.4**	**G-E**
25A-19*	1999	10.2	6.9	1.3	20.6	0	0.6	0	**39.8**	**P**
25A-19*	2004	7.6	-5.6	1	15.9	0	0.5	0	**19.4**	**VP**
25A-19*	2009	11	5.3	0.5	21	0	0.2	0	**37.9**	**P**
25A-20*	1999	17.3	6.9	2.6	18	0	1.9	0	**46.7**	**P**
25A-20*	2004	15.8	-0.5	2.5	16.7	0	0.4	0	**34.8**	**VP-P**
25A-20*	2009	17.5	3.9	0.7	21	0	0.3	0	**43.4**	**P**

Table 3.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 25A, Fishlake Plateau. 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
25A-01	Triangle Mountain	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
25A-02	Black Mountain	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Energy Development	High	Fragmentation and degradation/loss of habitat
		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
25A-03	Sage Flat	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25A-04	Durfee Homestead	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
25A-05	Praetor Slope	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
25A-07	Evans Reservoir	None Identified		
25A-08	Lower Dog Flat	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25A-09	Row of Pines	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25A-10	Cedarless Flat	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25A-11	Forsyth Reservoir	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25A-12	East Tidwell	None Identified		
25A-13	Ox Spring	None Identified		
25A-14	Row of Pines Exclosure	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
25A-16	Tommy Hollow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25A-18	Elk Camp	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25R-09	Sand Ledges	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity

Table 3.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 25A, Fishlake Plateau. All assessments are based off the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A – Threat Assessment**.

Discussion and Recommendations

Deer winter range on the Fishlake Plateau has generally improved from poor to fair; in 2023, the unit averaged fair for wintering conditions, and the last three sample years have been fairly good. Most sites are considered to be between fair and good condition; however, Triangle Mountain, Black Mountain, Sage Flat, and Durfee Homestead are either in very poor or poor condition, and lower the overall unit average when evaluated together. The factor contributing to the poor conditions shared between sites is the lack of preferred browse. Most of these sites are lacking perennial forb components, and all have cheatgrass (*Bromus tectorum*) invading their understories to varying degrees. Evans Reservoir, Tommy Hollow, and Elk Camp are all sites that contribute to the overall stability and habitat quality of this unit. Shared factors among these sites that lead to good quality include high cover of preferred browse, perennial grasses, and forbs, while cheatgrass cover has been absent. The biggest improvements have occurred on Praetor Slope and Row of Pines Exclosure. Praetor Slope has experienced active recruitment of sagebrush (*Artemisia spp.*) that has led to substantially increased cover in the most recent sampling. Row of Pines Exclosure has had similar, but more gradual improvements (**Figure 3.19**, **Table 3.5**).

A positive thing to note on this unit is that a majority of the studies with have robust browse components that have persisted or, like Praetor Slope and Row of Pines Exclosure, have increased. More explicitly, the preferred shrub components on Evans Reservoir, Tommy Hollow, and Elk Camp have not exhibited decreases in cover or density to a degree that would cause the associated plant communities to shift into a different (and possibly degraded) ecological state. Improvements in habitat quality on this unit are concentrated on deer winter range and aimed at reducing pinyon-juniper encroachment; the diversification and increased production of browse; and/or the amplification of the herbaceous understory to increase production. The Gooseberry, Sand Ledges, Durfee Homestead, Cedarless Flat, Forsyth Reservoir, Ox Spring, and Elk Camp study sites have all been observed following treatment with most sites showing some form of deer habitat improvement. Habitat treatment projects have also been and continue to be implemented in areas not monitored by the Range Trend program; a net total of 47,843 treatment acres have been completed in the Fishlake unit through the Watershed Restoration Initiative (WRI) as of February 2024 (**Table 3.2**, **Map 3.7**).

Like much of the Plateau region, the Fishlake unit, as a whole, has not experienced any significant impact from wildfire. Few fires have been observed with high enough intensity to cause high vegetation acreage losses; the most notable incidences are the Johnson and Willow Patch fires. The Johnson fire appears to have burned through a mix of sagebrush steppe, aspen (*Populus tremuloides*), and spruce-fir forests, which are areas of focus for the Wildlife Action Plan. No trend studies are found within the Johnson fire perimeter and the condition of the sagebrush steppe is unknown; however, these high potential sagebrush systems are resilient and the fire may have rejuvenated this crucial deer summer range. The Sand Ledges site samples within the Willow Patch fire perimeter and is designated as crucial deer winter range. The Willow Patch fire burned pinyon-juniper and sagebrush steppe ecotypes, and had a significant negative impact on this portion of winter range. Not only did the fire negate the efforts and success of the Sandledges Lop and Scatter Project (**Table 3.3**, **Table 3.4**, **Map 3.6**), but the fire removed a rehabilitated community of preferred browse and a productive herbaceous understory. However, fire recovery efforts have been made with some success, although the site has transitioned from a mountain big sagebrush and bitterbrush site to state dominated by introduced perennial grasses.

There are also a number of concerns or threats that may impact mule deer habitat on the Fishlake Plateau unit ranging from human influences to biotic and abiotic factors.

Wildlife collision data suggests that there are a few hot spots along the periphery of the Fishlake unit where big game mortality is high. Carcass pick-up appears to be highest along SR-24 in Plateau Valley between Daniels Road and Koosharem Reservoir, and between Praetor Slopes to SR-25. Another location where big game mortality appears to be elevated is along I-70 between Spring Canyon and Fremont Junction (Utah Division of Wildlife Resources, 2024). This area of high mortality appears to be a known concern to local biologists and a fencing draft survey is currently being performed for the Utah Department of Transportation. Coincidently, these roads make up portions of the unit boundary and fall within the unit's mule winter range. Mule deer mortality may be highest when deer are using their winter range at a time when drivers experience the least amount of daylight and visibility of wildlife is at its lowest. Areas along I-70 (Sigurd to Niotche Creek) with installed wildlife exclusionary fencing and/or escape ramps appear to have lower wildlife mortality, indicating that these installations are functioning as intended to reduce wildlife collisions and mortality.

Other human influences that may affect wildlife habitat come from energy resource development. Oil and gas development is occurring on the northwest side of the unit. Oil and gas wells and their associated fields are concentrated between Sage Flat Road and Kings Meadow along SR-24, with wells becoming more dispersed moving into the mountains northwest of Sage Flat. This area is designated as crucial mule deer winter range. In addition to oil and gas extraction, some solar development is occurring northeast of Richfield along the I-70 corridor. Much of this corridor has been evaluated for peak solar production and is considered to be a valuable area for solar energy; however, much of this corridor falls just outside of mule deer winter range. One area of interest evaluated as a valuable solar production zone runs along SR-24 in Plateau Valley: this section is considered winter mule deer habitat that spans private and SITLA ownership with wetland meadow and sagebrush steppe ecotypes that abut one another. Although existing renewable energy installations do not currently affect habitat, the potential for future development remains; according to the Bureau of Land Management (2024), interest in developing solar projects on publicly managed lands throughout the west is ongoing. Therefore, the potential for solar (and fossil) energy infrastructure to negatively impact wildlife through habitat fragmentation and loss may remain on this unit.

The increase in outdoor recreation in recent years may pose additional threats to big game habitat within the Fishlake Plateau management unit. Fishlake National Forest, Fish Lake, and Pando (famously one of the largest known organisms) are some of the attractions that bring people to the unit. Numerous fishing opportunities are found on and near Fish Lake and are some of the main draws to the area that benefit local economies. Aerial imaging shows that over the last 20 years new cabin development and improvements to campgrounds near the Fish Lake Lodge have occurred. New and continued community development within this unit and 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 of animals within the area through human-wildlife interactions, and degradation of habitat through the introduction of non-native species. In addition to the attraction of Fish Lake itself, the National Forest has approximately 2,700 miles of trails and roads available for recreational driving and scenic viewing (US Forest Service, 2024). Two popular trails on this unit are the Great Western and the Paiute ATV trail systems, and these trails may lead to increased human-wildlife interactions. Improvements to Gooseberry Road and Deadman Road (connector between SR-24 and SR-25) by paving will increase recreation opportunities, but may also increase overall speeds of vehicles traveling to Fish Lake in areas that may be frequented by big game.

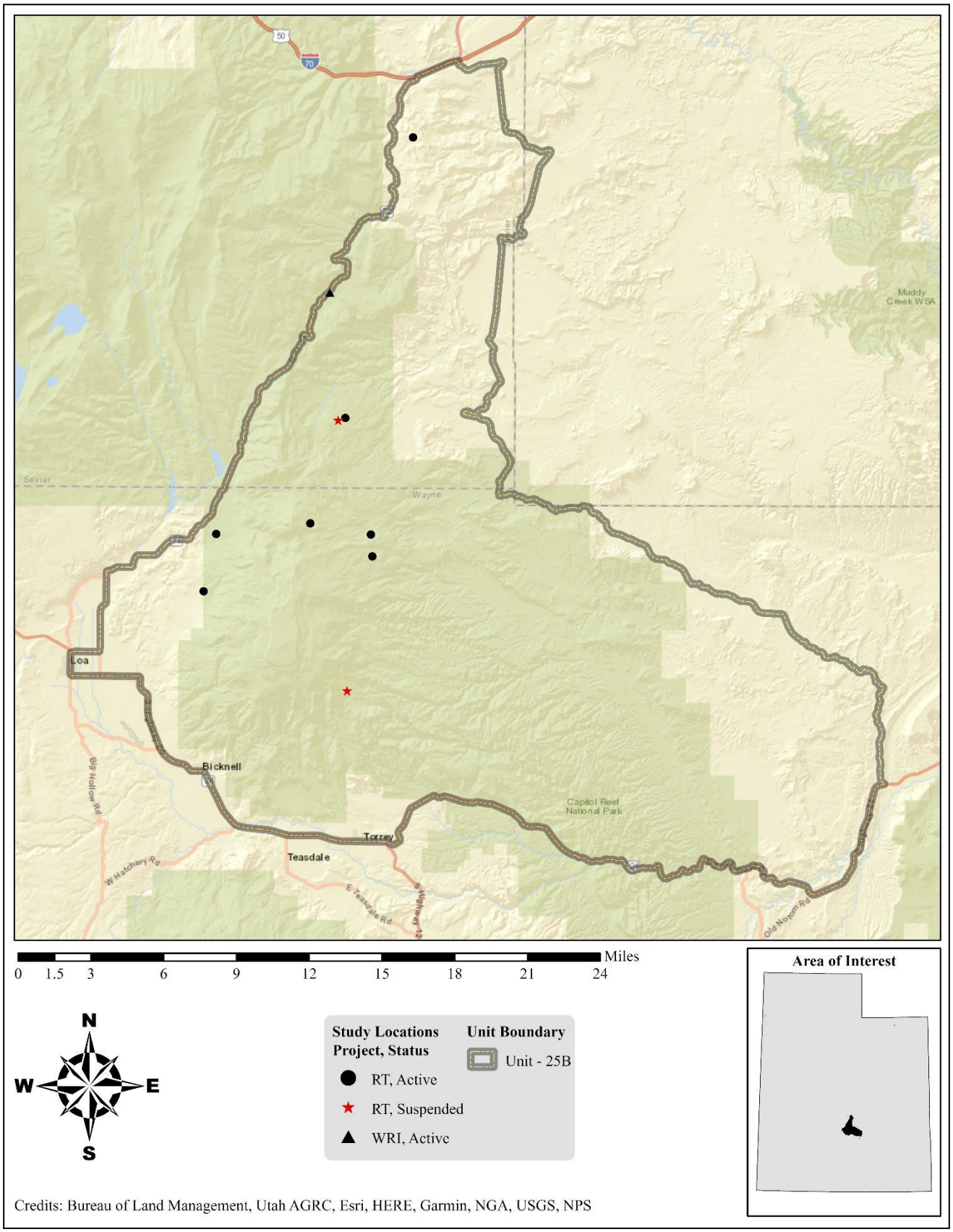
Introduced annual grasses (namely cheatgrass) are not a concern for most of the unit; however, cheatgrass does present more of a concern on the northwest side of the unit. These grasses pose a low- to medium-level threat on a few Range Trend sites found at lower elevations (**Table 3.5**, **Table 3.6**). In 2023, cheatgrass contributed nearly 4% cover on the Sage Flat study. However, average cover of cheatgrass on this site in all previous years has been over 10 percent, which may translate to a large cheatgrass seedbank being present in this community. The presence of annual grasses can increase fine fuel loads, exacerbate the risk of wildfire, and may even result in altered fire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). This in turn can perpetuate and expand the removal of valuable reestablishing or extant browse communities. Should the affected sites burn, they may be at risk for the release of even greater amounts of cheatgrass and the increased fire frequency associated with annual grasses (Balch, D'Antonio, & Gómez-Dans, 2013; Bradley, 2018).

Aspen woodland and aspen-mixed conifer forest health is an area of focus on mule deer summer range. A large portion of deer summer range includes these two forest types. Approximately seventy-six percent of all aspen community types in the Fishlake unit are found to be between 34 and 48 percent departed from their respective reference states (LC22_VDEP_230, 2022), aspen woodland being the larger of the two communities. Two Range Trend sites (Ox Spring and East Tidwell) sample near aspen communities, but do not contribute any data that informs overall aspen community health. To address aspen community departure near Wide Hollow, a prescribed burn (as part of the Last Chance/Porcupine prescribed burn Phase II Project) will be implemented to encourage aspen rejuvenation in areas that are encroached primarily by subalpine fir (*Abies lasiocarpa*) (Watershed Restoration Initiative, 2024). Many of these areas border mountain sagebrush habitat, so improving these two adjoining ecotypes together will likely have great effects benefiting deer summer range in this area.

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**).

A number of recommendations should be taken into consideration when trying to mitigate or slow the effects of big game habitat loss in the Fishlake Plateau management unit. A considerable portion of this unit has already been treated for tree encroachment (**Table 3.2**); however, restoration efforts in historic sagebrush habitat should continue where active infilling or encroachment of pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) in both previously treated and untreated areas is occurring. Habitat projects in general should also continue to help restore and maintain historic and current sagebrush stands. When these projects do take place, care should be taken in method selection (lop and scatter, bullhog, chaining, etc.) to ensure that annual grass loads are not unintentionally amplified. Additionally, range monitoring should proactively continue in areas where annual grass levels are high, and appropriate actions (herbicide application, changes in grazing management, etc.) should be taken if outbreaks occur in the future. If reseeding is necessary to restore herbaceous species, care should be taken in species selection and preference should be given to native species whenever possible. As was mentioned earlier, this unit is likely impacted by outdoor recreation. Human-wildlife interactions are common in this area and take many forms including traffic, hiking, camping, hunting and wildlife viewing. Human interaction with wildlife can negatively impact wildlife behavior and habitat use. With recreationalists or tourists coming from other areas of the state or regionally, public education about their impact to wildlife through signage placed in high-use areas or newly paved roads may be a method of reducing human-wildlife impact. Finally, both Range Trend studies and areas where rehabilitation projects have occurred should continue to be monitored. Data collected in the future will indicate whether the severity of current limiting factors is increasing, and may provide guidance on what actions are needed to mitigate these identified potential threats to habitat and wildlife.

4. WILDLIFE MANAGEMENT UNIT 25B – THOUSAND LAKES PLATEAU



WILDLIFE MANAGEMENT UNIT 25B – THOUSAND LAKES PLATEAU

Boundary Description

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

Management Unit Description

Geography

The Thousand Lakes Plateau Wildlife Management Unit is part of the larger management unit 25 – Plateau. Unit 25 is divided into three sub-units: Fishlake Plateau (25A), Thousand Lakes Plateau (25B), and Boulder Plateau (25C).

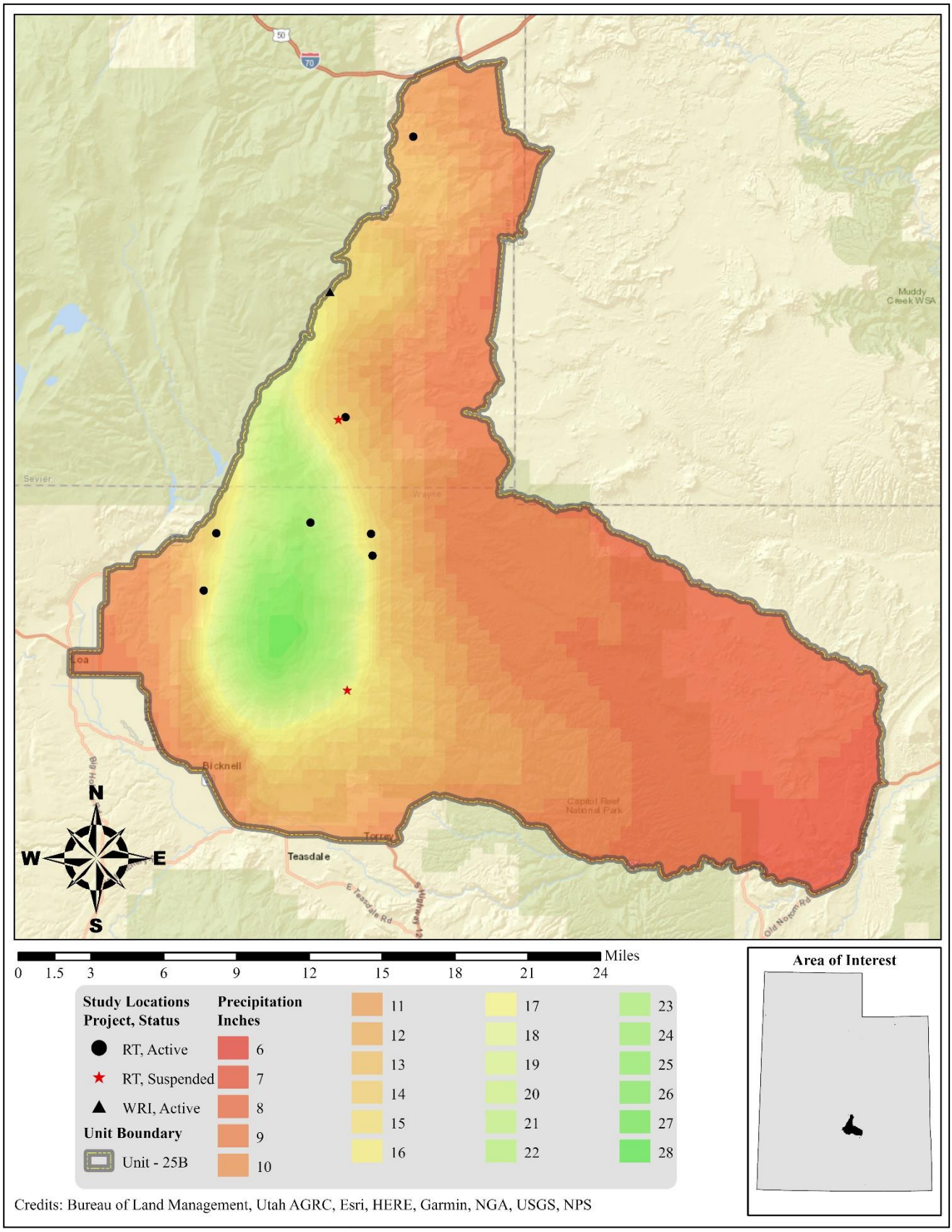
Management unit 25B was named after Thousand Lake Mountain, a lava-capped plateau with numerous small natural lakes. Thousand Lake Mountain reaches an elevation of 11,295 feet and overlooks Capitol Reef National Park and the desert country east of the unit. At the extreme southeastern corner of the unit is Caineville, which is the lowest point in elevation in the herd unit at about 4,100 feet. The vegetation composition varies greatly throughout the unit with respect to topographical relief and elevation. The major towns in this unit are Fremont, Loa, Bicknell, and Caineville.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows that precipitation on this unit ranges from 6 inches on the lower east side of the unit to 28 inches on the peak of Thousand Lake Mountain. All of the active Range Trend and WRI monitoring studies on this unit occur within 11-23 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 South Central Division (Division 4).

The mean annual PDSI of the South Central Division, which the Thousand Lakes Plateau unit is a part of, has experienced some form of drought most years since 1993. Moreover, this climate division has been considered to be in some form of drought nearly 68% of the time since 1993. Of the drought years, nearly 43% are considered to be either moderate or extreme droughts. Also remarkable about this climate division is that drought is experienced over multiple years and is generally interrupted by a single wet year event; the most notable wet years occur in 2005 and 2011, which were both considered moderately wet (**Figure 4.1a**). The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI. These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September to May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although overall annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 4.1b**). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 4.3**). Years that were moderately wet occur in 1999 and 2023, but years where drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 4.1a, Figure 4.1b**) (Time Series Data, 2024).



Map 4.1: The 1991-2020 PRISM Precipitation Model for WMU 25B, Thousand Lakes Plateau (PRISM Climate Group, Oregon State University, 2021).

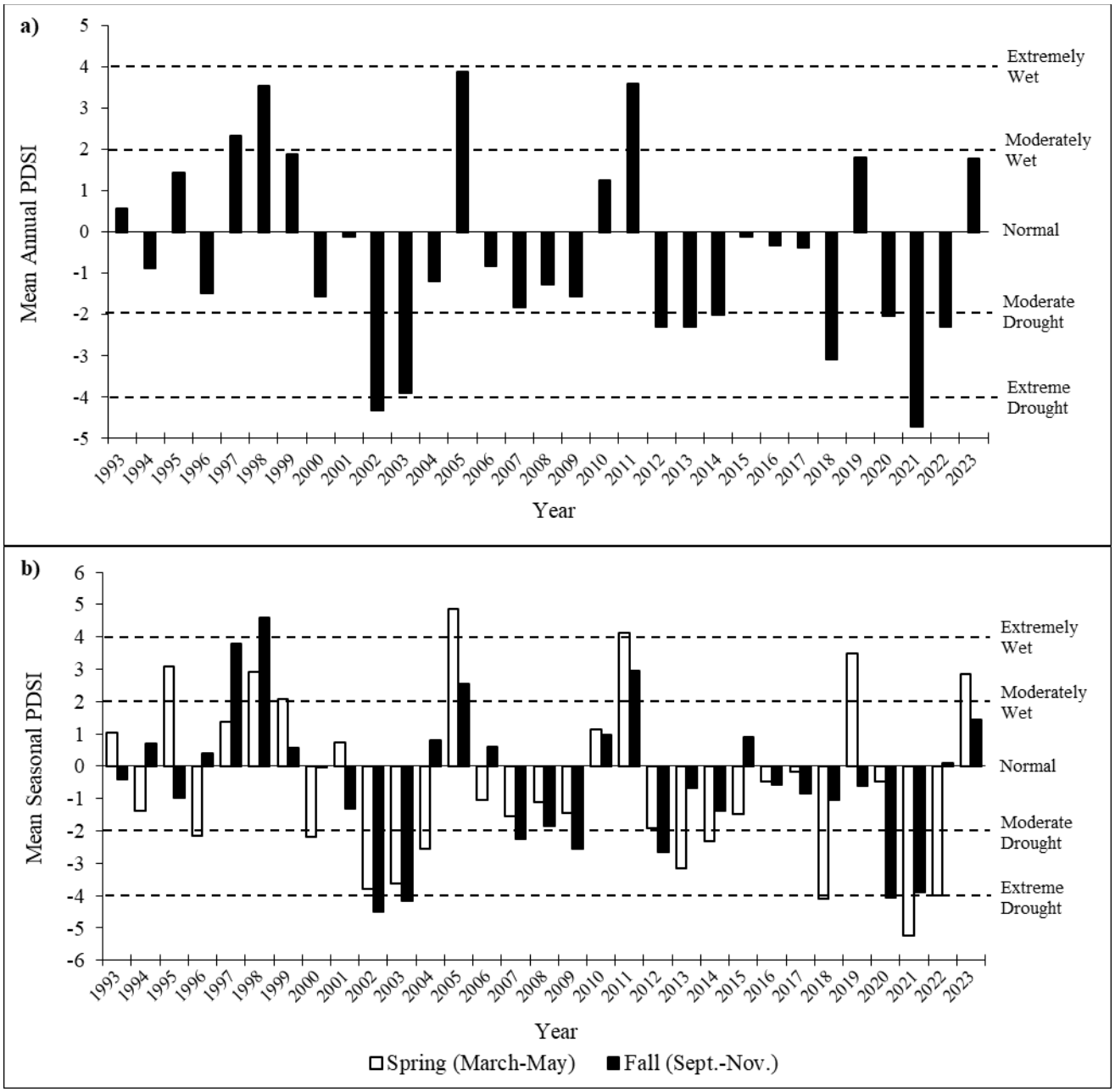


Figure 4.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

The winter range on this unit provides ample protective cover, large basins, draws, and open ridges. The upper limits of the normal winter range vary from 8,400 feet at the northern boundary to 9,000 feet on the south end of Thousand Lake Mountain. The lower normal winter range limit is between 6,000 and 7,400 feet in elevation. At present, the winter range appears ample enough to support deer and elk on the Thousand Lakes unit and many wintering deer from the adjacent Fishlake Pleateau unit. Solomon Basin, Sage Flat, Horse Valley, Sand Flat, Paradise Flat, and Lyman Slopes are all winter concentration areas (**Map 4.2**, **Map 4.3**).

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

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 period with years of good precipitation correlating with large flushes of annuals: this is more pronounced on winter habitats (**Figure 4.2**, **Figure 4.3**, **Figure 4.4**, **Figure 4.5**). The Range Trend data from 1992 to present shows a general increase in perennial cover, but annual cover has fluctuated. The Upland (Big Sagebrush) sites have had a noticeable increase in cover of annual grasses and forbs (**Figure 4.13**, **Figure 4.14**). 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 fluctuations over time, but cover has remained relatively stable overall for shrubs. Tree cover, however, has increased slightly over time from 7.09% cover in 1986 to 10.43% cover in 2023 (**Figure 4.6**, **Figure 4.7**). Range Trend data displays a stable trend for shrub cover. Trend data from 2004 to present shows a general increase in tree cover on sites of both mountain and upland potentials. However, it is important to note the different number of studies sampled from year to year (the ‘n’ value) and consider the implications that this may have on the data (**Figure 4.8**, **Figure 4.9**).

RAP – Herbaceous Biomass by Deer Habitat

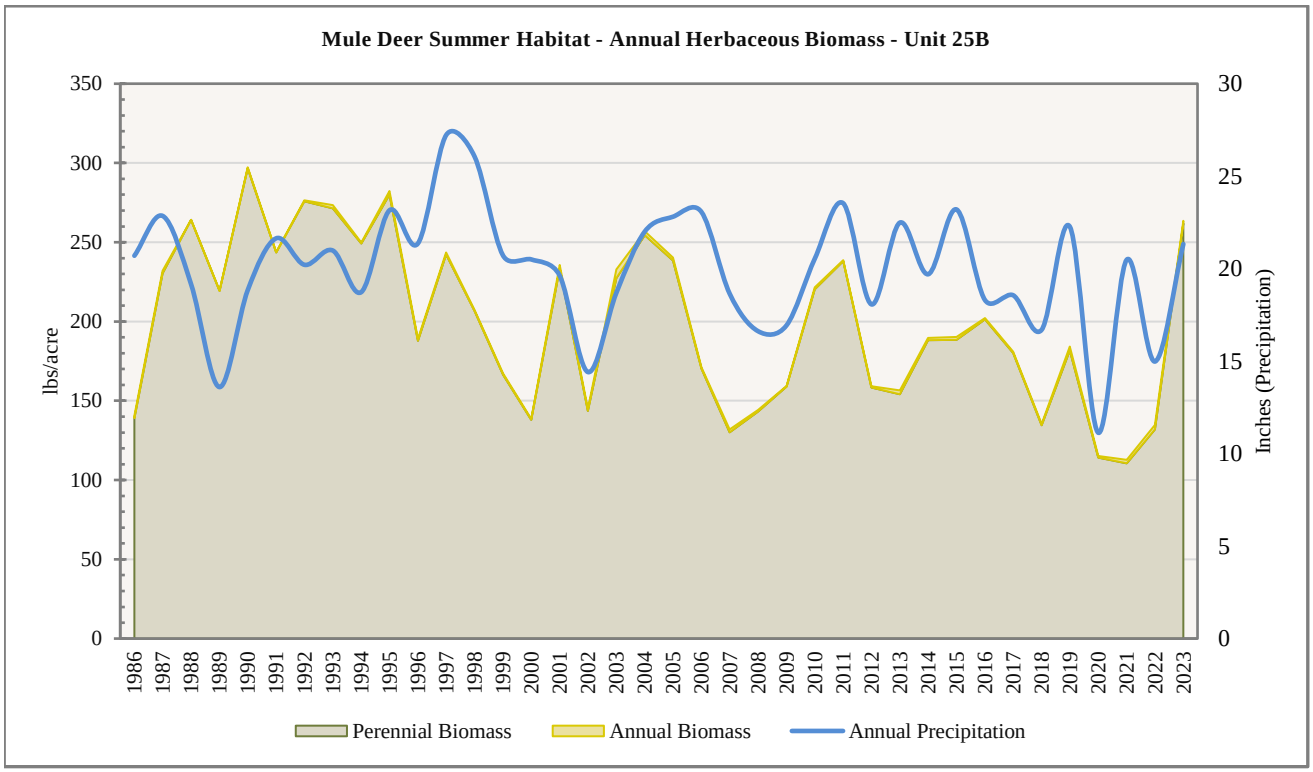


Figure 4.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 25B, Thousand Lakes Plateau (Rangeland Analysis Platform, 2024).

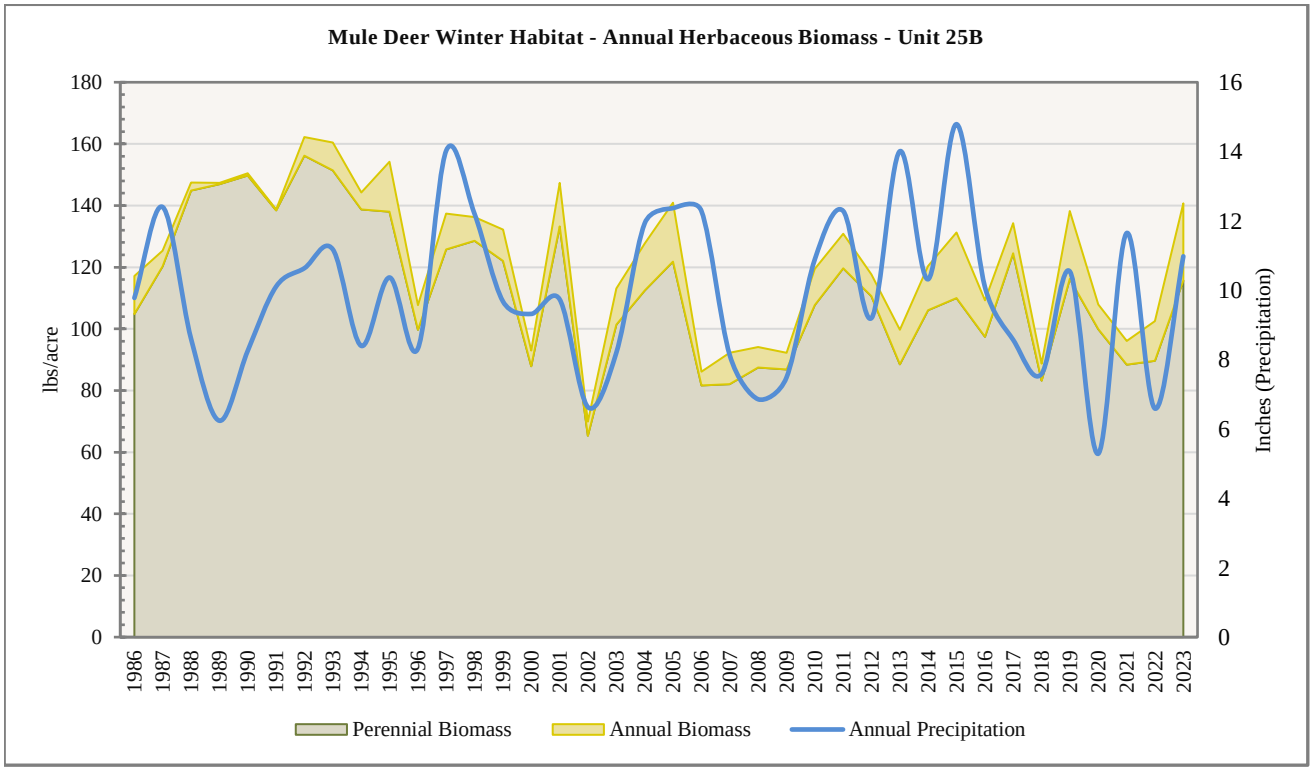


Figure 4.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 25B, Thousand Lakes Plateau (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

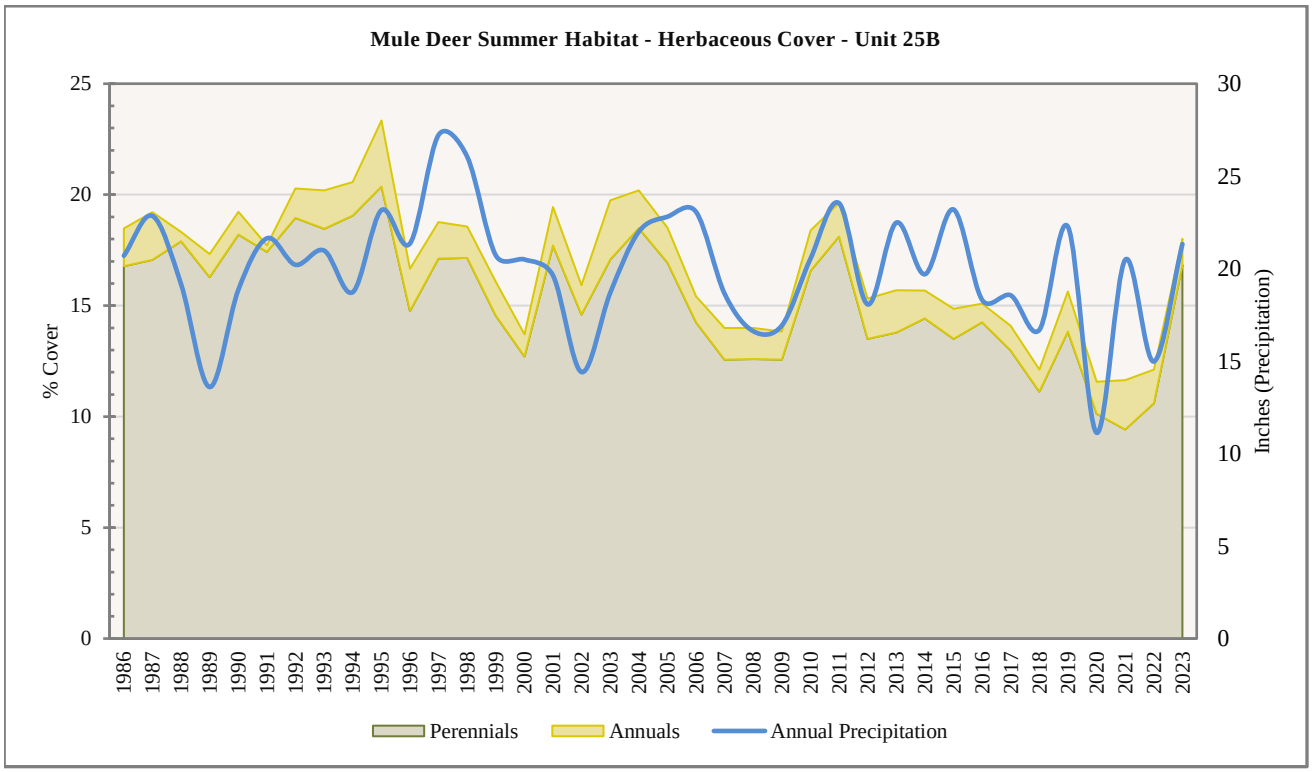


Figure 4.4: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 25B, Thousand Lakes Plateau (Rangeland Analysis Platform, 2024).

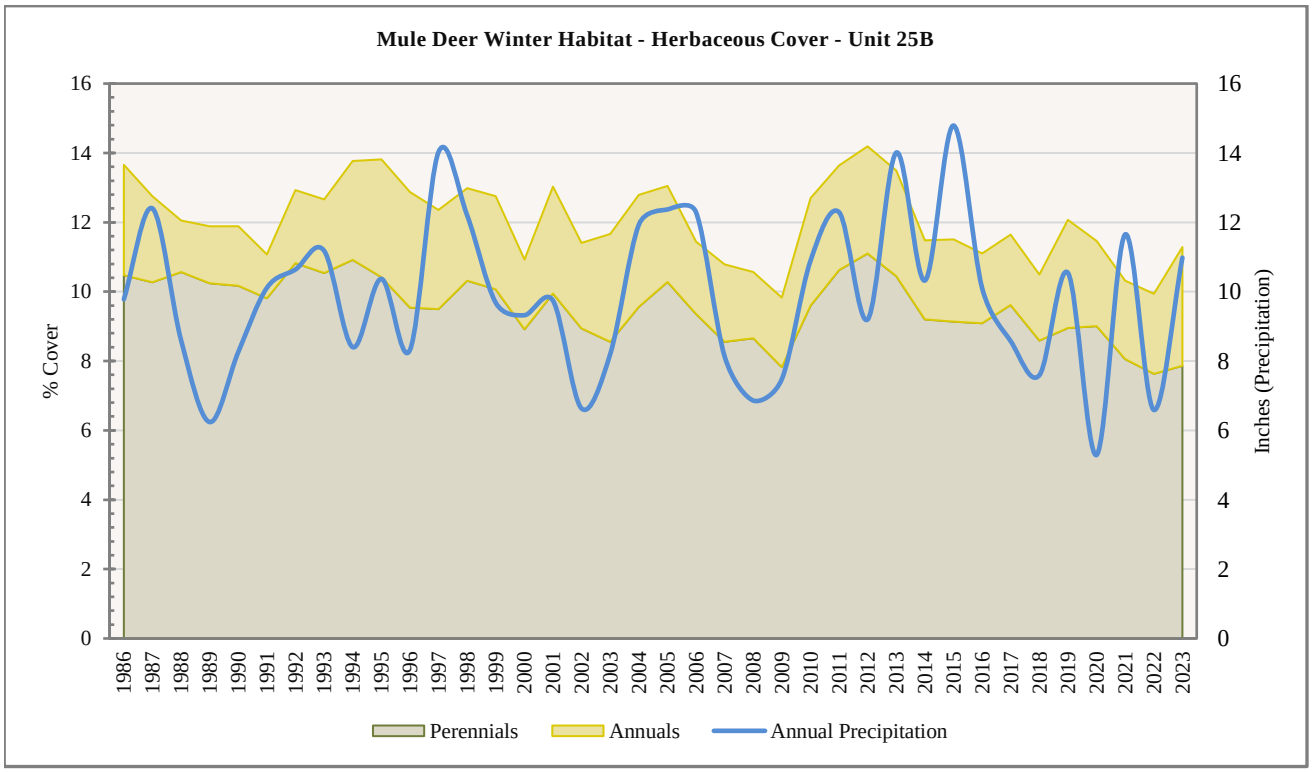


Figure 4.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 25B, Thousand Lakes Plateau (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

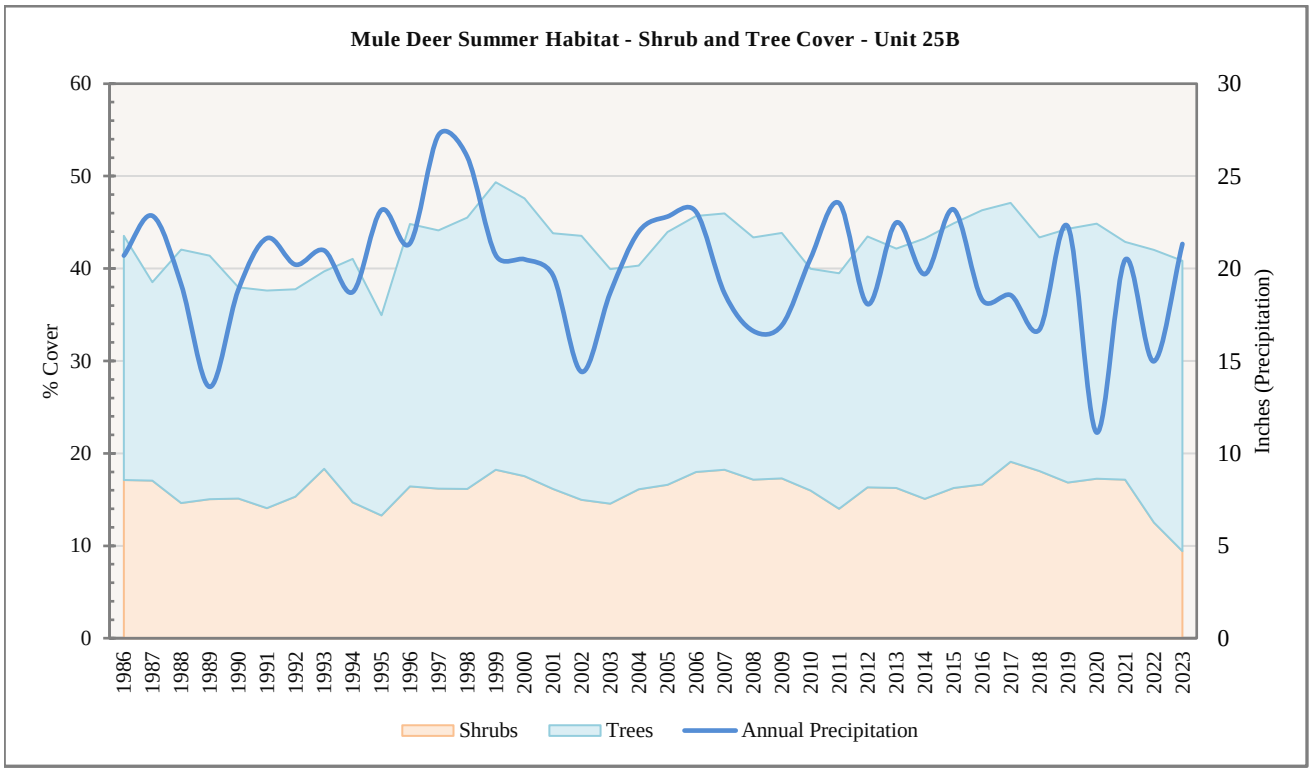


Figure 4.6: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 25B, Thousand Lakes Plateau (Rangeland Analysis Platform, 2024).

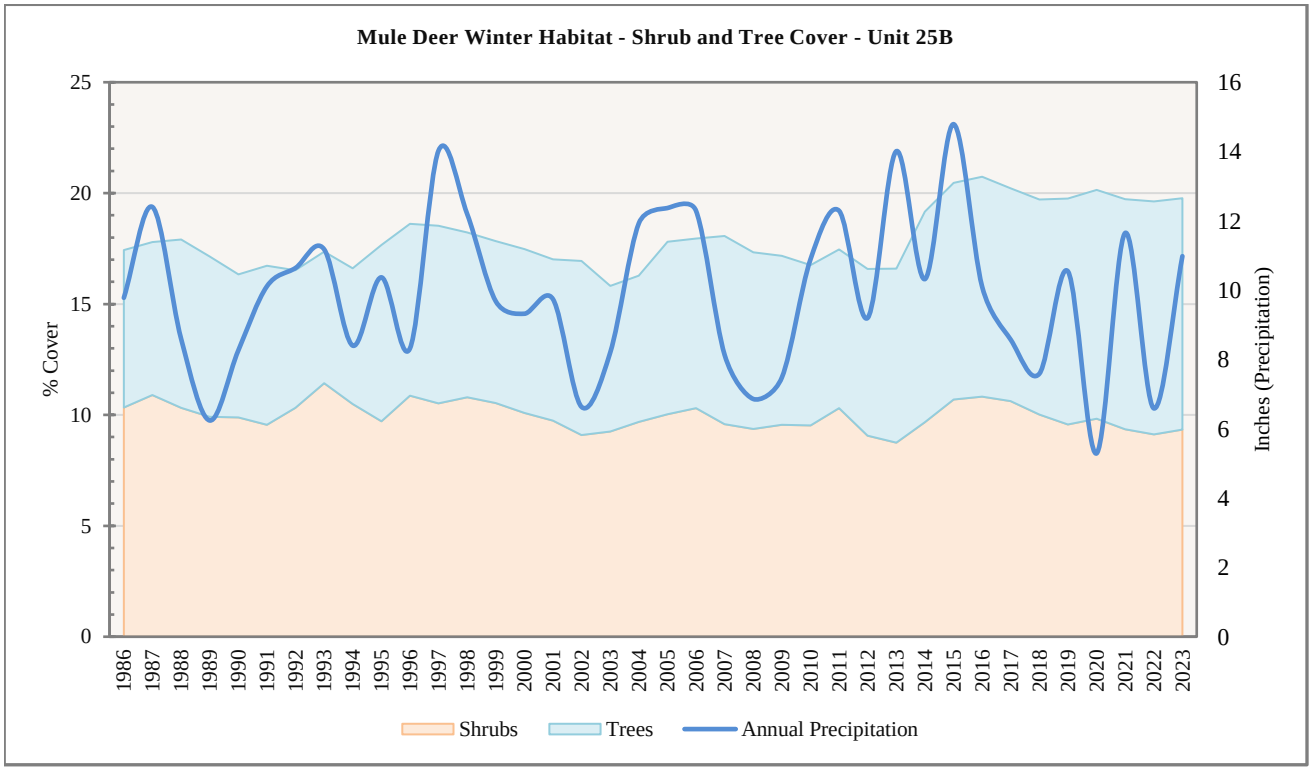
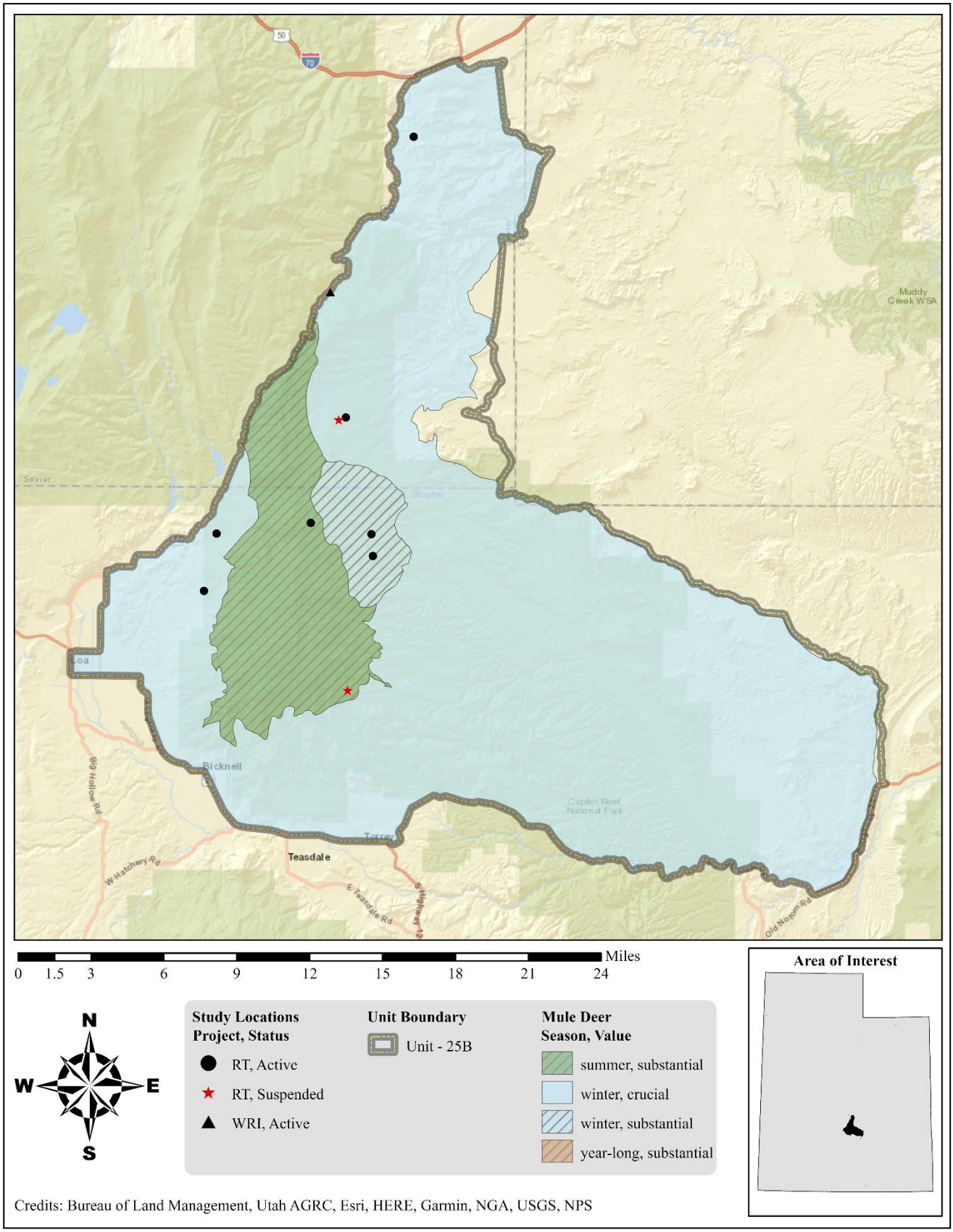
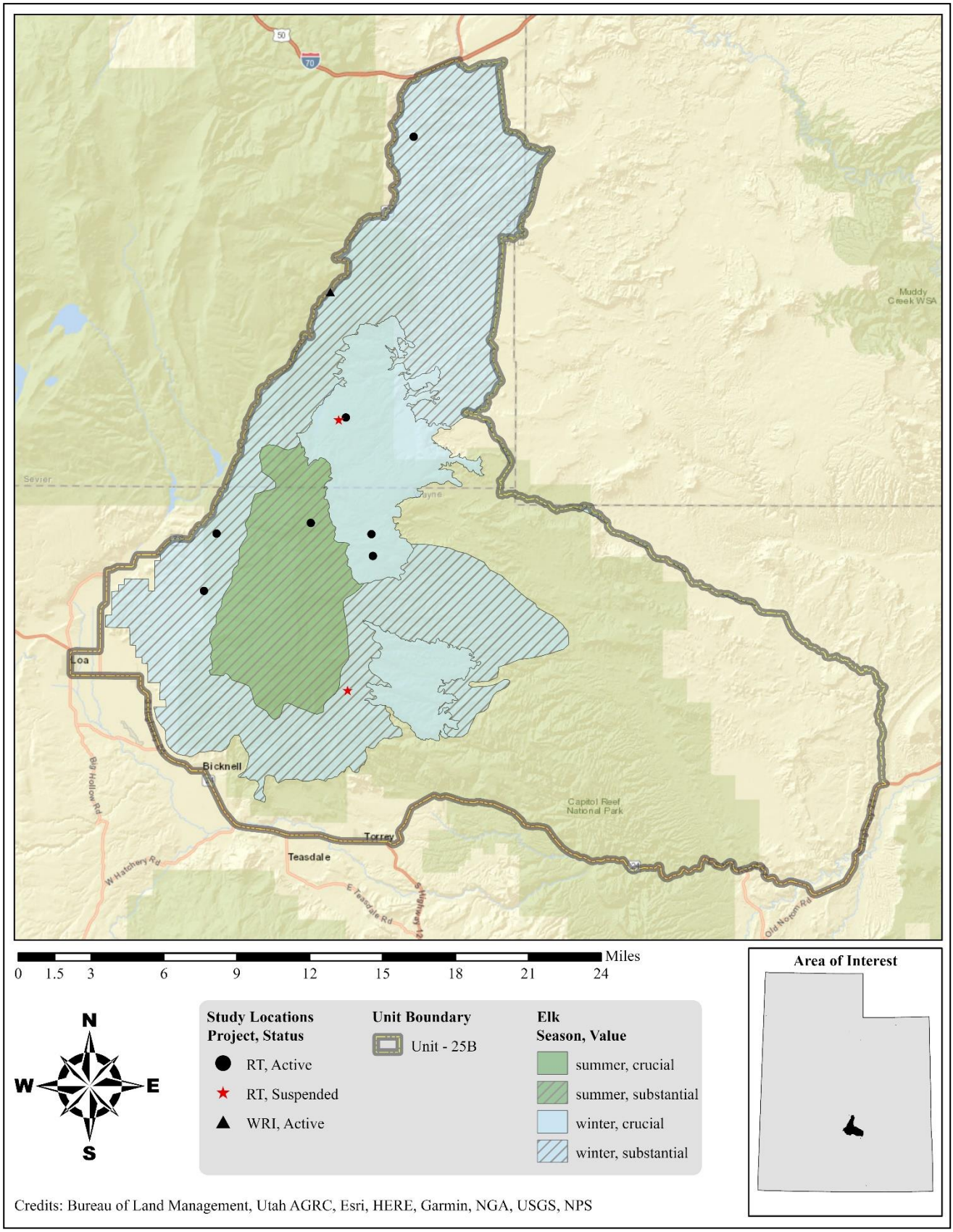


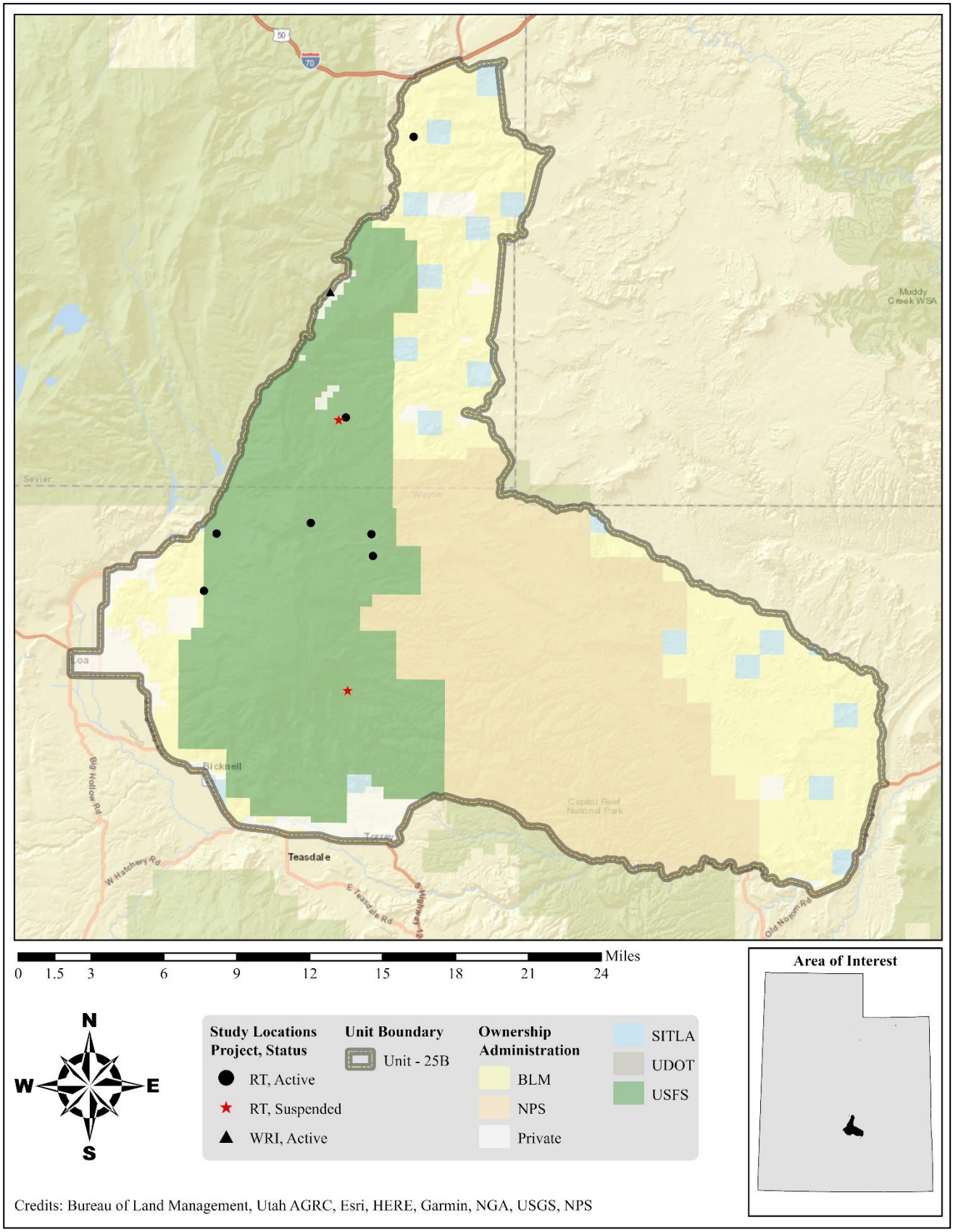
Figure 4.7: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 25B, Thousand Lakes Plateau (Rangeland Analysis Platform, 2024).



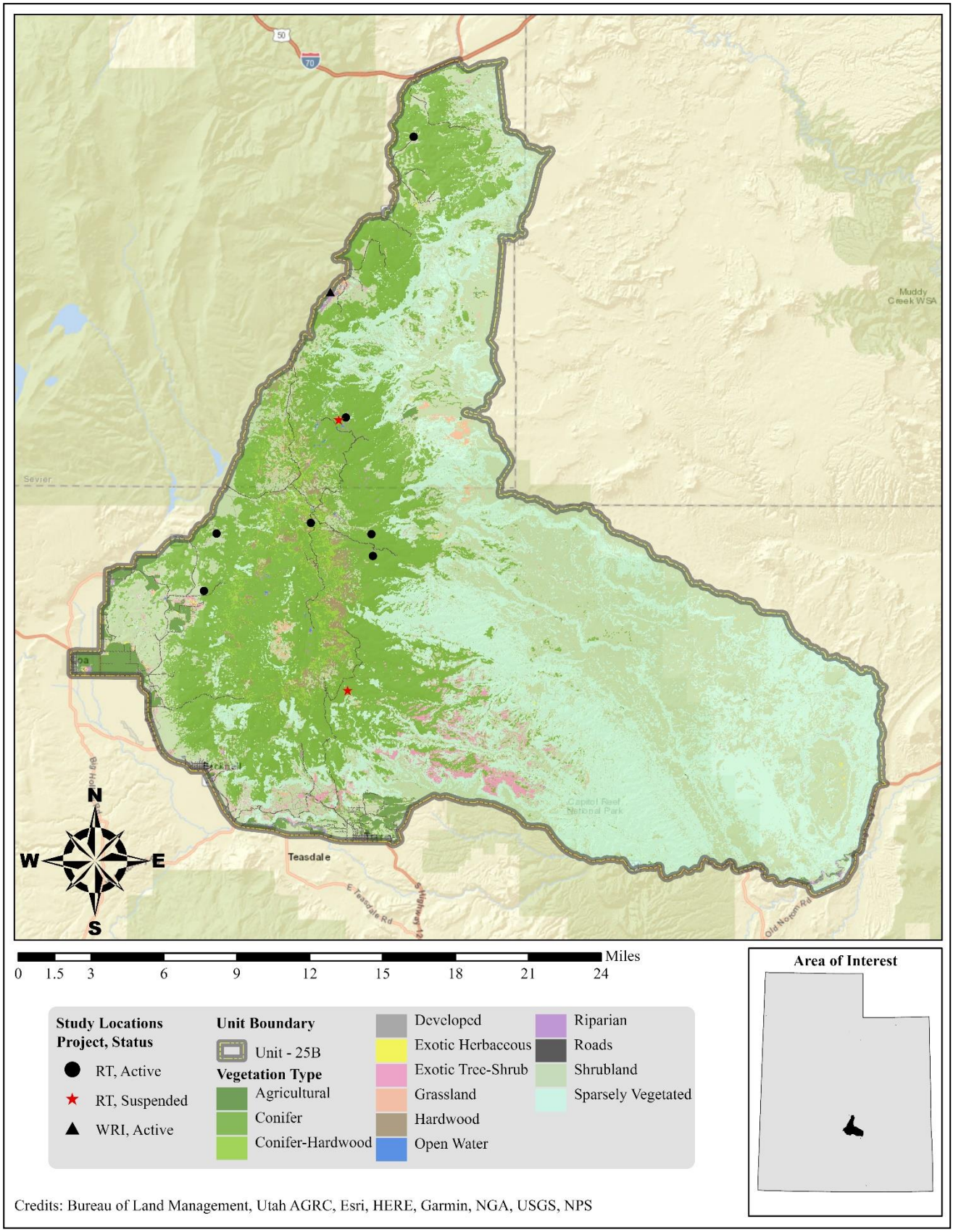
Map 4.2: Estimated mule deer habitat by season and value for WMU 25B, Thousand Lakes Plateau.



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



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



Map 4.5: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 25B, Thousand Lakes Plateau.

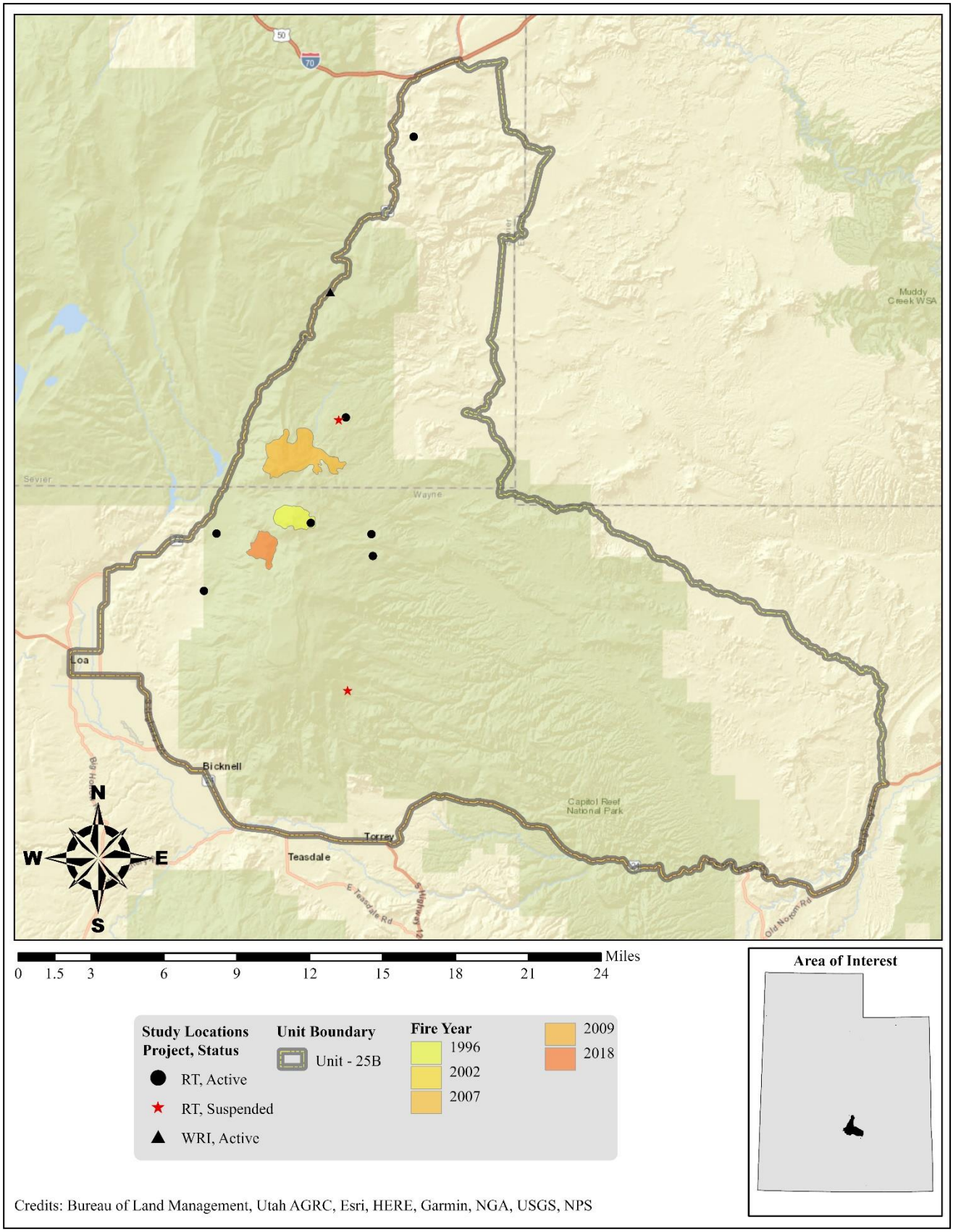
LANDFIRE Existing Vegetation Types on Mule Deer Habitat

Approximately 30% of the mule deer habitat in the Thousand Lakes Plateau unit is sparsely vegetated according to the current LANDFIRE Existing Vegetation Type model: this vegetation type may have less value for deer than other, more productive vegetation types, but nonetheless is included in deer habitat. The model states that an additional 20% of the unit's mule deer habitat is comprised of pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) woodlands (**Table 4.1**). These woodlands are usually located at lower elevations and may be associated with understory browse species known to be beneficial to mule deer, although abundance can vary widely. Pinyon and juniper woodlands may provide valuable escape and thermal cover for wildlife. When these trees encroach on existing shrublands, however, they can lead to decreased sagebrush (*Artemisia spp.*) and herbaceous components (Miller, Svejcar, & Rose, 2000), thereby decreasing available forage for wildlife.

The model also indicates that sagebrush steppe and shrublands make up just over 12% of the unit's mule deer habitat (**Table 4.1**). These biophysical sites can be found at elevations ranging from low (semidesert) to high (mountain and subalpine). Sagebrush species typically dominate these biophysical sites across the elevation gradient, and may provide valuable browse for deer when they are present on winter range. However, other preferred browse species may be present in lesser amounts. At higher elevations, these biophysical sites are often host to abundant herbaceous understories and pinyon and juniper may be present at lower to middle elevations. The rest of the mule deer habitat within the Thousand Lakes Plateau management unit is comprised of a number of other vegetation types (**Table 4.1**), but those will not be discussed here. Descriptions for these additional vegetation types are available on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Other	Sparsely Vegetated	95,409	29.96%	
	Agricultural	7,003	2.20%	
	Developed	4,819	1.51%	
	Riparian	923	0.29%	
	Open Water	71	0.02%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	15	0.00%	33.99%
Shrubland	Inter-Mountain Basins Mixed Salt Desert Scrub	20,102	6.31%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	15,222	4.78%	
	Inter-Mountain Basins Montane Sagebrush Steppe	14,475	4.55%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	12,886	4.05%	
	Inter-Mountain Basins Big Sagebrush Shrubland	11,890	3.73%	
	Southern Colorado Plateau Sand Shrubland	8,969	2.82%	
	Inter-Mountain Basins Mat Saltbush Shrubland	7,344	2.31%	
	Colorado Plateau Pinyon-Juniper Shrubland	5,844	1.83%	
	Colorado Plateau Blackbrush-Mormon-tea Shrubland	4,197	1.32%	
	Rocky Mountain Lower Montane-Foothill Shrubland	2,621	0.82%	
	Inter-Mountain Basins Greasewood Flat	669	0.21%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	667	0.21%	
	Rocky Mountain Alpine Dwarf-Shrubland	322	0.10%	33.04%
Conifer	Colorado Plateau Pinyon-Juniper Woodland	63,594	19.97%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	11,697	3.67%	
	Southern Rocky Mountain Ponderosa Pine Woodland	5,255	1.65%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	4,439	1.39%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	4,201	1.32%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	4,091	1.28%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	655	0.21%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	297	0.09%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	279	0.09%	
	Southern Rocky Mountain Ponderosa Pine Savanna	0	0.00%	29.68%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	5,086	1.60%	
	Interior Western North American Temperate Ruderal Shrubland	42	0.01%	1.61%
Hardwood	Rocky Mountain Aspen Forest and Woodland	3,537	1.11%	
	Rocky Mountain Bigtooth Maple Ravine Woodland	1	0.00%	1.11%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	453	0.14%	
	Southern Rocky Mountain Montane-Subalpine Grassland	409	0.13%	
	Rocky Mountain Alpine Turf	375	0.09%	
	Rocky Mountain Alpine Fell-Field	278	0.00%	0.48%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	185	0.06%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	74	0.02%	
	Great Basin & Intermountain Introduced Annual Grassland	32	0.01%	
	Interior Western North American Temperate Ruderal Grassland	28	0.01%	0.10%
Total		**318,460**	**100%**	**100%**

Table 4.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 25B, Thousand Lakes Plateau.



Map 4.6: Land coverage of fires by year from 2000-2018 for WMU 25B, Thousand Lakes Plateau (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

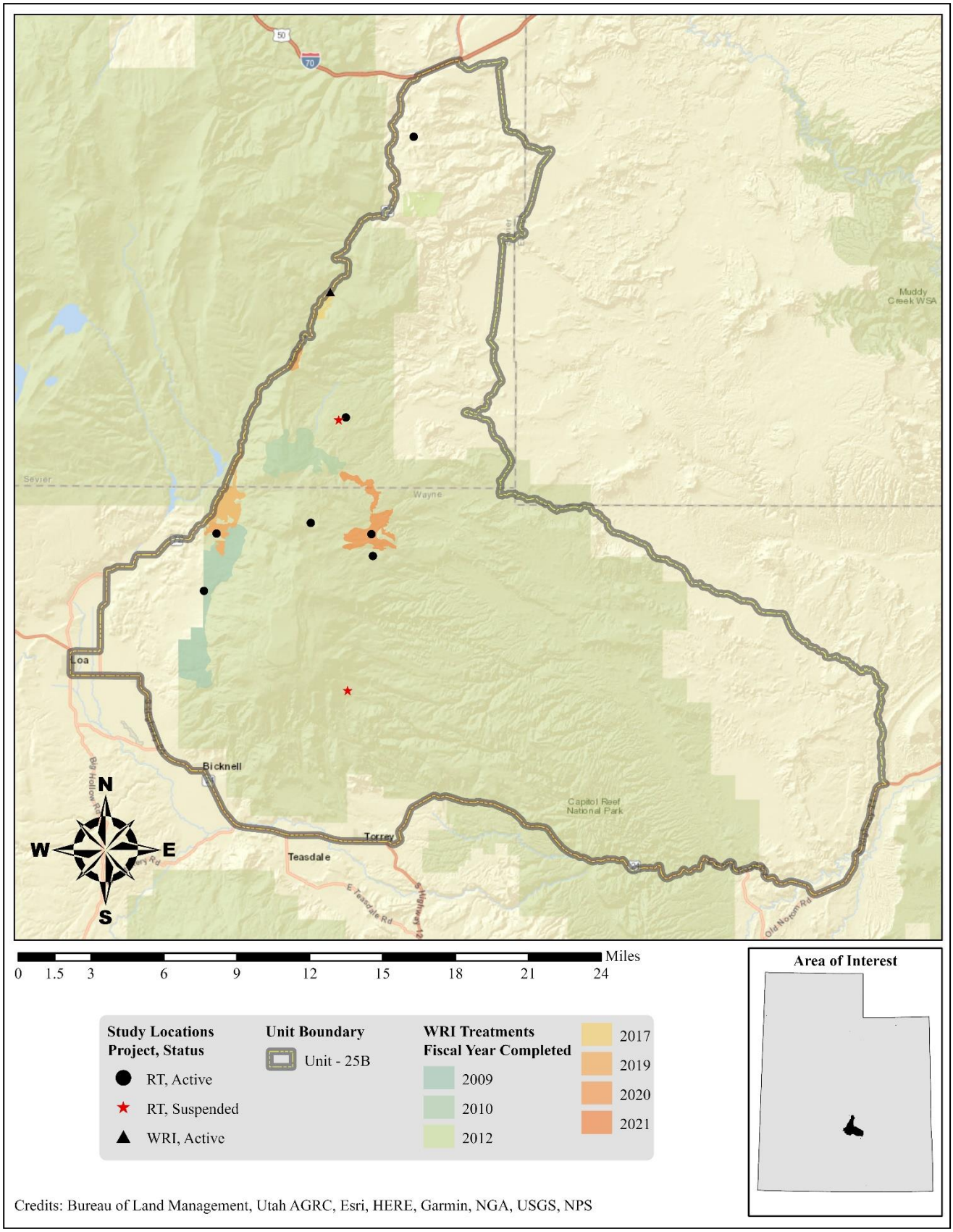
Treatments/Restoration Work

There has been an active effort to address some of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 9,950 acres of land have been treated within the Thousand Lakes Plateau subunit since the WRI was implemented in 2004 (**Map 4.7**). Treatments frequently overlap one another bringing the net total of completed treatment acres to 9,802 for this unit. 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.

Skid-steer mounted tree cutting treatments are the most common treatment by acreage across the Thousand Lakes Plateau unit. Seeding plants to supplement the herbaceous understory is also common, as are manual vegetation removal techniques such as lop and scatter. Other treatments include anchor chaining, seeding shrub species, and mowing (**Table 4.2**).

Type	Total Completed Acreage
Anchor Chain	**540**
Ely (One-Way)	342
Ely (Two-Way)	198
Mowing	**112**
Brush Hog	112
Seeding (Primary)	**2,592**
Broadcast (Aerial-Helicopter)	2,544
Drill (Rangeland)	48
Seeding (Secondary/Shrub)	**378**
Ground (Mechanical Application)	378
Skid-Steer Mounted Tree Cutter	**3,572**
Hydraulic Brush Saw	3,572
Vegetation Removal/Hand Crew	**2,757**
Lop & Scatter	2,757
Grand Total	**9,950**
***Total Land Area Treated**	**9,802**

Table 4.2: WRI treatment action size (acres) of completed projects for WMU 25B, Thousand Lakes Plateau. Data accessed on 02/07/2024.
*Does not include overlapping treatments.



Map 4.7: Terrestrial WRI treatments by fiscal year completed for WMU 25B, Thousand Lakes Plateau.

Range Trend Studies

Range Trend studies have been sampled within WMU 25B on a regular basis since 1985, with studies being added or suspended as was deemed necessary (**Table 4.3**). 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
25B-01	Thousand Lake	RT	Suspended	1985, 1991, 1999	Mountain Stony Loam (Antelope Bitterbrush)
25B-02	Horse Valley	RT	Active	1985, 1991, 1994, 1999, 2004, 2009, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
25B-03	Sage Flat	RT	Active	1985, 1991, 1994, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25B-04	Solomon Basin	RT	Suspended	1994, 1999, 2004, 2009, 2013	Upland Loam (Black Sagebrush)
25B-05	Polk Creek	RT	Active	1985, 1991, 1994, 1999, 2004, 2009, 2013, 2018, 2023	Mountain Stony Loam (Antelope Bitterbrush)
25B-06	Little Deer Peak	RT	Active	1985, 1991, 1999, 2004, 2009, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25B-07	Hens Peak Aspen	RT	Active	2013, 2018, 2023	High Mountain Stony Loam (Aspen)
25B-08	Morrell Pond	RT	Active	2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25B-09	McDonald Basin	RT	Active	2023	Mountain Loam (Mountain Big Sagebrush)
25R-12	Paradise Valley	WRI	Active	2016, 2020	Semiwet (Fresh Meadow)

Table 4.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 25B, Thousand Lakes Plateau.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
25B-02	Horse Valley	Bullhog	Cedar Creek Winter Range Enhancement	Fall 2012	3,569	818
25B-05	Polk Creek	Lop and Scatter	Thousand Lake Habitat Improvement Phase 3 (Proposed)	Fall 2023 or Spring 2024	1,220	6563
25B-07	Hens Peak Aspen	Wildfire Seed Unknown	Hens Peak	July 1996 1996	630	
25B-09	McDonald Basin	Lop and Scatter	Thousand Lake Habitat Improvement Project Phase 1	June 2021-October 2022	247	5206
25R-12	Paradise Valley	Tordon 22K	Paradise Valley Restoration Project	October-December 2017	112	3794
		Mower	Paradise Valley Restoration Project	October-December 2017	112	3794

Table 4.4: Range Trend and WRI studies known disturbance history for WMU 25B, Thousand Lakes Plateau. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Ecotypes that are represented by only one study site throughout most or all of the sample period are not discussed in this section. These ecotypes include:

- Mountain (Aspen) - Hens Peak Aspen (25B-07)
- Mountain (Big Sagebrush) - McDonald Basin (25B-09)
- Mountain (Shrub) - Thousand Lake (25B-01) (suspended) and Polk Creek (25B-05)
- Upland (Black/Low Sagebrush) - Solomon Basin (25B-04) (suspended)

Trend summaries and/or data for these ecotypes are available in the corresponding site reports.

Upland (Big Sagebrush)

Four studies [Horse Valley (25B-02), Sage Flat (25B-03), Little Deer Peak (25B-06), and Morrell Pond (25B-08)] are classified as Upland (Big Sagebrush) ecological sites. The Horse Valley site is located approximately four miles east of Fremont, between the town and Thousand Lake Mountain. The Sage Flat study site is situated northeast of Fremont, approximately one mile east of SR-72. The Little Deer Peak site is located approximately three miles south of the I-70 and SR-72 junction and roughly three quarters of a mile east of SR-72. The Morrell Pond study site is located in Solomon Basin, approximately one quarter of a mile north of Morrell Pond.

Shrubs/Trees: The dominant preferred browse species on Horse Valley, Little Deer Peak, and Morrell Pond is mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), while Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) dominates the Sage Flat study. Other preferred browse species such as black sagebrush (*A. nova*) and/or prairie sagewort (*A. frigida*) have also been observed on these sites, but in lesser amounts. Despite yearly fluctuations, total average shrub cover has remained stable when comparing 2004 with 2023 data (**Figure 4.8**). Average shrub demographic data shows that density of preferred browse has decreased over time and that mature plants have been the dominant demographic throughout the study period. Both decadence and recruitment of young have decreased overall. More particularly, site-level data reveals that the slight decrease in the number of young plants between 2018 and 2023 can be attributed to the Sage Flat and Morrell pond sites (**Figure 4.11**). Average preferred browse utilization has varied over the sample period, but 52% of plants displayed signs of moderate or heavy use in 2023 (**Figure 4.12**).

Twoneedle pinyon (*Pinus edulis*) and/or Utah juniper (*Juniperus osteosperma*) have been observed on some of these study sites. Although it has remained low, average tree cover has increased over time. The cover increase between 2013 and 2018 in particular is due to both the Horse Valley study and the establishment of Morrell Pond (**Figure 4.9**). Average tree density has increased overall. However, average tree density exhibited a notable decrease between the two most recent sample years, which was entirely due to the Horse Valley study (**Figure 4.10**).

Herbaceous Understory: The herbaceous understories on these sites are relatively sparse, but typical of lower-precipitation sagebrush sites. Perennial grasses have been the dominant herbaceous component throughout the study period, and have primarily been composed of native species on most sites. Total average herbaceous cover and frequency have fluctuated over the sample years. Both values decreased between 1999 and 2009, but increased overall after 2009. Perennial forbs have been observed each sample year, but with less cover and abundance than perennial grasses. Annual grasses and forbs have remained sparse; the introduced annual grass species cheatgrass (*Bromus tectorum*) has only been sampled on the Morrell Pond study (**Figure 4.13**, **Figure 4.14**).

Occupancy: Average pellet transect data indicates that animal presence has decreased overall when comparing 1999 data with that from 2023. Elk were the primary occupants of these sites in 2004 and 2013, and mean abundance of elk pellet groups has ranged from 2 days use/acre in 2018 to 16 days use/acre in 1999. Deer have been the main occupants in all other sample years, and presence has been as low as 4.5 days use/acre in 2013 and as high as 18 days use/acre in 1999. Finally, cattle have also been present on these sites, and average pellet group abundance has fluctuated between 1 days use/acre in 2009 and 2013 and 7.5 days use/acre in 1999 (**Figure 4.15**).

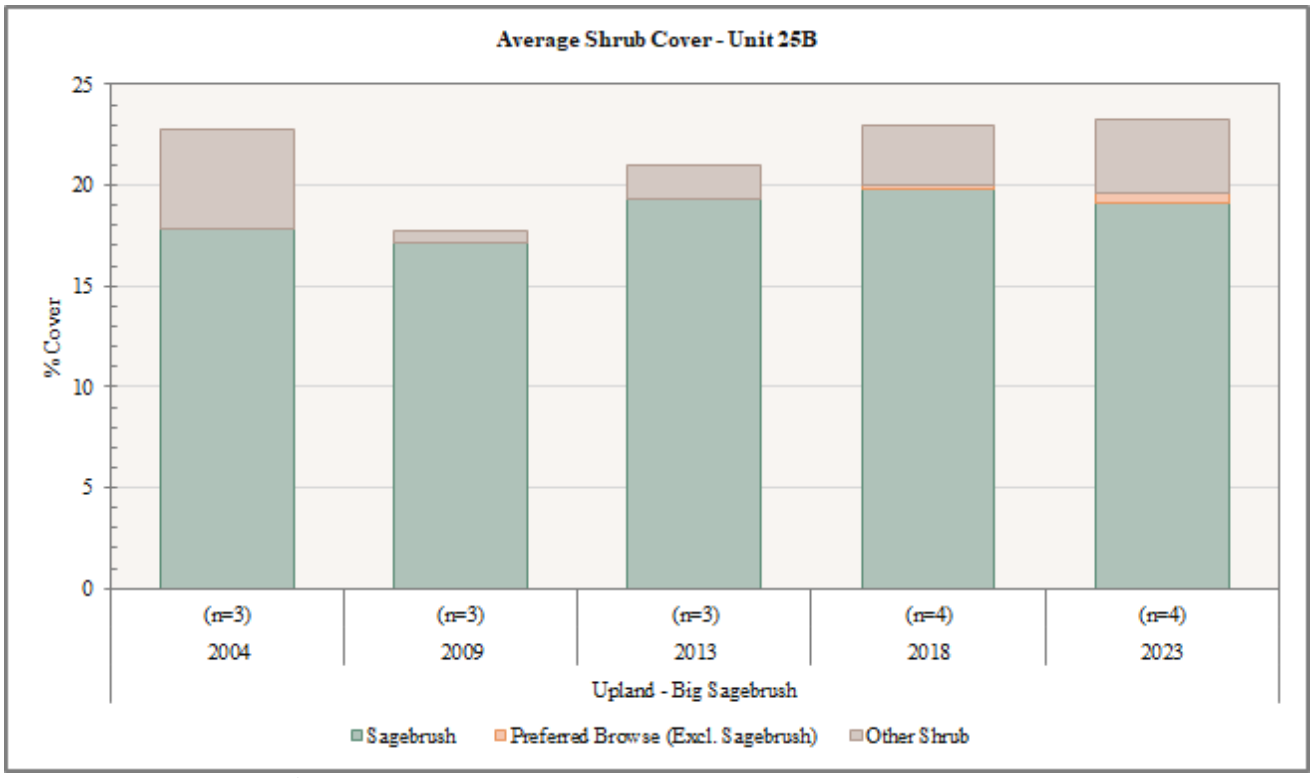


Figure 4.8: Average shrub cover for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

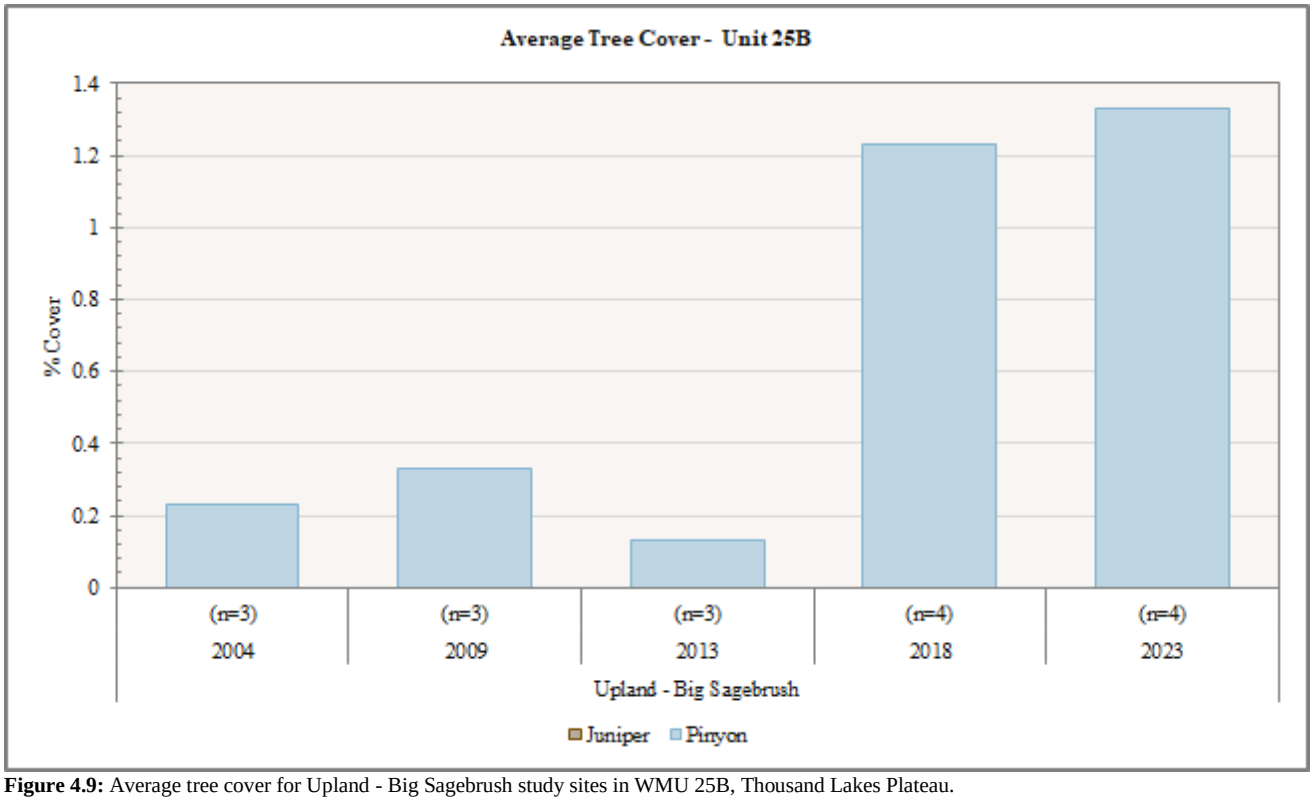


Figure 4.9: Average tree cover for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

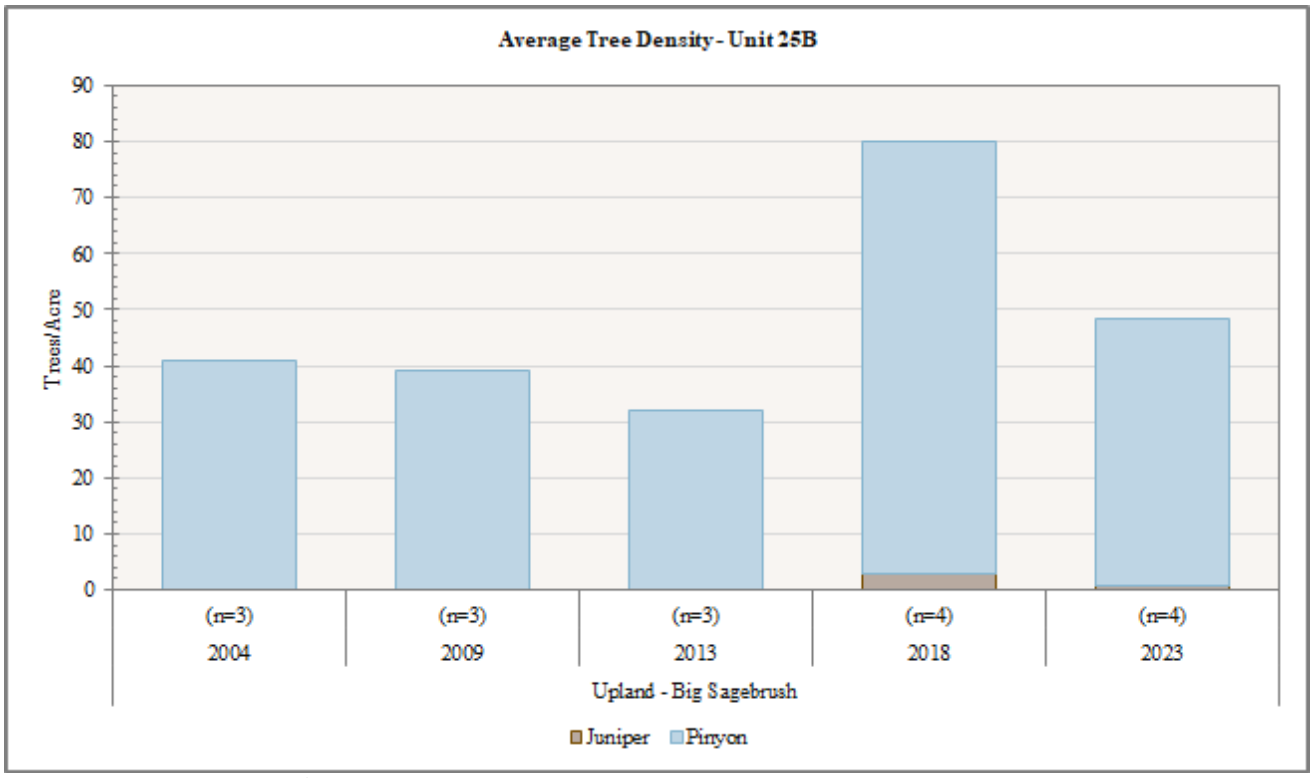


Figure 4.10: Average tree density for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

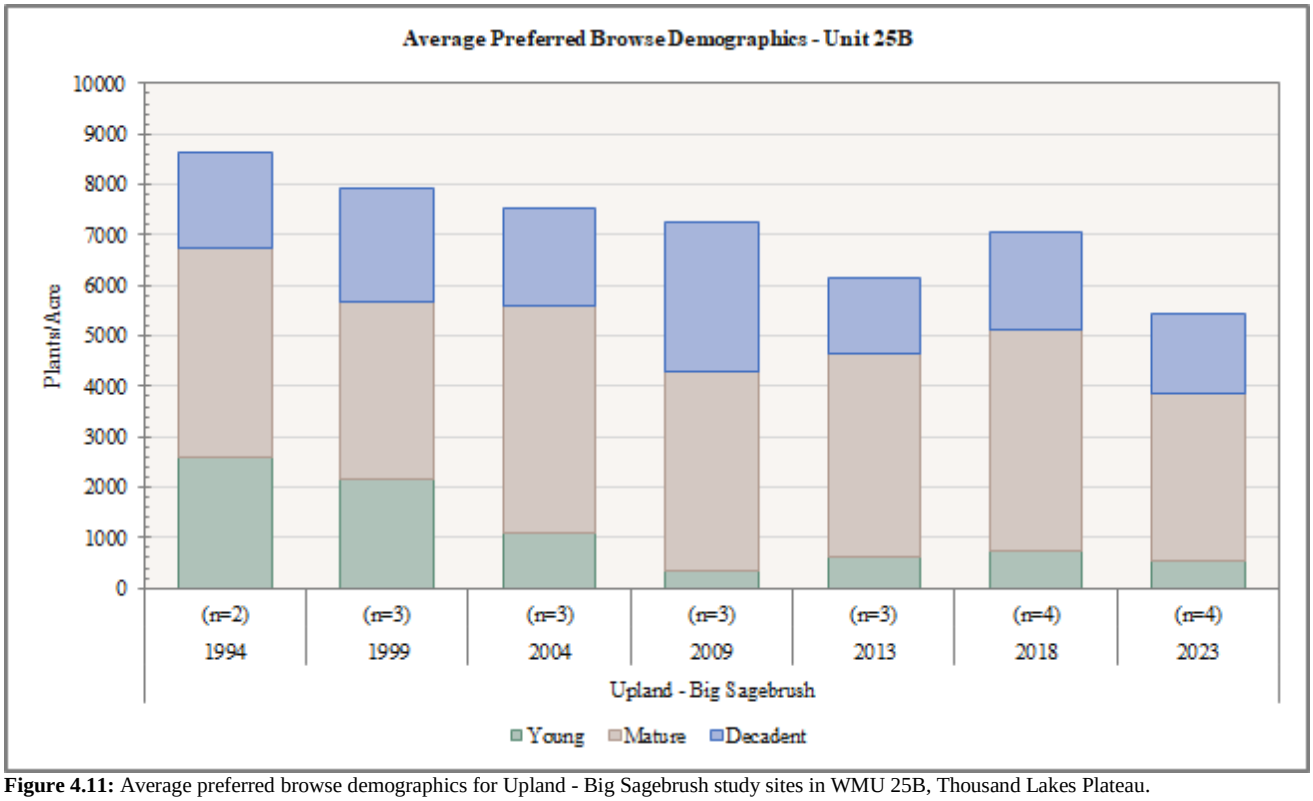


Figure 4.11: Average preferred browse demographics for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

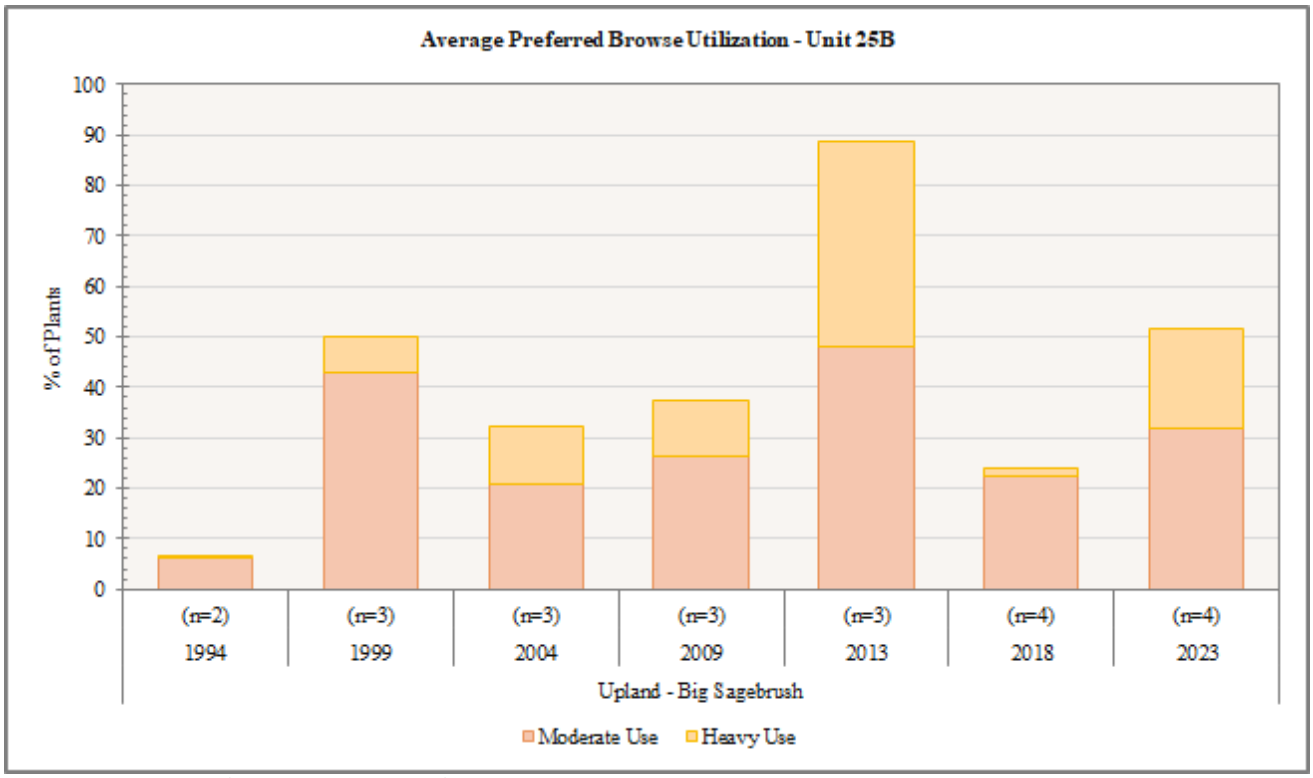


Figure 4.12: Average preferred browse utilization for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

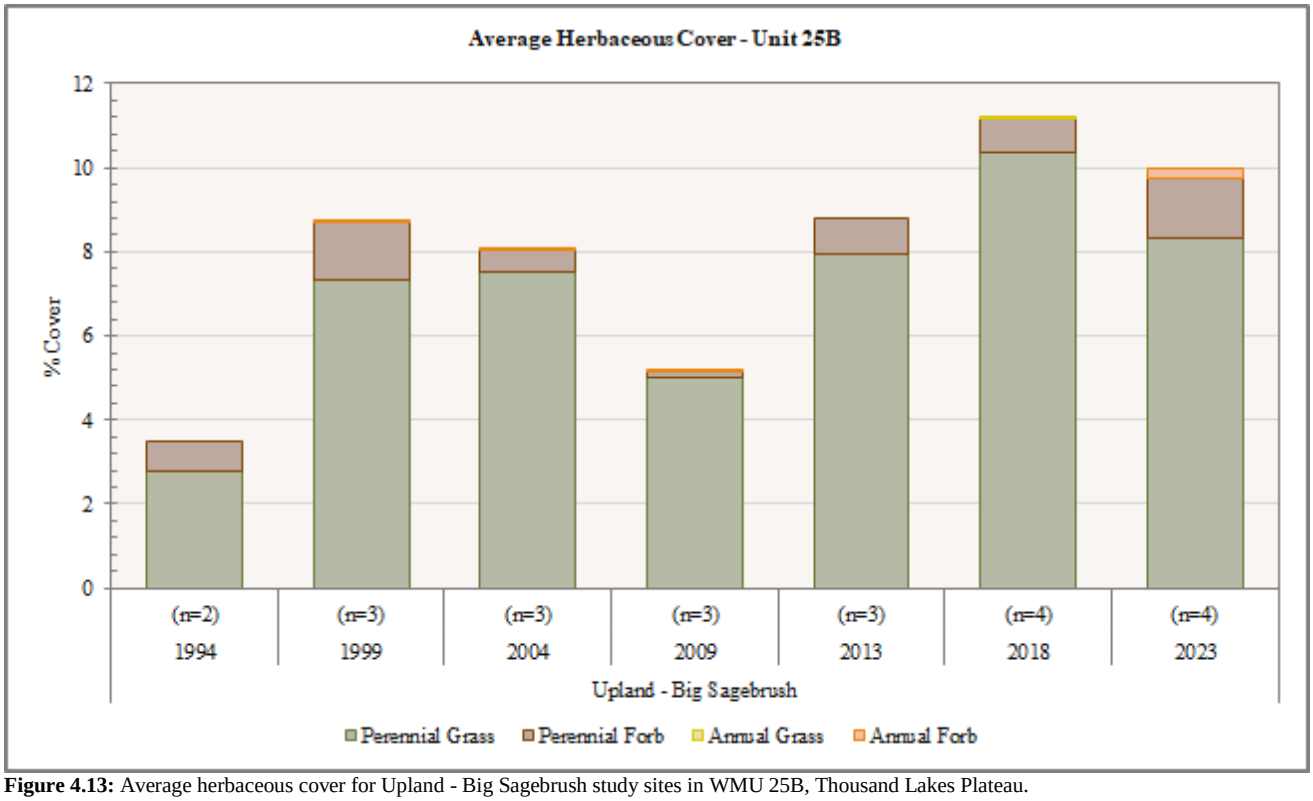


Figure 4.13: Average herbaceous cover for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

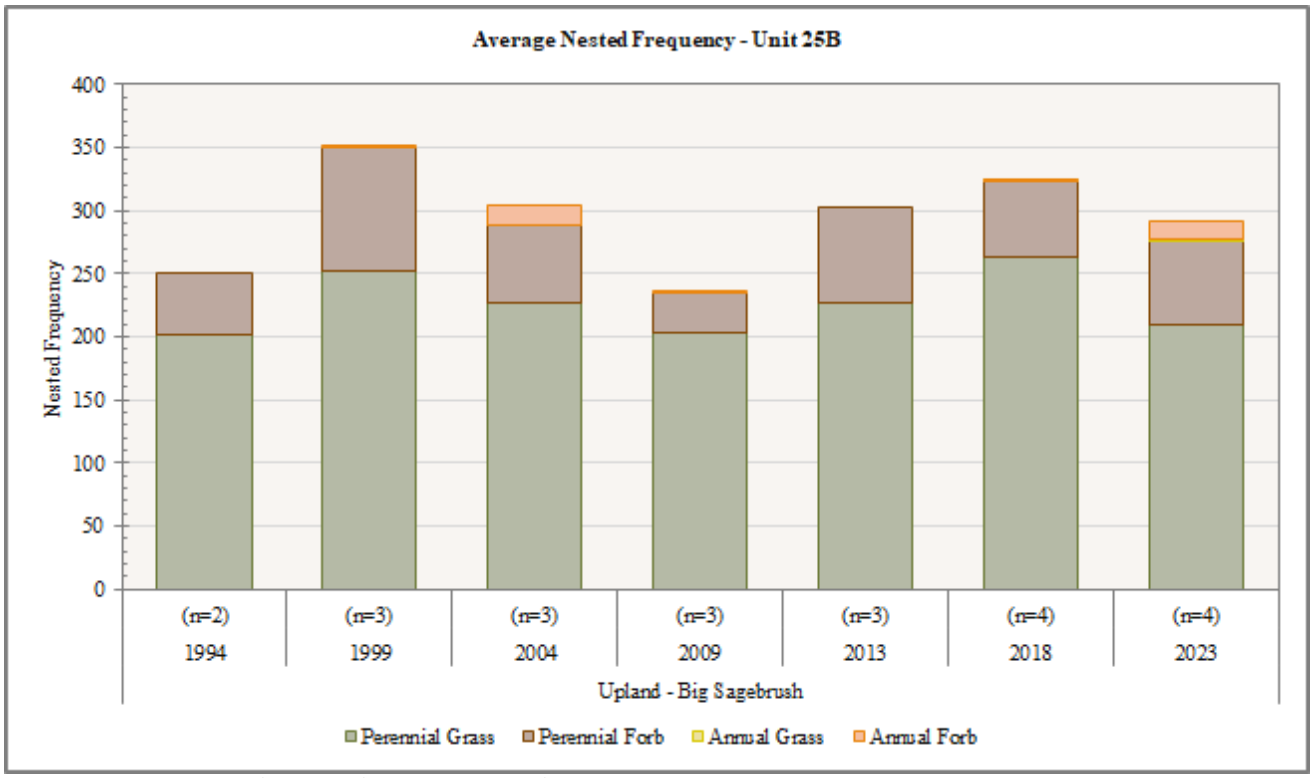


Figure 4.14: Average nested frequency of herbaceous species for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

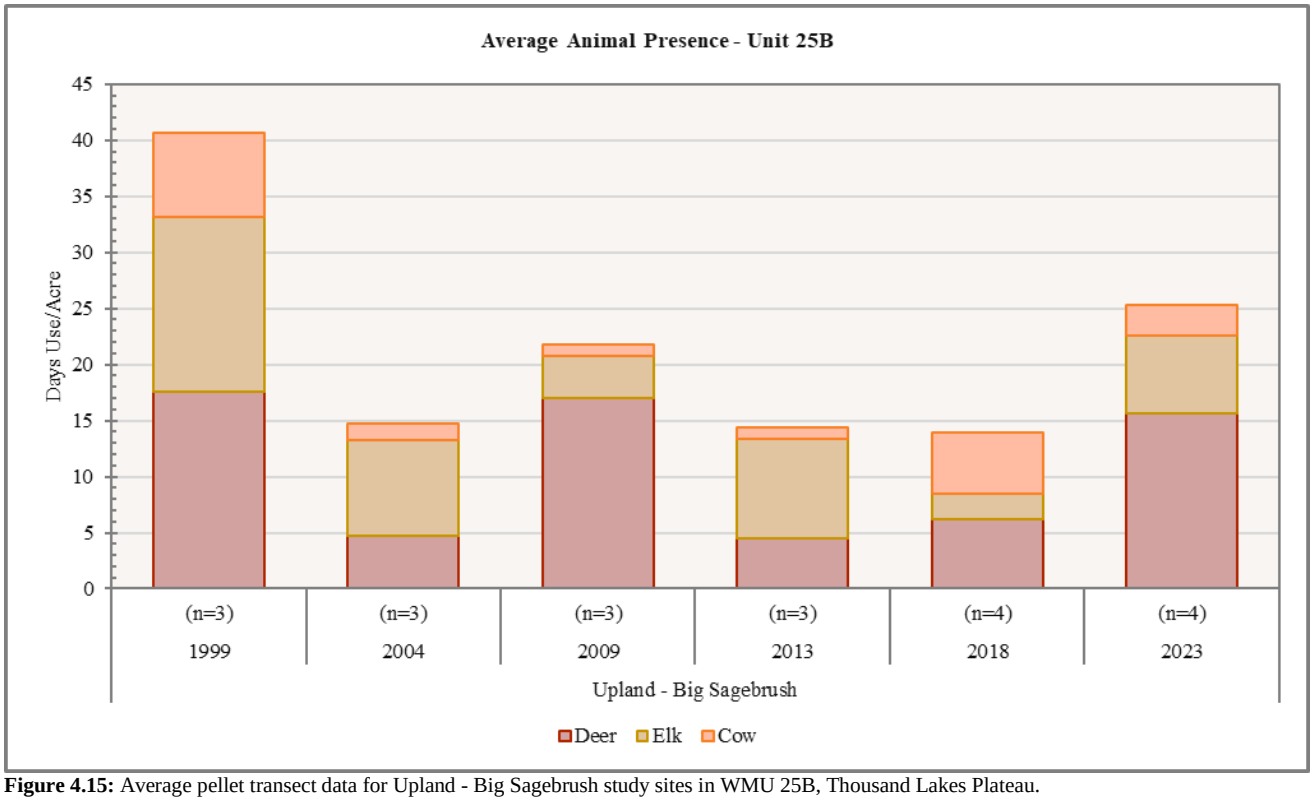


Figure 4.15: Average pellet transect data for Upland - Big Sagebrush study sites in WMU 25B, Thousand Lakes Plateau.

Deer Winter Range Condition Assessment

The overall condition of deer winter range within the Thousand Lakes Plateau Management unit has remained similar from year to year with sites averaging from poor to fair since 1994, but there was a notable decease in range condition in 2009. Long-term, Sage Flat (25B-03), Polk Creek (25B-05) and Little Deer Peak (25B-6) are the main drivers for the unit's wintering habitat stability and quality, and average as fair for deer winter range condition. With the addition of Morrell Pond (25B-08) and McDonald Basin (25B-09) and their similar range conditions, the unit's averaged range condition is further supported as being fair. Horse Valley (25B-02) is considered to have very poor to poor wintering habitat condition consistently from year to year: these poor conditions suppress the unit's overall winter range quality. Range Trend sites in WMU 25B that tend to have higher winter habitat variability include Solomon Basin (25B-04) (suspended), Polk Creek, and Little Deer Peak. This may suggest a higher potential for winter range improvement, but this may also suggest that these sites may have a lower resistance and resilience to disturbances that influence state transitions. As such, caution should be given when applying landscape-scale treatments to improve habitat in these areas.

The overall deer winter range assessment in 2023 for WMU 25B is that the unit is in poor-fair condition with individual sites ranging between poor-fair and fair condition. The Little Deer Peak and McDonald Basin sites' winter habitats could benefit from an increase in preferred browse cover, while increasing perennial grass and forb cover would benefit the remaining studies. Fortunately, annual grass has been absent from the understories of these sites. Efforts to reduce pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) encroachment on these sites will likely lead to improvement in the overall health of deer habitat, as reducing pinyon and juniper can lead to increased browse and forb health and diversity (**Figure 4.16**, **Table 4.5**).

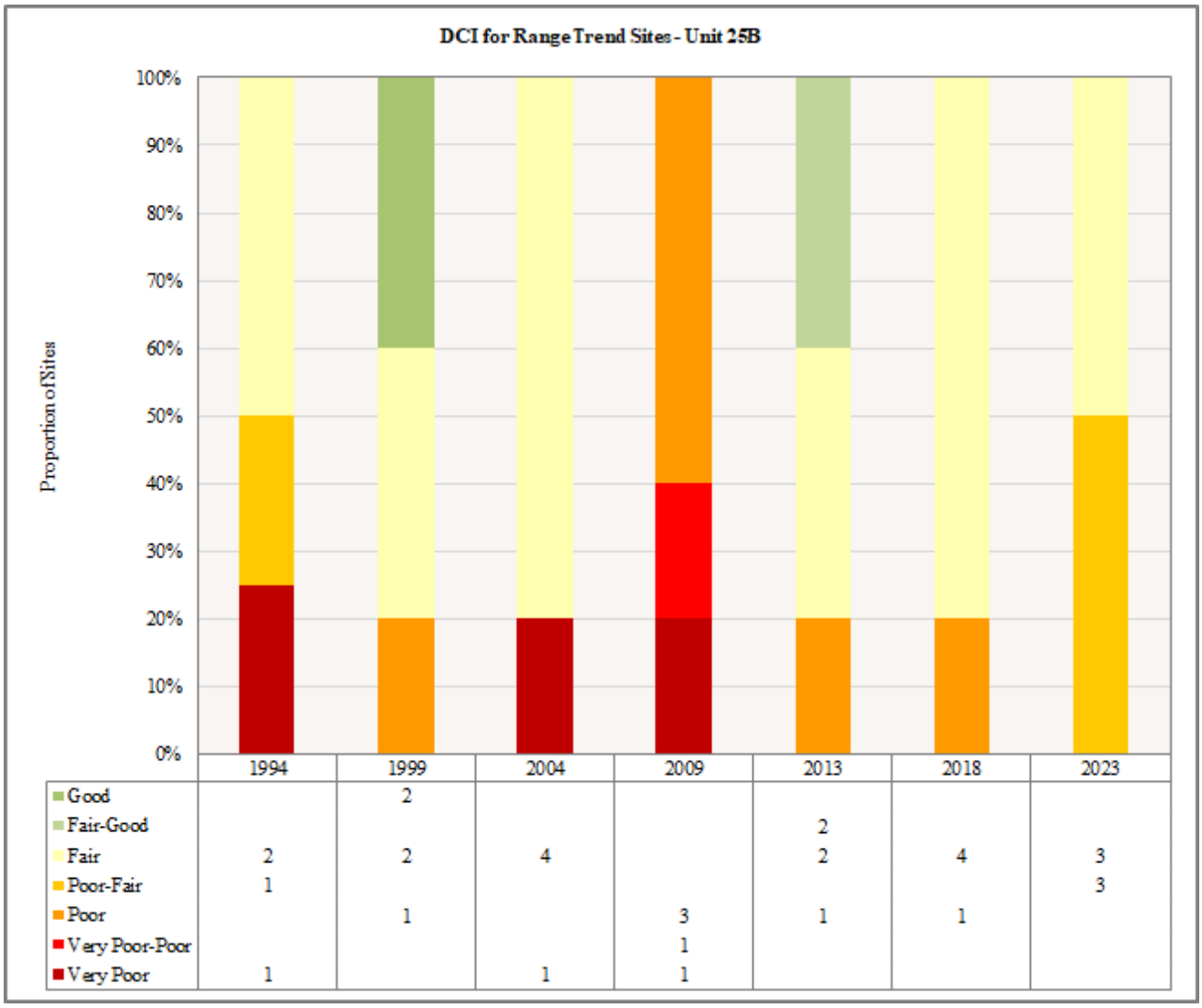


Figure 4.16: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 25B, Thousand Lakes Plateau.

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
25B-02	1994	18.8	2.2	1.3	3	0	2.5	0	**27.7**	**VP**
25B-02	1999	23.6	2.8	4.9	4.4	0	4.4	0	**40**	**P**
25B-02	2004	22.9	4	2.1	3.1	0	0.4	0	**32.4**	**VP**
25B-02	2009	25.5	-2.7	1	3.1	0	0.3	0	**27.2**	**VP**
25B-02	2013	27	3.6	2.5	3.8	0	2.8	0	**39.8**	**P**
25B-02	2018	28.1	4.9	1.5	6.5	0	2.7	0	**43.8**	**P**
25B-02	2023	30	7.8	2.9	5.6	0	2.4	0	**48.7**	**P-F**
25B-03	1994	26.8	10.2	15	8.1	0	0.5	0	**60.6**	**F**
25B-03	1999	26	8.1	15	6	0	0.7	0	**55.7**	**F**
25B-03	2004	25.5	9.1	13.2	5.5	0	0.4	0	**53.6**	**F**
25B-03	2009	26.9	7	3.2	4.8	0	0.4	0	**42.2**	**P**
25B-03	2013	27.9	9.1	4.7	13.1	0	0.8	0	**55.6**	**F**
25B-03	2018	30	6.7	6.5	9.6	0	1.4	0	**54.2**	**F**
25B-03	2023	27.4	5.6	5.1	12.2	0	0.5	0	**50.6**	**P-F**
25B-04*	1994	11.6	11.1	8.7	18.3	0	4	0	**53.6**	**F**
25B-04*	1999	17.8	10.9	6.8	23.3	0	8.8	0	**67.6**	**G**
25B-04*	2004	26.2	11.9	8.5	11.5	0	3.8	0	**61.9**	**F**
25B-04*	2009	17.6	9.3	9.6	9.9	0	1.5	0	**48**	**P**
25B-04*	2013	29.6	14	10.8	8.6	0	3.3	0	**66.2**	**F-G**
25B-05	1994	30	8.6	1.5	9.5	0	3.9	0	**53.4**	**P-F**
25B-05	1999	30	8.9	6.7	18.7	0	10	0	**74.2**	**G**
25B-05	2004	30	9	2.1	18.5	0	3.4	0	**63.1**	**F**
25B-05	2009	30	5.9	4.2	11.1	0	1.8	0	**52.9**	**P**
25B-05	2013	30	8.1	3.4	16.8	0	4	0	**62.2**	**F**
25B-05	2018	30	8	3.2	20.5	0	2.3	0	**63.9**	**F**
25B-05	2023	30	10.2	1.1	17.6	0	4.2	0	**63**	**F**
25B-06	1999	17.4	6	5.5	30	0	3.1	0	**61.9**	**F**
25B-06	2004	18.6	6.3	0.5	30	0	2.5	0	**57.9**	**F**
25B-06	2009	11.8	-2.1	1.6	22	0	0.3	0	**33.5**	**VP-P**
25B-06	2013	17.6	8.9	7.6	30	0	1.4	0	**65.5**	**F-G**
25B-06	2018	16.3	3.9	1.7	30	0	1.8	0	**53.6**	**F**
25B-06	2023	12.6	2.6	5	30	0	7	0	**57.2**	**F**
25B-08	2018	25.4	10.4	9.3	15	0	0.3	0	**60.2**	**F**
25B-08	2023	24.5	9.1	6.2	8.7	0	1.3	0	**49.7**	**P-F**
25B-09	2023	14.5	11	4.4	30	0	6.2	0	**66**	**F**

Table 4.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 25B, Thousand Lakes Plateau. 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 Impact	Potential Impact
25B-02	Horse Valley	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25B-03	Sage Flat	None Identified		
25B-05	Polk Creek	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor
25B-06	Little Deer Peak	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
25B-07	Hens Peak Aspen	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Conifer Encroachment	Medium	Reduced understory shrub, aspen stand, and herbaceous vigor
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
25B-08	Morrell Pond	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25B-09	McDonald Basin	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25R-12	Paradise Valley	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 25B, Thousand Lakes Plateau. All assessments are based off the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A – Threat Assessment**.

Discussion and Recommendations

Year-to-year condition of deer wintering habitat within the Thousand Lakes Plateau Management unit appears to be stable as a whole. Three study sites are in poor-fair wintering condition and three sites are considered as fair wintering habitat as of 2023. Current factors that limit the quality of winter range on these sites include (but are not limited to) lack of browse cover on Little Deer Peak and McDonald Basin; an undiversified age class structure among preferred browse populations on most sites; and low amounts of perennial forbs within their understories.

Extensive habitat rehabilitation projects along the west side of the Thousand Lakes Plateau unit have been completed (**Table 4.2**, **Map 4.7**). Efforts both in and out of the Watershed Restoration Initiative (WRI) have been taking place. These treatments have been concentrated along the SR-72 corridor, Horse Valley, and McDonald Basin, all of which are within deer and elk winter range. Although few Range Trend sites sample the bulk of the habitat treatments in this unit, many of the seeding and pinyon-juniper removal projects appear to be successful.

Few wildfires have occurred on this unit; Hens Peak (1996), Solomon Basin (2009), and Pole Canyon (2018) were relatively small with varying intensity. Because of the small sizes and varying intensities of these fires, most of the ecotypes have remained stable or are transitioning to late-stage successional phases. The low frequency and small size of wildfires that have occurred on the Thousand Lakes Plateau have potentially been beneficial for wildlife by diversifying summer habitat within the burned areas. Plant communities of interest identified by LANDFIRE that are impacted by wildfire include aspen and mixed conifer woodlands, pinyon-juniper woodlands, and montane sagebrush steppe ecotypes. Of the communities most impacted by wildfire are Inter-Mountain Basins Montane Sagebrush Steppe sites, which have had an estimated 705 acres burn, most of which occurred in the Solomon Basin fire. However, there are no Range Trend studies within this fire perimeter. The Hens Peak Aspen (25B-07) study is located in a burn area (Hens Peak Fire) identified by LANDFIRE as a Rocky Mountain Aspen Forest and Woodland, discussed later. Approximately 400 of 3,537 acres of this ecotype burned in this unit. However, only approximately 500 out of 4,438 acres of Inter-Mountain Basin Aspen-Mixed Conifer Forest and Woodland burned, which may mean the majority of this aspen ecotype may be considered to be in mid- to late-stage succession (**Table 4.1**, **Table 4.4**, **Map 4.5**, **Map 4.6**). It should be noted that this ecotype is identified as a Key Terrestrial Habitat in the Utah Division of Wildlife Resources' Wildlife Action Plan (Utah Division of Wildlife Resources, 2015). Typically, this ecosystem is comprised of mostly aspen (*Populus tremuloides*) with few to several species of conifer interspersed in the community. Without regular disturbances like fire, aspen replacement can occur. Communities dominated by aspen tend to have a more complex understory comprised of a range of graminoids, forbs, and shrub; this variety of community structure provides multiple habitats for wildlife. If aspen replacement were to occur in these communities through conifer encroachment, there is the potential to reduce and/or lose beneficial habitat (The Nature Conservancy LANDFIRE Team, 2023). 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, positive effects are also possible, and include (but are not limited to) the rejuvenation of quaking aspen stands and removal of undesirable species (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 these fires have had an overall positive or negative effect on big game habitat in this unit nor any measure of departure from reference states.

Aspen cover on the Hens Peak Aspen site has increased from year to year, but density of trees has remained relatively the same. Aspen trees have become taller, and as such, less herbivory on aspen has been observed (Cox, Lane, & Payne, 2023). As of 2023, the understory appears to be filling in with mountain snowberry (*Symphoricarpos oreophilus*), which is considered to provide some benefit to deer and elk as forage. This site is also host to stable grass and forb communities; herbaceous cover, abundance, and diversity have remained similar since 2013. Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) densities have increased over time, but not at levels active enough to cause concern over loss of community diversity and structure.

Mule deer habitat is highly diversified due to the range and extent of the varying biophysical settings (hereafter referred to as ecological systems) and the total area that is considered valuable for deer (**Table 4.1**, **Map 4.2**, **Map 4.5**). Floral diversity in these ecological systems provides increased alternatives for deer as seasonal and life history requirements shift with the changing seasons. However, these ecological systems may be departed from their reference state by varying degrees. On-site verification should be made to establish ecosystem departure and habitat quality by professional estimates, which is the intent of Range Trend.

Sagebrush (*Artemisia spp.*) communities sampled by Range Trend have little to no cheatgrass (*Bromus tectorum*) invasion occurring. In addition, in areas where cheatgrass invasion has been observed (Hens Peak Aspen), cheatgrass levels are decreasing. In the case of the Hens Peak Aspen study, this decrease speaks to the area's resilience to disturbance and recovery following the Hens Peak wildfire (Cox, Lane, & Payne, 2023).

Despite Thousand Lakes Plateau's connection to Capitol Reef National Park, much of the unit remains isolated and inaccessible to general motorists due to geographic features and unimproved road systems. Therefore, high traffic is likely kept to the periphery of the unit. Any vehicle-wildlife interactions on the unit's interior are likely at lower speeds and with local and backcountry traffic, keeping wildlife mortality to a minimum in this area. Wildlife and motorist interactions appear to have minimal impact on highway mortality in this unit for highways 24 and 72 as illustrated by Utah Roadkill reports between 2018 and 2022 (Utah Division of Wildlife Resources, 2024). As such, highway mortality is not considered a limiting factor for this sub-unit (Utah Division of Wildlife Resources, 2024).

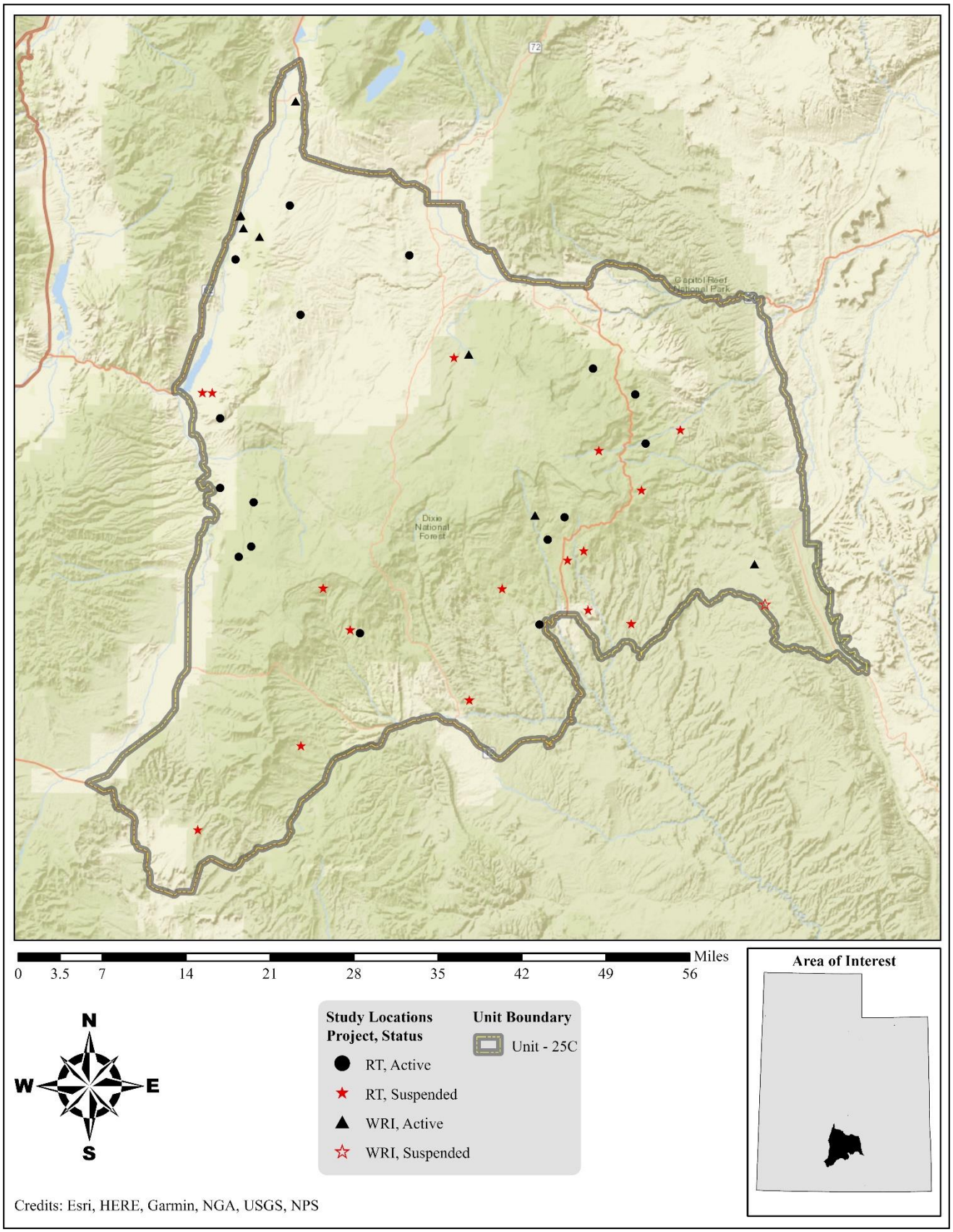
Although some portions of the unit have been treated to remove pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*), tree encroachment remains a concern across the Thousand Lake Plateau. Polk Creek and McDonald Basin are areas where antelope bitterbrush (*Purshia tridentata*) and sagebrush provide valuable browse for deer and elk; however, pinyon-juniper encroachment has, or may have, an impact on the vigor and density of shrubs. Presence of pinyon and juniper can result in reduced understory shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000). Density measurements and repeat photographs taken on the Polk Creek study reveal that ponderosa pine (*Pinus ponderosa*) is on site. This suggests that the area was likely not a pinyon-juniper site historically, but a ponderosa pine woodland with an understory of mountain browse and sagebrush. This may indicate a highly departed state from reference conditions for this particular community.

There are a few suggestions to consider for improving big game habitat within the Thousand Lakes Plateau unit. Spruce-fir encroachment into aspen and pinyon-juniper encroachment into big sagebrush (*Artemisia tridentata*) shrublands appear to be the most prominent threats.

Inappropriate fire frequency and intensity, drought, and improper grazing are priority threats considered by the Wildlife Action Plan that may be negatively affecting aspen communities in this unit. Management of these threats includes increasing occurrence of larger and more intense prescribed or natural fires that encourage more successful aspen regeneration than smaller, less intense fires. In addition to fire, mechanical disturbances like logging can also encourage aspen regeneration. All disturbances are encouraged to be applied at large scale in order to distribute ungulate pressure across a large area as aspen communities recover. Human and/or domestic grazing disturbances may also need to be managed using fencing, hazing, hunting, and/or domestic grazing management and implementation of policies that reduce improper browsing and grazing by wildlife and livestock (Utah Division of Wildlife Resources, 2015).

A portion of this unit has already been treated for pinyon-juniper encroachment (**Table 4.2**). 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 taken in method selection (lop and scatter, bullhog, chaining, etc.) to ensure that annual grass loads are not unintentionally introduced or amplified in areas of low potential. 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 25C – BOULDER PLATEAU



WILDLIFE MANAGEMENT UNIT 25C – BOULDER PLATEAU

Boundary Description

Sevier, Garfield, Piute, and Wayne counties - Boundary begins at SR-24 and SR-62 north of Koosharem; south on SR-24 to SR-62; south on SR-62 to SR-22; south on SR-22 to the Widtsoe-Antimony road; south on the Widstoe-Antimony road to SR-12; east on SR-12 to the Burr Trail at Boulder; east on the Burr Trail to Notom Road; north on Notom Road to SR-24; west on SR-24 to the junction of SR-24 and SR-62.

Management Unit Description

Geography

The Boulder Plateau Wildlife Management Unit is part of the larger management unit 25 – Plateau. Unit 25 is divided into three sub-units: Fishlake Plateau (25A), Thousand Lakes Plateau (25B), and Boulder Plateau (25C).

The Boulder Plateau Wildlife Management Unit includes the high country of the Aquarius Plateau, which is commonly known as Boulder Mountain. The unit also contains the slopes of the Aquarius Plateau, which slope down to the south and west through variable desert terrain that makes up a major portion of the winter range in Unit 25C. The Boulder Plateau Wildlife Management Unit also encloses areas to the north including Parker Mountain (Awapa Plateau), Boulder Mountain, Miners Mountain, and portions of the Waterpocket Fold and Capitol Reef National Park. Parker Mountain is an open rolling plateau with a maximum elevation of 9,600 feet and northeastern exposure. The Aquarius Plateau is a high, lava-capped mountain plateau rising to 11,322 feet in elevation on Boulder Mountain. Miners Mountain is a large anticline located in the northeast corner of the unit. The lowest points in the Boulder Plateau management unit are located in the far northeast portion with elevations of roughly 5,000 feet. A small section along the west side of Parker Mountain drains west into Otter Creek. The southern section of the unit drains to the south into the Escalante River, while the remainder of the unit drains to the north into the Fremont River.

Municipalities located along the unit boundaries include Koosharem and Antimony on the west, Loa, Lyman, Bicknell, Teasdale, and Torrey on the north, and Escalante and Boulder on the south side.

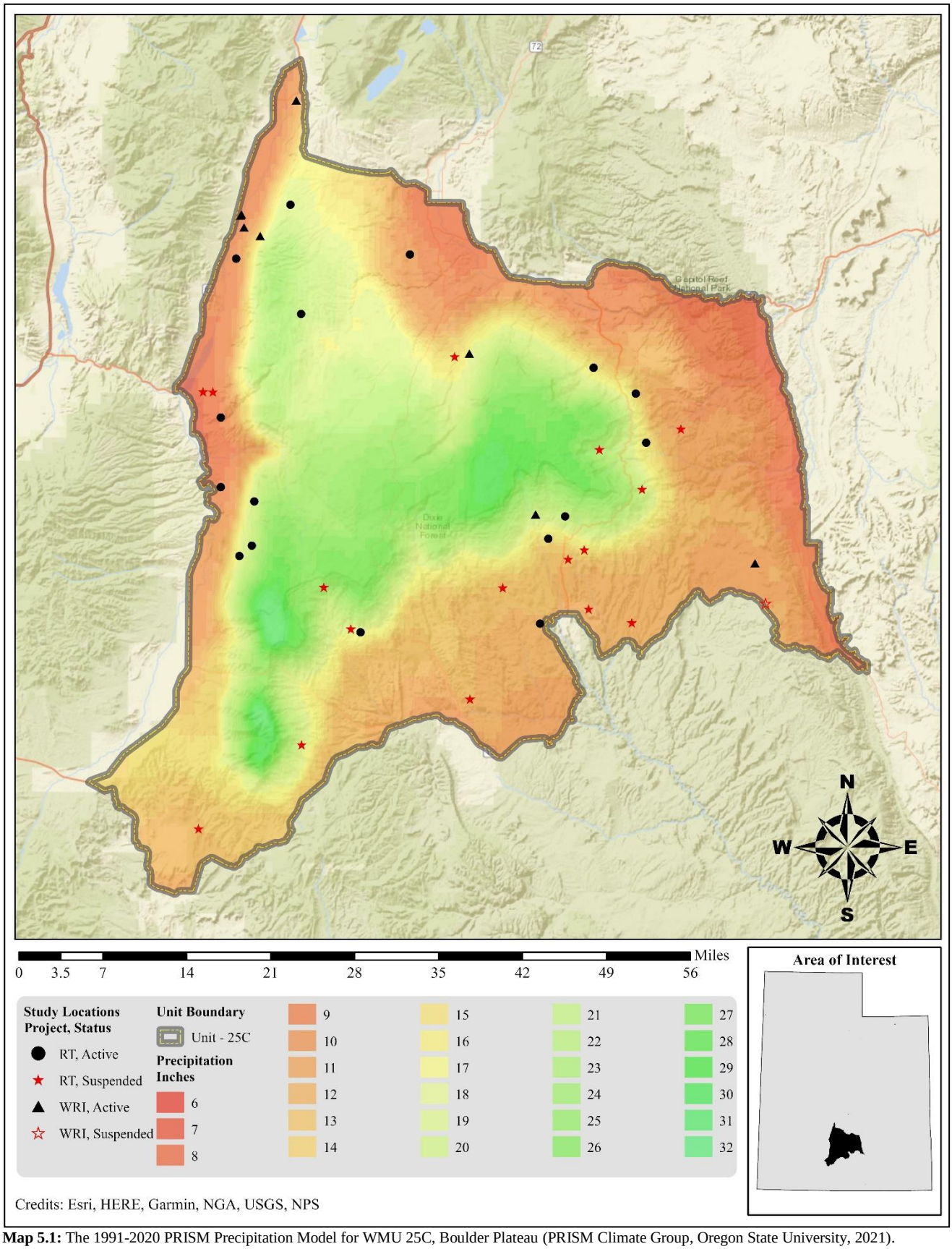
Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 7 inches along the eastern portions the unit and near Otter Creek State Park to 32 inches on Barney Top and Griffin Top in the Escalante Mountains. All of the active Range Trend and WRI monitoring studies on the unit occur within 9-21 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 South Central Division (Division 4).

The mean annual PDSI of the South Central Division, which the Boulder Plateau unit is a part of, has experienced some form of drought most years since 1993. Moreover, this climate division is considered to be in drought nearly 68% of the time since 1993. Of the drought years, nearly 43% are considered to be either moderate or extreme droughts. Also remarkable about this climate division is that drought is experienced over multiple years and is generally interrupted by a single wet year event; the most notable wet years occur in 2005 and 2011, which were both considered moderately wet year (**Figure 5.1a).** The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI. These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September and May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 5.1b**). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 5.3**). Years that were moderately wet occur in 1999 and 2023, but years where

drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 5.1a, Figure 5.1b**) (Time Series Data, 2024).



Map 5.1: The 1991-2020 PRISM Precipitation Model for WMU 25C, Boulder Plateau (PRISM Climate Group, Oregon State University, 2021).

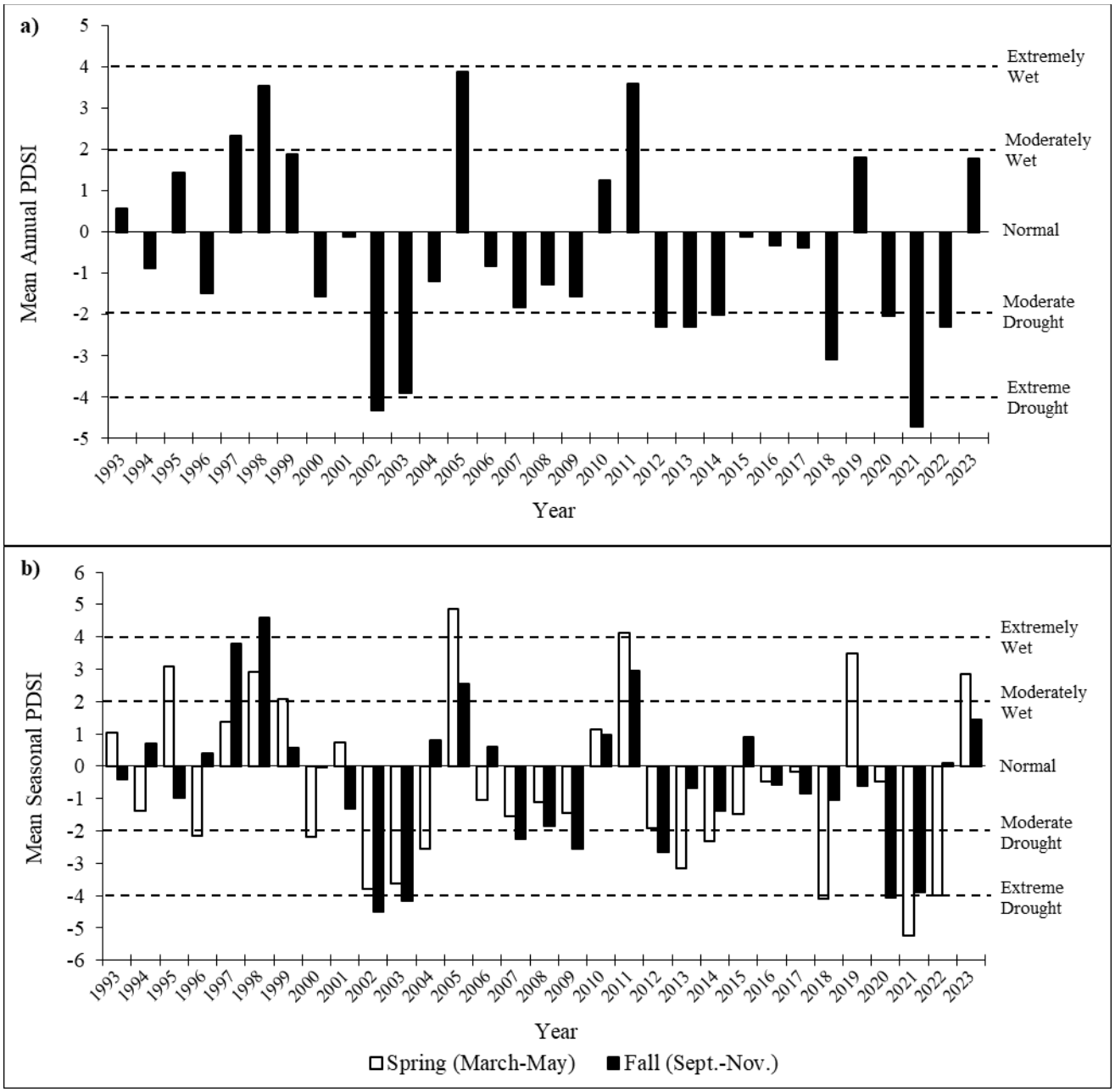


Figure 5.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

The winter range on the Boulder Plateau unit is large enough to support all of the deer summering on the unit (**Map 5.2**). With a few localized exceptions, it is in mostly good condition. Huff & Coles (1966) drew the upper limits of the winter range between 8,000 and 8,400 feet and the lower limits between 6,500 and 7,000 feet. The pinyon-juniper and sagebrush (*Artemisia spp.*) types and various combinations of the two dominate the winter range. There is abundant winter range south of Boulder Mountain. However, much of the country is comprised of slickrock canyons and mesas that support few deer; most wintering takes place on the lower slopes and at the base of the mountain. The upper limits of the normal winter range are uniform at 8,000 feet across the south slopes of the Boulder Mountain. Seven thousand feet is the usual upper limit during severe winter conditions. The lower limit for most wintering deer on the south side of the unit is Highway 12. Winter range is more restricted on the west side of the Aquarius Plateau between Antimony and Widtsoe. The mountain drops off steeply from Griffin Top to the river valley. Deer can typically utilize vegetation up to 9,000 feet during normal winters, but are limited to an upper limit of around 8,000 feet during severe winters. The lower boundary for severe winters is the bottom of the valley on the Sevier River, which is approximately 6,500 feet in elevation.

Summer range is limited to specific areas on Parker Mountain and Boulder Mountain (**Map 5.2**). Boulder Mountain contains approximately 50,000 acres above 10,500 feet (Christensen & Bogedahl, 1983). This high summer range is unsuitable for fawning and receives only light deer use in late summer. Most fawning and summer use is concentrated underneath the lava rock rim where stands of aspen (*Populus tremuloides*), fir (*Abies spp.*), and spruce (*Picea spp.*) are interspersed with sage flats and meadows. Because of fire suppression, vegetation trends toward a denser spruce climax community. Logging and/or prescribed burns may help maintain this important habitat in a seral stage, which is more productive and more favorable to big game. Lower down the slopes, ponderosa pine (*Pinus ponderosa*) with its associated mountain brush understory receives limited summer use. Summer range on Parker Mountain is more limited to the higher southern end, where aspen stands in association with big sagebrush (*Artemisia tridentata*) and antelope bitterbrush (*Purshia tridentata*) provide excellent fawning areas.

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

The RAP data illustrates a relatively broad peak where herbaceous cover and biomass were highest during the early to late-1990s, but cover and biomass have slowly decreased to present values. Annual species in the summer range have shown very little change in biomass since 1986. Annual cover in summer range shares the same overall trend with no net change in cover amounts, but cover varies from year to year. Years of good precipitation generally correlate with large flushes of annuals: this is more pronounced on the winter habitats. Annual biomass on winter range has ranged between 0.81 lbs/acre in 1991 and 21.49 lbs/acre in 2003, and is an example of the degree of annual biomass variation that occurs in this area (**Figure 5.2**, **Figure 5.3**, **Figure 5.5**, **Figure 5.6**). Range Trend data from 1994 to present on Mountain (Big Sagebrush) sites shows perennial cover to be stable, but annual cover has increased over time. However, total perennial cover has decreased on Upland (Big Sagebrush and Black/Low Sagebrush) sites while total annual cover has increased with some yearly fluctuations (**Figure 5.21**, **Figure 5.22**). Fluctuations in annual cover are expected due to differences in timing and amounts of precipitation for each sample year read. RAP biomass and cover data for perennials in year-long habitat have decreased overall. A few prominent peaks of increased cover occur in the mid-1990s, 2000s and again in 2010, which appear to correlate with increased precipitation periods. However, there is an event of increased precipitation occurring in 1997 that does not relate to any increase in cover or biomass, but a period of decrease for each metric (**Figure 5.4**, **Figure 5.7**).

The RAP data for tree and shrub cover shows fluctuations over time. Cover has remained relatively stable for shrubs on all range types, but tree cover has steadily increased on summer and winter ranges. RAP tree cover on year-long range has remained relatively stable (**Figure 5.8**, **Figure 5.9**, **Figure 5.10**). Range Trend data displays general increases in shrub and tree cover since 2003. Any decreases in tree cover on Range Trend sites are due to land treatments targeting tree cover and its reduction, but overall tree cover continues to increase following treatment (**Figure 5.11**, **Figure 5.12**, **Figure 5.13**, **Figure 5.14**).

RAP – Herbaceous Biomass by Deer Habitat

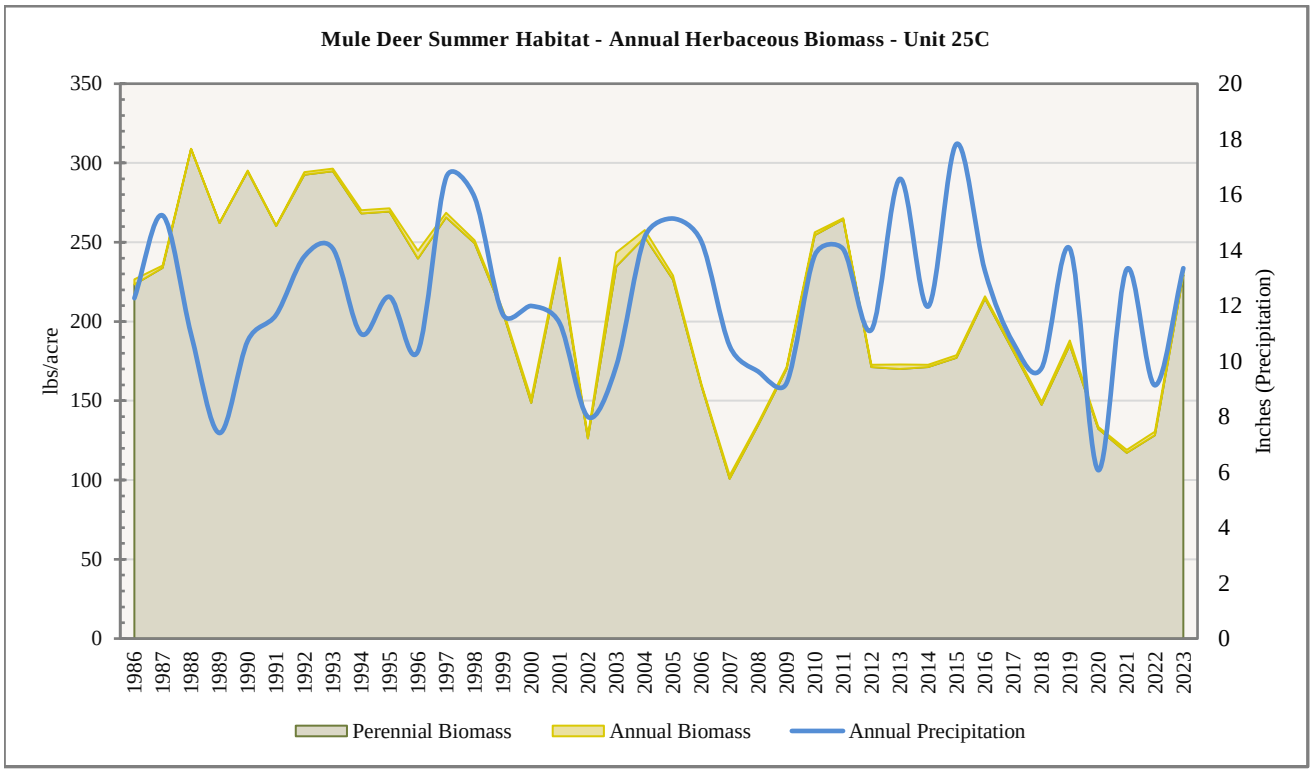


Figure 5.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

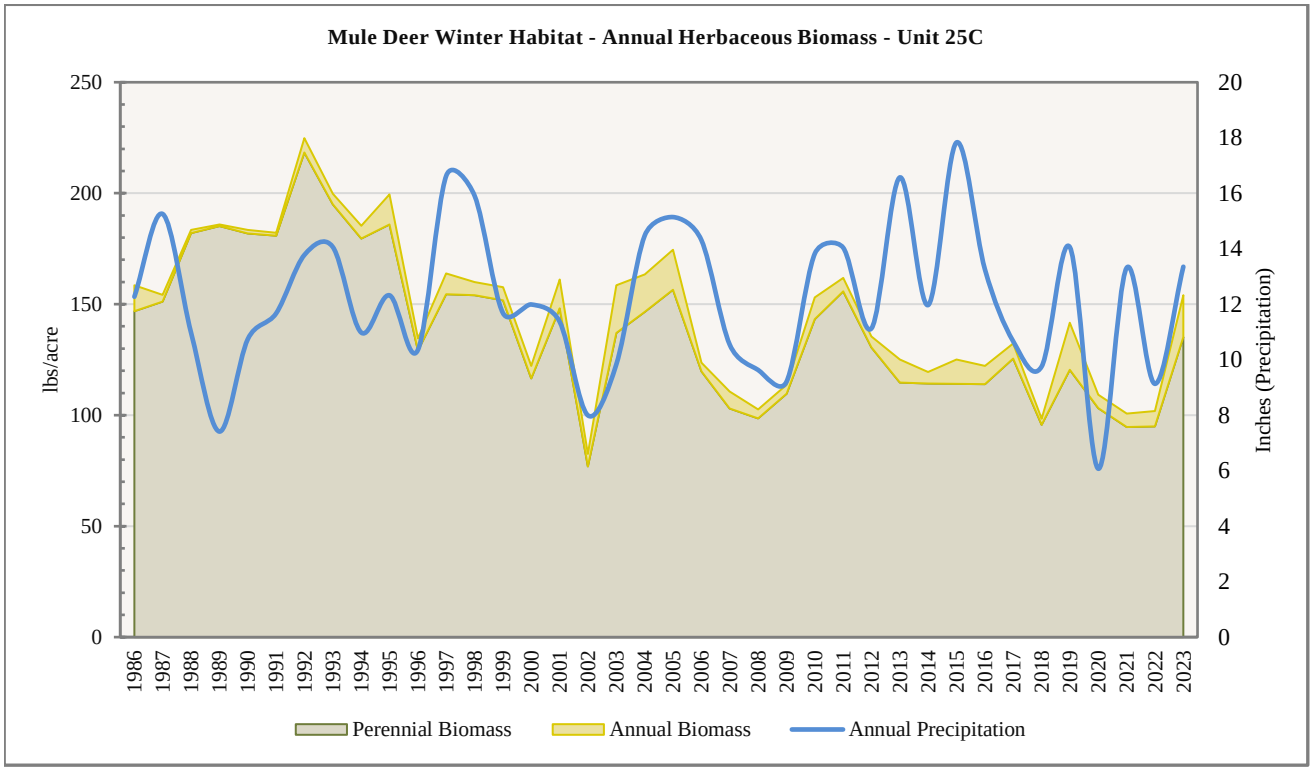


Figure 5.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

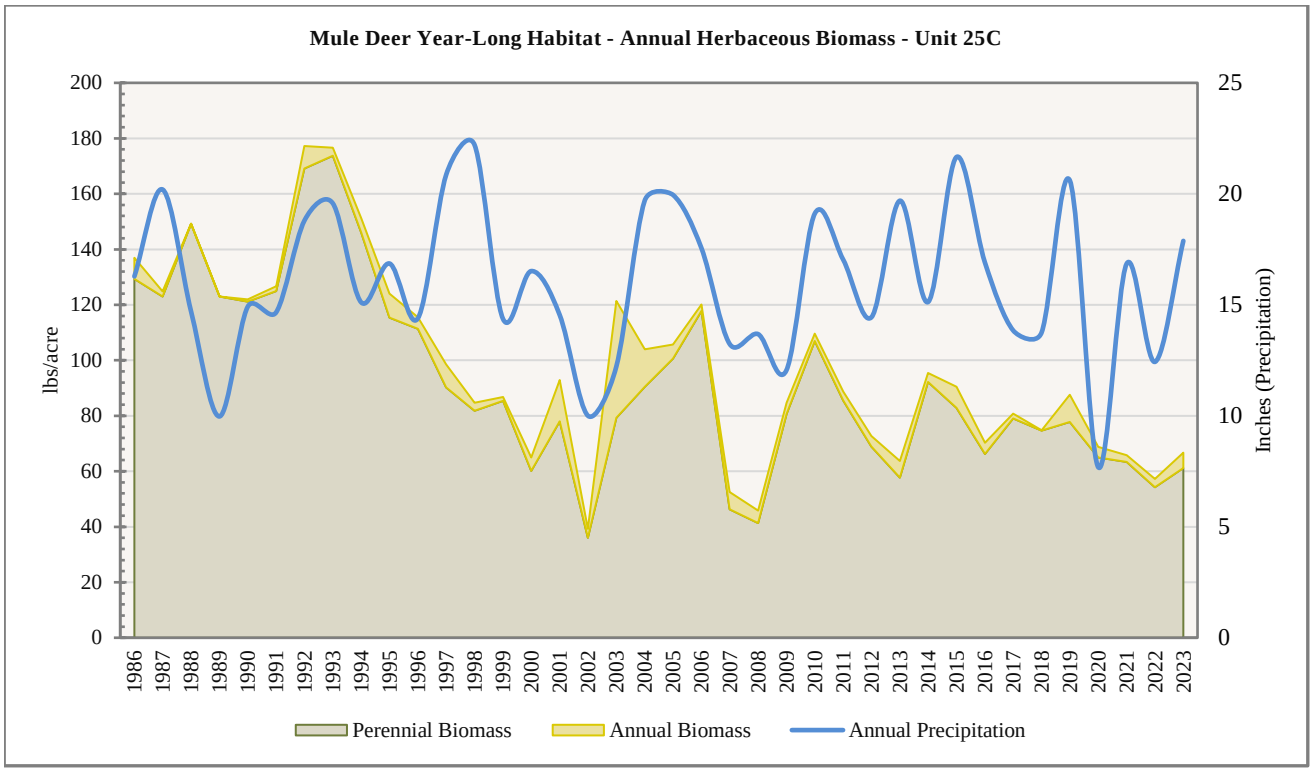


Figure 5.4: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

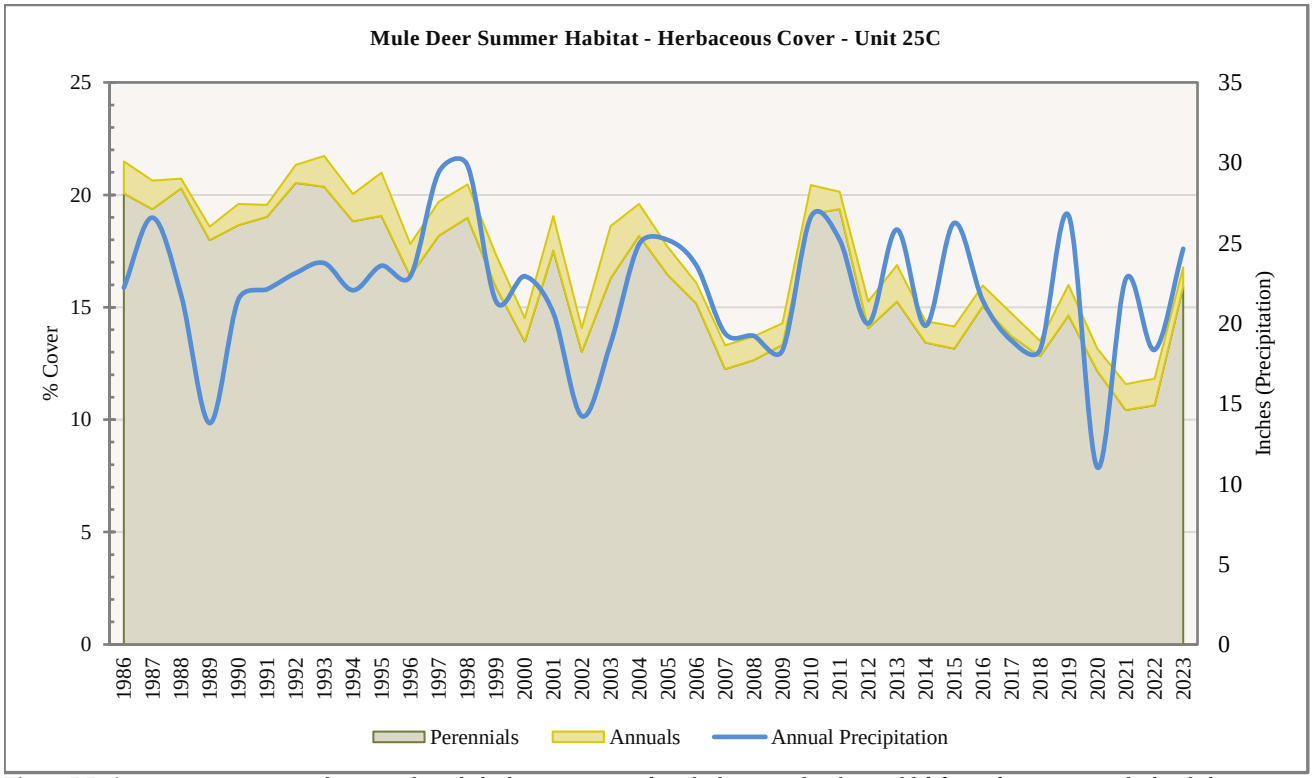


Figure 5.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

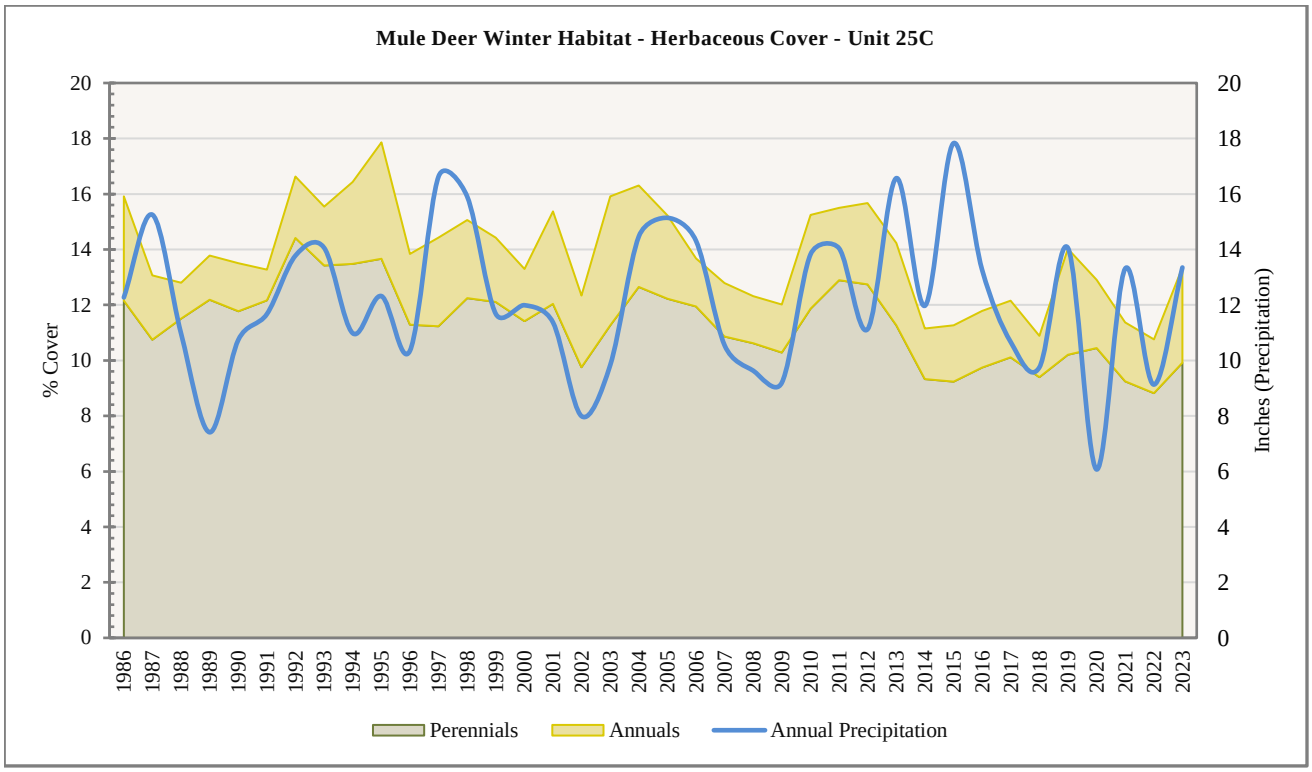


Figure 5.6: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

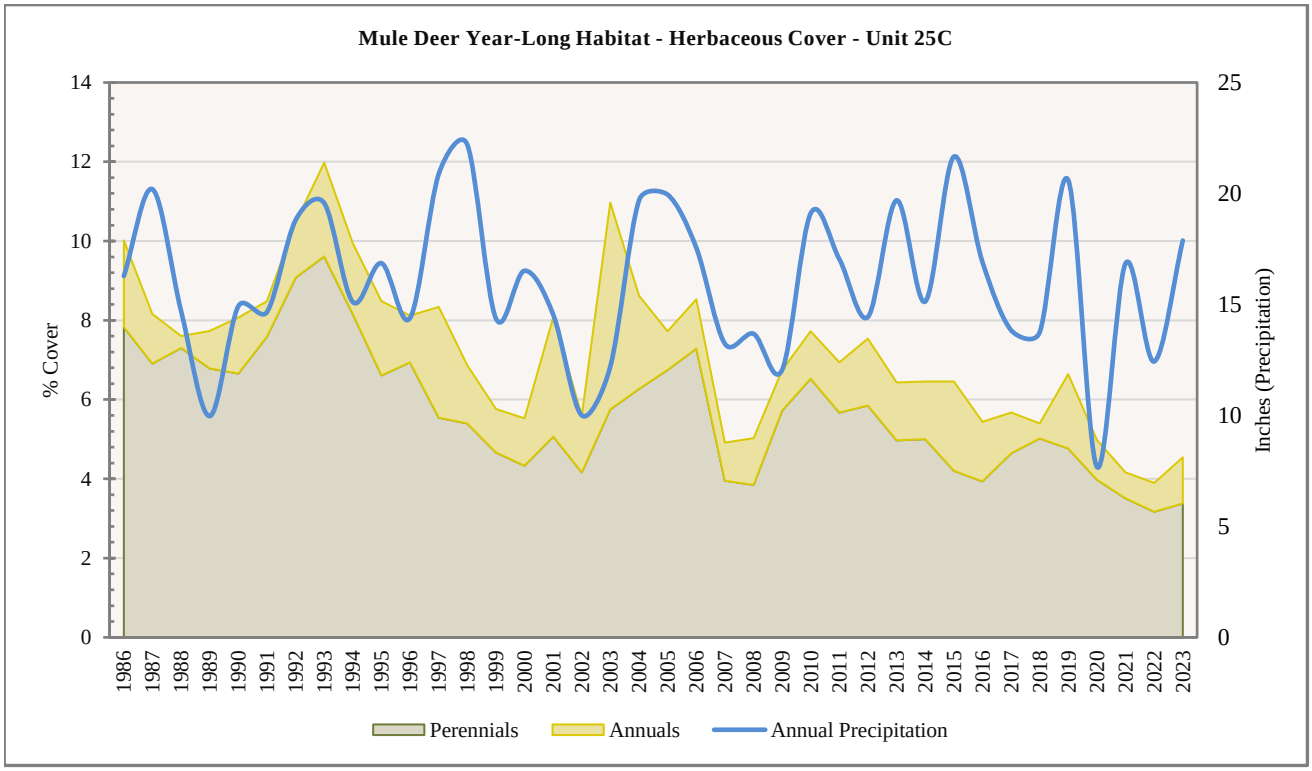


Figure 5.7: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for year-long deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

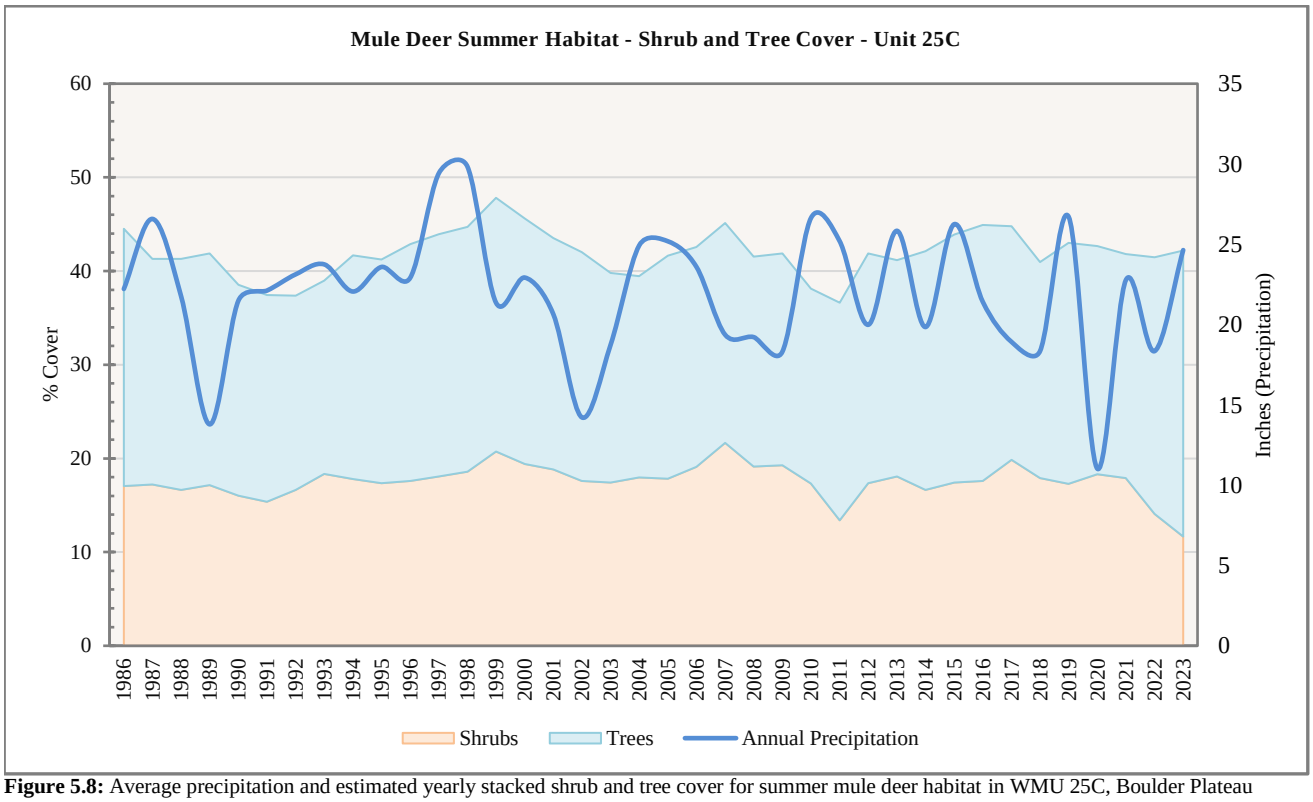


Figure 5.8: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

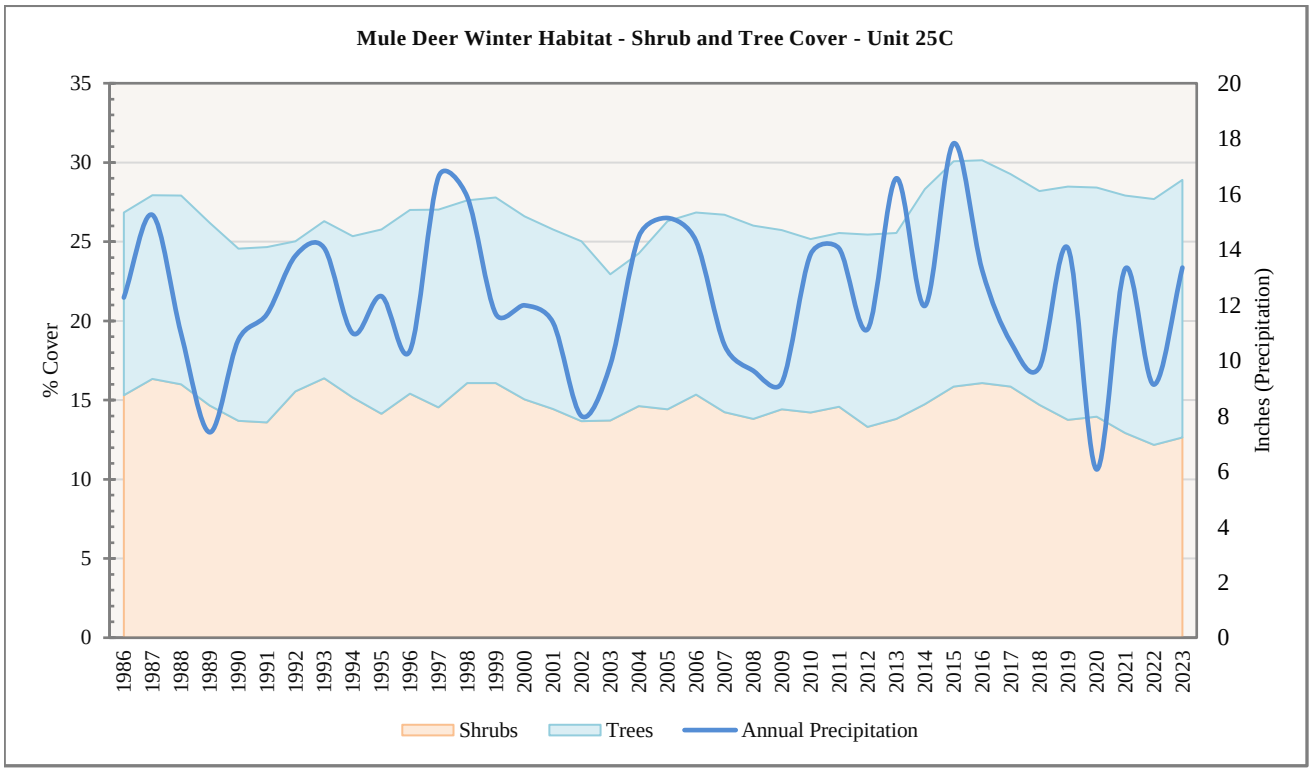


Figure 5.9: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).

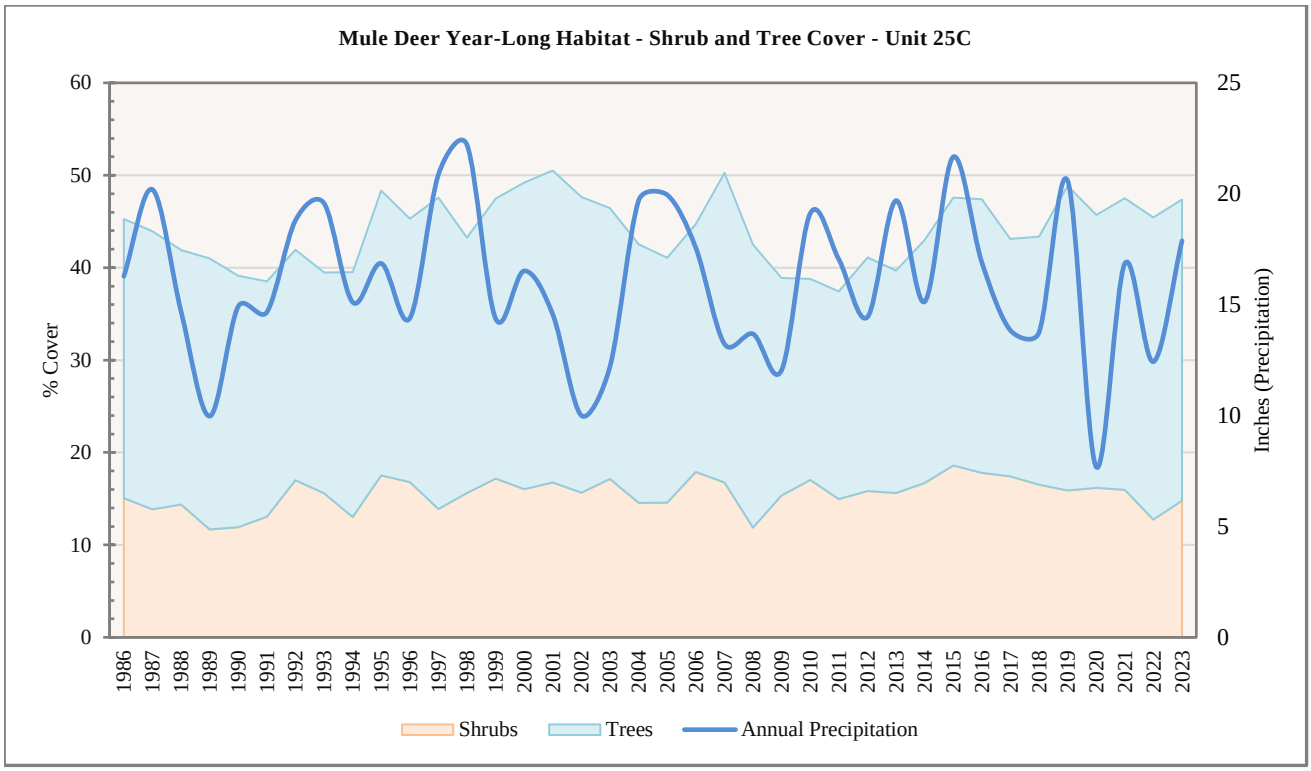
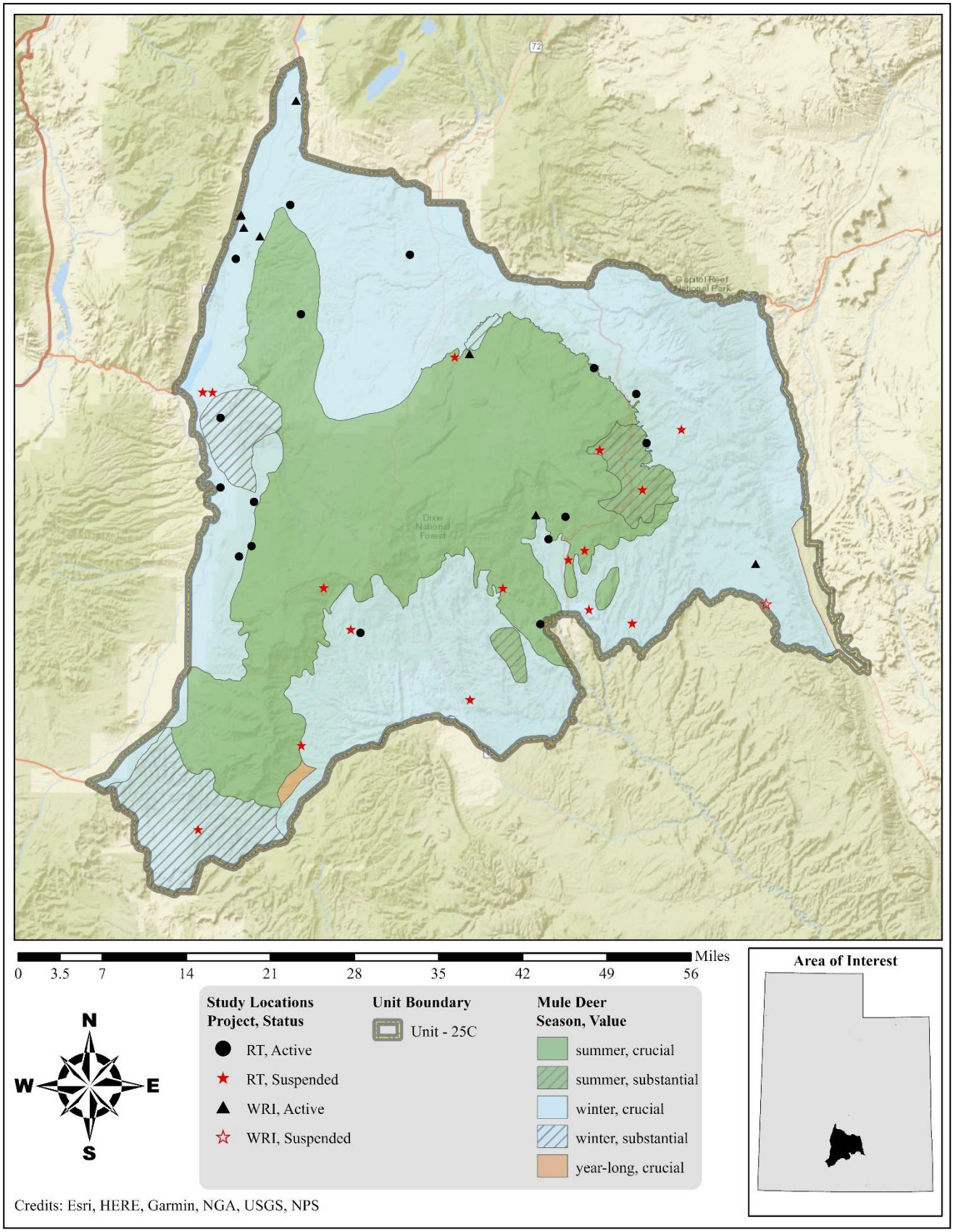
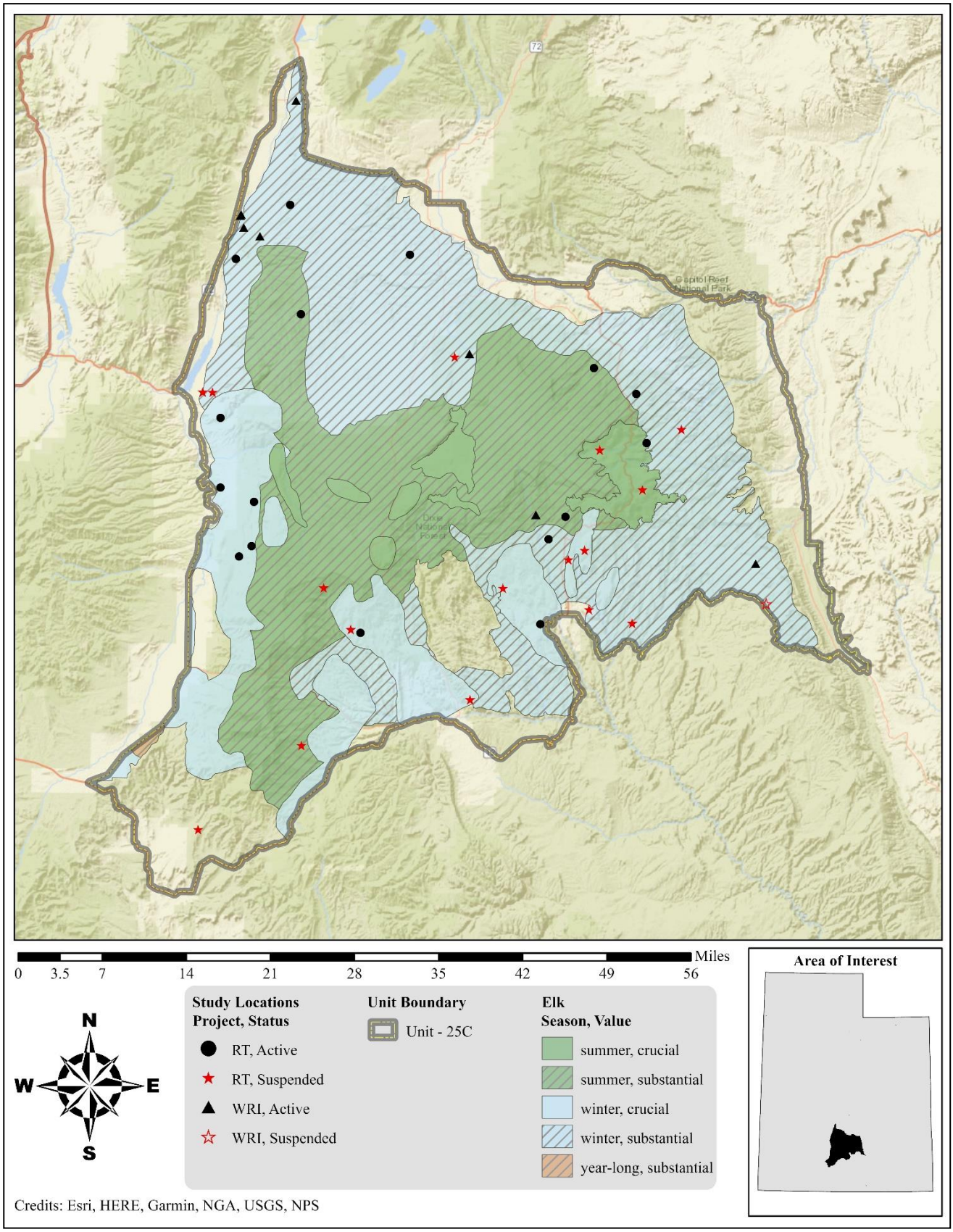


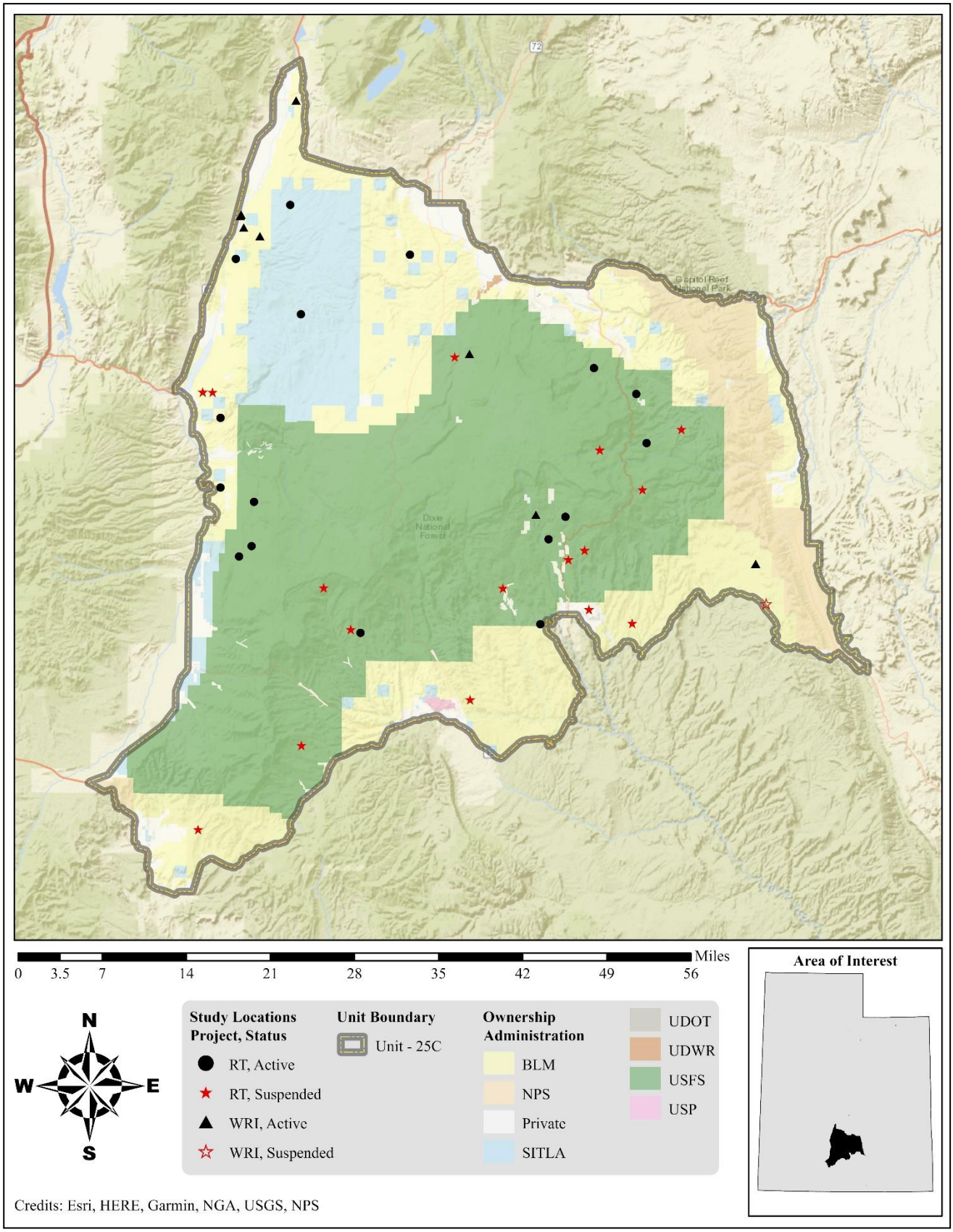
Figure 5.10: Average precipitation and estimated yearly stacked shrub and tree cover for year-long mule deer habitat in WMU 25C, Boulder Plateau (Rangeland Analysis Platform, 2024).



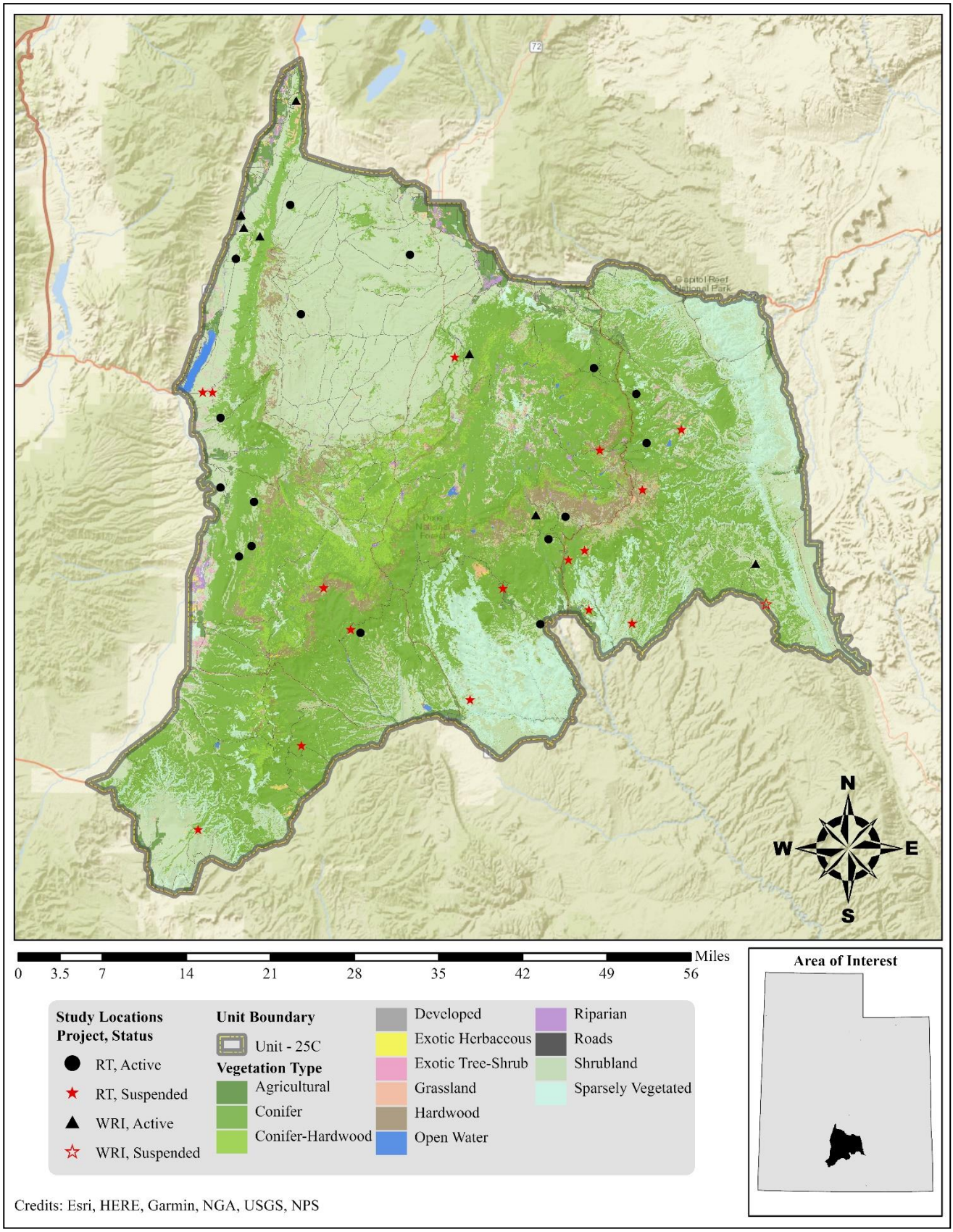
Map 5.2: Estimated mule deer habitat by season and value for WMU 25C, Boulder Plateau.



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



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



Map 5.5: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 25C, Boulder Plateau.

LANDFIRE Existing Vegetation Types on Mule Deer Habitat

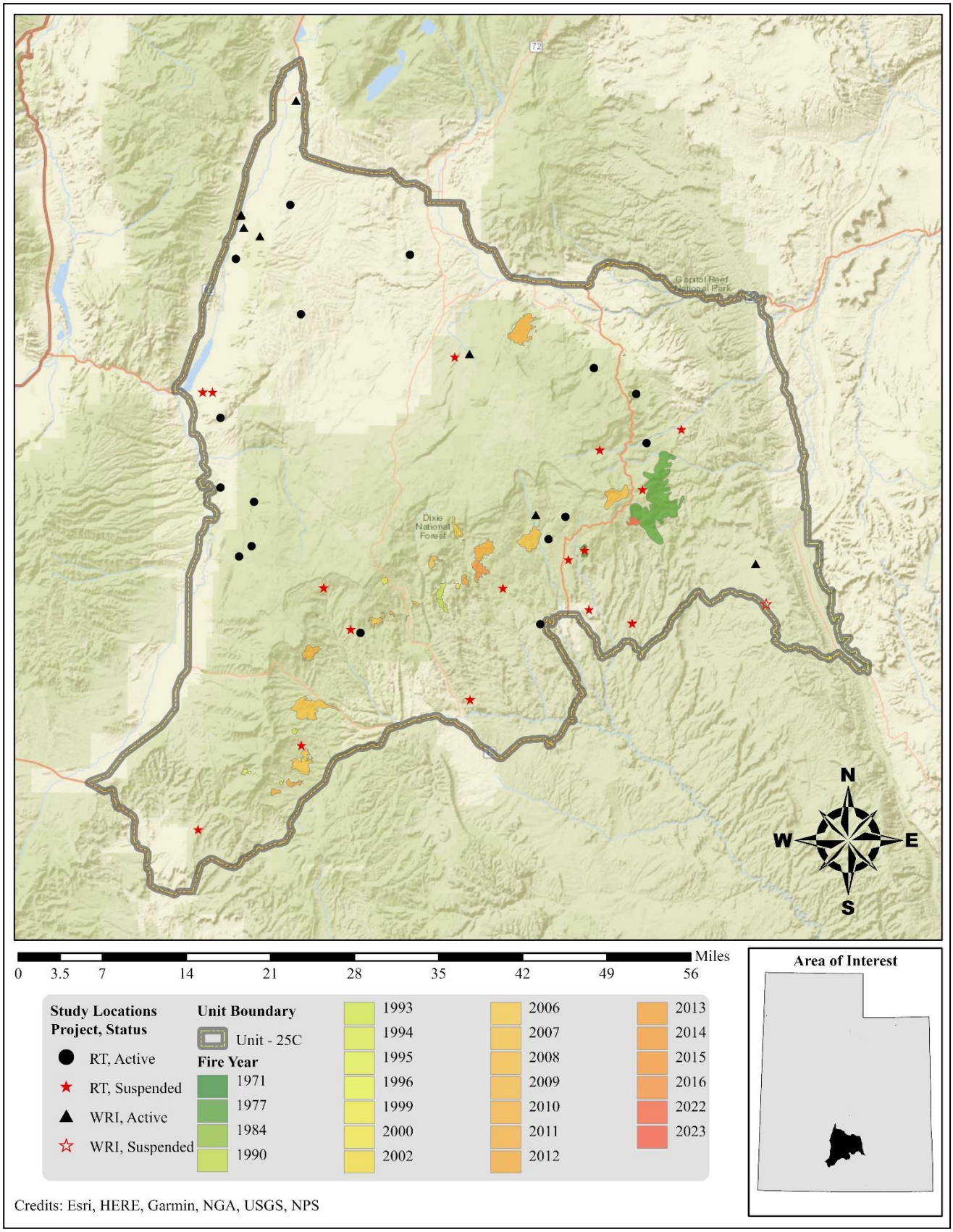
According to the current LANDFIRE Existing Vegetation Type model, 23% of the mule deer habitat in the Boulder Plateau management unit is comprised of pinyon-juniper woodlands (**Table 5.1**). These woodlands are usually located at lower elevations and may be associated with understory browse species known to be beneficial to mule deer, although abundance may vary widely. Pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) woodlands may provide valuable escape and thermal cover for wildlife. When these trees encroach on existing shrublands, however, they have been shown to lead to decreased sagebrush (*Artemisia spp.*) and herbaceous components (Miller, Svejcar, & Rose, 2000), thereby decreasing available forage for wildlife.

The model also indicates that sagebrush shrublands and steppe comprise approximately 21% of the unit's mule deer habitat (**Table 5.1**). These sagebrush biophysical sites can be found at elevations ranging from low (semidesert) to high (mountain and subalpine). Sagebrush species typically dominate these biophysical sites across the elevation gradient, and may provide valuable browse for deer when they are present on winter range. However, other preferred browse species may be present in lesser amounts. At higher elevations, these biophysical sites are often host to abundant herbaceous understories that could provide valuable forage for mule deer during the summer months. Pinyon and juniper may be present at lower to middle elevations on some biophysical sites. In addition to the previously mentioned types, just over 11% of the unit's mule deer habitat is sparsely vegetated according to the model: this vegetation type may have less value for deer than other, more productive vegetation types.

The rest of the mule deer habitat within the Boulder Plateau management unit is comprised of a variety of other vegetation types (**Table 5.1**) that will not be discussed here. Descriptions for these additional vegetation types is available on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	308,069	23.02%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	97,546	7.29%	
	Southern Rocky Mountain Ponderosa Pine Woodland	79,814	5.97%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	62,683	4.68%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	27,941	2.09%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	24,425	1.83%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	5,222	0.39%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	1,702	0.13%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	998	0.07%	
	Southern Rocky Mountain Ponderosa Pine Savanna	1	0.00%	45.47%
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	212,829	15.91%	
	Inter-Mountain Basins Big Sagebrush Shrubland	53,456	4.00%	
	Colorado Plateau Pinyon-Juniper Shrubland	51,050	3.82%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	42,541	3.18%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	20,061	1.50%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	16,401	1.23%	
	Rocky Mountain Lower Montane-Foothill Shrubland	14,527	1.09%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	11,852	0.89%	
	Colorado Plateau Blackbrush-Mormon-tea Shrubland	9,245	0.69%	
	Inter-Mountain Basins Mat Saltbush Shrubland	2,715	0.20%	
	Rocky Mountain Alpine Dwarf-Shrubland	2,030	0.15%	
	Southern Colorado Plateau Sand Shrubland	1,868	0.14%	
	Inter-Mountain Basins Greasewood Flat	409	0.03%	32.81%
Other	Sparsely Vegetated	151,831	11.35%	
	Agricultural	26,522	1.98%	
	Developed	26,504	1.98%	
	Riparian	12,605	0.94%	
	Open Water	3,768	0.28%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	31	0.00%	16.54%
Hardwood	Rocky Mountain Aspen Forest and Woodland	45,010	3.36%	
	Rocky Mountain Bigtooth Maple Ravine Woodland	17	0.00%	3.37%
Grassland	Southern Rocky Mountain Montane-Subalpine Grassland	6,107	0.46%	
	Rocky Mountain Alpine Turf	2,777	0.21%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	2,610	0.20%	
	Inter-Mountain Basins Semi-Desert Grassland	963	0.07%	0.93%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	8,745	0.65%	
	Interior Western North American Temperate Ruderal Shrubland	271	0.02%	0.67%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	1,692	0.13%	
	Interior Western North American Temperate Ruderal Grassland	517	0.04%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	384	0.03%	
	Great Basin & Intermountain Introduced Annual Grassland	246	0.02%	0.21%
Total		**1,337,986**	**100%**	**100%**

Table 5.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 25C, Boulder Plateau.



Map 5.6: Land coverage of fires by year from 1971-2023 for WMU 25C, Boulder Plateau (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

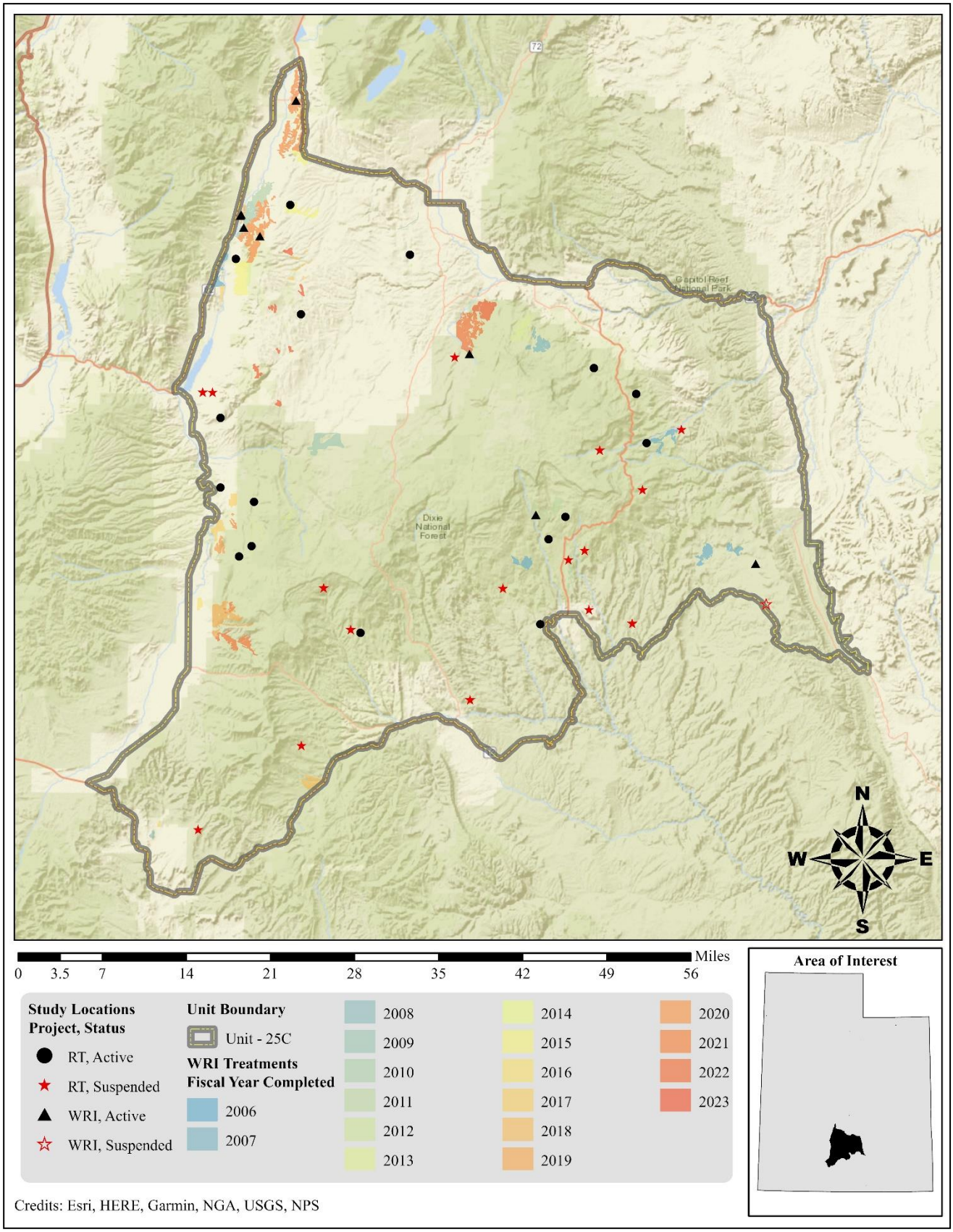
Treatments/Restoration Work

There has been an active effort to address habitat limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 30,402 acres of land have been treated within the Boulder Plateau subunit since the WRI was implemented in 2004 (**Map 5.7**). Treatments frequently overlap one another, bringing the net total of completed acres to 27,502 acres for this unit. Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

Vegetation removal by hand crew (through methods such as lop and scatter) to remove pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) is the most common management practice in this unit, with bullhog and harrow treatments also being frequently used. Other common treatments on the Boulder Plateau unit include (but are not limited to) prescribed fire, anchor chaining, herbicide application, and seeding plants to augment the herbaceous understory (**Table 5.2**).

Type	Total Completed Acreage
Anchor Chain	**1,793**
Ely (Two-Way)	565
Smooth (Two-Way)	1,228
Bullhog	**7,190**
Full Size	6,605
Skid Steer	585
Forestry Practices	**502**
Coppice Cutting	157
Thinning (Non-Commercial)	91
Group Selection Cuts	255
Harrow	**4,810**
≤ 15 ft. (One-Way)	1,334
> 15 ft. (One-Way)	1,056
> 15 ft. (Two-Way)	2,419
Herbicide Application	**1,504**
Aerial (Helicopter)	1,032
Ground	472
Mowing	**350**
Brush Hog	74
Other	275
Prescribed Fire	**1,849**
Prescribed Fire	1,849
Seeding (Primary)	**1,215**
Broadcast (Aerial-Fixed Wing)	348
Broadcast (Aerial-Helicopter)	727
Drill (Rangeland)	9
Ground (Mechanical Application)	43
Hand Seeding	88
Vegetation Removal/Hand Crew	**11,134**
Lop (No Scatter)	941
Lop & Scatter	9,898
Lop-Pile-Burn	295
Other	**55**
Road Decommissioning	28
Road/Parking Area Improvements	27
Grand Total	**30,402**
***Total Land Area Treated**	**27,502**

Table 5.2: WRI treatment action size (acres) of completed projects for WMU 25C, Boulder Plateau. Data accessed on 02/07/2024.
*Does not include overlapping treatments.



Map 5.7: Terrestrial WRI treatments by fiscal year completed for WMU 25C, Boulder Plateau.

Range Trend Studies

Range Trend studies have been sampled within WMU 25C on a regular basis since 1985, with studies being added or suspended as 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
25C-01	Yergy	RT	Suspended	1985, 1991, 1994, 1998, 2003, 2008	Upland Loam (Mountain Big Sagebrush)
25C-02	Wildcat	RT	Active	1985, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25C-03	Happy Valley	RT	Active	1985, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Gravelly Loam (Ponderosa Pine)
25C-04	North Slope	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Gravelly Loam (Ponderosa Pine)
25C-05	Giles Hollow	RT	Suspended	1985, 1991, 1994, 1998, 2003	Upland Stony Loam (Black Sagebrush)
25C-06	Terza Flat	RT	Active	1985, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
25C-07	Cedar Grove	RT	Active	1985, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Black Sagebrush)
25C-08	South Narrows	RT	Active	1985, 1991, 1994, 1998, 2003, 2008, 2009, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
25C-09	Dry Wash	RT	Active	1985, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
25C-10	Pleasant Creek Exclosure (In)	RT	Suspended	1991, 1994, 1998	Semiwet (Fresh Meadow)
25C-11	Pleasant Creek Exclosure (Out)	RT	Suspended	1991, 1994, 1998	Semiwet (Fresh Meadow)
25C-12	Nazer Draw	RT	Active	1987, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Gravelly Loam (Ponderosa Pine)
25C-13	Short Neck	RT	Suspended	1987, 1991, 1994, 1998, 2003	Mountain Loam (Browse)
25C-14	New Home Bench	RT	Active	1987, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush)
25C-15	Steep Creek Bench	RT	Suspended	1987, 1991, 1994, 1998, 2003	Upland Loam (Mountain Big Sagebrush)
25C-16	Whites Flat	RT	Suspended	1987, 1991, 1994, 1998, 2003	Mountain Stony Loam (Antelope Bitterbrush)
25C-17	Varney-Griffin Chaining	RT	Active	1987, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Mountain Big Sagebrush)
25C-18	Allen Canyon	RT	Suspended	1987, 1991, 1998	Mountain Gravelly Loam (Ponderosa Pine)
25C-19	Rock Bench	RT	Suspended	1987, 1991	Not Verified
25C-20	Baldys	RT	Active	1987, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	High Mountain Loam (Aspen)
25C-21	Griffin	RT	Suspended	1987, 1991, 1994, 1998	High Mountain Loam (Aspen)
25C-22	Salt Gulch	RT	Suspended	1987, 1991, 1994, 1998	Upland Stony Loam (Pinyon-Utah Juniper)
25C-23	Coal Bench	RT	Suspended	1987, 1991, 1998, 2003, 2008	Upland Stony Loam (Black Sagebrush)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
25C-24	Black Ridge	RT	Suspended	1987, 1991, 1998	Upland Loam (Mountain Big Sagebrush)
25C-25	Center Creek	RT	Active	1987, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Mountain Big Sagebrush)
25C-26	Black Canyon	RT	Active	1987, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Upland Gravelly Loam (Black Sagebrush)
25C-27	Poison Creek Bench	RT	Active	1987, 1991, 1994, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Gravelly Loam (Mountain Big Sagebrush)
25C-28	North Creek	RT	Active	1987, 1991, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Gravelly Loam (Mountain Big Sagebrush)
25C-30	Pole Corral Draw	RT	Suspended	1998	Semiwet (Fresh Meadow)
25C-31	Parker Mountain Aerator	RT	Active	2003, 2008, 2013, 2018, 2023	Mountain Loam (Mountain Big Sagebrush)
25C-32	Antone Flat	RT	Suspended		Not Verified
25R-02	Lower Meadow Estates	RT	Suspended	1997, 2003	Not Verified
25R-03	Upper Meadow Estates	RT	Suspended	1997, 2003	Not Verified
25R-04	Onion Field	WRI	Suspended	2004	Not Verified
25R-05	Lamp Stand	WRI	Active	2004, 2007, 2012, 2018	Semidesert Loam (Wyoming Big Sagebrush)
25R-07	North Narrows Dixie	WRI	Active	2008, 2009, 2010, 2013, 2017, 2022	Semidesert Loam (Wyoming Big Sagebrush)
25R-08	Sawmill Point Aspen	WRI	Active	2010, 2013, 2018	High Mountain Loam (Aspen)
25R-10	Parker Front	WRI	Active	2013, 2016, 2020	Mountain Stony Loam (Mountain Big Sagebrush)
25R-11	Brown Spring	WRI	Active	2013, 2016, 2020	Upland Loam (Wyoming Big Sagebrush)
25R-19	Otter Creek	WRI	Active	2018, 2022	Semiwet Fresh Meadow (Narrowleaf Cottonwood)
25R-20	Otter Creek 2	WRI	Active	2018, 2022	Semiwet Fresh Meadow (Riparian)
25R-21	Pine Creek	WRI	Active	2021	Mountain Stony Loam (Black Sagebrush)

Table 5.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 25C, Boulder Plateau.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
25C-01	Yergy	Chain Unknown Seed Unknown One-Way Dixie Broadcast		1970 1970 Fall 2005 Fall 2005		
25C-02	Wildcat	Chain Unknown Seed Unknown Bullhog		1970 1970 August-December 2005		
25C-03	Happy Valley	Wildfire Seed Unknown		June 1984 1984		
25C-04	North Slope	Lop and Scatter Bullhog	Teasdale Front Fuels Reduction Treatment Phase 1	June-August 2021 Between 2016 and 2017	1,017	5543
25C-12	Nazer Draw	Seed Unknown		1955	1,200	
25C-17	Varney-Griffin Chaining	Chain Unknown Seed Unknown Bullhog Slash Pile		1981 1981 Between 2003 and 2008 1981	1,100 1,100 1,100 1,100	25C-17 25C-17 25C-17 25C-17
25C-19	Rock Bench	Bullhog Prescribed Lop and Scatter Aerial After	Rock Bench Pinyon/Juniper and Brush Removal	July 2009-May 2010 1991 1991 1991	237 235 235 235	1489

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
25C-23	Coal Bench	Two-Way Unknown	Coal Bench Seeding 1966	June-December 1966	3,487	LTDL
		Aerial Unknown	Coal Bench Seeding 1966	1966		
25C-25	Center Creek	Prescribed Fire		1984		
		Seed Unknown		Historic		
25C-27	Poison Creek Bench	Prescribed Fire		1994		
25C-28	North Creek	Wildfire		2002		
25C-31	Parker Mountain Aerator	Double Drum		2002		
25R-04	Onion Field	Rangeland Drill	Onion Flat Seeding 1968	1968	1,200	LTDL
		Plow	Onion Flat Seeding 1968	1968	1,200	LTDL
25R-05	Lamp Stand	Truax Drill	Circle Cliffs-Year 1	November 2004	1,000	PDB
		Aerial Unknown	Lamp Stand Seeding	1970	650	LTDL
		Chain Unknown	Lamp Stand Seeding	1970	650	LTDL
25R-07	North Narrows Dixie	Two-Way Dixie	North Narrows Year 1	October-December 2008	1,369	1155
		Broadcast Before	North Narrows Year 1	October 2008	1,369	1155
		Broadcast After	North Narrows Year 1	December 2008	1,369	1155
25R-08	Sawmill Point Aspen	Lop (No Scatter)	Sawmill Point/Baldy's Ridge Aspen Improvement Stewardship	July 2010-June 2011	940	1691
25R-10	Parker Front	Two-Way Smooth	Parker Front PJ Removal	October-November 2013	496	2547
			Parker Front PJ Removal	November 2013	1,230	2547
			Parker Front PJ Removal	January 2014	1,230	2547
			East Grass Valley P/J Maintenance	October 2020-February 2021	5,299	5294
25R-11	Brown Spring	Bullhog	Parker Front PJ Removal	November 2013-January 2014	404	2547
		Aerial Before	Parker Front PJ Removal	November 2013	1,230	2547
		Lop and Scatter	East Grass Valley P/J Maintenance	October 2020-February 2021	5,299	5294
25R-19	Otter Creek	Hand Transplant	Otter Creek Stream Restoration Phase III	Spring 2019	2	4398
		Stream Corridor/Channel Improvements	Otter Creek Stream Restoration Phase III	September 2018-November 2019	2	4398
		Broadcast After	Otter Creek Stream Restoration Phase III	September 2018-November 2019	2	4398
25R-20	Otter Creek 2	Broadcast Before	Otter Creek Stream Restoration Phase III	September 2018-November 2019	81	4398
		Mower	Otter Creek Stream Restoration Phase III	September 2018-November 2019	81	4398
		Herbicide Unknown	Otter Creek Stream Restoration Phase III	September 2018-November 2019	81	4398
25R-21	Pine Creek	Bullhog	Government Creek Improvement Phase II	October 2022-June 2023	2014	5533

Table 5.4: Range Trend and WRI studies known disturbance history for WMU 25C, Boulder Plateau. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Ecotypes that are represented by only one study site throughout most or all of the sample period are not discussed in this section. These ecotypes include:

- High Mountain (Aspen) - Baldys (25C-20) and Griffin (25C-21) (suspended)
- Mountain (Shrub) - Whites Flat (25C-16) (suspended)
- Mountain (Browse) - Short Neck (25C-13) (suspended)
- Upland (Pinyon-Juniper) - Salt Gulch (25C-22) (suspended)
- Semiwet (Fresh Meadow) - Pleasant Creek Exclosure (Out) (25C-11) (suspended) and Pole Corral Draw (25C-30) (suspended)

Trend summaries and/or data for these ecotypes are available in the corresponding site reports.

Mountain (Ponderosa Pine)

Four studies [Happy Valley (25C-03), North Slope (25C-04), Nazer Draw (25C-12), and Allen Canyon (25C-18) (suspended)] are classified as Mountain (Ponderosa Pine) ecological sites. The Happy Valley site is located near the Singletree Campground off Highway 12. The North Slope study is found near Fish Creek between Grover and Blind

Lake. The Nazer Draw study is located north of Boulder near the powerhouse off Highway 12. Finally, the Allen Canyon site can be found just north of Allen Creek and east of Table Cliff Plateau in the Escalante Mountains. Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. Specifically, data for the 1994 year was contributed by the Happy Valley and Nazer Draw studies, while Happy Valley, North Slope, Nazer Draw, and Allen Canyon provided 1998 data. Finally, the Happy Valley, North Slope, and Nazer Draw studies have contributed all data since 2003.

Shrubs/Trees: Antelope bitterbrush (*Purshia tridentata*) or black sagebrush (*Artemisia nova*) are the dominant preferred browse species on the active study sites; Gambel oak (*Quercus gambelii*) was the primary preferred browse species on Allen Canyon before site suspension. Lesser amounts of other preferred browse species are also present on the active sites, including Gambel oak and Utah serviceberry (*Amelanchier utahensis*). Average shrub cover data shows that there have been yearly fluctuations in total shrub cover, but the overall trend is stable. Cover data also indicates that both bitterbrush and preferred browse species other than bitterbrush have contributed significant cover on these sites throughout the sample period (**Figure 5.12**). Average density of preferred browse has also varied from year to year. However, density has generally decreased since 2008, with the increase in 2018 due to mature and decadent individuals on the Nazer Draw study. According to average demographic data, the preferred browse populations on these sites have been primarily comprised of mature plants throughout the study period. In addition, both decadence and recruitment of young have decreased when comparing 1994 data with that from 2023 (**Figure 5.17**). Average preferred browse utilization has fluctuated over the sample period. In 2023, 24% of plants were moderately hedged and 17% showed signs of heavy use (**Figure 5.19**).

Tree cover increased steadily each year through 2018. The majority of the tree cover on these sites has been contributed by ponderosa pine (*Pinus ponderosa*). However, other trees such as twoneedle pinyon (*Pinus edulis*) and Rocky Mountain juniper (*Juniperus scopulorum*) have also been present. Total average tree cover increased steadily each year through 2018. Cover decreased between the two most recent sample years, however, mainly due to ponderosa pine on the Happy Valley study; in 2023 average tree cover was equivalent to 2003 values (**Figure 5.14**). Average total tree density decreased between 2018 and 2023, but has increased overall; ponderosa pine has had higher density values than other tree species (**Figure 5.16**).

Herbaceous Understory: The herbaceous understories of these sites have remained diverse and moderately abundant, although total average cover and frequency have decreased overall since 1998. Perennial grasses have been the dominant herbaceous component in all years, and have largely been comprised of native species such as blue grama (*Bouteloua gracilis*) and muttongrass (*Poa fendleriana*). Perennial forbs have decreased slightly in overall cover and frequency. Annual grasses and forbs have remained rare throughout the study period (**Figure 5.21**, **Figure 5.23**).

Occupancy: Average pellet transect data for this ecological type shows that the primary occupants of these sites are deer and that presence has decreased over time. Mean abundance of deer pellet groups has fluctuated between 15 days use/acre in 2023 and 60 days use/acre in 2003. Elk have also been present, with average pellet group abundance ranging from 2 days use/acre in 2018 and 7 days use/acre in 2008. Mean abundance of cattle pellet groups has been as low as 3 days use/acre in 2018 and as high as 23 days use/acre in 1998 (**Figure 5.25**).

Mountain (Big Sagebrush)

Five studies [Varney-Griffin Chaining (25C-17), Center Creek (25C-25), Poison Creek Bench (25C-27), North Creek (25C-28), and Parker Mountain Aerator (25C-31)] are classified as Mountain (Big Sagebrush) ecological sites. The Varney-Griffin Chaining is located in the Escalante Mountains to the east of North Creek. The Center Creek study is situated approximately five miles southeast of Osiris. The Poison Creek Bench site can be found approximately four miles east of the town of Osiris. The North Creek study site is situated north of North Creek, which is located southeast of Osiris. Finally, the Parker Mountain Aerator study is placed on the Awapa Plateau to the east of Parker Mountain.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. Specifically, Center Creek and Poison Creek Bench have contributed data since 1994, while Varney-Griffin Chaining and North Creek have provided data since 1998. Finally, the Parker Mountain Aerator study has provided data since 2003.

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant preferred browse species on these study sites, although other preferred browse species such as antelope bitterbrush, Gambel oak and/or mountain snowberry (*Symphoricarpos oreophilus*) have also been present in lesser amounts. Preferred browse species, particularly sagebrush, have exhibited significant increases in cover over time, and site-level data shows that these increases have

occurred on all study sites (**Figure 5.11**). Average preferred browse density has increased overall, with the significant increase between 2003 and 2008 largely due to young plants on the Parker Mountain Aerator study. Mature individuals have been the dominant demographic in these populations in all years except 2008. Recruitment of young has decreased since 2008, while decadence has slightly increased over the same time period (**Figure 5.17**). Preferred browse utilization has fluctuated, but has exhibited an overall increase. Twenty percent of plants were moderately hedged and 21% were heavily used in 2023 (**Figure 5.19**).

Average tree cover exhibited an initial decrease between 2003 and 2008 due to a bullhog treatment on the Varney-Griffin Chaining study. However, cover has increased in all subsequent sample years. Most cover can be attributed to twoneedle pinyon, but Utah juniper (*Juniperus osteosperma*) and/or Rocky Mountain juniper have also provided less cover. Average tree density has fluctuated from year to year, but density decreased between 2018 and 2023 due to the Varney-Griffin Chaining site. When comparing 2003 data with that from 2023, average tree density remains similar (**Figure 5.13**, **Figure 5.15**).

Herbaceous Understory: The herbaceous understories of these study sites have fluctuated, but both frequency and cover have slightly increased overall. Perennial grasses have been the dominant herbaceous component on these sites throughout the sample period, although both cover and abundance have decreased since 2008. Perennial forbs have been moderately abundant, while annual grasses and forbs have generally remained rare. However, annual forb frequency was moderate in 2023, largely due to the Varney-Griffin Chaining study (**Figure 5.21**, **Figure 5.23**).

Occupancy: Average pellet transect data indicates that the animal presence has slightly decreased over time. Deer and/or antelope were the primary occupants of these sites in 1998, and mean pellet group abundance has varied between 8 days use/acre in 2023 and 23 days use/acre in 1998. Elk were the main occupants in 2003 and 2018, with an average pellet group abundance as low as 11 days use/acre in 2018 and as high as 20 days use/acre in 2013. Finally, cattle primarily occupied these sites in 2008, 2013, and 2023. Mean cattle pellet group abundance has ranged from 10 days use/acre in 2018 to 20.5 days use/acre in 2008 (**Figure 5.25**).

Upland (Big Sagebrush)

There are eight studies [Yergy (25C-01) (suspended), Wildcat (25C-02), Terza Flat (25C-06), South Narrows (25C-08), Dry Wash (25C-09), New Home Bench (25C-14), Steep Creek Bench (25C-15) (suspended), and Black Ridge (25C-24) (suspended)] that are classified as Upland (Big Sagebrush) ecological sites. The Yergy study is located east of SR-20 on Yergy Flat. The Wildcat site can be found east of SR-12 near Sulfur Creek. The Terza Flat study site is placed about four miles south of Loa. The South Narrows study is situated roughly eight miles north of Otter Creek Reservoir near SR-62. The Dry Wash study site can be found approximately two miles east of Antimony. The New Home Bench study is located to the west of Boulder near the Boulder landing strip. The Steep Creek Bench site can be found roughly five and a half miles southeast of Boulder on Steep Creek Bench. Finally, the Black Ridge study is located just over one and a half miles east of Boulder.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. Specifically, the Wildcat, Terza Flat, South Narrows, and Dry Wash studies have all contributed data since 1994; New Home Bench has provided data since 1998. Data was provided by the Yergy study between 1994 and 2008, and Steep Creek Bench contributed data between 1994 and 2003. Finally, data was provided by the Black Ridge study site only in 1998.

Shrubs/Trees: Mountain big sagebrush is the dominant preferred browse species on the active study sites. However, Steep Creek Bench was host to a Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) population and basin big sagebrush (*A. tridentata* ssp. *tridentata*) dominated the Yergy site before these studies were suspended. Other preferred browse species such as black sagebrush and fourwing saltbush (*Atriplex canescens*) have also been present on the active sites, but in much lesser amounts. Total average shrub cover has exhibited an overall increase over time. However, the increase in average total shrub cover between 2013 and 2023 is due to shrubs other than preferred browse species, as sagebrush cover remained stable overall (**Figure 5.11**). Average preferred browse density has decreased overall, with the initial decrease between 1994 and 1998 largely driven by the Dry Wash study. However, density has only marginally decreased overall between 2013 and 2023. Mature individuals have comprised a majority of the browse populations on these sites throughout the sample years. Decadence has remained low in most years, as has recruitment of young (**Figure 5.18**). Average utilization of preferred browse has generally increased. In 2023, 25% of plants were moderately hedged and 44% were heavily used (**Figure 5.20**).

Average tree cover has increased over time. Trends in tree cover have been entirely driven by the Dry Wash, New Home Bench, and Steep Creek Bench studies, as trees have not contributed cover on any other site. Tree density increased through the 2018 sample year, but then decreased in 2023: this was largely due to a decrease of twoneedle pinyon on the Dry Wash study between the two most recent samplings (**Figure 5.13**, **Figure 5.15**).

Herbaceous Understory: The understories of these sites have exhibited fluctuations in average herbaceous cover, while frequency has slightly decreased overall. However, total average abundance has slightly decreased since 2013, while total cover has overall remained stable over the same period. The understories of these studies have been primarily composed of native perennial grasses, although introduced species have been present on some sites. Perennial and annual forbs have generally remained rare in comparison with perennial grasses. Annual grasses, particularly the introduced species cheatgrass (*Bromus tectorum*), have been present on some study sites throughout the sample period, but also with generally low cover and frequency (**Figure 5.22**, **Figure 5.24**).

Occupancy: Average pellet transect data shows that animal presence has decreased over time and that deer and/or antelope have been the primary occupants in all years. The mean abundance of deer and/or antelope pellet groups has ranged from 23 days use/acre in 2018 to 50 days use/acre in 2008. Elk have also been present on this site, with an average pellet group abundance as low as 8 days use/acre in 2018 and as high as 25 days use/acre in 2008. Finally, mean abundance of cattle pellet groups has fluctuated between 2 days use/acre in 2023 and 20 days use/acre in 2008 (**Figure 5.26**).

Upland (Black/Low Sagebrush)

There are four studies [Giles Hollow (25C-05) (suspended), Cedar Grove (25C-07), Coal Bench (25C-23) (suspended), and Black Canyon (25C-26)] classified as Upland (Black/Low Sagebrush) ecological sites. The Giles Hollow study can be found approximately nine and a half miles southwest of the town of Bicknell, adjacent to Giles Hollow. The Cedar Grove site is located on the Parker Mountain bench southeast of Greenwich. The Coal Bench study is located on Coal Bench, which is east of the town of Tropic and south of the mouth of Henderson Canyon. Finally, the Black Canyon study site is situated north of Osiris on the benches to the east of the East Fork Sevier River.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. Specifically, the Cedar Grove and Black Canyon studies have contributed data since 1998, and the Giles Hollow site provided data between 1994 and 2003. Finally, the Coal Bench study contributed data from 1998 through 2008.

Shrubs/Trees: Black sagebrush has been the dominant preferred browse species sampled on these sites, with mountain big sagebrush codominant on the Cedar Grove and Black Canyon studies. There have been fluctuations in cover, but a generally increasing trend has occurred over time. However, cover increases in 2008 and 2013 can partially be attributed to the different number of study sites sampled each year. The Giles Hollow study had little sagebrush cover in 2003, but was suspended following that sample year and is not included in the subsequent averaged values. In addition, sagebrush cover on Coal Bench was less than that on Cedar Grove and Black Canyon. However, the Coal Bench study was suspended after 2008 and therefore has not influenced the average cover values since 2013. Preferred browse cover has marginally decreased each sample year since 2013, a trend largely driven by the Black Canyon study (**Figure 5.11**). Average preferred browse density data displays an overall increase between 1994 and 2023: again, this trend is largely influenced by the different number of studies sampled each year. Density increased between 2013 and 2018, but a decrease occurred between the two most recent sample years. Mature plants have comprised a majority of the preferred browse populations on these sites throughout the study period. Decadence and recruitment of young have fluctuated from year to year, but both values are relatively low as of 2023 (**Figure 5.18**). Average utilization of preferred browse has fluctuated significantly, but has decreased in general since 2013. In 2023, 11% of plants were moderately used and 20% displayed signs of heavy browsing (**Figure 5.20**).

Average tree cover has decreased over time with no cover observed since 2013. This decreasing trend is entirely due to the suspension of the Coal Bench study, as trees have not provided cover on any other site (**Figure 5.13**). Average tree density has remained low throughout the sample period and has decreased overall (**Figure 5.15**).

Herbaceous Understory: Total average herbaceous cover and frequency have decreased overall. Like with shrub trends, however, this is largely due to the differing number of studies sampled from year to year. The same studies have been sampled since 2013, and total average cover and abundance have exhibited slight overall increases. Perennial grasses have been the primary herbaceous component throughout the study period, with species such as blue grama and

muttongrass providing much of the cover in recent sample years. Perennial and annual forbs have remained rare in comparison with perennial grasses, and annual grasses have not been observed (**Figure 5.22**, **Figure 5.24**).

Occupancy: Average pellet transect data shows that the primary occupants of these sites have been deer, antelope, and/or sheep throughout the study period, and mean abundance has ranged from 8 days use/acre in 2003 to 28.5 days use/acre in 2013. Average abundance of elk pellet groups has been as low as 0 days use/acre in 2013 and as high as 9 days use/acre in 1998. Finally, cattle have also been present, and mean pellet group abundance has fluctuated between 2 days use/acre in 2008 and 7 days use/acre in 2003 (**Figure 5.26**).

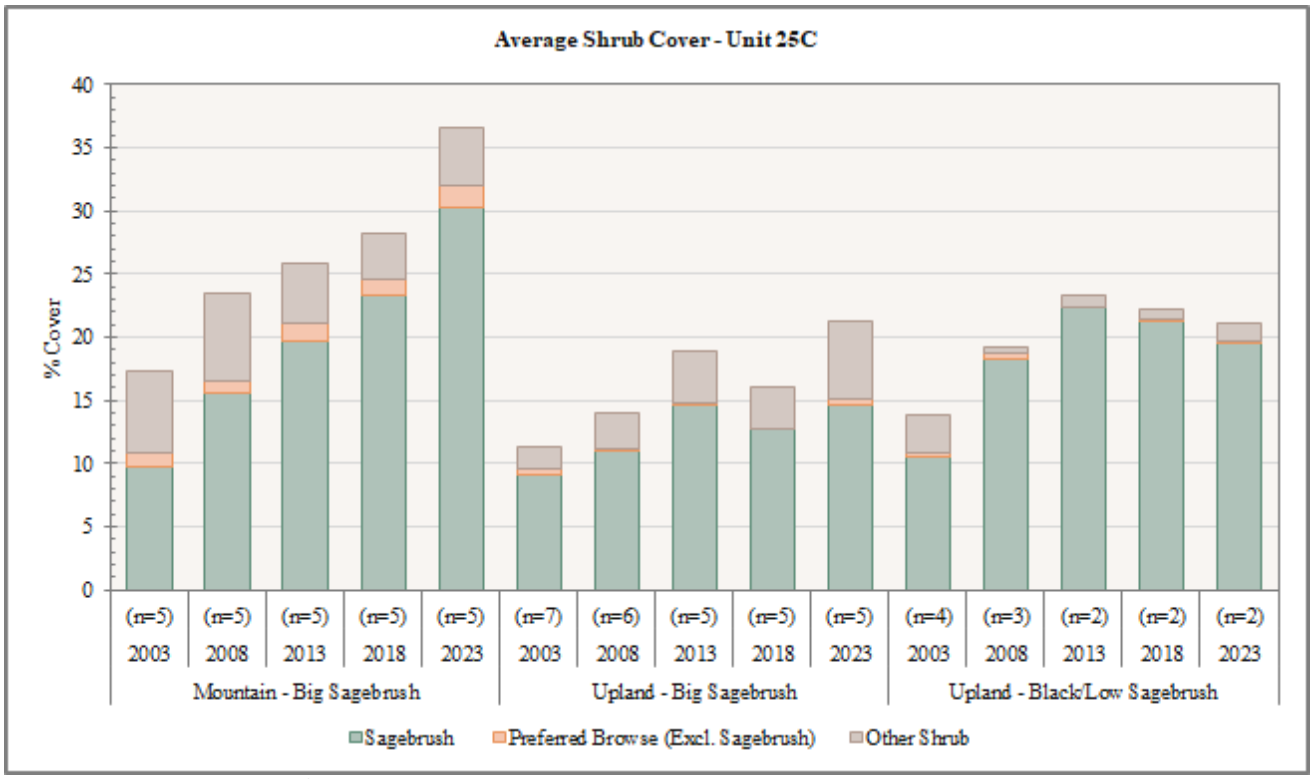


Figure 5.11: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.

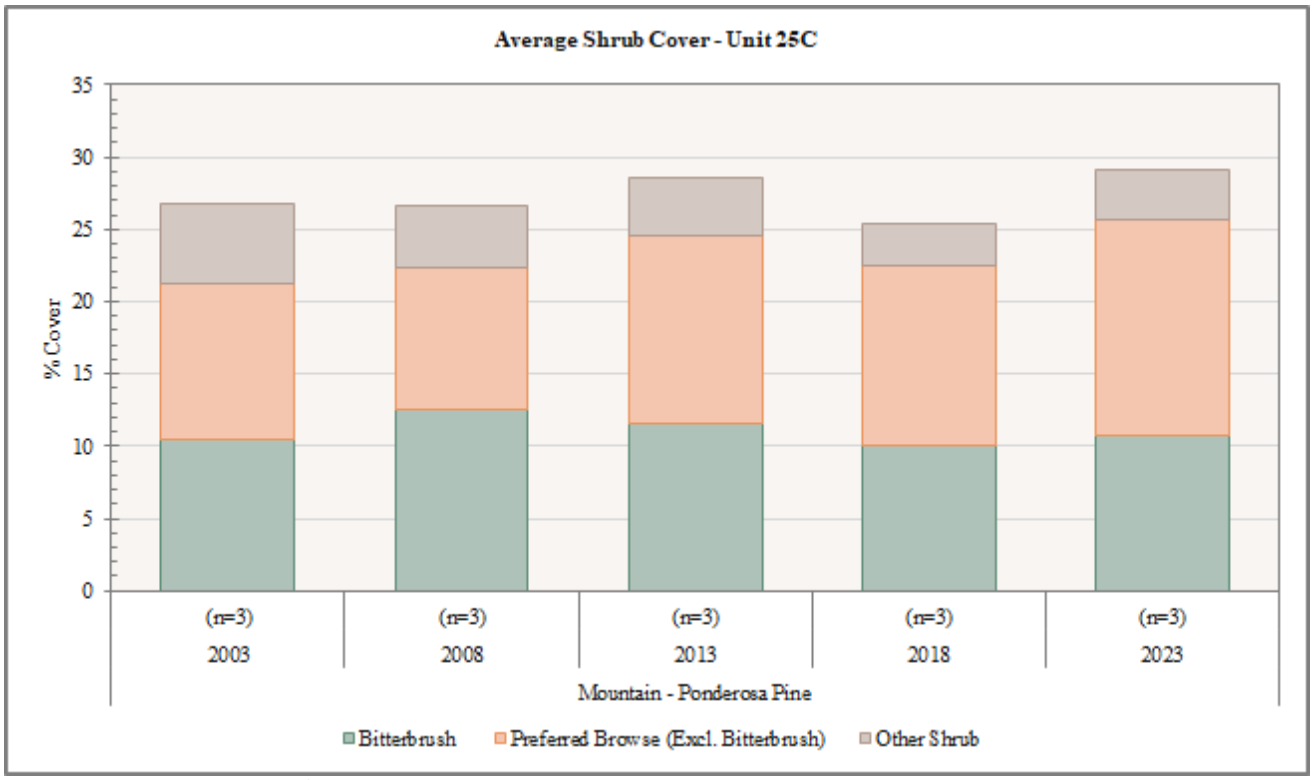


Figure 5.12: Average shrub cover for Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.

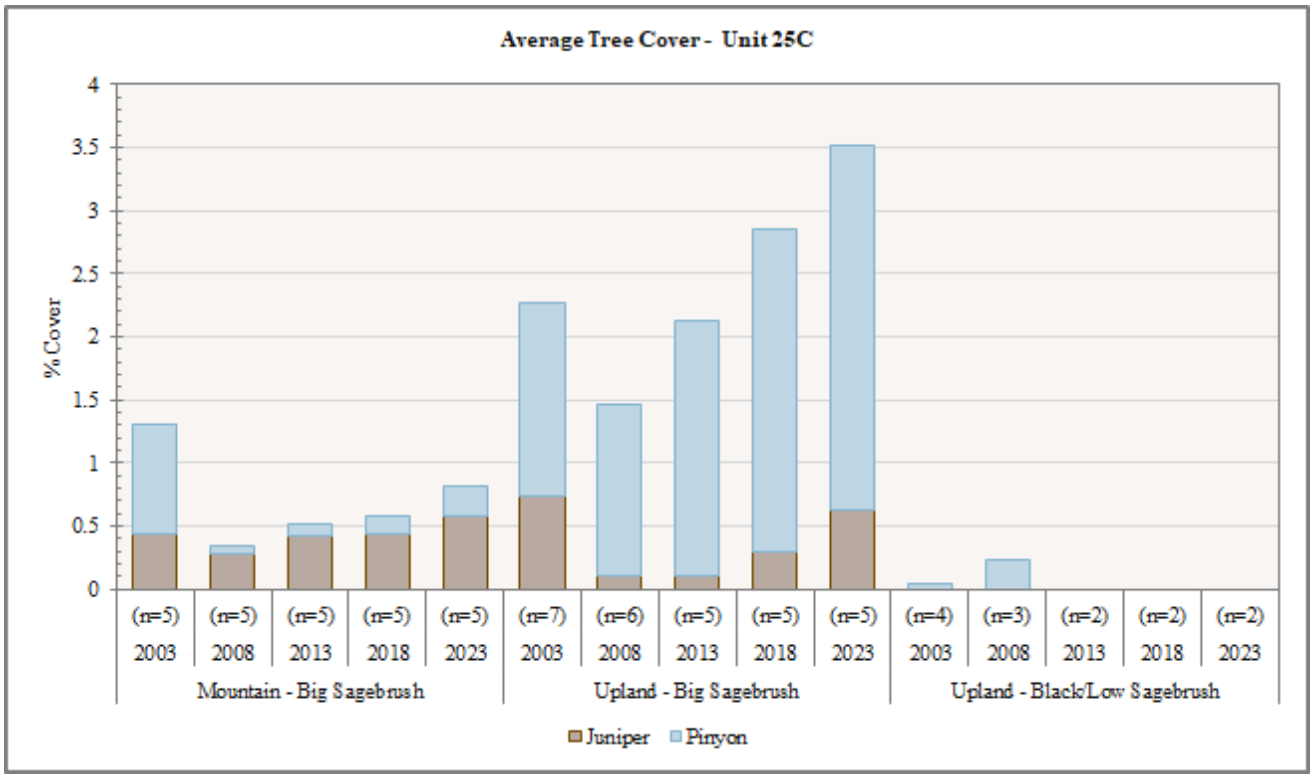


Figure 5.13: Average tree cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.

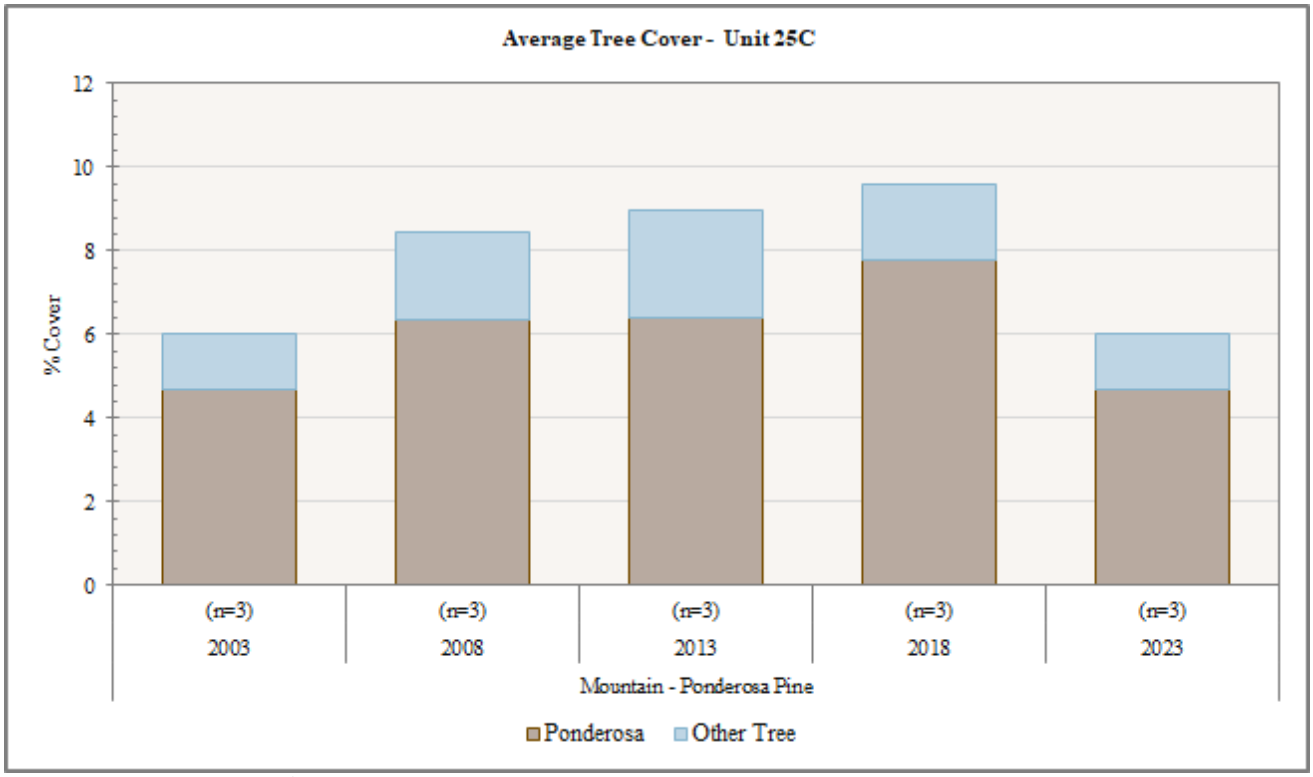


Figure 5.14: Average tree cover for Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.

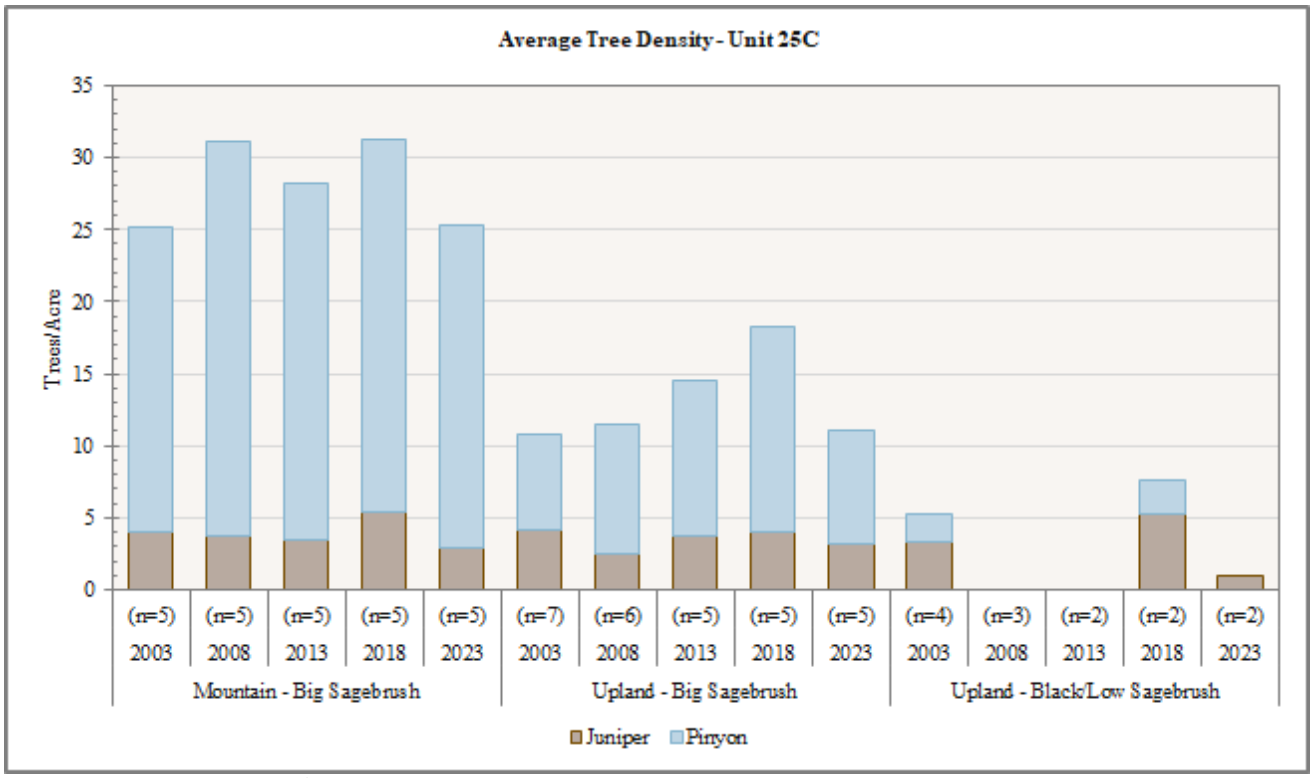


Figure 5.15: Average tree density for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.

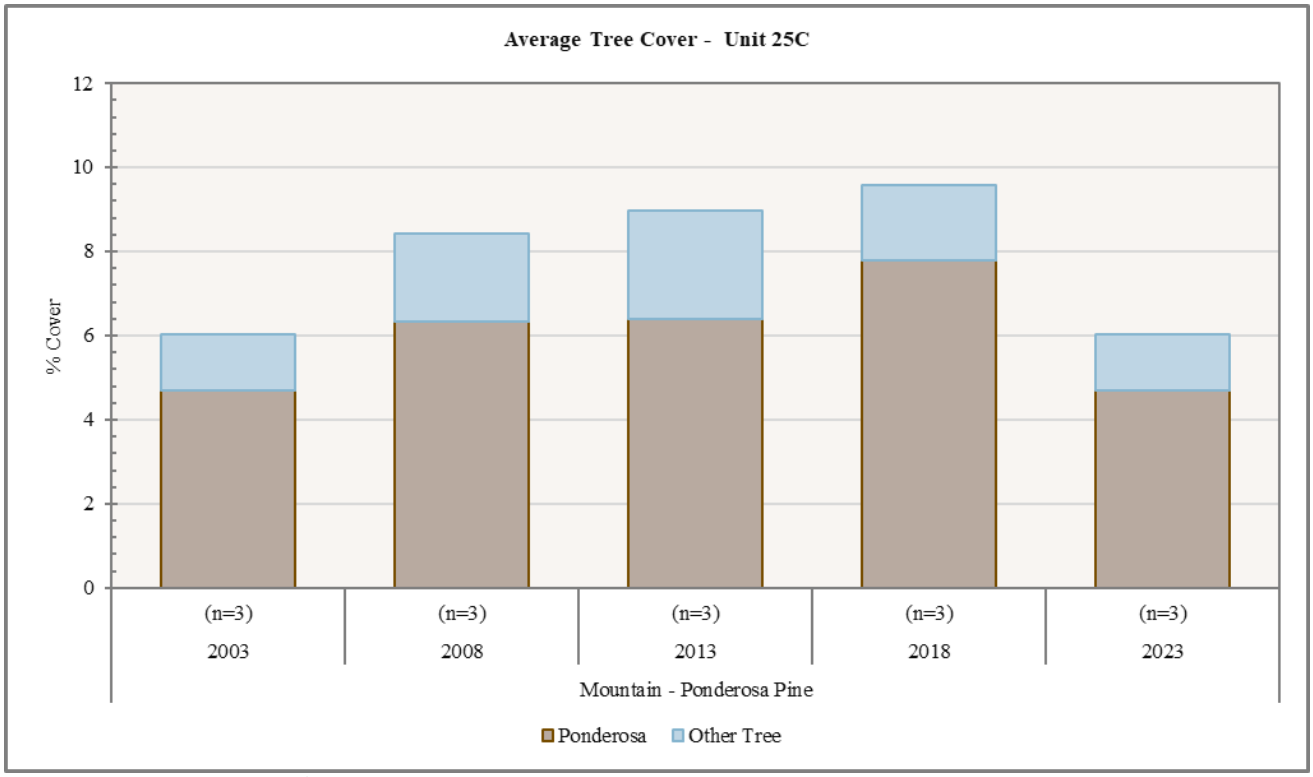


Figure 5.16: Average tree density for Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.

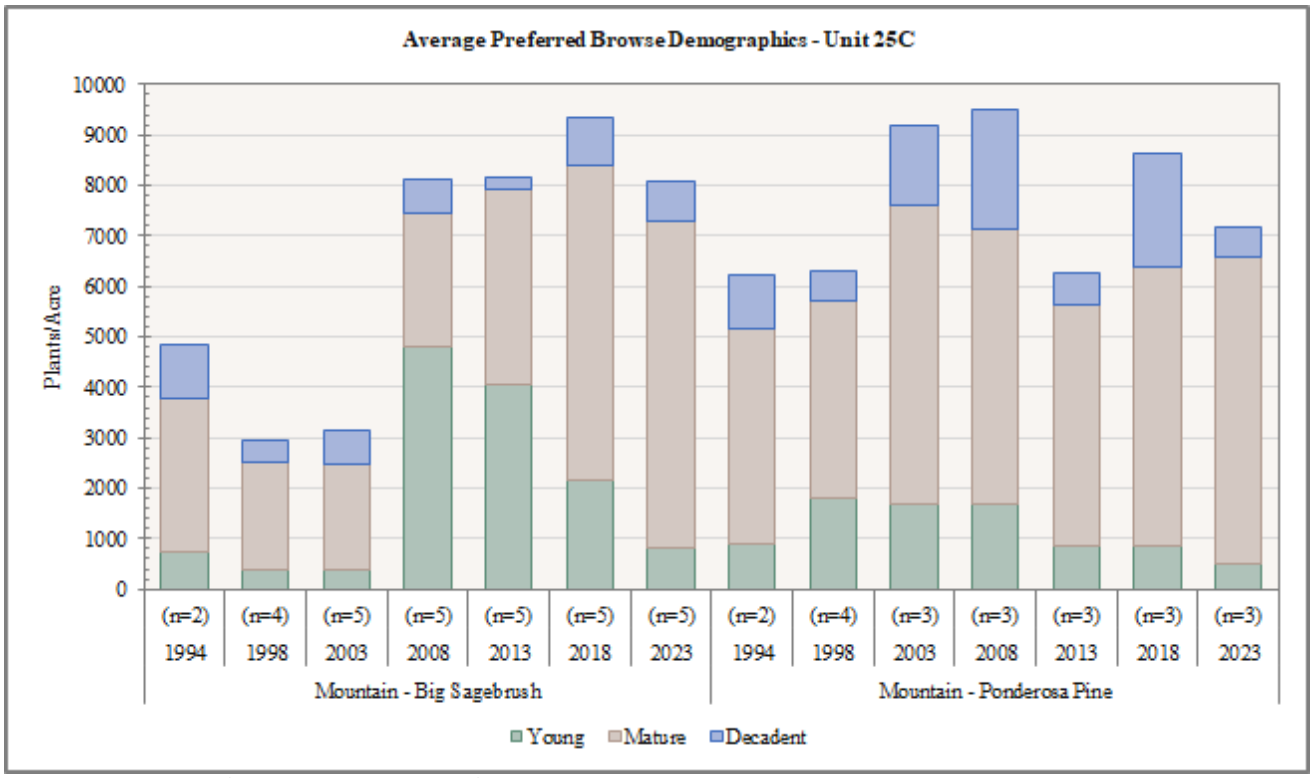


Figure 5.17: Average preferred browse demographics for Mountain - Big Sagebrush and Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.

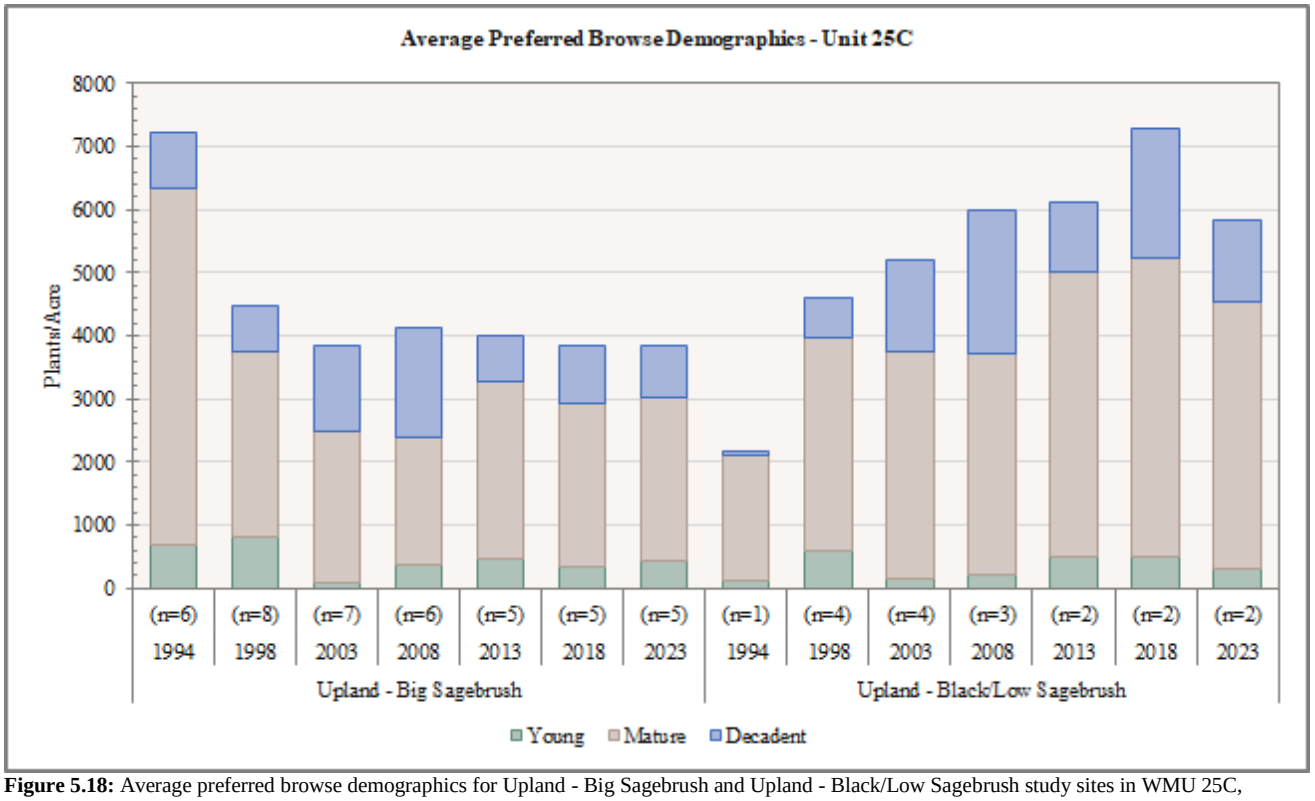


Figure 5.18: Average preferred browse demographics for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.

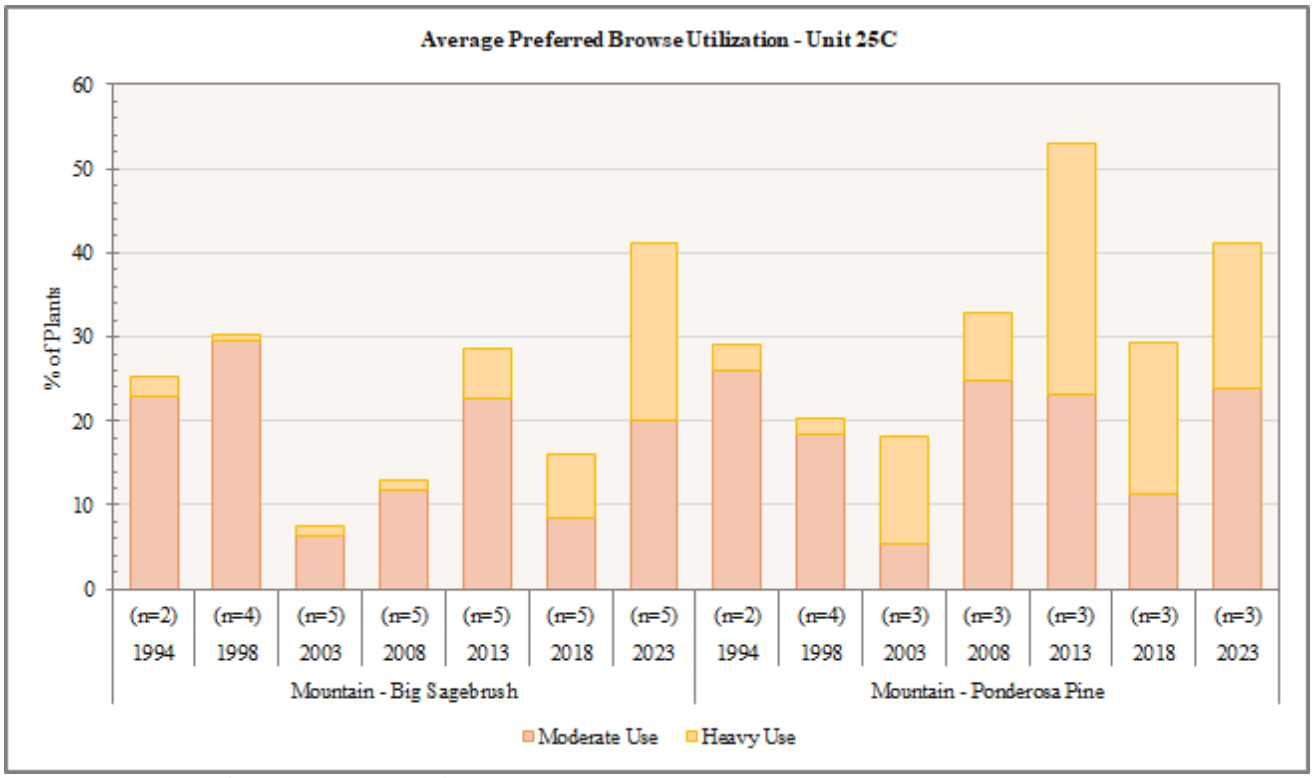


Figure 5.19: Average preferred browse utilization for Mountain - Big Sagebrush and Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.

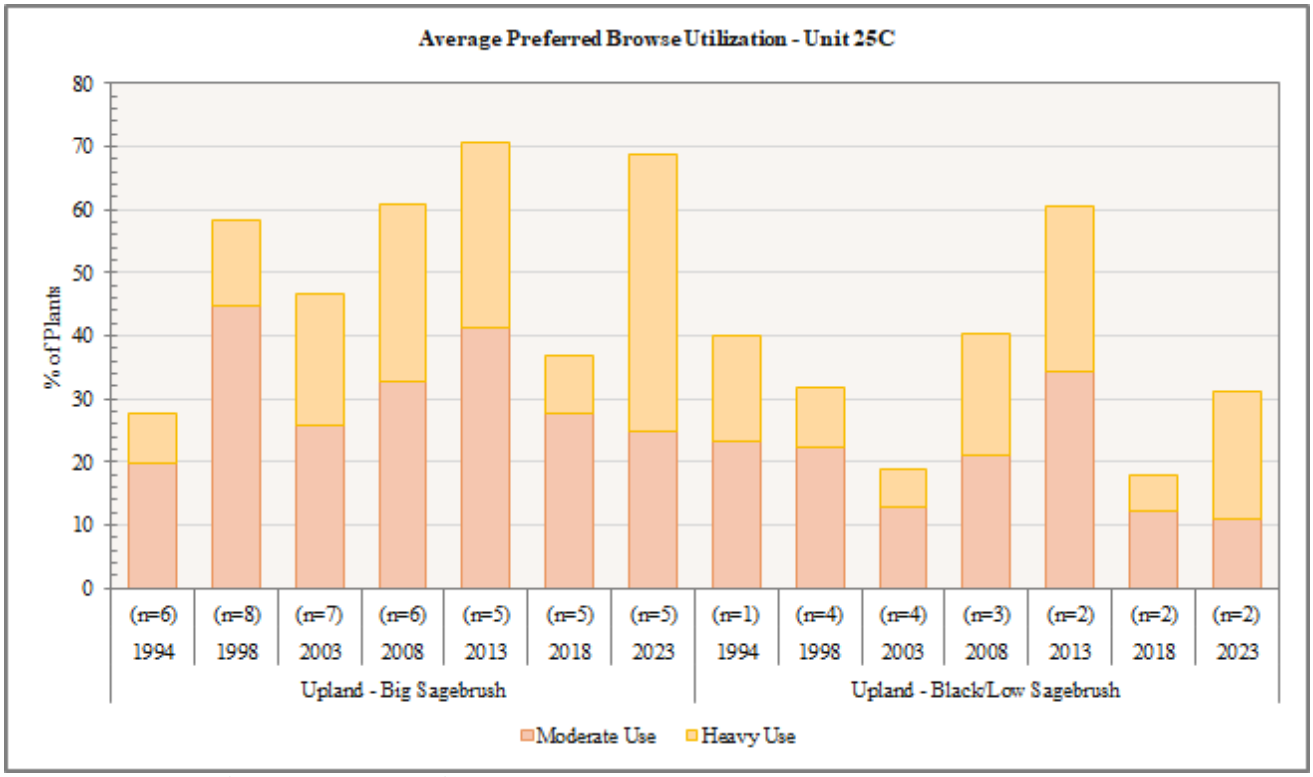


Figure 5.20: Average preferred browse utilization for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.

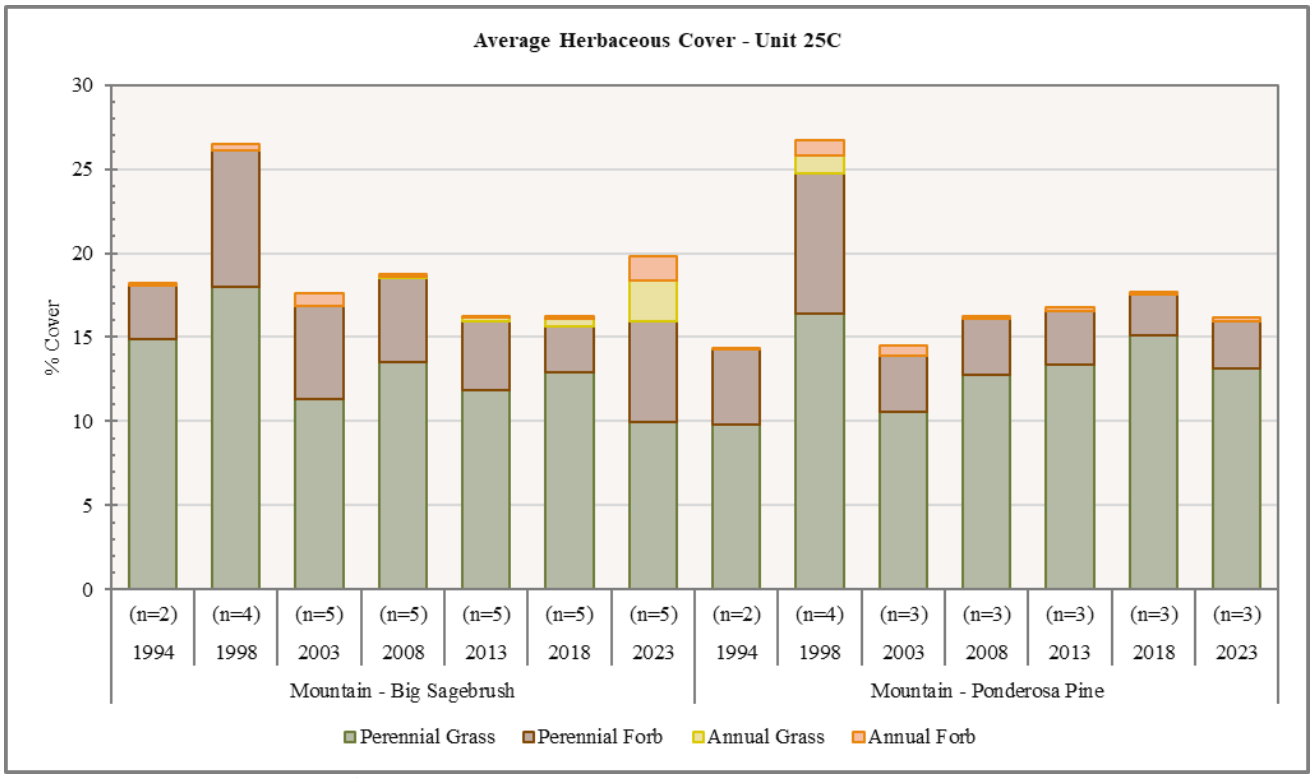


Figure 5.21: Average herbaceous cover for Mountain - Big Sagebrush and Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.

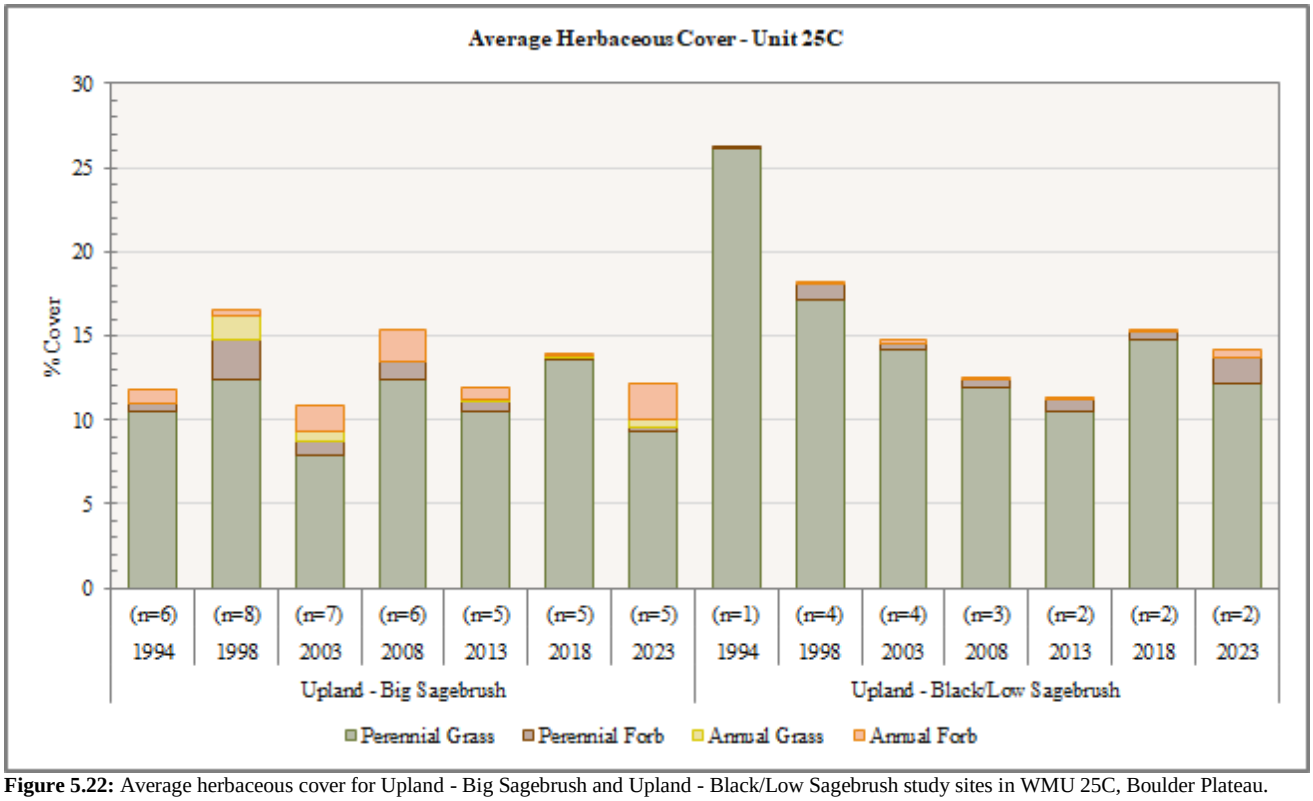


Figure 5.22: Average herbaceous cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.

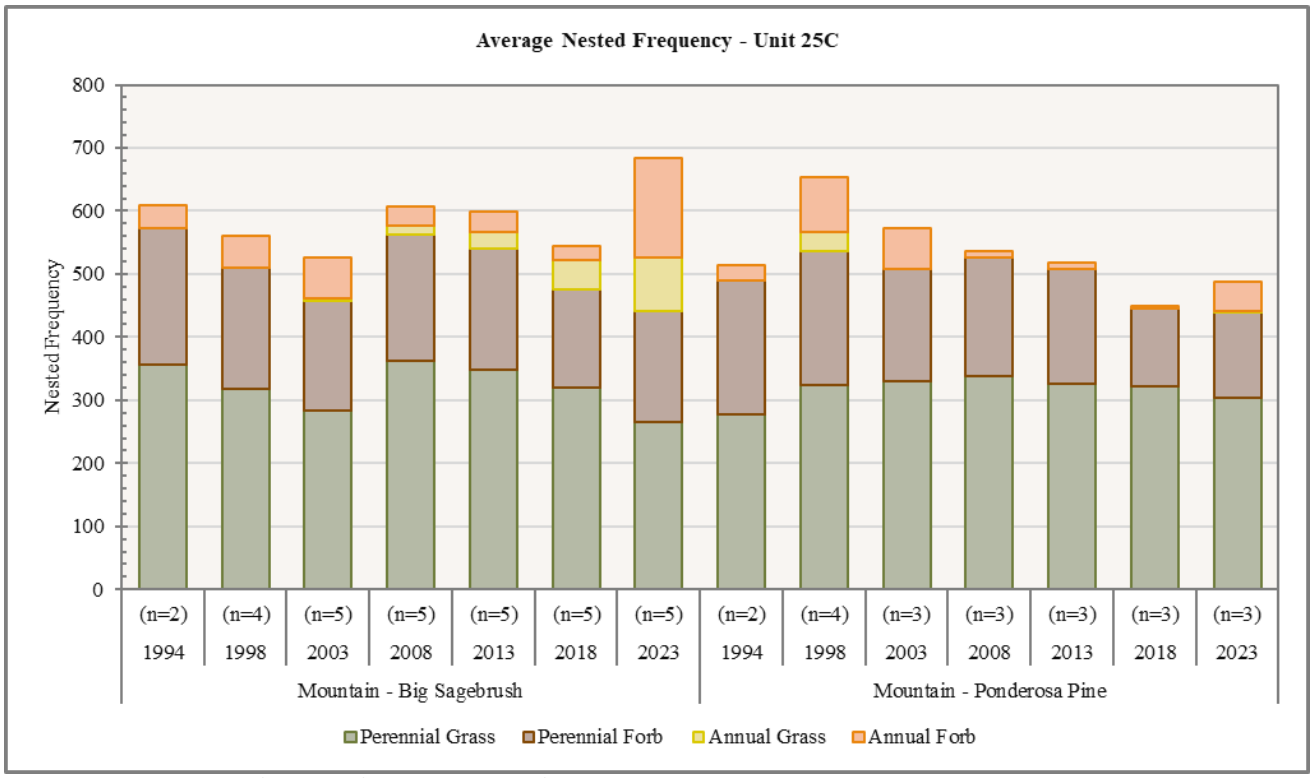


Figure 5.23: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.

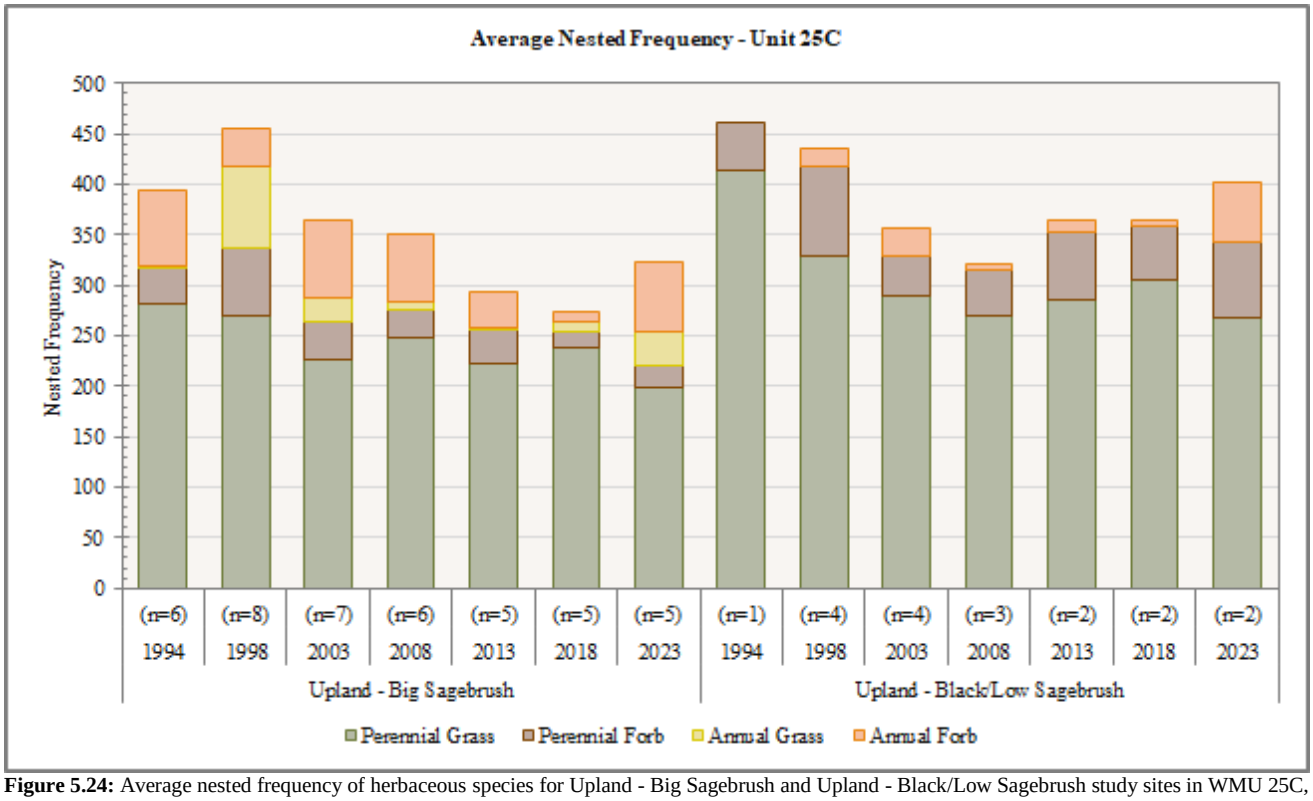


Figure 5.24: Average nested frequency of herbaceous species for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.

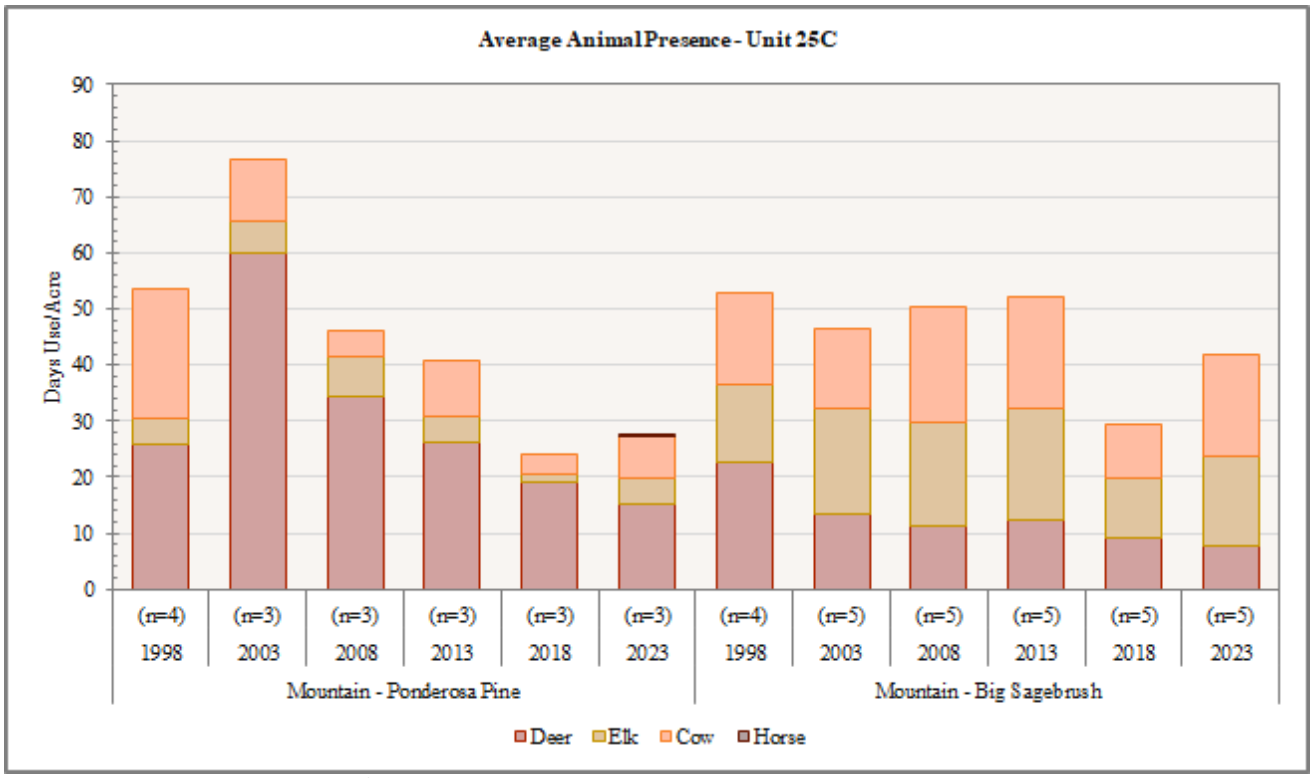


Figure 5.25: Average pellet transect data for Mountain - Big Sagebrush and Mountain - Ponderosa Pine study sites in WMU 25C, Boulder Plateau.
*Mountain - Big Sagebrush deer pellets include deer and antelope pellet groups.

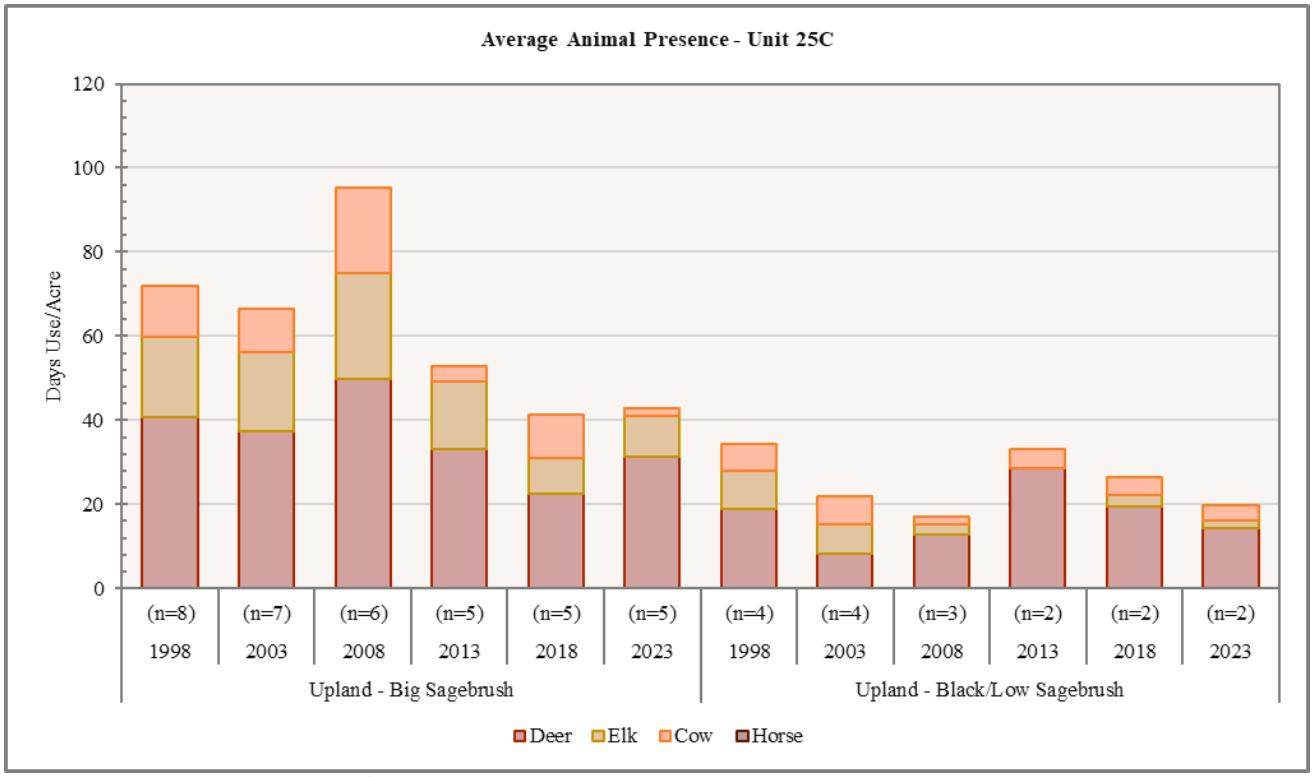
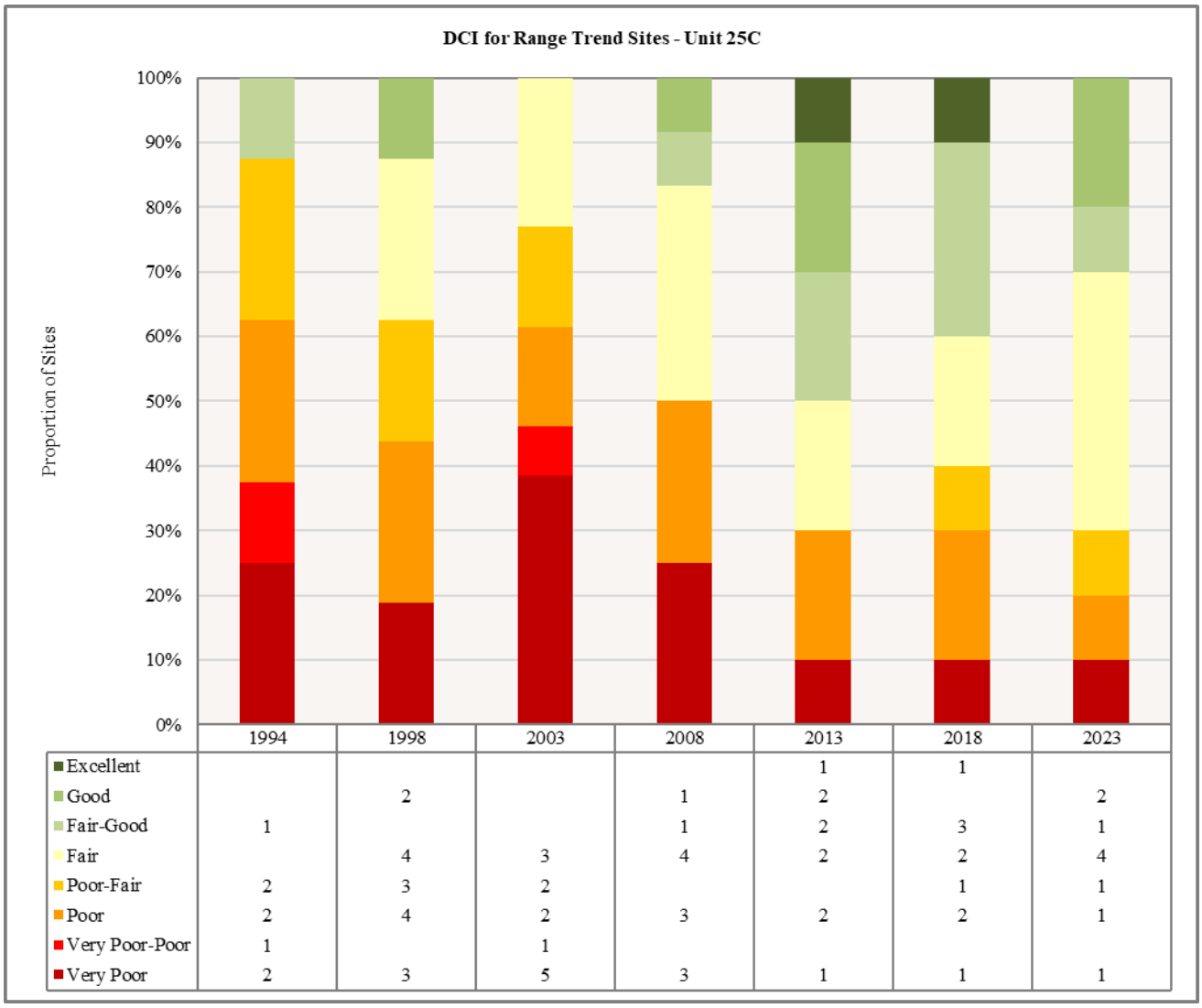


Figure 5.26: Average pellet transect data for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 25C, Boulder Plateau.
*Upland - Big Sagebrush and Upland - Black/Low Sagebrush deer pellets include deer and antelope pellet groups.

Deer Winter Range Condition Assessment

The overall condition of deer winter range on the Boulder Plateau management unit has improved from poor averaged conditions in 1994 to poor-fair averaged conditions in 2023. Happy Valley (25C-03), South Narrows (25C-08), Varney-Griffin Chaining (25C-17), Black Canyon (25C-26), and Poison Creek Bench (25C-27) are the main drivers for the unit's wintering habitat stability and quality, and average between poor-fair and fair-good condition for deer winter range. Terza Flat (25C-06) and New Home Bench (25C-14) are considered to have very poor and poor (respective) wintering habitat condition consistently from year to year: these poor conditions suppress the unit's overall quality of winter habitat. Range Trend sites in WMU 25C that tend to have higher winter habitat variability include Happy Valley, Poison Creek Bench, and North Creek (25C-28). This variability may suggest a higher potential for winter range improvement, but may also suggest some instability in each communities' resistance and resilience to state transitions. However, all these sites appear to exhibit improvement in winter habitat and may experience the most success if treatments were applied in these areas.

The overall deer winter range assessment in 2023 for WMU 25C was that the unit is in fair condition with most sites ranging between fair and good condition. However, Terza Flat and New Home Bench remain in very poor and poor (respective) condition due to low amounts of preferred browse and lack perennial grass and forbs. Furthermore, landscape-scale treatments for habitat improvement in the Terza Flat and New Home Bench areas may not be recommended due to their respective communities' low productivity and resistance to change in the long term (**Figure 5.27**, **Table 5.5**).



	1994	1998	2003	2008	2013	2018	2023
Excellent					1	1	
Good		2		1	2		2
Fair-Good	1			1	2	3	1
Fair		4	3	4	2	2	4
Poor-Fair	2	3	2			1	1
Poor	2	4	2	3	2	2	1
Very Poor-Poor	1		1				
Very Poor	2	3	5	3	1	1	1

Figure 5.27: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 25C, Boulder Plateau.

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
25C-01*	1994	6.3	0	0	30	0	0.9	0	**37.2**	**P**
25C-01*	1998	9.2	9.6	7.4	30	0	0.6	0	**56.7**	**F**
25C-01*	2003	15.8	10.9	2.4	28.1	0	0.7	0	**57.9**	**F**
25C-01*	2008	7.8	10.3	6.4	30	0	1.6	0	**56**	**F**
25C-03	1994	6.2	0	0	22.6	0	10	0	**38.8**	**VP-P**
25C-03	1998	7.5	14.4	3.9	30	-0.3	10	0	**65.5**	**F**
25C-03	2003	11.5	13	2.8	24.7	0	8.3	0	**60.3**	**F**
25C-03	2008	14.6	13.3	4.2	23.8	0	4.8	0	**60.7**	**F**
25C-03	2013	16.3	14.5	9.5	25.9	0	6.2	0	**72.4**	**G**
25C-03	2018	14.8	5.4	8.4	24.5	0	4.2	0	**57.2**	**F**
25C-03	2023	21.7	13.8	10.3	29	0	4.6	0	**79.4**	**G**
25C-06	1994	2.5	0	0	0.9	0	0	0	**3.4**	**VP**
25C-06	1998	5.3	0	0	0.8	0	0	0	**6.1**	**VP**
25C-06	2003	3.6	0	0	0	0	0	0	**3.6**	**VP**
25C-06	2008	4.9	0	0	0	0	0	0	**4.9**	**VP**
25C-06	2013	6	0	0	0.1	0	0	0	**6.1**	**VP**
25C-06	2018	6.2	0	0	0.1	0	0	0	**6.3**	**VP**
25C-06	2023	8.4	6.7	2.2	0.1	0	0.1	0	**17.4**	**VP**
25C-07	1998	18.8	6.2	1.8	20	0	3	0	**49.8**	**P-F**
25C-07	2003	25.8	3.2	0.3	17.7	0	1.8	0	**48.7**	**P-F**
25C-07	2008	29.1	-0.4	1.8	19.6	0	2.4	0	**52.5**	**F**
25C-07	2013	27.3	8.9	5.5	21.9	0	2.9	0	**66.5**	**F-G**
25C-07	2018	26.5	6.5	3.9	25.5	0	1.6	0	**64**	**F-G**
25C-07	2023	28.6	8	2.6	17.7	0	5.4	0	**62.3**	**F**
25C-08	1994	13.9	4.5	1.8	30	0	0.2	0	**50.4**	**P-F**
25C-08	1998	12.4	5.3	6.9	27.1	0	0.2	0	**51.9**	**P-F**
25C-08	2003	16.1	-1.8	0.5	27.1	0	0	0	**41.9**	**P**
25C-08	2008	19.8	-4.9	1	30	0	0	0	**45.9**	**P**
25C-08	2009	16.8	0	0	30	0	0	0	**46.8**	**P**
25C-08	2013	21.1	5.6	1.1	30	0	0.2	0	**58.1**	**F**
25C-08	2018	16.4	5.7	1.7	30	0	0.2	0	**53.9**	**F**
25C-08	2023	19.3	5.3	3.9	30	-0.1	0.2	0	**58.5**	**F**
25C-09	1994	15.6	12	9.6	12.2	0	0.2	0	**49.4**	**P-F**
25C-09	1998	13.5	12.7	12.1	13.4	-0.9	0.2	0	**51**	**P-F**
25C-09	2003	11.3	4.7	2.9	10.4	-2.9	0.1	0	**26.4**	**VP**
25C-09	2008	12.3	1.6	1	13.7	-0.1	0	0	**28.6**	**VP**
25C-09	2013	16.1	10.2	2.5	16.4	0	0	0	**45.2**	**P**
25C-09	2018	12.4	6.7	2.1	21.1	0	0	0	**42.3**	**P**
25C-09	2023	16.1	7.5	2.3	22.5	-0.1	0.1	0	**48.5**	**P-F**
25C-14	1998	23.2	4.5	6.6	13.7	-6.5	0.1	0	**41.8**	**P**
25C-14	2003	11.9	-12.4	0.3	5.1	0	0.1	0	**4.9**	**VP**
25C-14	2008	18.6	-6.2	7.4	3.1	0	0	0	**22.9**	**VP**
25C-14	2013	20.9	1.6	4.5	9.8	0	1.8	0	**38.6**	**VP**
25C-14	2018	17.5	5.3	4	15	-0.1	0.2	0	**41.9**	**VP**
25C-14	2023	18.1	6.6	4	15	-1.5	1.2	0	**43.4**	**VP**
25C-15*	1994	4.1	0	0	12.3	0	1.5	0	**17.8**	**VP**
25C-15*	1998	4.4	0	0	12.7	-0.1	7.2	0	**24.2**	**VP**
25C-15*	2003	4.4	0	0	6.5	0	3.3	0	**14.2**	**VP**
25C-16*	1994	30	3.3	1.7	11	0	1.6	0	**47.7**	**P**
25C-16*	1998	30	11.2	2.4	12.3	0	4.6	0	**60.5**	**F**
25C-17	1998	11.1	13.1	9.8	30	0	9.9	0	**73.9**	**G**
25C-17	2003	17.2	11.2	2.6	10.8	0	9.4	0	**51.3**	**P**
25C-17	2008	11.7	9.2	15	20.5	0	4.3	0	**60.8**	**F**
25C-17	2013	20.5	14.8	15	17	0	1.2	0	**68.6**	**F-G**
25C-17	2018	20.1	14.7	4.9	27.8	0	1.8	0	**69.3**	**F-G**
25C-17	2023	30	14.7	1.9	22.1	0	7.2	0	**75.8**	**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
25C-18*	1998	23.8	14.4	7.3	24.6	-2.9	10	0	**77.2**	**G**
25C-23*	1998	6.4	0	0	30	0	2.3	0	**38.7**	**P**
25C-23*	2003	8.7	11	3.6	10.2	0	0.8	0	**34.3**	**VP-P**
25C-23*	2008	12.6	6.3	2.5	15.7	0	0.5	0	**37.6**	**P**
25C-24*	1998	20.9	-2.7	1.3	6.9	-1	5	0	**30.3**	**VP**
25C-26	1998	14.6	11.6	5.7	25.1	0	1.3	0	**58.3**	**F**
25C-26	2003	18.5	3.6	0.1	27.9	0	0	0	**50.2**	**P-F**
25C-26	2008	29.1	5.6	1.6	30	0	0.1	0	**66.4**	**F-G**
25C-26	2013	28.5	9.7	2.3	20	0	0.2	0	**60.7**	**F**
25C-26	2018	27	5.8	1.6	30	0	0.2	0	**64.7**	**F-G**
25C-26	2023	20.5	8.2	1.7	30	0	0.8	0	**61.2**	**F**
25C-27	1994	30	6.4	7	20.4	0	6.4	0	**70.2**	**F-G**
25C-27	1998	3.4	0	0	30	0	10	0	**43.4**	**P**
25C-27	2003	11.8	12.3	1.1	30	0	9.9	0	**65.1**	**F**
25C-27	2008	18.8	12	15	30	0	6.4	0	**82.2**	**G**
25C-27	2013	26.5	15	15	29.4	0	7.4	0	**93.3**	**E**
25C-27	2018	30	13.7	15	30	0	4	0	**92.7**	**E**
25C-27	2023	30	13.3	5.6	15.3	0	6.3	0	**70.6**	**F-G**
25C-28	1998	30	10.2	2.7	1.5	0	1.5	0	**45.8**	**P**
25C-28	2003	7.9	6.3	4.6	3.9	-0.2	10	0	**32.5**	**VP**
25C-28	2008	13.5	8.9	10.6	14.5	-0.3	5.3	0	**52.5**	**P**
25C-28	2013	21.9	14.3	15	13.6	-0.9	10	0	**73.9**	**G**
25C-28	2018	26.7	11.6	10.3	4.7	-1.9	3.1	0	**54.5**	**P-F**
25C-28	2023	30	13.3	7.7	5.2	-9.2	10	0	**57.1**	**F**

Table 5.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 25C, Boulder Plateau. 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
25C-02	Wildcat	Introduced Perennial Grass PJ Encroachment	High Low	Reduced diversity of desirable grass and forb species Reduced understory shrub and herbaceous vigor
25C-03	Happy Valley	Annual Grass PJ Encroachment	Low Low	Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
25C-04	North Slope	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25C-06	Terza Flat	None Identified		
25C-07	Cedar Grove	None Identified		
25C-08	South Narrows	Annual Grass Energy Development PJ Encroachment	Low Low Low	Increased fire potential and reduced herbaceous diversity Fragmentation and degradation/loss of habitat Reduced understory shrub and herbaceous vigor
25C-09	Dry Wash	Annual Grass PJ Encroachment	Low Low	Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
25C-12	Nazer Draw	Annual Grass Introduced Perennial Grass PJ Encroachment	Low Low Low	Increased fire potential and reduced herbaceous diversity Reduced diversity of desirable grass and forb species Reduced understory shrub and herbaceous vigor
25C-14	New Home Bench	Annual Grass PJ Encroachment	Low Low	Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
25C-17	Varney-Griffin Chaining	Introduced Perennial Grass PJ Encroachment	High Low	Reduced diversity of desirable grass and forb species Reduced understory shrub and herbaceous vigor
25C-20	Baldys	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
25C-25	Center Creek	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
25C-26	Black Canyon	None Identified		
25C-27	Poison Creek Bench	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25C-28	North Creek	Annual Grass PJ Encroachment	High Low	Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
25C-31	Parker Mountain Aerator	Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
25R-05	Lamp Stand	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
25R-07	North Narrows Dixie	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance
25R-08	Sawmill Point Aspen	Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Conifer Encroachment	Low	Reduced understory shrub, aspen stand, and herbaceous vigor
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
25R-10	Parker Front	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25R-11	Brown Spring	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
25R-19	Otter Creek	Noxious Weeds	High	Reduced diversity of desirable grass and forb species
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		Energy Development	Low	Fragmentation and degradation/loss of habitat
25R-20	Otter Creek 2	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
25R-21	Pine Creek	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor

Table 5.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 25C, Boulder Plateau. All assessments are based off 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 Deer Desirable Components Index for 2023 averages as fair for unit-wide conditions, and have been improving since 1994 (generally improving from poor to fair). Terza Flat, Steep Creek Bench (suspended 2003), and Black Ridge (suspended 2003) all have, or have had, consistently poor conditions. Terza Flat is dominated by yellow rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus* var. *stenophyllus*) with small populations of mountain big and black sagebrush (*Artemisia tridentata* ssp. *vaseyana* and *A. nova*) and has very little herbaceous cover. Unit stability is likely driven by the studies Cedar Grove, Varney-Griffin Chaining, Allen Canyon (suspended in 2003), Black Canyon and Poison Creek Bench. All of these studies appear to maintain fair to good conditions that can be attributed to high preferred browse and perennial grass cover. However, perennial forb cover is lacking on the majority of sites. Factors that could lead to winter range improvement include increasing young of preferred browse to ensure population replacement, and establishing diverse perennial forb communities. Attention should be given to North Creek where the presence of cheatgrass (*Bromus tectorum*) is high, and native perennial grass cover low.

Time will be taken here to discuss the Boulder Mountain Landscape Conservation Forecasting model (LCF) produced by the Nature Conservancy for the Utah Watershed Restoration Initiative; Boulder Mountain is an area of interest to both groups. The LCF's potential for evaluating biophysical settings with better resolution (1-m resolution) and ability to evaluate biophysical departure from reference state will help provide more accurate information to agencies who monitor and manage the Boulder Mountain. Estimating condition of current ecological systems more accurately will help create a prioritized overview of restoration efforts that will yield the most return (restored ecological function) for investment. The Boulder Plateau unit is quite diverse with 38 ecological systems accounted for; however, the most dominant of these ecotypes (estimated by LCF) are over 100,000 acres and include big sageberush-mountain [123,934 acres (17%)], ponderosa pine-mesic [121,934 acres (17%)], and aspen-spruce-fir sites [100,871 acres (14%)]. These three ecotypes alone account for nearly 50% of Boulder Plateau's total ecological systems. Of the 691,249 total acres estimated by the LCF Model, there are a few Key Habitats of interest identified by Utah's Wildlife Action Plan found on the Boulder Plateau unit. The most notable of these habitats estimated by the LCF model are Aspen-Mixed Conifer at 54,044 acres (7.8%) and Aspen Woodland at 20,211 acres (2.9%). Other Key Habitats included in the LCF model are Big Sagebrush-Upland, Mountain Shrub, Basin Big Sagebrush, Gambel Oak-Mountain Shrub, and Curl-Leaf Mountain Mahogany. Common cohort shrubs valuable to big game in Pinyon-Juniper Woodlands include little sagebrush (*Artemisia arbuscula*), black sagebrush, big sagebrush, curlleaf mountain mahogany (*Cercocarpus ledifolius*), and blackbrush (*Coleogyne ramosissima*). The process of infilling by pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) can lead to the loss of these shrubs and other understory components. Maintaining early seral stages of these woodlands likely has more value to wildlife than later seral states due to a more abundant herbaceous understory in the former stages (Miller, Svejcar, & Rose, 2000). Neighboring biophysical systems encroached by pinyon and juniper may have been misidentified as Pinyon-Juniper Woodlands due remote sensing not reliably distinguishing between late successional Basin Big Sagebrush (and like)

systems and early successional classes of Pinyon-Juniper Woodlands (The Nature Conservancy LANDFIRE Team, 2023). This is important to note, as Basin Big Sagebrush, Montane Sagebrush Steppe, and Mountain Shrub biophysical systems all experience pinyon-juniper encroachment and all are considered to be Key Habitat by Utah's Wildlife Action Plan (Utah Division of Wildlife Resources, 2015). Therefore, shrublands with the potential to be misidentified as Pinyon-Juniper Woodlands may be overlooked or under prioritized for needed landscape-scale treatments. Regardless of the possibility of misidentification between these two systems, resetting both of these systems to an early successional structure and composition is likely more beneficial to wildlife.

Areas suggested by the LCF Model that are most departed from their reference state are aspen (*Populus tremuloides*) and pinyon-juniper communities. All aspen communities displaying departure from their reference states include the Aspen Woodland, Aspen-Mixed Conifer, and Aspen-Spruce-Fir biophysical systems. The community with the most natural late-stage successional acreage is Aspen-Mixed Conifer with nearly 89% of the community (100,991 acres) designated as late-stage. In contrast, roughly 47% of the Aspen-Mixed Conifer community is classified as successionally uncharacteristic at 22,143 acres. However, the community on the Boulder Plateau displaying the most natural late-stage succession is the Pinyon-Juniper Woodlands biophysical site with 96% of this system's total 165,828 acreage (Provencher, Byer, Badik, & Whitham, 2023).

The habitat and system condition on the Boulder Plateau and surrounding areas has been a longstanding focus of a variety of agencies and local biologists. Past restoration work has focused on vegetation improvement projects that have included pinyon-juniper reduction and seeding. These projects have improved more than 20,000 acres of habitat while benefiting wildlife. Contracting the development of the LCF model is more proof of management's focus on the Aquarius Plateau, and in turn, the model has provided valuable information on the degradation of the biophysical systems in the area. The LCF model will assist managers in where to concentrate rehabilitation efforts that will benefit wildlife moving forward over the next 25 years.

Ecological systems of most concern identified by the LCF model are Big Sagebrush-Mountain (the largest system), Mountain Shrub, Aspen-Spruce-Fir, Aspen-Mixed Conifer and Aspen Woodland stands. All of these systems are considered to be 100% ecologically departed from their reference state (Provencher, Byer, Badik, & Whitham, 2023).

Mountain big sagebrush and mountain shrub systems both experience encroachment by pinyon and juniper trees. Mountain big sagebrush systems still have reference phases present with active Phase I woodland encroachment occurring (25.5%), but the majority of these systems are uncharacteristically departed (≈71%) and could be considered to be in the late stages of Phase II and Phase III woodland succession. The degree of departure suggests that much of this system has, in some form, a degraded understory with both reduced cover and vigor of sagebrush and its cohorts; or a loss of the system's characteristic understory entirely. Similarly, mountain shrub systems (though smaller in defined area) are also degraded, but with no reference phases being represented. Furthermore, nearly all (95.5%) of the systems are uncharacteristically departed from reference state due to tree encroachment; the remainder of these systems are considered departed from reference due to introduced seeded species. It can be assumed that many of the mountain shrub systems are within Phase III of woodland succession and have experienced a high reduction in cover and vigor of the characteristic understory (Provencher, Byer, Badik, & Whitham, 2023). With respect to Range Trend studies that sample mountain big sagebrush communities, sagebrush cover has increased, including on Upland (Big sagebrush and Black/Low Sagebrush) communities (**Figure 5.11**). However, Range Trend sites as a whole have experienced active encroachment by pinyon-juniper within sagebrush systems (**Figure 5.13**, **Figure 5.15**).

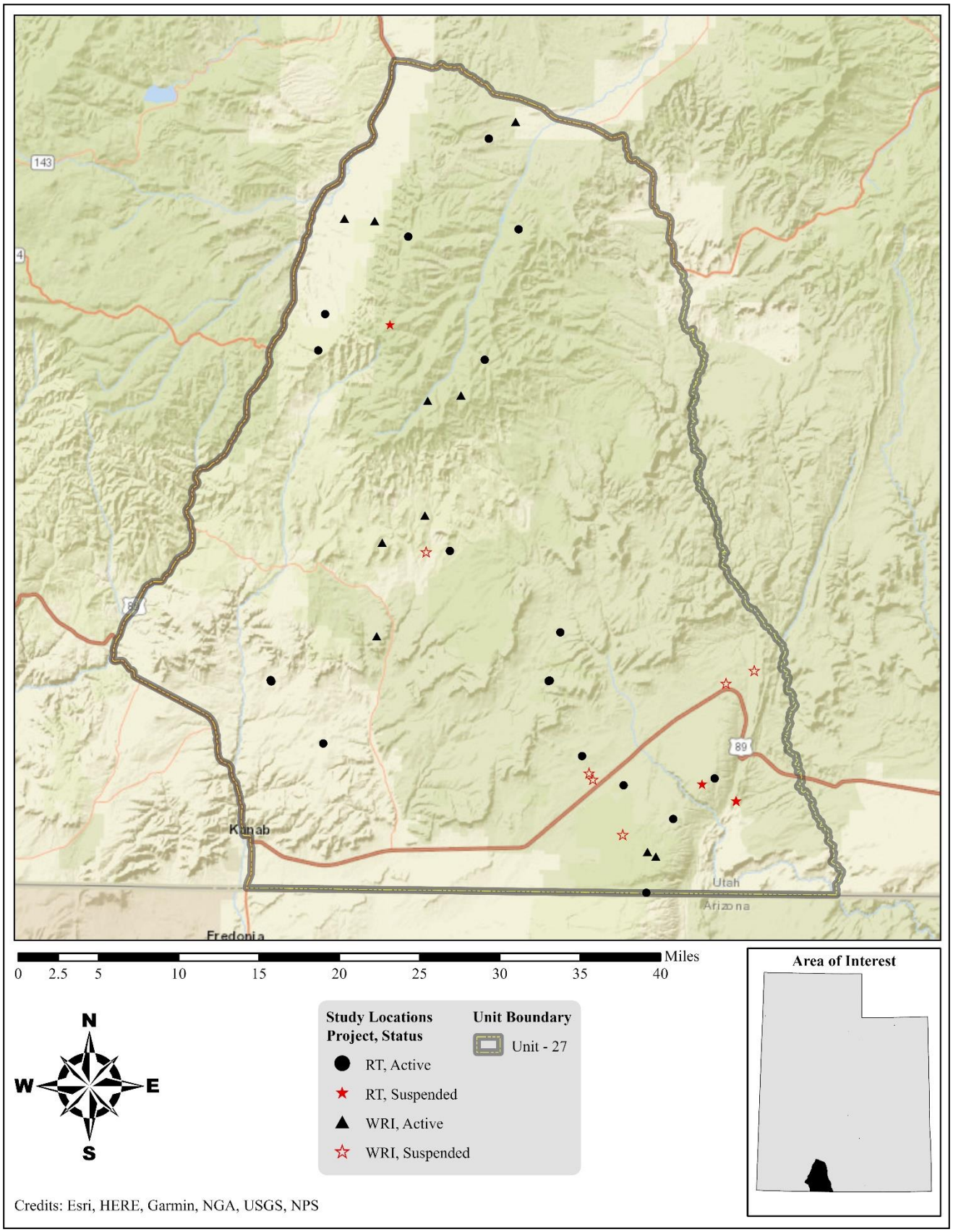
The highly departed aspen systems mentioned above are likely the result of fire suppression practiced over decades-long management and policy implementation, which has allowed for fir (*Abies spp.*) and spruce (*Picea spp.*) to accumulate. This has also allowed these systems to advance to late-stage reference or depleted classes, despite fire being the most common disturbance on the Boulder Plateau. Between 1980 and 2016, approximately 84% of wildfires that have occurred on the plateau have been 10 acres or less in size (Provencher, Byer, Badik, & Whitham, 2023). Though not summarized in this report, the Range Trend site Baldys is considered an Aspen Woodland that has maintained a mature aspen stand, yet aspen cover and density has decreased while size class distribution has shifted to larger trees (Cox, Lane, & Payne, 2023). Although this is only one study sampled by the Utah Division of Wildlife Resources (DWR), it is one example that supports that Aspen Woodlands in the area are aging within their reference states (Provencher, Byer, Badik, & Whitham, 2023).

A number of recreational pressures from tourism may impact the Boulder Plateau's wildlife habitat and wildlife populations. These pressures likely extend from the unit's close proximity to Grand Staircase-Escalante National Monument, Calf Creek Falls, Bryce Canyon and Capitol Reef National Parks, a number of wilderness study areas, and the scenic by-way itself, SR-12, which defines the unit's southern border. These sites draw tens of thousands of vehicles yearly. SR-12 near Bryce Canyon City averaged annual daily traffic of 1,600 vehicles in 2019; Hell's Backbone had an average of 610 vehicles per day; and the SR-12 and SR-24 junction had an average of 680 vehicles per day (Annual Average Daily Traffic, 2019). Concentrations of reported wildlife road kill along SR-12 are found between Bryce Canyon City and Henrieville, which is the section of highway that receives the most traffic on a daily basis. Other areas of concentrated wildlife-vehicle mortality that are concerning can be found near the towns of Antimony, Koosharem, and Loa. According to the National Park Service, an average of 1,886,043 people visited Bryce Canyon National Park for recreation each year between 2013 and 2017. Between 2018 and 2023, that average grew to 2,239,659 people per year, which is nearly a 19% increase in visitations. Using the same timeframes, Capitol Reef also experienced an increase in visitations by 31% (National Park Service, 2023). The Grand Staircase-Escalante National Monument reported that 53% of total visitors either come from outside the western U.S. (30%) or are visiting internationally (23%) (Gale, et al., 2014). Visitor statistics for the Grand Staircase-Escalate NM may represent visitor demographics on a smaller scale, so it is expected that the majority of visitors may not be familiarized with public land rules. To educate the public, wildlife etiquette signage may be a useful tool to reduce impacts to wildlife and their habitat. Human recreation can result in disturbances of animals within the area through human-wildlife interactions. Furthermore, even lower impact recreational activities such as hiking may have an effect on the duration of presence and timing of use of an area by various wildlife species including elk (Anderson, Waller, & Thornton, 2023). More specifically, human-caused noise can negatively impact wildlife in terms of foraging, wildlife presence, body condition and reproductive success (Francis & Barber, 2013; Shannon, et al., 2016). Managing noise through signage has been shown to lower sound by 1.2 decibels and a sound reduction equivalent to 21% less visitors (Levenhagen, et al., 2021). This level of sound reduction using signage may benefit big game use in areas of human concentration.

There will likely be many landscape-scale treatments focusing on sagebrush and aspen community rejuvenation that will occur in the next 25 years. A number of recommendations should be taken into consideration for improving big game habitat within the Boulder Plateau management unit. The Desirable Components Index highlights the North Creek site as an area where cheatgrass cover is high and native perennial grass cover is low; attention to this site and surrounding area through efforts that reduce cheatgrass while increasing perennial grasses and forbs would improve wildlife habitat (**Table 5.5**). Moreover, the presence of annual grasses can increase fine fuel loads, exacerbate the risk of wildfire, and may even result in altered fire regimes (Balch, D'Antonio, & Gómez-Dans, 2013). This in turn can perpetuate and expand the removal of valuable reestablishing or extant browse communities. Should the affected sites burn, they may be at risk for the release of even greater amounts of cheatgrass and the increased fire frequency associated with annual grasses (Balch, D'Antonio, & Gómez-Dans, 2013; Bradley, 2018). 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. Though not an overarching concern on this unit, 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. Work within aspen communities should also continue to alleviate the threat of fir and spruce infilling: this could be accomplished with prescribed fire or allowing wildfire to burn where appropriate. Fire can play a key process in the function and structure of big game habitat (Pastro, Dickman, & Letnic, 2011), especially in high potential areas where ecological resilience is high and allows for the return of early successional vegetation composition while retaining a resistance to invasive species. Logging and pile burning are also viable methods for conifer reduction in these aspen communities. When appropriate, fencing should also be considered where disturbances are small and herbivory may be concentrated (Kota, 2010), but where disturbances are large in scale, herbivory might be safely dispersed throughout the landscape. Overall, management actions should focus on resetting the above ecological systems from late-successional or depleted classes to early-successional reference states. Timely removal of conifer from sagebrush, shrub, and aspen systems is essential before community vigor is lost through decadence and low recruitment. This ensures that reference classes will return to provide suitable and abundant habitat for wildlife. Finally, it is highly recommended that 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. Considerations for adding monitoring sites in summer habitat may be appropriate if there is need for better information on habitat

trends in that portion of the unit; however, site suspension of other Range Trend studies may be needed to accommodate newly prioritized site locations.

6. WILDLIFE MANAGEMENT UNIT 27 – PAUNSAUGUNT



WILDLIFE MANAGEMENT UNIT 27 – PAUNSAUGUNT

Boundary Description

Beaver, Iron and Millard counties - Boundary begins at US-89A and the Utah-Arizona state line; north on US-89A to US-89; north on US-89 to SR-12; east on SR-12 to the Paria River; south along the Paria River to the Utah-Arizona state line; west along this state line to US-89A.

Management Unit Description

Geography

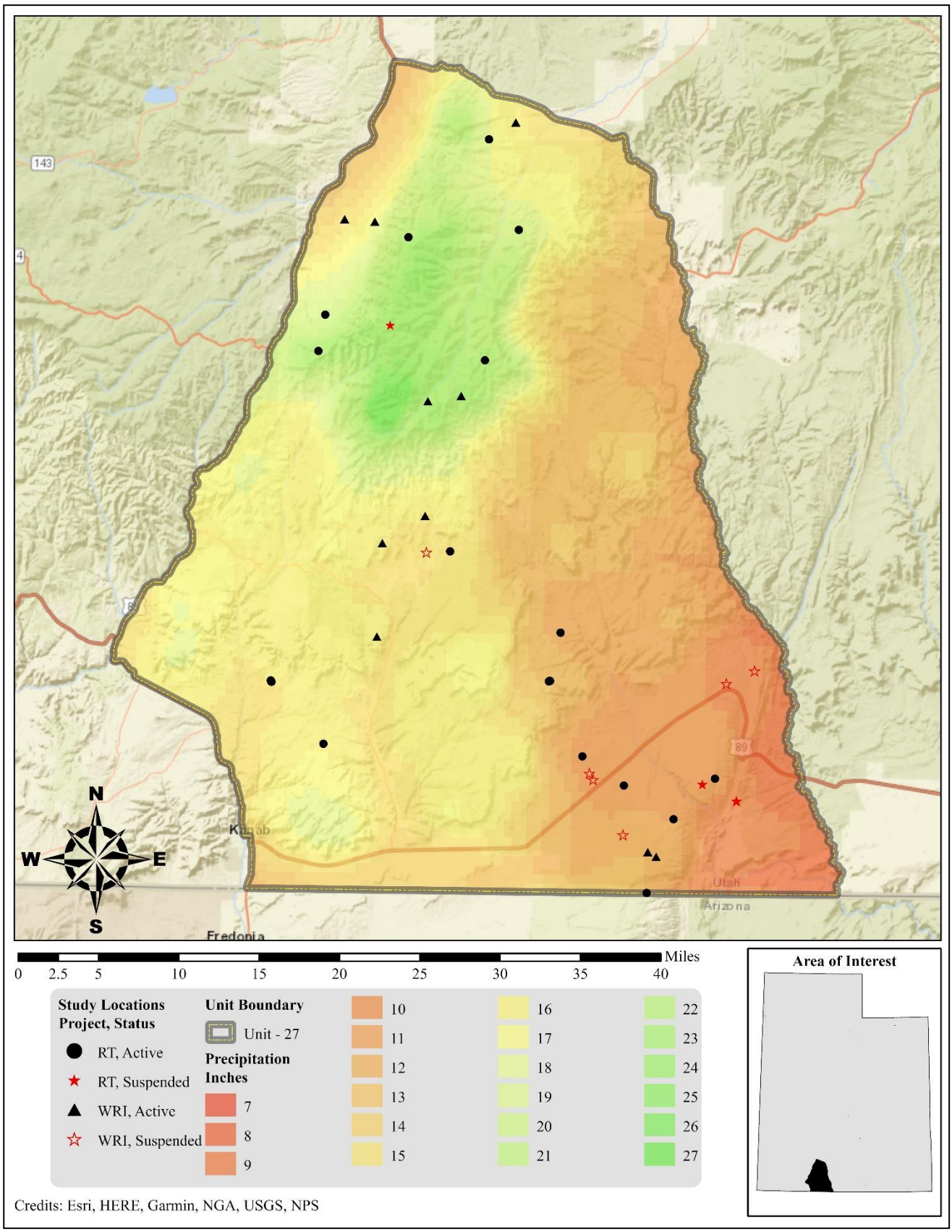
The Paunsaugunt Wildlife Management Unit is located in south-central Utah. It includes the Paunsaugunt Plateau in the northern part of the unit and the lower benches that stretch to the south, extending to the Utah and Arizona border. The highest portion of the unit is Pink Cliff at 9,394 feet, which is found on the Paunsaugunt Plateau; the Paunsaugunt Plateau is mainly considered to be summer range. The Pink Cliffs of Bryce Canyon National Park and the Sunset Cliffs to the west delineate the southern rim of the Paunsaugunt Plateau. Terrain of the transitional and/or winter range is characterized by gently sloping terraces broken by extensive cliff formations. The Skutumpah Terrace lies between the Pink Cliffs and White Cliffs; Wygaret Terrace, Nephi Pasture, and Little Man's Mesa lie between the White and Vermillion Cliffs. Buckskin Mountain is a lower-elevation mountain that is located in the southeast portion of the unit. The bulk of the winter range is found on the Wygaret Terrace and Buckskin Mountain.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows that precipitation on this unit ranges from 7 inches in the southeastern portion of the unit near Bridger Canyon to 27 inches on the high-elevation portion of the Paunsaugunt Plateau. All of the active Range Trend and WRI monitoring studies on the unit occur between 10-24 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 South Central Division (Division 4).

The mean annual PDSI of the South Central Division has displayed some form of drought most years since 1993. Moreover, this climate division has been considered to be in drought nearly 68% of the time since 1993. Of the drought years, nearly 43% are considered either moderate or extreme droughts. Also remarkable about this climate division is that drought is experienced over multiple years and generally interrupted by a single wet year event; the most notable wet years occur in 2005 and 2011, which were both considered moderately wet (**Figure 6.1a**). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September to May that result in higher soil moisture reserves that are available to plants for longer periods during the dry summer months. Although overall annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI (**Figure 6.1b**) (Time Series Data, 2024). These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 6.3**). Years that were moderately wet occur in 1999 and 2023, but years where drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 6.1a, Figure 6.1b**).



Map 6.1: The 1991-2020 PRISM Precipitation Model for WMU 27, Paunsaugunt (PRISM Climate Group, Oregon State University, 2021).

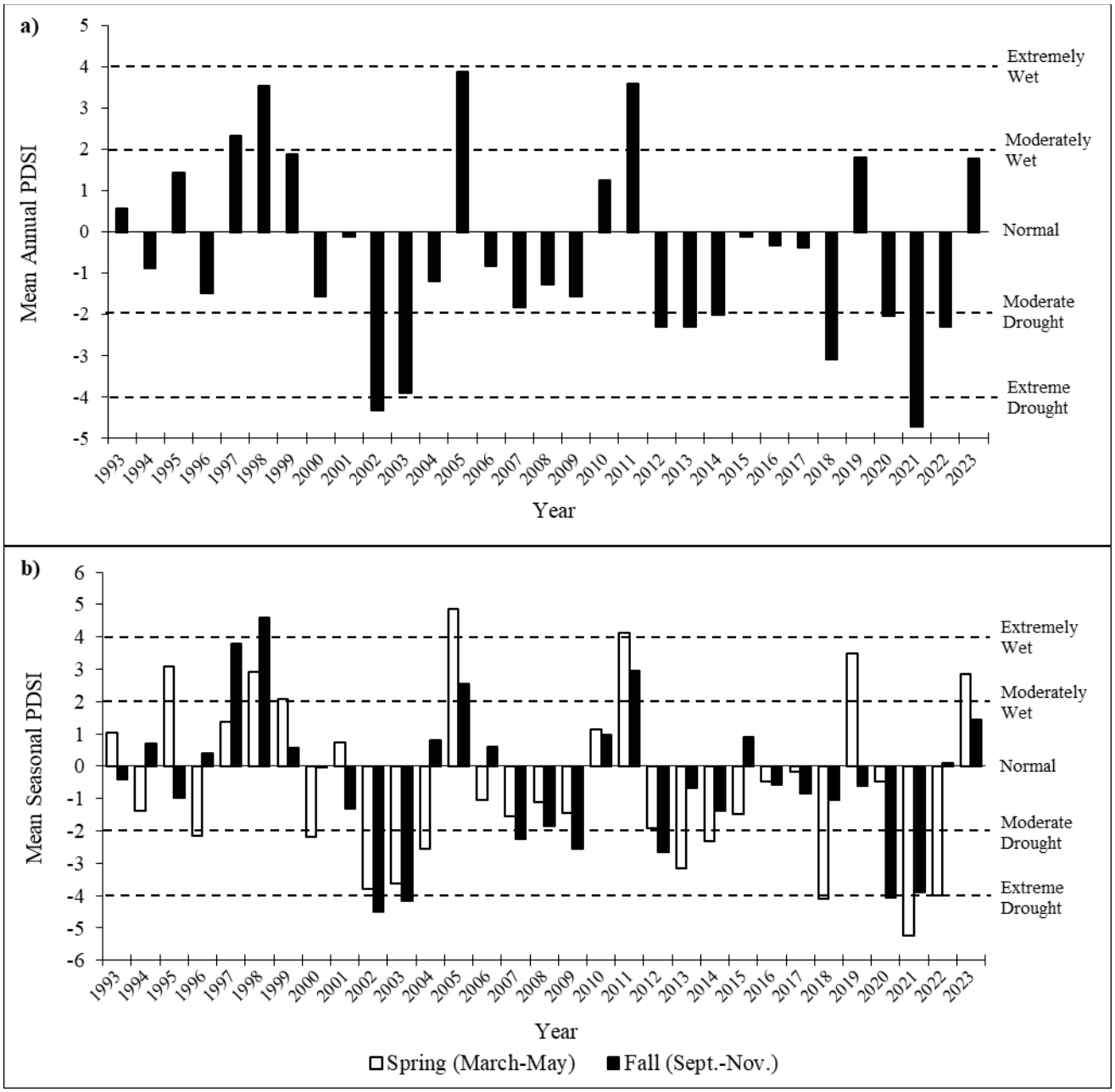


Figure 6.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

The Paunsaugunt Plateau provides the bulk of the summer range in the unit with an average elevation of 9,000 feet (**Map 6.2**). The key areas that have been identified on summer range are the mixed mountain brush community in the upper reaches of Proctor Canyon; a high-elevation black sagebrush (*Artemisia nova*)-grass community between Ahlstrom Hollow and Johnson Bench; the ponderosa pine (*Pinus ponderosa*) type on Whiteman Bench; the conifer clear-cut with its associated aspen resurgence below the Sunset Cliffs near Sand Pass; and the grass meadow type in Podunk Creek.

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

The RAP data illustrates a peak in herbaceous cover and biomass in the early to mid-1990s that has slowly decreased to the present. However, annuals showed a general increase in cover over this same period with years of good precipitation correlating with large flushes of annuals: this is more pronounced on the winter range. Overall perennial biomass and cover have decreased on both summer and winter ranges (**Figure 6.2**, **Figure 6.3**, **Figure 6.4**, **Figure 6.5**). The Range Trend data from 1992 to present shows a general stability in perennial and annual cover on most ecological potentials, although some fluctuation has occurred; however, total perennial cover has increased on Mountain (Shrub) and Mountain (Black/Low Sagebrush) ecotypes. Range Trend data also indicates that total annual cover is increasing on Upland (Cliffrose) ecotypes (**Figure 6.19**, **Figure 6.20**). These fluctuations in annual and perennial cover are expected due to differences in timing and amounts of precipitation for each sample year read.

The RAP data for tree and shrub cover on summer range shows fluctuation over time, but cover has remained relatively stable overall for both lifeforms. However, tree cover on winter range has increased from 10.37% in 1986 to 16.58% in 2023 (**Figure 6.6**, **Figure 6.7**). Range Trend data indicates general increases in shrub cover for Mountain (Black/Low Sagebrush) and Upland (Big Sagebrush) ecotypes. Since 2003, tree cover has increased on Mountain (Black/Low Sagebrush) and Mountain (Shrub) ecotypes (**Figure 6.8**, **Figure 6.11**, **Figure 6.12**).

RAP – Herbaceous Biomass by Deer Habitat

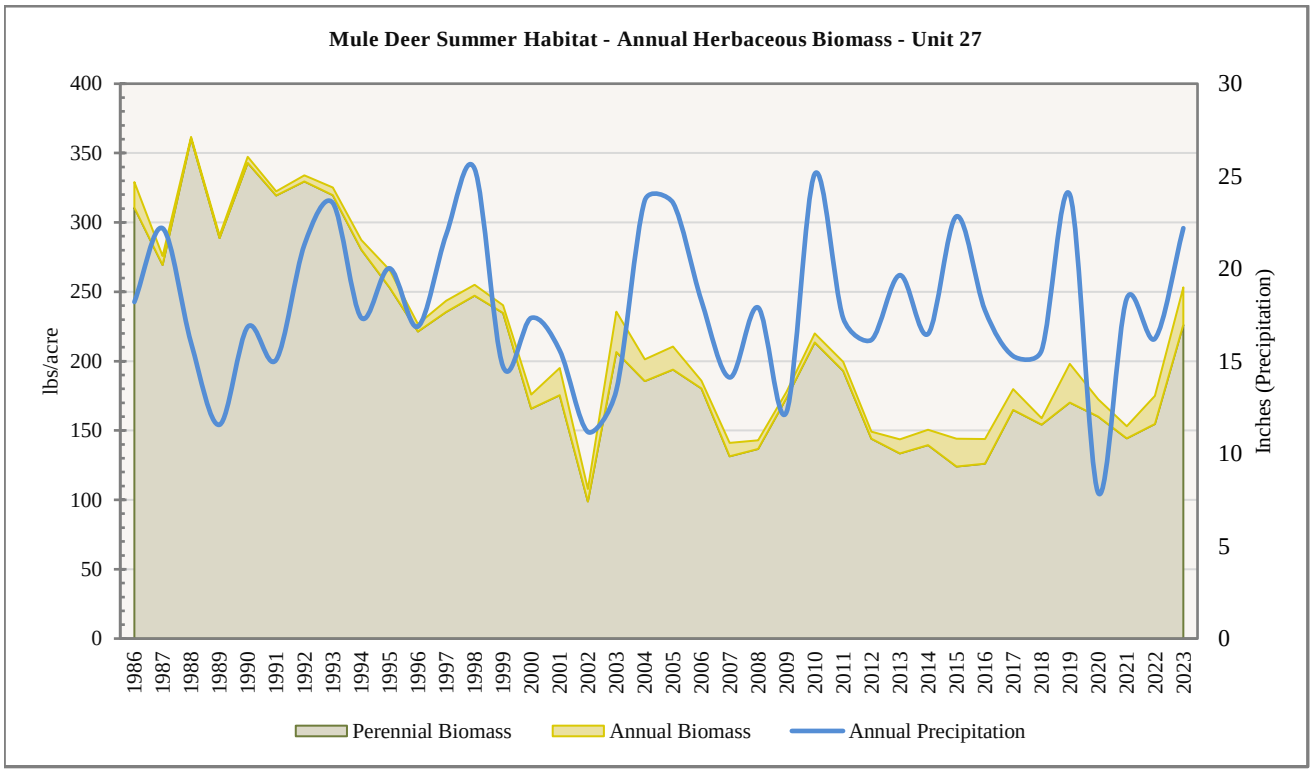


Figure 6.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 27, Paunsaugunt (Rangeland Analysis Platform, 2024).

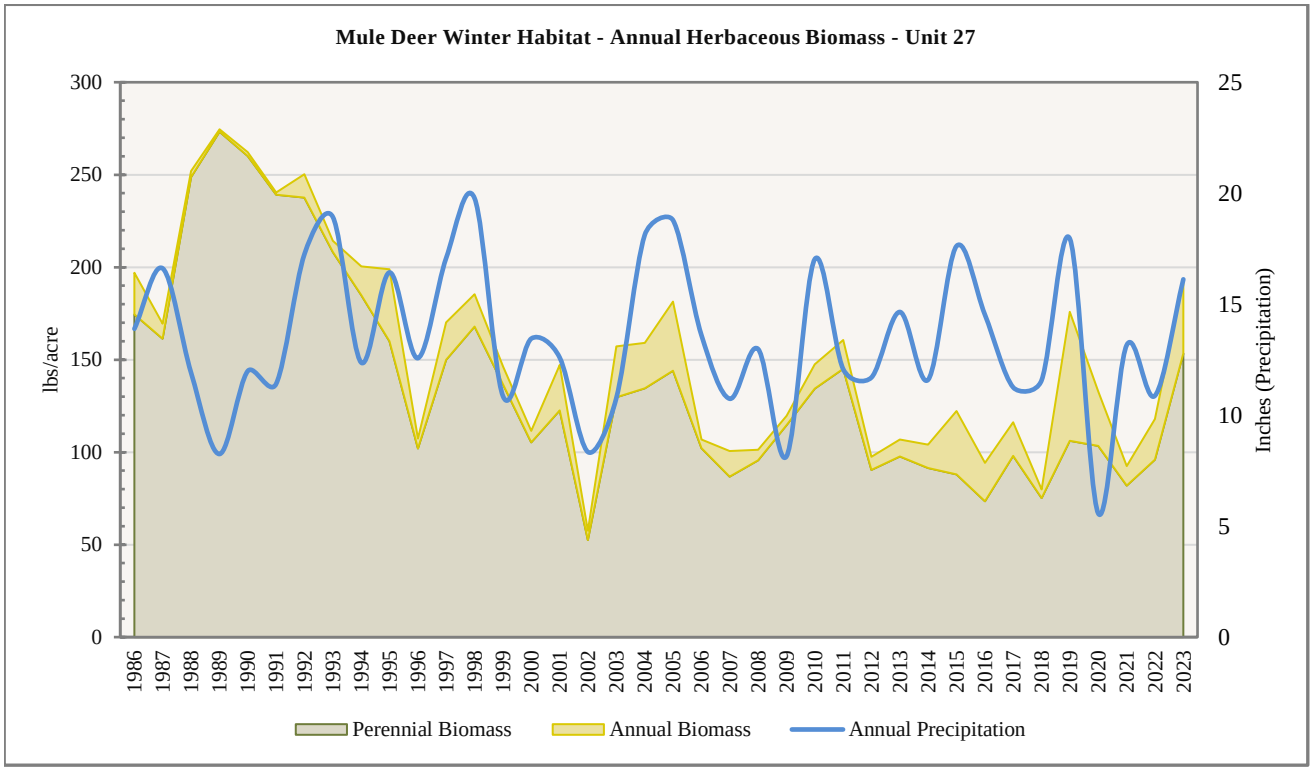


Figure 6.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 27, Paunsaugunt (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

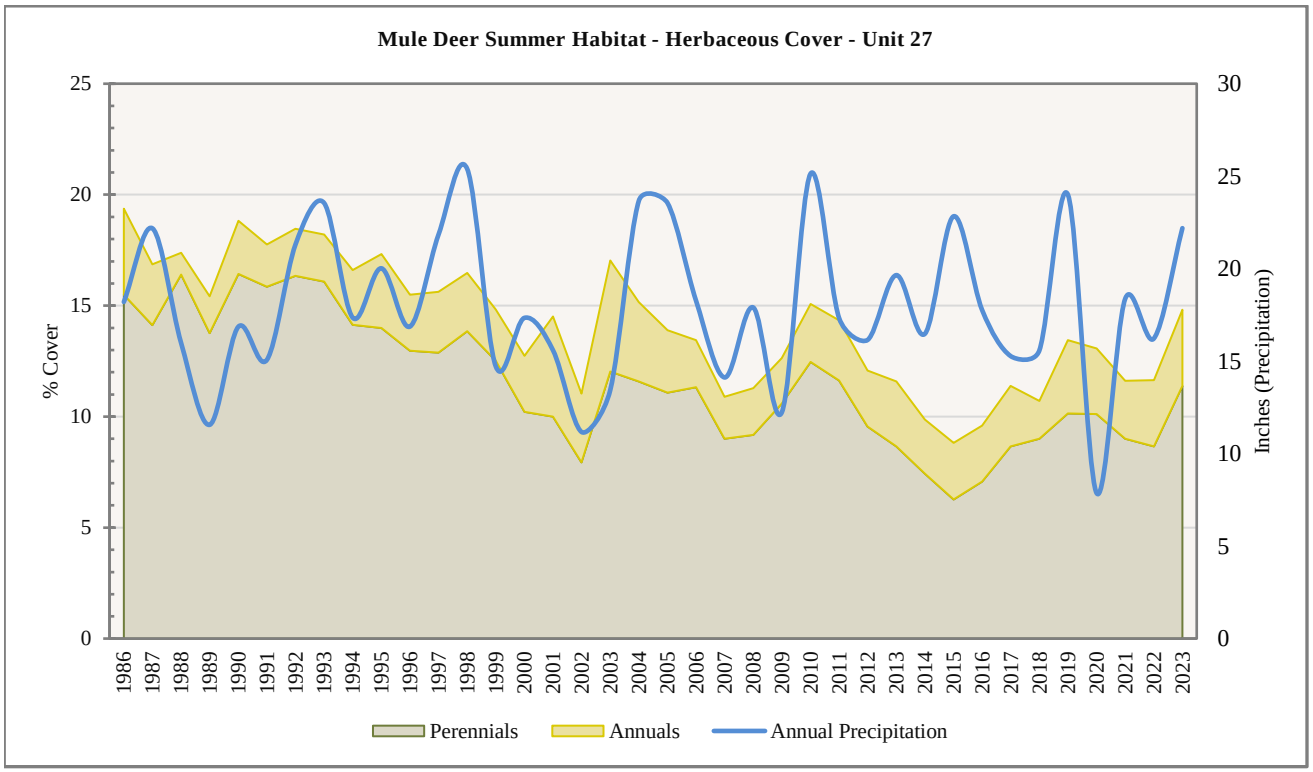


Figure 6.4: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 27, Paunsaugunt (Rangeland Analysis Platform, 2024).

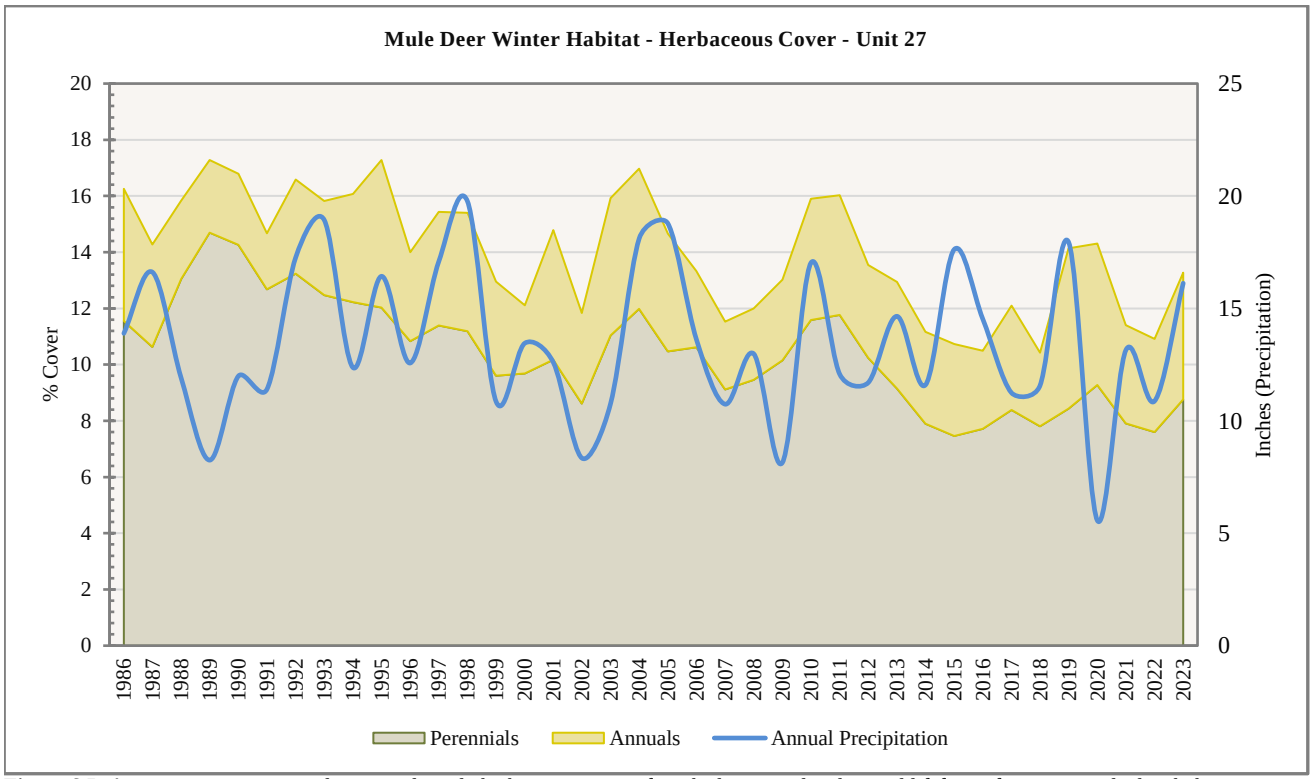


Figure 6.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 27, Paunsaugunt (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

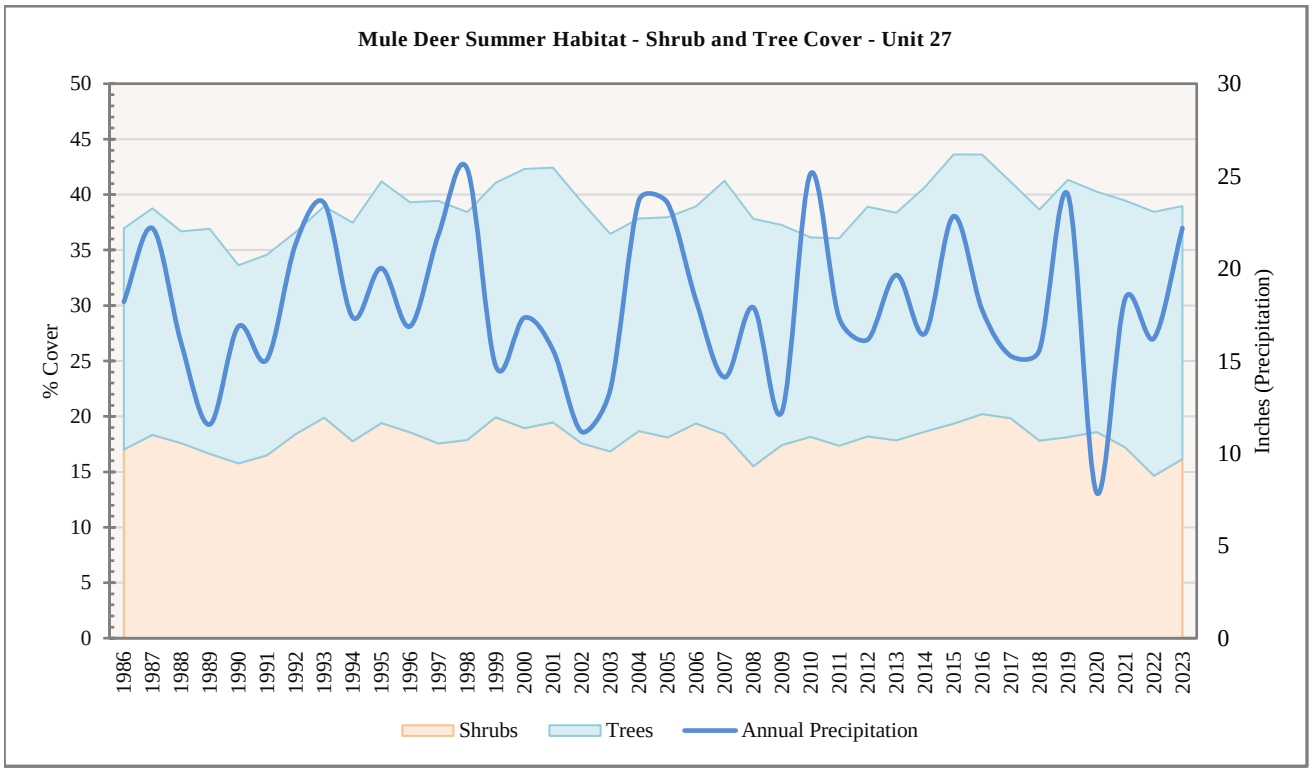


Figure 6.6: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 27, Paunsaugunt (Rangeland Analysis Platform, 2024).

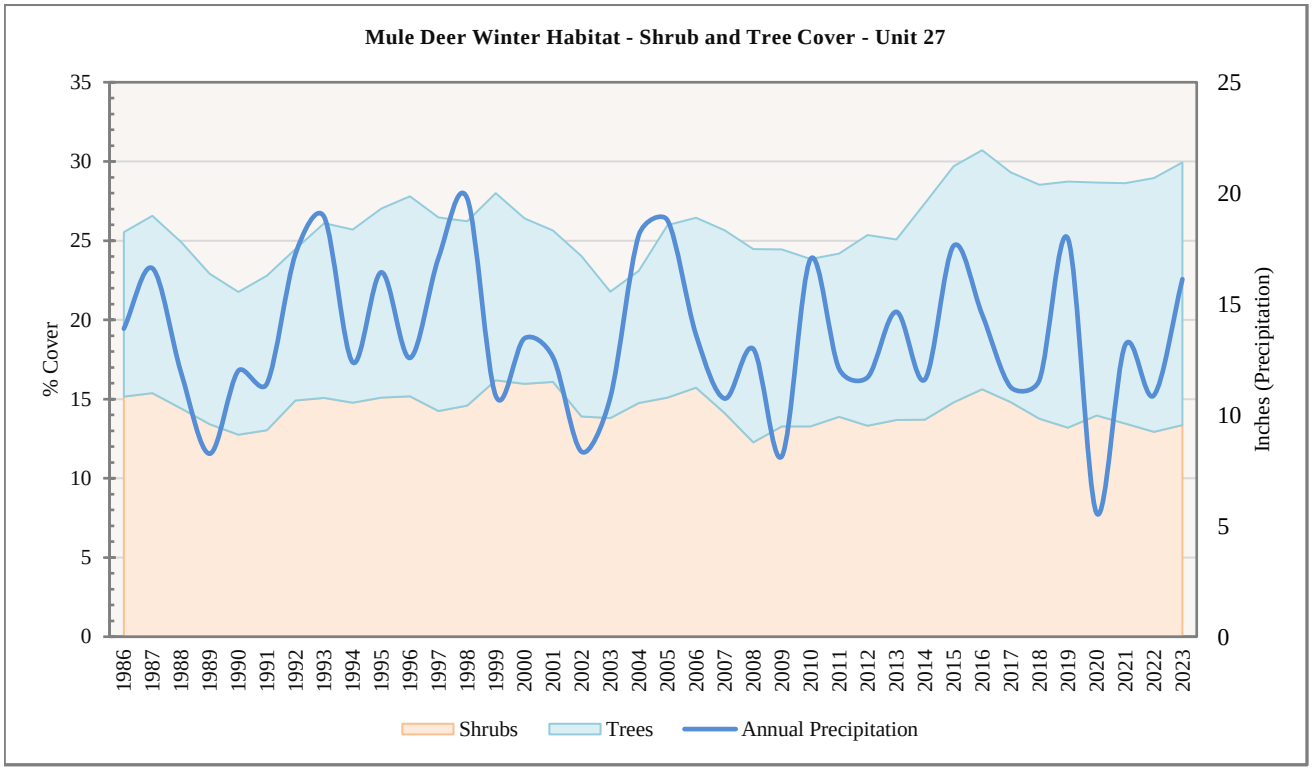
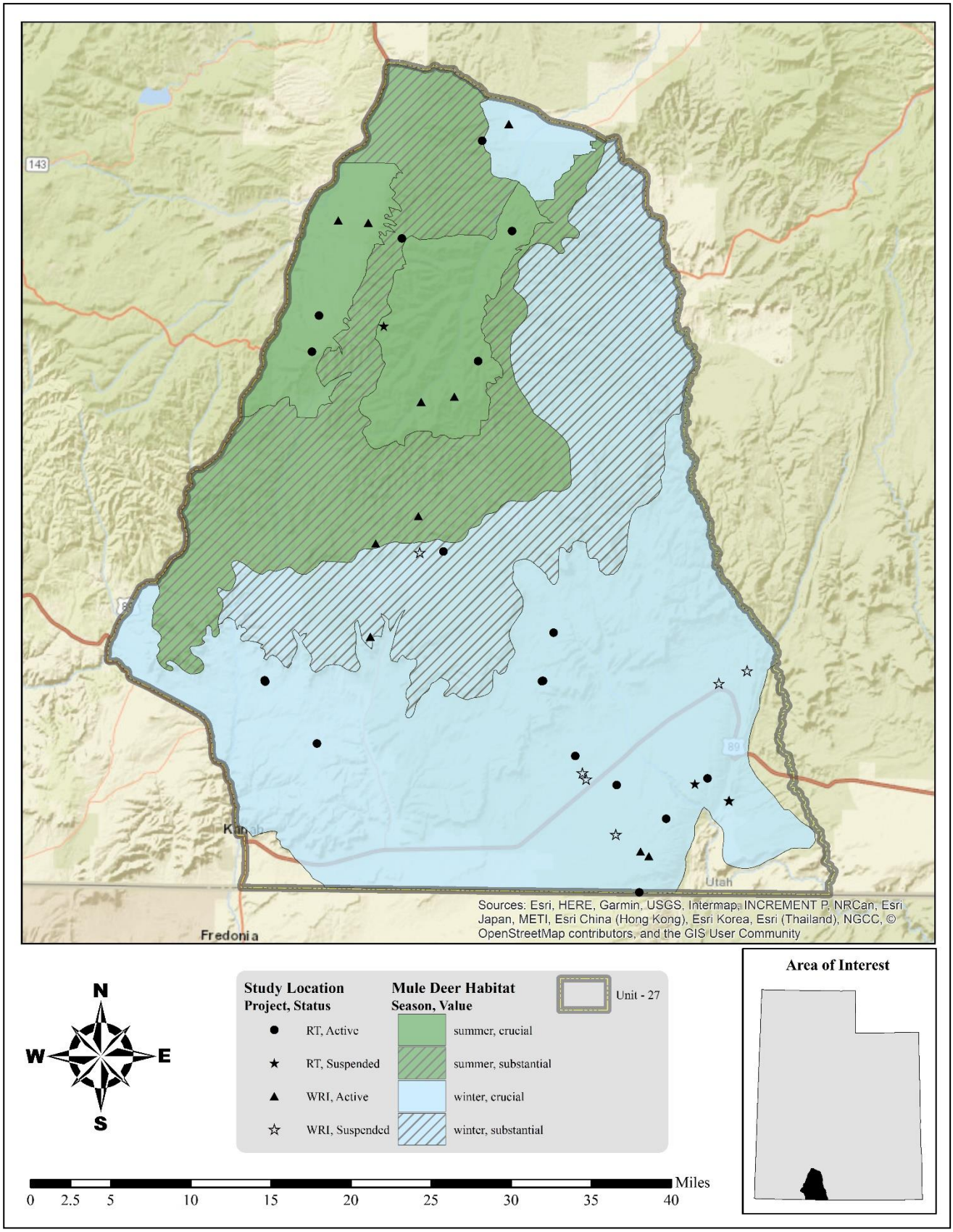
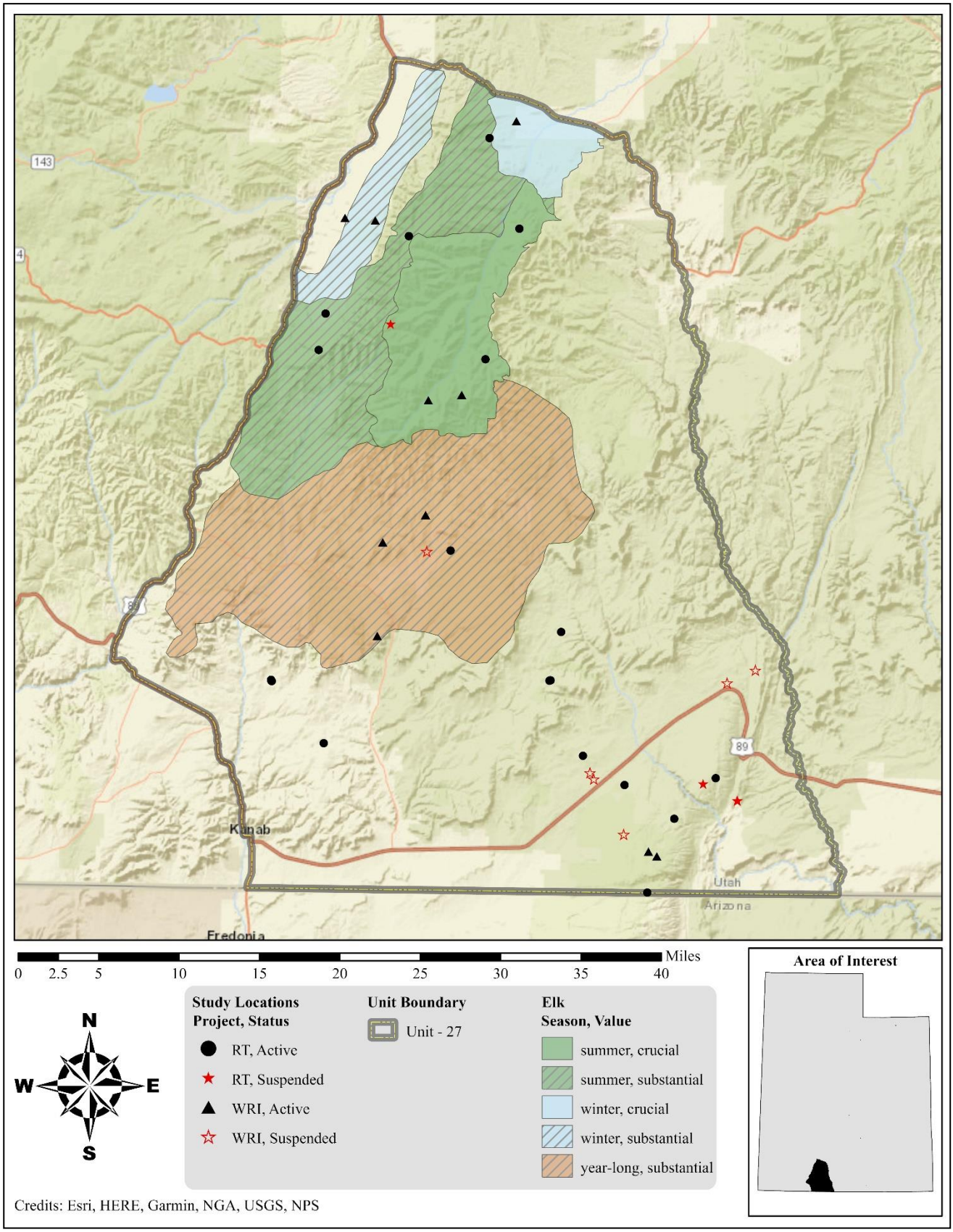


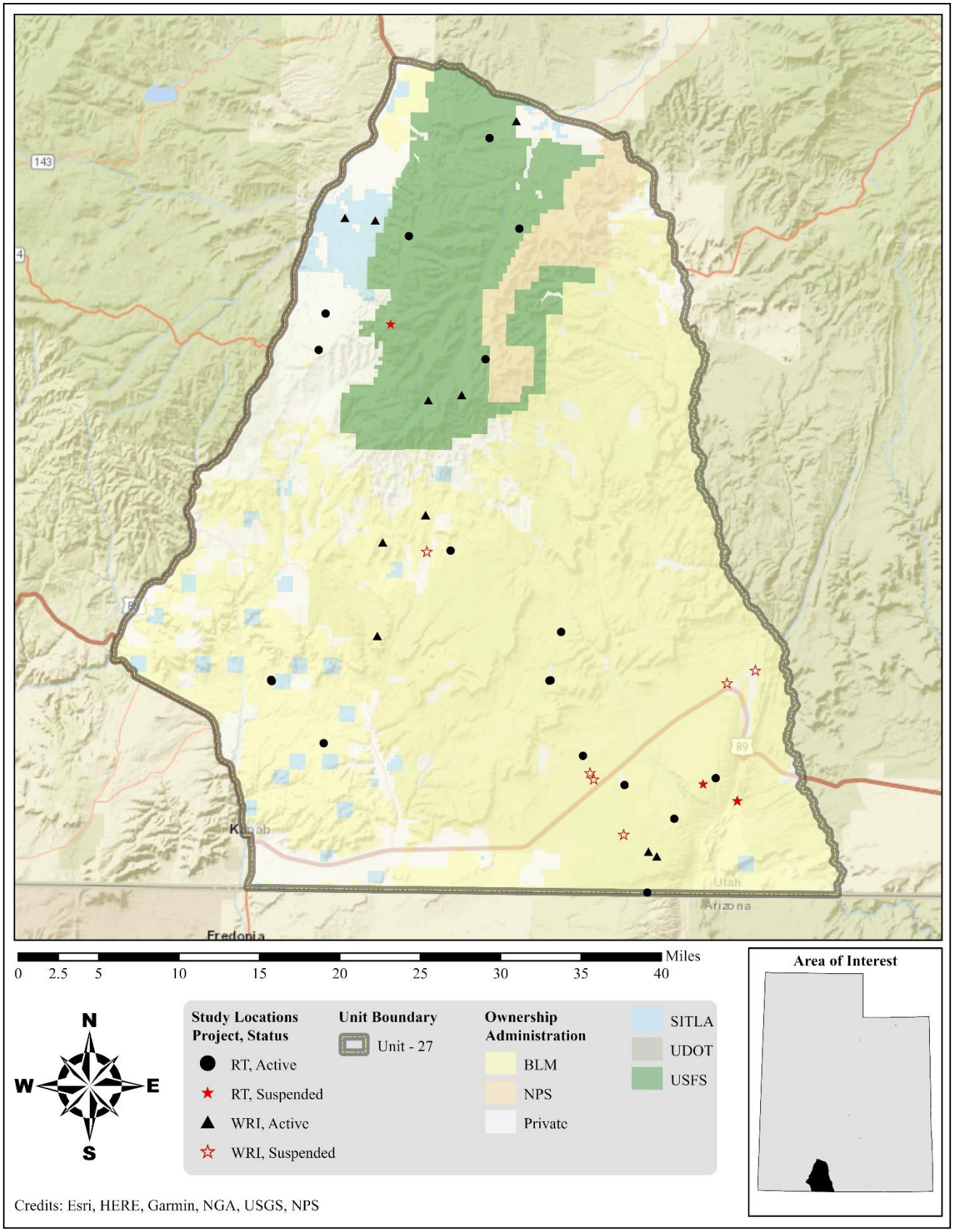
Figure 6.7: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 27, Paunsaugunt (Rangeland Analysis Platform, 2024).



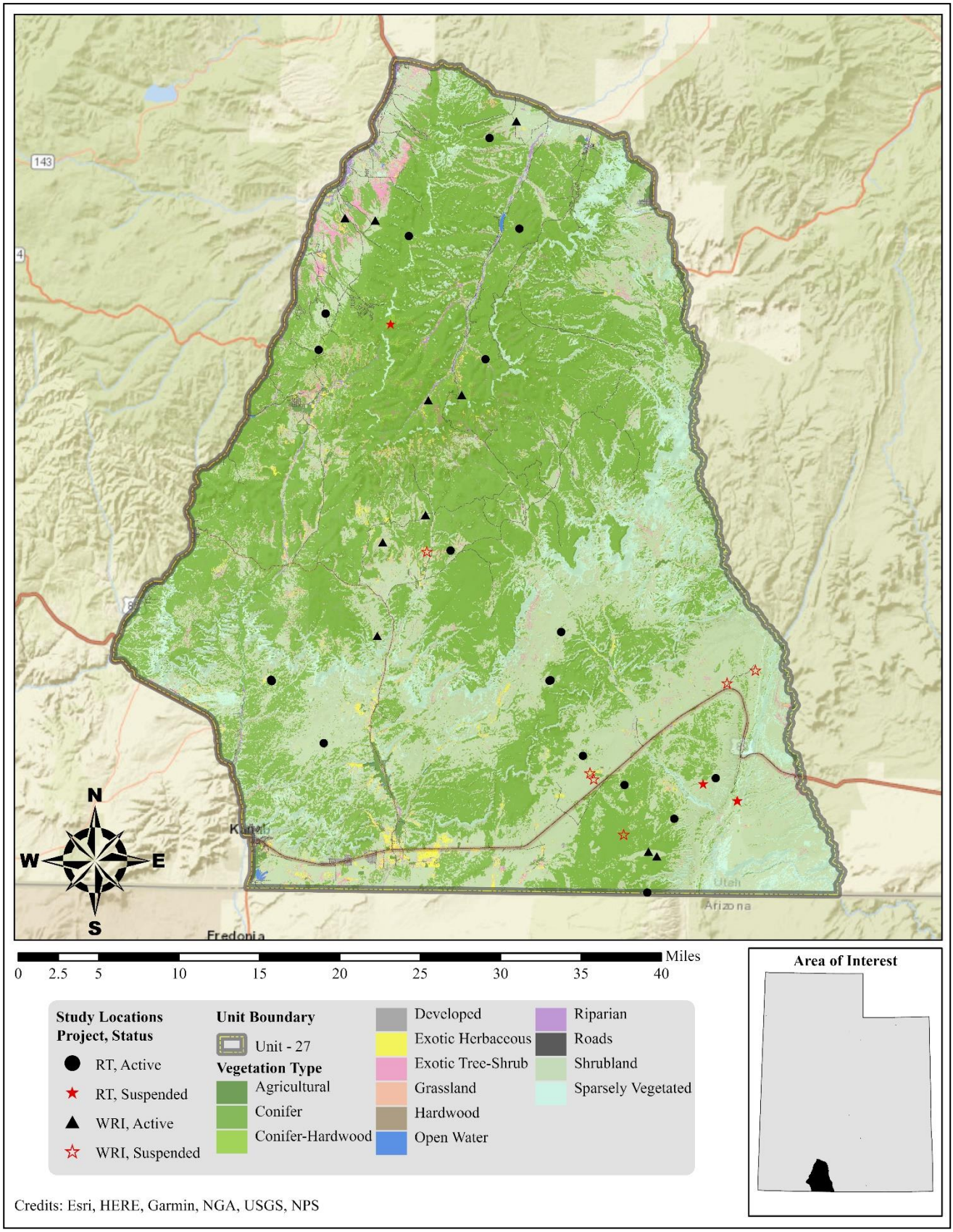
Map 6.2: Estimated mule deer habitat by season and value for WMU 27, Paunsaugunt.



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



Map 6.4: Land ownership for WMU 27, Paunsaugunt.



Map 6.5: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 27, Paunsaugunt.

LANDFIRE Existing Vegetation Types on Mule Deer Habitat

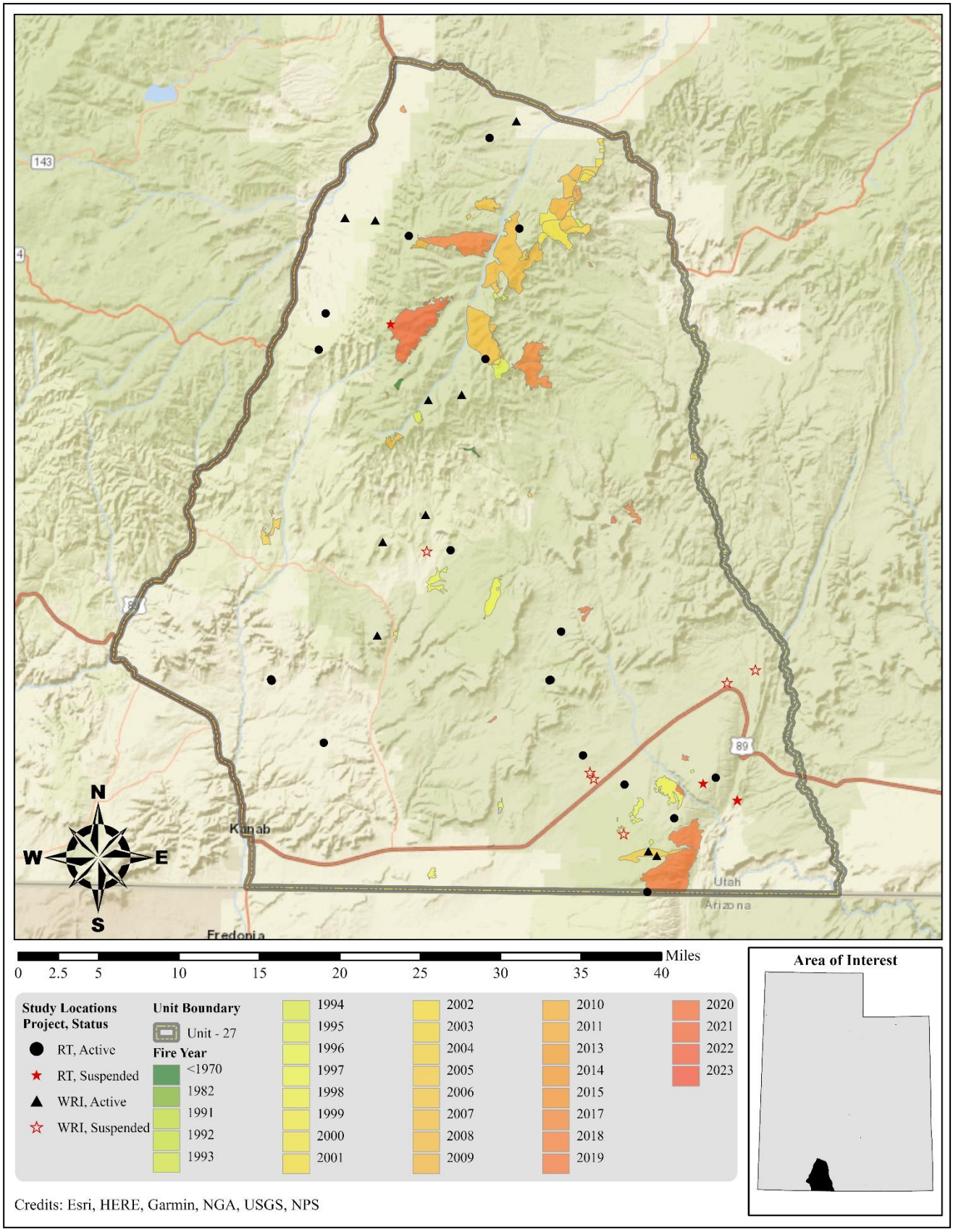
Twenty three percent of the mule deer habitat in Unit 27 is comprised of pinyon-juniper woodlands according to the current LANDFIRE Existing Vegetation Type model (**Table 6.1**). These woodlands are usually located at lower elevations. Although abundance may vary widely, these woodlands can be associated with understory browse species known to be beneficial to mule deer. Pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) woodlands can provide wildlife with thermal cover and valuable escape. When these trees encroach on existing shrublands, however, they can lead to decreased sagebrush (*Artemisia spp.*) and herbaceous components (Miller, Svejcar, & Rose, 2000), therefore decreasing available forage for wildlife.

The model also indicates that sagebrush shrublands and steppe comprise nearly 16.5% of the Paunsaugunt unit's mule deer habitat (**Table 6.1**). These sagebrush biophysical sites can be found at elevations ranging from low (semidesert) to high (mountain and subalpine). Sagebrush species typically dominate these biophysical sites across the elevation gradient, and may provide valuable browse for deer when they are present on winter range. However, other preferred browse species may be present in lesser amounts. At higher elevations, these biophysical sites are often host to abundant herbaceous understories that could provide forage for mule deer during the summer months. Pinyon and juniper may be present at lower to middle elevations on some biophysical sites. Just over 9% of the unit's mule deer habitat is occupied by sparsely vegetated, developed, and agricultural areas according to the model: these types may have less value for deer when compared with more productive vegetation types.

The rest of the mule deer habitat within Unit 27 is comprised of a variety of other vegetation types (**Table 6.1**) that will not be discussed here. Descriptions for these additional vegetation types are available on the LANDFIRE BpS Models and Descriptions Support webpage. (The Nature Conservancy LANDFIRE Team, 2023)

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	274,453	39.86%	
	Southern Rocky Mountain Ponderosa Pine Woodland	49,771	7.23%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	29,987	4.36%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	10,626	1.54%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	3,128	0.45%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	2,315	0.34%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	774	0.11%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	613	0.09%	
	Great Basin Pinyon-Juniper Woodland	558	0.08%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	16	0.00%	54.06%
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	89,386	12.98%	
	Colorado Plateau Pinyon-Juniper Shrubland	58,067	8.43%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	17,230	2.50%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	15,263	2.22%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	13,867	2.01%	
	Inter-Mountain Basins Montane Sagebrush Steppe	10,137	1.47%	
	Rocky Mountain Lower Montane-Foothill Shrubland	7,813	1.13%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	5,443	0.79%	
	Colorado Plateau Blackbrush-Mormon-tea Shrubland	2,051	0.30%	
	Southern Colorado Plateau Sand Shrubland	1,776	0.26%	
	Inter-Mountain Basins Greasewood Flat	399	0.06%	
	Inter-Mountain Basins Mat Saltbush Shrubland	267	0.04%	32.20%
Other	Sparsely Vegetated	42,263	6.14%	
	Developed	14,425	2.10%	
	Agricultural	5,508	0.80%	
	Riparian	5,205	0.76%	
	Open Water	393	0.06%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	99	0.01%	9.86%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	9,967	1.45%	
	Interior Western North American Temperate Ruderal Shrubland	1,311	0.19	1.64%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	2,505	0.36%	
	Great Basin & Intermountain Introduced Annual Grassland	2,258	0.33%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	2,062	0.30%	
	Interior Western North American Temperate Ruderal Grassland	1,020	0.15%	1.14%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	3,212	0.47%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	1,178	0.17%	
	Southern Rocky Mountain Montane-Subalpine Grassland	692	0.10%	0.74%
Hardwood	Rocky Mountain Aspen Forest and Woodland	1,188	0.17	
	Rocky Mountain Bigtooth Maple Ravine Woodland	1,319	0.19	0.36
Total		**688,547**	**100%**	**100%**

Table 6.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 27, Paunsaugunt.



Map 6.6: Land coverage of fires by year from prior to 1970-2023 for WMU 27, Paunsaugunt (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

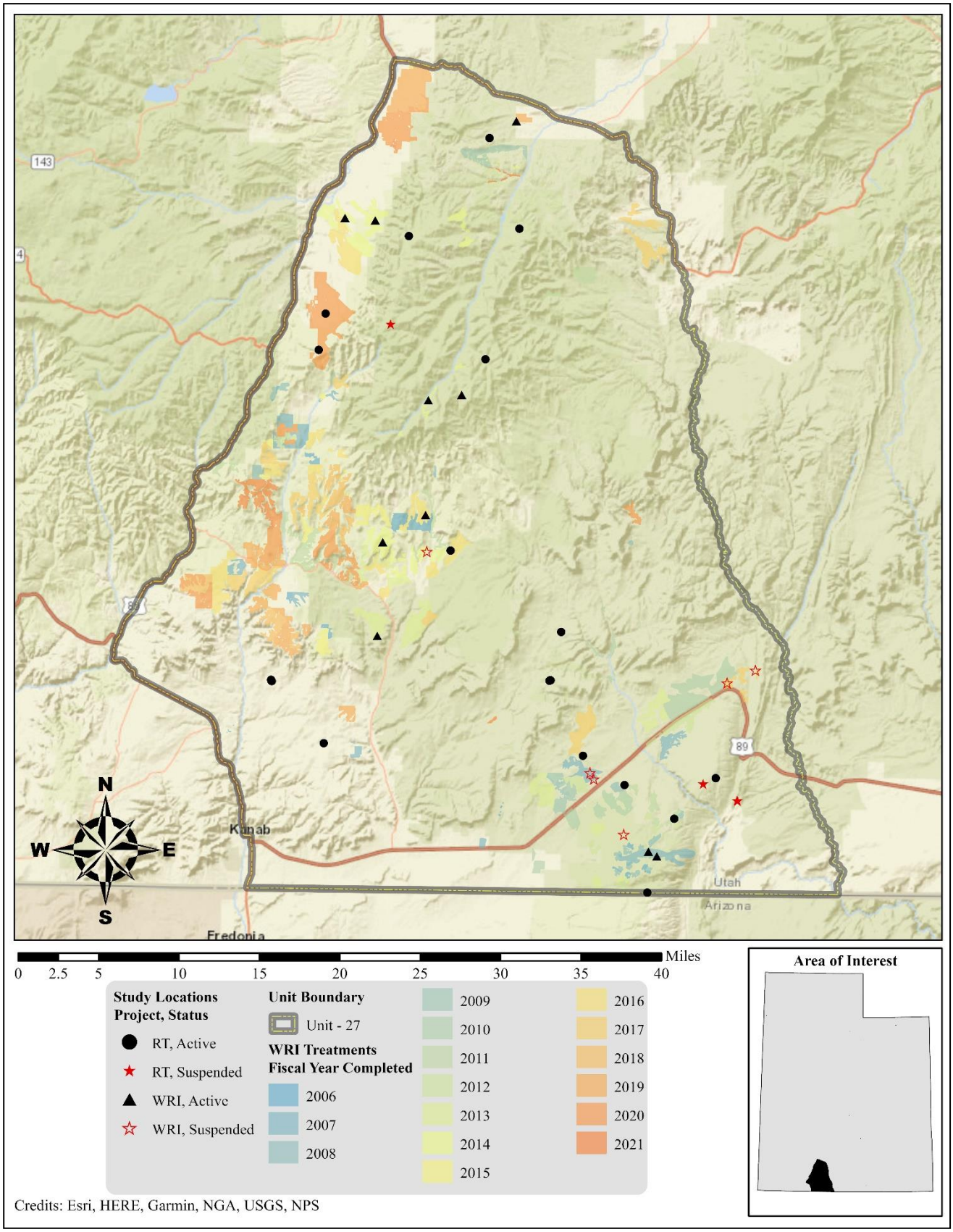
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 93,863 acres of land have been treated within the Paunsaugunt unit since the WRI was implemented in 2004 (**Map 6.7**). Treatments frequently overlap one another, bringing the net total of treated land area to 80,717 acres for this unit. Other treatments have occurred outside of the WRI through independent agencies and landowners, but the WRI comprises the majority of work done on deer winter ranges throughout the state of Utah.

The most common management practice in the Paunsaugunt unit is manual vegetation removal (through methods such as lop and scatter and lop-pile-burn) to remove pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) trees. Other tree-removing management techniques such as bullhog and anchor chaining are also commonly used. Additional management practices include (but are not limited to) seeding plants to augment the herbaceous understory, harrowing, seeding plants to enhance shrub communities, mowing, and prescribed fire (**Table 6.2**).

Type	Total Completed Acreage
Anchor Chain	**16,323**
Ely (One-Way)	3,226
Ely (Two-Way)	12,799
Smooth (Two-Way)	298
Bulldozing	**911**
Tree Push	911
Bullhog	**22,216**
Full Size	19,595
Skid Steer	2,621
Chain Harrow	**242**
> 15 ft. (Two-Way)	242
Disc	**1,834**
Off-Set (One-Way)	796
Plow (One-Way)	1,038
Forestry Practices	**118**
Coppice Cutting	22
Thinning (Commercial)	44
Group Selection Cuts	52
Harrow	**4,259**
≤ 15 ft. (One-Way)	3,590
≤ 15 ft. (Two-Way)	512
> 15 ft. (Two-Way)	157
Herbicide Application	**475**
Aerial (Fixed-Wing)	280
Ground	195
Mowing	**1,978**
Brush Hog	175
Other	1,802
Prescribed Fire	**1,478**
Prescribed Fire	1,478
Seeding (Primary)	**5,411**
Broadcast (Aerial-Fixed Wing)	3,689
Broadcast (Aerial-Helicopter)	263
Drill (Rangeland)	1,220
Ground (Mechanical Application)	220
Hand Seeding	19
Seeding (Secondary/Shrub)	**2,602**
Broadcast (Aerial-Fixed Wing)	90
Ground (Mechanical Application)	1,159
Hand Seeding	1,354
Skid-Steer Mounted Tree Cutter	**1,018**
Hydraulic Shears	1,018
Vegetation Removal/Hand Crew	**34,515**
Lop & Scatter	33,873
Lop-Pile-Burn	642
Other	**482**
Road Decommissioning	482
Grand Total	**93,863**
***Total Land Area Treated**	**80,717**

Table 6.2: WRI treatment action size (acres) of completed projects for WMU 27, Paunsaugunt. Data accessed on 02/07/2024.
*Does not include overlapping treatments.



Map 6.7: Terrestrial WRI treatments by fiscal year completed for WMU 27, Paunsaugunt.

Range Trend Studies

Range Trend studies have been sampled within WMU 27 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (**Table 6.3**). Due to changes in sampling methodologies, only data collected following the 1992 sample year is included in this summary. Monitoring studies of Watershed Restoration Initiative (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
27-01	Proctor Canyon	RT	Active	1987, 1992, 1997, 2003, 2008, 2013, 2018, 2023	Mountain Stony Loam (Antelope Bitterbrush)
27-02	Ahlstrom Hollow	RT	Active	1987, 1992, 1997, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Black Sagebrush)
27-03	Whiteman Bench	RT	Active	1987, 1992, 1997, 2003, 2008, 2013, 2018, 2023	Mountain Shallow Loam (Ponderosa Pine)
27-04	Sand Pass	RT	Suspended	1987, 1992, 1997, 2003	High Mountain Stony Loam (Mixed Conifer)
27-05	Podunk Creek	RT	Active	1987, 1992, 1997, 2003, 2008, 2013, 2018, 2023	Semiwet (Fresh Meadow)
27-06	Nephi Pasture I	RT	Active	1987, 1992, 1997, 2003, 2008, 2013, 2018, 2023	Upland Sand (Mountain Big Sagebrush)
27-07	Nephi Pasture Exclosure Outside	RT	Active	1987, 1992, 1997, 1998, 2003, 2008, 2013, 2018, 2023	Upland Sand (Mountain Big Sagebrush)
27-08	Fivemile Mountain	RT	Active	1987, 1992, 1997, 2003, 2008, 2013, 2018, 2023	Semidesert Shallow Loam (Black Sagebrush)
27-09	Buckskin Mountain	RT	Active	1997, 2003, 2008, 2013, 2018, 2023	Upland Shallow Loam (Cliffrose)
27-10	Telegraph Flat	RT	Active	1997, 2003, 2008, 2013, 2018, 2023	Upland Shallow Loam (Cliffrose)
27-11	Crocodile	RT	Active	1997, 2003, 2008, 2013, 2018, 2023	Upland Sand (Mountain Big Sagebrush)
27-12	Moons Landing	RT	Active	1997, 2003, 2008, 2013, 2018, 2023	Mountain Stony Loam (Antelope Bitterbrush)
27-13	Heaton	RT	Active	1997, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Black Sagebrush)
27-14	Mustang Pond South	RT	Active	2013, 2018, 2023	Upland Shallow Loam (Cliffrose)
27-15	Jeppson Pond	RT	Active	2018, 2023	Upland Shallow Loam (Cliffrose)
27-16	Carly Knoll	RT	Active	2018, 2023	Upland Loam (Mountain Big Sagebrush)
27R-01	John R. Flat Total Exclosure	RT	Active	1998, 2003, 2008, 2018	Upland Sand (Mountain Big Sagebrush)
27R-02	John R. Flat Livestock Exclosure	RT	Active	1998, 2003, 2008, 2018	Upland Sand (Mountain Big Sagebrush)
27R-03	John R. Flat Exclosure Outside	RT	Active	1998, 2003, 2008, 2018, 2023	Upland Sand (Mountain Big Sagebrush)
27R-04	Nephi Pasture Total Exclosure	RT	Active	1998, 2003, 2008, 2013, 2023	Upland Sand (Mountain Big Sagebrush)
27R-05	Nephi Pasture Livestock Exclosure	RT	Active	1998, 2003, 2008, 2013, 2023	Upland Sand (Mountain Big Sagebrush)
27R-08	Five Mile Mountain Outside	RT	Suspended	1998	Semidesert Shallow Loam (Black Sagebrush/Indian Ricegrass)
27R-09	Five Mile Mountain Exc.	RT	Suspended	1998	Not Verified
27R-10	Cockscomb Exclosure	RT	Suspended	1998	Not Verified

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
27R-11	Cockscomb Outside	RT	Suspended	1998	Semidesert Sandy Loam (Fourwing Saltbush)
27R-12	Paria Road 1	WRI	Suspended	2004	Not Verified
27R-13	Paria Road 2	WRI	Suspended	2004	Not Verified
27R-14	Telegraph Flat 2	WRI	Suspended	2004	Upland Shallow Loam (Cliffrose)
27R-15	Telegraph Flat 1	WRI	Suspended	2004	Upland Shallow Loam (Cliffrose)
27R-16	Alton/Millcreek LS	WRI	Suspended	2005, 2012	Upland Loam (Mountain Big Sagebrush)
27R-17	Buckskin 2	WRI	Active	2005, 2008, 2013, 2017, 2022	Upland Shallow Loam (Cliffrose)
27R-18	Buckskin 1	WRI	Active	2005, 2008, 2013, 2017, 2022	Upland Shallow Loam (Cliffrose)
27R-19	Alton-Millcreek 2	WRI	Active	2007, 2010, 2014, 2019	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
27R-20	Hatch Bench	WRI	Active	2012, 2015, 2019	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
27R-21	Buckskin Lop and Scatter	WRI	Suspended	2012	Not Verified
27R-22	Pine Point Handthin	WRI	Active	2012, 2015, 2019	Upland Loam (Mountain Big Sagebrush)
27R-23	UKC Thompson Creek	WRI	Active	2013, 2016, 2023	Mountain Loam (Oak)
27R-24	Hatch Bench 2	WRI	Active	2013, 2016, 2020	Upland Loam (Black Sagebrush)
27R-25	Sieler Creek	WRI	Active	2013, 2016, 2022	High Mountain Loam (Aspen)
27R-26	Crawford Creek	WRI	Active	2016, 2021	High Mountain Loam (Aspen)
27R-27	Johnson Bench	WRI	Active	2018, 2021	Upland Loam (Black Sagebrush)

Table 6.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 27, Paunsaugunt.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
27-02	Ahlstrom Hollow	Wildfire		Between 1997 and 2002		
27-03	Whiteman Bench	Logging/Clear-Cut		Historic		
27-05	Podunk Creek	Contour Trench		1960s		
		Seed Unknown		1960s		
27-09	Buckskin Mountain	Wildfire	Pine Hollow	July-September 2020	11,405	
		Aerial Before	Wire Pass/Pine Hollow Fire ESR	December 2020	3,015	5498
		Two-Way Ely	Wire Pass/Pine Hollow Fire ESR	December 2020-March 2021	1,235	5498
		Aerial After	Wire Pass/Pine Hollow Fire ESR	Spring 2021	3,917	5498
27-10	Telegraph Flat	Two-Way Ely	Jenny Clay Flex Harrow	December 2017-February 2018	1,342	3786
		Aerial Before	Jenny Clay Flex Harrow	December 2017-February 2018	1,342	3786
		Two-Way Chain	Clay Hole Chaining	1966		
		Unknown				
		Aerial Before	Clay Hole Chaining	1966		
		Lop and Scatter	Five Mile Mountain Habitat Restoration Phase III	Fall 2008-Spring 2009	1,043	1169
27-11	Crocodile	Seed Unknown		1960s		
27-12	Moons Landing	Two-Way Chain	Sevy Bench Habitat Improvement Project	November 2020	242	4958
		Aerial Before	Sevy Bench Habitat Improvement Project	October 2020	242	4958
27-13	Heaton	Lop and Scatter	Sevy Bench Habitat Improvement Project	September 2019-Spring 2020	4,406	4958
		Seed Unknown		Historic		
		Double Drum		Between 1997 and 2003		
		Herbicide Unknown		Between 2003 and 2008		
27-14	Mustang Pond South	Lop and Scatter	Buckskin Lop and Scatter FY12	September-December 2011	604	2002

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
27-15	Jeppson Pond	Lop and Scatter	Buckskin Lop and Scatter	August-December 2008	500	823
27-16	Carly Knoll	Aerial Before	UKC - Carly Knoll/Mill Creek	Winter 2015-Spring 2016	548	3279
		Aerial After	UKC - Carly Knoll/Mill Creek	Winter 2016	548	3279
		Bullhog	UKC - Carly Knoll/Mill Creek	Winter 2015-2016	548	3279
27R-13	Paria Road 2	One-Way Chain	Cockscomb Vegetation Enhancement Project	February-March 2018	400	3737
		Broadcast Before	Cockscomb Vegetation Enhancement Project	February-March 2018	400	3737
27R-14	Telegraph Flat 2	One-Way Dixie	Fivemile GSENM Habitat Restoration Complex Year 1	December 2006-January 2007	1,219	124
		Broadcast Before	Fivemile GSENM Habitat Restoration Complex Year 1	December 2006-January 2007	1,219	124
27R-15	Telegraph Flat 1	One-Way Dixie	Fivemile GSENM Habitat Restoration Complex Year 1	December 2006-January 2007	1,219	124
		Broadcast Before	Fivemile GSENM Habitat Restoration Complex Year 1	December 2006-January 2007	1,219	124
27R-16	Alton/Millcreek LS	Push	Alton/Millcreek	2009-2011		Private
		Seed Unknown	Alton/Millcreek	2009-2011		Private
27R-17	Buckskin 2	Lop and Scatter	Buckskin P-J Thinning 2005	November 2005	882	112
		Aerial	Buckskin P-J Thinning 2005	November 2005	418	112
		Wildfire	Buckskin	June 2006	1,437	
		One-Way Ely	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	November-December 2006	1,437	453
		Aerial Before	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	November 2006	1,437	453
		Aerial After	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	February 2007	1,437	453
27R-18	Buckskin 1	Wildfire	Buckskin	June 2006	1,437	
		One-Way Ely	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	November-December 2006	1,437	453
		Aerial Before	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	November 2006	1,437	453
		Aerial After	Lower Buckskin Telephone Wash Sagebrush Restoration Year 1	February 2007	1,437	453
27R-19	Alton-Millcreek 2	Lop and Scatter	Alton/Mill Creek Sagebrush Restoration - Year 1	December 2005-February 2006	1,630	188
		Bullhog	Alton/Mill Creek Sagebrush Restoration - Year 3	October 2008-February 2009	912	900
		Aerial Before	Mill Creek Aerial Seeding	October 2008	912	1313
27R-20	Hatch Bench	Lop and Scatter	Hatch Bench Vegetation Enhancement Phase II	July 2013-January 2015	2,990	2690
		Two-Way Ely	Hatch Bench Vegetation Enhancement Phase I	September-October 2012	1,134	2069
		Aerial Before	Hatch Bench Vegetation Enhancement Phase I	September 2012	1,134	2069
		Dribbler	Hatch Bench Vegetation Enhancement Phase I	September 2012	1,134	2069
		Aerial After	Hatch Bench Vegetation Enhancement Phase I	January 2013	1,134	2069
27R-22	Pine Point Handthin	Lop and Scatter	Pine Point Handthin	December 2012-May 2013	2,525	2359
		Aerial Before	Pine Point Handthin	November 2012	2,525	2359
27R-23	UKC Thompson Creek	Aerial After	UKC Thompson Creek	January 2015	959	2701
		Two-Way Ely	UKC Thompson Creek	September-November 2014	959	2701
		Aerial Before	UKC Thompson Creek	September 2014	959	2701
27R-24	Hatch Bench 2	Lop and Scatter	Hatch Bench Vegetation Enhancement Phase II	Fall 2014	2,989	2690
27R-25	Sieler Creek	Lop-Pile-Burn	Sieler Stewardship	August-September 2014	70	2716
		Coppice Cutting	Sieler Stewardship	October-June 2014-2015	70	2716
27R-26	Crawford Creek	Selective	Paunsaugunt Boreal Toad Habitat Improvement Project	2016-2019	28	3631

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
27R-27	Johnson Bench	Two-Way Chain Harrow	Johnson Bench UPD Habitat Enhancement Phase II	October 2018-May 2019	243	4429
		Aerial Before	Johnson Bench UPD Habitat Enhancement Phase II	October 2018	243	4429
		Spike		2015	270	

Table 6.4: Range Trend and WRI studies known disturbance history for WMU 27, Paunsaugunt. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Ecotypes that are represented by only one study site throughout most or all of the sample period are not discussed in this section. These ectoypes include:

- Mountain (Mixed Conifer) - Sand Pass (27-04) (suspended)
- Semidesert (Black Sagebrush/Indian Ricegrass) - Five Mile Mountain Outside (27R-08) (suspended)
- Semidesert (Black Sagebrush) - Fivemile Mountain (27-08)
- Semidesert (Fourwing Saltbush) - Cockscomb Outside (27R-11) (suspended)
- Semiwet (Fresh Meadow) - Podunk Creek (27-05)

Trend summaries and/or data for these ecotypes are available in the corresponding site reports.

Mountain (Black/Low Sagebrush)

Two studies [Ahlstrom Hollow (27-02) and Heaton (27-13)] are considered to be Mountain (Black/Low Sagebrush) ecological sites. The Ahlstrom Hollow study is situated between Ahlstrom Hollow and SR-12. Heaton is located east of US-89 on Heaton Ranch.

Shrubs/Trees: The shrubs on these ecological sites are diverse and abundant with black sagebrush (*Artemisia nova*) providing a majority of the cover. Sagebrush cover has increased over time, particularly between 2018 and 2023. Other preferred browse cover has also displayed an increasing trend that is largely driven by antelope bitterbrush (*Purshia tridentata*) on the Heaton study. Cover of other shrubs has also increased, resulting in a generally increasing trend overall (**Figure 6.8**). Average density of preferred browse has decreased over time; the initial decrease between 1992 and 1997 was due to a decrease on Ahlstrom Hollow and the addition of the Heaton study. Mature plants have comprised a majority of the browse populations on these study sites. Both decadence and recruitment of young have decreased over the study period (**Figure 6.15**). Average preferred browse utilization shows that use on these sites has generally increased over time; 16% of plants were heavily browsed and 20% showed signs of moderate use in 2023 (**Figure 6.17**).

Cover and density of Rocky Mountain juniper (*Juniperus scopulorum*) and twoneedle pinyon (*Pinus edulis*) have both increased over time. However, these trends are entirely driven by the Ahlstrom Hollow site, as trees have not been observed in cover or density data in any sample year on the Heaton study (**Figure 6.11**, **Figure 6.13**).

Herbaceous Understory: These sites support herbaceous communities that are primarily comprised of perennial grasses. Overall herbaceous cover has increased over time mainly due to increases in perennial grasses. In 2023, muttongrass (*Poa fendleriana*) provided the most cover of any perennial grass species on both study sites. Perennial and annual forbs have also been present, but to a lesser extent than perennial grasses. Nested frequency of herbaceous species has slightly increased overall. This increase can largely be attributed to an increase in the abundance of perennial forbs over time. Annual grasses have been observed in the understories of both sites, but in very low amounts (**Figure 6.19**, **Figure 6.21**).

Occupancy: Animal presence on these study sites has fluctuated, but has decreased overall. Average pellet transect data shows that cattle have been the primary occupants of these sites; mean abundance of cattle pellet groups has fluctuated between 26 days use/acre in 2023 and 65 days use/acre in 2008. Deer usage has also been variable with 16 days use/acre occurring in 2023 and 44 days use/acre observed in 2008. Finally, mean abundance of elk pellet groups has been as low as 0 days use/acre in 2023 and as high as 16 days use/acre in 2003 (**Figure 6.23**).

Mountain (Shrub)

Two study sites [Proctor Canyon (27-01) and Moons Landing (27-12)] are classified as Mountain (Shrub) ecological sites. The Proctor Canyon study is located south of Proctor Canyon near the Sunset Cliffs, while the Moons Landing site is situated east of US-89 on Heaton Ranch.

Shrubs/Trees: Antelope bitterbrush has contributed the most cover of any single shrub species on the Proctor Canyon study. Bitterbrush also provided a majority of the preferred browse cover on the Moons Landing study through 2018. However, bitterbrush cover decreased significantly on Moons Landing following a 2020 harrow and seeding treatment. Other preferred browse species on these sites have been numerous and altogether provided nearly as much average cover as bitterbrush through 2018, and more cover than bitterbrush during the most recent sampling. Total average shrub cover exhibited an overall increase through 2018, but decreased in 2023 due to the treatment on the Moons Landing study (**Figure 6.9**). Average density of preferred browse species showed an initial decrease between 1992 and 1997: this can be attributed to the establishment of the Moons Landing study and density decreases on Proctor Canyon. Despite a slight decrease between the two most recent samplings due to the previously discussed treatment, total average density has since increased overall. Mature plants have made up a majority of these populations in all sample years. Decadence within these preferred browse stands has remained low throughout the study period, but so has recruitment of young since 1997 (**Figure 6.15**). Average preferred browse utilization has fluctuated from year to year, but has decreased each sample year since 2013. In 2023, 16% of plants displayed signs of heavy browsing and 8% were moderately used (**Figure 6.17**).

Average tree cover has increased over time, a trend that is entirely driven by Rocky Mountain juniper (*Juniperus scopulorum*) on the Proctor Canyon study (**Figure 6.11**). Photos and point-quarter density data show that trees were present on both sites in 2018 and on Proctor Canyon in 2023. Average density has displayed an increase overall. Trees present in density measurements on Proctor Canyon besides Rocky Mountain juniper include ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) (**Figure 6.13**).

Herbaceous Understory: These study sites have remained dominated by a mixture of mainly native perennial grasses throughout the study period. Overall average herbaceous cover decreased between 1992 and 1997 due to the establishment of the Moons Landing site. However, cover has increased in subsequent sample years, and the significant increase between 2018 and 2023 can be attributed to the Moons Landing study (**Figure 6.19**). Total average nested frequency decreased from 1992 through 2018: this trend was in part driven by a decrease in the annual forb species Douglas' knotweed (*Polygonum douglasii*) and pygmyflower rockcress (*Androsace septentrionalis*) on Moons Landing. However, total herbaceous abundance increased to nearly 1992 levels between the two most recent sample years (**Figure 6.21**).

Occupancy: Average pellet transect data indicates that animal presence on these study sites exhibited an increase between 2003 and 2008, but has since decreased. This data also shows that deer are the primary occupants of these sites, with a mean abundance of pellet groups ranging from 34.5 days use/acre in 2023 to 102.5 days use/acre in 2008. Mean abundance of elk pellet groups has been as low as 1 days use/acre in 2003 and as high as 6 days use/acre in 2008. Cattle have also been present, with a mean abundance of pellet groups ranging from 11 days use/acre in 2003 to 17 days use/acre in 2013 (**Figure 6.23**).

Upland (Big Sagebrush)

Five study sites [Nephi Pasture I (27-06), Nephi Pasture Exclosure Outside (27-07), Crocodile (27-11), Carly Knoll (27-16), and John R. Flat Exclosure Outside (27R-03)] are considered to be Upland (Big Sagebrush) ecological sites. The Nephi Pasture study is situated north of US-89 on Nephi Pasture, and Nephi Pasture Exclosure Outside can be found south of the Nephi Pasture study. Crocodile is located east of John R. Flat and just north of Wygaret Terrace. The Carly Knoll study can be found on the lower south-facing slopes of Carly Knoll. Finally, the John R. Flat Exclosure Outside study is located north of Kanab on John R. Flat.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, Nephi Pasture I and Nephi Pasture Exclosure Outside have contributed data each year since 1992. Crocodile has provided data since 1997, and data for the John R. Flat Exclosure Outside site was collected in 1998, 2003, 2018, and 2023. Finally, the Carly Knoll study has contributed data since 2018.

Shrubs/Trees: Average shrub cover has exhibited an overall increase: this is due to both increases in cover on existing study sites and addition of new or reactivated studies. Sagebrush species (*Artemisia spp.*) contribute a significant amount of cover on these study sites. However, data shows that as a whole, other preferred browse species such as Utah serviceberry (*Amelanchier utahensis*) and antelope bitterbrush have provided a majority of the shrub cover throughout the sample period (**Figure 6.8**).

Preferred browse demographics indicate an overall decrease in total density, which may be due in part to a differing number of studies from year to year. Demographic data also shows that mature individuals have comprised a majority of the preferred browse populations in most sample years. In 2003 and 2008, however, decadent individuals were the most

abundant of any age class. Recruitment of young has remained low since 1997 (**Figure 6.16**). Average preferred browse utilization has fluctuated from year to year; over 50% of plants were moderately and/or heavily browsed in 1997 and 2013, while a majority of plants exhibited little or no use in other sample years. In 2023, 19% of plants were heavily used and 16% displayed signs of moderate browsing (**Figure 6.18**).

Average tree cover has increased overall with most of the cover being contributed by Utah juniper (*Juniperus osteosperma*). For this unit, Nephi Pasture I has had the most juniper cover of any study of this ecological type in most sample years (**Figure 6.12**). Average tree density has also exhibited an overall increase, although one should note that some studies have only been sampled in select years. The density increase between 2013 and 2018 can partially be attributed to the inclusion of the John R. Flat Exclosure Outside and Nephi Pasture I studies (which haven't been sampled regularly) and the addition of the Carly Knoll study (**Figure 6.14**).

Herbaceous Understory: Perennial grasses have comprised a majority of the herbaceous understories of these sites throughout the sample period. Overall herbaceous cover has increased over time. Much of the increase through 2018 was due to an increase in perennial forbs on the Nephi Pasture I, Nephi Pasture Exclosure Outside, and Carly Knoll studies. In addition, the increase in cover between the two most recent sample years can largely be ascribed to increases in perennial grass cover on John R. Flat Exclosure Outside, Carly Knoll, and Crocodile (**Figure 6.20**). Average nested frequency has fluctuated over time. However, some of these fluctuations are due in part to the difference in the number of studies read each year. Total average frequency increased between 2018 and 2023, a trend mainly driven by increases in perennial grasses and annual forbs (**Figure 6.22**).

Occupancy: Average pellet transect data shows that animal presence has varied over the sample years. Deer have been the primary occupants in all sample years, having a mean abundance ranging from 38 days use/acre in 2023 to 63 days use/acre in 2003. Elk were present in 2018 with an average pellet group abundance of 1 days use/acre, but were absent in all other sample years. Finally, the mean abundance of cattle pellet groups has been as low as 2 days use/acre in 2018 and as high as 11 days use/acre in 2003 (**Figure 6.24**).

Upland (Cliffrose)

Four studies [Buckskin Mountain (27-09), Telegraph Flat (27-10), Mustang Pond South (27-14), and Jeppson Pond (27-15)] are classified as Upland (Cliffrose) ecological sites. Buckskin Mountain is located on the Utah-Arizona border on Buckskin Mountain, and part of the transect lies in Arizona. The Telegraph Flat study can be found just south of the Vermilion Cliffs on Telegraph Flat. Mustang Pond South is situated on Buckskin Mountain, south of Kaibab Gulch. Jeppson Pond is located south of US-89 and just north of Buckskin Mountain.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, Buckskin Mountain and Telegraph Flat have provided data since 1997, while the Mustang Pond South study has contributed data since 2013. Finally, Jeppson Pond has provided data since it was established in 2018.

Shrubs/Trees: Average cover of shrubs on these study sites increased between the sample years 2003 and 2013, but average cover decreased in 2018 and remained similar in 2023. This decrease between 2013 and 2018 can largely be attributed to a decrease in Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and cliffrose (*Purshia stansburiana*) as a result of a chaining and seeding treatment on the Telegraph Flat study. Cliffrose contributed a moderate amount of cover through 2013. However, cliffrose cover decreased following a treatment on the Telegraph Flat study and fire on the Buckskin Mountain site. Other preferred browse species such as sagebrush have provided a majority of the shrub cover throughout the sample period. The increase in cover of shrubs other than preferred browse species between 2018 can largely be attributed to the establishment of the Jeppson Pond study (**Figure 6.10**). Average demographic data indicates that mature plants have comprised most of the preferred browse populations in a majority of the study years. Decadent individuals, however, were the most prevalent in 2008, a trend that was driven by the Buckskin Mountain study. Density of preferred browse has decreased overall. However, decadence marginally decreased and recruitment of young slightly increased between 2018 and 2023 (**Figure 6.16**). Average preferred browse utilization has fluctuated, with the percentage of plants heavily or moderately browsed being as low as 33.5% in 2023 and as high as 71.5% in 2008 (**Figure 6.18**).

Utah juniper has contributed most of the tree cover in all sample years. Average tree cover has exhibited an overall decrease, in part due to treatments on Telegraph Flat and the addition of the Mustang Pond South and Jeppson Pond studies. Furthermore, the significant decrease in tree cover between 2018 and 2023 was entirely due to the Buckskin Mountain site, which burned in 2020 (**Figure 6.12**). Average tree density increased overall between 2003 and 2018,

largely due to the establishment of additional studies. However, density decreased between the two most recent sample years, a trend that can again be attributed to the Buckskin Mountain study (**Figure 6.14**).

Herbaceous Understory: Annual grasses, mainly the introduced species cheatgrass (*Bromus tectorum*), have dominated the herbaceous understories of these sites. This trend is primarily driven by the Buckskin Mountain study, on which cheatgrass cover more than doubled between 2018 and 2023. Perennial grasses and perennial and annual forbs have been comparatively minor understory components throughout the study years. However, perennial forb and grass cover and frequency increased slightly during the most recent sample year due to the Buckskin Mountain and Telegraph Flat studies, respectively. Average annual forb abundance also increased over the same period, a trend that can mainly be attributed to the Buckskin Mountain, Telegraph Flat, and Jeppson Pond sites. Total average nested frequency and cover of annual species decreased overall through 2018, but increased in 2023 (**Figure 6.20**, **Figure 6.22**).

Occupancy: Average animal presence data indicates that occupancy has decreased over time and that deer are the primary occupants on these sites. Mean abundance of deer pellet groups has ranged from 37 days use/acre in 2023 to 65 days use/acre in 2008. Cattle have also been present, with an average pellet group abundance as low as 1 days use/acre in 2018 and as high as 10.5 days use/acre in 2003. Elk were present in 2003 and 2008 with a mean abundance of 0.3 days use/acre, but no pellet groups were observed in any other sample year (**Figure 6.24**).

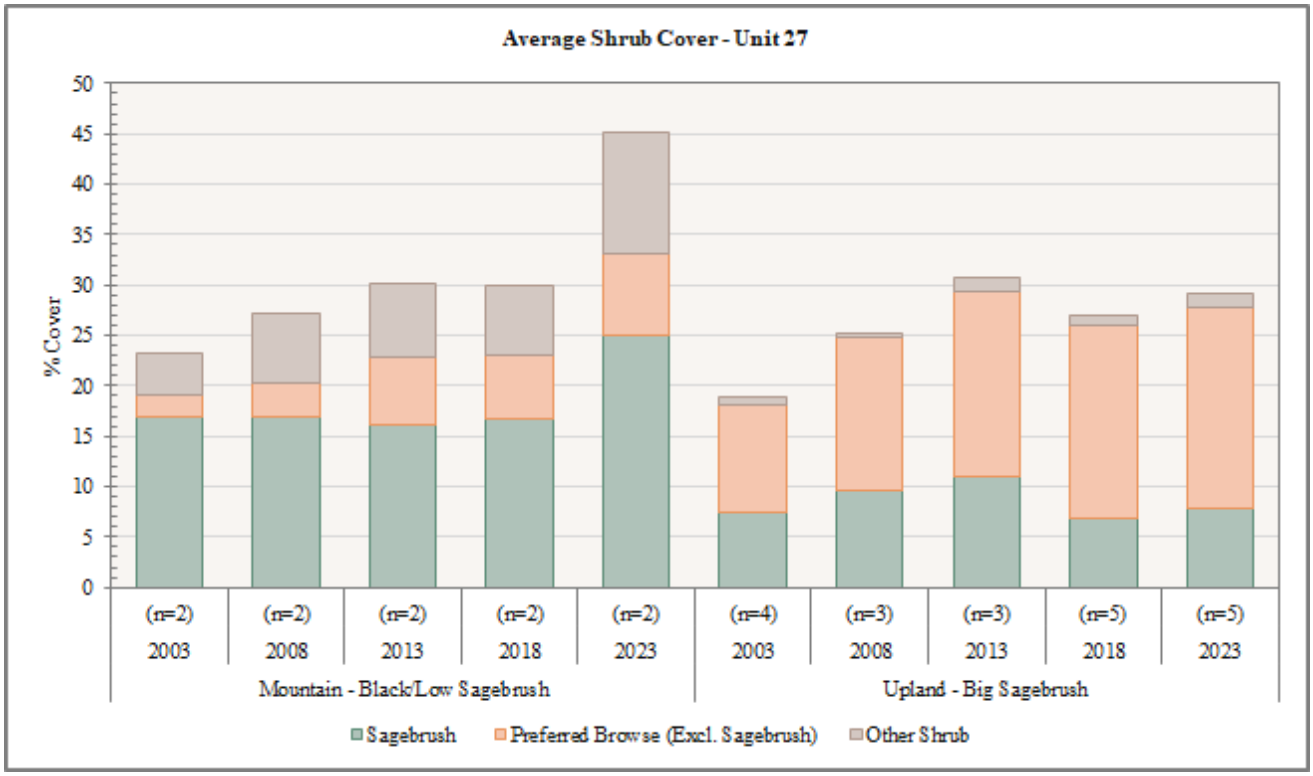


Figure 6.8: Average shrub cover for Mountain - Black/Low Sagebrush and Upland - Big Sagebrush study sites in WMU 27, Paunsaugunt.

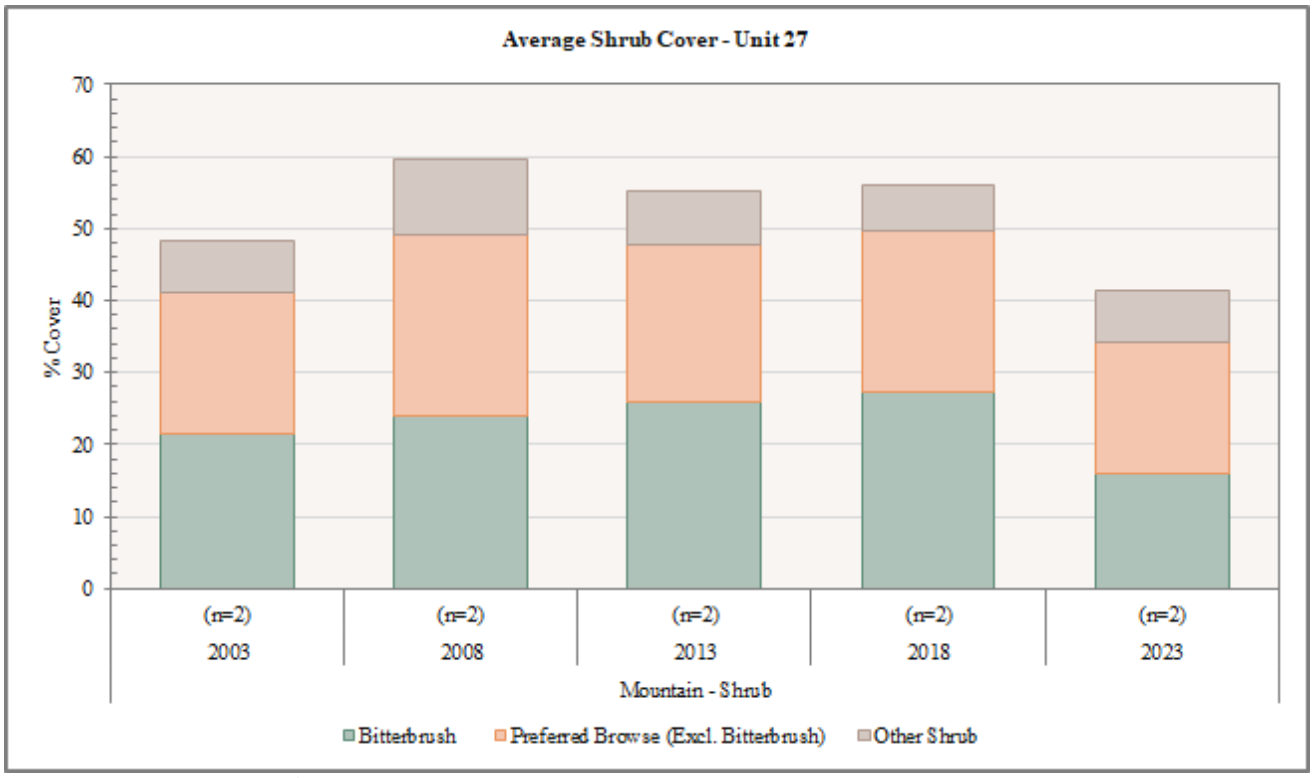


Figure 6.9: Average shrub cover for Mountain - Shrub study sites in WMU 27, Paunsaugunt.

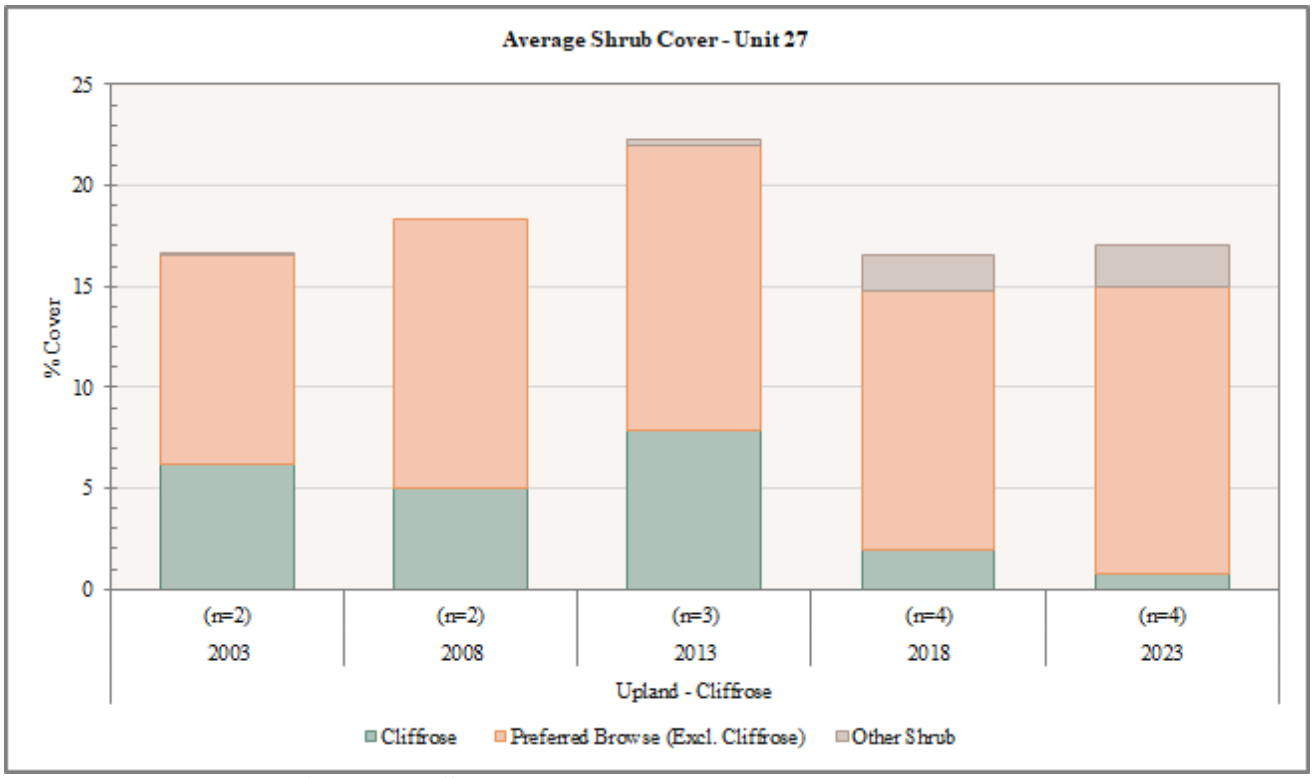


Figure 6.10: Average shrub cover for Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

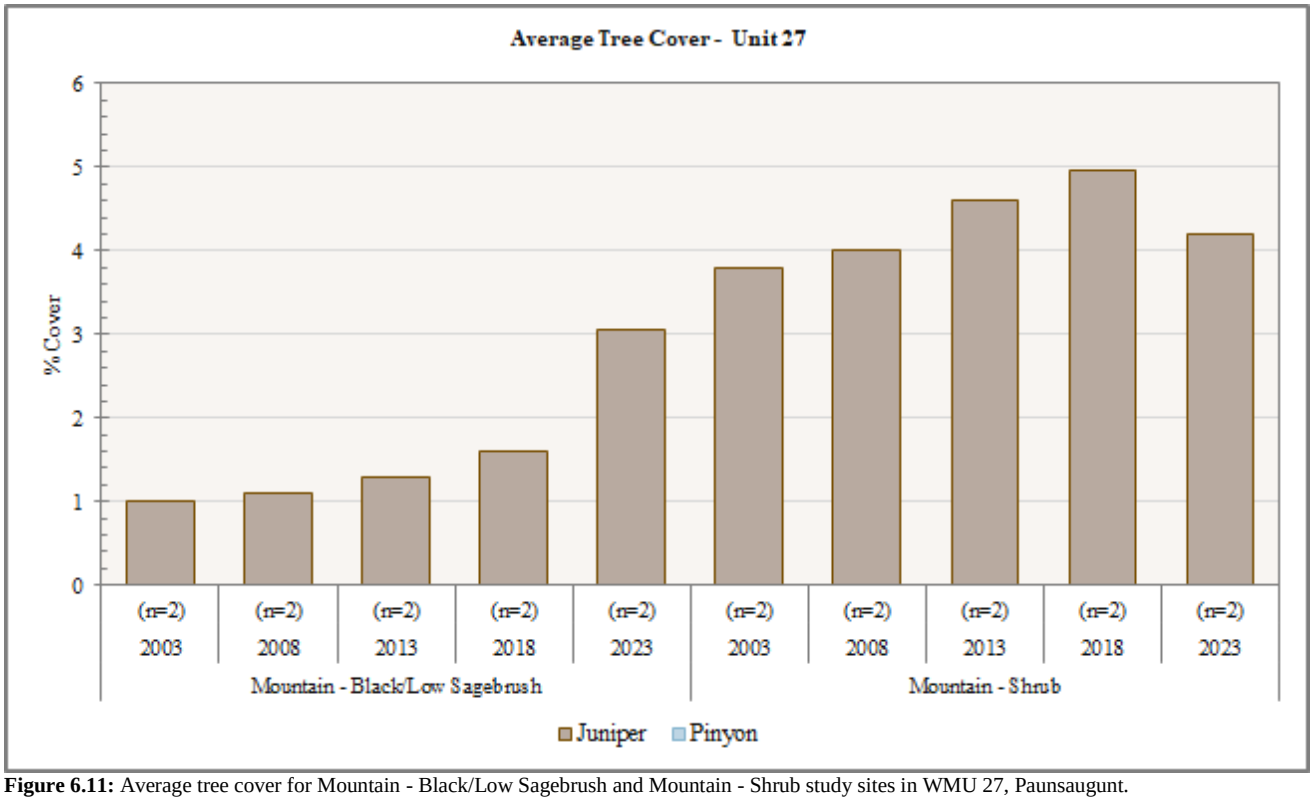


Figure 6.11: Average tree cover for Mountain - Black/Low Sagebrush and Mountain - Shrub study sites in WMU 27, Paunsaugunt.

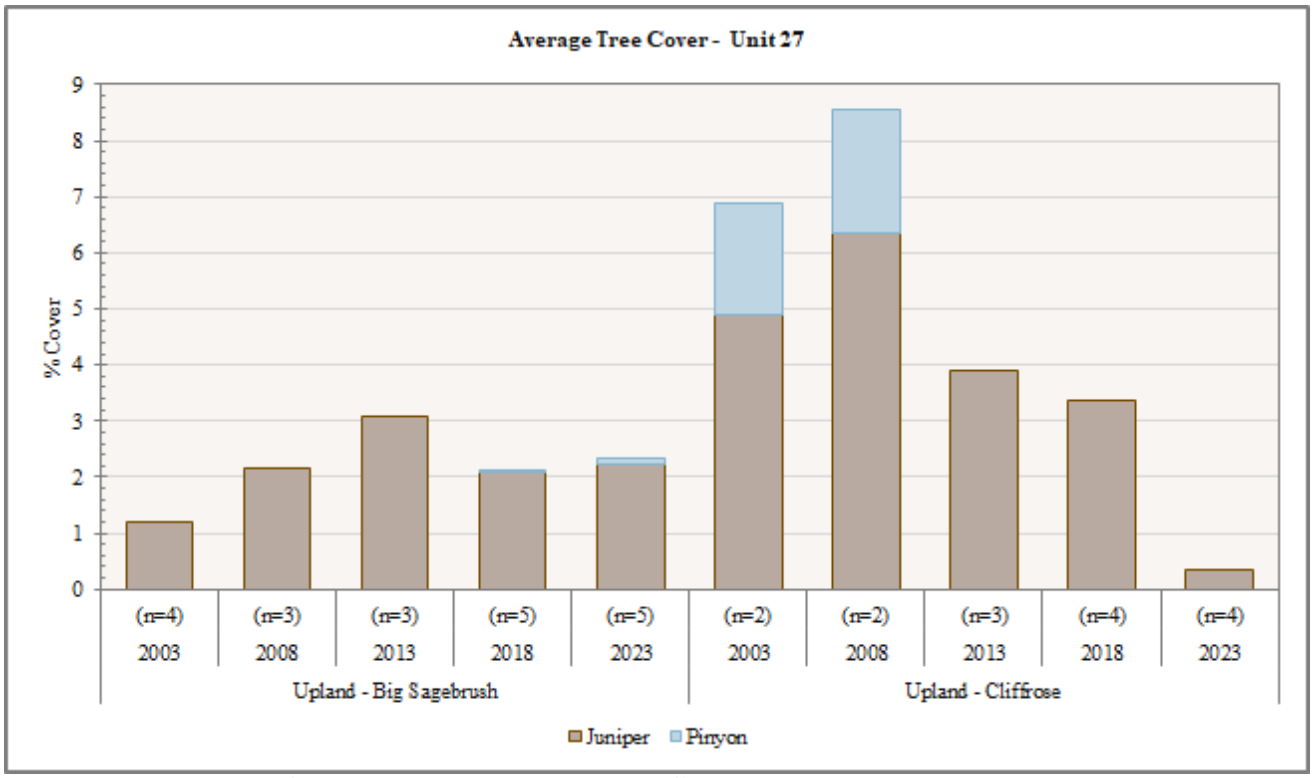


Figure 6.12: Average tree cover for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

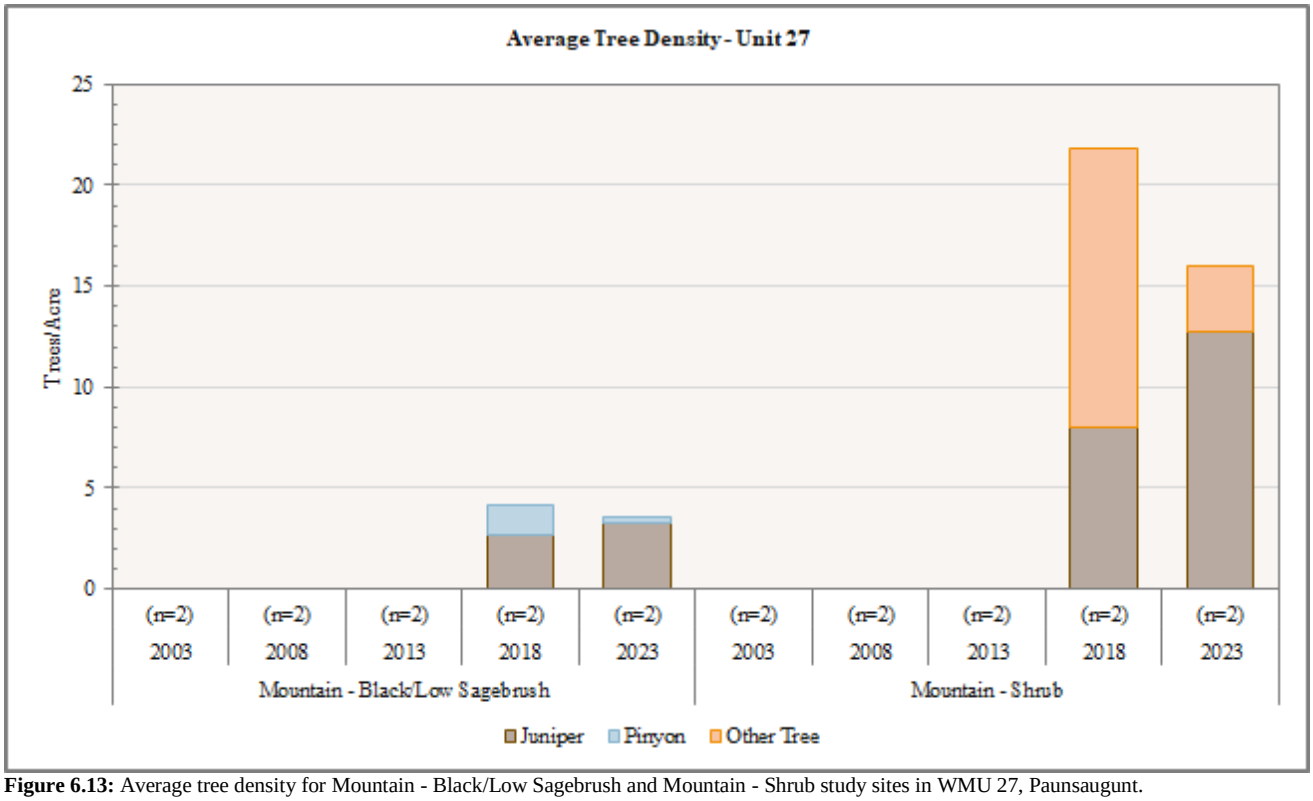


Figure 6.13: Average tree density for Mountain - Black/Low Sagebrush and Mountain - Shrub study sites in WMU 27, Paunsaugunt.

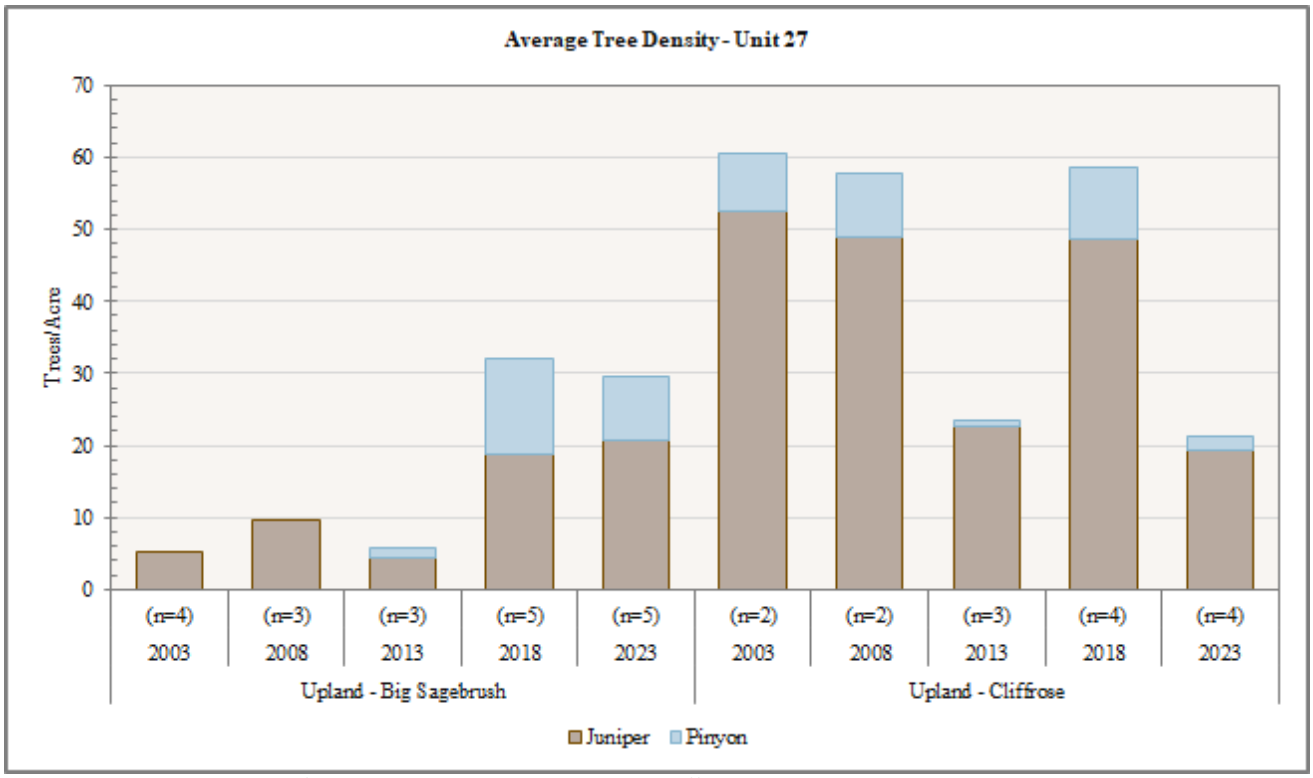


Figure 6.14: Average tree density for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

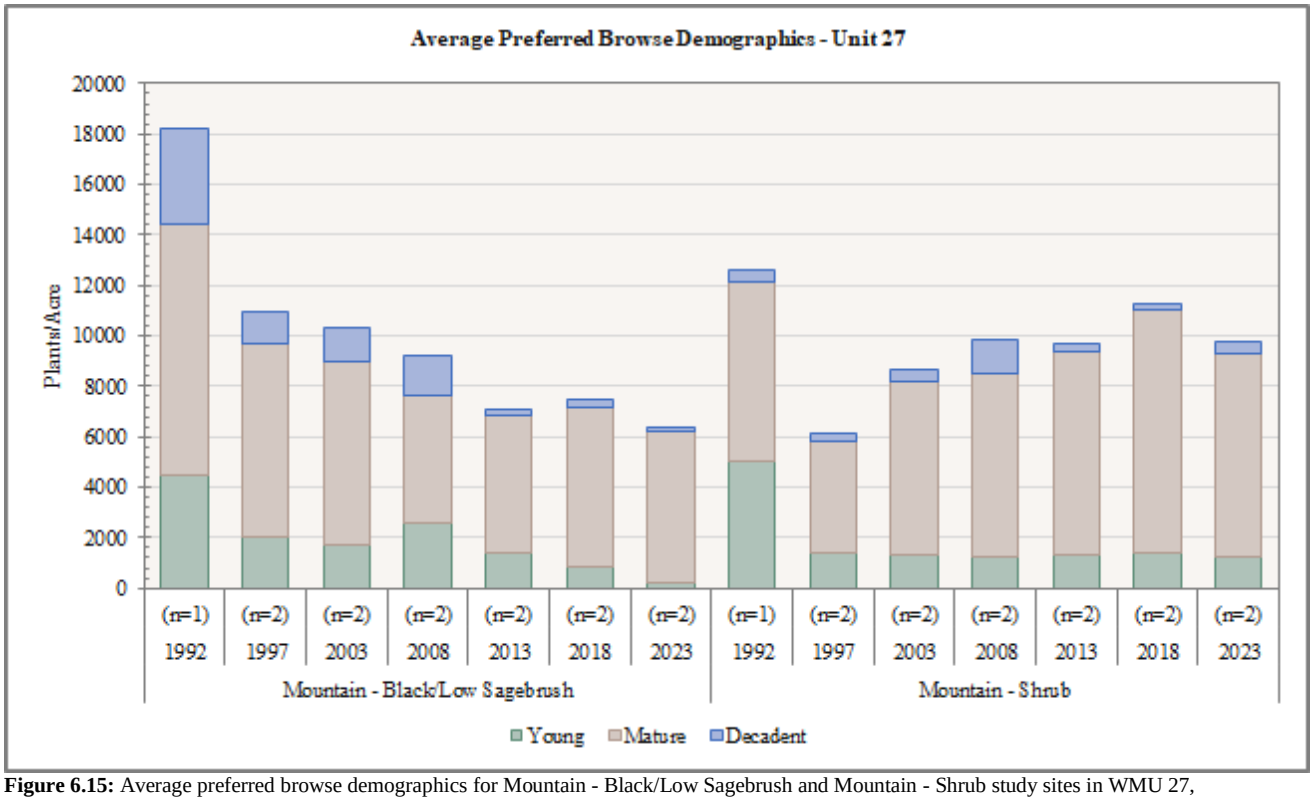


Figure 6.15: Average preferred browse demographics for Mountain - Black/Low Sagebrush and Mountain - Shrub study sites in WMU 27, Paunsaugunt.

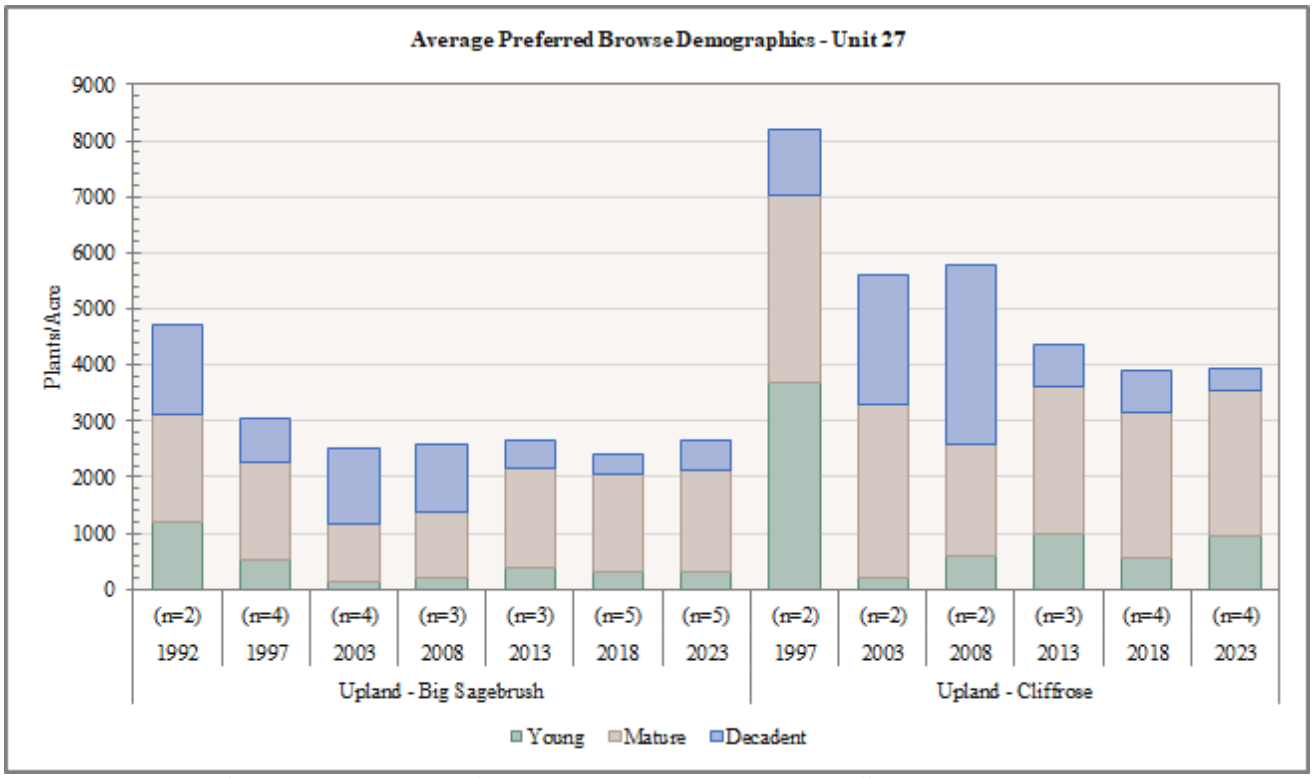


Figure 6.16: Average preferred browse demographics for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

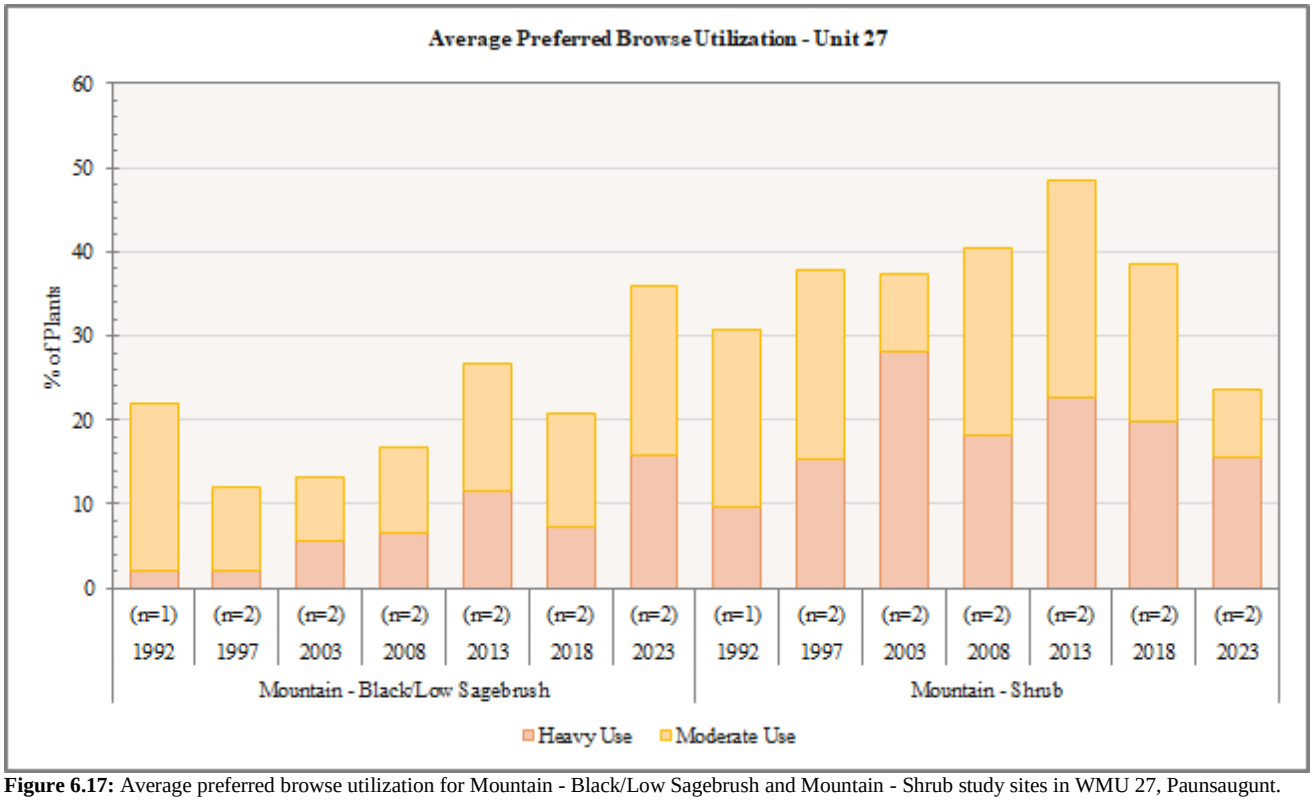


Figure 6.17: Average preferred browse utilization for Mountain - Black/Low Sagebrush and Mountain - Shrub study sites in WMU 27, Paunsaugunt.

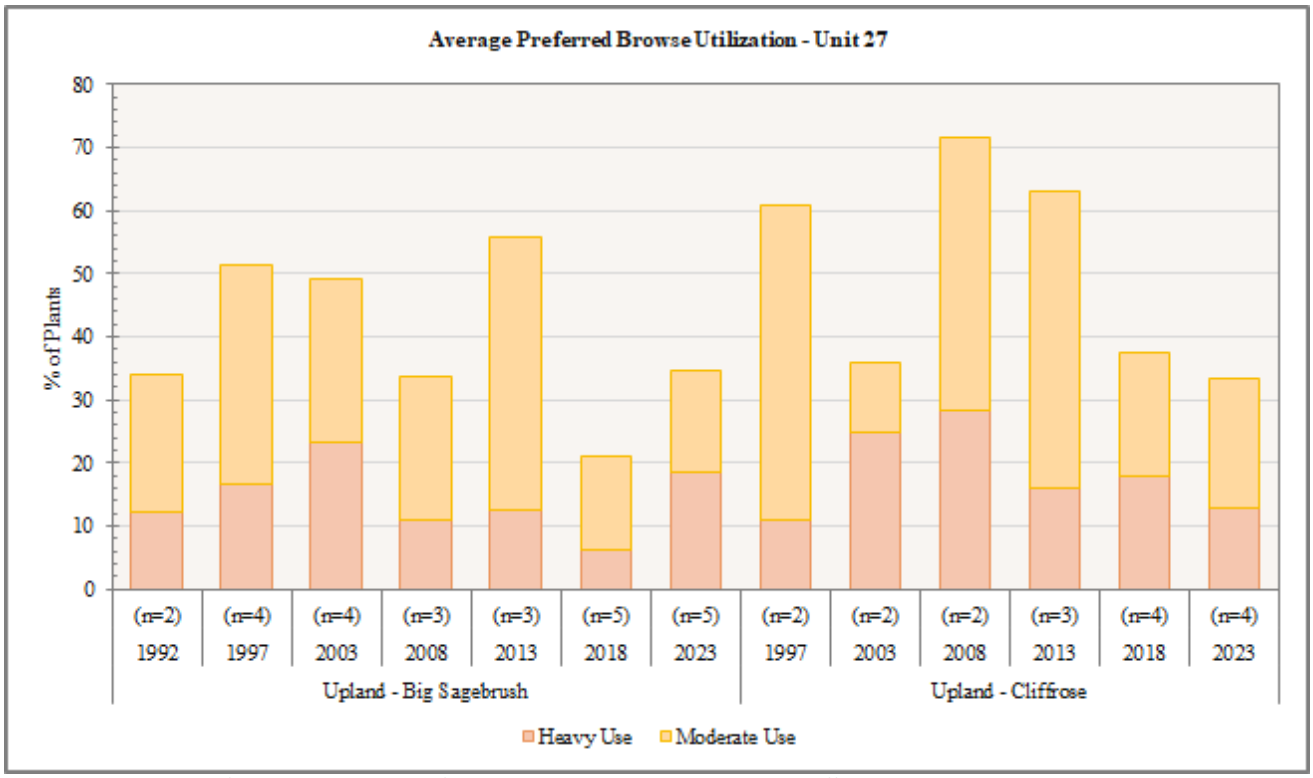


Figure 6.18: Average preferred browse utilization for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

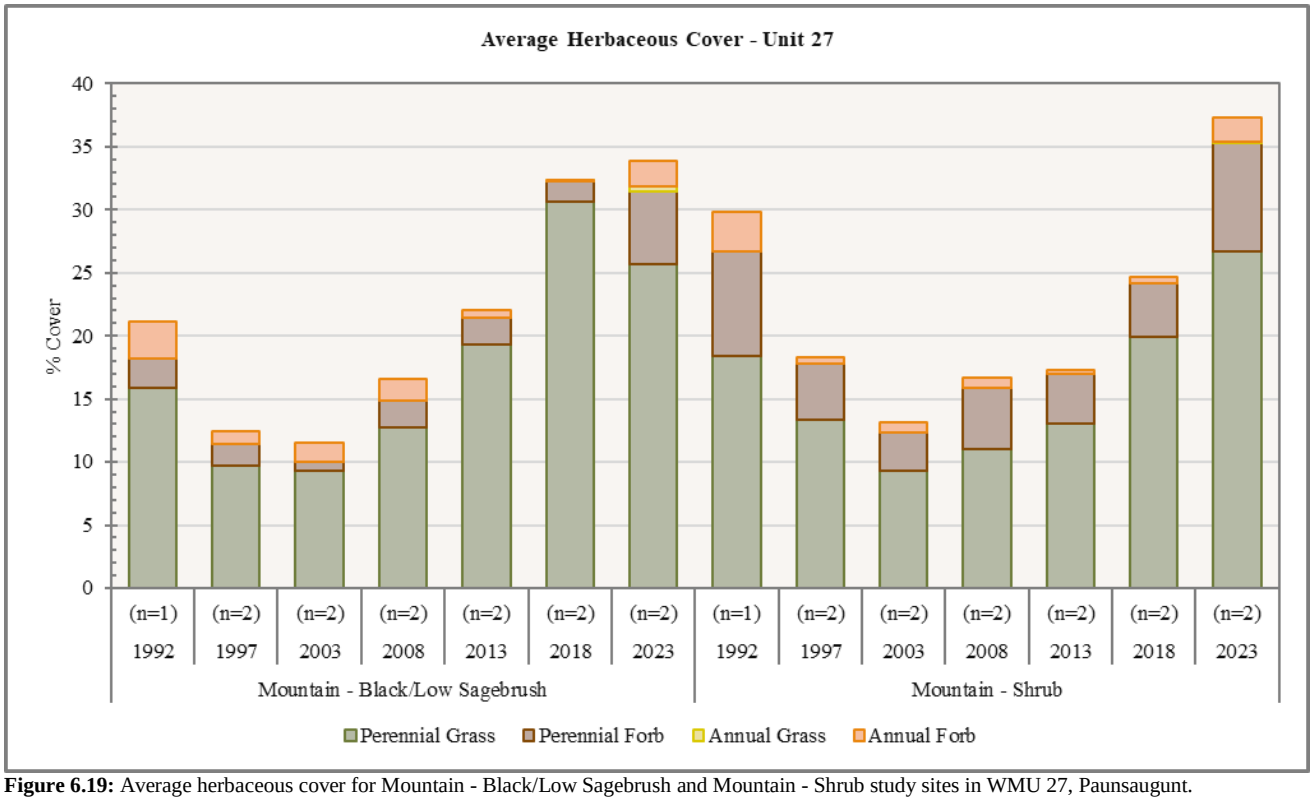


Figure 6.19: Average herbaceous cover for Mountain - Black/Low Sagebrush and Mountain - Shrub study sites in WMU 27, Paunsaugunt.

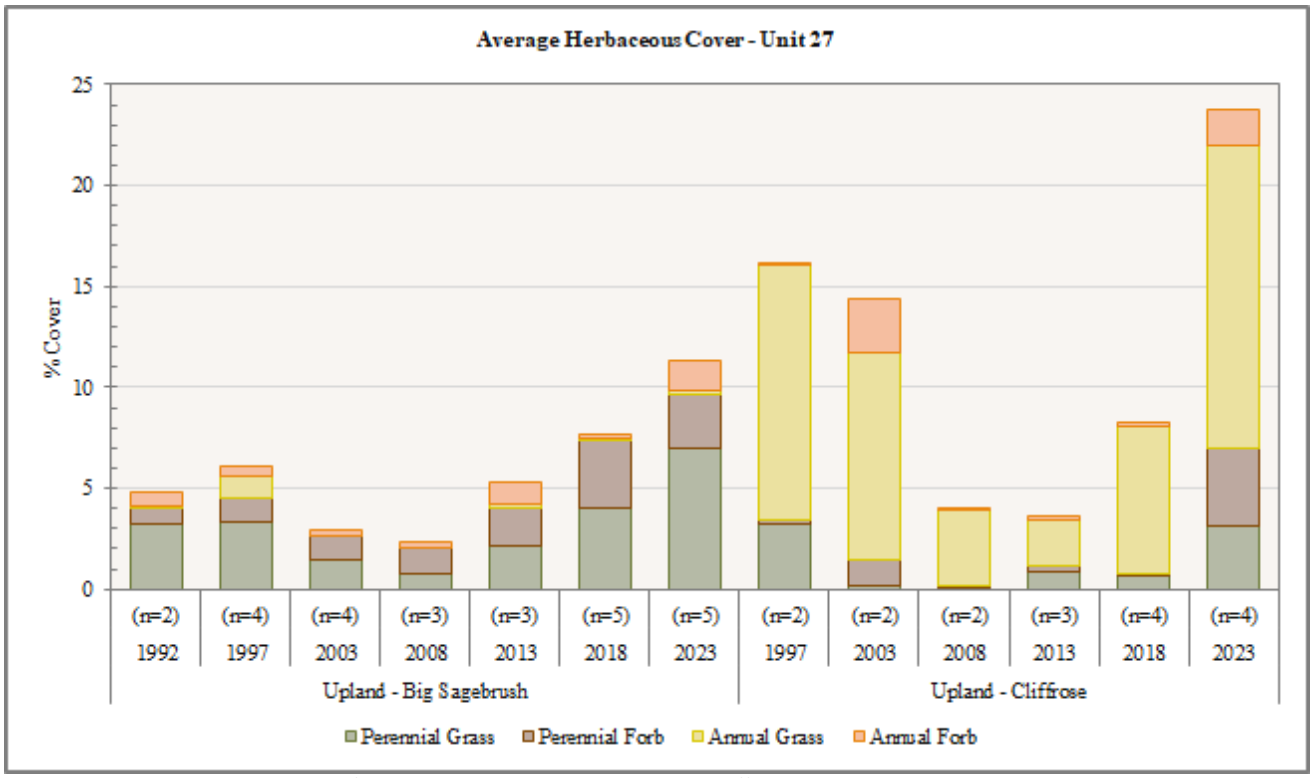


Figure 6.20: Average herbaceous cover for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

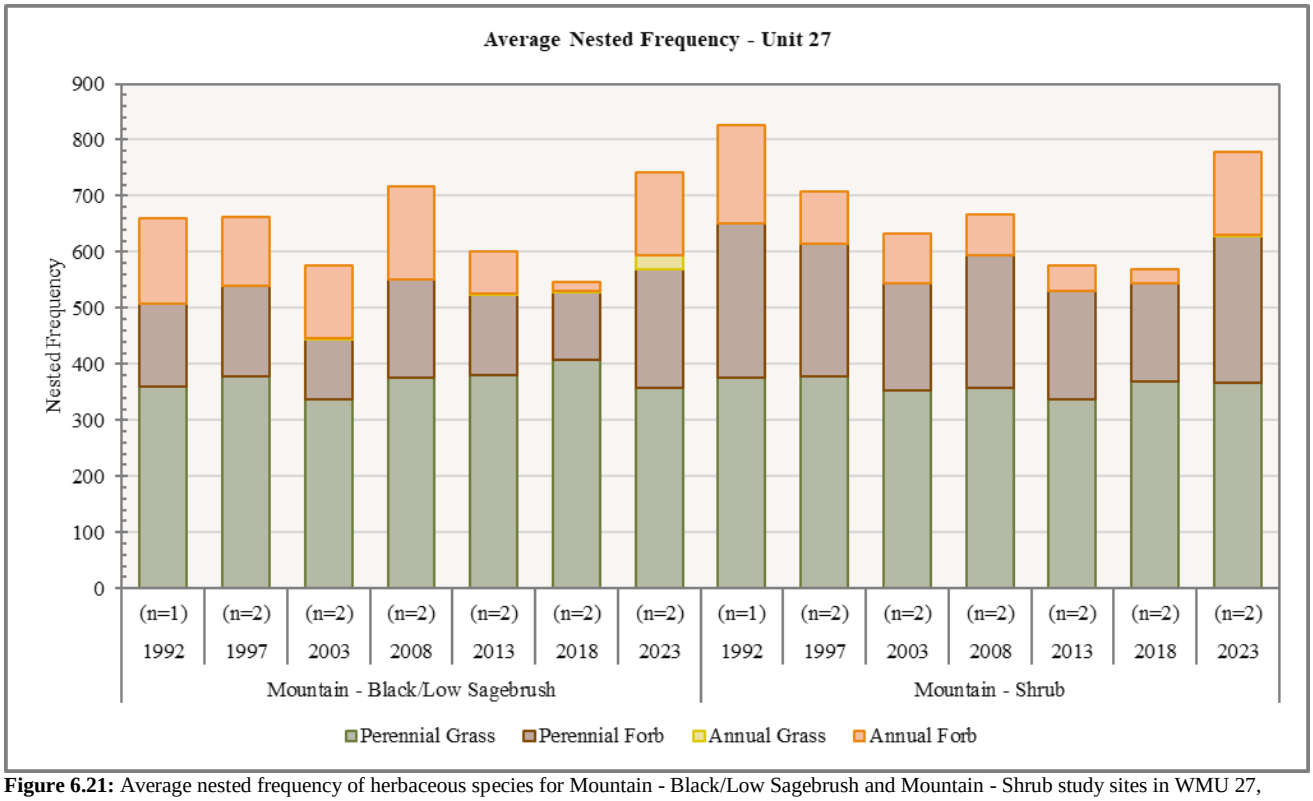


Figure 6.21: Average nested frequency of herbaceous species for Mountain - Black/Low Sagebrush and Mountain - Shrub study sites in WMU 27, Paunsaugunt.

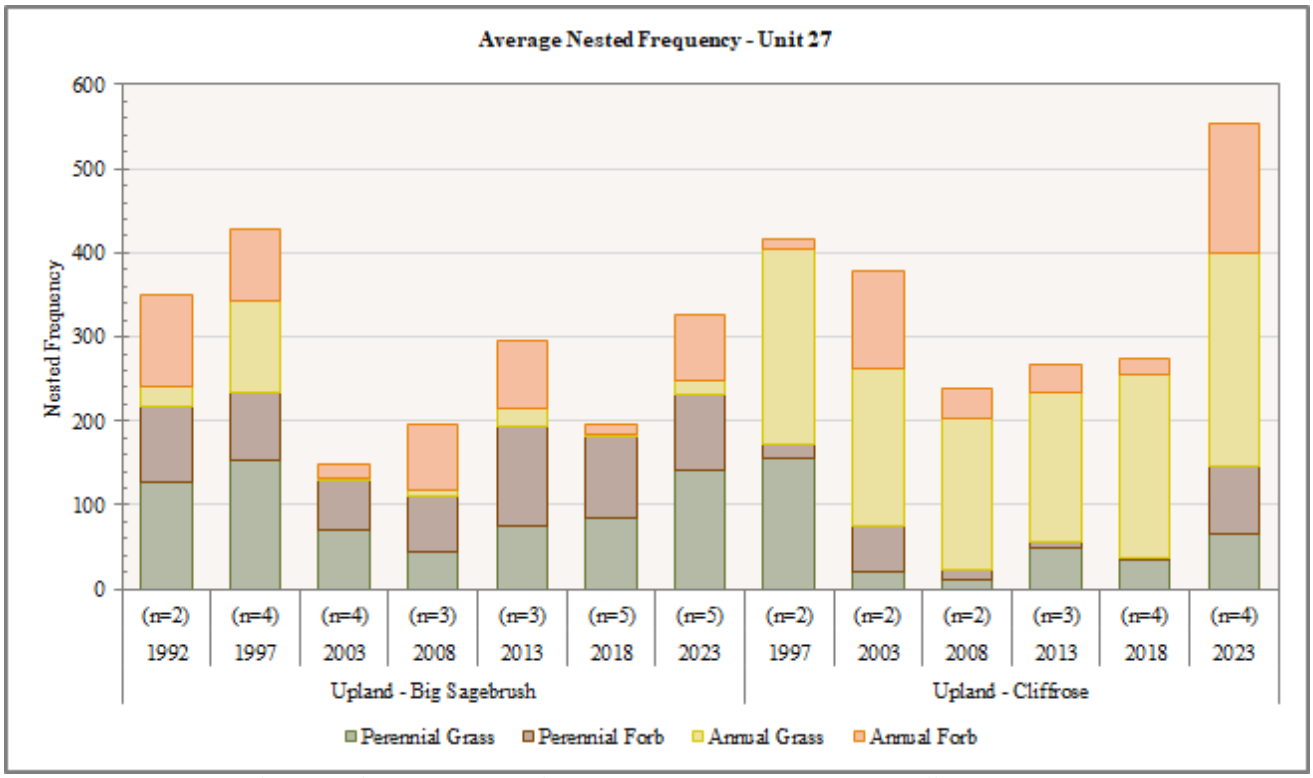


Figure 6.22: Average nested frequency of herbaceous species for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

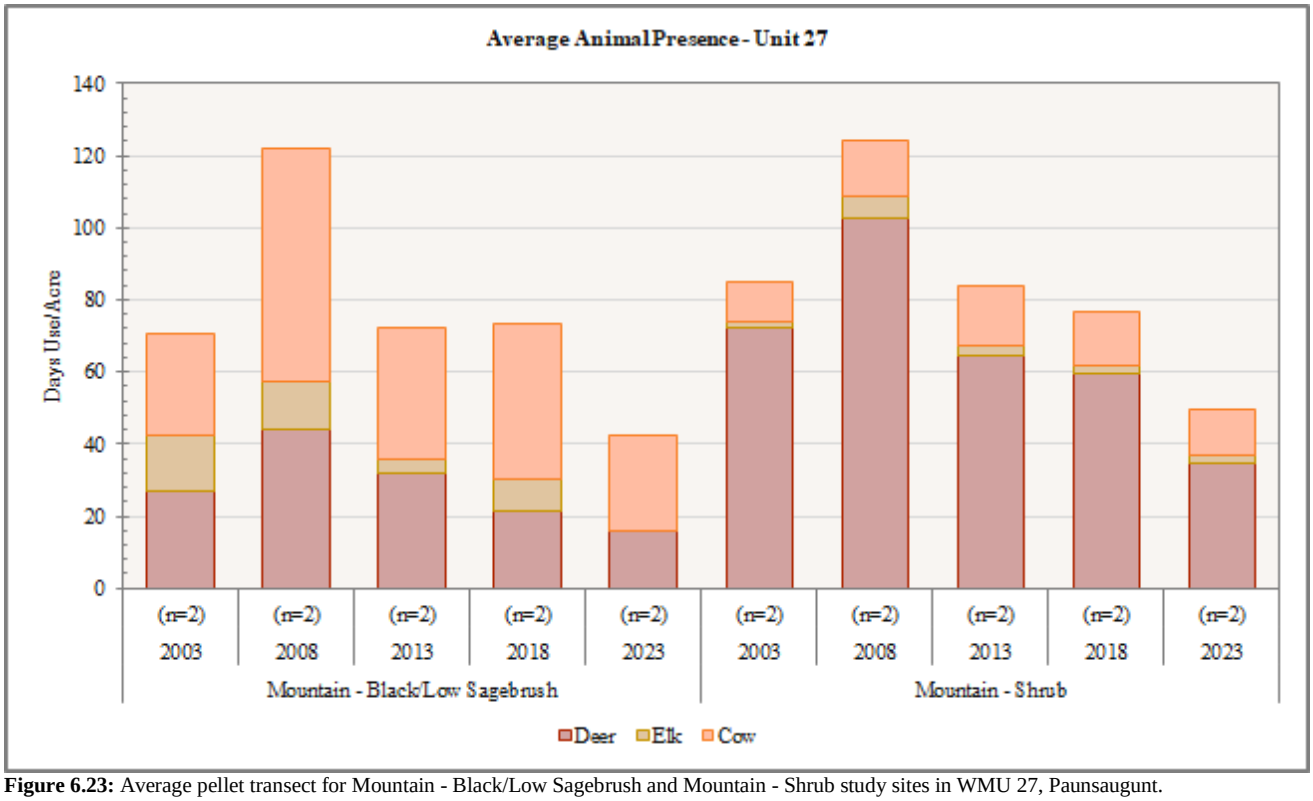


Figure 6.23: Average pellet transect for Mountain - Black/Low Sagebrush and Mountain - Shrub study sites in WMU 27, Paunsaugunt.

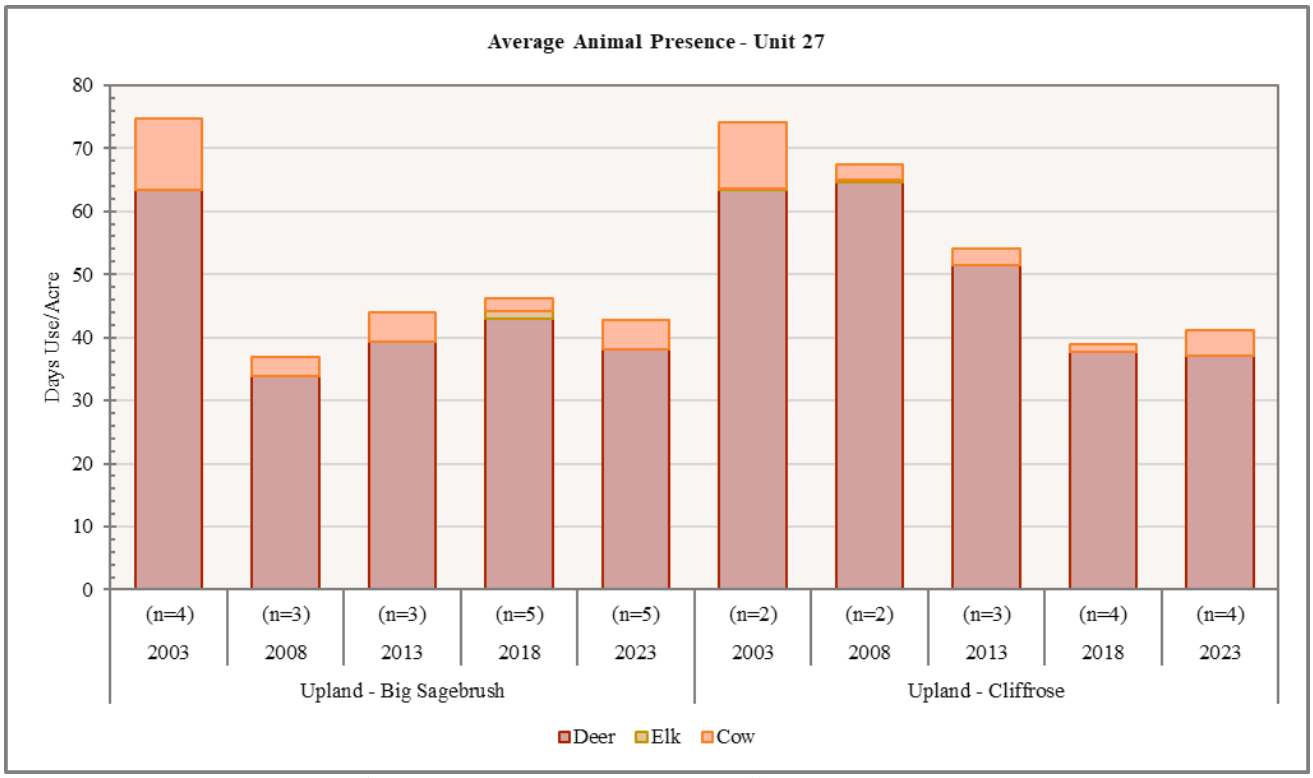
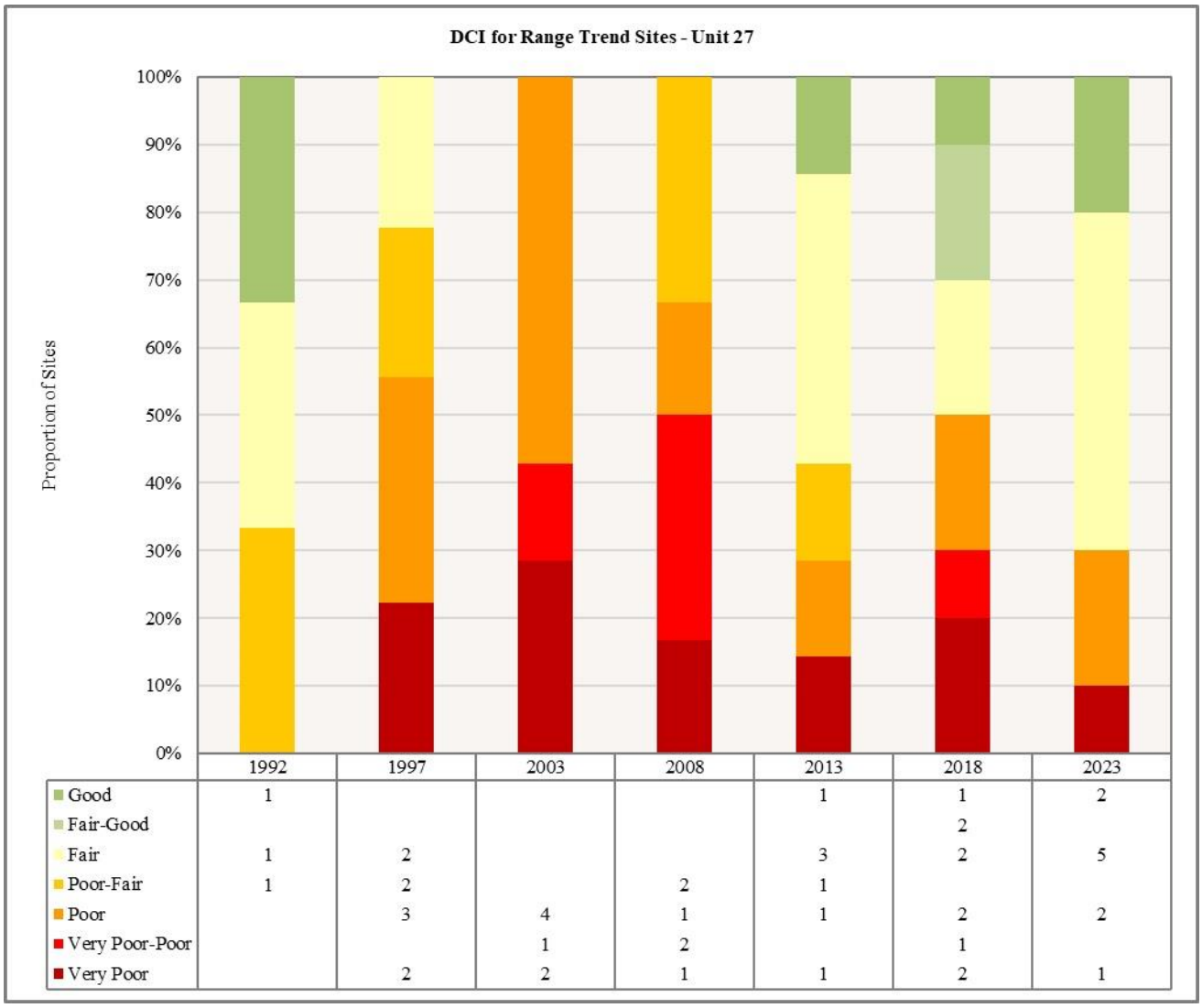


Figure 6.24: Average pellet transect data for Upland - Big Sagebrush and Upland - Cliffrose study sites in WMU 27, Paunsaugunt.

Deer Winter Range Condition Assessment

The conditions of deer winter range within the Paunsaugunt management unit have varied over time, but have measurably improved since 1997. Mean wintering condition on WMU 27 decreased from poor averaged condition in 1997 to very poor-poor averaged condition in 2008. Winter range has since improved to poor-fair averaged condition in 2023. Nephi Pasture I (27-06), Nephi Pasture Exclosure Outside (27-07), Fivemile Mountain (27-08), Telegraph Flat (27-10), and Crocodile (27-11) are the main drivers for the unit's habitat stability and average between poor and poor-fair deer winter range condition. Estimated winter range condition appears to have stabilized or improved since 2008 in part due to the addition of Range Trend sites Mustang Pond South (27-14), Jeppson Pond (27-15), Carly Knoll (27-16), and the intermittent data collection that has occurred on John R. Flat (27R-03). More specifically, improvements of range conditions on Carly Knoll and John R. Flat are the main contributors to winter range improvement. Sites on this WMU that bring the current overall quality down are Mustang Pond South and Jeppson Pond. John R. Flat and Telegraph Flat tend to have higher variability in deer winter habitat quality from year to year. This variance suggests a higher potential for winter range improvement, but this may also suggest that these sites may have a lower resistance and resilience to disturbances that influence state transitions. As such, caution should be given when applying landscape-scale treatments to improve habitat in these areas.

The overall deer winter range assessment in 2023 for WMU 27 was that the unit is in poor-fair condition. Nephi Pasture I and Carly Knoll were in good condition due to an abundance of preferred browse cover; however, improvement could be made by increasing native perennial grasses and forbs on these sites. Overall concerns identified on this unit are lower perennial grass and forb abundance. In addition, annual grasses are a concern on most sites, and annual grass reduction is needed to improve conditions on Mustang Pond South. Addressing these areas as a focus for habitat rehabilitation would improve winter range conditions for deer in this unit (**Figure 6.25**, **Table 6.5**).



	1992	1997	2003	2008	2013	2018	2023
Good	1				1	1	2
Fair-Good						2	
Fair	1	2			3	2	5
Poor-Fair	1	2		2	1		
Poor		3	4	1	1	2	2
Very Poor-Poor			1	2		1	
Very Poor		2	2	1	1	2	1

Figure 6.25: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 27, Paunsaugunt.

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
27-06	1992	30	2.1	9.5	8.8	0	1.1	0	**51.6**	**P-F**
27-06	1997	24.8	4.5	5.3	8.3	-1	2.8	0	**44.7**	**P**
27-06	2003	29.8	3.9	0	1.4	0	4.7	0	**39.8**	**P**
27-06	2008	30	4.6	10.3	2.3	0	1.6	0	**48.8**	**P-F**
27-06	2013	30	10	14.1	5.7	-0.2	2.6	0	**62.2**	**F**
27-06	2018	30	10.8	9.6	8.2	0	7.3	0	**65.9**	**F-G**
27-06	2023	30	8.8	15	8.5	0	7	0	**69.3**	**G**
27-07	1992	30	8.3	15	3.9	-0.1	2.2	0	**59.3**	**F**
27-07	1997	28.9	9.2	9.6	3.7	-2	4.3	0	**53.7**	**F**
27-07	1998	20.3	9	7.8	4	-3.8	3.3	0	**40.5**	**P**
27-07	2003	30	3.4	4.6	0.8	0	3.1	0	**41.9**	**P**
27-07	2008	30	3.9	4.2	0.1	0	6	0	**44.2**	**P**
27-07	2013	30	12.2	9.4	0.7	0	6.9	0	**59.2**	**F**
27-07	2018	30	12.7	1.7	0.1	0	9.4	0	**54**	**F**
27-07	2023	30	11.2	2.7	0.3	-0.5	10	0	**53.8**	**F**
27-08	1992	28	7.8	6.2	4.9	-0.3	1	-2	**45.6**	**F-G**
27-08	1997	16.1	5.8	0.9	4.8	-1.9	0.4	0	**26.1**	**P-F**
27-08	2003	18.1	-3.2	0.8	4.9	-5.6	0.2	0	**15**	**P**
27-08	2008	22.8	-2.9	0.9	4.8	-0.4	0.1	0	**25.3**	**P-F**
27-08	2013	28.8	9.7	4.5	6.9	-0.1	0.8	0	**50.6**	**G**
27-08	2018	29	10.5	1.5	9.7	-0.9	0.6	0	**50.2**	**G**
27-08	2023	22.4	1.7	0.8	8.8	-7.6	1.2	0.0	**27.2**	**F**
27-09	1997	25	6.7	9.6	0.7	-19	0.1	0	**23.1**	**VP**
27-09	2003	21.7	6.2	3.8	0.1	-15.3	0	0	**16.6**	**VP**
27-09	2008	17.4	-7.2	2	0.1	-5.7	0	0	**6.6**	**VP**
27-09	2013	30	7.6	4	1.8	-2.3	0.4	0	**41.5**	**P**
27-09	2018	24.2	6.9	3.8	0.9	-11.7	0	0	**24.2**	**VP**
27-09	2023	1.7	0.0	0.0	5.7	-20.0	10.0	0.0	**-2.7**	**VP**
27-10	1997	17.3	12.2	15	12.3	0	0.5	0	**57.2**	**F**
27-10	2003	22.9	3.9	3.2	0.6	0	0.2	0	**30.7**	**VP**
27-10	2008	30	-1.1	5.5	0.2	0	0.1	0	**34.7**	**VP-P**
27-10	2013	30	10.3	13.3	0.5	0	0.1	0	**54.1**	**F**
27-10	2018	2.3	0	0	0	0	0.1	0	**2.3**	**VP**
27-10	2023	19.1	14.6	9.2	14.7	-0.2	2	0	**59.5**	**F**
27-11	1997	19.2	12.7	9.9	8.2	-0.1	0.3	0	**50.1**	**P-F**
27-11	2003	30	1.9	3.7	5	0	1	0	**41.7**	**P**
27-11	2008	30	0.7	3	2	0	0.1	0	**35.7**	**VP-P**
27-11	2013	30	8.7	2.4	6.3	-0.1	2.1	0	**49.3**	**P-F**
27-11	2018	30	8.8	3.8	13.3	0	0.7	0	**56.5**	**F**
27-11	2023	30	3.9	3.9	23.1	0	1.7	0	**62.6**	**F**
27-14	2013	11.6	7.2	6.3	3.1	-2.8	1	0	**26.4**	**VP**
27-14	2018	21.2	11	9.7	4.4	-9.8	0.1	0	**36.7**	**VP-P**
27-14	2023	25.5	11.7	15	4.8	-17.2	0.9	0	**40.6**	**P**
27-15	2018	28.2	10	4.7	0.1	-0.6	0	0	**42.4**	**P**
27-15	2023	29.4	10	4	0.2	-1.7	4.6	0	**46.5**	**P**
27-16	2018	30	14.9	5.2	4.2	-0.2	10	0	**64.1**	**F-G**
27-16	2023	30	15	3.1	16.7	-0.4	4.2	0	**68.6**	**G**
27R-01	1998	26.5	12.7	5.7	0.2	0	0.4	0	**45.5**	**P**
27R-01	2003	21.2	2	0	0.5	0	0.5	0	**24.2**	**VP**
27R-01	2018	30	12.1	4.3	0	0	1.2	0	**47.6**	**P**
27R-02	1998	20.6	12.2	15	1	0	0.2	0	**49**	**P-F**
27R-02	2003	14.7	-5.5	0	0.2	0	0	0	**9.5**	**VP**
27R-02	2018	27.7	10.7	3.4	0	0	0.1	0	**41.9**	**P**
27R-03	1998	8.8	5.7	14	6.4	0	2.3	0	**37.2**	**P**
27R-03	2003	7	2.7	3.4	4.4	0	0.5	0	**18.1**	**VP**
27R-03	2018	15.1	13.1	0	14.4	0	3.3	0	**44.2**	**P**
27R-03	2023	16.6	9.7	5	20.7	0	2.6	0	**54.6**	**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
27R-04	1998	26.6	3.9	7.9	6.9	-6.6	7.2	0	**45.9**	**P**
27R-04	2003	27.6	2.6	0	1.7	0	6.1	0	**38**	**P**
27R-04	2008	30	-4.1	1.3	0	0	9.4	0	**36.6**	**VP-P**
27R-04	2013	30	8.2	2.6	0.9	-0.1	7.5	0	**49.2**	**P-F**
27R-04	2023	30	6.7	4.4	0.1	-1.1	10	0	**50.1**	**P-F**
27R-05	1998	30	8.5	12.4	13.7	-5	7.6	0	**67.2**	**G**
27R-05	2003	30	6.1	6.1	1.4	0	1.4	0	**45.1**	**P**
27R-05	2008	30	1	4.7	0	0	3.2	0	**38.8**	**P**
27R-05	2013	30	10.3	9.2	0.6	0	3.4	0	**53.5**	**F**
27R-05	2023	30	6.1	4.2	1.9	-0.4	9.1	0	**50.9**	**P-F**
27R-08*	1998	5.6	0	0	0.3	-6.5	0.2	0	**-0.5**	**VP**
27R-09*	1998	2.9	0	0	1.5	-3.7	0.5	0	**1.2**	**VP**
27R-10*	1998	3.9	0	0	8	-2.3	3.8	0	**13.3**	**P**
27R-11*	1998	2.1	0	0	9.9	-1.5	5.9	0	**16.4**	**P**

Table 6.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 27, Paunsaugunt. 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
27-01	Proctor Canyon	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Gras	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27-02	Ahlstrom Hollow	Annual Grass	Low	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
27-03	Whiteman Bench	None Identified		
27-05	Podunk Creek	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
27-06	Nephi Pasture I	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
27-07	Nephi Pasture Exclosure Outside	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27-08	Fivemile Mountain	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
27-09	Buckskin Mountain	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
27-10	Telegraph Flat	Animal Use – Cattle	High	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27-11	Crocodile	Animal Use – Deer	Medium	Reduced/less vigorous browse component
		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
27-12	Moons Landing	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27-13	Heaton	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
27-14	Mustang Pond South	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Animal Use – Deer	High	Reduced/less vigorous browse component
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27-15	Jeppson Pond	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27-16	Carly Knoll	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
27R-01	John R. Flat Total Exclosure	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27R-02	John R. Flat Livestock Exclosure	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27R-03	John R. Flat Exclosure Outside	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance
27R-04	Nephi Pasture Total Exclosure	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
27R-05	Nephi Pasture Livestock Exclosure	PJ Encroachment Annual Grass	Medium Low	Reduced understory shrub and herbaceous vigor Increased fire potential and reduced herbaceous diversity
27R-17	Buckskin 2	Annual Grass PJ Encroachment	High Low	Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
27R-18	Buckskin 1	Introduced Perennial Grass Annual Grass PJ Encroachment	Medium Medium Low	Reduced diversity of desirable grass and forb species Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
27R-19	Alton-Millcreek 2	Introduced Perennial Grass Annual Grass PJ Encroachment	High Low Low	Reduced diversity of desirable grass and forb species Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
27R-20	Hatch Bench	Introduced Perennial Grass Annual Grass PJ Encroachment	Medium Low Low	Reduced diversity of desirable grass and forb species Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
27R-22	Pine Point Handthin	Animal Use – Cattle Introduced Perennial Grass Annual Grass PJ Encroachment	High Medium Low Low	Reduced diversity of desirable grass and forb species Reduced diversity of desirable grass and forb species Increased fire potential and reduced herbaceous diversity Reduced understory shrub and herbaceous vigor
27R-23	UKC Thompson Creek	Introduced Perennial Grass PJ Encroachment	High Low	Reduced diversity of desirable grass and forb species Reduced understory shrub and herbaceous vigor
27R-24	Hatch Bench 2	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
27R-25	Sieler Creek	Introduced Perennial Grass Conifer Encroachment	High Low	Reduced diversity of desirable grass and forb species Reduced understory shrub, aspen stand, and herbaceous vigor
27R-26	Crawford Creek	Conifer Encroachment	High	Reduced understory shrub, aspen stand, and herbaceous vigor
27R-27	Johnson Bench	Introduced Perennial Grass PJ Encroachment	Medium Medium	Reduced diversity of desirable grass and forb species 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 27, Paunsaugunt. All assessments are based off 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 condition on the Paunsaugunt unit was considered fair in 2023, and there has been an overall improvement in winter range condition since 2003 (**Figure 6.25**, **Table 6.5**). Nephi Pasture I, Nephi Pasture Exclosure Outside, Crocodile, and Heaton are all sites responsible for the overall stable or improving condition of the unit due to high amounts of preferred browse cover and the well-diversified age classes within the populations on these sites. The remaining sites, Mustang Pond South and Jeppson Pond, are in poor condition. These two studies have very little perennial grass and forb cover and have annual grass established. Furthermore, cheatgrass (*Bromus tectorum*) is increasing on Mustang Pond South. However, since the lop and scatter treatment that occurred on Mustang Pond South, preferred browse cover has steadily increased, which accounts for the improvement of condition on this site. Range conditions on Carly Knoll are considered good, but the data from this site only contributes to the last two rotational samplings for the region. The long-term conditional overview should take into consideration the consistency of samplings taken from Nephi Pasture I, Nephi Pasture Exclosure Outside, Telegraph Flat, and Crocodile. Telegraph Flat has had the most variability in habitat conditions, which is driven by the harrow disturbance that occurred during the winter of 2017/18. The harrow accounts for the loss of preferred browse and perennial grass cover during the 2018 sample year. Since 2018, preferred browse and perennial grass cover have rebounded, and age class structure of preferred browse has diversified. However, cheatgrass was sampled on Telegraph Flat for the first time in 2023.

The northwestern portion of the Paunsaugant unit near the towns of Hatch and Long Valley Junction appears to be in good condition. The Moons Landing and Heaton sites near Heaton Ranch both sample summer range and were affected by the Sevy habitat improvement project. Sagebrush (*Artemisia spp.*) and antelope bitterbrush (*Purshia tridentata*) are the dominant preferred browse species on these two sites. However, bitterbrush density and cover were significantly (but expectedly) reduced on the Moons Landing site following a two-way chaining in 2020 (**Table 6.4**). Following the chaining, antelope bitterbrush's age class structure remained relatively the same, but poor vigor increased. However, Gambel oak (*Quercus gambelii*) and black sagebrush (*Artemisia nova*) did show some diversification in age class structure. Ultimately, preferred browse and the herbaceous understory of this site are abundant and diverse, indicating that summer range in this portion of the unit is healthy and suitable for mule deer. Proctor Canyon is another example of an area where mule deer summer range is healthy and abundant. According to site data, preferred shrub (mainly antelope bitterbrush) cover and density are increasing with perennial grasses and forbs following a similar trend (Cox, Lane, & Payne, 2023).

The frequency and intensity of fire on this unit appear to be low as a whole. However, there is a small, concentrated area inside and around Bryce Canyon National Park that frequently burns due to a mixture of prescribed burns and wildfires.

This may suggest that some fire suppression has occurred on this unit, while active forest management using fire is happening within Bryce Canyon National Park and the Dixie National Forest. There are no Range Trend sites that monitor the northern portion of the unit where fires have occurred. However, a few Range Trend sites monitor burned areas on the Kaibab, which is another active spot for wildfire (**Table 6.4**, **Map 6.6**). Buckskin 1 and Buckskin 2 burned in the Buckskin wildfire in 2006. Preferred shrubs and the herbaceous understories on these sites provided little cover prior to the fire, which was likely due to the dominance of pinyon and juniper suppressing the understories. Following the fire, however, preferred shrub cover has increased, but the herbaceous response has been mixed. The grass communities on these sites are dominated by cheatgrass, but the forb communities have remained diverse and dominated by native perennial species. This response is likely due to the reduction in trees and supplementary seedings. Since the Buckskin wildfire, habitat appears to have improved on the Buckskin 1 and Buckskin 2 sites as suggested by the increase in mule deer pellet groups following the wildfire (Cox, Lane, & Payne, 2023). The 2020 Pine Hollow wildfire (which affected the Buckskin Mountain site) was intense and only remnants of the earlier community persist; cheatgrass currently dominates the site as of 2023 (Cox, Lane, & Payne, 2023). However, it is important to note that fire can play a key process in the function and structure of big game habitat (Pastro, Dickman, & Letnic, 2011). Higher-elevation summer range habitat may have benefitted from the fires (e.g. Little Bear wildfire) that have occurred west of Bryce Canyon Nation Park in the Dixie National Forest. However, Range Trend sites that monitor mule deer summer range in this area do not overlap areas that have experienced fire. Therefore, no assessment can be made on how fire has ultimately affected deer habitat.

Extensive work has been done on the Paunsaugunt unit in an effort to address pinyon-juniper encroachment over 38,000 acres have been treated by bullhog and anchor chain. The majority of these treatments have occurred in the transition area between substantial summer and winter ranges for mule deer found on the Skutumpah Terrace. Anchor chaining treatments are split between Skutumpah Terrace and winter range on the Kaibab Plateau. These treatments also occur on greater sage-grouse habitat, which likely benefit from the reduction or removal of pinyon-juniper trees. As a whole, these treatments have improved community health and resilience by reducing continuity and fuel loads that have the potential to burn and therefore remove understories of beneficial shrub and herbaceous species. Removal of these trees reduces this threat and improves habitat not only for big game, but also for sage-grouse as well (Knick, Hanser, & Leu, 2014).

The threat of cheatgrass is mixed among the sites sampled, but there are a few hot spots (such as Buckskin 1 and 2, and Buckskin Mountain) that likely require some attention as increases in annual grass abundance and cover could become an issue if left unchecked. Fires on or near these sites could open niches for further invasion, thus the need for continued fuel reductions in areas of high pinyon-juniper densities (Payne, Lane, & Cox, 2023; Cox, Lane, & Payne, 2023).

Like Boulder Plateau, the Paunsaugunt unit experiences a high volume of human activity through multi-use recreation and tourism. The major road arteries US-89 and SR-12 roughly define boundaries for the Paunsaugunt unit. Areas of notable vehicle concentrations estimated by UDOT occur near Carmel Junction where average annual daily traffic from 2013 to 2022 was 3,110 vehicles per day. In 2022, average annual daily traffic between Kanab and Johnson Canyon Road was 4,600 vehicles per day (Annual Average Daily Traffic, 2019). Roadkill reports also reflect high traffic densities in the form of wildlife-vehicle collisions in the same areas reported by UDOT (Utah Division of Wildlife Resources, 2024). Wildlife highway mortality is a current and ongoing concern by managers for the unit; six wildlife culverts and one bridge have been installed along US-89 that span from the east border of Grand Staircase-Escalante National Monument to Kaibab Gulch. Additional plans are to have wildlife exclusion fencing installed over the same length of road (Utah Division of Wildlife Resources, 2024). Both Wildlife Tracker and Utah Roadkill Report data appear to suggest some success with mitigating wildlife mortality (Utah Division of Wildlife Resources, 2024). Like the Boulder Plateau unit, the Paunsaugunt unit is a corridor (at least the periphery) for tourists and recreationalists to travel between National Parks, National Monuments, and Wilderness areas. Parks and monuments that may directly (or indirectly) influence the number of visitors to the unit include Zion NP (4,692,417 visitors in 2022), Bryce Canyon NP (2,354,660 visitors in 2022), Grand Canyon NP (4,732,101 visitors in 2022), Grand Staircase-Escalante NM (over 1,300,000 visitors in 2021), Vermillion Cliffs NM, Glen Canyon National Recreation Area (2,842,776 visitors in 2022), Coral Pink Sand Dunes State Park (128,675 visitors in 2023), and Kodachrome Basin SP (57,689 visitors in 2023) (National Park Service, 2023; Tyler, et al., 2021; Utah State Parks, 2024). There are also a number of wilderness study areas that surround the Paunsaugunt. These areas also contribute to visitation in or through, the unit, bringing increased human-wildlife interactions.

Chances for human-wildlife interactions on the unit's interior likely occur on Forest Service road and OHV trail systems. The Paunsaugunt Rim Trail system is extensive and one of the popular trails in the area, with six trail loops that extend from the main trail to total approximately 77 miles of trail. The Utah Division of Outdoor Recreation estimates that 200 OHV trail systems exist near the Kanab area, and range between a few miles to over 60 miles in length (Utah Division of Outdoor Recreation, 2023). Education on best practices required by state law likely helps mitigate some of the negative outcomes that might otherwise result from OHV recreation. However, deleterious effects on wildlife and wildlife habitat are always a possibility. Many official roads and trails within the unit overlap deer and elk habitat and are located on land

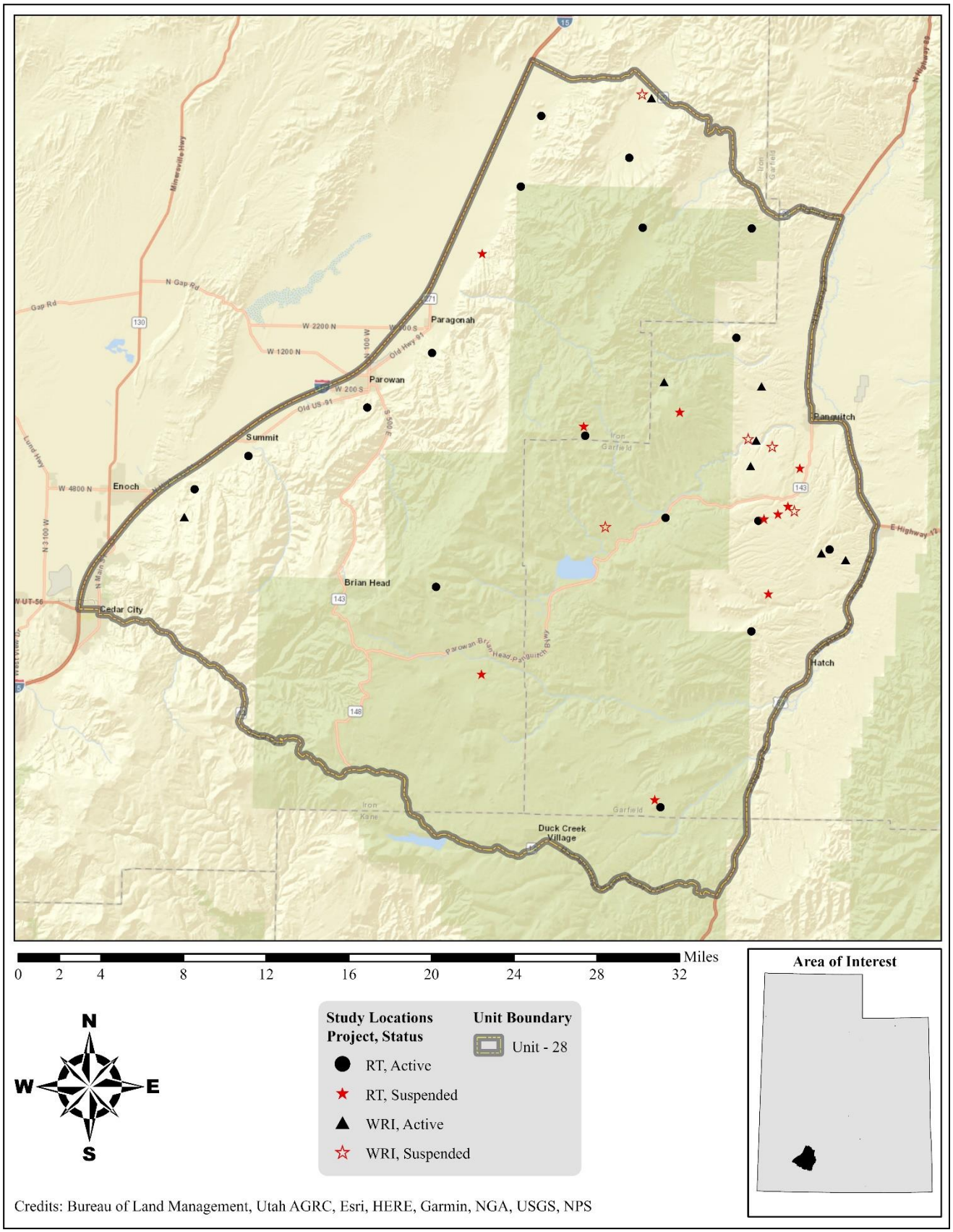
administrated by the United States Forest Service (USFS) and Bureau of Land Management (BLM). The USFS monitors use and manages land and resources within its jurisdiction accordingly, but unauthorized use of roads and trails has been known to occur.

A number of human developments have occurred on the Paunsaugunt unit that are of concern. The road into Daves Hollow and Tropic Reservoir has been paved, and there has been some tourism development around Bryce Canyon City. Furthermore, the town of Tropic in particular has increased accommodations for tourists. There is an open-pit mine south of the town of Alton that has become active in the last 10 years. Depending on ownership and permitting, this mine has the potential to expand. In addition, active urban development is occurring on deer winter range between Johnson Canyon and Kanab; urban sprawl poses threats to big game habitat. 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.

When trying to slow or alleviate the effects of habitat loss that are occurring within the Paunsuagunt 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 include Low and Mountain Sagebrush communities near and along Heaton Ranch and Hatch Bench; along the SR-12 corridor between the top of Red Canyon and Bryce Canyon City; and along US-89 from Kanab to Kimball Valley. As available preferred browse and valuable forage continue to be threatened, these ranges will likely become increasingly important for deer herds in the area as urbanization pressures become more influential on the southern portion of the unit. Efforts to restore and/or rejuvenate sagebrush habitat where feasible along these corridors would be beneficial. Pinyon-Juniper Woodland and Shrublands cover a significant portion of this unit (**Table 6.1**). Maintaining these communities in their early-successional states will not only reduce the chances of catastrophic fire, but will also improve habitat by increasing available forage for big game and other wildlife. A number of pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) removal projects have occurred within this unit (**Table 6.2**) and have generally been effective. However, 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. Presence of pinyon and juniper can result in reduced understory shrub and herbaceous health as encroachment advances (Miller, Svejcar, & Rose, 2000).

Consideration should also be given to continuing to monitoring the rehabilitation efforts in the burned areas on Buckskin Mountain. Following wildfires, community types can transition away from more resistant and resilient systems to communities that are less resistant to fire because of increased fuel loads from annual cheatgrass. Mule deer summer range on the Paunsaugunt unit is strongly influenced by Ponderosa Pine Woodland (**Table 6.1**, **Map 6.2**, **Map 6.5**), and early-successional states that have open, productive understories are important for summer range health. When and where appropriate, the influence of fire (by either prescription or wildfire) may benefit this community. As mentioned earlier, this unit is likely impacted by heavy tourism. Human-wildlife interactions are common in this area and take many forms from traffic, hiking, camping, hunting, to wildlife viewing. Human interaction with wildlife can negatively impact wildlife behavior and habitat use (Anderson, Waller, & Thornton, 2023). With most tourists coming from other areas of the country and world, public education about their impact to wildlife through signage placed in high use areas (National Parks etc.) may be a method of reducing human-wildlife impact. 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.

7. WILDLIFE MANAGEMENT UNIT 28 – PANGUITCH LAKE



WILDLIFE MANAGEMENT UNIT 28 – PANGUITCH LAKE

Boundary Description

> **Garfield, Iron, and Kane counties -** Boundary begins at SR-14 and US-89; north on US-89 to SR-20; west on SR-20 to I-15; south on I-15 to SR-14; east on SR-14 to US-89.

Management Unit Description

Geography

The Panguitch Lake Wildlife Management Unit includes the section of the Colorado Plateau that falls between I-15 and US-89. The unit also contains the Markagunt Plateau, Cedar Breaks National Monument, Upper Bear Valley, Buckskin Valley, and Grass Valley. Brian Head Peak, the highest point of the Markagunt Plateau, reaches an elevation of 11,307 feet. The lowest point is at about 5,700 feet and occurs along I-15. Towns and cities in this area include Cedar City, Parowan, Paragonah, Panguitch, and Hatch.

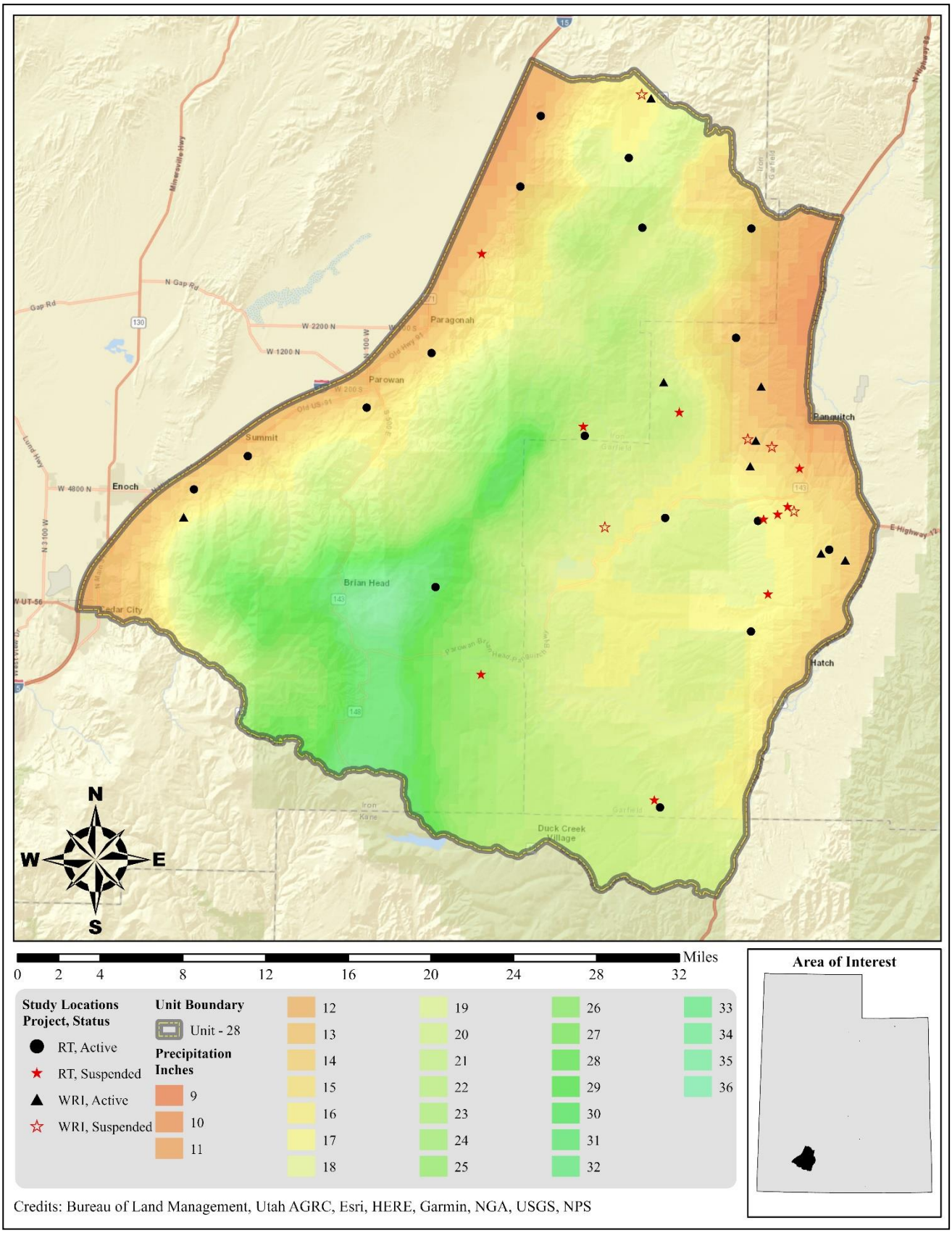
The Cedar Breaks National Monument area serves as the headwaters of the Mammoth Creek tributary of the Sevier River. Panguitch Creek flows into Panguitch Lake, which also feeds into the Sevier River. This management unit also includes Three Creeks Drainage, Buckskin Wash, Bear Creek, and Rattlesnake and Ashdown Creeks, which flow through the Ashdown Gorge Wilderness area.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation on the unit ranges from 9 inches in the far northeastern portion of the unit near Panguitch to 36 inches on the high-elevation peak of Brian Head. All of the active Range Trend and Watershed Restoration Initiative (WRI) monitoring studies in the unit occur within 12-30 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 has displayed some form of drought most years since 1993. Moreover, this climate division has been considered to be in drought nearly 68% of the time since 1993. Of the drought periods, nearly 43% are considered to be either moderate or extreme drought years. Also remarkable about this climate division is that drought is experienced over multiple years and is generally interrupted by a single wet year event; the most notable wet years occur in 2005 and 2011, which were both considered moderately wet (**Figure 7.1a**). The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI. These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September and May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 7.1b**). Range Trend sampling occurs on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 7.3**). Years that were moderately wet occur in 1999 and 2023, but years where drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 7.1a, Figure 7.1b**) (Time Series Data, 2024).



Map 7.1: The 1991-2020 PRISM Precipitation Model for WMU 28, Panguitch Lake (PRISM Climate Group, Oregon State University, 2021).

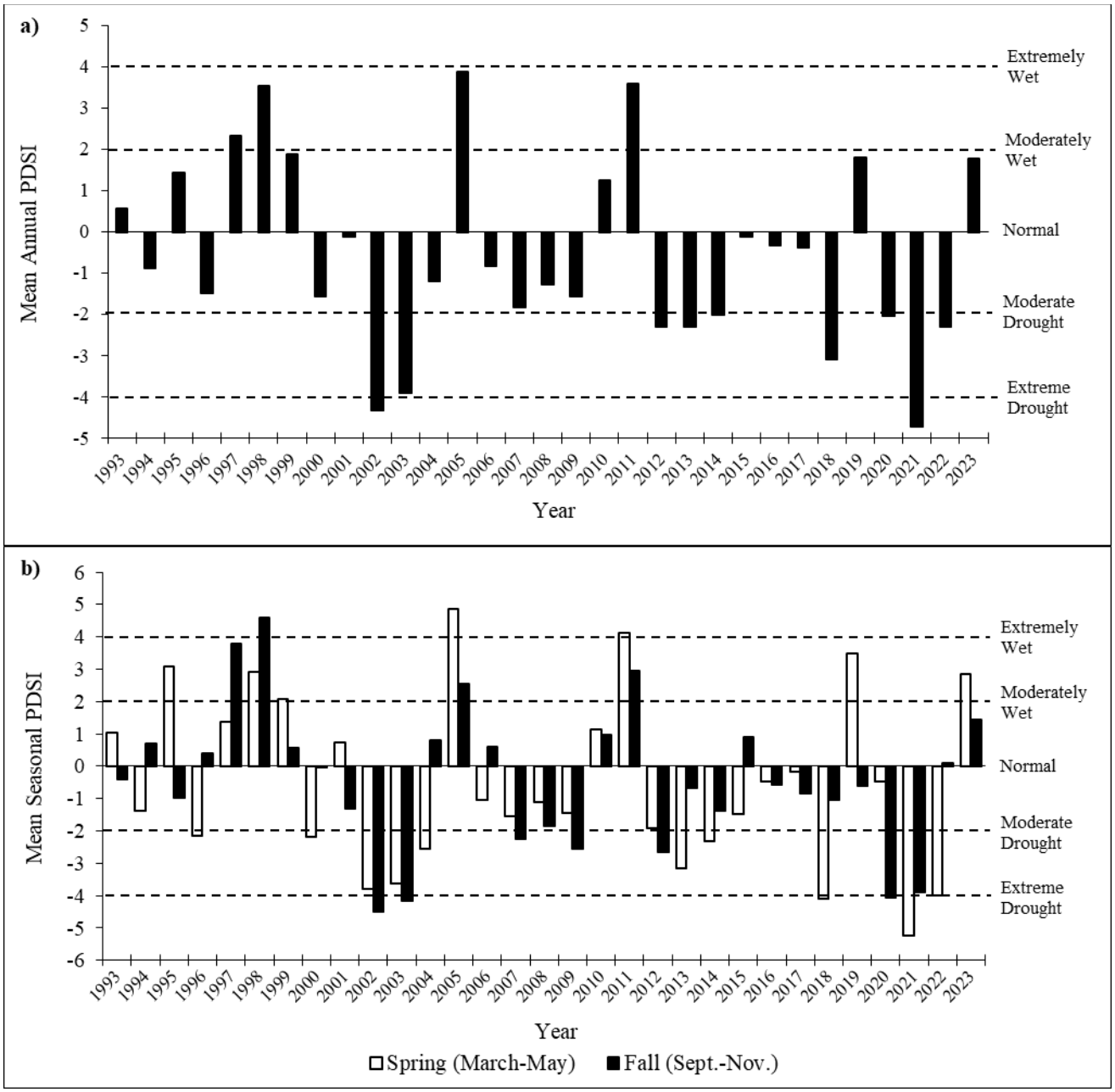


Figure 7.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

According to current habitat maps, mule deer winter range in the western portion of the unit is located on and below the Hurricane Cliffs on the western edge of the Markagunt Plateau from Cedar City to SR-20. The Buckskin and Lower Bear Valleys serve as winter range near the unit's northern borders. On the eastern side of the unit, winter range stretches from the junction of US-89 and SR-20 down to the southern slopes of Hatch Mountain (**Map 7.2**). The winter range on the eastern portion of the unit is higher in elevation and experiences colder temperatures than areas on the Parowan side. Key areas that were identified on the winter range on the northern and eastern sides of the unit include the following: pinyon-juniper (*Pinus spp*. and *Juniperus spp.*) woodlands south of Panguitch, seeded range at the north end of Upper Bear Valley, the mixed brush type in Buckskin Valley, and the pinyon-juniper chaining in the Three Creeks drainage. These study sites range in elevation from 7,100 to 7,600 feet and represent key areas within the limits of normal winter range on the east side.

Summer range is not considered a limiting factor for this deer herd unit. Summer range on the northern portion of the unit generally lies between 8,000 and 9,000 feet and consists largely of gentle rolling terrain. Summer ranges on the south side of the unit reach elevations of over 10,000 feet bordering Cedar Breaks National Monument (**Map 7.2**).

The key areas that were identified by the local interagency committee for this unit include the Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) type west of Swayback Knoll; a Wyoming big sagebrush type in the mouth of Cottonwood Creek, a pinyon-juniper chaining east of Paragonah; a large sagebrush/pinyon-juniper ecotone in Grass Valley south of Parowan; and a mountain big sagebrush (*A. tridentata* ssp. *vaseyana*)/pinyon-juniper ecotone in Elliker Basin. The importance of each of these areas for deer has increased over the years as sagebrush flats have been converted into agricultural lands.

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

The RAP data displays fluctuations in herbaceous cover and biomass on mule deer ranges of all seasonality; the timing of the highest values for these measurements varies between range types. Despite yearly fluctuations, herbaceous cover and biomass on summer range have remained similar overall; peaks for both measurements have occurred in the late 1980s, early 1990s, early 2010s, and early 2020s. On winter range, these peaks were observed in the late 1980s, early 1990s, and mid 1990s; cover and biomass have slightly decreased. Herbaceous cover and biomass on year-long range have remained similar overall despite year-to-year variations, and peaks for these values occurred in the late 1980s, mid-1990s, early and mid-2000s, early 2010s, and early 2020s. Annual species have generally contributed the most cover on mule deer winter range with flushes correlating with years of good precipitation. However, flushes of annual lifeforms have also occurred in some years on year-long habitat. Annual and perennial cover and biomass have followed precipitation trends in many years on ranges of all seasonality, although lag effects of a year or so have occurred at other times (**Figure 7.2**, **Figure 7.3**, **Figure 7.4**, **Figure 7.5**, **Figure 7.6**, **Figure 7.7**). The Range Trend data from 1992 to present shows a general increase in perennial cover on sites of both mountain and upland potentials, and cover of annuals has increased on upland study sites. However, it is important to note the different number of studies sampled from year to year (the 'n' value) and consider the implications that this may have on the data. Furthermore, Range Trend sites are summarized by ecological potential in this report and not seasonality of mule deer range (**Figure 7.18**). As such, incongruences between Range Trend data and that reported by the RAP are probable.

The RAP data for tree and shrub cover shows fluctuations over time, but cover has remained similar overall. Cover of both lifeforms correlates with precipitation in some years, but more loosely so than herbaceous data (**Figure 7.8**, **Figure 7.9**, **Figure 7.10**). Range Trend data displays general decreases in tree cover since 2003; shrub cover has remained similar on Mountain (Shrub) and Upland (Big Sagebrush) sites, but has decreased overall on Upland (Black/Low Sagebrush) studies (**Figure 7.11**, **Figure 7.12**, **Figure 7.13**, **Figure 7.14**). Again, it is important to consider the caveats discussed above when making comparisons between RAP and Range Trend data.

RAP – Herbaceous Biomass by Deer Habitat

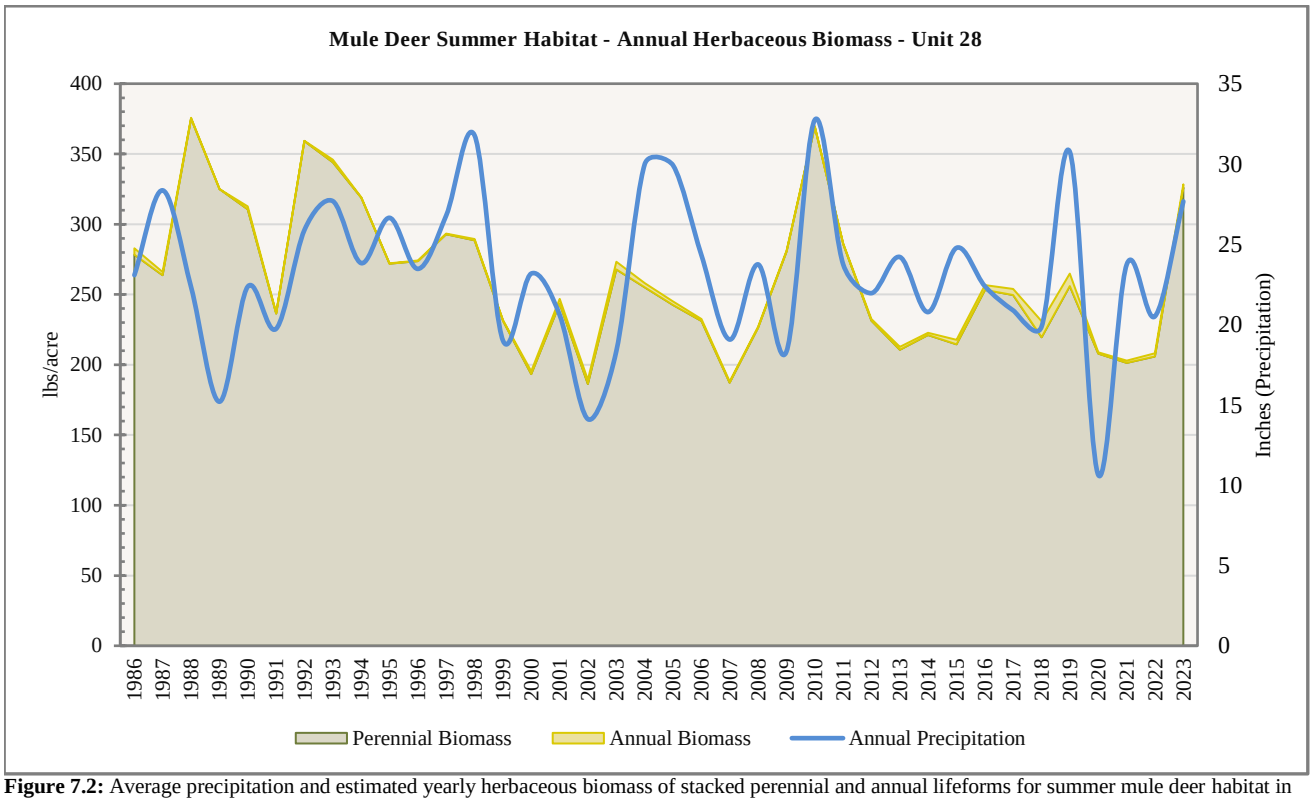


Figure 7.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).

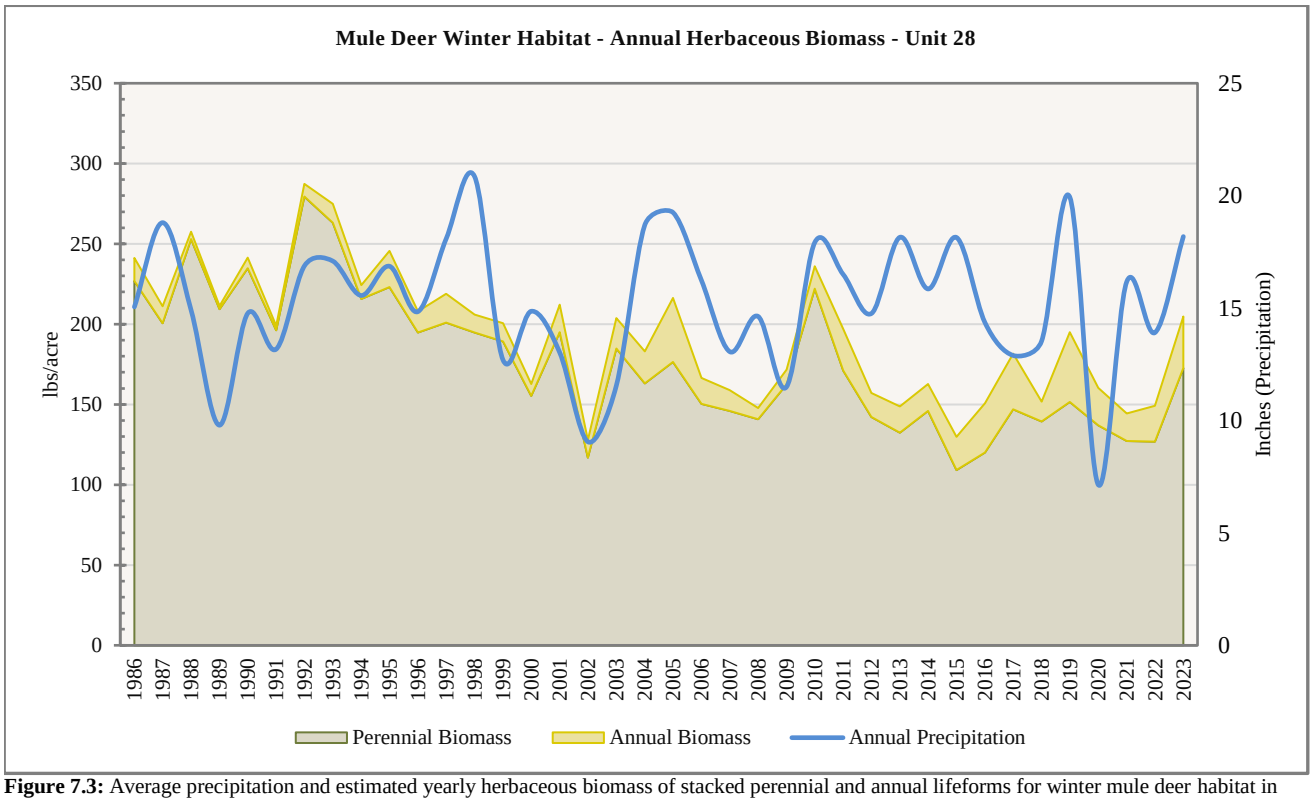


Figure 7.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).

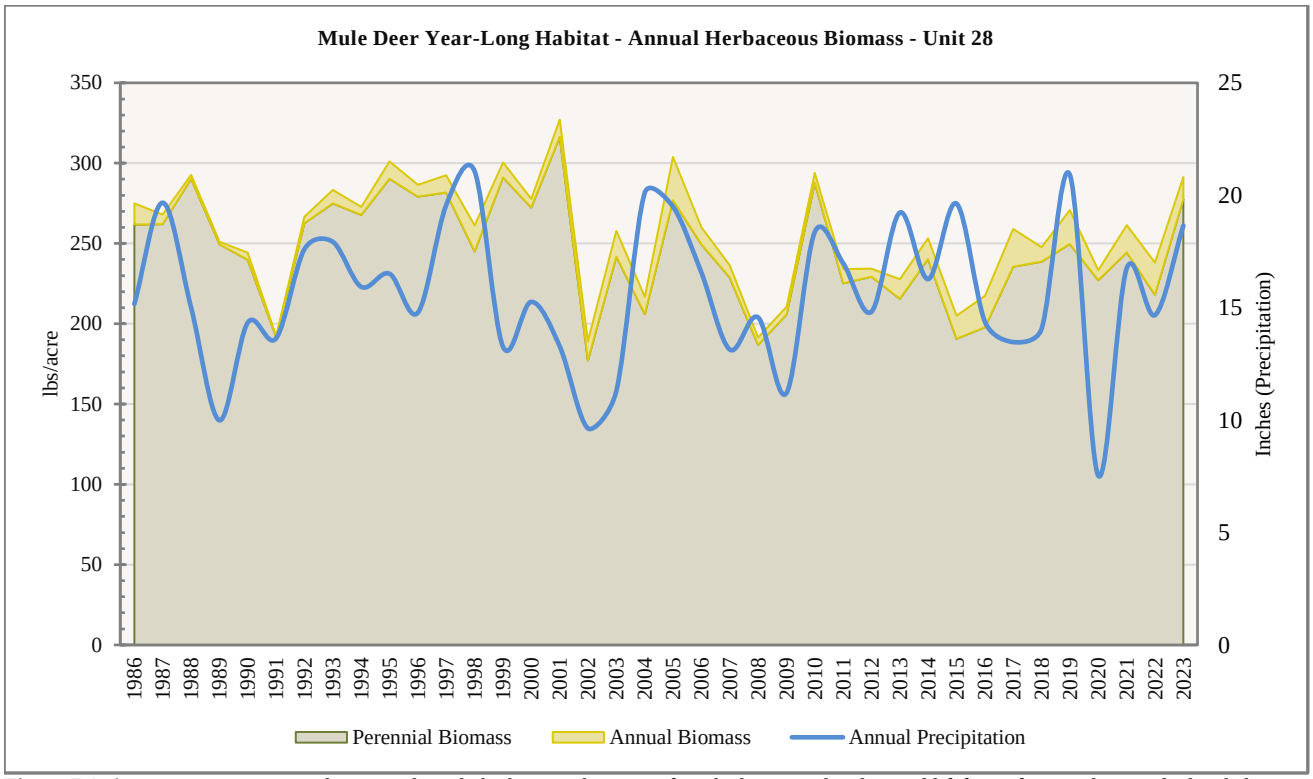


Figure 7.4: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

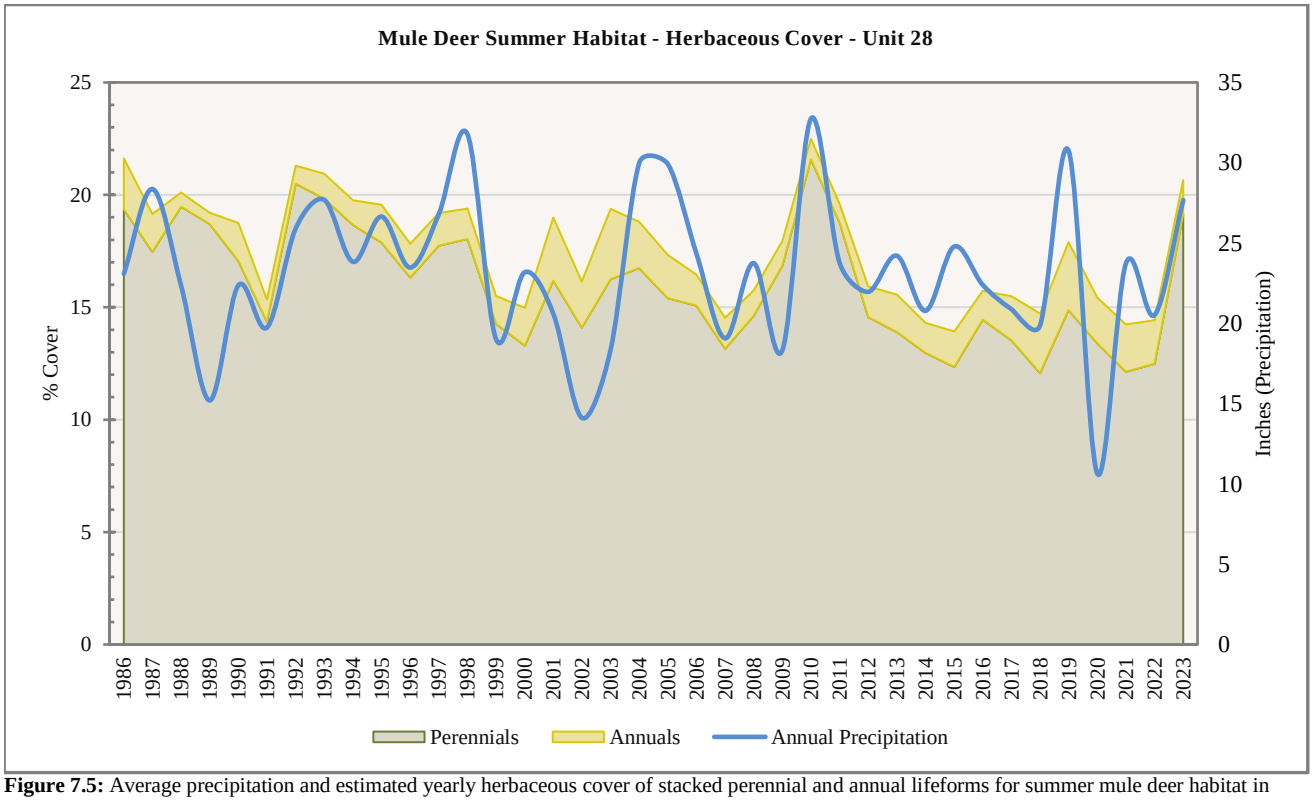


Figure 7.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).

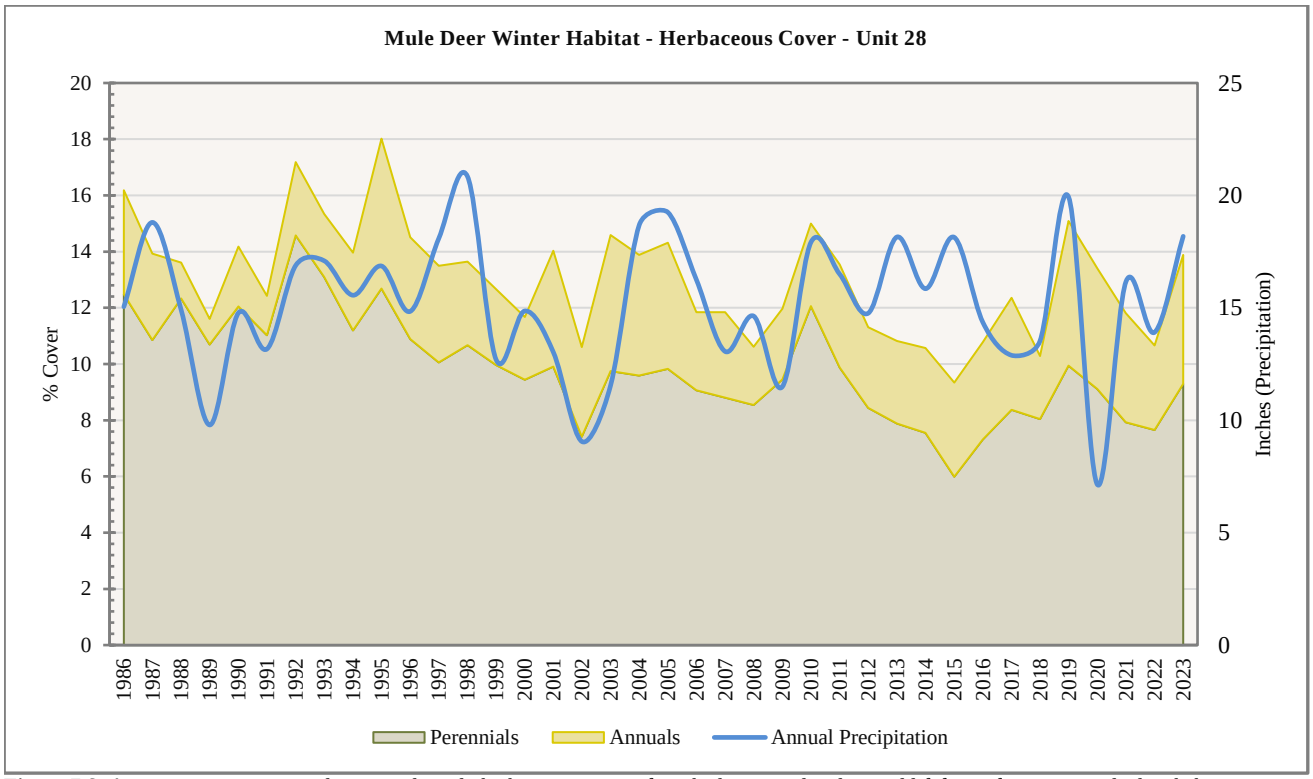


Figure 7.6: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2023).

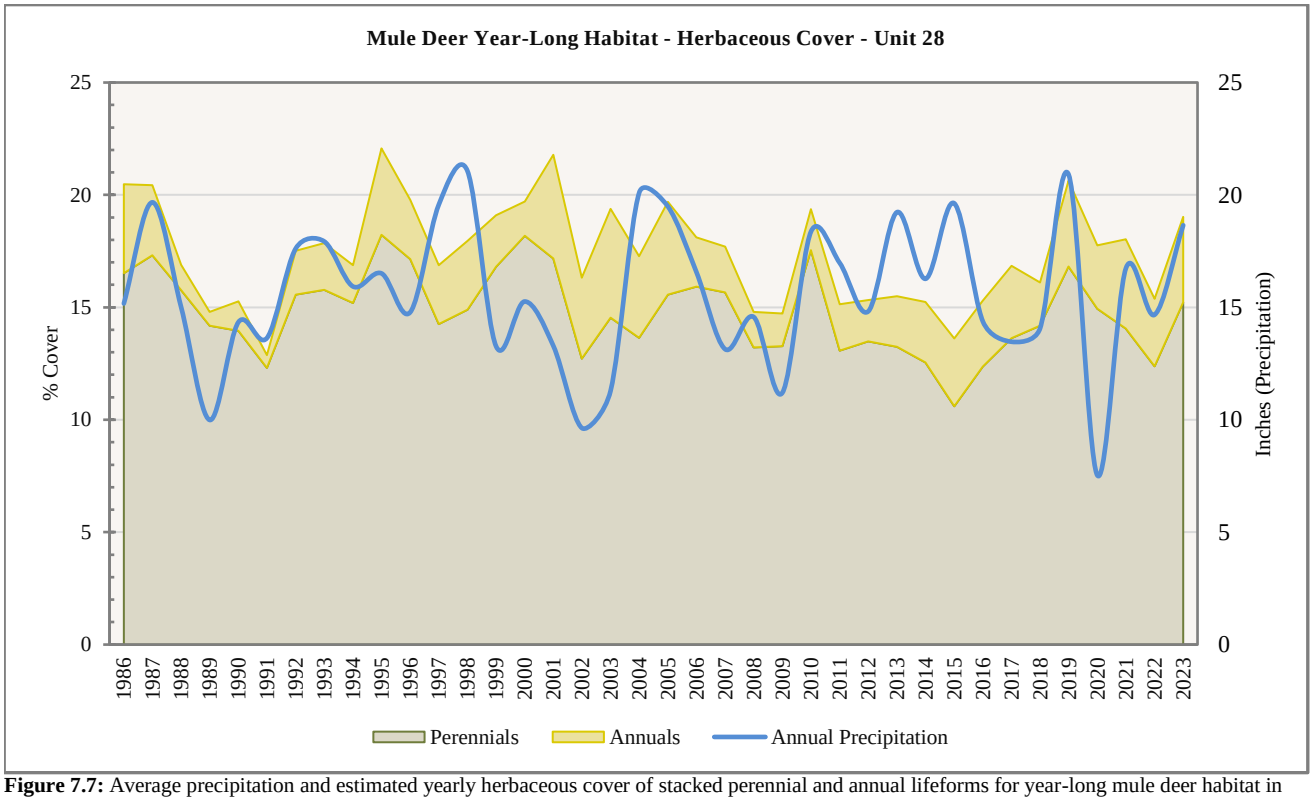


Figure 7.7: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

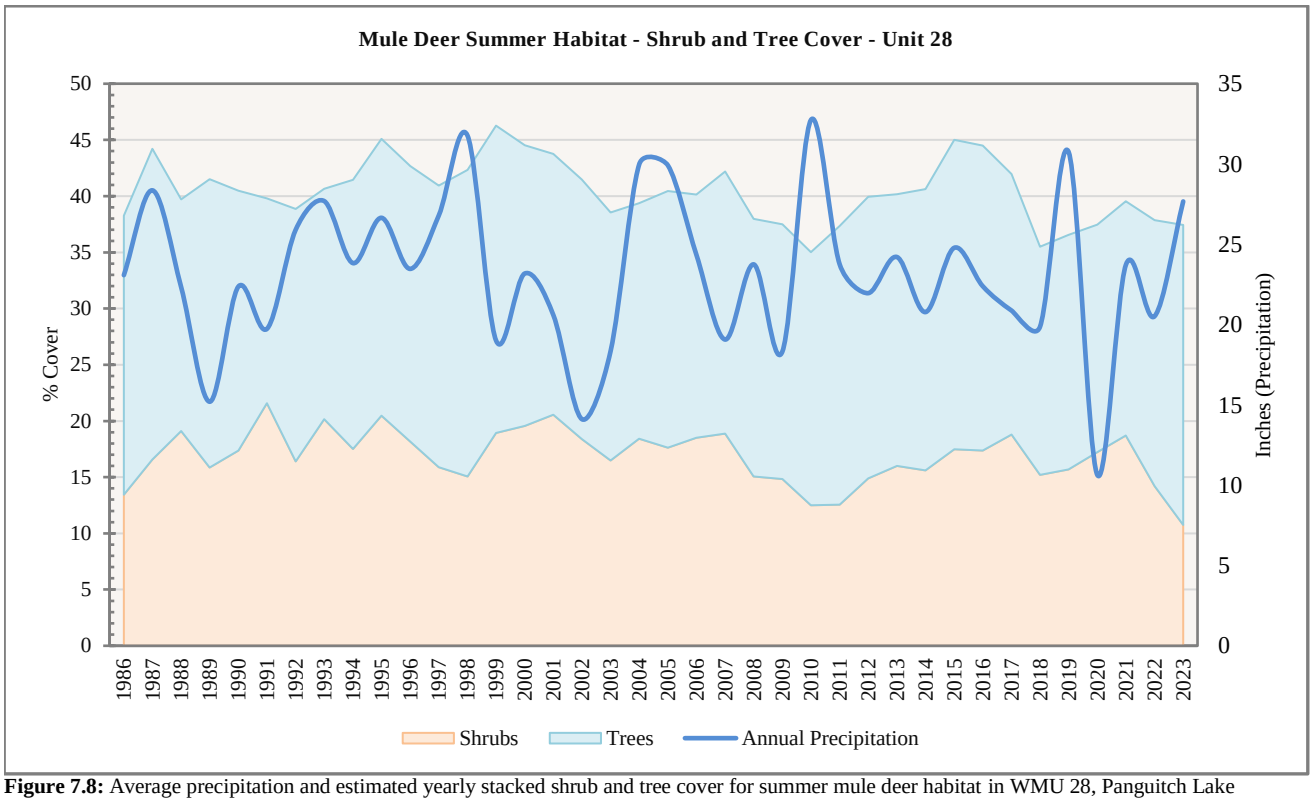


Figure 7.8: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).

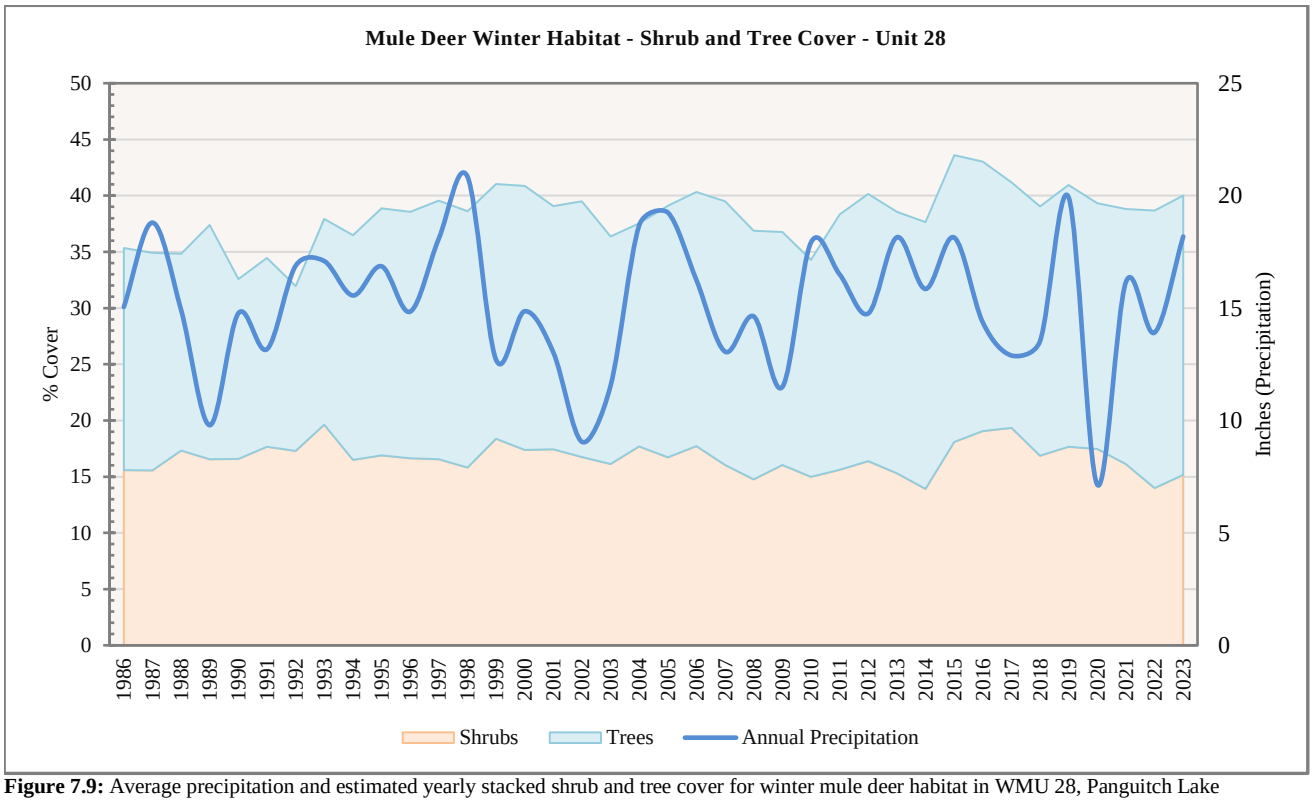


Figure 7.9: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).

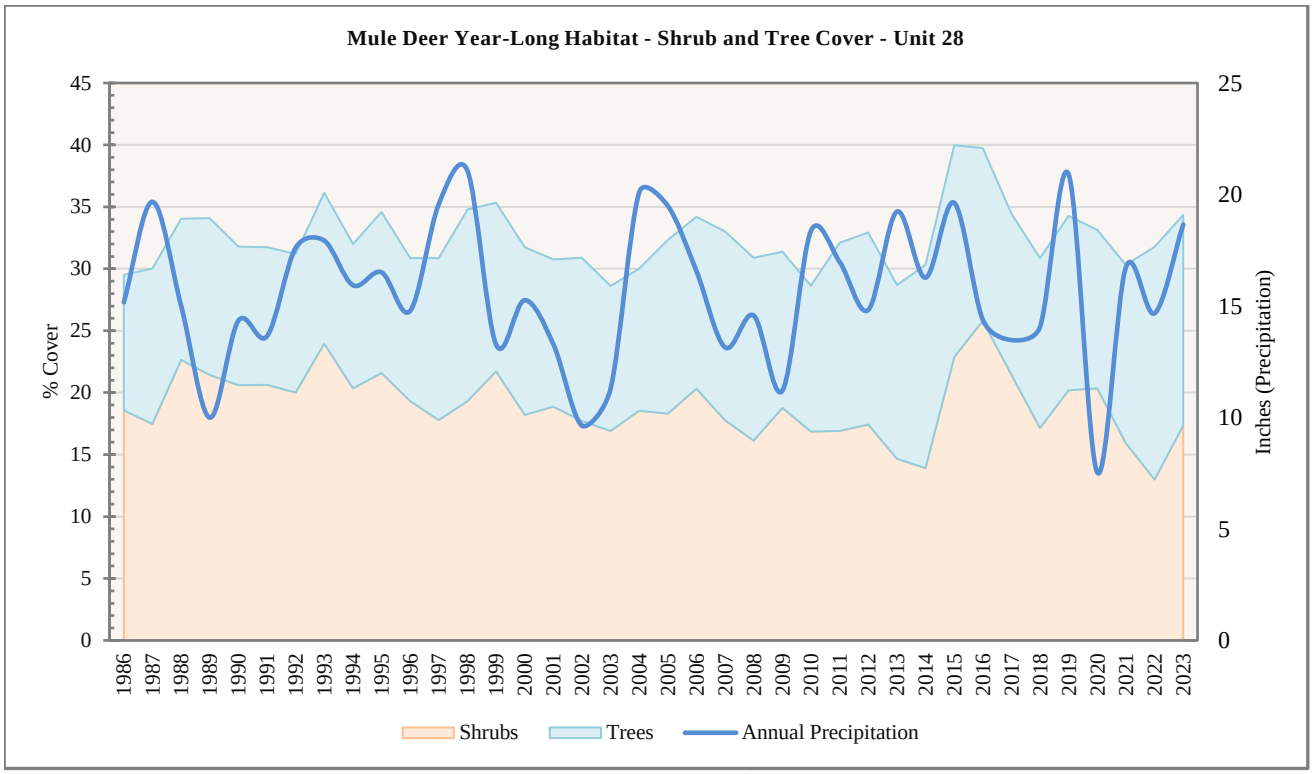
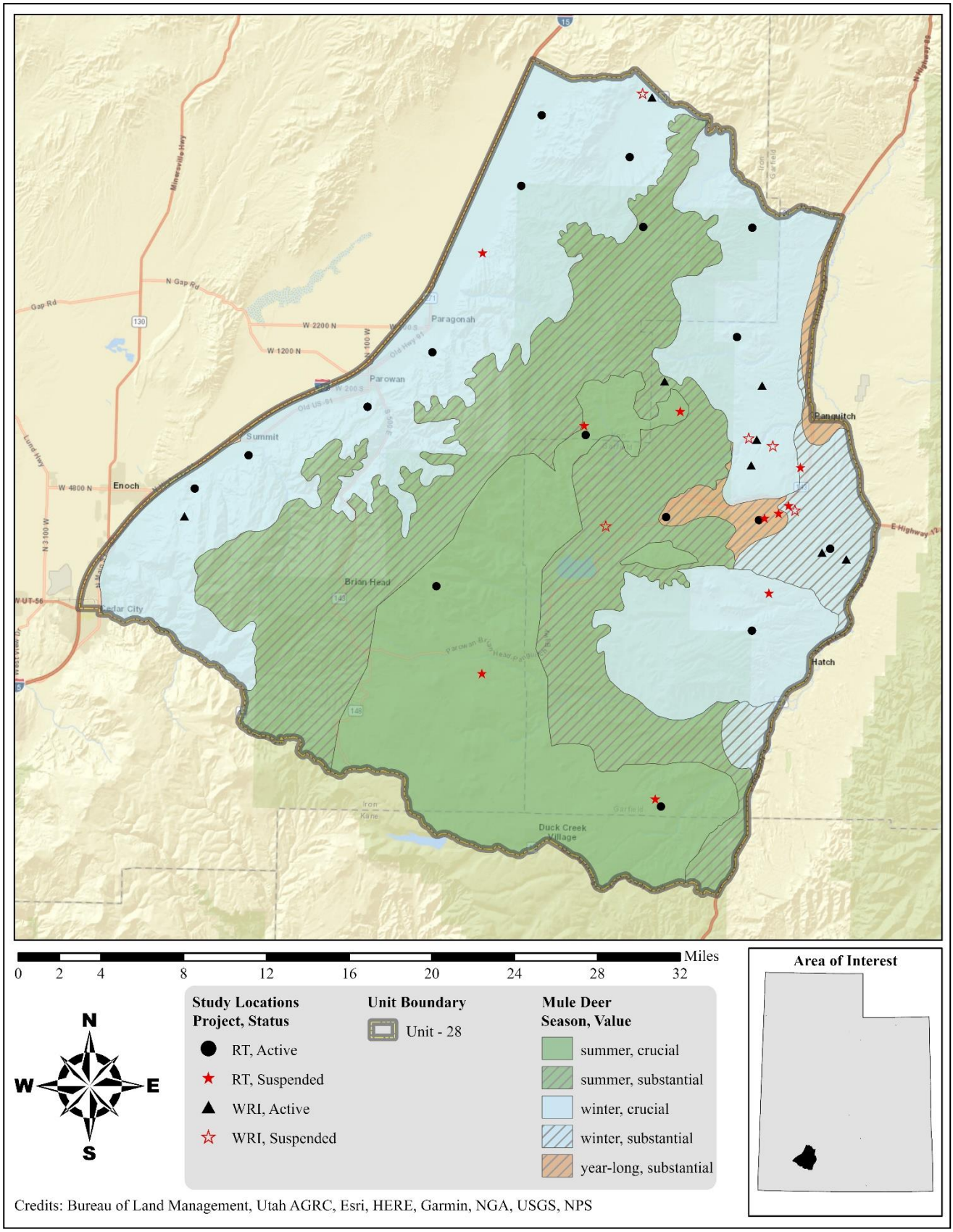
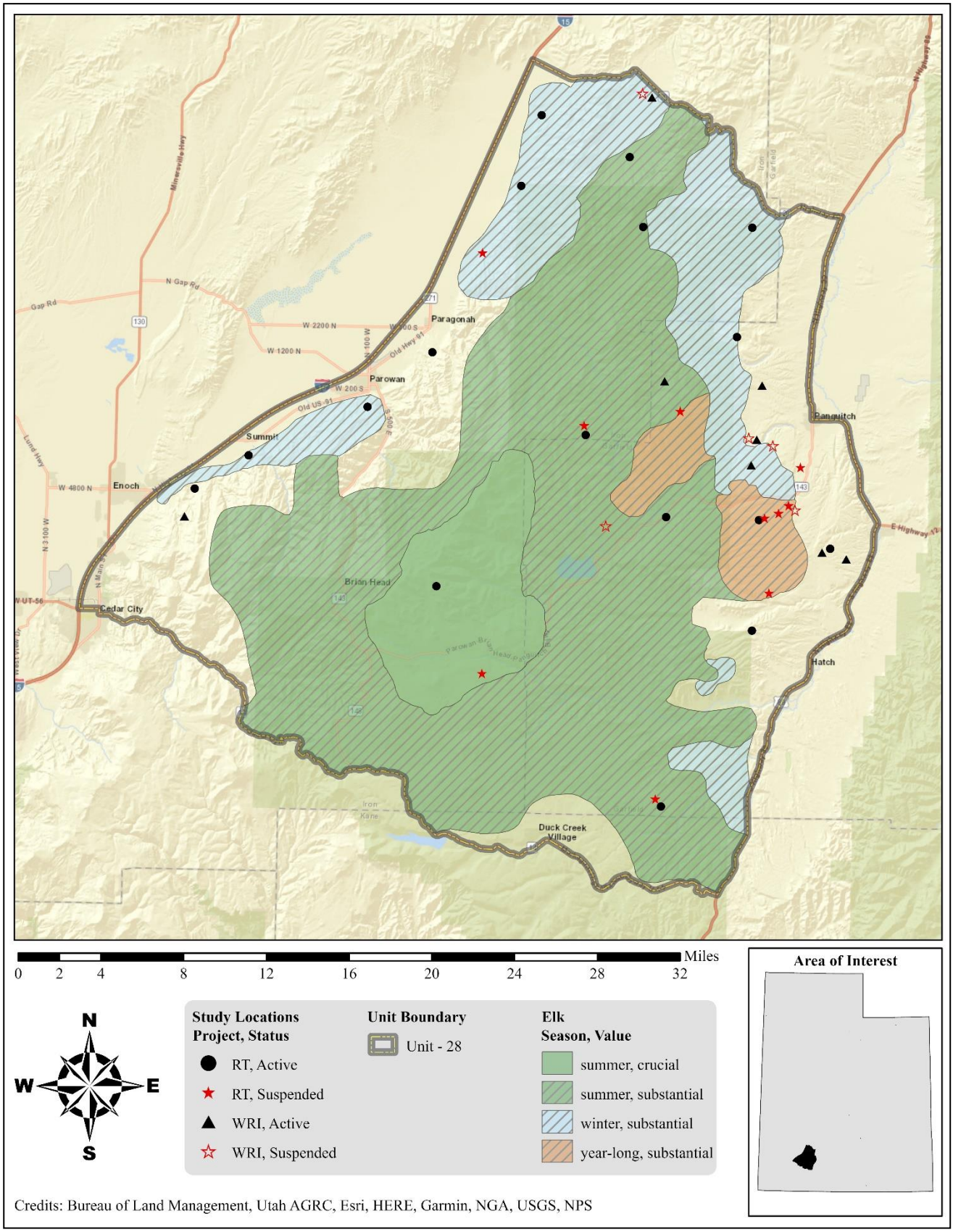


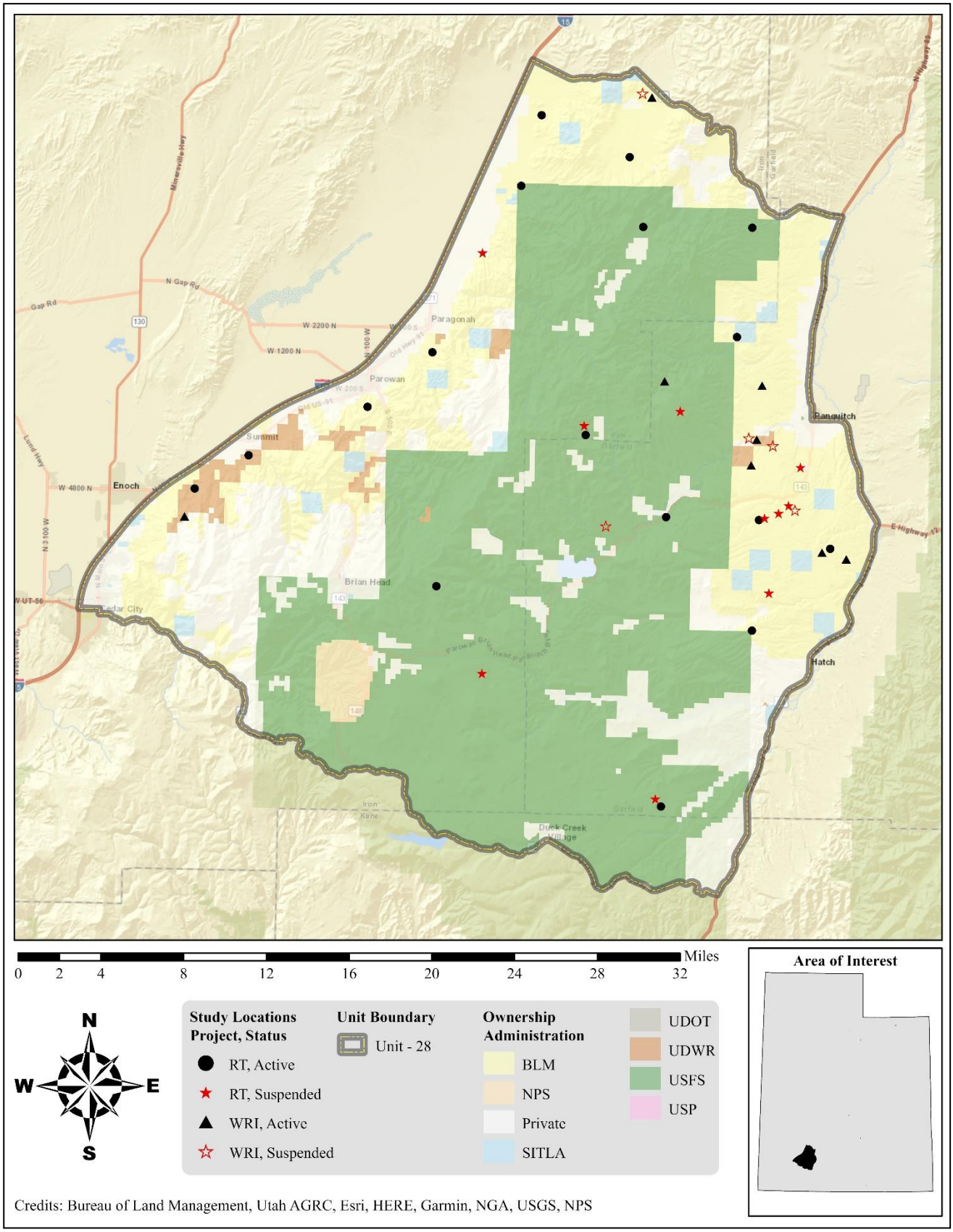
Figure 7.10: Average precipitation and estimated yearly stacked shrub and tree cover for year-long mule deer habitat in WMU 28, Panguitch Lake (Rangeland Analysis Platform, 2024).



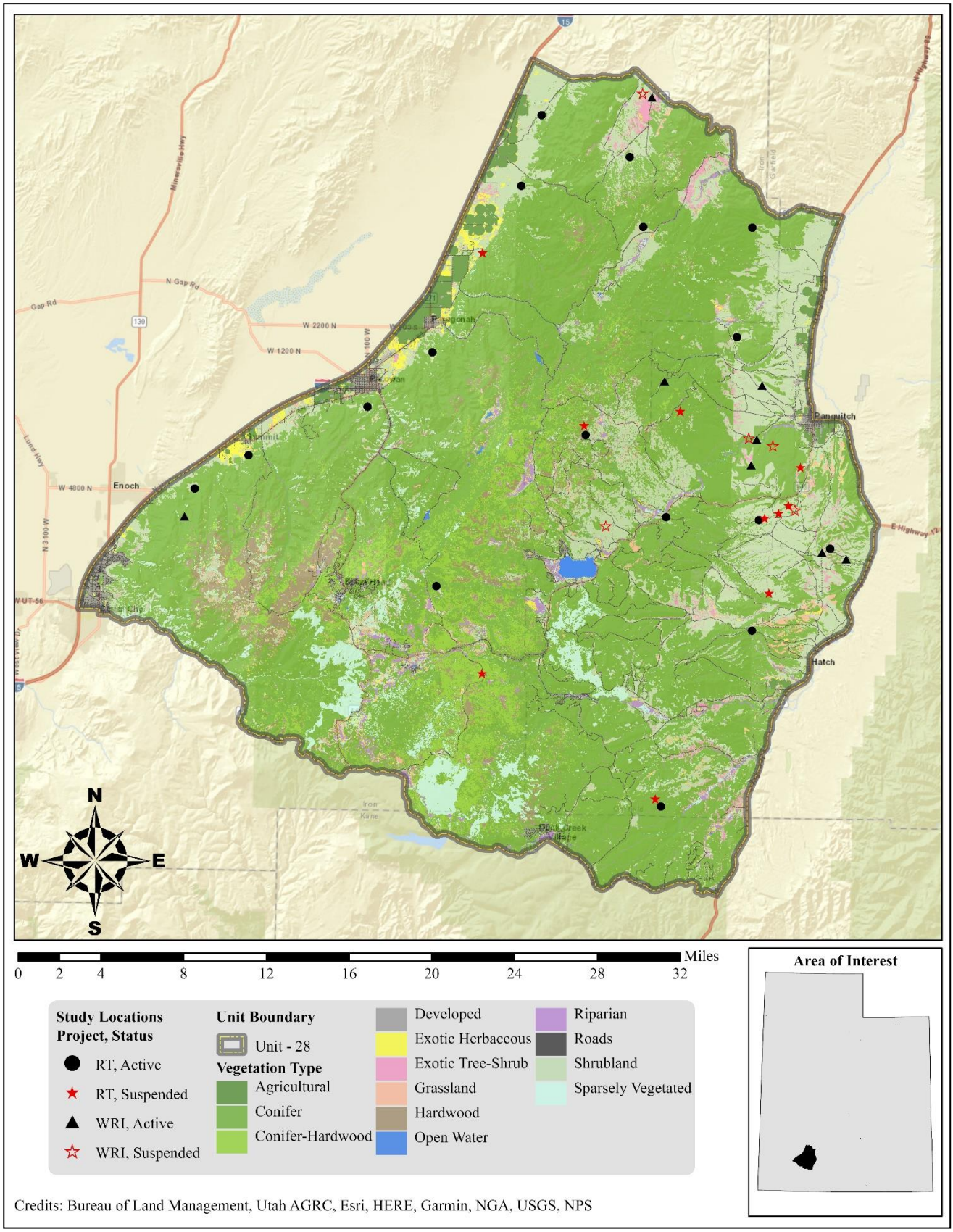
Map 7.2: Estimated mule deer habitat by season and value for WMU 28, Panguitch Lake.



Map 7.3: Estimated elk habitat by season and value for WMU 28, Panguitch Lake.



Map 7.4: Land ownership for WMU 28, Panguitch Lake.



Map 7.5: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 28, Panguitch Lake.

LANDFIRE Existing Vegetation Types on Mule Deer Habitat

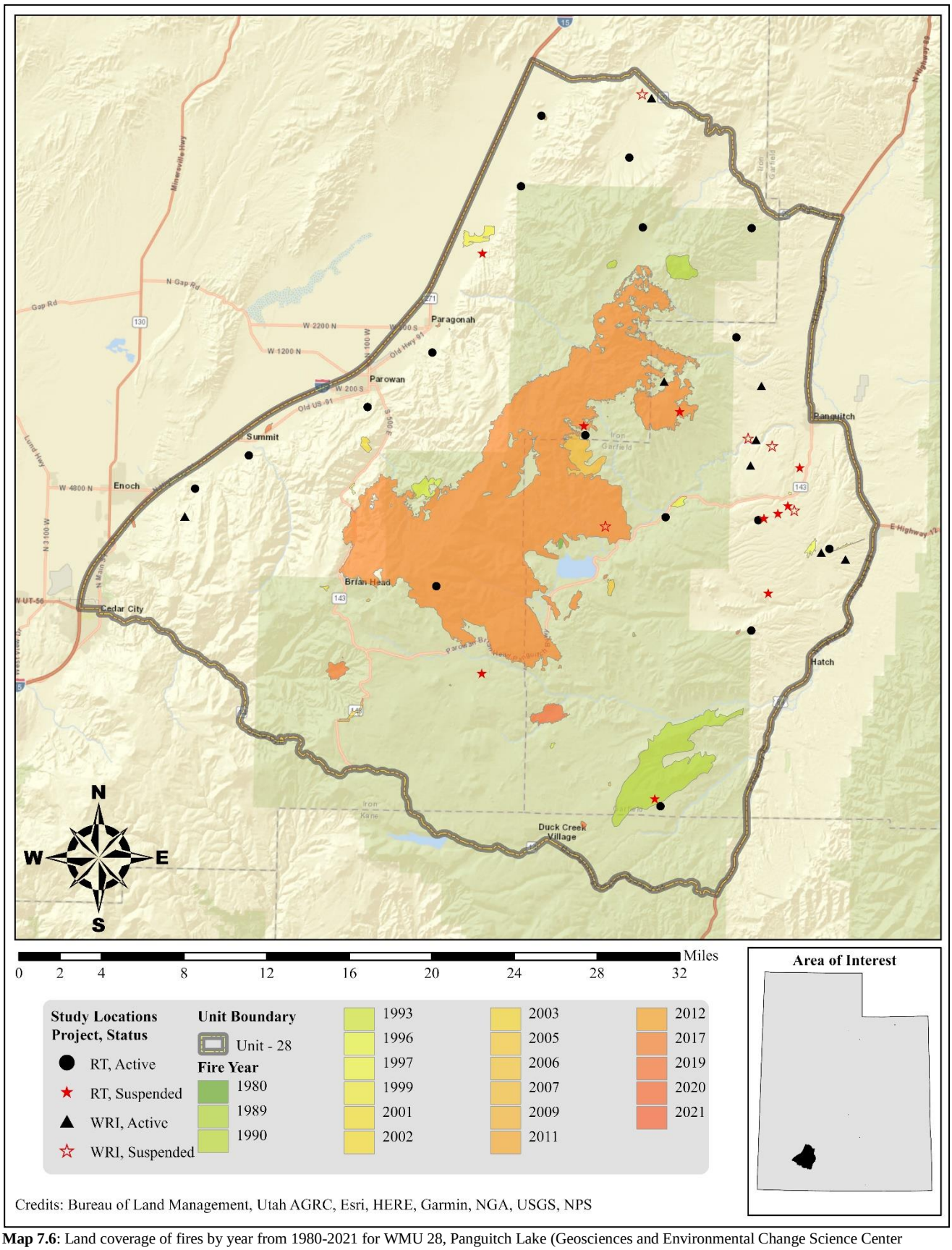
According to the current LANDFIRE Existing Vegetation Type model, just over 32% of the mule deer habitat in the Panguitch Lake management unit is comprised of pinyon-juniper woodlands (**Table 7.1**). These woodlands are usually located at lower elevations. These woodlands can be associated with understory browse species known to be beneficial to mule deer, although abundance may vary widely. Pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) woodlands can provide wildlife with thermal cover and valuable escape. When these trees encroach on existing shrublands, however, they can lead to decreased sagebrush (*Artemisia spp.*) and herbaceous components (Miller, Svejcar, & Rose, 2000), therefore decreasing available forage for wildlife.

The model also states that sagebrush steppe and shrublands make up approximately 14% of the unit's mule deer habitat (**Table 7.1**). These sagebrush biophysical sites can be found at elevations ranging from low (semidesert) to high (mountain and subalpine). Sagebrush species usually dominate these biophysical sites across the elevation gradient, and may provide valuable browse for deer when they are present on winter range. However, lesser amounts of other preferred browse species may also be present. At higher elevations, these biophysical sites are often host to abundant herbaceous understories that could provide forage for mule deer during the summer months. Pinyon and juniper may be present at lower to middle elevations on some biophysical sites.

The rest of the mule deer habitat within the Panguitch Lake unit is comprised of a variety of other vegetation types (**Table 7.1**) that will not be discussed here. Descriptions for these additional vegetation types are available on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	174,906	31.13%	
	Southern Rocky Mountain Ponderosa Pine Woodland	57,682	10.27%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	38,860	6.92%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	33,260	5.92%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	17,268	3.07%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	16,157	2.88%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	10,307	1.83%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	9,364	1.67%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	7,211	1.28%	
	Great Basin Pinyon-Juniper Woodland	5,593	1.00%	65.97%
Shrubland	Inter-Mountain Basins Montane Sagebrush Steppe	35,782	6.37%	
	Inter-Mountain Basins Big Sagebrush Shrubland	34,861	6.21%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	9,206	1.64%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	5,203	0.93%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	2,924	0.52%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	951	0.17%	
	Great Basin Xeric Mixed Sagebrush Shrubland	616	0.11%	
	Rocky Mountain Lower Montane-Foothill Shrubland	383	0.07%	
	Rocky Mountain Alpine Dwarf-Shrubland	45	0.01%	
	Inter-Mountain Basins Greasewood Flat	7	0.00%	
	Inter-Mountain Basins Big Sagebrush Steppe	6	0.00%	
	Great Basin Semi-Desert Chaparral	4	0.00%	
	Mojave Mid-Elevation Mixed Desert Scrub	0	0.00%	16.02%
Other	Developed	23089	4.11%	
	Sparsely Vegetated	21604	3.85%	
	Agricultural	8776	1.56%	
	Riparian	6657	1.18%	
	Open Water	1258	0.22%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	23	0.00%	10.93%
Hardwood	Rocky Mountain Aspen Forest and Woodland	20,952	3.73%	
	Rocky Mountain Bigtooth Maple Ravine Woodland	1,302	0.23%	3.96%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	3,660	0.65%	
	Southern Rocky Mountain Montane-Subalpine Grassland	2,521	0.45%	
	Inter-Mountain Basins Semi-Desert Grassland	247	0.04%	
	Rocky Mountain Alpine Turf	17	0.00%	
	Rocky Mountain Alpine Fell-Field	1	0.00%	1.15%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	5,795	1.03%	
	Interior Western North American Temperate Ruderal Shrubland	375	0.07%	1.10%
Exotic Herbaceous	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	3,535	0.63%	
	Great Basin & Intermountain Introduced Annual Grassland	634	0.11%	
	Interior Western North American Temperate Ruderal Grassland	515	0.09%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	230	0.04%	0.87%
Total		**561,788**	**100%**	**100%**

Table 7.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 28, Panguitch Lake.



Map 7.6: Land coverage of fires by year from 1980-2021 for WMU 28, Panguitch Lake (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

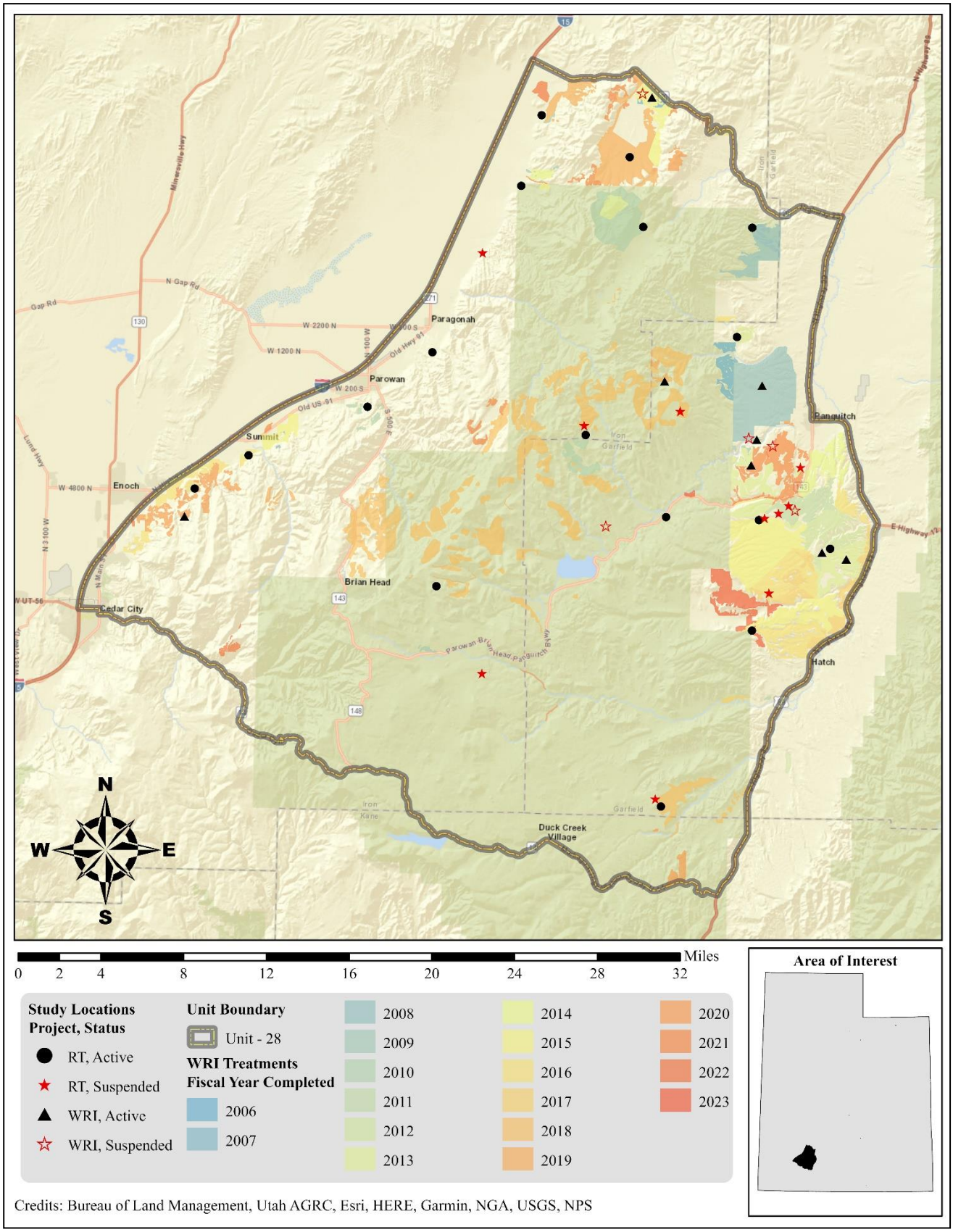
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 78,585 acres of land have been treated within the Panguitch Lake subunit since the WRI was implemented in 2004 (**Map 7.7**). Treatments frequently overlap one another bringing the net total of completed treatment acres to 72,427 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.

Manual vegetation removal such as lop and scatter treatments to remove trees is the most common management practice in the Panguitch Lake unit. Bullhog projects to remove pinyon and juniper and seeding projects to augment the herbaceous understory are also very common. Other management practices include (but are not limited to) prescribed fires, anchor chaining to remove trees, harrow treatments, and mowing (**Table 7.2**).

Type	Total Completed Acreage
Anchor Chain	**608**
Ely (One-Way)	332
Ely (Two-Way)	276
Bullhog	**19,591**
Full Size	17,936
Skid Steer	1,655
Harrow	**1,381**
≤ 15 ft. (One-Way)	457
≤ 15 ft. (Two-Way)	270
> 15 ft. (One-Way)	572
> 15 ft. (Two-Way)	82
Mowing	**1,267**
Brush Hog	1,113
Other	154
Prescribed Fire	**3,529**
Pile Burn	3,529
Seeding (Primary)	**18,927**
Broadcast (Aerial-Fixed Wing)	18,071
Broadcast (Aerial-Helicopter)	301
Drill (Rangeland)	54
Ground (Mechanical Application)	457
Hand Seeding	44
Seeding (Secondary/Shrub)	**412**
Hand Seeding	412
Vegetation Removal/Hand Crew	**32,852**
Lop & Scatter	31,700
Lop-Pile-Burn	1,152
Other	**18**
Road Decommissioning	18
Grand Total	**78,585**
***Total Land Area Treated**	**72,427**

Table 7.2: WRI treatment action size (acres) of completed projects for WMU 28, Panguitch Lake. Data accessed on 02/07/2024.
*Does not include overlapping treatments.



Map 7.7: Terrestrial WRI treatments by fiscal year completed for WMU 28, Panguitch Lake.

Range Trend Studies

Range Trend studies have been sampled within WMU 28 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (**Table 7.3**). 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
28-01	Three Creeks	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
28-02	Panguitch	RT	Suspended	1987, 1992, 1998	Mountain Loam (Black Sagebrush)
28-03	Bear Valley	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Mountain Big Sagebrush)
28-04	Buckskin Valley	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Shrub)
28-05	Swayback Knoll	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Bonneville Big Sagebrush)
28-06	Cottonwood	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush)
28-07	Paragonah	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Black Sagebrush)
28-08	Grass Valley	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
28-09	Little Valley	RT	Suspended	1987, 1992, 1998	High Mountain Loam (Aspen)
28-10	Red Desert	RT	Suspended	1987, 1992, 1998	High Mountain Loam (Aspen)
28-11	Elliker Basin	RT	Active	1987, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
28-12	Hurricane Cliffs	RT	Suspended	1987	Not Verified
28-13	Asay Knoll	RT	Suspended	1992, 1998, 2003	Mountain Stony Loam (Mountain Big Sagebrush)
28-14	Sheep Hollow West	RT	Active	1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Black Sagebrush)
28-15	Sheep Hollow East	RT	Suspended	1998, 2003, 2008, 2013	Upland Clay (Black Sagebrush)
28-16	Asay Bench	RT	Active	2003, 2008, 2013, 2018, 2023	Mountain Loam (Shrub)
28-17	Sidney Valley	RT	Active	2003, 2008, 2013, 2018, 2023	Subalpine Loam (Geranium)
28-18	Shakespeare Hollow	RT	Active	2003, 2008, 2013, 2018, 2023	High Mountain Loam (Silver Sagebrush)
28-19	DD Hollow	WRI	Active	2003, 2011, 2014, 2018, 2023	Upland Gravelly Loam (Black Sagebrush)
28-20	South Canyon	RT	Suspended	2003	Upland Loam (Black Sagebrush)
28-21	South Summit WMA	RT	Active	2008, 2013, 2018, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
28-22	Haycock Mountain	RT	Active	2013, 2018, 2023	Mountain Stony Loam (Antelope Bitterbrush)
28-23	Threemile Creek	RT	Active	2013, 2016, 2018, 2023	Upland Stony Loam (Black Sagebrush)
28-24	Above Limerock Canyon	RT	Active	2018, 2023	Mountain Stony Loam (Antelope Bitterbrush)
28R-01	Panguitch III	RT	Suspended	1998	Upland Stony Loam (Black Sagebrush)
28R-02	Five Mile Ridge Cattle Exc.	RT	Suspended	1998	Not Verified
28R-03	Five Mile Ridge Outside	RT	Suspended	1998	Not Verified
28R-04	Five Mile Ridge Wildlife Exc.	RT	Suspended	1998	Not Verified

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
28R-05	Five Mile Ridge Total Exc.	RT	Suspended	1998	Not Verified
28R-07	Sage Hen Hollow	RT	Suspended	2000, 2001	Not Verified
28R-08	South Canyon Burn 1	WRI	Suspended	2005	Not Verified
28R-09	South Canyon 2	WRI	Active	2005, 2012, 2016, 2020	Upland Gravelly Loam (Black Sagebrush)
28R-10	Buckskin Valley Highway 20	WRI	Active	2005, 2008, 2009, 2013, 2017, 2023	Upland Loam (Mountain Big Sagebrush-Indian Ricegrass)
28R-11	Five Mile Hollow	WRI	Suspended	2005	Not Verified
28R-12	Fivemile 2	WRI	Active	2007, 2011, 2015, 2019	Upland Loam (Black Sagebrush)
28R-13	Panguitch Creek	WRI	Active	2008, 2011, 2015, 2019	Upland Loam (Black Sagebrush)
28R-14	Buckskin Valley Highway 20 Reference	WRI	Suspended	2009	Not Verified
28R-15	Panguitch Creek WMA	WRI	Active	2009, 2010, 2013, 2017, 2022	Upland Gravelly Loam (Black Sagebrush)
28R-16	Panguitch Creek WMA Reference	WRI	Suspended	2009	Not Verified
28R-19	South Canyon	RT	Active	2011, 2014, 2018, 2023	Upland Loam (Black Sagebrush)
28R-20	Indian Hollow	WRI	Active	2018, 2022	High Mountain Loam (Douglas Fir)
28R-21	Williams Hollow	WRI	Suspended	2018	Mountain Stony Loam (Antelope Bitterbrush)
28R-22	Above Elliker Basin	WRI	Active	2018, 2022	Mountain Stony Loam (Oak)

Table 7.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 28, Panguitch Lake.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
28-01	Three Creeks	Hopper	Tebbs Hollow/Mud Springs Sagebrush and PJ Treatment	July-September 2006	400	458
		Chain Unknown		1967		
		Seed Unknown		1967		
		Lop and Scatter		Between 1987 and 1992		
		Prescribed Fire		2003		
		Lop and Scatter		Between 2003 and 2008		
28-03	Bear Valley	Chain Unknown		Historic		
		Seed Unknown		Historic		
28-04	Buckskin Valley	Lop and Scatter	Little Bear Valley to Fremont Canyon Sagebrush Steppe Habitat Restoration	November 2018-January 2019	4,095	4402
28-05	Swayback Knoll	Wildfire	Laub	Summer 2012	40	
		Broadcast After	Laub and Cotton Fire Rehab	August-September 2012	43	2469
		Browse Seed Planter	Laub and Cotton Fire Rehab	August-September 2012	43	2469
28-06	Cottonwood	Chain Unknown		1970		
		Seed Unknown		1970		
28-07	Paragonah	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Lop and Scatter		Between 1998 and 2003		
		Lop and Scatter		Between 2008 and 2013		
28-08	Grass Valley	Lop and Scatter	Parowan Front P-Hill	April-September 2022	671	5758
		Chain Unknown		Mid-1960s		
		Seed Unknown		Mid-1960s		
		Lop and Scatter		Between 1998 and 2003		
28-11	Elliker Basin	Seed Unknown		Historic		
		Lop and Scatter		Spring 1992		
		Lop and Scatter	Parowan Front WMA Arc for Bullhog and Lop and Scatter	Fall 2017-Summer 2018	1,674	3435
28-13	Asay Knoll	Wildfire		1989	3,436	

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
28-14	Sheep Hollow West	Lop and Scatter		Between 1996 and 1997		
		Lop and Scatter	South Canyon Lop and Scatter	August-October 2014	5,390	2987
28-15	Sheep Hollow East	Lop and Scatter	South Canyon Lop and Scatter	August 2014-October 2014	5,390	2987
28-17	Sidney Valley	Wildfire	Brian Head	June-July 2017	71,692	
28-19	DD Hollow	Bullhog	BLM	2012		
		Bullhog	BLM Project	Fall 2003	765	BLM
		Seed Unknown	BLM Project	Fall 2003	765	BLM
		Lop and Scatter	2022 Cedar City and Kanab Field Offices BLM Maintenance (Proposed)	Fall 2023	805	5888
28-21	South Summit WMA	Chain Unknown		Historic		
		Seed Unknown		Historic		
		Herbicide Unknown		Historic		
		Lop and Scatter		Historic		
		Lop and Scatter	Parowan Front WMA Arc for Bullhog and Lop and Scatter	September 2017-June 2018	1,674	3435
		Lop and Scatter	Parowan Front (Cottonwood and Summit) Chaining)	July 2014-June 2015	1,109	3070
28-23	Threemile Creek	Two-Way Ely	Panguitch West Bench Habitat Improvement	September-November 2012	276	2373
		Aerial Before	Panguitch West Bench Habitat Improvement	September 2012	276	2373
		Dribbler	Panguitch West Bench Habitat Improvement	September-November 2012	276	2373
		Aerial After	Panguitch West Bench Habitat Improvement	February 2013	276	2373
28-24	Above Limerock Canyon	Aerial Before	South Canyon (Limestone)	November 2015	1,694	3264
		Bullhog	South Canyon (Limestone)	October 2015-January 2016	1,694	3264
28R-1	Panguitch III	Aerial Before	South Canyon	October 2010	1,749	1716
		Bullhog	South Canyon	December 2010-April 2011	1,749	1716
28R-2	Five Mile Ridge Cattle Exc.	Wildfire	Brianhead	June-July 2017	71,693	
		Aerial After	Brian Head Fire Rehabilitation	September-October 2017	6,882	4358
28R-3	Five Mile Ridge Outside	Wildfire	Brianhead	June-July 2017	71,693	
		Aerial After	Brian Head Fire Rehabilitation	September-October 2017	6,882	4358
28R-4	Five Mile Ridge Wildlife Exc.	Wildfire	Brianhead	June-July 2017	71,693	
		Aerial After	Brian Head Fire Rehabilitation	September-October 2017	6,882	4358
28R-5	Five Mile Ridge Total Exc.	Wildfire	Brianhead	June-July 2017	71,693	
		Aerial After	Brian Head Fire Rehabilitation	September-October 2017	6,882	4358
28R-7	Sage Hen Hollow	Lop and Scatter	South Canyon (Limestone)	October 2015-January 2016	1,694	3264
28R-8	South Canyon Burn 1	Aerial Before	South Canyon	October 2010	1,749	1716
		Bullhog	South Canyon	December 2010-April 2011	1,749	1716
28R-9	South Canyon 2	Bullhog	South Canyon (Hillsdale)	October 2012-February 2013	2,279	2311
		Aerial Before	South Canyon (Hillsdale)	September 2012	2,279	2311
28R-10	Buckskin Valley Highway 20	Seeding Unknown	Middle Buckskin Seeding	Historic		
		Two-Way Dixie	Buckskin Valley Hwy 20	September 2005	270	242
		Broadcast Before	Buckskin Valley Hwy 20	September 2005	270	242
28R-11	Five Mile Hollow	Lop and Scatter	Fivemile Hollow Sagebrush Restoration - Year 3	November 2008-May 2009	6,465	901
28R-12	Fivemile 2	Lop and Scatter	Five Mile Hollow Sagebrush Restoration - Year 3	November 2008-May 2009	6,465	901
28R-13	Panguitch Creek	Bullhog	Panguitch Creek WMA PJ Thinning	Spring 2009	28	1206
		Aerial Before	Panguitch Creek WMA PJ Thinning	November 2008	383	1206
28R-15	Panguitch Creek WMA	Lop and Scatter	Annual Habitat Restoration Project Maintenance	August 2013	1,274	1998
		Two-Way Ely	Panguitch Creek WMA PJ Thinning	November 2008	383	1206
		Aerial Before	Panguitch Creek WMA PJ Thinning	November 2008	383	1206
		Dribbler	Panguitch Creek WMA PJ Thinning	November 2008	383	1206
28R-19	South Canyon	Bullhog	South Canyon Year 2	October 2011-January 2012	1,901	2027
		Aerial Before	South Canyon Year 2	October 2011	1,901	2027

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
28R-20	Indian Hollow	Lop and Pile	Brian Head Fire Rehabilitation Phase II	Fall 2017	188	4532
		Prescribed	Brian Head Fire Rehabilitation Phase II	Fall 2018	188	4532
28R-21	Williams Hollow	Aerial Before	Brian Head Fire Rehabilitation Phase II (Proposed)	Fall 2018	2,080	4532
		Two-Way Ely	Brian Head Fire Rehabilitation Phase II (Proposed)	Fall 2018	2,080	4532
		Wildfire	Brian Head	June 2017	71,693	
28R-22	Above Elliker Basin	Aerial Before	Parowan Front Braffits Creek	November 2019	1,507	4990
		Bullhog	Parowan Front Braffits Creek	November 2019-January 2020 and March-June 2020	1,507	4990

Table 7.4: Range Trend and WRI studies known disturbance history for WMU 28, Panguitch Lake. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Ecotypes that are represented by only one study site throughout most or all of the sample period are not discussed in this section. These ectoypes include:

- Subalpine (Geranium) - Sidney Valley (28-17)
- Mountain (Aspen) - Little Valley (28-09) (suspended) and Red Desert (28-10) (suspended)
- Mountain (Big Sagebrush) - Bear Valley (28-03) and Asay Knoll (28-13) (suspended)
- Mountain (Black/Low Sagebrush) - Panguitch (28-02) (suspended) and Sheep Hollow West (28-14)]
- Mountain (Silver Sagebrush) - Shakespeare Hollow (28-18).

Trend summaries and/or data for these ecotypes are available in the corresponding site reports.

Mountain (Shrub)

Four studies [Buckskin Valley (28-04), Asay Bench (28-16), Haycock Mountain (28-22), and Above Limerock Canyon (28-24)] are classified as Mountain (Shrub) ecological sites. The Buckskin Mountain study is situated south of SR-20 in Buckskin Valley. The Asay Bench site is located on Asay Bench, just east of Asay Knoll. Haycock Mountain is located northeast of Panguitch Lake on the north-facing slopes of Haycock Mountain. The Above Limerock Canyon study site is found near Limestone Creek, west of the town of Hatch.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, the Buckskin Valley site has provided data since 1992, while Asay Bench has contributed data since 2003. Data has also been provided by Haycock Mountain since 2013, and Above Limerock Canyon has contributed data since it was established in 2018.

Shrubs/Trees: These study sites generally support stands of antelope bitterbrush (*Purshia tridentata*) and other preferred browse such as sagebrush (*Artemisia spp.*). Average cover data indicates that overall shrub cover has exhibited some fluctuations but with no overall discernable trend: this may be due in part to the addition of new study sites in 2013 and 2018. Despite these fluctuations, however, cover has remained fairly stable overall. In addition, preferred browse other than bitterbrush has contributed a majority of the cover on these sites throughout the duration of the study period (**Figure 7.11**). According to average preferred browse demographics, mature individuals have made up a majority of these plant populations in all sample years with decadence varying widely. Overall density has decreased, with the decrease between 1992 and 1998 entirely driven by the Buckskin Mountain study (**Figure 7.16**). Overall utilization has also varied widely since 2008 along with the percentage of moderate to heavy utilization (**Figure 7.17**).

Average tree cover on these sites has remained low over the sample period, and is mainly contributed by Rocky Mountain juniper (*Juniperus scopulorum*) on the Buckskin Valley study. Although tree cover has remained low, a decrease was observed between 2018 and 2023 due to a lop and scatter treatment that occurred between 2018 and 2019 (**Figure 7.13**). Average tree density was observed beginning in 2018 and has since decreased. However, it would be prudent to consider that this density increase could be due to point-quarter data consistently being sampled beginning in 2018 (**Figure 7.15**).

Herbaceous Understory: On average, perennial grasses have contributed a majority of the herbaceous cover in most sample years, and have gradually increased as studies have been added to this ecological potential. The exception to this is 1998: a mixture of perennial forbs and annual grasses and forbs dominated the only site sampled that year (Buckskin Valley) (**Figure 7.18**). Nested frequencies of annual and perennial forbs have driven an overall decreasing trend while perennial grass frequency has remained fairly stable (**Figure 7.19**).

Occupancy: Average pellet transect data shows that animal occupancy exhibited an increase between 1998 and 2013, but decreased between 2013 and 2023. Deer and/or sheep have been the primary occupants in all sample years, with a mean pellet group abundance ranging from 38.5 days use/acre in 2018 to nearly 52 days use/acre in 2008 and 2013. Cattle pellet groups have had a mean abundance ranging from nearly 4 days use/acre in 2023 to almost 9 days use/acre in 2008. Finally, mean pellet group abundance for elk has been as low as 0 days use/acre in 1998 and as high as just over 23 days use/acre in 2013 (**Figure 7.20**).

Upland (Big Sagebrush)

Six study sites [Three Creeks (28-01), Swayback Knoll (28-05), Cottonwood (28-06), Grass Valley (28-08), Elliker Basin (28-11), and South Summit WMA (28-21)] are considered to be Upland (Big Sagebrush) ecological sites. The Three Creeks study is situated west of Bear Valley Junction and near Three Creeks Spring. The Swayback Knoll site is located just south of Swayback Knoll below the Hurricane Cliffs. Cottonwood can be found north of Paragonah at the mouth of Cottonwood Canyon, and the Grass Valley study is located south of Parowan in Grass Valley. The Elliker Basin study site is situated southeast of I-15 in Elliker Basin. Finally, South Summit WMA can be found just south of the town of Summit on the Parowan Front Wildlife Management Area.

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) contributes a majority of the shrub cover on these study sites, and average shrub cover has exhibited a slight decrease over the sample years. Other shrubs and preferred browse species excluding sagebrush contribute little cover (**Figure 7.12**). Average preferred browse demographics indicate that density has steadily decreased over time. Demographic data also shows that mature individuals have comprised a majority of the browse populations and that recruitment of young and decadence have decreased overall (**Figure 7.16**). Average utilization of preferred browse has fluctuated over time, but appears to have slightly decreased overall. In most sample years (including 2023), at least 50% of the plants have been moderately to heavily browsed. However, only 44% of plants were moderately to heavily used in 1998 and 25% of plants exhibited that utilization in 2018 (**Figure 7.17**).

Average tree cover on sites of this ecological potential has been absent to very low. Twoneedle pinyon (*Pinus edulis*) was observed on the Three Creeks study site in 2003 and 2023, and Utah juniper (*Juniperus osteosperma*) was observed on the South Summit WMA site in 2023 (**Figure 7.13**). Although tree cover was absent in some years, tree density data indicates that both twoneedle pinyon and Utah juniper have been present throughout the study period. However, all of the density prior to 2018 was contributed by the Three Creeks and Grass Valley studies; point-quarter data for Elliker Basin, Cottonwood, and South Summit WMA has been taken from 2018 onwards (**Figure 7.15**).

Herbaceous Understory: Perennial grasses have dominated the understories of these study sites in most sample years. Prior to 2008, however, perennial and annual grasses were codominant components: much of the annual grass cover can be attributed to the introduced species cheatgrass (*Bromus tectorum*) on the Elliker Basin and Cottonwood studies. The introduced perennial grass species bulbous bluegrass (*Poa bulbosa*) has been present in all years in the average cover and nested frequency data with an increasing trend. Bulbous bluegrass has been observed on the Grass Valley, Elliker Basin, and South Summit WMA studies, but the increasing trend is largely driven by the Grass Valley site. Forbs have generally remained rare when compared to grasses (**Figure 7.18**, **Figure 7.19**).

Occupancy: Average pellet transect data shows that animal presence increased between 1998 and 2008, but has decreased overall since that time. Deer have primarily occupied these study sites in all sample years. Mean abundance of deer pellet groups has ranged from just under 20 days use/acre in 2018 to 87 days use/acre in 2008. Cattle have also been present, with mean pellet group abundance fluctuating between just under 4 days use/acre in 2018 and 11.5 days use/acre in 1998. Mean abundance of elk pellet groups has been as low as 1 days use/acre in 2023 and as high as 4 days use/acre in 2008 (**Figure 7.21**).

Upland (Black/Low Sagebrush)

Six studies [Paragonah (28-07), Sheep Hollow East (28-15) (suspended), South Canyon (28-20) (suspended), Threemile Creek (28-23), Panguitch III (28-01) (suspended), and Sage Hen Hollow (28R-07) (suspended)] are classified as Upland (Black/Low Sagebrush) ecological sites. The Paragonah study is located south of the town of Paragonah and in between the mouths of Water and Order Canyons. Sheep Hollow East is situated in Sheep Hollow, just east of the Sheep Hollow West site. The South Canyon site is located south of South Canyon and north of Sheep Hollow. The Threemile Creek study can be found northwest of the city of Panguitch near Threemile Creek. The Panguitch III site is south of Panguitch and just north of Sheep Hollow. Finally, the Sage Hen Hollow study is located approximately five miles southwest of Hillsdale and just north of Rock Canyon.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, the Paragonah site has provided data since 1992, Panguitch III contributed data in 1998 and was then suspended, and Sage Hen Hollow only provided data in 1998 and 2003. South Canyon provided data only in 2003, and Sheep Hollow East has contributed data since 1998. Finally, the Threemile Creek site has provided data since it was established in 2013.

Shrubs/Trees: Average shrub cover on these study sites has exhibited an overall increase, mainly due to black sagebrush (*Artemisia nova*); mountain big sagebrush is also present on all three study sites to a lesser extent. Other preferred browse and other shrubs have also been observed, but have contributed less cover. Due to the different number of studies sampled from year to year, it is difficult to establish a trend (**Figure 7.12**). Average preferred browse demographics indicate that despite yearly fluctuations, density has increased overall. The data also shows that mature individuals have comprised a majority of the plant populations in most study years (**Figure 7.16**). Average utilization of preferred browse has fluctuated. Less than 20% of plants exhibited moderate to heavy use in 2003 and 2018. In 1992, 2013, and 2023, however, over 20% were moderately to heavily browsed (**Figure 7.17**).

Juniper species (*Juniperus spp.*) and twoneedle pinyon (*Pinus edulis*) have been present on all study sites, except for on the Panguitch III and Sheep Hollow East sites where pinyon species (*P. spp*.) were the only trees present. Average tree cover has was high in 2003 and was primarily influenced by South Canyon, which was dominated by pinyon pine. South Canyon has since been suspended, which is the reason for the large decrease in average cover in 2008. Average tree cover has remained low overall since 2008 (**Figure 7.14**). The decrease in mean density between 2003 and 2008 is due to the suspension of the South Canyon study. Average density has increased overall since 2008 despite multiple treatments targeting pinyon and juniper occurring during this period on Paragonah, Sheep Hollow East, and Threemile Creek (**Figure 7.15**).

Herbaceous Understory: Native and/or introduced perennial grasses have contributed a majority of the herbaceous cover on these studies in all sample years, with overall average cover gradually increasing over time. Perennial forbs and annual grasses and forbs are present, but have provided much less cover. However, annual grasses had a notable increase in average cover in 2023, which was likely due to the wet winter and spring of 2022/23 (**Figure 7.18**). Average nested frequency values have varied from year to year. Fluctuations in frequency of the introduced annual grass species cheatgrass can be almost entirely attributed to the Paragonah study in 2008 and the Threemile Creek study in 2023 (**Figure 7.19**).

Occupancy: Animal presence has exhibited a decrease over the study years according to average pellet transect data; however, an overall trend is difficult to determine due to the differing number of studies sampled from year to year. Deer have been the primary occupants in all study years. Mean abundance of deer pellet groups has been as low as 10 days use/acre in 2023 and as high at just over 36 days use/acre in 2008. Cattle have also been present, with a mean pellet group abundance ranging from 0 days use/acre in 2013 to nearly 8 days use/acre in 2003. Finally, mean abundance of elk pellet groups has been as low as 0 days use/acre in 2013 and as high as 4 days use/acre in 1998 (**Figure 7.21**).

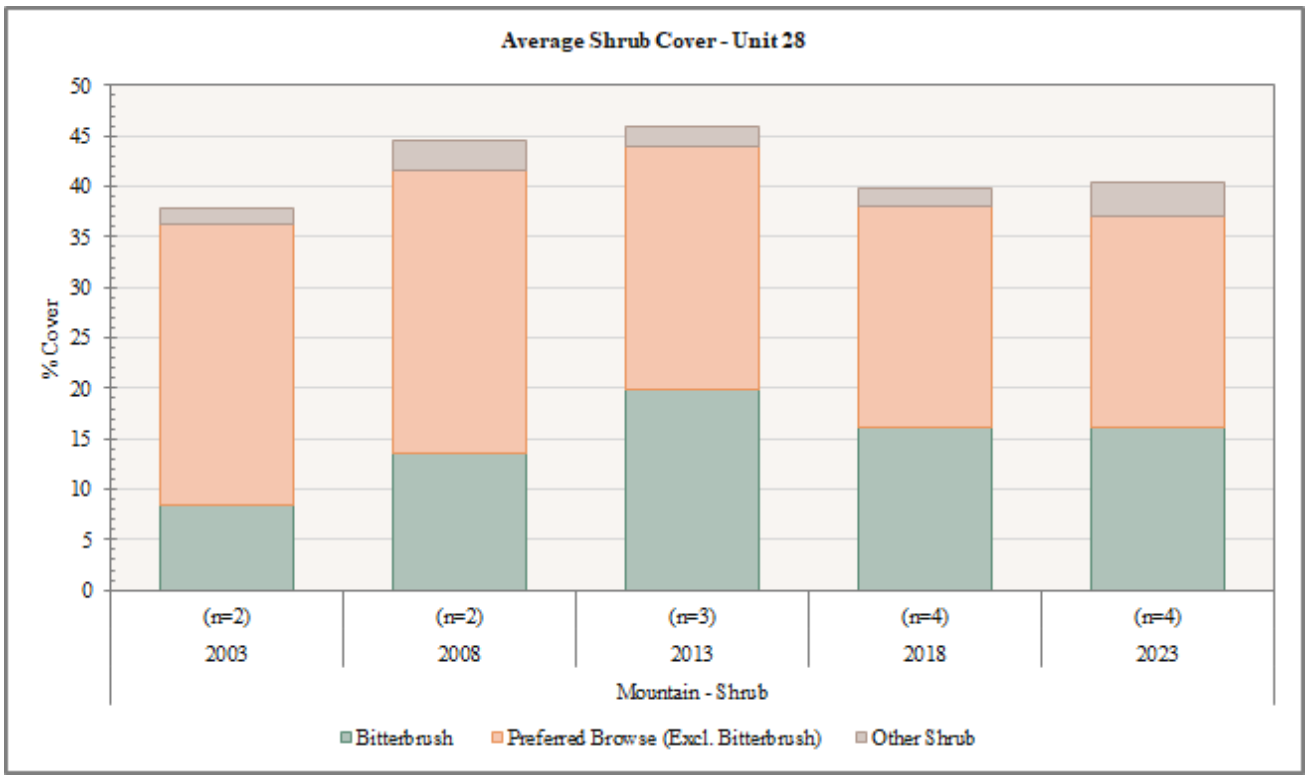


Figure 7.11: Average shrub cover for Mountain - Shrub study sites in WMU 28, Panguitch Lake.

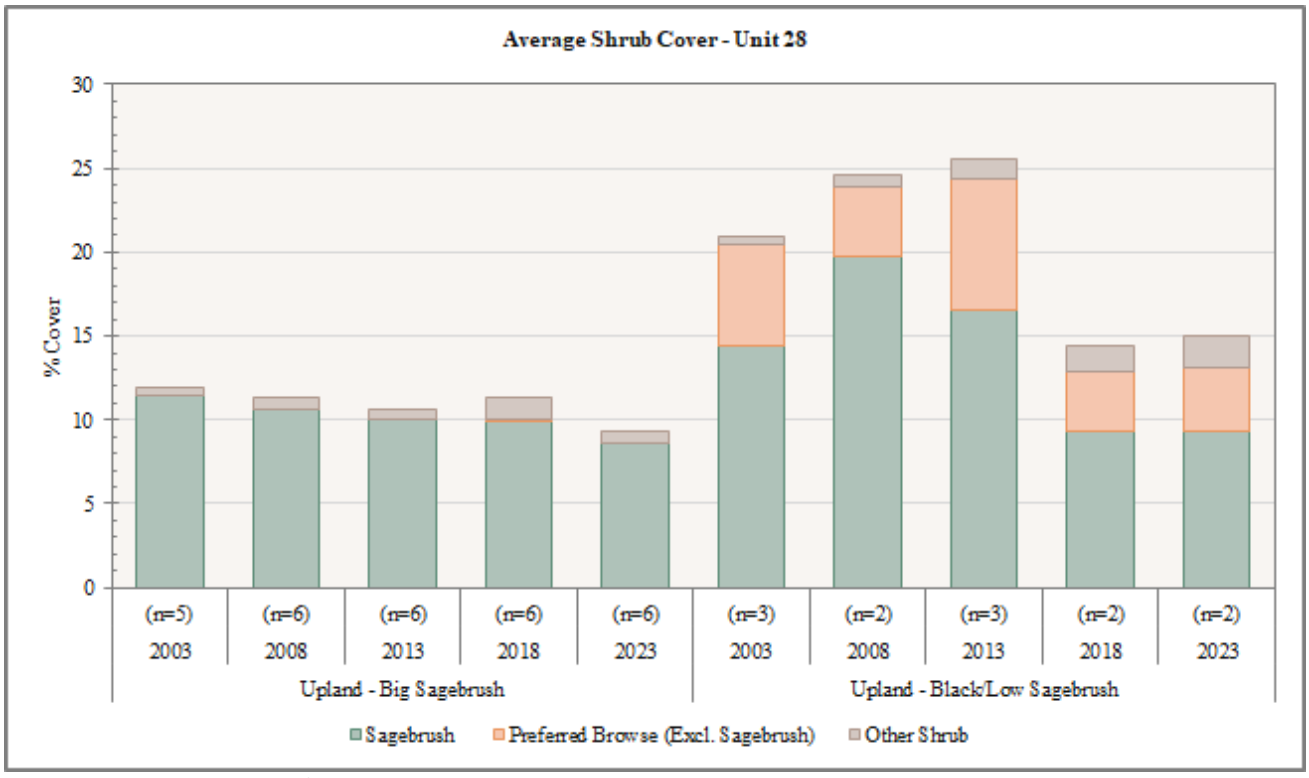


Figure 7.12: Average shrub cover for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

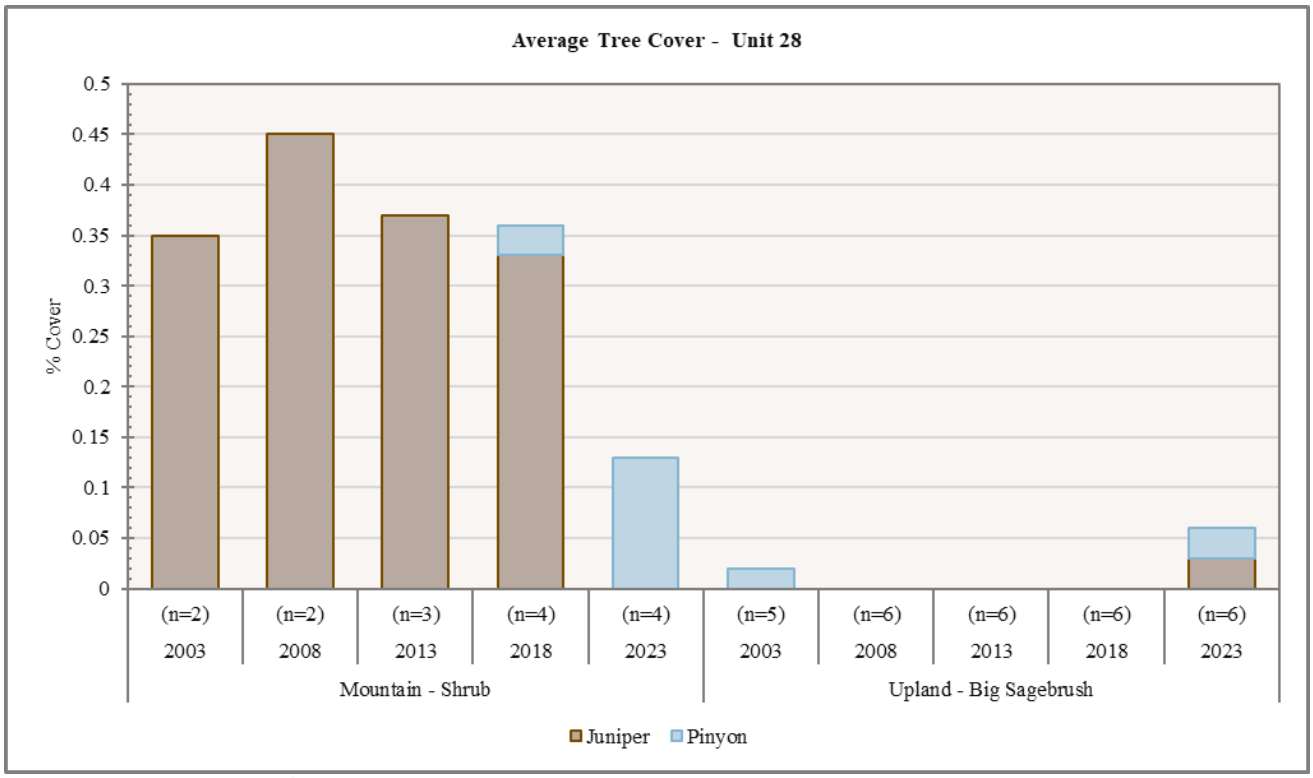


Figure 7.13: Average tree cover for Mountain - Shrub and Upland - Big Sagebrush study sites in WMU 28, Panguitch Lake.

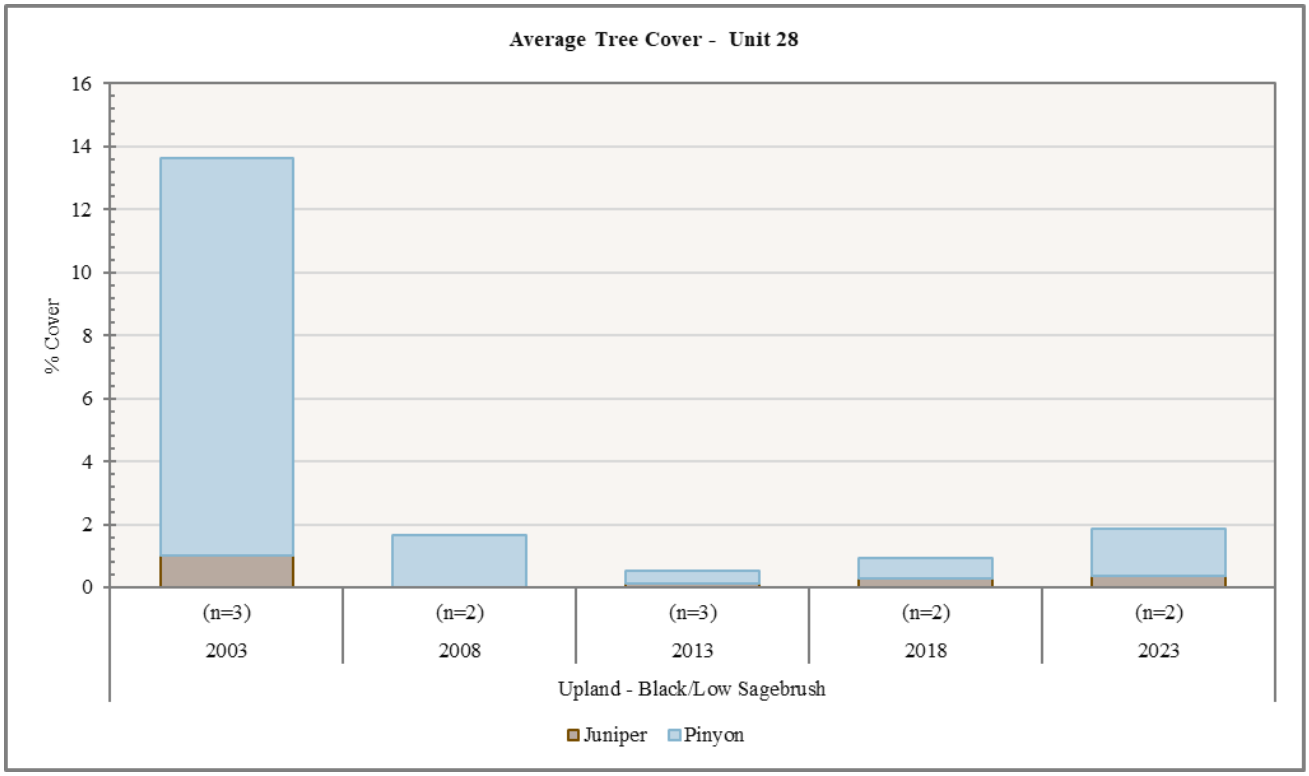


Figure 7.14: Average tree cover for Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

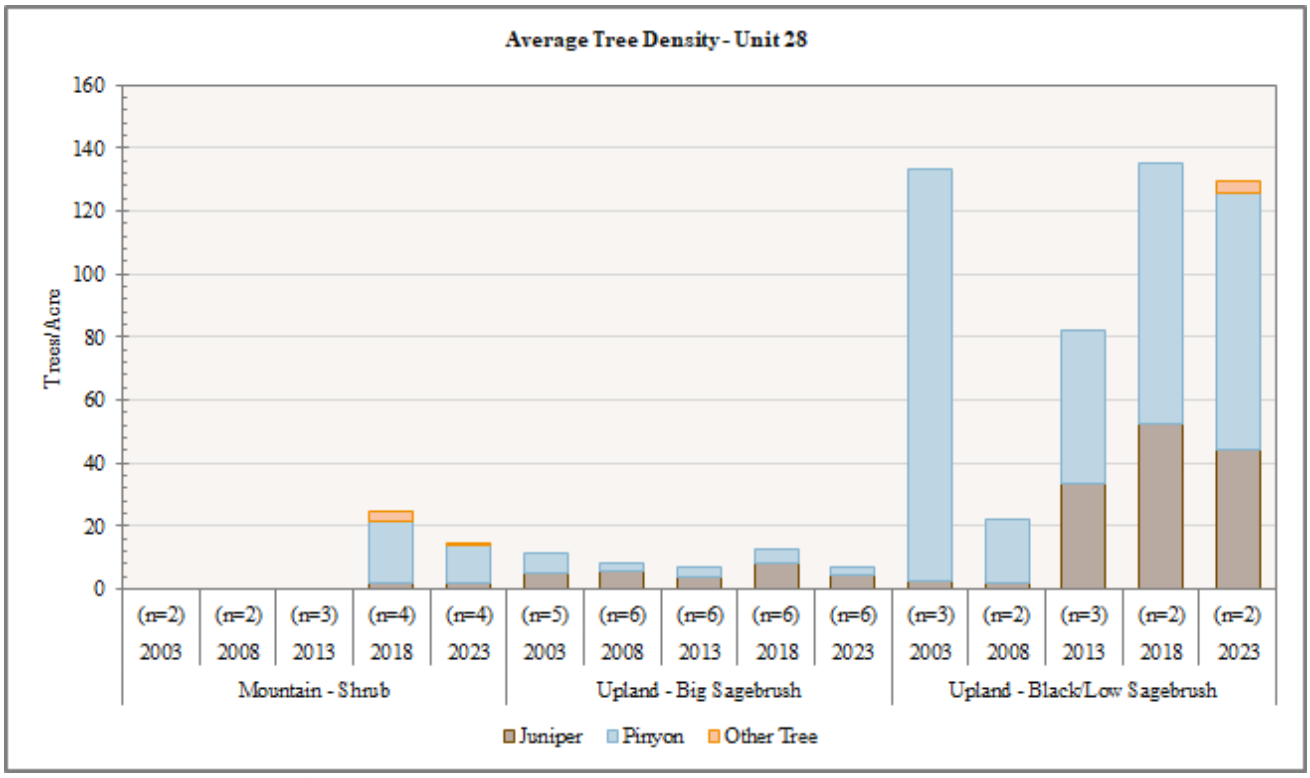


Figure 7.15: Average tree density for Mountain - Shrub, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

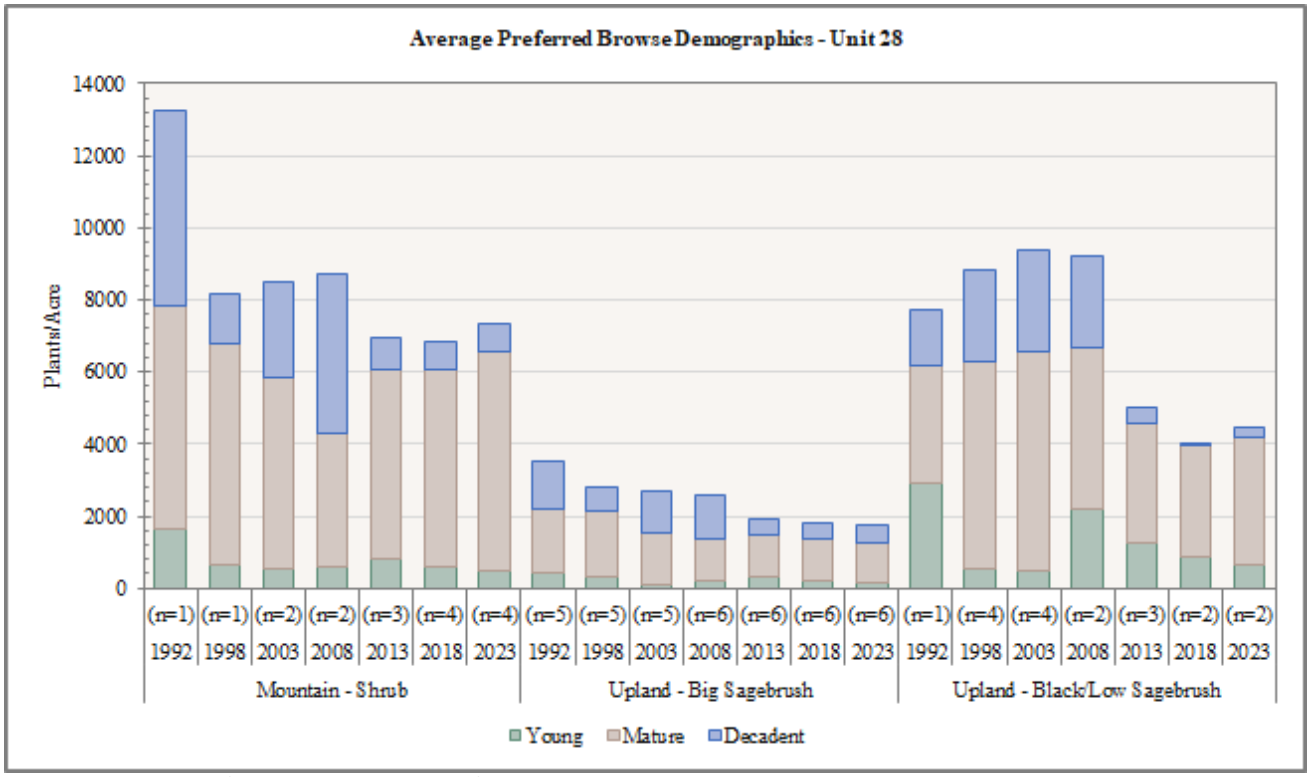


Figure 7.16: Average preferred browse demographics for Mountain - Shrub, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

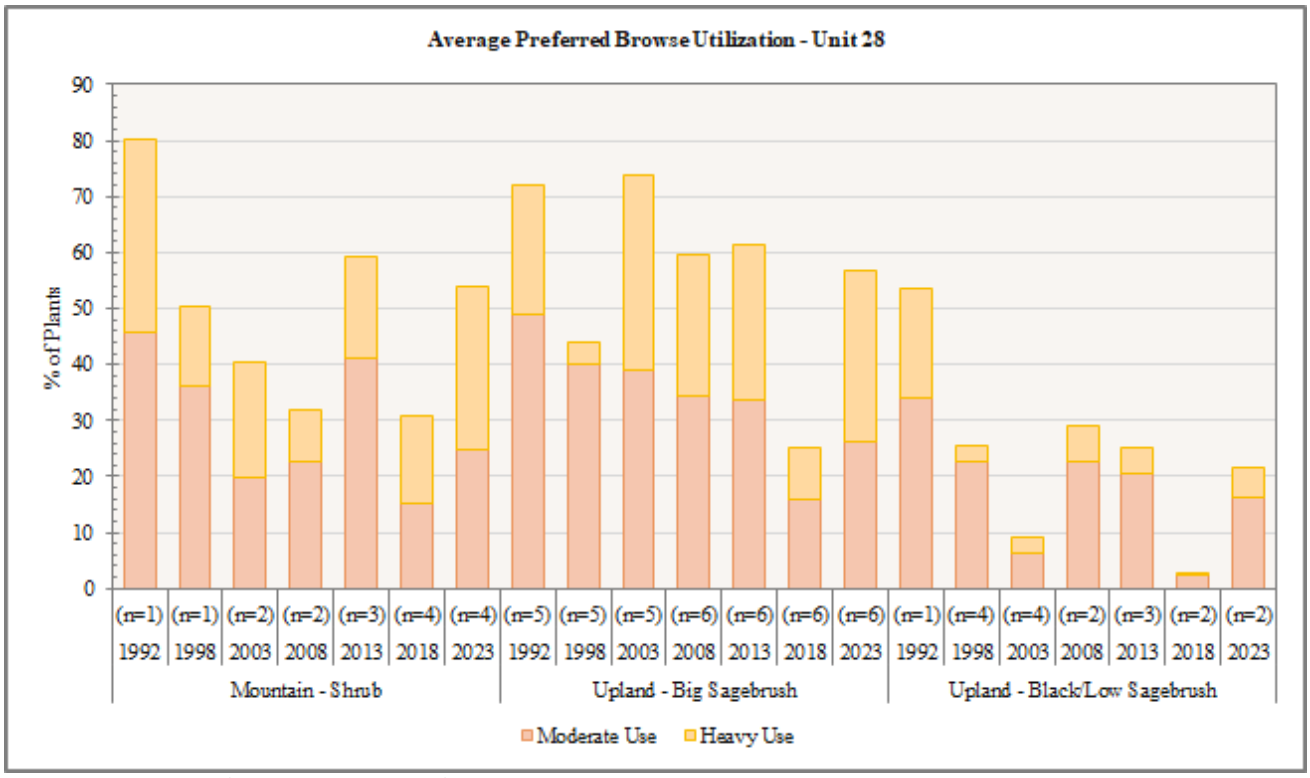


Figure 7.17: Average preferred browse utilization for Mountain - Shrub, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

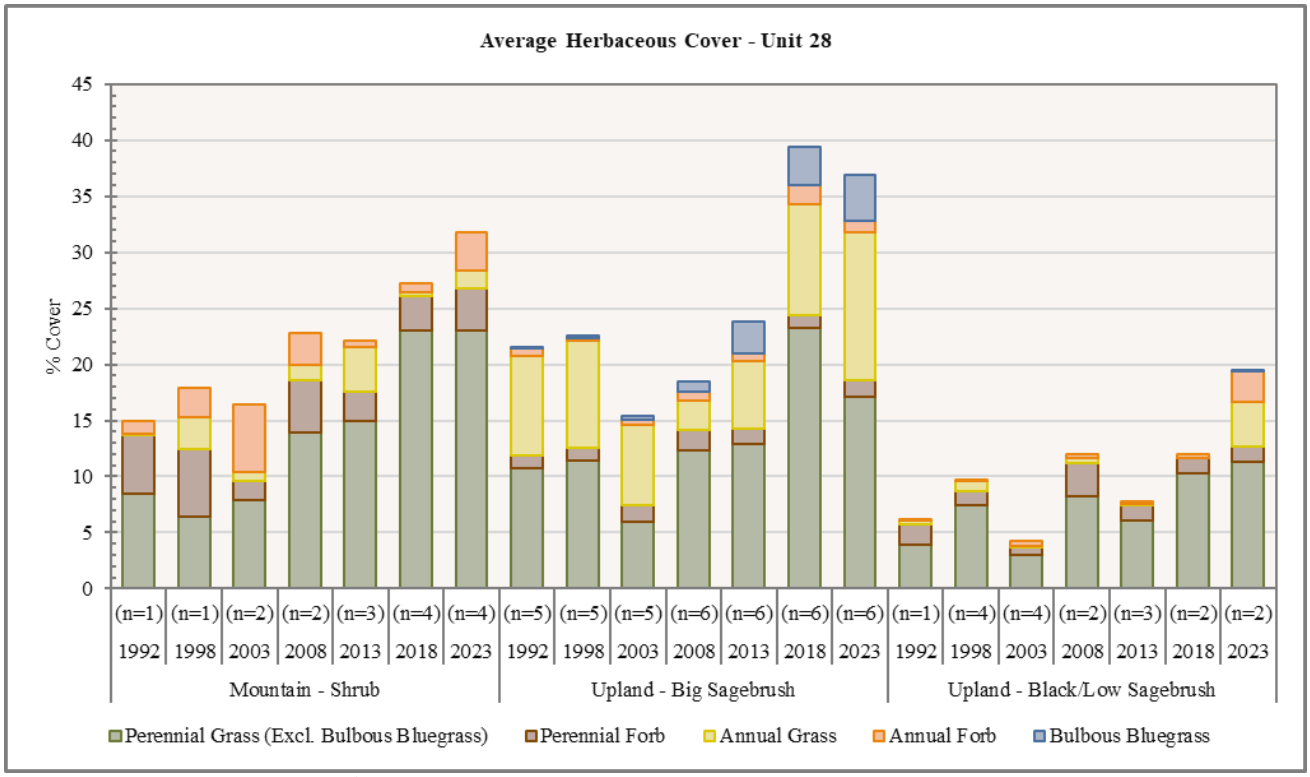


Figure 7.18: Average herbaceous cover for Mountain - Shrub, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

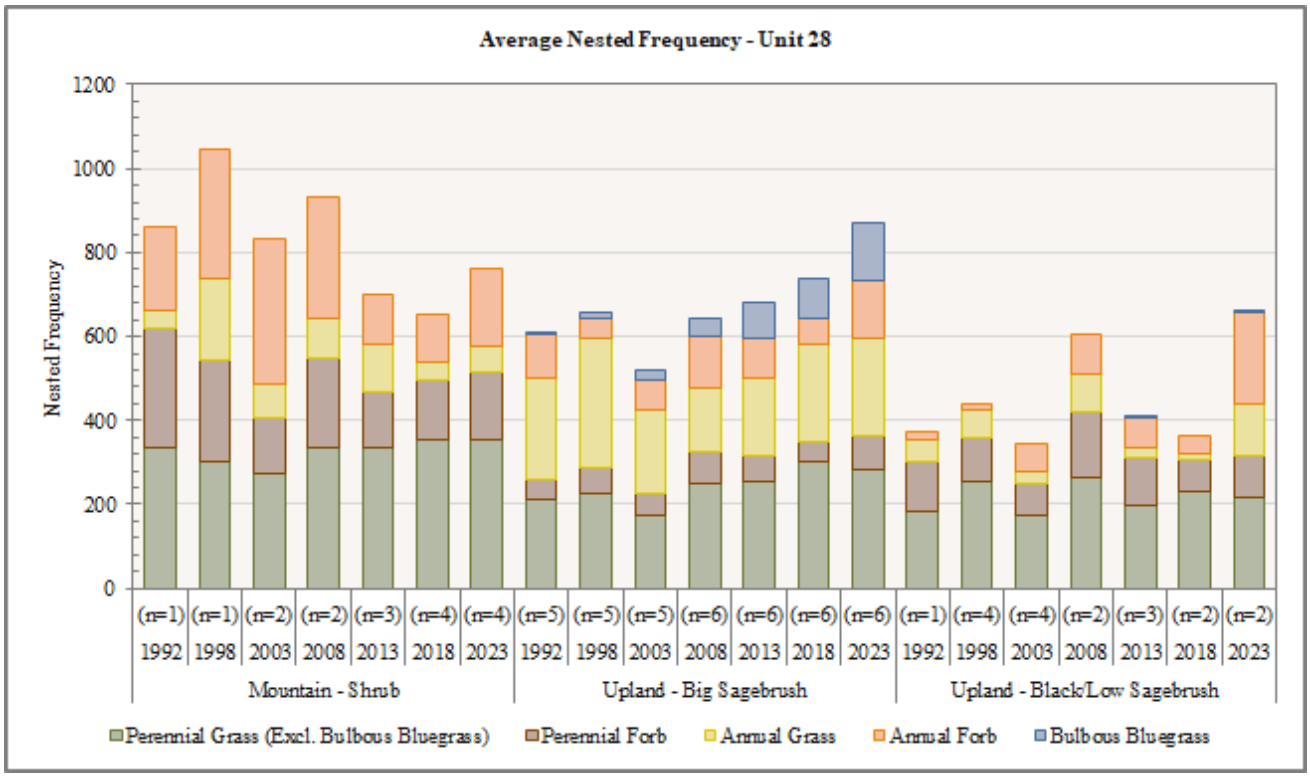


Figure 7.19: Average nested frequency of herbaceous species for Mountain - Shrub, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

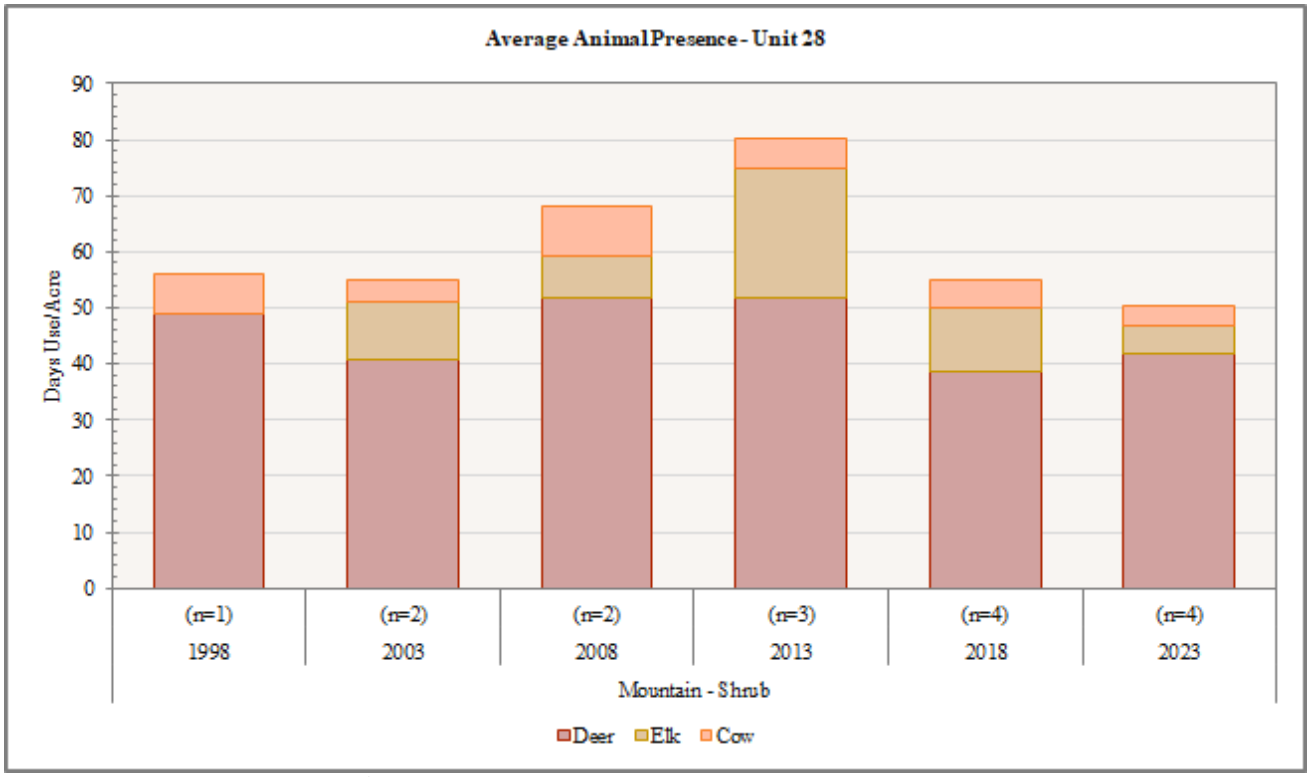


Figure 7.20: Average pellet transect data for Mountain - Shrub study sites in WMU 28, Panguitch Lake. *Mountain - Shrub deer pellets include deer and sheep pellet groups.

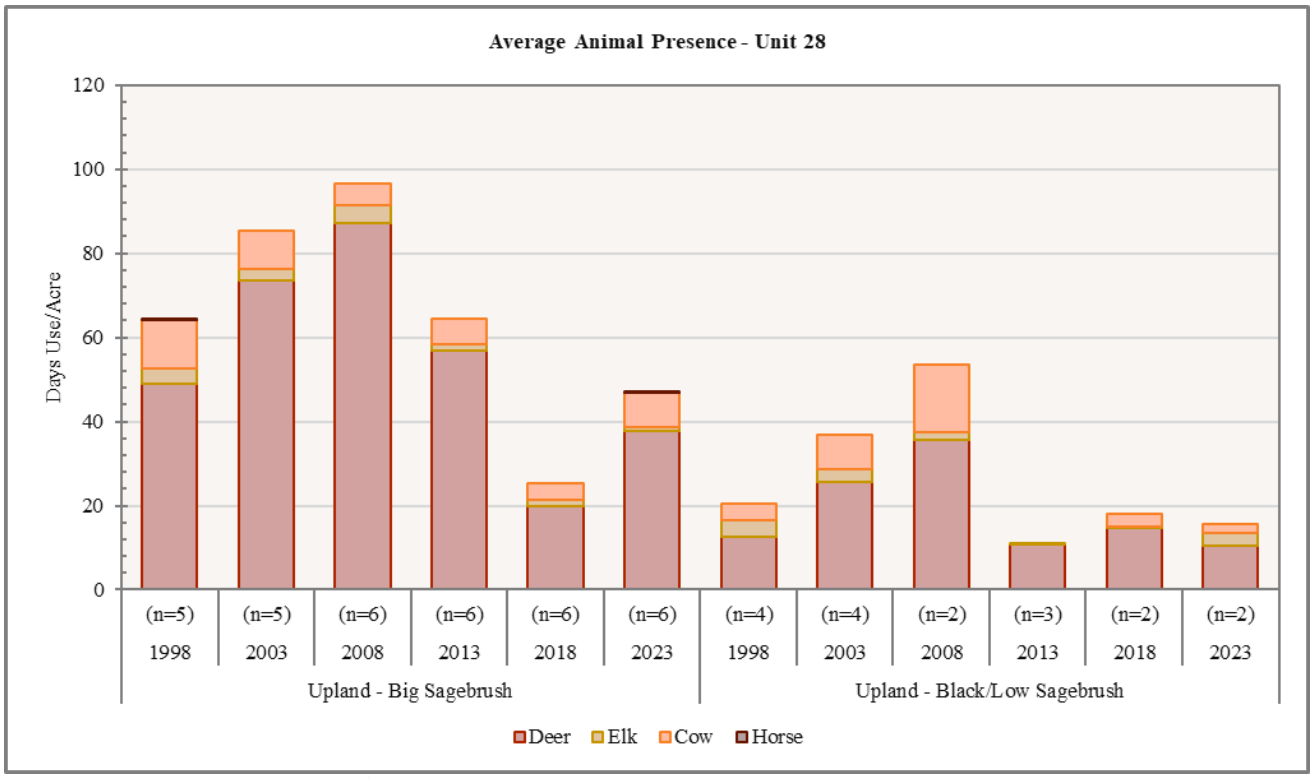
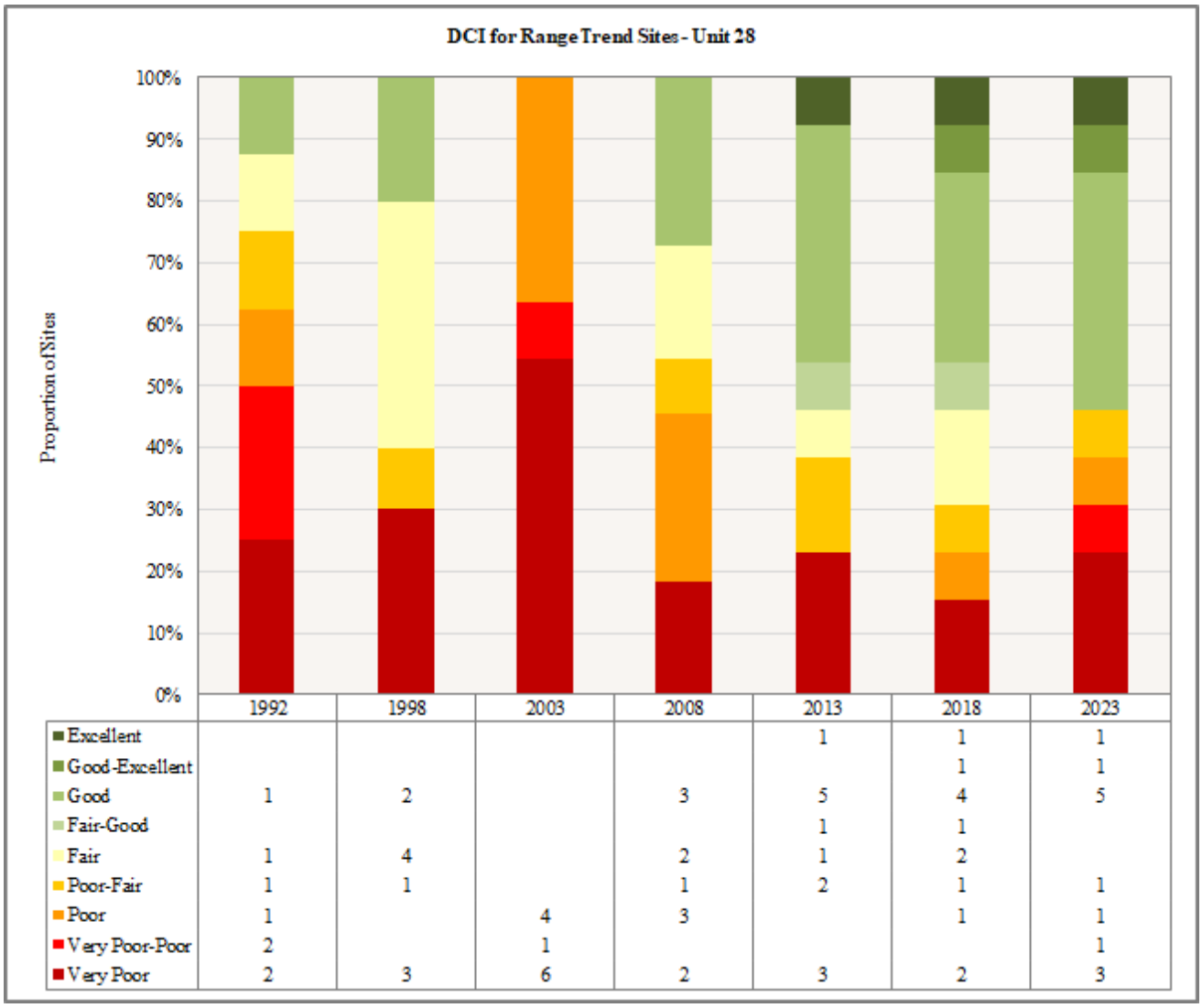


Figure 7.21: Average pellet transect data for Upland - Big Sagebrush and Upland - Black/Low Sagebrush study sites in WMU 28, Panguitch Lake.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Panguitch Lake Management Unit has generally improved from poor averaged condition in 1992 to fair averaged condition in 2023. Three Creeks (28-01), Buckskin Valley (28-04), Paragonah (28-07), Sheep Hollow West (28-14), Sheep Hollow East (28-15) (suspended), South Canyon (28R-19), Haycock Mountain (28-22), and Above Limerock Canyon (28-24) are the main drivers for the unit's wintering habitat stability or quality, and deer winter range conditions average between fair and good. It is important to note that Haycock Mountain and Above Limerock Canyon study sites were not added to the unit until recently and have only contributed to the unit's improvement in wintering conditions since 2013: this accounts for the unit's larger improvement beginning at that time. Panguitch (28-02) (suspended), Swayback Knoll (28-05), Cottonwood (28-06), South Canyon (28-20) and Threemile Creek (28-23), 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. Range Trend sites in this unit that tend to have higher variability and positive conditional change in deer winter habitat include Buckskin Valley, Paragonah, Elliker Basin (28-11), Sheep Hollow West, Sheep Hollow East, and South Canyon. This variability may be indicative of community resilience after disturbance and these sites may respond well to further habitat improvement projects.

The overall deer winter range assessment in 2023 for WMU 28 was that the unit is in fair condition, but just over half the sites were considered to be between good and excellent winter condition. A factor contributing to this overall fair condition is that the majority of the sites have a notable presence of preferred browse and perennial grass, although Swayback Knoll and Threemile Creek are lacking in preferred browse. Perennial forbs are limited across the unit and most sites have a notable amount of annual grass: addressing these components would greatly improve winter range habitat conditions for mule deer (**Figure 7.22**, **Table 7.5**).



	1992	1998	2003	2008	2013	2018	2023
Excellent					1	1	1
Good-Excellent						1	1
Good	1	2		3	5	4	5
Fair-Good					1	1	
Fair	1	4		2	1	2	
Poor-Fair	1	1		1	2	1	1
Poor	1		4	3		1	1
Very Poor-Poor	2		1				1
Very Poor	2	3	6	2	3	2	3

Figure 7.22: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 28, Panguitch Lake.

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
28-01	1992	8.7	11.3	15	30	0	5.9	0	**70.9**	**G**
28-01	1998	10.5	14.5	14.6	30	0	6	0	**75.6**	**G**
28-01	2003	6.3	0	0	10	0	6.1	0	**22.4**	**VP**
28-01	2008	10.3	13.2	15	28.9	0	5.1	0	**72.3**	**G**
28-01	2013	15.1	13.8	9	30	0	4.1	0	**72.1**	**G**
28-01	2018	17.2	12.7	4.5	30	0	1.7	0	**66.1**	**F-G**
28-01	2023	20.3	12.3	8.5	30	0	9	0	**80.1**	**G-E**
28-02*	1992	14.4	-8.1	1.5	2.1	0	0.2	0	**10.1**	**VP**
28-02*	1998	14	6.3	6	6.3	0	0.4	0	**33.1**	**VP**
28-04	1992	30	1.7	5.1	16.9	-0.1	10	0	**63.6**	**F**
28-04	1998	30	9.6	3.8	12.9	-2.2	10	0	**64.1**	**F**
28-04	2003	30	3.2	1.2	5.3	-1.2	5.7	0	**44.2**	**P**
28-04	2008	30	2.1	1.9	12.8	-2	10	0	**54.8**	**P-F**
28-04	2013	30	8.8	3.2	12.1	-8.9	10	0	**55.2**	**P-F**
28-04	2018	30	11.3	2	20.1	-0.9	10	0	**72.5**	**G**
28-04	2023	30	9.8	3.9	25.4	-4.5	10	0	**74.6**	**G**
28-05	1992	13.8	6.3	8	6.3	-0.9	0.1	0	**33.6**	**VP-P**
28-05	1998	15.5	8.3	5.9	6.8	-14.6	0.2	0	**22.1**	**VP**
28-05	2003	20.4	5.2	2.1	6.4	-1.7	0	0	**32.4**	**VP**
28-05	2008	13.9	-0.4	3.3	9.6	-1.7	0.3	0	**24.9**	**VP**
28-05	2013	1	0	0	3.8	-15	0.5	0	**-9.7**	**VP**
28-05	2018	0.3	0	0	18.9	-16.9	0	0	**2.3**	**VP**
28-05	2023	0.6	0	0	19.1	-20	1.2	0	**0.9**	**VP**
28-06	1992	12.3	10.3	3.2	10.2	-6.1	5.2	0	**35.1**	**VP-P**
28-06	1998	9.4	6.2	3.2	13.8	-13.4	4.6	0	**23.8**	**VP**
28-06	2003	10.3	0.2	0.6	6.9	-0.3	8.8	0	**26.5**	**VP**
28-06	2008	10.9	3.2	2.6	9.7	-9	10	0	**27.4**	**VP**
28-06	2013	10.4	8	0	10.8	-11.3	10	0	**27.8**	**VP**
28-06	2018	9.8	4.5	1.8	30	-13.6	9.9	0	**42.3**	**P**
28-06	2023	10.3	6.8	0	11.8	-17.2	7.1	0	**18.7**	**VP**
28-07	1992	11.2	9.9	15	7.9	-0.2	3.6	0	**47.3**	**P**
28-07	1998	12.2	11.7	15	14.9	-2.6	3.1	0	**54.3**	**F**
28-07	2003	9.4	9.4	11.5	2.1	-0.3	1.7	0	**33.8**	**VP-P**
28-07	2008	12.2	11.7	15	18.6	-0.8	4.8	0	**61.5**	**F**
28-07	2013	20.3	14.4	15	11.3	-0.1	5.2	0	**66.1**	**F-G**
28-07	2018	29.4	14.6	12.2	17.1	0	5.4	0	**78.7**	**G-E**
28-07	2023	29.2	13	7.3	19.3	-0.3	4.3	0	**72.8**	**G**
28-08	1992	20.6	-3.1	3.3	30	-1.7	0	0	**49.1**	**P-F**
28-08	1998	17	4.8	4.6	30	-1.6	0.2	0	**54.9**	**F**
28-08	2003	16	0.9	1.2	24.4	-4.3	0.1	0	**38.3**	**P**
28-08	2008	15.6	0.2	1.9	30	-0.1	0.2	0	**47.8**	**P**
28-08	2013	17.6	1.3	2.9	30	0	0.1	0	**51.9**	**P-F**
28-08	2018	15.5	3.4	2	30	-0.9	0.1	0	**50**	**P-F**
28-08	2023	12.9	6	0.9	30	-0.2	0.5	0	**50.1**	**P-F**
28-11	1992	29.7	-0.2	2.9	9.8	-20	0.1	0	**22.4**	**VP**
28-11	1998	29	7.5	1.9	15.3	-6	0.7	0	**48.4**	**P-F**
28-11	2003	19	-2.1	0.8	12	-20	0	0	**9.7**	**VP**
28-11	2008	15	-4.2	1.4	24.8	-0.2	0.4	0	**37.2**	**P**
28-11	2013	15.4	6.8	15	30	-0.3	0.4	0	**67.2**	**G**
28-11	2018	17.5	9.3	11.6	30	-12.7	0.3	0	**56**	**F**
28-11	2023	11.1	1.7	3.5	30	-12.9	0.5	0	**34**	**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
28-14	1998	24.1	6.2	4.5	30	0	9.6	0	**74.3**	**G**
28-14	2003	26.3	4.6	2.4	16.8	0	2.9	0	**52.9**	**P**
28-14	2008	30	3.4	2.8	30	0	6	0	**72.1**	**G**
28-14	2013	30	12.9	3.7	30	0	2.2	0	**78.8**	**G**
28-14	2018	30	10.2	5.8	30	0	4	0	**80**	**G**
28-14	2023	30	13	4.3	30	0	8.5	0	**85.7**	**G**
28-15*	1998	30	7.8	2.3	15.5	0	5.3	0	**60.9**	**F**
28-15*	2003	30	8	2	4.6	0	2.4	0	**46.9**	**P**
28-15*	2008	30	1.7	5.5	14.3	0	6.9	0	**58.3**	**F**
28-15*	2013	30	11.5	3	21.8	0	3.1	0	**69.3**	**G**
28-20*	2003	17.9	5.5	1.8	2.3	0	0.3	0	**27.9**	**VP**
28-21	2008	14	-2.7	1.5	30	-0.7	0	0	**42.1**	**P**
28-21	2013	15.8	7.8	1.8	30	-0.1	0.3	0	**55.5**	**F**
28-21	2018	14.9	9.9	2.9	30	-0.9	0.7	0	**57.4**	**F**
28-21	2023	9.4	4.8	6.5	30	-3.3	0.1	0	**47.4**	**P**
28-22	2013	30	11.2	5.6	30	0	1.5	0	**78.3**	**G**
28-22	2018	30	7.6	3.2	30	0	3.4	0	**74.3**	**G**
28-22	2023	30	11.1	4.7	30	-0.1	6.2	0	**81.9**	**G**
28-23	2013	0.3	0	0	3.1	0	0.4	0	**3.8**	**VP**
28-23	2016	0.4	0	0	25.9	-0.2	0.3	0	**26.4**	**VP**
28-23	2018	1	0	0	23.9	0	0.1	0	**25**	**VP**
28-23	2023	2	0	0	25.9	-5.6	1	-2	**21.3**	**VP**
28-24	2018	30	13.4	5.3	30	0	0.3	0	**79.1**	**G**
28-24	2023	30	13.8	1	30	0	0.4	0	**75.2**	**G**
28R-01*	1998	20.7	7.3	2.7	17.4	0	0.6	0	**48.7**	**P-F**
28R-07*	2000	30	4.4	0.1	11.5	0	1.3	0	**47.3**	**P**
28R-07*	2001	30	4	0.7	15.2	0	1.1	0	**51**	**P-F**
28R-19	2011	13.1	8	15	2.8	0	0.9	0	**39.8**	**P**
28R-19	2014	11.3	14.6	15	30	0	5	0	**75.9**	**G**
28R-19	2018	10.3	14.5	11.1	30	0	0.7	0	**66.5**	**F-G**
28R-19	2023	25.3	14.4	7.7	30	0	1.3	0	**78.6**	**G-E**

Table 7.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 28, Panguitch Lake. 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
28-01	Three Creeks	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
28-03	Bear Valley	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
28-04	Buckskin Valley	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28-05	Swayback Knoll	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
28-06	Cottonwood	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Animal Use – Deer	Medium	Reduced/less vigorous browse component
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28-07	Paragonah	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
28-08	Grass Valley	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Animal Use – Cattle	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28-11	Elliker Basin	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Drought	-	Lowered resilience and resistance to disturbance

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
28-14	Sheep Hollow West	Annual Grass	Low	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
28-16	Asay Bench	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
28-17	Sidney Valley	None Identified		
28-18	Shakespeare Hollow	Introduced Perennial Grass	Low	Reduced diversity of desirable grass and forb species
28-19	DD Hollow	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
		Introduced Perennial Grass	Low	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
28-21	South Summit WMA	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
28-22	Haycock Mountain	Annual Grass	Low	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
28-23	Threemile Creek	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28-24	Above Limerock Canyon	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28R-09	South Canyon 2	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28R-10	Buckskin Valley Highway 20	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
28R-12	Fivemile 2	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28R-13	Panguitch Creek	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
28R-15	Panguitch Creek WMA	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28R-19	South Canyon	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28R-20	Indian Hollow	PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
28R-22	Above Elliker Basin	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		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 28, Panguitch Lake. All assessments are based off 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 2023, deer wintering range averages as being in fair condition in the Panguitch Lake management unit. Despite unit-wide condition averaging as fair, however, just over half of the sites are considered to be between good and excellent condition. Factors influencing poor conditions on some studies include annual grass presence and a lack of perennial forbs (**Figure 7.22**, **Table 7.5**).

A positive aspect of the Panguitch Lake unit is that the browse components on many Range Trend sites in the western portion of the unit (Cottonwood, Paragonah, Grass Valley, Elliker Basin, South Summit WMA) have persisted. These sites are considered to be wintering range for mule deer and have not had irreversible plant community transitions occur due to a major disturbance. Of additional positive note, improvements in habitat quality (pinyon-juniper reduction, browse diversification, amplification of the herbaceous understory, etc.) have been observed following treatment on some Range Trend sites such as Grass Valley and Threemile Creek. Habitat treatment projects have also been and continue to be implemented in areas not monitored by the Range Trend program; 78,585 total treatment acres have been completed in the Panguitch Lake management unit through the Watershed Restoration Initiative (WRI) as of February 2024 (**Table 7.2**, **Map 7.7**). In addition, the Brian Head fire burned many standing dead and downed trees within its perimeters that had been ravaged by the bark beetle epidemic. Numerous acres of conifers also burned, some of which were likely encroaching into and negatively affecting existing aspen (*Populus tremuloides*) stands. Finally, recent research has observed both sexual (seedlings) and asexual (suckers) aspen regeneration in response to the fire. When large burns like the Brian Head fire remove

vast areas of trees, sexual reproduction of aspen may be particularly advantageous. Suckering, or regeneration from existing aspen roots, limits new growth to a location where an aspen clone previously existed. On the other hand, aspen seeds are small and lightweight, which allows for dispersal over long distances (Kreider & Yocom, 2021).

Recreation benefits members of the public and provides opportunities for economic growth. If not properly managed, however, recreation may become unsustainable and can result in degradation of habitat. Furthermore, research has found that even lower impact activities such as hiking may have an impact on the presence in and timing of use of an area by various wildlife species, including elk (Anderson, Waller, & Thornton, 2023). Single interactions may not greatly affect local wildlife populations. However, continued incidents may have greater impacts that could be exacerbated by other simultaneous stressors (Utah Division of Wildlife Resources, 2015). As such, the potential for increased human recreation and the effects on wildlife and wildlife habitat are possible concerns within this unit.

According to data from the National Park Service, the actual number of recreational visitors to Cedar Breaks National Monument exhibits yearly fluctuations. However, the average number of recreational visitors per year has increased over time. Between 2003 and 2012, there was an average of 527,535 recreational visitors per year, and that average increased to 736,361 between 2013 and 2022 (National Park Service, 2023). Many of these visitors may be from outside Utah, and may therefore have varying degrees of knowledge about local flora and fauna and associated best practices. The National Park Service has relevant policies in place for prevention of negative impacts (National Park Service, 2022). However, deleterious effects associated with increased visitors may still be possible, although the degree of impact is unknown to the authors of this report.

Of additional and related concern may be the potential for increased presence through other forms of recreation. Numerous roads and trails open to off-highway vehicles (OHVs), bicycles, and hikers are located throughout the Panguitch Lake Management Unit. OHV use in particular remains a popular form of recreation throughout the state of Utah: there were over 200,000 in-state OHV registrations and over 23,000 out-of-state permits issued between January and August of 2023 (Utah Division of Outdoor Recreation, 2023). Education on best practices required by state law likely helps mitigate some of the negative outcomes that might otherwise result from OHV recreation. However, negative effects on wildlife and wildlife habitat are always a possibility. Many official roads and trails within the unit overlap deer and elk summer habitat and are located on land administrated by the United States Forest Service (USFS). The USFS monitors use and manages land and resources within its jurisdiction accordingly, but unauthorized use of roads and trails has been known to occur. In the past, for example, there have been incidents of members of the public removing or ignoring barriers placed by the USFS. In one instance within Dixie National Forest (likely in the Zion management unit, but in very close proximity to the border between units 28 and 29), the decision was made to reopen a road or trail in response to public resistance. Members of the public removing or bypassing barriers can cause more damage to vegetation than continuing to allow access (Cedar City Ranger District, Dixie National Forest, personal communication, January 30, 2024).

Human development in portions of this unit also poses a threat to big game habitat. The communities of Mammoth Creek, Panguitch Lake, half of Duck Creek, Brian Head, and the Brian Head ski resort are all located within higher-elevation areas classified as crucial or substantial summer range for mule deer and elk, as are a number of cabins. In lower elevations on the western side of the unit lie the communities of Summit, Parowan, Paragonah, and the northeast portion of Cedar City: all of these settlements overlap crucial mule deer wintering range. Human expansion is by nature dynamic in location, extent, and timeframe. However, satellite imagery makes evident the occurrence of development over time in localized portions of the unit, and there is always potential for future growth. Increased human presence through new construction of buildings and roads can have unintended consequences for wildlife habitat including (but not limited to) a loss of preferred browse and herbaceous forage for wildlife, habitat fragmentation, and degradation through the introduction of non-native species.

Heavy utilization by and concentrations of deer in areas north of Paragonah are additional (and known) concerns in the Panguitch Lake unit (Utah Division of Wildlife Resources, 2024). Ungulate browsing over time may suppress perennial grasses and older shrubs and allow young sagebrush (*Artemisia spp.*) plants to establish. However, this browsing may also be associated with decreased density and biomass of adult sagebrush plants. Although appropriate levels of ungulate browsing likely have positive impacts on the productivity of sagebrush ecosystems (Veblen, Nehring, McGlone, & Ritchie, 2015), it is reasonable to conclude that overuse could have detrimental effects on sagebrush stands. According to average pellet transect data, deer presence on the Cottonwood site has

remained high in most years since 1998. More specifically, mean abundance of deer pellet groups was 59 days use/acre in 2023, but has been as high as 121 days use/acre in 2008. Furthermore, utilization data states that 22% of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) plants on this site were moderately utilized and 66% were heavily browsed in 2023. The high abundance of deer pellet groups along with utilization data for the most recent sample year indicate that deer concentrations on this study may still be an issue. The Swayback Knoll site supported a robust sagebrush population from study establishment through the 2008 sample year; mean abundance of deer pellet groups between 1998 and 2008 ranged from 82 days use/acre in 1998 and 93 days use/acre in 2008. However, the study burned in 2012 and sagebrush density has remained low in subsequent sample years despite rehabilitation treatments. Increased amounts of heavy sagebrush utilization during post-burn samplings can likely be attributed to the decreased amount of sagebrush available, as mean abundance of deer pellet groups has remained low since 2013 (Cox, Lane, & Payne, 2023). Deer concentrations and levels of utilization may still be a concern in the vicinity of this study, but Range Trend data is unavailable as no sites exist in the surrounding area.

Many areas of standing dead trees (snags) killed by bark beetles or fire have been assessed by land management agencies. This has led to salvage operations where they were deemed appropriate, particularly on land burned by the Brian Head fire. However, snags remain present in some places south of the burn perimeter. Snags can have ecological value as habitat for some species of birds, but may also pose threats to habitat in some situations. Although it may take years, standing dead trees eventually become unstable due to decay and fall to the forest floor. Depending on specific location and circumstances, these fallen trees may cause fuel loads to exceed desirable levels. In addition, accumulation of dead and downed trees can result in reduced habitat for wildlife such as deer and elk. Much of the land in this area falls under USFS jurisdiction, but there are pockets of privately owned property that may not undergo threat assessments on standing dead trees like those performed by the Forest Service. Although treatments continue to take place, conifer encroachment into aspen stands is occurring in some places within the unburned area south of SR-143. Conifer encroachment can be associated with the decline of aspen stands (Kitchen, et al., 2019).

Utah Roadkill Reports data indicates that highway mortality may pose an additional threat to wildlife (particularly mule deer) in portions of this unit. Roadkill pick-up reports between 2018 and 2024 appear to be concentrated from the junction of US-89 and SR-14 west to just past Navajo Lake; on the unit boundary along US-89; and on roads in/with close proximity to Cedar City, Summit, Parowan, and Paragonah. This data also shows reports scattered along I-15 and SR-20, with very few reports towards the interior of the unit. However, one should keep in mind that collisions occurring at high enough speeds to result in animal mortality are likely more common on main roads that receive the most use. As the boundaries of the Panguitch Lake Management Unit follow these main roads, this could explain the relative lack of reports on less-traveled routes towards the interior of the unit (Utah Division of Wildlife Resources, 2024).

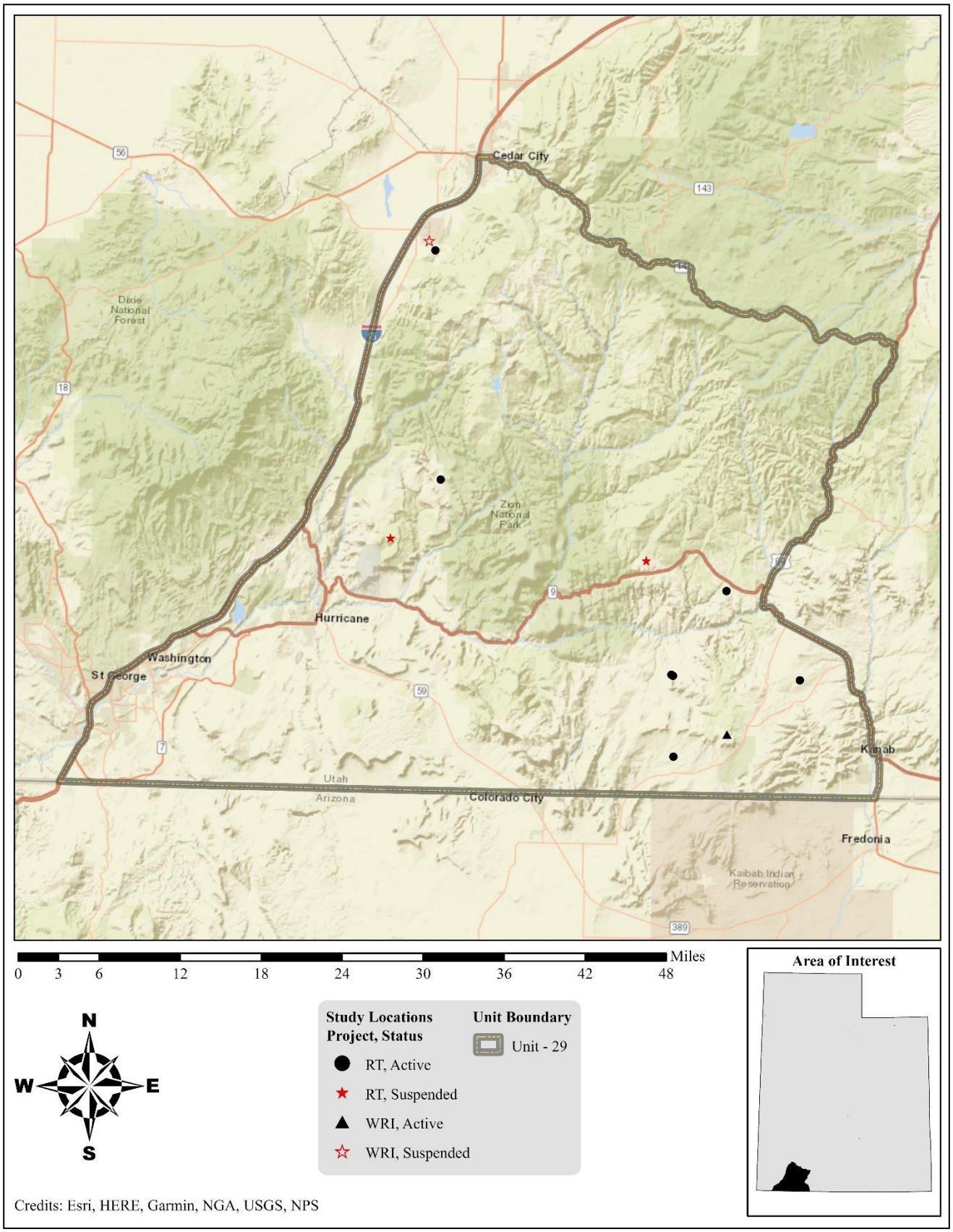
Finally, many of the lower-elevation sites on the western side of the unit have cheatgrass (*Bromus tectorum*) present in their understories. In 2023, cheatgrass contributed more than 15% cover on three of these sites in particular: Elliker Basin, Swayback Knoll (which burned in 2012), and Cottonwood. High presence of cheatgrass can alter fire regimes (Balch, D'Antonio, & Gómez-Dans, 2013) by exacerbating fine fuel loads and increasing fire return following an initial burn. This in turn can perpetuate and expand the removal of valuable reestablishing or extant browse communities. Should these sites burn (or in the case of Swayback Knoll, burn again), they may be at risk for even greater amounts of cheatgrass and the increased fire frequency associated with annual grasses (Bradley, 2018).

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**).

There are a number of recommendations to mitigate or slow the effects of habitat loss in the Panguitch Lake 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, urban, and road developments occur, improvement projects may be needed to provide “buffering” in areas immediately around private land development and replace habitat as it is lost. In addition, support should be given for policies that result in responsible urban development. Habitat improvement projects in general should be continued throughout the unit when and where they are deemed necessary. Careful selection of appropriate restoration methods based on the needs of a specific area should also continue to occur when these projects are implemented. Although projects have taken place, additional removal of slash from beetle-killed conifer in aspen stands may be advisable in some areas. 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. Finally, continued monitoring of Range Trend studies and areas where rehabilitation projects have occurred will likely prove valuable. Data collected in the future will indicate whether the severity of current limiting factors is increasing, and what actions are needed to mitigate these identified potential threats to habitat and wildlife.

8. WILDLIFE MANAGEMENT UNIT 29 – ZION



WILDLIFE MANAGEMENT UNIT 29 – ZION

Boundary Description

Iron, Kane, and Washington counties - Boundary begins at I-15 and the Utah-Arizona state line; north on I-15 to SR-14; east on SR-14 to US-89; south on US-89 to US-89A; south on US-89A to the Utah-Arizona state line; west on the Utah-Arizona state line to I-15.

Management Unit Description

Geography

The Zion Wildlife Management Unit includes the southern portion of the Markagunt Plateau. The unit also contains Pine Spring Knoll, Kolob Peak, and Little Creek Mountain. Pine Knoll, located in the northeastern part of the unit, is the highest point with an elevation of 10,000 feet. In contrast, the lowest point in the unit has an elevation of about 2,500 feet and is located east of St. George. Zion National Park is also included in the unit; the highest point in the park is Horse Ranch Mountain with an elevation of 8,726 feet, and the lowest point is Coalpits Wash at 3,666 feet. The park occurs at the junction of the Mojave Desert, Colorado Plateau, and Great Basin, giving it a unique assembly of flora and fauna in addition to a variety of geographical configurations such as canyons, buttes, mesas, natural arches, and monoliths. Towns in this unit include Kanarraville; Hurricane; Springdale; Rockville; Mt. Carmel; and the cities of St. George (and the greater metropolitan area), Kanab, and Cedar City on the unit boundaries.

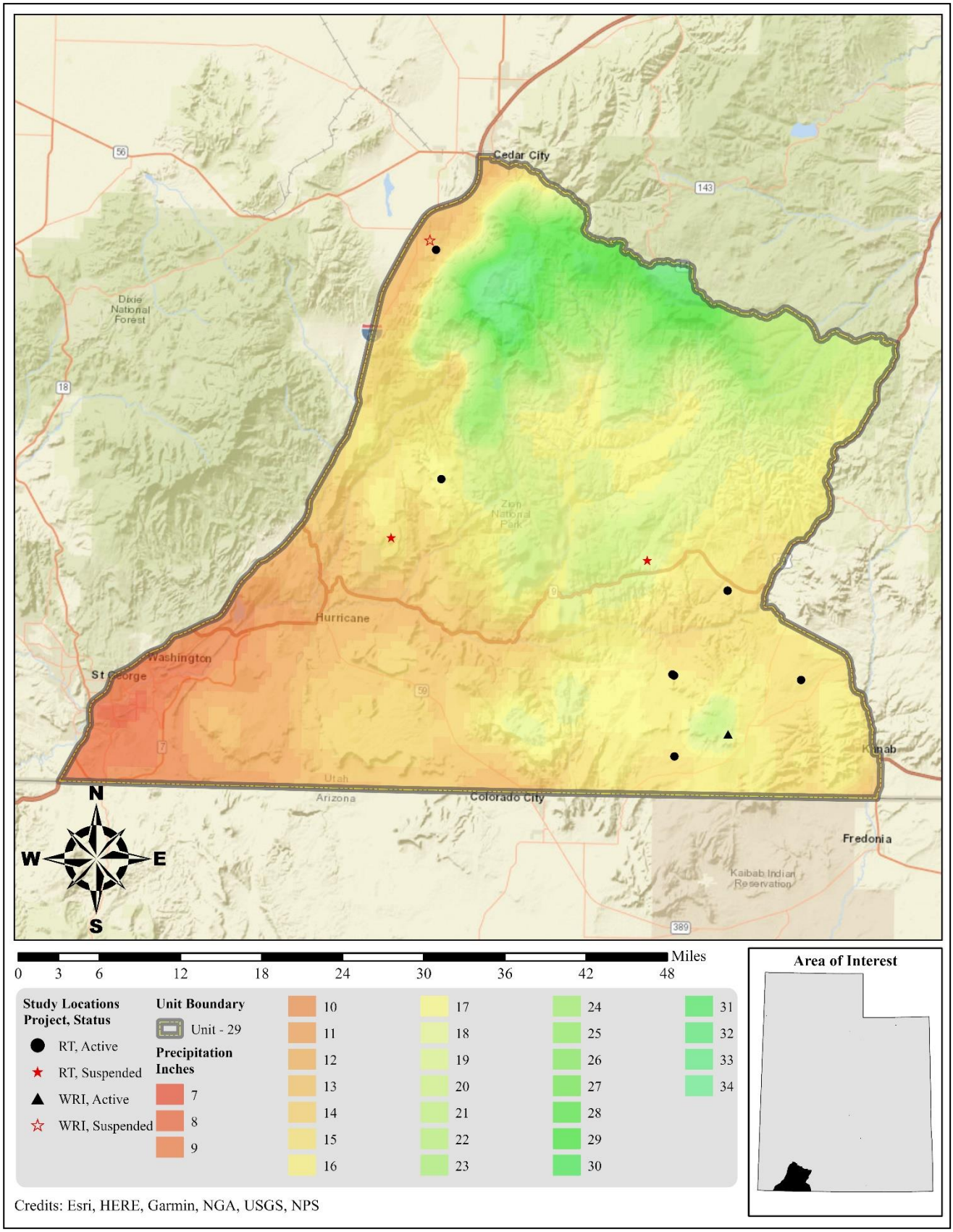
A number of streams are located within this unit, including La Verkin Creek, Muddy Creek, Blue Creek, Crystal Creek, and Deep Creek: most of these are tributaries of the Virgin River. The Virgin River itself is formed by the confluence of the North Fork Virgin and East Fork Virgin just outside of Zion National Park near the town of Springdale. Navajo Lake and Kolob Reservoir are also found within the Zion management unit.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows precipitation ranges on the unit from 7 inches in the southwest portion of the unit near St. George to 34 inches near Pine Spring Knoll on Cedar Mountain. All of the active Range Trend and WRI monitoring studies on the unit occur within 12-19 inches of precipitation (**Map 8.1**) (PRISM Climate Group, Oregon State University, 2021).

Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the South Central Division (Division 4).

The mean annual PDSI of the South Central Division has displayed some form of drought most years since 1993. Moreover, this climate division has been considered to be in drought nearly 68% of the time since 1993. Of the drought periods, nearly 43% are considered to be years of either moderate or extreme droughts. Also remarkable about this climate division is that drought is experienced over multiple years and is generally interrupted by a single wet year event; the most notable wet years occur in 2005 and 2011, which were both considered moderately wet (**Figure 8.1a**). The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI. These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September and May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 8.1b**). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 8.3**). Years that were moderately wet occur in 1999 and 2023, but years where drought may have affected plant condition occur in 2009, 2013, and 2018 (**Figure 8.1a, Figure 8.1b**) (Time Series Data, 2024).



Map 8.1: The 1991-2020 PRISM Precipitation Model for WMU 29, Zion (PRISM Climate Group, Oregon State University, 2021).

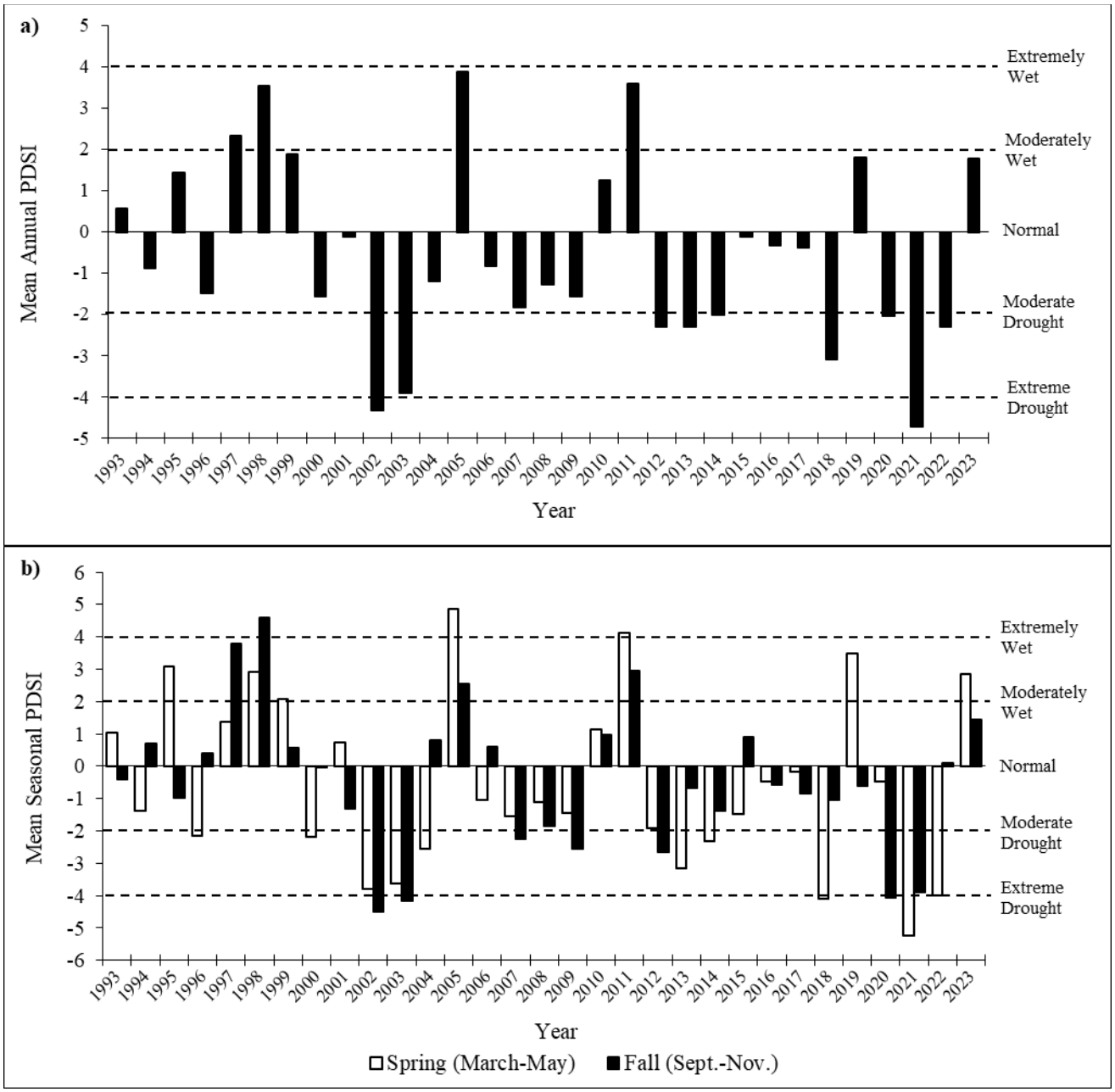


Figure 8.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

Most of the summer range is found in the northern part of the unit, which includes the southern end of the Markagunt Plateau. Unlike the majority of the wildlife management units in the state, most of the summer range in the Zion unit occurs on private land with increased summer home development becoming more of a management problem. The United States Forest Service (USFS) and Zion National Park administrate the remaining summer range. Winter range predominantly occurs on land administrated by the Bureau of Land Management (BLM), but Zion National Park and private land make up a minor portion (**Map 8.2**, **Map 8.4**).

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

According to the RAP data, herbaceous biomass and cover have exhibited yearly fluctuations on summer, winter, and year-long mule deer ranges. When comparing 1986 data to that from 2023, however, values for both measurements have decreased on summer habitat and have remained on winter range. On year-long habitat, biomass has increased overall due to annual lifeforms, and cover has similar remained similar. The highest biomass and cover values for annual lifeforms have consistently occurred on year-long mule deer range, with large flushes generally coinciding with years of good precipitation. Annual and perennial cover and biomass have followed precipitation trends in many years on ranges of all seasonality, although lag effects of a year or so have occurred at other times (**Figure 8.2**, **Figure 8.3**, **Figure 8.4**, **Figure 8.5**, **Figure 8.6**, **Figure 8.7**). The Range Trend data from 2003 to present shows a general increase in perennial cover; an increase in annual cover on Mountain (Browse) study sites; and an overall decrease in annual herbaceous cover on Upland (Big Sagebrush) ecological sites. However, it is important to note the different number of studies sampled from year to year (the 'n' value) and consider the implications that this may have on the data. Furthermore, Range Trend sites are summarized by ecological potential in this report and not seasonality of mule deer range (**Figure 8.17**). As such, incongruences between Range Trend data and that reported by the RAP are probable.

The RAP data for tree and shrub cover shows variation from year to year. Values for both lifeforms have correlated with precipitation in some years, but to a lesser degree and with generally less drastic peaks and troughs than herbaceous data. Overall shrub cover has remained similar on mule deer ranges of all seasonality discussed. Tree cover was also similar between 1986 and 2023 on year-long habitat, but increased overall on summer and winter range (**Figure 8.8**, **Figure 8.9**, **Figure 8.10**). Range Trend data displays general increases in shrub and tree cover since 2003, although tree cover decreased overall on Mountain (Browse) sites (**Figure 8.11**, **Figure 8.12**, **Figure 8.13**). Again, however, it is important to consider the caveats discussed above when making comparisons between RAP and Range Trend data. Range Trend data is site-specific and granular while RAP data is aggregated to the unit scale for deer habitat.

RAP – Herbaceous Biomass by Deer Habitat

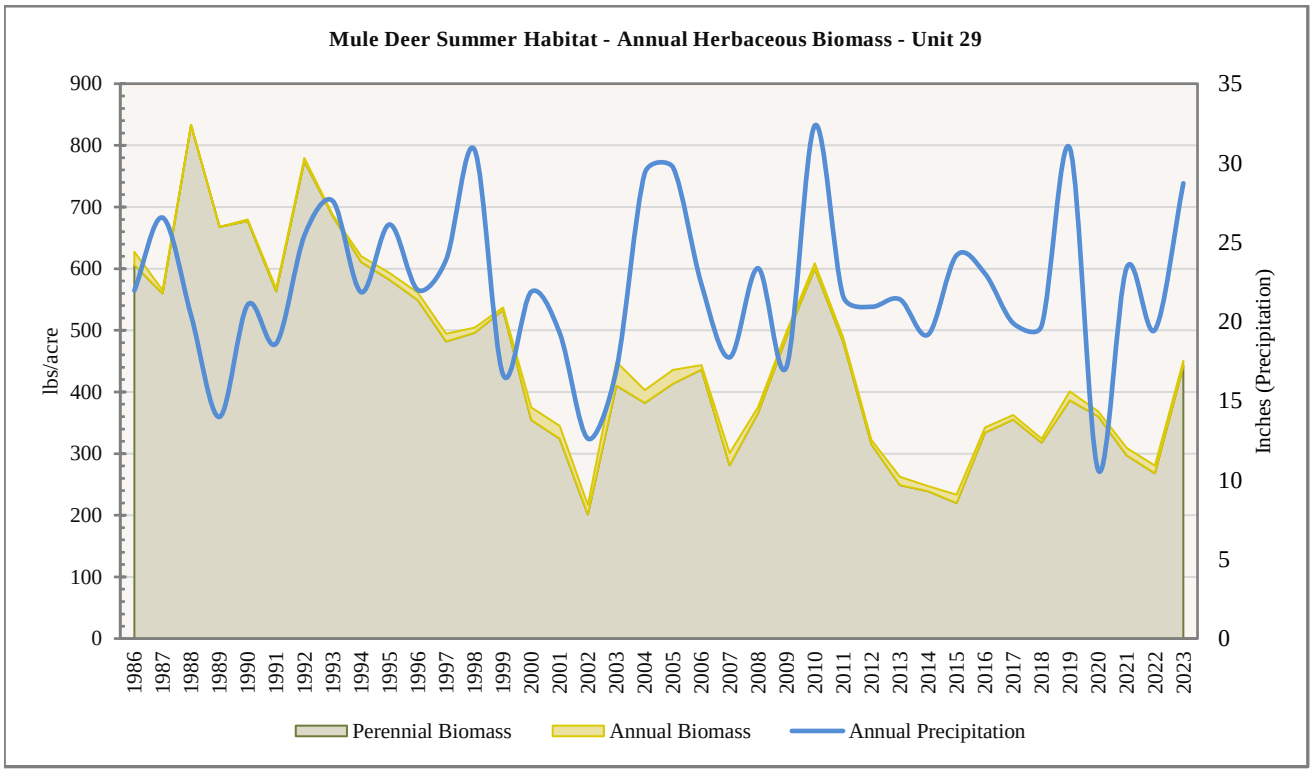


Figure 8.2: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

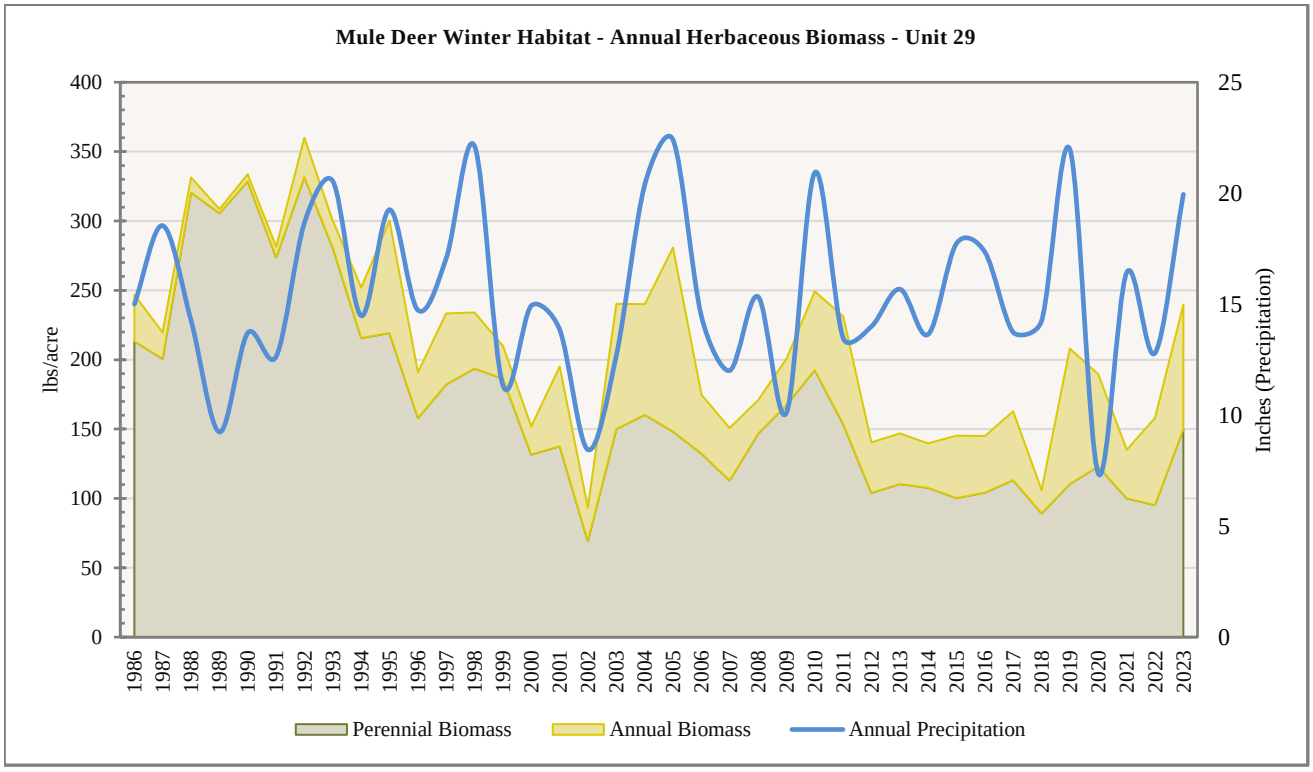


Figure 8.3: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

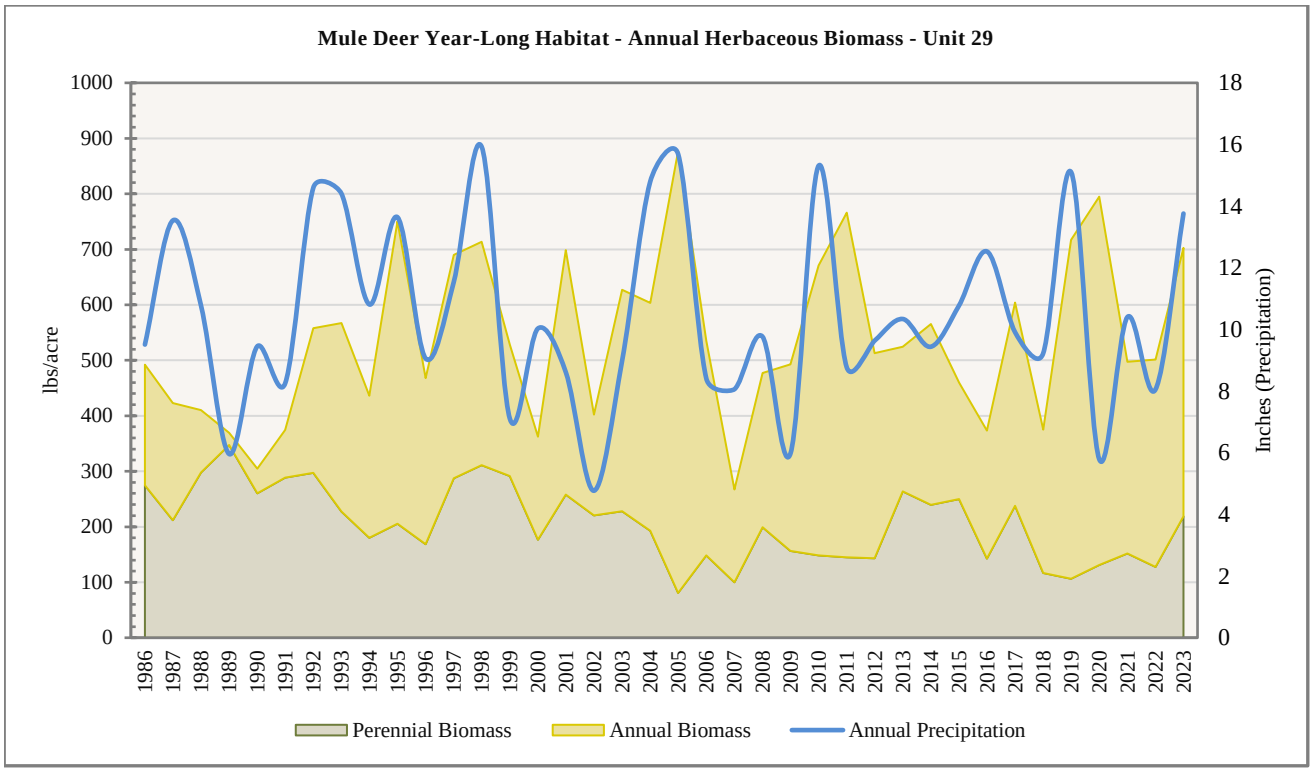


Figure 8.4: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

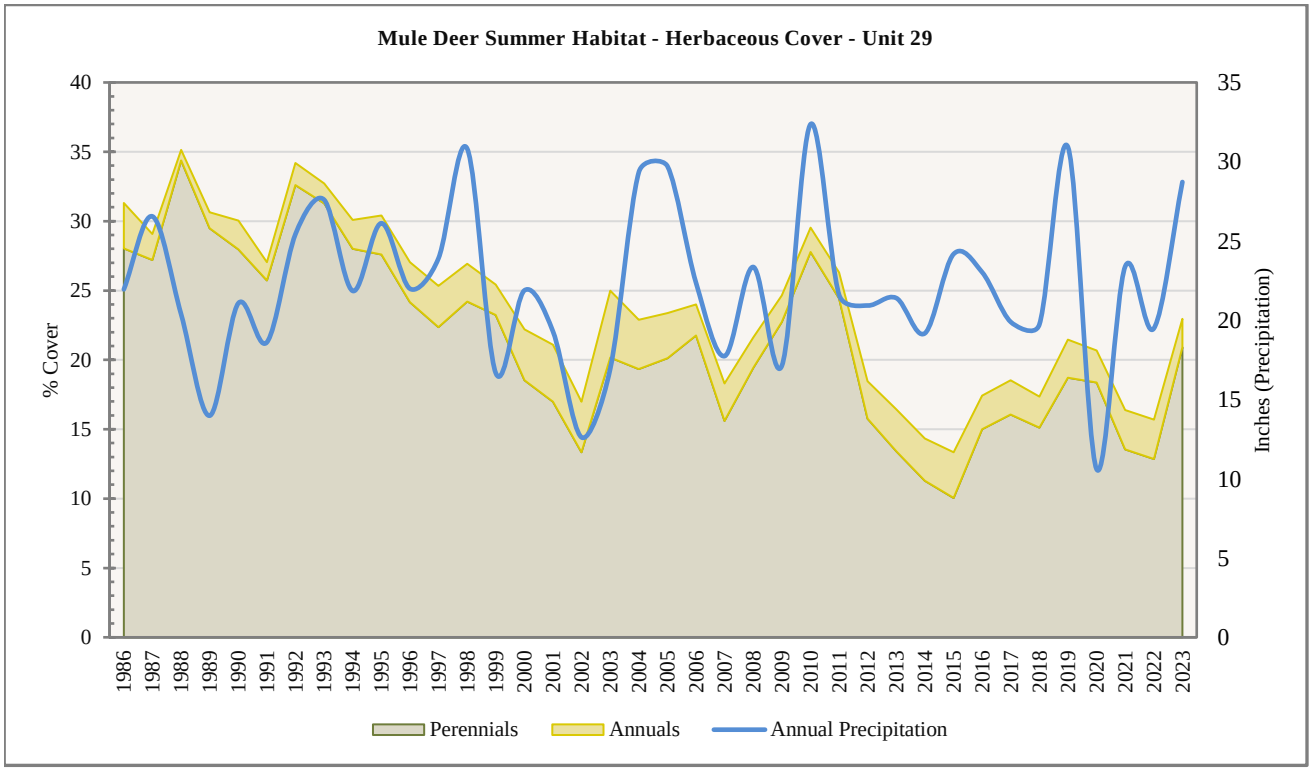


Figure 8.5: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

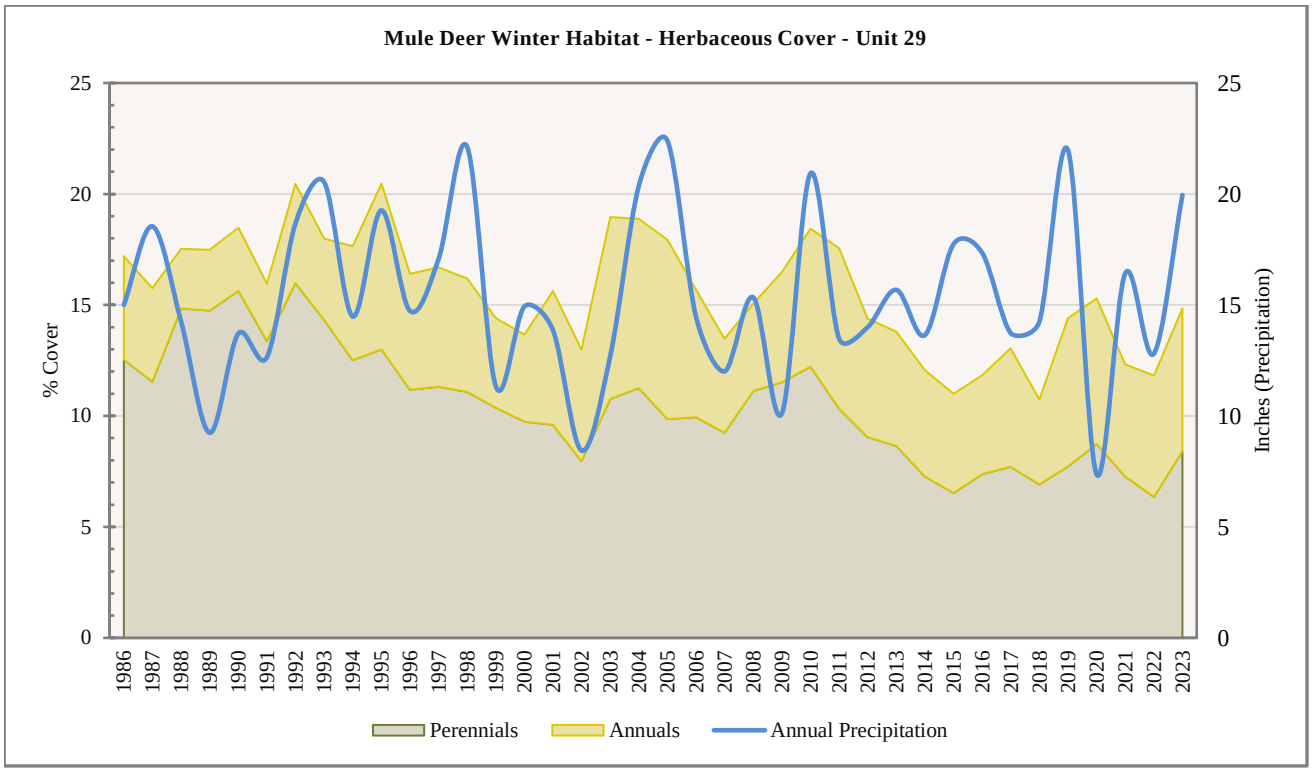


Figure 8.6: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

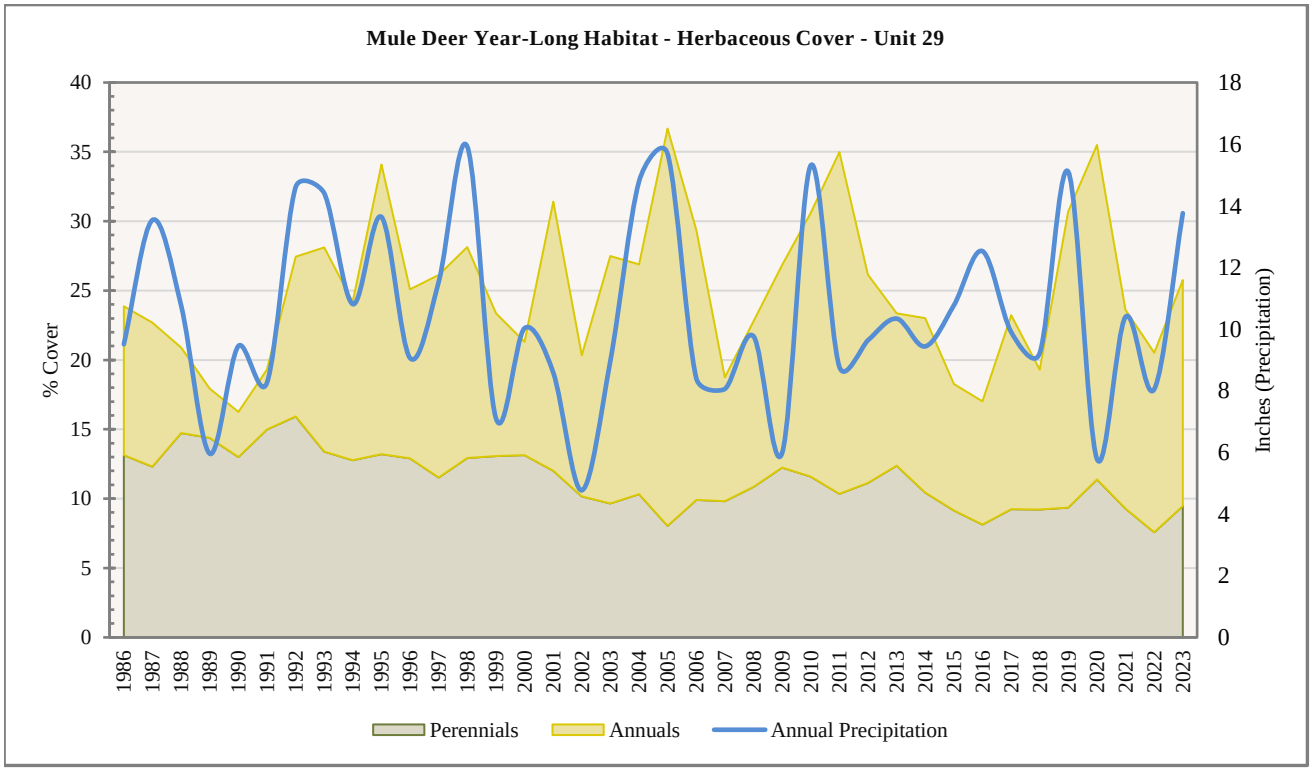


Figure 8.7: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

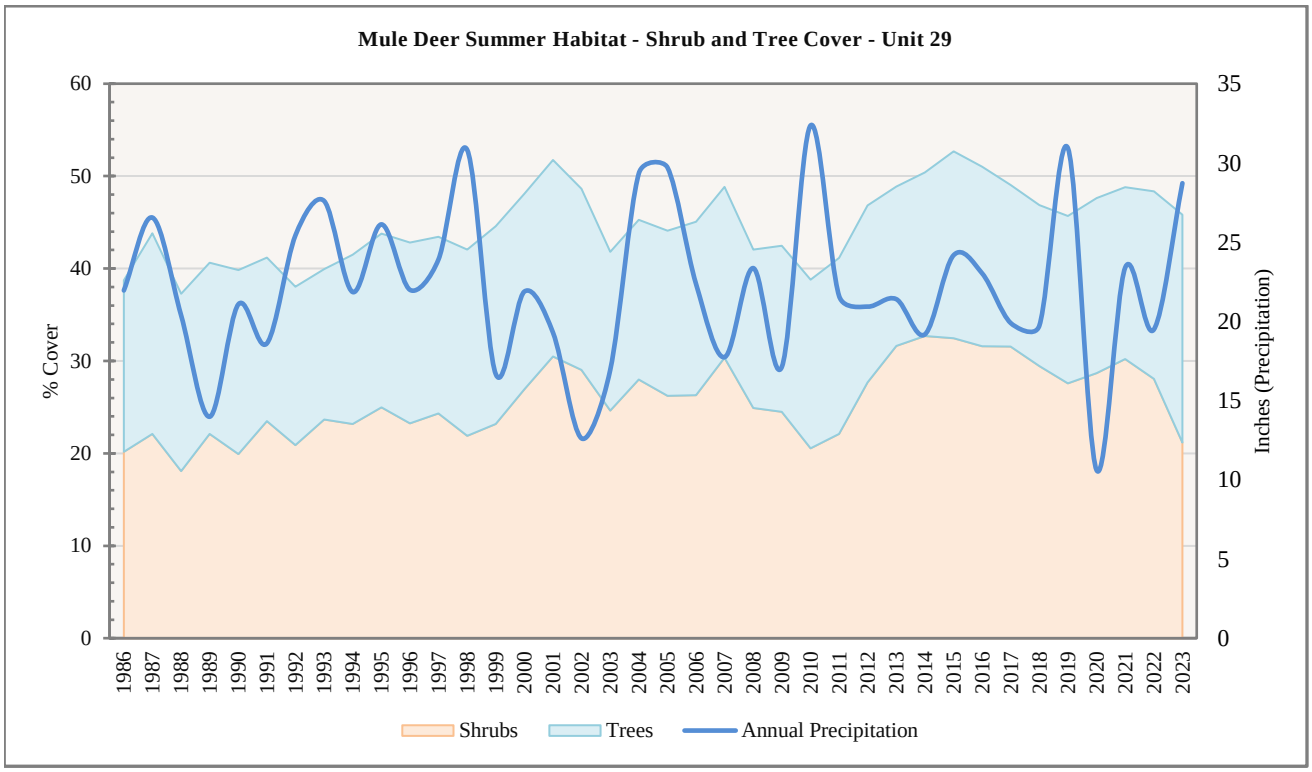


Figure 8.8: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

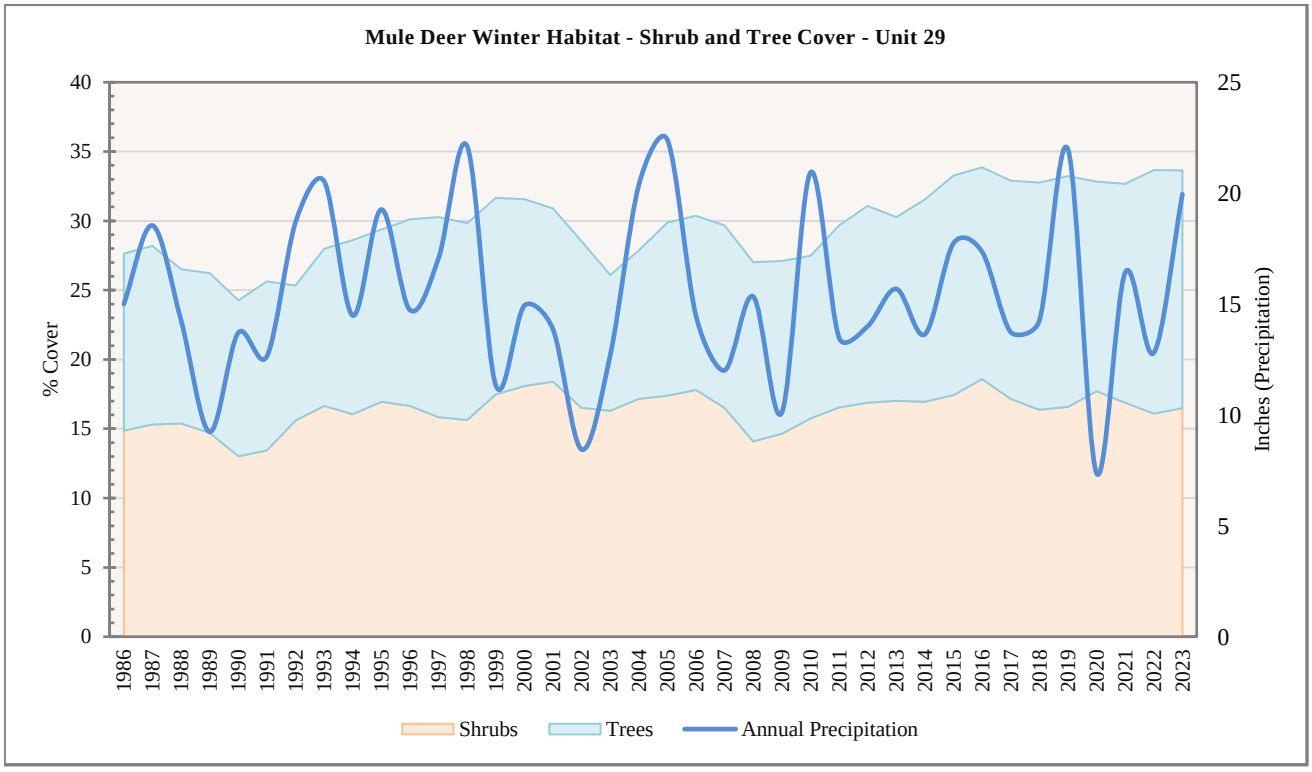


Figure 8.9: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).

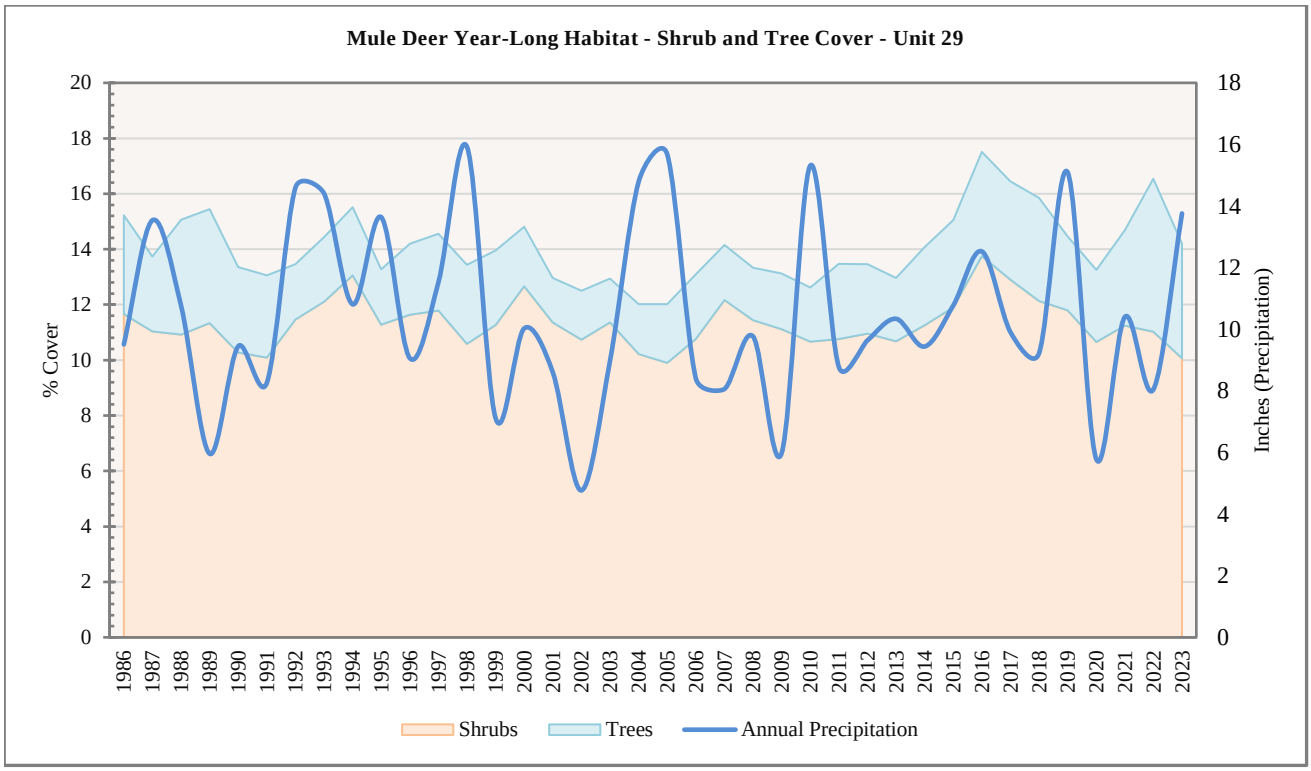
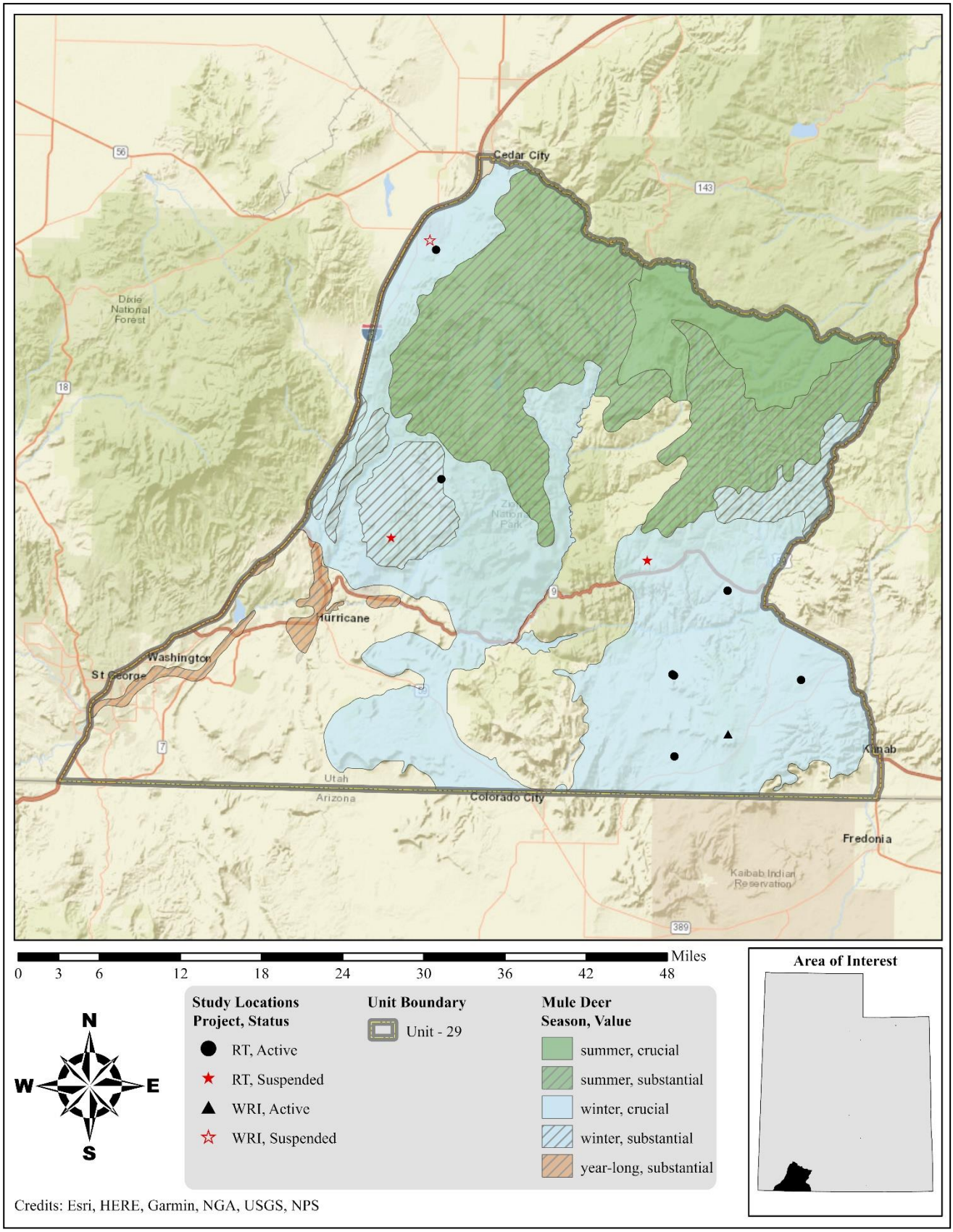
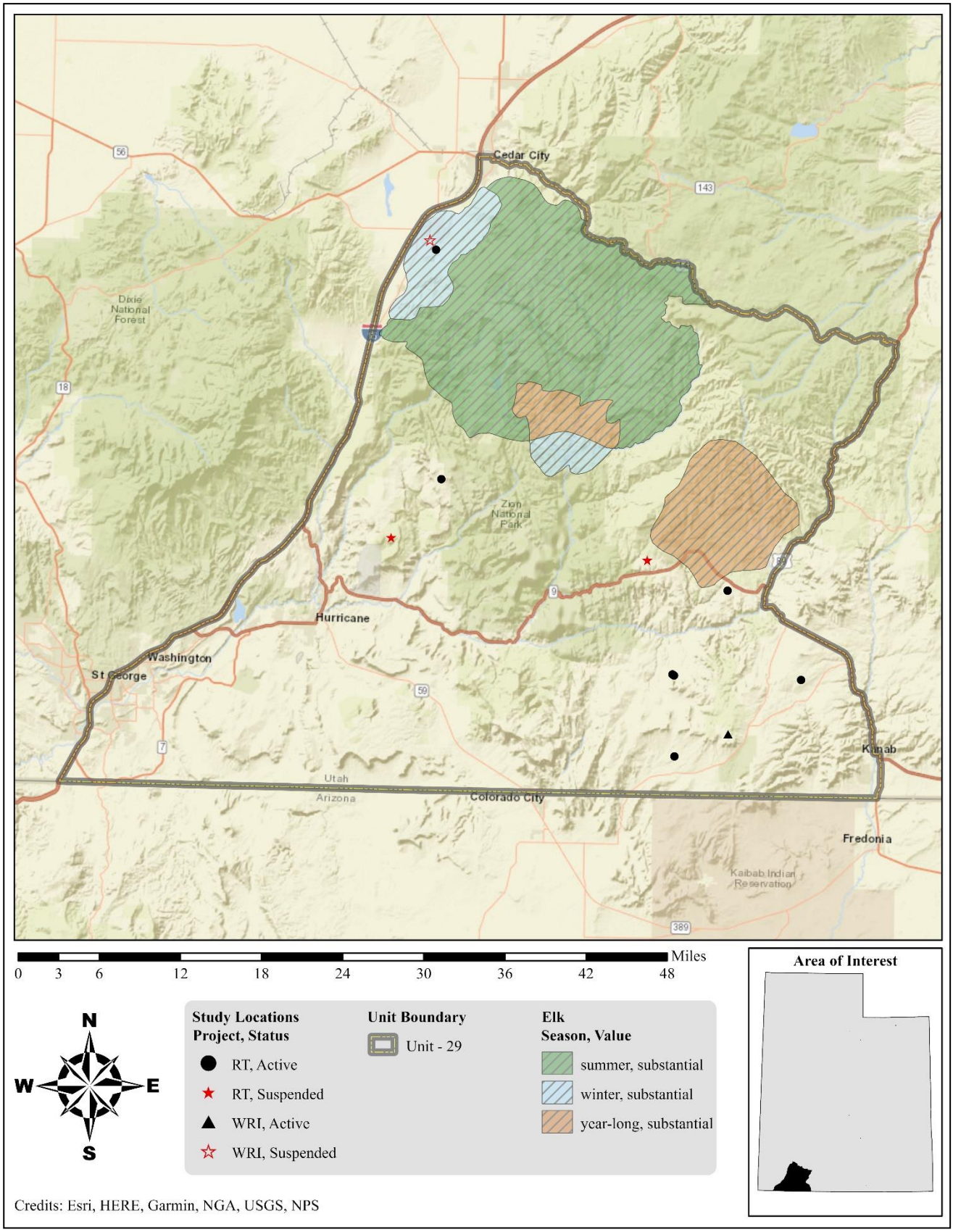


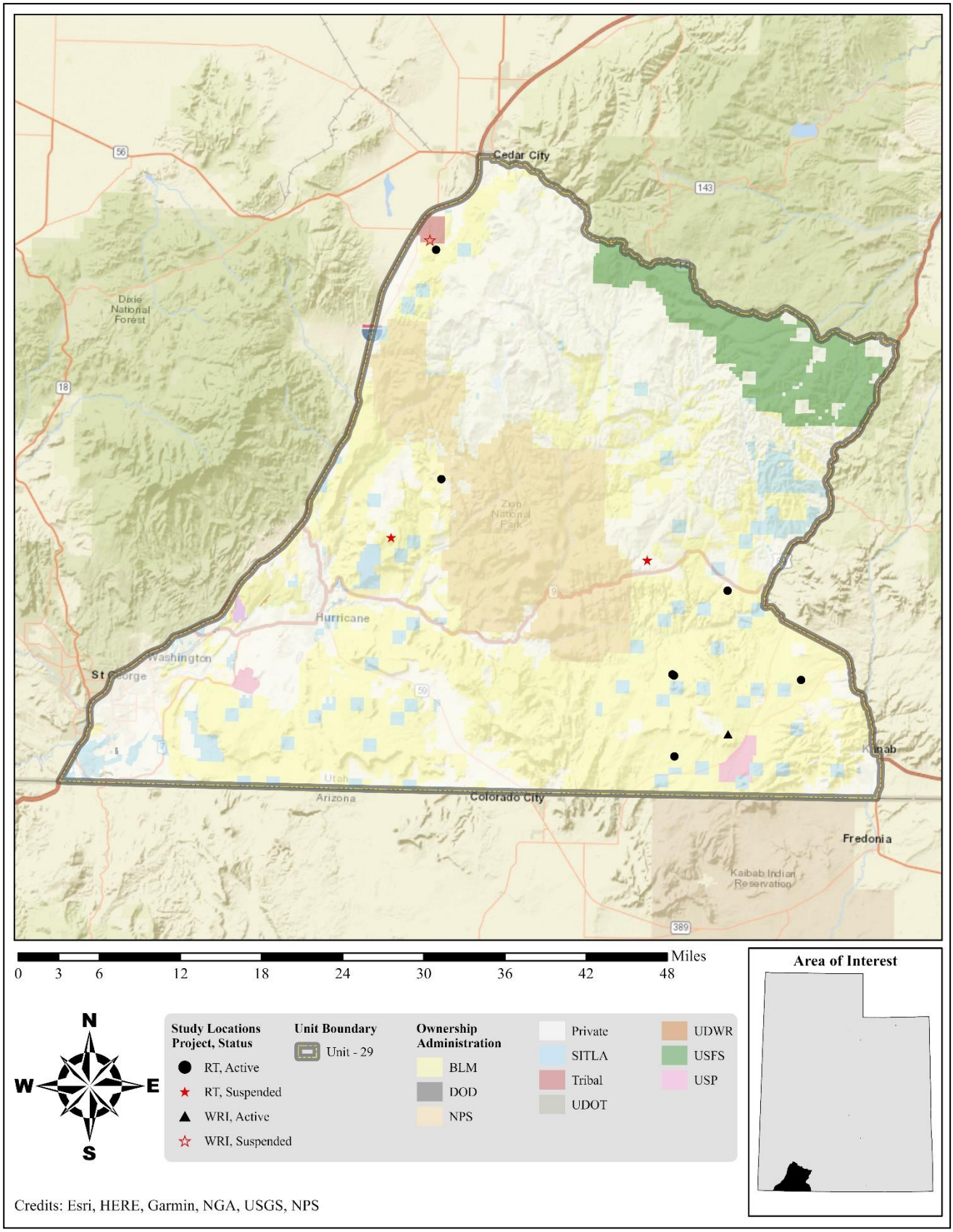
Figure 8.10: Average precipitation and estimated yearly stacked shrub and tree cover for year-long mule deer habitat in WMU 29, Zion (Rangeland Analysis Platform, 2024).



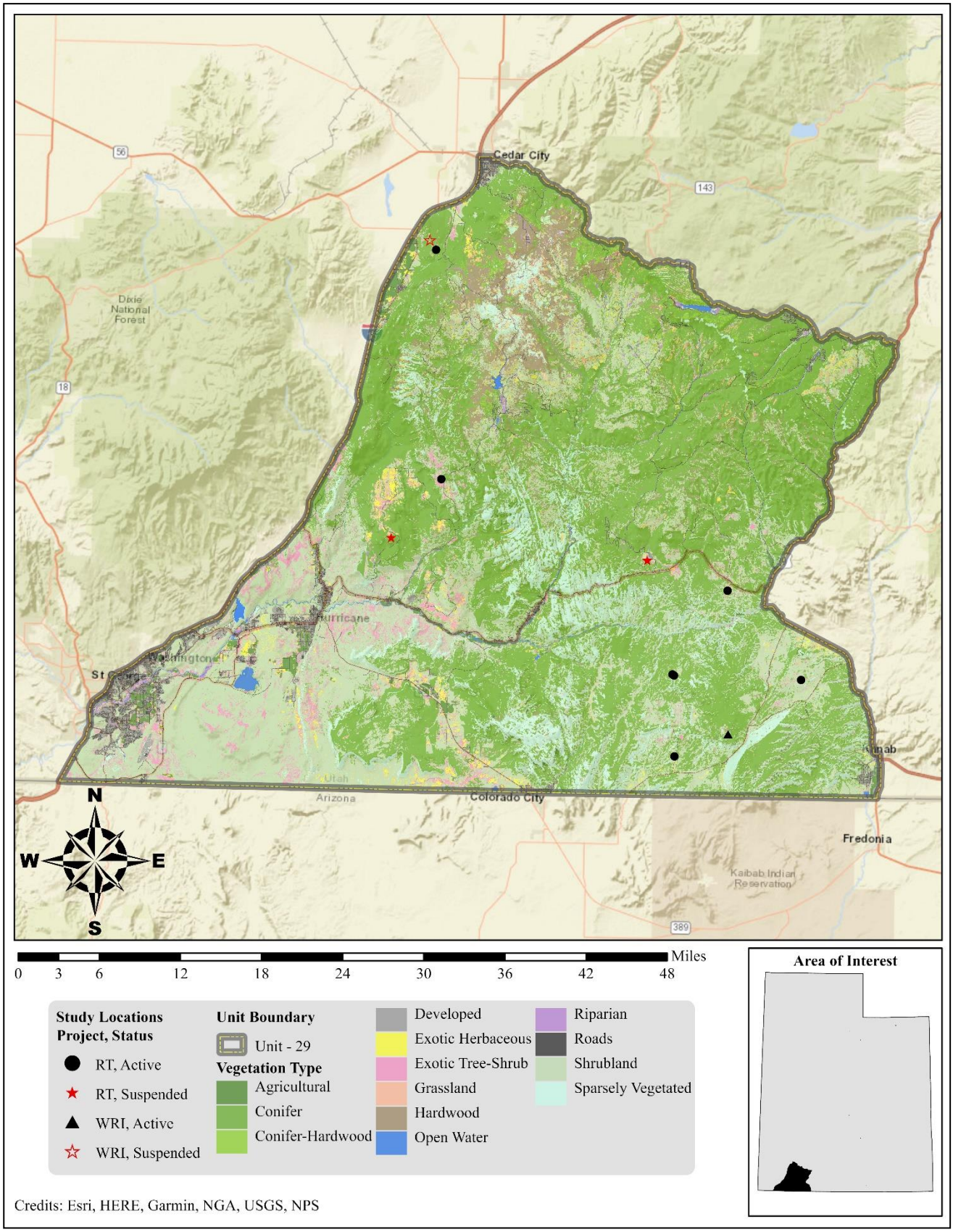
Map 8.2: Estimated mule deer habitat by season and value for WMU 29, Zion.



Map 8.3: Estimated elk habitat by season and value for WMU 29, Zion.



Map 8.4: Land ownership for WMU 29, Zion.



Map 8.5: LANDFIRE Existing Vegetation Type map (LC22_VDEP_230, 2022) for WMU 29, Zion.

LANDFIRE Existing Vegetation Types on Mule Deer Habitat

According to the current LANDFIRE Existing Vegetation Type model, 38% of the mule deer habitat in the Zion management unit is made up of pinyon-juniper woodlands (**Table 8.1**). These woodlands are usually located at lower elevations. Although abundance may vary widely, these woodlands can be associated with understory browse species known to be beneficial to mule deer. Pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) woodlands can provide wildlife with valuable escape and thermal cover. When these trees encroach on existing shrublands, however, they have been shown to lead to decreased sagebrush (*Artemisia spp*.) and herbaceous components (Miller, Svejcar, & Rose, 2000), therefore decreasing available forage for wildlife.

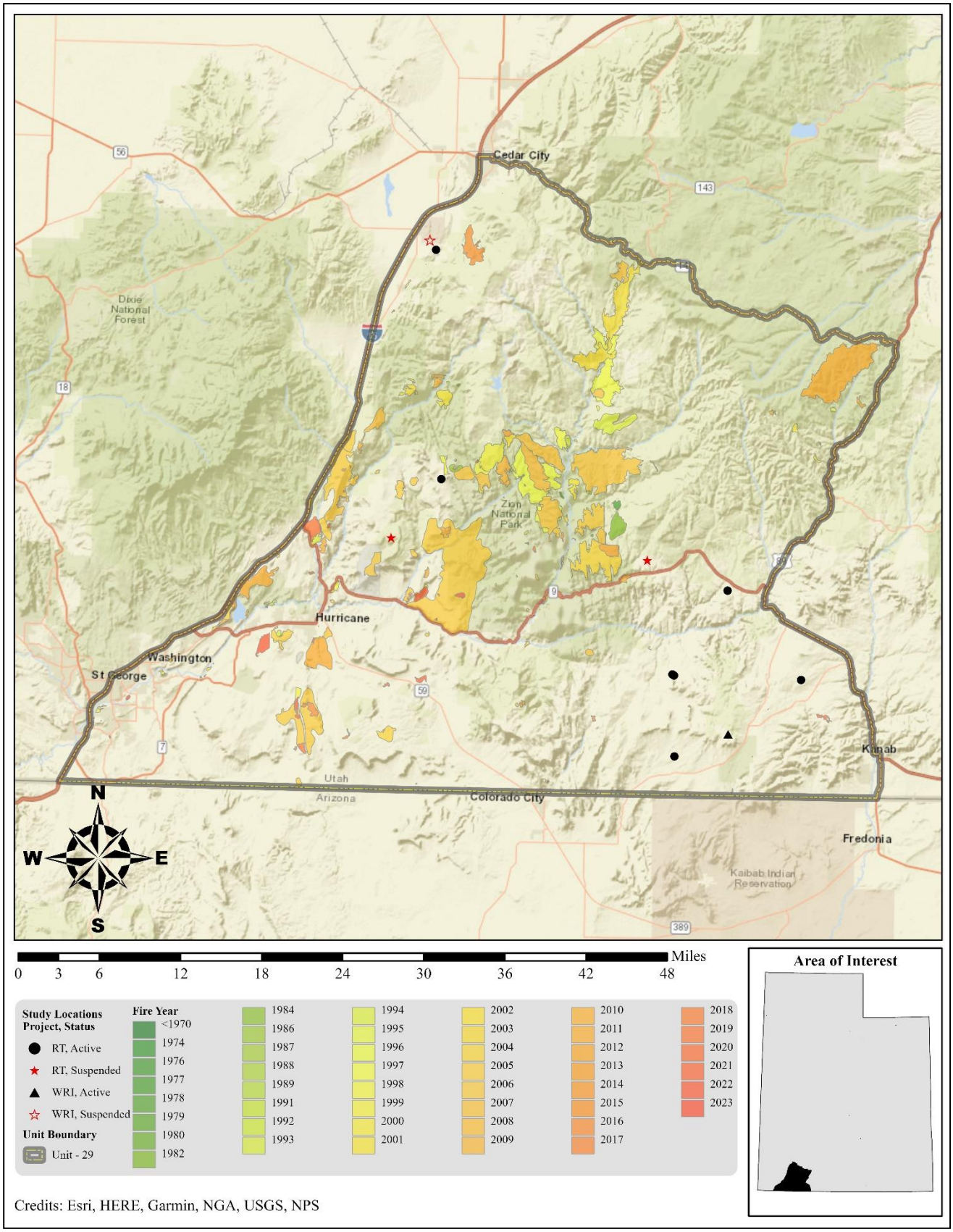
The model also indicates that sagebrush shrublands and steppe and oak shrublands combined make up almost 14% of Unit 29's mule deer habitat (**Table 8.1**). The sagebrush biophysical sites can be found at elevations ranging from low (semidesert) to high (mountain and subalpine). Sagebrush species typically dominate sagebrush steppe and shrubland across the elevation gradient, and may provide valuable browse for deer when they are present on winter range. However, other preferred browse species may be present in lesser amounts. At higher elevations, sagebrush biophysical sites are often host to abundant herbaceous understories that could provide valuable forage for mule deer during the summer months. Pinyon and juniper may be present at lower to middle elevations on some sagebrush biophysical sites. Elevations where the oak shrubland vegetation type range from low-middle (upland) to high (mountain). Sites of this vegetation type are dominated by either patchy or more contiguous stands of Gambel oak (*Quercus gambelii*), a species which is considered to be preferred browse for mule deer. Like the sagebrush vegetation types, other shrub species that may be present on these oak biophysical sites can be beneficial for mule deer. In addition, grasses and forbs may be found in the open spaces between areas occupied by oak. Just over 11% of the unit's mule deer habitat is occupied by sparsely vegetated, developed, agricultural, and open water areas according to the model: these types may have lesser or no value for deer when compared with more productive vegetation types.

The rest of the mule deer habitat within the Zion management unit is comprised of a variety of other vegetation types (**Table 8.1**) that will not be discussed here. Descriptions for these additional vegetation types is available on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Colorado Plateau Pinyon-Juniper Woodland	222,376	28.27%	
	Great Basin Pinyon-Juniper Woodland	80,316	10.21%	
	Southern Rocky Mountain Ponderosa Pine Woodland	47,841	6.08%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	25,074	3.19%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	15,260	1.94%	
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	9,689	1.23%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	4,638	0.59%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	3,177	0.40%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	2,503	0.32%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	646	0.08%	
	Southern Rocky Mountain Ponderosa Pine Savanna	2	0.00%	52.32%
Shrubland	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	56,434	7.17%	
	Inter-Mountain Basins Big Sagebrush Shrubland	41,041	5.22%	
	Colorado Plateau Pinyon-Juniper Shrubland	24,209	3.08%	
	Rocky Mountain Lower Montane-Foothill Shrubland	22,068	2.81%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	16,350	2.08%	
	Inter-Mountain Basins Montane Sagebrush Steppe	8,233	1.05%	
	Colorado Plateau Blackbrush-Mormon-tea Shrubland	7,300	0.93%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	3,816	0.49%	
	Southern Colorado Plateau Sand Shrubland	3,646	0.46%	
	Mojave Mid-Elevation Mixed Desert Scrub	3,502	0.45%	
	Sonora-Mojave Creosotebush-White Bursage Desert Scrub	2,099	0.27%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	685	0.09%	
	Inter-Mountain Basins Greasewood Flat	615	0.08%	
	Sonora-Mojave Semi-Desert Chaparral	216	0.03%	
	Great Basin Xeric Mixed Sagebrush Shrubland	178	0.02%	
	Sonora-Mojave Mixed Salt Desert Scrub	20	0.00%	
	Great Basin Semi-Desert Chaparral	7	0.00%	
	Inter-Mountain Basins Mat Saltbush Shrubland	1	0.00%	
	Inter-Mountain Basins Big Sagebrush Steppe	0	0.00%	24.21%
Other	Sparsely Vegetated	58,304	7.41%	
	Developed	23,163	2.94%	
	Agricultural	7,749	0.99%	
	Riparian	6,848	0.87%	
	Open Water	1,743	0.22%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	60	0.01%	12.44%

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Hardwood	Rocky Mountain Aspen Forest and Woodland	31,081	3.95%	
	Rocky Mountain Bigtooth Maple Ravine Woodland	15,323	1.95%	5.90%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	13,525	1.72%	
	Interior Western North American Temperate Ruderal Shrubland	579	0.07%	
	North American Warm Desert Ruderal & Planted Scrub	530	0.07%	1.86%
Exotic Herbaceous	Interior Western North American Temperate Ruderal Grassland	4,607	0.59%	
	Great Basin & Intermountain Introduced Annual Grassland	4,111	0.52%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	3,137	0.40%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	2,008	0.26%	
	North American Warm Desert Ruderal & Planted Grassland	107	0.01%	1.78%
Grassland	Inter-Mountain Basins Semi-Desert Grassland	4,534	0.58%	
	Rocky Mountain Subalpine-Montane Mesic Meadow	4,238	0.54%	
	Southern Rocky Mountain Montane-Subalpine Grassland	2,952	0.38%	1.49%
Total		**786,538**	**100%**	**100%**

Table 8.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 29, Zion.



Map 8.6: Land coverage of fires by year from prior to 1970-2023 for WMU 29, Zion (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

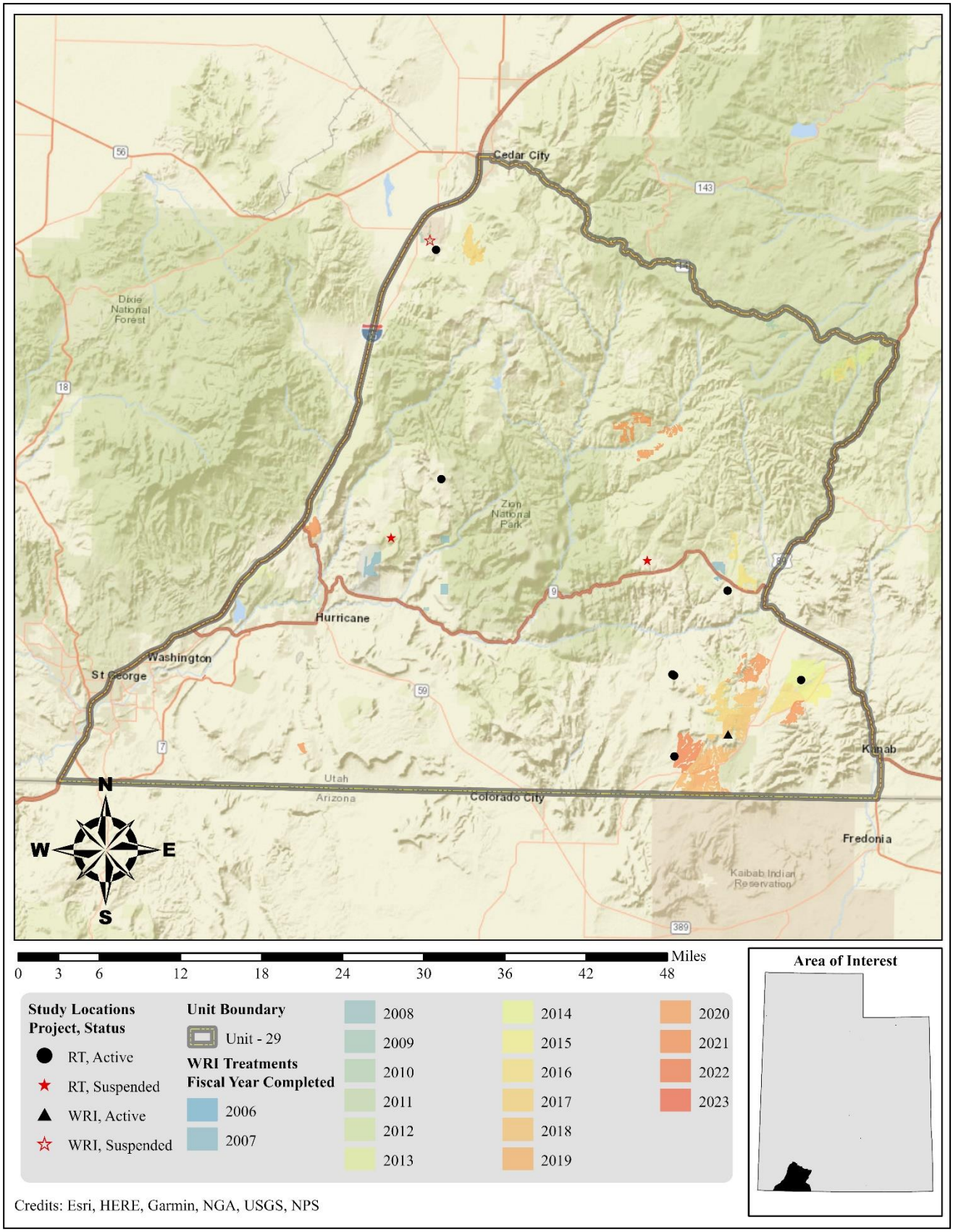
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 30,293 acres of land have been treated within the Zion unit since the WRI was implemented in 2004 (**Map 8.7**). Treatments frequently overlap one another, bringing the net total of treated acres to 28,508 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.

The most common management practice in this unit is the use of bullhog treatments to remove pinyon and juniper trees. Seeding plants to augment the herbaceous understory is also very common and frequently occurs together with other treatments. Other management practices include (but are not limited to) anchor chaining and manual vegetation removal techniques to remove trees, planting and transplanting plants, discing, and prescribed fire (**Table 8.2**).

Type	Total Completed Acreage
Anchor Chain	**1,534**
Ely (Two-Way)	1,534
Bulldozing	**53**
Tree Push	53
Bullhog	**17,915**
Full Size	17,765
Skid Steer	150
Disc	**349**
Off-Set (Two-Way)	8
Plow (One-Way)	341
Harrow	**45**
≤ 15 ft. (One-Way)	45
Herbicide	**46**
Spot Treatment	46
Planting/Transplanting	**450**
Other	450
Prescribed Fire	**298**
Prescribed Fire	298
Seeding (Primary)	**8,588**
Broadcast (Aerial-Fixed Wing)	7,432
Broadcast (Aerial-Helicopter)	1,046
Drill (Rangeland)	71
Ground (Mechanical Application)	23
Hand Seeding	16
Seeding (Secondary/Shrub)	**14**
Hand Seeding	14
Vegetation Removal/Hand Crew	**1,000**
Lop & Scatter	1,000
Lop-Pile-Burn	<1
Grand Total	**30,293**
***Total Land Area Treated**	**28,508**

Table 8.2: WRI treatment action size (acres) of completed projects for WMU 29, Zion. Data accessed on 02/07/2024.
*Does not include overlapping treatments.



Map 8.7: Terrestrial WRI treatments by fiscal year completed for WMU 29, Zion.

Range Trend Studies

Range Trend studies have been sampled within WMU 29 on a regular basis since 1987, with studies being added or suspended as was deemed necessary (**Table 8.3**). 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
29-01	Wilson Ranch	RT	Suspended	1987, 1992, 1998	Upland Loam (Mountain Big Sagebrush)
29-02	Smith's Mesa	RT	Suspended	1998, 2003, 2008	Upland Sand (Mountain Big Sagebrush)
29-03	North Hills	RT	Active	1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Browse)
29-04	Barracks Chaining	RT	Active	2003, 2008, 2013, 2018, 2023	Mountain Loam (Browse)
29-05	Kolob Terrace	RT	Active	2013, 2018, 2023	Upland Sand (Mountain Big Sagebrush)
29-06	Elephant Butte	RT	Active	2013, 2018, 2023	Upland Sand (Mountain Big Sagebrush)
29R-01	Elephant Gap Total Exclosure	RT	Active	1998, 2003, 2008, 2018	Upland Sand (Mountain Big Sagebrush)
29R-02	Elephant Gap Livestock Exclosure	RT	Active	1998, 2003, 2008, 2018	Upland Sand (Mountain Big Sagebrush)
29R-03	Elephant Gap Exclosure Outside	RT	Active	1998, 2003, 2008, 2018, 2023	Upland Sand (Mountain Big Sagebrush)
29R-04	North Hills Bullhog	WRI	Suspended	2008, 2011	Upland Shallow Hardpan (Pinyon-Utah Juniper)
29R-05	Yellow Jacket	RT	Active	2013, 2016, 2021, 2023	Upland Sand (Mountain Big Sagebrush)
29R-06	Block Mesas	WRI	Active	2017, 2021	Upland Sand (Mountain Big Sagebrush)

Table 8.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 29, Zion.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
29-03	North Hills	Chain Unknown Seed Unknown Lop and Scatter		1967 1967 Between 2008 and 2013		
29-04	Barracks Chaining	Chain Unknown Seed Unknown Lop and Scatter		Historic Historic Between 2013 and 2018		
29-06	Elephant Butte	Bullhog Aerial Before Two-Way Chain	Yellowjacket Rosy Canyon (Proposed) Yellowjacket Rosy Canyon (Proposed) Yellowjacket Rosy Canyon (Proposed)	Fall 2023 Fall 2023 Fall 2023	577 577 577	5884 5884 5884
29R-04	North Hills Bullhog	Two-Way Unkown Aerial Before Bullhog Aerial Before	North Hills Seeding 1967 North Hills Seeding 1967 North Hills Thinning North Hills Thinning	August-November 1967 August-November 1967 October-November 2008 September 2008	1,500 1,500 150 150	LTDL LTDL 1190 1190
29R-05	Yellow Jacket	Bullhog Aerial Before	Yellowjacket (Kinnickinnic) Yellowjacket (Kinnickinnic)	2014 January 2014	2,147 2,147	2687 2687
29R-06	Block Mesas	Aerial Before Bullhog	Yellow Jacket (Buck Pasture) Yellow Jacket (Buck Pasture)	November 2017 January-March 2018	3,500 1,599	3977 3977

Table 8.4: Range Trend and WRI studies known disturbance history for WMU 29, Zion. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Mountain (Browse)

Two studies [North Hills (29-03) and Barracks Chaining (29-04)] are classified as Mountain (Browse) ecological sites. The North Hills study is located in North Hills, south of Cedar City. Barracks Chaining can be found west of Mt. Carmel Junction near Mineral Gulch.

Shrubs/Trees: Data for total average shrub cover indicates that preferred browse species other than Utah serviceberry (*Amelanchier utahensis*) and mountain mahogany (*Cercocarpus spp.*) contribute a majority of the cover for this ecological type. More specifically, other preferred browse species on these sites include mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*), among others. Total shrub cover has increased over time, and is driven by the increase of serviceberry on both study sites (**Figure 8.11**). However, average preferred browse demographics show that density has slightly decreased overall, but could be considered stable since 2008 with little change to the percentage of young and mature plants within the population. Low amounts of decadence also contribute to the stability of the browse populations on these sites. The initial decrease in density between 1998 and 2003 can largely be attributed to the establishment of the Barracks Chaining study (**Figure 8.15**). Preferred browse has exhibited some fluctuations in average utilization. However, there has been an overall decreasing trend in the percentage of plants that have been mostly heavily browsed (**Figure 8.16**).

Tree cover displayed an increasing trend from 2003 to 2013, but no cover was observed in 2018 or 2023 (**Figure 8.13**). This trend is entirely driven by the Barracks Chaining site, which underwent a lop and scatter treatment between 2013 and 2018. Average tree density, however, has shown a decreasing trend for both pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) (**Figure 8.14**).

Herbaceous Understory: Seeded and introduced perennial grasses such as crested wheatgrass (*Agropyron cristatum*) and intermediate wheatgrass (*Thinopyrum intermedium*) have dominated most of the herbaceous understories of these sites throughout the study period. Perennial forbs have also been a notable component, although abundance and average cover have been variable. Annual grasses have been observed throughout the study period and exhibited a notable increase in average cover in 2023. Total average herbaceous cover has increased overall while average nested frequency has displayed slight to moderate fluctuations over the study period (**Figure 8.17**, **Figure 8.18**).

Occupancy: Average pellet transect data indicates that overall occupancy has decreased over time. Deer have been the primary occupants of these sites in all sample years, with mean pellet group abundance ranging from nearly 42 days use/acre in 2018 to over 103 days use/acre in 1998. Mean abundance of elk pellet groups has been as low as 0 days use/acre in 2013 and 2023, and as high as 6 days use/acre in 1998. Cattle have also been present with a mean pellet group abundance ranging from 2.5 days use/acre in 2018 to over 17 days use/acre in 2008 (**Figure 8.19**).

Upland (Big Sagebrush)

Five study sites [Wilson Ranch (29-01) (suspended), Smith's Mesa (29-02) (suspended), Kolob Terrace (29-05), Elephant Butte (29-06), and Elephant Gap Exclosure Outside (29R-03)] are considered to be Upland (Big Sagebrush) ecological sites. The Wilson Ranch study is placed approximately one mile north of Co-op Creek and just over a mile east of the Zion National Park boundary. The Smith's Mesa site is located on the southern portion of Smith Mesa, east of Toquerville. Kolob Terrace is located on the Lower Kolob Plateau near the western border of Zion National Park. The Elephant Gap study site is situated just south of Elephant Gap. Finally, the Elephant Gap Exclosure Outside study is found just north of Harris Mountain in Elephant Cove.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, the Wilson Ranch study contributed data in 1992 and 1998, while Smith's Mesa provided data from 1998 through 2008. The Elephant Gap Exclosure Outside site has provided data in all sample years since 1998 except 2013. Finally, Kolob Terrace and Elephant Butte have contributed data since 2013.

Shrubs/Trees: In 2013, the Kolob Terrace and Elephant Butte studies were established while the Elephant Gap Exclosure Outside site was not sampled. Big sagebrush provided the most cover overall in 2013. Elephant Gap Exclosure Outside, Kolob Terrace, and Elephant Butte were sampled in 2018 and big sagebrush remained as the dominant browse species. Total average shrub cover decreased between 2013 and 2023 due to the inclusion of the Elephant Gap Exclosure Outside study in 2018, but remained similar in 2023 (**Figure 8.12**).

Average preferred browse demographics indicate that density has fluctuated, but has exhibited an overall decrease since 2013. This decreasing trend is largely driven by the Elephant Gap Exclosure Outside study, on which preferred browse density decreased significantly between 2018 and 2023. Demographic data also indicates that mature individuals have comprised a majority of the plant populations in all sample years. Young plants have decreased while decadence has slightly increased (**Figure 8.15**). Since 2003, average preferred browse utilization has fluctuated drastically from summary year to summary year. Much of these browse populations have received moderate use, but utilization has generally increased over time. Utilization increased between 2018 and 2023 on all three sites, but the greatest increase over this period was observed on the Kolob Terrace study (**Figure 8.16**).

Utah juniper contributes a majority of the tree cover on these sites and has been observed on the Elephant Butte and Elephant Gap Exclosure Outside studies. Overall tree cover has displayed fluctuations over time with no clear trend (**Figure 8.13**). Like tree cover, average tree density has shown no clear trend, which is likely due to different study inputs for each summary year (**Figure 8.14**).

Herbaceous Understory: Annual forb cover showed an initial decrease in 2008 due to the suspension of Smith's Mesa, but total average cover has steadily increased, while that of perennial forbs has remained relatively stable. Perennial forbs have been the dominant herbaceous component since 2003. Annual grasses have fluctuated and have mainly been observed on the Kolob Terrace and Elephant Gap Exclosure Outside studies. Annual grasses have gradually increased overall since 2008; there was a notable decrease in average cover of annual grass when Smith's Mesa was suspended. Perennial grass followed a similar trend with average cover and nested frequency also gradually increasing. Since Smith's Mesa's suspension in 2008, overall average herbaceous cover has increased, while frequency has generally decreased over the same timeframe (**Figure 8.17**, **Figure 8.18**).

Occupancy: Average pellet transect data indicates that overall occupancy has increased over time, but with some fluctuations. Pellet group abundance decreased between 1998 and 2008, a trend entirely driven by the Elephant Gap Exclosure Outside study. However, occupancy has since increased due to the inclusion of the Elephant Butte and Kolob Terrace studies. Deer have been the primary occupants on these sites in all sample years, with a mean pellet group abundance ranging from 31 days use/acre in 2003 to 144 days use/acre in 2023. Cattle have had a mean pellet group abundance as low as 1 days use/acre in 2018 and 2023, and as high as over 6 days use/acre in 1998 (**Figure 8.19**).

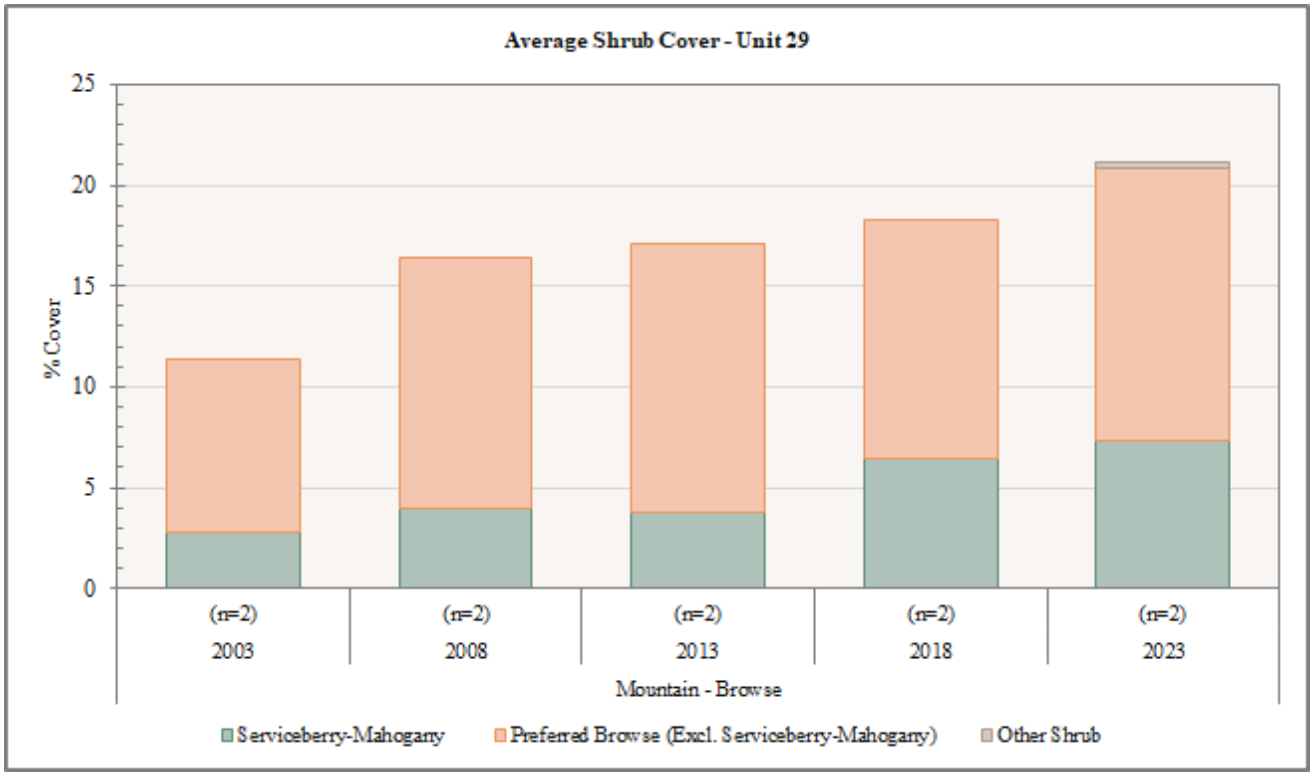


Figure 8.11: Average shrub cover for Mountain -Browse study sites in WMU 29, Zion.

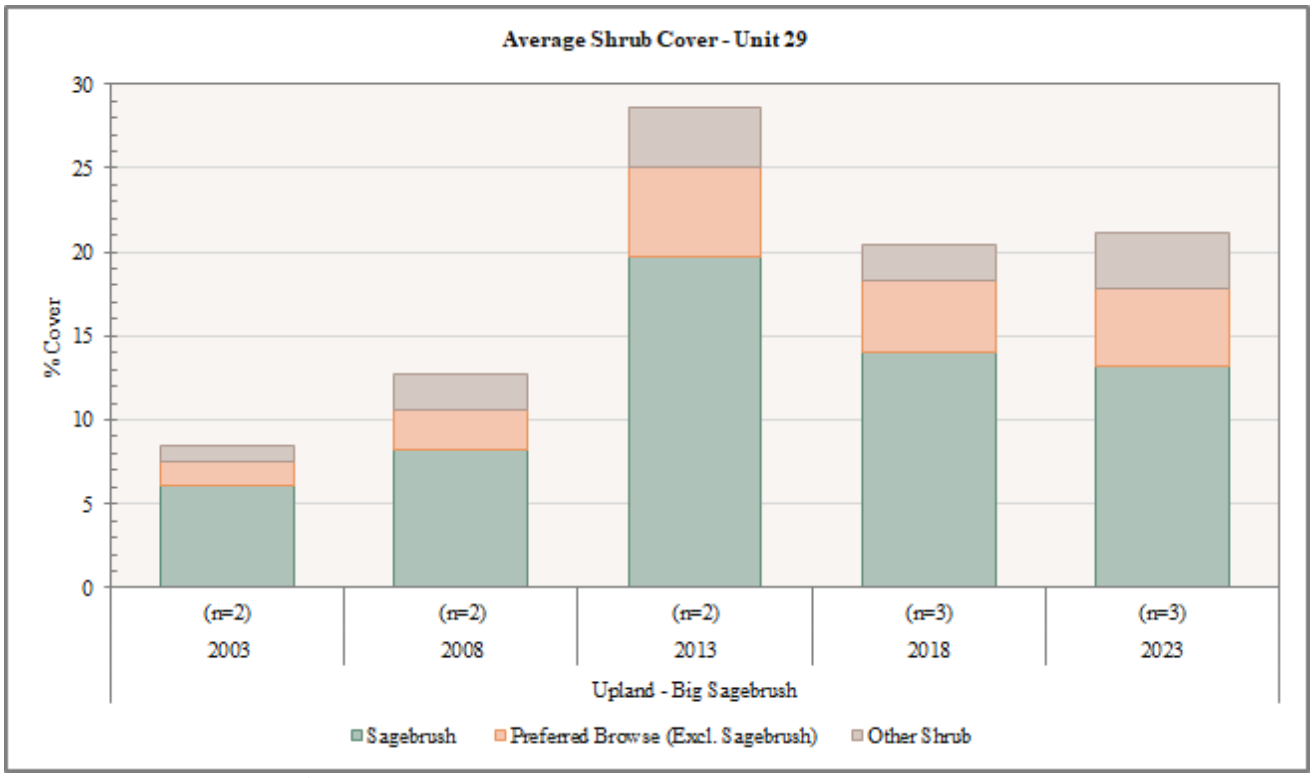


Figure 8.12: Average shrub cover for Upland - Big Sagebrush study sites in WMU 29, Zion.

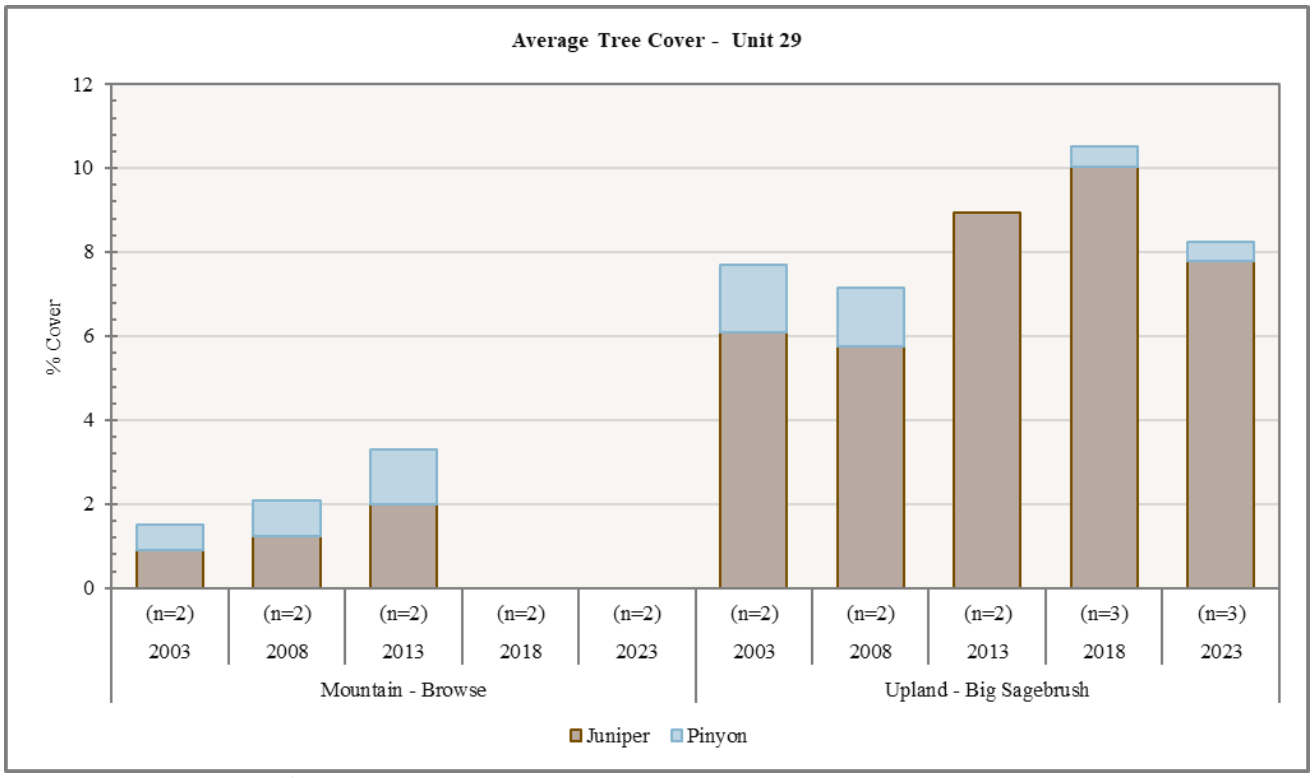


Figure 8.13: Average tree cover for Mountain - Browse and Upland - Big Sagebrush study sites in WMU 29, Zion.

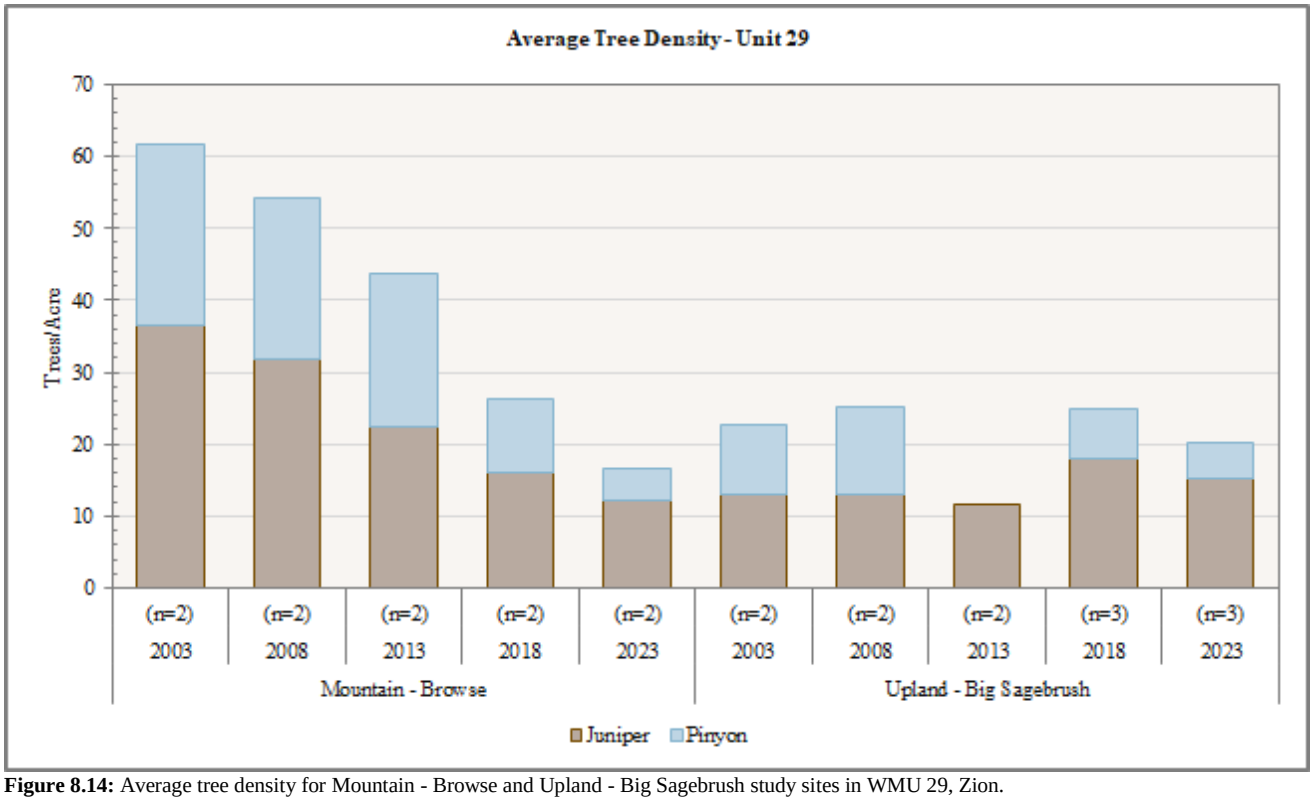


Figure 8.14: Average tree density for Mountain - Browse and Upland - Big Sagebrush study sites in WMU 29, Zion.

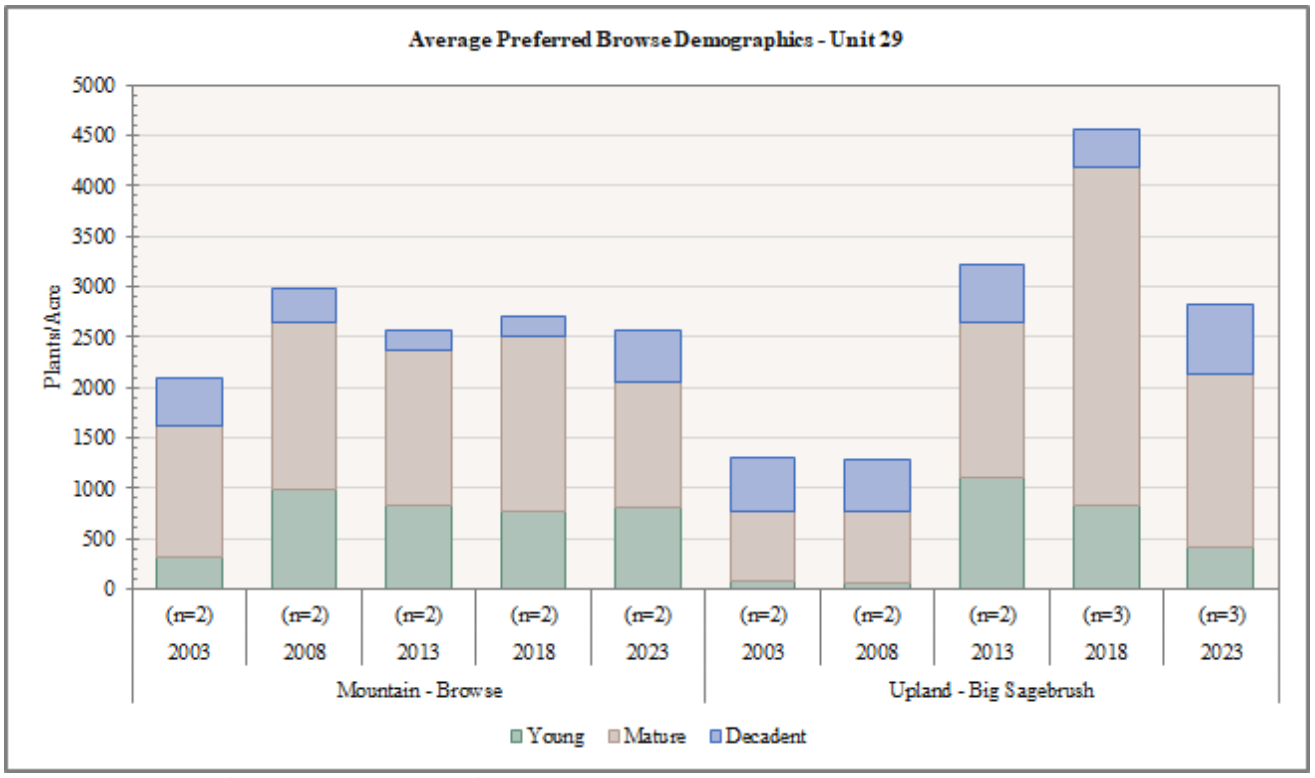


Figure 8.15: Average preferred browse demographics for Mountain - Browse and Upland - Big Sagebrush study sites in WMU 29, Zion.

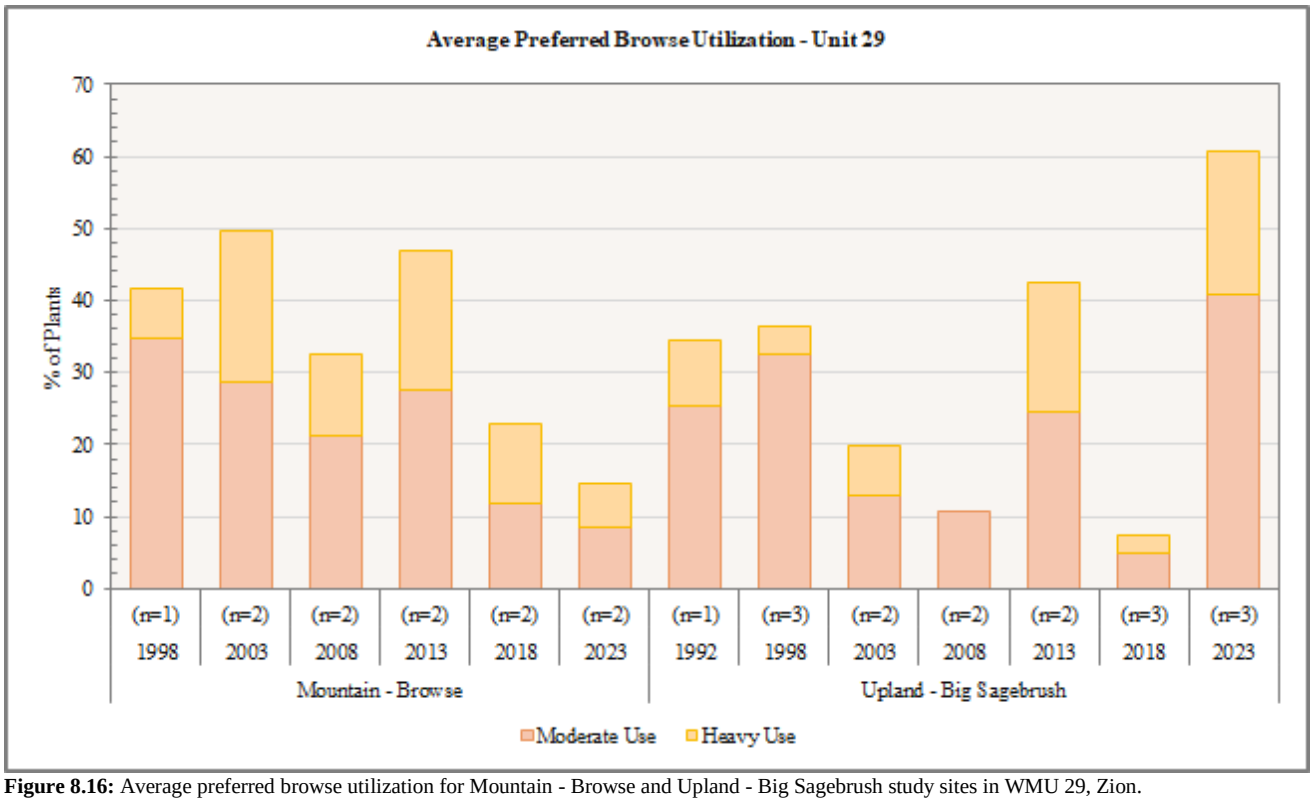


Figure 8.16: Average preferred browse utilization for Mountain - Browse and Upland - Big Sagebrush study sites in WMU 29, Zion.

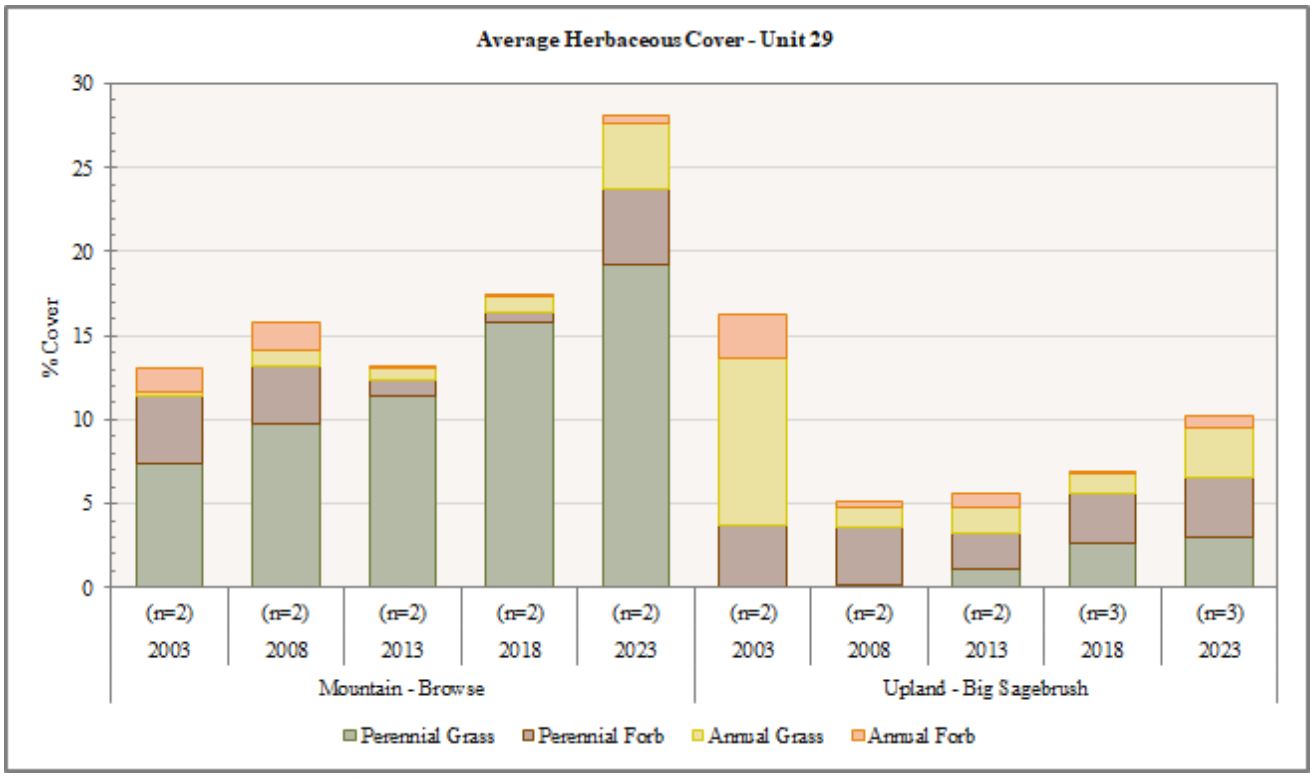


Figure 8.17: Average herbaceous cover for Mountain - Browse and Upland - Big Sagebrush study sites in WMU 29, Zion.

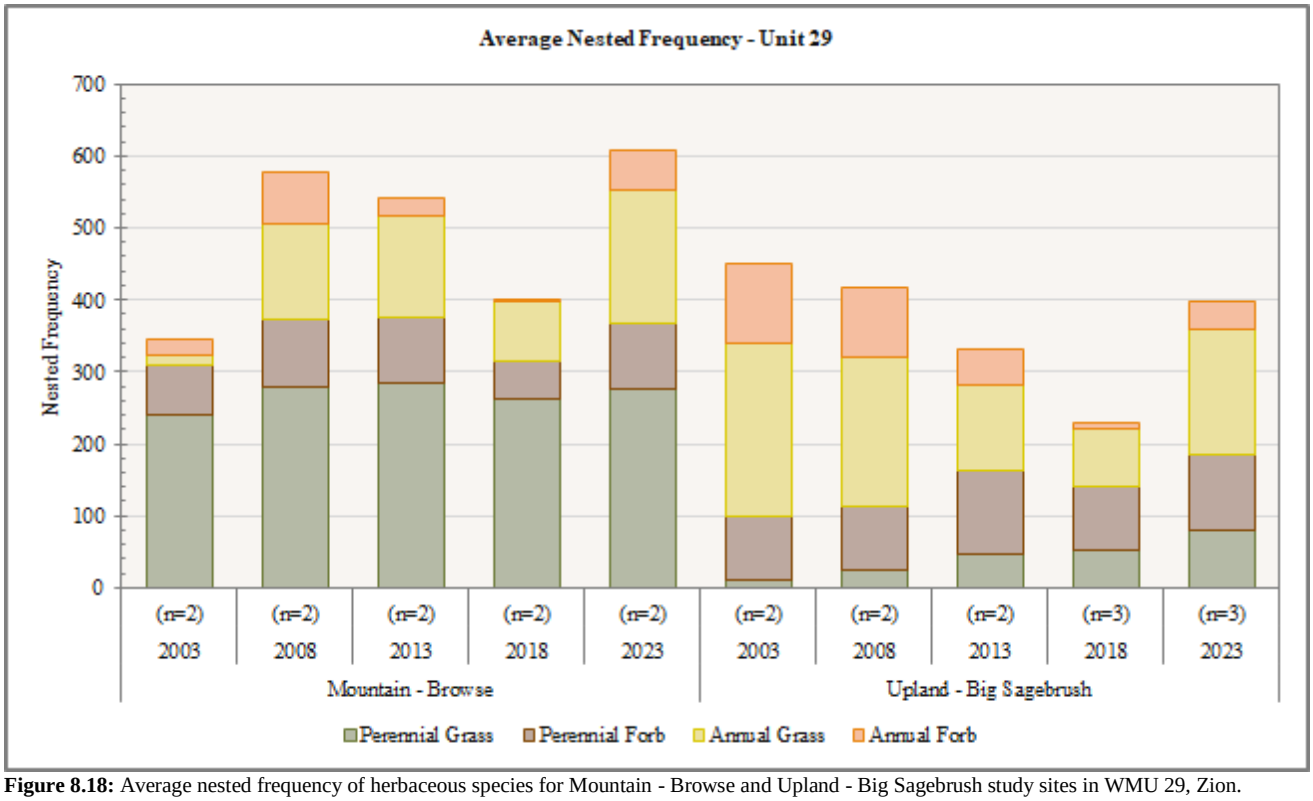


Figure 8.18: Average nested frequency of herbaceous species for Mountain - Browse and Upland - Big Sagebrush study sites in WMU 29, Zion.

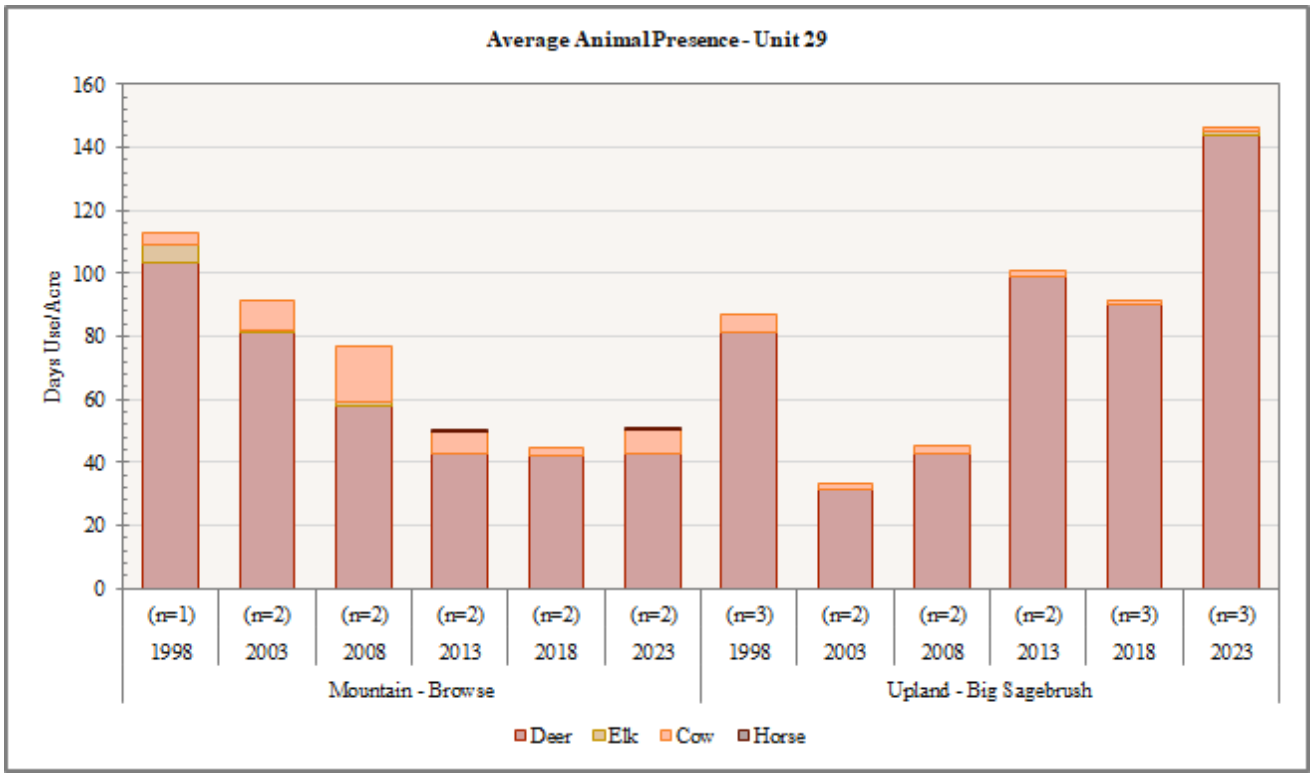


Figure 8.19: Average pellet transect for Mountain - Browse and Upland - Big Sagebrush study sites in WMU 29, Zion.

Deer Winter Range Condition Assessment

The condition of deer winter range within the Zion management unit has had no net gain in winter range improvement for mule deer since 1992. However, it is important to note that this unit has few sites and establishing a trend that adequately reflects the unit is difficult. Further complicating trend establishment is the suspension of old and activation of new sites. Therefore, an informative discussion about trend can only be had when considering the years between 2013 and 2023. The unit as a whole ranged between poor-fair averaged conditions in 2013 through 2023. North Hills (29-03), Barracks Chaining (29-04), and Kolob Terrace (29-05) are the main drivers for the unit's wintering habitat stability and quality, and average as fair for deer winter range condition. Wilson Ranch (29-01) (suspended), Smith's Mesa (29-02) (suspended), Elephant Butte (29-06), and Elephant Gap Exclosure Outside (29R-03) are considered to have poor conditions consistently from year to year, which suppresses the unit's overall winter habitat quality; Wilson Ranch and Smith's Mesa were suspended prior to 2013. Barracks Chaining tends to have higher variability in deer winter habitat with improving conditions over time, and appears to have the highest degree for potential winter range improvement. As such, the area immediately around this site may benefit and respond the most to improvement projects. Areas for improvement may include a reduction in pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) tree cover and/or cheatgrass (*Bromus tectorum*), and increasing the amount of native perennial grasses.

The overall deer winter range assessment in 2023 was that WMU 29 is in poor-fair condition. Factors negatively influencing this condition are the presence of annual grass, low abundance of perennial grasses and forbs (Kolob Terrace, Elephant Butte, and Elephant Gap Exclosure Outside), and a lack of preferred shrub recruitment (same sites). However, Barracks Chaining has a notable perennial forb community present (**Figure 8.20**, **Table 8.5**).

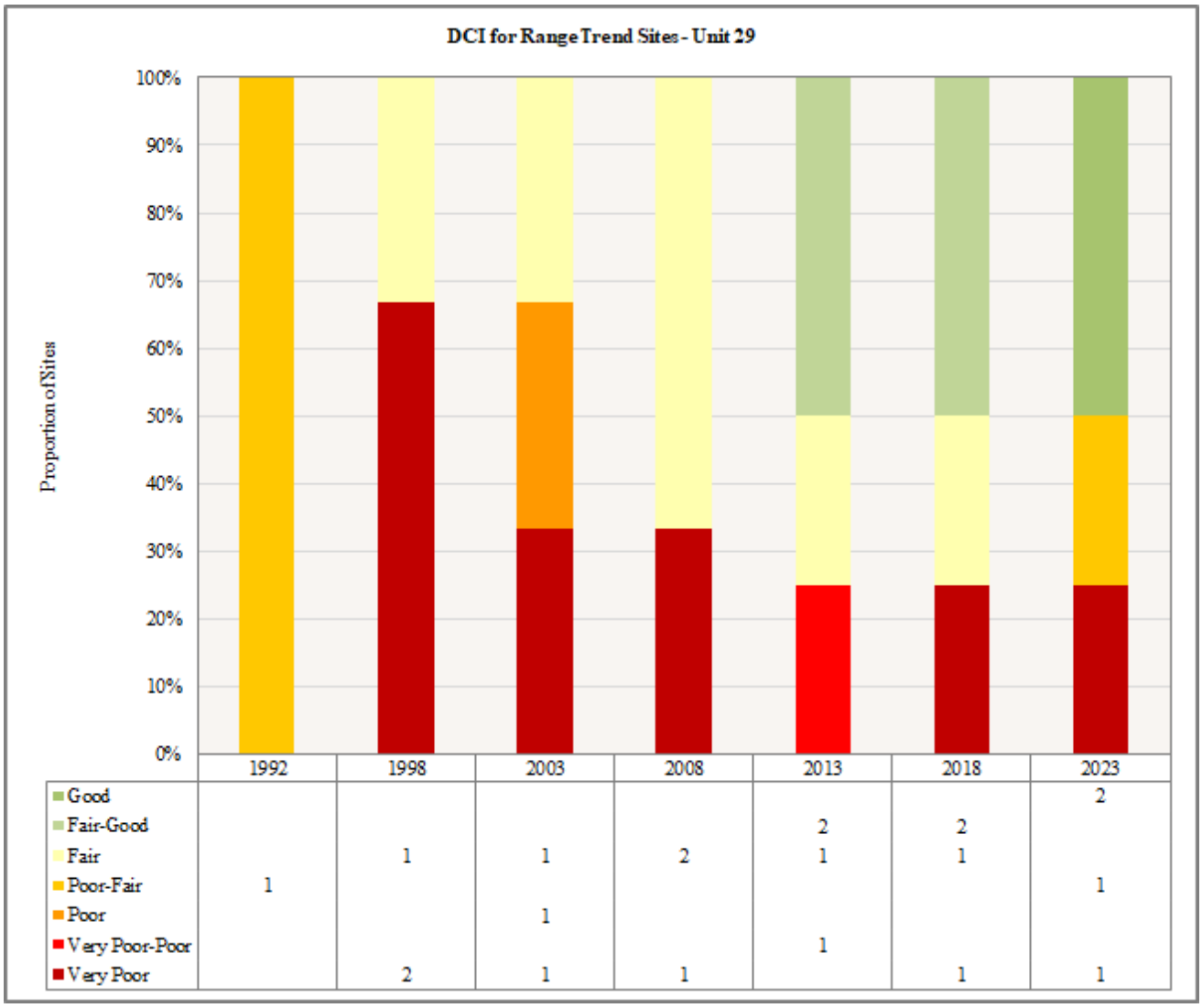


Figure 8.20: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 29, Zion.

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
29-01*	1992	23.5	9.7	15	4.2	-0.8	0.5	-2	**50.1**	**P-F**
29-01*	1998	16.2	8.9	8.5	4.9	-8	0.7	0	**31.3**	**VP**
29-02*	1998	14.6	11.2	5	0.2	-20	0.2	0	**11.2**	**VP**
29-02*	2003	13.4	5	0	0.1	-14.4	0.9	0	**4.9**	**VP**
29-02*	2008	18.6	2.7	0.6	0	-1.5	0.5	0	**20.8**	**VP**
29-03	1998	22.2	7.9	6.6	30	-0.2	0.7	0	**67.2**	**F**
29-03	2003	20.9	7.9	9.1	18.4	0	1	0	**57.3**	**F**
29-03	2008	30	11.5	13.9	10.9	-0.5	0.3	0	**66.1**	**F**
29-03	2013	27.2	12.8	15	16.2	-0.7	1.2	0	**71.6**	**F-G**
29-03	2018	30	13.3	15	10.8	-0.5	0.6	0	**69.2**	**F-G**
29-03	2023	30	10.3	15	20.2	-1.8	1	0	**74.7**	**G**
29-04	2003	8.8	7.7	5.3	11.1	-0.4	10	0	**42.5**	**P**
29-04	2008	11.6	8	8.2	27.9	-1	10	0	**64.6**	**F**
29-04	2013	16.5	14.7	5.6	29.3	-0.2	2.9	0	**68.8**	**F-G**
29-04	2018	14.3	12.8	11.7	30	-0.8	1.8	0	**69.8**	**F-G**
29-04	2023	19.3	13.2	15	30	-4.1	10	0	**83.5**	**G**
29-05	2013	30	8.1	13.8	2.6	-2.4	4.7	0	**56.7**	**F**
29-05	2018	30	11.2	6.4	7.6	-2.5	6.1	0	**58.8**	**F**
29-05	2023	30	11	5.1	6	-4.3	4.2	0	**52**	**P-F**
29-06	2013	13.6	11	4.4	1.7	0	3.9	0	**34.5**	**VP-P**
29-06	2018	10	8.9	4.7	5.1	0	2.6	0	**31.3**	**VP**
29-06	2023	13.1	-3.4	4.5	9.4	-0.7	6.2	0	**29**	**VP**
29R-01*	1998	15.5	10.6	5.3	4.2	-0.1	3.9	0	**39.5**	**P**
29R-01*	2003	14.9	2.8	1.8	1.3	0	3.3	0	**24**	**VP**
29R-01*	2008	18.7	-0.5	5.7	3.5	0	4.2	0	**31.7**	**VP**
29R-01*	2018	12.1	7.9	6.2	8.1	0	4.1	0	**38.4**	**P**
29R-02*	1998	17.3	9.9	15	3	-0.4	6.9	0	**51.7**	**P-F**
29R-02*	2003	23.9	7.6	4.9	2.1	0	4.4	-2	**40.9**	**P**
29R-02*	2008	27.3	2.1	8.7	0.8	-0.4	5.3	0	**43.7**	**P**
29R-02*	2018	23.4	11.4	4.8	4	0	4.8	0	**48.4**	**P-F**
29R-03	1998	8.3	3.3	10.2	2.5	-0.6	6.1	0	**29.9**	**VP**
29R-03	2003	5.4	0	0	0.1	-0.5	10	0	**14.9**	**VP**
29R-03	2008	8	5.6	3.9	0.4	-0.2	10	0	**27.7**	**VP**
29R-03	2018	9.4	12.7	4.1	2.9	-0.1	9.4	0	**38.5**	**P**
29R-03	2023	9.8	3.2	0.5	2.3	-1.6	10	0	**24.1**	**VP**
29R-05	2013	5.8	0	0	11.5	-0.1	2.4	0	**19.6**	**VP**
29R-05	2016	2.8	0	0	25.9	-0.1	5.2	0	**33.8**	**VP-P**
29R-05	2021	4.8	0	0	22.1	-0.1	2.5	0	**29.2**	**VP**
29R-05	2023	7	15	7.8	30	-0.6	9.5	0	**68.6**	**G**

Table 8.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 29, Zion. 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 Impact	Potential Impact
29-03	North Hills	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
		Tourism/Recreation	Low	Loss of habitat, reduced shrub and herbaceous vigor
29-04	Barracks Chaining	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
29-05	Kolob Terrace	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
29-06	Elephant Butte	Animal Use – Deer	High	Reduced/less vigorous browse component
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
29R-01	Elephant Gap Total Exclosure	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Study #	Study Name	Limiting Factor and/or Threat	Level of Impact	Potential Impact
29R-02	Elephant Gap Livestock Exclosure	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
29R-03	Elephant Gap Exclosure Outside	Animal Use – Deer	High	Reduced/less vigorous browse component
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
29R-05	Yellow Jacket	Introduced Perennial Grass	Moderate	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
29R-06	Block Mesas	Animal Use – Cattle	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
		Drought	-	Lowered resilience and resistance to disturbance

Table 8.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 29, Zion. All assessments are based off 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 deer wintering habitat within the Zion management unit has remained similar over the past 10 years: conditions across the unit averaged as poor-fair in 2023. Factors contributing to current conditions include (but are not limited to) an undiversified age class structure among preferred browse species, a lack of perennial grasses and forbs, and the presence of annual grasses (**Figure 8.20**, **Table 8.5**).

Of positive note in the Zion management unit is that there are pockets of aspen (*Populus tremuloides*) stands (including on the eastern portion of Cedar Mountain above Hurricane Cliffs and in areas just south of SR-14) that appear to have lower levels of conifer encroachment occurring than in other areas. Range Trend data does not address specific and detailed conditions of these areas, as aspen communities are not sampled by any active study sites. However, the LANDFIRE Vegetation Departure model indicates that aspen ecotypes in these areas have departed from reference conditions to a lesser degree than in other places in the unit (LC22_VDEP_230, 2022); this can be corroborated by satellite imagery in some locations. An additional positive aspect is that Range Trend studies located on mule deer winter range (North Hills, Barracks Chaining, Kolob Terrace, Elephant Butte, Elephant Gap Exclosure Complex, and Yellow Jacket) have not experienced major disturbances that have caused irreversible plant community transitions to a degraded state. As such, these sites still host browse communities that may act as valuable forage for mule deer. Other positive aspects in Unit 29 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 Yellow Jacket and Block Mesas studies. Additional habitat treatments have been and continue to be implemented within the Zion unit, but are not all monitored by Range Trend study sites; over 30,000 treatment acres have been completed through the Watershed Restoration Initiative (WRI) as of February 2024 (**Table 8.2**).

The expansion of urban sprawl poses a threat to big game habitat within the Zion management unit. Half of the St. George metropolitan area lies within Unit 29 boundaries. In addition, a number of adjacent towns and cities (Hurricane, La Verkin, Springdale, etc.) are located to the east and northeast of St. George. In the northwest portion of the unit near the intersection of I-15 and SR-56/SR-14 lies the southeast portion of Cedar City. Half of Kanab is located in the extreme southeastern portion of Unit 29. In addition, various smaller communities such as Swains Creek and portions of Duck Creek can also be found within unit boundaries. Human expansion is by nature dynamic in location, extent, and timeframe. However, satellite imagery makes evident the occurrence of urban development over time in portions of the unit. A number of these developing or developed areas overlap mule deer habitats of various seasonality; the communities of Hurricane and La Verkin, for example, lie within a larger contiguous area of land that is considered to be substantial year-long mule deer habitat. Expansion of human presence through new construction of buildings and roads can have unintended consequences for wildlife habitat including (but not limited to) a loss of preferred browse and herbaceous forage for wildlife, habitat fragmentation, and degradation through the introduction of non-native species.

Furthermore, opportunities to compensate elsewhere for habitat loss and degradation caused by urban development may be limited by the availability of publicly owned land. Large swathes of land located within the northern portion

of the unit between United States Forest Service (USFS) and Zion National Park boundaries are privately owned. Much of this area is higher in elevation and considered to be summer habitat for both deer and elk. Cabins and small communities dot the landscape, and cattle grazing has been known to occur in some areas south of SR-14. Naturally, further human development and activity are possible within this large, privately owned island along with the deleterious effects on habitat that can accompany them. In addition, many publicly owned parcels in the southeast portion of this area are landlocked (**Map 8.4**), which could possibly affect access for and feasibility of restoration projects.

Increased human recreation and the effect on wildlife and wildlife habitat within the Zion management unit is of additional concern. According to the National Park Service, an average of 3,689,174 people visited Zion National Park for recreation each year between 2013 and 2017. Between 2018 and 2022, that average grew to 4,426,361 people per year (National Park Service, 2023). In addition to potential degradation of habitat, human recreation can result in disturbances of animals within the area through human-wildlife interactions. Furthermore, even lower impact recreational activities such as hiking may have an effect on the presence in and timing of use of an area by various wildlife species including elk (Anderson, Waller, & Thornton, 2023). The National Park Service monitors a variety of natural resources within park boundaries (National Park Service, 2019), but impacts on habitat could be possible outside the extent of the park with visitor growth to the surrounding area. Although Sand Hollow State Park does not overlap mule deer habitat, data provided by Utah State Parks (2024) further illustrates this trend of visitor growth over the past decade. Between fiscal year 2014 (FY 2014) and FY 2018, Sand Hollow averaged nearly 461,000 visitors per year. However, that average increased to nearly 1,200,000 yearly visitors between FY 2019 and FY 2023.

Potential threats posed by increased human presence and recreation are not limited to Zion National Park, Sand Hollow State Park, and their immediate vicinities, however. Off-highway vehicle (OHV) use remains a popular form of recreation throughout the state of Utah: there were over 200,000 in-state OHV registrations and over 23,000 out-of-state permits were issued between January and August of 2023 (Utah Division of Outdoor Recreation, 2023). Popular trails in the sandy areas west of Kanab overlap crucial wintering areas for mule deer, as does Coral Pink Sand Dunes State Park. Data provided by Utah State Parks (2024) shows that between FY 2014 and FY 2018, Coral Pink Sand Dunes averaged approximately 93,000 yearly visitors. Between FY 2019 and FY 2023, that average increased to over 195,000 visitors per year. Education on proper OHV use required by state law and guidelines issued by federal land management agencies likely help mitigate some of the negative outcomes that might otherwise result from OHV recreation. However, deleterious effects on wildlife and wildlife habitat are always a possibility. Level of impact varies between and does not affect all locations equally, but auditory disturbances to wildlife, physical damage to habitat, and the introduction of non-native plant species can all result from improperly managed OHV recreation.

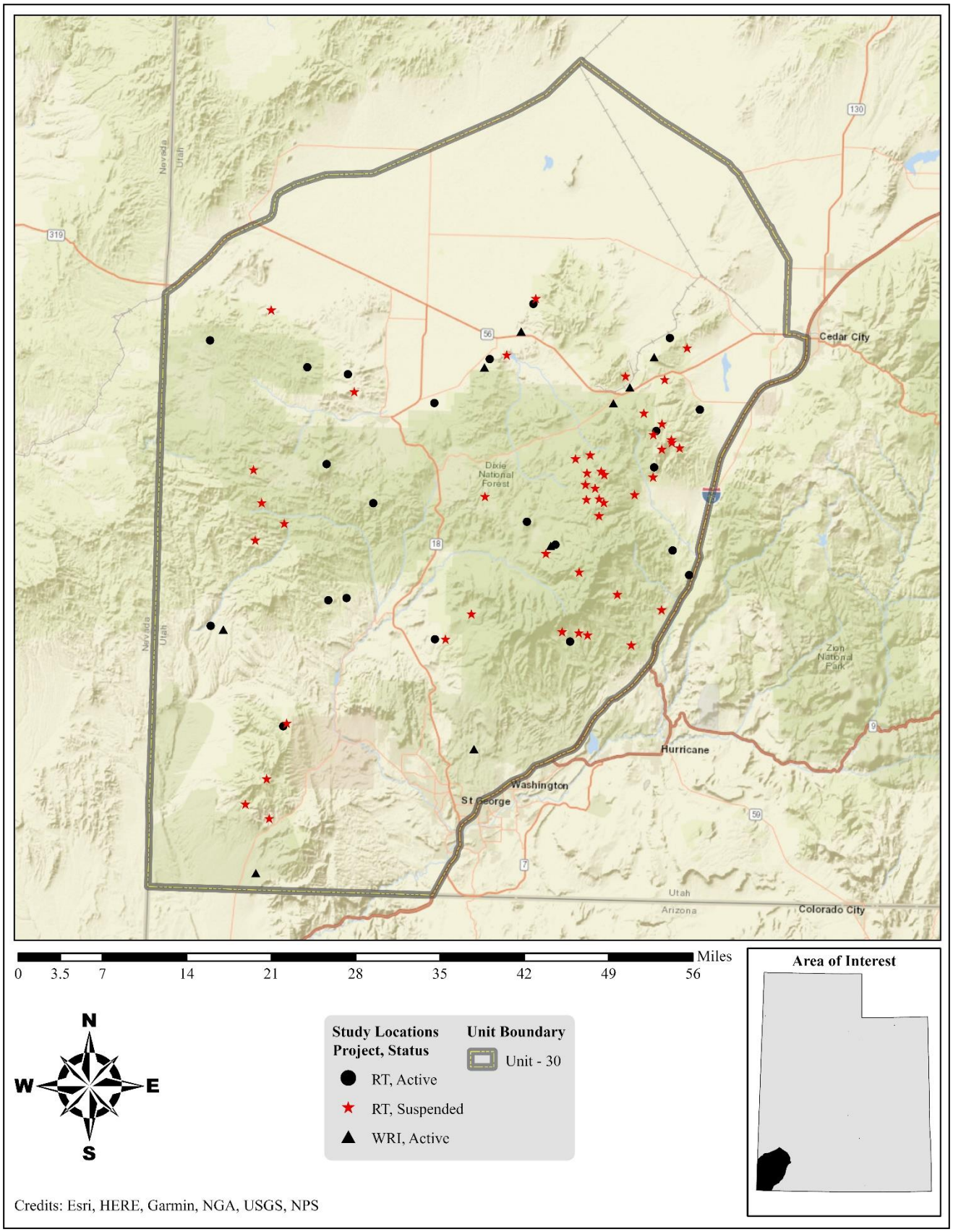
Finally, concern about the condition of certain aspen stands within this management unit has arisen, particularly in the Cedar Mountain area (McAvoy & Wiarda, 2011). Some of this concern has been in the context of Sudden Aspen Death (SAD) (Bowns as cited in Rogers, Leffler, & Ryel, 2010), which occurs when mature trees die "at an accelerated rate with little or no new sprouts occurring, indicating that the lateral roots may also be affected" (Bartos & Shepperd, 2010). However, SAD was not deemed a widespread occurrence on Cedar Mountain in 2008 according to Rogers et al. (2010). In addition, a 2021 follow up survey of many of the original plots further corroborated the original findings that SAD is unlikely to be an issue in most stands on Cedar Mountain. However, this recent research concluded that other factors may pose a threat to the future quality of aspen stands in the area, including conifer encroachment, increased insect/pathogenic damage to individual trees, and sustained crown die-back (Cappaert, 2023). Although these findings apply to a localized area, consideration that there could be implications for a wider geographical area is reasonable. However, no current Range Trend studies in this unit monitor aspen ecotypes to determine if these threats are more widespread.

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 8.6**).

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. Continued cooperation with federal land management agencies and private landowners is encouraged to implement habitat improvement projects where possible, including summer range when and where necessary. When considering management strategies within this

unit, it may be prudent to consider the diverse makeup of visitors to the area via Zion National Park and other attractions. As many people visit the area from outside of Utah, there may be varying degrees of knowledge about local flora and fauna and associated best practices. Although the National Park Service provides information on interacting with wildlife (National Park Service, 2021), providing and promoting additional easily accessible information may be a worthwhile consideration. Continued coordination with Zion National Park on matters concerning wildlife is also advisable. If and when possible, support should be given for policies that result in responsible urban development, particularly in the greater St. George area and around Cedar City. In addition, monitoring of 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.

9. WILDLIFE MANAGEMENT UNIT 30 – PINE VALLEY



WILDLIFE MANAGEMENT UNIT 30 – PINE VALLEY

Boundary Description

Iron and Washington counties - Boundary begins at I-15 and the Utah-Arizona state line; north on I-15 to SR-56; west on SR-56 to Lund Highway; northwest along Lund Highway to the Union Pacific railroad tracks at Lund; southwest on the Union Pacific railroad tracks to the Utah-Nevada state line; south on the Utah-Nevada state line to the Utah-Arizona state line; west on this state line to I-15.

Management Unit Description

Geography

The Pine Valley Wildlife Management Unit is located in the southwest corner of Utah. The unit includes three physiographic regions: the Mojave Desert, Great Basin, and Colorado Plateau. The Mojave Desert is situated in the southern portion of the WMU. The Great Basin is located in the central and northern sections of the unit. Finally, the eastern section of the unit – mainly the Pine Valley Mountains and Harmony Mountains – are on the western edge of the Colorado Plateau. These three physiographic regions are host to a diverse array of vegetation and transitional communities that are important areas for wildlife.

The Pine Valley unit includes several mountain ranges, including the Pine Valley Mountains, Cove Mountain, Atchison Mountain, the Harmony Mountains, McFarlane Mountain, the Bull Valley Mountains, Mineral Mountain, the Beaver Dam Mountains, Bull Mountain, the Antelope Range, Iron Mountain, Swett Hills, and Eightmile Hills.

Climate Data

The 30-year (1991-2020) annual precipitation PRISM model shows that precipitation on this unit ranges from 7 inches in the southern end of Beaver Dam Wash where it crosses into Arizona and up to 37 inches just north of Signal Peak in the Pine Valley Mountains. All of the active Range Trend and Watershed Restoration Initiative (WRI) monitoring studies on the unit occur within 9-28 inches of precipitation (**Map 9.1**) (PRISM Climate Group, Oregon State University, 2021).

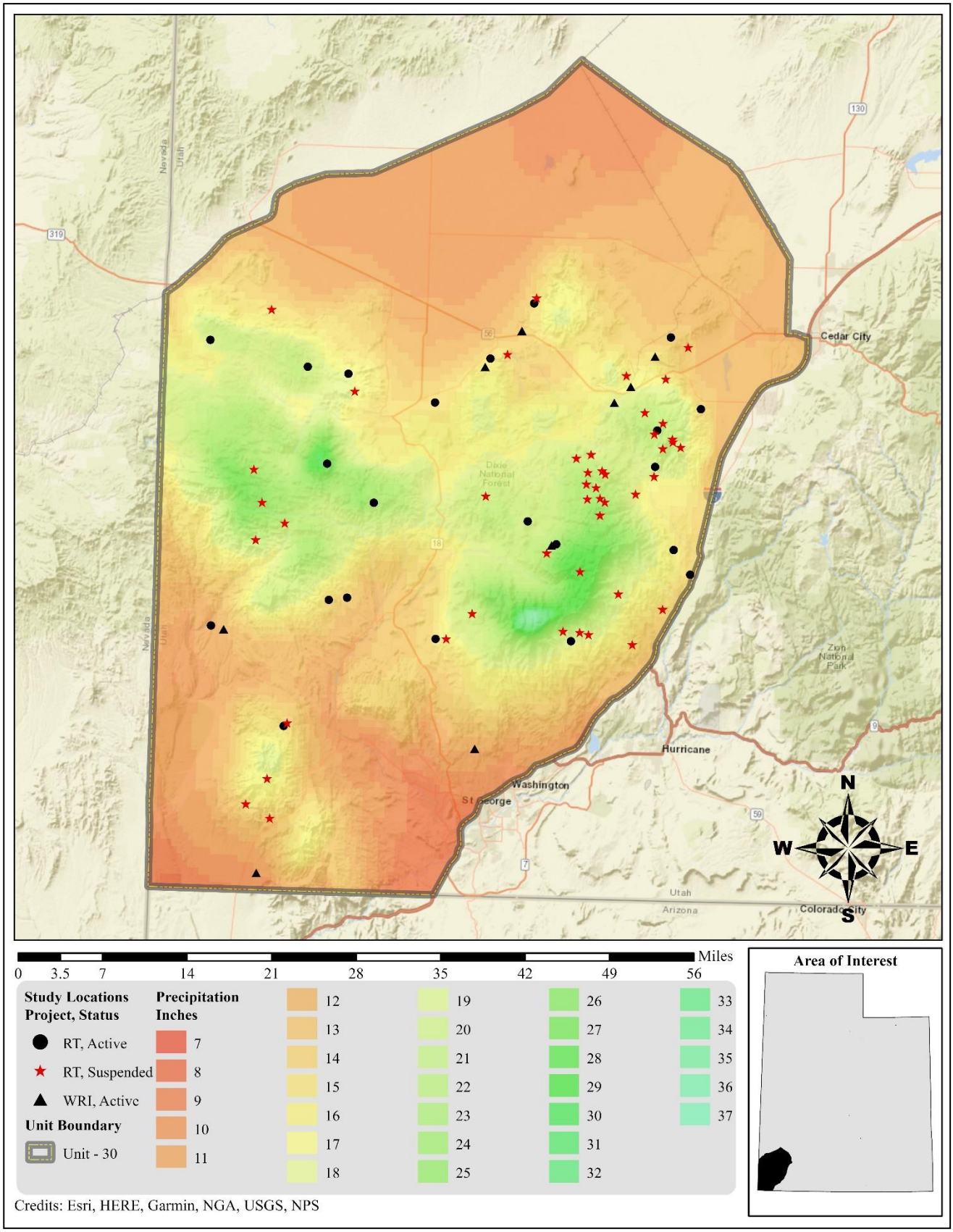
Vegetation trends are dependent upon annual and seasonal precipitation patterns. Palmer Drought Severity Index (PDSI) data for the unit was compiled from the National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Division (PSD) as part of the Western Division (Division 1), Dixie Division (Division 2), and South Central Division (Division 4).

The mean annual PDSI of the Western Division has displayed mild to moderate drought for 12 out of the past 31 years, and severe to extreme drought has occurred during an additional four years. The most recent annual PDSI score with an extreme drought ranking was 2021. Wet years were relatively consistent in the 1990s, with four moderately to extremely wet years occurring between 1993 and 1999. However, these "wet" rankings have become less common since 2000. Annual PDSI data shows an apparently cyclical pattern over the past 20 years, with one very to extremely wet year occurring amid longer periods of drought. The most recent extremely wet years were 2019 and 2023, with 2020-2022 being years of mild to extreme drought. Overall, 26% of the 1993-2023 period consisted of moderately to extremely wet years, while 52% was considered to be years of mild to extreme drought; the remaining 22% of this period was comprised of normal, incipiently wet, or incipiently dry years. Mean spring (March-May) and fall (September-November) PDSI values show similar patterns to the one demonstrated by mean annual data. The fall PDSI rankings have been slightly wetter than the spring rankings during the last three years that were considered to be extremely wet on an annual scale (2011, 2019, and 2023) (**Figure 9.1a**, **Figure 9.1b**).

Twelve of the past 31 years in the Dixie Division have had mean annual PDSI rankings of mild to moderate drought. Four additional years have been periods of severe to extreme drought, and the last year with a severe drought ranking was 2021. Wet years have been more common in the Dixie Division than in the Western Division. Five of the years between 1993 and 2023 have been slightly wet, and four have been very wet to extremely wet; 2023 was the most recent very wet year. Like in the Western Division, however, these wet PDSI rankings have typically presented as periods of one or two years among longer periods of drought. When characterized as percentages of the 1993-2023 period, 52% were years of mild to extreme drought; 29% were slightly to extremely wet years; and the remaining 19% were normal, incipiently dry, or incipiently wet years (**Figure 9.2a**). According to mean seasonal PDSI data, more periods of drought have occurred during the spring (March-May) than the fall (September-November) from 1993 to 2023. However, rankings of slightly to

extremely wet have also occurred more frequently during the spring than in the fall. In 2023, both the spring and the fall were considered very wet according to mean seasonal PDSI data (**Figure 9.2b**).

The mean annual PDSI of the South Central Division displayed mild to moderate drought in 11 out of the past 31 years. Four additional years have been periods of severe to extreme drought, and 2021 was the most recent year with an extreme drought ranking. Six of the years between 1993 and 2023 have been slightly to moderately wet, and three have been very wet. Again, however, one or two slightly to very wet years at a time have occurred among longer periods of drought, and 2011 was the last year that was considered very wet. Of the 1993-2023 period, 48% was comprised of years of mild to extreme drought; 29% consisted of slightly to very wet years; and the remaining 23% has consisted of normal, incipiently wet, or incipiently dry years (**Figure 9.3a**). The mean spring (March-May) and mean fall (Sept.-Nov.) PDSI estimations typically follow the same trends as the average annual PDSI trends, but can show split seasonal precipitation events that are not captured in the overall annual PDSI (**Figure 9.3b**) (Time Series Data, 2024). These seasonal precipitation events can play a crucial role on timing of plant growth and production for the remainder of the year (spring), or for the year ahead (fall). When a wet fall aligns with a wet spring of the following year, plant health and production for that following year can have a positive effect on forage availability. This is due to lower evaporation and transpiration rates between the months of September and May that result in higher soil moisture reserves made available to plants for longer periods during the dry summer months. Although annual precipitation is likely the driver for plant production, the interplay of fall/spring wetness may make a drought year less impactful as a plant stressor. The ecotypes evaluated by Range Trend are primarily found on deer transitional and winter ranges. Plant growth on these ranges is primarily affected by the seasonal precipitation that occurs during the fall and spring months (Cox, et al., 2009), and is the reason fall and spring PDSI estimations are focused on in this report (**Figure 9.3b**). Range Trend sample years occur on a five-year rotation, so the PDSI years of interest should be examined by the corresponding rotation year (**Table 9.3**).



Map 9.1: The 1991-2020 PRISM Precipitation Model for WMU 30, Pine Valley (PRISM Climate Group, Oregon State University, 2021).

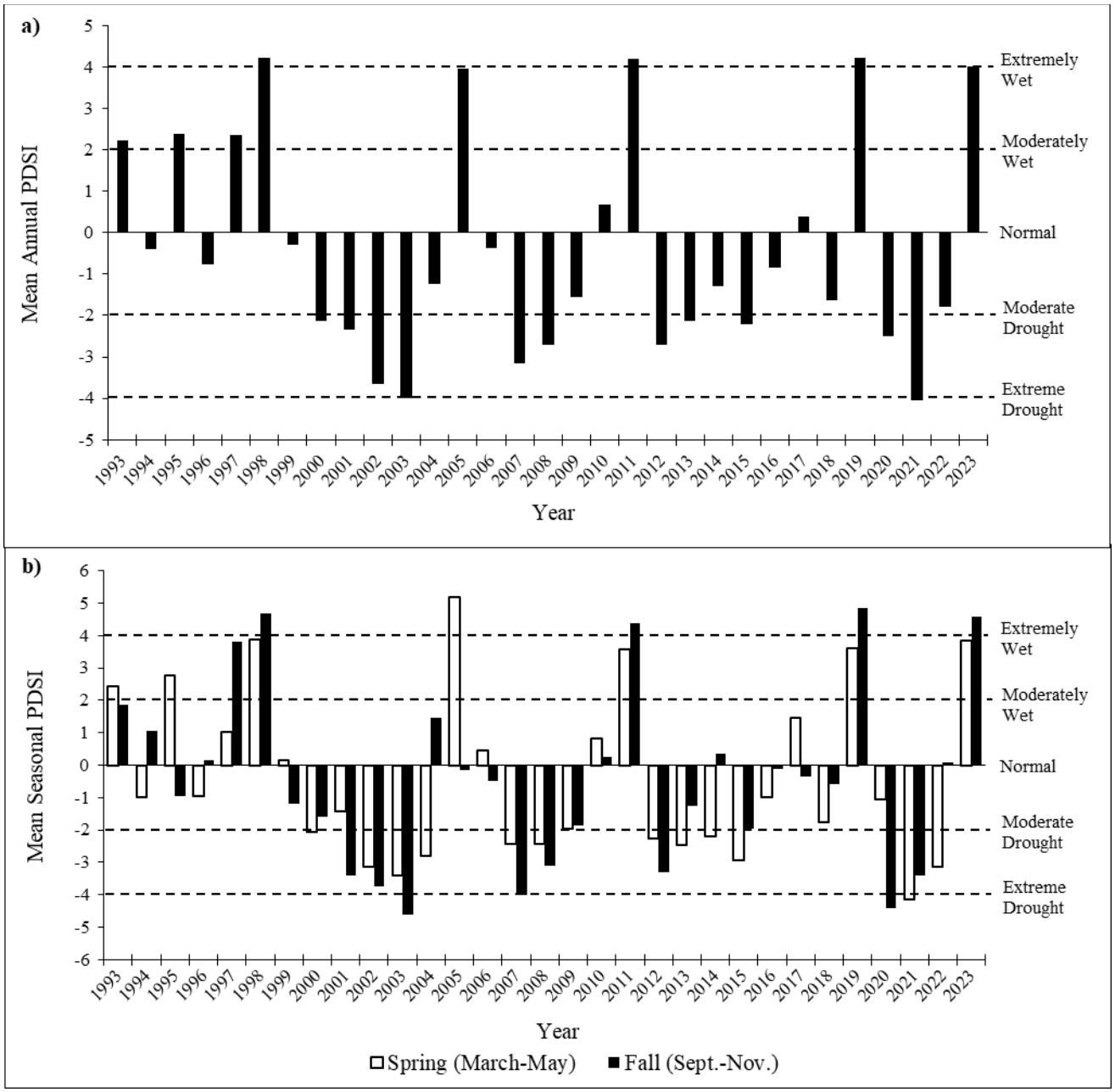


Figure 9.1: The 1993-2023 Palmer Drought Severity Index (PDSI) for the Western Division (Division 1). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

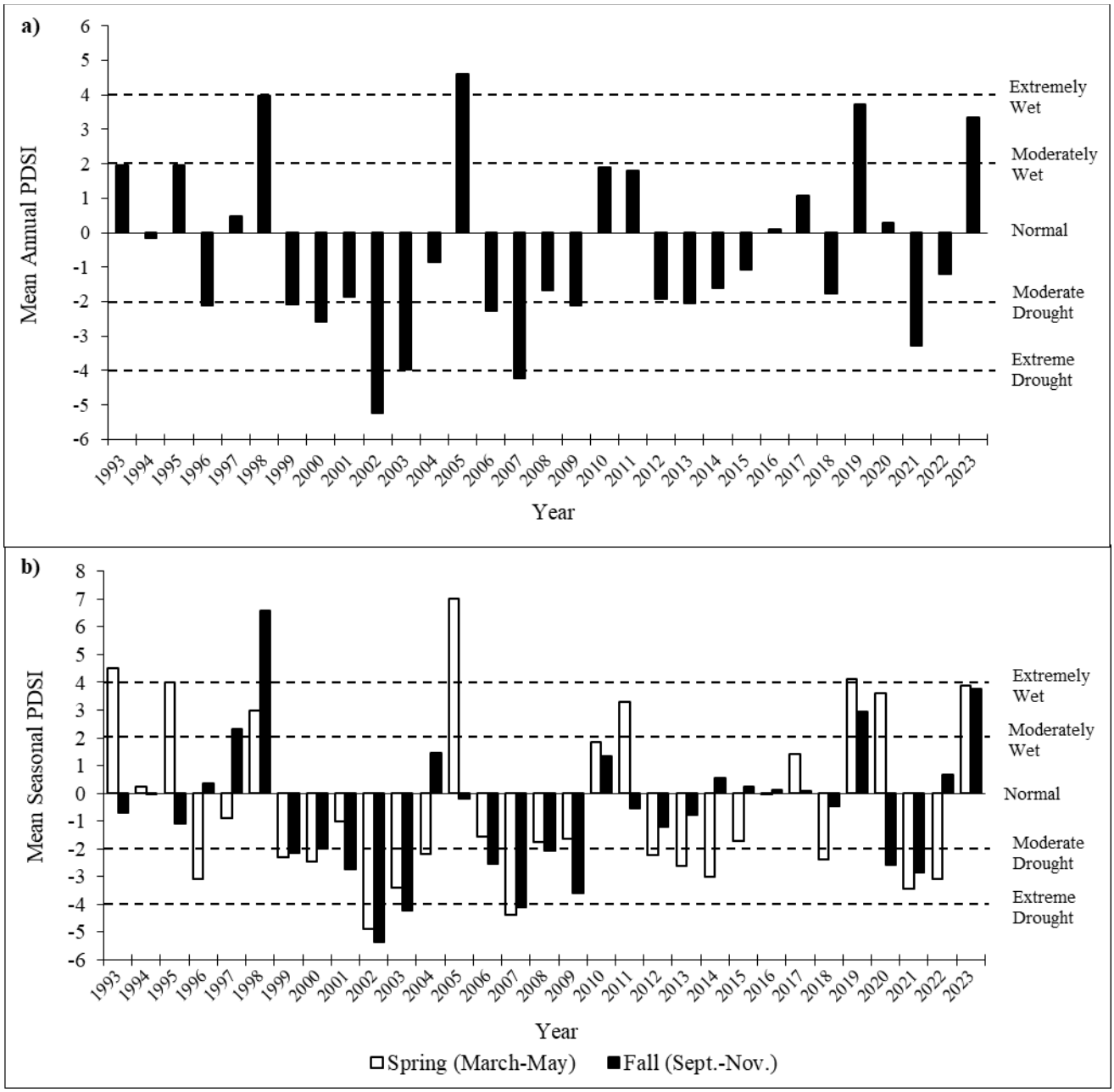


Figure 9.2: The 1993-2023 Palmer Drought Severity Index (PDSI) for the Dixie Division (Division 2). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

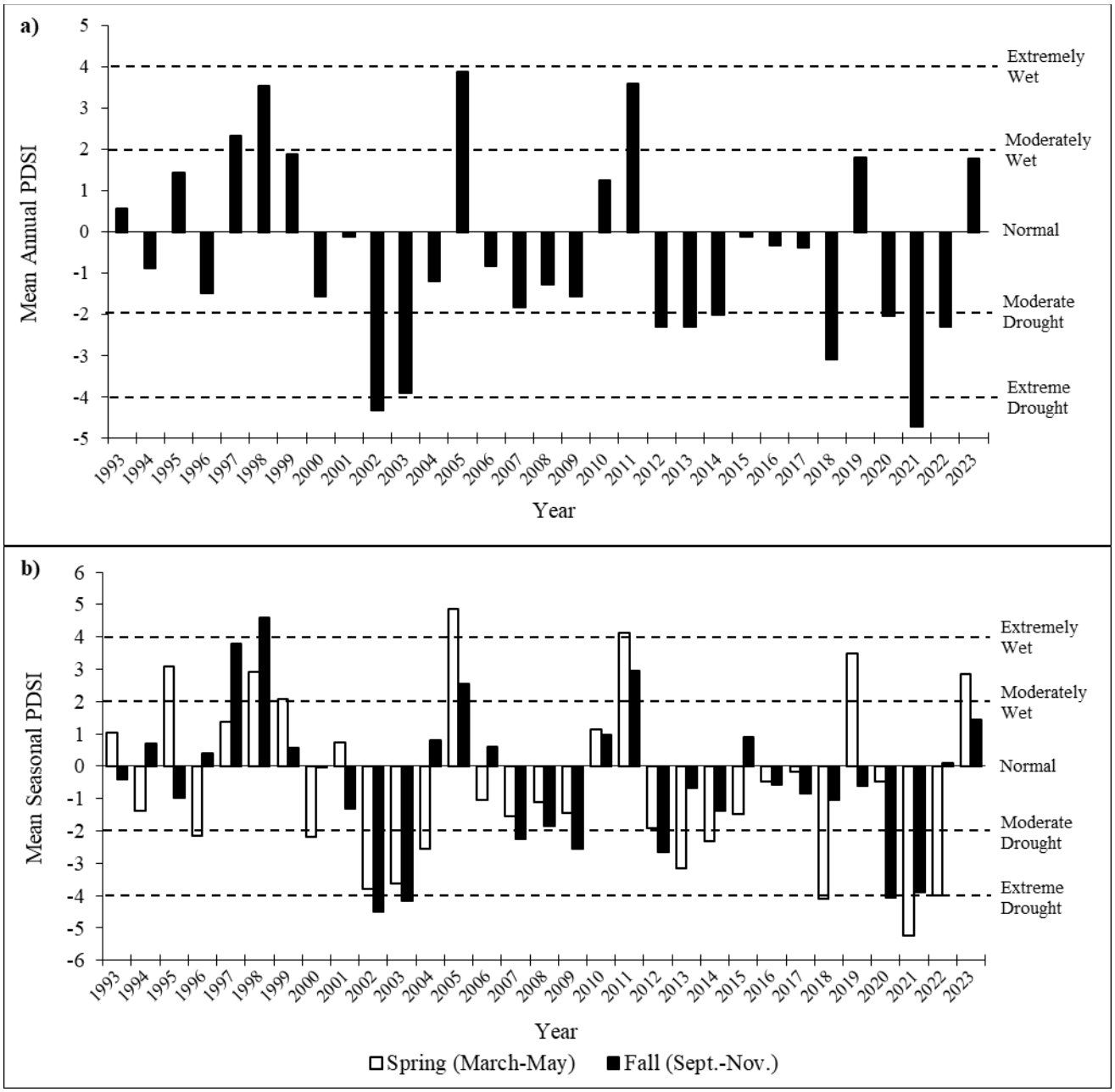


Figure 9.3: The 1993-2023 Palmer Drought Severity Index (PDSI) for the South Central Division (Division 4). The PDSI is based on climate data gathered from 1895 to 2023. The PDSI uses a scale where 0 indicates normal, positive deviations indicate wet, and negative deviations indicate drought. Classification 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, 2024).

Big Game Habitat

Crucial summer range is confined to elevations above 6,000 to 6,500 feet on the Harmony and Pine Valley Mountains. The summer range consists of dense conifers, mixed conifer-aspen, aspen (*Populus tremuloides*) clones, and dry meadows at higher elevations and mixed oak (*Quercus spp.*) brush, mountain brush, southern desert shrub, and sagebrush (*Artemisia spp.*)-grasslands at lower elevations. Part of the summer range is within the officially designated wilderness area. Vegetation of the Harmony Mountains and lower slopes of Pine Valley is principally dominated by oak brush and mountain brush. Aspen and conifer are common on the higher portions of the Pine Valley Mountains, but much less prevalent on the Harmony Mountains. Sagebrush-grasslands and meadows can be found at the summit of the Harmony Mountains: these areas are important for deer during a short period in the summer months. Many similar sagebrush grasslands and meadows also occur on the northern end of the Pine Valley Mountains. Summer deer concentrations are primarily on Harmony Mountain and the north end of the Pine Valley Mountains (**Map 9.2**).

Herd Unit 30 winter range varies greatly depending upon elevation. North of the Great Basin-Colorado River divide, pinyon-juniper and sagebrush-grass predominate. South of the divide, pinyon-juniper is still prevalent, but there are increasing amounts of desert shrublands dominated by shrub liveoak (*Quercus turbinella*) and other browse species not often found in the northern portion. Both areas possess important acreages of seeded range, most notably east of Pinto at Page Ranch, Woolsey Ranch, New Harmony, and Pintura Bench: deer tend to congregate in these areas, especially the latter three. Additional winter range in the Pine Valley unit can be found south of Pintura, but currently supports few deer. Winter range is extensive, but not uniformly utilized. Important critical winter concentration areas include the Antelope range, Swett Hills, the Shoal Creek drainage, Tobin Bench, and Dammeron Valley. Only during the most severe winters do deer utilize the lower portions of the winter range, especially the Mojave Desert areas. During the spring, summer, and fall, crucial concentration areas include the higher elevations of the Bull Valley Mountains, Lost Peak, Maple Ridge, the slopes surrounding Pine Valley Reservoir, the meadows of the Whipple Valley area, and Flattop Mountains (**Map 9.2**).

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

According to the RAP data, herbaceous biomass and cover have exhibited yearly fluctuations on summer, winter, and year-long mule deer ranges. When comparing 1986 data to that from 2023, biomass and cover have generally increased on winter and year-long ranges, primarily due to annual lifeforms. Biomass has decreased on summer habitat over the same period while herbaceous cover has remained similar. Annual lifeforms have provided notable biomass and cover on mule deer ranges of all mentioned seasonality. Large flushes of annuals have occurred during many years of good precipitation, with slightly more pronounced increases occurring on winter and year-long ranges than on summer habitat. Annual and perennial cover and biomass have followed precipitation trends in numerous years on ranges of all seasonality, although lag effects of a year or so have occurred at other times (**Figure 9.4**, **Figure 9.5**, **Figure 9.6**, **Figure 9.7**, **Figure 9.8**, **Figure 9.9**). Range Trend data from 1998 to present shows fluctuations in herbaceous cover depending on ecotype; annual grasses and forbs have generally contributed more cover on upland sites than on mountain ecotypes. However, it is important to note the different number of studies sampled from year to year (the 'n' value) in some ecotypes and consider the implications that this may have on the data. Furthermore, Range Trend sites are summarized by ecological potential in this report and not seasonality of mule deer range (**Figure 9.24**, **Figure 9.25**). As such, incongruences between Range Trend data and that reported by the RAP are possible.

The RAP data for tree and shrub cover shows fluctuation over time on all three range types, but values have remained similar when comparing 1986 and 2023 data. Cover data for both lifeforms has correlated with precipitation in some years, but to a lesser degree and with generally less drastic peaks and troughs than herbaceous data (**Figure 9.10**, **Figure 9.11**, **Figure 9.12**). Range Trend data displays overall increases in shrub cover since 2003, while tree cover has fluctuated depending on ecotype (**Figure 9.13**, **Figure 9.14**, **Figure 9.15**, **Figure 9.16**, **Figure 9.17**). Again, however, it is important to consider the caveats discussed above when making comparisons between RAP and Range Trend data. Range Trend data is site-specific and granular while RAP data is aggregated to the unit scale for deer habitat.

RAP – Herbaceous Biomass by Deer Habitat

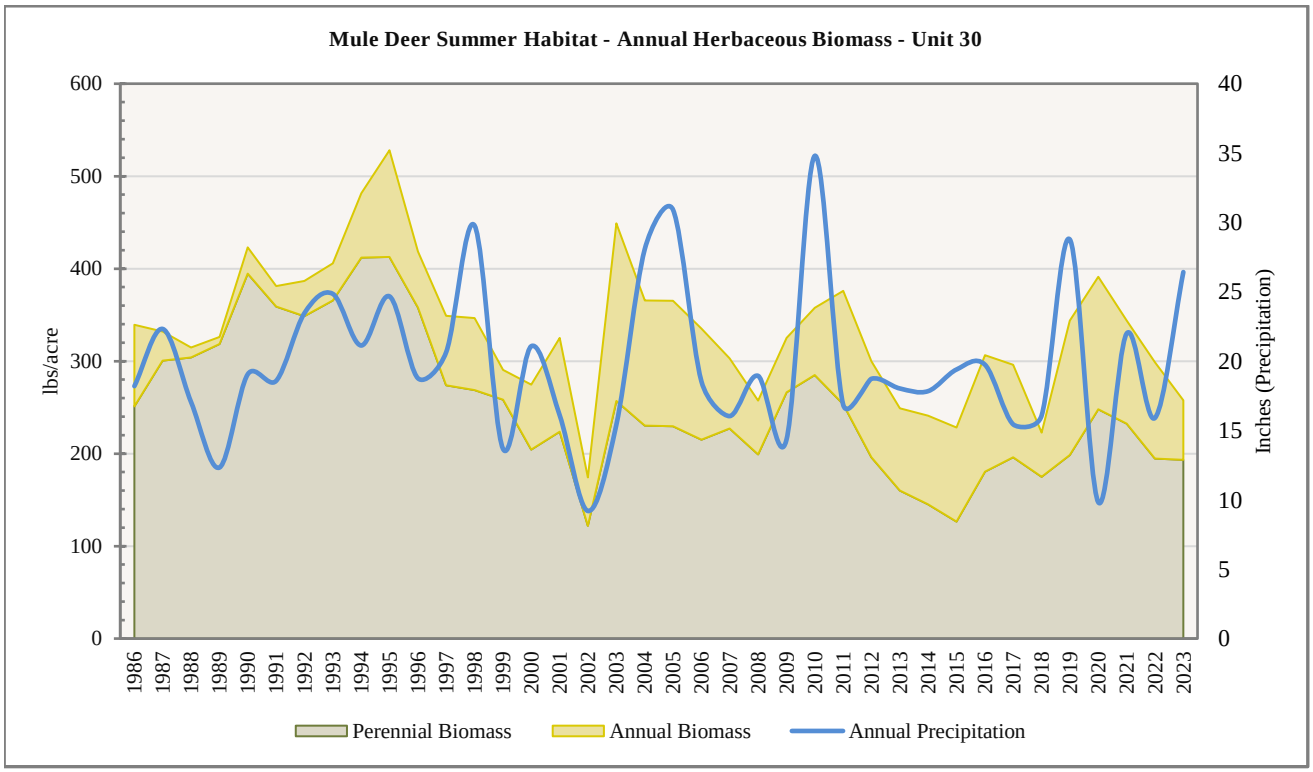


Figure 9.4: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

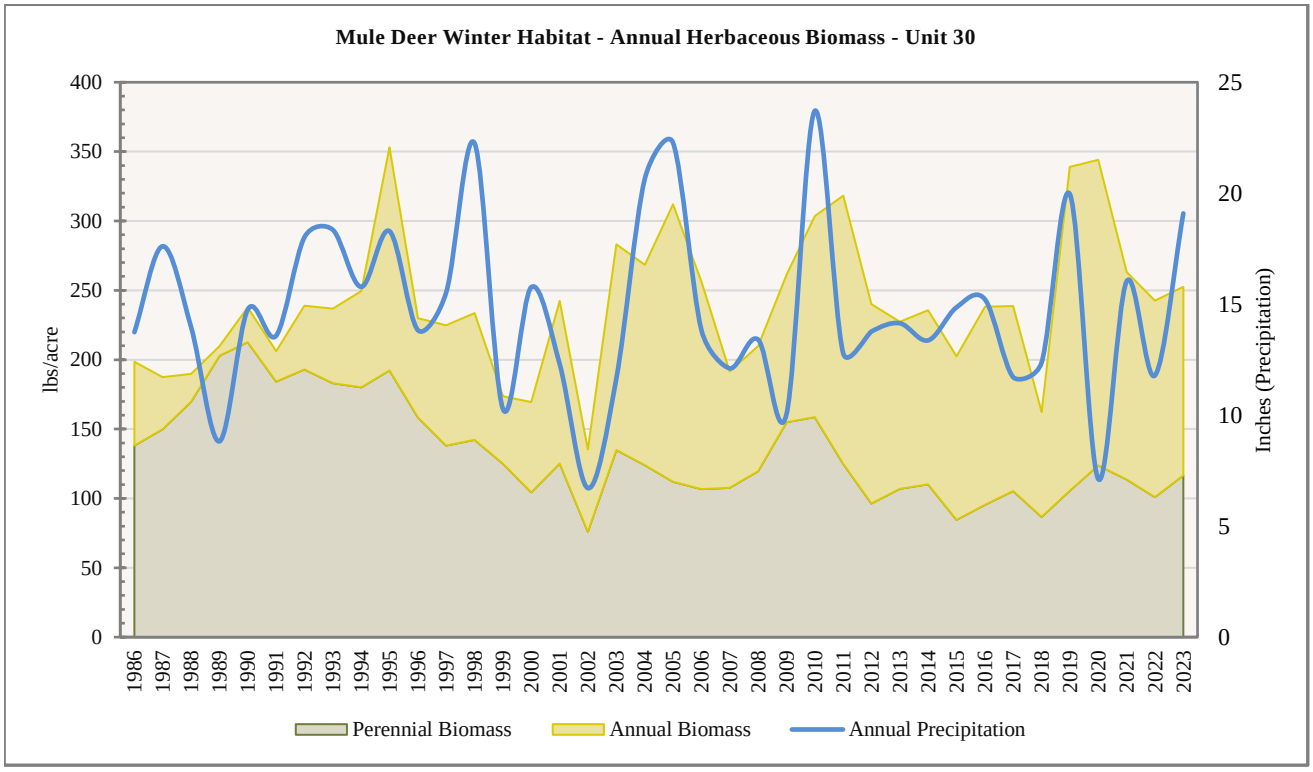


Figure 9.5: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

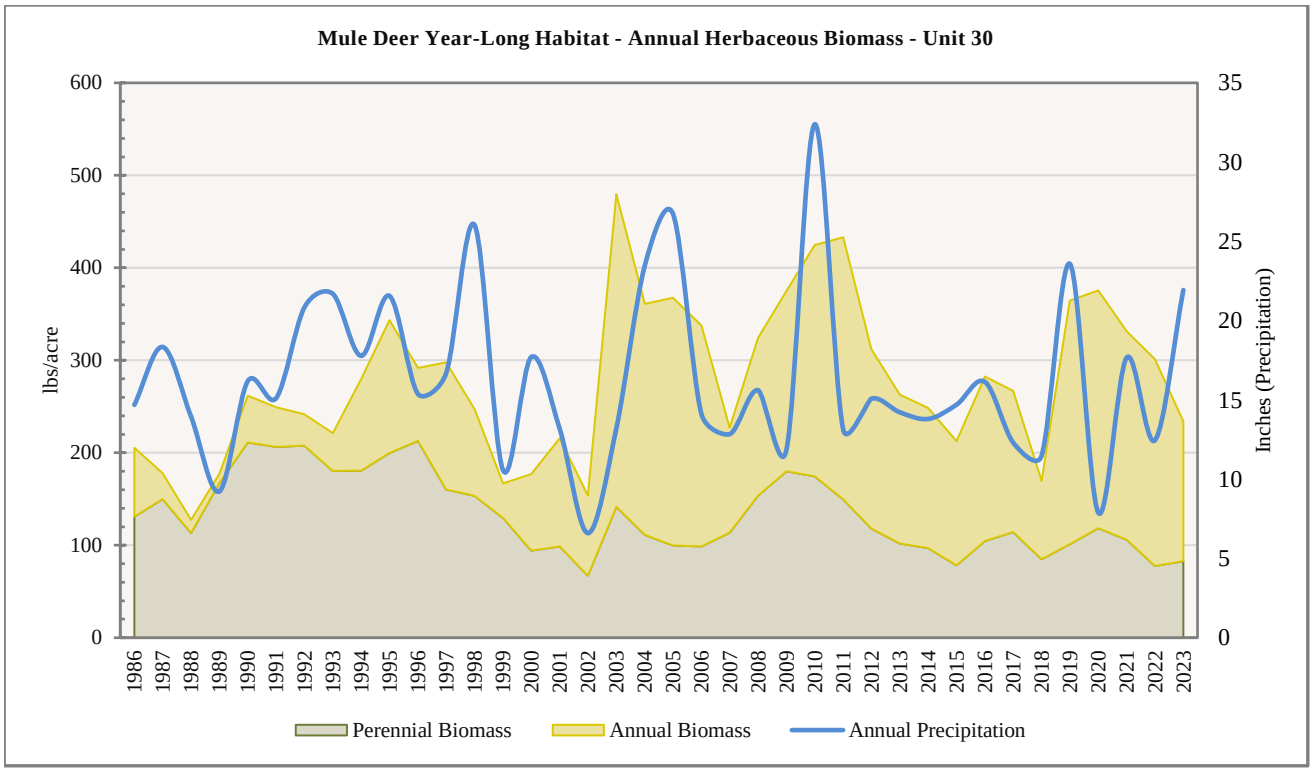


Figure 9.6: Average precipitation and estimated yearly herbaceous biomass of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

RAP – Herbaceous Cover by Deer Habitat

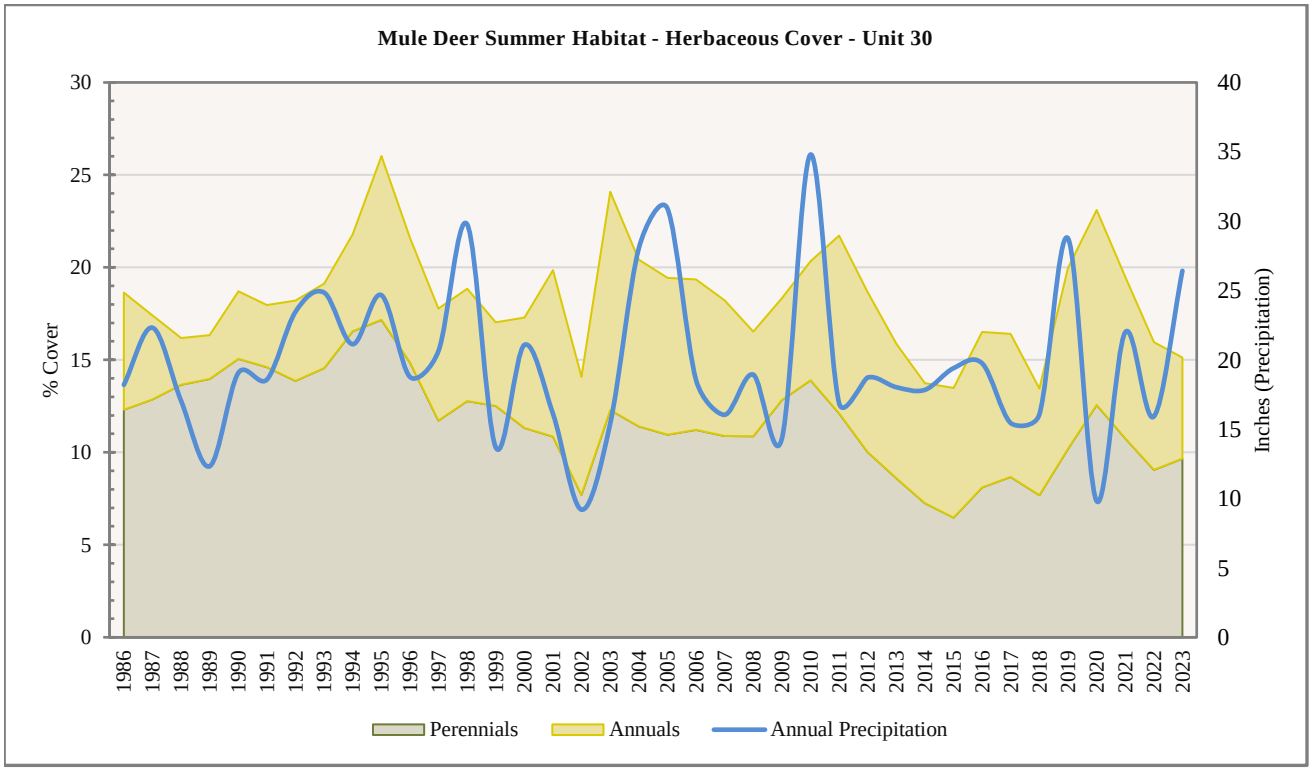


Figure 9.7: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for summer mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

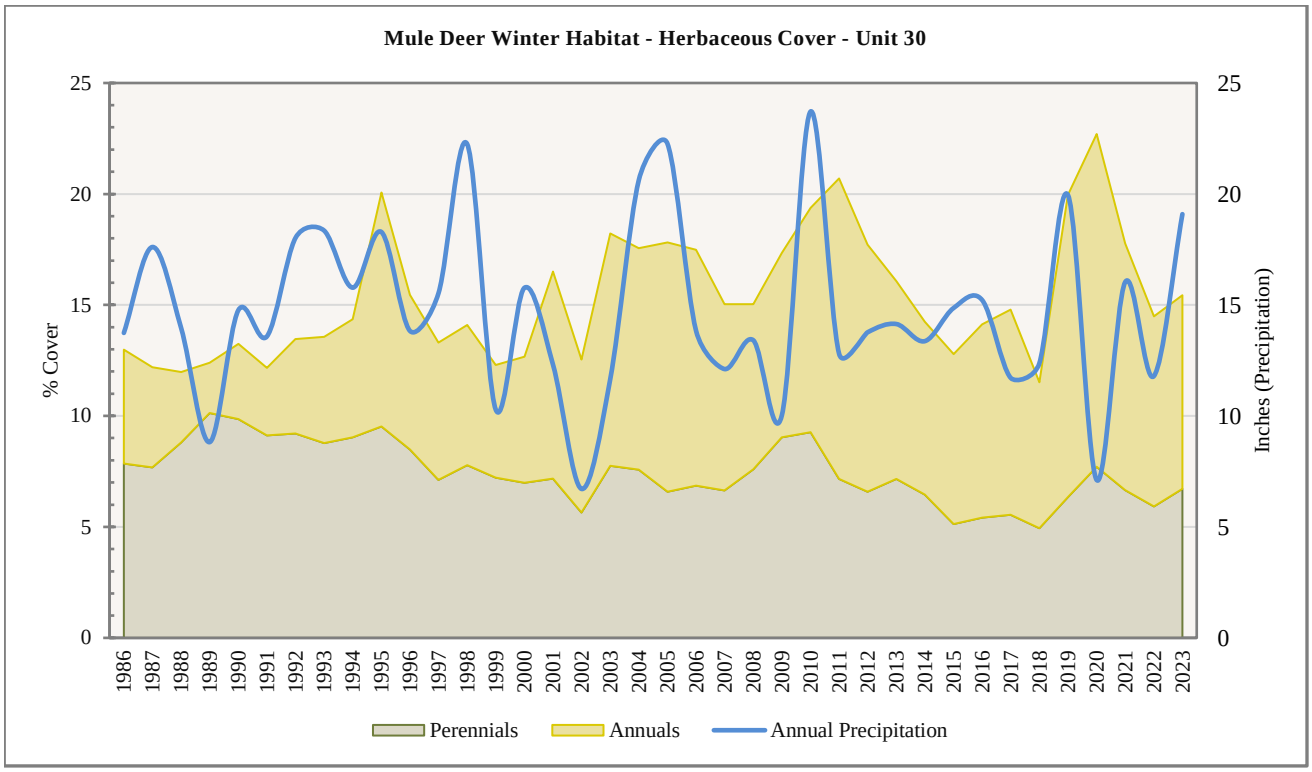


Figure 9.8: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for winter mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

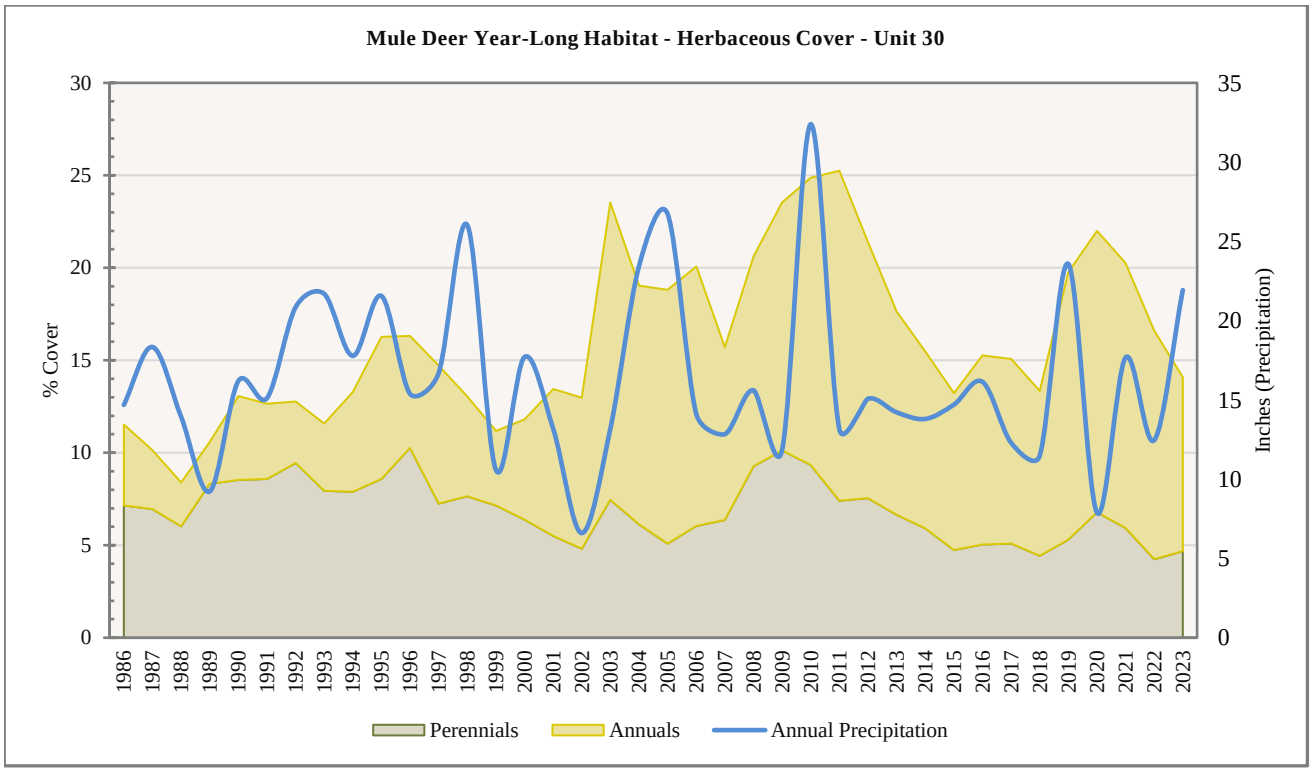


Figure 9.9: Average precipitation and estimated yearly herbaceous cover of stacked perennial and annual lifeforms for year-long mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

RAP – Shrub and Tree Cover by Deer Habitat

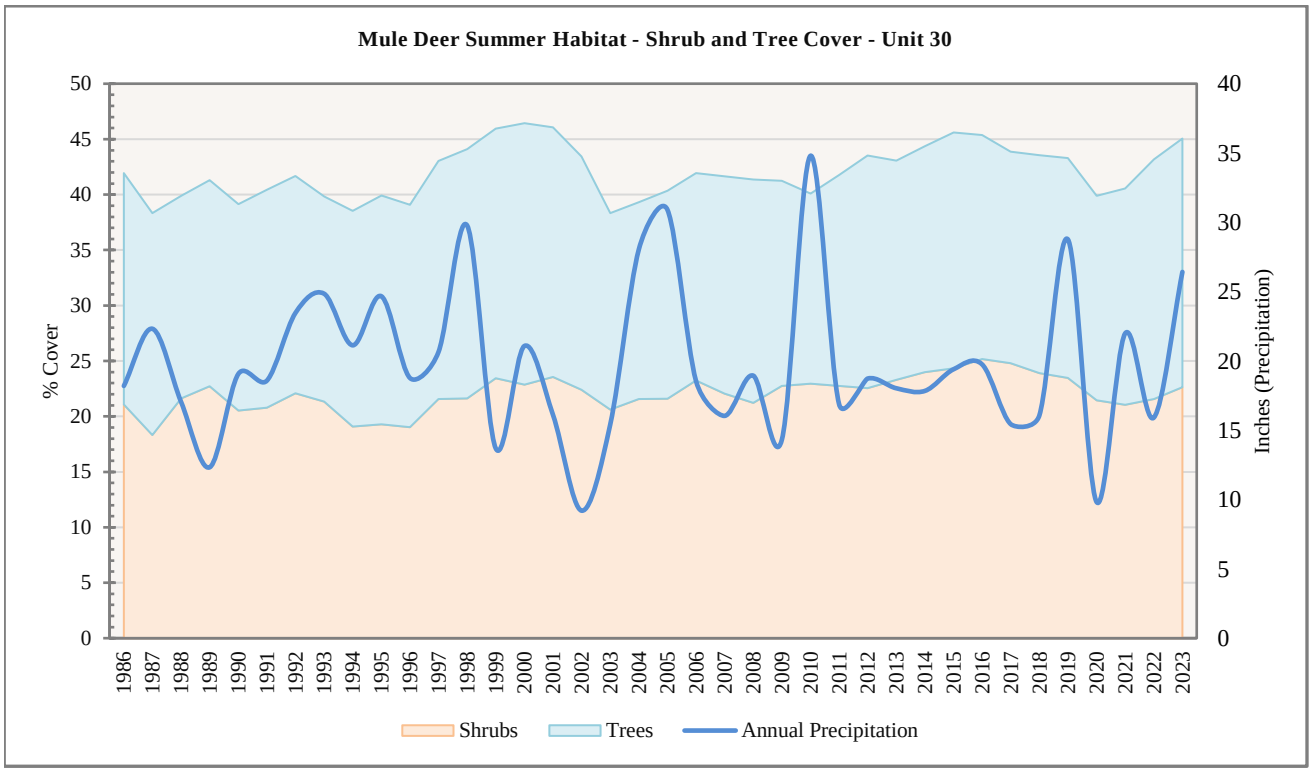


Figure 9.10: Average precipitation and estimated yearly stacked shrub and tree cover for summer mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

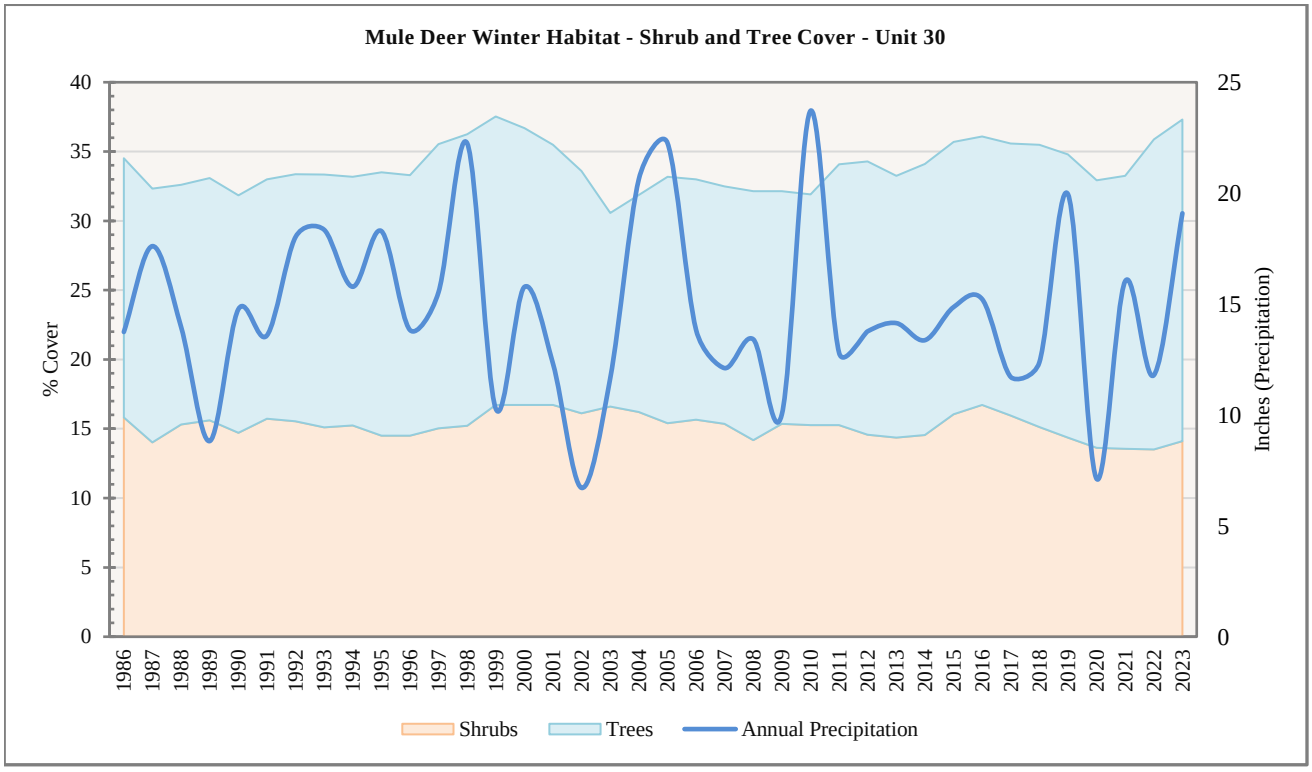


Figure 9.11: Average precipitation and estimated yearly stacked shrub and tree cover for winter mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).

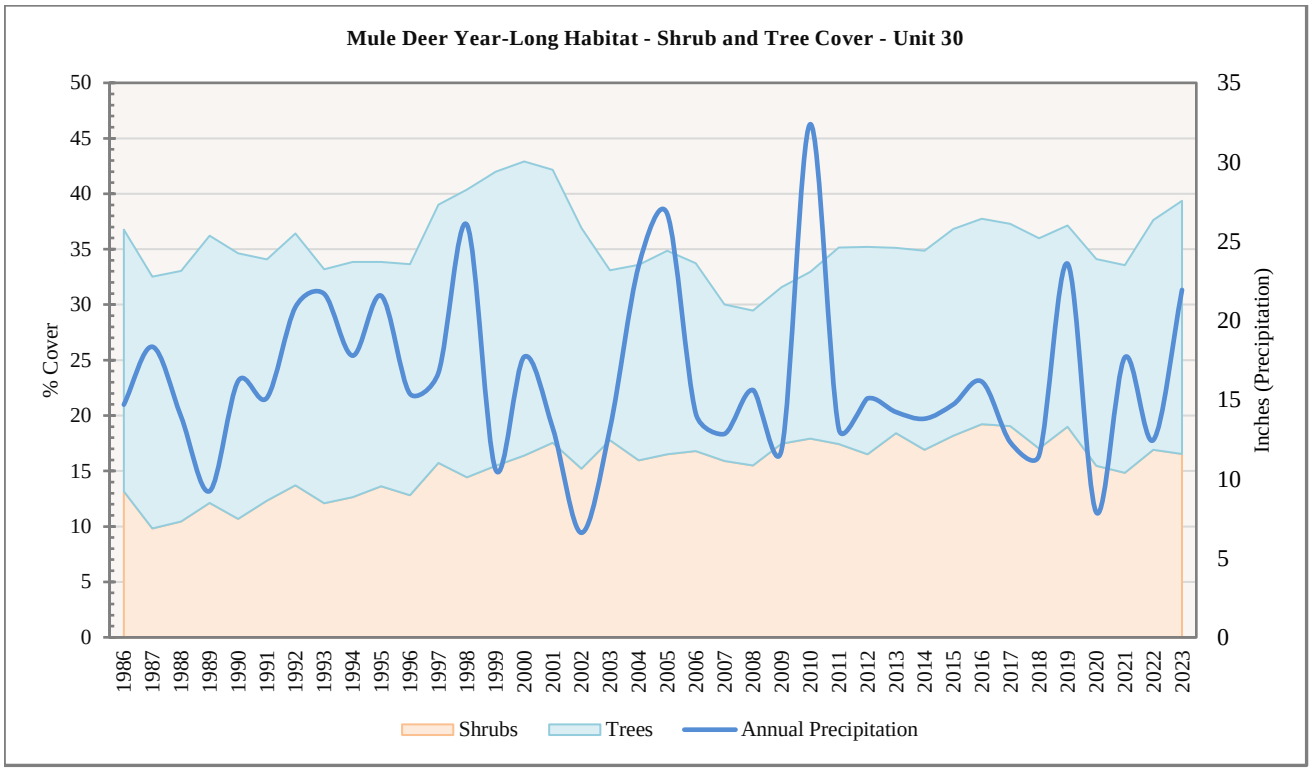
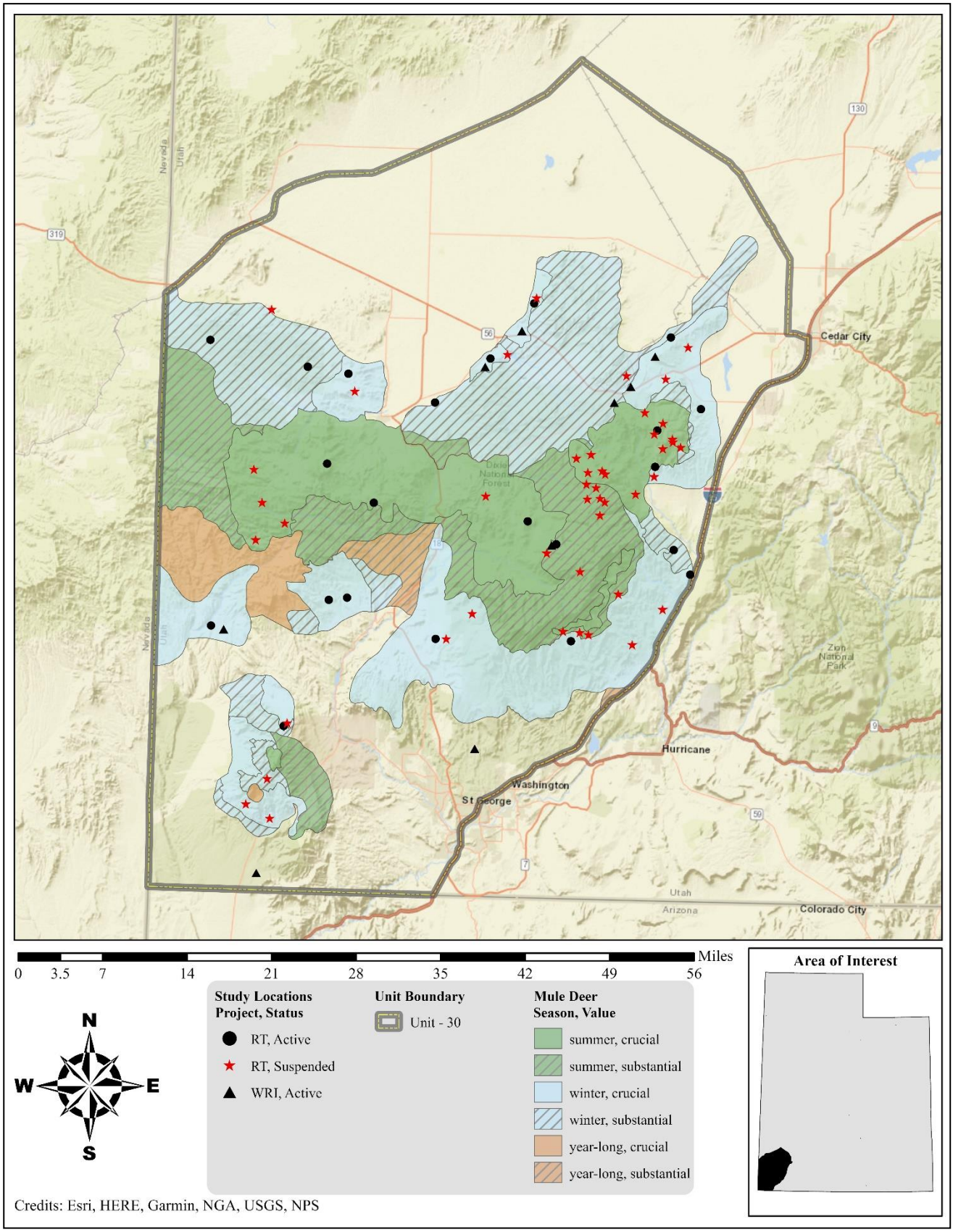
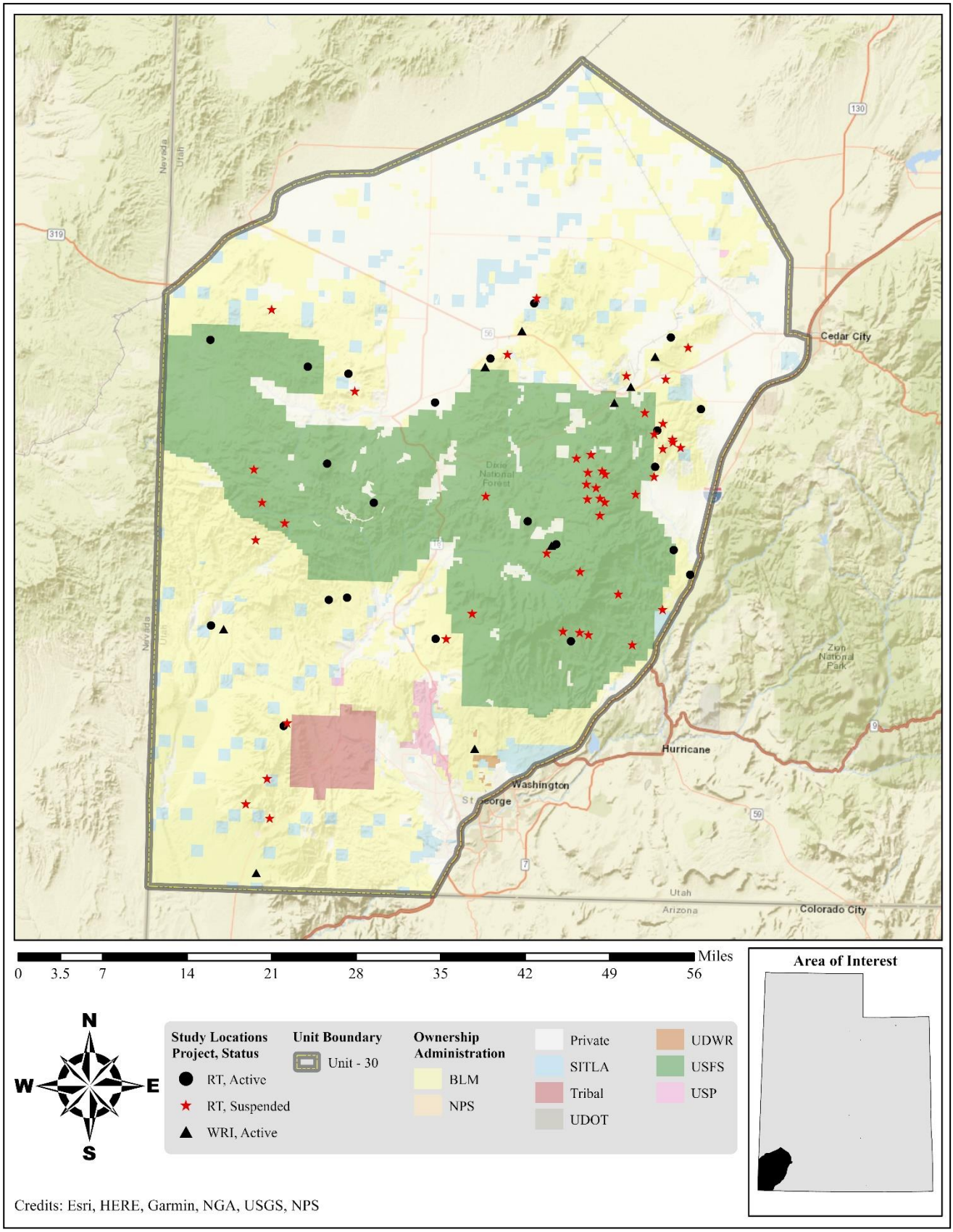


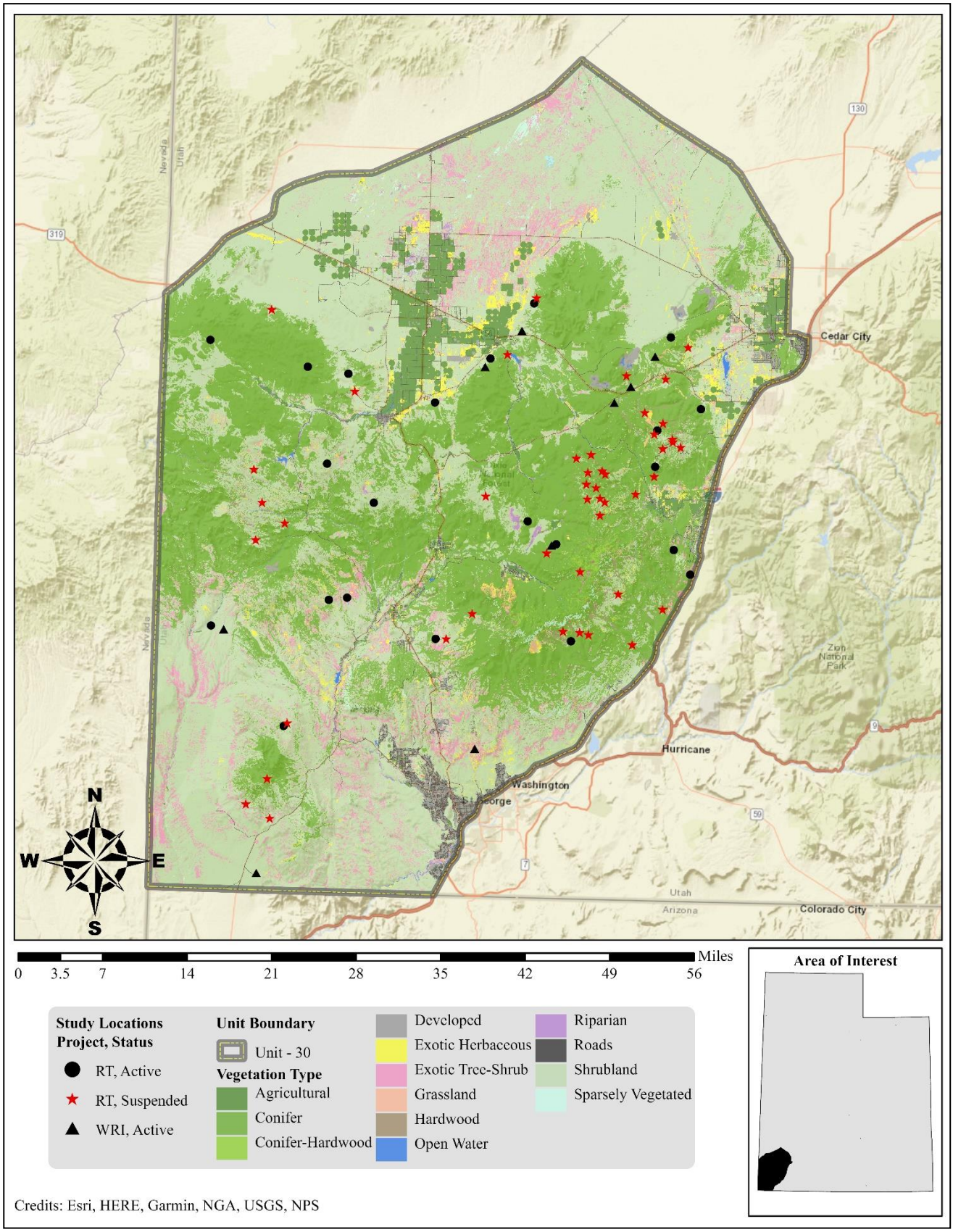
Figure 9.12: Average precipitation and estimated yearly stacked shrub and tree cover for year-long mule deer habitat in WMU 30, Pine Valley (Rangeland Analysis Platform, 2024).



Map 9.2: Estimated mule deer habitat by season and value for WMU 30, Pine Valley.



Map 9.3: Land ownership for WMU 30, Pine Valley.



Map 9.4: LANDFIRE Existing Vegetation Type map (LC22_EVT_230, 2022) for WMU 30, Pine Valley.

LANDFIRE Existing Vegetation Types on Mule Deer Habitat

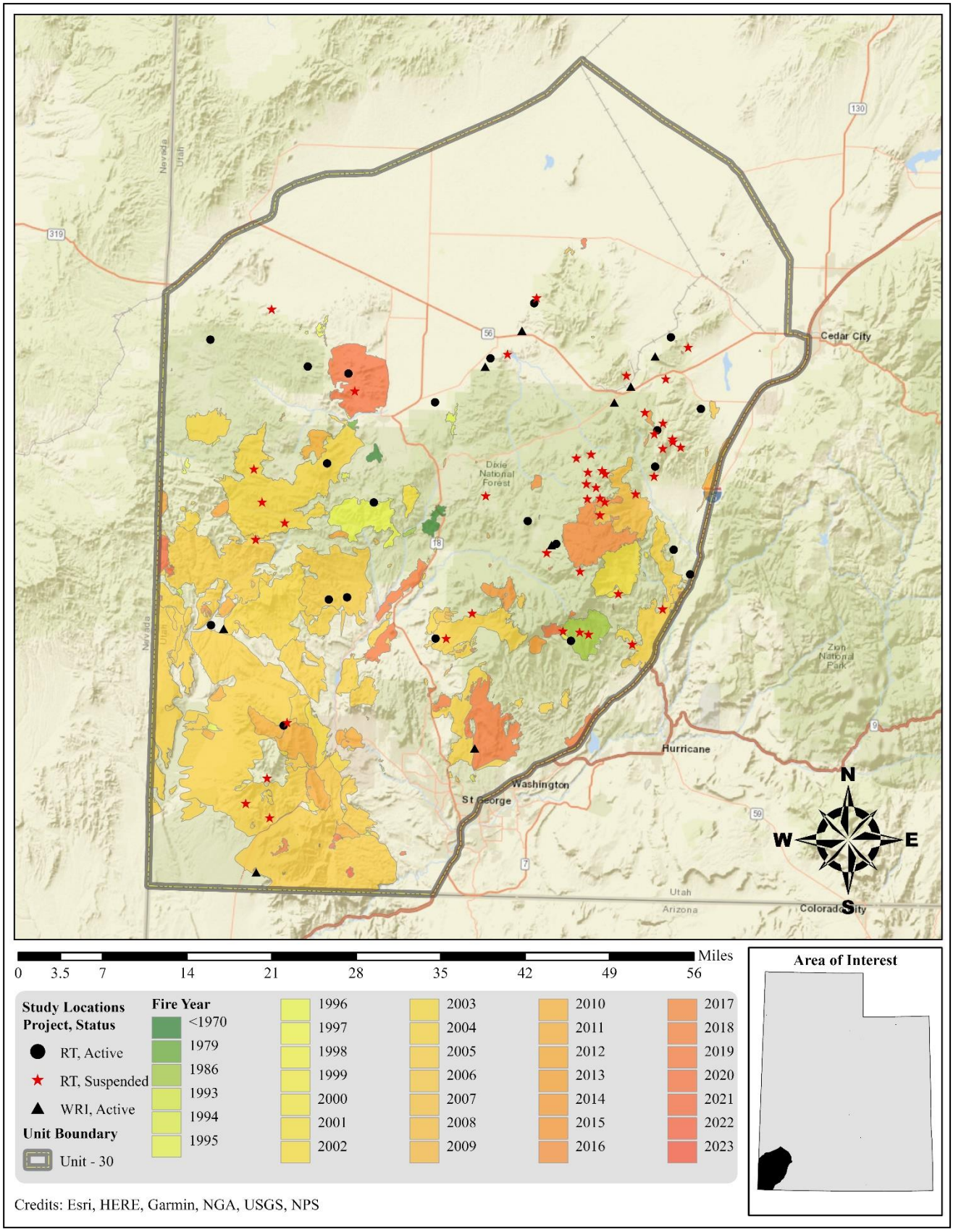
The current LANDFIRE Existing Vegetation Type model shows that nearly 60% of mule deer habitat in Unit 30 is comprised of biophysical sites (hereafter referred to as ecological sites) that are pinyon-juniper dominated woodlands (**Table 9.1**). Overstory cover can range from 25 to 50%, with higher percentages occurring in lower elevations. These woodlands are often associated with preferred browse species known to be beneficial to mule deer. However, these preferred browse species are often limited to absent within sites of this ecological type. Widespread encroachment of pinyon and juniper into sagebrush shrublands has been observed. As such, it is likely that some historical sagebrush types within this unit have been identified as pinyon-juniper woodland types due to their departure from the reference vegetation conditions. When pinyon and juniper encroach on existing shrublands, they can lead to decreased sagebrush and herbaceous components (Miller, Svejcar, & Rose, 2000), therefore decreasing available forage for wildlife. Big sagebrush (*Artemisia tridentata*) ecological sites comprise just over 10% of the unit's mule deer habitat (**Table 9.1**). Sagebrush sites can be negatively impacted by conifer encroachment, frequent fire return, severe drought or wet years, and herbivory, among other factors.

Other limiting factors to big game habitat include introduced annual grasses such as cheatgrass (*Bromus tectorum*). The LANDFIRE model shows that 0.68% of the unit's deer habitat is comprised of introduced annual grasslands (**Table 9.1**). Increased amounts of cheatgrass may increase the risk for catastrophic wildfire (Balch, D'Antonio, & Gómez-Dans, 2013). Other ecological sites of interest include mixed oak shrublands and desert scrub sites that may provide important habitat, and together make up just over 12% of the unit's mule deer habitat (**Table 9.1).** These ecological sites are dominated by Gambel oak (*Quercus gambelii*) and blackbrush (*Coleogyne ramosissima*), respectively: these two species are considered preferred browse for mule deer. A number of other vegetation types comprise the rest of the mule deer habitat within the Pine Valley management unit (**Table 9.1**), but will not be discussed here. Descriptions for these additional vegetation types are available on the LANDFIRE BpS Models and Descriptions Support webpage (The Nature Conservancy LANDFIRE Team, 2023).

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Conifer	Great Basin Pinyon-Juniper Woodland	415,064	48.03%	
	Colorado Plateau Pinyon-Juniper Woodland	92,745	10.73%	
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	11,017	1.27%	
	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	7,568	0.88%	
	Southern Rocky Mountain Ponderosa Pine Woodland	6,459	0.75%	
	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	5,478	0.63%	
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	4,394	0.31%	
	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	2,679	0.30%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	2,552	0.20%	
	Inter-Mountain Basins Juniper Savanna	62	0.01%	
	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	57	0.01%	63.23%
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	89,745	10.39%	
	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	59,802	6.92%	
	Mojave Mid-Elevation Mixed Desert Scrub	52,526	6.08%	
	Great Basin Semi-Desert Chaparral	10,753	1.24%	
	Inter-Mountain Basins Semi-Desert Shrub-Steppe	7,982	0.92%	
	Inter-Mountain Basins Montane Sagebrush Steppe	7,590	0.88%	
	Great Basin Xeric Mixed Sagebrush Shrubland	6,430	0.74%	
	Mogollon Chaparral	4,765	0.55%	
	Sonora-Mojave Semi-Desert Chaparral	2,405	0.28%	
	Sonora-Mojave Mixed Salt Desert Scrub	2,091	0.24%	
	Inter-Mountain Basins Mixed Salt Desert Scrub	1,628	0.19%	
	Rocky Mountain Lower Montane-Foothill Shrubland	673	0.08%	
	Sonora-Mojave Creosotebush-White Bursage Desert Scrub	332	0.04%	
	Inter-Mountain Basins Greasewood Flat	207	0.02%	
	Inter-Mountain Basins Big Sagebrush Steppe	94	0.01%	
	Colorado Plateau Blackbrush-Mormon-tea Shrubland	26	0.00%	
	Colorado Plateau Mixed Low Sagebrush Shrubland	22	0.00%	28.50%
Other	Developed	8,565	0.99%	
	Agricultural	5,453	0.63%	
	Riparian	4,786	0.55%	
	Sparsely Vegetated	3,480	0.40%	
	Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	3,037	0.35%	
	Open Water	719	0.08%	3.00%
Exotic Tree-Shrub	Great Basin & Intermountain Ruderal Shrubland	20,916	2.42%	
	North American Warm Desert Ruderal & Planted Scrub	1,563	0.18%	
	Interior Western North American Temperate Ruderal Shrubland	490	0.06%	2.65%

Group	Existing Vegetation Type	Acres	% of Total	Group % of Total
Exotic Herbaceous	Great Basin & Intermountain Introduced Annual Grassland	5,867	0.68%	
	Great Basin & Intermountain Introduced Perennial Grassland and Forbland	3,233	0.37%	
	Interior Western North American Temperate Ruderal Grassland	789	0.09%	
	Great Basin & Intermountain Introduced Annual and Biennial Forbland	545	0.06%	
	North American Warm Desert Ruderal & Planted Grassland	120	0.01%	1.22%
Hardwood	Rocky Mountain Bigtooth Maple Ravine Woodland	6,187	0.71%	
	Rocky Mountain Aspen Forest and Woodland	1,868	0.22%	0.93%
Grassland	Rocky Mountain Subalpine-Montane Mesic Meadow	1,865	0.22%	
	Southern Rocky Mountain Montane-Subalpine Grassland	1,100	0.13%	
	Inter-Mountain Basins Semi-Desert Grassland	1,090	0.13%	0.47%
Total		**866,820**	**100%**	**100%**

Table 9.1: LANDFIRE Existing Vegetation Types (LC22_EVT_230, 2022) on mule deer habitat in WMU 30, Pine Valley.



Map 9.5: Land coverage of fires by year from prior to 1970-2023 for WMU 30, Pine Valley (Geosciences and Environmental Change Science Center (GECSC) Outgoing Datasets, 2023).

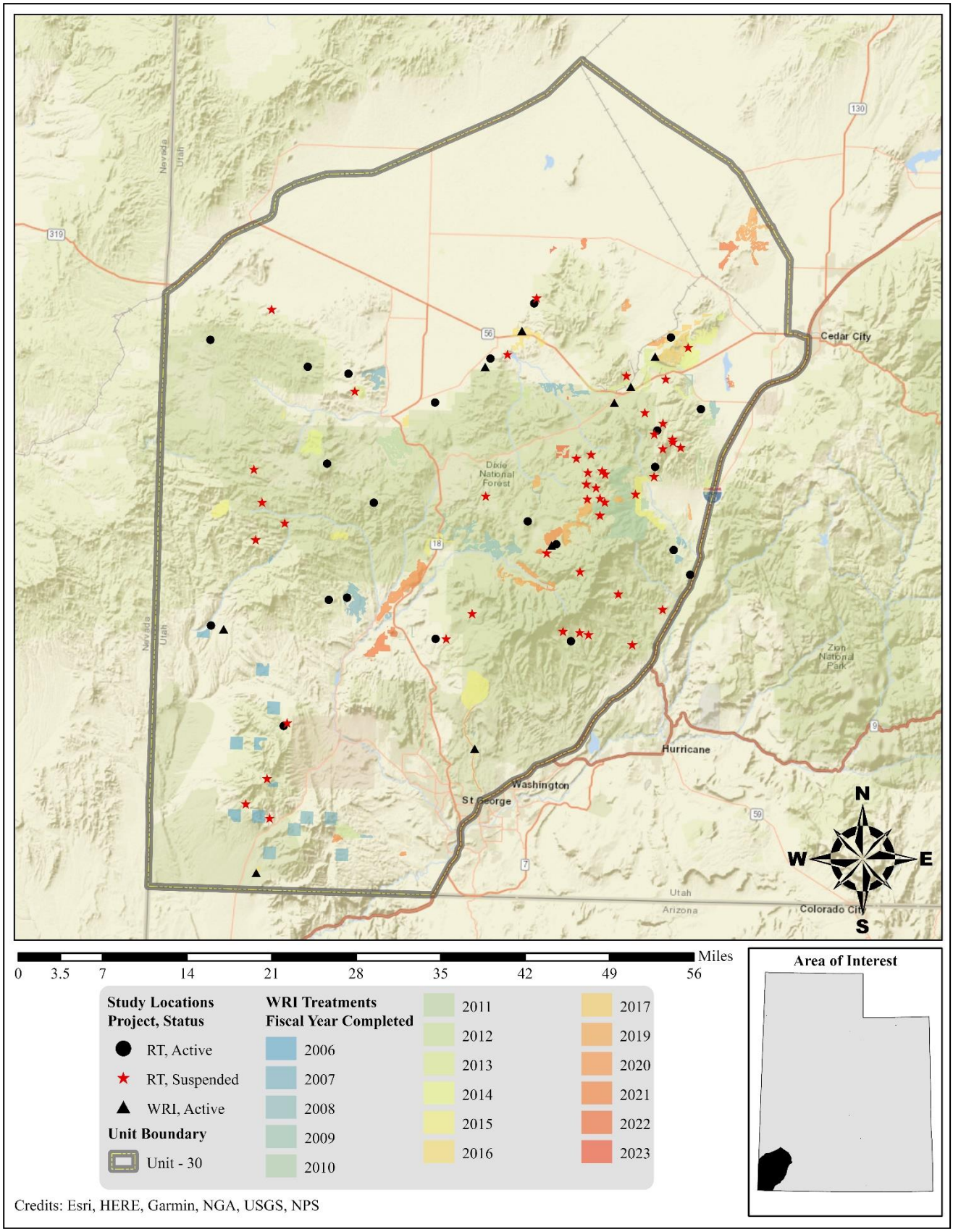
Treatments/Restoration Work

There has been an active effort to address many of the limitations on this unit through the Watershed Restoration Initiative (WRI). A total of 62,441 acres of land have been treated within the Pine Valley unit since the WRI was implemented in 2004 (**Map 9.6**). Treatments frequently overlap one another, bringing the net total of completed treatment acres to 57,892 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.

Seeding plant species to supplement the herbaceous understory is the most common management practice in this unit and often occurs along with other treatment types. Bullhog treatments, manual vegetation removal techniques (such as lop and scatter), and anchor chainings to remove pinyon and juniper trees are also frequently used in the unit. Other management practices include (but are not limited to) seeding plants to enhance the shrub component, harrowing, and herbicide application (**Table 9.2**).

Type	Total Completed Acreage
Anchor Chain	**4,886**
Ely (One-Way)	1,122
Ely (Two-Way)	3,764
Bulldozing	**41**
Tree Push	41
Bullhog	**11,863**
Full Size	6,796
Skid Steer	5,068
Forestry Practices	**96**
Group Selection Cuts	96
Greenstripping	**264**
Greenstripping	264
Harrow	**220**
≤ 15 ft. (One-Way)	201
> 15 ft. (One-Way)	19
Herbicide Application	**774**
Aerial (Fixed-Wing)	131
Aerial (Helicopter)	643
Planting/Transplanting	**200**
Other	200
Seeding (Primary)	**34,942**
Broadcast (Aerial-Fixed Wing)	21,288
Broadcast (Aerial-Helicopter)	10,430
Drill (Rangeland)	244
Ground (Mechanical Application)	2,964
Hand Seeding	16
Seeding (Secondary/Shrub)	**3,600**
Broadcast (Aerial-Fixed Wing)	108
Broadcast (Aerial-Helicopter)	508
Hand Seeding	2,984
Vegetation Removal/Hand Crew	**5,543**
Lop & Scatter	5,482
Lop-Pile-Burn	61
Other	**12**
Road Decommissioning	11
Road/Parking Area Improvements	1
Grand Total	**62,441**
***Total Land Area Treated**	**57,892**

Table 9.2: WRI treatment action size (acres) of completed projects for WMU 30, Pine Valley. Data accessed on 02/07/2024.
*Does not include overlapping treatments.



Map 9.6: Terrestrial WRI treatments by fiscal year completed for WMU 30, Pine Valley.

Range Trend Studies

Range Trend studies have been sampled within WMU 30 on a regular basis since 1982, with studies being added or suspended as was deemed necessary **(Table 9.3**). Due to changes in sampling methodologies, only data collected following the 1992 sample year is included in this summary. Monitoring studies of Watershed Restoration Initiative (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
30-01	Lower Broad Hollow	RT	Active	1982	Not Verified
30-02	Comanche Creek Ditch	RT	Suspended	1987, 1992	Not Verified
30-03	Upper Broad Hollow	RT	Active	1982, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Shrub Liveoak)
30-04	Rock Spring	RT	Suspended	1982	Not Verified
30-05	Harmony Mountain Summit	RT	Active	1982, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Mountain Big Sagebrush)
30-06	Upper Duncan Canyon	RT	Suspended	1982	Not Verified
30-07	Bumblebee Spring	RT	Suspended	1982	Not Verified
30-08	Upper Groves Creek	RT	Suspended	1982	Not Verified
30-09	Upper Lime Spring	RT	Suspended	1982, 1992, 1998, 2003	Mountain Loam (Shrub)
30-10	Upper Bumblebee Spring	RT	Suspended	1982, 1992	Not Verified
30-11	Quichapa Canyon	RT	Suspended	1982	Not Verified
30-12	Pintura Bench	RT	Suspended	1982, 1992, 1998	Upland Stony Loam (Shrub Liveoak)
30-13	Black Ridge	RT	Active	1982, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Black Sagebrush)
30-14	Browse	RT	Suspended	1982	Not Verified
30-15	Wet Sandy Trail	RT	Suspended	1982	Not Verified
30-16	Upper Leeds Creek	RT	Suspended	1982, 1992	Not Verified
30-17	Upper Grants Spring	RT	Suspended	1982	Not Verified
30-18	Grants Ranch Trail	RT	Suspended	1982, 1992	Not Verified
30-19	Big Water Reservoir	RT	Suspended	1982, 1992	Not Verified
30-20	Upper Lone Pine Reservoir	RT	Suspended	1982	Not Verified
30-21	Upper Comanche Canyon	RT	Suspended	1982, 1992	Not Verified
30-22	Sheep Pens	RT	Suspended	1982	Not Verified
30-23	Grants Ranch	RT	Suspended	1982	Not Verified
30-24	Water Canyon	RT	Suspended	1982, 1992	Not Verified
30-25	New Castle Reservoir	RT	Suspended	1982, 1992	Not Verified
30-26	Grassy Flat Ridge	RT	Active	1982, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Stony Loam (Browse)
30-27	Paradise	RT	Suspended	1982, 1992	Not Verified
30-28	Bullion Canyon	RT	Suspended	1982	Not Verified

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
30-29	Southwest of Newcastle	RT	Active	1982, 1992, 1998, 2003, 2004, 2008, 2013, 2018, 2023	Upland Loam (Bonneville Big Sagebrush)
30-30	Swett Hills	RT	Suspended	1982, 1992	Not Verified
30-31	Oak Spring	RT	Suspended	1982, 1992	Not Verified
30-32	Whiterocks Reservoir	RT	Suspended	1982, 1992, 2018	Mountain Stony Loam (Mountain Big Sagebrush)
30-33	South Side Rencher Peak	RT	Suspended	1982	Not Verified
30-34	West of Long Flat	RT	Suspended	1982, 1992	Not Verified
30-35	Deep Canyon	RT	Active	1982, 1992, 1998, 2003, 2008, 2018, 2023	Mountain Shallow Loam (Curlleaf Mountain Mahogany)
30-36	Atchison Mountain	RT	Suspended	1982, 1992	Not Verified
30-37	Truman Bench	RT	Suspended	1982, 1992, 1998	Mountain Stony Loam (Mountain Big Sagebrush)
30-38	Wide Canyon	RT	Suspended	1982, 1992, 1998, 2003, 2008	Upland Shallow Loam (Mountain Big Sagebrush)
30-39	West Valley	RT	Suspended	1982, 1992	Not Verified
30-40	Telegraph Draw	RT	Active	1982, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Gravelly Loam (Mountain Big Sagebrush)
30-41	Joe Spring	RT	Active	1982, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Loam (Oak)
30-42	Grapevine Spring	RT	Active	1982, 1992, 1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Shrub Liveoak)
30-43	Dagget Flat	RT	Suspended	1982	Not Verified
30-44	Motoqua	RT	Active	1982, 1992, 2018, 2023	Semidesert Shallow Hardpan (Blackbrush)
30-45	Flat Top Mountain	RT	Active	1982, 1998, 2003, 2008, 2013, 2018, 2023	Mountain Gravelly Loam (Oak)
30-46	Pahcoon Bench	RT	Suspended	1982, 1992, 1998, 2003, 2008, 2013	Upland Gravelly Loam (Bonneville Big Sagebrush)
30-47	Lost Peak	RT	Suspended	1982, 1998	Mountain Loam (Oak)
30-48	Welcome Springs	RT	Suspended	1982	Not Verified
30-49	Rattlesnake Spring	RT	Suspended	1982, 1992	Not Verified
30-50	Hell Hole Pass	RT	Suspended	1982	Not Verified
30-51	Pinnacles	RT	Suspended	1982, 1992	Not Verified
30-52	Northwest of Enterprise	RT	Suspended	1982, 1992, 1998, 2003, 2008, 2013	Semidesert Loam (Wyoming Big Sagebrush)
30-53	Sevy Hollow	RT	Suspended	1982, 1998	Upland Stony Loam (Mountain Big Sagebrush)
30-54	Bullion Canyon	RT	Active	1998, 2003, 2008, 2013, 2018, 2023	Upland Stony Loam (Black Sagebrush)
30-55	Quichapa Canyon	RT	Active	1998, 2003, 2008, 2013, 2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)
30-56	Woolsey Reseed	RT	Suspended	1998, 2003, 2008, 2013	Upland Gravelly Loam (Bonneville Big Sagebrush)
30-57	Summit Spring	RT	Suspended	1998, 2003, 2008, 2013	Semidesert Shallow Hardpan (Blackbrush)
30-58	Spirit Creek South Burned	RT	Suspended	1986, 1987, 1992, 1998, 2003, 2008, 2013, 2018	Mountain Loam (Mountain Big Sagebrush)
30-59	Upper Horse Creek	RT	Suspended	1986, 1987, 1992, 1998, 2003	Mountain Stony Loam (Oak)
30-60	Jones Hollow	RT	Suspended	1986, 1987, 1992, 1998, 2003	Mountain Loam (Oak)
30-61	Tobin Bench	RT	Active	2003, 2008, 2013, 2018, 2023	Semidesert Gravelly Loam (Desert Bitterbrush)
30-62	North Hills	RT	Active	2003, 2008, 2013, 2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)

Study #	Study Name	Project	Status	Years Sampled	Ecological Site Description
30-63	Holt Canyon	RT	Active	2003, 2008, 2013, 2018, 2023	Upland Loam (Bonneville Big Sagebrush)
30-70	Oak Grove	RT	Suspended	1987	Not Verified
30-71	Pig Creek	RT	Suspended	1987	Not Verified
30-72	Spirit Creek	RT	Suspended	1987	Not Verified
30-73	Wide Canyon 2	RT	Active	2013, 2018, 2023	Upland Stony Loam (Mountain Big Sagebrush)
30-74	Pinion Park	RT	Active	2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)
30-75	Swett Hills North	RT	Active	2018, 2023	Upland Gravelly Loam (Wyoming Big Sagebrush)
30-77	Pahcoon Bench West	RT	Active	2018, 2023	Upland Gravelly Loam (Bonneville Big Sagebrush)
30-78	Ash Creek	RT	Active	2023	Upland Stony Loam (Mountain Big Sagebrush)
30R-01	Newcastle Bullhog	WRI	Active	2004, 2007, 2012, 2017, 2022	Upland Loam (Wyoming Big Sagebrush)
30R-02	Square Fire Rehab	WRI	Active	2006, 2011, 2017, 2022	Semidesert Shallow Hardpan (Blackbrush)
30R-04	North New Castle	WRI	Active	2008, 2011, 2015, 2019	Upland Loam (Mountain Big Sagebrush)
30R-05	Duncan Creek/Hwy 56	WRI	Active	2012, 2015, 2019	Mountain Loam (Browse)
30R-06	Tabeau Peak	WRI	Active	2016, 2022	Desert Loam (Creosote Bush)
30R-07	Middletown Wash	WRI	Active	2016, 2022	Semidesert Shallow Hardpan (Blackbrush)
30R-08	Swett Hills Point	WRI	Active	2019, 2022	Mountain Shallow Loam (Oak)
30R-09	Duncan Canyon	WRI	Active	2019, 2022	Mountain Loam (Browse)
30R-10	Wide Hollow	WRI	Active	2021	Mountain Stony Loam (Curlleaf Mountainmahogany)

Table 9.3: Range Trend and WRI project studies monitoring history and ecological site potential for WMU 30, Pine Valley.

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
30-02	Comanche Creek Ditch	Aerial Before	New Harmony/Central Fuelbreak Improvement Phase II	December 2014	2,252	2988
30-13	Black Ridge	Chain Unknown Seed Unknown Dozer Push Aerial	 Pine Valley WCSL GNA with UTDWR, 10 year strategy (Proposed)	Historic Historic Between 2013 and 2018 Fall 2023-Unknown	 3,797	 6805
30-15	Wet Sandy Trail	Wildfire	Jones	July 2004	702	
30-20	Upper Lone Pine Reservoir	Wildfire Aerial After	Mill Flat Mill Flat BAER Vegetation Stabilization	July 2009 November 2009	12,603 8,893	 1604
30-21	Upper Comanche Canyon	Wildfire	Mill Flat	July 2009	12,607	
30-22	Sheep Pens	Wildfire	Mill Flat	July 2009	12,607	
30-26	Grassy Flat Ridge	Brush Saw Seed Unknown	Pine Valley WCSL GNA with UTDWR, 10 year strategy (Proposed)	Fall 2023-Unknown Historic	918	6805
30-29	Southwest of Newcastle	Lop and Scatter		Between 2003 and 2008		
30-30	Swett Hills	Two-Way Ely Aerial After	Duncan Creek Phase II Vegetation Enhancement Duncan Creek Phase II Vegetation Enhancement	October 2014-February 2015 October 2014-February 2015	2,925 2,925	2704 2704
30-35	Deep Canyon	Lop and Pile	Upper Santa Clara Watershed Restoration and Defensible Fire Space Project Phase I (Proposed)	Fall 2022	43	5588
30-38	Wide Canyon	Wildfire Aerial	Dameron Complex	2004 Winter 2004-2005	10,027	
30-40	Telegraph Draw	Chain Unknown Seed Unknown		Historic Historic		

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
30-42	Grapevine Spring	Chain Unknown	Tobin Wash Seeding	July-December 1965	1,925	LTDL
		Wildfire	Bull Complex	2006	41,500	LTDL
		Aerial	Bull Complex Fire ESR	2006-2007	29,532	LTDL
		Aerial Before	Tobin Wash Seeding	July-December 1965	1,925	LTDL
30-43	Dagget Flat	Wildfire	Bull Complex	2006	41,500	
30-45	Flat Top Mountain	Wildfire	Hawkins	2004	35,427	
30-46	Pahcoon Bench	Chain Unknown		1979		
		Seed Unknown		1979		
		Wildfire	Pahcoon	1998	6,363	
		Seed Unknown		1998?		
		Wildfire	Apex	2003	29,933	
30-47	Lost Peak	Wildfire	Hawkins	2004	35,427	
30-48	Welcome Springs	Wildfire	West Side Complex	2005	68,418	
30-49	Rattlesnake Spring	Wildfire	Hawkins	2004	35,427	
30-51	Pinnacles	Wildfire	Hawkins	2004	35,427	
30-52	Northwest of Enterprise	Wildfire	Barn	1998	1,815	
		Aerial		1998		
30-56	Woolsey Reseed	Chain Unknown	Woolsey Ranch Seeding	Historic	1,600	
		Seed Unknown	Woolsey Ranch Seeding	Historic	1,500	
		Lop and Scatter	Woolsey/Vandenburg Fuels Reduction	May-June 2004	312	
30-57	Summit Spring	Wildfire	Westside Complex	2005	68,418	
		Aerial		Winter 2005-2006		
30-58	Spirit Creek South Burned	Wildfire		June 1986		
		Seed Unknown		July 1986		
30-59	Upper Horse Creek	Wildfire	Oak Grove	1986		
30-60	Jones Hollow	Wildfire	Oak Grove	1986		
30-61	Tobin Bench	Wildfire	Bull Complex	2006	41,500	
		Aerial		2007	1,000	
30-62	North Hills	Wildfire	Flatt	2021	14,357	
		One-Way Ely	Flatt Fire ESR (Proposed)	2022	11,211	5844
		Aerial Before	Flatt Fire ESR (Proposed)	December 2021 - January 2022	11,211	5844
30-75	Swett Hills North	Aerial Before	Duncan Creek - Final Phase	Fall 2016	998	3563
		Bullhog	Duncan Creek - Final Phase	October 2016-May 2017	998	3563
30-77	Pahcoon Bench West	Wildfire	Apex	June 2003	29,933	
		Aerial After		2003		
		Wildfire	West Mountain	August 2012	2,456	
		Aerial After		2012		
30R-01	Newcastle Bullhog	Bullhog		October 2004	900	PDB
30R-02	Square Fire Rehab	Wildfire	Square	2004	17,146	
		One-Way Unknown	Square Fire Rehab	Fall 2004		PDB
		Aerial Before	Square Fire Rehab	Fall 2004	6,287	PDB
		Aerial After	Square Fire Rehab	February 2005	3,000	PDB
		Aerial Before	Aerial Seeding	October-December 1981	1,450	PDB
		One-Way Unknown	Soil Disturbance: Chaining	October-December 1981	660	PDB
		Dribbler	Ground Seeding: Dribble	October-December 1981	660	PDB
30R-04	North New Castle	Bullhog	North Newcastle	December 2008-January 2009	870	446
		Aerial Before	North Newcastle	October 2008	870	446
		Lop and Scatter	Enterprise/Hwy 56 Project Maintenance	August-December 2015	1,323	3431
30R-05	Duncan Creek/Hwy 56	Bullhog	Duncan Creek/Hwy 56 Interface - Phase 1	October 2012-April 2013	2,146	2303
		Aerial Unknown	Duncan Creek/Hwy 56 Interface - Phase 1	October 2012-April 2013	2,146	2303
30R-06	Tabeau Peak	Transplant	Desert Tortoise Habitat Restoration in Burned Areas within two National Conservation Areas in SW Utah	November 2016-Fall 2017	200	3284
		Wildfire	Jarvis	June 2006	50,702	

Study #	Study Name	Type	Disturbance Name (If Available)	Date	Acres	WRI Project #
30R-07	Middletown Wash	Transplant	Desert Tortoise Habitat Restoration in Burned Areas within two National Conservation Areas in SW Utah (Proposed)	November 2016-Fall 2017	200	3284
		Wildfire	Plateau	June 2005	2,986	
		Wildfire	Mill Creek	July 2005	7,888	
		Wildfire	Turkey Farm Road	July 2020	11,993	
		Aerial	2020 Turkey Farm Road ESR (Proposed)	February-March 2021	5,686	5499
30R-08	Swett Hills Point	Lop and Scatter	Duncan Creek - Final Phase	October 2016-May 2017	1,279	3563
30R-09	Duncan Canyon	Bullhog	Pinto Watershed and Defensible Fire Space Restoration Project Phase I	Between 2020 and June 2022	1,800	4779
		Aerial Before	Pinto Watershed and Defensible Fire Space Restoration Project Phase I	Between October 2019 and June 2022	1,800	4779
30R-10	Wide Hollow	Aerial Before	Upper Santa Clara Watershed Restoration and Defensible Fire Space project Phase I (Proposed)	Fall 2021	742	5588
		Bullhog	Upper Santa Clara Watershed Restoration and Defensible Fire Space project Phase I (Proposed)	Fall 2021	742	5588

Table 9.4: Range Trend and WRI studies known disturbance history for WMU 30, Pine Valley. PDB = Pre-Database; LTDL = Land Treatment Digital Library (Pilliod, Welty, & Jefferies, 2019).

Study Trend Summary (Range Trend)

Ecotypes that are represented by only one study site throughout most or all of the sample period are not discussed in this section. These ectoypes include:

- Mountain (Browse) - Grassy Flat Ridge (30-26)
- Mountain (Curlleaf Mountain Mahogany) - Deep Canyon (30-35)
- Mountain (Shrub) - Upper Lime Spring (30-09) (suspended)
- Semidesert (Big Sagebrush) - Northwest of Enterprise (30-52) (suspended)
- Semidesert (Blackbrush) - Motoqua (30-44) and Summit Spring (30-57) (suspended)
- Semidesert (Desert Bitterbrush) - Tobin Bench (30-61)

Trend summaries and/or data for these ecotypes are available in the corresponding site reports.

Mountain (Big Sagebrush)

Five studies [Harmony Mountain Summit (30-05), Whiterocks Reservoir (30-32) (suspended), Truman Bench (30-37) (suspended), Telegraph Draw (30-40), and Spirit Creek South Burned (30-58) (suspended)] are classified as Mountain (Big Sagebrush) ecological sites. The Harmony Mountain Summit study site is located approximately eight miles north of New Harmony on Harmony Mountain. The Whiterocks Reservoir site can be found in the Pine Valley Mountains northeast of Grass Valley, and the Truman Bench study is located roughly six miles east of the town of Veyo on Truman Bench. The Telegraph Draw study is situated approximately three miles east of the Nevada border and north of Crestline Road near Enterprise. The Spirit Creek South Burned study is located around 10 miles northwest of Leeds in the Pine Valley Mountains.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, the Harmony Mountain Summit and Telegraph Draw studies have provided data since 1998, and Spirit Creek South Burned contributed data from 1998 through 2018. The Truman Bench site provided data in 1998, and Whiterocks Reservoir contributed data in 2018.

Shrubs/Trees: Mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is the dominant browse species on all study sites except for Spirit Creek South Burned, on which Gambel oak (*Quercus gambelii*) is the dominant species. Average cover of sagebrush has displayed an overall increase (**Figure 9.13**). Average preferred browse demographic data shows that the communities on these sites are primarily composed of mature individuals. Decadence has remained low, except for in 2008 when the amount of decadent individuals was moderate. Recruitment of young sagebrush has generally decreased and was considered low in 2023 (**Figure 9.20**). Overall utilization of preferred browse has consistently remained low over time with most plants receiving moderate use (**Figure 9.22**).

Tree cover for these sites is provided by Utah juniper (*Juniperus osteosperma*) and singleleaf pinyon (*Pinus monophylla*). An overall increasing cover trend has been observed, and is driven by both species of trees. However, this trend in average tree cover is affected by the change in the number of study sites for the 2018 and 2023 sample years. Two study sites with no observed tree cover were suspended after 2018 and therefore did not affect the average in 2023 (**Figure 9.16**). Density of trees remained stable between 2003 and 2018, but increased in 2023. As with cover, however, this trend can mainly be attributed to two study sites not being sampled during the most recent sample year rather than an actual increase in density (**Figure 9.18**).

Herbaceous Understory: The herbaceous understories of these sites are mostly abundant and moderately diverse. The higher-elevation sites display more diversity in the forb and grass components; introduced perennial grasses dominate the Spirit Creek South Burned study. Total average cover increased between 1998 and 2018 primarily due to perennial grasses, but decreased in 2023. However, this decrease in average cover is likely due to yearly variation in the number of studies sampled and as such, may not accurately portray the trend as a whole. Nested frequency appears to have remained stable overall since 2003 with some fluctuation from year to year. This yearly variability is primarily due to larger shifts in the annual grass community, although there have also been fluctuations of perennial forbs. Again, the differing number of studies sampled from year to year may affect the portrayal of the overall trend (**Figure 9.24**, **Figure 9.26**).

Occupancy: Average pellet transect data shows that animal presence on these sites has generally decreased and that deer are the primary occupants. Mean abundance of deer pellet groups has varied from 18 days use/acre in 2013 to 69 days use/acre in 2008. Cattle presence has fluctuated between 4 days use/acre in 2023 and nearly 11 days use/acre in 2003. Mean abundance of elk pellet groups has remained low with less than 1 day use/acre observed, and only in the 2008 and 2018 sample years. Horse pellet groups have been sampled in all sample years, and mean abundance has ranged from 1 day use/acre in 2018 to 3 days use/acre in 1998 and 2003 (**Figure 9.28**).

Mountain (Oak)

Five studies [Joe Spring (30-41), Flat Top Mountain (30-45), Lost Peak (30-47) (suspended), Upper Horse Creek (30-59) (suspended), and Jones Hollow (30-60) (suspended)] are classified as Mountain (Oak) ecological sites. The Joe Spring study is located in the Black Hills near Ox Valley. The Flat Top Mountain site is situated on Flat Top Mountain approximately seven miles southwest of Enterprise. Lost Peak can be found southeast of Lost Peak Spring in the Bull Valley Mountains, and the Upper Horse Creek site is located north of Leeds Creek and Ash Grove Spring in the Pine Valley Mountains. Finally, the Jones Hollow study can be found approximately one and a half miles north of the mouth of Jones Hollow in the Pine Valley Mountains.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, the Joe Spring and Flat Top Mountain studies have provided data since 1998, and the Upper Horse Creek site contributed data in 1998 and 2003. Finally, the Lost Peak and Jones Hollow studies provided data only in 1998.

Shrubs/Trees: Gambel oak is the dominant browse species on the Flat Top Mountain study and is codominant with mountain big sagebrush on the Joe Spring site. Lesser amounts of other preferred browse such as Utah serviceberry (*Amelanchier utahensis*), mountain snowberry (*Symphoricarpos oreophilus*), currant (*Ribes sp.*) and black sagebrush (*Artemisia nova*) have also been observed on these sites. Average preferred browse cover decreased in 2008 due to the Hawkins fire that occurred on the Flat Top Mountain site. However, subsequent years have shown the return of preferred browse species and cover appears to have stabilized between 2018 and 2023 (**Figure 9.14**). Average preferred browse demographics show that the communities on these sites have been mostly composed of mature plants. Decadence has been low in all years except for 2008, when there were high amounts of decadent plants. Recruitment of young has been notable in all sample years and has gradually increased over time (**Figure 9.20**). Overall utilization of preferred browse has varied from year to year with most utilization being considered moderate in all years. Total utilization was low in 2008 likely due to the fire reducing available forage (**Figure 9.22**).

Trees have not been observed on these study sites and therefore will not be discussed in this section (**Figure 9.16**, **Figure 9.18**).

Herbaceous Understory: The herbaceous understories of these sites are robust and abundant with perennial forbs as the dominant component. There was a significant increase in average perennial forb cover in 2023, which corresponds with the wet winter and spring of 2022/23. Annual grasses have been present on these sites in moderate abundance, but have generally decreased. Perennial grasses have fluctuated in both average cover and nested frequency with no discernable

overall trend. Muttongrass (*Poa fendleriana*) is the dominant perennial grass species on both active study sites as of 2023 (**Figure 9.24**, **Figure 9.26**).

Occupancy: Average pellet transect data shows a stable trend in animal presence and that deer are the primary occupants of these sites. Mean abundance of deer pellet groups has exhibited a low of 34 days use/acre in 1998 and a high of 46 days use/acre in 2008. Cattle pellet groups had a mean abundance varying between 0 days use/acre in 2013 and 9 days use/acre in 2008 (**Figure 9.28**).

Upland (Big Sagebrush)

Thirteen studies [Southwest of Newcastle (30-29), Wide Canyon (30-38) (suspended), Pahcoon Bench (30-46) (suspended), Sevy Hollow (30-53) (suspended), Quichapa Canyon (30-55), Woolsey Reseed (30-56) (suspended), North Hills (30-62), Holt Canyon (30-63), Wide Canyon 2 (30-73), Pinion Park (30-74), Swett Hills North (30-75), Pahcoon Bench West (30-77), and Ash Creek (30-78)] are classified as Upland (Big Sagebrush) ecological sites. The Southwest of Newcastle site is located in the foothills off Bench Road, which is southwest of Newcastle. The Wide Canyon study can be found north of Wide Canyon and east of the Wide Canyon 2 study site. Pahcoon Bench is located roughly eight miles west of Shivwits and just northeast of the Pahcoon Bench West site. The Sevy Hollow study can be found near Sevy Hollow, which is in the northern foothills of the Bull Valley Mountains. Quichapa Canyon is placed off Bumblebee Road, southwest of Cedar City. Woolsey Reseed is less than a mile south of SR-56 at the base of the Harmony Mountains. The North Hills study site is situated in the hills to the south of Hamiltons Fort. Holt Canyon is located south of Bench Road between Enterprise and Newcastle. Wide Canyon 2 can be found approximately two miles east of Dammeron Valley. The Pinion Park study is approximately 10 miles northeast of Enterprise. The Swett Hills North site is located about 12 miles west of Cedar City in the Swett Hills. The Pahcoon Bench West study is placed approximately eight miles west of Shivwits. Finally, the Ash Creek site can be found west of I-15 and south of Ash Creek Reservoir.

Consideration should be given to the varying number of study sites sampled each year (the 'n' value) and the relevant implications that this may have on the data. More specifically, the Southwest of Newcastle and Quichapa Canyon studies have provided data in all sample years since 1998, and Pahcoon Bench and Woolsey Reseed contributed data from 1998 through 2013. The Sevy Hollow site provided data only in 1998, and Wide Canyon contributed data from 1998 through 2008. Data has been provided by the North Hills and Holt Canyon studies in all years since 2003; Wide Canyon 2 has contributed data since 2013. Pinion Park, Swett Hills North, and Pahcoon Bench West have all provided data since they were established in 2018. Finally, the Ash Creek study was established in 2023 and has only provided data for that year.

Shrubs/Trees: The dominant preferred browse species on these Upland (Big Sagebrush) ecological sites have been either mountain big sagebrush or Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Lesser amounts of other browse are also present depending on the site; these other preferred browse species include narrowleaf yerba santa (*Eriodictyon angustifolium*), desert almond (*Prunus fasciculata*), Stansbury cliffrose (*Purshia stansburiana*), antelope bitterbrush (*Purshia tridentata*), Gambel oak, and/or Utah serviceberry. Average cover of preferred browse has generally increased, although it stabilized between 2018 and 2023 (**Figure 9.13**). Preferred browse demographic data shows that the communities on these sites are primarily composed of mature individuals and that decadence has decreased overall since 2008. There has generally been no net change in average density (**Figure 9.21**). Utilization of preferred browse has fluctuated significantly, but heavy utilization occurred in 2003 and 2023 (**Figure 9.23**). It should be noted that there are differences in the number of studies sampled from year to year, which make it difficult to determine trends.

Trees sampled on these study sites include Utah juniper, singleleaf pinyon, and twoneedle pinyon (*Pinus edulis*). Tree cover measurements showed a decreasing trend until 2018 and 2023, when Pinion Park was added to the sampling rotation. The increase in average cover is likely driven by the establishment of this site, which in turn indicates that the Pinion Park study has a higher average tree cover value than the sites sampled prior to 2018. Density measurements also show a similar trend to cover: density decreased until 2018, then increased. These increases observed in 2018 and 2023 are also due to the addition of the Pinion Park study (**Figure 9.17**, **Figure 9.19**).

Herbaceous Understory: The herbaceous understories of these sites are in varied conditions. A mixture of perennial and annual grasses dominates most of the sites. Perennial grasses have fluctuated in nested frequency from year to year, but have mostly been stable overall. Average cover of perennial grasses has fluctuated more drastically than nested frequency, but no net change in average cover has occurred. The varying number of studies sampled from year to year may have implications on data interpretation and may not fully portray the overall trend. Average nested frequency of perennial forbs has exhibited small fluctuations over the study period and perennial forbs have been considered sparse overall. However, average perennial forb cover has gradually increased over time. Most of the sites are dominated by

native species as of 2023 except for the Swett Hills North site, on which crested wheatgrass (*Agropyron cristatum*) is codominant with bluebunch wheatgrass (*Pseudoroegneria spicata*) (**Figure 9.25**, **Figure 9.27**).

Occupancy: Average pellet transect data indicates a fluctuating trend in animal presence and that deer are the primary occupants of these sites. Deer presence has varied from a low of 17 days use/acre in 2013 to a high of 50 days use/acre in 1998. Elk pellets were sampled only in 2008 and 2018 with a mean abundance of less than 1 days use/acre. Cattle presence on these sites has fluctuated, ranging in mean abundance from 4 days use/acre in 2013 to over 11 days use/acre in 1998. Finally, horse pellet groups have been observed on these sites in low amounts, ranging from 0 days use/acre in 1998 and 2013 to 0.8 days use/acre in 2018 (**Figure 9.29**).

Upland (Black/Low Sagebrush)

Two studies [Black Ridge (30-13) and Bullion Canyon (30-54)] are classified as Upland (Black/Low Sagebrush) ecological sites. The Black Ridge study is situated approximately two miles west of Ash Creek Reservoir, which is off I-15 south of Kanarraville. The Bullion Canyon study site is located approximately four miles northeast of Newcastle.

Shrubs/Trees: The primary browse species present on these Upland (Black/Low Sagebrush) ecological sites are black sagebrush and little sagebrush (*Artemisia arbuscula*). Additional preferred browse species are present and include Utah serviceberry, antelope bitterbrush, Gambel oak, Sonoran scrub oak (*Q. turbinella*), and Nevada jointfir (*Ephedra nevadensis*). Average cover of sagebrush has increased slightly over the study years (**Figure 9.13**). Preferred browse demographic data shows that the communities are primarily comprised of mature individuals with a moderate but decreasing amount of decadence. Overall preferred browse density has decreased over the study period (**Figure 9.21**). Preferred browse utilization has fluctuated from year to year, but there was a notable decrease in utilization in 2018 and 2023. Overall utilization is considered to be moderate, but browse was more heavily utilized in 2013 (**Figure 9.23**).

Utah juniper and twoneedle pinyon have been sampled on these sites, but juniper has been the driver for average tree cover and density trends. Average juniper cover increased between 2003 and 2013, but had a notable decrease in 2018 associated with a bulldozer push (**Figure 9.17**). Average tree density follows a similar trend to cover and is primarily provided by juniper, but some pinyon has been sampled. Again, the decreasing trend in tree density between 2013 and 2018 is driven by the bulldozer push. However, juniper density has continued to decrease, while average pinyon density has remained stable (**Figure 9.19**).

Herbaceous Understory: The herbaceous understories for both Bullion Canyon and Black Ridge are fairly sparse. Perennial grasses have been the dominant component in all years except in 1998, when annual grass was the dominant understory type. Average nested frequency for most herbaceous components has remained stable since 2003, but annual grasses have had the most variability. Average cover for all vegetation types has generally exhibited an increasing trend since 2008 with perennial grasses having the greatest increase in average cover. The most notable increase in average cover for all vegetation types occurred in 2023, which may be related to the wet winter and spring of 2022/23 (**Figure 9.25**, **Figure 9.27**).

Occupancy: Average pellet transect data displays fluctuations in animal presence and indicates that deer are the primary occupants of these sites. The mean abundance of deer pellet groups has been as low as 7 days use/acre in 2013 and as high as 47 days use/acre in 2008. Cow pellet groups have had a mean abundance ranging from 0 days use/acre in 2013 to 5 days use/acre in 2023. Horse pellet groups were sampled in 2018 and 2023, but data showed an average abundance of less than 1 days use/acre in both years (**Figure 9.29**).

Upland (Shrub Liveoak)

There are three studies [Upper Broad Hollow (30-03), Pintura Bench (30-12) (suspended), and Grapevine Spring (30-42)] that are considered to be Upland (Shrub Liveoak) ecological sites. Upper Broad Hollow is located about three miles due north of the town of New Harmony. The Pintura Bench study is situated on a bench above and just west of Pintura. Finally, Grapevine Spring can be found approximately five miles west of the town of Veyo.

Shrubs/Trees: The preferred browse component on these sites is composed of a mixture of browse species. On the Upper Broad Hollow study, Utah serviceberry is the dominant browse with mountain big sagebrush as a codominant species. On the Grapevine Spring site, Sonoran scrub oak is the dominant preferred browse species. Cover of both Sonoran scrub oak and other preferred browse has generally increased since 2008. Overall cover decreased between 2003 and 2008 due to the Bull Complex Fire in 2005. Average cover of shrubs other than preferred browse species has increased over the sample period (**Figure 9.15**). There has been a net decrease in overall preferred browse density since 1998, although 2023

density is similar to that of 2003. Demographic data shows that the preferred browse communities on these sites are mostly composed of mature individuals and that decadence has decreased overall (**Figure 9.21**). Utilization of preferred browse decreased slightly between 1998 and 2018, but notably increased in 2023. Overall utilization is mostly considered moderate (**Figure 9.23**).

Trees have been present on both sites, but cover has not been observed on the Grapevine Spring study following the fire. However, an overall increasing trend has occurred since 2008 (**Figure 9.17**). Average tree density has followed a similar trend with density decreasing notably between 2003 and 2008, but increasing in the years after 2008 (**Figure 9.19**).

Herbaceous Understory: The herbaceous understory of the Grapevine Spring site is depleted while that of Upper Broad Hollow is more diverse and abundant. Annual grass cover has been nominal in most years except 1998, when average cover was over six percent. Perennial forbs have fluctuated, but have generally contributed moderate cover overall. Average perennial grass cover has increased slightly after an initial decrease between 1998 and 2003, but average nested frequency has remained stable over the sample period (**Figure 9.25**, **Figure 9.27**).

Occupancy: Average pellet transect data for these sites has shown an overall decreasing trend in animal presence and that the primary occupants of these sites are deer. Mean abundance of deer pellet groups has varied from 19 days use/acre in 2018 to 80 days use/acre in 2008. Cows have been present on these sites with low pellet group abundance, with average abundance ranging from 0 days use/acre in 2003 and 2018 to nearly 2 days use/acre in 1998, 2008, and 2023 (**Figure 9.29**).

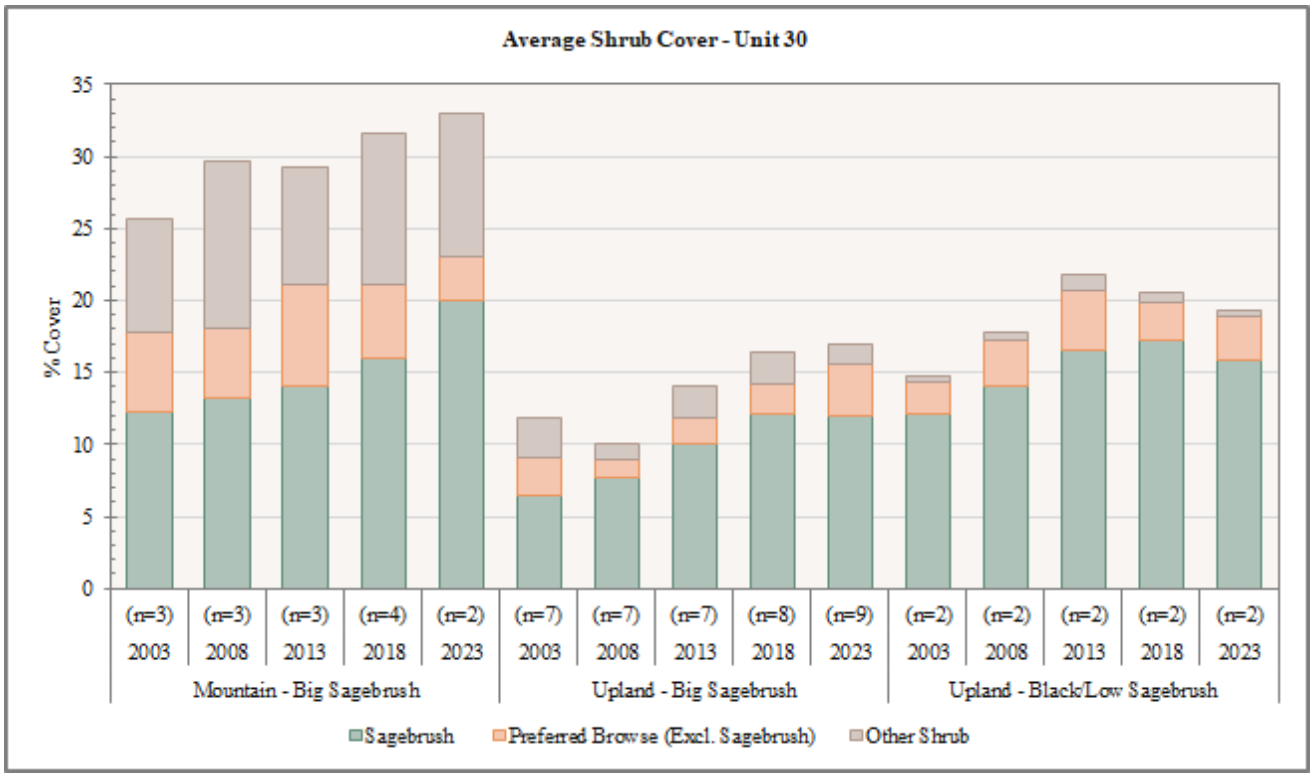


Figure 9.13: Average shrub cover for Mountain - Big Sagebrush, Upland - Big Sagebrush, and Upland - Black/Low Sagebrush study sites in WMU 30, Pine Valley.

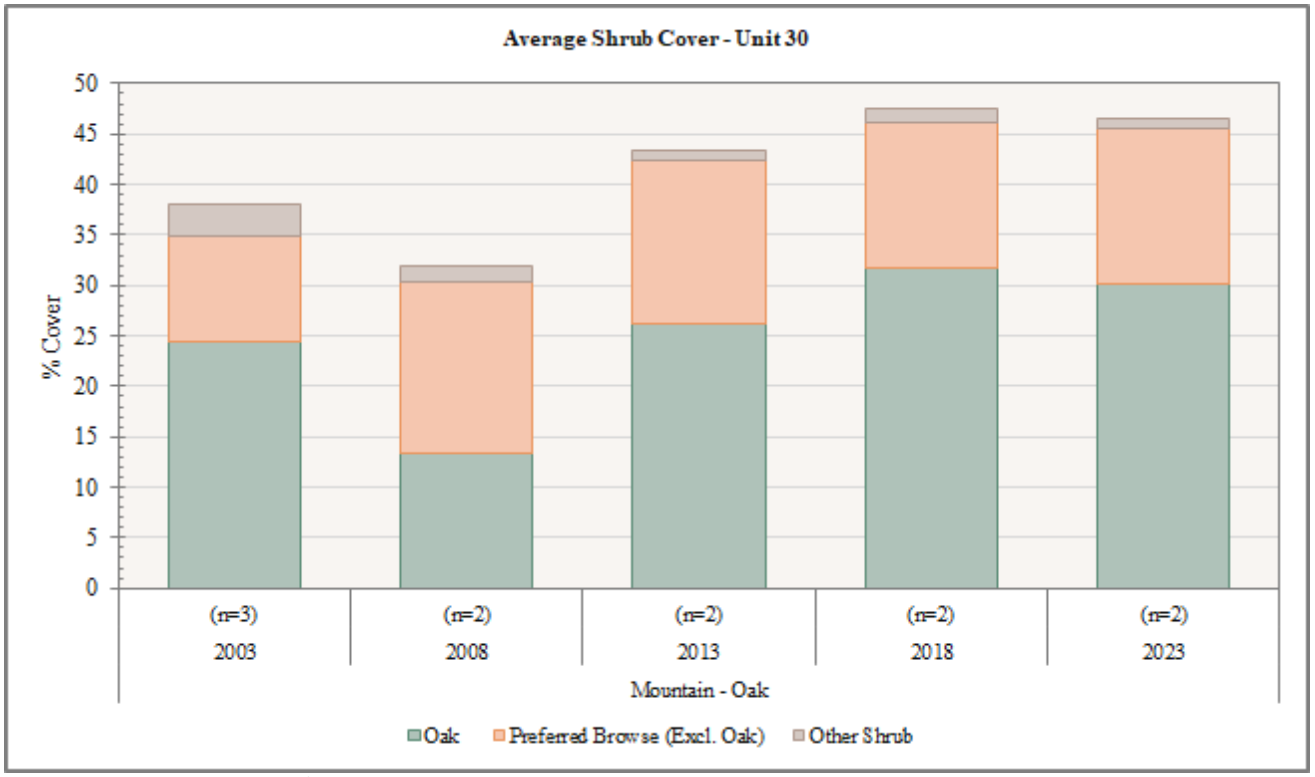


Figure 9.14: Average shrub cover for Mountain - Oak study sites in WMU 30, Pine Valley.

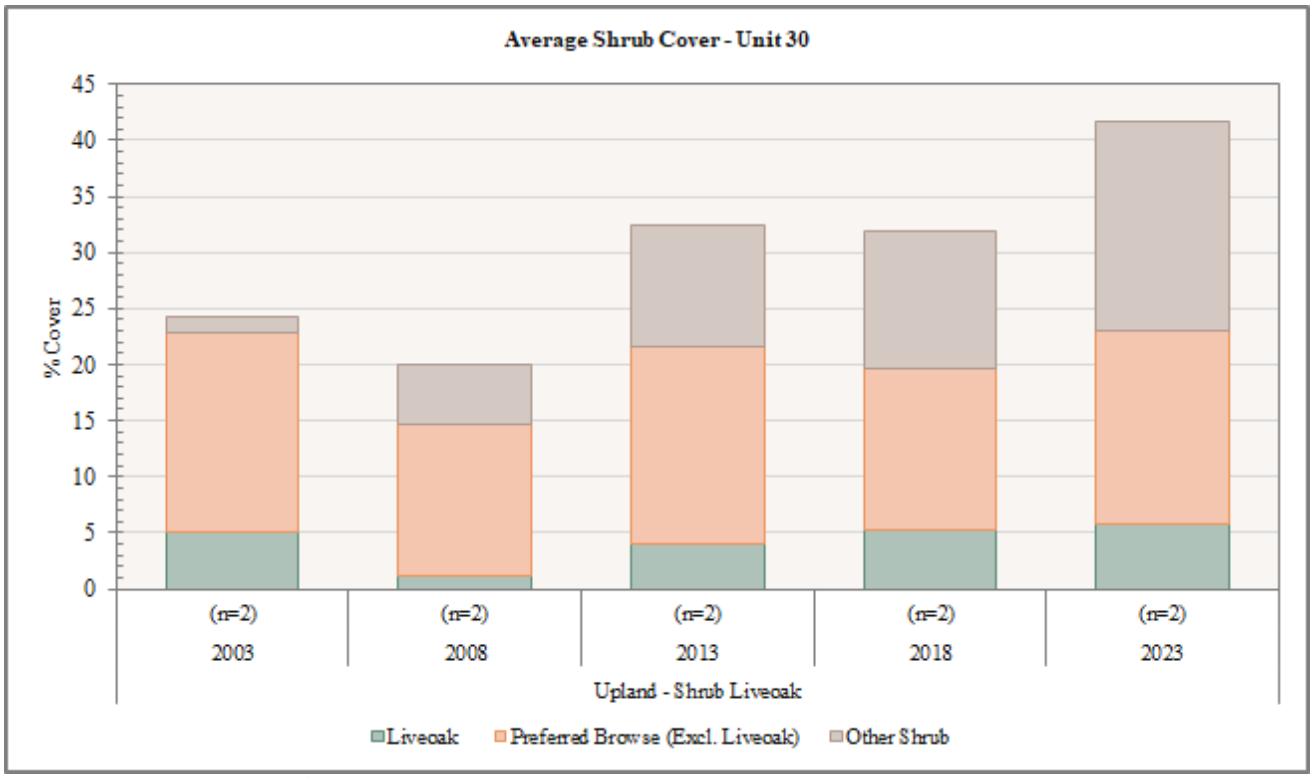


Figure 9.15: Average shrub cover for Upland - Shrub Liveoak study sites in WMU 30, Pine Valley.

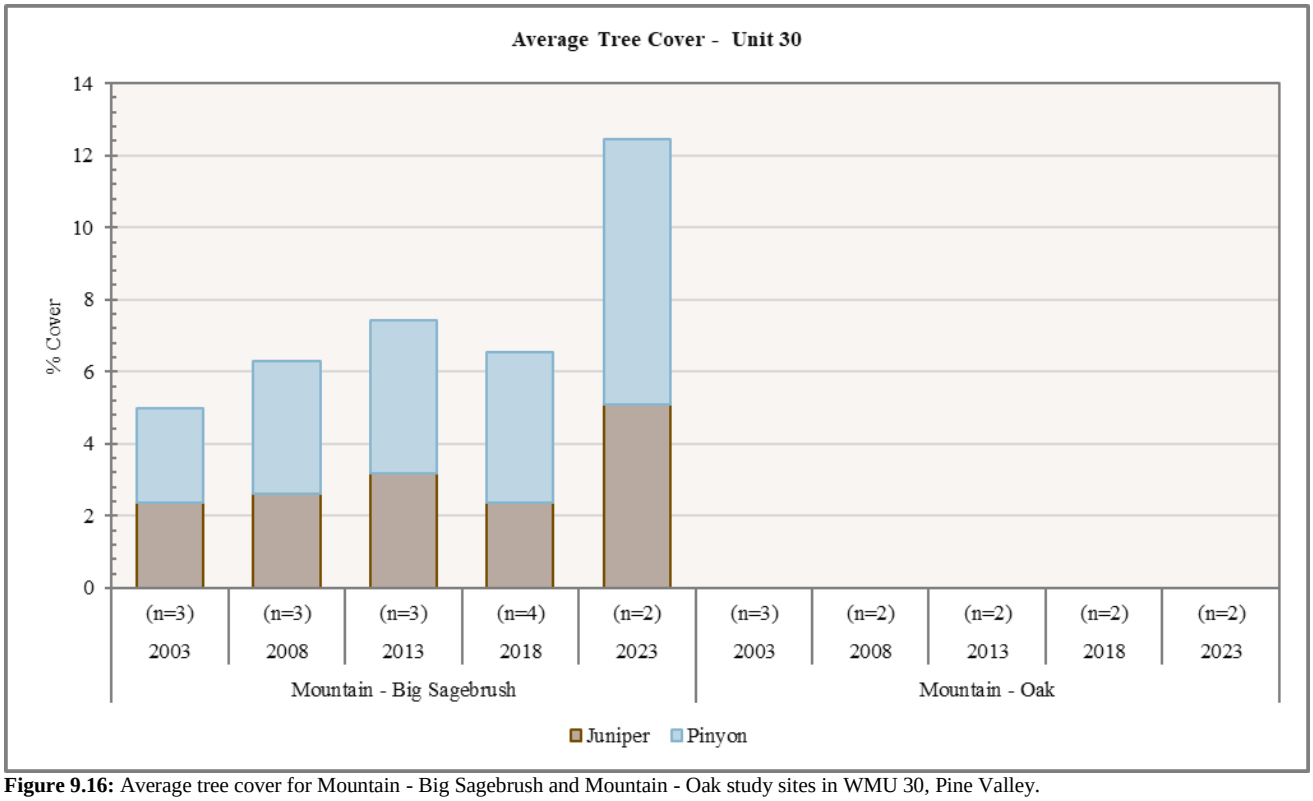


Figure 9.16: Average tree cover for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 30, Pine Valley.

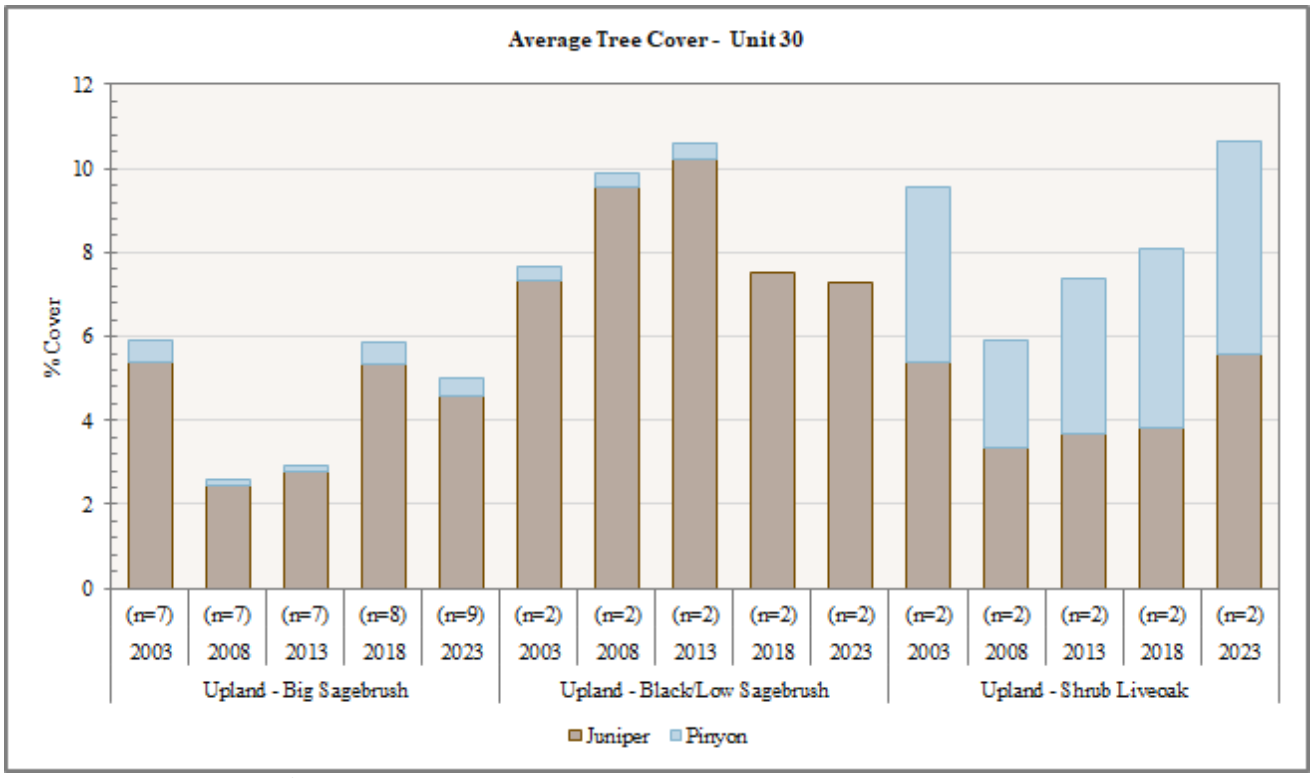


Figure 9.17: Average tree cover for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Shrub Liveoak study sites in WMU 30, Pine Valley.

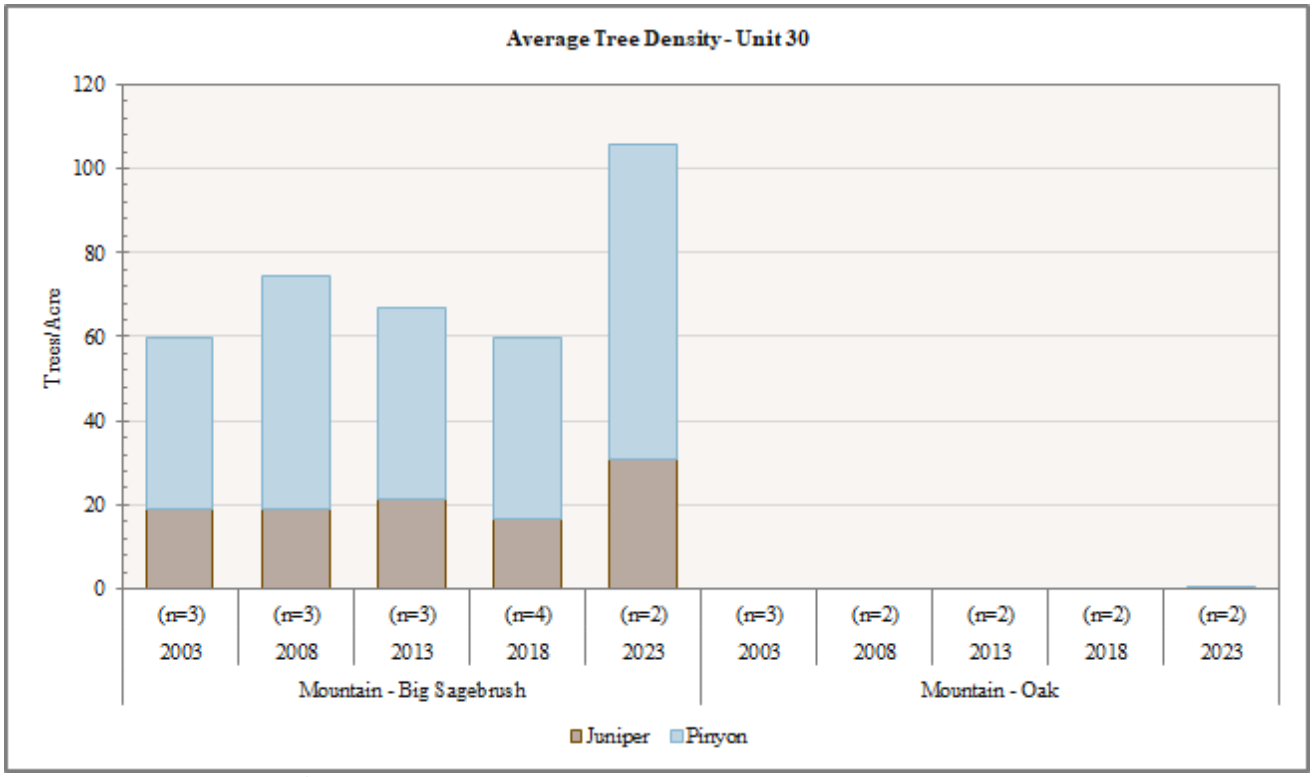


Figure 9.18: Average tree density for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 30, Pine Valley.

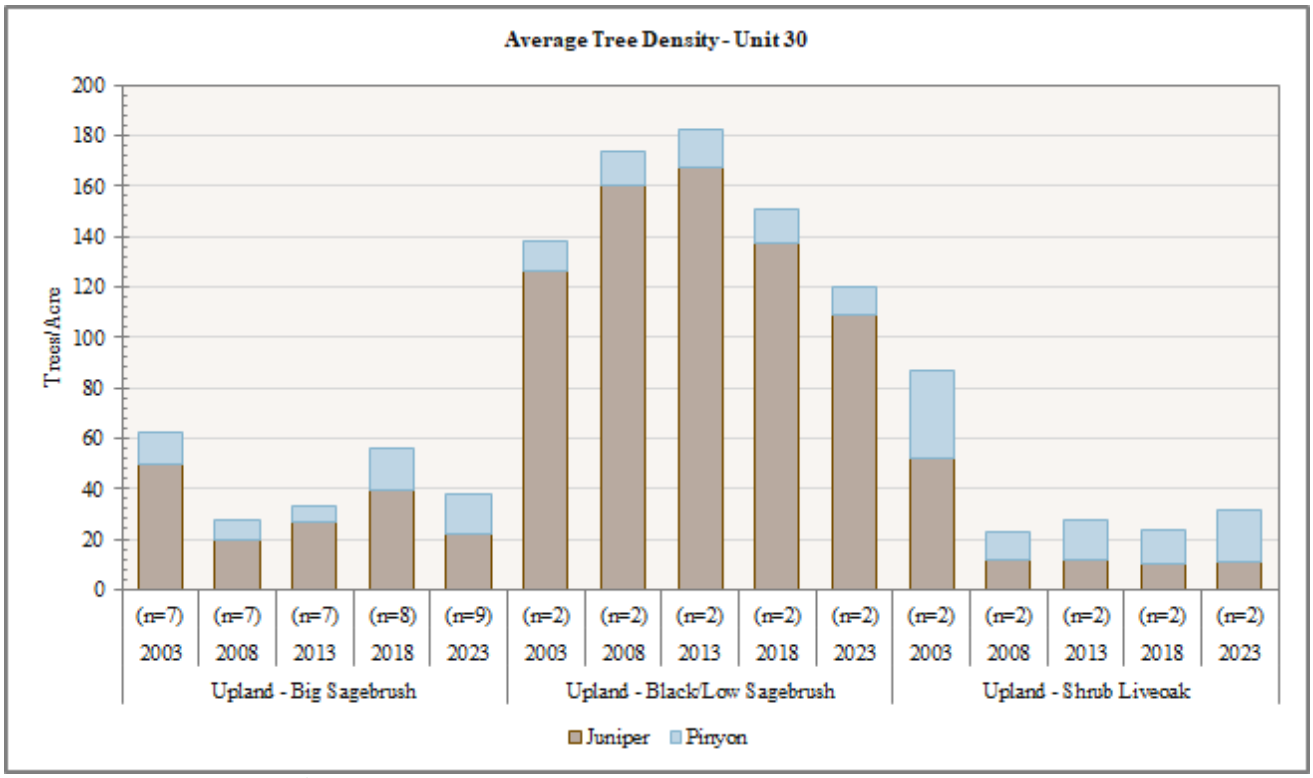


Figure 9.19: Average tree density for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Shrub Liveoak study sites in WMU 30, Pine Valley.

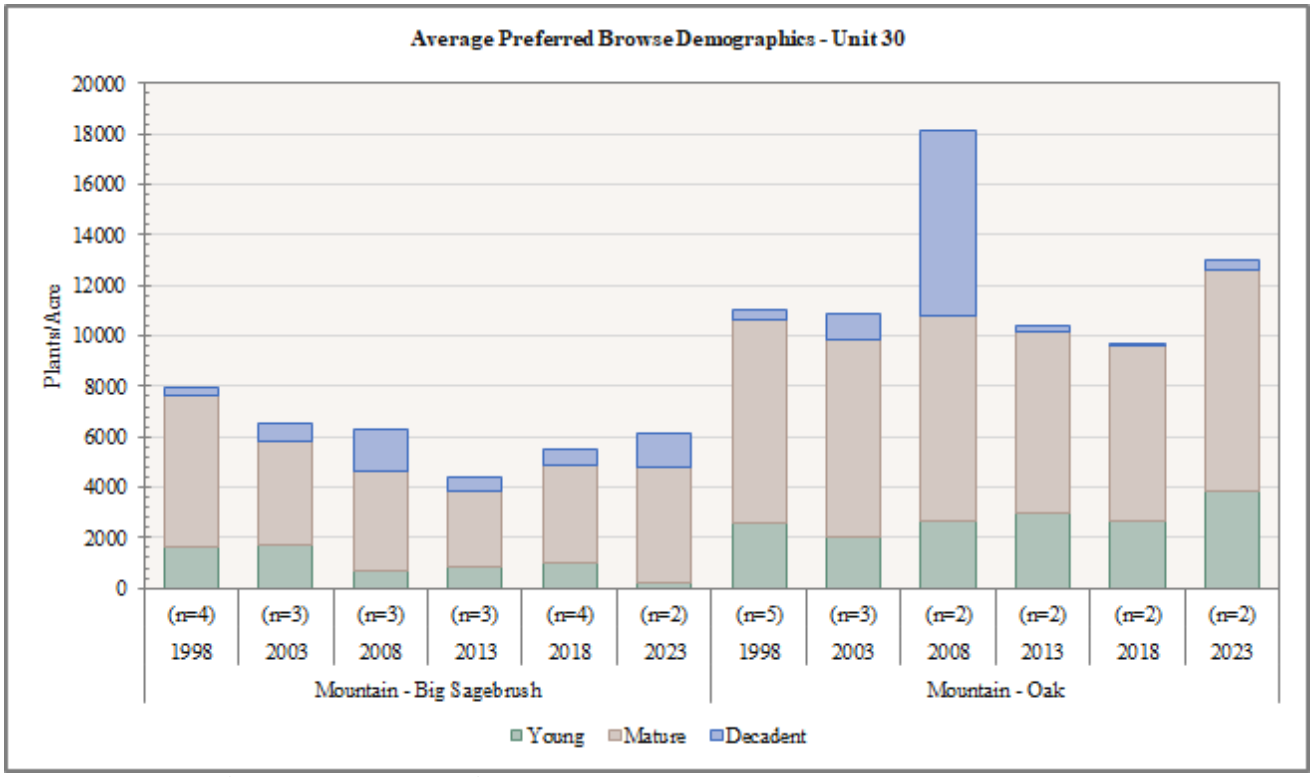


Figure 9.20: Average preferred browse demographics for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 30, Pine Valley.

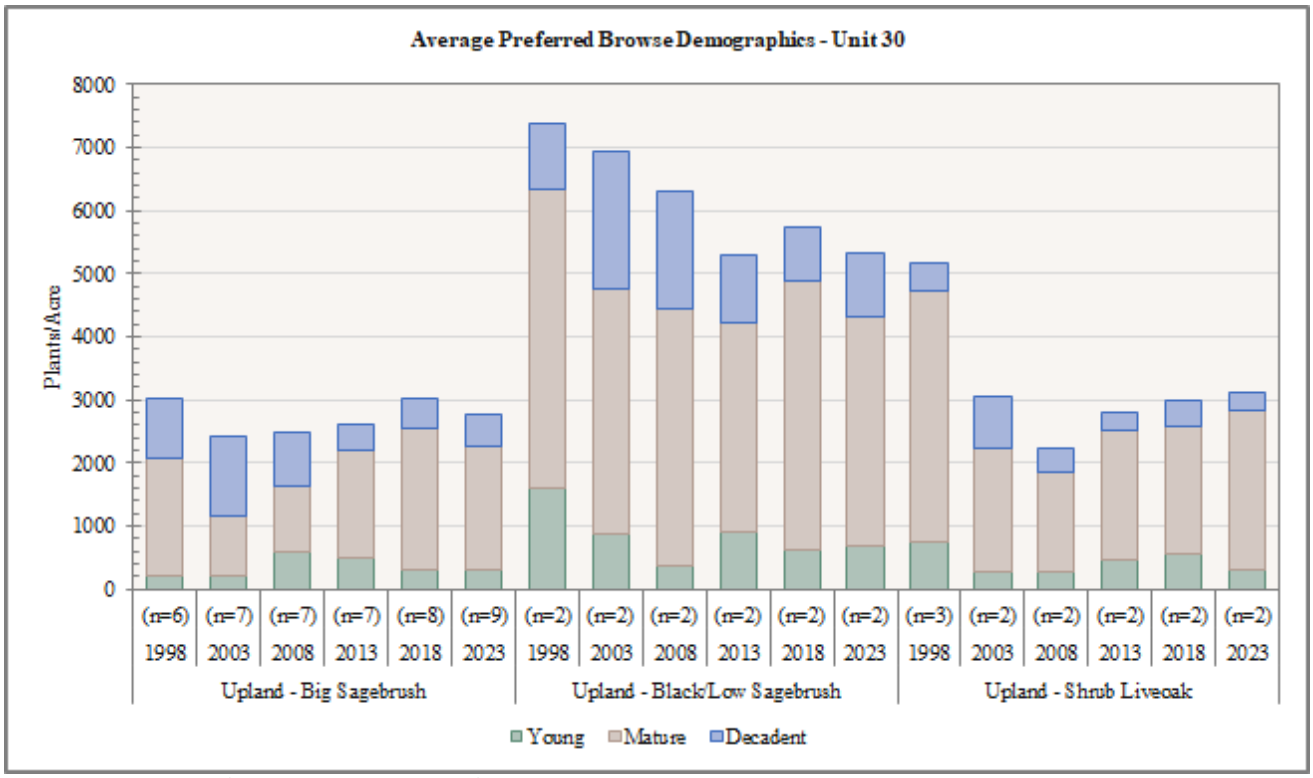


Figure 9.21: Average preferred browse demographics for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Shrub Liveoak study sites in WMU 30, Pine Valley.

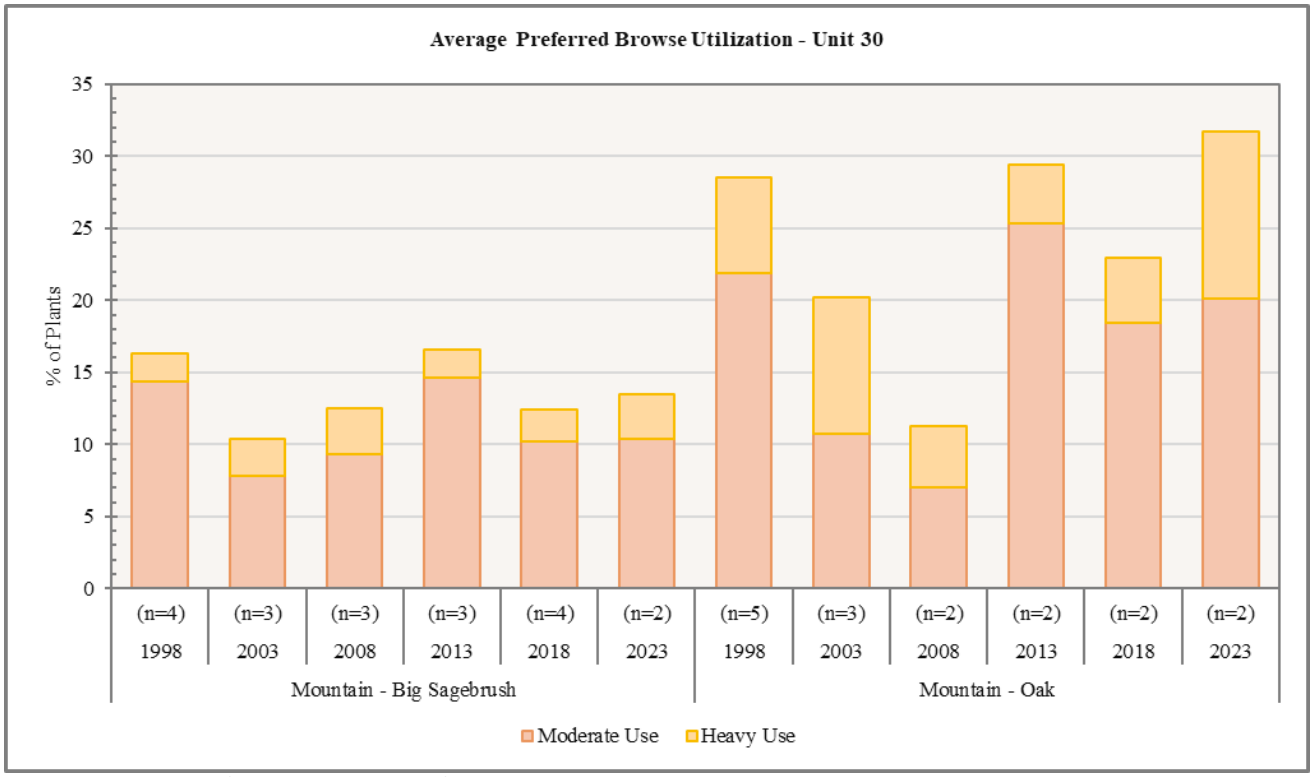


Figure 9.22: Average preferred browse utilization for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 30, Pine Valley.

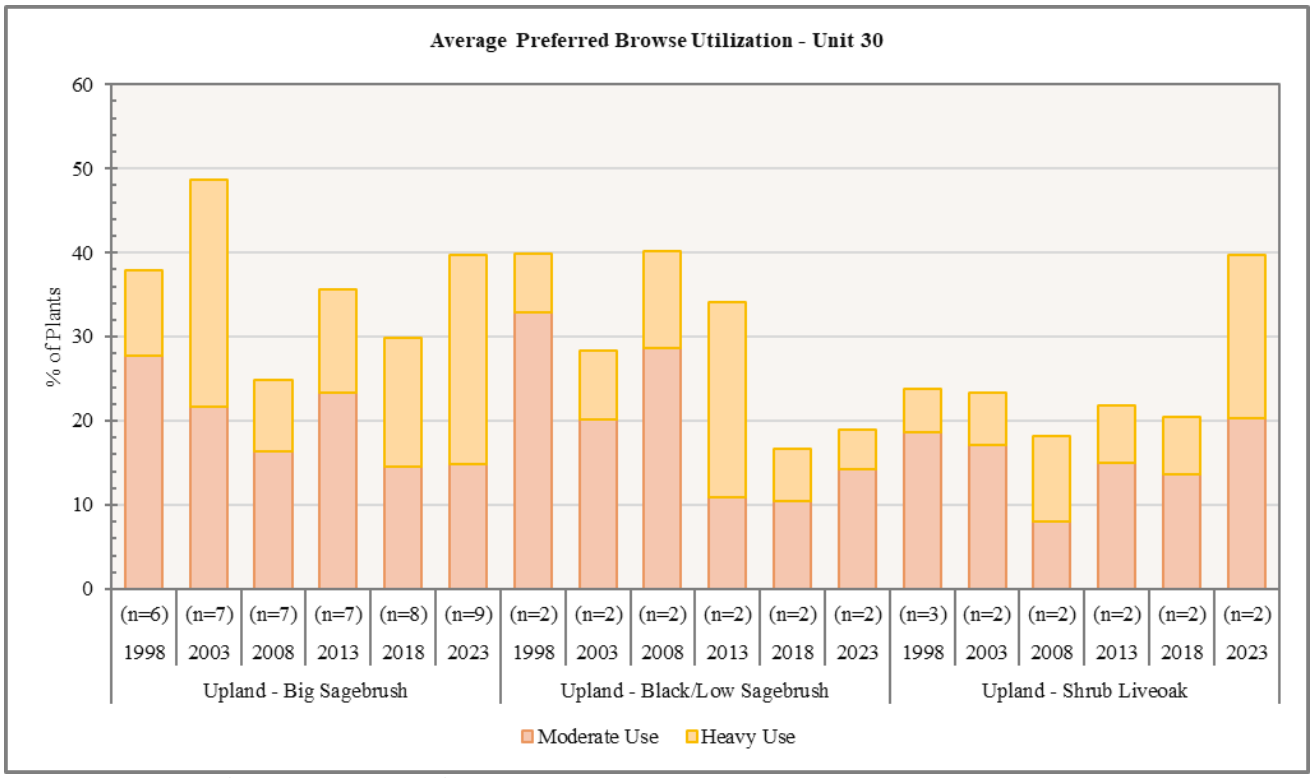


Figure 9.23: Average preferred browse utilization for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Shrub Liveoak study sites in WMU 30, Pine Valley.

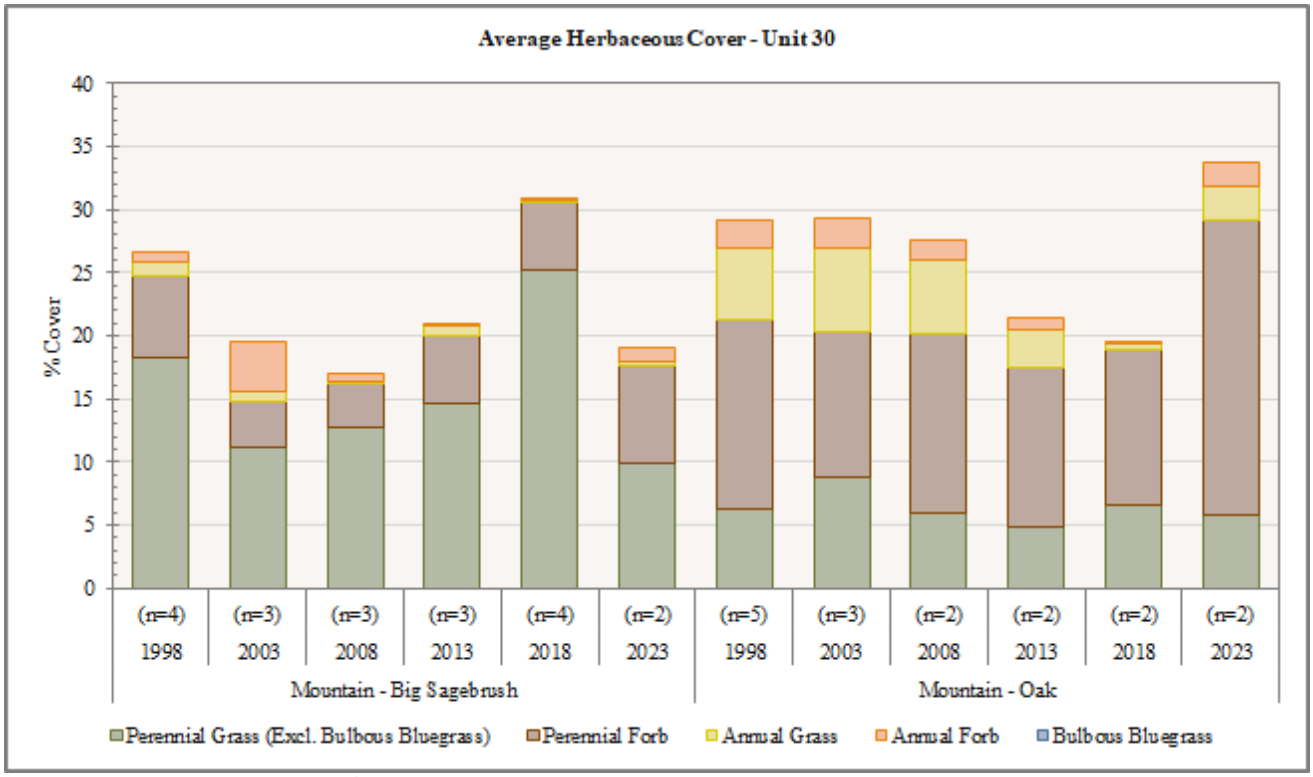


Figure 9.24: Average herbaceous cover for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 30, Pine Valley.

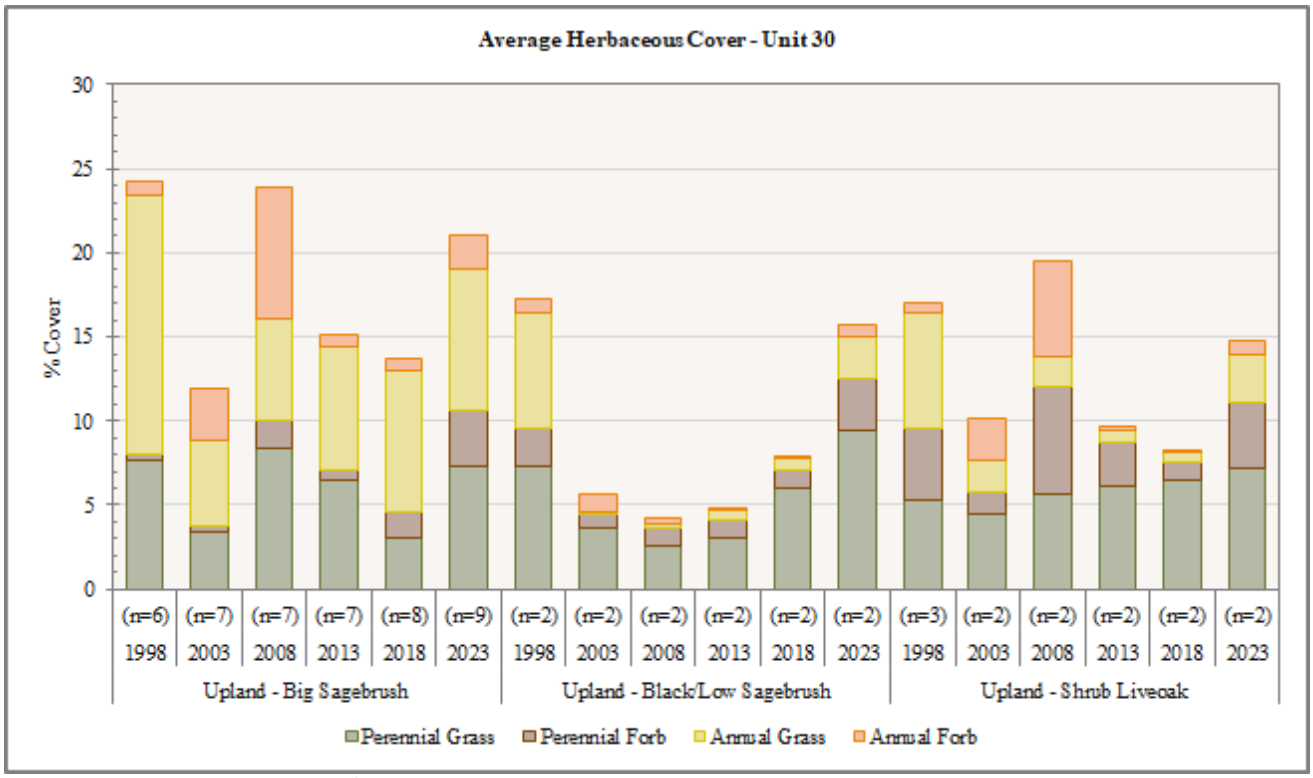


Figure 9.25: Average herbaceous cover for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Shrub Liveoak study sites in WMU 30, Pine Valley.

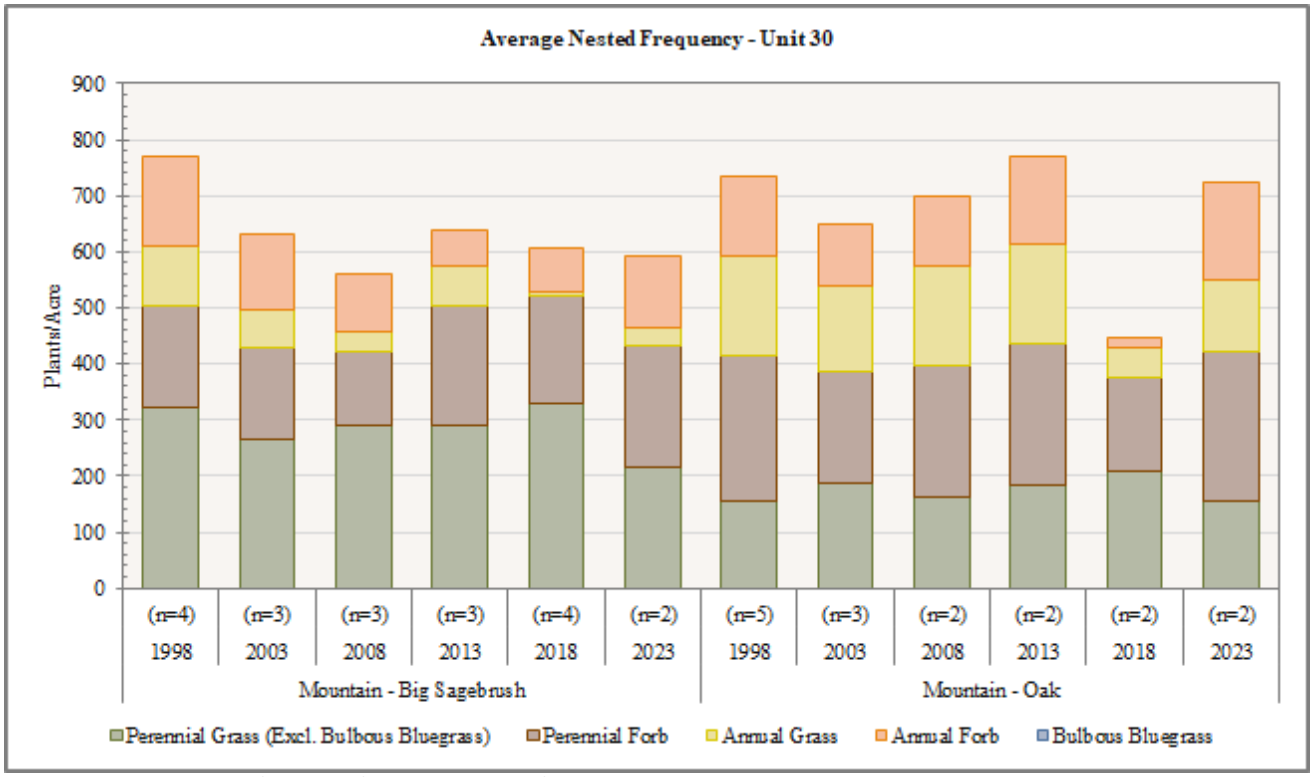


Figure 9.26: Average nested frequency of herbaceous species for Mountain - Big Sagebrush and Mountain - Oak study sites in WMU 30, Pine Valley.

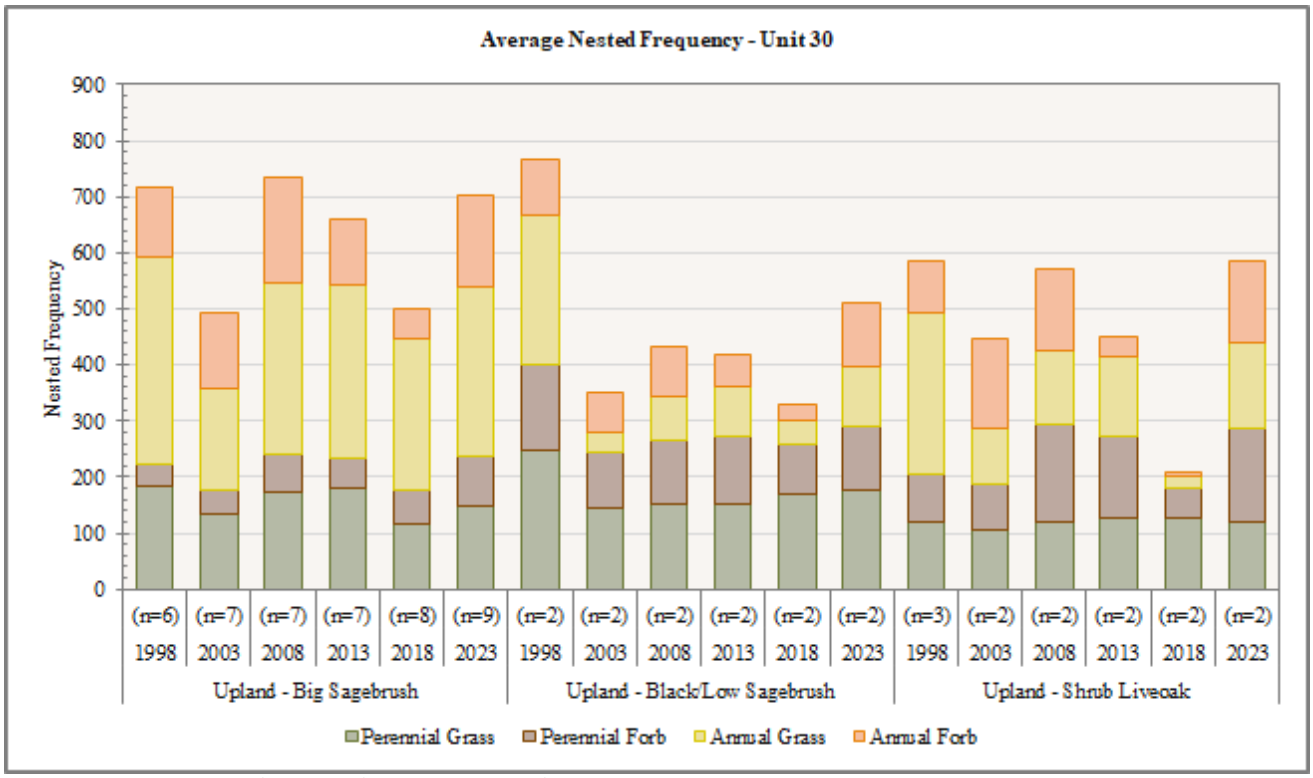


Figure 9.27: Average nested frequency of herbaceous species for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Shrub Liveoak study sites in WMU 30, Pine Valley.

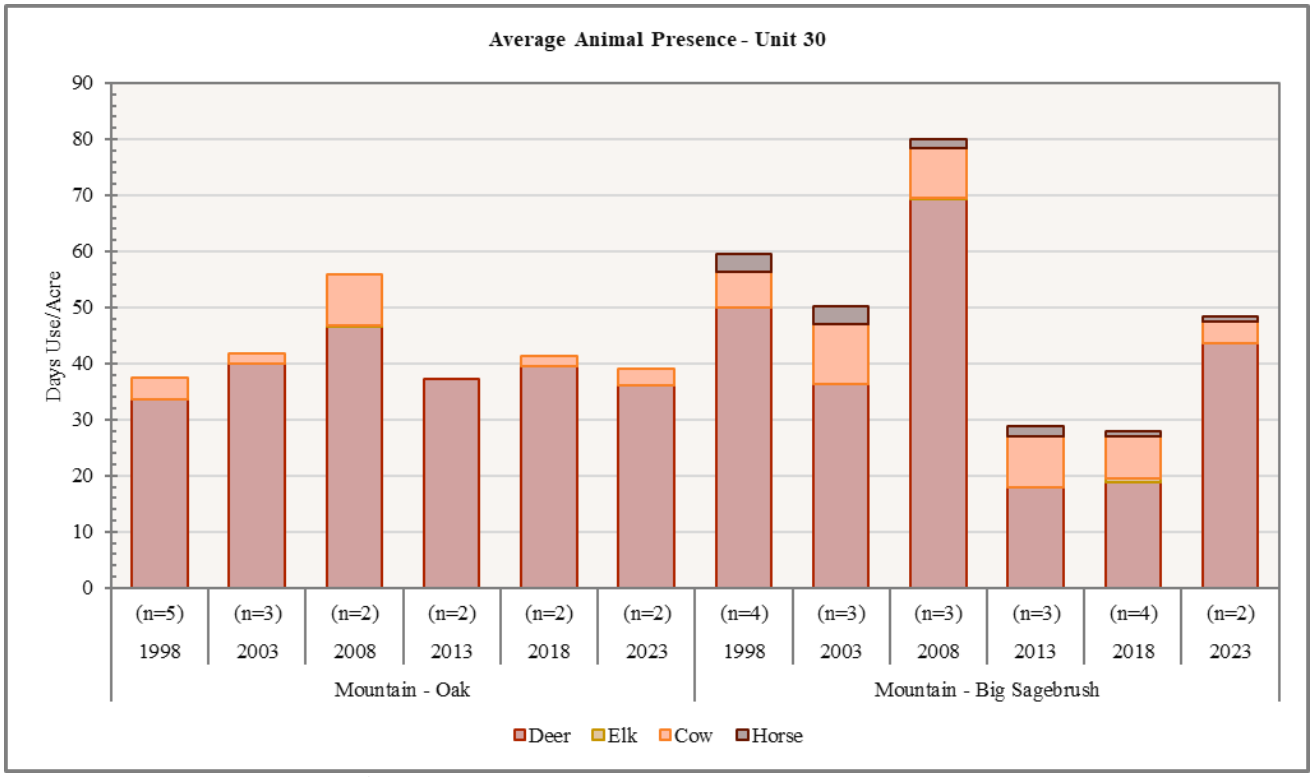


Figure 9.28: Average pellet transect data for Mountain - Oak and Mountain - Big Sagebrush study sites in WMU 30, Pine Valley.

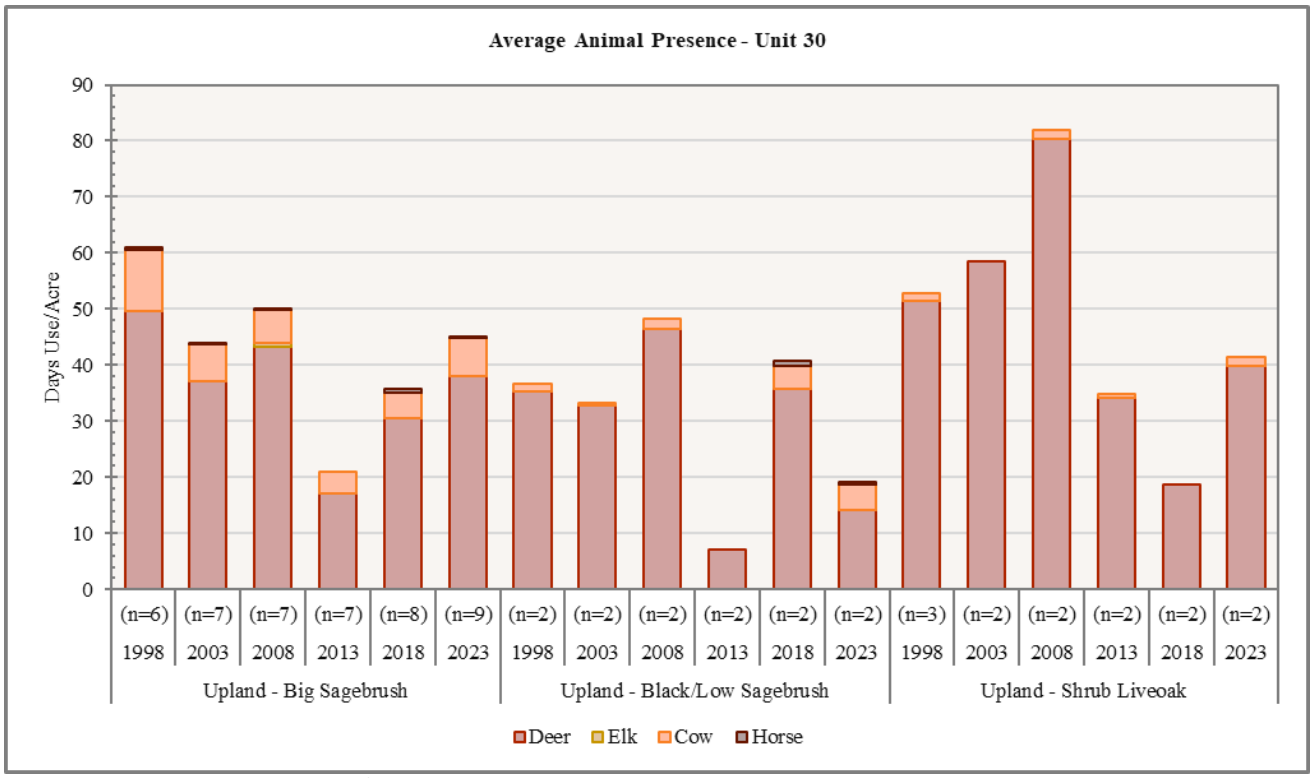


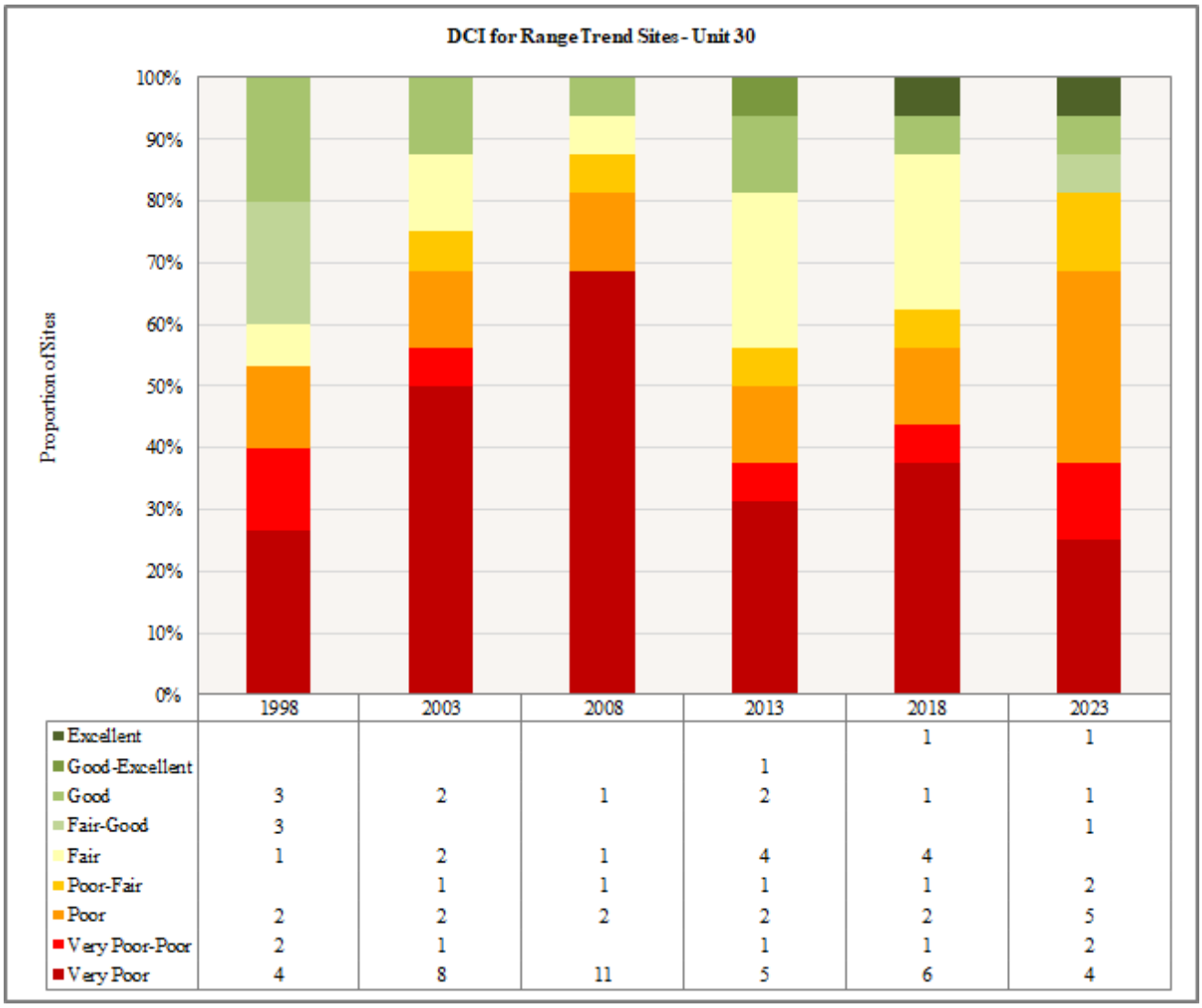
Figure 9.29: Average pellet transect data for Upland - Big Sagebrush, Upland - Black/Low Sagebrush, and Upland - Shrub Liveoak study sites in WMU 30, Pine Valley. *Upland - Big Sagebrush deer pellets include deer and sheep pellet groups.

Deer Winter Range Condition Assessment

On average, the condition of deer winter range within the Pine Valley management unit has had no net change since 1998; however, there has been some bimodal variation between 1998 through 2008 and 2013 through 2023. Overall winter habitat quality decreased from an averaged poor-fair condition in 1998 to an averaged very poor-poor condition in 2008. However, deer habitat quality improved in 2013 with averaged condition considered to be poor, and remains in a similar condition as of 2023.

Unit stability can be attributed to the Upper Broad Hollow (30-03), Black Ridge (30-13), Truman Bench (30-37) (suspended after three samplings), Spirit Creek South Burned (30-58), and Pahcoon Bench West (30-77) studies, which have been consistently considered to be between fair and good conditions. The majority of Range Trend sites on this unit lower the overall deer winter range quality of the unit and/or have higher variability in quality from year to year. Pintura Bench (30-12) (suspended), Southwest Newcastle (30-29), Wide Canyon (30-38) (suspended), Telegraph Draw (30-40), Grapevine Spring (30-42), Motoqua (30-44), Pahcoon Bench (30-46) (suspended), Northwest of Enterprise (30-52) (suspended), Bullion Canyon (30-54), Quichapa (30-55) (suspended), Woolsey Reseed (30-56) (suspended), Summit Spring (30-57) (suspended), Tobin Bench (30-61), North Hills (30-62), Holt Canyon (30-63), Wide Canyon 2 (30-73), Pinion Park (30-74), Swett Hills North (30-75), and Ash Creek (30-78) are all considered to be in poor condition. Reasons for these poor winter range 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. Grapevine Spring, Northwest of Enterprise, and Tobin Bench have had the highest degree of conditional change driven by wildfire and may make good candidates for additional habitat improvements. Low variability in conditional change may be indicative of community resistance and resilience to ecological state transitions and may suggest that sites could be resistant to improvement inputs, or it may mean that these communities have not had major disturbances in their sample histories. Sites that have had disturbances with low conditional variability may be resistant to habitat improvement inputs, and as such, caution and planning are likely necessary to avoid treatment failure.

The overall deer winter range assessment in 2023 for WMU was is that the unit remains in poor condition. Of the 16 sites sampled in 2023, just over 80% were evaluated to be between very poor to poor-fair wintering habitat condition. Pahcoon Bench West was considered to be in fair-good condition, Black Ridge was in good condition, and Upper Broad Hollow was considered to be in excellent winter condition (**Figure 9.30**, **Table 9.5**).



	1998	2003	2008	2013	2018	2023
Excellent					1	1
Good-Excellent				1		
Good	3	2	1	2	1	1
Fair-Good	3					1
Fair	1	2	1	4	4	
Poor-Fair		1	1	1	1	2
Poor	2	2	2	2	2	5
Very Poor-Poor	2	1		1	1	2
Very Poor	4	8	11	5	6	4

Figure 9.30: Deer winter range Desirable Components Index (DCI) summary by year of Range Trend sites for WMU 30, Pine Valley.

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
30-03	1998	30	11.1	7.2	29.4	-7.1	7.1	0	**77.7**	**G**
30-03	2003	30	11.4	9.1	17.7	-2	3.8	0	**69.9**	**G**
30-03	2008	30	8.9	7.1	22.1	-1.2	3.3	0	**70.2**	**G**
30-03	2013	30	13.1	9.2	24.6	-0.8	4	0	**80.2**	**G-E**
30-03	2018	30	12.9	11.7	26.1	-0.8	3.4	0	**83.3**	**E**
30-03	2023	30	12.4	6.5	28.7	-2.8	8.7	0	**83.5**	**E**
30-12	1998	14.3	12.8	7.9	0.1	-7.3	7.2	0	**35.1**	**VP-P**
30-13	1998	22.2	12.3	14.3	21.3	-1	7.6	0	**76.6**	**G**
30-13	2003	25.6	10.4	7.7	8.2	-0.2	2	0	**53.7**	**F**
30-13	2008	29.6	10.1	3.6	3.3	0	2.1	0	**48.6**	**P-F**
30-13	2013	30	10.7	11.7	5.2	-0.1	3.6	0	**61**	**F**
30-13	2018	30	13.1	7.3	8	0	3.7	0	**62.2**	**F**
30-13	2023	30	13.5	7.3	8.7	0	8.8	0	**68.3**	**G**
30-29	1998	14.4	5.1	1.1	18	-14.3	0.9	0	**25.2**	**VP**
30-29	2003	2	0	0	10.3	-0.1	0.3	0	**12.6**	**VP**
30-29	2008	9.1	-1.6	7.3	16.6	-4.1	0.7	0	**28**	**VP**
30-29	2013	13.6	10.7	7.1	8.3	-12.4	0.5	0	**27.7**	**VP**
30-29	2018	11.3	11.8	0.9	6.7	-13.2	0.1	0	**17.6**	**VP**
30-29	2023	9.5	5.5	1.9	12	-10.2	1.2	0	**19.9**	**VP**
30-37	1998	30	12.7	6.8	27.7	0	5.3	0	**82.5**	**G**
30-38*	1998	12.9	10.6	6.5	0.4	-17.2	0.2	0	**13.3**	**VP**
30-38*	2003	15.4	6.7	3	0.1	-9.7	0.4	0	**15.8**	**VP**
30-38*	2008	0.5	0	0	2.5	-6.5	10	0	**6.5**	**VP**
30-40	1998	24.4	13.8	12.6	4.6	-1.9	10	0	**63.6**	**F**
30-40	2003	30	9.9	10	1.1	-0.3	5.8	0	**56.5**	**P-F**
30-40	2008	30	3.9	5.9	2.7	-0.1	5.5	0	**48**	**P**
30-40	2013	30	10.9	6.9	2.1	-1.7	7.2	0	**55.3**	**P-F**
30-40	2018	30	6.7	2.5	1	0	4	0	**44.1**	**P**
30-40	2023	29.8	5.9	1.8	2.9	-0.6	9.7	0	**49.5**	**P**
30-42	1998	30	14.4	8.6	2.4	-1.1	10	0	**64.3**	**F-G**
30-42	2003	25.1	8.1	2	0.1	-0.8	1.6	0	**36**	**VP-P**
30-42	2008	3.1	0	0	0.3	-1.4	10	0	**12**	**VP**
30-42	2013	11.7	13.6	8.4	0.1	-0.2	6.4	0	**39.9**	**P**
30-42	2018	12.7	11.5	4.2	0	0	0.7	0	**29.1**	**VP**
30-42	2023	14.1	14.4	8.8	0.2	-1.6	6.8	0	**42.7**	**P**
30-44	2018	29.6	12.7	0.8	0	-3	0	0	**40.1**	**F**
30-44	2023	26	0.3	0	0.1	-20	1	0	**7.3**	**VP**
30-46*	1998	10.8	11.9	0.7	6.3	-20	0.2	0	**9.9**	**VP**
30-46*	2003	1.9	0	0	0.4	-11.8	2	0	**-7.6**	**VP**
30-46*	2008	2.7	0	0	0.8	-4.8	5.5	0	**4.2**	**VP**
30-46*	2013	4.1	0	0	5.3	-10.1	5.4	0	**4.7**	**VP**
30-52*	1998	12.1	1.3	4.4	29.5	-2.6	1.3	0	**46**	**F-G**
30-52*	2003	3.2	0	0	22.5	-0.1	1.8	0	**27.3**	**F**
30-52*	2008	2.6	0	0	16.7	-18.1	2.3	0	**3.4**	**VP**
30-52*	2013	8.4	15	15	17	-10.7	5.1	0	**49.8**	**G**
30-54	1998	25.6	9.4	6.3	7.8	-9.4	1.4	0	**41.1**	**P**
30-54	2003	10.1	-1.3	3.3	6.4	0	1.1	0	**19.6**	**VP**
30-54	2008	13.8	3.4	0.5	6.9	-0.4	2.1	0	**26.2**	**VP**
30-54	2013	13.9	6.9	1.8	7	-0.6	0.9	0	**29.8**	**VP**
30-54	2018	14.3	6	0.3	15.8	-1	0.9	0	**36.3**	**VP-P**
30-54	2023	7.4	0.3	1.8	29.1	-3.7	3.7	0	**38.5**	**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
30-55	1998	17.1	2.3	6.2	5.6	-5.3	0.8	0	**26.6**	**VP**
30-55	2003	15.8	2.6	9.3	2.4	-0.7	0.6	0	**30.1**	**VP**
30-55	2008	19	8.7	15	5.3	-1.8	0.9	0	**47.1**	**P**
30-55	2013	22.3	11.2	15	6.1	-0.7	1.8	0	**55.7**	**F**
30-55	2018	22.1	11.1	11.7	6.6	0	0.4	0	**51.8**	**P-F**
30-55	2023	22.3	11.3	7.5	9.3	-1.1	1.8	0	**51.1**	**P-F**
30-56*	1998	4	0	0	30	-0.6	1.7	0	**35.1**	**VP-P**
30-56*	2003	1.6	0	0	22.7	0	1.3	0	**25.6**	**VP**
30-56*	2008	1.9	0	0	30	-0.3	0.7	0	**32.4**	**VP**
30-56*	2013	3.7	0	0	30	0	0.8	0	**34.5**	**VP-P**
30-57*	1998	15.4	14.8	3.2	0	-16.4	0.1	0	**17.2**	**P**
30-57*	2003	16.7	8.2	0.3	0.5	-10.4	0.9	0	**16.2**	**P**
30-57*	2008	3.2	0	0	0.2	-1.4	1	0	**3**	**VP**
30-57*	2013	8.4	15	15	2.6	-7.2	2.6	0	**36.4**	**F**
30-58	1998	5.7	12.2	14.5	30	-1.7	10	0	**70.7**	**F-G**
30-58	2003	6.8	10.7	14.3	30	-1.3	8.3	0	**68.7**	**F-G**
30-58	2008	12.1	10.8	5.7	30	-0.2	6.3	0	**64.7**	**F**
30-58	2013	17.7	12.4	15	30	-0.2	10	0	**84.9**	**G**
30-58	2018	19.6	12.8	15	30	0	0.6	0	**78**	**G**
30-61	2003	14.4	0.4	1.5	0.1	0	6.5	0	**22.9**	**P**
30-61	2008	2	0	0	0.1	0	1.6	0	**3.7**	**VP**
30-61	2013	11.9	15	0	0.5	0	0	0	**27.4**	**F**
30-61	2018	14.6	15	0	3.5	-1.1	1.4	0	**33.3**	**F**
30-61	2023	12.3	15	0	4.9	-14.5	6.6	0	**24.3**	**P-F**
30-62	2003	21.5	1.3	1	4	-3.5	0.6	0	**24.9**	**VP**
30-62	2008	23.7	2.7	0	12	-9.3	0.3	0	**29.4**	**VP**
30-62	2013	23.8	5.4	0.4	4.6	-3.2	0.2	0	**31.2**	**VP**
30-62	2018	29.5	8.8	0	6.2	-2.8	0	0	**41.8**	**P**
30-62	2023	0	0	0	30	-1.3	10	0	**38.7**	**P**
30-63	2003	23.1	-1.2	1.6	6.9	-0.8	0.6	0	**30.2**	**VP**
30-63	2008	23.1	-2.9	0	3	-5	1.1	0	**19.4**	**VP**
30-63	2013	28.5	10	1.8	5.8	-4.4	0.3	0	**42**	**P**
30-63	2018	30	6.3	4.2	6.9	-15.4	0.9	0	**32.9**	**VP**
30-63	2023	28.8	6.7	1.2	11.2	-11.8	0.8	0	**36.8**	**VP-P**
30-73	2013	9.5	9.6	8	1.4	-7.5	0.8	0	**21.8**	**VP**
30-73	2018	9.3	8.8	2.5	2.7	-11.3	0.7	0	**12.5**	**VP**
30-73	2023	12.6	7.5	0.5	6.8	-1.8	7.7	0	**33.3**	**VP-P**
30-74	2018	15.9	3.5	2.1	0.7	-0.4	8.8	0	**30.6**	**VP**
30-74	2023	14.9	4.8	0.3	4.8	-3.1	7.6	0	**29.2**	**VP**
30-75	2018	3.6	0	0	16.7	-4.1	2.4	0	**18.7**	**VP**
30-75	2023	5.2	0	0	30	-8.3	1	-2	**25.9**	**VP**
30-77	2018	22.5	15	8.2	2.9	-3.6	10	0	**55**	**F**
30-77	2023	30	13.7	13.7	4	-7.7	10	0	**63.6**	**F-G**
30-78	2023	30	9.4	0.9	17.5	-12	1.1	0	**46.9**	**P**

Table 9.5: Deer winter range Desirable Components Index (DCI) information by site number of Range Trend studies for WMU 30, Pine Valley. 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
30-03	Upper Broad Hollow	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
30-05	Harmony Mountain Summit	Animal Use – Deer	Medium	Reduced/less vigorous browse component
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30-13	Black Ridge	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
30-26	Grassy Flat Ridge	Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30-29	Southwest of Newcastle	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
30-35	Deep Canyon	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30-40	Telegraph Draw	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
30-41	Joe Spring	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30-42	Grapevine Spring	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
30-44	Motoqua	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
30-45	Flat Top Mountain	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
30-54	Bullion Canyon	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
30-55	Quichapa Canyon	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
30-58	Spirit Creek South Burned	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
30-61	Tobin Bench	Introduced Perennial Grass	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
30-62	North Hills	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
30-63	Holt Canyon	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30-73	Wide Canyon 2	PJ Encroachment	Medium	Reduced understory shrub and herbaceous vigor
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
30-74	Pinion Park	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
30-75	Swett Hills 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	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30-77	Pahcoon Bench West	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
30-78	Ash Creek	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
30R-01	Newcastle Bullhog	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
30R-02	Square Fire Rehab	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30R-04	North New Castle	Animal Use – Cattle	High	Reduced diversity of desirable grass and forb species
		Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30R-05	Duncan Creek/Hwy 56	Annual Grass	Low	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
30R-06	Tabeau Peak	Annual Grass	High	Increased fire potential and reduced herbaceous diversity
		Drought	-	Lowered resilience and resistance to disturbance
30R-07	Middletown Wash	Annual Grass	Low	Increased fire potential and reduced herbaceous diversity
		Energy Development	Low	Fragmentation and degradation/loss of habitat
30R-08	Swett Hills Point	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor

Study #	Study Name	Limiting Factor and/or Threat	Level of Threat	Potential Impact
30R-09	Duncan Canyon	Annual Grass	Medium	Increased fire potential and reduced herbaceous diversity
		Introduced Perennial Grass	Medium	Reduced diversity of desirable grass and forb species
		Noxious Weeds	Low	Reduced diversity of desirable grass and forb species
		PJ Encroachment	Low	Reduced understory shrub and herbaceous vigor
30R-10	Wide Hollow	PJ Encroachment	High	Reduced understory shrub and herbaceous vigor
		Drought	-	Lowered resilience and resistance to disturbance

Table 9.6: Assessment of the potential limiting factors and/or threats and level of threat to study sites for WMU 30, Pine Valley. All assessments are based off the most current sample date for each study site. Criteria for evaluating limiting factors is available in **Appendix A – Threat Assessment**.

Discussion and Recommendations

Averaged unit-wide conditions of deer winter range within the Pine Valley management unit are considered poor as of 2023. Upper Broad Hollow, Black Ridge, and Pahcoon Bench West ranged from fair-good to excellent for deer winter range during the 2023 sample year: all of these sites had some age class diversity in and significant cover provided by the preferred browse communities. However, condition of the other 13 sites read in 2023 ranged from very poor to poor-fair. The drivers of poor conditions on these other sites vary between a lack of preferred browse cover, little recruitment of young preferred browse individuals, a lack of perennial forbs, and/or high amounts of annual grasses (**Figure 9.30**, **Table 9.5**).

Of positive note within the Pine Valley management unit is that many of the Range Trend sites (Southwest of Newcastle, Telegraph Draw, Bullion Canyon, Quichapa Canyon, Holt Canyon, Pinion Park, and Swett Hills North) in the northern portion of the unit have browse components that have persisted over time. These sites are located on winter range and have not had irreversible plant community transitions occur due to a major disturbance. Additional positive aspects include the improvements in habitat quality (browse diversification, augmentation of the herbaceous understory, pinyon-juniper reduction, etc.) that have been observed following treatment on many Range Trend studies. Habitat treatment projects have also been and continue to be implemented in areas not monitored by the Range Trend program. As of February 2024, an estimated 62,441 acres have been treated in the Pine Valley management unit through the Watershed Restoration Initiative (WRI) (**Table 9.2**, **Map 9.6**). The geographic diversity of this unit is also noteworthy. Portions of the Great Basin, Mojave Desert, and Colorado Plateau physiographic regions are all located within this unit's borders; each of these regions hosts a variety of vegetation communities of varying usefulness for wildlife. Collar data confirms that deer herds use a wide variety of habitat types in this management unit over the course of a year. Finally, numerous fires have occurred in this unit, some of which have been in higher elevations such as in the Pine Valley Mountains (**Map 9.5**). In some circumstances, fire can play a key process in the structure and function of big game habitat (Pastro, Dickman, & Letnic, 2011). Habitat change fueled by fire can rely on multiple variables, and a single fire can have both negative and positive impacts depending on localized factors. However, fires may have the potential to be more beneficial in higher-elevation summer habitat than on lower-elevation landscapes (Chambers, et al., 2013). Current Range Trend studies do not monitor most of the summer range that was burned in these higher elevations, but there still may be the possibility of fire-driven regeneration and improvement in these areas.

Response to fire in the lower elevations of WMU 30 can be dynamic. In the 17 years following the Bull Complex fire, the chapparal community on Grapevine Spring has continued to reestablish and infilling of pinyon (*Pinus spp.*) and juniper (*Juniperus spp.*) has not occurred. However, many other lower-elevation areas in this unit have been negatively affected by fire; numerous sagebrush (*Artemisia spp.*) communities around Dammeron Valley were removed by wildfires in the mid-2000s, while the browse component was reduced and annual grass loads amplified on Pahcoon Bench following burns in 1998 and 2003. Desert bitterbrush (*Purshia glandulosa*) has returned on Tobin Bench after the 2006 Bull Complex fire (**Table 9.4**), but large amounts of annual forbs and/or annual grasses have been observed during subsequent samplings. Preferred browse species such as desert almond (*Prunus fasciculata*) and blackbrush (*Coleogyne ramosissima*) are present on the Square Fire Rehab study as of 2022, but reestablishment has been slow and the site has remained dominated by threadleaf snakeweed (*Gutierrezia microcephala*) in recent sample years (Cox, Lane, & Payne, 2023). In addition to effects that have already precipitated following fire, the potential for harmful outcomes after a hypothetical burn exists in many of the extant blackbrush, creosote, and interior chapparal communities that are common in the southern portion of the Pine Valley unit. Fires in these areas can and do remove browse components that may take significant time to reestablish, create opportunities for introduced annual grasses to proliferate, lead to shortened fire return intervals, and create a cycle of

further annual grass proliferation and subsequent fires (Brooks, Esque, & Duck, 2007; Bradley, 2018). For example, the Motoqua study hosts a robust stand of blackbrush and other desert browse species. However, the introduced annual grass species red brome (*Bromus rubens*) and cheatgrass (*B. tectorum*) contributed nearly 36% cover and filled the interspaces on this site in 2023 (Cox, Lane, & Payne, 2023). These grasses would likely serve as a fine fuel source in the case of a fire and could potentially carry the burn. Blackbrush communities in particular are considered very flammable and are known to be slow to reestablish, especially after entire stand-removing fires (Brooks, Esque, & Duck, 2007).

Increased human presence may pose an additional threat to wildlife and wildlife habitat in the Pine Valley management unit. A number of communities are on the perimeter of or directly overlap mule deer habitats of varying seasonality, including Dammeron Valley, Veyo, Central, Pine Valley, Enterprise, Newcastle, and New Harmony. Urban development in these communities is likely not occurring to the extent of that in larger municipalities such as Cedar City, St. George, and their respective metropolitan areas; human expansion is by nature dynamic in location, extent, and timeframe. However, satellite imagery shows localized construction occurring over time in some of these areas. Although the impacts may not be as immediate or apparent as they would be with more extensive and accelerated development, expansion of human presence through new construction of buildings and roads can have unintended consequences for wildlife habitat. Satellite imagery also shows the presence of solar farms between Enterprise and Newcastle and northwest of Cedar City. These specific installations do not directly overlap defined mule deer winter habitat, but are adjacent to the peripheral edges of currently specified winter range (**Map 9.2**) and could impede wildlife movement. Furthermore, future solar energy development remains possible; according to the Bureau of Land Management (2024), interest in developing solar projects on publicly managed lands throughout the west is ongoing. Much like urban development, renewable energy development can potentially have negative effects including (but not limited to) a loss of preferred browse and herbaceous forage for wildlife, habitat fragmentation, and degradation of habitat through introduction of non-native species.

Recreation in general benefits members of the public and provides opportunities for economic growth. If not properly managed, however, recreation may become unsustainable for wildlife. As such, the potential for and occurrence of increased human presence through recreation and the effects on wildlife and wildlife habitat are concerns within this unit. The cities of St. George and Cedar City straddle the borders of the Pine Valley unit: the population of the former increased by 7.5% between April 2020 and July of 2022, while that of the latter increased by nearly 10% over the same period (United States Census Bureau, 2023). Construction in and around these cities largely does not directly affect designated mule deer habitat. However, population growth may still have an indirect effect on wildlife; people find opportunities for and participate in recreational activities in and around the areas where they live and work. As such, it is reasonable to hypothesize that population growth may lead to increased human presence in the surrounding area.

Outdoor recreation is not limited to residents of local communities, however. Although some communities experience more use than others do, a number of areas within this management unit are popular destinations for both residents and visitors alike. Two state parks – Gunlock State Park and Snow Canyon State Park – are located within the boundaries of the Pine Valley unit. Deer winter range can be found within one mile of Gunlock, and the northern portion of Snow Canyon State Park overlaps crucial winter habitat. Snow Canyon in particular is host to numerous hiking and biking trails, and visitors to the park have increased significantly in recent years. Between fiscal year 2014 (FY 2014) and FY 2018, there were over 277,000 average yearly visitors to Snow Canyon State Park. Between FY 2019 and FY 2023, this average grew to nearly 713,000; over 950,000 visitors were recorded during FY 2023 alone (Utah State Parks, 2024). In addition to those located in Snow Canyon, a variety of trails for a wide range of activities can be found throughout the unit. A notable number of mountain biking trails are scattered throughout Red Cliffs National Conservation Area and in Three Peaks Recreation Area northwest of Cedar City: many of these are located in or pass through deer habitats of varying seasonality. The unit is also home to a large amount of hiking trails, including some located in wilderness areas. The level of use these trails receive is unknown to the authors of this report. However, outdoor recreation in general continues to grow statewide; as human presence in wildlife habitat increases, so do the chances of human-wildlife interactions. Single negative incidents may not greatly affect local wildlife populations, but continued interactions may have greater impacts that could be exacerbated by other simultaneous stressors (Utah Division of Wildlife Resources, 2015).

In addition, off-highway vehicle (OHV) use remains a popular form of recreation throughout the state of Utah: there were over 200,000 in-state OHV registrations and over 23,000 out-of-state permits were issued between January and

August of 2023 (Utah Division of Outdoor Recreation, 2023). OHV routes traverse vast areas of the Pine Valley management unit, with hundreds of miles of trails in Washington County alone (Utah Division of Outdoor Recreation, 2016). Education on proper OHV use required by state law and guidelines issued by federal land management agencies likely help mitigate some of the negative outcomes that might otherwise result from OHV recreation. However, deleterious effects on wildlife and wildlife habitat are always a possibility. Threat levels vary between and do not affect all locations equally, but auditory disturbances to wildlife, physical damage to habitat, and the introduction of non-native plant species can all result from improperly managed OHV recreation.

Utah Roadkill Reports data indicates that highway mortality may pose an additional threat to wildlife (particularly mule deer) in portions of this unit. Roadkill pick-up reports between 2018 and 2024 appear to be concentrated along SR-18 from Enterprise to Diamond Valley; on SR-56 between Newcastle and Quichapa Lake; along various portions of I-15; and on the roads in or with close proximity to New Harmony and western Cedar City. However, one should keep in mind that collisions occurring at high enough speeds to result in animal mortality and those leading to reports are likely more common on main roads that receive the most use. There is a relative lack of reports on other roads (Utah Division of Wildlife Resources, 2024), but Newcastle Bench is also known to be an area with many deer-vehicle collisions. However, there is existing awareness of highway mortality in this unit. The issue has been and continues to be addressed as needed; deer crossing signs have been installed in many of the areas mentioned, deer fencing has been put in place along certain stretches of I-15, and wildlife mortality continues to be monitored (Utah Division of Wildlife Resources, 2024).

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 9.6**).

A number of recommendations in this unit should be considered for the benefit of both wildlife and habitat. A considerable portion of this unit has already been treated for pinyon-juniper encroachment (**Table 9.2**), and treatments have generally been effective. 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. Habitat improvement projects in general should continue to occur where and when they are deemed necessary. However, care should be taken in areas prone to annual grass invasion to select restoration methods that will not unintentionally amplify fuel loads. Treatments such as herbicide application and changes in grazing management may be appropriate in places where annual grass flushes occur in the future. Additional considerations for addressing anthropologically driven threats may also be appropriate. In heavily visited areas where it is not already present, strategically placed signage on proper wildlife etiquette and responsible recreation may prove beneficial. In addition and when possible, support should be given for policies that result in responsible urban and energy development. Finally, continued monitoring of Range Trend studies and areas where rehabilitation projects have occurred will prove valuable. Data collected in the future will indicate whether the severity of current limiting factors is increasing, and may provide guidance on what actions are needed to mitigate these identified potential threats to habitat and wildlife.

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APPENDIX A – THREAT ASSESSMENT

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.

Annual Grass:

Species: *Bromus tectorum, B. rubens, Taeniatherum caput-medusae, Eremopyrum triticeum*
Low: If present, automatically a threat. Present in any sample year and/or cover 0-3% in the most recent sample year.
Medium: 3-7% cover in most recent sample year.
High: >7% cover in the most recent sample year.

Potential impact*:* Increased fire potential and reduced herbaceous diversity.

Conifer Encroachment (Aspen):

Species: All conifer species
Low: Conifer present or near site. Present -<1%.
Medium: Conifer >1% but not codominant.
High: Conifers codominant.

Potential Impact: Reduced understory shrub, aspen stand, and herbaceous vigor.

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 have been 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 (does not have to include the most recent or consecutive years if holdover effects are observed).*

*Select sites may be classified as being limited by drought even when the stated thresholds are not met. These thresholds give general guidance to aid in the identification of drought, but are not all-inclusive and do not exclusively delineate drought conditions.

Potential Impact: Lowered resilience and resistance to disturbance.

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.

Introduced Perennial Grasses:

Species: *Thinopyrum intermedium, Bromus inermis, Agropyron cristatum, Poa pratensis, Psathyrostachys juncea, Poa bulbosa*

Low: 1% of actual cover has to be contributed by a single species AND ratio to total perennial grass cover has to be up to 20%.
Medium: 20-50% of total perennial grass cover is contributed by introduced species.
High: >50% of total perennial grass cover is contributed by introduced species.

Potential Impact: Reduced diversity of desirable grass and forb species.

Noxious Weeds:

Low: If present, automatically a threat. Present in any sample year and/or cover 0-3% in the most recent sample year.
Medium: 1-5% cover in the most recent sample year.
High: >5% cover in the most recent sample year.

Potential Impact: Reduced diversity of desirable grass and forb species.

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.

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.