Badger Fire Vegetation Recovery Report 2022-Year Two Post Fire Conditions

Figure 1 OV-UB-2S North photos from 2016

Figure 2 OV-UB-2S North photos from 2021

Figure 3 OV-UB-2S North photos from 2022

Badger Post Fire Vegetation Monitoring

Cassia Division, Minidoka Ranger District - Sawtooth National Forest

Written and prepared by:

Jacob Gardner, Wildlife Technician, Sawtooth National Forest, Minidoka Ranger District

Scott Soletti, District Wildlife Biologist, Sawtooth National Forest, Minidoka Ranger District

Introduction

The Badger Fire burned in the Minidoka Ranger District of the Sawtooth National Forest in 2020. The fire began September 12th, 2020 and was not declared "out" until January 4th, 2021. This fire burned a total of 90,190 acres on land owned by the Forest Service, Bureau of Land Management, and private entities in Cassia and Twin Falls Counties. The burned area is located in the South Hills, south of Twin Falls, Idaho. Elevations range from approximately 4200 feet along lower Rock Creek to 8060 feet on Monument Peak. Precipitation in the fire area ranges from approximately 13-14 inches annually along lower Rock Creek to approximately 30 inches annually on Monument Peak (USGS Streamstats, n.d.).

The burned area consists of steep canyons, rolling uplands, ridgelines and benches with various vegetation communities. These include mid to late seral mountian big (*Artemisia tridentata* var. *vaseyana),* big basin (*Artemisia tridentata* var. *tridentata),* and low sagebrush (*Artemisia arbuscula)* communities with deep rooted bunch grass species such as Great Basin wildrye (*Leymus cinereus*), bluebunch wheatgrass *(Pseudoroegneria spicata),* Thurber needlegrass *(Achnatherum thurberianum),* needle-and-thread grass *(Hesperostipa comata),* Idaho fescue *(Festuca idahoensis),* and Sandberg bluegrass *(Poa secunda).* Aspen (*Populus tremuloides*) stands below ridgelines and in side canyons, slopes and benches of Utah juniper (*Juniperus osteosperma),* and pockets of lodgepole pine (*Pinus contorta*) and subalpine fir (*Abies lasiocarpa*) stands (Stewart, 2020).

The sagebrush in the moderate to high intensity burned areas was readily killed when above ground plant parts were charred by the fire. Typically, when sagebrush foliage is exposed to temperatures above 195 degrees Fahrenheit (90^{o}C) for longer than 30 seconds, the plant dies. In some areas, scattered unburned sagebrush survived, particularly where rocky and sparsely vegetated areas limited the fire's spread. Sagebrush does not sprout after fire but recolonizes a site primarily by off-site seed or seed from plants that survive in unburned patches. Depending on climatic conditions and land management actions, mountain big sagebrush requires at least 15 years to recover after fire, basin big sagebrush requires at least 10 years and Wyoming big

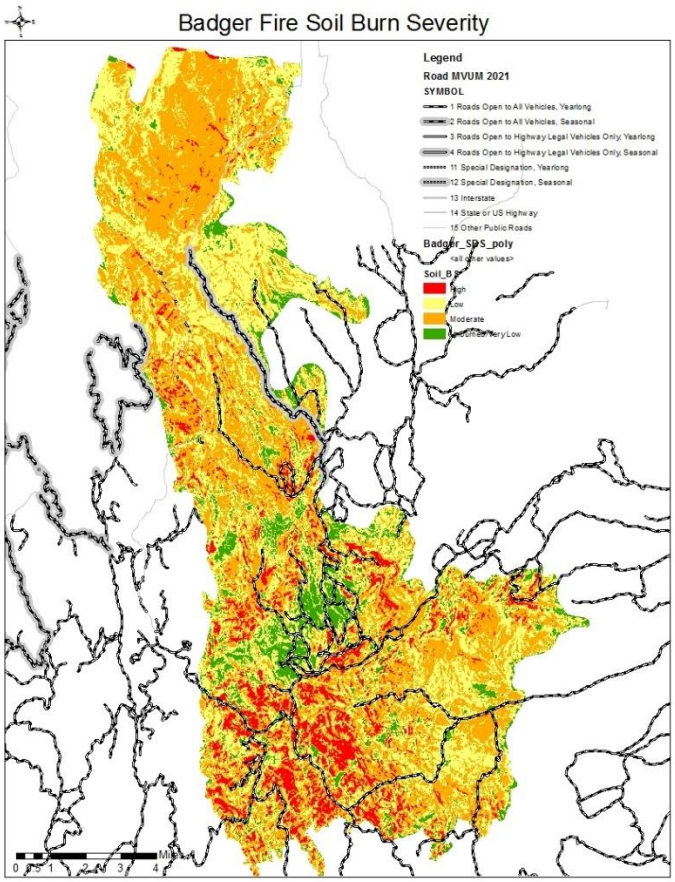

Figure 4: Fire Soil Burn Severity map of the Badger Fire, Courtesy USFS 2020

sagebrush is characterized at a 10- to 70-year recovery time frame. Seed of most subspecies of big sagebrush can withstand low fire intensity and persists in a seed bank however sagebrush seed is only viable for approximately two years. Unlike many of the other subspecies, viability of basin big sagebrush seed appears to be reduced by exposure to heat.

Some bunchgrasses foliage burns quickly, with little heat transferred down into the root crown. As a result, basal buds located at or just below the ground surface are not subjected to prolonged heating and may survive and sprout. Great Basin wildrye's coarse foliage resists prolonged burning, allowing plants to avoid exposure of their basal growing points to sustained heating.

Plants sprout from surviving root crowns and rhizomes. In the areas of low and moderate intensity the root crowns and rhizomes were viable. Literature reviews of bunch grass recovery indicate it takes bluebunch wheatgrass one to three years; Idaho fescue two or more years; and needle grasses three or more years, all depending on soil moisture and intensity of the fire (Stewart, 2020).

The aspen found throughout the burn area appear to have burned at all levels of fire intensity. In low intensity fire areas the aspen had scorched leaves or was top killed, in moderate to high intensity areas the aspen was top killed, but some large trees only scorched. Aspen is a rhizomotous species that generally sprouts vigorously from the roots and establishes from off-site, wind-blown seed after fire. The stands will likely benefit from fire and rebound quickly. In some areas the aspen is already resprouting. See Figure 5 below for monitoring results of aspen.

The juniper in moderate and high intensity burn areas were killed by fire, especially when trees are small. Juniper within the Badger Fire was primarily located in the Trapper Creek drainage. Fire pushed down the Trapper Creek drainage on September 14, 2020 (see Figure 117) and was primarily wind driven, which produced a running crown fire through juniper stands and resulted in near complete mortality of juniper and moderate to high severity fire effects. Some areas that burned were treated in 2020 as a lop and scatter treatment. These treatments were effective at dropping the fire from a crown fire to a ground fire; however, due to the lack of firefighting resources, no personnel were in the area to utilize previously cut areas as control features.

Nonetheless, in Trapper Creek overall fire spread was limited to the east when winds declined and fire could not become reestablished as a crown fire.

Post-fire treatment activities in Trapper Creek included aproximately 1,300 acres of seeding in high severity burned juniper stands to reduce the likelihood these sites would transition to an annual grassland. The USFS also masticiated approximately 1000 acres of burned juniper skeletons (within the seeding area) to reduce the amount of bare cover, work seed into the soil to improve germination rates and in the long term, provide areas of functional sage-grouse habitat.

Riparian communities in the burn area are dominated by various species of willow such as Booths willow (*Salix boothii),* wolf willow *(S, exigua),* yellow willow (S. lutea), whiplash willow *(S. lucida*), Woods rose (*Rosa woodsii),* cottonwood (*Populus trichocarpa*), water birch (*Betula occidentalis*), and red osier dogwood (*Cornus stolonifera*).The woody species in riparian areas that burned at low to moderate intensity will sprout from stumps, charred boles, root crowns, or lateral roots post fire. The Rock Creek corridor saw moderate to high burn severity in some places as wind funneled fire through the canyon. Vegetation recovery in the Rock Creek drainage was delayed the first year due to high severity fire effects and drought conditions, and could be slow to recovery in the future. Issues of concern primarily include public health and safety associated with soil erosion, falling rocks and landslides. The risk of noxious weed invasion will be present in Rock Creek canyon for many years and management focus will need to occur in Rock Creek canyon through time.

Monitoring Protocol

Habitat Assessment Framework Site Selection

The monitoring site selection method was conducted using a randomly generated stratified grid pattern within mapped sage-steppe vegetation communities. Once the parameters were deployed, the program randomly generated a set number of points as potential monitoring locations across livestock grazing pastures within the Minidoka Ranger District (Stiver et al., 2015). Sites were assigned a random number and were visited in numerical order to maintain statistical validity; a site rejection criterion was applied to a site and if no site rejection criteria were met, the site was sampled. This was applied to all sites that were established in 2016 as part of a district-wide effort to collect data on the condition of sage-grouse habitats. In 2021, we reread a portion of these sites that burned in the 2020 Badger Fire using the same protocol. This will provide a direct comparison of pre and post fire conditions with only a short time gap between pre fire and post fire. Due to the poor vegetation recovery that has been observed in year one, the Minidoka Ranger District modified sampling the first season and did the full protocol on a minimum of one site per livestock grazing pasture for the first year to help inform a baseline and provide a relative trajectory on recovery for subsequent years but did not sample every plot within the burn perimeter. On all the other monitoring sites within the burn, repeat photo plots monitoring was completed in year one. In year two, the full protocol will be applied to all pre-established monitoring sites to assess vegetation response and recovery.

Habitat Assessment Framework Methodology

The Sage-Grouse Habitat Assessment Framework (HAF) (Stiver et al., 2015) protocol was used to collect data for pre and post burn data to analyze vegetation response post fire. The HAF

protocol is a line point intercept protocol measuring composition, diversity, density and canopy cover of sagebrush, grasses and forbs. Transects were run north off a compass bearing and measured fifty meters in distance. A pin drop was conducted every half meter totaling 100 data points per site. At those pin drops, species and height were recorded of whatever living plant matter was contacted, as well as the ground cover type. Forb sweeps were conducted every two meters by recording all forbs in a one-meter half circle from the transect line. (Stiver et al., 2015). The Minidoka Ranger District also required a Sage Grouse Habitat Characterization survey at each site, in which one takes photos of the plot from each cardinal direction and on the ground, answers questions about land uses such as motor vehicle routes, campsites, water developments, and fences, disturbances such as fire, seeding, flooding, saw work, etc., dominant shrubs, dominant grasses, all other species encountered, noxious weeds and non-native grasses, snow and grazing impacts, wildlife uses, vegetation trends, soil trends, and has a component for adding other site notes.

Forested Vegetation Post-Badger Monitoring

Forested vegetation is slower to respond post fire than shrub communities so monitoring efforts the first year were largely qualitative in nature. Quantitative monitoring on forest regeneration post fire will start in earnest two years post fire with a focus on lodgepole pine regeneration. The USFS did monitor aspen in 2021 and resampled points in 2022 to assess recovery of aspen, which is an important species in the South Hills as well as a species on which management actions are often based. Monitoring included aspen stem counts and photo plots to assess post fire recovery.

Aspen Monitoring and Assessments

Aspen is a species that thrives on disturbances; it is a stoloniferous species that generally sprouts vigorously from the roots post fire and can establish from off-site, wind-blown seed after fire. Aspen stem counts consist of running a transect tape 1/100th of an acre (approximately 11.8-foot radius) to determine the number of aspen stems within the plot. The aspen are classified by five different size characteristics, ≤1” diameter, <18” in height; ≤1” diameter, <18”-5’ in height; <1” diameter, > 5’ in height; >1” diameter, >5’ in height, and decadent standing aspen >5” diameter. The survey also requires answers to a series of questions determining if the mature aspen are decadent, if the stand is dominantly conifer or aspen, what kind and percentage of the stand is aspen/conifer, and requires a determination of the stand's ecological succession, including if the stand is serial, disclimax, or stable. Further, the survey requires one to determine the community type of the stand based on a key breaking down potential species within the site with a corresponding name i.e., Aspen/Mountain Snowberry/Kentucky Bluegrass. There is also a table determining the site’s risk rating, ranging from highest to none.

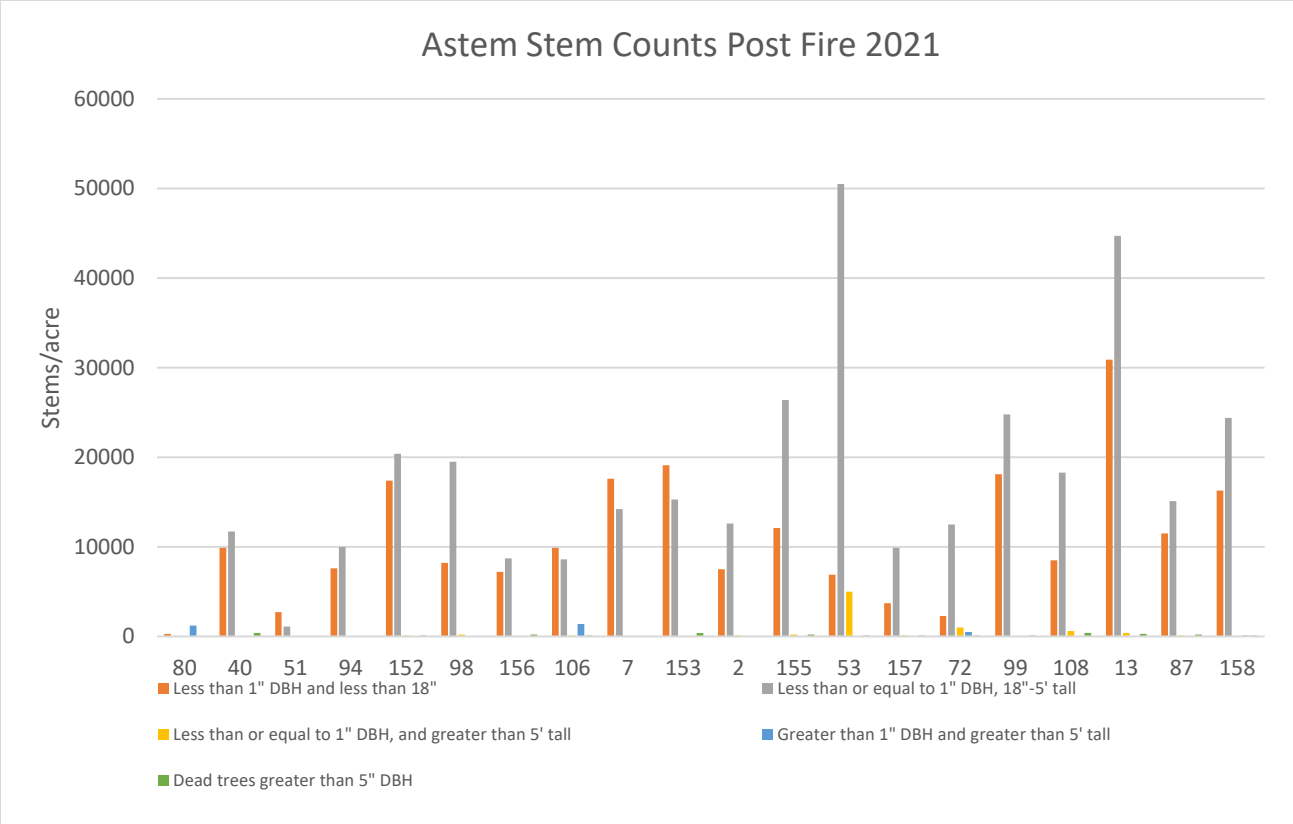

Figure 5: Post-Badger Aspen Regeneration by Size Class

Aspen stem plot surveys were taken at 20 different sites within the Badger Fire perimeter. The Y axis shows the number of stems counted per size class. The X axis shows the plot number at the site. The size class that is the most common currently is less than or equal to 1" DBH and 18"-5' tall. The second most successful are those that are less than 1" DBH and less than 18" tall. This is expected due to the disturbance of the Badger Fire. The minimum level of aspen regeneration that the Minidoka Ranger District typically expected to see post fire to ensure long term maintenance of aspen at a site is a minimum of 3000 aspen stems per acre. We can see in most sites that recovery is very high and easily exceeds this minimum. The average amount of stems per acre in the less than 1" DBH and less than 18" tall size class is approximately 10,000. The average for less than or equal to 1" DBH and 18"-5' tall size class is approximately 17,500 stems per acre, although two sites in this size class indicated extremely high levels of regeneration, having an estimated 44,700 and 50,500 stems per acre. The latter three size classes were not nearly as significant, which indicates that the regeneration is a direct result of the Badger Fire. The average for less than or equal to 1" DBH and greater than 5' tall size class is approximately 395 stems per acre in 2021. The average for greater than 1" DBH and greater than 5' tall size class is approximately 160 stems per acre. Dead trees average 140 stems per acre, highlighting the fact that aspen did not all experience mortality as a result of the fire. The total average of stems per acre for all sites is approximately 6,400. Monitoring in 2022 indicated a continued growth and expansion of aspen, with most sites easily exceeding desired recovery parameters for height and total stems. A continued upward trajectory is expected on aspen moving forward.

Monitoring indicated nearly all aspen monitoring sites are being used by deer, elk or moose, indicating post fire use of these areas is high. Habitat improvements on summer range for big game has likely increased the carrying capacity on summer range.

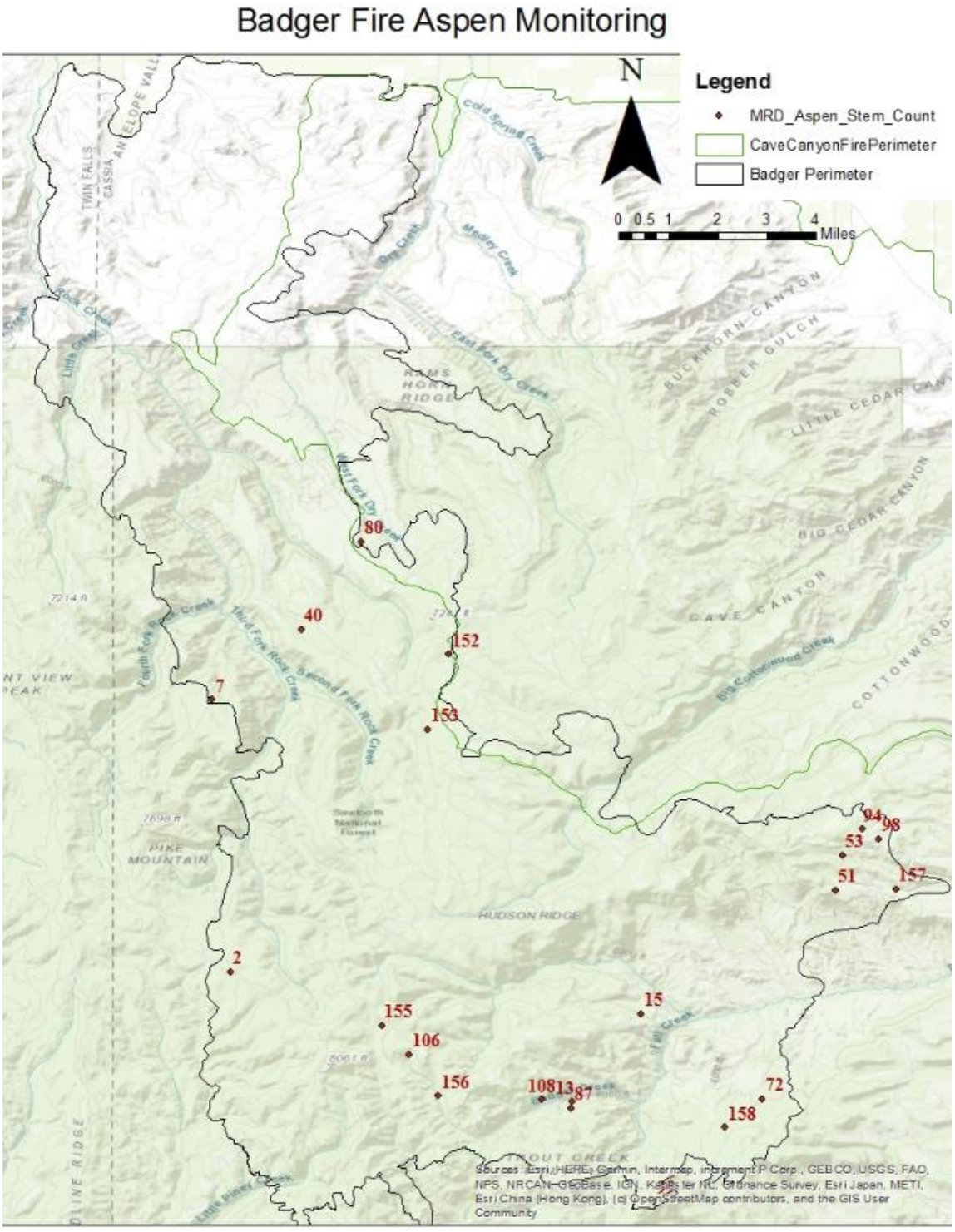

Figure 6: Badger Fire Aspen Monitoring Site Locations

Conifer

Lodgepole pine is the primary conifer species of management interest and concern. Lodgepole is a fire adapted species and typically regenerates well after fire. However, very high severity fire which affected soils coupled with drought conditions and climate change may affect the expected recovery of the species within the South Hills. Conifer regeneration is difficult to determine after only one growing season so quantitative monitoring and assessment was not undertaken until the fall of 2022. That assessment on conifer recovery, specifically lodgepole pine regeneration in 2022 indicated that most areas are regenerating naturally. Approximately 230 acres were identified as potentially not regenerating and conifer planting may need to occur to reestablish desired tree species.

Current Conditions

In the sage-steppe communities, sites dominated by mountain big sagebrush burned with moderate severity and high severity in areas where fire was largely wind driven. This was especially pronounced in the portions of the Dry Creek area that did not burn in the 2012 Cave Canyon Fire (see progression map, Figure 117). As expected, sites that burned in Cave Canyon burned with much less severity. The sites evaluated in 2021 that were burned in both the Cave Canyon Fire and the Badger Fire included: CP-FF-2S, CP-LR-3B, CP-IS-2S, CP-RH-3S and CP-C-1S. In 2022, sites monitored that burned in both fires included: CP-C-1S, CP-C-2S, CP-FF-2S, CP-FF-5S, CP-IS-2S, CP-IS-5S, CP-LR-3B, CP-LR-4B, CP-RH-3S, CP-WDC-2B, and CP-WDC-8B.

In sagebrush sites that have been encroached by juniper, primarily the Trapper Creek drainage, a combination of high winds and fuel loading created by juniper encroachment resulted in a wind driven crown fire that burned through the Trapper Creek drainage. That resulted in high severity fire effects in most areas dominated by juniper, with noticeable soil effects i.e., loss of all soil organic matter and soil sterilization in some areas of thick juniper.

The Badger Fire was a late season fire, burning well into October, so regrowth before freezing temperatures generally did not occur, apart from some burned riparian sites. Winter and spring precipitation was below normal for the area and drought conditions quickly set in. Lack of spring rains in April and May of 2021, combined with well above average daily temperatures in June and July of 2021 hampered vegetation recovery the first year. The winter and spring of 2022 however were slightly above normal with ideal spring precipitation, rapidly improving vegetation recovery in most areas of the burn.

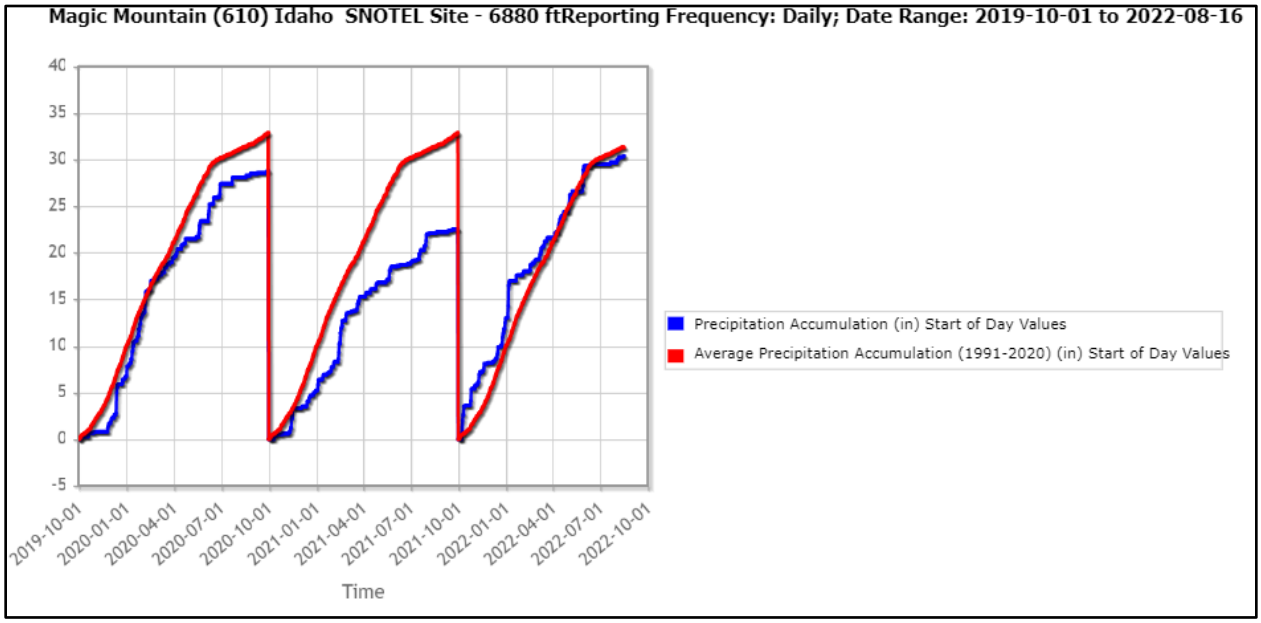

Figure 7: Magic Mountain SNOWTEL Data from 10/01/2019 to 08/16/2022

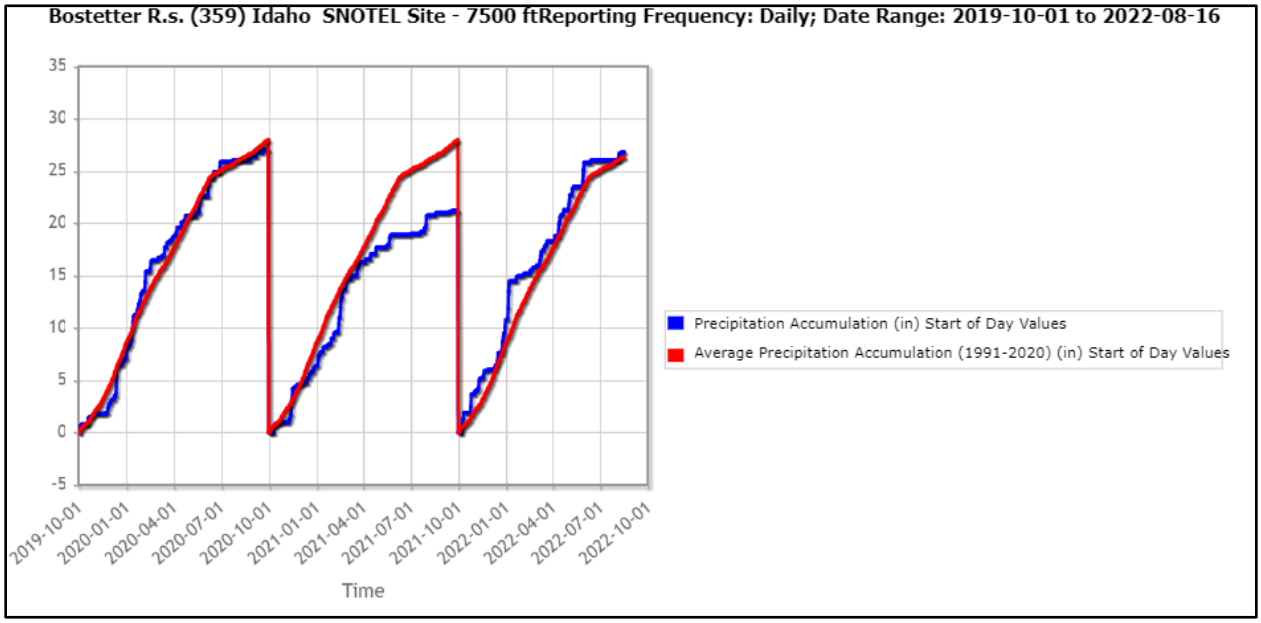

Figure 8: The Bostetter SNOWTEL Data from 10/01/2019 to 08/16/2022.

Footnote: These values for the graphs above were taken at the start of the water year, October 1st. The red line indicates the 30 year average precipitation accumulation in a given year. The blue line indicates actual precipitation accumulation. The units given are in inches. (NWCC Report Generator, n.d.)

Total precipitation for 2021 was much lower than 2020, and well below the 30-year average, around 60% (NWCC Report Generator). The biggest difference in 2021, particularly of vegetative recovery and response post fire, was growing season precipitation (after May 1) which was well below average for 2021. Plant germination and plant establishment were poor due to low levels of growing season precipitation coupled with above average temperatures and drought conditions. This restricted natural recovery as well as recovery in aerially seeded areas.

The winter and spring of 2022 were slightly above average for precipitation accumulation at the Bostetter and Magic Mountain SNOTEL site (Figure 7 and 8). The loss of shrubs, nutrient cycling, and exposed bare ground coupled with an above average spring caused the grass and forbs within the Badger Fire perimeter to increase drastically. The vegetation response post fire was markedly different than the recovery in year 1 when the spring of 2021 was exceptionally dry and recovery was poor in most of the burned area. Fortunately, in most areas of the burn, the vegetative community is thriving with an increase in grasses and forbs alike due to the excellent spring conditions in 2022.

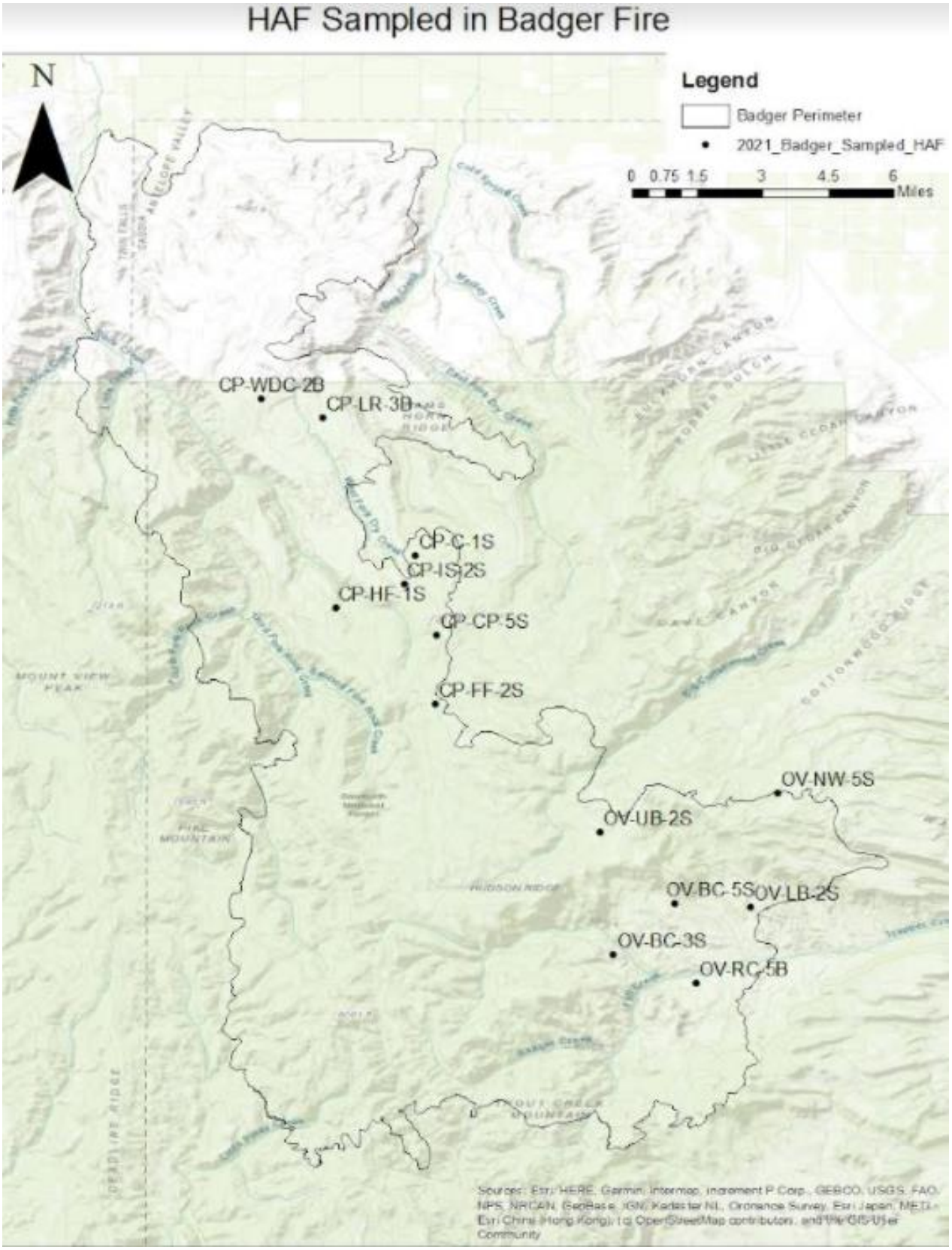

Figure 9: HAF Points Sampled within the Badger Fire perimeter one year post fire.

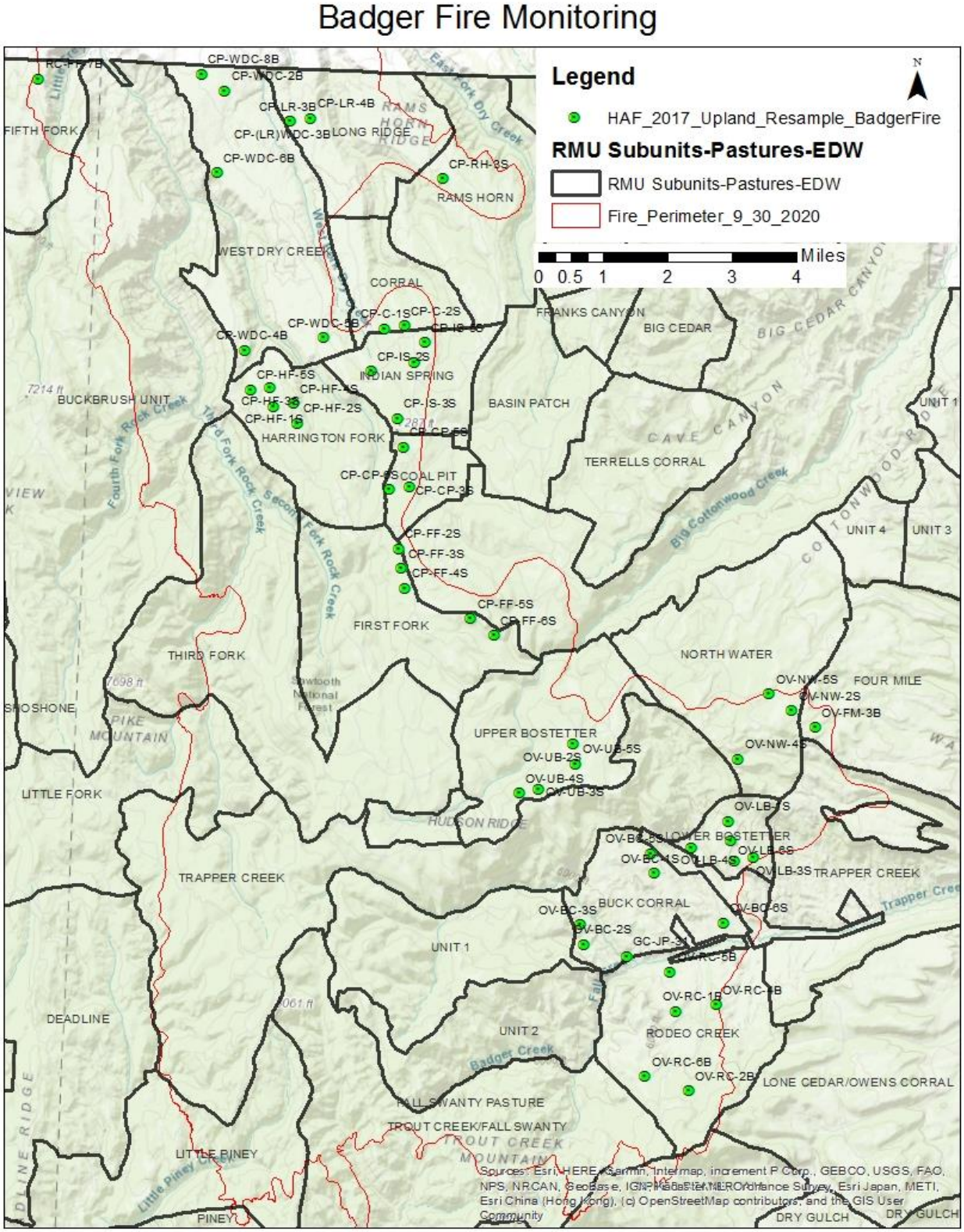

Figure 10: HAF Points Sampled within the Badger Fire perimeter during year two post fire sampling, excluding RC-FF-7B (NW corner).

2021 Year 1 and Year 2 resample Data Analysis, n=12

The number system utilized to name each sampling site is based on allotment, pasture, sampling site number, and dominant habitat classification (sage grouse summer habitat or breeding habitat). For example, CP-HF-1S is within the Coal Pit allotment, abbreviated CP, the Harrington Fork Pasture, abbreviated HF, is the first sampling site within this pasture of this allotment denoted numerically as 1 and is a predominantly sage grouse summer habitat, denoted with an S. If the number were 1B, it would be classified as the first in the pasture and breeding habitat for sage grouse.

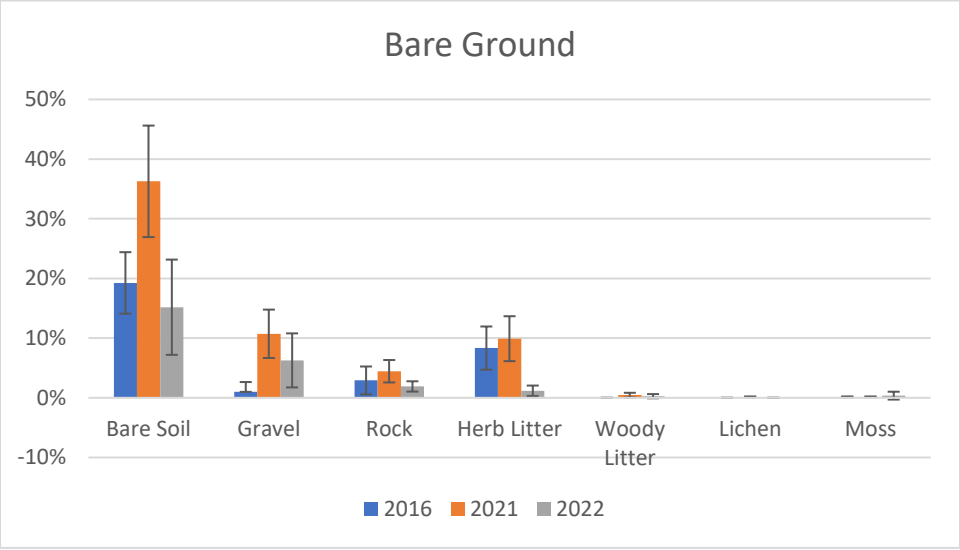

Figure 11: Average ground cover not including masticated site (OV-RC-5B), α=0.10.

Average Ground Cover Discussion:

Ground cover percentage is significantly different pre- and post-fire (90% CI). Figure 11 illustrates average ground cover in all the sampled sites where no seeding or post fire treatment was applied. The masticated site, OV-RC-5B was removed from this analysis of ground cover as the ground cover at that monitoring site was artificially manipulated by mastication of juniper skeletons. Across the burned area, bare soil increased from 19% to 36%, gravel increased from 1% to 10%, rock increased from 2% to 4%, and herbaceous litter increased from 8% to 10% the first year following the Badger Fire. Drought conditions in the spring of 2021 is likely the reason there was a significant increase in bare soil, as recovery was delayed substantially even by the time sampling occurred in the summer months. The increase in gravel as a cover hit, while statistically significant, is not unexpected, as the removal of litter and vegetation from the fire resulted in more hits on gravel in 2021 post fire that in 2016 would have been hits on litter or vegetation for the soil surface; gravel hits were also more difficult to detect in 2016 but easier to detect in 2021 due to removal of vegetation that impeded sight of smaller sized gravel in 2016. In

2022, range conditions improved dramatically, and total bare ground decreased to below pre fire levels as this space was taken up by foliage.

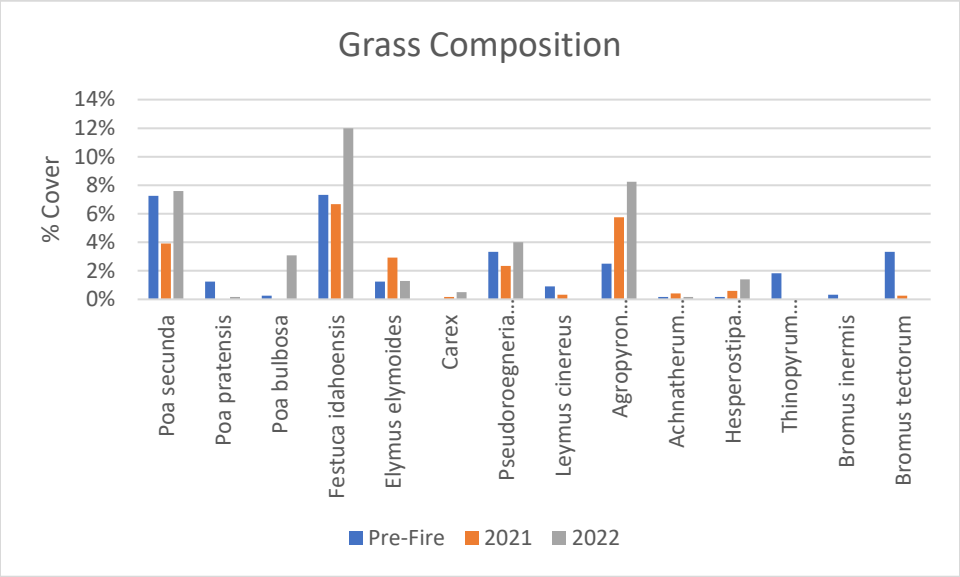

Figure 12: Percent top cover of perennial bunchgrasses averaged across sampling population (n=12).

Footnote: Six grass species were detected in the top cover analysis in 2022 that were not detected in previous years but are not included in this graph.

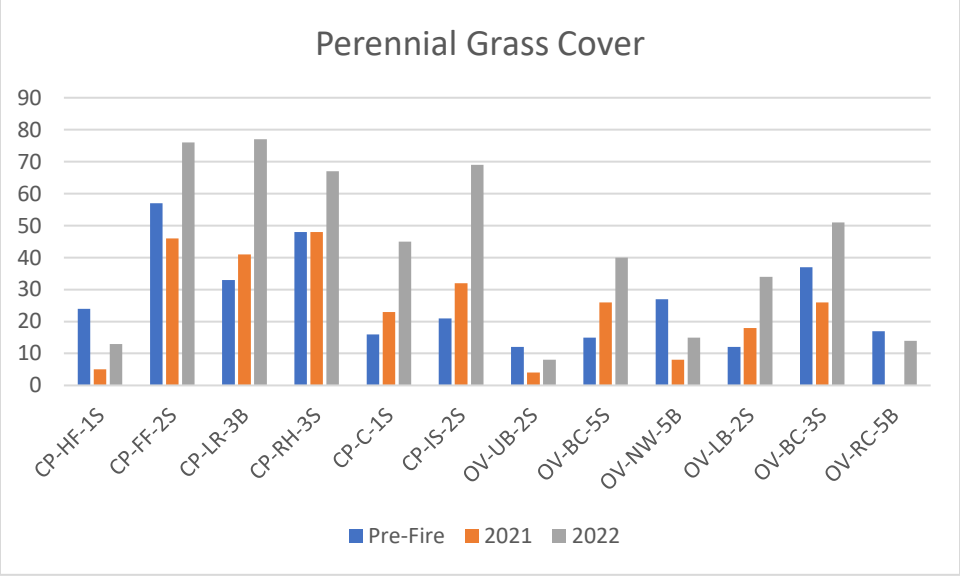

Figure 13: Grass percent cover pre- versus post-fire by site

Grass Cover Discussion:

Species diversity often increases post fire, especially if the burn is low severity as the seed bank is released by disturbance. The first year following the fire, approximately half of the sites decreased in grass percent cover, and half increased. In many sites, the pre-fire grass species is no longer established or dominant. This is true for Kentucky Bluegrass *(poa pratensis),* bulbous bluegrass *(poa bulbosa),* intermediate wheatgrass *(thinopyrum intermedium),* and smooth brome *(Bromus intermis).* In 2022, bulbous bluegrass averaged higher than pre fire levels. Kentucky bluegrass was also present. Six species were detected in 2021 that were not previously detected. These include *Elymus glaucus, Elymus trachylcaulus, Hordeum jubatum, Koeleria macrantha, Pascopyrum smithii,* and *Poa arida.* Species not detected in 2022 are *leymus cinereus, Poa pratensis, Anchnatherum nelsonii, Thinopyrum intermedium,* and *Bromus inermis*. That is likely due to plant identification error and is insignificant from a plant community perspective.

Grass cover differed an exceptional amount pre- and post-fire. All sites increased in perennial grass cover from 2021 to 2022, and most are currently above pre fire levels. The following sites however are still below 2016 (pre fire) levels CP-HF-1S (11%), OV-UB-2S(4%), OV-NW-5B (12%), and OV-RC-5B (3%). Those that increased in grass cover the first year following fire include CP-LR-3B, CP-C-1S, CP-IS-2S, OV-BC-5B, and OV-LB-2S. These were also the sites that had the largest increase in 2022. Sites that burned at low intensity increased in grass cover due to an immediate release of grasses post-fire and low plant mortality. Those that decreased in grass cover the first year include CP-HF-1S, CP-FF-2S, OV-UB-2S, OV-NW-5B, OV-BC-3S, and OV-RC-5B. In comparison to sites that increased in cover from 2016 to 2021, these sites did not have as large of an increase in 2022. Four of these six sites are still below pre fire levels, CP-HF-1S (11%), OV-UB-2S(4%), OV-NW-5B (12%), and OV-RC-5B (3%). This is likely a result of higher severity fire effects. Sites that saw higher severity fire include OV-NW-5B, OV-UB-2S, OV-BC-5S, and OV-RC-5B, while the remaining saw low to moderate severity fire. Another likely factor that contributed to a decrease in grass percentage and abundance the first year is lower average precipitation.

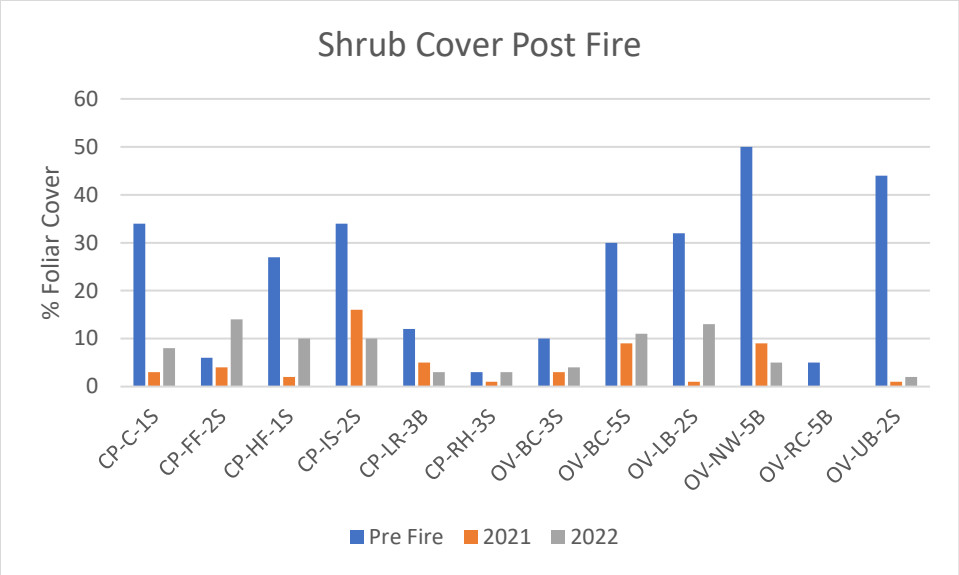

Figure 14: Shrub Percent Cover Pre- and Post-Fire

Shrub Cover Discussion:

As expected, shrub cover decreased substantially post fire. In 2022, there was a slight increase in shrub cover from 2021. This is primarily due to regrowth of yellow rabbitbrush (*Chrysothamnus viscidiflorus*), a sprouting shrub that generally increases post fire. Yellow rabbitbrush, while native, is not a palatable forage shrub for mule deer, sage-grouse, elk or livestock.

Shrub cover loss is expected to continue to negatively affect species which depend on shrubs for cover and forage, especially mule deer and sage-grouse. In areas that burned in the 2012 Cave Canyon fire and then reburned in the 2020 Badger Fire, it is likely that shrubs never reached reproductive maturity after being burned in 2012 and there is no seedbank to regenerate shrubs on-site. Reestablishing shrubs in these areas will likely have to occur through active management efforts (planting, seeding) or more slowly through passive management of seed dispersal into these sites from adjacent areas via wind. Passive management on these sites will likely not meet objectives for the area i.e. functional sage-grouse and mule deer habitat within desired time frames and could take nearly a century to passively recover on some sites to the density and canopy cover desired. This is especially a concern on more xeric, lower elevation sites.

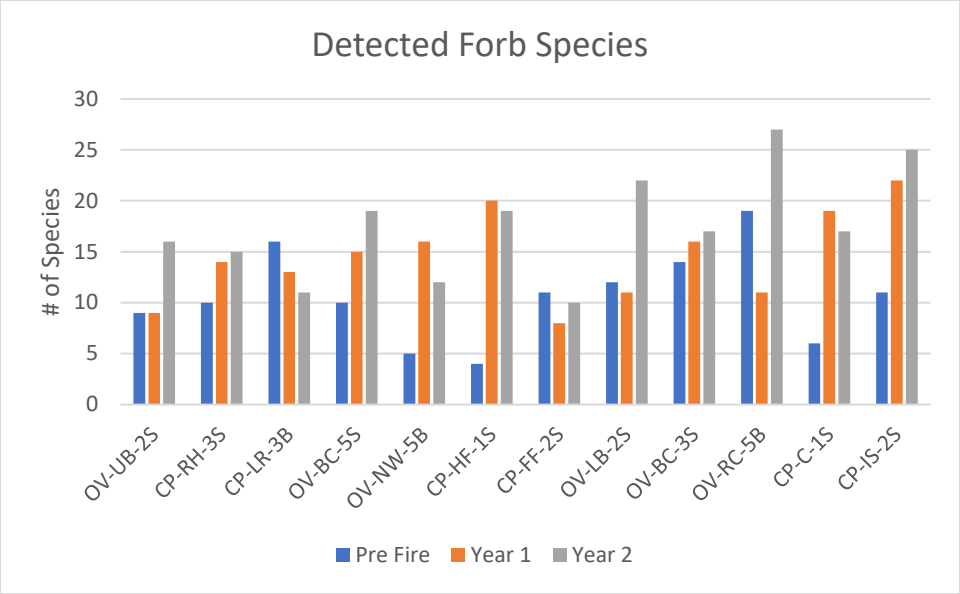

Figure 15: Number of forb species detected in the top cover analysis pre- and post-fire

Species Detected Discussion:

In site OV-UB-2S, we can see that the number of species did not differentiate between 2016 and 2021. In sites CP-RH-3S, OV-BC-5S, OV-NW-5B, CP-HF-1S, OV-BC-3S, and CP-C-1S, we can see that the number of species detected increased between 2016 and 2021. Generally, there is increased diversity post-fire in sage-steppe ecosystems due to a release of nutrients and seeds in the seedbank, which have a chance at germination post-fire. In sites CP-LR-3B, CP-FF-2S, OV-LB-2S, and OV-RC-5B there were more species in 2016 than in 2021. This is likely of moderate to high intensity burning of ground fuels that impacted the seed bank. Based on the BARC map, these areas mostly burned at moderate intensity levels, causing soil and seedbank impacts. Further, sites CP-LR-3B and CP-FF-2S both also burned in the 2012 Cave Canyon Fire and the seedbank on these sites was likely not replenished by the time it burned a second time.

In 2022, the number of detected species was variable. We detected less species in sites CP-LR-3B, OV-OV-NW-5B, CP-HF-1S, and CP-C-1S from 2021 to 2022. This is likely due to the dramatic increases in perennial grass cover at these sites. For example, the number of detected species at CP-LR-3B has continually regressed post fire. Perennial bunchgrasses have continually increased from 33% pre fire to 41% in 2021 and to 77% in 2022. In other cases, such as ON-NW-5B, fire intensity is likely the cause, as we have seen poor response from this site from all indicators.

First year data post fire indicate that species composition, ground cover type, and shrub cover were altered a considerable amount between 2016 and 2021. Grass percent cover generally increased. As expected, shrub cover decreased substantially post fire. The ground cover percentage is also significantly different pre- and post-fire, plummeting in 2021 as expected. In 2022, foliar cover increased significantly from 2021 (90%CI) and is now above pre-fire levels.

Site ID	Pre-Fire Grass Cover	2021 Grass Cover	2022 Grass Cover	Pre-Fire Bare Soil	2021 Bare Soil	2022 Bare Soil
OV-UB-2S	0.21	0.04	0.08	0.04	0.69	0.51
OV-NW-5B	0.27	0.08	0.15	0	0.43	0.34
OV-LB-2S	0.34	0.19	0.34	0.21	0.52	0.12
OV-IS-2S	0.21	0.32	0.69	0.11	0.25	0.1
OV-BC-5S	0.15	0.26	0.4	0.23	0.06	0.04
OV-BC-3S	0.37	0.26	0.51	0.26	0.45	0.11
CP-C-1S	0.16	0.23	0.45	0.30	0.35	0.13
CP-RH-3S	0.49	0.48	0.67	0.12	0.24	0.15
CP-LR-3B	0.33	0.41	0.77	0.15	0.14	0.01
CP-HF-1S	0.24	0.05	0.13	0.33	0.61	0.1
CP-FF-2S	0.74	0.48	0.76	0.16	0.25	0.06
OV-RC-5B	0.17	0	0.14	0.4	0.5	0.09

Table 1. Comparison of Pre and Post Fire grass cover and bare soil conditions. Percentages by 100.

Reburned Sites

The 2012 Cave Canyon Fire and 2020 Badger Fire overlapped in the Coal Pit Allotment. In 2021, 5 sites were monitored within the re-burned area. In 2022, all 12 sites within the re-burn were monitored. Initially, those 12 sites were collected in 2016, 4 years after the Cave Canyon fire. Recovery in this portion of the Cave Canyon and Badger fires is similar to recovery throughout the rest of the monitored sites. There was a drastic decrease in bare ground from 2021 to 2022, and there is now less bare soil than there was in 2016. Perennial grass has also nearly doubled in cover from pre fire levels. Annual grass invasion and shrub recovery are the two greatest concerns in this portion of the burn. There was not sufficient data to quantify annual grass invasion in 2021. In 2022, annual grasses were detected in 4 of the 5 sites that had annual grasses in 2016. All sites had a decrease in annual grass cover since 2016, but we will likely see in increase in sites that still have exposed soil. Fortunately, perennial grasses increased in cover greatly and it is possible that the increase in annual grass cover will not materialize in the future.

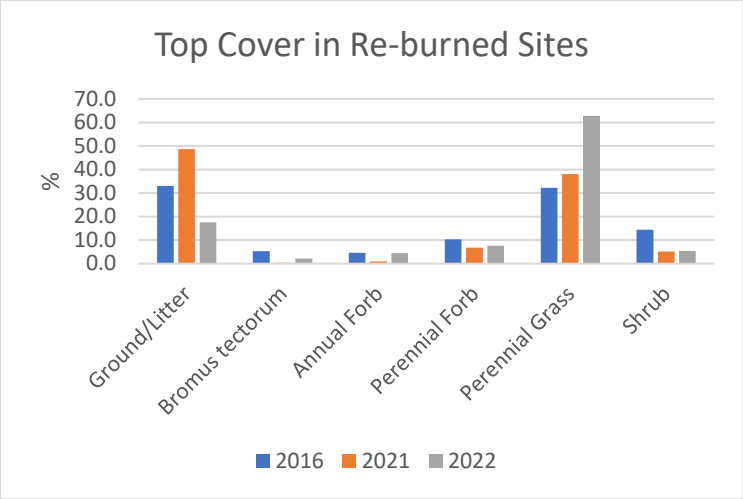

Figure 16: Percent top cover in sites that burned in both the Cave Canyon and Badger Fire.

Footnote: All sites were averaged by functional group. 12 sites were monitored in 2016 and 2022, and 5 were monitored in 2021.

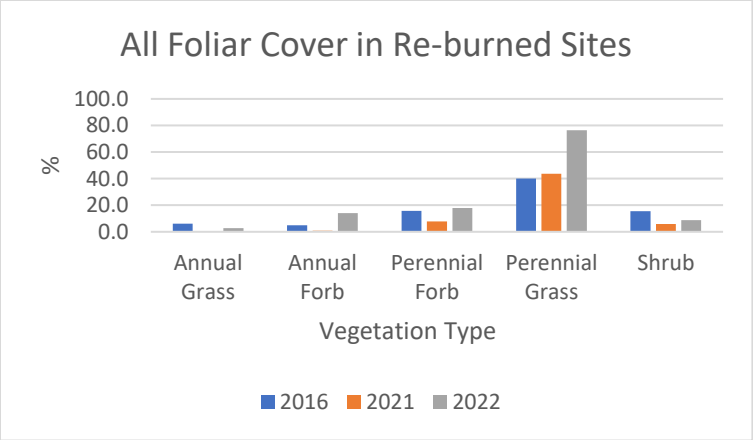

Figure 17: Percent all foliar cover in sites that burned in both the Cave Canyon and Badger Fire.

Footnote: All sites were averaged by functional group. 12 sites were monitored in 2016 and 2022, and 5 were monitored in 2021. Annual grass average in this chart is skewed, as we detected annual grasses in four sites sampled in 2016 and 2022, and only one sampled in 2021.

Data Limitations

The most comprehensive limiting factor for this assessment is time. Both forested and sagebrush steppe ecotypes take time to recover from disturbances whether they are natural, or human caused. The biggest limitation with the current dataset is that it represents the two years of vegetation recovery post fire.

Weather is another limiting factor for this assessment. Amount of precipitation in a given year can affect grass and forb cover as well as the rate of recovery from disturbance. The first year of

post fire recovery coincides with severe drought conditions however the second year was markedly different, with spring rains resulting in drastically improved conditions. It will be critical to continue further monitoring to assess the rate of recovery to inform future management actions and to determine what actions are warranted as well as to discern the effects of short-term weather patterns from the long-term direction that a plant community is moving towards. The next logical time frame for post fire monitoring is in year five; if that is not possible, year-10 post fire would be important as the long-term trend should be apparent by that time.

Discussion

As expected, there were differences in recovery as a function of fire severity, elevation, aspect and vegetation community. In the first year following fire, the differences in response between mountain shrub communities and lower elevation sagebrush communities was more dramatic than expected, most likely as a function of precipitation or lack thereof. Forest Service lands in the Cassia Division have historically benefitted from being slightly higher in elevation and getting slightly more precipitation than lower and drier BLM lands. As a result, natural recovery is often sufficient in many areas and direct management inputs are not needed. In the future if we continue to experience hotter and drier summers with less yearly precipitation, a shift in a management approach/philosophy may be needed as natural site recovery in higher elevations sites may not be the norm moving forward and resistant and resilience as a function of elevation may change.

We saw a slightly above average spring in 2022, and the vegetation community responded accordingly. Top cover boomed in many areas and is now, in many cases, greater than pre-fire levels. Close attention should be paid to the amount of biomass post fire. Fire reduces competition as it kills shrubs, opening space in the root zone making nutrient and water resources readily available to grasses and forbs. This increases the fine fuel loading across the landscape, therefore increasing fire danger. Across the Great Basin, portions of the landscape reburn very frequently, leading to invasion of annual grasses and forbs. Management actions such as grazing or creating fuels breaks should be considered in cases such as this to prevent constant re-burn and conversion to a grassland state.

The amount of bare ground present after the first growing season post fire was alarming as it represented open spaces/niches and resources for invasive species to colonize. A review of annual grass invasion two years post fire from the 2012 Cave Canyon fire shows a dramatic increase in cheatgrass the second growing season post fire. In 2022, there was not a dramatic increase in annual grasses in many of the sites expected. Currently, annual grass cover is below what it was in 2016 on some sites. With the exceptional increase in perennial bunchgrasses in 2022, annual grass invasion will likely be resisted in many areas of the Badger Fire. Areas that still have more bare ground than pre fire levels are at the greatest risk of annual grass invasion, as is the case for North Water and Upper Bostetter pastures. Management actions may need to take place in these areas to resist invasion and assist native vegetation recovery.

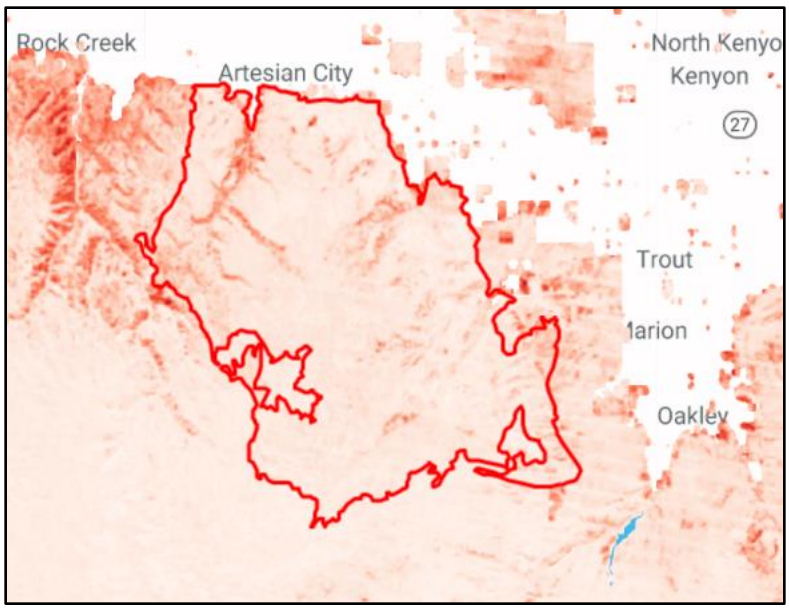

Figure 18: Annual Forb and Grass Cover in Cave Canyon fire, 2013 one-year post fire. Courtesy Rangeland Analysis Platform 2021.

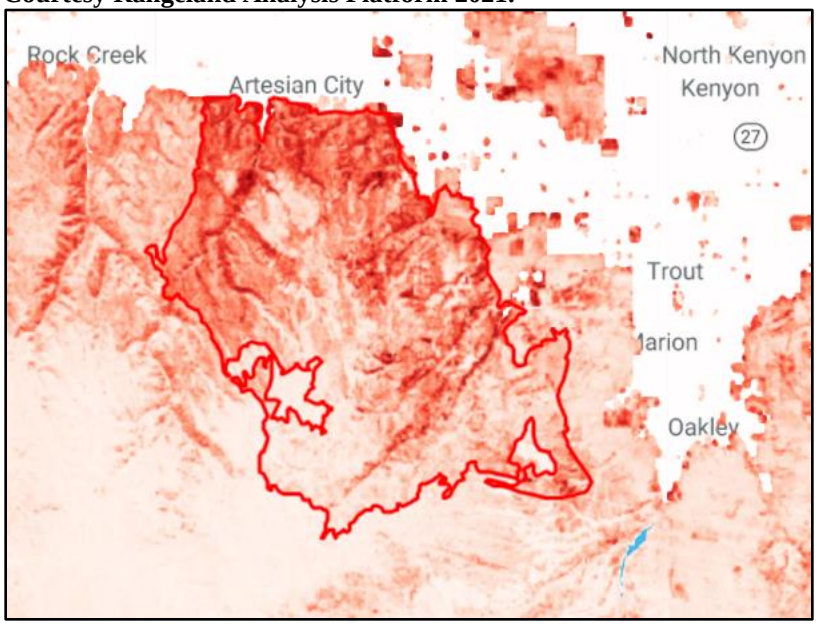

Figure 19: Annual Forb and Grass Cover in Cave Canyon fire, 2014 two-years post fire. Courtesy Rangeland Analysis Platform 2021.

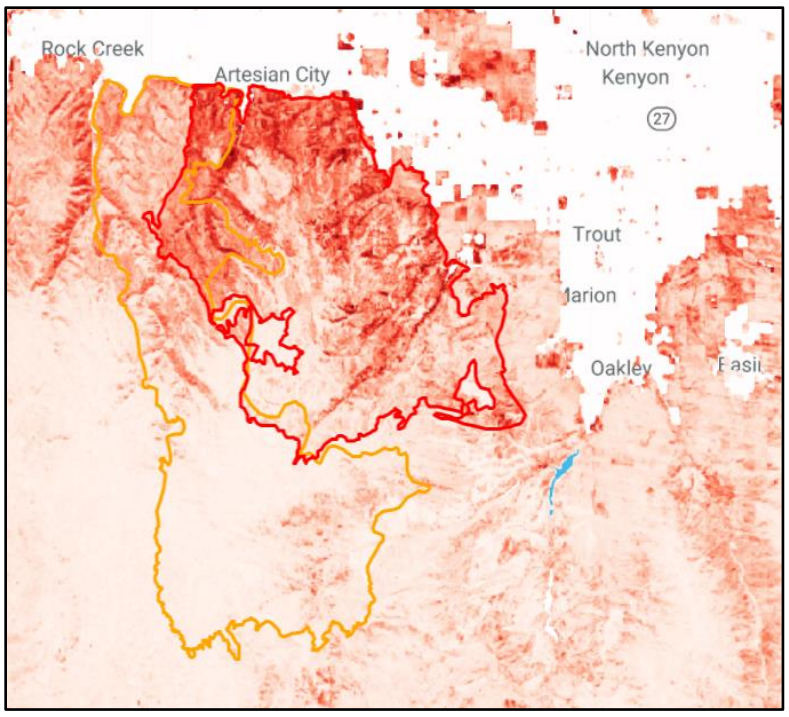

Figure 20: Annual Forb and Grass Cover in Cave Canyon fire, 2014 two-years post fire. Badger Fire perimeter added in orange perimeter outline. Courtesy Rangeland Analysis Platform 2021.

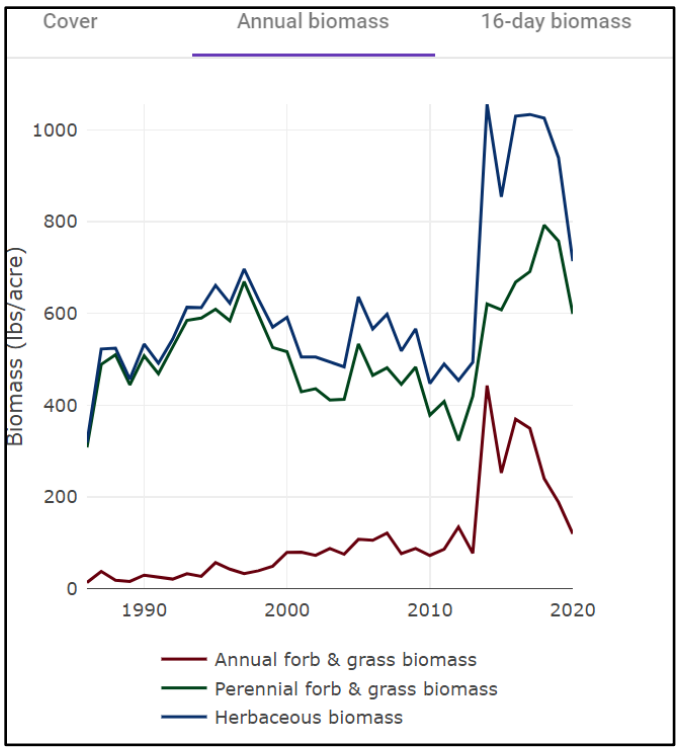

Figure 21: Annual Forb and Grass Cover, Perennial Forb & Grass Biomass, Herbaceous Biomass within Cave Canyon fire, Courtesy Rangeland Analysis Platform 2021.

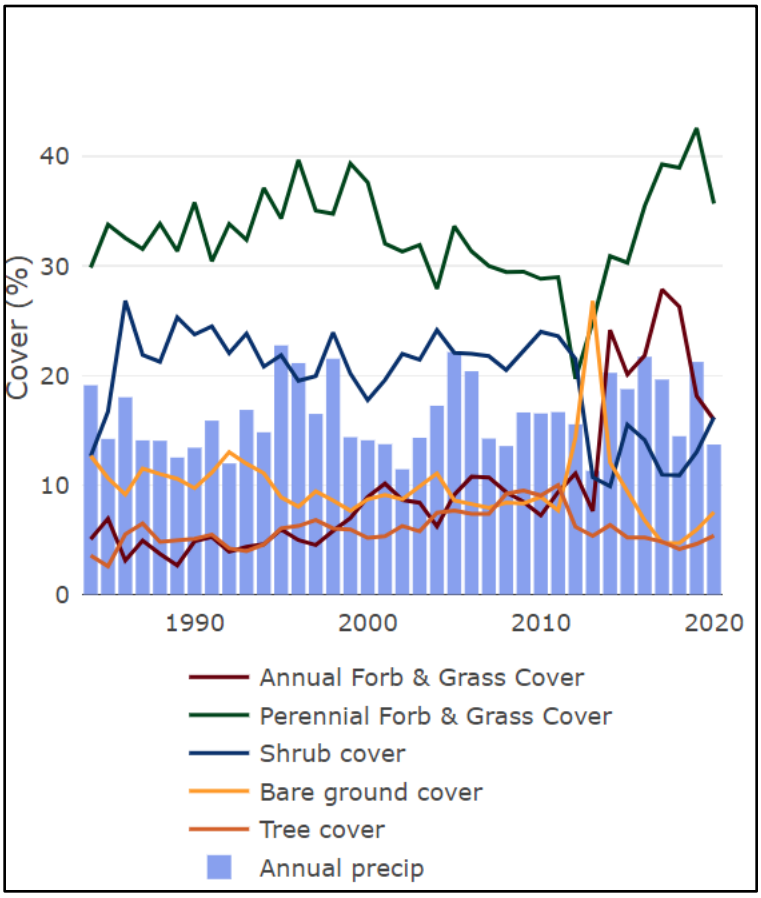

Figure 22: Time Series of Percent Cover with Annual Precipitation in Cave Canyon Perimeter, Courtesy Rangeland Analysis Platform 2021.

We can see that post-Cave Canyon Fire annual grass cover saw a major influx two years post-fire. In comparing one year post-fire (Figure 15) to two years post-fire (Figure 16), it is evident that annual grasses, especially in the northern most boundary of the fire, began to thrive in the Cave Canyon Fire perimeter. We can also look at the graphs in Figures 18 and 19 and see the rapid expansion of annual forb and grass cover, perennial forb and grass cover, and herbaceous biomass around 2014. Annual forb and grass cover in Figure 18 increased from 77.2 pounds per acre to 442.6 pounds per acre.

2022 Analysis

All sites within the Badger Fire perimeter that were sampled pre fire were resampled in 2022. An additional monitoring method was added to the protocol to assess root strength and seed production of perennial bunchgrasses. Multiple types of data were analyzed to understand indicators such as ground cover, percent bare ground, percent perennial grass cover, percent all foliar cover, root strength, seed production, and others.

In this analysis, data was averaged by pasture for purposes of understanding how the vegetation community is responding post fire, and to determine if and what rate the pastures can be grazed at for the 2023 season.

Trend in Vegetation response

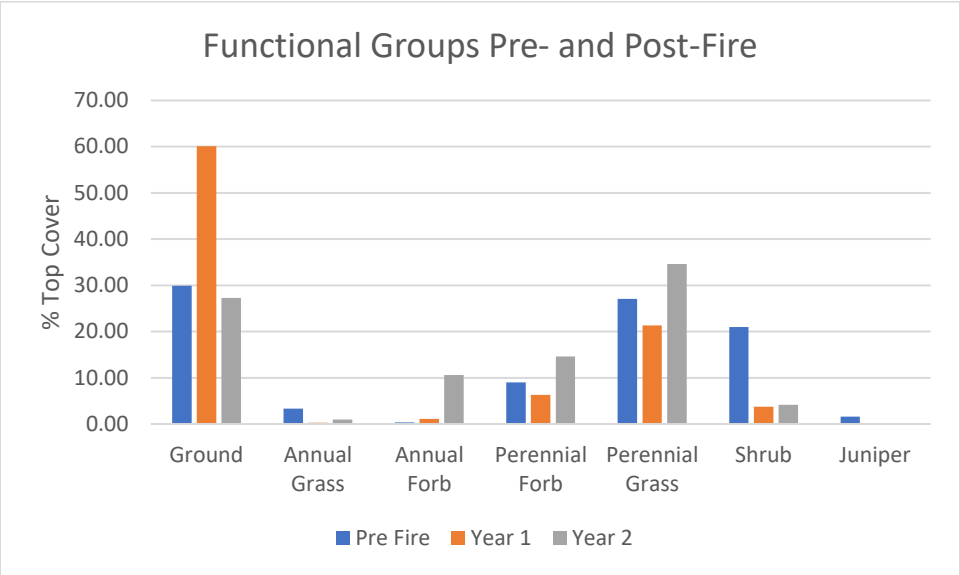

Figure 23 Change in % top cover by functional group pre-fire, 1 year post fire, and 2 years post fire of the 12 sites sampled in 2021.

Foliar cover increased greatly from 2021 to 2022. In many cases, foliar cover is greater in 2022 than it was pre fire. On average, bare ground has decreased by over half (33%) from 2021. Perennial bunchgrasses have increased by 7% of pre fire levels and 20% since 2021. Perennial forbs have increased by 5% of pre fire levels and 8% since 2021. Annual forbs have increased by 9% since 2021. There was a very slight increase in shrubs and annual grass from 2021 to 2022 as well. Unexpectedly, annual grass cover has decreased by 2.31% since pre fire levels (Figure 23).

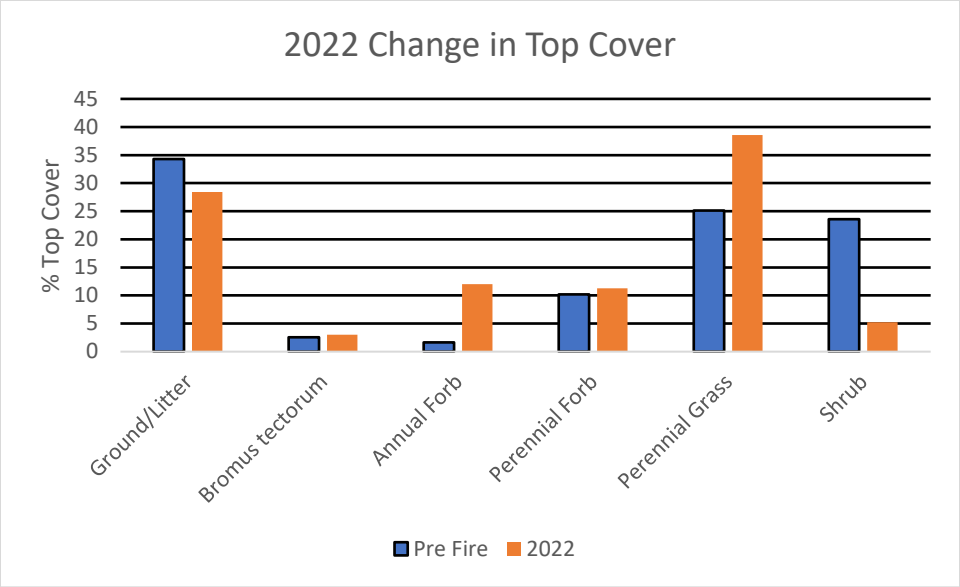

Figure 24. Change in Top cover by functional group averaged by 50 resampled sites within the fire perimeter.

We have found since 2016 when the sites were initially collected on average ground cover has decreased by 6%, annual grass has increased by 0.5%, annual forbs have increased significantly by 11%, perennial forbs have increased by 1%, perennial grasses have increased significantly by 13%, and shrubs have decreased significantly by 18% cover (Table 2 and 3).

Pre-Fire	Average	St.dev	Confidence (10%)	Upper	Lower
Ground/Litter	34.30	14.40	3.41	37.71	30.89
Bromus tectorum	2.58	5.47	1.30	3.88	1.28
Annual Forb	1.66	3.52	0.83	2.49	0.83
Perennial Forb	10.22	7.84	1.86	12.08	8.36
Perennial Grass	25.10	14.21	3.37	28.47	21.73
Shrub	23.56	15.52	3.68	27.24	19.88

Table 2. Pre-fire percent top cover of functional groups. n=50, α=0.10 Red font indicates statistical significance.

2022	Average	St.dev	Confidence (10%)	Upper	Lower
Ground/Litter	28.40	18.27	4.33	32.73	24.07
Bromus tectorum	3.02	6.81	1.62	4.64	1.40
Annual Forb	12.04	15.44	3.66	15.70	8.38
Perennial Forb	11.30	9.51	2.26	13.56	9.04
Perennial Grass	38.54	22.93	5.44	43.98	33.10
Shrub	5.24	7.02	1.66	6.90	3.58

Table 3. Post-fire percent top cover of functional groups. n=50, α=0.10. Red font indicates statistical significance

Average Ground Cover Discussion:

Ground cover was significantly affected by the Badger fire. In some pastures, ground cover increased drastically, indicating the ground cover standard has been met and soils should be protected from erosion. In other pastures, ground cover declined. Upper Bostetter and North Water are regenerating considerably slower than the other pastures. Foliar cover in Upper Bostetter is still only half of pre fire levels, and top cover has only reached 53%. North Water on average has 51% bare ground, 16% more than pre fire levels and foliar cover is still only half of pre fire levels. In comparison to pastures of similar ecological type and even lower elevation, such as West Dry Creek or Harrington Fork, the rate of recovery is slower. Both West Dry Creek and Harrington fork have doubled in foliar cover, primarily perennial bunchgrasses (Table 20). It is apparent when looking at the BARC map that there were portions of the North Water and Bostetter units that burned very intensely, which is likely the reason foliar cover regeneration has been delayed.

Bare Ground	Pre-Fire	2022
Corral	48	17.00
Coal Pit	27.00	15.33
First Fork	30.00	32.00
Harrington Fork	27.80	9.60
Indian Springs	37.25	20.50
Long Ridge/Rams Horn	24.67	23.33
West Dry Creek	33.20	12.60
Four Mile	52.00	63.00
Buck Corral	46.20	42.40
Lower Bostetter	46.00	27.80
North Water	35.33	51.33
Rodeo Creek	34.00	32.20
Upper Bostetter	17.75	47.00

Table 4. Ground cover averaged by pasture. Red font indicates an increase in bare ground post fire.

Grass Pulls

A belt transect was conducted at each monitoring point within the Badger Fire in 2022 to assess if perennial grasses were producing viable seed, therefore restoring the seedbank and if they are firmly rooted in the soil. Grasses were tested by examining the inflorescence to determine whether the seeds were of proper size and number, and by giving the grasses a firm pull. If the grass felt like it was going to pull up or was not producing seeds typical of the species, it was marked either as being not firmly rooted or not seed producing.

	Seed Producing (%)	Firmly Rooted (%)
Corral	100.0	100.0

Coal Pit	97.7	88.3
First Fork	93.2	100.0
Harrington Fork	99.2	100.0
Indian Springs	93.3	95.3
Long Ridge/Rams horn	100.0	100.0
West Dry Creek	99.0	97.0
Buck Corral	93.8	79.4
Four Mile	34.0	90.0
Lower Bostetter	100.0	93.0
North Water	84.3	37.3
Rodeo Creek	88.0	82.0
Upper Bostetter	86.5	81.3

Table 5. Summary of data collected per the belt transect monitoring method. Red font indicates that grasses are not ready to be grazed according to our standard of having 75% producing seed and firmly rooted in the soil.

Only two pastures did not meet the monitoring standard, Four Mile and North Water. Only one site was sampled in Four Mile because a very small portion of the unit burned. North water only had an average of 37% of grasses being firmly rooted. There were recorded notes stating two of three surveyed sites had very shallow soils (OV-NW-2S & OV-NW-4S). Shallow soils can play a role in this type of monitoring method, as grasses have to spread more laterally to be firmly rooted when tested by hand pulls rather then spread both laterally and vertically.

Grass Cover Discussion

Perennial grasses have increased significantly since pre-fire data collection (Table 12 and 13). With the loss of competition from shrubs and amount of exposed bare ground, perennial grasses were able to create a foothold and increase in cover in almost every pasture (Table 15). North Water and Upper Bostetter were the only two pastures which decreased in perennial grass cover, although both sites monitored in 2021 have increased in perennial grass cover. Annual grass was not detected at either site in North Water or Upper Bostetter, indicating that these sites are still regenerating to a perennial dominated state.

Perennial Grass		
	Pre Fire	2022
Corral	16.5	53.00
Coal Pit	17.33	29.33
First Fork	37.60	50.20
Harrington Fork	17.20	26.00
Indian Springs	29.75	50.00
Long Ridge/Rams Horn	47.00	63.00
West Dry Creek	27.00	67.60
Four Mile	17.00	23.00
Buck Corral	27.60	42.20
Lower Bostetter	10.40	19.60

North Water	26.33	18.00
Rodeo Creek	18.60	33.20
Upper Bostetter	30.50	18.25

Table 6. Perennial grass cover pre and post fire. Red font indicates a reduction in cover from pre fire levels.

Conclusion & Future Needs

Invasive Species

Cheatgrass *(Bromus Tectorum)* was detected at sample locations, CP-LR-3B OV-BC-3S, OV-LB-2S, and OV-RC-5B. Cheatgrass is a difficult species to accurately estimate abundance using LPI methodology as it is a small single stemmed annual grass. Counts of stems using quadrats is a more effective measurement however on the sites where it was detected, it is possible a portion of these sites will transition to an annual grass community without active intervention to reduce cheatgrass competition and increase perennial bunchgrasses. Interestingly, there was a substantial decrease in percent foliar cover from 2016 to 2022. If normal water years progress, perennial bunchgrasses will likely resist annual grass invasion in the future. Hot and dry years could potentially lead to an increase in annual grasses. Close attention should be paid to sites where annual grasses were detected to evaluate need for treatment.

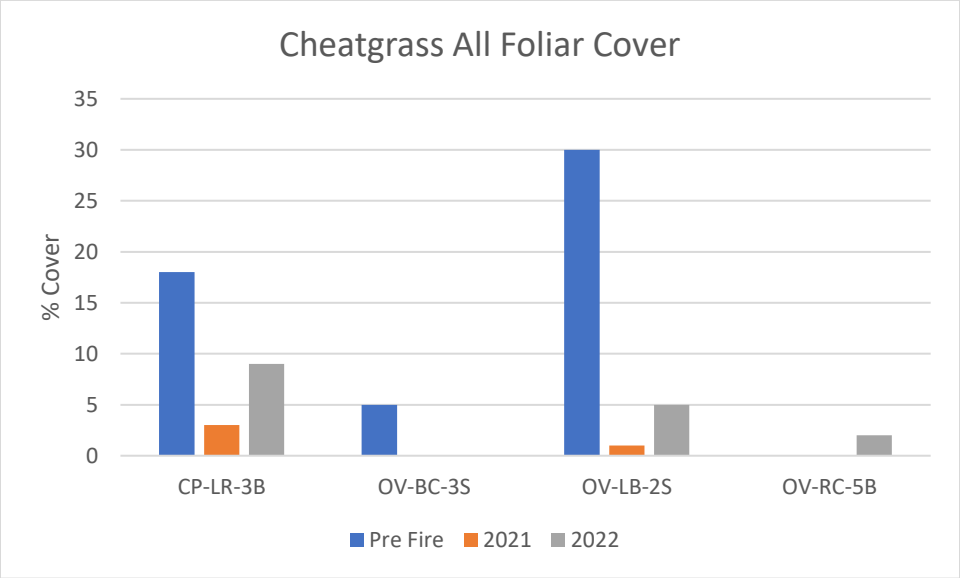

Figure 25: Pre- versus Post-Badger Cheatgrass Detected Sites

Post Fire Grazing Management

Post-fire grazing management will be important going forward as the long-term vegetation recovery in the burned area depends on management of the timing, duration and intensity of grazing. The Sawtooth Forest Plan requires burned areas to be rested for a minimum of two seasons or until objectives are met. It isimportant to monitor year one and year two grazing effects in burned pastures that were not completely rested due to unburned areas of the pastures being utilized to assess if herding and other management methods were successful in keeping

livestock out of the burned area. If not, the Forest Service needs to determine what level of resource effects occurred to assess if a change in management strategy is warranted to ensure long term recovery occurs. It will be critical to ensure grazing is rotated and intensity is managed to avoid long term soil effects associated with lack of cover or stressing plants to a point that invasive annuals are allowed the opportunity to further colonize sites. Management of grazing through time will be needed to ensure cattle and sheep utilization levels provide for adequate regrowth of vegetation and afford plants the opportunity to store carbohydrates and produce seed to replenish the seedbank. Conversely, in some areas, such as Dry Creek, it is likely that some sites will become "trapped" in a perennial grass state where shrubs establishment is difficult in the long term as there are few available resources due to a robust plant community of perennial grasses and a shrub seedbank that is severely depleted. This is especially true of the areas that burned in the 2012 Cave Canyon Fire and again in the 2020 Badger Fire. If restoring shrubs is a high priority and value, it would be appropriate to look at livestock grazing as a facilitative management tool to reduce perennial grass competition and provide a foothold to begin reestablishing shrubs into perennial grass dominated sites.

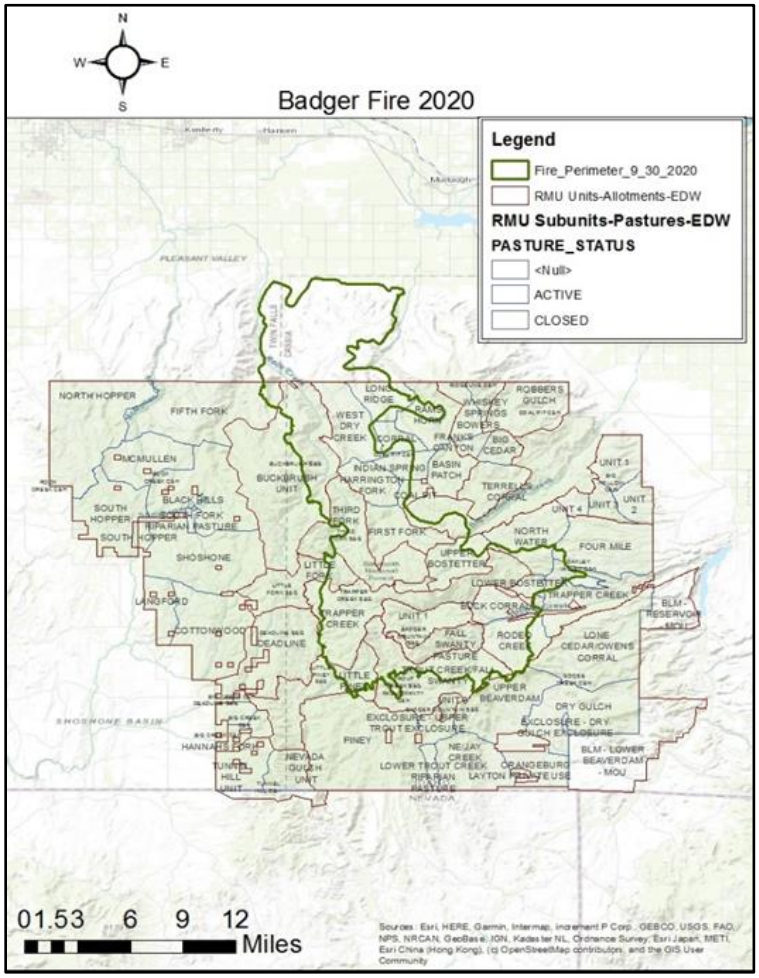

Figure 26: Badger Fire Perimeter with Pastures

Grazing Recommendations for the 2023 season

Coal Pit, Harrington Fork, and West Dry Creek stocking rates can likely resume grazing use at full numbers based on post fire recovery monitoring. Grass cover has increased significantly in these pastures based on our analysis and in the long term, increased stocking rates on upland sites may be appropriate to promote shrub regeneration.

Our analysis indicated that grazing can continue at normal stocking rates/full permitted numbers on the First Fork, Indian Springs, Long Ridge, Rams Horn, and Four Mile pastures. Apart from Four Mile, these pastures all showed an increase in perennial grass cover and are very close to pre fire levels in perennial forb cover. Aside from Indian Springs and Four Mile, our data shows that the grasses are firmly rooted, are producing seed, and ground cover has stayed the same or increased from pre fire levels. Although Indian springs is currently not meeting standards per our grass pulls, it is very close in both root strength and seed production indicators, and has increased in ground cover by 17%, most of which is from perennial grass. Thus, these indicators are expected to be met by the 2023 grazing season.

Lower Bostetter increased in cover in all functional groups except shrubs. Annual grasses should be closely monitored, as we saw the biggest increase in this pasture. Due to the increase in annual grass and grasses not meeting the objectives for root strength and seed production, it is recommended that grazing be deferred in the Lower Bostetter pasture until after seed ripe. Deferring grazing will provide another growing season of root expansion, carbohydrate storage, and seed production for native perennials. This more conservative approach would reduce the risk of annual grasses becoming co-dominant in the plant community and perennials being more resilient to grazing in the medium to long term. No monitoring was conducted inside the mastication in the Lower Bostetter unit, however based on the monitoring in Rodeo Creek and Buck Corral mastication sites, the mastication treatment should be rested during the 2023 season.

Based on the data analysis, our recommendation is for grazing in the mastication units be deferred for another year. Although foliar cover has increased, root strength is still a concern; the mastication sites were in poor ecological condition pre-fire and are more dependent on the seeding treatment for long term recovery post fire. That is likely why there is a slightly slower recovery response in these sites. The adjacent sites have increased in all foliar cover, and have strongly rooted, seed producing grass. A temporary fence could be installed around the mastication units, or constant livestock management will need to take place to ensure livestock do not disturb the regenerating vegetation inside the mastication treatment areas.

The burned portion of North Water and Upper Bostetter pastures will likely need deferred in 2023 until after seed ripe due to the loss of perennial bunchgrasses, total ground cover, and perennial grass root strength. Although these pastures are meeting our standards in ground cover, they are recovering at a rate much slower than every other pasture in the burn, indicating that a more conservative approach may be more appropriate. Grazing at normal levels, especially during the critical growth period could potentially lead to a reduction in root mass on perennial natives and an increase in invasive annual grasses and forbs.

Lastly, the increase in biomass on the landscape in many of these pastures needs to be addressed in the near term. If the goal is to continue to restore shrub habitat for sage grouse and wintering ungulates, grazing should be considered as a tool to promote shrub regeneration and biodiversity within the fire perimeter. The pastures that have not fully recovered should be monitored, as another normal water year could cause boom in biomass production in these areas as well. Grazing timing and duration need to be monitored as improper grazing in these areas could potentially cause a reduction in perennial grasses and forbs and an increase in exotic annuals as well.

Future Management Recommendations

The Badger Fire effects on the landscape appear to be similar to 2012 Cave Canyon Fire. The upper elevation sites largely benefited from the wildfire, with a significant response from aspen and mixed confer sites. Many of the areas that burned in the higher elevations were identified by the Forest Service as needing a stand or site reset; this monitoring confirmed largely beneficial effects even when burning under extreme weather conditions. This is useful information to inform future vegetation management actions and projects. There should be landscape scale benefits to species such as mule deer, elk, moose and livestock from the increase in palatable species and early seral vegetation on the landscape in the long term.

The lower elevation sage-steppe sites the Badger Fire did not respond as favorably when compared to the higher elevation sites. This was expected however unlike the 2012 Cave Canyon Fire, the large increase in annual grasses at the lower elevation did not materialize at a landscape scale. We hypothesize that this was due to two factors: the first being that the fire did not burn as much lower elevation acreage as the Cave Canyon Fire and did not burn to the east as much as the Cave Canyon Fire. As storms move across the Cassia Division, they tend to put more precipitation down on the western side and less as they move east. We suspect that slight increase in precipitation helped perennial bunchgrasses. Second, 2021 was exceptionally dry in the spring, to the point that even cheatgrass didn't germinate and do well, while in 2022, we had an exceptionally wet spring, which provided moisture for perennials to thrive and expand rapidly. We suspect this sequence of weather events helped reduce the competitiveness of cheatgrass. It is important to note that most of the sites we expected to have a large increase in cheatgrass we still had a perennial grass component that capitalized on favorable precipitation conditions in 2022. While cheatgrass expansion may continue in the next few years within the burned area and managers should pay attention to an increases in years 3-5, it is unlikely that at this point, sites that are dominated by perennial bunchgrasses will transition to being co-dominant with cheatgrass. Attention should be paid to the sites that monitoring detected cheatgrass and there is still some bare ground and resources that will be colonized in the coming years.

The Badger Fire represents another loss of habitat for sage-grouse as well as mule deer winter range. West-wide this has been an issue at a landscape level as losses of sagebrush continue to climb. If sage-grouse and mule deer remain priority species for wildlife and land managers, it will be important to maintain a long-term focus on the Cave Canyon and Badger Fire perimeters for at least the next decade. The true extent of what that effort will entail will not be fully

understood for a few more years however in the areas that burned in both the Cave Canyon and Badger Fires, it is likely that managers will have to plant and seed shrubs if they desire them to reestablish in desired densities of 12-25% shrub cover in the next 25 years. Perennial bunchgrass densities may impede shrub establishment as well and adaptive strategies and changes in livestock grazing intensity may be needed if shrub establishment objectives at desired densities are going to be met. Seeding in the future will likely have to shift from aerial seeding to drill seeding as the success of aerial seeding declines as soil cover increases and soil stabilize and seed-soil contact becomes less, which negatively affects germination rates. In some areas, cheatgrass treatment will likely be needed to first address annual grasses and there is a potential that drill seeding will be needed as a follow up treatment to establish desired species.

Acknowledgements

We would like to thank all the partners and stakeholders who have helped the Forest Service both during and after the Badger Fire. The success that the Minidoka Ranger District has had with post fire management would not have been possible without the help of partners and stakeholders.

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Appendix A- Site Data Analysis and Plot Photos

Data Analysis Methodology

Raw top cover, forb frequency, and all foliar cover was taken from Vegetation GIS Data Systems (VGS) and inputted into excel to determine community characteristics such as percent bare ground, percent all foliar cover, and species presence by site. Once the data was in excel, cover was summed by functional group. The standard deviation (St.Dev.s) was then calculated by each site's value of percent cover by functional group. Confidence intervals (confidence.t, α=0.1) were then calculated using the average of each functional group for all sites per year. Upper and lower confidence limits were calculated by adding and subtracting the confidence interval by the average.

Top cover and foliar cover are two separate characteristics. Top cover only accounts for the first species, or ground hit, encountered by the pin and nothing below it. This value will always sum to 100%. In this analysis, juniper and aspen were not included in cover, which is the reason a few sites do not sum to 100% in top cover. All foliar cover includes every species encountered by the pin and can be above or below 100%. For example, if 3 species were encountered on a single pin drop, the cover would be considered 300% at that individual pin drop. If no vegetation was encountered at the pin drop, the cover would be considered 0%. This is the reason why there are sights with perennial bunchgrass alone exceeding 100%.

CP-HF-1S

Figure 27: Pre-Fire Photo CP-HF-1S
Allotment: Coal Pit
Pasture: Harrington Fork
Unit #: 1S
Date: August 1st, 2016
Direction: North

Figure 28: Post-Fire Photo CP-HF-1S
Allotment: Coal Pit
Pasture: Harrington Fork
Unit #: 1S
Date: June 29th, 2021
Direction: North

Figure 29: Post-Fire Photo CP-HF-1S
Allotment: Coal Pit
Pasture: Harrington Fork
Unit #: 1S
Date: July 20th, 2022
Direction: North

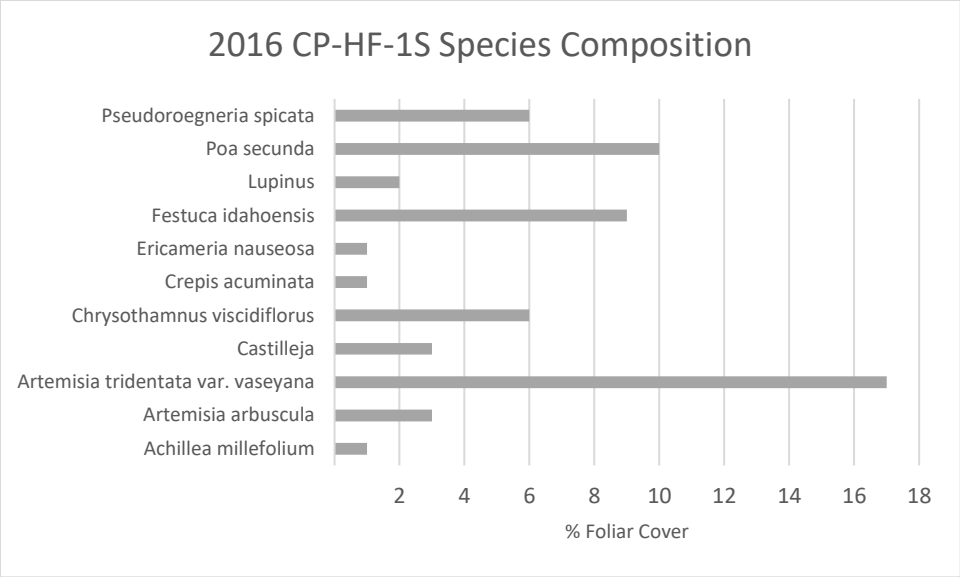

Figure 30: 2016 Species composition

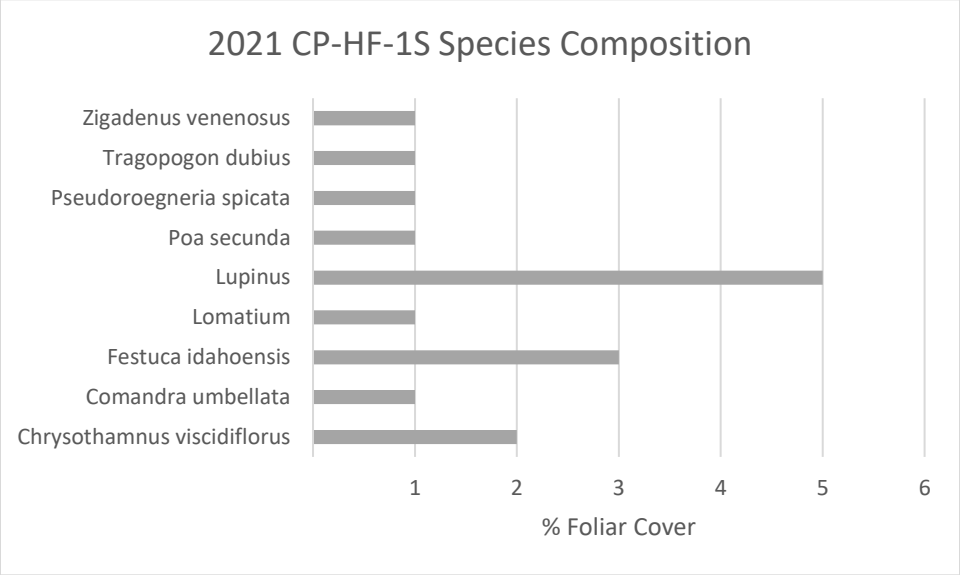

Figure 31: 2021 Species composition

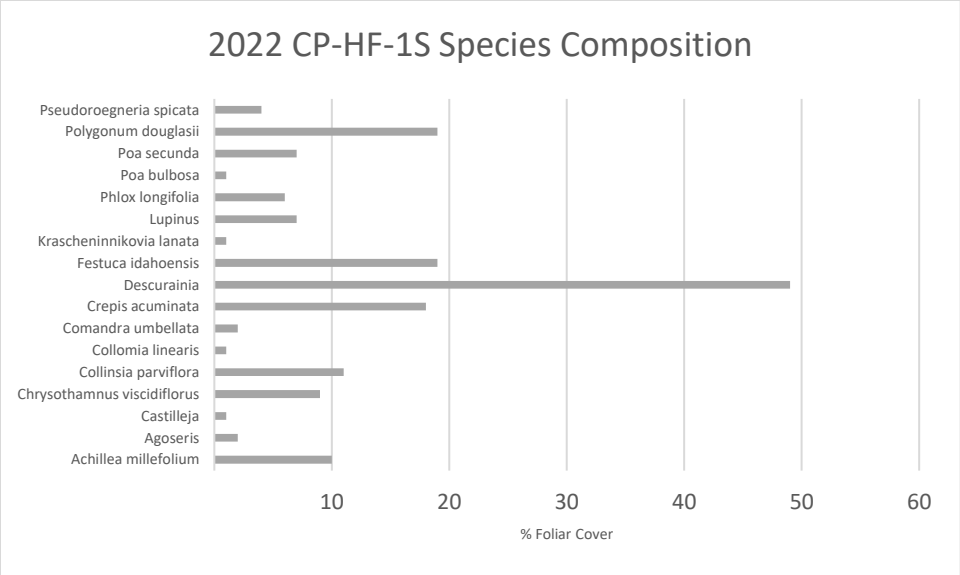

Figure 32: 2022 Species Composition

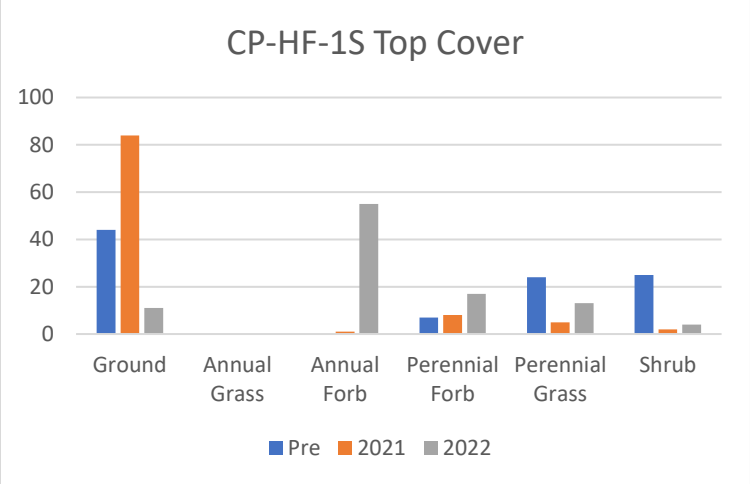

Figure 33: Percent Top cover at site CP-HF-1S

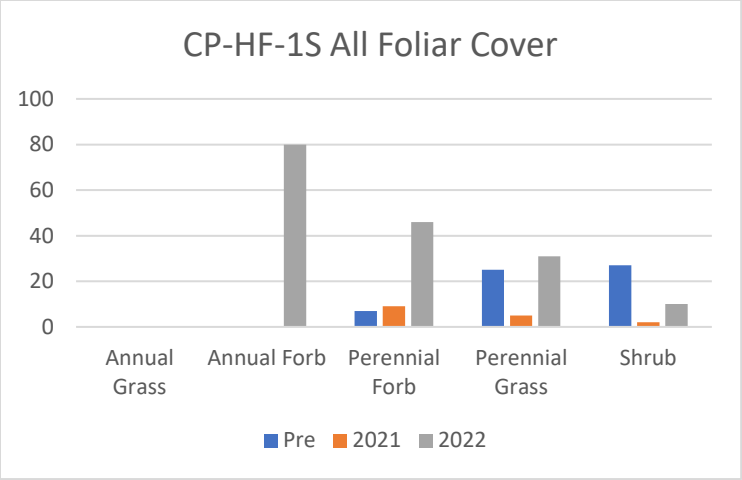

Figure 34: Percent All Foliar cover at site CP-HF-1S

Notes:
It is evident that this area burned at a moderate to high intensity based on the post-fire photo (Figure 23) and the BARC Map (Figure 116). This could have been due to wind, vegetation type, fuel loading, etc. There are noticeable soil effects. Species such as bluebunch wheatgrass (*Pseudoroegenera spicata*), mountain big sagebrush (*Artemisia tridentata ssp. Vaseyana*), and other species may not be able to recover for multiple years post-fire. It has been observed that bluebunch wheatgrass can take anywhere from 1-3 years and mountain big sagebrush 10+ years. In 2022, there was a large increase in Idaho fescue, 8% greater than pre fire levels. Bluebunch wheatgrass and Sandberg bluegrass are still lower than pre fire levels. There was a very large increase in an annual introduced forb tumble mustard (*Descurania*). Mustard species are not palatable to sage grouse or ungulates and can reduce the regeneration of native and grasses and forbs significantly. This is likely the reason perennial grasses at this site did not increase in cover well as compared to sites in similar ecological types, such as CP-LR-3B.

CP-FF-2S

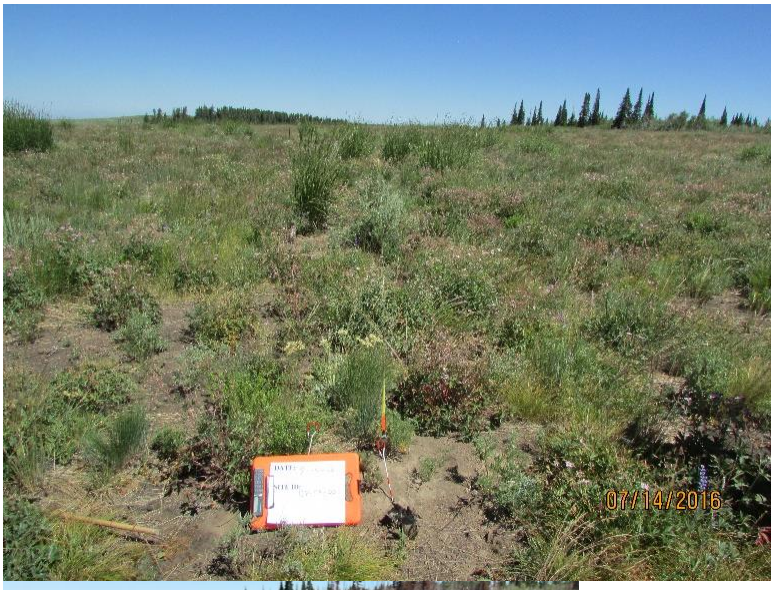

Figure 35: Pre-Fire Photo CP-FF-2S
Allotment: Coal Pit
Pasture: First Fork
Unit #: 2S
Date: July 14th, 2016
Direction: North

Figure 36: Post-Fire Photo CP-FF-2S
Allotment: Coal Pit
Pasture: First Fork
Unit #: 2S
Date: June 29th, 2021
Direction: North

Figure 37: Post-Fire Photo CP-FF-2S
Allotment: Coal Pit
Pasture: First Fork
Unit #: 2S
Date: July 27th, 2022
Direction: North

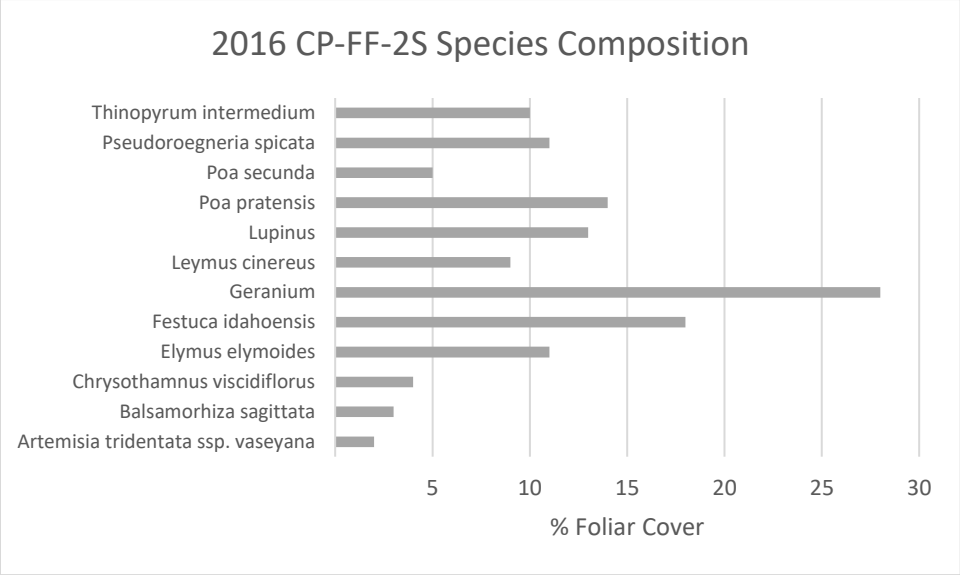

Figure 38: 2016 CP-FF-2S Species Composition

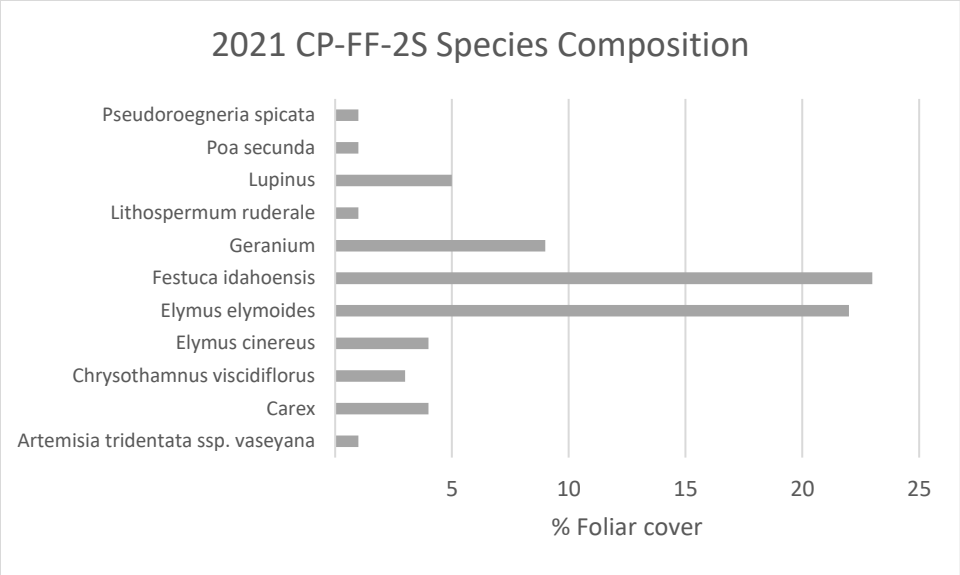

Figure 39: 2021 CP-FF-2S Species Composition

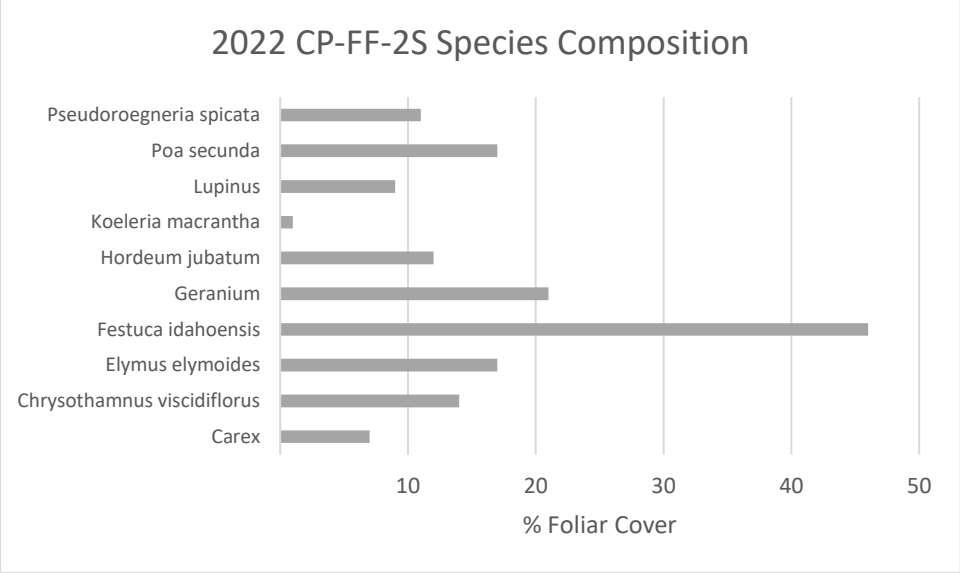

Figure 40: 2022 CP-FF-2S Species Composition

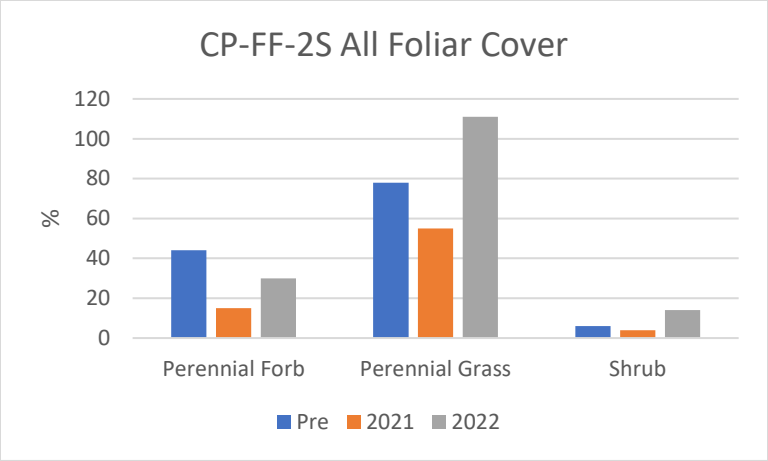

Figure 41: Percent All foliar cover at CP-FF-2S

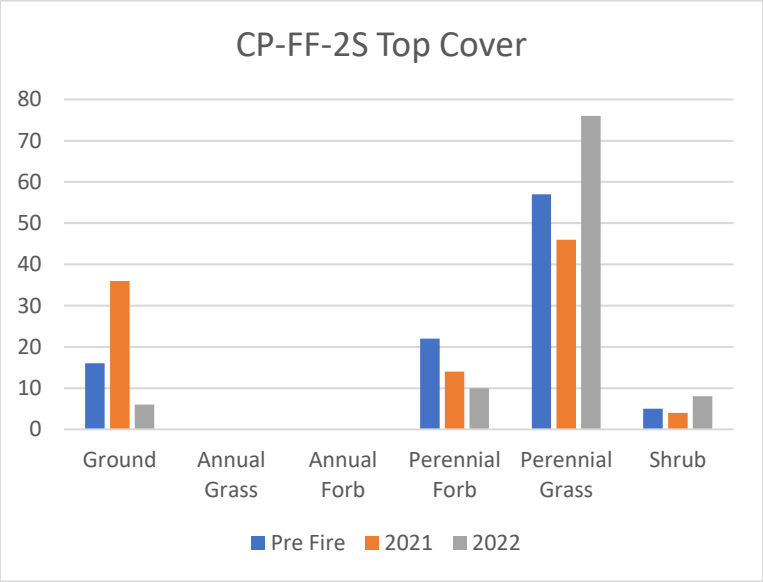

Figure 42: Percent Top cover at CP-FF-2S

Notes:
The pre- and post- photos taken at this site indicate that the burn in the First Fork area was not nearly as severe as in other sites. Post-fire, Idaho Fescue (*Festuca Idahoensis)*, squirreltail *(Elymus elymoides)*, Western Stone seed *(Lithospermum ruderale)*, and *carex* are in higher cover than pre-fire. Although, as we can see, there is greater soil and herbaceous litter hits post-fire, indicating that the overall ground cover is sparser. The decreases in species detected post-fire is likely due to the area also burning in 2012 in the Cave Canyon Fire and because 2021 is a drought year.

CP-LR-3B

Figure 43: Pre-Fire Photo CP-LR-3B
Allotment: Coal Pit
Pasture: Long Ridge
Unit #: 3B
Date: May 31st, 2016
Direction: North

Figure 44: Post-Fire Photo CP-LR-3B
Allotment: Coal Pit
Pasture: Long Ridge
Unit #: 3B
Date: July 7th, 2021
Direction: North

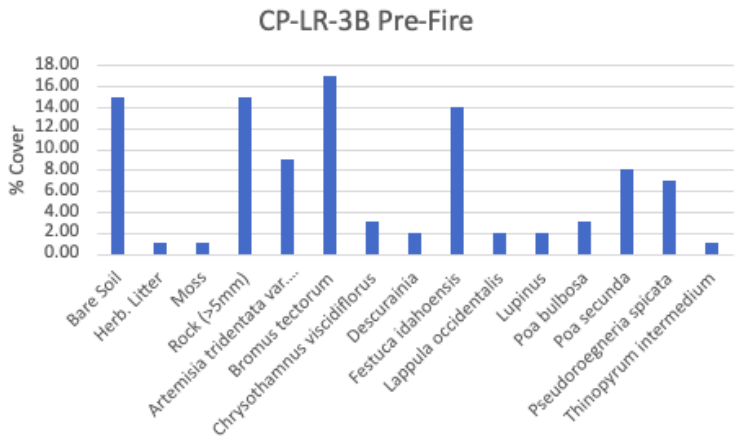

Figure 45: Pre-Fire Detected Species Percent Cover

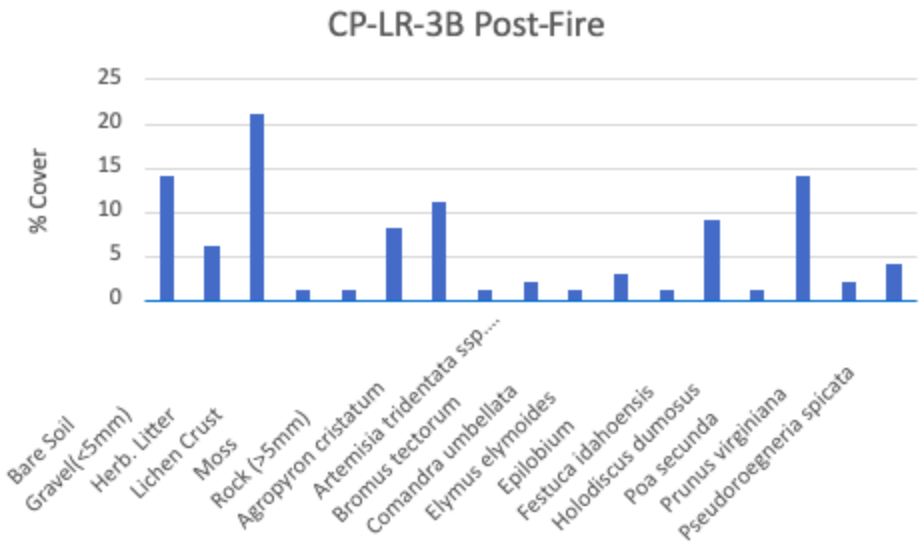

Figure 46: Post-Fire Detected Species Percent Cover

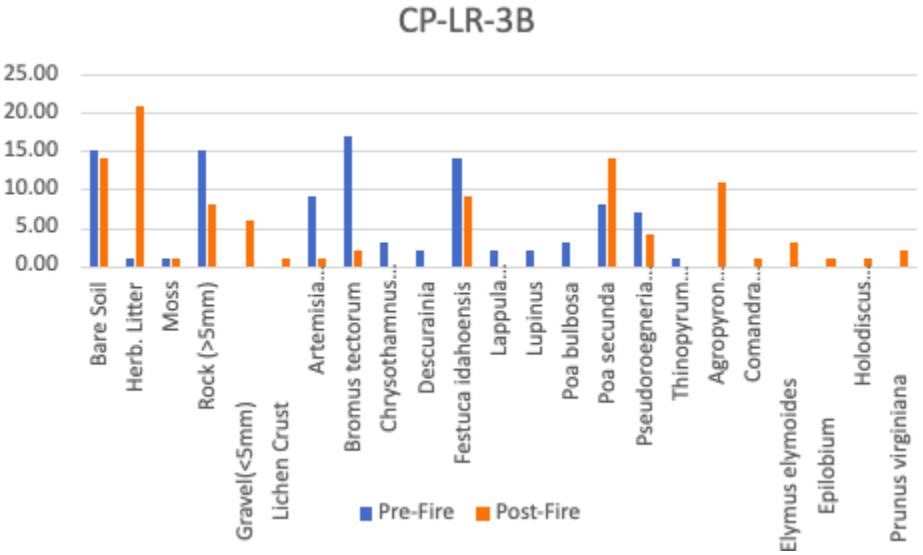

Figure 47: Comparison of Pre- and Post-Fire Detected Species Percent Cover

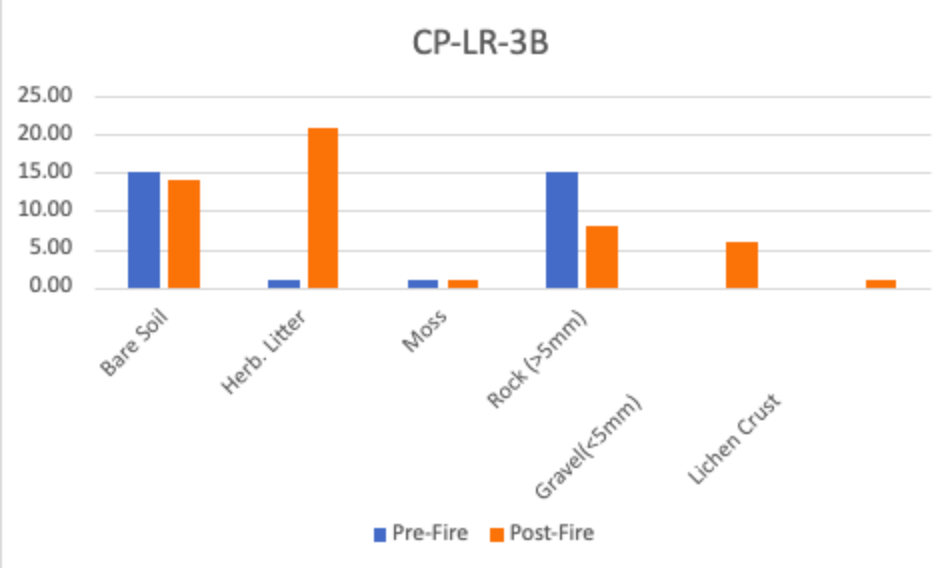

Figure 48: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

Notes:
The species composition in this site differs widely pre- and post- fire. This site was a low-intensity burn. It should be noted that post-fire cheatgrass (*Bromus techtorum*) went from approximately 17% cover to about 2%. This is important because cheatgrass is an invasive species. Further, pre-fire species not detected include yellow rabbitbrush *(Chrysotamnus visdlorus)*, tansy mustard *(Descuralinia)*, bulbous bluegrass *(poa bulbosa)*, lupine *(Lupinus)*, and intermediate wheatgrass *(thinopyrum intermedium)*. Post-fire species detected that were not present in 2016 include willowherb *(Epilobium)*, rockspirea *(holodiscus dumasus)*, chokecherry *(prunus virginiana)*, crested wheatgrass *(agropyron crustatium)*, bastard toadflax *(comandra umbellala)*, and squirreltail *(elymus elymoides)*. Fire impacted mountain big sagebrush (*Artemisia tridentata ssp. Vaseyana*) at this site, Figure 116 highlights that this sagebrush decreased from approximately 9% cover pre-fire to around 2%. This site is likely to see increases of invasive annual grasses and increaser species in 2022.Close attention needs to be paid to the amount of bulbous bluegrass cover in comparison to native species at this site in the future.

OV-RC-5B

Figure 49: Pre-Fire Photo OV-RC-5B
Allotment: Oakley Valley
Pasture: Rodeo Creek
Unit #: 5B
Date: June 14th, 2016
Direction: North

Figure 50: Post-Fire Photo OV-RC-5B
Allotment: Oakley Valley
Pasture: Rodeo Creek
Unit #: 5B
Date: June 23rd, 2021
Direction: North

Figure 51: Post-Fire Photo OV-RC-5B
Allotment: Oakley Valley
Pasture: Rodeo Creek
Unit #: 5B
Date: July 8th, 2022
Direction: North

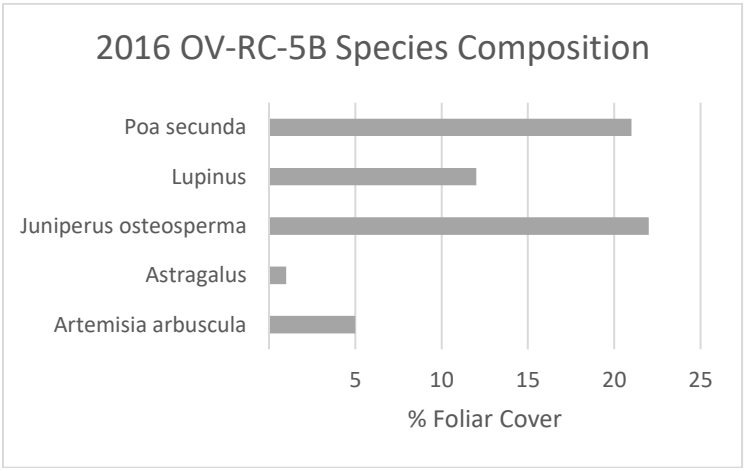

Figure 52: Pre-Fire Detected Species Percent Cover

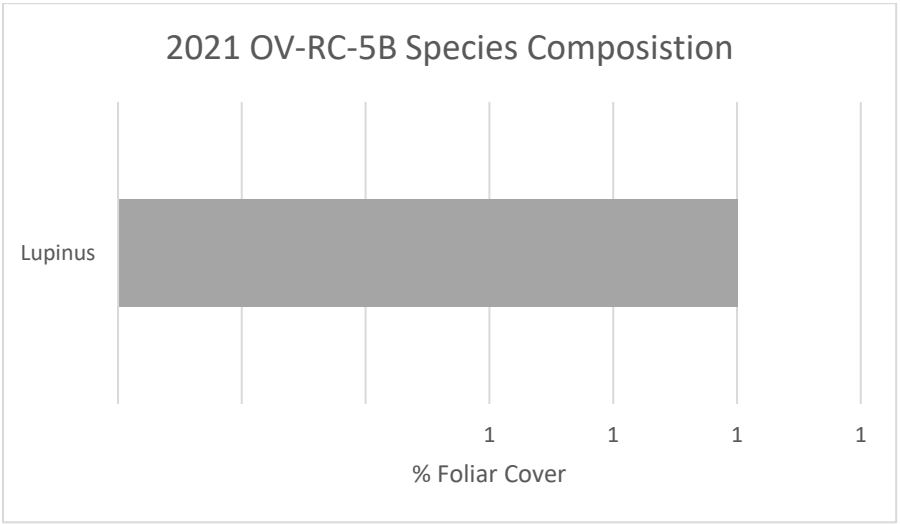

Figure 53: Post-Fire Detected Species Percent Cover

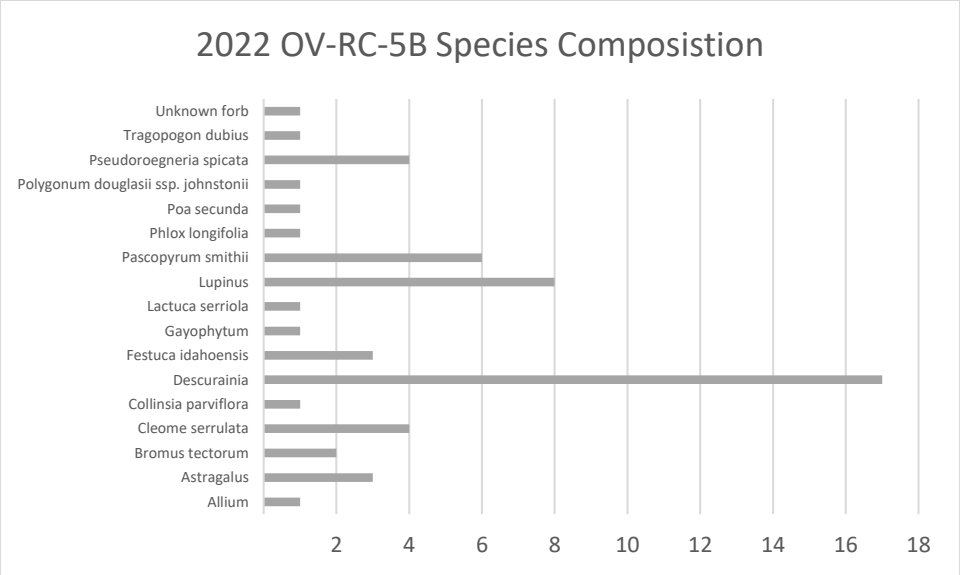

Figure 54: Comparison of Pre- and Post-Fire Detected Species Percent Cover

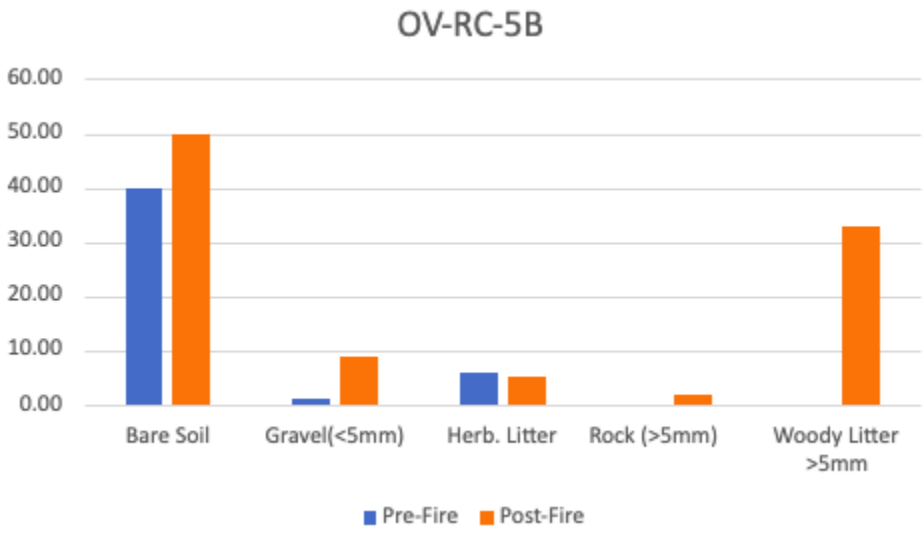

Figure 55: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

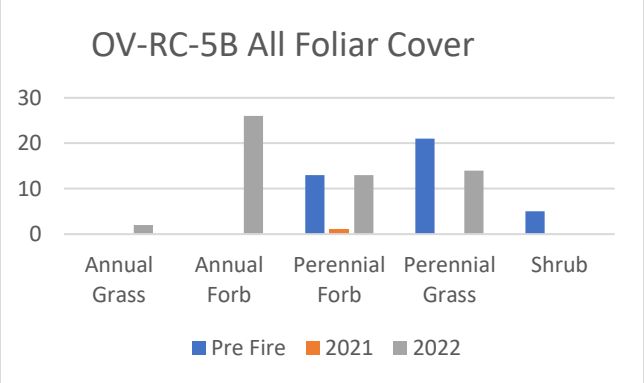

Figure 56: Percent All foliar cover by functional group

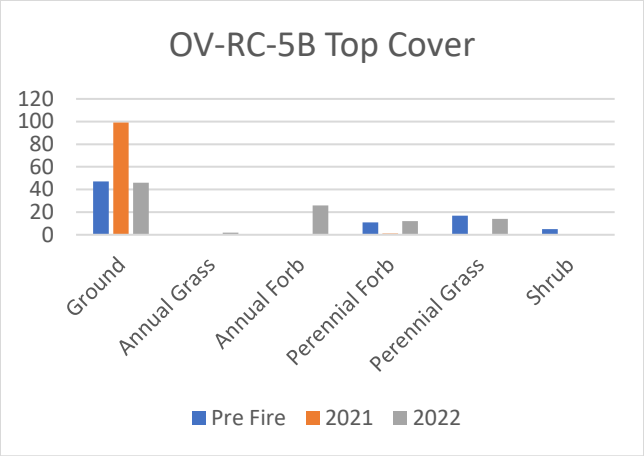

Figure 57: Percent Top cover by functional group

Notes:
Mastication occurred in the Trapper Creek corridor in November and December of 2020 to assist in increasing germination potential of the seeds flown. Just under 1,000 acres were masticated.

Rodeo Creek was one area of five areas that were masticated and seeded post-Badger fire. The other areas included Hudson Ridge, Trapper Creek, Squaw Creek, and Little Squaw Creek. This seed mix included mountain big sagebrush *(Artemisia tridentata ssp. vaseyana)*, bluebunch wheatgrass *(Pseudoroegneria spicata)*, Idaho Fescue *(Festuca idahoensis)*, and Sandberg bluegrasss *(Poa secunda)*. These seeds may not yet be established. The Trapper Creek drainage witnessed high wind driven fire. This and the fact that the area had a great deal of fuel loading due to juniper encroachment resulted in high severity effects in most areas with noticeable soil effects. The combination of poor soil quality and the fact that the winter and spring of 2021 was below normal precipitation and above average temperatures has been detrimental to seed establishment. In 2022, Sandberg bluegrass (1%), bluebunch wheatgrass (4%), Idaho fescue (3%), and western wheatgrass (6%) were detected. It is likely that seeded species did not germinate in 2021 as the conditions were unfavorable. Seeds applied in 2020 may no longer be viable. This site also had a very large increase in cover of tumble mustard (*Descurania*), an introduced annual forb. Another annual native forb detected in this site is Rocky Mountain Bee Plant (*Cleome serrulata*). This unpalatable forb has spread widely in the burned area of Trapper creek, especially in the mastication. This site will need to be closely monitored in the future for annual grass and forb invasion.

OV-NW-5B

Figure 58: Pre-Fire Photo OV-NW-5S
Allotment: Oakley Valley
Pasture: North Water
Unit #: 5S
Date: June 20th, 2016
Direction: North

Figure 59: Post-Fire Photo OV-NW-5S
Allotment: Oakley Valley
Pasture: North Water
Unit #: 5S
Date: June 30th, 2021
Direction: North

Figure 60: Post-Fire Photo OV-NW-5S
Allotment: Oakley Valley
Pasture: North Water
Unit #: 5S
Date: June 13th, 2022
Direction: North

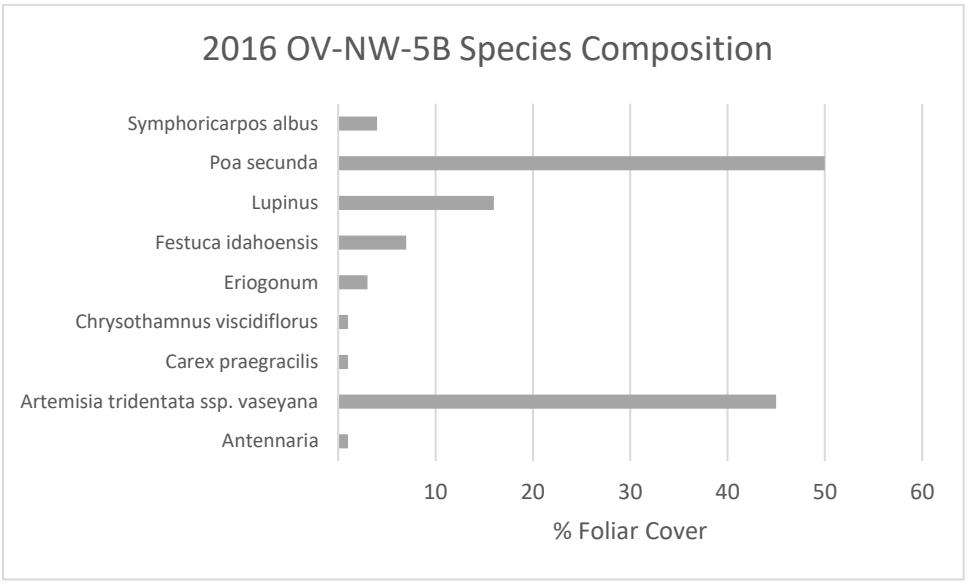

Figure 61: Pre-Fire Detected Species Percent Cover

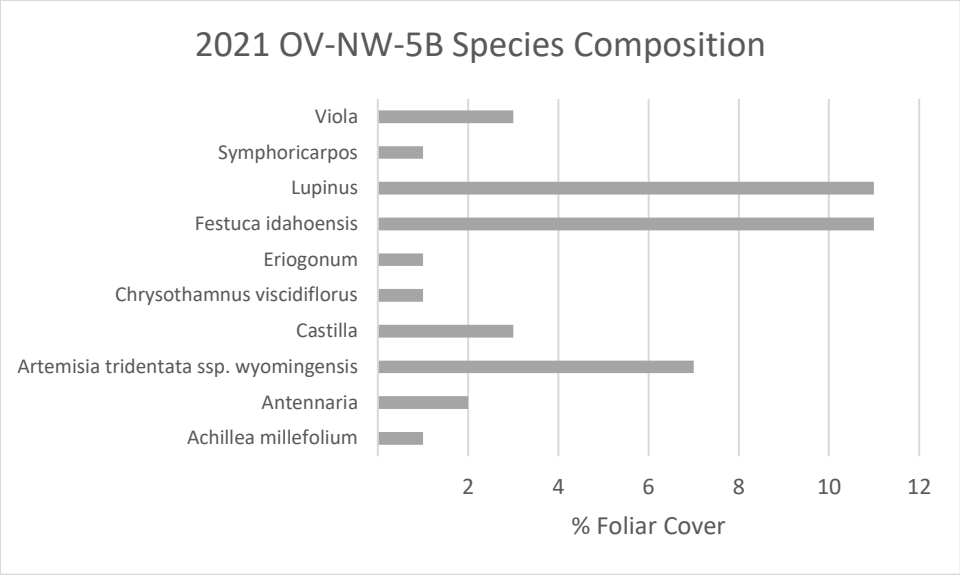

Figure 62: Post-Fire Detected Species Percent Cover

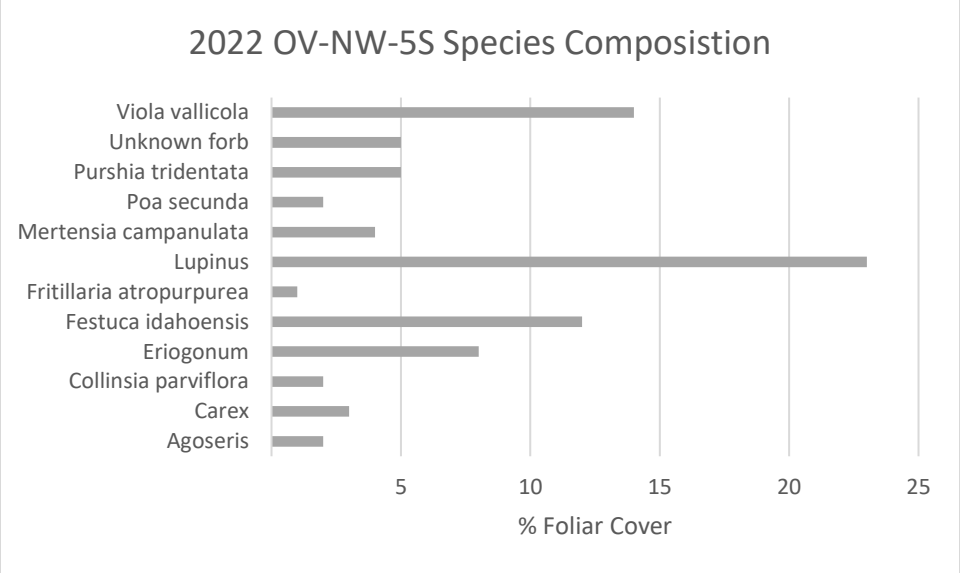

Figure 63: Comparison of Pre- and Post-Fire Detected Species Percent Cover

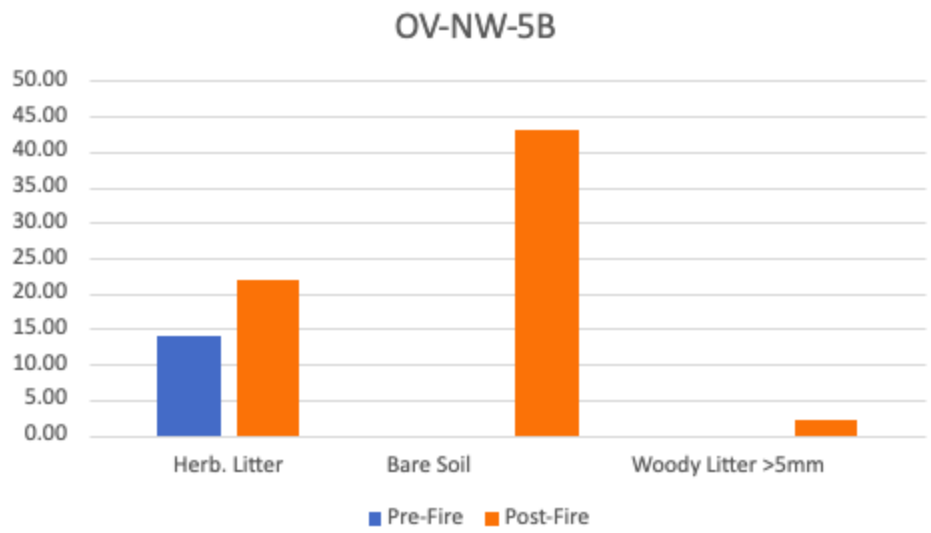

Figure 64: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

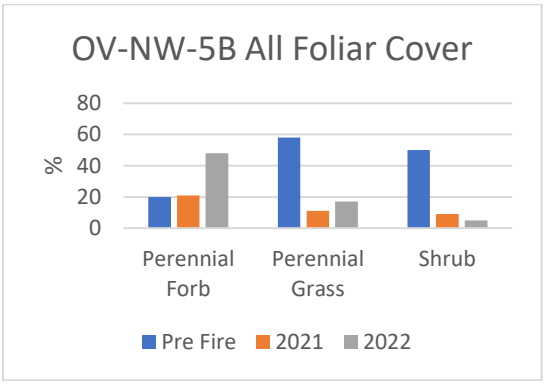

Figure 65: Percent All foliar cover by functional group

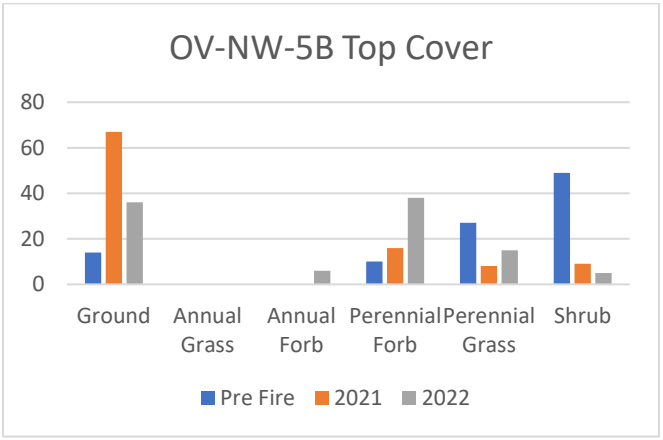

Figure 66: Percent Top cover by functional group.

Notes:
Bare soil percentage went up a total of 43% in 2021. This is likely indicative of high fire intensity. Plant regeneration at this site and pasture as a whole has been considerably slower than

sites in similar ecological types. In 2021, bare soil was extremely high, and persisted into 2022. Perennial grass had a slight increase from 2021 to 2022. Lupine responded to the fire well, almost doubling in foliar cover.

CP-IS-2S

Figure 67: Pre-Fire Photo CP-IS-2S
Allotment: Coal Pit
Pasture: Indian Springs
Unit #: 2S
Date: July 7th, 2016
Direction: North

Figure 68: Post-Fire Photo CP-IS-2S
Allotment: Coal Pit
Pasture: Indian Springs
Unit #: 2S
Date: July 8th, 2021
Direction: North

Figure 69: Post-Fire Photo CP-IS-2S
Allotment: Coal Pit
Pasture: Indian Springs
Unit #: 2S
Date: July 11th, 2022
Direction: North

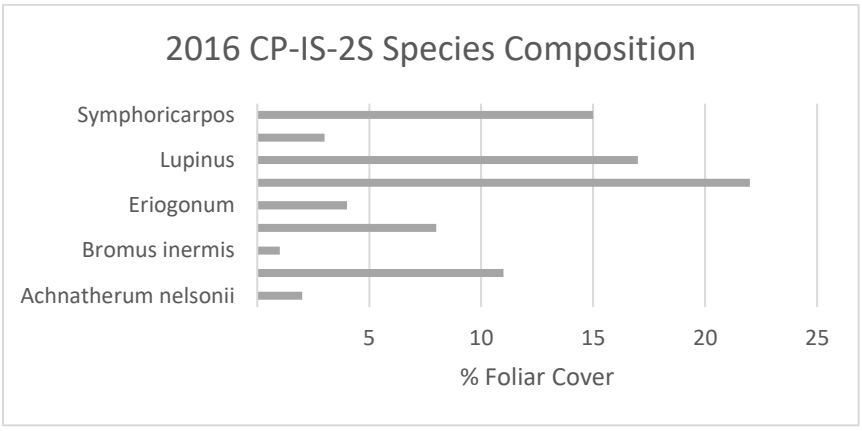

Figure 70: Pre-Fire Detected Species Percent Cover

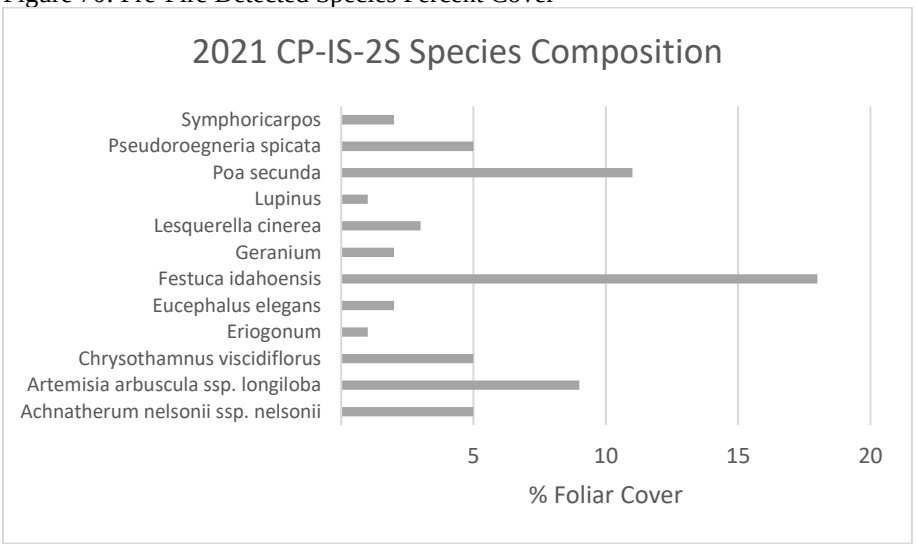

Figure 71: Post-Fire Detected Species Percent Cover

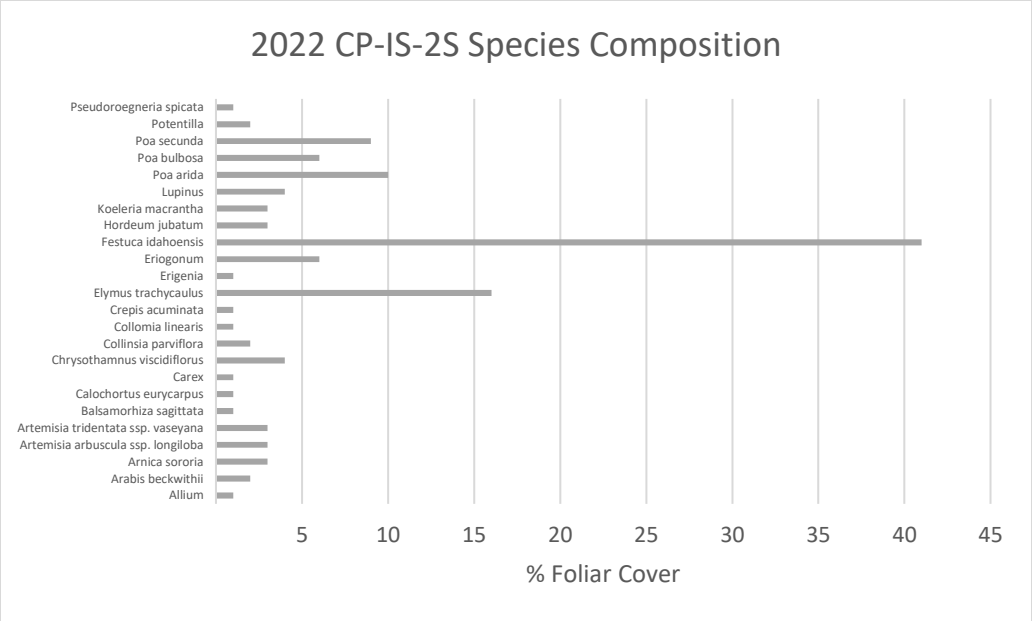

Figure 72: Comparison of Pre- and Post-Fire Detected Species Percent Cover

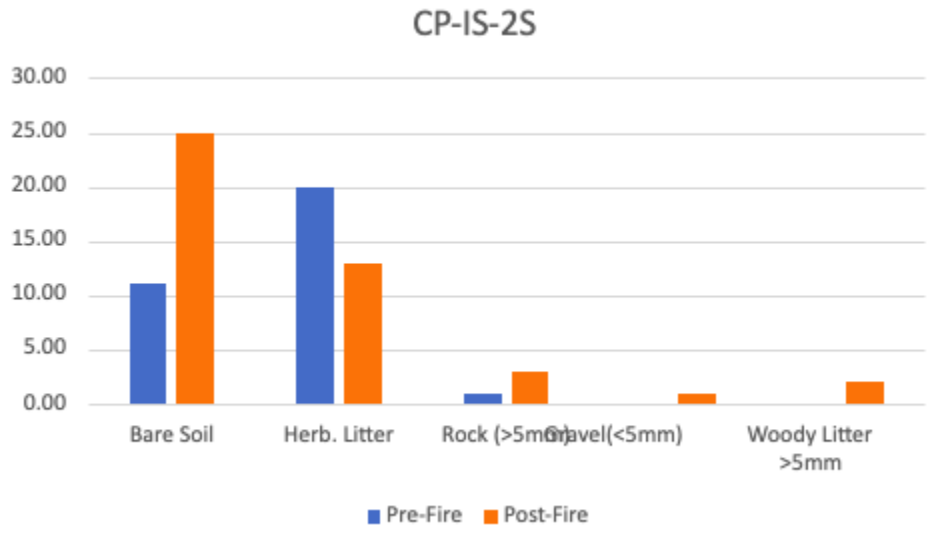

Figure 73: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

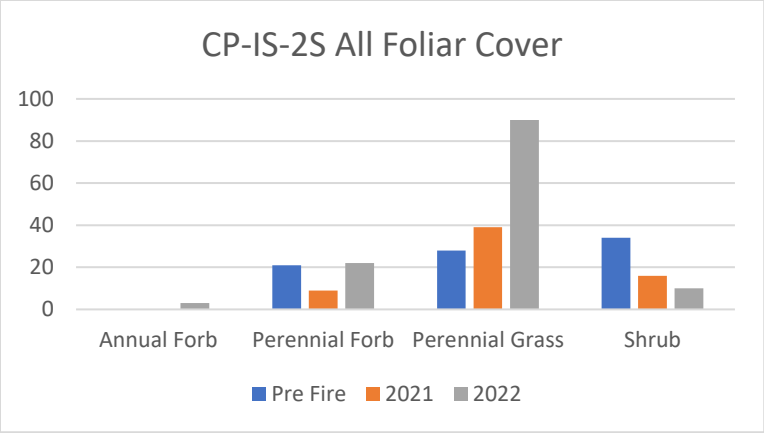

Figure 74: Percent all foliar cover by functional group.

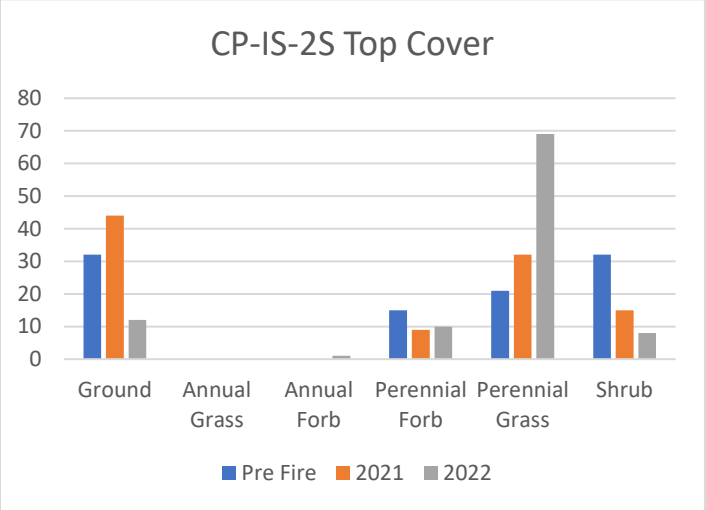

Figure 75: Percent top cover by functional group

Notes:
Bare soil percentage increased from 11% to 25% between 2016 and 2021, but recovery in 2022 decreased bare ground considerably. Perennial grasses at this site responded well, especially Idaho fescue, amounting to over 40% foliar cover. Shrub cover has continually decreased at the site. According to our composition data, both low sage and big sage were detected. This indicates the site lays on a soil type transition. Low sage frequently grows in shallow soils. Shallow soils often cannot support as much vegetation as deep soils, and is more vulnerable to invasion of annual grasses and forbs.

OV-BC-5S

Figure 78: Pre-Fire Photo OV-BC-5S
Allotment: Oakley Valley
Pasture: Buck Corral
Unit #: 5S
Date: July 26th, 2016
Direction: North

Figure 79: Post-Fire Photo OV-BC-5S
Allotment: Oakley Valley
Pasture: Buck Corral
Unit #: 5S
Date: July 7th, 2021
Direction: North

Figure 80: Post-Fire Photo OV-BC-5S
Allotment: Oakley Valley
Pasture: Buck Corral
Unit #: 5S
Date: July 14th, 2022
Direction: North

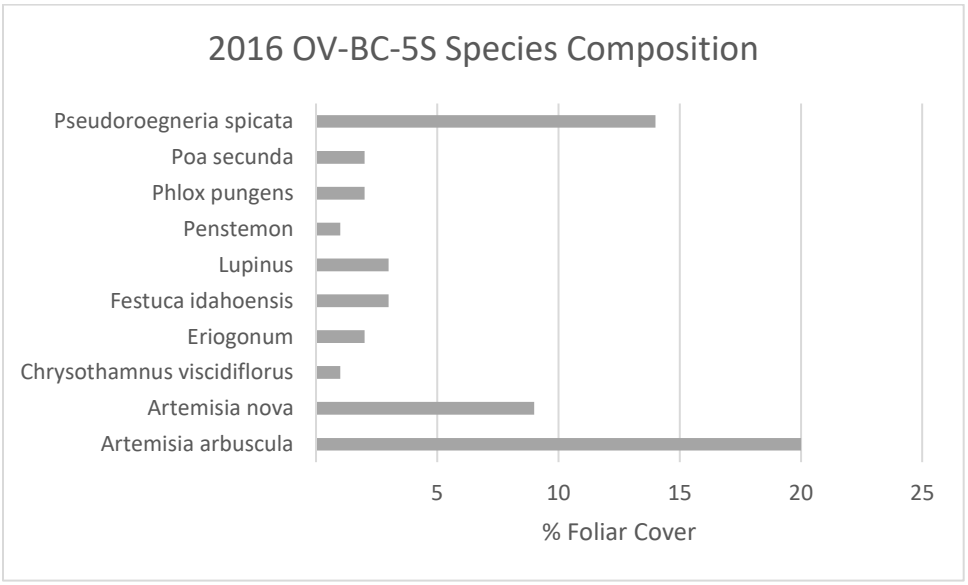

Figure 81: Pre-Fire Detected Species Percent Cover

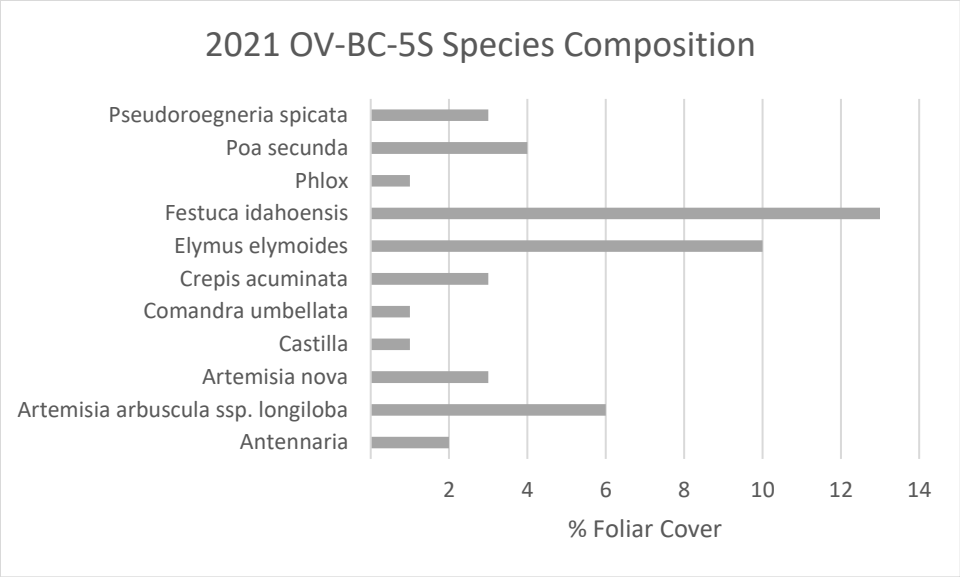

Figure 82: Post-Fire Detected Species Percent Cover

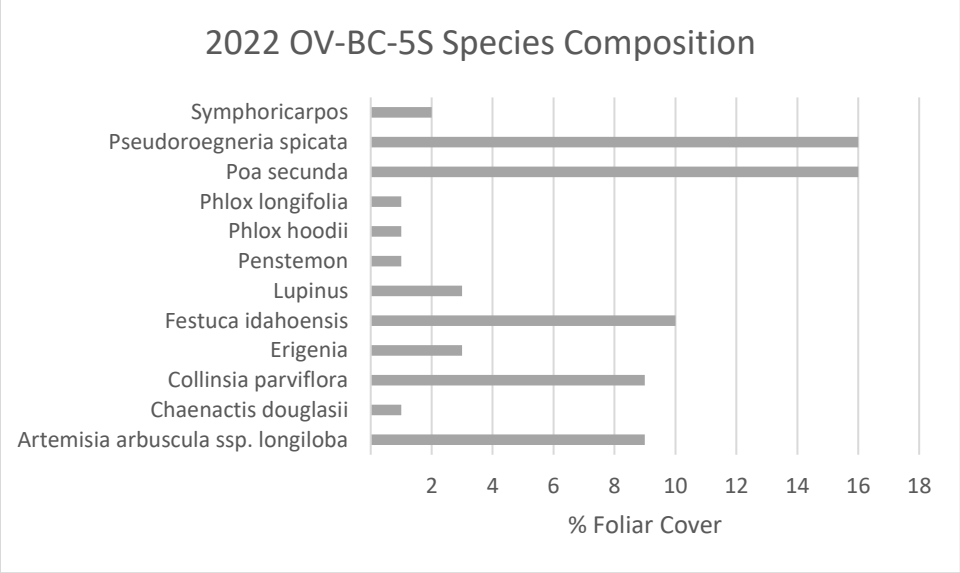

Figure 83: Comparison of Pre- and Post-Fire Detected Species Percent Cover

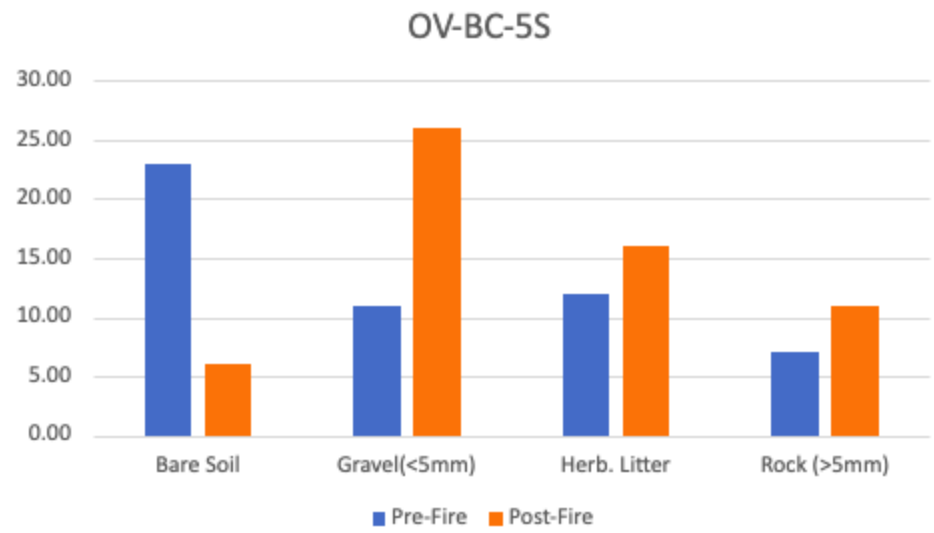

Figure 84: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

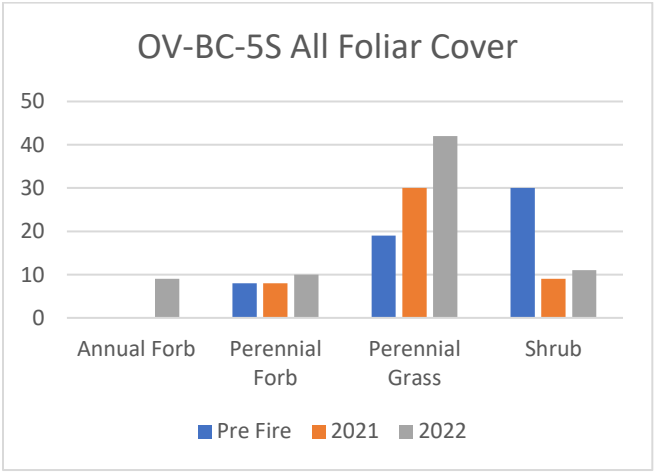

Figure 85: Percent foliar cover by functional group.

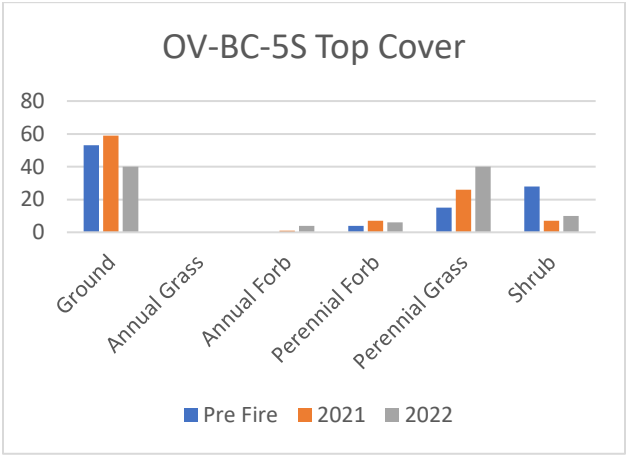

Figure 86: Percent top cover by functional group.

Notes:
This site is responding well post fire, likely because it burned at a low intensity due to low growing vegetation. There was some sagebrush survival, and perennial grasses including bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue are all increasing in cover. The increase in annual forbs is from a native, Maiden blue-eyed Mary (*Collinsia parviflora)*, which provides good forage to sage grouse early in the spring.

OV-LB-2S

Figure 87: Pre-Fire Photo OV-LB-2S
Allotment: Oakley Valley
Pasture: Lower Bostetter
Unit #: 2S
Date: July 30th, 2016
Direction: North

Figure 88: Post-Fire Photo OV-LB-2S
Allotment: Oakley Valley
Pasture: Lower Bostetter
Unit #: 2S
Date: June 28th, 2021
Direction: North

Figure 89: Post-Fire Photo OV-LB-2S
Allotment: Oakley Valley
Pasture: Lower Bostetter
Unit #: 2S
Date: July 6th, 2022
Direction: North

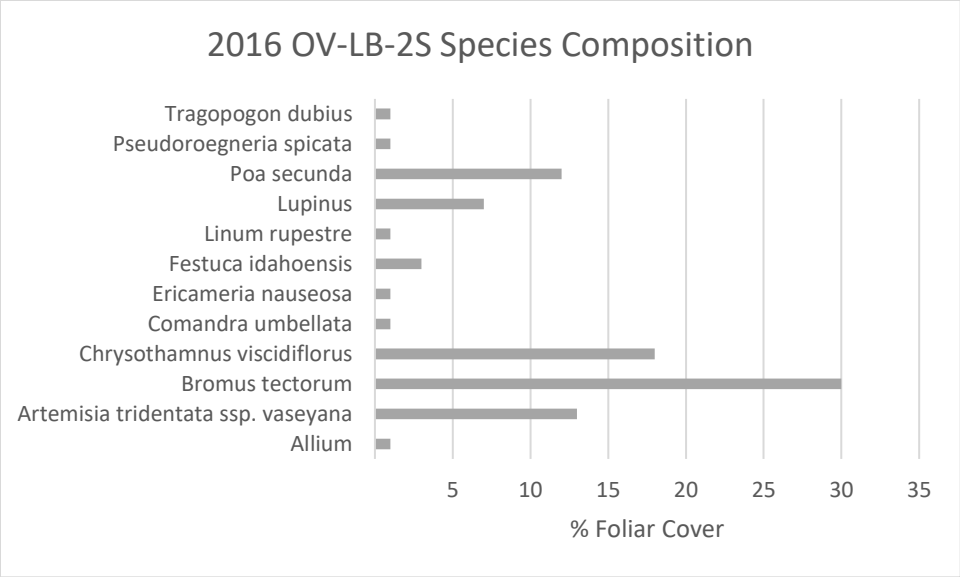

Figure 90: Pre-Fire Detected Species Percent Cover

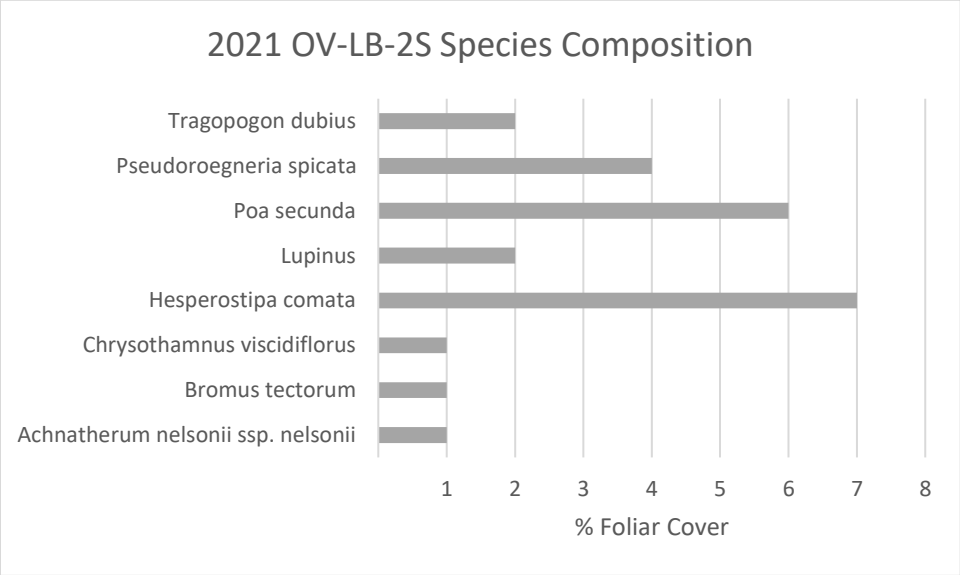

Figure 91: Post-Fire Detected Species Percent Cover

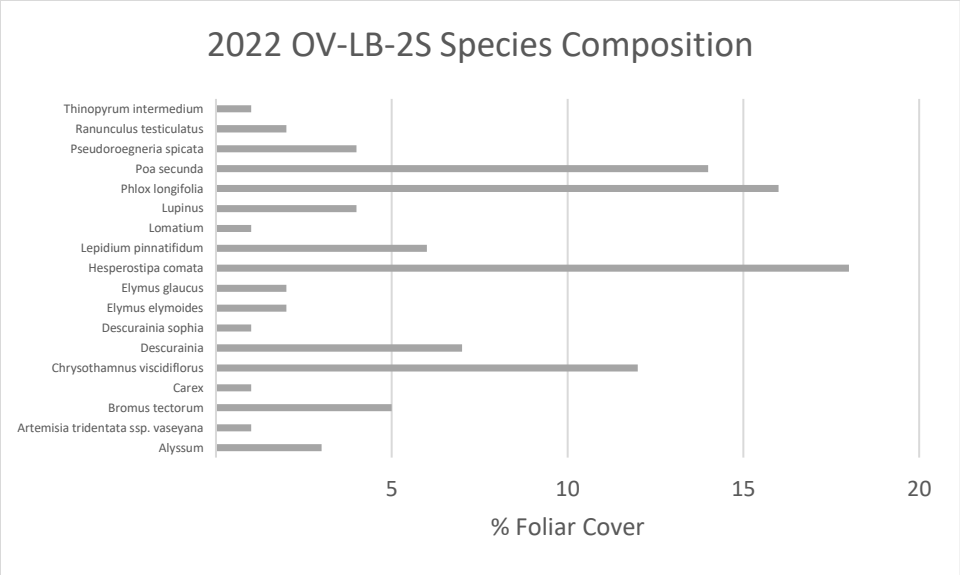

Figure 92: Comparison of Pre- and Post-Fire Detected Species Percent Cover

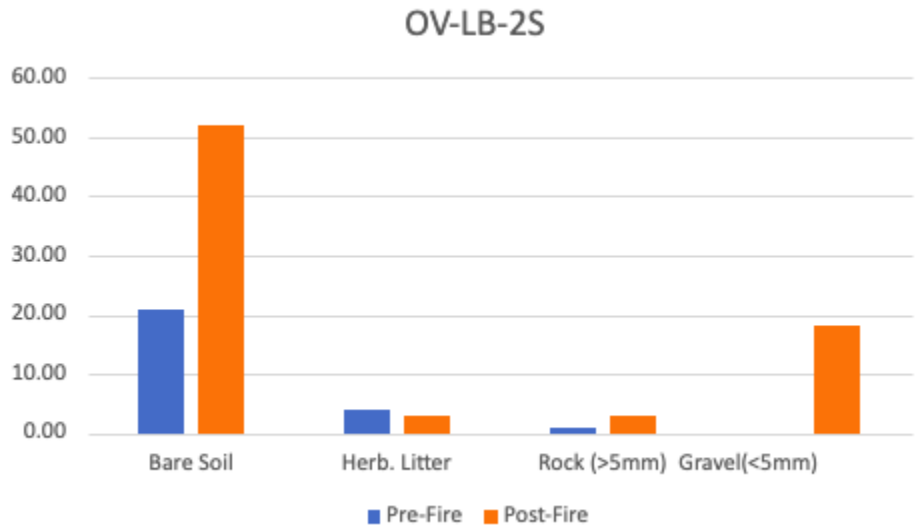

Figure 93: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

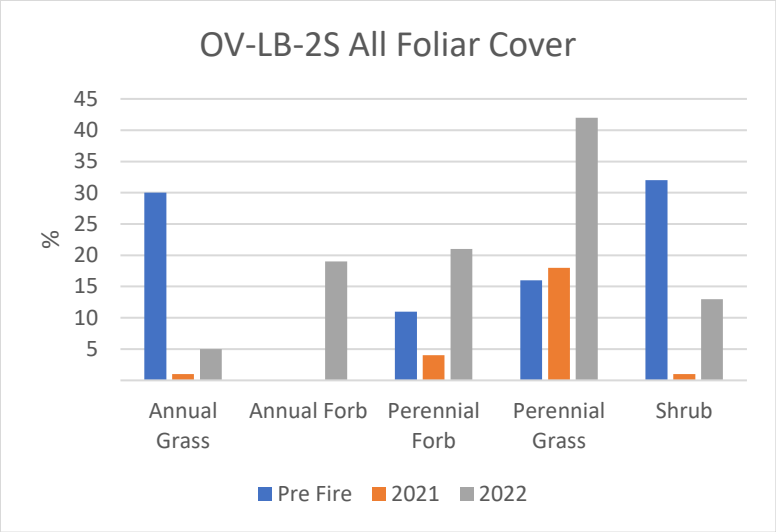

Figure 94: Percent all foliar cover by functional group.

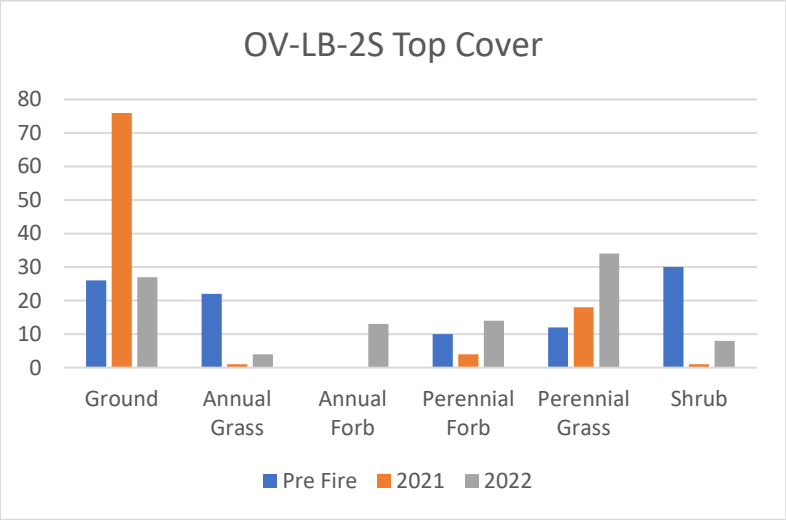

Figure 95: Percent top cover by functional group.

Notes:

The juniper in moderate and high intensity burn areas, such as in Figure 65, were readily killed by fire. Nearly all shrub cover was lost.. Species dominance at this site has changed considerably following fire. In 2016, the primary grasses present were cheatgrass and Sandberg bluegrass. In 2022, the dominant grasses were Needle-and-Thread (*Hesperostipa comata)*, and Sandberg bluegrass. Cheatgrass decreased in foliar cover from 30% in 2016 to 5% in 2022. This site will likely increase in composition considerably, as fire has released the seedbank and the vegetation will not have to compete with juniper.

OV-UB-2S

Figure 96: Pre-Fire Photo OV-UB-2S
Allotment: Oakley Valley
Pasture: Upper Bostetter
Unit #: 2S
Date: June 6, 2016
Direction: North

Figure 97: Post-Fire Photo OV-UB-2S
Allotment: Oakley Valley
Pasture: Upper Bostetter
Unit #: 2S
Date: July 8th, 2021
Direction: North

Figure 98: Post-Fire Photo OV-UB-2S
Allotment: Oakley Valley
Pasture: Upper Bostetter
Unit #: 2S
Date: July 8th, 2021
Direction: North

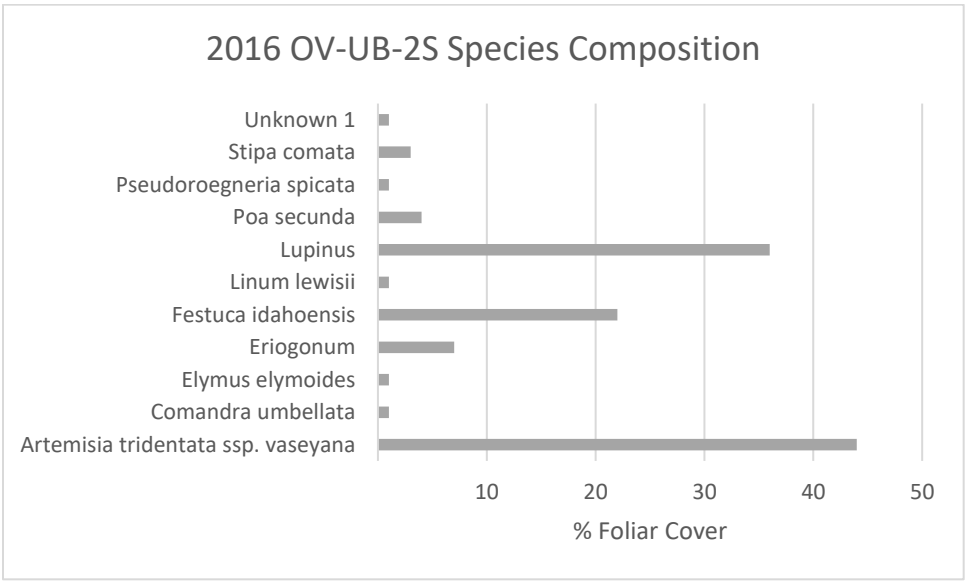

Figure 99: Pre-Fire Detected Species Percent Cover

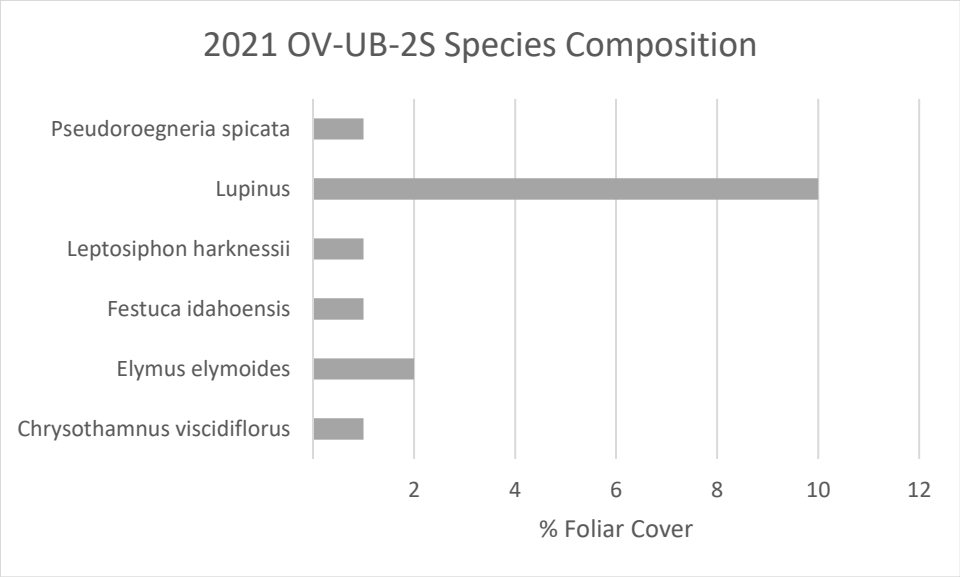

Figure 100: Post-Fire Detected Species Percent Cover

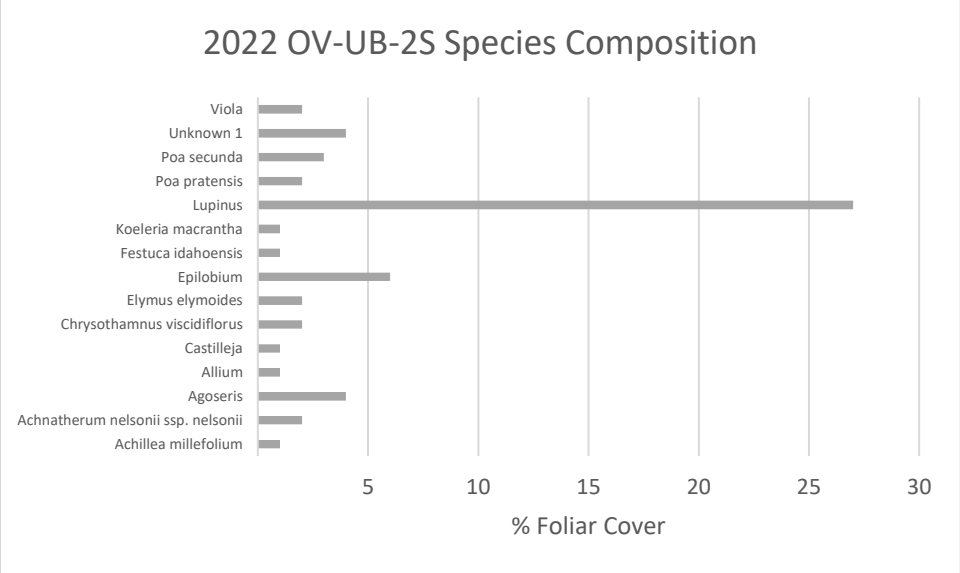

Figure 101: Comparison of Pre- and Post-Fire Detected Species Percent Cover

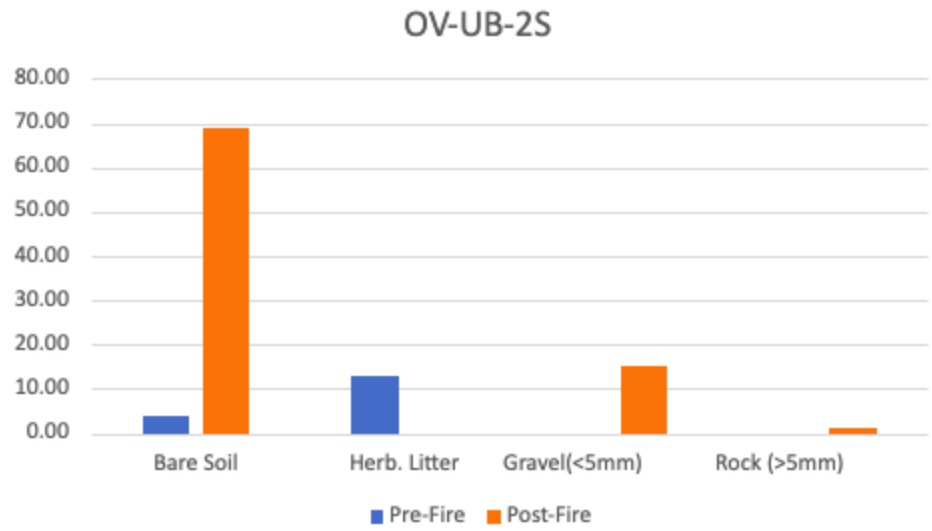

Figure 102: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

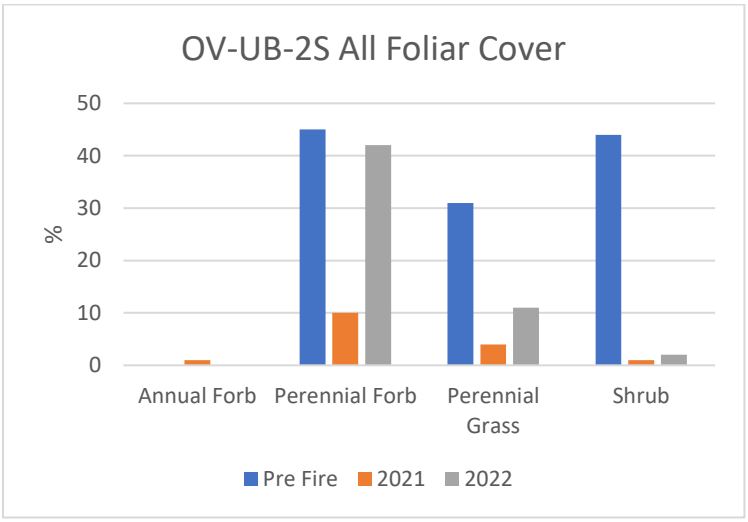

Figure 103: Percent all foliar cover by functional group.

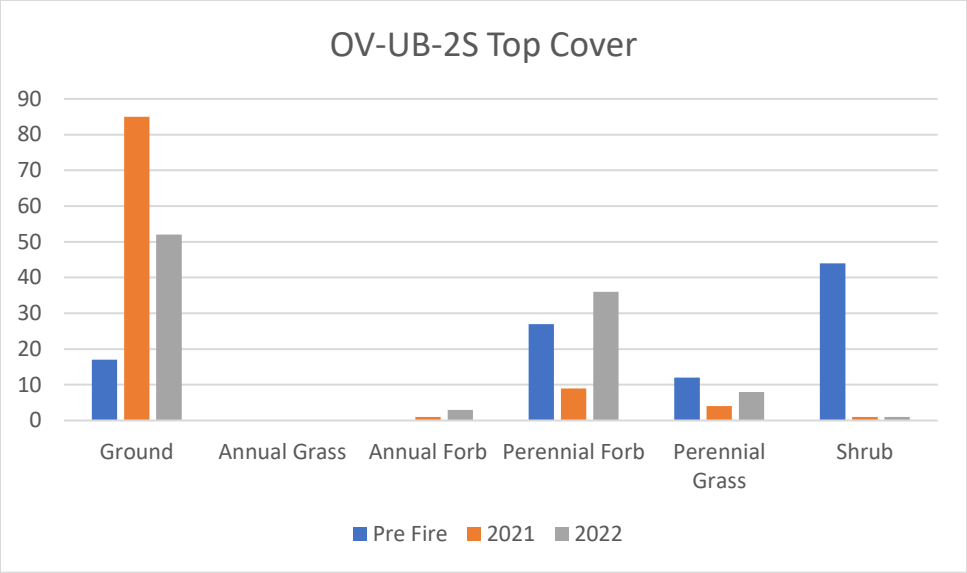

Figure 105: Percent top cover by functional group

Notes:
OV-UB-2S is clearly another site largely impacted by high intensity fire. This site had almost no foliar cover in 2021, and the third highest amount of bare soil of monitored sites in 2022. The fire severity at this site likely impacted the seedbank considerably. Fortunately, this site still has fair forb diversity. Five different grasses were detected in 2021, totaling 7% foliar cover. Grazing at this site should be monitored very closely, as livestock will likely target the very few grass species in this area.

CP-RH-3S

Figure 106: Pre-Fire Photo CP-RH-3S
Allotment: Coal Pit
Pasture: Rams Horn
Unit #: 3S
Date: 2016
Direction: North

Figure 107: Post-Fire Photo CP-RH-3S
Allotment: Coal Pit
Pasture: Rams Horn
Unit #: 3S
Date: July 7th, 2021
Direction: North

Figure 108: Post-Fire Photo CP-RH-3S
Allotment: Coal Pit
Pasture: Rams Horn
Unit #: 3S
Date: July 28th, 2022
Direction: North

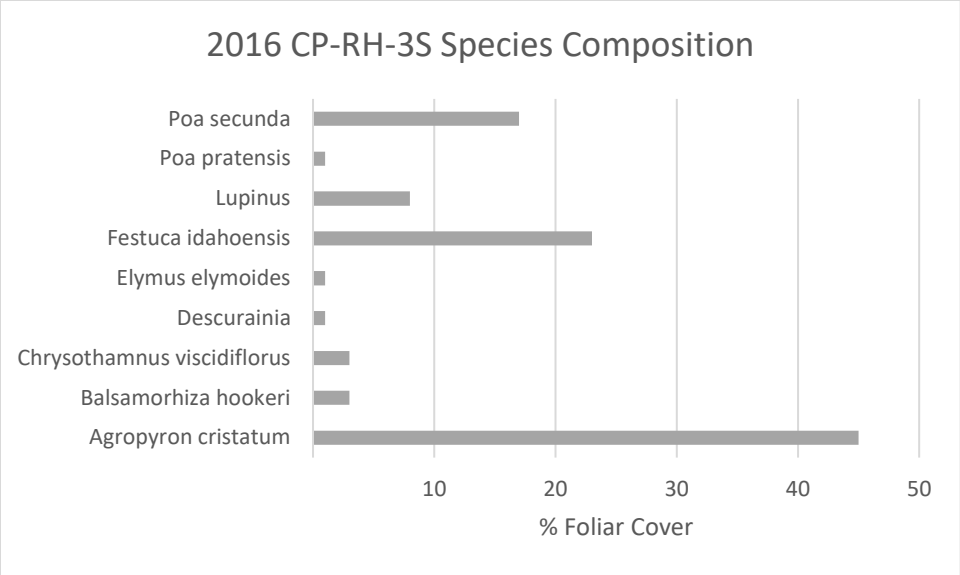

Figure 109: Pre-Fire Detected Species Percent Cover

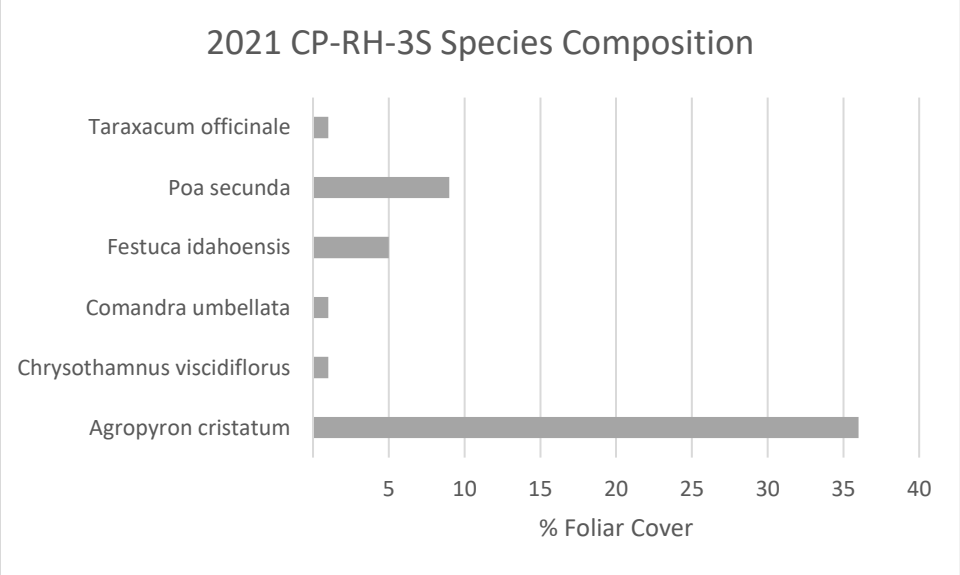

Figure 110: 2021 Post-Fire Detected Species Percent Cover

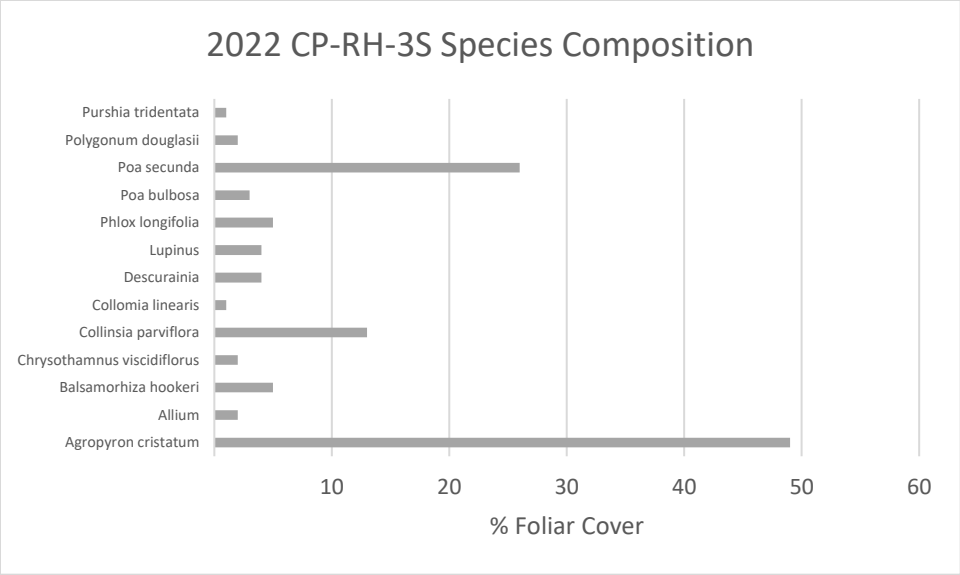

Figure 111: 2022 Post-Fire Detected Species Percent Cover

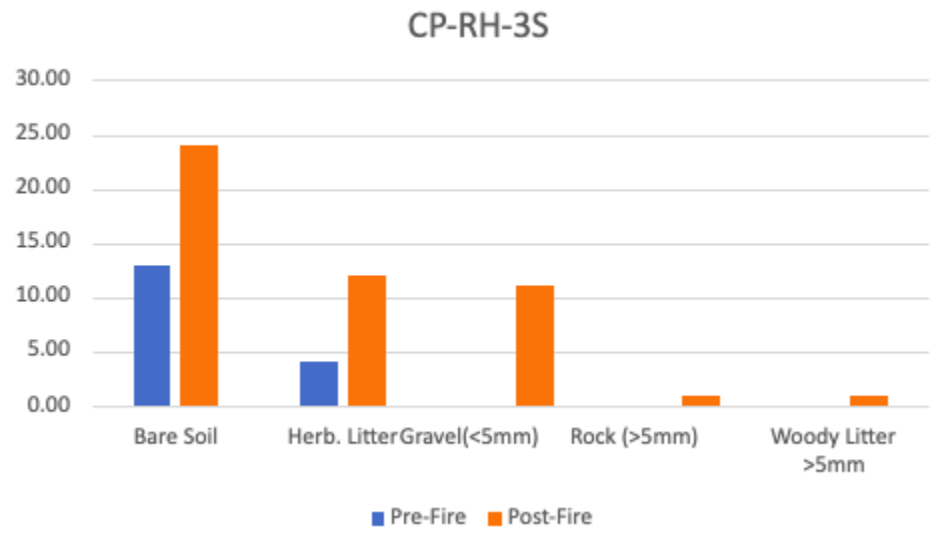

Figure 112: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

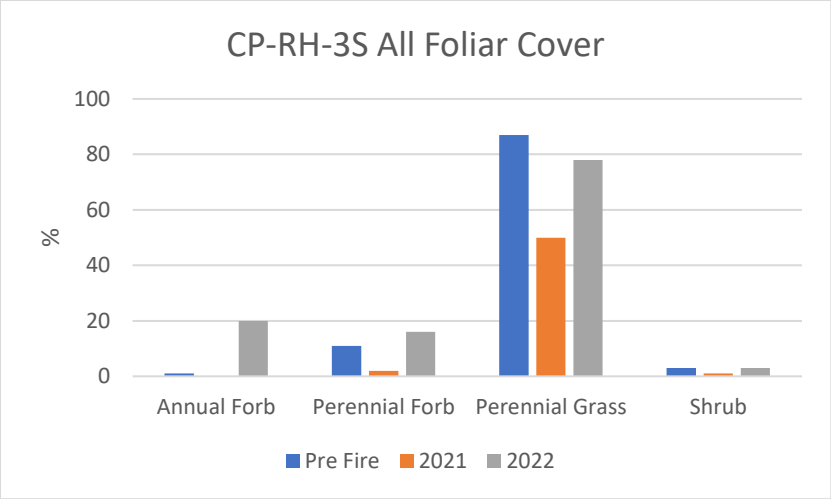

Figure 113: Percent all foliar cover by functional group

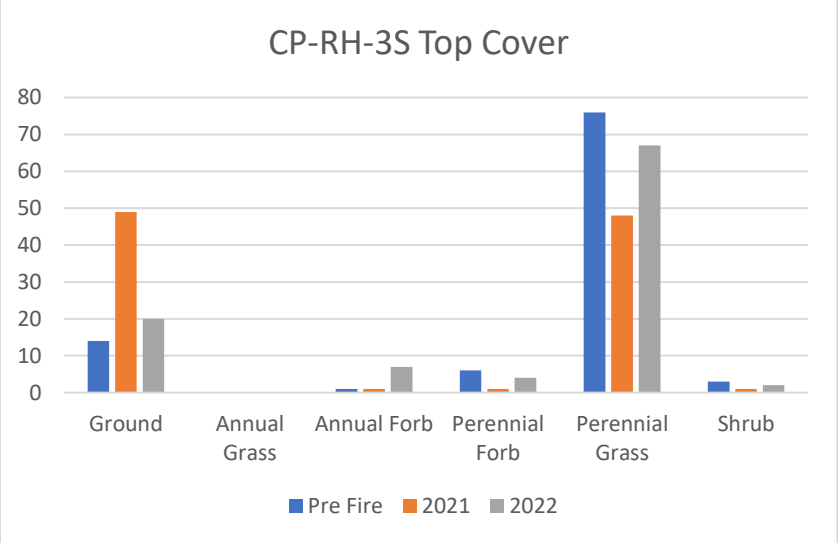

Figure 114: Percent top cover by functional group.

Notes:
Perennial grass cover at this site has increased considerably, almost to pre-fire levels. The grasses present in 2022 are crested wheatgrass, Sandberg bluegrass, and bulbous bluegrass. Crested wheatgrass and bulbous bluegrass are both introduced species. This site burned in both the Cave Canyon and Badger fires and will likely need management actions to restore species diversity in both grasses and forbs.

CP-C-1S

Figure 115: Pre-Fire Photo CP-C-1S
Allotment: Coal Pit
Pasture: Corral
Unit #: 1S
Date: August 4th, 2016
Direction: North

Figure 116: Post-Fire Photo CP-C-1S
Allotment: Coal Pit
Pasture: Corral
Unit #: 1S
Date: June 21st, 2021
Direction: North

Figure 117: Post-Fire Photo CP-C-1S
Allotment: Coal Pit
Pasture: Corral
Unit #: 1S
Date: July 11th, 2022
Direction: North

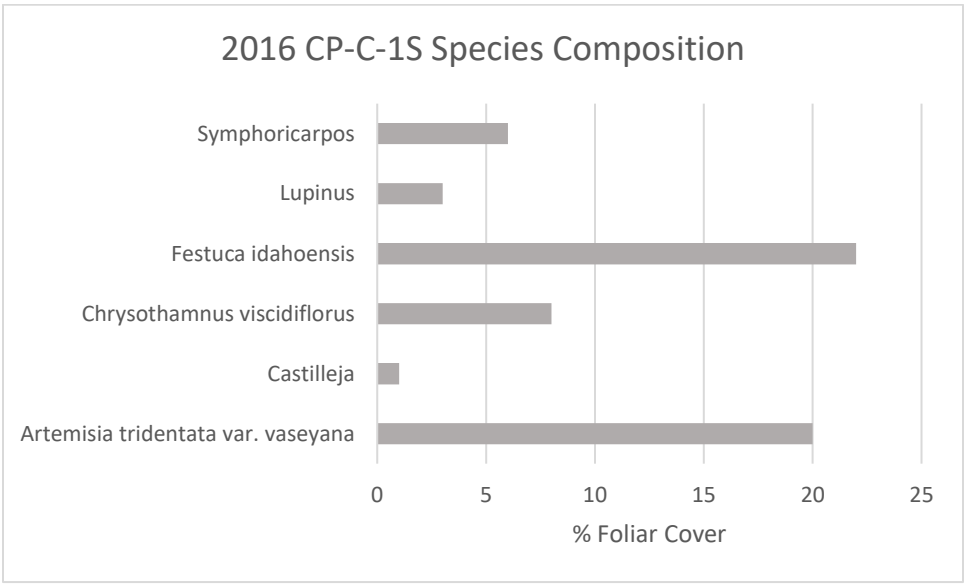

Figure 118: Pre-Fire Detected Species Percent Cover

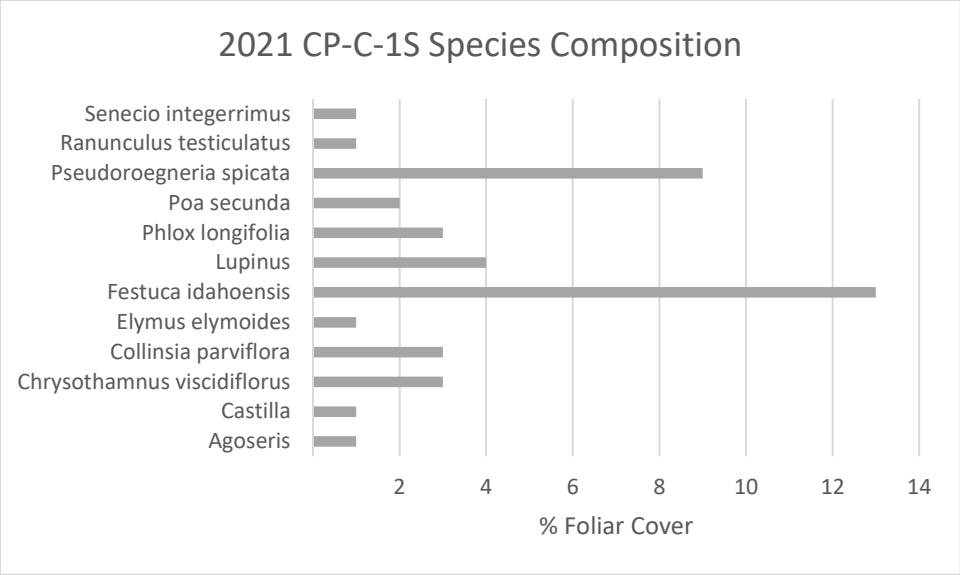

Figure 119: Post-Fire Detected Species Percent Cover

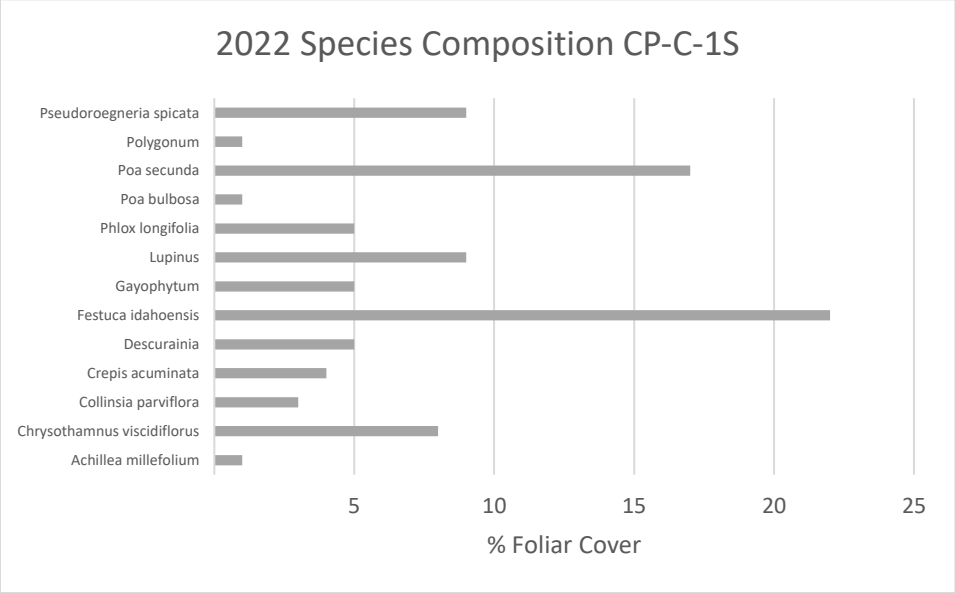

Figure 120: Comparison of Pre- and Post-Fire Detected Species Percent Cover

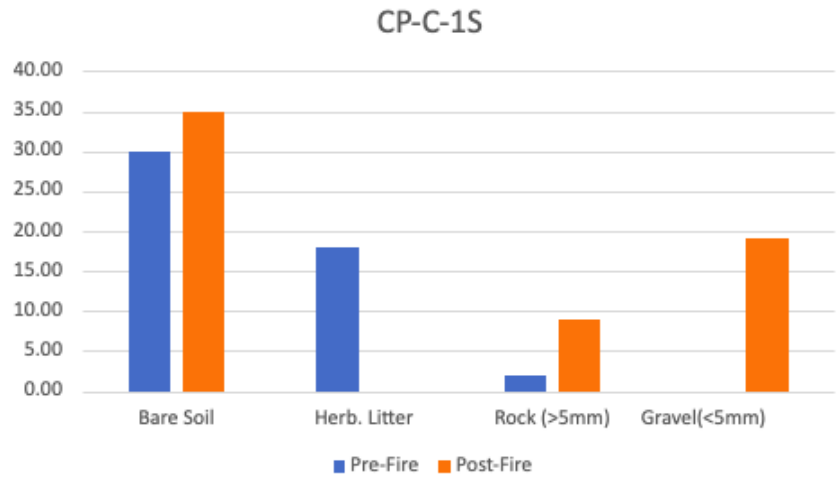

Figure 121: Comparison of Pre- and Post-Fire Percent Ground Cover Hits

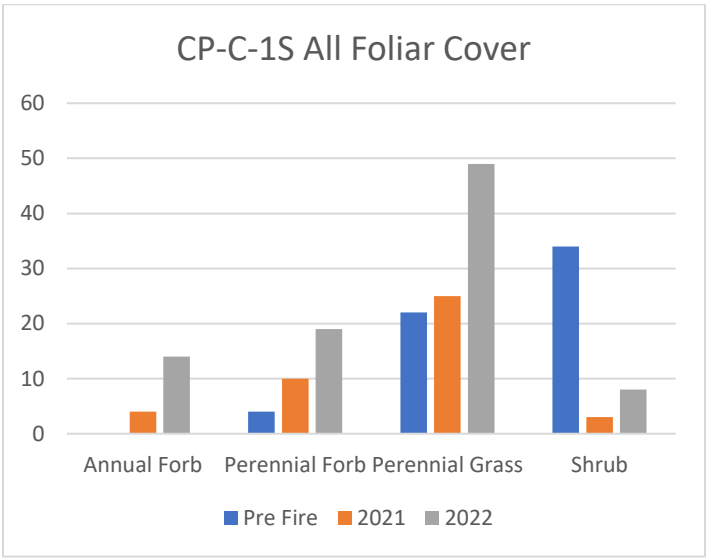

Figure 122: Percent all foliar cover by functional group

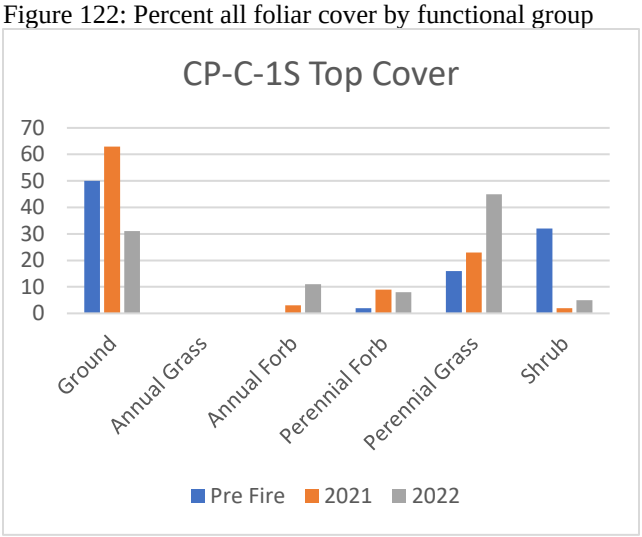

Figure 123: Percent top cover by functional group

Notes:
This site is responding well to the fire. Bare ground has decreased from pre fire levels and perennial grasses have more than doubled in cover. These grasses are primarily native, with bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass having the greatest increases.

OV-BC-3S

*Note-We do not have 2016 pre-fire photos for this site.

Figure 124: Post-Fire Photo OV-BC-3S
Allotment: Oakley Valley
Pasture: Buck Corral
Unit #: 3S
Date: June 24th, 2021
Direction: North

Figure 125: Post-Fire Photo OV-BC-3S
Allotment: Oakley Valley
Pasture: Buck Corral
Unit #: 3S
Date: July 27th, 2022
Direction: North

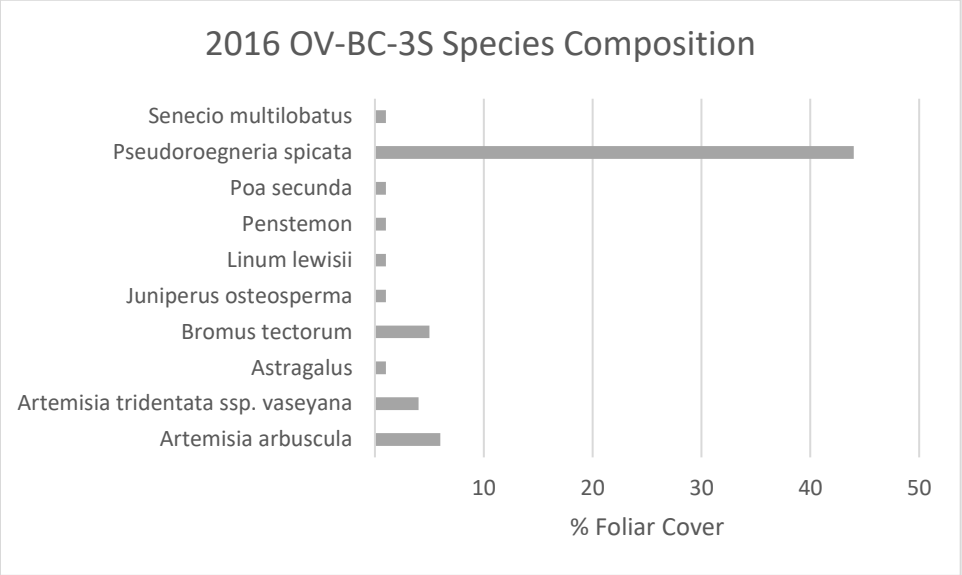

Figure 126: Pre-Fire Detected Species Percent Cover

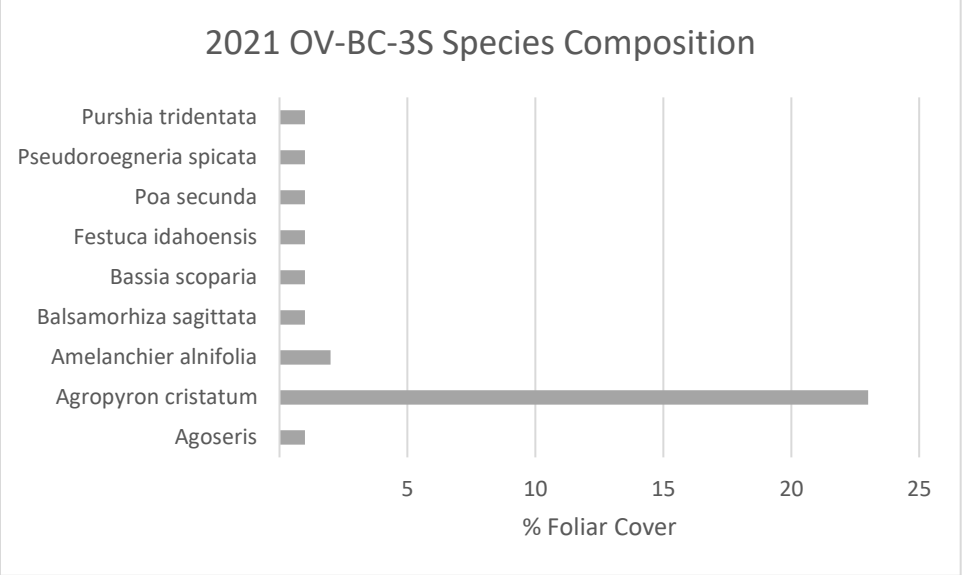

Figure 127: Post-Fire Detected Species Percent Cover

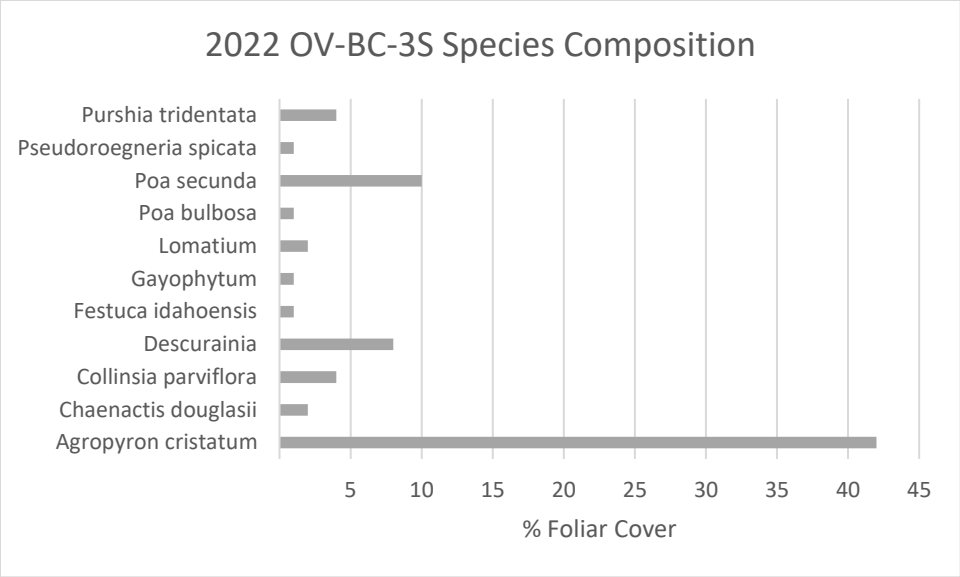

Figure 128: Comparison of Pre- and Post-Fire Detected Species Percent Cover

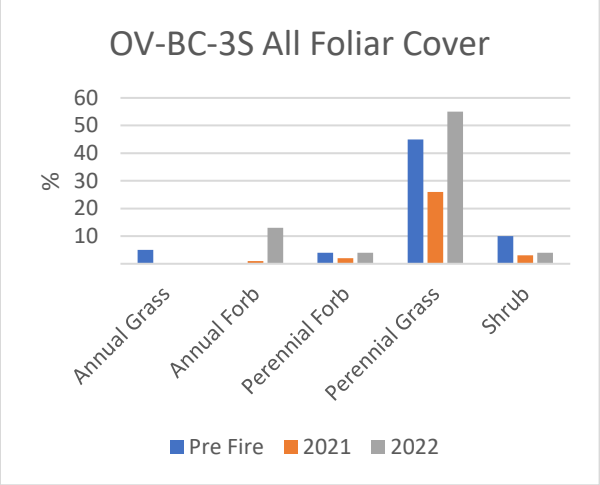

Figure 129: Percent all foliar cover by functional group.

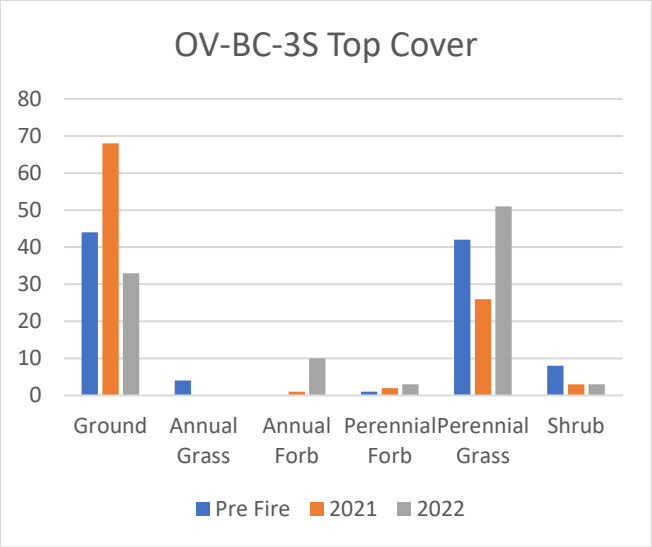

Figure 130: Percent top cover by functional group.

Notes:
While maintaining good perennial grass cover, this site had a major transition in dominant grass post fire. In 2016, the dominant grass was bluebunch wheatgrass totaling over 40% cover alone. In 2021 and 2022, bluebunch wheatgrass were hardly present. Crested wheatgrass, an introduced species, was not detected in 2016. Currently, crested wheatgrass is at 42% foliar cover at this site. Close attention needs to be paid to sites such as these as crested wheatgrass only is palatable to wildlife before it has senesced. Management actions such as targeted grazing coupled with aerially applying seed will need to be used to convert the plant community back to native vegetation.

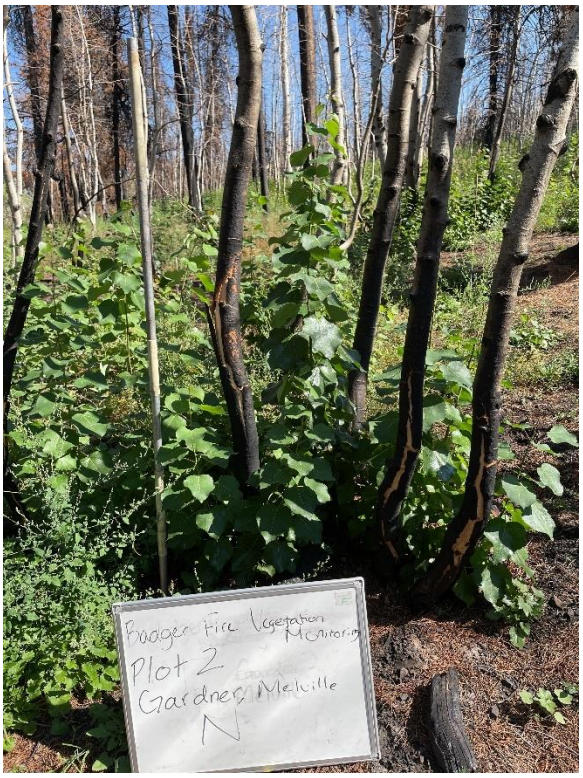

Figure 131: Post-Fire Photo FY21-BadgerAspen-2
Date: August 9th, 2021
Direction: North

Figure 132: Post-Fire Photo FY22-BadgerAspen-2
Date: August 19th, 2022
Direction: North

Figure 133: Post-Fire Photo FY21-BadgerAspen-7
Date: August 9th, 2021
Direction: North

Figure 134: Post-Fire Photo FY22-BadgerAspen-7
Date: August 22, 2022
Direction: North

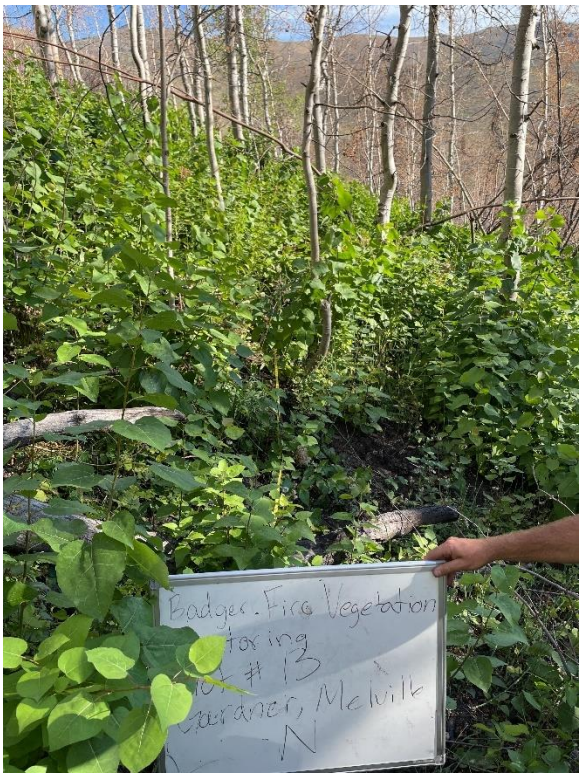

Figure 135: Post-Fire Photo FY21-BadgerAspen-13
Date: August 11th, 2021
Direction: North

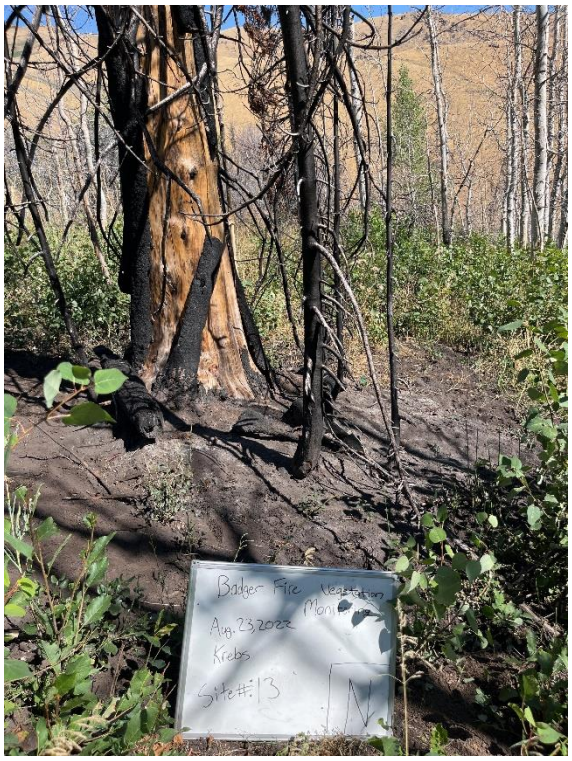

Figure 136: Post-Fire Photo FY22-BadgerAspen-13
Date: August 23, 2022
Direction: North

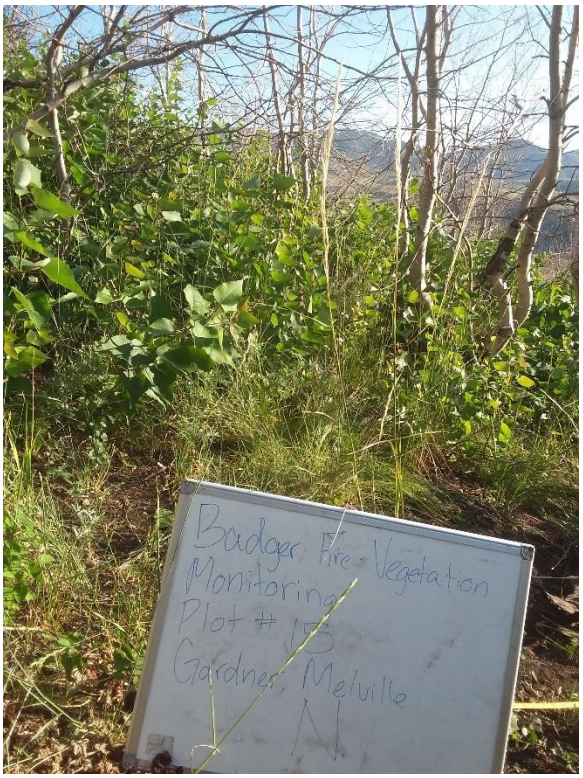

Figure 137: Post-Fire Photo FY21-BadgerAspen-15
Date: August 12th, 2021
Direction: North

Figure 138: Post-Fire Photo FY22-BadgerAspen-15
Date: August 24th, 2022
Direction: North

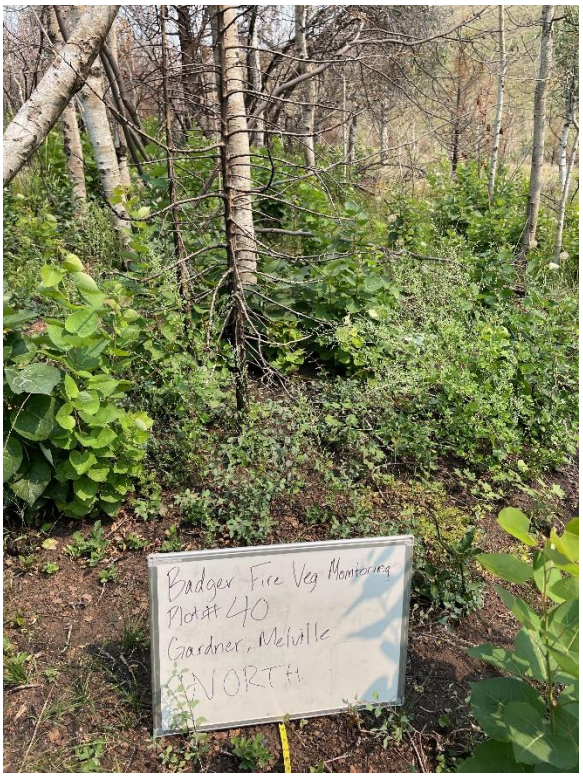

Figure 139: Post-Fire Photo FY21-BadgerAspen-40
Date: August 4th, 2021
Direction: North

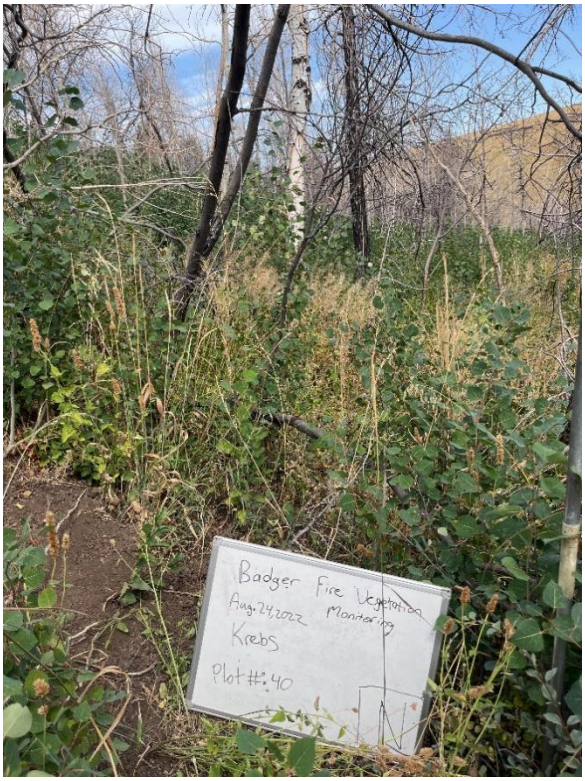

Figure 140: Post-Fire Photo FY22-BadgerAspen-40
Date: August 24th, 2022
Direction: North

Figure 141: Post-Fire Photo FY21-BadgerAspen-51
Date: August 10th, 2021
Direction: North

Figure 142: Post-Fire Photo FY22-BadgerAspen-51
Date: August 2, 2022
Direction: North

Figure 143: Post-Fire Photo FY21-BadgerAspen-53
Date: August 10th, 2021
Direction: North

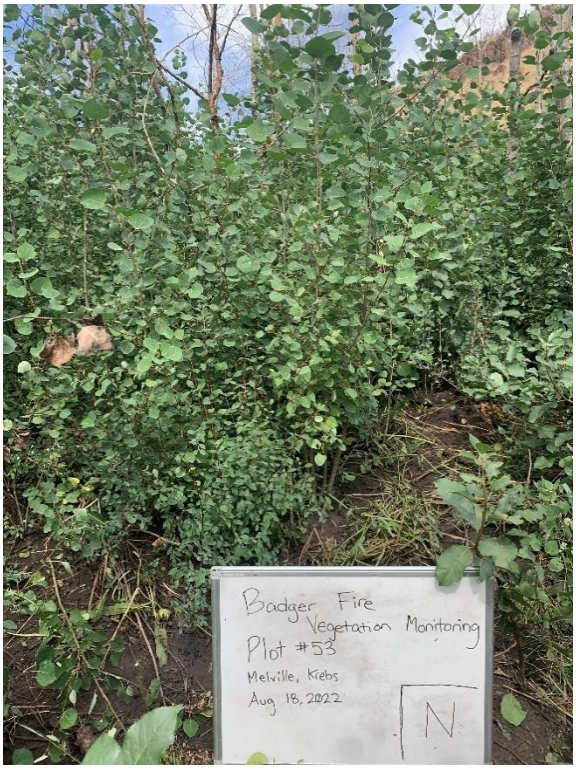

Figure 144: Post-Fire Photo FY22-BadgerAspen-53
Date: August 18th, 2022
Direction: North

Figure 145: Post-Fire Photo FY21-BadgerAspen-72
Date: August 12th, 2021
Direction: North

Figure 146: Post-Fire Photo FY22-BadgerAspen-72
Date: August 24th, 2022
Direction: North

Figure 147: Post-Fire Photo FY21-BadgerAspen-80
Date: August 4th, 2021
Direction: North

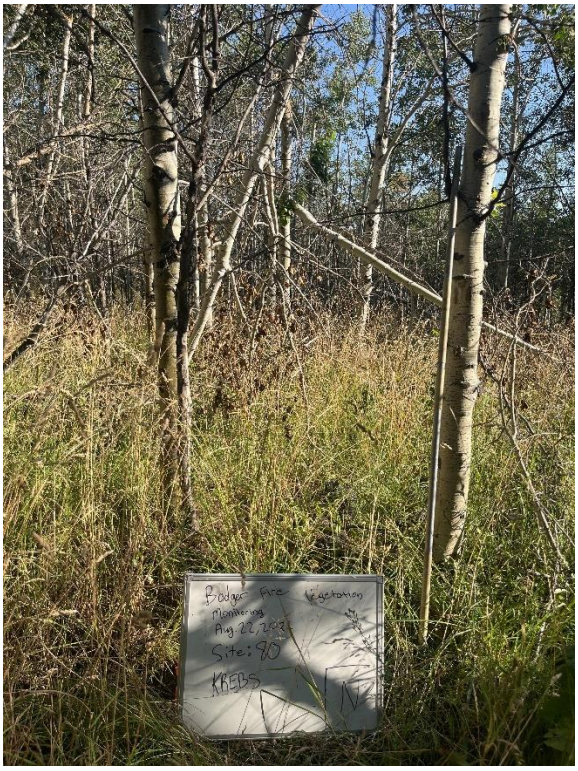

Figure 148: Post-Fire Photo FY22-BadgerAspen-80
Date: August 22nd, 2022
Direction: North

Figure 149: Post-Fire Photo FY21-BadgerAspen-87
Date: August 11th, 2021
Direction: North

Figure 150: Post-Fire Photo FY22-BadgerAspen-87
Date: August 23rd, 2022
Direction: North

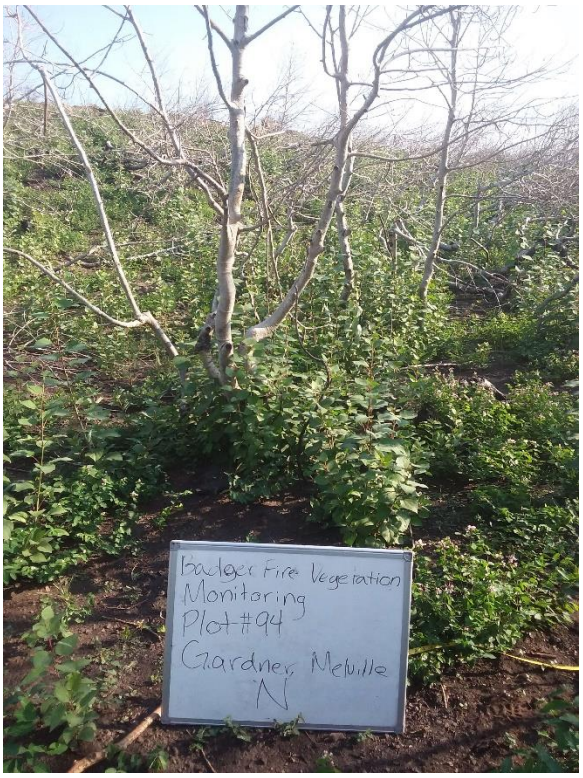

Figure 151: Post-Fire Photo FY21-BadgerAspen-94
Date: August 10th, 2021
Direction: North

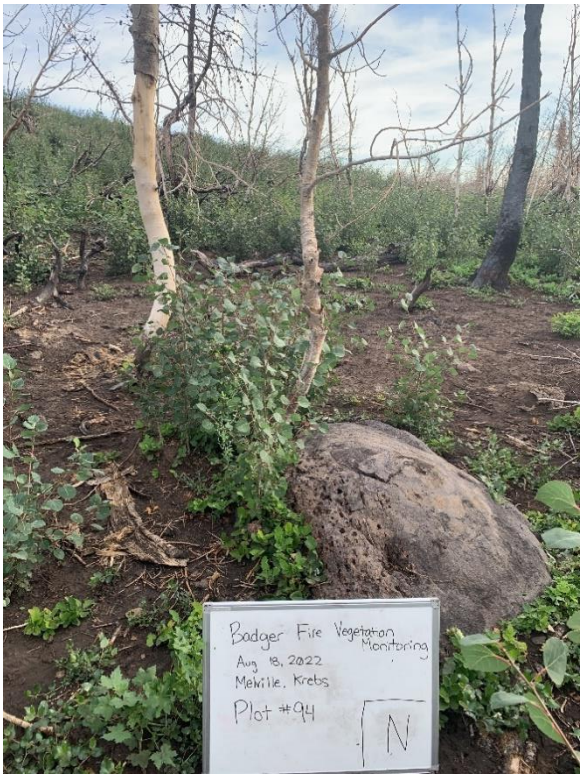

Figure 152: Post-Fire Photo FY22-BadgerAspen-94
Date: August 18th, 2022
Direction: North

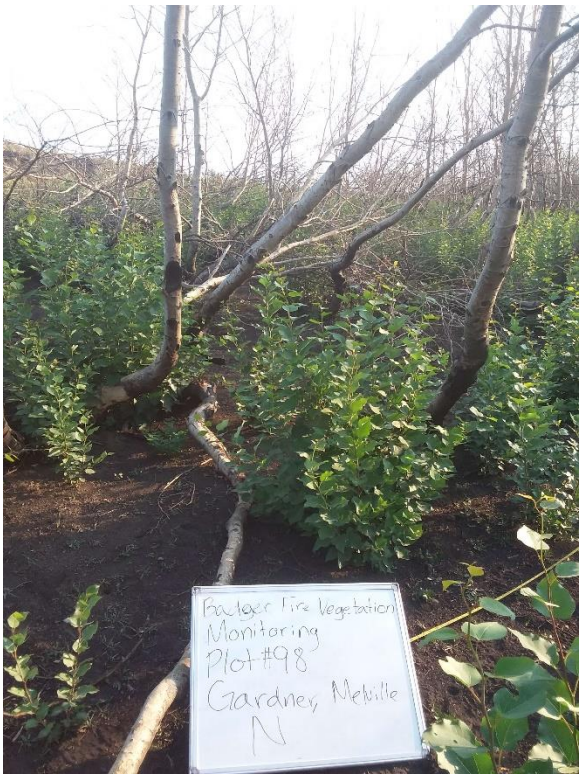

Figure 153: Post-Fire Photo FY21-BadgerAspen-98
Date: August 10th, 2021
Direction: North

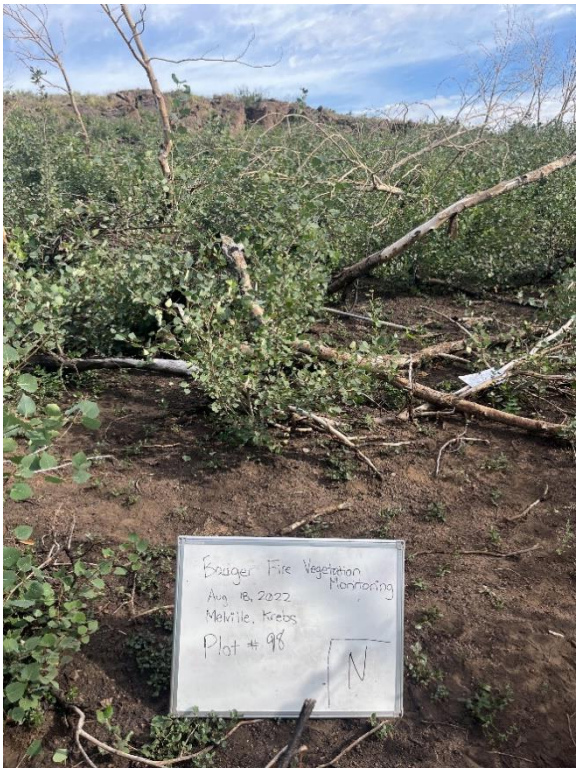

Figure 154: Post-Fire Photo FY21-BadgerAspen-98
Date: August 18th, 2022
Direction: North

Figure 155: Post-Fire Photo FY21-BadgerAspen-99
Date: August 11th, 2021
Direction: East

Figure 156: Post-Fire Photo FY22-BadgerAspen-99
Date: August 23rd, 2022
Direction: East

Figure 157: Post-Fire Photo FY21-BadgerAspen-106
Date: August 9th, 2021
Direction: North

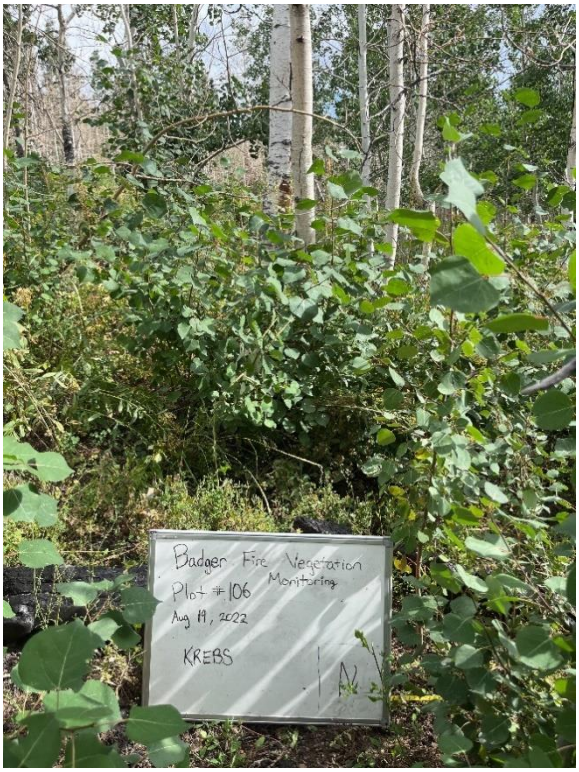

Figure 158: Post-Fire Photo FY22-BadgerAspen-106
Date: August 19th, 2022
Direction: North

Figure 159: Post-Fire Photo FY21-BadgerAspen-108
Date: August 11th, 2021
Direction: North

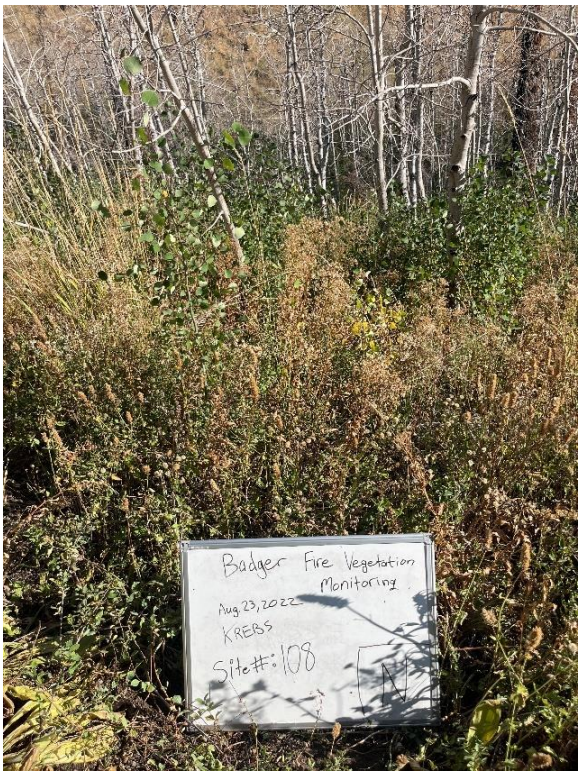

Figure 160: Post-Fire Photo FY21-BadgerAspen-108
Date: August 23rd, 2022
Direction: North

Figure 161: Post-Fire Photo FY21-BadgerAspen-150
Date: August 5th, 2021
Direction: North

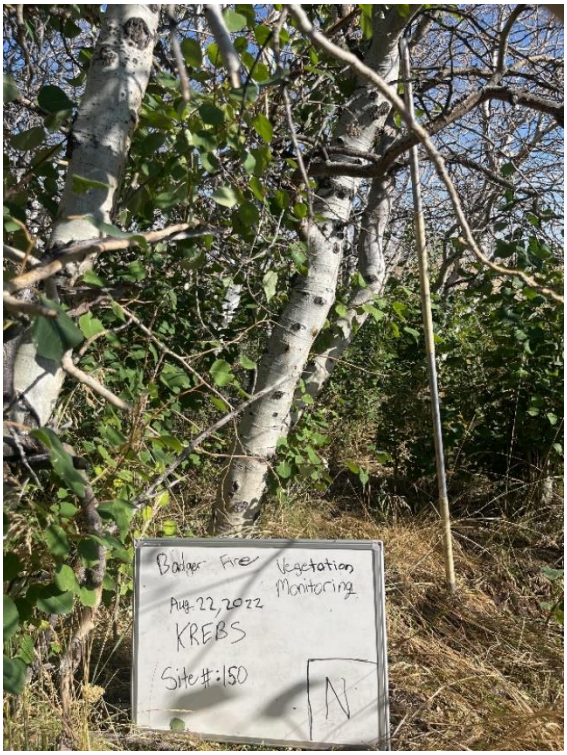

Figure 162: Post-Fire Photo FY22-BadgerAspen-150
Date: August 22nd, 2022
Direction: North

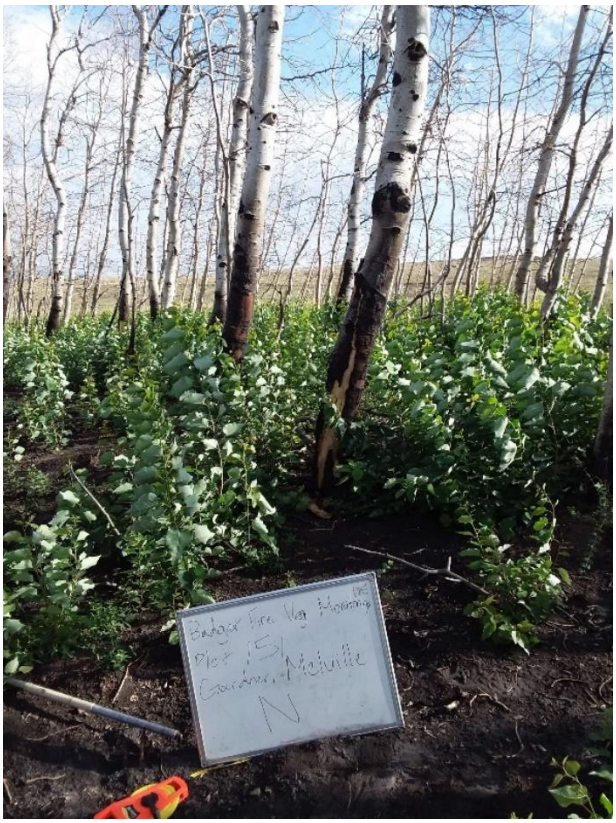

Figure 163: Post-Fire Photo FY21-BadgerAspen-151
Date: August 5th, 2021
Direction: North

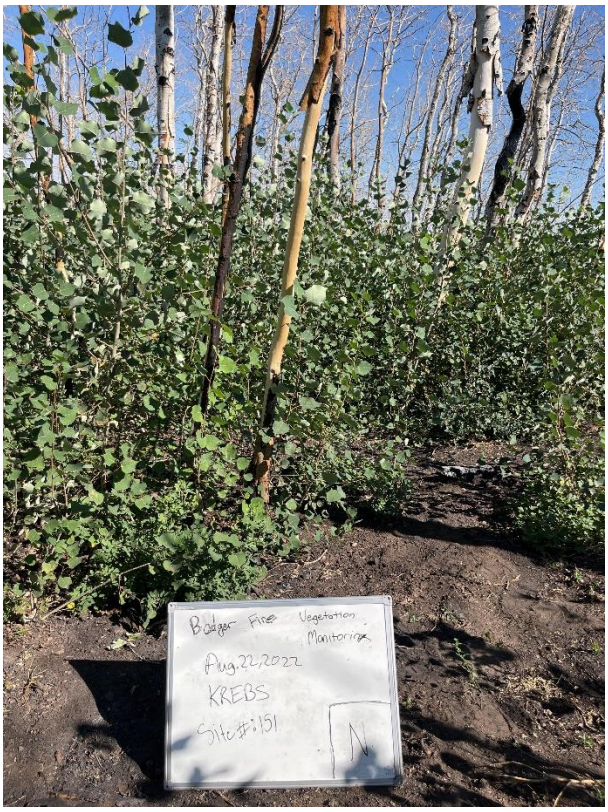

Figure 164: Post-Fire Photo FY21-BadgerAspen-151
Date: August 22nd, 2022
Direction: North

Figure 165: Post-Fire Photo FY21-BadgerAspen-152
Date: August 5th, 2021
Direction: North

Figure 166: Post-Fire Photo FY21-BadgerAspen-152
Date: August 22nd, 2022
Direction: North

Figure 167: Post-Fire Photo FY21-BadgerAspen-153
Date: August 5th, 2021
Direction: North

Figure 168: Post-Fire Photo FY22-BadgerAspen-153
Date: August 22nd, 2022
Direction: North

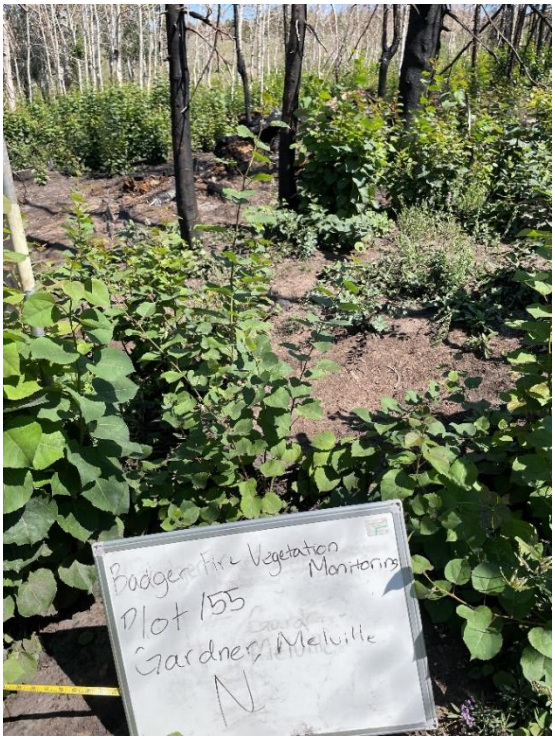

Figure 169: Post-Fire Photo FY21-BadgerAspen-155
Date: August 9th, 2021
Direction: North

Figure 170: Post-Fire Photo FY22-BadgerAspen-155
Date: August 19th, 2022
Direction: North

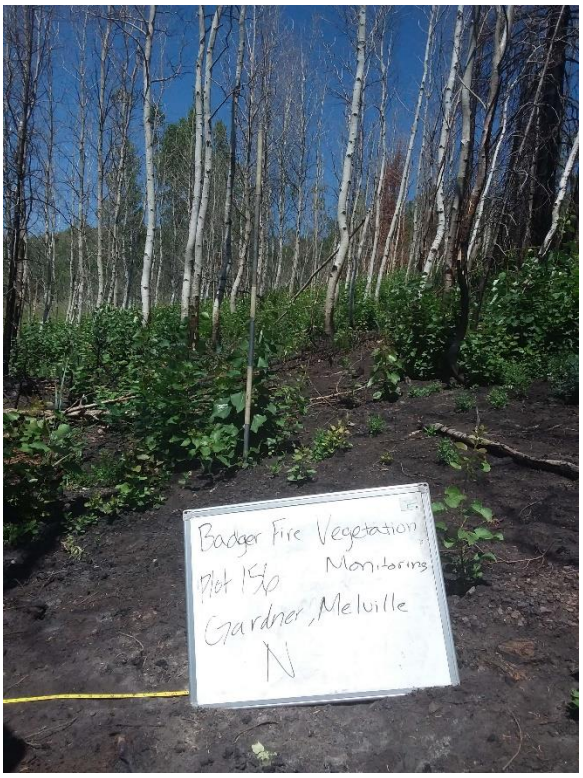

Figure 171: Post-Fire Photo FY21-BadgerAspen-156
Date: August 9th, 2021
Direction: North

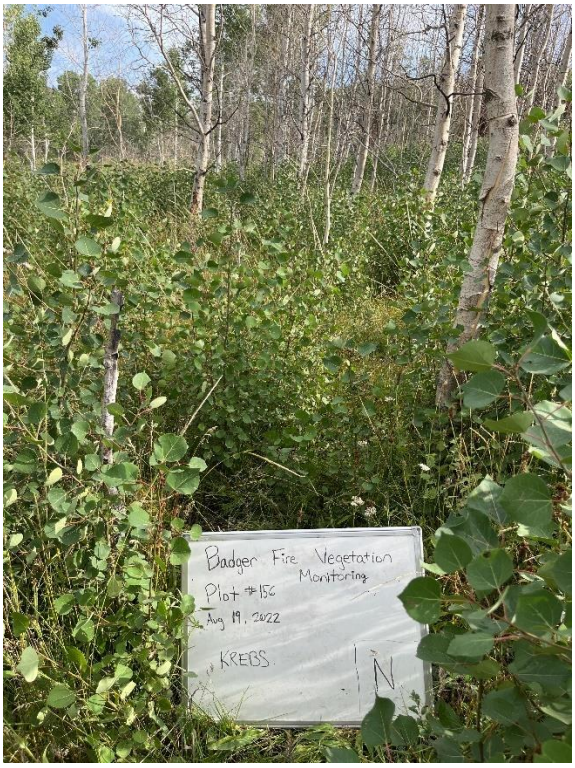

Figure 172: Post-Fire Photo FY21-BadgerAspen-156
Date: August 19th, 2022
Direction: North

Figure 173: Post-Fire Photo FY21-BadgerAspen-157
Date: August 10th
Direction: North

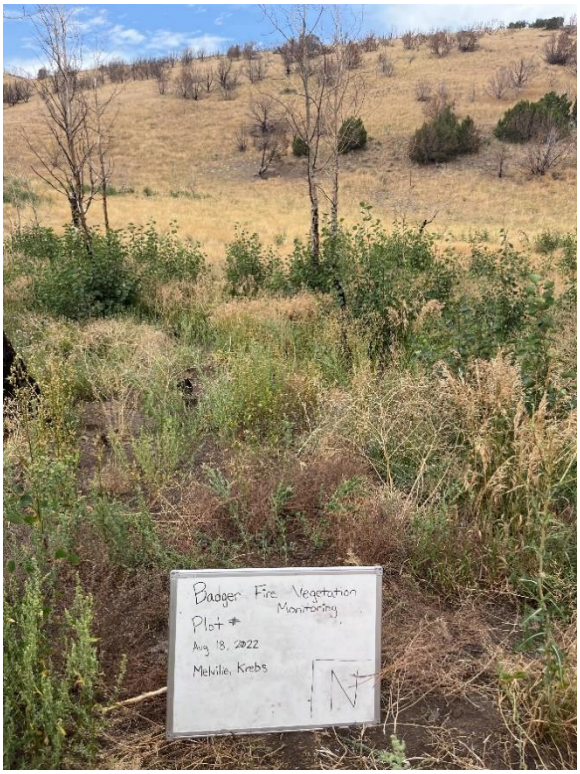

Figure 174: Post-Fire Photo FY22-BadgerAspen-157
Date: August 18th, 2022
Direction: North

Figure 175: Post-Fire Photo FY21-BadgerAspen-158
Date: August 11th, 2021
Direction: North

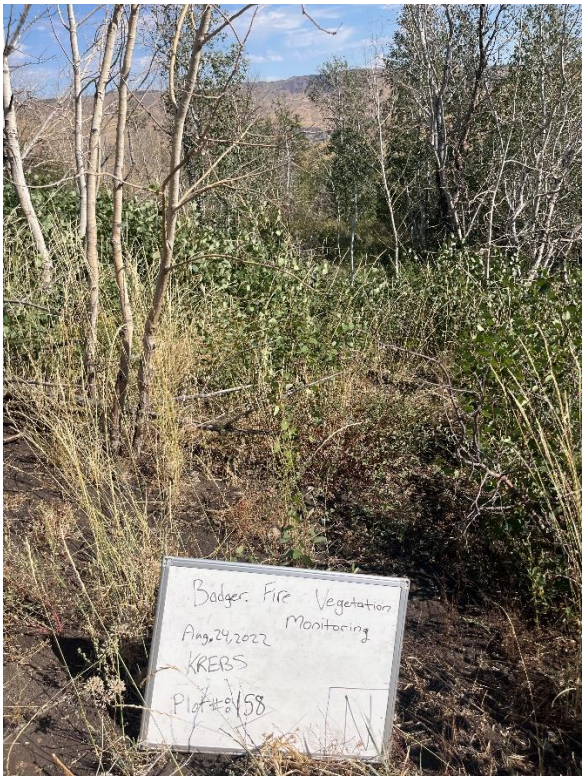

Figure 176: Post-Fire Photo FY22-BadgerAspen-158
Date: August 24th, 2022
Direction: North

Appendix B- Maps

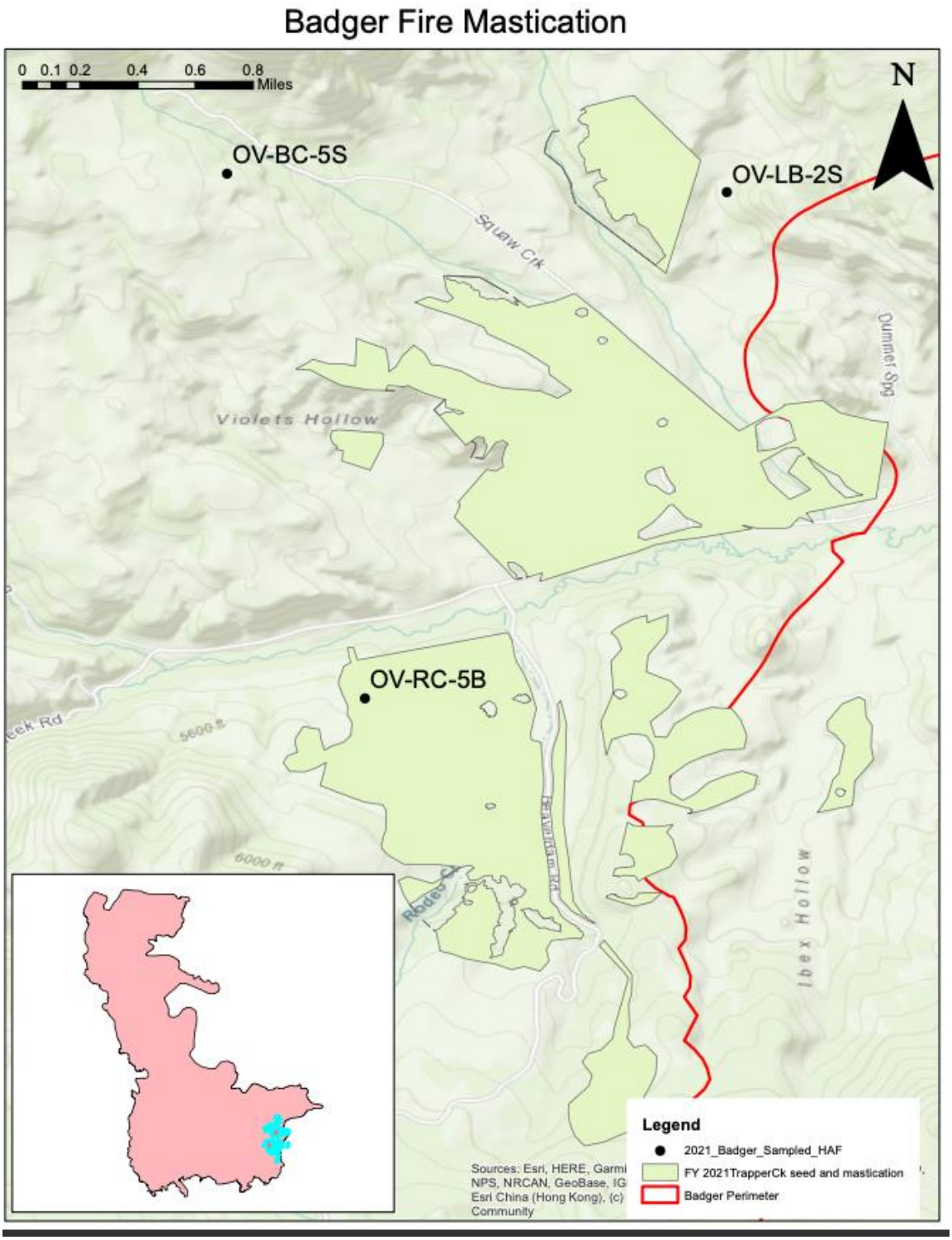

Figure 177: Map of Masticated Sites within the 2020 Badger Fire

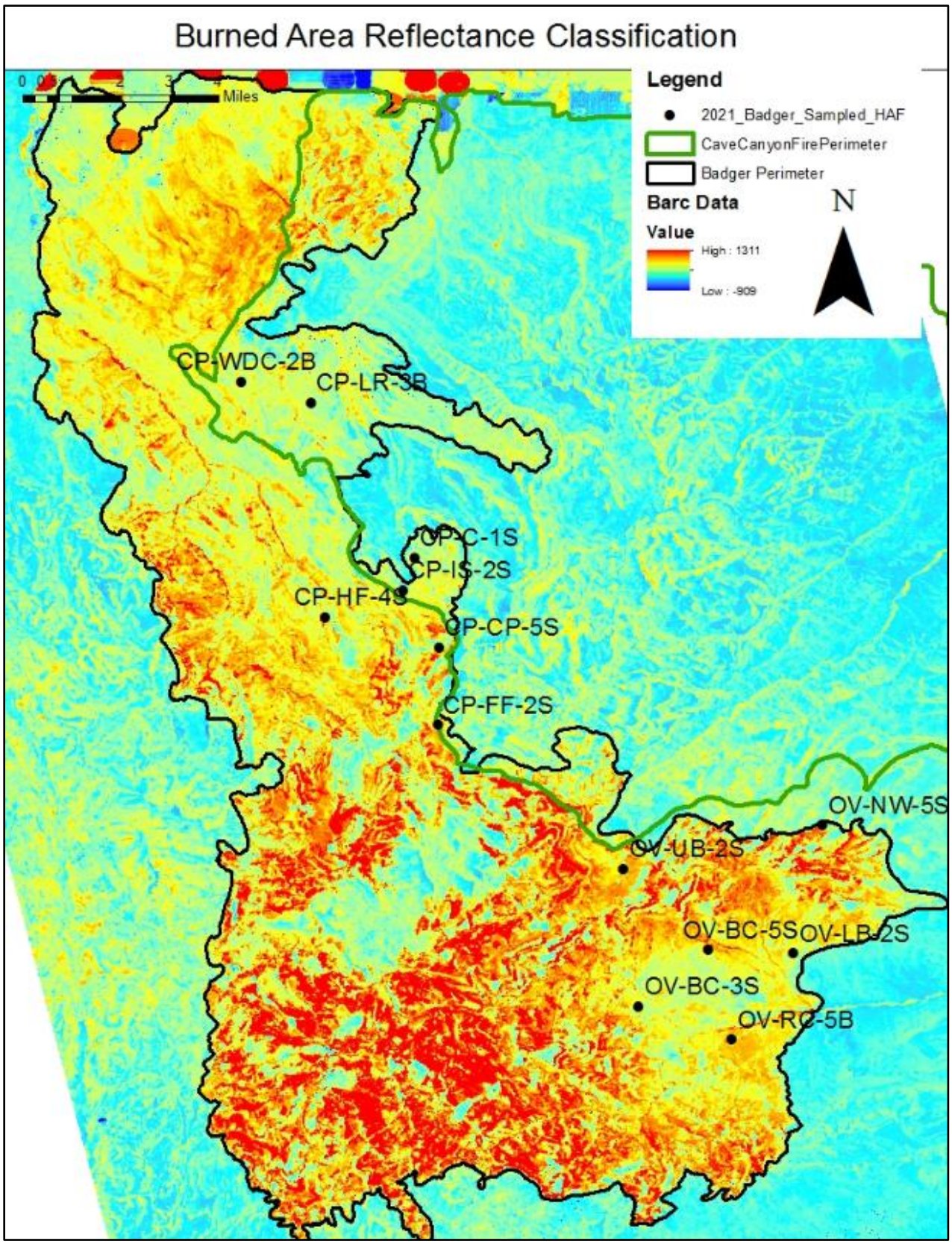

Figure 178: BARC Map with HAF sites.

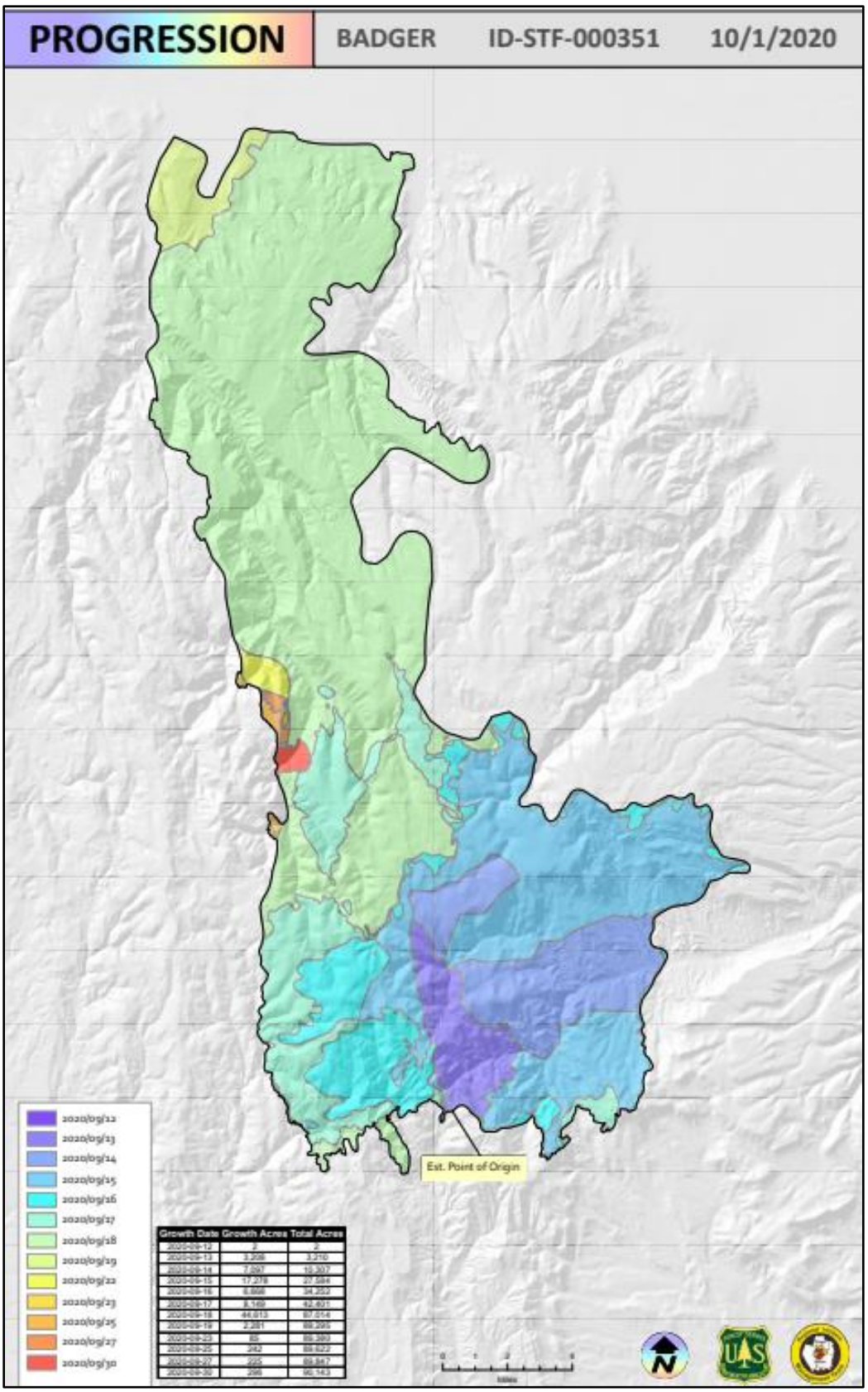

Figure 179: Badger Fire Progression Map