Boulder Mountain UT Landscape Conservation Forecasting

WRI #5810 & #6121

Final Report to the Watershed Restoration Initiative

Louis Provencher[#], Sarah Byer[#], Kevin Badik[#], & Linda Whitham[&]

[#]The Nature Conservancy in Nevada, Reno, NV

[&]The Nature Conservancy in Utah, Moab, UT

July, 2023

This page left blank intentionally

Citation: Provencher L, Byer S, Badik KJ, Whitham L. 2023. Boulder Mountain UT Landscape Conservation Forecasting. Final Report to the Utah Watershed Restoration Initiative for Contracts WRI #5810 & #6121. The Nature Conservancy, Moab, UT. 269 pages.

Credits of cover page photographs: Louis Provencher/TNC, 2021

Contents

Executive Summary i
1. Introduction 1
1.1 Background 1
1.2 Objective 2
2. Methods 3
2.1 Study Area 3
2.2 Tasks 3
2.2.1 Vegetation mapping 4
2.2.2 State-and-transition Simulation Modeling 10
2.2.3 Unified Ecological Departure 28
3. Outcomes 30
3.1. Vegetation Map 30
3.2. Future Results by System 34
3.2.1. Aspen Woodland 34
3.2.2. Aspen-Mixed Conifer 38
3.2.3. Aspen-Ponderosa Pine 42
3.2.4. Aspen-Spruce-Fir 46
3.2.5. Basin Big Sagebrush 51
3.2.6. Big Sagebrush - mountain 56
3.2.7. Big Sagebrush - upland 61
3.2.8. Montane Riparian 66
3.2.9. Mountain Shrub 72
3.2.10. Ponderosa Pine - dry 77
3.2.11. Ponderosa Pine - mesic 81
3.2.12. Wet Meadow - montane 85
3.2.13. Wet Meadow - subalpine 89
3.3. Landscape-wide Outcomes 93
3.3.1. Future Wildfires 93
3.3.2. Future Results by Treatment 94
4. Conclusions 111
5. Acknowledgments 114

6. Literature Cited 114
Appendix 1 117
Appendix 2 175
Appendix 3 179

Table of Figures

Figure 1.Area of interest covered by Fremont River (upper section) and Escalante (lower section) Ranger Districts on Boulder Mountain. 1
Figure 2. Aspen-ponderosa pine near and east of Posey Lake....6
Figure 3. Aspen-mixed conifer on the northern slope of Canaan Mountain where aspen is barely present. Note the two dead boles of standing and leaning aspen in the background....7
Figure 4. Black sagebrush site dominated by snakeweed, cacti, and herbaceous weed. 8
Figure 5. Mountain shrub system (A) with visible and common Utah serviceberry in the understory and (B) pinyon-juniper woodland systems (middle up to top of photograph) co-mingled with shrubland systems (right-central and left-central side of photograph). 9
Figure 6.. Mixed conifer on Claron formation soils. (A) Eight different conifer species were observed at the location where photograph A was taken, including bristlecone pine. (B) Distinct Claron formation soil with a very diverse communities of conifers, including bristlecone pine....10
Figure 7. Wind directions that would "push" fire to elongate in the direction of the arrows. The longer the arrow, the higher probability of spread in that direction....12
Figure 8. Map of constraints and vegetation management equipment access areas in Boulder Mountain. A 300-ft buffer from aquatic habitats prevented prescribed fire ignition but not mechanical operations. Mechanical equipment was not allowed in Research Natural Areas and Wilderness areas. The buffer from each side of roads allowing access with low-boy trucks carrying feller-bunchers and masticators was no more than 1,800 ft, including on existing roads in Inventoried Roadless Areas. 24
Figure 9. Ecological systems of Boulder Mountain based on a resampled 25-m map from 1.5 m Spot 6/7 imagery. The area comprised the southern section of Fremont River Ranger District (Fishlake National Forest), entire Escalante Ranger District (Dixie National Forest), and all private inholdings. Map accuracy was assumed worse for most private lands than USFS lands as the former lands were not accessed....31
Figure 10. Annual cost of treatments in aspen woodland on Boulder Mountain. The line is the mean and error bars are the 25TH-75TH percentiles. 36
Figure 11. Vegetation classes of aspen woodland treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25TH-75TH percentiles. 37
Figure 12. Annual cost of treatments in aspen-mixed conifer on Boulder Mountain. The line is the mean and error bars are the 25TH-75TH percentiles....40
Figure 13. Vegetation classes of aspen-mixed conifer treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 41
Figure 14. Annual cost of treatments in aspen-ponderosa pine on Boulder Mountain. The line is the mean and error bars are the 25TH-75TH percentiles....44
Figure 15. Vegetation classes of aspen-ponderosa pine treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25TH-75TH percentiles. 45
Figure 16. Annual cost of treatments in aspen-spruce-fir on Boulder Mountain. The line is the mean and error bars are the 25TH-75TH percentiles. 48
Figure 17. Vegetation classes of aspen-spruce-fir treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bar are the 25TH-75TH percentiles. 50
Figure 18. Annual cost of treatments in basin big sagebrush on Boulder Mountain. The line is the mean and error bars are the 25TH-75TH percentiles....54
Figure 19. Vegetation classes of basin big sagebrush treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25TH-75TH percentiles. 55
Figure 20. Annual cost of treatments in big sagebrush-mountain on Boulder Mountain. The line is the mean and error bars are the 25TH-75TH percentiles. 59

Figure 21. Vegetation classes of big sagebrush-mountain treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 60
Figure 22. Annual cost of treatments in big sagebrush-upland on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles....64
Figure 23. Vegetation classes of big sagebrush-upland treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 65
Figure 24. Annual cost of treatments in montane riparian on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles. 69
Figure 25 A and B. Vegetation classes of montane riparian treated (A) or recruited into (B) after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 71
Figure 26. Annual cost of treatments in mountain shrub on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles. 74
Figure 27. Vegetation classes of mountain shrub treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 76
Figure 28. Annual cost of treatments in ponderosa pine-dry on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles....79
Figure 29. Vegetation classes of ponderosa pine-dry treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 80
Figure 30. Annual cost of treatments in ponderosa pine-mesic on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles....83
Figure 31. Vegetation classes of ponderosa pine-mesic treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 84
Figure 32. Annual cost of treatments in wet meadow-montane on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles. 87
Figure 33. Vegetation classes of wet meadow-montane treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 88
Figure 34. Annual cost of treatments in wet meadow-subalpine on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles. 91
Figure 35. Vegetation classes of wet meadow-subalpine treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles. 92
Figure 36. Mapped frequency (number of events) of wildfire per map pixel in the Custodial and Proposed management scenarios on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 93
Figure 37. Total annual cost ($) of all proposed actions for Boulder Mountain. 94
Figure 38A-D. Mapped frequency (number of events) of beaver-reintroduction per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 96
Figure 39. Mapped frequency (number of events) of chainsaw followed by pile burning per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 98
Figure 40A-E. Mapped frequency (number of events) of Dixie or chain harrowing following by seeding per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 101
Figure 41. Mapped frequency (number of events) of exotic species control with herbicides per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 102

Figure 42. Mapped frequency (number of events) of feller-buncher logging of merchantable trees per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 103
Figure 43. Mapped frequency (number of events) of feller-buncher logging of non-merchantable trees per map pixel on Boulder Mountain. This map is not accurate because the location of subalpine fir was not mapped. The maximum possible frequency across 25 years and20 replicates was 25 × 20 = 500 events. 104
Figure 44. Mapped frequency (number of events) of fencing per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events 105
Figure 45. Mapped frequency (number of events) of lopping and scattering trees per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 106
Figure 46. Mapped frequency (number of events) of lopping and pile burning trees per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 107
Figure 47. Mapped frequency (number of events) of mastication followed by optional herbicide spraying for annual species and seeding per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 108
Figure 48. Mapped frequency (number of events) of broadcast prescribed fire per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 109
Figure 49. Mapped frequency (number of events) of small tree lopping per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events. 110

Table of Tables

Table 1. Size distribution (acres or ha) of fire events for Boulder Mountain (UT) based on federal fire occurrence data from several Great Basin, Columbia Plateau, Utah High Plateau, eastern Sierra Nevada field sites from 1980 to 2016 and the Monitoring Trends in Burn Severity (MTBS) data from 1984 to 2016. For example, a size class of "≤10" indicates fire events were ≤10 acres (≤4 ha). 11
Table 2. Fire spread slope multipliers using McArthur's fire danger meter. 12
Table 3. Relative cattle and sheep grazing preference ranking of ecological systems based on NRCS annual productivity. 13
Table 4. Relative native grazing and native browse preference ranking of ecological systems based on NRCS annual productivity. 15
Table 5. Proportional allocation of seasonal cattle grazing outcomes into no class change and transition to undesirable classes. 17
Table 6. Proportional allocation of seasonal native browsing and native grazing outcomes into no class change and transition to undesirable classes. 19
Table 7. Guiding management objectives established by partners during the first management workshop for Boulder Mountain, UT. 21
Table 8. Cost per acre of management actions. 22
Table 9. Climate variability factors used to build temporal multipliers (TM) for ecological processes directly affected by temperature and precipitation, or through water stress, as expressed by the Standard-Evapotranspiration Precipitation Index (SPEI). The symbol "×" indicates multiplication of the two temporal multipliers as performed by the ST-Sim software. 26
Table 10. Unified ecological departure and area of ecological systems in 2021. Area estimates were based on the resampled 25-m map layers, but not the 1-m map layers. Reddish color was highly departed (>65%), yellow indicated moderate departure (34 to 65%), and greenish color represented low departure. The estimation of departure is less accurate for systems with longer intervals between stand-replacing events and small areas. 32
Table 11. Vegetation classes of aspen woodland expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition. 34
Table 12. Implemented treatment rates in aspen woodland from 2023 to 2046. 35

Table 13. Vegetation classes of aspen-mixed conifer expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition. 38
Table 14. Implemented treatment rates in aspen-mixed conifer from 2023 to 2046. 39
Table 15. Vegetation classes of aspen-ponderosa pine expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition....42
Table 16. Implemented treatment rates in aspen-ponderosa pine from 2023 to 2046. 43
Table 17. Vegetation classes of aspen-spruce-fir expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition. 46
Table 18. Implemented treatment rates in aspen-spruce-fir from 2023 to 2046. 47
Table 19. Vegetation classes of basin big sagebrush expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition. 51
Table 20. Implemented treatment rates in basin big sagebrush from 2023 to 2046. 52
Table 21. Vegetation classes of big sagebrush-mountain expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition....56
Table 22. Implemented treatment rates in big sagebrush-mountain from 2023 to 2046. 57
Table 23. Vegetation classes of big sagebrush-upland expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition....61
Table 24. Implemented treatment rates in big sagebrush-mountain from 2023 to 2046. 62
Table 25. Vegetation classes of montane riparian expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition. 66
Table 26. Implemented treatment rates in montane riparian from 2023 to 2046. 67
Table 27. Vegetation classes of mountain shrub expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition. 72
Table 28. Implemented treatment rates in mountain shrub from 2023 to 2046. 73
Table 29. Vegetation classes of ponderosa pine-dry expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition. 77
Table 30. Implemented treatment rates in ponderosa pine-dry from 2023 to 2046. 78
Table 31. Vegetation classes of ponderosa pine-mesic expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition....81
Table 32. Implemented treatment rates in ponderosa pine-mesic from 2023 to 2046. 82
Table 33. Vegetation classes of wet meadow-montane expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition....85
Table 34. Implemented treatment rates in wet meadow-montane from 2023 to 2046. 86
Table 35. Vegetation classes of wet meadow-subalpine expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition....89
Table 36. Implemented treatment rates in wet meadow-subalpine from 2023 to 2046. 90
Table 37. Ratio of area browsed by native herbivores in all four aspen forests divided by the area of early- and mid-successional reference and depleted aspen vegetation classes and area of native browsing in all aspen forest types (acres). N = 20 replicates. 113

Executive Summary

Goals

Utah's Watershed Restoration Initiative and The Nature Conservancy worked with the US Forest Service on proposed National Environmental Protection Act (NEPA) planning at the Fremont River Ranger District and anticipated NEPA planning at the Escalante Ranger District for Boulder Mountain. Partners acquired high-resolution vegetation maps and forecast with state-and-transition simulation models the most feasible of set of actions that would achieve the greatest conservation outcomes within the multiple-use mandate and within a pre-defined annual budget.

Staff of the US Forest Service and Utah Watershed Restoration Initiative and other partners proposed four guiding objectives for Boulder Mountain:

1. Increase landscape health by shifting ecological processes towards natural range of variation.
2. Reduce ecological departure for targeted systems that can support wildlife populations, such as mule deer.
3. Maintain or improve watershed integrity and hydrologic function to protect and benefit aquatic resources and water quality.
4. Complement other multi-use objectives.

Methods

The methodology Landscape Conservation Forecasting was deployed to achieve these objectives:

1. Map ecological systems and their current vegetation at high spatial resolution;
2. Upload these vegetation layers into spatially explicit state-and-transition simulation models for each ecological system, forecast a set of partner-defined land management actions for a Custodial management scenario (a.k.a., No-Action in NEPA parlance) and an active Proposed management scenario; and
3. compare metrics of success, namely unified ecological departure from reference condition (UED) and the areas of vegetation classes that contribute to mule deer habitat suitability, between scenarios.

Three images from Spot 6/7 1.5-m resolution multispectral satellite were ordered in May 2021 for capture in mid-June and July:

- 562,907 acres (227,800 ha) were captured by the satellite at elevations <10,000 ft (3,048 m) on June 11, 2021, as the herbaceous vegetation would be the first to senescence in June;
- 128,342 acres (51,938 ha) captured twice at elevations ≥10,000 ft (3,048 m) elevation on July 8, 2019 and August 6, 2021 to match the later senescence of subalpine herbaceous vegetation. We used archival imagery from 2019 because TNC's field work would have been completed by the end of July and remaining snow and monsoonal rains might have interfered with cloud-free and snow-free imagery capture. The satellite

was tasked to capture starting in mid-July, but summer rains only permitted the first cloud-free capture on August 6th. This latter imagery was captured after the summer field work conducted entirely with the archival imagery; interpretation of vegetation was based on both imageries; however.

Remote sensing by Spatial Solutions followed an unsupervised classification of imagery to identify ecological systems and vegetation classes. Field work was conducted from 8-31 July and 18-29 October 2021. The summer field work included helicopter-based observations from 27-29 July 2021 to access remote, roadless, or rugged areas. More than 5,000 rapid observation points were collected to ensure that a large percentage of the landscape was visited. At each rapid observation location, the ecological system, vegetation class, explanatory notes, and at least two georeferenced photographs were taken.

For simulations, we resampled the ecological system-vegetation class rasters to 25 m for simulations to stay within the computational limits imposed by hardware and software Syncrosim. To avoid losing small, narrow, and ecologically important vegetation types, ecological systems and vegetation classes were resampled according to a user-defined hierarchy scripted in Python code. The final vegetation class raster represents current condition vegetation.

The ecological system and vegetation class map layers were uploaded in the Syncrosim simulation database. A first management workshop with 28 experts attending was conducted in Escalante UT on September 27-29th, 2022 to:

- Review the vegetation map and propose map revisions (three were proposed).
- Define joint guiding management objectives for both Ranger Districts.
- Define the anticipated annual budget ranging between $1,000,000 and $1,500,000.
- Define management scenarios as a set of sequenced actions and the “order-of-magnitude” desired implementation rates.
- Define a 25-year duration of simulations (2022-2046) with 2023 being the first year of treatment implementation.
- Specify cost per unit area and the use of each management action per system.
- Define the success and failure rates, and ecological outcomes of each management actions.
- Describe the regulatory and spatial land management constraints where different types of actions can or cannot be deployed and, if any, specific conditions only applicable in one Ranger District.
- View results of draft Custodial management and straw-person and simplistic active management scenario.

Following the first workshop, The Nature Conservancy implemented all actions, budgetary details, regulatory and spatial constraints, and drafted the Custodial management and only one Proposed management scenario in the Syncrosim database. Development of scenarios, vegetation map revisions, and creation of spatial constraint rasters, especially grazing rasters, consumed several months of trial-and-error work.

After the completion of new simulations to the extent possible without review of results and further critical input, a second hybrid workshop was conducted in Escalante on March 28-29th, 2023. Fourteen stakeholders attended in person and seven people online. The goals of the second workshop were simpler than the first workshop:

- Review key decisions from and changes made after the first workshop.
- Review results of both management scenarios and revise implementation rates, if needed.

An important revision was to first focus on big sagebrush and mountain shrub systems for removal of conifers followed by seedings to improve mule deer habitat, and then focus on aspen-conifer systems after 2026. All workshop revisions were incorporated in simulation models and scenarios rerun, again using a trial-and-error process to respect budgetary limits.

Outcomes

2021 vegetation

- Forty-four "systems" were mapped but five were not ecological systems, such as agriculture, barren-rock-mud, developed, roads, and water. While badland was not considered for analysis, it could be considered an ecological system sometimes harboring rare species or old individuals of a species.
- The three most extensive ecological systems were big sagebrush-mountain (123,934 acres or 50,154 ha), ponderosa pine-mesic (121,499 acres or 49,169 ha), and aspen-spruce-fir (100,871 acres or 40,821 ha). The three smallest systems were saline meadow (14 acres or 6 ha), pinyon-juniper-shrubland (5 acres or 2 acres), and four-wing saltbush (3 acres or 1.2 acres).
- Eleven ecological systems were highly departed from reference conditions (in decreasing order of area): big sagebrush-mountain, aspen-spruce-fir, aspen-mixed conifer, mountain shrub, upper subalpine grassland, aspen woodland, aspen-ponderosa pine, desert wash, curl-leaf mountain mahogany, semi-desert grassland, and four-wing saltbush.
- Ten ecological systems were moderately departed from reference conditions: ponderosa pine-mesic, black sagebrush, mixed conifer-montane, ponderosa pine-dry, mixed conifer-Claron, big sagebrush-upland, basin big sagebrush, wet-meadow-montane, montane riparian, and spruce-fir.
- The remaining ecological systems exhibited low departure from reference conditions: lower subalpine grassland, pinyon-juniper woodland, pure spruce, dry wet meadow, wet meadow-subalpine, riparian blue spruce, silver sagebrush, greasewood-basin big sagebrush, Gamble oak-mountain shrub, limber and bristlecone pine, seep, mixed salt desert, subalpine upper-montane riparian wetland, subalpine montane mesic meadow, saline meadow, and pinyon and juniper shrubland.
- All aspen systems, except aspen-spruce-fir, were 100% departed from reference conditions and dominated by depleted classes. These were widespread and important to mule deer. Also important to mule deer, the big sagebrush-mountain and mountain shrub were highly departed from reference condition and commonly encroached with conifers after many

decades of fire exclusion. Big sagebrush-upland, also important mule deer browse, was moderately departed from reference condition.

Future Vegetation

Proposed actions reduced over-abundant target vegetation classes compared to Custodial management within the specified annual budget limits (roughly $1,300,000 per year); however, not all systems showed a reduction in unified ecological departure compared to Custodial management:

- Management in the following systems achieved lower Unified Ecological Departure (a measure of how departed systems are from desired conditions; hereafter UED) compared to Custodial management; aspen-spruce-fir, big sagebrush-upland, and wet meadow-montane. These systems had large enough resources devoted to them *relative* to their size and, thus, previously under-represented reference classes increased following restoration.
- Other systems with extensive focal vegetation classes simply had too much area left untreated, thus there were minor UED differences, although mule deer habitat likely improved by thousands of acres. Examples of this were big sagebrush-mountain and mountain shrub where, respectively, 10,000 and 7,000 acres (4,047 and 2,833 ha) of tree-encroached shrublands were treated but 70,000 (40,470 ha) and 40,000 acres (16,187 ha) were not treated because of funding and other constraints. This would overwhelm any departure metric, but a mule deer habitat suitability model would likely show improvement. For aspen woodland and aspen-mixed conifer, respectively, 1,000 and 12,000 acres (405 and 4,856 ha) were treated, but 15,000 and >20,000 acres (6,070 and >8,094 ha) of late-successional aspen-mixed conifer, of which 10,000 acres (4,047 ha) were depleted in aspen-mixed conifer, remained standing. Depleted aspen classes carried higher penalties than “neutral” uncharacteristic classes in the UED equation; therefore, such large areas of depleted aspen classes caused high levels of departure.
- In a few systems, simulated restoration actions increased introduced species seedings to systems with historic introduced species seedings. These systems were basin big sagebrush, big sagebrush-upland, and mountain shrub; all would be used by mule deer. To address historic seedings of introduced species and their potential benefits to wildlife, partners chose a 45% penalty-free threshold for introduced species seedings (i.e., UED is neutral to those vegetation classes up to 45% but any new such seedings directly contribute to departure). An added complication was that the 45% threshold of seeded area had to follow the same successional distribution as found among reference successional classes, i.e., all seeded classes could not all be in the early-successional phase (U-A:SI). By year 2046, UED did not change because no reference classes were added to the total area already above the 45% threshold of introduced species seedings. Many introduced species seedings also were not well distributed among successional classes, an additional cause of departure.
- Both ponderosa pine systems and wet meadow-subalpine were dominated by classes in reference condition; therefore, UED was not expected to be substantially different between the Custodial and Proposed management scenarios. However, operations

maintained the canopy open of ponderosa pine dry and mesic and generated timber revenues.

- The montane riparian's treatments effectively accomplished the reduction of uncharacteristic classes, especially incised classes. However, we were puzzled that ecological departure substantially deteriorated over time in both scenarios. This system was an interesting example, not frequently encountered, where the non-spatial and spatial reference conditions substantially diverged because of the spatial constraints of disturbances such as flooding and, especially, fire. In our spatial simulations, fire from fire-dependent systems, such as ponderosa pine and mixed conifers with or without aspen, was the dominant source of fires and completely changed the balance of successional processes of flooding and fire, therefore the underlying reference dynamics. Therefore, the reader should take in advisement that the riparian system's ecological departure values in years 2021 and 2046 might be inaccurate because the reference condition was not spatial.

While it was harder to demonstrate reduction of UED despite obvious changes in vegetation classes, simulations did achieve the very desirable partner-defined goal of widely spreading actions to dilute detrimental herbivory effects everywhere, but especially in aspen forests. Several highly used treatments were scattered all over Boulder Mountain in aspen forests and shrublands, such as cutting trees with chainsaws followed by pile burning, feller-buncher operations, lopping and scattering of young trees, mastication of pinyon and juniper followed with optional herbicide spraying and required seeding, prescribed broadcast burning, and small-tree lopping. To estimate grazing pressure on young aspen classes, we calculated the area of native browsing in all four aspen forest types divided by the area of early- and mid-successional reference and depleted aspen classes per management scenario. We found substantially less grazing pressure (smaller ratio) in the Proposed management than the Custodial management scenario. Not only did treatments reduce browsing pressure on young aspen, the area of native browsing, presumably the mule deer population size, increased by about 12,000 acres (4,856 ha). We believe this was an important outcome of this project.

One of the guiding objectives for the management of Boulder Mountain natural resources was "Maintain or improve watershed integrity and hydrologic function to protect and benefit aquatic resources and water quality." Our simulations were not coupled to sedimentation and hydrologic models nor were results post-processed to estimate sedimentation and changes to runoff as an outcome of management scenarios. However, we prevented prescribed fire 300 ft from streams and lakes; therefore, minimizing sedimentation. Also, the various ephemeral "Char" classes in the state-and-transition simulation models, which would be a source of sediment after high-severity fires during summer storm events, never reached even small area values. Should the US Forest Service or the Utah Division of Wildlife Resources want to study forecasted fire effects on sedimentation and the endangered Colorado River cutthroat trout, the current version of the model is already set up to estimate sedimentation through the "Char" vegetation classes in each applicable system. Additional external modeling would be required to estimate sedimentation risk.

1. Introduction

1.1 Background

The Boulder Mountain Area of Interest (AOI) mostly occupied by the southern section of the Fremont River Ranger District (Fishlake National Forest) and all of the Escalante Ranger District (Dixie National Forest) in south-central Utah is considered a top state priority focal conservation area by the Utah Watershed Restoration initiative (WRI) and The Nature Conservancy (Fig. 1; https://wri.utah.gov/wri/map/map.html; Comer and others 2006). This area is also economically important for big game hunting, fishing, camping, off-highway motorized vehicle recreation, and forest thinning that achieves conservation and fuels management goals.

The WRI and The Nature Conservancy wanted to work with USFS on proposed National Environmental Protection Act (NEPA) planning at the Fremont River Ranger District and anticipated NEPA planning at the Escalante Ranger District. Partners wanted to acquire useful planning data such as an accurate and high-resolution map of vegetation and modeling results that identify the most feasible of several alternative management scenarios that would achieve the greatest conservation outcomes within the multiple-use mandate (Provencher and others 2021a). One desired conservation outcome includes the improvement of mule deer habitat.

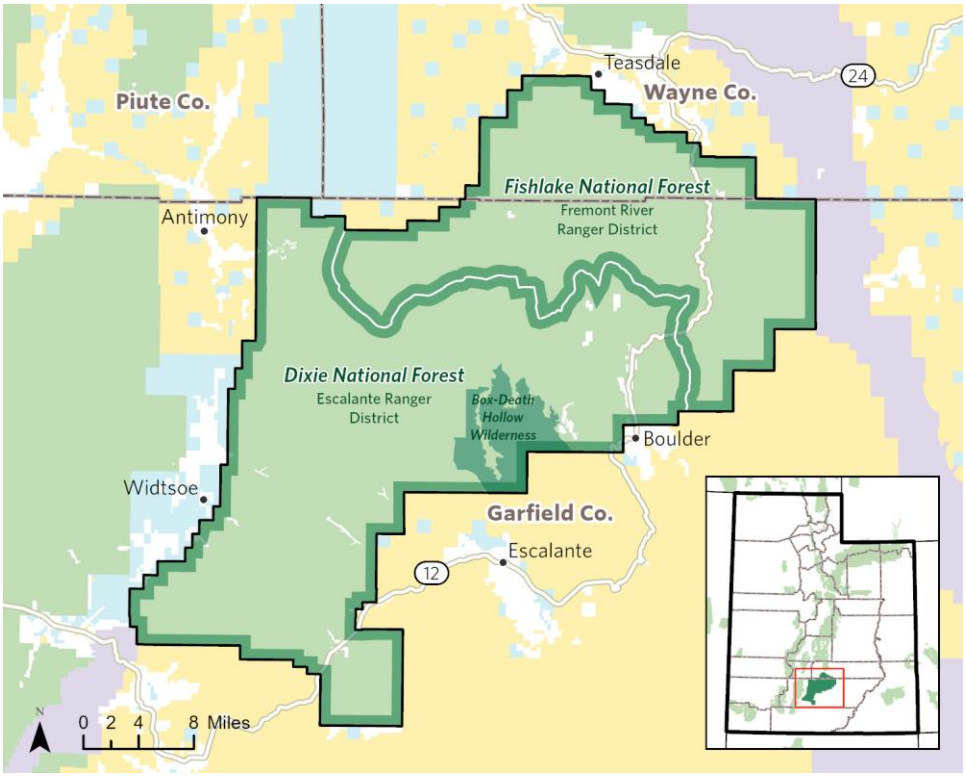


Figure 1.Area of interest covered by Fremont River (upper section) and Escalante (lower section) Ranger Districts on Boulder Mountain.

Landscape Conservation Forecasting (LCF) will be used to map vegetation at high pixel resolution and compare the ecological benefits of possible USFS NEPA alternative scenarios. LCF was deployed by The Nature Conservancy in several US Forest Service (USFS), Bureau of Land Management, and National Park Service projects in Utah and Nevada (Low and others 2010; Provencher and others 2011, 2013, 2015, 2016a&b, 2017, 2018, 2019, 2021a&b). LCF was created by staff of The Nature Conservancy of Nevada to help land managers responsible for the stewardship of large landscapes make cost-efficient current and future protection and restoration decisions based on reference conditions, current conditions, desired future conditions, and budget data. LCF helps land managers answer the following basic questions:

- What is the current condition of each ecological system and/or focal at-risk species in your landscape?
- What is likely to get worse using current management?
- What strategies could improve degraded ecological systems or at-risk species?
- Will strategies work?
- Which strategies produce the highest ecological return-on-investment?

LCF can be summarized by "3 Ms": Maps, Models, and Metrics. The two necessary maps of LCF are the ecological system and current vegetation class layers of the focal landscape. These maps, which are obtained by remote sensing analysis, are the foundation of LCF (Low and others 2010; Provencher and others 2013). Models are agent-based models called state-and-transition simulation models (STSM) constructed in a simulation software platform, more recently ST-Sim in the Syncrosim© platform (Daniel and others 2016; www.syncrosim.com). STSMs allow stakeholders to explore the future effects of alternative what-if management scenarios on the ecological condition of a landscape experiencing different stochastic futures. Metrics reflect the status of the landscape's ecological condition. LCF keeps the number of metrics to a minimum: Basic application uses one unifying metric, whereas more complicated projects involving disparate management objectives, such as wildlife species habitat suitability or carbon accounting, will involve at least two metrics. The performance of scenarios compared to *status quo* management (a.k.a., *Custodial* management) is assessed by calculating the metric's ecological return-on-investment (also termed *cost effectiveness* in the conservation literature; Provencher and others 2013).

1.2 Objective

The main objective was to collaboratively design at a 25-year management scenario that restored focal ecological systems or economically important. While the condition of the mule deer population was foremost in the mind of partners, the overarching goal was to restore ecological systems for all species using the landscape-wide metric of unified ecological departure (UED; Provencher and others 2021a).

2. Methods

2.1 Study Area

The Boulder Mountain AOI is located in southern Wayne County (south of Highway 24) and Garfield County UT immediately west of Capitol Reef National Park and north of Grand Staircase - Escalante National Monument (approximate central location at 38º06'41.27" N, 111º39'09.54" W) and encompasses a total of 691,249 acres (279,739 ha). The entirety of the Escalante Ranger District of the Dixie National Forest and the southern part of Fremont River Ranger District of the Fishlake National Forest are within the AOI. In addition, private lands within the USFS boundaries and a 100m standard remote sensing buffer to handle mapped and field boundary mismatches were included.

Boulder Mountain occupies the eastern end of the Aquarius Plateau. Boulder Top reaches approximately 11,000 feet (3,353 m) where it forms an extensive plateau. Its edges form cliffs that drop about 1,000 ft (305 m). The plateau top is covered with a succession of lava flows from which large boulder landslides have descended to cover the flanks. Boulder Mountain is covered with many small lakes interspersed with shallow depressions that form wet meadows. Most of the lakes were excavated by glaciers. Lakes below the highest plateau were the result of landslides and Pleistocene glacial movement on the flank of Boulder Top. A few broad, very shallow U-shaped valleys, which are now occupied in places by morainal lakes, were carved by glacial tongues extending from Boulder Top.

Another extensive plateau to the west of Boulder Top reaching 10,000 ft (3,048 m) and tilted downwards towards the north supports subalpine grasslands, subalpine forests, and montane and subalpine shrublands. Towards the south and east at lower elevations, bedrock changes to sandstones that are also found in Capitol Reef National Park and Escalante-Grand Staircase National Monument. At the western end, the extensive, reddish, and erodible Claron Formation limestone forms a large plateau and spectacular cliffs that were not covered by lava flows. Steeper slopes descending into montane elevations occupy the area surrounding the lower plateau and Boulder Top.

While Boulder Mountain supports diverse plant communities at higher subalpine elevations, only two rare plant species occasionally are found in these high elevation meadows, Aquarius paintbrush (*Castilleja aquariensis*) and Angell cinquefoil (*Potentilla angelliae*). The AOI is more commonly known by hunters and fishers for the populations of elk, mule deer, pronghorn, and brook and brown trout. Among sensitive animal species are Utah prairie dog (*Cynomys parvidens*), greater sage-grouse (*Centrocercus urophasianus*), Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), and various raptor and neo-tropical migrant bird species.

2.2 Tasks

To achieve the main objective, a series of complex tasks were required:

a) Map the ecological systems and current vegetation classes of AOI;
b) Build spatial STSMs of all ecological systems; and

c) Using collaborative workshops, define guiding management objectives for simulations, chose a metric to measure success, management scenarios, annual budgets, actions used to treat vegetation, their costs per unit area and success and failure rates.

2.2.1 Vegetation mapping

The first step of all LCF projects completed prior to any field work, mapping, or modeling was the writing of a "live" document describing all ecological systems and vegetation classes (Appendix 1). This document also included non-vegetation "systems" such as roads, buildings, water bodies, and so on. At the onset, the document included ecological systems that were likely to be found but may not be detected during remote sensing.

Ecological systems are potential vegetation types expected in the physical environment under natural disturbance regimes usually named for the dominant upper-layer vegetation (e.g., black sagebrush, mesic ponderosa pine). Ecological systems are considered mostly permanent over centuries as they intimately correlate to soils. Vegetation class is the ecological system's current status defined by canopy structure, successional stage, and whether it is in reference or uncharacteristic condition. An uncharacteristic class is not a refence class and caused by post-European settlement disturbances. While ecological systems rarely change, vegetation classes can be changed by single disturbances. The nested description of 43 potential systems (38 ecological and the rest non-vegetated or agriculture) combined with vegetation classes resulted in >450 unique thematic combinations (Appendix 1) that were modeled and potentially mapped by remote sensing.

The vegetation description document was primarily written for the remote sensing contractor, field work, and modelers; therefore, description of classes includes short descriptions of all systems and classes, including the naming and numerical codes as used in models. The Word document was 36 pages, including a one-page table of content.

Three images from Spot 6/7 1-m/1.5-m resolution black and white/multispectral satellite were ordered in May 2021 for capture in mid-June and July:

A. 562,907 acres (227,800 ha) captured at elevations <10,000 ft (3,048 m) on June 11, 2021 as the herbaceous vegetation would be the first to senescence in June;
B. 128,342 acres (51,938 ha) captured twice at elevations ≥10,000 ft (3,048 m) elevation on July 8, 2019 and August 6, 2021 to match the later senescence of subalpine herbaceous vegetation. We used excellent archival imagery from 2019 because TNC's field work would be completed by the end of July and remaining snow and monsoonal rains might have interfered with cloud-free and snow-free imagery capture. The satellite was tasked to image starting in mid-July, but summer rains only permitted the first cloud-free capture on August 6th. This latter imagery was captured after the summer field work conducted entirely with the archival imagery.

Remote sensing was conducted with the software Imagine® from Hexagon Geospatial (formerly ERDAS Imagine® from Leica Geosystems) applied to Spot 6/7 imagery resolution multi-spectral satellite imagery. Moreover, freely available Google Earth imagery (www.earth.google.com/web/), including historical imagery, were used to assist with interpretation after all the field work. The mapping methodology has evolved over decades

because of technology and innovations and has been previously described (Low and others 2010; Provencher and others 2013, 2021a). Following an unsupervised classification of imagery to identify unique spectral combinations of red, blue, green and near infrared and image texture to specific ecological systems and vegetation classes, field work was conducted from 8-31 July and 18-29 October 2021. The summer field work included helicopter-based observations from 27-29 July 2021 to access remote, roadless, or rugged areas. More than 5,000 rapid observation points were collected to ensure that a large percentage of the landscape was visited. At each rapid observation location, the ecological system, vegetation class, explanatory notes, and at least two georeferenced photographs were taken.

Spatial Solutions delivered the vegetation map of ecological systems and vegetation classes on July 1, 2022. The resolution of the delivered imagery was 1 m because the coarser multi-spectral imagery was pan-sharpened to the 1.5m black-and-white resolution, then resampled to 1m in Imagine® while processing the imagery. This version of the map contains the contractor's short-hand field codes (and not the codes in the document describing the ecological systems and vegetation classes) that required quality control by TNC staff and translation from short-hand codes to 8-digit codes found in Appendix 1. Revisions were made to the vegetation map after review by US Forest Service and UDWR staff during the first management workshop at the end of September.

While the map and imagery shared with partners was at 1 m resolution, we resampled the system-class rasters to 25 m for simulations to stay within the limits imposed by hardware and simulation software. To avoid losing small, narrow, and ecologically important vegetation types, ecological systems and vegetation classes were resampled according to a user-defined hierarchy scripted in Python (Appendix 2). Small or linear ecological systems and vegetation classes, and systems critical to species success were given higher priority than common systems, which were resampled with a majority rule. This final vegetation class raster represented the "current condition" vegetation.

A few remote sensing challenges were encountered during field work:

A. The boundary between aspen-mixed conifer and aspen-spruce-fire was not obvious and required repeatedly driving and flying the elevation gradient. Often the ecotone was just below the rim of the lower plateau. The transition between the two systems was noted when the species composition shifted from Douglas-fir, ponderosa pine, white fir, limber pine, and Engelmann spruce often all present but no species dominant (i.e., mixed conifer) to strictly being dominated by Engelmann spruce and subalpine fir, with occasional limber pine and Douglas-fir. The transition both applied to the aspen with conifers and the transition from mixed conifer to spruce-fir systems without aspen.

B. Aspen-ponderosa pine was a new and unusual system for the authors and remote sensing contractor (Fig. 2). The fire regimes and fire sensitivity of aspen and ponderosa pine are incompatible; yet they co-exist on Boulder Mountain. The most surprising aspect of aspen-ponderosa pine ecology was that fire could entirely top-kill aspen and caused dense suckering but not appreciably top-kill mature ponderosa pine. It was also interesting that a severe enough fire could top-kill both tree species, thus causing

succession from a full stand-replacing event. This later successional pathway was far less common. This meant that two parallel successional pathways exist in this system that eventually merge with co-dominance of aspen and ponderosa pine (as in Fig. 2). The first challenge with aspen-ponderosa pine was to correctly label it to distinguish vegetation classes from each pathway, which was not recognized when this system was first observed. The second challenge was to avoid incorrectly labelling areas as ponderosa pine-mesic that were truly aspen-ponderosa pine because the aspen clone was depleted or mostly absent, probably because of past management. This was especially difficult to distinguish looking down from a helicopter and just from satellite imagery.

Figure 2. Aspen-ponderosa pine near and east of Posey Lake.

Aspen could be very difficult to detect in aspen-mixed conifer, especially on the northern slopes of Canaan Mountain (Fig. 3). These forests were dominated by young Douglas-fir and white fir with an abundance of woody debris on the ground. Close inspection revealed a few old and dead standing aspen boles. Our first visit to these closed-canopied forests required 15 minutes of driving and walking before we concluded that these were aspen-mixed conifer stands, but not true mixed conifer forests as we initially assumed from the imagery, where the aspen clones had died. Helicopter surveys later revealed very scattered dead and live aspen over large areas. This type of aspen degradation required a

disproportional amount of field work and helicopter observation to correctly distinguish between aspen-mixed conifer and mixed conifer forests, which were also present in the area.

The challenge of missing or few remaining aspen was not unique to aspen-mixed conifer as it was also observed in aspen-spruce-fir on the lower plateau. This mapping difficulty also required intensive field work to detect dead aspen boles standing or on the ground.

Figure 3. Aspen-mixed conifer on the northern slope of Canaan Mountain where aspen is barely present. Note the two dead boles of standing and leaning aspen in the background.

C. Black sagebrush was a widespread system on the northwestern slopes of Boulder Mountain. At the lower elevations nearest Bicknell, however, we found many large areas that were covered with snakeweed (*Gutierrezia sarothrae*), sometimes abundant cacti, and bare ground but devoid of a single black sagebrush shrub (Fig. 4). While the initial assignment of pixels to the black sagebrush ecological system and early shrub vegetation class was determined, it was not until later that we confirmed from local experts that black sagebrush was indeed the correct ecological system. Because there was high uncertainty about the assignment of black sagebrush, we spent considerable field time driving and, especially, flying over these areas. Historic domestic sheep

grazing close to towns and in winter range might best explain the absence of palatable black sagebrush.

Figure 4. Black sagebrush site dominated by snakeweed, cacti, and herbaceous weed.

D. There was some difficulty distinguishing between pinyon-juniper woodland and mountain shrub or mountain big sagebrush systems encroached with conifers in special cases. When conifers were young (<125 years old) and conical and mountain shrub species were obviously present (Fig. 5A), the designation to the mountain shrub system and the tree-encroached class was straightforward. We observed over the decades of mapping, that mountain shrub species, such as Utah serviceberry (*Amelanchier utahensis*), persist in the understory with tree encroachment. Sagebrush species, however, are often eliminated with decades of encroachment. This latter case required identification of sagebrush skeletons and/or assessing the dominance of young and generally conical conifers found in denser stands (>30% canopy cover) indicating that areas were open shrublands a few decades ago.

   The greater challenge was in areas where patches of older pinyon or juniper trees where intermixed with tree-encroached shrubland (Fig. 5B). At the periphery of the AOI, especially on lower mountain benches where shallower soils supporting true pinyon and juniper woodlands alternated with deeper soils supporting shrublands (Fig. 5B), we

specifically sought out zones with denser conifers indicating greater soil productivity with visible shrubs (if possible) and reserved the status of pinyon juniper woodland for areas with bright exposed soils and many older trees with obvious flat-topping canopies made of thick lateral branches observable with the imagery and Google Earth.

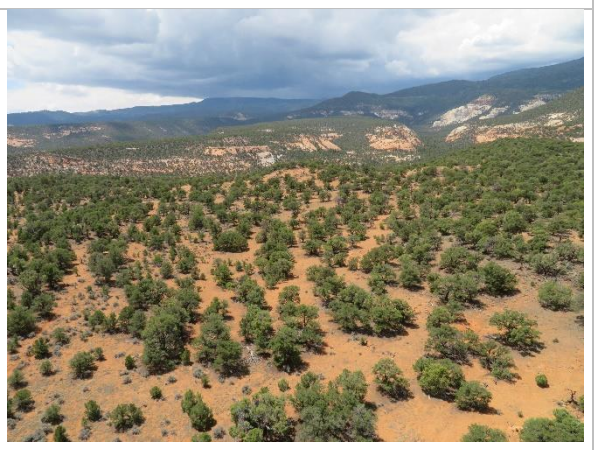
A.	B.
	

Figure 5. Mountain shrub system (A) with visible and common Utah serviceberry in the understory and (b) pinyon-juniper woodland systems (middle up to top of photograph) co-mingled with shrubland systems (right-central and left-central side of photograph).

E. Two different mixed conifer systems were found. One was the traditional mixed conifer system where three to six different conifer species are present on cooler slopes. This system was commonly composed of Douglas-fir, ponderosa pine, white fir, and limber pine, with occasional occurrence of Engelmann spruce, Rocky Mountain juniper, and Utah juniper. The other system was mixed conifer on the Claron Formation (Fig. 6), which is a reddish erodible limestone that is iconic in Bryce Canyon National Park. The diversity of conifer species is unusually high on Claron formation soil: Bristlecone pine, limber pine, ponderosa, Douglas-fir, ponderosa pine, white fir, limber pine, Colorado blue spruce, Rocky Mountain juniper, Utah juniper, and pinyon. It was common to observe at least eight different conifer species within one hectare with none of them dominant or abundant (Fig. 6). The mapping challenge was to correctly assign the label of mixed conifer-Claron only when bristlecone pine was present in the formation. Many areas with an influence of Claron formation did not have bristlecone pine, which is the indicator species. When bristlecone pine was absent, we simply labelled the site as mixed conifer. Usually, those sites were more productive. Another surprise with this system was that it was not limited to the southwest portion of Boulder Mountain; occurrences were found near Teasdale in the very northern part and frequently along the western edge of the AOI.

A.	B.

Figure 6.. Mixed conifer on Claron formation soils. (A) Eight different conifer species were observed at the location where photograph A was taken, including bristlecone pine. (B) Distinct Claron formation soil with a very diverse communities of conifers, including bristlecone pine.

2.2.2 State-and-transition Simulation Modeling

STSMs are stochastic models of landscape change. The landscape in an STSM consists of a discrete set of simulation cells classified into a discrete set of states. Simulation cells change over discrete timesteps according to a discrete set of possible transitions that are caused by either natural (e.g., wildfire) or anthropogenic (e.g., chainsaw thinning) processes (Daniel and others 2016). All simulations were conducted using the ST-Sim package in SyncroSim (Version 2.3.12; Daniel and others 2016; www.apexrms.com).

STSMs were spatially simulated for 25 years. In ST-Sim each pixel was assigned an initial condition state (a state is the combination of an ecological system and a vegetation class) obtained from remote sensing that can either (a) age one timestep and stay in the same class, (b) age one timestep into an older class (i.e., succession), or (c) experience a probabilistic disturbance and transition to ≥1 other states, including the originating state. Additionally, land ownership, categorized as USFS or private, was uploaded to constrain USFS management actions.

Transitions are probabilistic (ecological disturbances and, sometimes, succession) or deterministic (succession to another class after a fixed number of years). Land management actions were implemented using area targets (e.g., 1,000 acres·yr^{-1} or 405 ha·yr^{-1} seeded on average in designated vegetation classes). Probabilistic disturbances and management actions can be modified or constrained temporally or spatially to mimic real world processes such as climate variability, fire spread behavior, and equipment operation limits.

Fire was the dominant ecological disturbance in Boulder Mountain, although fires have not been common or large in recent history. In the last 50 years, fires have ranged from ~10 to

2,200 acres (0.4 to 890 ha) except for the largest reported fire of about 9,000 acres (3,642 ha) in 1977. These numbers reflected fire suppression management. The theoretical fire size distribution that appears common in Nevada and Utah (Provencher and others 2021) is show in Table 1.

Table 1. Size distribution (acres or ha) of fire events for Boulder Mountain (UT) based on federal fire occurrence data from several Great Basin, Columbia Plateau, Utah High Plateau, eastern Sierra Nevada field sites from 1980 to 2016 and the Monitoring Trends in Burn Severity (MTBS) data from 1984 to 2016. For example, a size class of "≤10" indicates fire events were ≤10 acres (≤4 ha).

Area of Disturbance Acres (ha)	Boulder Mountain Percent Occurrence
≤0.25 (≤0.1)	64
>0.25 to 10 (>0.1 to 4)	20
>10 to 100 (>4 to 40)	7
>100 to 300 (>40 to 121)	2
>300 to 1,000 (>121 to 405)	4
>1,000 to 5,000 (>405 to 2,023)	2
>5,000 to 20,000 (>2,023 to 8,094)	1

To approximately match these numbers given that each system's model was based on reference fire return intervals, the simulations suppressed fire return intervals of reference classes and other vegetation classes without non-native annual fuel by 90% (Provencher and others 2021a); however, simulations that imitated reference conditions did not contain a suppression factor. The modeling of the annual variability of wildfire (i.e., the high, average, and low fire years) is explained later in the section on temporal multipliers.

Fire spread was modeled using three principles: 1) prevailing winds elongate fire predominantly from the southwest to the northeast, while allowing other directions (Fig. 7); 2) fire spreads more readily upslope than downslope relative to wind directions based on McArthur's fire danger meter (Weise and Biging 1997; Table 2); and 3) natural fire ignition locations were spatially determined by observed lightning strikes and likely anthropogenic ignition locations near roads.

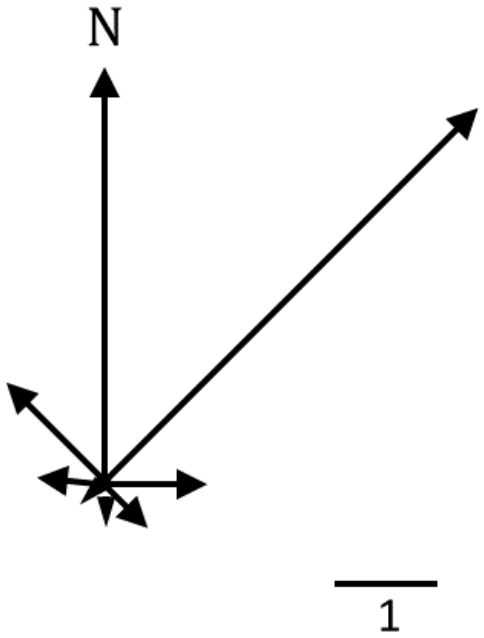


Figure 7. Wind directions that would "push" fire to elongate in the direction of the arrows. The longer the arrow, the higher probability of spread in that direction.

Table 2. Fire spread slope multipliers using McArthur's fire danger meter.

Slope (%)	Multiplier
-16	0.4700
-8	1.1320
0	1.0000
8	0.5600
16	3.9620

Lightning strike locations obtained by USFS from the Western Regional Climate Center in Reno NV were converted to a frequency map using a trial-and-error 12.5 km^2 moving window. The frequency values were standardized from 0 to 1 and converted into a 25m resolution raster of lightning strike density to model natural fire starts. Pixels with values of 1 had the highest likelihood of fire starts via lightning. A second raster of human-caused ignitions was modelled using the distance from frequently used roads. Based on Morrison's (2007) ignition data, distances from roads were also standardized to values between 0 and 1 using the equation:

$$H_i = 1.0171 \cdot e^{-0.004 \cdot Dist} \quad (1)$$

where H_i = Probability of human ignition at pixel *i* and $Dist_i$ = Distance from pixel *i* to the nearest road with frequent use. The maximum value between the two layers for each pixel was retained to create the final map of ignition likelihood. Once fire ignited in these locations, the fire spread based on underlying vegetation characteristics and prevailing wind directions (Fig. 7).

The other dominant process was herbivory expressed as livestock grazing (primarily cattle and a limited amount of domestic sheep grazing), native grazing by elk, and native browsing primarily from mule deer. The four forms of herbivory (cattle, sheep, native grazing, and native browsing) were modeled separately. Moreover, discussion with USFS experts led to separating cattle grazing between the boot-stage phase (mid-May to late June), which is the most damaging to perennial grasses, and the rest of the year (July to early May). Because herbivory was present in nearly all classes, especially cattle grazing, it had the potential to considerably slow the speed of simulations depending on the approach used. We avoided the most time-consuming approach controlled by iterative moving window calculations checked against a total stocking rate; instead, we used area targets (for example, 300,000 acres [121,406 ha] grazed per year).

The rate of cattle and sheep grazing varies among ecological systems according to their productivity. All grazing rates were set at 1.0 in vegetation classes but then adjusted with a number from 1 (most preferred vegetation) to 0.01 (least preferred vegetation) applied to the whole ecological system in the transition multiplier menu of ST-Sim (Table 3). The highest values were assigned to the most productive (i.e., most palatable) systems such as wet meadows, subalpine grassland, upper-montane and subalpine meadows, and montane riparian, based on actual forage production from NRCS ecological site descriptions prorated to the most likely season of use for a system. Other grazing rates were in decreasing order of system productivity, such as greasewood and mixed salt desert. Similar ranking was conducted for native browsing and native grazing (Table 4).

Table 3. Relative cattle and sheep grazing preference ranking of ecological systems based on NRCS annual productivity.

Ecological System	15 May-30 June Cattle Grazing Probability Per Year	July to April Cattle Grazing Probability Per Year	Sheep Grazing Probability Per Year
Aspen Woodland	0.0200	0.2200	0.2400
Aspen-Mixed Conifer	0.0200	0.2200	0.2400
Aspen-Ponderosa Pine	0.0200	0.2200	0.2400
Aspen-Spruce Fir	0.0200	0.2200	0.2400
Basin Big Sagebrush	0.0500	0.5500	0.6000
Big Sagebrush-mountain	0.0300	0.3300	0.3600

Ecological System	15 May-30 June Cattle Grazing Probability Per Year	July to April Cattle Grazing Probability Per Year	Sheep Grazing Probability Per Year
Big Sagebrush-upland	0.0220	0.2380	0.2600
Black Sagebrush	0.0270	0.2933	0.3200
Curl-leaf Mountain Mahogany	0.0230	0.2570	0.2800
Desert Wash	0.0160	0.1800	0.1960
Dry Wet Meadow	0.0830	0.9170	0.9990
Four-Wing Saltbush	0.0180	0.2020	0.2200
Gamble Oak-Mountain Shrub	0.0250	0.2750	0.3000
Greasewood-Basin Big Sagebrush	0.0230	0.2570	0.2800
Limber-Bristlecone Pine	0.0050	0.0510	0.0560
Lower Subalpine Grassland	0.0800	0.8800	0.8800
Mixed Conifer-Claron	0.0130	0.1470	0.1600
Mixed Conifer-montane	0.0170	0.1830	0.2000
Mixed Salt Desert	0.0180	0.2020	0.2200
Montane Riparian	0.0400	0.4400	0.4800
Mountain Shrub	0.0250	0.2750	0.3000
Pinyon-Juniper Shrubland	0.0130	0.1470	0.1800
Pinyon-Juniper Woodland	0.0180	0.0180	0.2200
Ponderosa Pine-dry	0.0080	0.0920	0.1000
Ponderosa Pine-mesic	0.0180	0.1830	0.2000
Riparian Blue Spruce	0.0400	0.4400	0.4800
Saline Meadow	0.0550	0.6050	0.6600
Semi-Desert Grassland	0.0150	0.1650	0.1800
Silver Sagebrush	0.0300	0.3300	0.3600
Pure Spruce	0.0170	0.1830	0.2000
Spruce-Fir	0.0170	0.1830	0.2000
Subalpine-Montane Mesic Meadow	0.0830	0.9170	0.9990
Subalpine-Upper Montane Riparian	0.0400	0.4400	0.4800

Ecological System	15 May-30 June Cattle Grazing Probability Per Year	July to April Cattle Grazing Probability Per Year	Sheep Grazing Probability Per Year
Upper Subalpine Grassland	0.0830	0.9170	0.9990
Wet Meadow-Montane	0.0830	0.9170	0.9990
Wet Meadow-Subalpine	0.0830	0.9170	0.9990
Wetland	0.0830	0.9170	0.9990

Table 4. Relative native grazing and native browse preference ranking of ecological systems based on NRCS annual productivity.

Ecological System	Native Grazing Probability Per Year	Native Browsing Probability Per Year
Aspen Woodland	0.0552	0.1300
Aspen-Mixed Conifer	0.0552	0.1300
Aspen-Ponderosa Pine	0.0552	0.1300
Aspen-Spruce Fir	0.0552	0.1300
Basin Big Sagebrush	0.1380	0.3900
Big Sagebrush-mountain	0.0828	0.2340
Big Sagebrush-upland	n/a	0.1690
Black Sagebrush	0.0736	0.2080
Curl-leaf Mountain Mahogany	0.0644	0.1820
Desert Wash	0.0451	0.1800
Dry Wet Meadow	0.0000	0.6494
Four-Wing Saltbush	0.0506	n/a
Gamble Oak-Mountain Shrub	0.0690	n/a
Greasewood-Basin Big Sagebrush	0.0644	n/a
Limber-Bristlecone Pine	0.0084	n/a
Lower Subalpine Grassland	n/a	n/a
Mixed Conifer-Claron	0.0368	n/a

Ecological System	Native Grazing Probability Per Year	Native Browsing Probability Per Year
Mixed Conifer-montane	0.0460	n/a
Mixed Salt Desert	0.0506	n/a
Montane Riparian	0.1104	0.3120
Mountain Shrub	0.0690	0.1950
Pinyon-Juniper Shrubland	n/a	n/a
Pinyon-Juniper Woodland	0.0506	0.1430
Ponderosa Pine-dry	0.0230	0.0650
Ponderosa Pine-mesic	0.0460	0.1300
Riparian Blue Spruce	0.1104	0.3120
Saline Meadow	n/a	0.4290
Semi-Desert Grassland	0.0414	0.1170
Silver Sagebrush	0.0538	0.2340
Pure Spruce	n/a	0.0460
Spruce-Fir	0.0460	n/a
Subalpine-Montane Mesic Meadow	0.2298	0.6494
Subalpine-Upper Montane Riparian	0.1104	0.3120
Upper Subalpine Grassland	n/a	0.6494
Wet Meadow-Montane	n/a	0.6494
Wet Meadow-Subalpine	n/a	0.6494
Wetland	0.2298	n/a

The probability of being grazed per year is one aspect of modeling herbivory. The other component is the proportional allocation of grazing and browsing effects to different vegetation classes. With proper grazing management, there generally is no change in vegetation composition or structure (i.e., the class does not change due to proper grazing). However, intense grazing transitions a small proportion of pixels to a less desirable vegetation class, such as around water sources. Grazing that occurred from May to late June (i.e., the boot stage) was considered more physiologically damaging to grass species than grazing during the rest of the year (Tables 5 and 6; Provencher and others 2021a). The outcome of herbivory to undesirable recipient classes were listed in Appendix 3.

Table 5. Proportional allocation of seasonal cattle grazing outcomes into no class change and transition to undesirable classes.

	15 May-30 June Cattle Grazing Probability Per Year		July-April Cattle Grazing Probability Per Year	
Ecological System	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**
Aspen Woodland	0.999	0.001	0.9995	0.0005
Aspen-Mixed Conifer	0.999	0.001	0.9995	0.0005
Aspen-Ponderosa Pine	0.999	0.001	0.9995	0.0005
Aspen-Spruce Fir	0.999	0.001	0.9995	0.0005
Basin Big Sagebrush	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Big Sagebrush-mountain	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Big Sagebrush-upland	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Black Sagebrush	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Curl-leaf Mountain Mahogany	0.999	0.001	0.9995	0.0005
Desert Wash	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Dry Wet Meadow	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Four-Wing Saltbush	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Gamble Oak-Mountain Shrub	0.999	0.001	0.9995	0.0005
Greasewood-Basin Big Sagebrush	0.999	0.001	0.9995	0.0005
Limber-Bristlecone Pine	n/a	n/a	0.9995	0.0005
Lower Subalpine Grassland	0.999	0.001	1.0000	0.0000
Mixed Conifer-Claron	0.999	0.001	1.0000	0.0000
Mixed Conifer-montane	0.999	0.001	1.0000	0.0000
Mixed Salt Desert	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Montane Riparian	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Mountain Shrub	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Pinyon-Juniper Shrubland	n/a	n/a	n/a	n/a

	15 May-30 June Cattle Grazing Probability Per Year		July-April Cattle Grazing Probability Per Year	
Ecological System	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**
Pinyon-Juniper Woodland	0.999	0.001	0.9995	0.0005
Ponderosa Pine-dry	0.999	0.001	1.0000	0.0000
Ponderosa Pine-mesic	0.999	0.001	0.9995	0.0005
Riparian Blue Spruce	0.999	0.001	0.9995 / 0.9999	0.0005 / 0.0001
Saline Meadow	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Semi-Desert Grassland	0.999	2× 0.0005 / 0.001[#]	0.9995	0.0005
Silver Sagebrush	0.999	0.001	1.0000 / 0.9995	0.0000/ 0.0005
Pure Spruce	n/a	n/a	1.0000	0.0000
Spruce-Fir	0.999	0.001	1.0000	0.0000
Subalpine-Montane Mesic Meadow	0.999 / 0.9995	0.0010 / 0.0005[&]	1.0000 / 0.9995	0.0000/ 0.0005
Subalpine-Upper Montane Riparian	0.999	0.001	1.0000 / 0.9995	0.0000/ 0.0005
Upper Subalpine Grassland	n/a	n/a	1.0000 / 0.9995	0.0000/ 0.0005
Wet Meadow-Montane	0.999	2× 0.0005 / 0.001[#]	1.0000 / 0.9995	0.0000/ 0.0005
Wet Meadow-Subalpine	0.999	2× 0.0005 / 0.001[#]	1.0000 / 0.9995	0.0000/ 0.0005
Wetland	0.999	0.001	1.0000 / 0.9995	0.0000/ 0.0005

[#]Split pathways result in different possible classes at 0.0005 each, whereas more degraded classes or less complex vegetation dynamics often result in a single outcome at 0.001.

[&] The 0.9995/0.0005 combination includes a low vulnerability class at elevations rarely grazing in late spring.

Table 6. Proportional allocation of seasonal native browsing and native grazing outcomes into no class change and transition to undesirable classes.

	Native Browsing Probability Per Year		Native Grazing Probability Per Year	
Ecological System	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**
Aspen Woodland	1.0	0.0	1.0	0.0
Aspen-Mixed Conifer	1.0	0.0	1.0	0.0
Aspen-Ponderosa Pine	1.0	0.0	1.0	0.0
Aspen-Spruce Fir	1.0	0.0	1.0	0.0
Basin Big Sagebrush	0.9999	0.0001	0.9999	0.0001
Big Sagebrush-mountain	n/a	n/a	0.9999	0.0001
Big Sagebrush-upland	n/a	n/a	0.9999	0.0001
Black Sagebrush	n/a	n/a	0.9999	0.0001
Curl-leaf Mountain Mahogany	0.9999	0.0001	0.9999	0.0001
Desert Wash	1.0	0.0	n/a	n/a
Dry Wet Meadow	n/a	n/a	1.0	0.0
Four-Wing Saltbush	0.9999	0.0001	1.0	0.0
Gamble Oak-Mountain Shrub	1.0	0.0	n/a	n/a
Greasewood-Basin Big Sagebrush	n/a	n/a	0.9999	0.0001
Limber-Bristlecone Pine	n/a	n/a	n/a	n/a
Lower Subalpine Grassland	n/a	n/a	1.0	0.0
Mixed Conifer-Claron	n/a	n/a	n/a	n/a
Mixed Conifer-montane	1.0	0.0	1.0	0.0
Mixed Salt Desert	1.0	0.0	n/a	n/a
Montane Riparian	0.9999	0.0001	1.0	0.0
Mountain Shrub	1.0	0.0	1.0 /0.9999 / 0.9995	0.0 / 0.0001 / 0.0005
Pinyon-Juniper Shrubland	n/a	n/a	n/a	n/a
Pinyon-Juniper Woodland	1.0	0.0	1.0	0.0

	Native Browsing Probability Per Year		Native Grazing Probability Per Year	
Ecological System	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**	**Proper Grazing Proportion (no change in class)**	**Less Undesirable Proportion**
Ponderosa Pine-dry	1.0	0.0	n/a	n/a
Ponderosa Pine-mesic	1.0	0.0	0.9999	0.0001
Riparian Blue Spruce	1.0	0.0	1.0	0.0
Saline Meadow	n/a	n/a	n/a	n/a
Semi-Desert Grassland	0.9999	0.0001	0.9999	0.0001
Silver Sagebrush	n/a	n/a	1.0	0.0
Pure Spruce	n/a	n/a	n/a	n/a
Spruce-Fir	1.0	0.0	1.0	0.0
Subalpine-Montane Mesic Meadow	1.0	0.0	1.0	0.0
Subalpine-Upper Montane Riparian	1.0	0.0	1.0	0.0
Upper Subalpine Grassland	n/a	n/a	1.0 /0.9999	0.0 / 0.0001
Wet Meadow-Montane	n/a	n/a	1.0 /0.9999	0.0 / 0.0001
Wet Meadow-Subalpine	n/a	n/a	1.0 /0.9999	0.0 / 0.0001
Wetland	n/a	n/a	n/a	n/a

Cattle and sheep grazing were spatially constrained as defined by USFS grazing permits per each Ranger District. Because a deferred grazing system was applied in each Ranger District, distinct even and odd-year rasters were built for the entire landscape. Moreover, each even year and odd year were partitioned by the late spring grazing season (May 15-June 30) and rest of the year (July 1 to May 14 next year); therefore, four rasters were created for cattle. The odd and even year rasters were repeated every other year from 2023 to 2047 in ST-Sim's spatial constraint menu. For sheep grazing, we did not partition by season of use although we retained the more undesirable effects of late-spring use (Table 4); therefore, only two rasters were deployed for the even and odd years. In each district, we attributed each allotment-pasture combination with the stocking rate expressed as head months. Each stocking rate was divided by the area of the pasture and multiplied the relative duration of the permit's grazing period for each season of use and divided by the total adjusted stocking rate over the entire Ranger

District (thus two District totals for the entire Boulder Mountain). Rested pastures were assigned a stocking rate of 0 in their respective seasons/years.

Disturbances other than fire and herbivory included plant mortality from severe drought, drought (of various duration depending on disturbance affected), native conifer invasion of shrubland, stream flooding, non-native annual species invasion, exotic forb invasion, insect and disease outbreaks, wet years, very wet years, aspen clone loss, natural recovery of degraded vegetation, and succession. Avalanches that promote aspen resprouting were too rare or insignificant to be part of the Boulder Mountain dynamics.

Management Scenarios. A management scenario is a group of land management actions and specific climate effects that define a simulation theme. Scenario development was guided by the general management objectives of the partners, the Utah Division of Wildlife Resources and both US Forest Service ranger districts. During the first workshop, partners established the following guiding objectives (Table 7):

Table 7. Guiding management objectives established by partners during the first management workshop for Boulder Mountain, UT.

2022 Guiding Objectives for Boulder Mountain's Natural Resources
Increase landscape health by shifting ecological processes towards natural range of variation.
Reduce ecological departure for targeted systems that can support wildlife populations, such as mule deer.
Maintain or improve watershed integrity and hydrologic function to protect and benefit aquatic resources and water quality.
Complement other multi-use objectives.

Two management scenarios were simulated for 25 years. The two scenarios were (1) a Status-Quo scenario (named Custodial management) that included the maintenance of current fire-suppression activities and livestock grazing practices but did not use any mechanical or prescribed burning actions (this was a control and all workshop participants understood that USFS has deployed tree thinning and prescribed fire operations under current management) and (2) Proposed management that represented an ambitious level of vegetation treatment implementation. While $0 per year were assigned to the Custodial management scenario, the Proposed management scenario was limited to a maximum annual expenditures level of about $1.5 million from year 2023 (first year) to 2046. If simulated treatments cannot find enough areas to treat, realized expenditures will be less than the maximum allowed. A list of management actions was selected by agency experts per ecological systems. Each action was assigned a cost per area (Table 8) and other implementation attributes were imbedded in the simulation library: success and failure proportions, vegetation class outcomes for success and failures, and slope constraints described above).

Table 8. Cost per acre of management actions.

Action	Average Cost ($/acre)	Minimum Cost[#]	Maximum Cost
Beaver Reintro	$1,500	n/a	n/a
Chainsaw+PileBurning	$1,530	n/a	n/a
Chainsaw-Thinning	$1,500	n/a	n/a
Exotic-Control	$5	n/a	n/a
Feller-Buncher+Skidder-Merch[&]	$1	n/a	n/a
Feller-Buncher+Skidder-SubalpineFir	$1,500	n/a	n/a
Fence	$6,100	$2,200	$10,000
Floodplain-Restoration	$5,000	n/a	n/a
Harrow-Dixie-Chain+Seed	$320	n/a	n/a
Herbicide-Plateau+Native-Seed	$350	$300	$400
Herbicide-Plateau+Seed	$150	$120	$180
Lop+Pile+Burn	$1,315	$1,130	$1,530
Lop+Scatter	$125	n/a	n/a
Masticate+Spot-Herbicide+Seed	$630	$580	$780
Mastication	$500	$400	$600
Mowing+Seed	$230	n/a	n/a
RxFire	$200	$150	$250
Small-Tree-Lopping	$35	$30	$40
Water-Table-Uplift	$1,500	n/a	n/a

[#] The range between minimum and maximum cost was sampled with a uniform distribution by ST-Sim.

[&] The USFS does not incur cost for feller-buncher operations conducted by contractors, except to remove subalpine fir (another distinct action listed above). While the cost is $0, we prudently assigned a $1 cost to avoid divisions by zero.

Constraints on Management Actions. Rasters that spatially constrain implementation of management actions were uploaded to ST-Sim. Based on the experience of BLM machinery operators, all actions that used feller-bunchers and tractors pulling seeders, mowers, or harrows were limited to slopes less than 15% in a raster calculated from the US Geological Survey Digital Elevation Model. Similarly, masticators and various chainsaw operations could be used on slopes up to 30%. Prescribed fire was not limited by slopes. Another group of constraints were the zones where some or any machinery could not be used. Inventoried

Roadless Areas did not allow any machinery requiring a road for access beyond a 1,800-ft (549m) buffer from the road (Fig. 8); therefore, mechanical actions could be used within the buffer. Prescribed fire and chainsaws not requiring roads could be used in the Inventoried Roadless Area. Research Natural Areas do not allow any mechanical actions, although fires can occur (Fig. 8). Another equipment constraint raster was based on the ability of USFS roads to allow access by low-boy trucks loaded with a feller-buncher. Feller-bunchers and masticators could be used up to 1,800 ft (549m) on either side from the road; therefore, we created a raster of all appropriate roads designated by the USFS and buffered up to 1,300 ft (396 m) that limited the use of feller-bunchers to only within the buffer. The final constraint raster prevented ignition of prescribed fires in areas 300 ft (91 m) away from waterways and water bodies to prevent sedimentation into fish species habitat.

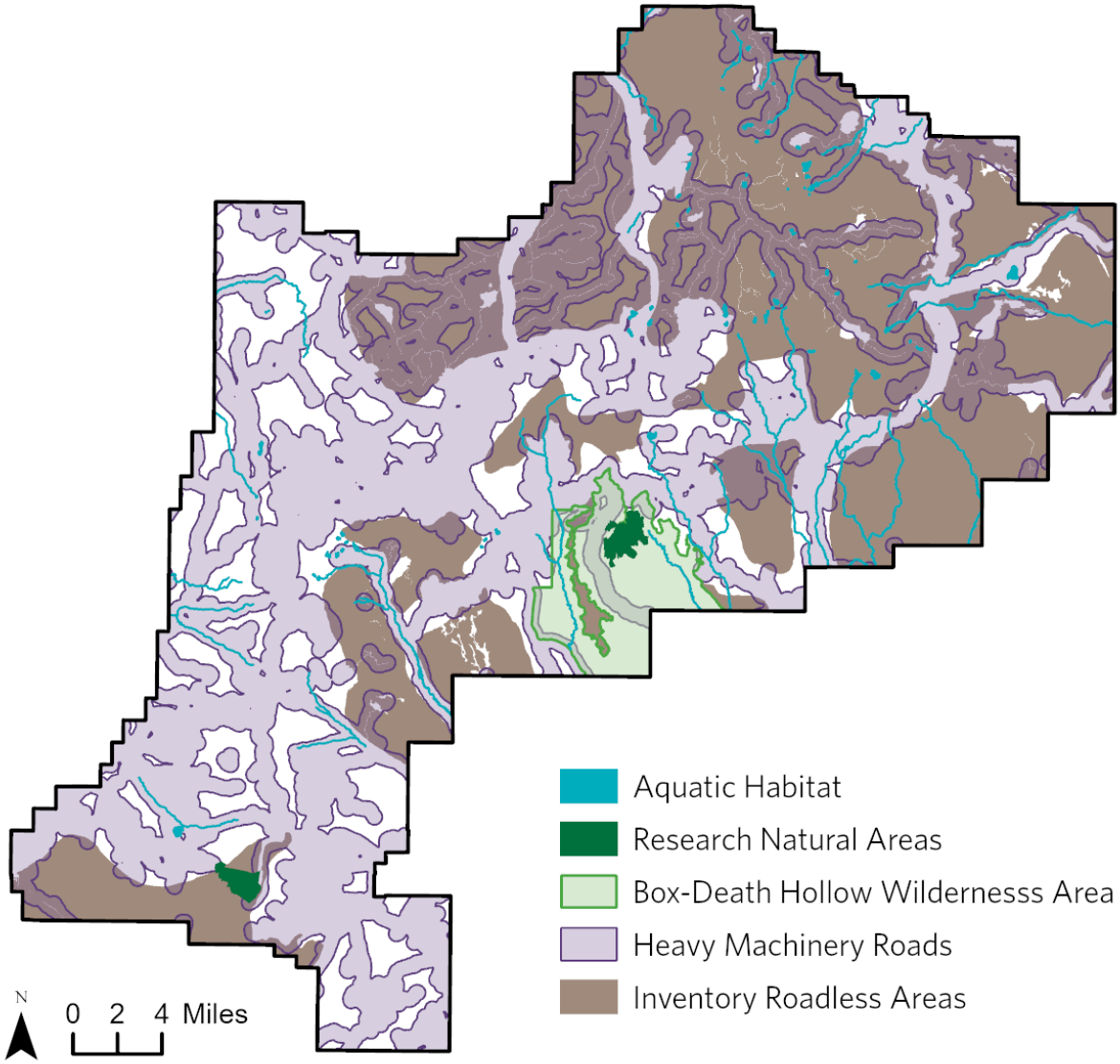


Figure 8. Map of constraints and vegetation management equipment access areas in Boulder Mountain. A 300-ft buffer from aquatic habitats prevented prescribed fire ignition but not mechanical operations. Mechanical equipment was not allowed in Research Natural Areas and Wilderness areas. The buffer from each side of roads allowing access with low-boy trucks carrying feller-bunchers and masticators was no more than 1,800 ft, including on existing roads in Inventoried Roadless Areas.

Replication and Climate Variability. Each scenario used the same climate time series to introduce temporal variability into the expression of ecological disturbances. The climate scenario was historic climate data from 1945 to 2022 obtained from the Parameter-elevation Relationships on Independent Slopes Model (PRISM; Daly and others 2008). This period captured the severe droughts of the 1950s, represented better climate station instrumentation after the Second World War, and showed an emerging climate warming trend in recent years.

Monthly precipitation and monthly minimum and maximum temperatures were downloaded from PRISM for a location at the center of the project area (approximately 38°4'48.0" N, 111° 37'4.0" W). A stochastic weather generator (SWG; Verdin and others 2014) was used to statistically replicate each climate time series 20 times over 25 years.

The purpose of simulating future climate was to introduce temporal variability in dominant ecological processes (Provencher and others 2016b). Variability directly affects processes through temperature and precipitation, or indirectly mediates processes through the Standard Precipitation-Evapotranspiration Index (SPEI). SPEI is a standardized drought index that, as the name implies, includes both precipitation and evapotranspiration. and is expressed in positive (wet) and negative (dry) standard deviations from the mean (Vicente-Serrano and others 2010). Unlike the Palmer's Drought Index, SPEI is calculated over user defined time lags. SPEI was calculated from PRISM's replicated time series of monthly precipitation and minimum and maximum temperatures using the "spei" function in R package 'SPEI' (Begueria and Vicente-Serrano 2017). Each of the 20 climate replicates resulted in one SPEI time series expressed each year as a matrix organized by month of reporting (for example, September) and backward lag of drought values expressed in months (for example, 9 months prior).

Temperature, precipitation or SPEI time series were transformed into transition multipliers in ST-Sim (Provencher and others 2016b). Transition multipliers are a quantitative method to determine how climate variations influence ecological processes. Transition multipliers are traditionally determined by dividing each yearly value of the time series (for example, area burned) by the temporal average of the time series, thus creating a non-dimensional time series with an average of one. A transition multiplier is a varying unitless number ≥0 in an annual time series that multiplies a base disturbance rate in the STSM. For example, a transition multiplier of 1 implies no change in the annual probability for fire, a transition of 0 is a complete suppression of fire, and a transition of 3 triples the annual probability of fire. Patterns of climate variability can therefore be used to reproduce patterns in fire activity over periods of years that were statistically replicated by the SWG.

Often, however, we do not have access to time series of data from which to calculate even a single replicate; therefore, we theoretically generated the transition multipliers using different SPEI and curve-fitting equations based on the theorizes relationships, sometimes documented in the scientific literature, between an ecological process and different standard deviations of SPEI (Table 9).

Table 9. Climate variability factors used to build temporal multipliers (TM) for ecological processes directly affected by temperature and precipitation, or through water stress, as expressed by the Standard-Evapotranspiration Precipitation Index (SPEI). The symbol "×" indicates multiplication of the two temporal multipliers as performed by the ST-Sim software.

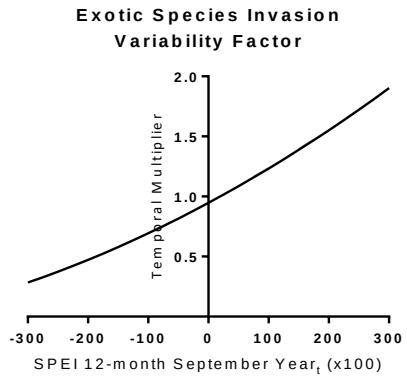
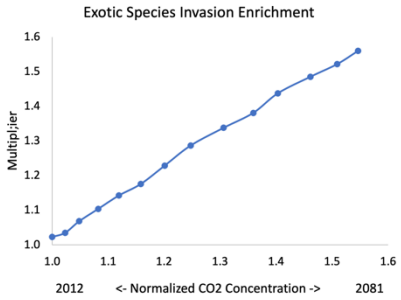
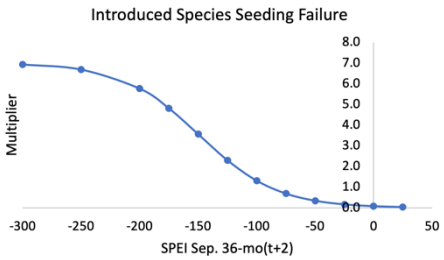
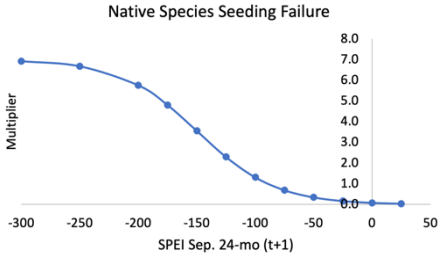
Ecological Process Affected	First factor	Second Factor
Exotic Species Invasion[#]: TM corresponding to the 12-month SPEI of that year (regressed to represent annual flows in riparian corridor).	 ×	
May Hard Freeze: TM obtained by multiplying the resampled Beta density functions for episodic rare events of early spring thaw in April causing Gamble oak bud breaks followed by bud kill during hard May freeze.	April Thaw: Beta Distribution Mean = 4.75 Standard Deviation = 4.50 Minimum value = 0.001 Maximum value = 100.00 ×	May Hard Freeze: Beta Distribution Mean = 4.75 Standard Deviation = 3.54 Minimum value = 0.001 Maximum value = 100.00
36-month drought mortality[%]: Three-year drought one year prior and two years into the future will cause introduced species failure.		
24-month drought mortality[@]: Two-year drought one year prior and one year into the future will cause native species failure.		

Table 9. Climate variability factors used to build temporal multipliers (TM) for ecological processes directly affected by temperature and precipitation, or through water stress, as expressed by the Standard-Evapotranspiration Precipitation Index (SPEI). The symbol "×" indicates multiplication of the two temporal multipliers as performed by the ST-Sim software.

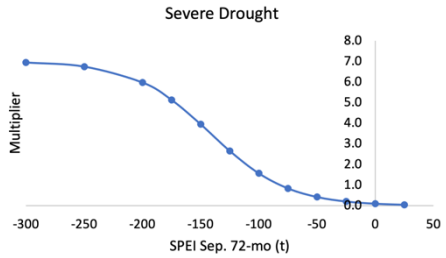
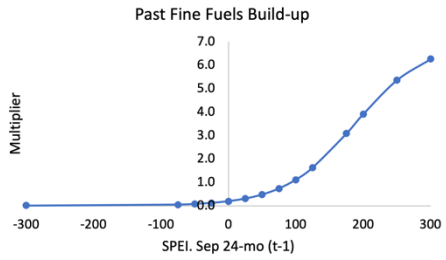
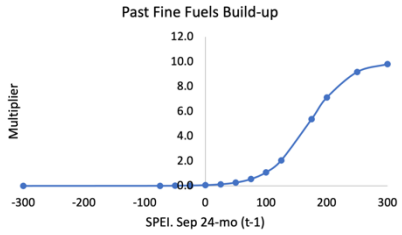
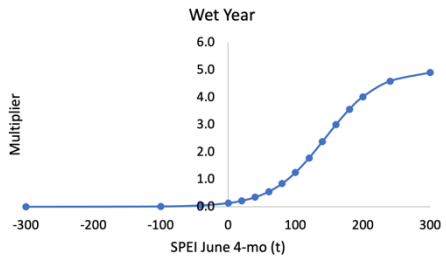
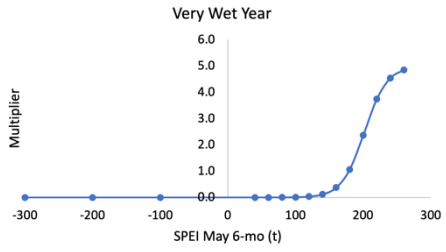
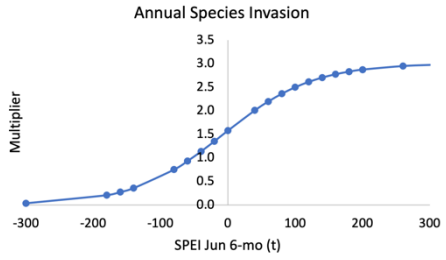
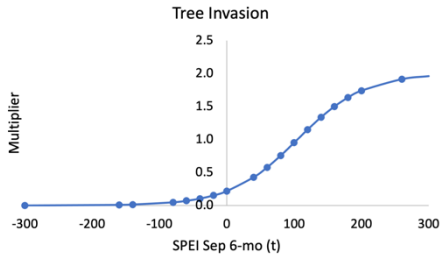
Ecological Process Affected	First factor	Second Factor
Severe Drought[+]: Five-year drought for the current and past four years will cause shrub and tree thinning, and affect woody succession in wet systems.		
Fire Activity[*]: Greater fire activity occurs in shrub systems if fine fuels first accumulate two years prior to the current year, followed by year with dry fuels. The resulting functions multiplied the historic maximum fire size of each landscape.	 × 
Wet Year[&]: A wet year is equal to one standard deviation more moisture than the mean; TM = 1 when SPEI = 100. Wet years primarily fertilize cheatgrass cover-increase in upland systems, and slightly reverse woody succession in saline and wet meadows.		
Very-Wet year[^]: A very-wet year is equal to two standard deviations more moisture than the mean; TM = 1 when SPI = 200. Wet year was only used as a stand replacing event in salt desert communities through root rot.		
Annual Species Invasion[$]: Non-native annual species can invade even during droughts: Invasion is enhanced at SPI>-0.42 STDEV from mean.		

Table 9. Climate variability factors used to build temporal multipliers (TM) for ecological processes directly affected by temperature and precipitation, or through water stress, as expressed by the Standard-Evapotranspiration Precipitation Index (SPEI). The symbol "×" indicates multiplication of the two temporal multipliers as performed by the ST-Sim software.

Ecological Process Affected	First factor	Second Factor
Tree (Native) Invasion‡: Conifer species (primarily pinyon and juniper) germinate and establish during wet years: Invasion is enhanced at SPI>+1 STDEV from mean.		

Footnotes for Table 5 are listed below:

#Annual $Flow_t = 49.9158 + 0.1421 \cdot SPEI_{Sept[t]} + 0.000085259 \cdot SPEI_{Sept[t]}^2$

%36-month introduced seeding drought mortality = $7 \cdot (1-e^{-3 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t+2],36mo} + 195))} / (4+e^{-3 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t+2],36mo} + 195))}))$

@24-month native seeding drought mortality = $7 \cdot (1-e^{-3 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t+1],24mo} + 195))} / (4+e^{-3 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t+1],24mo} + 195))}))$

+Severe $Drought_t$ variability factor = $7 \cdot (1-e^{-3 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t],72mo} + 195))} / (5+e^{-3 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t],72mo} + 195))}))$

*Shrubland Area $Burned_t$ variability factor = Past Fine Fuels Buildup · Current Fuels Dryness, where

Past Fine Fuels $Buildup_t = 10 \cdot e^{(3*(0.01*(100 \times SPEI_{Sep[t-1],24mo} - 170)))} / (1+e^{(3 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t-1],24mo} - 170)))})$, and

Current Fuels $Dryness_t = 7 \cdot (1-e^{(3.5 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t],8mo} + 150)))} / (1+e^{(3.5 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t],8mo} + 150)))}))$

&Wet $Year_t$ variability factor = $5 \cdot e^{2.5 \cdot (0.01 \cdot (100 \times SPEI_{June[t],4mo} - 100))} / (3+e^{2.5 \cdot (0.01 \cdot (SPEI_{June[t],4mo} - 100))}$

^Very-Wet $Year_t$ variability factor = $5 \cdot e^{6 \cdot (0.01 \cdot (100 \times SPEI_{May[t],6mo} - 175))} / (5+ e^{6 \cdot (0.01 \cdot (100 \times SPEI_{May[t],6mo} - 175)})$

$Non-Native Annual Species $Invasion_t$ variability factor = $3 \cdot e^{1.5 \cdot (0.01 \cdot (100 \times SPEI_{June[t],9-mo=} + 80)} / (3+ e^{1.5 \cdot (0.01 \cdot SPEI_{June[t],9-mo} + 80)})$
3*EXP(1.5*(0.01*(A62+80)))/(3+EXP(1.5*(0.01*(A62+80))))

‡Tree (Native) $Invasion_t$ variability factor = $2 \cdot e^{2 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t],6-mo} - 50))} / (3+ e^{2 \cdot (0.01 \cdot (100 \times SPEI_{Sep[t],6-mo} - 50))})$

2.2.3 Unified Ecological Departure

Unified ecological departure is the metric of condition that is based on the distribution of vegetation classes and assumed that low ecological departure would accommodate the habitat requirements of many animal and plant species. Lower values indicate that vegetation is closer to the reference condition and may not require intensive or any management interventions. Traditional ecological departure was pioneered by the LANDFIRE program and is the dissimilarity between the *observed* distribution of vegetation class percentages and the *expected* distribution of vegetation class percentages in the reference condition (i.e., most often assumed to be pre-European settlement condition; Hann and Strom 2003; Shlisky and Hann 2003; Rollins 2009; Blankenship and others 2021; Swaty and others 2022):

Ecological Departure (ED) = 100% – $\sum_{i=1}^{N} \min\left(Observed\%_i, Expected\%_i\right)$ (2)

where *i* = 1,…,*N* classes (Provencher and others 2008; for an example see Low and others 2010).

Unified ecological departure is coded into ST-Sim's menu *Ecological Departure* and begins with ecological departure calculated the traditional way, and then (1) scores the departure higher (makes condition worse) according to levels of vegetation class undesirability present (e.g., noxious forbs) and (2) scores the departure slightly lower (makes condition slightly better) according to agreed-upon management threshold levels of allowable uncharacteristic classes present (e.g., introduced species seeding):

$$\text{Unified Ecological Departure (UED)} = Min\left(100, Max\left[0, ED - \sum_{i=R+1}^{U_{No-Thresh}} \min\{HRF_i \times Observed\%_i, 0\} - \sum_{j=U_{No-Thresh}+1}^{N} \min\{Threshold\%_j, Observed\%_j\}\right]\right) \quad (3)$$

where *R*, $U_{No\text{-}Thresh}$, and *N* are, respectively, number of reference classes, uncharacteristic classes without threshold values, and total vegetation classes. $Threshold_j$ is a user-supplied management threshold for class *j*, and *HRF* is the high-risk function of class *j* for different levels of "undesirability." Uncharacteristic vegetation classes with an undesirability level >0 are assigned a high risk value based on the arbitrary function *HRF* selected based on desirable curve fitting properties. We chose a negative sigmoid function for *HRF*:

$$HRF_j = -e^{c(B-1)}/(1 + e^{c(B-1)})$$

where *c* is an arbitrary fitted coefficient (here 10) and B is the undersirability level from the table. HRF = 0, -0.5, and -1 for, respectively, values of B = 0, 1, and 2. When thresholds and HRFs are not specified in ST-Sim, the UED equation simplifies to the ED equation.

3. Outcomes

To better inform managers, outcomes of simulated vegetation and treatments were presented in two part:

- Description of mapped ecological systems and unified ecological departure as obtained from remote sensing and Custodial management simulations; and
- Prescriptions for management based on vegetation classes that contribute most to ecological departure or mule deer habitat suitability of focal ecological systems.

3.1. Vegetation Map

Forty-four "systems" were mapped but five were not ecological systems, such as agriculture, barren-rock-mud, developed, roads, and water. While badland was not considered for analysis, it could be considered an ecological system sometimes harboring rare species or old individuals of a species. The three most extensive ecological systems of Boulder Mountain were big sagebrush-mountain (123,934 acres or 50154 ha), ponderosa pine-mesic (121,499 acres or 41,169 ha), and aspen-spruce-fir (100,871 acres or 40,821 ha; Table 9). The three smallest systems were saline meadow (14 acres or 6 ha), pinyon-juniper-shrubland (5 acres or 2 ha), and four-wing saltbush (3 acres or 1 ha; Table 9).

The vegetation of Boulder Mountain was very zonal (Fig. 9). The subalpine elevations were centrally located and dominated by aspen-spruce-fir, lower subalpine grassland, pure spruce, and upper subalpine grassland. This high-elevation plateau was primarily surrounded by aspen-ponderosa pine and mesic ponderosa pine, except to the north where black sagebrush dominated the montane elevations to the project's boundary. The next zone down was a mixture of pinyon-juniper woodland, big sagebrush-mountain and upland, mountain shrub, and black sagebrush.

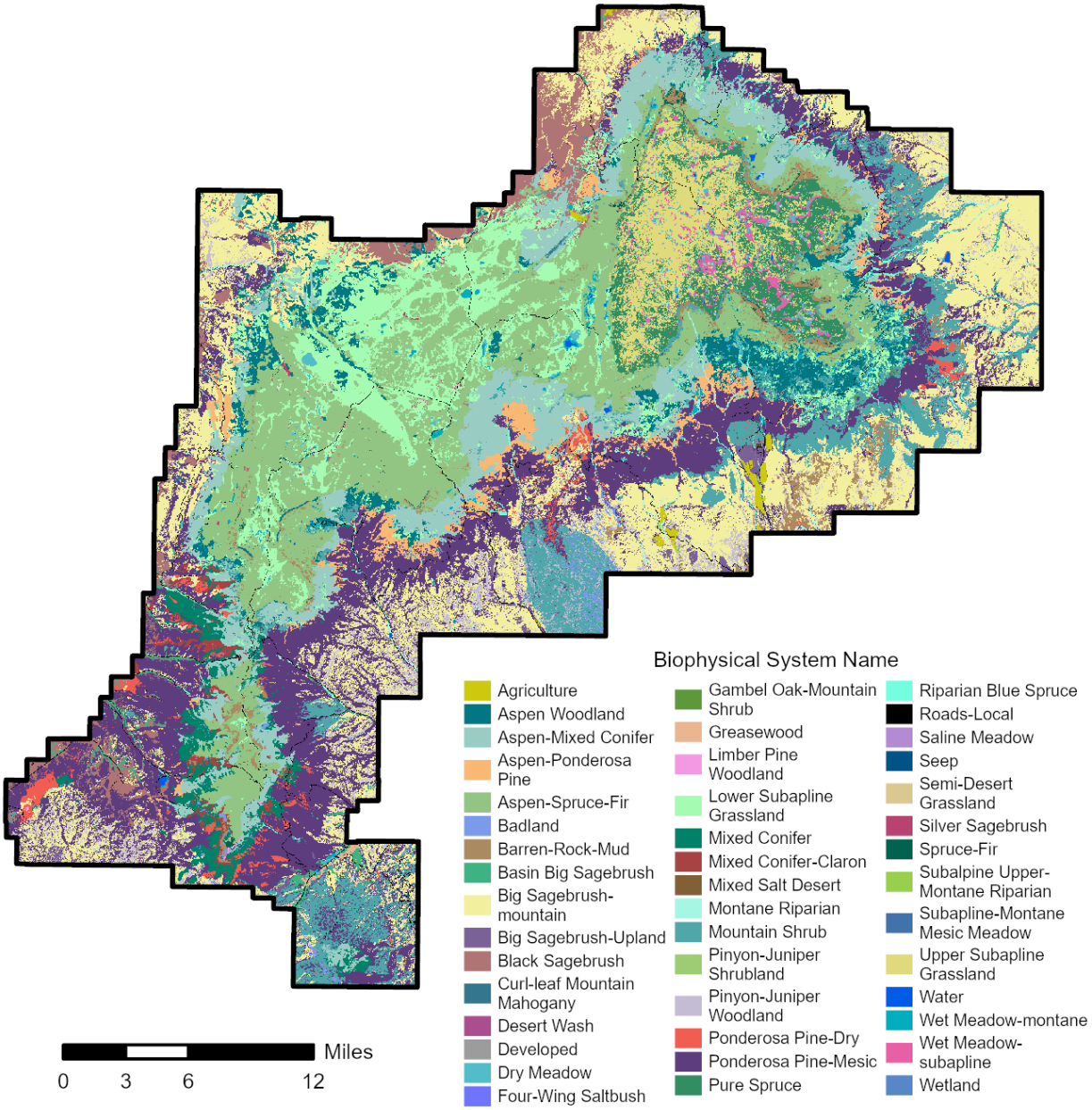


Figure 9. Ecological systems of Boulder Mountain based on a resampled 25-m map from 1.5 m Spot 6/7 imagery. The area comprised the southern section of Fremont River Ranger District (Fishlake National Forest), entire Escalante Ranger District (Dixie National Forest), and all private inholdings. Map accuracy was assumed worse for most private lands than USFS lands as the former lands were not accessed.

Eleven ecological systems were highly departed from reference conditions (in decreasing order of area): big sagebrush-mountain, aspen-spruce-fir, aspen-mixed conifer, mountain shrub, upper subalpine grassland, aspen woodland, aspen-ponderosa pine, desert wash, curl-leaf mountain mahogany, semi-desert grassland, and four-wing saltbush (Table 10). Ten ecological systems were moderately departed from reference conditions: ponderosa pine-mesic, black

sagebrush, mixed conifer-montane, ponderosa pine-dry, mixed conifer-Claron, big sagebrush-upland, basin big sagebrush, wet-meadow-montane, montane riparian, and spruce-fir. The remaining ecological systems exhibited low departure from reference conditions; lower subalpine grassland, pinyon-juniper woodland, pure spruce, dry wet meadow, wet meadow-subalpine, riparian blue spruce, silver sagebrush, greasewood-basin big sagebrush, Gamble oak-mountain shrub, limber and bristlecone pine, seep, mixed salt desert, subalpine upper-montane riparian wetland, subalpine montane mesic meadow, saline meadow, and pinyon and juniper shrubland.

All aspen systems, except aspen-spruce-fir, were 100% departed from reference conditions (Table 10). These are widespread and assumed to be important to mule deer. As addressed later, depleted aspen classes dominated aspen systems. Also important to mule deer, the big sagebrush-mountain and mountain shrub were highly departed from reference condition and commonly encroached with conifers after many decades of fire exclusion. Big sagebrush-upland, also important mule deer browse, were all moderately departed from reference condition.

Table 10. Unified ecological departure and area of ecological systems in 2021. Area estimates were based on the resampled 25-m map layers, but not the 1-m map layers. Reddish color was highly departed (>65%), yellow indicated moderate departure (34 to 65%), and greenish color represented low departure. The estimation of departure is less accurate for systems with longer intervals between stand-replacing events and small areas.

Ecological Systems	Mean UED (%)	Acres (ha)
Big Sagebrush-mountain	100	123,934 (50,154)
Ponderosa Pine-Mesic	43	121,499 (49,169)
Aspen-Spruce-Fir	80	100,871 (40,821)
Aspen-Mixed Conifer	100	54,044 (21,871)
Lower Subalpine Grassland	0	51,268 (20,747)
Mountain Shrub	100	50,870 (20,586)
Upper Subalpine Grassland	77	24,634 (9,969)
Black Sagebrush	42	21,950 (8,883)
Aspen Woodland	100	20,211 (8,179)
Pinyon-Juniper Woodland	28	18,161 (7,349)
Pure Spruce	26	17,863 (7,229)
Aspen-Ponderosa Pine	100	14,599 (5,908)
Barren-Rock-Mud	n/a	13,218 (5,349)
Mixed Conifer	60	12,553 (5,080)
Ponderosa Pine-Dry	38	6,262 (2,534)

Dry Wet Meadow	2	5,882 (5,882)
Roads-Local	n/a	4,568 (1,849)
Wet Meadow-subalpine	6	4,189 (1,695)
Mixed Conifer-Claron	58	3,295 (1,333)
Big Sagebrush-Upland	54	3,209 (1,299)
Basin Big Sagebrush	46	3,194 (1,293)
Wet Meadow-montane	51	3,073 (1,244)
Montane Riparian	65	2,678 (1,084)
Badland	n/a	2,568 (1,039)
Riparian Blue Spruce	28	1,993 (807)
Agriculture	n/a	1,589 (643)
Spruce-Fir	35	896 (363)
Water	n/a	681 (276)
Silver Sagebrush	2	603 (244)
Desert Wash	86	466 (189)
Greasewood	0	367 (149)
Curl-leaf Mountain Mahogany	69	287 (116)
Gambel Oak-Mountain Shrub	25	204 (83)
Limber Pine Woodland	24	147 (59)
Developed	n/a	114 (46)
Seep	2	90 (36)
Mixed Salt Desert	10	84 (34)
Subalpine Upper-Montane Riparian	3	42 (17)
Wetland	1	30 (12)
Subalpine-Montane Mesic Meadow	22	27 (11)
Semi-Desert Grassland	96	27 (11)
Saline Meadow	20	14 (6)
Pinyon-Juniper Shrubland	25	5 (2)
Four-Wing Saltbush	55	3 (1)

3.2. Future Results by System

3.2.1. Aspen Woodland

2021 System Acres at 25-m resolution: 20,211

2021 UED: 100% (high departure)

Problems or Concerns

Aspen woodland was dominated (16,785 acres or 83% of total area) by older depleted stands (U-D:Depleted; Table 11). Continued long-term degradation of depleted aspen woodland can cause the loss of clones (U-A:Lost-Aspen), of which 515 acres (2.5%) of dead boles were observed (Table 11). Loss of clones is permanent and should be avoided with a high priority.

Table 11. Vegetation classes of aspen woodland expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Area (acres)	Percent of Total in 2021	Reference Condition (a.k.a., NRV) % of Total
A:Char1	ephemeral	<0.1	1
A:All	17	0.1	7
B:Closed	216	1.1	16
C:Closed	201	1.0	36
D:Open	1,840	9.1	39
U-A:Char-DPL	0	0.0	n/a
U-A:Depleted	142	0.7	n/a
U-B:Depleted	225	1.1	n/a
U-C:Depleted	270	1.3	n/a
U-D:Depleted	16,785	83.1	n/a
U-A:Char-LostAspen	0	0.0	n/a
U-A:Lost-Aspen	515	2.5	n/a

Objectives for Management Actions

The primary objective was to reduce the area of older depleted classes by recruiting into younger depleted classes first and, to a lesser extent, when these classes retained enough vigor to escape their degraded state, into reference classes. However, aspen woodland is generally

not the focus of active management. The wider strategy was to dilute herbivory to this system by restoring other systems that would attract herbivores; however, partners agreed to chainsaw trees followed by pile burning late in the planning phase (Table 12). Occasional fencing and prescribed fire were used, although this was unplanned.

Table 12. Implemented treatment rates in aspen woodland from 2023 to 2046.

	Chainsaw + Pile-Burning ($1,530/acre)	Fence ($2,200-$10,000/acre)	Rx Fire ($150-$250/acre)
Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres
2023-2024	0	0	1-4
2025-2026	0	0	0
2027-2029	0	0	0
2030-2039	0	4-6	0
2040-2046	682 - 718	0	0
Sums Total	**682 - 718**	**4-6**	**1-4**

Limited chainsaw cutting followed by pile burning after 2039 resulted in an increase of recruitment of both younger reference classes (A:All) and depleted (U-A:Depleted) classes; however, the dominance of untreated mature depleted classes (U-D:Depleted) maintained the high UED score (Fig. 11; below). Minor amounts of unplanned prescribed fire (2022) and fencing (2034 were conducted, which surprisingly led to recruitment of younger classes and increased cost.

2047 UED:

MINIMUM MANAGEMENT: 100% ± 0% (high departure)

PROPOSED MANAGEMENT: 100% ± 0% (high departure)

Cost by year (ST-Sim Results)

The primary cost was chainsaw cutting followed by pile burning after 2039. Prescribed fire and fencing were occasionally used, and their cumulative cost was low.

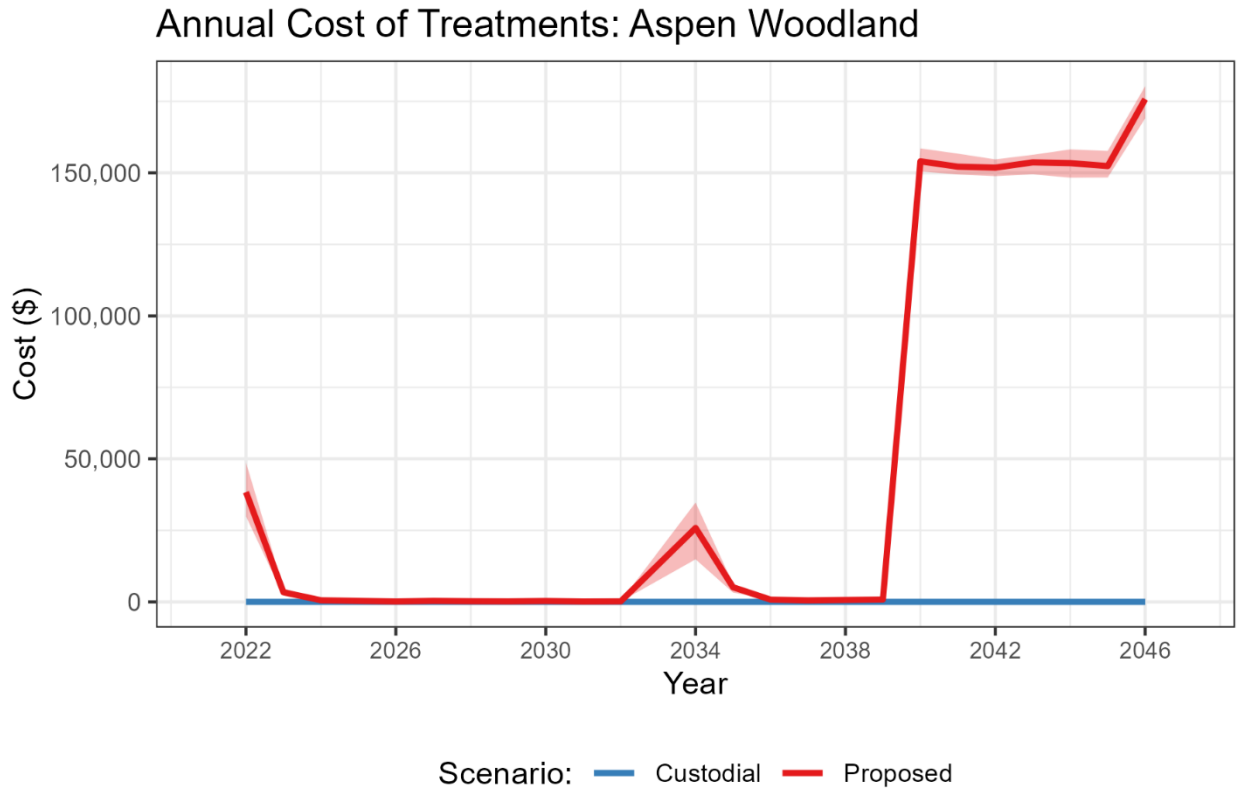


Figure 10. Annual cost of treatments in aspen woodland on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results):

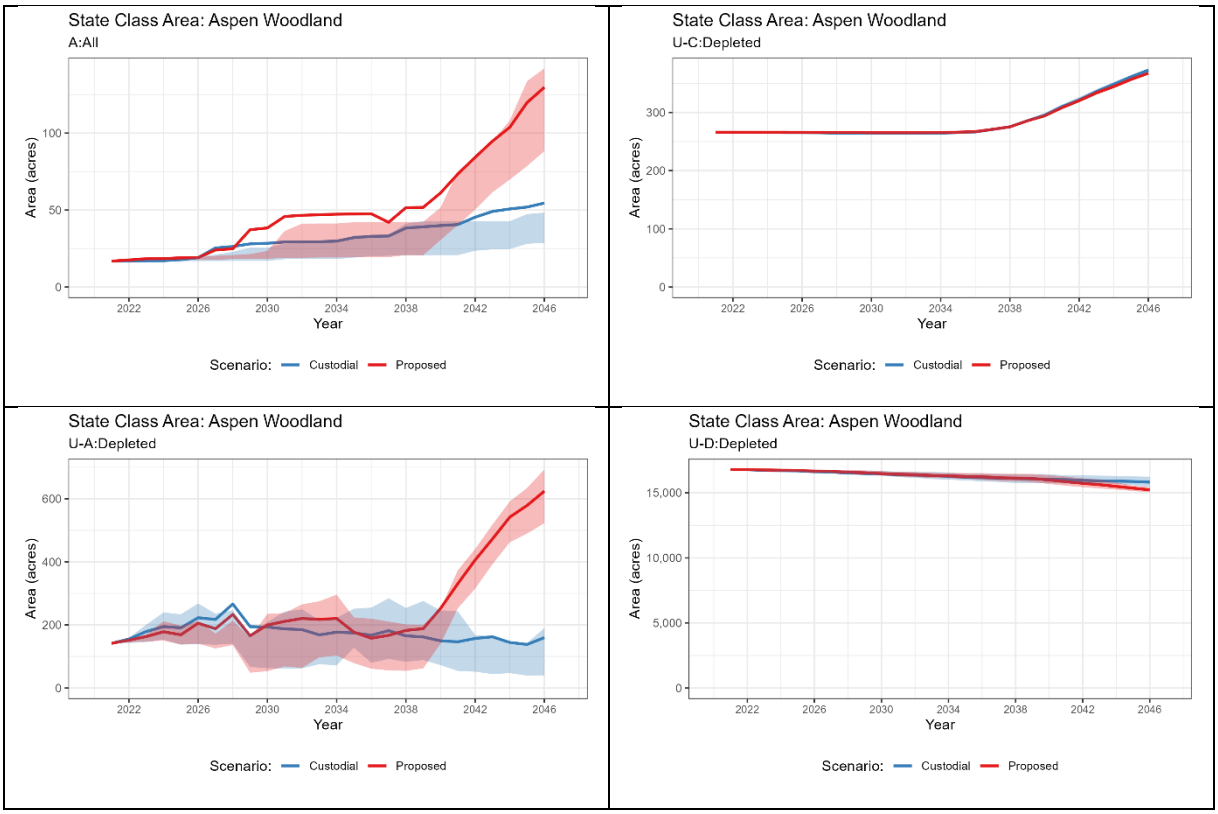


Figure 11. Vegetation classes of aspen woodland treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.2. Aspen-Mixed Conifer

2021 System Acres at 25-m resolution: 54,044

2021 UED: 100% (high departure)

Problems or Concerns

Aspen-mixed conifer was dominated by two vegetation classes that should either be less than 10% of the system in the reference condition (E:Closed) or absent (i.e., late-successional depleted aspen class, U-D:Depleted; Table 13). In the reference condition, the dominance classes should be B:Closed (39%), C:Closed (26%), and A:All (19%; Table 13).

Table 13. Vegetation classes of aspen-mixed conifer expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Area (acres)	Percent of Total in 2021	Reference Condition % of Total
A:Char1	ephemeral	<0.1	1
A:All	885	1.6	19
B:Closed	42	0.1	39
C:Closed	126	0.2	26
D:Open	196	0.4	6
E:Closed	28,121	52.0	9
U-A:Char-DPL	0	0.0	n/a
U-A:Depleted	364	0.7	n/a
U-B:Depleted	300	0.6	n/a
U-C:Depleted	721	1.3	n/a
U-D:Depleted	20,874	38.6	n/a
U-A:Char-LostAspen	0	0.0	n/a
U-A:Lost-Aspen	2,415	4.5	n/a

Objectives for Management Actions

The two problems required the same solution of substantially reducing conifer cover and recruiting into younger aspen classes that would mature into mid- and late-successional classes. An additional complication of restoration of the late-successional depleted class was to prevent

the loss of clones. Treatments will cause the increase in area of young aspen, which need to be protected from excessive herbivory. Our working hypothesis was to dilute herbivory in any one area by implementing actions over large areas.

Merchantable conifers were removed with feller-bunchers where roads allowed throughout the 25 years of management, whereas prescribed fire was used to maintain stand openness after 2026 (Table 14).

Table 14. Implemented treatment rates in aspen-mixed conifer from 2023 to 2046.

	Feller-Buncher for merchantable conifers ($1/acre)	Rx Fire ($150-$250/acre)
Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres
2023-2024	987 – 1,014	0
2025-2026	992 – 1,011	0
2027-2029	8,955 – 9,028	445 - 924
2030-2039	25,783 – 30,0045	4,574 – 8,022
2040-2046	10,701 – 17,522	3,661 – 5,842
Sums Total	47,48 – 58,619	8,680 – 14,789

2047 UED:

MINIMUM MANAGEMENT: 100% ± 0% (high departure)

PROPOSED MANAGEMENT: 99% ± 1% (high departure)

Cost by Year (ST-Sim Results)

The cost of feller-buncher was nearly zero because contractors pay the USFS to harvest trees. Therefore, all the cost in Fig. 12 was from prescribed fire conducted after 2026 to maintain stand openness.

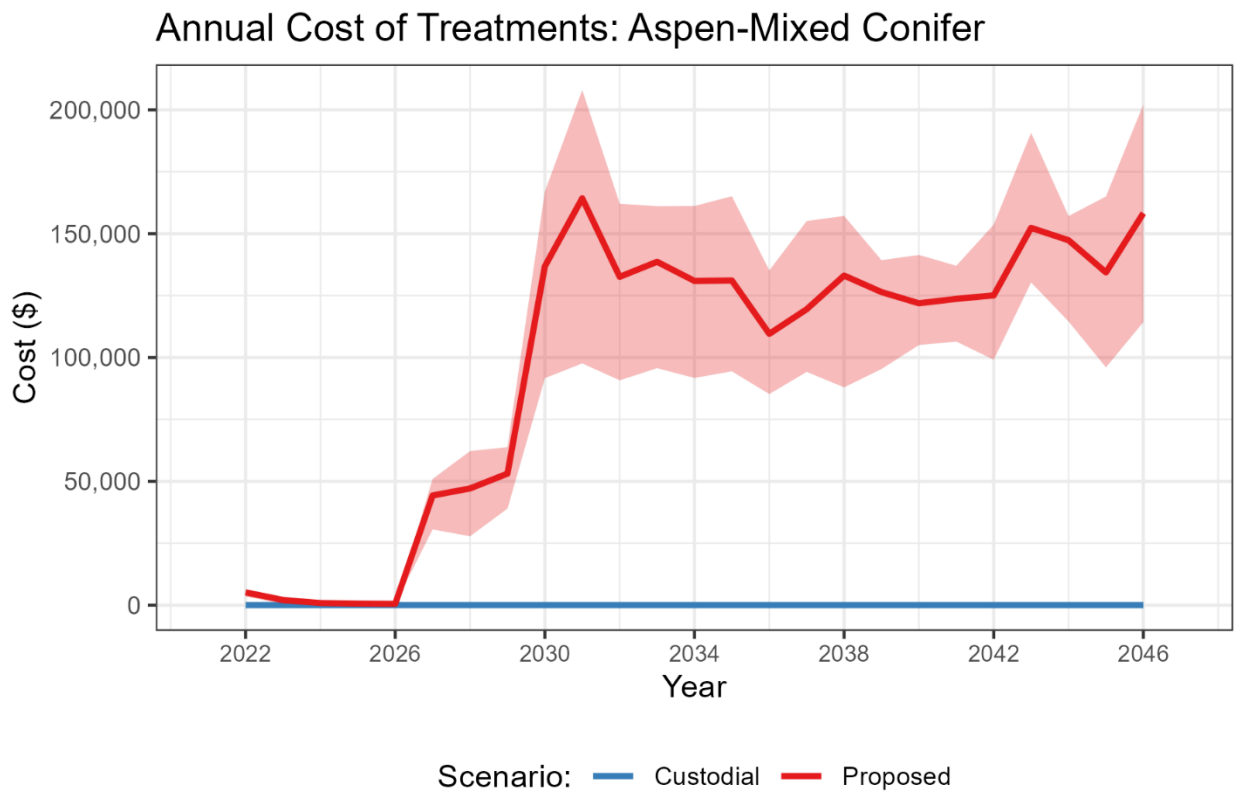


Figure 12. Annual cost of treatments in aspen-mixed conifer on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

Feller-bunchers were used to thin conifers in the reference late-successional class dominated by conifers (E:Closed) and the late-successional depleted class (U-D:Depleted); as a result, the main recipient classes of transitions, respectively, were the early-successional class of aspen (A:All), which increased by at least 10,000 acres by 2049, and the early-successional depleted class of aspen (U-A:Depleted) that increased by 1,500 acres by 2049 (Fig. 13). It was assumed that with herbivory management and recovery the U-A:Depleted class would transition to A:All. There was also evidence that management in the U-D:Depleted class caused an area increase of about 1,000 acres of the late-successional reference open-canopied class (D:Open). Despite these changes, the depleted classes were still dominant.

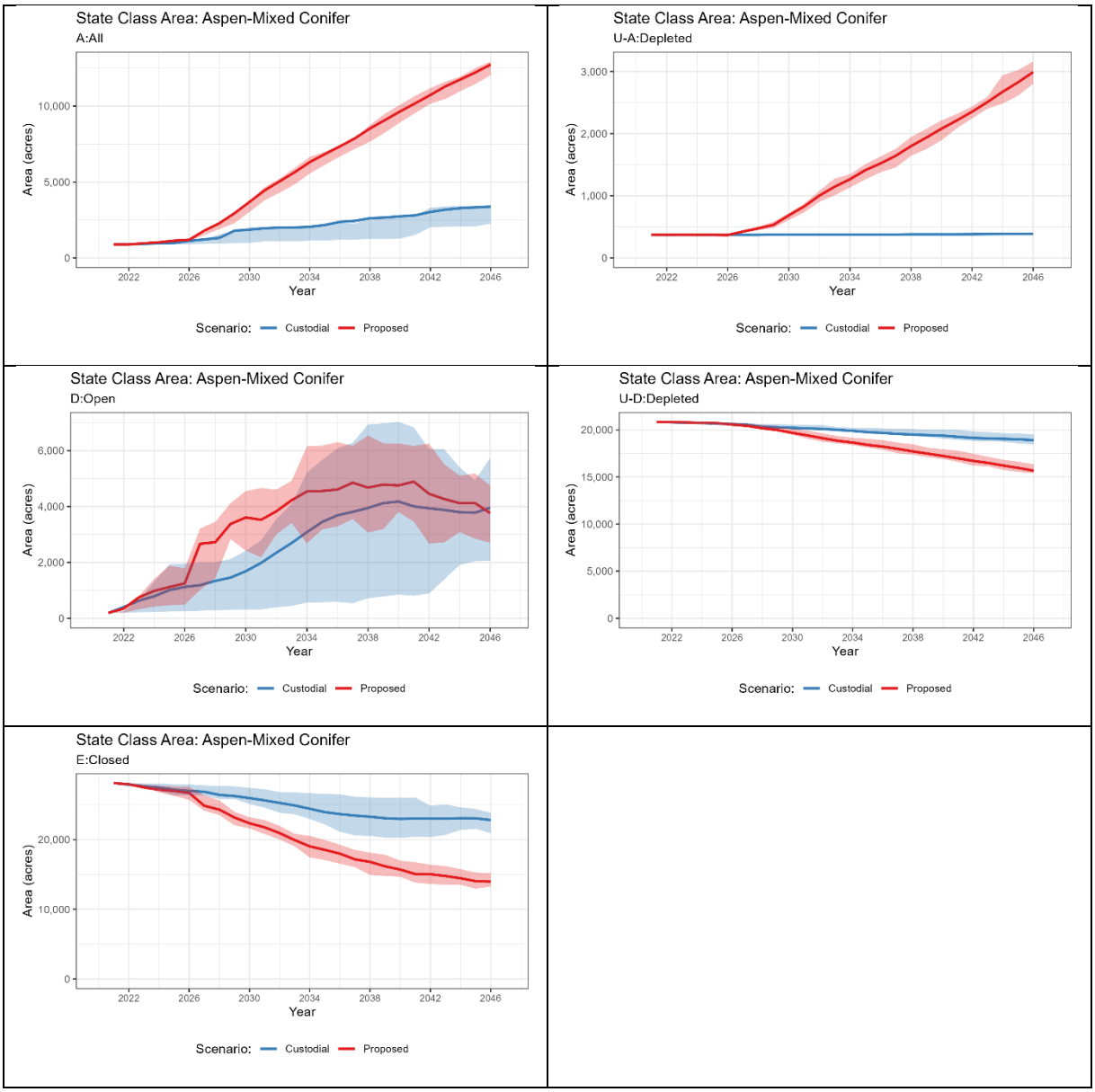


Figure 13. Vegetation classes of aspen-mixed conifer treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.3. Aspen-Ponderosa Pine

2021 System Acres at 25-m resolution: 14,599

2021 UED: 100% (high departure)

Problems or Concerns

More than 50% of aspen-ponderosa pine was in the depleted classes, especially 50.3% in the late-successional class (U-D:Depl-ASP-PIPO), of the open pathway where mature ponderosa pines persist throughout aspen succession (Table 15). On the other hand, 35% of the system was in two reference class (A:Open B:Open, and E:Closed).

Table 15. Vegetation classes of aspen-ponderosa pine expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	ephemeral	<0.1	0.0
A:Open	199	1.4	12
B:Open	476	3.3	17
C:Open	0	0.0	21
D:Closed	0	0.0	17
A:All	0	0.0	2
B:Closed	0	0.0	5
C:Closed	0	0.0	6
D;Open	0	0.0	4
E:Closed	4,527	31.0	17
U-A:Depl-ASP-PIPO	284	1.9	n/a
U-B:Depl-ASP-PIPO	169	1.2	n/a
U-C:Depl-ASP-PIPO	202	1.4	n/a
U-D:Depl-ASP-PIPO	7,343	50.3	n/a
U-A:Depleted	0	0.0	n/a
U-B:Depleted	0	0.0	n/a
U-C:Depleted	0	0.0	n/a
U-D:Depleted	0	0.0	n/a

U-A:Char-LostAspen	0	0.0	n/a
U-A:Lost-Aspen	1,400	9.6	n/a

Objectives for Management Actions

Reduction of the late-successional depleted class with ponderosa pine (U-D:Depl-ASP-PIPO) and the late-successional reference class (E:Closed) and recruitment into the reference early-successional open class (A:Open), mid-successional open class (B:Open), and the late-successional closed class (C:Open) were the only objectives (Fig. 15). These objectives required harvesting merchantable ponderosa pines from the E:Closed and U-D:Depl-ASP-PIPO classes with feller-bunchers with the hope of stimulating aspen suckering. After closed canopied forests were thinned, prescribed fires were used to maintain thinned stands of aspen-ponderosa pine and further recruit into younger aspen classes but maintain mature pines. Minor use of very expensive chainsaw cutting following by pile burning primarily allowed recruitment of mature ponderosa pines and mature aspen trees and secondarily younger aspen.

Table 16. Implemented treatment rates in aspen-ponderosa pine from 2023 to 2046.

	Feller-Buncher for merchantable conifers ($1/acre)	Rx Fire ($150-$250/acre)	Chainsaw + Pile-Burning ($1,530/acre)
Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres
2023-2024	987 – 1,009	0	0
2025-2026	998 – 1,007	0	0
2027-2029	751 - 806	701 – 1,309	70 - 80
2030-2039	0	2,012 – 4,353	0
2040-2046	0	1,014 – 2,562	0
Sums Total	2,728 – 2,822	3,644 – 8,224	70 - 80

2047 UED:

MINIMUM MANAGEMENT: 100% ± 0% (high departure)

PROPOSED MANAGEMENT: 96% ± 1% (high departure)

Cost by Year (ST-Sim Results)

Spending on aspen-ponderosa pine started in 2027 with the use of prescribed fire and the expensive chainsaw cutting followed by pile burning used for only 3 years (Fig. 14). The cost of feller-buncher was paid for by contractor bids. The highest expenditure of $120,000 was in 2027 and progressively decreased thereafter (Fig. 14).

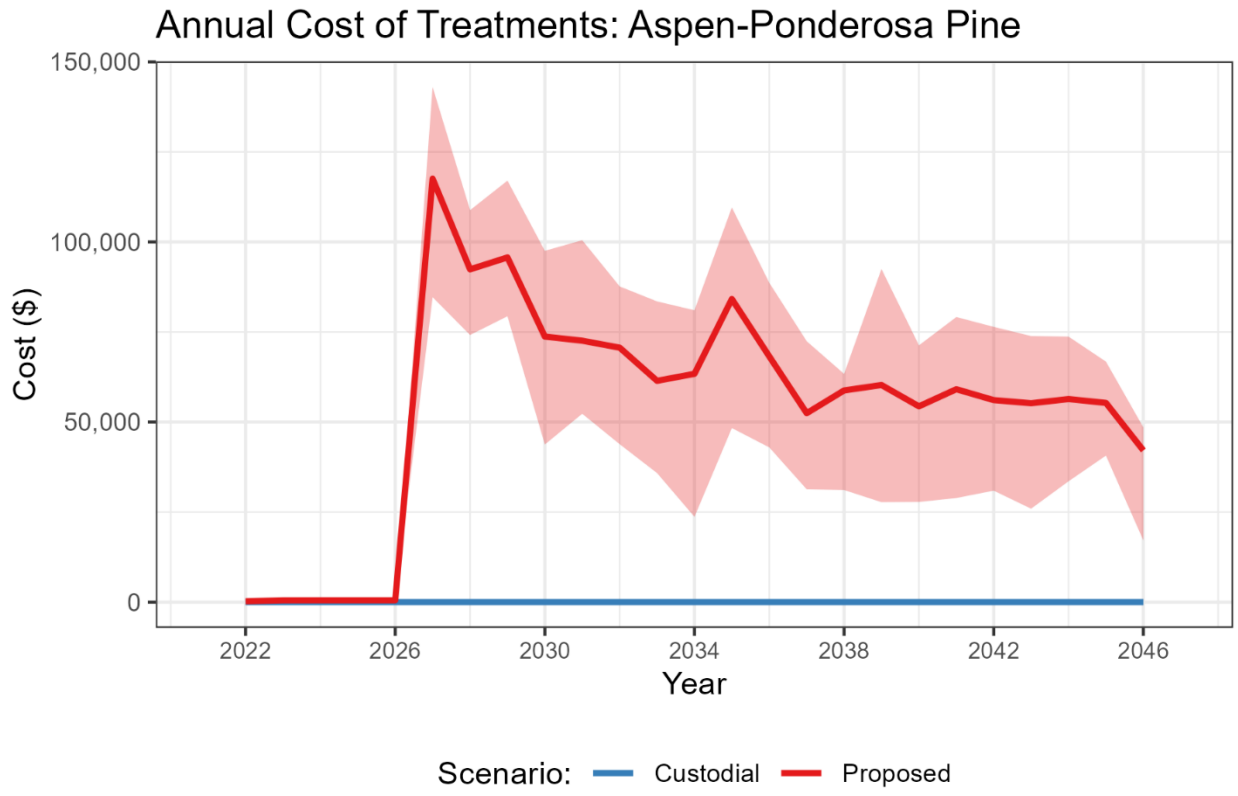


Figure 14. Annual cost of treatments in aspen-ponderosa pine on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results):

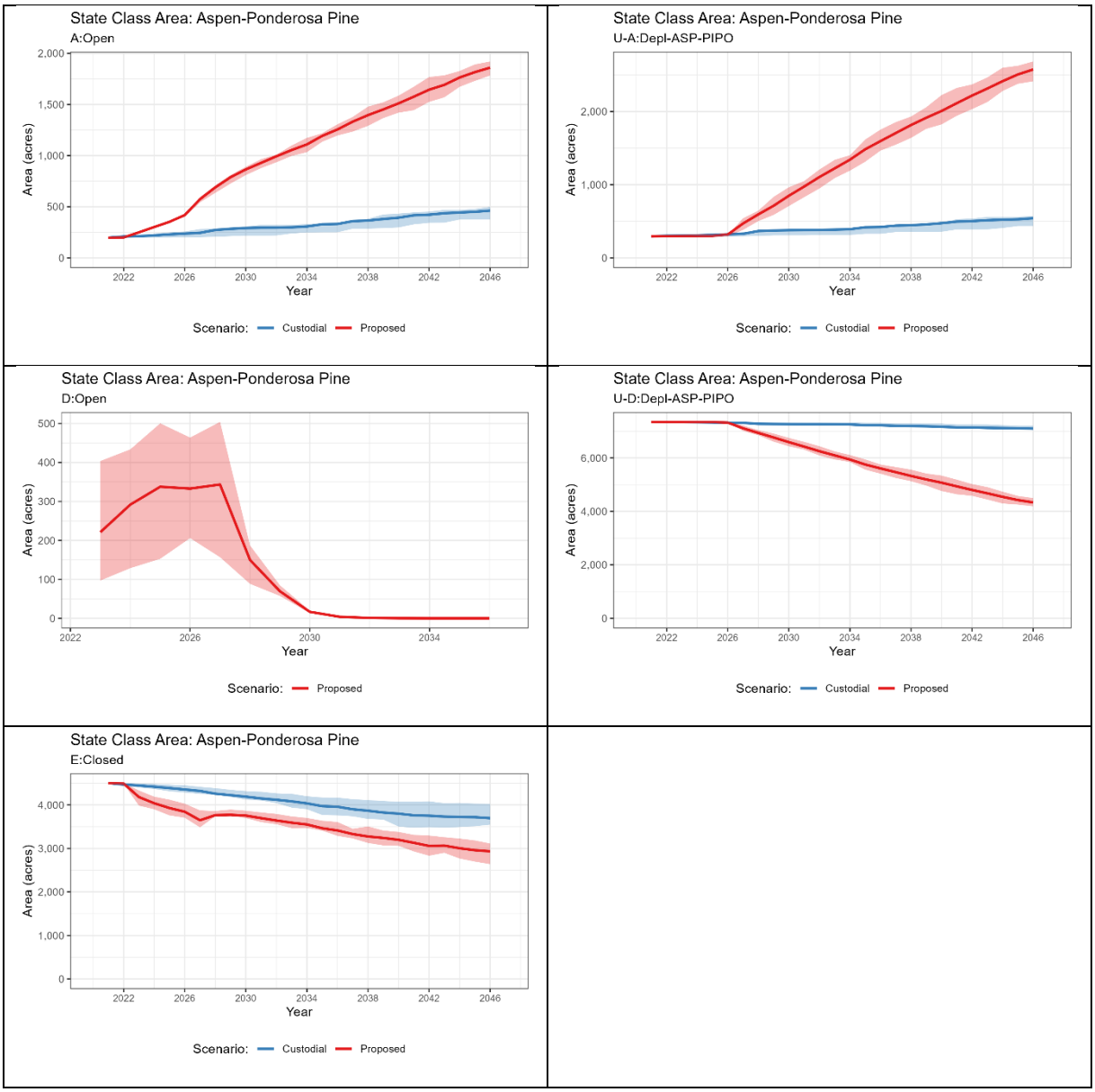


Figure 15. Vegetation classes of aspen-ponderosa pine treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.4. Aspen-Spruce-Fir

2021 System Acres at 25-m resolution: 100,871

2021 UED: 80% (high departure)

Problems or Concerns

There are three problems in aspen-spruce-fir. 1) The reference late-successional closed class (D:Closed) was over-abundant at 63.1%, whereas the three younger reference classes were absent or under-represent compared to the reference condition. The conifers in this class need to be removed and aspen suckering stimulated. 2) About 10% of aspen-spruce-fir was the late-successional depleted class, which should be absent in the refence condition, and treated to recruit into either the younger depleted classes and, then with rest from herbivory, recruiting into reference classes. 3) The third problem was the protection of early-successional depleted classes, which were created by recent logging, to allow recovery of vigor and recruit into reference classes.

Table 17. Vegetation classes of aspen-spruce-fir expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Area (acres)	Percent of Total in 2021	Reference Condition % of Total
A:Char1	ephemeral	<0.1	1
A:All	27	0.0	4
B:Closed	296	0.3	23
C:Open	6,502	6.4	58
D:Closed	63,678	63.1	14
U-A:Char-DPL	0	0.0	n/a
U-A:Depleted	18,646	18.5	n/a
U-B:Depleted	361	0.4	n/a
U-C:Depleted	247	0.2	n/a
U-D:Depleted	10,427	10.3	n/a
U-D:Open	0	0.0	n/a
U-A:Char-LostAspen	0	0.0	n/a
U-A:LostAspen	688	0.7	n/a

Objectives for Management Actions

Spruce and subalpine fir need to be harvested from both late-successional classes (reference and depleted) with feller-bunchers within 1,800 ft from passable roads (Table 18). While spruce harvesting was paid for by contractor bids, subalpine fir was assigned a cost of $1,500/acre. Contractors are required to take both species, although subalpine fir was not merchantable. Feller-buncher harvesting was an on-going operation for the 25-year duration of simulations. After 2026, prescribed fire will be used in these fire-sensitive conifers to recruit aspen and improve mule deer habitat, presumably in areas beyond the road buffer mapped for lowboy truck access (Table 18). The use of prescribed fire in this system would be a new practice for the USFS. Finally, chainsaw cutting followed by pile burning was used after 2029 again under the assumption to treat areas dominated by subalpine fir where contractors will not bid or for areas beyond the reach of feller-bunchers. This operation was also designed to improve and dilute mule deer browse.

Table 18. Implemented treatment rates in aspen-spruce-fir from 2023 to 2046.

	Feller-Buncher for merchantable conifers ($1/acre)	Feller-Buncher for Subalpine Fir ($1,500/acre)	Rx Fire ($150-$250/acre)	Chainsaw + Pile-Burning ($1,530/acre)
Years	$25^{th} – 75^{th}$ percentiles of total treatment acres	$25^{th} – 75^{th}$ percentiles of total treatment acres	$25^{th} – 75^{th}$ percentiles of total treatment acres	$25^{th} – 75^{th}$ percentiles of total treatment acres
2023-2024	987 – 1,012	236 - 249	0	0
2025-2026	993 – 1,015	232 - 242	0	0
2027-2029	1,772 – 1,810	441 - 456	296 - 311	0
2030-2039	5,942 – 6,061	1,474 – 1,539	3,662 – 4,452	478 - 518
2040-2046	4,856 – 4,951	958 - 996	2,297- 3,682	339 - 363
Sums Total	14,550 – 14,850	3,341 – 3,482	6,255 – 3,682	817 - 881

2047 UED:

MINIMUM MANAGEMENT: 71% ± 1% (high departure)

PROPOSED MANAGEMENT: 59% ± 1% (intermediate departure)

Cost by Year (ST-Sim Results)

Spending on aspen-spruce fir represented an important fraction of the total annual spending ($1.3 M to $1.5 M) on Boulder Mountain (Fig. 16). Most of the cost was attributable to harvesting of subalpine fir as spruce harvesting with feller-buncher was paid for by contractor bids (Fig. 16). Prescribed fire added at least an additional $100,000 from 2027 to 2029 (Fig. 16). Maximum spending of about $380,000 was achieved when subalpine fir harvesting, prescribed fire, and chainsaw cutting followed by pile burning were all annually conducted at high rates (Fig. 16).

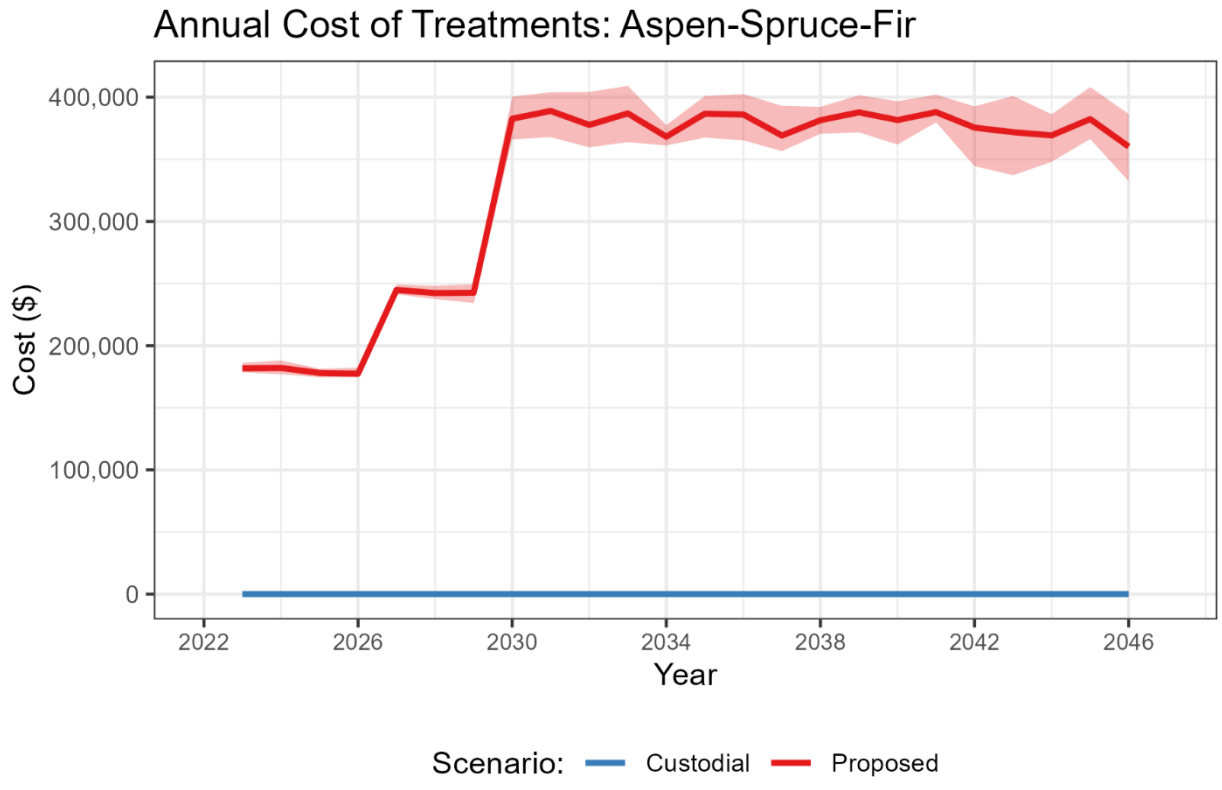
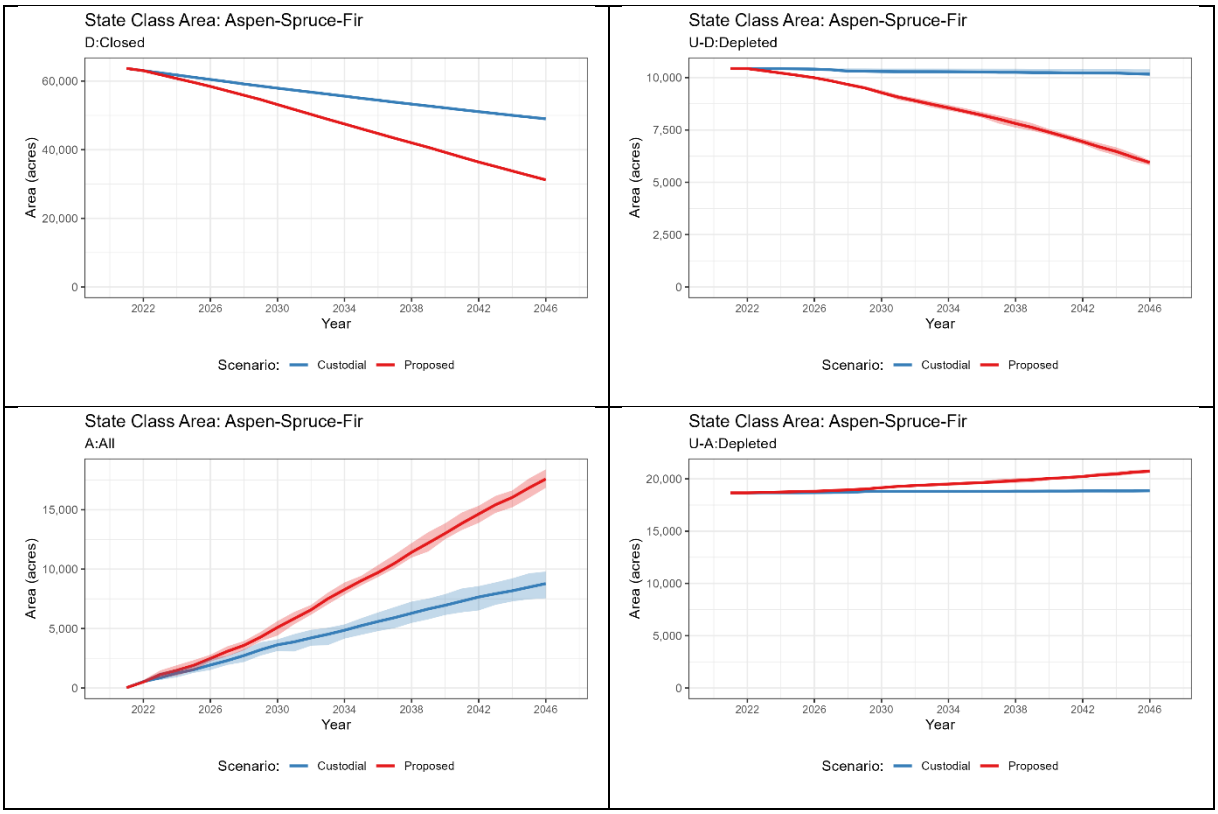


Figure 16. Annual cost of treatments in aspen-spruce-fir on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results):

Feller-buncher harvesting and later prescribed fire were very effective at reducing both late-successional classes compared to custodial management (Fig. 17). The area of the D:Closed class was reduced by about 20,000 acres compared to custodial management, whereas the reduction of the area of the U-D:Depleted class was smaller at 3,000 acres. An oddity of tree harvesting in the reference D:Open class (and U-D:Depleted class) was the creation of a non-reference (i.e., uncharacteristic) U-D:Open class because the harvesting operation was designed to keep older spruce present but open the stand, perhaps to allow for future tree harvest decades later. This new open stand (U-D:Open) was not a naturally occurring structure of late-successional aspen-spruce-fir. As a result, the U-D:Open class increased by about 11,000 acres caused by transitions from D:Open and U-D:Depleted (Fig. 17). Part of the harvesting operation and prescribed fire and chainsaw and pile burning caused predictable increases in early successional classes (A:All and U-A:Depleted) of several 1,000s of acres. Note that transition from any depleted class to an early-successional one did not generally remove the depleted condition; depleted aspen would become un-depleted only through rest from herbivory and buildup of aspen carbohydrate root reserves.



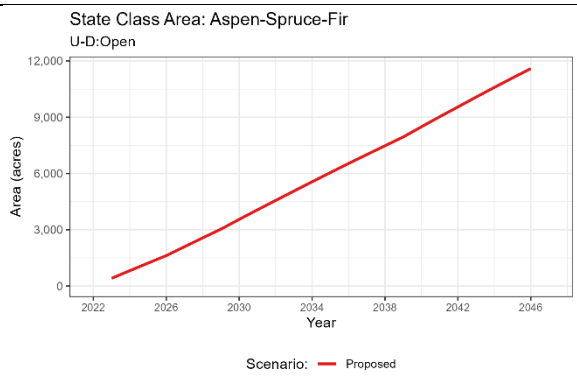


Figure 17. Vegetation classes of aspen-spruce-fir treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bar are the 25th-75th percentiles.

3.2.5. Basin Big Sagebrush

2021 System Acres at 25-m resolution: 3,194

2021 UED: 73% (high departure)

Problems or Concerns

Basin big sagebrush was a small area system with contributions to mule deer habitat suitability. The main problem was too much area occupied by reference and seeded late-successional classes (C:Closed at 398 acres and U-C:SI at 1,666 acres) dominated by older sagebrush and conifers (Table 19). This dominance by older vegetation caused the shortage of reference early- and mid-successional classes that together should account for 67% of the system (Table 19). Because existing seedings were dominated by introduced species, it would not be possible to return those to native species, but it would be possible to increase the proportion of early-successional seeded classes area. Another potential problem was the large area of the early-shrub class (rabbitbrush; 148 acres) whose restoration would require thinning of shrubs and herbicides but that was not contemplated by partners (Table 19).

Table 19. Vegetation classes of basin big sagebrush expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	ephemeral	<0.1	2
A:Char2	ephemeral	<0.1	2
A:All	2	0.1	24
B:Open	68	2.1	43
C:Closed	398	12.5	29
U-A:Char-AnnSpp	0	0.0	n/a
U-A:Annual Spp	0	0.0	n/a
U-A:Bare Ground	3	0.1	n/a
U-A:Char-EarlyShrub	0	0.0	n/a
U-A:Early-Shrub	143	4.5	n/a
U-A:Char-EF	0	0.0	n/a
U-A:Exotic Forb	0	0.0	n/a
U-A:Char1-SAP	0	0.0	n/a
U-A:Char2-SAP	0	0.0	n/a

U-A:SAP	0	0.0	n/a
U-A:Char-NativeSeeding	0	0.0	n/a
U-A:Seeded Native	112	10.7	n/a
U-A:Char-SI	0	0.0	n/a
U-A:SI	341	3.5	n/a
U-A:Char-SI+AS	0	0.0	n/a
U-A:SI+AS	0	0.0	n/a
U-B:SAP	0	0.0	n/a
U-B:SI	415	13.0	n/a
U-B:SI+AS	0	0.0	n/a
U-C:Depleted	28	0.9	n/a
U-C:SA	1	0.0	n/a
U-C:SAP	2	0.1	n/a
U-C:SI	1,666	52.1	n/a
U-C:SI+AS	0	0.0	n/a
U-C:TEA	14	0.4	n/a

Objectives for Management Actions

The primary objective was to reduce the area of late-successional classes from the reference late-successional C:Closed and uncharacteristic late-successional seeded class U-C:SI with lop and scatter of conifers. Dixie and chain harrows followed by seeding were used in limited amount to reduce sagebrush cover, but not trees, in the uncharacteristic depleted class (U-C:Depleted).

Table 20. Implemented treatment rates in basin big sagebrush from 2023 to 2046.

	Lop & Scatter ($125/acre)	Dixie or Chain Harrow & Seed ($320/acre)
Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres

2023-2024	98 - 103	15 -16
2025-2026	0	0
2027-2029	149 - 159	1 - 4
2030-2039	0	0
2040-2046	0	0
Sums Total	246 - 262	16 - 20

2047 UED:

MINIMUM MANAGEMENT: 58% ± 2% (intermediate departure)

PROPOSED MANAGEMENT: 59% ± 2% (intermediate departure)

Cost by Year (ST-Sim Results)

The least amount of annual funding (<$12,000) among all systems was spent on basin big sagebrush and most of it before 2030.

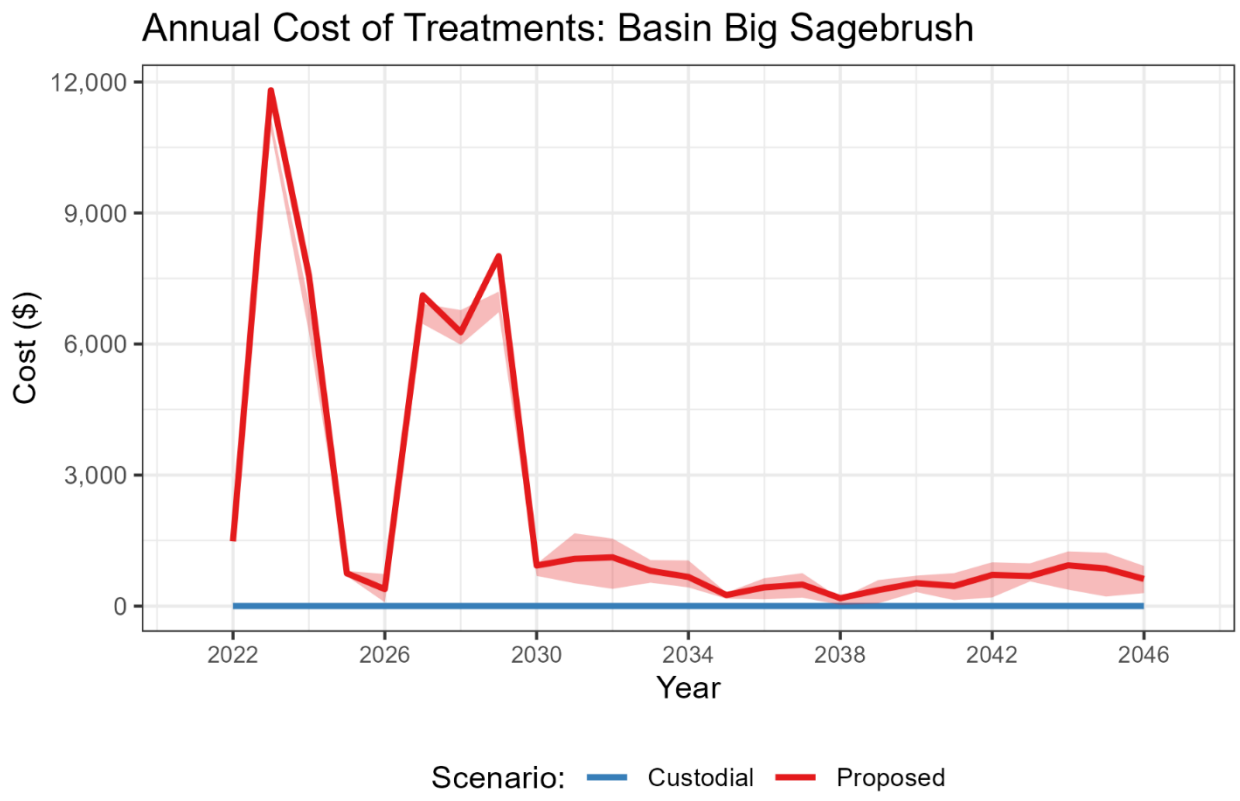
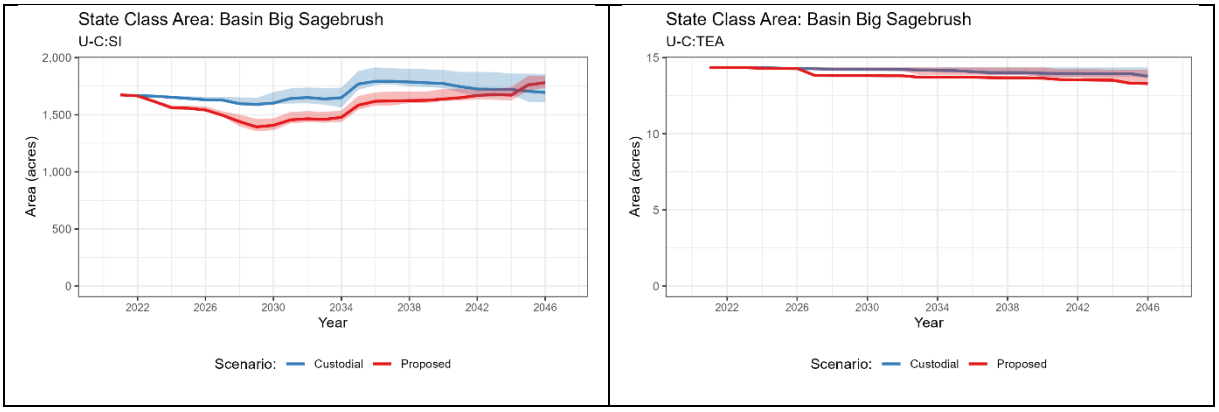


Figure 18. Annual cost of treatments in basin big sagebrush on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

Because of the amount of treatments occurring in classes with trees applied only late in succession, the reduction of those classes with trees (U-C:SI and U-C:TEA) was limited relative to the total area of the system (Fig. 19). The classes receiving the Dixie and chain harrow treatment, however, were reduced the most relative to their small areas (U-C:Depleted; Fig. 19). All these actions slightly increased the areas of reference early-successional class (A:All) and the seeded classes (U-A:SI and U-B:SI) by 100s of acres (Fig. 19).



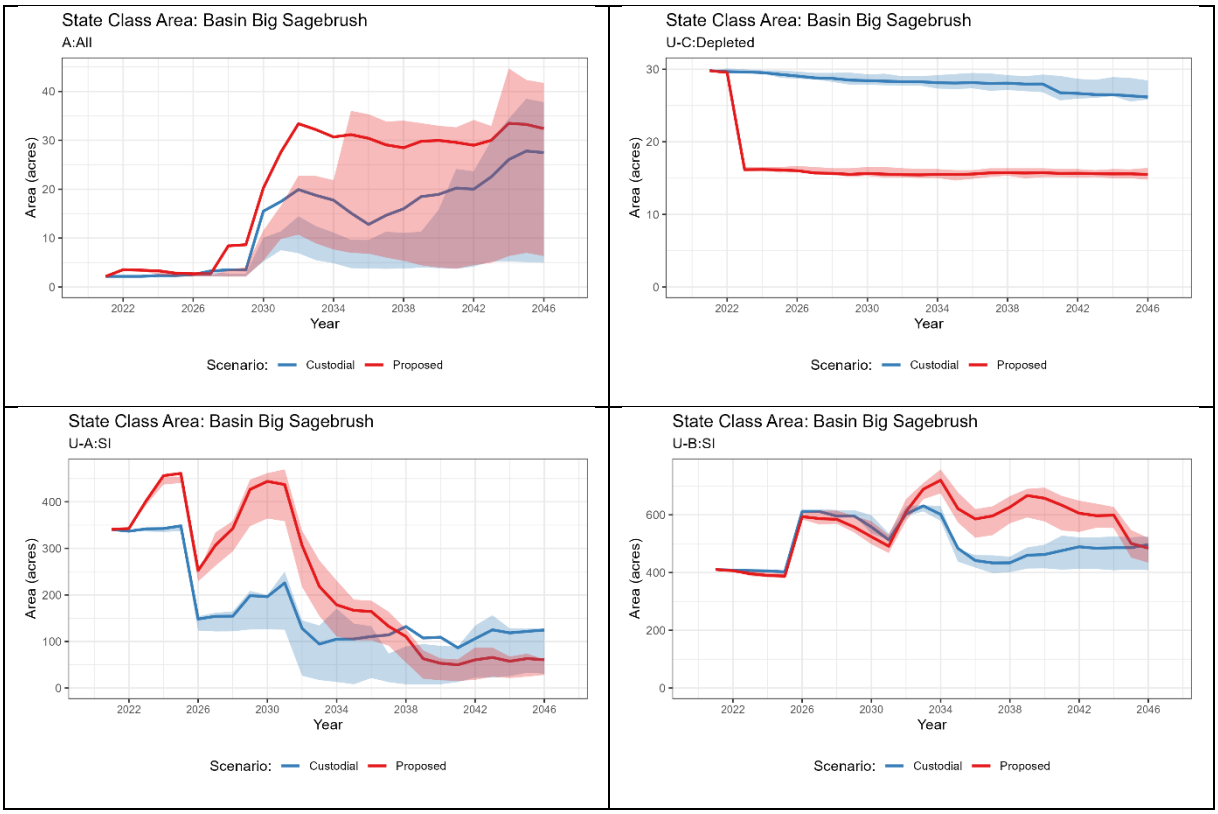


Figure 19. Vegetation classes of basin big sagebrush treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.6. Big Sagebrush - mountain

2021 System Acres at 25-m resolution: 123,934

2021 UED: 100% (high departure)

Problems or Concerns

Two problems stood out with big sagebrush-mountain: a) the uncharacteristic tree-encroached class (U-E:TEA) occupied 71% (87,815 acres) of the system's area and b) 17% (21,326 acres) of the area was occupied by the reference late-successional open class (D:Open, i.e., the Christmas tree phase; Table 21). The D:Open class should not exceed 3% of the system in the reference condition. The U-E:TEA class was considered poor mule deer habitat.

Table 21. Vegetation classes of big sagebrush-mountain expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	ephemeral	<0.1	2
A:Char2	ephemeral	<0.1	2
A:All	482	0.4	13
B:Open	5,238	4.2	35
C:Closed	5,050	4.1	43
D:Open	21,326	17.2	3
E:Closed	0	0.0	2
U-A:Char-AnnSpp	0	0.0	n/a
U-A:Annual Spp	0	0.0	n/a
U-A:Bare Ground	0	0.0	n/a
U-A:Char-EarlyShrub	0	0.0	n/a
U-A:Early-Shrub	384	0.3	n/a
U-A:Char-EF	0	0.0	n/a
U-A:Exotic Forb	0	0.0	n/a
U-A:Char1-SAP	0	0.0	n/a
U-A:Char2-SAP	0	0.0	n/a
U-A:SAP	0	0.0	n/a

U-A:Char-NativeSeeding	0	0.0	n/a
U-A:Seeded Native	0	0.0	n/a
U-A:Char-SI	0	0.0	n/a
U-A:SI	282	0.2	n/a
U-A:Char-SI+AS	0	0.0	n/a
U-A:SI+AS	0	0.0	n/a
U-B:SAP	4		n/a
U-B:SI	1,554	1.3	n/a
U-B:SI+AS	0	0.0	n/a
U-C:Depleted	48	0.0	n/a
U-C:SA	0	0.0	n/a
U-C:SAP	0	0.0	n/a
U-C:SI	1,590	1.3	n/a
U-C:SI+AS	0	0.0	n/a
U-D:SAP	6	0.0	n/a
U-D:SI	153	0.0	n/a
U-D:SI+AS	0	0.0	n/a
U-D:Unpalat. Forb	0	0.0	n/a
U-E:TEA	87,815	70.9	n/a

Objectives for Management Actions

The primary objectives were to remove mature and young trees, respectively, from the U-E:TEA and D:Open classes. Additionally, seeding of the tree-encroached class after tree removal would be needed as, by definition, tree-encroachment assumes lack of viable native understory. While small-tree lopping could be used in the D:Closed class, a masticator hauled on a lowboy truck would be required for mature trees in the U-E:TEA class.

Table 22. Implemented treatment rates in big sagebrush-mountain from 2023 to 2046.

		Small Tree Lopping ($35/acre)		Masticate & Spot-Herbicide & Seed ($580-$780/acre)
Years		$25^{th} – 75^{th}$ percentiles of		$25^{th} – 75^{th}$ percentiles of

	total treatment acres	total treatment acres
2023-2024	101 - 172	991 – 1,014
2025-2026	190 - 263	1,183 – 1,211
2027-2029	524 - 605	1,786 – 1,823
2030-2039	1.030 – 1,129	3,446 – 3,541
2040-2046	706 - 720	2,417 – 2,477
Sums Total	2,551 – 2,888	9,824 – 10,066

2047 UED:

MINIMUM MANAGEMENT: 100% ± 0% (high departure)

PROPOSED MANAGEMENT: 100% ± 0% (high departure)

Cost by year (ST-Sim Results)

The one system where most of the total annual funding was spent was big sagebrush-mountain (Fig. 20). Expenditures reached about $500,000 before 2030, which dropped to about $250,000 for the duration of the simulation.

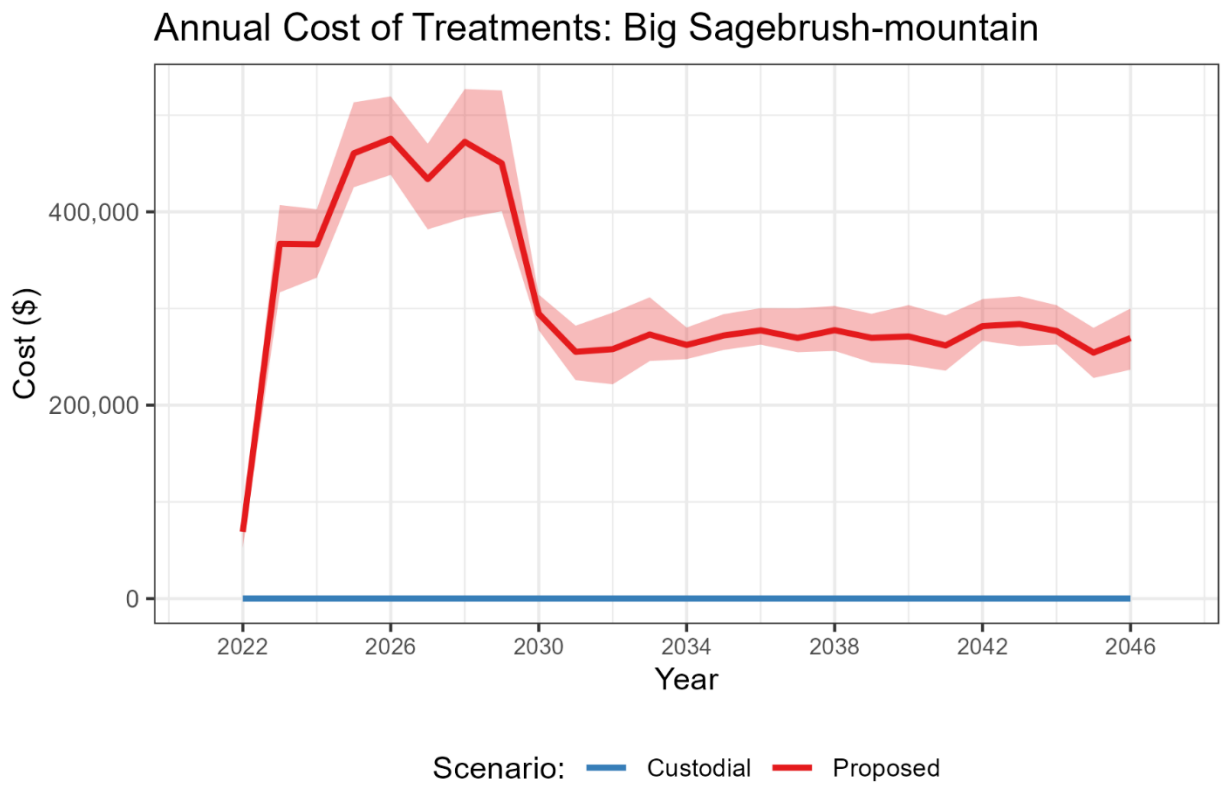


Figure 20. Annual cost of treatments in big sagebrush-mountain on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

The area of the tree-encroached class (U-E:TEA) was reduced by about 10,000 acres compared to Custodial management, however, this left about 75,000 acres of that class untreated (Fig. 21). The outcome of treatment in the U-E:TEA class was the creation of >1,000 acres of native species seeding (Fig. 21), which itself transition to reference class with recovery time. Similarly, about 2,000 acres of young trees in the reference late-successional open class (D:Open) were cut compared to Custodial management, thus causing a transition to the reference late-successional class without trees (C:Closed; Fig. 21). While this change would be considered successful relative to the investment, plenty more of the system could be treated, even with logistic constraints, if the budget allowed.

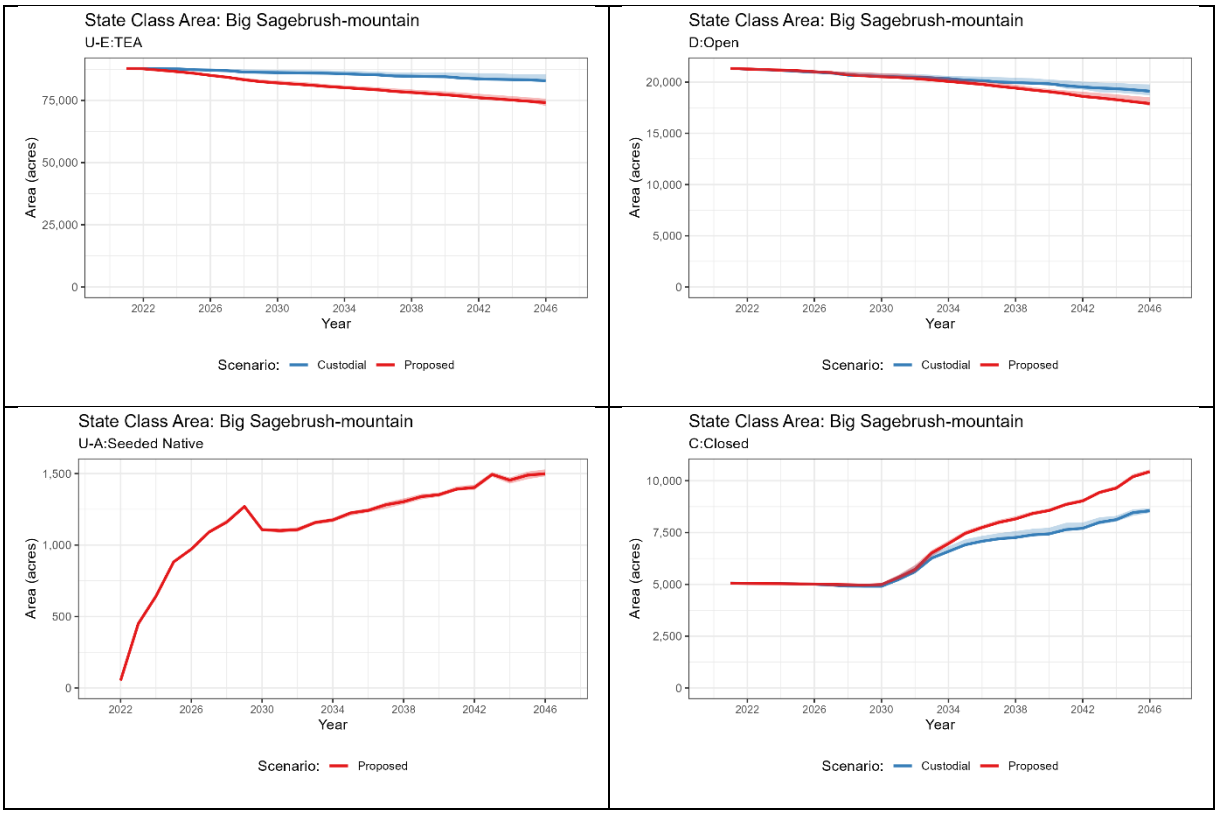


Figure 21. Vegetation classes of big sagebrush-mountain treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.7. Big Sagebrush - upland

2021 System Acres at 25-m resolution: 3,209

2021 UED: 78% (high departure)

Problems or Concerns

The upland big-sagebrush system was two orders of magnitude smaller in extent than its mountain counterpart but had the same problems with too many mature and young trees than specified by the reference condition (Table 23). About 17% (537 acres) of the system was tree-encroached (U-E:TEA) populated by mature trees and an unacceptable proportion of the area of reference (D:Open; 625 acres) and seeded (U-D:SI at 164 acres and U-D:SI+AS at 29 acres) classes were occupied by young trees requiring lopping.

Table 23. Vegetation classes of big sagebrush-upland expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	ephemeral	<0.1	1
A:Char2	ephemeral	<0.1	1
A:All	1	0.0	14
B:Open	391	12.2	28
C:Closed	115	3.6	42
D:Open	675	21.0	6
E:Closed	0	0.0	8
U-A:Char-AnnSpp	0	0.0	n/a
U-A:Annual Spp	1	0.0	n/a
U-A:Bare Ground	6	0.2	n/a
U-A:Char-EarlyShrub	0	0.0	n/a
U-A:Early-Shrub	4	0.1	n/a
U-A:Char-EF	0	0.0	n/a
U-A:Exotic Forb	0	0.0	n/a
U-A:Char1-SAP	0	0.0	n/a
U-A:Char2-SAP	0	0.0	n/a
U-A:SAP	43	1.3	n/a

U-A:Char-NativeSeeding	0	0.0	n/a
U-A:Seeded Native	9	0.3	n/a
U-A:Char-SI	0	0.0	n/a
U-A:SI	93	2.9	n/a
U-A:Char-SI+AS	0	0.0	n/a
U-A:SI+AS	11	0.3	n/a
U-B:SA	0	0.0	n/a
U-B:SAP	66	2.1	n/a
U-B:SI	410	12.8	n/a
U-B:SI+AS	65	2.0	n/a
U-B:Unpalat. Forb	17	0.5	n/a
U-C:Depleted	91	2.8	n/a
U-C:SAP	40	1.2	n/a
U-C:SI	440	13.7	n/a
U-C:SI+AS	0	0.0	n/a
U-D:SAP	0	0.0	n/a
U-D:SI	164	5.1	n/a
U-D:SI+AS	29	0.9	n/a
U-E:TEA	537	16.7	n/a

Objectives for Management Actions

The least suitable vegetation class for mule deer was the tree-encroached class (U-E:TEA); therefore, the objective was to masticate trees, where lowboy trucks could approach target areas, and seed the depleted understory (Table 26). No other equipment was used in this class. For the classes with young trees, small-tree lopping was the only action used (Table 24). Other classes dominated by late-successional shrubs would benefit from creation by small amounts of woody cover thinning, using Dixie or chain harrows (Table 26).

Table 24. Implemented treatment rates in big sagebrush-mountain from 2023 to 2046.

	Lop & Scatter ($125/acre)	Dixie or Chain Harrow & Seed ($320/acre)	Masticate & Spot-Herbicide & Seed ($580-$780/acre)	Lop & Pile-Burning ($1,130-1,530/acre)	Small Tree Lopping ($35/acre)

Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres
2023-2024	0 – 0.31	0	0	0	0
2025-2026	0	41 - 52	96 - 102	44 - 59	160 - 275
2027-2029	0	0.2 – 0.6	146 - 155	0	150 - 169
2030-2039	0	0 - 1	142 -151	0 - 1	353 - 463
2040-2046	0 – 0.4	0 - 0.6	0	0 - 1	1 - 10
Sums Total	0 – 0.7	41 - 54	384 -408	44 -62	664 - 916

2047 UED:

MINIMUM MANAGEMENT: 57% ± 0% (high departure)

PROPOSED MANAGEMENT: 36% ± 0% (intermediate departure)

Cost by Year (ST-Sim Results)

The highest cost was about $150,000 only in 2030 when both the highest levels of mastication and small-tree lopping overlapped; otherwise, annual cost was generally less that $50,000 and close to zero after 2030 (Fig. 22).

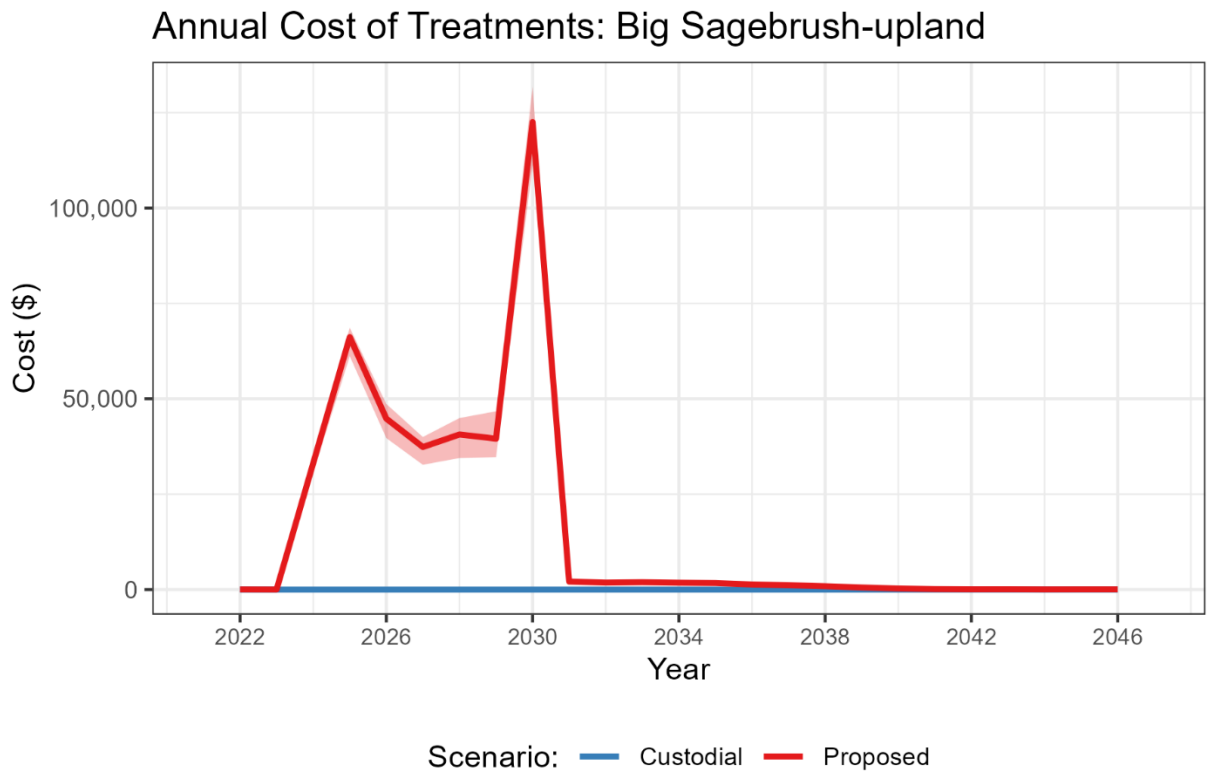
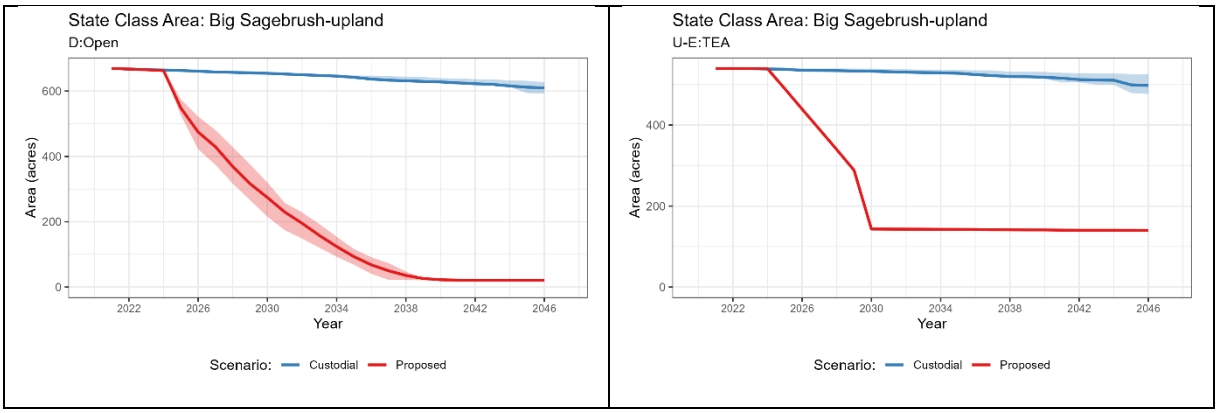


Figure 22. Annual cost of treatments in big sagebrush-upland on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

Tree removal treatments very effectively reduced the area of all wooded classes (U-E:TEA, D:Closed, and U-D:SI; Fig. 23). As a result, seeded classes (U-B:SI and U-C:SI) without trees and the area of the reference late-successional class without trees (C:Closed) increased as much as the area of the D:Closed class decrease (Fig. 23). Also, UED was reduced due to management actions (above).



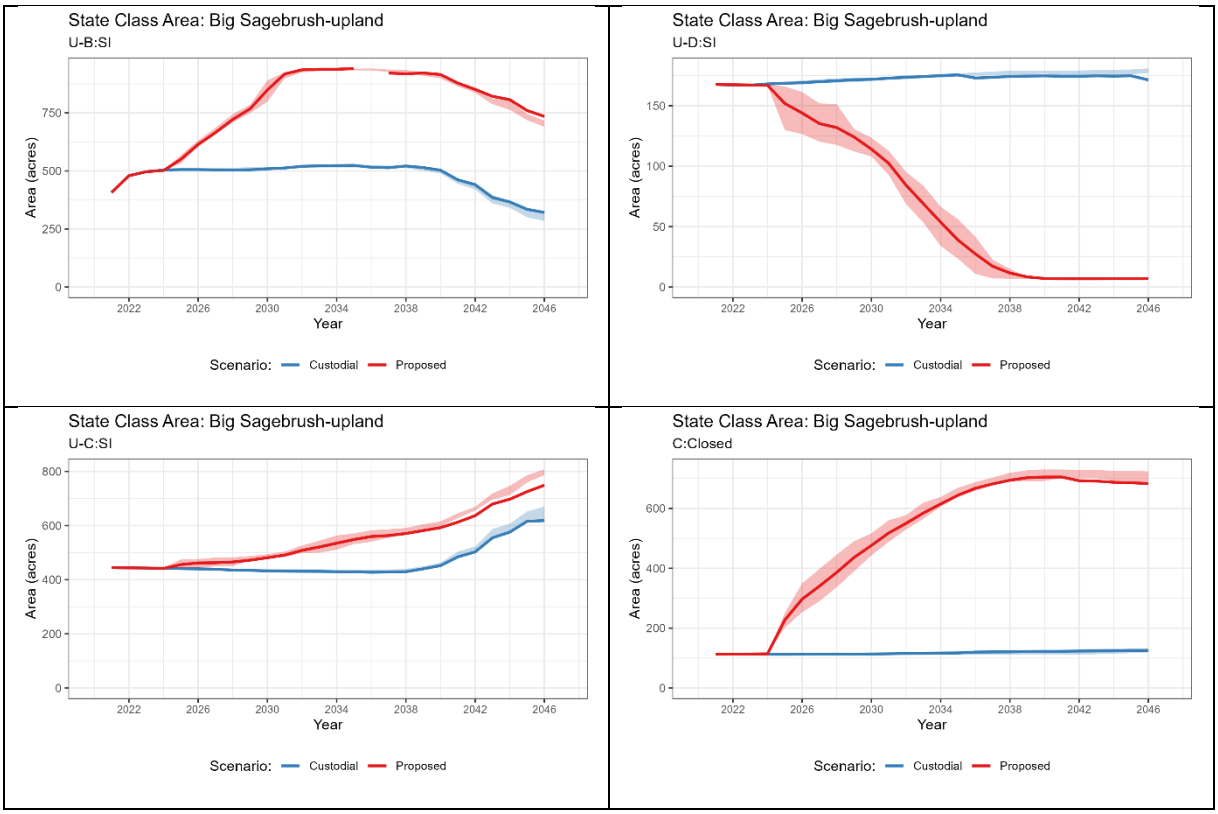


Figure 23. Vegetation classes of big sagebrush-upland treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.8. Montane Riparian

2021 System Acres at 25-m resolution: 2,678

2021 UED: 21% (low departure)

Problems or Concerns

UED was at low departure (21%, above) due in part to the balanced distribution among montane riparian reference classes (Table 25). The three greater problems were 15 acres of invasive species (U-A:EFT), 10 acres of inset floodplain (U-A:Inset) , and 11 acres of incised (U-C:Desertified) floodplain.

Table 25. Vegetation classes of montane riparian expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Sediment	0	0.0	0
A:Char-Cottonwood	Ephemeral	<0.1	1
A-Cottonwood:All	0	0.0	3
B-Cottonwood:Closed	688	26.8	26
C-Cottonwood:Closed	561	21.9	2
A:Char1	Ephemeral	<0.1	1
A-Willow:All	0	0.0	5
B-Willow:Closed	1,271	49.6	56
U-A:Agriculture	0	0.0	n/a
U-A:Char-AnnSpp	0	0.0	n/a
U-A:Annual Spp	0	0.0	n/a
U-A:Bare Ground	0	0.0	n/a
U-A:Char-EarlyShrub	0	0.0	n/a
U-A:Early-Shrub	0	0.0	n/a
U-A:Char-EF	0	0.0	n/a
U-A:EFT	15	0.6	n/a
U-A:Hummocked	0	0.0	n/a
U-A:Char-Incised-EFT	0	0.0	n/a

U-A:Incised-EFT	0	0.0	n/a
U-A:Char-Inset	0	0.0	n/a
U-A:Inset	10	0.4	n/a
U-A:Char-Inset-EF	0	0.0	n/a
U-A:Inset-EF	0	0.0	n/a
U-A:Inset-Hummocked	0	0.0	n/a
U-A:Char-NativeSeeding	0	0.0	n/a
U-A:Seeded Native	0	0.0	n/a
U-A:Char-SFE	0	0.0	n/a
U-A:Shrb-Frb Encr	8	0.3	n/a
U-A:Char-SI	0	0.0	n/a
U-A:SI	0	0.0	n/a
U-A:Char-SI+AS	0	0.0	n/a
U-A:SI+AS	0	0.0	n/a
U-A:Char-DE	0	0.0	n/a
U-C:Desertified	11	0.4	n/a
U-A:Char1-SAP	0	0.0	n/a
U-C:SAP	0	0.0	n/a
U-C:TEA	0	0.0	n/a

Objectives for Management Actions

Restoring an inset floodplain was not considered desirable or feasible by partners; however, restoring an incised floodplain was judged possible with beaver re-introduction that could also affect inset floodplains. Beaver re-introduction was possible where enough woody vegetation was available to feed beaver. In addition, minor amount was fencing was also used to prevent further incision. Controlling exotic forbs or trees was an additional objective accomplished with herbicide spraying of discovered patches of noxious weeds, salt cedar, or Russian olive. A third objective, albeit a less obvious one, was to cut upland conifers encroaching (pinyon and juniper) the floodplain.

Table 26. Implemented treatment rates in montane riparian from 2023 to 2046.

	Beaver Reintroduction ($1,500/7 acres)	Exotic Control ($5/acre)	Fence ($6,100/acre)	Chainsaw Thinning ($1,500/acre)

Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	Average total acres	Average total acres
2023-2024	18 - 20	15 - 16	0.01	0
2025-2026	1 – 2	1 - 2	0.01	0
2027-2029	14 - 17	0.2 - 1	0.02	0
2030-2039	11 - 18	0.2 - 3	0.1	0.1
2040-2046	3 – 7	1 - 2	0.1	0.1
Sums Total	48 - 65	17 - 25	0.2	0.2

2047 UED:

MINIMUM MANAGEMENT: 61% ± 4% (intermediate departure)

PROPOSED MANAGEMENT: 60% ± 5% (intermediate departure)

Cost by Year (ST-Sim Results)

The highest cost of $15,500 was incurred in 2023 with the first beaver re-introductions and most exotic control with herbicide (Fig. 24). Additional beaver re-introduction in 2027 caused a second but smaller peak cost <$10,000. Minor chainsaw thinning of upland conifers was applied in small amount from 2030 to 2039, although the other three treatment continued during the duration of the simulation (Table 28; Fig. 24).

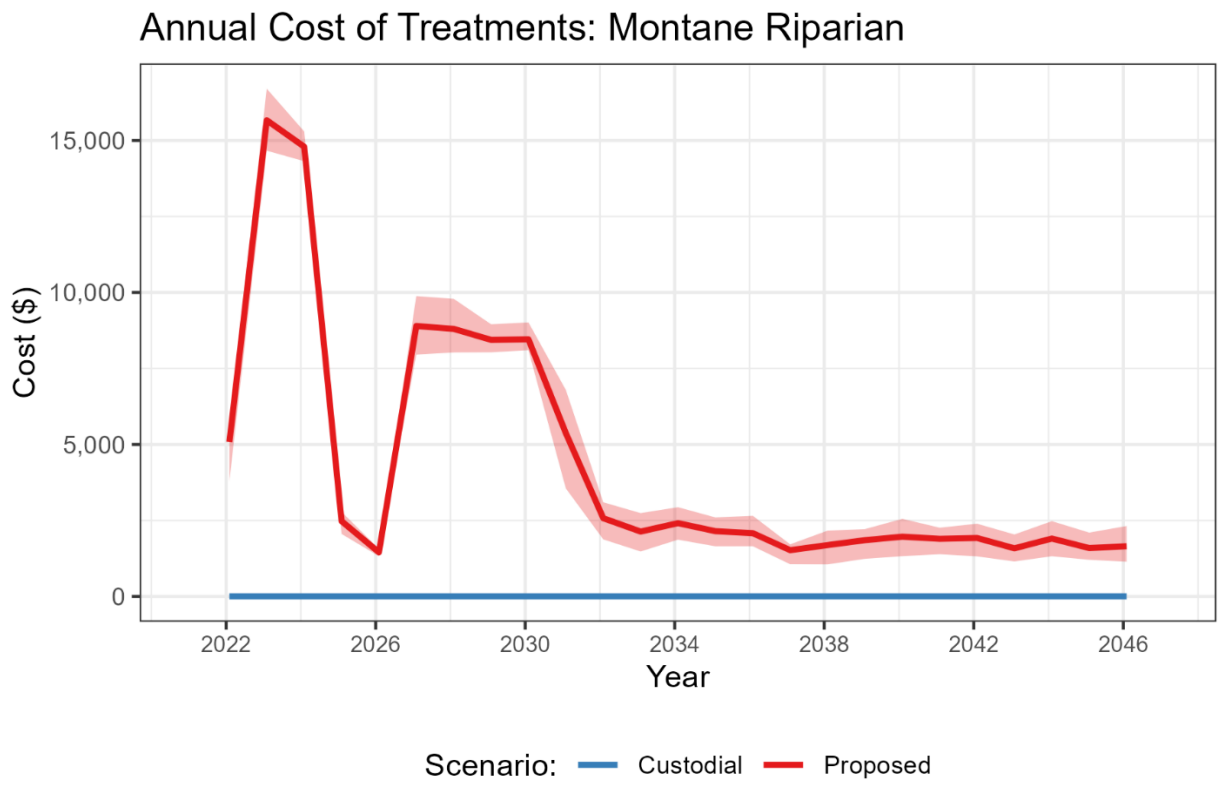


Figure 24. Annual cost of treatments in montane riparian on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

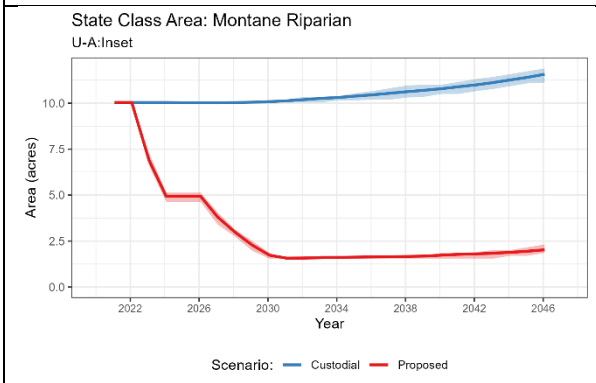
Vegetation Classes (ST-Sim Results)

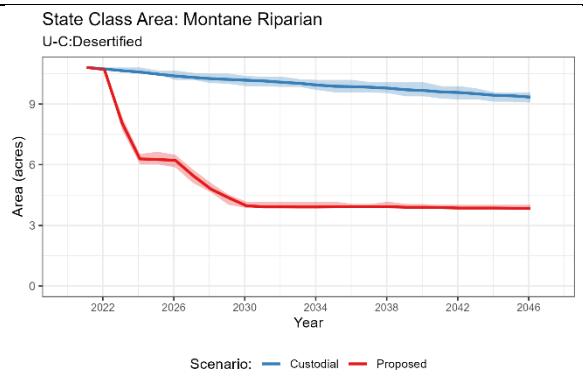
Beaver re-introduction effectively reduced the area of incised streams (U-C:Desertified) and inset floodplains (U-A:Inset; Fig. 25A). Herbicide spraying of exotic forbs and trees was also effective at reducing the U-A:EFT class (Fig. 25A). Beaver re-introduction caused a transition of upland vegetation in the incised stream to the shrub-forb encroached class (U-C:Shrb-Frb-Encr) compared to Custodial management, an intermediate recovery pathway to one of several reference classes of willow. This action also caused a more direct transition from the inset floodplain class (U-A:Inset) to the reference early-successional class of willow (A-Willow:All) compared to Custodial management (Fig. 25A&B), based on the assumption that willow can "track" rapid inundation after beaver activity started lifting water levels. A tiny amount of upland conifer removal was simulated after age 50 since stand-replacing events in the reference late-successional willow and cottonwood classes (B-Willow:Closed and C-Cottonwood-Closed), the shrub and forb encroached class (U-A:Shrb-Frb-Encr), the incised classe (U-C:Desertified), and the incised tree-encroached class (U-C:TEA). However, the effect from the tiny amount of conifer cutting was not noticeable because it was confounded with stronger disturbances.

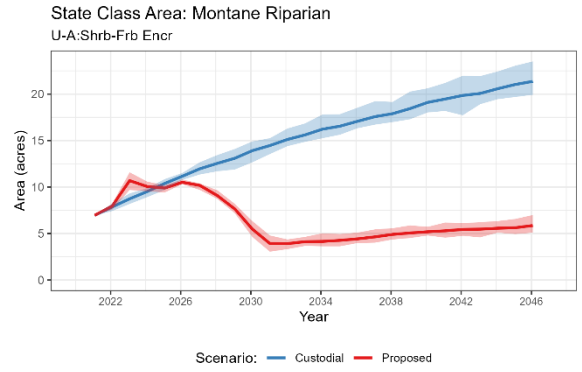
The more troubling result was the increased of UED from 21% in 2022 to about 60% in both scenarios by 2046, despite significant reduction of all uncharacteristic classes. The cause of

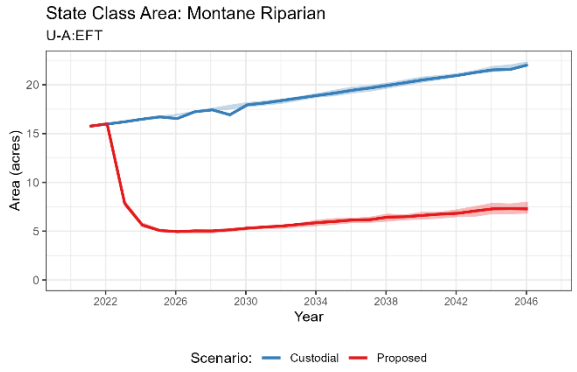
increased UED was the consistent decreased of the area of the B-Willow:Closed and B-Cottonwood:Closed classes and commensurate large increases of the A-Willow:All and A-Cottonwood:All classes (Fig. 25B). In the reference condition, we see the opposite where the area of the A classes should be small and those of the B classes large or dominant (Table 27). Interestingly, the area of C-Cottonwood-Closed class increased in steps corresponding to successional events from the B-Cottonwood:Closed class (Fig. 25B); therefore, the cause of this decrease of B class areas and recruitment of areas to A classes was the high level of stand-replacing floods in the B classes in both scenarios (i.e., about 20-year flood events) and more fire imported from adjacent systems than predicted by the non-spatial reference condition (results not shown). This suggest that non-spatial and spatial reference conditions (not simulated in this project) are different for small or long and narrow systems imbedded in a landscape covered with fire-dependent systems, such as ponderosa pine and mixed conifer.

A - Treated classes









B – Destination classes

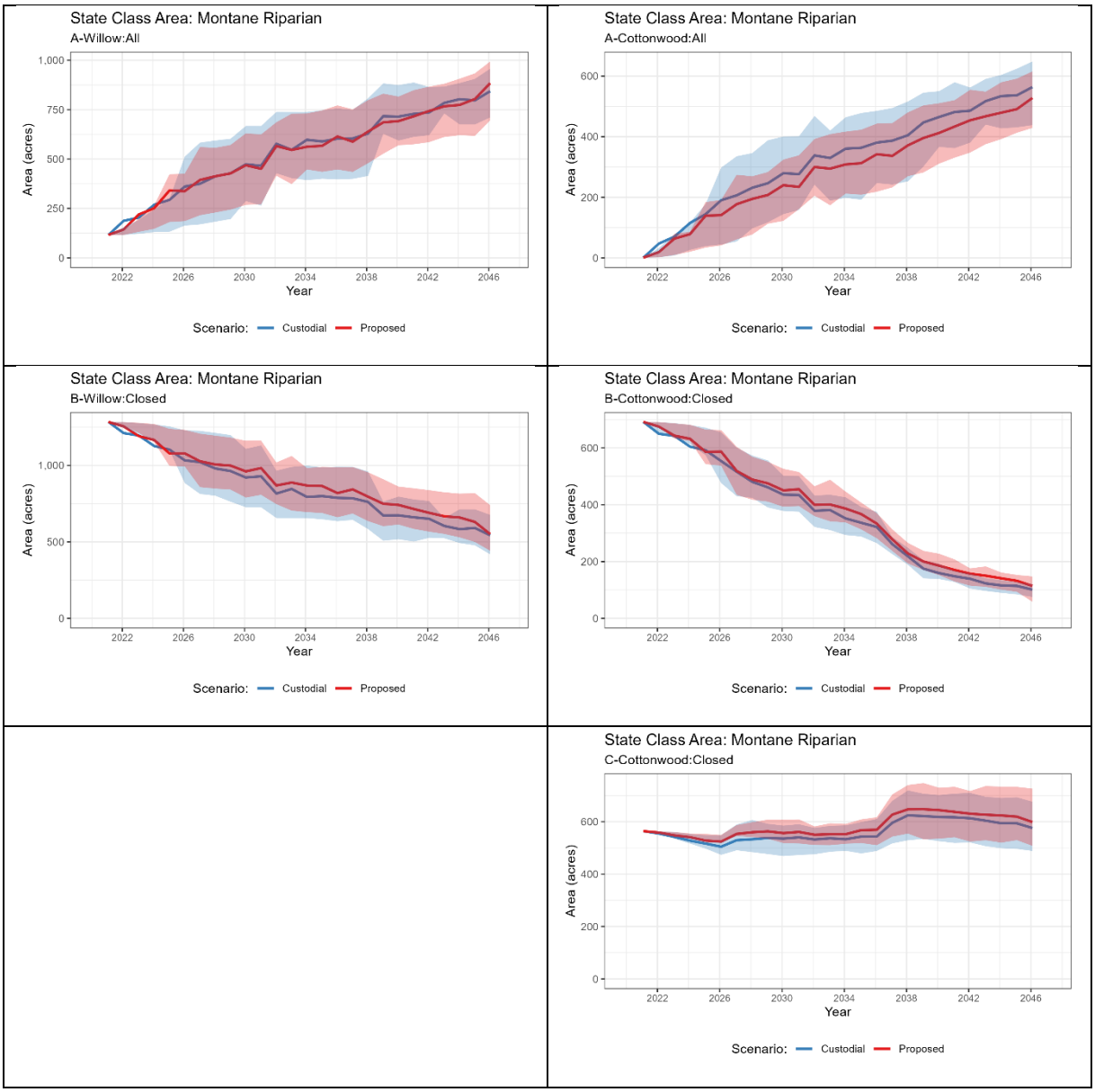


Figure 25 A and B. Vegetation classes of montane riparian treated (A) or recruited into (B) after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.9. Mountain Shrub

2021 System Acres at 25-m resolution: 50,870

2021 UED: 100% (high departure)

Problems or Concerns

There was only one overwhelming problem in mountain shrub; 99% of the area (50,633) was encroached by conifers (pinyon and juniper) and, as a result, all reference classes were absent. Classes that did not contain trees were already seeded with introduced species, which contributed to UED even with the 45% penalty-free threshold.

Table 27. Vegetation classes of mountain shrub expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	Ephemeral	<0.1	2
A:All	0	0.0	4
B:Closed	0	0.0	28
C:Closed	0	0.0	61
D:Open	0	0.0	4
U-A:Char-AnnSpp	0	0.0	n/a
U-A:Annual Spp	0	0.0	n/a
U-A:Bare Ground	0	0.0	n/a
U-A:Char-EarlyShrub	0	0.0	n/a
U-A:Early-Shrub	2	0.0	n/a
U-A:Char-SI	0	0.0	n/a
U-A:SI	50	0.1	n/a
U-A:Char-SI+AS	0	0.0	n/a
U-A:SI+AS	0	0.0	n/a
U-A:Char1-SAP	0	0.0	n/a
U-B:SAP	0	0.0	n/a
U-B:SI	182	0.4	n/a
U-B:SI+AS	0	0.0	n/a

U-C:Depleted	0	0.0	n/a
U-C:SAP	0	0.0	n/a
U-C:SI	0	0.0	n/a
U-C:SI+AS	0	0.0	n/a
U-D:SI	2	0.0	n/a
U-D:SI+AS	0	0.0	n/a
U-D:TEA	50,633	99.5	n/a

Objectives for Management Actions

The only objectives were to reduce tree cover and then seed grasses and shrubs. While introduced grass species might be seeded, The Nature Conservancy encourages partners to use native grass and forb species. It was assumed that seeded shrubs were native species. Seeding introduced species will not decrease UED because no reference vegetation classes will be included in the calculations.

Table 28. Implemented treatment rates in mountain shrub from 2023 to 2046.

	Lop & Scatter ($125/acre)	Masticate & Spot-Herbicide & Seed ($580-$780/acre)	Small Tree Lopping ($35/acre)
Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres
2023-2024	1,008 – 1,024	1,188 – 1,228	0
2025-2026	200	1,194 – 1,209	0
2027-2029	1,508 – 1,527	589 - 612	0
2030-2039	1,004 – 1,053	0	0
2040-2046	700 - 725	0	<1

Sums Total	4,419 – 4,426	2,971 – 3,049	<1

2047 UED:

MINIMUM MANAGEMENT: 100% ± 0% (high departure)

PROPOSED MANAGEMENT: 100% ± 0% (high departure)

Cost by year (ST-Sim Results)

About $500,000 was spent from 2023 to 2026 on mostly mastication and seeding. Lopping and scattering trees was widely used but contribute substantially less to cost (Fig. 26). A reduced implementation rate of mastication and seeding from 2027-2029 reduced cost to about $200,000. Cost was minimal and limited to lopping and scattering trees after 2029.

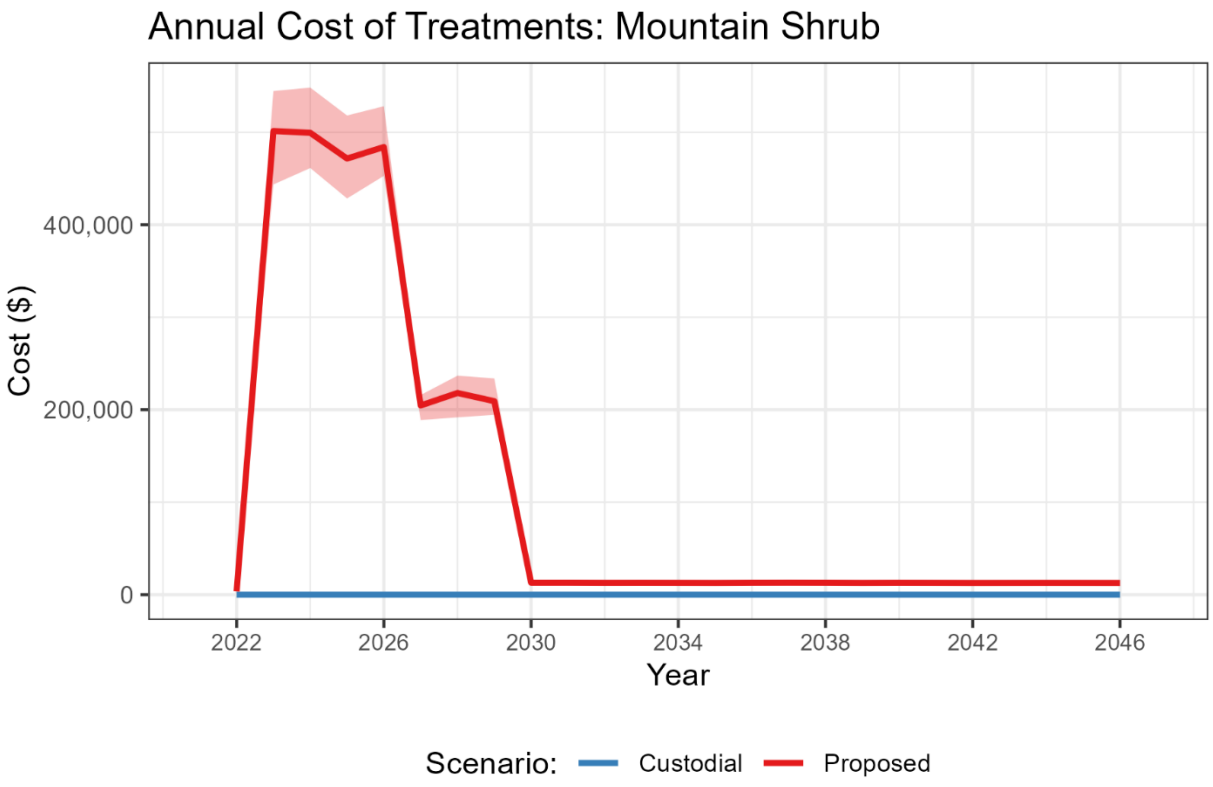
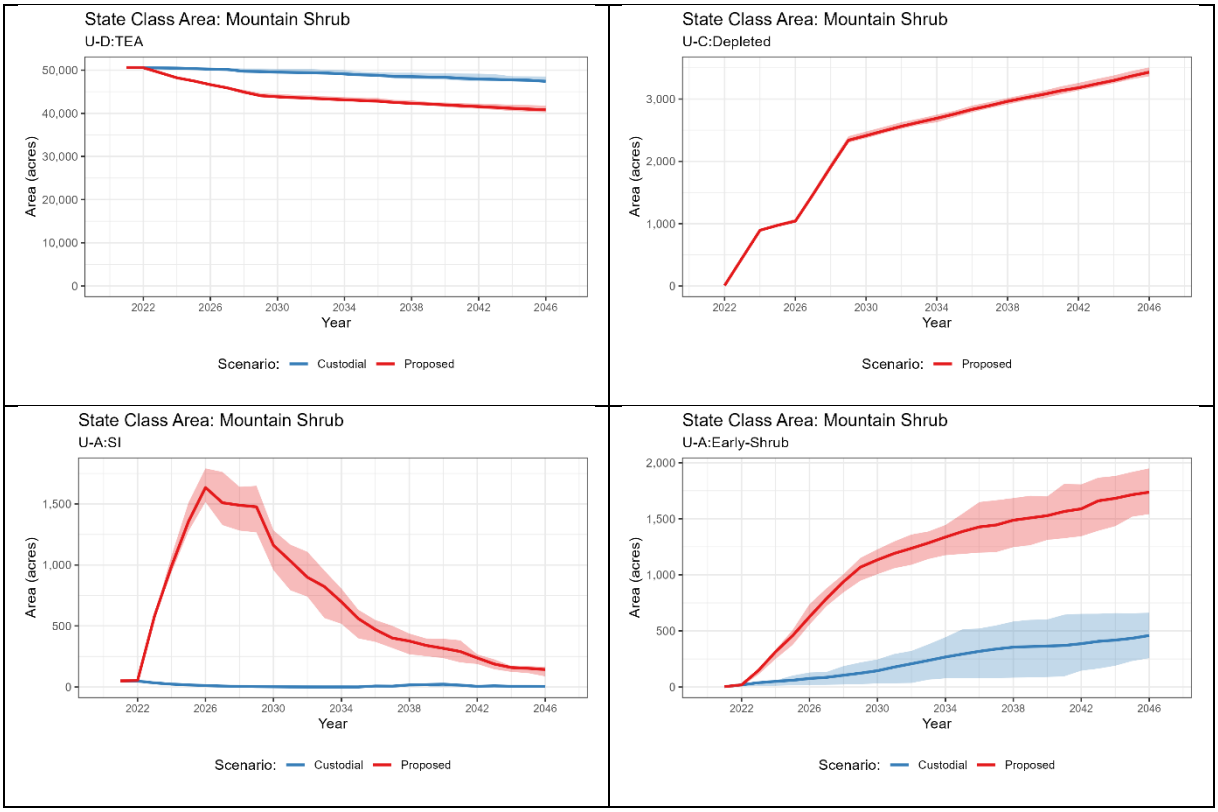


Figure 26. Annual cost of treatments in mountain shrub on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

Despite the $500,000 annually spent in a few years, the area of the tree-encroached class (U-C:TEA) only deceased by 5,000-6,000 acres compared to Custodial management, thus leaving 40,000 acres untreated by 2046 (Fig. 27). The area of new seedings (U-A:SI) jumped rapidly to about 1,500 acres for 3 years and then are decrease as woody succession transitioned seedings to the mid-successional seeding (U-B:S; Fig. 27)I). The lop and scatter of trees did not result in seedings, but increased the areas of late-successional depleted shrubland (U-C:Depleted) by about 3,000 acres, the area dominated by early shrubs such as rabbitbrush and snakeweed by about 1,700 acres, and the area of annual species (U-A:Annual Species) dominated classes to 1,500 acres. While Boulder Mountain is not currently prone to non-annual species dominance, this result should be view as cautionary as partners noted the slow increase of cheatgrass.



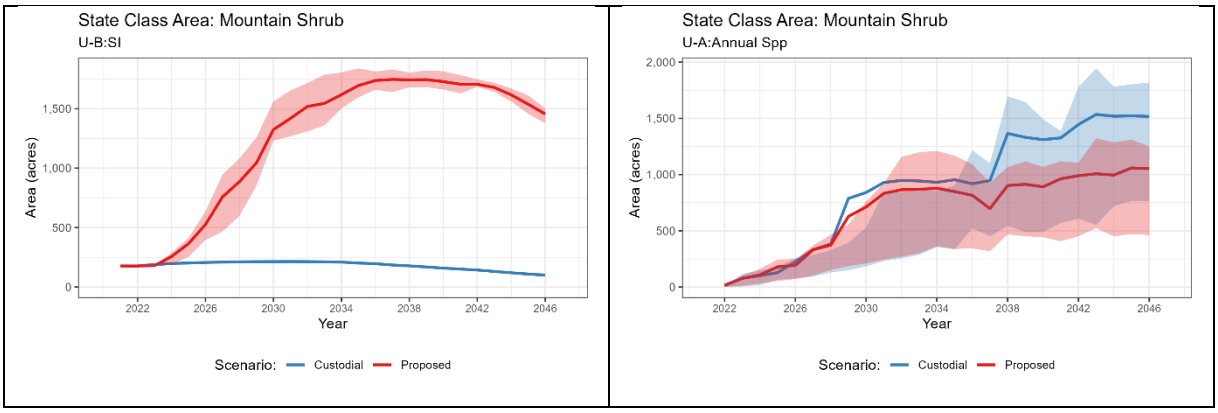


Figure 27. Vegetation classes of mountain shrub treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.10. Ponderosa Pine - dry

2021 System Acres at 25-m resolution: 6,262

2021 UED: 38% (intermediate departure)

Problems or Concerns

About 67% of ponderosa pine-dry (4,215 acres) was in the reference mid-successional open class (B:Open; Table 29). The reference condition allowed for 29% of the system to be in this class. The reference late-successional open class (C:Open) was predicted to be 62% in the reference condition but only 27% was mapped (1,673 acres). Only successional time could increase the area of the C:Open class.

Table 29. Vegetation classes of ponderosa pine-dry expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	Ephemeral	<0.1	0
A:Char2	Ephemeral	<0.1	0
A:All	348	5.6	6
B:Closed	6	0.1	1
B:Open	4,215	67.3	29
C:Closed	20	0.3	1
C:Open	1,673	26.7	62
U-A:Bare Ground	0	0.0	n/a
U-A:Char-FIC	0	0.0	n/a
U-A:FIC-All	0	0.0	n/a
U-A:SAP	0	0.0	n/a
U-B:FIC-Closed	0	0.0	n/a
U-B:FIC-Open	0	0.0	n/a
U-B:TEA	0	0.0	n/a
U-C:FIC-Closed	0	0.0	n/a
U-C:FIC-Open	0	0.0	n/a

Objectives for Management Actions

The primary ecological objective was to maintain the open-canopied classes as open using prescribed fire and feller-buncher tree removal of merchantable conifers greater than 20 inches of diameter-at-breast-height (DBH), including closed-canopied classes. A commercial objective was the harvest of merchantable ponderosa pine, hopefully achieving the secondary goal of maintaining stand openness.

Table 30. Implemented treatment rates in ponderosa pine-dry from 2023 to 2046.

	Feller-Buncher for merchantable conifers ($1/acre)	Rx Fire ($150-$250/acre)
Years	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres
2023-2024	23	2 - 3
2025-2026	0	1,000 – 1,001
2027-2029	0 - 1	246 - 745
2030-2039	0 - 1	1,048 – 3,099
2040-2046	0	685 – 2,215
Sums Total	23 - 24	2,982 – 7,062

2047 UED:

MINIMUM MANAGEMENT: 39% ± 0% (intermediate departure)

PROPOSED MANAGEMENT: 39% ± 0% (intermediate departure)

Cost by year (ST-Sim Results)

The highest spending was $100,000 from 2025 to 2026 when most prescribed fire was used as feller-buncher harvesting of merchantable trees does not cost the USFS. Cost dropped below $60,000 for the reminder of the maintenance phase after 2026 and was attributable to prescribed fire.

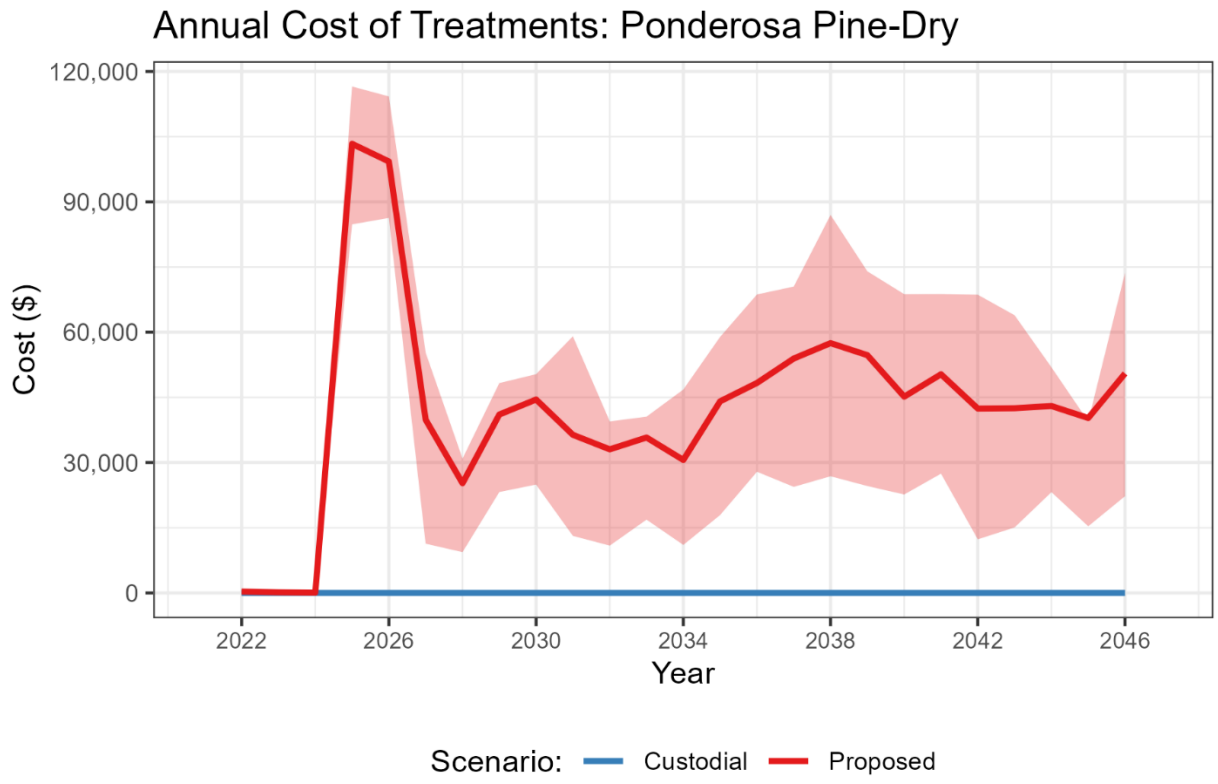


Figure 28. Annual cost of treatments in ponderosa pine-dry on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

The areas of both reference mid- and late-successional reference classes remained unchanged over time (Fig. 29). Application of prescribed fire and feller-buncher harvesting reduced the area of closed canopied classes (Fig. 29).

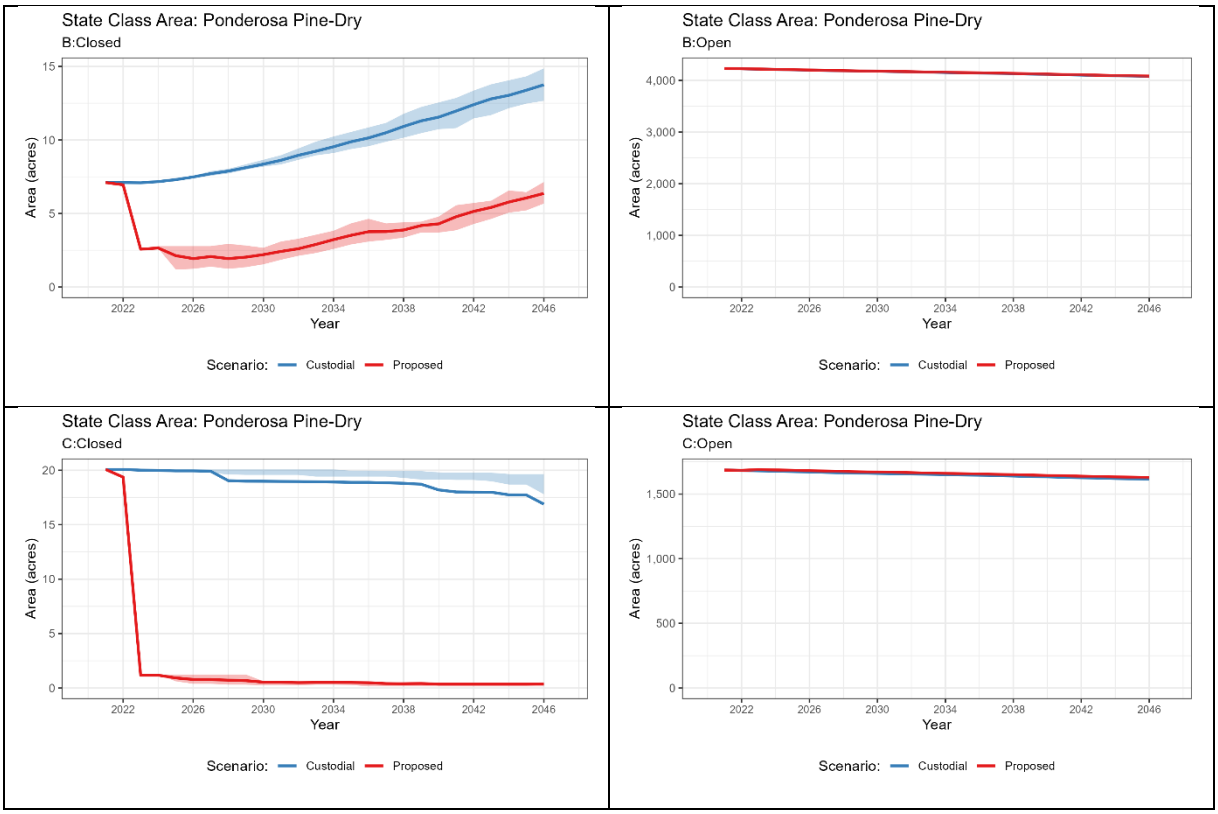


Figure 29. Vegetation classes of ponderosa pine-dry treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.11. Ponderosa Pine - mesic

2021 System Acres at 25-m resolution: 121,499

2021 UED: 43% (intermediate departure)

Problems or Concerns

The main problem of ponderosa pine-mesic was the same as ponderosa pine-dry. The areas of the reference open-canopied mid- and late-successional classes, respectively, were 83,030 acres and 33,677 acres when it should have been the opposite under the reference condition (Table 31).

Table 31. Vegetation classes of ponderosa pine-mesic expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	Ephemeral	<0.1	0
A:Char2	Ephemeral	<0.1	0
A:All	3,335	2.7	11
B:Closed	38	0.0	9
B:Open	83,030	68.3	26
C:Closed	9	0.0	3
C:Open	33,677	27.7	51
U-A:Bare Ground	0	0.0	n/a
U-A:SAP	338	0.3	n/a
U-B:TEA	1	0.0	n/a
U-A:Char-SI	0	0.0	n/a
U-A:SI	436	0.4	n/a
U-A:Char-SI+AS	0	0.0	n/a
U-A:SI+AS	0	0.0	n/a
U-A:Char-FIC	0	0.0	n/a
U-A:FIC-All	1	0.0	n/a
U-B:FIC-Closed	410	0.3	n/a
U-B:FIC-Open	178	0.1	n/a

U-C:FIC-Closed	0	0.0	n/a
U-C:FIC-Open	46	0.0	n/a

Objectives for Management Actions

The primary ecological objective was to maintain the open-canopied classes as open using prescribed fire and feller-buncher tree removal of merchantable conifers greater than 20 inches of diameter-at-breast-height (DBH), including closed-canopied classes. A commercial objective was the harvest of merchantable ponderosa pine, hopefully achieving the secondary goal of maintaining stand openness.

Table 32. Implemented treatment rates in ponderosa pine-mesic from 2023 to 2046.

	Feller-Buncher for merchantable conifers ($1/acre)	Rx Fire ($150-$250/acre)	Chainsaw + Pile-Burning ($1,530/acre)
Year	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres	25th – 75th percentiles of total treatment acres
2023-2024	19 - 27	1,415 – 1,416	23 - 96
2025-2026	48 - 188	5 - 6	0
2027-2029	286 - 973	2,700 – 3,601	0
2030-2039	4,514 – 5,040	9,954 – 14,983	0
2040-2046	3,471 – 3,540	8,662 – 10,971	0
Sums Total	8,338 – 9,797	23,869 – 30,977	23 - 96

2047 UED:

MINIMUM MANAGEMENT: 36% ± 0% (high departure)

PROPOSED MANAGEMENT: 35% ± 0% (intermediate departure)

Cost by year (ST-Sim Results)

Cost increased from $200,000 to $300,000 from 2023 to 2046, except for zero cost in 2025 and 2026 to allow expenditures to other systems. The main source of the cost was prescribed fire as feller-buncher operations do not cost the USFS.

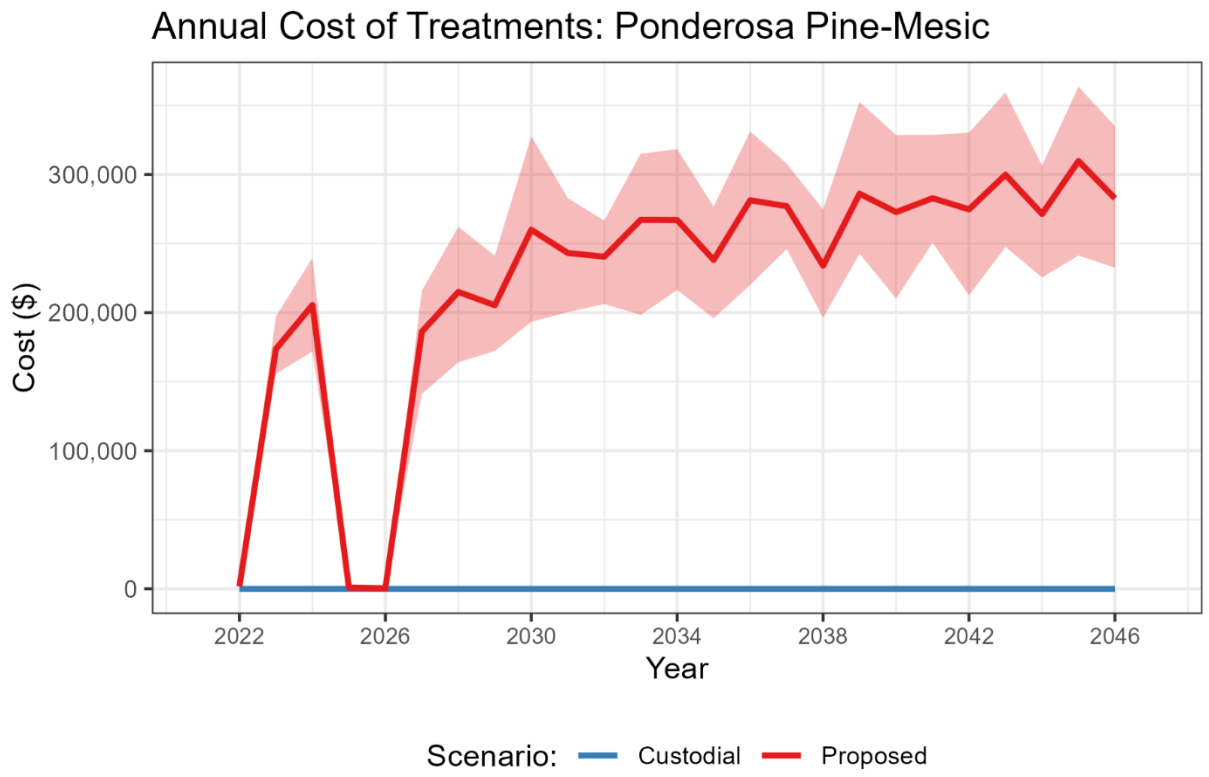


Figure 30. Annual cost of treatments in ponderosa pine-mesic on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

Unlike for ponderosa pine-dry, the area of open classes, especially the mid-successional one, decreased in later years because the fuel ladder build-up was twice as fast in the mesic than dry ponderosa pine system without fuel thinning factors affecting a pixel (any fire and mechanical thinning of conifers), although less in the Proposed and Custodial management scenarios (Fig. 31). The area of closed classes (primarily B:Closed) progressively increased with time by 30,000 acres in the Custodial management scenario and by 20,000 acres in the Proposed management scenario by 2046 (Fig. 31). This suggest that the prescribed fire and feller-buncher rates were insufficient relative to the area of ponderosa pine-mesic.

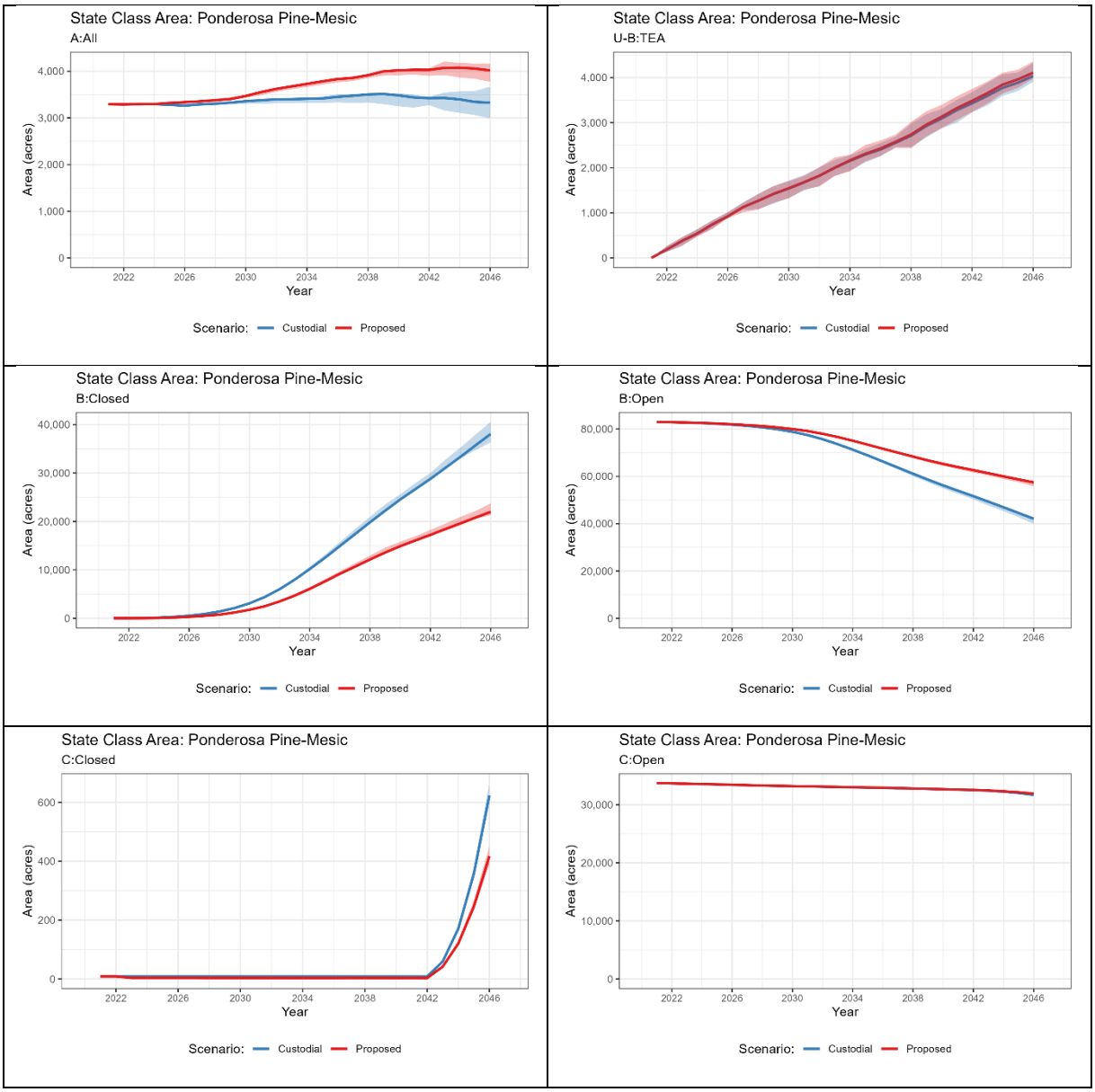


Figure 31. Vegetation classes of ponderosa pine-mesic treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.12. Wet Meadow - montane

2021 System Acres at 25-m resolution: 3,073

2021 UED: 51% (intermediate departure)

Problems or Concerns

Wet meadow-montane had too much area of exotic forb or tree species (U-A:EFT; 14 acres), hummocked (U-A:Hummocked; 899 acres; Table 33), and woody species in the reference late-successional class (C:Open).

Table 33. Vegetation classes of wet meadow-montane expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Sediment	0	0.0	0
A:Char1	Ephemeral	<0.1	0
A:All	0	0.0	1
B:Closed	1,857	60.4	93
C:Open	96	3.1	5
U-A:Char-AnnSpp	0	0.0	n/a
U-A:Annual Spp	0	0.0	n/a
U-A:Bare Ground	0	0.0	n/a
U-A:Char-EarlyShrub	0	0.0	n/a
U-A:Early-Shrub	0	0.0	n/a
U-A:Char-EF	0	0.0	n/a
U-A:Exotic Forb	14	0.5	n/a
U-A:Hummocked	899	29.2	n/a
U-A:Char-Inset	0	0.0	n/a
U-A:Inset	23	0.8	n/a
U-A:Char-Inset-EF	0	0.0	n/a
U-A:Inset-EF	0	0.0	n/a
U-A:Inset-Hummocked	0	0.0	n/a
U-A:Char-SI	0	0.0	n/a

U-A:SI	90	2.9	n/a
U-A:Char-DE	0	0.0	n/a
U-C:Desertified	0	0.0	n/a
U-C:SA	0	0.0	n/a
U-A:Char-SFE	0	0.0	n/a
U-C:Shrb-Frb Encr	87	2.8	n/a
U-C:TEA	7	0.2	n/a

Objectives for Management Actions

While there was an abundance of the desirable reference mid-successional class (B:Closed), albeit grazed low to the ground, montane wet meadows require attention with exotic species control, reversing hummocking caused by hoof action in wet soils, and reduction of native woody vegetation. While spraying noxious forb and tree species and even lop and scatter of woody vegetation was inexpensive, fencing to allow recovery of hummocked areas was very expensive.

Table 34. Implemented treatment rates in wet meadow-montane from 2023 to 2046.

	Exotic Control ($5/acre)	Fence ($6,100/acre)	Lop & Scatter ($125/acre)
Years	$25^{th} – 75^{th}$ percentiles of total treatment acres	$25^{th} – 75^{th}$ percentiles of total treatment acres	$25^{th} – 75^{th}$ percentiles of total treatment acres
2023-2024	2	9	6 - 13
2025-2026	2	0	0
2027-2029	3	6	13 - 26
2030-2039	9 - 11	20	48 - 96
2040-2046	4 - 6	15	45 - 70
Sums Total	19 - 25	52	113 - 205

2047 UED:

MINIMUM MANAGEMENT: 34% ±5% (intermediate departure)

PROPOSED MANAGEMENT: 27% ± 2% (low departure)

Cost by year (ST-Sim Results)

Total annual expenditure rarely exceeded $25,000 and was generally <$20,000. No implementation was applied in 2025-2026 while funding was directed to other systems with peak implementation during those years.

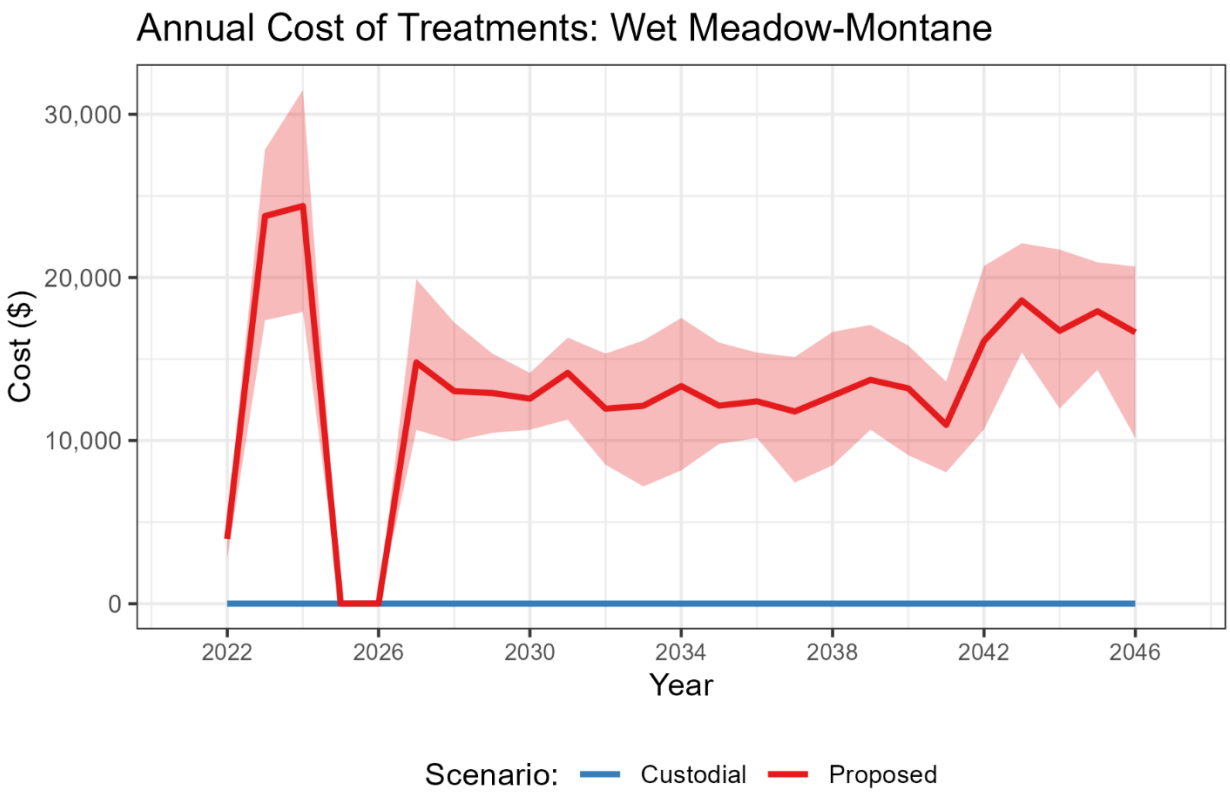


Figure 32. Annual cost of treatments in wet meadow-montane on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

The control of exotic forbs and trees decreased the area of the U-A:EFT class by 20 acres compared to Custodial management by year 2046 (Fig. 33). Very few exotic forbs and trees were present at the time of mapping. The lop and scatter of woody species applied most to the C:Open class. This action lowered the area of this class by 100 acres compared to the Custodial scenario after 2037 (Fig. 33). Both exotic control and lop-and-scatter increased transitions to

the reference early-successional and then mid-successional, sometimes by 100s of acres (Fig. 33). The effect of fencing on hummocked vegetation was counter-intuitive because recovery from hummocked meadows to reference classes takes 5 years if a pixel is not grazed at all, which was comparable in both management scenarios because fencing had very limited implementation and the deferred grazing system as modeled rested meadows enough to allow natural recovery; however, fencing prevented the transition from hummocked vegetation to incised meadows (U-C:Desertified), albeit in limited amount (Fig. 33).

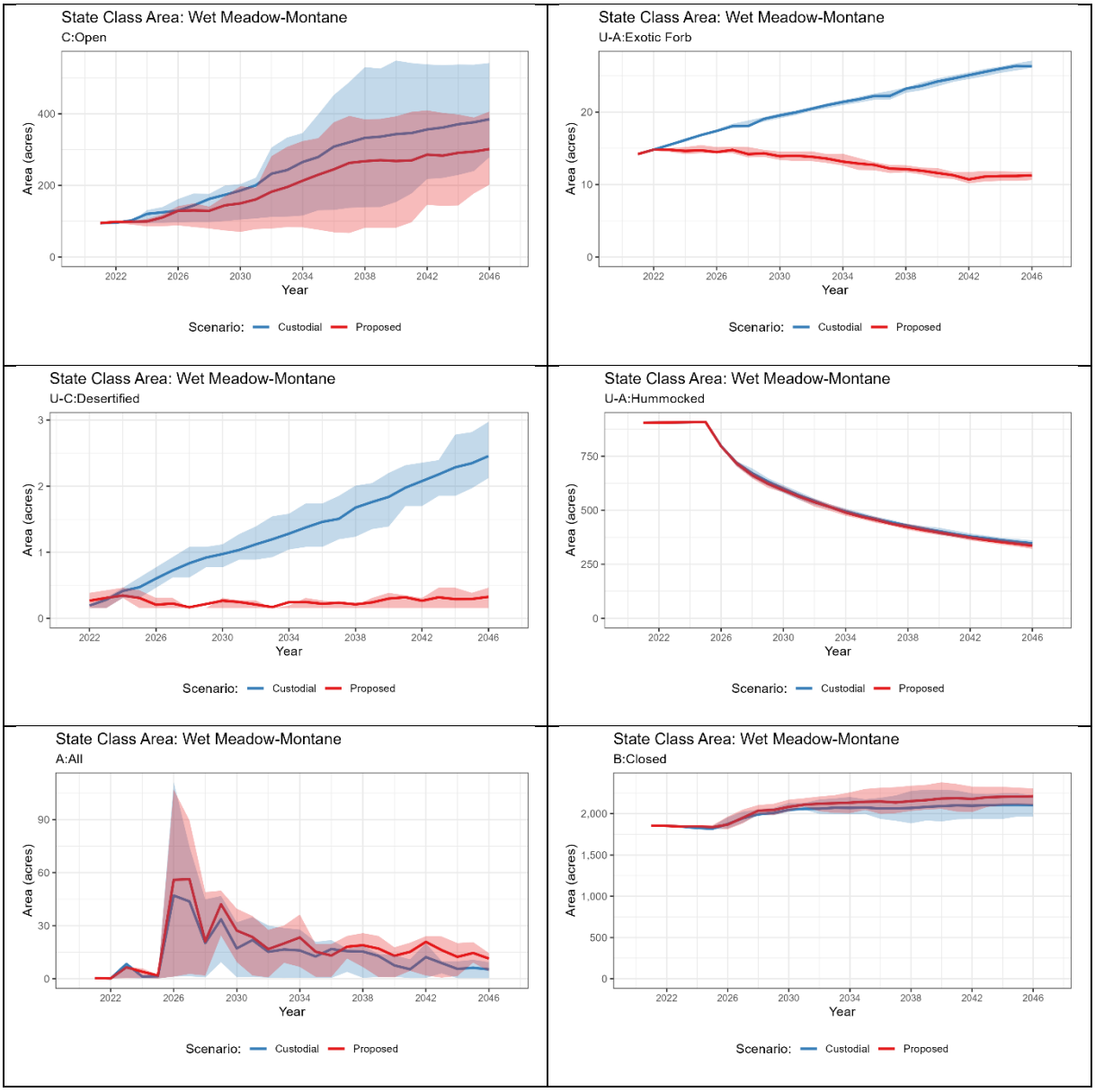


Figure 33. Vegetation classes of wet meadow-montane treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.2.13. Wet Meadow - subalpine

2021 System Acres at 25-m resolution: 4,189

2021 UED: 6% (low departure)

Problems or Concerns

The wet meadow-subalpine system was in great condition at 6% departure (above); however, small areas occupied by exotic forbs (U-A:EFT) and trees (spruce) in the reference late-successional class required attention.

Table 35. Vegetation classes of wet meadow-subalpine expressed in current area (acres), current class percentage of entire system, and percentage of each class in the reference condition.

Class	Acres	Percent of Total in 2021	Reference Condition % of Total
A:Char1	Ephemeral	<0.1	0
A:All	0	0.0	1
B:Closed	4,182	99.9	94
C:Open	4	0.1	5
U-A:Bare Ground	0	0.0	n/a
U-A:Char-EF	0	0.0	n/a
U-A:Exotic Forb	4	0.1	n/a
U-A:Hummocked	0	0.0	n/a
U-A:Char-Inset	0	0.0	n/a
U-A:Inset	0	0.0	n/a
U-A:Char-Inset-EF	0	0.0	n/a
U-A:Inset-EF	0	0.0	n/a
U-A:Inset-Hummocked	0	0.0	n/a
U-A:Char-SI	0	0.0	n/a
U-A:SI	0	0.0	n/a
U-A:Char-DE	0	0.0	n/a
U-C:Desertified	0	0.0	n/a
U-A:Char-SFE	0	0.0	n/a
U-C:Shrb-Frb Encr	1	0.0	n/a

Objectives for Management Actions

Three objectives were considered, although one was about reversing with fences the future problem of hummocking caused by ungulate hoof action in wet soils (Table 36). The primary objective was to control small areas of exotic forbs, which were mostly thistles. The second was objective was to lop and scatter spruce invading subalpine wet meadows. As this system was in good shape, only low levels of treatment were necessary but rates increased with time (Table 36).

Table 36. Implemented treatment rates in wet meadow-subalpine from 2023 to 2046.

	Exotic Control ($5/acre)	Lop & Scatter ($125/acre)	Fence ($2,200-$10,000/acre)
Years	25^{th} – 75^{th} percentiles of total treatment acres	25^{th} – 75^{th} percentiles of total treatment acres	25^{th} – 75^{th} percentiles of total treatment acres
2023-2024	0	0	0
2025-2026	2	8	10
2027-2029	2 - 3	6	11 - 15
2030-2039	3 - 8	20	46 – 51
2040-2046	1 - 5	14	35
Sums Total	8 - 18	46	96 - 111

2047 UED:

MINIMUM MANAGEMENT: 10% ± 4% (low departure)

PROPOSED MANAGEMENT: 9% ± 4% (low departure)

Cost by year (ST-Sim Results)

The subalpine wet meadow achieved some the lowest spending among focal systems due to its low departure from reference conditions (Fig. 34). The highest annual costs were in 2025-2026 at about $25,000. After 2026, average annual cost rarely exceeded $15,000.

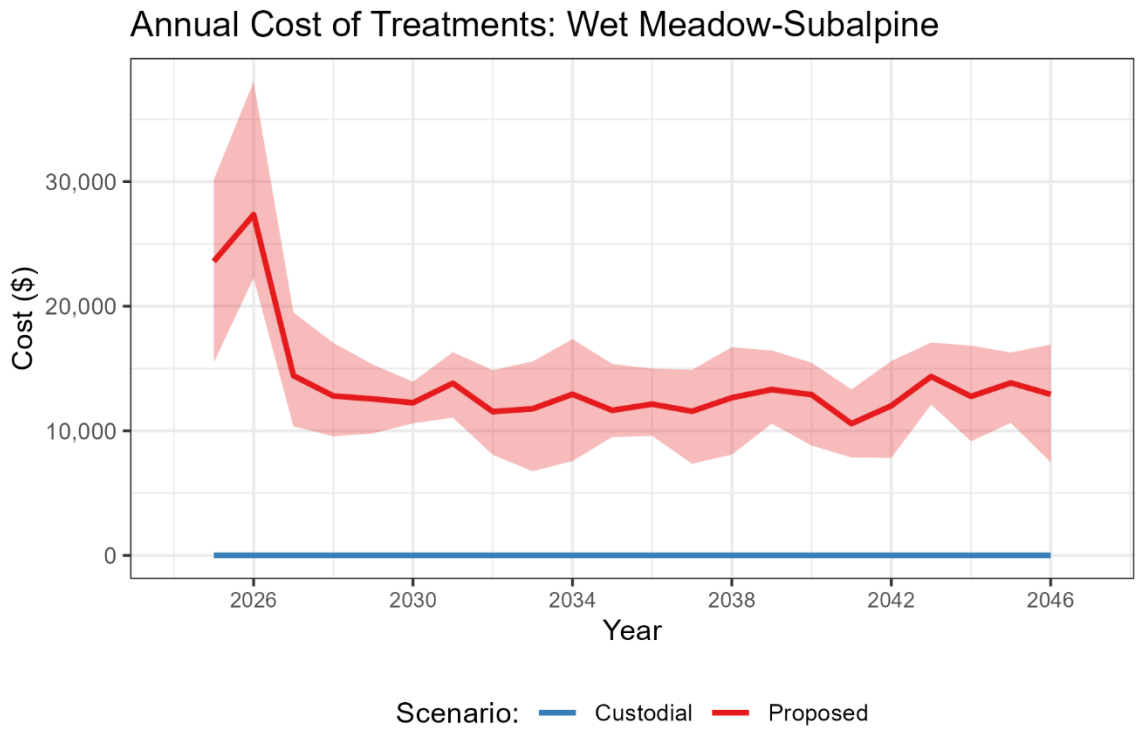


Figure 34. Annual cost of treatments in wet meadow-subalpine on Boulder Mountain. The line is the mean and error bars are the 25th-75th percentiles.

Vegetation Classes (ST-Sim Results)

Control of exotic forbs was effective and nearly eliminated the area of the U-A:EFT class (Fig. 35). The class that primarily increased in area from this action was the reference mid-successional class (B:Closed) were differences were hard to see in Fig. 35 but commensurate with application rates. The lop and scatter of young spruce in the C:Open class also added to the B:Closed class. The rate of increase of the area of the C:Open class was surprising and dependent on severe droughts favoring shrub and tree establishment. We will test in future simulations if the transition from B:Closed to C:Open was too rapid. The effect of fencing of the hummocked class (U-A:Hummocked) was minimal despite a rate of 2 acres per year (Fig. 35), and should probably not be implemented at the rates we modeled by USFS given the high cost.

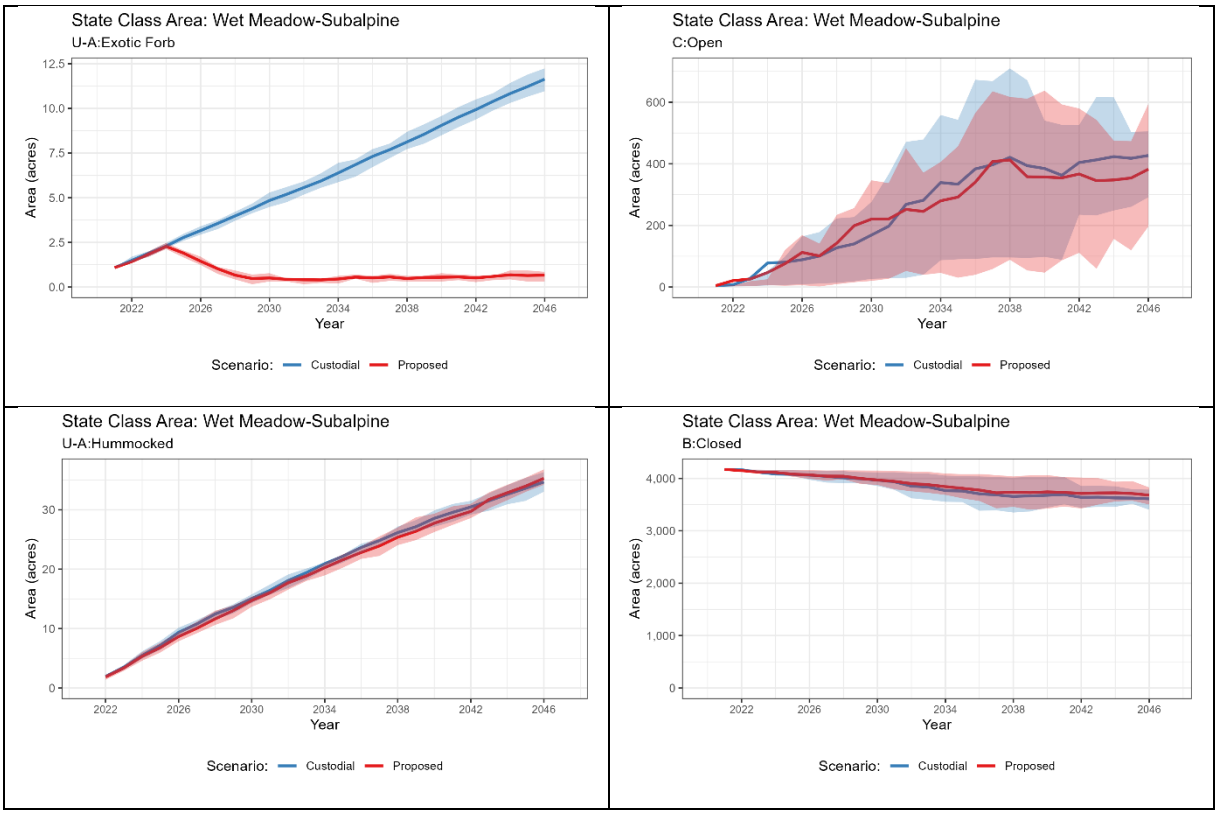


Figure 35. Vegetation classes of wet meadow-subalpine treated or recruited into after treatment on Boulder Mountain. Management scenarios are Custodial (i.e., equivalent to No Action NEPA scenario) and Proposed (active management). The line is the mean and error bars are the 25th-75th percentiles.

3.3. Landscape-wide Outcomes

The simulated results above were by focal system. In this part of the report, results were for the entire AOI. A very useful result presented here were frequency rasters that show the number of times each single simulated map pixel was selected to receive the same disturbance over the 25-year simulation and across all 20 replicates. The theoretical maximum number of events would be 25 years × 20 replicates = 500 events, which never happens. In the figures below, we converted the probability of those events in terms of number of events (probability × 500), which is more easily understood. Here, we presented the wildfire frequency, because fire is very consequential to vegetation dynamics, and all the management treatments.

3.3.1. Future Wildfires

Fire was widespread on the broad rim of AOI but absent in many high plateaus dominated by subalpine grasslands, subalpine conifer forests, and aspen stands that do not burn at all or infrequently (Fig. 36). As explained in Methods, Boulder Mountain historically was not a landscape with large wildfires. The highest wildfire frequencies were closer to Capitol Reef National Park and off the southern Rim north of Escalante, where 20+ fire events occurred. Slightly lower fire frequencies were observed under Proposed than Custodial management scenarios (Fig. 36).

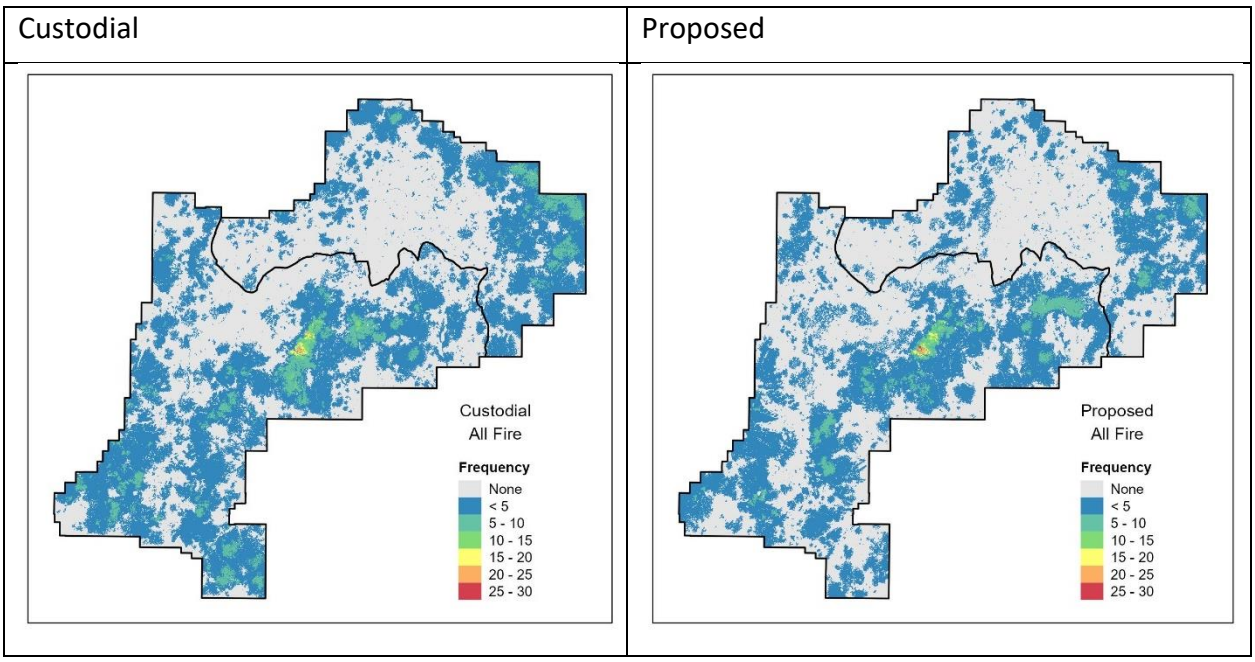


Figure 36. Mapped frequency (number of events) of wildfire per map pixel in the Custodial and Proposed management scenarios on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

3.3.2. Future Results by Treatment

The total annual budget ranged between $1,100,000 and $1,500,000 and variability among replicates was small. Partners had agreed upon an annual limit of $1,500,000. This means that additional treatments can be implemented in systems deemed a priority and where implementation rates were woefully insufficient (e.g., big sagebrush-mountain and mountain shrub).

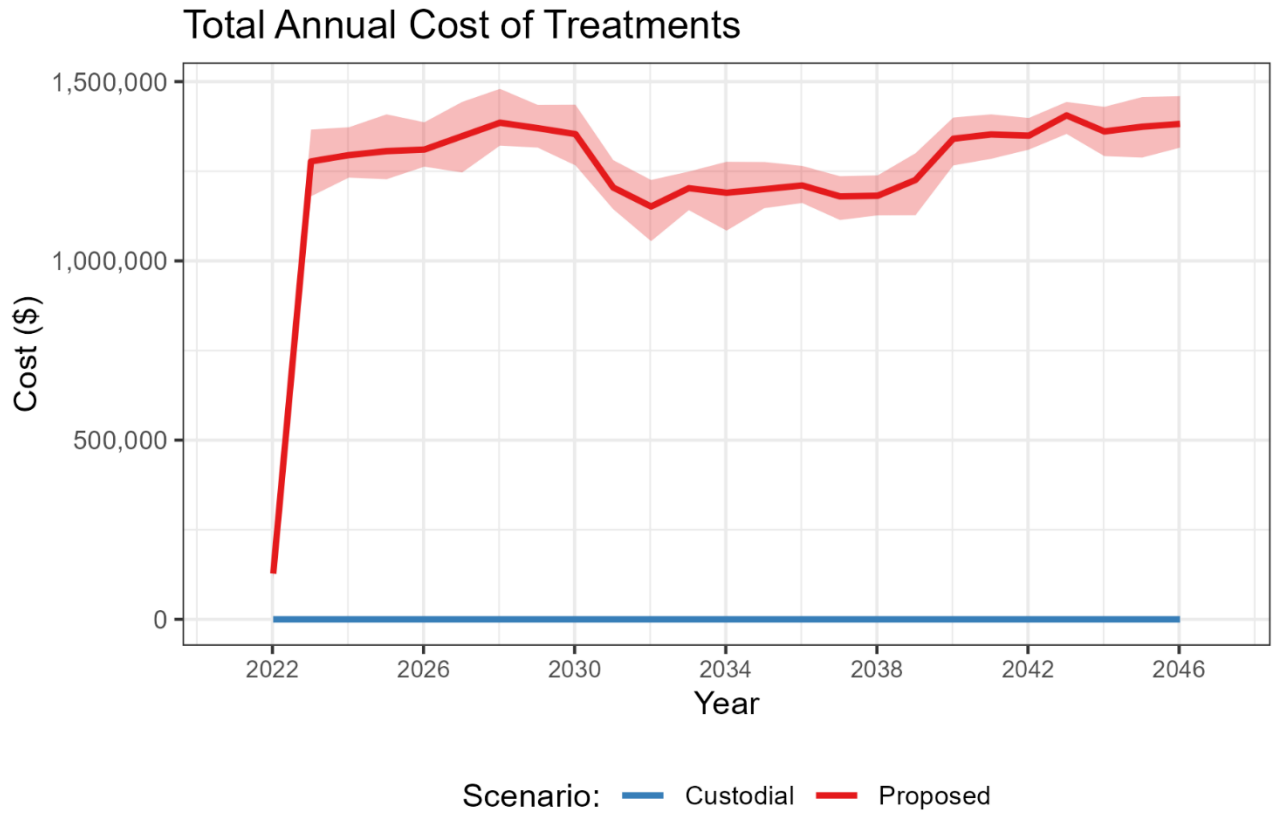
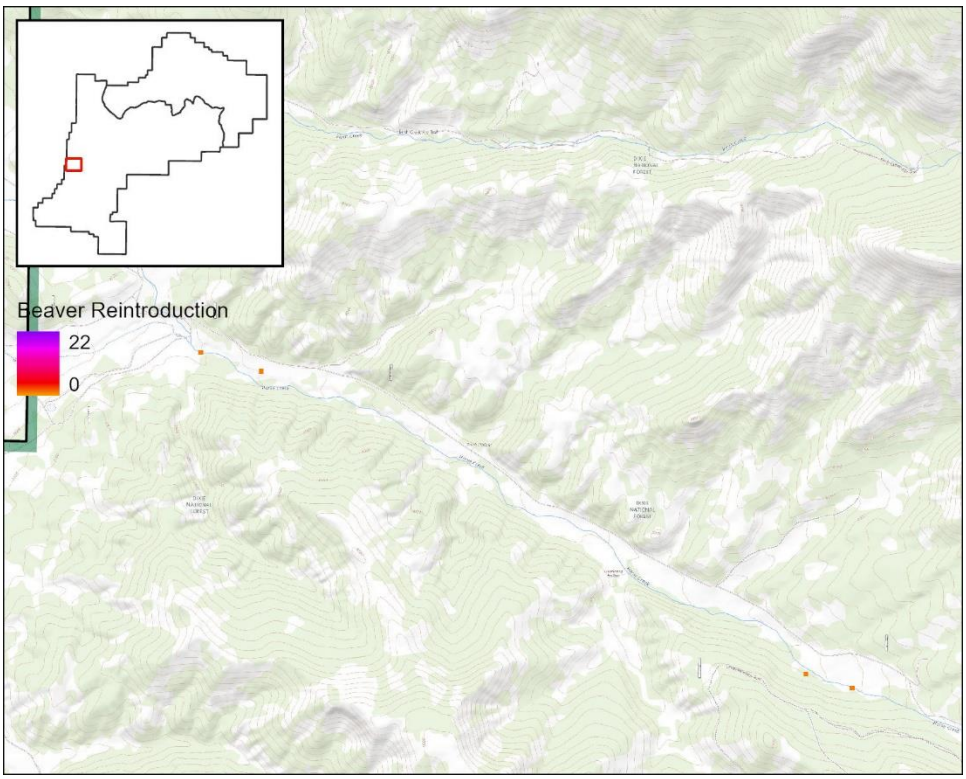


Figure 37. Total annual cost ($) of all proposed actions for Boulder Mountain.

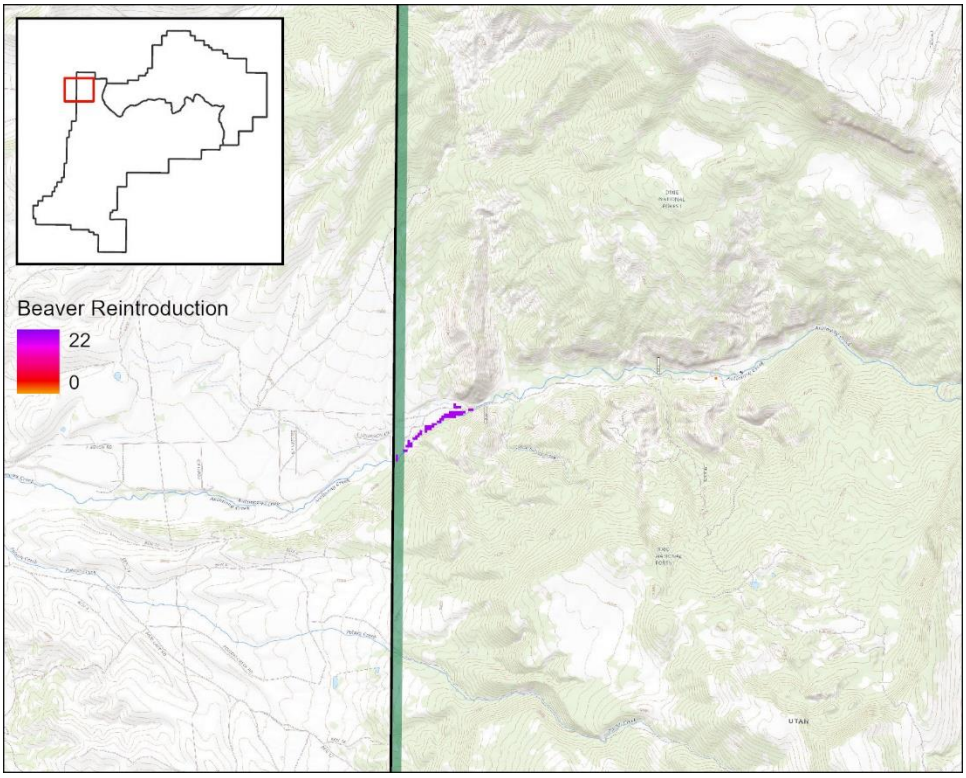
The remaining figures were frequency rasters of each proposed action shown in alphabetical order that could be mapped, although some actions were barely visible. We recommended using a Geographic Information System (GIS) to view small and localized treatment areas. The Nature Conservancy will supply these geotiff rasters by partners as they are valuable for proposing projects consistently selected by the ST-Sim simulation tool. In this section, our goal is to make partners aware of these resources but not to explain them.

Beaver re-introductions were not visible without GIS, but beavers were reintroduced in small reaches of North Creek and Antimony Creek (Fig. 38).

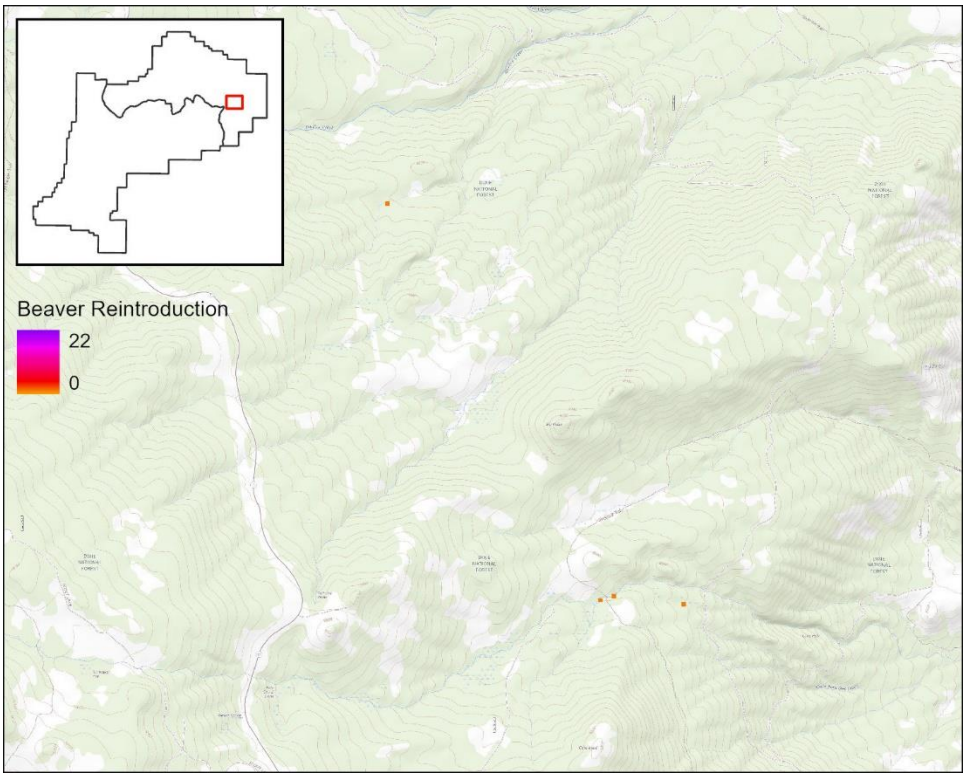
A


Beaver Reintroduction
22
0

B


Beaver Reintroduction
22
0
UTAH

C



D

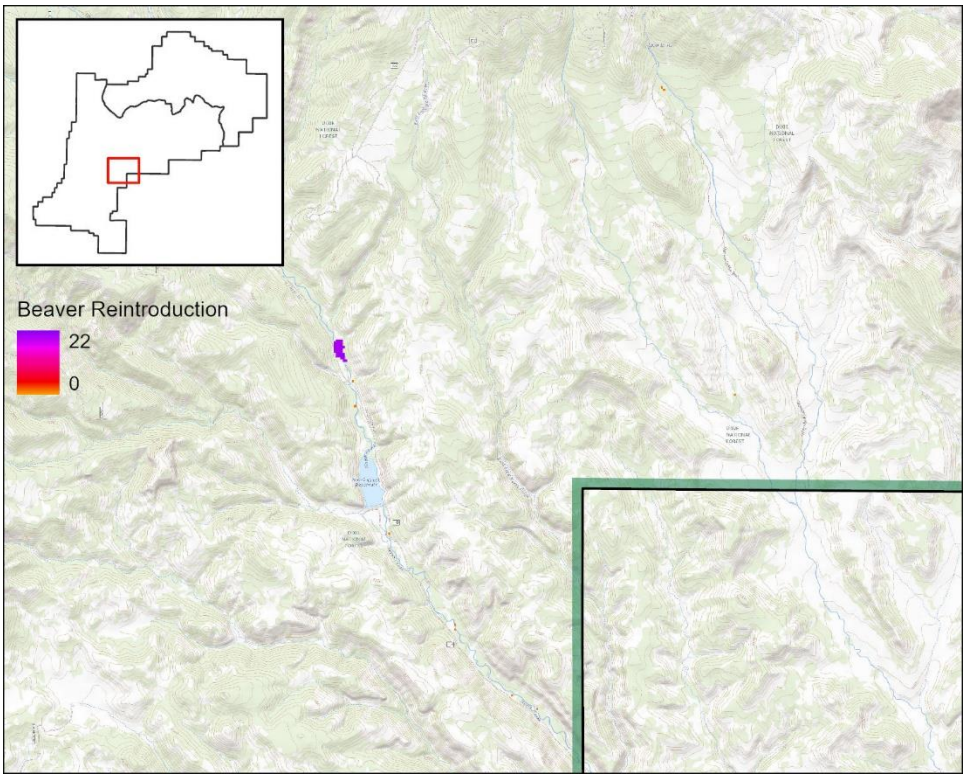


Figure 38A-D. Mapped frequency (number of events) of beaver-reintroduction per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Chainsaw followed by pile burning was used in several forested systems (aspen woodland, aspen-mixed conifer, aspen-spruce-fir, ponderosa pine-mesic) but was used sparingly because of the high cost of pile burning (Fig. 39). As a result, use was scattered at low frequency across the upper montane and subalpine elevations (Fig. 39).

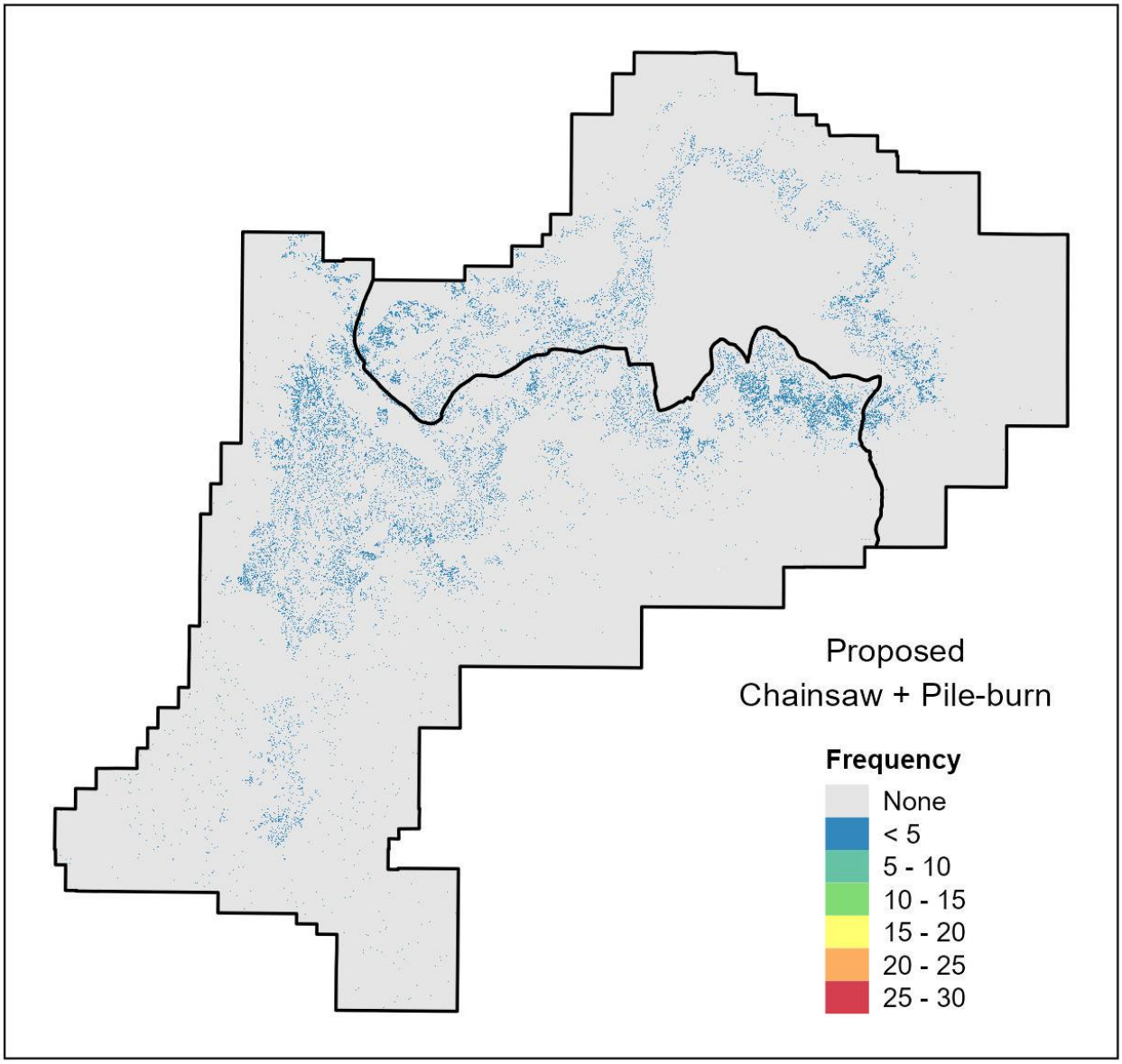
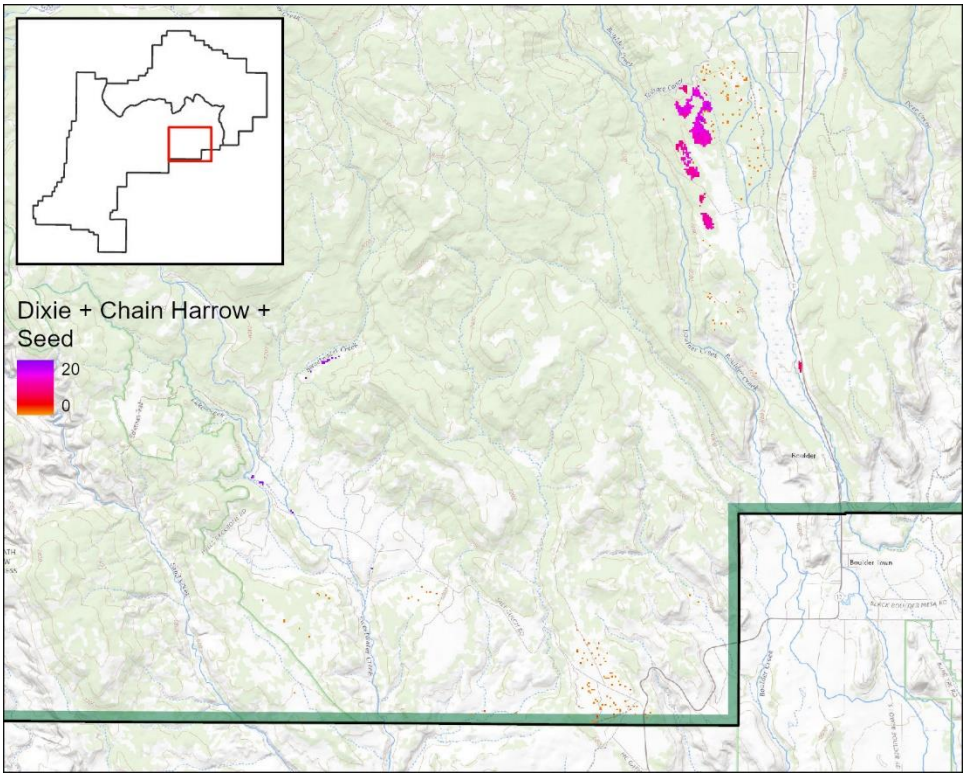


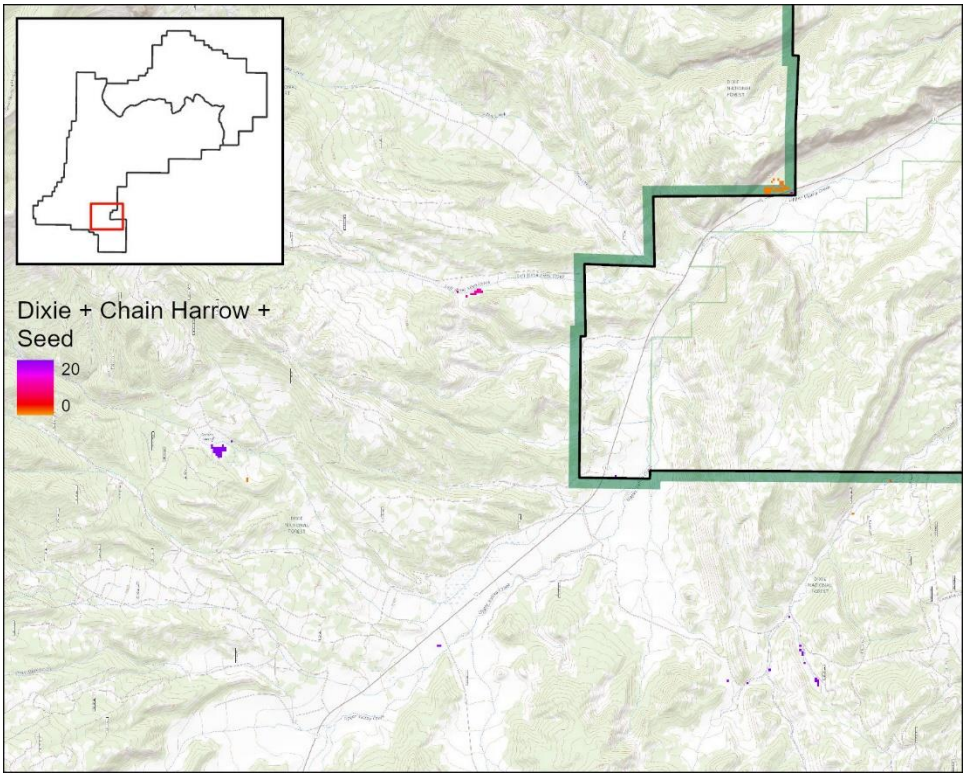
Figure 39. Mapped frequency (number of events) of chainsaw followed by pile burning per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Driving a tractor-pulled Dixie or chain harrow followed by seeding was only used in basin big sagebrush and big sagebrush-upland. Larger concentrations of implementation were in the Boulder Creek area and on the western boundary between Proctor Creek and Big Hollow (near Hatch; Fig. 40). Other smaller patches will be more visible with GIS.

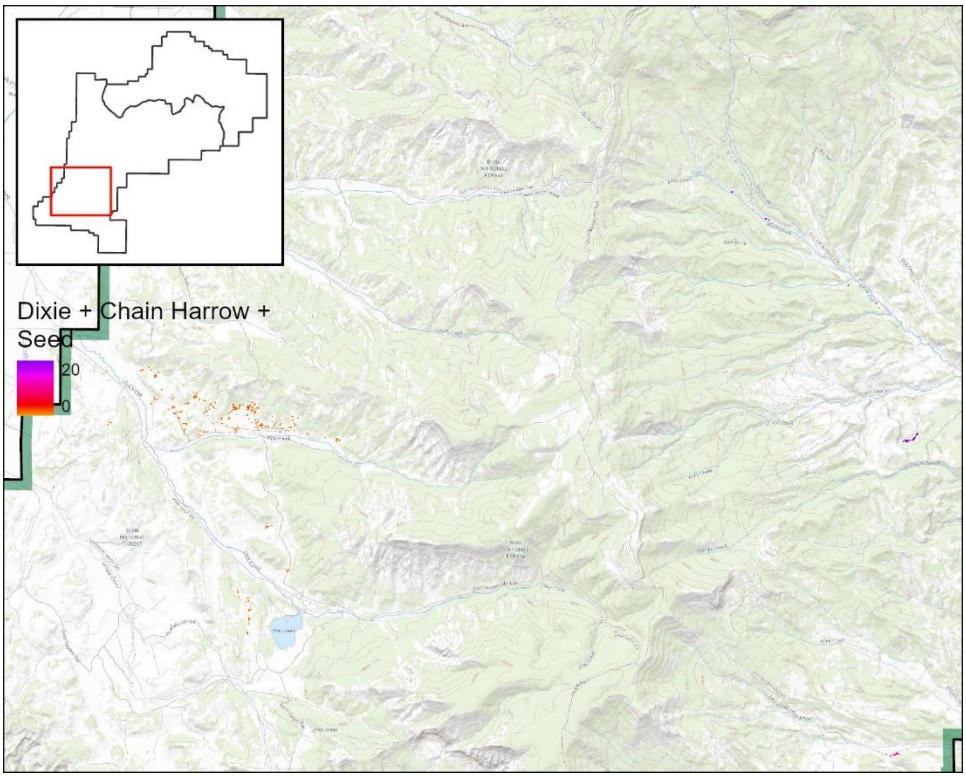
A



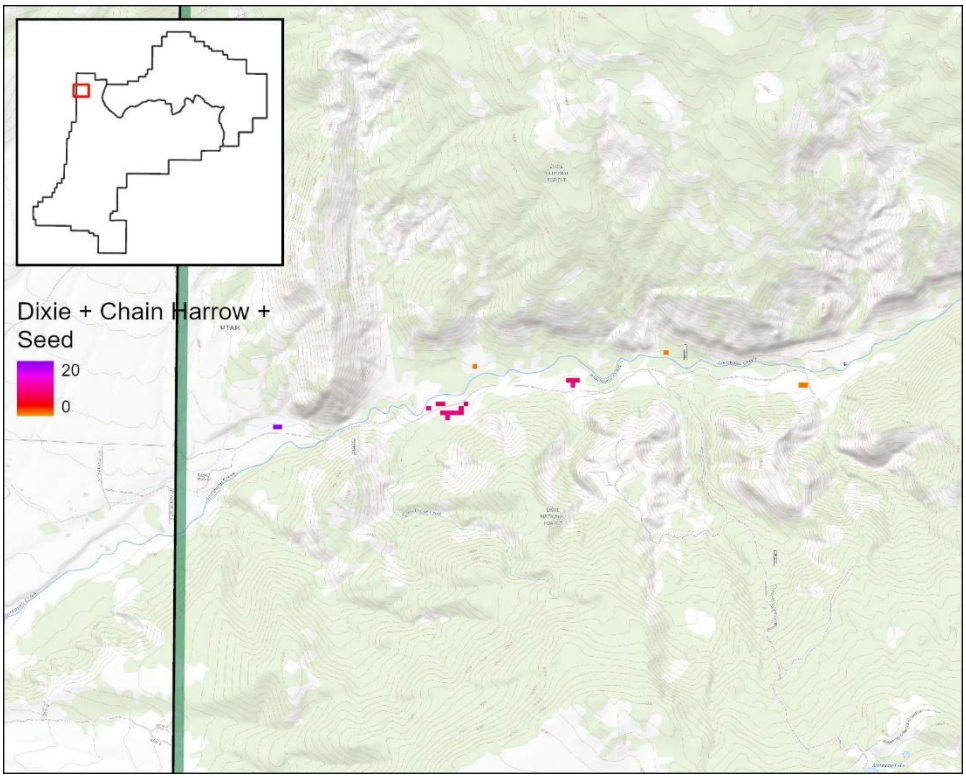
B



C



D



E

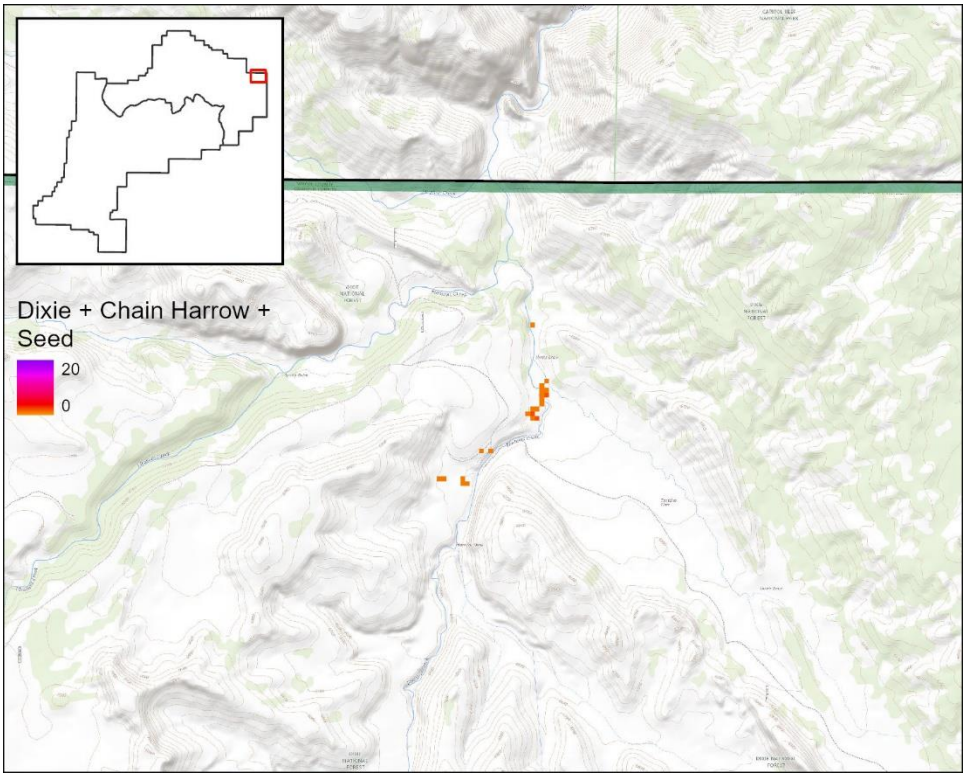


Figure 40A-E. Mapped frequency (number of events) of Dixie or chain harrowing following by seeding per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Exotic species control was speckled throughout the AOI's wet systems (Fig. 41). It is critical to note that many exotic species occurrences were simulated future invasions in areas where exotic forbs and trees might be absent in 2021. To find where exotic species were mapped in 2021, the reader should view the 2021 ecological system and class map layers at 15m resolution in GIS.

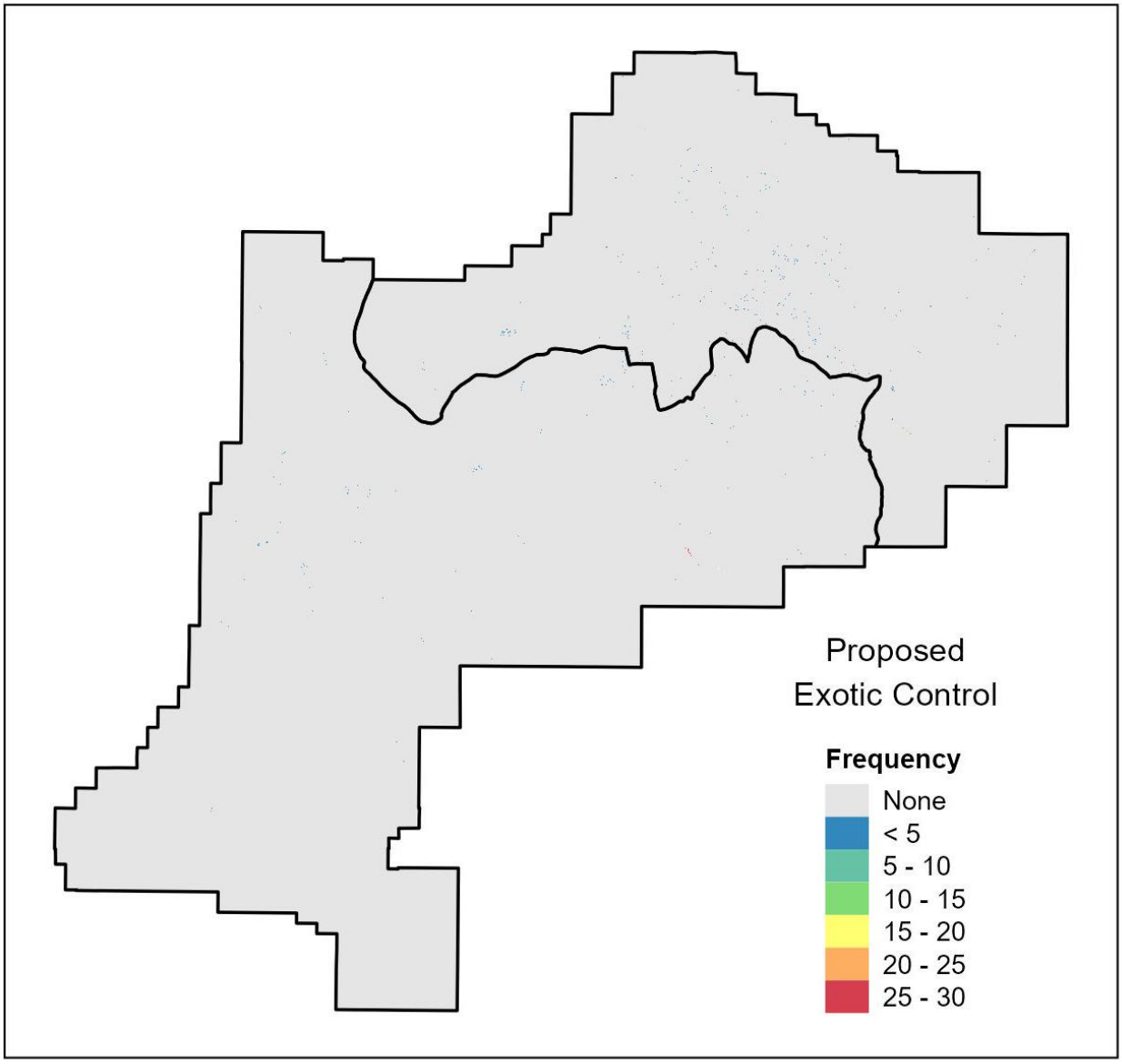


Figure 41. Mapped frequency (number of events) of exotic species control with herbicides per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Merchantable tree harvesting with feller-bunchers was widespread and frequently used (Fig. 42). All aspen types, except woodland, and both ponderosa pine systems were treated at high rates with feller-bunchers within 1,800 ft (549m) of existing passable roads.

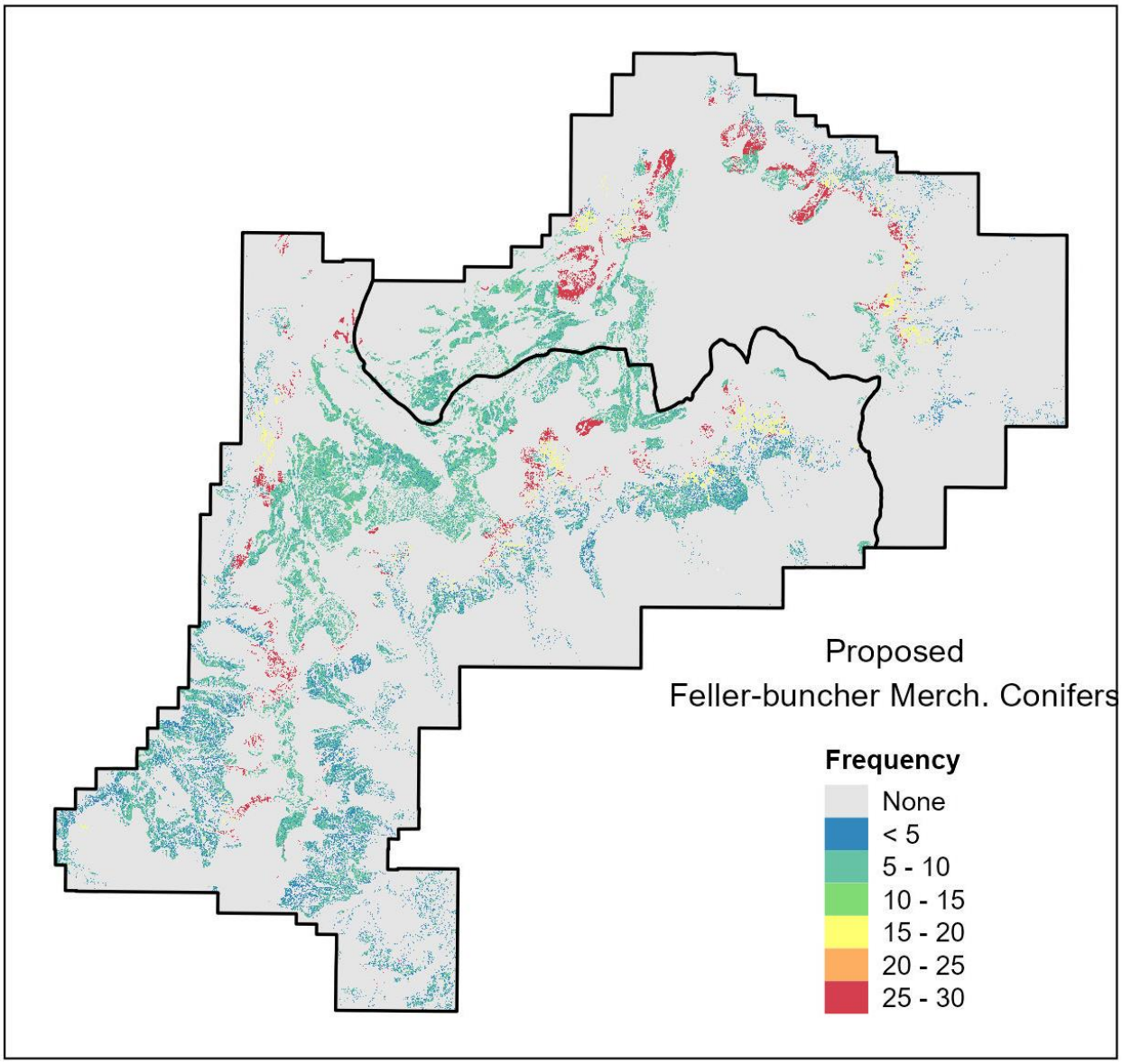


Figure 42. Mapped frequency (number of events) of feller-buncher logging of merchantable trees per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

The frequency map of non-merchantable tree harvesting with feller-bunchers was misleading for location because this project did not map subalpine fir trees (Fig. 43). This raster might be a good indicator of area treated, however, but we do not recommend its use.

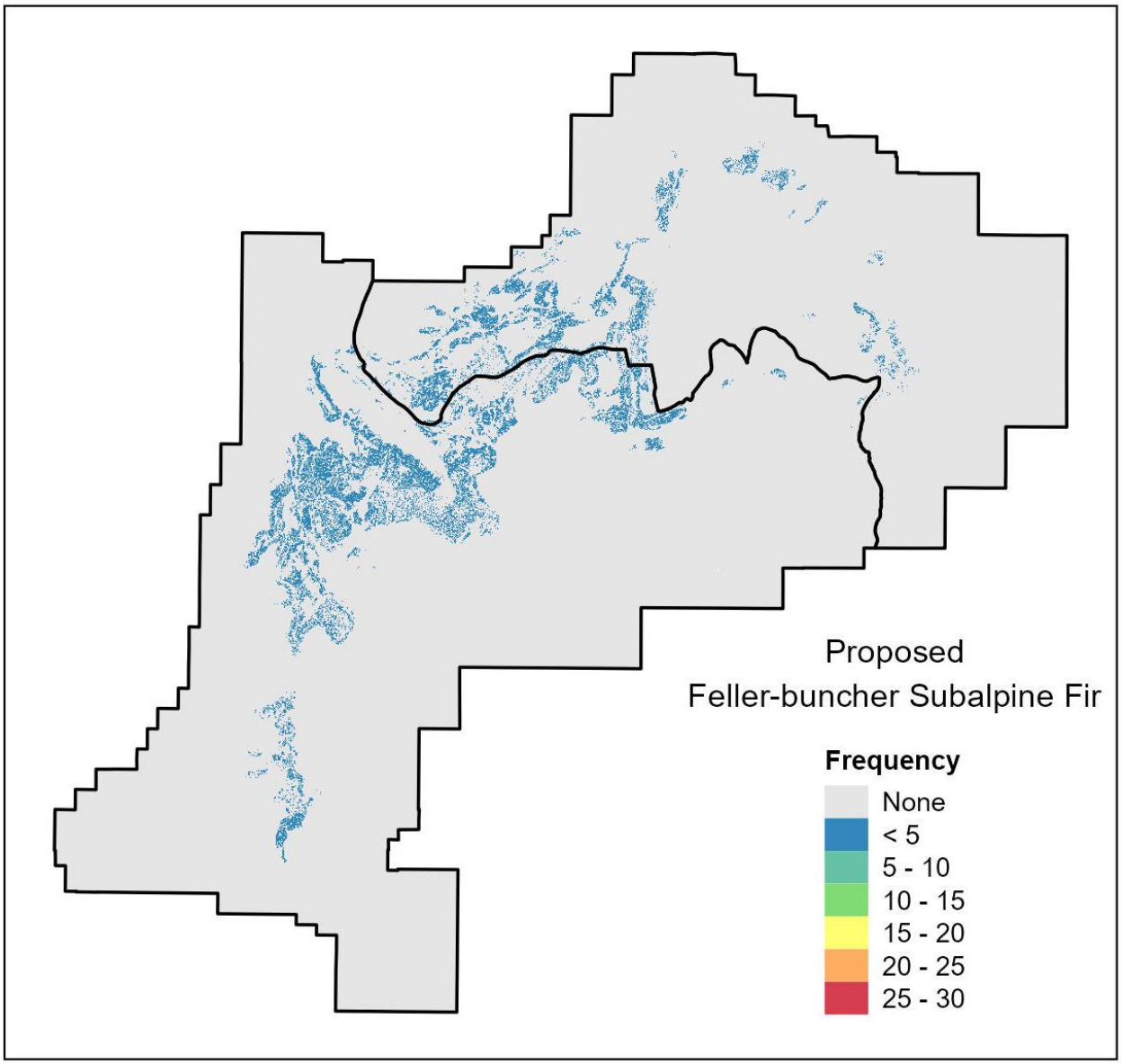


Figure 43. Mapped frequency (number of events) of feller-buncher logging of non-merchantable trees per map pixel on Boulder Mountain. This map is not accurate because the location of subalpine fir was not mapped. The maximum possible frequency across 25 years and20 replicates was 25 × 20 = 500 events.

Fences were placed in hummocked vegetation of montane riparian and wet meadows (montane and subalpine) that were often located in the northern part of the AOI straddling the Fremont River and Escalante Ranger District boundary (Fig. 44). Many smaller occurrences were found throughout the AOI. The reader should be cautioned that many fences were located to protect future simulated hummocked vegetation. The location of currently hummocked classes can be viewed in the 2021 ecological system and class map layers at 1m resolution in GIS.

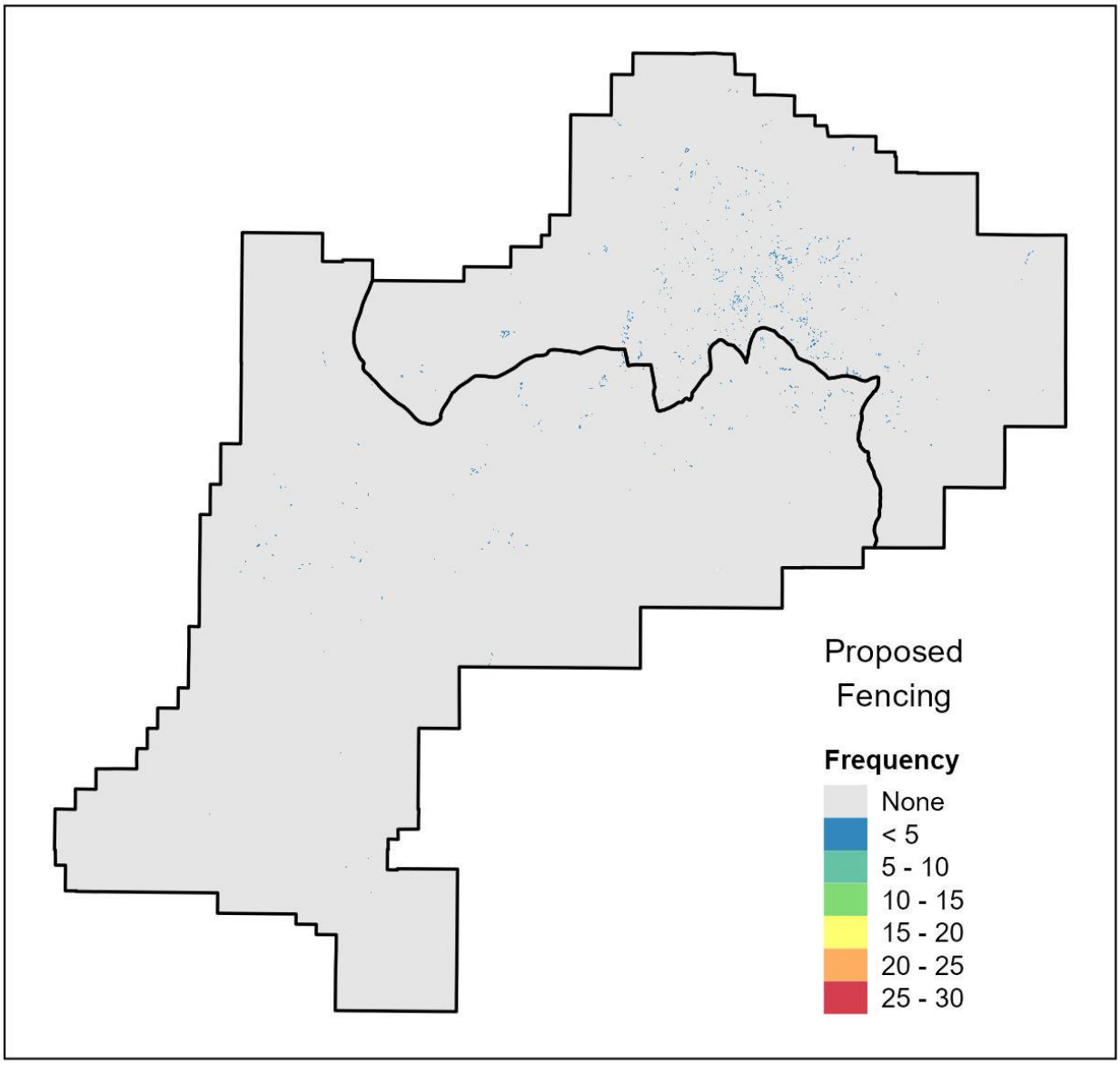


Figure 44. Mapped frequency (number of events) of fencing per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events

Lopping and scattering of trees, primarily pinyon and juniper, was widely used as a cost-effective action applied mostly in the outer, eastern, and lower elevation ring of the AOI (Fig. 45). The systems receiving the greatest proportion of this action were big sagebrush-mountain and mountain shrub, although basin big sagebrush, montane riparian and both wet meadow systems were smaller recipient of the action.

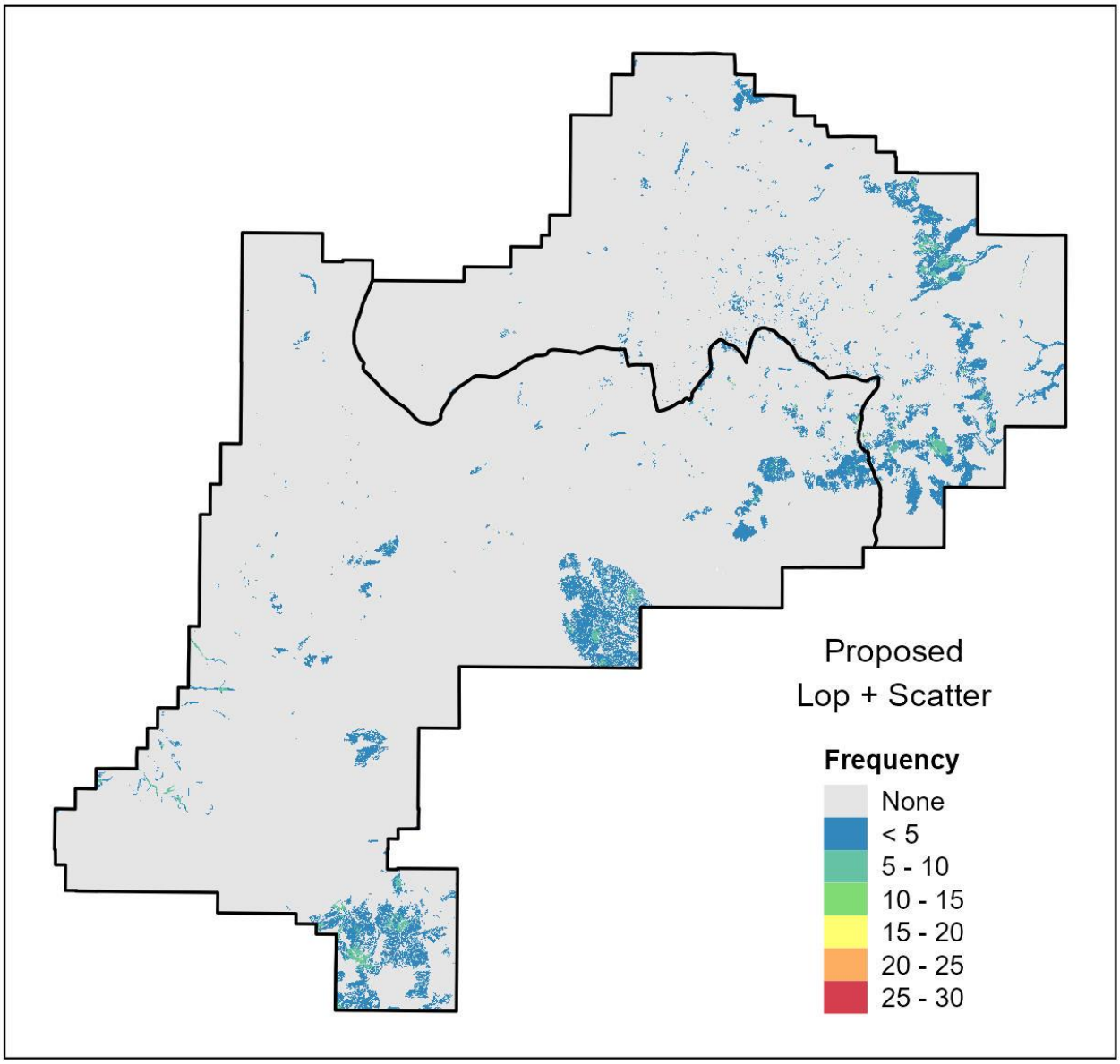


Figure 45. Mapped frequency (number of events) of lopping and scattering trees per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Lopping and pile burning of trees, primarily pinyon and juniper, was rarely used due to the high cost of pile burning (Fig. 46). Only big sagebrush-upland received this action and GIS should be used to map this action.

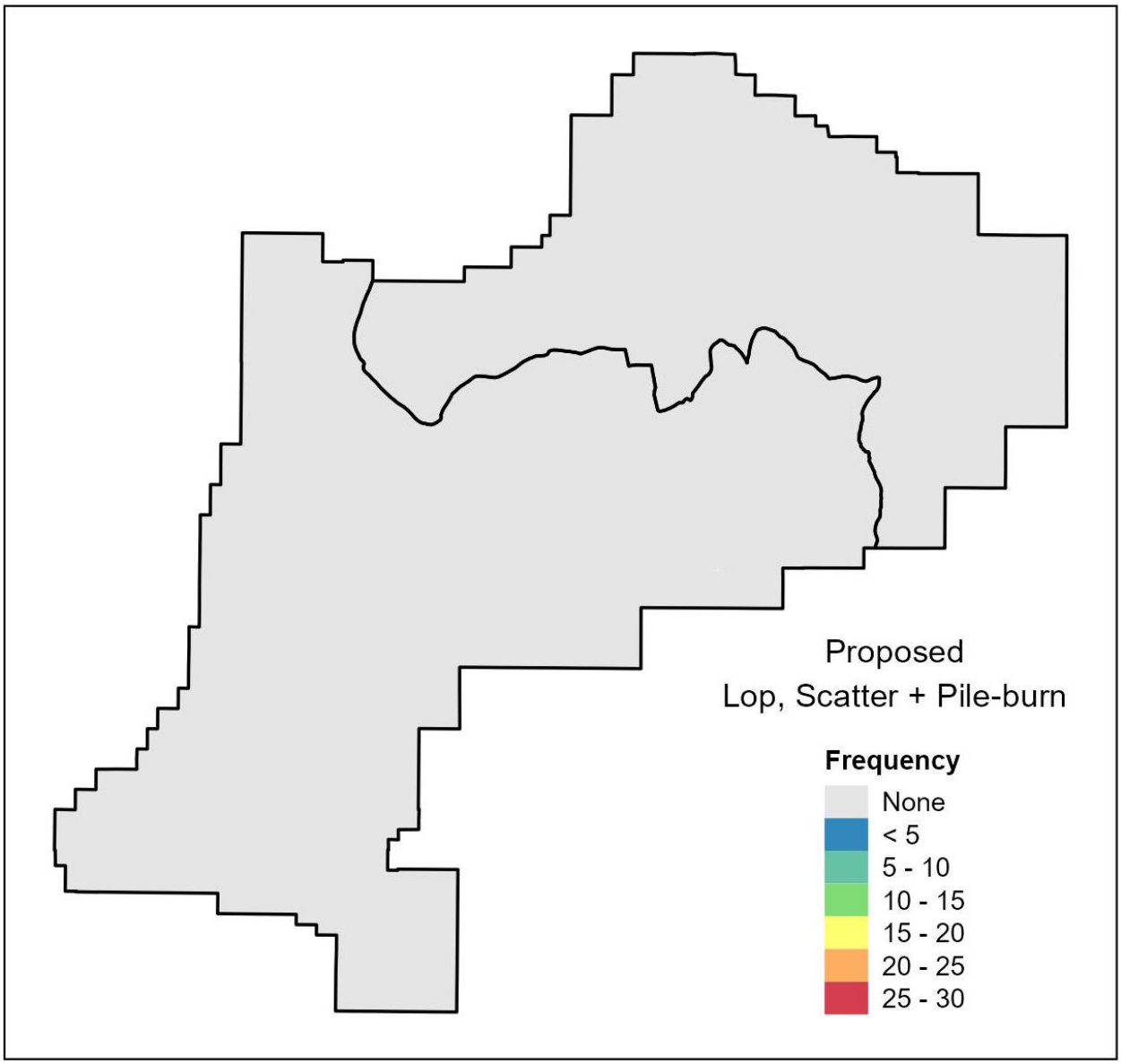


Figure 46. Mapped frequency (number of events) of lopping and pile burning trees per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Mastication of pinyon and/or juniper followed by seeding (herbicide is optional) was widespread and a dominant activity in shrublands that substantially contribute to mule deer habitat (Fig. 47). Its implementation was primarily in the lower and mid-elevation sections of the AOI. Masticators also required road access by lowboy trucks.

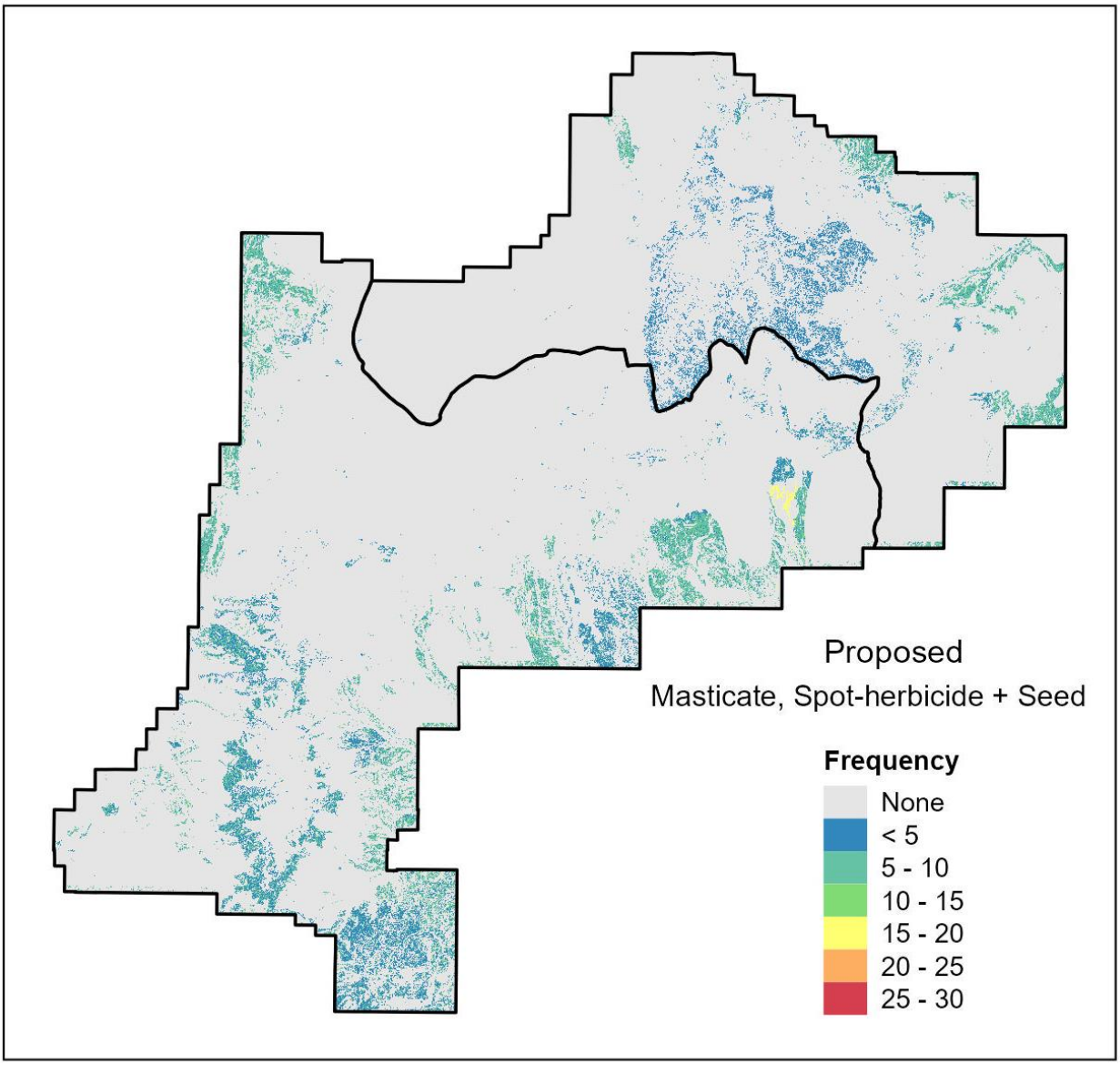


Figure 47. Mapped frequency (number of events) of mastication followed by optional herbicide spraying for annual species and seeding per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Prescribed fire (excluding pile burning) was repeatedly used in ponderosa pine (dry and mesic) and all aspen systems, especially in out years (Fig. 48). Because these systems cover a high proportion of the AOI, prescribed fire also covered much of the AOI. Not surprisingly, ponderosa pine overlapped with the highest frequencies of this action.

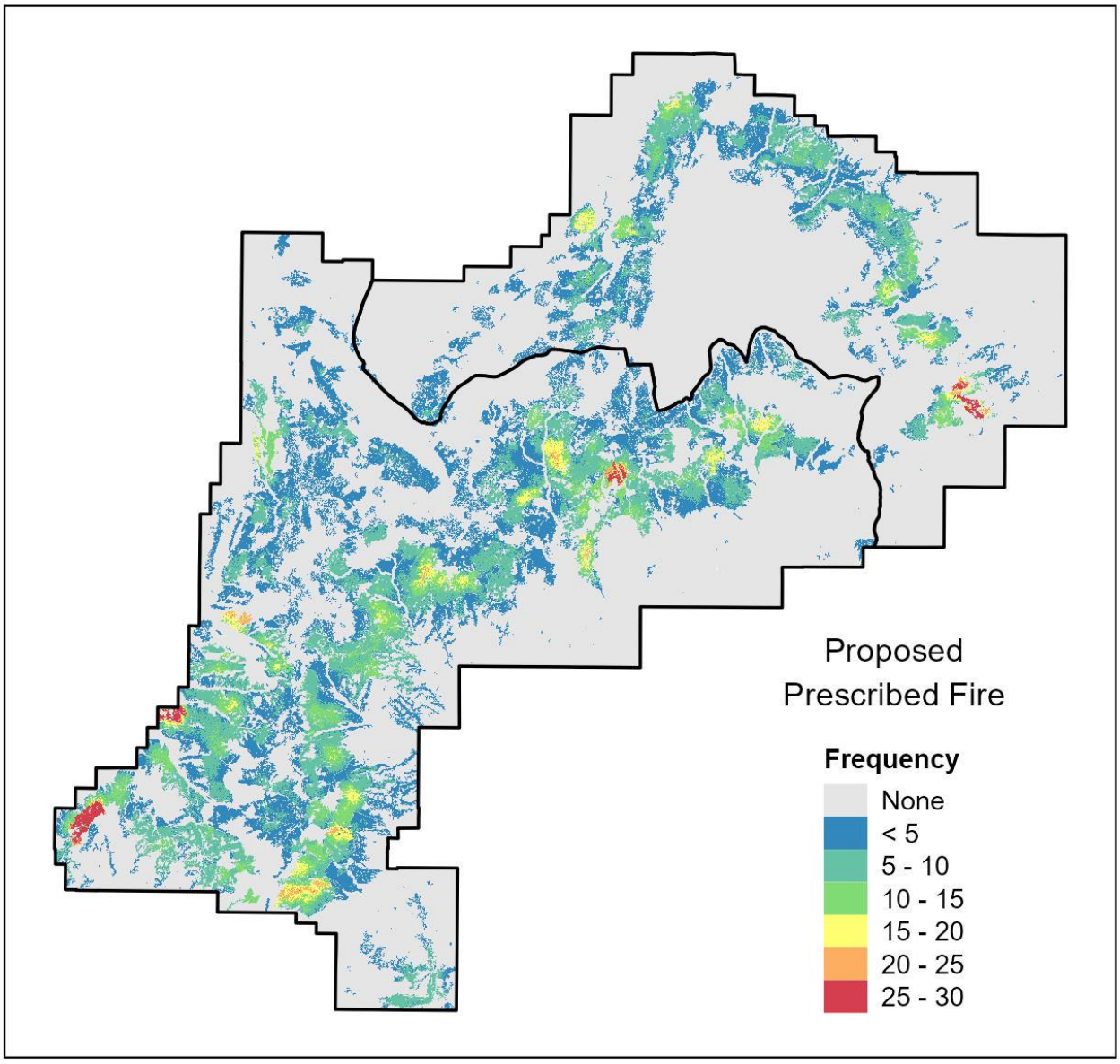


Figure 48. Mapped frequency (number of events) of broadcast prescribed fire per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

Small-tree lopping was inexpensive and commonly used for small trees in shrubland reference vegetation classes where seeding or herbicide spraying generally were not required (Fig. 49). The three systems receiving this action were big sagebrush-mountain, big sagebrush-upland, and mountain shrub.

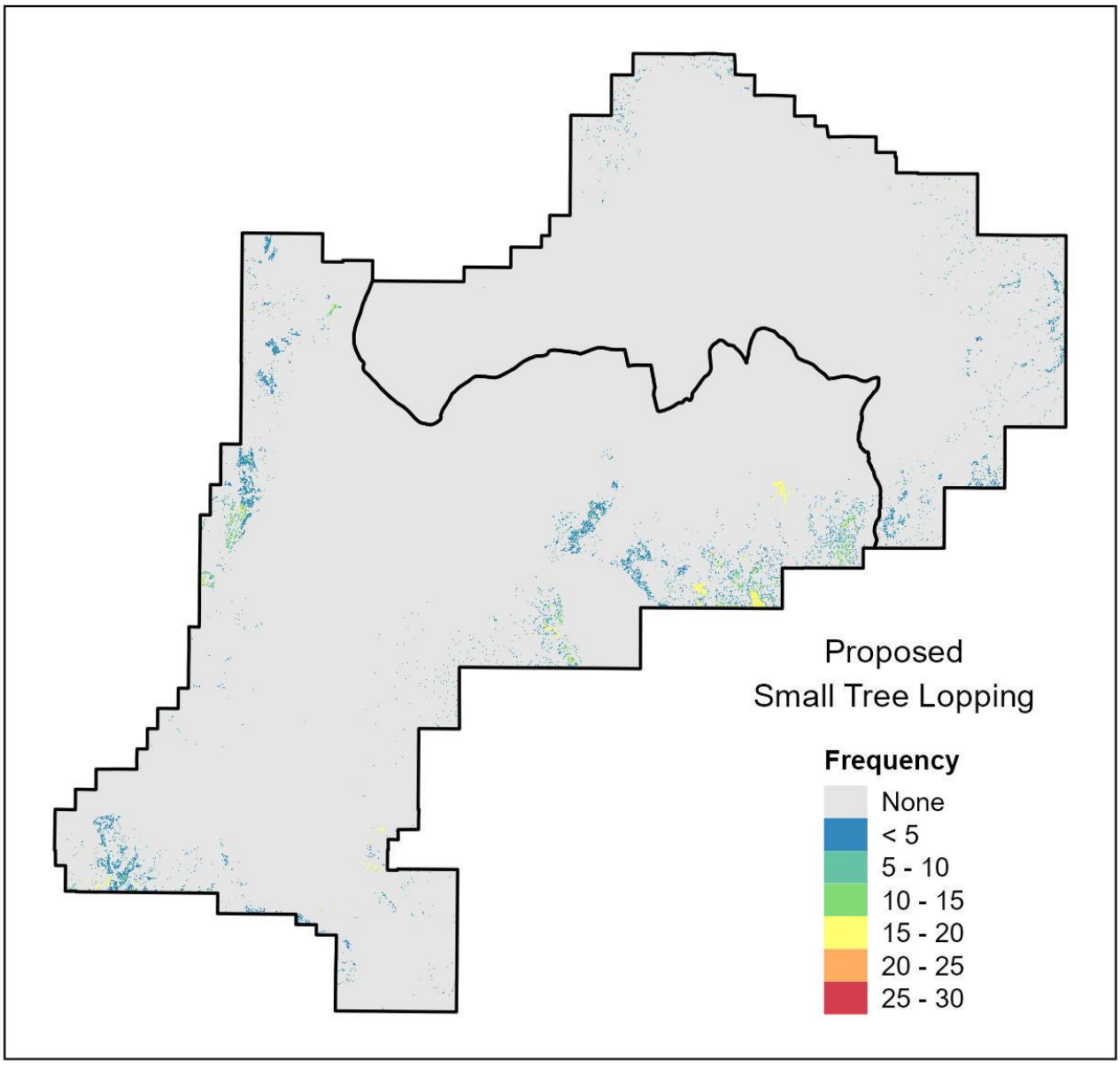


Figure 49. Mapped frequency (number of events) of small tree lopping per map pixel on Boulder Mountain. The maximum possible frequency across 25 years and 20 replicates was 25 × 20 = 500 events.

4. Conclusions

Restoration objectives for Boulder Mountain were straightforward; reduce departure from reference conditions, improve mule deer habitat, and maintain forest and recreational economic activities (Table 7). The restrictions placed on land uses complicated the realization of these objectives (Fig. 8). Furthermore, the annual total management budget could not exceed $1,500,000 and was expected to be at least $1,000,000 annually, which was achieved (Fig. 37).

An important conceptual limitation to the objective of reducing ecological departure from reference conditions was the use of introduced grass species for restoration. In addition, historic seedings of introduced grass species were found everywhere grass could be seeded in shrublands, aspen and ponderosa pine forests, and wet systems. With traditional ecological departure (ED; Eq. 2), this type of seeding would maintain departure (i.e., show no improvement) as only native species seedings that matured into reference vegetation classes could count towards reduced departure from reference conditions. This project, however, used unified ecological departure (UED; Eq. 3) and specified an introduced species seeding threshold of 45% distributed successionally among seeded classes to allow for historic legacies without penalty and allow for measurable improvement in system not already completely dominated by introduced species. In other projects, the management threshold was 10% (Provencher and others 2021a). The Nature Conservancy encouraged USFS and the WRI to consider native grass species in *all* future seedings when elevation favors a high success rate. Only big sagebrush-mountain was simulated with all new native species seedings (Fig. 21).

All systems improved for target vegetation classes with proposed actions compared to Custodial management; however, not all systems showed a reduction in UED compared to Custodial management because they remained dominated by seeded introduced grass species, retained too much area in a depleted condition even after treatment because of resource management constraints (funding, regulatory, and physical), or not enough funding was available to meaningfully reduced the area of extensive uncharacteristic classes:

- Management in the following systems achieved lower UED compared to Custodial management; aspen-spruce-fir, big sagebrush-upland, and wet meadow-montane. These systems had in common that the resources devoted to them were large *relative* to their size and previously under-represented reference classes increased following restoration.
- In many other systems with extensive focal vegetation classes targeted for treatment simply had too much area left untreated, thus there were minor UED differences between the Custodial and Proposed management scenarios after 25 years although mule deer habitat likely improved by thousands of acres. Perfect shrubland examples of this outcome were big sagebrush-mountain and mountain shrub where, respectively, 10,000 and 7,000 acres (4,047 and 2,833 ha) of tree-encroached shrublands were treated but 70,000 and 40,000 acres (28,328 and 16,187 ha) were not treated because of funding and other constraints (Figs. 21, 23). These last two numbers would overwhelm any departure metric, but a mule deer habitat suitability model would likely show improvement. For aspen woodland and aspen-mixed conifer, respectively, 1,000 and 12,000 acres (405 and 4,857 ha) were treated, but 15,000 and >20,000 acres (6,070 and 8,094 ha) of late-

successional aspen-mixed conifer, of which 10,000 acres (4,047 ha) were depleted in aspen-mixed conifer, remained standing Figs. 11, 13). Depleted aspen classes carried higher penalties than "neutral" uncharacteristic classes in the UED equation; therefore, such large areas of depleted aspen classes would cause high levels of departure.

- In a few systems, simulated restoration actions resulted in introduced species seedings that simply added uncharacteristic class area to systems with historic introduced species seedings. These systems were basin big sagebrush, big sagebrush-upland, and mountain shrub; all would be used by mule deer (Figs. 21, 23, 27). To address historic seedings of introduced species and their potential benefits to wildlife, partners chose a 45% penalty-free threshold for introduced species seedings (i.e., UED is neutral to those vegetation classes up to 45% but any new such seedings directly contribute to departure). An added complication was that the 45% threshold of seeded area had to follow the same successional distribution as found among reference successional classes, i.e., all seeded classes could not all be in the early-successional phase (U-A:SI). By year 2046, UED did not change because no reference classes were added to the total area already above the 45% threshold of introduced species seedings. Many introduced species seedings also were not well distributed among successional classes, an additional cause of departure.
- Both ponderosa pine systems and wet meadow-subalpine were dominated by classes also dominant in the reference conditions; therefore, UED was not expected to be substantially different between the Custodial and Proposed management scenarios (Figs. 29, 31, 35). However, operations *maintained* the canopy open of ponderosa pine dry and mesic and generated timber revenues.
- The Montane riparian's treatments effectively accomplished the reduction of uncharacteristic classes, especially incised classes. However, we were puzzled that ecological departure substantially deteriorated over time in <u>both</u> scenarios. This system was an interesting example not frequently encountered where the non-spatial and spatial reference conditions substantially diverged because of the combination of flooding and, especially, fire. In non-spatial simulations as conducted here to estimate the reference condition and calculate ecological departure, fire cannot spread from adjacent systems as such a process would require spatial dynamics (Daniel and others 2016; Provencher and others 2016b); therefore, the fire within the riparian system was that specified from internal dynamics in the model's pathways, which was about a 150 year mean fire return interval because we assumed the surrounding vegetation would be dominated by pinyon-juniper. It was not as ponderosa pine was more prevalent. In spatial simulations, fire touches the riparian system from internal dynamics as above (i.e., 150-year MFRI) and from importation of fires that start elsewhere and traverse the riparian system with normal fire spread (Daniel and others 2016; Provencher and others 2016b). In our spatial simulations, fire from fire-dependent systems, such as ponderosa pine and mixed conifers with or without aspen, was the dominant source of fires and completely changed the balance of successional processes of flooding and fire, therefore the underlying reference dynamics. Therefore, the reader should take in advisement that the riparian system's ecological departure values in years 2021 and 2046 might be inaccurate because the reference condition was not spatial. One solution to this issue would require a more

complicated simulation and calculation of spatial reference conditions, which we coded for the development of a new spatially explicit and stochastic ecological departure (but not yet unified ecological departure) metric (Provencher and others, *in review*).

While it was harder to demonstrate reduction of UED despite obvious changes in vegetation classes, simulations did achieve the very desirable partner-defined goal of widely spreading actions to dilute detrimental herbivory effects everywhere, but especially in aspen forests. Several highly used treatments were scattered all over Boulder Mountain in aspen forests and shrublands, such as cutting trees with chainsaws followed by pile burning (Fig. 39), feller-buncher operations (Fig. 42-43), lopping and scattering of young trees (Fig. 45), mastication of pinyon and juniper followed with optional herbicide spraying and required seeding (Fig. 47), prescribed broadcast burning (Fig. 48), and small-tree lopping (Fig. 49). To estimate grazing pressure on young aspen classes, we calculated the area of native browsing in all four aspen forest types divided by the area of early- and mid-successional reference and depleted aspen classes per management scenario. We found substantially less grazing pressure (smaller ratio) in the Proposed management than the Custodial management scenario (Table 37). Not only did treatments reduce browsing pressure on young aspen, the area of native browsing, presumably the mule deer population size, increased by about 12,000 acres (Table 37). We believe this was an important outcome of this project.

Table 37. Ratio of area browsed by native herbivores in all four aspen forests divided by the area of early- and mid-successional reference and depleted aspen vegetation classes and area of native browsing in all aspen forest types (acres). N = 20 replicates.

	Custodial Average ± 95% C.I.	Proposed Average ± 95% C.I.
Ratio	2.25 ± 0.06	1.55 ± 0.01
Area of Native Browsing (acres)	91,368 ± 809	103,875 ± 356

One of the guiding objectives for the management of Boulder Mountain natural resources was “Maintain or improve watershed integrity and hydrologic function to protect and benefit aquatic resources and water quality” (Table 7). Our simulations were not coupled to sedimentation and hydrologic models nor were results post-processed to estimate sedimentation and changes to runoff as an outcome of management scenarios. However, we did upload in the Syncrosim database a spatial riparian buffer that prevented prescribed fire next to waterways; therefore, minimizing sedimentation. Also, the various ephemeral “Char” classes in the state-and-transition simulation models, which would be a source of sediment after high-severity fires during summer storm events (Badik and others 2022), never reached even small area values in part because fires were not large on Boulder Mountain. Should the US Forest Service or the Utah Division of Wildlife Resources want to study forecasted fire effects on sedimentation and the endangered Colorado River cutthroat trout, the current version of the model is already set up to estimate sedimentation through the “Char” vegetation classes in

each applicable system. Additional external modeling would be required to estimate sedimentation risk.

5. Acknowledgments

We thank Utah's Watershed Restoration Initiative for funding (contracts WRI #5810 & #6121). Jeff Campbell at Spatial Solutions Inc. conducted remote sensing field work with TNC staff and analysis. We are especially grateful for support and shared expertise from Kurt Robbins (USFS), Terry Delay (USFS), and Garry Bezzant (UDWR). The USFS provided a conference room in Escalante. The following agency natural resources specialists and managers, and partners participated in both workshops and shared valuable information: Joel Tuhy, Richard Hepworth, Mayson Southwick, Kent Chappell, Kurtis Robins, Terry DeLay, Buck Ehler, Rhianna James, Daniel Child, Maggie Toone, Jeremy Keys, Mike Elson, Jason Cox, Daniel Eddington, Brooke Shakespeare, Mike Golden, Shane Woolsey, Jana Caliebe, Alexandria Robinson, Teresa Griffin, Erica Wightman, Jason Lane, Evando Vega, Jim Lamb, Lisa Young, Kevin Bunnell, Gary Bezzant, Chance Stewart, Morgan Hinton, Jason Cling, Kelley Hart, Evan DeHamer, Devin McHugh, Charles Chamberlain.

6. Literature Cited

Badik KJ, Wilson C, Kampf S, Saito L, Provencher L, Byer S, Hazelwood M. 2022. A novel approach to estimating soil yield risk in fire prone ecosystems. Forest Ecology & Management 505: 119887. https://doi.org/10.1016/j.foreco.2021.119887

Beguería S, Vicente-Serrano SM. 2017. SPEI: Calculation of the Standardized Precipitation-Evapotranspiration Index. R package version 1.7. <URL https://CRAN.R-project.org/package=SPI>.

Comer P, Tuhy J, Esselman R. 2006. Scenario Building in the Utah High Plateaus Ecoregion. Case Study in Ecoregion Assessments and Biodiversity Vision Toolbox. The Nature Conservancy.

Daniel CJ, Frid L, Sleeter BM, Fortin M-J. 2016. State-and-transition simulation models: a framework for forecasting landscape change. Methods Ecol Evol 7:1413–1423 doi: 10.1111/2041-210X.12597

Hayes MJ, Svoboda MD, Wilhite DA, Vanyarkho OV. 1999. Monitoring the 1996 drought using the standardized precipitation index. Bulletin of the American Meteorological Society 80:429-438.

Low G, Provencher L, Abele SL. 2010. Enhanced conservation action planning: Assessing landscape condition and predicting benefits of conservation strategies. Journal of Conservation Planning 6:36-60

Provencher L, Anderson T., Badik K., Cameron M., Munn L., Welch N. 2016a. Sage-grouse conservation forecasting for Newmont Mining's IL and TS-Horseshoe Ranches. Final report by The Nature Conservancy in Nevada to Newmont Mining Corp., Elko, NV. The Nature Conservancy, Reno, NV.

Provencher L, Anderson T, Low G, Hamilton B, Williams T, Roberts B. 2013. Landscape Conservation Forecasting™ for Great Basin National Park. Park Science 30: 56-67.

Provencher L, Badik K, Anderson T, Munn L, Cameron M. 2017. Sage-Grouse conservation forecasting for Barrick's Bank Study Area and Deep South Expansion Projects Plan of Operations Study Area. Report by The Nature Conservancy in Nevada to Barrick Gold Corp., Elko, NV, Version 1.0. The Nature Conservancy, Reno, NV

Provencher L, Badik K, Anderson T, Tuhy J, Fletcher D, York E, Byer S. 2021a. Landscape conservation forecasting for data-poor at-risk species on western public lands, USA. Climate 9, 79. https://doi.org/10.3390/cli9050079

Provencher L, Badik K, Anderson T, Tuhy JS, York E. 2018. Application of climate variability forcing effects to Landscape Conservation Forecasting™ for Hamlin Valley and Black Mountains Supplemental Report to Bureau of Land Management, Cedar City Field Office in partial fulfillment of Cooperative Agreement No. L16AC00162. The Nature Conservancy, Nevada and Utah Field Offices. 161 p.

Provencher L, Badik K, Anderson T, Tuhy J, York E. 2019. Landscape Conservation Forecasting™ Pine Valley and Mountain Home Range. Report to Bureau of Land Management, Cedar City Field Office in partial fulfillment of Cooperative Agreement No. L16AC00162. The Nature Conservancy, Nevada and Utah Field Offices. 231 p.

Provencher L, Byer S, Badik K, Clifford M. *in review*. Measuring Spatially explicit and stochastic ecological departure. International Journal of Wildland Fire.

Provencher L, Byer S, Badik K, Tuhy J. York E. 2021b. Landscape Conservation Forecasting™ for the Indian Peak Range, Pine Valley, and Mountain Home Range Project. Report to the Utah Division of Wildlife Resources in partial fulfillment of contract No. 191715 and to the Bureau of Land Management, Cedar City Field Office in partial fulfillment of Cooperative Agreement No. L16AC00162. 126 pages.

Provencher L, Frid L, Czembor C, Morisette JT. 2016b. State-and-Transition Models: Conceptual vs. Simulation Perspectives, Usefulness and Breadth of Use, and Land Management Applications. p 371-407. In: Germino MJ, Chambers JC, Brown CS, editors. Exotic Brome Grasses in Arid and Semi-arid Ecosystems of the Western U.S.: Causes, Consequences and Management Implications. Springer Environmental Series. Zug, Switzerland. 439 pp.

Provencher L, Tuhy J, Green G, York E. Anderson T. 2015. Landscape Conservation Forecasting™ for Hamlin Valley and Black Mountains. Report to Bureau of Land Management, Cedar City Field Office in partial fulfillment of Cooperative Agreement No. L12AC20604. The Nature Conservancy, Nevada and Utah Field Offices. 290 p.

Provencher L, Tuhy J, York E, Green G, Anderson T. 2011. Landscape Conservation Forecasting™ for Washington County's National Conservation Areas. Report to the St. George Field Office, Bureau of Land Management, St. George, UT. The Nature Conservancy, Nevada and Utah Field Offices. 297 p.

Verdin A, Rajagopalan B, Kleiber W, Katz RW. 2014. Coupled stochastic weather generation using spatial and generalized linear models. Stochastic Environmental Research and Risk Assessment. DOI 10.1007/s00477-014-0911-6.

Vincente-Serrano SM, Beguería S, Lopez-Moreno JI. 2010. A Multiscalar Drought Index Sensitive to Global Warming: The Standardized Precipitation Evapotranspiration Index. Journal of Climate 23: 1696-1718.

Appendix 1

Descriptions of Ecological Systems (Biophysical Settings) and their Vegetation Classes
Boulder Mountain, UT

Table of Contents Page

Agriculture 10070 2
Aspen-Mixed Conifer (ASM) 10610 2
Aspen-Ponderosa Pine (APP) 10612 3
Aspen-Spruce-Fir (ASF) 10611 4
Aspen Woodland (ASP) 10110 5
Badland 10002 5
Barren-Rock-Mud (Barren) 10000 6
Basin Big Sagebrush (BBS) 10806 6
Black Sagebrush (BS) 10791 7
Curl-leaf Mountain Mahogany (CMM) 10620 9
Desert Sand Sagebrush (DSS) 10930 10
Desert Wash (DW) 11544 10
Dry Wet Meadow (DWM) 11453 11
Four-wing Saltbush (FWS) 10811 12
Gambel Oak-Mountain Shrub (GOMS) 11070 13
Greasewood-Basin Big sagebrush (GW) 11530 14
Limber-Bristlecone Pine Woodland (LB) 10200 14
Lower Subalpine-Grassland (SLG) 11400 15
Mixed Conifer – Montane (MC) 10520 15
Mixed Conifer – Claron (MCC) 10523 16
Mixed Salt Desert (MSD) 10810 17
Montane Riparian (MR) 11540 18
Montane Sagebrush Steppe-upland (MSS) 11260 19
Mountain Shrub (MS) 10860 21
Pinyon-Juniper Shrubland (PJS) 11020 23
Pinyon-Juniper Woodland (PJ) 10190 23
Ponderosa Pine - dry (PP) 10541 24
Ponderosa Pine - mesic (PP) 10540 25
Pure Spruce (PS) 10561 26
Riparian Blue Spruce (RBS) 11545 26
Roads-Local 10032 27
Roads-Paved 10031 27
Saline Meadow (11451) 27
Seep (11546) 28
Semi-Desert Grassland (SDG) 11350 28
Silver Sagebrush (SS) 11262 29
Sparsely Vegetated (Sparse) 10030 29
Spruce-Fir (SF) 10560 30
Subalpine-Montane Mesic Meadow (MM) 11460 30
Subalpine Upper-Montane Riparian (SR) 11600 31
Upper Subalpine Grassland (USG) 11401 31
Water 10040 31
Wetland (WTL) 11543....32
Wet Meadow-montane (WM) 11450 32
Wet Meadow-Subalpine (WMS) 11455 33
Wyoming Big Sagebrush Shrubland-upland soils (WS) 10804 34

Agriculture 10070	*Overview*: Agricultural lands and obvious irrigated pastures where soils may have been graded or modified.
U-A:Agriculture 100070122	**Agriculture**: Irrigated pastures, crops, alfalfa fields.
Aspen-Mixed Conifer (ASM) 10610	*Overview*: The Aspen-Mixed Conifer BpS is perhaps the most widespread aspen type in Utah and is commonly called "seral aspen." *Populus tremuloides* is the dominant tree species, except in late succession where prolonged fire exclusion and ungulate herbivory allow dominance by mixed conifers, such as white fir and Douglas-fir. The presence of even a single aspen tree in a stand provides strong evidence that the area historically supported aspen clones. This BpS typically occurs on flat to steep terrain (<80%) on all aspects. Elevation generally ranges from 2,135 m to 2,745 m (7,000' to 9,000') in southern Utah. Soils are highly variable, but generally cool. This type occurs above the pinyon-juniper and/or sagebrush zones but below the subalpine spruce-fir zone. Aspen stands that are difficult to "see through" are considered healthy. Shrub, forb, and grass species typical of mesic sites are very diverse and plant cover is very high.
A:All 10610010[1]	**Early-all:** 10-100% cover of aspen <5m tall; mountain snowberry and *Ribes* common; 0-9 yrs.
B:Closed 10610021	**Mid1-closed**: 40-99% cover of aspen 5-10m tall; mountain snowberry and *Ribes* common; 10-39 yrs.
C:Closed 10610030	**Mid2-closed**: 40-99% cover of aspen 10-24m tall; conifer visible in mid-story <8" DBH; mountain snowberry and *Ribes* common; 40-79 yrs.
D:Open 10610042	**Late1-open**: 10-39% cover of aspen 10-25m tall; 10-25% cover of mixed conifer, 8-19" DBH, 5-10m tall; mountain snowberry and *Ribes* common; >80 yrs.
E:Closed 10610050	**Late1-closed**: 40-80% cover of mixed conifer ≥20" DBH, 10-50m tall; <40% cover of aspen 10-25m tall; mountain snowberry and *Ribes* present; >100 yrs.
U-A:Depleted 10610103	**Early-depleted:** <10% cover aspen <4.9m; 0-40% cover of mixed conifer variously thinned by fire or mechanical thinning with tree height ranging from bole-size to mature trees; woody debris often abundant mountain snowberry and *Ribes* common; 0-9 yrs

[1] Remote Sensing code (geotiff code)

U-B:Depleted 10610203	**Mid1-depleted**: <40% cover aspen 5-9.9m; mountain snowberry and *Ribes* common; 0-40% cover of mixed conifer variously thinned by fire or mechanical thinning with tree height ranging from bole-size to mature trees; 10-39 yrs
U-C:Depleted 10610303	**Mid2-depleted**: <40% cover aspen 10-24m; conifer <8" DBH visible in mid-story in addition to remnant mature conifer trees that survived thinning; mountain snowberry and *Ribes* common; 40-79 yrs
U-D:Depleted 10610403	**Late1-depleted**: Aspen and conifer canopy height co-dominant; <10% cover aspen 10-25 m; >40% mixed conifer cover 8-19" DBH; mountain snowberry and *Ribes* common; >80 yrs
U-A:Lost-Aspen (aka: No-ASP) 10610115	**Loss of clone**: Permanent conversion to Mixed Conifer (MC) - 10520; >50% cover of Douglas-fir, white fir and/or limber pine ≥20" DBH; aspen absent or in trace amount; dead aspen boles may be present.
Aspen-Ponderosa Pine 10612	*Overview*: The aspen-ponderosa pine BpS is a special case of aspen-mixed conifer where aspen functions like Aspen Woodland (10110) regardless of the age of ponderosa pine trees. The system is found in the same landforms where ponderosa pine (10540) might be present. The dominant species is aspen (*Populus tremuloides*) with ponderosa pine (*Pinus ponderosa*) codominant. Two parallel successional pathways are hypothesized and modeled: (a) the most likely pathway is where mature ponderosa pines (some >19" DBH) are present during all phases of aspen succession, including the early-successional phase, as they survive fires that top-killed aspen, and (b) the infrequent pathway where both aspen and mature ponderosa pine were top-killed by high-severity fire and new succession restarts dense canopies (i.e., closed canopies) of young aspen and young ponderosa pine. Douglas-fir (*Pseudotsuga menziesii*) might be occasionally present.
A:All 10612010[2]	***Early-all;***: >50% cover aspen <2m; boles of mostly dead standing mature ponderosa pine might be scattered to common after fire; mountain snowberry and *Ribes* common; 0-9 yrs
A:Open 106120513	***Early-open***:>50% cover aspen <2m; boles of live mature ponderosa pine scattered to common after fire; mountain snowberry and *Ribes* common; 0-9 yrs
B:Closed 10612021	***Mid1-closed***: >40% cover aspen 2-10m high; boles of dead standing mature ponderosa pine might be scattered to common after fire; mountain snowberry and *Ribes* common; 10-39 yrs

B:Open 10612022	***Mid1-Open:*** >40% cover aspen 2-10m high; boles of mature ponderosa pine scattered to common after fire; mountain snowberry and *Ribes* common; 10-39 yrs
C:Closed 10612030	***Mid2-open***: >40% cover aspen 10-24m; few boles of dead standing mature ponderosa pine remained from past fire; 10-25% cover of ponderosa pine saplings to bole-size trees <8" DBH for ponderosa pine; mountain snowberry and *Ribes* common; 40-169 yrs
C:Open 10612032	***Mid2-open***: >40% cover aspen 10-24m; boles of mature to older ponderosa pine scattered to common after fire; 10-25% cover of ponderosa pine saplings to bole-size trees <8" DBH for ponderosa pine; mountain snowberry and *Ribes* common; 40-169 yrs
D:Closed 10612040	**Late1:Open**: Aspen and ponderosa pine approximately co-dominate in tree height; 10-30% cover aspen 10-24m; 10-25% cover of ponderosa pine >8" DBH including several >20" DBH that survived the last fire
D:Open 10612042	**Late1:Open**: Aspen and ponderosa pine approximately co-dominate in tree height; 10-30% cover aspen 10-24m; 10-25% cover of ponderosa pine 8-19" DBH, larger trees that survived the last fire are absent to uncommon
E:Closed 10612050	***Late1-closed:*** conifers dominates with trees higher than aspen canopy; >40% cover of larger ponderosa pine, >20" DBH; <10% cover of aspen; mountain snowberry and *Ribes* common;
U-A:Depl-ASP-PIPO 10612114	***Early-depleted-Aspen-PIPO*****:** ≤50% cover aspen <2m; boles of mostly dead standing mature ponderosa pine might be scattered to common after fire; mountain snowberry and *Ribes* common; dead boles of aspen present standing or on the ground; 0-9 yrs
U-A:Depleted 10612103	***Early-depleted*****:** ≤50% cover aspen <2m; boles of mature ponderosa pine might be scattered to common after fire; mountain snowberry and *Ribes* common; dead boles of aspen present standing or on the ground; 0-9 yrs
U-B:Depl-ASP-PIPO 10612214	***Mid1-depleted-Aspen-PIPO*****:** ≤40% cover aspen 2-10m high; boles of mature ponderosa pine scattered to common after fire; dead boles of aspen present standing or on the ground; mountain snowberry and *Ribes* common; 10-39 yrs
U-B:Depleted 10612203	***Mid1-depleted-Aspen-PIPO*****:** ≤40% cover aspen 2-10m high; boles of dead standing mature ponderosa pine might be scattered to common after fire; dead boles of aspen present standing or on the ground; mountain snowberry and *Ribes* common; 10-39 yrs

U-C:Depl-ASP-PIPO 10612314	***Mid2-open***: ≤40% cover aspen 10-24m; boles of mature ponderosa pine scattered to common after fire; 10-25% cover of ponderosa pine saplings to bole-size trees, <8" DBH for ponderosa pine; dead boles of aspen present standing or on the ground; mountain snowberry and *Ribes* common; 40-169 yrs
U-C:Depleted 10612303	***Mid2-open***: ≤40% cover aspen 10-24m; ; few boles of dead standing mature ponderosa pine remained from past fire; 10-25% cover of ponderosa pine saplings to bole-size trees, <8" DBH for ponderosa pine; dead boles of aspen present standing or on the ground; mountain snowberry and *Ribes* common; 40-169 yrs
U-D:Depl-ASP-PIPO 10612414	***Late-depleted-Aspen-PIPO*:** Aspen and ponderosa pine approximately co-dominate in tree height; ≤10% cover aspen 10-24m; 10-25% cover of ponderosa pine >8, including several >19" DBH that survived the last fire; dead boles of aspen present standing or on the ground
U-D:Depleted 10612403	***Late-depleted*:** Aspen and ponderosa pine approximately co-dominate in tree height; ≤10% cover aspen 10-24m; 10-25% cover of ponderosa pine 8-19" DBH; dead boles of aspen present standing or on the ground
U-A:Lost-Aspen (aka: No-ASP) 10612115	***Loss of Clone***: >50% ponderosa pine cover; aspen absent or in trace amount; dead aspen boles may be present
Aspen-Spruce-Fir (ASF) 10611	*Overview:* The Aspen-Spruce-Fir BpS is a special case of Aspen-Mixed Conifer BpS. *Populus tremuloides* is the dominant tree species, except in late succession where fire exclusion and ungulate herbivory allow dominance by Engelmann spruce and subalpine fir. Douglas-fir, white fir and limber pine may be present. The presence of even a single aspen tree in a stand provides strong evidence that the area historically supported aspen clones. The BpS typically occurs on flat to steep terrain (<80%) on all aspects. Elevation generally ranges from 2,745 m to 3,353 m (9,000' to 11,000'). Soils are highly variable, but generally cool to frigid. This type occurs at the same elevation as the subalpine spruce-fir zone. Aspen exist in single-storied or multi-storied stands. The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Plant species diversity is often high.
A:All 10611010[3]	**Early-all**: 50-100% cover of aspen <2m tall; mountain snowberry and *Ribes* common; 0-9 yrs.

B:Closed 10611021	**Mid1-closed**: 40-99% cover of aspen 5-10m tall; mountain snowberry and *Ribes* common; 10-39 yrs.
C:Open 10611022	**Mid2-open**: 10-30% cover of aspen 10-24m tall; 10% cover of subalpine fir, spruce, and limber pine <8" DBH; mountain snowberry and *Ribes* common; 40-169 yrs.
D:Closed 10611030	**Late1-closed**: 40-50% cover of subalpine fir, spruce, and limber pine ≥8' DBH, 25-50m tall; <40% cover of aspen; mountain snowberry and *Ribes* common; >169 yrs.
U-A:Depleted 10611103	**Early-depleted**: <50% aspen regeneration, often sparse; 0-40% cover of Engelmann spruce or subalpine fir variously thinned by fire or mechanical thinning with tree height ranging from bole-size to mature trees; woody debris often abundant
U-B:Depleted 10611203	**Mid1-depleted:** ≤40% cover aspen <5-10m; conifer presence ranging from saplings often present following previous fire and/or dispersed mature trees after mechanical thinning
U-C:Depleted 10611303	**Mid2-depleted:** conifers and aspen approximately co-dominate in tree height; <10% cover aspen 10-24m; >10% cover of Engelmann spruce and subalpine fir, <8"DBH; mountain snowberry and Ribes common
U-A:Lost-Aspen (aka: No-ASP) 10611115	**Loss of clone**: Permanent conversion to Spruce-Fir (SF) - 10560; >50% cover of subalpine fir, spruce, and limber pine >8" DBH; aspen absent or in trace amount; dead aspen boles may be present.

Aspen Woodland (ASP) 10110	*Overview*: The Aspen Woodland BpS is dominated by *Populus tremuloides* and is commonly called "stable aspen." Aspen woodland is a debated BpS as it is assumed, but not proven, that soils prevent encroachment of conifers even with fire exclusion, therefore soils maintain the relative cover of conifers to <25%. Where the BpS is adjacent to conifers, an occasional conifer seedling may occur, but conifers do not drive the fire regime. Elevations generally range from 1,525 to 3,050 m (5,000'-10,000'), but occurrences can be found at lower elevations in some regions. Distribution of this BpS is limited primarily by adequate soil moisture required to meet its high evapotranspiration demand, and secondarily by the length of the growing season or low temperatures. This BpS occurs commonly as multi-storied stands. Stands are usually closed. Aspen suckers 1.5 m to 4.6 m (5'-15') tall will be present in all classes (min. 500 stems/acre). The Aspen Woodland BpS typically occurs above pinyon/juniper and adjacent to mountain big sagebrush. At elevations below 6,500 feet this group grades into black and narrowleaf cottonwood types along riparian corridors. Understory consists of abundant shrub and herbaceous components. The herbaceous layer may be lush and diverse, often with species of tall forbs and perennial grasses.
A:All 10110010	**Early-all**: 10-100% cover of aspen <5m tall; 0-9 yrs.
B:Closed 10110021	**Mid1-closed**: 40-99% cover of aspen 5-10m tall (this class also includes aspen thickets caused by heavy snow bank deposition); 10-39 yrs.
C:Closed 10110030	**Late1-closed**: 40-99% cover of aspen 10-25m tall; few conifers in mid-story; 39 -99 yrs.
D:Open 10110042	**Late1-open**: 10-39% cover of aspen 10-25m tall; conifers may be present but less than 25% relative cover; >99 yrs.
U-A:Depleted (aka: DP) 10110103	**Depleted-Early-open**: 1-9% cover of aspen <5m tall (suckers); no or little aspen regeneration; mountain big sagebrush common in understory; high visibility through the midstory; 0-9 yrs.
U-B:Depleted (aka: DP) 10110203	**Depleted-Mid1-open**: 10-39% cover of aspen 5-10m tall (pole size); no or little aspen regeneration; mountain big sagebrush common in understory; high visibility through the midstory; at most few conifers in mid-story; 10-39 yrs.

U-C:Depleted (aka: DP) 10110303	**Depleted-Late1-open**: 10-39% cover of aspen 10-25m tall; no or little aspen regeneration; mountain big sagebrush common in understory; high visibility through the midstory; at most few conifers in mid-story; 39 -99 yrs.
U-D:Depleted (aka: DP) 10110403	**Depleted-Late2-open**: 10-39% cover of older aspen 10-25m tall; no or little aspen regeneration; mountain big sagebrush common in understory; high visibility through the midstory; at most few conifers in mid-story; >99 yrs.
U-A:Lost-Aspen (aka: No-ASP) 10110115	**Loss of clone**: Permanent conversion to Montane Sagebrush Steppe (MSS) - 11260; dead clone of aspen; very few aspen stems present; dead boles may be visible on the ground; 5-50% cover of mountain big sagebrush/mountain shrub; <50% herbaceous cover.
Badland 10002	*Overview*: Natural badlands formed of barren to very sparsely vegetated soils. Usually associated with erosional lacustrine hills or sumps, or unwelded tuff. Soil is usually highly reflective.
A:Bare Ground 10002001	**Bare Ground**: >90% mineral soil; <5% cover or shrubs, grasses or forbs.
Barren-Rock-Mud (Barren) 10000	*Overview*: This feature can be present as natural barren areas of soil, rock, or mud, or human-caused barren areas.
A:Bare Ground 10000001	**Bare Ground**: natural barren areas of soil, rock, or mud.
U-A:Bare Ground 10000101	**Bare Ground**: Human-caused barren area.

Basin Big Sagebrush (aka, BBS) 10806	*Overview***:** The Basin Big Sagebrush BpS is found in loamy bottoms where fine loam is deep along stream terraces and dry drainages. Slopes range from flat to moderately steep. While soils are deep and made of fine loam, rocky material can be present. Elevations range from the lowest parts of the Boulder Mountain at 7,500 ft (2,286m) to >9,000 ft (2,743m) is deep soil is available. Nearly every drainage with deep soil supports this BpS in Boulder mountain. The dominant shrub species is basin big sagebrush (*Artemisia tridentata* spp. *tridentata*). Due to staure and distinctive leaf morphology, the species is easily distinguished from other big sagebrush which are rarely to occasionally present when soil is more shallow. Rabbitbrush species (*Ericameria* spp.) are present to co-dominant depending on disturbance levels. Indian ricegrass (*Oryzopsis hymenoides*), bottlebrush squirreltail (*Sitanion hystrix*), needle -and-tread (*Stipa comata*), and *Poa secunda* are common native grasses.
A:All 10806010	**Early-all**: 10-25% herbaceous cover; <10% cover of rabbitbrush species; <10% cover of basin big sagebrush; 0-9 yrs.
B:Open 10806022	**Mid-open**: 11-30% cover of basin big sagebrush; 10-25% herbaceous cover; 10-30 yrs.
C:Closed 10806030	**Late1-closed**: >30% cover of basin big sagebrush; 10-20% native herbaceous cover; 60-100 yrs.
U-A:Annual Spp (aka: AG) 10806100	**Annual-Species**: >10% cover of non-native annual species.
U-A:Bare Ground (aka: BAGR) 10806101	**Bare Ground**: Primarily bare ground due primarily to anthropogenic disturbances.
U-A:Early-Shrub (aka: ES) 10806105	**Early-Shrub**: >10% cover of rabbitbrush species.
U-A:Exotic Forb (aka: EF) 10806108	**Exotic-Forb**: >5% cover of halogeton, exotic mustards, or thisltles; <10% cover of non-native annual species; >50% cover of mineral soil.

U-A:SAP (aka: AGPG) 10806124	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover non-native annual species; <10% cover of Wyoming big sagebrush <0.5m tall; ≥5% cover of native grasses; pinyon-juniper absent.
U-A:Seeded Native (aka: SD) 10806135	**Seeded-Native**: >10% cover of seeded native grasses, forbs, and shrubs; <5% cover of non-native annual species.
U-A:SI (aka: SDI-A) 10806129	**Seeded-Introduced-Early**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, smooth brome, or forage kochia); <10% cover of rabbitbrush species; <10% cover of basin big sagebrush; native grass may be present to common; <5% cover of non-native annual species.
U-A:SI+AS 10806138	**Seeded-Introduced-Early+Annual-Species**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, smooth brome, or forage kochia); <10% cover of rabbitbrush species; 11-20% cover of basin big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species.
U-B:SAP 10806224	**Shrub-Annual-Species-Perennial-Grass**: ≥5% cover of non-native annual species; 11-30% cover of basin big sagebrush <0.5m tall; 5-20% cover of native grasses; scattered pinyon-juniper saplings may be present later in succession.
U-B:SI (aka: SDI-B) 10806229	**Seeded-Introduced-Mid-open**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, smooth brome, or forage kochia); 11-30% cover of basin big sagebrush; native grass may be present to common; <5% cover of non-native annual species.
U-B:SI+AS 10806238	**Seeded-Introduced-Mid-open+Annual-Species**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 11-30% cover of basin big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species.
U-C:Depleted (aka: DP) 10806303	**Depleted**: >20% cover of basin big sagebrush (dominant); <5% herbaceous cover; <30% cover of conif`er saplings; litter and mineral soil common.
U-C:SA 10806321	**Shrub-Annual-Species**: ≥5% cover of non-native annual species; ≥10% cover of basin big sagebrush <0.5m tall; scattered pinyon-juniper saplings may be present; native grasses rare.

U-C:SI (aka: SDI-C) 10804329	**Seeded-Introduced-Late1-closed**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); >30% cover of basin big sagebrush; native grass may be present to common; <5% cover of non-native annual species.
U-C:SI+AS 10804338	**Seeded-Introduced-Late1-closed+Annual-Species**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); >30% cover of basin big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species.
U-C:TEA 10804544	**Tree-Encroached-Annual-Species**: 11-60% cover of trees 5-9m tall; non-native annual species may be present to abundant; remnant sagebrush may be present; native grasses absent or present in trace amounts.
Black Sagebrush (BS) 10791	*Overview:* The Black Sagebrush BpS occurs sporadically within the project area. *Artemisia nova* is the dominant species. Black sagebrush tends to grow where there is a calcite-based root-limiting layer in the soil profile. Wyoming big sagebrush and basin big sagebrush may occur with black sagebrush on moderately deep to deep soils that are well-drained. Elevations range from 1,500 m to 2,600 m (4,920' to 6,530'), although the BpS is sometimes found as high as 2,743 m (9,000'). The BpS tends to occur on locally convex microsites of flats, hills and mountain slopes. Black sagebrush generally has relatively low fuel loads with low-growing and cushion forbs and scattered bunchgrasses such as Thurber needlegrass (*Achnatherum thurberianum*), Sandberg's bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), and bluebunch wheatgrass (*Pseudoroegneria spicata*) at higher elevations. Forbs often include buckwheats (*Eriogonum* spp.), fleabanes (*Erigeron* spp.), phloxes (*Phlox* spp.), paintbrushes (*Castilleja* spp.), globemallows (*Sphaeralcea* spp.), and lupines (*Lupinus* spp.).
A:All 10791010	**Early-all**: <10% cover of rabbitbrush; 10-40% cover of grass; <50% cover of mineral soil; 0-25 yrs.
B:Open 10791022	**Mid-open**: 10-19% cover of black sagebrush and rabbitbrush; 10-30% cover of grass; <40% cover of mineral soil; 25-119 yrs.
C:Closed 10791030	**Late-closed**: 1-10% cover of pinyon or juniper saplings; 20-30% cover of black sagebrush; 10-30% cover of grasses; 120-194 yrs.
D:Open 10791042	**Late-open**: 10-40% cover of pinyon or juniper 3-8m tall; <10% cover of black sagebrush; <10% cover of grasses cover; >195 yrs.

U-A:Annual Spp (aka: AG) 10791100	**Annual-Species**: >10% cover of non-native annual species; <10% cover of shrubs.
U-A:Bare Ground (aka: BAGR) 10791101	**Bare Ground**: Bare ground due primarily to anthropogenic disturbances.
U-A:Exotic Forb (aka: EF) 10791108	**Exotic-Forbs:** 5-100% cover of exotic forbs (thistles, halogeton, knapweed); cover of rabbitbrush and black sagebrush increases with successional age; native grasses may be present.
U-A:Early-Shrub (aka: ES) 10791105	**Early-Shrub**: 10-40% cover of rabbitbrush species.
U-A:SAP (aka: ASPG) 10791124	**Shrub-Annual-Species-Perennial-Grass-early**: 5-14% cover of non-native annual species; ≥5% cover of native grasses; <10% cover of shrubs.
U-A:Seeded Native (aka: SD) 10791135	**Seeded**: >5% cover of seeded native species; cover of shrubs varies with successional age.
U-A:SI (aka: SDI-A) 10791129	**Seeded-Introduced-Early**: >10% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; <5% cover of non-native annual species.
U-A:SI+AS 10791138	**Seeded-Introduced-Early+Annual-Species**: >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover
U-B:SAP (aka: ASPG) 10791224	**Shrub-Annual-Species-Perennial-Grass+-early**: ≥15% cover of non-native annual species; ≥5% cover of native grasses; ≤10% cover of shrubs.
U-B:SI (aka: SDI-B) 10791229	**Seeded-Introduced-Mid**: >10% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of black sagebrush and rabbitbrush; native grasses and forbs may be present to abundant; <5% cover of non-native annual species.

U-B:SI+AS 10791238	**Seeded-Introduced-Mid+Annual-Species**: >10% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of black sagebrush and rabbitbrush; native grasses and forbs may be present to abundant; ≥5% cover of non-native annual species.
U-C:Depleted (aka:DP) 10791303	**Depleted**: 20-50% cover of black sagebrush; <5% herbaceous cover; <10% cover of pinyon or juniper saplings.
U-C:SA 10791321	**Shrub-Annual-Species**: 5-14% cover of non-native annual species; 10-50% cover of black sagebrush; <5% cover of native grass; <10% cover of pinyon or juniper saplings.
U-C:SI (aka: SDI-C) 10791329	**Seeded-Introduced-Late**: >5% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 1-10% cover of pinyon-juniper saplings 20-30% cover of black sagebrush; native grasses and forbs may be present to abundant; <5% cover of non-native annual species.
U-C:SI+AS 10791338	**Seeded-Introduced-Late+Annual-Species**: >5% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 1-10% cover of pinyon-juniper saplings; 20-30% cover of black sagebrush; native grasses and forbs may be present to abundant; ≥5% cover of non-native annual species.
U-D:SI (aka: SDI-D) 10791429	**Seeded-Introduced-Late**: >5% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia; 10-40% cover of pinyon or juniper 3-8m tall; <10% cover of black sagebrush; native grasses and forbs may be present to abundant; <5% cover of non-native annual species.
U-D:SI+AS (aka: SI-D+AG) 10791438	**Seeded-Introduced-Late+Annual-Species**: >5% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-40% cover of pinyon or juniper 3-8m tall; <10% cover of black sagebrush; native grasses and forbs may be present to abundant; ≥5% cover of non-native annual species.
U-D:TEA 10791444	**Tree-Encroached-Annual-Species**: >10% cover of mature pinyon or juniper cover 3-8m tall; <5% cover of shrubs; **either** <5% native herbaceous cover **and** <5% non-native annual species; **OR** ≥5% non-native annual species **and** >0% native herbaceous cover.

Curl-leaf Mountain Mahogany (CMM) 10620	*Overview:* The Curl-leaf Mountain Mahogany BpS is usually found on upper slopes and ridges between 2,133 m to 3,200 m (7,000' to 10,500') elevation. Most stands occur on rocky shallow soils and outcrops. Stands are assumed to reach old age, >1,000 years, without fire. The BpS is present in two distinct forms due to soil differences: 1) Savannas of old and well -dispersed trees form open and often grassy woodlands (with mature stand cover between 10-55%) with a diverse understory on soils with a large proportion of boulders above and below ground; and 2) Dense thickets of old shrubs (56% to 100% cover) with thick litter and little understory cover form on soils without bouldering. Curl-leaf mountain mahogany (*Cercocarpus ledifolius*) is both a primary early successional colonizer rapidly occupying bare mineral soils after disturbance, and the dominant long-lived species. Seedlings require mineral soil without plant competition to reestablish after fire. Reproduction often appears dependent upon geographic variables (slope, aspect, and elevation) more than biotic factors. Where curl-leaf mountain mahogany has reestablished quickly after fire, rabbitbrush (*Chrysothamnus nauseosus*) may co-dominate. Litter and shading by woody plants inhibits establishment of curl-leaf mountain mahogany. Mountain big sagebrush is the most common codominant with curl-leaf mountain mahogany, although chaparral species such as manzanita (*Arctostaphylos patula*), tobaccobrush (*Ceanothus velutinus)*, and green ephedra (*Ephedra viridis*) may codominate on some sites. Snowberry, Utah serviceberry, and currant are present on cooler sites, with more moisture. Colorado pinyon, Douglas-fir, white fir, Rocky Mountain juniper, ponderosa pine, and limber pine may be present, with less than 10% total cover. In old, closed canopy stands, understory may consist largely of prickly phlox (*Leptodactylon pungens*).
A:All 10620010	**Early**: <70% cover of mountain mahogany; other shrubs (snowberry, rabbitbrush) and grasses may be present; 0-20 yrs.
B:Open 10620022	**Mid-open**: 10-30% cover of mountain mahogany and other shrubs; 20-60 yrs.
C:Closed 10620030	**Mid-closed**: 30-70% cover of mountain mahogany; other shrubs (snowberry, rabbitbrush, big sagebrush, bitterbrush, black sagebrush) abundant; 60-150 yrs.
D:Open (aka: D) 10620042	**Late-open**: 10-30% cover of mountain mahogany; other shrubs (big sagebrush, black sagebrush, bitterbrush) and grasses abundant; >150 yrs.

D:Closed (aka: E) 10620040	**Late-closed**: >30% cover of mountain mahogany; 5-10% cover of pinyon-juniper; snowberry may be common; >150 yrs.
U-A:Annual Spp (aka: AG) 10620100	**Annual-Species**: ≥10% cover of non-native annual species; mountain mahogany largely absent; ≤80% cover of mineral soil, bedrock, and rock.
U-A:SI (aka: SDI) 10620129	**Seeded-Introduced-Early**: >10% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; <5% cover of non-native annual species.
U-A:SI+AS (aka: SDI+AG) 10620138	**Seeded-Introduced-Early+Annual-Species**: >10% cover of seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; ≥5% cover of non-native annual species.
U-D:TEA (aka: TA) 10620444	**Tree-Encroached or with Annual-Species**: >5% cover of non-native annual species; >10% cover of mountain mahogany; <40% cover of mineral soil, bedrock, and rock.

Desert Sand Sagebrush (DSS) 10930	*Overview*: The Desert Sand Sagebrush BpS occupies deep sandy soil. The dominant and diagnostic species is sand sagebrush (*Artemisia filifolia*). The BpS is characterized by abundant sand and blowout areas. Subdominant shrubs include snakeweed and desert almond. Common grasses include big galleta, bush muhly, Indian ricegrass, and desert needlegrass.
A:All 10930010	**Early**: 5-19% sand sagebrush and snakeweed/rabbitbrush cover; 5-20% cover of grasses (big galleta, bush muhly, Indian ricegrass, desert needlegrass); >40% bare ground (mostly sand); 0-2 yrs after fire
B:Closed 10930021	**Late-closed**: ≥20% cover of sand sagebrush, desert almond, and rabbitbrush; 5-20% grasses (big galleta, bush muhly, Indian ricegrass, desert needlegrass); scattered juniper may be present; >30% bare ground (mostly sand); 3+ yrs
U-B:Depleted 10930203	**Depleted**: ≥20% sand sagebrush, snakeweed, and rabbitbrush cover; <5% cover of grasses; >40% bare ground cover juniper or pinyon seedlings may be present
U-B:SAP 10930224	**Shrub-Annual-Grass-Perennial-Grass**: ≥5% sand sagebrush and rabbitbrush cover; ≥5% cover of exotic species (Bromus rubens, Bromus tectorum, Erodium cicutarium); native grasses may be present to common; >30% bare ground (mostly sand); juniper or pinyon seedlings may be present
U-B:TEA 10930244	**Tree-Encroached or with Annual Species**: >10% cover of juniper or pinyon; ≥5% sand sagebrush and rabbitbrush cover; either ≥5% cover of exotic species (Bromus rubens, Bromus tectorum, Erodium cicutarium); native grasses may be present to common; OR <5% cover of exotic species (Bromus rubens, Bromus tectorum, Erodium cicutarium); <5% native grasses cover; >20% bare ground (mostly sand)
Desert Wash (DWA) 11544	*Overview*: The Desert Wash BpS comprises intermittent to dry desert drainages with mostly deeper subsurface flow whose banks can be deeply incised, but usually on one side of meanders. Flash-flooding is the major disturbance in this BpS. Gravels and desert shrub species dominate the system with shrub cover increasing with time since last flood. Common species include big sagebrush, snakeweed, rabbitbrush, galleta, Indian ricegrass, and squirreltail
A:All 11544010	**Early-all**: 30-50% cover may be gravel, sands, and/or flood debris; 10-19% cover of rabbitbrush, snakeweed, and desert willows; ≥5% cover of grasses (Indian ricegrass, squirreltail); forbs present to abundant; 0-5 yrs.

B:Closed 11544021	**Mid-closed**: 10-30% cover of gravel and rocks; 20-50% cover of big sagebrush and rabbitbrush; 5-10% cover of grasses (galleta, Indian ricegrass, squirreltail); forbs present to abundant; 5-19 yrs.
C:Closed 11544030	**Late-closed**: <10% cover of gravel and rocks; 30-50% cover of big sagebrush, rabbitbrush, Woods Rose, and other tall shrubs; 5-10% cover of grasses (galleta, Indian ricegrass, squirreltail); forbs present to abundant; >20 yrs.
U-A:Bare Ground (aka: BAGR) 11544101	**Bare-Ground**: Mineral soil exposed by human-caused disturbances.
U-A:Early-Shrub (aka: ES) 11544105	**Early-Shrub**: 20-50% cover of snakeweed or rabbitbrush species.
U-A:EFT 11544106	**Exotic-Forb-Tree:** >5% cover of salt cedar, Russian olive, or exotic forbs (knapweed, tall whitetop); ≥10% cover of big sagebrush and rabbitbrush; gravel and rocks common to abundant.
U-B:SA 11544221	**Shrub-Annual-Species**: 5-14% cover of non-native annual species (*Bromus tectorum,* mustards, etc.); 0-50% cover of small trees and shrubs; <5% cover of native grasses; mineral soil may be common.
U-B:SA+ 11544225	**Shrub-Annual-Species+**: ≥15% cover of non-native annual species (*Bromus tectorum,* mustards, etc.); 0-50% cover of small trees and shrubs; <5% cover of native grasses; mineral soil may be common.
U-B:SAP 11544224	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover of non-native annual species (*Bromus tectorum,* mustards, etc.); 0-50% cover of small trees and shrubs, ≥5% cover of grasses (galleta, Indian ricegrass, squirreltail); mineral soil may be common.
U-B:SAP+ 11544230	**Shrub-Annual-Species-Perennial-Grass+**: ≥15% cover of non-native annual species (*Bromus tectorum,* mustards, etc.); 0-50% cover of small trees and shrubs, ≥5% cover of grasses (galleta, Indian ricegrass, squirreltail); mineral soil may be common.

Dry Wet Meadow (DWM) 11453	*Overview:* The Dry Wet Meadow BpS is a drier version of wet meadows that usually do not have an obvious spring or proximate waterway. Dry wet meadows are usually sub-irrigated and dry out by mid-July as graminoids become senescent. Some dry wet meadows can be found in the outer concentric ring of wet meadows. Because soils are not heavily saturated with water or channels are not present, channel incision or hummocking are not found. Saturated soils during the spring and early summer favor graminoid dominance, but dominant graminoids differ from those of wetter meadows. The presence of shrubs (Wood's rose, sagebrush, rabbitbrush) at the meadow's edge increases during consecutive drought years and decreases during consecutive high water years. With grazing pressure, early shrub species, such as rabbitbrush, increase in abundance.
A:All 11453010	**Early-all**: 10-60% herbaceous cover, mostly graminoids; 0-2 yrs.
B:Closed 11453021	**Mid-closed**: 61-100% herbaceous cover, mostly graminoids; 3-22 yrs.
C:Open 11453032	**Late-open**: 5-10% cover of shrubs (Wood's rose, sagebrush, rabbitbrush); 60-80% herbaceous cover, mostly graminoids; >22 yrs.
U-A:Annual Spp (aka: AG) 11453100	**Annual-Species**: >5% cover of non-native annual species; < 10% cover of shrubs.
U-A:Bare Ground (aka: BAGR) 11453101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:Early-Shrub (aka: ES) 11453105	**Early-Shrub**: >20% cover of mostly rabbitbrush species.
U-A:Exotic Forb (aka: EF) 11453108	**Exotic-Forb**: >5% cover of exotic forbs (knapweed, purple loosestrife, thistles).
U-A:SAP (aka: ASPG) 11453124	**Shrub-Annual-Perennial-Grass-Early**: 5-14% cover of non-native annual species; native graminoids dominant; no shrubs; soil cover may be high.

U-A:SI (aka: SDI) 11453129	**Seeded-Introduced**: ≥10% cover of introduced forage species (e.g., smooth brome, intermediate wheatgrass); native graminoids present to common.
U-A:SI+AS (aka: SDI) 11453138	**Seeded-Introduced-Annual-Species**: >5% cover of non-native annual species ≥10% cover of introduced forage species (e.g., smooth brome, intermediate wheatgrass); native graminoids present to common;.
U-B:SAP 11453224	**Shrub-Annual-Perennial-Grass-Mid**: ≥5% cover of non-native annual species; 61-100% herbaceous cover, mostly graminoids.
U-C:SA 11453321	**Shrub-Annual-Species**: >10% cover of native shrubs; <5% cover of native graminoids; ≥5% cover of non-native annual species.
U-C:SAP 11453324	**Shrub-Annual-Perennial-Grass-Mid**: ≥5% cover of non-native annual species; 61-80% herbaceous cover, mostly graminoids; 5-10% cover of shrubs (Wood's rose, sagebrush, rabbitbrush).
U-C:Shrb-Frb Encr 11453337	**Shrub-Forb-Encroached**: >10% cover of less-palatable grasses and forbs (e.g., *Iris missouriensis*) **OR** >10% cover of shrubs (willow, Wood's rose, sagebrush); 10-30% cover of bare ground.
U-C:TEA 11453344	**Tree-Encroached-Annual-Species (on incised meadow)**: >20% cover of conifers 10-25m tall; **Either** <5% cover of shrubs; <5% native herbaceous cover; <5% cover of non-native annual species; **OR** >5% cover of non-native annual species; >5% cover of shrubs; <5% native herbaceous cover.

Four-Wing Saltbush (FWS) 10811	*Overview*: The Four-Wing Saltbush BpS occurs from 1,524 – 1,585 m (5,000 – 5,200'). It is part of the Mixed Salt Desert community, but the high stature and high density of four-wing saltbush (*Atriplex canescens*) makes it stand apart. Soils are alkaline, made of loamy fine sand, highly permeable, and very deep (>152 cm or >60"). Many soils are derived from eolian deposits and often associated with dunes. Average annual precipitation ranges from 0-25.4 cm (0 to 10"). This system generally occurs as small patches and stringers. Summers are hot and dry with many days reaching 30 degrees C (100 degrees F). Spring is the only dependable growing season with moisture both from winter and spring precipitation. Cool springs can delay the onset of plant growth and drought can curtail the length of active spring growth. Four-wing saltbush are tall shrubs found at high density (3-5 plants per sq. m) interspersed with low to mid-height bunch grasses. Other shrubs include basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and rubber rabbitbrush (*Ericameria nauseosa*). Common bunch grass species are Indian ricegrass (*Achnatherum hymenoides*), needle-and-thread (*Hesperostipa comata*), and, where monsoonal influences are present, rhizomatous/sod forming grasses such as galleta grass (*Pleuraphis jamesii*) and sand dropseed (*Sporobolus cryptandrus*). The biophysical setting has not evolved with fire and fire is absent from the reference condition.
A:All 10811010	**Early-all**: ≥10% Indian ricegrass, galleta grass, needle-and-thread, or bottlebrush cover;<5% young four-wing saltbush or rubber rabbitbrush cover; mineral soil common to abundant; 0-5 yrs
B:Open 10811022	**Mid1-open**: 5-20% four-wing saltbush, basin big sagebrush, or rabbitbrush cover; >10% Indian ricegrass, galleta grass, needle-and-thread, or bottlebrush cover; mineral soil common to abundant; 6-19 yrs
C:Closed 10811030	**Late1-closed**: >20% four-wing saltbush and basin big sagebrush cover >1m tall; 10-20% Indian ricegrass, galleta grass, needle-and-thread, or bottlebrush cover; ≥20 years
U-A:Annual Spp (aka: AG) 10811100	**Annual-Species**: ≥10% non-native annual species cover; <5% shrub cover; native grass may be present to common
U-A:Bare Ground (aka: BAGR) 10811101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances

U-A:Early-Shrub (aka: ES) 10811105	**Early-Shrub**: 10-40% cover rabbitbrush and snakeweed species
U-A:Seeded Native (aka: SD) 10811135	**Seeded-Native**: >10% native grass and four-wing saltbush seed mix cover; <5% non-native annual species cover
U-A:SI (aka: SDI) 10811129	**Seeded-Introduced**: >10% seeded introduced grasses and shrub species (crested wheatgrass and forage kochia); <5% non-native annual species cover; native shrubs may be present to common
U-A:SI+AS (aka: SDI+AG) 10811138	**Seeded-Introduced+Annual-Species**: >10% seeded introduced grasses and shrub species (crested wheatgrass and forage kochia); ≥5% non-native annual species cover; native shrubs may be present to common
U-C:Depleted (aka: DP) 10811303	**Depleted**: 5-20% cover of four-wing saltbush, basin big sagebrush, or rabbitbrush; <10% native grass; <5% non-native annual species cover
U-C:SAP 10811324	**Shrub-Annual-Species**: 5-14% non-native annual species cover; ≥5% cover of four-wing saltbush, basin big sagebrush, or rabbitbrush; native grass may be present to common
Gambel Oak-Mountain Shrub (GOMS) 11070	*Overview*: The Gambel Oak-Mountain Shrub BpS is found on a variety of soil types, often rocky and potentially erosive, and on slopes that range from gentle to steep, on all aspects. Elevations range from 915 m to 2,438 m (3,000' to 8,000'), typically on mountain foothills and lower slopes. The BpS exists in two sub-types based on aspect and soils. The patchy form of the BpS is characterized by Gambel oak covering ≤60% of the area and generally occurs on sites less than 1,676 m (5,500') in elevation, more often on south- or west-facing slopes, and on shallower soils than the continuous form that has >60% Gambel oak cover and more often occupies higher elevations and northern and eastern slopes. There is, of course, overlap in the gradients for these two sub-types. The BpS is dominated by Gambel oak, often with serviceberry, big sagebrush, chokecherry, bitterbrush, and snowberry. Oak and most other associated shrubs will sprout readily after disturbance.
A: All 11070010	**Early-all**: 5-40% cover of Gambel oak sprouts ≤2 m (6.6') tall; <5% cover of sagebrush and other shrubs; grass and forb cover low in oak patches but abundant between patches; 0-4 yrs.

B:Closed 11070021	**Mid1-closed**: >40% cover of patches of Gambel oak with stems 2-3+m tall; low herbaceous cover in oak patches; 5-20% cover of grass/herb/sagebrush/mountain shrub in interspaces between clones; 5-19 yrs.
C:Closed 11070030	**Late-closed**: 40-80% cover of Gambel oak (greater at the periphery than center of patches due to self-thinning) with trees reaching 3-8m tall; herbaceous understory low; 20-30% cover of sagebrush and mountain shrubs (and other low shrubs) in interspaces between clones; in older patches (>50 yrs), Gambel oak adopts a tree form in southern Utah; >20 yrs.
U-C:SAP 11070324	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover of non-native annual species between oak patches; >5% cover of Gambel oak; native herbaceous cover usually present to abundant between oak patches.
Greasewood-Basin Big Sagebrush (GW) 11530	*Overview*: The Greasewood-Basin Big Sagebrush BpS occurs on alluvial flats, along creek floodplains, and in washes with fine saline to sodic soils. Sites typically have saline to sodic soils, shallow water table, and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. Slope gradients of less than 2 percent are most typical. Elevations range from 1,158 to 1,768 m (3,800 to 5,800'). Average annual precipitation is 13 to 20 cm (5 to 8"); mean temperature is 45 to 50 degrees F; average growing season is 100 to 120 days. The surface layer normally crusts over, inhibiting water infiltration and seedling emergence. This BpS sometimes occurs as a mosaic of multiple communities, with open to moderately-dense shrublands dominated or co-dominated by *Sarcobatus vermiculatus* (greasewood). *Atriplex confertifolia* (shadscale) and basin big sagebrush (*Artemisia tridentata* spp. *tridentata*) may be present or co-dominant. An herbaceous layer, if present, is usually dominated by salt-tolerant graminoids. There may be inclusions of *Sporobolus airoides* (alkali sacaton), *Distichilis spicata* (saltgrass), and basin wildrye (*Elymus cinereus*). Vegetation on this site is normally restricted to coppice mound areas that are surrounded by playa-like depressions or nearly level, usually barren, inner spaces. As ecological condition declines, herbaceous understory is reduced or eliminated, and the site becomes a community of halophytic shrubs dominated by greasewood.
A:All 11530010	**Early-all**: >5% herbaceous cover of inland salt grass, alkali sacaton, or basin wildrye; ≤5% cover of young or resprouting greasewood; >25% mineral soil; flood debris may be abundant; 0-4 yrs.
B:Closed 11530021	**Mid-closed**: >5% cover of mature greasewood with other shrubs possible (basin big sagebrush and shadscale); >5% herbaceous cover of inland salt grass, alkali sacaton, or basin wildrye; mineral soil may be common; >4 yrs.

U-A:Annual Spp (aka: AG) 11530100	**Annual-Species**: >10% cover of non-native annual species; <5% cover of mature greasewood and other shrubs.
U-A:Bare Ground (aka: BAGR) 11530101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:SI (aka: SDI) 11530129	**Seeded-Introduced**: >10% cover of seeded introduced grasses (usually Russian wheatgrass), forbs, and shrubs; greasewood and other shrubs may be present to common;<5% cover of non-native annual species.
U-A:SI+AS (aka: SDI+AG) 11530138	**Seeded-Introduced+Annual-Species**: >10% cover of seeded introduced grasses (usually Russian wheatgrass), forbs, and shrubs; greasewood and other shrubs may be present to common; ≥5% cover of non-native annual species.
U-B:SAP 11530224	**Shrub-Annual-Perennial-Grass**: 5-14% cover of non-native annual species; >5% cover of mature greasewood or basin big sagebrush; native grasses may be present to common; >4 yrs.
Limber-Bristlecone Pine (LB) 10200	*Overview*: The Limber-Bristlecone Pine BpS occurs at elevations of 2,438 m to 3,505 m (8,000' to 11,500') on high windswept ridges, clifftop margins, and open slopes with thin stony soils and minimal ground cover. *Pinus longaeva* and *Pinus flexilis* can exist separately or as mixed stands. *Picea engelmannii* and *Pseudotsuga menziesii* may occur incidentally with *Pinus longaeva*. Sparse forbs, grasses and short shrubs form a discontinuous understory.
A:All 10200010	**Early-all**: 0-10% cover of limber and bristlecone pine 0-5m tall; abundant mineral soil or talus cover; sparse ground cover; 0-99 yrs.
B:Open 10200022	**Mid1-open**: 11-30% cover of limber and bristlecone pine 5-10m tall; abundant mineral soil or talus cover; sparse ground cover; 100-249 yrs.
C:Open 10200032	**Late1-open**: very old trees; 11-30% cover of limber and bristlecone pine 5-25m tall; abundant mineral soil or talus cover; sparse ground cover; >250 yrs.

Lower Subalpine Grassland (LSG) 11400	*Overview*: The Lower Subalpine Grassland BpS generally occurs above is found at elevations typically ranging from 2,590 m to 3,353 m (8,500-11,000') in the lower subalpine zone on gentle to moderately steep terrain on the Aquarius Plateau. This system fills in the spaces between silver sagebrush mima mounds (BpS 11262) on the Aquarius Plateau. Farther east and higher, a different subalpine grassland (11401) is found on Boulder Mountain top where silver sagebrush is absent. The Lower Subalpine Grassland is the drier of the two subalpine grassland systems. The soils are moderately deep to very deep to bedrock and well drained. These soils are modified by high volumes of pebbles, gravel, rock fragments through their profile. On rocky soils, some shrub species increase in cover. Heavy snow accumulation on this site often persists into summer and significantly reduces the potential plant growth period. Snow melt adds to the soil moisture supply. The BpS has medium to rapid potential for surface erosion on moderate to high slopes. Graminoids are dominant, with sheep fescue (*Festuca ovina*) the most abundant and *Poa secunda* is also common. Pedestalling of graminoid clumps is noticeable in many locations. Silver sagebrush is present to common in this system and is perhaps the dominant shrub. A variety of forbs are present, subordinate to the graminoids. Shrub species such as shrubby cinquefoil (*Potentilla fruticosa*) and mountain gooseberry (*Ribes montigenum*) are incidental.
A:All 11400010	**Early-all**: <5% shrub cover, especially silver sagebrush; 5-19% grass cover; ≤20% forb cover; abundant bare ground and rock cover; 0-4 yrs.
B:Closed 11400021	**Mid-closed**: 5-10% shrub cover, especially silver sagebrush; ≥20% graminoid cover; ≤10% forb cover; abundant bare ground and rock cover; 5-9 yrs.
U-B:Shrb-Frb-Encr (aka: SFE) 11400337	**Shrub-Forb Encroached**: >10% cover of shrubs, especially silver sagebrush; or > 20% cover of increaser forbs such as sneezeweed (*Hymenoxys hoopesii*); abundant bare ground and rock cover

Mixed Conifer-Montane (MC) 10520	*Overview*: The Mixed Conifer – Montane BpS is found at elevations ranging from 1,200 m to 2,743 m (4,000'-9,000'). Sites include lower and middle slopes of ravines, along stream terraces, moist concave topographic positions, and north- and east-facing slopes which burn somewhat infrequently. White fir (*Abies concolor*) and Douglas-fir (*Pseudotsuga menziesii*) are most common canopy dominants, but ponderosa pine (*Pinus ponderosa*), Engelmann spruce (*Picea engelmannii*), blue spruce (*Pinus pungens*), and limber pine (*Pinus flexilis*) may be occasional. Many cold-deciduous shrub, graminoid, and forb species can occur, although litter is often the dominant understory cover. Aspen is absent and there is no evidence of remnant aspen boles.
A:All 10520010	**Early-all**: 0-15% cover of young trees/shrub/grass <5m tall, <8" DBH.
B:Closed (aka: B) 10520021	**Mid1-closed**: 35-100% cover of pole-sized conifers <24m tall; 8-19" DBH
B:Open (aka: C) 10520022	**Mid1-open**: 0-35% cover of pole-sized conifers <24m tall; 8-19" DBH
C:Open (aka: D) 10520032	**Late1-open**: 0-35% cover of mature conifers 25-49m tall; ≥20" DBH
C:Closed (aka: E) 10520030	**Late1-closed**: 35-100% cover of mature conifers 25-49m tall; ≥20" DBH
U-A:Annual Spp (aka: AG) 10520100	**Annual-Species**: Saplings plus >10% cover of non-native annual grass.
U-C:TEA (aka: TA) 10520344	**Tree-Annual-Species**: Any mid- to late-successional class plus >5% cover of non-native annual grass.

Mixed Conifer-Claron (MCC) 10523	*Overview*: The Mixed Conifer-colluvium BpS is found at elevations ranging from 2,475 m to 2,743 m (8,120-9,000'), mainly below Claron Limestone cliffs on the Escalante Ranger District. Sites largely occur on colluvial or alluvial deposits of limestone materials below the erodible cliffs; soil is bright. The open forests appear to burn very infrequently. The BpS is especially known for a high diversity of conifer species in close proximity on the same site, including Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), blue spruce (*Picea pungens*), Great Basin bristlecone pine (*Pinus longaeva*), limber pine (*Pinus flexilis*), ponderosa pine (*Pinus ponderosa*), pinyon pine (*Pinus edulis*), and Rocky Mountain juniper (*Juniperus scopulorum*). The understory can be as diverse as the conifer canopy, although not dense. Major shrubs are *Arctostaphylos patula, Juniperus communis, Symphoricarpos oreophilus, Ceanothus fendleri, Purshia tridentata (prostrate),* and *Cercocarpus montanus*.
A:All 10523010	**Early-all**: 0-15% cover of young trees/shrub/grass <1m tall, <8" DBH.; mineral soil made primarily of colluvium or alluvium should be abundant
B:Closed (aka: B) 10523021	**Mid1-closed**: >20% cover of pole-sized but short conifers, 8-11" DBH; mineral soil made primarily of colluvium or alluvium should be abundant
B:Open (aka: C) 10523022	**Mid1-open**: 5-19% cover of pole-sized but short conifers, 8-11" DBH; mineral soil made primarily of colluvium or alluvium should be abundant
C:Open (aka: D) 10523032	**Late1-open**: 5-19% cover of mature and short conifers, >12" DBH; mineral soil made primarily of colluvium or alluvium should be abundant
C:Closed (aka: E) 10523030	**Late1-closed**: >20% cover of mature and short conifers, >12" DBH; mineral soil made primarily of colluvium or alluvium should be abundant
U-C:TEA 10523344	**Tree-Encroached or with annual species**: Any of the B or C classes with >5% non-native annual species

Mixed Salt Desert (MSD) 10810	*Overview*: The Mixed Salt Desert BpS occurs from lower slopes to valley bottoms ranging in elevation from 1,158 - 1981m (3,800 - 6,500'). Soils are often alkaline or calcareous. Soil permeability ranges from high to low, with more impermeable soils occurring in valley bottoms. Water ponds on alkaline bottoms. Texture is variable becoming finer toward valley bottoms. Many soils are derived from alluvium. Average annual precipitation ranges from 7.5-25.4 cm (3 to 10"); however, this system is in 12.7-30.3 cm (5-8") of effective moisture within this broader range. Thus, other site characteristics (e.g. aspect, drainage, soil type) should be considered in identifying this biophysical setting. At the precipitation extremes, this system generally occurs as small patches and stringers. Summers are hot and dry with many days reaching 30 degrees C (100 degrees F). Spring is the only dependable growing season with moisture both from winter and spring precipitation. Cool springs can delay the onset of plant growth and drought can curtail the length of active spring growth. Freezing temperatures are common from November through April. Mixed Salt Desert generally lies above playas, lakes, and greasewood communities. Upslope the BpS is bordered by low elevation big sagebrush groups, commonly Wyoming big sagebrush, low sagebrush, and black sagebrush communities. Mixed Salt Desert includes low (<0.91 m or 3') and medium-sized shrubs found widely scattered (often 6.1-9.1 m [20-30'] apart) to high density (3-5 plants per sq. m) shrubs interspersed with low to mid-height bunch grasses. Common shrubs are shadscale, winterfat, budsage, Nevada ephedra, horsebrush, low rabbitbrush, broom snakeweed, and spiny hopsage. Shrub dominance is highly dependent on the site. Some of these shrubs will be present. Common bunchgrass species are Indian ricegrass, needle-and-thread, purple three-awn, sand dropseed, and squirreltail, and where monsoonal influences are present one may find common rhizomatous/sod forming grasses such as galleta grass and blue grama. Globemallows are the most common and widespread forbs. The understory grasses and forbs are salt-tolerant, not particularly drought tolerant, and are variably abundant. The relative abundance of species may vary in a patchwork pattern across the landscape in relation to subtle differences in soils (e.g., sand sheets or other surface textural differences) and reflect variation in disturbance history. Total cover rarely exceeds 25% and annual precipitation is closely linked to prior 12 months precipitation. Stand-replacing disturbances (insects, extended wet periods and drought) shift dominance between shrub and grass species. Following drought coupled with insect infestations, the system will tend more toward bud sagebrush dominance. The BpS has not evolved with fire, and fire is absent from the reference condition.
A:All 10810010	**Early-all**: 0-5% cover of young *Atriplex* spp. or other shrubs; Indian ricegrass and squirreltail common; 0-5 yrs.

B:Open 10810022	**Late1-open**: >5% cover of *Atriplex* spp. or other shrubs; Indian ricegrass and squirreltail present to common; ≥6 yrs.
C:Open 10810032	**Late2-open**: >5% cover of budsage <0.25m tall; Indian ricegrass and squirreltail present to common; ≥6 yrs.
U-A:Annual Spp (aka: AG) 10810100	**Annual-Species**: ≥5% cover of non-native annual species; <5% cover of shrubs.
U-A:Bare Ground (aka: BAGR) 10810101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:Early-Shrub (aka: ES) 10810105	**Early-Shrub**: ≥10% cover of rabbitbrush and snakeweed species.
U-A:Exotic-Forb 10810108	
U-A:Seeded Native (aka: SD) 10810135	**Seeded-Native**: >10% cover of native seed mix, including shadscale; <5% cover of non-native annual species.
U-A:SI (aka: SDI) 10810129	**Seeded-Introduced**: >10% cover of seeded introduced grasses, forbs, and shrubs; <5% cover of non-native annual species; shrubs may be present to common.
U-A:SI+AG (aka: SDI+AG) 10810138	**Seeded-Introduced+Annual-Species:** >10% cover of seeded introduced grasses and shrubs; ≥5% cover of non-native annual species; shrubs may be present to common.
U-B:SAP 10810224	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover of non-native annual species; ≥5% cover of *Atriplex* spp. or other shrubs; native grasses may be present to common.

Montane Riparian (MR) 11540	*Overview*: The Montane Riparian BpS is found within a broad elevation range from 1,220 m to 2437 m (4,000' to 8,000') and the upper elevational limit may be at lower in the northern part of the project. Riparian forests and woodlands require flooding and gravel for reestablishment. The BpS is found in low- to mid-elevation canyons and draws, on floodplains, in steep-sided canyons, or narrow V-shaped valleys with rocky substrates. Sites are subject to temporary flooding during spring runoff, although summer flash floods can have dramatic effects on succession. Underlying gravels, which are favored substrates for cottonwood and willow germination, may keep the water table just below ground surface. In steep-sided canyons, streams typically have perennial flow on mid to high gradients. Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Codominant and diagnostic species include willow, cottonwood, and mixed conifers. Vegetation is very heterogeneous and diverse along river reaches.
A-Willow:All 11540014	**Early-Willow-All**: 0-40% cover of shrubs—willow dominates after fire, whereas cottonwood and willow co-dominate after flooding; grass may co-dominate; <50% cover of gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs.
B-Willow:Closed 11540024	**Mid-Willow-closed**: 31-100% cover of tall shrubs (willows, others), small trees and small cottonwood trees; <20% cover of gravel, rock, and boulders; 5-19 yrs.
A-Cottonwood:All 11540013	**Early-Cottonwood-All**: 1-40% cover of cottonwood seedlings and saplings; grass may co-dominate; <50% cover of gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs.
B-Cottonwood:Closed 11540023	**Mid-Cottonwood-Closed**: 31-100% cover of small cottonwood trees and other tall shrubs (willows, chokecherry); <20% cover of gravel, rock, and boulders; 5-19 yrs.
C-Cottonwood:Closed 11540033	**Late-Cottonwood-Closed**: 31-100% cover of cottonwood, willow, conifers and other trees 10-24m tall; <20% cover of gravel, rock, and boulders; >20 yrs.
U-A:Agriculture	**Agriculture**: Irrigated pastures.
U-A:Annual Spp (aka: AG) 11540100	**Annual-Species**: >10% cover of non-native annual species on dry incised banks; < 10% cover of shrubs.

U-A:Bare Ground (aka: BAGR) 11540101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances on either incised (most common case) or un-incised banks.
U-A:EFT 11540106	**Exotic-Forb-Tree**: >10% cover of exotic forb or tree species (knapweed, tall whitetop, thistles, purple loosestrife, salt cedar, or Russian olive).
U-A:Hummocked (aka: HU) 11540110	**Hummocked:** Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs.
U-A:Incised-EFT 11540111	**Incised-Exotic-Forb-Tree-early**: >5% cover of exotic forb species or tree species on incised banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 5-20% cover of native grass, especially basin wildrye; upland shrubs may be present to common (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose).
U-A:Inset 11540113	**Inset-Floodplain-early**: Reformed riparian floodplain at bottom of incised creeks; 1-40% cover of willow; young cottonwood may be present; grass may co-dominate or dominate; although this may be highly variable by reach; 0-5 yrs.
U-A:Inset-HU 11540117	**Inset-Floodplain-Hummocked:** Reformed riparian floodplain at bottom of incised creeks; trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs.
U-A:Inset-SFE 11540118	**Inset-Floodplain-Shrub-Forb-Encroached-early:** Reformed riparian floodplain at bottom of incised creeks; 10-50% cover of Wood's rose, sumac. or other unpalatable forbs and shrubs in open areas or under tree canopy; 1-40% cover of willow; young cottonwood may be present.
U-A:Seeded Native (aka: SD) 11540135	**Seeded-Native**: >10% cover of seeded basin wildrye, other grasses native to deep loamy soils, forbs, and shrubs; <5% cover of non-native annual species (if ≥5 cover of non-native annual species, then SAP or even AS).
U-A:Shrb-Frb-Encr (aka: SFE) 11540137	**Shrub-Forb-Encroached**: 10-50% cover of Wood's rose, sumac, or other unpalatable forbs and shrubs in open areas or under tree canopy.
U-A:SI (aka: SDI-A) 11540129	**Seeded-Introduced-early**: >10% cover of seeded introduced grasses, with native grasses and forbs possible; <5% cover of non-native annual species.

U-A:SI+AS (aka: SDA) 11540138	**Seeded-Introduced-Species-Annual-Species**: Incised river/creek with >20% cover of introduced grass species; >5% cover of non-native annual species; pinyon and juniper may be present.
U-C:Desertified (aka: DES) 11540304	**Desertified**: Incised river/creek with 10-50% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush); <5% cover of native grass.
U-C:SAP 11540324	**Shrub-Annual-Species-Perennial-Grass**: Incised river/creek with 10-50% cover of upland shrubs (e.g., big sagebrush); >5% cover of non-native annual species; >5% cover of native grass; ≤20% cover of pinyon and juniper.
U-C:TEA (aka: TE) 11540344	**Tree-Encroached or with Annual-Species**: Incised river/creek with >20% cover of pinyon or juniper; highly variable cover of riparian shrubs and cottonwood; degree of incision is highly variable; non-native annual species may be present.
Montane Sagebrush Steppe-upland soils (MSS) 11260	*Overview*: The Montane Sagebrush Steppe BpS (a.k.a., mountain big sagebrush*, A. tridentata* spp. *vaseyana*) is found above and intergrades with the mesic sites of the Wyoming Big Sagebrush BpS. Elevation is generally above 2,134 m (6,500'). In general, this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes; soils often have a substantial volume of coarse fragments and are derived from a variety of parent materials. This system primarily occurs on deep soiled to stony flats, ridges, nearly flat ridge tops, and mountain slopes. Vegetation types are usually dominated by *Artemisia tridentata* ssp. *vaseyana*, but other high-elevation sagebrush species can be present, such as low sagebrush (*A. arbuscula*) and trace amount of silver sagebrush (*A. cana*). If silver sagebrush is dominant, especially on post-glacial mima mounds of the Aquarius Plateau, see the Silver Sagebrush model (11262). A variety of other shrubs can be found in some occurrences, but these are seldom dominant. Abundant forbs are an indicator of good range condition. Grasses are abundant, sometimes very abundant, and often diverse.
A:All 11260010	**Early-all**: 10-80% cover of grasses and forbs; 0-10% cover of mountain sagebrush, mountain brush; 0-12 yrs.
B:Open 11260022	**Mid-open**: 11-30% cover of mountain sagebrush, mountain shrub; >50% herbaceous cover; 13-38 yrs.

C:Closed 11260030	**Mid-closed**: >30% cover of mountain sagebrush (dominant) and mountain brush; 25-50% herbaceous cover; <10% cover of conifer saplings; 39+ yrs.
D:Open 11260042	**Late-open**: 10-30% cover of young pinyon-juniper; 25-40% cover of mountain sagebrush (dominant) and mountain brush; >10% herbaceous cover; 80-129 yrs.
E:Closed 11260050	**Late-closed**: >30% cover of older pinyon-juniper (>100 years); 6-20% shrub cover; >10% herbaceous cover; 130+ yrs.
U-A:Annual Spp (aka: AG) 11260100	**Annual-Species**: >10% cover of non-native annual species; snakeweed or rabbitbrush may be present.
U-A:Bare Ground (aka: BAGR) 11260101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:Early-Shrub (aka: ES) 11260105	**Early-Shrub**: >20% cover of snakeweed or rabbitbrush species.
U-A:SAP (aka:AGPG) 11260124	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover of non-native annual species; ≤10% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; no conifers.
U-A:Exotic Forb (aka: EF) 11260108	**Exotic-Forb**: 1-100% cover of exotic forbs (e.g., thistles, knapweed).
U-A:Seeded Native (aka: SD) 11260135	**Seeded-Native**: >10% cover of seeded native grasses, forbs, and shrubs.
U-A:SI (aka: SDI-A) 11260129	**Seeded-Introduced-Early**: >10% cover of seeded introduced grasses and shrubs; 0-10% cover of mountain sagebrush and mountain brush; native grasses present to common; <5% cover of non-native annual species.
U-A:SI+AS (aka: SDI-A+AG) 11260138	**Seeded-Introduced-Early+Annual-Species-Early**: >10% cover of seeded introduced grasses and shrubs; 0-10% cover of mountain sagebrush and mountain brush; native grasses present to common; ≥5% cover of non-native annual species.

U-B:SAP 11260224	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover of non-native annual species; 11-50% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; <30% cover of conifer saplings.
U-B:SI (aka: SDI-B) 11260229	**Seeded-Introduced-Mid-open**: >10% cover of seeded introduced grasses and shrubs; 11-30% cover of mountain sagebrush and mountain shrub; native grasses present to common; <5% cover of non-native annual species.
U-B:SI+AS (aka: SDI-B+AG) 11260238	**Seeded-Introduced-Mid-Open+Annual-Species**: >10% cover of seeded introduced grasses and shrubs; 11-30% cover of mountain sagebrush and mountain shrub; native grasses present to common; ≥5% cover of non-native annual species.
U-C:Depleted (aka: DP) 11260303	**Depleted**: >20% cover of mountain sagebrush (dominant) and mountain brush; <5% herbaceous cover; <30% cover of conifer saplings; litter and mineral soil common.
U-C:SA 11260321	**Shrub-Annual-Species**: 5-14% cover of non-native annual species; >10% cover of mountain sagebrush (dominant) and mountain brush; ≤5% cover of native grass; <30% cover of conifer saplings.
U-C:SI (aka: SDI-C) 11260329	**Seeded-Introduced-Mid-Closed**: >5% cover of seeded introduced grasses and shrubs**;** >30% cover of mountain sagebrush and mountain shrub; native grasses present to common; <10% cover of conifer saplings; <5% cover of non-native annual species.
U-C:SI+AS (aka: SDI-C+AG) 11260338	**Seeded-Introduced-Mid-Closed+Annual-Species**: >5% cover of seeded introduced grasses and shrubs**;** >30% cover of mountain sagebrush and mountain shrub; native grasses present to common; <10% cover of conifer saplings; ≥5% cover of non-native annual species.
U-D:SI (aka: SDI-D) 11260429	**Seeded-Introduced-Late-Open**: >5% cover of seeded introduced grasses and shrubs**;** 10-30% cover of conifers; 25-40% cover of mountain sagebrush and mountain shrub; native grasses present to common; <5% cover of non-native annual species.
U-D:SI+AS (aka: SDI-D+AG) 11260438	**Seeded-Introduced-Late-Open+Annual-Species**: >5% cover of seeded introduced grasses and shrubs**;** 10-30% cover of conifers; 25-40% cover of mountain sagebrush and mountain shrub; native grasses present to common; ≥5% cover of non-native annual species.
U-E:TEA (aka: TE or TA) 11260544	**Tree-Encroached-Annual-Species**: >20% cover of pinyon-juniper 3-8m tall; <5% shrub cover; <5% herbaceous cover; <5% cover of non-native annual species **OR** >20% cover of pinyon-juniper 3-8m tall; ≥5% cover of non-native annual species; ≥5% shrub cover; ≥5% herbaceous cover.

Mountain Shrub (MS) 10860	*Overview*: The Mountain Shrub BpS has Utah serviceberry (*Amelanchier utahensis*) as the diagnostic shrub, in the absence of Gambel oak, but other shrubs can locally dominate. The BpS occupies the same elevation band as pinyon-juniper woodlands and big sagebrush steppe. These shrublands occur between 1,500-2,900 m (4,921-9,515') elevation and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. Scattered trees or inclusions of grassland patches or sagebrush steppe may be present, but the vegetation is typically dominated by a variety of shrubs including *Amelanchier utahensis*, *Symphoricarpos oreophilus*, *Cercocarpus montanus*, *Purshia tridentata*, *Rhus trilobata*, or *Ribes cereum*. In Utah, true mountain mahogany (*Cercocarpus montanus*) is a resprouting shrub that sometimes dominates this ecological system, whereas *Ribes*, *Acer*, and *Chrysothamnus* are less common. *Artemisia tridentata* ssp. *vaseyana* and *Holodiscus* are more common shrubs on dry sites in Utah and the Great Basin. Grasses are represented as species of *Muhlenbergia*, *Bouteloua*, *Stipa*, and *Elymus spicatus*. Fire plays an important role in this system as the dominant shrubs are usually affected by severe die-back, although some plants will stump-sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth. When trees are present, they include pinyon pine and juniper. On more mesic sites, Douglas-fir and white fir may be found.
A:All 10860010	**Early-all**: 0-10% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; 10-80% cover of grasses and forbs; 0-4 yrs.
B:Closed 10860021	**Mid-closed**: 11-30% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; >50% herbaceous cover; 5-19 yrs.
C:Closed 10860030	**Mid-closed**: 31-50% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; 25-50% herbaceous cover; <10% cover of conifer saplings; 20-79 yrs.
D:Open 10860042	**Late-open**: 10-20% cover of pinyon-juniper <5m tall; 25-40% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; ≥5% herbaceous cover; ≥80 yrs.
U-A:Annual Spp (aka: AG) 10860100	**Annual-Species**: ≥10% cover of non-native annual species; snakeweed or rabbitbrush may be present.

U-A:Bare Ground (aka: BAGR) 10860101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:Early-Shrub (aka: ES) 10860105	**Early-Shrub**: 20-50% cover of rabbitbrush species.
U-A:SAP (aka:AGPG) 10860124	**Shrub-Annual-Species-Perennial-Grass-Early**: >5% cover of non-native annual species; ≤10% cover of mountain brush (dominant); >5% cover of native grass; no conifers.
U-A:SI (aka: SDI-A) 10860129	**Seeded-Introduced-Early**: >10% cover of seeded introduced grass and shrubs; 0-10% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; 10-80% cover of grasses and forbs; <5% cover of non-native annual species.
U-A:SI+AS (aka: SDI-A+AG) 10860138	**Seeded-Introduced-Early+Annual-Species**: >10% cover of seeded introduced grass and shrubs; 0-10% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; 10-80% cover of grasses and forbs; ≥5% cover of non-native annual species.
U-B:SAP (aka:AGPG) 10860224	**Shrub-Annual-Species-Perennial-Grass-Mid**: 5-14% cover of non-native annual species; >10% cover of mountain brush (dominant) and mountain big sagebrush; >5% cover of native grass; no conifers.
U-B:SAP+ (aka:AGPG) 10860230	**Shrub-Annual-Species-Perennial-Grass-Mid**: >14% cover of non-native annual species; >10% cover of mountain brush (dominant) and mountain big sagebrush; >5% cover of native grass; no conifers.
U-B:SI (aka: SDI-B) 10860229	**Seeded-Introduced-Mid-open**: >10% cover of seeded introduced grass and shrubs; 11-30% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; >50% herbaceous cover; <5% cover of non-native annual species.
U-B:SI+AS (aka: SDI-B+AG) 10860238	**Seeded-Introduced-Mid-open+Annual-Species**: >10% cover of seeded introduced grass and shrubs; 11-30% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; >50% herbaceous cover; ≥5% cover of non-native annual species.
U-C:Depleted (aka: DP) 10860303	**Depleted**: 31-50% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; <5% herbaceous cover; <10% cover of conifer saplings.

U-C:SAP (aka:AGPG) 10860324	**Shrub-Annual-Species-Perennial-Grass-Late**: ≥5% cover of non-native annual species; 31-50% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; 25-50% herbaceous cover; <10% cover of conifer saplings.
U-C:SI (aka: SDI-C) 10860329	**Seeded-Introduced-Mid-closed**: >10% cover of seeded introduced grass and shrubs; 31-50% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; 25-50% herbaceous cover; <10% cover of conifer saplings; <5% cover of non-native annual species.
U-C:SI+AS (aka: SDI-C+AG) 10860338	**Seeded-Introduced-Mid-closed+Annual-Species**: >10% cover of seeded introduced grass and shrubs; 31-50% cover of serviceberry, antelope bitterbrush, or true mountain mahogany; 25-50% herbaceous cover; <10% cover of conifer saplings; ≥5% cover of non-native annual species.
U-D:SI (aka: SDI-D) 10860429	**Seeded-Introduced-Late-open**: >10% cover of seeded introduced grass and shrubs; 10-20% cover of pinyon-juniper <5m tall; 25-40% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; ≥5% herbaceous cover; <5% cover of non-native annual species.
U-D:SI+AS (aka: SDI-D+AG) 10860438	**Seeded-Introduced-Late-open+Annual-Species**: >10% cover of seeded introduced grass and shrubs; 10-20% cover of pinyon-juniper <5m tall; 25-40% cover of serviceberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; ≥5% herbaceous cover; ≥5% cover of non-native annual species.
U-D:TEA (aka: TA, TE) 10860444	**Tree-Encroached or with Annual-Species**: >21% cover of pinyon-juniper 3-8m tall; <5% shrub cover; <5% native herbaceous cover; <5% cover of non-native annual species **OR** >21% cover of pinyon-juniper 3-8m tall; ≥5% cover of non-native annual grasses and forbs; ≥5% cover of snowberry, mountain snowberry, antelope bitterbrush, or true mountain mahogany; <30% herbaceous cover.

Pinyon-Juniper Shrubland (PJS) 11020	*Overview*: The Pinyon-Juniper Shrubland BpS is characteristic of rocky mesa tops and slopes on the Colorado Plateau and western slope of Colorado. Substrates are shallow rocky and shaly soils at lower elevations (1,200-2,000 m). These stunted tree shrublands may extend farther upslope along the low-elevation margins of taller pinyon-juniper woodlands. The vegetation is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* trees forming extensive tall shrublands in the region along low-elevation margins of pinyon-juniper woodlands. Other shrubs, if present, may include *Artemisia nova*, *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, or *Coleogyne ramosissima*. Herbaceous layers are sparse to moderately dense and typically composed of xeric graminoids. Patches range from 10's to 100's of acres in size. In areas with very broken topography and/or mesa landforms, this type may have occurred in patches of several hundred acres.
A:All 11020010	**Early-all**: 2-10% cover of herbaceous annuals; charred stumps and trunks may be present; 0-9 yrs.
B:Open 11020022	**Mid1-open**: 5-10% cover, dominated by shrubs; <5% cover of perennial forbs and grasses <1.0m tall; 10-40% herbaceous cover; 10-29 yrs.
C:Open 11020032	**Mid2-open**: 11-20% cover of young big sagebrush and rabbitbrush <2m tall; <5% cover of pinyon and/or juniper seedlings emerging from the shrub canopy; <20% herbaceous cover; 30-99 yrs.
D:Open 11020042	**Late1-open**: 21-30% cover of stunted shrub-like pinyon and/or juniper <3m tall; <10% shrub cover; <10% herbaceous cover; 100-399 yrs.
Pinyon-Juniper Woodland (PJ) 10190	*Overview*: The Pinyon-Juniper Woodland BpS is typically found from 1,675-2,440 m (5,500-8,000'), with or above the black sagebrush and Wyoming big sagebrush zones. This BpS generally occurs on most soils and landforms, especially fire-safe sites of steep or rocky flat to steep slopes where bedrock is believed to be close to the surface. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. Woodlands comprising this system can be dominated by a mix of *Pinus edulis* and *Juniperus osteosperma*; by pure or nearly pure stands of *Pinus edulis*; or solely by *Juniperus osteosperma*. Understory layers are variable. Grass and shrub species are often diverse and common, although not abundant.
A:All 10190010	**Early-all**: 5-20% herbaceous cover; charred stumps and trunks may be present; 0-9 yrs.

B:Open 10190022	**Mid1-open**: 11-30% cover of big sagebrush, black sagebrush, or bitterbrush <1.0m tall; 10-40% herbaceous cover; 10-29 yrs.
C:Open 10190032	**Mid2-open**: 11-20% cover of young (<100 yrs old) pinyon and/or juniper <5m tall; 10-20% shrub cover; <20% herbaceous cover; 30-99 yrs.
D:Open 10190042	**Late-open**: 21-60% cover of pinyon and/or juniper <5m-9m tall; 10-40% shrub cover; <20% herbaceous cover; ≥100 yrs.
U-A:Annual Spp (aka:AG) 10190100	**Annual-Species**: >10% cover of non-native annual species; dead pinyon or juniper visible.
U-A:Bare Ground (aka: BAGR) 10190101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:Exotic Forb (aka: EF) 10190108	**Exotic-Forb**: 5-100% cover of exotic forbs (e.g., thistles, knapweed).
U-A:SAP 10190124	**Shrub-Annual-Species-Perennial-Grass**: >5% cover of non-native annual species; 11-30% cover of big sagebrush, black sagebrush, or bitterbrush <1.0m tall; <40% herbaceous cover.
U-A:Seeded Native (aka: SD) 10190135	**Seeded-Native**: >10% cover of seeded native grasses, forbs, and shrubs; <5% non-native annual species cover.
U-A:SI (aka: SDI) 10190129	**Seeded-Introduced**: >10% cover of seeded introduced grass and forbs; <5% cover of non-native annual species.
U-A:SI+AS (aka: SDI+AG) 10190138	**Seeded-Introduced+Annual-Species**: >10% cover of seeded introduced grass and forbs; ≥5% cover of non-native annual species.
U-D:TEA (aka: TA) 10190444	**Tree-Encroached or with Annual-Species**:≥20% cover of pinyon-juniper 3-8m tall; <5% shrub cover; <5% herbaceous cover; <5% non-native annual species cover **OR** ≥20% pinyon-juniper cover 3-8m tall; ≥5% non-native annual species cover; ≥5% shrub cover; ≥5% herbaceous cover; ≥30 yrs.

Ponderosa Pine - dry (PPD) 10541	*Overview*: The Ponderosa Pine - dry BpS has been reported from the mountains and plateaus in Colorado, Utah and California. Elevation ranges from 1,770-2,590 m (5,800-8,500 feet). Sites are dry, warm, mid to lower slopes, benches and ridges often with southerly aspects. Soils are typically sandy loams but vary from sand to silt loam. Parent materials are sandstone, especially on the flanks of Boulder Mountain, plus limestone and occasionally basalt and andesite. The tree canopy is typically open (about 30% cover), but can range from 10-80% cover and is dominated by *Pinus ponderosa*. Scattered *Juniperus scopulorum* trees may also be present. *Arctostaphylos patula* dominates the moderate to sparse shrub layer. Others shrub species present may include *Amelanchier utahensis, Ceanothus* spp., *Cercocarpus montanus, Mahonia repens, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus*, and *Tetradymia canescens*. The sparse herbaceous layer (<20% cover) is primarily composed of graminoids such as *Carex rossii, Achnatherum hymenoides, Elymus elymoides, Leymus salinus*, and *Poa fendleriana*. Forbs are sparse and may include *Achillea millefolium, Balsamorhiza sagittata*, and *Eriogonum racemosum* A high percentage of rock and bare soil are typically present.
A:All 10541010	**Early-all**: 5-30% cover of shrub/grass; conifer seedlings <5m can be sparse to common; mineral soil is common; <8” DBH
B:Closed (aka: B) 10541021	**Mid-closed**: >21% cover of ponderosa pine and juniper 5-10m tall; sparse to moderately abundant shrub cover possible; exposed rock and mineral soil common; 8”-19” DBH
B:Open (aka: C) 10541022	**Mid-open**: 5-20% cover of ponderosa pine (dominant) and juniper 5-10m tall; abundant shrub and grass cover; exposed rock and mineral soil common; 8”-19” DBH
C:Open (aka: D) 10541032	**Late-open**: 5-20% cover of ponderosa pine (dominant) and juniper 11-20m tall; abundant shrub and grass cover; ≥20” DBH
C:Closed (aka: E) 10541030	**Late-closed**: >21% cover of ponderosa pine and juniper 11-20m tall; Greenleaf manzanita common ; ≥20” DBH

U-A:Annual Spp (aka: AG) 10541100	**Annual-Species**: >10% cover of non-native annual grass; ponderosa pine saplings may be present.
U-A:Bare Ground (aka: BAGR) 10541101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-C:TEA (aka: TA) 10541344	**Tree-Encroached or with Annual-Species**: Any class B,C,D, or E plus >5% cover of non-native annual grass.
Ponderosa Pine - mesic (PP) 10540	*Overview*: The Ponderosa Pine - mesic BpS is found at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Occurrences are found on all slopes and aspects, though moderately steep to very steep slopes or ridge tops are most common. The BpS generally occurs on igneous, metamorphic, and sedimentary material-derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. *Pinus ponderosa* is the predominant conifer; *Pseudotsuga menziesii*, *Pinus edulis*, and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus montanus*, *Purshia tridentata*, *Quercus gambelii*, *Symphoricarpos oreophilus*, and *Rosa* spp. common species. *Pseudoroegneria spicata* and species of *Hesperostipa*, *Achnatherum*, *Festuca*, *Muhlenbergia*, and *Bouteloua* are some of the common grasses. *Pinus ponderosa* / *Purshia tridentata* represents the extreme with typically a high percentage of rock and bare soil present.
A:All 10540010	**Early-all**: 5-60% cover of shrub/grass; conifer seedlings <5m can be abundant; <8” DBH
B:Closed (aka: B) 10540021	**Mid-closed**: 31-60% cover of ponderosa pine dominant while pinyon, juniper, Douglas-fir, and white fir may be present, 5-10m tall; dense shrub cover possible; 8”-19” DBH
B:Open (aka: C) 10540022	**Mid-open**: 5-30% cover of ponderosa pine (dominant) 5-10m tall; abundant shrub and grass cover; 8”-19” DBH

C:Open (aka: D) 10540032	**Late-open**: 5-30% cover of ponderosa pine (dominant) 11-50m tall; abundant shrub and grass cover; ≥20" DBH
C:Closed (aka: E) 10540030	**Late-closed**: 31-80% cover of ponderosa pine dominant while Douglas-fir, pinyon, juniper, and white fir present 11-50m tall; bitterbrush and mountain snowberry common; ≥20" DBH
U-A:Annual Spp (aka: AG) 10540100	**Annual-Species**: >10% cover of non-native annual grass; ponderosa pine saplings may be present.
U-A:Bare Ground (aka: BAGR) 10540101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:FIC-All 10540151	**Fire-Intolerant Conifers-Early:** ≥10% herbaceous cover; cover of mountain big sagebrush, black sagebrush, or bitterbrush increases with succession; charred trunks and limbs of conifers and curl-leaf mountain mahogany should be visible; no or very scattered ponderosa pine trees may be present; historically-logged stumps of ponderosa pine sometimes found
U-A:SI (aka: SDI) 10540129	**Seeded-Introduced**: >10% cover of seeded introduced grass and forbs; <5% cover of non-native annual species.
U-A:SI+AS (aka: SDI+AG) 10540138	**Seeded-Introduced+Annual-Species**: >10% cover of seeded introduced grass and forbs; ≥5% cover of non-native annual species.
U-B:FIC-Closed 10540251	**Fire-Intolerant Conifers-Mid-Closed:** >20% cover of young (<100 yrs old) pinyon, juniper, and/or curl-leaf mountain mahogany; 10-20% shrub cover; <20% herbaceous cover; no or very scattered ponderosa pine trees may be present; historically-logged stumps of ponderosa pine sometimes found
U-B:FIC-Open 10540252	**Fire-Intolerant Conifers-Mid-Open:** 11-20% cover of young (<100 yrs old) pinyon, juniper, and/or curl-leaf mountain mahogany; 10-20% shrub cover; <20% herbaceous cover; no or very scattered ponderosa pine trees may be present; historically-logged stumps of ponderosa pine sometimes found

U-C:FIC-Closed 10540351	**Fire-Intolerant Conifers-Late-Closed:** >20% cover of older (≥100 yrs old) pinyon, juniper, and/or curl-leaf mountain mahogany; no or very scattered ponderosa pine trees may be present; historically-logged stumps of ponderosa pine sometimes found
U-C:FIC-Open 10540352	**Fire-Intolerant Conifers-Late-Open:** ≤20% cover of older (≥100 yrs old) pinyon, juniper, and/or curl-leaf mountain mahogany; no or very scattered ponderosa pine tree may be present; historically-logged stump of ponderosa pine sometimes found; no or very scattered ponderosa pine tree may be present; historically-logged stumps of ponderosa pine sometimes found
U-C:TEA (aka: TA) 10540344	**Tree-Encroached or with Annual-Species**: Any class B,C,D, or E plus >5% cover of non-native annual grass.
Pure Spruce (PS) 10561	*Overview:* The Pure Spruce BpS is found at elevations above 3,290 m (10,800') in the high subalpine zone on gentle to moderately steep terrain (10-60% slopes) only on Boulder Mountain Top in the project area. This forest type is typically found on plateau like surfaces. The overstory is entirely dominated by Engelmann spruce. Understory shrub, forbs, and graminoid species are limited to a high elevation species and can sometimes be diverse. Litter is often the dominant ground cover. Fires appears rare to non-existent on Boulder top, however single tree mortality creates micro-gap dynamics of regeneration.
A:All 10561010	**Early**: 5-100% cover of Engelmann spruce seedling/shrub/grass <5m tall; 0-39 yrs.
B:Closed 10561021	**Mid1-closed**: 40-100% cover of Engelmann spruce, 5-24m (pole size); 40-129 yrs.
B:Open 10561022	**Mid1-open**: 5-39% cover of Engelmann spruce, 5-24m (pole size); 40-129 yrs.
C:Closed 10561030	**Late1-closed**: 40-100% cover of Engelmann spruce 25-49m tall; ≥130 yrs.

Riparian-Blue Spruce (RBS) 11545	*Overview*: The Riparian-Blue Spruce system occupies narrow cold air drainages often associated with mountain streams, although dry washes that appear to be sub-irrigated cold air drainages also qualify. Blue spruce (*Picea pungens*) is an indicator species nearly always found with water birch (*Betula occidentalis*). Other common species that should be considered incidental are aspen (*Populus tremuloides*), narrowleaf cottonwood (*Populus angustifolia*), Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), and Engelmann spruce (*Picea engelmannii*). Horsetail (*Equisetum arvense***)** is often present and considered an herbaceous indicator.
A:All 11545010	**Early-all**: 0-15% cover of young trees/shrub/grass; <5m; <8 in DBH
B:Closed 11545021	**Mid1-closed**: 35-100% cover of pole-sized blue spruce and other trees 5-10m; 8-19 in DBH
C:Closed 11545030	**Late1-closed**: 35-100% cover of mature blue spruce, other conifers and deciduous trees; water birch present to common in midstory >10m; >19 in DBH
A:Bare Ground 11545001	**Bare Ground**: >70% mud, sand, slit, or rocky material from severe flooding; >5% coarse woody debris
Roads-Local 10032	*Overview*: County-maintained dirt roads and larger unmaintained dirt roads, but not two-tracks.
U-A:Bare Ground 10032101	**Bare-Ground**: Local dirt road bigger than two-track road.
Roads-Paved 10031	*Overview*: Paved roads.
U:Paved 10031120	**Paved**: Paved road.

Saline Meadow (SM) 11451	*Overview*: The Saline Meadow BpS is found at the bottom of broad valleys or axial valley, and on alluvial flats at elevations of 1,219 m to 1,829 m (4,000' to 6,000') with slopes between 0-4%, although more typically <2%, usually surrounded by salt tolerant plant communities. The BpS is wetted by an elevated water table at a depth of 102 cm (40") on saline soils and between 51-102 cm (20" to 40") on sodic floodplains that periodically rise to the surface during the spring or is spring-fed in broad valley bottoms. Saturated soils support graminoid dominance. Soils are deep saline and often calcareous or sodic and made of alluvium of mixed origins. Average annual precipitation ranges from 15 to 25 cm (6" to 10"). Alkali sacaton (*Sporobolus airoides*) and alkali muhly (*Muhlenbergia asperifolia*) dominate, although inland saltgrass (*Distichlis spicata*), and alkali cordgrass (*Spartina gracilis*) may co-dominate. Inland saltgrass dominates on sodic soils. Black greasewood (*Sarcobatus vermiculatus*), iodine bush (*Allenrolfea occidentalis*), silver buffaloberry (*Shepherdia argentea*), alkali rabbitbrush (*Chrysothamnus albidus*), and willow (*Salix* spp.) may be present at low abundance. As the sodium concentration in the soil increases, vegetation cover decreases from <70% to <15%.
A 11451010	**Early-all**: 10-39% alkali sacaton and other salt-tolerant grasses cover; >60% mineral soil cover; 0-2 yrs
B 11451021	**Mid-closed**: ≥40% alkali sacaton and other salt-tolerant grasses cover; >30% mineral soil cover; <5% shrub cover; 3-22 yrs
C 11451032	**Late-open**: 5-10% shrub (greasewood and other shrubs) cover; ≥40% alkali sacaton and other salt-tolerant grasses cover; >50% mineral soil cover; >22 yrs
U-A:Annual Spp (aka: AS) 11451100	**Annual-Species**: ≥10% cover of non-native annual species; <10% inland saltgrass, Baltic rush cover, and other salt-tolerant grasses cover; <10% shrub cover; >30% mineral soil cover
U-A:Bare Ground (aka: BAGR) 11451101	**Bare-Ground**: **Bare-ground:** Mostly mineral soil due to anthropogenic disturbances
U-B:Depleted (aka: DP) 11451203	**Depleted**: <5% shrub cover (greasewood and other shrubs); <40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground
U-C:Depleted (aka: DP) 11451303	**Depleted**: ≥5% shrub cover (greasewood and other shrubs); <40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground

U-A:Exotic-Forb-Tree (aka: EFT) 11451106	**Exotic-Forb-Tree-early**: >5% cover of exotic forb species or tree species (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 10-39% alkali sacaton and other salt-tolerant grasses cover; native shrub absent; 10-30% cover of bare ground
U-B:Exotic-Forb-Tree (aka: EFT) 11451206	**Exotic-Forb-Tree-mid,**: >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); <5% shrub cover (greasewood and other shrubs); ≥40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground
U-C:Exotic-Forb-Tree (aka: EFT) 11451306	**Exotic-Forb-Tree-late**: >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); ≥5% shrub cover (greasewood and other shrubs); ≥40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground
U-A:Hummocked (aka: HU) 11451110	**Hummocked:** Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs
U-A:SAP (aka: ASPG) 11451124	**Shrub-Annual-Species-Perennial-Grass-early** : ≥5% cover of non-native annual species; 10-39% inland saltgrass, Baltic rush cover, and other salt-tolerant grasses cover; native shrubs absent; >20% mineral soil cover
U-B:SAP 11451224	**Shrub-Annual-Species-Perennial-Grass-mid**: ≥5% non-native annual species cover; <5% cover of native shrubs; ≥40% inland saltgrass and Baltic rush cover
U-C:SAP 11451324	**Shrub-Annual-Species-Perennial-Grass-late**: ≥5 non-native annual species cover; ≥5% cover of native shrubs; ≥10% inland saltgrass and Baltic rush cover
Seep 11546	*Overview*: The Seep BpS is a localized system that is disconnected from true streams or desert washes. Seeps are typically small (<1 acre) and while likely sub-irrigated water is rarely observed. The BpS can be found in many landform positions where sub-irrigation occurs. Tall shrubs and vines (*Clematis* spp.) dominate in near impenetrable tickets. Common shrubs are *Rosa Woodsii, Rhus trilobata, Amelanchier Utahensis, and Ribes cereum.*
A:All	**Early-all**: >5% shrub cover; Shrub height <1m after fire or flash flood (if in proximity of lateral dry washes); 0-2 yrs
B:Closed	**Mid-Closed**: >60% shrub cover; >5% cover of vines; >2 yrs after fire or flash flood

Semi-Desert Grassland (SDG) 11350	*Overview*: The Semi-Desert Grassland BpS occupies sandy soil. Indian ricegrass (*Stipa hymenoides*) is often the diagnostic and dominant grass species. In Boulder Mountain, these grasslands occur as local and small upland terraces along streams or dry washes in canyons where sandstone and slick rock dominate the geology. The BpS is often adjacent to ponderosa pine. Substrates are often well-drained sandy or loamy-textured soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. These grasslands occur on a variety of aspects and slopes. Sites may range from flat to moderately steep. Grasslands within this system are typically characterized by a sparse to moderately dense herbaceous layer dominated by medium-tall and short bunch grasses, often in a sod-forming growth. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants.
A:All 11350010	**Early-all**: <5% shrub cover (rabbitbrush); >10% cover of grasses (Indian ricegrass, needle-and-thread, galleta, dropseeds); sandy soil cover may be high; 0-19 yrs.
B:Closed 11350021	**Mid-closed**: ≥5% shrub cover (rabbitbrush, big sagebrush); >25% cover of grasses (Indian ricegrass, needle-and-thread, galleta, dropseeds); sandy soil cover may be high; ≥20 yrs.
U-A:Bare Ground (aka: BAGR) 11350101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-B:Depleted (aka: DP) 11350203	**Depleted**: ≥5% shrub cover (mostly rabbitbrush, big sagebrush); <10% cover of grasses; 10-30% cover of bare ground; sandy soil cover may be high.
U-A:Early-Shrub (aka: ES) 11350105	**Early Shrub**: 10-30% cover of rabbitbrush; 10-30% cover of bare ground; <10% cover of native grass; sandy soil cover may be high.
U-A:Seeded Native (aka: SD) 11350135	**Seeded-Native**: >10% cover of seeded native grasses, forbs, and shrubs; <5% non-native annual species cover.

U-A:SI (aka: SDI) 11350129	**Seeded-Introduced**: >10% cover of introduced seeded grass species; <5% cover of non-native annual species; shrubs may be present; sandy soil cover may be moderately high.
U-A:SI+AS (aka: SDI+AG) 11350138	**Seeded-Introduced+Annual-Species**: >10% cover of introduced seeded grass species; ≥5% cover of non-native annual grasses; shrubs may be present; sandy soil cover may be moderately high.
U-B:SAP 11350224	**Shrub-Annual-Perennial-Grass-Late**: 5-14% cover of non-native annual grasses; ≥5% shrub cover (mostly rabbitbrush, sagebrush); native grasses may be present to common; sandy soil cover may be high.
Silver Sagebrush (SS) **11262**	*Overview*: The Silver Sagebrush BpS (a.k.a., mountain big sagebrush-silver sagebrush) is generally found on the Aquarius Plateau (though not on Boulder Top) where glaciation created mima mounds that appear as pimples about 10m in diameter surrounded by subalpine grass-dominated meadows. While this system behaves as a special case of montane sagebrush steppe, silver sage has a very distinct landform. Elevation is generally above 2,590 m (8,500') on the Aquarius Plateau. In general, this system shows an affinity for mild topography, fine soils, and subsurface moisture. Soils generally are moderately deep to deep, well-drained, and made of loam, sandy loam, clay loam, or gravelly loam textural classes. This system primarily occurs on large plateaus and benches where glacial deposits could form mima mounds. Vegetation types are usually dominated by silver sagebrush (*Artemisia cana*). A variety of other high-elevation shrubs (shrubby cinquefoil or *Potentilla fruticosa*) can be found in some occurrences, but these are seldom dominant. Abundant forbs are an indicator of good range condition. Subalpine grasses are abundant, sometimes very abundant, and often diverse.
A:All 11262010	**Early-all**: <20% cover of silver sagebrush;10-80% grass and forb cover; 0-12 yrs.
B:Open 11262022	**Mid-open**: ≥20% cover of silver sagebrush; >50% herbaceous cover; 13-38 yrs.
U-A:Bare Ground (aka: BAGR) 11262101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.

U-A:Early-Shrub (aka: ES) 11262105	**Early-Shrub**: >20% cover of increaser shrub species resistant to grazing
U-B:Depleted (aka: DP) 11262303	**Depleted**: >30% cover of silver sagebrush; <5% herbaceous cover; litter and mineral soil common.
Sparsely Vegetated (Sparse) 10030	*Overview*: Mostly barren area with 1-5% cover of vegetation scattered on mud hills, bedrock, rock talus, and mostly bare cliffs.
A:Sparse 10030002	**Sparse**: Mostly barren area with 1-5% cover of vegetation scattered on mud hills, bedrock, rock talus, but not cliffs.
A:Cliff 10030007	**Cliff**: Mostly barren area with 1-5% cover of vegetation scattered on only cliffs and narrow cliff ledges. Isolated shrubs and pedestalled grasses might be visible from a distance.
Spruce-Fir (SF) 10560	*Overview:* The Spruce-Fir BpS is found at elevations typically ranging from 2,590 m to 3,353 m (8,500-11,000') in the subalpine zone on gentle to moderately steep terrain (10-60% slopes). These forests are found on mountain slopes, high-elevation ridge tops and upper slopes, plateau like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. The overstory is typically dominated by Engelmann spruce and subalpine fir. This system is different from the pure Engelmann spruce forest type BpS found only on Boulder Top. Other tree species may include aspen maintained as suppressed shrubs following the early phase, limber pine, bristlecone pine, and Douglas-fir. Understory shrub, forbs, and graminoid species are limited to a few high elevation species. Litter is often the dominant ground cover.
A:All 10560010	**Early**: 5-100% cover of Engelmann spruce and subalpine fir seedling/shrubby aspen, shrub/grass <5m tall; 0-39 yrs.

B:Closed 10560021	**Mid1-closed**: 40-100% cover of Engelmann spruce and subalpine fir, and may include stunted aspen, 5-24m tall (pole size); 40-129 yrs.
B:Open 10560022	**Mid1-open**: 5-39% cover of Engelmann spruce and subalpine fir, 5-24m tall (pole size); 40-129 yrs.
C:Closed 10560030	**Late1-closed**: 40-100% cover of Engelmann spruce and subalpine fir 25-49m tall; ≥130 yrs.
Subalpine-Montane Mesic Meadow (MM) 11460	*Overview:* The Subalpine-Montane Mesic Meadow BpS typically occurs between 2,200 and 3,000 m (7,218' and 9,842') on flat to rolling plains and parks or on lower sideslopes that are dry, but it may extend up to 3,350 m (10,990') on warm aspects. These prairie sites are drier than dry wet meadows (BpS 11453), although they are expected to be saturated during snow melt, which they depend on to prevent tree establishment. This system is not spring-fed and does not require subalpine lake sub-irrigation. Soils resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acidic, and usually well-drained. This BpS usually consists of a mosaic of two or three plant communities with one of the following dominant grasses: *Danthonia californica*, *Muhlenbergia filiculmis*, *Elymus spicatus*, or various sedges (*Carex* spp.) in moist (concave) sites. Subdominants include *Muhlenbergia montana*, *Boutela gracilis*, and *Poa secunda*. These large-patch grasslands are intermixed with matrix stands of spruce-fir, ponderosa pine, and aspen forest.
A:All 11460010	**Early-all:** 5-34% herbaceous cover dominated by graminoids with sedges and rushes in localized wetter spots; mineral soil cover may be high; 0-4 yrs.
B:Closed 11460021	**Mid-closed**: 35-100% herbaceous cover dominated by graminoids with sedges and rushes in wetter spots; <65% cover of mineral soil; >5 yrs.
U-A:SI (aka: SDI) 11460129	**Seeded-Introduced:** >10% seeded introduced grasses (usually smooth brome); 35-100% herbaceous cover dominated by graminoids with sedges and rushes in wetter spots; <65% cover of mineral soil.
U-A:Shrb-Frb-Encr (aka: SFE) 11460137	**Shrub-Forb-Encroached**: ≥10% cover of unpalatable forbs (typically, skunk cabbage = false hellebore or *Veratrum californicum*), shrubs (e.g., Wood's rose, shrubby cinquefoil [*Potentilla fruticosa*]), or Baltic rush (early succession); 5-64% graminoid cover; occasional conifers may be present; mineral soil cover variable but usually high.

Subalpine Upper-Montane Riparian (SR) 11600	Overview**:** The Subalpine Upper-Montane Riparian is found above 2,438m (8,000') and 2,286m (7,500 ft), respectively, in the southern and northern parts of the project area where very small upper-montane and subalpine creeks, seeps, and rivulets are bordered by dense willows and herbaceous patches. It is often present as willow thickets in high-elevation snow basins and seep/spring areas where a single channel is not obvious because of the presence of many rivulets. With succession, conifers from adjacent forest stands can sometimes encroach among willow clumps, but they never dominate because soils are too water-logged.
A:All 11600010	**Early-all**: 10-29% cover of willow <3m tall; 10-30% cover of graminoids and forbs; 10-50% cover of bare ground; 0-4 yrs.
B:Closed 1160021	**Mid-closed:** 30-100% cover of willow 3-5m tall; ≥10% cover of graminoids and forbs; 10-50% cover of bare ground; conifer saplings may be present; 5+ yrs.
C:Open 1160032	**Late-open**: >10% cover of conifers 5-10m tall; 30-100% cover of willow 3-5m tall; ≥10% cover of graminoids and forbs; 10-50% cover of bare ground; 37+ yrs.
U-A:Unpalat. Forb (A UF, B UF, C UF) 11600146	**Unpalatable Forb**: >10% cover of unpalatable forbs (e.g., iris) dominate in herbaceous areas between willows clumps; ≥10% cover of graminoids; 10-50% cover of bare ground; conifers can be present.

Upper Subalpine Grassland (USG) 11401	*Overview*: The Upper Subalpine Grassland BpS generally occurs above 3,353 m (11,000') on Boulder Top. Silver sagebrush is absent and is replaced by shrubby cinquefoil (*Potentilla fruticosa*). While shallow subalpine mounding is present, mima mounds are not found on Boulder Top. The soils are moderately deep to very deep to bedrock and well drained. These soils are modified by high volumes of pebbles, gravel, rock fragments through their profile. On rocky soils, some shrub species increase in cover. There is no reported evidence that fire is a known process in the BpS at that elevation. Heavy snow accumulation on this site often persists into summer and significantly reduces the potential plant growth period. Snow melt adds to the soil moisture supply. The BpS has medium to rapid potential for surface erosion on moderate to high slopes. Graminoids are dominant, with Sandberg bluegrass (*Poa secunda)* and sheep fescue (*Festuca ovina*) being the most abundant. Pedestalling of graminoid clumps is noticeable in many locations. A variety of forbs are present, subordinate to the graminoids. Shrub species such as shrubby cinquefoil (*Potentilla fruticosa*) and mountain gooseberry (*Ribes montigenum*) are incidental to common, especially on rockier soil.
A:All 11410010	**Early-all**: 5-19% grass cover; ≤20% forb cover; abundant bare ground and rock cover; <5% shrub cover; 0-4 yrs.
B:Closed 11410021	**Mid-closed**: ≥20% graminoid cover; ≤10% forb cover; abundant bare ground and rock cover; <5% shrub cover; ≥5+ yrs.
C:Open 11410032	**Late-open**: 5-10% cover of shrubs (mostly shrubby cinquefoil), especially on rockier soil; ≥20% graminoid cover; common bare ground and rock cover; <5% palatable forb cover; >150 yrs.
U-C:Shrb-Frb-Encr (aka: SFE) 11410337	**Shrub-Forb Encroached**: >10% cover of shrubs, especially shrubby cinquefoil ; or > 20% cover of increaser forbs such as sneezeweed (*Hymenoxys hoopesii*); abundant bare ground and rock cover
Water 10040	*Overview*: Consists of both natural and human-made water bodies.
Water 10040011	**Water**: Natural water body.
U:Water 10040148	**Anthropogenic-Water**: Water in reservoir, impoundment, or irrigation ditch.

Wetland (WL) 11543	*Overview:* The Wetland BpS is found as inclusions in lakes or wet meadows on Boulder Mountain. Typically, wetland are found in small patches or at on the rim of lakes. Vegetation is dominated by bullrushes or, less frequently, cattails. Open water is not part of the wetland BpS as open water is a lake or wet meadow feature.
A:All 11543010	**Early-all**: <10% herbaceous cover – mostly bullrushes or cattail
B:Closed 11543021	**Late-closed**: ≥10% herbaceous cover – mostly bullrushes or cattail
Wet Meadow-Montane (WM) 11450	*Overview:* The Wet Meadow-Montane BpS is wetted by an elevated water table adjacent to creeks, rivers, lakes, or is spring-fed. Saturated soils support graminoid dominance. Elevation is generally below 2,490 m (8,500'). See Wet Meadow-Subalpine (WMS) BpS for wet meadows above 2,490 m. Rushes and sedges dominate in wetter soils, whereas tufted hairgrass and Sandberg bluegrass are more common father from the wettest areas. The presence of shrubs (aspen, willow, Wood's rose, sagebrush) at the meadow's edge increases during consecutive drought years and decreases during consecutive high water years.
A:All 11450010	**Early-all**: 10-60% herbaceous cover, mostly graminoids; 0-2 yrs.
B:Closed 11450021	**Mid-closed**: 61-100% herbaceous cover, mostly graminoids; 3-22 yrs.
C:Open 11450032	**Late-open**: 5-10% cover of trees-shrubs (willow, Wood's rose, sagebrush, aspen); 60-80% herbaceous cover, mostly graminoids; >22 yrs.
U-A:Annual Spp (aka: AG) 11450100	**Annual-Species (on incised meadow)**: >5% cover of non-native annual species; < 10% shrub cover.
U-A:Bare Ground (aka: BAGR) 11450101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:Exotic Forb (aka: EF) 11450108	**Exotic-Forb**: >5% cover of exotic forbs (knapweed, purple loosestrife, thistles).

U-A:Hummocked (aka: HUM) 11450110	**Hummocked**: Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs.
U-A:Inset 11450113	**Inset-Floodplain**: Functional wet meadow dominated by graminoids has formed on a new floodplain at the bottom of a widened incision.
U-A:Inset-EF 11450116	**Inset-Floodplain-Exotic-Forb**: Functional wet meadow dominated by graminoids has formed on a new floodplain at the bottom of a widened incision; >5% cover of exotic forbs (knapweed, purple loosestrife, thistles).
U-A:Inset-HU 11450117	**Inset-Floodplain-Hummocked**: Functional wet meadow has formed on a new floodplain at the bottom of a widened incision that has been trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs.
U-A:SI (aka: SDI) 11450129	**Seeded-Introduced**: ≥10% cover of introduced forage species (e.g., smooth brome, intermediate wheatgrass); >10% cover of native graminoids.
U-C:Desertified (aka: DES) 11450304	**Desertified (= incised)**: Entrenched water table with 10-50% cover of subxeric upland shrubs, such as sagebrush.
U-C:SA 11450321	**Shrub-Annual-Species (on incised meadow)**: >10% cover of native shrubs; <5% cover of native grasses; 5-30% cover of non-native annual species.
U-C:Shrb-Frb_Encr (aka: SFE) 11450337	**Shrub-Forb-Encroached**: >10%% cover of less palatable grasses and forbs (e.g., Iris) **OR** >10% cover of shrubs (willow, Wood's rose, sagebrush, aspen); 10-30% cover of bare ground.
U-C:TEA 11450344	**Tree-Encroached-Annual-Species (on incised meadow)**: >20% conifer cover 10-25m tall; <5% shrub cover; <5% native herbaceous cover; ≥0% cover of non-native annual species.

Wet Meadow-Subalpine (WMS) 11455	*Overview:* The Wet Meadow-Subalpine BpS is wetted by an elevated water table adjacent to lakes, creeks, rivers, or is spring-fed. These are common around lakes on the Aquarius Plateau and Boulder Top. Saturated soils support graminoid dominance. Elevation is generally above 2,490 m (8,500'). Rushes and sedges dominate in wetter soils whereas tufted hairgrass and Sandberg bluegrass increase are more common father from the wettest areas. The presence of shrubs (aspen, willow, silver sagebrush) at the meadow's edge increases during consecutive drought years and decreases during consecutive high water years.
A:All 11455010	**Early-all**: 10-60% herbaceous cover, mostly graminoids; 0-2 yrs.
B:Closed 11455021	**Mid-closed**: 61-100% herbaceous cover, mostly graminoids; 3-22 yrs.
C:Open 11455032	**Late-open**: 5-10% cover of trees and shrubs (willow, silver sagebrush, aspen); 60-80% herbaceous cover, mostly graminoids; >22 yrs.
U-A:Bare Ground (aka: BAGR) 11455101	**Bare-Ground:** Mostly mineral soil due to anthropogenic disturbances.
U-A:Exotic Forb (aka: EF) 11455108	**Exotic-Forb**: >5% cover of exotic forbs (thistles).
U-A:Hummocked (aka: HUM) 11455110	**Hummocked**: Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs.
U-A:Inset 11455113	**Inset-Floodplain**: Functional wet meadow dominated by graminoids has formed on a new floodplain at the bottom of a widened incision.
U-A:Inset-EF 11455116	**Inset-Floodplain-Exotic-Forb**: Functional wet meadow dominated by graminoids has formed on a new floodplain at the bottom of a widened incision; >5% cover of exotic forbs (thistles).
U-A:Inset-HU 11455117	**Inset-Floodplain-Hummocked**: Functional wet meadow has formed on a new floodplain at the bottom of a widened incision that has been trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs.

U-A:SI (aka: SDI) 11455129	**Seeded-Introduced**: ≥10% cover of introduced forage species (e.g., smooth brome, intermediate wheatgrass); >10% cover of native graminoids.
U-C:Desertified (aka: DES) 11455304	**Desertified (= incised)**: Entrenched water table with 10-50% cover of shrubs (silver sagebrush).
U-C:Shrb-Frb-Encr (aka: SFE) 11455337	**Shrub-Forb-Encroached**: >10%% cover of less palatable grasses and forbs (e.g., Iris) **OR** >10% cover of shrubs; (willow, sagebrush, aspen); 10-30% cover of bare ground.
Wyoming Big Sagebrush-upland soils (WSup) 10804	*Overview*: The Wyoming Big Sagebrush upland BpS is common in the Basin and Range and Colorado Plateau provinces. It ranges from 1,219 m to 2,132 m (4,000' - 7,000') in elevation, and occurs on well-drained soils on foothills, terraces, slopes and plateaus. It is found on soil depths greater than 45 cm (18") and up to 152 cm (60+"). The BpS is found between low elevation salt desert shrub typically unfavorable to tree establishment, and higher elevation mountain big sagebrush zones where pinyon and juniper can establish. The BpS occurs from 10 cm to 35 cm (4 to 14") precipitation zones; however, Wyoming big sagebrush requires 20-30 cm (8-12") of effective moisture within this broader range. Thus, other site characteristics (e.g. aspect, drainage) should be considered in identifying this BpS. At the precipitation extremes, this BpS generally occurs as small patches and stringers. Shrub canopy cover generally ranges from 5 to 25% but can exceed 30% at the upper elevation and precipitation zones. Wyoming big sagebrush sites have fewer understory species relative to other big sagebrush types. Rubber rabbitbrush may be co-dominant and basin big sagebrush might occur on concave sites with finer soils. Perennial forb cover is usually <10% and perennial grass cover reaches 20 - 25% on more productive sites. Bluebunch wheatgrass may be a dominant species following replacement fires and as a co-dominant after 20 years, but only in precipitation zones above 25 cm (10"). Bottlebrush squirreltail and Indian ricegrass are common on more xeric sites. Percent cover and species richness of understory are determined by site limitations. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) are present, occasionally reaching 50% canopy cover in areas where recent fire has not occurred.
A:All 10804010	**Early-all**: 10-25% herbaceous cover; <10% cover of rabbitbrush species; <10% cover of Wyoming big sagebrush; 0-20 yrs.

B:Open 10804022	**Mid-open**: 11-20% cover of Wyoming big sagebrush; 10-25% herbaceous cover; 20-60 yrs.
C:Closed 10804030	**Late1-closed**: >20% cover of Wyoming big sagebrush; 10-20% native herbaceous cover; 60-100 yrs.
D:Open 10804042	**Late2-open**: 0-15% cover of pinyon or juniper saplings <5m tall; 10-25% cover of Wyoming big sagebrush; <15% native herbaceous cover; 100-150 yrs.
E:Closed 10804050	**Late2-closed**: >20% cover of pinyon or juniper <10m tall; <10% cover of Wyoming big sagebrush; ~5% native herbaceous cover; 150+ yrs.
U-A:Annual Spp (aka: AG) 10804100	**Annual-Species**: >10% cover of non-native annual species.
U-A:Bare Ground (aka: BAGR) 10804101	**Bare Ground**: Primarily bare ground due primarily to anthropogenic disturbances.
U-A:Early-Shrub (aka: ES) 10804105	**Early-Shrub**: >10% cover of rabbitbrush species.
U-A:Exotic Forb (aka: EF) 10804108	**Exotic-Forb**: >5% cover of halogeton, exotic mustards, or thisltles; <10% cover of non-native annual species; >50% cover of mineral soil.
U-A:SAP (aka: AGPG) 10804124	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover non-native annual species; <10% cover of Wyoming big sagebrush <0.5m tall; ≥5% cover of native grasses; pinyon-juniper absent.
U-A:Seeded Native (aka: SD) 10804135	**Seeded-Native**: >10% cover of seeded native grasses, forbs, and shrubs; <5% cover of non-native annual species.
U-A:SI (aka: SDI-A) 10804129	**Seeded-Introduced-Early**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of rabbitbrush species; <10% cover of Wyoming big sagebrush; native grass may be present to common; <5% cover of non-native annual species.

U-A:SI+AS 10804138	**Seeded-Introduced-Early+Annual-Species**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of rabbitbrush species; <10% cover of Wyoming big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species.
U-B:SAP 10804224	**Shrub-Annual-Species-Perennial-Grass**: 5-14% cover of non-native annual species; ≥10% cover of Wyoming big sagebrush <0.5m tall; 5-20% cover of native grasses; scattered pinyon-juniper saplings may be present later in succession.
U-B:SAP+ (aka: SAP) 10804230	**Shrub-Annual-Species-Perennial-Grass+**: ≥15% cover of non-native annual species; ≥10% cover of Wyoming big sagebrush <0.5m tall; 5-20% cover of native grasses; scattered pinyon-juniper saplings may be present later in succession.
U-B:SI (aka: SDI-B) 10804229	**Seeded-Introduced-Mid-open**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 11-20% cover of Wyoming big sagebrush; native grass may be present to common; <5% cover of non-native annual species.
U-B:SI+AS 10804238	**Seeded-Introduced-Mid-open+Annual-Species**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 11-20% cover of Wyoming big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species.
U-C:Depleted (aka: DP) 10804303	**Depleted**: >20% cover of Wyoming big sagebrush (dominant); <5% herbaceous cover; <30% cover of conifer saplings; litter and mineral soil common.
U-C:SA 10804321	**Shrub-Annual-Species**: 5-14% cover of non-native annual species; ≥10% cover off Wyoming big sagebrush <0.5m tall; scattered pinyon-juniper saplings may be present; native grasses rare.
U-C:SA+ 10804325	**Shrub-Annual-Species+**: ≥15% cover of non-native annual species; ≥10% cover of Wyoming big sagebrush <0.5m tall; scattered pinyon-juniper saplings may be present; native grasses rare.
U-C:SAP 10804324	
U-C:SI (aka: SDI-C) 10804329	**Seeded-Introduced-Late1-closed**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 20-40% cover of Wyoming big sagebrush; native grass may be present to common; <5% cover of non-native annual species.

U-C:SI+AS 10804338	**Seeded-Introduced-Late1-closed+Annual-Species**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 20-40% cover of Wyoming big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species.
U-D:SAP 10804424	
U-D:SI (aka: SDI-D) 10804429	**Seeded-Introduced-Late2-open**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 0-15% cover of pinyon or juniper saplings <5m tall; 10-25% cover of Wyoming big sagebrush; native grass may be present to common; <5% cover of non-native annual species.
U-D:SI+AS 10804438	**Seeded-Introduced-Late2-open+Annual-Species**: ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 0-15% cover of pinyon or juniper saplings <5m tall; 10-25% cover of Wyoming big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species.
U-E:TEA 10804544	**Tree-Encroached-Annual-Species**: 11-60% cover of trees 5-9m tall; non-native annual species may be present to abundant; native grasses absent or present in trace amounts.

Appendix 2

Python script to resample vegetation rasters from 1m to 25m.

```
############
## SETUP ##
############

# Import ArcGIS modules
import arcpy
from arcpy import env
from arcpy.sa import *

# Make sure the Spatial Analyst extension is on
arcpy.CheckOutExtension("spatial")

# Set environment settings
env.workspace = r'K:\GIS3\Projects\BoulderMtn\Maps\BoulderMtn\BoulderMtn.gdb'
env.overwriteOutput = True

def checkrowcol(raster):
   rows = arcpy.GetRasterProperties_management(raster, "ROWCOUNT")
   cols = arcpy.GetRasterProperties_management(raster, "COLUMNCOUNT")
   return int(rows.getOutput(0)), int(cols.getOutput(0))

########################
## RESAMPLE 1m TO 25m ##
########################

# 1-meter raster with BM priority rank field
bm =
arcpy.Raster(r'K:\GIS3\Projects\BoulderMtn\Geodata\Raster\BMt_Landscape_1m_033023.tif')
print([f.name for f in arcpy.ListFields(bm)])
```

```
## RESAMPLE WITH VEGETATION PRIORITY ##
# 1 meter environment
env.snapRaster = bm
env.cellSize = 1

# Extract cells where vegetation priority values are greater than 0
priorityExtract = ExtractByAttributes(bm, "Revised_BM > 0")

# Compute block statistics in 25m window
priorityBlockStat = BlockStatistics(priorityExtract, NbrRectangle(25, 25, "CELL"), "MAXIMUM",
"DATA")

# 25m environment
dem25 =
arcpy.Raster(r'K:\GIS3\Projects\UT_LCF_merge\Maps\UT_LCF\UT_LCF.gdb\ut_dem_25m2')
env.snapRaster = dem25
env.cellSize = 25
veg_prior = arcpy.Resample_management(priorityBlockStat, "veg_prior", "25", "NEAREST")

# Join info from priorityextract raster
arcpy.JoinField_management(veg_prior, 'Value', priorityExtract, 'Value', ['SYSXCLA'])

# Lookup on SYSXCLA
veg_resamp = Lookup(veg_prior, 'SYSXCLA')
veg_resamp.save('veg_resamp')
checkrowcol(veg_resamp)


## RESAMPLE WITHOUT VEGETATION PRIORITY ##
```

```
# Run Majority Filter on original raster w/o regard to PRIORITY codes, then resample at 25-m resolution
env.snapRaster = bm
env.cellSize = 1
copy = Lookup(bm, "SYSXCLA")
copy.save('temp_bm_1m')

# Want to nibble into roads!!
# Roads become null then nibble in from surrounding pixels - roads will be stamped later
# Make all non-road pixels = NoData
copy_noroads = SetNull(copy, copy, "VALUE <> 10032101")

# Make a mask where all NoData pixels (non-roads) = 1; road pixels = NoData
roads_mask = Con(IsNull(copy_noroads), 1)
roads_mask.save(r'bm_nullroads')

# Have neighboring pixels "Nibble" into the empty road pixels
roads_mask = arcpy.Raster(r'bm_nullroads')
bm_nibble = arcpy.sa.Nibble(copy, roads_mask)
arcpy.BuildRasterAttributeTable_management(bm_nibble)
majorStat = BlockStatistics(bm_nibble, NbrRectangle(25, 25, "CELL"), "MAXIMUM", "DATA")

# Resample to 25m
env.snapRaster = dem25
env.cellSize = dem25
orig_resamp = arcpy.Resample_management(majorStat, "orig_resamp", "25", "NEAREST")

## ROADS STAMP ##

env.snapRaster = dem25
```

```
env.cellSize = dem25
break_roads = 'bmt_fuelbreak_roads'
rd_stamp = arcpy.Raster(r'road_stamp')

## MOSAIC ROADS ONTO VEG-PRIORITY - THEN MOSAIC ONTO BACKGROUND/NO-PRIORITY RASTER ##

# Mosaic the resampled layers:
env.snapRaster = dem25
env.cellSize = dem25

mos = arcpy.MosaicToNewRaster_management(['road_stamp', 'veg_resamp', 'orig_resamp'], env.workspace, "bm_mos", "", "32_BIT_SIGNED", 25, 1, "FIRST", "")

arcpy.BuildRasterAttributeTable_management(mos)
arcpy.JoinField_management(mos, "Value", bm, "SYSXCLA", ["SYS_NAME", "SYS_CODE", "CLA_NAME", "CLA_CODE", "SYSXCLA", "Class_Name"])
print(checkrowcol('bm_mos'))
print(checkrowcol('orig_resamp'))

# Clip to original resampled layer - roads have little stringers outside the project area
bm_mask = arcpy.sa.ExtractByMask('bm_mos', 'orig_resamp')
print(checkrowcol(bm_mask))

# Save full 25m raster with all fields
arcpy.CopyRaster_management(bm_mask, r'K:\GIS3\Projects\BoulderMtn\Geodata\Raster\BMt_Landscape_033023.tif')
```

Appendix 3

System	StateClassSource	StateClassDestination	Transition	Probability	Proportion	AgeMin	AgeMax	AgeRelative	AgeReset	TSTMin
Aspen Woodland	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	12
Aspen Woodland	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	12
Aspen Woodland	A:All	A:All	Sheep-Grazing	1	0.999	3		1	No	12
Aspen Woodland	A:All	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	12
Aspen Woodland	A:All	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3			Yes	12
Aspen Woodland	A:All	U-A:LostAspen	Sheep-Grazing	1	0.001	3			Yes	12
Aspen Woodland	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen Woodland	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999				No	12
Aspen Woodland	B:Closed	B:Closed	Sheep-Grazing	1	0.999				No	12
Aspen Woodland	B:Closed	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen Woodland	B:Closed	U-B:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen Woodland	B:Closed	U-B:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen Woodland	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen Woodland	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999				No	12
Aspen Woodland	C:Closed	C:Closed	Sheep-Grazing	1	0.999				No	12

Aspen Woodland	C:Closed	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen Woodland	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen Woodland	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen Woodland	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen Woodland	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999				No	12
Aspen Woodland	D:Open	D:Open	Sheep-Grazing	1	0.999				No	12
Aspen Woodland	D:Open	U-D:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen Woodland	D:Open	U-D:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen Woodland	D:Open	U-D:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen Woodland	U-A:Depleted	U-A:Depleted	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	12
Aspen Woodland	U-A:Depleted	U-A:Depleted	Cattle-May->June-Grazing	1	0.999	3		2	No	12
Aspen Woodland	U-A:Depleted	U-A:Depleted	Sheep-Grazing	1	0.999	3		1	No	12
Aspen Woodland	U-A:Depleted	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	12
Aspen Woodland	U-A:Depleted	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001				Yes	12
Aspen Woodland	U-A:Depleted	U-A:LostAspen	Sheep-Grazing	1	0.001				Yes	12
Aspen Woodland	U-B:Depleted	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen Woodland	U-B:Depleted	U-B:Depleted	Cattle-May->June-Grazing	1				2	No	12

Aspen Woodland	U-B:Depleted	U-B:Depleted	Sheep-Grazing	1					No	12
Aspen Woodland	U-C:Depleted	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen Woodland	U-C:Depleted	U-C:Depleted	Cattle-May->June-Grazing	1					No	12
Aspen Woodland	U-D:Depleted	U-D:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen Woodland	U-D:Depleted	U-D:Depleted	Cattle-May->June-Grazing	1				2	No	12
Aspen Woodland	U-D:Depleted	U-D:Depleted	Sheep-Grazing	1				1	No	12
Aspen-Mixed Conifer	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	12
Aspen-Mixed Conifer	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	12
Aspen-Mixed Conifer	A:All	A:All	Sheep-Grazing	1	0.999	3		1	No	12
Aspen-Mixed Conifer	A:All	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3			No	12
Aspen-Mixed Conifer	A:All	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3			Yes	12
Aspen-Mixed Conifer	A:All	U-A:LostAspen	Sheep-Grazing	1	0.001	3			Yes	12
Aspen-Mixed Conifer	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Mixed Conifer	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999				No	12
Aspen-Mixed Conifer	B:Closed	B:Closed	Sheep-Grazing	1	0.999				No	12
Aspen-Mixed Conifer	B:Closed	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Mixed Conifer	B:Closed	U-B:Depleted	Cattle-May->June-Grazing	1	0.001				No	12

Aspen-Mixed Conifer	B:Closed	U-B:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Mixed Conifer	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Mixed Conifer	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999				No	12
Aspen-Mixed Conifer	C:Closed	C:Closed	Sheep-Grazing	1	0.999			1	No	12
Aspen-Mixed Conifer	C:Closed	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Mixed Conifer	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Mixed Conifer	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Mixed Conifer	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Mixed Conifer	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999				No	12
Aspen-Mixed Conifer	D:Open	D:Open	Sheep-Grazing	1	0.999			1	No	12
Aspen-Mixed Conifer	D:Open	U-D:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Mixed Conifer	D:Open	U-D:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Mixed Conifer	D:Open	U-D:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Mixed Conifer	U-A:Depleted	U-A:Depleted	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	12
Aspen-Mixed Conifer	U-A:Depleted	U-A:Depleted	Cattle-May->June-Grazing	1	0.999	3		2	No	12
Aspen-Mixed Conifer	U-A:Depleted	U-A:Depleted	Sheep-Grazing	1	0.999	3		1	No	12
Aspen-Mixed Conifer	U-A:Depleted	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3			No	12

Aspen-Mixed Conifer	U-A:Depleted	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3			Yes	12
Aspen-Mixed Conifer	U-A:Depleted	U-A:LostAspen	Sheep-Grazing	1	0.001	3			Yes	12
Aspen-Mixed Conifer	U-B:Depleted	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Mixed Conifer	U-B:Depleted	U-B:Depleted	Cattle-May->June-Grazing	1					No	12
Aspen-Mixed Conifer	U-B:Depleted	U-B:Depleted	Sheep-Grazing	1					No	12
Aspen-Mixed Conifer	U-C:Depleted	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Mixed Conifer	U-C:Depleted	U-C:Depleted	Cattle-May->June-Grazing	1					No	12
Aspen-Mixed Conifer	U-C:Depleted	U-C:Depleted	Sheep-Grazing	1					No	12
Aspen-Mixed Conifer	U-D:Depleted	U-D:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Mixed Conifer	U-D:Depleted	U-D:Depleted	Cattle-May->June-Grazing	1					No	12
Aspen-Mixed Conifer	U-D:Depleted	U-D:Depleted	Sheep-Grazing	1					No	12
Aspen-Ponderosa Pine	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	12
Aspen-Ponderosa Pine	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3			Yes	12
Aspen-Ponderosa Pine	A:All	A:All	Sheep-Grazing	1	0.999	3			Yes	12
Aspen-Ponderosa Pine	A:All	U-A:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005	6			No	12
Aspen-Ponderosa Pine	A:All	U-A:Depleted	Sheep-Grazing	1	0.0005	6			No	12
Aspen-Ponderosa Pine	A:All	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3	5		No	12

Aspen-Ponderosa Pine	A:All	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3			Yes	12
Aspen-Ponderosa Pine	A:All	U-A:LostAspen	Sheep-Grazing	1	0.0005	3	5		Yes	12
Aspen-Ponderosa Pine	A:Open	A:Open	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	12
Aspen-Ponderosa Pine	A:Open	A:Open	Cattle-May->June-Grazing	1	0.999	3			Yes	12
Aspen-Ponderosa Pine	A:Open	A:Open	Sheep-Grazing	1	0.999	3		1	No	12
Aspen-Ponderosa Pine	A:Open	U-A:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1	0.0005	6			No	12
Aspen-Ponderosa Pine	A:Open	U-A:Depl-ASP-PIPO	Cattle-May->June-Grazing	1	0.001	6			No	12
Aspen-Ponderosa Pine	A:Open	U-A:Depl-ASP-PIPO	Sheep-Grazing	1	0.0005	6			No	12
Aspen-Ponderosa Pine	A:Open	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3	5	160	Yes	12
Aspen-Ponderosa Pine	A:Open	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3	5	160	Yes	12
Aspen-Ponderosa Pine	A:Open	U-A:LostAspen	Sheep-Grazing	1	0.0005	3	5	160	Yes	12
Aspen-Ponderosa Pine	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Ponderosa Pine	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Ponderosa Pine	B:Closed	B:Closed	Sheep-Grazing	1	0.999			1	No	12
Aspen-Ponderosa Pine	B:Closed	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Ponderosa Pine	B:Closed	U-B:Depleted	Cattle-May->June-Grazing	1	0.001				No	12

Aspen-Ponderosa Pine	B:Closed	U-B:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Ponderosa Pine	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Ponderosa Pine	B:Open	B:Open	Sheep-Grazing	1	0.999			1	No	12
Aspen-Ponderosa Pine	B:Open	U-B:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Ponderosa Pine	B:Open	U-B:Depl-ASP-PIPO	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	B:Open	U-B:Depl-ASP-PIPO	Sheep-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Ponderosa Pine	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Ponderosa Pine	C:Closed	C:Closed	Sheep-Grazing	1	0.999			1	No	12
Aspen-Ponderosa Pine	C:Closed	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Ponderosa Pine	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Ponderosa Pine	C:Open	C:Open	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Ponderosa Pine	C:Open	C:Open	Sheep-Grazing	1	0.999			1	No	12

Aspen-Ponderosa Pine	C:Open	U-C:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Ponderosa Pine	C:Open	U-C:Depl-ASP-PIPO	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	C:Open	U-C:Depl-ASP-PIPO	Sheep-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	D:Closed	D:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Ponderosa Pine	D:Closed	D:Closed	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Ponderosa Pine	D:Closed	D:Closed	Sheep-Grazing	1	0.999			1	No	12
Aspen-Ponderosa Pine	D:Closed	U-D:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Ponderosa Pine	D:Closed	U-D:Depl-ASP-PIPO	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	D:Closed	U-D:Depl-ASP-PIPO	Sheep-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Ponderosa Pine	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Ponderosa Pine	D:Open	D:Open	Sheep-Grazing	1	0.999			1	No	12
Aspen-Ponderosa Pine	D:Open	U-D:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Ponderosa Pine	D:Open	U-D:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	D:Open	U-D:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Ponderosa Pine	U-A:Depl-ASP-PIPO	U-A:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	12

Aspen-Ponderosa Pine	U-A:Depl-ASP-PIPO	U-A:Depl-ASP-PIPO	Cattle-May->June-Grazing	1	0.999	3		2	No	12
Aspen-Ponderosa Pine	U-A:Depl-ASP-PIPO	U-A:Depl-ASP-PIPO	Sheep-Grazing	1	0.999	3		1	No	12
Aspen-Ponderosa Pine	U-A:Depl-ASP-PIPO	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3		160	Yes	12
Aspen-Ponderosa Pine	U-A:Depl-ASP-PIPO	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3		160	Yes	12
Aspen-Ponderosa Pine	U-A:Depl-ASP-PIPO	U-A:LostAspen	Sheep-Grazing	1	0.001	3		160	Yes	12
Aspen-Ponderosa Pine	U-A:Depleted	U-A:Depleted	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	12
Aspen-Ponderosa Pine	U-A:Depleted	U-A:Depleted	Cattle-May->June-Grazing	1	0.999	3		2	No	12
Aspen-Ponderosa Pine	U-A:Depleted	U-A:Depleted	Sheep-Grazing	1	0.999	3		1	No	12
Aspen-Ponderosa Pine	U-A:Depleted	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	12
Aspen-Ponderosa Pine	U-A:Depleted	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3			Yes	12
Aspen-Ponderosa Pine	U-A:Depleted	U-A:LostAspen	Sheep-Grazing	1	0.001	3			Yes	12
Aspen-Ponderosa Pine	U-B:Depl-ASP-PIPO	U-B:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Ponderosa Pine	U-B:Depl-ASP-PIPO	U-B:Depl-ASP-PIPO	Cattle-May->June-Grazing	1				2	No	12
Aspen-Ponderosa Pine	U-B:Depl-ASP-PIPO	U-B:Depl-ASP-PIPO	Sheep-Grazing	1					No	12
Aspen-Ponderosa Pine	U-B:Depleted	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Ponderosa Pine	U-B:Depleted	U-B:Depleted	Cattle-May->June-Grazing	1				2	No	12

Aspen-Ponderosa Pine	U-B:Depleted	U-B:Depleted	Sheep-Grazing	1					No	12
Aspen-Ponderosa Pine	U-C:Depl-ASP-PIPO	U-C:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Ponderosa Pine	U-C:Depl-ASP-PIPO	U-C:Depl-ASP-PIPO	Cattle-May->June-Grazing	1					No	12
Aspen-Ponderosa Pine	U-C:Depl-ASP-PIPO	U-C:Depl-ASP-PIPO	Sheep-Grazing	1					No	12
Aspen-Ponderosa Pine	U-C:Depleted	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Ponderosa Pine	U-C:Depleted	U-C:Depleted	Cattle-May->June-Grazing	1					No	12
Aspen-Ponderosa Pine	U-C:Depleted	U-C:Depleted	Sheep-Grazing	1					No	12
Aspen-Ponderosa Pine	U-D:Depl-ASP-PIPO	U-D:Depl-ASP-PIPO	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Ponderosa Pine	U-D:Depl-ASP-PIPO	U-D:Depl-ASP-PIPO	Cattle-May->June-Grazing	1				2	No	12
Aspen-Ponderosa Pine	U-D:Depl-ASP-PIPO	U-D:Depl-ASP-PIPO	Sheep-Grazing	1				1	No	12
Aspen-Ponderosa Pine	U-D:Depleted	U-D:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Ponderosa Pine	U-D:Depleted	U-D:Depleted	Cattle-May->June-Grazing	1				2	No	12
Aspen-Ponderosa Pine	U-D:Depleted	U-D:Depleted	Sheep-Grazing	1				1	No	12
Aspen-Spruce-Fir	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	12
Aspen-Spruce-Fir	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3			Yes	12
Aspen-Spruce-Fir	A:All	A:All	Sheep-Grazing	1	0.999	3		1	No	12

Aspen-Spruce-Fir	A:All	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3			No	12
Aspen-Spruce-Fir	A:All	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3			Yes	12
Aspen-Spruce-Fir	A:All	U-A:LostAspen	Sheep-Grazing	1	0.001	3			Yes	12
Aspen-Spruce-Fir	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Spruce-Fir	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Spruce-Fir	B:Closed	B:Closed	Sheep-Grazing	1	0.999			1	No	12
Aspen-Spruce-Fir	B:Closed	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Spruce-Fir	B:Closed	U-B:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Spruce-Fir	B:Closed	U-B:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Spruce-Fir	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	12
Aspen-Spruce-Fir	C:Open	C:Open	Cattle-May->June-Grazing	1	0.999			2	No	12
Aspen-Spruce-Fir	C:Open	C:Open	Sheep-Grazing	1	0.999			1	No	12
Aspen-Spruce-Fir	C:Open	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	12
Aspen-Spruce-Fir	C:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.001				No	12
Aspen-Spruce-Fir	C:Open	U-C:Depleted	Sheep-Grazing	1	0.001				No	12
Aspen-Spruce-Fir	U-A:Depleted	U-A:Depleted	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	12
Aspen-Spruce-Fir	U-A:Depleted	U-A:Depleted	Cattle-May->June-Grazing	1	0.999	3			Yes	12

Aspen-Spruce-Fir	U-A:Depleted	U-A:Depleted	Sheep-Grazing	1	0.999	3		1	No	12
Aspen-Spruce-Fir	U-A:Depleted	U-A:LostAspen	Cattle-Jul->Aprl-Grazing	1	0.0005	3			No	12
Aspen-Spruce-Fir	U-A:Depleted	U-A:LostAspen	Cattle-May->June-Grazing	1	0.001	3			Yes	12
Aspen-Spruce-Fir	U-A:Depleted	U-A:LostAspen	Sheep-Grazing	1	0.001	3			Yes	12
Aspen-Spruce-Fir	U-B:Depleted	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Spruce-Fir	U-B:Depleted	U-B:Depleted	Cattle-May->June-Grazing	1				2	No	12
Aspen-Spruce-Fir	U-B:Depleted	U-B:Depleted	Sheep-Grazing	1					No	12
Aspen-Spruce-Fir	U-C:Depleted	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1					No	12
Aspen-Spruce-Fir	U-C:Depleted	U-C:Depleted	Cattle-May->June-Grazing	1					No	12
Aspen-Spruce-Fir	U-C:Depleted	U-C:Depleted	Sheep-Grazing	1					No	12
Aspen-Spruce-Fir	U-D:Depleted	U-D:Depleted	Cattle-Jul->Aprl-Grazing	1					No	
Aspen-Spruce-Fir	U-D:Depleted	U-D:Depleted	Cattle-May->June-Grazing	1					No	
Aspen-Spruce-Fir	U-D:Depleted	U-D:Depleted	Sheep-Grazing	1					No	
Basin Big Sagebrush	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Basin Big Sagebrush	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Basin Big Sagebrush	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	

Basin Big Sagebrush	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Basin Big Sagebrush	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Basin Big Sagebrush	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Basin Big Sagebrush	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Basin Big Sagebrush	B:Open	B:Open	Sheep-Grazing	1	0.999			1	No	
Basin Big Sagebrush	B:Open	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Basin Big Sagebrush	B:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				Yes	
Basin Big Sagebrush	B:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				Yes	
Basin Big Sagebrush	B:Open	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Basin Big Sagebrush	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Basin Big Sagebrush	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Basin Big Sagebrush	C:Closed	C:Closed	Sheep-Grazing	1	0.999			1	No	
Basin Big Sagebrush	C:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Basin Big Sagebrush	C:Closed	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Basin Big Sagebrush	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005			2	No	
Basin Big Sagebrush	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Basin Big Sagebrush	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1					No	

Basin Big Sagebrush	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1				2	No	
Basin Big Sagebrush	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1					No	
Basin Big Sagebrush	U-A:Exotic Forb	U-A:Exotic Forb	Sheep-Grazing	1				2	No	
Basin Big Sagebrush	U-A:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Basin Big Sagebrush	U-A:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Basin Big Sagebrush	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Basin Big Sagebrush	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Basin Big Sagebrush	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1		3	5		Yes	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1		3	5		Yes	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	6	13		No	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1		3	5		Yes	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1	0.001	6	12		Yes	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	6			Yes	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	6			No	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	6			No	

Basin Big Sagebrush	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	6		2	No	
Basin Big Sagebrush	U-A:Seeded Native	U-A:Seeded Native	Sheep-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-A:Seeded Native	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005	14		2	No	
Basin Big Sagebrush	U-A:Seeded Native	U-C:Depleted	Sheep-Grazing	1	0.001	13			No	
Basin Big Sagebrush	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			No	
Basin Big Sagebrush	U-A:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Basin Big Sagebrush	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Basin Big Sagebrush	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Basin Big Sagebrush	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	U-A:SI	U-A:SI	Sheep-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Basin Big Sagebrush	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Basin Big Sagebrush	U-A:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Basin Big Sagebrush	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Basin Big Sagebrush	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999	3		2	No	
Basin Big Sagebrush	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	

Basin Big Sagebrush	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-B:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.001			2	No	
Basin Big Sagebrush	U-B:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	
Basin Big Sagebrush	U-B:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Basin Big Sagebrush	U-B:SI	U-B:SI	Cattle-Jul->Aprl-Grazing	1					No	
Basin Big Sagebrush	U-B:SI	U-B:SI	Cattle-May->June-Grazing	1				2	No	
Basin Big Sagebrush	U-B:SI	U-B:SI	Sheep-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-B:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Basin Big Sagebrush	U-B:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Basin Big Sagebrush	U-B:SI+AS	U-B:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Basin Big Sagebrush	U-B:SI+AS	U-B:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-B:SI+AS	U-B:SI+AS	Sheep-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-C:SA	U-C:SA	Cattle-Jul->Aprl-Grazing	1					No	
Basin Big Sagebrush	U-C:SA	U-C:SA	Sheep-Grazing	1				2	No	
Basin Big Sagebrush	U-C:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.001			2	No	
Basin Big Sagebrush	U-C:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	
Basin Big Sagebrush	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1					No	

Basin Big Sagebrush	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-C:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Basin Big Sagebrush	U-C:SI	U-C:SI	Cattle-Jul->Aprl-Grazing	1					No	
Basin Big Sagebrush	U-C:SI	U-C:SI	Cattle-May->June-Grazing	1				2	No	
Basin Big Sagebrush	U-C:SI	U-C:SI	Sheep-Grazing	1	0.999			1	No	
Basin Big Sagebrush	U-C:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Basin Big Sagebrush	U-C:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Basin Big Sagebrush	U-C:SI+AS	U-C:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Basin Big Sagebrush	U-C:SI+AS	U-C:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Basin Big Sagebrush	U-C:SI+AS	U-C:SI+AS	Sheep-Grazing	1	0.999			1	No	
Big Sagebrush-mountain	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Big Sagebrush-mountain	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Big Sagebrush-mountain	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Big Sagebrush-mountain	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	

Big Sagebrush-mountain	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Big Sagebrush-mountain	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Big Sagebrush-mountain	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	B:Open	B:Open	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	B:Open	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Big Sagebrush-mountain	B:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	B:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	B:Open	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Big Sagebrush-mountain	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Big Sagebrush-mountain	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	C:Closed	C:Closed	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	C:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	C:Closed	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Big Sagebrush-mountain	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Big Sagebrush-mountain	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	

Big Sagebrush-mountain	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	D:Open	D:Open	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	D:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	D:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	D:Open	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Big Sagebrush-mountain	D:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	D:Open	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Big Sagebrush-mountain	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Big Sagebrush-mountain	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1		3		2	No	
Big Sagebrush-mountain	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1		3			No	
Big Sagebrush-mountain	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-May->June-Grazing	1		3		2	No	
Big Sagebrush-mountain	U-A:Exotic Forb	U-A:Exotic Forb	Sheep-Grazing	1		3		2	No	
Big Sagebrush-mountain	U-A:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Big Sagebrush-mountain	U-A:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Big Sagebrush-mountain	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Big Sagebrush-mountain	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	

Big Sagebrush-mountain	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1		3	5		Yes	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1		3	5		Yes	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	6	13		No	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1		3	5		Yes	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1	0.001	6	12		Yes	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3	5		Yes	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	6			No	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	6		2	No	
Big Sagebrush-mountain	U-A:Seeded Native	U-A:Seeded Native	Sheep-Grazing	1	0.999	6		2	No	
Big Sagebrush-mountain	U-A:Seeded Native	U-C:Depleted	Cattle-May->June-Grazing	1	0.001	14			No	
Big Sagebrush-mountain	U-A:Seeded Native	U-C:Depleted	Sheep-Grazing	1	0.001	13			No	
Big Sagebrush-mountain	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Big Sagebrush-mountain	U-A:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	

Big Sagebrush-mountain	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Big Sagebrush-mountain	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Big Sagebrush-mountain	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	U-A:SI	U-A:SI	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Big Sagebrush-mountain	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Big Sagebrush-mountain	U-A:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Big Sagebrush-mountain	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Big Sagebrush-mountain	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-mountain	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-B:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.001				No	
Big Sagebrush-mountain	U-B:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	
Big Sagebrush-mountain	U-B:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	

Big Sagebrush-mountain	U-B:SI	U-B:SI	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-B:SI	U-B:SI	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-mountain	U-B:SI	U-B:SI	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-B:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Big Sagebrush-mountain	U-B:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Big Sagebrush-mountain	U-B:SI+AS	U-B:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-B:SI+AS	U-B:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-B:SI+AS	U-B:SI+AS	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-C:SA	U-C:SA	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-C:SA	U-C:SA	Sheep-Grazing	1				2	No	
Big Sagebrush-mountain	U-C:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.001				No	
Big Sagebrush-mountain	U-C:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	
Big Sagebrush-mountain	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-C:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	

Big Sagebrush-mountain	U-C:SI	U-C:SI	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-C:SI	U-C:SI	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-mountain	U-C:SI	U-C:SI	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-C:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Big Sagebrush-mountain	U-C:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Big Sagebrush-mountain	U-C:SI+AS	U-C:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-C:SI+AS	U-C:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-C:SI+AS	U-C:SI+AS	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-D:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-mountain	U-D:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	
Big Sagebrush-mountain	U-D:SAP	U-D:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-D:SAP	U-D:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-D:SAP	U-D:SAP	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-mountain	U-D:SI	U-D:SI	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-D:SI	U-D:SI	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-mountain	U-D:SI	U-D:SI	Sheep-Grazing	1				2	No	

Big Sagebrush-mountain	U-D:SI+AS	U-D:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-mountain	U-D:SI+AS	U-D:SI+AS	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-mountain	U-D:SI+AS	U-D:SI+AS	Sheep-Grazing	1				2	No	
Big Sagebrush-upland	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Big Sagebrush-upland	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Big Sagebrush-upland	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-upland	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Big Sagebrush-upland	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Big Sagebrush-upland	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Big Sagebrush-upland	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Big Sagebrush-upland	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Big Sagebrush-upland	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	B:Open	B:Open	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	B:Open	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Big Sagebrush-upland	B:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-upland	B:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	

Big Sagebrush-upland	B:Open	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Big Sagebrush-upland	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Big Sagebrush-upland	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	C:Closed	C:Closed	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	C:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-upland	C:Closed	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Big Sagebrush-upland	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Big Sagebrush-upland	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Big Sagebrush-upland	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Big Sagebrush-upland	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	D:Open	D:Open	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	D:Open	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Big Sagebrush-upland	D:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.001				No	
Big Sagebrush-upland	D:Open	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Big Sagebrush-upland	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Big Sagebrush-upland	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1		3		2	No	

Big Sagebrush-upland	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1		3			No	
Big Sagebrush-upland	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-May->June-Grazing	1		3		2	No	
Big Sagebrush-upland	U-A:Exotic Forb	U-A:Exotic Forb	Sheep-Grazing	1		3		2	No	
Big Sagebrush-upland	U-A:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Big Sagebrush-upland	U-A:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Big Sagebrush-upland	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Big Sagebrush-upland	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Big Sagebrush-upland	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999	3		2	No	
Big Sagebrush-upland	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1		3	5		Yes	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	6	19		Yes	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1		3	5		Yes	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1	0.001	6	19		Yes	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	6			Yes	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1		3	5		Yes	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	6			Yes	

Big Sagebrush-upland	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	6			No	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	6		2	No	
Big Sagebrush-upland	U-A:Seeded Native	U-A:Seeded Native	Sheep-Grazing	1	0.999	6		2	No	
Big Sagebrush-upland	U-A:Seeded Native	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005	20			No	
Big Sagebrush-upland	U-A:Seeded Native	U-C:Depleted	Sheep-Grazing	1	0.001	20			Yes	
Big Sagebrush-upland	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Big Sagebrush-upland	U-A:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Big Sagebrush-upland	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Big Sagebrush-upland	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Big Sagebrush-upland	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Big Sagebrush-upland	U-A:SI	U-A:SI	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-upland	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Big Sagebrush-upland	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Big Sagebrush-upland	U-A:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			No	
Big Sagebrush-upland	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Big Sagebrush-upland	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	

Big Sagebrush-upland	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999	3		2	No	
Big Sagebrush-upland	U-B:SA	U-B:SA	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-B:SA	U-B:SA	Sheep-Grazing	1				2	No	
Big Sagebrush-upland	U-B:SAP	U-B:SA	Cattle-May->June-Grazing	1	0.001				No	
Big Sagebrush-upland	U-B:SAP	U-B:SA	Sheep-Grazing	1	0.001				No	
Big Sagebrush-upland	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-B:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Big Sagebrush-upland	U-B:SI	U-B:SI	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-B:SI	U-B:SI	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-upland	U-B:SI	U-B:SI	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-B:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Big Sagebrush-upland	U-B:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Big Sagebrush-upland	U-B:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-B:SI+AS	U-B:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	

Big Sagebrush-upland	U-B:SI+AS	U-B:SI+AS	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-C:SAP	U-B:SA	Cattle-May->June-Grazing	1	0.001				No	
Big Sagebrush-upland	U-C:SAP	U-B:SA	Sheep-Grazing	1	0.001				No	
Big Sagebrush-upland	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-C:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Big Sagebrush-upland	U-C:SI	U-C:SI	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-C:SI	U-C:SI	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-upland	U-C:SI	U-C:SI	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-C:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Big Sagebrush-upland	U-C:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Big Sagebrush-upland	U-C:SI+AS	U-C:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-C:SI+AS	U-C:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-C:SI+AS	U-C:SI+AS	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-D:SAP	U-B:SA	Cattle-May->June-Grazing	1	0.0005			2	No	

Big Sagebrush-upland	U-D:SAP	U-B:SA	Sheep-Grazing	1	0.001				No	
Big Sagebrush-upland	U-D:SAP	U-D:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-D:SAP	U-D:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-D:SAP	U-D:SAP	Sheep-Grazing	1	0.999			2	No	
Big Sagebrush-upland	U-D:SI	U-D:SI	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-D:SI	U-D:SI	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-upland	U-D:SI	U-D:SI	Sheep-Grazing	1				2	No	
Big Sagebrush-upland	U-D:SI+AS	U-D:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Big Sagebrush-upland	U-D:SI+AS	U-D:SI+AS	Cattle-May->June-Grazing	1				2	No	
Big Sagebrush-upland	U-D:SI+AS	U-D:SI+AS	Sheep-Grazing	1				2	No	
Black Sagebrush	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Black Sagebrush	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Black Sagebrush	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Black Sagebrush	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Black Sagebrush	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Black Sagebrush	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	

Black Sagebrush	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Black Sagebrush	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	
Black Sagebrush	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Black Sagebrush	B:Open	B:Open	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	B:Open	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Black Sagebrush	B:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Black Sagebrush	B:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Black Sagebrush	B:Open	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Black Sagebrush	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Black Sagebrush	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Black Sagebrush	C:Closed	C:Closed	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	C:Closed	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	
Black Sagebrush	C:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Black Sagebrush	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Black Sagebrush	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Black Sagebrush	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Black Sagebrush	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999			2	No	

Black Sagebrush	D:Open	D:Open	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	D:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Black Sagebrush	D:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Black Sagebrush	D:Open	U-D:TEA	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Black Sagebrush	D:Open	U-D:TEA	Sheep-Grazing	1	0.001				No	
Black Sagebrush	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Black Sagebrush	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1		3		2	No	
Black Sagebrush	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1		3			No	
Black Sagebrush	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-May->June-Grazing	1		3		2	No	
Black Sagebrush	U-A:Exotic Forb	U-A:Exotic Forb	Sheep-Grazing	1		3		2	No	
Black Sagebrush	U-A:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Black Sagebrush	U-A:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Black Sagebrush	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Black Sagebrush	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Black Sagebrush	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999	3		2	No	
Black Sagebrush	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.999	3		2	No	
Black Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1		3	5		No	

Black Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	6	24		Yes	
Black Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1		3	5		Yes	
Black Sagebrush	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1	0.001	6	24		Yes	
Black Sagebrush	U-A:Seeded Native	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0002	6			No	
Black Sagebrush	U-A:Seeded Native	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0003	6			Yes	
Black Sagebrush	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1		3	5		No	
Black Sagebrush	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	6			No	
Black Sagebrush	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	6		1	No	
Black Sagebrush	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	6		2	No	
Black Sagebrush	U-A:Seeded Native	U-A:Seeded Native	Sheep-Grazing	1	0.999	6		2	No	
Black Sagebrush	U-A:Seeded Native	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005	25			No	
Black Sagebrush	U-A:Seeded Native	U-C:Depleted	Sheep-Grazing	1	0.001	25			No	
Black Sagebrush	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Black Sagebrush	U-A:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Black Sagebrush	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Black Sagebrush	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Black Sagebrush	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	

Black Sagebrush	U-A:SI	U-A:SI	Sheep-Grazing	1	0.999	3		2	No	
Black Sagebrush	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Black Sagebrush	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Black Sagebrush	U-A:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Black Sagebrush	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Black Sagebrush	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Black Sagebrush	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1		3		2	No	
Black Sagebrush	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Black Sagebrush	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	U-B:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.001				No	
Black Sagebrush	U-B:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	
Black Sagebrush	U-B:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Black Sagebrush	U-B:SI	U-B:SI	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-B:SI	U-B:SI	Cattle-May->June-Grazing	1				2	No	
Black Sagebrush	U-B:SI	U-B:SI	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	U-B:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Black Sagebrush	U-B:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	

Black Sagebrush	U-B:SI+AS	U-B:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-B:SI+AS	U-B:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Black Sagebrush	U-B:SI+AS	U-B:SI+AS	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	U-C:SA	U-C:SA	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-C:SA	U-C:SA	Sheep-Grazing	1				2	No	
Black Sagebrush	U-C:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.001				No	
Black Sagebrush	U-C:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	
Black Sagebrush	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Black Sagebrush	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	U-C:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Black Sagebrush	U-C:SI	U-C:SI	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-C:SI	U-C:SI	Cattle-May->June-Grazing	1				2	No	
Black Sagebrush	U-C:SI	U-C:SI	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	U-C:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Black Sagebrush	U-C:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Black Sagebrush	U-C:SI+AS	U-C:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-C:SI+AS	U-C:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	

Black Sagebrush	U-C:SI+AS	U-C:SI+AS	Sheep-Grazing	1	0.999			2	No	
Black Sagebrush	U-D:SI	U-D:SI	Cattle-Jul->Aprl-Grazing	1					No	
Black Sagebrush	U-D:SI	U-D:SI	Cattle-May->June-Grazing	1				2	No	
Black Sagebrush	U-D:SI	U-D:SI	Sheep-Grazing	1					No	
Black Sagebrush	U-D:SI+AS	U-D:SI+AS	Cattle-Jul->Aprl-Grazing	1				1	No	
Black Sagebrush	U-D:SI+AS	U-D:SI+AS	Cattle-May->June-Grazing	1					No	
Black Sagebrush	U-D:SI+AS	U-D:SI+AS	Sheep-Grazing	1	0.999				No	
Black Sagebrush	U-D:SI+AS	U-D:TEA	Sheep-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	A:All	A:All	Cattle-Jul->Aprl-Grazing	1			3		Yes	
Curl-leaf Mountain Mahogany	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.0005	4		-1	No	
Curl-leaf Mountain Mahogany	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	4		2	No	
Curl-leaf Mountain Mahogany	A:All	A:All	Cattle-May->June-Grazing	1			3		Yes	
Curl-leaf Mountain Mahogany	A:All	A:All	Cattle-May->June-Grazing	1	0.001	4		-1	No	
Curl-leaf Mountain Mahogany	A:All	A:All	Cattle-May->June-Grazing	1	0.999	4		2	No	
Curl-leaf Mountain Mahogany	A:All	A:All	Sheep-Grazing	1			4		Yes	
Curl-leaf Mountain Mahogany	A:All	A:All	Sheep-Grazing	1	0.999	4		2	No	
Curl-leaf Mountain Mahogany	A:All	U-A:Unpalat. Forb	Sheep-Grazing	1	0.001	4			No	

Curl-leaf Mountain Mahogany	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1					No	
Curl-leaf Mountain Mahogany	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Curl-leaf Mountain Mahogany	B:Open	B:Open	Sheep-Grazing	1	0.999			1	No	
Curl-leaf Mountain Mahogany	B:Open	U-B:Unpalat. Forb	Cattle-May->June-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	B:Open	U-B:Unpalat. Forb	Sheep-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Curl-leaf Mountain Mahogany	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999				No	
Curl-leaf Mountain Mahogany	C:Closed	C:Closed	Sheep-Grazing	1	0.999				No	
Curl-leaf Mountain Mahogany	C:Closed	U-C:Unpalat. Forb	Cattle-May->June-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	C:Closed	U-C:Unpalat. Forb	Sheep-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1					No	
Curl-leaf Mountain Mahogany	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999				No	
Curl-leaf Mountain Mahogany	D:Open	D:Open	Sheep-Grazing	1	0.999				No	
Curl-leaf Mountain Mahogany	D:Open	U-D:Unpalat. Forb	Cattle-May->June-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	D:Open	U-D:Unpalat. Forb	Sheep-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	U-A:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	

Curl-leaf Mountain Mahogany	U-A:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001	3	19		Yes	
Curl-leaf Mountain Mahogany	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1		3			No	
Curl-leaf Mountain Mahogany	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999	3		2	No	
Curl-leaf Mountain Mahogany	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.999	3		2	No	
Curl-leaf Mountain Mahogany	U-A:SAP	U-B:Unpalat. Forb	Sheep-Grazing	1	0.001	20	59		No	
Curl-leaf Mountain Mahogany	U-A:SAP	U-C:Unpalat. Forb	Sheep-Grazing	1	0.001	60	149		No	
Curl-leaf Mountain Mahogany	U-A:SAP	U-D:Unpalat. Forb	Sheep-Grazing	1	0.001	150			No	
Curl-leaf Mountain Mahogany	U-A:SI	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Curl-leaf Mountain Mahogany	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Curl-leaf Mountain Mahogany	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Curl-leaf Mountain Mahogany	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1			2		Yes	
Curl-leaf Mountain Mahogany	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1		3		2	No	
Curl-leaf Mountain Mahogany	U-A:SI	U-A:SI	Sheep-Grazing	1	0.999	3		2	No	
Curl-leaf Mountain Mahogany	U-A:SI	U-A:Unpalat. Forb	Sheep-Grazing	1	0.001	3	19		No	
Curl-leaf Mountain Mahogany	U-A:SI	U-B:Unpalat. Forb	Sheep-Grazing	1	0.001	20	59		No	
Curl-leaf Mountain Mahogany	U-A:SI	U-C:Unpalat. Forb	Sheep-Grazing	1	0.001	60	149		No	

Curl-leaf Mountain Mahogany	U-A:SI	U-D:Unpalat. Forb	Sheep-Grazing	1	0.001	150			No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999			1	No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-B:Unpalat. Forb	Cattle-May->June-Grazing	1	0.001	3	19		No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-B:Unpalat. Forb	Sheep-Grazing	1	0.001	3	19		No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-C:Unpalat. Forb	Cattle-May->June-Grazing	1	0.001	20	59		No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-C:Unpalat. Forb	Sheep-Grazing	1	0.001	20	59		No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-D:Unpalat. Forb	Cattle-May->June-Grazing	1	0.001	60			No	
Curl-leaf Mountain Mahogany	U-A:SI+AS	U-D:Unpalat. Forb	Sheep-Grazing	1	0.001	60			No	
Curl-leaf Mountain Mahogany	U-B:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Curl-leaf Mountain Mahogany	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999	1		2	No	
Curl-leaf Mountain Mahogany	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.001			-1	No	
Curl-leaf Mountain Mahogany	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999	1		2	No	
Curl-leaf Mountain Mahogany	U-C:TEA	U-C:TEA	Cattle-Jul->Aprl-Grazing	1					No	

Curl-leaf Mountain Mahogany	U-C:TEA	U-C:TEA	Cattle-May->June-Grazing	1					No	
Curl-leaf Mountain Mahogany	U-C:TEA	U-C:TEA	Sheep-Grazing	1	0.999				No	
Curl-leaf Mountain Mahogany	U-C:TEA	U-C:Unpalat. Forb	Sheep-Grazing	1	0.001				No	
Curl-leaf Mountain Mahogany	U-D:TEA	U-D:TEA	Cattle-Jul->Aprl-Grazing	1					No	
Curl-leaf Mountain Mahogany	U-D:TEA	U-D:TEA	Cattle-May->June-Grazing	1					No	
Curl-leaf Mountain Mahogany	U-D:TEA	U-D:TEA	Sheep-Grazing	1	0.999				No	
Curl-leaf Mountain Mahogany	U-D:TEA	U-D:Unpalat. Forb	Sheep-Grazing	1	0.001				No	
Desert Wash	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Desert Wash	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Desert Wash	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Desert Wash	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Desert Wash	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Desert Wash	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Desert Wash	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Desert Wash	B:Closed	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005				Yes	
Desert Wash	B:Closed	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	

Desert Wash	B:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Desert Wash	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Desert Wash	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Desert Wash	C:Closed	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005				Yes	
Desert Wash	C:Closed	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Desert Wash	C:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Desert Wash	U-B:SAP	U-B:SA	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Desert Wash	U-B:SAP	U-B:SA	Cattle-May->June-Grazing	1	0.001				No	
Desert Wash	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Desert Wash	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Dry Wet Meadow	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Dry Wet Meadow	A:All	A:All	Cattle-May->June-Grazing	1	0.999			2	No	20
Dry Wet Meadow	A:All	A:All	Sheep-Grazing	1	0.999			1	No	20
Dry Wet Meadow	A:All	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Dry Wet Meadow	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001				Yes	20
Dry Wet Meadow	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	20

Dry Wet Meadow	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Dry Wet Meadow	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	20
Dry Wet Meadow	B:Closed	B:Closed	Sheep-Grazing	1	0.999			1	No	20
Dry Wet Meadow	B:Closed	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Dry Wet Meadow	B:Closed	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001				Yes	20
Dry Wet Meadow	B:Closed	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	20
Dry Wet Meadow	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Dry Wet Meadow	C:Open	C:Open	Cattle-May->June-Grazing	1	0.999			2	No	20
Dry Wet Meadow	C:Open	C:Open	Sheep-Grazing	1	0.999			1	No	20
Dry Wet Meadow	C:Open	U-C:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0005			1	No	20
Dry Wet Meadow	C:Open	U-C:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.0005			2	No	20
Dry Wet Meadow	C:Open	U-C:Shrb-Frb Encr	Sheep-Grazing	1	0.001				Yes	20
Dry Wet Meadow	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1				1	No	20
Dry Wet Meadow	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1					Yes	20
Dry Wet Meadow	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1				1	No	20
Dry Wet Meadow	U-A:Exotic Forb	U-A:Exotic Forb	Sheep-Grazing	1					No	20
Dry Wet Meadow	U-A:SAP	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20

Dry Wet Meadow	U-A:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	20
Dry Wet Meadow	U-A:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	20
Dry Wet Meadow	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Dry Wet Meadow	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999			2	No	20
Dry Wet Meadow	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.999			1	No	20
Dry Wet Meadow	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1				1	No	20
Dry Wet Meadow	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1				2	No	20
Dry Wet Meadow	U-A:SI	U-A:SI	Sheep-Grazing	1				1	No	20
Dry Wet Meadow	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1				1	No	20
Dry Wet Meadow	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1				2	No	20
Dry Wet Meadow	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1				1	No	20
Dry Wet Meadow	U-B:SAP	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Dry Wet Meadow	U-B:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	20
Dry Wet Meadow	U-B:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	20
Dry Wet Meadow	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Dry Wet Meadow	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			1	No	20
Dry Wet Meadow	U-C:SA	U-C:SA	Cattle-Jul->Aprl-Grazing	1				1	No	20
Dry Wet Meadow	U-C:SA	U-C:SA	Sheep-Grazing	1				1	No	20

Dry Wet Meadow	U-C:SAP	U-C:SA	Cattle-Jul->Aprl-Grazing	1	0.0005			1	No	20
Dry Wet Meadow	U-C:SAP	U-C:SA	Cattle-May->June-Grazing	1	0.0005			2	No	20
Dry Wet Meadow	U-C:SAP	U-C:SA	Sheep-Grazing	1	0.001				No	20
Dry Wet Meadow	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Dry Wet Meadow	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.999			2	No	20
Dry Wet Meadow	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.999			1	No	20
Dry Wet Meadow	U-C:Shrb-Frb Encr	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Dry Wet Meadow	U-C:Shrb-Frb Encr	U-A:Bare Ground	Sheep-Grazing	1	0.0005				Yes	20
Dry Wet Meadow	U-C:Shrb-Frb Encr	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.001				Yes	20
Dry Wet Meadow	U-C:Shrb-Frb Encr	U-A:Early-Shrub	Sheep-Grazing	1	0.0005			1	No	20
Dry Wet Meadow	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Dry Wet Meadow	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.999			2	No	20
Dry Wet Meadow	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Sheep-Grazing	1	0.999			1	No	20
Four-Wing Saltbush	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Four-Wing Saltbush	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Four-Wing Saltbush	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Four-Wing Saltbush	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Four-Wing Saltbush	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	

Four-Wing Saltbush	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Four-Wing Saltbush	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Four-Wing Saltbush	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Four-Wing Saltbush	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Four-Wing Saltbush	B:Open	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005				Yes	
Four-Wing Saltbush	B:Open	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Four-Wing Saltbush	B:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Four-Wing Saltbush	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Four-Wing Saltbush	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Four-Wing Saltbush	C:Closed	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Four-Wing Saltbush	C:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Four-Wing Saltbush	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Four-Wing Saltbush	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Four-Wing Saltbush	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1		3	5		Yes	
Four-Wing Saltbush	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1		3	5		Yes	
Four-Wing Saltbush	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	6	19		Yes	

Four-Wing Saltbush	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	6			No	
Four-Wing Saltbush	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	6		2	No	
Four-Wing Saltbush	U-A:Seeded Native	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005	6			No	
Four-Wing Saltbush	U-A:Seeded Native	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005	6	19		No	
Four-Wing Saltbush	U-A:Seeded Native	U-C:Depleted	Cattle-May->June-Grazing	1	0.001	20			No	
Four-Wing Saltbush	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Four-Wing Saltbush	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			No	
Four-Wing Saltbush	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Four-Wing Saltbush	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Four-Wing Saltbush	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Four-Wing Saltbush	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Four-Wing Saltbush	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Four-Wing Saltbush	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Four-Wing Saltbush	U-B:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Four-Wing Saltbush	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Four-Wing Saltbush	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	

Four-Wing Saltbush	U-C:Depleted	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1				-1	No	
Four-Wing Saltbush	U-C:Depleted	U-C:Depleted	Cattle-May->June-Grazing	1				-2	No	
Gamble Oak-Mountain Shrub	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Gamble Oak-Mountain Shrub	A:All	A:All	Cattle-May->June-Grazing	1	0.001	3			Yes	
Gamble Oak-Mountain Shrub	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Gamble Oak-Mountain Shrub	A:All	A:All	Sheep-Grazing	1	0.001			-1	No	
Gamble Oak-Mountain Shrub	A:All	A:All	Sheep-Grazing	1	0.999			2	No	
Gamble Oak-Mountain Shrub	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Gamble Oak-Mountain Shrub	B:Closed	B:Closed	Cattle-May->June-Grazing	1				2	No	
Gamble Oak-Mountain Shrub	B:Closed	B:Closed	Sheep-Grazing	1	0.001			-1	No	
Gamble Oak-Mountain Shrub	B:Closed	B:Closed	Sheep-Grazing	1	0.999			2	No	
Gamble Oak-Mountain Shrub	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Gamble Oak-Mountain Shrub	C:Closed	C:Closed	Cattle-May->June-Grazing	1					No	
Gamble Oak-Mountain Shrub	C:Closed	C:Closed	Sheep-Grazing	1					No	
Gamble Oak-Mountain Shrub	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1		3			No	
Gamble Oak-Mountain Shrub	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.001	3			Yes	

Gamble Oak-Mountain Shrub	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999	3		2	No	
Gamble Oak-Mountain Shrub	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.001	3		-1	No	
Gamble Oak-Mountain Shrub	U-A:SAP	U-A:SAP	Sheep-Grazing	1	0.999	3		2	No	
Gamble Oak-Mountain Shrub	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005			1	No	
Gamble Oak-Mountain Shrub	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Gamble Oak-Mountain Shrub	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.001			2	No	
Gamble Oak-Mountain Shrub	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Gamble Oak-Mountain Shrub	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.001			2	No	
Gamble Oak-Mountain Shrub	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			1	No	
Gamble Oak-Mountain Shrub	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Gamble Oak-Mountain Shrub	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1				2	No	
Gamble Oak-Mountain Shrub	U-C:SAP	U-C:SAP	Sheep-Grazing	1				2	No	
Greasewood-Basin Big Sagebrush	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Greasewood-Basin Big Sagebrush	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Greasewood-Basin Big Sagebrush	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Greasewood-Basin Big Sagebrush	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	

Greasewood-Basin Big Sagebrush	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Greasewood-Basin Big Sagebrush	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Greasewood-Basin Big Sagebrush	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Greasewood-Basin Big Sagebrush	B:Closed	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001				Yes	
Greasewood-Basin Big Sagebrush	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Greasewood-Basin Big Sagebrush	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1		3			No	
Greasewood-Basin Big Sagebrush	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-May->June-Grazing	1		3		2	No	
Greasewood-Basin Big Sagebrush	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	
Greasewood-Basin Big Sagebrush	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Greasewood-Basin Big Sagebrush	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Greasewood-Basin Big Sagebrush	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Greasewood-Basin Big Sagebrush	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Greasewood-Basin Big Sagebrush	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Greasewood-Basin Big Sagebrush	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Greasewood-Basin Big Sagebrush	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Greasewood-Basin Big Sagebrush	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1				2	No	

Lower-Subalpine Grassland	A:All	A:All	Cattle-Jul->Aprl-Grazing	1					No	
Lower-Subalpine Grassland	A:All	A:All	Cattle-May->June-Grazing	1	0.999			2	No	
Lower-Subalpine Grassland	A:All	A:All	Sheep-Grazing	1	0.999			1	No	
Lower-Subalpine Grassland	A:All	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.001				Yes	
Lower-Subalpine Grassland	A:All	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				Yes	
Lower-Subalpine Grassland	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1					No	
Lower-Subalpine Grassland	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1				2	No	
Lower-Subalpine Grassland	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Sheep-Grazing	1				1	No	
Mixed Conifer-Claron	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Mixed Conifer-Claron	A:All	A:All	Cattle-May->June-Grazing	1	0.001	3			Yes	
Mixed Conifer-Claron	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Mixed Conifer-Claron	A:All	A:All	Sheep-Grazing	1	0.001	3			Yes	
Mixed Conifer-Claron	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Mixed Conifer-Claron	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1					No	
Mixed Conifer-Claron	B:Open	B:Open	Cattle-May->June-Grazing	1				2	No	
Mixed Conifer-Claron	B:Open	B:Open	Sheep-Grazing	1					No	
Mixed Conifer-Claron	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1					No	

Mixed Conifer-Claron	C:Open	C:Open	Cattle-May->June-Grazing	1					No	
Mixed Conifer-Claron	C:Open	C:Open	Sheep-Grazing	1					No	
Mixed Conifer-Montane	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Mixed Conifer-Montane	A:All	A:All	Cattle-May->June-Grazing	1	0.001	3			Yes	
Mixed Conifer-Montane	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Mixed Conifer-Montane	A:All	A:All	Sheep-Grazing	1	0.001	3			Yes	
Mixed Conifer-Montane	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Mixed Conifer-Montane	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1					No	
Mixed Conifer-Montane	B:Open	B:Open	Cattle-May->June-Grazing	1				2	No	
Mixed Conifer-Montane	B:Open	B:Open	Sheep-Grazing	1					No	
Mixed Conifer-Montane	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1					No	
Mixed Conifer-Montane	C:Open	C:Open	Cattle-May->June-Grazing	1					No	
Mixed Conifer-Montane	C:Open	C:Open	Sheep-Grazing	1					No	
Mixed Salt Desert	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Mixed Salt Desert	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Mixed Salt Desert	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	

Mixed Salt Desert	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Mixed Salt Desert	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Mixed Salt Desert	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Mixed Salt Desert	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Mixed Salt Desert	B:Open	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005				Yes	
Mixed Salt Desert	B:Open	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	
Mixed Salt Desert	B:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				Yes	
Mixed Salt Desert	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	
Mixed Salt Desert	C:Open	C:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Mixed Salt Desert	C:Open	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Mixed Salt Desert	C:Open	U-A:Early-Shrub	Cattle-May->June-Grazing	1					No	
Mixed Salt Desert	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Mixed Salt Desert	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1		3		1	No	
Mixed Salt Desert	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-May->June-Grazing	1		3		2	No	
Mixed Salt Desert	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1		3	5		Yes	
Mixed Salt Desert	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1		3	5		Yes	

Mixed Salt Desert	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	6			Yes	
Mixed Salt Desert	U-A:Seeded Native	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	6			Yes	
Mixed Salt Desert	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	6			No	
Mixed Salt Desert	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	6			No	
Mixed Salt Desert	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	6		2	No	
Mixed Salt Desert	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Mixed Salt Desert	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Mixed Salt Desert	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Mixed Salt Desert	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Mixed Salt Desert	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Mixed Salt Desert	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	4			Yes	
Mixed Salt Desert	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Mixed Salt Desert	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	4		2	No	
Mixed Salt Desert	U-B:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.0005				Yes	
Mixed Salt Desert	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Mixed Salt Desert	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	

Montane Riparian	A-Cottonwood:All	A-Cottonwood:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			Yes	20
Montane Riparian	A-Cottonwood:All	A-Cottonwood:All	Cattle-May->June-Grazing	1	0.999	3			Yes	20
Montane Riparian	A-Cottonwood:All	A-Cottonwood:All	Sheep-Grazing	1	0.999	3			Yes	20
Montane Riparian	A-Cottonwood:All	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	20
Montane Riparian	A-Cottonwood:All	U-A:Hummocked	Cattle-May->June-Grazing	1	0.001	3			Yes	20
Montane Riparian	A-Cottonwood:All	U-A:Hummocked	Sheep-Grazing	1	0.001	3			Yes	20
Montane Riparian	A-Willow:All	A-Willow:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			Yes	20
Montane Riparian	A-Willow:All	A-Willow:All	Cattle-May->June-Grazing	1	0.999	3			Yes	20
Montane Riparian	A-Willow:All	A-Willow:All	Sheep-Grazing	1	0.999	3			Yes	20
Montane Riparian	A-Willow:All	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	20
Montane Riparian	A-Willow:All	U-A:Hummocked	Cattle-May->June-Grazing	1	0.001	3			Yes	20
Montane Riparian	A-Willow:All	U-A:Hummocked	Sheep-Grazing	1	0.001	3			Yes	20
Montane Riparian	B-Cottonwood:Closed	B-Cottonwood:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Montane Riparian	B-Cottonwood:Closed	B-Cottonwood:Closed	Cattle-May->June-Grazing	1	0.999			2	No	20
Montane Riparian	B-Cottonwood:Closed	B-Cottonwood:Closed	Sheep-Grazing	1	0.999			2	No	20
Montane Riparian	B-Cottonwood:Closed	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0005				No	20
Montane Riparian	B-Cottonwood:Closed	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.001				No	20

Montane Riparian	B-Cottonwood:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	20
Montane Riparian	B-Willow:Closed	B-Willow:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Montane Riparian	B-Willow:Closed	B-Willow:Closed	Cattle-May->June-Grazing	1	0.999			2	No	20
Montane Riparian	B-Willow:Closed	B-Willow:Closed	Sheep-Grazing	1	0.999			2	No	20
Montane Riparian	B-Willow:Closed	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0005				No	20
Montane Riparian	B-Willow:Closed	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.001				No	20
Montane Riparian	B-Willow:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	20
Montane Riparian	C-Cottonwood:Closed	C-Cottonwood:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Montane Riparian	C-Cottonwood:Closed	C-Cottonwood:Closed	Cattle-May->June-Grazing	1	0.999				No	20
Montane Riparian	C-Cottonwood:Closed	C-Cottonwood:Closed	Sheep-Grazing	1	0.999				No	20
Montane Riparian	C-Cottonwood:Closed	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0005				No	20
Montane Riparian	C-Cottonwood:Closed	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.001				No	20
Montane Riparian	C-Cottonwood:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	20
Montane Riparian	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	20
Montane Riparian	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1		3		1	No	20
Montane Riparian	U-A:EFT	U-A:EFT	Cattle-Jul->Aprl-Grazing	1		3			No	20
Montane Riparian	U-A:EFT	U-A:EFT	Cattle-May->June-Grazing	1		3		2	No	20

Montane Riparian	U-A:EFT	U-A:EFT	Sheep-Grazing	1		3		2	No	20
Montane Riparian	U-A:Hummocked	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.9995				Yes	20
Montane Riparian	U-A:Hummocked	U-A:Hummocked	Cattle-May->June-Grazing	1	0.999				Yes	20
Montane Riparian	U-A:Hummocked	U-A:Hummocked	Sheep-Grazing	1					Yes	
Montane Riparian	U-A:Hummocked	U-C:Desertified	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Montane Riparian	U-A:Hummocked	U-C:Desertified	Cattle-May->June-Grazing	1	0.001				Yes	20
Montane Riparian	U-A:Incised-EFT	U-A:Inset-EF	Cattle-Jul->Aprl-Grazing	1		3			No	20
Montane Riparian	U-A:Incised-EFT	U-A:Inset-EF	Cattle-May->June-Grazing	1		3		2	No	20
Montane Riparian	U-A:Incised-EFT	U-A:Inset-EF	Sheep-Grazing	1		3		1	No	20
Montane Riparian	U-A:Inset	U-A:Inset	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	20
Montane Riparian	U-A:Inset	U-A:Inset	Cattle-May->June-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-A:Inset	U-A:Inset	Sheep-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-A:Inset	U-A:Inset-Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	20
Montane Riparian	U-A:Inset	U-A:Inset-Hummocked	Cattle-May->June-Grazing	1	0.001	3			Yes	20
Montane Riparian	U-A:Inset	U-A:Inset-Hummocked	Sheep-Grazing	1	0.001	3			Yes	20
Montane Riparian	U-A:Inset-EF	U-A:Inset-EF	Cattle-Jul->Aprl-Grazing	1		3		1	No	20
Montane Riparian	U-A:Inset-EF	U-A:Inset-EF	Cattle-May->June-Grazing	1		3		2	No	20

Montane Riparian	U-A:Inset-EF	U-A:Inset-EF	Sheep-Grazing	1		3		2	No	20
Montane Riparian	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	20
Montane Riparian	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	20
Montane Riparian	U-A:Seeded Native	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	20
Montane Riparian	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	20
Montane Riparian	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-A:Seeded Native	U-A:Seeded Native	Sheep-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	20
Montane Riparian	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-A:Shrb-Frb Encr	U-C:Desertified	Cattle-Jul->Aprl-Grazing	1	0.0005	3			No	20
Montane Riparian	U-A:Shrb-Frb Encr	U-C:Desertified	Cattle-May->June-Grazing	1	0.001	3			No	20
Montane Riparian	U-A:Shrb-Frb Encr	U-C:Desertified	Sheep-Grazing	1	0.001	3			No	20
Montane Riparian	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0001	3			Yes	20
Montane Riparian	U-A:SI	U-A:Early-Shrub	Sheep-Grazing	1	0.0001	3			Yes	20
Montane Riparian	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3		1	No	20
Montane Riparian	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.9999	3		2	No	20
Montane Riparian	U-A:SI	U-A:SI	Sheep-Grazing	1	0.9999	3		2	No	20

Montane Riparian	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	20
Montane Riparian	U-A:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	20
Montane Riparian	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1		3		1	No	20
Montane Riparian	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999	3		2	No	20
Montane Riparian	U-C:Desertified	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Montane Riparian	U-C:Desertified	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005				Yes	20
Montane Riparian	U-C:Desertified	U-A:Bare Ground	Sheep-Grazing	1	0.0005				Yes	20
Montane Riparian	U-C:Desertified	U-C:Desertified	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Montane Riparian	U-C:Desertified	U-C:Desertified	Cattle-May->June-Grazing	1	0.0005				Yes	20
Montane Riparian	U-C:Desertified	U-C:Desertified	Cattle-May->June-Grazing	1	0.999			2	No	20
Montane Riparian	U-C:Desertified	U-C:Desertified	Sheep-Grazing	1	0.0005				Yes	20
Montane Riparian	U-C:Desertified	U-C:Desertified	Sheep-Grazing	1	0.999			2	No	20
Montane Riparian	U-C:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	20
Montane Riparian	U-C:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	20
Montane Riparian	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1				1	No	20
Montane Riparian	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.999			2	No	20
Montane Riparian	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.999			2	No	20

Mountain Shrub	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Mountain Shrub	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Mountain Shrub	A:All	A:All	Sheep-Grazing	1	0.0005	3		-1	No	
Mountain Shrub	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Mountain Shrub	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Mountain Shrub	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.0005	3			Yes	
Mountain Shrub	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Mountain Shrub	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Mountain Shrub	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Mountain Shrub	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Mountain Shrub	B:Closed	B:Closed	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	B:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Mountain Shrub	B:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Mountain Shrub	B:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Mountain Shrub	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Mountain Shrub	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Mountain Shrub	C:Closed	C:Closed	Sheep-Grazing	1	0.999			2	No	

Mountain Shrub	C:Closed	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Mountain Shrub	C:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005				No	
Mountain Shrub	C:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Mountain Shrub	C:Closed	U-C:Depleted	Sheep-Grazing	1	0.001				No	
Mountain Shrub	D:Open	D:Open	Cattle-Jul->Aprl-Grazing	1					No	
Mountain Shrub	D:Open	D:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Mountain Shrub	D:Open	D:Open	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	D:Open	U-D:TEA	Cattle-May->June-Grazing	1	0.001				No	
Mountain Shrub	D:Open	U-D:TEA	Sheep-Grazing	1	0.001				No	
Mountain Shrub	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Mountain Shrub	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1		3		2	No	
Mountain Shrub	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	
Mountain Shrub	U-A:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Mountain Shrub	U-A:SI	U-A:Early-Shrub	Cattle-May->June-Grazing	1		3			Yes	
Mountain Shrub	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Mountain Shrub	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Mountain Shrub	U-A:SI	U-A:SI	Sheep-Grazing	1	0.999	3		2	No	

Mountain Shrub	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Mountain Shrub	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Mountain Shrub	U-A:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001	3			Yes	
Mountain Shrub	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Mountain Shrub	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Mountain Shrub	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999	3		2	No	
Mountain Shrub	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Mountain Shrub	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.0005				Yes	
Mountain Shrub	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Mountain Shrub	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.0005			-1	No	
Mountain Shrub	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	U-B:SI	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Mountain Shrub	U-B:SI	U-B:SI	Cattle-Jul->Aprl-Grazing	1					No	
Mountain Shrub	U-B:SI	U-B:SI	Cattle-May->June-Grazing	1				2	No	
Mountain Shrub	U-B:SI	U-B:SI	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	U-B:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Mountain Shrub	U-B:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Mountain Shrub	U-B:SI+AS	U-B:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	

Mountain Shrub	U-B:SI+AS	U-B:SI+AS	Cattle-May->June-Grazing	1	0.999			2	No	
Mountain Shrub	U-B:SI+AS	U-B:SI+AS	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Mountain Shrub	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1				2	No	
Mountain Shrub	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.001			-1	No	
Mountain Shrub	U-C:SAP	U-C:SAP	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	U-C:SI	U-C:SI	Cattle-Jul->Aprl-Grazing	1					No	
Mountain Shrub	U-C:SI	U-C:SI	Cattle-May->June-Grazing	1				2	No	
Mountain Shrub	U-C:SI	U-C:SI	Sheep-Grazing	1	0.001			-1	No	
Mountain Shrub	U-C:SI	U-C:SI	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	U-C:SI+AS	U-C:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	
Mountain Shrub	U-C:SI+AS	U-C:SI+AS	Cattle-May->June-Grazing	1				2	No	
Mountain Shrub	U-C:SI+AS	U-C:SI+AS	Sheep-Grazing	1	0.001			-1	No	
Mountain Shrub	U-C:SI+AS	U-C:SI+AS	Sheep-Grazing	1	0.999			2	No	
Mountain Shrub	U-D:SI	U-D:SI	Cattle-Jul->Aprl-Grazing	1					No	
Mountain Shrub	U-D:SI	U-D:SI	Cattle-May->June-Grazing	1				2	No	
Mountain Shrub	U-D:SI	U-D:SI	Sheep-Grazing	1				2	No	
Mountain Shrub	U-D:SI+AS	U-D:SI+AS	Cattle-Jul->Aprl-Grazing	1					No	

Mountain Shrub	U-D:SI+AS	U-D:SI+AS	Cattle-May->June-Grazing	1				2	No	
Mountain Shrub	U-D:SI+AS	U-D:SI+AS	Sheep-Grazing	1				2	No	
Pinyon-Juniper Woodland	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Pinyon-Juniper Woodland	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Pinyon-Juniper Woodland	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Pinyon-Juniper Woodland	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	
Pinyon-Juniper Woodland	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Pinyon-Juniper Woodland	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1					No	
Pinyon-Juniper Woodland	B:Open	B:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Pinyon-Juniper Woodland	B:Open	B:Open	Sheep-Grazing	1	0.999			2	No	
Pinyon-Juniper Woodland	B:Open	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001				Yes	
Pinyon-Juniper Woodland	B:Open	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Pinyon-Juniper Woodland	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Pinyon-Juniper Woodland	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1		3		2	No	
Pinyon-Juniper Woodland	U-A:SI	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Pinyon-Juniper Woodland	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1			2		Yes	

Pinyon-Juniper Woodland	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Pinyon-Juniper Woodland	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1		3		2	No	
Pinyon-Juniper Woodland	U-A:SI	U-A:SI	Sheep-Grazing	1		3		2	No	
Pinyon-Juniper Woodland	U-A:SI+AS	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Pinyon-Juniper Woodland	U-A:SI+AS	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001	3			Yes	
Pinyon-Juniper Woodland	U-A:SI+AS	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Pinyon-Juniper Woodland	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Pinyon-Juniper Woodland	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Pinyon-Juniper Woodland	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999			2	No	
Pinyon-Juniper Woodland	U-B:SAP	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	
Pinyon-Juniper Woodland	U-B:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.001				Yes	
Pinyon-Juniper Woodland	U-B:SAP	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	
Pinyon-Juniper Woodland	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Pinyon-Juniper Woodland	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Pinyon-Juniper Woodland	U-B:SAP	U-B:SAP	Sheep-Grazing	1	0.999			2	No	
Ponderosa Pine-Dry	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	

Ponderosa Pine-Dry	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Dry	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Dry	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Dry	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Dry	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Dry	B:Open	B:Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Dry	B:Open	B:Open	Sheep-Grazing	1					No	
Ponderosa Pine-Dry	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Dry	C:Open	C:Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Dry	C:Open	C:Open	Sheep-Grazing	1					No	
Ponderosa Pine-Dry	U-A:FIC-All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0001	3			Yes	
Ponderosa Pine-Dry	U-A:FIC-All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Dry	U-A:FIC-All	U-A:FIC-All	Cattle-Jul->Aprl-Grazing	1		3			No	
Ponderosa Pine-Dry	U-A:FIC-All	U-A:FIC-All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Dry	U-A:FIC-All	U-A:FIC-All	Sheep-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Dry	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1		3			No	
Ponderosa Pine-Dry	U-A:SAP	U-A:SAP	Sheep-Grazing	1		3		2	No	
Ponderosa Pine-Dry	U-B:FIC-Open	U-B:FIC-Open	Cattle-Jul->Aprl-Grazing	1					No	

Ponderosa Pine-Dry	U-B:FIC-Open	U-B:FIC-Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Dry	U-B:FIC-Open	U-B:FIC-Open	Sheep-Grazing	1					No	
Ponderosa Pine-Dry	U-B:TEA	U-B:TEA	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Dry	U-B:TEA	U-B:TEA	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Dry	U-B:TEA	U-B:TEA	Sheep-Grazing	1					No	
Ponderosa Pine-Dry	U-C:FIC-Open	U-C:FIC-Open	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Dry	U-C:FIC-Open	U-C:FIC-Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Dry	U-C:FIC-Open	U-C:FIC-Open	Sheep-Grazing	1					No	
Ponderosa Pine-Mesic	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Ponderosa Pine-Mesic	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Mesic	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Mesic	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Mesic	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Mesic	B:Open	B:Open	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Mesic	B:Open	B:Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Mesic	B:Open	B:Open	Sheep-Grazing	1					No	
Ponderosa Pine-Mesic	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1					No	

Ponderosa Pine-Mesic	C:Open	C:Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Mesic	C:Open	C:Open	Sheep-Grazing	1					No	
Ponderosa Pine-Mesic	U-A:FIC-All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0001	3			Yes	
Ponderosa Pine-Mesic	U-A:FIC-All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Mesic	U-A:FIC-All	U-A:FIC-All	Cattle-Jul->Aprl-Grazing	1		3			No	
Ponderosa Pine-Mesic	U-A:FIC-All	U-A:FIC-All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Mesic	U-A:FIC-All	U-A:FIC-All	Sheep-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Mesic	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1		3			No	
Ponderosa Pine-Mesic	U-A:SAP	U-A:SAP	Sheep-Grazing	1		3		2	No	
Ponderosa Pine-Mesic	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Ponderosa Pine-Mesic	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1		3		2	No	
Ponderosa Pine-Mesic	U-A:SI	U-A:SI	Sheep-Grazing	1		3		2	No	
Ponderosa Pine-Mesic	U-A:SI+AS	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Ponderosa Pine-Mesic	U-A:SI+AS	U-A:SAP	Cattle-May->June-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Mesic	U-A:SI+AS	U-A:SAP	Sheep-Grazing	1	0.001	3			Yes	
Ponderosa Pine-Mesic	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	

Ponderosa Pine-Mesic	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Mesic	U-A:SI+AS	U-A:SI+AS	Sheep-Grazing	1	0.999	3		2	No	
Ponderosa Pine-Mesic	U-B:FIC-Open	U-B:FIC-Open	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Mesic	U-B:FIC-Open	U-B:FIC-Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Mesic	U-B:FIC-Open	U-B:FIC-Open	Sheep-Grazing	1					No	
Ponderosa Pine-Mesic	U-B:TEA	U-B:TEA	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Mesic	U-B:TEA	U-B:TEA	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Mesic	U-B:TEA	U-B:TEA	Sheep-Grazing	1					No	
Ponderosa Pine-Mesic	U-C:FIC-Open	U-C:FIC-Open	Cattle-Jul->Aprl-Grazing	1					No	
Ponderosa Pine-Mesic	U-C:FIC-Open	U-C:FIC-Open	Cattle-May->June-Grazing	1					No	
Ponderosa Pine-Mesic	U-C:FIC-Open	U-C:FIC-Open	Sheep-Grazing	1					No	
Riparian Blue Spruce	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			Yes	
Riparian Blue Spruce	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3			Yes	
Riparian Blue Spruce	A:All	A:All	Sheep-Grazing	1	0.999	3			Yes	
Riparian Blue Spruce	A:All	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Riparian Blue Spruce	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	

Riparian Blue Spruce	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Riparian Blue Spruce	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9999				No	
Riparian Blue Spruce	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Riparian Blue Spruce	B:Closed	B:Closed	Sheep-Grazing	1	0.999			2	No	
Riparian Blue Spruce	B:Closed	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	
Riparian Blue Spruce	B:Closed	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001				Yes	
Riparian Blue Spruce	B:Closed	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Riparian Blue Spruce	C:Closed	C:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Riparian Blue Spruce	C:Closed	C:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Riparian Blue Spruce	C:Closed	C:Closed	Sheep-Grazing	1	0.999			2	No	
Riparian Blue Spruce	C:Closed	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001				Yes	
Riparian Blue Spruce	C:Closed	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Saline Meadow	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Saline Meadow	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Saline Meadow	A:All	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Saline Meadow	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			No	
Saline Meadow	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	

Saline Meadow	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Saline Meadow	B:Closed	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Saline Meadow	B:Closed	U-C:Depleted	Cattle-May->June-Grazing	1	0.001			2	No	
Saline Meadow	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Saline Meadow	C:Open	C:Open	Cattle-May->June-Grazing	1	0.999			2	No	
Saline Meadow	C:Open	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Saline Meadow	C:Open	U-C:Depleted	Cattle-May->June-Grazing	1	0.001			2	No	
Saline Meadow	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1		3			No	
Saline Meadow	U-A:Annual Spp	U-A:Annual Spp	Cattle-May->June-Grazing	1				2	No	
Saline Meadow	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1		3		1	No	
Saline Meadow	U-A:SAP	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Saline Meadow	U-A:SAP	U-A:Annual Spp	Cattle-May->June-Grazing	1	0.0005				Yes	
Saline Meadow	U-A:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Saline Meadow	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.0005				Yes	
Saline Meadow	U-A:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Saline Meadow	U-C:Depleted	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	

Saline Meadow	U-C:Depleted	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001				Yes	
Saline Meadow	U-C:Depleted	U-C:Depleted	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Saline Meadow	U-C:Depleted	U-C:Depleted	Cattle-May->June-Grazing	1	0.999			2	No	
Saline Meadow	U-C:SAP	U-A:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	
Saline Meadow	U-C:SAP	U-A:SAP	Cattle-May->June-Grazing	1	0.0005				Yes	
Saline Meadow	U-C:SAP	U-C:SAP	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Saline Meadow	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.0005				Yes	
Saline Meadow	U-C:SAP	U-C:SAP	Cattle-May->June-Grazing	1	0.999			2	No	
Seep	A:All	A:All	Cattle-Jul->Aprl-Grazing	1					No	
Seep	A:All	A:All	Cattle-May->June-Grazing	1	0.9999			2	No	
Seep	A:All	A:All	Sheep-Grazing	1	0.999			2	No	
Seep	A:All	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.0001				No	
Seep	A:All	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	
Seep	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Seep	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.9999			2	No	
Seep	B:Closed	B:Closed	Sheep-Grazing	1	0.999			2	No	
Seep	B:Closed	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.0001				No	

Seep	B:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	
Semi-Desert Grassland	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Semi-Desert Grassland	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Semi-Desert Grassland	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Semi-Desert Grassland	A:All	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Semi-Desert Grassland	A:All	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	3			Yes	
Semi-Desert Grassland	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Semi-Desert Grassland	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Semi-Desert Grassland	B:Closed	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005				Yes	
Semi-Desert Grassland	B:Closed	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Semi-Desert Grassland	B:Closed	U-B:Depleted	Cattle-May->June-Grazing	1	0.0005				No	
Semi-Desert Grassland	U-A:Seeded Native	U-A:Bare Ground	Cattle-Jul->Aprl-Grazing	1		3	5		Yes	
Semi-Desert Grassland	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1		3	5		Yes	
Semi-Desert Grassland	U-A:Seeded Native	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.0005	6	19		Yes	
Semi-Desert Grassland	U-A:Seeded Native	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005	6			Yes	
Semi-Desert Grassland	U-A:Seeded Native	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.0005	6			Yes	

Semi-Desert Grassland	U-A:Seeded Native	U-A:Seeded Native	Cattle-Jul->Aprl-Grazing	1	0.9995	6			No	
Semi-Desert Grassland	U-A:Seeded Native	U-A:Seeded Native	Cattle-May->June-Grazing	1	0.999	6		2	No	
Semi-Desert Grassland	U-A:Seeded Native	U-B:Depleted	Cattle-May->June-Grazing	1	0.0005	20			No	
Semi-Desert Grassland	U-A:SI	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3	19		Yes	
Semi-Desert Grassland	U-A:SI	U-A:SI	Cattle-Jul->Aprl-Grazing	1		3			No	
Semi-Desert Grassland	U-A:SI	U-A:SI	Cattle-May->June-Grazing	1	0.999	3		2	No	
Semi-Desert Grassland	U-A:SI	U-B:Depleted	Cattle-May->June-Grazing	1	0.001	20			No	
Semi-Desert Grassland	U-A:SI+AS	U-A:SI+AS	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Semi-Desert Grassland	U-A:SI+AS	U-A:SI+AS	Cattle-May->June-Grazing	1	0.999	3		2	No	
Semi-Desert Grassland	U-A:SI+AS	U-B:SAP	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Semi-Desert Grassland	U-A:SI+AS	U-B:SAP	Cattle-May->June-Grazing	1	0.001	3	19		Yes	
Semi-Desert Grassland	U-A:SI+AS	U-B:SAP	Cattle-May->June-Grazing	1	0.001	20			No	
Semi-Desert Grassland	U-B:Depleted	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.001				No	
Semi-Desert Grassland	U-B:Depleted	U-A:Early-Shrub	Sheep-Grazing	1	0.001				No	
Semi-Desert Grassland	U-B:Depleted	U-B:Depleted	Cattle-Jul->Aprl-Grazing	1				1	No	
Semi-Desert Grassland	U-B:Depleted	U-B:Depleted	Cattle-May->June-Grazing	1	0.999			2	No	

Semi-Desert Grassland	U-B:Depleted	U-B:Depleted	Sheep-Grazing	1	0.999			2	No	
Semi-Desert Grassland	U-B:SAP	U-B:SAP	Cattle-Jul->Aprl-Grazing	1					No	
Semi-Desert Grassland	U-B:SAP	U-B:SAP	Cattle-May->June-Grazing	1				2	No	
Silver Sagebrush	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Silver Sagebrush	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Silver Sagebrush	A:All	A:All	Sheep-Grazing	1	0.999	3		1	No	
Silver Sagebrush	A:All	U-A:Bare Ground	Cattle-May->June-Grazing	1	0.001	3			Yes	
Silver Sagebrush	A:All	U-A:Bare Ground	Sheep-Grazing	1	0.001	3			Yes	
Silver Sagebrush	A:All	U-A:Depleted	Cattle-Jul->Aprl-Grazing	1	0.0005	3			No	
Silver Sagebrush	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Silver Sagebrush	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Silver Sagebrush	B:Closed	B:Closed	Sheep-Grazing	1	0.999			1	No	
Silver Sagebrush	B:Closed	U-A:Bare Ground	Sheep-Grazing	1	0.001				Yes	
Silver Sagebrush	B:Closed	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.001				Yes	
Silver Sagebrush	U-A:Depleted	U-A:Depleted	Cattle-Jul->Aprl-Grazing	1					No	
Silver Sagebrush	U-A:Depleted	U-A:Depleted	Cattle-May->June-Grazing	1	0.999			2	No	
Silver Sagebrush	U-A:Depleted	U-A:Depleted	Sheep-Grazing	1	0.9999			1	No	

Silver Sagebrush	U-A:Depleted	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.001				Yes	
Silver Sagebrush	U-A:Depleted	U-A:Early-Shrub	Sheep-Grazing	1	0.001				Yes	
Silver Sagebrush	U-A:Early-Shrub	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1					No	
Silver Sagebrush	U-A:Early-Shrub	U-A:Early-Shrub	Cattle-May->June-Grazing	1				2	No	
Silver Sagebrush	U-A:Early-Shrub	U-A:Early-Shrub	Sheep-Grazing	1				1	No	
Spruce Pure	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Spruce Pure	A:All	A:All	Sheep-Grazing	1	0.001	3			Yes	
Spruce Pure	A:All	A:All	Sheep-Grazing	1	0.999	3		1	No	
Spruce-Fir	A:All	A:All	Cattle-Jul->Aprl-Grazing	1		3			No	
Spruce-Fir	A:All	A:All	Cattle-May->June-Grazing	1	0.001	3			Yes	
Spruce-Fir	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Spruce-Fir	A:All	A:All	Sheep-Grazing	1		3			Yes	
Spruce-Fir	A:All	A:All	Sheep-Grazing	1		3		1	No	
Subalpine Montane Mesic Meadow	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3		1	No	
Subalpine Montane Mesic Meadow	A:All	A:All	Cattle-May->June-Grazing	1	0.999	3		2	No	
Subalpine Montane Mesic Meadow	A:All	A:All	Sheep-Grazing	1	0.999	3		2	No	
Subalpine Montane Mesic Meadow	A:All	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.001	3			No	

Subalpine Montane Mesic Meadow	A:All	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001	3			No	
Subalpine Montane Mesic Meadow	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Subalpine Montane Mesic Meadow	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.9995			2	No	
Subalpine Montane Mesic Meadow	B:Closed	B:Closed	Sheep-Grazing	1	0.999	3		2	No	
Subalpine Montane Mesic Meadow	B:Closed	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.0005				No	
Subalpine Montane Mesic Meadow	B:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001	3			No	
Subalpine Montane Mesic Meadow	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1		3			No	
Subalpine Montane Mesic Meadow	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1		3		2	No	
Subalpine Montane Mesic Meadow	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Sheep-Grazing	1		3		2	No	
Subalpine Upper-Montane Riparian	A-Willow:All	A-Willow:All	Cattle-Jul->Aprl-Grazing	1	0.9995	3			No	
Subalpine Upper-Montane Riparian	A-Willow:All	A-Willow:All	Cattle-May->June-Grazing	1	0.999	3			Yes	
Subalpine Upper-Montane Riparian	A-Willow:All	A-Willow:All	Sheep-Grazing	1	0.999	3			Yes	
Subalpine Upper-Montane Riparian	A-Willow:All	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005	3			Yes	
Subalpine Upper-Montane Riparian	A-Willow:All	U-A:Hummocked	Cattle-May->June-Grazing	1	0.001	3			Yes	
Subalpine Upper-Montane Riparian	A-Willow:All	U-A:Hummocked	Sheep-Grazing	1	0.001	3			Yes	
Subalpine Upper-Montane Riparian	B-Willow:Closed	B-Willow:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	

Subalpine Upper-Montane Riparian	B-Willow:Closed	B-Willow:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Subalpine Upper-Montane Riparian	B-Willow:Closed	B-Willow:Closed	Sheep-Grazing	1	0.999			1	No	
Subalpine Upper-Montane Riparian	B-Willow:Closed	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Subalpine Upper-Montane Riparian	B-Willow:Closed	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.001				No	
Subalpine Upper-Montane Riparian	B-Willow:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	
Subalpine Upper-Montane Riparian	C-Willow:Closed	C-Willow:Closed	Cattle-Jul->Aprl-Grazing	1					No	
Subalpine Upper-Montane Riparian	C-Willow:Closed	C-Willow:Closed	Cattle-May->June-Grazing	1	0.999			2	No	
Subalpine Upper-Montane Riparian	C-Willow:Closed	C-Willow:Closed	Sheep-Grazing	1	0.999			1	No	
Subalpine Upper-Montane Riparian	C-Willow:Closed	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.001				No	
Subalpine Upper-Montane Riparian	C-Willow:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	
Subalpine Upper-Montane Riparian	U-A:Hummocked	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1					Yes	
Subalpine Upper-Montane Riparian	U-A:Hummocked	U-A:Hummocked	Cattle-May->June-Grazing	1					Yes	
Subalpine Upper-Montane Riparian	U-A:Hummocked	U-A:Hummocked	Sheep-Grazing	1					Yes	
Subalpine Upper-Montane Riparian	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1					No	
Subalpine Upper-Montane Riparian	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-May->June-Grazing	1				2	No	
Subalpine Upper-Montane Riparian	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Sheep-Grazing	1				1	No	

Upper-Subalpine Grassland	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9999				No	
Upper-Subalpine Grassland	A:All	A:All	Sheep-Grazing	1	0.999			1	No	
Upper-Subalpine Grassland	A:All	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0001				No	
Upper-Subalpine Grassland	A:All	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	
Upper-Subalpine Grassland	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Upper-Subalpine Grassland	B:Closed	B:Closed	Sheep-Grazing	1	0.999			1	No	
Upper-Subalpine Grassland	B:Closed	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Upper-Subalpine Grassland	B:Closed	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	
Upper-Subalpine Grassland	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	
Upper-Subalpine Grassland	C:Open	C:Open	Sheep-Grazing	1	0.999			1	No	
Upper-Subalpine Grassland	C:Open	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.0005				No	
Upper-Subalpine Grassland	C:Open	U-A:Shrb-Frb Encr	Sheep-Grazing	1	0.001				No	
Upper-Subalpine Grassland	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1					No	
Upper-Subalpine Grassland	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Sheep-Grazing	1				1	No	
Wet Meadow-Montane	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Wet Meadow-Montane	A:All	A:All	Cattle-May->June-Grazing	1	0.999			2	No	20

Wet Meadow-Montane	A:All	A:All	Sheep-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	A:All	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Montane	A:All	U-A:Hummocked	Cattle-May->June-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	A:All	U-A:Hummocked	Sheep-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Wet Meadow-Montane	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	B:Closed	B:Closed	Sheep-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	B:Closed	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				No	20
Wet Meadow-Montane	B:Closed	U-A:Hummocked	Cattle-May->June-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	B:Closed	U-A:Hummocked	Sheep-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Wet Meadow-Montane	C:Open	C:Open	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	C:Open	C:Open	Sheep-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	C:Open	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Montane	C:Open	U-A:Hummocked	Cattle-May->June-Grazing	1	0.0005				Yes	20
Wet Meadow-Montane	C:Open	U-A:Hummocked	Sheep-Grazing	1	0.0005				Yes	20

Wet Meadow-Montane	C:Open	U-C:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.0005				No	20
Wet Meadow-Montane	C:Open	U-C:Shrb-Frb Encr	Sheep-Grazing	1	0.0005				No	20
Wet Meadow-Montane	U-A:Annual Spp	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1					No	20
Wet Meadow-Montane	U-A:Annual Spp	U-A:Annual Spp	Sheep-Grazing	1				2	No	20
Wet Meadow-Montane	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1					No	20
Wet Meadow-Montane	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-May->June-Grazing	1				2	No	20
Wet Meadow-Montane	U-A:Exotic Forb	U-A:Exotic Forb	Sheep-Grazing	1				2	No	20
Wet Meadow-Montane	U-A:Hummocked	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.9995				Yes	20
Wet Meadow-Montane	U-A:Hummocked	U-A:Hummocked	Cattle-May->June-Grazing	1	0.999				Yes	20
Wet Meadow-Montane	U-A:Hummocked	U-A:Hummocked	Sheep-Grazing	1	0.999				Yes	
Wet Meadow-Montane	U-A:Hummocked	U-C:Desertified	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Montane	U-A:Hummocked	U-C:Desertified	Cattle-May->June-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	U-A:Hummocked	U-C:Desertified	Sheep-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	U-A:Inset	U-A:Inset	Cattle-Jul->Aprl-Grazing	1	0.9995			1	No	20
Wet Meadow-Montane	U-A:Inset	U-A:Inset	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	U-A:Inset	U-A:Inset	Sheep-Grazing	1	0.999			2	No	20

Wet Meadow-Montane	U-A:Inset	U-A:Inset-Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Montane	U-A:Inset	U-A:Inset-Hummocked	Cattle-May->June-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	U-A:Inset	U-A:Inset-Hummocked	Sheep-Grazing	1	0.999				Yes	20
Wet Meadow-Montane	U-A:Inset-EF	U-A:Inset-EF	Cattle-Jul->Aprl-Grazing	1					No	20
Wet Meadow-Montane	U-A:Inset-EF	U-A:Inset-EF	Cattle-May->June-Grazing	1				2	No	20
Wet Meadow-Montane	U-A:Inset-EF	U-A:Inset-EF	Sheep-Grazing	1				2	No	20
Wet Meadow-Montane	U-A:Inset-Hummocked	U-A:Inset-Hummocked	Cattle-Jul->Aprl-Grazing	1					Yes	20
Wet Meadow-Montane	U-A:Inset-Hummocked	U-A:Inset-Hummocked	Cattle-May->June-Grazing	1					Yes	20
Wet Meadow-Montane	U-A:Inset-Hummocked	U-A:Inset-Hummocked	Sheep-Grazing	1					Yes	20
Wet Meadow-Montane	U-C:Desertified	U-A:Early-Shrub	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Montane	U-C:Desertified	U-A:Early-Shrub	Cattle-May->June-Grazing	1	0.001				Yes	
Wet Meadow-Montane	U-C:Desertified	U-A:Early-Shrub	Sheep-Grazing	1	0.0005				No	
Wet Meadow-Montane	U-C:Desertified	U-A:Early-Shrub	Sheep-Grazing	1	0.001				Yes	
Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Sheep-Grazing	1	0.0005				No	

Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Sheep-Grazing	1	0.999			2	No	
Wet Meadow-Montane	U-C:SA	U-A:Annual Spp	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Montane	U-C:SA	U-A:Annual Spp	Sheep-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	U-C:SA	U-C:SA	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Wet Meadow-Montane	U-C:SA	U-C:SA	Sheep-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Desertified	Cattle-Jul->Aprl-Grazing	1	0.0005				No	20
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Desertified	Cattle-May->June-Grazing	1	0.001				Yes	20
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Desertified	Sheep-Grazing	1	0.001				No	20
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Sheep-Grazing	1	0.999			2	No	20
Wet Meadow-Subalpine	A:All	A:All	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Wet Meadow-Subalpine	A:All	A:All	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Subalpine	A:All	A:All	Sheep-Grazing	1	0.999			2	No	
Wet Meadow-Subalpine	A:All	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Subalpine	A:All	U-A:Hummocked	Cattle-May->June-Grazing	1	0.001				Yes	20

Wet Meadow-Subalpine	A:All	U-A:Hummocked	Sheep-Grazing	1	0.001				Yes	
Wet Meadow-Subalpine	B:Closed	B:Closed	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Wet Meadow-Subalpine	B:Closed	B:Closed	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Subalpine	B:Closed	B:Closed	Sheep-Grazing	1	0.999			2	No	
Wet Meadow-Subalpine	B:Closed	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				No	20
Wet Meadow-Subalpine	B:Closed	U-A:Hummocked	Cattle-May->June-Grazing	1	0.001				Yes	20
Wet Meadow-Subalpine	B:Closed	U-A:Hummocked	Sheep-Grazing	1	0.001				Yes	
Wet Meadow-Subalpine	C:Open	C:Open	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Wet Meadow-Subalpine	C:Open	C:Open	Cattle-May->June-Grazing	1	0.999			2	No	20
Wet Meadow-Subalpine	C:Open	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Subalpine	C:Open	U-A:Hummocked	Cattle-May->June-Grazing	1	0.0005				Yes	20
Wet Meadow-Subalpine	C:Open	U-A:Hummocked	Sheep-Grazing	1	0.0005				Yes	
Wet Meadow-Subalpine	C:Open	U-C:Shrb-Frb Encr	Cattle-May->June-Grazing	1	0.0005				No	20
Wet Meadow-Subalpine	C:Open	U-C:Shrb-Frb Encr	Sheep-Grazing	1	0.0005				No	20
Wet Meadow-Subalpine	C:Open	U-C:Shrb-Frb Encr	Sheep-Grazing	1	0.999			2	No	
Wet Meadow-Subalpine	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-Jul->Aprl-Grazing	1					No	20

Wet Meadow-Subalpine	U-A:Exotic Forb	U-A:Exotic Forb	Cattle-May->June-Grazing	1				2	No	20
Wet Meadow-Subalpine	U-A:Exotic Forb	U-A:Exotic Forb	Sheep-Grazing	1				2	No	
Wet Meadow-Subalpine	U-A:Hummocked	U-A:Hummocked	Cattle-Jul->Aprl-Grazing	1	0.9995				Yes	20
Wet Meadow-Subalpine	U-A:Hummocked	U-A:Hummocked	Cattle-May->June-Grazing	1	0.999				Yes	20
Wet Meadow-Subalpine	U-A:Hummocked	U-A:Hummocked	Sheep-Grazing	1	0.999				Yes	
Wet Meadow-Subalpine	U-A:Hummocked	U-C:Desertified	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Subalpine	U-A:Hummocked	U-C:Desertified	Cattle-May->June-Grazing	1	0.001				Yes	
Wet Meadow-Subalpine	U-A:Hummocked	U-C:Desertified	Sheep-Grazing	1	0.001				Yes	
Wet Meadow-Subalpine	U-A:Inset	U-A:Inset	Cattle-Jul->Aprl-Grazing	1	0.9995				No	20
Wet Meadow-Subalpine	U-A:Inset	U-A:Inset	Cattle-May->June-Grazing	1	0.999			2	No	
Wet Meadow-Subalpine	U-A:Inset	U-A:Inset	Sheep-Grazing	1	0.999			2	No	
Wet Meadow-Subalpine	U-A:Inset	U-A:Inset-Hummocked	Cattle-Jul->Aprl-Grazing	1	0.0005				Yes	20
Wet Meadow-Subalpine	U-A:Inset	U-A:Inset-Hummocked	Cattle-May->June-Grazing	1	0.001				Yes	
Wet Meadow-Subalpine	U-A:Inset	U-A:Inset-Hummocked	Sheep-Grazing	1	0.001				Yes	
Wet Meadow-Subalpine	U-A:Inset-EF	U-A:Inset-EF	Cattle-Jul->Aprl-Grazing	1					No	20
Wet Meadow-Subalpine	U-A:Inset-EF	U-A:Inset-EF	Cattle-May->June-Grazing	1				2	No	