



Landscape Conservation Forecasting™ for Washington County's National Conservation Areas

*Report to the Bureau of Land Management St. George Field Office
September 2011*



Photos: Red Cliffs (above) and Beaver Dam Wash (below) National Conservation Areas; L. Provencher, 2011

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Table of Contents

Executive Summary..... 1
 Introduction..... 1
Process and Methods..... 2
 Key Findings..... 5
Introduction 8
 Background..... 8
 Project Area 10
 Management Objectives..... 11
Process and Methods..... 12
 Vegetation Mapping..... 13
 Remote Sensing Analysis of Ecological Systems and Current Vegetation Classes 14
 Mapping Ecological Systems..... 15
 Ecological System Descriptions and Natural Range of Variability (NRV)..... 17
 Refinement of Predictive Ecological Models 18
 Models and Descriptions..... 19
 Assessment of Current Ecological Condition 19
 Calculating Ecological Departure 19
 Calculating Desert Tortoise Departure 20
 Accounting for Variability in Disturbances and Climate 22
 Assessment of Future Ecological Condition – MINIMUM MANAGEMENT 23
 Assessment of Future Ecological Condition – Alternative Management Strategies 23
 Management Strategies 24
 Management Scenarios 25
 Computer Simulations and Reporting Variables 28
 Return-On-Investment Analysis 28
Findings 29
 Ecological Systems 29
 Current Ecological Departure 29
 Current Desert Tortoise Departure..... 29
 Predicted Future Ecological Condition – MINIMUM MANAGEMENT..... 32
 Ecological Departure 32
 Desert Tortoise Departure..... 33
 Management Strategies and Scenarios..... 34
 Introduction..... 34
 Red Cliffs NCA..... 34
 Beaver Dam Wash NCA..... 73
 Prioritizing Actions among Biophysical Settings: Return-on-Investment..... 99
 Areas of Implementation..... 105
Conclusions 105
Acknowledgments..... 108
Literature Cited 109
 Appendix 1. Descriptions of vegetation classes within biophysical settings for the Beaver Dam Wash and Red Cliffs National Conservation Areas 113

| | |
|--|-----|
| Appendix 2. Description of ecological model dynamics for the Red Cliffs and Beaver Dam Wash NCAs. | 121 |
| Introduction..... | 121 |
| Appendix 3. Probabilistic transitions for biophysical settings of the Red Cliffs and Beaver Dam Wash NCAs. Output obtained from PATH database. Legend: BSu = Big Sagebrush Steppe-upland, BM = Blackbrush-mesic, BT= Blackbrush-thermic, CB = Creosotebush-White Bursage, DSS = Desert Sand Sagebrush, GRL = Warm Season Grassland, MR = Montane Riparian, MSh = Mountain Shrub, PJ = Pinyon-Juniper Woodland, WAS = Desert Washes, WDR = Warm-Desert Riparian. | 184 |
| Appendix 4. Temporal multipliers..... | 238 |
| Appendix 5. Management actions and cost by ecological systems. | 246 |
| Appendix 6. Current acres by vegetation class, natural range of variability (NRV) and ecological departure (ED) calculations for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs..... | 252 |
| Appendix 7. MINIMUM MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs. | 256 |
| Appendix 8. MAXIMUM MANAGEMENT scenario 50-year area results (acre) by vegetation class for ecological systems of Red Cliffs and Beaver Dam Wash NCA, Utah..... | 261 |
| Appendix 9. STREAMLINED MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs..... | 266 |
| Appendix 10. PLANTING AND HERBICIDE-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs..... | 271 |
| Appendix 11. PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Beaver Dam Wash NCA. | 276 |
| Appendix 12. FUEL-BREAK-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs..... | 279 |
| Appendix 13. FINGERS-OF-DEATH WITH 75% SUCCESS RATE MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs..... | 284 |
| Appendix 14. FINGERS-OF-DEATH WITH 50% SUCCESS RATE MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs..... | 289 |
| Appendix 15. FINGERS-OF-DEATH WITH 25% SUCCESS RATE MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs..... | 294 |
| Appendix 16. NO-GRAZING-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Beaver Dam Wash NCA..... | 299 |

List of Figures & Tables

| | |
|--|----|
| FIGURE 1. RED CLIFFS AND BEAVER DAM WASH NCAS IN WASHINGTON COUNTY, UTAH. | 11 |
| TABLE 2. ECOLOGICAL SYSTEMS OF THE TWO NCAS IN WASHINGTON COUNTY. ACRES ONLY INCLUDE LAND MANAGED BY THE BLM ALTHOUGH A LARGER AREA WAS REMOTELY SENSED. BARREN AREAS MADE PRIMARILY OF ROCK OUTCROPS ACCOUNTED FOR ~10,000 ACRES IN RED CLIFFS NCA. | 16 |
| TABLE 3. THE NATURAL RANGE OF VARIABILITY FOR ECOLOGICAL SYSTEMS OF RED CLIFFS AND BEAVER DAM WASH NCAS. | 18 |
| TABLE 4. EXAMPLE OF CALCULATION OF ECOLOGICAL DEPARTURE AND FRCC. | 20 |

| | |
|---|----|
| TABLE 5. DESERT TORTOISE “POINTS” BY VEGETATION CLASS FOR EACH BIOPHYSICAL SETTING USED BY DESERT TORTOISE. | 21 |
| TABLE 6. FOCAL ECOLOGICAL SYSTEMS OF WASHINGTON COUNTY’S NCAS SELECTED FOR MANAGEMENT. ACRES ONLY INCLUDE LAND MANAGED BY THE BLM ALTHOUGH A LARGER AREA WAS REMOTELY SENSED. | 24 |
| TABLE 7. DESCRIPTIONS OF STANDARD AND ONE-ACTION MANAGEMENT SCENARIOS FOR BEAVER DAM WASH AND RED CLIFFS NCAS. | 26 |
| FIGURE 2. ECOLOGICAL SYSTEMS OF THE RED CLIFFS NCA, UT. | 30 |
| FIGURE 3. ECOLOGICAL SYSTEMS OF THE BEAVER DAM WASH NCA, UT. | 31 |
| TABLE 8. ECOLOGICAL DEPARTURE (%) AND DESERT TORTOISE DEPARTURE (%) OF RED CLIFFS AND BEAVER DAM WASH NCAS’SECOLOGICAL SYSTEMS. BOTH DEPARTURE SCORES WERE CLASSED AS GOOD (0-33%, GREEN); FAIR (34-66%, YELLOW); AND POOR (>66%, RED). BLANK ENTRIES UNDER DESERT TORTOISE DEPARTURE (%) INDICATE THAT THE METRIC DOES NOT APPLY. | 32 |
| TABLE 9. CURRENT AND PREDICTED ECOLOGICAL DEPARTURE (%) AND DESERT TORTOISE DEPARTURE (%) OF RED CLIFFS AND BEAVER DAM WASH NCAS’SECOLOGICAL SYSTEMS. THE PREDICTED CONDITION WAS UNDER MINIMUM MANAGEMENT. BOTH DEPARTURE SCORES WERE CLASSED AS GOOD (0-33%, GREEN); FAIR (34-66%, YELLOW); AND POOR (>66%, RED). BLANK ENTRIES UNDER DESERT TORTOISE DEPARTURE (%) INDICATE THAT THE METRIC DOES NOT APPLY. | 33 |
| FIGURE 4. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT ED) OF BLACKBRUSH–MESIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. | 38 |
| FIGURE 5. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT DT) OF BLACKBRUSH–MESIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. | 39 |
| FIGURE 6. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT ED) OF BLACKBRUSH–THERMIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. | 43 |
| FIGURE 7. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT DT) OF BLACKBRUSH–THERMIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. | 44 |
| FIGURE 8. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT ED) OF CREOSOTEBUSH-WHITE BURSAGE AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. | 48 |
| FIGURE 9. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT DT) OF CREOSOTEBUSH-WHITE BURSAGE AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. | 49 |

- FIGURE 10. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT _{ED}) OF DESERT WASHES AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. 53
- FIGURE 11. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT _{DT}) OF DESERT WASHES AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. 54
- FIGURE 12. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT _{ED}) OF DESERT SAND SAGEBRUSH AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. 57
- FIGURE 13. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT _{DT}) OF DESERT SAND SAGEBRUSH AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. 58
- FIGURE 14. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT _{ED}) OF WARM-SEASON GRASSLAND AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. 61
- FIGURE 15. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT _{DT}) OF WARM-SEASON GRASSLAND AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; FOD = FINGERS-OF-DEATH. 62
- FIGURE 16. ECOLOGICAL DEPARTURE (%) OF BIG SAGEBRUSH STEPPE AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. 64
- FIGURE 17. ECOLOGICAL DEPARTURE (%) OF MONTANE RIPARIAN AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. 66
- FIGURE 18. ECOLOGICAL DEPARTURE (%) OF MOUNTAIN SHRUB AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. 68
- FIGURE 19. ECOLOGICAL DEPARTURE (%) OF PINYON-JUNIPER WOODLAND AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO

- IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. 70
- FIGURE 20. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT_{ED}) OF WARM DESERT RIPARIAN AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE RED CLIFFS NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. 73
- FIGURE 21. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT_{ED}) OF BLACKBRUSH–MESIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 77
- FIGURE 22. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT_{DT}) OF BLACKBRUSH–MESIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH 78
- FIGURE 23. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT_{ED}) OF BLACKBRUSH–THERMIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 82
- FIGURE 24. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT_{DT}) OF BLACKBRUSH–THERMIC AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 83
- FIGURE 25. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT_{ED}) OF CREOSOTEBUSH-WHITE BURSAGE AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 87
- FIGURE 26. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT_{DT}) OF CREOSOTEBUSH-WHITE BURSAGE AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 88
- FIGURE 27. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT_{ED}) OF DESERT WASHES AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 92

- FIGURE 28. DESERT TORTOISE DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR DESERT TORTOISE DEPARTURE (SUBSCRIPT _{DT}) OF DESERT WASHES AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 93
- FIGURE 29. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT _{ED}) OF MOUNTAIN SHRUB AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 96
- FIGURE 30. ECOLOGICAL DEPARTURE (%) AND RETURN-ON-INVESTMENT FOR ECOLOGICAL DEPARTURE (SUBSCRIPT _{ED}) OF WARM DESERT RIPARIAN AFTER 50 YEARS SIMULATING DIFFERENT MANAGEMENT SCENARIOS FOR THE BEAVER DAM WASH NCA. THE MINIMUM MANAGEMENT SCENARIO IS NOT SHOWN IN THE ROI GRAPH BECAUSE THIS SCENARIO IS USED IN THE ROI CALCULATION. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: P+H = PLANTING AND HERBICIDE; L-C = LIVESTOCK CLOSURE; FOD = FINGERS-OF-DEATH. 99
- FIGURE 31. AVERAGE ECOLOGICAL SYSTEM-WIDE RETURN ON INVESTMENT (ROI) BASED ON DESERT TORTOISE DEPARTURE (SUBSCRIPT _{DTD}) FOR THE SIX ECOLOGICAL SYSTEMS OF BLM'S RED CLIFFS NCA USED BY DESERT TORTOISE AND SELECTED FOR ACTIVE MANAGEMENT ANALYSES. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: BM = BLACKBRUSH-MESIC, BT= BLACKBRUSH-THERMIC, CB = CREOSOTEBUSH-WHITE BURSAGE, DSS = DESERT SAND SAGEBRUSH, GRL = WARM SEASON GRASSLAND, WAS = DESERT WASHES. 101
- FIGURE 32. AVERAGE ECOLOGICAL SYSTEM-WIDE RETURN ON INVESTMENT (ROI) BASED ON ECOLOGICAL DEPARTURE (SUBSCRIPT _{ED}) FOR THE 11 ECOLOGICAL SYSTEMS OF BLM'S RED CLIFFS NCA SELECTED FOR ACTIVE MANAGEMENT ANALYSES. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: BSU = BIG SAGEBRUSH STEPPE-UPLAND, BM = BLACKBRUSH-MESIC, BT= BLACKBRUSH-THERMIC, CB = CREOSOTEBUSH-WHITE BURSAGE, DSS = DESERT SAND SAGEBRUSH, GRL = WARM SEASON GRASSLAND, MR = MONTANE RIPARIAN, MSH = MOUNTAIN SHRUB, PJ = PINYON-JUNIPER WOODLAND, WAS = DESERT WASHES, WDR = WARM-DESERT RIPARIAN. 102
- FIGURE 33. AVERAGE ECOLOGICAL SYSTEM-WIDE RETURN ON INVESTMENT (ROI) BASED ON DESERT TORTOISE DEPARTURE (SUBSCRIPT _{DTD}) FOR THE FOUR ECOLOGICAL SYSTEMS OF BLM'S RED CLIFFS NCA USED BY DESERT TORTOISE AND SELECTED FOR ACTIVE MANAGEMENT ANALYSES. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: BM = BLACKBRUSH-MESIC, BT= BLACKBRUSH-THERMIC, CB = CREOSOTEBUSH-WHITE BURSAGE, WAS = DESERT WASHES. 103
- FIGURE 34. AVERAGE ECOLOGICAL SYSTEM-WIDE RETURN ON INVESTMENT (ROI) BASED ON ECOLOGICAL DEPARTURE (SUBSCRIPT _{ED}) FOR THE SIX ECOLOGICAL SYSTEMS OF BLM'S BEAVER DAM WASH NCA SELECTED FOR ACTIVE MANAGEMENT ANALYSES. CENTER OF BOX IS THE MEAN, EDGES OF BOX ARE ± 1 SE, AND BARS ARE 95% CONFIDENCE INTERVAL LIMITS. N = 5 REPLICATES. LEGEND: BM = BLACKBRUSH-MESIC, BT= BLACKBRUSH-THERMIC, CB = CREOSOTEBUSH-WHITE BURSAGE, MSH = MOUNTAIN SHRUB, WAS = DESERT WASHES, WDR = WARM-DESERT RIPARIAN. 104
- FIGURE 4-1. FIVE REPLICATES OF TEMPORAL PROBABILITY MULTIPLIERS FOR FIRE ACTIVITY. EACH REPLICATE IS NUMBERED AND REPRESENTED BY 50-YEAR PERIOD. THE HORIZONTAL GRAY LINE FOR TEMPORAL MULTIPLIER = 1 REPRESENTS THE "NO-CHANGE" OR NEUTRAL PARAMETER LINE. 239
- FIGURE 4-2. PALMER DROUGHT SEVERITY INDEX (PDSI) TIME SERIES (TOP) AND CALCULATED DROUGHT TEMPORAL MULTIPLIERS (BOTTOM) FOR THE FOURTH CLIMATIC DIVISIONS OF NEVADA AND UTAH. FIVE REPLICATES (REPL) ARE SHOWN EACH PER 50-YEAR PERIOD. THE GRAY LINE FOR PDSI = 0 REPRESENTED AVERAGE DROUGHT CONDITIONS, WHEREAS THE GRAY LINE FOR THE DROUGHT TEMPORAL MULTIPLIER = 1 REPRESENTED THE "NO-CHANGE" OR NEUTRAL PARAMETER LINE. 240

FIGURE 4-3. TEMPORAL MULTIPLIERS OF ANNUAL GRASS INVASION AND TREE INVASION FOR THE FOURTH CLIMATIC DIVISION OF NEVADA AND UTAH. FIVE REPLICATES (REPL) ARE SHOWN EACH PER 50-YEAR PERIOD. THE GRAY LINE FOR THE DROUGHT TEMPORAL MULTIPLIER = 1 REPRESENTED THE “NO-CHANGE” OR NEUTRAL PARAMETER LINE. 241

FIGURE 4-4. RIPARIAN TEMPORAL MULTIPLIERS FOR 7-YEAR, 20-YEAR, 100-YEAR FLOOD EVENTS, AND FLASH FLOODING. FOR THE 20-YEAR AND 100-YEAR FLOOD EVENTS ALL VALUES BELOW THEIR THRESHOLD ARE ZERO. DATA FROM U.S. GEOLOGICAL SURVEY GAGE OBTAINED FROM THE SANTA CLARA RIVER AT GUNLOCK, UT, FOR 7-YEAR, 20-YEAR, AND 100-YEAR FLOOD EVENTS. FLASH FLOODING DATA WERE FROM THE U.S. GEOLOGICAL SURVEY GAGE ON THE BEAVER DAM WASH AT BEAVER DAM, ARIZONA. THE HORIZONTAL GRAY LINE FOR TEMPORAL MULTIPLIER = 1 REPRESENTS THE “NO-CHANGE” OR NEUTRAL PARAMETER LINE. 243

FIGURE 4-5. RIPARIAN TEMPORAL MULTIPLIERS FOR EXOTIC FORB INVASION AND EXOTIC TREE INVASION. ANNUAL DISCHARGE DATA FROM U.S. GEOLOGICAL SURVEY GAGE OBTAINED FROM THE SANTA CLARA RIVER AT GUNLOCK, UT. THE HORIZONTAL GRAY LINE FOR TEMPORAL MULTIPLIER = 1 REPRESENTS THE “NO-CHANGE” OR NEUTRAL PARAMETER LINE. 244

Executive Summary

Introduction

In 2011, the St. George Field Office of the Bureau of Land Management (BLM) and The Nature Conservancy (TNC) entered into a Cooperative Agreement to collaborate on fire, vegetation, and desert tortoise management issues for the Red Cliffs and Beaver Dam Wash National Conservation Areas (NCAs) of Washington County in southwestern Utah. TNC applied Landscape Conservation Forecasting™ – including satellite imagery, remote sensing, predictive ecological models, and cost-benefit assessments (Provencher et al. 2008, 2009; Low et al. 2010) – to accomplish the Agreement’s objectives. These Agreement objectives appear in the box below.

Objectives of the BLM-TNC Agreement for the two Washington County NCAs

- Map current vegetation and potential vegetation (the latter known as *ecological systems* or *biophysical settings*) of the two NCAs.
- Determine the condition of ecological systems expressed as ecological departure from reference conditions, or as departure from desirable habitat conditions for desert tortoise.
- Guide the development of specific, cost-effective fire and vegetation management actions to maintain, enhance or restore the condition of the NCAs’ ecological systems.

The Red Cliffs and Beaver Dam Wash NCAs were designated by Congress in the Omnibus Public Land Management Act of 2009 “to conserve, protect, and enhance...the ecological, scenic, wildlife, recreational, cultural, historical, natural, and scientific resources” of these public lands. Beaver Dam Wash NCA is comprised of roughly 63,500 acres and Red Cliffs NCA includes about 45,000 acres. The Mojave Desert, the Great Basin Desert and the Colorado Plateau merge in Washington County and result in ecological transition zones within the NCAs. Both NCAs support a diversity of ecosystems which provide habitat for a variety of plant and animal species including the federally-listed desert tortoise, Gila monster, mule deer, kit fox and migratory birds.

The Beaver Dam Wash and Red Cliffs NCAs are separated by at least 15 miles and current management differs between them. Red Cliffs is not grazed by livestock and most of this NCA is fenced to restrict vehicular travel by the public. Beaver Dam Wash is grazed by several permittees and, although not fenced to prevent travel, many minor unpaved roads are closed to travel without a permit. Accordingly, the two NCAs were analyzed separately.

The Beaver Dam Wash NCA is a mostly unfragmented landscape formed by alluvial benches west of the Beaver Dam Wash, and alluvial fans on the limestone-dominated Beaver Dam Mountains. The Red Cliffs NCA is a mosaic of sandstone, sand dunes, lava flows and mesas on the slopes of the Pine Valley Mountains. Substantial parts of the Red Cliffs NCA are a wildland-urban interface immediately adjacent to St. George and surrounding towns and developments. Houses, buildings, utilities, and paved roads fragment this landscape.

It is the mutual desire of the BLM, TNC, U.S. Fish and Wildlife Service (USFWS), Utah Division of Wildlife Resources, and other stakeholders to conserve and restore the NCAs for the benefit of desert tortoise, other desert wildlife species, and ecological systems threatened by non-native plant species and uncharacteristic wildfires.

Process and Methods

The Landscape Conservation Forecasting™ process used for the NCAs consisted of six primary components or steps, as follows:

1. Develop maps of potential vegetation types, called biophysical settings or synonymously ecological systems, and current vegetation classes within ecological systems, by conducting remote sensing of satellite imagery.
2. Refine computerized predictive state-and-transition ecological models for the ecological systems by updating TNC's "library" of models.
3. Determine current condition of all ecological systems using two metrics:
 - a. Ecological departure (a.k.a., Fire Regime Condition or FRC), a broad-scale measure of ecological-system "health."
 - b. Desert tortoise habitat departure, a new metric pioneered by TNC that measures the "health" of ecological systems in terms of meeting habitat needs of the tortoise.
4. Use the computerized ecological models to forecast anticipated future conditions (both ecological and tortoise) of ecological systems under a minimum management scenario.
5. Use the computerized ecological models to forecast anticipated future conditions (both ecological and tortoise) of ecological systems under alternative management scenarios.
6. Use Return-on-Investment analysis to assess which strategies for which ecological systems yield the most advantageous results.

Several workshops were held during 2011 with natural resource managers and wildlife experts to review and refine ecological models, review findings, and identify and explore potential vegetation management scenarios. Workshops included one session prior to remote sensing to define vegetation classes, held at the Utah Division of Wildlife Resources office in Hurricane, UT; and two multi-day planning workshops held at the BLM office in St. George, UT.

TNC used two separate but complementary metrics to assess ecological conditions of the two project areas: ecological departure and desert tortoise habitat departure. Ecological departure was used to forecast success of management actions in ecological systems that are not used by desert tortoise, and that can respond to restoration actions. Desert tortoise habitat departure was used to forecast success in ecological systems that are used by desert tortoise; it is a useful alternative metric, in that current restoration technologies in Mojave Desert lowlands generally cannot return vegetation to reference classes, so that the ecological departure metric is usually poor and is unlikely to show marked improvement.

Ecological departure is an integrated, landscape-level estimate of the ecological condition of terrestrial, riparian, and wetland ecological systems. More specifically, ecological departure is the Fire Regime Condition concept developed by the national LANDFIRE program – it incorporates species composition, vegetation structure, and disturbance regimes to estimate an ecological system’s departure from its natural range of variability (NRV). NRV is the percentage of each vegetation succession class that would be expected under a natural disturbance regime. Ecological departure is measured using a scale of 0 to 100, where higher numbers indicate higher departure from NRV (and thus poorer condition).

Desert tortoise habitat departure was a new metric proposed by TNC that essentially quantifies relative restoration success by assigning tortoise habitat-suitability values to both reference and uncharacteristic (mostly non-native) vegetation classes. Departure is “relativized” by dividing a current suitability score by the maximum desirable suitability score (which is the sum of class-suitability weights multiplied by the NRV of each), and then subtracting the resulting quotient from 100. Similar to the ecological departure concept, a “good” desert tortoise habitat departure score is represented by low values (best = 0 or even negative numbers), whereas the worst (total) departure is represented by a score of 100. Importantly, good (low value) tortoise habitat departure scores can be reached via management actions in ecological systems that are used by tortoises but that are heavily invaded by non-native annual species.

TNC completed the following tasks that were reviewed at the workshops:

- Worked with Spatial Solutions, Inc. to obtain high-resolution satellite imagery, ground-truthed the imagery via two field surveys, and conducted remote sensing to interpret and map current ecological systems and their succession classes across the two NCAs.
- Refined ecological models for each ecological system, using reference and management models initially developed by staff from the USDA Forest Service, U.S. Geological Survey, Bureau of Land Management, and TNC. These models incorporated vegetation composition, structural classes, and disturbance regimes to predict the natural range of succession classes.
- Mapped the NCAs’ biophysical settings – the dominant *potential* vegetation types expected in the physical environment under natural disturbance regimes – also referred to as ecological systems.
- For each ecological system, compared current vegetation class distributions with the “natural” class distributions (as defined by NRV), and calculated each system’s departure from its NRV. Each ecological system was assigned an ecological departure score ranging from 0% to 100% departure from NRV, and an associated ecological departure class (=Fire Regime Condition Class or FRCC) rating of 1, 2 or 3 based on the departure score.
- For each ecological system, compared the desert tortoise habitat suitability of current vegetation classes with the suitability of “natural” class distributions (as defined by NRV), again on a scale of 0% to 100% departure from maximum tortoise suitability.

- Identified which ecological systems are likely to suffer future impairment over the next 50 years, based on computer simulations using the predictive ecological models.

Several focal ecological systems were selected for active treatment analyses and forecasting in the two NCAs, based on management priorities, high scores for ecological departure, and importance for desert tortoise habitat. The focal systems selected for such analyses in the two NCAs are:

| Ecological System | Red Cliffs (acres) | Beaver Dam Wash (acres) |
|-----------------------------|---------------------------|--------------------------------|
| Big Sagebrush Steppe-upland | 3,060.6 | 14.4 [#] |
| Blackbrush-mesic | 17,260.4 | 33,627.8 |
| Blackbrush-thermic | 5,005.4 | 3,652.5 |
| Creosotebush-White Bursage | 3,043.1 | 22,040.8 |
| Desert Sand Sagebrush | 1,585.7 | — |
| Desert Washes | 402.5 | 3,345.2 |
| Montane Riparian | 39.5 | — |
| Mountain Shrub | 4.2 | 142.5 |
| Pinyon-Juniper | 3,719.4 | 270.4 [#] |
| Warm Desert Riparian | 159.9 | 114.3 |
| Warm Season Grassland | 118.2 | — |
| Total | 34,398.9 | 63,207.9 |

[#] Not selected for active management analysis.

As noted above, one of the objectives of the BLM-TNC Agreement for this project was to guide the development of specific, cost-effective fire and vegetation management actions to maintain, enhance, or restore the condition of the NCAs' ecological systems. This general statement was expanded by natural resource managers at the July 2011 workshop into a set of key **Management Objectives** for the two NCAs, listed in the box below:

| Management Objectives for the Red Cliffs and Beaver Dam Wash NCAs |
|---|
| ➤ Meet NCA statutory objectives (conserve, protect, and enhance) and other statutory or administrative requirements. |
| ➤ Improve or maintain ecological condition of all systems. |
| ➤ For the six ecological systems that are vital tortoise habitat, reduce departure from desired future condition (Tortoise Departure) from high to low. |
| ➤ For the remaining ecological systems that are not vital tortoise habitat, reduce departure from desired future condition (NRV) from high to moderate or low, to the degree that strategies are feasible and affordable. |
| ➤ Protect reference vegetation classes, unburned, and only once-burned shrubland classes. |
| ➤ Decrease fuel loading and continuity to help reduce risk of loss from wildfire to natural and cultural resources in the NCAs. |
| ➤ Consider other objects of importance in the enabling legislation (e.g., recreation, endangered species, scenic, etc.) – do no harm! |
| ➤ Help make treatment projects competitive for funding resources. |
| ➤ Keep multiple management options open within above context. |

At and between workshops, management models were explored to achieve (or make progress toward) the above-listed objectives for the NCAs' focal ecological systems. Predictive state-and-transition computer models were used to simulate conditions under alternative future management scenarios. Using computer-based models, the likely future conditions (both ecological and tortoise, where applicable) of the focal ecological systems for each NCA were assessed after 20 and 50 years under three primary scenarios:

- (1) **MINIMUM MANAGEMENT** – no actions except continuation of current livestock grazing and fire suppression; i.e., no treatment of invasive species, no prescribed fire, etc.
- (2) **MAXIMUM MANAGEMENT** – management actions geared to restore ecological conditions (reduce ecological departure or tortoise habitat departure) to the greatest possible degree, regardless of budget.
- (3) **STREAMLINED MANAGEMENT** – management actions identified as feasible to implement to improve ecological conditions at reduced cost or relatively low investment.

Additional scenarios were developed to test the effectiveness of single actions with potentially promising outcomes. Return on Investment (ROI) was calculated for the **MAXIMUM**, **STREAMLINED MANAGEMENT**, and single-action scenarios, to compare ecological benefits against costs, both *within* and *across* ecological systems. The BLM's natural resource managers may select final actions or treatment areas based upon a variety of additional factors, such as availability of financial resources, policy constraints, and non-ecological objectives.

Key Findings

The primary findings of the Landscape Conservation Forecasting™ assessment on the two NCAs are summarized in the box below.

1. **At the current time, all ecological systems are highly departed from their natural range of variability.** Only a very small occurrence of littleleaf mountain mahogany in the Beaver Dam Wash NCA was not highly departed. Accordingly, both NCAs fall within Ecological Departure Class (a.k.a., Fire Regime Condition Class) 3.
2. **The primary cause of ecological departure across the landscape is due to the nearly complete presence of non-native annual grasses and forbs in burned and unburned areas.**
3. **Large areas of each NCA burned in 2005, and thereby converted from shrub to non-native annual grasslands and forblands.**
4. **Desert tortoise departure, a new metric developed by TNC and stakeholders, is at worse moderately departed for both NCA's ecological systems: three out of five ecological systems of the Red Cliffs show low departure, whereas one of four ecological systems of the Beaver Dam Wash is at a low level of departure.** Despite complete invasion by non-native annuals, sufficient vegetation structure from shrubs is available to desert tortoise to provide shade and food.
5. **Without active management, non-native grassland and forbland vegetation classes**

are projected to increase at the expense of shrublands that have been invaded by non-native grasses and forbs.

6. Without active management, exotic trees and forbs are predicted to increase in desert washes and riparian systems (montane and warm desert types).

7. A subset of ecological systems was selected for specific analyses of active management in the two NCAs. Key ecological management issues by system include:

- *Thermic and mesic blackbrush, and creosotebush-white bursage* – burned areas are dominated by, and non-burned shrublands are invaded by, non-native annual species; burned areas are projected to increase with time.
- *Mountain shrub and big sagebrush steppe* – large proportions of burned areas are dominated by non-native annual grasses and forbs.
- *Warm season grassland and desert sand sagebrush* – contain high percentages of late-succession classes with significant cover of non-native annual grasses and forbs.
- *Riparian and desert washes* – invasion by saltcedar (tamarisk) and non-native annual grasses and forbs. Desert washes were also dominated by early succession vegetation due to recent December flash floods after heavy rains.

8. A variety of actions, some experimental, were modeled for each ecological system selected for management. Multiple actions are required for most systems;

- *Thermic and mesic blackbrush, and creosotebush-white bursage* management strategies include: a) herbicide application followed by planting containerized shrub and forbs, b) herbicide application followed by seeding of new and successful native plant species cultivars; c) exclusion of planted areas from livestock for 10 years, and d) deployment of landscape-level fuel breaks, e) application of the fingers-of-death fungi with higher success rates of infection as a standalone “herbicide” and as a replacement of herbicide used in other treatments.
- *Mountain shrub and big sagebrush steppe* management strategies include: herbicide application followed by seeding of native herbaceous and shrub species.
- *Warm season grassland and desert sand sagebrush* management strategies include: a) herbicide application to control non-native annuals, b) herbicide application followed by seeding native herbaceous species, and c) deployment of landscape-level fuel breaks.
- *Riparian and desert washes* management strategies include: a) weed inventory, b) cutting of saltcedar followed by stump painting with herbicide, c) spraying exotic forbs with herbicide, and d) controlling non-native annuals in riparian understory with herbicide.

9. A comparison of scenarios using actions in combination or alone were simulated for ecological systems used by desert tortoise;

- Landscape-level fuel breaks alone can cost-effectively slow the loss of remaining shrublands needed by desert tortoise and prevent a devastating second fire in already burned areas. By preventing wildfires from returning, many Mojave Desert shrubs other than blackbrush can resprout or reestablished in non-native annual grasslands

and forblands. Suggested implementation rates for fuel breaks are high. Strategic spatial analysis of fire risk from testing different positioning of fuel breaks is recommended.

- Restoration of desert tortoise habitat is highly dependent on the commercial development of four experimental technologies: a) planting containerized Mojave shrubs and forbs b) the fingers-of-death fungi (mode of application and potency), c) highly performing cultivars of Mojave Desert species, and d) methods of seed delivery that reduce granivory. The first two had the greatest simulated contributions to restoration of desert tortoise habitat.
- In the Beaver Dam Wash NCA, cessation of livestock grazing (i.e., retiring grazing permits) benefitted desert washes, but had negative return-on-investments for creosotebush-white bursage and thermic and mesic blackbrush because of the tradeoff between livestock grazing slowing down fire activity (desirable) and accelerating woody succession (undesirable). Simulated livestock closure only used to reduce stocking rates in desert washes and protecting plantings and seeding in creosotebush-white bursage and thermic and mesic blackbrush always had small (i.e., not statistically significant) beneficial effects on desert tortoise departure when used in combination with planting and seeding.

10. Distribution of ROIs alone indicates a higher priority for implementation in desert washes, warm-season grassland, mountain shrub, and mesic blackbrush. It is understood, however, that planning for the recovery of desert tortoise may dictate resources to also be delivered to creosotebush-white bursage and thermic blackbrush, especially because fuel breaks are most likely to be implemented in these systems.

11. BLM staff and stakeholders created two groups of actions with spatial consequences: landscape level and species to vegetation classes.

- The area of implementation for special livestock management and law enforcement is potentially the whole Beaver Dam Wash NCA.
- Mapping fuel breaks is a more strategic exercise that requires a narrowing of a whole NCA down to selective strips of lands that are most likely to stop fires.
- All restoration actions that require seeding or planting are conducted in burned areas, which are well defined, whereas all actions that propose to control non-native annuals in the understory of shrublands with the fingers-of-death fungi are the shrublands that did not burn.
- Other ecological systems that do not fall into the burned *versus* unburned classes are montane riparian and warm desert riparian. The area of montane riparian is only 40 acres and nearly the whole area needs to be visited and treated. The problems in warm desert riparian are more localized and mapped.

Introduction

Background

The Red Cliffs and Beaver Dam Wash National Conservation Areas (NCAs) are located in Washington County in southwestern Utah. The two NCAs were designated by Congress in the Omnibus Public Land Management Act of 2009 “to conserve, protect, and enhance...the ecological, scenic, wildlife, recreational, cultural, historical, natural, and scientific resources” of these public lands. These two NCAs are the only ones in Utah as of the date of this report. It is the mutual desire of the Bureau of Land Management (BLM), The Nature Conservancy (TNC), U.S. Fish and Wildlife Service (USFWS), the Utah Division of Wildlife Resources (UDWR), and other stakeholders to conserve and restore these NCAs for the benefit of desert tortoise, other desert wildlife species, and ecological systems threatened by non-native plant species and uncharacteristic wildfires.

The BLM St. George Field Office is responsible for managing the Red Cliffs and Beaver Dam Wash NCAs. In 2011, the BLM and TNC entered into a Cooperative Agreement to collaborate on fire, vegetation, and desert tortoise management issues for the two NCAs. TNC applied Landscape Conservation Forecasting™ – including satellite imagery, remote sensing, predictive ecological models, and cost-benefit assessments (Provencher et al. 2008, 2009; Low et al. 2010) – to accomplish the Agreement’s objectives (see box below). This report is submitted to the BLM to inform the development of future management plans for these two NCAs.

Objectives of the BLM-TNC Agreement for the two Washington County NCAs

- Map current vegetation and potential vegetation (the latter known as *ecological systems* or *biophysical settings*) of the two NCAs.
- Determine the condition of ecological systems expressed as ecological departure from reference conditions, or as departure from desirable habitat conditions for desert tortoise.
- Guide the development of specific, cost-effective fire and vegetation management actions to maintain, enhance or restore the condition of the NCAs’ ecological systems.

The two NCAs support primarily Mojave Desert ecological systems – creosotebush-white bursage, blackbrush, sand sagebrush, warm season grassland, warm desert riparian and washes, and pinyon-juniper woodland. Although both NCAs are considered part of the Mojave Desert ecoregion, the Red Cliffs NCA shares more characteristics with the Colorado Plateau than the Mojave Desert, such as thick sandstone layering, sand deposits, sand sagebrush, warm season grasslands, and increased monsoonal storm activity. The Beaver Dam Mountains appear to act as an effective climatic barrier between the two NCAs. TNC identified the Mormon Mesa (part of Beaver Dam Wash)-Pine Valley Mountains corridor as a Mojave Desert and Great Basin ecoregional priority landscape (The Nature Conservancy 2000; Nachlinger et al. 2001), due to the diversity of vegetation types and high occurrence of Mojave Desert wildlife species, such as desert tortoise and Gila monster.

Ecological systems of the lower elevations of the Mojave Desert are not adapted to fire because they have not evolved with fire. The low productivity of the warm desert shrublands prevents the accumulation of fine fuels that would carry fire. It is only at the greater precipitation zones of higher elevations that fire becomes a natural component of the disturbance regime. Fire was infrequent in the Mojave Desert until the banner wet year of 2005 that caused a massive expansion of non-native annual grass and forb species. After a prodigious accumulation of non-native fine fuels, large areas of the eastern Mojave Desert in Nevada and Utah burned, including parts of the Beaver Dam Wash and Red Cliffs NCAs.

The regional invasion by non-native annual grasses, mostly red brome (*Bromus rubens*) and cheatgrass (*B. tectorum*), introduced atypical fire events to the Mojave Desert, with burned areas now supporting fire return intervals as short as 5-10 years in areas where it was previously absent. Many native shrubs do not respond well to one burn, and especially to multiple burns (Callison et al. 1985; Abella et al. 2009a; Engel and Abella 2011). Moreover, non-native annual grasses and forbs compete successfully against native herbaceous and shrub species by extracting soil moisture before natives are active (Melgoza et al. 1990; Young et al. 1987). Control of non-native annual grass and forb species, even for the purpose of restoring native species, may face obstacles because it is best achieved by multiple applications of herbicides. In the Mojave Desert, herbicide control is short lived (2-3 years) because seedbank emergence and new invasion allow non-natives to completely re-establish within 3 years.

Restoration of lowland Mojave Desert shrublands, especially burned areas, is notoriously unsuccessful (Abella and Newton 2009b) with experts reporting success rates of <5% for native species seedlings and <10% for introduced species, such as forage kochia (above 3,500 feet). Although new restoration technologies are currently being investigated by federal agencies (<http://www.werc.usgs.gov/Project.aspx?ProjectID=94>) and universities (Abella et al. 2010; Abella et al. 2009a) to improve success rates, experts appear unanimous that success will decrease if livestock graze new seedlings or plantings. Livestock grazing does not appear to be related to non-native species invasion but to yearly precipitation (especially since 2005); moreover, Red Cliffs, which has been closed to grazing for many years, is heavily invaded by non-native annual species. As is the case with herbicides, retiring livestock grazing on public lands – even in areas with such low productivity as the Mojave Desert – is controversial.

Public agencies responsible for range management have responded to the major ecological changes of the Intermountain West and, accordingly, stakeholders have strongly supported or opposed traditional land management practices and proposed restoration actions (Fleischner 1994; Brown and McDonald 1995; Brussard et al. 1994; Wuerthner and Matteson 2002; Freilich et al. 2003). Stakeholders may disagree with public rangeland management because they share different values about land uses or because there is historic distrust of public land management. Therefore, bringing stakeholders together and in-depth examination of land management values has been described as a first step towards effectively managing and conserving natural resources through community-based conservation (Margoluis and Salafsky 1998; Groves and The Nature Conservancy 2003). Adaptive management theory proposes that stakeholders may quantify and partially resolve their beliefs about land management by

comparing the effects of alternative management actions on whole ecosystems using simple, yet robust experimental design procedures (Walters and Holling 1990; Wilhere 2002). Because the space, investment, and time frame required to carry out an experiment can be large, modeling of alternative management actions is often recommended prior to experimentation, if only to discard ineffective actions and document beliefs about system function (Hilborn et al. 1995; Hardesty et al. 2000; Forbis et al. 2006). Managers also may not have the time or funding to wait several years for experimental results; therefore, modeling provides more immediate recommendations. One type of modeling, the state-and-transition models (Horn 1975; Westoby et al. 1989; McIver and Starr 2001; Bestelmeyer et al. 2004) are increasingly popular in natural resource management because their discrete representations of vegetation dynamics simplify ecological complexity and can be developed in cooperation with specialists and lay-people.

Thus, the new Washington County NCAs with their legacy of many past decades of meeting multiple-use needs of people, coupled with new mandates that needed to be defined and recent changes in disturbance regimes (fire and non-native species), now provide opportunities to improve the ecological resilience, conserve and restore quality of desert tortoise habitat, and reduce detrimental effects of wildfire to human structures and ecological systems with uncharacteristic fuel accumulation. This Landscape Conservation Forecasting™ project aims to build a good foundation for this to happen.

Project Area

Located in southwestern Utah, the Beaver Dam Wash and Red Cliffs NCAs comprise roughly 63,500 acres and 45,000 acres, respectively (Figure 1). The Mojave Desert, the Great Basin Desert and the Colorado Plateau merge in Washington County and result in ecological transition zones within the NCAs. Both NCAs support a diversity of ecosystems which provide habitat for a variety of plant and animal species including the federally-listed desert tortoise, Gila monster, mule deer, kit fox and migratory birds.

The Beaver Dam Wash NCA is a mostly unfragmented landscape formed by alluvial benches west of the Beaver Dam Wash, and alluvial fans on the limestone-dominated Beaver Dam Mountains. The Red Cliffs NCA is a mosaic of sandstone, sand dunes, lava flows, and mesas on the slopes of the Pine Valley Mountains. Substantial parts of the Red Cliffs NCA are a wildland-urban interface immediately adjacent to St. George and surrounding towns and developments. Houses, buildings, utilities, and paved roads fragment this landscape.

The two NCAs are separated by at least 15 miles (Figure 1) and current management differs between them. Red Cliffs is not grazed by livestock and most of this NCA is fenced to restrict vehicular travel by the public. Beaver Dam Wash is grazed by several permittees and, although not fenced to prevent travel, many minor unpaved roads are closed to travel without a permit. Accordingly, the two NCAs were analyzed separately.

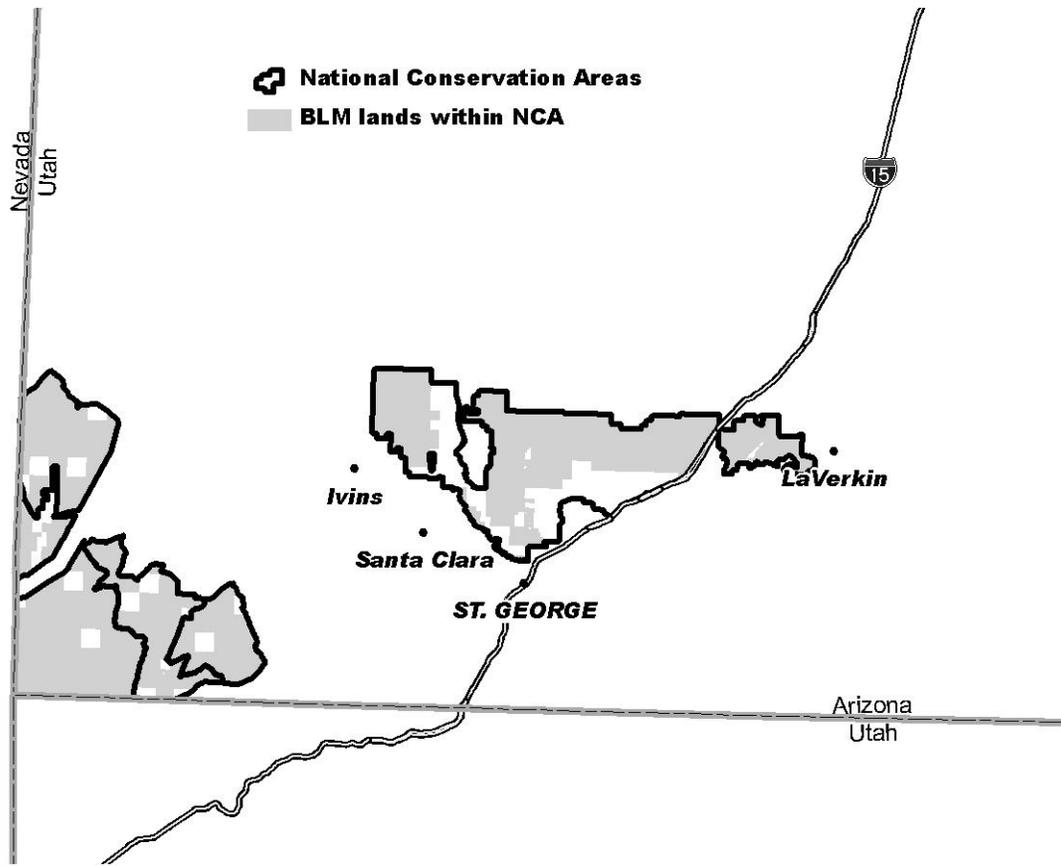


Figure 1. Red Cliffs and Beaver Dam Wash NCAs in Washington County, Utah.

Management Objectives

One of the objectives of the BLM-TNC Agreement for this project was to guide the development of specific, cost-effective fire and vegetation management actions to maintain, enhance, or restore the condition of the NCAs' ecological systems. This general statement was expanded by natural resource managers of the BLM and other stakeholder agencies into a set of key **Management Objectives** for the two NCAs, listed in the box below:

- Management Objectives for the Red Cliffs and Beaver Dam Wash NCAs**
- Meet NCA statutory objectives (conserve, protect, and enhance) and other statutory or administrative requirements.
 - Improve or maintain ecological condition of all systems.
 - For the six ecological systems that are vital tortoise habitat, reduce departure from desired future condition (Tortoise Departure) from high to low.
 - For the remaining ecological systems that are not vital tortoise habitat, reduce departure from desired future condition (NRV) from high to moderate or low, to the degree that strategies are feasible and affordable.
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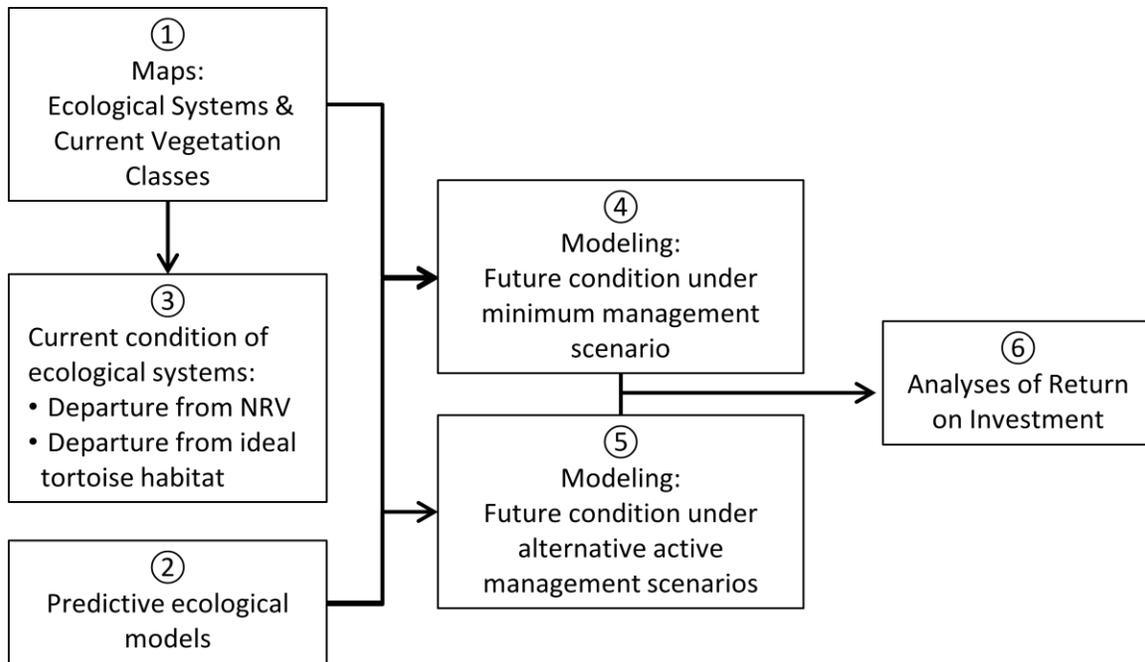
- Decrease fuel loading and continuity to help reduce risk of loss from wildfire to natural and cultural resources in the NCAs.
- Consider other objects of importance in the enabling legislation (e.g., recreation, endangered species, scenic, etc.) – do no harm!
- Help make treatment projects competitive for funding resources.
- Keep multiple management options open within above context.

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5. Use the computerized ecological models to forecast anticipated future conditions (both ecological and tortoise) of ecological systems under alternative management scenarios.
6. Use Return-on-Investment analysis to assess which strategies for which ecological systems yield the most advantageous results.

A simple schematic diagram that displays the relationship of these components to each other is presented below:



In terms of project chronology, the majority of the remote sensing was conducted during the winter and spring of 2011, and planning started during July 2011. Separate remote sensing efforts were conducted for each NCA, starting with Beaver Dam Wash. This chronology was much accelerated compared to other projects conducted by TNC. Several workshops were held with natural resource managers and wildlife experts to review and refine ecological models, review findings, and identify and explore potential vegetation management scenarios. Workshops included one session to define vegetation classes prior to remote sensing at Utah Division of Wildlife Resources’ offices in Hurricane, Utah, and two multi-day planning workshops at the BLM’s offices in St. George, Utah. A rough timeline of the work done on the project’s components is presented in Table 1.

Detailed descriptions of methods used in each of the project’s component six steps are presented in the subsections that follow.

Vegetation Mapping

The fundamental elements of Ecological Departure analysis include: 1) mapping the distribution of biophysical settings (ecological systems) – i.e., the dominant *potential* vegetation types expected in the physical environment under natural disturbance regimes; 2) mapping current vegetation succession classes of each ecological system; and 3) for each ecological system, comparing the current vegetation class distributions with the expected “natural” class distributions – known as Natural Range of Variability (NRV) – and calculating each system’s departure from its NRV. NRV is the percentage of each vegetation succession class that would be expected under natural disturbance regimes. Vegetation mapping with remote sensing started in January 2011, with the first field survey during March 12-28, 2011.

Table 1.
Chronology of project.

| | 2011 | | | | | | | | | | |
|---|------|-----|-----|-----|--------------------------------|-----|-----|--------------------------------|-----|-----|-----|
| | Mar | Apr | May | Jun | Modeling workshop Jul 19-21 | Jul | Aug | Modeling workshop Aug 24-26 | Sep | Oct | Nov |
| Remote sensing: mapping | | | | | Major Review | | | | | | |
| Remote sensing: field work | | | | | | | | | | | |
| Desert tortoise geo-data reinterpretation | | | | | | | | | | | |
| Predictive ecological models | | | | | Major Review | | | Observe & Comment | | | |
| Current condition of ecological systems | | | | | Observe & Comment | | | | | | |
| Modeling: future condition min mgmt | | | | | Major Review | | | | | | |
| Modeling: future condition alt mgmt | | | | | Develop initial strategies | | | Major Evaluation | | | |
| Return-on-Investment analyses | | | | | | | | Observe | | | |
| Accuracy Assessment | | | | | | | | | | | |
| Report preparation | | | | | | | | | | | |

Remote Sensing Analysis of Ecological Systems and Current Vegetation Classes

Spatial Solutions, Inc. was contracted by TNC to conduct remote sensing analysis of the project area. TNC provided Spatial Solutions with a description of ecological systems and assisted in remote sensing field surveys. Spatial Solutions used the software Imagine® from Leica Geosystems to conduct the unsupervised classification of color-infrared NAIP imagery (pixels are 1m multispectral imagery) captured on 2009 during different dates, including early spring captures for Red Cliffs. The imagery was clipped to the boundary defined by BLM, which exceeded that of the NCAs and was buffered outward by ½ km. Additional remote sensing and field work were completed for areas missed by the first mapping.

The unsupervised classification of the satellite imagery is described in Provencher et al. (2008, 2009) and Low et al. (2010). To support interpretation of spectral classes (Lillesand and Kiefer 2000), TNC and Spatial Solutions conducted an initial field trip to establish training plots and rapid observations from March 12-28, 2011. Spatial Solutions collected formal training

plots and 1,000+ geo-referenced rapid road and hiking observations. A large proportion of both project areas were visited.

The field and geo-referenced road data were combined, when necessary, with the BLM's precipitation zone Geographic Information Systems layer to create draft maps of ecological systems and current vegetation classes. Vegetation classes could only be defined after the ecological system was assigned to a group of pixels. The short description of each vegetation class by ecological system used for remote sensing is presented in Appendix 1. A draft map of ecological systems and vegetation classes was verified and improved during a second field trip from on May 17-20, 2011. At each pre-selected field location, TNC verified the mapped ecological system and current vegetation class. The same verification process was conducted for "road and hiking observations." This final field trip allowed Spatial Solutions to complete the ecological system map and the current vegetation class map. The last iteration in the final draft map of current vegetation classes was used to calculate draft ecological departure scores. The current vegetation class map and the ecological departure score were reviewed at the first workshop and revised before the second August workshop.

Mapping Ecological Systems

The foundation of ecological departure mapping is the stratification of a landscape via ecological systems, which represent potential vegetation. Preferably, ecological systems are mapped by interpreting ecological sites from Natural Resource Conservation Service (NRCS) soil surveys because ecological systems and NRCS's ecological sites are very similar. The NRCS defines an ecological site as "a distinctive kind of land with specific physical characteristics that differs from other kinds on land in its ability to produce a distinctive kind and amount of vegetation." (*National Forestry Manual*, www.nrcs.usda.gov/technical/ECS/forest/2002_nfm_complete.pdf). Staff from NRCS, however, did not recommend using Washington County's soil survey because it is outdated.

The ecological systems that were finally mapped for the Red Cliffs and Beaver Dam Wash NCAs are shown in Table 2. They reflect the influence of geology, landforms, soils, elevation, and ecological processes such as fire, flooding, and insect outbreaks.

A number of difficulties were encountered during remote sensing. The following challenges and solutions were dealt with:

1. It was very difficult to separate thermic (lower elevation) and mesic (higher elevation) blackbrush at their ecotone. The difficulty increases in burned areas where shrub cover has been removed. The difference is important because desert tortoise greatly prefers thermic blackbrush. Also, juniper and pinyon can occupy mesic blackbrush, but not thermic blackbrush, in the oldest vegetation classes. Two rules were arbitrarily used: a) the presence of white bursage indicated thermic blackbrush, and b) blackbrush found above and inclusive of the 10 inch precipitation zone was considered mesic, whereas blackbrush below this limit was thermic (*Personal communication, Patti Nowak, NRCS of Nevada*).

Table 2. Ecological systems of the two NCAs in Washington County. Acres only include land managed by the BLM although a larger area was remotely sensed. Barren areas made primarily of rock outcrops accounted for ~10,000 acres in Red Cliffs NCA.

| Ecological System | Red Cliffs (acres) | Beaver Dam Wash (acres) |
|------------------------------|---------------------------|--------------------------------|
| Big Sagebrush Steppe-upland | 3,060.6 | 14.4 [#] |
| Blackbrush-mesic | 17,260.4 | 33,627.8 |
| Blackbrush-thermic | 5,005.4 | 3,652.5 |
| Creosotebush-White Bursage | 3,043.1 | 22,040.8 |
| Desert Sand Sagebrush | 1,585.7 | — |
| Desert Washes | 402.5 | 3,345.2 |
| Littleleaf Mountain Mahogany | — | 0.4 |
| Montane Riparian | 39.5 | — |
| Mountain Shrub | 4.2 | 142.5 |
| Pinyon-Juniper | 3,719.4 | 270.4 |
| Warm Desert Riparian | 159.9 | 114.3 |
| Warm Season Grassland | 118.2 | — |
| Total | 34,398.9 | 63,208.3 |

2. Similarly to above, it was difficult to separate thermic blackbrush from creosotebush-white bursage at their ecotone, as they share the same species but in slightly different proportions. We rapidly discovered that the species creosotebush (*Larrea tridentata*) is a poor indicator because it is found even as high in elevation as big sagebrush steppe. To resolve this issue, we arbitrarily labeled an ecological system as blackbrush-thermic if the species blackbrush was present, because it is more “ancient” than either creosotebush or white bursage. We tracked the ecotone very carefully to find an elevation break point, which was not well defined because slope, soil depth, and aspect played an important role. The separation of this ecotone consumed many field hours.
3. Separation of ecological systems in burned areas proved very challenging, especially in Red Cliffs. Burned areas usually contained no remaining evidence of blackbrush or creosotebush, unless fire intensity was low enough to allow resprouting of creosotebush. Further, creosotebush was observed resprouting in areas known to be formerly blackbrush. An ecological system was judged to be blackbrush if we could find stumps of blackbrush, which have distinctive split stems. This required walking large areas. If stumps were not found, the ecological system was determined to be creosotebush-white bursage. Further, Spatial Solutions Inc. used pre-fire Landsat imagery (30-m multi-spectral) from 2005 to help determine whether an ecological system was blackbrush or creosotebush-white bursage.
4. We found two types of the mountain shrub ecological system that we nonetheless lumped. At lower elevation and on shallower soil, Stansbury’s cliffrose (*Purshia mexicana*) was present standing, albeit dead, after fires. At higher elevation on steep slopes and in deeper soils of the Beaver Dam Mountains, serviceberry (*Amelanchier* spp.) was found in burned and unburned areas with more abundant perennial grass cover than those areas with cliffrose. We may have under-estimated the area of mountain shrub, especially that with cliffrose, because we needed visual confirmation of standing stems and fire could have

completely consumed some stems. Moreover, serviceberry is brighter than cliffrose in the infrared spectrum, therefore it was easier to detect.

5. We distinguished between the mountain riparian and warm desert riparian where perennial water was present. The great majority of the project area contained the warm desert riparian ecological system defined by species such as Goodding's willow (*Salix gooddingii*) and mesquite (*Prosopis* spp). We found one occurrence where these species were absent: Quail Creek upstream of Interstate-15, which was clearly above the 10 inch precipitation zone.
6. We initially mapped desert washes as deep and shallow (these were lumped after the first workshop but the remote sensing kept them separate) because we assumed these features were important to desert tortoise. Whether a wash is shallow or deep is entirely a matter of perspective, which was that of desert tortoise and necessitated a vertical barrier preventing exit. Moreover, the same wash can be deep or shallow in different reaches. The only method available to Spatial Solutions Inc. to map a deep wash was to detect the shadow of a wash wall on the wash floor (the satellite imagery is rarely taken exactly at noon, so shadows are common); therefore, if shadows were present, the wash was mapped as deep; otherwise it was shallow by default.
7. It was generally straightforward to distinguish between big sagebrush steppe and pinyon-juniper woodland ecological systems. It was more difficult to separate wooded vegetation classes of big sagebrush shrublands from true pinyon-juniper woodlands. As we have done elsewhere (Low et al. 2010), shrublands encroached by trees usually contain dead sagebrush shrubs, little perennial grass cover, and trees are usually conical indicating ages of <125 years old. True woodlands generally have live shrubs and perennial grasses in the understory, and several trees should show sign of old age (large diameter lateral branches and flat-topping). Unlike elsewhere, however, steep slopes were not often a factor for mapping true woodlands in the Red Cliffs because trees grow on mesas with thin soils.

Ecological System Descriptions and Natural Range of Variability (NRV)

In order to measure the current (or future) ecological condition of each ecological system, it was first necessary to define the Natural Range of Variability (NRV) for each system. NRV is the relative amount (percentage) of each vegetation class that would be expected to occur in an ecological system under natural disturbance regimes and post-European settlement climate (Hann and Bunnell 2001; Provencher et al. 2007, 2008; Rollins 2009).

The NRV was calculated with the state-and-transition modeling software PATH/Vegetation Dynamics Development Tool (VDDT, ESSA Technologies; Barrett 2001; Beukema et al. 2003). To determine the NRV for each ecological system in the project area, we modified models from a TNC project completed with the Dixie National Forest (Tuhy et al. 2010). The NRV for each ecological system in each NCA is listed below in Table 3; the NCAs are shown separately because some ecological systems have different NRVs in the two areas.

Table 3. The Natural Range of Variability for ecological systems of Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | NRV¹ | | | | |
|--------------------------------|----------|------------------------|----------|----------|----------|----------|
| Ecological System | A | B | C | D | E | U |
| Big Sagebrush Steppe-upland | 30 | 47 | 20 | 1 | 2 | 0 |
| Blackbrush-mesic | 11 | – | 73 | 16 | – | 0 |
| Blackbrush-thermic | 5 | – | 95 | – | – | 0 |
| Creosotebush-White Bursage | 8 | – | 92 | – | – | 0 |
| Desert Sand Sagebrush | 2 | 98 | – | – | – | 0 |
| Desert Washes (shallow & deep) | 10 | 18 | 72 | – | – | 0 |
| Montane Riparian | 10 | 19 | 71 | – | – | 0 |
| Mountain Shrub | 7 | 15 | 63 | 14 | – | 0 |
| Pinyon-Juniper | 2 | 3 | 13 | 82 | – | 0 |
| Warm Desert Riparian | 10 | 19 | 8 | 40 | 23 | 0 |
| Warm Season Grassland | 4 | 96 | – | – | – | 0 |

| Beaver Dam Wash NCA | | NRV¹ | | | | |
|--------------------------------|----------|------------------------|----------|----------|----------|----------|
| Ecological System | A | B | C | D | E | U |
| Big Sagebrush Steppe-upland | 30 | 47 | 20 | 1 | 2 | 0 |
| Blackbrush-mesic | 10 | 39 | 35 | 8 | 8 | 0 |
| Blackbrush-thermic | 5 | 48 | 47 | – | – | 0 |
| Creosotebush-White Bursage | 9 | 36 | 38 | 17 | – | 0 |
| Desert Washes (shallow & deep) | 10 | 18 | 72 | – | – | 0 |
| Littleleaf Mountain Mahogany | 6 | 10 | 84 | – | – | 0 |
| Mountain Shrub | 7 | 15 | 63 | 14 | – | 0 |
| Pinyon-Juniper | 2 | 3 | 13 | 82 | – | 0 |
| Warm Desert Riparian | 10 | 19 | 8 | 40 | 23 | 0 |

1. Standard LANDFIRE coding for the 5-box vegetation model: A = early-development; B = mid-development, closed; C = mid-development, open; D = late-development, open; E = late-development, closed; and U = uncharacteristic. This terminology was often modified (Appendix 1).

Refinement of Predictive Ecological Models

Landscape conservation forecasting™ includes the simulation of management scenarios using state-and-transition models that include reference and management vegetation classes for each biophysical setting. A state-and-transition model is a discrete, box-and-arrow representation of the continuous variation in vegetation composition and structure of an ecological system (Bestelmeyer et al. 2004). An example of an older state-and-transition model for mountain big sagebrush from eastern Nevada is shown in Forbis et al. (2006). Different boxes in the model belong either: (a) to different *states*, or (b) to different *phases* within a state. States are formally defined in rangeland literature (Bestelmeyer et al. 2004) as: persistent vegetation and soils per potential ecological sites that can be represented in a diagram with two or more boxes (phases of the same state). Different states are separated by

“thresholds.” A threshold implies that substantial management action would be required to restore ecosystem structure and function. A threshold also implies the creation of uncharacteristic classes. Relatively reversible changes (e.g., fire, flooding, drought, insect outbreaks, and others), unlike thresholds, operate between phases within a state.

Models and Descriptions

At their core, all models had the LANDFIRE reference condition represented by some variation around the A-B-C-D-E succession classes (see Table 3). The A-E class models typically represented succession, usually from herbaceous vegetation to increasing woody species dominance where the dominant woody vegetation might be shrubs or trees. The vegetation classes of pre-settlement vegetation described in the NRV were considered to be each biophysical setting’s core reference condition. As such, the reference condition does not describe vegetation condition caused by post-settlement management or unintentional actions (e.g., release of cheatgrass).

In addition to modeling reference conditions, the predictive models included a management component to allow managers to simulate future conditions under alternative management strategies and scenarios (Low et al. 2010). The vegetation classes of all ecological systems are briefly defined in Appendix 1. Class definitions found in Appendix 1 are essential to understanding desert tortoise departure described shortly. A complete description of the models (model dynamics) is found in Appendix 2, and model parameter values (probabilistic transitions) are shown in Appendix 3.

Assessment of Current Ecological Condition

Two metrics are used to track the ecological condition of the NCAs because the Mojave Desert poses unique challenges. Restoration of Mojave Desert low elevation scrub is generally unsuccessful because existing methods cannot provide long term control of non-native annuals. Therefore, ecological departure cannot be sensitive to management actions at lower elevations because the metric treats all uncharacteristic classes as equal. A second metric, desert tortoise departure, was developed that meets the need of managers to track the effects of restoration actions on desert tortoise habitat suitability. The NRV is used to calculate both ecological departure and desert tortoise departure.

Calculating Ecological Departure

Ecological departure is a broad-scale measure of biophysical setting condition – an integrated, landscape-level estimate of the ecological condition of terrestrial and wet biophysical settings. Ecological departure incorporates species composition, vegetation structure, and disturbance regimes to estimate a biophysical setting’s *departure* from its NRV. Technically, ecological departure is a measure of dissimilarity between the NRV (expected “natural” distribution of vegetation classes; Table 3) and the current vegetation class distribution.

Ecological departure is scored on a scale of 0% to 100%: Zero percent represents NRV while 100% represents total departure [i.e., the higher the number, the greater the departure]. Further, a coarser-scale metric known as Fire Regime Condition Class (FRCC) is used by federal agencies to group ecological departure scores into three classes: FRCC 1 represents biophysical setting with low (<34%) departure; FRCC 2 indicates biophysical setting with moderate (34 to 66%) departure; and FRCC 3 indicates biophysical settings with high (>66%) departure (Hann et al. 2004). An example of ecological departure and corresponding FRCC is shown in Table 4.

Table 4. Example of calculation of Ecological Departure and FRCC.

| | Current Vegetation Class ¹ | | | | | | Total |
|---|---------------------------------------|-------|--------|-------|-----|--------|---------|
| | A | B | C | D | E | U | |
| Natural range of variability (%) | 20 | 50 | 15 | 10 | 5 | 0 | 100 |
| Current acres by class in project area | 182 | 7,950 | 58,718 | 6,659 | 264 | 46,123 | 119,894 |
| Current presence of classes (%) | 0.2 | 6.6 | 49.0 | 5.6 | 0.2 | 37.4 | |
| Ecological Departure (%) ² (a.k.a. Fire Regime Condition) | 0.2 | 6.6 | 15 | 5.6 | 0.2 | 0 | 72.4 |
| Ecological Departure Class ³ (a.k.a. Fire Regime Condition Class) | | | | | | | 3 |

1. Legend modified from LANDFIRE: A = early-development; B = mid-development, open; C = mid-development, closed; D = late-development, open; E = late-development, closed; and U = uncharacteristic.

2. Ecological Departure (ED) = $100\% - \sum_{i=1}^n \min\{Current_i, NRV_i\}$

3. Ecological Departure Class: 1 for $0\% \leq ED \leq 33\%$; 2 for $34\% \leq ED \leq 66\%$; 3 for $67\% \leq ED \leq 100\%$.

Calculating Desert Tortoise Departure

The goal of desert tortoise departure is to represent it as a proportion relative to the reference condition (as with ecological departure). The desert tortoise departure combines three types of data for each vegetation class of a biophysical setting:

1. Value (weight) of a class to an average desert tortoise compared to other classes;
2. Area of the class; and
3. Expected area under reference conditions (NRV).

Through iterative drafts closely reviewed by local desert tortoise experts, the following points were assigned to vegetation classes of each biophysical setting used by desert tortoise (Table 5). The higher the points, the more valuable the class is to an average desert tortoise relative to other classes. In addition, the maximum point among biophysical settings is not

equal to reflect that some biophysical settings contribute more than others to the fitness of desert tortoise.

Experts used simple rules of thumb to rank vegetation classes and biophysical settings. Classes with more developed vertical structure of Mojave Desert shrubs, which provide shade to desert tortoise, received higher scores. Classes that supplied more food in the form of herbaceous native vegetation received higher scores. Non-native annual grass and forb species have a minor negative effect on total score if mature vertical structure and native herbaceous food are available.

Table 5. Desert tortoise “points” by vegetation class for each biophysical setting used by desert tortoise.

| Vegetation Class | Code | Biophysical Setting | | | | | |
|--|----------|-----------------------|-------------------------|---------------------------|---------------------------|-----------------------------|-----------------------------|
| | | Blackbrush-mesic (BM) | Blackbrush-thermic (BT) | Creosotebush-Bursage (CB) | Desert Shallow Wash (SWA) | Desert Sand Sagebrush (DSS) | Warm-Season Grassland (GRL) |
| Early-succession# | A | 5 | 6 | 6 | 5 | 3 | 8 |
| Mid-succession + Joshua Tree | variable | 6 | 8 | 8 | | | |
| Mid-succession - no Joshua Tree | variable | 6 | 8 | 8 | 8 | | 8 |
| Late-succession - no Joshua Tree | variable | 3 | | | | 7 | |
| Late-succession + Joshua Tree | variable | 4 | | 8 | 8 | | |
| Bare Ground | BG | 0 | 0 | 0 | 0 | | |
| Depleted | DP | | | | | 2 | 3 |
| Early Shrub | ES | 3 | 3 | 3 | 3 | | |
| Early Exotic Annual Grasses and Forbs | | | | | | | 1 |
| Exotic Annual Grasses and Forbs (once burned) | EX | 1 | 1 | 1 | | | 6 |
| Exotic Annual Grasses and Forbs (> twice burned) | EX2B | 1 | 1 | 1 | | | |
| Planted Mojave Vegetation | PL | 5 | 6 | 6 | | | |
| Native Species Seeding | SD | 3 | 3 | 3 | | | |
| Introduced and Native Species Seeding | SDI | 2 | 2 | 2 | | | |
| Shrubs with Exotic Annuals and | SEP | 6 | 7 | 7 | 7 | 6 | |

| | | | | |
|--|------|---|---|---|
| Native Perennials | | | | |
| Shrubs with Exotic Annuals and Native Perennials with Joshua Tree | SEPJ | 6 | 7 | 7 |
| Shrubs with Exotic Annuals | SES | | | 3 |
| Shrubs with Exotic Annuals with Joshua Tree | SESJ | | | 7 |
| Tree Encroached | TE | 1 | | |
| Tree with Exotic Annual Grasses | TEX | 1 | | |
| Exotic Trees (tamarisk) | ET | | | 0 |

See Appendix 1 for a description of each vegetation classes.

To obtain the desert tortoise departure, the values in Tables 3 and 5 are combined in the following formula:

$$\text{Desert Tortoise Departure} = 1 - \left[\frac{\sum(TP_i \times \% \text{Class}_i)}{\sum(TP_i \times \% \text{NRV}_i)} \right].$$

The value is multiplied by 100 to obtain the percent desert tortoise departure. TP_i is the tortoise points of class i from Table 5, $\% \text{Class}_i$ is the percentage of class i 's area relative to the area of the biophysical setting, and $\% \text{NRV}_i$ is the NRV of the class i from Table 3. As for ecological departure, smaller values indicate greater habitat suitability for desert tortoise. It is noteworthy that desert tortoise departure can be negative if managed acres are concentrated in one high scoring class.

Accounting for Variability in Disturbances and Climate

The basic VDDT state-and-transition models incorporate by default stochastic disturbance rates that vary around a mean value for a particular disturbance associated with each succession class for each ecological system. For example, fire is a major disturbance factor for most ecological systems, including replacement fire, mixed severity fire, and surface fire. These fire regimes have different rates (i.e., mean fire return interval) that are incorporated into the models for each ecological system where they are relevant. VDDT automatically supplies variability around these rates. However, in real-world conditions the disturbance rates are likely to vary appreciably over time and more than provided by VDDT's default variability. To simulate strong yearly variability for fire activity, drought-induced mortality, non-native species invasion rates, tree encroachment rate, loss of herbaceous understory, and flooding, TNC incorporated *temporal multipliers* in the model run replicates. Due to the extreme episodic nature of weather, fire, and flooding in the Mojave Desert, temporal multipliers have profound effects of reporting variables.

A temporal multiplier is a number in a yearly time series that multiplies a base disturbance rate in the VDDT models: e.g., for a given year, a temporal multiplier of one implies no change

in a disturbance rate, whereas a multiplier of zero is a complete suppression of the disturbance rate, and a multiplier of three triples the disturbance rate. Temporal multipliers can be obtained from data, statistical projections, mechanistic equations, and heuristic equations.

The description of temporal multipliers is presented in Appendix 4 because the topic is arduous.

Assessment of Future Ecological Condition – MINIMUM MANAGEMENT

Using the computer-based models, TNC simulated the likely future condition of each ecological system after 20 and 50 years, assuming *MINIMUM MANAGEMENT*. *MINIMUM MANAGEMENT* essentially represents a custodial level of BLM management with no proactive projects other than the continuation of fire suppression management and current livestock grazing practices; it achieves no inventory or treatment of exotic forbs, no prescribed fire, no vegetation treatments, etc. The *MINIMUM MANAGEMENT* scenario is also required to estimate Return-On-Investment (ROI defined later). Potential sources of future ecosystem alteration were explicitly modeled, and included increased invasion rates of non-native species (cheatgrass and exotic forbs), increased tree encroachment rates in shrublands, modified mean fire return intervals in shrublands, livestock grazing, and illegal off-highway vehicle use.

The two primary indicators chosen for assessing future condition were the same as current condition: *ecological departure* and *desert tortoise departure* in each system after 20 and 50 years (in the final analysis, the 50-year results were reported).

Ecological departure can be categorized into three classes corresponding to LANDFIRE's Fire Regime Condition Classes:

- Class 1 (low departure) contains values for ecological departure from 0% to 33%.
- Class 2 (moderate departure) contains values for ecological departure from 34% to 66%.
- Class 3 (high departure) contains values for ecological departure \geq 67%.

Desert tortoise departure was not broken into categorical levels of condition; however, lower scores indicate more suitable habitat for desert tortoise. Moreover, desert tortoise departure can be negative if there is a concentration of vegetation classes into one class assigned a high score and whose sum exceeds that of the reference condition.

Assessment of Future Ecological Condition – Alternative Management Strategies

Eleven and six focal ecological systems, respectively, were selected for management analyses in the Red Cliffs and Beaver Dam Wash NCA, based upon their size, high departure from NRV, likelihood of high future departure, and importance to the desert tortoise and mule deer (mountain shrub). The reasons each of these ecological systems was chosen for

management is presented later in **Findings** under the section **Management Strategies and Scenarios**:

Table 6. Focal ecological systems of Washington County’s NCAs selected for management. Acres only include land managed by the BLM although a larger area was remotely sensed.

| | Red Cliffs (acres) | Beaver Dam Wash (acres) |
|--------------------------------|---------------------------|--------------------------------|
| Big Sagebrush Steppe | 3,060.6 | — |
| Blackbrush-mesic | 17,260.4 | 33,627.8 |
| Blackbrush-thermic | 5,005.4 | 3,652.5 |
| Creosotebush-White Bursage | 3,043.1 | 22,040.8 |
| Desert Sand Sagebrush | 1,585.7 | — |
| Desert Washes (shallow & deep) | 402.5 | 3,345.2 |
| Littleleaf Mountain Mahogany | — | — |
| Montane Riparian | 39.5 | — |
| Mountain Shrub | 4.2 | 142.5 |
| Pinyon-Juniper | 3,719.4 | 270.4 |
| Warm Desert Riparian | 159.9 | 114.3 |
| Warm Season Grassland | 118.2 | — |

As noted previously, the fundamental purpose of this project is to identify specific, cost-effective vegetation management strategies to maintain, enhance, or restore ecological systems to their NRV or desert tortoise habitat suitability if NRV was impractical. BLM staff, other stakeholders, and TNC worked jointly on three interrelated tasks toward achieving this fundamental purpose: (1) develop a set of more-specific guiding *objectives*; (2) list a comprehensive set of management *strategies* that the BLM and other partners can implement; and (3) analyze the results (per ecological departure and desert tortoise departure) of various alternative management *scenarios*, i.e., combinations of management strategies that have a similar theme.

Management Strategies

Varied management strategies and scenarios were developed as a means of achieving the objectives for the focal ecological systems, and the effectiveness of strategies was tested using the predictive ecological models.

Stakeholders developed management strategies to achieve the project objectives. All strategies were fundamentally designed to: (1) improve the condition of ecological systems that are currently in an undesirable condition, and/or (2) abate the most serious future threats to ecological systems or human settlements. A cost-per-acre and yearly application rate budget were determined for each management strategy, using various published sources as well as the local experience of managers (Appendix 5). The array of general management strategies

included the following (details will be presented later in **Findings** under the section **Management Strategies and Scenarios**):

- Landscape level actions:
 - Fuels breaks;
 - Special livestock management (Beaver Dam Wash NCA only); and
 - Greater law enforcement (Beaver Dam Wash NCA only).
- Ecological system specific actions:
 - Creosotebush-white bursage and blackbrush — herbicide application to control non-native annuals and native plant seeding or planting of containerized Mojave shrubs and forbs;
 - Desert washes — chainsaw cutting of saltcedar followed by stump painting with herbicide, herbicide application to control non-native annuals;
 - Warm-season grasslands, desert sand sagebrush, mountain shrub, and pinyon-juniper woodland — herbicide application to control non-native annuals and native plant seeding;
 - Montane riparian—chainsaw cutting of saltcedar followed by stump painting with herbicide, and spot application of herbicides to exotic forbs; and
 - Warm Desert Riparian — weed inventory, chainsaw cutting of saltcedar followed by stump painting with herbicide, spot application of herbicides to exotic forbs, hand spraying of herbicide to control non-native annuals in the understory of riparian woodlands.

Initial draft sets of management strategies were developed by stakeholders in the July 2011 workshop. TNC then conducted PATH/VDDT computer runs of the state-and-transition models to test and refine a suite of strategies for each of the targeted ecological systems over a 50-year time horizon. A 50-year horizon was chosen over a 20-year one because some experimental management actions were predicted to become commercially viable only in 20 years. These models also included a “failure rate” for many management strategies to reflect that some management actions only partially succeed at restoring a vegetation class, although cost is incurred for failure. Many different combinations of alternative management strategies and levels of treatment were tested to develop successful scenarios. This trial-and-error process created a robust set of strategies that reduced ecological departure and/or desert tortoise departure while minimizing cost. At the request of the BLM, a set of one-action strategies were also developed to guide general decision making.

Management Scenarios

Management scenarios basically represent common “themes” or approaches for grouping individual management strategies, so that the effectiveness of sets-of-strategies can be better compared within and across ecological systems. Scenarios are comparable to alternatives proposed in agency management plans or National Environmental Protection Act (NEPA) documents. Based on past experience in eastern California, Nevada, and southwestern Utah, TNC recommended the use of three management scenarios that have become more-or-less

standardized in the landscape conservation forecasting™ process. These three scenarios are thematically described in Table 7. Because scenarios are broad themes to guide modeling during workshops, they become more specific for each biophysical setting, details will be presented later in **Findings** under the section **Management Strategies and Scenarios**).

Each scenario required budgets for each biophysical setting, which included costs of all management strategies. Budgets were also expressed as area limits, which was the maximum area that could be treated per year for individual actions. If computer simulations reached a given management strategy’s annual area limit, that management strategy was subsequently discontinued in the simulation for that year. Cost information for each management strategy for each ecological system, under all scenarios, is listed in Appendix 4.

Table 7. Descriptions of standard and one-action management scenarios for Beaver Dam Wash and Red Cliffs NCAs.

| STANDARD MANAGEMENT SCENARIOS | |
|--|--|
| MINIMUM | |
| A control scenario that only included natural disturbances, unmanaged non-native species invasion, current livestock grazing, and fire suppression management. Fire suppression by agencies was simulated by reducing natural, reference fire return intervals using time series that reflected current fire events from the immediate and nearby areas (temporal multiplier). Fire event data were obtained from the Federal Fire Occurrence Website. In essence, this scenario can be considered a no-treatment control, but does not always represent current management. | |
| MAXIMUM | |
| This scenario allocated unlimited management funds to strategies with the goal of reducing ecological departure and/or desert tortoise departure to the greatest extent possible. This scenario assumed no financial or other resource constraints on strategy implementation (i.e., annual agency budgets were typically exceeded). | |
| STREAMLINED | |
| The STREAMLINED MANAGEMENT scenario was the result of management strategies identified by managers and stakeholders, at and following the workshops. It was usually effective at reducing ecological departure and desert tortoise departure while recognizing anticipated agency budgets, management funding availability, and regulatory constraints. Strategies were sought that produced the highest ROI. | |
| THEMATIC MANAGEMENT SCENARIOS | |
| FUEL BREAK-ONLY | |

The FUEL BREAK-ONLY scenario only included 200-foot fuel breaks strategically applied along rights-of-ways, roads, and boundaries throughout the landscape. The herbicide Plateau® was aerially applied during years of greater productivity (7-year El Niño cycle). Five ecological systems benefited from fuel breaks: creosotebush-white bursage, mesic, and thermic blackbrush, desert washes, and warm-season grasslands. The number of acres treated was obtained from the STREAMLINED SCENARIO.

PLANTING AND HERBICIDE-ONLY

The PLANTING AND HERBICIDE-ONLY MANAGEMENT scenario consisted of spraying Plateau® to control non-native annual grasslands and forblands followed by planting of containerized shrubs and forbs. Due to the experimental nature of this method, it was expected that the treatment would only be applied after five years of commercial development. Targeted ecological systems were creosotebush-white bursage and mesic and thermic blackbrush.

PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY (BEAVER DAM WASH)

The PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY MANAGEMENT scenario consisted of spraying Plateau® to control non-native annual grasslands and forblands followed by planting of containerized shrubs and forbs. Moreover, plantings are protected from livestock grazing for 10 consecutive years; however, reduction of stocking rates was also applied to desert washes, especially since these also are found everywhere in the landscapes. A secondary effect of livestock closures was the small increase of fuel loadings: the models assumed a small suppression of fire activity when livestock grazing non-native annuals during the winter months. Due to the experimental nature of this method, it was expected that the treatment would only be applied after five years of commercial development. Targeted ecological systems were creosotebush-white bursage, mesic and thermic blackbrush, and desert washes.

NO GRAZING-ONLY (BEAVER DAM WASH)

The NO GRAZING-ONLY MANAGEMENT scenario was the retirement of all grazing permits in the Beaver Dam Wash NCA. As above, elimination of livestock grazing allowed slightly greater fire activity through increase of fine fuel loadings.

LAW ENFORCEMENT-ONLY (BEAVER DAM WASH)

The LAW ENFORCEMENT-ONLY MANAGEMENT scenario was designed to substantially increase the visibility of law enforcement to reduce illegal OHV activity.

FINGERS-OF-DEATH (FOD)-ONLY WITH 75% SUCCESS RATE

The FINGERS-OF-DEATH (FOD)-ONLY MANAGEMENT scenario involves an experimental application of the fungi called fingers-of-death (finger-shaped smut emerging from annual grass seeds) to non-native annual grasses that acts as an herbicide. With patent pending, the stakeholder group allowed a 5-year period of commercial development of the fingers-of-death, i.e., the treatment was only available five years from the start of simulations. The FOD biocide would be combined with the planting and seeding treatments, and also used alone as an herbicide. We limited the use of FOD to creosotebush-white bursage, mesic and thermic blackbrush, desert sand sagebrush, desert washes, and warm-season grasslands. Because current projections of success of FOD are 75-80%, we first simulated a 75% success rate of FOD (independent of the success rate of planting or a seeding).

FINGERS-OF-DEATH (FOD)-ONLY WITH 50% SUCCESS RATE

The same as FINGERS-OF-DEATH (FOD)-ONLY MANAGEMENT scenario with a 75% success rate, except that success rate was reduced to 50%.

FINGERS-OF-DEATH (FOD)-ONLY WITH 25% SUCCESS RATE

The same as FINGERS-OF-DEATH (FOD)-ONLY MANAGEMENT scenario with a 75% success rate, except that success rate was reduced to 25%.

Computer Simulations and Reporting Variables

The scenarios from Table 7 were simulated for each ecological system for 50 years using PATH/VDDT. Five replicates were run for each scenario to capture extremes in fire activity, drought, and flash-flooding. The two reporting variables for simulations, i.e. the indicators of future ecological condition, were: (1) ecological departure and (2) desert tortoise departure.

Return-On-Investment Analysis

The final step in the process was the calculation of benefits (magnitude of ecological improvement) as compared to cost of management strategies. TNC developed an ROI metric to determine which of the scenarios produced the greatest ecological benefits per dollar invested across multiple scenarios *within* each ecological system, and *across* the targeted ecological systems, in relation to MINIMUM MANAGEMENT. The ROI metric was:

Ecological system-wide ROI. The change of ecological departure or desert tortoise departure between the MINIMUM MANAGEMENT scenario and the MAXIMUM, STREAMLINED, OR OTHER THEMATIC MANAGEMENT scenario in the last year of the simulation, multiplied by the total area of the ecological system, divided, respectively, by total cost of each scenario over the duration of the simulation (here 50 years). One uniform correction factor of 1,000 across all ecological systems was used to bring all measures to a common order of magnitude.

The ROI values are a useful tool for land managers to decide where to allocate scarce management resources among many possible choices on lands that they administer. Of course,

managers may also select final strategies or treatment areas based upon a variety of additional factors, such as availability of financial resources, regulatory constraints, and other multiple-use or societal objectives.

Findings

Ecological Systems

Eleven and nine ecological systems, respectively, were mapped in the Red Cliffs NCA (Figure 2; Table 2) and Beaver Dam Wash NCA (Figure 3; Table 2). Mesic blackbrush was the most widespread ecological system in both NCAs. In the Red Cliffs NCA, other abundant ecological systems were in decreasing order of area: thermic blackbrush, pinyon-juniper woodland, big sagebrush steppe upland, creosotebush-white bursage, desert sand sagebrush, and desert washes. The decreasing order of other ecological systems by area for the Beaver Dam Wash NCA was: creosotebush-white bursage, thermic blackbrush, and desert washes. The smallest biophysical settings (<50 acres) were mountain shrub and montane riparian for the Red Cliffs NCA and littleleaf mountain mahogany and big sagebrush steppe for the Beaver Dam Wash NCA (Table 2).

Current Ecological Departure

With the exception of littleleaf mountain mahogany, all ecological systems were highly departed from their NRV (Table 8). Desert washes were primarily departed because of the concentration of pixels in the early succession classes following the flash floods of December 2010. The primary cause of ecological departure for other ecological systems across both landscapes was the presence or dominance of non-native annual grasses (red brome and cheatgrass) and forbs (*Erodium* spp.). Many areas of Utah that burned as an extension of the southern Nevada fire complex of 2005 were transformed into non-native annual grasslands and forblands with few shrubs remaining (Abella et al. 2009a). The shrublands and woodlands that did not burn were invaded by non-native annuals. Therefore, both landscapes were nearly entirely in uncharacteristic classes (areas by vegetation classes in Appendix 6).

Current Desert Tortoise Departure

Despite high levels of non-native annual invasion, desert tortoise departure was at most moderately departed (Table 8). Desert shrubs were sufficiently abundant to have value to desert tortoise. In the Red Cliffs NCA, the following ecological systems had low levels of desert tortoise departure: mesic blackbrush, thermic blackbrush, desert sand sagebrush, and warm-season grassland. For Beaver Dam Wash, low levels of departure were observed only in the creosotebush-white bursage. Moderate levels of desert tortoise departure were observed in creosotebush-white bursage and desert washes in the Red Cliffs NCA and in mesic blackbrush, thermic blackbrush, and desert washes in the Beaver Dam Wash NCA.

Red Cliffs Desert Reserve NCA

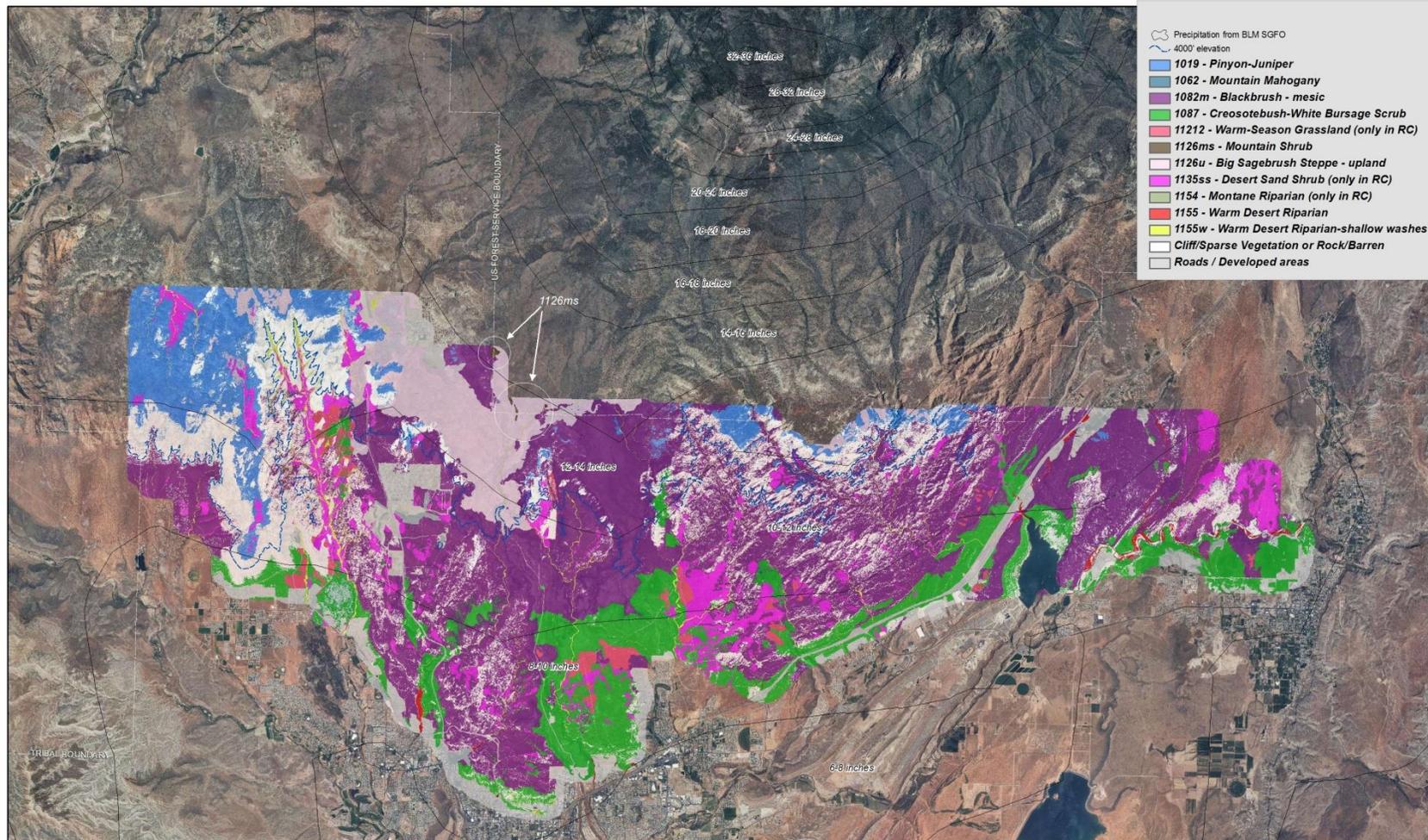


Figure 2. Ecological Systems of the Red Cliffs NCA, UT.

Beaver Dam Wash NCA

BIOPHYSICAL SETTINGS - BPS MODELS

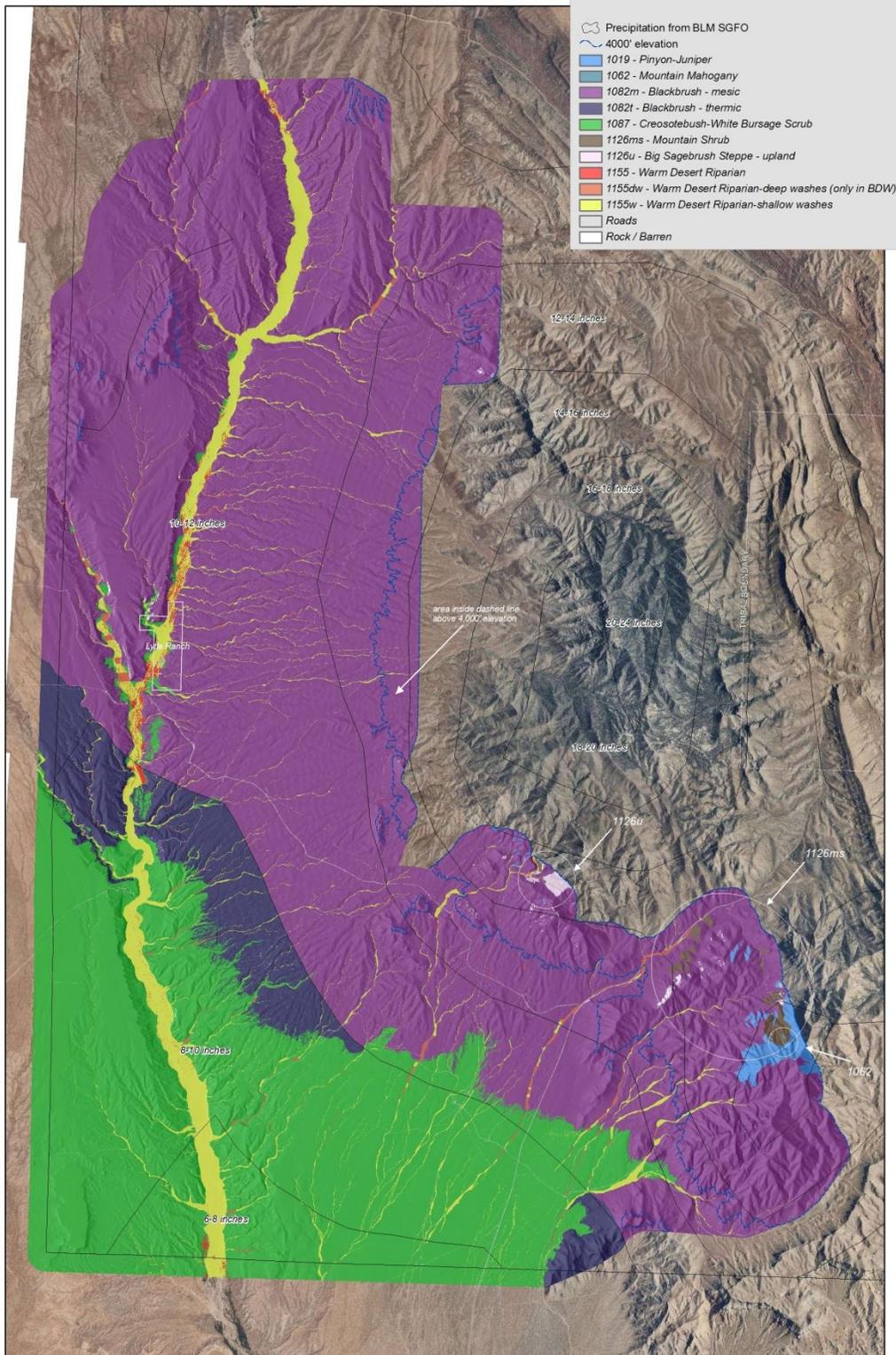


Figure 3. Ecological systems of the Beaver Dam Wash NCA, UT.

Table 8. Ecological departure (%) and desert tortoise departure (%) of Red Cliffs and Beaver Dam Wash NCAs' ecological systems. Both departure scores were classed as good (0-33%, green); fair (34-66%, yellow); and poor (>66%, red). Blank entries under desert tortoise departure (%) indicate that the metric does not apply.

| | Red Cliffs (acres) | Ecological Departure (%) | Desert Tortoise Departure (%) |
|--------------------------------|---------------------------|---------------------------------|--------------------------------------|
| Big Sagebrush Steppe | 3,060.6 | 100 | |
| Blackbrush-mesic | 17,260.4 | 100 | 25 |
| Blackbrush-thermic | 5,005.4 | 100 | 20 |
| Creosotebush-White Bursage | 3,043.1 | 100 | 52 |
| Desert Sand Sagebrush | 1,585.7 | 100 | 13 |
| Desert Washes (shallow & deep) | 402.5 | 90 | 50 |
| Montane Riparian | 39.5 | 99 | |
| Mountain Shrub | 4.2 | 100 | |
| Pinyon-Juniper | 3,719.4 | 100 | |
| Warm Desert Riparian | 159.9 | 100 | |
| Warm Season Grassland | 118.2 | 100 | 15 |
| Beaver Dam Wash (acres) | | | |
| Big Sagebrush Steppe | 14.4 | 100 | |
| Blackbrush-mesic | 33,627.8 | 100 | 58 |
| Blackbrush-thermic | 3,652.5 | 100 | 37 |
| Creosotebush-White Bursage | 22,040.8 | 100 | 18 |
| Desert Washes (shallow & deep) | 3,345.2 | 90 | 40 |
| Littleleaf Mountain Mahogany | 0.4 | 14 | |
| Mountain Shrub | 142.5 | 100 | |
| Pinyon-Juniper | 270.4 | 94 | |
| Warm Desert Riparian | 114.3 | 100 | |

Predicted Future Ecological Condition – MINIMUM MANAGEMENT

Ecological Departure

With the exception of desert washes in the Beaver Dam Wash NCA, ecological departure remained highly departed after 50 years under minimum management (Table 9), although high, ecological departure decreased in desert washes and the montane riparian of the Red Cliffs NCA due to rebalancing of succession classes after flash flooding. In the Beaver Dam Wash NCA, ecological departure shifted from highly departed from moderately departed. In 2011, desert washes were dominated by the early succession vegetation class and, therefore, was very highly departed although not due to non-native annuals.

Desert Tortoise Departure

Desert tortoise departure increased in mesic and thermic blackbrush, desert sand sagebrush, desert washes, and warm-season grassland in the Red Cliffs NCA; however, desert tortoise departure decreased, an improvement, in creosotebush-white bursage due to natural recovery of shrubs after fire (Table 9). The reversal was observed in the Beaver Dam Wash NCA where desert tortoise departure only increased in creosotebush-white bursage.

Table 9. Current and predicted ecological departure (%) and desert tortoise departure (%) of Red Cliffs and Beaver Dam Wash NCAs' ecological systems. The predicted condition was under minimum management. Both departure scores were classed as good (0-33%, green); fair (34-66%, yellow); and poor (>66%, red). Blank entries under desert tortoise departure (%) indicate that the metric does not apply.

| | Ecological Departure (%) | | Desert Tortoise Departure | |
|------------------------------|--------------------------|-----------------------|---------------------------|-----------------------|
| | Current condition | Minimum Mgmt - 50 yrs | Current Condition | Minimum Mgmt - 50 yrs |
| Red Cliffs NCA | | | | |
| Big Sagebrush Steppe | 100 | 98 | | |
| Blackbrush-mesic | 100 | 100 | 25 | 51 |
| Blackbrush-thermic | 100 | 100 | 20 | 61 |
| Creosotebush-White Bursage | 100 | 100 | 52 | 40 |
| Desert Sand Sagebrush | 100 | 100 | 13 | 13 |
| Desert Washes | 90 | 69 | 50 | 36 |
| Montane Riparian | 99 | 100 | | |
| Mountain Shrub | 100 | 100 | | |
| Pinyon-Juniper | 100 | 100 | | |
| Warm Desert Riparian | 100 | 71 | | |
| Warm Season Grassland | 100 | 100 | 15 | 15 |
| Beaver Dam Wash NCA | | | | |
| Big Sagebrush Steppe | 100 | | | |
| Blackbrush-mesic | 100 | 100 | 58 | 20 |
| Blackbrush-thermic | 100 | 100 | 37 | 21 |
| Creosotebush-White Bursage | 100 | 100 | 18 | 38 |
| Desert Washes | 90 | 45 | 40 | 21 |
| Littleleaf Mountain Mahogany | 14 | | | |
| Mountain Shrub | 100 | 100 | | |
| Pinyon-Juniper | 94 | | | |
| Warm Desert Riparian | 100 | 89 | | |

Management Strategies and Scenarios

Introduction

For the targeted ecological systems analyzed in greater detail, management strategies were developed under MAXIMUM MANAGEMENT, STREAMLINED MANAGEMENT, and THEMATIC MANAGEMENT scenarios. All strategies were designed to improve the condition of ecological systems that are currently in an undesirable condition and/or to abate serious future threats to them. Different types of strategies and degrees of application were tested to achieve specific objectives of the scenarios. Total 50-year costs for strategy implementation were calculated for each ecological system under each scenario, as well as any one-time costs.

All scenarios for each ecological system were then tested via computer simulations using PATH/VDDT to determine whether or not they achieved the desired objectives. Outcomes were calculated for ecological departure and desert tortoise departure over 50 years. Area results by vegetation class and ecological system for each replicate are shown, respectively, for all management scenarios in Appendices 7 to 16.

Summary descriptions of active-management modeling results are presented for each targeted ecological systems that were selected for such analyses for each landscape. Each system description includes text, a summary table, and a composite figure that together provide the following information:

1. Brief description of each ecological system's causes of departure for each landscape;
2. List of management objectives per scenario;
3. Table of description of management strategies, including acres treated and cost, for all scenarios;
4. Summary of outcomes (ecological departure, ROI based on ecological departure, desert tortoise departure, and ROI based on desert tortoise departure) expressed as box plots (mean, ± 1 standard error, and the 95% confidence interval). Overlapping confidence intervals from different boxes generally indicates that averages are not statistically different.

Following these individual descriptions of targeted ecological systems, a sub-section summarized inter-system ROI results, and a final section discusses mapping of areas for implementation of actions.

Red Cliffs NCA

Blackbrush - mesic

Mesic blackbrush is the largest ecological system of the Red Cliffs NCA and is found from east to west in the NCA. At present, this system exhibits complete ecological departure at

100%; however, desert tortoise departure is relatively low at 25% because shrublands invaded by non-native annuals represent 61% of the landscape. These shrublands provide shade and food to desert tortoise. About 39% of the ecological system transitioned to non-native annual grasslands and forblands after burning in 2005.

After 50 years in a regime of minimum management, ecological departure did not change because acres were shuffled among uncharacteristic vegetation classes. With minimum management, wildfires converted more shrublands with non-native annuals into non-native annual grasslands and forblands. As a result, desert tortoise departure increased (i.e., became worse) from 25% to 51% reflecting the elimination of vegetation structure providing shade and, perhaps, food for desert tortoise.

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including herbicide application, native species seeding and planting, and fuel breaks.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect blackbrush shrublands from future fire.
- Increase native shrub and herbaceous cover in burned areas.
- Maintain desert tortoise departure below the current 25% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|-------------|--|----------------|----------------|-----------------|---------------|------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 308 | 422 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 3,284 | 4,629 | 5,105 | \$11 | \$14,155,828 |
| Streamlined | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 145 | 303 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 1,318 | 9,312 | 10,770 | \$11 | \$9,166,756 |

| | | | | | | |
|-----------------------------|---|------------------|------------------|------------------|-------|--------------|
| Planting+ Herbicide-only | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 334 | 601 | \$650 | |
| | | | | | | \$15,367,798 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 3,285 | 4,600 | 5,217 | \$11 | |
| | | | | | | \$2,682,452 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 10% of 17,260 | 10% of 17,260 | 10% of 17,260 | \$1 | |
| | | | | | | \$86,300 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 400 | 512 | \$300 | |
| | Application of Finger-of-Death fungi at 75% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 327 | 223 | \$650 | |
| | | | | | | \$13,655,553 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 394 | 710 | \$300 | |
| | Application of Finger-of-Death fungi at 50% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 319 | 231 | \$650 | |
| | | | | | | \$15,537,082 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 401 | 792 | \$300 | |
| | Application of Finger-of-Death fungi at 25% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 315 | 231 | \$650 | |
| | | | | | | \$16,900,629 |

The average annual cost of these treatments among scenarios for the Red Cliffs NCA varied between \$1,726 and \$338,013 per year of implementation.

50-year Outcomes

- Clear differences for ecological departure existed between scenarios with and without the fingers-of-death fungi (Figure 4 top). Without the fingers-of-death fungi, departure remained above 95%, although the MAXIMUM and PLANTING AND HERBICIDE-ONLY MANAGEMENT scenarios achieved the greatest reductions to ecological departure. Actions with the fingers-of-death fungi reaching 75% and 50% success rates greatly reduced ecological departure from the >95% to <20% compared to the MINIMUM MANAGEMENT scenario. At a 25% success rate, ecological departure only reached an average of about 58%. For the Mojave Desert, this stunning outcome means that reference classes can be reclaimed from uncharacteristic shrublands.
- The ROI for ecological departure was close to zero and differences minimal among scenarios without the fingers-of-death fungi (Figure 4 bottom). ROI increased dramatically with the fingers-of-death fungi. The higher the success rate for the fingers-of-death fungi, the greater the ROI. The difference in ROI between 75% and 50% success rates (Figure 4 bottom) where more noticeable than for ecological departure (Figure 4 top).
- Very different and more encouraging results were observed for desert tortoise departure (Figure 5 top). The lowest (best) average scores of desert tortoise departure (about -5%) were achieved in the MAXIMUM, STREAMLINED, and PLANTING AND HERBICIDE-ONLY MANAGEMENT scenarios (figure 5 top). The next lowest score were observed for the 75% and 50% success rates of the FINGERS-OF-DEATH-ONLY scenarios. The FUEL-BREAK-ONLY and MINIMUM MANAGEMENT scenarios were about equal, whereas the 25% success rate FINGERS-OF-DEATH-ONLY scenario achieved the highest departure at about 80%.
- The greatest ROI based on desert tortoise departure was achieved by the STREAMLINED MANAGEMENT scenario (~110), whereas the lowest ROI was realized by the 25% SUCCESS RATE FINGERS-OF-DEATH-ONLY scenario (~-30) because the MINIMUM MANAGEMENT scenario did better (Figure 5 bottom). Other scenarios were about equal because of overlapping 95% confidence intervals, although a case could be made for the FUEL-BREAK-ONLY MANAGEMENT scenario as a distinct second best ROI.

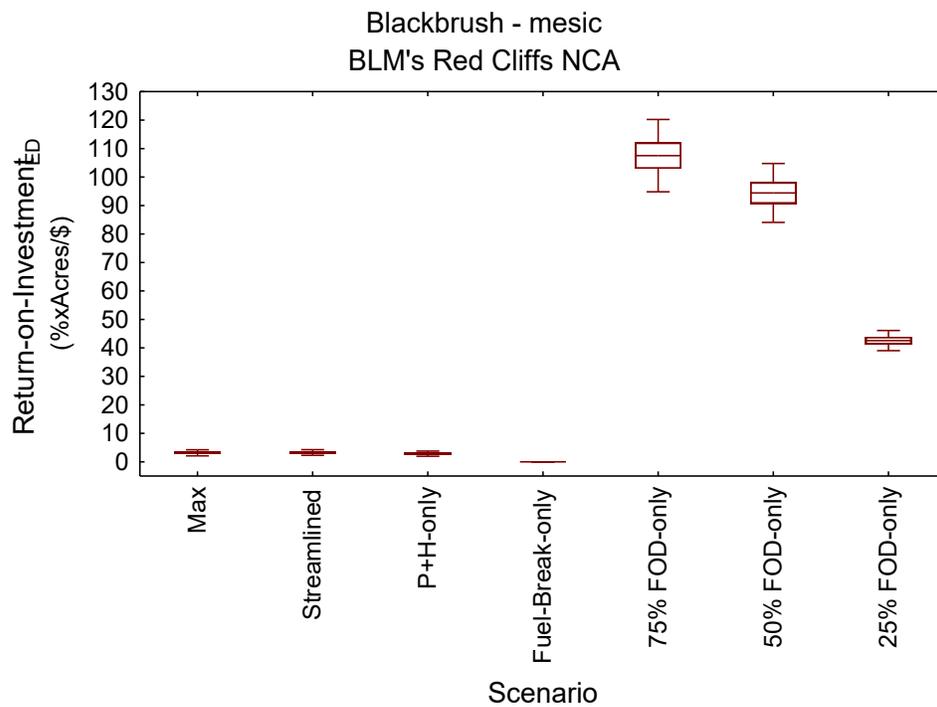
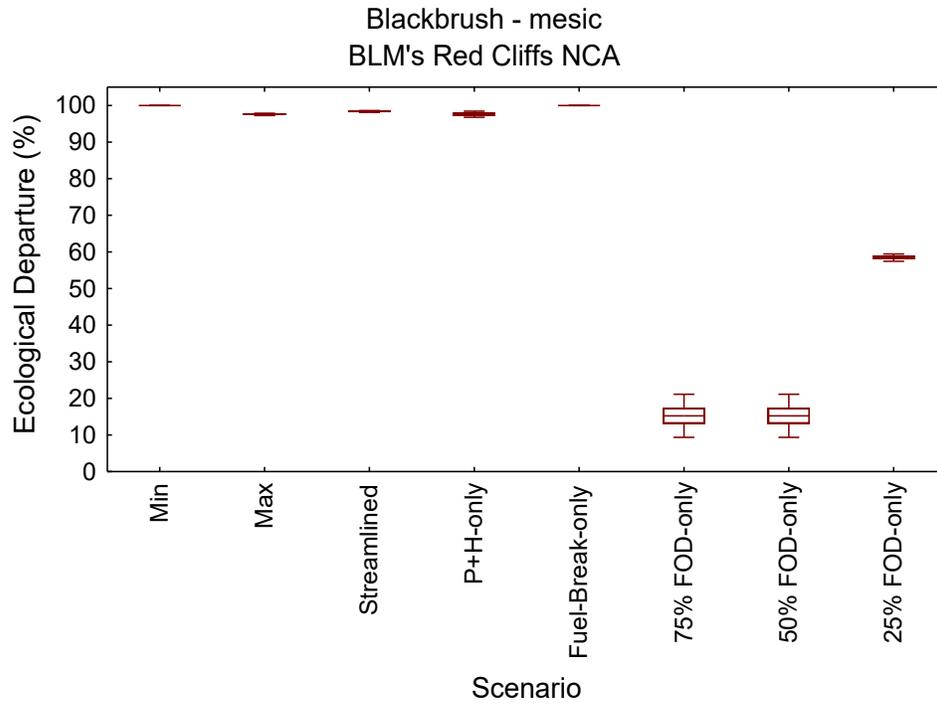


Figure 4. Ecological departure (%) and Return-on-Investment for ecological departure (subscript ED) of blackbrush–mesic after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

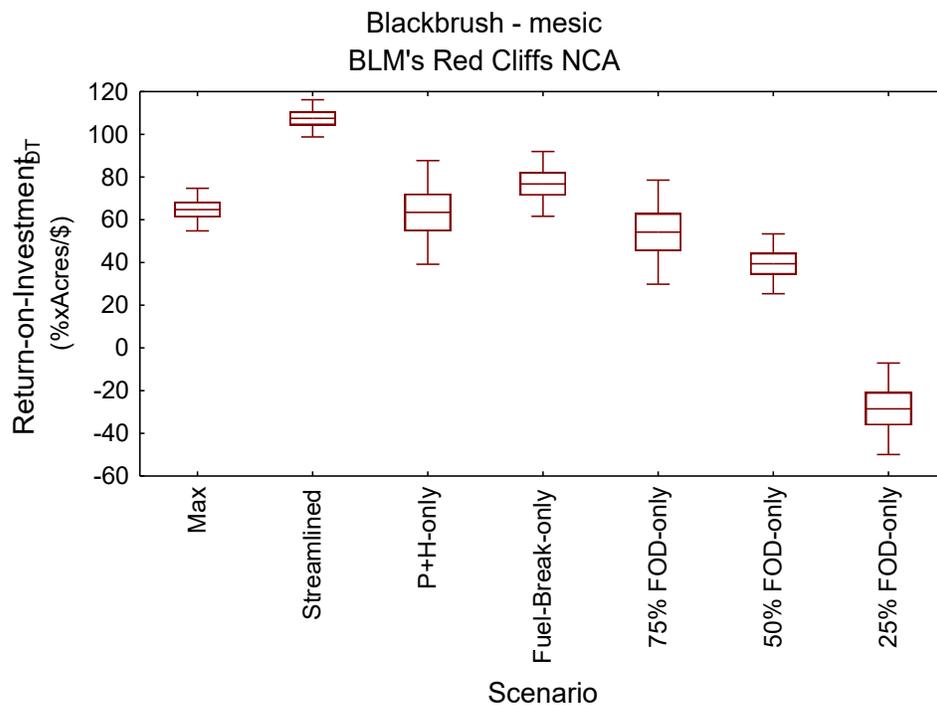
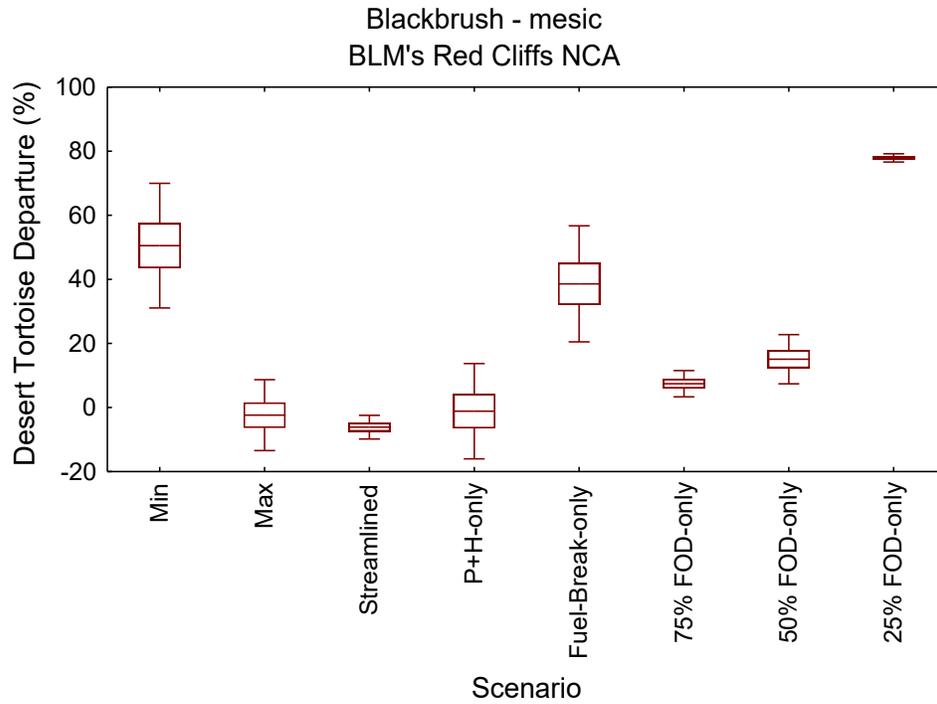


Figure 5. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of blackbrush-mesic after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

Blackbrush-thermic

Thermic blackbrush is the second largest ecological system of the Red Cliffs NCA and is mostly located in the central southern part of the NCA. At present, this system exhibits complete ecological departure at 100%; however, desert tortoise departure is relatively low at 20% because shrublands invaded by non-native annuals represent 88% of the landscape. These shrublands provide shade and food to desert tortoise. The remaining 22% of the ecological system transitioned to non-native annual grasslands and forblands after burning in 2005.

After 50 years in a regime of minimum management, ecological departure did not change because acres were shuffled among uncharacteristic vegetation classes. With minimum management, wildfires converted more shrublands with non-native annuals into non-native annual grasslands and forblands. As a result, desert tortoise departure increased (i.e., became worse) from 20% to 61% reflecting the elimination of vegetation structure providing shade and, primarily, food for desert tortoise.

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including herbicide application, native species seeding and planting, and fuel breaks.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect blackbrush shrublands from future fire.
- Increase native shrub and herbaceous cover in burned areas.
- Maintain desert tortoise departure below the current 20% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|-------------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 43 | 223 | \$250 | \$5,686,214 |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 998 | 1,618 | 1,359 | \$11 | |
| Streamlined | Application of Plateau® followed by planting of containerized Mojave | 0 | 38 | 114 | \$650 | |

| | | | | | | |
|-----------------------------|---|-----------------|-----------------|-----------------|-------|-------------|
| | shrubs and herbaceous species in non-native annual grasslands and forblands | | | | | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 392 | 3,238 | 3,183 | \$11 | |
| | | | | | | \$4,305,934 |
| Planting+ Herbicide-only | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 48 | 349 | \$650 | |
| | | | | | | \$7,495,980 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 1,004 | 1,648 | 1,549 | \$11 | |
| | | | | | | \$2,682,452 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 10% of 5,005 | 10% of 5,005 | 10% of 5,005 | \$1 | |
| | | | | | | \$25,025 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 74 | 216 | \$450 | |
| | Application of Finger-of-Death fungi at 75% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 104 | 141 | \$650 | |
| | | | | | | \$5,905,959 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 350 | 57 | \$450 | |
| | Application of Finger-of-Death fungi at 50% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 15 | 16 | \$650 | |
| | | | | | | \$5,973,851 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 74 | 636 | \$450 | |
| | Application of Finger-of-Death fungi at 25% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 87 | 129 | \$650 | |
| | | | | | | \$9,702,065 |

The average annual cost of these treatments among scenarios for the Red Cliffs NCA varied between \$500 and \$194,044 per year of implementation.

50-year Outcomes

- Without the FINGERS-OF-DEATH scenarios, ecological departure remained departed at about 100% (Figure 6 top). All three scenarios with the fingers-of-death fungi greatly reduced ecological departure from 100% to ~10% compared to the MINIMUM MANAGEMENT scenario (FIGURE 6 TOP).
- The ROI for ecological departure was zero without the FINGERS-OF-DEATH scenario (Figure 6 bottom). Given a fixed application rate of restoration actions with the fingers-of-death fungi included, ROI increased dramatically. The ROI slightly increased with the success rate of the fingers-of-death fungi, although the highest success rates for the fungi were associated with the highest variability.
- Compared to the MINIMUM MANAGEMENT scenario, desert tortoise departure exhibited three levels (Figure 7 top). The lowest (best) average scores of desert tortoise departure (about 0%) were achieved by the FINGERS-OF-DEATH scenarios with 75% and 50% success rates. The MAXIMUM MANAGEMENT, STREAMLINED, and PLANTING AND HERBICIDE-ONLY belonged to the second lowest group at about 18%. The 25% success rate FINGERS-OF-DEATH-ONLY and FUEL-BREAK-ONLY MANAGEMENT scenarios performed the least well and were only slightly better than the MINIMUM MANAGEMENT scenario.
- Due to its very low cost, the FUEL-BREAK-ONLY scenario showed the highest desert tortoise departure ROI (Figure 7 bottom). This indicates a real benefit to fuel breaks in the absence of more aggressive restoration. The second best ROIs were about equal (although with very unequal variability) among the STREAMLINED MANAGEMENT and the FINGERS-OF-DEATH WITH 75% AND 50% SUCCESS RATES scenarios (Figure 9 bottom).

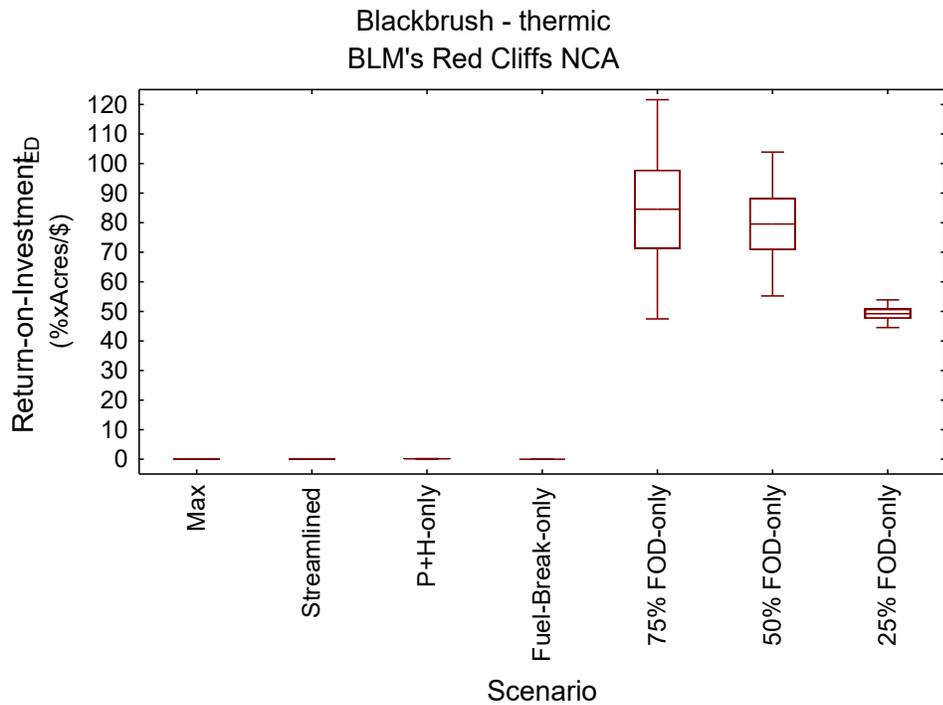
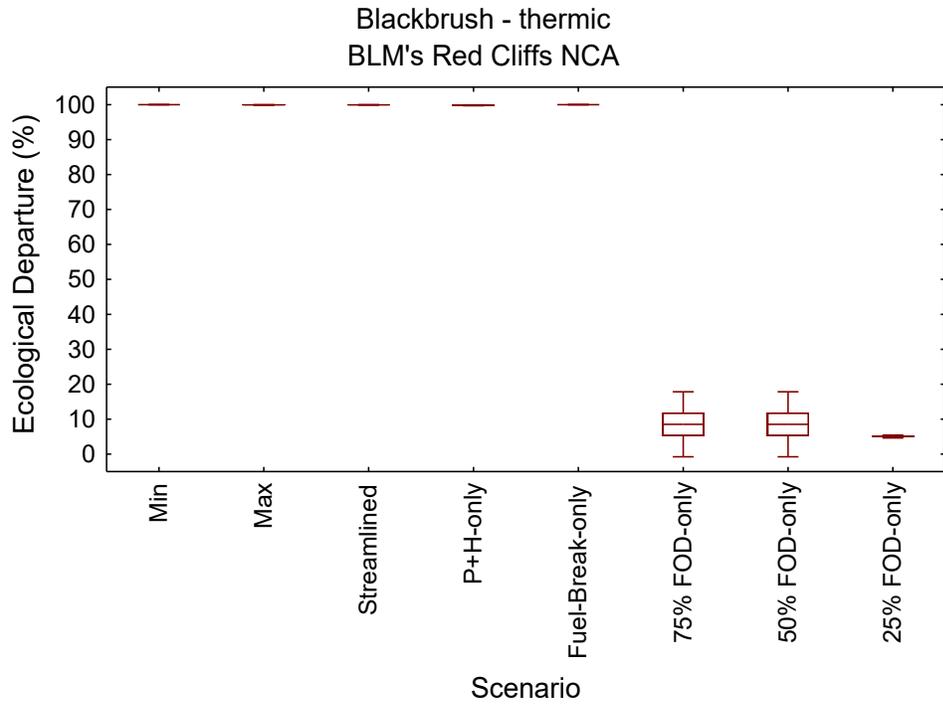


Figure 6. Ecological departure (%) and return-on-investment for ecological departure (subscript $_{ED}$) of blackbrush–thermic after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

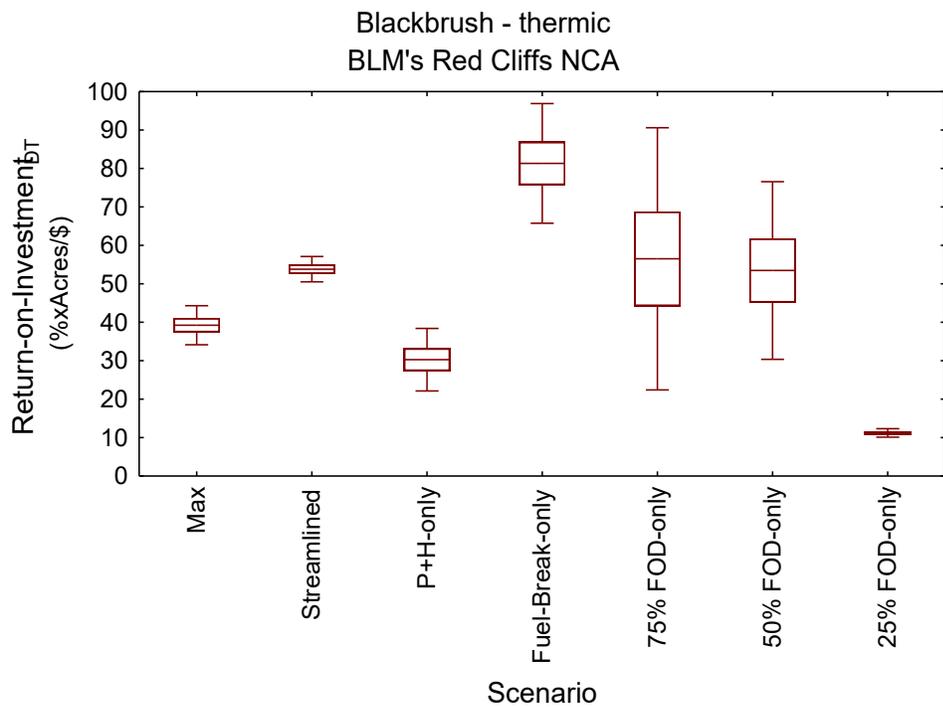
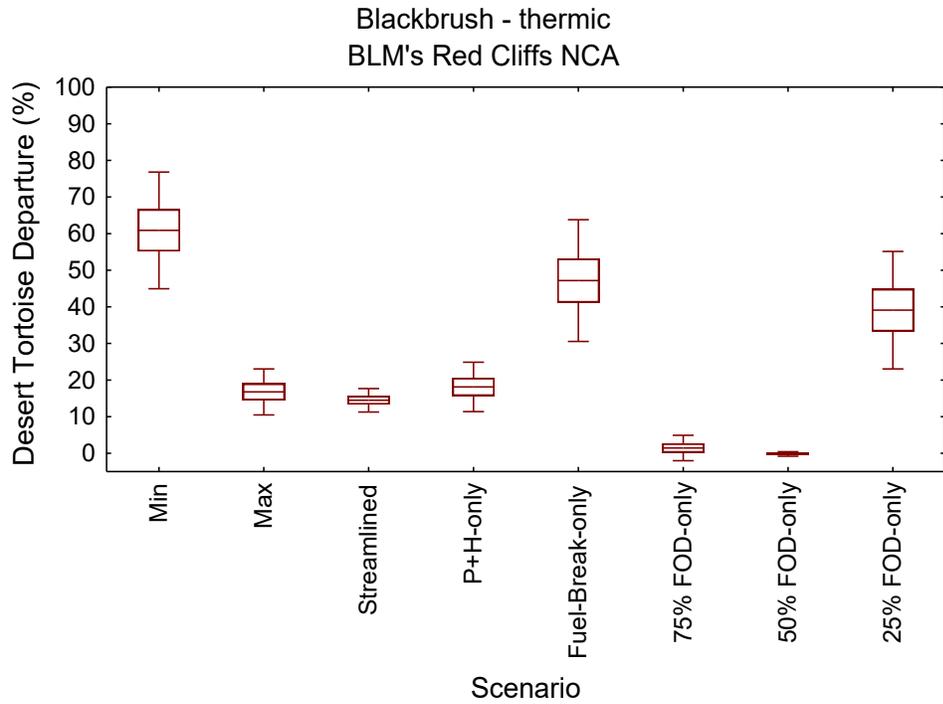


Figure 7. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of blackbrush-thermic after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

Creosotebush-White Bursage

Creosotebush-white bursage is a small system, but important desert tortoise habitat, in the south-central part of Red Cliffs NCA. At present, this system exhibits complete ecological departure at 100%. Desert tortoise departure is moderate at 52%. The majority (55%) of the ecological system is non-native annual grasslands and forblands of low value to desert tortoise that resulted from the 2005 fires. Conversely, 45% remains as shrublands that provide shade and food to desert tortoise.

After 50 years in a regime of minimum management, ecological departure did not change because acres were shuffled among uncharacteristic vegetation classes. Desert tortoise departure decreased (i.e., became better) from 52% to ~40% because creosotebush and other shrubs have the ability to resprout and recover within 20 years if an area only burned once.

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including herbicide application, native species seeding and planting, and fuel breaks.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect creosotebush-white bursage shrublands from future fire.
- Increase native shrub and herbaceous cover in burned areas.
- Maintain desert tortoise departure below the current 40% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|-------------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® followed by seeding of new native seed mix supplemented by germination innovations in non-native annual grasslands and forblands | 0 | 0 | 51 | \$250 | |
| | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 80 | 26 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 615 | 1,036 | 1,200 | \$11 | |
| | | | | | | \$2,148,198 |
| Streamlined | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in | 0 | 80 | 27 | \$650 | |

| | | | | | | |
|-----------------------------|---|-----------------|-----------------|-----------------|-------|-------------|
| | non-native annual grasslands and forblands | | | | | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 246 | 2,054 | 2,396 | \$11 | |
| | | | | | | \$2,488,812 |
| Planting+ Herbicide-only | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 84 | 34 | \$650 | |
| | | | | | | \$1,491,679 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 621 | 1,074 | 1,011 | \$11 | |
| | | | | | | \$549,173 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 10% of 3,043 | 10% of 3,043 | 10% of 3,043 | \$1 | |
| | | | | | | \$15,215 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 252 | 53 | \$450 | |
| | Application of Finger-of-Death fungi at 75% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 15 | 16 | \$650 | |
| | | | | | | \$2,061,399 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 350 | 57 | \$450 | |
| | Application of Finger-of-Death fungi at 50% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 15 | 16 | \$650 | |
| | | | | | | \$2,535,144 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 401 | 240 | \$450 | |
| | Application of Finger-of-Death fungi at 25% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 15 | 21 | \$650 | |
| | | | | | | \$4,602,307 |

The average annual cost of these treatments among scenarios for the Red Cliffs NCA varied between \$10,983 and \$92,045 per year of implementation.

50-year Outcomes

- Without the FINGERS-OF-DEATH scenarios, ecological departure remained departed at about 100% (figure 8 top). All three scenarios with the fingers-of-death fungi greatly reduced ecological departure from the 100% to <5% compared to the MINIMUM MANAGEMENT scenario (Figure 8 top).
- The ROI for ecological departure was zero without the FINGERS-OF-DEATH scenario (Figure 8 bottom). ROI dramatically increased with application of the fingers-of-death fungi. The ROI increased with the success rate of the fingers-of-death fungi. Difference among the three success rates were strong in creosotebush-white bursage.
- Compared to the MINIMUM MANAGEMENT scenario, desert tortoise departure exhibited three levels (Figure 9 top). The lowest (best) average scores of desert tortoise departure (<0%) were achieved by the FINGERS-OF-DEATH scenarios at all levels of success rates. The MAXIMUM, STREAMLINED, and PLANTING AND HERBICIDE-ONLY MANAGEMENT scenarios belonged to the second lowest group at about 12% desert tortoise departure. The FUEL-BREAK-ONLY MANAGEMENT scenario performed the least well and was only 10% better (lower) than the MINIMUM MANAGEMENT scenario.
- The PLANTING AND HERBICIDE-ONLY and the FINGERS-OF-DEATH WITH 75% SUCCESS RATE scenarios showed the highest ROI for desert tortoise departure and were about equal. Due to its very low cost, the FUEL-BREAK-ONLY scenario was in second rank for ROI with the more expensive FINGERS-OF-DEATH WITH 50% SUCCESS RATE scenario (Figure 9 bottom). Again, this indicates a real benefit to fuel breaks in the absence of more aggressive restoration.

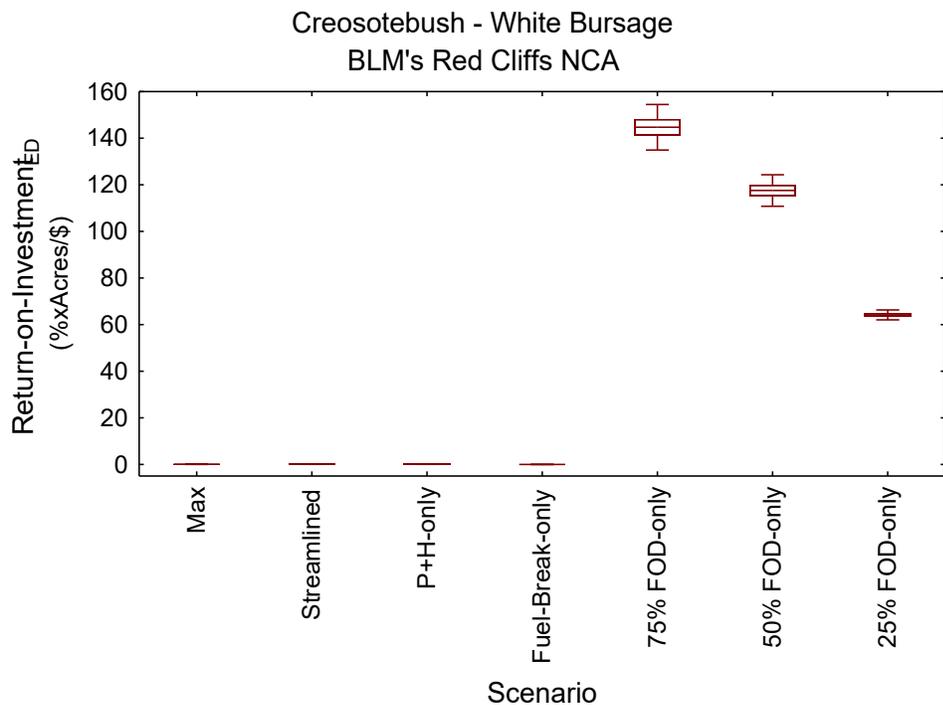
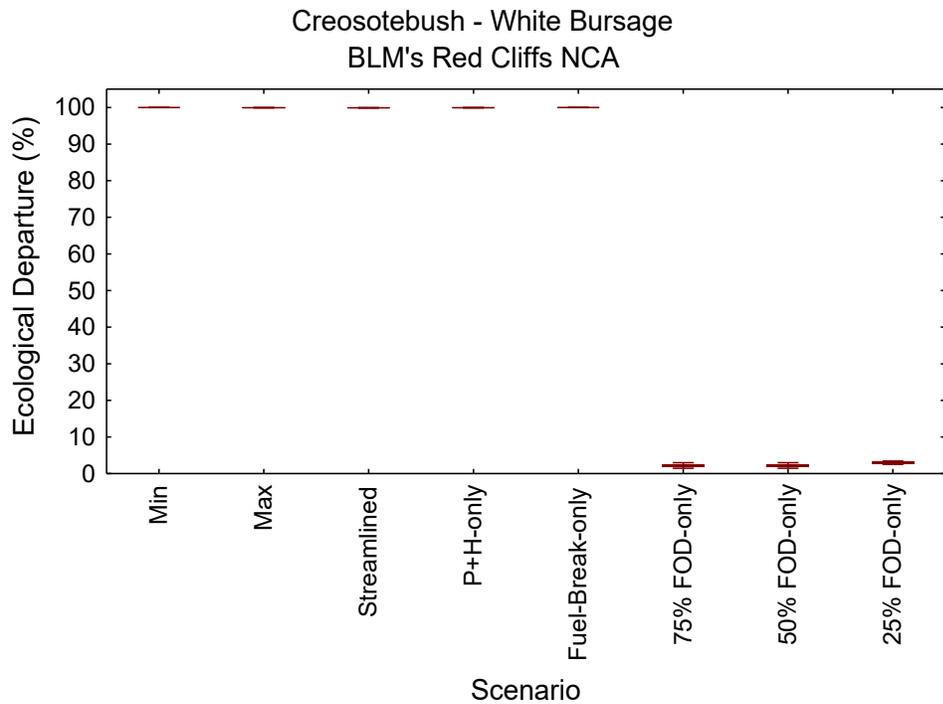


Figure 8. Ecological departure (%) and return-on-investment for ecological departure (subscript $_{ED}$) of creosotebush-white bursage after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

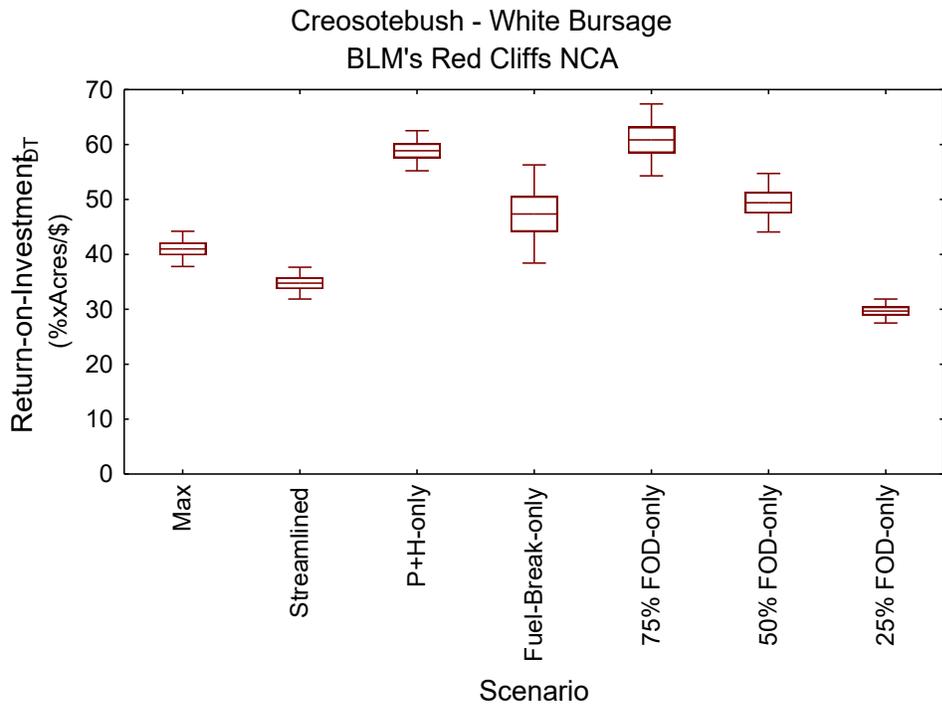
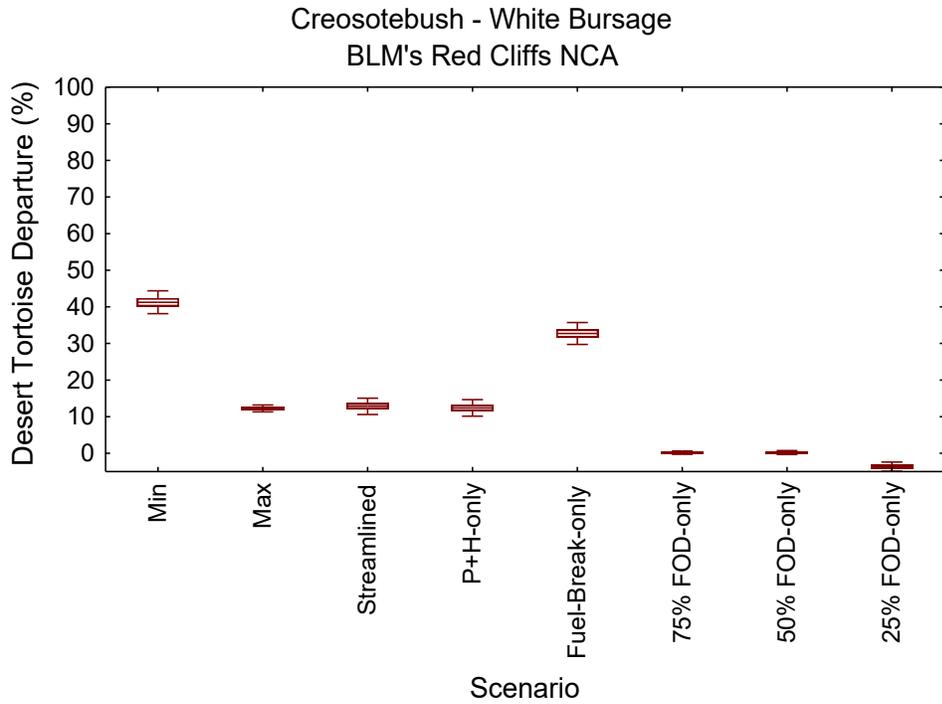


Figure 9. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of creosotebush-white bursage after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

Desert Washes

Desert washes occupied 403 acres in the Red Cliffs NCA and are one of the most important desert tortoise habitat. Desert tortoise feed in the productive washes and take advantage of wash slopes for excavating dens. Desert washes are found throughout the NCA. At present, this system exhibits high ecological departure at 90%. Desert tortoise departure is moderate at 50%. Forty-three percent of the ecological system is in the early succession class due to high flood events experienced in December 2010. The remaining and majority of washes (57%) are shrublands invaded by non-native annuals and low cover of native herbaceous species.

After 50 years in a regime of minimum management, ecological departure decreased from 90% to 69% as vegetation transitioned from early to middle or late succession, thus approaching the NRV. Desert tortoise departure decreased (i.e., improved) from 50% to 36% as vegetation classes matured, although they were invaded by non-native annuals. The resulting vegetation class received higher desert tortoise suitability because increasing mature wash shrubs provide shade and food to desert tortoise.

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including aerial herbicide application, weed inventory, control of exotic saltcedar and forb species, and fuel breaks.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect shrublands from future fire.
- Control non-native annuals, trees, and forbs.
- Maintain desert tortoise departure below the current 36% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Inventory of weeds and saltcedar for immediate control or future control | 5 | 5 | 5 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 4 | 1 | 0 | \$200 | |
| | Aerial application of Plateau® of wash shrubs invaded by non-native annuals | 26 | 26 | 4 | \$25 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 83 | 145 | 163 | \$11 | |
| | | | | | | \$113,194 |

| | | | | | | |
|----------------------|--|-----|-----|-----|-------|-----------|
| Streamlined | Inventory of weeds and saltcedar for immediate control or future control | 6 | 5 | 5 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 4 | 1 | 1 | \$200 | |
| | Aerial application of Plateau® of wash shrubs invaded by non-native annuals | 15 | 15 | 10 | \$11 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 33 | 289 | 787 | \$11 | |
| | | | | | | \$187,071 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 79 | 142 | 133 | \$11 | |
| | | | | | | \$66,588 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 402 | 402 | 402 | \$1 | |
| | | | | | | \$20,100 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 35 | 3 | \$300 | |
| | | | | | | \$137,971 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 35 | 3 | \$300 | |
| | | | | | | \$188,729 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 100 | 49 | \$300 | |
| | | | | | | \$350,985 |

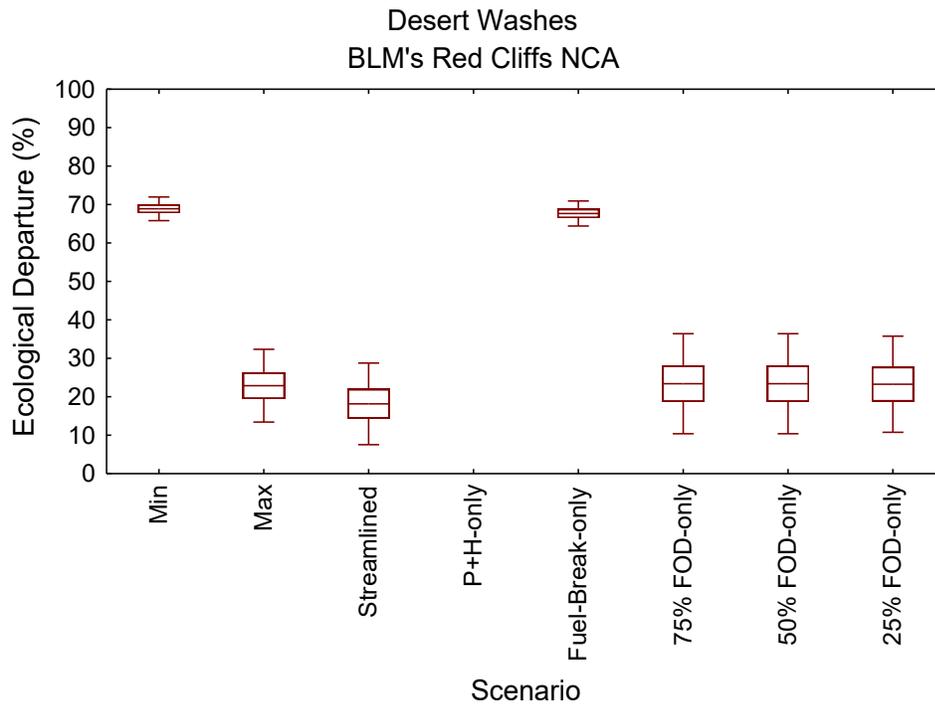
The average annual cost of these treatments among scenarios for the Red Cliffs NCA varied between \$1,332 and \$7,020 per year of implementation.

50-year Outcomes

- All scenarios, except the FUEL-BREAK-ONLY MANAGEMENT scenario, decreased ecological departure to about 20% (figure 10 top). THE FUEL-BREAK-ONLY MANAGEMENT and the MINIMUM MANAGEMENT scenario achieved similar departure at about 69% (Figure 10 top).
- The highest ROI for ecological departure was realized by the MAXIMUM MANAGEMENT scenario followed by the FINGERS-OF-DEATH scenario WITH 75% SUCCESS RATE (Figure 10 bottom). Due to overlapping confidence intervals, the ROIs of the STREAMLINED and FINGERS-OF-DEATH scenario WITH 75% AND 50% SUCCESS RATES were similar. The differences between the MAXIMUM MANAGEMENT and

STREAMLINED MANAGEMENT scenarios were instructive: the former focused more on aerial spraying of non-native annuals in shrublands, whereas the latter placed more focus on increasing fuel breaks.

- Compared to the MINIMUM MANAGEMENT scenario, only four scenarios met the objective of desert tortoise departure less than 36% (Figure 11 top): MAXIMUM MANAGEMENT, STREAMLINED, and FINGERS-OF-DEATH WITH 75% AND 50% SUCCESS RATES. They achieved about 0% departure.
- The MAXIMUM MANAGEMENT and FINGERS-OF-DEATH WITH 75% SUCCESS RATE scenarios showed the highest ROI based on desert tortoise departure (Figure 11 bottom). The STREAMLINED and FINGERS-OF-DEATH WITH 50% SUCCESS RATE scenarios were close seconds for ROI.



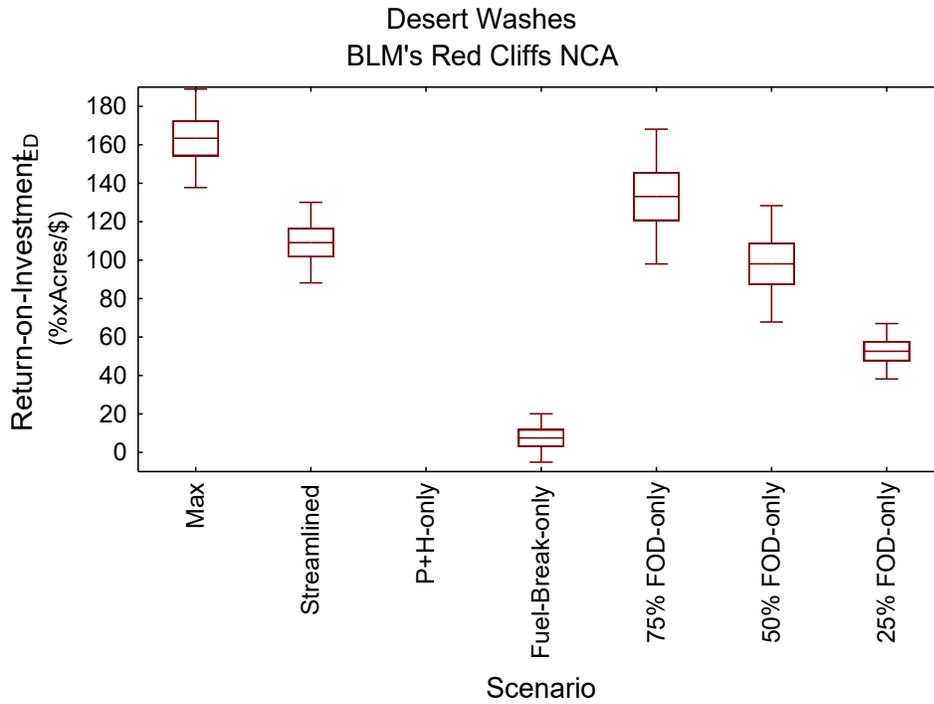
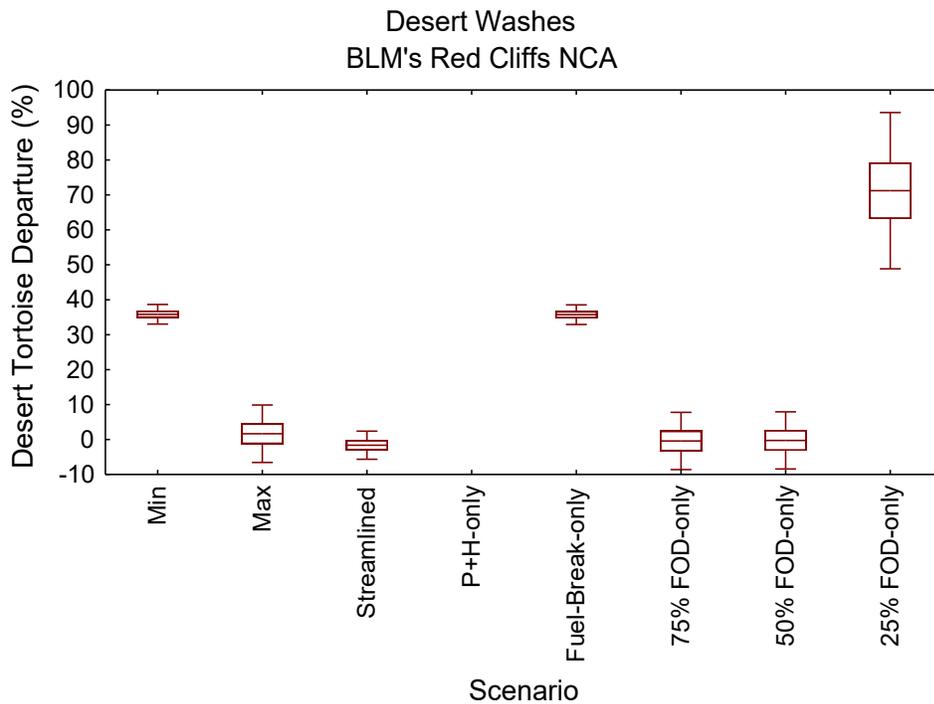


Figure 10. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of desert washes after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.



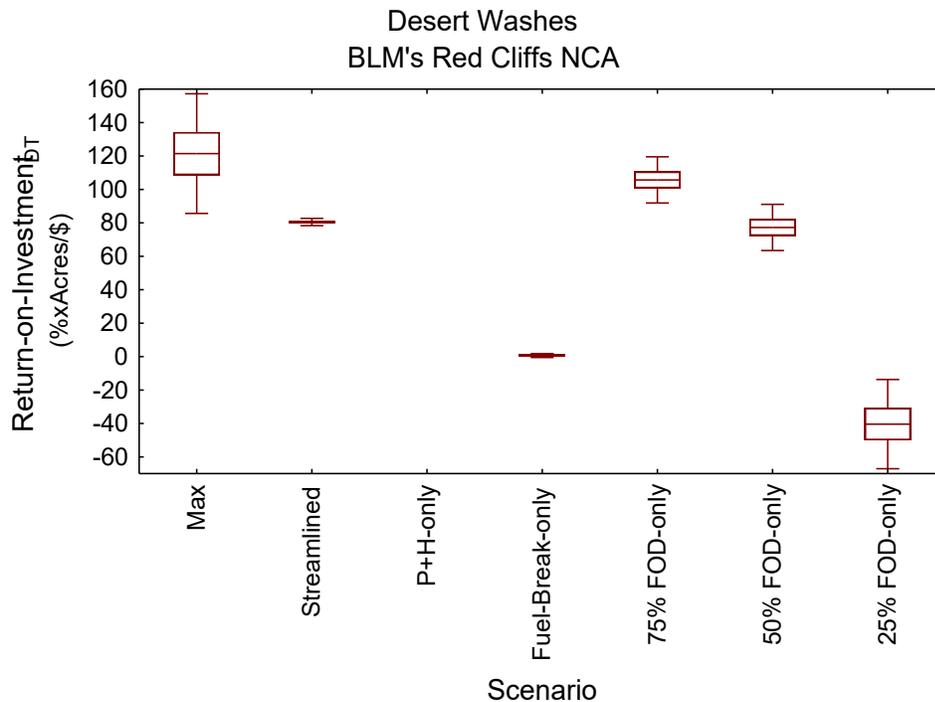


Figure 11. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of desert washes after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

Desert Sand Sagebrush

Desert sand sagebrush is only found in the deep sandy soils (1,586 acres) of the Red Cliffs NCA. It is used by desert tortoise for borrowing and foraging. At present, this system exhibits complete ecological departure at 100% because all shrublands are invaded by non-native annuals. Desert tortoise departure is low at 13% as sand sagebrush resprouts after fire and other stand replacing disturbances.

After 50 years in a regime of minimum management, ecological departure and desert tortoise departure were not predicted to change because of the high resilience of the shrub species.

BLM and stakeholders focused on a variety of treatment actions (strategies) used in combination including aerial herbicide application and native plant seeding.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect shrublands from future fire.
- Control non-native annuals, trees, and forbs.

- Maintain desert tortoise departure below the current 36% score.

50-YEAR MANAGEMENT Strategies and Costs

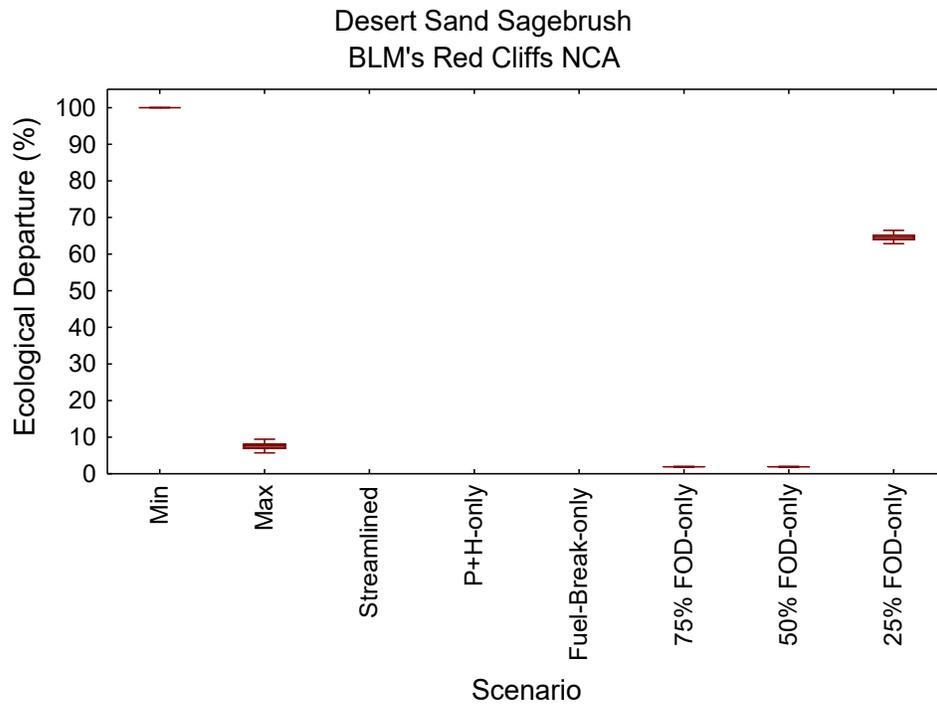
| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|--------------|---|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® to control non-native annuals followed by seeding of native grass species in non-native annual grasslands and forblands | 50 | 50 | 35 | \$250 | |
| | | | | | | \$511,748 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate followed by seeding of native grass species in shrubland invaded by non-native annuals | 0 | 99 | 39 | \$300 | |
| | | | | | | \$1,219,311 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate followed by seeding of native grass species in shrubland invaded by non-native annuals | 0 | 101 | 50 | \$300 | |
| | | | | | | \$1,376,278 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate followed by seeding of native grass species in shrubland invaded by non-native annuals | 0 | 100 | 49 | \$300 | |
| | | | | | | \$1,357,067 |

The average annual cost of these treatments among scenarios for the Red Cliffs NCA varied between \$10,235 and \$27,526 per year of implementation.

50-year Outcomes

- The MAXIMUM MANAGEMENT and FINGERS-OF-DEATH WITH 75% AND 50% SUCCESS RATES scenarios reduced ecological departure to <10%. The FINGERS-OF-DEATH WITH 25% SUCCESS RATE improved departure (~65%) compared to the 100% departure observed simulating the MINIMUM MANAGEMENT scenario (Figure 12 top).
- All scenarios had positive ROI based on ecological departure, but the highest ROI for ecological departure was clearly realized by the MAXIMUM MANAGEMENT scenario (Figure 12 bottom). Not surprisingly, the cost of the MAXIMUM MANAGEMENT scenario was half the price of other scenarios.

- All scenarios, except the FINGERS-OF-DEATH WITH 25% SUCCESS RATE, achieved lower desert tortoise departure than the MINIMUM MANAGEMENT scenario (Figure 13 top). The FINGERS-OF-DEATH WITH 75% AND 50% SUCCESS RATES scenarios had lower desert tortoise departure values (0% to 5%) by 10% than the MAXIMUM MANAGEMENT scenario.
- The MAXIMUM MANAGEMENT and FINGERS-OF-DEATH WITH 75% SUCCESS RATE scenario showed the highest ROI based on desert tortoise departure (FIGURE 13 BOTTOM). The ROI for the FINGERS-OF-DEATH WITH 25% SUCCESS RATE scenario was strongly negative.



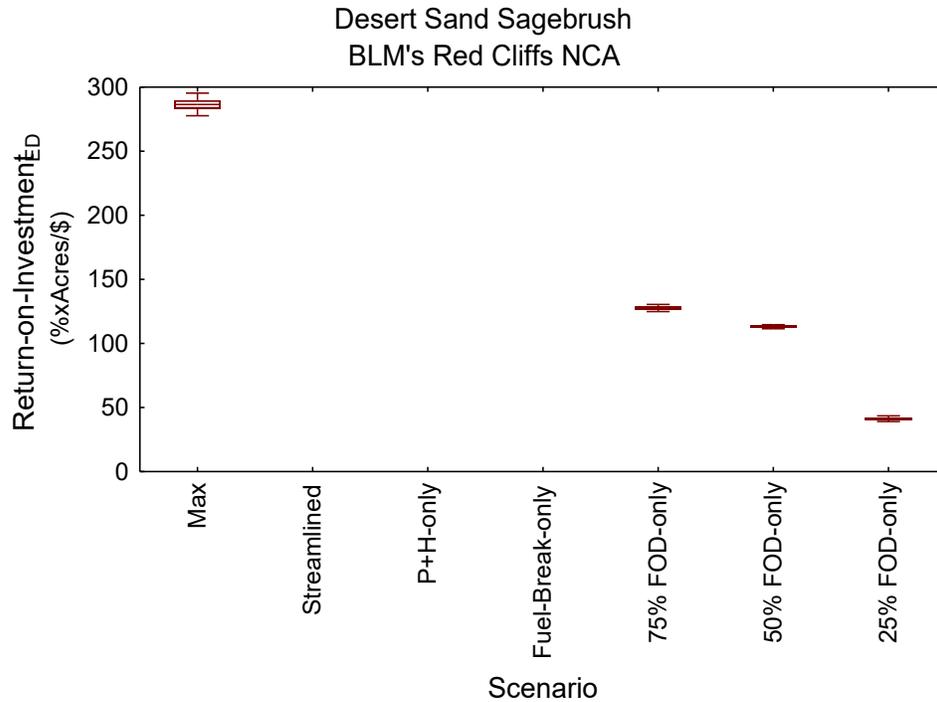
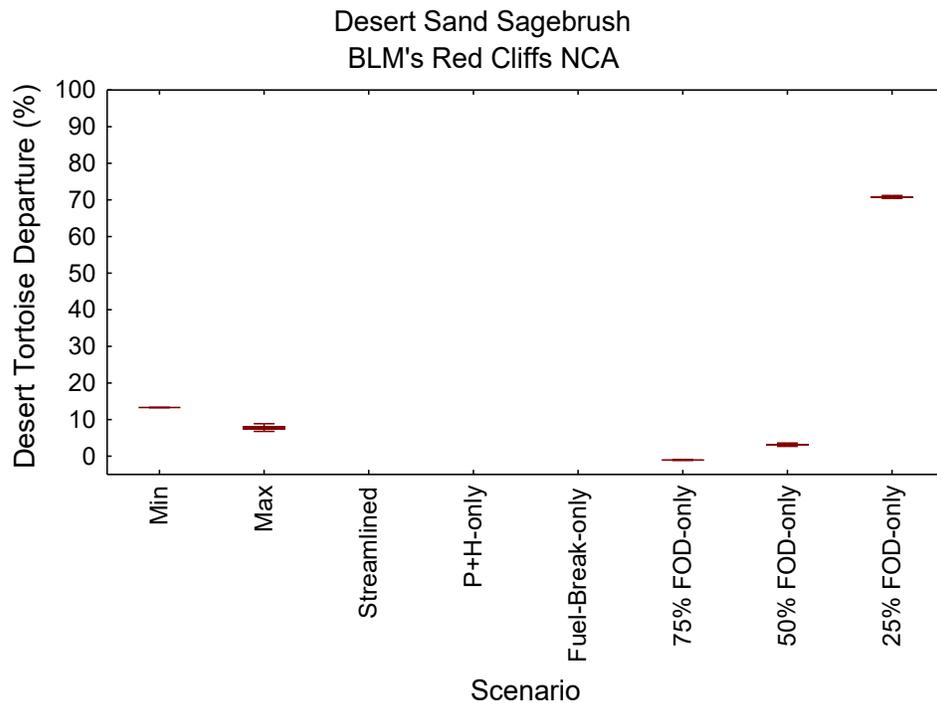


Figure 12. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of desert sand sagebrush after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.



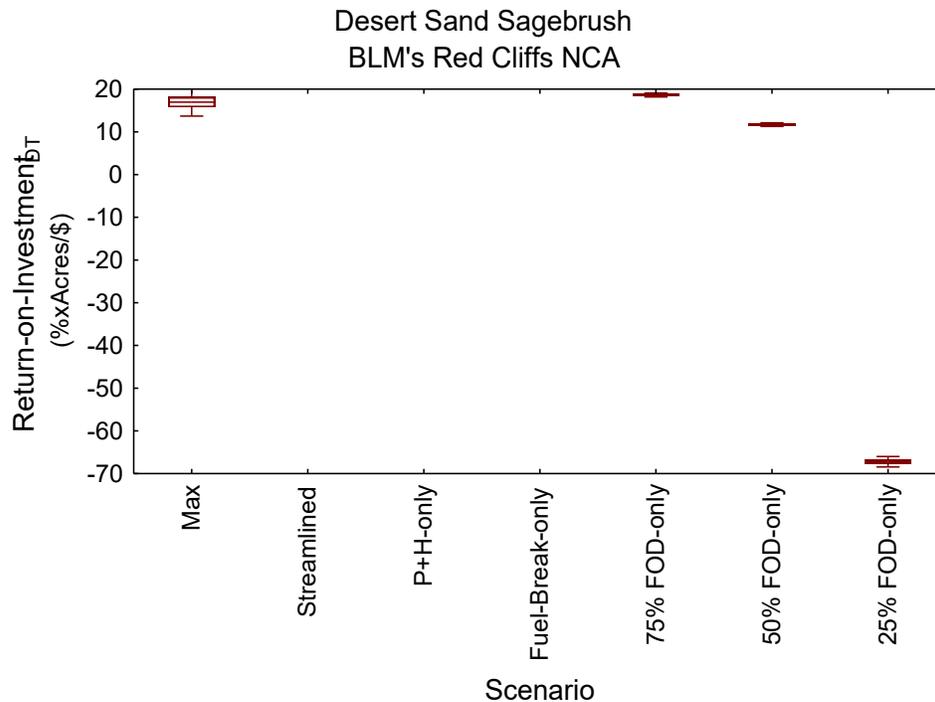


Figure 13. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of desert sand sagebrush after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

Warm-Season Grassland

Warm-season grassland, at 118 acres, is only found in the fine soils and shallow depressions of the Red Cliffs NCA. It is used by desert tortoise for foraging. Grasslands currently exhibit complete ecological departure at 100% because they are all invaded by non-native annuals. Desert tortoise departure is low at 15%. Few areas of grassland are depleted of galleta grass, therefore desert tortoise scores are high.

After 50 years in a regime of minimum management, ecological departure and desert tortoise departure were not predicted to change because of the high resilience of the grassland to fire.

BLM and stakeholders focused on a variety of treatment actions (strategies) used in combination including herbicide application, native plant seeding, and fuel breaks.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Control non-native annuals.
- Restore grassland with low native grass cover.

- Maintain desert tortoise departure below 15%.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|-----------------|---|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® in grasslands invaded by non-native annuals | 10 | 10 | 1 | \$50 | |
| | Application of Plateau® followed by seeding of native grass species in depleted grasslands invaded by non-native annuals | 2 | 0 | 0 | \$250 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 23 | 44 | 49 | \$11 | |
| | | | | | | \$38,142 |
| Streamlined | Application of Plateau® in grasslands invaded by non-native annuals | 10 | 9 | 2 | \$50 | |
| | Application of Plateau® followed by seeding of native grass species in depleted grasslands invaded by non-native annuals | 1 | 0 | 0 | \$250 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 10 | 84 | 95 | \$11 | |
| | | | | | | \$59,480 |
| Fuel Break-only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 23 | 41 | 39 | \$11 | |
| | | | | | | \$21,216 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in grasslands invaded by non-native annuals | 0 | 11 | 0 | \$300 | |
| | Application of Finger-of-Death fungi at 75% success rate followed by seeding of native grass species in depleted grasslands invaded by non-native annuals | 0 | 0.4 | 0 | \$450 | |
| | | | | | | \$52,875 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in grasslands invaded by non-native annuals | 0 | 101 | 50 | \$300 | |
| | Application of Finger-of-Death fungi at 50% success rate followed by seeding of native grass species in depleted grasslands invaded by non-native annuals | 0 | 16 | 0 | \$450 | |
| | | | | | | \$73,673 |

| | | | | | |
|--------------|---|---|----|---|------------------|
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in grasslands invaded by non-native annuals | 0 | 25 | 0 | \$300 |
| | Application of Finger-of-Death fungi at 25% success rate followed by seeding of native grass species in depleted grasslands invaded by non-native annuals | 0 | 1 | 0 | |
| | | | | | \$119,575 |

The average annual cost of these treatments among scenarios for the Red Cliffs NCA varied between \$424 and \$2,392 per year of implementation.

50-year Outcomes

- The MAXIMUM MANAGEMENT and STREAMLINED MANAGEMENT scenarios reduced ecological departure (<5%) more than the FINGERS-OF-DEATH (15%-35%) and FUEL BREAK-ONLY scenarios (100%; Figure 14 top).
- All scenarios, except FUEL BREAK-ONLY had ROI based on ecological departure >0, but the highest ROI for ecological departure was realized by the MAXIMUM MANAGEMENT scenario (Figure 14 bottom). The FUEL BREAK-ONLY scenario was zero. The higher ROI of the MAXIMUM MANAGEMENT scenario was explained by its lower cost compared to other scenarios. The STREAMLINED and the FINGERS-OF-DEATH WITH 75% SUCCESS RATE scenarios had the second highest ROIs.
- The MAXIMUM, STREAMLINED MANAGEMENT, the FINGERS-OF-DEATH WITH 75% AND 50% SUCCESS RATES MANAGEMENT scenarios achieved lower desert tortoise departure (~0%) than the MINIMUM MANAGEMENT scenario at 15% (Figure 15 top). Others scenarios did not meet management objectives.
- Among the four scenarios that met management objectives (<15% desert tortoise departure), the MAXIMUM MANAGEMENT scenario had the highest ROI based on desert tortoise departure (Figure 15 bottom). The cost of the MAXIMUM MANAGEMENT scenario was less than the price of other scenarios. The STREAMLINED MANAGEMENT and the FINGERS-OF-DEATH WITH 75% SUCCESS RATE scenarios had the second highest ROIs. The ROI for the FINGERS-OF-DEATH WITH 25% SUCCESS RATE MANAGEMENT scenario was strongly negative.

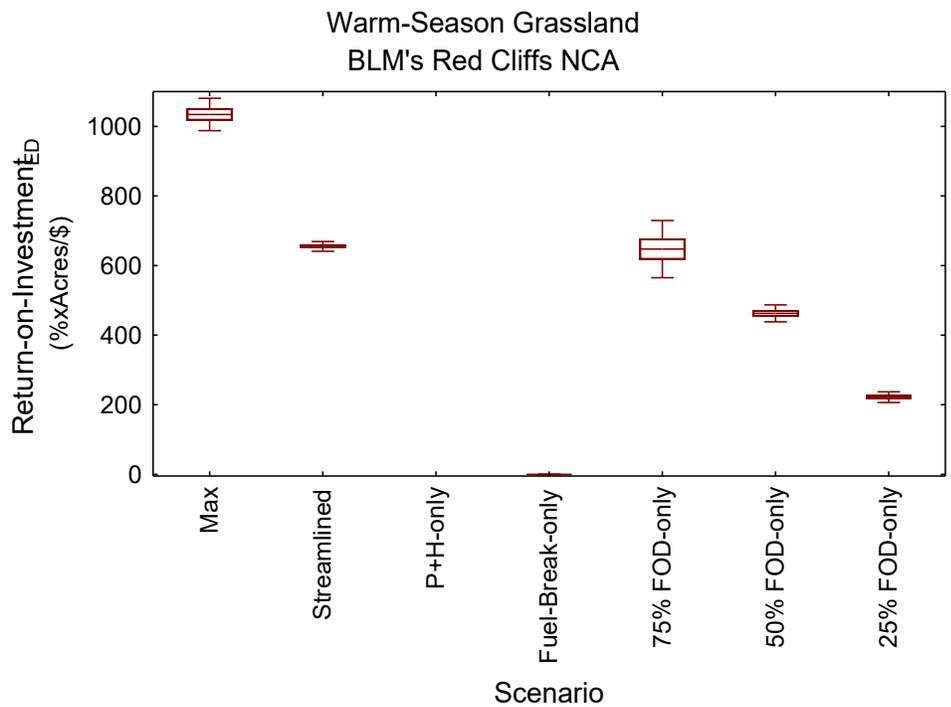
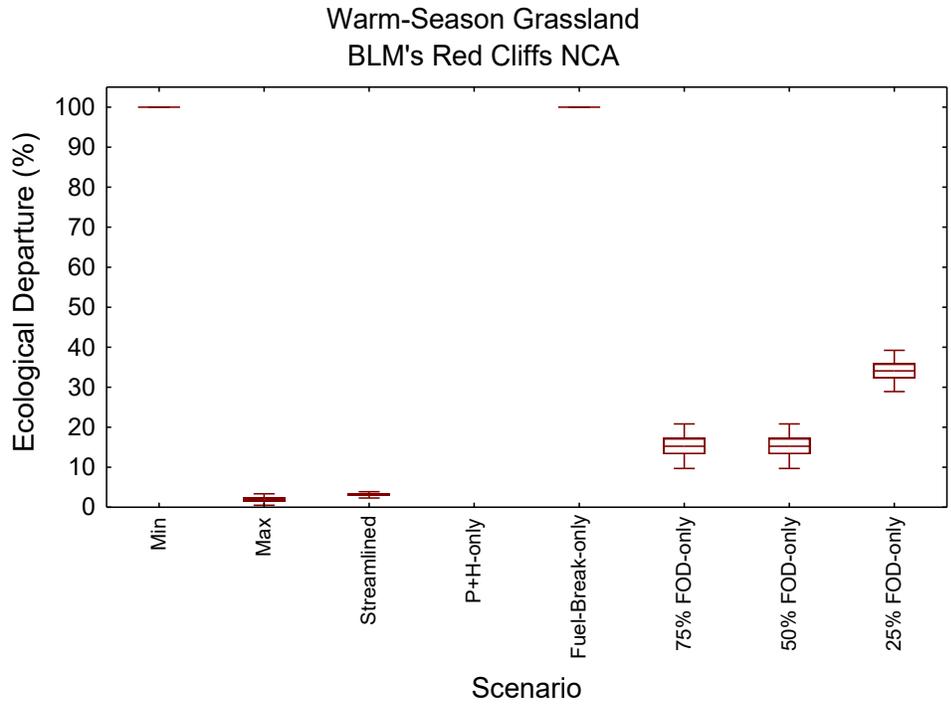


Figure 14. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of warm-season grassland after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

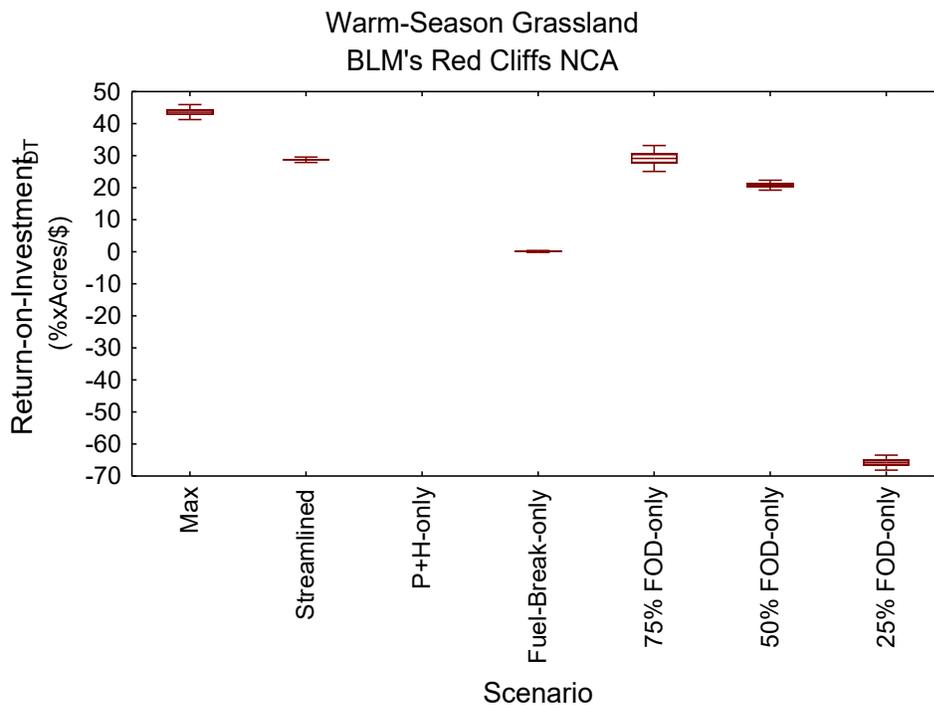
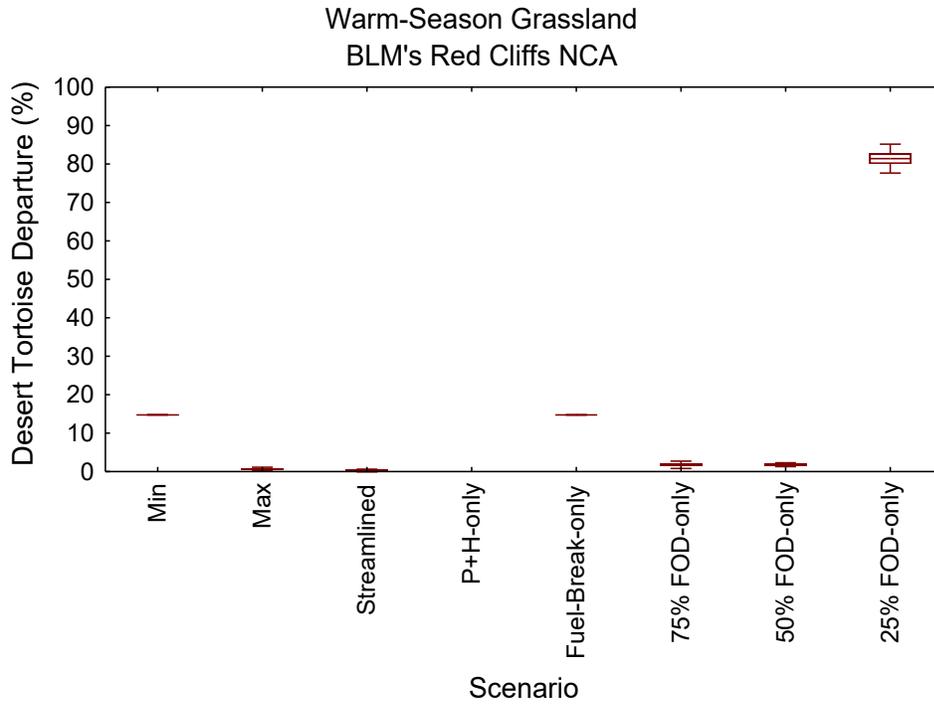


Figure 15. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of warm-season grassland after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; FOD = Fingers-of-Death.

Big Sagebrush Steppe

Big sagebrush steppe is found in both NCAs, but management actions were only simulated for the Red Cliffs NCA because the sagebrush acreage is too small (14 acres) in the Beaver Dam Wash NCA. Big sagebrush steppe is found above the blackbrush-mesic zone and is not used by desert tortoise. Sagebrush currently exhibits complete ecological departure at 100% because all vegetation classes are uncharacteristic. About 79% of the Red Cliff NCA's sagebrush burned in 2005 and, therefore, became non-native annual grassland. Seventeen percent of the ecological system that did not burn is shrubland, but invaded by non-native annual grasses. Tree-encroached sagebrush without visible non-native annual grasses occupies the remaining 5% of vegetation classes.

After 50 years in a regime of minimum management, ecological departure was predicted to barely change by 2%, i.e., from 100% to 98%.

BLM and stakeholders focused on one management action: herbicide application to control non-native annual grasses followed by native plant seeding, perhaps using a rangeland drill or aerial broadcasting. Therefore, there is no comparison of ROI among different scenarios. This action results in the expansion of a temporary seeded class, which is itself uncharacteristic.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Restore burned shrublands currently dominated by non-native annuals.
- Reduce the non-native annual grassland class to less than 10% of the ecological system.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|---|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® to control non-native annuals followed by seeding of native species in non-native annual grasslands and forblands | 199 | 196 | 17 | \$250 | |
| | | | | | | \$1,120,581 |

The average annual cost of the scenario for the Red Cliffs NCA was \$24,412 per year of implementation.

50-year Outcomes

- The MAXIMUM MANAGEMENT scenario reduced ecological departure from 98% to about 75% (Figure 16). Approximately 82% of vegetation classes were in the seeded state after 50 years, 10% in the late-closed class (class C), and 3% in the early succession class. The non-native annual grassland class was predicted to be less than 3%. The 75% departure overestimates the future ecological condition of big sagebrush steppe because of the size of the seeded class that will transition to reference classes with time.

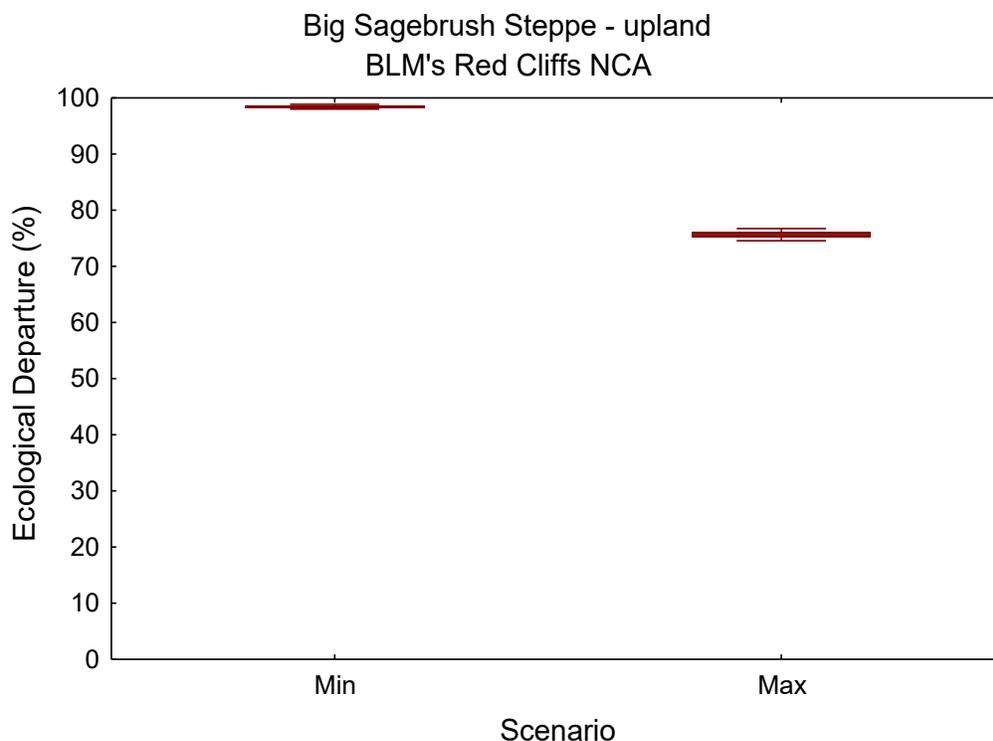


Figure 16. Ecological departure (%) of big sagebrush steppe after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates.

Montane Riparian

The montane riparian ecological system is small (40 acres), heterogeneous, usually above the 12-inch precipitation zone, and found only in the eastern part of the Red Cliffs NCA. Plant and animal species diversity are high. Typical dominant woody species are Fremont

cottonwood, willows (several species), other riparian trees and shrubs, and Wood’s rose. At present, this system exhibits high ecological departure at 99%. Although many creeks appear to be in good hydrological condition, saltcedar is found throughout the system.

After 50 years in a regime of minimum management, ecological departure increased to 100% from 99% due to exotic tree and forb species invasion, even including saltcedar beetle biocontrol. These levels of departure and exotic forb invasion were judged unacceptable.

BLM and stakeholders focused on one management action: chainsaw cutting of saltcedar followed by immediate herbicide application to stumps and herbicide application to exotic forb species if found.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Restore the montane riparian ecological departure to <33% ecological departure.
- Contain uncharacteristic classes to <11%.

50-YEAR PREFERRED MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Chainsaw cutting of saltcedar flowed by application of herbicide to control exotic saltcedar and forbs | 9 | 3 | 1 | \$200 | \$113,193 |

The average annual cost of the scenario for the Red Cliffs NCA was \$2,263 per year of implementation.

50-year Outcomes

- The MAXIMUM MANAGEMENT scenario reduced ecological departure from 100% to about 26% (Figure 17), thus meeting management objective for ecological departure. Less than 8% of the montane riparian was occupied by exotic trees and forbs in all replicate simulations.

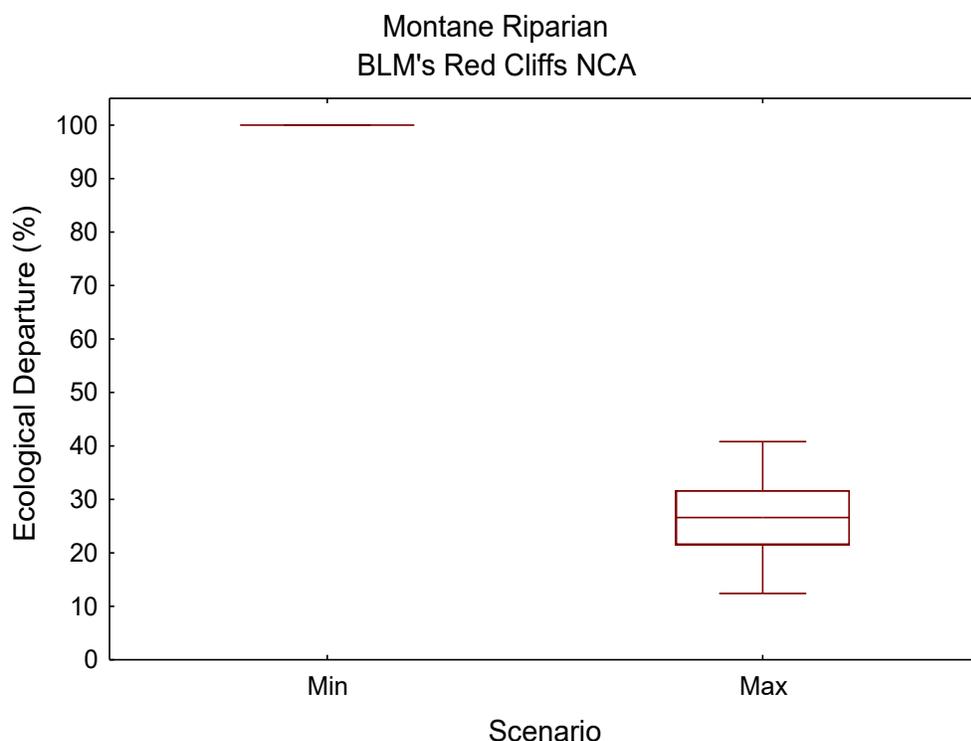


Figure 17. Ecological departure (%) of montane riparian after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates.

Mountain Shrub

The mountain shrub ecological system is small (4.2 acres) and the presence of Stansbury cliffrose makes it critical mule deer winter range. Mountain shrubs are found within the big sagebrush steppe and pinyon-juniper woodland zone. In the Red Cliffs, the mountain shrub extends outside the NCA. Mountain shrub currently exhibits complete ecological departure at 100% because all vegetation classes are uncharacteristic. About 64% of the Red Cliff NCA's mountain shrub burned and is in the non-native annual grassland class. Seven percent of the ecological system that did not burn is shrubland, but invaded by non-native annual grasses. Tree-encroached mountain shrub without visible non-native annual grasses occupies 29% of vegetation classes.

After 50 years in a regime of minimum management, ecological departure remained at 100%. The vegetation class representing shrubs invaded by non-native annual grass were predicted to increase at the expense of non-native annual grasslands. Without increased fire activity, cliffrose could reestablish from seed within a few years.

BLM and stakeholders focused on two management actions in one scenario: herbicide application to control non-native annual grasses followed by cliffrose seeding in non-native

annual grasslands, and herbicide application to control non-native annual grasses followed by native grass seeding in shrublands invaded by non-native annual grass. Cliffrose is commonly used in mine reclamation and mule deer habitat restoration projects, therefore these actions should be well established.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Restore ecological departure to at least moderate levels (<67%).
- Reduce the non-native annual grassland class to less than 10% of the ecological system.
- Reduce the shrublands invaded by non-native annual grass to less than 10%.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® to control non-native annuals followed by seeding of Stansbury cliffrose in non-native annual grasslands and forblands | <1 | 0 | 0 | \$100 | |
| | Application of Plateau® to control non-native annuals followed by seeding of native grasses in shrublands invaded by non-native annuals | 1 | 0 | 0 | \$250 | |
| | | | | | | \$1,023 |

The average annual cost of the scenario for the Red Cliffs NCA was \$20 per year of implementation.

50-year Outcomes

- The MAXIMUM MANAGEMENT scenario reduced ecological departure from 100% to about 39% (Figure 18). There was large variability among replicates with ecological departure varying between 23% and 53%. The non-native annual grasslands and shrublands invaded by non-native annual grass were largely eliminated, however the tree-encroached class persisted (average of 20%) in many replicates that did not burn. Reference classes approached NRV.

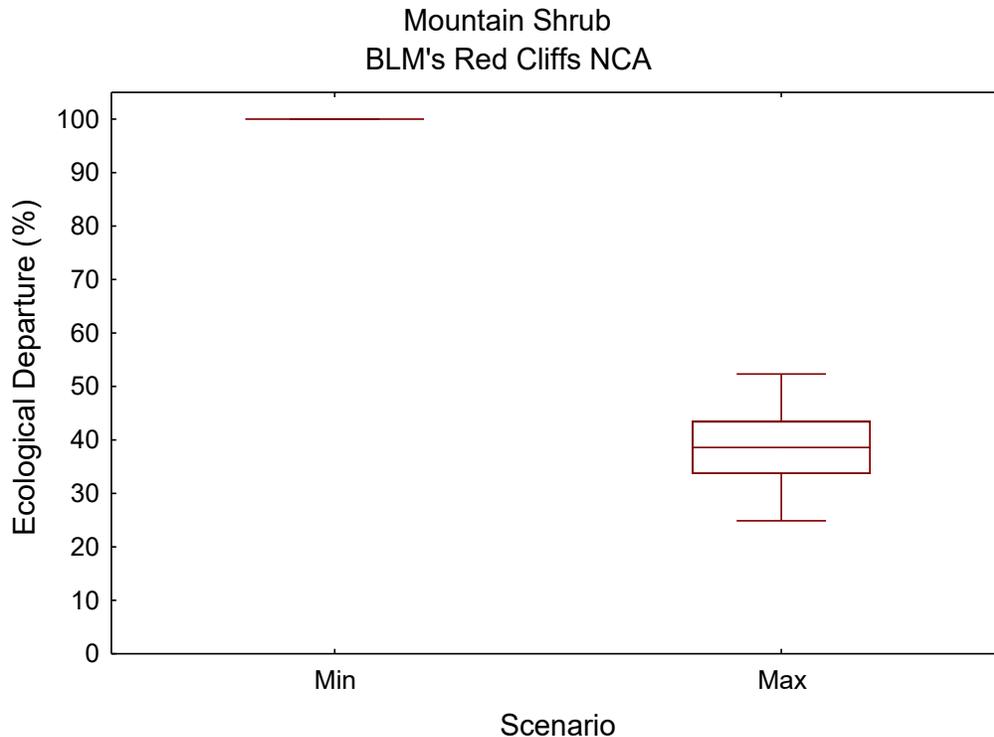


Figure 18. Ecological departure (%) of mountain shrub after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates.

Pinyon-Juniper Woodland

Pinyon-juniper woodland is found in both NCAs, but management actions were only simulated for the Red Cliffs NCA because pinyon-juniper woodland is too small (270 acres) and very difficult to access in the Beaver Dam Wash NCA. A large fraction of pinyon-juniper woodland is located on Red Mountain wilderness in Red Cliffs NCA. Pinyon-juniper woodland currently exhibits complete ecological departure at 100% because all vegetation classes are non-native annual grass.

After 50 years in a regime of minimum management, ecological departure was unchanged. Approximately 20% of woodlands burned in 50 years, resulting in non-native annual grasslands.

BLM and stakeholders focused on two management actions for one scenario: hand application of herbicide to control non-native annual grasses under the canopy of trees and herbicide application to control non-native annual grasses followed by aerially applied native plant seeding. Therefore, there is no comparison of ROI among different scenarios.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Reduce ecological departure to moderate levels (<67%).

- Restore burned areas as they are created by future wildfires.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® to control non-native annuals under the canopy of trees | 101 | 101 | 100 | \$50 | |
| | Application of Plateau® to control non-native annuals followed by aerial seeding of native species in non-native annual grasslands and forblands | 0 | 0 | 22 | \$250 | |
| | | | | | | \$420,220 |

The average annual cost of the scenario for the Red Cliffs NCA was \$8,404 per year of implementation.

50-year Outcomes

- The MAXIMUM MANAGEMENT scenario reduced ecological departure from 100% to about 22% (Figure 19). Approximately 63% of vegetation classes were trees with non-native annual grass in the understory after 50 years and about 28% were in the late-closed class (class D) as a result of understory herbicide spraying.

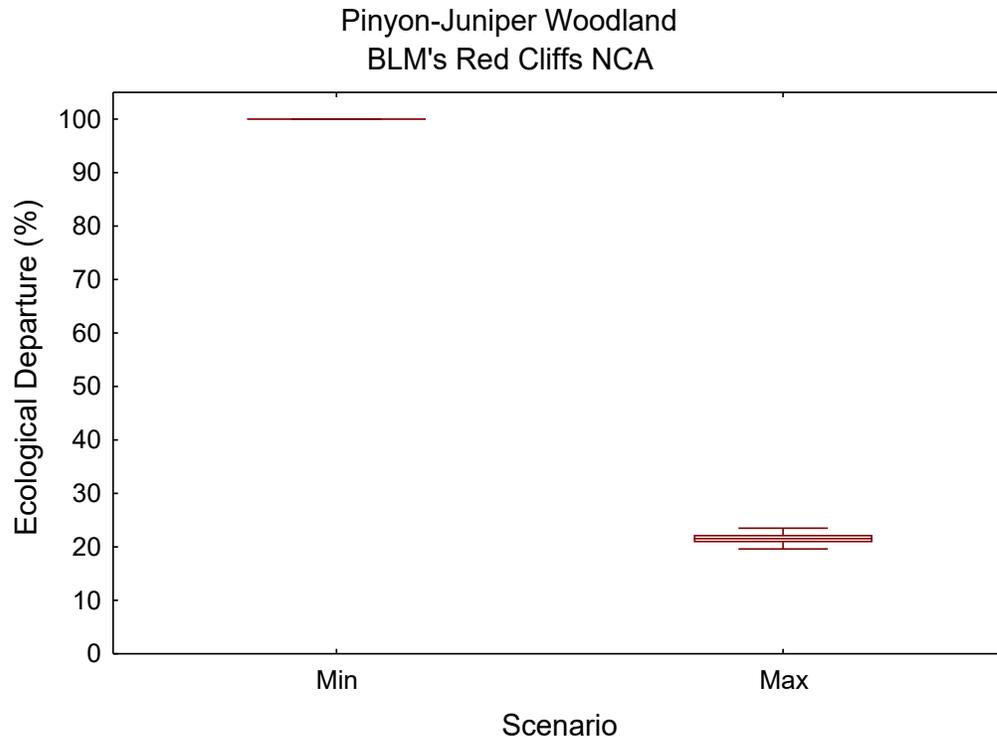


Figure 19. Ecological departure (%) of pinyon-juniper woodland after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates.

Warm Desert Riparian

The warm desert riparian ecological system is small (160 acres) and consists of the Virgin River and low elevation tributaries to it. Plant and animal species diversity are typically very high. Typical dominant woody species are Fremont cottonwood, Goodding’s willow, mesquite, velvet ash, other willows (several species), and other riparian trees and shrubs. At present, this system exhibits complete ecological departure at 100%. Saltcedar is found in 21% of the system, whereas the remaining 79% of the warm desert riparian has an understory of non-native annual species.

After 50 years in a regime of minimum management, ecological departure decreased to 71% from 100% due to several factors. The saltcedar biocontrol beetle allowed recruitment into a) reference classes and b) the exotic forb class (for example, Russian knapweed), a common pathway after removal of saltcedar. Severe flooding also caused transition of mature riparian vegetation to the early succession class. These levels of departure and exotic forb invasion were judged unacceptable.

BLM and stakeholders focused on several management action: weed inventory, chainsaw cutting of saltcedar followed by immediate herbicide application to stumps, herbicide

application to exotic forb species, hand spraying of herbicide to control non-native annuals in the understory of trees and shrubs, and law enforcement.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Restore the warm desert riparian ecological departure to <67% (moderate departure) ecological departure.
- Contain exotic trees and forbs to <11% cover.

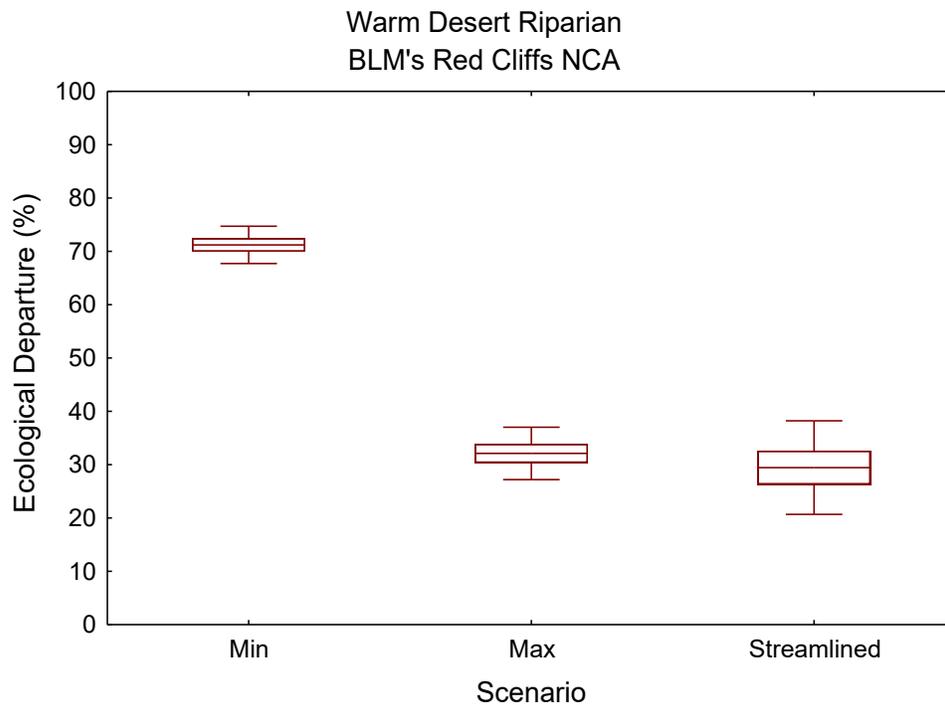
50-YEAR PREFERRED MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------------------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Inventory of weeds and saltcedar for immediate control or future control | 5 | 5 | 5 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 4 | 1 | 0 | \$200 | |
| | Application of herbicide to control exotic forbs | 1 | 1 | 1 | \$50 | |
| | Hand application of Plateau® to riparian woodland's understory invaded by non-native annuals | 11 | 11 | 3 | \$50 | |
| | | | | | | \$111,767 |
| Streamlined | Inventory of weeds and saltcedar for immediate control or future control | 6 | 5 | 5 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 4 | 1 | 1 | \$200 | |
| | Application of herbicide to control exotic forbs | 2 | 1 | 1 | \$50 | |
| | Hand application of Plateau® to riparian woodland's understory invade by non-native annuals | 31 | 30 | 30 | \$50 | |
| | | | | | | \$112,175 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 160 | 160 | 160 | \$1 | |
| | | | | | | \$8,700 |

The average annual cost among scenarios for the Red Cliffs NCA varied between \$2,235 and \$2,243 per year of implementation.

50-year Outcomes

- Differences in ecological departure between the MAXIMUM MANAGEMENT and STREAMLINED MANAGEMENT scenarios were small and ranged between 32% and 30% (Figure 20 top), thus meeting management objective for ecological departure. Exotic trees and forbs were <7% for the MAXIMUM MANAGEMENT scenario and <8% for the STREAMLINED MANAGEMENT scenario. Again, these results met management objectives. The largest difference between the two scenarios was the near elimination of trees with a non-native annual grass understory in the STREAMLINED MANAGEMENT scenario, whereas about 15% of this vegetation class persisted in the MAXIMUM MANAGEMENT scenario.
- There was no statistical difference for ROI between the two scenarios (Figure 20 bottom).



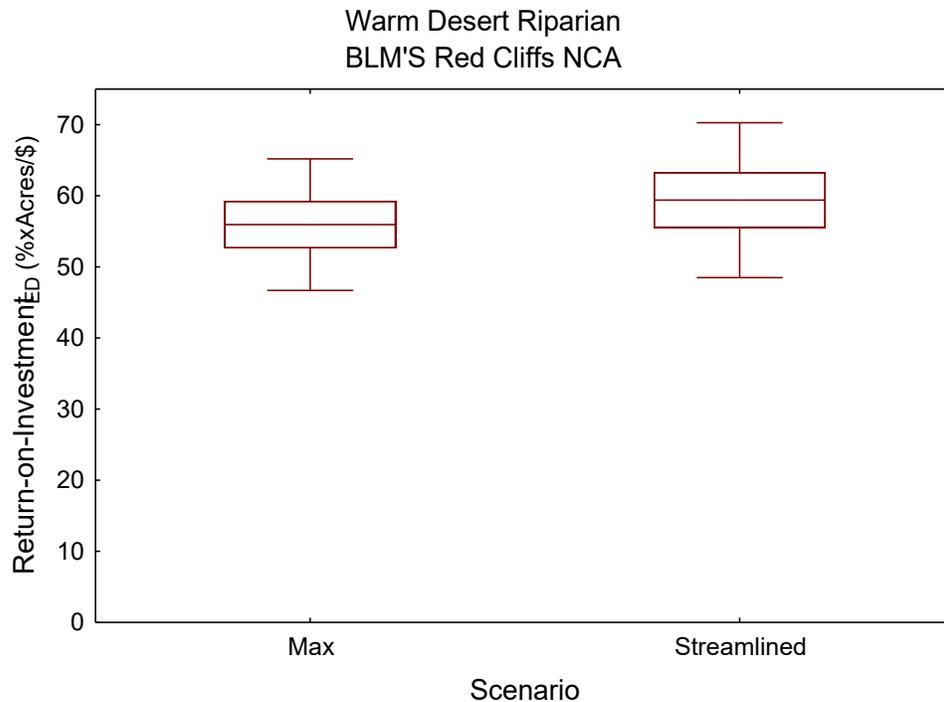


Figure 20. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of warm desert riparian after 50 years simulating different management scenarios for the Red Cliffs NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates.

Beaver Dam Wash NCA

Blackbrush-mesic

Mesic blackbrush is the largest ecological system of the Beaver Dam Wash NCA and is found from southeast to northwest in the NCA. At present, this system exhibits complete ecological departure at 100%; however, desert tortoise departure is moderate at 58% because shrublands invaded by non-native annual species represent 27% of the landscape. These shrublands provide shade and food to desert tortoise. About 63% of the ecological system transitioned to non-native annual grasslands and forblands, which have more limited value to desert tortoise, after the wildfires of 2005.

After 50 years in a regime of minimum management, ecological departure did not change because acres remained as non-native annual grasslands and forblands. Additional wildfires, which converted more shrublands with non-native annuals into non-native annual grasslands and forblands in shrublands, were limited. With respect to desert tortoise departure, the case of minimum management in the Beaver Dam Wash NCA was very different than for the Red Cliffs NCA: desert tortoise departure decreased from 58% to 20%. Mojave Desert shrubs and some forbs can either resprout or recover from **one** fire within 20 years; this recovery adds up as the area of recovery represents 63% of the largest ecological system. This additional

vegetation structure provides shade and food to desert tortoise and, as a result, desert tortoise departure decreased. This special outcome would not be possible after 2 or more fire in the same location ((Callison et al. 1985; Abella et al. 2009a; Engel and Abella 2011)).

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including herbicide application, native species seeding and planting, fuel breaks, special livestock management, and law enforcement.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect blackbrush shrublands from future fire.
- Increase native shrub and herbaceous cover in burned areas.
- Maintain desert tortoise departure below the current 20% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|-----------------------------|--|----------------|----------------|-----------------|---------------|------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® followed by seeding of new native seed mix supplemented by germination innovations in non-native annual grasslands and forblands | 0 | 0 | 20 | \$250 | |
| | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 670 | 47 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 7,786 | 6,835 | 7,636 | \$11 | |
| | Prevent grazing of seedings and plantings for 10 years | 0 | 44 | 69 | \$11 | |
| | | | | | | \$14,782,333 |
| Streamlined | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 348 | 253 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 7,765 | 6,883 | 7,621 | \$11 | |
| | Prevent grazing of seedings and plantings for 10 years | 0 | 21 | 80 | \$11 | |
| | | | | | | \$12,598,839 |
| Planting+ Herbicide-only | Application of Plateau® followed by planting of containerized Mojave | 0 | 676 | 332 | \$650 | |

| | | | | | | |
|---|---|-------------|--------|--------|-------|--------------|
| | shrubs and herbaceous species in non-native annual grasslands and forblands | | | | | \$13,293,550 |
| Planting+ Herbicide & Livestock-Closure | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 674 | 299 | \$650 | |
| | Prevent grazing of seedings and plantings for 10 years, and reduce livestock stocking rate in desert washes | 0 | 66 | 110 | \$11 | |
| | | | | | | \$12,587,570 |
| No-Grazing only | Close allotment using third party to purchase AUM's from permittees | 33,628 once | | | \$11 | |
| | | | | | | \$369,908 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 7,784 | 6,846 | 7,407 | \$11 | |
| | | | | | | \$4,598,685 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 33,628 | 33,628 | 33,628 | \$1 | |
| | | | | | | \$1,681,400 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 497 | 1,304 | \$450 | |
| | Application of Finger-of-Death fungi at 75% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 497 | 226 | \$650 | |
| | | | | | | \$23,045,879 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 499 | 1,700 | \$450 | |
| | Application of Finger-of-Death fungi at 50% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 497 | 256 | \$650 | |
| | | | | | | \$25,426,271 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 498 | 1705 | \$450 | |
| | Application of Finger-of-Death fungi at 25% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 491 | 279 | \$650 | |
| | | | | | | \$26,264,125 |

The average annual cost of these treatments among scenarios for the Beaver Dam Wash NCA varied between \$7,936 and \$525,283 per year of implementation.

50-year Outcomes

- Clear differences for ecological departure existed between scenarios with and without the fingers-of-death fungi (Figure 21 top). Without the fingers-of-death fungi, departure remained above 95%, although the MAXIMUM, PLANTING AND HERBICIDE-ONLY and PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY MANAGEMENT scenarios achieved the greatest reductions to ecological departure. Actions with the fingers-of-death fungi reaching 75% and 50% success rates greatly reduced ecological departure from the >95% to <23% compared to the MINIMUM MANAGEMENT scenario. At a 25% success rate, ecological departure only reached about an average of 58%. As observed for the Red Cliffs NCA, the promise of the fingers-of-death fungi states the potential to restore reference classes from uncharacteristic shrublands.
- The ROI for ecological departure was close to zero and differences minimal among scenarios without the fingers-of-death fungi (Figure 21 bottom). Given a fixed application rate of restoration actions ROI increased dramatically with the fingers-of-death fungi. The ROI increased with the success rate of the fingers-of-death fungi. The larger variability around the mean for the 50% success rate of the FINGERS-OF-DEATH-ONLY scenario compared to the 75% and 25% success rate may indicate that 50% might be a tipping point between excellent and weak performance for the fungi (FIGURE 21 TOP).
- All scenarios, except NO-GRAZING-ONLY MANAGEMENT, achieved a lower desert tortoise departure score than MINIMUM MANAGEMENT (Figure 22 top). The lowest (best) average scores of desert tortoise departure (about -3% to -7%) were achieved in the MAXIMUM, STREAMLINED, and PLANTING AND HERBICIDE-ONLY, and PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY, AND all three success rates of the FINGERS-OF-DEATH-ONLY MANAGEMENT scenarios (figure 22 top). The next lowest score was observed for the FUEL-BREAK-ONLY scenario at about 10%.
- Several scenarios achieve comparable high ROI for desert tortoise departure, with the highest being FUEL-BREAK-ONLY, PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY, and STREAMLINED MANAGEMENT scenarios (Figure 22 bottom). THE PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY AND MAXIMUM MANAGEMENT scenarios were close to the top performers. A clear second group with intermediate ROIs was the three FINGERS-OF-DEATH MANAGEMENT scenarios. The NO-GRAZING-ONLY MANAGEMENT scenario varied between having low and negative ROI depending on replicates.

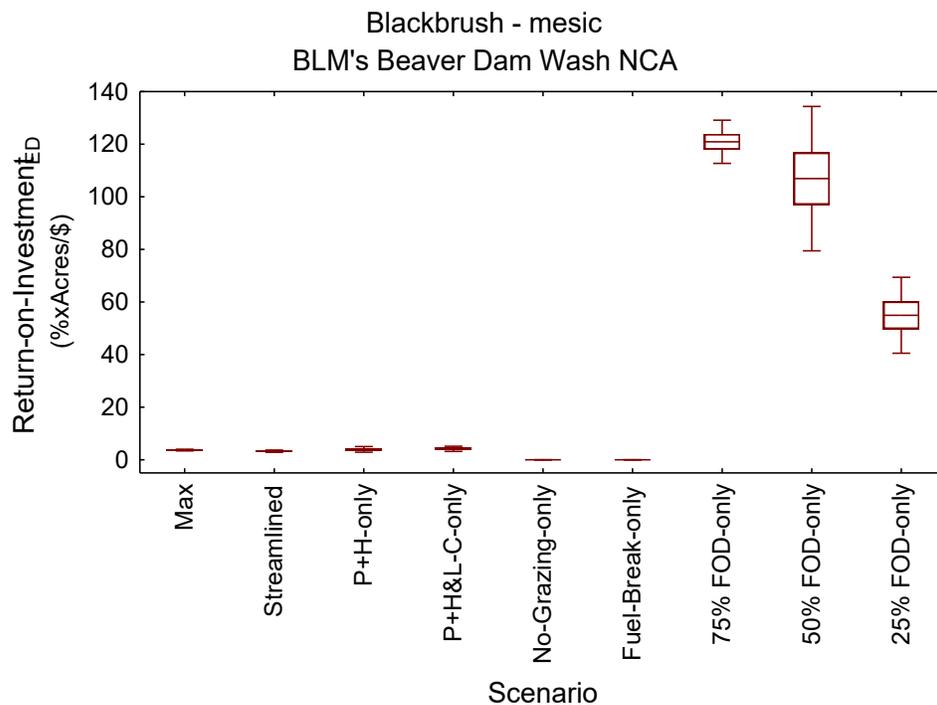
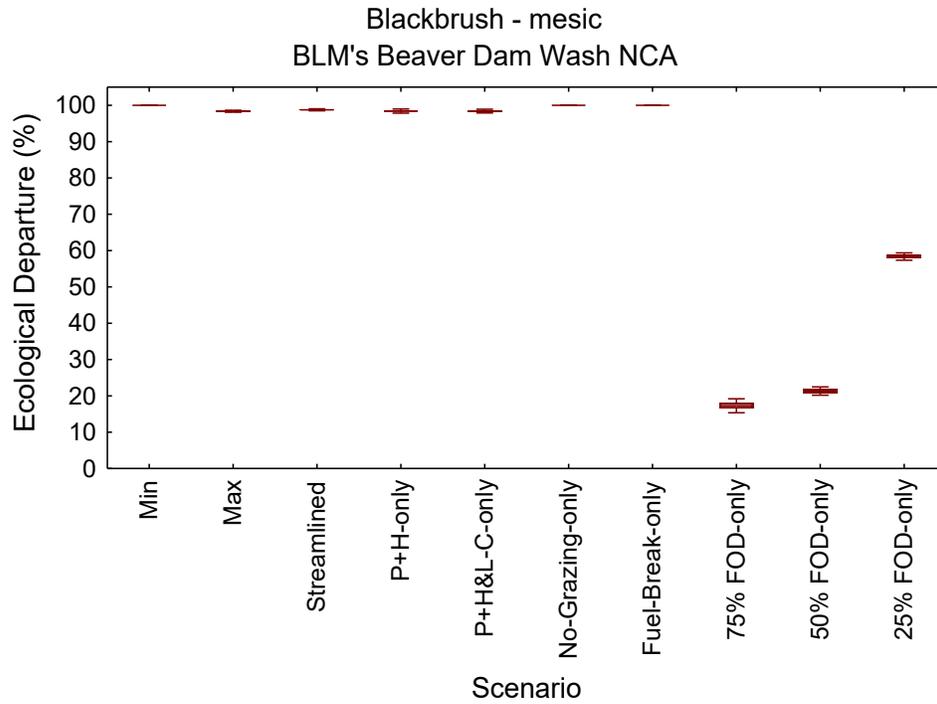


Figure 21. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of blackbrush–mesic after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

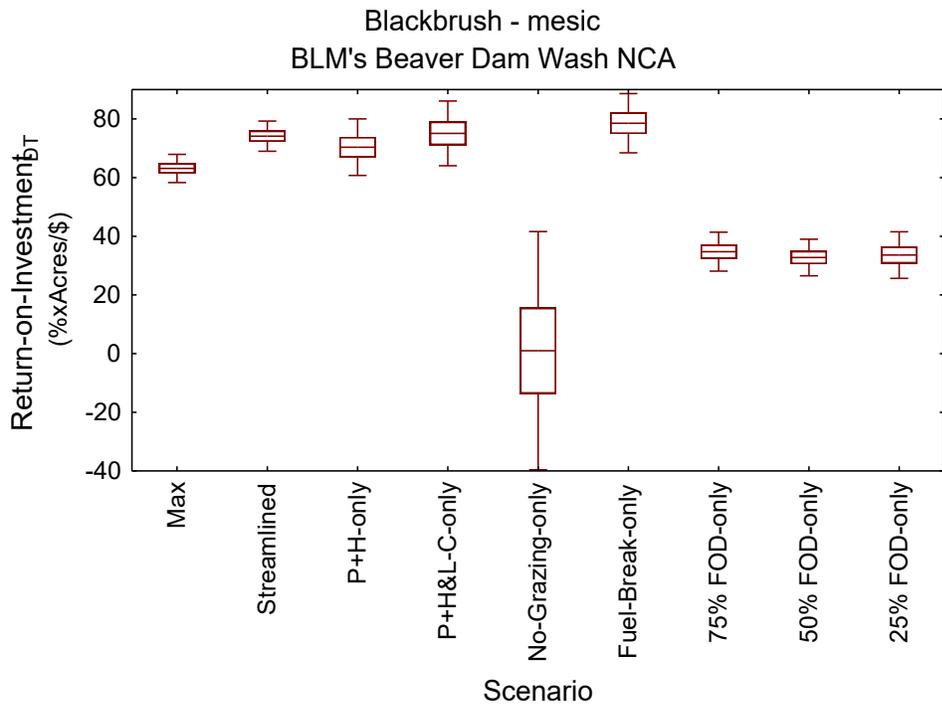
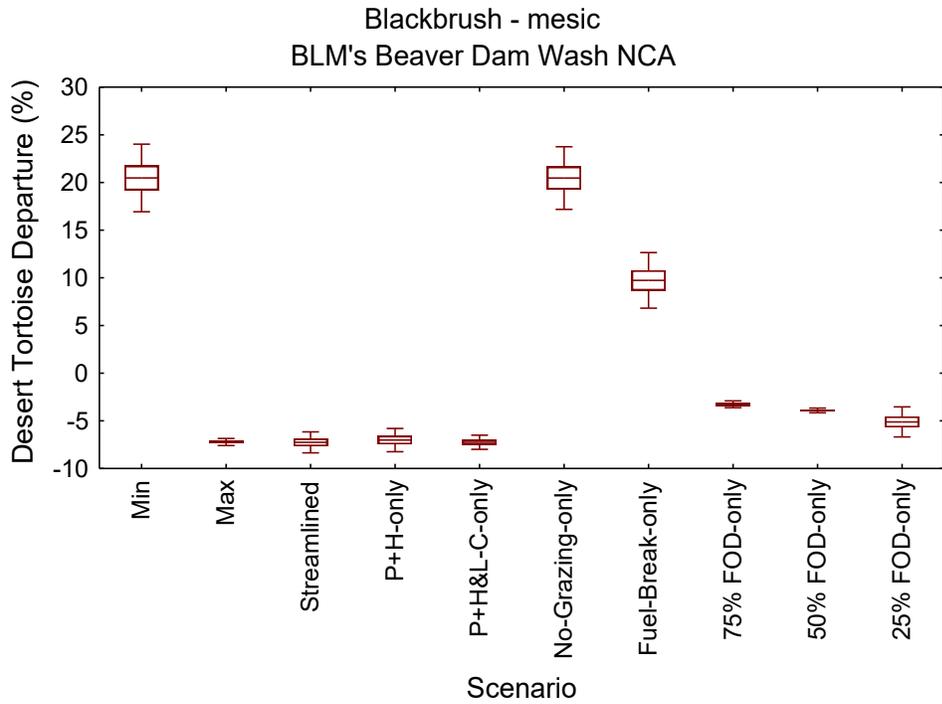


Figure 22. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of blackbrush-mesic after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death

Blackbrush - thermic

Thermic blackbrush is a relatively small ecological system in the Beaver Dam Wash NCA. At present, this system exhibits complete ecological departure at 100%. Desert tortoise departure is moderately high at 37% because shrublands invaded by non-native annuals represent 67% of the landscape. These shrublands provide shade and food to desert tortoise. The remaining 33% of the ecological system transitioned to non-native annual grasslands and forblands after the wildfires of 2005.

After 50 years in a regime of minimum management, ecological departure did not change because acres were shuffled among uncharacteristic vegetation classes. With minimum management, native shrubs and forbs resprouted and recovered within a 20-year period; therefore, vegetation structure providing shade and, perhaps, food for desert tortoise recovered. As a result, desert tortoise departure decreased (i.e., became better) from 37% to 21%.

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including herbicide application, native species seeding and planting, and fuel breaks, special livestock management, and law enforcement.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect blackbrush shrublands from future fire.
- Increase native shrub and herbaceous cover in burned areas.
- Maintain desert tortoise departure below the current 21% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® followed by seeding of new native seed mix supplemented by germination innovations in non-native annual grasslands and forblands | 0 | 0 | 2 | \$250 | |
| | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 37 | 4 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 891 | 1,026 | 929 | \$11 | |

| | | | | | | |
|---|---|----------------|-------|-------|-------|-------------|
| | Prevent grazing of seedings and plantings for 10 years | 0 | 31 | 12 | \$11 | |
| | | | | | | \$1,250,217 |
| Streamlined | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 38 | 15 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 915 | 1,020 | 936 | \$11 | |
| | Prevent grazing of seedings and plantings for 10 years | 0 | 31 | 12 | \$11 | |
| | | | | | | \$1,235,476 |
| Planting+ Herbicide-only | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 41 | 29 | \$650 | |
| | | | | | | \$988,659 |
| Planting+ Herbicide & Livestock-Closure | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 674 | 299 | \$650 | |
| | Prevent grazing of seedings and plantings for 10 years | 0 | 40 | 26 | \$11 | |
| | | | | | | \$925,427 |
| No-Grazing only | Close allotment using third party to purchase AUM's from permittees | 33,628 once | | | \$11 | |
| | | | | | | \$40,183 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 909 | 1,026 | 885 | \$11 | |
| | | | | | | \$521,988 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 3,653 | 3,653 | 3,653 | \$1 | |
| | | | | | | \$182,650 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 74 | 366 | \$450 | |
| | Application of Finger-of-Death fungi at 75% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 37 | 8 | \$650 | |
| | | | | | | \$4,227,812 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 76 | 395 | \$450 | |
| | Application of Finger-of-Death fungi at 50% success rate followed by | 0 | 36 | 8 | \$650 | |

| | | | | | | |
|--------------|---|---|----|-----|-------|-------------|
| | planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | | | | | \$4,396,139 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 75 | 398 | \$450 | |
| | Application of Finger-of-Death fungi at 25% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 36 | 8 | \$650 | |
| | | | | | | \$4,436,544 |

The average annual cost of these treatments among scenarios for the Beaver Dam Wash NCA varied between \$803 and \$88,711 per year of implementation.

50-year Outcomes

- Without the FINGERS-OF-DEATH MANAGEMENT scenarios, ecological departure remained departed at about 100% (Figure 23 top). Scenarios with the fingers-of-death fungi reaching 75% and 50% success rates greatly reduced ecological departure from the 100% to ~20% compared to the MINIMUM MANAGEMENT scenario (Figure 23 top). At a 25% success rate for the fungi, ecological departure reached an average departure of 33% with partial restoration of reference classes.
- The ROI for ecological departure was zero without the FINGERS-OF-DEATH scenario (Figure 23 bottom). ROI increased dramatically. The ROI increased with the success rate of the fingers-of-death fungi. Differences among the difference fungi success rates were moderate.
- Compared to the MINIMUM MANAGEMENT scenario, desert tortoise departure exhibited three levels (Figure 24 top). The lowest (best) average scores of desert tortoise departure (about 2-8%) were achieved by the FINGERS-OF-DEATH scenarios at all success rates. The MAXIMUM, STREAMLINED, and PLANTING AND HERBICIDE-ONLY, PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY, and, to some extent, FUEL-BREAK-ONLY MANAGEMENT scenarios belonged to the second lowest group at about 10% to 18%. The NO-GRAZING-ONLY scenario performed the least well being 10% worse than the MINIMUM MANAGEMENT scenario.
- With the exception of a NO-GRAZING-ONLY scenario, which had a negative ROI for desert tortoise departure, all scenarios achieved comparable and slightly positive ROIs (Figure 24 bottom).

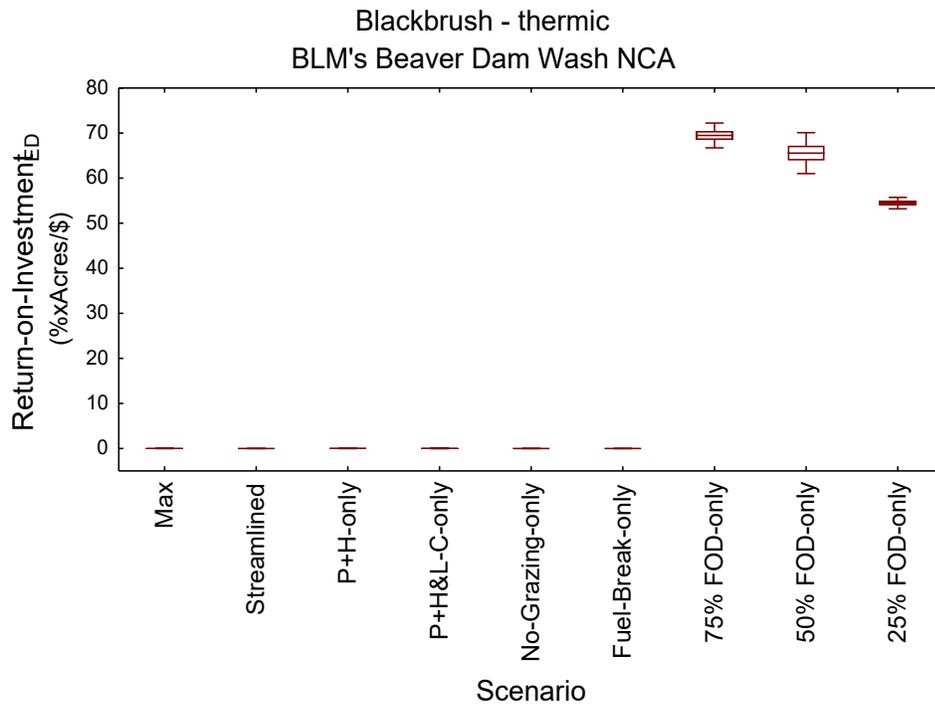
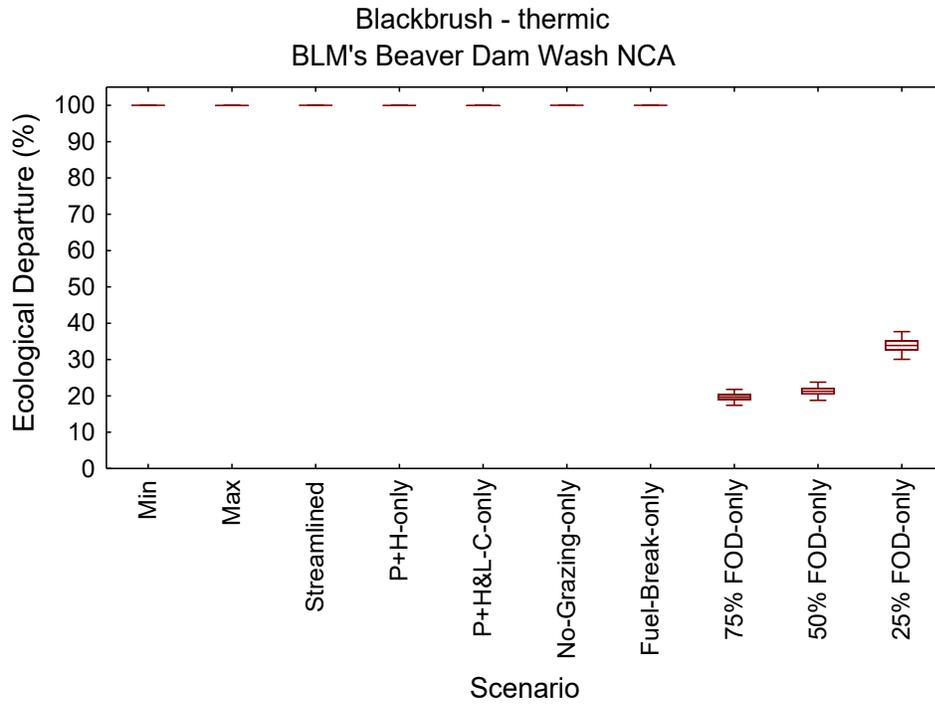


Figure 23. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of blackbrush–thermic after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

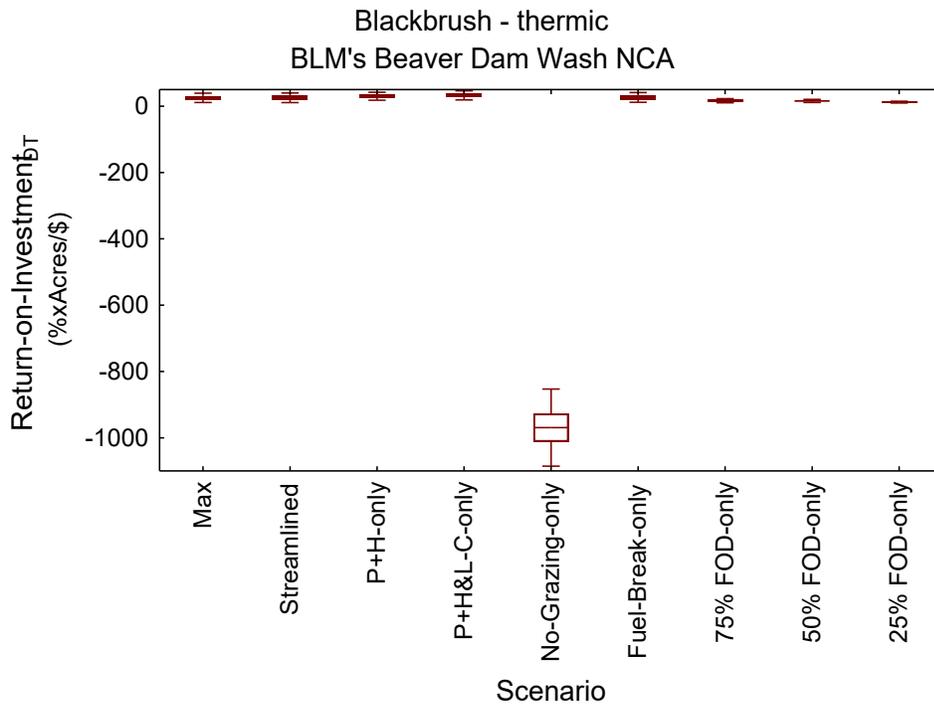
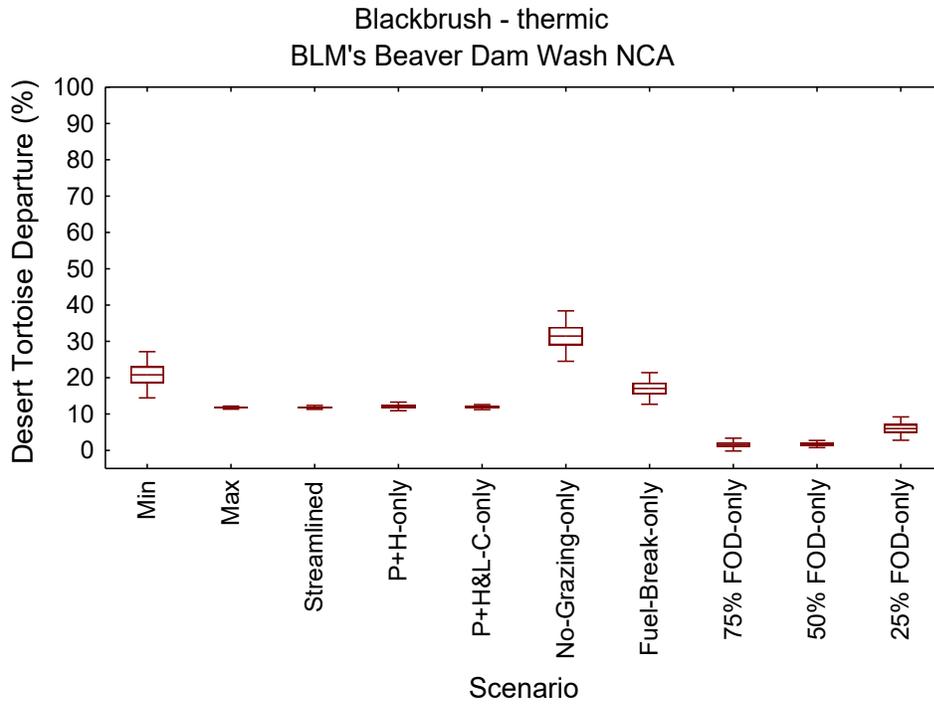


Figure 24. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of blackbrush–thermic after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

Creosotebush-White Bursage

Creosotebush-white bursage is the second largest ecological system of the Beaver Dam Wash NCA and important desert tortoise habitat. At present, this system exhibits complete ecological departure at 100%. Desert tortoise departure is low at 18% because the majority of the ecological system did not burn in 2005; indeed, only 9% of the area is non-native annual grasslands and forblands. Of the remaining 91% in shrubland invaded by non-native annual species, a small fraction represents burned areas where creosotebush vigorously resprouted. Preservation of shrublands in this preferred desert tortoise habitat is therefore critical.

After 50 years in a regime of minimum management, ecological departure did not change because acres were shuffled among uncharacteristic vegetation classes. Desert tortoise departure, however, was predicted to increase (i.e., become worse) from 18% to 38% because of simulated wildfires causing a transition to non-native annual grasslands and forblands, which received low scores of habitat suitability.

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including herbicide application, native species seeding and planting, fuel breaks, special livestock management, and law enforcement.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect creosotebush-white bursage shrublands from future fire.
- Increase native shrub and herbaceous cover in burned areas.
- Maintain desert tortoise departure below the current 18% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® followed by seeding of new native seed mix supplemented by germination innovations in non-native annual grasslands and forblands | 0 | 0 | 8 | \$250 | |
| | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 281 | 60 | \$650 | |
| | Create 200-ft wide fuel breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 5,470 | 6,132 | 5,487 | \$11 | |
| | Prevent grazing of seedlings and plantings for 10 years | 0 | 215 | 173 | \$11 | |

| | | | | | | |
|---|---|-------------|--------|--------|-------|--------------|
| | | | | | | \$10,940,729 |
| Streamlined | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 246 | 246 | \$650 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 5,467 | 6,151 | 5,530 | \$11 | |
| | Prevent grazing of seedings and plantings for 10 years | 0 | 188 | 201 | \$11 | |
| | | | | | | \$10,592,300 |
| Planting+ Herbicide-only | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 314 | 288 | \$650 | |
| | | | | | | \$8,869,562 |
| Planting+ Herbicide & Livestock-Closure | Application of Plateau® followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 293 | 266 | \$650 | |
| | Prevent grazing of seedings and plantings for 10 years | 0 | 234 | 206 | \$11 | |
| | | | | | | \$8,330,064 |
| No-Grazing only | Close allotment using third party to purchase AUM's from permittees | 22,041 once | | | \$11 | |
| | | | | | | \$242,451 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 5,478 | 6,179 | 5,357 | \$11 | |
| | | | | | | \$3,152,777 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 22,041 | 22,041 | 22,041 | \$1 | |
| | | | | | | \$1,102,050 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 995 | 497 | \$450 | |
| | Application of Finger-of-Death fungi at 75% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 98 | 120 | \$650 | |
| | | | | | | \$12,209,198 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 994 | 499 | \$450 | |
| | Application of Finger-of-Death fungi at 50% success rate followed by planting of containerized Mojave shrubs and herbaceous species in | 0 | 98 | 116 | \$650 | |

| | | non-native annual grasslands and forblands | | | | |
|--------------|---|--|-----|-----|-------|--------------|
| | | | | | | \$11,542,343 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 996 | 498 | \$450 | |
| | Application of Finger-of-Death fungi at 25% success rate followed by planting of containerized Mojave shrubs and herbaceous species in non-native annual grasslands and forblands | 0 | 99 | 117 | \$650 | |
| | | | | | | \$12,429,870 |

The average annual cost of these treatments among scenarios for the Red Cliffs NCA varied between \$4,849 and \$248,597 per year of implementation.

50-year Outcomes

- Without the FINGERS-OF-DEATH scenarios, ecological departure remained departed at about 100% (Figure 25 top). All three scenarios with the fingers-of-death fungi reduced ecological departure from 100% to three different ecological departure scores compared to the MINIMUM MANAGEMENT scenario (Figure 23 top). Ecological departure decreased more (improved) with higher success rates of the fungi: for success rates of 75%, 50%, and 25%, respectively, departure was predicted to be 22%, 46%, and 70%.
- The ROI for ecological departure was zero without the FINGERS-OF-DEATH MANAGEMENT scenarios (Figure 25 bottom). ROI dramatically increased with application of the fingers-of-death fungi. The ROI increased with the success rate of the fingers-of-death fungi. Differences among the three success rates were strong in creosotebush-white bursage.
- Compared to the MINIMUM MANAGEMENT scenario, all scenarios decreased (improved) desert tortoise departure (Figure 26 top). However, the stated objective of desert tortoise departure below 18% was only met by the following scenarios for smallest to largest departure <18%: FINGERS-OF-DEATH WITH 75% SUCCESS RATE, MAXIMUM, STREAMLINED, and PLANTING AND HERBICIDE-ONLY and PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY, and FINGERS-OF-DEATH WITH 50% SUCCESS RATE MANAGEMENT. The FUEL-BREAK-ONLY and NO-GRAZING-ONLY MANAGEMENT scenarios failed the objective.
- The PLANTING AND HERBICIDE-ONLY, PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY, and the FINGERS-OF-DEATH WITH 75% SUCCESS RATE MANAGEMENT scenarios showed the highest ROIs for desert tortoise departure and, as shown above, met management objectives (FIGURE 26 BOTTOM). With the exception of the NO-GRAZING-ONLY MANAGEMENT scenario that achieved negative and highly variable ROIs, all other scenarios showed positive ROI.

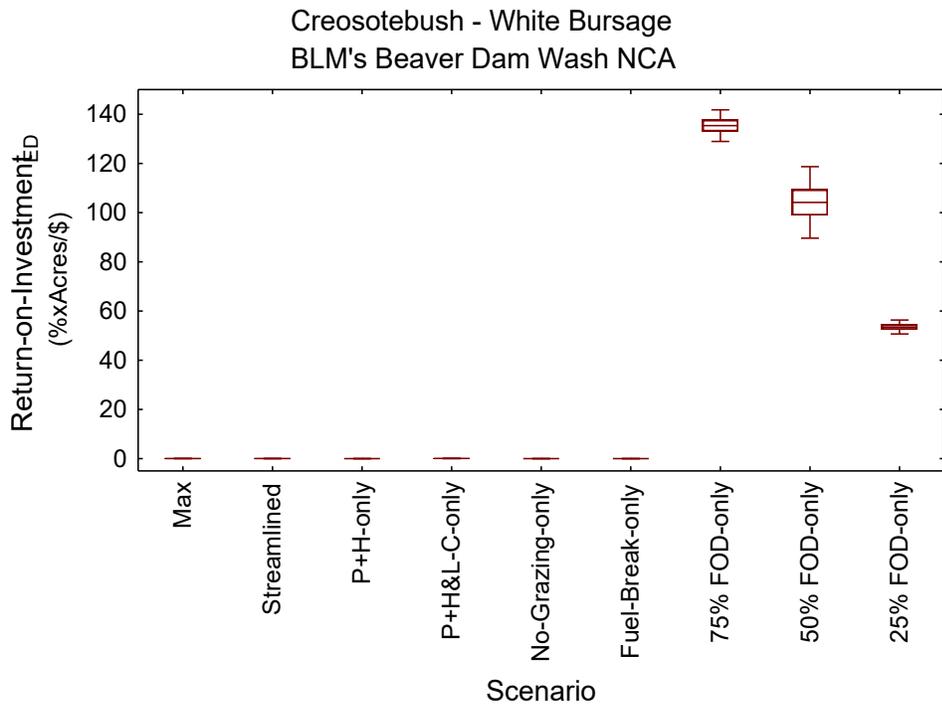
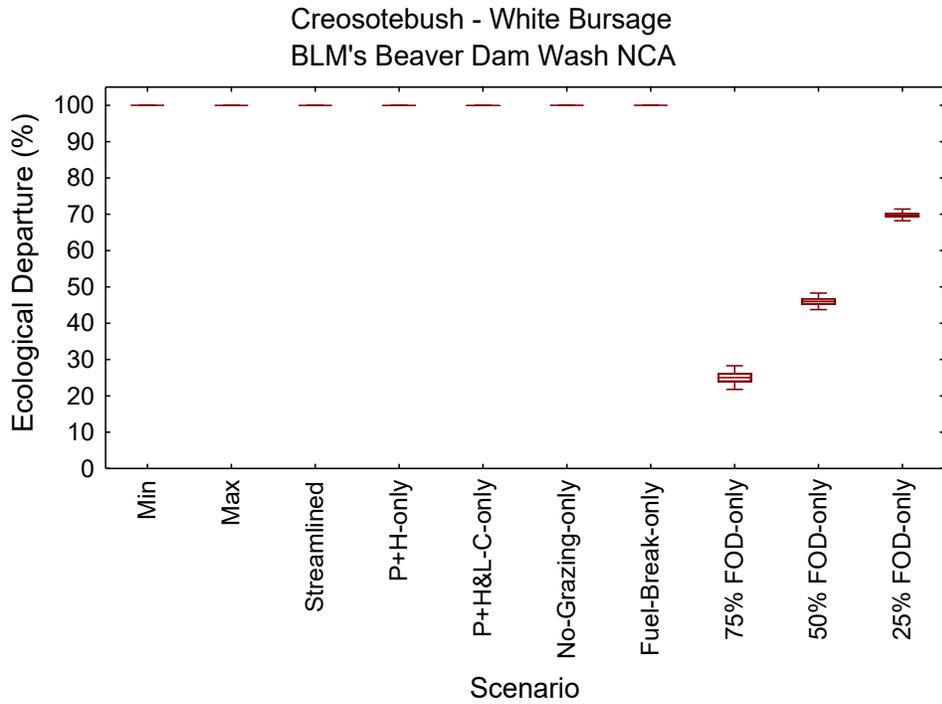


Figure 25. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of creosotebush-white bursage after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

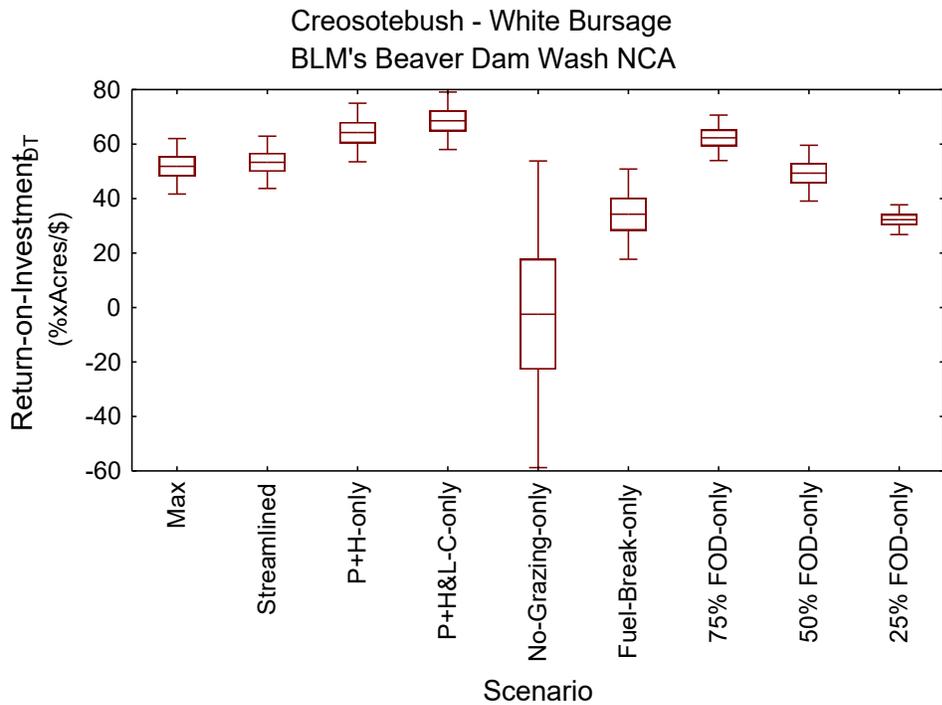
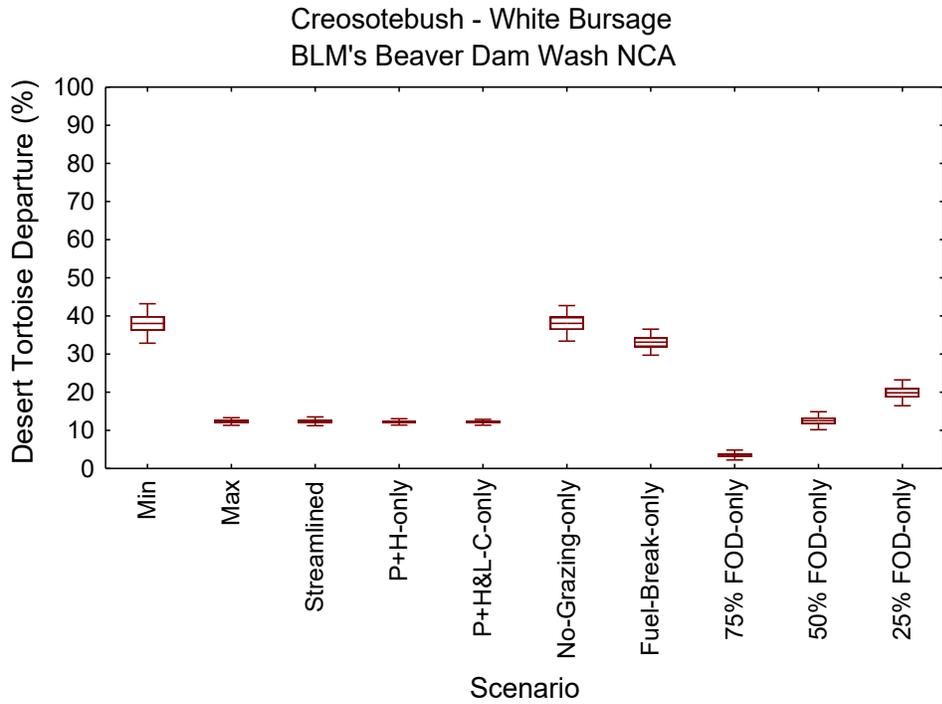


Figure 26. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of creosotebush-white bursage after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

Desert Washes

Desert washes occupied 3,345 acres in the Beaver Dam Wash NCA, thus making washes the third largest ecological system. Desert washes are also the most suitable desert tortoise habitat (Table 5). Desert tortoise feed in the productive washes and take advantage of wash slopes for excavating dens. Desert washes are distributed throughout the NCA. At present, this system exhibits high ecological departure at 90%. Desert tortoise departure is moderate at 40%. The majority (79%) of the ecological system is in the early succession class due to high flood events experienced in December 2010. The remaining 21% is shrublands invaded by non-native annuals.

After 50 years in a regime of minimum management, ecological departure decreased from 90% to 45% as vegetation transitioned from early to middle or late succession, thus approaching the NRV. Desert tortoise departure decreased (i.e., improved) from 40% to 21% as vegetation classes matured, although some acres were invaded by non-native annuals. The resulting vegetation class received higher desert tortoise suitability because more mature wash shrubs provide shade and food to desert tortoise.

BLM and stakeholders focused on a variety of treatment actions (strategies) used alone or in combination including aerial herbicide application, weed inventory, control of exotic saltcedar and forb species, and fuel breaks.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Protect shrublands from future fire.
- Control non-native annuals, trees, and forbs.
- Maintain desert tortoise departure below the predicted 21% score.

50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Inventory of weeds and saltcedar for immediate control or future control | 9 | 13 | 3 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 0.1 | 0.2 | 0.1 | \$200 | |
| | Aerial application of Plateau® of wash shrubs invaded by non-native annuals | 173 | 78 | 5 | \$25 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 422 | 541 | 491 | \$11 | |

| | | | | | | |
|----------------------|--|------------|-------|-------|-------|-------------|
| | Reduce livestock stocking rate in desert washes | 2,536 | 2,652 | 2,802 | \$11 | |
| | | | | | | \$1,875,650 |
| Streamlined | Inventory of weeds and saltcedar for immediate control or future control | 10 | 13 | 13 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 0.16 | 0.30 | 0.22 | \$200 | |
| | Aerial application of Plateau® of wash shrubs invaded by non-native annuals | 95 | 53 | 36 | \$11 | |
| | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 416 | 524 | 506 | \$11 | |
| | Reduce livestock stocking rate in desert washes | 2,627 | 2,693 | 2,769 | \$11 | |
| | | | | | | \$1,875,899 |
| No-Grazing only | Close allotment using third party to purchase AUM's from permittees | 3,345 once | | | \$11 | |
| | | | | | | \$36,795 |
| Fuel Break only | Create 200-ft wide fuels breaks along right-of-ways and boundaries by applying Plateau® at strategic landscape locations | 814 | 926 | 861 | \$11 | |
| | | | | | | \$472,279 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 3,345 | 3,345 | 3,345 | \$1 | |
| | | | | | | \$1,102,050 |
| 75% FOD only | Application of Finger-of-Death fungi at 75% success rate in shrublands invaded by non-native annuals | 0 | 49 | 39 | \$300 | |
| | | | | | | \$582,976 |
| 50% FOD only | Application of Finger-of-Death fungi at 50% success rate in shrublands invaded by non-native annuals | 0 | 50 | 49 | \$300 | |
| | | | | | | \$685,453 |
| 25% FOD only | Application of Finger-of-Death fungi at 25% success rate in shrublands invaded by non-native annuals | 0 | 49 | 49 | \$300 | |
| | | | | | | \$676,249 |

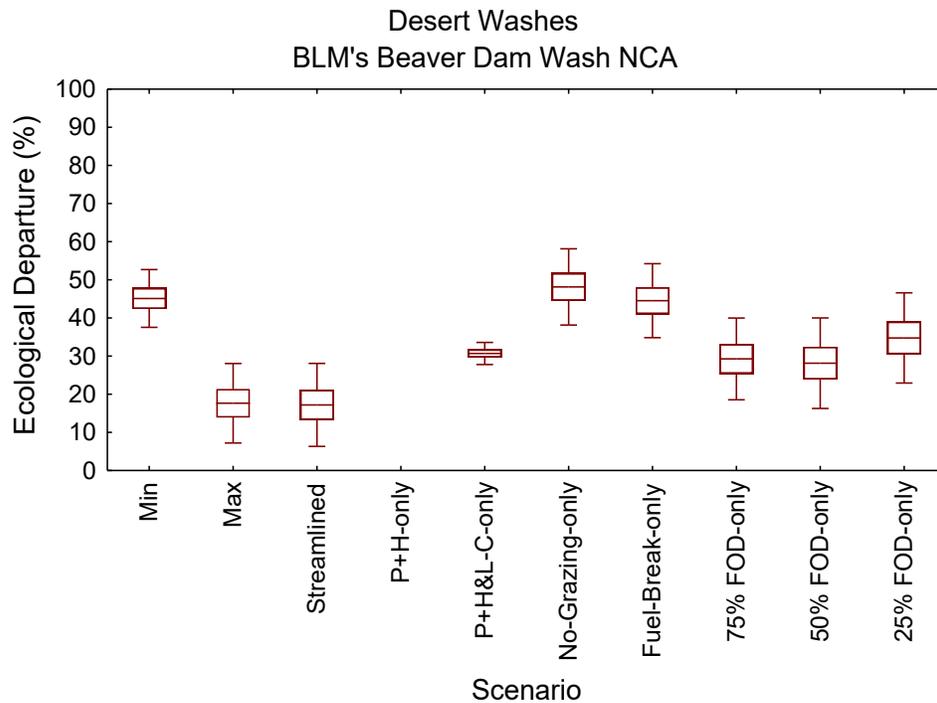
The average annual cost of these treatments among scenarios for the Beaver Dam Wash NCA varied between \$736 and \$37,518 per year of implementation.

50-year Outcomes

- All scenarios, except the NO-GRAZING-ONLY and FUEL-BREAK-ONLY MANAGEMENT scenarios, decreased ecological departure below the 45% achieved by the MINIMUM MANAGEMENT scenario (Figure 27 top).

Top performing scenarios were MAXIMUM and STREAMLINED MANAGEMENT scenarios both reaching about 15% departure (Figure 27 top). Interestingly, livestock closure alone (i.e., PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY MANAGEMENT SCENARIO) had a comparable effect on ecological departure as did any of the FINGERS-OF-DEATH MANAGEMENT scenarios.

- The highest ROIs for ecological departure were realized by the FINGERS-OF-DEATH SCENARIOS WITH 75% AND 50% SUCCESS RATES (Figure 27 bottom). The MAXIMUM, STREAMLINED, PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY, and FINGERS-OF-DEATH WITH 25% SUCCESS RATE MANAGEMENT scenarios showed the second highest ROI. The scenario showed a highly negative and variable ROI.
- All scenarios, except the FUEL-BREAK-ONLY, reduced desert tortoise departure below the 21% realized by the MINIMUM MANAGEMENT scenario (Figure 28 top). The lowest desert tortoise departure (about 0%) was observed in the MAXIMUM, STREAMLINED, and FINGERS-OF-DEATH WITH 75% AND 50% SUCCESS RATES MANAGEMENT scenarios.
- The NO-GRAZING-ONLY MANAGEMENT scenario's ROI based on desert tortoise departure outpaced all other scenarios by at least one order of magnitude (Figure 28 bottom). This scenario also had the lowest cost on implementation, which produce modest reduction to desert tortoise departure (Figure 28 top). The FINGERS-OF-DEATH WITH 75% AND 50% SUCCESS RATES MANAGEMENT scenarios were distant second highest. The FUEL-BREAK-ONLY MANAGEMENT scenario performed the least well (0% ROI).



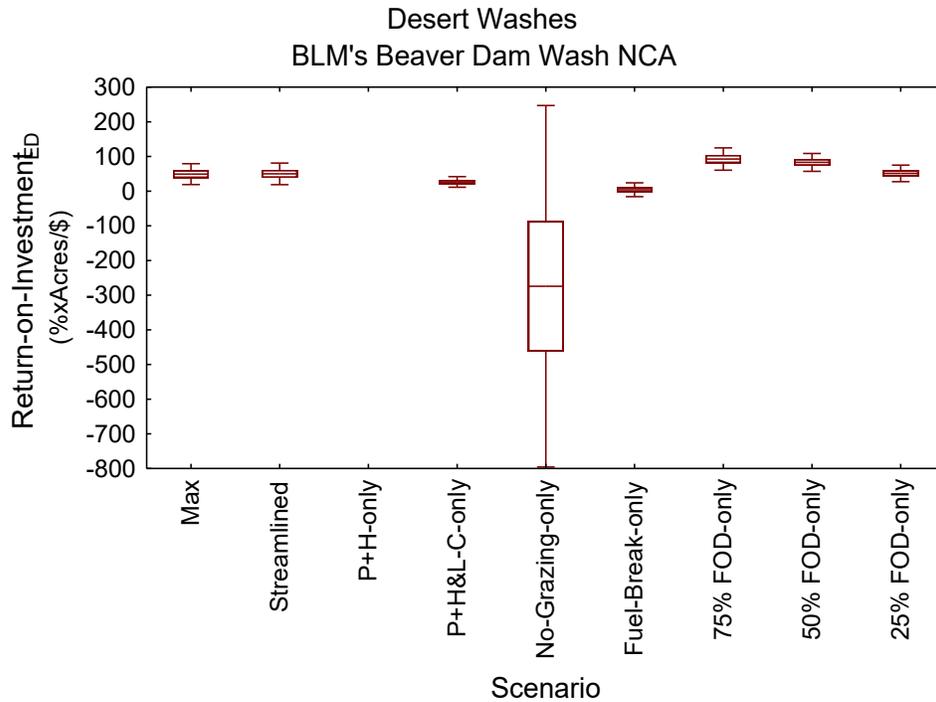
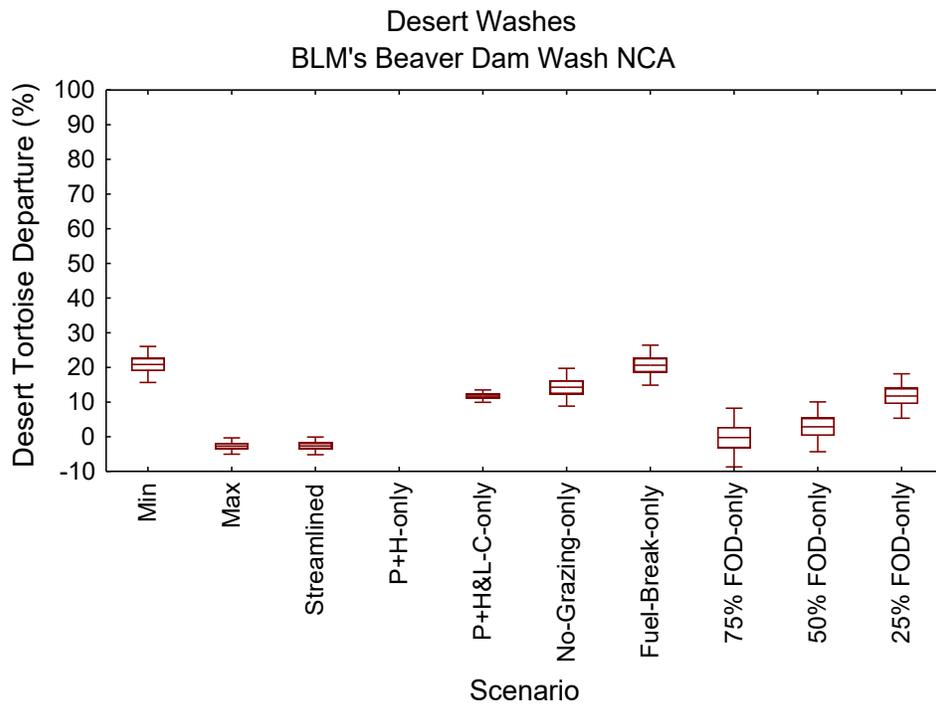


Figure 27. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of desert washes after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.



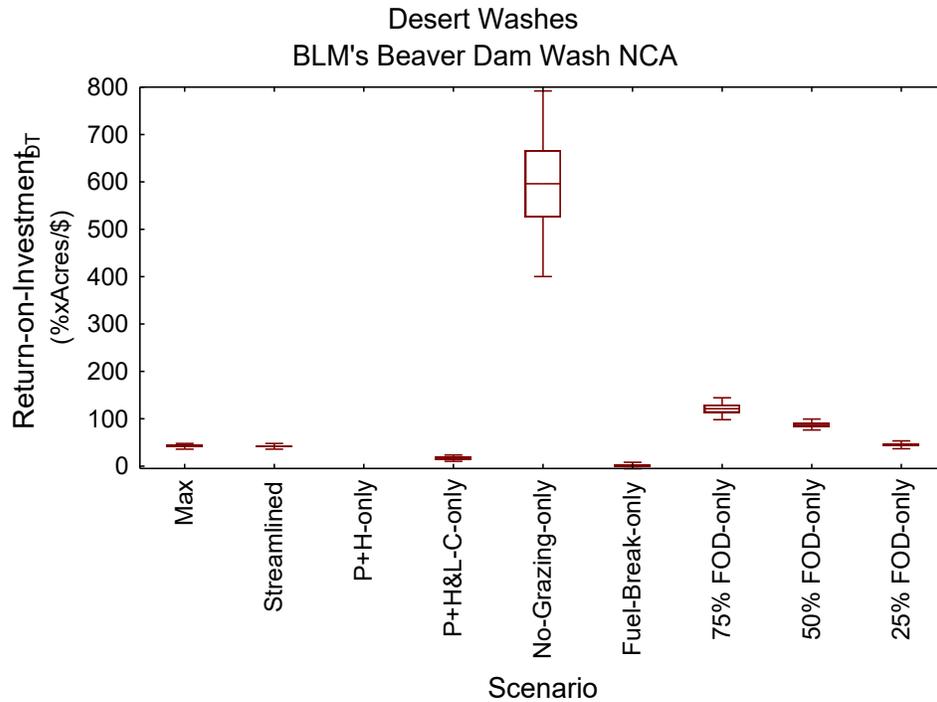


Figure 28. Desert tortoise departure (%) and return-on-investment for desert tortoise departure (subscript $_{DT}$) of desert washes after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

Mountain Shrub

The mountain shrub ecological system is 143 acres and the presence of Stansbury cliffrose (lower elevations) and serviceberry (higher elevation) makes it critical mule deer winter range in the Beaver Dam Wash NCA. Mountain shrub is found within the upper blackbrush-mesic and pinyon-juniper woodland zone. Mountain shrub currently exhibits complete ecological departure at 100% because most areas burned in 2005 and were converted to non-native annual grasslands and forblands, or the few shrublands that escaped fire are invaded by non-native annual species.

After 50 years in a regime of minimum management, ecological departure remained at 100%. Depending on simulated wildfire activity, vegetation classes were either non-native annual grasslands and forblands or shrubs invaded by non-native annual grass. Cliffrose reestablishes from seed within a few years after fire. Variability among replicates for these two classes of vegetation was large and entirely depended on time since the last fire.

Two scenarios applied to the restoration of mountain shrub. One scenario was the landscape level retirement of all grazing permits that was considered for other ecological systems. Because the landscape-level NO-GRAZING-ONLY scenario applies to all grazed ecological

systems, this scenario indirectly affected mountain shrub and required reporting (BLM and stakeholders did not select this scenario for mountain shrub). BLM and stakeholders focused on two management actions in one scenario: Herbicide application to control non-native annual grasses followed by cliffrose seeding in non-native annual grasslands, and herbicide application to control non-native annual grasses followed by native grass seeding in shrublands invaded by non-native annual grass. Cliffrose is commonly used in mine reclamation and mule deer habitat restoration projects, therefore these actions should be well established.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Restore ecological departure to at least moderate levels (<67%).
- Reduce the non-native annual grassland class to less than 10% of the ecological system.
- Reduce the shrublands invaded by non-native annual grass to less than 10%.

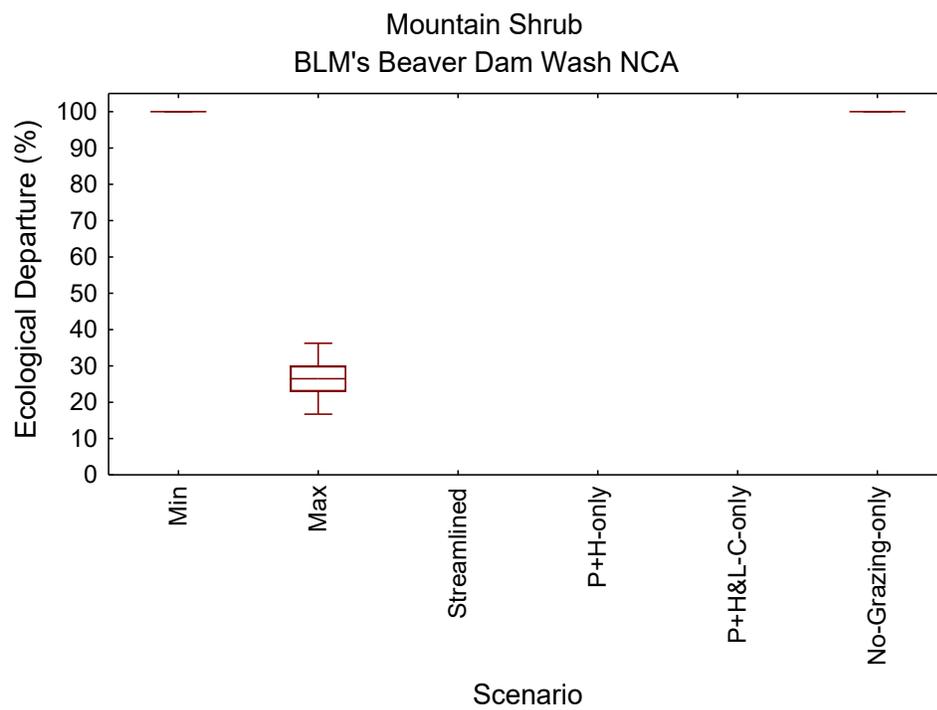
50-YEAR MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|----------------------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Application of Plateau® to control non-native annuals followed by seeding of Stansbury cliffrose in non-native annual grasslands and forblands | 71 | 4 | 0 | \$100 | |
| | Application of Plateau® to control non-native annuals followed by seeding of native grasses in shrublands invaded by non-native annuals | 8 | 5 | 0 | \$250 | |
| | | | | | | \$66,024 |
| No-Grazing only | Close allotment using third party to purchase AUM's from permittees | 143 once | | | \$11 | |
| | | | | | | \$1,573 |
| Law Enforcement only | Part-time patrolling by one law enforcement officer to prevent illegal use of OHVs | 143 | 143 | 143 | \$1 | |
| | | | | | | \$7,150 |

The average annual cost of the scenario for the Beaver Dam Wash NCA varied among scenario between \$32 and \$1,320 per year of implementation.

50-year Outcomes

- The MAXIMUM MANAGEMENT scenario reduced ecological departure from 100% to about 26% (Figure 29 top), therefore achieving low ecological departure. The NO-GRAZING-ONLY scenario had no effect compared to MINIMUM MANAGEMENT. There was large variability in the percentage of reference classes among replicates with ecological departure varying between 18% and 38%. The non-native annual grasslands and shrublands invaded by non-native annual grass were eliminated.
- The ROI based on ecological departure for the MAXIMUM MANAGEMENT scenario was positive and high compared to zero ROI for the NO-GRAZING-ONLY MANAGEMENT scenario (Figure 29 bottom).



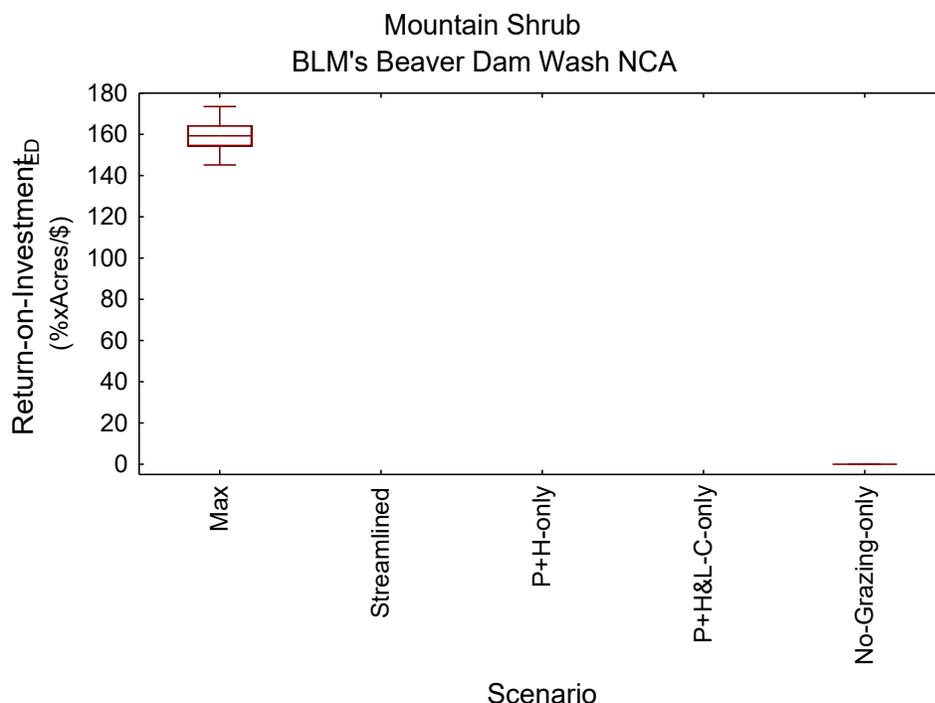


Figure 29. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of mountain shrub after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

Warm Desert Riparian

The warm desert riparian ecological system is small (114 acres) and consists of perennial reaches of Beaver Dam Wash and desert washes. Plant and animal species diversity are typically very high. Typical dominant woody species are Fremont cottonwood, Goodding’s willow, mesquite, velvet ash, other willows (several species), other riparian trees and shrubs. At present, this system exhibits complete ecological departure at 100%. Saltcedar is found in 4% of the system, whereas the remaining 96% of the warm desert riparian woodlands and shrublands has an understory of non-native annual species.

After 50 years in a regime of minimum management, ecological departure decreased to 89% from 100% due to several factors. The saltcedar biocontrol beetle allowed recruitment into a) reference classes and b) the exotic forb class (for example, Russian knapweed), a common pathway after control of saltcedar. Also, the wooded floodplain was invaded by exotic trees and forbs. The biocontrol beetle also attacked these exotic trees. Severe flooding also caused transition of mature riparian vegetation to the early succession class. These levels of departure and exotic forb invasion were judged unacceptable.

Two scenarios applied to the restoration of warm desert riparian. One scenario was the landscape level retirement of all grazing permits that was considered for other ecological systems. Because the landscape-level NO-GRAZING-ONLY scenario applies to all grazed ecological systems, this scenario indirectly affected warm desert riparian and required reporting (BLM and stakeholders did not select this scenario for warm desert riparian). For the other scenario (MAXIMUM MANAGEMENT), BLM and stakeholders focused on several management actions: Weed inventory, chainsaw cutting of saltcedar followed by immediate herbicide application to stumps, herbicide application to exotic forb species, hand spraying of herbicide to control non-native annuals in the understory of trees and shrubs, and law enforcement.

50-YEAR PREFERRED MANAGEMENT Scenario Objectives

- Restore the warm desert riparian ecological departure to <67% (moderate departure) ecological departure.
- Contain exotic trees and forbs to <11% cover.

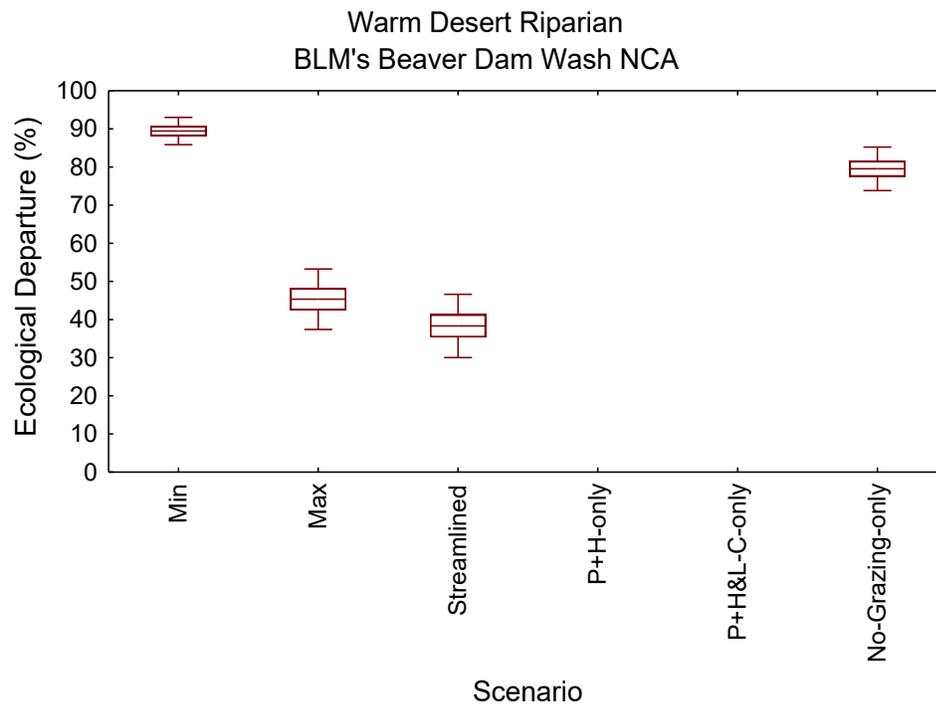
50-YEAR PREFERRED MANAGEMENT Strategies and Costs

| Scenario | Action Description | Acres/ year | | | Cost/ acre | 50-yr total cost |
|-----------------|--|----------------|----------------|-----------------|---------------|---------------------|
| | | 1 to 4 yrs | 5 to 19 yrs | 20 to 50 yrs | | |
| Max | Inventory of weeds and saltcedar for immediate control or future control | 31 | 30 | 7 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 1.2 | 0.4 | 0.1 | \$200 | |
| | Application of herbicide to control exotic forbs | 0.2 | 0.7 | 0.1 | \$50 | |
| | Hand application of Plateau® to riparian woodland's understory invade by non-native annuals | 10 | 10 | 0 | \$50 | |
| | | | | | | \$100,771 |
| Max | Inventory of weeds and saltcedar for immediate control or future control | 31 | 30 | 30 | \$55 | |
| | Hand-cutting of saltcedar followed by immediate application of herbicide to stumps and herbicide application to exotic forbs | 1 | 0.4 | 0.3 | \$200 | |
| | Application of herbicide to control exotic forbs | 0.2 | 0.7 | 0.3 | \$50 | |
| | Hand application of Plateau® to riparian woodland's understory invade by non-native annuals | 10 | 10 | 2 | \$50 | |
| | | | | | | \$100,770 |
| No-Grazing only | Close allotment using third party to purchase AUM's from permittees | 114 once | | | \$11 | |
| | | | | | | \$34,254 |
| Law Enforcement | Part-time patrolling by one law enforcement officer to prevent | 114 | 114 | 114 | \$1 | |

The average annual cost among scenarios for the Beaver Dam Wash NCA varied between \$685 and \$2,015 per year of implementation.

50-year Outcomes

- Differences in ecological departure between the MAXIMUM and STREAMLINED MANAGEMENT scenarios were small and ranged between 38% and 45% (Figure 30 top), thus meeting management objective for ecological departure. The NO-GRAZING-ONLY scenario achieved 80% ecological departure, therefore did not meet management objective. Exotic trees and forbs were <4% for the MAXIMUM MANAGEMENT scenarios and <1% for the STREAMLINED MANAGEMENT SCENARIO. Again, this met the management objectives.
- There was no statistical difference for ROI between the MAXIMUM and STREAMLINED MANAGEMENT scenarios, although the STREAMLINED MANAGEMENT scenario reached the highest ROI (Figure 30 bottom).



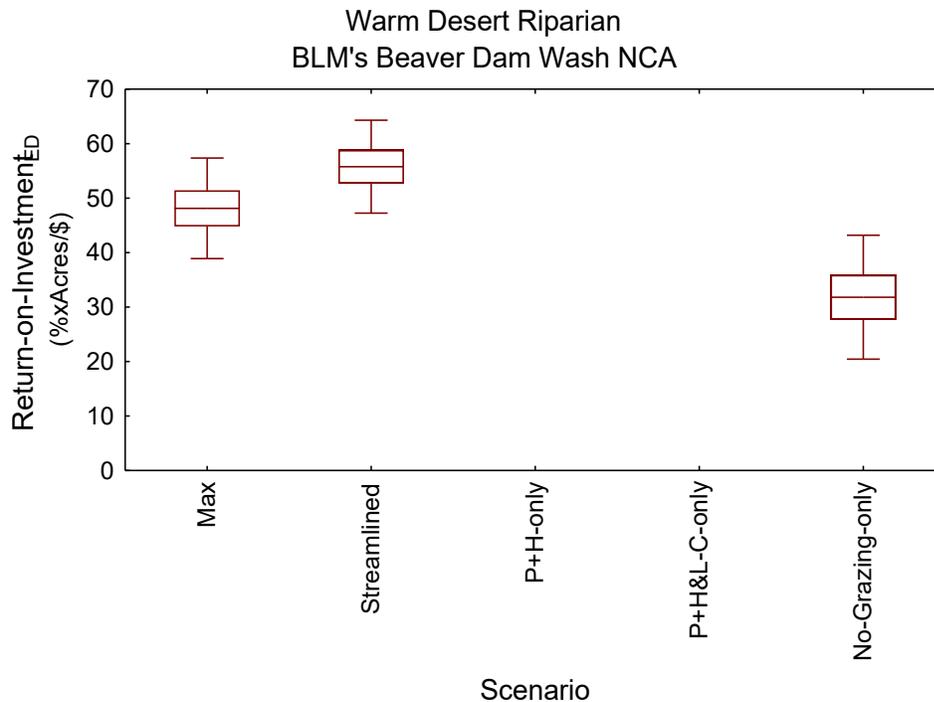


Figure 30. Ecological departure (%) and return-on-investment for ecological departure (subscript ED) of warm desert riparian after 50 years simulating different management scenarios for the Beaver Dam Wash NCA. The MINIMUM MANAGEMENT scenario is not shown in the ROI graph because this scenario is used in the ROI calculation. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: P+H = planting and herbicide; L-C = livestock closure; FOD = Fingers-of-Death.

Prioritizing Actions among Biophysical Settings: Return-on-Investment

Although ROIs were compared among scenarios within an ecological system, ROI is also used to prioritize implementation of scenarios among ecological systems. ROI was measured based on desert tortoise departure and ecological departure for each of two landscapes; therefore, there are four sets of ROI results. Another added level of complexity is that some ROI values are based on future achievements of experimental restoration techniques.

Six ecological systems were used by desert tortoise in the Red Cliffs NCA. The highest ROI was reached in the desert wash system; however its ROI was comparable to that of blackbrush-mesic because of overlapping confidence intervals (Figure 31). Restoration of desert washes includes established actions, whereas the more experimental method of planting containerized shrubs and forbs followed by herbicide application is used in mesic blackbrush. Importantly, fuel-breaks are deployed for both systems. Blackbrush-thermic showed the clear next highest ROI followed by creosotebush-white bursage. The only action deployed in thermic blackbrush is fuel breaks, which underscores the importance of this single action in the Red Cliffs NCA.

Two comparable experimental methods (only one required) allowed creosotebush-white bursage to reach the third place in the ROI scale: planting containerized shrubs and forbs followed by herbicide application OR application of the fingers-of-death fungi assuming 75% success rate. If future research finds the fungi to be at best 50% successful, then the best method is planting containerized shrubs and forbs. In both case, the fate of creosotebush-white bursage depend on future, experimental successes. Although not shown here, only using fuel break is an acceptable compromise with a lower ROI. In decreasing order, warm-season grassland and desert sand sagebrush had the lowest, but positive ROIs. None of these ecological systems required experimental methods, although grasslands would greatly benefit from application of the fingers-of-death fungi.

Eleven ecological systems were considered for management based on ecological departure in the Red Cliffs NCA. It is noteworthy that thermic and mesic blackbrush, and creosotebush-white bursage would not be on Figure 32 without the application of the fingers-of-death fungi with at least a 50% success rate. Results were surprising with pinyon-juniper woodland and warm season grassland eclipsing other ecological systems with their high and statistically equal ROIs (Figure 32). These systems required only small, non-experimental investments in herbicide application and seeding to improve them. Although variable, the mountain shrub's ROI was the second largest because this system responds well to established restoration actions for relative low investments. Mountain shrub was also a tiny system in the Red Cliffs NCA. Other ecological systems are more grouped.

Desert washes, montane riparian, desert sand sagebrush, and creosotebush-white bursage were in the third tier of higher ROIs. Only creosotebush-white bursage required the experimental application of fingers-of-death fungi. The bottom group included big sagebrush steppe-upland, mesic and thermic blackbrush, and warm desert riparian.

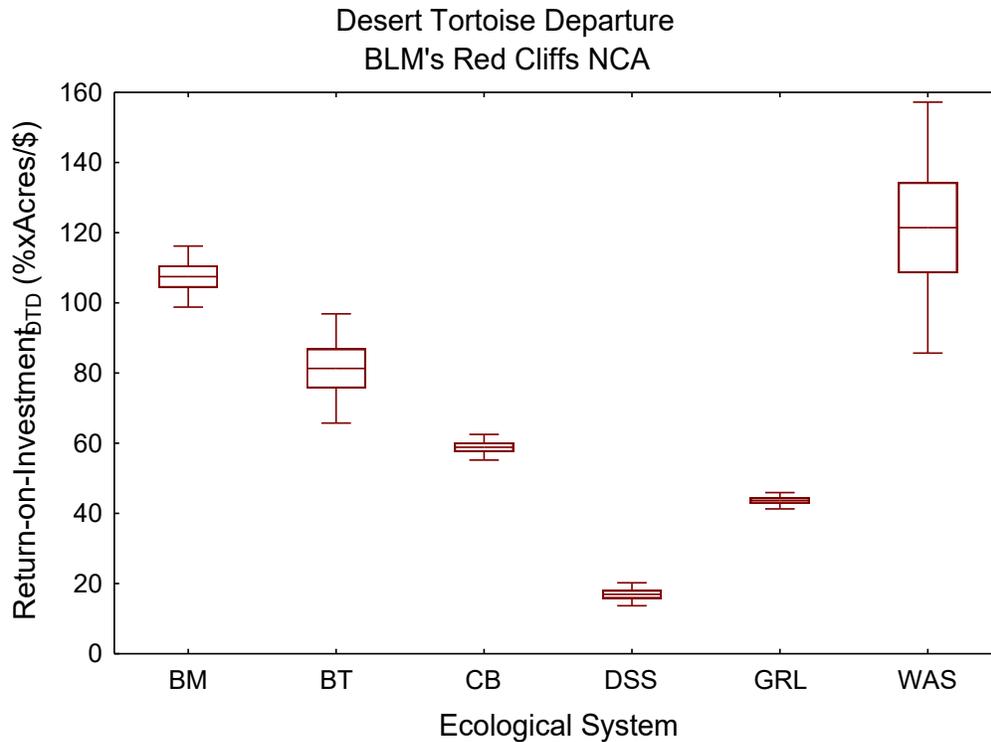


Figure 31. Average ecological system-wide return on investment (ROI) based on desert tortoise departure (subscript $_{DTD}$) for the six ecological systems of BLM’s Red Cliffs NCA used by desert tortoise and selected for active management analyses. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: BM = Blackbrush-mesic, BT= Blackbrush-thermic, CB = Creosotebush-White Bursage, DSS = Desert Sand Sagebrush, GRL = Warm Season Grassland, WAS = Desert Washes.

The Beaver Dam Wash NCA’s ecological systems used by desert tortoise were mesic and thermic blackbrush, creosotebush-white bursage, and desert washes (Figure 33). The ROI for desert washes reached the highest value, nearly twice of others. The management causing this result was only cessation of livestock grazing in desert washes because this management action is very inexpensive compared to other scenarios tested, although it did not achieve as large reduction in ecological departure as other actions. Cessation of livestock grazing is a trade-off between slowing down woody succession and a small amount of excessive herbivory *versus* increasing the likelihood of fire activity (livestock eat fine fuels, thus slow fire activity to a small degree). The ROIs for mesic blackbrush and creosotebush-white bursage were second highest and statistically equal because of overlapping confidence intervals. These systems are the largest in the NCA. The mesic blackbrush only required a fuel break; however statistically equal results were achieved with much lower desert tortoise departure with three other scenarios: a) herbicide application followed by planting containerized shrub and forbs and excluding from livestock planted areas for 10 years, b) herbicide application followed by planting containerized shrub and forbs, and c) STREAMLINED MANAGEMENT. Three scenarios, all experimental, performed equally well for creosotebush-white bursage: a) herbicide application followed by planting

containerized shrub and forbs and excluding planted areas from livestock for 10 years, b) herbicide application followed by planting containerized shrub and forbs, and c) FINGERS-OF-DEATH with a 75% success rates. The latter scenario also achieved the lowest desert tortoise departure. Blackbrush-thermic was clearly the lowest ROI. Several different scenarios achieved this ROI for thermic blackbrush with minor differences among them: a) herbicide application followed by planting containerized shrub and forbs and excluding planted areas from livestock for 10 years, b) herbicide application followed by planting containerized shrub and forbs, c) STREAMLINED MANAGEMENT), d) MAXIMUM MANAGEMENT, e) FUEL-BREAK-ONLY, f) any of the FINGERS-OF-DEATH-ONLY success rates. Overall, fuel breaks either alone or in combinations are beneficial to desert tortoise.

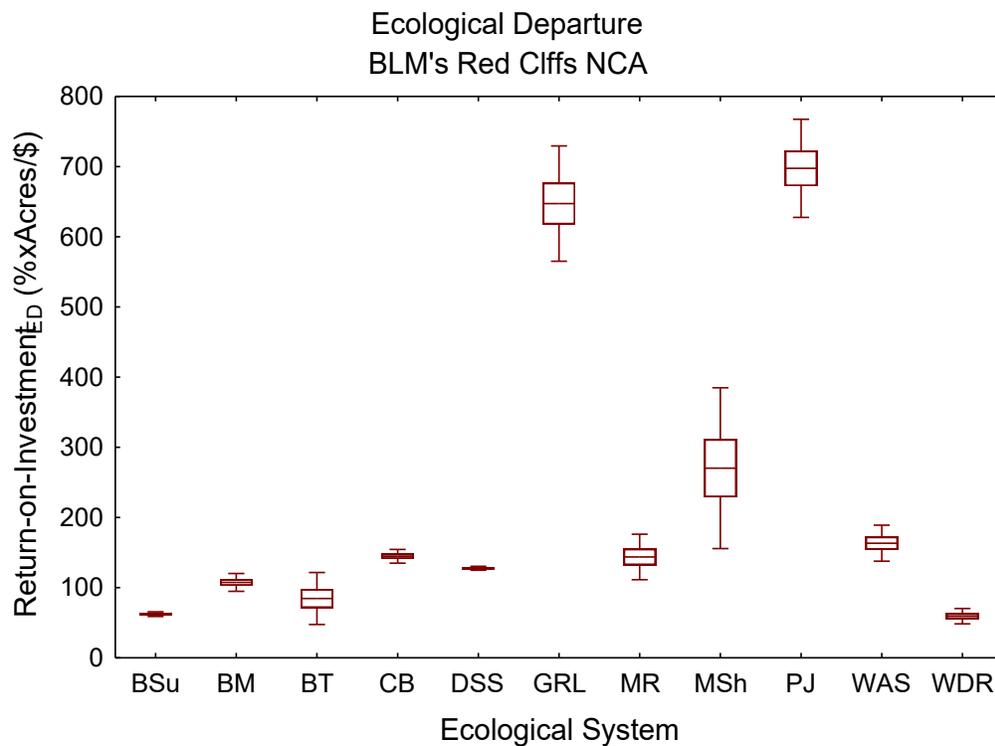


Figure 32. Average ecological system-wide return on investment (ROI) based on ecological departure (subscript ED) for the 11 ecological systems of BLM’s Red Cliffs NCA selected for active management analyses. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: BSu = Big Sagebrush Steppe-upland, BM = Blackbrush-mesic, BT= Blackbrush-thermic, CB = Creosotebush-White Bursage, DSS = Desert Sand Sagebrush, GRL = Warm Season Grassland, MR = Montane Riparian, MSh = Mountain Shrub, PJ = Pinyon-Juniper Woodland, WAS = Desert Washes, WDR = Warm-Desert Riparian.

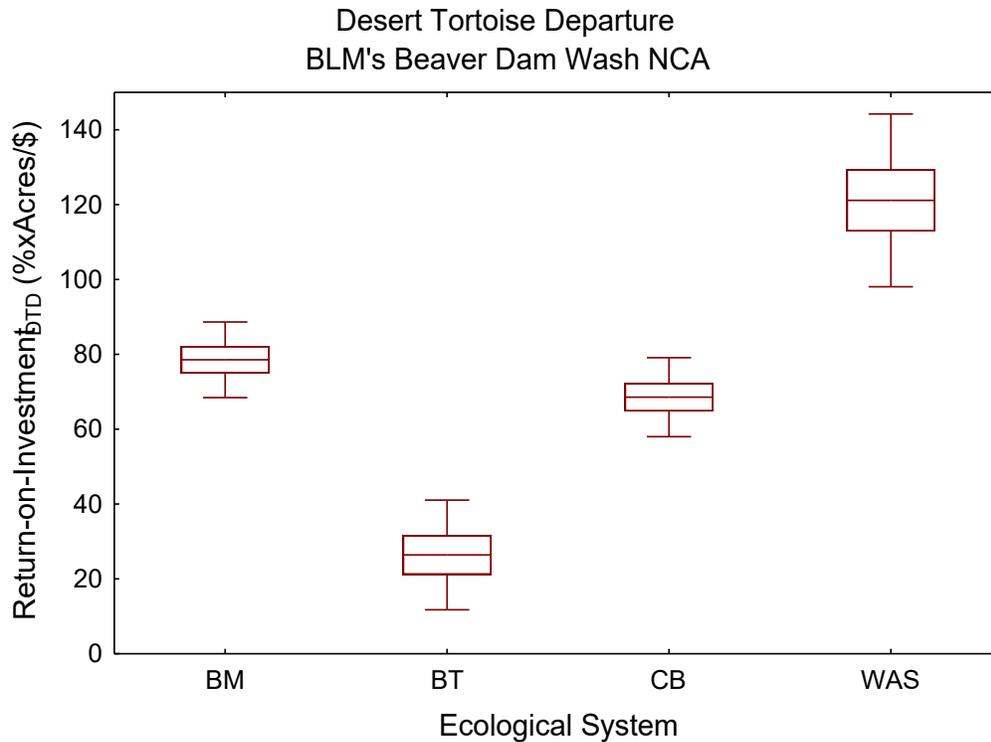


Figure 33. Average ecological system-wide return on investment (ROI) based on desert tortoise departure (subscript $_{DT}$) for the four ecological systems of BLM's Red Cliffs NCA used by desert tortoise and selected for active management analyses. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: BM = Blackbrush-mesic, BT= Blackbrush-thermic, CB = Creosotebush-White Bursage, WAS = Desert Washes.

Ecological departure applied to six ecological systems in the Beaver Dam Wash NCA. Mesic and thermic blackbrush, creosotebush-white bursage, and desert washes all required application of commercially available fingers-of-death fungi, whereas mountain shrub and warm desert riparian did not. The highest ROI based on ecological departure is found for mountain shrub, as it was for the Red Cliffs NCA (Figure 34). Success rates of actions are high and cost is relatively low for mountain shrub. Creosotebush-white bursage and mesic blackbrush occupy the second group of higher ROIs and both depended on the success rate of the fingers-of-death fungi. These are the largest ecological systems in the NCA and have significant burned areas in need of restoration. Blackbrush-mesic, desert washes, and warm desert riparian had comparable ROIs and overlapping confidence intervals. Restoration of warm desert riparian did not utilize the fingers-of-death fungi.

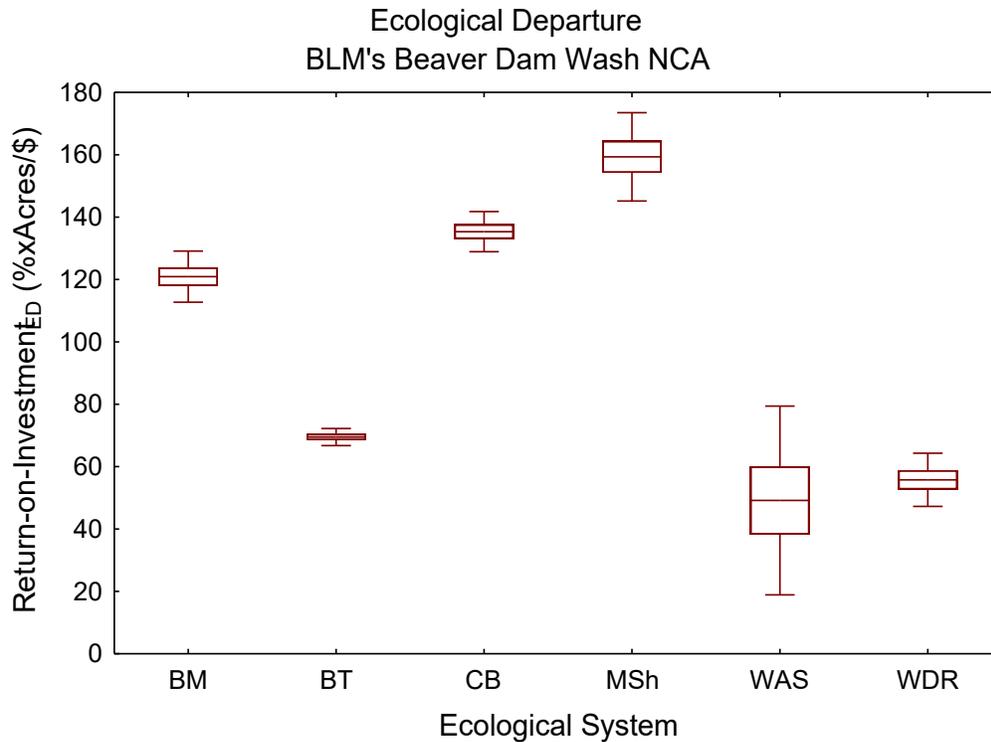


Figure 34. Average ecological system-wide return on investment (ROI) based on ecological departure (subscript $_{ED}$) for the six ecological systems of BLM's Beaver Dam Wash NCA selected for active management analyses. Center of box is the mean, edges of box are ± 1 SE, and bars are 95% confidence interval limits. N = 5 replicates. Legend: BM = Blackbrush-mesic, BT= Blackbrush-thermic, CB = Creosotebush-White Bursage, MSh = Mountain Shrub, WAS = Desert Washes, WDR = Warm-Desert Riparian.

In summary, these various ROI values are useful tools for land managers to decide where to allocate scarce management resources among many possible choices on lands that they administer. As a rule of thumb, the higher ROI indicates a higher priority for implementation; therefore, managers should pay special attention to desert washes, warm-season grassland, mountain shrub, and mesic blackbrush (Figures 31-34). Of course, managers may also select final strategies or treatment areas based upon a variety of additional factors, such as listed species recovery plans, availability of financial resources, policy constraints, and other uses or societal objectives.

The ROI comparison also revealed two important facts:

- Fuel breaks alone can cost-effectively slow the loss of remaining shrublands needed by desert tortoise and prevent a devastating second fire in already burned areas.
- Restoration of the two NCAs is highly dependent on the commercial development of two experimental technologies: planting containerized Mojave shrubs and forbs and the fingers-of-death fungi.

Areas of Implementation

The state-and-transition modeling and analysis of simulation outcomes were not spatial. BLM staff and stakeholders created two groups of actions with spatial consequences: landscape level and specific to vegetation classes.

Fuel breaks, special livestock management, and law enforcement are landscape level and broadly distributed. The area of implementation for special livestock management and law enforcement is potentially the whole Beaver Dam Wash NCA. Mapping fuel breaks is a more strategic exercise that requires a narrowing of a whole NCA down to selective strips of lands that are most likely to stop fires. Spatial fire behavior software is required to map fuel breaks and TNC has not conducted such analysis. BLM, however, has initiated such an analysis.

The vast majority of all other management actions target two widespread classes of vegetation: non-native annual grassland and forblands, and shrublands invaded by non-native annuals. In other words, these are burned and unburned areas, which are well defined (BLM has already obtained TNC's geodata), fairly homogenous, and widespread. All restoration actions that require seeding or planting are conducted in burned areas, whereas all actions that propose to control non-native annuals in the understory of shrublands with the fingers-of-death fungi are the shrublands that did not burn. Whether or not BLM decides to restore higher elevation shrublands and woodlands, including the upper mesic blackbrush, not used by desert tortoise is a management decision that would be applied as a mapping constraint. TNC cannot make that mapping decision for BLM and stakeholders.

Other ecological systems that do not fall into the burned *versus* unburned classes are montane riparian and warm desert riparian. The area of montane riparian is only 40 acres and nearly the whole area needs to be visited and spot treated. Again, a special map would not be more informative than the existing ecological system and vegetation class maps. The problems in warm desert riparian are more localized and difficult to find, but again the existing combined ecological by vegetation class map is sufficient.

Conclusions

The primary findings of Landscape Conservation Forecasting™ for Washington County's NCAs are summarized below:

- 1. At the current time, all ecological systems are highly departed from their natural range of variability.** Only a very small occurrence of littleleaf mountain mahogany in the Beaver Dam Wash NCA was not highly departed. Accordingly, both NCAs fall within Ecological Departure Class (a.k.a., Fire Regime Condition Class) 3.

2. **The primary cause of ecological departure across the landscape is due to the nearly complete presence of non-native grasses and forbs in burned and unburned areas.** Desert washes, however, are also departed because vegetation is concentrated in one class (*early-succession*) after the heavy December 2010 floods.
3. **Large areas of each NCA burned in 2005, and thereby converted from shrub to annual non-native grassland and formland.**
4. **Desert tortoise departure, a new metric developed by TNC and stakeholders, is slightly to moderately departed for both NCAs' ecological systems: three out of five ecological systems of the Red Cliffs show low departure, whereas one of four ecological systems is at a low level of departure for Beaver Dam Wash.** Despite complete invasion by non-native annuals, sufficient vegetation structure from shrubs is available to desert tortoise to provide shade and food.
5. **Without active management, non-native grassland and formland vegetation classes are projected to increase at the expense of shrublands that have been invaded by non-native grasses and forbs.**
6. **Without active management, exotic trees and forbs are predicted to increase in desert washes and riparian systems (montane and warm desert types).**
7. **A subset of ecological systems was selected for specific analyses of active management in the two NCAs.** Key ecological management issues by system include:
 - a. ***Thermic and mesic blackbrush, and creosotebush-white bursage*** – burned areas are dominated by, and non-burned shrublands are invaded by, non-native annual species; burned areas are projected to increase with time.
 - b. ***Mountain shrub and big sagebrush steppe*** – large proportions of burned areas are dominated by non-native annual grasses and forbs.
 - c. ***Warm season grassland and desert sand sagebrush*** – contain high percentages of late-succession classes with significant cover of non-native annual grasses and forbs.
 - d. ***Riparian and desert washes*** – invasion by saltcedar and non-native annual grasses and forbs, and invasion by exotic forbs and trees.
8. **A variety of actions, some experimental, were modeled for each ecological system selected for management. Multiple actions are required for most systems;**
 - a. ***Thermic and mesic blackbrush, and creosotebush-white bursage*** management strategies include: a) herbicide application followed by planting containerized shrub and forbs, b) herbicide application followed by seeding of new and successful native plant species cultivars; c) exclusion of planted areas from livestock for 10 years, and d) deployment of landscape-level fuel breaks, e) application of the fingers-of-death fungi with higher success rates of infection as a standalone “herbicide” and as a replacement of herbicide used in treatments.

- b. ***Mountain shrub and big sagebrush steppe*** management strategies include: herbicide application followed by seeding of native herbaceous and shrub species.
 - c. ***Warm season grassland and desert sand sagebrush*** management strategies include: a) herbicide application to control non-native annuals, b) herbicide application followed by seeding native herbaceous species; and c) deployment of landscape-level fuel breaks.
 - d. ***Riparian and desert washes*** management strategies include: a) weed inventory, b) cutting of saltcedar followed by stump painting with herbicide, c) spraying exotic forbs with herbicide, and d) controlling non-native annuals in riparian understory with herbicide.
- 9. A comparison of scenarios using actions in combination or a single actions were simulated for ecological systems used by desert tortoise;**
- a. Landscape-level fuel breaks alone can cost-effectively slow the loss of remaining shrublands needed by desert tortoise and prevent a devastating second fire in already burned areas. By preventing wildfires from returning, many Mojave Desert shrubs other than blackbrush can resprout or reestablished in non-native annual grasslands and forblands. Suggested implementation rates for fuel breaks are high. Strategic spatial analysis of fire risk from testing different positioning of fuel breaks is recommended.
 - b. Restoration of the two NCA's desert tortoise habitat is highly dependent on the commercial development of four experimental technologies: a) planting containerized Mojave shrubs and forbs b) the fingers-of-death fungi (mode of application and potency), c) highly performing cultivars of Mojave Desert species, and d) methods of seed delivery that reduce granivory. The first two had the greatest simulated contributions to restoration of desert tortoise habitat.
 - c. In the Beaver Dam Wash NCA, cessation of livestock grazing (i.e., retiring grazing permits) benefitted desert washes, but had negative return-on-investments for creosotebush-white bursage and thermic and mesic blackbrush because of the tradeoff between livestock grazing slowing down fire activity (desirable) and accelerating woody succession (undesirable). Simulated livestock closure, which is different than cessation of grazing in models, was only used to reduce the stocking rate in desert washed and protecting plantings and seeding in creosotebush-white bursage, and thermic and mesic blackbrush. The effect of this scenario was always small (i.e., not statistically significant) and beneficial on desert tortoise departure when used in combination with planting and seeding.
- 10. Distribution of ROIs alone indicates a higher priority for implementation in desert washes, warm-season grassland, mountain shrub, and mesic blackbrush.** It is understood, however, that planning for the recovery of desert tortoise may dictate

resources to also be delivered to creosotebush-white bursage and thermic blackbrush, especially because fuel breaks are most likely to be implemented in these systems.

11. BLM staff and stakeholders created actions that can be spatially mapped:

- a. The area of implementation for special livestock management and law enforcement is potentially the whole Beaver Dam Wash NCA.
- b. Mapping fuel breaks is a more strategic exercise that requires a narrowing of a whole NCA down to selective strips of lands that are most likely to stop fires.
- c. All restoration actions that require seeding or planting are conducted in burned areas, which are well defined, whereas all actions that propose to control non-native annuals in the understory of shrublands with the fingers-of-death fungi are the shrublands that did not burn.
- d. Other ecological systems that do not fall into the burned *versus* unburned classes are montane riparian and warm desert riparian. The area of montane riparian is only 40 acres and nearly the whole area needs to be visited and treated. The problems in warm desert riparian are more localized and mapped.

Acknowledgments

This project was funded jointly by the Bureau of Land Management and The Nature Conservancy. We are thankful to the David and Lucile Packard Foundation for generous support to The Nature Conservancy for this important public/private partnership that brought together some amazing minds to address conservation on public lands.

The authors gratefully acknowledge the contributions of many to the success of this project, especially by the following individuals:

Bureau of Land Management (St. George Field Office)

- Jimmy Tyree
- Dawna Ferris-Rowley
- Kim Leany
- Dave Kiel
- Bob Douglas
- Marisa Monger
- Tim Croissant
- Dave Corry

Washington County, Utah

- Alan Gardner
- Bob Sandberg
- Cameron Rognan

Utah Division of Wildlife Resources

- Ann McLuckie
- Jason Jones
- Jimi Gragg

U.S. Fish and Wildlife Service

- Betsy Herrmann
- Renee Chi

Bureau of Land Management (Color Country District Office)

- Paul Briggs
- Keith Rigtrup

Bureau of Land Management (Arizona Strip Field Office)

- Kathleen Harcksen
- Richard Spotts

University of Nevada, Las Vegas

- Scott Abella

U.S. Geological Survey

- Leslie Defalco

Applied Conservation, Inc.

Enduring Conservation Outcomes, Inc.

Spatial Solutions, Inc.

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Appendix 1. Descriptions of vegetation classes within biophysical settings for the Beaver Dam Wash and Red Cliffs National Conservation Areas.

Big Sagebrush Steppe - upland (BSu)

1126u

*Overview: The Big Sagebrush Steppe - upland site BpS (a.k.a., mountain big sagebrush) is found above and intergrades with the mesic sites (≥ 10 inch Precipitation Zone) of the Blackbrush BpS in the both NCAs. Elevation is generally above 8,000 ft (2,440 m) in the Mojave Desert. 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 Mojave Desert communities have received less taxonomic description than northern mapping zones. 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 and often diverse.*

- A **Early;** 0-10% canopy of mountain sage, mountain brush; 10-80% grass/forb cover; 0-12 yrs
- B **Mid-open;** 11-30% cover of mountain sage, mountain shrub; >50% herbaceous cover; 13-38 yrs
- C **Mid-closed;** 31-50% cover of mountain sage, mountain brush, occasional blackbrush; 25-50% herbaceous cover; <10% conifer sapling cover; 38+ yrs
- D **Late-open;** 10-30% cover pinyon-juniper <3m; 25-40% cover of mountain sage, mountain brush, occasional blackbrush; <30% herbaceous cover; 80-129 yrs
- E **Late-closed;** 31-40% pinyon-juniper cover <8m; 6-20% shrub cover; <20% herbaceous cover; 130+ yrs
- U-ES **Early-Shrub;** 20-50% cover of cholla, snakeweed or rabbitbrush species
- U-TE **Tree-Encroached;** 31-40% pinyon-juniper cover 10-25m; <5% shrub cover; <5% herbaceous cover
- U-DP **Depleted;** 20-50% cover of mountain sage, mountain brush, occasional blackbrush; <5% herbaceous cover; <10% conifer sapling cover
- U-SEP **Shrub-Exotic-Species-Perennial-Grass;** 11-50% cover of mountain sage, mountain brush, occasional blackbrush; >5% cover of native grass; >5% cheatgrass cover; <10% conifer sapling cover
- U-SES **Shrub-Exotic-Species;** 11-50% cover of mountain sage, mountain brush, occasional blackbrush; $\geq 5\%$ cheatgrass cover; $\leq 5\%$ cover of native grass; <10% conifer sapling cover
- U-EX **Exotic-Species;** 10-30% cover of cheatgrass; snakeweed or rabbitbrush may be present
- U-TEX **Tree- Exotic-Species;** 31-40% pinyon-juniper cover <8m; $\geq 5\%$ cover of cheatgrass; <20% shrub cover; <20% herbaceous cover
- U-SD **Seeded (native);** >10% seeded native grasses, forbs, and shrubs

Blackbrush - mesic (≥ 10 inch precipitation zone) (BM)

1082m

Overview: The Blackbrush-mesic BpS differs between the Beaver Dam Wash and Red Cliffs NCAs: Joshua trees are present on half the area in Beaver Dam Wash NCA, but absent in the Red Cliffs NCA. The description below includes all classes with and without Joshua trees. Within the Mojave-Colorado Plateau ecotone, blackbrush is found on dry slopes and benches above the river canyons of southern Utah and northern Arizona. It is also found midslope on mountain ranges throughout this area. Soils are mesic, predominantly shallow to a root restrictive layer, on low hills and mountains and broad alluvial fans. Precipitation ranges from 10 to 12+ inches, with most occurring from November through April. Summers are hot and dry with many days reaching above 100 degrees F. The dominant shrub is blackbrush (*Coleogyne ramosissima*). Blackbrush is considered to be one of the most flammable native plant assemblages in the Mojave Desert, although this desert does not have a history of fire. Codominant shrub species include *Eriogonum fasciculatum*, *Ephedra nevadensis*, *Grayia spinosa*, *Menodora spinescens*, *Opuntia acanthocarpa*, *Yucca brevifolia*, or *Yucca schidigera*. Utah juniper is often associated with mesic blackbrush at higher elevations.

- A **Early:** 0-199 yrs; 0-40% cover of snakeweed, rabbitbrush, big sagebrush, turpentine bush, yucca, and desert bitterbrush; young blackbrush may be present
- B **Mid-closed:** 200+ yrs; 10-50% cover blackbrush <1.0m; >1% cover of young Joshua trees; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present, pinyon or juniper saplings present
- C **Mid-open:** 200+ yrs; 10-50% cover blackbrush <1.0m; Joshua trees **absent**; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present, pinyon or juniper saplings present
- D **Late-open:** 400+ yrs; 10-40% of pinyon or juniper; 5-40% blackbrush cover; Joshua trees **absent**; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present
- E **Late-closed:** 400+ yrs; 10-40% of pinyon or juniper; 5-40% blackbrush cover; >1% cover of Joshua trees; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present
- U-ES **Early-Shrub;** 20-50% cover of cholla, snakeweed or rabbitbrush species
- U-SEPJ **Shrub-Exotic-Species-Perennial-Grass-Joshua-Tree;** 10-50% cover of blackbrush or other shrubs <1.0m tall; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; >1% cover of Joshua trees; ≥5% native grass cover
- U-SEP **Shrub-Exotic-Species-Perennial-Grass;** 10-50% cover of blackbrush or other shrubs <1.0m tall; Joshua trees **absent**; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; ≥5% native grass cover
- U-SES **Shrub-Exotic-Species;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <5% native grass cover
- U-TEX **Tree- Exotic-Species;** 10-40% of pinyon or juniper; >5% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <20% blackbrush cover; Joshua trees may be present
- U-EX **Exotic-Species;** >10% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <10% cover of blackbrush or other shrubs; unburned and charred Joshua tree may be present
- U-EX2B **Exotic-Species-2nd-Burn;** identical to U-EX, except that it has experienced a second burn.
- U-SD **Seeded (native);** >10% seeded native grasses, forbs, and shrubs
- U-SDI **Seeded (introduced);** >10% seeded non-native grasses, forbs, and shrubs
- U-PL **Planted;** >5% planted shrubs and perennial herbaceous species; <5% non-native annual grasses and forbs
- U-BG **Bare ground;** mineral soil exposed by human disturbances

Blackbrush - thermic (≤10 inch precipitation zone) (BT)

1082t

Overview: The Blackbrush-thermic BpS differs between the Beaver Dam Wash and Red Cliffs NCAs: Joshua trees are present on half the area in Beaver Dam Wash NCA, but absent in the Red Cliffs NCA. The description below includes all classes with and without Joshua trees. Within the Mojave-Colorado Plateau ecotone, blackbrush is found on dry slopes and benches above the river canyons of southern Utah and northern Arizona. It is also found midslope on mountain ranges throughout this area. Soils are thermic, predominantly shallow to a root restrictive layer, on low hills and mountains and broad alluvial fans. Precipitation is <10 inches, with most occurring from November through April. Summers are hot and dry with many days reaching above 100 degrees F. The dominant shrubs are blackbrush (Coleogyne ramosissima) and white bursage (Ambrosia dumosa). Blackbrush is considered to be one of the most flammable native plant assemblages in the Mojave Desert, although this desert does not have a history of fire. Codominant shrub species include Eriogonum fasciculatum, Ephedra nevadensis, Grayia spinosa, Menodora spinescens, Opuntia acanthocarpa, Yucca brevifolia, or Yucca schidigera. Utah juniper is never present.

- A **Early:** 0-499 yrs; 0-50% cover of snakeweed, turpentine bush, yucca; <10% cover blackbrush
- B **Late-closed:** 500+ yrs; 10-40% cover blackbrush <1.0m; creosotebush present; >1% cover of Joshua trees; 0-10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn), other shrubs present
- C **Late-open:** 500+ yrs; 10-40% cover blackbrush <1.0m; creosotebush present; 0-10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present
- U-ES **Early-Shrub;** 20-50% cover of cholla, snakeweed or rabbitbrush species
- U-SEPJ **Shrub-Exotic-Species-Perennial-Grass-Joshua-Tree;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; >1% cover of Joshua trees; ≥5% native grass cover
- U-SEP **Shrub- Exotic-Species-Perennial-Grass;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; Joshua trees **absent**; ≥5% native grass cover
- U-SES **Shrub-Exotic-Species;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <5% native grass cover
- U-EX **Exotic-Species;** >10% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <10% cover of blackbrush or other shrubs; unburned and charred Joshua tree may be present
- U-EX2B **Exotic-Species-2nd-Burn;** identical to U-EX, except that it has experienced a second burn.
- U-PL **Planted;** >5% planted shrubs and perennial herbaceous species; <5% non-native annual grasses and forbs
- U-BG **Bare ground;** mineral soil exposed by human disturbances

Creosotebush-White Bursage Scrub (CB)

1087

Overview: The Creosotebush-White Bursage BpS occupies the lowest elevations of both NCAs and is typically found below the blackbrush zone on well-drained alluvial flats. Elevations range from 5,000-6,000 ft (1,525-1,830 m) on lower mountain foot slopes. Soil types vary from shallow to very deep on erosional fan remnants, fan piedmonts, and sideslopes of hills and lower mountains. Slopes range from 2-75%, but slope of 2-15% are typical. Creosotebush (Larrea tridentata) and white bursage (Ambrosia dumosa) co-dominate, with bursage more prevalent in warmer and drier sites.

- A **Early;** 5-20% cover of creosote and white bursage builds up over time; 5-20% grass cover depending on winter precipitation and season; 0-19 yrs
- B **Mid-closed;** 21-40% creosote and white bursage cover; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); >1% cover of Joshua trees; 20+ yrs
- C **Late-open;** 21-40% creosote and white bursage cover; Joshua trees **absent**; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); 20+ yrs
- D **Late- closed;** 21-40% creosote and white bursage cover; >1% cover of Joshua trees; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); 400+ yrs
- U-ES **Early-Shrub;** 20-50% cover of cholla, snakeweed or rabbitbrush species

- U-SEP **Shrub-Exotic-Species-Perennial-Grass**; 21-40% cover of creosote and white bursage; 0-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); Joshua trees **absent**
- U-SEPJ **Shrub- Exotic-Species-Perennial-Grass-Joshua-Tree**; 21-40% cover of creosote and white bursage; 0-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); >1% cover of Joshua trees
- U-SES **Shrub-Exotic-Species**; 10-40% cover of creosotebush or other shrubs <1.0m tall; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <5% cover of native grasses or forbs; Joshua tree **absent**
- U-SESJ **Shrub-Exotic-Species-Joshua-Tree**; 10-40% cover of creosotebush or other shrubs <1.0m tall; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; >1% cover of Joshua trees; <5% cover of native grasses and forbs
- U-EX **Exotic-Species**; >10% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <10% cover of creosotebush or other shrubs; unburned and charred Joshua tree may be present
- U-EX2B **Exotic-Species-2nd-Burn**; identical to U-EX, except that it has experienced a second burn.
- U-SD **Seeded (native)**; >10% seeded native grasses, forbs, and shrubs
- U-SDI **Seeded (introduced)**; >10% seeded non-native grasses, forbs, and shrubs
- U-PL **Planted**; >5% planted shrubs and perennial herbaceous species; <5% non-native annual grasses and forbs
- U-BG **Bare ground**; mineral soil exposed by human disturbances

Desert Sand Sagebrush (DSS)

1135ss

Overview: The Desert Sand Sagebrush BpS occupies deep sandy soils of the Red Cliffs NCA and Snow Canyon State Park. The dominant and diagnostic species is sand sagebrush, Artemisia filifolia. The community 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 **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 **Late-closed**; 20-40% 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-DP **Depleted**; 20-40% sand sagebrush, snakeweed, and rabbitbrush cover; <5% cover of grasses; >40% bare ground cover
- U-SEP **Shrub-Exotic-Species-Perennial-Grass**; 5-40% sand sagebrush and rabbitbrush cover; 5-10% cover of exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*); native grasses may be present to common; >30% bare ground (mostly sand)

Montane Riparian (MR)

1154

Overview: The Montane Riparian BpS is found within a broad elevation range from about 4,000 ft (1,220 m) to over 7,000 ft (2,135 m). Riparian forests and woodlands require flooding and gravel for reestablishment. The BpS is found in low- to mid-elevation canyons and draws, on floodplains, or in steep-sided canyons, or narrow V-shaped valleys with rocky substrates. Sites are subject to temporary flooding during spring runoff. Underlying gravels may keep the water table just below ground surface, and are favored substrates for cottonwood and willow. 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, buffaloberry, cottonwood, velvet ash, conifers, and mesquite. Vegetation is very heterogeneous along river reaches.

- A **Early;** 0-40% cover of shrub—willow dominates after fire, whereas cottonwood and willow co-dominate after flooding; grass may co-dominate; <50% cover gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs
- B **Mid-closed;** 31-100% cover of tall shrubs (willows, buffaloberry, young mesquite) and small trees (velvet ash, conifers) and small cottonwood trees; <20% gravel, rock, and boulders; 5-19yrs
- C **Late-closed;** 31-100% cover of cottonwood, willow, conifers and other trees 10-24m; <20% gravel, rock, and boulders; >20 yrs
- U-SFE **Shrub-Forb-Encroached;** 10-50% cover of Wood’s rose or other unpalatable forbs and shrubs in open areas or under tree canopy
- U-EF **Exotic-Forb;** 10-100% cover of exotic forbs (knapweed, tall whitetop, purple loosestrife), salt cedar, or Russian olive)
- U- DE **Desertification;** Entrenched river/creek with 10-50% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush); >5% native grass cover

Mountain Mahogany (Littleleaf Mountain Mahogany) (MM)

1062

Overview: The Mountain Mahogany BpS is only found in Beaver Dam Wash NCA in small patches on limestone bedrock, coarse rock fragments, and very shallow dry limestone soils either at the base of limestone cliffs or on ledges. The dominant and diagnostic species is little-leaf mountain mahogany (Cercocarpus intricatus). Other shrubs include bitterbrush (Purshia sp.) and snowberry (Symphoricarpos sp.).

- A **Early;** 10-55% cover little-leaf mountain mahogany (*Cercocarpus intricatus*) seedlings and saplings <0.5m high; mineral soil, bedrock, and rock abundant; grasses and shrubs present but not abundant; 0-9 yrs
- B **Mid-open;** 10-30% cover littleleaf mountain mahogany 0.5-1m high; mineral soil abundant; 10% native perennial grasses cover; 5% cover of mountain shrubs other than mahogany; mineral soil, bedrock, and rock abundant; 10-29 yrs
- C **Late-closed (formerly E);** 30-45% cover of littleleaf mountain mahogany 1-2m high; 15% cover of mountain shrubs other than mahogany; 45% cover of mineral soil, bedrock, and rock; >30 yrs
- U-TEX **Tree-Exotic-Species;** 10-55% cover of littleleaf mountain mahogany; 5-10% cheatgrass cover; 40% cover of mineral soil, bedrock, and rock
- U-EX **Exotic-Species;** 5-20% cheatgrass cover; littleleaf mountain mahogany largely absent; 80% cover of mineral soil, bedrock, and rock

Mountain Shrub (MSh)

1126ms

Overview: The Mountain Shrub BpS is found in primarily two compositional forms where either Stansbury cliffrose (Purshia mexicana) or snowberry (Amelanchier sp.) is the diagnostic shrub. The BpS is found in small patches on different montane landforms. The snowberry form is usually at higher elevations on moderate to steep slopes with deep mesic soils above 8,000 ft (2,440 m) elevation, sometimes with coarse fragments. Other shrubs, grasses, and forb species can be abundant. The cliffrose form is usually at lower elevations and adjacent or imbedded in the pinyon and juniper woodlands on moderate to steep slopes, and often follows linear geologic features (rock ledges).

- A **Early;** 0-10% canopy of snowberry, desert bitterbrush, or Stansbury cliffrose; 10-80% grass and forb cover; 0-12 yrs
- B **Mid-open;** 11-30% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; >50% herbaceous cover; 13-38 yrs
- C **Mid-closed;** 31-50% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; 25-50% herbaceous cover;<10% conifer sapling cover; 38+ yrs
- D **Late-open;** 10-20% pinyon pine-juniper cover <5m; 25-40% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; <30% herbaceous cover; 80-129 yrs
- U-ES **Early-Shrub;** 20-50% cover rabbitbrush species
- U-DP **Depleted;** 31-50% cover of snowberry, desert bitterbrush, Stansbury cliffrose; <5% herbaceous cover; <10% conifer sapling cover

- U-SEP **Shrub-Exotic-Species-Perennial-Grass**; 5-40% cover of mountain shrubs; 5-20% non-native grass cover; native herbaceous cover usually present; trees may be present
- U-TE **Tree-Encroached**; >21% pinyon pine-juniper cover 10-25m; <5% shrub cover; <5% herbaceous cover
- U-TEX **Tree-Exotic-Species**; 10-20% pinyon pine-juniper cover <5m; ≥5% cover of non-native annual grasses and forbs; 25-40% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; <30% herbaceous cover
- U-EX **Exotic-Species**; 10-30% cover of cheatgrass; snakeweed or rabbitbrush may be present; dead standing stems of cliffrose often present

Pinyon-Juniper (PJ)

1019

Overview: The Pinyon-Juniper Woodland BpS is typically found from 5,500-8,000 ft (1,675-2440 m) above the blackbrush (Coleogyne ramosissima) zone. This type generally occurs on most soils and landforms, especially fire-safe sites of steep and rocky slopes. 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 monophylla and Juniperus osteosperma, pure or nearly pure occurrences of Pinus monophylla, or solely by Juniperus osteosperma. Understory layers are variable. Grass and shrub species are often diverse and common, although not abundant.

- A **Early-open**; 5-20% herbaceous cover; 0-9 yrs
- B **Mid1-open**; 11-20% cover big sage or black sage <1.0m; 10-40% herbaceous cover; 10-29 yrs
- C **Mid2-open**; 11-30% cover of pinyon and/or juniper <5m; 10-40% shrub cover; <20% herbaceous cover; 30-99 yrs
- D **Late-open**; 31-50% cover of pinyon and/or juniper <5m-9m; 10-40% shrub cover; <20% herbaceous cover; >99 yrs
- U-TEX **Tree- Exotic-Species**; 31-50% cover of pinyon and/or juniper <5m-9m; 5-20% cheatgrass cover 10-40% shrub cover;
- U-EX **Exotic-Species**; 5-30% cheatgrass cover; dead pinyon or juniper visible

Warm Desert Riparian (WDR)

1155

Overview: The Warm Desert Riparian BpS occurs primarily along perennial streams/rivers along the Colorado, Salt, Virgin, Muddy, and Mojave River corridors adjacent to low elevation shrublands. Elevation is typically below 4,000 ft (1,220 m). When mesquite bosque is the dominant type outside of perennial waterways, it is also found at elevations lower than 3,600 ft (1,100 m) along intermittent streams or in valleys bottoms along playa edges with a perched water table. The vegetation is a mix of riparian woodlands, shrublands, and grasslands. Vegetation is very patchy in rivers with active flood regimes. Dominant species are Salix gooddingii, Populus fremontii, Salix exigua, Pluchea sericea, Distichlis spicata, Sporobolus airoides, Carex spp., Typha sp., and Prosopis sp. Halophytic shrub-dominated patches occur on drier sediment deposits or saltier surfaces. Vegetation is dependent upon periodic flooding.

- A **Early**; 10-50% cover of Gooding willow and Fremont Cottonwood seedlings and shrubs; riparian and wetland graminoids may co-dominate; 0-4 yrs post-flooding
- B **Mid-closed**; 51-100% cover of willow and small trees (willow and cottonwood) <3 m; patches of graminoids and halophytic shrubs common; 5-19 yrs after flooding
- C **Mid-open**; 11-50% cover of fire resprouts of mesquite and Gooding willow; patches of graminoids frequent after fire; mesquite mature to larger trees several years after fire; 1-89 yrs after fire
- D **Late1-closed**; 51%-90% of mature Gooding willow and Fremont cottonwood; patches of graminoids in saturated soils and of halophytic shrubs on drier sediment deposits or more saline surfaces; 10-89 yrs
- E **Late2-closed**; 51-90% mesquite cover; Gooding willow and Fremont cottonwood minor component; understory often dominated by graminoids and forbs; >90 yrs
- U-DE **Desertified**; incised river bank caused by human disturbance; 10-90% native halophytic shrub or riparian tree cover; graminoid patches may be present
- U-DET **Desertified-Exotic-Tree**; >5% exotic tree species (tamarisk or Russian olive) regardless of native cover; river bank incised

- U-DEF **Desertified-Exotic-Forb**; >5% exotic forb species regardless of native cover; river bank incised
- U-DEX **Desertified-Exotic-Species**; 5-40% exotic annual grasses and forbs; charred remnants of trees and shrubs often present; snakeweed often present to abundant; river bank incised
- U-TEX **Tree- Exotic-Species**; 51%-90% of young or mature Gooding willow and Fremont cottonwood; >5% cover of exotic annual grass and forb species; patches of graminoids in saturated soils and of halophytic shrubs on drier sediment deposits or more saline surfaces
- U-EF **Exotic Forb**; >5% exotic forb species regardless of native cover; river bank not incised
- U-ET **Exotic-Tree**; >5% exotic tree species (tamarisk or Russian olive) regardless of native cover; river bank not incised
- U-EX **Exotic-Species**; 5-40% exotic annual grasses and forbs; charred remnants of trees and shrubs often present; snakeweed often present to abundant
- U-BG **Bare ground**; mineral soil exposed by human-caused disturbances

Warm Desert Riparian-Wash (Shallow & Deep combined) (SWA)

1155w

Overview: The Warm Desert Riparian-Wash BpS comprises intermittent to dry warm-desert drainages with mostly subsurface flow whose banks are deeply incised. The distinction between shallow and deep washes is primarily from the perspective of whether or not a desert tortoise could climb out of the wash. 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.

- A **Early**; 20-50% cover may be gravel, sands, and/or flood debris; 10-19% cover of desert almond, burrobrush, rabbitbrush, creosotebush, desert willows present; 5-15% cover of grasses (big galleta, bush muhly); forbs present to abundant; 0-5 yrs
- B **Mid-closed**; 20-50% cover of desert almond, bursage, bladdersage, burrobrush, creosotebush, Anderson's wolfberry, rabbitbrush; 5-10% cover of grasses (big galleta, bush muhly); forbs present to abundant; <30% of gravel and rocks; 5-19 yrs
- C **Late-closed**; 30-50% cover of bursage, burrobrush, creosotebush, desert almond, bladdersage, Anderson's wolfberry, rabbitbrush, mesquite; Joshua tree present; 5-10% cover of grasses (big galleta, bush muhly); forbs present to abundant; <10% of gravel and rocks; >20 yrs
- U-SEP **Shrub-Exotic-Species-Perennial-Grass**; >5% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 0-50% small mesquite, Joshua tree, and shrubs, 5-10% cover of grasses (big galleta, bush muhly); mineral soil may be common
- U-SES **Shrub-Exotic Species**; >5% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 0-50% small trees and shrubs; <5% cover of native grasses; mineral soil may be common
- U-ES **Early-Shrub**; 20-50% cover of cholla, snakeweed or rabbitbrush species
- U-ET **Exotic-Tree (formerly EX)**; >5% cover of salt cedar; 0-50% cover of bursage, burrobrush, creosotebush, Anderson's wolfberry, rabbitbrush, mesquite, Joshua tree
- U-BG **Bare ground**; mineral soil exposed by human-caused disturbances

Warm-Season Grassland (GRL)

11212

*Overview: The Warm-Season Grassland BpS is only found in the Red Cliffs NCA and Snow Canyon State Park. Grasslands are located on fine soils, sometimes fine sandy soils, at the toe of slopes, in shallow bottoms with gentle to moderate slopes, and on gentle slopes. Galleta grass (*Hilaria sp.*) is the dominant species and usually abundant, although Indian ricegrass (*Stipa hymenoides*) may be present to abundant. With time since fire or other disturbances, woody shrub cover will increase.*

- A **Early**; 20-70% cover of warm-season grasses (big galleta); forbs may be present; trace amount of resprouting shrubs may be present; woody vegetation largely absent; 30% mineral soil cover typical but ranges from 30 to 80% with time since fire; 0-19 yrs
- B **Late-open**; 5-20% cover of shrub and succulents; 50-70% cover of warm-season grasses (big galleta); forbs may be present; 30% mineral soil cover typical; >20 yrs
- U-DP **Depleted**; 5-20% cover of shrub and succulents; <10% cover of warm-season grasses (big galleta); forbs may be present; 30% mineral soil cover typical; >20 yrs

- U-SES **Shrub-Exotic-Species-Perennial-Grass**; 5-20% cover of exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*); 5-20% cover of shrub and succulents; 10-60% cover of warm-season grasses (big galleta); forbs may present
- U-EEEX **Early-Exotic-Species**; <20% cover of warm-season grasses (big galleta); 5-30% cover of exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*); 50-70% cover of mineral soil
- U-EX **Exotic-Species**; 5-30% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 20-70% native grass species (big galleta); 5% cover of mineral soil
-

Appendix 2. Description of ecological model dynamics for the Red Cliffs and Beaver Dam Wash NCAs.

Introduction

Non-spatial state-and-transition models of ecological systems were created with the software PATH and Vegetation Dynamics Development Tool (VDDT from ESSA Technologies, Ltd.; Barrett 2001; Beukema et al. 2003). Although PATH is the general architecture of the simulation, VDDT is “called in” by PATH to perform runs. In VDDT, succession and disturbance are simulated in a semi-Markovian framework. Each vegetation state has one possible deterministic transition based on time in the state (usually succession) and several possible probabilistic transitions (natural and management). Each of these transitions has a new destination state and probability associated with it. Based on the timing of the deterministic transition and the probabilities of the stochastic transitions, at each time step a polygon may remain the same, undergo a deterministic transition based on elapsed time in the current state or undergo a probabilistic transition based on a random draw (for example, replacement fire). Model parameters (succession duration and disturbance rates) are presented in Appendix 3.

We created 11 state-and-transition models for each of the ecological systems in Table 2 (except the very small littleleaf mountain mahogany). Appendix 1 presents the different states, phases, and their abbreviations for each ecological system. Although each model represented a distinct ecological system, some models were grouped on the same VDDT project page (i.e., Uber model) to allow for seamless system conversions should models be used for climate change analysis (it was not):

- Low-to-high elevation Uber VDDT project contained 9 ecological systems: Big Sagebrush Steppe-upland, Blackbrush-mesic, Blackbrush-thermic, Creosotebush-White Bursage, Desert Washes, Montane Riparian, Pinyon-Juniper Woodland, Mountain Shrub, and Warm-Season Grassland;
- Single project: Desert sand sagebrush; and
- Single project: Warm desert riparian.

All models had at their core the LANDFIRE reference condition represented by some variation around the A-B-C-D-E classes (Table 2; Appendix 1). Essentially, this meant that models had an early development class and mid-development and/or late-development classes. Mid- and late-development classes may be expressed as open or closed canopy. Several models contained <5 boxes that did not follow the classic nomenclature. The A-E class models simply represented succession from usually herbaceous vegetation to increasing woody species dominance where the dominant woody vegetation might be shrubs or trees. For the models to also reflect the effects of management, we added uncharacteristic vegetation classes that represented different states that only exist because of direct or indirect human activity (Appendix 1).

In all models, any disturbance was quantified by a rate expressed as a probability per year. This rate is the inverse of the return interval of a disturbance or a frequency of spatial events. For example, a mean fire return interval of 100 years is equal to a rate of 0.01/year (0.01 =

1/100). The probability/year rate is used in VDDT because it has the very convenient property of being additive, whereas return intervals are not additive. This rate was further multiplied by a proportion that partitioned the main rate in terms of success and failure outcomes, allocation of resources to realize different management objectives, or extent of application (for example, 5% of the biophysical setting was grazed at a rate of 1.0/year – livestock grazed every year [not a current practice in the Red Cliffs NCA], thus the return interval is 1 year). The rate that was ultimately used was the probability/year multiplied by proportions of allocation. Any rate, which is generally based on return intervals, is converted to a spatial draw per year as a necessary time for space substitution. Although VDDT is a non-spatial simulation software, the underlying process imitates temporal rates with virtual pixel draws. To pursue the fire return interval example, a probability/year of 0.01 means that 1 out of every 100 pixels on average receives fire within a year. Temporal multipliers described in the main text can be used to modify how many pixels are selected per year while maintaining a temporally average rate of 0.01/year (Appendix 4).

Models contained more management activities than were actually employed in final simulations to explore possibilities with workshop participants. The rate of application of each management action was set by Treatment Details in PATH or area limit function of VDDT that was reflective of management budgets and minimum treatments required to achieve objectives. Because area limits overrule rates, we generally used a default rate of 0.01 for all actions –another arbitrary rate could have been chosen; however, the proportional allocation of the area limit to different outcomes of the same management action was controlled by VDDT entries (Appendix 3). Some outcomes represented failure rates for an action, such as when a plant seeding failed and was replaced by a non-native annual species.

The format of model descriptions that follow will consist of a standard template of entries by ecological system (alphabetical order). Some entries will be repetitive among ecological systems and with Appendix 1. Each ecological system's model is intended to be self contained.

Big Sagebrush Steppe-upland (BSu) 1126u

Area of Application and Context:

- **Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah**
- **Livestock grazing on Beaver Dam Wash only**
- **Full fire suppression management**
- **Date created: July 2011**

Vegetation classes:

- **A-Early:** 0-10% canopy of mountain sage, mountain brush; 10-80% grass/forb cover; 0-12 yrs
- **B-Mid-open:** 11-30% cover of mountain sage, mountain shrub; >50% herbaceous cover; 13-38 yrs
- **C-Mid-closed:** 31-50% cover of mountain sage, mountain brush, occasional blackbrush; 25-50% herbaceous cover; <10% conifer sapling cover; 38+ yrs
- **D-Late-open:** 10-30% cover pinyon-juniper <3m; 25-40% cover of mountain sage, mountain brush, occasional blackbrush; <30% herbaceous cover; 80-129 yrs
- **E-Late-closed:** 31-40% pinyon-juniper cover <8m; 6-20% shrub cover; <20% herbaceous cover; 130+ yrs
- **U-ES: Early-Shrub:** 20-50% cover snakeweed or rabbitbrush species
- **U-TE: Tree-Encroached:** 31-40% pinyon-juniper cover 10-25m; <5% shrub cover; <5% herbaceous cover
- **U-DP: Depleted:** 20-50% cover of mountain sage, mountain brush, occasional blackbrush; <5% herbaceous cover; <10% conifer sapling cover
- **U-SEP: Shrub-Exotic-Species-Perennial-Grass:** 11-50% cover of mountain sage, mountain brush, occasional blackbrush; >5% cover of native grass; >5% cheatgrass cover; <10% conifer sapling cover
- **U-SES: Shrub-Exotic-Species:** 11-50% cover of mountain sage, mountain brush, occasional blackbrush; ≥5% cheatgrass cover; ≤5% cover of native grass; <10% conifer sapling cover
- **U-EX: Exotic-Species:** 10-30% cover of cheatgrass; snakeweed or rabbitbrush may be present
- **U-TEX: Tree- Exotic-Species:** 31-40% pinyon-juniper cover <8m; ≥5% cover of cheatgrass; <20% shrub cover; <20% herbaceous cover
- **U-SD: Seeded (native):** >10% seeded native grasses, forbs, and shrubs

Reference Condition:

- **Natural Range of Variability**
 - 30%: *A-Early*
 - 47%: *B-Mid-open*
 - 20%: *C-Mid--closed*
 - 1%: *D-Late-open*
 - 2%: *E-Late-closed*
 - 0%: *U*

Succession:

Succession follows the 5-box pathway with vegetation starting as predominantly herbaceous and ending

with pinyon and juniper dominance and a viable shrub and herbaceous understory. The succession pathway is not entirely deterministic as the *tree-invasion* probabilistic disturbance is used to cause a transition from the mid-succession closed (*BSu-C*) to the late-succession open (*BSu-D*) classes. This rate of transition is 0.01 probability/year pixels starting at age 100 in the mid-succession closed class (*BSu-C*). This rate is consistent with the transition from Phase 1 to Phase 2 by Miller and Tausch (2001): this rate approximately replicated encroachment levels proceeding in three phases of about 50 years each. Deterministic succession transitions occur at the following ages:

- Early-succession to mid-succession open: 19 years
- Mid-succession open to closed: 75 years
- Mid-succession closed to late-succession open: ≥100 years (probabilistic)
- Late-succession open to closed: 134 years

Natural Disturbances:

Replacement fire was the primary stochastic disturbance. *Replacement fire* restarts the succession clock at age zero within the reference condition, which was labeled the *early-succession* or *BSu-A* class. The mean return interval of *replacement fire* changed with vegetation classes:

- 80 years (0.0125/year) in the *early-succession* class (*BSu-A*);
- 50 years (0.02/year) in the *mid-succession classes* and *late-succession open classes* (*BSu-B*, *BSu-C* and *BSu-D*); and
- 75 years (0.013/year) in the wooded *late-succession closed* class (*BSu-E*).

Replacement fire in vegetation classes that already experienced a threshold transition also caused a threshold transition to other uncharacteristic classes:

- Fire in the *tree-encroached shrubland* (*TE*) has a mean fire return interval of 120 years (0.0085/year) and causes the following transitions:
 - 45% of times to the *exotic species* class (*EX*);
 - 45% to the *early shrub* class (*ES*); and
 - 10% to the *shrub exotic species* class (*SES*).
- Fire in the *tree-encroached shrubland with exotic annual species* class (*TEX*) has a mean fire return interval of 120 years (0.0085/year) and causes a transition to the *exotic species* class (*EX*) 45% of times.
- The *depleted shrubland* class (*DP*) burns with a 50-year return interval (0.02/year) and converts to the *early shrub* class (*ES*). Fire in this latter class (50-year fire return interval) simply promotes rabbitbrush as a self-loop for 100% of outcomes.
- A 10-year fire cycle applies to the *exotic species* class (*EX*) and behaves as a self-loop.
- Due to the presence of non-native annual species, the fire return interval is shorter (25 years or 0.04/year) in the *shrub with exotic annual species* class (*SES*) than in the *depleted shrub* class (*DP*). Fire in this class causes a conversion to the *exotic-species* class (*EX*).
- With a *replacement fire* of 25 years (0.04/year), the *shrubland with exotic annual and native perennial grasses* class (*SEP*) will become two classes:
 - *Exotic annual species* (*EX*) 90% of times; and
 - *Early-succession* class (*BSu-A*) the other 10% of occurrences.
- *Replacement fire* varied with the age of the *seeded* class (*SD*) and acted as a self-loop:

- 80-year fire return interval (0.0125/year) from 0 to 19 years and after age 135 years; and
- 50-year fire return interval (0.02/year) from 20 to 134 years.

Drought is found in most classes and causes stand replacing events (generally 10% of times) or stand thinning (90% of times). In most cases *drought* created tree and shrub mortality under the assumption that prolonged and decreased soil moisture weakens plants that might ultimately be killed by insects or disease. Therefore, we did not double-count mortality. A *drought* return interval rate of every 178 years (a rate of 0.0056/year) is used based on the frequency of severe drought intervals estimated by Biondi *et al.* (2007) from 2,300 years of western juniper (*Juniperus occidentalis*) tree ring data from the Walker River drainage of eastern California and western Nevada. Although we recognize that droughts may be more common than every 178 years, severe droughts, which were >7-year drought events with consecutive far-below average soil moisture (narrow tree rings), kill naturally drought resistant shrubs and trees. For vegetation classes in the reference condition, drought affects the *mid-succession closed* (BSu-C) to *late-succession closed* (BSu-E) classes (i.e., not the first two classes of succession) in different ways.

- The *mid-succession closed* class (BSu-C) follows the more traditional outcome of 90% thinning within the class (to its beginning) and 10% to the *early-succession* class (BSu-A).
- Drought partitions the *late-succession open* class (BSu-D) into three pathways that results from thinning young pinyon, juniper, or old shrubs:
 - 10% thinning within the class;
 - 60% thinning to the previous class (*mid-succession closed* or BSu-C); and
 - 30% to the *mid-succession open* class (BSu-B).
- The *late-succession closed* class (BSu-E), which is wooded, behaves differently than others to drought. Because trees have already suppressed the understory,
 - 10% of the thinning effect kills trees but releases shrubs and grass at a low cover value more typical of the *mid-succession open* class (BSu-B); and
 - The remaining 90% of *drought* effects accelerates woody succession by 5 years when a pixel is chosen because increased resource competition is to the detriment of shrubs and the herbaceous understory.

Drought affects four uncharacteristic classes.

- *Drought* in the *depleted shrubland* class (DP) causes a transition to:
 - *Early-succession shrub* (ES) 10% of times; and
 - Selectively thins older shrubs to age zero within the *depleted* class (DP) 90% of times.
- The fate of the *shrub-exotic-species* class (SES) is similar to the *depleted shrubland* class (DP) except the *exotic annual species* class (EX) replaces *early-succession shrubs* (ES).
- Drought thins the *tree-encroached shrubland with exotic annual species* (TEX) to two classes:
 - 10% to the *exotic annual species* class (EX); and
 - 90% as a self-loop to the beginning of the class.
- The *tree-encroached shrubland* class (TE) is thinned by drought:
 - 5% of times to the *early-shrub* class (ES);
 - 5% to the *exotic annual species* class (EX); and
 - 90% of times vegetation remained in the originating class.

- The *shrubland with mixed exotic annual species and perennial grasses* class (*SEP*) responds to drought by thinning to the following classes:
 - 1% to the *early-succession* class (*BSu-A*);
 - 9% to the *exotic species* class (*EX*); and
 - 90% as a self-loop.
- Drought also affects the *seeded* class (*SD*) by setting age back to zero.

Exotic annual species invasion (*EX-invasion*) is set at a moderate rate of 0.005/year (1 out of 200 pixels converted to a cheatgrass-invaded class per year). A base rate of 0.001/year was estimated from data of northwest Utah collected by the Utah Division of Wildlife Resources in black sagebrush semi-desert. Black sagebrush semi-desert is usually considered more resistant to cheatgrass invasion than Wyoming big sagebrush semi-desert or other big sagebrush dominated ecological systems. Because workshop participants did not have similar data, we defaulted to five times the rate estimated from the Utah data. The higher rates indicate greater susceptibility to non-native annual species because soils are more productive.

- Exotic annual species invasion (*EX-invasion*) starts in the mid-succession open class (*BSu-B*) and continues in the *late-succession open* class (*BSu-D*), causing a transition to the *shrubland with mixed exotic annual species and perennial grasses* class (*SEP*).
- *Exotic annual species invasion* is absent from the *late-succession closed* (wooded; *BSu-E*) and the *tree-encroached* class (*TE*) due to shading.
- The *depleted shrub* (*DP*) converts to the *shrub with non-native annual grass* class (*SES*) with *exotic annual species invasion* at a rate of 0.005/year.
- The rate of invasion in the *seeded* class, generally 0.005/year, was smaller from ages 20 to 134: 0.001/year because the class is more resistant to exotic annual species invasion.

Management Actions:

Modeled management activities included herbicide coupled with native plant seeding or thinning.

- Herbicide (Plateau®) application to control exotic annual grasses in exotic annual grassland and forblands (i.e., burned areas) followed by seeding native plant species. Failure rate is 20%, leading to the *exotic annual species* class (*EX*). Success causes a transition to the *seeded* class (*SD*).
- Chainsaw thinning of older trees in *tree-encroached shrublands with or without exotic annual species* (*TE* and *TEX*), conducting herbicide application for exotic annual species, and followed by seeding native plant species. Failure rate is 20%, causing a transition *exotic annual species* class (*EX*) if the originating class was *TEX* or a transition to the *early shrub* class (*ES*).

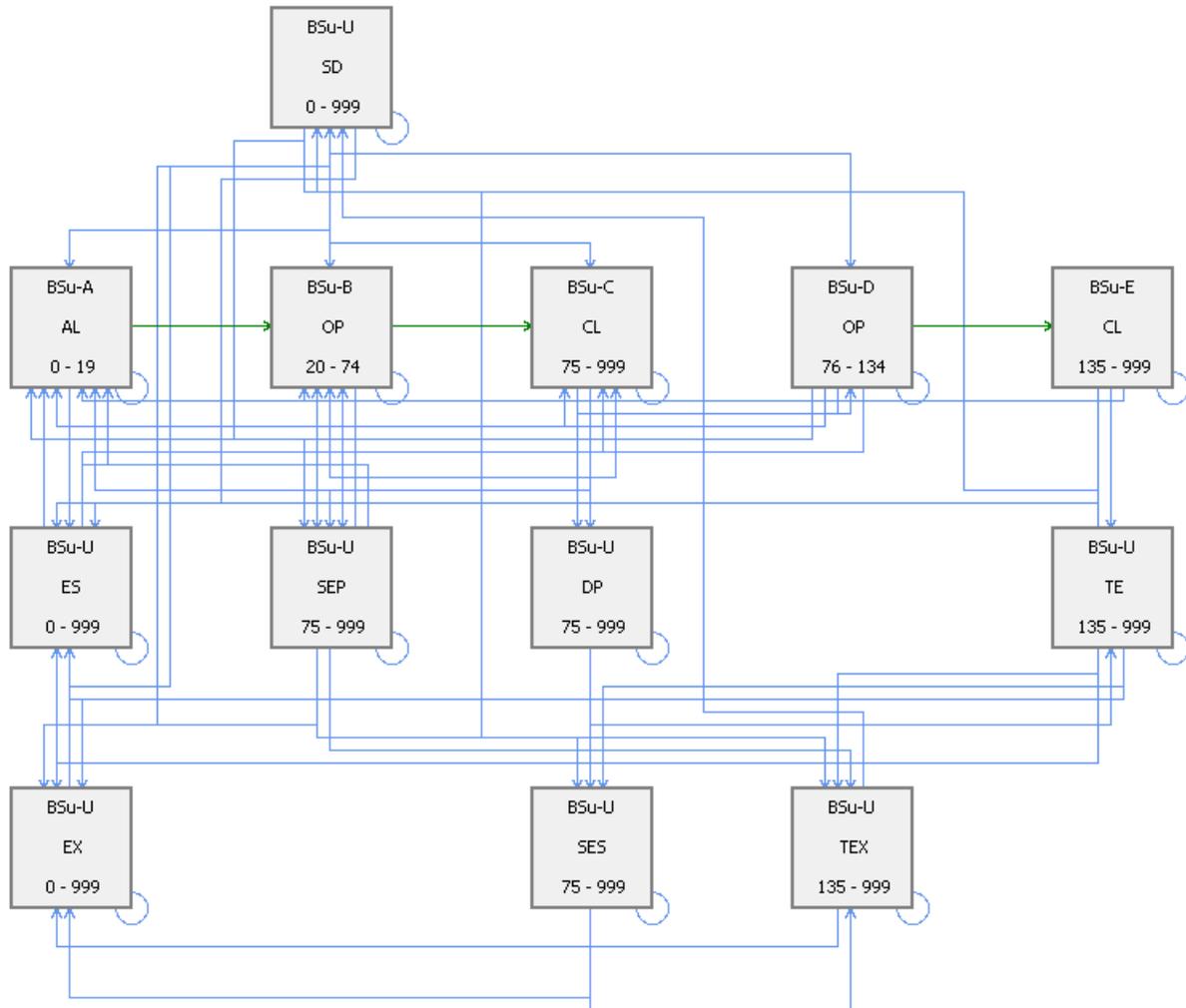
In theory, other management actions, such as prescribed fire, can be used. Because the big sagebrush steppe-upland ecological system is at elevations with heavy presence of exotic annual species and near housing in the Red Cliffs NCA, prescribed fire is avoided.

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State-and-Transition Model:



Blackbrush-mesic (BM) 1082m

Area of Application and Context:

- **Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah**
- **Livestock grazing on Beaver Dam Wash only**
- **Full fire suppression management**
- **Date created: July 2011**

Vegetation classes:

Two versions of mesic blackbrush were developed at the request of stakeholders: with and without Joshua Trees. USDA's Natural Resource Conservation Service (NRCS), however, does not recognize Joshua tree woodlands as a distinct ecological site because the soils on which Joshua tree grow are the same the soils as creosotebush-white bursage, thermic and mesic blackbrush, and Great Basin mixed salt desert ecological sites. Joshua tree is absent from the Red Cliffs NCA and from some areas of the Beaver Dam Wash NCA (thus boxes B, E, and U-*SEPI* below do not exist). Joshua tree is present in a large fraction of the Beaver Dam Wash NCA and the description below applies in its entirety:

- **A-Early:** 0-199 yrs; 0-40% cover of snakeweed, rabbitbrush, big sagebrush, turpentine bush, yucca, and desert bitterbrush; young blackbrush may be present
- **B-Mid-closed:** 200+ yrs; 10-50% cover blackbrush <1.0m; >1% cover of young Joshua trees; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present, pinyon or juniper saplings present
- **C-Mid-open:** 200+ yrs; 10-50% cover blackbrush <1.0m; Joshua trees **absent**; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present, pinyon or juniper saplings present
- **D-Late-open:** 400+ yrs; 10-40% of pinyon or juniper; 5-40% blackbrush cover; Joshua trees **absent**; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present
- **E-Late-closed:** 400+ yrs; 10-40% of pinyon or juniper; 5-40% blackbrush cover; >1% cover of Joshua trees; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present
- **U-ES: Early-Shrub;** 20-50% cover of cholla, snakeweed or rabbitbrush species
- **U-SEPI: Shrub-Exotic-Species-Perennial-Grass-Joshua-Tree;** 10-50% cover of blackbrush or other shrubs <1.0m tall; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; >1% cover of Joshua trees; ≥5% native grass cover
- **U-SEP: Shrub-Exotic-Species-Perennial-Grass;** 10-50% cover of blackbrush or other shrubs <1.0m tall; Joshua trees **absent**; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; ≥5% native grass cover
- **U-SES: Shrub-Exotic-Species;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <5% native grass cover
- **U-TEX: Tree- Exotic-Species;** 10-40% of pinyon or juniper; >5% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <20% blackbrush cover; Joshua trees may be present
- **U-EX: Exotic-Species;** >10% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover;

<10% cover of blackbrush or other shrubs; unburned and charred Joshua tree may be present

- U-EX2B: **Exotic-Species-2nd-Burn**; identical to U-EX, except that it has experienced a second burn.
- U-SD: **Seeded (native)**; >10% seeded native grasses, forbs, and shrubs
- U-SDI: **Seeded (introduced)**; >10% seeded non-native grasses, forbs, and shrubs
- U-PL: **Planted**; >5% planted shrubs and perennial herbaceous species; <5% non-native annual grasses and forbs
- U-BG: **Bare ground**; mineral soil exposed by human disturbances

Reference Condition:

- **Natural Range of Variability without Joshua tree**
 - 11%: A-Early
 - 0%: B-Mid-closed
 - 73%: C-Mid-open
 - 16%: D-Late-open
 - 0%: E-Late-closed
 - 0%: U
- **Natural Range of Variability with Joshua tree**
 - 10%: A-Early
 - 39%: B-Mid-closed
 - 35%: C-Mid-open
 - 8%: D-Late-open
 - 8%: E-Late-closed
 - 0%: U

Succession:

Succession varies with the presence of Joshua trees.

In the absence of Joshua trees, succession follows the 3-box pathway with vegetation starting as predominantly dominated by snakeweed and herbaceous species and ending with pinyon or juniper dominance and a viable shrub understory. Deterministic succession transitions occur in the first two boxes, whereas the last step of succession is probabilistic:

- Early-succession to mid-succession open: 200 years
- Mid-succession open to late-succession open: ≥400 years (probabilistic)

With Joshua trees, succession is a 5-box model with parallel open and closed branches originating from the *early-succession* class (BM-A). Deterministic transitions govern succession between the *early-succession* (BM-A) and both *mid-succession* classes (BM-B and BM-C). The deterministic transition is not a true succession and reflects a partitioning of acres proportional to the current area without and with Joshua tree. *Tree-invasion* acts as a probabilistic succession disturbance between the mid-succession and late-succession classes.

- Early-succession to mid-succession open and closed: 200 years

- Mid-succession open or closed, respectively, to late-succession open or closed: ≥ 400 years (probabilistic)

Natural Disturbances:

Very few natural disturbances affect blackbrush: replacement fire, drought, and tree invasion. Blackbrush is an ancient vegetation type whose individual plants resisted disturbances for hundreds of years (Pendleton et al. 1986). Moreover, blackbrush is not fire adapted and has not evolved with fire (Callison et al. 1985).

Replacement fire is present at very low rates in most classes. The fire return interval of *replacement fire* changes with vegetation classes:

- From 10,000 years (0.0001/year) in the *early-succession class (BM-A)*;
- 2,000 years (0.0005/year) in both *mid-succession with or without Joshua tree classes (BM-B and BM-C)*; and
- 1,000 years (0.001/year) in both wooded *late-succession with or without Joshua tree classes (BM-D and BM-E)*.

Replacement fire in vegetation classes that already experienced a threshold transition also causes a threshold transition to other uncharacteristic classes.

- Fire experienced every 400 years (0.0025/year) on average in the *tree encroached shrubland with exotic annual species class (TEX)* causes a transition to the *exotic annual species class (EX)*.
- The *shrubland with mixed exotic annual and native perennial species class (SEP)* burns every 200 years (0.005/year) on average, causing a transition to the *once-burned exotic annual species class (EX)* or *twice-burned exotic annual species class (EX2B)*, respectively, for shrubland with previously unburned and burned (i.e., absent) blackbrush.
- The *twice-burned exotic annual species class (EX2B)* and *once-burned exotic annual species class (EX)* classes burn every 10 years (0.1/year) on average from ages 0 to 20 years classes (self loop), whereas the *EX* class older than 20 years burns every 20 years on average. When the *once-burned exotic annual species class (EX)* class burns, it becomes the *twice-burned exotic annual species class (EX2B)* from which shrub natural recovery is nearly impossible without dedicated management.
- *Planted (PL)* and *seeded (SD)* classes, whose exotic annual fine fuel component is temporally suppressed, burn every 1,000 years (0.001/year). These classes transition to age zero in the same class (this possibility is very remote because residence time in these classes is short due to exotic annual seedbank emergence).

Blackbrush is assumed drought adapted. Older reference classes with juniper and pinyon and some uncharacteristic classes are affected. *Drought* causes stand replacing events (generally 1% to 10% of events) and stand thinning (99% to 90%, respectively, of events) in classes with trees. A *drought* return interval rate of every 178 years (a rate of 0.0056/year) is used based on the frequency of severe drought intervals estimated by Biondi et al. (2007) from 2,300 years of western juniper (*Juniperus occidentalis*) tree ring data from the Walker River drainage of eastern California and western Nevada.

Although we recognize that droughts may be more common than every 178 years, severe droughts, which are >7-year drought events with consecutive far-below average soil moisture (narrow tree rings), kill naturally drought resistant shrubs and trees.

- For the *late-succession closed with Joshua tree* class (*BM-E*), drought-induced mortality either:
 - Causes a transition to the previous succession class (*BM-B*) 99% of times by thinning juniper and pinyon; or
 - Kills shrubs and trees as a rare stand replacing event (1% of events), causing a transition to the *early succession* class (*BM-A*).
- For the *late-succession open without Joshua tree* class (*BM-D*), drought-induced mortality either:
 - Causes a transition to the previous succession class (*BM-C*) 99% of times by thinning juniper and pinyon; or
 - Kills shrubs and trees as a rare stand replacing event (1% of events) causing a transition to the *early succession* class (*BM-A*).
- The *tree-encroached shrubland with exotic annual species* class (*TEX*) experiences drought with:
 - Thinning back to age 400 years within the class for about 90% of times. We chose 90% thinning, as opposed to 99%, because trees are at the elevational lower limit of their tolerance to warmer climate and competition for soil moisture is assumed more intense among denser tree stands.
 - The remaining 10% of drought mortality is partitioned as 1% going to the *once-burned exotic annual species* class (*EX*) and 9% to the *mid-succession* classes (reflecting their landscape proportions of 5.7% and 3.3%, respectively, for *shrubs with exotic annual species with and without Joshua trees* [*SEPJ* and *SEP*]).
- The *shrubs with exotic annual species with and without Joshua trees* classes (respectively, *SEPJ* and *SEP*) each experience drought following:
 - The self-thinning proportion of 99% (and woody succession reversal to the beginning ages of the class); and
 - Transition to the *once-burned exotic annual grassland and forbland* class (*EX*) for the remaining 1% of events.
- The *seeded* (*SD*), but not the *planted* (*PL*) class:
 - Is thinned by drought within the class causing a reversal of woody succession 90% of times; whereas
 - The remaining 10% of times the transition is to the *once-burned exotic annual grassland and forbland* class (*EX*). We use a 10% stand-replacing event proportion to reflect that plantings are more fragile than natural shrublands.

Tree (pinyon and juniper) invasion is responsible for the last succession step between both *mid-succession* classes (*BM-B* and *BM-C*) and their respective *late-succession* classes (*BM-E* and *BM-D*, respectively). This disturbance also determines succession between both *shrubland with mixed exotic annual and native perennial species* classes (*SEP* and *SEPJ*) and the *tree-encroached shrubland with exotic annual species* class (*TEX*). Pinyon and juniper invade shrublands at a rate 0.0025/year after 400 years of age.

A few anthropogenic disturbances cause accelerated woody succession in reference classes and

transitions to uncharacteristic classes of vegetation.

Present only in Beaver Dam Wash NCA, *managed herbivory* and *excessive herbivory* have return intervals of one year (livestock is present every year) but different impact areas based on the distance livestock is willing to travel away from water. The impact of grazing is modeled with fixed rates of implementation (around an average) because grazing permits have fixed stocking rates, season of use, distribution. It is assumed that *managed herbivory* utilizes 5% of all grazable areas in the Beaver Dam Wash NCA (not just blackbrush); therefore, only 5% of the area is selected for *managed herbivory* and vegetation classes in blackbrush “compete” for selection. This method of modeling livestock grazing can only be implemented with the PATH software; VDDT cannot achieve landscape-level disturbances. Similarly, *excessive herbivory* affects 0.1% of the Beaver Dam Wash NCA causing a transition to the *early shrub* class (ES); however, *excessive herbivory* is caused by the movement of livestock through the same areas near or on the way to water sources. Therefore, once areas dominated by early shrubs are created, they become permanent and no new areas are created unless watering sources are moved or created. As a consequence, 0.1% of the Beaver Dam Wash is chosen among candidate vegetation classes to become the *early shrub* class (ES) in the first years of simulations, and then the process is stopped.

Managed herbivory causes the following:

- Accelerates woody succession by
 - One year in the *early-succession* class (BM-A) and *once-burned exotic annual grassland and forbland* class (EX); and
 - Three years in other classes through consumption of palatable herbaceous species.
- The *tree-encroached shrubland with exotic annual species* class (TEX) is not grazed.
- *Managed-herbivory* in the *planted* (PL) or *seeded* (SD) classes causes a transition to the *once-burned exotic annual grassland and forbland* class (EX).

Excessive herbivory is present in the *early-succession* (BM-A), *mid-succession closed* (BM-B), *midsuccession-open* (BM-C), *shrubland with mixed exotic annual species and perennial grasses* (BM-SEP and BM-SEPJ), *once-burned exotic annual grassland and forbland* class (EX), *planted* (PL), and *seeded* (SD) classes. The disturbance only causes a transition to the *early shrub* class (ES) during the first five years of simulation.

Exotic invasion affects the reference (BM-A, BM-B, BM-C, BM-D, and BM-E), *early-shrub* (ES), *planted* (PL) and, *seeded* classes at a rate of 0.005/year. We chose an invasion rate equal to that of the big sagebrush steppe-upland ecological system because of the mesic condition of the blackbrush ecological system.

- Before age 5, *exotic invasion* of the *early-succession* class (BM-A) causes a transition to the *exotic annual species* class (EX); whereas
- After age 5, the transition will be to both *shrubland with mixed exotic annual species and perennial grasses* classes (BM-SEP and BM-SEPJ) (if Joshua tree is present, the transition is partitioned according to the proportion of Joshua tree versus no Joshua tree in the ecological system).
- The *planted* class (PL) transitions to both *shrubland with mixed exotic annual species and perennial grasses* classes (BM-SEP and BM-SEPJ) as above.
- The *seeded* class (SD) converts to the *once-burned exotic annual grassland and forbland* class

(EX).

Seedbank-emergence is a disturbance specific to the *planted (PL)* and *seeded (SD)* classes. These classes are created with an application of herbicide or biocide that inhibits germination, thus controlling exotic annuals. In the Mojave Desert, the duration of the herbicide or biocide's residual effect is 2-3 years. Therefore, the seedbank emerges at a high rate of 0.2/year (it takes about 5+ years for full conversion) after this period:

- The planting reverts to either *shrubland with mixed exotic annual species and perennial grasses* classes (*BM-SEP* and *BM-SEPJ*) classes; and
- The seeding transforms to the *once-burned exotic annual forbland and forbland* class (*EX*).

Natural-recovery is also a disturbance specific to the *planted (PL)* and *seeded (SD)* classes. After 20 years in these classes without 10 years of consecutive grazing from age 10 to 20, the class will transition to the *early-succession* class (*BM-A*).

The *Utilities* disturbance is predominantly the establishment of right-of-ways (pipelines and powerlines) made of excavated or cleared areas that become the *once-burned exotic annual forbland and forbland* (*EX*) class. The rate is low (0.0001/year) and present in all classes.

The *OHV* disturbance creates the *bare ground* class (*BG*) from illegal recreational use of off-highway vehicles. All classes are source classes. The rate is 10% of 0.0001/year to reflect that users predominantly reuse existing disturbed areas and only incrementally add new areas of illegal driving.

Management Actions:

Modeled management activities included fuel breaks, livestock closure (localized), law-enforcement, cessation of livestock grazing, and herbicide or fingers-of-death used alone and coupled with native plant seeding and planting:

- Fuel breaks are 250 feet wide strips of vegetation aerially sprayed with herbicide (Plateau®) to remove the continuous fine fuel beds created by exotic annual species. Strips are placed throughout the landscape and benefit all ecological systems by slowing or stopping wildfires. Spraying is only conducted during years of higher precipitation (perhaps following a 7-year El Nino cycle) or during of years of seedbank emergence not associated with high precipitation.
- Livestock-closure is a landscape-level treatment of the Beaver Dam Wash NCA that is applied to seedings and plantings. Closure results in the protection of seedings and plantings from livestock grazing for 10 consecutive years to the extent that enough resources (funding) allow it. Funding is shared with other ecological systems.
- Law enforcement only affects the creation of one vegetation class from OHV activity in several ecological systems of the Beaver Dam Wash NCA: *bare ground (BG)*. Increased law-enforcement reduces the OHV disturbance by 50% (to 5% from 10%) using a static transition multiplier in PATH.
- Complete cessation of livestock grazing of the Beaver Dam Wash NCA was achieved by setting the static transition multiplier (in PATH) for livestock grazing to zero.
- Herbicide (Plateau®) application to control exotic annual grasses in the *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by seeding native plant species with the current mix of seed sources. Failure rate is 99%, leading to the *exotic annual*

grassland and forblands class (EX). Success causes a transition to the *seeded class (SD)*.

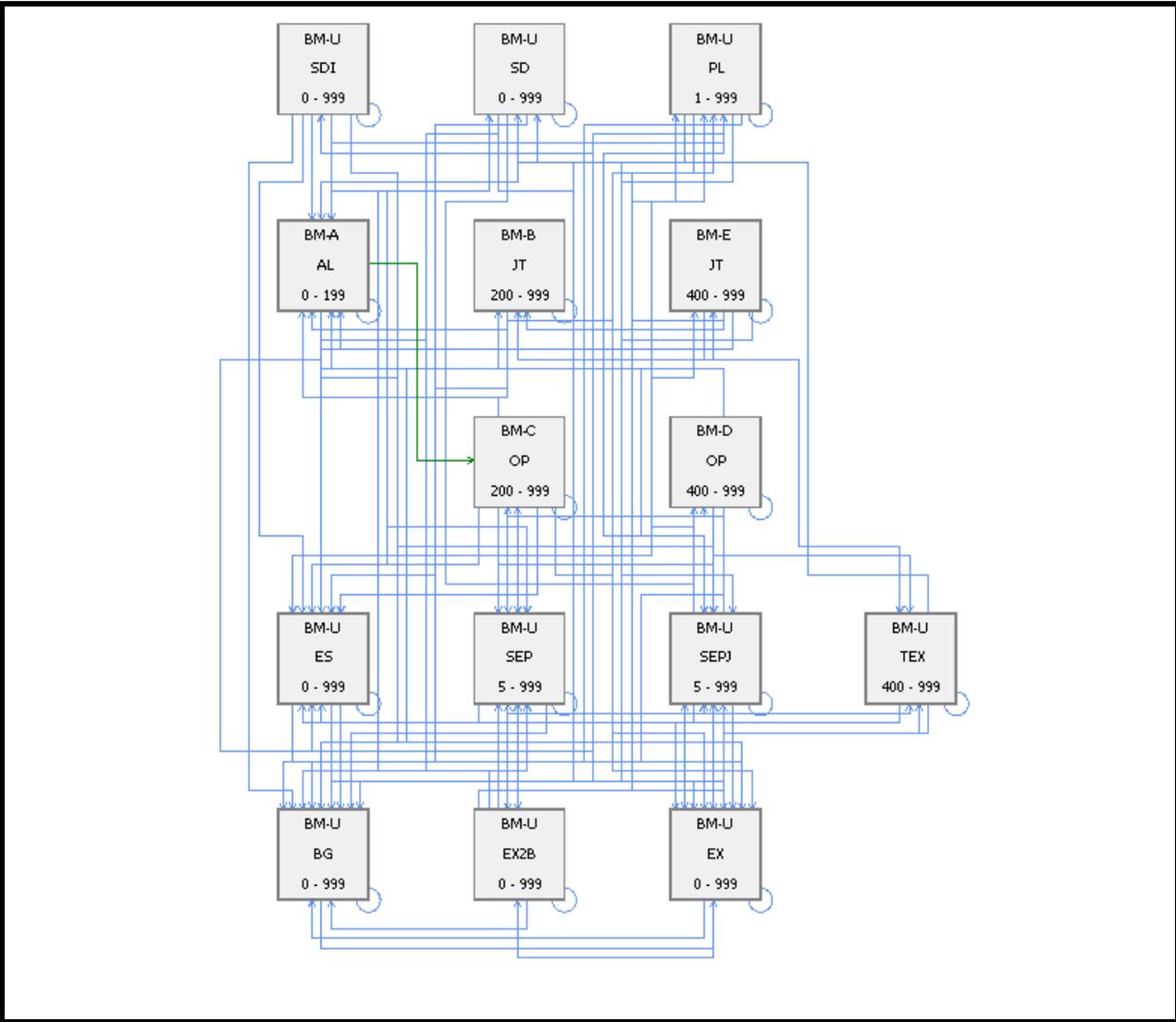
- Herbicide (Plateau®) application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands classes (EX and EX2B)* followed by seeding native plant species with new high-performance cultivars whose commercial release is scheduled to be 20 years in the future. Failure rate is 95%, leading to the *exotic annual grassland and forblands class (EX)*. Success causes a transition to the *seeded class (SD)*.
- Herbicide (Plateau®) application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands classes (EX and EX2B)* followed by planting of containerized native shrubs and forbs. Failure rate is 25%, leading to the *exotic annual grassland and forblands class (EX)*. Success causes a transition to the *planted class (SD)*.
- Fingers-of-death fungi application to control exotic annual species in the *shrubland with mixed exotic annual and perennial grass species (SEP)* and *shrubland with mixed exotic annual, and perennial grass and Joshua tree (SEPJ)* classes. Failure rate is 25% to 75% (no change of class), whereas success causes a transition to the *mid-succession (BM-B and BM-C)* and *late-succession classes (BM-D and BM-E)* depending on the age of originating vegetation and the presence of Joshua tree in the originating class.
- Fingers-of-death fungi application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands classes (EX and EX2B)* followed by seeding native plant species with new high-performance cultivars whose commercial release is scheduled to be 20 years in the future. Failure rate is 95%, leading to the *exotic annual grassland and forblands class (EX)*, because seedling establishment and survival remains the limiting factor even with the fingers-of-death fungi. Success causes a transition to the *seeded class (SD)*.
- Fingers-of-death fungi application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands classes (EX and EX2B)* followed by planting of containerized native shrubs and forbs. Two levels of failure rates apply to the treatment. Failure rate of planting is 25% (no change in vegetation class), leading to the *exotic annual grassland and forblands class (EX)*. Success causes a transition to the *planted class (PL)*. After shrubs and forbs are planted, the fungi-of-death fungi failure rate was tested at three different levels: 25%, 50%, and 75%. If the fingers-of-death fungi fails to control the seedbank of exotic annual species, the *planted class (PL)* transitions to the *shrubland with mixed exotic annual and perennial grass species (SEP)* and *shrubland with mixed exotic annual and perennial grass, and Joshua tree (SEPJ)* classes. The amount of either class created depends on the proportion of area with and without Joshua tree in the ecological system. Success keeps vegetation in the *planted class (PL)* until either future invasion by exotic species or natural recovery to *early-succession class (BM-A)*.

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State-and-Transition Model:



Blackbrush - thermic (BT) 1082t

Area of Application and Context:

- Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah
- Livestock grazing on Beaver Dam Wash only
- Full fire suppression management
- Date created: July 2011

Vegetation classes:

Two versions of thermic blackbrush were developed at the request of stakeholders: with and without Joshua Trees. USDA's Natural Resource Conservation Service (NRCS), however, does not recognize Joshua tree woodlands as a distinct ecological site because the soils on which it grows are the same the soils as creosotebush-white bursage, thermic and mesic blackbrush, and Great Basin mixed salt desert ecological sites. Joshua tree is absent from the Red Cliffs NCA and from some areas of the Beaver Dam Wash NCA (thus boxes B and U-SEPJ below do not exist). Joshua tree is present in a large fraction of the Beaver Dam Wash NCA and the description below apply in its entirety:

- **BM-A: Early;** 0-50% cover of snakeweed, turpentine bush, yucca; <10% cover blackbrush; 0-499 yrs
- **BM-B: Late-closed;** 10-40% cover blackbrush <1.0m; creosotebush present; >1% cover of Joshua trees; 0-10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threawn), other shrubs present; 500+ yrs
- **BM-C: Late-open;** 10-40% cover blackbrush <1.0m; creosotebush present; 0-10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threawn); other shrubs present; 500+ yrs
- **U-ES: Early-Shrub;** 20-50% cover of cholla, snakeweed or rabbitbrush species
- **U-SEPJ: Shrub-Exotic-Species-Perennial-Grass-Joshua-Tree;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; >1% cover of Joshua trees; ≥5% native grass cover
- **U-SEP: Shrub- Exotic-Species-Perennial-Grass;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; Joshua trees **absent**; ≥5% native grass cover
- **U-SES: Shrub-Exotic-Species;** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <5% native grass cover
- **U-EX: Exotic-Species;** >10% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <10% cover of blackbrush or other shrubs; unburned and charred Joshua tree may be present
- **U-EX2B: Exotic-Species-2nd-Burn;** identical to U-EX, except that it has experienced a second burn.
- **U-PL: Planted;** >5% planted shrubs and perennial herbaceous species; <5% non-native annual grasses and forbs
- **U-BG: Bare ground;** mineral soil exposed by human disturbances

Reference Condition:

- Natural Range of Variability without Joshua tree

- 5%: A-Early
- 0%: B-Mid-closed
- 95%: C-Mid-open
- 0%: U

- **Natural Range of Variability with Joshua tree**

- 5%: A-Early
- 48%: B-Mid-closed
- 47%: C-Mid-open
- 0%: U

Succession:

Succession varies with the presence of Joshua trees.

In the absence of Joshua trees, succession follows the 2-box pathway with vegetation starting as predominantly dominated by snakeweed and herbaceous species and ending with a shrublands with a significant cover of blackbrush. Deterministic succession transitions occur between the first two boxes:

- Early-succession to mid-succession open: 500 years

With Joshua trees, succession is a 3-box model with parallel open and closed branches originating from the *early-succession* class (*BT-A*). Deterministic transitions govern succession between the *early succession* (*BM-A*) and both *mid-succession* classes (*BM-B* and *BM-C*). The deterministic transition is not a true succession and reflects a partitioning of acres proportional to the current area without and with Joshua tree.

- Early-succession to mid-succession open and closed: 500 years

Natural Disturbances:

Very few natural disturbances affect thermic blackbrush: replacement fire and drought. Blackbrush is an ancient vegetation type whose individual plants resisted disturbances for hundreds of years (Pendleton et al. 1986). Moreover, blackbrush is not fire adapted and has not evolved with fire (Callison et al. 1985).

Replacement fire was present at very low rates in most classes. The fire return interval of *replacement fire* was 10,000 years (0.0001/year) in all reference classes. *Replacement fire* in vegetation classes that already experienced a threshold transition also cause a threshold transition to other uncharacteristic classes:

- The *shrubland with mixed exotic annual and native perennial species* classes (*SEP* and *SEPJ*) burn every 200 years (0.005/year) on average, causing a transition to the *once-burned exotic annual species* class (*EX*) or *twice-burned exotic annual species* class (*EX2B*), respectively, for shrubland with previously unburned and burned (i.e., absent) blackbrush (the arbitrary difference is an age of 500 years).
 - From ages 0 to 20 years, the *EX2B* and *EX* classes burn every 10 years (0.1/year) on

average (self loop);

- For vegetation older than 20 years, the *once-burned exotic annual species* class (*EX*) class burns every 20 years on average. When the *EX* class burns, it becomes the *twice-burned exotic annual species* class (*EX2B*) from which shrub natural recovery is nearly impossible without dedicated management.
- *Planted* (*PL*) and *seeded* (*SD*) classes, whose exotic annual fine fuel component is temporally suppressed, burn every 1,000 years (0.001/year) on average. Burned vegetation transitions to age zero in the same class (this possibility is very remote because residence in these classes is short due to exotic annual seedbank emergence).
- The *early-shrub* (*ES*) class also burns every 1,000 years (0.001/year) on average; resulting vegetation stays in the class and returns to age zero.

Blackbrush is drought adapted. Only uncharacteristic classes are affected. *Drought* causes stand replacing events (generally 1% to 10% of times) and stand thinning (99% to 90%, respectively, of times). A *drought* return interval rate of every 178 years (a rate of 0.0056/year) is used based on the frequency of severe drought intervals estimated by Biondi *et al.* (2007) from 2,300 years of western juniper (*Juniperus occidentalis*) tree ring data from the Walker River drainage of eastern California and western Nevada. Although we recognize that droughts may be more common than every 178 years, severe droughts, which are >7-year drought events with consecutive far-below average soil moisture (narrow tree rings), kill naturally drought resistant shrubs and trees.

- The *shrubland with mixed exotic annual and native perennial species* classes (*SEP* and *SEPJ*) each experience drought with the self-thinning proportion of 99%, whereas vegetation transitions to the *once-burned exotic annual grassland and forbland* class (*EX*) for the remaining 1% of events.
- The same partitioning of drought effects applies to the *planted* (*PL*) class with 1% transitioning to the *once-burned exotic annual grassland and forbland* class (*EX*) and the remaining 99% staying in the *planted* (*PL*) class but at an age of zero.
- The *seeded* (*SD*) class is thinned by drought within the class causing a reversal of woody succession 90% of times, whereas the remaining 10% of times the transition is to the *once-burned exotic annual grassland and forbland* class (*EX*). We used a 10% stand-replacing event proportion to reflect that plantings are more fragile than natural shrublands.

A few anthropogenic disturbances cause accelerated woody succession in reference classes and some transition to uncharacteristic classes of vegetation.

Present only in Beaver Dam Wash NCA, *managed herbivory* and *excessive herbivory* have return intervals of one year (livestock is present every year) but different impact areas based on the distance livestock is willing to travel away from water. The impact of grazing is modeled with fixed rates of implementation (around an average) because grazing permits have fixed stocking rates, season of use, distribution. It is assumed that *managed herbivory* utilizes 5% of all grazable areas in the Beaver Dam Wash NCA (not just blackbrush); therefore, only 5% of the area is selected for *managed herbivory* and vegetation classes in blackbrush “compete” for selection. This method of modeling livestock grazing can only be implemented with the PATH software; VDDT cannot achieve landscape-level disturbances. Similarly, *excessive herbivory* affects 0.1% of the Beaver Dam Wash NCA causing a transition to the *early*

shrub class (ES); however, *excessive herbivory* is caused by the movement of livestock through the same areas near or on the way to water sources. Therefore, once areas dominated by early shrubs are created, they become permanent and no new areas are created unless watering sources are moved or created. As a consequence, 0.1% of the Beaver Dam Wash is chosen among candidate vegetation classes to become the *early shrub* class (ES) in the first years of simulations, and then the process is stopped.

Managed herbivory accelerates woody succession by:

- Two years in the *reference* classes (BT-A, BT-B, and BT-C) and both *shrubland with mixed exotic annual and native perennial species* classes (SEP and SEPJ); and
- By one year in the *once-burned exotic annual grassland and forbland* class (EX) accelerates woody succession (succession to a shrub class too young to have blackbrush is likely), but has no effect in the *twice-burned exotic annual grassland and forbland* class (EX2B).

Managed-herbivory in the *planted* (PL) or *seeded* (SD) classes have different outcomes:

- A transition to the *once-burned exotic annual grassland and forbland* class (EX) for the highly exposed and vulnerable *planted* (PL) class; and
- A self loop with a one-year reversal of woody succession within the *seeded* (SD) class (the seeds of this class do not all emerge at once from the seedbank and become immediately vulnerable).

Excessive herbivory is present in the *early-succession* (BT-A), *mid-succession closed* (BT-B), *mid-succession-open* (BT-C), *shrubland with mixed exotic annual species and perennial grasses* (BT-SEP and BT-SEPJ), *once-burned exotic annual grassland and forbland* class (EX), *planted* (PL), and *seeded* (SD) classes. The disturbance only causes a transition to the *early shrub* class (ES) during the first five years of simulation.

Exotic invasion affects the *reference* (BT-A, BT-B [Beaver Dam Wash NCA only]), and BT-C), *bare ground* (BG), *early-shrub* (ES), *planted* (PL), and *seeded* (SD) classes at a rate of 0.005/year, the same as for mesic blackbrush.

- For the *early-succession* class (BT-A):
 - Before age 5, *exotic invasion* causes a transition to the *exotic annual grassland and forbland* class (EX); whereas
 - After age 5, the transition will be to both *shrubland with mixed exotic annual species and perennial grasses* (BT-SEP and BT-SEPJ) (if Joshua tree is present, the transition is partitioned according to the proportion of Joshua tree *versus* no Joshua tree in the ecological system).
- The *planted* class (PL) converts to both *shrubland with mixed exotic annual species and perennial grasses* classes (BT-SEP and BT-SEPJ) as above,
- The *seeded* (SD) and *bare ground* (BG) classes transitions to the *once-burned exotic annual grassland and forbland* class (EX).

Seedbank-emergence is a disturbance specific to the *planted* (PL) and *seeded* (SD) classes. These classes are created with an application of herbicide or biocide that inhibits germination to control exotic annual species. In the Mojave Desert, the duration of the herbicide or biocide's residual effect is 2-3 years. Therefore, the seedbank emerges at a high rate of 0.2/year (it takes about 5+ years for full conversion) after this period:

- Plantings revert to both *shrubland with mixed exotic annual species and perennial grasses*

(*BT-SEP* and *BT-SEPJ*) classes; and

- Seedlings transition to the *once-burned exotic annual forbland and forbland (EX)* class.

Natural-recovery is also a disturbance specific to the *planted (PL)* and *seeded (SD)* classes. After 20 years in these classes without 10 years of consecutive grazing from age 10 to 20, the class will transition to the *early-succession* class (*BT-A*) at a slow rate of 0.1/year (1 of 10 pixels per year).

The *Utilities* disturbance is predominantly the establishment of right-of-ways (pipelines and powerlines) made of excavated or cleared areas that become the *once-burned exotic annual forbland and forbland (EX)* class. The rate is low (0.0001/year) and present in all classes.

The *OHV* disturbance creates the *bare ground (BG)* class from illegal recreational use of off-highway vehicle, primarily in the Beaver Dam Wash NCA. All classes are source classes. The rate is 10% of 0.0001/year to reflect that users predominantly reuse existing disturbed areas and only incrementally add new areas of illegal driving.

Management Actions:

Modeled management activities included fuel breaks, livestock closure (localized), law-enforcement, cessation of livestock grazing, and herbicide or fingers-of-death used alone and coupled with native plant seeding and planting:

- Fuel breaks are 250 feet wide strips of vegetation aerially sprayed with herbicide (Plateau®) to remove the continuous fine fuel beds created by exotic annual species. Strips are placed throughout the landscape and benefit all ecological systems by slowing or stopping wildfires. Spraying is only conducted during years of higher precipitation (perhaps following a 7-year El Nino cycle) or during of years of seedbank emergence not associated with high precipitation.
- Livestock-closure is a landscape-level treatment of the Beaver Dam Wash NCA that is applied to seedlings and plantings. Closure results in the protection of seedlings and plantings from livestock grazing for 10 consecutive years to the extent that enough resources (funding) allow it. Funding is shared with other ecological systems.
- Law enforcement only affected the creation of one vegetation class from OHV activity in several ecological systems of the Beaver Dam Wash NCA: *bare ground (BG)*. Increased law-enforcement reduces the OHV disturbance by 50% (to 5% from 10%) using a static transition multiplier.
- Complete cessation of livestock grazing of the Beaver Dam Wash NCA was achieved by setting the static transition multiplier for livestock grazing to zero.
- Herbicide (Plateau®) application to control exotic annual grasses in the *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by seeding native plant species with the current mix of seed sources. Failure rate is 99%, leading to the *exotic annual grassland and forblands* class (*EX*). Success causes a transition to the *seeded* class (*SD*).
- Herbicide (Plateau®) application to control exotic annual grasses in the *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by seeding native plant species with new high-performance cultivars whose commercial release is scheduled to be 20 years in the future. Failure rate is 95%, leading to the *exotic annual grassland and forblands* class (*EX*). Success causes a transition to the *seeded* class (*SD*).
- Herbicide (Plateau®) application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by planting of containerized

native shrubs and forbs. Failure rate is 25%, leading to the *exotic annual grassland and forblands* class (EX). Success causes a transition to the *planted* class (SD).

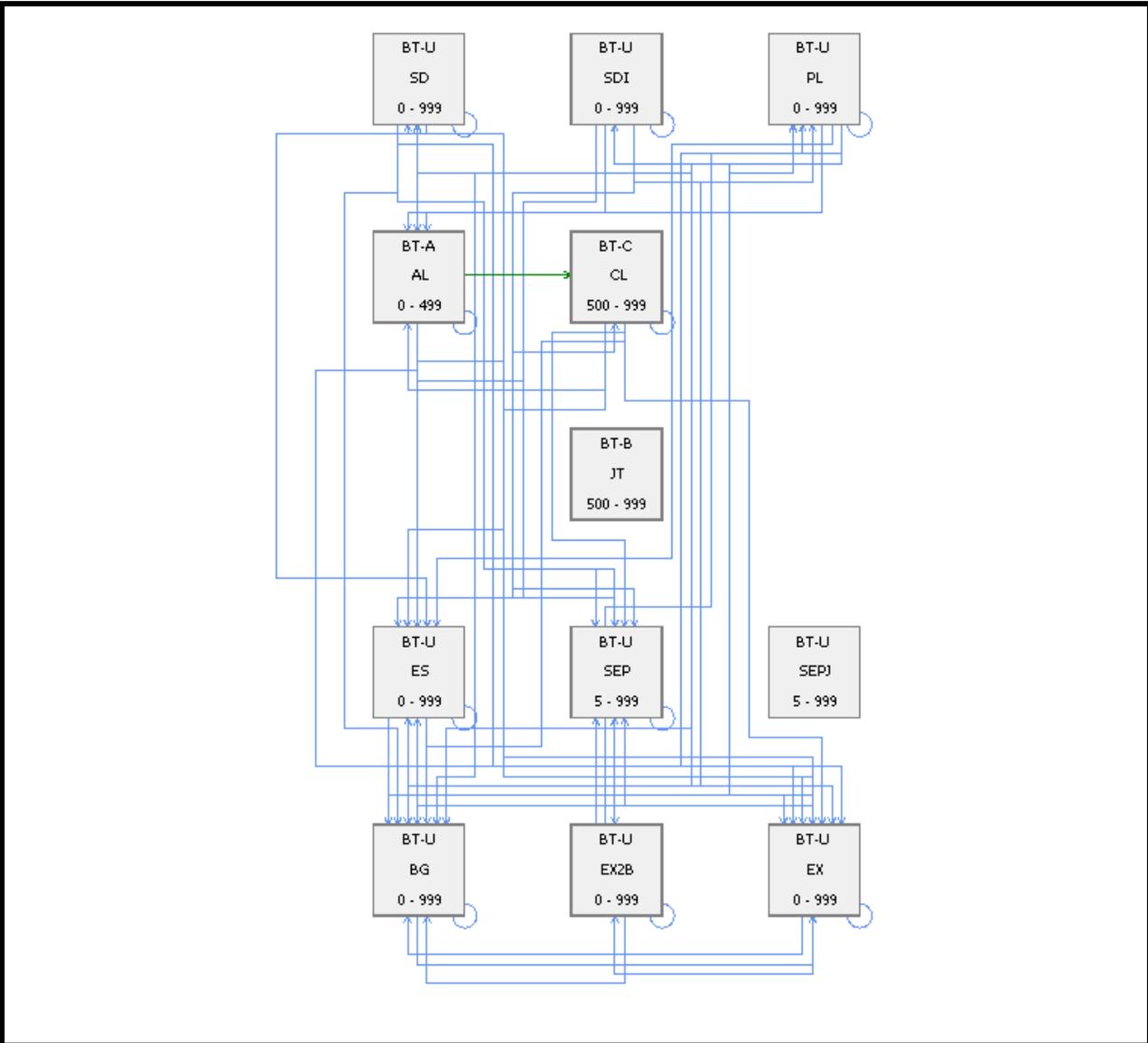
- Fingers-of-death fungi application to control exotic annual species in the *shrubland with mixed exotic annual and perennial grass species (SEP)* and *shrubland with mixed exotic annual, and perennial grass and Joshua tree (SEPJ)* classes. Failure rate is 25% to 75% (no change of class), whereas success causes a transition to the *mid-succession (BT-B and BT-C)* and *late-succession* classes (BT-D and BT-E) depending on the age of originating vegetation and the presence of Joshua tree in the originating class.
- Fingers-of-death fungi application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (EX and EX2B) followed by seeding native plant species with new high-performance cultivars whose commercial release is scheduled to be 20 years in the future. Failure rate is 95%, leading to the *exotic annual grassland and forblands* class (EX), because seedling establishment and survival remains the limiting factor even with the fingers-of-death fungi. Success causes a transition to the *seeded* class (SD).
- Fingers-of-death fungi application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (EX and EX2B) followed by planting of containerized native shrubs and forbs. Two levels of failure rates apply to the treatment. Failure rate of planting is 25% (no change in vegetation class), leading to the *exotic annual grassland and forblands* class (EX). Success causes a transition to the *planted* class (PL). After shrubs and forbs are planted, the fungi-of-death fungi failure rate was tested at three different levels: 25%, 50%, and 75%. If the fingers-of-death fungi fails to control the seedbank of exotic annual species, the *planted* class (PL) transitions to the *shrubland with mixed exotic annual and perennial grass species (SEP)* and *shrubland with mixed exotic annual and perennial grass, and Joshua tree (SEPJ)* classes. The amount of either class created depends on the proportion of area with and without Joshua tree in the ecological system. Success keeps vegetation in the *planted* class (PL) until either future invasion by exotic species or natural recovery to *early-succession* class (BM-A).

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State-and-Transition Model:



Creosotebush-White Bursage (CB) 1087

Area of Application and Context:

- **Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah**
- **Livestock grazing on Beaver Dam Wash only**
- **Full fire suppression management**
- **Date created: July 2011**

Vegetation classes:

Two versions of creosotebush-white bursage were developed at the request of stakeholders: with and without Joshua Trees. USDA's Natural Resource Conservation Service (NRCS), however, does not recognize Joshua tree woodlands as a distinct ecological site because the soils on which it grows are the same the soils as creosotebush-white bursage, thermic and mesic blackbrush, and Great Basin mixed salt desert ecological sites. Joshua tree is absent from the Red Cliffs NCA and from some areas of the Beaver Dam Wash NCA (thus boxes B, D, and U-SEPJ below do not exist). Joshua tree is present in a large fraction of the Beaver Dam Wash NCA and the description below apply in its entirety:

- **CB-A: Early**; 5-20% cover of creosote and white bursage builds up over time; 5-20% grass cover depending on winter precipitation and season; 0-19 yrs
- **CB-B: Mid-closed**; 21-40% creosote and white bursage cover; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); >1% cover of Joshua trees; 20+ yrs
- **CB-C: Late-open**; 21-40% creosote and white bursage cover; Joshua trees **absent**; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); 20+ yrs
- **CB-D: Late-closed**; 21-40% creosote and white bursage cover; >1% cover of Joshua trees; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); 400+ yrs
- **U-ES: Early-Shrub**; 20-50% cover of cholla, snakeweed or rabbitbrush species
- **U-SEP: Shrub-Exotic-Species-Perennial-Grass**; 21-40% cover of creosote and white bursage; 0-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); Joshua trees **absent**
- **U-SEPJ: Shrub-Exotic-Species-Perennial-Grass-Joshua-Tree**; 21-40% cover of creosote and white bursage; 0-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); >1% cover of Joshua trees
- **U-SES: Shrub-Exotic-Species**; 10-40% cover of creosotebush or other shrubs <1.0m tall; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <5% cover of native grasses or forbs; Joshua tree **absent**
- **U-SESJ: Shrub-Exotic-Species-Joshua-Tree**; 10-40% cover of creosotebush or other shrubs <1.0m tall; 5-20% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; >1% cover of Joshua trees; <5% cover of native grasses and forbs
- **U-EX: Exotic-Species**; >10% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; <10% cover of creosotebush or other shrubs; unburned and charred Joshua tree may be present
- **U-EX2B: Exotic-Species-2nd-Burn**; identical to U-EX, except that it has experienced a second burn
- **U-SD: Seeded (native)**; >10% seeded native grasses, forbs, and shrubs
- **U-SDI: Seeded (introduced)**; >10% seeded non-native grasses, forbs, and shrubs

- U-PL: **Planted**; >5% planted shrubs and perennial herbaceous species; <5% non-native annual grasses and forbs
- U-BG: **Bare ground**; mineral soil exposed by human disturbances

Reference Condition:

- **Natural Range of Variability without Joshua tree**
 - 8%: A-Early
 - 0%: B-Mid-closed
 - 92%: C-Mid-open
 - 0%: U
- **Natural Range of Variability with Joshua tree**
 - 9%: A-Early
 - 36%: B-Mid-closed
 - 38%: C-Mid-open
 - 17%: D-Late-closed
 - 0%: U

Succession:

Succession varies with the presence of Joshua trees.

In the absence of Joshua trees, succession follows the 2-box pathway with vegetation starting as predominantly dominated by resprouting (mostly from vegetative recolonization) and herbaceous species and ending with a sometimes diverse community of creosotebush (loamier soil) and/or white bursage (harsher, warmer soils). Deterministic succession transitions occur between the first two boxes:

- Early-succession to mid-succession open: 20 years

With Joshua trees, succession is a 4-box model with parallel open (shorter) and closed (longer) branches originating from the *early-succession* class (CB-A). Deterministic transitions govern succession between the *early succession* (CB-A) and both *mid-succession* classes (CB-B and CB-C). The deterministic transition is not a true succession and reflects a partitioning of acres proportional to the current area without and with Joshua tree. A second succession step occurs at age 399 in the closed branch with Joshua trees.

- Early-succession to mid-succession open and closed: 20 years
- Mid-succession closed to late-succession closed: 399 years

Natural Disturbances:

Very few natural disturbances affect creosotebush-white bursage: drought and replacement fire. Creosotebush-white bursage is not fire adapted and has not evolved with fire.

Replacement fire is present at very low rates in most classes:

- The fire return interval is 2,000 years (0.0005/year) in all reference classes, except the late-succession closed (*CB-D*) class that contains more fuel (interval of 1,000 years or a rate of 0.001/year).
- *Replacement fire* in vegetation classes that already experienced a threshold transition also cause a threshold transition to other uncharacteristic classes.
 - The *shrubland with mixed exotic annual and native perennial species* classes (*SEP* and *SEPJ*) burns every 600 years (0.0015+/year) on average, causing a transition to the *once-burned exotic annual species* class (*EX*).
 - The *twiced-burned exotic annual grassland and forbland* class (*EX2B*) burns every 10 years (0.1/year) on average (self loop); and
 - The *once-burned exotic annual grassland and forbland* class (*EX*), which contains recovering shrubs, is converted to the *twice-burned exotic annual grassland and forbland* class (*EX2B*) class by fire occurring every 20 years (0.05/year) on average.
 - *Planted (PL)* and *seeded (SD)* classes, whose exotic annual fine fuel component is temporally suppressed, burn every 600 years (0.0015+/year) on average and transitions to age zero in the same class (this possibility is very remote because residence in these classes is short due to exotic annual seedbank emergence).
 - The *early-shrub (ES)* class also burns every 1,000 years (0.001/year) on average and resulting vegetation stays in the class and returns to age zero.

Creosotebush is not as drought adapted as blackbrush is assumed to be. Drought is the strongest natural disturbance in this ecological system. A *drought* return interval rate of every 178 years (a rate of 0.0056/year) is used based on the frequency of severe drought intervals estimated by Biondi *et al.* (2007) from 2,300 years of western juniper (*Juniperus occidentalis*) tree ring data from the Walker River drainage of eastern California and western Nevada. Although we recognize that droughts may be more common than every 178 years, severe droughts, which were >7-year drought events with consecutive far-below average soil moisture (narrow tree rings), kill naturally drought resistant shrubs and trees:

- The *mid-succession closed (CB-B)* class and both *late-succession* classes (*CB-C* and *CB-D*) transition to the *early-succession (CB-A)* class;
- The *shrubland with mixed exotic annual and perennial grass species* classes (*SEPJ* and *SEP*) each transition to the *once-burned exotic annual grassland and forbland* class (*EX*); and
- The *planted (PL)* class experiences
 - self-thinning to age zero for 99% of drought events, and
 - a transition to the *once-burned exotic annual grassland and forbland* class (*EX*) for the other 1% of events.

A few anthropogenic disturbances cause accelerated woody succession in reference classes and transitions to uncharacteristic classes of vegetation.

Present only in Beaver Dam Wash NCA, *managed herbivory* and *excessive herbivory* have return intervals of one year (livestock is present every year) but different impact areas based on the distance livestock is willing to travel away from water. The impact of grazing is modeled with fixed rates of implementation (around an average) because grazing permits have fixed stocking rates, season of use,

distribution. It is assumed that *managed herbivory* utilizes 5% of all grazable areas in the Beaver Dam Wash NCA (not just creosotebush-white bursage); therefore, only 5% of the area is selected for *managed herbivory* and vegetation classes in creosotebush-white bursage “compete” for selection. This method of modeling livestock grazing can only be implemented with the PATH software; VDDT cannot achieve landscape-level disturbances. Similarly, *excessive herbivory* affects 0.1% of the Beaver Dam Wash NCA causing a transition to the *early shrub* class (ES); however, *excessive herbivory* is caused by the movement of livestock through the same areas near or on the way to water sources. Therefore, once areas dominated by early shrubs are created, they become permanent and no new areas are created unless watering sources are moved or created. As a consequence, 0.1% of the Beaver Dam Wash is chosen among candidate vegetation classes to become the *early shrub* class (ES) in the first years of simulations, and then the process is stopped.

Managed herbivory accelerates woody succession by:

- Two years in the *reference* class (CB-A, CB-B, CB-C, and CB-D) and both *shrubland with mixed exotic annual and native perennial species* classes (SEP and SEPJ) when a pixel is chosen for grazing;
- One year in the *once-burned exotic annual grassland and forbland* class (EX) (succession to non-blackbrush shrub phase is likely); but has no effect in the *twice-burned exotic annual grassland and forbland* class (EX) (succession to non-blackbrush shrubs state is very unlikely).

Managed-herbivory in the *planted* (PL) or *seeded* (SD) classes have different outcomes:

- A transition to the *once-burned exotic annual grassland and forbland* class (EX) for the highly exposed and vulnerable *planted* (PL) class; and
- A self loop with a one-year reversal of woody succession within the *seeded* (SD) class (the seeds of this class do not all emerge at once from the seedbank and become immediately vulnerable).

Excessive herbivory is present in all classes, except the *bare ground* (BG), *early-shrub* (ES; the recipient class of this disturbance), and *twice-burned exotic annual grassland and forbland* class (EX2B), during the first five years of simulation.

Exotic invasion affects the *reference* (CB-A, CB-B [Beaver Dam Wash NCA only]), and CB-C), *bare ground* (BG), *early-shrub* (ES), *planted* (PL) and *seeded* (SD) classes at a rate of 0.005/year.

- For the *early succession* class (CB-A), *exotic invasion* causes:
 - Before age 19, a transition to the *exotic annual grassland and forbland* class (EX); whereas
 - After age 19, the transition proceeds from classes CB-B, CB-C, CB-D, and ES to both *shrubland with mixed exotic annual species and perennial grasses* classes (CB-SEP and CB-SEPJ) (if Joshua tree is present, the transition is partitioned according to the proportion of Joshua tree *versus* no Joshua tree in the ecological system).
- The *planted* class (PL) converts to both *shrubland with mixed exotic annual species and perennial grasses* classes (BT-SEP and BT-SEPJ) as above,
- The *seeded* (SD) and *bare ground* (BG) classes transition to the *once burned exotic annual grassland and forbland* class (EX).

Seedbank-emergence is a disturbance specific to the *planted* (PL) and *seeded* (SD) classes. These classes are created with an application of herbicide or biocide that inhibits germination to control exotic annual

species. In the Mojave Desert, the duration of the herbicide or biocide's residual effect is 2-3 years. Therefore, the seedbank emerges at a high rate of 0.2/year (it takes about 5+ years for full conversion) after this period:

- Plantings revert to both *shrubland with mixed exotic annual species and perennial grasses* (*CB-SEP* and *CB-SEPJ*) classes according to the proportion of creosotebush-white bursage with Joshua trees in Beaver Dam Wash NCA (no Joshua tree in Red Cliffs NCA); and
- Seedlings transition to the *once-burned exotic annual forbland and forbland* (*EX*) class.

Natural-recovery is also a disturbance specific to the *planted* (*PL*) and *seeded* (*SD*) classes. After 20 years in these classes without 10 years of consecutive grazing from age 10 to 20, the class will transition to the *early-succession* class (*CB-A*) at a slow rate of 0.1/year (1 of 10 pixels per year).

The *Utilities* disturbance is predominantly the establishment of right-of-ways (pipelines and powerlines) with excavated or cleared areas that become the *once-burned exotic annual forbland and forbland* (*EX*) class. The rate is low (0.0001/year) and present in all classes.

The *OHV* disturbance creates the *bare ground* (*BG*) class from illegal recreational use of off-highway vehicles, primarily in the Beaver Dam Wash NCA. All classes are source classes. The rate is 10% of 0.0001/year to reflect that users predominantly reuse existing disturbed areas and only incrementally add new areas of illegal driving.

Management Actions:

Modeled management activities included fuel breaks, livestock closure (localized), law-enforcement, cessation of livestock grazing, and herbicide or fingers-of-death used alone and coupled with native plant seeding and planting:

- Fuel breaks are 250 feet wide strips of vegetation aerially sprayed with herbicide (Plateau®) to remove the continuous fine fuel beds created by exotic annual species. Strips are placed throughout the landscape and benefit all ecological systems by slowing or stopping wildfires. Spraying is only conducted during years of higher precipitation (perhaps following a 7-year El Nino cycle) or during of years of seedbank emergence not associated with high precipitation.
- Livestock-closure is a landscape-level treatment of the Beaver Dam Wash NCA that is applied to seedlings and plantings. Closure results in the protection of seedlings and plantings from livestock grazing for 10 consecutive years to the extent that enough resources (funding) allow it. Funding is shared with other ecological systems.
- Law enforcement only affects the creation of one vegetation class from OHV activity in several ecological systems of the Beaver Dam Wash NCA: *bare ground* (*BG*). Increased law-enforcement reduces the OHV disturbance by 50% (to 5%) using a static transition multiplier.
- Complete cessation of livestock grazing of the Beaver Dam Wash NCA is achieved by setting the static transition multiplier for livestock grazing to zero.
- Herbicide (Plateau®) application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by seeding native plant species with the current mix of seed sources. Failure rate is 99%, leading to the *exotic annual grassland and forblands* class (*EX*). Success causes a transition to the *seeded* class (*SD*).
- Herbicide (Plateau®) application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by seeding native plant

species with new high-performance cultivars whose commercial release is scheduled to be 20 years in the future. Failure rate is 95%, leading to the *exotic annual grassland and forblands* class (*EX*). Success causes a transition to the *seeded* class (*SD*).

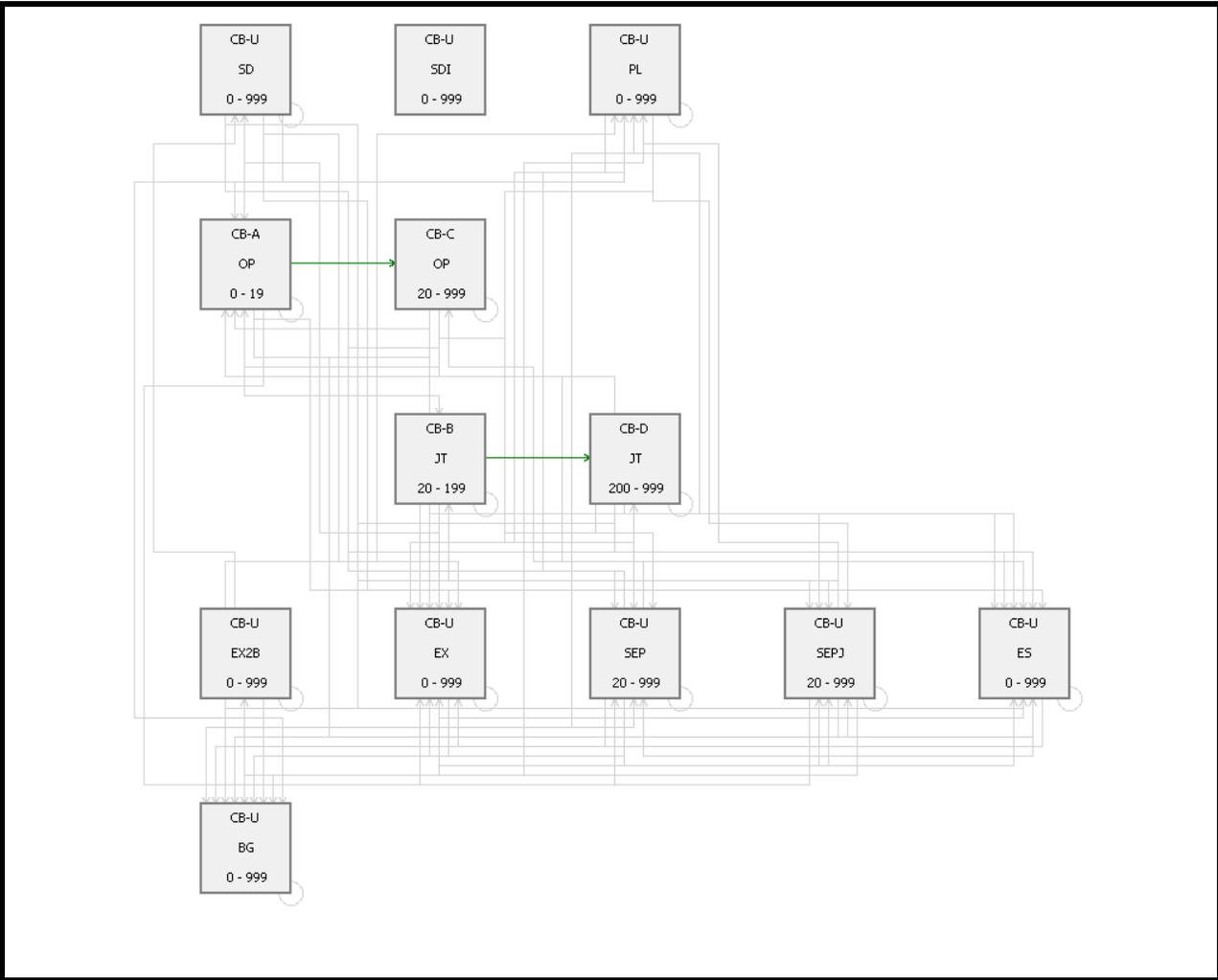
- Herbicide (Plateau®) application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by planting of containerized native shrubs and forbs. Failure rate is 25%, leading to the *exotic annual grassland and forblands* class (*EX*). Success causes a transition to the *planted* class (*SD*).
- Fingers-of-death fungi application to control exotic annual species in the *shrubland with mixed exotic annual and perennial grass species (SEP)* and *shrubland with mixed exotic annual, and perennial grass and Joshua tree (SEPI)* classes. Failure rate is 25% to 75% (no change of class), whereas success causes a transition to the *mid-succession (CB-B and CB-C)* and *late-succession* classes (*CB-D and CB-E*) depending on the age of originating vegetation and the presence of Joshua tree in the originating class.
- Fingers-of-death fungi application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by seeding native plant species with new high-performance cultivars whose commercial release is scheduled to be 20 years in the future. Failure rate is 95%, leading to the *exotic annual grassland and forblands* class (*EX*), because seedling establishment and survival remains the limiting factor even with the fingers-of-death fungi. Success causes a transition to the *seeded* class (*SD*).
- Fingers-of-death fungi application to control exotic annual grasses in *once-burned and twice-burned exotic annual grassland and forblands* classes (*EX* and *EX2B*) followed by planting of containerized native shrubs and forbs. Two levels of failure rates apply to the treatment. Failure rate of planting is 25% (no change in vegetation class), leading to the *exotic annual grassland and forblands* class (*EX*). Success causes a transition to the *planted* class (*PL*). After shrubs and forbs are planted, the fungi-of-death fungi failure rate was tested at three different levels: 25%, 50%, and 75%. If the fingers-of-death fungi fails to control the seedbank of exotic annual species, the *planted* class (*PL*) transitions to the *shrubland with mixed exotic annual and perennial grass species (SEP)* and *shrubland with mixed exotic annual and perennial grass, and Joshua tree (SEPI)* classes. The amount of either class created depends on the proportion of area with and without Joshua tree in the ecological system. Success keeps vegetation in the *planted* class (*PL*) until either future invasion by exotic species or natural recovery to *early-succession* class (*CB-A*).

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State-and-Transition Model:



Desert Sand Sagebrush (DSS) 1135ss

Area of Application and Context:

- Red Cliffs National Conservation Areas of southwestern Utah
- No livestock grazing
- Very limited off-highway travel east of Interstate-15
- Full fire suppression management
- Date created: July 2011

Vegetation classes:

- DSS-A: **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
- DSS-B: **Late-closed**; 20-40% 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-DP: **Depleted**; 20-40% sand sagebrush, snakeweed, and rabbitbrush cover; <5% cover of grasses; >40% bare ground cover
- U-SEP: **Shrub-Exotic-Species-Perennial-Grass**; 5-40% sand sagebrush and rabbitbrush cover; 5-10% cover of exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*); native grasses may be present to common; >30% bare ground (mostly sand)

Reference Condition:

- **Natural Range of Variability**
 - 2%: A-Early
 - 98%: B-Late-closed
 - 0%: U

Succession:

Succession follows the 2-box pathway with vegetation starting as resprouting desert sand sagebrush and ending as denser desert sand sagebrush with 20-40% of shrubs. Sand sagebrush dominates all phases of succession. The succession pathway is entirely deterministic with transitions occurring at the following ages:

- Early-succession to late-succession closed: 2 years

Natural Disturbances:

Replacement fire and variation in precipitation, therefore the frequency of *drought*, are the primary natural stochastic disturbances in desert sand sagebrush. Native herbivory by small mammals is a marginal disturbance that only applies to the *early-succession* class while grass is present.

Sand sagebrush resprouts after fire and has been observed to return to pre-fire structural levels within 3

years. We assume that the likelihood on ignition increases with fuel buildup. *Replacement fire* is present in all classes at a mean fire return interval of:

- 120 years (rate of 0.0083/year) in the *early-succession* class (*DSS-A*);
- 95 years (0.0106/year) in the *late-succession closed* class (*DSS-B*); and
- 120 years in the *depleted* class (*DP*) because of the absence of fine fuel despite mature shrub structure.

The fire return interval varies in the *shrubland with exotic annual and native grass species* class (*SEP*):

- 20 years (0.05/year) during the first 2 years of succession essentially dominated by non-native annual grasses; and
- 95 years as woody structure builds up while non-native annual grasses persist.

Drought causes shrub thinning in the older vegetation class under the assumption that prolonged and decreased soil moisture weakened plants that might ultimately be killed by insects or disease.

Therefore, we do not double-count mortality. A *drought* return interval rate of every 178 years (a rate of 0.0056/year) is used based on the frequency of severe drought intervals estimated by Biondi *et al.* (2007) from 2,300 years of western juniper (*Juniperus occidentalis*) tree ring data from the Walker River drainage of eastern California and western Nevada. Although we recognize that droughts may be more common than every 178 years, severe droughts, which were >7-year drought events with consecutive far-below average soil moisture (narrow tree rings), kill naturally drought resistant shrubs.

- Drought kills some, but not all shrubs in the *late-succession closed* class (*DSS-B*); therefore drought thins this class under the assumption that older shrubs succumb first and the class is reset at 3 years.
- In the two uncharacteristic classes, *drought* is only a thinning agent resetting to zero the age of the following classes:
 - *Depleted* desert sand sagebrush (*DP*); and
 - *Shrubland with exotic annual and perennial grass species* class (*SEP*).

Lagomorphs and small mammals accelerate woody succession by the consumption of grasses and forbs during the early outburst of herbaceous vegetation (for example, Indian ricegrass and galleta grass) after a stand replacing event. We assume a small rate (5 out of 1,000 pixels per year) that advances succession by one extra year when chosen for *native herbivory*.

Exotic annual species invasion (*EX-invasion*) only affects uninvaded classes (*DSS-A*, *DSS-B*, and *DP*). The rate of is tied to a base rate of 0.001/year estimated from data of northwest Utah collected by the Utah Division of Wildlife Resources in black sagebrush semi-desert, which is usually considered more resistant to cheatgrass invasion than big sagebrush dominated biophysical settings. Sandy soils also appear resistant to non-native annual species. *EX-invasion* transforms the *early-succession* (*DSS-A*), *late-succession* (*DSS-B*), and *depleted* (*DP*) classes into the *exotic annual and native grass species* class (*SEP*) with the age of pixels maintained.

Management Actions:

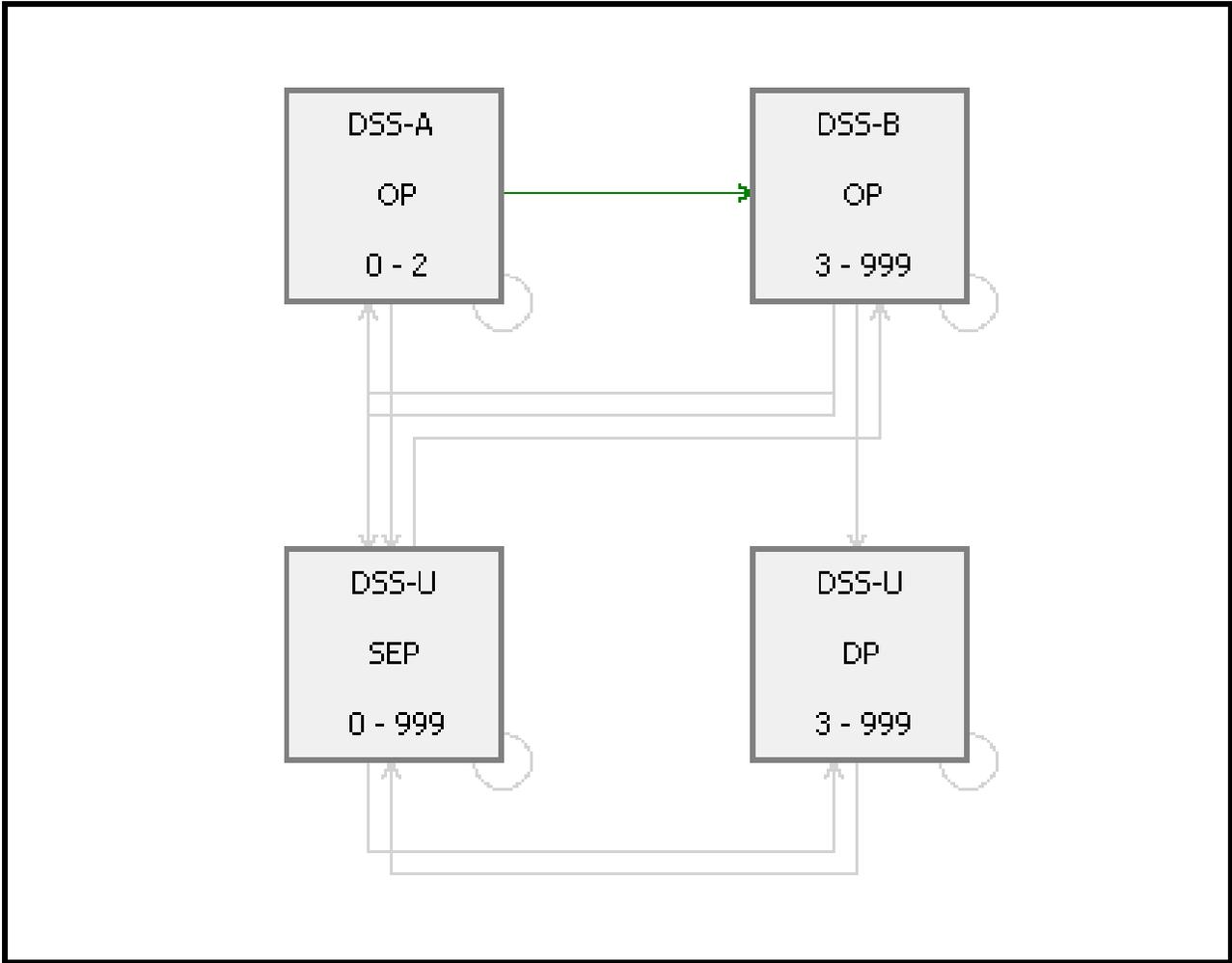
Modeled management activities include herbicide or fingers-of-death coupled with native plant seeding:

- Application of Plateau® to control non-native annuals followed by seeding of native grass species in *shrub with mixed annual and perennial grass species class (DSS-SEP)*. The combined success rates of herbicide application and seeding is 50% leading to the *late-closed succession class (DSS-B)*. Failure results in vegetation staying in the originating class (*DSS-SEP*).
- Application of the finger-of-death fungi followed by seeding of native grass species in *shrubland invaded by non-native annuals (SEP)*. Failure rate of the finger-of-death fungi is varied from 25% to 75%, leading to the shrubs with mixed *exotic annual and perennial grass species class (SEP)*. The combined success rates of herbicide application and seeding varies from 18% to 56% leading to the *late-closed succession class (DSS-B)*. Failure results in vegetation staying in the originating class (*SEP*).

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State-and-Transition Model (cropped):



Desert Washes (SWA) 1155w

Area of Application and Context:

- **Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah**
- **Livestock grazing on Beaver Dam Wash only**
- **Full fire suppression management**
- **Date created: July 2011**

Vegetation:

- **SWA-A: Early**; 20-50% cover may be gravel, sands, and/or flood debris; 10-19% cover of desert almond, burrobrush, rabbitbrush, creosotebush, desert willows present; 5-15% cover of grasses (big galleta, bush muhly); forbs present to abundant; 0-5 yrs
- **SWA-B: Mid-closed**; 20-50% cover of desert almond, bursage, bladdersage, burrobrush, creosotebush, Anderson's wolfberry, rabbitbrush; 5-10% cover of grasses (big galleta, bush muhly); forbs present to abundant; <30% of gravel and rocks; 5-19 yrs
- **SWA-C: Late-closed**; 30-50% cover of bursage, burrobrush, creosotebush, desert almond, bladdersage, Anderson's wolfberry, rabbitbrush, mesquite; Joshua tree present; 5-10% cover of grasses (big galleta, bush muhly); forbs present to abundant; <10% of gravel and rocks; >20 yrs
- **U-SEP: Shrub-Exotic-Species-Perennial-Grass**; >5% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 0-50% small mesquite, Joshua tree, and shrubs, 5-10% cover of grasses (big galleta, bush muhly); mineral soil may be common
- **U-SES: Shrub-Exotic Species**; >5% exotic species (*Bromus rubens*, *Bromus tectorum*, *Erodium cicutarium*) cover; 0-50% small trees and shrubs; <5% cover of native grasses; mineral soil may be common
- **U-ES Early-Shrub**; 20-50% cover of cholla, snakeweed or rabbitbrush species
- **U-ET: Exotic-Tree (formerly EX)**; >5% cover of saltcedar; 0-50% cover of bursage, burrobrush, creosotebush, Anderson's wolfberry, rabbitbrush, mesquite, Joshua tree
- **U-BG: Bare ground**; mineral soil exposed by human-caused disturbances

Reference Condition:

- **Natural Range of Variability**
 - 10%: A-Early
 - 18%: B-Mid-closed
 - 72%: C-Late-closed
 - 0%: U

Succession:

Succession follows the 3-box pathway with heterogeneous vegetation starting with abundant flood material (gravel, sand, and cobble) mixed with snakeweed and herbaceous species ending with a denser cover of shrubs and small trees. The succession pathway is entirely deterministic with transitions occurring at the following ages:

- Early-succession to mid-succession closed: 4 years
- Mid-succession closed to late-succession closed: 19 years

Natural Disturbances:

Flash flooding dominates the dynamics of desert washes, which do not have perennial water. Three levels of *flooding* were:

- 7-year events (0.14/year) that kills or removes only herbaceous vegetation in the *early-succession* class (SWA-A);
- 20-year events (0.05/year) that kills or removes shrubs and young trees in the *mid-succession closed* class (SWA-B); and
- 100-year events (0.01/year) that top-kills larger trees and everything else in the *late-succession closed* class (SWA-C).

One hundred-year *flash floods* affect three uncharacteristic classes: *exotic tree (ET)*, *shrubs with non-native annual and perennial grass species (SEP)*, and *shrubs with non-native annual species (SES)*.

Outcomes are similar for these three classes:

- 1% of each class is converted to to the early succession class as flood debris (sand, gravel, rock, and wood); and
- The remaining 99% of vegetation stays within the original classes while experiencing a return to age zero.

Replacement fire generally originates from the surrounding landscape and restarts the succession clock to age zero after sweeping through the riparian corridor. Fire is possible in all classes. Fuel breaks will prevent fire activity for three consecutive years after their implementation. Fire is rare because the surrounding blackbrush and creosotebush-white bursage ecological systems do not carry fire, unless they are invaded by non-native annual grasses. The mean fire return interval is set at:

- 1,000 years (rate of 0.001/year) for the *mid-succession closed (SWA-B)* and *late-succession closed (SWA-C)* classes; and
- 10,000 years (0.0001/year) for the *early-succession class (SWA-A)*, which is dominated by sand and gravel.

Fire return intervals are shorter in uncharacteristic classes:

- The *early shrub (ES)* class burns every 650 years (0.0015/year) on average and burned vegetation resets to age zero within the class.
- The *exotic tree (ET)* and *shrubs with non-native annual and perennial grass species (SEP)* class both have a 50-year return intervals (0.02/year) because the added fine fuels from non-native annual grass or saltcedar increase ignition probabilities. Vegetation in these classes remains in them, although at a younger age.
- The shortest fire return interval (50 years or 0.02/year) was in the *shrubs with non-native annual species (SES)* class because of the importance of non-native annual grass species. Again, fire is a self-loop.

Present only in Beaver Dam Wash NCA, *managed herbivory* and *excessive herbivory* have return

intervals of one year (livestock is present every year) but different impact areas based on the distance livestock is willing to travel away from water. The impact of grazing is modeled with fixed rates of implementation (around an average) because grazing permits have fixed stocking rates, season of use, distribution. It is assumed that *managed herbivory* utilizes 5% of all grazable areas in the Beaver Dam Wash NCA (not just desert washes); therefore, only 5% of the area is selected for *managed herbivory* and vegetation classes in desert washes “compete” for selection. This method of modeling livestock grazing can only be implemented with the PATH software; VDDT cannot achieve landscape-level disturbances. Similarly, *excessive herbivory* affects 0.1% of the Beaver Dam Wash NCA causing a transition to the *early shrub* class (ES); however, *excessive herbivory* is caused by the movement of livestock through the same areas near or on the way to water sources. Therefore, once areas dominated by early shrubs are created, they become permanent and no new areas are created unless watering sources are moved or created. As a consequence, 0.1% of the Beaver Dam Wash is chosen among candidate vegetation classes to become the *early shrub* class (ES) in the first years of simulations, and then the process is stopped.

Managed herbivory accelerates woody succession by one year for selected pixels in all grazable classes (SWA-A, SWA-B, SWA-C, SEP, and SES). *Excessive herbivory* is present in all classes except the *bare ground* (BG) and *early-shrub* (ES) class. It causes a transition to the *early-shrub* (ES) class.

An important disturbance is the invasion by exotic trees (*exotic-tree-invasion*) represented by saltcedar. *Exotic-tree-invasion* causes a transition to the *exotic tree* class (ET). Saltcedar’s tiny seeds are wind dispersed. Workshop participants agreed to a low rate (0.0001/year) for most classes because washes lack perennial water, but a rate five times higher for the *bare ground* (BG) and *early shrub* (ES) classes that have more disturbed soils and vegetation. It is assumed that invasion will happen at specified rates if a weed detection effort and follow-up treatment has not occurred for five consecutive years. *Exotic tree invasion* occurs in seven classes: *early-succession closed* (SWA-A), *mid-succession closed* (SWA-B), *late-succession closed* (SWA-C), *bare ground* (BG), *early shrub* (ES), *shrubs with non-native annual and perennial grass species* (SEP), and *shrubs with non-native annual species* (SES).

An important source of saltcedar mortality is the introduced biocontrol beetle (*beetle-mortality*), which is present to abundant in the Virgin River drainage. Workshop participants decided that beetles kill saltcedars after 4 consecutive years of defoliation; therefore, the return interval for beetle induced mortality was 4 years (rate of 0.25/year). Beetle induced mortality cause age-dependent transitions from the *exotic-tree* class (ET) to the *early-succession* (SWA-A), *mid-succession* (SWA-B), and *late-succession* (SWA-C) classes.

Another invasion is by non-native annual species (*EX-invasion*) occurring at a rate of 0.005/year (5 of 1,000 pixels per year) in all uninvaded classes: *early-succession closed* (SWA-A), *mid-succession closed* (SWA-B), *late-succession closed* (SWA-C), *bare ground* (BG), and *early shrub* (ES). A base rate of 0.001/year was estimated for cheatgrass from data of northwest Utah collected by the Utah Division of Wildlife Resources in black sagebrush semi-desert. We defaulted to five times the rate estimated from the Utah data because desert washes are more productive systems. Invasion of:

- Reference classes causes an age-dependent transition to the *shrubs with non-native annual and perennial grass species* (SEP); and
- The *early shrub* (ES) and *bare ground* (BG) classes causes a transition to *shrubs with non-native annual species* (SES).

The *Utilities* disturbance is predominantly the establishment of right-of-ways (pipelines and powerlines).

Excavated or cleared areas become:

- *Early-succession (SWA-A)* class no different than the wash channel for 30% of the cleared area; and
- The remaining 70% of the area becomes the *shrub with non-native annual* class (*SES*) for vegetation originating from the reference (*SWA-A, SWA-B, and SWA-C*), *bare ground (BG)*, *early-shrub (ES)*, and *shrubs with non-native annual and perennial grass species (SEP)* classes. For the *exotic tree (ET)* class, the remaining 70% of the cleared area stays in the *exotic tree* class.

The *OHV* disturbance creates the *bare ground (BG)* class from illegal recreational use of off-highway vehicle in the Beaver Dam Wash NCA only. All classes are source classes. The rate is 10% of 0.0001/year to reflect that users predominantly reuse existing disturbed areas and only incrementally add new areas of illegal driving.

Management Actions:

Several actions (six in Beaver Dam Wash and five in Red Cliffs NCAs, respectively) are used in this ecological system:

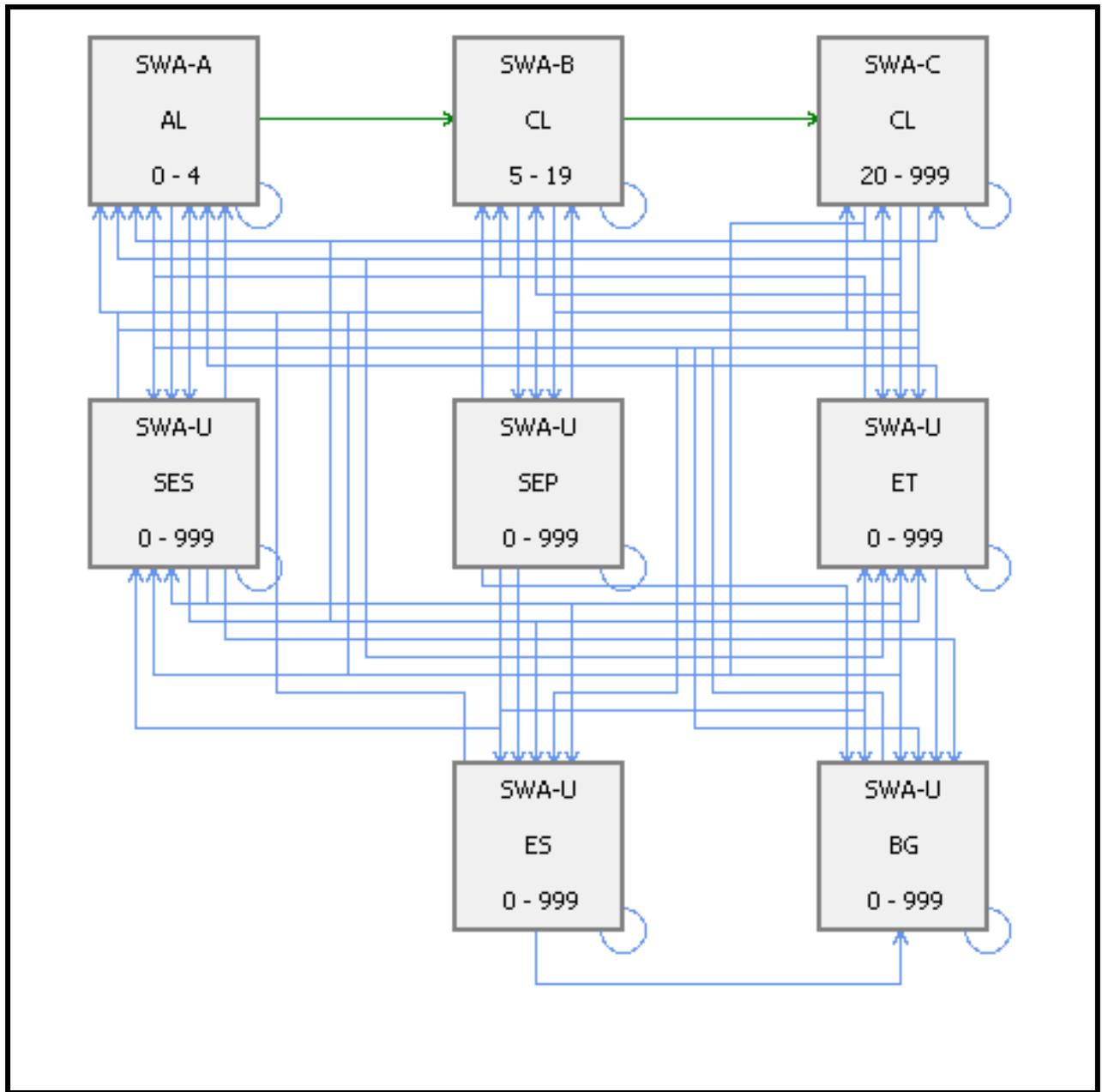
- Inventory of weeds and saltcedar on a rotation (i.e., revisit the same reach every *X* years) for identification of occurrences for immediate or future treatment (*weed-inventory-WAS*).
- Control of saltcedar and exotic forbs: *exotic-control-MR*. Action consists of cutting saltcedar and immediately painting the stumps with the herbicide Garlon IV®. If exotic forbs are found, they are sprayed with a different herbicide. Failure rate is 10% (no change of class), whereas success causes a transition to the *early-succession (SWA-A)*, *mid-succession (SWA-B)*, and *late-succession* classes (*SWA-C*) depending on the age of originating vegetation class.
- In the Beaver Dam Wash NCA, reduction of livestock stocking rates (*livestock-closure*) in desert washes whose effect last for 10 consecutive years.
- Fuel breaks are 250 feet wide strips of vegetation aerially sprayed with herbicide (Plateau®) to remove the continuous fine fuel beds created by exotic annual species. Strips are placed throughout the landscape and benefit all ecological systems by slowing or stopping wildfires. Spraying is only conducted during years of higher precipitation (perhaps following a 7-year El Nino cycle) or during of years of seedbank emergence not associated with high precipitation. The effect of fuel breaks persists for 3 years.
- Herbicide Plateau® application to control exotic annual species in the *shrubland with mixed exotic annual and perennial grass species (SEP)* class. Failure rate is 50% (no change of class), whereas success causes a transition to the *early-succession (SWA-A)*, *mid-succession (SWA-B)* and *late-succession* classes (*SWA-C*) depending on the age of originating vegetation class.
- Fingers-of-death fungi application to control exotic annual species in the *shrubland with mixed exotic annual and perennial grass species (SEP)* and *shrubland with mixed exotic annual and perennial grass (SES)* classes. Failure rate is 25% to 75% (no change of class), whereas success causes a transition to the *early-succession (SWA-A)*, *mid-succession (SWA-B)*, and *late-succession* classes (*SWA-C*) depending on the age of originating vegetation class.

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State-and-Transition Model (cropped):



Montane Riparian (MR) 1154

Area of Application and Context:

- **Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah**
- **Livestock grazing on Beaver Dam Wash only**
- **Full fire suppression management**
- **Date created: July 2011**

Vegetation:

- **A-Early:** 0-40% cover of shrub—willow dominates after fire, whereas cottonwood and willow co-dominate after flooding; grass may co-dominate; <50% cover gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs
- **B-Mid-closed:** 31-100% cover of tall shrubs (willows, buffaloberry, young mesquite) and small trees (velvet ash, conifers) and small cottonwood trees; <20% gravel, rock, and boulders; 5-19yrs
- **C-Late-closed:** 31-100% cover of cottonwood, willow, conifers and other trees 10-24m; <20% gravel, rock, and boulders; >20 yrs
- **U-SFE: Shrub-Forb-Encroached;** 10-50% cover of Wood's rose or other unpalatable forbs and shrubs in open areas or under tree canopy
- **U-EF-Exotic-Forb:** 10-100% cover of exotic forbs (knapweed, tall whitetop, purple loosestrife), salt cedar, or Russian olive)
- **U-DE-Desertification:** Entrenched river/creek with 10-50% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush); >5% native grass cover

Reference Condition:

- **Natural Range of Variability**
 - 10%: *A-Early*
 - 19%: *B-Mid-closed*
 - 71%: *C-Late-closed*
 - 0%: *U*

Succession:

Succession follows the 3-box pathway with heterogeneous vegetation starting with willow and Fremont cottonwood, and wet meadows and ending with a forested mix of willow, cottonwood, pinyon, juniper, alder, and wet meadows. The succession pathway is entirely deterministic with transitions occurring at the following ages:

- Early-succession to mid-succession closed: 4 years
- Mid-succession closed to late-succession closed: 19 years

Natural Disturbances:

Flooding dominates the dynamics of the montane riparian system. Three levels of *flooding* are:

- 7-yr events (0.14/year) that killed or removed only herbaceous vegetation in the *early-succession* class (MR-A);
- 20-year events (0.05/year) that killed or removed shrubs and young trees in the *mid-succession closed* class (MR-B); and
- 100-year events (0.01/year) that top-killed larger trees and everything else in the *late-succession closed* class (MR-C).

Replacement fire originates from the surrounding landscape and restarts the succession clock to age zero after sweeping through the riparian corridor. Fire is possible in all classes. However, fire is rare because the surrounding blackbrush, creosotebush-white bursage, and sand sagebrush ecological systems only rarely burn. The mean fire return interval is set at 1,000 years (rate of 0.001/year). Fire in reference classes causes a stand replacing event and recruitment into the *early-succession* class (MR-A), whereas fire in uncharacteristic classes acts as a self-loop and resets all vegetation to age zero.

An important disturbance was the invasion by exotic trees and forbs (*exotic-riparian-invasion*) represented mainly by saltcedar, tall whitetop, knapweeds, and thistles. *Exotic-riparian-invasion* causes a transition to the *exotic forb* class (EF; old terminology that actually contains exotic riparian trees). Workshop participants agreed to a moderately high rate (0.01/year) to plan for a worst case scenario. Roadways, off-highway vehicles, and animals are usually the greatest vectors of exotic forbs. Saltcedar is wind dispersed. *Exotic invasion* occurs in four classes: *early-succession closed* (MR-A), *mid-succession closed* (MR-B), *late-succession closed* (MR-C), and *shrub and forb encroached* (SFE).

An important source of saltcedar mortality is the introduced biocontrol beetle (*beetle-mortality*), which is present to abundant in the Virgin River drainage. Workshop participants decided that beetles kill saltcedars after 4 consecutive years of defoliation; therefore, the return interval for beetle induced mortality was 4 years (rate of 0.25/year). Beetle induced mortality causes age-dependent transitions from the *exotic-tree* class (ET) to the *early-succession* (SWA-A), *mid-succession* (SWA-B), and *late-succession* (SWA-C) classes.

A class reflecting historic grazing is the dominance of riparian corridors by native forbs and shrub species unpalatable to domestic sheep and cattle (*shrub and forb encroached* or SFE). Wood's rose (*Rosa woodsii*) and shinkbush (*Rhus trilobata*) are classic examples. The dynamics crating this class are retained in the model but the class was not detected by remote sensing and livestock no longer graze in the Red Cliffs NCA. Due to the proximity of creeks, *100-year flooding* events have the power to:

- Substantially rework sediments over 1% of the area of the class and cause a transition to the *early-succession* class (MR-A); whereas
- 99% of the remaining area is returned to age zero of the *shrub and forb encroached* class (SFE).

Desertification (or incision) of riparian vegetation, largely from past management, opens up dynamics more typical of upland communities. Incision causes a drop of water table and dries out riparian vegetation in favor of upland species. Due to the proximity of creeks, *100-year flooding* events have the power to

- Substantially rework sediments over 1% of the area of the class and cause a transition to the *early-succession* class (MR-A); whereas

- 99% of the remaining area is returned to age zero of the *desertified* class (*DE*).

One other natural disturbance can “restore” desertified riparian vegetation: flows will naturally rework banks and promote riparian vegetation at a low rate of 0.001/year (*floodplain recovery* disturbance) if and only if livestock grazing is absent for 10 consecutive years, which should happen in the Red Cliffs NCA.

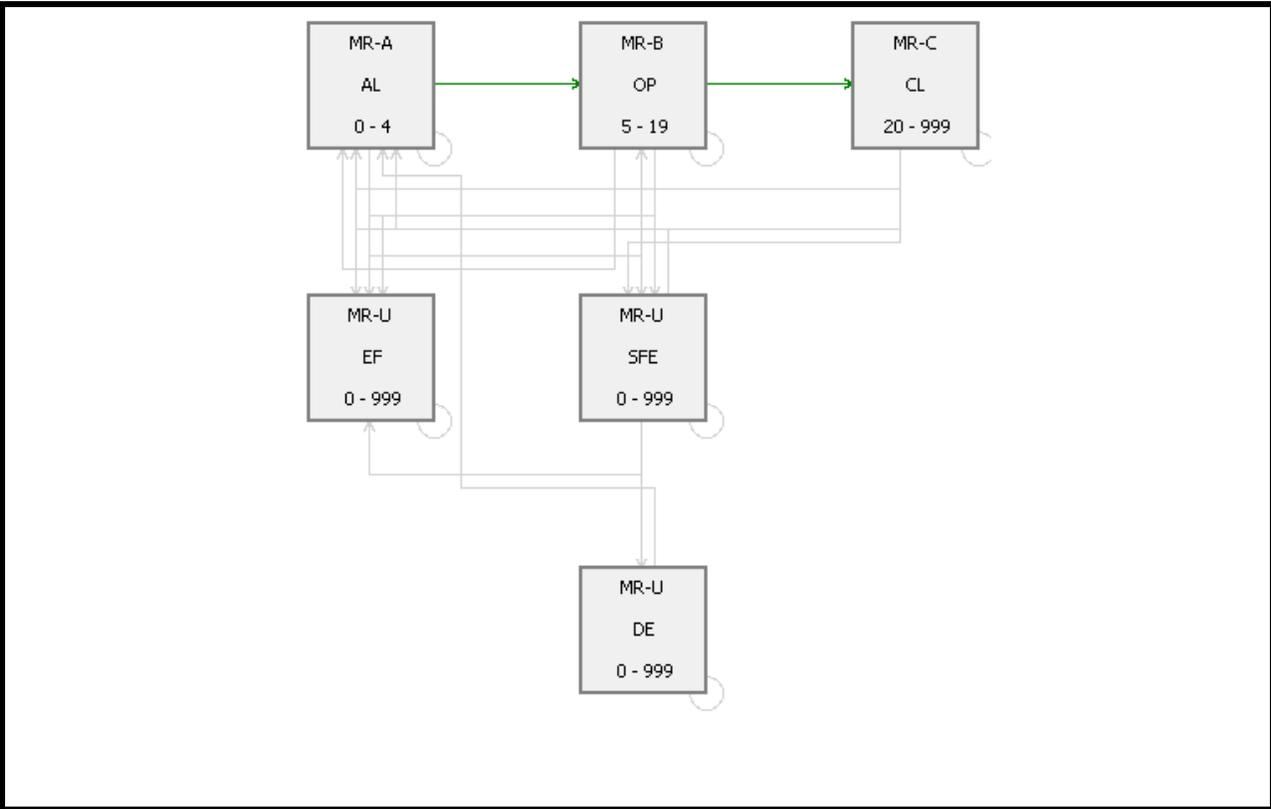
Management Actions:

The only action retained for this small ecological system is control of saltcedar and exotic forbs: *exotic-control-MR*. Small saltcedar saplings and trees are peppered throughout the montane riparian and relatively easy to locate. Action consists of cutting saltcedar and immediately painting the stumps with the herbicide Garlon IV®. If exotic forbs are found, they are sprayed with a different herbicide.

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State-and-Transition Model (cropped):



Mountain Shrub (MSb) 1126ms

Area of Application and Context:

- **Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah**
- **Livestock grazing on Beaver Dam Wash only**
- **Full fire suppression management**
- **Date created: July 2011**

Vegetation classes:

- **A-Early:** 0-10% canopy of snowberry, desert bitterbrush, or Stansbury cliffrose; 10-80% grass and forb cover; 0-12 yrs
- **B-Mid-open:** 11-30% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; >50% herbaceous cover; 13-38 yrs
- **C-Mid-closed:** 31-50% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; 25-50% herbaceous cover; <10% conifer sapling cover; 38+ yrs
- **D-Late-open:** 10-20% pinyon pine-juniper cover <5m; 25-40% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; <30% herbaceous cover; 80-129 yrs
- **U-ES: Early-Shrub;** 20-50% cover rabbitbrush species
- **U-DP: Depleted;** 31-50% cover of snowberry, desert bitterbrush, Stansbury cliffrose; <5% herbaceous cover; <10% conifer sapling cover
- **U-SEP: Shrub-Exotic-Species-Perennial-Grass;** 5-40% cover of mountain shrubs; 5-20% non-native grass cover; native herbaceous cover usually present; trees may be present
- **U-TE: Tree-Encroached;** >21% pinyon pine-juniper cover 10-25m; <5% shrub cover; <5% herbaceous cover
- **U-TEX: Tree-Exotic-Species;** 10-20% pinyon pine-juniper cover <5m; ≥5% cover of non-native annual grasses and forbs; 25-40% cover of snowberry, desert bitterbrush, or Stansbury cliffrose; <30% herbaceous cover
- **U-EX: Exotic-Species;** 10-30% cover of cheatgrass; snakeweed or rabbitbrush may be present; dead standing stems of cliffrose often present

Reference Condition:

- **Natural Range of Variability**
 - 7%: *A-Early*
 - 15%: *B-Mid-open*
 - 63%: *C-Mid-closed*
 - 14%: *D-Late-open*
 - 0%: *U*

Succession:

Succession follows the 4-box pathway with vegetation starting as predominantly herbaceous and ending with pinyon or juniper, dominance and a viable shrub and herbaceous understory. Deterministic succession transitions occur in the first three boxes, whereas the last step of succession is probabilistic:

- Early-succession to mid-succession open: 4 years

- Mid-succession open to mid-succession closed: 19 years
- Mid-succession closed to late-succession open: ≥50 years (probabilistic)

Natural Disturbances:

Replacement fire is the primary stochastic disturbance. We chose a fire return interval slightly longer than that of the big sagebrush steppe-upland ecological system because mountain shrub dominated by cliffrose or desert bitterbrush is located on harsher, thinner soils. The mean return interval of *replacement fire* changes with vegetation classes:

- 70 years (0.014/year) in the *mid-succession* class (*MSb-B*) and in the *late-succession* class; to
- 150 years (0.0067/year) in the more wooded *late-succession open* class (*MSb-D*).

Replacement fire in vegetation classes that already experienced a threshold transition also causes a threshold transition to other uncharacteristic classes:

- For a 150-year fire return interval;
 - The *tree encroached shrubland* class (*TE*) converts to the *early shrub* class (*ES*), and
 - The *tree encroached shrubland with exotic annual species* class (*TEX*) transitions to the *exotic annual species* class (*EX*);
- With a 70-year (0.014/year) fire return interval, the *early shrub* class (*ES*) simply promotes rabbitbrush as a self-loop; and
- The *shrubland with mixed exotic annual and native perennial species* class (*SEP*) burns every 40 years (0.025/year) on average, causing a transition to the *exotic annual species* class (*EX*).

Cliffrose is drought adapted. Seedling germination and survival is higher during dry years because drought reduces competition from grasses (Price and Botherson 1987). *Drought* causes stand replacing events (generally 10% of times) and stand thinning (90% of times) in classes with trees. A *drought* return interval rate of every 178 years (a rate of 0.0056/year) is used based on the frequency of severe drought intervals estimated by Biondi *et al.* (2007) from 2,300 years of western juniper (*Juniperus occidentalis*) tree ring data from the Walker River drainage of eastern California and western Nevada. Although we recognize that droughts may be more common than every 178 years, severe droughts, which were >7-year drought events with consecutive far-below average soil moisture (narrow tree rings), kill naturally drought resistant shrubs and trees.

- In the *late-succession closed* class (*MSh-D*):
 - For 10% of events, drought-induced mortality converts vegetation to the previous succession class (*MSh-C*); and
 - For the remaining 90% of events, *drought* reverses woody succession within the same vegetation class the originating class (*MSh-D*).
- In the *tree-encroached shrubland* class and *tree-encroached shrubland with exotic annual species* class, respectively, *drought* causes a transition to *early-shrub* (*ES*) and *exotic annual species* class (*ES*) 10% of times (otherwise, self thinning within each originating class).

Because cliffrose is drought adapted, the *wet-year* disturbance reverses succession by one year in the *early-succession* class (*MSh-A*); therefore making this a weak disturbance. The *wet-year* disturbance is caused by the 7-year El Nino cycle (rate of 0.14/year).

Tree (pinyon and juniper) invasion is responsible for the last succession step between the *mid-succession closed (MSh-C)* and *late-succession closed (MSh-D)* classes. This disturbance also causes succession from the *shrubland with mixed exotic annual and native perennial species class (SEP)* to the *tree-encroached shrubland with exotic annual species class (TEX)*. Pinyon and juniper invade shrublands at two different rates:

- 0.001/year from ages 50 to 99 years; and
- 0.005/year from ages after 100 years.

Pinyon and juniper require mature shrubs (usually sagebrush and bitterbrush) as nurse plants for seed germination and seedling establishment; therefore, the rate of tree invasion accelerates with time since succession.

A few anthropogenic disturbances cause accelerated woody succession in reference classes and transitions to uncharacteristic classes of vegetation.

Present only in Beaver Dam Wash NCA, *managed herbivory* and *excessive herbivory* have return intervals of one year (livestock is present every year) but different impact areas based on the distance livestock is willing to travel away from water. The impact of grazing is modeled with fixed rates of implementation (around an average) because grazing permits have fixed stocking rates, season of use, distribution. It is assumed that *managed herbivory* utilizes 5% of all grazable areas in the Beaver Dam Wash NCA (not just mountain shrub); therefore, only 5% of the area is selected for *managed herbivory* and vegetation classes in mountain shrub “compete” for selection. This method of modeling livestock grazing can only be implemented with the PATH software; VDDT cannot achieve landscape-level disturbances. Similarly, *excessive herbivory* affects 0.1% of the Beaver Dam Wash NCA causing a transition to the *early shrub class (ES)*; however, *excessive herbivory* is caused by the movement of livestock through the same areas near or on the way to water sources. Therefore, once areas dominated by early shrubs are created, they become permanent and no new areas are created unless watering sources are moved or created. As a consequence, 0.1% of the Beaver Dam Wash is chosen among candidate vegetation classes to become the *early shrub class (ES)* in the first years of simulations, and then the process is stopped.

Managed herbivory reverses woody succession to age zero (i.e., stand replacing event) in the *early succession class (MSh-A)* through consumption of palatable cliffrose seedlings and grasses.

- After cliffrose establishes, managed herbivory accelerates woody succession by one year for every year selected for grazing by removal of grasses in the *mid-succession open (MSh-B)*, *mid-succession-closed (MSh-C)*, and *shrubland with mixed exotic annual species and perennial grasses (MSh-SEP)* classes.
- The wooded *late-succession closed class (MSh-D)* is not grazed.
- *Managed herbivory* is present but does not have any successional effect in the *early shrub (ES)* and the *exotic annual species (EX)* classes.

Excessive herbivory is present in the *mid-succession open (MSh-B)*, *mid-succession-closed (MSh-C)*, and *shrubland with mixed exotic annual species and perennial grasses (MSh-SEP)* classes and only causes a transition to the *early shrub class (ES)* during the first five years of simulation.

Exotic invasion affects the reference (*MSh-A, MSh-B, MSh-C, and MSh-D*) and *tree-encroached (TE)*

classes at a rate of 0.0025/year. We chose an invasion rate half that of the big sagebrush steppe-upland ecological system because cliffrose grows on harsher, thinner soils. *Exotic invasion of:*

- The *early succession class (MSH-A)* causes a transition to the *exotic annual species class (EX)*;
- The *mid-succession (MSh-B and MSh-C)* and *late-succession (MSh-D)* classes convert to the *shrubland with mixed exotic annual species and perennial grasses class (MSh-SEP)*; and
- The *tree-encroached shrublands (TE)* converts to the *tree-encroached shrubland with exotic annual species class (TEX)*.

Management Actions:

Two restoration actions are proposed:

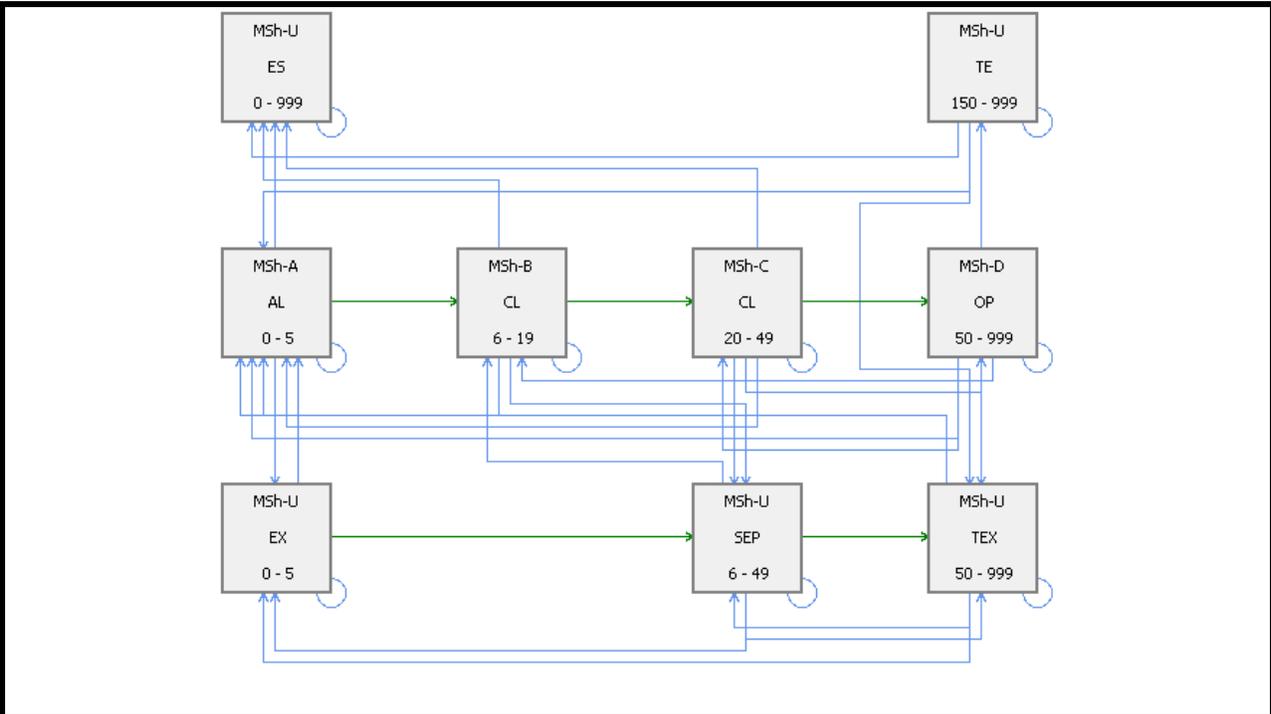
- Spraying the herbicide Plateau® to control exotic annual species followed by seeding cliffrose in the *exotic annual grassland and forbland class (EX)*.
- Spraying the herbicide Plateau® to control exotic annual species followed by seeding perennial native grasses in the *shrubland with exotic annual species class (SES)*.

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State-and-Transition Model:



Pinyon-Juniper Woodland (PJ) 1019

Area of Application and Context:

- Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah
- Livestock grazing on Beaver Dam Wash only
- Full fire suppression management
- Date created: July 2011

Vegetation classes:

- A-**Early-open**: 5-20% herbaceous cover; 0-9 yrs
- B-**Mid1-open**: 11-20% cover big sage or black sage <1.0m; 10-40% herbaceous cover; 10-29 yrs
- C-**Mid2-open**: 11-30% cover of pinyon and/or juniper <5m; 10-40% shrub cover; <20% herbaceous cover; 30-99 yrs
- D-**Late-open**: 31-50% cover of pinyon and/or juniper <5m-9m; 10-40% shrub cover; <20% herbaceous cover; >99 yrs
- U-TEX: **Tree- Exotic-Species**; 31-50% cover of pinyon and/or juniper <5m-9m; 5-20% cheatgrass cover 10-40% shrub cover
- U-EX: **Exotic-Species**; 5-30% cheatgrass cover; dead pinyon or juniper visible

Reference Condition:

- **Natural Range of Variability**
 - 2%: A-*Early*
 - 3%: B-*Mid1-open*
 - 13%: C-*Mid2--open*
 - 82%: D-*Late-open*
 - 0%: U

Succession:

Succession follows the 4-box pathway with vegetation starting as predominantly native annual and perennial herbaceous species and ending with old (>300 years) pinyon and juniper and generally with a viable shrub and herbaceous understory. The succession pathway is entirely deterministic.

Deterministic succession transitions occur at the following ages:

- Early-succession to mid-succession open: 9 years
- Mid1-succession open to mid2-succession open: 29 years
- Mid2-succession open to late-succession open: 99 years

Natural Disturbances:

Replacement fire restarts the succession clock to age zero within the reference condition, which is the *early-succession* or PJ-A class. The mean return interval of *replacement fire* is:

- 300 years (0.003/year) in the *early-succession* class (PJ-A);
- 200 years (0.005/year) in *mid1-succession open*, and *mid2-succession open* classes; and
- 1,000 years (0.001/year) in the *late-succession open* classes (PJ-D).

Replacement fire in vegetation classes that already experienced a threshold transition also causes a threshold transition to other uncharacteristic classes. The fire return interval is;

- 200 years in the *tree with exotic annual species* class (TEX). Fire causes a conversion to the *exotic annual grassland and forbland* class (EX); and
- 10 years in the *exotic annual grassland and forbland* class (EX), where vegetation remains in the class (self-loop).

Drought operates in the *mid2-succession open* (PJ-C), *late-succession open* (PJ-D) and *tree with exotic annual species* (TEX) class. *Drought* causes thinning to the previous succession class (generally 10% of times) and thinning within a class (90% of times). In most cases *drought* created tree and shrub mortality under the assumption that prolonged and decreased soil moisture weakened plants that might ultimately be killed by insects or disease. Therefore, we do not double-count mortality. A *drought* return interval rate of every 178 years (a rate of 0.0056/year) is used based on the frequency of severe drought intervals estimated by Biondi *et al.* (2007) from 2,300 years of western juniper (*Juniperus occidentalis*) tree ring data from the Walker River drainage of eastern California and western Nevada. Although we recognize that droughts may be more common than every 178 years, severe droughts, which were >7-year drought events with consecutive far-below average soil moisture (narrow tree rings), kill naturally drought resistant shrubs and trees.

- The *mid2-succession closed* class (PJ-C) is thinned by *drought*:
 - Within the class (to its beginning) for 90% of events; and
 - To the previous succession class, *mid1-succession open* class (PJ-B), for the other 10% of events, which assumes older trees are more affected.
- The *late-succession open* class (PJ-D) responds differently to *drought* because older trees become more vulnerable to the baseline 178-year return interval of severe *droughts* and additional insect attacks (both sources are assumed in the total 0.0168/year rate [60 years] for *drought* in the model):
 - 90% of mortality is expressed as thinning to age 100 year within the class;
 - 7% of thinning is to the previous succession class (*mid2-succession open* or PJ-C); and
 - 3% of thinning results in the *mid1-succession open* class (PJ-B).
- The only uncharacteristic class affected is *trees with exotic annual species* (TEX) class:
 - 90% of the class is thinned from within; and
 - 10% of the class converts to the *exotic annual grassland and forbland* class (EX).

Exotic annual species invasion (*EX-invasion*) is set at a slow rate of 0.001/year (1 out of 1,000 pixels converted to a cheatgrass-invaded class per year). A base rate of 0.001/year is estimated from data of northwest Utah collected by the Utah Division of Wildlife Resources in black sagebrush semi-desert. Black sagebrush semi-desert is usually considered more resistant to cheatgrass invasion than Wyoming big sagebrush semi-desert or other big sagebrush dominated biophysical settings. We default to five times the rate estimated from the Utah data. The soils of pinyon-juniper woodlands are either harsher or similar to those of black sagebrush. Exotic annual species invasion (*EX-invasion*) starts in the *mid2-succession open* class (PJ-C) and continues in the *late-succession open* class (PJ-D), causing a transition to

the tree with annual grass class (TA).

Management Actions:

Two management actions were retained for pinyon and juniper woodlands invaded by exotic annual species:

- In mostly wilderness areas, hand spraying of herbicide (Plateau®) to control exotic annual species followed by aerial seeding of native species in *exotic annual grasslands and forblands* (EX). Success rate is 60% and restores the *early-succession* class (PJ-A). Failure simply keeps vegetation in the originating class.
- In mostly wilderness areas, hand spraying of herbicide (Plateau®) under the canopy of trees to control exotic annual species in the *tree with exotic annual species* class (TEX). Herbicide succeeds 60% of times causing recruitment to the *mid2-succession closed* class (PJ-C) for vegetation from 60-99 years and to the *late-succession closed* class (PJ-D) for vegetation older than 99 years.

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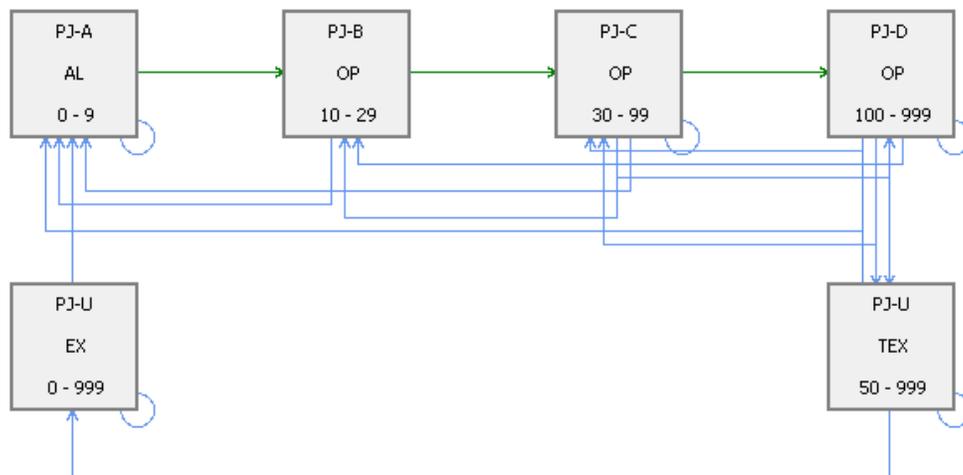
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State-and-Transition Model:



Warm Desert Riparian (WDR) 1155

Area of Application and Context:

- **Red Cliffs and Beaver Dam Wash National Conservation Areas of southwestern Utah**
- **Livestock grazing on Beaver Dam Wash only**
- **Full fire suppression management**
- **Date created: July 2011**

Vegetation:

- *WDR-A: Early*; 10-50% cover of Gooding willow and Fremont Cottonwood seedlings and shrubs; riparian and wetland graminoids may co-dominate; 0-4 yrs post-flooding
- *WDR-B: Mid-closed*; 51-100% cover of willow and small trees (willow and cottonwood) <3 m; patches of graminoids and halophytic shrubs common; 5-19 yrs after flooding
- *WDR-C: Mid-open*; 11-50% cover of fire resprouts of mesquite and Gooding willow; patches of graminoids frequent after fire; mesquite mature to larger trees several years after fire; 1-89 yrs after fire
- *WDR-D: Late1-closed*; 51%-90% of mature Gooding willow and Fremont cottonwood; patches of graminoids in saturated soils and of halophytic shrubs on drier sediment deposits or more saline surfaces; 10-89 yrs
- *WDR-E: Late2-closed*; 51-90% mesquite cover; Gooding willow and Fremont cottonwood minor component; understory often dominated by graminoids and forbs; >90 yrs
- *U-DE: Desertified*; incised river bank caused by human disturbance; 10-90% native halophytic shrub or riparian tree cover; graminoid patches may be present
- *U-DET: Desertified-Exotic-Tree*; >5% exotic tree species (tamarisk or Russian olive) regardless of native cover; river bank incised
- *U-DEF: Desertified-Exotic-Forb*; >5% exotic forb species regardless of native cover; river bank incised
- *U-DEX: Desertified-Exotic-Species*; 5-40% exotic annual grasses and forbs; charred remnants of trees and shrubs often present; snakeweed often present to abundant; river bank incised
- *U-TEX: Tree- Exotic-Species*; 51%-90% of young or mature Gooding willow and Fremont cottonwood; >5% cover of exotic annual grass and forb species; patches of graminoids in saturated soils and of halophytic shrubs on drier sediment deposits or more saline surfaces
- *U-EF: Exotic Forb*; >5% exotic forb species regardless of native cover; river bank not incised
- *U-ET: Exotic-Tree*; >5% exotic tree species (tamarisk or Russian olive) regardless of native cover; river bank not incised
- *U-EX: Exotic-Species*; 5-40% exotic annual grasses and forbs; charred remnants of trees and shrubs often present; snakeweed often present to abundant
- *U-BG: Bare ground*; mineral soil exposed by human-caused disturbances

Reference Condition:

- **Natural Range of Variability**
 - 10%: *A-Early*
 - 19%: *B-Mid-closed*
 - 8%: *C-Mid-open*
 - 40%: *D-Late1-closed*

- 23%: E-Late2-closed
- 0%: U

Succession:

Succession follows the 4-box pathway with one lateral pathway. The succession pathway is determined most by flooding has heterogeneous vegetation starting with young Goodding's willow and Fremont cottonwood, and graminoids (*WDR-A*) and finishing with mature mesquite, Goodding's willow, and Fremont cottonwood (*WDR-E*). When any of the late-closed classes (*WDR-D* and *WDR-E*) burn, they transition to the *mid-succession open* (*WDR-C*) class dominated by resprouting mesquite, which succeeds to the *late2-succession closed* (*WDR-E*) class. Therefore, fire has a key role in this succession pathway. Succession is entirely deterministic with transitions occurring at the following ages:

- Early-succession to mid-succession closed: 4 years
- Mid-succession closed to late1-succession closed: 19 years
- Late1-succession closed to late2-succession closed: 89 years
- Mid-succession open to late2-succession closed: 89 years

Natural Disturbances:

Flooding dominates the dynamics of the warm desert riparian system. Three levels of *flooding* are:

- 7-yr events (0.14/year) that kills or removes only herbaceous vegetation in the *early-succession* class (*WDR-A*);
- 20-year events (0.05/year) that kills or removes shrubs and young trees in the *mid-succession* classes (*WDR-B* and *WDR-C*); and
- 100-year events (0.01/year) that top-kills larger trees and everything else in the *late-succession* closed classes (*WDR-D* and *WDR-E*).

One-hundredth-year flooding events also transformed uncharacteristic classes:

- In all classes except *exotic forbs* (*EF*), 100-year flooding acted as a self-loop (class stays the same) in 99% of cases with the age of the class being reset to the age at the beginning of the class;
- Variation exists for the remaining 1% of events:
 - Most classes transition to the *early-succession* class (*WDR-A*) due to pure scouring; but
 - The *trees with exotic annual species* class (*TEX*) will become the *exotic-annual-species* class (*EX*) because trees are toppled; and
 - The *desertified exotic tree* (*DET*) and *desertified exotif forb* (*DEF*) classes, respectively, transition to the *exotic tree* (*ET*) and *exotic forbs* (*EF*) classes as the energy of the flow reworks the sediments of the perched river bank (i.e., eliminates it) but does not entirely remove roots of exotic species that could then resprout.
- The *exotic-forb* class (*EF*) remains the same in 100% of cases due to a resprouting and extensive root system.

Replacement fire originates from the surrounding landscape and restarts the succession clock to age

zero after sweeping through the riparian corridor. Fire is possible in both *late-succession closed* classes (*WDR-D* and *WDR-E*), because greater woody debris and drier vegetation classes are more prone to lightning strikes in addition to fire importation. Fire in reference classes causes a stand replacing event and recruitment into the *mid-succession* open class (*WDR-C*). However, fire is rare because the surrounding blackbrush and creosotebush-white bursage ecological systems do not carry fire, unless invaded by non-native annual grasses. The mean fire return interval is set at:

- About 750 years (rate of 0.0013/year) in the *late1-succession closed (WDR-D)* class; and
- 250 years (rate of 0.004/year) *late2-succession closed (WDR-E)* class.

Fire in most uncharacteristic classes often acts as a self-loop, returning all vegetation to age zero.

- These classes are *desertified-exotic-tree (DET)*, *exotic-tree (ET)*, *desertified-exotic-annual-species (DEX)*, and *exotic-annual-species (EX)* and they all have a 20-year fire return interval (rate of 0.05/year). In other words, saltcedar, red brome, and *Erodium* spp. either strongly resprout after or strive with fire.
- The *tree with exotic annual species* class (*TEX*) converts to the *exotic-annual-species (EX)* class after fire experienced, on average, about every 650 years (rate of 0.0015/year).

An important disturbance is the invasion by exotic trees (*exotic-tree-invasion*) represented mainly by saltcedar. This invasion is triggered if weed inventory and follow-up control has not happened in a pixel for five consecutive years. *Exotic-tree-invasion* causes a transition to the *exotic-tree* class (*ET*) on unincised river banks and to the *desertified-exotic-tree (DET)* class. Workshop participants agreed to moderate rates of invasion varying from 0.005/year to 0.01/year to plan for a worst case scenario. Saltcedar is wind dispersed. *Exotic-tree-invasion* occurs in several classes: *early-succession closed (WDR-A)*, *mid-succession closed* and *open* classes (*WDR-B* and *WDR-C*, respectively), *late1-succession closed (WDR-D)*, *late2-succession closed class (WDR-E)*, *desertified (DE)*, *desertified-exotic-annual-species (DEX)*, *exotic-annual-species (EX)*, and *tree with exotic annual species* class (*TEX*). Invasion rates vary:

- The highest rate of invasion of 0.01/year is found in classes with exposed mineral soil or substrate: *early-succession (WDR-A)* and the first four years of *mid-succession open class (WDR-C)*;
- As vegetation builds up, the invasion rate decreases to 0.0075/year in the following classes: *mid-succession closed (WDR-B)*, from year 5 to 89 of the *mid-succession open (WDR-C)*, *exotic-annual-species (EX)*, *desertified (DE)*, and *tree with exotic annual species (TEX)*; and
- The lowest rate of invasion of 0.005/year is observed in either the most mature reference classes or desertified (drier) classes: *late1-succession closed (WDR-D)*, *late2-succession closed (WDR-E)*, and *desertified-exotic-annual-species (DEX)*.

An important source of saltcedar mortality is the introduced biocontrol beetle (*beetle-mortality*), which is present to abundant in the Virgin River drainage. Workshop participants decided that beetles kill saltcedars after 4 consecutive years of defoliation; therefore, the return interval for beetle induced mortality is 4 years (rate of 0.25/year). *Beetle-mortality* has a failure rate of 75% (vegetation remains in the same class), whereas success (25%) is a transition. Beetle induced mortality causes age-dependent transitions from:

- The *exotic-tree* class (*ET*) to the *early-succession (DWR-A)*, *mid-succession closed (DWR -B)*, *mid-succession open (DWR-C)*, *late1-succession closed (DWR -D)*, and *late2-succession closed (DWR -E)* classes; and

- The *desertified-exotic-tree* class (DET) to the *desertified* class (DE).

In the warm desert riparian system, *exotic-forb-invasion* is decoupled from *exotic-tree-invasion* (it is not in other riparian ecological systems). Exotic forbs are represented mainly by knapweed species and tall whitetop. *Exotic-forb-invasion* causes a transition to the *exotic-forb* class (EF) on un-incised river banks and to the *desertified-exotic-tree* (DEF) class. Classes affected and rates of invasion of the *exotic-forb* class (EF) are identical to those of the *exotic-tree* (ET) class. There is not, however, a biocontrol beetle for exotic forb control.

A third form of invasion is by non-native annual species (*EX-invasion*) occurring at a rate of 0.005/year (5 of 1,000 pixels per year) in all uninvaded classes: *early-succession closed* (DWR-A), *mid-succession closed* (DWR-B), *mid-succession open* (DW-C), *late1-succession closed* (DWR-D), and *late2-succession closed* (DWR-E). Exotic annual species invasion (*EX-invasion*) is set at a moderate rate of 0.005/year (1 out of 200 pixels converted to a cheatgrass-invaded class per year). A base rate of 0.001/year was estimated for cheatgrass from data of northwest Utah collected by the Utah Division of Wildlife Resources in black sagebrush semi-desert. We default to five times the rate estimated from the Utah data because desert riparian systems are more productive systems. Invasion of reference classes causes an age-dependent transition to the *trees with non-native annual species* (TEX).

Present in Beaver Dam Wash only, *managed herbivory* and *excessive herbivory* have return intervals of one year (livestock is present every year) but different impact areas based on the distance livestock is willing to travel away from water. In theory, water is in this ecological system. The impact of grazing was modeled with area limits, because grazing permits have fixed stocking rates, season of use, and distribution. It was assumed that *managed herbivory* utilizes 5% of all grazable areas in the Beaver Dam Wash NCA (not just desert riparian); therefore, only 5% of the area is selected for *managed herbivory* and vegetation classes in desert riparian “compete” for selection. This method of modeling livestock grazing can only be implemented with the PATH software; VDDT cannot achieve landscape-level disturbances. Similarly, *excessive herbivory* affects 0.1% of the Beaver Dam Wash NCA causing a transition to the *desertified* class (DE); however, *excessive herbivory* is caused by the movement of livestock through the same areas near or on the way to water sources. Therefore, once areas dominated by incised river banks are created, they become permanent and no new areas are created. As a consequence, 0.1% of the Beaver Dam Wash is chosen among candidate vegetation classes to become the *desertified* class (DE) in the first years of simulations, and then the process is stopped.

Managed herbivory has different effects on woody succession depending on the age of the grazable vegetation classes:

- The *early-succession* class (WDR-A) is very vulnerable to grazing; therefore, new vegetation is largely eliminated and the age of grazed vegetation is reset at zero years;
- A similar effect is found in the *exotic-annual-species* class (EX) because livestock is concentrated in riparian areas and livestock will focus on non-native annual species because, during winter grazing (the permit is primarily for winter grazing), these species are often the only green forage available;
- In both *mid-succession* classes (WDR-B and WDR-C), grazing of more established vegetation has a small negative effect that consist of a one year reversal of woody vegetation after vegetation is grazed. This effect reverses woody succession through the reduction of preferentially herbaceous and nutrient-rich soft woody vegetation;
- Preference for these food types in more developed woody vegetation of the *late1-succession*

closed (WDR-D), desertified with exotic annual species (DEX), and tree with exotic species (TEX) classes causes a small acceleration of woody succession by favoring unpalatable or hardened woody species; and

- Grazing has no effect on the succession age of the *late2-succession closed* class (*WDR-E*).

Excessive herbivory is present in all classes except the *desertified (DE), exotic-tree (ET), exotic forb (EF), desertified exotic tree (DET), and desertified exotic forb (DEF)* classes. *Excessive herbivory* primarily causes a transition to the *desertified (DE)* class, however the *desertified with exotic annual species (DEX)* is one exception. This class cannot be further incised but the shade from trees and presence of green winter forage creates a strong grazing pressure that accelerates woody succession by three years for every pixel chosen.

Management Actions:

Several actions (six in Beaver Dam Wash and five in Red Cliffs NCAs, respectively) are used in this ecological system:

- Inventory of weeds and saltcedar on a rotation (i.e., revisit the same reach every *X* years) for identification of occurrences for future treatment (*weed-inventory*).
- Control of saltcedar: *exotic-tree-control*. Action consists of cutting saltcedar and immediately painting the stumps with the herbicide Garlon IV® in the *exotic-tree (ET)* and *desertified-exotic-tree (DET)* classes. Two types of failures occur: 10% of times there is no change of class because saltcedar resprout immediately and vigorously and 10% of times exotic forb species (knapweeds and tall whitetop) emerge (therefore, the *exotic-forb [EF]* or *desertified-exotic-forb [DEF]* classes). Success rate, therefore, is 80% and results in a transition to the *early-succession (WDR-A)* class for the non-desertified river reaches or the *desertified (DE)* class for saltcedar originally growing on incised river banks.
- Control of exotic forbs: *exotic-forb-control*. Action consists of spraying exotic forbs in the *exotic-forb (EF)* and *desertified-exotic-forb (DEF)* classes. On incised river banks, failure rate is 40% (no change of class), whereas “success” occurs 60% of time leaving a desertified and seeded (native species) river bank. On un-incised river banks, the treatment fails 40% of times with no change of class, whereas the treatment succeeds 60% of times resulting in a transition to the *early-succession (WDR-A)* class.
- In the Beaver Dam Wash NCA, cessation of livestock grazing by having a third party purchase all AUMs and retire grazing permits (i.e., by turning off grazing with one transition multiplier).
- Hand spraying of the herbicide Plateau® to control exotic annual species in the *tree with exotic species (TEX)* class. Failure rate is 50% (no change of class), whereas success causes a transition to the *early-succession (WDR-A), mid-succession closed (WDR-B), late1-succession closed (WDR-D), and late2-succession closed (WDR-D)* classes that depends on the age of originating vegetation class.
- Law enforcement only affected the creation of one vegetation class from OHV activity in several ecological systems of the Beaver Dam Wash NCA: *bare ground (BG)*. Increased law-enforcement reduces the OHV disturbance by 50% (to 5% absolute rate) using a static transition multiplier in PATH.

Appendix 3. Probabilistic transitions for biophysical settings of the Red Cliffs and Beaver Dam Wash NCAs. Output obtained from PATH database. Legend: BSu = Big Sagebrush Steppe-upland, BM = Blackbrush-mesic, BT= Blackbrush-thermic, CB = Creosotebush-White Bursage, DSS = Desert Sand Sagebrush, GRL = Warm Season Grassland, MR = Montane Riparian, MSh = Mountain Shrub, PJ = Pinyon-Juniper Woodland, WAS = Desert Washes, WDR = Warm-Desert Riparian.

| From Class | To Class | Transition Type | Prob | Propn | Start Age | End Age | Rel Age | Keep Age | Min TST | Max TST |
|-----------------------|-----------|------------------------|--------|--------|-----------|---------|---------|----------|---------|---------|
| Red Cliffs NCA | | | | | | | | | | |
| DSS-A:OP | DSS-A:OP | NativeHerbivory | 0.0050 | 1.0000 | 0 | 2 | 1 | No | 0 | 9999 |
| DSS-A:OP | DSS-A:OP | ReplacementFire | 0.0083 | 1.0000 | 0 | 2 | -2 | No | 0 | 9999 |
| DSS-A:OP | DSS-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 0 | 2 | 0 | Yes | 0 | 9999 |
| DSS-B:OP | DSS-A:OP | ReplacementFire | 0.0106 | 1.0000 | 3 | 999 | 0 | No | 0 | 9999 |
| DSS-B:OP | DSS-B:OP | Drought | 0.0056 | 1.0000 | 3 | 999 | -999 | No | 0 | 9999 |
| DSS-B:OP | DSS-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 3 | 999 | 2 | No | 0 | 9999 |
| DSS-B:OP | DSS-U:DP | Excessive-Herbivory | 0.0010 | 1.0000 | 10 | 10 | 0 | Yes | 0 | 9999 |
| DSS-B:OP | DSS-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 3 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:DP | DSS-U:DP | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| DSS-U:DP | DSS-U:DP | ReplacementFire | 0.0083 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| DSS-U:DP | DSS-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:SEP | DSS-B:OP | FOD+Seed-DSS | 0.0100 | 0.6000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:SEP | DSS-B:OP | Hrbx+Seed-DSS | 0.0100 | 0.5000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:SEP | DSS-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | FOD+Seed-DSS | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | Hrbx+Seed-DSS | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | ReplacementFire | 0.0106 | 1.0000 | 3 | 999 | -999 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | ReplacementFire | 0.0500 | 1.0000 | 0 | 2 | -999 | No | 0 | 9999 |
| BM-A:AL | BM-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-A:AL | BM-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 199 | 1 | No | 0 | 9999 |
| BM-A:AL | BM-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 199 | -999 | No | 3 | 9999 |
| BM-A:AL | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 199 | 0 | No | 2 | 9999 |

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|---------|----------|-----------------------------|--------|--------|-----|-----|------|-----|---|------|
| BM-A:AL | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 0 | 9999 |
| BM-A:AL | BM-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| BM-A:AL | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-A:AL | BM-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 5 | 199 | 0 | Yes | 0 | 9999 |
| BM-C:OP | BM-A:AL | ReplacementFire-Mojave | 0.0005 | 1.0000 | 200 | 999 | 0 | No | 3 | 9999 |
| BM-C:OP | BM-C:OP | FuelBreak | 0.0100 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-C:OP | BM-C:OP | Managed-Herbivory | 1.0000 | 0.0500 | 200 | 999 | 3 | No | 0 | 9999 |
| BM-C:OP | BM-D:OP | Tree-Invasion | 0.0025 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-C:OP | BM-U:BG | OHV | 1.0000 | 0.0001 | 200 | 999 | 0 | No | 2 | 9999 |
| BM-C:OP | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 210 | 210 | 0 | Yes | 0 | 9999 |
| BM-C:OP | BM-U:EX | Utilities | 0.0001 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-A:AL | Drought | 0.0056 | 0.0100 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-A:AL | ReplacementFire-Mojave | 0.0010 | 1.0000 | 400 | 999 | 0 | No | 3 | 9999 |
| BM-D:OP | BM-C:OP | Drought | 0.0056 | 0.9900 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-D:OP | FuelBreak | 0.0100 | 1.0000 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-D:OP | Managed-Herbivory | 1.0000 | 0.0500 | 400 | 999 | 3 | No | 0 | 9999 |
| BM-D:OP | BM-U:BG | OHV | 1.0000 | 0.0001 | 400 | 999 | 0 | No | 2 | 9999 |
| BM-D:OP | BM-U:EX | Utilities | 0.0001 | 1.0000 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-D:OP | BM-U:TEX | Tree-Encroachment | 0.0050 | 1.0000 | 600 | 999 | 0 | No | 0 | 9999 |
| BM-U:BG | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| BM-U:BG | BM-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:BG | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:ES | BM-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:ES | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:ES | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:EX | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Hrbx+Current-Native-Seed-BM | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |

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|-----------|-----------|-----------------------------|--------|--------|----|-----|------|-----|----|------|
| BM-U:EX | BM-U:EX | Hrbx+Introduced-Seed-BM | 0.0100 | 0.9500 | 0 | 999 | -999 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Hrbx+New-Seed-BM | 0.0100 | 0.9500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Planting+FOD-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Planting+Herbicide-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 21 | 999 | -999 | No | 3 | 9999 |
| BM-U:EX | BM-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 20 | -999 | No | 3 | 9999 |
| BM-U:EX | BM-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:PL | Planting+FOD-BM | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:PL | Planting+Herbicide-BM | 0.0100 | 0.4500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SD | Hrbx+Current-Native-Seed-BM | 0.0100 | 0.0100 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SD | Hrbx+New-Seed-BM | 0.0100 | 0.0500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SDI | Hrbx+Introduced-Seed-BM | 0.0100 | 0.0500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SEP | Non-Joshua-Succession | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:SEP | Planting+FOD-BM | 0.0100 | 0.2050 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:SEP | Planting+Herbicide-BM | 0.0100 | 0.4500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX2B | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:EX2B | BM-U:EX2B | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Hrbx+New-Seed-BM | 0.0100 | 0.9500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Planting+FOD-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Planting+Herbicide-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:EX2B | BM-U:PL | Planting+FOD-BM | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:PL | Planting+Herbicide-BM | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SD | Hrbx+New-Seed-BM | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SEP | Planting+FOD-BM | 0.0100 | 0.2050 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SEP | Planting+Herbicide-BM | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BM-U:PL | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| BM-U:PL | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 10 | 9999 |

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|----------|----------|------------------------|--------|--------|-----|-----|------|-----|----|------|
| BM-U:PL | BM-U:EX | Drought | 0.0056 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 0 | No | 10 | 9999 |
| BM-U:PL | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-U:PL | Drought | 0.0056 | 0.9000 | 0 | 999 | -999 | No | 0 | 9999 |
| BM-U:PL | BM-U:PL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-U:SEP | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | Yes | 2 | 9999 |
| BM-U:SD | BM-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BM-U:SD | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:SD | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 10 | 9999 |
| BM-U:SD | BM-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BM-U:SD | BM-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 10 | 9999 |
| BM-U:SD | BM-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | Yes | 2 | 9999 |
| BM-U:SD | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SD | BM-U:SD | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SD | BM-U:SD | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BM-U:SD | BM-U:SD | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:SD | BM-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SDI | BM-A:AL | Natural-Recovery | 0.0010 | 1.0000 | 20 | 199 | 0 | Yes | 10 | 9999 |
| BM-U:SDI | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:SDI | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0001 | 10 | 10 | 0 | Yes | 10 | 9999 |
| BM-U:SDI | BM-U:EX | EX-Invasion | 0.0010 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BM-U:SDI | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SDI | BM-U:SDI | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SDI | BM-U:SDI | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BM-U:SDI | BM-U:SDI | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 10 | 9999 |
| BM-U:SDI | BM-U:SDI | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:SDI | BM-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SDI | BM-U:SEP | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | Yes | 2 | 9999 |
| BM-U:SEP | BM-C:OP | Fingers-of-Death-BM | 0.0100 | 0.7500 | 5 | 399 | 0 | Yes | 0 | 9999 |
| BM-U:SEP | BM-D:OP | Fingers-of-Death-BM | 0.0100 | 0.7500 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SEP | BM-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| BM-U:SEP | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 0 | Yes | 0 | 9999 |

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|----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| BM-U:SEP | BM-U:EX | Drought | 0.0056 | 0.0100 | 20 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:EX | ReplacementFire-Mojave | 0.0050 | 1.0000 | 199 | 999 | 0 | No | 3 | 9999 |
| BM-U:SEP | BM-U:EX | Utilities | 0.0001 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 199 | 0 | No | 3 | 9999 |
| BM-U:SEP | BM-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:PL | Herbicide-BM | 0.0100 | 0.5000 | 5 | 15 | 0 | No | 1 | 9999 |
| BM-U:SEP | BM-U:SEP | Drought | 0.0056 | 0.9900 | 20 | 999 | -999 | No | 0 | 9999 |
| BM-U:SEP | BM-U:SEP | Fingers-of-Death-BM | 0.0100 | 0.2500 | 5 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:SEP | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:SEP | Herbicide-BM | 0.0100 | 0.5000 | 5 | 15 | 0 | No | 1 | 9999 |
| BM-U:SEP | BM-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| BM-U:SEP | BM-U:TEX | Tree-Invasion | 0.0025 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:TEX | BM-U:EX | Drought | 0.0056 | 0.0100 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:EX | ReplacementFire-Mojave | 0.0025 | 1.0000 | 400 | 999 | 0 | No | 3 | 9999 |
| BM-U:TEX | BM-U:SD | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:SEP | Chainsaw-Lopping-BM | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:SEP | Drought | 0.0056 | 0.1000 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:TEX | Drought | 0.0056 | 0.9000 | 400 | 999 | -999 | No | 0 | 9999 |
| BM-U:TEX | BM-U:TEX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-A:AL | BSu-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| BSu-A:AL | BSu-A:AL | ReplacementFire | 0.0125 | 1.0000 | 0 | 19 | -999 | No | 0 | 9999 |
| BSu-A:AL | BSu-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 0 | 9999 |
| BSu-B:OP | BSu-A:AL | ReplacementFire | 0.0200 | 1.0000 | 20 | 74 | 0 | No | 0 | 9999 |
| BSu-B:OP | BSu-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 74 | 1 | No | 0 | 9999 |
| BSu-B:OP | BSu-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 0 | Yes | 0 | 9999 |
| BSu-B:OP | BSu-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 74 | 0 | Yes | 0 | 9999 |
| BSu-C:CL | BSu-A:AL | ReplacementFire | 0.0200 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-C:CL | BSu-B:OP | Drought | 0.0060 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-C:CL | BSu-C:CL | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-C:CL | BSu-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 75 | 999 | 1 | No | 0 | 9999 |
| BSu-C:CL | BSu-D:OP | Tree-Invasion | 0.0050 | 1.0000 | 100 | 999 | 0 | Yes | 0 | 9999 |
| BSu-C:CL | BSu-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 85 | 85 | 0 | Yes | 0 | 9999 |

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|----------|-----------|-----------------------|--------|--------|-----|-----|------|-----|---|------|
| BSu-C:CL | BSu-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-D:OP | BSu-A:AL | ReplacementFire | 0.0200 | 1.0000 | 76 | 134 | 0 | No | 0 | 9999 |
| BSu-D:OP | BSu-B:OP | Drought | 0.0056 | 0.3000 | 76 | 134 | 0 | No | 0 | 9999 |
| BSu-D:OP | BSu-C:CL | Drought | 0.0056 | 0.6000 | 76 | 134 | 0 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Chainsaw-Thinning-BSu | 0.0100 | 1.0000 | 76 | 134 | -999 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Drought | 0.0056 | 0.1000 | 76 | 134 | -999 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Excessive-Herbivory | 0.0010 | 0.7500 | 86 | 86 | 3 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Managed-Herbivory | 1.0000 | 0.0500 | 76 | 134 | 1 | No | 0 | 9999 |
| BSu-D:OP | BSu-U:DP | Excessive-Herbivory | 0.0010 | 0.2500 | 86 | 86 | 0 | Yes | 0 | 9999 |
| BSu-D:OP | BSu-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 76 | 134 | 0 | No | 0 | 9999 |
| BSu-E:CL | BSu-A:AL | Chainsaw-Thinning-BSu | 0.0100 | 1.0000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-E:CL | BSu-A:AL | ReplacementFire | 0.0130 | 1.0000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-E:CL | BSu-B:OP | Drought | 0.0056 | 0.1000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-E:CL | BSu-E:CL | Drought | 0.0056 | 0.9000 | 135 | 999 | 5 | No | 0 | 9999 |
| BSu-E:CL | BSu-U:TE | Tree-Encroachment | 0.0200 | 1.0000 | 250 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:DP | BSu-U:DP | Chainsaw-Lopping-BSu | 0.0100 | 1.0000 | 100 | 999 | -999 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:DP | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:ES | Drought | 0.0056 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:ES | ReplacementFire | 0.0200 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:SES | EX-Invasion | 0.0050 | 1.0000 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:DP | BSu-U:TE | Tree-Invasion | 0.0050 | 1.0000 | 134 | 999 | 0 | No | 0 | 9999 |
| BSu-U:ES | BSu-A:AL | ReplacementFire | 0.0200 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:ES | BSu-B:OP | Natural-Recovery | 0.0010 | 1.0000 | 12 | 49 | 10 | Yes | 0 | 9999 |
| BSu-U:ES | BSu-C:CL | Natural-Recovery | 0.0010 | 1.0000 | 50 | 999 | 10 | Yes | 0 | 9999 |
| BSu-U:ES | BSu-U:ES | ReplacementFire | 0.0200 | 0.9900 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:EX | BSu-U:EX | Herbicide+Seed-BSu | 0.0100 | 0.2000 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:EX | BSu-U:EX | ReplacementFire | 0.1000 | 0.1000 | 0 | 999 | -999 | No | 0 | 9999 |
| BSu-U:EX | BSu-U:SD | Herbicide+Seed-BSu | 0.0100 | 0.8000 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SD | BSu-A:AL | Natural-Recovery | 0.0010 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-B:OP | Natural-Recovery | 0.0100 | 1.0000 | 20 | 74 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-C:CL | Natural-Recovery | 0.0500 | 1.0000 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-D:OP | Tree-Invasion | 0.0050 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|-------------------------|--------|--------|-----|-----|------|-----|----|------|
| BSu-U:SD | BSu-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | ReplacementFire | 0.0125 | 1.0000 | 0 | 19 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | ReplacementFire | 0.0125 | 1.0000 | 135 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | ReplacementFire | 0.0200 | 1.0000 | 20 | 134 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 20 | 134 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 135 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:SEP | BSu-A:AL | Drought | 0.0056 | 0.0100 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-A:AL | ReplacementFire | 0.0400 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-C:CL | Herbicide+Seed-BSu | 0.0100 | 0.9000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-C:CL | Natural-Recovery | 0.0010 | 1.0000 | 75 | 999 | 0 | Yes | 10 | 9999 |
| BSu-U:SEP | BSu-U:EX | Drought | 0.0056 | 0.0900 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:EX | ReplacementFire | 0.0400 | 0.9000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Chainsaw-Lopping-BSu | 0.0100 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Herbicide+Seed-BSu | 0.0100 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 75 | 99 | 1 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SES | Excessive-Herbivory | 0.0010 | 1.0000 | 85 | 85 | 0 | Yes | 0 | 9999 |
| BSu-U:SEP | BSu-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 100 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:TEX | Tree-Invasion | 0.0050 | 1.0000 | 134 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:EX | Drought | 0.0056 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:EX | ReplacementFire | 0.0400 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:SES | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:TEX | Tree-Invasion | 0.0050 | 1.0000 | 134 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:TE | BSu-U:ES | Drought | 0.0056 | 0.0500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:ES | ReplacementFire | 0.0085 | 0.4500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:EX | Drought | 0.0056 | 0.0500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:EX | ReplacementFire | 0.0085 | 0.4500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:EX | Thin+Herbicide+Seed-BSu | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:SD | Thin+Herbicide+Seed-BSu | 0.0100 | 0.9000 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|-------------------------|--------|--------|-----|-----|------|-----|---|------|
| BSu-U:TE | BSu-U:SES | ReplacementFire | 0.0085 | 0.1000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:TE | Drought | 0.0056 | 0.9000 | 135 | 999 | -999 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 135 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:TEX | BSu-U:EX | Drought | 0.0056 | 0.1000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:EX | ReplacementFire | 0.0085 | 1.0000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:EX | Thin+Herbicide+Seed-BSu | 0.0100 | 0.2000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:SD | Thin+Herbicide+Seed-BSu | 0.0100 | 0.8000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:TEX | Drought | 0.0056 | 0.9000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-A:AL | BT-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 499 | 0 | No | 0 | 9999 |
| BT-A:AL | BT-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 499 | 2 | No | 0 | 9999 |
| BT-A:AL | BT-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 499 | -999 | No | 3 | 9999 |
| BT-A:AL | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 499 | 0 | No | 2 | 9999 |
| BT-A:AL | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 0 | 9999 |
| BT-A:AL | BT-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| BT-A:AL | BT-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 5 | 499 | 0 | Yes | 0 | 9999 |
| BT-C:CL | BT-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 500 | 999 | 0 | No | 3 | 9999 |
| BT-C:CL | BT-C:CL | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-C:CL | BT-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 500 | 999 | 2 | No | 0 | 9999 |
| BT-C:CL | BT-U:BG | OHV | 1.0000 | 0.0001 | 500 | 999 | 0 | No | 2 | 9999 |
| BT-C:CL | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 510 | 510 | 0 | Yes | 0 | 9999 |
| BT-C:CL | BT-U:EX | Utilities | 0.0001 | 1.0000 | 500 | 999 | 0 | No | 0 | 9999 |
| BT-C:CL | BT-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 500 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:BG | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| BT-U:BG | BT-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:BG | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:ES | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:ES | BT-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:ES | BT-U:ES | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BT-U:ES | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:ES | BT-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:EX | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|-----------------------------|--------|--------|----|-----|------|-----|----|------|
| BT-U:EX | BT-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Hrbx+Current-Native-Seed-BT | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Hrbx+Introduced-Seed-BT | 0.0100 | 0.9500 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Hrbx+New-Seed-BT | 0.0500 | 0.9500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Planting+FOD-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Planting+Herbicide-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BT-U:EX | BT-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:EX | BT-U:PL | Planting+FOD-BT | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:PL | Planting+Herbicide-BT | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:SD | Hrbx+Current-Native-Seed-BT | 0.0100 | 0.0100 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SD | Hrbx+New-Seed-BT | 0.0100 | 0.0500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SDI | Hrbx+Introduced-Seed-BT | 0.0100 | 0.0500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SEP | Non-Joshua-Succession | 0.1000 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SEP | Planting+FOD-BT | 0.0100 | 0.2050 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:SEP | Planting+Herbicide-BT | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:EX2B | BT-U:EX2B | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Hrbx+New-Seed-BT | 0.0100 | 0.9500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Planting+FOD-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Planting+Herbicide-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:PL | Planting+FOD-BT | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:PL | Planting+Herbicide-BT | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SD | Hrbx+New-Seed-BT | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SEP | Planting+FOD-BT | 0.0100 | 0.2050 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SEP | Planting+Herbicide-BT | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:PL | BT-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BT-U:PL | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |

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|----------|----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| BT-U:PL | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | No | 10 | 9999 |
| BT-U:PL | BT-U:EX | Drought | 0.0056 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:PL | BT-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -3 | No | 10 | 9999 |
| BT-U:PL | BT-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | Yes | 2 | 9999 |
| BT-U:PL | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:PL | BT-U:PL | Drought | 0.0056 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:PL | BT-U:PL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BT-U:SD | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:SD | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 10 | 9999 |
| BT-U:SD | BT-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BT-U:SD | BT-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | Yes | 2 | 9999 |
| BT-U:SD | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Drought | 0.0056 | 0.1000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Drought | 0.0056 | 0.9000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -1 | No | 10 | 9999 |
| BT-U:SD | BT-U:SD | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| BT-U:SD | BT-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:SDI | BT-A:AL | Natural-Recovery | 0.0020 | 1.0000 | 0 | 999 | 0 | No | 10 | 9999 |
| BT-U:SDI | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:SDI | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 10 | 9999 |
| BT-U:SDI | BT-U:EX | EX-Invasion | 0.0010 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BT-U:SDI | BT-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | Yes | 2 | 9999 |
| BT-U:SDI | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Drought | 0.0056 | 0.1000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Drought | 0.0056 | 0.9000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -1 | No | 10 | 9999 |
| BT-U:SDI | BT-U:SDI | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |

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|----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| BT-U:SDI | BT-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-C:CL | Fingers-of-Death-BT | 0.0100 | 0.7500 | 5 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:SEP | BT-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| BT-U:SEP | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:EX | Drought | 0.0056 | 0.0100 | 20 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:EX | ReplacementFire-Mojave | 0.0050 | 1.0000 | 499 | 999 | 0 | No | 3 | 9999 |
| BT-U:SEP | BT-U:EX | Utilities | 0.0001 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 499 | 0 | No | 3 | 9999 |
| BT-U:SEP | BT-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:PL | Herbicide-BT | 0.0100 | 0.5000 | 5 | 15 | 0 | Yes | 1 | 9999 |
| BT-U:SEP | BT-U:SEP | Drought | 0.0056 | 0.9900 | 20 | 999 | -999 | No | 0 | 9999 |
| BT-U:SEP | BT-U:SEP | Fingers-of-Death-BT | 0.0100 | 0.2500 | 5 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:SEP | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:SEP | Herbicide-BT | 0.0100 | 0.5000 | 5 | 15 | 0 | Yes | 1 | 9999 |
| BT-U:SEP | BT-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 2 | No | 0 | 9999 |
| CB-A:OP | CB-A:OP | FuelBreak | 0.0100 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| CB-A:OP | CB-A:OP | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| CB-A:OP | CB-A:OP | ReplacementFire-Mojave | 0.0005 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| CB-A:OP | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 19 | 0 | No | 2 | 9999 |
| CB-A:OP | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | No | 0 | 9999 |
| CB-A:OP | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| CB-A:OP | CB-U:EX | Utilities | 0.0050 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| CB-C:OP | CB-A:OP | Drought | 0.0056 | 1.0000 | 20 | 399 | 0 | No | 0 | 9999 |
| CB-C:OP | CB-A:OP | ReplacementFire-Mojave | 0.0005 | 1.0000 | 20 | 999 | 0 | No | 3 | 9999 |
| CB-C:OP | CB-C:OP | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-C:OP | CB-C:OP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 3 | No | 0 | 9999 |
| CB-C:OP | CB-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| CB-C:OP | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 0 | Yes | 0 | 9999 |
| CB-C:OP | CB-U:EX | Utilities | 0.0001 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-C:OP | CB-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:BG | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| CB-U:BG | CB-U:BG | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|---|------|
| CB-U:BG | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:ES | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:ES | CB-U:ES | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| CB-U:ES | CB-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:ES | CB-U:ES | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| CB-U:ES | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| CB-U:ES | CB-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:ES | CB-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:EX | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:EX | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | Hrbx+New-Seed-CB | 0.0100 | 0.9500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:EX | CB-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | Planting+FOD-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | Planting+Herbicide-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| CB-U:EX | CB-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| CB-U:EX | CB-U:PL | Planting+FOD-CB | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:PL | Planting+Herbicide-CB | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SD | Hrbx+New-Seed-CB | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SEP | Non-Joshua-Succession | 0.1000 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:EX | CB-U:SEP | Planting+FOD-CB | 0.0100 | 0.2050 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SEP | Planting+Herbicide-CB | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:EX2B | CB-U:EX2B | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Hrbx+New-Seed-CB | 0.0100 | 0.9500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Planting+FOD-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Planting+Herbicide-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 999 | 0 | No | 3 | 9999 |
| CB-U:EX2B | CB-U:PL | Planting+FOD-CB | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:PL | Planting+Herbicide-CB | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| CB-U:EX2B | CB-U:SD | Hrbx+New-Seed-CB | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:SEP | Planting+FOD-CB | 0.0100 | 0.2050 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:SEP | Planting+Herbicide-CB | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-A:OP | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| CB-U:PL | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:PL | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | No | 10 | 9999 |
| CB-U:PL | CB-U:EX | Drought | 0.0056 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -3 | No | 10 | 9999 |
| CB-U:PL | CB-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-U:PL | Drought | 0.0056 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| CB-U:PL | CB-U:PL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-U:SEP | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:SD | CB-A:OP | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| CB-U:SD | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:SD | CB-U:ES | Excessive-Herbivory | 0.0010 | 1.0000 | 10 | 10 | 0 | No | 10 | 9999 |
| CB-U:SD | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| CB-U:SD | CB-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 10 | 9999 |
| CB-U:SD | CB-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 19 | 0 | No | 2 | 9999 |
| CB-U:SD | CB-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:SD | CB-U:SD | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:SD | CB-U:SD | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| CB-U:SD | CB-U:SD | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| CB-U:SD | CB-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:SEP | CB-C:OP | Fingers-of-Death-CB | 0.0100 | 0.7500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:SEP | CB-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| CB-U:SEP | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:EX | Drought | 0.0056 | 1.0000 | 21 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:EX | ReplacementFire-Mojave | 0.0015 | 1.0000 | 21 | 999 | 0 | No | 3 | 9999 |
| CB-U:SEP | CB-U:EX | Utilities | 0.0001 | 1.0000 | 21 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:PL | Herbicide-CB | 0.0100 | 0.0500 | 20 | 999 | 0 | No | 1 | 9999 |
| CB-U:SEP | CB-U:SEP | Fingers-of-Death-CB | 0.0100 | 0.2500 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:SEP | FuelBreak | 0.0100 | 1.0000 | 21 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|---|------|
| CB-U:SEP | CB-U:SEP | Herbicide-CB | 0.0100 | 0.0500 | 20 | 999 | 0 | No | 1 | 9999 |
| CB-U:SEP | CB-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 21 | 999 | 3 | No | 0 | 9999 |
| DSS-U:SEP | DSS-B:OP | FOD+Seed-DSS | 0.0100 | 0.8000 | 0 | 999 | 0 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | FOD+Seed-DSS | 0.0100 | 0.2000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-A:AL | GRL-A:AL | Drought | 0.0056 | 1.0000 | 0 | 19 | -10 | No | 0 | 9999 |
| GRL-A:AL | GRL-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| GRL-A:AL | GRL-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| GRL-A:AL | GRL-A:AL | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| GRL-A:AL | GRL-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 0 | 9999 |
| GRL-A:AL | GRL-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| GRL-B:OP | GRL-A:AL | Drought | 0.0056 | 0.1000 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-B:OP | GRL-A:AL | ReplacementFire-Mojave | 0.0015 | 1.0000 | 20 | 999 | 0 | No | 3 | 9999 |
| GRL-B:OP | GRL-B:OP | Drought | 0.0056 | 0.9000 | 20 | 999 | -999 | No | 0 | 9999 |
| GRL-B:OP | GRL-B:OP | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-B:OP | GRL-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| GRL-B:OP | GRL-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 0 | Yes | 0 | 9999 |
| GRL-B:OP | GRL-U:SES | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | Drought | 0.0056 | 1.0000 | 0 | 999 | -10 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 3 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| GRL-U:DP | GRL-U:EEX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:EEX | GRL-A:AL | FOD+Seed-GRL | 0.0100 | 0.6000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:EEX | GRL-A:AL | Hrbx+Seed-GRL | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | Drought | 0.0056 | 1.0000 | 0 | 999 | -10 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | FOD+Seed-GRL | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | Hrbx+Seed-GRL | 0.0100 | 0.6000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| GRL-U:EEX | GRL-U:SES | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 20 | 0 | Yes | 0 | 9999 |

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|-----------|-----------|-----------------------------|--------|--------|-----|-----|------|-----|---|------|
| GRL-U:EX | GRL-A:AL | Herbicide-GRL | 0.0100 | 0.5000 | 0 | 19 | 0 | No | 0 | 9999 |
| GRL-U:EX | GRL-B:OP | Fingers-of-Death-GRL | 0.0100 | 0.7500 | 0 | 19 | 0 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EEX | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | Drought | 0.0056 | 1.0000 | 0 | 19 | -10 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | Fingers-of-Death-GRL | 0.0100 | 0.2500 | 0 | 19 | 0 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | Herbicide-GRL | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| GRL-U:SES | GRL-B:OP | Fingers-of-Death-GRL | 0.0100 | 0.7500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:SES | GRL-B:OP | Herbicide-GRL | 0.0100 | 0.6000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Drought | 0.0056 | 1.0000 | 20 | 999 | -10 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 3 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Fingers-of-Death-GRL | 0.0100 | 0.2500 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Herbicide-GRL | 0.0100 | 0.4000 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | ReplacementFire-Mojave | 0.0100 | 1.0000 | 20 | 999 | -999 | No | 3 | 9999 |
| MM-A:AL | MM-A:AL | NativeHerbivory | 0.0200 | 1.0000 | 0 | 9 | -999 | No | 0 | 9999 |
| MM-A:AL | MM-A:AL | ReplacementFire | 0.0020 | 1.0000 | 0 | 9 | -999 | No | 0 | 9999 |
| MM-A:AL | MM-A:AL | Wet-Year | 0.1500 | 1.0000 | 0 | 999 | -1 | No | 0 | 9999 |
| MM-B:OP | MM-A:AL | ReplacementFire | 0.0070 | 1.0000 | 10 | 29 | 0 | No | 0 | 9999 |
| MM-C:CL | MM-A:AL | ReplacementFire | 0.0070 | 1.0000 | 60 | 999 | 0 | No | 0 | 9999 |
| MM-C:CL | MM-U:TEX | EX-Invasion | 0.0001 | 1.0000 | 60 | 999 | 0 | Yes | 0 | 9999 |
| MM-U:EX | MM-U:EX | ReplacementFire | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MM-U:TEX | MM-U:EX | ReplacementFire | 0.0070 | 1.0000 | 150 | 999 | 0 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | Flooding-7yr | 0.1300 | 1.0000 | 0 | 4 | -5 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 4 | -5 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | ReplacementFire | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | Weed-Inventory-MR | 0.2500 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| MR-A:AL | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 5 | 9999 |
| MR-A:AL | MR-U:SFE | Excessive-Herbivory | 0.0010 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |

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| MR-B:OP | MR-A:AL | Flooding-20yr | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-B:OP | MR-A:AL | ReplacementFire | 0.0010 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-B:OP | MR-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 19 | -1 | No | 0 | 9999 |
| MR-B:OP | MR-B:OP | Weed-Inventory-MR | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-B:OP | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 5 | 9999 |
| MR-B:OP | MR-U:SFE | Excessive-Herbivory | 0.0010 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-A:AL | Flooding-100yr | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-A:AL | ReplacementFire | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| MR-C:CL | MR-C:CL | Weed-Inventory-MR | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 5 | 9999 |
| MR-C:CL | MR-U:SFE | Excessive-Herbivory | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-U:DE | MR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:DE | MR-A:AL | Floodplain-Recovery | 0.0010 | 1.0000 | 0 | 999 | 0 | No | 10 | 9999 |
| MR-U:DE | MR-A:AL | Floodplain-Restoration | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:DE | MR-U:DE | Flooding-100yr | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:DE | MR-U:DE | ReplacementFire | 0.0200 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:EF | MR-B:OP | Exotic-Control-MR | 0.6000 | 1.0000 | 0 | 999 | 0 | No | 0 | 20 |
| MR-U:EF | MR-U:EF | Exotic-Control-MR | 0.4000 | 1.0000 | 0 | 999 | 0 | No | 0 | 20 |
| MR-U:EF | MR-U:EF | ReplacementFire | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:SFE | MR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:SFE | MR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:SFE | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.3300 | 1.0000 | 0 | 999 | 0 | No | 5 | 9999 |
| MR-U:SFE | MR-U:SFE | Flooding-100yr | 0.0100 | 0.9900 | 20 | 999 | -999 | No | 0 | 9999 |
| MR-U:SFE | MR-U:SFE | ReplacementFire | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:SFE | MR-U:SFE | Weed-Inventory-MR | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| MSD-A:AL | MSD-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 4 | 1 | No | 0 | 9999 |
| MSD-A:AL | MSD-A:AL | Very-Wet-Year | 0.0100 | 1.0000 | 0 | 4 | -4 | No | 0 | 9999 |
| MSD-B:OP | MSD-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-B:OP | MSD-A:AL | ReplacementFire | 0.0001 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-B:OP | MSD-A:AL | Very-Wet-Year | 0.0180 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-B:OP | MSD-C:OP | Drought | 0.0056 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|-----------------------|--------|--------|----|-----|------|-----|---|------|
| MSD-B:OP | MSD-U:SES | EX-Invasion | 0.0050 | 1.0000 | 5 | 999 | 0 | Yes | 0 | 9999 |
| MSD-C:OP | MSD-A:AL | Very-Wet-Year | 0.0500 | 1.0000 | 10 | 59 | 0 | No | 0 | 9999 |
| MSD-C:OP | MSD-C:OP | Drought | 0.0056 | 1.0000 | 10 | 59 | -999 | No | 0 | 9999 |
| MSD-C:OP | MSD-U:SES | EX-Invasion | 0.0050 | 1.0000 | 10 | 59 | 0 | Yes | 0 | 9999 |
| MSD-U:EX | MSD-U:EX | ReplacementFire | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSD-U:SD | MSD-A:AL | Natural-Recovery | 0.0010 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| MSD-U:SD | MSD-B:OP | Natural-Recovery | 0.0050 | 1.0000 | 5 | 999 | 0 | Yes | 0 | 9999 |
| MSD-U:SD | MSD-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Drought | 0.0056 | 1.0000 | 0 | 4 | -999 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Drought | 0.0056 | 1.0000 | 5 | 999 | -1 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Managed-Herbivory | 1.0000 | 0.0500 | 3 | 999 | 1 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Very-Wet-Year | 0.0180 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SES | EX-Invasion | 0.0050 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-U:SES | MSD-U:EX | ReplacementFire | 0.0250 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-U:SES | MSD-U:EX | Very-Wet-Year | 0.0500 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSh-A:AL | MSh-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 5 | -999 | No | 0 | 9999 |
| MSh-A:AL | MSh-A:AL | NativeHerbivory | 1.0000 | 0.0200 | 0 | 999 | -1 | No | 0 | 9999 |
| MSh-A:AL | MSh-A:AL | Wet-Year | 0.1500 | 1.0000 | 0 | 5 | -1 | No | 0 | 9999 |
| MSh-A:AL | MSh-U:ES | Excessive-Herbivory | 0.0010 | 1.0000 | 5 | 5 | 0 | Yes | 0 | 9999 |
| MSh-A:AL | MSh-U:EX | EX-Invasion | 0.0025 | 1.0000 | 0 | 5 | 0 | Yes | 0 | 9999 |
| MSh-B:CL | MSh-A:AL | ReplacementFire | 0.0140 | 1.0000 | 6 | 19 | 0 | No | 0 | 9999 |
| MSh-B:CL | MSh-B:CL | Managed-Herbivory | 1.0000 | 0.0500 | 6 | 19 | 1 | No | 0 | 9999 |
| MSh-B:CL | MSh-U:ES | Excessive-Herbivory | 0.0010 | 1.0000 | 10 | 10 | 0 | Yes | 0 | 9999 |
| MSh-B:CL | MSh-U:SEP | EX-Invasion | 0.0025 | 1.0000 | 20 | 49 | 0 | Yes | 0 | 9999 |
| MSh-C:CL | MSh-A:AL | ReplacementFire | 0.0140 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MSh-C:CL | MSh-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| MSh-C:CL | MSh-D:OP | Tree-Invasion | 0.0010 | 1.0000 | 50 | 99 | 0 | No | 0 | 9999 |
| MSh-C:CL | MSh-D:OP | Tree-Invasion | 0.0050 | 1.0000 | 99 | 999 | 0 | No | 0 | 9999 |
| MSh-C:CL | MSh-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 30 | 30 | 0 | Yes | 0 | 9999 |
| MSh-C:CL | MSh-U:SEP | EX-Invasion | 0.0025 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| MSh-D:OP | MSh-A:AL | Chainsaw-Thinning-MSh | 0.0100 | 0.2000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSh-D:OP | MSh-A:AL | ReplacementFire | 0.0067 | 1.0000 | 50 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| MSH-D:OP | MSH-B:CL | Chainsaw-Thinning-MSH | 0.0100 | 0.8000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-D:OP | MSH-C:CL | Drought | 0.0056 | 0.1000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-D:OP | MSH-D:OP | Drought | 0.0056 | 0.9000 | 50 | 999 | -999 | No | 0 | 9999 |
| MSH-D:OP | MSH-U:TE | Tree-Encroachment | 0.0067 | 1.0000 | 150 | 999 | 0 | Yes | 0 | 9999 |
| MSH-D:OP | MSH-U:TEX | EX-Invasion | 0.0025 | 1.0000 | 50 | 999 | 0 | Yes | 0 | 9999 |
| MSH-U:ES | MSH-U:ES | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| MSH-U:ES | MSH-U:ES | ReplacementFire | 0.0140 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSH-U:EX | MSH-A:AL | Herbicide+SeedRose-MSH | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | Herbicide+SeedRose-MSH | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | Planting+FOD-BM | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | Wet-Year | 0.1500 | 1.0000 | 0 | 5 | -5 | No | 0 | 9999 |
| MSH-U:SEP | MSH-B:CL | Hrbx+SeedGrass-MSH | 0.0100 | 0.7000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| MSH-U:SEP | MSH-U:EX | ReplacementFire | 0.0250 | 1.0000 | 6 | 300 | 0 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:SEP | Excessive-Herbivory | 1.0000 | 0.0010 | 6 | 999 | 3 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:SEP | Hrbx+SeedGrass-MSH | 0.0100 | 0.3000 | 6 | 999 | 0 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 6 | 999 | 1 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:TEX | Tree-Invasion | 0.0010 | 1.0000 | 50 | 99 | 0 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:TEX | Tree-Invasion | 0.0050 | 1.0000 | 100 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-A:AL | Thin+Hrbx+SeedRose-MSH | 0.0100 | 0.9000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:ES | Drought | 0.0056 | 0.1000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:ES | ReplacementFire | 0.0067 | 1.0000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:ES | Thin+Hrbx+SeedRose-MSH | 0.0100 | 0.1000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:TE | Drought | 0.0056 | 0.9000 | 150 | 999 | -999 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 150 | 999 | 0 | Yes | 0 | 9999 |
| MSH-U:TEX | MSH-A:AL | Thin+Hrbx+SeedRose-MSH | 0.0100 | 0.8000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:EX | Drought | 0.0056 | 0.1000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:EX | ReplacementFire | 0.0067 | 1.0000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:EX | Thin+Hrbx+SeedRose-MSH | 0.0100 | 0.2000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:SEP | ReplacementFire | 0.0067 | 1.0000 | 50 | 149 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:TEX | Drought | 0.0056 | 0.9000 | 50 | 999 | -999 | No | 0 | 9999 |
| PJ-A:AL | PJ-A:AL | ReplacementFire | 0.0030 | 1.0000 | 0 | 9 | -999 | No | 0 | 9999 |

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|----------|-----------|------------------------|--------|--------|-----|-----|------|-----|----|------|
| PJ-B:OP | PJ-A:AL | ReplacementFire | 0.0050 | 1.0000 | 10 | 29 | 0 | No | 0 | 9999 |
| PJ-C:OP | PJ-A:AL | ReplacementFire | 0.0050 | 1.0000 | 30 | 99 | 0 | No | 0 | 9999 |
| PJ-C:OP | PJ-B:OP | Drought | 0.0056 | 0.1000 | 30 | 99 | 0 | No | 0 | 9999 |
| PJ-C:OP | PJ-C:OP | Drought | 0.0056 | 0.9000 | 30 | 99 | -999 | No | 0 | 9999 |
| PJ-C:OP | PJ-U:TEX | EX-Invasion | 0.0001 | 1.0000 | 50 | 99 | 0 | Yes | 0 | 9999 |
| PJ-D:OP | PJ-A:AL | ReplacementFire | 0.0010 | 1.0000 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-D:OP | PJ-B:OP | Drought | 0.0067 | 0.0300 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-D:OP | PJ-C:OP | Drought | 0.0057 | 0.0700 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-D:OP | PJ-D:OP | Drought | 0.0056 | 0.9000 | 100 | 999 | -999 | No | 0 | 9999 |
| PJ-D:OP | PJ-U:TEX | EX-Invasion | 0.0010 | 1.0000 | 100 | 999 | 0 | Yes | 0 | 9999 |
| PJ-U:EX | PJ-A:AL | Hrbx+Seed-PJ | 0.0100 | 0.6000 | 0 | 999 | 0 | No | 0 | 9999 |
| PJ-U:EX | PJ-U:EX | Hrbx+Seed-PJ | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |
| PJ-U:EX | PJ-U:EX | ReplacementFire | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| PJ-U:TEX | PJ-C:OP | Herbicide-PJ | 0.0100 | 0.6000 | 30 | 99 | 0 | Yes | 0 | 9999 |
| PJ-U:TEX | PJ-D:OP | Herbicide-PJ | 0.0100 | 0.6000 | 100 | 999 | 0 | Yes | 0 | 9999 |
| PJ-U:TEX | PJ-U:EX | Drought | 0.0056 | 0.1000 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-U:TEX | PJ-U:EX | ReplacementFire | 0.0050 | 1.0000 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-U:TEX | PJ-U:TEX | Drought | 0.0056 | 0.9000 | 100 | 999 | -999 | No | 0 | 9999 |
| PJ-U:TEX | PJ-U:TEX | Herbicide-PJ | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | Flash-Flood | 0.1400 | 1.0000 | 0 | 4 | -999 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 4 | 1 | No | 10 | 9999 |
| SWA-A:AL | SWA-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 4 | -999 | No | 3 | 9999 |
| SWA-A:AL | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | -999 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-A:AL | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 4 | 0 | No | 2 | 9999 |
| SWA-A:AL | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0005 | 10 | 10 | 0 | No | 10 | 9999 |
| SWA-A:AL | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 0 | 4 | 0 | Yes | 5 | 9999 |
| SWA-A:AL | SWA-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-A:AL | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-A:AL | Flash-Flood | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |

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|----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| SWA-B:CL | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 5 | 999 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-B:CL | FuelBreak | 0.0100 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-B:CL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-B:CL | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 19 | 1 | No | 10 | 9999 |
| SWA-B:CL | SWA-B:CL | ReplacementFire-Mojave | 0.0010 | 1.0000 | 5 | 19 | 0 | No | 3 | 9999 |
| SWA-B:CL | SWA-B:CL | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-U:BG | OHV | 1.0000 | 0.0001 | 5 | 19 | 0 | No | 2 | 9999 |
| SWA-B:CL | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0005 | 10 | 10 | 0 | No | 10 | 9999 |
| SWA-B:CL | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 5 | 19 | 0 | Yes | 5 | 9999 |
| SWA-B:CL | SWA-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-B:CL | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 5 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-A:AL | Flash-Flood | 0.0100 | 1.0000 | 20 | 999 | -999 | No | 0 | 9999 |
| SWA-C:CL | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-B:CL | ReplacementFire-Mojave | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 3 | 9999 |
| SWA-C:CL | SWA-C:CL | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-C:CL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 10 | 9999 |
| SWA-C:CL | SWA-C:CL | Weed-Inventory-WAS | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| SWA-C:CL | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0005 | 10 | 10 | 0 | Yes | 10 | 9999 |
| SWA-C:CL | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 20 | 999 | 0 | No | 5 | 9999 |
| SWA-C:CL | SWA-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-C:CL | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:BG | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:BG | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| SWA-U:BG | SWA-U:BG | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:BG | SWA-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:BG | SWA-U:SES | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:BG | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| SWA-U:ES | SWA-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|---|------|
| SWA-U:ES | SWA-U:ES | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-U:ES | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | 0 | No | 3 | 9999 |
| SWA-U:ES | SWA-U:ES | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:ES | SWA-U:SES | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:ES | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-A:AL | Beetle-Mortality | 0.2500 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:ET | SWA-A:AL | Exotic-Control-WAS | 0.0100 | 0.9000 | 0 | 4 | 0 | No | 0 | 50 |
| SWA-U:ET | SWA-A:AL | Flash-Flood | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-B:CL | Beetle-Mortality | 0.2500 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:ET | SWA-B:CL | Exotic-Control-WAS | 0.0100 | 0.9000 | 5 | 19 | 0 | No | 0 | 50 |
| SWA-U:ET | SWA-C:CL | Beetle-Mortality | 0.2500 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:ET | SWA-C:CL | Exotic-Control-WAS | 0.0100 | 0.9000 | 20 | 999 | 0 | No | 0 | 50 |
| SWA-U:ET | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| SWA-U:ET | SWA-U:ET | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 3 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | Exotic-Control-WAS | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 50 |
| SWA-U:ET | SWA-U:ET | Flash-Flood | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | ReplacementFire-Mojave | 0.0200 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| SWA-U:ET | SWA-U:ET | Utilities | 0.0001 | 0.7000 | 0 | 999 | -999 | No | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Flash-Flood | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-B:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-B:CL | Herbicide-WAS | 0.0100 | 0.5000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-C:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-C:CL | Herbicide-WAS | 0.0100 | 0.5000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| SWA-U:SEP | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | No | 10 | 9999 |
| SWA-U:SEP | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Fingers-of-Death-SWA | 0.0100 | 0.2500 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Flash-Flood | 0.0100 | 0.9900 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | ReplacementFire-Mojave | 0.0200 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 0 | No | 10 | 9999 |
| SWA-U:SEP | SWA-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 19 | 1 | No | 10 | 9999 |
| SWA-U:SEP | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Flash-Flood | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-B:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-B:CL | Herbicide-WAS | 0.0100 | 0.5000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-C:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-C:CL | Herbicide-WAS | 0.0100 | 0.5000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| SWA-U:SES | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 10 | 10 | 0 | Yes | 10 | 9999 |
| SWA-U:SES | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:SES | SWA-U:SES | Fingers-of-Death-SWA | 0.0100 | 0.2500 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Flash-Flood | 0.0100 | 0.9900 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 10 | 9999 |
| SWA-U:SES | SWA-U:SES | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| SWA-U:SES | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |

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|----------|-----------|----------------------|--------|--------|----|-----|------|-----|---|------|
| WDR-A:AL | WDR-A:AL | Flooding-7yr | 0.1300 | 1.0000 | 0 | 4 | -999 | No | 0 | 9999 |
| WDR-A:AL | WDR-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 4 | -999 | No | 0 | 9999 |
| WDR-A:AL | WDR-A:AL | Weed-Inventory | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| WDR-A:AL | WDR-U:DE | Excessive-Herbivory | 0.0010 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| WDR-A:AL | WDR-U:EF | Exotic-Forb-Invasion | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 5 | 9999 |
| WDR-A:AL | WDR-U:ET | Exotic-Tree-Invasion | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 5 | 9999 |
| WDR-A:AL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| WDR-B:CL | WDR-A:AL | Flooding-20yr | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| WDR-B:CL | WDR-B:CL | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 19 | -1 | No | 0 | 9999 |
| WDR-B:CL | WDR-B:CL | Weed-Inventory | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| WDR-B:CL | WDR-U:DE | Excessive-Herbivory | 0.0010 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| WDR-B:CL | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 5 | 19 | 0 | No | 5 | 9999 |
| WDR-B:CL | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 5 | 19 | 0 | No | 5 | 9999 |
| WDR-B:CL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| WDR-C:OP | WDR-A:AL | Flooding-20yr | 0.0500 | 1.0000 | 1 | 89 | 0 | No | 0 | 9999 |
| WDR-C:OP | WDR-C:OP | Managed-Herbivory | 1.0000 | 0.0500 | 1 | 89 | -1 | No | 0 | 9999 |
| WDR-C:OP | WDR-U:DE | Excessive-Herbivory | 0.0010 | 1.0000 | 1 | 89 | 0 | Yes | 0 | 9999 |
| WDR-C:OP | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 5 | 89 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:EF | Exotic-Forb-Invasion | 0.0100 | 1.0000 | 1 | 4 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 5 | 89 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:ET | Exotic-Tree-Invasion | 0.0100 | 1.0000 | 1 | 4 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 1 | 89 | 0 | Yes | 0 | 9999 |
| WDR-D:CL | WDR-A:AL | Flooding-100yr | 0.0100 | 1.0000 | 20 | 89 | 0 | No | 0 | 9999 |
| WDR-D:CL | WDR-C:OP | ReplacementFire | 0.0013 | 1.0000 | 20 | 89 | 0 | No | 0 | 9999 |
| WDR-D:CL | WDR-D:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 89 | 1 | No | 0 | 9999 |
| WDR-D:CL | WDR-D:CL | Weed-Inventory | 0.0100 | 1.0000 | 20 | 89 | 0 | No | 0 | 9999 |
| WDR-D:CL | WDR-U:DE | Excessive-Herbivory | 0.0010 | 1.0000 | 20 | 89 | 0 | Yes | 0 | 9999 |
| WDR-D:CL | WDR-U:EF | Exotic-Forb-Invasion | 0.0050 | 1.0000 | 20 | 89 | 0 | No | 5 | 9999 |
| WDR-D:CL | WDR-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 20 | 89 | 0 | No | 5 | 9999 |
| WDR-D:CL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 20 | 89 | 0 | Yes | 0 | 9999 |
| WDR-E:CL | WDR-A:AL | Flooding-100yr | 0.0020 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-C:OP | Flooding-100yr | 0.0100 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| WDR-E:CL | WDR-C:OP | ReplacementFire | 0.0040 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-C:OP | Senescence | 0.0200 | 1.0000 | 450 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-E:CL | Managed-Herbivory | 1.0000 | 0.0500 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-E:CL | Weed-Inventory | 0.0100 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 90 | 999 | 0 | Yes | 0 | 9999 |
| WDR-E:CL | WDR-U:EF | Exotic-Forb-Invasion | 0.0050 | 1.0000 | 90 | 999 | 0 | No | 5 | 9999 |
| WDR-E:CL | WDR-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 90 | 999 | 0 | Yes | 5 | 9999 |
| WDR-E:CL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 90 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:DE | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-A:AL | Floodplain-Restoration | 0.0100 | 0.9000 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DE | Flooding-100yr | 0.0100 | 0.9900 | 1 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DE | Floodplain-Restoration | 0.0100 | 0.1000 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DE | Weed-Inventory | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DEF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 1 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DE | WDR-U:DET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 1 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DEF | WDR-U:DE | Exotic-Forb-Control | 0.0100 | 0.6000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DEF | WDR-U:DEF | Exotic-Forb-Control | 0.0100 | 0.4000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DEF | WDR-U:DEF | Flooding-100yr | 0.0100 | 0.9900 | 1 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DEF | WDR-U:EF | Flooding-100yr | 0.0100 | 0.0100 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DET | WDR-U:DE | Beetle-Mortality | 0.2500 | 0.2500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:DET | WDR-U:DE | Exotic-Tree-Control | 0.0100 | 0.8000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DET | WDR-U:DEF | Beetle-Mortality | 0.2500 | 0.7500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:DET | WDR-U:DEF | Exotic-Tree-Control | 0.0100 | 0.1000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DET | WDR-U:DET | Exotic-Tree-Control | 0.0100 | 0.1000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DET | WDR-U:DET | Flooding-100yr | 0.0100 | 0.9900 | 1 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DET | WDR-U:DET | ReplacementFire | 0.0500 | 1.0000 | 5 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DET | WDR-U:ET | Flooding-100yr | 0.0100 | 0.0100 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DEX | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEF | Exotic-Forb-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DEX | WDR-U:DET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DEX | WDR-U:DEX | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 3 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEX | Flooding-100yr | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |

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|-----------|-----------|----------------------|--------|--------|----|-----|------|-----|----|------|
| WDR-U:DEX | WDR-U:DEX | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEX | ReplacementFire | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEX | Weed-Inventory | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:EF | WDR-A:AL | Exotic-Forb-Control | 0.0100 | 0.6000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:EF | WDR-U:EF | Exotic-Forb-Control | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:EF | WDR-U:EF | Flooding-100yr | 0.0100 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:ET | WDR-A:AL | Beetle-Mortality | 0.2500 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-A:AL | Exotic-Tree-Control | 0.0100 | 0.8000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:ET | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:ET | WDR-B:CL | Beetle-Mortality | 0.2500 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-C:OP | Beetle-Mortality | 0.2500 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-D:CL | Beetle-Mortality | 0.2500 | 1.0000 | 20 | 89 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-E:CL | Beetle-Mortality | 0.2500 | 1.0000 | 90 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-U:DET | Entrenchment | 0.0001 | 1.0000 | 0 | 999 | 0 | Yes | 10 | 9999 |
| WDR-U:ET | WDR-U:EF | Exotic-Tree-Control | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:ET | WDR-U:ET | Exotic-Tree-Control | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:ET | WDR-U:ET | Flooding-100yr | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:ET | WDR-U:ET | ReplacementFire | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 500 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 500 | 0 | Yes | 0 | 9999 |
| WDR-U:EX | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 0 | 500 | 0 | Yes | 5 | 9999 |
| WDR-U:EX | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 0 | 500 | 0 | Yes | 5 | 9999 |
| WDR-U:EX | WDR-U:EX | Flooding-100yr | 0.0100 | 0.9900 | 0 | 500 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 500 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-U:EX | ReplacementFire | 0.0500 | 1.0000 | 0 | 500 | -999 | No | 0 | 9999 |
| WDR-U:TEX | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 20 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-A:AL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| WDR-U:TEX | WDR-B:CL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| WDR-U:TEX | WDR-D:CL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 20 | 89 | 0 | Yes | 0 | 9999 |
| WDR-U:TEX | WDR-E:CL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 90 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:TEX | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0001 | 5 | 19 | 0 | Yes | 0 | 9999 |
| WDR-U:TEX | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 5 | 999 | 0 | Yes | 5 | 9999 |

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|-----------|-----------|----------------------|--------|--------|----|-----|---|----|---|------|
| WDR-U:TEX | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 5 | 999 | 0 | No | 5 | 9999 |
| WDR-U:TEX | WDR-U:EX | Flooding-100yr | 0.0100 | 0.9900 | 20 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:EX | Flooding-20yr | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:EX | ReplacementFire | 0.0015 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:TEX | Hrbx-EX-WDR | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:TEX | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 999 | 1 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:TEX | Weed-Inventory | 0.0100 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |

**Beaver Dam Wash
NCA**

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| DSS-A:OP | DSS-A:OP | NativeHerbivory | 0.0050 | 1.0000 | 0 | 2 | 1 | No | 0 | 9999 |
| DSS-A:OP | DSS-A:OP | ReplacementFire | 0.0083 | 1.0000 | 0 | 2 | -2 | No | 0 | 9999 |
| DSS-A:OP | DSS-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 0 | 2 | 0 | Yes | 0 | 9999 |
| DSS-B:OP | DSS-A:OP | ReplacementFire | 0.0106 | 1.0000 | 3 | 999 | 0 | No | 0 | 9999 |
| DSS-B:OP | DSS-B:OP | Drought | 0.0056 | 1.0000 | 3 | 999 | -999 | No | 0 | 9999 |
| DSS-B:OP | DSS-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 3 | 999 | 2 | No | 0 | 9999 |
| DSS-B:OP | DSS-U:DP | Excessive-Herbivory | 0.0010 | 1.0000 | 3 | 999 | 0 | Yes | 0 | 9999 |
| DSS-B:OP | DSS-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 3 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:DP | DSS-U:DP | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| DSS-U:DP | DSS-U:DP | ReplacementFire | 0.0083 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| DSS-U:DP | DSS-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:SEP | DSS-B:OP | Hrbx+Seed-DSS | 0.0100 | 0.8000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:SEP | DSS-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | Hrbx+Seed-DSS | 0.0100 | 0.2000 | 0 | 999 | 0 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | ReplacementFire | 0.0106 | 1.0000 | 3 | 999 | -999 | No | 0 | 9999 |
| DSS-U:SEP | DSS-U:SEP | ReplacementFire | 0.0500 | 1.0000 | 0 | 2 | -999 | No | 0 | 9999 |
| BM-A:AL | BM-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-A:AL | BM-A:AL | Law-Inforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-A:AL | BM-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 199 | 1 | No | 0 | 9999 |
| BM-A:AL | BM-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 199 | -999 | No | 3 | 9999 |
| BM-A:AL | BM-B:JT | Joshua-Succession | 0.6300 | 1.0000 | 198 | 198 | 0 | No | 0 | 9999 |
| BM-A:AL | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |

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|---------|-----------|------------------------|--------|--------|-----|-----|---|-----|---|------|
| BM-A:AL | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-A:AL | BM-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| BM-A:AL | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-A:AL | BM-U:SEP | EX-Invasion | 0.0050 | 0.5000 | 5 | 199 | 0 | Yes | 0 | 9999 |
| BM-A:AL | BM-U:SEPJ | EX-Invasion | 0.0050 | 0.5000 | 5 | 999 | 0 | Yes | 0 | 9999 |
| BM-B:JT | BM-A:AL | ReplacementFire-Mojave | 0.0005 | 1.0000 | 200 | 999 | 0 | No | 3 | 9999 |
| BM-B:JT | BM-B:JT | FuelBreak | 0.0100 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-B:JT | BM-B:JT | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-B:JT | BM-B:JT | Managed-Herbivory | 1.0000 | 0.0500 | 200 | 999 | 3 | No | 0 | 9999 |
| BM-B:JT | BM-E:JT | Tree-Invasion | 0.0025 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-B:JT | BM-U:BG | OHV | 1.0000 | 0.0001 | 200 | 999 | 0 | No | 2 | 9999 |
| BM-B:JT | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 200 | 999 | 0 | Yes | 0 | 9999 |
| BM-B:JT | BM-U:EX | Utilities | 0.0001 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-B:JT | BM-U:SEPJ | EX-Invasion | 0.0050 | 1.0000 | 200 | 999 | 0 | Yes | 0 | 9999 |
| BM-C:OP | BM-A:AL | ReplacementFire-Mojave | 0.0005 | 1.0000 | 200 | 999 | 0 | No | 3 | 9999 |
| BM-C:OP | BM-C:OP | FuelBreak | 0.0100 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-C:OP | BM-C:OP | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-C:OP | BM-C:OP | Managed-Herbivory | 1.0000 | 0.0500 | 200 | 999 | 3 | No | 0 | 9999 |
| BM-C:OP | BM-D:OP | Tree-Invasion | 0.0025 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-C:OP | BM-U:BG | OHV | 1.0000 | 0.0001 | 200 | 999 | 0 | No | 2 | 9999 |
| BM-C:OP | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 200 | 999 | 0 | Yes | 0 | 9999 |
| BM-C:OP | BM-U:EX | Utilities | 0.0001 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-A:AL | Drought | 0.0056 | 0.0100 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-A:AL | ReplacementFire-Mojave | 0.0010 | 1.0000 | 400 | 999 | 0 | No | 3 | 9999 |
| BM-D:OP | BM-C:OP | Drought | 0.0056 | 0.9900 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-D:OP | FuelBreak | 0.0100 | 1.0000 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-D:OP | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-D:OP | Managed-Herbivory | 1.0000 | 0.0500 | 400 | 999 | 3 | No | 0 | 9999 |
| BM-D:OP | BM-U:BG | OHV | 1.0000 | 0.0001 | 400 | 999 | 0 | No | 2 | 9999 |
| BM-D:OP | BM-U:EX | Utilities | 0.0001 | 1.0000 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-D:OP | BM-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-D:OP | BM-U:TEX | Tree-Encroachment | 0.0050 | 1.0000 | 600 | 999 | 0 | No | 0 | 9999 |

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|---------|-----------|-----------------------------|--------|--------|-----|-----|------|-----|---|------|
| BM-E:JT | BM-A:AL | Drought | 0.0056 | 0.0100 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-E:JT | BM-A:AL | ReplacementFire-Mojave | 0.0010 | 1.0000 | 400 | 999 | 0 | No | 3 | 9999 |
| BM-E:JT | BM-B:JT | Drought | 0.0056 | 0.9900 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-E:JT | BM-E:JT | FuelBreak | 0.0100 | 1.0000 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-E:JT | BM-E:JT | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-E:JT | BM-E:JT | Managed-Herbivory | 1.0000 | 0.0500 | 400 | 999 | 3 | No | 0 | 9999 |
| BM-E:JT | BM-U:BG | OHV | 1.0000 | 0.0001 | 400 | 999 | 0 | No | 2 | 9999 |
| BM-E:JT | BM-U:EX | Utilities | 0.0001 | 1.0000 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-E:JT | BM-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-E:JT | BM-U:TEX | Tree-Encroachment | 0.0050 | 1.0000 | 600 | 999 | 0 | No | 0 | 9999 |
| BM-U:BG | BM-U:BG | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:BG | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| BM-U:BG | BM-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:BG | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:ES | BM-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:ES | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:ES | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:ES | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:SEP | EX-Invasion | 0.0050 | 0.3700 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:ES | BM-U:SEPJ | EX-Invasion | 0.0050 | 0.6300 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:EX | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Hrbx+Current-Native-Seed-BM | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Hrbx+Introduced-Seed-BM | 0.0100 | 0.9500 | 0 | 999 | -999 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Hrbx+New-Seed-BM | 0.0100 | 0.9500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:EX | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX | Planting+FOD-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:EX | Planting+Herbicide-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 21 | 999 | -999 | No | 3 | 9999 |

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|-----------|-----------|-----------------------------|--------|--------|----|-----|------|-----|----|------|
| BM-U:EX | BM-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 20 | -999 | No | 3 | 9999 |
| BM-U:EX | BM-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:PL | Planting+FOD-BM | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:PL | Planting+Herbicde-BM | 0.0100 | 0.4500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SD | Hrbx+Current-Native-Seed-BM | 0.0100 | 0.0100 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SD | Hrbx+New-Seed-BM | 0.0100 | 0.0500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SDI | Hrbx+Introduced-Seed-BM | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:SEP | Non-Joshua-Succession | 0.1000 | 0.3700 | 20 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:SEP | Planting+FOD-BM | 0.0100 | 0.0850 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:SEP | Planting+Herbicde-BM | 0.0100 | 0.1700 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX | BM-U:SEPJ | Joshua-Succession | 0.1000 | 0.6300 | 20 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:SEPJ | Planting+FOD-BM | 0.0100 | 0.1400 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX | BM-U:SEPJ | Planting+Herbicde-BM | 0.0100 | 0.2800 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:EX2B | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:EX2B | BM-U:EX2B | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Hrbx+New-Seed-BM | 0.0100 | 0.9500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Law-Inforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Planting+FOD-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | Planting+Herbicde-BM | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:EX2B | BM-U:PL | Planting+FOD-BM | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:PL | Planting+Herbicde-BM | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SD | Hrbx+New-Seed-BM | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SEP | Planting+FOD-BM | 0.0100 | 0.0850 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SEP | Planting+Herbicde-BM | 0.0100 | 0.1700 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SEPJ | Planting+FOD-BM | 0.0100 | 0.1400 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:EX2B | BM-U:SEPJ | Planting+Herbicde-BM | 0.0100 | 0.2800 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BM-U:PL | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| BM-U:PL | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 2 | 999 | 0 | Yes | 10 | 9999 |
| BM-U:PL | BM-U:EX | Drought | 0.0056 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |

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|----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| BM-U:PL | BM-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 10 | 9999 |
| BM-U:PL | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-U:PL | Drought | 0.0056 | 0.9000 | 0 | 999 | -999 | No | 0 | 9999 |
| BM-U:PL | BM-U:PL | Law-Inforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-U:PL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BM-U:PL | BM-U:SEP | Seedbank-Emergence | 0.2000 | 0.6800 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:PL | BM-U:SEPJ | Seedbank-Emergence | 0.2000 | 0.3200 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:SD | BM-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BM-U:SD | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:SD | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 10 | 9999 |
| BM-U:SD | BM-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BM-U:SD | BM-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 10 | 9999 |
| BM-U:SD | BM-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | Yes | 2 | 9999 |
| BM-U:SD | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SD | BM-U:SD | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SD | BM-U:SD | Law-Inforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SD | BM-U:SD | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BM-U:SD | BM-U:SD | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:SD | BM-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SDI | BM-A:AL | Natural-Recovery | 0.0010 | 1.0000 | 20 | 199 | 0 | Yes | 10 | 9999 |
| BM-U:SDI | BM-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:SDI | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0001 | 0 | 999 | 0 | Yes | 10 | 9999 |
| BM-U:SDI | BM-U:EX | EX-Invasion | 0.0010 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BM-U:SDI | BM-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SDI | BM-U:SDI | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SDI | BM-U:SDI | Law-Inforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SDI | BM-U:SDI | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BM-U:SDI | BM-U:SDI | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 10 | 9999 |
| BM-U:SDI | BM-U:SDI | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BM-U:SDI | BM-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SDI | BM-U:SEP | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | No | 2 | 9999 |
| BM-U:SEP | BM-C:OP | Fingers-of-Death-BM | 0.0100 | 0.7500 | 5 | 399 | 0 | Yes | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|----|------|
| BM-U:SEP | BM-D:OP | Fingers-of-Death-BM | 0.0100 | 0.7500 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SEP | BM-U:BG | OHV | 1.0000 | 0.0001 | 5 | 999 | 0 | No | 2 | 9999 |
| BM-U:SEP | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 5 | 999 | 0 | Yes | 10 | 9999 |
| BM-U:SEP | BM-U:EX | Drought | 0.0056 | 0.0100 | 5 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:EX | ReplacementFire-Mojave | 0.0050 | 1.0000 | 200 | 999 | 0 | No | 3 | 9999 |
| BM-U:SEP | BM-U:EX | Utilities | 0.0001 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:EX2B | ReplacementFire-Mojave | 0.0050 | 1.0000 | 5 | 199 | 0 | No | 3 | 9999 |
| BM-U:SEP | BM-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 199 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:PL | Herbicide-BM | 0.0100 | 0.5000 | 5 | 15 | 0 | No | 1 | 9999 |
| BM-U:SEP | BM-U:SEP | Drought | 0.0056 | 0.9900 | 5 | 999 | -999 | No | 0 | 9999 |
| BM-U:SEP | BM-U:SEP | Fingers-of-Death-BM | 0.0100 | 0.2500 | 5 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:SEP | FuelBreak | 0.0100 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:SEP | Herbicide-BM | 0.0100 | 0.5000 | 5 | 15 | 0 | No | 1 | 9999 |
| BM-U:SEP | BM-U:SEP | Law-Enforcement | 0.0100 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEP | BM-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 999 | 1 | No | 10 | 9999 |
| BM-U:SEP | BM-U:TEX | Tree-Invasion | 0.0025 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SEPJ | BM-B:JT | Fingers-of-Death-BM | 0.0100 | 0.7500 | 5 | 399 | 0 | No | 0 | 9999 |
| BM-U:SEPJ | BM-E:JT | Fingers-of-Death-BM | 0.0100 | 0.7500 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:SEPJ | BM-U:BG | OHV | 1.0000 | 0.0001 | 5 | 999 | 0 | No | 2 | 9999 |
| BM-U:SEPJ | BM-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 5 | 999 | 0 | Yes | 10 | 9999 |
| BM-U:SEPJ | BM-U:EX | Drought | 0.0056 | 0.0100 | 5 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEPJ | BM-U:EX | ReplacementFire-Mojave | 0.0050 | 1.0000 | 200 | 999 | 0 | No | 3 | 9999 |
| BM-U:SEPJ | BM-U:EX | Utilities | 0.0001 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEPJ | BM-U:EX2B | ReplacementFire-Mojave | 0.0050 | 1.0000 | 5 | 199 | 0 | No | 3 | 9999 |
| BM-U:SEPJ | BM-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 199 | 0 | No | 0 | 9999 |
| BM-U:SEPJ | BM-U:PL | Herbicide-BM | 0.0100 | 0.5000 | 5 | 15 | 0 | No | 1 | 9999 |
| BM-U:SEPJ | BM-U:SEPJ | Drought | 0.0056 | 0.9900 | 20 | 999 | -999 | No | 0 | 9999 |
| BM-U:SEPJ | BM-U:SEPJ | Fingers-of-Death-BM | 0.0100 | 0.2500 | 5 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEPJ | BM-U:SEPJ | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEPJ | BM-U:SEPJ | Herbicide-BM | 0.0100 | 0.5000 | 5 | 15 | 0 | No | 1 | 9999 |
| BM-U:SEPJ | BM-U:SEPJ | Law-Enforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:SEPJ | BM-U:SEPJ | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 10 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| BM-U:SEPJ | BM-U:TEX | Tree-Invasion | 0.0025 | 1.0000 | 400 | 999 | 0 | Yes | 0 | 9999 |
| BM-U:TEX | BM-U:EX | Drought | 0.0056 | 0.0100 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:EX | ReplacementFire-Mojave | 0.0025 | 1.0000 | 400 | 999 | 0 | No | 3 | 9999 |
| BM-U:TEX | BM-U:SD | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:SEP | Drought | 0.0056 | 0.0330 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:SEPJ | Drought | 0.0056 | 0.0570 | 400 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:TEX | Drought | 0.0056 | 0.9000 | 400 | 999 | -999 | No | 0 | 9999 |
| BM-U:TEX | BM-U:TEX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BM-U:TEX | BM-U:TEX | Law-Inforcement | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-A:AL | BSu-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| BSu-A:AL | BSu-A:AL | ReplacementFire | 0.0125 | 1.0000 | 0 | 19 | -999 | No | 0 | 9999 |
| BSu-A:AL | BSu-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BSu-B:OP | BSu-A:AL | ReplacementFire | 0.0200 | 1.0000 | 20 | 74 | 0 | No | 0 | 9999 |
| BSu-B:OP | BSu-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 74 | 1 | No | 0 | 9999 |
| BSu-B:OP | BSu-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 74 | 0 | Yes | 0 | 9999 |
| BSu-B:OP | BSu-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 74 | 0 | Yes | 0 | 9999 |
| BSu-C:CL | BSu-A:AL | ReplacementFire | 0.0200 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-C:CL | BSu-B:OP | Drought | 0.0060 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-C:CL | BSu-C:CL | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-C:CL | BSu-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 75 | 999 | 1 | No | 0 | 9999 |
| BSu-C:CL | BSu-D:OP | Tree-Invasion | 0.0050 | 1.0000 | 100 | 999 | 0 | Yes | 0 | 9999 |
| BSu-C:CL | BSu-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-C:CL | BSu-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-D:OP | BSu-A:AL | ReplacementFire | 0.0200 | 1.0000 | 76 | 134 | 0 | No | 0 | 9999 |
| BSu-D:OP | BSu-B:OP | Drought | 0.0056 | 0.3000 | 76 | 134 | 0 | No | 0 | 9999 |
| BSu-D:OP | BSu-C:CL | Drought | 0.0056 | 0.6000 | 76 | 134 | 0 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Chainsaw-Thinning-BSu | 0.0100 | 1.0000 | 76 | 134 | -999 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Drought | 0.0056 | 0.1000 | 76 | 134 | -999 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Excessive-Herbivory | 0.0010 | 0.7500 | 76 | 134 | 3 | No | 0 | 9999 |
| BSu-D:OP | BSu-D:OP | Managed-Herbivory | 1.0000 | 0.0500 | 76 | 134 | 1 | No | 0 | 9999 |
| BSu-D:OP | BSu-U:DP | Excessive-Herbivory | 0.0010 | 0.2500 | 86 | 86 | 0 | Yes | 0 | 9999 |
| BSu-D:OP | BSu-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 76 | 134 | 0 | No | 0 | 9999 |

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|-----------|-----------|-----------------------|--------|--------|-----|-----|------|-----|---|------|
| BSu-E:CL | BSu-A:AL | Chainsaw-Thinning-BSu | 0.0100 | 1.0000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-E:CL | BSu-A:AL | ReplacementFire | 0.0130 | 1.0000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-E:CL | BSu-B:OP | Drought | 0.0056 | 0.1000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-E:CL | BSu-E:CL | Drought | 0.0056 | 0.9000 | 135 | 999 | 5 | No | 0 | 9999 |
| BSu-E:CL | BSu-U:TE | Tree-Encroachment | 0.0200 | 1.0000 | 250 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:DP | BSu-U:DP | Chainsaw-Lopping-BSu | 0.0100 | 1.0000 | 100 | 999 | -999 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:DP | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:ES | Drought | 0.0056 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:ES | ReplacementFire | 0.0200 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:DP | BSu-U:SES | EX-Invasion | 0.0050 | 1.0000 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:DP | BSu-U:TE | Tree-Invasion | 0.0050 | 1.0000 | 134 | 999 | 0 | No | 0 | 9999 |
| BSu-U:ES | BSu-A:AL | ReplacementFire | 0.0200 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:ES | BSu-B:OP | Natural-Recovery | 0.0010 | 1.0000 | 12 | 49 | 10 | Yes | 0 | 9999 |
| BSu-U:ES | BSu-C:CL | Natural-Recovery | 0.0010 | 1.0000 | 50 | 999 | 10 | Yes | 0 | 9999 |
| BSu-U:ES | BSu-U:ES | ReplacementFire | 0.0200 | 0.9900 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:EX | BSu-U:EX | Herbicide+Seed-BSu | 0.0100 | 0.2000 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:EX | BSu-U:EX | ReplacementFire | 0.1000 | 0.1000 | 0 | 999 | -999 | No | 0 | 9999 |
| BSu-U:EX | BSu-U:SD | Herbicide+Seed-BSu | 0.0100 | 0.8000 | 0 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SD | BSu-A:AL | Natural-Recovery | 0.0010 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-B:OP | Natural-Recovery | 0.0100 | 1.0000 | 20 | 74 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-C:CL | Natural-Recovery | 0.0500 | 1.0000 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-D:OP | Tree-Invasion | 0.0050 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 75 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | ReplacementFire | 0.0125 | 1.0000 | 0 | 19 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | ReplacementFire | 0.0125 | 1.0000 | 135 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SD | ReplacementFire | 0.0200 | 1.0000 | 20 | 134 | -999 | No | 0 | 9999 |
| BSu-U:SD | BSu-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 20 | 134 | 0 | Yes | 0 | 9999 |
| BSu-U:SD | BSu-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 135 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:SEP | BSu-A:AL | Drought | 0.0056 | 0.0100 | 75 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|-------------------------|--------|--------|-----|-----|------|-----|----|------|
| BSu-U:SEP | BSu-A:AL | ReplacementFire | 0.0400 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-C:CL | Herbicide+Seed-BSu | 0.0100 | 0.9000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-C:CL | Natural-Recovery | 0.0010 | 1.0000 | 75 | 999 | 0 | Yes | 10 | 9999 |
| BSu-U:SEP | BSu-U:EX | Drought | 0.0056 | 0.0900 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:EX | ReplacementFire | 0.0400 | 0.9000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Chainsaw-Lopping-BSu | 0.0100 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Herbicide+Seed-BSu | 0.0100 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 75 | 99 | 1 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:SES | Excessive-Herbivory | 1.0000 | 0.0010 | 75 | 99 | 0 | Yes | 0 | 9999 |
| BSu-U:SEP | BSu-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 100 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SEP | BSu-U:TEX | Tree-Invasion | 0.0050 | 1.0000 | 134 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:EX | Drought | 0.0056 | 0.1000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:EX | ReplacementFire | 0.0400 | 1.0000 | 75 | 999 | 0 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:SES | Drought | 0.0056 | 0.9000 | 75 | 999 | -999 | No | 0 | 9999 |
| BSu-U:SES | BSu-U:TEX | Tree-Invasion | 0.0050 | 1.0000 | 134 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:TE | BSu-U:ES | Drought | 0.0056 | 0.0500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:ES | ReplacementFire | 0.0085 | 0.4500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:EX | Drought | 0.0056 | 0.0500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:EX | ReplacementFire | 0.0085 | 0.4500 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:SES | ReplacementFire | 0.0085 | 0.1000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:TE | Drought | 0.0056 | 0.9000 | 135 | 999 | -999 | No | 0 | 9999 |
| BSu-U:TE | BSu-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 135 | 999 | 0 | Yes | 0 | 9999 |
| BSu-U:TEX | BSu-U:EX | Drought | 0.0056 | 0.1000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:EX | ReplacementFire | 0.0085 | 1.0000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:EX | Thin+Herbicide+Seed-BSu | 0.0100 | 0.2000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:SD | Thin+Herbicide+Seed-BSu | 0.0100 | 0.8000 | 135 | 999 | 0 | No | 0 | 9999 |
| BSu-U:TEX | BSu-U:TEX | Drought | 0.0056 | 0.9000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-A:AL | BT-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 499 | 0 | No | 0 | 9999 |
| BT-A:AL | BT-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 499 | 2 | No | 0 | 9999 |
| BT-A:AL | BT-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 499 | -999 | No | 3 | 9999 |
| BT-A:AL | BT-B:JT | Joshua-Succession | 0.5400 | 1.0000 | 498 | 498 | 0 | No | 0 | 9999 |

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|---------|-----------|-----------------------------|--------|--------|-----|-----|------|-----|---|------|
| BT-A:AL | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 499 | 0 | No | 2 | 9999 |
| BT-A:AL | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 2 | 499 | 0 | Yes | 0 | 9999 |
| BT-A:AL | BT-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| BT-A:AL | BT-U:SEP | EX-Invasion | 0.0050 | 0.5000 | 5 | 499 | 0 | Yes | 0 | 9999 |
| BT-A:AL | BT-U:SEPJ | EX-Invasion | 0.0050 | 0.5000 | 5 | 499 | 0 | Yes | 0 | 9999 |
| BT-B:JT | BT-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 500 | 999 | 0 | No | 3 | 9999 |
| BT-B:JT | BT-B:JT | FuelBreak | 0.0100 | 1.0000 | 500 | 999 | 0 | No | 0 | 9999 |
| BT-B:JT | BT-B:JT | Managed-Herbivory | 1.0000 | 0.0500 | 500 | 999 | 2 | No | 0 | 9999 |
| BT-B:JT | BT-U:BG | OHV | 1.0000 | 0.0001 | 500 | 999 | 0 | No | 2 | 9999 |
| BT-B:JT | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 500 | 999 | 0 | Yes | 0 | 9999 |
| BT-B:JT | BT-U:EX | Utilities | 0.0001 | 1.0000 | 500 | 999 | 0 | No | 0 | 9999 |
| BT-B:JT | BT-U:SEPJ | EX-Invasion | 0.0050 | 1.0000 | 500 | 999 | 0 | Yes | 0 | 9999 |
| BT-C:CL | BT-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 500 | 999 | 0 | No | 3 | 9999 |
| BT-C:CL | BT-C:CL | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-C:CL | BT-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 500 | 999 | 2 | No | 0 | 9999 |
| BT-C:CL | BT-U:BG | OHV | 1.0000 | 0.0001 | 500 | 999 | 0 | No | 2 | 9999 |
| BT-C:CL | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 500 | 999 | 0 | Yes | 0 | 9999 |
| BT-C:CL | BT-U:EX | Utilities | 0.0001 | 1.0000 | 500 | 999 | 0 | No | 0 | 9999 |
| BT-C:CL | BT-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 500 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:BG | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| BT-U:BG | BT-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:BG | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:ES | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:ES | BT-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:ES | BT-U:ES | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BT-U:ES | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:ES | BT-U:SEP | EX-Invasion | 0.0050 | 0.3500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:ES | BT-U:SEPJ | EX-Invasion | 0.0050 | 0.6500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:EX | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Hrbx+Current-Native-Seed-BT | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |

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|-----------|-----------|-----------------------------|--------|--------|----|-----|------|-----|---|------|
| BT-U:EX | BT-U:EX | Hrbx+Introduced-Seed-BT | 0.0100 | 0.9500 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Hrbx+New-Seed-BT | 0.0100 | 0.9500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Planting+FOD-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX | Planting+Herbicide-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BT-U:EX | BT-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:EX | BT-U:PL | Planting+FOD-BT | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:PL | Planting+Herbicide-BT | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:SD | Hrbx+Current-Native-Seed-BT | 0.0100 | 0.0100 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SD | Hrbx+New-Seed-BT | 0.0100 | 0.0500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SDI | Hrbx+Introduced-Seed-BT | 0.0100 | 0.0500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SEP | Non-Joshua-Succession | 0.1000 | 0.5400 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SEP | Planting+FOD-BT | 0.0100 | 0.1050 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:SEP | Planting+Herbicide-BT | 0.0100 | 0.1800 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:SEPJ | Joshua-Succession | 0.1000 | 0.4600 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:EX | BT-U:SEPJ | Planting+FOD-BT | 0.0100 | 0.1200 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX | BT-U:SEPJ | Planting+Herbicide-BT | 0.0100 | 0.2700 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:EX2B | BT-U:EX2B | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Hrbx+New-Seed-BT | 0.0100 | 0.9500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Planting+FOD-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Planting+Herbicide-BT | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BT-U:EX2B | BT-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:PL | Planting+FOD-BT | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:PL | Planting+Herbicide-BT | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SD | Hrbx+New-Seed-BT | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SEP | Planting+FOD-BT | 0.0100 | 0.1050 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SEP | Planting+Herbicide-BT | 0.0100 | 0.1800 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SEPJ | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:EX2B | BT-U:SEPJ | Planting+FOD-BT | 0.0100 | 0.1200 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| BT-U:EX2B | BT-U:SEPJ | Planting+Herbicide-BT | 0.0100 | 0.2700 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:PL | BT-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BT-U:PL | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:PL | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 10 | 9999 |
| BT-U:PL | BT-U:EX | Drought | 0.0056 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:PL | BT-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -3 | No | 10 | 9999 |
| BT-U:PL | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:PL | BT-U:PL | Drought | 0.0056 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:PL | BT-U:PL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BT-U:PL | BT-U:SEP | Seedbank-Emergence | 0.2000 | 0.4600 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:PL | BT-U:SEPJ | Seedbank-Emergence | 0.2000 | 0.5400 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:SD | BT-A:AL | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| BT-U:SD | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:SD | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 10 | 9999 |
| BT-U:SD | BT-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BT-U:SD | BT-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:SD | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Drought | 0.0056 | 0.1000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Drought | 0.0056 | 0.9000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BT-U:SD | BT-U:SD | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -1 | No | 10 | 9999 |
| BT-U:SD | BT-U:SD | ReplacementFire-Mojave | 0.0010 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| BT-U:SD | BT-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:SDI | BT-A:AL | Natural-Recovery | 0.0020 | 1.0000 | 0 | 999 | 0 | No | 10 | 9999 |
| BT-U:SDI | BT-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:SDI | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 10 | 9999 |
| BT-U:SDI | BT-U:EX | EX-Invasion | 0.0010 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| BT-U:SDI | BT-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 999 | 0 | No | 2 | 9999 |
| BT-U:SDI | BT-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Drought | 0.0056 | 0.1000 | 0 | 999 | -999 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Drought | 0.0056 | 0.9000 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|----|------|
| BT-U:SDI | BT-U:SDI | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| BT-U:SDI | BT-U:SDI | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -1 | No | 10 | 9999 |
| BT-U:SDI | BT-U:SDI | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| BT-U:SDI | BT-U:SEP | EX-Invasion | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-C:CL | Fingers-of-Death-BT | 0.0100 | 0.7500 | 5 | 499 | 0 | Yes | 0 | 9999 |
| BT-U:SEP | BT-U:BG | OHV | 1.0000 | 0.0001 | 5 | 999 | 0 | No | 2 | 9999 |
| BT-U:SEP | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 5 | 999 | 0 | Yes | 10 | 9999 |
| BT-U:SEP | BT-U:EX | Drought | 0.0056 | 0.0100 | 5 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:EX | ReplacementFire-Mojave | 0.0050 | 1.0000 | 500 | 999 | 0 | No | 3 | 9999 |
| BT-U:SEP | BT-U:EX | Utilities | 0.0001 | 1.0000 | 500 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:EX2B | ReplacementFire-Mojave | 0.0050 | 1.0000 | 5 | 499 | 0 | No | 3 | 9999 |
| BT-U:SEP | BT-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 499 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:PL | Herbicide-BT | 0.0100 | 0.5000 | 5 | 15 | 0 | Yes | 1 | 9999 |
| BT-U:SEP | BT-U:SEP | Drought | 0.0056 | 0.9900 | 5 | 999 | -999 | No | 0 | 9999 |
| BT-U:SEP | BT-U:SEP | Fingers-of-Death-BT | 0.0100 | 0.2500 | 5 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:SEP | FuelBreak | 0.0100 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEP | BT-U:SEP | Herbicide-BT | 0.0100 | 0.5000 | 5 | 15 | 0 | Yes | 1 | 9999 |
| BT-U:SEP | BT-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 999 | 2 | No | 10 | 9999 |
| BT-U:SEPJ | BT-B:JT | Fingers-of-Death-BT | 0.0100 | 0.7500 | 5 | 999 | 0 | Yes | 0 | 9999 |
| BT-U:SEPJ | BT-U:BG | OHV | 1.0000 | 0.0001 | 5 | 999 | 0 | No | 2 | 9999 |
| BT-U:SEPJ | BT-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 5 | 999 | 0 | Yes | 10 | 9999 |
| BT-U:SEPJ | BT-U:EX | Drought | 0.0056 | 0.0100 | 5 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEPJ | BT-U:EX | ReplacementFire-Mojave | 0.0050 | 1.0000 | 500 | 999 | 0 | No | 3 | 9999 |
| BT-U:SEPJ | BT-U:EX | Utilities | 0.0000 | 1.0000 | 500 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEPJ | BT-U:EX2B | ReplacementFire-Mojave | 0.0050 | 1.0000 | 5 | 499 | 0 | No | 3 | 9999 |
| BT-U:SEPJ | BT-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 499 | 0 | No | 0 | 9999 |
| BT-U:SEPJ | BT-U:PL | Herbicide-BT | 0.0100 | 0.5000 | 5 | 15 | 0 | Yes | 1 | 9999 |
| BT-U:SEPJ | BT-U:SEPJ | Drought | 0.0056 | 0.9900 | 5 | 999 | -999 | No | 0 | 9999 |
| BT-U:SEPJ | BT-U:SEPJ | Fingers-of-Death-BT | 0.0100 | 0.2500 | 5 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEPJ | BT-U:SEPJ | FuelBreak | 0.0100 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| BT-U:SEPJ | BT-U:SEPJ | Herbicide-BT | 0.0100 | 0.5000 | 5 | 15 | 0 | Yes | 1 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|----|------|
| BT-U:SEPJ | BT-U:SEPJ | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 999 | 2 | No | 10 | 9999 |
| CB-A:OP | CB-A:OP | FuelBreak | 0.0100 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| CB-A:OP | CB-A:OP | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| CB-A:OP | CB-A:OP | ReplacementFire-Mojave | 0.0005 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| CB-A:OP | CB-B:JT | Joshua-Succession | 0.6500 | 1.0000 | 18 | 18 | 0 | No | 0 | 9999 |
| CB-A:OP | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 19 | 0 | No | 2 | 9999 |
| CB-A:OP | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 19 | 0 | Yes | 0 | 9999 |
| CB-A:OP | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| CB-A:OP | CB-U:EX | Utilities | 0.0050 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| CB-B:JT | CB-A:OP | Drought | 0.0056 | 1.0000 | 20 | 399 | 0 | No | 0 | 9999 |
| CB-B:JT | CB-A:OP | ReplacementFire-Mojave | 0.0005 | 1.0000 | 20 | 399 | 0 | No | 3 | 9999 |
| CB-B:JT | CB-B:JT | FuelBreak | 0.0100 | 1.0000 | 20 | 399 | 0 | No | 0 | 9999 |
| CB-B:JT | CB-B:JT | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 399 | 3 | No | 0 | 9999 |
| CB-B:JT | CB-U:BG | OHV | 1.0000 | 0.0001 | 20 | 399 | 0 | No | 2 | 9999 |
| CB-B:JT | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 399 | 0 | Yes | 0 | 9999 |
| CB-B:JT | CB-U:EX | Utilities | 0.0001 | 1.0000 | 20 | 399 | 0 | No | 0 | 9999 |
| CB-B:JT | CB-U:SEPJ | EX-Invasion | 0.0050 | 1.0000 | 20 | 399 | 0 | Yes | 0 | 9999 |
| CB-C:OP | CB-A:OP | Drought | 0.0056 | 1.0000 | 20 | 399 | 0 | No | 0 | 9999 |
| CB-C:OP | CB-A:OP | ReplacementFire-Mojave | 0.0005 | 1.0000 | 20 | 999 | 0 | No | 3 | 9999 |
| CB-C:OP | CB-C:OP | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-C:OP | CB-C:OP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 3 | No | 0 | 9999 |
| CB-C:OP | CB-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| CB-C:OP | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-C:OP | CB-U:EX | Utilities | 0.0001 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-C:OP | CB-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-D:JT | CB-A:OP | Drought | 0.0056 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| CB-D:JT | CB-A:OP | ReplacementFire-Mojave | 0.0010 | 1.0000 | 200 | 999 | 0 | No | 3 | 9999 |
| CB-D:JT | CB-D:JT | FuelBreak | 0.0100 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |
| CB-D:JT | CB-D:JT | Managed-Herbivory | 1.0000 | 0.0500 | 200 | 999 | 3 | No | 0 | 9999 |
| CB-D:JT | CB-U:BG | OHV | 1.0000 | 0.0001 | 200 | 999 | 0 | No | 2 | 9999 |
| CB-D:JT | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 200 | 999 | 0 | Yes | 0 | 9999 |
| CB-D:JT | CB-U:EX | Utilities | 0.0001 | 1.0000 | 200 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| CB-D:JT | CB-U:SEPJ | EX-Invasion | 0.0050 | 1.0000 | 200 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:BG | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| CB-U:BG | CB-U:BG | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:BG | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:ES | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:ES | CB-U:ES | Drought | 0.0056 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| CB-U:ES | CB-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:ES | CB-U:ES | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| CB-U:ES | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| CB-U:ES | CB-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:ES | CB-U:SEP | EX-Invasion | 0.0050 | 0.3500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:ES | CB-U:SEPJ | EX-Invasion | 0.0050 | 0.6500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:EX | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:EX | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | Hrbx+New-Seed-CB | 0.0100 | 0.9500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:EX | CB-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | Planting+FOD-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX | Planting+Herbicide-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:EX2B | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| CB-U:EX | CB-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| CB-U:EX | CB-U:PL | Planting+FOD-CB | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:PL | Planting+Herbicide-CB | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SD | Hrbx+New-Seed-CB | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SEP | Non-Joshua-Succession | 0.1000 | 0.3500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:EX | CB-U:SEP | Planting+FOD-CB | 0.0100 | 0.0750 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SEP | Planting+Herbicide-CB | 0.0100 | 0.1600 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SEPJ | Joshua-Succession | 0.1000 | 0.6500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:EX | CB-U:SEPJ | Planting+FOD-CB | 0.0100 | 0.1500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX | CB-U:SEPJ | Planting+Herbicide-CB | 0.0100 | 0.2900 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:EX2B | CB-U:EX2B | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| CB-U:EX2B | CB-U:EX2B | Hrbx+New-Seed-CB | 0.0100 | 0.9500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Planting+FOD-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Planting+Herbicide-CB | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:EX2B | ReplacementFire-Mojave | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| CB-U:EX2B | CB-U:EX2B | Utilities | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:PL | Planting+FOD-CB | 0.0100 | 0.6950 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:PL | Planting+Herbicide-CB | 0.0100 | 0.4500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:SD | Hrbx+New-Seed-CB | 0.0100 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:SEP | Planting+FOD-CB | 0.0100 | 0.0750 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:SEP | Planting+Herbicide-CB | 0.0100 | 0.1600 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:SEPJ | Planting+FOD-CB | 0.0100 | 0.1400 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:EX2B | CB-U:SEPJ | Planting+Herbicide-CB | 0.0100 | 0.2900 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-A:OP | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| CB-U:PL | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:PL | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 10 | 9999 |
| CB-U:PL | CB-U:EX | Drought | 0.0056 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | -3 | No | 10 | 9999 |
| CB-U:PL | CB-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-U:PL | Drought | 0.0056 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| CB-U:PL | CB-U:PL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |
| CB-U:PL | CB-U:SEP | Seedbank-Emergence | 0.2000 | 0.3500 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:PL | CB-U:SEPJ | Seedbank-Emergence | 0.2000 | 0.6500 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:SD | CB-A:OP | Natural-Recovery | 0.1000 | 1.0000 | 20 | 999 | 0 | No | 10 | 9999 |
| CB-U:SD | CB-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| CB-U:SD | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 10 | 9999 |
| CB-U:SD | CB-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| CB-U:SD | CB-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 10 | 9999 |
| CB-U:SD | CB-U:EX | Seedbank-Emergence | 0.2000 | 1.0000 | 0 | 19 | 0 | No | 2 | 9999 |
| CB-U:SD | CB-U:EX | Utilities | 0.0001 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:SD | CB-U:SD | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| CB-U:SD | CB-U:SD | Livestock-Closure | 0.0100 | 1.0000 | 1 | 2 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|----|------|
| CB-U:SD | CB-U:SD | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| CB-U:SD | CB-U:SEP | EX-Invasion | 0.0050 | 0.3500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:SD | CB-U:SEPJ | EX-Invasion | 0.0050 | 0.6500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:SEP | CB-C:OP | Fingers-of-Death-CB | 0.0100 | 0.7500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:SEP | CB-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| CB-U:SEP | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 21 | 999 | 0 | Yes | 10 | 9999 |
| CB-U:SEP | CB-U:EX | Drought | 0.0056 | 1.0000 | 21 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:EX | ReplacementFire-Mojave | 0.0015 | 1.0000 | 21 | 999 | 0 | No | 3 | 9999 |
| CB-U:SEP | CB-U:EX | Utilities | 0.0001 | 1.0000 | 21 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:PL | Herbicide-CB | 0.0100 | 0.0500 | 20 | 999 | 0 | No | 1 | 9999 |
| CB-U:SEP | CB-U:SEP | Fingers-of-Death-CB | 0.0100 | 0.2500 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:SEP | FuelBreak | 0.0100 | 1.0000 | 21 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEP | CB-U:SEP | Herbicide-CB | 0.0100 | 0.0500 | 20 | 999 | 0 | No | 1 | 9999 |
| CB-U:SEP | CB-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 21 | 999 | 3 | No | 10 | 9999 |
| CB-U:SEPJ | CB-B:JT | Fingers-of-Death-CB | 0.0100 | 0.7500 | 20 | 199 | 0 | Yes | 0 | 9999 |
| CB-U:SEPJ | CB-D:JT | Fingers-of-Death-CB | 0.0100 | 0.7500 | 200 | 999 | 0 | Yes | 0 | 9999 |
| CB-U:SEPJ | CB-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |
| CB-U:SEPJ | CB-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 999 | 0 | Yes | 10 | 9999 |
| CB-U:SEPJ | CB-U:EX | Drought | 0.0056 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEPJ | CB-U:EX | ReplacementFire-Mojave | 0.0015 | 1.0000 | 20 | 999 | 0 | No | 3 | 9999 |
| CB-U:SEPJ | CB-U:EX | Utilities | 0.0001 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEPJ | CB-U:PL | Herbicide-CB | 0.0100 | 0.5000 | 20 | 999 | 0 | No | 1 | 9999 |
| CB-U:SEPJ | CB-U:SEPJ | Fingers-of-Death-CB | 0.0100 | 0.2500 | 20 | 199 | 0 | No | 0 | 9999 |
| CB-U:SEPJ | CB-U:SEPJ | Fingers-of-Death-CB | 0.0100 | 0.2500 | 200 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEPJ | CB-U:SEPJ | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| CB-U:SEPJ | CB-U:SEPJ | Herbicide-CB | 0.0100 | 0.5000 | 20 | 999 | 0 | No | 1 | 9999 |
| CB-U:SEPJ | CB-U:SEPJ | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 3 | No | 10 | 9999 |
| GRL-A:AL | GRL-A:AL | Drought | 0.0056 | 1.0000 | 0 | 19 | -10 | No | 0 | 9999 |
| GRL-A:AL | GRL-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| GRL-A:AL | GRL-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| GRL-A:AL | GRL-A:AL | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| GRL-A:AL | GRL-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 19 | 0 | Yes | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|---|------|
| GRL-A:AL | GRL-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| GRL-B:OP | GRL-A:AL | Drought | 0.0056 | 0.1000 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-B:OP | GRL-A:AL | ReplacementFire-Mojave | 0.0015 | 1.0000 | 20 | 999 | 0 | No | 3 | 9999 |
| GRL-B:OP | GRL-B:OP | Drought | 0.0056 | 0.9000 | 20 | 999 | -999 | No | 0 | 9999 |
| GRL-B:OP | GRL-B:OP | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-B:OP | GRL-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| GRL-B:OP | GRL-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 999 | 0 | Yes | 0 | 9999 |
| GRL-B:OP | GRL-U:SES | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | Drought | 0.0056 | 1.0000 | 0 | 999 | -10 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 3 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| GRL-U:DP | GRL-U:DP | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| GRL-U:DP | GRL-U:EEX | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | Drought | 0.0056 | 1.0000 | 0 | 999 | -10 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 0 | 9999 |
| GRL-U:EEX | GRL-U:EEX | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| GRL-U:EEX | GRL-U:SES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:EX | GRL-U:EEX | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | Drought | 0.0056 | 1.0000 | 0 | 19 | -10 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | FuelBreak | 0.0100 | 1.0000 | 0 | 19 | 0 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 19 | 1 | No | 0 | 9999 |
| GRL-U:EX | GRL-U:EX | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 19 | -999 | No | 3 | 9999 |
| GRL-U:SES | GRL-B:OP | Herbicide-GRL | 0.0100 | 0.6000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Drought | 0.0056 | 1.0000 | 20 | 999 | -10 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 999 | 3 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Herbicide-GRL | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| GRL-U:SES | GRL-U:SES | ReplacementFire-Mojave | 0.0100 | 1.0000 | 20 | 999 | -999 | No | 3 | 9999 |
| MM-A:AL | MM-A:AL | NativeHerbivory | 0.0200 | 1.0000 | 0 | 9 | -999 | No | 0 | 9999 |

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|----------|----------|-----------------------------|--------|--------|-----|-----|------|-----|----|------|
| MM-A:AL | MM-A:AL | ReplacementFire | 0.0020 | 1.0000 | 0 | 9 | -999 | No | 0 | 9999 |
| MM-A:AL | MM-A:AL | Wet-Year | 0.1500 | 1.0000 | 0 | 999 | -1 | No | 0 | 9999 |
| MM-B:OP | MM-A:AL | ReplacementFire | 0.0070 | 1.0000 | 10 | 29 | 0 | No | 0 | 9999 |
| MM-C:CL | MM-A:AL | ReplacementFire | 0.0070 | 1.0000 | 60 | 999 | 0 | No | 0 | 9999 |
| MM-C:CL | MM-U:TEX | EX-Invasion | 0.0001 | 1.0000 | 60 | 999 | 0 | Yes | 0 | 9999 |
| MM-U:EX | MM-U:EX | ReplacementFire | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MM-U:TEX | MM-U:EX | ReplacementFire | 0.0070 | 1.0000 | 150 | 999 | 0 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | Flooding-7yr | 0.1300 | 1.0000 | 0 | 4 | -5 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 4 | -5 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | ReplacementFire | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-A:AL | MR-A:AL | Weed-Inventory-MR | 0.2500 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| MR-A:AL | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 5 | 9999 |
| MR-A:AL | MR-U:SFE | Excessive-Herbivory | 0.0010 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| MR-B:OP | MR-A:AL | Flooding-20yr | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-B:OP | MR-A:AL | ReplacementFire | 0.0010 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-B:OP | MR-B:OP | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 19 | -1 | No | 0 | 9999 |
| MR-B:OP | MR-B:OP | Weed-Inventory-MR | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-B:OP | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 5 | 9999 |
| MR-B:OP | MR-U:SFE | Excessive-Herbivory | 0.0010 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-A:AL | Flooding-100yr | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-A:AL | ReplacementFire | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| MR-C:CL | MR-C:CL | Weed-Inventory-MR | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-C:CL | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 5 | 9999 |
| MR-C:CL | MR-U:SFE | Excessive-Herbivory | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MR-U:DE | MR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:DE | MR-A:AL | Floodplain-Recovery | 0.0010 | 1.0000 | 0 | 999 | 0 | No | 10 | 9999 |
| MR-U:DE | MR-A:AL | Floodplain-Restoration | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:DE | MR-U:DE | Flooding-100yr | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:DE | MR-U:DE | ReplacementFire | 0.0200 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:EF | MR-B:OP | Exotic-Control-MR | 0.6000 | 1.0000 | 0 | 999 | 0 | No | 0 | 20 |
| MR-U:EF | MR-U:EF | Exotic-Control-MR | 0.4000 | 1.0000 | 0 | 999 | 0 | No | 0 | 20 |

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|-----------|-----------|-----------------------------|--------|--------|----|-----|------|-----|---|------|
| MR-U:EF | MR-U:EF | ReplacementFire | 0.0001 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:SFE | MR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:SFE | MR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 0 | 9999 |
| MR-U:SFE | MR-U:EF | Exotic-Riparian-Invasion-MR | 0.3300 | 1.0000 | 0 | 999 | 0 | No | 5 | 9999 |
| MR-U:SFE | MR-U:SFE | Flooding-100yr | 0.0100 | 0.9900 | 20 | 999 | -999 | No | 0 | 9999 |
| MR-U:SFE | MR-U:SFE | ReplacementFire | 0.0010 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MR-U:SFE | MR-U:SFE | Weed-Inventory-MR | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| MSD-A:AL | MSD-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 4 | 1 | No | 0 | 9999 |
| MSD-A:AL | MSD-A:AL | Very-Wet-Year | 0.0100 | 1.0000 | 0 | 4 | -4 | No | 0 | 9999 |
| MSD-B:OP | MSD-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-B:OP | MSD-A:AL | ReplacementFire | 0.0001 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-B:OP | MSD-A:AL | Very-Wet-Year | 0.0180 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-B:OP | MSD-C:OP | Drought | 0.0056 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-B:OP | MSD-U:SES | EX-Invasion | 0.0050 | 1.0000 | 5 | 999 | 0 | Yes | 0 | 9999 |
| MSD-C:OP | MSD-A:AL | Very-Wet-Year | 0.0500 | 1.0000 | 10 | 59 | 0 | No | 0 | 9999 |
| MSD-C:OP | MSD-C:OP | Drought | 0.0056 | 1.0000 | 10 | 59 | -999 | No | 0 | 9999 |
| MSD-C:OP | MSD-U:SES | EX-Invasion | 0.0050 | 1.0000 | 10 | 59 | 0 | Yes | 0 | 9999 |
| MSD-U:EX | MSD-U:EX | ReplacementFire | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSD-U:SD | MSD-A:AL | Natural-Recovery | 0.0010 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| MSD-U:SD | MSD-B:OP | Natural-Recovery | 0.0050 | 1.0000 | 5 | 999 | 0 | Yes | 0 | 9999 |
| MSD-U:SD | MSD-U:EX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Drought | 0.0056 | 1.0000 | 0 | 4 | -999 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Drought | 0.0056 | 1.0000 | 5 | 999 | -1 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Managed-Herbivory | 1.0000 | 0.0500 | 3 | 999 | 1 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SD | Very-Wet-Year | 0.0180 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSD-U:SD | MSD-U:SES | EX-Invasion | 0.0050 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-U:SES | MSD-U:EX | ReplacementFire | 0.0250 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSD-U:SES | MSD-U:EX | Very-Wet-Year | 0.0500 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| MSh-A:AL | MSh-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 5 | -999 | No | 0 | 9999 |
| MSh-A:AL | MSh-A:AL | NativeHerbivory | 1.0000 | 0.0200 | 0 | 999 | -1 | No | 0 | 9999 |
| MSh-A:AL | MSh-A:AL | Wet-Year | 0.1500 | 1.0000 | 0 | 5 | -1 | No | 0 | 9999 |
| MSh-A:AL | MSh-U:ES | Excessive-Herbivory | 0.0010 | 1.0000 | 0 | 5 | 0 | Yes | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| MSH-A:AL | MSH-U:EX | EX-Invasion | 0.0025 | 1.0000 | 0 | 5 | 0 | Yes | 0 | 9999 |
| MSH-B:CL | MSH-A:AL | ReplacementFire | 0.0140 | 1.0000 | 6 | 19 | 0 | No | 0 | 9999 |
| MSH-B:CL | MSH-B:CL | Managed-Herbivory | 1.0000 | 0.0500 | 6 | 19 | 1 | No | 0 | 9999 |
| MSH-B:CL | MSH-U:ES | Excessive-Herbivory | 0.0010 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| MSH-B:CL | MSH-U:SEP | EX-Invasion | 0.0025 | 1.0000 | 20 | 49 | 0 | Yes | 0 | 9999 |
| MSH-C:CL | MSH-A:AL | ReplacementFire | 0.0140 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| MSH-C:CL | MSH-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 0 | 9999 |
| MSH-C:CL | MSH-D:OP | Tree-Invasion | 0.0010 | 1.0000 | 50 | 99 | 0 | No | 0 | 9999 |
| MSH-C:CL | MSH-D:OP | Tree-Invasion | 0.0050 | 1.0000 | 99 | 999 | 0 | No | 0 | 9999 |
| MSH-C:CL | MSH-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 999 | 0 | Yes | 0 | 9999 |
| MSH-C:CL | MSH-U:SEP | EX-Invasion | 0.0025 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| MSH-D:OP | MSH-A:AL | Chainsaw-Thinning-MSH | 0.0100 | 0.2000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-D:OP | MSH-A:AL | ReplacementFire | 0.0067 | 1.0000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-D:OP | MSH-B:CL | Chainsaw-Thinning-MSH | 0.0100 | 0.8000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-D:OP | MSH-C:CL | Drought | 0.0056 | 0.1000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-D:OP | MSH-D:OP | Drought | 0.0056 | 0.9000 | 50 | 999 | -999 | No | 0 | 9999 |
| MSH-D:OP | MSH-U:TE | Tree-Encroachment | 0.0067 | 1.0000 | 150 | 999 | 0 | Yes | 0 | 9999 |
| MSH-D:OP | MSH-U:TEX | EX-Invasion | 0.0025 | 1.0000 | 50 | 999 | 0 | Yes | 0 | 9999 |
| MSH-U:ES | MSH-U:ES | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 0 | No | 0 | 9999 |
| MSH-U:ES | MSH-U:ES | ReplacementFire | 0.0140 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSH-U:EX | MSH-A:AL | Herbicide+SeedRose-MSH | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | Herbicide+SeedRose-MSH | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 0 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | ReplacementFire | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| MSH-U:EX | MSH-U:EX | Wet-Year | 0.1500 | 1.0000 | 0 | 5 | -5 | No | 0 | 9999 |
| MSH-U:SEP | MSH-B:CL | Hrbx+SeedGrass-MSH | 0.0100 | 0.7000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| MSH-U:SEP | MSH-U:EX | ReplacementFire | 0.0250 | 1.0000 | 6 | 300 | 0 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:SEP | Excessive-Herbivory | 1.0000 | 0.0010 | 6 | 999 | 3 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:SEP | Hrbx+SeedGrass-MSH | 0.0100 | 0.3000 | 6 | 999 | 0 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:SEP | Managed-Herbivory | 1.0000 | 0.0500 | 6 | 999 | 1 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:TEX | Tree-Invasion | 0.0010 | 1.0000 | 50 | 99 | 0 | No | 0 | 9999 |
| MSH-U:SEP | MSH-U:TEX | Tree-Invasion | 0.0050 | 1.0000 | 100 | 999 | 0 | No | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| MSH-U:TE | MSH-A:AL | Thin+Hrbx+SeedRose-MSh | 0.0100 | 0.9000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:ES | Drought | 0.0056 | 0.1000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:ES | ReplacementFire | 0.0067 | 1.0000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:ES | Thin+Hrbx+SeedRose-MSh | 0.0100 | 0.1000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:TE | Drought | 0.0056 | 0.9000 | 150 | 999 | -999 | No | 0 | 9999 |
| MSH-U:TE | MSH-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 150 | 999 | 0 | Yes | 0 | 9999 |
| MSH-U:TEX | MSH-A:AL | Thin+Hrbx+SeedRose-MSh | 0.0100 | 0.8000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:EX | Drought | 0.0056 | 0.1000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:EX | ReplacementFire | 0.0067 | 1.0000 | 150 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:EX | Thin+Hrbx+SeedRose-MSh | 0.0100 | 0.2000 | 50 | 999 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:SEP | ReplacementFire | 0.0067 | 1.0000 | 50 | 149 | 0 | No | 0 | 9999 |
| MSH-U:TEX | MSH-U:TEX | Drought | 0.0056 | 0.9000 | 50 | 999 | -999 | No | 0 | 9999 |
| PJ-A:AL | PJ-A:AL | ReplacementFire | 0.0030 | 1.0000 | 0 | 9 | -999 | No | 0 | 9999 |
| PJ-B:OP | PJ-A:AL | ReplacementFire | 0.0050 | 1.0000 | 10 | 29 | 0 | No | 0 | 9999 |
| PJ-C:OP | PJ-A:AL | ReplacementFire | 0.0050 | 1.0000 | 30 | 99 | 0 | No | 0 | 9999 |
| PJ-C:OP | PJ-B:OP | Drought | 0.0056 | 0.1000 | 30 | 99 | 0 | No | 0 | 9999 |
| PJ-C:OP | PJ-C:OP | Drought | 0.0056 | 0.9000 | 30 | 99 | -999 | No | 0 | 9999 |
| PJ-C:OP | PJ-U:TEX | EX-Invasion | 0.0001 | 1.0000 | 50 | 99 | 0 | Yes | 0 | 9999 |
| PJ-D:OP | PJ-A:AL | ReplacementFire | 0.0010 | 1.0000 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-D:OP | PJ-B:OP | Drought | 0.0067 | 0.0300 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-D:OP | PJ-C:OP | Drought | 0.0057 | 0.0700 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-D:OP | PJ-D:OP | Drought | 0.0056 | 0.9000 | 100 | 999 | -999 | No | 0 | 9999 |
| PJ-D:OP | PJ-U:TEX | EX-Invasion | 0.0010 | 1.0000 | 100 | 999 | 0 | Yes | 0 | 9999 |
| PJ-U:EX | PJ-A:AL | Hrbx+Seed-PJ | 0.0100 | 0.6000 | 0 | 999 | 0 | No | 0 | 9999 |
| PJ-U:EX | PJ-U:EX | Hrbx+Seed-PJ | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |
| PJ-U:EX | PJ-U:EX | ReplacementFire | 0.1000 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| PJ-U:TEX | PJ-C:OP | Herbicide-PJ | 0.0100 | 0.6000 | 30 | 99 | 0 | Yes | 0 | 9999 |
| PJ-U:TEX | PJ-D:OP | Herbicide-PJ | 0.0100 | 0.6000 | 100 | 999 | 0 | Yes | 0 | 9999 |
| PJ-U:TEX | PJ-U:EX | Drought | 0.0056 | 0.1000 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-U:TEX | PJ-U:EX | ReplacementFire | 0.0050 | 1.0000 | 100 | 999 | 0 | No | 0 | 9999 |
| PJ-U:TEX | PJ-U:TEX | Drought | 0.0056 | 0.9000 | 100 | 999 | -999 | No | 0 | 9999 |
| PJ-U:TEX | PJ-U:TEX | Herbicide-PJ | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 9999 |

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|----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| SWA-A:AL | SWA-A:AL | Flash-Flood | 0.1400 | 1.0000 | 0 | 4 | -999 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | FuelBreak | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 4 | 0 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 4 | 1 | No | 10 | 9999 |
| SWA-A:AL | SWA-A:AL | ReplacementFire-Mojave | 0.0001 | 1.0000 | 0 | 4 | -999 | No | 3 | 9999 |
| SWA-A:AL | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 4 | -999 | No | 0 | 9999 |
| SWA-A:AL | SWA-A:AL | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| SWA-A:AL | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 4 | 0 | No | 2 | 9999 |
| SWA-A:AL | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0005 | 0 | 4 | 0 | No | 10 | 9999 |
| SWA-A:AL | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 0 | 4 | 0 | Yes | 5 | 9999 |
| SWA-A:AL | SWA-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-A:AL | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 4 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-A:AL | Flash-Flood | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 5 | 19 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-B:CL | FuelBreak | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-B:CL | Livestock-Closure | 0.0100 | 1.0000 | 1 | 19 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-B:CL | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 19 | 1 | No | 10 | 9999 |
| SWA-B:CL | SWA-B:CL | ReplacementFire-Mojave | 0.0010 | 1.0000 | 5 | 19 | 0 | No | 3 | 9999 |
| SWA-B:CL | SWA-B:CL | Weed-Inventory-WAS | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| SWA-B:CL | SWA-U:BG | OHV | 1.0000 | 0.0001 | 5 | 19 | 0 | No | 2 | 9999 |
| SWA-B:CL | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0005 | 5 | 19 | 0 | No | 10 | 9999 |
| SWA-B:CL | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 5 | 19 | 0 | Yes | 5 | 9999 |
| SWA-B:CL | SWA-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-B:CL | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 5 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-A:AL | Flash-Flood | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-B:CL | ReplacementFire-Mojave | 0.0010 | 1.0000 | 20 | 999 | 0 | No | 3 | 9999 |
| SWA-C:CL | SWA-C:CL | FuelBreak | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-C:CL | Livestock-Closure | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-C:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 1 | No | 10 | 9999 |
| SWA-C:CL | SWA-C:CL | Weed-Inventory-WAS | 0.0100 | 1.0000 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-C:CL | SWA-U:BG | OHV | 1.0000 | 0.0001 | 20 | 999 | 0 | No | 2 | 9999 |

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|----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| SWA-C:CL | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0005 | 20 | 999 | 0 | Yes | 10 | 9999 |
| SWA-C:CL | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 20 | 999 | 0 | No | 5 | 9999 |
| SWA-C:CL | SWA-U:SEP | EX-Invasion | 0.0050 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-C:CL | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-U:BG | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:BG | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | -999 | No | 2 | 9999 |
| SWA-U:BG | SWA-U:BG | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:BG | SWA-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:BG | SWA-U:SES | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:BG | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| SWA-U:ES | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 3 | No | 10 | 9999 |
| SWA-U:ES | SWA-U:ES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-U:ES | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-U:ES | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 10 | 9999 |
| SWA-U:ES | SWA-U:ES | ReplacementFire-Mojave | 0.0015 | 1.0000 | 0 | 999 | 0 | No | 3 | 9999 |
| SWA-U:ES | SWA-U:ES | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ES | SWA-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:ES | SWA-U:SES | EX-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:ES | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-A:AL | Beetle-Mortality | 0.2500 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:ET | SWA-A:AL | Exotic-Control-WAS | 0.0100 | 0.9000 | 0 | 4 | 0 | No | 0 | 50 |
| SWA-U:ET | SWA-A:AL | Flash-Flood | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-B:CL | Beetle-Mortality | 0.2500 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:ET | SWA-B:CL | Exotic-Control-WAS | 0.0100 | 0.9000 | 5 | 19 | 0 | No | 0 | 50 |
| SWA-U:ET | SWA-C:CL | Beetle-Mortality | 0.2500 | 1.0000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:ET | SWA-C:CL | Exotic-Control-WAS | 0.0100 | 0.9000 | 20 | 999 | 0 | No | 0 | 50 |
| SWA-U:ET | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| SWA-U:ET | SWA-U:ET | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 3 | No | 10 | 9999 |
| SWA-U:ET | SWA-U:ET | Exotic-Control-WAS | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 50 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| SWA-U:ET | SWA-U:ET | Flash-Flood | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:ET | SWA-U:ET | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 10 | 9999 |
| SWA-U:ET | SWA-U:ET | ReplacementFire-Mojave | 0.0200 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| SWA-U:ET | SWA-U:ET | Utilities | 0.0001 | 0.7000 | 0 | 999 | -999 | No | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Flash-Flood | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-B:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-B:CL | Herbicide-WAS | 0.0100 | 0.5000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-C:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-C:CL | Herbicide-WAS | 0.0100 | 0.5000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| SWA-U:SEP | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | No | 10 | 9999 |
| SWA-U:SEP | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Fingers-of-Death-SWA | 0.0100 | 0.2500 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Flash-Flood | 0.0100 | 0.9900 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SEP | SWA-U:SEP | ReplacementFire-Mojave | 0.0200 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| SWA-U:SEP | SWA-U:SEP | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SEP | SWA-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 999 | 0 | No | 10 | 9999 |
| SWA-U:SEP | SWA-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 19 | 1 | No | 10 | 9999 |
| SWA-U:SEP | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Flash-Flood | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-A:AL | Utilities | 0.0001 | 0.3000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-B:CL | Herbicide-WAS | 0.0100 | 0.5000 | 5 | 19 | 0 | Yes | 0 | 9999 |

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|-----------|-----------|------------------------|--------|--------|----|-----|------|-----|----|------|
| SWA-U:SES | SWA-C:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 5 | 19 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-C:CL | Fingers-of-Death-SWA | 0.0100 | 0.7500 | 20 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-C:CL | Herbicide-WAS | 0.0100 | 0.5000 | 20 | 999 | 0 | Yes | 0 | 9999 |
| SWA-U:SES | SWA-U:BG | OHV | 1.0000 | 0.0001 | 0 | 999 | 0 | No | 2 | 9999 |
| SWA-U:SES | SWA-U:ES | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 0 | Yes | 10 | 9999 |
| SWA-U:SES | SWA-U:ET | Exotic-Tree-Invasion | 0.0001 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| SWA-U:SES | SWA-U:SES | Fingers-of-Death-SWA | 0.0100 | 0.2500 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Flash-Flood | 0.0100 | 0.9900 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | FuelBreak | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Herbicide-WAS | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Livestock-Closure | 0.0100 | 1.0000 | 1 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 999 | 1 | No | 10 | 9999 |
| SWA-U:SES | SWA-U:SES | ReplacementFire-Mojave | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 3 | 9999 |
| SWA-U:SES | SWA-U:SES | Utilities | 0.0001 | 0.7000 | 0 | 999 | 0 | No | 0 | 9999 |
| SWA-U:SES | SWA-U:SES | Weed-Inventory-WAS | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-A:AL | WDR-A:AL | Flooding-7yr | 0.1300 | 1.0000 | 0 | 4 | -999 | No | 0 | 9999 |
| WDR-A:AL | WDR-A:AL | Managed-Herbivory | 1.0000 | 0.0500 | 2 | 4 | -999 | No | 0 | 9999 |
| WDR-A:AL | WDR-A:AL | Weed-Inventory | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 0 | 9999 |
| WDR-A:AL | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 4 | 0 | Yes | 0 | 9999 |
| WDR-A:AL | WDR-U:EF | Exotic-Forb-Invasion | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 5 | 9999 |
| WDR-A:AL | WDR-U:ET | Exotic-Tree-Invasion | 0.0100 | 1.0000 | 0 | 4 | 0 | No | 5 | 9999 |
| WDR-A:AL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| WDR-B:CL | WDR-A:AL | Flooding-20yr | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| WDR-B:CL | WDR-B:CL | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 19 | -1 | No | 0 | 9999 |
| WDR-B:CL | WDR-B:CL | Weed-Inventory | 0.0100 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| WDR-B:CL | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 5 | 19 | 0 | Yes | 0 | 9999 |
| WDR-B:CL | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 5 | 19 | 0 | No | 5 | 9999 |
| WDR-B:CL | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 5 | 19 | 0 | No | 5 | 9999 |
| WDR-B:CL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 0 | 19 | 0 | Yes | 0 | 9999 |
| WDR-C:OP | WDR-A:AL | Flooding-20yr | 0.0500 | 1.0000 | 1 | 89 | 0 | No | 0 | 9999 |
| WDR-C:OP | WDR-C:OP | Managed-Herbivory | 1.0000 | 0.0500 | 1 | 89 | -1 | No | 0 | 9999 |
| WDR-C:OP | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 1 | 89 | 0 | Yes | 0 | 9999 |

| | | | | | | | | | | |
|-----------|-----------|------------------------|--------|--------|-----|-----|------|-----|---|------|
| WDR-C:OP | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 5 | 89 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:EF | Exotic-Forb-Invasion | 0.0100 | 1.0000 | 1 | 4 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 5 | 89 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:ET | Exotic-Tree-Invasion | 0.0100 | 1.0000 | 1 | 4 | 0 | Yes | 5 | 9999 |
| WDR-C:OP | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 1 | 89 | 0 | Yes | 0 | 9999 |
| WDR-D:CL | WDR-A:AL | Flooding-100yr | 0.0100 | 1.0000 | 20 | 89 | 0 | No | 0 | 9999 |
| WDR-D:CL | WDR-C:OP | ReplacementFire | 0.0013 | 1.0000 | 20 | 89 | 0 | No | 0 | 9999 |
| WDR-D:CL | WDR-D:CL | Managed-Herbivory | 1.0000 | 0.0500 | 20 | 89 | 1 | No | 0 | 9999 |
| WDR-D:CL | WDR-D:CL | Weed-Inventory | 0.0100 | 1.0000 | 20 | 89 | 0 | No | 0 | 9999 |
| WDR-D:CL | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 20 | 89 | 0 | Yes | 0 | 9999 |
| WDR-D:CL | WDR-U:EF | Exotic-Forb-Invasion | 0.0050 | 1.0000 | 20 | 89 | 0 | No | 5 | 9999 |
| WDR-D:CL | WDR-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 20 | 89 | 0 | No | 5 | 9999 |
| WDR-D:CL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 20 | 89 | 0 | Yes | 0 | 9999 |
| WDR-E:CL | WDR-A:AL | Flooding-100yr | 0.0020 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-C:OP | Flooding-100yr | 0.0100 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-C:OP | ReplacementFire | 0.0040 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-C:OP | Senescence | 0.0200 | 1.0000 | 450 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-E:CL | Managed-Herbivory | 1.0000 | 0.0500 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-E:CL | Weed-Inventory | 0.0100 | 1.0000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-E:CL | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 90 | 999 | 0 | Yes | 0 | 9999 |
| WDR-E:CL | WDR-U:EF | Exotic-Forb-Invasion | 0.0050 | 1.0000 | 90 | 999 | 0 | No | 5 | 9999 |
| WDR-E:CL | WDR-U:ET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 90 | 999 | 0 | Yes | 5 | 9999 |
| WDR-E:CL | WDR-U:TEX | EX-Invasion | 0.0050 | 1.0000 | 90 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:DE | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-A:AL | Floodplain-Restoration | 0.0100 | 0.9000 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DE | Flooding-100yr | 0.0100 | 0.9900 | 1 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DE | Floodplain-Restoration | 0.0100 | 0.1000 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DE | Weed-Inventory | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DE | WDR-U:DEF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 1 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DE | WDR-U:DET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 1 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DEF | WDR-U:DE | Exotic-Forb-Control | 0.0100 | 0.6000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DEF | WDR-U:DEF | Exotic-Forb-Control | 0.0100 | 0.4000 | 1 | 999 | 0 | No | 0 | 20 |

| | | | | | | | | | | |
|-----------|-----------|----------------------|--------|--------|----|-----|------|-----|----|------|
| WDR-U:DEF | WDR-U:DEF | Flooding-100yr | 0.0100 | 0.9900 | 1 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DEF | WDR-U:EF | Flooding-100yr | 0.0100 | 0.0100 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DET | WDR-U:DE | Beetle-Mortality | 0.2500 | 0.2500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:DET | WDR-U:DE | Exotic-Tree-Control | 0.0100 | 0.8000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DET | WDR-U:DEF | Beetle-Mortality | 0.2500 | 0.7500 | 0 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:DET | WDR-U:DEF | Exotic-Tree-Control | 0.0100 | 0.1000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DET | WDR-U:DET | Exotic-Tree-Control | 0.0100 | 0.1000 | 1 | 999 | 0 | No | 0 | 20 |
| WDR-U:DET | WDR-U:DET | Flooding-100yr | 0.0100 | 0.9900 | 1 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DET | WDR-U:DET | ReplacementFire | 0.0500 | 1.0000 | 5 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DET | WDR-U:ET | Flooding-100yr | 0.0100 | 0.0100 | 1 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DEX | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEF | Exotic-Forb-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DEX | WDR-U:DET | Exotic-Tree-Invasion | 0.0050 | 1.0000 | 0 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:DEX | WDR-U:DEX | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 999 | 3 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEX | Flooding-100yr | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEX | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 999 | 1 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEX | ReplacementFire | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:DEX | WDR-U:DEX | Weed-Inventory | 0.0100 | 1.0000 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:EF | WDR-A:AL | Exotic-Forb-Control | 0.0100 | 0.6000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:EF | WDR-U:EF | Exotic-Forb-Control | 0.0100 | 0.4000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:EF | WDR-U:EF | Flooding-100yr | 0.0100 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:ET | WDR-A:AL | Beetle-Mortality | 0.2500 | 1.0000 | 0 | 4 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-A:AL | Exotic-Tree-Control | 0.0100 | 0.8000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:ET | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:ET | WDR-B:CL | Beetle-Mortality | 0.2500 | 1.0000 | 5 | 19 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-C:OP | Beetle-Mortality | 0.2500 | 1.0000 | 0 | 89 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-D:CL | Beetle-Mortality | 0.2500 | 1.0000 | 20 | 89 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-E:CL | Beetle-Mortality | 0.2500 | 1.0000 | 90 | 999 | 0 | Yes | 0 | 9999 |
| WDR-U:ET | WDR-U:DET | Entrenchment | 0.0001 | 1.0000 | 0 | 999 | 0 | Yes | 10 | 9999 |
| WDR-U:ET | WDR-U:EF | Exotic-Tree-Control | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:ET | WDR-U:ET | Exotic-Tree-Control | 0.0100 | 0.1000 | 0 | 999 | 0 | No | 0 | 20 |
| WDR-U:ET | WDR-U:ET | Flooding-100yr | 0.0100 | 0.9900 | 0 | 999 | -999 | No | 0 | 9999 |

| | | | | | | | | | | |
|-----------|-----------|----------------------|--------|--------|----|-----|------|-----|---|------|
| WDR-U:ET | WDR-U:ET | ReplacementFire | 0.0500 | 1.0000 | 0 | 999 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 0 | 500 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 0 | 500 | 0 | Yes | 0 | 9999 |
| WDR-U:EX | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 0 | 500 | 0 | Yes | 5 | 9999 |
| WDR-U:EX | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 0 | 500 | 0 | Yes | 5 | 9999 |
| WDR-U:EX | WDR-U:EX | Flooding-100yr | 0.0100 | 0.9900 | 0 | 500 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-U:EX | Managed-Herbivory | 1.0000 | 0.0500 | 0 | 500 | -999 | No | 0 | 9999 |
| WDR-U:EX | WDR-U:EX | ReplacementFire | 0.0500 | 1.0000 | 0 | 500 | -999 | No | 0 | 9999 |
| WDR-U:TEX | WDR-A:AL | Flooding-100yr | 0.0100 | 0.0100 | 20 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-A:AL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 0 | 5 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-B:CL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 5 | 19 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-D:CL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 20 | 89 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-E:CL | Hrbx-EX-WDR | 0.0100 | 0.5000 | 90 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:DE | Excessive-Herbivory | 1.0000 | 0.0010 | 5 | 19 | 0 | Yes | 0 | 9999 |
| WDR-U:TEX | WDR-U:EF | Exotic-Forb-Invasion | 0.0075 | 1.0000 | 5 | 999 | 0 | Yes | 5 | 9999 |
| WDR-U:TEX | WDR-U:ET | Exotic-Tree-Invasion | 0.0075 | 1.0000 | 5 | 999 | 0 | No | 5 | 9999 |
| WDR-U:TEX | WDR-U:EX | Flooding-100yr | 0.0100 | 0.9900 | 20 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:EX | Flooding-20yr | 0.0500 | 1.0000 | 5 | 19 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:EX | ReplacementFire | 0.0015 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:TEX | Hrbx-EX-WDR | 0.0100 | 0.5000 | 0 | 999 | 0 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:TEX | Managed-Herbivory | 1.0000 | 0.0500 | 5 | 999 | 1 | No | 0 | 9999 |
| WDR-U:TEX | WDR-U:TEX | Weed-Inventory | 0.0100 | 1.0000 | 5 | 999 | 0 | No | 0 | 9999 |

Appendix 4. Temporal multipliers.

Fire Activity

Federal data were available for fire activity between 1980 and 2009 for both NCAs. Data from the Federal Fire Occurrence Website were downloaded for the whole western U.S.A. and time series of fire size from 1980 to 2009 were extracted from “clipped” NCAs with ARC GIS 10. Five time series of fire activity were used as replicates for all scenarios. The Red Cliffs and Beaver Dam Wash time series were each 29 years long; time series for 50 years were created by re-sampling the original fire series data (the original 29-year data sequence was not used in any replicate) using the yearly total area burned divided by the temporal average of total area burned. All fire activity was assumed replacement fire.

The 10 time series (i.e., 5 replicates × 2 landscapes) were uploaded into PATH. For strictly management reasons, we used the same variability time series for two different parameters: Mojave replacement fire and (upper elevation) replacement fire. Each yearly value in a replicate temporal multiplier multiplied the average wildfire rate in the models for a specific time step. All replicates had several peaks of fire activity with the fourth replicate being the least active (Figure 4-1).

Upland Variability

Remaining upland temporal multipliers were climate related: drought-induced mortality, annual grass invasion rate, and tree invasion rate. The Palmer Drought Severity Index (PDSI; Heddinghaus and Sabol 1991) was used for all multipliers. PDSI is a long-term drought measure because it incorporates the cumulative influence of past monthly observations (Heddinghaus and Sabol 1991). PDSI values are available from 1895 to current for the four climatic regions of Nevada and Utah. The Mojave Desert is in climate division #4. PDSI values starting in 1935 to 2009 were extracted and this original 75-year time series was resampled five times for 50 years to obtain a total of five replicates. Negative PDSI values indicate drought, whereas positive ones represent wetter than average years. Severe droughts and very wet periods, respectively, have PDSI values < -3 and > 3 . Taylor and Beaty (2005) showed that the PDSI is highly negatively correlated to fire frequency and total area burned for forest types during pre-settlement in the northern Sierra Nevada: more fire was observed during increasingly drier years. The same relationship holds for average temperature (Westerling et al. 2006). This, however, does not apply to shrublands that must first experience consecutive wetter than average years to accumulate fine fuels that will more likely burn in a dry year immediately following the wet year sequence (Westerling and Bryant 2008; Westerling, *in press*).

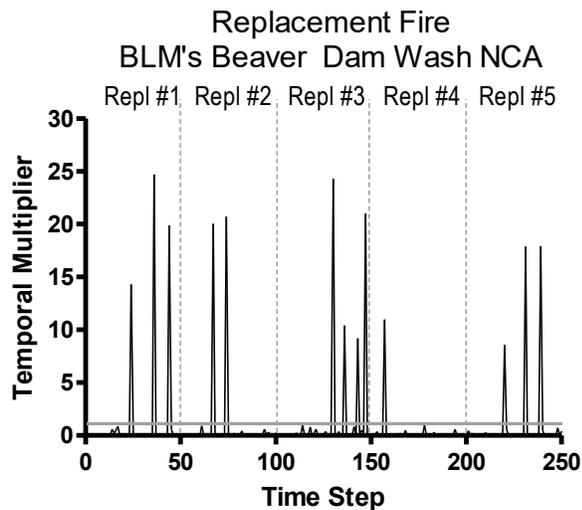
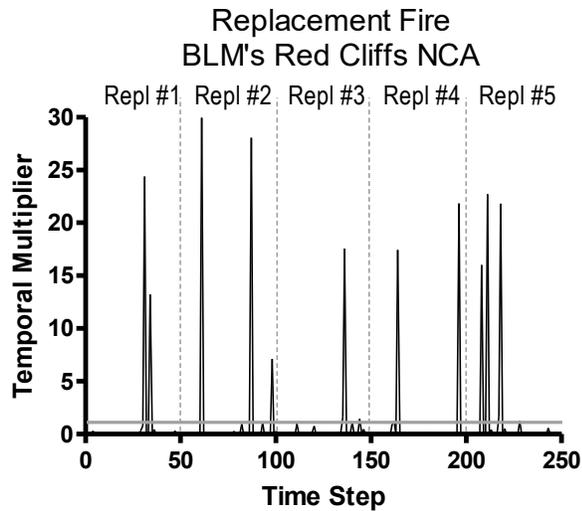


Figure 4-1. Five replicates of temporal probability multipliers for fire activity. Each replicate is numbered and represented by 50-year period. The horizontal gray line for temporal multiplier = 1 represents the “no-change” or neutral parameter line.

We assumed that more severe droughts cause increased mortality, whereas wetter conditions suppress mortality. Because PDSI can be negative, therefore incompatible with VDDT, we chose a negative exponential function to create positive values that increased exponentially with smaller (more negative) PDSI values:

$$\begin{aligned} \text{Temporal multiplier for drought mortality} \\ = 0.6 \times e^{-0.6 \times \text{PDSI}} \end{aligned}$$

The parameters of this function were chosen such that PDSI values close to -3 were slightly greater than 3 (actually, 3.63) and that very severe droughts with PDSI as high as -5.2 translated into slightly more than

doubling of the temporal multipliers (13.8). Another consideration was that a mild drought characterized by a PDSI of -1 would about equal to a neutral temporal multiplier value of 1. Figure 4-2 demonstrates the relationship between PDSI and the temporal multiplier for climatic division #4.

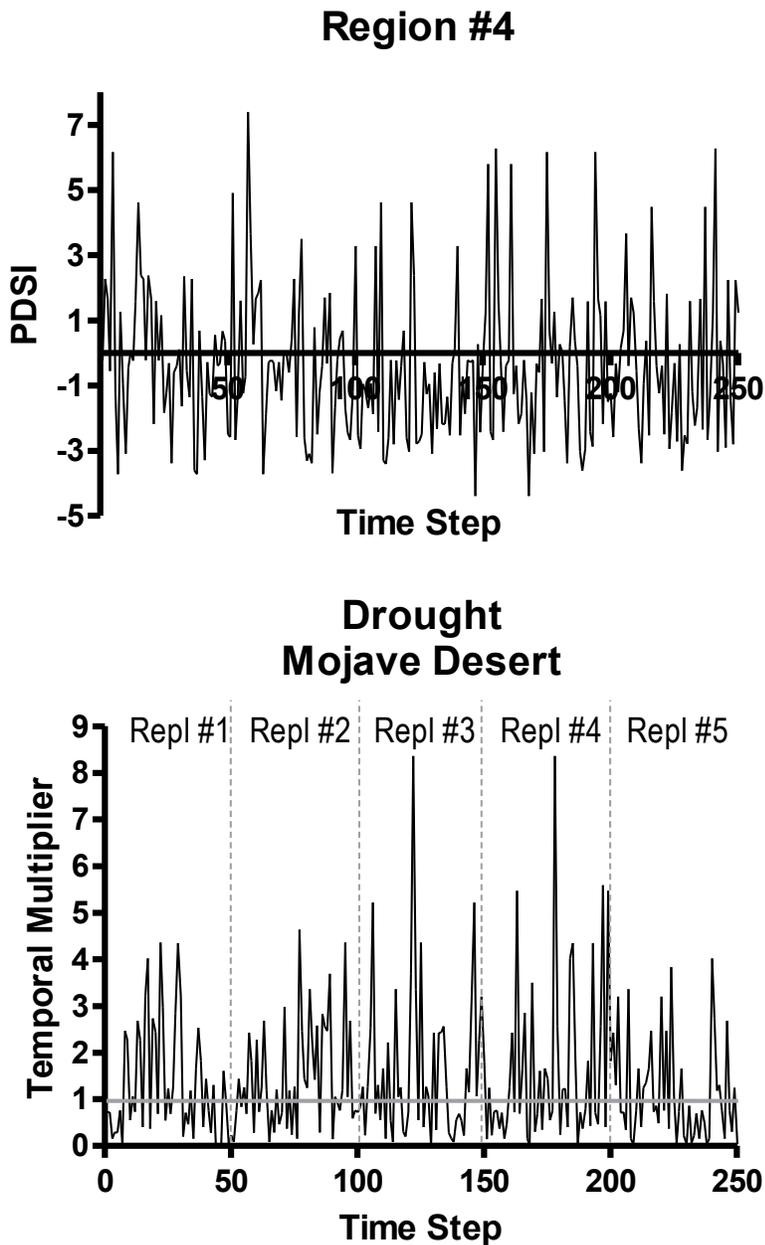


Figure 4-2. Palmer drought severity index (PDSI) time series (top) and calculated drought temporal multipliers (bottom) for the fourth climatic divisions of Nevada and Utah. Five replicates (Repl) are shown each per 50-year period. The gray line for PDSI = 0 represented average drought conditions, whereas the gray line for the drought temporal multiplier = 1 represented the “no-change” or neutral parameter line.

Temporal variability for non-native annual grass and forb invasion and tree (mostly pinyon and juniper) invasion rates were dependent on drought levels: greater drought severity, therefore lower soil moisture, was detrimental to recruitment and growth and, conversely, greater soil moisture favored the spread of annual grasses and trees (Bradley 2009; Brown et al. 2004; Smith et al. 2000). We assumed that tree invasion was a much slower process than annual grass invasion. This implies that PDSI was directly related to the variability of these invasion rates:

Annual grass invasion (Figure 4-3 top)

$$\text{PDSI} > 0, \text{ temporal multiplier} = (0.75 \times e^{0.75 \times \text{PDSI}})^{0.5}$$

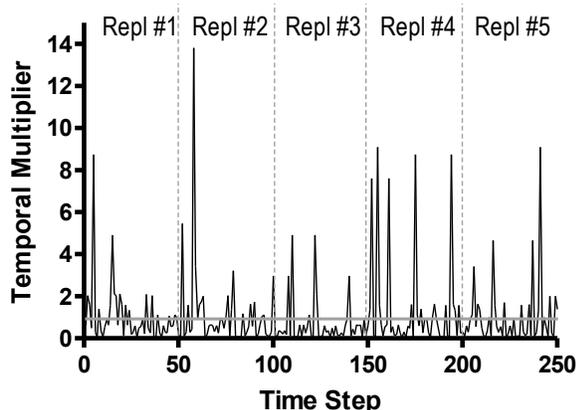
$$\text{PDSI} \leq 0, \text{ temporal multiplier} = 0.75 \times e^{0.75 \times \text{PDSI}}$$

Tree invasion (Figure 4-3 bottom)

$$\text{PDSI} > 0, \text{ temporal multiplier} = (0.2 \times e^{0.8 \times \text{PDSI}})^{0.5}$$

$$\text{PDSI} \leq 0, \text{ temporal multiplier} = 0.2 \times e^{0.8 \times \text{PDSI}}$$

Nonnative Annual Grass & Forb Invasion Rate



Tree Invasion Rate

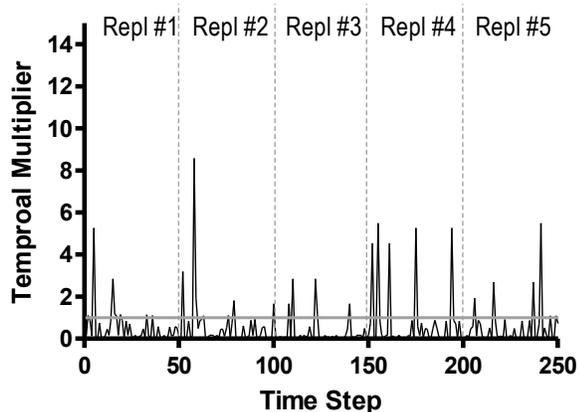


Figure 4-3. Temporal multipliers of annual grass invasion and tree invasion for the fourth climatic division of Nevada and Utah. Five replicates (Repl) are shown each per 50-year period. The gray line for the drought temporal multiplier = 1 represented the “no-change” or neutral parameter line.

Riparian Variability

Montane, warm desert riparian, and desert washes systems were strongly dependent on flood events and their discharge variation (Rood et al. 2003; McBride and Strahan 1984). For perennial reaches, we used flow data from the Santa Clara River at Gunlock, Utah, measured between 1970 and 2010 (US Geological Survey: # USGS 09409880 SANTA CLARA RIVER AT GUNLOCK, UT). We created five replicates of 50 years each by resampling the original time series using random numbers and MS Excel®'s vlookup function. Each resampled peak discharge values were divided by the temporal average discharge of that gage, thus generating a dimensionless time series of peak flow with an average of one (i.e., the temporal multiplier).

Peak flow data from the Santa Clara River were used to calculate temporal variability for the 7-year, 20-year, and 100-year flood events, whereas annual flow data were used to derived exotic species invasion rates. Seven-year, 20-year, and 100-year flood events were all based on filtering for increasingly higher values of annual peak flow. The three levels of flooding corresponded to 7-year events that killed or removed only herbaceous vegetation; 20-year events that killed or removed shrubs and young trees; and 100-year events that top-killed larger trees (i.e., these are three distinct disturbances in the riparian models). The 7-year flood events encompass the full time series of peak flow divided by the temporal average (Figure 4-4). The 20-year flood event for the Santa Clara River at Gunlock was determined to correspond to a temporal multiplier of 3.062, whereas the threshold for 100-year event was 7.8399 (Natural Channel Design, Inc. 2005: Table 2.2).

Flash flooding was obtained from USGS peak flow data at Beaver Dam, Arizona (USGS 09414900 BEAVER DAM WASH AT BEAVER DAM, AZ), from 1998 to 2010. Most of Beaver Dam Wash is dry and flows are frequently null, except during major events. The same dimensionless transformation used for peak flow in the Santa Clara River was used here. The original time series was resampled because it contained only one major flood event and practically no flow for other years (Figure 4-4).

Annual discharge from the Santa Clara River at Gunlock was used to determine exotic forb and exotic tree invasion rates. For simplicity, exotic-species invasion was identical for three related temporal multipliers: exotic invasion (mostly saltcedar) in the montane riparian ecological system, and exotic-forb invasion and exotic-tree invasion in the warm desert riparian ecological system. The exotic-invasion disturbance generally encompasses forbs and trees, whereas the disturbance was split by forb and tree species in the Mojave Desert. We assumed that the variability of exotic species invasion was entirely dependent on average annual discharge (annual discharge is the average discharge among months, whereas peak discharge is the maximum discharge recorded). Years of greater than average annual discharge would favor the invasion of exotic forbs and trees. The rate of exotic forb invasion in PATH/VDDT models was, therefore, multiplied by the annual flow temporal multiplier. The temporal multipliers were obtained exactly as done for peak discharge, except annual discharge was used. Data are shown in Figure 4-5.

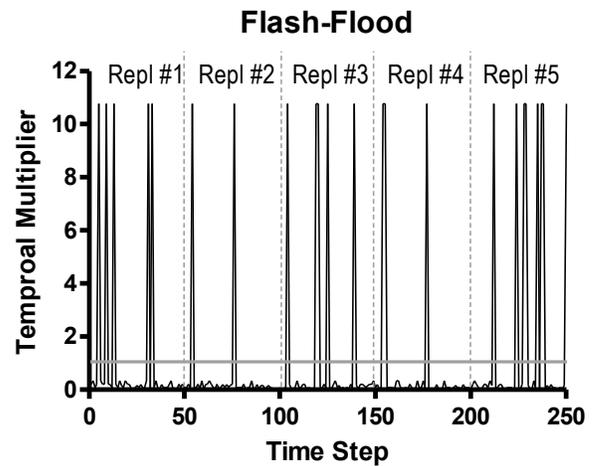
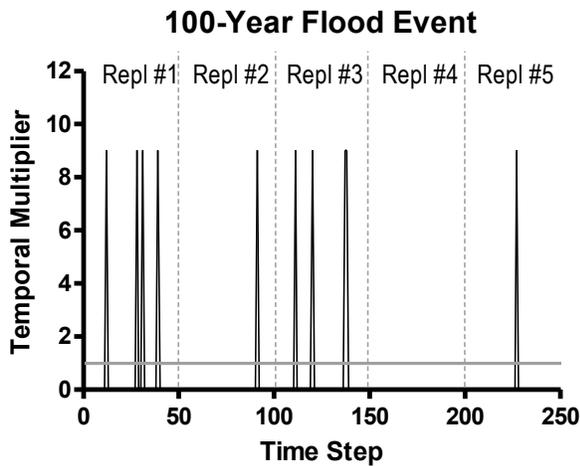
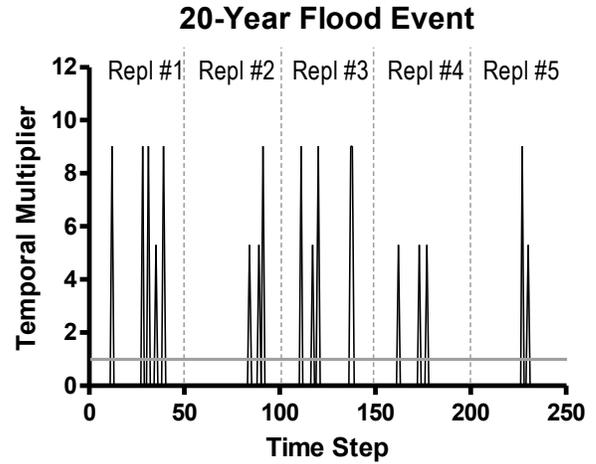
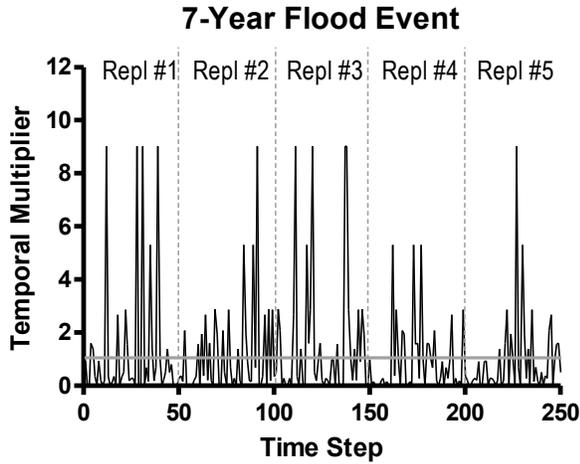


Figure 4-4. Riparian temporal multipliers for 7-year, 20-year, 100-year flood events, and flash flooding. For the 20-year and 100-year flood events all values below their threshold are zero. Data from U.S. Geological Survey gage obtained from the Santa Clara River at Gunlock, UT, for 7-year, 20-year, and 100-year flood events. Flash flooding data were from the U.S. Geological Survey gage on the Beaver Dam Wash at Beaver Dam, Arizona. The horizontal gray line for temporal multiplier = 1 represents the “no-change” or neutral parameter line.

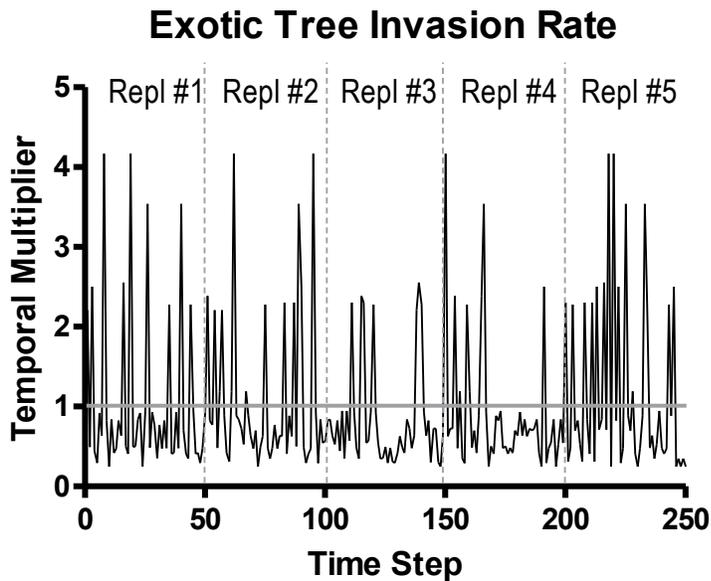
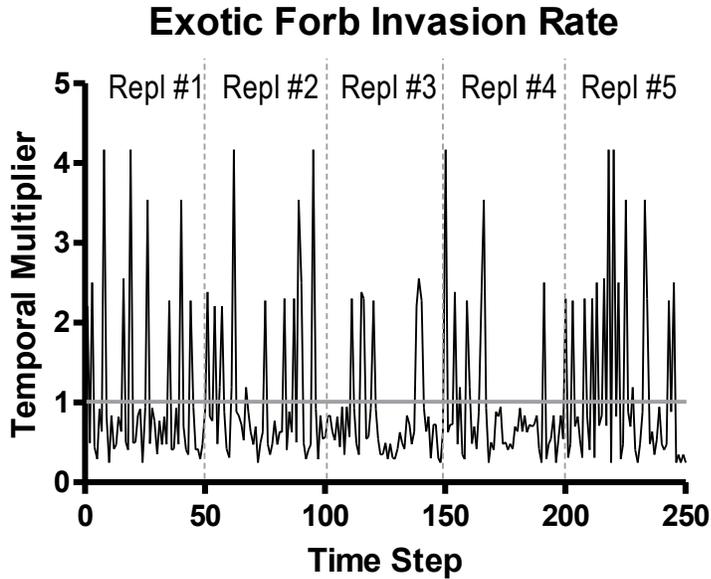


Figure 4-5. Riparian temporal multipliers for exotic forb invasion and exotic tree invasion. Annual discharge data from U.S. Geological Survey gage obtained from the Santa Clara River at Gunlock, UT. The horizontal gray line for temporal multiplier = 1 represents the “no-change” or neutral parameter line.

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Appendix 5. Management actions and cost by ecological systems.

| Ecological System | Management Action in Model | Management Action Description | From Class | To Class | Cost/Acre | Success Rate | Comment |
|--|----------------------------|---|---|------------------------|-----------|---------------------------------------|--|
| Multiple Systems: Blackbrush-mesic and thermic, and Creosotebush-White Bursage, Desert Washes, Warm-Season Grassland | Fuel breaks | Aerial spraying to create 250 feet wide fuel breaks along roads, rights-of-ways, and boundaries (all that are in several BpS) to maintain the SEP/SEPJ class; Reduces the frequency of fires for 3 years. | ALL | ALL | \$ 11 | 3 years less fire activity | Reapply every wet year of good exotic annual species productivity (i.e., about 7 years with El Nino cycle): \$80/acre but spread out over every 7 years. Arizona Strip BLM uses 8oz vs 4-6oz for St George BLM. |
| Multiple Systems of Beaver Dam Wash NCA | Law-enforcement | Reduces bare ground creation caused by OHV in BDW only. | ALL | ALL | \$0.8 | 90% | Law enforcement only affects OHV and in BDW; too inefficient to model large acres of law enforcement with PATH, therefore, we reduced OHV rate to 5% with static transition multiplier. Salary of one law enforcement person maybe 1/3 FTE: \$50K divided by 64K acres \$0.80/acre |
| Multiple Systems: Blackbrush-mesic and thermic, Creosotebush-White Bursage, Desert Wash | Livestock-Closure | Beaver Dam Wash only; Reduction of stocking rate in Desert Washes and 10-year closure of plantings and seedings in blackbrush and creosotebush-white bursage | All in Desert Washes and seedings and plantings | All classes, except BG | \$ 11 | 10 yrs no grazing for selected pixels | This is modeled as a reduction of stocking rate, however, closing the allotment, if chosen, is different (No-Grazing-only scenario) would be better done with static transition multiplier setting Managed-Herbivory = 0 and Excessive-Herbivory = 0. |

| | | | | | | | |
|---|---|--|---------|---------------------|----------|-----------|--|
| Big Sagebrush Steppe | Herbicide+Seed | Control cheatgrass and Erodium and broadcast seed or harrow on some plateaus | EX, SEP | A, C (respectively) | \$ 250 | 80% & 90% | |
| Big Sagebrush Steppe | Thin+Herbicide+Seed | Chainsaw invading PJ, apply herbicide to control exotic annuals, and seed native species | TEX, TE | SD | \$ 350 | 80% | |
| Blackbrush-mesic | Herbicide+Current Native Species Seeding | Aerial spraying Plateau on non-native annuals followed by native seeding with mechanical covering | EX | SD | \$ 1,000 | 1% | Not used due to low success rate of current quality of native seed and granivory; Success rate assumes no grazing |
| Blackbrush-mesic | Herbicide+Mixed Introduced and Native Species Seeding | Aerial spraying Plateau on non-native annuals followed by introduced and native species seeding with mechanical covering | EX | SDI | \$ 450 | 5% | Not used as most of BLM's Beaver Dam Wash is below the elevation suitable for forage koshia (~3500 feet); need to track success for forage koshia with low precipitation. Can still have grazing with introduced species; \$200 seed; 5 applications of herbicide over 10 yrs. |
| Blackbrush-mesic and thermic, and Cresotebush-White Bursage | Herbicide+ New Native cultivar Seeding | Aerial spraying Plateau on non-native annuals followed by new native species cultivar seeding, including seedballing (ball of clay with seeds that prevents granivory) | EX | SD | \$ 150 | 5% | In experimental development. Seed new native cultivar after 20 years of development. The new seed mix would incorporate new proven technologies such as "seedballing" and seed coating. Seedballing. Simulations assumed that the new seed mix would include all new technological development. Cost: \$100 lb native/10 lbs acre, plus application costs. |
| Blackbrush-mesic | Carbon addition | Add sugar or wood chips to soil | EX | SD | TBD | TBD | Not used: Supplemental treatment to seeding, or perhaps standalone, to reduce nitrogen availability to exotic species by stimulating bacterial and fungal uptake of nitrogen |

| | | | | | | | |
|---|------------------------------------|---|-----------|---------------|--------|------------|--|
| | | | | | | | during carbon processing |
| Blackbrush - mesic | Chainsaw-Lopping | Thin juniper and pinyon in late class | TEX | SEP | \$ 70 | 100% | Not used. Release blackbrush by removing trees in Red Cliffs were a large amount of shrubland has been lost. |
| Blackbrush-mesic and thermic, and Cresotebush-White Bursage | Herbicide+Planting | From Scott Abella's: Aerial spraying of Plateau on non-native annuals and plant containerized desert shrubs and forbs (but not blackbrush) with gel caps included in potting soil. | EX | PL, SEP, SEPJ | \$ 650 | 90% | In experimental development: commercial scaling up needs to be demonstrated. Main pathway is to Planting state, but then slower succession pathway to SEP or SEPJ if herbicide fails. Seedbank emergence of exotics after 2-3 years in the Planting state will also cause a transition to SEP or SEPJ. Six dollars for plant, gel cap and labor; 100 plants per acre; add \$50/acre for brome control. |
| Blackbrush-mesic and thermic, and Cresotebush-White Bursage | Fngers-of-Death+Planting | From Scott Abella's: Application of fingers-of-death on non-native annuals and plant containerized desert shrubs and forbs (but not blackbrush) with gel caps included in potting soil. | EX | PL, SEP, SEPJ | \$ 650 | 90% | In experimental development: commercial scaling up needs to be demonstrated. Main pathway is to Planting state, but then slower succession pathway to SEP or SEPJ if herbicide fails. Seedbank emergence of exotics after 2-3 years in the Planting state will also cause a transition to SEP or SEPJ. Six dollars for plant, gel cap and labor; 100 plants per acre; add \$50/acre for brome control. |
| Blackbrush-mesic and thermic, and Cresotebush-White Bursage | Fingers-of-Death-BM, BT, CB, & WAS | Apply the fingers-of-death fungi to kill exotic annual species | SES & SEP | A,B,C | \$ 300 | 25% to 75% | In experimental development: Patent filed for fungi. Expect fungi to be ready for commercial release in 5 years. Curent research estimates success rate of 75% at killing seed, but simulations tested success artes at 25%, 50%, |

| | | | | | | | |
|-----------------------|----------------------|---|-----------|------------|--------|------------|--|
| | | | | | | | and 75%. Mode of application (liquid or granular) undecided and in feasibility research. |
| Desert Sand Sagebrush | Herbicide+Seed | Seed with native perennial grasses after application of Plateau to control exotic annual species; had 80% back with 10 years | SEP | B | \$ 250 | 80% | For SEP, the cover of exotic annual species is not high and not considered high risk; quick recovery |
| Desert Wash | Herbicide-WAS | Aerial spraying Plateau on non-native annuals | SES & SEP | A, B, or C | \$ 25 | 50% | Lasts for 2 years because of seedbank emergence and invasion; must be done every 3-5 years |
| Desert Wash | Fingers-of-Death-WAS | Apply the fingers-of-death fungi to kill exotic annual species | SES & SEP | A,B,C | \$ 300 | 25% to 75% | In experimental development: Patent filed for fungi. Expect fungi to be ready for commercial release in 5 years. Current research estimates success rate of 75% at killing seed, but simulations tested success rates at 25%, 50%, and 75%. Mode of application (liquid or granular) undecided and in feasibility research. |
| Desert Wash | Exotic-Control-WAS | Cut tamarisk and immediately apply Garlon to stumps | ET | A,B,C | \$ 200 | 90% | If biocontrol beetle doesn't kill enough tamarisk |
| Montane Riparian | Exotic Control | Cut tamarisk and immediately apply Garlon to stumps. | | | \$ 200 | 90% | If biocontrol beetle doesn't kill enough tamarisk |
| Mountain Shrub | Herbicide+SeedRose | Application of Plateau (perhaps by ATV) to control cheatgrass and Erodium in burned areas, followed by seeding of cliffrose during drier years. | EX | A | \$ 100 | 70% | Rehabilitation of mine sites and degraded range with seeded cliffrose is a common and successful practice. Cliffrose has a greater germination success during drought years and wet years can set back reestablishment after fire. Cliffrose seedlings do not tolerate plant competition. Ability to reprints varies a lot by ecotype and uncommon, but seeding is successful and seed |

| | | | | | | | |
|-----------------------|---------------------|---|------------------------------|------------|--------|-----|--|
| | | | | | | | catching by rodents contributes to success. |
| Mountain Shrub | Herbicide+SeedGrass | Application of Plateau (perhaps by ATV or spot treatment) to control cheatgrass and Erodium in SEP, followed by seeding of grass species during wet years. | SEP | B | \$ 250 | 70% | Cliffrose may come back from seedbank; however cheatgrass competes strongly against seedlings. |
| Pinyon-Juniper | Herbicide | Spot treatment of brome with Plateau under canopy of mature trees. | TEX | C, D | \$ 75 | 60% | Very difficult to spray and applied by hand. |
| Pinyon-Juniper | Herbicide+Seed | Aerial application of herbicide to control annual exotic species (Bromus & Erodium) in burned areas followed by aerial seeding in burned areas | EX | A | \$ 250 | 60% | Need to consider constraints on aerial application over Red Cliffs wilderness. |
| Warm Desert Riparian | Weed Inventory | Periodic inventory of invasive weeds / tamarisk. Assumes spot treatment of small patches and tamarisk, and identifies a need to return to control larger trees and patches. | ALL, except ET, EF, DEF, DET | ALL | \$ 55 | | Visit every 3-5 years |
| Warm Desert Riparian | Exotic Tree Control | Cut tamarisk and immediately apply Garlon to stumps: replant native shrubs/trees and seed native forbs if needed. | ET, DET | A | \$ 200 | 90% | If the beetle doesn't do the job |
| Warm Desert Riparian | Herbicide-EX | Spot treatment of Plateau to control exotic annual species (Bromus and Erodium) under mature riparian vegetation | TEX | A, B, D, E | \$ 50 | 50% | Spot treatment mostly along Beaver Dam Wash. |
| Warm Desert Riparian | Exotic Forb Control | Control exotic forbs (Knapweed spp., tall whitetop, others) with herbicide | EF, DEF | A | \$ 150 | 60% | |
| Warm Season Grassland | Herbicide+Seed | Spray exotic annual species and seed in grass species (Galleta and others) to increase grass cover | EEX | A | \$ 250 | 40% | Literature reports difficulty of seeding galleta grass. |

| | | | | | | | |
|-----------------------|------------------------|--|-----|---|--------|-----|--|
| Warm Season Grassland | Fingers-fo-Death | Spot treatment of fingers-of-death fungi in SES. | SES | B | \$ 300 | 75% | In experimental development: Patent filed for fungi. Expect fungi to be ready for commercial release in 5 years. Already high cover of Galleta grass. |
| Warm Season Grassland | Fingers-fo-Death +Seed | Apply fingers-of-death on exotic annual species and seed in grass species (Galleta and others) to increase grass cover | EEX | A | \$ 600 | 63% | In experimental development: Patent filed for fungi. Expect fungi to be ready for commercial release in 5 years. Literature reports difficulty of seeding Galleta grass. |

Appendix 6. Current acres by vegetation class, natural range of variability (NRV) and ecological departure (ED) calculations for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | | | | | | | | | | | | |
|--------------------------------|----------------|------|----|------|----|---|-----|------|----|------|-------|------|-----|-----|-----|-------|
| BpS ↓ | Class→ | A | B | C | D | E | EEX | EF | ET | EX | SEP | SEPJ | SES | TE | TEX | Total |
| Big Sagebrush Steppe-upland | Current acres | 0 | 0 | 0 | 0 | 0 | | | | 2408 | 505 | | | 148 | | 3061 |
| | NRV | 30 | 47 | 20 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | 0 | | | | 79 | 17 | | 0 | 5 | | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Blackbrush- mesic | Current acres | 0 | 0 | 0 | 0 | | | | | 6750 | 10510 | | | | | 17260 |
| | NRV | 11 | 0 | 73 | 16 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | | | | | 39 | 61 | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Blackbrush- thermic | Current acres | 0 | 0 | 0 | | | | | | 583 | 4422 | | | | | 5005 |
| | NRV | 5 | 0 | 95 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | | | 0 | 0 | 0 | 12 | 88 | 0 | 0 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Creosotebush- White Bursage | Current acres | 0 | 0 | 0 | 0 | | | | | 1661 | 1382 | | | | | 3043 |
| | NRV | 8 | 0 | 92 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | | | | | 55 | 45 | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Desert Sand Sagebrush | Current acres | 0 | 0 | | | | | | | | 1586 | | | | | 1586 |
| | NRV | 2 | 98 | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | | | | | | | | 100 | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Montane Riparian | Current acres | 0.02 | 0 | 0.33 | | | | 39.5 | | | | | | | | 40 |
| | NRV | 10 | 19 | 71 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 1 | | | | 99 | | | | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | 99 |
| Mountain Mahogany | Current acres | | | | | | | | | | | | | | | |
| | NRV | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---------------------------|----------------|-----|----|----|----|----|---|---|---|-----|-----|---|-----|-----|------|------|
| | Current % area | | | | | | | | | | | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | |
| Mountain Shrub | Current acres | 0 | 0 | 0 | 0 | | | | | 2.7 | 0.3 | | | 1.2 | | 4.2 |
| | NRV | 7 | 15 | 63 | 14 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | | | | | 64 | 7 | | | 29 | | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Pinyon-Juniper | Current acres | 0 | 0 | 0 | 0 | | | | | | | | | | 3719 | 3719 |
| | NRV | 2 | 3 | 13 | 82 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | | | | | | | | | | 100 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Warm Desert Riparian | Current acres | 0 | 0 | 0 | 0 | 0 | | | | 34 | | | | | 126 | 160 |
| | NRV | 10 | 19 | 8 | 40 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | 0 | | | | 21 | | | | | 79 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Warm Desert Riparian-Wash | Current acres | 171 | 0 | 0 | | | | | | | | | 231 | | | 402 |
| | NRV | 10 | 18 | 72 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 43 | 0 | 0 | | | | | | | | | 57 | | | |
| | Ecol Departure | | | | | | | | | | | | | | | 90 |
| Warm-Season Grassland | Current acres | 0 | 0 | | | | 3 | | | 7 | | | 108 | | | 118 |
| | NRV | 4 | 96 | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | | | | 3 | | | 6 | | | 91 | | | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |

| Beaver Dam Wash NCA | | | | | | | | | | | | | | | | |
|-----------------------------|----------------|----|----|----|---|---|-----|----|----|-------|------|------|-----|----|-----|-------|
| BpS ↓ | Class→ | A | B | C | D | E | EEX | EF | ET | EX | SEP | SEPJ | SES | TE | TEX | Total |
| Big Sagebrush Steppe-upland | Current acres | 0 | 0 | 0 | 0 | 0 | | | | 12 | | | 2 | | | 14 |
| | NRV | 30 | 47 | 20 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83 | 0 | 0 | 17 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Blackbrush- | Current acres | 0 | 0 | 0 | 0 | 0 | | | | 24629 | 3364 | 5629 | | | 6 | 33628 |

| | | | | | | | | | | | | | | | | |
|----------------------------|----------------|-----|----|-----|----|---|---|---|---|------|------|-------|---|---|----|-------|
| mesic | NRV | 10 | 39 | 35 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 73 | 10 | 17 | 0 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Blackbrush-thermic | Current acres | 0 | 0 | 0 | | | | | | 1211 | 1133 | 1309 | | | | 3653 |
| | NRV | 5 | 48 | 47 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | | | 0 | 0 | 0 | 33 | 31 | 36 | 0 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Creosotebush-White Bursage | Current acres | 0 | 0 | 0 | 0 | | | | | 1960 | 7024 | 13057 | | | | 22041 |
| | NRV | 9 | 36 | 38 | 17 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 9 | 32 | 59 | 0 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Desert Sand Sagebrush | Current acres | | | | | | | | | | | | | | | |
| | NRV | | | | | | | | | | | | | | | |
| | Current % area | | | | | | | | | | | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | |
| Montane Riparian | Current acres | | | | | | | | | | | | | | | |
| | NRV | | | | | | | | | | | | | | | |
| | Current % area | | | | | | | | | | | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | |
| Mountain Mahogany | Current acres | 0.1 | 0 | 0.4 | | | | | | | | | | | | 0.5 |
| | NRV | 6 | 10 | 84 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 20 | 0 | 80 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 14 |
| Mountain Shrub | Current acres | 0 | 0 | 0 | 0 | | | | | 143 | | | | | | 143 |
| | NRV | 7 | 15 | 63 | 14 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Pinyon-Juniper | Current acres | 0 | 0 | 0 | 16 | | | | | 220 | | | | | 34 | 270 |
| | NRV | 2 | 3 | 13 | 82 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Current % area | 0 | 0 | 0 | 6 | | 0 | 0 | 0 | 82 | 0 | 0 | 0 | 0 | 13 | |
| | Ecol Departure | | | | | | | | | | | | | | | 94 |

| | | | | | | | | | | | | | | | | |
|--------------------------------------|-----------------------|------|----|----|----|----|---|---|---|---|---|---|-----|---|-----|------|
| Warm Desert Riparian | Current acres | 0 | 0 | 0 | 0 | 0 | | | 4 | | | | | | 110 | 114 |
| | NRV | 10 | 19 | 8 | 40 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Current % area | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 96 | |
| | Ecol Departure | | | | | | | | | | | | | | | 100 |
| Warm Desert Riparian-Wash | Current acres | 2646 | 0 | 0 | | | | | | | | | 699 | | | 3345 |
| | NRV | 10 | 18 | 72 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Current % area | 79 | 0 | 0 | | | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 0 | |
| | Ecol Departure | | | | | | | | | | | | | | | 90 |
| Warm-Season Grassland | Current acres | | | | | | | | | | | | | | | |
| | NRV | | | | | | | | | | | | | | | |
| | Current % area | | | | | | | | | | | | | | | |
| | Ecol Departure | | | | | | | | | | | | | | | |

Appendix 7. MINIMUM MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 1% | 0% | 1% | 0% | 1% |
| BSu-B:OP: 0% | 0% | 2% | 1% | 1% | 1% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 1% | 1% | 1% | 0% | 1% |
| BSu-U:EX: 0% | 94% | 93% | 95% | 87% | 94% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 6% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 2% | 2% | 2% | 3% | 2% |
| BSu-U:TEX: 0% | 1% | 2% | 1% | 3% | 1% |
| BM-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 3% | 2% | 3% | 1% | 3% |
| BM-U:EX2B: 0% | 73% | 64% | 76% | 35% | 67% |
| BM-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 23% | 33% | 21% | 63% | 29% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 1% | 1% | 1% | 2% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 3% | 2% | 3% | 1% | 3% |
| BT-U:EX2B: 0% | 73% | 63% | 76% | 35% | 66% |
| BT-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|------|------|------|------|------|
| BT-U:SEP: 0% | 24% | 35% | 21% | 64% | 30% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 3% | 16% | 5% | 20% | 8% |
| CB-U:EX2B: 0% | 37% | 26% | 38% | 20% | 26% |
| CB-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 60% | 58% | 57% | 60% | 65% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:EF: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-U:SFE: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 33% | 0% | 0% | 25% | 25% |
| MSh-U:EX: 0% | 0% | 0% | 50% | 0% | 25% |
| MSh-U:SEP: 0% | 67% | 75% | 25% | 75% | 50% |
| MSh-U:TE: 0% | 0% | 25% | 25% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-U:EX: 0% | 24% | 20% | 26% | 10% | 19% |
| PJ-U:TEX: 0% | 76% | 80% | 74% | 90% | 81% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 14% |
| SWA-B:CL: 0% | 20% | 0% | 15% | 1% | 12% |
| SWA-C:CL: 0% | 11% | 29% | 19% | 31% | 7% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 10% | 13% | 8% | 11% | 10% |
| SWA-U:SES: 0% | 58% | 57% | 57% | 57% | 57% |
| WDR-A:AL: 0% | 0% | 3% | 1% | 0% | 2% |
| WDR-B:CL: 0% | 13% | 8% | 15% | 3% | 7% |
| WDR-C:OP: 0% | 4% | 7% | 6% | 8% | 11% |
| WDR-D:CL: 0% | 7% | 4% | 3% | 7% | 9% |
| WDR-E:CL: 0% | 7% | 3% | 4% | 10% | 7% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 28% | 34% | 30% | 31% | 30% |
| WDR-U:ET: 0% | 1% | 1% | 2% | 1% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 4% | 0% | 0% |
| WDR-U:TEX: 0% | 41% | 40% | 35% | 41% | 34% |
| GRL-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 3% | 3% | 3% | 3% | 3% |
| GRL-U:EX: 0% | 0% | 0% | 0% | 0% | 1% |
| GRL-U:SES: 0% | 97% | 97% | 97% | 97% | 96% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 89% | 100% | 100% | 89% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 11% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 11% | 0% | 0% | 0% | 0% |
| BM-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 1% | 1% | 1% | 1% | 1% |
| BM-U:EX2B: 0% | 32% | 30% | 34% | 27% | 27% |
| BM-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 24% | 25% | 24% | 26% | 26% |
| BM-U:SEPJ: 0% | 41% | 42% | 40% | 45% | 44% |
| BM-U:TEX: 0% | 1% | 1% | 0% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 1% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 3% | 3% | 2% | 1% | 3% |
| BT-U:EX2B: 0% | 14% | 5% | 17% | 2% | 9% |
| BT-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 33% | 35% | 33% | 41% | 37% |
| BT-U:SEPJ: 0% | 49% | 56% | 48% | 55% | 51% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 1% | 0% | 1% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 3% | 18% | 5% | 22% | 8% |
| CB-U:EX2B: 0% | 33% | 19% | 37% | 6% | 23% |
| CB-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 22% | 22% | 20% | 26% | 24% |
| CB-U:SEPJ: 0% | 41% | 41% | 37% | 46% | 45% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 28% | 2% | 79% | 1% | 29% |
| MSh-U:SEP: 0% | 72% | 98% | 21% | 99% | 71% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| PJ-B:OP: 0% | 1% | 0% | 1% | 1% | 1% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 1% | 0% |
| PJ-D:OP: 0% | 5% | 5% | 5% | 4% | 5% |
| PJ-U:EX: 0% | 84% | 85% | 84% | 82% | 85% |
| PJ-U:TEX: 0% | 10% | 10% | 11% | 12% | 9% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 26% |
| SWA-B:CL: 0% | 27% | 2% | 25% | 1% | 19% |
| SWA-C:CL: 0% | 33% | 57% | 41% | 56% | 17% |
| SWA-U:BG: 0% | 0% | 1% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 4% | 5% | 3% | 7% | 7% |
| SWA-U:SES: 0% | 34% | 35% | 28% | 36% | 31% |
| WDR-A:AL: 0% | 4% | 10% | 6% | 4% | 6% |
| WDR-B:CL: 0% | 0% | 0% | 1% | 1% | 0% |
| WDR-C:OP: 0% | 4% | 6% | 1% | 3% | 4% |
| WDR-D:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-E:CL: 0% | 1% | 0% | 0% | 0% | 1% |
| WDR-U:DE: 0% | 0% | 4% | 1% | 3% | 0% |
| WDR-U:DEF: 0% | 1% | 1% | 1% | 3% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 19% | 14% | 24% | 6% | 24% |
| WDR-U:ET: 0% | 0% | 1% | 1% | 0% | 0% |
| WDR-U:EX: 0% | 19% | 7% | 13% | 1% | 7% |
| WDR-U:TEX: 0% | 50% | 57% | 51% | 79% | 58% |

Appendix 8. MAXIMUM MANAGEMENT scenario 50-year area results (acre) by vegetation class for ecological systems of Red Cliffs and Beaver Dam Wash NCA, Utah.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 1% | 6% | 1% | 2% | 3% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 14% | 8% | 15% | 9% | 13% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 3% | 1% | 0% | 1% | 2% |
| BSu-U:SD: 0% | 80% | 84% | 83% | 86% | 81% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 1% | 1% | 1% | 1% | 1% |
| BSu-U:TEX: 0% | 1% | 1% | 0% | 1% | 0% |
| BM-A:AL: 0% | 3% | 3% | 3% | 2% | 3% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 1% | 0% | 0% | 1% |
| BM-U:EX2B: 0% | 0% | 18% | 1% | 0% | 13% |
| BM-U:PL: 0% | 2% | 7% | 1% | 3% | 1% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 94% | 69% | 95% | 93% | 82% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 2% | 2% | 1% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 1% | 1% | 0% | 1% | 1% |
| BT-U:EX2B: 0% | 0% | 9% | 1% | 2% | 14% |
| BT-U:PL: 0% | 2% | 10% | 2% | 6% | 2% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 97% | 79% | 97% | 90% | 83% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 3% | 0% | 1% | 1% | 2% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 4% | 3% | 3% | 3% | 4% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 93% | 96% | 97% | 95% | 94% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 3% |
| DSS-B:OP: 0% | 40% | 41% | 41% | 40% | 37% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 60% | 59% | 59% | 60% | 60% |
| MM-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MM-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MM-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MM-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| MM-U:TEX: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-A:AL: 0% | 0% | 2% | 50% | 0% | 2% |
| MR-B:OP: 0% | 62% | 36% | 24% | 58% | 34% |
| MR-C:CL: 0% | 32% | 62% | 18% | 40% | 60% |
| MR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:EF: 0% | 6% | 0% | 8% | 2% | 4% |
| MR-U:SFE: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-A:AL: 0% | 0% | 20% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 60% | 60% | 20% | 75% | 50% |
| MSh-C:CL: 0% | 20% | 0% | 60% | 25% | 50% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:TE: 0% | 20% | 20% | 20% | 0% | 0% |
| PJ-A:AL: 0% | 2% | 2% | 1% | 1% | 1% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 3% | 3% | 3% | 3% | 3% |
| PJ-D:OP: 0% | 28% | 28% | 30% | 29% | 29% |
| PJ-U:EX: 0% | 1% | 6% | 1% | 4% | 4% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| PJ-U:TEX: 0% | 67% | 60% | 64% | 62% | 63% |
| SWA-A:AL: 0% | 4% | 2% | 40% | 1% | 0% |
| SWA-B:CL: 0% | 42% | 31% | 6% | 42% | 29% |
| SWA-C:CL: 0% | 45% | 64% | 51% | 52% | 70% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 3% | 2% | 1% | 2% | 0% |
| SWA-U:SES: 0% | 6% | 2% | 2% | 3% | 1% |
| WDR-A:AL: 0% | 3% | 2% | 20% | 4% | 6% |
| WDR-B:CL: 0% | 9% | 13% | 4% | 10% | 9% |
| WDR-C:OP: 0% | 8% | 9% | 5% | 6% | 8% |
| WDR-D:CL: 0% | 7% | 10% | 4% | 8% | 9% |
| WDR-E:CL: 0% | 56% | 48% | 49% | 59% | 52% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 0% | 1% | 1% | 1% | 3% |
| WDR-U:ET: 0% | 0% | 0% | 1% | 1% | 2% |
| WDR-U:EX: 0% | 1% | 1% | 4% | 0% | 0% |
| WDR-U:TEX: 0% | 17% | 15% | 12% | 12% | 11% |
| GRL-A:AL: 0% | 4% | 5% | 5% | 4% | 5% |
| GRL-B:OP: 0% | 93% | 93% | 87% | 95% | 90% |
| GRL-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 0% | 1% | 0% | 0% | 1% |
| GRL-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:SES: 0% | 3% | 1% | 7% | 1% | 4% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 90% | 90% | 100% | 90% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 10% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BSu-U:TEX: 0% | 10% | 10% | 0% | 0% | 0% |
| BM-A:AL: 0% | 2% | 2% | 2% | 1% | 2% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 0% | 1% | 0% | 0% |
| BM-U:PL: 0% | 2% | 0% | 3% | 0% | 1% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 40% | 41% | 39% | 40% | 40% |
| BM-U:SEPJ: 0% | 55% | 56% | 54% | 57% | 56% |
| BM-U:TEX: 0% | 1% | 1% | 1% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:PL: 0% | 2% | 0% | 3% | 0% | 1% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 46% | 47% | 45% | 45% | 46% |
| BT-U:SEPJ: 0% | 52% | 53% | 51% | 55% | 53% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 0% | 1% | 2% | 2% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 1% | 3% | 4% | 4% | 2% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 35% | 35% | 33% | 33% | 35% |
| CB-U:SEPJ: 0% | 64% | 62% | 61% | 60% | 63% |
| MSh-A:AL: 0% | 7% | 0% | 27% | 1% | 6% |
| MSh-B:CL: 0% | 42% | 3% | 20% | 3% | 30% |
| MSh-C:CL: 0% | 35% | 74% | 26% | 78% | 38% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| MSh-D:OP: 0% | 15% | 22% | 26% | 17% | 25% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:SEP: 0% | 0% | 1% | 1% | 0% | 0% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 9% | 1% | 16% | 1% | 2% |
| PJ-B:OP: 0% | 21% | 12% | 15% | 3% | 17% |
| PJ-C:OP: 0% | 56% | 72% | 53% | 80% | 67% |
| PJ-D:OP: 0% | 5% | 5% | 6% | 5% | 5% |
| PJ-U:EX: 0% | 0% | 0% | 1% | 0% | 0% |
| PJ-U:TEX: 0% | 10% | 10% | 9% | 12% | 9% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 11% |
| SWA-B:CL: 0% | 14% | 1% | 13% | 1% | 23% |
| SWA-C:CL: 0% | 85% | 97% | 85% | 97% | 64% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 1% | 2% | 1% | 1% | 1% |
| SWA-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-A:AL: 0% | 0% | 5% | 3% | 0% | 3% |
| WDR-B:CL: 0% | 51% | 18% | 25% | 8% | 15% |
| WDR-C:OP: 0% | 12% | 15% | 15% | 3% | 11% |
| WDR-D:CL: 0% | 7% | 8% | 14% | 19% | 21% |
| WDR-E:CL: 0% | 23% | 47% | 36% | 64% | 47% |
| WDR-U:DE: 0% | 4% | 5% | 5% | 3% | 3% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 3% | 1% | 1% | 3% | 0% |
| WDR-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:TEX: 0% | 0% | 0% | 1% | 0% | 1% |

Appendix 9. STREAMLINED MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 14% | 1% | 12% | 0% | 7% |
| BSu-B:OP: 0% | 6% | 18% | 9% | 14% | 13% |
| BSu-C:CL: 0% | 4% | 5% | 2% | 11% | 6% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SD: 0% | 76% | 74% | 76% | 73% | 73% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 1% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 1% | 0% |
| BM-A:AL: 0% | 2% | 2% | 2% | 1% | 2% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX2B: 0% | 1% | 0% | 7% | 0% | 1% |
| BM-U:PL: 0% | 9% | 0% | 9% | 0% | 2% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 87% | 95% | 80% | 95% | 93% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 2% | 2% | 1% | 3% | 2% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 4% | 1% | 3% | 0% | 2% |
| BT-U:EX2B: 0% | 0% | 0% | 4% | 0% | 1% |
| BT-U:PL: 0% | 12% | 2% | 12% | 1% | 5% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|------|------|------|------|------|
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 84% | 97% | 81% | 99% | 92% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 0% | 2% | 4% | 5% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 1% | 3% | 2% | 3% | 2% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 99% | 95% | 94% | 91% | 97% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-B:OP: 0% | 100% | 100% | 100% | 100% | 100% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-A:AL: 0% | 0% | 4% | 2% | 0% | 0% |
| MR-B:OP: 0% | 56% | 18% | 46% | 6% | 16% |
| MR-C:CL: 0% | 42% | 74% | 48% | 92% | 84% |
| MR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:EF: 0% | 2% | 4% | 4% | 2% | 0% |
| MR-U:SFE: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 20% | 0% |
| MSh-B:CL: 0% | 40% | 0% | 50% | 0% | 20% |
| MSh-C:CL: 0% | 20% | 80% | 50% | 60% | 40% |
| MSh-D:OP: 0% | 20% | 0% | 0% | 20% | 20% |
| MSh-U:ES: 0% | 20% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:TE: 0% | 0% | 20% | 0% | 0% | 20% |
| PJ-A:AL: 0% | 4% | 0% | 7% | 0% | 1% |
| PJ-B:OP: 0% | 9% | 11% | 10% | 5% | 11% |
| PJ-C:OP: 0% | 15% | 19% | 16% | 18% | 15% |
| PJ-D:OP: 0% | 61% | 61% | 57% | 62% | 64% |
| PJ-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-U:TEX: 0% | 10% | 8% | 10% | 15% | 9% |
| SWA-A:AL: 0% | 2% | 0% | 1% | 0% | 20% |
| SWA-B:CL: 0% | 16% | 2% | 19% | 3% | 29% |
| SWA-C:CL: 0% | 80% | 96% | 80% | 91% | 49% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|------|-----|-----|-----|-----|
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 1% | 2% | 0% | 4% | 2% |
| SWA-U:SES: 0% | 0% | 0% | 0% | 1% | 0% |
| WDR-A:AL: 0% | 1% | 12% | 5% | 1% | 2% |
| WDR-B:CL: 0% | 46% | 18% | 40% | 7% | 14% |
| WDR-C:OP: 0% | 9% | 12% | 11% | 9% | 14% |
| WDR-D:CL: 0% | 16% | 17% | 14% | 23% | 31% |
| WDR-E:CL: 0% | 25% | 38% | 24% | 57% | 33% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 3% | 2% | 6% | 2% | 2% |
| WDR-U:ET: 0% | 1% | 0% | 1% | 1% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:TEX: 0% | 0% | 2% | 1% | 1% | 3% |
| GRL-A:AL: 0% | 0% | 2% | 1% | 2% | 1% |
| GRL-B:OP: 0% | 100% | 97% | 98% | 96% | 98% |
| GRL-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 0% | 0% | 0% | 0% | 1% |
| GRL-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:SES: 0% | 0% | 2% | 2% | 2% | 1% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 89% | 100% | 89% | 100% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 11% | 0% | 11% | 0% | 0% |
| BM-A:AL: 0% | 1% | 1% | 2% | 1% | 1% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 0% | 2% | 0% | 0% |
| BM-U:PL: 0% | 2% | 0% | 3% | 0% | 1% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 40% | 41% | 38% | 40% | 40% |
| BM-U:SEPJ: 0% | 56% | 57% | 54% | 58% | 57% |
| BM-U:TEX: 0% | 1% | 1% | 1% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:PL: 0% | 2% | 0% | 3% | 0% | 1% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 45% | 47% | 44% | 46% | 46% |
| BT-U:SEPJ: 0% | 53% | 52% | 52% | 53% | 53% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 0% | 1% | 2% | 2% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 2% | 3% | 4% | 4% | 2% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 35% | 34% | 33% | 34% | 34% |
| CB-U:SEPJ: 0% | 63% | 63% | 60% | 60% | 63% |
| MSh-A:AL: 0% | 9% | 1% | 25% | 0% | 1% |
| MSh-B:CL: 0% | 40% | 1% | 21% | 1% | 29% |
| MSh-C:CL: 0% | 33% | 75% | 32% | 83% | 45% |
| MSh-D:OP: 0% | 17% | 22% | 22% | 16% | 24% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 1% |
| MSh-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:SEP: 0% | 0% | 2% | 0% | 0% | 0% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| PJ-A:AL: 0% | 9% | 2% | 10% | 1% | 2% |
| PJ-B:OP: 0% | 16% | 10% | 15% | 1% | 19% |
| PJ-C:OP: 0% | 60% | 73% | 62% | 82% | 64% |
| PJ-D:OP: 0% | 5% | 6% | 4% | 5% | 5% |
| PJ-U:EX: 0% | 0% | 0% | 0% | 1% | 0% |
| PJ-U:TEX: 0% | 10% | 9% | 9% | 11% | 10% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 12% |
| SWA-B:CL: 0% | 14% | 2% | 13% | 1% | 21% |
| SWA-C:CL: 0% | 85% | 96% | 85% | 97% | 66% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 1% | 1% | 1% | 1% | 2% |
| SWA-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-A:AL: 0% | 0% | 5% | 3% | 0% | 3% |
| WDR-B:CL: 0% | 51% | 18% | 25% | 8% | 15% |
| WDR-C:OP: 0% | 12% | 15% | 15% | 3% | 11% |
| WDR-D:CL: 0% | 7% | 8% | 14% | 19% | 21% |
| WDR-E:CL: 0% | 23% | 47% | 36% | 64% | 47% |
| WDR-U:DE: 0% | 4% | 5% | 5% | 3% | 3% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 3% | 1% | 1% | 3% | 0% |
| WDR-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:TEX: 0% | 0% | 0% | 1% | 0% | 1% |

Appendix 10. PLANTING AND HERBICIDE-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 1% | 0% | 1% | 0% | 1% |
| BSu-B:OP: 0% | 0% | 2% | 1% | 1% | 1% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 1% | 0% | 1% | 0% | 1% |
| BSu-U:EX: 0% | 95% | 93% | 94% | 87% | 93% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 1% | 0% | 7% | 1% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 2% | 3% | 2% | 3% | 2% |
| BSu-U:TEX: 0% | 1% | 2% | 1% | 3% | 1% |
| BM-A:AL: 0% | 3% | 3% | 3% | 1% | 2% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 2% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 1% | 27% | 0% | 1% |
| BM-U:PL: 0% | 20% | 1% | 19% | 1% | 7% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 74% | 93% | 49% | 95% | 88% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 2% | 2% | 1% | 3% | 2% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 7% | 2% | 8% | 1% | 4% |
| BT-U:EX2B: 0% | 0% | 1% | 5% | 0% | 1% |
| BT-U:PL: 0% | 31% | 6% | 37% | 2% | 17% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|------|------|------|------|------|
| BT-U:SEP: 0% | 62% | 91% | 50% | 96% | 78% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 0% | 0% | 4% | 2% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 1% | 0% | 0% |
| CB-U:PL: 0% | 2% | 2% | 4% | 3% | 2% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 98% | 97% | 91% | 94% | 98% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:EF: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-U:SFE: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 25% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 50% | 0% | 25% | 0% | 0% |
| MSh-U:SEP: 0% | 25% | 75% | 50% | 75% | 75% |
| MSh-U:TE: 0% | 0% | 25% | 25% | 25% | 25% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-U:EX: 0% | 22% | 21% | 24% | 9% | 19% |
| PJ-U:TEX: 0% | 78% | 79% | 76% | 91% | 81% |
| SWA-A:AL: 0% | 0% | 0% | 0% | 0% | 15% |
| SWA-B:CL: 0% | 23% | 2% | 16% | 1% | 11% |
| SWA-C:CL: 0% | 9% | 29% | 20% | 29% | 9% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 11% | 13% | 7% | 12% | 9% |
| SWA-U:SES: 0% | 56% | 57% | 56% | 57% | 56% |
| WDR-A:AL: 0% | 0% | 3% | 1% | 0% | 2% |
| WDR-B:CL: 0% | 13% | 8% | 15% | 3% | 7% |
| WDR-C:OP: 0% | 4% | 7% | 6% | 8% | 11% |
| WDR-D:CL: 0% | 7% | 4% | 3% | 7% | 9% |
| WDR-E:CL: 0% | 7% | 3% | 4% | 10% | 7% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 28% | 34% | 30% | 31% | 30% |
| WDR-U:ET: 0% | 1% | 1% | 2% | 1% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 4% | 0% | 0% |
| WDR-U:TEX: 0% | 41% | 40% | 35% | 41% | 34% |
| GRL-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 3% | 3% | 3% | 3% | 3% |
| GRL-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:SES: 0% | 97% | 97% | 97% | 97% | 97% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 100% | 100% | 100% | 89% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 11% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-A:AL: 0% | 2% | 2% | 2% | 1% | 2% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 1% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 0% | 2% | 0% | 0% |
| BM-U:PL: 0% | 3% | 0% | 5% | 0% | 1% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 40% | 41% | 37% | 41% | 40% |
| BM-U:SEPJ: 0% | 54% | 56% | 53% | 56% | 56% |
| BM-U:TEX: 0% | 1% | 1% | 1% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 0% | 0% | 1% | 0% | 0% |
| BT-U:EX2B: 0% | 0% | 0% | 1% | 0% | 0% |
| BT-U:PL: 0% | 3% | 0% | 4% | 0% | 1% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 44% | 45% | 42% | 45% | 46% |
| BT-U:SEPJ: 0% | 53% | 55% | 51% | 54% | 53% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 0% | 1% | 1% | 2% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 1% | 2% | 5% | 4% | 1% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 35% | 34% | 33% | 34% | 35% |
| CB-U:SEPJ: 0% | 63% | 63% | 61% | 60% | 63% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 24% | 2% | 73% | 1% | 30% |
| MSh-U:SEP: 0% | 76% | 98% | 27% | 99% | 70% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 1% | 0% |
| PJ-D:OP: 0% | 6% | 3% | 6% | 5% | 5% |
| PJ-U:EX: 0% | 83% | 85% | 85% | 82% | 85% |
| PJ-U:TEX: 0% | 11% | 11% | 9% | 12% | 9% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 26% |
| SWA-B:CL: 0% | 27% | 1% | 26% | 1% | 20% |
| SWA-C:CL: 0% | 33% | 56% | 41% | 55% | 16% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 4% | 6% | 4% | 6% | 6% |
| SWA-U:SES: 0% | 35% | 36% | 29% | 37% | 32% |
| WDR-A:AL: 0% | 0% | 1% | 1% | 0% | 3% |
| WDR-B:CL: 0% | 18% | 1% | 8% | 1% | 1% |
| WDR-C:OP: 0% | 5% | 5% | 3% | 3% | 8% |
| WDR-D:CL: 0% | 3% | 1% | 1% | 4% | 7% |
| WDR-E:CL: 0% | 0% | 1% | 0% | 0% | 0% |
| WDR-U:DE: 0% | 3% | 0% | 1% | 1% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 36% | 40% | 32% | 30% | 40% |
| WDR-U:ET: 0% | 0% | 0% | 4% | 0% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 7% | 0% | 0% |
| WDR-U:TEX: 0% | 36% | 49% | 42% | 60% | 41% |

Appendix 11. PLANTING AND HERBICIDE & LIVESTOCK CLOSURE-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Beaver Dam Wash NCA.

| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
|---|----------|----------|----------|----------|----------|
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 100% | 100% | 100% | 100% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-A:AL: 0% | 2% | 2% | 2% | 1% | 2% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 0% | 1% | 0% | 0% |
| BM-U:PL: 0% | 3% | 0% | 5% | 0% | 1% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 40% | 41% | 39% | 41% | 41% |
| BM-U:SEPJ: 0% | 54% | 56% | 52% | 56% | 55% |
| BM-U:TEX: 0% | 1% | 1% | 1% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX2B: 0% | 0% | 0% | 1% | 0% | 0% |
| BT-U:PL: 0% | 4% | 0% | 5% | 0% | 1% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 44% | 45% | 41% | 45% | 45% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BT-U:SEPJ: 0% | 52% | 54% | 53% | 55% | 54% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 0% | 1% | 1% | 1% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 2% | 3% | 6% | 4% | 2% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 35% | 35% | 33% | 34% | 35% |
| CB-U:SEPJ: 0% | 63% | 62% | 60% | 60% | 63% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 26% | 5% | 78% | 1% | 17% |
| MSh-U:SEP: 0% | 74% | 95% | 22% | 99% | 83% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 1% | 1% | 1% |
| PJ-D:OP: 0% | 5% | 6% | 5% | 5% | 5% |
| PJ-U:EX: 0% | 85% | 86% | 85% | 84% | 83% |
| PJ-U:TEX: 0% | 10% | 8% | 9% | 10% | 12% |
| SWA-A:AL: 0% | 0% | 0% | 0% | 0% | 9% |
| SWA-B:CL: 0% | 10% | 1% | 10% | 1% | 15% |
| SWA-C:CL: 0% | 60% | 67% | 62% | 65% | 46% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 9% | 11% | 7% | 13% | 10% |
| SWA-U:SES: 0% | 21% | 21% | 21% | 21% | 21% |
| WDR-A:AL: 0% | 0% | 1% | 1% | 0% | 3% |
| WDR-B:CL: 0% | 18% | 1% | 8% | 1% | 1% |
| WDR-C:OP: 0% | 5% | 5% | 3% | 3% | 8% |
| WDR-D:CL: 0% | 3% | 1% | 1% | 4% | 7% |
| WDR-E:CL: 0% | 0% | 1% | 0% | 0% | 0% |
| WDR-U:DE: 0% | 3% | 0% | 1% | 1% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 36% | 40% | 32% | 30% | 40% |
| WDR-U:ET: 0% | 0% | 0% | 4% | 0% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 7% | 0% | 0% |
| WDR-U:TEX: 0% | 36% | 49% | 42% | 60% | 41% |

Appendix 12. FUEL-BREAK-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 1% | 0% | 1% | 0% | 1% |
| BSu-B:OP: 0% | 0% | 2% | 1% | 1% | 1% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 1% | 1% | 1% | 0% | 1% |
| BSu-U:EX: 0% | 94% | 93% | 94% | 87% | 93% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 6% | 1% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 2% | 2% | 2% | 3% | 2% |
| BSu-U:TEX: 0% | 2% | 2% | 1% | 3% | 1% |
| BM-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 3% | 1% | 3% | 1% | 3% |
| BM-U:EX2B: 0% | 59% | 52% | 62% | 23% | 51% |
| BM-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 37% | 44% | 34% | 73% | 44% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 2% | 2% | 1% | 3% | 2% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 3% | 2% | 3% | 1% | 3% |
| BT-U:EX2B: 0% | 57% | 42% | 61% | 18% | 46% |
| BT-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|------|------|------|------|------|
| BT-U:SEP: 0% | 41% | 56% | 36% | 81% | 50% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 9% | 19% | 11% | 22% | 12% |
| CB-U:EX2B: 0% | 18% | 11% | 21% | 9% | 13% |
| CB-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 73% | 70% | 69% | 69% | 76% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:EF: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-U:SFE: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 25% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 0% | 25% | 50% | 0% | 0% |
| MSh-U:SEP: 0% | 75% | 50% | 25% | 75% | 100% |
| MSh-U:TE: 0% | 0% | 25% | 25% | 25% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-U:EX: 0% | 23% | 19% | 25% | 9% | 20% |
| PJ-U:TEX: 0% | 77% | 81% | 75% | 91% | 80% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 16% |
| SWA-B:CL: 0% | 16% | 1% | 14% | 1% | 8% |
| SWA-C:CL: 0% | 17% | 31% | 20% | 32% | 11% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 9% | 11% | 7% | 10% | 10% |
| SWA-U:SES: 0% | 57% | 57% | 57% | 57% | 56% |
| WDR-A:AL: 0% | 0% | 3% | 1% | 0% | 2% |
| WDR-B:CL: 0% | 13% | 8% | 15% | 3% | 7% |
| WDR-C:OP: 0% | 4% | 7% | 6% | 8% | 11% |
| WDR-D:CL: 0% | 7% | 4% | 3% | 7% | 9% |
| WDR-E:CL: 0% | 7% | 3% | 4% | 10% | 7% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 28% | 34% | 30% | 31% | 30% |
| WDR-U:ET: 0% | 1% | 1% | 2% | 1% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 4% | 0% | 0% |
| WDR-U:TEX: 0% | 41% | 40% | 35% | 41% | 34% |
| GRL-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 3% | 3% | 3% | 3% | 3% |
| GRL-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:SES: 0% | 97% | 97% | 97% | 97% | 97% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 100% | 100% | 100% | 100% | 89% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 0% | 11% |
| BM-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 1% | 1% | 1% | 1% | 1% |
| BM-U:EX2B: 0% | 20% | 19% | 22% | 15% | 18% |
| BM-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 29% | 31% | 28% | 31% | 30% |
| BM-U:SEPJ: 0% | 48% | 49% | 48% | 52% | 50% |
| BM-U:TEX: 0% | 1% | 1% | 0% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 3% | 2% | 3% | 1% | 3% |
| BT-U:EX2B: 0% | 8% | 2% | 10% | 1% | 4% |
| BT-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 40% | 43% | 39% | 44% | 41% |
| BT-U:SEPJ: 0% | 49% | 53% | 48% | 54% | 52% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 8% | 19% | 10% | 23% | 10% |
| CB-U:EX2B: 0% | 22% | 11% | 24% | 3% | 14% |
| CB-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 24% | 25% | 23% | 26% | 26% |
| CB-U:SEPJ: 0% | 46% | 45% | 43% | 48% | 49% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 19% | 2% | 72% | 1% | 26% |
| MSh-U:SEP: 0% | 81% | 98% | 28% | 99% | 74% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 1% | 0% | 0% | 0% | 1% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 5% | 6% | 4% | 6% | 5% |
| PJ-U:EX: 0% | 83% | 84% | 85% | 84% | 83% |
| PJ-U:TEX: 0% | 12% | 10% | 11% | 10% | 11% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 27% |
| SWA-B:CL: 0% | 23% | 2% | 24% | 1% | 20% |
| SWA-C:CL: 0% | 38% | 59% | 42% | 56% | 14% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 5% | 4% | 4% | 7% | 7% |
| SWA-U:SES: 0% | 34% | 35% | 29% | 35% | 33% |
| WDR-A:AL: 0% | 1% | 4% | 1% | 1% | 1% |
| WDR-B:CL: 0% | 18% | 8% | 11% | 8% | 5% |
| WDR-C:OP: 0% | 3% | 1% | 4% | 5% | 11% |
| WDR-D:CL: 0% | 1% | 3% | 7% | 11% | 4% |
| WDR-E:CL: 0% | 0% | 0% | 0% | 1% | 0% |
| WDR-U:DE: 0% | 3% | 0% | 1% | 0% | 1% |
| WDR-U:DEF: 0% | 1% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 1% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 40% | 34% | 25% | 21% | 37% |
| WDR-U:ET: 0% | 0% | 3% | 1% | 1% | 1% |
| WDR-U:EX: 0% | 0% | 0% | 12% | 0% | 0% |
| WDR-U:TEX: 0% | 33% | 47% | 36% | 51% | 38% |

Appendix 13. FINGERS-OF-DEATH WITH 75% SUCCESS RATE MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 1% | 0% | 1% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 1% | 1% | 1% | 0% | 1% |
| BSu-U:EX: 0% | 95% | 94% | 96% | 87% | 95% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 1% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 6% | 1% |
| BSu-U:TE: 0% | 2% | 2% | 2% | 3% | 2% |
| BSu-U:TEX: 0% | 1% | 1% | 1% | 2% | 1% |
| BM-A:AL: 0% | 3% | 1% | 3% | 0% | 2% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 69% | 61% | 66% | 76% | 68% |
| BM-D:OP: 0% | 18% | 15% | 16% | 15% | 19% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 2% | 1% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 6% | 2% | 0% | 0% |
| BM-U:PL: 0% | 3% | 6% | 5% | 0% | 3% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 2% | 2% | 2% | 0% | 1% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 5% | 7% | 5% | 9% | 6% |
| BT-A:AL: 0% | 1% | 0% | 1% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 96% | 78% | 98% | 94% | 93% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 1% | 4% | 0% | 1% | 1% |
| BT-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:PL: 0% | 1% | 15% | 0% | 3% | 3% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|------|------|------|------|------|
| BT-U:SEP: 0% | 1% | 3% | 1% | 2% | 2% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 6% | 6% | 8% | 8% | 5% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 93% | 91% | 91% | 90% | 93% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 1% | 0% | 0% |
| CB-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 0% | 0% | 0% | 1% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 0% | 2% | 0% | 1% | 1% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-B:OP: 0% | 100% | 100% | 100% | 100% | 99% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:EF: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-U:SFE: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 25% | 0% | 25% |
| MSh-U:EX: 0% | 75% | 75% | 75% | 67% | 75% |
| MSh-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:TE: 0% | 25% | 25% | 0% | 33% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-U:EX: 0% | 23% | 21% | 25% | 10% | 19% |
| PJ-U:TEX: 0% | 77% | 79% | 75% | 90% | 81% |
| SWA-A:AL: 0% | 2% | 0% | 2% | 1% | 38% |
| SWA-B:CL: 0% | 35% | 2% | 27% | 3% | 27% |
| SWA-C:CL: 0% | 63% | 97% | 70% | 96% | 33% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 1% | 1% | 1% | 1% | 1% |
| SWA-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-A:AL: 0% | 1% | 4% | 1% | 1% | 1% |
| WDR-B:CL: 0% | 9% | 11% | 10% | 3% | 8% |
| WDR-C:OP: 0% | 6% | 6% | 7% | 6% | 11% |
| WDR-D:CL: 0% | 2% | 3% | 3% | 7% | 6% |
| WDR-E:CL: 0% | 8% | 6% | 2% | 9% | 4% |
| WDR-U:DE: 0% | 3% | 1% | 1% | 2% | 2% |
| WDR-U:DEF: 0% | 0% | 1% | 0% | 0% | 1% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 28% | 30% | 25% | 25% | 30% |
| WDR-U:ET: 0% | 1% | 0% | 2% | 2% | 1% |
| WDR-U:EX: 0% | 3% | 1% | 6% | 0% | 0% |
| WDR-U:TEX: 0% | 40% | 38% | 44% | 46% | 38% |
| GRL-A:AL: 0% | 7% | 0% | 8% | 4% | 4% |
| GRL-B:OP: 0% | 81% | 90% | 84% | 79% | 75% |
| GRL-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EX: 0% | 0% | 0% | 0% | 0% | 1% |
| GRL-U:SES: 0% | 13% | 10% | 7% | 17% | 20% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 100% | 100% | 100% | 89% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 11% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-A:AL: 0% | 2% | 1% | 3% | 0% | 2% |
| BM-B:JT: 0% | 49% | 48% | 49% | 48% | 48% |
| BM-C:OP: 0% | 38% | 41% | 39% | 42% | 39% |
| BM-D:OP: 0% | 3% | 2% | 3% | 3% | 3% |
| BM-E:JT: 0% | 5% | 4% | 4% | 4% | 5% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEPJ: 0% | 0% | 1% | 0% | 0% | 1% |
| BM-U:TEX: 0% | 2% | 3% | 2% | 3% | 2% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 52% | 49% | 53% | 52% | 53% |
| BT-C:CL: 0% | 33% | 32% | 34% | 32% | 30% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 0% | 1% | 0% | 0% | 0% |
| BT-U:EX2B: 0% | 0% | 3% | 0% | 0% | 0% |
| BT-U:PL: 0% | 1% | 1% | 1% | 0% | 1% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 13% | 13% | 10% | 15% | 15% |
| BT-U:SEPJ: 0% | 0% | 1% | 1% | 0% | 1% |
| CB-A:OP: 0% | 6% | 9% | 11% | 11% | 6% |
| CB-B:JT: 0% | 20% | 18% | 19% | 17% | 17% |
| CB-C:OP: 0% | 32% | 31% | 32% | 30% | 31% |
| CB-D:JT: 0% | 33% | 32% | 31% | 30% | 34% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 1% | 2% | 1% | 1% | 0% |
| CB-U:EX2B: 0% | 2% | 1% | 2% | 0% | 0% |
| CB-U:PL: 0% | 2% | 2% | 2% | 2% | 2% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 1% | 2% | 1% | 3% | 4% |
| CB-U:SEPJ: 0% | 2% | 3% | 1% | 5% | 6% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 28% | 2% | 72% | 1% | 23% |
| MSh-U:SEP: 0% | 72% | 98% | 28% | 99% | 77% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 1% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| PJ-B:OP: 0% | 1% | 0% | 1% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 5% | 5% | 5% | 6% | 6% |
| PJ-U:EX: 0% | 83% | 85% | 84% | 84% | 83% |
| PJ-U:TEX: 0% | 12% | 9% | 10% | 10% | 11% |
| SWA-A:AL: 0% | 1% | 0% | 3% | 0% | 40% |
| SWA-B:CL: 0% | 52% | 3% | 38% | 2% | 29% |
| SWA-C:CL: 0% | 47% | 95% | 59% | 97% | 30% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 0% | 1% | 0% | 0% | 1% |
| SWA-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-A:AL: 0% | 0% | 4% | 0% | 0% | 0% |
| WDR-B:CL: 0% | 14% | 14% | 8% | 3% | 7% |
| WDR-C:OP: 0% | 10% | 4% | 5% | 8% | 7% |
| WDR-D:CL: 0% | 0% | 3% | 3% | 1% | 10% |
| WDR-E:CL: 0% | 0% | 0% | 0% | 3% | 1% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 25% | 36% | 38% | 29% | 30% |
| WDR-U:ET: 0% | 0% | 0% | 1% | 1% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 7% | 0% | 0% |
| WDR-U:TEX: 0% | 52% | 40% | 37% | 55% | 45% |

Appendix 14. FINGERS-OF-DEATH WITH 50% SUCCESS RATE MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 1% | 0% | 1% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 1% | 1% | 1% | 0% | 1% |
| BSu-U:EX: 0% | 96% | 94% | 96% | 87% | 95% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 1% | 0% |
| BSu-U:SES: 0% | 0% | 1% | 0% | 6% | 1% |
| BSu-U:TE: 0% | 2% | 3% | 2% | 3% | 2% |
| BSu-U:TEX: 0% | 1% | 1% | 0% | 2% | 1% |
| BM-A:AL: 0% | 2% | 1% | 2% | 0% | 1% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 56% | 57% | 54% | 69% | 54% |
| BM-D:OP: 0% | 18% | 15% | 16% | 15% | 18% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 1% | 2% | 1% | 0% | 2% |
| BM-U:EX2B: 0% | 12% | 12% | 16% | 0% | 13% |
| BM-U:PL: 0% | 4% | 4% | 3% | 0% | 4% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 3% | 3% | 3% | 9% | 3% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 5% | 6% | 4% | 7% | 5% |
| BT-A:AL: 0% | 1% | 0% | 1% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 96% | 94% | 98% | 98% | 96% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 1% | 1% | 0% | 0% | 0% |
| BT-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:PL: 0% | 2% | 3% | 0% | 0% | 1% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|------|------|------|------|------|
| BT-U:SEP: 0% | 1% | 2% | 1% | 1% | 2% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 5% | 7% | 9% | 8% | 5% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 94% | 90% | 90% | 90% | 93% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 0% | 2% | 1% | 1% | 2% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-B:OP: 0% | 72% | 68% | 74% | 70% | 70% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 28% | 32% | 26% | 30% | 30% |
| MR-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |
| MR-U:EF: 0% | 100% | 100% | 100% | 100% | 100% |
| MR-U:SFE: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 25% | 50% | 25% |
| MSh-U:EX: 0% | 0% | 0% | 25% | 0% | 25% |
| MSh-U:SEP: 0% | 100% | 75% | 50% | 50% | 50% |
| MSh-U:TE: 0% | 0% | 25% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-U:EX: 0% | 22% | 20% | 25% | 10% | 20% |
| PJ-U:TEX: 0% | 78% | 80% | 75% | 90% | 80% |
| SWA-A:AL: 0% | 1% | 0% | 2% | 1% | 38% |
| SWA-B:CL: 0% | 33% | 3% | 32% | 3% | 23% |
| SWA-C:CL: 0% | 66% | 94% | 65% | 96% | 36% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 0% | 2% | 1% | 0% | 2% |
| SWA-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-A:AL: 0% | 1% | 4% | 1% | 1% | 1% |
| WDR-B:CL: 0% | 9% | 11% | 10% | 3% | 8% |
| WDR-C:OP: 0% | 6% | 6% | 7% | 6% | 11% |
| WDR-D:CL: 0% | 2% | 3% | 3% | 7% | 6% |
| WDR-E:CL: 0% | 8% | 6% | 2% | 9% | 4% |
| WDR-U:DE: 0% | 3% | 1% | 1% | 2% | 2% |
| WDR-U:DEF: 0% | 0% | 1% | 0% | 0% | 1% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 28% | 30% | 25% | 25% | 30% |
| WDR-U:ET: 0% | 1% | 0% | 2% | 2% | 1% |
| WDR-U:EX: 0% | 3% | 1% | 6% | 0% | 0% |
| WDR-U:TEX: 0% | 40% | 38% | 44% | 46% | 38% |
| GRL-A:AL: 0% | 9% | 1% | 5% | 1% | 3% |
| GRL-B:OP: 0% | 81% | 84% | 84% | 81% | 81% |
| GRL-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 0% | 0% | 0% | 0% | 0% |
| GRL-U:EX: 0% | 1% | 0% | 1% | 1% | 1% |
| GRL-U:SES: 0% | 10% | 15% | 10% | 16% | 14% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 100% | 100% | 100% | 89% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 11% | 0% |
| BM-A:AL: 0% | 2% | 0% | 2% | 0% | 1% |
| BM-B:JT: 0% | 44% | 45% | 45% | 43% | 43% |
| BM-C:OP: 0% | 31% | 33% | 32% | 32% | 31% |
| BM-D:OP: 0% | 3% | 3% | 2% | 2% | 3% |
| BM-E:JT: 0% | 4% | 4% | 4% | 4% | 5% |

| | | | | | |
|---------------|-----|-----|-----|------|-----|
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:PL: 0% | 1% | 0% | 1% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 5% | 5% | 5% | 6% | 6% |
| BM-U:SEPJ: 0% | 8% | 8% | 6% | 10% | 9% |
| BM-U:TEX: 0% | 2% | 2% | 2% | 3% | 2% |
| BT-A:AL: 0% | 0% | 0% | 1% | 0% | 0% |
| BT-B:JT: 0% | 53% | 55% | 51% | 54% | 52% |
| BT-C:CL: 0% | 32% | 28% | 33% | 30% | 30% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 0% | 1% | 1% | 0% | 1% |
| BT-U:EX2B: 0% | 0% | 0% | 2% | 0% | 0% |
| BT-U:PL: 0% | 1% | 1% | 1% | 0% | 1% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 14% | 14% | 11% | 15% | 16% |
| BT-U:SEPJ: 0% | 0% | 1% | 1% | 0% | 1% |
| CB-A:OP: 0% | 4% | 5% | 7% | 7% | 4% |
| CB-B:JT: 0% | 12% | 11% | 11% | 10% | 11% |
| CB-C:OP: 0% | 21% | 21% | 21% | 20% | 20% |
| CB-D:JT: 0% | 24% | 23% | 23% | 21% | 24% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 2% | 7% | 2% | 7% | 3% |
| CB-U:EX2B: 0% | 9% | 3% | 11% | 1% | 3% |
| CB-U:PL: 0% | 1% | 1% | 1% | 1% | 1% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 9% | 10% | 8% | 11% | 12% |
| CB-U:SEPJ: 0% | 18% | 19% | 15% | 21% | 21% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 30% | 1% | 74% | 0% | 17% |
| MSh-U:SEP: 0% | 70% | 99% | 26% | 100% | 83% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 1% |
| PJ-C:OP: 0% | 1% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 3% | 6% | 6% | 6% | 5% |
| PJ-U:EX: 0% | 85% | 85% | 85% | 83% | 83% |
| PJ-U:TEX: 0% | 10% | 9% | 9% | 11% | 12% |
| SWA-A:AL: 0% | 2% | 0% | 3% | 0% | 35% |
| SWA-B:CL: 0% | 40% | 2% | 34% | 2% | 28% |
| SWA-C:CL: 0% | 50% | 87% | 63% | 84% | 29% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 3% | 3% | 1% | 6% | 4% |
| SWA-U:SES: 0% | 5% | 7% | 0% | 8% | 3% |
| WDR-A:AL: 0% | 0% | 1% | 1% | 0% | 3% |
| WDR-B:CL: 0% | 18% | 1% | 8% | 1% | 1% |
| WDR-C:OP: 0% | 5% | 5% | 3% | 3% | 8% |
| WDR-D:CL: 0% | 3% | 1% | 1% | 4% | 7% |
| WDR-E:CL: 0% | 0% | 1% | 0% | 0% | 0% |
| WDR-U:DE: 0% | 3% | 0% | 1% | 1% | 0% |
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 36% | 40% | 32% | 30% | 40% |
| WDR-U:ET: 0% | 0% | 0% | 4% | 0% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 7% | 0% | 0% |
| WDR-U:TEX: 0% | 36% | 49% | 42% | 60% | 41% |

Appendix 15. FINGERS-OF-DEATH WITH 25% SUCCESS RATE MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Red Cliffs and Beaver Dam Wash NCAs.

| Red Cliffs NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 1% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 1% | 0% | 1% | 0% | 1% |
| BSu-U:EX: 0% | 96% | 95% | 96% | 88% | 95% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 1% | 0% |
| BSu-U:SES: 0% | 0% | 1% | 0% | 6% | 1% |
| BSu-U:TE: 0% | 2% | 2% | 2% | 3% | 2% |
| BSu-U:TEX: 0% | 1% | 1% | 1% | 2% | 1% |
| BM-A:AL: 0% | 1% | 0% | 1% | 0% | 1% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 27% | 29% | 27% | 34% | 28% |
| BM-D:OP: 0% | 15% | 11% | 13% | 7% | 14% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 2% | 2% | 1% | 0% | 2% |
| BM-U:EX2B: 0% | 39% | 19% | 44% | 0% | 32% |
| BM-U:PL: 0% | 2% | 2% | 2% | 0% | 2% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 11% | 32% | 9% | 53% | 19% |
| BM-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:TEX: 0% | 3% | 4% | 3% | 5% | 4% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 96% | 96% | 95% | 98% | 94% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 1% | 1% | 1% | 0% | 1% |
| BT-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:PL: 0% | 2% | 1% | 2% | 0% | 2% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BT-U:SEP: 0% | 1% | 2% | 2% | 1% | 3% |
| BT-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-A:OP: 0% | 5% | 6% | 9% | 8% | 5% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 94% | 91% | 90% | 89% | 93% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 1% | 0% | 0% | 1% | 0% |
| CB-U:EX: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX2B: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:PL: 0% | 0% | 0% | 0% | 1% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 1% | 2% | 1% | 2% | 1% |
| CB-U:SEPJ: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-B:OP: 0% | 37% | 34% | 37% | 35% | 34% |
| DSS-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| DSS-U:SEP: 0% | 63% | 66% | 63% | 64% | 66% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 33% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 67% | 0% | 50% | 0% | 0% |
| MSh-U:SEP: 0% | 33% | 67% | 25% | 67% | 50% |
| MSh-U:TE: 0% | 0% | 0% | 25% | 33% | 50% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-U:EX: 0% | 22% | 20% | 24% | 10% | 19% |
| PJ-U:TEX: 0% | 78% | 80% | 76% | 90% | 81% |
| SWA-A:AL: 0% | 2% | 1% | 1% | 0% | 37% |
| SWA-B:CL: 0% | 35% | 4% | 30% | 3% | 28% |
| SWA-C:CL: 0% | 63% | 94% | 69% | 95% | 33% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 1% | 1% | 0% | 2% | 1% |
| SWA-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-A:AL: 0% | 1% | 4% | 1% | 1% | 1% |
| WDR-B:CL: 0% | 9% | 11% | 10% | 3% | 8% |
| WDR-C:OP: 0% | 6% | 6% | 7% | 6% | 11% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| WDR-D:CL: 0% | 2% | 3% | 3% | 7% | 6% |
| WDR-E:CL: 0% | 8% | 6% | 2% | 9% | 4% |
| WDR-U:DE: 0% | 3% | 1% | 1% | 2% | 2% |
| WDR-U:DEF: 0% | 0% | 1% | 0% | 0% | 1% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 28% | 30% | 25% | 25% | 30% |
| WDR-U:ET: 0% | 1% | 0% | 2% | 2% | 1% |
| WDR-U:EX: 0% | 3% | 1% | 6% | 0% | 0% |
| WDR-U:TEX: 0% | 40% | 38% | 44% | 46% | 38% |
| GRL-A:AL: 0% | 6% | 1% | 5% | 1% | 2% |
| GRL-B:OP: 0% | 59% | 66% | 68% | 60% | 64% |
| GRL-U:DP: 0% | 0% | 1% | 0% | 0% | 0% |
| GRL-U:EEX: 0% | 0% | 0% | 1% | 1% | 0% |
| GRL-U:EX: 0% | 0% | 0% | 1% | 1% | 1% |
| GRL-U:SES: 0% | 35% | 32% | 25% | 37% | 32% |

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 100% | 100% | 100% | 89% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 11% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-A:AL: 0% | 1% | 0% | 1% | 0% | 0% |
| BM-B:JT: 0% | 23% | 23% | 23% | 22% | 21% |
| BM-C:OP: 0% | 15% | 15% | 15% | 15% | 15% |
| BM-D:OP: 0% | 1% | 1% | 1% | 1% | 1% |
| BM-E:JT: 0% | 2% | 2% | 2% | 2% | 2% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 0% | 0% | 1% | 0% | 0% |
| BM-U:EX2B: 0% | 1% | 0% | 3% | 0% | 0% |
| BM-U:PL: 0% | 1% | 0% | 1% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 21% | 23% | 20% | 22% | 22% |
| BM-U:SEPJ: 0% | 33% | 34% | 32% | 34% | 35% |
| BM-U:TEX: 0% | 1% | 1% | 1% | 2% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 40% | 40% | 41% | 40% | 37% |
| BT-C:CL: 0% | 29% | 26% | 27% | 26% | 24% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 1% | 0% | 2% | 0% | 1% |
| BT-U:EX2B: 0% | 5% | 0% | 6% | 0% | 3% |
| BT-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 16% | 21% | 15% | 22% | 22% |
| BT-U:SEPJ: 0% | 9% | 11% | 8% | 12% | 13% |
| CB-A:OP: 0% | 2% | 3% | 4% | 3% | 2% |
| CB-B:JT: 0% | 6% | 5% | 6% | 5% | 5% |
| CB-C:OP: 0% | 11% | 10% | 11% | 10% | 10% |
| CB-D:JT: 0% | 12% | 12% | 12% | 11% | 12% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 2% | 10% | 4% | 12% | 5% |
| CB-U:EX2B: 0% | 13% | 5% | 16% | 2% | 5% |
| CB-U:PL: 0% | 1% | 1% | 0% | 1% | 1% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 18% | 19% | 16% | 20% | 21% |
| CB-U:SEPJ: 0% | 34% | 35% | 31% | 37% | 39% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 23% | 2% | 73% | 1% | 17% |
| MSh-U:SEP: 0% | 77% | 98% | 27% | 99% | 83% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-B:OP: 0% | 1% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 0% | 0% | 1% | 1% | 0% |
| PJ-D:OP: 0% | 5% | 6% | 5% | 5% | 6% |
| PJ-U:EX: 0% | 84% | 84% | 85% | 84% | 86% |
| PJ-U:TEX: 0% | 10% | 10% | 10% | 10% | 8% |
| SWA-A:AL: 0% | 1% | 0% | 2% | 0% | 30% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| SWA-B:CL: 0% | 32% | 2% | 30% | 2% | 24% |
| SWA-C:CL: 0% | 41% | 75% | 51% | 68% | 23% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 5% | 4% | 3% | 7% | 6% |
| SWA-U:SES: 0% | 22% | 19% | 13% | 24% | 17% |
| WDR-A:AL: 0% | 3% | 3% | 0% | 3% | 0% |
| WDR-B:CL: 0% | 14% | 3% | 5% | 0% | 4% |
| WDR-C:OP: 0% | 4% | 5% | 1% | 7% | 7% |
| WDR-D:CL: 0% | 0% | 3% | 1% | 3% | 3% |
| WDR-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 3% | 0% |
| WDR-U:DEF: 0% | 0% | 1% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 40% | 38% | 37% | 29% | 42% |
| WDR-U:ET: 0% | 0% | 0% | 3% | 0% | 0% |
| WDR-U:EX: 0% | 3% | 0% | 5% | 0% | 0% |
| WDR-U:TEX: 0% | 37% | 47% | 47% | 56% | 44% |

Appendix 16. No-GRAZING-ONLY MANAGEMENT scenario areas (acre) by vegetation class for ecological systems of the Beaver Dam Wash NCA.

| Beaver Dam Wash NCA | | | | | |
|---|----------|----------|----------|----------|----------|
| Ecological System × Vegetation Class | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 |
| BSu-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-B:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-E:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:DP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:EX: 0% | 100% | 100% | 100% | 100% | 100% |
| BSu-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SEP: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:SES: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| BSu-U:TEX: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-E:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:EX: 0% | 1% | 1% | 1% | 1% | 1% |
| BM-U:EX2B: 0% | 33% | 31% | 34% | 27% | 28% |
| BM-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BM-U:SEP: 0% | 24% | 25% | 24% | 26% | 26% |
| BM-U:SEPJ: 0% | 41% | 42% | 41% | 45% | 44% |
| BM-U:TEX: 0% | 1% | 1% | 0% | 1% | 1% |
| BT-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:EX: 0% | 3% | 2% | 3% | 1% | 4% |
| BT-U:EX2B: 0% | 30% | 22% | 31% | 14% | 23% |
| BT-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| BT-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| BT-U:SEP: 0% | 32% | 37% | 32% | 41% | 35% |
| BT-U:SEPJ: 0% | 36% | 39% | 35% | 44% | 38% |
| CB-A:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-B:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-C:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-D:JT: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:EX: 0% | 3% | 17% | 5% | 23% | 8% |
| CB-U:EX2B: 0% | 34% | 19% | 37% | 6% | 23% |
| CB-U:PL: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SD: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SDI: 0% | 0% | 0% | 0% | 0% | 0% |
| CB-U:SEP: 0% | 22% | 22% | 21% | 24% | 24% |
| CB-U:SEPJ: 0% | 41% | 41% | 37% | 46% | 45% |
| MSh-A:AL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-B:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-C:CL: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-D:OP: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| MSh-U:EX: 0% | 24% | 1% | 75% | 1% | 25% |
| MSh-U:SEP: 0% | 76% | 99% | 25% | 99% | 75% |
| MSh-U:TE: 0% | 0% | 0% | 0% | 0% | 0% |
| PJ-A:AL: 0% | 0% | 0% | 1% | 0% | 0% |
| PJ-B:OP: 0% | 1% | 0% | 0% | 0% | 0% |
| PJ-C:OP: 0% | 1% | 1% | 0% | 1% | 1% |
| PJ-D:OP: 0% | 4% | 5% | 5% | 5% | 5% |
| PJ-U:EX: 0% | 85% | 85% | 85% | 83% | 85% |
| PJ-U:TEX: 0% | 9% | 9% | 10% | 11% | 10% |
| SWA-A:AL: 0% | 1% | 0% | 1% | 0% | 26% |
| SWA-B:CL: 0% | 37% | 2% | 29% | 2% | 19% |
| SWA-C:CL: 0% | 24% | 59% | 36% | 55% | 15% |
| SWA-U:BG: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ES: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:ET: 0% | 0% | 0% | 0% | 0% | 0% |
| SWA-U:SEP: 0% | 17% | 18% | 12% | 22% | 19% |
| SWA-U:SES: 0% | 21% | 21% | 21% | 21% | 21% |
| WDR-A:AL: 0% | 0% | 4% | 0% | 0% | 0% |
| WDR-B:CL: 0% | 14% | 14% | 8% | 3% | 7% |
| WDR-C:OP: 0% | 10% | 4% | 5% | 8% | 7% |
| WDR-D:CL: 0% | 0% | 3% | 3% | 1% | 10% |
| WDR-E:CL: 0% | 0% | 0% | 0% | 3% | 1% |
| WDR-U:DE: 0% | 0% | 0% | 0% | 0% | 0% |

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| WDR-U:DEF: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DET: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:DEX: 0% | 0% | 0% | 0% | 0% | 0% |
| WDR-U:EF: 0% | 25% | 36% | 38% | 29% | 30% |
| WDR-U:ET: 0% | 0% | 0% | 1% | 1% | 0% |
| WDR-U:EX: 0% | 0% | 0% | 7% | 0% | 0% |
| WDR-U:TEX: 0% | 52% | 40% | 37% | 55% | 45% |