Demonstration Project

Fire Regime Condition Class (FRCC) Mapping at Mount Grant, Hawthorne Army Depot

Jeff Campbell, Spatial Solutions, Inc.
and
Louis Provencher and Jan Nachlinger,
The Nature Conservancy of Nevada

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Background

The Great Basin Conservation Initiative is a collaborative effort between Department of Defense and The Nature Conservancy to address conservation planning, strategy development, and implementation on priority areas within the 72 million acre Great Basin ecoregion. In 2003, Hawthorne Army Depot, a 147,236 acres military installation located in the western Great Basin, developed conservation strategies for an identified conservation area in the southern Wassuk Range (Nachlinger 2003). The installation's assessment team was comprised of representatives from Hawthorne Army Depot, Day Zimmermann Hawthorne Corporation (the base operating contractor), U.S. Fish & Wildlife Service, Nevada Division of Wildlife, University of Nevada Reno, Flying M Ranch (BLM public lands permittee holder), Walker River Paiute Tribe, and The Nature Conservancy. The initial conservation assessment of Mount Grant indicated that overall viability of the sagebrush and pinyon woodlands mosaic and Greater Sage-Grouse was fair, while Mount Grant's surface water was good. Importantly, the assessment identified fire suppression/risk of catastrophic fire as the highest threat to the viability of these ecological systems and species. In late 2003, Hawthorne Army Depot agreed to move forward with a demonstration project, funded by DoD's Legacy Resource Management Program, which would map fire regime condition classes of Mount Grant's landscape to prioritize areas for hazardous fuels reduction.

Demonstration Project Overview

Fire managers across diverse landscapes recognize the need to reduce hazardous fuel loads, restore sustainable fire regimes and ecosystems, and decrease the threat of catastrophic wildfires to community values. The USDA Forest Service recently provided national-level, coarse resolution data to address the degree and nature of departure of current vegetation and fuels from historic conditions (Hardy *et al.* 2001, Schmidt *et al.* 2002, Menakis *et al.* 2003). This coarse-scale fire regime condition class (FRCC) data was a significant leap forward in the integration and mapping of biophysical, vegetation, fire occurrence, and community data for the purposes of gaining an ecologically-based perspective on national priorities for resource allocation for fire regime restoration, fuels treatment, and biodiversity conservation. However, while this highly anticipated and relevant coarse-scale data was not intended to be used at scales finer than regions, the lack of similarly available data at finer scales has led to misuse of the coarse data for region- and project-level prioritization and planning. Currently available FRCC data only addresses prioritization between regions and states and not projects. Finer scale data is available for the Northern Rockies and is being developed for the Pacific Northwest, but is not consistent in methods or continuous in extent. The LANDFIRE project for mid scale continuous and consistent mapping of FRCC using remote sensing and gradient modeling is underway, but it is only in a prototype stage that will not lead to completion of the contiguous lower 48 states until 2007-2010 (USDA, USDI 2002). Availability of continuous spatial FRCC and associated data will help instill coordination into the tasks of restoration and fire hazard reduction across multi-ownership landscapes. Consistent, science-based measures of opportunities and risks across all land ownerships is a prerequisite for successful collaborative, multi-partner watershed-scale fire planning.

The FRCC concept is readily being adopted by Congress and land management decision-makers as a useful metric to account for the success of hazardous fuels and ecosystem restoration projects. Locally, issues such as the need to develop a science-based foundation for assessment of interactions between fire regimes and invasive weeds, and conservation of species of local and regional interest (e.g. Greater Sage-Grouse), can be favorably addressed through implementation of the FRCC mapping approach.

Objectives

The objectives of the FRCC assessment were to provide the structure and resources necessary to cooperatively develop data at appropriate scales to directly address key priorities for DoD (Hawthorne Army Depot), including those for mission-related surface watershed management, forest and rangeland health, the National Fire Plan, the Cohesive Implementation Strategy, and biodiversity conservation. Specifically, this collaborative demonstration project was designed to benefit partners with mutual interest and needs to:

- Prioritize hazardous fuels reduction where negative impacts of wildland fire to communities, ecosystems, and biodiversity health are greatest;
- Restore healthy, diverse, and resilient ecological systems to minimize uncharacteristically severe fires on a priority watershed basis through long-term restoration;
- Promote the development and use of the best available science; and,
- Monitor restoration and rehabilitation projects for effectiveness and facilitate multi-party adaptive implementation.

This rapid assessment provided fire regime condition class (FRCC) data for prioritization of fire use, fuel restoration and maintenance projects, development of multi-agency fire management plans, development of conservation area strategies for biodiversity protection, tracking success of restoration strategies, and revision and amendment of resource land management plans. All project cooperators worked together to develop the best quality data possible, while partners and adjoining land managers are benefiting and will continue to benefit from results and implementation of demonstration project findings.

Methods

The Rapid FRCC Assessment process was designed to use the most recent data available. Four primary tasks were undertaken in this project approach. Each of these is described below. The foundation for these methods is recent work in mapping environmental gradients (Keane *et al.* 2002), using reference ecological conditions in ecosystem management (Kaufmann *et al.* 1994; White and Walker 1997; Swetnam *et al.* 1999), and calculating departure of current from reference conditions (Hann *et al.* 2003b). Similar methods were described by Hann (Hann 2003) and McNicoll and Hann (McNicoll and Hann 2003) to classify FRCC at finer project scales.

A flowchart of project methodology is illustrated in Figure 1, and each step is briefly described below.

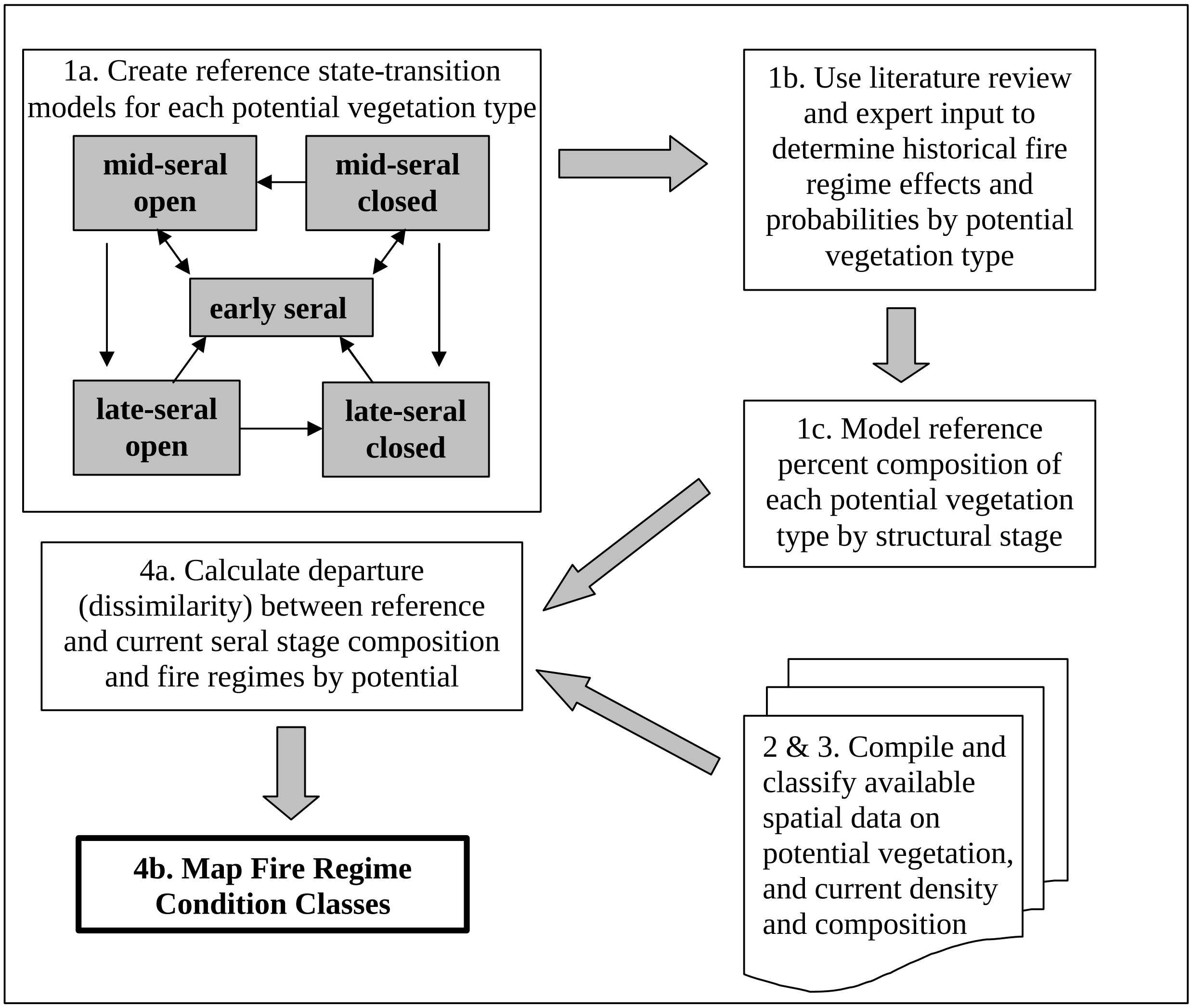

Figure 1. Rapid Fire Regime Condition Class (FRCC) Assessment process (Shlisky and Hann 2003).

Task 1: Identify biophysical types and model reference conditions. Potential natural vegetation types (PNVT) are one type of biophysical classification based on plant species that are indicators of the natural disturbance regime, site climate, and topo-edaphic relationships. Biophysical characteristics that to a large extent control fire regimes and the distribution of vegetation are reflected in the distribution of PNVTs. PNVTs are the foundation for stratification of reference and vegetation-fuel conditions, the development of reference models and calculation of departures between reference and current conditions. The PNVT represents reference condition and is defined as the vegetation that would exist under the historic range of variability (HRV), with natural disturbances, and in the absence of modern human interference (native burning is allowed). Thus, it is the pre-settlement vegetation, but with the current climate. HRV is defined as the distribution of structural vegetation classes (see below) in the pre-settlement landscape. Because quantitative historical data are generally absent for the pre-settlement period, the HRV is modeled—hence the FRCC methodology.

PNVTs for the 45,000 acres of Mount Grant were first obtained from an order III soil survey completed in the 1990s by the Natural Resources Conservation Service (NRCS) for Hawthorne Army Depot (USDA SCS 1991). Order III soil surveys do not map inclusions (ecological sites <10 acres), therefore small ecological systems were imbedded into larger ecological systems (e.g., aspen is included in riparian mountain meadows). The soil survey was downloaded from the NRCS's SSURGO website (www.ftw.nrcs.usda.gov/ssur_data.html) and dominant species matched with ecological range site polygons. All ecological range sites sharing the same dominant species in the upper layer lifeform (e.g., mountain big sagebrush) were lumped into major vegetation types. These major vegetation types became the PNVTs (Table 1).

Table 1. Potential natural vegetation types (PNVT) of Mount Grant and equivalent LANDFIRE ecological systems used to obtain historic range of variability (HRV).

PNVT	LANDFIRE Ecological System and Code
Infrequent Fire Pinyon-Juniper	Juniper Steppe and Pinyon-Juniper Steppe Woodland (infrequent fire) = R2PIJU
Low Sagebrush	Inter-Mountain Basins Montane Sagebrush Steppe (low); mapping zone 16 = 1126low
Curlleaf Mountain Mahogany	Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland; mapping zones 12 and 17 = 1062
Mountain Big Sagebrush (no tree invasion)	Inter-Mountain Basins Montane Sagebrush Steppe = R2SBMT
Wyoming Big Sagebrush with potential for pinyon-juniper invasion	Inter-Mountain Basins Big Sagebrush Shrubland; mapping zones 16, 12, and 17 = 1080
Riparian Mountain Meadow	Rocky Mountain Riparian Herbaceous (mapping zone 16; crosswalk requires interpretation and compromise with old PNVG) = 1164
Mixed Desert Shrub	Intermountain Basins Semi-Desert Shrub Steppe (mapping zone 16) = 1127

Prior to the availability of models and descriptions of ecological system from LANDFIRE (www.landfire.gov), original models were developed by TNC staff using quantitative state-transition models for each PNVT developed with the software Vegetation Dynamics Development Tool (VDDT from ESSA Technologies, Inc.; Beukema and Kurz 2000). In the case of Mixed Desert Shrub, the model was downloaded as-is from the FRCC Guidebook (www.frcc.gov; Hann *et al.* 2003a), which is a collection of coarse-scale PNVTs classified by the Rocky Mountain Research Station Fire Modeling Institute (RMRS FMI) used as the foundation for modeling reference conditions and mapping FRCC. Original FRCC maps for Mount Grant were based on these models. The original models were replaced with new LANDFIRE models from the Great Basin Rapid Assessment and from detailed modeling efforts for zones 16 (Utah High Plateau), 12 (western Great Basin), and 17 (eastern Great Basin). LANDFIRE models were preferred because they were developed and reviewed by experts for a specific region and incorporated the most recent ecological knowledge on estimated successional transition times, fire frequency and severity, and disturbance probabilities between a relatively simple set of structural stages (PNVT classes) expected to occur historically, and representing reference conditions. Structural stages were identified as early development, mid-development open, mid-development closed, late-development open, and late-development closed, or a subset thereof. The terms “seral” and “development” are used interchangeably. This simple classification is consistent with mid-scale spatial data likely to be available for structure and composition. VDDT models were parameterized with reference successional and fire disturbance probabilities and run for 500-1000 years, or until PNVT structural stage composition stabilized.

Because the overlap between the original and LANDFIRE models was high, we only needed to crosswalk the structural vegetation classes (crosswalking was necessary to preserve the original coding for the imagery without incurring huge expenses). The least direct crosswalk, which required interpretation, was between the Riparian Mountain Meadow PNVT and the Rocky Mountain Riparian Herbaceous ecological system (Table 2). The crosswalk for the Wyoming Big Sagebrush with Pinyon-Juniper was direct but the original class names, although preserved for mapping, were not needed (Table 2).

Table 2. Before and after crosswalking potential natural vegetation types (PNVT) to match the LANDFIRE historic range of variability (HRV) with the original satellite coding.

Class	HRV Before Crosswalk (%)	HRV After Crosswalk (%)
	INFREQUENT FIRE PINYON-JUNIPER	
Early	5	5
Mid Closed	5	5
Mid Open	15	15
Late Open	35	35
Late Closed	40	40
	LOW SAGEBRUSH	
Early	10	10
Mid Closed	N/A	N/A
Mid Open	35	35
Late Open	N/A	N/A
Late Closed	55	55
	MOUNTAIN MAHOGANY	
Early	10	10
Mid Closed	15	15
Mid Open	10	10
Late Open	20	20
Late Closed	45	45
	MOUNTAIN BIG SAGEBRUSH	

Class	HRV Before Crosswalk (%)	HRV After Crosswalk (%)
Early	20	20
Mid Closed	N/A	35
Mid Open	45	45
Late Open	N/A	N/A
Late Closed	35	0
	WYOMING BIG SAGEBRUSH WITH PJ	
Early	15	15
Mid Closed	25	25
Mid Open	50	50
Late Open	5	N/A
Late Closed	5	5
Late Wooded	N/A	5
	RIPARIAN MOUNTAIN MEADOW	
Early	5	5
Mid Closed	N/A	70[1]
Mid Open	80[1]	10[1]
Late Open	13[2]	N/A
Late Closed	2[2]	15[2]
	MIXED DESERT SHRUB	
Early	10	10
Mid Closed	40	40
Mid Open	N/A	50
Late Open	50	N/A
Late Closed	N/A	N/A

[1] The 80% class representation for Mid Open was split into classes Mid Closed and Mid Open according to the original PNVG model.
[2] Classes Late Open and Late Closed represent a shrub-dominated condition. Thus, they were combined into the Late Closed class.

The description of each PNVT is provided in seven PDF documents provided in appendix A. These LANDFIRE descriptions include sections on the range, bio-physical setting, vegetation composition, disturbance regimes, comments by experts, structural classes (i.e., early, mid-closed, mid-open, late-open, and late-closed) and their dynamics, and on the mean Fire Return Interval. The VDDT model files that produced the HRV values and mean Fire Return Intervals, including the definition files needed to code the simulation, are provided digitally in a separate accompanying DVD. The VDDT software is Public Domain software that can be downloaded free from www.essa.com. The password to install the software must be obtained from ESSA as per instructions on their website. In order to understand and run the models, the reader should follow instructions by downloading the modeling manual from http://www.landfire.gov/Workshops/RAModelingManualv2.1.pdf.

Task 2: Map PNVTs using existing spatial data. The FRCC assessment process requires the use of available spatial data on current land cover, PNVT and seral/structural stage to refine spatial data layers to mid-scale resolutions (e.g., 30m^2) as well as large-scale resolutions (e.g., $\leq$4m^2). Mapped PNVTs must coincide with models, fire regime characteristics and reference conditions developed in task 1. Lands converted to other uses, such as agriculture or urban development, can be classified as such, or a determination of the PNVT prior to conversion can be made. For this project, a combination of existing NRCS soils data, recent plant community mapping at Mount Grant (Nachlinger 1990), and current vegetative conditions identified from satellite imagery was used to develop and refine a PNVT layer for Mount Grant and the surrounding lands. First, NRCS soil survey polygons were digitized and attributed with the most appropriate PNVT label for each polygon as outlined in the NRCS soils documentation. This effort resulted in an initial draft PNVT layer for the project. To further spatially refine this layer, vegetation information derived from an earlier plant community classification for Mount Grant and the Ikonos satellite imagery acquired for the project was utilized in areas where the scale of the NRCS data did not sufficiently resolve smaller patches of some PNVTs. For example, in many areas along the slopes and drainages of Mount Grant, narrow bands of Mountain Big Sagebrush extended into areas identified only as Low Sagebrush by the NRCS data. It was determined by the 1990 mapping effort (Nachlinger 1990) and local expert ecologists that these narrow bands of Mountain Big Sagebrush were indeed representative of the Mountain Big Sagebrush PNVT and should be mapped as such. The resolution of the Ikonos imagery clearly identified the presence of the Mountain Big Sagebrush. Based on the classification from the satellite imagery, the draft NRCS-based PNVT map was revised to include the more spatially robust Mountain Big Sagebrush characterization. Similar processes were utilized to spatially refine the Pinyon-Juniper, Low Sagebrush, and Mountain Mahogany PNVTs. The result of this process provided a large-scale characterization of PNVTs throughout the Mount Grant study area that more closely and appropriately matched the spatial resolution of the 4m Ikonos satellite imagery.

It is very important to note the significance of utilizing input data for the FRCC process (e.g., PNVT, satellite imagery, etc.) that are of comparable scale. Incorporating data of varying incomparable scales greatly limits the applicability of the FRCC mapping results. If one utilizes very high-resolution satellite imagery to characterize existing conditions and structural stages in conjunction with more coarsely defined PNVT data, for instance, the results are only applicable at the scale of the smallest scale data used in the process. For this reason, it was imperative that the scales/resolution of all input data be comparable for this FRCC mapping effort. Otherwise, it would have been unnecessary and a waste of resources to utilize the more costly high-resolution Ikonos satellite imagery along with the more coarsely defined PNVT data.

Task 3: Classify and map seral/structural stages and canopy cover. Two options were evaluated for completing the task of classifying and mapping seral/structural stages and canopy cover. The options involved acquiring and utilizing different sources and resolutions of base digital satellite imagery for mapping of seral/structural stages and canopy cover. The general process for manipulating the satellite imagery to discern and map the desired features of interest was essentially identical for each source of imagery. The primary difference between the two options, aside from cost, was the spatial resolution of the data and the potential scale at which the resulting data may be applied.

The first imagery option evaluated, Landsat Thematic Mapper (TM), had a spatial resolution of 30m and was most appropriate for more regional analysis and characterization. While the concept of a minimum-mapping-unit (mmu) is not entirely applicable to mapping with raster satellite imagery, a mmu of 3-5 acres is typically what can be realized with Landsat TM-derived mapping efforts. In other words, a patch size for any given fuel type/land cover condition of 3-5 acres is necessary to be adequately resolved and mapped by the 30m resolution satellite imagery. Patch sizes of conditions/land cover smaller than 3-5 acres will likely not be discernable from the Landsat TM imagery and therefore not indicated on the resulting maps.

The second imagery option evaluated the use of high-resolution satellite imagery from the Ikonos satellite (4-meter Multi-spectral) on July 10, 2004 acquired from SpaceImaging Corporation. This high-resolution satellite image sources provided a much more site-specific characterization of the landscape than the more spatially coarse Landsat TM imagery. A minimum-mapping-unit of ¼ to ½ acre can be expected from high-resolution imagery.

Based on the desire to produce the most spatially refined characterization of Fire Regime Condition Class possible for this study area, the 4m Ikonos imagery was selected and utilized for this mapping effort. Figures 2 and 3 show the high-resolution satellite imagery of the Mount Grant area obtained on July 10, 2004 for this demonstration project.

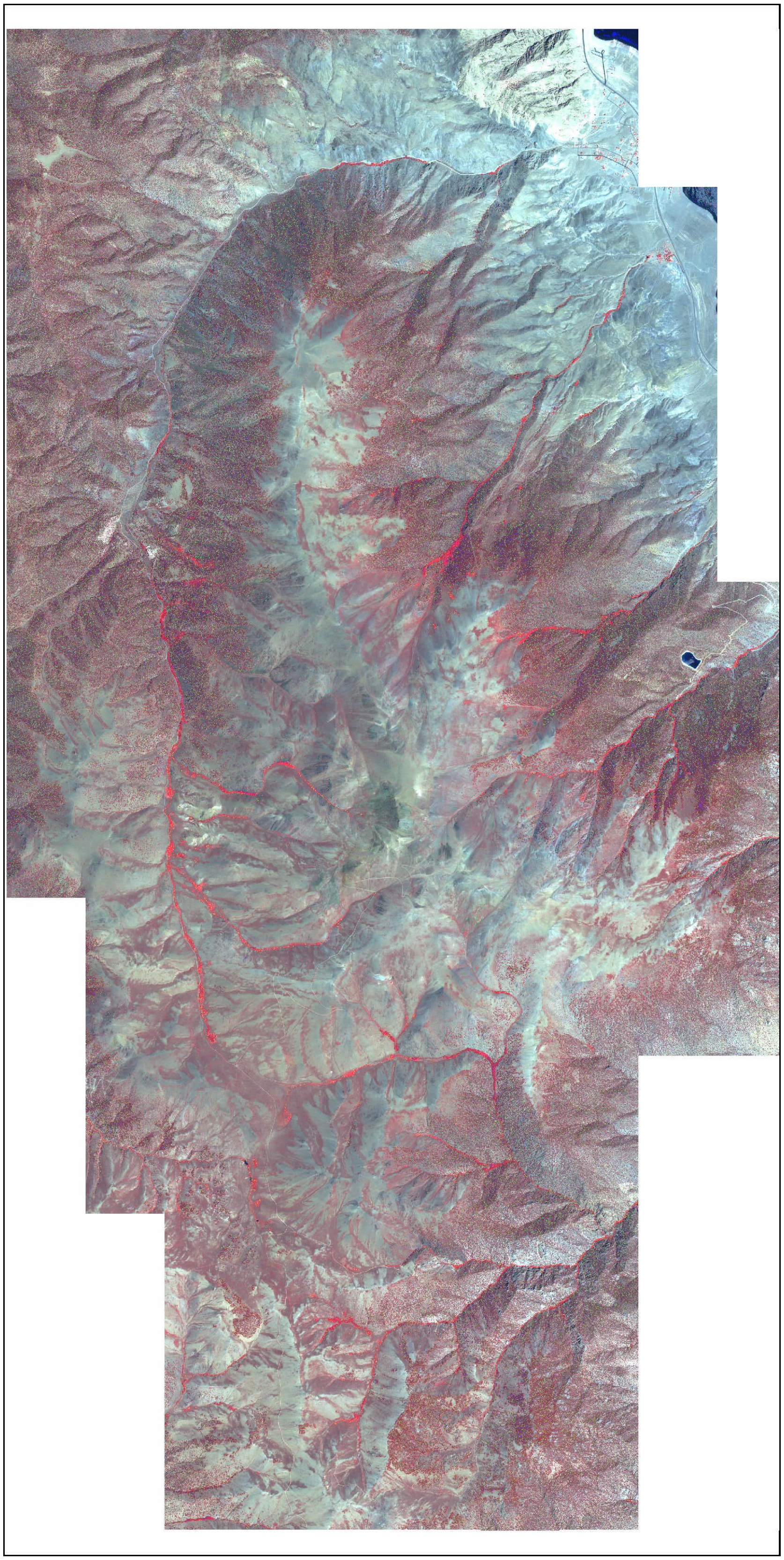

Figure 2. Ikonos satellite imagery of Mount Grant study area (R,G,B) 4,2,1.

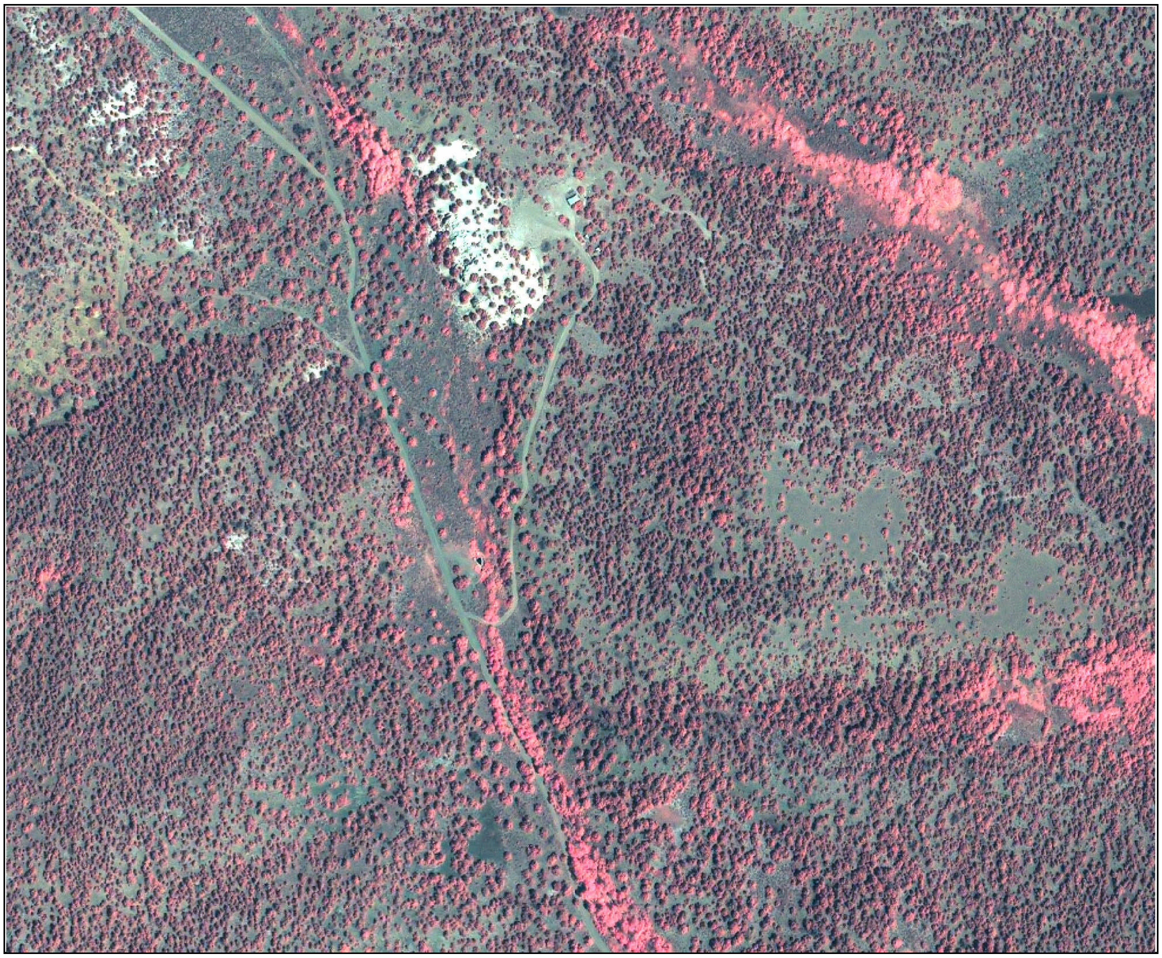

Figure 3. Ikonos satellite imagery of Camp Dixie area (R,G,B) 4,2,1. Visible are Cottonwood Canyon Road, Camp Dixie Road and outbuildings, riparian vegetation (bright red), Pinyon Pine (dark red/maroon), and Wyoming Big Sagebrush communities (blue/gray tones).

The 4m Ikonos satellite imagery was processed to develop a current conditions land cover classification and seral/structural stage map for the study area. For this process to work successfully, seral/structural stages had to coincide with classes used to model reference conditions in task 1. Classification of vegetation structure involved utilizing thematic stratification, unsupervised classification techniques, spatial modeling, and manual editing. Existing GIS data pertaining to current seral stage, size class, structure, or any other pertinent vegetation characterization was evaluated and utilized to map structure where appropriate. This primarily included existing GAP vegetation data; although usefulness of this data for this project was quite limited. For the majority of the assessment, an unsupervised classification of the satellite imagery resulted in spectral classes were evaluated using existing GIS structural data, aerial imagery, field-based data, or any other available ancillary data to determine the relationship between the spectral reflectance characteristics from the satellite imagery and current structure/seral stages. Most importantly, three full days of field data collection from July 29 – 31 was completed. During this field work, specific pre-selected field sites corresponding to specific spectral classes of interest that were identified from the Ikonos imagery were visited. At each field site, a set of digital photos was taken and specific estimations of existing vegetative cover were made to fully characterize the current vegetation type, current vegetative structure (e.g. early-, mid-, late-seral) and current vegetative canopy cover (e.g. open, closed). Armed with this site specific data as well as other more subjective field notes and expert input from TNC ecologists, spectral classes were labeled as “early”, “mid-seral open”, “mid-seral closed”, late-seral open”, or “late-seral closed”. Other ancillary GIS data such as DEM, NRCS soils, and GAP classification data was used to aid in refining the resulting classification through spatial modeling. These models included the use of elevation/aspect zones and current vegetation types to further stratify the spectral classes for more accurate labeling of structure. Also, for areas exhibiting spectral anomalies or known errors that can not be efficiently and effectively corrected through further automated image processing techniques, manual editing was employed to enhance the thematic accuracy of the final structure classification.

Task 4: Calculate and map departure in vegetation/fuels and fire frequency/severity. The departure in vegetation/fuels and fire frequency/severity was calculated by comparing reference seral/structural stage compositions and fire frequency/severity by PNVT to current conditions. The general methodology utilized is described by Hann *et al.* (2003a) and can be applied at any spatial scale.

Specifically for this demonstration, percent area coverage of each structure/density class (e.g., early seral, mid-seral closed, mid-seral open, late-seral closed, late-seral open) for each PNVT was computed from the final structure/density map created through task 3. These percentages indicate the cover of the current vegetative conditions within each PNVT. The current vegetative condition cover percentages were then directly compared to the historic range of variability (HRV) percentages calculated through VDDT modeling as described in task 1 for each PNVT. By summing the lowest of the two area coverage percentages between the HRV and current conditions for each structure/density combination, a measure of “similarity” is obtained. Correspondingly, subtracting this similarity measure from “100” renders a measure of “dissimilarity” between the HRV and current conditions. Dissimilarity measures (i.e., combined vegetation and fire regime departures) ranging from 0-33% are classified as “intact” or unaltered (FRCC 1). Departures ranging from 34-66% and 67-100% are classified as “moderate” (FRCC 2) or “high” (FRCC 3) departure, respectively. By cross-walking dissimilarity measures with the corresponding FRCC class value, a measure of FRCC is derived for each PNVT.

It should be noted that summarizing current condition structure/density values, and therefore, deriving FRCC value, can be accomplished at a variety of scales. For instance, in this project, current condition percentages and FRCC were calculated by PNVT for the entire study area as a whole—that is, the FRCC value calculated for Mountain Big Sagebrush is the same throughout the study area wherever Mountain Big Sagebrush was mapped to currently exist. Another option would have been to summarize current condition structure/density cover percentages and calculate FRCC values using some smaller spatial stratification (e.g., sub-watershed, 1st order hydrologic units, etc.). An approach of this sort would have rendered a more spatially robust characterization of FRCC. One could calculate FRCC utilizing a smaller spatial stratification and using the same current conditions structure/density maps and calculated HRV values that were developed and utilized during this mapping effort.

In addition to the calculation of FRCC across the Mount Grant study area, an additional derivative map was produced from the comparisons of current condition structural/density cover values and HRV values. For every 4-meter pixel in this map, an attribute of "Reduce", "Recruit", or "Maintain" was developed based on the following relationship between current conditions and HRV:

Current Condition %	>	HRV %	?	Reduce
Current Condition %	<	HRV %	?	Recruit
Current Condition %	= (+/- 5%)	HRV %	?	Maintain

This map, referred to as the Action map, provides the user with a spatial representation of a more sensitive measure of the ecological relationship/conformity between each current structural/density stage and its corresponding HRV estimation for each PNVT. The Action map used in conjunction with the FRCC map provides a strong spatial characterization of ecological condition of the study area, as defined by FRCC criteria.

Results

As described throughout the methods section above, final products resulting from this FRCC demonstration project include:

1. Comprehensive digital spatial coverage of Potential Natural Vegetation Types (PNVTs) for the entire Mount Grant study area;
2. Digital raster map of vegetation density cover;
3. Digital raster map of structure/seral stage;
4. Quantified state-transition (VDDT) models of all PNVTs in the study area, useable for future project work (e.g., assessment of relative ecosystem effects of alternative management strategies);
5. Reference values for vegetation and fire regime characteristics for all PNVTs in the study area;
6. Digital raster map of Fire Regime Condition Class (FRCC) depicting departure from "natural" conditions in vegetation/fuels and fire frequency/severity;
7. Digital raster Action map depicting an additional characterization of departure from "natural" conditions; and,
8. Project documentation detailing the methods and results of the demonstration project.

Digital versions of the demonstration products are provided in an accompanying DVD. Examples of each of these spatial and non-spatial data products are provided in the following figures and tables. Figure 4 presents the results of the draft PNVT classification for Mount Grant. This PNVT layer will be peer-reviewed and will be validated in the field during the 2005 field season. An unseasonably early 2004 snowstorm concluded last year's field season before field checking the draft PNVT classification could be accomplished.

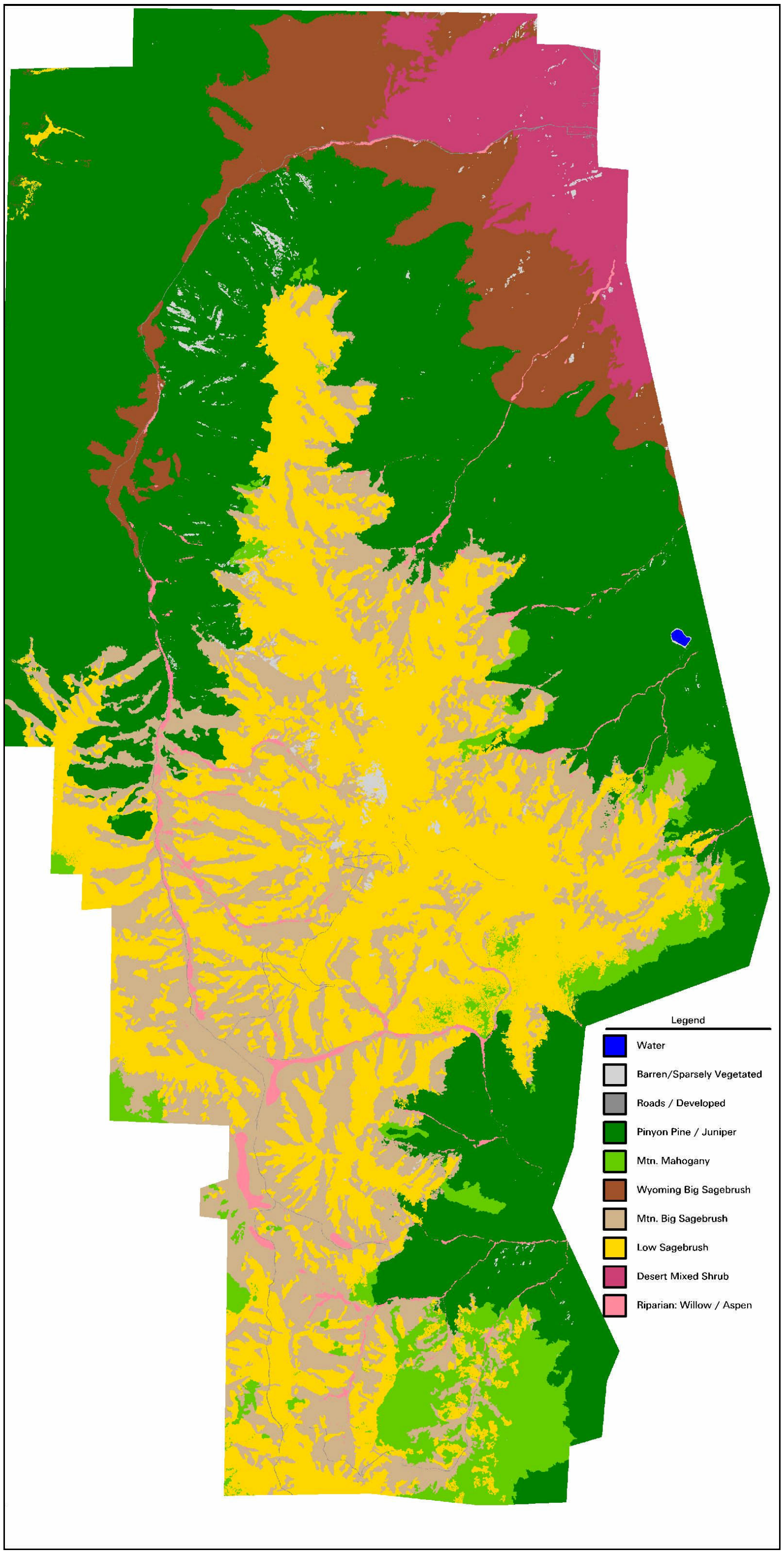

Figure 4. Potential Natural Vegetation Type (PNVT) map developed from NRCS soils data, TNC plant community classification mapping, and Ikonos satellite imagery.

Figure 5 presents results from the current conditions land cover classification developed from the 4m Ikonos satellite imagery.

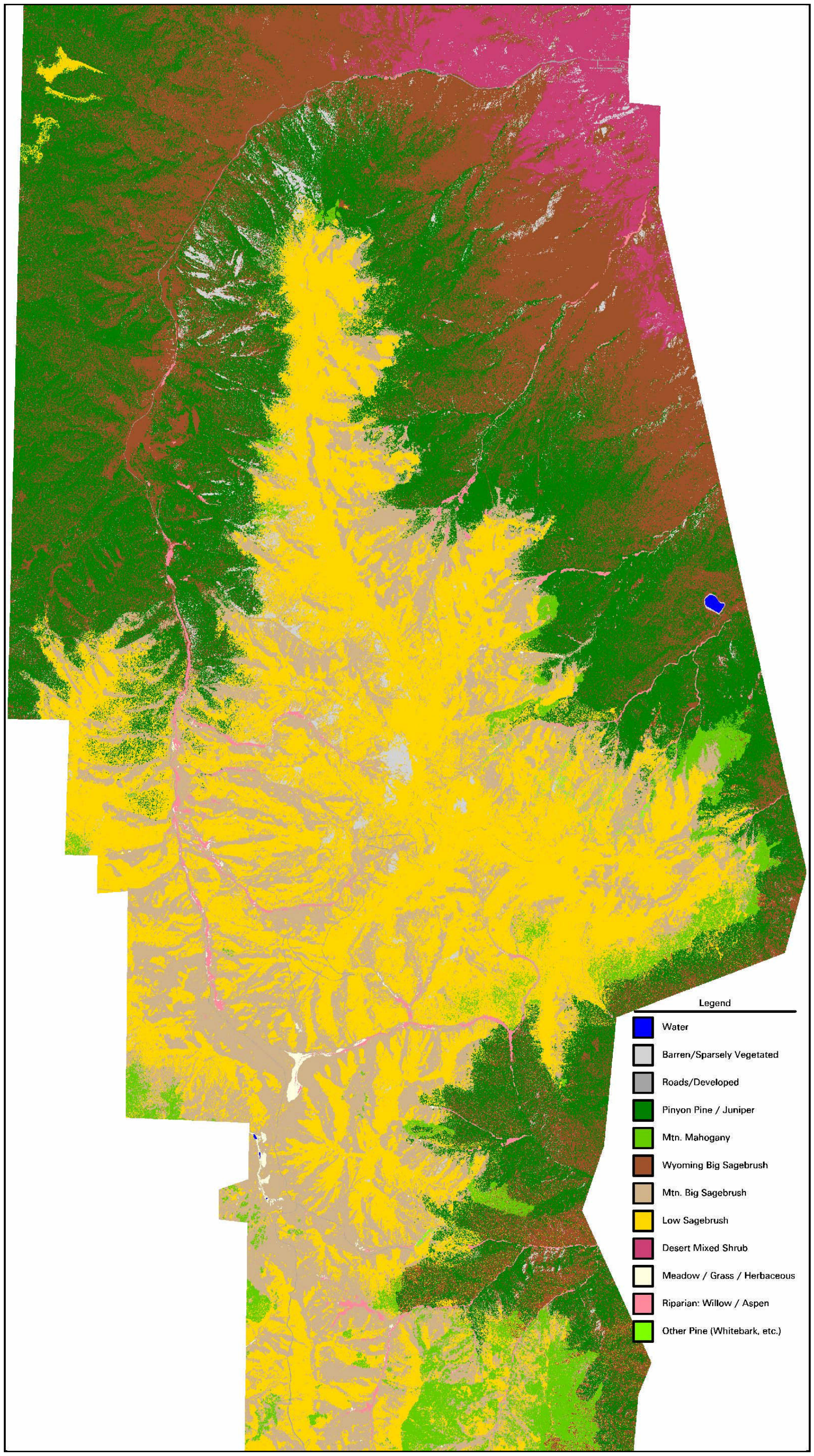

Figure 5. Current Land Cover Classification developed from Ikonos satellite imagery.

Figure 6 presents results from the draft current conditions land cover classification developed from the 4m Ikonos satellite imagery.

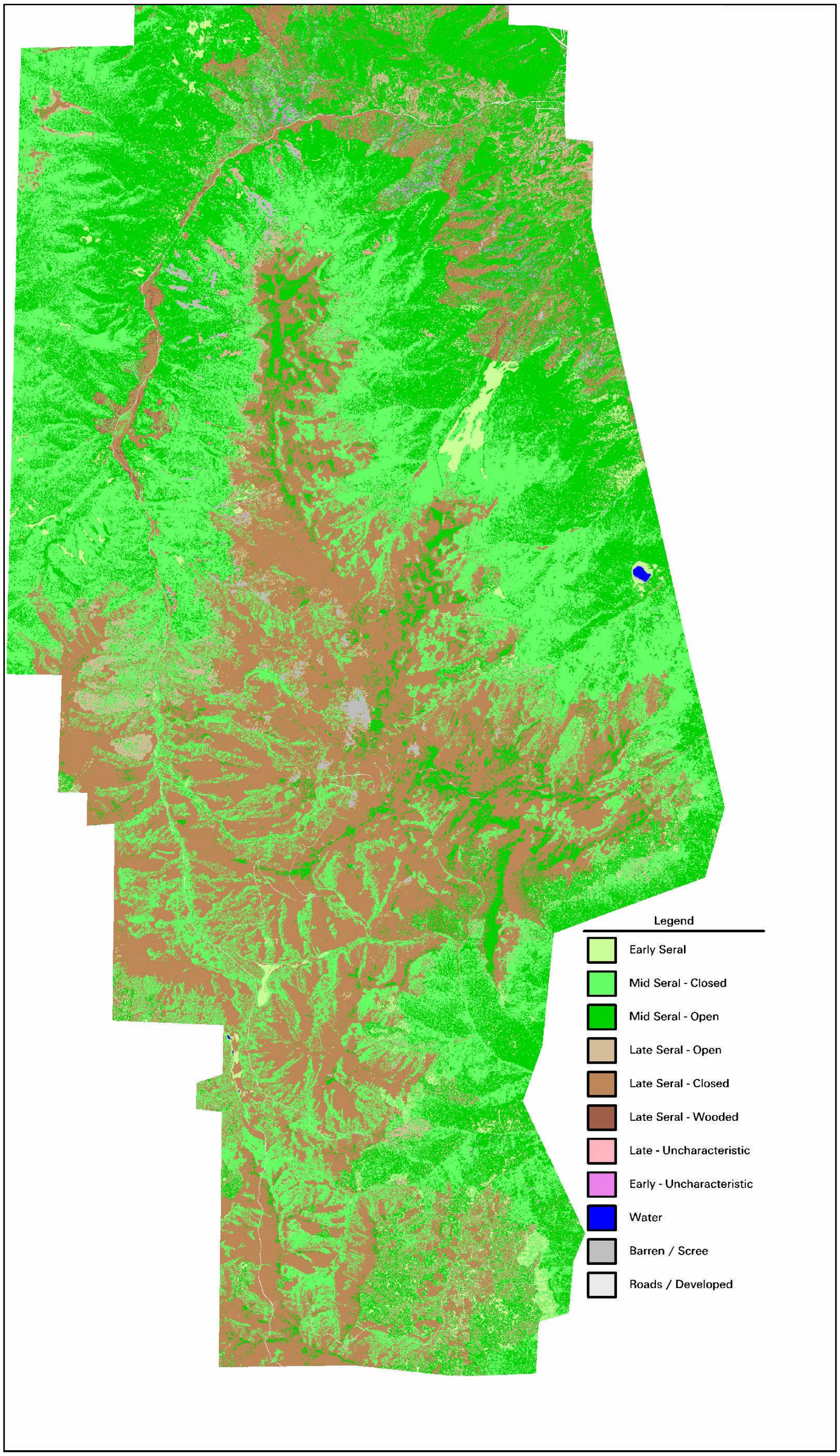

Figure 6. Current Structure/Density Classification developed from Ikonos satellite imagery.

The draft FRCC classification map is presented in Figure 7.

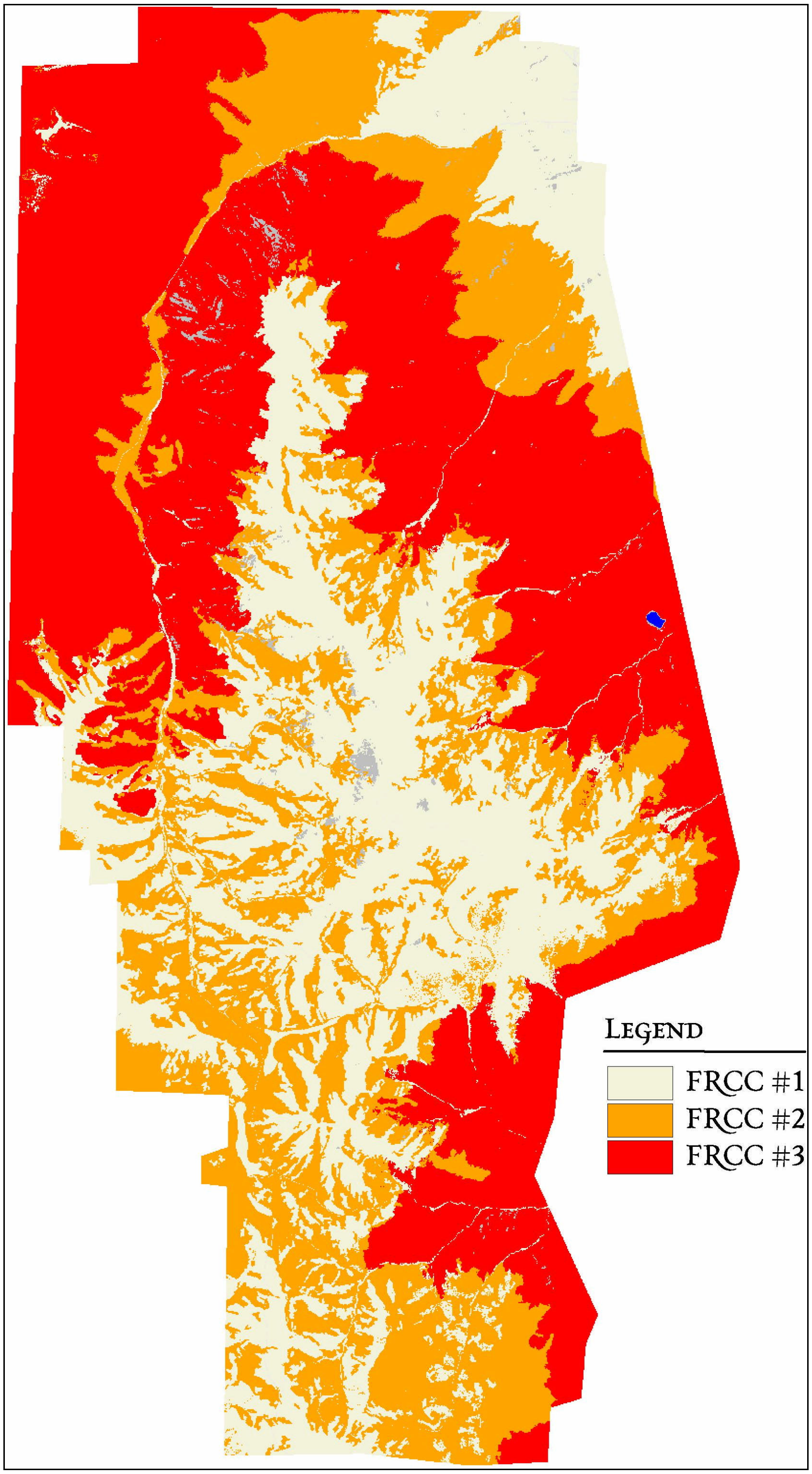

Figure 7. Fire Regime Condition Class (FRCC) Map for Mount Grant study area. FRCC 1 is considered intact, while FRCC 2 and FRCC 3 are interpreted as moderate and high departure from historic range of variability, respectively.

Table 3 contains the full summary of current condition structure/density and HRV cover percentages for each PNVT within the Mount Grant study area.

Table 3. Actual current condition structure/density and cover percentages of historic range of variability (HRV) for each potential natural vegetation type (PNVT) at Mount Grant. Fire regime condition class is given in bottom line where 1 represents intact condition, 2 is moderate departure condition, and 3 is high departure condition.

	Infrequent Fire PJ	Low Sagebrush	Mountain Meadow	Mountain Mahogany	Mountain Big Sagebrush	Wyoming w/PJ	Riparian Mountain Meadow	Mixed Desert Shrub
Early	4.0	0.8		10.7	0.6	6.5	1.4	2.5
Mid Closed	47.5	N/A		22.7	60.8	12.5	57.5	14.9
Mid Open	44.0	12.0		35.6	0.0	38.8	3.5	82.6
Late Open	4.0	N/A	N/A	11.0	N/A	N/A	N/A	N/A
Late Closed	0.5	87.2	N/A	20.0	38.6	38.5	37.6	N/A
Late Wooded (for Wyoming/PJ invasion)	N/A	N/A	N/A	N/A	N/A	3.7	N/A	
Late - Uncharacteristic						0.5		
Early – Uncharacteristic						5.3		
Sum of Lower %s (SIMILARITY)[1]	28.5	67.8		66.0	35.6	66.5	77.4	67.4
DISSIMILARITY	71.5	32.2		34.0	64.4	33.5	22.6	32.6
FRCC	**3**	**1**		**2**	**2**	**2**	**1**	**1**

[1]: Similarity was based on differences between reference values from Table 2 and actual current values provided here.

Table 4. Recommended actions resulting from comparison of current condition structure/density and historic range of variability (HRV) for each potential natural vegetation type (PNVT) at Mount Grant.

	Infrequent Fire PJ	Low Sagebrush	Mountain Meadow	Mountain Mahogany	Mountain Big Sagebrush	Wyoming w/PJ	Riparian Mountain Meadow	Mixed Desert Shrub
Early	MAINTAIN	RECRUIT		MAINTAIN	RECRUIT	RECRUIT	RECRUIT	RECRUIT
Mid Closed	REDUCE	N/A		REDUCE	REDUCE	RECRUIT	RECRUIT	RECRUIT
Mid Open	REDUCE	RECRUIT		REDUCE	RECRUIT	RECRUIT	RECRUIT	REDUCE
Late Open	RECRUIT	N/A	N/A	RECRUIT	N/A	N/A	N/A	N/A
Late Closed	RECRUIT	REDUCE	N/A	RECRUIT	REDUCE	REDUCE	REDUCE	N/A
Late Wooded (for Wyoming/PJ invasion)	N/A	N/A	N/A	N/A	N/A	MAINTAIN	N/A	
Late - Uncharacteristic						REDUCE		
Early - Uncharacteristic						REDUCE		

The draft Action map is presented here in Figure 8.

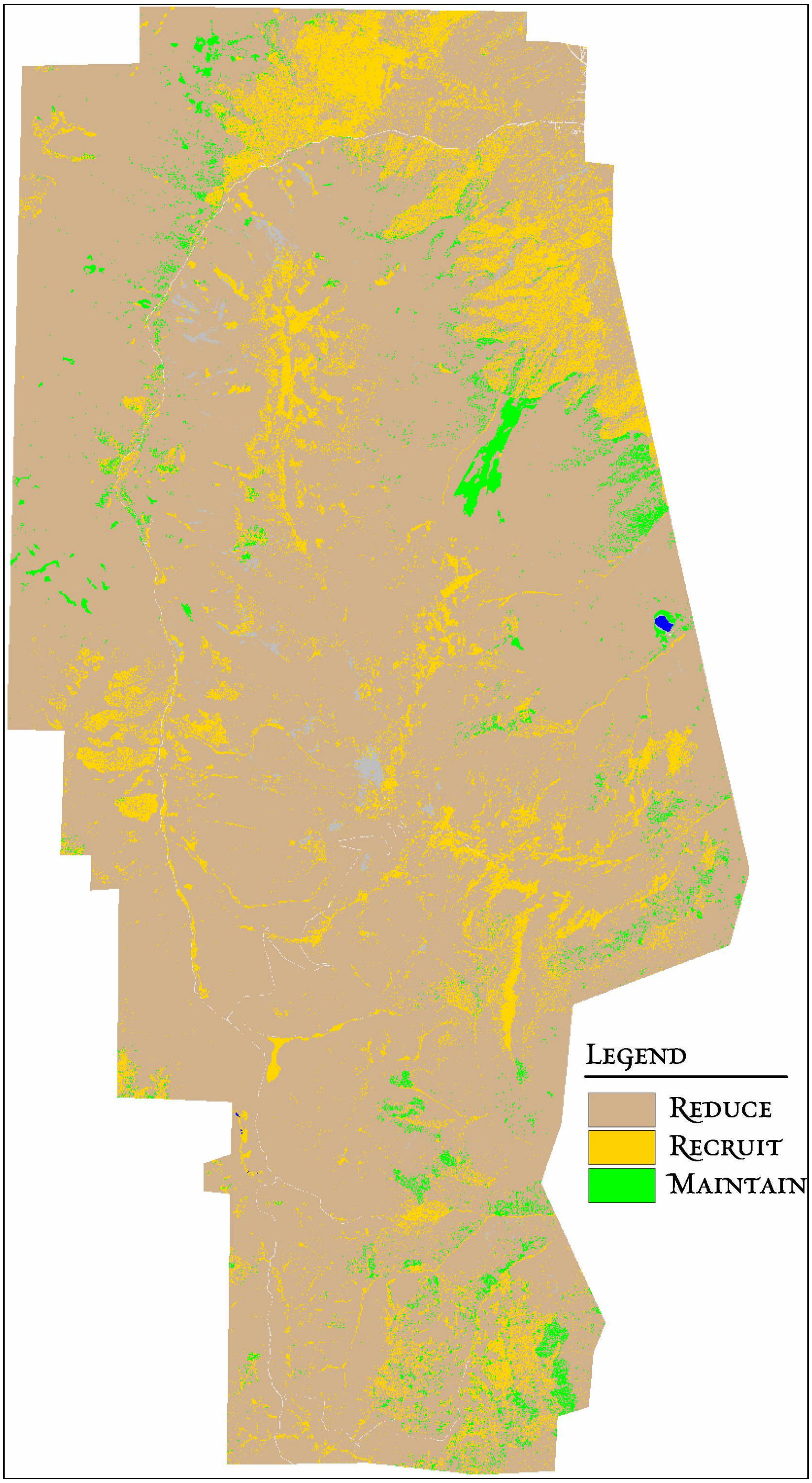

Figure 8. Action Map for Mt. Grant study area.

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Appendix A:

Potential Natural Vegetation Type Descriptions for

Infrequent Fire Pinyon-Juniper
Low Sagebrush
Mountain Mahogany
Mountain Big Sagebrush
Wyoming Big Sagebrush with PJ
Riparian Mountain Meadow
Mixed Desert Shrub

DRAFT Rapid Assessment Reference Condition Model

PNVG: R2PIJU Juniper Steppe and Pinyon-Juniper Steppe Woodland (infrequent)

General Information

Veg Type Woodland **Date** 11/15/2004

Modeler	Steve Bunting	sbunting@uidaho.edu
Modeler	Krista Waid	krista_waid@blm.gov
Modeler	Henry Bastian	henry_bastian@ios.doi.g
Reviewer1	George Gruell	ggruell@charter.net
Reviewer2	Jolie Pollet	jpollet@blm.gov
Reviewer3	Peter Weisberg	pweisberg@cabnr.unr.ed

FRCC

Dominant Species*

JUOS
PIED
JUOC
PIMO

Region

- [ ] *Alaska*
- [ ] *California*
- [x] *Great Basin*
- [ ] *Great Lakes*
- [ ] *Northeast*
- [ ] *Northern Plains*
- [ ] *N-Cent. Rockies*
- [ ] *Pacific Northwest*
- [ ] *South Central*
- [ ] *Southeast*
- [ ] *S. Appalachians*
- [ ] *Southwest*

Geographic Range

This PNVG is found throughout the Great Basin zone. Juniper Steppe generally occurred at the lower elevation portions and transitions into the Pinyon-juniper woodlands at the upper end of its range. Pinyon is not found north of northwestern Nevada (Interstate 80 in Nevada is close to the northern edge of pinyon distribution) and is absent from lower elevations where juniper can tolerate drier conditions (elevation of lower limt varies greatly throughout the Great Basin). Similarly, pinyon is found in pure stands at higher elevations where juniper cannot establish. PNVG is Juniper Pinyon-Infrequent Fire type, scattered throughout the Colorado Plateau, Southern Rockies, and Southwest Desert.

Biophysical Site Description

This type generally occurred on shallow rocky soils, or rock dominated sites that are protected from frequent fire (rocky ridges, steep slopes, broken topography, mesa tops). Anuual precipitation is typically greater than 12 inches, although drier sites (>5 inches) are common in Nevada. Elevation ranges from 4500-8000 feet, but varies greatly from north to south.

Vegetation Description

Since disturbance was uncommon to rare in this PNVG and the overstory conifers may live for over 1000 years, patches were primarily composed of later seral stages (D & E; see below) that did not occur as extensive woodlands, and that should be distinguished from shrubland ecological sites encroached by pinyon or juniper during the last 150 years. It is estimated that 400 years is required for old juniper woodland stands to develop (Romme et al. 2003). In the northwestern portions of the Great Basin zone, no co- dominant pinyon pine occurs with JUOC and here western juniper dominates throughout the entire woodland zone.

Tree overstory of mature woodlands varies across the Great Basin zone and consists of large individuals of Utah juniper (Juniperus osteosperma), western juniper (Juniper occidentalis), oneseed juniper (Juniperus monosperma), pinyon pine (Pinus edulis) and/or single-leaf pinyon (Pinus monophylla). The age structure may vary from uneven to even aged. The overstory cover is normally less that 25%, although it can sometimes be higher (<40%) where pinyon occurs.

Understory shrub cover is less than 5% and composed of various sagebrush species, rabbitbrush, and/or mountain snowberry. Common herbaceous plants include (with regional variation) Idaho fescue, bottlebrush squireltail, needle-and-thread grass, onion grass, Sandberg bluegrass, arrowleaf balsamroot, tapertip hawksbeard, and wild onion. In Utah and Nevada the understory shrub cover consists of various sagebrush species. Herbaceous plants would include Sandberg bluegrass, bottlebrush squireltail, needle-and-thread grass, Idaho fescue (more north), and blue gramma.

Disturbance Description

Uncertainty exists about the fire frequencies of this PNVG, especially since this PNVG groups different types of pinyon-juniper communities for different slopes, exposures, and elevations. Fire occurrence was primarily determined by fire occurrence in the surrounding matrix vegetation. Lightning-ignited fires were common but typically did not affect more than a few individual trees. Replacement fires were uncommon to rare (average FRI of 100-500 yrs) and occurred primarily during extreme fire behavior conditions. Mixed severity fire (average FRI of 100-500 yrs) was characterized as a mosaic of replacement and surface fires distributed through the patch at a fine scale (<0.1 acres). Surface fires could occur in stands where understory grass (FEID) cover is high and provides adequate fuel. Surface fire were primarily responsible for producing fire scars on juniper or pinyon trees (average FRI of 100 yrs).

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Adjacency or Identification Concern

Fire regime primarily determined by adjacent vegetation and spread from the adjacent types into this community.

In modern days, surrounding matrix vegetation has changed to young-mid aged woodlands that burn more intensely than the former sagebrush matrix. Many lay-people confuse these younger piynon and juniper woodlands with true woodlands dependent on naturally fire-protected features.

Scale Description

Juniper/Pinyon-Juniper Steppe was usually distributed across the landscape in patches that range from 10's to 100's of acres in size. In areas with very broken topography and/or mesa landforms this type may have occurred in patches of several hundred acres. In Utah and Nevada pinyon and juniper landscape patches tended to be 10-100's of acres in size.

General Model Source

- [x] Literature
- [x] Local Data
- [x] Expert Estimate

Average Patch Size

- [x] 10's of acres
- [x] 100's of acres
- [ ] 1,000's of acres
- [ ] 10,000's of acres
- [ ] 100,000's of acres
- [ ] 1,000,000's of acres

Sources of Scale Data

- [ ] Literature
- [x] Local Data
- [x] Expert Estimate

Issues/Problem

Experts pointed out that there is much uncertainty in model parameters, particularly the fire regime. Quantitative data is lacking and research is on-going. The literature for this PNVG's fire history is based on the chronologies from other pines species that are better fire recorders, growing under conditions that may not represent fire environments typical of infrequent-fire pinyon and juniper communities. Different experts offered that fire was much more frequent or much less frequent than proposed here and that min and max cover values per class were lower or higher. For example, surface fire, which leaves scars on these other pine species (but not on fire-sensitive pinyon or juniper), has no effect on the dynamics of the model, although surface fire maintains the open structure of classes D and E by thinning younger trees. However, experts argued strongly for less or more surface fire. Because the parameter values of the FRIs for surface fire, mixed severity, and replacement fire are actually comparable to those of surrounding sagebrush systems (see PNVGs for Wyoming big sagebrush, black sagebrush, and dwarf sagebrushes), the proposed FRIs were judged frequent enough and retained. The key parameter was the long FRI of replacement fire in classes D and E. Reducing the FRI from 1,000 yrs to 500 yrs (retained), decreased, respectively, the percent of class E from 65 to 45 but increased, respectively, the percentage of class D from 20 to 35.

Replacement fire in classes B and C cause a transition to A, however, in reality, this type of fire does not topkill perennial grasses. Therefore, succession age in A after these transitions should be greater than 0 and less than 10. In future LANDFIRE modeling, one should consider creating 2 early development classes; one dominated by annual forbs (the result of replacement fire in mature woodlands) succeeding to the other early class after 10 years and the second early development class dominated by perennial grasses (the result of replacement fire in shrub-dominated classes of woodlands), then shrubs later on, succeeding to a shrub-dominated class after 30 years. Overall, results would not be too different, if at all, from current results, but be more ecologically correct.

Comments

Other expert reviewers: Gary Back (gback@srk.com) and William Bryant (wbryant@fs.fed.us).

Vegetation Classes

	Percent	Description of class	Species*	Canopy Cover
Class A Early1 PostRep	5	Initial post-fire community dominated by annual forbs. Later stages of this class contain greater amounts of perennial grasses and forbs. Duration 10 years with succession to B, mid-development closed. Replacement fire occurs every 100 yrs on average, thus resetting to zero the succession clock. Infrequent mixed severity fire (average FRI of 300 yrs) thins vegetation but has no effect on succession age.	EPAN CRAC CRYP SENEC	Min Cover: 2 % Max Cover 10 %

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Class B Mid1 Closed	5	Dominated by shrubs, perennial forbs and grasses. Total cover remains low due to shallow unproductive soil. Duration 20 years with succession to C unless infrequent replacement fire (FRI of 100 yrs) returns the vegetation to A. It is important to note that replacement fire at this stage does not eliminate perennial grasses, thus, in reality, succession age in A after this type of fire would be older than 0 and less than 10. Mixed severity fire (average FRI of 100 yrs) thins the woody vegetation but does not change its succession age.	ARTRV SYOR ACOC3 CRAC	Min Cover: 5 % Max Cover 10 %
Class C Mid1 Open	15	Shrub dominated community with young juniper and pinyon seedlings becoming established. Duration 70 years with succession to D unless replacement fire (average FRI of 200 yrs) causes a transition to A. It is important to note that replacement fire at this stage does not eliminate perennial grasses, thus, in reality, succession age in A after this type of fire would be older than 0 and less than 10. Mixed severity fire as in B.	ARTRV SYOR POSE ACOC3	Min Cover: 11 % Max Cover 20 %
Class D Late1 Open	35	Community dominated by young juniper and pine of mixed age structure. Juniper and pinyon becoming competitive on site and beginning to affect understory composition. Duration 300 years with succession to E unless replacement fire (average FRI of 500 yrs) causes a transition to A. Mixed severity fire is less frequent than in previous states (200 yrs), whereas surface fire every 100 yrs on average becomes more important at this age in succession.	JUOC/JU PIED/PI SYOR FEID	Min Cover: 11 % Max Cover 30 %
Class E Late1 Open	40	Site dominated by widely spaced old juniper and pinyon. Understory depauperate and high amounts of bare ground present. Grasses (e.g., Idaho fescue in more northern or cooler areas) present on microsites sites with deeper soils (>20 inches) with restricting clay subsurface horizon. Potential maximum overstory coverage is greater in those stands with pinyon as compared to those with only juniper. Replacement fire and mixed severity fires are rare (average FRIs of 500 yrs). Surface fire every 100 yrs on average will scar ancient trees. Duration 600+ yrs.	JUOC/JU PIED/PI FEID BASA	Min Cover: 21 % Max Cover 40 %

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Disturbances

Fire Regime Group: 4

Fire Regime Groups
I: 0-35 yr frequency, surface
II: 0-35 yr frequency, replacement
III: 35-100+ yr frequency, mixed
IV: 35-100+ yr frequency, replacement
V: 200+ yr frequency, replacement

Sources of Fire Regime Data

- [ ] Literature
- [ ] Local Data
- [x] Expert Estimate

Fire Intervals

	Ave FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	322	100	1000	0.003106	20
Mixed	217	100	1000	0.004608	29
Surface	126	100	100	0.007937	51
All Fires	64			0.015650	

Fire Intervals (FI):
Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

- [x] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other

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DRAFT Rapid Assessment Reference Condition Model

Biophysical Setting: **1126low** **Inter-Mountains Basins Montane Sagebrush Steppe**

General Information

Contributors

Modeler 1	Louis Provencher	lprovencher@tnc.org	**Reviewer**
Modeler 2			**Reviewer**
Modeler 3			**Reviewer**
			FRCC

Vegetation Type

Shrubland

Date

2/24/2005

Dominant Species

ARAR
ARNO
ARCA
ACTH
PSSP6

General Model Sources

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Map Zones

16
0
0
0
0
0
0
0
0
0

Model Zones

- [ ] Alaska
- [ ] California
- [x] Great Basin
- [ ] Great Lakes
- [ ] Northeast
- [ ] Northern Plains
- [ ] N-Cent.Rockies
- [ ] Pacific Northwest
- [ ] South Central
- [ ] Southeast
- [ ] S. Appalachians
- [ ] Southwest

Geographic Range

Montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies.

Biophysical Site Description

This type is found in subalpine and alpine zones. This ecological system describes low, black, and occasionally silver sagebrush that grow on shallow soils where a root-limiting layer exists. Low sagebrush tends to grow where claypan layers exist in the soil profile and soils are often saturated during a portion of the year. Black sagebrush tends to grow where either a calcareous or volcanic cement layer exists in the soil profile. Elevations range from 1,500 m in eastern Oregon and Washington to over 3,000 m in the southern Rockies.

Vegetation Description

This type includes communities dominated by low sagebrush (Artemisia arbuscula), black sagebrush (Artemisia nova), and, in the Utah High Plateau, silver sagebrush (Artemisia cana). Although these types do not usually grow in combination, they do share similar fire regimes and are considered high-elevation dwarf sagebrushes. Dwarf sagebrushes generally have relatively low fuel loads with low growing and cushion forbs and scattered bunch grasses such as bluebunch wheatgrass (Pseudoroegneria spicata), needlegrasses (Achnatherum spp.), Sandberg's bluegrass (Poa secunda) and Indian ricegrass (Oryopsis hymenoides). Forbs often include buckwheats (Eriogonum spp.), fleabanes (Erigeron spp.), phloxs (Phlox spp.), paintbrushes (Castilleja spp.), globemallows (Sphaeralcea spp.), and lupines (Lupinus spp.).

Disturbance Description

High elevation low sagebrush burns infrequently and burn sizes are small. Low sagebrush is very sensitive to

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

fire. Bare ground acts as a micro-barrier to fire between low statured shrubs. Oils and resins present in the foliage and stems of sagebrush allow fire to spread. Stand-replacing fires (average FRI of 200-240 yrs) can occur in this type when successive years of above average precipitation are followed by an average or dry year under windy conditions. Stand replacement fires dominate in the late successional class where the herbaceous component has diminished. This type fits best into Fire Group V.

Grazing by wild ungulates occurs in this type due to it's high palatability (mostly for A. nova and A. arbuscula) compared to other browse. Native browsing tends to open up the canopy cover of shrubs but does not often change the successional stage.

Adjacency or Identification Concerns

BPS 1126 was separated into two very distinct montane sagebrush steppe not distinguished by NatureServe: Inter-Mountain Basins Montane Sagebrush Steppe dominated by mountain big sagebrush (1126big) and Inter-Mountain Basins Montane Sagebrush Steppe dominated by low sagebrush (1226low). Both systems cover large high-elevation areas in the Intermountain West. Mountain big sagebrush is a tall shrubs with a mean FRI from 10-70 years, whereas high-elevation low sagebrush is a dwarf shrub with a mean FRI of 200+ years. The subalpnie and montane dwarf sagebrush type tends to occur adjacent to mountain big sagebrush steppe. The dwarf sagebrush types create a mosaic within the mountain big sagebrush types, acting as a fire break that burns only under severe conditions. Often, dwarf sagebrush types are the larger community in which mountain big sagebrush are stringers associated with drainages.

It was noted during a VDDT modeling workshop for mapping zones 12 and 17 that BPS 1124 (Columbia Plateau Low Sagebrush Steppe) fits the description for 1126low, but the range description of 1124 does not extend to UT and NV, which is incorrect.

Scale Description

Sources of Scale Data ☑ Literature ☐ Local Data ☑ Expert Estimate

Dwarf sagebrush communities occur from small patches of 10 acres to vast areas of several 1,000 acres on mountain tops and high elevation mountain benches.

Disturbance patch size for this type is not well known but is estimated to be less than 100s of acres due to the limited potential for fire spread.

Issues/Problems

The dominant species in each vegetation class reflect a compilation of species found in the BpS but do not usually occur in the same communities.

Comments

The model for this BpS and description were largely based on the Rapid Assessment PNVG R2SBDW developed by Sarah Heide (Sarah_Heide@blm.gov) and Gary Medlyn (gmedlyn@nv.blm.gov) for dwarf sagebrushes. The high elevation component of R2SBDW is developed here by Louis Provencher. Reviewers of R2SDDW were Michael Zielinski (mike_zielinski@nv.blm.gov), Gary Back (gback@srk.com), and Paul Tueller (ptt@intercomm.com).

Vegetation Classes

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class A 10 %

Early1 PostRep

Description

Early seral community dominated by herbaceous vegetation; less than 6% sagebrush canopy cover; up to 24 years post-disturbance. Replacement fire occurs every 240 yrs on average. Succession to B after 24 years.

Dominant Species* and Canopy Position

PSSP6 Lower
POSE Lower
ACHY Lower
ACTH7 Lower

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model 1

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	6 %
Height	Shrub Dwarf <0.5m	Shrub Dwarf <0.5m
Tree Size Class	None	

- [x] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Herbaceous response post-fire is vigorous and dominant. Scattered shrubs recovering.

Class B 35 %

Mid1 Open

Description

Mid-seral community with a mixture of herbaceous and shrub vegetation; 6 to 10% sagebrush canopy cover present; between 20 to 59 years post-disturbance. Replacement fire (FRI of 240 yrs) causes a transition to A. Succession to class C.

Dominant Species* and Canopy Position

ARAR8 Upper
ARNO4 Upper
ARCA1 Lower
PSSP6 Lower

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	Max
Cover	6 %	10 %
Height	Shrub Dwarf <0.5m	Shrub Dwarf <0.5m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class C 55 %

Late1 Closed

Description

Late seral community with a mixture of herbaceous and shrub vegetation; >10% sagebrush canopy cover present; 75 or more years post-disturbance. In class C, replacement fire is every 200 yrs on average (transition to A). Succession will keep the site in class C without fire.

Dominant Species* and Canopy Position

ARNO4 Upper
ARAR8 Upper
ARCA1 Upper
PSSP6 Lower

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	20 %
Height	Shrub Dwarf <0.5m	Shrub Dwarf <0.5m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class D 0 %

Late1 Open

Description

Dominant Species* and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class	None	

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model 2

Class E **0 %**

Late1 Open

Description

Dominant Species* and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class	None	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model

Disturbances

Fire Regime Group:** 5

Historical Fire Size (acres)

Avg 10

Min 1

Max 100

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	217	100	240	0.00461	100
Mixed					
Surface					
All Fires	217			0.00463	

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

- ☐ Insects/Disease
- ☐ Wind/Weather/Stress
- ☐ Native Grazing
- ☐ Competition
- ☐ Other (optional 1)
- ☐ Other (optional 2)

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

DRAFT Rapid Assessment Reference Condition Model

Biophysical Setting: 1062 **Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland**

General Information

Contributors

Modeler 1	Don Major	dmajor@tnc.org	**Reviewer**
Modeler 2	Chris Ross	c1ross@nv.blm.gov	**Reviewer**
Modeler 3	Louis Provencher	lprovencher@tnc.org	**Reviewer**
			FRCC

Vegetation Type

Shrubland

Date

3/18/2005

Dominant Species

CELE3
ARTR
PUTR2
SYMP

General Model Sources

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Map Zones

16
0
12
0
0
17
0
0
0
0
0

Model Zones

- ☐ Alaska
- ☐ California
- ☑ Great Basin
- ☐ Great Lakes
- ☐ Northeast
- ☐ Northern Plains
- ☐ N-Cent.Rockies
- ☐ Pacific Northwest
- ☐ South Central
- ☐ Southeast
- ☐ S. Appalachians
- ☐ Southwest

Geographic Range

The Curlleaf mountain mahogany (Cercocarpus ledifolius var. intermontanus) community type occurs in the Sierra Nevada and Cascade Range to Rocky Mountains from Montana to northern Arizona, and in Baja California, and Mexico(Marshall, 1995)

Biophysical Site Description

Curlleaf mountain mahogany (Cercocarpus ledifolius var. intermontanus) communities are usually found on upper slopes and ridges between 7,000 to 10,500 ft. elevations (NRCS, 2003), although northern stands may occur as low as 2,000 ft (Marshall, 1995). In western Nevada, curlleaf mountain mahogany may occur down to 5,000 ft or lower and restricted to northwestern and especially northeastern aspects at drier, lower edge of range. Most stands occur on rocky shallow soils and outcrops, with mature stand cover between 10-55%. In fire absence, old stands may occur on somewhat deeper soils, with more than 55% cover.

Vegetation Description

Mountain big sagebrush is the most common codominant with curlleaf mountain mahogany, although chaparral species such as manzanita (Arctostaphylos patula), tobaccobrush (Ceanothus velutinus), and green ephedra (Ephedra viridis) often codominate on some sites. Curlleaf mountain mahogany is both a primary early succssesional colonizer rapidly invading bare mineral soils after disturbance and the dominant long-lived species. Where curlleaf mountain mahogany has reestablished quickly after fire, rabbitbrush (Chrysothamnus nauseosus) may co-dominate. Litter and shading by woody plants inhibits establishment of curlleaf mountaiun mahogany. Reproduction often appears dependent upon geographic variables (slope, aspect, and elevation) more than biotic factors. Low sagebrush and black sagebrush are infrequently associated. Snowberry, Utah serviceberry, and currant are present on cooler sites, with more

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

moisture. Singleleaf pinyon, western juniper, Dougas fir, red fire, white fir, Rocky Mountain juniper, Jeffrey pine, and limber pine may be present, with less than 10% total cover. In old, closed canopy stands,understory may consist largely of prickly phlox (Leptodactylon pungens).

Disturbance Description

Fire: Curlleaf mountain mahogany does not resprout, and is easily killed by fire (Marshall, 1995). Curlleaf mountain mahogany is a primary early succssesional colonizer rapidly invading bare mineral soils after disturbance. Fires are not common in early seral stages, when there is little fuel, except in chaparral. Replacement fires (mean FRI of 100-500 yrs) become more common in mid-seral stands, where herbs and smaller shrubs provide ladder fuels. By late succession, two classes and fire regimes are possible depending on the history of mixed severity and surface fires. In the presence of surface fire (FRI of 50 yrs) and past mixed severity fires in younger classes, the stand will adopt a savanna-like woodland structure with a grassy understory, spiny flox, and currant. Trees can become very old and will rarely show fire scars. In late, closed stands, the absence of herbs and small forbs makes replacement fires uncommon (FRI of 500 yrs), requiring extreme winds and drought, because thick duff provides fuel for more intense fires. Mixed severity fires (mean FRI of 50-200 yrs) are present in all classes, except the late closed one, and more frequent in the mid-development classes.

Ungulate herbivory: Heavy browsing by native medium-sized and large mammals reduces mountain mahogany productivity and reproduction (NRCS, 2003). This is an important disturbance in early, especially, and mid-seral stages, when mountain mahogany seedlings are becoming established. Browsing by small mammals has been documented (Marshall, 1995), but is relatively unimportant and was incorporated as a minor component of native herbivory mortality.

Avian-caused mortality: In western Nevada for ranges in close proximity to the Sierra Nevada, sapsuckers drilling of young curlleaf mountain mahogany has been observed to cause stand replacement mortility (personal communication, Christopher Ross, NV BLM).

Windthrow and snow creep on steep slopes are also sources of mortality.

Adjacency or Identification Concerns

Littleleaf mountain mahogany, Cercocarpus intricatus, is restricted to limestone substrates and very shallow soils in California, Nevada, and Utah. It has similar stand structure and disturbance regime, so the curlleaf mountain mahogany model should be applicable to it. Some existing curlleaf mountain mahogany stands may be in the big sagebrush PNVG, now uncharacteristic because of fire exclusion.

Scale Description

Sources of Scale Data ☑ Literature ☐ Local Data ☑ Expert Estimate

Because these communities are restricted to rock outcrops and thin soils, stands usually occur on a small scale, and are spatially separated from each other by other communities that occur on different aspects or soil types. A few curlleaf mountain mahogany stands may be much larger than 100 acres.

Issues/Problems

Classes B and C are reversed (i.e., class B is mid-development, open).

Data for the setback in succession caused by native grazing are lacking, but consistently observed by experts; in the model, only class A had a setback of -20 for native grazing, whereas no setback was specified for classes B and C, which do not have many seedlings.

Several fire regimes affect this community type. It is clear that being very sensitive to fire and very long-lived would suggest FRG V. This is true of late development classes, but younger classes can resemble

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

more the surrounding chaparral or sagebrush communities in their fire behavior and exhibit a FRG IV. Experts had divergent opinions on this issue; some emphasized infrequent and only stand replacing fires whereas others suggested more frequent replacement fires, mixed severity fires, and surface fires. The current model is a compromise reflecting more frequent fire in early development classes, surface fire in the late, open class, and infrequent fire in the late, closed class.

Comments

BPS 1062 for mapping zones 12 and 17 (additional modelers are Sandy Gregory, s50grego@nv.blm.gov, Julia Richardson, jhrichardson@fs.fed.us, and Cheri Howell, chowell@fs.fed.us) is based on one model modifications (and associated HRV) of BPS 1062 for mapping zone 16 developed by Stanley Kitchen (skitchen@fs.fed.us) and Don Major (dmajor@tnc.org). BPS 1062 for mapping zone 16 was based on R2MTMA with moderate revisions to the original model. Current description is close to original. Original modelers were Michele Slaton (mslaton@fs.fed.us), Gary Medlyn (gmedlyn@nv.blm.gov), and Louis Provencher (lprovencher@tnc.org). Reviewers of R2MTMA were Stanley Kitchen (skitchen@fs.fed.us), Christopher Ross (c1ross@nv.blm.gov), and Peter Weisberg (pweisberg@cabnr.unr.edu).

Data from a thesis in Nevada and expert observations suggests some large mountain mahogany may survive less intense fires. Therefore, surface fires were added as a disturbance to late seral stages, but this is a more recent concept in curlleaf mountain mahogany ecology. Surface fires were assumed to occur on a very small scale, perhaps caused by lightning strikes.

An extensive zone of mixed mountain mahogany and pinyon pine exists in western Nevada and Eastern California, and perhaps elsewhere. This type was not incorporated into the model, and is probably more appropriately included in the pinyon pine model.

Vegetation Classes

Class A **10 %**

Early1 PostRep

Description

Curlleaf mountain mahogany rapidly invades bare mineral soils after fire. Litter and shading by woody plants inhibits establishment. Bunch grasses and disturbance-tolerant forbs and resprouting shrubs, such as snowberry, may be present. Rabbitbrush and sagebrush seedlings are present. Vegetation composition will affect fire behavior, especially if chaparral species are present. Replacement fire (average FRI of 500 yrs), mixed severity (average FRI of 100 yrs), and native herbivory (2 out every 100 seedlings) of seedlings all affect this class. Replacement fire and native herbivory will reset

Dominant Species* and Canopy Position

CELE3 Upper
ARTR2 Upper
CHRYS Upper
SYMPH Upper

Upper Layer Lifeform

- [ ] Herbaceous
- [ ] Shrub
- [x] Tree

Fuel Model 6

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	25 %
Height	Tree Regen <5m	Tree Regen <5m
Tree Size Class	Seedling <4.5ft	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

the ecological clock to zero. Mixed severity fire does not affect successional age. Succession to class B after 20 years.

Class B 10 %

Mid1 Open

Description

Curlleaf mountain mahogany may co-dominante with mature sagebrush, bitterbrush, snowberry, rabbitbrush co-dominant. Few mountain mahogany seedlings are present. Replacement fire (mean FRI is 150 yrs) will cause a transition to class A, whereas mixed severity fire (mean FRI of 50 yrs) will thin this class but not cause a transition to another class. Native herbivory of seedlings and young saplings occurs at a rate of 1/100 seedlings but does not cause an ecological setback or transition. Succession to C after 40 yrs.

Dominant Species* and Canopy Position

CELE3 Upper
ARTR2 Mid-Upper
CHRYS Mid-Upper
SYMPH Mid-Upper

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 8

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	35 %
Height	Tree Regen <5m	Tree Short 5-9m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class C 15 %

Mid1 Closed

Description

Young curlleaf mountain mahogany are common, although shrub diversity is very high. One out of every 1000 mountain mahogany are taken by herbivores but this has no effect on model dynamics. Replacement fire (mean FRI of 150 yrs) causes a transition to class A. Mixed severity fire can result in either maintenance (mean FRI of 80 yrs) in the class or a transition to Class D (mean FRI of 200 yrs).

Dominant Species* and Canopy Position

CELE3 Upper
ARTR2 Low-Mid
PUTR2 Low-Mid
SYMPH Low-Mid

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 8

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	45 %
Height	Tree Regen <5m	Tree Short 5-9m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Various shrub species typically dominate. However, under mixedfire disturbance various grass species may dominate

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class D 20 %

Mid2 Open

Description

Moderate cover of mountain mahogany. This class represents a combined Mid2-Open and Late1/Open cover/strucute resulting from a mixed fire in class C (note: the combined class results in a slightly inflated representation in the landscape). Further, this class describes one of two late-successional endpoints for curlleaf mountain mahogany that is maintained by surface fire (mean FRI of 50 yrs). Evidence of fire scars on older trees and presence of open savanna-like woodlands with herbaceous-dominated understory are evidence for this condition. Other shrub species may be abundant, but decadent. In the absence of fire for 150 yrs (2-3 FRIs for mixed severity and surface fires), the stand will become closed (transition to class E) and not support a herbaceous understory. Stand replacement fire every 300 yrs on average will cause a transition to class A. Class D maintains itself with infrequent surface fire and trees reaching very old age.

Dominant Species* and Canopy Position

CELE3 Upper
ARTR2 Low-Mid
PUTR2 Low-Mid

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	5 %	30 %
Height	Tree Short 5-9m	Tree Medium 10-24m
Tree Size Class	Medium 9-21"DBH	

Upper Layer Lifeform

- [ ] Herbaceous
- [ ] Shrub
- [x] Tree

- [x] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Various shrub species typically dominate. However, under mixed fire disturbance various grass species may dominate.

Fuel Model 8

Class E 45 %

Late2 Closed

Description

High cover of large shrub- or tree-like mountain mahogany. Very few other shrubs are present, and herb cover is low. Duff may be very deep. Scattered trees may occur in this class. This class describes one of two late-successional endpoints for curlleaf mountain mahogany. Replacement fire every 500 yrs on average is the only disturbance and

Dominant Species* and Canopy Position

CELE3 Upper

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	10 %	55 %
Height	Tree Short 5-9m	Tree Medium 10-24m
Tree Size Class	Medium 9-21"DBH	

Upper Layer Lifeform

- [ ] Herbaceous
- [ ] Shrub
- [x] Tree

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model 8

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

causes a transition to class A. Class will become old-growth with trees reported to reach 1000+ years.

Disturbances

Fire Regime Group:** 4

Historical Fire Size (acres)

Avg 50
Min 1
Max 100

Sources of Fire Regime Data

☐ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	285	100	500	0.00351	24
Mixed	149	50	150	0.00671	47
Surface	238	50	200	0.00420	29
All Fires	69			0.01442	

Fire Intervals (FI):
Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

☐ Insects/Disease ☑ Native Grazing ☐ Other (optional 1)
☐ Wind/Weather/Stress ☐ Competition ☐ Other (optional 2)

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

DRAFT Rapid Assessment Reference Condition Model

PNVG: R2SBMT Mountain Big Sagebrush

General Information

Veg Type Shrubland **Date** 11/15/2004

			Dominant Species*	Region	
Modeler	David Tart	dtart@fs.fed.us		☐ Alaska	☐ N-Cent. Rockies
Modeler				☐ California	☐ Pacific Northwest
Modeler			ARTRP	☑ Great Basin	☐ South Central
Reviewer1	Stanley G. Kitchen	skitchen@fs.fed.us	PUTR2	☐ Great Lakes	☐ Southeast
Reviewer2	Michael Zielinski	mike_zielinski@nv.blm.g	SYOR2	☐ Northeast	☐ S. Appalachians
Reviewer3	Gary N. Back	gback@srk.com		☐ Northern Plains	☐ Southwest
FRCC					

Geographic Range

Within the Great Basin, this type occurs in mountain ranges in central and northern Nevada, southern Idaho, Utah, and eastern California. Similar vegetation occurs in Wyoming, Colorado, Oregon, and Washington.

Biophysical Site Description

Within the Great Basin modeling zone, elevation ranges from 4500 feet in Idaho to 10,500 feet in the White Mountains of California (Winward and Tisdale 1977, Blaisdell et al. 1982, Cronquist et al. 1994, Miller and Eddleman 2000). However, elevations are predominantly between 5000 and 9000 feet. Mean annual precipitation is typically between 14 and 22 inches, but ranges from 10 to 30 inches (Mueggler and Stewart 1980, Tart 1996).

This type mostly occupies moist, productive rolling upland sites. Soils are typically deep and have well developed dark organic surface horizons (Hironaka et al. 1983, Tart 1996). However, at the high ends of its precipitation and elevation ranges mountain big sagebrush occurs on shallow and/or rocky soils.

Vegetation Description

This vegetation type is a mosaic of mountain big sagebrush (Artemisia tridentata var. vaseyana and A. tridentata var. pauciflora depending on taxonomy used) and herbaceous communities where tree (conifers) encroachment is unlikely (due to high elevation or soils). Codominant shrubs can include antelope bitterbrush, mountain snowberry, and viscid rabbitbrush. Graminoids are very diverse. Dominant graminoids include Idaho fescue, bluebunch wheatgrass, mountain brome, needlegrasses, slender wheatgrass, bluegrasses, or rough fescue. Among the large number of possible forb species, common forbs may include sulphur buckwheat, pussytoes, lupine, phlox, arrowleaf balsamroot, prairie smoke, and sticky geranium. Mueggler and Stewart (1980), Hironaka et al. (1983), Jensen et al. 1988, and Tart (1996) described several mountain big sagebrush habitat types.

Disturbance Description

Mean fire return intervals in and recovery times of mountain big sagebrush are subjects of lively debate in recent years (Welch and Criddle 2003). Mountain big sagebrush communities were historically subject to stand replacing fires with a mean return interval ranging from 10 years at the Ponderosa pine ecotone, 40+ years at the Wyoming big sagebrush ecotone, and up to 80 years in areas with a higher proportion of low sagebrush in the landscape (Crawford et al. 2004, Johnson 2000, Miller et al. 1994, Burkhardt and Tisdale 1969 and 1976, Houston 1973, Miller and Rose 1995, Miller et al. 2000). Under pre-settlement conditions mosaic burns generally exceeded 75% topkill due to the relatively continuous herbaceous layer. Brown (1982) reported that fire ignition and spread in big sagebrush is largely (90%) a function of herbaceous cover. Mountain big sagebrush communities are also subject to periodic mortality due to insects, diseases, winter kill, rodent outbreaks, and drought (Anderson and Inouye 2001). These disturbances in combination may have significantly reduced the cover of dense stands about every 50 to 100 years.

Recovery rates for shrub canopy cover vary widely in this type, depending post fire weather conditions, abundance of resprouting shrubs, and size and severity of the burn. Mountain big sagebrush typically reaches 5% canopy cover in 8 to 14 years (mean of 12 years). This may take as little as 4 years under favorable conditions and longer that 25 years in unfavorable situations (Pedersen et al. 2003, Miller unpublished data). Mountain big sagebrush typically reaches 25% canopy cover in about 25 years, but an average recovery time of 40 years was used because recovery may take as few as 9 years or as long as 70 years (Winward 1991, Pedersen et al. 2003, Miller unpublished data). Variation in recovery rates is dependent upon burn size and uniformity, survival of residual seed, and upon environmental factors (especially weather). Mountain snowberry and resprouting forms of bitterbrush may return to pre-burn cover values in a few years. Bitterbrush plants less than fifty years old are more likely to resprout than older plants (Simon 1990).

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Adjacency or Identification Concer

This type may be adjacent to forests dominated by aspen, Ponderosa pine, Douglas-fir or lodgpole pine. It also occurs adjacent to pinyon-juniper woodlands. This type probably served as an ignition source for adjacent aspen stands.

At the lower elevation, dry end of the type, mountain big sagebrush could be confused with Wyoming big sagebrush. At the higher elevation, moist end of the type, mountain big sagebrush, while generally recognized as A. tridentata var. vaseyana, could be confused with A. tridentata var. pauciflora and spiked big sagebrush (Artemisia tridentata ssp. spiciformis) or mountain shrub communities characterized by Amelanchier, Prunus, and or Rosa.

Uncharacteristic conditions in this type include herbaceous canopy cover less than 40% and dominance of the herbaceous layer by mulesears (Wyethia amplexcaulis) on clayey soils.

Scale Description

This type occupies areas ranging in size from 10's to 10,000's of acres. Disturbance patch size can also range from from 10,s to 1,000's of acres. The distribution of past burns was assumed to consist of many small patches in the landscape.

General Model Source

- [x] Literature
- [x] Local Data
- [x] Expert Estimate

Average Patch Size

- [x] 10's of acres
- [x] 100's of acres
- [x] 1,000's of acres
- [ ] 10,000's of acres
- [ ] 100,000's of acres
- [ ] 1,000,000's of acres

Sources of Scale Dat

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Issues/Problem

Reviewers and modelers had very differents opinions on the range of mean FRIs and mountain big sagebrush recovery times (see Welch and Criddle 2003). It is increasingly agreed upon that a MFI of 20 years, which used to be the accepted norm, is simply too frequent to sustain populations of Greater Sage Grouse and mountain big sagebrush ecosystems whose recovery time varies from 10-70 years. Reviewers consistently suggested longer FRIs and recovery times. The revised model is a compromise with longer recovery times and FRIs. Modeler and reviewers also disagreed on the choice of FRG: II (modeler) vs. IV (reviewers). In future efforts, this PNVG should be restricted to high elevations where conifer encroachment is unlikely. The PNVG with conifer encroachment is R2SBMTwc.

Comments

The three development classes chosen for this PNVG correspond to the early, mid-, and late seral stages familiar to range ecologists. The depleted or decadent sagebrush condition was considered uncharacteristic of the pre-settlement condition, thus not included.

Resprouting bitterbrush in mountain big sagebrush types is potentially important to wildlife in early stand development.

Vegetation Classes

	Percent	Description of class	Species*	Canopy Cover
Class A Early1 PostRep	20	Herbaceous cover is variable but typically >50% (50-80%). Shrub cover is 0 to 5%. Replacement fire is uncommon during early recovery (average FRI of 80 yrs) and maintains vegetation in A by causing an ecological setback of 12 yrs. Succession to class B after 12 years.	ARTRV PUTR2 SYOR2	Min Cover: 0 % Max Cover 5 %
Class B Mid1 Open	45	Shrub cover 6-25%. Mountain big sagebrush cover up to 20%. Herbaceous cover is typically >50%. Replacement fire occurs with a mean FRI of 40 yrs. Succession to class C after 28 years.	ARTRV PUTR2 SYMPH	Min Cover: 6 % Max Cover 25 %

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Class C Late1 Closed	35	Shrubs are the dominant lifeform. Shrub cover 26-45+%. Herbaceous cover is typically <50%. Insects and disease every 75 yrs on average will thin the stand and cause a transition to class B. Replacement fire is every 50 yrs on average. Succession keeps vegetation in class C.	ARTRV PUTR2 SYMPH	Min Cover: 26 %	Max Cover 45 %
Class D	0			Min Cover: %	Max Cover %
Class E	0			Min Cover: %	Max Cover %

Disturbances

Fire Regime Group: 4

Fire Regime Groups
I: 0-35 yr frequency, surface
II: 0-35 yr frequency, replacement
III: 35-100+ yr frequency, mixed
IV: 35-100+ yr frequency, replacement
V: 200+ yr frequency, replacement

Fire Intervals

	Ave FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	48	15	100	0.020833	100
Mixed					
Surface					
All Fires	48			0.020853	

Fire Intervals (FI):
Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Sources of Fire Regime Data
- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Additional Disturbances Modeled
- [x] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

DRAFT Rapid Assessment Reference Condition Model

Biophysical Setting: 1080 **Inter-Mountain Basins Big Sagebrush Shrubland**

General Information

Contributors

Modeler 1	Don Major	dmajor@tnc.org	**Reviewer**
Modeler 2			**Reviewer**
Modeler 3			**Reviewer**
			FRCC

Vegetation Type

Shrubland

Date

2/22/2005

Dominant Species

ARTR
CHVI8
ACHY
HECO

General Model Sources

☑ Literature
☐ Local Data
☑ Expert Estimate

Map Zones

16
0
0
0
0
0
0
0
0
0

Model Zones

☐ Alaska
☐ California
☑ Great Basin
☐ Great Lakes
☐ Northeast
☐ Northern Plains
☐ N-Cent.Rockies
☐ Pacific Northwest
☐ South Central
☐ Southeast
☐ S. Appalachians
☐ Southwest

Geographic Range

This ecological system is found in western CA, central NV, and UT and is distinct from sagebrush steppe (Inter-Mountain Basins Big Sagebrush Steppe; BPS 1125) found on the Columbia Plateau and in Wyoming.

Biophysical Site Description

This widespread system is common to the Basin and Range province. In elevation it ranges from 3,000 - 7,000 ft, and occurs on well-drained soils on foothills, terraces, slopes and plateaus. It is found on soil depths greater than 18 inches and up to 60+ inches. Elevationally it is found between low elevation salt desert shrub and mountain big sagebrush zones where pinyon and juniper can establish. Occurs from 4 to 14 inch precipitation zones.

Vegetation Description

This ecological system is commonly referred to as Wyoming big sagebrush semi-desert. Shrub canopy cover generally ranges from 5 to 25%, but can exceed 30% at the upper elevation and precipitation zones. Wyoming big sagebrush sites have fewer understory species relative to other big sagebrush types. Rabbit rubberbrush co-dominant. Perennal forb cover is usually <10%. Perennial grass cover may reach 20 - 25% on the more productive sites. Bluebunch wheatgrass may be a dominant species following replacement fires and as a co-dominant after 20 years. Bottlebrush squirreltail and Indian ricegrass are common. Percent cover and species richness of understory are determined by site limitations. Pinyon (generally Pinus monophyla) and juniper (generally Juniper osteosperma) present, infrequently reaching 90% canopy cover in areas that have escaped fire. Wyoming big sagebrush semi-desert is critical habitat for the Greater Sage Grouse and many sagebrush obligates.

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Disturbance Description

This ecological system is characterized by replacement fires where shrub canopy exceeds 25% (60 - 100 years; mean FRI of 100 years) or where grass cover is >15% and shrub cover is > 20% (20 - 60 years; mean FRI of 125 years). Mixed Severity fires account for 20% of fire activity (mean FRI of 500 years) where shrub cover ranges from 10 to 20% (20 - 60 years). Surface fires where shrub cover is <10% (0 - 20 years) and generally uncommon during early development (FRI of 200 years). Where pinyon or juniper has encroached after 100 years without fire, mean FRI of fire replacement increases from 100 to 125 years.

The Aroga moth is capable of defoliating large acreages (i.e., > 1,000 ac; mean return interval of 75 years), but usually 10 to 100 acres.

Weather stress: Prolonged drought (1 in 100 years) on the more xeric sites may reduce shrub cover. Flooding may also cause mortality if the soil remains saturated for an extended period of time (i.e., 1 in 300 year flood events).

Herbivory (non-insect); Herbivory can remove the fine fuels that support Mixed Severity fires and result in woody fuel build up that leads to severe Replacement fires.

Adjacency or Identification Concerns

ID Concerns: This ecological system represents the merging of Basin big sagebrush (R2SBBB) and all Wyoming big sagebrush semi-desert PNVGs from the Rapid Assessment: R2SBW and R2SBWYwt. The NatureServe description of Intermountain Basins Big Sagebrush Shrubland (BPS 1080) includes both Artemesia tridentata spp tridentata AND Artemesia tridentata spp wyomingensis. Strong concerns were voiced that these two big sagebrush species should and can be mapped separately (especially areas currently invaded by adjacent trees).

ID concerns: The NatureServe description of this ecological system does not distinguish between sagebrush systems too low elevation to allow tree invasion (e.g., as Humboldt River drainage of Nevada) and where trees can readily invade under fire exclusion (above 4,500 ft in Nevada). These two types of sagebrush system need to be separated, especially for management of Greater Sage Grouse.

Adjacency concerns: This community may be adjacent to mountain big sagebrush at elevations above 6,500 ft., or adjacent to pinyon-juniper, ponderosa pine, at mid- to high-elevations, and salt desert shrub at low elevations. Low sagebrush or black sagebrush may form large islands within this community where soils are shallow or have root-restrictive layers.

ID Concerns: Post-settlement conversion to cheatgass is common and results in change in fire frequency and vegetation dynamics. Fire suppression can lead to pinyon-juniper encroachment with subsequent loss of shrub and herbaceous understory. Disturbance of this comumunity may result in establishment of annual grasslands (e.g., cheatgrass) and/or noxious weeds. Lack of disturbance can result in pinyon-juniper encroachment where adjacent to pinyon-juniper woodlands.

Scale Description

Sources of Scale Data ☑ Literature ☐ Local Data ☑ Expert Estimate

Historic disturbance (fire) likely ranged from small (< 10 ac) to large (> 10,000 acres) depending on conditions, time since last ignition, and fuel loading. Assumed the average patch size is 250 acres.

Issues/Problems

This ecological system represents the merging of basin big sagebrush (R2SBBB) and all Wyoming big sagebrush ecological systems from the Rapid Assessment: R2SBWY and R2SBWYwt. The NatureServe description of Intermountain Basins Big Sagebrush Shrubland (BPS 1080) includes both Artemesia

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tridentata spp tridentata AND Artemesia tridentata spp wyomingensis. Evaluation of plot-level data was of limited use as no distinction was made between big sagebrush types. Strong concerns were voiced that these two big sagebrush species should and can be mapped separately (especially areas currently invaded by adjacent trees).

There are no data, although abundant opinions, for the percentage of replacement and mixed severity fires, especially during mid-development, or whether surface fires occurred at all during early development under reference (pre-settlement) condition.

Comments

This ecological system is closely based on R2SBWY and R2SBWYwt originally modeled by Gary Back (gback@srk.com) and modified by Louis Provencher (lprovencher@tnc.org) based on reviews by Stanley G. Kitchen (skitchen@fs.fed.us), Peter Weisberg (pweisberg@cabnr.unr.edu), and Jolie Pollet (jpollet@blm.gov). This model assumes the sites are near pinyon-juniper savanna or woodlands and without frequent fire, pinyon or juniper will encroach into the sagebrush range site. In areas without a potential for tree invasion (e.g., lower elevation), the Historic Range of Natural Variability for classes A, B, and C, respectively, is 10%, 55%, and 35% (results of R2SBWY).

The first three development classes chosen for this ecological system correspond to the early, mid-, and late seral stages familiar to range ecologists. The two classes with conifer invasion (classes D and E) approximately correspond to Miller and Tausch's (2001) phases 2 and 3 of pinyon and juniper invasion into shrublands.

Vegetation Classes

Class A 15 %

Early1 PostRep

Description

Post-replacement disturbance; grass dominated with scattered shrubs. Fuel loading discontinuous. Surface fire occurs every 200 years on average but has no effect on succession. Succession to class B after 20 years.

Dominant Species* and Canopy Position

ACHY	Upper
HECOC	Upper
CHVI8	Upper
ARTR	Upper

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 1

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	10 %
Height	Shrub Dwarf <0.5m	Shrub Short 0.5-0.9m
Tree Size Class	None	

☑ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Early development is dominanted by grasses and forbs with scattered shrubs at < 10% cover.

Class B 50 %

Mid1 Open

Description

Shrubs and herbaceous vegetation can be co-dominant, fine fuels bridge the woody fuels, but fuel discontinuities are possible. Replacement fire occounts for 80% of fire activity (mean FRI of 125 years), whereas mixed severity fire

Dominant Species* and Canopy Position

ARTR	Upper
ACHY	Lower
CHVI8	Mid-Upper
HECO2	Lower

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	11 %	25 %
Height	Shrub Dwarf <0.5m	Shrub Short 0.5-0.9m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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occurs every 500 years on average (20% of fire activity) and maintains vegetation in class B. Succession to class C after 40 years.

Class C **25 %**

Mid2 Closed

Description

Shrubs dominate the landscape; fuel loading is primarily woody vegetation. Shrub density sufficient in old stands to carry the fire without fine fuels. Establishment of pinyon and juniper seedlings and saplings widely scattered. Replacement fire (mean FRI of 100 years) and rare flood events (return interval of 333 years) cause a transition to class A. Prolongued drought (mean return interval of 100 years) and insect/disease (every 75 years on average) cause a transition to class B. Succession to class D after 40 years.

Dominant Species* and Canopy Position

ARTR Upper
CHVI8 Mid-Upper
ELEL5 Lower
HECO2 Lower

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	26 %	35 %
Height	Shrub Dwarf <0.5m	Shrub Short 0.5-0.9m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class D **5 %**

Late1 Open

Description

Pinyon-juniper encroachment where disturbance has not occurred for 100+ years (tree species cover <15%). Saplings and young trees are the dominant lifeform. Sagebrush cover (<25%) and herbaceous cover decreasing compared to class C. Replacement fire occurs every 120 years on average. Insect/disease (every 75 years) and prolongued drought (every 100 years) thin both trees and shrubs, causing a transition to class C. Succession to class E after 50 years.

Dominant Species* and Canopy Position

JUNIP Upper
PIMO Upper
ARTR Mid-Upper
HECO2

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	0 %	15 %
Height	Tree Regen <5m	Tree Regen <5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☑ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Shrubs may still represent the dominant lifeform with pinyon and juniper saplings common.

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class E 5 %

Late1 Closed

Description

Shrubland encroached with mature pinyon and/or juniper (cover 16-90%) where disturbance does not occur for 50+ years in Class D. Shrub cover <10% and graminoids scattered. Replacement fire occurs every 125 years on average. Prolongued drought thins trees, causing a transition to class B. Succession from class E to E.

Dominant Species* and Canopy Position

JUNIP	Upper
PIMO	Upper
SYOR	Lower
HECO2	Lower

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 6

Structure Data (for upper layer lifeform)

	Min	Max
Cover	16 %	90 %
Height	Tree Regen <5m	Tree Short 5-9m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Disturbances

Fire Regime Group:** 4

Historical Fire Size (acres)

Avg 500
Min 10
Max 1E+0

Sources of Fire Regime Data

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	137	30	200	0.0073	84
Mixed	1000	20	333	0.001	11
Surface	2500	20	200	0.0004	5
All Fires	115			0.0087	

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

- ☑ Insects/Disease
- ☑ Wind/Weather/Stress
- ☐ Native Grazing
- ☐ Competition
- ☐ Other (optional 1)
- ☐ Other (optional 2)

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

DRAFT Rapid Assessment Reference Condition Model

Biophysical Setting: **1164** **Rocky Mountain Riparian Herbaceous**

General Information

Contributors

Modeler 1 Louis Provencher	lprovencher@tnc.org	**Reviewer**	
Modeler 2		**Reviewer**	
Modeler 3		**Reviewer**	
		FRCC	

Vegetation Type
Grassland

Date
2/24/2005

Dominant Species
DECA
CARE
JUNC
ELTR

General Model Sources
- [x] Literature
- [x] Local Data
- [x] Expert Estimate

Map Zones
16
0
0
0
0
0
0
0
0
0

Model Zones
- [ ] Alaska
- [ ] California
- [x] Great Basin
- [ ] Great Lakes
- [ ] Northeast
- [ ] Northern Plains
- [ ] N-Cent.Rockies
- [ ] Pacific Northwest
- [ ] South Central
- [ ] Southeast
- [ ] S. Appalachians
- [ ] Southwest

Geographic Range

This system is found throughout the Rocky Mountain cordillera from New Mexico north into Montana, and also occurs in mountainous areas of the Intermountain region and Colorado Plateau.

Biophysical Site Description

These are montane to subalpine riparian shrublands occurring as narrow bands of shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels. Generally it is found at higher elevations, but can be found anywhere from 1600-3475 m. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Slope varies from 1-10%. Annual precipitation is from 14-25+ inches. Soils are deep to very deep, mostly cryic, well developed mollic horizon, generally loams, somewhat poorly to very poorly drained.

Vegetation Description

This system often occurs as a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams. The dominant shrubs reflect the large elevational gradient and include Alnus incana, Betula nana, Betula occidentalis, Cornus sericea, Salix bebbiana, Salix boothii, Salix brachycarpa, Salix drummondiana, Salix eriocephala, Salix geyeriana, Salix monticola, Salix planifolia, and Salix wolfii. Generally the upland vegetation surrounding these riparian systems are of either conifer or aspen forests. Common grasses include slender wheatgrass (Elymus trachycaulus), Poa secunda juncifolia(Nevada bluegrass), tufted hairgrass (Deschampsia caespitosa), junegrass (Koeleria macrantha), Columbia needlegrass (Achnatherum nelsonii), oatgrass (Danthonia spp.), mountain brome (Bromus carinatus), alpine timothy (Phleum alpinum), streambank wheatgrass (Elymus lanceolatus), Fendlre's bluegrass (Poa fendleri). Common sedges include Douglas sedge (Carex douglasii), field sedge (Carex praegracilis), Shorthair sedge (Carex exerta), Nebraska

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sedge (Carex nebrascensis), beaked sedge (Carex athrostachya), and smallwing sedge (Carex microptera). Rushes (Juncus spp.) are common.

Disturbance Description

Fire most often occurred in these sites when adjacent shrublands burned. Fires were typically mixed severity (average FRI of 60 yrs) and stand replacement (average FRI of 30 yrs). Fires are less frequent on the more mesic sites of this ecological systems. Burns in these plant community types result from fire started in adjacent upland communities. The fires tend to be less frequent and less severe than surrounding ecological systems. Most species respond favorably to fire.

These sites were prone to flooding during high precipitation, resulting in erosion of topsoil and some short term loss of vegetative cover. In cases of +500-yr flooding event, the site could downcut, thus lower the water table, and favor woody species in an altered state.

Infrequent native grazing has occurred, which may have resulted in heavy defoliation, but was confined to small acreage and generally temporary in nature. Native grazing either maintained an open structure during mid-development or resulted in browse (reversal of woody succession) during later development. Drought cycles likely resulted in a reduction in vegetative cover, production and acreage of these sites. Drought negatively affected woody species. Native Americans likely used these sites for camping and some vegetation collection, while hunting and gathering in adjacent wetlands and upland habitats. Human's likely caused heavy impacts to soils and vegetation in small campsites, but overall impact was light and transitory in nature.

Many of the plant associations found within this system are associated with beaver activity.

Adjacency or Identification Concerns

Found adjacent to wet meadows, wetlands, sagebrush uplands, conifer woodlands, aspen woodlands and broadleaf riparian. Sites adjacent to sagebrush uplands, aspen woodlands and conifer woodlands tended to burn more frequently.

Many of these sites were impacted by introduced grazing animals post-European settlement and have been converted to systems dominated by drought tolerant species. With soil compaction problems these systems move toward an increase in tap-rooted forb species and a decrease in overstory cover. Altered disturbance regimes with livestock grazing, changes in fire frequency, altered water flow and climate change, these sites can move toward brush or tree dominated overstory (sagebrush, mountain brush, conifer).

Scale Description

Sources of Scale Data ☑ Literature ☑ Local Data ☑ Expert Estimate

These sites are generally small and often moist. Fire in these systems is usually introduced from adjacent shrublands or native burning to improve herbaceous understory.

Issues/Problems

Class D in this model is the result of rare downcutting after 500-yr flood events that causes a drop of the water table. Class D, therefore may belong to another vegetation type, such as basin big sagebrush. It was included here to reflect the dynamic geomorphology of riparian systems.

Comments

BPS model and description is R2MGCOws (dry to mesic mountain meadow) developed by Cheri Howell (chowell02@fs.fed.us) and modified by Louis Provencher (lprovencher@tnc.org) for the Great Basin Rapid Assessment. Reviewers on the R2MGCOws were Wayne Padgett (wpadgett@fs.fed.us) and Clinton K. Williams (cwilliams03/@fs.fed.us). R2MGCOws was used as-is.

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Vegetation Classes

Class A 5 %

Early1 PostRep

Description

Post fire, flood or drought early development community. Bare ground is 10 to 40%. Total vegetative canopy cover is 20-80%. Relative forb cover is 20-40%. Relative graminoid cover is 20-80%. Shrub cover is minimal or non-existent. Replacement (FRI of 30 yrs) and mixed severity fires (FRI of 60 yrs) are active at this stage. Rare 500-yr flood events can cause downcutting during the post-fire stage, thus causing a transition to D. Primary succession to B.

Dominant Species* and Canopy Position

CAREX Upper
JUNCU Upper
POA Upper
ELYM Upper

Upper Layer Lifeform

- [x] Herbaceous
- [ ] Shrub
- [ ] Tree

Fuel Model 1

Structure Data (for upper layer lifeform)

	Min	Max
Cover	20 %	80 %
Height	Herb Short <0.5m	Herb Medium 0.5-0.9m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class B 80 %

Mid1 Open

Description

Mostly stable and resilient system. Bare ground is less than 5%. Total canopy cover is 80-100%. Relative cover of grasses is >75%. Relative cover of forbs is 0-25%. Relative cover of willows and other shrubs is 0-5%. Fire follows the regime described in A. Weather and flooding affect this sytem in three different ways: 1) Recurring drought with a 100-yr return interval will thin vegetation and keep this state open; 2) The site will be scoured, but not downcut, by 100-yr flood events causing a transition to A; and 3) Rare 1000-yr flooding events will cause a downcut and alteration of the site towards a more permanent woody condition (D). Native grazing on 1% of the area will maintain the open structure of the PNVG. Succession is from class B to B,

Dominant Species* and Canopy Position

CAREX Upper
JUNCU Upper
ELYM Upper
POA Upper

Upper Layer Lifeform

- [x] Herbaceous
- [ ] Shrub
- [ ] Tree

Fuel Model 1

Structure Data (for upper layer lifeform)

	Min	Max
Cover	80 %	100 %
Height	Herb Short <0.5m	Herb Medium 0.5-0.9m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

however the site will transition to class C in the absence of fire for 40 yrs.

Class C **13 %**

Late1 Open

Description

This system differs from mid-open by an increase in the shrub cover component. Bare ground is <5%. Although total canopy cover is 100+%, the classe's structure is determined by shrub cover. Relative cover of grasses is >65%. Relative cover of forbs is 0-25% Relative cover of shrubs (most frequently willow, but also currant, wild rose, chokecherry, conifer, broadleaf trees) is 5-10%. These sites tend toward meadows, but without disturbance will have some increase in woody vegetation. Replacement fire (mean FRI of 30 yrs) will cause a transition to A whereas mixed severity fire will remove the woody component, thus returning the burn area to class B. Weather and flooding function as in class B, except that drought will selectively kill woody species and cause a transition to class B. Native grazing affects more negatively woody species (browse), thus also resulting in a transition to class B. The site will succeed to itself.

Dominant Species* and Canopy Position

CAREX Lower
JUNCU Lower
GRASS Lower
SALIX Upper

Upper Layer Lifeform

☐ Herbaceous
☑ Shrub
☐ Tree

Fuel Model 1

Structure Data (for upper layer lifeform)

	Min	Max
Cover	5 %	10 %
Height	Shrub Dwarf <0.5m	Shrub Medium 1.0-2.9m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class D **2 %**

Late1 Closed

Description

This class is an altered state, which is a result of downcutting of the stream channel and of prolonged drought (rare event) which dries out the site resulting in a shrub or tree cover type (10-60% relative cover) with a grassland understory. Therefore, this class is only included here because this PNVG is broad, but the class may be more accurately placed within the basin big sagebrush PNVG if the site's potemtial is truly changed by downcutting. Replacement fire will return the site to class A (FRI of 30 yrs) and mixed severity fire (FRI of 60 yrs) will open the stand, but not chage its woody nature (i.e., transition to class C). The site succeeds to itself without disturbance.

Dominant Species* and Canopy Position

ARTR2	Middle
PIMO	Upper
POSE	Lower
ELTRT	Lower

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	Max
Cover	10 %	60 %
Height	Herb Short <0.5m	Shrub Tall >3.0 m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class E **0 %**

Late1 Closed

Description

Dominant Species* and Canopy Position

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	%
Height		
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Disturbances

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Fire Regime Group:** 2

Historical Fire Size (acres)

Avg 10
Min 1
Max 50

Sources of Fire Regime Data

- ☑ Literature
- ☑ Local Data
- ☑ Expert Estimate

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	31	15	45	0.03226	66
Mixed	59	30	90	0.01695	34
Surface					
All Fires	20			0.04922	

Fire Intervals (FI):
Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

- ☐ Insects/Disease
- ☑ Wind/Weather/Stress
- ☑ Native Grazing
- ☐ Competition
- ☐ Other (optional 1)
- ☐ Other (optional 2)

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DRAFT Rapid Assessment Reference Condition Model

Biophysical Setting: **1127** — **Intermountain Basins Semi-Desert Shrub Steppe**

General Information

Contributors

Modeler 1	Jim Bowns	bowns_je@suu.edu	**Reviewer**
Modeler 2	Don Major	dmajor@tnc.org	**Reviewer**
Modeler 3	Beth Corbin	ecorbin@fs.fed.us	**Reviewer**
			FRCC

Vegetation Type

Shrubland

Date

3/2/2005

Dominant Species

ARTRt
ARTR
ATCA
ACHY
PSSP6

General Model Sources

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Map Zones

16
0
0
0
0
0
0
0
0
0

Model Zones

- [ ] Alaska
- [ ] California
- [x] Great Basin
- [ ] Great Lakes
- [ ] Northeast
- [ ] Northern Plains
- [ ] N-Cent.Rockies
- [ ] Pacific Northwest
- [ ] South Central
- [ ] Southeast
- [ ] S. Appalachians
- [ ] Southwest

Geographic Range

This ecological system occurs throughout the Intermountain West from the western Great Basin to the northern Rocky Mountains and Colorado Plateau.

Biophysical Site Description

Found at elevations ranging from 300 m up to 2500 m. The climate where this system occurs is generally hot in summers and cold in winters with low annual precipitation, ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variation. Sites are generally alluvial fans and flats with moderate to deep soils. Some sites can be flat, poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (West 1983). Substrates are generally shallow, calcareous, fine-textured soils (clays to silt-loams), derived from alluvium; or deep, fine to medium-textured alluvial soils with some source of sub-irrigation during the summer season. Soils may be alkaline and typically moderately saline (West 1983). Some occurrences occur on deep, sandy soils, or soils that are highly calcareous (Hironaka et al. 1983).

Vegetation Description

This semi-arid shrub-steppe is typically dominated by grasses at more than 25% cover. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layer. Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some stands. The plant associations in this system are characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of Artemisia filifolia, Ephedra cutleri, Ephedra nevadensis, Ephedra torreyana, Ephedra viridis, Ericameria nauseosa, Chrysothamnus viscidiflorus, Gutierrezia sarothrae,

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Sarcobatus vermiculatus, or Atriplex canescens. Other shrubs occasionally present include Purshia tridentata and Tetradymia canescens. Artemisia tridentata may be present but does not dominate. Trees are very rarely present in this system, but some individuals of Pinus ponderosa, Juniperus scopulorum, Juniperus occidentalis, or Cercocarpus ledifolius may occur. The herbaceous layer is dominated by bunch grasses which occupy patches in the shrub matrix. The most widespread species is Pseudoroegneria spicata, which occurs from the Columbia Basin to the northern Rockies. Other locally dominant or important species include Sporobolus airoides, Leymus cinereus, Festuca idahoensis, Pascopyrum smithii, Bouteloua gracilis, Distichlis spicata, Pleuraphis jamesii, Elymus lanceolatus, Elymus elymoides, Koeleria macrantha, Muhlenbergia richardsonis, Hesperostipa comata, and Poa secunda. Forbs are generally of low importance and are highly variable across the range, but may be diverse in some occurrences. Species that often occur are Symphyotrichum ascendens (= Aster adscendens), Collinsia parviflora, Penstemon caespitosus, Achillea millefolium, Erigeron compositus, Senecio spp, and Taraxacum officinale. Other important genera include Astragalus, Oenothera, Eriogonum, and Balsamorhiza.

Disturbance Description

Replacement fire is rare, modeled as occuring at 250-yr return in mid-seral stage and 200-yr return interval in early and late seral. Mixed fire modeled in the mid-seral stage at 100-yr return, which does not change its seral stage. Drought occurs frequently (10-yr return for all seral stages), but does not change seral stage. The Aroga moth can affect sagebrush (100-yr return in mid-seral, 50-yr return in late seral), but does not change serals stage. A wood borer may affect Atriplex, without changing seral stage.

Adjacency or Identification Concerns

This ecological system is transitional between mixed salt desert shrub and Wyoming big sagebrush. Separates from greasewood and saltbrush types because they will be on saline soils. This type is somewhat lower elevation and drier than the sagebrush semi-desert (BPS 1080; Intermountain Basins Big Sagebrush Shrubland). Differs from Intermountain Basins Big sagebrush Steppe in 1127 being somewhat farther south and drier.

Scale Description

Sources of Scale Data ☐ Literature ☐ Local Data ☑ Expert Estimate

The BPS can occupy fairly large areas (1000s to 10,000 acres). Disturbance patch size within the type are generally 100s of acres.

Issues/Problems

Not a particularly alkaline soil type.

It was not clear whether a xeric sagebrush type or mixed salt desert scrub model should be used to model this system. As a compromise, the dwarf sagebrush model from the rapid assessment was used.

Comments

Model is based on R2SBDW (dwarf sabebrush) developed by Sarah Heidi (Sarah_Heide@blm.gov) and Gary Medlyn (gmedlyn@nv.blm.gov). R2SBDW was reviewed by Michael Zielinski (mike_zielinski@nv.blm.gov), Gary Back (gback@srk.com), and Paul Tueller (ptt@intercomm.com). Suggested reviewers for BpS 1127: Niell West (Utah State U, Logan) and Ralph Homgren (retired, in Provo; go through Shrub Lab) and Kim Harper (at UVSC, Provo).

Vegetation Classes

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Class A 10 %

Early1 All Struct

Description

Primarily grass, with shrubs just beginning. Stand age up to 24 years then succession to class B. Replacement fire (mean FRI of 200 years) and drought (mean return interval 10 years) would keep it in class A.

Dominant Species* and Canopy Position

STCO4 Lower
PSSP6 Lower
ACHY Lower
ATTR Mid-Upper

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	10 %
Height	Shrub Dwarf <0.5m	Shrub Dwarf <0.5m
Tree Size Class	None	

- [x] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Grasses are dominant lifeform, with 20-50% cover, height 0-1m.

Class B 50 %

Mid1 Open

Description

Mid-seral, open, still primarily grasses, but also includes mature shrubs. Age 25 to 145 years (succeeding to late seral after 120 years without fire). Replacement fire modeled at 250-yr return sets back to early seral. Mixed fire (100-yr return) maintains within mid-seral. Drought (10-yr return) will not change vegetation structure from mid-seral. Insects (100-yr return) will affect sagebrush and Atriplex, but not change the seral stage.

Dominant Species* and Canopy Position

ARTRT Upper
ARTR Upper
ATCA2 Upper
PSSP6 Lower

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model 5

Structure Data (for upper layer lifeform)

	Min	Max
Cover	5 %	15 %
Height	Shrub Dwarf <0.5m	Shrub Short 0.5-0.9m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class C 40 %

Late1 Open

Description

Late seral shrubs over grasses. Shrubs are dominated by Atriplex species and sagebrush, and grass cover will be lower than the mid-seral stage. Disturbance is replacement fire at 200-yr return, which produces early seral, and frequent drought (10-yrs) and infrequent insects (50-yr) which do not change the seral stage.

Dominant Species* and Canopy Position

ARTRT Upper
ARTR Upper
ATCA2 Upper
PSSP6 Lower

Upper Layer Lifeform

- [ ] Herbaceous
- [x] Shrub
- [ ] Tree

Fuel Model 5

Structure Data (for upper layer lifeform)

	Min	Max
Cover	15 %	25 %
Height	Shrub Short 0.5-0.9m	Shrub Medium 1.0-2.9m
Tree Size Class	None	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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Class D **0 %**

Late1 All Structu

Description

Dominant Species* and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	0 %
Height	NONE	NONE
Tree Size Class	None	

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model

Class E **0 %**

Late1 All Structu

Description

Dominant Species* and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height	NONE	NONE
Tree Size Class	None	

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☐ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model

Disturbances

Fire Regime Group:** 3

Historical Fire Size (acres)

Avg 100
Min 10
Max 1500

Sources of Fire Regime Data

☑ Literature
☐ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	227			0.00441	46
Mixed	196			0.00510	54
Surface					
All Fires	105			0.00952	

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

☑ Insects/Disease
☑ Wind/Weather/Stress
☐ Native Grazing
☐ Competition
☐ Other (optional 1)
☐ Other (optional 2)

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.