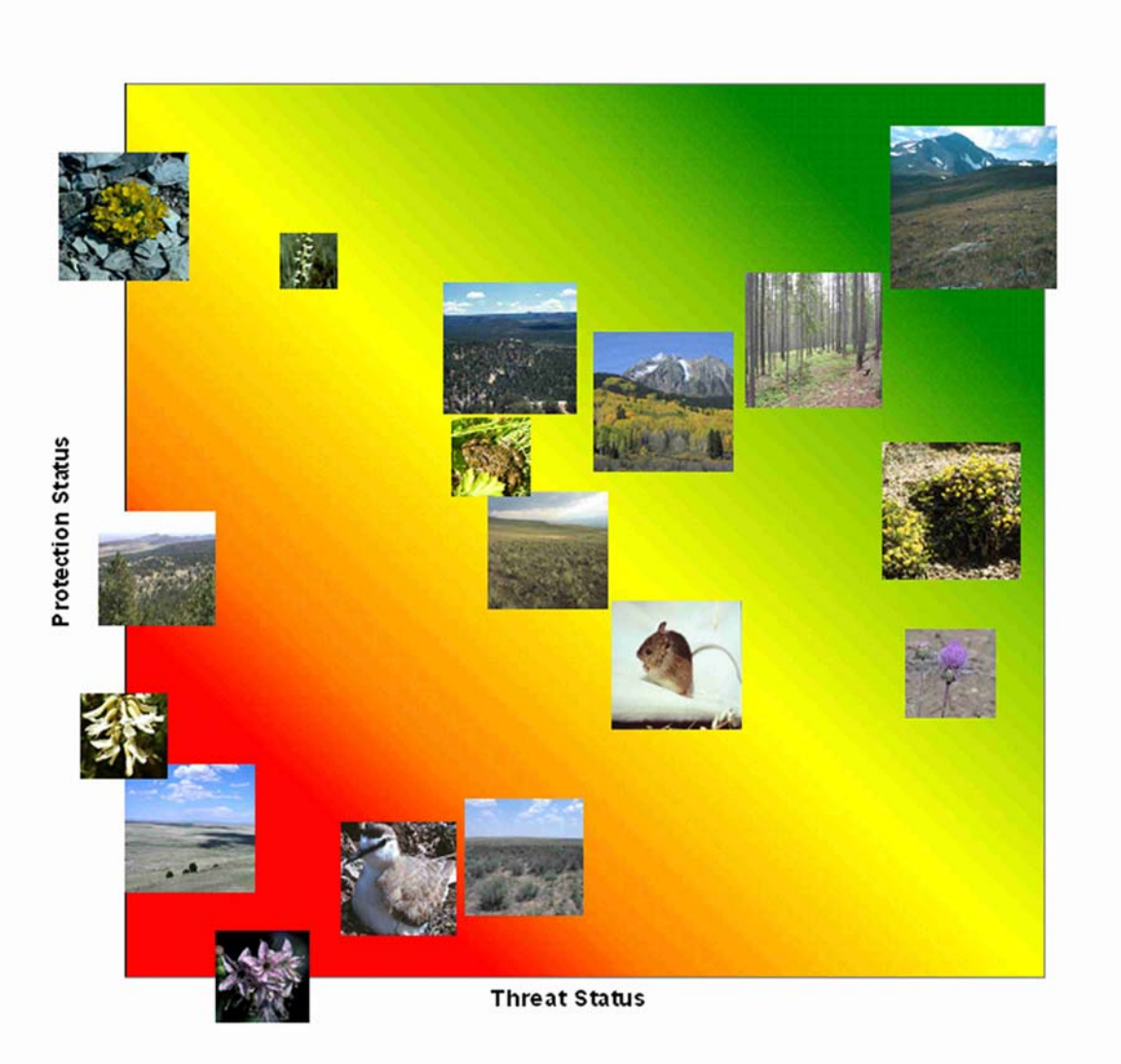
A Biodiversity Scorecard for Colorado



Colorado Natural Heritage Program
and
The Nature Conservancy

Draft of October 20, 2008

The Nature Conservancy
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Natural Heritage Program
COLORADO

Colorado State University

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EXECUTIVE SUMMARY

Conservationists and planners need methods to identify priority areas for conservation, information on how to characterize the relative importance, quality, and urgency of these areas (inform conservation strategies), and a means to measure conservation success on a regional or statewide basis over time. In order to assist the Colorado office of The Nature Conservancy with their "Measures of Success" program, and to provide biodiversity status information to other organizations in Colorado, the Colorado Natural Heritage Program has developed a prototype analysis of the status of Colorado's biodiversity, using a "scorecard" approach. Following the three-part model of "effective conservation" developed by The Nature Conservancy, our scorecard evaluated the status of ecological systems, animals, and rare plants under three broad categories: 1) Biodiversity status – including size, quality; and landscape integrity 2) Threat status – focused on both current and potential future impacts; and 3) Protection status. **Plants, animals, and ecological systems can only be considered effectively conserved when their biodiversity status is viable, threats have been abated, and land management/protection is sufficient to ensure the long-term persistence of the element.** This scorecard includes 11 ecological systems and 103 of Colorado's rarest plant species. The evaluation of rare animal species is not included in this draft. The work reported here includes Colorado's most common/widespread ecological systems, and a representative sample of Colorado's rarest plant species. Our objectives for this project were to measure the degree of effective conservation for these species and ecological systems.

Common and widespread ecological systems in Colorado are generally of good to high quality and part of functional landscapes. For some ecological systems, however, threats and lack of protection may change this situation rapidly. Only two of our eleven dominant ecological systems (the Alpine and the Spruce-fir) are effectively conserved. Our most threatened and least protected systems are those of the eastern plains and lower montane areas of the Front Range. Shortgrass prairie is by far the most altered of any of Colorado's major ecological systems, has fair threat status, and is poorly protected. Although we have lost perhaps 48% of our shortgrass prairie in the past century, there are still some very large, high quality areas that present excellent opportunities for conservation.

Of Colorado's 113 G1G2 plant species, 100 were included in this analysis, together with three G3 species. The majority of rare plant species analyzed here received good to very good scores in at least two of the conservation status categories, and most can be considered reasonably well conserved. However, of the species having a significant portion of their range in Colorado, nearly half are poorly or weakly conserved. Fortunately, we still have high quality occurrences of many of these species, which gives us the opportunity to improve our rare plant grade through prompt conservation action. The foremost strategies that would improve rare plant conservation in Colorado are threat abatement and on-the-ground protection for the best occurrences. Colorado's barrens and shrubland habitats are especially important for rare plants. These habitats are primarily threatened by energy development, exurban development, and motorized recreation.

INTRODUCTION

The international network of state natural heritage programs and conservation data centers is a primary source for biodiversity information that can inform the process of conservation. These entities are responsible for compiling and maintaining comprehensive databases about at-risk species, natural communities, and the ecosystems that constitute the biodiversity of an area of interest, and that may serve as the focus of conservation efforts. For many areas of the country, however, particularly in western states that retain substantial tracts of natural habitat, biological survey information is a work in progress. Even in well-surveyed areas, information is continuously updated, reflecting the dynamic nature of our biodiversity knowledge (Stein and Davis 2000). At the same time, conservation and planning efforts can not be put on hold until our knowledge is complete. Conservationists and planners need 1) methods to identify priority areas for conservation, 2) information on how to characterize the relative importance, quality, and urgency of these areas (inform conservation strategies), and 3) a means to measure conservation success on a regional or statewide basis over time.

In order to assist the Colorado office of The Nature Conservancy (TNC) with their "Measures of Success" program, and to provide biodiversity status information to other organizations in Colorado, the Colorado Natural Heritage Program (CNHP) has developed a prototype analysis of the status of Colorado's biodiversity, using a "scorecard" approach. Scorecard methods have become widely used in business as a technique for measuring corporate performance indicators (e.g., the "balanced scorecard" of Kaplan and Norton, 1992). Other organizations have adopted scorecard techniques to analyze and report on the status of biological and ecological resources at various scales (e.g., Harwell 1999, Heinz Center 2002, Paul 2003). A scorecard can provide a comprehensive, repeatable, science-based approach for identifying the constituent components of a subject, exploring the relative contributions of these components, identifying which factors are of greatest concern, and producing summary statistics. Scorecards are suitable for use at many levels, from the broad general picture to in-depth, local analysis.

The work reported here includes a representative sample of Colorado's rarest plant species and Colorado's most common/widespread ecological systems. Reflecting the three-factor approaches of Parrish et al. (2003) and Ervin (2003) as well as the three-part model of "effective conservation" developed by The Nature Conservancy (Dutton & Salzar 2005), our scorecard evaluated the status of each element under three broad categories:

1) Biodiversity Status – including abundance and quality
2) Threat status – current and potential future impacts
3) Protection/Land management Status

Plants, animals, and ecological systems can only be considered effectively conserved when their biodiversity status is viable, threats have been abated, and land management/protection is sufficient to ensure the long-term persistence of the element. Our objectives for this project were to measure the degree of effective conservation for these elements by:

1. Using a subset of elements to develop protocols for measuring conservation status that will be repeatable over time and scaleable to a variety of applications.

2. Incorporating metrics that address factors important to TNC and other conservation or management organizations.
3. Reporting on the challenges and information gaps identified during the analysis.

Natural Heritage Methodology

Our scorecard uses standardized natural heritage methodology that incorporates a rigorous set of procedures for identifying, inventorying, and mapping species and ecosystems of conservation concern (Master 1991, Master et al. 2000, NatureServe 2008). In the standardized usage of natural heritage methodology, species, natural communities, and ecological systems are "elements of biodiversity," and as such are often identified as conservation targets in planning and management efforts. The central concept in tracking imperiled elements is the "element occurrence," a spatial representation of a species or ecological community at a specific location (Stein et al. 2000, NatureServe 2002). An element occurrence delineates a species population or contiguous tract of ecological community or system, and is intended to represent the biological feature that is the target of conservation and management efforts. Element occurrence records contain information about the extent, population size, condition, and management status of each occurrence. Elements are tracked by state natural heritage programs or conservation data centers according to their degree of imperilment and taxonomic status.

The standard natural heritage methodology is a consistent method for evaluating the relative imperilment of species, and designating a conservation status rank (Master 1991, Stein et al. 2000). In addition to the information contained in element occurrence records, NatureServe and the individual natural heritage programs compile and maintain qualitative and discriptive information about each element. Together with the element occurrence records, this data serves as the basis for an element's global and state conservation ranking. For plant and animal species these ranks provide an estimate of extinction risk. Status is assessed and documented at both the global (G), and state/provincial (S) geographic scales. Infraspecific taxon ranks (T-ranks) refer to subspecies, varieties and other designations below the level of the species, and have a similar interpretation. Conservation status ranks are on a scale from one to five, ranging from critically imperiled (G1, S1 or T1) to demonstrably secure (G5, S5 or T5). These ranks are based on the best available information, and incorporate a variety of factors such as abundance, viability, distribution, population trends, and threats (see Appendix D for additional explanation of G ranks). The Colorado Natural Heritage Program uses the Biodiversity Tracking and Conservation System (BIOTICS) database to track species and plant community elements. As of May 2008 the database contained information on 13,067 element occurrences (CNHP 2008), and served as the primary data source for analysis of rare species presented in this report.

As part of the application of standard natural heritage program methodology to element occurrence data, CNHP develops and uses ranking specifications for individual element occurrences. Element occurrence ranks are intended to reflect the likelihood that a particular occurrence will remain extant if current conditions remain essentially unchanged for the foreseeable future, and to provide a measure of the relative quality of an occurrence (NatureServe 2002). Ranks are a summary estimate of the viability of an occurrence. The estimated viability ranks are: A - excellent, B - good, C - fair, or D - poor. The three primary rank factors (size, condition, and landscape context) reflect the present status, or quality of an

occurrence and are used as the basis for estimating its long-term viability: Size + Condition + Landscape Context => Estimated viability ~ EO rank.

Although our objective was to evaluate the biodiversity, threat, and protection status of all elements selected, the actual scoring methods differ somewhat between taxonomic groups. Plant elements were scored in this analysis by using the element occurrence records for each species, as well as the qualitative threat evaluation from the element's state or global rank record. Additional information, including GIS analysis of landscape integrity and energy development potential, federal and/or state status, habitat association, degree of endemism in Colorado, confidence in scoring, and conservation recommendations, was also incorporated for each species as appropriate. Element occurrence data is not yet available for Colorado's ecological systems, so the analysis used a variety of spatially referenced data to address the viability of each system under the primary ranking factors of size, condition, and landscape context. Historic trends were also incorporated when available.

Our analysis is necessarily limited by the available data. Occurrence information is incomplete or unavailable for some species and ecosystems, and statewide georeferenced data is not available for every factor that we wished to consider in our analysis, especially for threats and condition. In particular, it is difficult to address the effects of anthrpogenic disturbance in the future, as in the case of global climate change. In addition, it is important to note that although adequate protection status is one of the three requisites for effective conservation, it is difficult to determine the true level of protection for most elements. Consequently, we have used an estimate of conservation management status based on ownership as a surrogate for protection in portions of this analysis, under the assumption that certain land management types (e.g. wilderness areas, conservation easments, etc.) are less likely to be converted to land use that is incompatible with the viability of rare elements that may be present.

ECOLOGICAL SYSTEMS

Background

Ecological systems are dynamic groupings of plant and/or animal communities that 1) occur together on the landscape; 2) are linked by similar ecological processes, underlying abiotic environmental factors, or gradients; and 3) form a readily identifiable unit on the ground (NatureServe 2003). Anderson et al. (1999) characterized ecological communities as belonging to four broad types: matrix-forming, large patch, small patch and linear. These categories were subsequently applied to ecological system types as well (NatureServe 2003). Our prototype analysis focused on Colorado's matrix-forming ecological systems. These ecological systems form the dominant vegetation over extensive areas, encompassing a range of environmental conditions, and serving as important habitat for species both common and rare (Anderson et al. 1999). The patch-type systems are typically nested within matrix systems, and linear types occur along features such as riparian corridors, coastal areas, or linear landforms such as escarpments (NatureServe 2003). Matrix-forming systems may also occur as large patches in parts of their range.

In contrast to the plants and animals scored in this report, matrix ecological systems are not rare, but do often provide habitat for rare elements. Ecological systems may also serve as a coarse-scale filter in the identification of conservation targets. Ecological systems have not yet been documented as occurrences as with other elements of biodiversity, so our analysis is intended to identify contiguous patches of each type and to characterize the conservation status of those patches, as well as the conservation status of the matrix-forming ecological systems on a statewide basis.

We analyzed eleven matrix-forming systems, grouping the mapped vegetation types from the Southwest Regional GAP analysis landcover map (USGS 2004) as shown in Table 1. These are the ecological systems that occur as matrix-forming systems in Colorado. Future analysis will include the remaining large-patch, small-patch, and linear systems found in Colorado. The methods presented here are based only on matrix-forming systems mapped at a statewide level, and will require modification to adapt them to smaller system types.

Table 1. Matrix-forming system types included in analysis.

System Name	Includes SWReGAP types:
Alpine Tundra	North American Alpine Ice Field – *note; none in focal majority grid* Rocky Mountain Alpine Bedrock and Scree Rocky Mountain Alpine Fell-Field Rocky Mountain Dry Tundra Rocky Mountain Alpine-Montane Wet Meadow
Aspen	Rocky Mountain Aspen Forest and Woodland Intermountain West Aspen-Mixed Conifer Forest and Woodland Complex
CO Plateau Pinyon-Juniper	Colorado Plateau Pinyon-Juniper Shrubland Colorado Plateau Pinyon-Juniper Woodland Colorado Plateau Mixed Bedrock Canyon and Tableland
Lodgepole	Rocky Mountain Lodgepole Pine Forest

System Name	Includes SWReGAP types:
Oak-Mixed Mtn. Shrub	Rocky Mountain Gambel Oak-Mixed Montane Shrubland
Ponderosa	Rocky Mountain Ponderosa Pine Woodland
Sagebrush	Inter-Mountain Basins Big Sagebrush Shrubland Inter-Mountain Basins Montane Sagebrush Steppe
Sandsage	Western Great Plains Sandhill Shrubland Western Great Plains Sandhill Prairie, if any
Shortgrass	Western Great Plains Shortgrass Prairie
Spruce-Fir	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
Southern Rocky Mtn Pinyon-Juniper	Southern Rocky Mountain Pinyon-Juniper Woodland

Methods

As part of the application of standard natural heritage program methodology to element occurrence data, CNHP develops and uses ranking specifications for individual element occurrences that are intended to reflect the likelihood that a particular occurrence will remain extant if current conditions remain essentially unchanged for the foreseeable future, and to provide a measure of the relative quality of an occurrence (NatureServe 2002). For ecological systems, the term "viability" is used loosely, since systems are comprised of many separate communities and species, each with their own viability. The viability of an ecological system is considered to be the sum of the viability or persistence of the component communities and their ecological processes. More directly, the ranks usually reflect the degree of negative anthropogenic impact to a community (i.e., the degree to which people have directly or indirectly adversely impacted community composition, structure, and/or function, including alteration of natural disturbance processes). Occurrences of adequate size with relatively few impacts would generally be ranked "A", "B", or "C" – at least "fair" viability, with a high probability of long-term persistence, and those with significant degradation would be ranked "D" –"poor" viability, requiring significant restoration work to enable persistence of the occurrence (NatureServe 2002). For matrix-forming systems, size is the most important ranking factor.

Because occurrences for ecological systems have not been delineated or incorporated into BIOTICS, our first task was to develop a surrogate for the ecological system occurrences. We based our analysis on the Land Cover Map for the Southwestern United States - SWReGAP landcover (USGS 2004). This dataset provides a statewide vegetation map for Colorado that uses the same U.S. National Vegetation Classification ecological system names as our conservation targets. The focal majority routine in ESRI ArcInfo (ESRI 2006) was used to produce a smoothed version of the vegetation map. This technique reduces the number of small inclusions of dissimilar system types within larger patches, resulting in a more generalized vegetation map appropriate for matrix-scale systems. The generalized map was then "re-fragmented" with current highway data to represent existing fragmentation of the landscape. The resulting discrete patches of each system type became potential occurrences. Our analysis used only patches larger than a minimum size corresponding to the C-ranked occurrence specifications in Rondeau (2001) and CNHP (2005a). All scores were normalized to fall between 0 – 10, inclusive, with 10 being the best possible score.

In addition to the three categories of biodiversity status, threat status, and protection/management status discussed in the introduction, we evaluated the post-settlement trend of loss over time. A detailed explanation of scores is included in Appendix A, and metadata is provided with GIS datasets.

Biodiversity Status

Biodiversity status scores address the three element occurrence ranking factors (size, condition, and landscape context) as much as possible. Size scores include proportion of total acreage in at least minimum size patches (C-rank or better) and proportion in preferred size patches (A-rank). These two metrics characterize the patch size distribution of the system and can reflect change over time. More acreage in larger patches is preferred for overall system viability. Condition was scored by using the LANDFIRE Fire Regime Condition Class dataset (USFS 2007) that maps degree of departure from historic fire regime. The fire condition metric is most meaningful for forest systems, but was included for all systems except alpine tundra. Landscape context was scored by calculating the proportion of natural landscape within a ½ mile buffer for each patch, and by a landscape integrity score representing the cumulative impacts from oil and gas wells, gas pipelines, surface mines, urban development, agriculture, roads, and transmission lines. The landscape integrity data layer was developed by CNHP as part of this project (See Appendix A for details).

Threat Status

In addition to the landscape integrity score included in biodiversity status that could be interpreted as reflecting current threats to an occurrence, we developed several data layers to characterize future threats and historic trends. Future threats included potential energy development, population growth, and highway development. Energy development potential was mapped as the cumulative potential for development of oil and gas, oil shale, coal mining, uranium mining, and wind energy, using available statewide data sets for these factors (BLM 1998, 2006, TrueWind Solutions 2003), and scored as an area-weighted average. Population growth was based on the 30-year population projections of Theobald (2005), and scored as the area-weighted loss of undeveloped private land for each occurrence. Highway development was mapped as a variable-width buffer on current highways based on 20-year traffic volume projections from the Colorado Department of Transportation (CDOT 2006), and scored as the area-weighted proportion of each system falling within the buffer.

Protection/Management Status

The protection and management status of matrix systems in Colorado was evaluated by using the Colorado Ownership, Management and Protection (CoMAP) GIS dataset (Wilcox et al. 2007), in conjunction with the Conservation Management Status Measures developed by The Nature Conservancy (Supples et al. 2007). Every record in CoMAP was assigned a rank for each of three conservation management status measures: Conservation Tenure, Management Intent, and Potential Management Effectiveness (PME). Ranks assigned by The Nature Conservancy's Colorado Field Office were converted to a numerical score, and used to calculate area-weighted scores for patches and entire systems (See Appendix A for details).

Trends

Long term trends were evaluated by comparing the current mapped extent (acreage) of each matrix system with a representation of historic vegetation developed for this project. The historic vegetation dataset is intended to represent Colorado's natural vegetation more-or-less as it was in the immediate pre-settlement period (circa 1850). Pre-settlement vegetation of Colorado was modeled by using a 90m resampled version of the SWReGAP landcover (USGS 2004) as a base. Existing non-natural landcover was replaced by:

1) Replacing all agriculture in shortgrass and mixedgrass prairie with the "Historic shortgrass component" dataset (CNHP 2005b),
2) Replacing all other non-natural landcover with the most common native vegetation found on the underlying STATSGO soil type (USDA Soil Conservation Service 1994), following the methods of Duncan et al. (2000),
3) Replacing modeled and existing shortgrass with foothills/piedmont grassland on selected soil types along the mountain front,
4) Manual editing to replace man-made water bodies with the common surrounding landcover types.

Agricultural modifications by native peoples that would have been present (Vale 2002) were not modeled. Changes due to climatic variability are also not reflected in the historic model, but are most likely to have affected the quality instead of the identity of most of the ecological systems considered (Veblen and Donnegan 2005). Short term trends can be evaluated at the next scoring iteration.

Results

Matrix ecological system patches in Colorado

The eleven matrix-forming ecological systems cover approximately 65% of Colorado's 66.6 million acres. The remaining 35% consists of either non-natural cover types such as agriculture and development, or natural vegetation belonging to large patch, small patch, or linear ecological systems. Total acreages for each matrix-forming system, based on the generalized vegetation map, are shown in Table 2. Although very few patches are of minimum (C-ranked) size or larger, the A-, B-, and C-ranked patches represent substantial proportions of the total acreage. The average proportion of total acreage of a system in patches of at least C-ranked size is 75%, and the average proportion of total acreage in patches of at least A-ranked size is 50%.

Status scores

Statewide matrix system summary scores under each of three conservation factor categories are shown in Table 3, arranged more-or-less in descending order of overall status. The subcategory scores are shown on the complete scorecard in Appendix B, and summary graphics are presented in Appendix C. Scores are color-coded by quartile; Green = Very Good (7.5-10), Yellow = Good (5-7.4), Orange = Fair (2.5-4.9), Red = Poor (0-2.4). The distribution of patch scores within systems for each of the three conservation factor categories is shown in Table 4 and graphed by percentage in Figure 1. The statewide distribution of patch scores is shown in Figures 2-4. Patch subscores within system type are listed in the individual system scorecards in Appendix B.

Historic trend

The percent loss for each matrix system is shown in Table 3. Spatial distribution of lost acreage is shown in Figure 5.

Table 2. Matrix ecological system patches in Colorado.

Systems are arranged in alphabetical order. The total number of acres of each system in Colorado is calculated from the generalized focal-majority grid. The total number of discrete patches is calculated before the application of size criteria. Minimum patch size correspondes to a C-ranked occurrence of the system.

System Name	Total acres	No. patches	Minimum size (ac.)	No. patches C-ranked (min)	No. patches B-ranked (2x min)	No. patches A-ranked (4x min)	% >= C-rank size	% >= A-rank size	Largest patch (ac.)
Alpine Tundra	1,681,811	480	10,000	13	11	9	79%	52%	250,970
Aspen	3,580,854	1,564	20,000	10	6	10	63%	48%	513,422
CO Plateau PJ	4,942,190	668	30,000	11	8	13	91%	69%	512,906
Lodgepole	2,199,719	643	30,000	4	4	6	64%	41%	264,169
Oak & Mixed Mtn Shrub	2,717,460	1224	5,000	29	20	27	70%	43%	206,256
Ponderosa	3,220,297	1,153	30,000	13	6	6	72%	38%	516,243
Sagebrush	5,564,595	1,995	30,000	15	7	10	69%	47%	516,243
Sandsage	1,959,451	672	14,000	10	5	10	79%	58%	179,704
Shortgrass	11,855,162	1,827	50,000	14	6	14	81%	65%	1,072,828
Spruce-fir	4,880,993	956	20,000	27	9	15	83%	59%	458,277
Southern Rocky Mtn. PJ	1,253,413	401	30,000	2	5	5	68%	24%	168,167

Table 3. Matrix ecological system summary scores.

Scores shown in the three primary analysis categories represent summary values for each ecological system across all patches greater than or equal to minimum size. Biodiversity status combines proportion of total acres in patches larger than minimum size, proportion of total acreage in patches of preferred size, percent natural within 1/2 mile of patches, landscape integrity, and condition index scores. Threat status combines energy development potential, population growth and development projections, and transportation development projections. Protection status summarizes the conservation tenure, management intent, and potential management effectiveness of land ownership patterns for each system. The overall conservation status for each system summarizes the three subcategories.

System Name	Biodiversity Status	Threat Status	Protection Status	Historic trend	Conservation Status
Alpine Tundra	8.1	9.2	8.1	-1%	Effectively conserved
Spruce-fir	7.7	8.4	7.8	-1%	Effectively conserved
Lodgepole	6.6	7.4	6.3	-6%	Moderately conserved
Aspen	6.9	5.9	5.6	-3%	Moderately conserved
SRM PJ	5.3	5.9	2.5	-8%	Moderately conserved
CO Plateau PJ	7.0	4.2	4.3	-14%	Weakly conserved
Oak & Mixed Mtn Shrub	7.1	4.5	2.9	-5%	Weakly conserved
Sagebrush	6.2	4.6	2.7	-12%	Weakly conserved
Ponderosa	5.0	3.6	3.7	-3%	Weakly conserved
Shortgrass	6.5	4.9	0.9	-48%	Poorly conserved
Sandsage	6.6	4.4	0.8	-19%	Poorly conserved

Table 4. Percent acreage and number of patches in each conservation status category.

Biodiversity Status

% acres (number of patches)

Ecological System	Poor		Fair		Good		Very Good	
Alpine Tundra	0%	(0)	0%	(0)	1%	(1)	99%	(30)
Aspen	0%	(0)	0%	(0)	21%	(10)	79%	(14)
CO Plateau PJ	0%	(0)	6%	(6)	61%	(20)	33%	(6)
Lodgepole	0%	(0)	0%	(0)	19%	(3)	81%	(11)
Oak & Mixed Mtn Shrub	0%	(0)	8%	(16)	63%	(47)	29%	(13)
Ponderosa	0%	(0)	17%	(9)	83%	(16)	0%	(0)
Sagebrush	0%	(0)	4%	(3)	68%	(26)	29%	(3)
Sandsage	0%	(0)	8%	(6)	68%	(14)	24%	(5)
Shortgrass	0%	(0)	27%	(18)	52%	(13)	21%	(3)
Spruce-fir	0%	(0)	0%	(0)	16%	(23)	84%	(28)
SRM PJ	0%	(0)	7%	(1)	93%	(11)	0%	(0)

Threat Status

% acres (number of patches)

Ecological System	Poor (very high threat)		Fair (high threat)		Good (low threat)		Very Good (very low threat)	
Alpine Tundra	7%	(2)	1%	(1)	6%	(2)	86%	(26)
Aspen	15%	(3)	15%	(7)	60%	(8)	9%	(6)
CO Plateau PJ	30%	(12)	40%	(9)	29%	(10)	1%	(1)
Lodgepole	3%	(1)	43%	(5)	9%	(1)	45%	(7)
Oak & Mixed Mtn Shrub	42%	(36)	32%	(24)	22%	(10)	4%	(6)
Ponderosa	40%	(12)	50%	(10)	9%	(2)	1%	(1)
Sagebrush	28%	(5)	45%	(15)	17%	(9)	10%	(3)
Sandsage	3%	(2)	78%	(18)	19%	(5)	0%	(0)
Shortgrass	24%	(8)	29%	(15)	47%	(11)	0%	(0)
Spruce-fir	4%	(3)	5%	(6)	14%	(9)	77%	(33)
SRM PJ	15%	(3)	53%	(6)	10%	(1)	22%	(2)

Protection Status

% acres (number of patches)

Ecological System	Poor		Fair		Good		Very Good	
Alpine Tundra	0%	(0)	2%	(1)	14%	(7)	84%	(23)
Aspen	3%	(1)	5%	(4)	44%	(15)	49%	(4)
CO Plateau PJ	5%	(5)	68%	(20)	19%	(6)	8%	(1)
Lodgepole	0%	(0)	2%	(1)	70%	(11)	28%	(2)
Oak & Mixed Mtn Shrub	43%	(36)	20%	(25)	27%	(12)	10%	(3)
Ponderosa	24%	(7)	42%	(12)	12%	(5)	22%	(1)
Sagebrush	33%	(14)	64%	(17)	3%	(1)	0%	(0)
Sandsage	92%	(21)	6%	(3)	2%	(1)	0%	(0)
Shortgrass	89%	(32)	11%	(2)	0%	(0)	0%	(0)
Spruce-fir	0%	(0)	2%	(3)	16%	(19)	82%	(29)
SRM PJ	47%	(8)	53%	(4)	0%	(0)	0%	(0)

Figure 1. Ecological system patch scores.

A graphical summary of the information in Table 4 is shown. For each of the three primary conservation status categories, the cummulative acreage of score categories for each system are shown. Each bar indicates the percent of acres in that system in poor, fair, good, or very good status. Systems are arranged in descending order of overall status from best to worst.

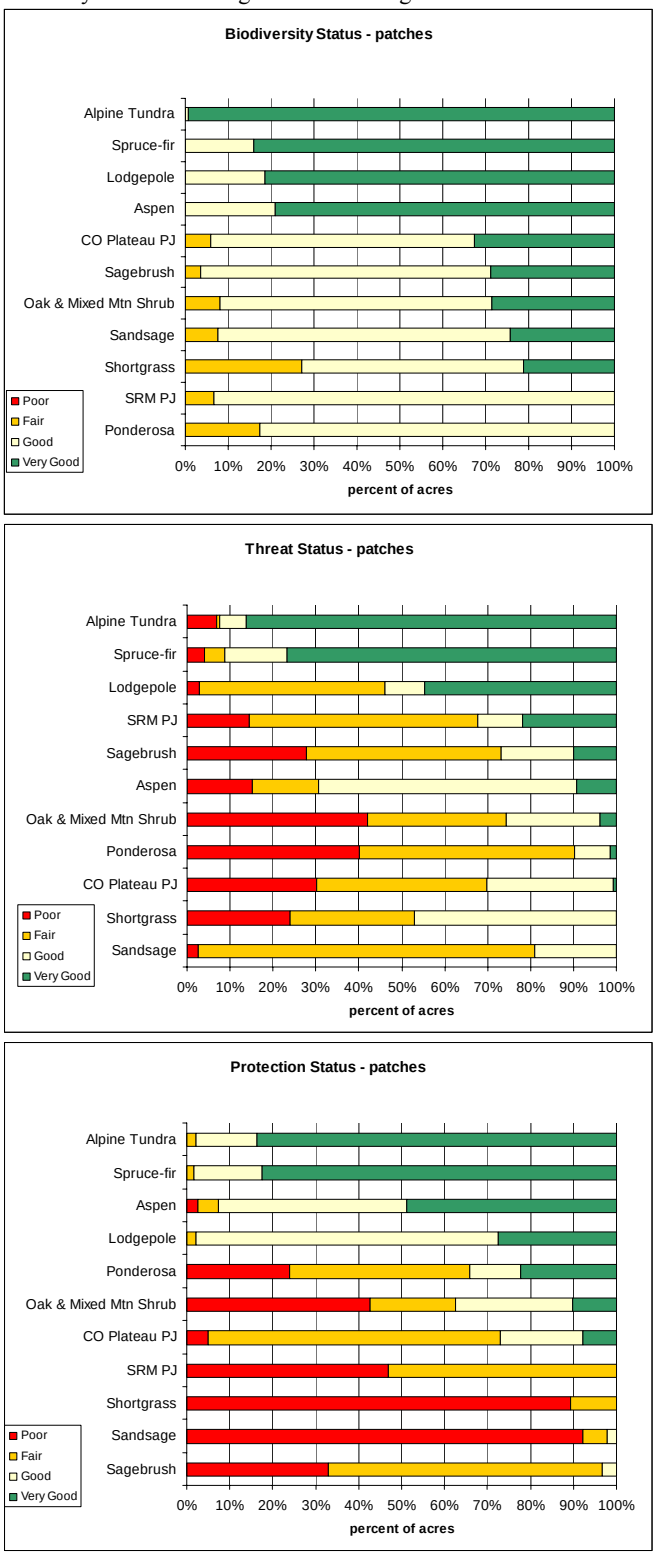


Figure 2. Ecological system patch biodiversity status.

Spatial distribution of patch biodiversity scores is shown. No patches have "poor" (red) biodiversity status. Patches with "fair" (orange) biodiversity status are most prevalent in the northeastern portion of the state.

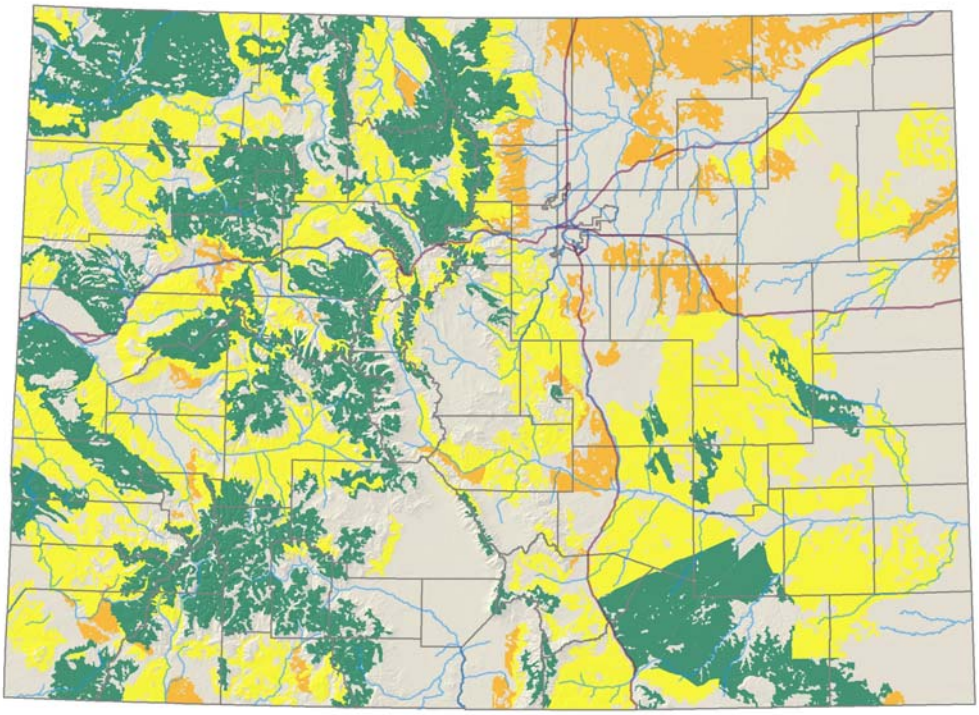


Figure 3. Ecological system patch threat status.

Spatial distribution of patch threat status scores is shown. Patches with very low threat levels (i.e., "very good"or green) status are generally correlated with higher elevation public lands, especially wilderness areas.

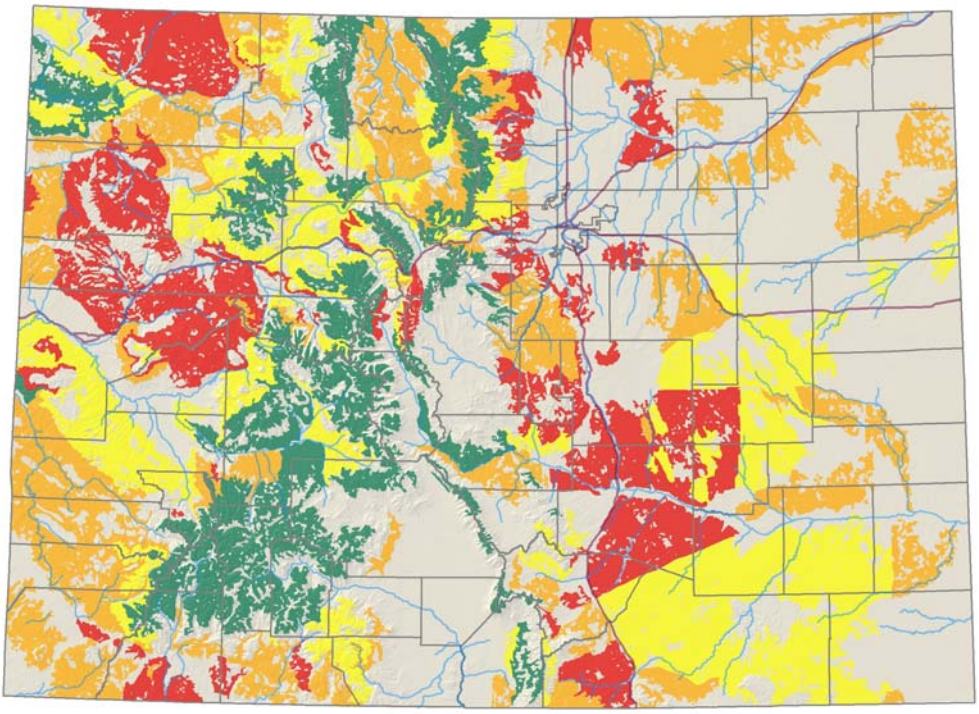
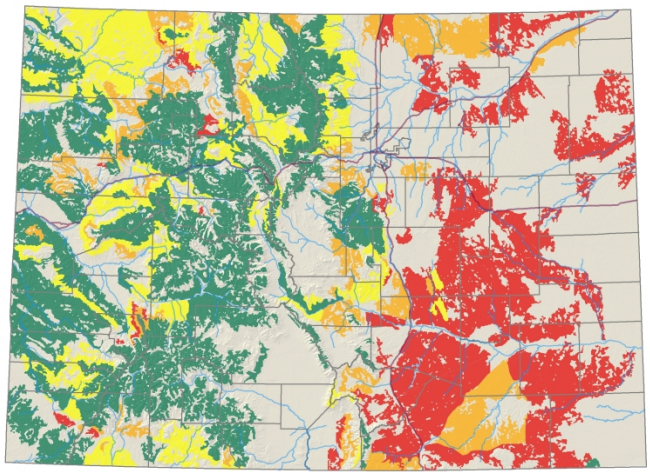


Figure 4. Ecological system patch protection status.

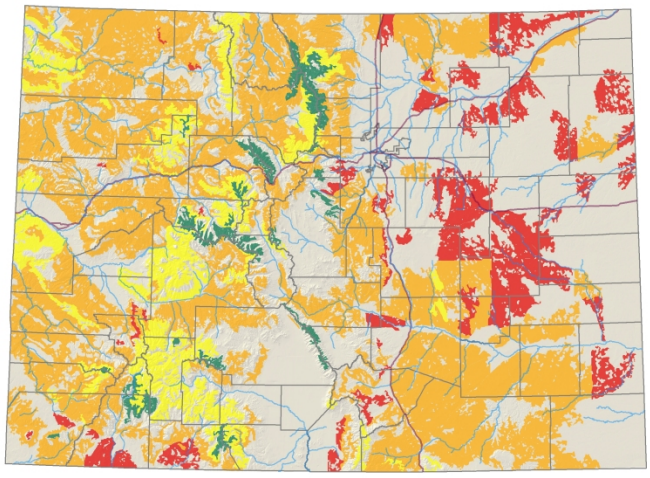
Spatial distribution of patch scores for the three components: (a) conservation tenure, (b) management intent, and (c) potential management effectiveness, are shown, in addition to the overall protection score (d) resulting from the combination of these three.

(a) Conservation Tenure



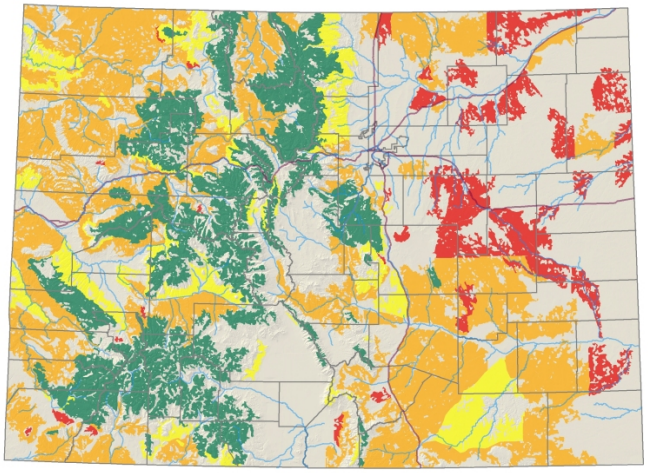
Conservation tenure scores are dominated by green and yellow, indicating permanent tenure or long-term commitment on the west slope, while red and orange are prevalent on the east slope, indicating no known commitment or short-term commitment, respectively.

(b) Management Intent



Management intent scores are generally low across the state, indicating either unknown intent, or that management intended to be compatible with biodiversity conservation is not explicit but may be incidental.

(c) Potential Management Effectiveness



Potential management effectiveness scores are high in areas having both a management prescription, and the institutional capacity to implement it, especially in wilderness areas. Scores are poor in areas lacking both conservation management prescriptions and resources for implementation.

(d) Overall Protection Status

Overall protection status scores are intended to represent a summary of the three components presented in (a) through (c) above, where in general, the most common scoring category determines the overall level of protection. The resulting pattern shows that public lands with strong management prescriptions (such as wilderness areas) score highest in overall protection, while public lands subject to intensive energy development activities score fair to poor. Privately owned lands, where the duration of tenure is uncertain, and management intents largely unknown, also score poor to fair in overall protection status.

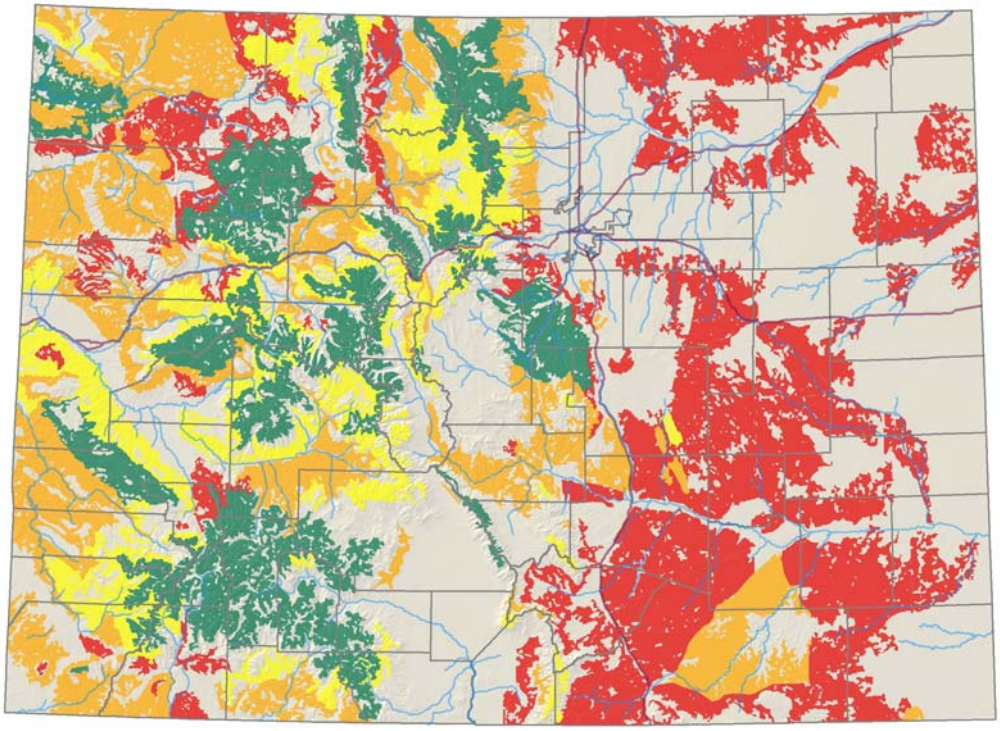
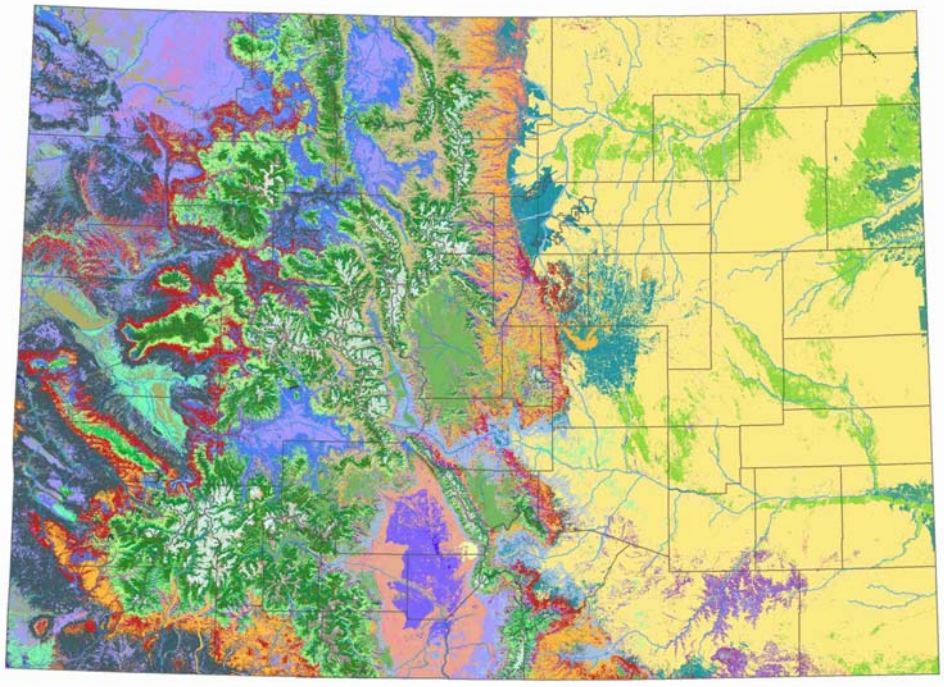
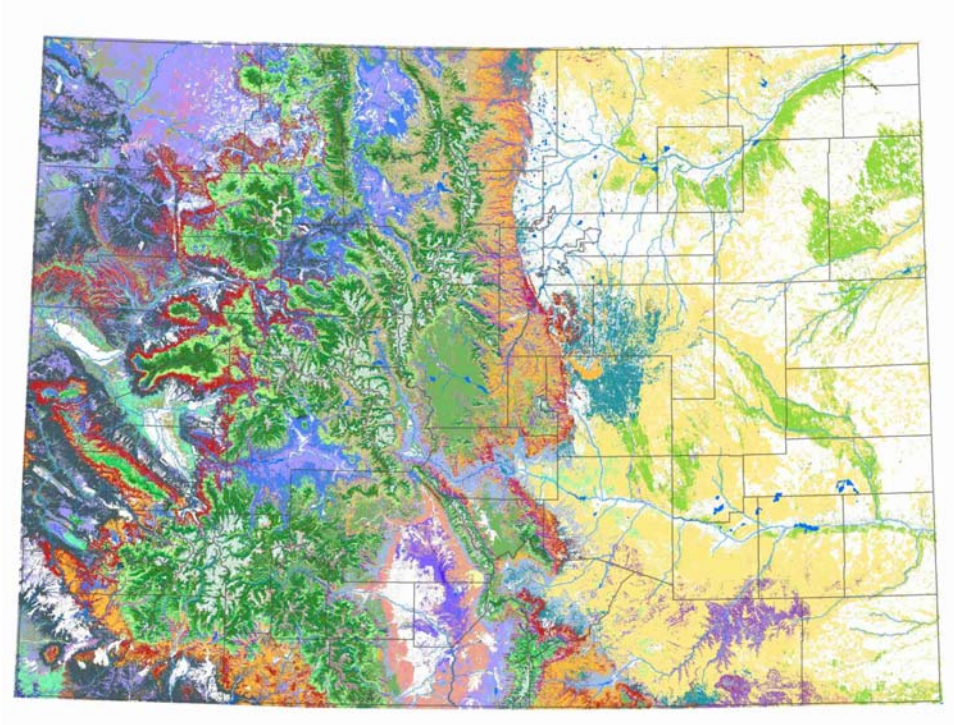


Figure 5. Historic and current vegetation.

(a) Historic vegetation. Spatial distribution of modeled pre-settlement vegetation (circa 1850) is shown. Model is based on USGS (2004), where existing non-natural landcover (e.g. agriculture, development, man-made water bodies, etc.) was replaced with selected natural vegetation types. See Appendix A for additional details.



(b) Current vegetation. Spatial distribution of existing natural vegetation (USGS 2004) is shown. Current non-natural vegetation appears as white.



Discussion

The generalized matrix system patches developed for this analysis are the first available representation of individual ecological system occurrences in Colorado. Previous work (e.g., Tinker et al. 1998, Theobald 2003) has utilized mapped patches of landcover types. These studies, however, focused on landscape fragmentation analysis rather than delineating occurrences that are part of a landscape-scale matrix of functional ecological systems. Previous work in Colorado and other states has analyzed each ecological system type as a single entity within a state (e.g., Merrill et al. 1996, Thompson et al. 1998, Schrupp et al. 2001) or multi-state area (Wright et al. 2001). Although useful for statewide conclusions, such analyses do not directly facilitate prioritization of specific conservation target areas within a system type. Through the use of discrete, spatially explicit patches of generalized ecological system types, our analysis evaluates the conservation status of individual occurrences of an ecological system, and allows conservation planners and land managers to focus on high quality areas that are in need of immediate action.

Not surprisingly, biodiversity status scores are generally high across the state, especially for the highest elevation ecological systems such as alpine tundra and spruce-fir forest. Additionally, all patches of lodgepole forest and aspen have very good or good biodiversity status. With the exception of shortgrass, all other matrix ecological systems have at least 60% of their patches in good or very good biodiversity status. When acreages are considered, all systems have at least 70% of their acreage in good or very good biodiversity status; shortgrass is the lowest at about 73%. **Our analysis shows that Colorado's dominant ecological systems still offer tremendous opportunities to preserve large functioning landscapes in our state.** Areas of lower biodiversity status are primarily concentrated in northeastern Colorado, from the urban corridor along the mountain front eastward across the agricultural areas of the plains.

The potential for increased energy development and exurban population growth are the primary factors affecting the threat status of Colorado's matrix ecological systems. Again, higher elevation system types are less threatened. All systems, however, have at least 5% of their acreage in poor (highly threatened) threat status areas. On the western slope, oil and gas and oil shale development are a primary threat in the Piceance Basin, Roan Plateau and parts of Moffat County, while population growth effects are seen most dramatically in the Pagosa Springs/Durango area. Colorado's eastern plains and foothills show the potential for both energy development and expanding population from the urban centers of the Front Range.

Protection status scores reflect the distribution of public lands, and the variety of permitted usage on public lands in Colorado. Once again, higher elevation system types are generally very well protected, and many areas of the west slope are in good to fair protection status. Systems of the eastern plains, especially shortgrass prairie and sandsage, have poor overall protection status. Four system types (sagebrush, sandsage, shortgrass, and Southern Rocky Mountain pinyon-juniper) have no patches with very good protection status; shortgrass prairie and Southern Rocky Mountain pinyon-juniper lack both good and very good status patches.

Change in acreage of Colorado ecological systems since about 1850 ranges from essentially no change to significant loss. By far the greatest loss has been to the shortgrass prairie; nearly half of the presettlement acreage has been converted to agriculture or development. Sandsage, Colorado Plateau pinyon-juniper, and sagebrush have also lost significant acreage to agricultural conversion. The remaining ecological systems have lost from 1 to 8%; given the imprecise nature of the mapping, these may be regarded as more-or-less unchanged in extent, if not condition.

The type of scorecard analysis presented here is almost entirely dependent on the availability of data layers at a statewide level. We would like to incorporate additional information (e.g., climate change models) as it becomes available. Statewide datasets are not always updated frequently, however, and this will limit the frequency at which the scorecard analysis can be meaningfully revised.

Common and widespread ecological systems in Colorado are generally of good to high quality and part of naturally functioning landscapes. For some ecological systems, however, threats and lack of protection may change this situation rapidly. Only two of our dominant ecological systems (those of higher elevations) are effectively conserved. Our most threatened and least protected systems are those of the eastern plains and lower montane areas of the Front Range. Shortgrass prairie is by far the most altered of any of Colorado's major ecological systems, has fair threat status, and is poorly protected as well. Although we have lost perhaps 48% of our shortgrass prairie in the past century, there are still some very large, high quality areas that present excellent opportunities for conservation.

ANIMALS

This section is not yet available.

RARE PLANTS

Background

Colorado's growth rate is soaring and imminent threats, such as energy development and residential development, are increasing impacts to Colorado's rare plants. The recent onset of rapid development of oil and gas reserves, as well as urban growth and development have prompted the need for botanists, land managers and conservationists to have the ability to rapidly assess species conservation status.

The Colorado Natural Heritage Program tracks over 500 rare plant species (CNHP 2008). Of these, 253 are critically imperiled (G1), imperiled (G2), or vulnerable to extinction (G3) on a global scale, and thirteen are federally listed as threatened or endangered. Due to the large number of rare plant species in Colorado, a subset of species was selected for this analysis. Species selected for analysis were prioritized by degree of imperilment (G rank), endemism, and completeness of data. All species selected are either endemic to Colorado (occurring no place else in the world) and/or globally imperiled. None of the selected species are common outside Colorado. All 13 federally listed species were included. Of the 113 G1 and G2 (or T1, T2) plants tracked by CNHP, 100 were included in this analysis, as well as three G3 plants. The G3 plants were included for comparison and validation of scorecard methodology. The three G3 species included are *Penstemon breviculus* (not endemic), *P. harringtonii* (endemic), and *Sclerocactus glaucus* (endemic, and listed as threatened under the Endangered Species Act). Thirteen G1 and G2 (or T1, T2) plant species were excluded from the analysis either because they are in need of data processing (backlog) before meaningful scores can be calculated or because taxonomic uncertainty or lack of information precluded their inclusion (see Appendix F).

The analysis presented here is limited by the available data; not every occurrence is well documented. The scorecard will be updated periodically to record changes in the conservation status of targeted rare plant species, and to add additional species as resources become available. In addition, as we continue to improve our knowledge about the size, quality and distribution of rare plant populations, scores will better reflect the true status of a species. We hope that this scorecard will directly support efforts to identify strategies that will result in the effective conservation of all of Colorado's rarest flora as well as facilite our understanding of the overall botanical conservation priorities for Colorado.

Methods

Species included in the analysis

The 103 rare plant species included in this analysis are listed in Table 5. Global and state ranks, federal agency status, degree of endemism, and habitat association are shown for each species.

Scoring

The selected species were scored in three broad categories; biodiversity status, threat status, and protection status. Possible scores range from zero to ten, where zero represents conditions most at risk and ten least at risk. The scale is designed to include all the plant species of Colorado such that S1 plants (the rarest plants in Colorado) score low on size and S5 plants (common and widespread in Colorado) score high (e.g., 9 or 10). Color values assigned to ranges of scores are shown in Table 6. A detailed explanation of scoring is included in Appendix F. In addition, a determination of the overall conservation status of each species was made from the biodiversity, threat, and protection status scores.

Table 5. Plant species included in analysis.

Species are listed alphabetically by the scientific name used in Colorado (Weber and Wittmann 2001). Agency status indicates federal listing under the Endangered Species Act (LE = Listed Endangered; LT = Listed Threatened; C =Candidate for listing), and/or inclusion on the Sensitive Species lists of the Bureau of Land Management Colorado Office or US Forest Service Region 2. The percent of a species range in Colorado is calculated as: Endemic = 100% of range within Colorado, Very High = 75-99% of range (EOs) within Colorado, High = 50-75% of range (EOs) within Colorado, Medium = 25-50% of range (EOs) within Colorado, Low = <25% of range (EOs) within Colorado.

Scientific Name (State)	G/S Rank	Agency Status	% Range in Colorado	Primary Habitat
Aletes humilis	G2G3 / S2S3		Endemic	Cliff & Canyon
Aletes latilobus	G1 / S1	BLM	Medium	Cliff & Canyon
Aletes macdougalii ssp. *breviradiatus*	G3T2T3 / S1		Medium	Pinyon-juniper
Aliciella sedifolia	G1 / S1	USFS	Endemic	Alpine
Anticlea vaginatus	G2 / S2		Low	Cliff & Canyon
Aquilegia chrysantha var. *rydbergii*	G4T1Q / S1	BLM/USFS	Endemic	Forest
Asclepias uncialis ssp. *uncialis*	G3G4T2T3 / S2	BLM/USFS	Very High	Grassland
Astragalus anisus	G2G3 / S2S3	BLM	Endemic	Shrubland
Astragalus cronquistii	G2 / S2	BLM	High	Shrubland
Astragalus debequaeus	G2 / S2	BLM	Endemic	Pinyon-juniper
Astragalus deterior	G1G2 / S1S2		Endemic	Cliff & Canyon
Astragalus equisolensis	G5T1 / S1		Low	Pinyon-juniper
Astragalus humillimus	G1 / S1	LE	Low	Cliff & Canyon
Astragalus iodopetalus	G2 / S1		Medium	Shrubland
Astragalus lonchocarpus var. *hamiltonii*	G1 / S1		Low	Pinyon-juniper
Astragalus microcymbus	G1 / S1	BLM	Endemic	Shrubland
Astragalus missouriensis var. *humistratus*	G5T1 / S1	USFS	Endemic	Shrubland
Astragalus naturitensis	G2G3 / S2S3	BLM	High	Cliff & Canyon
Astragalus osterhoutii	G1 / S1	LE	Endemic	Shrubland
Astragalus piscator	G2G3 / S1	BLM	Low	Shrubland
Astragalus rafaelensis	G2G3 / S1	BLM	High	Pinyon-juniper
Astragalus schmolliae	G1 / S1		Endemic	Pinyon-juniper
Astragalus tortipes	G1 / S1	C	Endemic	Shrubland
Botrychium lineare	G1 / S1	C, USFS	Medium	Forest
Camissonia eastwoodiae	G2 / S1		Medium	Shrubland
Carex stenoptila	G2 / S2		Medium	Forest
Castilleja puberula	G2G3 / S2S3		Endemic	Alpine
Cirsium perplexans	G2G3 / S2S3	BLM/USFS	Endemic	Shrubland
Cleome multicaulis	G2G3 / S2S3	BLM	High	Wetland
Corispermum navicula	G1? / S1		Endemic	Barrens
Cryptantha gypsophila	G1G2 / S1S2		Endemic	Pinyon-juniper

Scientific Name (State)	G/S Rank	Agency Status	% Range in Colorado	Primary Habitat
Delphinium ramosum var. *alpestre*	G2 / S2		High	Alpine
Draba exunguiculata	G2 / S2	USFS	Endemic	Alpine
Draba graminea	G2 / S2		Endemic	Alpine
Draba smithii	G2 / S2	USFS	Endemic	Cliff & Canyon
Draba weberi	G1 / S1		Endemic	Alpine
Erigeron kachinensis	G2 / S1	BLM	Low	Cliff & Canyon
Erigeron wilkenii	G1 / S1		Endemic	Cliff & Canyon
Eriogonum brandegeei	G1G2 / S1S2	BLM/USFS	Endemic	Barrens
Eriogonum clavellatum	G2 / S1	BLM	Medium	Shrubland
Eriogonum coloradense	G2 / S2	BLM	Endemic	Alpine
Eriogonum pelinophilum	G2 / S2	LE	Endemic	Shrubland
Eutrema edwardsii ssp. *penlandii*	G1G2 / S1S2	LT	Endemic	Wetland
Gaura neomexicana ssp. *coloradensis*	G3T2 / S1	LT	Medium	Wetland
Hackelia gracilenta	G1 / S1		Endemic	Pinyon-juniper
Herrickia horrida	G2? / S1		Medium	Pinyon-juniper
Ipomopsis aggregata ssp. *weberi*	G5T2 / S2	USFS	Very High	Forest
Ipomopsis globularis	G2 / S2	USFS	Endemic	Alpine
Ipomopsis polyantha	G1 / S1	C, BLM/USFS	Endemic	Barrens
Lepidium crenatum	G2 / S2		Medium	Shrublands
Lesquerella calcicola	G2 / S2		High	Barrens
Lesquerella congesta	G1 / S1	LT	Endemic	Barrens
Lesquerella parviflora	G2 / S2	BLM	Endemic	Barrens
Lesquerella pruinosa	G2 / S2	BLM/USFS	Endemic	Barrens
Lesquerella vicina	G2 / S2	BLM	Endemic	Pinyon-juniper
Limnorchis zothecina	G2 / S1		Low	Cliff & Canyon
Lomatium concinnum	G2G3 / S2S3	BLM	Endemic	Shrubland
Lupinus crassus	G2 / S2	BLM	Endemic	Pinyon-juniper
Lygodesmia doloresensis	G1G2 / S1	BLM	High	Pinyon-juniper
Machaeranthera coloradoensis	G2 / S2	USFS	High	Alpine
Mentzelia rhizomata	G2 / S2		Endemic	Barrens
Mertensia humilis	G2 / S1		Medium	Shrubland
Mimulus gemmiparus	G1 / S1	USFS	Endemic	Cliff & Canyon
Nuttallia chrysantha	G2 / S2	BLM	Endemic	Barrens
Nuttallia densa	G2 / S2	BLM	Endemic	Pinyon-juniper
Oenothera acutissima	G2 / S2	BLM	Medium	Shrubland
Oenothera harringtonii	G2G3 / S2S3	USFS	Endemic	Grassland
Oonopsis foliosa var. *monocephala*	G3G4T2 / S2		Endemic	Grassland
Oonopsis puebloensis	G2 / S2		Endemic	Grassland
Oreocarya osterhoutii	G2G3 / S2	BLM	Low	Barrens
Oreoxis humilis	G1 / S1	USFS	Endemic	Alpine
Oxybaphus rotundifolius	G2 / S2		Endemic	Barrens
Oxytropis besseyi var. *obnapiformis*	G5T2 / S2		Very High	Shrubland
Penstemon breviculus	G3 / S2		High	Pinyon-juniper
Penstemon debilis	G1 / S1	C	Endemic	Barrens
Penstemon degeneri	G2 / S2	BLM/USFS	Endemic	Pinyon-juniper
Penstemon fremontii var. *glabrescens*	G3G4T2 / S2		Endemic	Shrubland
Penstemon gibbensii	G1 / S1	BLM	High	Barrens
Penstemon grahamii	G2 / S1		Low	Barrens

Scientific Name (State)	G/S Rank	Agency Status	% Range in Colorado	Primary Habitat
Penstemon harringtonii	G3 / S3	BLM/USFS	Endemic	Shrubland
Penstemon penlandii	G1 / S1	LE	Endemic	Shrubland
Penstemon scariosus var. *albifluvis*	G4T1 / S1	C	Low	Barrens
Penstemon scariosus var. *cyanomontanus*	G4T2 / S2		High	Pinyon-juniper
Phacelia formosula	G1 / S1	LE	Endemic	Barrens
Phacelia submutica	G4T2 / S2	C, USFS	Endemic	Barrens
Physaria bellii	G2G3 / S2S3		Endemic	Barrens
Physaria obcordata	G1G2 / S1S2	LT	Endemic	Barrens
Physaria pulvinata	G1 / S1		Endemic	Shrubland
Physaria rollinsii	G2 / S2		Endemic	Barrens
Potentilla rupincola	G2 / S2	USFS	Endemic	Cliff & Canyon
Ptilagrostis porteri	G2 / S2	BLM/USFS	Endemic	Wetland
Puccinellia parishii	G2 / S1		Low	Wetland
Salix arizonica	G2G3 / S1	USFS	Low	Wetland
Saussurea weberi	G2G3 / S2	BLM	High	Alpine
Sclerocactus glaucus	G3 / S3	LT	High	Shrubland
Sclerocactus mesae-verdae	G2 / S2	LT	Low	Barrens
Sisyrinchium pallidum	G2G3 / S2	BLM	High	Wetland
Spiranthes diluvialis	G2 / S2	LT	Medium	Wetland
Telesonix jamesii	G2 / S2		Very High	Cliff & Canyon
Thalictrum heliophilum	G2 / S2	USFS	Endemic	Barrens
Townsendia fendleri	G2 / S1		High	Barrens
Townsendia glabella	G2 / S2		Endemic	Barrens
Townsendia rothrockii	G2G3 / S2S3		Endemic	Alpine

Table 6. Scoring categories for plants

Color-coded summary categories reflecting the level of concern for each species were assigned using the scoring breaks shown. The color gradient ranges from red (highest level of concern) to green (lowest level of concern).

Color code	**Categorical:** Threats Score and Landscape Integrity Score	**Continuous:** Size, Quality, Protection Status, and Energy Development Potential Scores
Red (most at risk)	0	0-1.9
Orange	2-4	2.0-2.9
Yellow	5-6	3.0-4.9
Green (least at risk)	8-10	5.0-10

Biodiversity status

Biodiversity status for each species included scores for size, quality, and landscape integrity. These scores are intended to mirror the element occurrence ranking factors of size, condition, and landscape context that are standard components of Natural Heritage methodology. The size score incorporates the number of documented occurrences, known occupied area, and estimated range in Colorado for each plant species. Quality was evaluated as the percentage of occurrences with good viability (A or B rank, NatureServe 2002). For species in which many occurrences are lacking rank information, this metric is not meaningful and therefore shown as "unknown." This

metric works reasonably well for our rarest species (G1, G2, or T1, T2), but may need to be scaled appropriately for more common species in order to mitigate against the increasing difficulty of attaining the same proportion of good occurrences as the total number of occurrences increases. Landscape integrity was scored for the area within a ¼ mile buffer around each occurrence, using the GIS dataset developed for ecological system scoring (see Appendix A). The three scores were summarized as a biodiversity status score. Because the landscape integrity dataset represents a coarser scale of analysis, it was downweighted in the summary to reflect its relative lack of precision.

Threat status

Threat status was evaluated for the primary threat listed in the element ranking record (CNHP 2008). Threat status was evaluated by ranking the scope, severity, and immediacy for the primary threat for each species (See Appendix F for details). Categorical threat scores were calculated from this information, and are intended to reflect the degree to which a species is threatened by the most critical known threat.

Protection status

Because land ownership status does not necessarily indicate effective management for an individual species, this score is evaluated as land management status. Current land management status was evaluated using the Colorado Ownership, Management and Protection (CoMAP) GIS dataset (Wilcox et al. 2007), in conjunction with the Conservation Management Status Measures developed by The Nature Conservancy (Supples et al. 2007). See Appendix F for a detailed description of scoring methodology. This score represents an overall protection level for the species, and does not indicate which occurrences are best protected.

Other scores

Energy development potential was scored for the area within a ¼ mile buffer around each occurrence, using the GIS dataset developed for ecological system scoring. Species were also characterized by the primary habitat type in which they occur, and by the degree to which their global range occurs in Colorado. Additionally, for each plant species, a recommended conservation action is included with the results of the scorecard calculations. Recommendations include on-the-ground protection, field inventory, taxonomic work, or monitoring (see Appendix F for details). Finally, a confidence score for each species is included that reflects the completeness of the data used in the scoring process. All database-derived values were current as of May 2008.

Results

Overall conservation status and priority

One desired outcome for scorecard is to identify which rare plants are most in need of conservation attention. The first priority for evaluation of conservation need is plants having "red or "orange" scores in two or more categories. These plants have imminent threats and may have a limited distribution with little protection. The lowest priority for evaluation of conservation needs is plants with "green" or "yellow" scores in all categories. Prioritization methods and the number of plants analyzed falling within each category are shown in Table 7 and summarized in Figures 6 and 9. Methods shown in the table below represent a decision tree

beginning with the scores for threat status, together with the color combinations of the other two scores. For instance, any species with a red score for threat status and red or orange for biodiversity and protection is regarded as poorly conserved. A species with an orange threat status score and at least one green score for biodiversity or protection is considered moderately conserved. There may be species that are naturally low in abundance even though they are little impacted by anthropogenic activities. If such species are otherwise well protected and little threatened, these are considered moderately or effectively conserved, but inherently vulnerable. That determination will depend on more detailed information about the species in question. For instance, a species with only one known population may score as effectively conserved, but is still more vulnerable to extinction than other species in that category. See Appendix G for the complete listing of species that fall within each category and their scores.

Table 7. Prioritization methods for plants.

The color category of threat status scores, in combination with the color categories of biodiversity and protection scores, are used to assign each species to an overall conservation status category. Not all possible color combinations are represented by species in this analysis. R=Red, O=Orange, Y=Yellow, G=Green, RO=Red or Orange, YG=Yellow or Green. Categories marked by * indicate species that may be naturally low in abundance even under adequate threat abatement and protection. Such species are considered inherently vulnerable, and may never achieve effectively conserved status.

IF	AND	AND	THEN	Number of species	
Threat Status	**Biodiversity**	**Protection**	**Overall Conservation Status**	Endemic or high-med % in Colo.	Low % range in Colo.
R	R O	R O	Poorly Conserved	2	
R	Y G	R O		4	
R	R	Y G		0	
O	R	R O		2	1
O	R	Y G		2	1
O	O	R O		1	
O	O	Y G	Weakly Conserved	6	1
R	O	Y G		3	
R	Y G	Y G		5	
O	Y G	R O		3	
Y	R O	R O		3	
G	R O	R O		6	
G	Y	R O		1	
O	Y	Y		6	
O	G	Y	Moderately Conserved	0	
O	Y	G		8	1
O	G	G		1	
Y	R O	Y G		6 *	2
Y	Y G	R O		1	2
G	R O	Y G		10 *	2
G	G	R O		0	
Y	Y	Y		2	
Y	G	Y	Effectively Conserved	0	
Y	Y	G		4	1
Y	G	G		0	1
G	Y G	Y G		14	1

Status scores

Results for the six scoring categories are summarized in Table 8. Individual occurrence locations color coded by score are shown in Figure 10 a-g. Example graphs for a selection of species are shown in Appendix H.

Biodiversity status scores indicate that while small population size is obviously a critical factor for rare plants, high quality and landscape integrity may compensate for low numbers of individuals in some situations. As expected for the rarest plants, size scores were distributed on the low end of the scale, ranging from 0 to 5.8. The score considers only Colorado occurrences and not all occurrences rangewide. Therefore, a G5 (globally common) S1 (state critically imperiled) species could receive the same score as a G1 (globally critically imperiled) S1 species, although no globally common species were included in the analysis. Two of the three G3 species included in the analysis and one G2G3 species scored in the green category for size. Size scores are poor to fair for more than 60% of the species analyzed. Because these species are our rarest, however, low population size may be natural for this group. In contrast, for many documented occurrences, quality and landscape integrity is still high enough to ensure that efforts to abate threats and provide on-the-ground protection have a good chance of succeeding. Of the 80 species receiving a quality score, 58 (72.5%) scored good to very good. The average score for the 80 species receiving a quality score was 4.8 (23 species were not scored for quality). Landscape integrity scores were fairly evenly distributed, with an overall average of 4.8. The spatial distribution of landscape integrity scores primarily reflects the distribution of urban development, agriculture, and transportation development (Figure 10c). Biodiversity scores averaged 3.0, largely due to the low size component characteristic of rare species.

Threat status scores ranged from 0 to 10, but the most frequent score was 2, indicating a moderate to severe, imminent threat to 20-60% of the population for those species. Threat status for 45% of our rare plant species is poor to fair, especially for species occurring in barrens and shrubland habitats. In general, species of higher elevations are less threatened, while those occurring in the Colorado's western plateaus and valleys are most threatened (Figure 10d). Although not used in scoring, the mean energy development potential score was 5.9.

Protection status scores for Colorado's rare plants are mixed, with a mean of 4.9. Overall, about half of the species, particularly those of higher elevations, have very good protection status scores (Figure 10f). Poor protection scores are concentrated in the barrens, shrubland, pinyon-juniper, and wetland habitats.

Table 8. Number of plant species in each scoring category.

The number of species in each color-coded scoring group is shown for the scorecard categories. Some species lack sufficient information for the assignment of a quality score, and are reported as "unknown". The color gradient ranges from Red = most at risk to Green = least at risk.

Biodiversity Status			Threat Status	Protection Status
Number of Species				
Size	Quality	Landscape Integrity	Threat status	Protection Status
36	13	18	14	14
27	9	25	33	12
37	21	26	22	27
3	37	34	34	50
	23 unknown			

Figure 6. Number of species in each conservation status category.

This figure summarizes the numbers presented in Table 7, representing the conservation status of 100 out of 113 of Colorado's G1G2 plant species, and three G3 species. The uncolored portion of the bar represents species with a low percentage of their range in Colorado. The Colorado status of these species may not reflect their rangewide status.

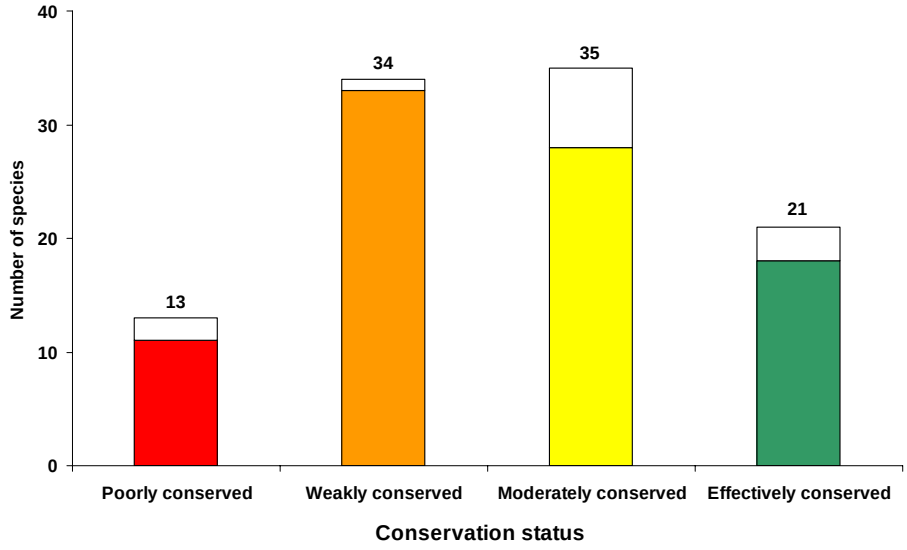


Figure 7. Map of rare plant occurrences by overall conservation status.

The figure shows a spatial representation of species overall conservation status using point locations that represent documented occurrences of 100 out of 113 of Colorado's G1G2 plant species, and three G3 species. Because the analysis is at the species level, all points for a species are the same color on a particular map, however, the statewide pattern of scores is of interest.

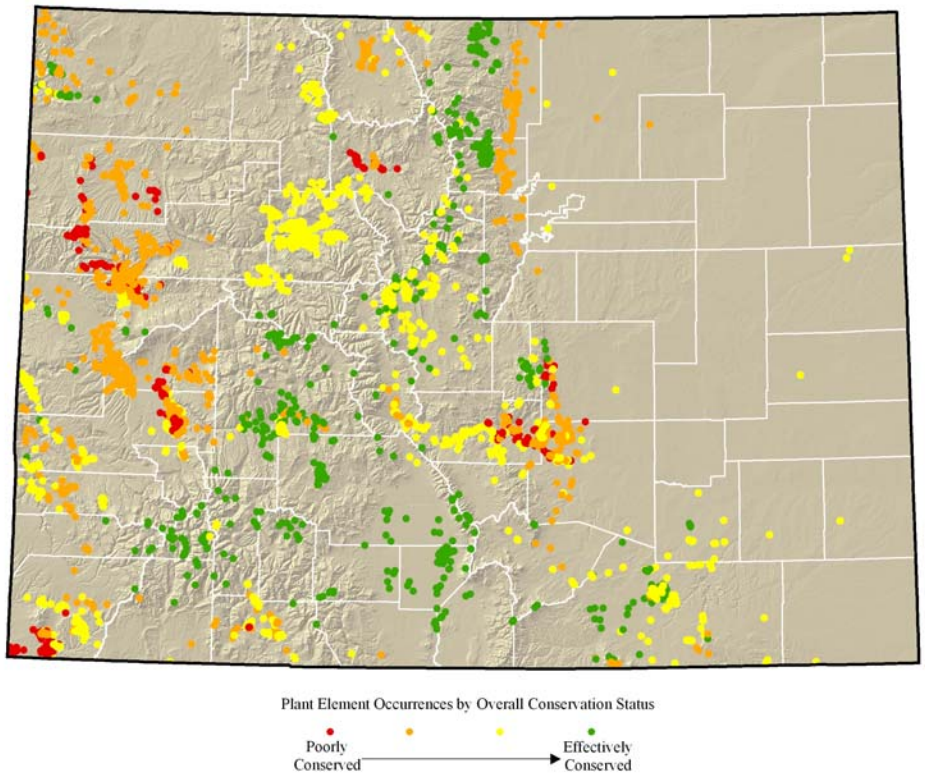
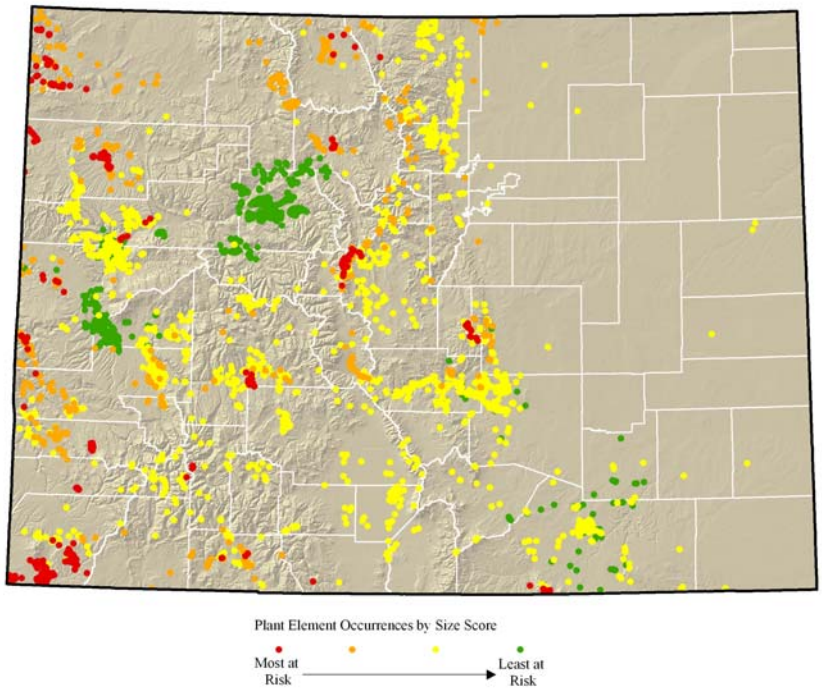


Figure 8. Maps of rare plant occurrence scores.

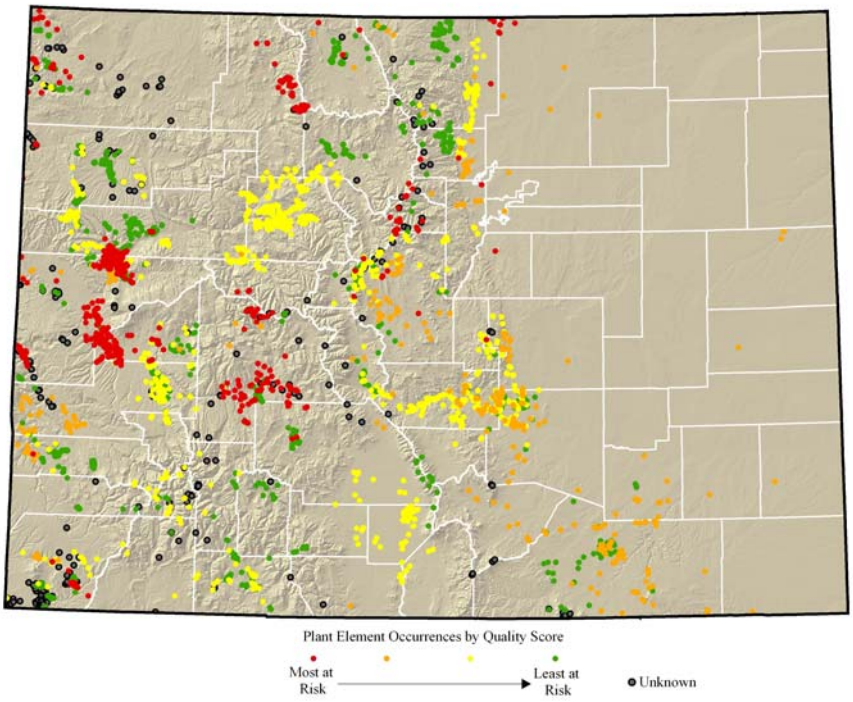
Maps a) through g) are spatial representations of species scores using point locations that represent documented occurrences for the 103 species analyzed. Because the analysis is at the species level, on each map all points for a species are the same color.

(a) Plant species size scores.

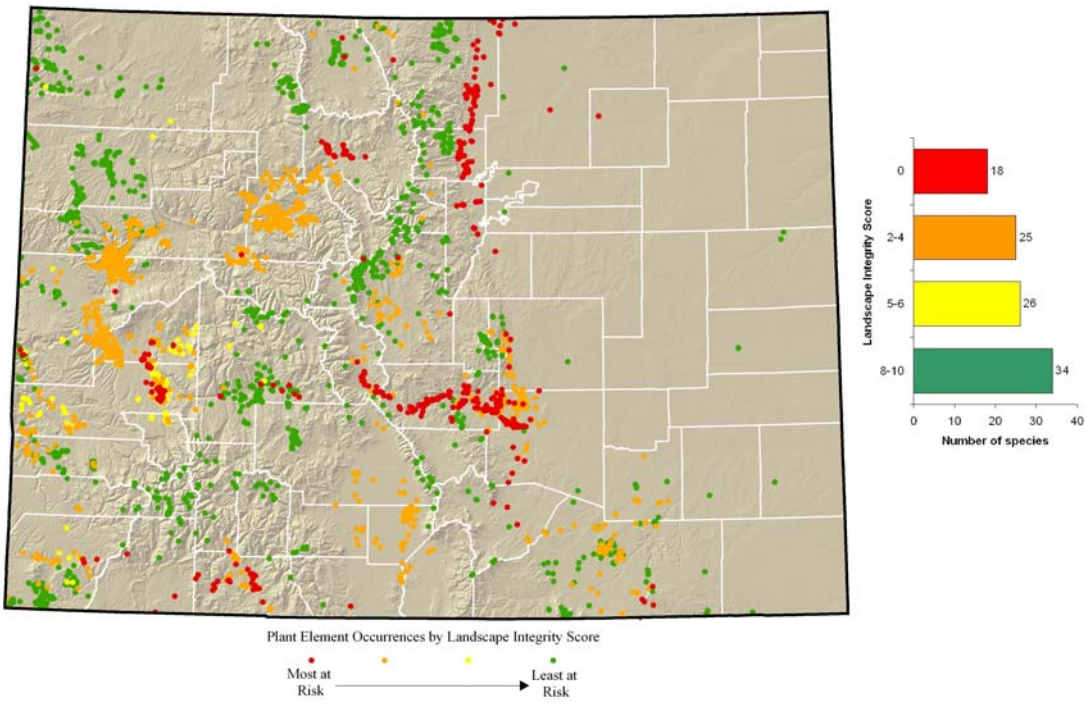
The three species with green size scores include two of the G3 species (*Penstemon harringtonii* and *Sclerocactus glaucus*), and one G2G3 species (*Oenothera harringtonii*).



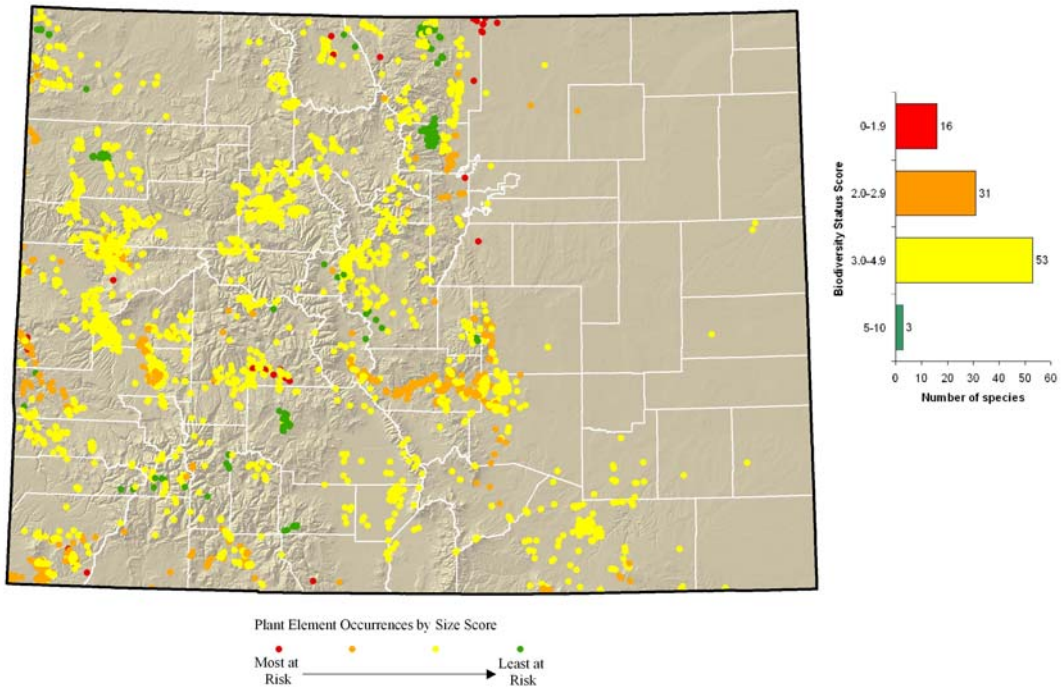
(b) Plant species quality scores.



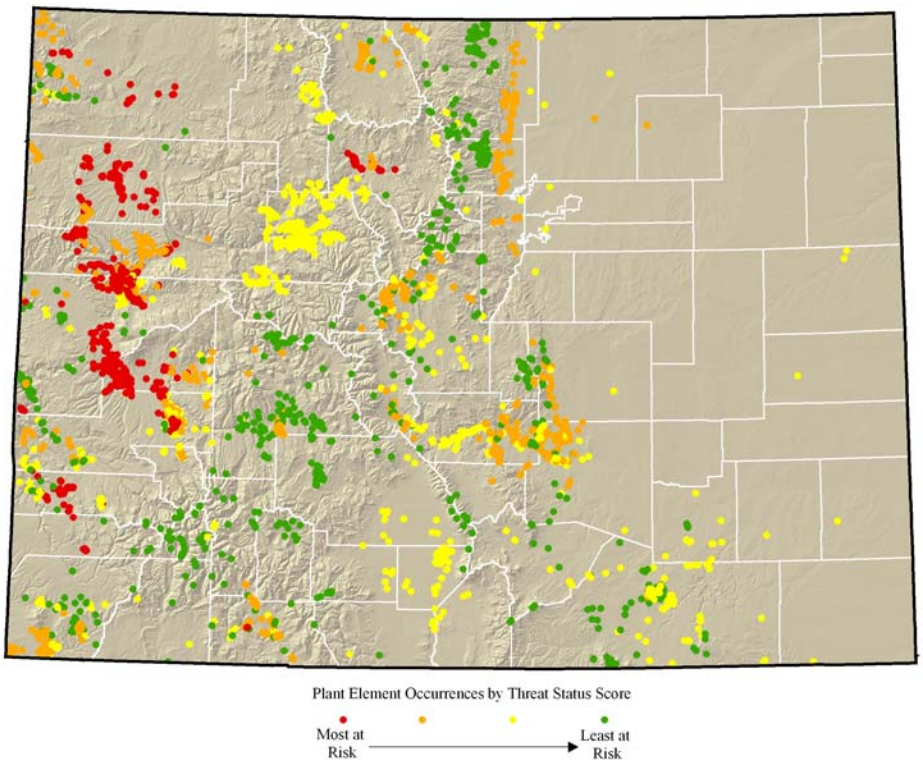
(c) Plant species landscape integrity scores.



(d) Plant species biodiversity status scores.

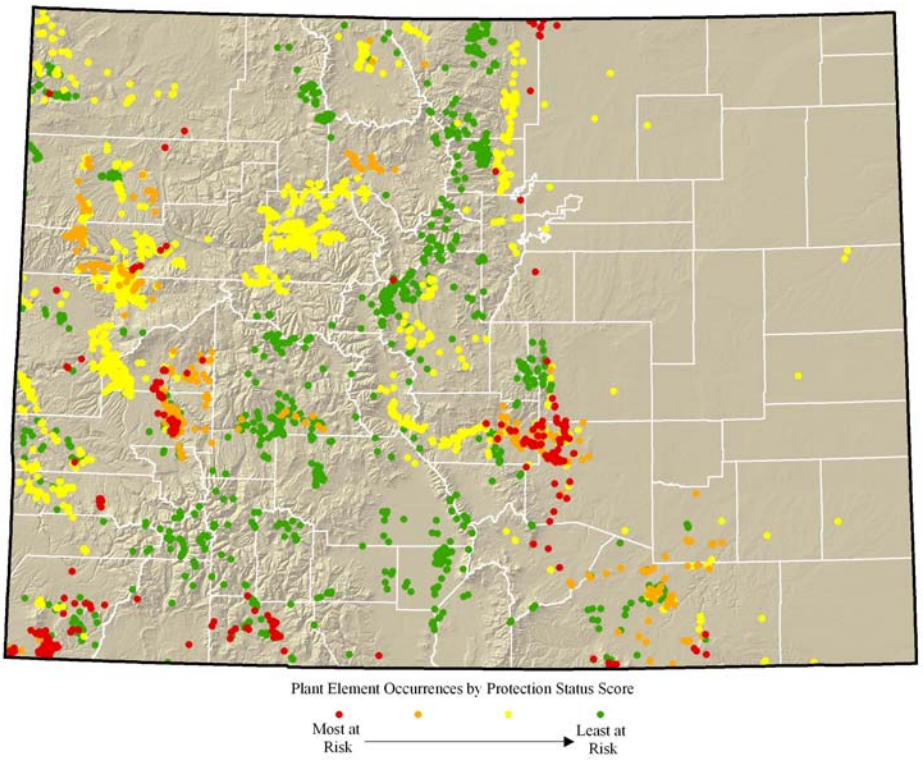


(e) Plant species threat status scores.

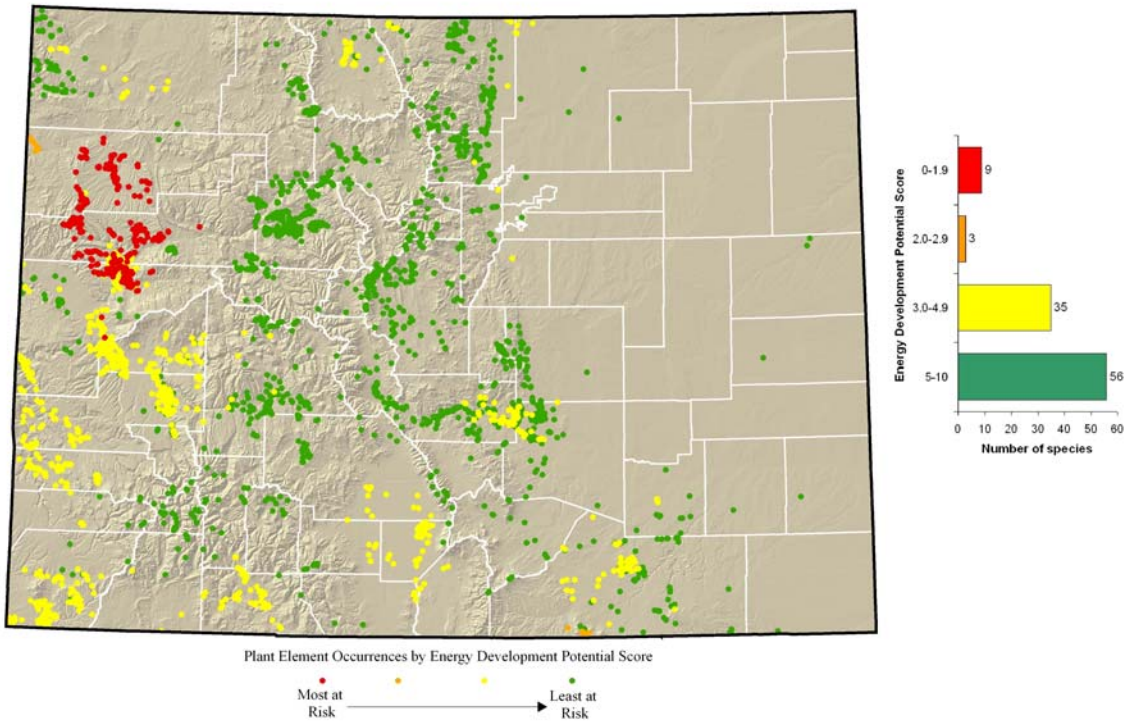


(f) Plant species protection status scores.

Although all points for a species show the same color of the average protection level, the spatial patterns reflect the underlying public and private land ownership in the state.



(g) Plant species energy development potential scores.
A high potential threat from energy development is a factor for about 10% of the species analyzed. The species most at risk from energy development are concentrated in the Piceance Basin and Roan Plateau areas.



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Rare plants by habitat type

Average scores for the three biodiversity sub-categories, threat status, and protection status for plants within eight different habitats are shown in Figure 11 a-h. Numbers of species by score category in each habitat are shown in Figure 10 a-f. Of the 46 species with the lowest threat status scores (red or orange, indicating a high level of threat), the majority (72%) are within the barrens and shrubland habitats (Table 9).

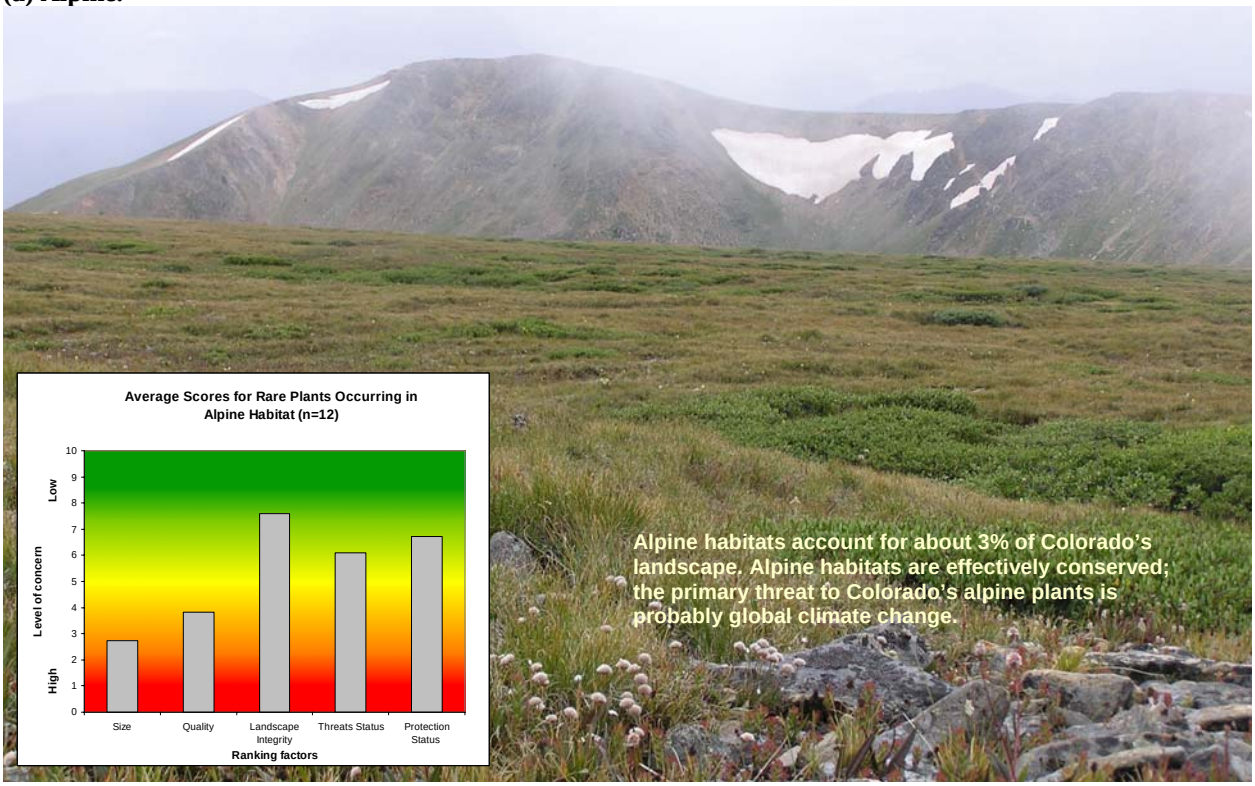
Table 9. Number of plant species and threat status scores by primary habitat.

The approximate percentage of Colorado's total acreage occupied by each habitat type is shown, together with the number of rare plant species primarily occurring in that habitat, and the number and percentage of those species having a high level of threat).

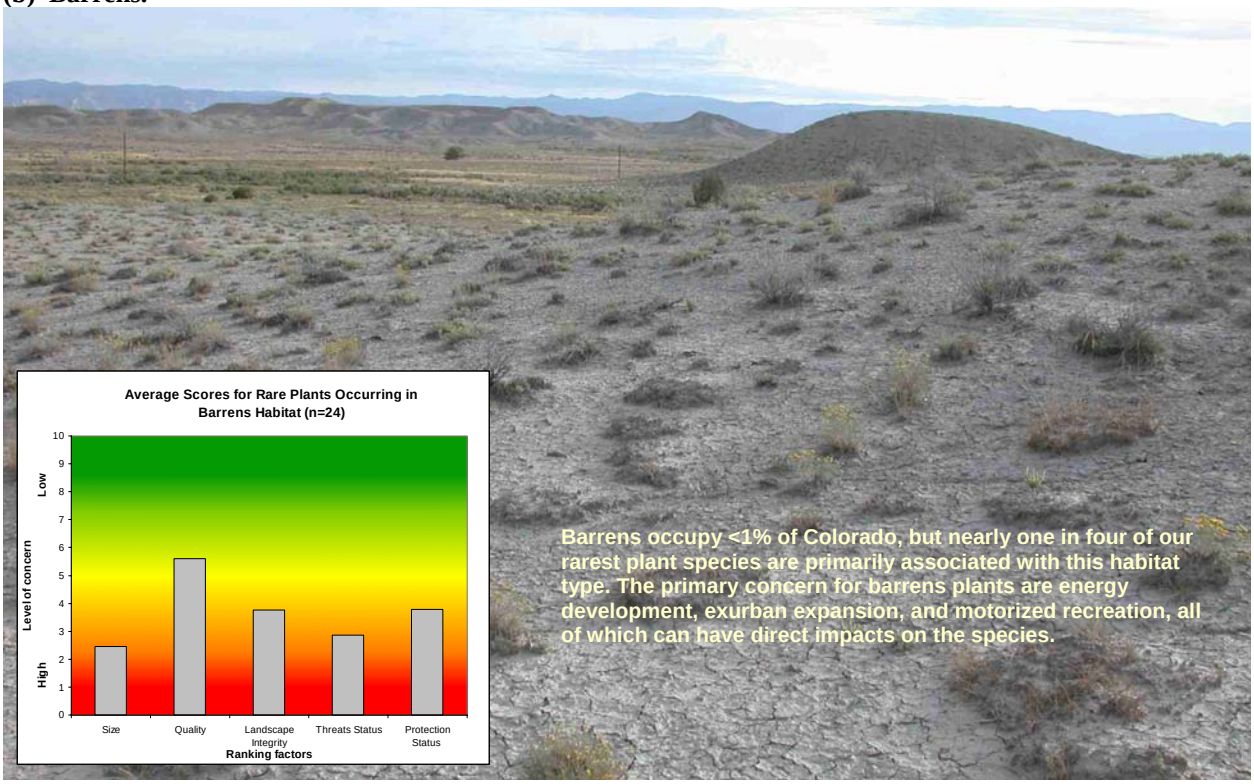
Habitat	% of Colorado Landscape	Number of Plant Species in Scorecard	Number of species in "most threatened" (red or orange) categories	Percent of species in "most threatened" (red or orange) categories
Barrens	< 1%	24	19	79%
Shrubland	19%	22	15	68%
Wetland	2%	8	3	38%
Pinyon-Juniper	10%	16	5	31%
Forest	21%	4	1	25%
Grassland	22%	4	1	25%
Alpine	3%	12	3	25%
Cliff and Canyon	< 1%	13	0	0%

Figure 9. Rare plant habitat types.

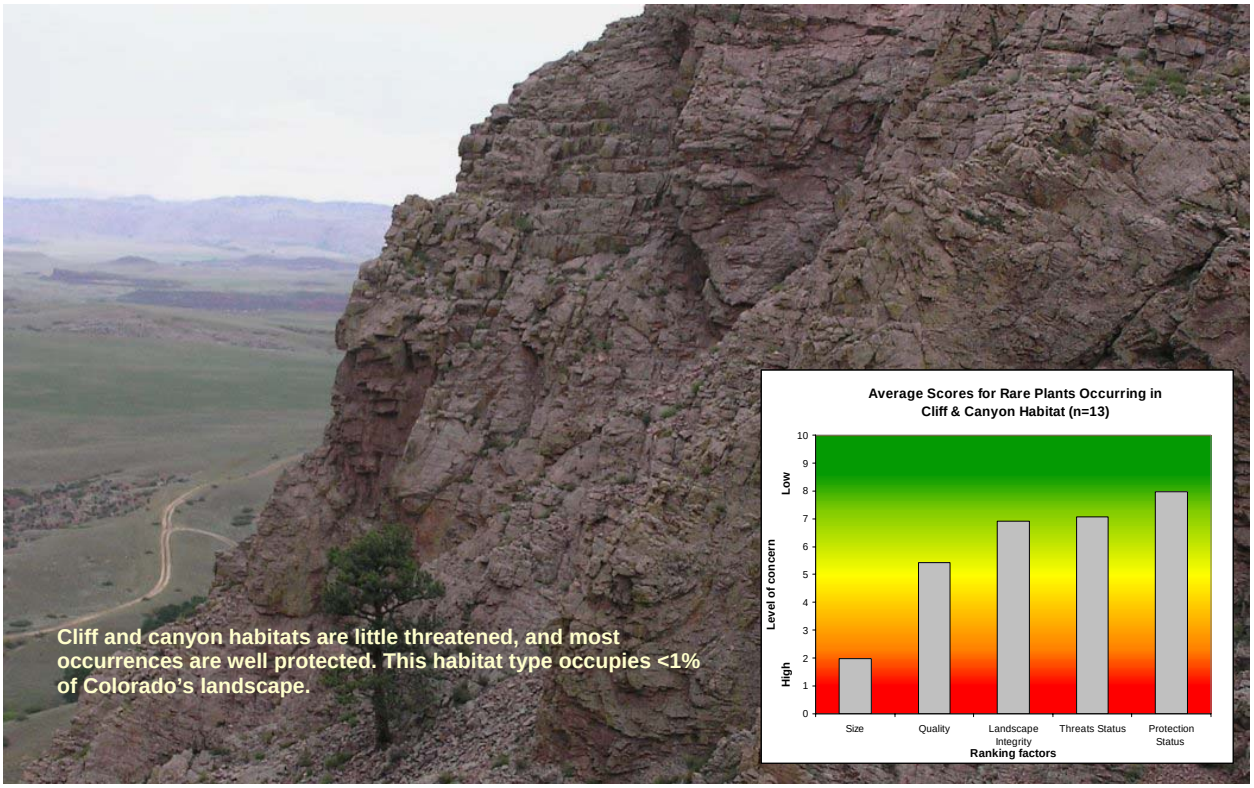
(a) Alpine.



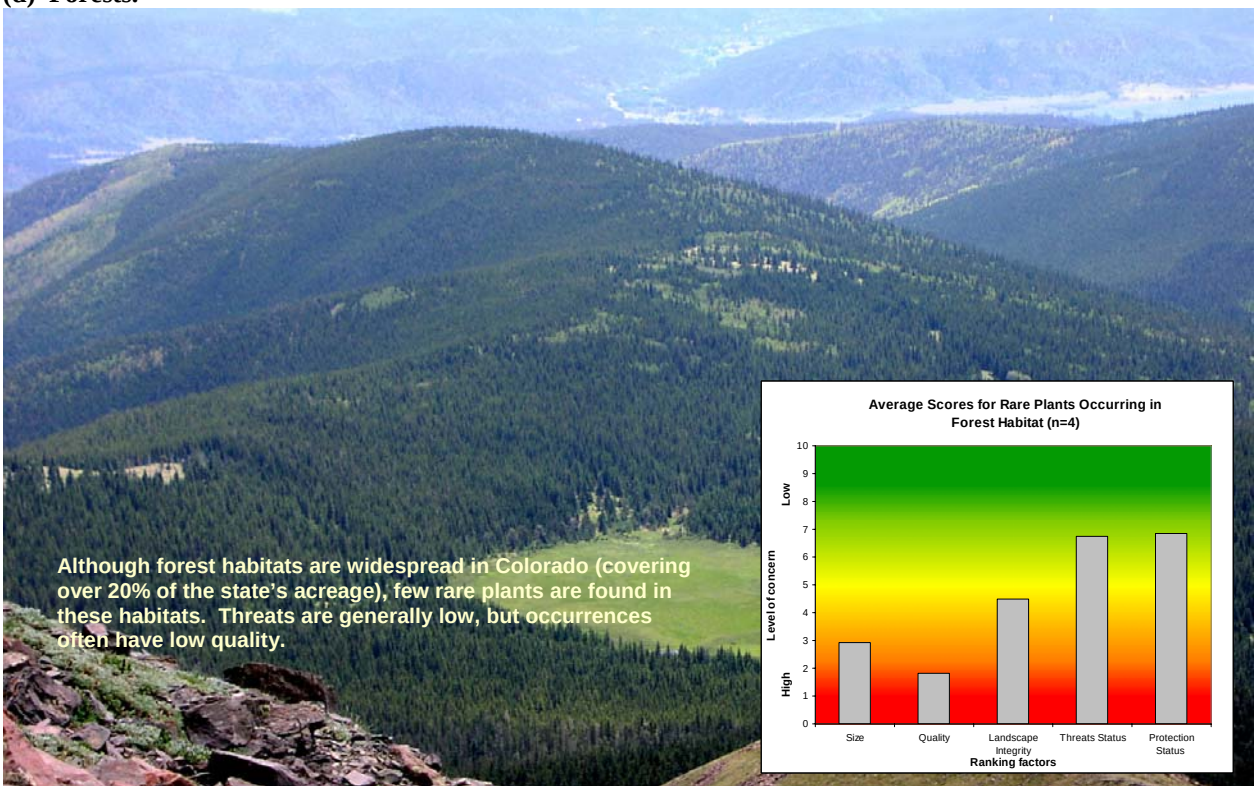
(b) Barrens.



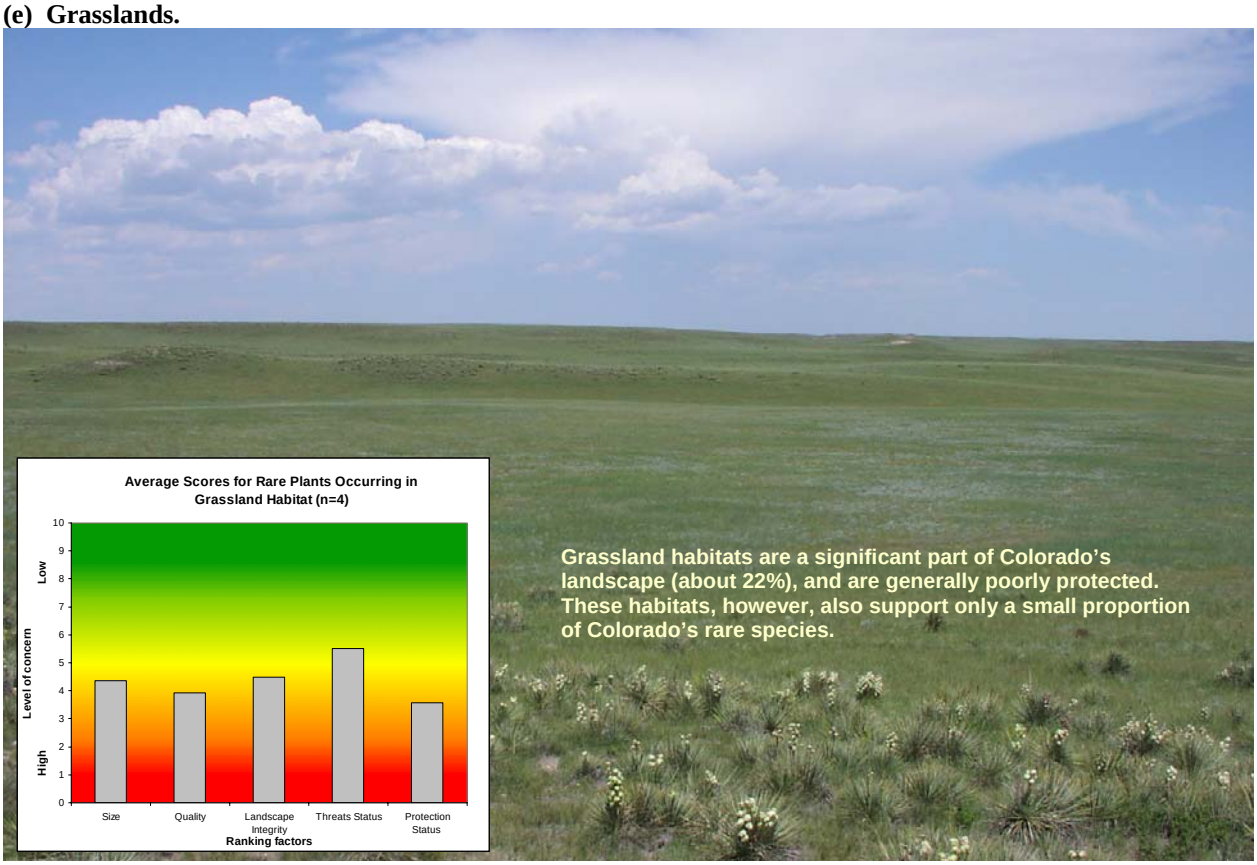
(c) Cliff and Canyon.



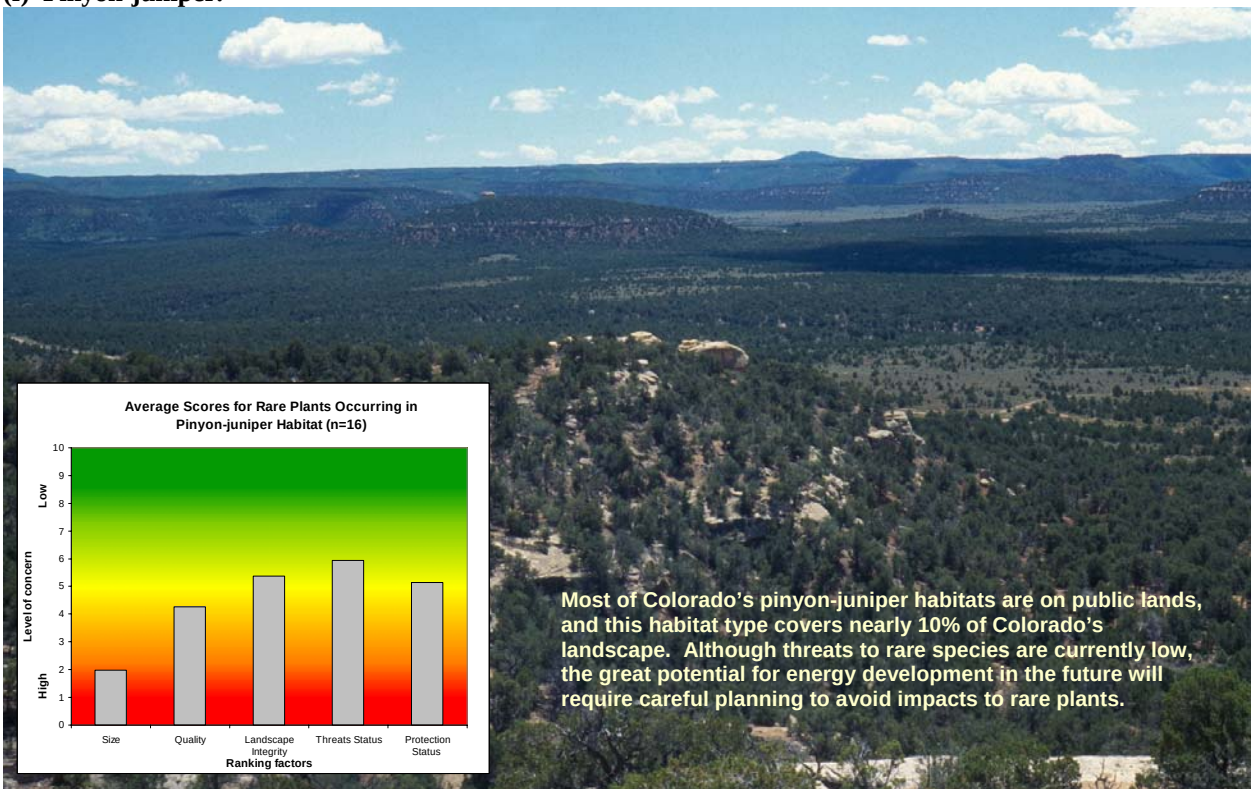
(d) Forests.



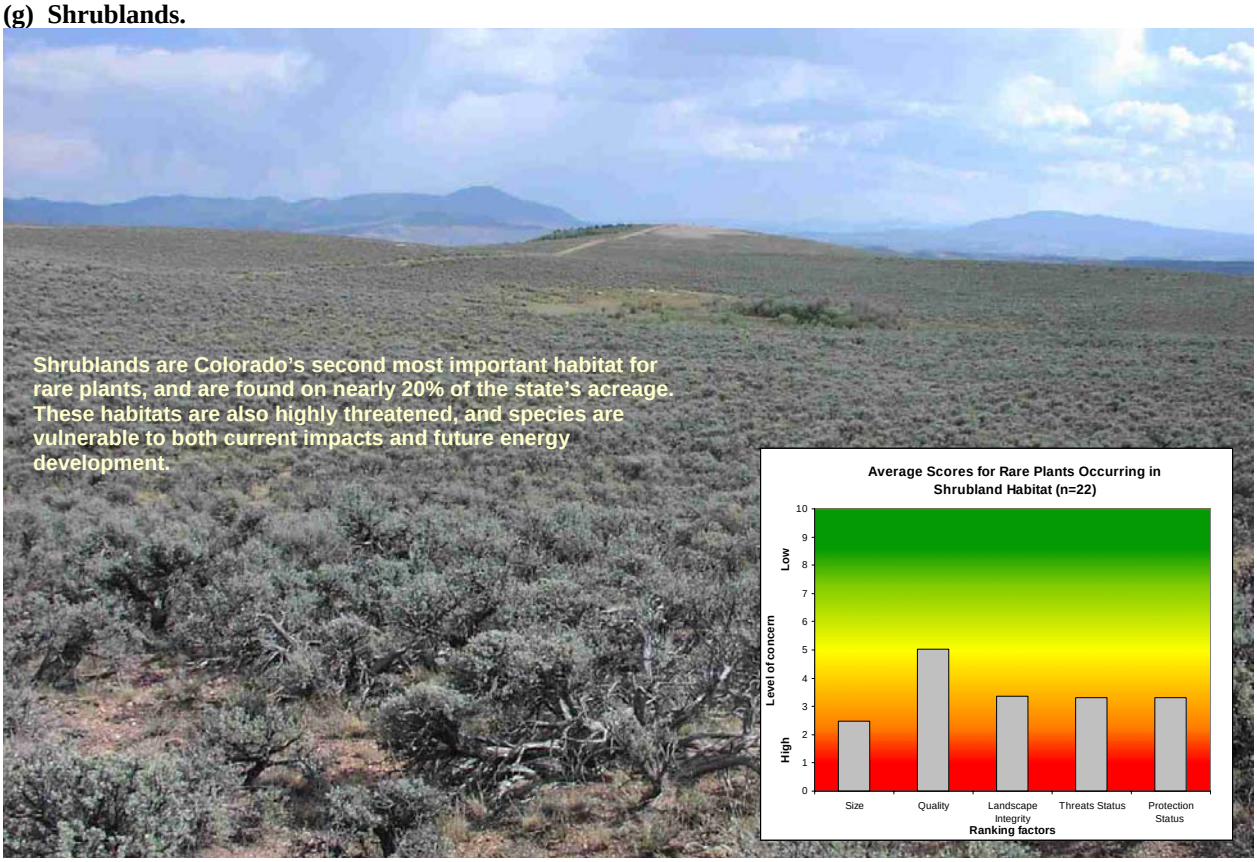
(e) Grasslands.



(f) Pinyon-juniper.



(g) Shrublands.



(h) Wetlands.

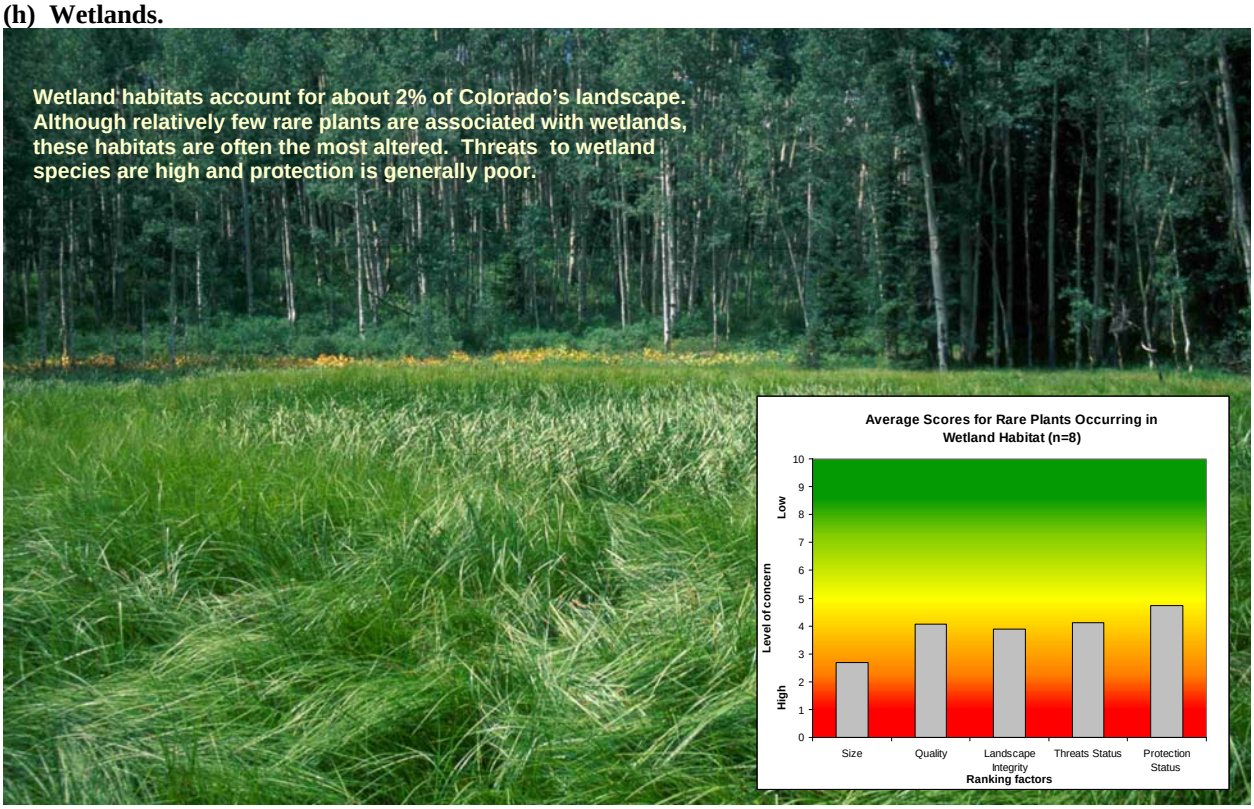
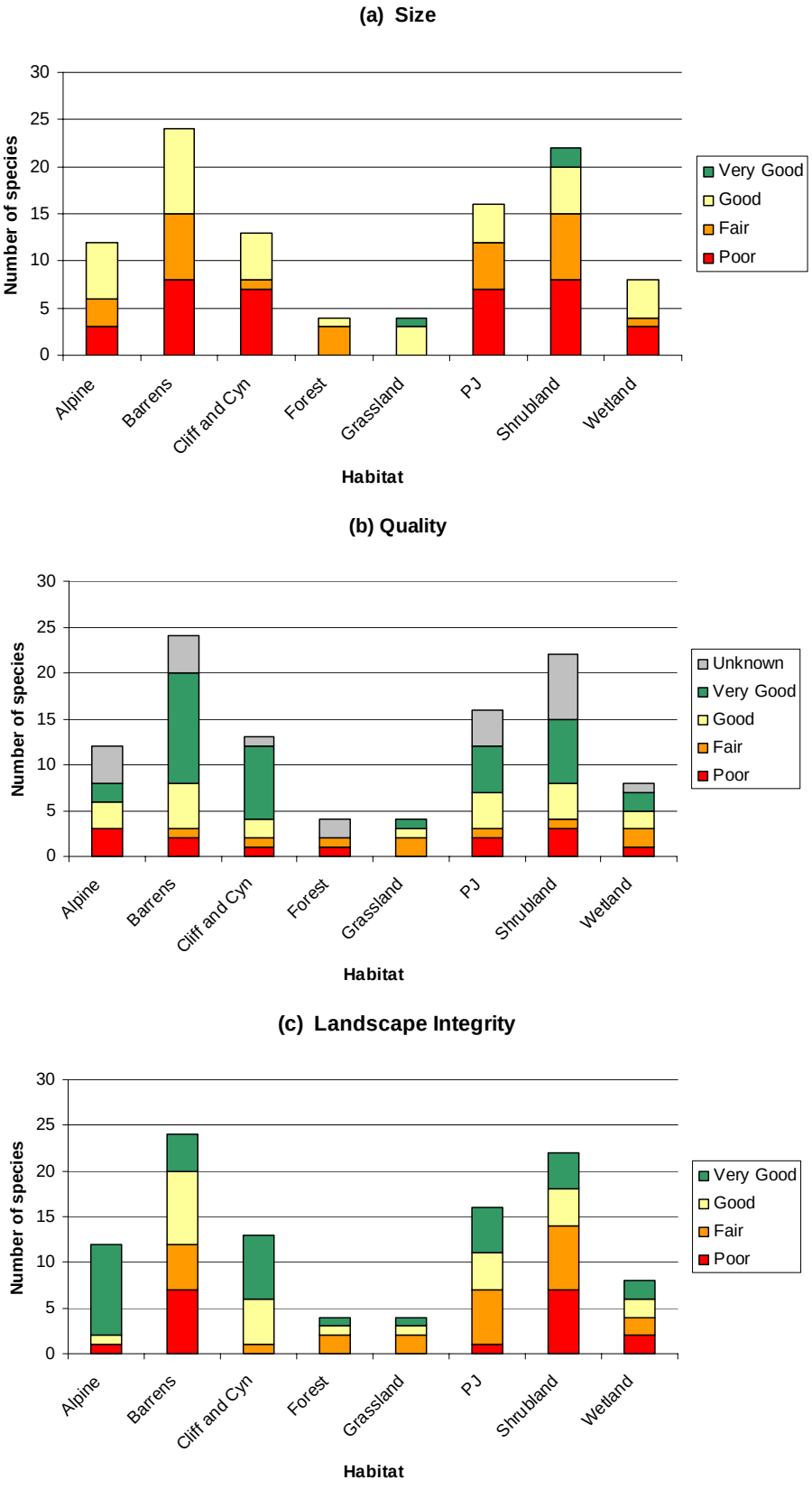
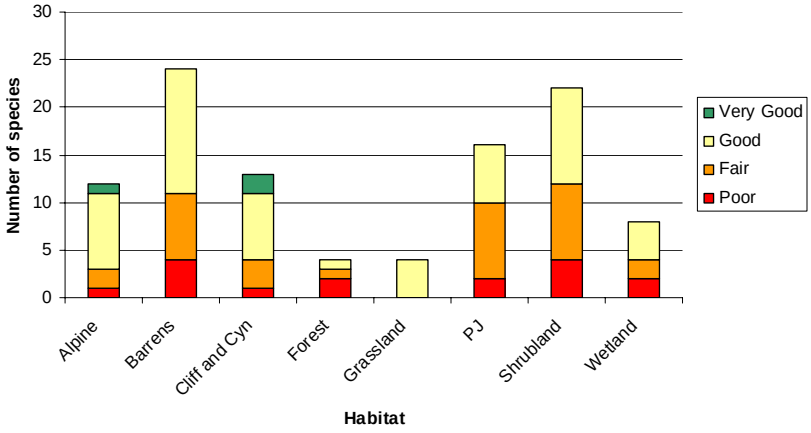


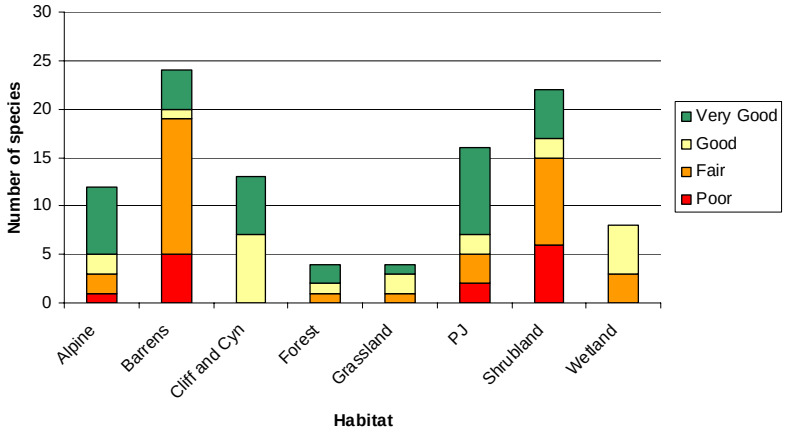
Figure 10. Rare plant scores within habitat type.



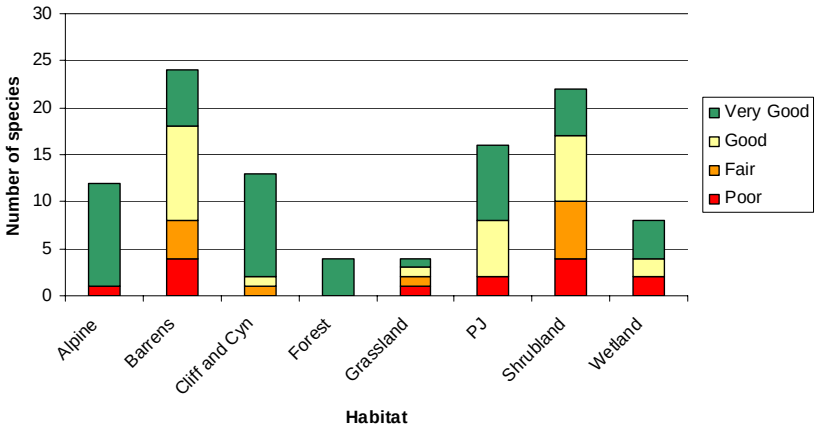
(d) Biodiversity Status



(e) Threat status



(f) Protection status



Discussion

An important conclusion from this analysis is that many of Colorado's rare plants are reasonably well conserved. Excluding species with a low percent of their range in Colorado, 51% of the rare species analyzed here are in the moderately or effectively conserved categories (Figure 6). A few of these species are extremely rare (one or two known occurrences), but are relatively unthreatened and well protected. In general, these species should be considered inherently vulnerable, and monitored carefully. Nearly half of Colorado's imperiled species are poorly or weakly conserved, often due to significant threats and lack of protection. Although many of Colorado's rare plants need more protection, the good news is that because many high quality occurrences are known to exist, there is still time for actions that will ensure effective conservation for these species.

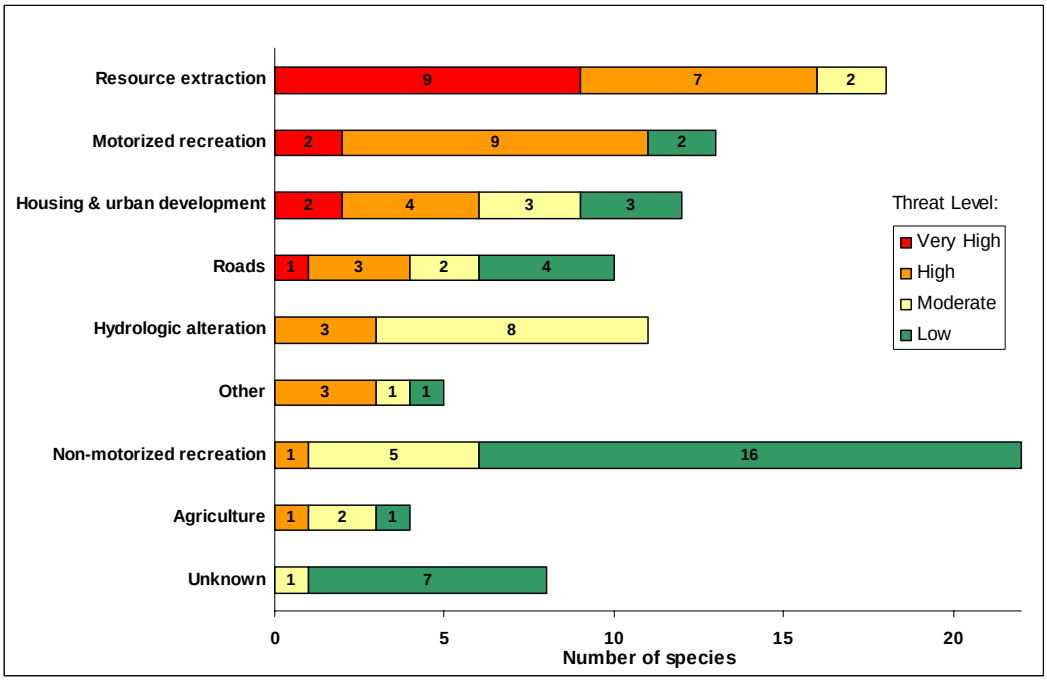
Our analysis also revealed that occurrence quality information for many species needs to be augmented. Scoring confidence could also be improved with more detailed information on the distribution of rare species whose range overlaps states adjacent to Colorado. Moreover, although many of the rare plants occur within areas that appear to have relatively good landscape integrity, the scale of analysis was small enough that this may not reflect true landscape-scale effects for a particular occurrence or species. Consequently, field inventory is a priority for many species, both to improve occurrence quality data, and to validate the results of the spatial analysis for landscape integrity and energy development potential.

The primary threats to Colorado's rare plants are varied, but the greatest impact is likely to come from only a few threat types. One third of Colorado's rare plant species are at risk from resource extraction, motorized recreation, housing and urban development, and roads. Figure 11 shows the number of species with red (most at risk), orange, yellow, or green (least at risk) threat status scores in each primary threat type, summarizing the relative importance of each threat type across all species. The overall threat score is a summary of the scope, severity, and immediacy of the primary threat to each species (See Appendix F). Although non-motorized recreation is the primary threat for the highest number of species (21), the majority of these species are relatively unthreatened (i.e., have yellow or green scores) by such impacts, usually because the scope of the threat is limited in area. In contrast, motorized recreation is the primary threat for 14 species, 11 of which have red or orange threat status scores. The overall threat from motorized recreation is therefore greater, typically because it affects a greater proportion of the habitat.

Rare plants occurring in the barrens or shrublands habitat types are the most likely to have threat status scores in the red or orange zone, indicating that conservation efforts focused on these habitat types can make the greatest difference for rare species. Barrens occupy less than 1% of Colorado acreage, but support more than 20% of the rarest species. These habitats are naturally sparsely vegetated lands often associated with specific geologic substrates such as shale. Barrens habitat is threatened by energy development, exurban growth, and impacts from motorized recreation. Shrubland habitats that support rare plant species are primarily those dominated by various types of sagebrush; these habitats are also threatened by widespread energy development.

Figure 11. Primary threat types for plants.

Summary of primary threat types, and the number of species most affected by each type. Resource extraction includes oil and gas development, oil shale mining, and other types of mining. Motorized recreation is distinct from other types of recreation, such as hiking, camping, hunting, etc. Roads include both construction of new roads and maintenance of existing rights of way. Agriculture includes development of new tilled areas, and incompatible grazing practices. The Other category includes effects of exotic species or their control, collecting, and herbivory at a level that threatens the entire species.



Nearly 60% of Colorado's rare plants have received some attention from federal agencies. In addition to the 13 species listed as threatened or endangered under the Endangered Species Act, 32 of the species in this analysis are on the BLM Colorado Office Sensitive Species List, and 23 are on the US Forest Service Region 2 Sensitive Species List. Land ownership patterns in Colorado reflect this situation; federal lands support nearly two-thirds of the well-documented acreage of G1 and G2 (or T1 and T2) species included in this analysis. Privately owned lands are also important to the conservation of Colorado's rare plant species, accounting for over a quarter of the acreage of G1, G2, T1, or T2 species. The protection analysis presented here could be improved by focusing on the individual occurrences. We currently lack accurate protection information for many occurrences; a more detailed analysis of protection patterns would enable us to correlate protection level and quality for each occurrence, and to focus on identifying the highest quality occurrences needing protection.

On a statewide basis, roughly half of the rare plant species evaluated (all of which are considered imperilled on a global scale) are reasonably well conserved. Even so, a significant number of rare plants in Colorado are inadequately conserved. Moreover, the future effects of global climate change were not addressed in this evaluation, and are likely to add to the impacts even on species that are currently well conserved. The persistence of high quality occurrences of many these species means that there is still time to act to improve the conservation of rare plant species in Colorado.

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APPENDIX A: MATRIX ECOLOGICAL SYSTEMS SCORECARD METHODOLOGY

These calculations are based on a smoothed version of SWReGAP landcover (USGS 2004) using a focal majority window of ½ mile radius (CNHP 2006a). The focal majority analysis reduces the number of small inclusions of disparate systems within larger system patches, to create a more generalized landcover appropriate for statewide analysis of matrix systems. Highways (CDOT 2004) were then added to represent anthropogenic fragmentation of matrix systems. The resolution of the grid is 30m cells (900 m^2 or 0.2 acre), however, all aerial measurements are rounded to the nearest thousand acres because they are based on an abstraction of data with only a modest level of accuracy to begin with.

All scores are normalized to fall between 0 – 10, inclusive, with 10 being the best possible score.

Ecological systems names used in this document are crossreferenced to the SWReGAP landcover types below:

System	Includes SWReGAP types
Alpine Tundra	1, North American Alpine Ice Field – note; none in focal majority grid 2, Rocky Mountain Alpine Bedrock and Scree 4, Rocky Mountain Alpine Fell-Field 69, Rocky Mountain Dry Tundra 86, Rocky Mountain Alpine-Montane Wet Meadow
Aspen	22, Rocky Mountain Aspen Forest and Woodland 38, IMW Aspen-Mixed Conifer Forest and Woodland Complex
CO Plateau PJ	46, Colorado Plateau Pinyon-Juniper Shrubland 36, Colorado Plateau Pinyon-Juniper Woodland 09, CP Mixed Bedrock Canyon and Tableland
Lodgepole	29, Rocky Mountain Lodgepole Pine Forest
Oak-Mixed mtn shrub	41, RM Gambel Oak-Mixed Montane Shrubland
Ponderosa	34, Rocky Mountain Ponderosa Pine Woodland
Sagebrush	48, Inter-Mountain Basins Big Sagebrush Shrubland 62, Inter-Mountain Basins Montane Sagebrush Steppe
Sandsage	43, Western Great Plains Sandhill Shrubland 75, WGP sandhill prairie, if any
Shortgrass	74, WGP Shortgrass Prairie
Spruce-fir	26, RM Subalpine Dry-Mesic Spruce-Fir Forest and Woodland 28, RM Subalpine Mesic Spruce-Fir Forest and Woodland
SRM PJ	35, Southern Rocky Mountain Pinyon-Juniper Woodland

Biodiversity Status (Abundance/Quality)
System name

Total system acreage in Colorado
Description: Total area, in acres, for the system, and for each patch. This value is used to calculate columns (C) and (D) below only. All other percent area calculations are based on column (C) below.
Interpretation: This is the total amount of this system within the state, regardless of spatial configuration (size and location of patches). For individual patches, this is the total size of the patch.

Minimum size patches
Description: The proportion of total acreage in patches equal to or larger than the minimum size. Minimum size is based on occurrence specification for C-ranked size, but does not imply that patches are occurrences. This figure is used in all percent area calculations below. This column does not apply to individual patches.
Interpretation: This score, in combination with (D) below, gives an indication of the patch size distribution of the system and how this may change over time. More acreage in larger patches is preferred for overall system viability.

System	minimum size (ac)	System	minimum size (ac)
Alpine Tundra	10,000	Sagebrush	30,000
Aspen	20,000	Sandsage	14,000
CO Plateau PJ	30,000	Shortgrass	50,000
Lodgepole	30,000	Spruce-fir	20,000
Oak & Mixed Mtn Shrub	5,000	SRM PJ	30,000
Ponderosa	30,000		

Preferred size patches

Description: The proportion of total acreage in large (A-ranked) patches (patches of at least 4x minimum size). For individual patches, this score represents the size of the individual patch relative to the large patch size with scores ranging from 5 to 10.
Interpretation: This score, in combination with (C) above, gives an indication of the patch size distribution of the system and how this may change over time. More acreage in larger patches is preferred for overall system viability. For individual patches, this score indicates how close the patch size is to the preferred size.

Landscape context

Description: Percent natural landscape within ½ mile of patches equal to or larger than the minimum size. Natural landscape was based on original SWReGAP landcover.
Interpretation: This score gives an indication of the landscape context of the system or the individual patch. Decreasing percent natural landscape indicates that the more viable patches of the system are becoming functionally isolated from each other.

Landscape Integrity score

Description: This is calculated using a "landscape integrity" GIS layer that represents cumulative impacts from oil and gas wells, surface mining, urban development, agriculture, and roads (CNHP and TNC 2008). The concept is adapted from distance decay methods of Tuffly and Comer (2005a & b). We used modifications of an s-curve for the decay functions:

$$y = \frac{1}{1 + \exp(\frac{bx}{c} - a)} \times w$$

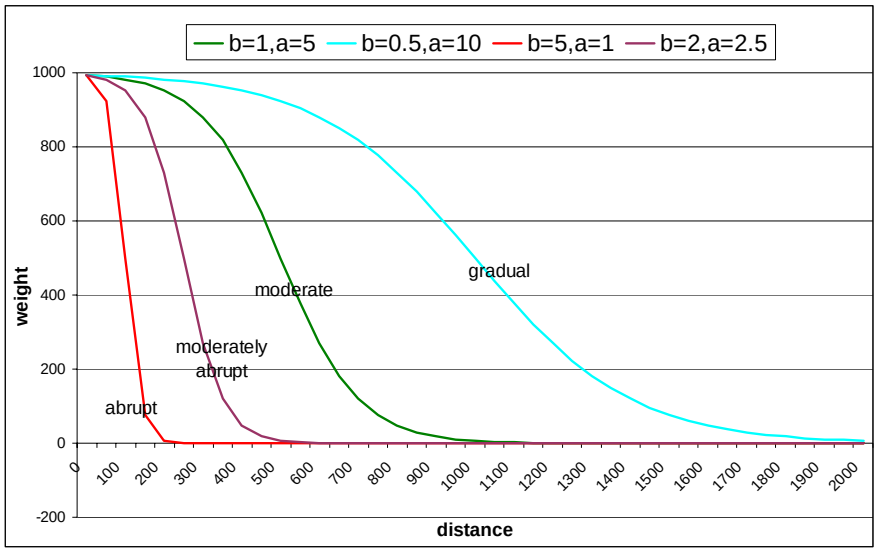
where
a - shifts curve to right or left
b - determines spread of curve, or slope of the rapidly decreasing part of curve.
c - scalar to adjust total distance of interest (=distance in meters divided by 20)
x - distance in meters from threat
w - weight of threat (maximum value)

The ratio a/b represents the value where the S-shaped curve reaches 0.5, the midway point on the curve (in this case, adjusted by scalar c).

By adjusting the shift and spread of the curve, it can be tailored to specific threats. The inflection point marks the distance where the effect of the threat is reduced by half. This curve is asymptotic at both ends, therefore the results of the equation must be manually adjusted to equal the maximum weight at zero distance and zero weight at a distance at which the weight becomes essentially zero ("cutoff distance").

As an example, for a total distance of 2,000 m, different values of a and b produce the following curve types.

curve type	*a*	*b*	inflection pt	cutoff
abrupt	1	5	100m	250m
moderately abrupt	2.5	2	300m	600m
moderate	5	1	500m	1,250m
gradual	10	0.5	1,000m	2,000m



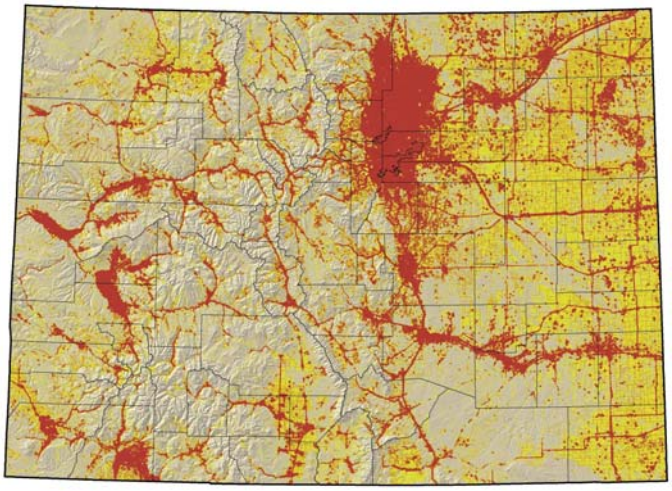
Individual threat layers:

Each individual layer has its own relevant weight and decay function type. The individual threat layers are then additively combined to produce an overall landscape integrity layer. These layers are not mutually exclusive in the threats they represent and are in fact chosen to compliment one another to compensate for incomplete and inaccurate source data.

Threat type	weight	distance decay function type	Data source
High/med intensity development	500	gradual	SWReGAP high/medium development types
Low intensity development	300	gradual	SWReGAP low intensity development types
Agriculture	300	mod-abr	SWReGAP agriculture
Roads - primary & secondary	500	moderate	2006 TIGER/Line roads (A1-A3)
Roads - local & rural, 4WD etc.	300	abrupt	2006 TIGER/Line roads (all other roads)
Oil & gas wells - active	400	moderate	Colorado Oil & Gas Commission (2008)
Oil & gas wells - inactive	200	mod-abr	Colorado Oil & Gas Commission (2008)
Gas pipelines	100	abrupt	2006 TIGER\Line utilities
Transmission lines	200	mod-abr	Digital Chart of the World Utilities layer
Surface Mines - active	500	moderate	Colo. Division of Reclamation, Mining, & Safety
Surface Mines - inactive	300	moderate	Colo. Division of Reclamation, Mining, & Safety

The culumative integrity layer ranges in value from 0 – 2,235. High impact was considered to be > = 500, medium impact >=250 and <500, low impact <250. The score is calculated using the percent of total acreage in high or medium impact. These are actual percentages, not normalized scores, and represent the proportion of each system (patch sizes equal to or greater than the minimum) or individual patch that falls within severely impacted areas. Note that such a method of scoring does not take into account how much of a system may have been entirely replaced by a particular land use (such as agriculture or urban development), only the proximity of these land uses to remaining system patches. The overall score is the weighted sum of the two impact types, converted to a scale of 0-10. High impact is weighted twice that of Medium impact. Scores are truncated at zero if negative, or at 10 if greater than 10.

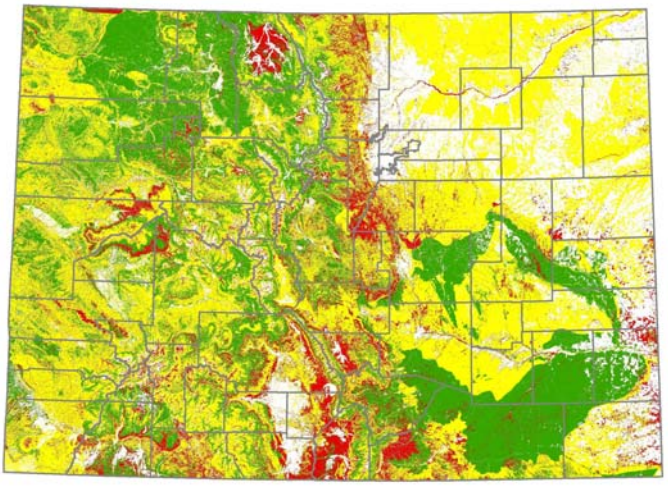
Interpretation: This score represents the overall level of impact to the system from land uses. Note that it does not take into account how much of the original extent has been replaced, but only how much the existing system acreage is currently impacted.



Landscape Integrity, showing high and medium impact areas (CNHP and TNC 2008).

Fire Regime Condition score

Description: Based on LANDFIRE Fire Regime Condition Class, a relative measure describing the degree of departure from the reference fire regime (USFS 2007). Calculated with area-weighted proportions of high and moderate (2/3 weight) departure from reference conditions. Scored as inverse of percent acreage in Moderate+High.
Interpretation: Most meaningful for forest types, this indicates the relative departure of a system or individual patch from its natural fire disturbance regime.



Fire Regime Condition Class (USFS 2007)

Biodiversity status score

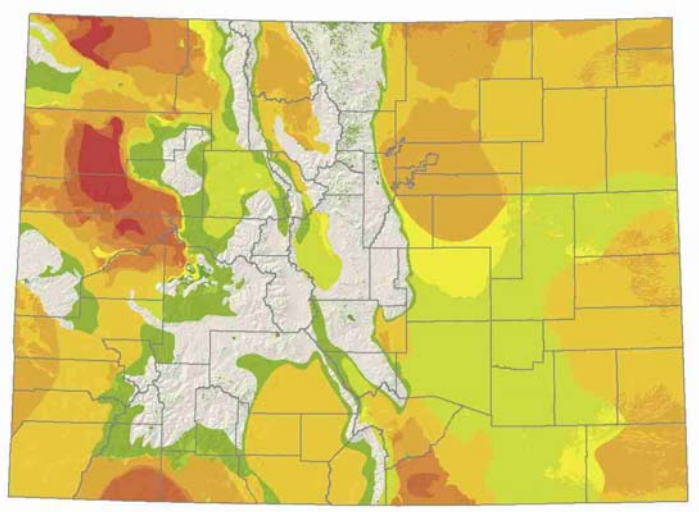
Description: Average of columns (C) through (G).

Threat status

Energy Development

Description: Based on a combination of statewide layers showing oil & gas potential, coal potential, and uranium/vanadium potential (BLM 1998), oil shale potential (digitized from BLM 2006), and wind energy potential (TrueWind Solutions 2003). Potential on original data was scored High = 3, Medium = 2, Low = 1, and No potential = 0, or as potential = 1, no potential = 0. Original shapefiles were converted to 30m grids, and added; Oil

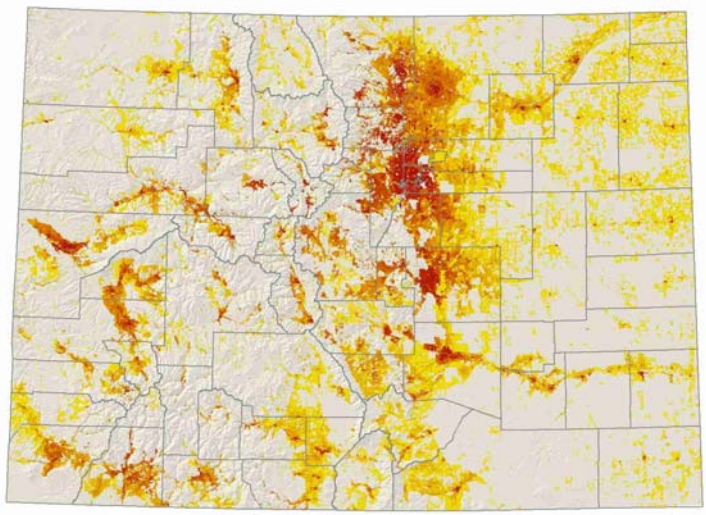
and Gas potential was double-weighted (CNHP 2006b). Possible scores for any cell range from 0 to 10. An area-weighted average score for each patch and for the entire system was calculated.
Interpretation: This score represents the combined potential for impact from a variety of energy development activities.



Energy development potential (CNHP 2006b)

Population growth and development

Description: Based on population growth projections modeled by Theobald (2005). Score is calculated as the area-weighted increase in developed private lands (urban, suburban, exurban, and rural), weighted by the proportion of private lands in the patch. Scores are scaled such that a patch with 25% private lands experiencing a 5% loss of undeveloped private land receives a score of 5. Scores are truncated to zero if negative. The summary score for each system is calculated as the area-weighted sum of the individual patch scores.
Interpretation: This score reflects the net loss of undeveloped private and rural acreage as lands shift to exurban, suburban, and urban classes.

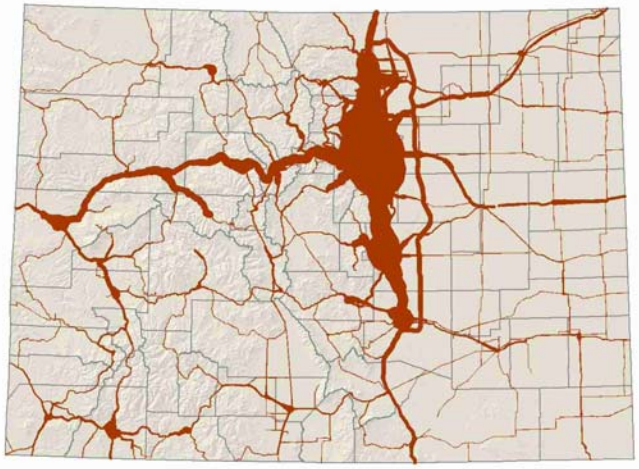


Population growth, projection for 2030 (Theobald 2005)

Transportation development

Description: The Colorado Department of Transportation highways dataset (CDOT 2006) includes a field that predicts the Annual Average Daily Traffic (AADT = Total of all vehicles counted in a year for each segment,

divided by 365 days) for 20 years in the future. This number was used to produce a variable-width buffer on the current linear highway coverage (CNHP 2006c), where AADT/10 was the size of the buffer in meters on each side of the highway. Range of buffer width is from about 60 km (37 mi) at the highly congested 1-25/I-70 interchange in Denver to about 0.02 km (0.01mi) in rural Bent County.
Interpretation: The overlap with system patches of the buffer that is proportional to traffic volumes is intended to reflect future local roadway expansion and development associated with increasing traffic.



Transportation development – 20 year traffic projection (CNHP 2006c)

Threat status score

Description: The minimum score of the three threat categories (I-K).
Interpretation: This score represents the level of the most critical threat for this system or patch.

Protection status

Calculations are based on three Conservation Management Status Measures developed by The Nature Conservancy (Supples et al. 2007). Every record in COMaP (Wilcox et al. 2007) was assigned a rank for each of three categories: Tenure, Intent, and Potential Management Effectiveness (PME), as well as a summary rank for conservation management status (CMS). These ranks represent the current state of knowledge about the status of the three conservation indicators on each parcel in COMaP. In southeastern Colorado, ranks assigned by TNC to private ranches were modified to reflect information collected during CNHP's 2007 survey of the area. Ranks assigned by TNC and CNHP were converted to a numerical score, and used to calculate area-weighted scores for patches and entire systems.

Conservation Tenure

The degree of permanence of conservation protection. Rank scoring: Permanent (Very good)=10, Long-term commitment (Good)=7, Short-term commitment (Fair)=4, No known commitment (Poor)=0.

Management Intent

The relative degree that stated objectives of management activities are intended to conserve biodiversity and ecological processes. Rank scoring: Biodiversity Intent (Very good)=10, Compatible Intent (Good)=7, Incidental Biodiversity (Fair)=4, Unknown Intent (Unknown)=2, Incompatible Intent (Poor)=0.

Potential Management Effectiveness (PME)

The capacity for management actions to be guided and implemented to achieve the designated management intent for biodiversity. Rank scoring: High potential for effective management (Very Good)=10, Lacking some components needed to achieve effective management (Fair)=4, Unknown potential for management (Unknown)=2, Not likely to achieve adequate management (Poor)=0.

Protection status score

Description: The individual Tenure, Intent, and PME ranks were "rolled up" to a final protection status rank according to a formula adapted from the method provided by The Nature Conservancy. For each COMaP parcel, scoring was majority rule, with the following exceptions and "averaging" rules: if any one category is Poor, then protection status is Poor; if two indicators are Very Good and one Fair, then protection status is Good; if one indicator is Very Good, one is Good, and one is Fair, then protection status is Good; if one indicator is Very Good, one is Fair, and one is Unknown, then protection status is Fair. The scored COMaP parcels were then converted to a 30m resolution grid, so that each grid cell had a numeric value or 0, 2, 4, 7, or 10, representing Poor, Unknown, Fair, Good, and Very Good protection status, respectively. The protection status score was then calculated by area-weighted average for each system and patch. Large (A-ranked) patches (patches of at least 4x minimum size) were weighted by the proportion of Good and Very Good conservation status acreage present in the patch, to compensate for the difficulty of achieving a higher score across a very large area.

Interpretation: This score represents the overall level of protection for the patch or system. The system score does not reflect the weighted large patch scores, and is therefore lower than the simple average of patch scores. Note that the category of Unknown was given a numeric score between Poor and Fair because some kind of score had to be assigned, but the low score of Unknown reflects more our uncertainty and lack of information than what is actually happening on the ground in terms of biodiversity protection.

Trends

Description: Long term trend reported as the percent loss of acreage in comparison with pre-settlement vegetation (circa 1850) as modeled by CNHP (2007). The pre-settlement model was produced using the SWReGAP GIS layer (USGS 2004). Existing non-natural landcover was replaced by 1) replacing all agriculture in shortgrass and mixedgrass prairie with "Historic shortgrass component" dataset (CNHP 2005), 2) replacing all other non-natural landcover with the most common native vegetation found on the underlying STATSGO soil type, 3) replacing existing modeled and existing shortgrass with foothills/piedmont grassland on selected soil types along the mountain front, 4) manual editing to replace man-made water bodies with the common surrounding landcover types. Agricultural modifications by native peoples that would have been present were not modeled.

Short-term trends will be evaluated at the next scoring iteration. This score is calculated only for systems at a statewide level.

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APPENDIX B: ECOLOGICAL SYSTEM SCORECARDS

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Alpine Tundra		5.2	9.9	9.4	N/A	**8.1**	9.6	9.2	9.8	**9.2**	9.4	7.2	9.2	**8.1**
	1,681,811	880,781												
Patch ID														
286	250,970	10.0	9.9	9.5		**9.8**	9.9	9.9	10.0	**9.9**	9.2	7.2	8.5	**10.0**
168	192,117	10.0	9.9	9.8		**9.9**	9.4	9.8	10.0	**9.4**	9.8	9.0	9.9	**10.0**
28	97,021	10.0	9.9	9.4		**9.8**	9.9	10.0	9.9	**9.9**	9.9	9.1	9.6	**10.0**
299	78,056	10.0	9.7	8.7		**9.4**	9.2	9.9	10.0	**9.2**	8.7	4.6	8.9	**8.1**
106	77,356	10.0	9.9	7.7		**9.2**	9.7	0.0	9.7	**0.0**	7.6	4.3	7.6	**6.9**
91	49,237	10.0	9.9	9.0		**9.6**	10.0	9.0	8.8	**8.8**	9.7	3.9	9.7	**7.9**
75	48,809	10.0	9.9	9.3		**9.7**	10.0	10.0	6.4	**6.4**	9.9	5.3	9.9	**8.8**
285	45,122	10.0	9.9	9.9		**10.0**	8.3	10.0	10.0	**8.3**	9.6	9.0	9.7	**10.0**
82	42,092	10.0	9.9	10.0		**10.0**	10.0	10.0	9.1	**9.1**	10.0	10.0	10.0	**10.0**
110	37,974	9.5	9.9	10.0		**9.8**	10.0	9.9	10.0	**9.9**	9.9	9.8	10.0	**9.8**
150	37,966	9.5	9.9	9.7		**9.7**	10.0	10.0	10.0	**10.0**	9.8	7.4	9.7	**8.5**
258	37,650	9.4	10.0	9.4		**9.6**	10.0	9.7	10.0	**9.7**	9.5	3.9	9.6	**6.6**
431	34,832	8.7	9.5	9.9		**9.4**	7.2	10.0	10.0	**7.2**	9.7	9.0	9.7	**9.3**
303	28,156	7.0	10.0	10.0		**9.0**	9.9	10.0	10.0	**9.9**	10.0	8.7	10.0	**9.3**
441	27,561	6.9	10.0	9.9		**8.9**	7.6	10.0	10.0	**7.6**	6.3	5.4	5.9	**5.0**
307	23,608	5.9	10.0	10.0		**8.6**	9.9	10.0	10.0	**9.9**	10.0	6.0	10.0	**8.0**
237	21,389	5.3	10.0	9.1		**8.1**	10.0	10.0	10.0	**10.0**	9.8	4.0	9.9	**6.9**
96	21,159	5.3	9.7	7.6		**7.5**	9.9	10.0	9.9	**9.9**	10.0	9.6	9.9	**9.8**
362	18,520	5.0	10.0	9.9		**8.3**	10.0	10.0	10.0	**10.0**	6.6	6.3	7.3	**6.2**
24	18,268	5.0	10.0	9.8		**8.3**	9.9	10.0	10.0	**9.9**	10.0	10.0	10.0	**10.0**
193	18,266	5.0	9.9	9.7		**8.2**	9.5	10.0	10.0	**9.5**	9.6	7.4	9.7	**8.5**
48	17,334	5.0	9.9	10.0		**8.3**	9.0	10.0	10.0	**9.0**	10.0	10.0	10.0	**10.0**
211	13,716	5.0	9.9	9.4		**8.1**	9.9	0.0	10.0	**0.0**	8.2	3.6	8.5	**5.7**
373	13,221	5.0	9.7	10.0		**8.2**	10.0	10.0	10.0	**10.0**	10.0	10.0	10.0	**10.0**
23	12,793	5.0	10.0	9.9		**8.3**	10.0	10.0	10.0	**10.0**	10.0	8.6	10.0	**9.3**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
149	12,778	5.0	10.0	10.0		**8.3**	10.0	10.0	10.0	**10.0**	10.0	10.0	10.0	**10.0**
123	12,755	5.0	9.9	9.4		**8.1**	8.0	10.0	10.0	**8.0**	9.4	4.2	9.5	**6.7**
13	10,904	5.0	9.9	9.4		**8.1**	10.0	10.0	10.0	**10.0**	9.6	7.6	9.6	**8.6**
321	10,502	5.0	9.9	10.0		**8.3**	8.0	10.0	10.0	**8.0**	9.8	9.2	9.8	**9.5**
289	10,241	5.0	10.0	10.0		**8.3**	10.0	10.0	10.0	**10.0**	10.0	9.4	10.0	**9.7**
111	10,145	5.0	9.4	5.6		**6.7**	8.2	2.6	9.8	**2.6**	8.5	3.7	8.8	**6.0**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Aspen		4.8	9.5	7.2	6.8	**6.9**	5.9	8.9	9.7	**5.9**	7.9	4.0	8.0	**5.6**
Acres	3,580,854													
Patches		size score												
151	513,475	10.0	9.5	7.7	8.3	**8.9**	6.9	9.5	9.9	**6.9**	7.9	3.9	8.0	**10.0**
455	292,771	10.0	9.8	8.2	6.1	**8.5**	2.4	9.3	9.9	**2.4**	8.6	3.7	8.7	**9.0**
13	237,986	10.0	8.8	5.4	7.6	**7.9**	5.1	9.6	10.0	**5.1**	6.5	3.3	6.9	**6.2**
788	155,807	10.0	9.6	8.0	3.3	**7.7**	6.8	9.2	10.0	**6.8**	9.0	3.8	9.2	**8.0**
1040	140,283	10.0	9.2	5.7	4.9	**7.4**	4.6	7.9	9.8	**4.6**	7.3	3.7	7.7	**6.4**
602	137,711	10.0	9.8	8.5	7.8	**9.1**	7.2	8.0	10.0	**7.2**	9.3	6.9	9.4	**9.6**
414	132,769	10.0	9.7	5.3	6.0	**7.8**	6.9	7.9	8.8	**6.9**	8.2	3.6	8.1	**6.8**
1289	91,814	10.0	9.2	6.3	6.5	**8.0**	5.9	9.3	9.9	**5.9**	9.0	3.8	9.1	**7.3**
884	59,171	7.4	9.8	5.2	5.3	**6.9**	8.3	2.8	10.0	**2.8**	3.1	2.7	4.0	**2.0**
61	50,544	6.3	9.1	5.3	8.8	**7.4**	10.0	9.5	9.6	**9.5**	8.4	4.0	8.3	**5.9**
373	45,493	5.7	9.6	6.1	7.7	**7.3**	6.3	9.8	5.9	**5.9**	8.6	4.4	8.9	**6.4**
1475	41,966	5.2	9.9	7.6	7.6	**7.6**	6.3	9.9	9.9	**6.3**	8.2	5.1	8.1	**5.9**
1321	41,396	5.2	9.3	5.6	8.0	**7.0**	8.0	9.9	9.3	**8.0**	9.6	3.9	9.7	**6.7**
1485	40,012	5.0	9.9	7.8	7.3	**7.5**	4.3	10.0	10.0	**4.3**	8.9	4.6	8.2	**6.3**
543	36,237	5.0	9.7	5.5	7.3	**6.9**	7.3	2.9	9.3	**2.9**	7.6	5.5	8.0	**6.3**
888	33,698	5.0	9.9	9.5	6.6	**7.8**	10.0	10.0	10.0	**10.0**	8.6	3.7	7.8	**5.5**
1267	30,485	5.0	9.9	8.9	7.3	**7.8**	8.3	9.4	9.9	**8.3**	5.1	4.0	5.4	**3.6**
500	29,307	5.0	9.9	8.5	3.1	**6.6**	1.1	9.7	10.0	**1.1**	7.3	3.5	7.8	**5.1**
1517	27,119	5.0	10.0	7.8	7.9	**7.7**	9.3	10.0	10.0	**9.3**	4.6	4.3	4.4	**3.3**
1546	25,634	5.0	9.7	8.4	6.7	**7.5**	4.1	10.0	10.0	**4.1**	6.5	3.4	5.9	**3.9**
795	24,560	5.0	9.7	8.3	5.5	**7.1**	8.2	9.6	10.0	**8.2**	8.9	3.8	8.8	**6.1**
1368	23,964	5.0	10.0	9.8	7.9	**8.2**	4.0	10.0	10.0	**4.0**	9.8	4.0	9.8	**6.8**
162	22,008	5.0	9.4	7.6	9.4	**7.9**	8.1	0.0	10.0	**0.0**	4.7	3.0	5.5	**3.2**
1523	21,945	5.0	9.5	9.3	4.0	**7.0**	3.2	9.7	10.0	**3.2**	8.3	5.7	8.6	**6.8**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
CO Plateau PJ		6.9	8.3	5.9	4.6	**7.0**	4.2	7.6	9.6	**4.2**	8.4	4.5	4.5	**4.3**
Acres	4,942,190													
Patches in decending order of size:			patch size score											
75	512,906	10	9.0	5.4	5.3	**7.4**	1.3	8.1	10.0	**1.3**	9.0	4.2	3.8	**4.1**
22	354,259	10	9.4	8.9	4.1	**8.1**	7.5	9.8	10.0	**7.5**	8.9	7.2	7.1	**8.6**
390	344,152	10	7.4	6.6	3.9	**7.0**	7.0	7.2	9.9	**7.0**	8.5	4.9	5.6	**5.9**
583	288,963	10	8.5	8.3	3.7	**7.6**	3.8	8.9	9.9	**3.8**	8.3	3.0	3.1	**2.7**
422	283,095	10	8.2	6.0	3.7	**7.0**	4.0	7.8	9.9	**4.0**	8.9	4.0	4.7	**4.1**
472	260,102	10	8.6	6.9	5.0	**7.6**	3.3	9.1	10.0	**3.3**	9.2	4.5	4.5	**4.4**
531	258,850	10	6.4	6.8	4.4	**6.9**	3.9	8.9	9.9	**3.9**	7.8	4.8	3.1	**4.4**
353	249,051	10	8.9	7.8	5.2	**8.0**	9.7	7.4	9.7	**7.4**	8.8	5.4	4.5	**5.2**
259	232,668	10	9.1	7.3	4.1	**7.6**	2.2	0.7	9.1	**0.7**	9.0	4.5	4.5	**4.3**
480	207,042	10	8.3	5.3	3.7	**6.8**	3.7	9.2	10.0	**3.7**	8.1	4.1	4.9	**4.2**
435	160,438	10	8.2	7.0	4.4	**7.4**	3.6	9.4	9.9	**3.6**	9.2	4.5	5.0	**4.6**
124	134,673	10	9.7	4.7	4.6	**7.2**	2.9	9.5	9.9	**2.9**	9.5	4.6	3.9	**4.1**
588	122,110	10	8.2	1.4	5.7	**6.3**	1.9	8.2	9.0	**1.9**	6.3	2.1	3.3	**2.5**
275	103,470	8.6	7.4	1.3	4.0	**5.3**	1.3	4.7	8.6	**1.3**	6.4	4.0	4.7	**3.6**
363	93,344	7.8	8.4	4.4	5.2	**6.4**	3.2	4.7	9.2	**3.2**	7.1	3.5	4.5	**3.4**
160	90,880	7.6	8.8	3.3	6.4	**6.5**	6.2	6.8	7.2	**6.2**	8.9	4.6	4.2	**4.2**
42	88,219	7.4	8.8	7.1	4.5	**7.0**	2.1	10.0	10.0	**2.1**	8.8	4.9	4.9	**4.7**
215	85,374	7.1	9.8	7.7	4.1	**7.2**	2.7	9.8	9.9	**2.7**	9.3	5.4	5.4	**5.2**
3	82,785	6.9	9.6	9.2	4.4	**7.5**	5.9	10.0	10.0	**5.9**	9.5	5.5	4.8	**5.1**
634	68,618	5.7	6.3	0.0	6.6	**4.7**	1.1	4.7	9.7	**1.1**	5.9	2.0	3.2	**2.4**
430	62,030	5.2	7.1	6.0	5.7	**6.0**	7.1	5.9	10.0	**5.9**	8.2	6.8	5.0	**6.1**
244	44,248	5	6.1	0.1	4.3	**3.9**	1.1	2.1	8.4	**1.1**	4.4	2.9	3.0	**1.9**
189	44,235	5	7.1	0.6	4.8	**4.4**	4.9	0.0	7.0	**0.0**	6.9	3.4	3.5	**2.8**
127	40,360	5	9.4	2.1	3.6	**5.0**	7.7	6.5	9.8	**6.5**	8.1	3.6	3.7	**3.3**
394	37,700	5	5.6	0.0	6.0	**4.2**	3.6	2.4	10.0	**2.4**	4.2	2.8	2.8	**1.7**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
459	37,088	5	7.3	0.5	4.8	**4.4**	5.9	6.2	8.4	**5.9**	5.4	3.1	3.1	**2.2**
547	36,082	5	6.3	1.4	4.4	**4.3**	4.0	0.0	8.5	**0.0**	2.1	2.4	2.4	**0.9**
108	34,660	5	10.0	6.1	5.8	**6.7**	2.2	10.0	10.0	**2.2**	8.3	3.6	3.6	**3.3**
415	32,913	5	9.5	7.6	4.2	**6.6**	8.2	10.0	9.9	**8.2**	9.5	7.3	4.5	**5.8**
620	32,580	5	7.6	4.0	7.0	**5.9**	1.2	3.2	9.7	**1.2**	7.7	2.5	5.2	**3.9**
151	31,155	5	8.9	2.7	3.7	**5.1**	6.0	5.7	9.7	**5.7**	7.7	4.2	3.6	**3.5**
201	30,478	5	8.0	1.9	7.6	**5.6**	6.1	9.8	5.7	**5.7**	8.5	3.7	3.8	**3.4**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Lodgepole		4.1	9.4	6.4	6.8	**6.6**	8.3	7.4	9.6	**7.4**	8.7	4.6	8.6	**6.3**
Acres	2,199,719													
Patches		size score:												
11	264,169	10	9.4	7.0	4.9	**7.8**	9.3	9.2	10.0	**9.2**	9.3	4.7	9.3	**8.8**
88	148,151	10	9.3	8.1	8.7	**9.0**	3.2	9.8	9.9	**3.2**	9.5	4.2	8.8	**7.4**
125	130,121	10	9.6	0.0	5.4	**6.2**	9.8	5.0	8.2	**5.0**	6.9	4.3	7.1	**5.8**
74	124,921	10	9.8	6.8	5.0	**7.9**	9.9	3.4	9.9	**3.4**	9.3	6.3	9.2	**8.5**
190	122,838	10	9.4	5.7	6.4	**7.9**	7.3	4.1	9.4	**4.1**	7.4	3.4	7.6	**5.7**
82	122,491	10	8.8	5.4	7.7	**8.0**	5.0	8.1	9.6	**5.0**	8.2	4.2	8.3	**6.6**
476	107,605	9.0	9.7	8.9	8.8	**9.1**	10.0	9.9	10.0	**9.9**	9.6	4.8	9.7	**7.2**
136	93,476	7.8	8.6	4.9	5.2	**6.6**	9.5	4.2	9.0	**4.2**	7.7	5.6	7.6	**6.1**
569	82,452	6.9	9.8	9.6	8.4	**8.7**	9.9	10.0	10.0	**9.9**	10.0	4.0	9.9	**7.0**
523	64,717	5.4	9.8	6.8	8.5	**7.6**	10.0	9.6	9.9	**9.6**	8.8	3.8	9.0	**6.2**
9	43,096	5	9.1	8.1	9.4	**7.9**	8.4	10.0	10.0	**8.4**	9.6	5.2	8.3	**6.7**
366	39,565	5	8.9	4.1	7.1	**6.3**	10.0	0.0	9.4	**0.0**	7.4	4.0	7.2	**5.1**
431	38,457	5	9.9	9.1	7.7	**7.9**	9.2	9.9	10.0	**9.2**	9.7	5.4	9.7	**7.4**
184	31,513	5	9.6	9.3	9.5	**8.3**	9.9	10.0	10.0	**9.9**	7.6	3.6	7.2	**4.9**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Oak & Mixed Mtn Shrub		6.7	8.9	4.2	5.1	**6.4**	4.5	6.8	9.2	**4.5**	5.1	3.2	4.7	**2.9**
	2,717,461	1,831,043												
Patches - ID	acres													
439	206,256	10.0	9.1	4.2	3.1	**6.6**	1.9	5.8	9.4	**1.9**	5.7	3.2	4.9	**6.3**
62	190,885	10.0	7.8	2.6	8.7	**7.3**	4.0	6.9	10.0	**4.0**	2.6	2.6	2.8	**1.6**
837	158,705	10.0	8.9	4.7	3.5	**6.8**	4.0	8.8	10.0	**4.0**	5.0	3.3	4.9	**5.8**
609	119,897	10.0	9.2	6.6	5.6	**7.8**	7.1	9.6	10.0	**7.1**	9.3	3.9	9.2	**10.0**
315	117,325	10.0	9.9	8.0	6.8	**8.7**	1.1	8.7	10.0	**1.1**	4.7	2.9	2.9	**1.9**
631	111,010	10.0	9.4	6.2	6.0	**7.9**	7.0	7.7	10.0	**7.0**	7.1	3.4	7.5	**8.6**
552	95,706	10.0	9.2	5.6	3.2	**7.0**	2.3	6.7	9.9	**2.3**	5.5	3.1	4.9	**4.5**
568	91,132	10.0	9.3	4.8	4.8	**7.2**	5.1	6.1	9.9	**5.1**	6.6	3.8	6.6	**7.1**
154	86,727	10.0	8.1	4.2	7.7	**7.5**	6.1	8.7	9.8	**6.1**	3.2	2.6	3.0	**1.7**
72	69,533	10.0	8.7	5.1	9.0	**8.2**	3.0	9.7	9.9	**3.0**	4.8	3.0	3.0	**2.0**
981	62,924	10.0	8.6	2.4	3.3	**6.1**	2.6	9.4	9.9	**2.6**	1.4	3.2	3.7	**1.1**
588	59,956	10.0	9.5	8.4	7.0	**8.7**	9.9	0.0	10.0	**0.0**	6.2	4.3	4.7	**4.5**
655	48,986	10.0	9.1	4.3	3.8	**6.8**	8.7	7.7	9.9	**7.7**	6.1	5.1	4.9	**5.1**
214	41,732	10.0	9.1	2.5	5.3	**6.8**	8.8	7.1	6.8	**6.8**	8.0	4.0	5.8	**5.4**
346	36,429	10.0	7.4	0.0	2.5	**5.0**	9.3	0.0	1.0	**0.0**	3.4	2.6	3.0	**1.6**
733	34,248	10.0	9.2	4.6	3.9	**6.9**	8.3	2.5	10.0	**2.5**	2.0	2.4	2.9	**1.2**
149	33,491	10.0	9.0	6.6	7.5	**8.3**	1.0	9.3	9.9	**1.0**	7.1	3.4	3.4	**2.8**
462	32,791	10.0	6.6	0.0	2.8	**4.9**	6.4	0.0	2.2	**0.0**	1.6	2.3	3.0	**1.2**
421	32,674	10.0	9.0	1.6	4.2	**6.2**	7.4	0.0	8.2	**0.0**	5.1	3.0	4.8	**3.5**
947	30,893	10.0	9.7	5.7	4.8	**7.6**	3.8	9.8	9.7	**3.8**	1.7	2.4	2.5	**0.8**
468	28,966	10.0	8.2	2.3	4.5	**6.3**	7.0	5.0	7.5	**5.0**	5.6	3.2	3.4	**2.5**
290	26,140	10.0	9.9	7.7	7.3	**8.7**	2.6	10.0	9.9	**2.6**	8.3	3.6	3.6	**3.3**
1132	25,197	10.0	9.8	9.1	2.9	**8.0**	2.5	10.0	10.0	**2.5**	0.1	4.0	4.0	**0.1**
857	23,977	10.0	8.2	2.4	5.0	**6.4**	7.7	6.3	9.8	**6.3**	1.1	3.1	4.1	**0.9**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
1069	23,833	10.0	9.9	9.0	2.7	**7.9**	1.3	10.0	9.9	**1.3**	9.7	3.5	8.3	**6.9**
977	21,311	10.0	8.3	0.0	4.7	**5.7**	3.9	2.2	9.2	**2.2**	0.9	2.2	2.6	**0.7**
549	20,316	10.0	9.7	6.3	3.4	**7.3**	2.8	0.0	10.0	**0.0**	4.4	2.9	5.1	**3.2**
582	19,839	9.9	8.2	0.0	3.0	**5.3**	6.4	0.0	0.0	**0.0**	5.9	1.4	6.0	**1.8**
881	19,667	9.8	8.6	6.0	3.4	**6.9**	3.0	9.8	10.0	**3.0**	6.8	3.4	3.4	**2.7**
213	19,607	9.8	9.9	6.6	7.8	**8.5**	0.2	10.0	10.0	**0.2**	2.5	2.5	2.8	**1.2**
1147	18,579	9.3	10.0	2.3	3.3	**6.2**	1.6	10.0	10.0	**1.6**	0.9	4.0	4.1	**0.5**
114	18,512	9.3	8.7	5.6	8.1	**7.9**	2.0	10.0	10.0	**2.0**	7.6	5.1	5.1	**4.6**
943	17,146	8.6	9.2	5.6	3.2	**6.6**	3.9	10.0	10.0	**3.9**	9.5	3.9	9.6	**6.7**
1030	15,826	7.9	9.0	5.6	5.0	**6.9**	3.0	0.0	8.4	**0.0**	1.0	2.3	2.3	**0.6**
1159	15,490	7.7	9.5	4.4	2.6	**6.1**	2.9	8.0	10.0	**2.9**	6.2	3.3	6.9	**4.3**
584	14,089	7.0	9.5	6.6	4.5	**6.9**	2.1	10.0	9.9	**2.1**	5.2	3.0	5.6	**3.3**
304	13,306	6.7	9.9	9.3	7.1	**8.2**	2.4	10.0	9.8	**2.4**	8.5	3.7	3.7	**3.4**
431	13,093	6.5	5.3	0.0	3.2	**3.8**	3.0	0.0	0.0	**0.0**	6.8	2.8	6.8	**4.3**
328	12,923	6.5	9.4	3.7	4.1	**5.9**	6.9	7.2	8.0	**6.9**	8.6	3.7	5.7	**4.5**
54	11,803	5.9	8.0	0.1	7.9	**5.5**	3.6	4.1	9.5	**3.6**	0.7	2.3	2.3	**0.5**
516	11,708	5.9	8.0	0.0	2.6	**4.1**	5.0	0.0	0.1	**0.0**	5.4	2.9	5.0	**3.0**
765	11,231	5.6	9.9	8.0	2.7	**6.5**	8.8	9.8	10.0	**8.8**	7.7	3.6	8.1	**5.4**
630	11,154	5.6	8.5	0.0	3.9	**4.5**	7.3	0.0	4.0	**0.0**	2.4	2.3	2.8	**1.2**
680	10,959	5.5	9.6	7.3	4.3	**6.7**	9.9	9.0	10.0	**9.0**	4.9	3.0	3.0	**2.0**
956	10,236	5.1	9.0	0.0	3.2	**4.3**	4.0	5.8	8.7	**4.0**	5.5	3.1	6.4	**3.9**
58	10,235	5.1	6.4	0.4	8.8	**5.2**	4.9	0.0	9.8	**0.0**	3.2	3.5	4.3	**2.2**
920	10,056	5.0	7.9	4.7	3.1	**5.2**	3.3	10.0	10.0	**3.3**	7.9	3.6	3.6	**3.1**
1027	9,947	5.0	9.0	0.0	4.7	**4.7**	3.1	10.0	7.0	**3.1**	4.1	2.8	3.8	**2.1**
905	9,750	5.0	8.2	0.0	5.4	**4.7**	5.6	0.0	8.9	**0.0**	1.2	2.3	3.1	**0.7**
20	9,256	5.0	8.0	0.7	8.2	**5.5**	1.8	10.0	10.0	**1.8**	3.0	2.7	3.2	**1.6**
759	9,006	5.0	8.9	2.4	4.1	**5.1**	8.0	1.3	10.0	**1.3**	1.5	2.4	2.4	**0.8**
455	8,945	5.0	6.4	0.0	3.1	**3.6**	3.0	0.0	0.0	**0.0**	0.3	1.3	2.0	**0.0**
17	8,841	5.0	8.8	2.3	7.5	**5.9**	1.9	10.0	10.0	**1.9**	0.7	2.2	2.2	**0.4**
1049	8,748	5.0	8.9	7.5	3.2	**6.1**	4.0	10.0	10.0	**4.0**	10.0	8.1	8.1	**8.1**
1090	8,587	5.0	9.6	3.7	2.1	**5.1**	3.0	0.0	10.0	**0.0**	7.5	3.5	8.0	**5.2**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
948	8,490	5.0	8.7	0.0	3.2	**4.2**	3.9	10.0	8.6	**3.9**	9.0	4.1	9.2	**6.3**
41	8,169	5.0	7.7	0.0	7.5	**5.1**	8.1	9.2	9.0	**8.1**	4.3	3.0	4.4	**2.6**
1095	7,907	5.0	10.0	8.0	3.7	**6.7**	2.6	10.0	9.9	**2.6**	4.4	2.0	2.9	**1.7**
1000	7,888	5.0	8.9	5.1	2.2	**5.3**	5.1	8.5	10.0	**5.1**	8.2	3.7	8.5	**5.7**
958	7,683	5.0	5.9	3.6	3.2	**4.4**	4.0	9.5	10.0	**4.0**	5.8	3.2	6.5	**4.0**
984	7,655	5.0	9.1	2.6	5.6	**5.6**	4.6	8.1	8.7	**4.6**	8.9	3.8	9.1	**6.2**
344	7,653	5.0	9.7	4.9	4.1	**5.9**	6.0	10.0	10.0	**6.0**	8.2	3.7	4.9	**4.0**
1011	7,647	5.0	8.3	5.2	2.6	**5.3**	3.7	0.0	8.0	**0.0**	4.7	3.6	3.6	**2.7**
1043	7,250	5.0	10.0	8.7	2.0	**6.4**	4.0	10.0	10.0	**4.0**	10.0	2.0	2.0	**2.0**
833	6,865	5.0	8.5	3.5	4.6	**5.4**	6.0	10.0	9.9	**6.0**	2.3	0.9	3.4	**1.4**
510	6,532	5.0	9.3	0.0	4.9	**4.8**	6.2	0.0	9.2	**0.0**	2.0	2.0	2.4	**0.7**
228	6,373	5.0	9.2	3.1	8.0	**6.3**	1.2	0.0	8.9	**0.0**	6.6	3.3	3.3	**2.7**
82	6,319	5.0	8.8	3.8	8.6	**6.6**	3.1	10.0	10.0	**3.1**	7.4	3.6	3.6	**3.2**
827	6,239	5.0	8.6	0.0	4.1	**4.4**	7.6	0.0	9.4	**0.0**	0.0	2.0	2.0	**0.0**
612	6,231	5.0	7.6	0.0	4.1	**4.2**	7.4	0.0	0.0	**0.0**	4.0	0.6	1.4	**0.1**
1098	6,215	5.0	10.0	6.6	1.6	**5.8**	2.9	5.4	10.0	**2.9**	5.9	2.9	5.7	**3.6**
766	6,096	5.0	10.0	9.5	2.2	**6.7**	9.8	10.0	10.0	**9.8**	8.2	3.7	5.4	**4.2**
277	6,068	5.0	9.7	6.9	8.2	**7.5**	0.0	10.0	10.0	**0.0**	0.5	2.1	2.3	**0.3**
55	5,603	5.0	7.2	0.0	7.2	**4.9**	3.0	10.0	9.1	**3.0**	1.6	2.8	3.1	**1.1**
820	5,357	5.0	9.8	6.3	3.1	**6.1**	8.2	10.0	10.0	**8.2**	8.4	3.5	6.7	**4.9**
524	5,309	5.0	8.4	0.0	5.8	**4.8**	7.0	0.0	4.3	**0.0**	3.5	2.5	4.2	**2.1**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Ponderosa		3.8	9.2	2.3	2.4	**5.0**	7.4	3.6	8.5	**3.6**	5.8	3.5	6.0	**3.7**
Acres	3,220,000													
Patch ID		size score												
188	516,244	10.0	9.1	3.4	2.3	**6.2**	9.9	3.6	8.2	**3.6**	7.6	3.5	7.7	**8.3**
312	158,493	10.0	9.5	2.7	4.1	**6.6**	10.0	0.0	9.7	**0.0**	4.9	3.1	4.6	**3.2**
1038	149,689	10.0	9.5	6.0	3.0	**7.1**	2.7	5.6	9.4	**2.7**	6.3	2.4	4.3	**3.3**
1001	143,692	10.0	9.2	1.1	3.2	**5.9**	1.7	7.0	10.0	**1.7**	1.1	4.0	4.0	**0.6**
36	136,432	10.0	9.3	3.0	2.6	**6.2**	10.0	0.0	9.4	**0.0**	5.6	3.9	6.0	**4.6**
1	128,225	10.0	9.6	4.0	3.0	**6.7**	9.9	5.6	9.9	**5.6**	5.9	3.5	6.2	**4.8**
1078	106,858	10.0	9.8	3.7	2.4	**6.5**	2.7	5.6	10.0	**2.7**	4.3	4.2	4.8	**2.2**
370	102,512	10.0	9.7	6.1	3.6	**7.3**	9.5	0.0	8.0	**0.0**	6.6	4.8	5.3	**4.4**
148	94,980	10.0	9.3	0.0	3.3	**5.7**	10.0	0.0	4.4	**0.0**	2.9	2.4	2.8	**1.1**
962	91,365	10.0	8.8	2.8	2.6	**6.0**	4.1	6.4	8.9	**4.1**	7.0	4.1	7.3	**5.0**
967	78,275	8.7	8.2	0.0	3.3	**5.1**	4.4	3.2	9.1	**3.2**	3.7	2.8	4.5	**2.4**
78	68,480	7.6	8.9	0.0	3.1	**4.9**	9.6	5.3	8.3	**5.3**	6.1	3.4	6.4	**3.9**
863	52,428	5.8	8.9	3.9	3.0	**5.4**	4.0	8.6	10.0	**4.0**	9.4	3.9	9.5	**6.6**
103	49,629	5.5	9.4	0.0	3.2	**4.5**	9.9	0.0	2.3	**0.0**	3.2	2.5	2.5	**0.9**
63	48,969	5.4	9.3	1.9	2.8	**4.9**	10.0	1.2	8.5	**1.2**	7.8	3.9	7.2	**5.0**
811	45,926	5.1	9.9	7.3	3.1	**6.3**	3.9	10.0	10.0	**3.9**	9.9	4.1	9.8	**7.0**
906	45,803	5.1	8.5	2.9	3.3	**4.9**	4.0	3.6	10.0	**3.6**	7.0	3.4	7.5	**4.9**
1096	43,040	5.0	9.9	3.0	5.0	**5.7**	2.1	6.7	9.1	**2.1**	2.5	4.7	4.0	**1.7**
985	42,057	5.0	8.7	1.8	3.0	**4.6**	3.2	0.0	9.4	**0.0**	6.9	3.4	7.5	**4.8**
57	40,910	5.0	9.3	0.8	2.6	**4.4**	9.9	0.0	8.0	**0.0**	5.7	3.1	6.3	**3.9**
91	35,798	5.0	8.3	0.0	3.1	**4.1**	9.7	4.4	4.2	**4.2**	6.5	4.2	6.4	**4.0**
285	34,486	5.0	6.6	0.0	1.2	**3.2**	5.0	0.0	6.1	**0.0**	0.7	0.3	2.2	**0.3**
320	34,174	5.0	9.5	1.6	3.5	**4.9**	10.0	0.0	2.6	**0.0**	6.1	2.8	5.6	**3.5**
584	33,189	5.0	8.5	3.7	6.6	**6.0**	4.0	9.3	9.8	**4.0**	9.2	4.0	9.1	**6.4**
480	30,994	5.0	10.0	5.1	3.6	**5.9**	10.0	7.6	10.0	**7.6**	6.3	3.3	3.3	**2.6**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Sagebrush		4.7	8.1	5.0	6.1	**6.2**	4.6	8.3	9.8	**4.6**	5.7	3.4	3.6	**2.7**
Acres	5,565,000													
Patch ID		size score												
3	924,242	10	8.1	5.7	7.9	**7.9**	1.3	9.7	9.9	**1.3**	5.9	3.3	3.3	**2.7**
203	448,930	10	8.0	4.7	6.4	**7.3**	3.3	9.0	9.9	**3.3**	5.1	3.1	3.1	**2.2**
1422	211,508	10	8.6	6.2	4.3	**7.3**	10.0	8.1	9.9	**8.1**	8.0	4.2	4.1	**3.9**
113	192,146	10	7.1	3.7	4.5	**6.3**	4.3	6.3	9.6	**4.3**	5.7	3.3	3.6	**2.7**
6	163,660	10	7.6	3.9	7.1	**7.1**	3.0	9.2	9.9	**3.0**	3.5	2.9	2.9	**1.8**
88	160,857	10	8.9	6.9	7.7	**8.4**	5.0	9.5	9.9	**5.0**	6.8	3.7	3.7	**3.2**
12	154,379	10	5.7	5.8	4.6	**6.5**	3.9	10.0	10.0	**3.9**	5.1	3.1	3.2	**2.3**
1327	131,806	10	7.3	5.2	4.9	**6.9**	8.6	8.7	9.5	**8.6**	7.6	5.1	5.4	**5.3**
1281	128,984	10	7.6	3.2	4.9	**6.4**	9.4	5.8	9.4	**5.8**	7.8	3.6	5.6	**4.5**
1435	125,052	10	8.4	4.6	4.2	**6.8**	9.9	3.4	9.7	**3.4**	5.8	3.3	3.4	**2.5**
234	96,884	8.1	9.9	6.5	4.8	**7.3**	7.0	6.1	10.0	**6.1**	5.7	4.1	3.6	**3.0**
31	94,619	7.9	6.7	4.3	4.1	**5.7**	3.8	10.0	9.9	**3.8**	5.2	3.3	3.7	**2.7**
497	90,822	7.6	9.6	5.2	7.4	**7.4**	2.7	8.9	9.9	**2.7**	8.7	3.9	3.7	**3.6**
517	90,679	7.6	7.7	0.8	5.3	**5.3**	6.9	5.6	9.3	**5.6**	5.3	3.1	4.2	**2.6**
5	71,241	5.9	9.5	7.2	6.5	**7.3**	5.5	8.7	10.0	**5.5**	7.4	4.0	4.0	**3.8**
642	70,992	5.9	9.5	5.2	5.0	**6.4**	6.0	8.3	9.1	**6.0**	5.5	3.7	3.5	**2.7**
1498	64,595	5.4	6.8	5.5	4.4	**5.5**	10.0	7.1	9.9	**7.1**	9.0	3.8	4.8	**4.1**
15	55,604	5	8.9	1.3	6.0	**5.3**	9.9	4.6	10.0	**4.6**	4.8	3.1	3.9	**2.5**
125	55,379	5	6.2	1.1	8.5	**5.2**	2.6	7.2	9.9	**2.6**	1.9	2.8	2.9	**1.3**
157	55,360	5	5.9	4.1	4.2	**4.8**	3.1	9.9	9.9	**3.1**	5.7	3.2	3.2	**2.5**
504	51,470	5	8.8	6.2	5.3	**6.3**	6.0	8.7	9.9	**6.0**	2.3	2.5	2.8	**1.1**
354	49,277	5	8.4	4.8	6.8	**6.3**	5.9	8.7	9.6	**5.9**	3.0	2.9	3.6	**2.2**
697	48,611	5	10.0	8.3	5.8	**7.3**	1.6	10.0	10.0	**1.6**	3.4	3.0	2.7	**1.5**
1883	45,792	5	7.9	4.8	1.8	**4.9**	4.8	10.0	9.9	**4.8**	1.0	2.2	2.7	**0.7**
184	40,492	5	7.5	5.0	5.2	**5.7**	3.5	10.0	9.9	**3.5**	3.0	3.2	3.5	**1.8**
488	38,455	5	7.7	2.8	6.0	**5.4**	5.7	4.0	9.2	**4.0**	2.5	2.5	3.2	**1.3**
526	37,938	5	9.4	6.5	6.6	**6.9**	9.1	8.6	9.8	**8.6**	6.2	3.3	5.1	**3.4**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
641	36,425	5	9.1	2.1	4.5	**5.2**	6.0	1.4	6.2	**1.4**	5.1	3.0	5.3	**3.1**
1752	34,829	5	7.7	1.8	1.0	**3.9**	5.6	10.0	9.5	**5.6**	0.5	2.1	2.1	**0.2**
780	33,789	5	9.7	7.6	6.6	**7.2**	0.0	9.7	9.9	**0.0**	8.5	3.7	4.6	**3.8**
1198	31,442	5	9.7	6.8	9.2	**7.7**	10.0	0.0	10.0	**0.0**	3.1	2.9	3.2	**1.8**
1574	30,382	5	9.4	6.6	8.6	**7.4**	3.1	10.0	9.9	**3.1**	8.1	3.6	3.6	**3.2**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Sandsage		5.8	6.4	4.4	5.3	**6.0**	4.4	9.6	9.6	**4.4**	1.1	3.4	2.6	**0.8**
	1,959,451													
Patches		size score												
229	179,704	10.0	5.4	4.8	3.8	**6.0**	4.0	10.0	10.0	**4.0**	0.6	2.3	2.3	**0.6**
406	169,754	10.0	7.8	6.7	9.5	**8.5**	4.0	10.0	10.0	**4.0**	0.3	2.2	2.2	**0.3**
271	138,428	10.0	5.4	5.3	3.7	**6.1**	4.1	10.0	10.0	**4.1**	0.9	2.5	2.7	**0.9**
96	129,614	10.0	4.3	2.3	3.8	**5.1**	4.0	10.0	9.9	**4.0**	0.2	2.1	2.1	**0.2**
467	107,531	10.0	8.1	6.0	6.0	**7.5**	6.0	10.0	10.0	**6.0**	1.0	2.3	2.3	**0.5**
15	96,927	10.0	5.3	2.8	3.8	**5.5**	3.8	9.5	8.7	**3.8**	2.2	3.0	3.2	**1.9**
100	91,870	10.0	4.3	3.0	3.9	**5.3**	3.9	9.7	9.8	**3.9**	0.4	2.2	2.3	**0.4**
103	88,809	10.0	7.2	4.9	3.5	**6.4**	4.0	10.0	9.1	**4.0**	0.4	2.2	2.2	**0.4**
196	74,789	10.0	5.9	4.2	3.6	**5.9**	4.0	8.8	10.0	**4.0**	0.3	2.1	2.1	**0.3**
333	63,129	10.0	3.2	4.0	4.4	**5.4**	6.0	10.0	10.0	**6.0**	0.4	2.2	2.2	**0.4**
383	45,052	8.0	8.9	6.2	9.6	**8.2**	5.4	10.0	10.0	**5.4**	0.3	2.1	2.1	**0.3**
492	43,984	7.9	9.0	5.2	7.9	**7.5**	6.0	10.0	9.6	**6.0**	5.9	5.5	4.4	**4.6**
495	43,398	7.7	6.0	2.6	8.8	**6.3**	4.0	10.0	9.9	**4.0**	0.2	2.1	2.1	**0.2**
76	34,823	6.2	8.6	4.8	3.5	**5.8**	4.0	9.6	9.1	**4.0**	2.5	3.2	3.2	**2.5**
437	33,187	5.9	9.6	7.1	9.1	**7.9**	5.9	9.9	9.9	**5.9**	6.2	5.7	7.9	**5.2**
83	24,861	5.0	7.8	2.1	3.5	**4.6**	3.6	0.0	9.3	**0.0**	0.4	2.2	2.2	**0.4**
423	22,811	5.0	7.4	4.5	8.5	**6.4**	4.7	10.0	10.0	**4.7**	0.2	2.1	2.1	**0.2**
646	22,151	5.0	7.3	1.6	5.2	**4.8**	3.8	10.0	9.9	**3.8**	8.0	3.7	3.7	**3.3**
177	21,163	5.0	7.0	5.6	3.5	**5.3**	4.0	6.5	9.8	**4.0**	0.3	2.2	2.2	**0.3**
206	20,752	5.0	7.5	1.3	3.4	**4.3**	3.5	10.0	8.9	**3.5**	0.9	2.5	2.5	**0.9**
161	20,005	5.0	6.6	4.8	3.7	**5.0**	3.9	10.0	9.9	**3.9**	0.4	2.2	2.2	**0.4**
446	19,895	5.0	9.5	7.5	9.8	**7.9**	6.0	9.6	3.0	**3.0**	2.6	3.7	3.1	**2.6**
491	19,069	5.0	7.6	1.1	9.3	**5.8**	3.9	10.0	9.8	**3.9**	0.1	2.1	2.1	**0.1**
204	16,816	5.0	7.7	0.0	3.5	**4.0**	3.0	0.0	4.2	**0.0**	0.4	2.2	2.2	**0.4**
193	14,538	5.0	7.2	2.7	3.8	**4.7**	4.1	10.0	9.6	**4.1**	0.6	2.3	2.3	**0.6**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Shortgrass		6.5	4.9	4.2	5.7	**5.9**	4.9	7.0	9.5	**4.9**	1.3	2.4	2.6	**0.9**
Acres	11,855,000													
Patch ID		size score												
1493	1,072,828	10	5.0	5.3	9.3	**7.4**	5.3	9.9	9.9	**5.3**	0.8	3.6	3.6	**0.5**
1176	917,024	10	6.8	4.2	4.6	**6.4**	5.9	0.0	8.8	**0.0**	2.1	3.4	3.5	**2.4**
1540	849,896	10	8.5	6.8	8.3	**8.4**	5.7	9.8	10.0	**5.7**	3.9	4.0	5.4	**3.4**
1529	781,502	10	7.8	7.5	6.6	**8.0**	5.1	9.3	9.7	**5.1**	1.9	3.9	4.2	**1.4**
1444	762,688	10	6.0	6.1	5.8	**7.0**	5.8	0.0	9.3	**0.0**	0.9	3.7	3.7	**0.9**
28	741,911	10	3.5	2.4	3.6	**4.9**	3.0	6.6	9.8	**3.0**	2.9	2.8	2.8	**1.6**
1171	499,304	10	5.1	4.4	4.0	**5.9**	5.2	10.0	10.0	**5.2**	0.8	2.3	2.5	**0.7**
1721	405,607	10	7.9	7.1	5.7	**7.7**	5.4	9.7	10.0	**5.4**	2.0	3.6	3.7	**1.0**
1329	381,210	10	2.5	3.2	5.6	**5.3**	4.8	10.0	10.0	**4.8**	1.8	3.4	3.4	**1.7**
7	299,078	10	3.6	0.8	3.7	**4.5**	3.7	9.2	10.0	**3.7**	1.0	2.3	2.3	**0.6**
1023	271,647	10	4.6	2.6	7.4	**6.2**	5.4	7.2	9.8	**5.4**	0.3	2.1	2.1	**0.2**
714	244,875	10	4.9	1.2	3.6	**4.9**	3.4	6.8	9.4	**3.4**	0.6	2.2	2.2	**0.4**
1499	244,042	10	3.0	2.7	8.2	**6.0**	3.6	10.0	9.9	**3.6**	0.5	2.2	2.3	**0.4**
965	241,225	10	3.1	4.4	3.6	**5.3**	5.6	9.8	9.6	**5.6**	0.2	2.1	2.1	**0.2**
1222	170,706	8.5	6.8	0.0	3.8	**4.8**	5.8	0.0	5.2	**0.0**	4.2	3.2	5.9	**3.1**
940	147,301	7.4	7.6	2.2	4.2	**5.3**	4.9	9.1	9.0	**4.9**	0.4	2.2	2.2	**0.4**
1741	140,398	7.0	8.8	5.3	3.7	**6.2**	4.4	9.0	9.9	**4.4**	0.4	4.0	4.0	**0.3**
725	132,218	6.6	3.1	2.0	3.6	**3.8**	5.1	9.9	8.9	**5.1**	0.5	2.3	2.3	**0.5**
165	105,880	5.3	4.5	1.3	3.6	**3.7**	3.5	0.0	9.1	**0.0**	1.4	2.6	2.6	**1.1**
163	101,645	5.1	3.0	1.7	3.7	**3.4**	4.0	10.0	10.0	**4.0**	0.8	2.3	2.4	**0.7**
1232	98,060	5	5.8	4.7	9.4	**6.2**	4.0	10.0	9.7	**4.0**	1.0	2.5	2.2	**0.7**
1063	97,725	5	4.7	5.1	7.7	**5.6**	5.8	10.0	9.9	**5.8**	0.8	2.4	2.4	**0.8**
1401	95,179	5	6.5	0.0	3.6	**3.8**	4.9	0.0	7.9	**0.0**	1.1	2.3	2.6	**0.3**
986	88,768	5	7.4	3.8	7.2	**5.9**	5.6	9.7	9.4	**5.6**	0.4	2.2	2.2	**0.4**
4	83,873	5	3.2	3.0	3.6	**3.7**	3.4	9.4	10.0	**3.4**	0.5	2.2	2.2	**0.5**

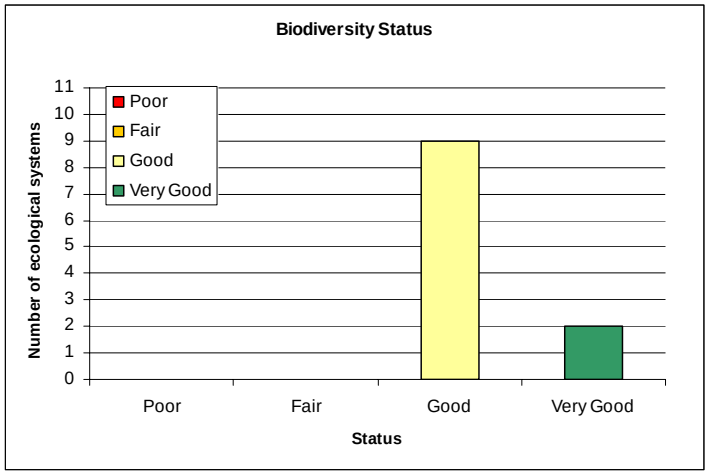
Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
675	83,298	5	3.7	0.3	3.7	**3.2**	3.0	0.0	4.6	**0.0**	2.8	3.2	4.1	**2.0**
270	82,085	5	5.8	0.0	3.5	**3.6**	3.2	0.0	7.3	**0.0**	0.6	2.3	2.3	**0.6**
18	80,366	5	4.6	0.2	3.8	**3.4**	2.9	0.0	6.5	**0.0**	0.9	2.3	2.3	**0.7**
19	79,461	5	6.3	0.0	3.2	**3.6**	3.4	5.0	7.5	**3.4**	4.6	2.8	3.2	**1.6**
628	68,990	5	3.8	1.2	3.9	**3.5**	5.7	10.0	9.9	**5.7**	0.6	2.3	2.2	**0.5**
398	62,612	5	4.4	2.2	3.8	**3.9**	4.0	9.9	10.0	**4.0**	0.6	2.3	2.3	**0.6**
503	60,386	5	3.9	0.4	3.6	**3.2**	4.0	10.0	10.0	**4.0**	0.4	2.3	2.2	**0.4**
541	60,286	5	4.8	3.8	3.6	**4.3**	4.3	10.0	10.0	**4.3**	1.3	2.6	2.8	**0.9**
362	57,740	5	5.0	2.7	3.9	**4.1**	4.0	9.3	10.0	**4.0**	0.4	2.2	2.2	**0.4**

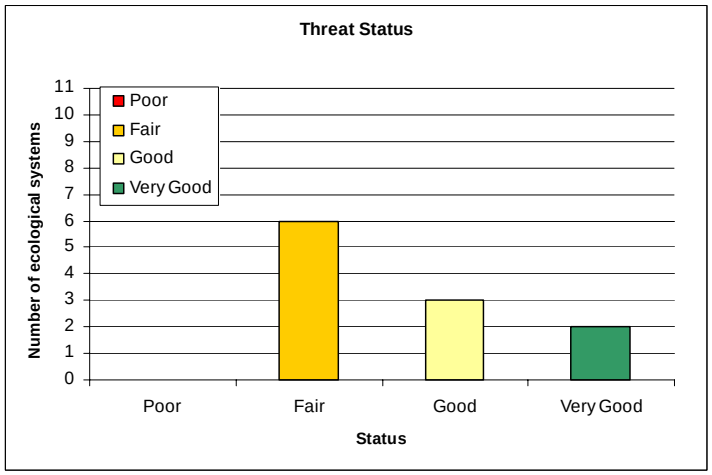
Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
Spruce-fir		5.9	9.8	8.5	5.8	**7.7**	8.4	9.7	9.8	**8.4**	9.6	6.2	9.6	**7.8**
Acres	4,881,000													
Patches		patch size score												
694	458,277	10	9.7	8.9	5.0	**8.4**	9.3	9.9	10.0	**9.3**	9.8	7.3	9.7	**10.0**
110	316,074	10	9.9	9.7	8.8	**9.6**	9.0	10.0	10.0	**9.0**	10.0	6.9	9.9	**10.0**
823	265,187	10	9.6	9.1	4.4	**8.3**	6.0	10.0	9.9	**6.0**	9.8	5.6	9.8	**10.0**
261	257,384	10	9.9	9.0	4.8	**8.4**	8.9	10.0	9.9	**8.9**	9.9	6.7	9.9	**10.0**
4	210,398	10	9.5	9.5	9.0	**9.5**	9.8	10.0	9.9	**9.8**	10.0	7.3	10.0	**10.0**
439	175,675	10	9.9	9.1	4.6	**8.4**	8.5	10.0	10.0	**8.5**	9.5	7.0	9.5	**10.0**
615	169,356	10	9.9	9.0	4.9	**8.4**	10.0	9.8	10.0	**9.8**	9.9	6.7	9.3	**9.9**
752	157,691	10	9.7	8.2	5.2	**8.3**	7.6	10.0	9.9	**7.6**	9.7	4.0	9.8	**8.7**
591	154,391	10	9.8	8.2	4.9	**8.2**	9.1	10.0	9.9	**9.1**	8.8	5.6	8.1	**8.0**
65	131,675	10	9.8	8.5	8.2	**9.2**	9.3	9.9	9.9	**9.3**	10.0	7.6	10.0	**10.0**
759	127,182	10	9.7	9.1	6.9	**8.9**	9.7	10.0	9.9	**9.7**	9.8	7.7	9.5	**10.0**
690	126,459	10	9.9	9.1	5.0	**8.5**	9.2	10.0	10.0	**9.2**	10.0	4.7	10.0	**8.9**
375	123,285	10	9.7	9.2	3.5	**8.1**	2.4	9.9	10.0	**2.4**	10.0	4.0	10.0	**8.5**
734	111,539	10	9.7	9.0	4.6	**8.3**	5.5	9.2	9.9	**5.5**	9.8	5.3	9.9	**8.9**
181	84,893	10	9.8	8.5	6.1	**8.6**	9.0	9.9	8.1	**8.1**	10.0	7.6	10.0	**9.8**
457	65,319	8.2	9.9	8.7	4.7	**7.9**	10.0	10.0	10.0	**10.0**	9.3	6.2	9.4	**7.7**
430	60,734	7.6	9.9	9.3	4.7	**7.9**	9.3	9.1	10.0	**9.1**	9.9	4.3	9.9	**7.1**
259	54,928	6.9	9.9	5.2	6.9	**7.2**	8.6	10.0	9.6	**8.6**	8.6	3.7	8.7	**5.9**
173	50,072	6.3	9.8	8.2	8.7	**8.2**	10.0	10.0	9.4	**9.4**	9.9	5.7	9.9	**7.8**
569	49,376	6.2	9.9	9.3	4.6	**7.5**	10.0	10.0	9.9	**9.9**	9.6	3.9	9.7	**6.7**
76	48,160	6.0	9.7	8.9	6.1	**7.7**	3.7	9.9	10.0	**3.7**	9.8	4.0	9.7	**6.8**
256	42,386	5.3	9.6	6.0	4.4	**6.3**	7.8	10.0	6.0	**6.0**	9.4	3.9	9.5	**6.6**
54	40,667	5.1	9.8	7.4	8.0	**7.6**	9.8	10.0	10.0	**9.8**	10.0	7.9	10.0	**9.0**
82	40,056	5.0	9.9	7.4	8.3	**7.6**	9.8	10.0	10.0	**9.8**	10.0	8.4	9.5	**9.0**

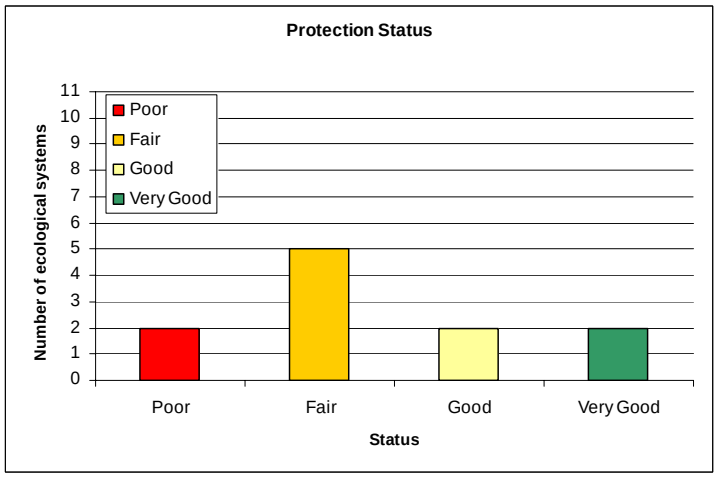
Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
101	37,204	5	9.7	9.5	9.4	**8.4**	10.0	6.5	10.0	**6.5**	10.0	6.7	10.0	**8.4**
80	36,920	5	9.9	9.2	9.0	**8.3**	10.0	9.2	9.8	**9.2**	10.0	10.0	10.0	**10.0**
335	36,030	5	10.0	8.8	3.5	**6.8**	4.1	10.0	10.0	**4.1**	9.0	3.8	9.2	**6.3**
677	34,987	5	9.8	9.2	4.2	**7.0**	9.9	7.3	10.0	**7.3**	9.6	4.6	9.7	**7.1**
126	33,510	5	9.8	8.1	7.2	**7.5**	10.0	10.0	9.3	**9.3**	9.5	5.4	9.5	**7.4**
575	33,044	5	10.0	9.9	4.9	**7.4**	8.6	9.6	10.0	**8.6**	9.9	8.7	9.8	**9.2**
194	32,533	5	9.9	9.8	8.2	**8.2**	9.3	9.7	9.0	**9.0**	9.9	5.1	9.9	**7.5**
355	30,463	5	10.0	9.9	4.8	**7.4**	8.0	10.0	10.0	**8.0**	10.0	9.5	10.0	**9.8**
39	30,316	5	9.9	8.8	4.7	**7.1**	3.1	10.0	10.0	**3.1**	10.0	4.0	10.0	**7.0**
213	29,824	5	9.5	2.6	8.0	**6.3**	9.9	10.0	4.1	**4.1**	8.5	4.9	8.5	**6.4**
913	29,271	5	9.7	10.0	4.8	**7.4**	4.7	9.2	10.0	**4.7**	7.6	7.6	7.8	**7.2**
87	28,791	5	9.1	8.7	9.0	**8.0**	10.0	10.0	9.4	**9.4**	10.0	5.1	10.0	**7.5**
398	28,492	5	9.9	7.3	4.7	**6.7**	10.0	6.5	9.8	**6.5**	9.1	7.6	9.3	**8.3**
587	28,049	5	9.7	9.7	4.7	**7.3**	9.9	10.0	10.0	**9.9**	10.0	4.0	10.0	**7.0**
666	27,616	5	9.8	8.4	5.2	**7.1**	9.1	8.5	9.9	**8.5**	8.6	4.8	8.9	**6.6**
156	26,623	5	9.9	5.4	8.1	**7.1**	9.8	7.0	10.0	**7.0**	8.5	6.0	8.8	**7.1**
302	25,624	5	9.9	9.3	8.4	**8.2**	9.9	10.0	9.9	**9.9**	9.9	9.1	10.0	**9.5**
272	24,229	5	9.6	1.1	5.0	**5.2**	9.3	0.0	7.2	**0.0**	6.5	3.3	7.2	**4.5**
705	24,039	5	10.0	10.0	4.6	**7.4**	10.0	10.0	10.0	**10.0**	10.0	7.7	10.0	**8.9**
404	23,236	5	10.0	9.8	4.1	**7.2**	9.3	10.0	10.0	**9.3**	10.0	8.2	10.0	**9.1**
417	22,531	5	9.6	8.3	3.5	**6.6**	5.5	10.0	9.8	**5.5**	9.5	3.9	9.6	**6.7**
353	22,215	5	10.0	9.9	5.0	**7.5**	10.0	10.0	10.0	**10.0**	10.0	9.6	10.0	**9.8**
412	21,406	5	9.9	7.1	4.8	**6.7**	7.9	9.7	10.0	**7.9**	8.4	6.5	8.7	**7.3**
718	21,335	5	10.0	9.4	4.8	**7.3**	10.0	9.7	10.0	**9.7**	9.3	3.9	9.4	**6.5**
337	20,489	5	9.8	6.9	4.6	**6.6**	9.1	5.5	9.7	**5.5**	5.7	4.3	5.8	**4.2**
927	20,447	5	9.7	10.0	4.5	**7.3**	3.8	10.0	10.0	**3.8**	4.4	2.9	5.3	**3.0**
306	20,146	5	9.9	9.8	3.6	**7.1**	0.9	10.0	10.0	**0.9**	8.2	3.6	8.5	**5.7**

Ecol Sys	Total CO acreage (fm model with maj hwys)	Proportion of total acreage in patches of preferred size	Percent natural within ½ mile of patches	Landscape Integrity Score	Condition Index Score	**Biodiversity Status**	Energy Dev.	Population growth & Dev.	Trans. Dev.	**Threat Status**	Tenure	Intent	PME	**Protection Status**
SRM PJ		2.4	9.1	3.6	4.6	**5.3**	6.4	5.9	9.5	**5.9**	4.5	3.7	3.8	**2.5**
Acres	1,253,413													
Patch ID		size score												
83	168,167	10.0	9.1	3.8	3.8	**6.7**	8.9	3.5	9.5	**3.5**	4.1	4.4	3.8	**3.3**
33	133,552	10.0	9.2	6.0	3.6	**7.2**	9.6	8.3	9.3	**8.3**	8.6	4.7	4.7	**4.8**
62	88,885	7.4	8.9	2.6	6.3	**6.3**	6.2	7.7	9.2	**6.2**	5.1	3.7	3.4	**2.7**
331	61,346	5.1	9.0	0.0	7.5	**5.4**	1.8	1.3	9.1	**1.3**	0.3	4.0	4.0	**0.2**
182	60,505	5.0	9.1	5.4	3.7	**5.8**	5.0	7.1	9.9	**5.0**	3.9	3.0	3.6	**2.1**
148	59,328	5.0	9.9	8.2	3.2	**6.6**	4.0	9.6	10.0	**4.0**	8.1	4.0	5.7	**4.5**
212	57,575	5.0	8.5	5.7	5.6	**6.2**	4.6	7.6	10.0	**4.6**	3.1	2.7	2.7	**1.4**
102	56,443	5.0	8.5	0.0	3.3	**4.2**	9.3	3.5	9.0	**3.5**	5.6	3.2	3.4	**2.5**
280	52,501	5.0	9.6	5.7	2.6	**5.7**	8.0	10.0	10.0	**8.0**	2.7	3.4	3.7	**1.9**
247	48,575	5.0	8.7	4.1	6.5	**6.1**	2.8	7.2	9.3	**2.8**	1.4	2.7	3.2	**1.0**
228	31,363	5.0	8.8	1.9	7.2	**5.7**	3.0	2.3	9.4	**2.3**	0.5	2.1	2.1	**0.3**
354	30,336	5.0	9.0	0.0	6.7	**5.2**	1.7	0.0	8.7	**0.0**	1.5	3.9	4.0	**0.6**

APPENDIX C: ECOLOGICAL SYSTEM GRAPHS

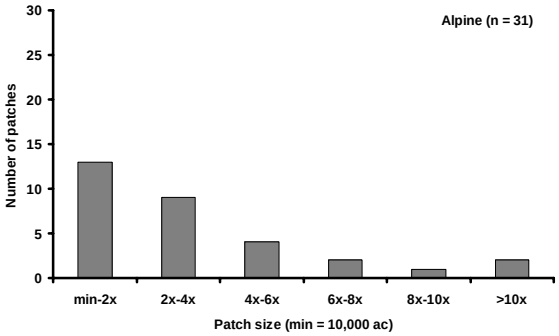


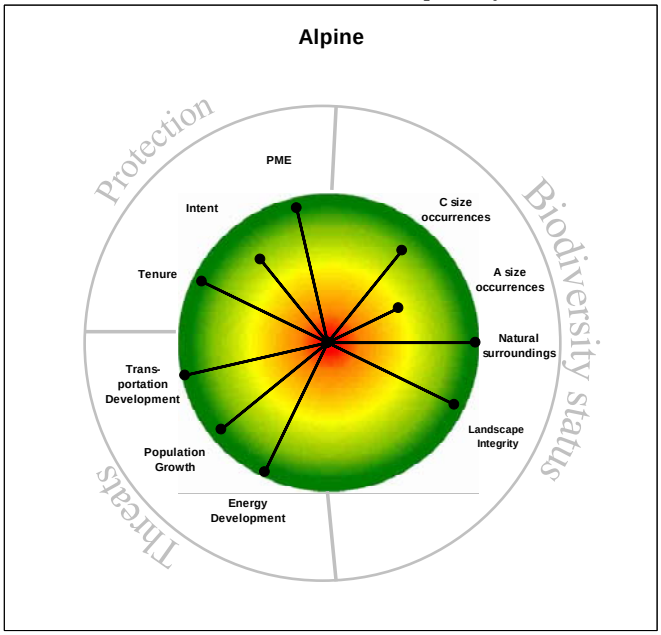




Alpine

photo by Renée Rondeau





Aspen

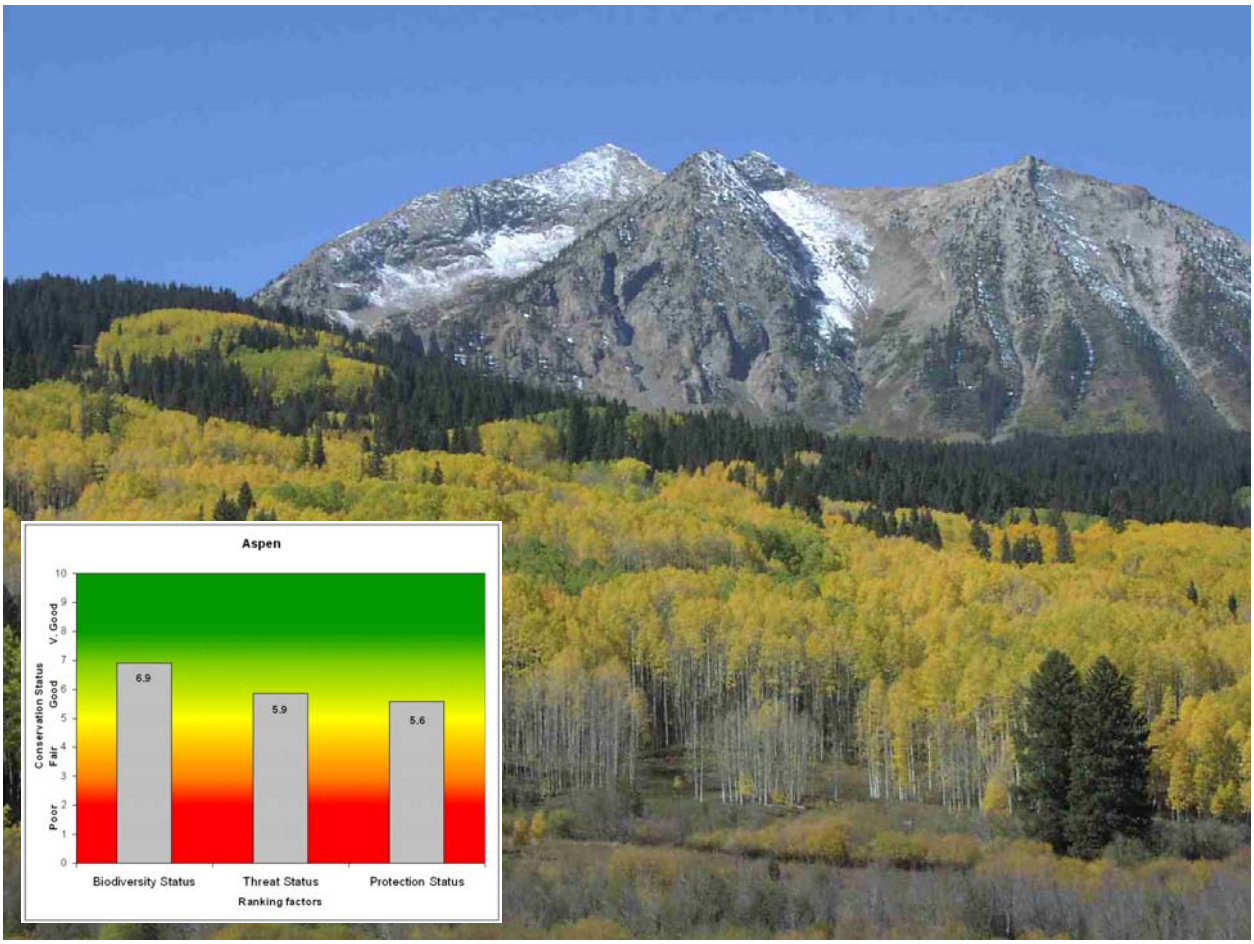
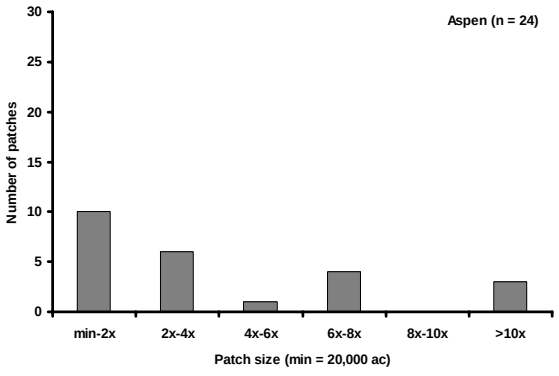
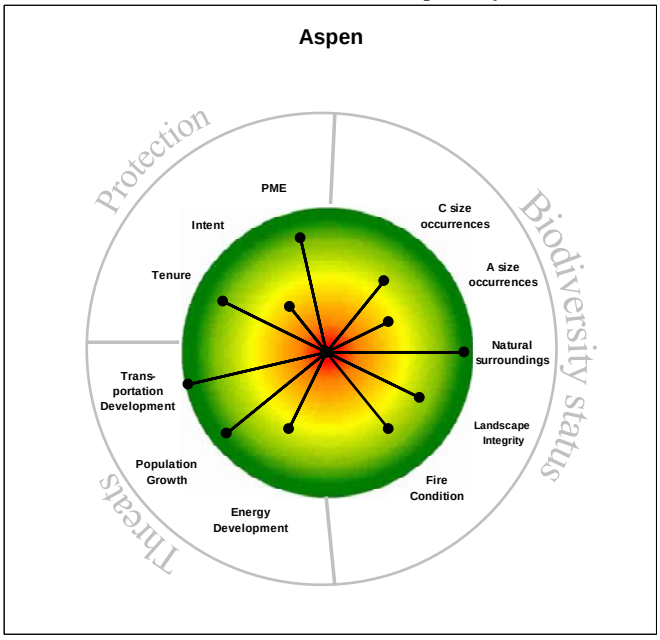


photo by Renée Rondeau





Colorado Plateau Pinyon-juniper

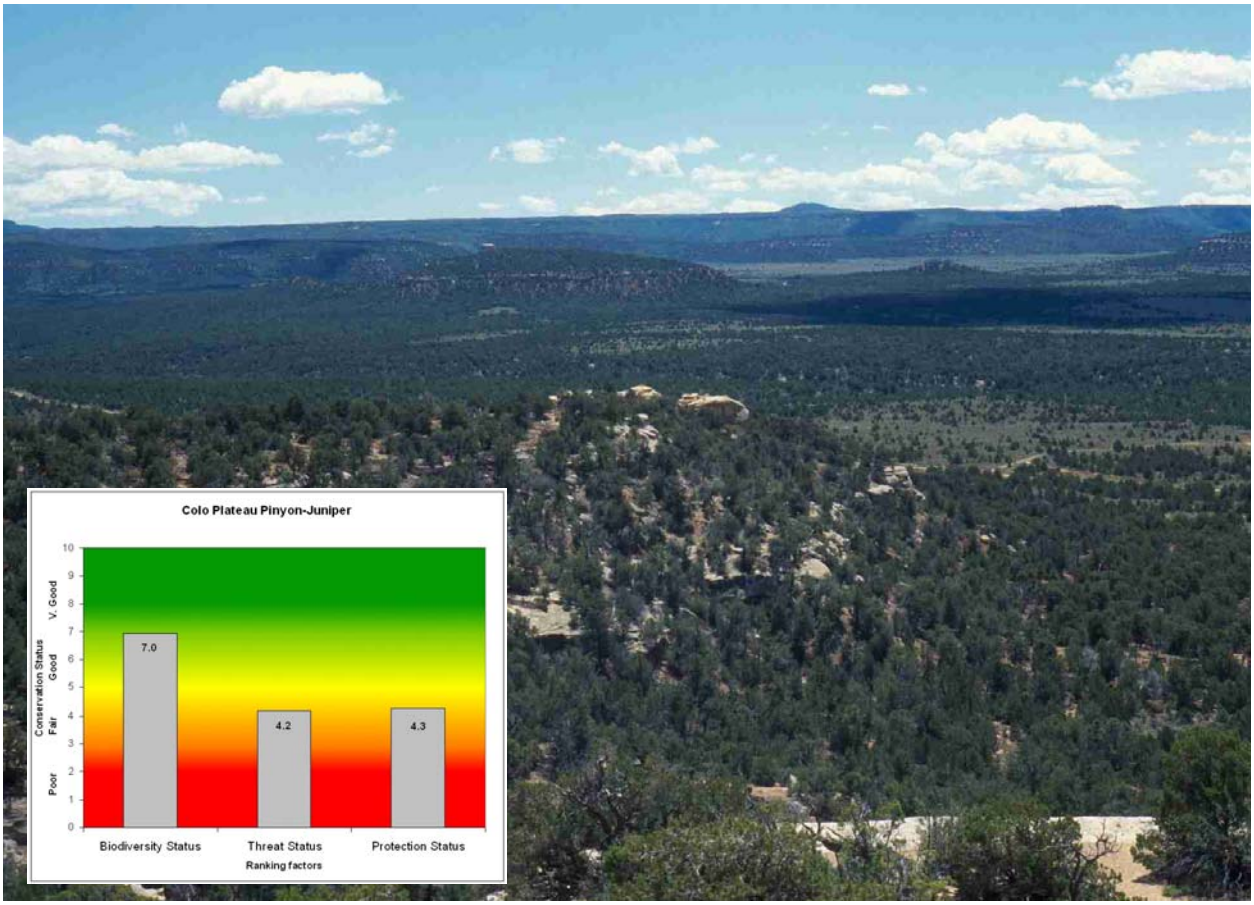
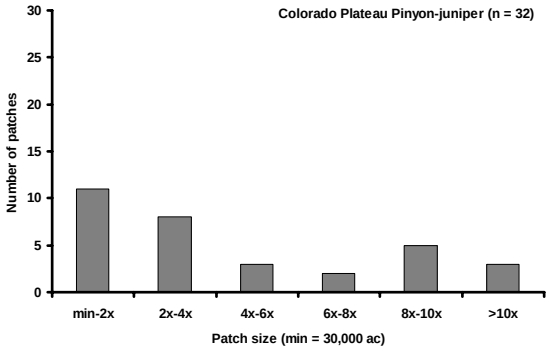
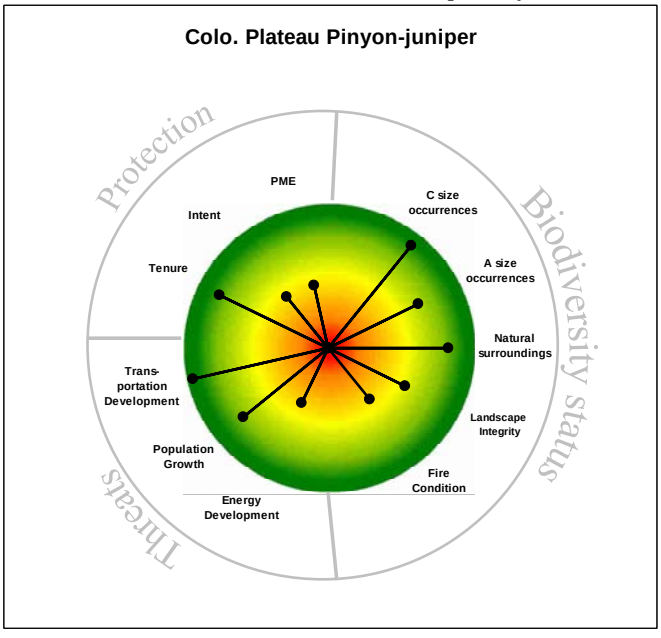


photo by Steve Kettler





Lodgepole

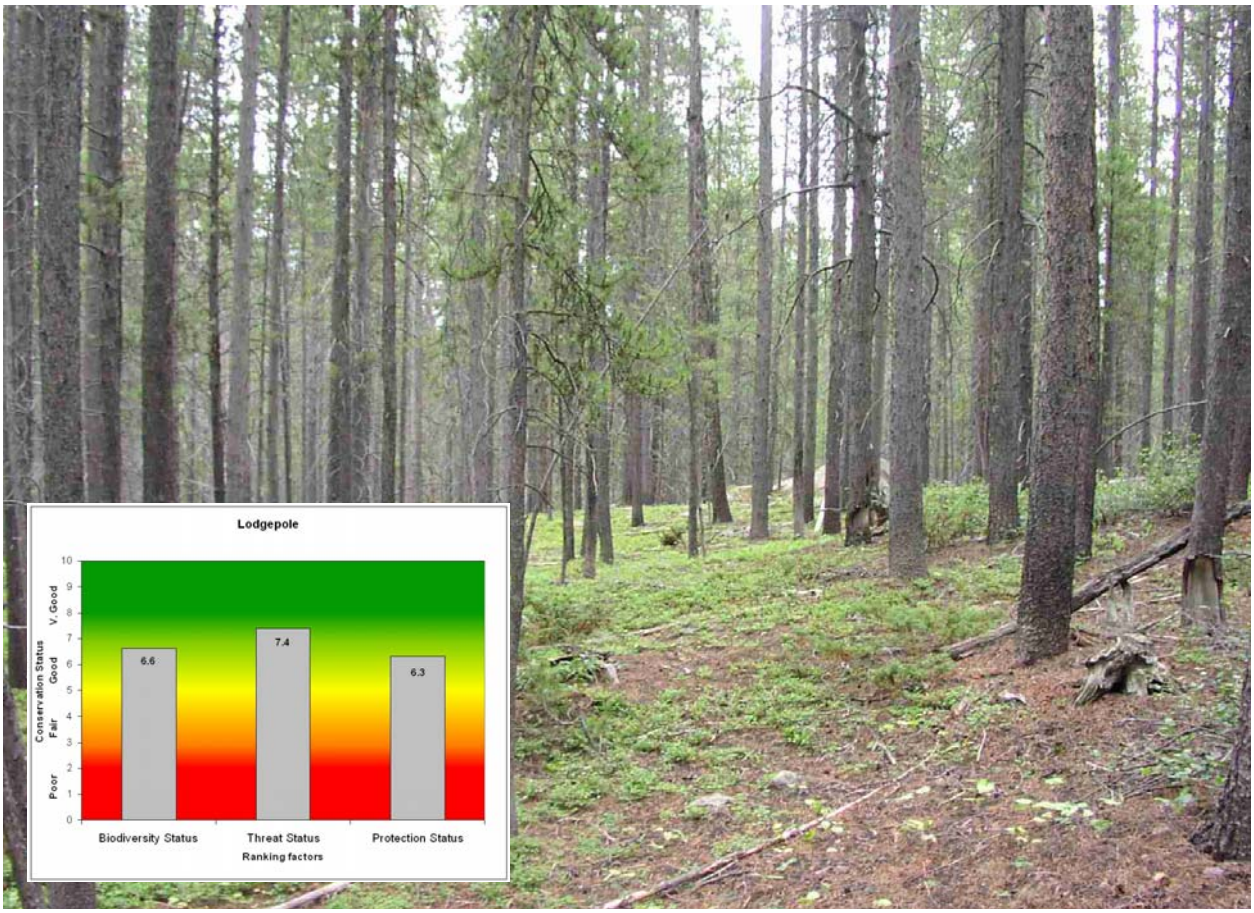
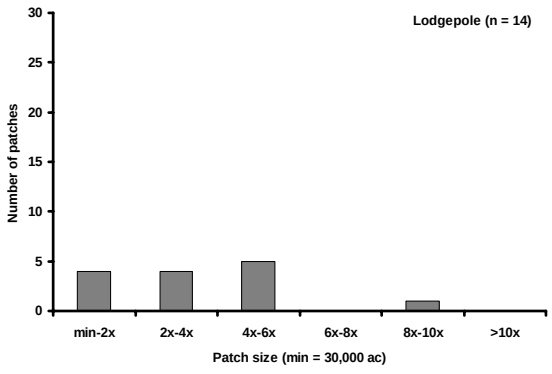
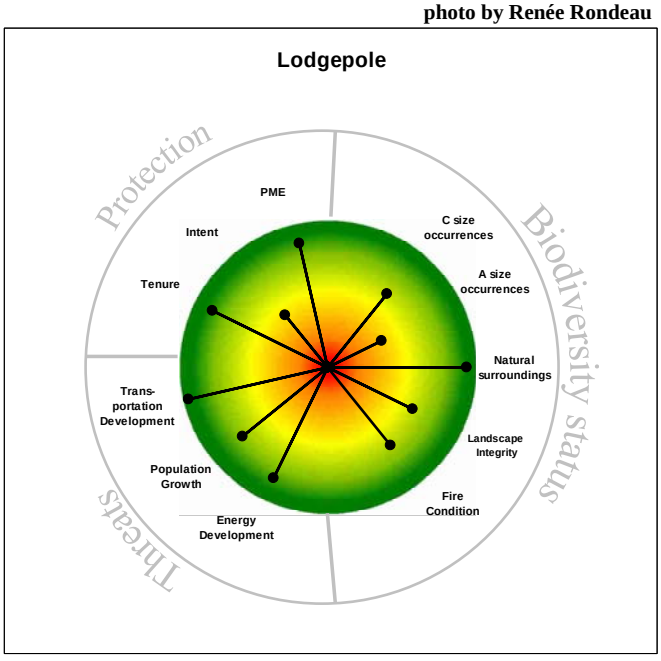


photo by Renée Rondeau





Oak and Mixed Mountain Shrub

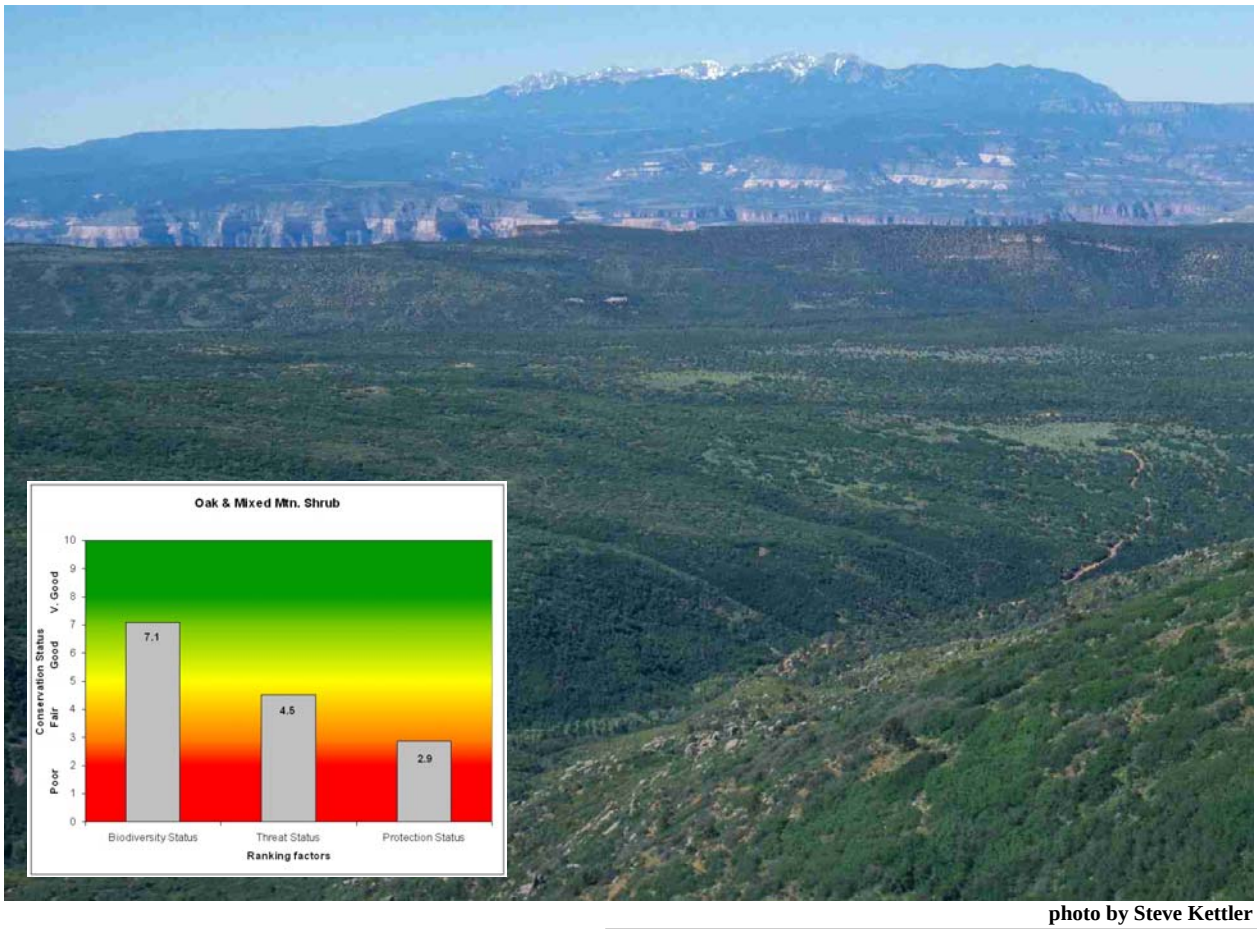
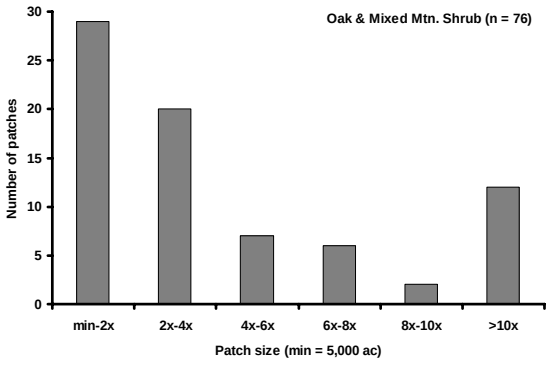
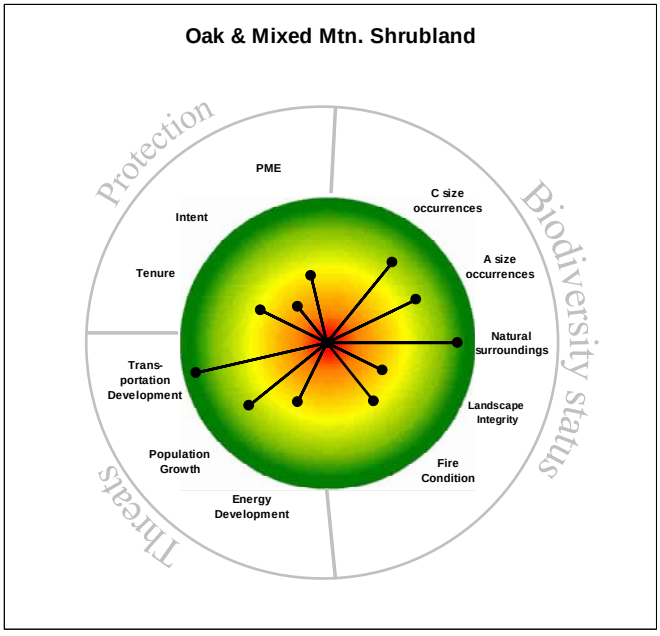


photo by Steve Kettler





Ponderosa

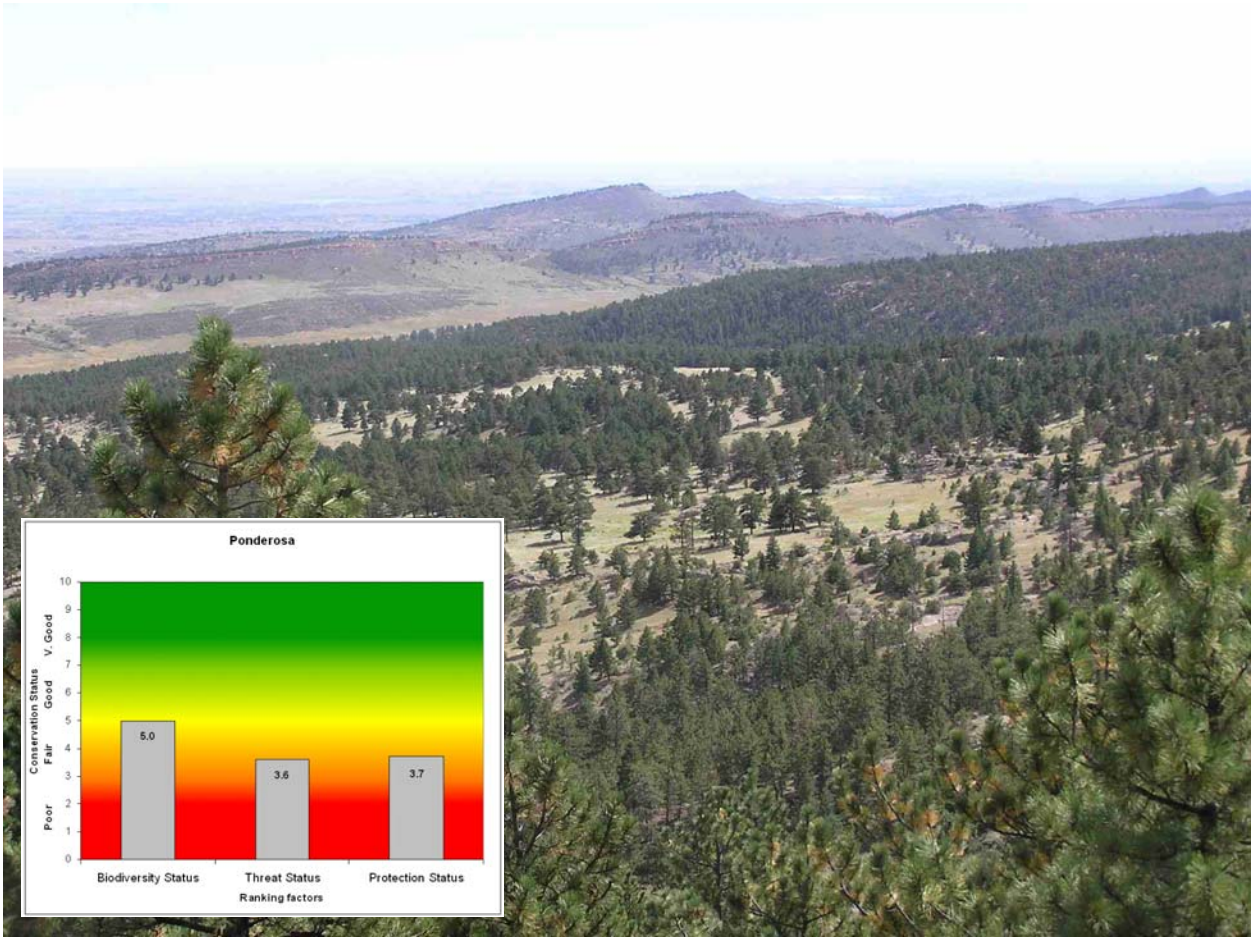
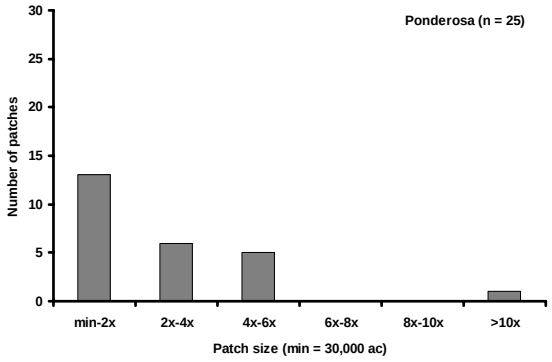
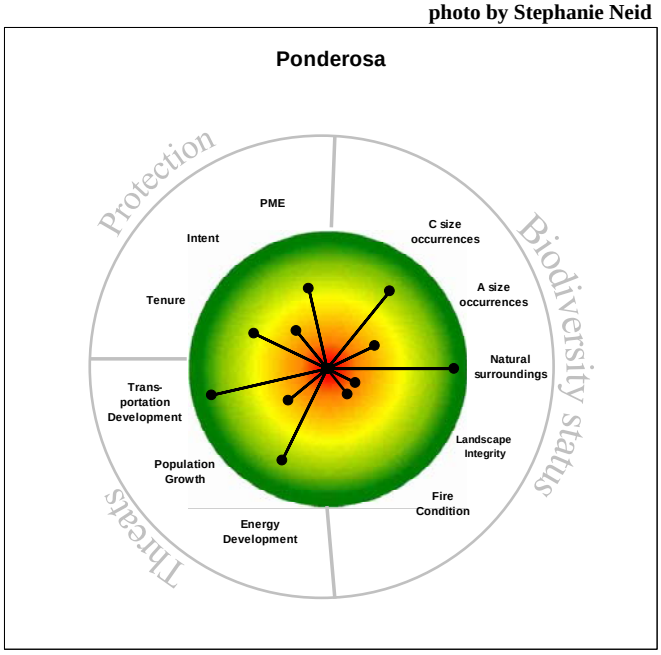


photo by Stephanie Neid





Sagebrush

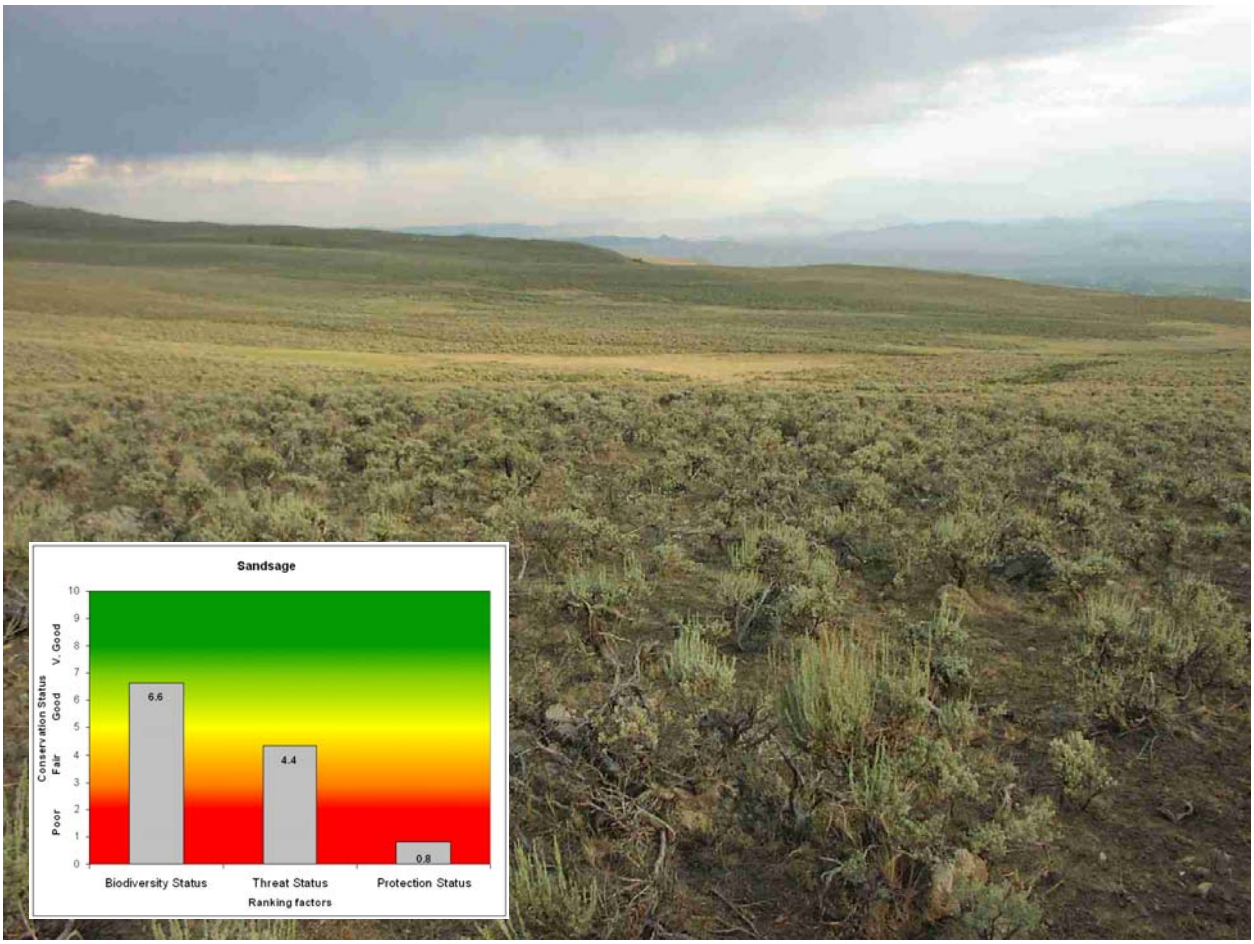
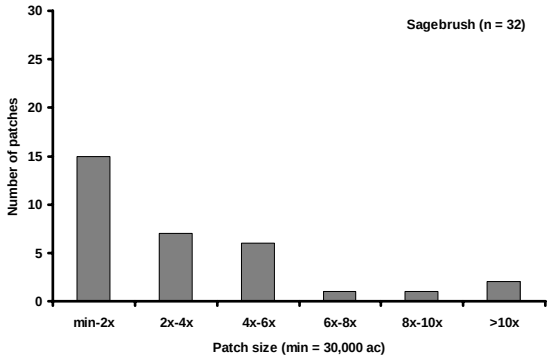
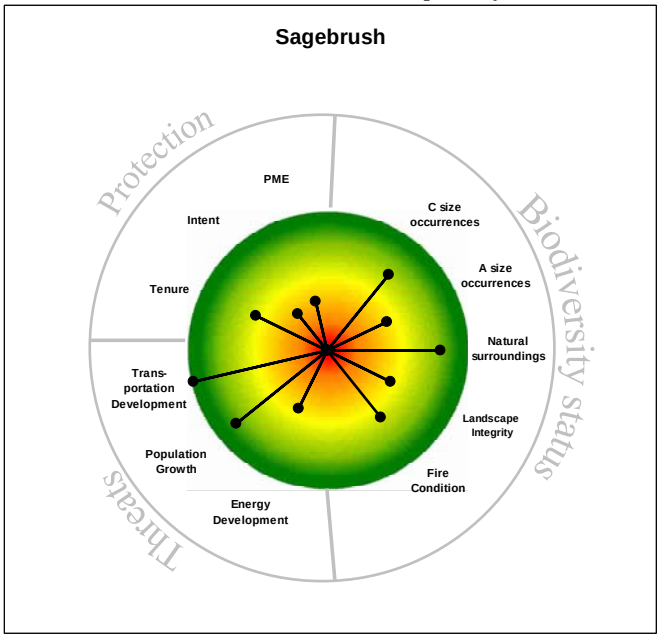


photo by Renée Rondeau





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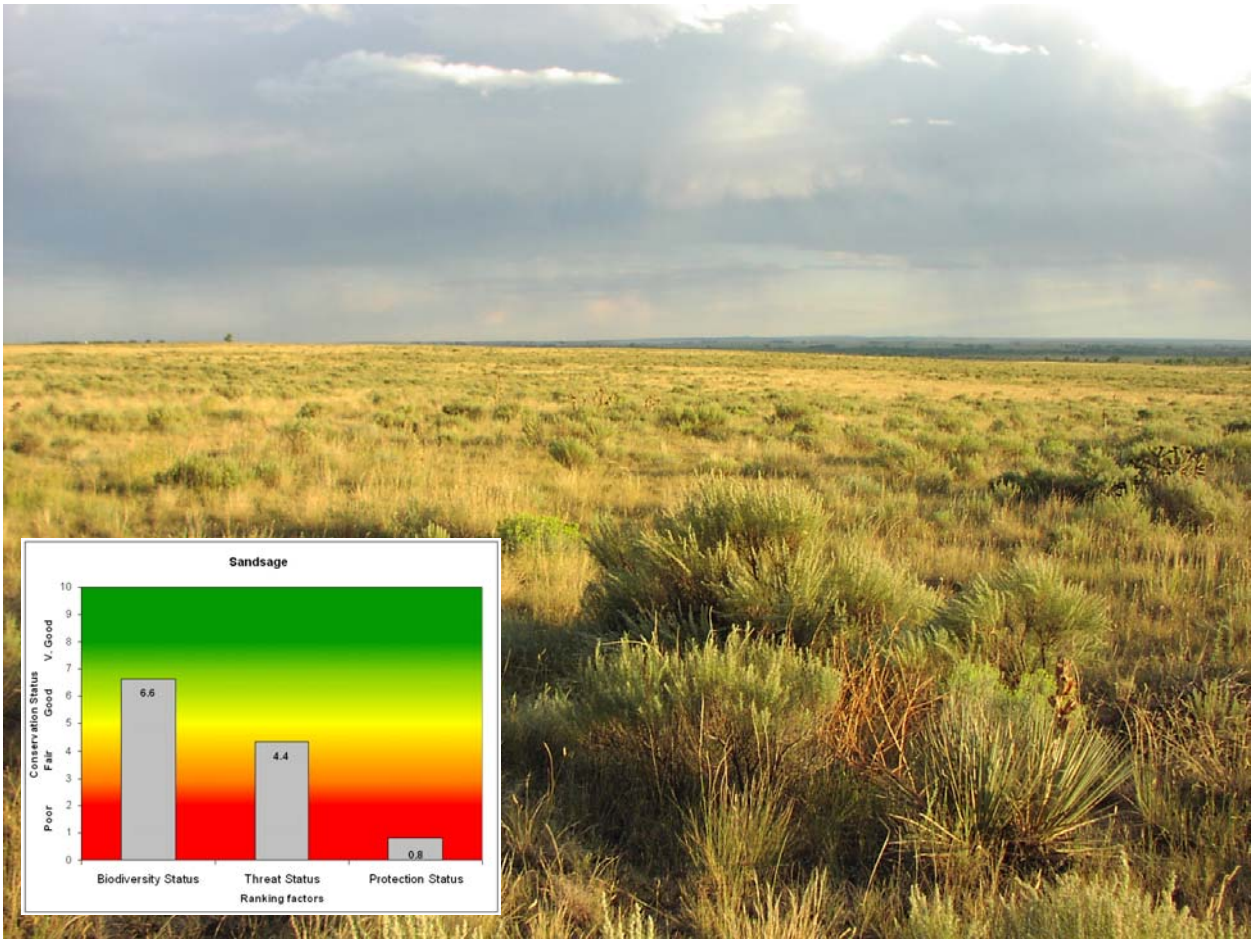
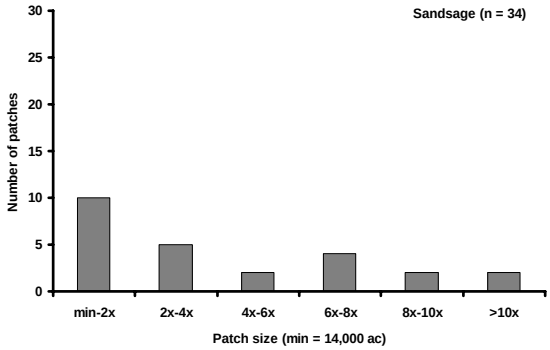
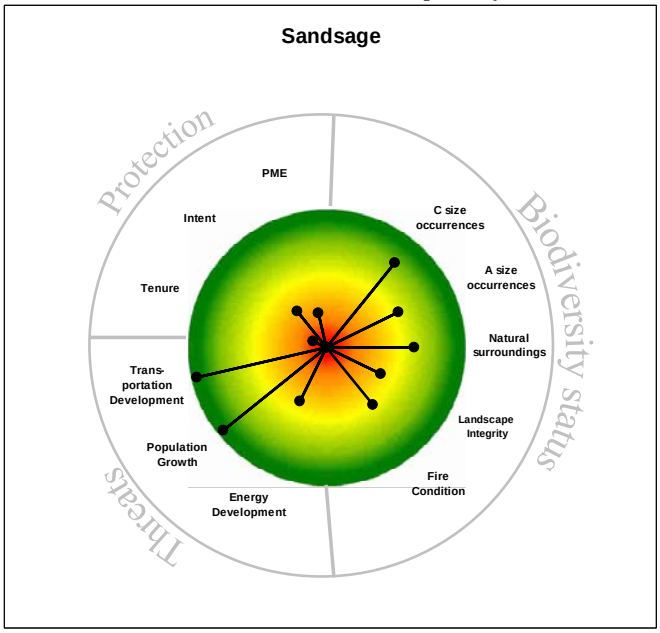


photo by Renée Rondeau





Shortgrass

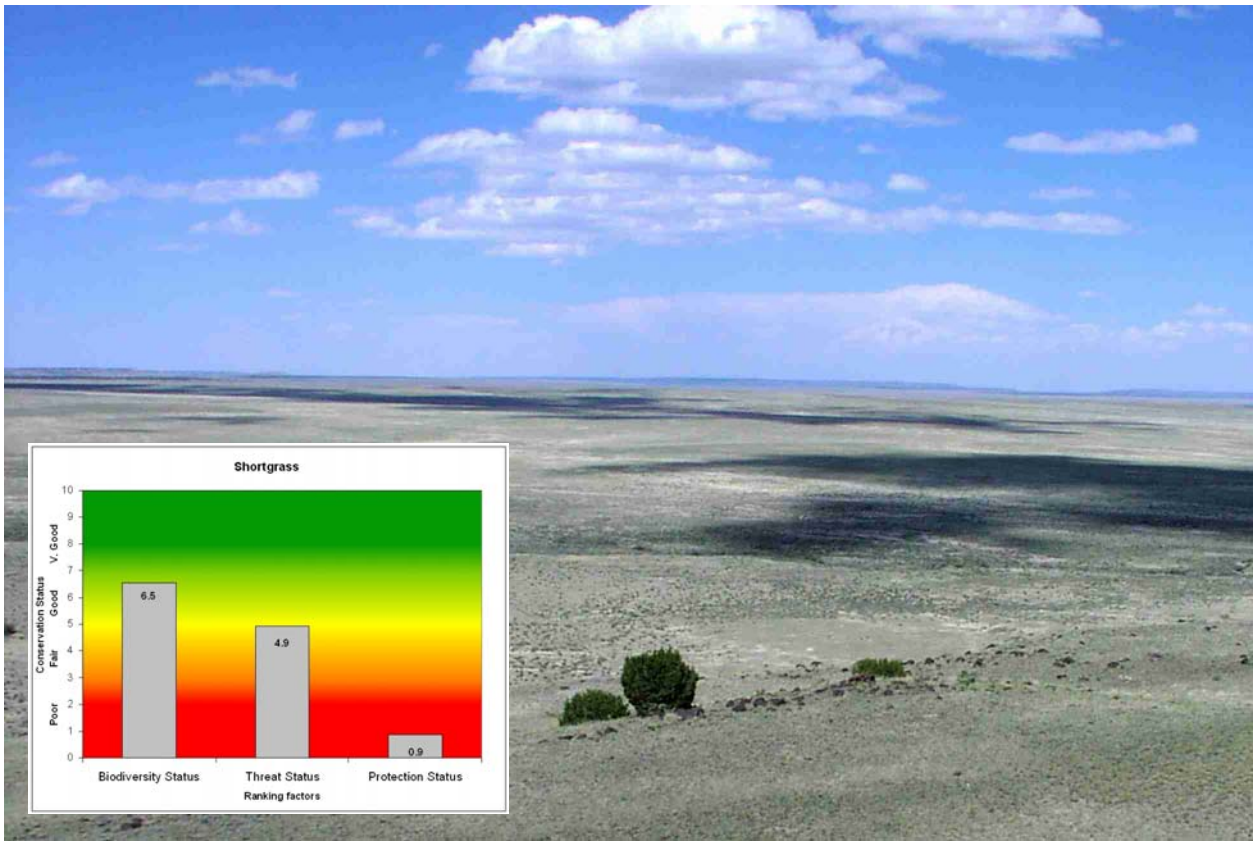
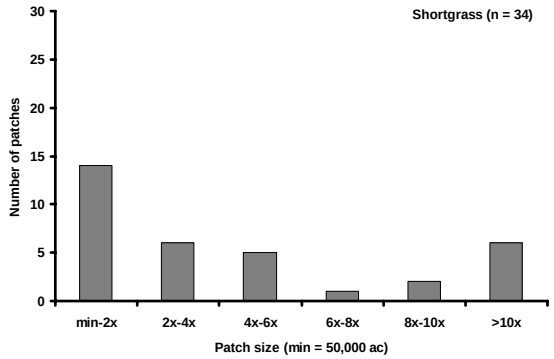
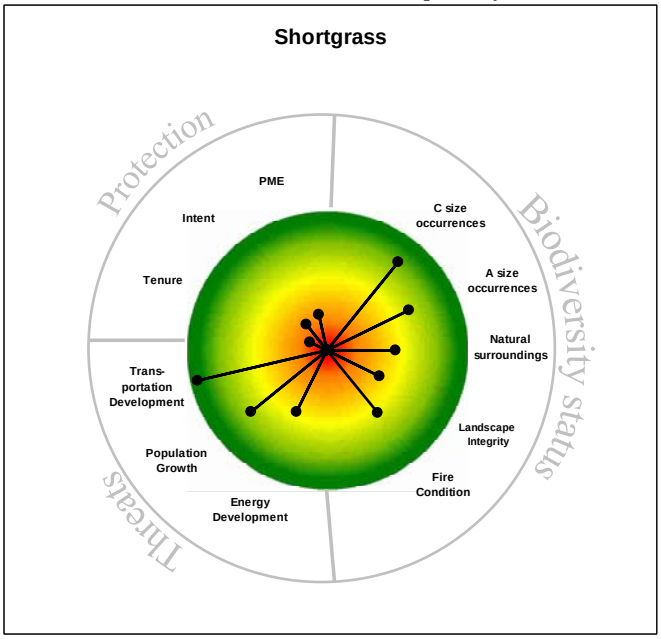


photo by Renée Rondeau





Southern Rocky Mountain Pinyon-juniper

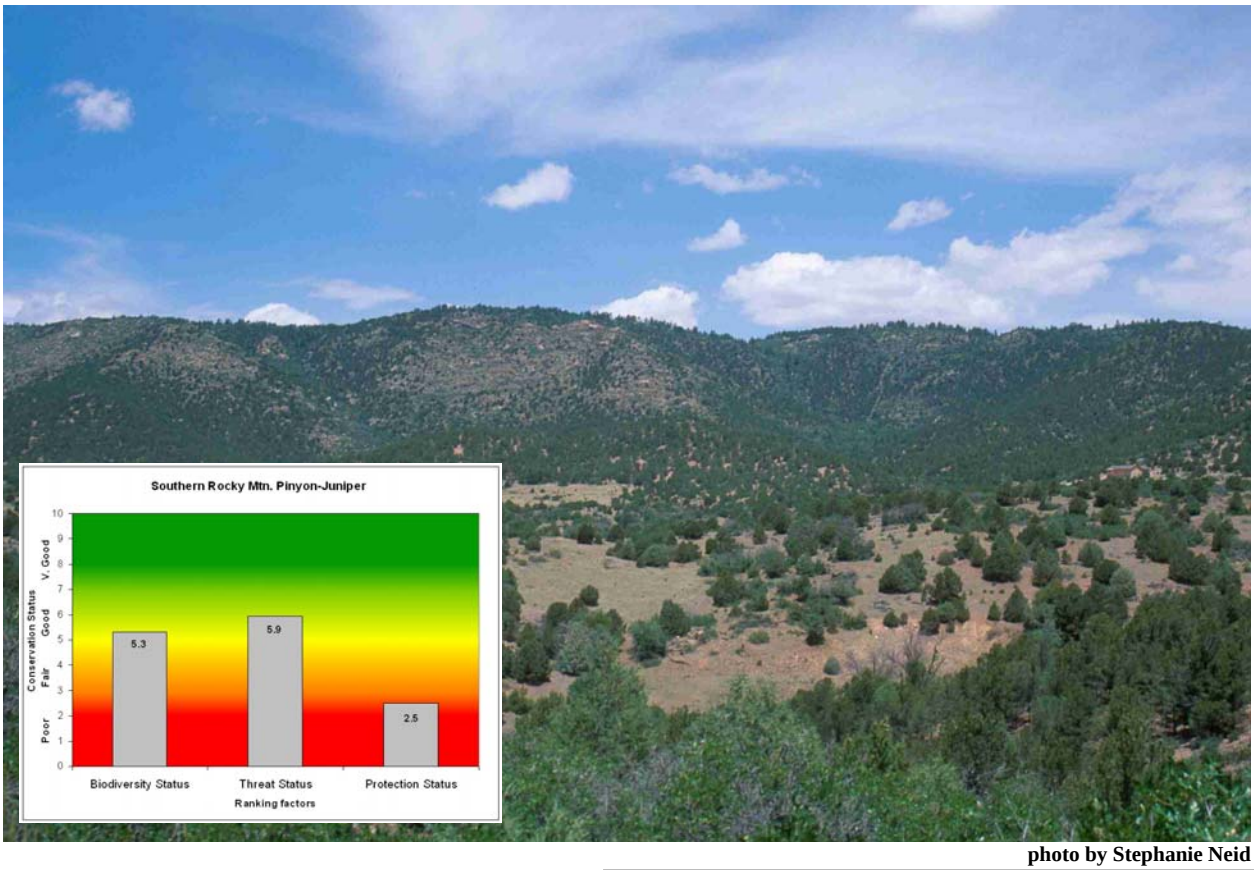
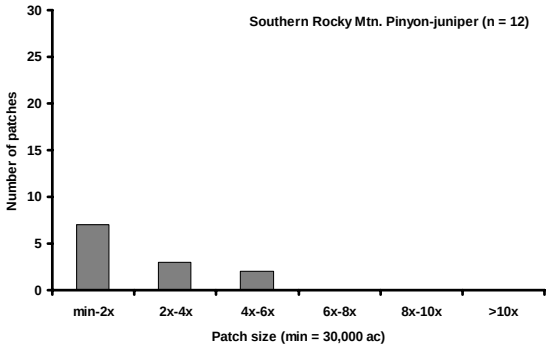
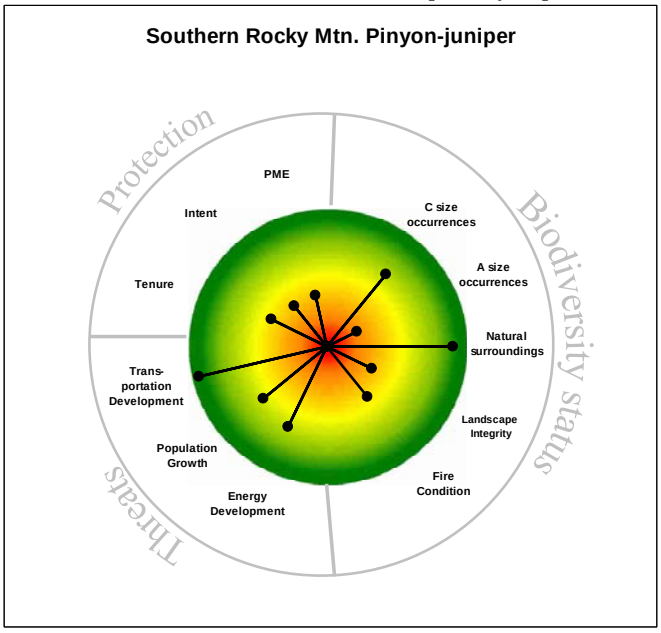
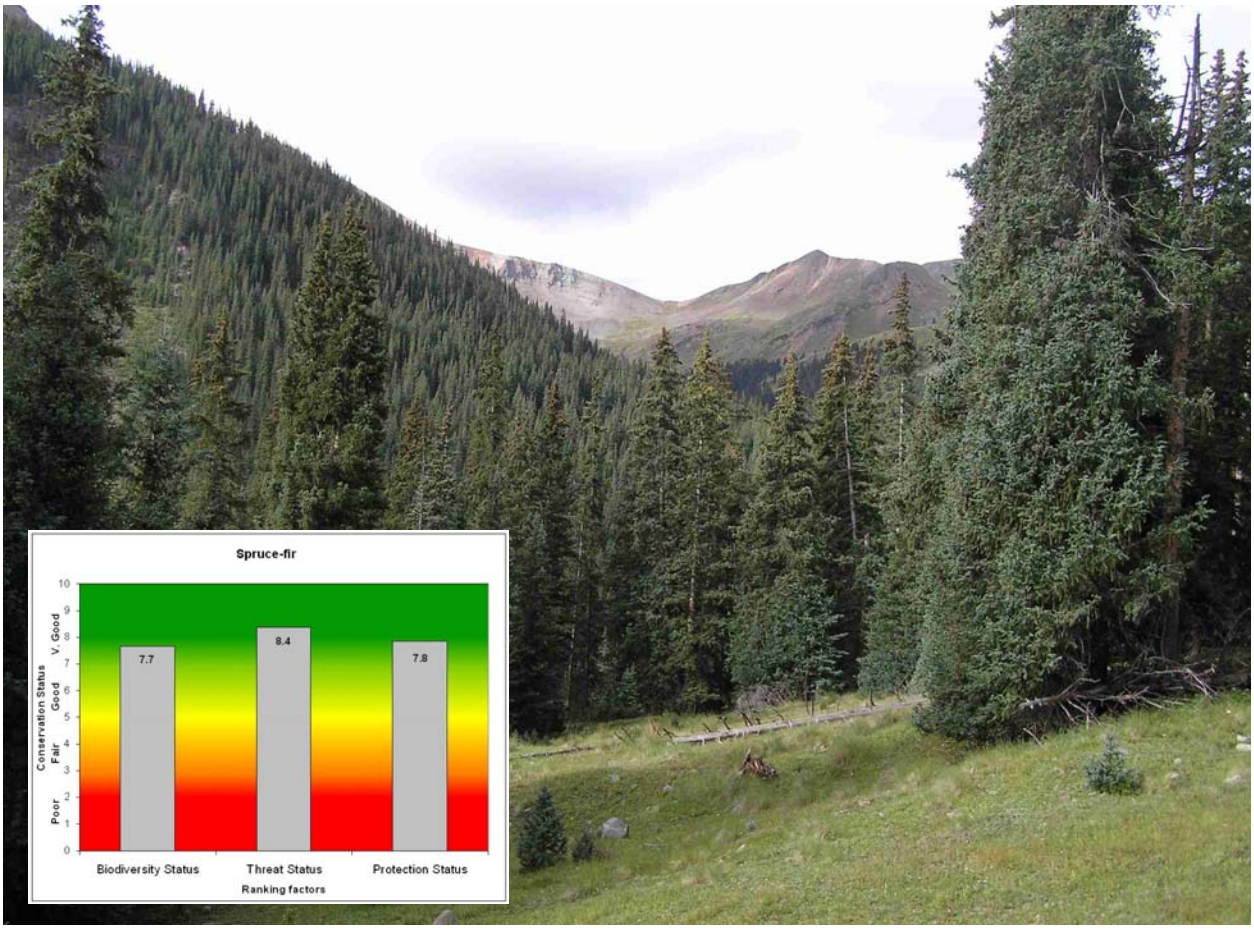


photo by Stephanie Neid





Spruce-fir



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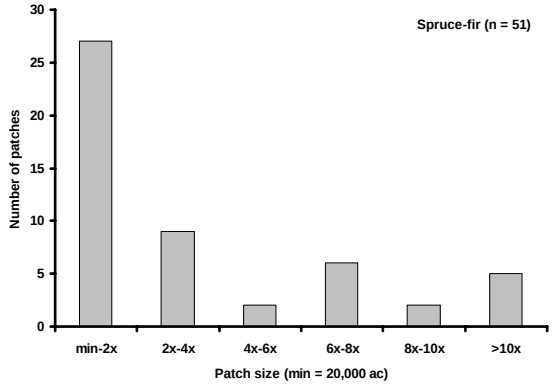
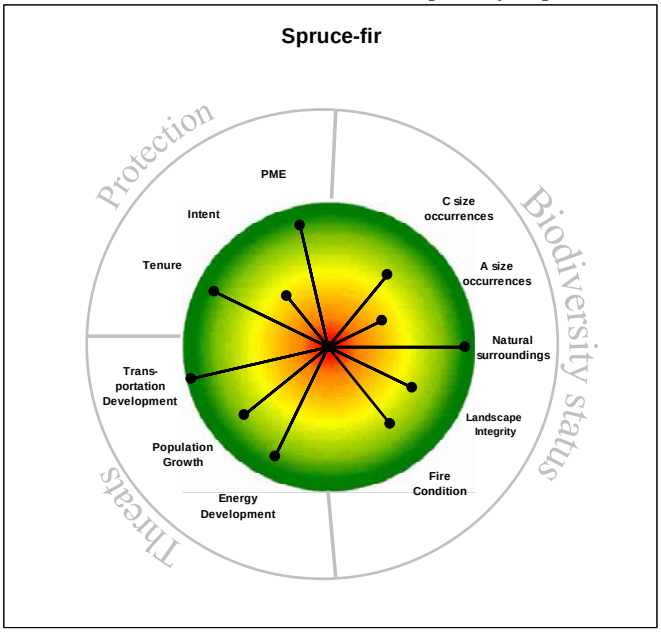




APPENDIX F: PLANT SCORECARD METHODOLOGY

Targets for this round of Scorecard include 100 G1 and G2 (and T1 T2) plants and 3 G3 plants[1].

The goal of the Scorecard procedure is to produce a baseline analysis that incorporates aspects of occurrence abundance/quality, degree and types of threats, and degree of protection for each target element. These analyses are summarized in a variety of formats. This scorecard will be updated periodically to record changes in conservation status of target elements.

For each plant species, a recommendation of what conservation action is needed next (i.e., on-the-ground protection, field inventory, taxonomic work, or monitoring) is included with the results of the scorecard calculations.

Explanation of scores for plants

Element occurrence records in the Colorado Natural Heritage Program database (BIOTICS) are the basis for scoring the plant species. This round of scoring uses element occurrence records in BIOTICS as of May 2008. Most of the fields used in the scoring are derived directly from the element occurrence records. One field, "threats," is based on our qualitative understanding of the primary threat to the species. All the fields are converted to a numeric scale of 0-10 for use in calculating a score.

Three of the fields derived from the element occurrence records (# of element occurrences, occupied area, and range) are converted to a scale of 0-10 using non-linear transformations. The graphs and equations used for the transformations are included in sections (E) through (G) below. Two graphs are included for each: the first includes the entire range (0-10), the second shows the beginning of each curve in detail. In the original trial run of the Scorecard process, number ranges used in standard natural heritage methodology (NatureServe 2008), referred to as BIOTICS bins on the graphs, were assigned values of 0-10 and used to calculate scores. In subsequent revisions of Scorecard, we discarded the bins in favor of using a continuous transformation to calculate scores. The original bins and assigned values were used to calibrate the curves in a trial-and-error fashion.

Three of the fields (landscape integrity, potential for energy development, and protection status) were derived by overlaying the element occurrences on a the appropriate GIS layers and developing scores.

All scores are based only on Colorado element occurrences (EOs), and do not include occurrences outside Colorado.

Independent of the scoring, two additional fields were developed to help put the scores in context. "Percent Range in Colorado" signifies what portion of the species range is within Colorado, and hence how important conservation within Colorado is to continued existence of the species. "Confidence in Score" indicates the degree to which CNHP feels the data provide an adequate basis for scoring, with high confidence reflecting a thorough understanding of distribution, abundance, occupance, quality, and threats, and low confidence indicating a lack of information in many of those categories. The global and state rank, agency status (i.e., USFWS listing, BLM Colorado Office and USFS Region 2 Sensitive), and primary ecological system for each species are also provided.

Element scientific name (state name)

Description: The scientific name used by CNHP to describe a species.
Interpretation: Nomenclature follows Weber and Wittmann 2001.

[1] There are 63 plants with a rank of G1 or G2 (and T1 or T2) that are endemic to Colorado and 50 G1 or G2 (and T1 or T2) plants that are not endemic to Colorado that are tracked by CNHP. Of these, 57 of the Colorado endemics and 43 of the non-endemics are included in this round of Scorecard. The others are excluded from this round either because they are in need of data processing (backlog) before meaningful scores can be calculated or because severe taxonomic uncertainty or lack of information preclude their inclusion. The three G3 species included are *Penstemon breviculus* (not endemic), *P. harringtonii* (endemic),and *Sclerocactus glaucus* (recently recognized as endemic).

Overall Conservation Status

Description: The color category of threat status, biodiversity, and protection scores are used to assign each species to an overall conservation status category. Not all possible color combinations are represented by species in this analysis. Methods shown in the table below represent a decision tree beginning with the scores for threat status, together with the color combinations of the other two scores. For instance, any species with a red score for threat status and red or orange for biodiversity and protection is regarded as poorly conserved. A species with an orange threat status score and at least one green green score for biodiversity or protection is considered moderately conserved. Not all possible color combinations are represented by species in this analysis. R=Red, O=Orange, Y=Yellow, G=Green, RO=Red or Orange, YG=Yellow or Green. Categories marked by * indicate species that may be naturally low in abundance even under adequate threat abatement and protection. Such species are considered inherently vulnerable, and may never achieve effectively conserved status.

IF **Threat Status**	AND **Biodiversity**	AND **Protection**	THEN **Overall Conservation Status**
R	R O	R O	Poorly Conserved
R	Y G	R O	
R	R	Y G	
O	R	R O	
O	R	Y G	
O	O	R O	
O	O	Y G	Weakly Conserved
R	O	Y G	
R	Y G	Y G	
O	Y G	R O	
Y	R O	R O	
G	R O	R O	
G	Y	R O	
O	Y	Y	
O	G	Y	Moderately Conserved
O	Y	G	
O	G	G	
Y	R O	Y G	
Y	Y G	R O	
G	R O	Y G	
G	G	R O	
Y	Y	Y	
Y	G	Y	Effectively Conserved
Y	Y	G	
Y	G	G	
G	Y G	Y G	

Global and State Rank

Description: The rarity rank assigned to a species by NatureServe and/or CNHP.
Interpretation: Methodology follows NatureServe Global Conservation Status Ranks (NatureServe 2008)

Rank	Definition
G1	Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	Imperiled—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	Vulnerable—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	Secure—Common; widespread and abundant.

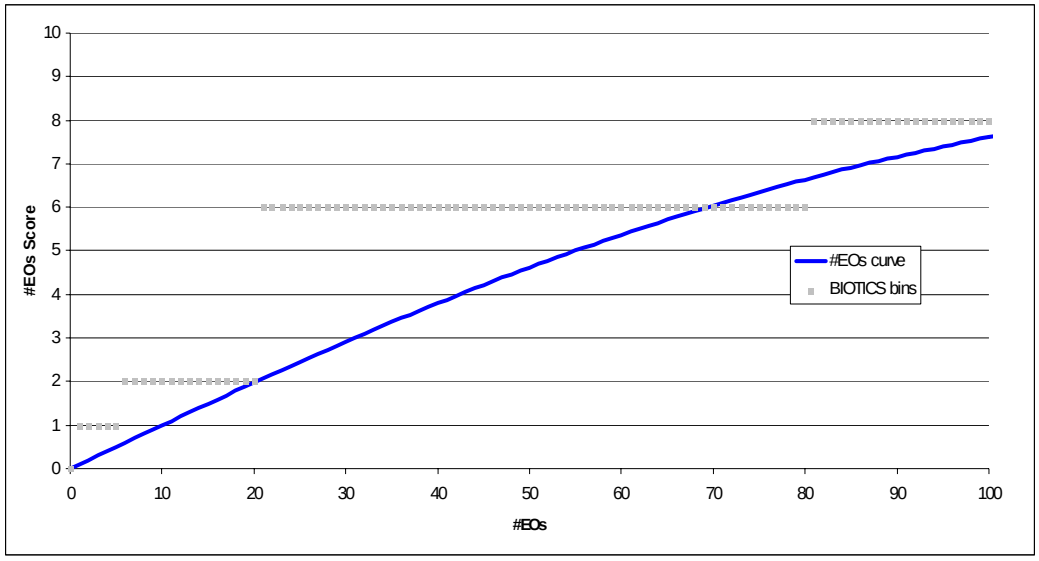
T# Infraspecific Taxon (trinomial)—The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above for global conservation status ranks. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1. A T-rank cannot imply the subspecies or variety is more abundant than the species as a whole-for example, a G1T2 cannot occur. A vertebrate animal population, such as those listed as distinct population segments under under the U.S. Endangered Species Act, may be considered an infraspecific taxon and assigned a T-rank; in such cases a Q is used after the T-rank to denote the taxon's informal taxonomic status. At this time, the T rank is not used for ecological communities

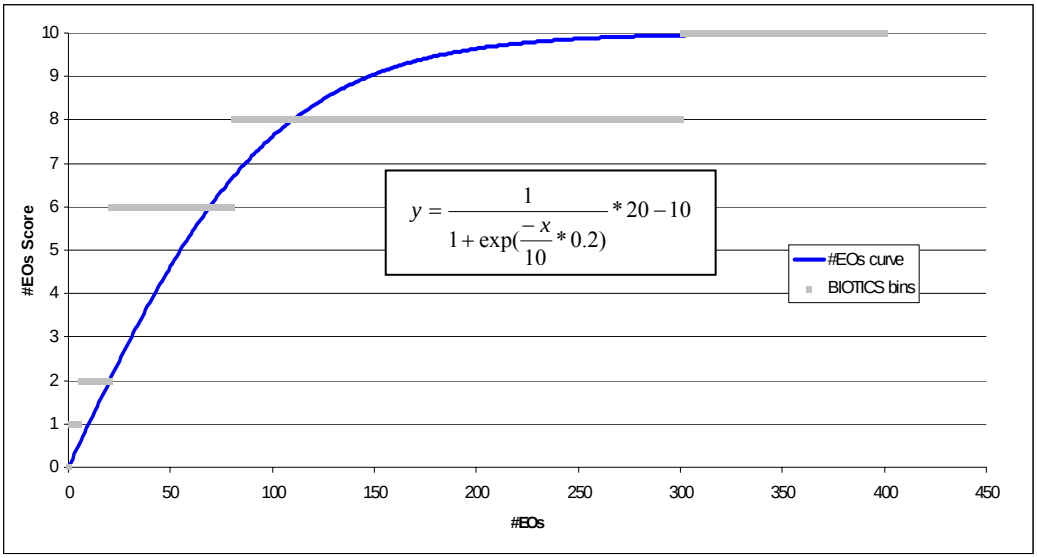
Agency Status

Description: Special status assigned by the U.S. and Wildlife Service (USFWS) under the Endangered Species Act, or the Bureau of Land Management or U.S. Forest Service.
Interpretation: Abbreviations for USFWS listings are as follows: LE, Listed Endangered; LT, Listed Threatened; C, Candidate for listing. BLM and USFS indicate inclusion on the respective agency's State or Regional Sensitive Species list.

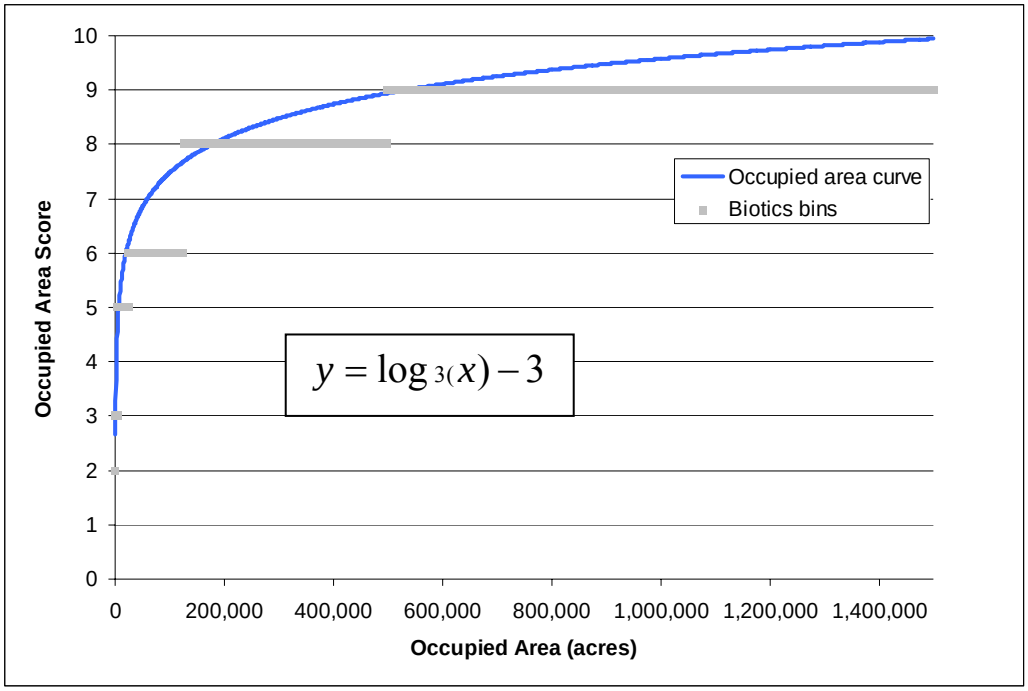
Number of occurrences (from element occurrence records) (Component of Abundance Score)

Description: The number of element occurrences. Element occurrence records were filtered to eliminate sub-EOs and X-ranked (extirpated) occurrences; all other occurrences are included in the analysis (all of the subsequent fields calculated or mapped from element occurrences follow this protocol). Species with excessive unprocessed data (over 25% of the total number of EOs) were excluded from the Scorecard analysis until processing of the data is complete; these species are included in the list of species and flagged as awaiting data processing.

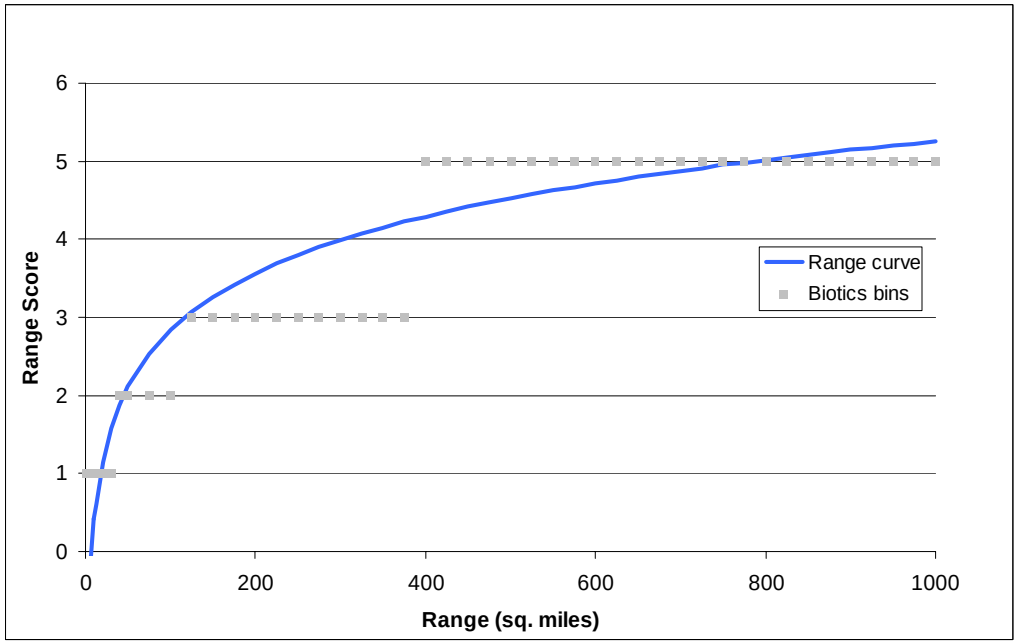


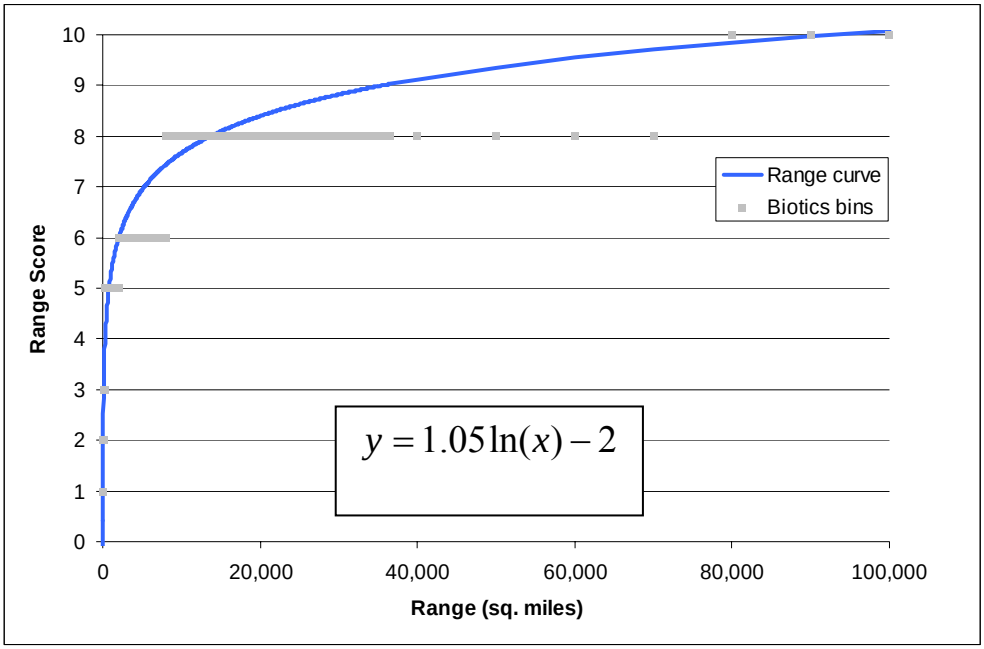


Occupied Area (from element occurrence records) (Component of Abundance Score)
Description: For plants, occupied area represents the sum of the area of EO polygons mapped in BIOTICS. All occurrences except those that are extirpated (X-ranked) are included. Seconds records represented by a dot (not a mapped polygon), minutes records, and general records were assigned an area of 0.5 acre for each occurrence (dot assigned a buffer of 25 meters, resulting in an area of approximately 0.5 acre).



Range (GIS analysis of element occurrence records) (Component of Abundance Score)
Description: The best estimate of the current range of the species. For plants, range was estimated by calculating the area of a minimum convex polygon drawn around all mapped occurrences of the species. Element occurrences flagged as identity questionable were not included in the minimum convex polygon.



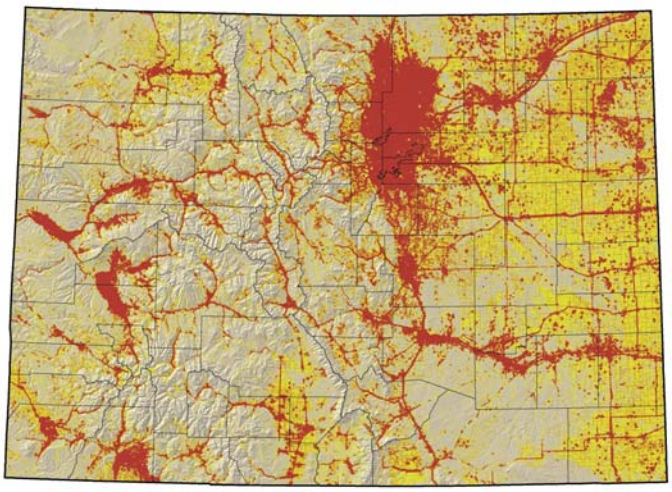


Size Score (Calculated)
Description: Average of columns (E) through (G).

Quality Score - % of EOs with Good Viability (from element occurrence records)
Description: Number of good viability EOs (A- and B-ranked) divided by the total number of EOs and converted to percent. This calculation is based on the EOs in BIOTICS. Note: if greater than 80% of the element occurrences were lacking an A through D element occurrence rank for quality (e.g., ranked E for extant or H for historic), the quality score is considered "unknown" and flagged as such.
Interpretation: The percent of good viability EOs divided by 10 (i.e., scale of 0 to 10). Used as a measure of the overall condition of the species.

Landscape Integrity Score: Percent area in High and Medium impact land use areas
Description: The rare plant element occurrence records were buffered by ¼ mile and then overlain on a landscape integrity layer to derive this score. The landscape integrity layer represents cumulative impacts from oil and gas wells, surface mining, urban development, agriculture, and roads (CNHP and TNC 2008, see metadata for details). The layer's values range from 0 – 2,235. High was considered to be > = 500. Medium was considered to be >=250 and <500. The score is derived from the area of the buffered element occurrences that fall within high and medium impact areas, converted to a scale of 0-10 as indicated below.
Interpretation: This score represents an estimate of the overall level of impact to the plant species (based on buffered element occurrences) from land uses. Used as a measure of the overall landscape context for the species.

% acreage in High Impact	% acreage in Medium Impact	Interpretation	Score
50-100%	any	Poor integrity	0
25-50	50-100		1
25-50	25-50	Fair integrity	2
25-50	0-25		4
1-25	50-100	Good integrity	5
1-25	25-50		6
1-25	0-25	Very good integrity	8
>1	>5		10



Landscape Integrity, showing high and medium impact areas (CNHP and TNC 2008).

Biodiversity Score (Calculated)
Description: The summary score for size, quality (condition), and landscape integrity (landscape context). Calculated as the average of the three scores, but with landscape integrity down-weighted by half. Where quality is unknown, the same value as size is used.
Interpretation: One of the three primary primary categories used to determine effective conservation.

Primary threat (from element global record)
Description: Scoring for threat is based on the scope, severity, and immediacy of what is considered to be the threat with the greatest overall impact on the species within Colorado. Primary threats listed include energy (e.g., oil and gas) development, housing/urbanization, hydrologic alteration, recreation (motorized/non-motorized), agricultural development, collecting, exotic species, and transportation (e.g., roads).

Threat – scope (from element global record)
Description: For the threat with the greatest overall impact on the species, the proportion of the species that is observed, inferred, or suspected to be directly or indirectly affected by this threat.
Interpretation: High = >60% of total population, occurrences, or area affected, Moderate = 20-60% of total population, occurrences, or area affected, Low = 5-20% of total population, occurrences, or area affected, Insignificant = <5% of total population, occurrences, or area affected.

Threat – severity (from element global record)
Description: For the threat with the greatest overall impact on the species, how badly and irreversibly the species is observed, inferred, or suspected to be directly or indirectly affected by this threat.
Interpretation: High = Loss of species population or destruction of species habitat in area affected with effects essentially irreversible or requiring long-term recovery (>100 years), Moderate = Major reduction of species population or long-term degradation or reduction of species habitat in area affected, with recovery expected in 10-50 years, Low = Low but nontrivial reduction of species population or reversible degradation or reduction of species habitat in area affected, with recovery expected in 10-50 years, Insignificant = Essentially no reduction of species population or degradation of species habitat, with ability to recover quickly (within 10 years) from minor temporary loss.

Threat – immediacy (from element global record)
Description: For the threat with the greatest overall impact on the species, the imminence of the threat to the species (i.e., how likely the threat to the species is and how soon it is expected to be realized).
Interpretation: High = Threat is operational (happening now) or imminent (within a year), Moderate = Threat is likely to be operational within 2-5 years, Low = Threat is likely to be operational within 5-20 years, Insignificant = Threat not likely to be operational within 20 years.

Threat Status Score (from element global record)
Description: Overall degree to which the species is observed, inferred, or suspected to be directly or indirectly threatened by the threat with the greatest overall impact on the species. BIOTICS calculates the overall degree of threat to the species based on values entered for Scope, Severity, and Immediacy (see table below). CNHP has converted the overall Biotics alpha threat scores to numeric scores so that the values can be included in Scorecard calculations. A low score indicates a species is highly threatened by the primary threat and a high score indicates a low level of threat.
Interpretation: see table below.

Threat summary table from BIOTICS

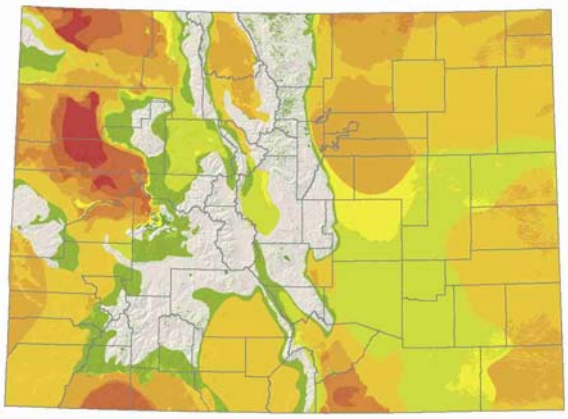
Scope	Severity	Immediacy	Score	Description
High	High	High	0	Moderate to severe, imminent threat for most (>60%) of population, occurrences, or area
High	High	Moderate		
High	Moderate	High		
High	Moderate	Moderate		
Moderate	High	High	2	Moderate to severe, imminent threat for a significant proportion (20-60%) of population, occurrences, or area
Moderate	High	Moderate		
Moderate	Moderate	High		
Moderate	Moderate	Moderate		
High	High	Low	4	Moderate to severe, non-imminent threat for most (>60%) of population, occurrences, or area
High	Moderate	Low		
Moderate	High	Low	5	Moderate to severe, non-imminent threat for a significant proportion (20-60%) of population, occurrences, or area
Moderate	Moderate	Low		
Low	High	High	6	Moderate to severe threat for small proportion (<20%) of population, occurrences, or area
Low	High	Moderate		
Low	High	Low		
Low	Moderate	High		
Low	Moderate	Moderate		
Low	Moderate	Low		
High	Low	High	8	Low severity threat for most or significant proportion of population, occurrences, or area
High	Low	Moderate		
High	Low	Low		
Moderate	Low	High		
Moderate	Low	Moderate		
Moderate	Low	Low		
Low	Low	High	9	Low severity threat for a small proportion of population, occurrences, or area
Low	Low	Moderate		
Low	Low	Low		
Unthreatened (value resulting if Scope, Severity, or Immediacy are considered "Insignificant") (Score = 10)				

Protection Status (derived from element occurrences and COMaP)

Description: Calculations are based on three Conservation Management Status Measures developed by The Nature Conservancy (Supples et al. 2007). Every record in COMaP (Wilcox et al. 2007) was assigned a rank for each of three categories: Tenure, Intent, and Potential Management Effectiveness (PME), as well as a summary rank for conservation management status (CMS). These ranks represent the current state of knowledge about the status of the three conservation indicators on each parcel in COMaP. In southeastern Colorado, ranks assigned by TNC to private ranches were modified to reflect information collected during CNHP's 2007 survey of the area. The individual Tenure, Intent, and PME ranks were "rolled up" to a final protection status rank according to a formula adapted from the method provided by The Nature Conservancy, which was used in this analysis. For each COMaP parcel, scoring was majority rule, with the following exceptions and "averaging" rules: if any one category is Poor, then protection status is Poor; if two indicators are Very Good and one Fair, then protection status is Good; if one indicator is Very Good, one is Good, and one is Fair, then protection status is Good; if one indicator is Very Good, one is Fair, and one is Unknown, then protection status is Fair. Ranks assigned by TNC and CNHP were converted to a numerical score. The scored COMaP parcels were then converted to a 30m resolution grid, so that each grid cell had a numeric value or 0, 2, 4, 7, or 10, representing Poor, Unknown, Fair, Good, and Very Good protection status, respectively. The protection status score was then calculated by area-weighted average for each species.
Interpretation: This score represents a summary of the land ownership, intent to manage for biodiversity, and potential effectiveness of such management for a particular species. Because an occurrence may span several different land management categories, this score is a generalization of land management trends across all occurrences of a species.

Energy Development Potential Score

Description: The rare plant element occurrence records were buffered by ¼ mile and then overlain on an energy development layer to derive this score. The energy development layer is based on a combination of statewide layers showing oil & gas potential, coal potential, and uranium/vanadium potential (BLM 1998), oil shale potential (digitized from BLM 2006), and wind energy potential (TrueWind Solutions 2003). Original shapefiles were converted to 30m grids, and added; Oil and Gas potential was double-weighted. Possible scores for any cell range from 0 to 10. An area-weighted average score for each buffered plant occurrence and for the entire species was calculated. This method was developed for scoring of matrix ecological systems, and is applied here to plants (see the Ecological Systems Scorecard for more information).
Interpretation: This score represents the combined potential for impact from a variety of energy development activities.



Energy development potential

Habitat

Description: Generalized setting of the plant in the context of the following habitats: alpine, barrens, cliff and canyon, grassland, forest, pinyon/juniper, shrubland, and wetland.

% Range in Colorado

Description: This field provides context for the final score in the form of a measure of the importance of Colorado to the conservation of the plant species rangewide. Range maps are not available for non-endemic species therefore, these values are based on the percentage of the element occurrences that are within Colorado (using NatureServe's online rangewide data set as the source of element occurrences outside of Colorado).
Interpretation: Endemic = 100% of range within Colorado, Very High = 75-99% of range (EOs) within Colorado, High = 50-75% of range (EOs) within Colorado, Medium = 25-50% of range (EOs) within Colorado, Low = <25% of range (EOs) within Colorado.

Confidence in Score

Description: This field quantifies CNHP's confidence in the scoring process for the individual species based on the completeness of the data. The following criteria are used to assess our confidence in the completeness of the data:
A = % EOs with imprecise locational information (General and Minute EOs)
B = % EOs with no recent information (EO Rank of Historical (>20 years since last observed) or Failed to Find (searched for and not found))
C = % EOs with incomplete information (EO Rank of Extant (E) – i.e., not enough information available to determine an EO Rank of A, B, C, or D)
D = % EOs mapped using CNHP old methodology vs. new methodology – New methodology maps polygons where that information is available, old methodology maps polygons as dots. There is a backlog of converting the old methodology EOs to new methodology.
Interpretation: Very High: A, B, and C <10% and D < 30%, High = A, B, and C ≤10-30% and D ≤ 50%, Moderate = A, B, or C ≤30-50% or D ≤50-80%, Low = A, B, or C >50% or D >80%. In some cases, CNHP has greater confidence in the data and score than this rating process indicates; ratings adjusted by hand are flagged with an asterisk*.

Conservation Recommendation

Description: These fields summarize recommended conservation actions for each species or subspecies. For taxa where the distribution is well documented and high quality occurrences are known, the recommended action is on-the-ground conservation action such as special designation, land purchase, or conservation easement. Monitoring is recommended for most G1, T1, and federally listed species. Field inventory is recommended for those species with a low confidence in score, to enhance our knowledge of those species. Taxonomic work is recommended for several species that are not well understood. Species with moderate confidence scores may be recommended for a combination of actions based on institutional knowledge of the individual species.

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APPENDIX G: RARE PLANT SCORECARD

Threat Scope:
High = > 60% of total population, occurrences, or area affected
Moderate = 20-60% affected
Low = 5-20% affected
Insignificant = < 5% affected

Threat Severity:
High = Loss of species population (all individuals) or destruction of species habitat or ecological community in area affected, with effects essentially irreversible or requiring long-term recovery (>100 years).
Moderate = Requiring 50-100 years for recovery.
Low = Recovery expected in 10-50 years.
Insignificant = Ability to recover quickly (within 10 years) from minor temporary loss.

Threat Immediacy:
High = Threat is happening now or imminent (within a year).
Moderate = Threat likely within 2-5 years.
Low = Threat within 5-20 years.
Insignificant = Threat not likely within 20 years.

Threats Status-summary:
0 = Moderate to severe, imminent threat to >60% of popn.
2 = Moderate to severe, imminent threat to 20-60% of popn.
4 = Moderate to severe, non-imminent threat for >60% of popn.
5 = Moderate to severe, non-imminent threat to 20-60% of popn.
6 = Moderate to severe threat for small proportion of popn.
8 = Low severity threat for most or significant proportion of popn.
9 = Low severity threat for small proportion of popn.
10 = Unthreatened.

Conservation Recommendation

Scientific Name (State)	Overall Conservation Status	G/S Rank	Agency Status	# Occurrences Score	Occupied Area Score	Range Score	Size Score	Quality Score	Land-scape Integrity Score	Bio-diversity Score	Primary Threat	Threat - Scope	Threat - Severity	Threat - Immediacy	Threats Status Score	Pro-tection Status Score	Potential for Energy Develop-ment Score	Habitat	% Range in CO	Confi-dence in Score	On-the-Ground Action	Field Inventory	Monitoring	Taxonomic Work
Aletes humilis	Effectively Conserved	G2G3/S2S3		3.0	2.6	4.6	**3.4**	**8.7**	**8**	**5.4**	recreational uses	Low	Low	Low	**9**	**7.0**	**9.9**	Cliff and Cyn	Endemic	Very High			X	
Aletes latilobus	Effectively Conserved	G1/S1	BLM	0.5	1.1	1.4	**1.0**	**6.0**	**6**	**3.3**	recreation/hiking	Low	Moderate	Low	**6**	**9.4**	**9.6**	Cliff and Cyn	Medium	Moderate*	X	X	X	
Aletes macdougalii ssp. breviradiatus	Weakly Conserved	G3T2T3/S1		0.1	0.0	0.0	**0.0**	**unknown**	**10**	**1.7**	recreation/hiking	Low	Low	Low	**9**	**0.9**	**4.0**	PJ	Medium	Low		X		
Aliciella sedifolia	Moderately Conserved	G1/S1	USFS	0.2	1.7	0.0	**0.6**	**unknown**	**10**	**2.1**	recreation/hiking	Moderate	Moderate	Low	**5**	**7.0**	**9.9**	Alpine	Endemic	Moderate	X	X	X	
Anticlea vaginatus	Effectively Conserved	G2/S2		0.4	0.0	0.0	**0.1**	**7.5**	**8**	**3.9**	hydrologic alteration	Moderate	Moderate	Low	**5**	**10.0**	**8.0**	Cliff and Cyn	Low	Low		X		
Aquilegia chrysantha var. rydbergii	Poorly Conserved	G4T1Q/S1	BLM/USFS	1.0	2.0	3.5	**2.2**	**2.0**	**2**	**1.7**	recreational uses	Moderate	Moderate	Moderate	**2**	**5.1**	**8.5**	Forest	Endemic	Low		X	X	X
Asclepias uncialis ssp. uncialis	Moderately Conserved	G3G4T2T3/S2	BLM/USFS	3.5	2.4	8.7	**4.9**	**2.7**	**8**	**3.9**	agricultural development	Moderate	Moderate	Low	**5**	**4.6**	**5.2**	Grassland	Very High	Moderate	X	X		
Astragalus anisus	Effectively Conserved	G2G3/S2S3	BLM	3.7	4.0	5.0	**4.2**	**1.5**	**8**	**3.3**	roads	Moderate	Low	Moderate	**8**	**5.7**	**9.5**	Shrubland	Endemic	Moderate	X			
Astragalus cronquistii	Poorly Conserved	G2/S2	BLM	1.3	0.0	2.4	**1.2**	**unknown**	**6**	**1.8**	roads	Moderate	Moderate	Moderate	**2**	**1.7**	**4.0**	Shrubland	High	Low		X		
Astragalus debequaeus	Weakly Conserved	G2/S2	BLM	1.7	3.6	4.8	**3.4**	**5.9**	**2**	**3.4**	oil & gas	High	Moderate	High	**0**	**3.6**	**1.7**	PJ	Endemic	Very High	X		X	
Astragalus deterior	Moderately Conserved	G1G2/S1S2		1.5	0.0	2.0	**1.2**	**0.0**	**6**	**1.4**	recreation/hiking	Low	Low	Low	**9**	**9.8**	**4.0**	Cliff and Cyn	Endemic	Low		X	X	
Astragalus equisolensis	Moderately Conserved	G5T1/S1		0.4	0.0	0.2	**0.2**	**0.0**	**4**	**0.7**	recreation	Moderate	Low	Unknown	**8**	**5.2**	**4.0**	PJ	Low	Low		X		
Astragalus humillimus	Moderately Conserved	G1/S1	LE	0.4	1.2	0.7	**0.8**	**5.0**	**8**	**3.3**	none documented	Low	Moderate	Low	**6**	**2.0**	**4.0**	Cliff and Cyn	Low	Low		X	X	
Astragalus iodopetalus	Moderately Conserved	G2/S1		0.4	0.0	6.3	**2.2**	**unknown**	**0**	**1.5**	recreation/biking	Moderate	Low	High	**8**	**5.2**	**4.6**	Shrubland	Medium	Low		X		
Astragalus lonchocarpus var. hamiltonii	Effectively Conserved	G1/S1		0.1	0.0	0.0	**0.0**	**10.0**	**8**	**4.7**	recreation/hiking	Moderate	Low	Low	**8**	**4.6**	**6.0**	PJ	Low	Low		X		
Astragalus microcymbus	Moderately Conserved	G1/S1	BLM	0.4	0.0	0.8	**0.4**	**5.0**	**8**	**3.1**	herbivory/motorized rec.	High	Moderate	High	**2**	**5.7**	**10.0**	Shrubland	Endemic	High*	X		X	
Astragalus missouriensis var. humistratus	Weakly Conserved	G5T1/S1	USFS	1.0	2.1	4.1	**2.4**	**4.0**	**0**	**2.1**	housing/urban dev.	Moderate	Low	Moderate	**8**	**0.7**	**3.2**	Shrubland	Endemic	Moderate	X		X	
Astragalus naturitensis	Moderately Conserved	G2G3/S2S3	BLM	3.3	3.1	6.6	**4.3**	**2.9**	**2**	**2.8**	oil & gas	Low	Moderate	High	**6**	**4.5**	**3.2**	Cliff and Cyn	High	Moderate	X			
Astragalus osterhoutii	Poorly Conserved	G1/S1	LE	0.6	3.1	2.4	**2.0**	**8.3**	**0**	**3.4**	recreation/motorized	High	High	Moderate	**0**	**2.1**	**5.0**	Shrubland	Endemic	High	X		X	
Astragalus piscator	Moderately Conserved	G2G3/S1	BLM	0.2	0.0	0.0	**0.1**	**10.0**	**0**	**3.4**	roads/urban dev.	Moderate	Moderate	High	**2**	**5.9**	**4.0**	Shrubland	Low	High	X			
Astragalus rafaelensis	Moderately Conserved	G2G3/S1	BLM	0.8	2.4	4.6	**2.6**	**unknown**	**2**	**2.1**	none documented	Low	Low	Low	**9**	**3.6**	**3.5**	PJ	High	Low		X		
Astragalus schmolliae	Moderately Conserved	G1/S1		0.6	3.9	0.4	**1.6**	**5.0**	**6**	**3.2**	exotic species	Moderate	Moderate	High	**2**	**10.0**	**4.0**	PJ	Endemic	Moderate	X		X	
Astragalus tortipes	Weakly Conserved	G1/S1	C	0.2	1.7	0.0	**0.6**	**5.0**	**8**	**3.2**	recreation/motorized	Moderate	Moderate	High	**2**	**2.0**	**4.0**	Shrubland	Endemic	Very High	X		X	
Botrychium lineare	Moderately Conserved	G1/S1	C, USFS	0.5	0.0	6.5	**2.3**	**unknown**	**2**	**1.9**	roads	Low	Low	Low	**9**	**6.6**	**9.8**	Forest	Medium	Low		X	X	
Camissonia eastwoodiae	Weakly Conserved	G2/S1		0.4	3.0	4.4	**2.6**	**2.5**	**2**	**2.0**	roads/ORV	Moderate	Moderate	Moderate	**2**	**4.1**	**5.4**	Shrubland	Medium	Moderate	X	X		
Carex stenoptila	Effectively Conserved	G2/S2		1.1	4.0	8.1	**4.4**	**unknown**	**8**	**4.3**	unknown - recreation?	Insig.	Insig.	Insig.	**10**	**9.3**	**6.1**	Forest	Medium	Low		X		
Castilleja puberula	Effectively Conserved	G2G3/S2S3		1.9	0.0	6.2	**2.7**	**unknown**	**8**	**3.1**	recreational uses	Moderate	Low	Low	**8**	**5.8**	**9.9**	Alpine	Endemic	Low		X		
Cirsium perplexans	Weakly Conserved	G2G3/S2S3	BLM/USFS	2.9	3.2	5.9	**4.0**	**3.7**	**2**	**2.9**	Cirsium bio control	Moderate	Moderate	Low	**5**	**2.7**	**3.5**	Shrubland	Endemic	High	X			
Cleome multicaulis	Effectively Conserved	G2G3/S2S3	BLM	3.6	4.7	5.6	**4.6**	**3.4**	**2**	**3.0**	hydrologic alteration	Moderate	Moderate	Low	**5**	**5.9**	**4.0**	Wetland	High	High*	X			
Corispermum navicula	Moderately Conserved	G1?/S1		0.2	2.5	0.0	**0.9**	**10.0**	**6**	**4.6**	recreation/motorized	Moderate	Moderate	High	**2**	**6.2**	**6.5**	Barrens	Endemic	Very High		X		X
Cryptantha gypsophila	Weakly Conserved	G1G2/S1S2		1.6	2.7	4.3	**2.9**	**6.9**	**6**	**4.2**	oil & gas	High	Moderate	Moderate	**0**	**3.9**	**3.5**	PJ	Endemic	Very High	X	X	X	
Delphinium ramosum var. alpestre	Effectively Conserved	G2/S2		0.9	2.9	7.3	**3.7**	**unknown**	**10**	**4.1**	recreation/hiking	Low	Low	Low	**9**	**8.2**	**7.4**	Alpine	High	Moderate		X		
Draba exunguiculata	Moderately Conserved	G2/S2	USFS	1.7	1.6	6.2	**3.2**	**0.6**	**8**	**2.6**	recreation/hiking	Moderate	Low	Moderate	**8**	**6.9**	**9.9**	Alpine	Endemic	Moderate		X		
Draba graminea	Effectively Conserved	G2/S2		2.4	2.2	5.4	**3.4**	**4.4**	**8**	**3.9**	recreation/hiking	Low	Low	Low	**9**	**7.5**	**9.5**	Alpine	Endemic	Moderate		X		

Scientific Name (State)	Overall Conservation Status	G/S Rank	Agency Status	# Occurrences Score	Occupied Area Score	Range Score	Size Score	Quality Score	Land-scape Integrity Score	Bio-diversity Score	Primary Threat	Threat - Scope	Threat - Severity	Threat - Immediacy	Threats Status Score	Pro-tection Status Score	Potential for Energy Develop-ment Score	Habitat	% Range in CO	Confi-dence in Score	On-the-Ground Action	Field Inventory	Monitoring	Taxonomic Work
Draba smithii	Effectively Conserved	G2/S2	USFS	2.2	1.2	7.0	**3.5**	**5.0**	**8**	**4.2**	recreation/hiking	Low	Low	Low	**9**	**7.8**	**8.6**	Cliff and Cyn	Endemic	Moderate		X		
Draba weberi	Poorly Conserved	G1/S1		0.1	0.0	0.0	**0.0**	**0.0**	**1**	**0.2**	road/dam construction	High	High	Moderate	**0**	**0.0**	**10.0**	Alpine	Endemic	Very High	X	X	X	
Erigeron kachinensis	Effectively Conserved	G2/S1	BLM	0.2	2.8	1.1	**1.4**	**10.0**	**8**	**5.1**	hydrologic alteration	Moderate	Moderate	Low	**5**	**10.0**	**4.0**	Cliff and Cyn	Low	High			X	
Erigeron wilkenii	Moderately Conserved	G1/S1		0.4	0.0	1.9	**0.8**	**unknown**	**10**	**2.2**	none documented	Low	Low	Low	**9**	**9.2**	**8.0**	Cliff and Cyn	Endemic	Low		X	X	
Eriogonum brandegeei	Weakly Conserved	G1G2/S1S2	BLM/USFS	0.9	2.9	4.3	**2.7**	**5.6**	**0**	**2.7**	recreation/motorized	Moderate	Moderate	Moderate	**2**	**4.9**	**8.4**	Barrens	Endemic	Moderate	X		X	
Eriogonum clavellatum	Poorly Conserved	G2/S1	BLM	0.8	0.0	2.0	**0.9**	**unknown**	**6**	**1.6**	oil and gas	Moderate	Moderate	Moderate	**2**	**2.1**	**4.0**	Shrubland	Medium	Low		X		
Eriogonum coloradense	Effectively Conserved	G2/S2	BLM	2.1	2.5	6.6	**3.7**	**1.9**	**8**	**3.2**	recreation/hiking/ORV	Moderate	Low	High	**8**	**9.7**	**8.3**	Alpine	Endemic	Low		X		
Eriogonum pelinophilum	Poorly Conserved	G2/S2	LE	1.9	3.4	3.8	**3.0**	**3.7**	**0**	**2.2**	housing/urban dev., ag	High	High	High	**0**	**1.9**	**4.0**	Shrubland	Endemic	Moderate	X		X	
Eutrema edwardsii ssp. penlandii	Moderately Conserved	G1G2/S1S2	LT	1.0	0.4	2.5	**1.3**	**6.0**	**6**	**3.4**	hydro alt./mining	Moderate	Moderate	Moderate	**2**	**8.2**	**9.6**	Wetland	Endemic	High*	X		X	
Gaura neomexicana ssp. coloradensis	Weakly Conserved	G3T2/S1	LT	1.0	2.0	5.7	**2.9**	**2.0**	**0**	**1.6**	hydrologic alteration	Moderate	Moderate	Low	**5**	**1.7**	**3.4**	Wetland	Medium	Low	X	X		
Hackelia gracilenta	Moderately Conserved	G1/S1		1.0	0.0	1.4	**0.8**	**unknown**	**10**	**2.2**	recreational uses	Low	Low	Low	**9**	**6.5**	**4.0**	PJ	Endemic	Low		X	X	
Herrickia horrida	Weakly Conserved	G2?/S1		0.5	2.8	1.1	**1.4**	**unknown**	**8**	**2.3**	none documented	Low	Low	Low	**9**	**0.0**	**2.0**	PJ	Medium	Low		X		
Ipomopsis aggregata ssp. weberi	Moderately Conserved	G5T2/S2	USFS	1.8	1.2	5.3	**2.8**	**1.7**	**6**	**2.5**	recreation/hiking	Low	Moderate	Low	**6**	**6.4**	**9.5**	Forest	Very High	Moderate*	X			
Ipomopsis globularis	Moderately Conserved	G2/S2	USFS	0.9	4.4	2.9	**2.7**	**4.4**	**8**	**3.7**	recreation/motorized	Moderate	Moderate	High	**2**	**7.7**	**8.2**	Alpine	Endemic	Moderate*	X	X		
Ipomopsis polyantha	Poorly Conserved	G1/S1	C, BLM/USFS	0.3	2.9	1.4	**1.5**	**6.7**	**0**	**2.7**	housing/urban dev.	High	High	Moderate	**0**	**0.0**	**3.0**	Barrens	Endemic	Very High	X		X	
Lepidium crenatum	Weakly Conserved	G2/S2		1.4	3.0	7.7	**4.0**	**unknown**	**4**	**3.4**	unknown	Insig.	Insig.	Insig.	**10**	**1.9**	**6.8**	Shrubland	Medium	Low		X		
Lesquerella calcicola	Weakly Conserved	G2/S2		3.0	3.5	7.6	**4.7**	**2.6**	**0**	**2.4**	housing/urban dev.	Moderate	Unknown	Moderate	**8**	**0.9**	**5.5**	Barrens	High	Moderate		X		
Lesquerella congesta	Weakly Conserved	G1/S1	LT	0.7	3.0	1.7	**1.8**	**10.0**	**6**	**4.9**	oil & gas/oil shale mining	High	High	High	**0**	**5.9**	**0.2**	Barrens	Endemic	Very High	X		X	
Lesquerella parviflora	Poorly Conserved	G2/S2	BLM	2.4	3.4	5.8	**3.9**	**4.8**	**8**	**4.2**	oil & gas/oil shale mining	High	High	High	**0**	**2.3**	**1.7**	Barrens	Endemic	Low		X	X	
Lesquerella pruinosa	Moderately Conserved	G2/S2	BLM/USFS	1.7	3.9	3.7	**3.1**	**5.3**	**2**	**3.1**	housing/urban dev.	Moderate	Moderate	Moderate	**2**	**5.7**	**4.5**	Barrens	Endemic	Moderate	X			
Lesquerella vicina	Moderately Conserved	G2/S2	BLM	1.9	0.4	4.5	**2.2**	**3.2**	**4**	**2.5**	roads/recreation	Moderate	Moderate	Low	**5**	**5.2**	**5.0**	PJ	Endemic	Moderate	X			
Limnorchis zothecina	Moderately Conserved	G2/S1		0.3	0.0	0.0	**0.1**	**3.3**	**8**	**2.5**	hydrologic alteration	Moderate	Moderate	Low	**5**	**10.0**	**8.0**	Cliff and Cyn	Low	Low		X		
Lomatium concinnum	Weakly Conserved	G2G3/S2S3	BLM	3.6	2.9	5.5	**4.0**	**5.0**	**4**	**3.7**	recreation/motorized	Moderate	Moderate	High	**2**	**3.0**	**4.5**	Shrubland	Endemic	High	X			
Lupinus crassus	Weakly Conserved	G2/S2	BLM	2.1	1.1	5.7	**2.9**	**2.4**	**4**	**2.4**	incompatible grazing	Moderate	Moderate	Moderate	**2**	**7.9**	**4.8**	PJ	Endemic	Low		X		
Lygodesmia doloresensis	Moderately Conserved	G1G2/S1	BLM	0.9	1.5	4.1	**2.2**	**1.1**	**6**	**2.1**	roads	Moderate	Unknown	High	**8**	**4.1**	**4.2**	PJ	High	Moderate	X	X		
Machaeranthera coloradoensis	Effectively Conserved	G2/S2	USFS	3.0	3.3	7.5	**4.6**	**5.2**	**8**	**4.6**	recreation/hiking	Low	Low	Low	**9**	**7.0**	**8.2**	Alpine	High	High			X	
Mentzelia rhizomata	Weakly Conserved	G2/S2		2.4	2.4	4.6	**3.1**	**5.8**	**2**	**3.3**	oil & gas/oil shale mining	Moderate	Moderate	High	**2**	**3.8**	**0.3**	Barrens	Endemic	Moderate	X			
Mertensia humilis	Weakly Conserved	G2/S1		0.3	0.0	2.8	**1.0**	**unknown**	**0**	**0.7**	unknown	Insig.	Insig.	Insig.	**10**	**2.1**	**5.1**	Shrubland	Medium	Low		X		
Mimulus gemmiparus	Effectively Conserved	G1/S1	USFS	0.8	0.0	5.2	**2.0**	**7.5**	**6**	**4.2**	recreation/hiking	Moderate	Moderate	Low	**5**	**9.9**	**10.0**	Cliff and Cyn	Endemic	High	X		X	
Nuttallia chrysantha	Poorly Conserved	G2/S2	BLM	2.6	3.5	4.6	**3.6**	**3.7**	**0**	**2.4**	housing/urban dev.	Moderate	Moderate	High	**2**	**2.9**	**4.6**	Barrens	Endemic	High	X			
Nuttallia densa	Moderately Conserved	G2/S2	BLM	2.1	2.8	5.4	**3.4**	**3.3**	**0**	**2.2**	recreational uses	Low	Moderate	High	**6**	**4.6**	**9.7**	PJ	Endemic	Moderate	X			
Oenothera acutissima	Weakly Conserved	G2/S2	BLM	1.5	2.7	4.7	**2.9**	**1.3**	**8**	**2.8**	hydrologic alteration	Moderate	Moderate	Moderate	**2**	**3.1**	**8.8**	Shrubland	Medium	Low		X		
Oenothera harringtonii	Moderately Conserved	G2G3/S2S3	USFS	5.1	4.3	7.2	**5.5**	**2.5**	**2**	**3.0**	housing/urban dev.	Low	Moderate	High	**6**	**2.3**	**5.3**	Grassland	Endemic	High	X			
Oonopsis foliosa var. monocephala	Effectively Conserved	G3G4T2/S2		1.3	2.7	6.1	**3.4**	**6.2**	**6**	**4.2**	roads	Low	Low	Low	**9**	**6.2**	**4.8**	Grassland	Endemic	High			X	
Oonopsis puebloensis	Weakly Conserved	G2/S2		2.4	4.1	4.4	**3.6**	**4.4**	**2**	**3.0**	mining/urbanization	Moderate	Moderate	High	**2**	**1.2**	**5.6**	Grassland	Endemic	Very High	X			
Oreocarya osterhoutii	Moderately Conserved	G2G3/S2	BLM	0.8	0.0	5.8	**2.2**	**unknown**	**8**	**2.8**	recreation/hiking	Low	Low	Low	**9**	**6.0**	**8.7**	Barrens	Low	Low		X		
Oreoxis humilis	Moderately Conserved	G1/S1	USFS	0.3	2.8	1.1	**1.4**	**10.0**	**8**	**5.1**	roads	Moderate	Moderate	Moderate	**2**	**6.8**	**9.8**	Alpine	Endemic	Very High			X	
Oxybaphus rotundifolius	Weakly Conserved	G2/S2		3.3	4.2	5.7	**4.4**	**6.2**	**2**	**3.9**	housing/urban dev.	Moderate	Moderate	High	**2**	**4.5**	**5.2**	Barrens	Endemic	Very High	X			
Oxytropis besseyi var. obnapiformis	Weakly Conserved	G5T2/S2		1.6	0.0	5.8	**2.5**	**unknown**	**6**	**2.6**	oil & gas	High	High	High	**0**	**4.4**	**4.3**	Shrubland	Very High	Low		X		
Penstemon breviculus	Moderately Conserved	G3/S2		2.2	3.3	6.1	**3.8**	**3.2**	**2**	**2.7**	recreation/motorized	Low	Low	Low	**9**	**6.1**	**3.8**	PJ	High	Moderate				
Penstemon debilis	Poorly Conserved	G1/S1	C	0.6	0.7	0.4	**0.6**	**6.7**	**6**	**3.4**	oil & gas	High	High	High	**0**	**1.3**	**0.7**	Barrens	Endemic	Very High	X		X	
Penstemon degeneri	Moderately Conserved	G2/S2	BLM/USFS	1.3	2.8	5.2	**3.1**	**3.1**	**6**	**3.1**	recreation/motorized	Moderate	Moderate	Moderate	**2**	**5.9**	**9.4**	PJ	Endemic	Moderate	X	X	X	
Penstemon fremontii var. glabrescens	Weakly Conserved	G3G4T2/S2		1.2	2.3	4.3	**2.6**	**unknown**	**6**	**2.7**	oil & gas	High	High	High	**0**	**4.6**	**0.9**	Shrubland	Endemic	Low		X		
Penstemon gibbensii	Weakly Conserved	G1/S1	BLM	0.2	1.1	0.0	**0.4**	**10.0**	**6**	**4.5**	recreation/motorized	Moderate	Moderate	Moderate	**2**	**4.0**	**6.2**	Barrens	High	High	X		X	
Penstemon grahamii	Weakly Conserved	G2/S1		0.5	2.9	0.3	**1.2**	**unknown**	**8**	**2.2**	oil and gas	Moderate	Moderate	High	**2**	**6.3**	**2.3**	Barrens	Low	Low	X	X	X	
Penstemon harringtonii	Moderately Conserved	G3/S3	BLM/USFS	6.2	5.2	6.0	**5.8**	**4.0**	**2**	**3.6**	housing/urban dev./rec.	Low	Moderate	Moderate	**6**	**3.2**	**6.5**	Shrubland	Endemic	Very High			X	
Penstemon penlandii	Weakly Conserved	G1/S1	LE	0.2	3.1	0.0	**1.1**	**10.0**	**0**	**3.7**	recreation/motorized	Moderate	Moderate	High	**2**	**2.1**	**9.1**	Shrubland	Endemic	Very High	X		X	

Scientific Name (State)	Overall Conservation Status	G/S Rank	Agency Status	# Occurrences Score	Occupied Area Score	Range Score	Size Score	Quality Score	Land-scape Integrity Score	Bio-diversity Score	Primary Threat	Threat - Scope	Threat - Severity	Threat - Immediacy	Threats Status Score	Pro-tection Status Score	Potential for Energy Develop-ment Score	Habitat	% Range in CO	Confi-dence in Score	On-the-Ground Action	Field Inventory	Monitoring	Taxonomic Work
Penstemon scariosus var. albifluvis	Poorly Conserved	G4T1/S1	C	0.2	1.4	0.2	**0.6**	**0.0**	**8**	**1.5**	oil & gas	Moderate	Moderate	High	**2**	**5.7**	**2.7**	Barrens	Low	Very High	X		X	
Penstemon scariosus var. cyanomontanus	Effectively Conserved	G4T2/S2		1.1	0.0	2.3	**1.1**	**7.3**	**8**	**4.1**	incompatible grazing	Low	Low	Low	**9**	**10.0**	**8.8**	PJ	High	Low		X		
Phacelia formosula	Weakly Conserved	G1/S1	LE	1.1	2.8	3.9	**2.6**	**7.3**	**6**	**4.3**	recreation/motorized	Moderate	Moderate	Moderate	**2**	**3.1**	**4.0**	Barrens	Endemic	High	X		X	
Phacelia submutica	Poorly Conserved	G4T2/S2	C, USFS	3.4	2.8	3.9	**3.4**	**0.9**	**2**	**1.7**	oil & gas	Moderate	Moderate	High	**2**	**4.7**	**1.7**	Barrens	Endemic	Moderate	X	X	X	
Physaria bellii	Weakly Conserved	G2G3/S2S3		2.8	3.8	5.6	**4.0**	**5.0**	**0**	**3.0**	housing/urban dev.	Moderate	Moderate	High	**2**	**3.3**	**6.3**	Barrens	Endemic	High	X			
Physaria obcordata	Weakly Conserved	G1G2/S1S2	LT	1.0	2.6	3.7	**2.4**	**6.0**	**6**	**3.8**	oil shale, nahcolite mining	High	High	High	**0**	**4.8**	**0.6**	Barrens	Endemic	Very High	X		X	
Physaria pulvinata	Weakly Conserved	G1/S1		0.2	0.8	1.5	**0.8**	**10.0**	**2**	**3.9**	recreation/motor and non	High	Moderate	High	**0**	**5.0**	**4.0**	Shrubland	Endemic	Very High	X	X		
Physaria rollinsii	Weakly Conserved	G2/S2		0.8	0.0	5.2	**2.0**	**unknown**	**0**	**1.3**	unknown	Insig.	Insig.	Insig.	**10**	**2.2**	**9.0**	Barrens	Endemic	Low		X		
Potentilla rupincola	Effectively Conserved	G2/S2	USFS	2.4	3.0	6.0	**3.8**	**5.0**	**6**	**3.9**	exotic species	Low	Low	Low	**9**	**7.2**	**10.0**	Cliff and Cyn	Endemic	High			X	
Ptilagrostis porteri	Moderately Conserved	G2/S2	BLM/USFS	2.4	3.0	5.6	**3.7**	**4.4**	**8**	**4.0**	hydrologic alteration	Moderate	High	Moderate	**2**	**5.9**	**8.4**	Wetland	Endemic	High	X			
Puccinellia parishii	Moderately Conserved	G2/S1		0.1	0.0	0.0	**0.0**	**10.0**	**5**	**4.2**	hydrologic alteration/rec.	Moderate	Moderate	Low	**5**	**1.0**	**4.0**	Wetland	Low	High*	X	X		
Salix arizonica	Moderately Conserved	G2G3/S1	USFS	0.1	0.0	0.0	**0.0**	**unknown**	**8**	**1.4**	incompatible grazing	Low	Moderate	Moderate	**6**	**7.3**	**8.0**	Wetland	Low	Moderate*	X	X		
Saussurea weberi	Effectively Conserved	G2G3/S2	BLM	1.2	3.0	3.3	**2.5**	**4.2**	**6**	**3.2**	mining	Moderate	Moderate	Low	**5**	**6.6**	**9.5**	Alpine	High	Moderate	X	X		
Sclerocactus glaucus	Weakly Conserved	G3/S3	LT	7.5	3.6	6.1	**5.7**	**1.4**	**2**	**2.7**	oil & gas	High	Moderate	High	**0**	**3.6**	**3.7**	Shrubland	Endemic	Moderate	X	X	X	
Sclerocactus mesae-verdae	Poorly Conserved	G2/S2	LT	2.3	0.0	1.7	**1.3**	**unknown**	**6**	**1.9**	collecting/insect herbivory	Moderate	Moderate	High	**2**	**2.0**	**4.0**	Barrens	Low	Low		X		
Sisyrinchium pallidum	Moderately Conserved	G2G3/S2	BLM	3.9	3.1	7.3	**4.8**	**2.4**	**2**	**2.7**	hydrologic alteration	Low	High	Moderate	**6**	**3.6**	**7.7**	Wetland	High	Moderate	X			
Spiranthes diluvialis	Weakly Conserved	G2/S2	LT	1.8	2.4	8.4	**4.2**	**2.2**	**0**	**2.1**	hydrologic alteration	Moderate	Moderate	Moderate	**2**	**4.4**	**5.1**	Wetland	Medium	High	X		X	
Telesonix jamesii	Effectively Conserved	G2/S2		2.2	2.4	5.9	**3.5**	**4.1**	**6**	**3.5**	recreation/hiking	Low	Low	Low	**9**	**6.7**	**9.8**	Cliff and Cyn	Very High	Moderate		X		
Thalictrum heliophilum	Weakly Conserved	G2/S2	USFS	3.3	2.1	5.3	**3.6**	**5.0**	**6**	**3.9**	oil & gas	Moderate	Moderate	Moderate	**2**	**4.3**	**1.0**	Barrens	Endemic	Low	X	X		
Townsendia fendleri	Moderately Conserved	G2/S1		0.8	1.1	5.4	**2.4**	**3.8**	**2**	**2.4**	housing/urban dev.	Moderate	Unknown	Moderate	**8**	**4.4**	**8.2**	Barrens	High	Moderate		X		
Townsendia glabella	Weakly Conserved	G2/S2		1.9	1.1	5.2	**2.7**	**3.7**	**0**	**2.1**	housing/urban dev.	Low	Moderate	High	**6**	**1.3**	**3.2**	Barrens	Endemic	Moderate	X			
Townsendia rothrockii	Effectively Conserved	G2G3/S2S3		2.7	2.9	7.8	**4.5**	**unknown**	**8**	**4.3**	motorized recreation	Moderate	Low	Unknown	**8**	**7.2**	**8.5**	Alpine	Endemic	Low		X		
Species not scored	**reason not included**																							
Boechera crandallii	backlog	G2/S2	BLM								roads							Shrubland	High	Low		X		
Caesalpinia repens	lack of information	G2/S1																		Low		X		
Cirsium scapanolepis	taxonomic uncertainty	G1G2Q/S1									Cirsium biocontrol								Endemic	Low				X
Delphinium robustum	lack of information	G2?/S2?																	Medium	Low		X		
Dicoria wetherillii	lack of information	G4T2?Q/SU																		Low		X		
Draba grayana	backlog	G2/S2	USFS								recreation/hiking							Alpine	Endemic	Low		X		
Hackelia besseyi	lack of information	G2G3/SNR																		Low		X		
Opuntia heacockiae	taxonomic uncertainty	G2G3Q/S2S3																	Endemic	Low				X
Penstemon crandallii ssp. procumbens	taxonomic uncertainty	G4T2Q/SU																	Endemic	Low				X
Penstemon teucrioides	taxonomic uncertainty	G2G3Q/S2S3																Shrubland		Low		X		X
Physaria alpina	backlog	G2/S2									recreation/motorized and n							Alpine	Endemic	Low		X		
Thelypodiopsis juniperorum	backlog	G2/S2									incompatible grazing							PJ	Endemic	Low		X		
Thelypodium paniculatum	lack of information	G2/S1																Wetland		Low		X		

Rare Plant summary scorecard

Scientific Name (State)	Overall Conservation Status	Biodiversity Score	Threats Status Score	Protection Status Score	% Range in CO
Aletes humilis	Effectively Conserved	5.4	9	7.0	Endemic
Aletes latilobus	Effectively Conserved	3.3	6	9.4	Medium
Aletes macdougalii ssp. *breviradiatus*	Weakly Conserved	1.7	9	0.9	Medium
Aliciella sedifolia	Moderately Conserved	2.1	5	7.0	Endemic
Anticlea vaginatus	Effectively Conserved	3.9	5	10.0	Low
Aquilegia chrysantha var. *rydbergii*	Poorly Conserved	1.7	2	5.1	Endemic
Asclepias uncialis ssp. *uncialis*	Moderately Conserved	3.9	5	4.6	Very High
Astragalus anisus	Effectively Conserved	3.3	8	5.7	Endemic
Astragalus cronquistii	Poorly Conserved	1.8	2	1.7	High
Astragalus debequaeus	Weakly Conserved	3.4	0	3.6	Endemic
Astragalus deterior	Moderately Conserved	1.4	9	9.8	Endemic
Astragalus equisolensis	Moderately Conserved	0.7	8	5.2	Low
Astragalus humillimus	Moderately Conserved	3.3	6	2.0	Low
Astragalus iodopetalus	Moderately Conserved	1.5	8	5.2	Medium
Astragalus lonchocarpus var. *hamiltonii*	Effectively Conserved	4.7	8	4.6	Low
Astragalus microcymbus	Moderately Conserved	3.1	2	5.7	Endemic
Astragalus missouriensis var. *humistratus*	Weakly Conserved	2.1	8	0.7	Endemic
Astragalus naturitensis	Moderately Conserved	2.8	6	4.5	High
Astragalus osterhoutii	Poorly Conserved	3.4	0	2.1	Endemic
Astragalus piscator	Moderately Conserved	3.4	2	5.9	Low
Astragalus rafaelensis	Moderately Conserved	2.1	9	3.6	High
Astragalus schmolliae	Moderately Conserved	3.2	2	10.0	Endemic
Astragalus tortipes	Weakly Conserved	3.2	2	2.0	Endemic
Botrychium lineare	Moderately Conserved	1.9	9	6.6	Medium
Camissonia eastwoodiae	Weakly Conserved	2.0	2	4.1	Medium
Carex stenoptila	Effectively Conserved	4.3	10	9.3	Medium
Castilleja puberula	Effectively Conserved	3.1	8	5.8	Endemic
Cirsium perplexans	Weakly Conserved	2.9	5	2.7	Endemic
Cleome multicaulis	Effectively Conserved	3.0	5	5.9	High
Corispermum navicula	Moderately Conserved	4.6	2	6.2	Endemic
Cryptantha gypsophila	Weakly Conserved	4.2	0	3.9	Endemic
Delphinium ramosum var. *alpestre*	Effectively Conserved	4.1	9	8.2	High
Draba exunguiculata	Moderately Conserved	2.6	8	6.9	Endemic
Draba graminea	Effectively Conserved	3.9	9	7.5	Endemic
Draba smithii	Effectively Conserved	4.2	9	7.8	Endemic
Draba weberi	Poorly Conserved	0.2	0	0.0	Endemic
Erigeron kachinensis	Effectively Conserved	5.1	5	10.0	Low
Erigeron wilkenii	Moderately Conserved	2.2	9	9.2	Endemic
Eriogonum brandegeei	Weakly Conserved	2.7	2	4.9	Endemic
Eriogonum clavellatum	Poorly Conserved	1.6	2	2.1	Medium
Eriogonum coloradense	Effectively Conserved	3.2	8	9.7	Endemic
Eriogonum pelinophilum	Poorly Conserved	2.2	0	1.9	Endemic
Eutrema edwardsii ssp. *penlandii*	Moderately Conserved	3.4	2	8.2	Endemic
Gaura neomexicana ssp. *coloradensis*	Weakly Conserved	1.6	5	1.7	Medium

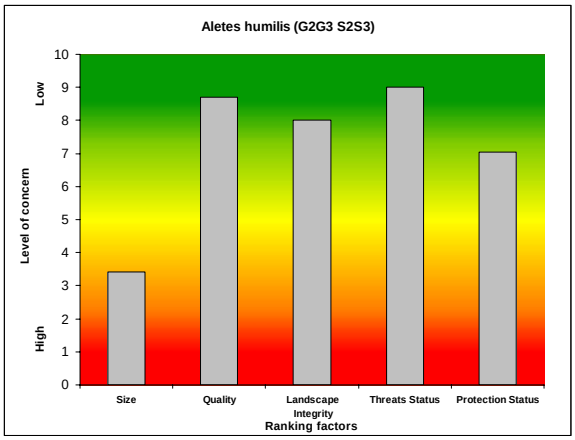
Scientific Name (State)	Overall Conservation Status	Biodiversity Score	Threats Status Score	Protection Status Score	% Range in CO
Hackelia gracilenta	Moderately Conserved	2.2	9	6.5	Endemic
Herrickia horrida	Weakly Conserved	2.3	9	0.0	Medium
Ipomopsis aggregata ssp. *weberi*	Moderately Conserved	2.5	6	6.4	Very High
Ipomopsis globularis	Moderately Conserved	3.7	2	7.7	Endemic
Ipomopsis polyantha	Poorly Conserved	2.7	0	0.0	Endemic
Lepidium crenatum	Weakly Conserved	3.4	10	1.9	Medium
Lesquerella calcicola	Weakly Conserved	2.4	8	0.9	High
Lesquerella congesta	Weakly Conserved	4.9	0	5.9	Endemic
Lesquerella parviflora	Poorly Conserved	4.2	0	2.3	Endemic
Lesquerella pruinosa	Moderately Conserved	3.1	2	5.7	Endemic
Lesquerella vicina	Moderately Conserved	2.5	5	5.2	Endemic
Limnorchis zothecina	Moderately Conserved	2.5	5	10.0	Low
Lomatium concinnum	Weakly Conserved	3.7	2	3.0	Endemic
Lupinus crassus	Weakly Conserved	2.4	2	7.9	Endemic
Lygodesmia doloresensis	Moderately Conserved	2.1	8	4.1	High
Machaeranthera coloradoensis	Effectively Conserved	4.6	9	7.0	High
Mentzelia rhizomata	Weakly Conserved	3.3	2	3.8	Endemic
Mertensia humilis	Weakly Conserved	0.7	10	2.1	Medium
Mimulus gemmiparus	Effectively Conserved	4.2	5	9.9	Endemic
Nuttallia chrysantha	Poorly Conserved	2.4	2	2.9	Endemic
Nuttallia densa	Moderately Conserved	2.2	6	4.6	Endemic
Oenothera acutissima	Weakly Conserved	2.8	2	3.1	Medium
Oenothera harringtonii	Moderately Conserved	3.0	6	2.3	Endemic
Oonopsis foliosa var. *monocephala*	Effectively Conserved	4.2	9	6.2	Endemic
Oonopsis puebloensis	Weakly Conserved	3.0	2	1.2	Endemic
Oreocarya osterhoutii	Moderately Conserved	2.8	9	6.0	Low
Oreoxis humilis	Moderately Conserved	5.1	2	6.8	Endemic
Oxybaphus rotundifolius	Weakly Conserved	3.9	2	4.5	Endemic
Oxytropis besseyi var. *obnapiformis*	Weakly Conserved	2.6	0	4.4	Very High
Penstemon breviculus	Moderately Conserved	2.7	9	6.1	High
Penstemon debilis	Poorly Conserved	3.4	0	1.3	Endemic
Penstemon degeneri	Moderately Conserved	3.1	2	5.9	Endemic
Penstemon fremontii var. *glabrescens*	Weakly Conserved	2.7	0	4.6	Endemic
Penstemon gibbensii	Weakly Conserved	4.5	2	4.0	High
Penstemon grahamii	Weakly Conserved	2.2	2	6.3	Low
Penstemon harringtonii	Moderately Conserved	3.6	6	3.2	Endemic
Penstemon penlandii	Weakly Conserved	3.7	2	2.1	Endemic
Penstemon scariosus var. *albifluvis*	Poorly Conserved	1.5	2	5.7	Low
Penstemon scariosus var. *cyanomontanus*	Effectively Conserved	4.1	9	10.0	High
Phacelia formosula	Weakly Conserved	4.3	2	3.1	Endemic
Phacelia submutica	Poorly Conserved	1.7	2	4.7	Endemic
Physaria bellii	Weakly Conserved	3.0	2	3.3	Endemic
Physaria obcordata	Weakly Conserved	3.8	0	4.8	Endemic
Physaria pulvinata	Weakly Conserved	3.9	0	5.0	Endemic
Physaria rollinsii	Weakly Conserved	1.3	10	2.2	Endemic
Potentilla rupincola	Effectively Conserved	3.9	9	7.2	Endemic

Scientific Name (State)	Overall Conservation Status	Biodiversity Score	Threats Status Score	Protection Status Score	% Range in CO
Ptilagrostis porteri	Moderately Conserved	**4.0**	**2**	**5.9**	Endemic
Puccinellia parishii	Moderately Conserved	**4.2**	**5**	**1.0**	Low
Salix arizonica	Moderately Conserved	**1.4**	**6**	**7.3**	Low
Saussurea weberi	Effectively Conserved	**3.2**	**5**	**6.6**	High
Sclerocactus glaucus	Weakly Conserved	**2.7**	**0**	**3.6**	Endemic
Sclerocactus mesae-verdae	Poorly Conserved	**1.9**	**2**	**2.0**	Low
Sisyrinchium pallidum	Moderately Conserved	**2.7**	**6**	**3.6**	High
Spiranthes diluvialis	Weakly Conserved	**2.1**	**2**	**4.4**	Medium
Telesonix jamesii	Effectively Conserved	**3.5**	**9**	**6.7**	Very High
Thalictrum heliophilum	Weakly Conserved	**3.9**	**2**	**4.3**	Endemic
Townsendia fendleri	Moderately Conserved	**2.4**	**8**	**4.4**	High
Townsendia glabella	Weakly Conserved	**2.1**	**6**	**1.3**	Endemic
Townsendia rothrockii	Effectively Conserved	**4.3**	**8**	**7.2**	Endemic

APPENDIX H: SAMPLE RARE PLANT GRAPHS

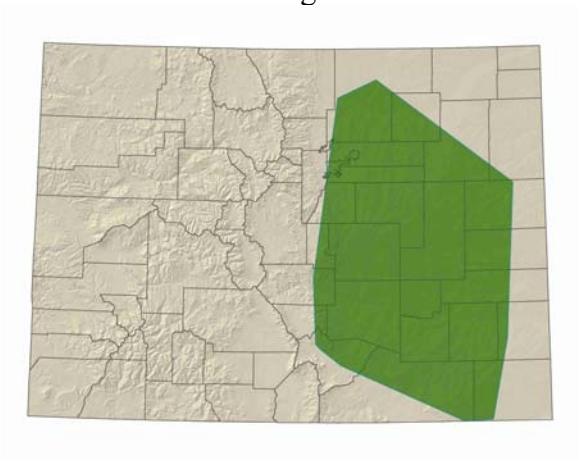
Aletes humilis (G2G3 S2S3)
Effectively conserved

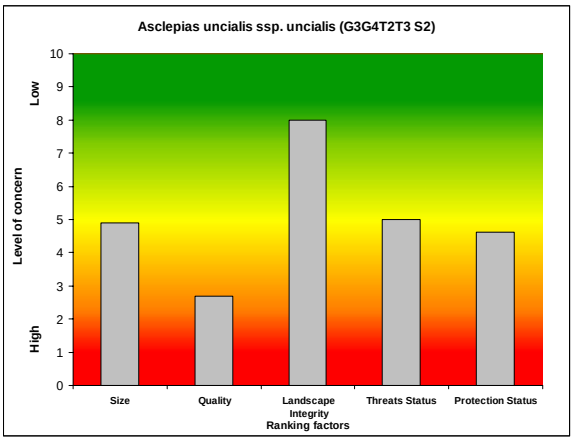
Range



Asclepias uncialis ssp. *uncialis* (G3G4T2T3 S2)
Moderately conserved

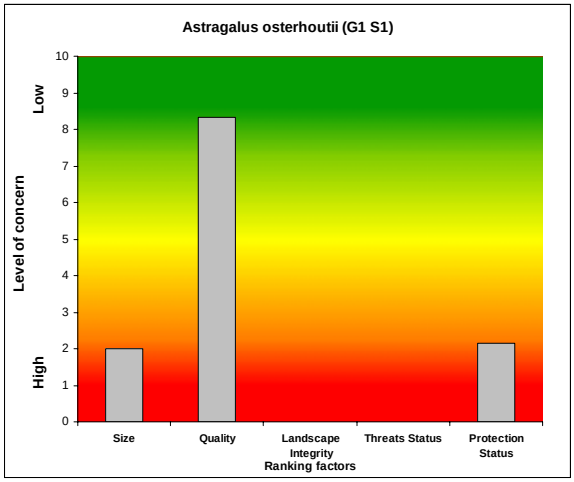
Range





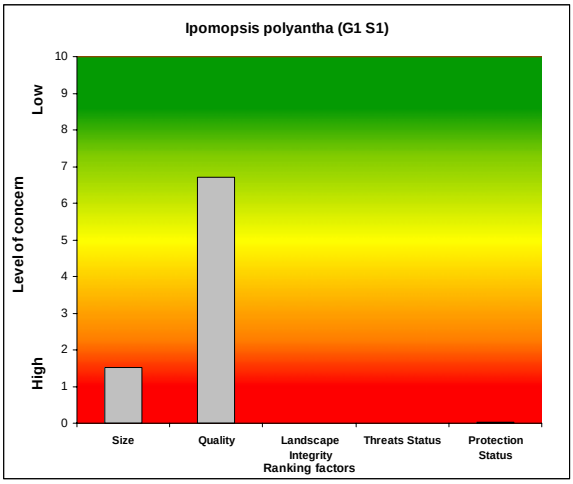
Astragalus osterhoutii (G1 S1)
Poorly conserved

Range



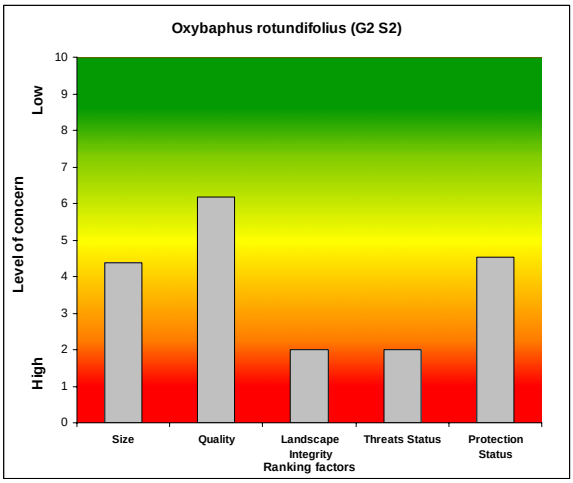
Ipomopsis polyantha (G1 S1)
Poorly conserved

Range



Oxybaphus rotundifolius (G2 S2)
Weakly conserved

Range



Penstemon harringtonii (G3 S3)
Moderately conserved

Range