A Conservation Blueprint for Neotropical Migratory Birds in Western Colorado

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Photo by Dave Menke, Photo Courtesy of U. S. Fish and Wildlife Service.

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Executive Summary

The purpose of this project was to incorporate land use, policy, and biological inputs to define areas representing the most important opportunities for conservation of Neotropical migratory birds in coniferous and aspen forest habitats in Western Colorado and to understand the current status and requirements for maintaining viable populations of these migratory birds within the project area. To that end, we used NatureServe Vista, a decision-support software, and SPOT, a conservation portfolio optimization software, to analyze information about bird distribution, abundance, conservation priorities, quantitative conservation goals, threats to ecosystem stability, and current landscape integrity in order to identify conservation needs and opportunities for birds in aspen and conifer forests in western Colorado.

Twenty-two forest-based bird species were used as conservation targets. Multi-year survey data from the Rocky Mountain Bird Observatory was combined with data from the Colorado Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS) database in addition to modified Southwest Regional GAP vertebrate models for the target species. We used available statewide spatial data to determine general landscape integrity for these species, current and future predicted land use, and policy mandated protection status. This information was then input in NatureServe Vista and SPOT projects and evaluated against varying conservation goal sets for the target species.

The results are as follows. Highest species richness of forest birds is shown to occur in the Animas and San Juan River valleys around Durango, the eastern slopes of the Sangre de Cristo mountains, the many small drainages on both the north and south slopes of the Uncompahgre Plateau, and all along the Front Range. Some of the least rich areas include the Sawatch Range, Rawah Peaks, and Rabbit Ears Pass. Areas of high species richness that are impacted by poor landscape integrity include the Purgatorie River headwaters and the Front Range.

The species predicted to be most impacted by future oil and gas and housing development are the Gray Vireo and Mexican Spotted Owl. Lewis's Woodpecker has the greatest goal shortfall by far, regardless of scenario evaluated. Beyond highways and metro areas, the two areas that stand out the most as endangering conservation efforts are south of Durango and west of Trinidad. These are both areas of heavy current oil and gas development. The Roan Plateau, Battlement Mesa, and Grand Mesa are also being heavily drilled, with predicted significant expansions of future oil and gas development in the near future.

The overall best conservation portfolio derived in SPOT was divided into four conservation strategies based on habitat integrity and land status. Areas with protected land status and good habitat quality are considered "Effectively Conserved." Areas with protected land status but poor quality fall into a "Management Strategy" designation, where active management is required to improve the habitat quality. Unprotected lands with high quality fall within a "Protection Strategy" potentially requiring purchase, easements, or legislation that will prevent further loss or degradation of target habitat. Finally, those areas that are both unprotected and of poor quality are designated as "Secondary Management and Protection Strategy" areas, and are unlikely to receive much active attention from practical conservation efforts.

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Introduction

Coniferous and Aspen forests in Colorado support large numbers of Neotropical migratory and resident bird populations that have been identified as conservation priorities. Threats to these habitats continue to increase with increasing human population densities and energy development, both of which likely have negative impacts on populations of birds. The purpose of this project was to incorporate land use, policy, and biological inputs to define areas representing the most important opportunities for conservation of Neotropical migratory birds in coniferous and aspen forest habitats in Western Colorado and to understand the current status and requirements for maintaining viable populations of these migratory birds within the project area.

By the year 2030, Colorado's population is predicted to increase by 25% (USCB 2005a). Most of this growth will occur in Colorado's Front Range and Western Slope (Theobald 2005, Figure 1). The impacts associated with increased development pressures include increases in habitat loss, habitat degradation, fragmentation, invasive species, pollution, and diseases. Additionally, Colorado habitats are increasingly threatened by oil and gas development, grazing management priorities, recreational demands, fire suppression, drought, and many other stressors. These threats are made more complex in western Colorado, where a diversity of ownership and management goals exist. And collectively, these impacts are likely having a negative effect on populations of Neotropical migratory birds. As human populations increase in Colorado, these threats will heavily impact coniferous and aspen forests and, consequently, the migratory bird populations that depend on them. To be effective and affordable, conservation activities will need to be thoughtfully targeted to the landscape in order to maintain healthy bird populations. The modeling process presented here incorporates past present and predicted disturbances mentioned above to develop threat scenarios and an integrity assessment.

Historically, few resources have been directed toward forested coniferous and aspen habitats, even though these habitats host a large number of bird species of concern (see Methods Table 1) and are subject to increasing threats. This project takes a proactive approach to conservation with the development of a conservation blueprint that can guide future bird conservation efforts in forested habitats in western Colorado. This document identifies the most critical habitat where the threats are highest and where opportunities for conservation action exist. Thus providing a spatially-explicit scenario for where protection and management are most needed and most likely to succeed for all of the species of concern. This should help maximize the application of limited conservation resources. Our work goes beyond existing conservation plans for the region (Schrupp et al. 2000, Neely et al. 2001) in that it specifically addresses high-priority bird species, incorporates the most recent bird distribution information, and explicitly uses known conservation threats and opportunities to focus conservation actions. This information will be an extremely important tool to help guide future conservation and planning decisions by local, state, regional, and national partners.

Conservation planning requires effective methods for evaluating a site based on resource quality, threats to resource quality, and costs associated with site conservation such that conservation effort can be prioritized to locales with the greatest chance for conservation impact and success (Davis et al. 2006). In addition, meeting conservation goals requires managing whole landscapes, not just parts of them, for both economic values and land protection. Currently, the majority of conservation efforts occur at remote places and other areas that are unsuitable for commercial activities, which leads to a bias in the biodiversity that is preserved. Future increases in numbers of people and their demands on natural resources will require more systematic approaches to conservation that will preserve biological resources throughout the landscape rather than just at isolated sites and within areas that are free of economic value (Margules and Pressey 2000). Modeling tools to assist biologists with identifying the best priority sites to conserve from throughout an entire landscape are becoming increasingly prevalent. One of these tools is NatureServe Vista, a modeling algorithm capable of

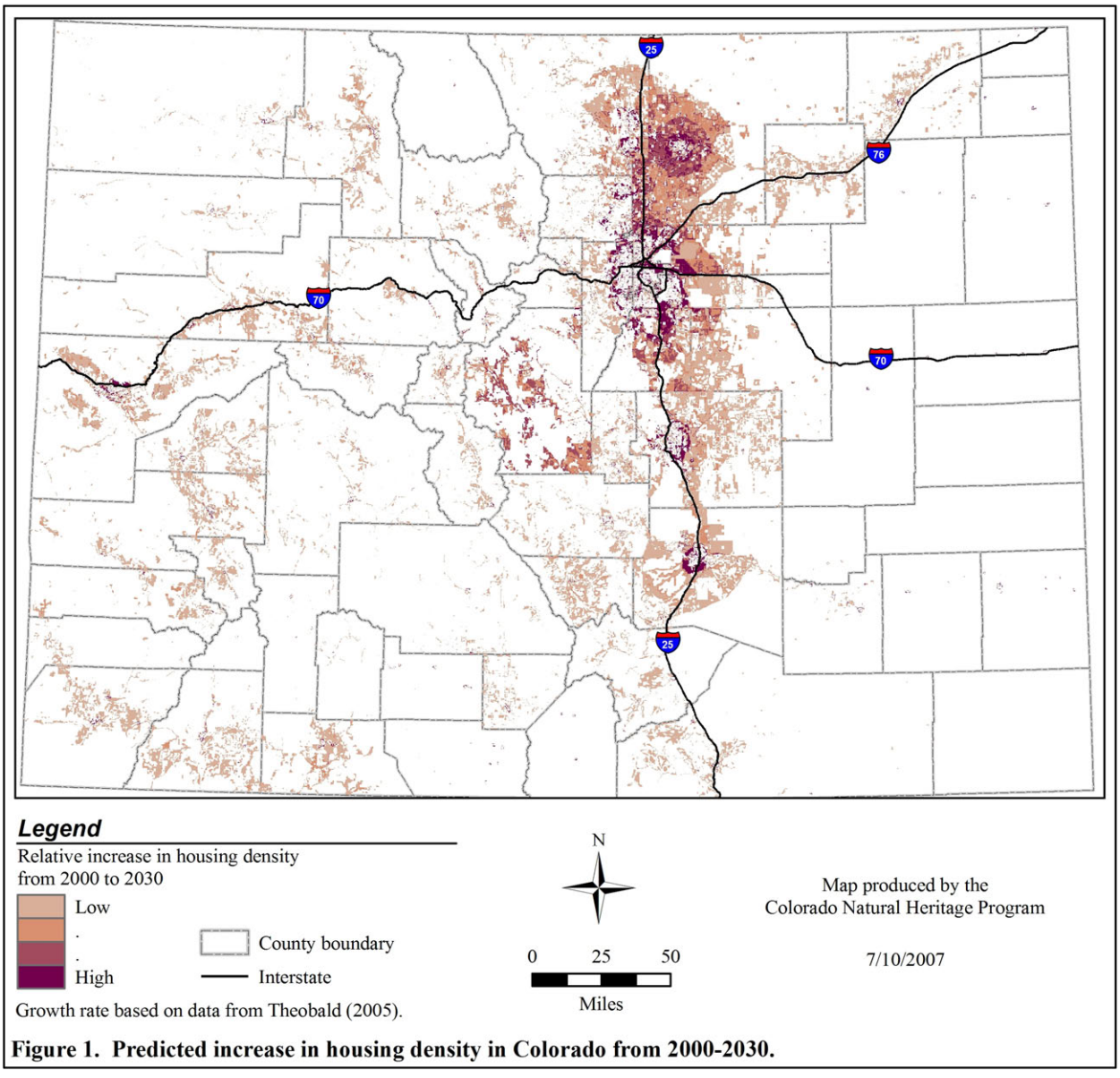


Figure 1. Predicted increase in housing density in Colorado from 2000-2030.

incorporating existing distribution maps of conservation targets, their current threats and biodiversity values, and analyzing this data to generate, evaluate, and summarize opportunities for biodiversity conservation planning (Natureserve 2006). The use of specialized computer software like NatureServe Vista, often referred to as "decision support systems" (DSS), to analyze complex natural resource datasets are becoming much more common within the forestry management profession (Johnson 2006). Development of forest management plans that incorporate the diversity of demands placed on forest resources including regulatory, social, recreational, economic, and biological are necessarily complex analyses. Computer-based software applications such as DSS have been used to facilitate the development of complex forest management plans for decades (Johnson 2006, Schuster et al. 1993, Iverson and Alston 1986). NatureServe Vista has been used to understand the tradeoffs that exist between the native biodiversity of forest ecosystems and their economic values through analysis of forest stand conservation value relative to economic value (Crist 2005).

Here we use NatureServe Vista to analyze information about bird distribution/abundance, conservation priorities, quantitative conservation goals, threats to ecosystem stability, and current landscape integrity in order to identify conservation needs and opportunities for birds in aspen and conifer forests in western Colorado. NatureServe Vista is capable of identifying spatially-explicit areas of highest conservation value and is a flexible tool that will accommodate exploration of multiple conservation scenarios. Success of the model application is dependent upon the availability of comprehensive and accurate information on the distribution and abundance of modeled species for incorporation into the modeling algorithm as well as information on the integrity of the landscape inhabited by the species in question and the threats these habitats face. The project will use information on the abundance and distribution of Neotropical migratory birds from the long-term state-wide breeding bird monitoring program, *Monitoring Colorado's Birds*, coordinated by the Rocky Mountain Bird Observatory (RMBO).

Methods

Study area

The study area encompasses Bird Conservation Regions (BCR) 10 (Northern Rockies) and 16 (Southern Rockies/Colorado Plateau) in western Colorado (Figure 2). A large proportion of BCR 16 occurs in the state and covers the majority of western Colorado. A small proportion of BCR 10 occurs in the extreme northwest corner of Colorado. BCRs 10 and 16 cover the entire montane portion of Colorado, over 15.6 million ha.

Coniferous and aspen forests are dominant landcover types at mid and high elevations, covering over 50% of western Colorado. Piñon-Juniper habitat covers approximately 2.6 million ha (17% of total landcover) and is owned primarily by BLM (56%), private landowners (27%) and USFS (6%). Ponderosa Pine forests cover over 1.3 million ha (9% of total landcover). Principal ownership is by private landowners (45%), USFS (43%), and BLM (6%). Mixed Conifer forests cover approximately 1.2 million ha (8% of total landcover) and is owned by USFS (68%), private landowners (23%) and BLM (6%). Spruce-Fir forests occupy high elevations and cover 2.3 million ha (15% of total landcover), owned primarily by USFS (80%), private landowners (12%), and BLM (5%). Aspen forests occupy 1.3 million ha in western Colorado (8% of total landcover). Primary ownership is by USFS (66%), Private (26%), and BLM (5%).

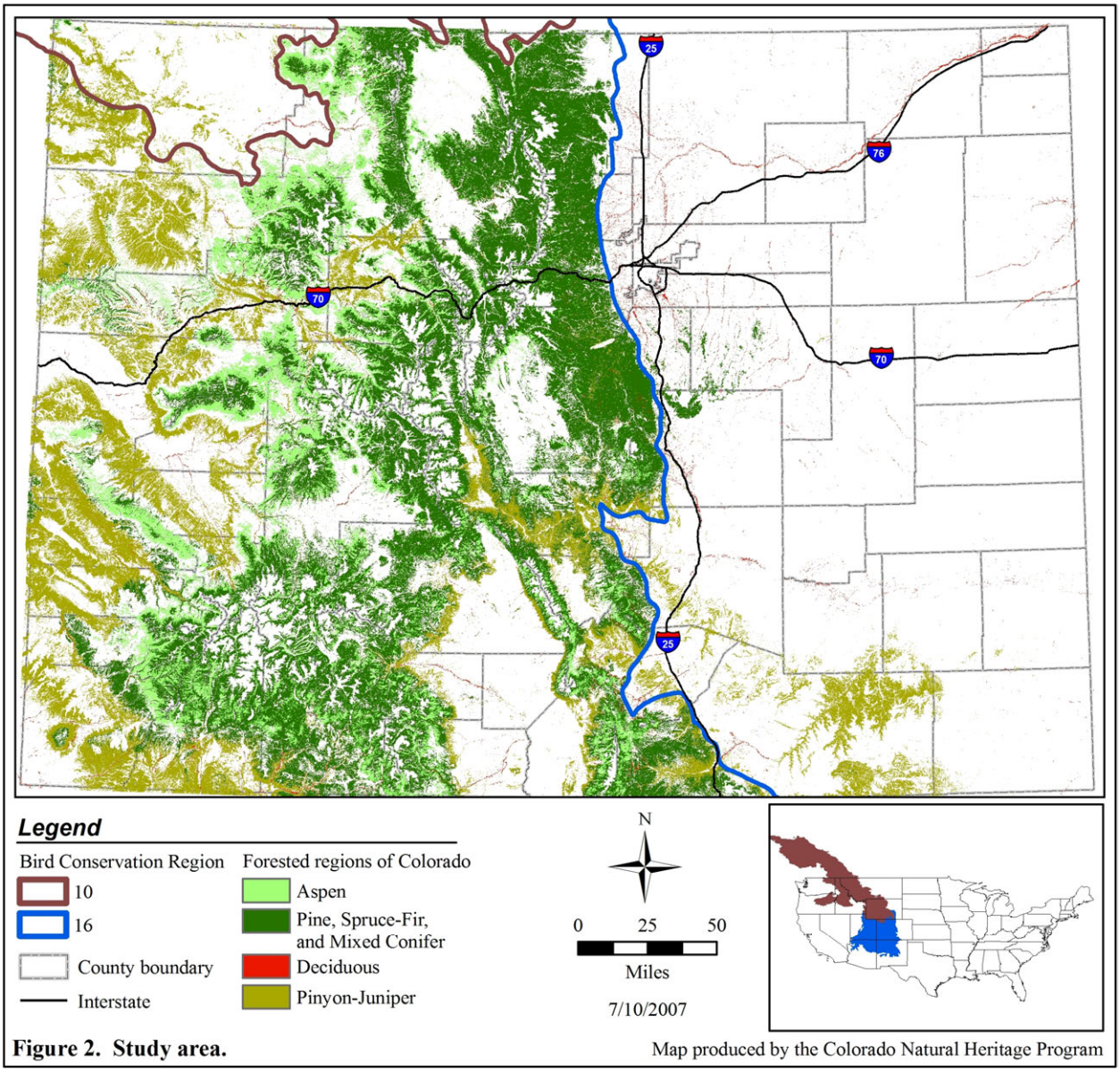


Figure 2. Study area.

All analyses for this project were done at 1 ha resolution (100 m x 100 m cells). Source raster data were at 30 m resolution and so resampled to 100 m. All vector data used are statewide datasets.

Species Data Acquisition and Synthesis

Twenty-two forest-based bird species were used as conservation targets in this project (Table 1). Many of these species are not considered rare and are therefore not tracked in the CNHP database. Those species for which sufficient occurrence-based data existed were modeled spatially as discrete occurrences (seven species, see Table 1). For the remainder, we used more general distribution models, hereafter referred to as "range-based" models, based on Southwest Regional Gap Analysis Project (SWReGAP, USGS 2004) Animal Habitat Models (USGS 2005). Northern Goshawk was modeled as both occurrence-based and range-based because data on nest sites is available for use in occurrence-based modeling while foraging dynamics must be

modeled using range-based information, and both components of Northern Goshawk ecology are important to consider in conservation planning efforts.

Range-based species models were stratified by habitat (Table 2). A primary habitat was considered to be a major habitat type in which greater than 5% of the species' sample points from RMBO's data set occurred (www.rmbo.org/public/monitoring). Only forested types were considered to be primary habitats for this project. SWReGAP Landcover (USGS 2004) was then crosswalked to the major habitat types identified by RMBO (Appendix A). Species distributions from the SWReGAP Animal Habitat Models were then intersected with the habitat type crosswalk to derive habitat-specific species distributions.

Minimum viable patch size was then determined for each range-based species based on territory sizes derived from the literature (Table 3). Contiguous patches (regardless of habitat type) that were smaller than the minimum viable patch size were removed from each range-based model prior to input into NatureServe Vista or SPOT.

Table 1. Target Species.

Common Name	Scientific Name	G-rank	S-rank	Migratory	Model
Band-tailed Pigeon	*Patagioenas fasciata*	G4	S4B	Y	Range
Black Swift	*Cypseloides niger*	G4	S3B	Y	Occurrences
Black-throated Gray Warbler	*Dendroica nigrescens*	G5	SNA	Y	Range
Boreal Owl	*Aegolius funereus*	G5	S2	N	Occurrences
Cassin's Finch	*Carpodacus cassinii*	G5	S5	N	Range
Cordilleran Flycatcher	*Empidonax occidentalis*	G5	S5B	Y	Range
Dusky Flycatcher	*Empidonax oberholseri*	G5	S5B	Y	Range
Dusky Grouse	*Dendragapus obscurus*	G5	S5	N	Range
Flammulated Owl	*Otus flammeolus*	G4	S4	Y	Occurrences
Grace's Warbler	*Dendroica graciae*	G5	S3B	Y	Range
Gray Flycatcher	*Empidonax wrightii*	G5	S5B	Y	Range
Gray Vireo	*Vireo vicinior*	G4	S3B	Y	Range
Juniper Titmouse	*Baeolophus ridgwayi*	G5	S4	N	Range
Lewis's Woodpecker	*Melanerpes lewis*	G4	S4	N	Occurrences
Mexican Spotted Owl	*Strix occidentalis lucida*	G3T3	S1B	N	Occurrences
Northern Goshawk	*Accipiter gentilis*	G5	S3B	N	Occ. (nests) & Range
Olive-sided Flycatcher	*Contopus cooperi*	G4	S3S4B	Y	Range
Pinyon Jay	*Gymnorhinus cyanocephalus*	G5	S5	N	Range
Purple Martin	*Progne subis*	G5	S3B	Y	Occurrences
Pygmy Nuthatch	*Sitta pygmaea*	G5	S4	N	Range
Red-naped Sapsucker	*Sphyrapicus nuchalis*	G5	S5	Y	Range
Williamson's Sapsucker	*Sphyrapicus thyroideus*	G5	S4B	Y	Range

Natural Heritage Network Ranking System (for more information, see NatureServe 2002):
G/S1 Critically imperiled globally/state because of rarity, or because some factor of its biology makes it especially vulnerable to extinction.
G/S2 Imperiled globally/state because of rarity, or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3 Vulnerable through its range or found locally in a restricted range.
G/S4 Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/S5 Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
S#B Refers to the breeding season imperilment of elements that are not residents.
S#N Refers to the migratory or winter season imperilment of elements that are not residents.
SNA Not Applicable. A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

Table 2. Range-based species stratification by habitat. (gray shading indicates habitats occupied by the species)

Species	Aspen	High Elev. Riparian	Lodgepole Pine	Mixed Conifer	Mountain Shrubland	Piñon-Juniper	Ponderosa Pine	Spruce-Fir
Band-tailed Pigeon								
Black-throated Gray Warbler								
Cassin's Finch								
Cordilleran Flycatcher								
Dusky Flycatcher								
Dusky Grouse								
Grace's Warbler								
Gray Flycatcher								
Gray Vireo								
Juniper Titmouse								
Northern Goshawk								
Olive-sided Flycatcher								
Pinyon Jay								
Pygmy Nuthatch								
Red-naped Sapsucker								
Williamson's Sapsucker								

Table 3. Range-based species minimum viable patch size.

Species	Territory Size (ha)	Min. Patch Size (ha)	Comments	Source
Band-tailed Pigeon	0.3482	n/a	Calculated from a diameter of 300m. Early reports of communal nesting with up to 17 nests in a single tree.	Glover 1953, Neff 1947
Black-throated Gray Warbler	3.23	3	based on RMBO density data, average of years 1999-2005	www.rmbo.org/public/ monitoring
Cassin's Finch	0.0734	n/a	Calculated from diameter of 15.6m (±1.7)	Sampson 1976
Cordilleran Flycatcher	1-3.5	3	Only estimate for similar species western Pacific-slope Flycatcher (range 1-3.5 n=7)	Ainsley 1992
Dusky Flycatcher	0.73	n/a	± .23 SE	Eckhardt 1979
Dusky Grouse	1.9	2		Hoffman 1981
Grace's Warbler	1.8	2	Based on estimates from CO. Estimates for NM 0.24-0.83	S. Hutchings (RMBO), Szaro and Balda 1979
Gray Flycatcher	1-5.3	5		Johnson 1963, McCallum et. al. 1978, McCallum 1980
Gray Vireo	7	7	Generated from work done in western Colorado (Dinosaur NM)	Hutchings, Leukering (RMBO)
Juniper Titmouse	1.3	n/a		Panik 1976
Northern Goshawk	170	170	Post-fledging area or portion of area defended	Kennedy et al. 1994
Olive-sided Flycatcher	10-20	20		Altman 1997
Pinyon Jay	n/a	n/a	Flocking species. Flocks could have a home range of 4 to 8 square kilometers.	Marzluff and Balda 1992
Pygmy Nuthatch	0.54-8.15	8	Variable based on density of pines, nest site availability and weather.	Norris 1958, Balda 1967, Storer 1977
Red-naped Sapsucker	0.7-2.63	3	Range .7 - 2.63 ha	Young 1975
Williamson's Sapsucker	4-9	9	Range 4 - 9 ha, n=10	Crockett 1975

n/a = Not applicable. For those species who either do not form territories or whose territory size is 1 hectare or less (minimum project resolution).

For occurrence-based species models, all available (as of September 2006) sampling data from RMBO was reviewed by CNHP zoologists and then combined with existing element occurrence record data into CNHP's BIOTICS database. This combined and quality-checked data was then exported out as discrete occurrence records for each of the seven species.

Conservation Value Summarization and Scenario Evaluation Using NatureServe Vista

Overview of NatureServe Vista

NatureServe Vista is a relatively new decision-support tool for land use and conservation evaluation and planning. Its primary purposes are to identify high-priority areas for conservation, to evaluate competing land use plans, to identify land uses that are in conflict with conservation goals, and to compare different stakeholder values and visions in order to highlight areas of agreement or conflict (Natureserve 2006). There are two main outputs from NatureServe Vista; Conservation Value Summaries and Scenario Evaluations. A Conservation Value Summary uses the distribution and quality of the conservation targets of concern to identify the relative conservation value (low to high) of different areas in the planning area. Scenario Evaluations indicate areas with compatible land use and adequate protection policies to meet element conservation goals (Natureserve 2006).

Limitations and Assumptions

As with all computer modeling and analysis tools, the outputs generated are only as good as the input data. Ecological systems are complex and comprehensive data is sorely lacking. NatureServe Vista is a support tool only. It cannot make decisions for the user, only highlight areas of perceived importance for further consideration and research.

This project used Vista version 1.3. Future enhancements of the software are planned, but some of the limitations that exist in version 1.3 include the inability to calculate either irreplaceability or complementarity of land units to contribute to goals, inability to relate target viability to target goals, restrictive binary assignment of target compatibility with land use classes, lack of batch import of input data, and performance issues with large projects and raster-based inputs. Additionally, Vista does not take into account seasonality, either in regards to a species' use of an area or to fluctuating recreational or traffic volume.

Target Integrity and Data Confidence Scores

In addition to species distribution, NatureServe Vista also accommodates information on the quality of each target species location and on the confidence in data used. These scores are ranked from 0 to 1 and can be incorporated in Vista's Conservation Value Summaries. For occurrence-based models, a quality score was based on CNHP Element Occurrence Rank and data confidence was based on data source and precision levels (Table 4 (a) and (b), NatureServe 2002 and 2006).

Table 4. Confidence (a) and Integrity (b) Scores for Occurrence-based Species Data.

a)

CNHP Data Precision	Vista Confidence Rank
Observations	1.0
Seconds	1.0
Minutes	0.8
General	0.4

b)

Element Occurrence Rank	Vista Integrity Rank
A	1.0
B	0.9
C	0.6
E	0.6
D	0.2
H	0.2

Observations are from field data of elements that are not actively tracked in BIOTICS.
Seconds precision: mappable to within approximately 3 arc seconds of latitude and longitude.
Minutes precision; mappable within approximately 1 mile in any direction.
General precision; any occurrence whose locational uncertainty exceeds approximately 1 mile.

All range-based models were given a single value of 0.8 for data confidence, because these data are based on multi-statewide distribution models of presumed modest accuracy. Habitat integrity of range-based models was modeled spatially and used to represent target viability as a continuous surface over the project area for these species. Due to the lack of documentation as well as statewide data relating to specific species requirements, one generalized habitat viability model was used for all range-based species. Habitat integrity was based on three wide-spread anthropogenic factors; road density, oil and gas development, and habitat conversion to non-natural land cover. These factors are not mutually exclusive, for instance, both energy development and habitat conversion lead to increased road densities. However, none of the available spatial datasets for these factors is fully complete and accurate. For example, many dirt roads leading to oil wells are not mapped, and the severity of habitat conversion on private land is very difficult to track. Therefore, these factors were chosen in the hopes that they will compliment one another and make up for incomplete and inaccurate source data.

Like other scores in NatureServe Vista, the habitat integrity layer ranges in value from 0 (from poor integrity) to 1 (excellent integrity). However, because the three components above result in negative impacts to population viability, the habitat integrity layer was first developed as a threats layer, with higher values corresponding to greater threat, and then once completed, inverted and scaled to fit the NatureServe 0-1 model. The scoring of each individual component was scaled so that it cannot contribute more than a third of the total scoring (0 – 30, with the final range from 0 – 90).

Traffic volume is believed to be the primary index of the negative impact of roads to bird population viability (D. Hanni, personal communication, August 2006). Unfortunately, traffic data are only available for highways. As a surrogate, road density was weighted by both the size of the road and the distance of local roads to highways, with the assumption that the larger the road, and/or the closer it is to a main transportation artery, the greater the traffic volume. Seasonality of traffic volume could not be accounted for in this simplistic model. For road size weights, primary roads (interstate highways and other U.S. highways) were given a score of 5, secondary roads (state highways) were scored as 4, and local and primitive roads were scored with a 1. For distance to highways, local and primitive roads within 5 km of a primary or secondary road were given a separate score of 2, those within 5 – 20 km of a primary or

secondary road were scored 1, and beyond 20 km received a score of 0. These two weighting schemes were combined additively, so that primary roads had a weight of 5, secondary a weight of 4, and local and primitive roads could be weighted 3, 2, or 1, depending on their distance to highways. Note that we were limited to measuring distance as the crow flies, instead of actual driving distance, so that this method has its limitations. A kernel density function was run using these weights and an 800 m radius moving window (800 m, or ½ mile, was used as the standard distance of threat impact to birds throughout this project). The resulting range of weighted road density (0 – 75 weighted km of road per square km) was reviewed and then scored as to its impact as shown in Figure 3.

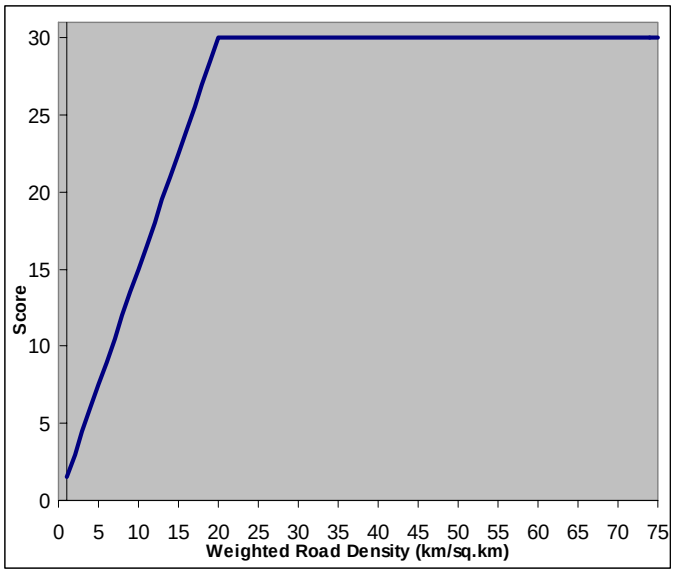


Figure 3. Conversion of weighted road density to threat score.

The impacts from oil and gas development and habitat conversion were modeled using distance decay functions. The method of using distance decay to spatially measure the impact of anthropogenic factors on landscape integrity is based on work by Tuffly and Comer (2005a and b), however the equations and parameters used here are based on Decker et al. (2007). We used modifications of an s-curve for the decay functions. By adjusting the shift and spread of the curve, it can be tailored to specific impacts. The curve created is asymptotic at both ends, and so requires post-function adjustments to make the area beyond the maximum distance equal 0 and the actual area impacted equal the full weight. Table 5 and Figure 4 show the curves used for this project.

Table 5. Equations used for distance decay functions in landscape integrity model.

Curve Type	Type of Impact	Max Distance (m)	Weight	Equation
Gradual	Urban	800	30	(1/(1+EXP((([Distance]/100)-4.5)*1.3)))*[Weight]
	Suburban	600	24	(1/(1+EXP((([Distance]/100)-3.5)*2)))*[Weight]
	Rural/Agriculture	400	15	(1/(1+EXP((([Distance]/100)-2.5)*2.5)))*[Weight]
	Inactive O&G wells	400	6	(1/(1+EXP((([Distance]/100)-2.5)*2.5)))*[Weight]
Abrupt	Active O&G wells	800	30	(1/(1+EXP((([Distance]/100)-3)*1.5)))*[Weight]

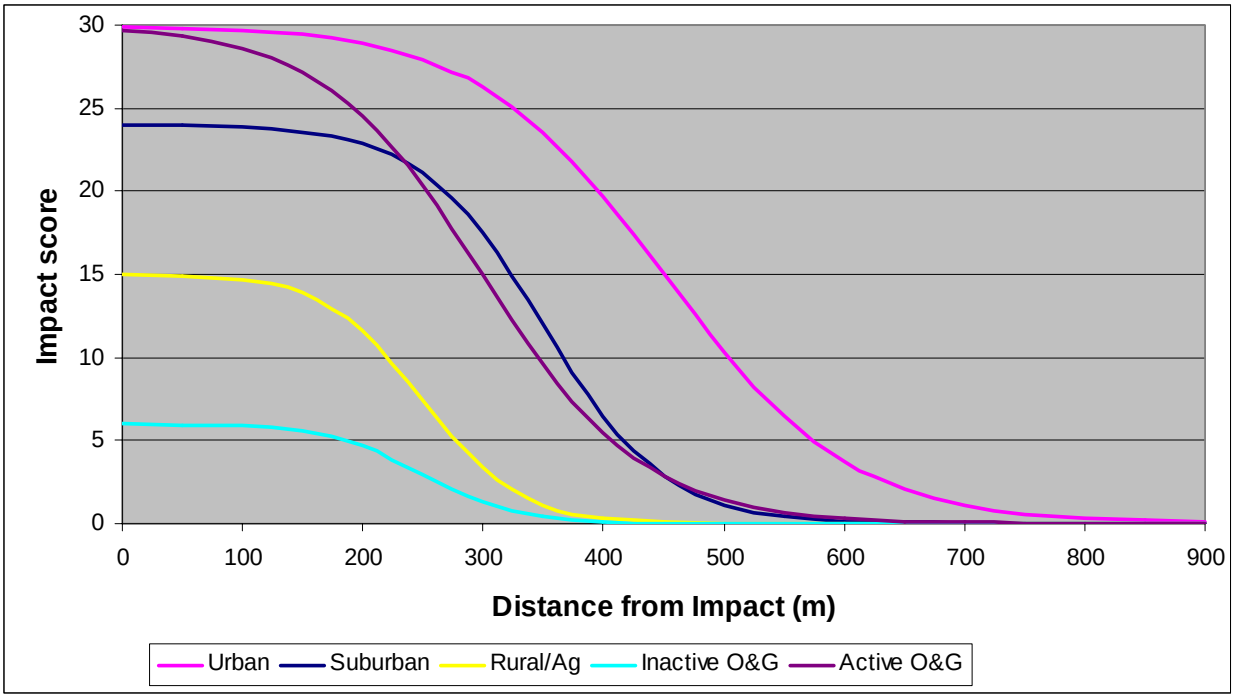


Figure 4. Curves used for distance decay functions in landscape integrity model.

Oil and gas development impacts were modeled from active and pending wells (as of 08/03/2006) from the Colorado Oil and Gas Conservation Commission (COGCC 2006). Active wells were determined to represent a large impact to bird habitat integrity, but abruptly decaying. An abrupt decay was here defined as reaching half the impact within approximately a third of the total distance.

Habitat conversion to non-natural land cover was separated out by the severity of the impact into urban development, suburban development, exurban/rural development and agriculture, and inactive (dry, abandoned, or test) oil and gas wells. We acknowledge that exurban and rural housing development likely have a different impact to bird habitat integrity than intensive agriculture. Unfortunately, at the scale of the project area, data does not exist that can consistently distinguish between these types of impacts. All were modeled using a gradual decay curve, though the more severe impacts were given greater initial weights and longer total distances. A gradual curve is here defined as reaching half the impact at somewhat greater than half the total distance. SWReGAP landcover (USGS 2004), COMaP v.5 (Wilcox et al. 2006), and 2000 U.S. Census data (USCB 2002) were used to estimate areas of urban, suburban, and rural/agriculture development within the study area. Inactive oil and gas wells (as of 08/03/2006) were from COGCC (2006). Distance decay was calculated for each component separately, and then combined by taking the maximum value for each analysis cell in the project area.

The completed models for weighted road density, oil and gas development, and habitat conversion each ranged in value from 0 to 30. These three models were then additively combined to create an interim habitat integrity layer that had a potential range of 0 (natural

landscape) to 90 (fully modified, inhospitable landscape). This value range was then inverted and scaled to 1 (excellent integrity) to 0 (poor integrity) via the formula:

*(90 - X) * 0.01111111*

to create the final habitat viability layer input into NatureServe Vista for range-based species.

Land Use Compatibility and Protection Policy

Two Scenarios were created to be evaluated against target conservation goals; a Baseline Scenario representing current land use and protection, and a Future Scenario with predicted changes to land use over approximately the next 25-30 years. NatureServe Vista looks at land use as being either compatible or incompatible with each conservation target of concern. Therefore, it is necessary to classify various land uses in such a way that is meaningful to the conservation of each target species in this project. The dichotomy of having to designate all land uses as either compatible or incompatible to the persistence of a species is extremely limiting, especially because not all relevant land uses that affect birds could be reliably mapped over the project area. Table 6 lists the land uses we decided upon. Those marked with a dagger ("†") are relevant, but are either not mappable over the entire project area, and/or not mutually exclusive (such as motorized/non-motorized versus grazing) and so were not used for this iteration of the project. Future iterations should focus on subsets of the full area, allowing finer scale land uses to be incorporated at that time. Future iterations of NatureServe Vista are also expected to be able to accommodate a less rigidly binary treatment of land use compatibility. Species compatibility assignments are in Appendix B.

Table 6. Land use categories and definitions.

Land Use		Definitions
Private/Tribal Land		
Rural		Less than 1 housing unit per 40 acres.
Exurban		Between 1 housing unit per 40 acres to 1 unit per 10 acres.
Suburban		Greater than exurban, but no more than 1 housing unit per 0.6 acre.
Urban/Industrial		Greater housing density than suburban.
Public Land		
General Public Land		Any non-private land for which no other category can be reliably assigned.
Non-motorized †		Any non-private land on which motorized vehicles are prohibited.
Motorized †		Any non-private land which allows motorized vehicles, but does not fall into one of the extractive/recreation categories below.
Extractive/Recreation uses irrespective of ownership		
Timber Management		
	Unknown Timber Management †	This category is used when it is not possible to determine management type.
	Thinning †	Anything less complete than clearcutting.
	Clearcut †	All standing trees, including snags, removed.
Reservoirs/impoundments		Man-made waterbody.
Ski Area		Designated ski area.
Mining †		Surface disturbance of mining, any type.
Oil and Gas development		Areas set aside for intensive drilling for oil or natural gas.
Roads		Primary and secondary roads.
Piñon-Juniper removal †		Clearing of Piñon-Juniper stands to increase cattle forage.
Grazing †		Active, moderate to intensive, cattle grazing.

† Unable to map consistently across extent of project area.

Baseline land use was derived from COMaP v.5 (Wilcox et al. 2006), 2000 Census Block Housing Densities (Theobald 2005), 2000 U.S. Census data (USCB 2002), TIGER/Line roads (USCB 2005), oil and gas wells as of 08/03/2006 (COGCC 2006), and USGS 1:100,000 hydrology. All land uses were converted to 1 ha resolution grids. Active oil and gas well points were buffered out 200 m (12.5 ha), inactive well points were converted to 1 ha in size (1 grid cell) and primary and secondary roads were given a width of 100 m (1 grid cell wide). So as not to obscure more influential land uses, data was combined in the following order (top to bottom); reservoirs, active/pending oil and gas wells, inactive wells, urban and suburban housing density, primary and secondary roads, and all other mapped landuses (general public land, ski areas, rural and exurban housing density).

Existing legal protection was generalized from The Nature Conservancy's GAP+ categorization scheme (Supples et al. 2006), itself a modification of GAP land ownership classification (USGS 2004, Scott et al. 1993). The GAP+ categories were further generalized into simply "Protected," "Semi-protected," and "Not Protected." GAP+ categories 1 and 2 were considered "Protected" and included public and private lands having permanent conservation protection (e.g., Wilderness Areas, BLM Areas of Critical Environmental Concern, National Parks, U.S. Forest Service Research Natural Areas and Special Interest Areas, TNC conservation easement lands, and some TNC preserves. GAP+ categories 3, 4a, and 4b were considered "Semi-Protected" and included public and private lands with permanent protection from conversion of natural land cover, but subject to extractive uses (e.g., BLM, U.S. Forest Service, State Land Board, Colorado Division of Wildlife, State Parks, private lands with agricultural easements). All other categories were considered "Not Protected." Protection levels were assigned using COMaP v. 5 (Wilcox et al. 2006).

For the Future Scenario, we wanted to project land use changes over the next 25-30 years. Predicting new reservoirs, ski areas, and roads with any spatial accuracy is extremely difficult, therefore, we only looked at predicted changes in housing density and oil and gas development. Protection levels were not changed, because these are meant to represent lasting legal mandates. Baseline housing density was replaced by predicted 2030 Block Housing Densities (Theobald 2005). Future oil and gas development was modeled based on past trends from data supplied online by the Colorado Oil and Gas Conservation Commission. It is impossible to model specific future well locations, so generalized areas representing predicted significant future oil and gas development were modeled instead using a resolution of 400 m (40 acre cells). This is a relatively simplistic model that is based in the following assumptions:

1) There is a maximum possible density of 40 wells within a single 40 ac cell (equivalent to 1 well per acre). This includes abandoned and test wells. Current maximum density is 1 well per 1.7 acres, so this predicted future maximum is considered conservative.
2) New wells are drilled close to existing wells, and there is a direct, linear correlation between the number of wells in an area (whether active or not) and the extent to which the surrounding area is drilled.

The relative rate of change, in relation to the theoretical maximum of 40 wells per cell, in the number of wells (whether active or not) from 1980 to 2006 was calculated. The rate of change ranged over the study area from 0 – 60% of the theoretical maximum. This range was then

linearly increased up to the maximum (i.e., 0 – 100%) and then translated back into the number of new wells per 40 acre cell, which was subsequently added to the existing number of wells, while maintaining a ceiling of 40 wells per cell. Each cell containing wells was then converted into a point and buffered out by 100 m times the number of wells (so that an area with 1 well per 40 acres was buffered 100 meters while the maximum of 40 wells per 40 acres was buffered out 4,000 meters, and so forth). Overlapping buffers were dissolved to create areas of predicted future oil and gas development.

Target Conservation Goals

Various goal sets were evaluated against these scenarios, representing different levels of risk in achieving adequate conservation of target species. Goals ranged from minimum viable population (MVP) to Partners in Flight (PIF) local restoration goals (PIF 2005). There has not been adequate study of the target bird species to empirically calculate minimum population sizes, or indeed even to know the relative scale of our study area to each species' minimum population requirements. In the absence of hard population data, we have made a number of assumptions based on expert opinion and followed rules of thumb for calculating MVP as presented in Reed et al. (2002). We assume that a "population" is discrete and isolated (no source-sink or other meta-population dynamics), a population is minimally viable if it has a 99% chance of persisting for 100 years, and we assume that the scale of forest bird populations in the western U.S. is at the level of Bird Conservation Regions, although individuals of a population may not be evenly dispersed over a region. Our study area of western Colorado encompasses 28% of BCR 16 and 1% of BCR 10. Rather than assume that our study area should contain 29% of an MVP for each target species, however, we have conservatively set goals as High Risk (1 MVP), Medium Risk (2.5 x MVP), Low Risk (4 x MVP), and Restoration (local PIF goals, which are all 100% or greater of current population levels).

Reed et al. (2002) conclude that an MVP for a species is *not* significantly influenced by body mass, taxonomic group, or trophic level, but rather by population variability, population growth rate, and generation length. They arrived at a mean MVP of approximately 7,000 breeding age adults for a 99% probability of persistence over 40 generations, more if the population is highly variable and growth is slow or negative. Therefore, we began with an MVP of 7,000 for each target species and adjusted it first based on generation length (extrapolating 40 generations for each species into 100 years by fitting to the slope of the line of the relationship between MVP and study length [Figure 1 in Reed et al. 2002]), and adjusted again on perceived population decline or stability as determined in the Partners In Flight Species Assessment Database (PIF 2005). The resulting MVP estimates (Table 7) were compared to different estimates using a body mass based rule of thumb created by Belovsky (1987). The MVP estimates based on Reed et al. (2002) fell within the range of values produced by the body mass based estimates, and so we considered our calculations to be reasonable. See Appendix C for MVP calculations.

Table 7. Estimated Minimum Viable Population (number of adults) for each species.

Species	Estimated MVP
Band-tailed Pigeon	10,000
Black Swift	24,000
Black-throated Gray Warbler	24,000
Boreal Owl	10,000
Cassin's Finch	32,000
Cordilleran Flycatcher	16,000
Dusky Flycatcher	16,000
Dusky Grouse	14,000
Flammulated Owl	16,000
Grace's Warbler	24,000
Gray Flycatcher	16,000
Gray Vireo	16,000
Juniper Titmouse	32,000
Lewis's Woodpecker	16,000
Mexican Spotted Owl	7,000
Northern Goshawk	4,000
Olive-sided Flycatcher	32,000
Pinyon Jay	14,000
Purple Martin	16,000
Pygmy Nuthatch	32,000
Red-naped Sapsucker	10,000
Williamson's Sapsucker	16,000

Like other spatially-based conservation planning tools, NatureServe Vista cannot set goals based on numbers of individuals, but instead needs either number (or percent) of discrete mapped occurrences or amount of area. Therefore, our population based goals needed to be translated into area, for range-based species models, or occurrences, for occurrence-based models. Additionally, we wished to stratify goals by habitat type, to utilize the most accurate density estimates calculated through the Monitoring Colorado's Birds program conducted by RMBO. Densities, as numbers of adult birds per square kilometer, were estimated for each range-based species for each habitat. Approximately half of these density estimates came from RMBO's multi-year "Monitoring Colorado's Birds" study, a state based a habitat stratified sampling scheme (Leukering et al. 2000), the remaining were derived from the literature (Table 8). These densities were then applied to the amount of habitat each range-based species model occupied in order to come up with the current estimated populations of each species in each habitat (Table 9). Using this information, it was then possible to calculate the amount of area of each habitat that would be required for a minimum viable population. These amounts were used as the High Risk goals. In those cases where the Medium Risk or Low Risk goals would have exceeded the amount of available habitat in the study area, the maximum amount of habitat in the study area was used instead. For the occurrence-based species models, the number of occurrences in the study area for each species, even when converted to estimated number of individuals, is far lower than the MVP estimates. This is presumably due to relatively low sampling effort for these less-common species. Therefore, we decided to instead use percentage of existing occurrences instead of MVP for these goals, so that High Risk = 50%, Medium Risk = 75%, and Low Risk =

100%. When stratified by habitat, the 22 species become 62 separate inputs. Table 10 presents each goalset used.

Table 8. Estimated density of adult birds in each habitat (birds/km^2)

Species	Aspen	High Elev. Riparian	Lodgepole Pine	Mixed Conifer	Mountain Shrubland	Piñon-Juniper	Ponderosa Pine	Spruce-Fir
Band-tailed Pigeon	0.52[6]			0.52[6]	0.52[6]	0.52[6]	0.52[6]	0.52[6]
Black-throated Gray Warbler						60.51[1]		
Dusky Grouse	0.51[6]			0.51[6]	0.51[6]		0.51[6]	0.51[6]
Cassin's Finch	1.30[2,4]			3.00[1]		0.65[4]	5.19[1]	2.72[1]
Cordilleran Flycatcher	5.80[1]	8.18[1]		8.40[1]			1.91[1]	7.63[1]
Dusky Flycatcher	12.00[1]	15.67[1]			59.00[1]	10.01[1]	28.08[1]	
Grace's Warbler							9.84[1]	
Gray Flycatcher						48.53[1]		
Gray Vireo						1.97[1]		
Juniper Titmouse						16.38[1]		
Northern Goshawk	0.24[5]	0.24[5]		0.24[5]	0.24[5]	0.24[5]	0.24[5]	
Olive-sided Flycatcher	0.60[1]	0.20[4]	0.10[4]	0.80[1]	0[4]		0.84[1]	1.04[1]
Pinyon Jay						4.50[1]		
Pygmy Nuthatch				0[2,3]			29.75[1]	
Red-naped Sapsucker	14.00[1]	45.00[1]		3.40[1]	29.00[1]		3.62[1]	
Williamson's Sapsucker				17.00[1]			12.68[1]	2.00[1]

Data Sources:
[1]Monitoring Colorado's Birds (MCB) data (Hutton et al. 2006)
[2]Breeding Bird Atlas - (Kingery 1998)
[3]Birds of North America – Poole (2005)
[4]Professional opinion of authors.
[5]Skorkowsky (2007) and Reynolds (2007)
[6]No available density information. Back calculated local PIF population estimate with modeled distribution to derive density.

Table 9. Population estimates based on habitat-specific densities (number of adult birds).

Species	Aspen	High Elev. Riparian	Lodgepole Pine	Mixed Conifer	Mountain Shrubland	Piñon-Juniper	Ponderosa Pine	Spruce-Fir	Total Estimated Population
Band-tailed Pigeon	2,192			1,547	1,611	3,285	1,415	2,691	12,741
Black-throated Gray Warbler						1,219,533			1,219,533
Dusky Grouse	5,798			4,504	5,750		5,131	9,208	30,391
Cassin's Finch	11,031			23,702		13,615	51,792	10,398	110,538
Cordilleran Flycatcher	62,732	15,617		68,383			17,744	127,706	292,183
Dusky Flycatcher	2,839	38,750			644,304	208,351	10,079		904,321
Grace's Warbler							1,361		1,361
Gray Flycatcher						904,880			904,880
Gray Vireo						24,179			24,179
Juniper Titmouse						311,968			311,968
Northern Goshawk (foraging)	1,773	160		1,510	80	29	1,604		5,157
Olive-sided Flycatcher	5,737	66	664	6,400	0		7,941	13,363	34,171
Pinyon Jay						95,367			95,367
Pygmy Nuthatch				0			285,984		285,984
Red-naped Sapsucker	117,663	30,318		19,406	91,014		34,770		293,171
Williamson's Sapsucker				135,684			117,362	34,255	287,301

Table 10. Goals for each target species, stratified by habitat.
(Units are hectares unless shaded gray, these are number of occurrences.)

Target name	High Risk	Medium Risk	Low Risk
Band-tailed Pigeon-Aspen	330,814	827,034	1,147,244
Band-tailed Pigeon-Mixed Conifer	233,541	583,852	895,587
Band-tailed Pigeon-Mountain Shrubland	243,169	607,923	972,677
Band-tailed Pigeon-Piñon-Juniper	495,837	1,239,592	1,983,347
Band-tailed Pigeon-Ponderosa Pine	213,526	533,815	854,105
Band-tailed Pigeon-Spruce-Fir	406,190	1,015,475	1,624,761
Black Swift	31	47	62
Black-throated Gray Warbler-Piñon-Juniper	39,661	99,152	158,644
Boreal Owl	61	92	122
Cassin's Finch-Aspen	245,647	614,116	982,586
Cassin's Finch-Mixed Conifer	228,714	571,785	895,587
Cassin's Finch-Piñon-Juniper	606,394	1,515,984	2,196,457
Cassin's Finch-Ponderosa Pine	288,886	722,215	1,035,667
Cassin's Finch-Spruce-Fir	110,745	276,862	442,980
Cordilleran Flycatcher-Aspen	59,228	148,070	236,912
Cordilleran Flycatcher-High Elevation Riparian	10,451	26,128	41,805
Cordilleran Flycatcher-Mixed Conifer	44,580	111,449	178,319
Cordilleran Flycatcher-Ponderosa Pine	50,956	127,390	203,824
Cordilleran Flycatcher-Spruce-Fir	91,613	229,033	366,453
Dusky Flycatcher-Aspen	419	1,046	1,674
Dusky Flycatcher-High Elevation Riparian	4,375	10,937	17,500
Dusky Flycatcher-Mountain Shrubland	19,321	48,303	77,285
Dusky Flycatcher-Piñon-Juniper	36,841	92,102	147,364
Dusky Flycatcher-Ponderosa Pine	635	1,588	2,541
Dusky Grouse-Aspen	523,736	1,147,244	1,147,244
Dusky Grouse-Mixed Conifer	406,859	895,587	895,587
Dusky Grouse-Mountain Shrubland	519,371	1,179,885	1,179,885
Dusky Grouse-Ponderosa Pine	463,449	1,035,667	1,035,667
Dusky Grouse-Spruce-Fir	831,684	1,822,752	1,822,752
Flammulated Owl	14	21	28
Grace's Warbler-Ponderosa Pine	243,833	609,583	975,332
Gray Flycatcher-Piñon-Juniper	32,971	82,427	131,883
Gray Vireo-Piñon-Juniper	813,752	2,034,381	2,196,457
Juniper Titmouse-Piñon-Juniper	195,408	488,520	781,632
Lewis's Woodpecker	48	71	89
Mexican Spotted Owl	11	16	21
Northern Goshawk-Aspen	572,945	1,147,244	1,147,244
Northern Goshawk-High Elevation Riparian	51,811	129,527	207,244
Northern Goshawk-Mixed Conifer	487,982	895,587	895,587
Northern Goshawk-Mountain Shrub	25,985	64,963	103,942
Northern Goshawk-Piñon-Juniper	9,480	23,699	37,919
Northern Goshawk-Ponderosa	518,464	1,035,667	1,035,667
Northern Goshawk-nesting	120	179	239
Olive-sided Flycatcher-Aspen	895,383	1,147,244	1,147,244
Olive-sided Flycatcher-High Elevation Riparian	30,983	77,458	123,933
Olive-sided Flycatcher-Lodgepole Pine	621,627	698,238	698,238
Olive-sided Flycatcher-Mixed Conifer	749,217	895,587	895,587

Olive-sided Flycatcher-Ponderosa Pine	884,820	1,035,667	1,035,667
Olive-sided Flycatcher-Spruce-Fir	1,200,119	1,822,752	1,822,752
Pinyon Jay-Piñon-Juniper	311,388	778,470	1,245,552
Purple Martin	34	50	67
Pygmy Nuthatch-Ponderosa Pine	107,567	268,917	430,267
Red-naped Sapsucker-Aspen	28,668	71,669	114,670
Red-naped Sapsucker-High Elevation Riparian	2,298	5,745	9,192
Red-naped Sapsucker-Mixed Conifer	19,468	48,671	77,873
Red-naped Sapsucker-Mountain Shrubland	10,705	26,763	42,820
Red-naped Sapsucker-Ponderosa Pine	32,769	81,924	131,078
Williamson's Sapsucker-Mixed Conifer	44,449	111,123	177,796
Williamson's Sapsucker-Ponderosa Pine	51,554	128,884	206,214
Williamson's Sapsucker-Spruce-Fir	95,384	238,461	381,537

Portfolio Optimization Using SPOT

Overview of SPOT and Portfolio Optimization

The Spatial Portfolio Optimization Tool (SPOT) is a conservation planning tool that utilizes an optimization algorithm known as "simulated annealing" in order to select planning areas that best meet goals while minimizing costs (Shoutis 2003). SPOT is very similar to previous simulated annealing software (SITES, MARXAN, SPEXAN), but with an emphasis on the "portfolio selection" methods developed and used by The Nature Conservancy for ecoregional conservation planning efforts, as well as additional improvements and updates to the interface, documentation, and run times (Shoutis 2003). A "conservation portfolio" is a set of priority areas representing the best opportunities for conservation of the region's biodiversity. Clearly, this project is not creating a true conservation portfolio for western Colorado, as we are only focusing on forest birds, and not all biodiversity in the region. This has already been done (Freilich et al. 2001, Neely et al. 2001, Tuhy et al. 2002). Instead, we are using SPOT as a prioritization tool to highlight specific areas that most contribute to our conservation goals, something that NatureServe Vista does not by itself do.

Limitations and Assumptions

As with all computer modeling and analysis tools, the outputs generated are only as good as the input data. Ecological systems are complex and comprehensive data is sorely lacking. SPOT is an initial planning tool only. It cannot make decisions for the user, only highlight areas of perceived importance for further consideration and research. Like NatureServe Vista, SPOT does not take into account seasonality, either in regards to a species' use of an area or to fluctuating recreational or traffic volume.

The process of simulated annealing creates and evaluates an entire portfolio at a time, so that there is no way to discern why specific areas were included or excluded from the resulting portfolio. The algorithm is statistically likely to find the most efficient portfolio given enough iterations, however it is not guaranteed, and the number of sufficient iterations is generally unknown and depends upon the complexity of the project. Additionally, the algorithm is not deterministic. Multiple runs using the same initial parameters can result in slightly different outcomes each time.

Input Data

The SPOT cost function is:

Total Cost = Base Cost + Boundary Cost + Shortfall Cost

To create a portfolio, the project area must be divided into small, and preferably similarly sized, areas called "analysis units." Each analysis unit is assigned a *Base Cost* which can be the actual monetary cost of purchasing the unit, or a relative cost based on size, landscape integrity, or other relative value. Every analysis unit selected adds to the total cost of the portfolio, which is balanced against the cost of not meeting a target goal (*Shortfall Cost*). The *Boundary Cost* is used to encourage SPOT to choose portfolios with a minimum perimeter to area ratio, thereby reducing fragmentation of the portfolio. To produce a balanced portfolio, each cost should be of similar magnitude, unless great emphasis needs to be placed on one over the others to achieve desired results.

Analysis units were generated as 1,000 ha hexagons across the entire study area. Analysis Units can be any shape or size, but hexagons of around 1,000 – 1,300 ha in size have become generally preferred for conservation portfolio selection (Miller et al. 2003, Neely et al. 2001, Neely et al. 2006, Wild Utah Project 2004) because they provide a smooth output that is unbiased by differing unit sizes and is generally at the scale of on-the-ground conservation action. Units at the edge of the study area were clipped to exactly match the project area boundary to avoid issues of missing data at the edges. Much of the data layers created for use in NatureServe Vista were again employed as inputs for SPOT. The original integrity layer (with a value range of 0 – 90, see the section "Target Integrity and Data Confidence Scores" above) was averaged over each analysis unit and then multiplied by the area of each unit (in square meters) to create the Base Cost. The equation used was:

*Base Cost = (Mean Integrity + 1) * Area*

One was added to the mean integrity score to prevent units with a mean less than 1 from resulting in a Base Cost less than the actual area of the hexagon. Note that clipped units at the edges have an overall smaller cost, due to less area, than whole hexagons, which can lead to preferential selection of edge units. To compensate, boundary length values of clipped hexagons were forced to have the same value as unclipped hexagon boundaries. Additionally, edge units should, on average, have proportionally less of each target element.

All analyses were done in square meters, which are the native map units of the input data layers. A Boundary Length Modifier (BLM), or weight, was used to bring the Boundary Cost, measured in linear meters, up to a similar magnitude of the Base Cost. Several BLMs were tried and the effect on the aggregation of selected Analysis Units compared. A BLM value of 1,000 was determined to have the desired effect of a moderate level of aggregation that still allowed isolated but potentially important areas to be considered in the final portfolio.

The same MVP-based goalsets —of High Risk, Medium Risk, and Low Risk—that were developed for the NatureServe Vista runs were used in SPOT as well (see the section "Target Conservation Goals" above). A Target Distribution table was created by either summing the amount (in square meters) of each habitat-stratified, range-based target distribution that occurred in each Analysis Unit, or counting the number of occurrences for occurrence-based targets in each unit. If an occurrence straddled more than one Analysis Unit, only the fraction that

occurred in each unit was recorded for that unit. SPOT was then instructed to only count an occurrence as contributing to goals if enough adjacent units containing that target were selected to add up to one whole occurrence. No such equivalent minimum area requirement was imposed on range-based species, because these data had already been filtered to remove areas smaller than minimum viable patch size as determined by territory size (see section "Species Data Acquisition and Synthesis" above). SPOT also gives users the option to add a Penalty Factor to weight target goals by modifying the Shortfall Cost, thereby forcing preferential selection of one or more targets. No Penalty Factor was applied here. Each goalset was run 10 times at 1,500,000 iterations each.

Results

Conservation Value Summaries

Of the 22 forest bird species used for this study, the number of species coinciding in the same areas ranges from 1 - 11 (Figure 5). Highest species richness (7-11 species coinciding) occur in the Animas and San Juan River valleys around Durango, the eastern slopes of the Sangre de Cristo mountains, the many small drainages on both the north and south slopes of the Uncompahgre Plateau, and all along the Front Range, from the Wyoming border to the Purgatorie River headwaters near Trinidad. Some of the least rich areas include the Sawatch Range, Rawah Peaks, and Rabbit Ears Pass. The Overall Conservation Value summary combines species richness with habitat or occurrence integrity, and data confidence (see "Target Integrity and Data Confidence Scores" in Methods above). All range-based species inputs were assigned the same level of data confidence (0.8 out of 1.0), so that data confidence does not greatly influence the conservation summary at the project-level scale (Figure 6). In addition, few occurrences of different occurrence-based species overlap, so there is no one area that stands out as having either very high or very low data confidence. Overall conservation value therefore closely follows species richness. Areas of high species richness that are impacted by poor integrity include the Purgatorie River headwaters (oil and gas development), and the Front Range (housing development and road density), particularly in middle Boulder County, Jefferson County south of I-70 and Teller County at Woodland Park and west along Highway 24. When weighted by CNHP state imperilment rank (S-Rank), the areas of highest conservation value become further restricted, particularly along the Front Range, but are generally in the same areas as before (Figure 7).

NatureServe Vista Scenario Evaluations

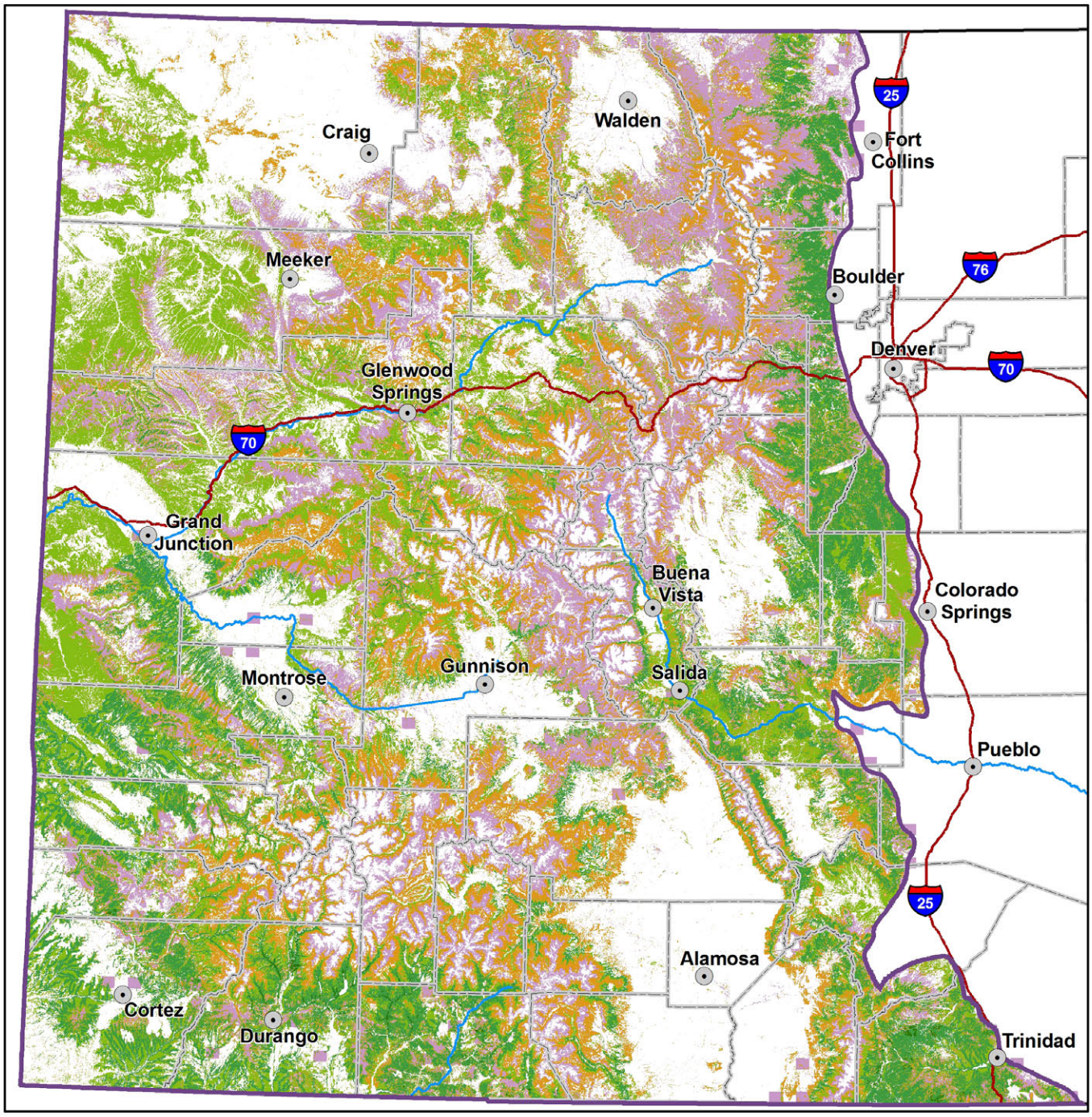
Table 11 summarizes the results of each Vista scenario evaluated. Considering only compatible land use, nearly all (94%) of the 62 stratified goals were met with the High Risk goalset, over half (55%) using the Medium Risk goalset, and over a third (37%) of the goals were met using the Low Risk goalset. No goal could be met when set at 100% of existing, because not all currently presumed occupied habitat was considered compatible. No goals could be met using local Partner's In Flight (PIF) goals either because these goals are all 100% - 200% of existing bird populations. At goals greater than the High Risk goalset, there is very little difference between the Baseline (Table 11(a)) and Future (Table 11(b)) land use scenarios in terms of number of goals met, though those goals that were not met under the Baseline scenario fail by a somewhat wider margin in the Future scenario (see Appendix D). Table 12(a-b) provides a

summary (not stratified by habitat) of the scenario results for the 100% and PIF goalsets. These two goalsets give an indication of existing shortfalls and management challenges to meeting local PIF goals. From these results, the species predicted to be most impacted by future expansion of either oil and gas or housing development are the Gray Vireo (96.9% of goal met in Baseline vs. 91.8% in Future Scenario) and Mexican Spotted Owl (90.5% vs. 85.7%). Lewis's Woodpecker has the greatest shortfall by far regardless of scenario (42.7% of goal met), although this may in fact be an artifact of the input data for the species, which consisted of low-quality section-wide blocks as each occurrence. In Vista, compatible land use must cover the entire occurrence, or it does not count toward goals. Appendix D provides the full results of each scenario evaluation, stratified by habitat.

Table 11. Summary of Vista Scenario Evaluations for the 62 stratified goals.

a) Baseline Scenario	Goals Met For	% of Goals Met	Goals Unmet For	% of Goals Unmet	b) Future Scenario	Goals Met For	% of Goals Met	Goals Unmet For	% of Goals Unmet
High Risk					**High Risk**				
Protected and Compatible	43	69%	19	31%	Protected and Compatible	41	66%	21	34%
Compatible	58	94%	4	6%	Compatible	58	94%	4	6%
Medium Risk					**Medium Risk**				
Protected and Compatible	29	47%	33	53%	Protected and Compatible	28	45%	34	55%
Compatible	34	55%	28	45%	Compatible	34	55%	28	45%
Low Risk					**Low Risk**				
Protected and Compatible	23	37%	39	63%	Protected and Compatible	23	37%	39	63%
Compatible	23	37%	39	63%	Compatible	23	37%	39	63%
100% & PIF Goals					**100% & PIF Goals**				
Protected and Compatible	0	0%	62	100%	Protected and Compatible	0	0%	62	100%
Compatible	0	0%	62	100%	Compatible	0	0%	62	100%

Figure 8 shows areas of incompatible land use that prevented goals from being met, colored by goalset. Incompatible areas that prevented 4 of the 62 High Risk goals (Baseline scenario) from being met are in red. Areas that prevented the 100% goals from the Baseline scenario from being met are in orange, and areas that prevented the 100% goals from the Future scenario from being met are in peach. This visualization can be regarded as a prioritization of potential land use changes for the conservation of forest birds in the area. Beyond highways and metro areas, the two areas that stand out the most as endangering conservation efforts are south of Durango and west of Trinidad. These are both areas of heavy current oil and gas development. The Roan Plateau, Battlement Mesa, and Grand Mesa are also being heavily drilled, with predicted significant expansions of future oil and gas development in the near future.



Legend

Number of Species

- 1 - 3
- 3 - 5
- 5 - 7
- 7 - 9
- 9 - 11

- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

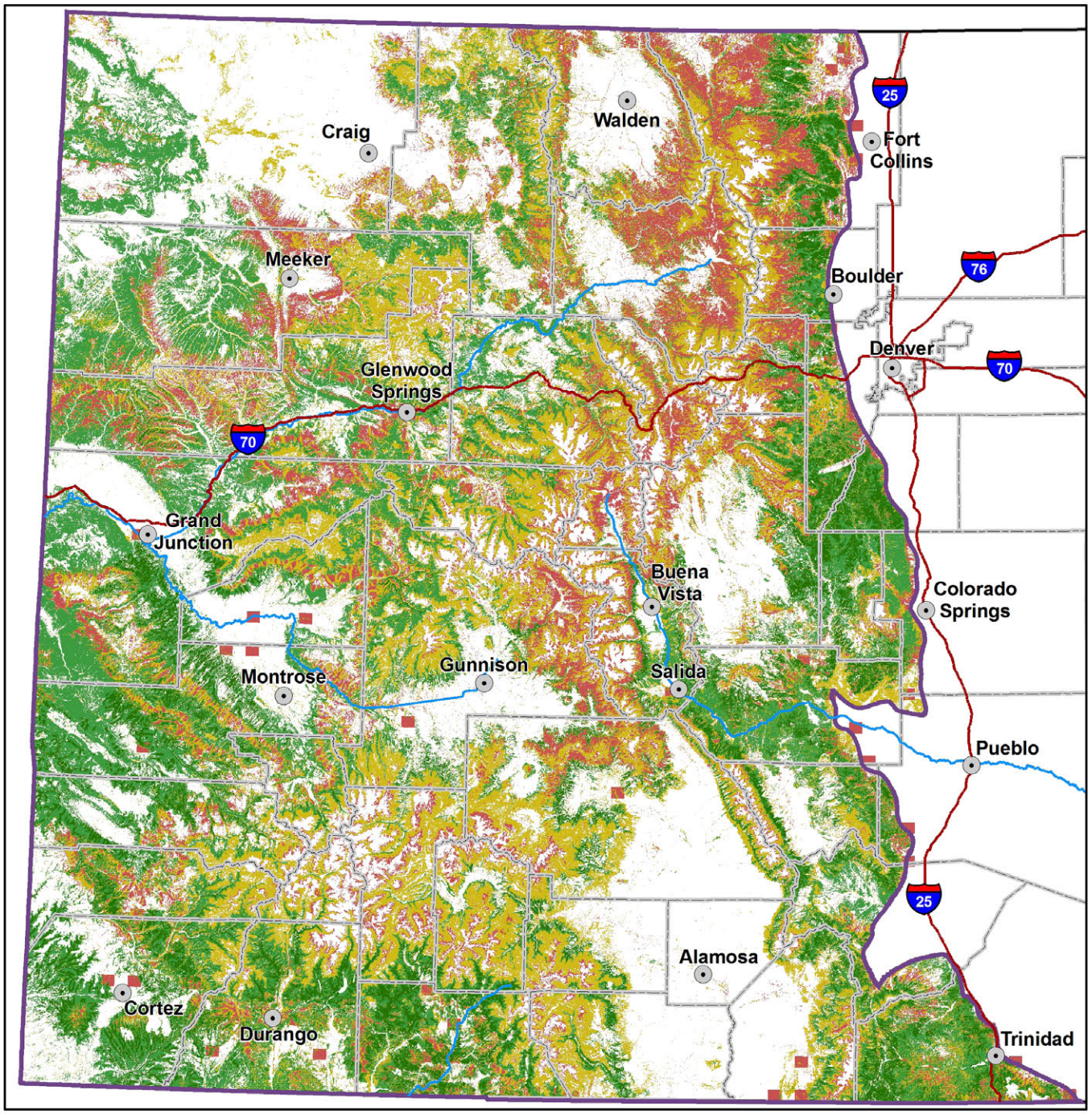
0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 5. Bird Species Richness of Forested Areas in Western Colorado.



Legend

Overall Conservation Value

- Low
- .
- .
- High

- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

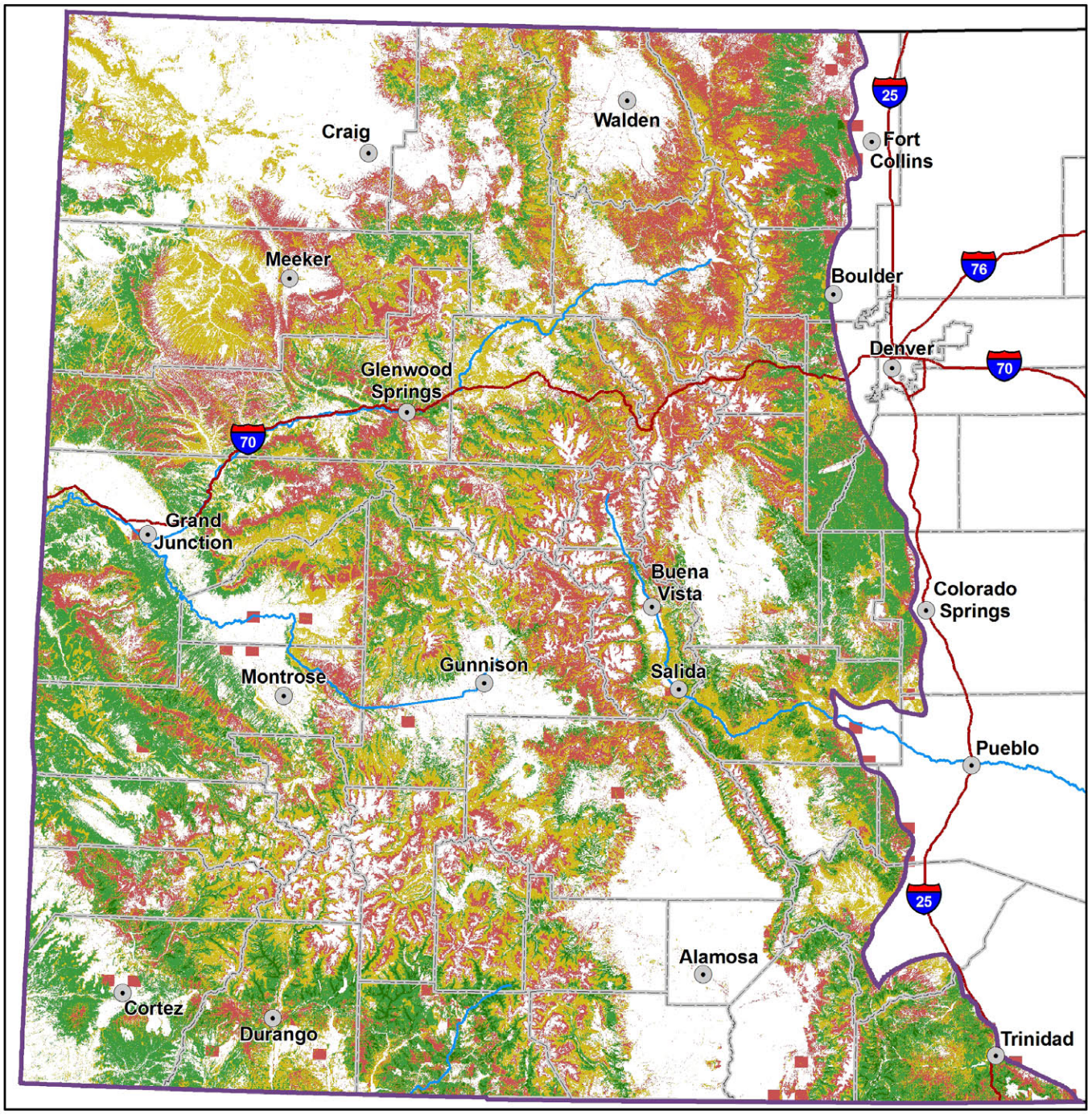
0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 6. Overall Conservation Value for Birds of Forested Areas in W. Colorado.



Legend

Conservation Value by S-Rank

- Low
- .
- .
- High

- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

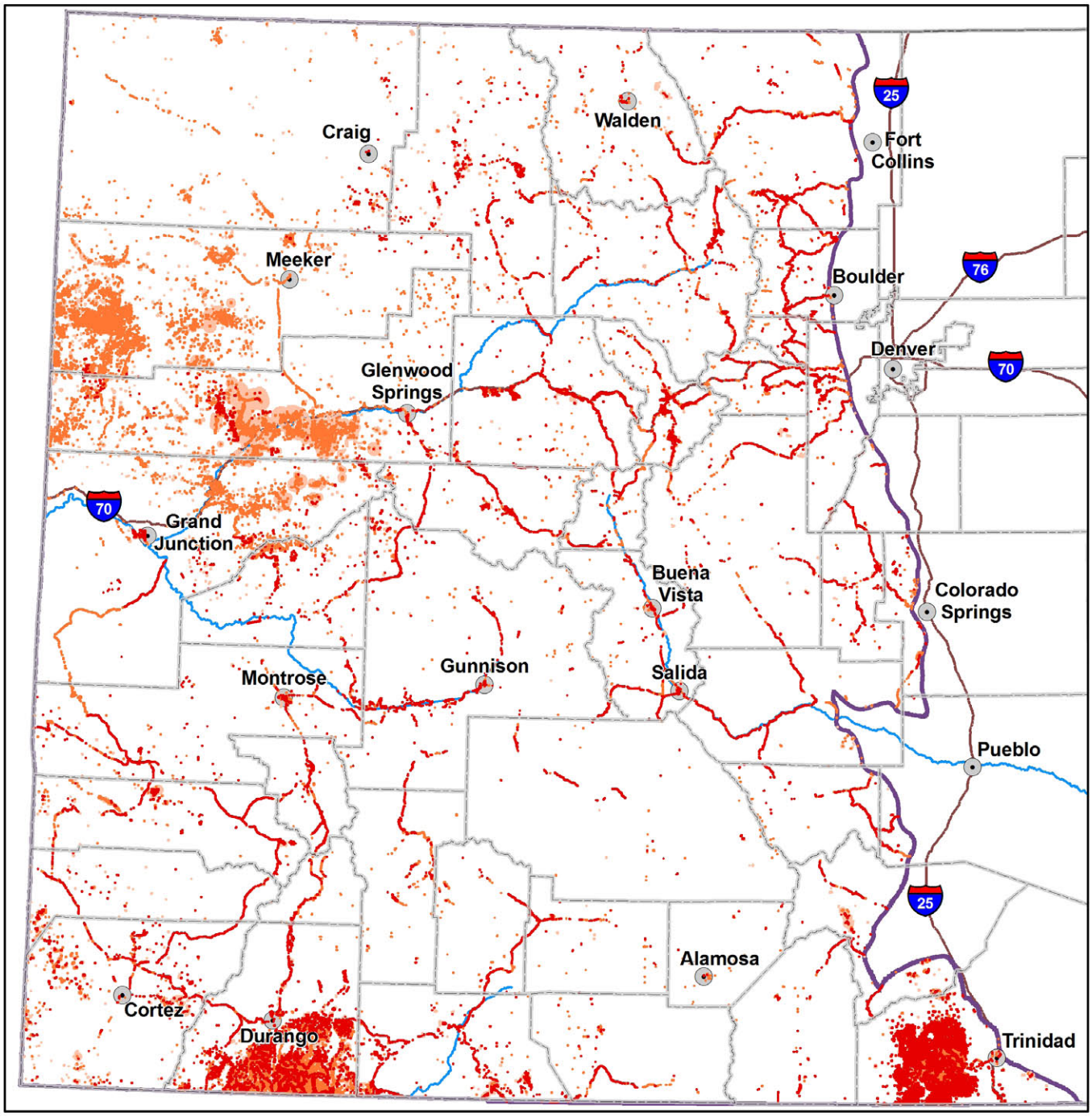
0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 7. Conservation Value for Birds of Forested Areas in Western Colorado, Weighted by State Imperilment Rank.



Legend

- Highest Priority Conflict
- Medium Priority Conflict
- Predicted Future Additional Conflict

See report for explanation of confict prioritization.

- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

0 25 50

Miles

Map produced by the Colorado Natural Heritage Program

07/10/2007

Figure 8. Prioritized Areas of Conflicting Land Use in the Conservation of Forest Birds in Western Colorado.

Table 12. Results of Vista Scenarios 100% and Local PIF, not stratified by habitat.
a) Baseline Scenario

Species	Goal	Distribution Area (ha)	Occs	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Local PIF Goal	Protected & Compat Goal Met	Percent of goal	Compatible only Goal Met	Percent of goal
Band-tailed Pigeon	100%	2,450,240		N	1,759,225		71.8%		2,414,618		98.6%	200%	N	35.9%	N	49.3%
Black Swift	100%		61	N		47	77.1%			58	95.1%	150%	N	51.4%	N	63.4%
Black-throated Gray Warbler	100%	2,015,324		N	1,525,359		75.7%		1,968,284		97.7%	110%	N	68.8%	N	88.8%
Boreal Owl	100%		112	N		90	80.4%	N		97	86.6%	100%	N	80.4%	N	86.6%
Cassin's Finch	100%	5,113,718		N	3,672,607		71.8%		5,034,508		98.5%	150%	N	47.9%	N	65.6%
Cordilleran Flycatcher	100%	4,690,043		N	3,676,358		78.4%		4,657,525		99.3%	100%	N	78.4%		99.3%
Dusky Flycatcher	100%	3,481,122		N	2,359,562		67.8%		3,413,021		98.0%	150%	N	45.2%	N	65.4%
Dusky Grouse	100%	5,959,102		N	4,363,543		73.2%		5,912,951		99.2%	200%	N	36.6%	N	49.6%
Flammulated Owl	100%		25	N		19	76.0%			23	92.0%	110%	N	69.1%	N	83.6%
Grace's Warbler	100%	13,823		N	7,777		56.3%		13,527		97.9%	150%	N	37.5%	N	65.2%
Gray Flycatcher	100%	1,864,655		N	1,423,843		76.4%		1,818,280		97.5%	100%	N	76.4%		97.5%
Gray Vireo	100%	1,229,711		N	965,394		78.5%		1,191,179		96.9%	100%	N	78.5%		96.9%
Juniper Titmouse	100%	1,905,030		N	1,456,046		76.4%		1,856,944		97.5%	110%	N	69.5%	N	88.6%
Lewis's Woodpecker	100%		89	N		11	12.4%	N		38	42.7%	110%	N	11.2%	N	38.8%
Mexican Spotted Owl	100%		21	N		17	81.0%			19	90.5%	100%	N	81.0%		90.5%
Northern Goshawk-foraging	100%	2,148,643		N	1,523,103		70.9%		2,128,315		99.1%	110%	N	64.4%		90.0%
nesting	100%		230			207	90.0%			222	96.5%	110%	N	81.8%	N	87.7%
Olive-sided Flycatcher	100%	4,715,436		N	3,685,168		78.2%		4,683,341		99.3%	200%	N	39.1%	N	49.7%
Pinyon Jay	100%	2,121,162		N	1,588,039		74.9%		2,068,693		97.5%	200%	N	37.4%	N	48.8%
Purple Martin	100%		64	N		43	67.2%			61	95.3%	100%	N	67.2%		95.3%
Pygmy Nuthatch	100%	1,685,593		N	1,098,813		65.2%		1,662,850		98.7%	110%	N	59.3%	N	89.7%
Red-naped Sapsucker	100%	2,753,122		N	1,763,790		64.1%		2,719,008		98.8%	110%	N	58.2%	N	89.8%
Williamson's Sapsucker	100%	3,436,611		N	2,758,948		80.3%		3,411,596		99.3%	110%	N	73.0%		90.2%

Table 12. (continued)
b) Future Scenario

Species	Goal	Distribution Area (ha)	Occs	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Local PIF Goal	Protected & Compat Goal Met	Percent of goal	Compatible only Goal Met	Percent of goal
Band-tailed Pigeon	100%	2,450,240		N	1,766,120		72.1%		2,382,702		97.2%	200%	N	36.0%	N	48.6%
Black Swift	100%		61	N		47	77.1%			58	95.1%	150%	N	51.4%	N	63.4%
Black-throated Gray Warbler	100%	2,015,324		N	1,506,528		74.8%		1,890,507		93.8%	110%	N	68.0%	N	85.3%
Boreal Owl	100%		112	N		90	80.4%	N		97	86.6%	100%	N	80.4%	N	86.6%
Cassin's Finch	100%	5,113,718		N	3,633,121		71.1%		4,919,834		96.2%	150%	N	47.4%	N	64.1%
Cordilleran Flycatcher	100%	4,690,043		N	3,636,632		77.5%		4,625,184		98.6%	100%	N	77.5%		98.6%
Dusky Flycatcher	100%	3,481,122		N	2,333,264		67.0%		3,297,408		94.7%	150%	N	44.7%	N	63.1%
Dusky Grouse	100%	5,959,102		N	4,313,637		72.4%		5,844,430		98.1%	200%	N	36.2%	N	49.0%
Flammulated Owl	100%		25	N		19	76.0%			23	92.0%	110%	N	69.1%	N	83.6%
Grace's Warbler	100%	13,823		N	7,820		56.6%		13,376		96.8%	150%	N	37.7%	N	64.5%
Gray Flycatcher	100%	1,864,655		N	1,409,065		75.6%		1,741,778		93.4%	100%	N	75.6%		93.4%
Gray Vireo	100%	1,229,711		N	959,794		78.1%		1,129,402		91.8%	100%	N	78.1%		91.8%
Juniper Titmouse	100%	1,905,030		N	1,441,347		75.7%		1,777,481		93.3%	110%	N	68.8%	N	84.8%
Lewis's Woodpecker	100%		89	N		11	12.4%	N		38	42.7%	110%	N	11.2%	N	38.8%
Mexican Spotted Owl	100%		21	N		17	81.0%	N		18	85.7%	100%	N	81.0%	N	85.7%
Northern Goshawk-foraging	100%	2,148,643		N	1,493,319		69.5%		2,105,559		98.0%	110%	N	63.2%	N	89.1%
nesting	100%		230	N		206	89.6%			218	94.8%	110%	N	81.4%	N	86.2%
Olive-sided Flycatcher	100%	4,715,436		N	3,651,390		77.4%		4,652,085		98.7%	200%	N	38.7%	N	49.3%
Pinyon Jay	100%	2,121,162		N	1,569,988		74.0%		1,986,019		93.6%	200%	N	37.0%	N	46.8%
Purple Martin	100%		64	N		43	67.2%			60	93.8%	100%	N	67.2%		93.8%
Pygmy Nuthatch	100%	1,685,593		N	1,084,874		64.4%		1,637,426		97.1%	110%	N	58.5%	N	88.3%
Red-naped Sapsucker	100%	2,753,122		N	1,745,576		63.4%		2,679,713		97.3%	110%	N	57.6%	N	88.5%
Williamson's Sapsucker	100%	3,436,611		N	2,730,639		79.5%		3,386,655		98.6%	110%	N	72.2%	N	89.6%

SPOT Portfolios

Table 13 summarizes the number of goals met for each goalset used in SPOT. These are almost identical to the number of goals met with these goalsets in NatureServe Vista, an indication that most if not all suitable habitat had to be selected in order to attempt to meet goals. Using the High Risk goalset, SPOT selected 8,929 hexagons, or 56% of the entire project area as the best overall solution out of the 10 runs (Figure 9). Considering all 10 runs together, over 80% of the hexagons selected were selected 10 out of 10 times, demonstrating a fairly stable portfolio that is likely to be near or at the optimal solution (Shoutis 2003). Table 14 lists each species input stratified by habitat and how well the SPOT solution met the High Risk goals. Most goals were met, with the notable exception of Grace's Warbler. The estimated existing Grace's Warbler population in the project area is only 6% of the calculated Minimum Viable Population (Tables 7 and 9). Approximately a third of the targets had their goals over-met by well over 1,000%. This is because those species have relatively high densities in the stated habitats and therefore require much smaller areas than those species with low densities. These low density species drive the portfolio selection, and SPOT will continue to select habitat for them until their goals are met, even after the goals of other species in those same habitats have long been satisfied. Those species most strongly driving the portfolio are Band-tailed Pigeon, Gray Vireo, Northern Goshawk (especially high elevation riparian and mountain shrubland habitats), and Olive-sided Flycatcher.

The overall best solution for the Medium Risk goalset consists of 12,236 hexagons, or 77% of the project area (Figure 10), and the Low Risk goalset portfolio contains 13,068 hexagons, or 82% of the project area (Figure 11). For each of these portfolios, less that 1% of all hexagons chosen were not chosen in each of the 10 runs, which is not a surprise considering that most of the available suitable habitat was required in order to meet goals. Table 15 lists the solution results for these goalsets.

Table 13. Summary of SPOT portfolio results for the 62 stratified goals.

Goalset	Goals Met For	% of Goals Met	Goals Unmet For	% of Goals Unmet
High Risk	58	94%	4	6%
Medium Risk	34	55%	28	45%
Low Risk	24	39%	38	61%

Table 14. High Risk goalset and resulting solution in SPOT.
(Gray cells are number of occurrences, all others are hectares.)

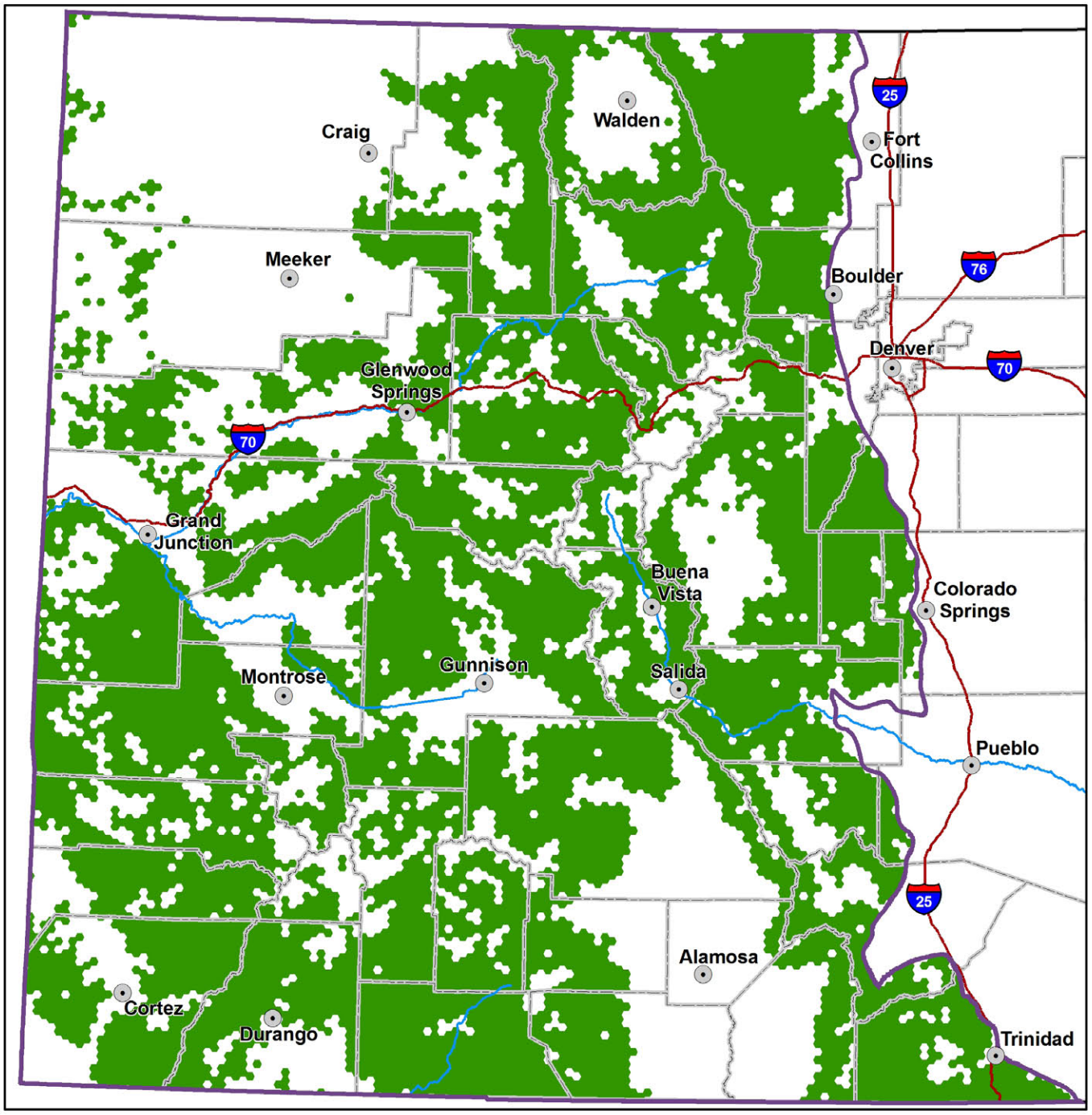
Target name	Amount in solution (ha)	Goal (ha)	Percent met
Band-tailed Pigeon-Aspen	390,304	330,814	118.0%
Band-tailed Pigeon-Mixed Conifer	282,091	233,541	120.8%
Band-tailed Pigeon-Mountain Shrubland	243,200	243,169	100.0%
Band-tailed Pigeon-Piñon-Juniper	495,845	495,837	100.0%
Band-tailed Pigeon-Ponderosa Pine	258,382	213,526	121.0%
Band-tailed Pigeon-Spruce-Fir	477,952	406,190	117.7%
Black Swift	39	31	124.7%
Black-throated Gray Warbler-Piñon-Juniper	1,107,786	39,661	2793.1%
Boreal Owl	82	61	134.2%
Cassin's Finch-Aspen	695,160	245,647	283.0%

Cassin's Finch-Mixed Conifer	692,825	228,714	302.9%
Cassin's Finch-Piñon-Juniper	1,161,665	606,394	191.6%
Cassin's Finch-Ponderosa Pine	916,370	288,886	317.2%
Cassin's Finch-Spruce-Fir	337,931	110,745	305.1%
Cordilleran Flycatcher-Aspen	924,021	59,228	1560.1%
Cordilleran Flycatcher-High Elev Riparian	146,970	10,451	1406.3%
Cordilleran Flycatcher-Mixed Conifer	726,984	44,580	1630.7%
Cordilleran Flycatcher-Ponderosa Pine	861,884	50,956	1691.4%
Cordilleran Flycatcher-Spruce-Fir	1,445,411	91,613	1577.7%
Dusky Flycatcher-Aspen	17,276	419	4123.2%
Dusky Flycatcher-High Elev Riparian	153,485	4,375	3508.2%
Dusky Flycatcher-Mountain Shrubland	637,983	19,321	3302.0%
Dusky Flycatcher-Piñon-Juniper	1,141,816	36,841	3099.3%
Dusky Flycatcher-Ponderosa Pine	31,399	635	4944.7%
Dusky Grouse-Aspen	963,254	523,736	183.9%
Dusky Grouse-Mixed Conifer	783,177	406,859	192.5%
Dusky Grouse-Mountain Shrubland	669,380	519,371	128.9%
Dusky Grouse-Ponderosa Pine	926,370	463,449	199.9%
Dusky Grouse-Spruce-Fir	1,522,816	831,684	183.1%
Flammulated Owl	22	14	157.2%
Grace's Warbler-Ponderosa Pine	13,542	243,833	5.6%
Gray Flycatcher-Piñon-Juniper	1,027,862	32,971	3117.5%
Gray Vireo-Piñon-Juniper	813,746	813,752	100.0%
Juniper Titmouse-Piñon-Juniper	1,023,063	195,408	523.6%
Lewis's Woodpecker	48	48	100.1%
Mexican Spotted Owl	16	11	145.5%
Northern Goshawk-Aspen	650,559	572,945	113.5%
Northern Goshawk-High elevation riparian	53,064	51,811	102.4%
Northern Goshawk-Mixed Conifer	580,347	487,982	118.9%
Northern Goshawk-Mountain Shrub	28,984	25,985	111.5%
Northern Goshawk-nesting	197	120	164.2%
Northern Goshawk-Piñon-Juniper	11,275	9,480	118.9%
Northern Goshawk-Ponderosa	634,078	518,464	122.3%
Olive-sided Flycatcher-Aspen	895,374	895,383	100.0%
Olive-sided Flycatcher-High Elev Riparian	30,983	30,983	100.0%
Olive-sided Flycatcher-Lodgepole Pine	621,627	621,627	100.0%
Olive-sided Flycatcher-Mixed Conifer	749,222	749,217	100.0%
Olive-sided Flycatcher-Ponderosa Pine	881,096	884,820	99.6%
Olive-sided Flycatcher-Spruce-Fir	1,200,126	1,200,119	100.0%
Pinyon Jay-Piñon-Juniper	1,159,139	311,388	372.2%
Purple Martin	44	34	129.4%
Pygmy Nuthatch-Ponderosa Pine	892,972	107,567	830.2%
Red-naped Sapsucker-Aspen	690,905	28,668	2410.0%
Red-naped Sapsucker-High Elev Riparian	54,159	2,298	2356.8%
Red-naped Sapsucker-Mixed Conifer	507,469	19,468	2606.7%
Red-naped Sapsucker-Mountain Shrubland	200,077	10,705	1869.0%
Red-naped Sapsucker-Ponderosa Pine	888,101	32,769	2710.2%
Williamson's Sapsucker-Mixed Conifer	720,095	44,449	1620.0%
Williamson's Sapsucker-Ponderosa Pine	861,211	51,554	1670.5%
Williamson's Sapsucker-Spruce-Fir	1,444,380	95,384	1514.3%

Table 15. Medium and Low-Risk goalsets and resulting solutions in SPOT.
(Gray cells are number of occurrences, all others are hectares.)

Target name	Medium-Risk Goalset			Low-Risk Goalset		
	Amount in solution (ha)	Goal (ha)	Percent met	Amount in solution (ha)	Goal (ha)	Percent met
Band-tailed Pigeon-Aspen	419,182	827,034	50.7%	419,620	1,147,244	36.6%
Band-tailed Pigeon-Mixed Conifer	296,399	583,852	50.8%	296,823	895,587	33.1%
Band-tailed Pigeon-Mountain Shrubland	301,550	607,923	49.6%	302,937	972,677	31.1%
Band-tailed Pigeon-Piñon-Juniper	596,291	1,239,592	48.1%	613,341	1,983,347	30.9%
Band-tailed Pigeon-Ponderosa Pine	270,548	533,815	50.7%	270,917	854,105	31.7%
Band-tailed Pigeon-Spruce-Fir	515,918	1,015,475	50.8%	516,307	1,624,761	31.8%
Black Swift	58	47	122.3%	58	62	92.7%
Black-throated Gray Warbler-Piñon-Juniper	1,603,070	99,152	1616.8%	1,925,407	158,644	1213.7%
Boreal Owl	105	92	114.3%	105	122	86.2%
Cassin's Finch-Aspen	844,777	614,116	137.6%	845,702	982,586	86.1%
Cassin's Finch-Mixed Conifer	785,120	571,785	137.3%	787,699	895,587	88.0%
Cassin's Finch-Piñon-Juniper	1,677,205	1,515,984	110.6%	2,013,801	2,196,457	91.7%
Cassin's Finch-Ponderosa Pine	992,016	722,215	137.4%	994,679	1,035,667	96.0%
Cassin's Finch-Spruce-Fir	382,272	276,862	138.1%	382,351	442,980	86.3%
Cordilleran Flycatcher-Aspen	1,078,346	148,070	728.3%	1,079,213	236,912	455.5%
Cordilleran Flycatcher-High Elev Riparian	182,850	26,128	699.8%	183,860	41,805	439.8%
Cordilleran Flycatcher-Mixed Conifer	811,256	111,449	727.9%	812,741	178,319	455.8%
Cordilleran Flycatcher-Ponderosa Pine	926,737	127,390	727.5%	928,369	203,824	455.5%
Cordilleran Flycatcher-Spruce-Fir	1,666,028	229,033	727.4%	1,666,834	366,453	454.9%
Dusky Flycatcher-Aspen	23,446	1,046	2241.5%	23,492	1,674	1403.3%
Dusky Flycatcher-High Elev Riparian	233,541	10,937	2135.3%	234,855	17,500	1342.0%
Dusky Flycatcher-Mountain Shrubland	1,061,933	48,303	2198.5%	1,072,441	77,285	1387.6%
Dusky Flycatcher-Piñon-Juniper	1,652,872	92,102	1794.6%	1,980,918	147,364	1344.2%
Dusky Flycatcher-Ponderosa Pine	35,443	1,588	2231.9%	35,765	2,541	1407.5%
Dusky Grouse-Aspen	1,132,958	1,147,244	98.8%	1,133,984	1,147,244	98.8%
Dusky Grouse-Mixed Conifer	878,844	895,587	98.1%	881,067	895,587	98.4%
Dusky Grouse-Mountain Shrubland	1,101,413	1,179,885	93.3%	1,110,153	1,179,885	94.1%
Dusky Grouse-Ponderosa Pine	1,001,184	1,035,667	96.7%	1,003,252	1,035,667	96.9%
Dusky Grouse-Spruce-Fir	1,795,817	1,822,752	98.5%	1,796,841	1,822,752	98.6%
Flammulated Owl	26	21	123.8%	26	28	92.9%
Grace's Warbler-Ponderosa Pine	13,818	609,583	2.3%	13,823	975,332	1.4%
Gray Flycatcher-Piñon-Juniper	1,490,538	82,427	1808.3%	1,782,582	131,883	1351.6%
Gray Vireo-Piñon-Juniper	1,131,490	2,034,381	55.6%	1,194,728	2,196,457	54.4%
Juniper Titmouse-Piñon-Juniper	1,495,560	488,520	306.1%	1,811,613	781,632	231.8%
Lewis's Woodpecker	58	71	82.1%	61	89	68.9%
Mexican Spotted Owl	19	16	116.1%	20	21	93.2%
Northern Goshawk-Aspen	738,527	1,147,244	64.4%	738,553	1,147,244	64.4%
Northern Goshawk-High elevation riparian	66,749	129,527	51.5%	66,749	207,244	32.2%
Northern Goshawk-Mixed Conifer	629,001	895,587	70.2%	629,064	895,587	70.2%
Northern Goshawk-Mountain Shrub	33,483	64,963	51.5%	33,484	103,942	32.2%
Northern Goshawk-nesting	237	179	132.4%	239	239	100.0%
Northern Goshawk-Piñon-Juniper	12,215	23,699	51.5%	12,215	37,919	32.2%
Northern Goshawk-Ponderosa	668,337	1,035,667	64.5%	668,349	1,035,667	64.5%
Olive-sided Flycatcher-Aspen	955,060	1,147,244	83.2%	955,443	1,147,244	83.3%

Olive-sided Flycatcher-High Elev Riparian	32,923	77,458	42.5%	32,964	123,933	26.6%
Olive-sided Flycatcher-Lodgepole Pine	658,367	698,238	94.3%	660,263	698,238	94.6%
Olive-sided Flycatcher-Mixed Conifer	798,659	895,587	89.2%	799,414	895,587	89.3%
Olive-sided Flycatcher-Ponderosa Pine	942,941	1,035,667	91.0%	943,970	1,035,667	91.1%
Olive-sided Flycatcher-Spruce-Fir	1,279,105	1,822,752	70.2%	1,279,697	1,822,752	70.2%
Pinyon Jay-Piñon-Juniper	1,678,550	778,470	215.6%	2,016,003	1,245,552	161.9%
Purple Martin	56	50	112.0%	57	67	85.1%
Pygmy Nuthatch-Ponderosa Pine	958,748	268,917	356.5%	959,955	430,267	223.1%
Red-naped Sapsucker-Aspen	837,262	71,669	1168.2%	838,129	114,670	730.9%
Red-naped Sapsucker-High Elev Riparian	62,791	5,745	1093.0%	63,729	9,192	693.3%
Red-naped Sapsucker-Mixed Conifer	569,263	48,671	1169.6%	569,913	77,873	731.8%
Red-naped Sapsucker-Mountain Shrubland	304,995	26,763	1139.6%	307,272	42,820	717.6%
Red-naped Sapsucker-Ponderosa Pine	956,789	81,924	1167.9%	958,434	131,078	731.2%
Williamson's Sapsucker-Mixed Conifer	796,082	111,123	716.4%	797,180	177,796	448.4%
Williamson's Sapsucker-Ponderosa Pine	923,399	128,884	716.5%	924,429	206,214	448.3%
Williamson's Sapsucker-Spruce-Fir	1,704,017	238,461	714.6%	1,704,930	381,537	446.9%



Legend

- High Risk Solution
- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

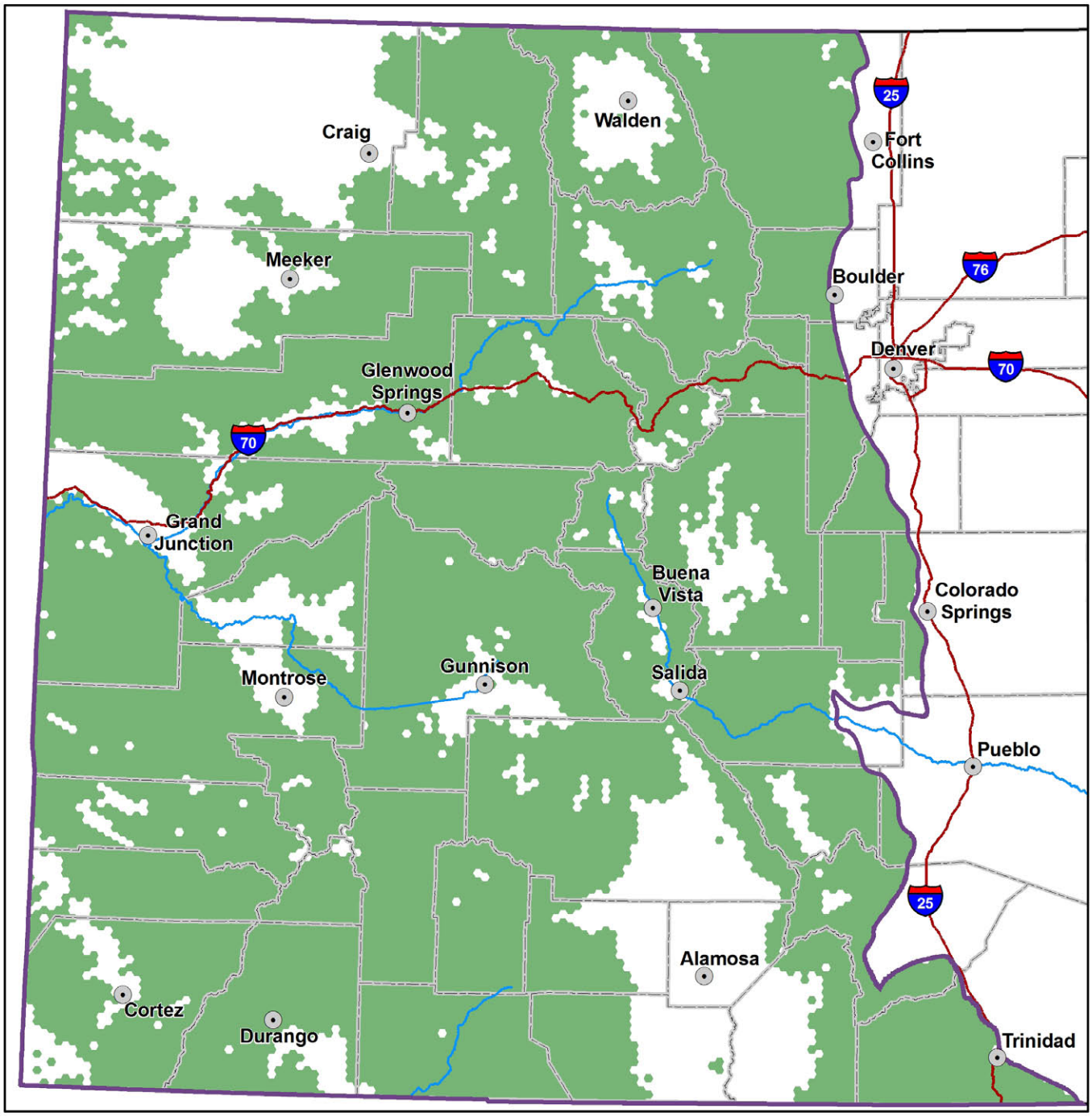
0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 9. SPOT Overall Best Solution of the High Risk Goalset for Conservation of Forest Birds in W. Colorado.



Legend

- Medium Risk Solution
- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 10. SPOT Overall Best Solution of the Medium Risk Goalset for Conservation of Forest Birds in W. Colorado.

Legend

- Low Risk Solution
- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 11. SPOT Overall Best Solution of the Low Risk Goalset for Conservation of Forest Birds in W. Colorado.

Identified Priority Areas for Forest Bird Conservation in Western Colorado

Areas within the High Risk portfolio were divided into four conservation strategies based on habitat integrity and land status (Figure 12). Areas with protected land status and good habitat quality are considered effectively conserved and only requiring a monitoring or maintenance strategy. Areas with protected land status but poor quality fall into a "Management Strategy" designation, where active management is required to improve the habitat quality. Unprotected lands (mostly private or tribal, though we also designated areas of heavy oil and gas development on public lands as unprotected) with high quality fall within a "Protection Strategy" potentially requiring purchase, easements, or legislation that will prevent further loss or degradation of target habitat. Finally, those areas that are both unprotected and of poor quality are designated as "Secondary Management and Protection Strategy" areas, which are unlikely to receive much active attention from practical conservation efforts.

Because the "Secondary Management and Protection Strategy" is not as high of a priority as the other three, the High Risk portfolio was revised by removing these lower priority areas and re-evaluated as to how well goals would be met with the remaining areas (Table 16). The goals of those species-habitat combinations that were near or below 100% with the full portfolio are, of course, not met with this reduced-size modified portfolio, although over two thirds of the goals (43 out of 62) are still met, many by a wide margin.

Table 16. Modified High Risk goalset solution in SPOT.
(Gray cells are number of occurrences, all others are hectares.)

Target name	Amount in solution (ha)	Goal (ha)	Percent met
Band-tailed Pigeon-Aspen	335,627	330,814	101.5%
Band-tailed Pigeon-Mixed Conifer	245,471	233,541	105.1%
Band-tailed Pigeon-Mountain Shrubland	163,996	243,169	67.4%
Band-tailed Pigeon-Piñon-Juniper	411,405	495,837	83.0%
Band-tailed Pigeon-Ponderosa Pine	181,978	213,526	85.2%
Band-tailed Pigeon-Spruce-Fir	469,077	406,190	115.5%
Black Swift	33	31	108.1%
Black-throated Gray Warbler-Piñon-Juniper	973,976	39,661	2455.8%
Boreal Owl	77	61	125.5%
Cassin's Finch-Aspen	584,316	245,647	237.9%
Cassin's Finch-Mixed Conifer	587,978	228,714	257.1%
Cassin's Finch-Piñon-Juniper	1,013,908	606,394	167.2%
Cassin's Finch-Ponderosa Pine	648,852	288,886	224.6%
Cassin's Finch-Spruce-Fir	324,070	110,745	292.6%
Cordilleran Flycatcher-Aspen	805,885	59,228	1360.6%
Cordilleran Flycatcher-High Elev Riparian	127,346	10,451	1218.5%
Cordilleran Flycatcher-Mixed Conifer	621,561	44,580	1394.3%
Cordilleran Flycatcher-Ponderosa Pine	607,141	50,956	1191.5%
Cordilleran Flycatcher-Spruce-Fir	1,418,679	91,613	1548.6%
Dusky Flycatcher-Aspen	13,476	419	3216.2%
Dusky Flycatcher-High Elev Riparian	139,192	4,375	3181.5%
Dusky Flycatcher-Mountain Shrubland	462,170	19,321	2392.1%

Dusky Flycatcher-Piñon-Juniper	998,133	36,841	2709.3%
Dusky Flycatcher-Ponderosa Pine	21,817	635	3435.7%
Dusky Grouse-Aspen	836,810	523,736	159.8%
Dusky Grouse-Mixed Conifer	671,749	406,859	165.1%
Dusky Grouse-Mountain Shrubland	484,277	519,371	93.2%
Dusky Grouse-Ponderosa Pine	656,733	463,449	141.7%
Dusky Grouse-Spruce-Fir	1,495,366	831,684	179.8%
Flammulated Owl	17	14	121.4%
Grace's Warbler-Ponderosa Pine	9,108	243,833	3.7%
Gray Flycatcher-Piñon-Juniper	902,912	32,971	2738.5%
Gray Vireo-Piñon-Juniper	733,164	813,752	90.1%
Juniper Titmouse-Piñon-Juniper	905,331	195,408	463.3%
Lewis's Woodpecker	13	48	27.3%
Mexican Spotted Owl	15	11	136.4%
Northern Goshawk-Aspen	575,674	572,945	100.5%
Northern Goshawk-High elevation riparian	44,540	51,811	86.0%
Northern Goshawk-Mixed Conifer	498,901	487,982	102.2%
Northern Goshawk-Mountain Shrub	21,525	25,985	82.8%
Northern Goshawk-nesting	158	120	131.7%
Northern Goshawk-Piñon-Juniper	8,549	9,480	90.2%
Northern Goshawk-Ponderosa	455,722	518,464	87.9%
Olive-sided Flycatcher-Aspen	782,443	895,383	87.4%
Olive-sided Flycatcher-High Elev Riparian	24,437	30,983	78.9%
Olive-sided Flycatcher-Lodgepole Pine	569,529	621,627	91.6%
Olive-sided Flycatcher-Mixed Conifer	642,124	749,217	85.7%
Olive-sided Flycatcher-Ponderosa Pine	624,666	884,820	70.6%
Olive-sided Flycatcher-Spruce-Fir	1,174,704	1,200,119	97.9%
Pinyon Jay-Piñon-Juniper	1,012,374	311,388	325.1%
Purple Martin	34	34	101.2%
Pygmy Nuthatch-Ponderosa Pine	633,033	107,567	588.5%
Red-naped Sapsucker-Aspen	580,423	28,668	2024.6%
Red-naped Sapsucker-High Elev Riparian	40,255	2,298	1751.7%
Red-naped Sapsucker-Mixed Conifer	432,732	19,468	2222.8%
Red-naped Sapsucker-Mountain Shrubland	140,675	10,705	1314.1%
Red-naped Sapsucker-Ponderosa Pine	627,633	32,769	1915.3%
Williamson's Sapsucker-Mixed Conifer	618,482	44,449	1391.4%
Williamson's Sapsucker-Ponderosa Pine	611,017	51,554	1185.2%
Williamson's Sapsucker-Spruce-Fir	1,419,620	95,384	1488.3%

The study area was divided into nine focus areas (Figure 13). The focal areas identify priority regions that offer opportunities for either protection or management actions that are important for the conservation of neotropical migratory birds in Colorado. Figure 14 shows how the top three conservation strategies fall out under these focus areas. Each focal area is briefly described below, with the proportions of each strategy in each area shown in Figure 15.

Arkansas River Forests

This area covers the Rampart Range south of Pikes Peak, portions of South Park, the Wet Mountains, and most of the Sangre de Cristo mountain range. The area contains roughly equal portions of USFS, BLM, and privately owned lands. About a tenth of the portfolio is represented

here. Approximately half of the portfolio within this focus area is considered Effectively Conserved. Roughly 20% is designated as requiring protection, 10% requiring management, and the remainder requiring both.

The Arkansas River Forests focus area contains the largest piñon-juniper landscape on the eastern slope of Colorado. The primary conservation strategy would focus on protection, which is to say, working with private land owners to preserve existing high quality habitat. Primary threats include urban development, increasing recreational use of public lands, and fire suppression. This focus area is most important to the Pinyon Jay and Gray Vireo.

Central Mountain High Elevation Forests

This is a very large area that covers the northern tip of the Sangre de Cristo mountains up to North Park and from Red Table Mountain to the western edge of the Front Range, including Rocky Mountain National Park. The USFS owns the majority of the land. This focus area contains about one fourth of the entire portfolio. Approximately two thirds of the portfolio within this focus area is considered Effectively Conserved, and is composed primarily of high-elevation forests managed by the USFS. About 5% is designated as requiring protection, 20% requiring management, and the remainder requiring both.

The primary strategy here would focus on management, working with federal and state agencies to manage and improve their lands for forest birds. Primary threats in the area include loss of trees due to beetle kill (although standing dead trees are potentially beneficial for sapsuckers and woodpeckers), increasing recreation on public lands, and fire suppression.

Colorado River

This area is bordered by Glenwood Springs to the east, and goes west past Grand Junction to the Colorado border. This area includes the Roan Plateau, Battlement Mesa, and Grand Mesa. The BLM owns the majority of land here, followed by the USFS and then private land owners. The area contains about 10% of the portfolio. Almost three fourths of the portfolio within this focus area is considered Effectively Conserved. Roughly 10% is designated as requiring protection, and another 10% requiring management, with the remainder requiring both.

The primary strategy here would focus on protection; working with private land owners to keep remaining high quality private lands from being degraded by oil and gas drilling. The primary threat is the dramatically increased oil and gas development in the area. Note that significant amounts of piñon-juniper habitat exist here, but very little was selected in the portfolio because significant impacts from oil and gas development caused the model algorithm to choose less threatened piñon-juniper elsewhere in the project area. Increasing urban development is also a significant threat.

Front Range Ponderosa Pine

This area includes the Front Range from Colorado Springs to the northern border of the state. Much of the land is privately owned, but the USFS owns substantial tracts as well, and city, county, and state owned lands are also important. About a tenth of the portfolio is represented here. Approximately a third of the portfolio within this focus area is considered Effectively

Conserved. Less than 10% is designated as requiring protection, and roughly a third is designated as requiring management. The remainder requires both.

The primary strategy would focus on management; managing and improving federal, state, and county open space for forest birds. Primary threats include continuing urban development, fire suppression, increasing recreational use of public lands, and bark beetle infestations. The Mexican Spotted Owl is a species of high concern in this focus area, as the majority of known sites for this bird in Colorado are located in the southern portion of this focus area.

Northwest Colorado Piñon-Juniper

This is the northwest corner of the state, covering large portions of Moffat and Rio Blanco counties. The BLM owns most of the land here, but the area also includes Dinosaur National Monument. This focus area contains only 1% of the portfolio. Two thirds of the portfolio within this focus area is considered Effectively Conserved. Less than 10% is designated as requiring protection, and about a fourth requiring management, with the remainder requiring both.

The primary strategy here would focus on protection; working with the oil and gas industry and the BLM to keep remaining high quality BLM lands from being degraded by oil and gas drilling. The primary threat is the dramatically increasing oil and gas development in the area. Note that significant amounts of piñon-juniper habitat exist here, but very little was selected in the portfolio because significant impacts from oil and gas development caused the model algorithm to choose less threatened piñon-juniper elsewhere in the project area.

Northern San Juan-Gunnison

This area is bounded by the cities of Gunnison, Delta, Telluride, and Alamosa, and includes the Black Canyon of the Gunnison River, the Uncompahgre Mountains, the Cochetopa Hills, and the northern portion of the San Luis Valley. The major land owner is the USFS, with the BLM and private ownership close seconds. It contains about a tenth of the portfolio. Three fourths of the portfolio within this focus area is considered Effectively Conserved. Only 5% is designated as requiring protection, between 10-20% is designated as requiring management, and the remainder requires both.

The primary strategy would focus on management; working with the BLM and USFS to improve some areas, but overall, this focus area has adequate conservation protections. The primary threats include urban development and increased recreation on public lands.

Southwest Colorado Piñon-Juniper

This area is bounded by the cities of Montrose, Telluride, and Cortez, and extends west to the Colorado border. It includes the Uncompaghre Plateau and the San Miguel Mountains. The BLM is the major land owner, with the USFS and private land owners a close second. There are also some tribal lands (Ute Mountain) to the south. The area contains about a tenth of the portfolio. Approximately half of the portfolio within this focus area is considered Effectively Conserved. Less than 5% is designated as requiring protection, and almost a third is designated as requiring management. The remainder requires both.

The primary strategy would focus on management – working with primarily the BLM to improve habitat for forest birds. However, improving relations and communications with tribal authorities should also be a focus. Primary threats include localized areas of oil and gas development, bark beetle infestations in piñon-juniper, and fire suppression. Existing sagebrush restoration programs, if not properly targeted, could potentially create a negative impact to piñon-juniper habitat in this area. This focus area is most important to the Pinyon Jay and Gray Vireo.

Southwest Colorado Rivers

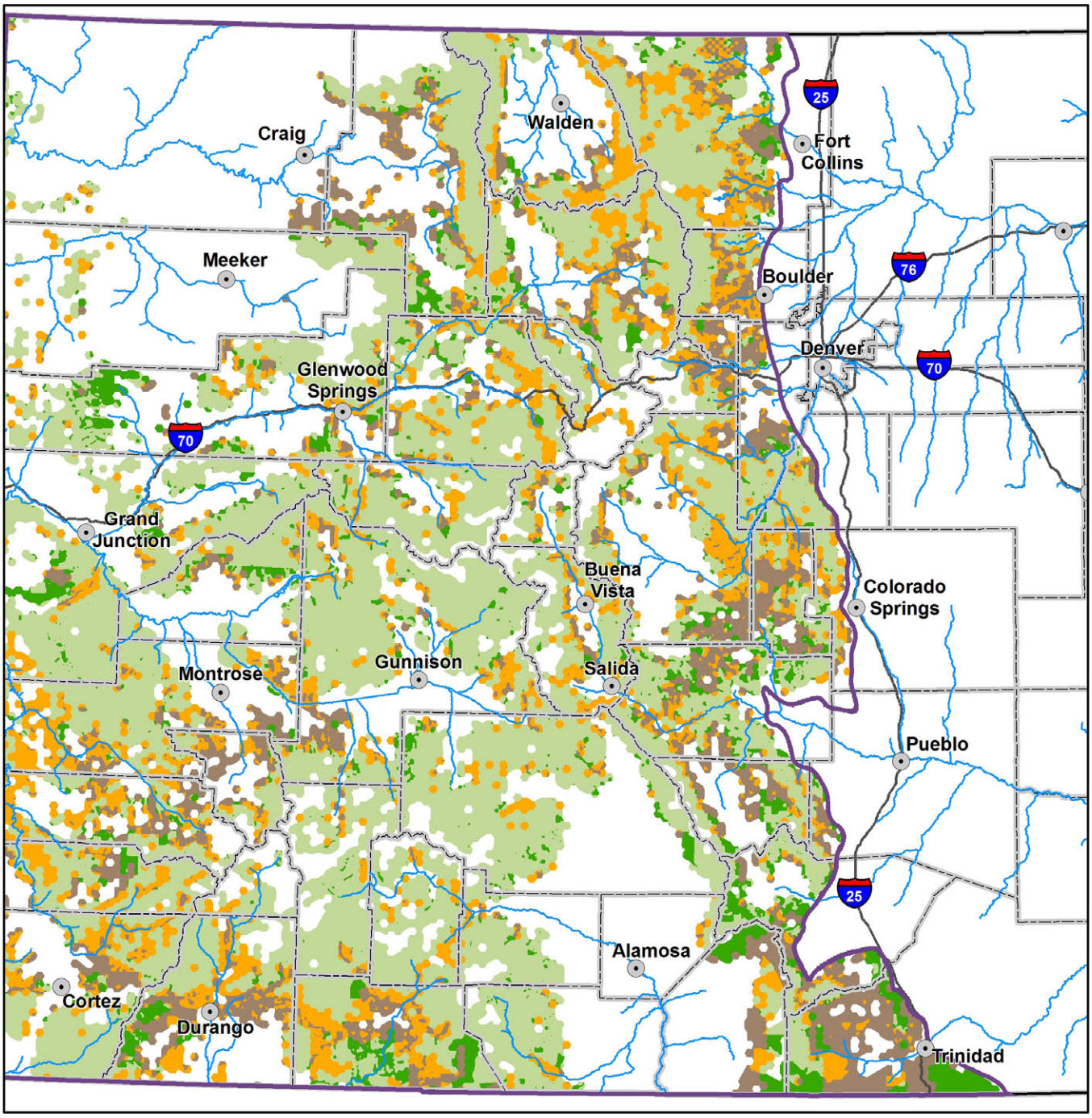
This area is bounded by the towns of Craig, Silverton, and Antonito, and extends south to the Colorado border. It includes Mesa Verde, the La Plata Mountains, and the southern San Juan Mountains. The USFS is the main land owner, but the area also includes sizeable tracts of private and tribal (Ute Mountain and Southern Ute) lands. The area contains between 10-20% of the portfolio. Over half of the portfolio within this focus area is considered Effectively Conserved. Between 5-10% is designated as requiring protection, and approximately 20% requires management, with the remainder requiring both.

The primary strategy would focus on management, with protection a close second. Working with the USFS and private land owners is important, but improving relations and communications with tribal authorities should not be neglected. Primary threats include oil and gas development and exurban development. This focus area is most important for the conservation of the Grace's Warbler.

Trinidad-Spanish Peaks

This area is bounded by the towns of Trinidad, Walsenburg, and Blanca, and extends south to the Colorado border. It includes the Spanish Peaks and the southern Sangre de Cristo Mountains. This area is almost entirely private land. It contains less than 5% of the portfolio. Only about 10-20% of the portfolio within this focus area is considered Effectively Conserved. About 25% is designated as requiring protection, and roughly 10% requires management. The remainder of the portfolio in this area, nearly half, requires both protection and management.

The primary strategy would be protection – working with private land owners and the oil and gas industry to protect existing high quality habitat. However, this area is so heavily impacted by oil and gas drilling already, that it is probably the lowest priority focus area.



Legend

Strategy

- Effectively Conserved
- Protection Strategy
- Management Strategy
- Management and Protection

- Interstate
- Major river
- Project area
- State boundary
- County boundary
- City

N

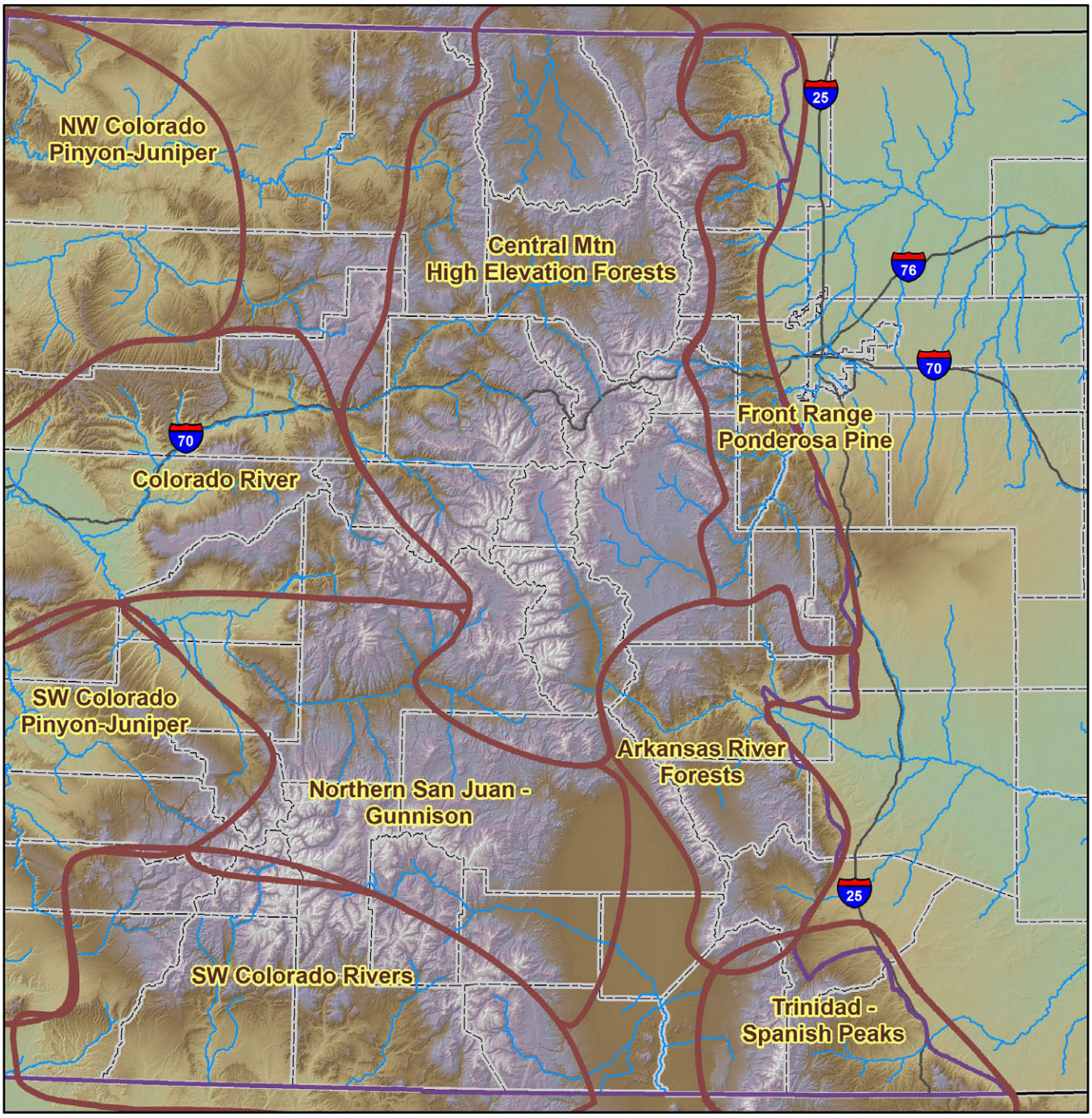
0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 12. Priority Areas to Target for Conservation of Forest Birds in Western Colorado, Classified by Conservation Strategy.



Legend

- Focus area
- Project area
- Interstate
- State boundary
- Major river
- County boundary

N

0 25 50

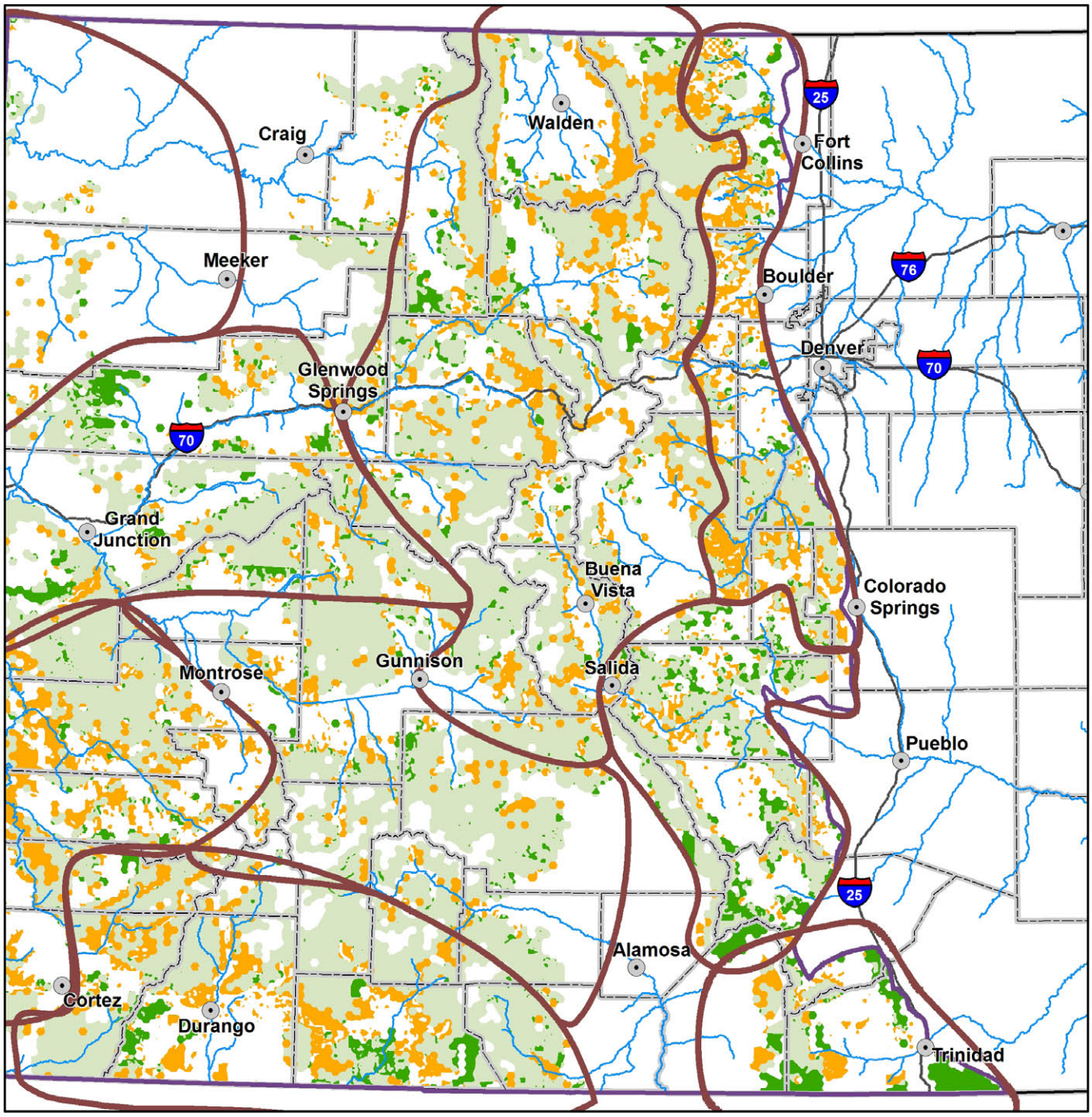
Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Elevation data from the USGS
http://seamless.usgs.gov/website/seamless/viewer.php

Figure 13. Focus Areas for Conservation of Forest Birds in Western Colorado.



Legend

- Focus area
- **Strategy**
  - Effectively Conserved
  - Protection Strategy
  - Management Strategy
- Interstate
- Major river
- Project area
- State boundary
- County boundary

N

0 25 50

Miles

Map produced by the
Colorado Natural Heritage Program

07/10/2007

Figure 14. Focus Areas with Top Conservation Strategies for Conservation of Forest Birds in Western Colorado.

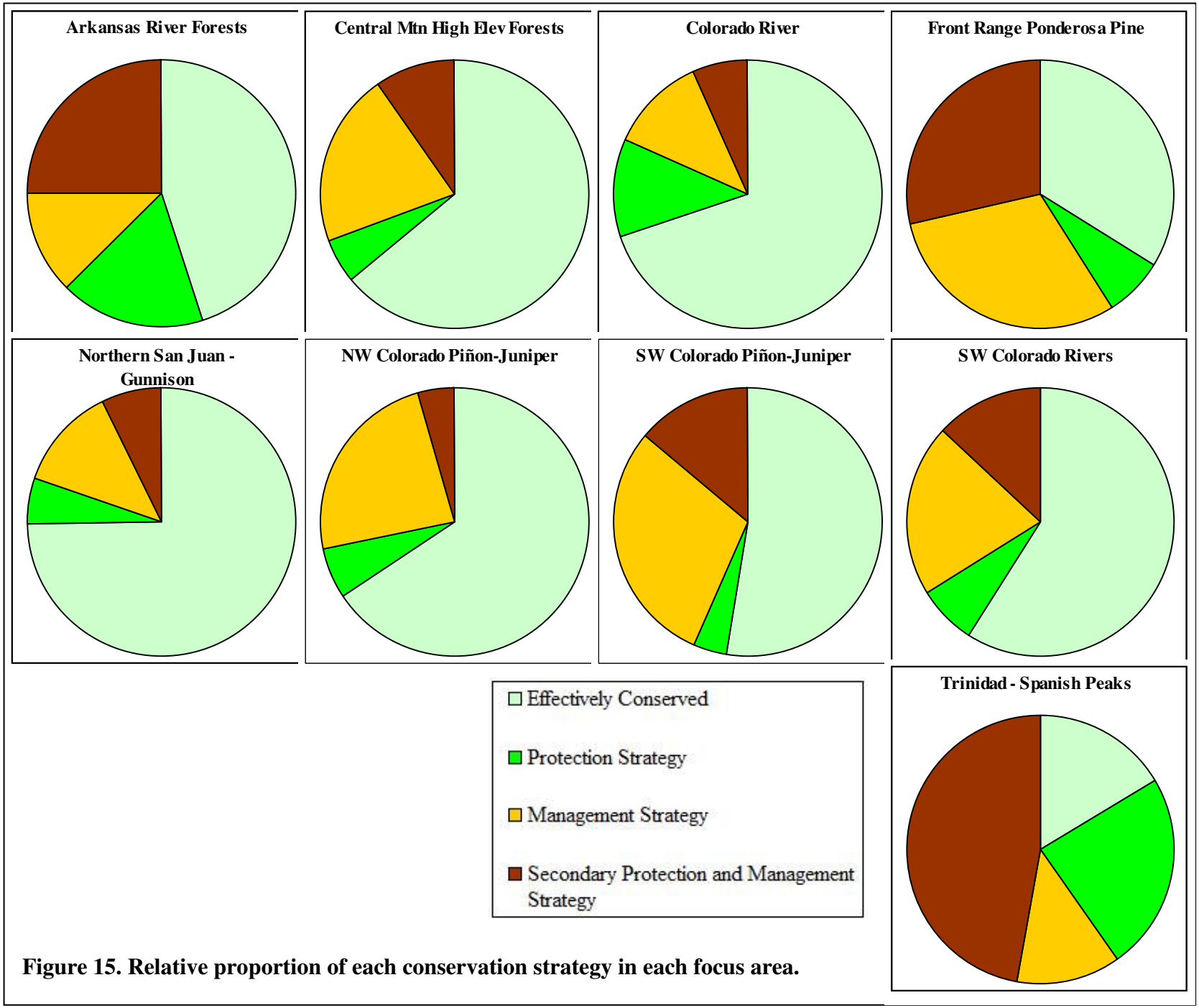


Figure 15. Relative proportion of each conservation strategy in each focus area.

Discussion

It is important to note that both Grace's Warbler and Gray Vireo are at the edge of their normal range in Colorado. Future iterations of this project should probably analyze these, and possibly some of the other low density species, separately so that they do not drive the model results. This modeling project takes into account large-scale influences that can be easily mapped at a statewide level and does not consider on-the-ground structure and quality of habitat. The results point to landscape level conservation strategies that should be the first step for identifying future on-the-ground action. Further refining this process by working at smaller scales and higher resolutions would produce more specific information as to the importance of a particular area.

In the meantime, however, we can conclude from these results that most of the birds that use coniferous and aspen forests in western Colorado have viable populations in high quality habitat with some level of policy-mandated protection. Those birds needing the most conservation action are Band-tailed Pigeon, Grace's Warbler, Gray Vireo, Lewis' Woodpecker, Northern Goshawk, and Olive-sided flycatcher. Suggested conservation strategies to assist with maintaining or increasing bird populations include identifying areas that are high quality but unprotected (either because of private ownership with no conservation easements or because of high levels of oil and gas development of public lands) or areas that are currently under some level of protection but require management for habitat improvement. The logical next step in this process would be to take the lands that were identified as needing conservation action and work with local agencies and land owner groups.

NatureServe Vista can be used interactively, current and future scenarios can be altered on the fly in cooperation with stakeholders and re-evaluated as to how the changes reflect against our conservation goals. The current project encompassing western Colorado is both too large and too coarse for effective interactive planning, but this is just a pilot project and we hope to work on more site specific areas with land managers in the near future.

Literature Cited

Ainsley, D.T.J. 1992. Vocalizations and nesting behavior of the Pacific-sloped Flycatcher. MSc thesis, Univ. of Victoria, Victoria BC.

Altman, B. 1998. Productivity of the Olive-sided Flycatcher in western North America. Status review prepared for the U.S. Fish and Wildl. Serv., Portland, OR.

Altman, B., and R. Sallabanks. 2000. Olive-sided Flycatcher (*Contopus cooperi*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Balda, R.P. 1967. Ecological relationships of the breeding birds of the Chiricahua Mountains, Arizona. Ph.D. diss., University of Illinois, Urbana.

Balda, R.P. 2002. Pinyon Jay (*Gymnorhinus cyanocephalus*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Barlow, J.C., S.N. Leckie, and C.T. Baril. 1999. Gray Vireo (*Vireo vicinior*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Belovsky, G.E. 1987. Extinction models and mammalian persistence. pp35 – 57 *In* Viable Populations for Conservation. Soulé, M. ed. 1987. Cambridge U. Press. 189p.

COGCC. 2006. Colorado Oil and Gas Conservation Commission Wells through 08/03/2006. Available online at: http://oil-gas.state.co.us/.

Crist, P. 2005. An Analysis of Conservation and Economic Value of Forest Stands: Final Report by NatureServe to Potlatch Corporation, Arkansas Timberlands. NatureServe, Arlington, Virginia.

Crockett, A.B. 1975. Ecology and Behavior of the Williamson's Sapsucker in Colorado. Ph.D. diss., Univ. of Colorado, Boulder.

Davis, F.W., C. Costello, and D. Stoms. 2006. Efficient Conservation in a Utility-Maximization Framework. Ecology and Society 11: 33. http://www.ecologyandsociety.org/vol11/iss1/art33/.

Decker, K, G. Doyle, C. Gaughan, R. Rondeau, M. Fink, and A. Lavender. 2007. A Biodiversity Scorecard for Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Dobbs, R.C., T.E. Martin, and C.J. Conway. 1997. Williamson's Sapsucker (*Sphyrapicus thyroideus*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Eckhardt, R.C. 1979. The adaptive syndromes of two guilds of insectivorous birds in the Colorado Rocky Mountains. Ecol. Monogr. 49: 129-149.

Freilich, J., B. Budd, T. Kohley, and B. Hayden. 2001. The Wyoming Basins Ecoregional Plan. The Nature Conservancy, Lander, WY. 130pp.

Glover, F. A. 1953. A nesting study of the Band-tailed Pigeon in north-western CA. Calif. Fish Game Bull. 39:397-407.

Guzy, M.J., and P.E. Lowther. 1997. Black-throated Gray Warbler (*Dendroica nigrescens*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Hayward, G.D. and P.H. Hayward. 1993. Boreal Owl (*Aegolius funereus*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Hutton, K., Blakesley, J., Beason, J., Giroir, G., Sparks, R., Panjabi, A., and D. Hanni. 2006. Monitoring Colorado's Birds: 2006 Field Season Report. Brighton, CO: Rocky Mountain Bird Observatory. 163 pp.

Iverson, D.C., and R.M. Alston. 1986. The genesis of FORPLAN: a historical and analytical review of Forest Service planning models. General Technical Report INT-214. Ogden, UT. USDA Forest Service, Intermountain Research Station.

Johnson, N.K. 1963. Biosystematics of sibling species of flycatchers in the *Emidonax hammondii-oberholseri-wrightii* complex. Univ. Calif. Publ. Zool. 66:79-238.

Johnson, S.N. 2006. Decision support systems for forest biodiversity management: A review of tools and an analytical-deliberative framework for understanding their successful application. Ph.D. Dissertation. Oregon State University.

Kennedy, P.L., J.M. Ward, G.A. Rinker, and J.A. Gessaman. 1994. Post-fledging areas in northern goshawk home ranges. Studies in Avian Biology 16:75-82.

Keppie, D.M., and C.E. Braun. 2000. Band-tailed Pigeon (*Columba fasciata*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Kingery, H.E., and C.K. Ghalambor. 2001. Pygmy Nuthatch (*Sitta pygmaea*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Kingery, H.E. 1998. Colorado Breeding Bird Atlas. Colorado Breeding Bird Atlas Partnership. Denver CO. 636pp.

Leukering, T., Carter, M.F., Panjabi, A., Faulkner, D., and R. Levad. 2000. Monitoring Colorado's Birds: The Plan for Count-based Monitoring. Brighton, CO: Rocky Mountain Bird Observatory. 23 pp. (updated 2004)

Margules, C.R. and R.L. Pressey. 2000. Systematic conservation planning. Nature, 405, 243-253.

Marzluff, J.M., and R.P. Balda. 1989. Causes and consequences of female biased dispersal in a flock-living bird, the Pinyon Jay. Ecology 70: 316-328.

McCallum, D.A. 1980. Pinyon-juniper-ponderosa pine ecotone. Am. Birds 34: 75-76.

McCallum, D.A., S.R. Buchsbaum, and J.J. Price. 1978. Pinyon-juniper-ponderosa pine ecotone. Am. Birds 32:89.

Miller, B., Foreman, D., Fink, M., Shinneman, D., Smith, J., DeMarco, M., Soulé, M., and R. Howard. 2003. Southern Rockies Wildlands Network Vision; A science-based approach to rewilding the Southern Rockies. CMC Press, Golden, CO. 248 pp.

NatureServe. 2002. Element Occurrence Data Standard. NatureServe, in cooperation with the network of Natural Heritage Programs and Conservation Data Centers.

NatureServe. 2006. NatureServe Vista On-line Help Documentation, version 2006-02-28. http://support.natureserve.org/Vista/.
NatureServe. 2007. NatureServe Explorer: An Online Encyclopedia of Life. http://www.natureserve.org/explorer/index.htm.

Neely, B., P. Connor, C. Moritz, M. Lammert, R. Rondeau, C. Pague, G. Bell, H. Copeland, J. Humke, S. Spackman, T. Schulz, D. Theobald, and L. Valutis. 2001. Southern Rocky Mountains: An ecoregional assessment and conservation blueprint. Prepared by The Nature Conservancy with support from U.S. Forest Service, Rocky Mountain Region; Colorado Division of Wildlife; and Bureau of Land Management.

Neely, B., S. Kettler, J. Horsman, C. Pague, R. Rondeau, R. Smith, L. Grunau, P. Comer, G. Belew, F. Pusateri, B. Rosenlund, D. Runner, K. Sochi, J. Sovell, D. Anderson, T. Jackson and M. Klavetter. 2006. Central Shortgrass Prairie Ecoregional Assessment and Partnership Initiative. The Nature Conservancy of Colorado and the Shortgrass Prairie Partnership. 124 pp. and Appendices.

Neff, J.A. 1947. Habits, food and economic status of the Band-tailed Pigeon. U.S. Fish Wildl. Serv. N. Am. Fauna 58.

Norris, R.A. 1958. Comparative Biosystematics and life history of the nuthatches *Sitta pygmaea* and *Sittapusilla*. Univ. Calif. Publ. Zool. 56:119-300.

Panik, H.R. 1976. The vertebrate structure of a pinyon-juniper woodland community in Northwestern Nevada. Ph.D. diss., Univ. of Nevada, Reno.

PIF. 2005. Partner's In Flight Species Assessment Database. http://www.rmbo.org/pif/pifdb.html

Poole, A. (Editor). 2005. The Birds of North America Online: http://bna.birds.cornell.edu/BNA/. Cornell Laboratory of Ornithology, Ithaca, NY.

Reed, D.H, O'Grady, J.J., Brook, B.W., Ballou, J.D., and R. Frankham. 2002. Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates. Biological Conservation 113 (2003) 23–34.

Reynolds, R. 2007. Personal communication with Richard T. Reynolds of the Rocky Mountain Research Station. Electronic mail, April 11, 2007.

Samson, F.B. 1976. Territory, breeding density, and fall departure in Cassin's Finch. Auk 93:477-497.

Schrupp, D.L., W.A. Reiners, T.G. Thompson, L.E. O'Brien, J.A. Kindler, M.B. Wunder, J.F. Lowsky, J.C. Buoy, L. Satcowitz, A.L. Cade, J.D. Stark, K.L. Driese, T.W. Owens, S.J. Russo, and F. D'Erichia. 2000. Colorado Gap Analysis Program: A geographic approach to planning for biological diversity – Final Report. USGS Biological Resources Divisions, Gap Analysis Program and Colorado Division of Wildlife, Denver, CO.

Schuster, E.G., L.A. Leefers, and J.E. Thompson. 1993. A Guide to Computer-Based Analytical Tools for Implementing National Forest Plans. General Technical Report INT-296. USDA Forest Service, Intermountain Research Station.

Scott, J.M., F. Davis, B. Csuti, R. Noss, B. Butterfield, C. Groves, H. Anderson, S. Caicco, D. D'erchia, T. Edwards, J. Ulliman, and R.G. Wright. 1993. Gap analysis: a geographical approach to protection of biodiversity. Wildlife Monograph 124.

Sedgwick, J.A. 1993. Dusky Flycatcher (*Empidonax oberholseri*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Shoutis, D. 2003. SPOT: The Spatial Portfolio Optimization Tool. The Nature Conservancy. http://conserveonline.org/workspaces/spot.

Skorkowsky, R. 2007. Personal communication with Robert C. Skorkowsky, District Wildlife Biologist and Region 2 Avian Program Coordinator for the Hahns Peak - Bears Ears Ranger District of the Medicine Bow - Routt National Forest. Electronic mail, April 11, 2007.

Squires, J.R., and R.T. Reynolds. 1997. Northern Goshawk (*Accipiter gentilis*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Sterling, J.C. 1999. Gray Flycatcher (*Empidonax wrightii*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Storer, B.E. 1977. Aspects of the breeding ecology of the Pygmy Nuthatch and the foraging ecology of wintering mixed-species flocks in western Montana. Master's Thesis, Univ. of Montana, Missoula.

Supples, C., T. Schulz, J. Ervin, C. Pague, and K. Sochi. 2006. Measuring the potential management effectiveness of conserved areas in Colorado. The Nature Conservancy, Boulder, CO.

Szaro, R.C., and R.P. Balda. 1979. Bird community dynamics in a ponderosa pine forest. Stud. Avian Biol. 3.

Theobald, D.M. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. http://www.ecologyandsociety.org/vol10/iss1/art32/.

Tuffly, M., and P. Comer. 2005a. Calculating Landscape Integrity: A Working Model. Draft of 4/19/2005. NatureServe, Boulder, CO. Available online at: http://conserveonline.org/workspaces/human.activity.index/li_data_4_19_2005.doc.

Tuffly, M., and P. Comer. 2005b. Example of landscape integrity from Puerto Rico. NatureServe, Boulder, CO. Available online at: http://conserveonline.org/workspaces/human.activity.index/PR%20example_Landscape%20Integrity.doc.

Tuhy, J.S., P. Comer, D. Dorfman, M. Lammert, J. Humke, B. Cholvin, G. Bell, B. Neely, S. Silbert, L. Whitham, and B. Baker. 2002. A conservation assessment of the Colorado Plateau Ecoregion. The Nature Conservancy, Moab Project Office, Moab, UT. 110pp and appendices.

USCB. 2002. Census 2000 Summary File 3 and Block Groups for Colorado. Prepared by the U.S. Census Bureau, 2002.

USCB. 2005a. U.S. Census Bureau, Population Division, Interim State Population Projections, 2005. Table A1: Interim Projections of the Total Population for the United States and States: April 1, 2000 to July 1, 2030. Internet Release Date: April 21, 2005.

USCB. 2005b. U.S. Census Bureau TIGER/Line files, 2005 first edition. More information available online at: http://www.census.gov/geo/www/tiger/.

USGS National Gap Analysis Program. 2004. Provisional Digital Land Cover Map for the Southwestern United States. Version 1.0. RS/GIS Laboratory, College of Natural Resources, Utah State University.

USGS National Gap Analysis Program. 2005. Provisional Digital Animal-Habitat Models for the Southwestern United States. Version 1.0. Center for Applied Spatial Ecology, New Mexico Cooperative Fish and Wildlife Research Unit, New Mexico State University.

Walters, E.L., E.H. Miller, and P.E. Lowther. 2002. Red-breasted Sapsucker (*Sphyrapicus ruber*) and Red-naped Sapsucker (*Sphyrapicus nuchalis*). *In* The Birds of North America Online. Poole, A. (Editor). 2005. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/BNA/.

Wilcox, G., D.M. Theobald, J. Whisman, and N. Peterson. 2006. Colorado Ownership, Management, and Protection V5. http://www.nrel.colostate.edu/projects/comap/contact.html.

Wild Utah Project. 2004. The Heart of the West Conservation Plan. Wild Utah Project, Salt Lake City, UT. 180pp.

Young, R.C. 1975. Interspecific territoriality in Williamson's and Red-naped Sapsuckers. M.S. thesis, Univ. of New Mexico, Albuquerque.

Appendix A. Crosswalk of Southwest Regional GAP Landcover and Major Habitat Types for Birds.

SWReGAP Description	Habitat Type
Agriculture	Agriculture
Barren Lands, Non-specific	Other
Colorado Plateau Blackbrush-Mormon-tea Shrubland	Semidesert Shrubland
Colorado Plateau Mixed Bedrock Canyon and Tableland	Piñon-Juniper
Colorado Plateau Mixed Low Sagebrush Shrubland	Sagebrush Shrubland
Colorado Plateau Pinyon-Juniper Shrubland	Piñon-Juniper
Colorado Plateau Pinyon-Juniper Woodland	Piñon-Juniper
Developed, Medium - High Intensity	Developed
Developed, Open Space - Low Intensity	Developed
Disturbed, Non-specific	Disturbed
Disturbed, Oil well	Disturbed
Inter-Mountain Basins Active and Stabilized Dune	Other natural
Inter-Mountain Basins Big Sagebrush Shrubland	Sagebrush Shrubland
Inter-Mountain Basins Cliff and Canyon	Cliff/Rock
Inter-Mountain Basins Greasewood Flat	Semidesert Shrubland
Inter-Mountain Basins Juniper Savanna	Piñon-Juniper
Inter-Mountain Basins Mat Saltbush Shrubland	Semidesert Shrubland
Inter-Mountain Basins Mixed Salt Desert Scrub	Semidesert Shrubland
Inter-Mountain Basins Montane Sagebrush Steppe	Sagebrush Shrubland
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	Mountain Shrubland
Inter-Mountain Basins Playa	Wetlands
Inter-Mountain Basins Semi-Desert Grassland	Grassland
Inter-Mountain Basins Semi-Desert Shrub Steppe	Semidesert Shrubland
Inter-Mountain Basins Shale Badland	Other natural
Inter-Mountain Basins Wash	Semidesert Shrubland
Inter-Mountain West Aspen-Mixed Conifer Forest and Woodland Complex	Mixed Conifer
Invasive Annual and Biennial Forbland	Disturbed
Invasive Annual Grassland	Disturbed
Invasive Perennial Forbland	Disturbed
Invasive Perennial Grassland	Disturbed
Invasive Southwest Riparian Woodland and Shrubland	Disturbed
Madrean Pine-Oak Forest and Woodland	Mixed Conifer
Madrean Pinyon-Juniper Woodland	Piñon-Juniper
North American Alpine Ice Field	Alpine tundra
North American Arid West Emergent Marsh	Wetlands
Open Water	Water
Recently Burned	Disturbed
Recently Chained Pinyon-Juniper Areas	Piñon-Juniper
Recently Logged Areas	Disturbed
Recently Mined or Quarried	Disturbed
Rocky Mountain Alpine Bedrock and Scree	Alpine tundra
Rocky Mountain Alpine Fell-Field	Alpine tundra
Rocky Mountain Alpine-Montane Wet Meadow	Wetlands
Rocky Mountain Aspen Forest and Woodland	Aspen
Rocky Mountain Cliff and Canyon	Cliff/Rock
Rocky Mountain Dry Tundra	Alpine tundra
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	Mountain Shrubland
Rocky Mountain Lodgepole Pine Forest	Lodgepole

SWReGAP Description	Habitat Type
Rocky Mountain Lower Montane Riparian Woodland and Shrubland	Lowland Riparian
Rocky Mountain Lower Montane-Foothill Shrubland	Mountain Shrubland
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	Mixed Conifer
Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	Mixed Conifer
Rocky Mountain Ponderosa Pine Woodland	Ponderosa Pine
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	Spruce-Fir
Rocky Mountain Subalpine Mesic Meadow	Wetlands
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Spruce-Fir
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	Mixed Conifer
Rocky Mountain Subalpine-Montane Riparian Shrubland	High Elev. Riparian
Rocky Mountain Subalpine-Montane Riparian Woodland	High Elev. Riparian
Southern Colorado Plateau Sand Shrubland	Semidesert Shrubland
Southern Rocky Mountain Juniper Woodland and Savanna	Piñon-Juniper
Southern Rocky Mountain Montane-Subalpine Grassland	Grassland
Southern Rocky Mountain Pinyon-Juniper Woodland	Piñon-Juniper
Western Great Plains Cliff and Outcrop	Cliff/Rock
Western Great Plains Floodplain Herbaceous Wetland	Lowland Riparian
Western Great Plains Foothill and Piedmont Grassland	Grassland
Western Great Plains Riparian Woodland and Shrubland	Lowland Riparian
Western Great Plains Sandhill Shrubland	Sagebrush Shrubland
Western Great Plains Shortgrass Prairie	Grassland
Wyoming Basins Low Sagebrush Shrubland	Sagebrush Shrubland

Note that Aspen-Mixed Conifer systems were translated to Mixed Conifer with the understanding that this category includes Aspen/Mixed Conifer mix. SWReGAP landcover from USGS (2004).

Appendix B. Species Compatibility with Specific Landuse Types.

C = Compatible, I = Incompatible

	BLGR	BLSW	BOOW	BTGW	BTPI	CAFI	COFL	DUFL	FLOW	GRFL	GRVI	GRWA	JUTI	LEWO
Private/Tribal Land														
Rural	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Exurban	C	C	C	C	C	C	C	C	I	C	C	C	C	C
Suburban	C	C	C	C	I	C	C	C	I	C	I	C	C	C
Urban/Industrial	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Public Land														
Non-motorized	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Motorized	C	C	C	C	C	C	C	C	C	C	I	C	C	C
General Public Land	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Extractive/Recreation uses irrespective of ownership														
Timber Management														
Unknown Timber Management	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Thinning	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Clearcut	C	C	I	I	C	C	C	C	I	I	I	I	I	I
Reservoirs/impoundments	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ski Area	C	C	C	C	C	C	C	C	I	C	C	C	C	C
Mining	I	I	I	I	I	C	I	I	I	I	I	I	I	I
Roads	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Oil and Gas development	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Piñon-Juniper removal	C	C	C	I	C	C	C	C	C	I	I	C	I	C
Intensive Grazing	C	C	C	C	C	C	I	I	C	C	C	I	C	C

BLGR	Dusky Grouse (formerly Blue Grouse)
BLSW	Black Swift
BOOW	Boreal Owl
BTGW	Black-throated Gray Warbler
BTPI	Band-tailed Pigeon
CAFI	Cassin's Finch
COFL	Cordlilleran Flycatcher
DUFL	Dusky Flycatcher
FLOW	Flammulated Owl
GRFL	Gray Flycatcher
GRVI	Gray Vireo
GRWA	Grace's Warbler
JUTI	Juniper Titmouse
LEWO	Lewis's Woodpecker
MSO	Mexican Spotted Owl
NOGO_f	Northern Goshawk - foraging
NOGO_n	Northern Goshawk - nesting
OSFL	Olive-sided Flycatcher
PIJA	Pinyon Jay
PUMA	Purple Martin
PYNU	Pygmy Nuthatch
RNSA	Red-naped Sapsucker
WISA	Williamson's Sapsucker

C = Compatible, I = Incompatible

	MSO	NOGO_f	NOGO_n	OSFL	PIJA	PUMA	PYNU	RNSA	WISA
Private/Tribal Land									
Rural	C	C	C	C	C	C	C	C	C
Exurban	I	C	I	C	C	C	C	C	C
Suburban	I	C	I	C	I	C	C	C	C
Urban/Industrial	I	I	I	I	I	C	I	I	I
Public Land									
Non-motorized	I	C	I	C	C	C	C	C	C
Motorized	I	I	I	C	I	C	C	C	C
General Public Land	C	C	C	C	C	C	C	C	C
Extractive/Recreation uses irrespective of ownership									
Timber Management									
Unknown Timber Management	I	C	I	C	C	C	C	C	C
Thinning	I	C	I	C	C	C	C	C	C
Clearcut	I	C	I	C	I	I	I	I	I
Reservoirs/impoundments	I	C	I	I	I	I	I	I	I
Ski Area	I	C	C	C	C	C	C	C	C
Mining	I	I	I	I	I	I	I	I	I
Roads	I	I	I	I	I	I	I	I	I
Oil and Gas development	I	I	I	I	I	I	I	I	I
Piñon-Juniper removal	C	C	C	C	C	C	C	C	C
Intensive Grazing	C	C	C	I	C	C	C	I	C

Justifications, assumptions, and explanations:

Exurban is assumed to mean 35+ acre lots where the owners do not disturb the majority of lot.
Rural is assumed to mean 100+ acre lots.

Removal of piñon-juniper is assumed to increase cowbird parasitism.

Reservoirs may increase food availability for foraging Northern Goshawks, but are otherwise considered incompatible for non-waterfowl species.

Band-tailed Pigeon may occur in high densities in shrubland that result from timber harvest. Conservation Reserve Program (CRP) lands may reduce food availability (Keppie and Braun 2000).

Black-throated Gray Warblers are little affected by human activities (Guzy and Lowther 1997).

Boreal Owls readily use nest boxes, but will avoid clear-cuts and require old-growth forest to survive (Hayward and Hayward 1993). We assume that Boreal Owl is compatible with ski areas only if snags remain available.

Dusky Flycatcher benefit from timber harvesting that leaves small openings. Stream side populations are vulnerable to grazing and recreation disturbances (Sedgewick 1993).

Gray Flycatchers appear to be eliminated after timber clear-cutting or extensive chaining of piñon-juniper woodlands (Sterling 1999).

Gray Vireo may abandon their nests due to human disturbance, and they are subject to cowbird parasitism resulting from clearing of lands for grazing (Barlow et al. 1999).

Juniper Titmouse is compatible with thinning activities only if older juniper trees are left intact.

Mexican Spotted Owl and nesting Northern Goshawks are assumed to be intolerant of even non-motorized public lands because of disturbance from human recreational activities such as camping, however, the designation "General Public Land" is too general to make assumptions about activities.

Northern Goshawk nesting pairs are highly threatened by timber activities that leave less than 35% canopy cover. Nearby camping has been known to disturb nesting pairs (Squires and Reynolds 1997).

Olive-sided Flycatchers have been documented utilizing areas of recent timber harvest, although this may be a population sink situation (Altman and Sallabanks 2000).

Pinyon Jays are not easily disturbed by human activities (Balda 2002).

Pygmy Nuthatch depends upon old-growth ponderosa pine forests (Kingery and Ghalambor 2001).

Red-naped Sapsucker is reasonably tolerate of traffic and other human disturbance. They require snags for nesting and are impacted by timber and grazing activities, including logging of aspen and degradation of riparian woodlands through grazing (Walters et al. 2002).

Williamson's Sapsucker can tolerate considerable disturbance. They rely on snags for nesting and forage in clearcuts. Large snags at a fairly high density (371/100 ha) are needed for maximum population densities (Dobbs et al. 1997).

Appendix C. Minimum Viable Population Calculations.

Species	Scientific Name	Body Mass (g)	max lifespan (yr)	Breeding Age (yr)	Breeding Interval (yr)	40 generations (yr)	Inferred Extent (km)	PIF Goals ‡	PT-r †	Base MVP*	Adjusted MVP **	Belovsky MVP Low+	Belovsky MVP High+
Band-tailed Pigeon	*Patagioenas fasciata*	398	20	1.5	1	60	3.5	100%	3	10,000	10,000	2,761	44,871
Black Swift	*Cypseloides niger*	46	15	1	1	40	-	150%	3	16,000	24,000	6,545	106,370
Black-throated Gray Warbler	*Dendroica nigrescens*	9	6	1	1	40	-	100%	4	16,000	24,000	12,570	204,279
Boreal Owl	*Aegolius funereus*	167	5	1.5	2	60	0.6	100%	3	10,000	10,000	3,908	63,509
Cassin's Finch	*Carpodacus cassinii*	27	6	1	1	40	-	100%	5	16,000	32,000	8,100	131,636
Cordilleran Flycatcher	*Empidonax occidentalis*	11	6	1	1	40	-	100%	2	16,000	16,000	11,600	188,523
Dusky Flycatcher	*Empidonax oberholseri*	10	6	1	1	40	-	100%	2	16,000	16,000	12,051	195,849
Dusky Grouse	*Dendragapus obscurus*	1,188	14	2	1	80	-	200%	3	7,000	14,000	1,783	28,973
Flammulated Owl	*Otus flammeolus*	57	10	1	1	40	0.6	100%	3	16,000	16,000	6,007	97,627
Grace's Warbler	*Dendroica graciae*	9	6	1	1	40	-	150%	4	16,000	24,000	12,570	204,279
Gray Flycatcher	*Empidonax wrightii*	13	6	1	1	40	-	100%	3	16,000	16,000	10,850	176,337
Gray Vireo	*Vireo vicinior*	13	6	1	1	40	-	100%	3	16,000	16,000	10,850	176,337
Juniper Titmouse	*Baeolophus ridgwayi*	15	7	1	1	40	-	100%	5	16,000	32,000	10,247	166,527
Lewis's Woodpecker	*Melanerpes lewis*	116	10	1	1	40	0.2	100%	3	16,000	16,000	4,521	73,475
Mexican Spotted Owl	*Strix occidentalis lucida*	539	18	2	3	80	-	100%	3	7,000	7,000	2,446	39,745
Northern Goshawk	*Accipiter gentilis*	1,137	11	3	1	120	2.5	100%	3	4,000	4,000	1,814	29,486
Olive-sided Flycatcher	*Contopus cooperi*	32	6	1	1	40	-	200%	3	16,000	32,000	7,568	122,988
Pinyon Jay	*Gymnorhinus cyanocephalus*	103	15	2	1	80	-	200%	5	7,000	14,000	4,741	77,052
Purple Martin	*Progne subis*	49	13	1	1	40	-	100%	3	16,000	16,000	6,382	103,715
Pygmy Nuthatch	*Sitta pygmaea*	11	6	1	1	40	-	100%	5	16,000	32,000	11,600	188,523
Red-naped Sapsucker	*Sphyrapicus nuchalis*	50	6	1.5	1	60	0.2	100%	3	10,000	10,000	6,331	102,880
Williamson's Sapsucker	*Sphyrapicus thyroideus*	48	6	1	1	40	0.2	100%	2	16,000	16,000	6,435	104,574

Information in gray is derived in part from Poole (2005) and NatureServe (2007).
Some numbers are approximated from similar species, or the average of a given range.

‡ Adapted in part from PIF (2005). Those species without PIF goals were given a goal of 100%.
† Population Trend score (regional, breeding-season score). From PIF (2005).

PT-r Score	Qualitative definitions
1	Large population increase
2	Possible or moderate population increase OR Population stable
3	Uncertain population trend
4	Possible or moderate population decrease
5	Large population decrease

* Base MVP has been adjusted to 100 years
(40 generation base = 7,000 breeding adults)
MVP is for 99% certainty over 100 years.
Base MVP and adjustments to generation length based on Reed et al. (2002).

** Adjusted MVP = (Base MVP * Modifier)

Condition	Modifier
PT-r <= 2	1
PT-r = 3	PIF Goal
PT-r = 4	1.5
PT-r = 5	2

+Belovsky MVP based on body size (Belovsky 1987).
Low = low population variability
High = high population variability

Appendix D. Full Results of NatureServe Vista Scenario Evaluations, Stratified by Habitat.

	100% Goals, Baseline Scenario										Local PIF Goals, Baseline Scenario					
Name	Distribution Area (ha)	Occs	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Percent of goal	Compatible only Goal Met	Percent of goal
Band-tailed Pigeon-Aspen	421,498		100%	N	311,484		73.9%		419,217		99.5%	200%	N	36.9%	N	49.7%
Band-tailed Pigeon-Mixed Conifer	297,560		100%	N	228,150		76.7%		295,417		99.3%	200%	N	38.3%	N	49.6%
Band-tailed Pigeon-Mountain Shrubland	309,828		100%	N	150,513		48.6%		304,884		98.4%	200%	N	24.3%	N	49.2%
Band-tailed Pigeon-Piñon-Juniper	631,758		100%	N	425,878		67.4%		614,524		97.3%	200%	N	33.7%	N	48.6%
Band-tailed Pigeon-Ponderosa Pine	272,059		100%	N	157,781		58.0%		264,763		97.3%	200%	N	29.0%	N	48.7%
Band-tailed Pigeon-Spruce-Fir	517,537		100%		485,419		93.8%		515,813		99.7%	200%	N	46.9%	N	49.8%
Black Swift		61	100%	N		47	77.1%			58	95.1%	150%	N	51.4%	N	63.4%
Black-throated Gray Warbler-Piñon-Juniper	2,015,324		100%	N	1,525,359		75.7%		1,968,284		97.7%	110%	N	68.8%	N	88.8%
Boreal Owl		119	100%	N		90	75.6%	N		97	81.5%	100%	N	75.6%	N	81.5%
Cassin's Finch-Aspen	848,541		100%	N	593,402		69.9%		845,050		99.6%	150%	N	46.6%	N	66.4%
Cassin's Finch-Mixed Conifer	790,050		100%	N	585,455		74.1%		786,316		99.5%	150%	N	49.4%	N	66.4%
Cassin's Finch-Piñon-Juniper	2,094,676		100%	N	1,565,111		74.7%		2,043,962		97.6%	150%	N	49.8%	N	65.1%
Cassin's Finch-Ponderosa Pine	997,903		100%	N	581,347		58.3%		977,468		98.0%	150%	N	38.8%	N	65.3%
Cassin's Finch-Spruce-Fir	382,548		100%		347,292		90.8%		381,712		99.8%	150%	N	60.5%	N	66.5%
Cordilleran Flycatcher-Aspen	1,081,586		100%	N	806,483		74.6%		1,077,710		99.6%	100%	N	74.6%		99.6%
Cordilleran Flycatcher-High Elev Riparian	190,855		100%	N	146,361		76.7%		188,249		98.6%	100%	N	76.7%		98.6%
Cordilleran Flycatcher-Mixed Conifer	814,088		100%	N	607,766		74.7%		810,618		99.6%	100%	N	74.7%		99.6%
Cordilleran Flycatcher-Ponderosa Pine	930,529		100%	N	539,862		58.0%		911,201		97.9%	100%	N	58.0%		97.9%
Cordilleran Flycatcher-Spruce-Fir	1,672,985		100%		1,575,886		94.2%		1,669,747		99.8%	100%		94.2%		99.8%
Dusky Flycatcher-Aspen	23,657		100%	N	13,882		58.7%		23,440		99.1%	150%	N	39.1%	N	66.1%
Dusky Flycatcher-High Elev Riparian	247,270		100%	N	205,213		83.0%		244,584		98.9%	150%	N	55.3%	N	65.9%
Dusky Flycatcher-Mountain Shrubland	1,092,040		100%	N	561,316		51.4%		1,077,449		98.7%	150%	N	34.3%	N	65.8%
Dusky Flycatcher-Piñon-Juniper	2,082,256		100%	N	1,559,771		74.9%		2,032,524		97.6%	150%	N	49.9%	N	65.1%
Dusky Flycatcher-Ponderosa Pine	35,899		100%	N	19,380		54.0%		35,024		97.6%	150%	N	36.0%	N	65.0%
Dusky Grouse-Aspen	1,136,934		100%	N	837,994		73.7%		1,132,735		99.6%	200%	N	36.9%	N	49.8%
Dusky Grouse-Mixed Conifer	883,215		100%	N	659,188		74.6%		879,473		99.6%	200%	N	37.3%	N	49.8%
Dusky Grouse-Mountain Shrubland	1,127,459		100%	N	578,691		51.3%		1,112,990		98.7%	200%	N	25.7%	N	49.4%
Dusky Grouse-Ponderosa Pine	1,006,062		100%	N	587,407		58.4%		985,693		98.0%	200%	N	29.2%	N	49.0%
Dusky Grouse-Spruce-Fir	1,805,432		100%		1,700,263		94.2%		1,802,060		99.8%	200%	N	47.1%	N	49.9%
Flammulated Owl		25	100%	N		19	76.0%			23	92.0%	110%	N	69.1%	N	83.6%
Grace's Warbler-Ponderosa Pine	13,823		100%	N	7,777		56.3%		13,527		97.9%	150%	N	37.5%	N	65.2%
Gray Flycatcher-Piñon-Juniper	1,864,655		100%	N	1,423,843		76.4%		1,818,280		97.5%	100%	N	76.4%		97.5%
Gray Vireo-Piñon-Juniper	1,229,711		100%	N	965,394		78.5%		1,191,179		96.9%	100%	N	78.5%		96.9%
Juniper Titmouse-Piñon-Juniper	1,905,030		100%	N	1,456,046		76.4%		1,856,944		97.5%	110%	N	69.5%	N	88.6%
Lewis's Woodpecker		89	100%	N		11	12.4%	N		38	42.7%	110%	N	11.2%	N	38.8%
Mexican Spotted Owl		21	100%	N		17	81.0%			19	90.5%	100%	N	81.0%		90.5%
Northern Goshawk - nesting		230	100%			207	90.0%			222	96.5%	110%	N	81.8%	N	87.7%
Northern Goshawk-Aspen	738,633		100%	N	573,287		77.6%		736,261		99.7%	110%	N	70.6%		90.6%
Northern Goshawk-High elevation riparian	66,794		100%	N	51,042		76.4%		66,089		98.9%	110%	N	69.5%	N	89.9%
Northern Goshawk-Mixed Conifer	629,099		100%	N	474,570		75.4%		626,826		99.6%	110%	N	68.6%		90.6%
Northern Goshawk-Mountain Shrub	33,500		100%	N	19,576		58.4%		32,968		98.4%	110%	N	53.1%	N	89.5%
Northern Goshawk-Piñon-Juniper	12,221		100%	N	7,607		62.3%		11,905		97.4%	110%	N	56.6%	N	88.6%
Northern Goshawk-Ponderosa	668,396		100%	N	397,021		59.4%		654,266		97.9%	110%	N	54.0%	N	89.0%

			100% Goals, Baseline Scenario									Local PIF Goals, Baseline Scenario					
Name	Distribution Area (ha)	Occs	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Percent of goal	Compatible only Goal Met	Percent of goal
Olive-sided Flycatcher-Aspen	956,125		100%	N	720,811		75.4%		952,850		99.7%	200%	N	37.7%	N	49.8%
Olive-sided Flycatcher-High Elev Riparian	33,085		100%	N	22,458		67.9%		32,751		99.0%	200%	N	33.9%	N	49.5%
Olive-sided Flycatcher-Lodgepole Pine	663,798		100%	N	567,754		85.5%		661,159		99.6%	200%	N	42.8%	N	49.8%
Olive-sided Flycatcher-Mixed Conifer	800,043		100%	N	597,039		74.6%		796,740		99.6%	200%	N	37.3%	N	49.8%
Olive-sided Flycatcher-Mountain Shrubland	36,005		100%	N	20,664		57.4%		35,425		98.4%	200%	N	28.7%	N	49.2%
Olive-sided Flycatcher-Ponderosa Pine	944,846		100%	N	554,526		58.7%		925,563		98.0%	200%	N	29.3%	N	49.0%
Olive-sided Flycatcher-Spruce-Fir	1,281,534		100%		1,201,916		93.8%		1,278,853		99.8%	200%	N	46.9%	N	49.9%
Pinyon Jay-Piñon-Juniper	2,121,162		100%	N	1,588,039		74.9%		2,068,693		97.5%	200%	N	37.4%	N	48.8%
Purple Martin		64	100%	N		43	67.2%			61	95.3%	100%	N	67.2%		95.3%
Pygmy Nuthatch-Mixed Conifer	724,271		100%	N	535,568		74.0%		721,140		99.6%	110%	N	67.2%		90.5%
Pygmy Nuthatch-Ponderosa Pine	961,322		100%	N	563,245		58.6%		941,710		98.0%	110%	N	53.3%	N	89.1%
Red-naped Sapsucker-Aspen	840,450		100%	N	588,363		70.0%		836,906		99.6%	110%	N	63.6%		90.5%
Red-naped Sapsucker-High Elev Riparian	67,374		100%	N	38,998		57.9%		65,728		97.6%	110%	N	52.6%	N	88.7%
Red-naped Sapsucker-Mixed Conifer	570,752		100%	N	428,300		75.0%		567,809		99.5%	110%	N	68.2%		90.4%
Red-naped Sapsucker-Mountain Shrubland	313,842		100%	N	148,101		47.2%		307,636		98.0%	110%	N	42.9%	N	89.1%
Red-naped Sapsucker-Ponderosa Pine	960,704		100%	N	560,028		58.3%		940,929		97.9%	110%	N	53.0%	N	89.0%
Williamson's Sapsucker-Mixed Conifer	798,143		100%	N	599,101		75.1%		794,961		99.6%	110%	N	68.2%		90.5%
Williamson's Sapsucker-Ponderosa Pine	925,714		100%	N	543,991		58.8%		906,918		98.0%	110%	N	53.4%	N	89.1%
Williamson's Sapsucker-Spruce-Fir	1,712,754		100%		1,615,856		94.3%		1,709,717		99.8%	110%	N	85.8%		90.7%

	100% Goals, Future Scenario									Local PIF Goals, Future Scenario				
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Percent of goal	Compatible only Goal Met	Percent of goal
Band-tailed Pigeon-Aspen	100%	N	306,796		72.8%		418,120		99.2%	200%	N	36.4%	N	49.6%
Band-tailed Pigeon-Mixed Conifer	100%	N	223,671		75.2%		294,258		98.9%	200%	N	37.6%	N	49.4%
Band-tailed Pigeon-Mountain Shrubland	100%	N	152,418		49.2%		299,990		96.8%	200%	N	24.6%	N	48.4%
Band-tailed Pigeon-Piñon-Juniper	100%	N	439,415		69.6%		598,350		94.7%	200%	N	34.8%	N	47.4%
Band-tailed Pigeon-Ponderosa Pine	100%	N	160,576		59.0%		256,490		94.3%	200%	N	29.5%	N	47.1%
Band-tailed Pigeon-Spruce-Fir	100%		483,244		93.4%		515,494		99.6%	200%	N	46.7%	N	49.8%
Black Swift	100%	N		47	77.1%			58	95.1%	150%	N	51.4%	N	63.4%
Black-throated Gray Warbler-Piñon-Juniper	100%	N	1,506,528		74.8%		1,890,507		93.8%	110%	N	68.0%	N	85.3%
Boreal Owl	100%	N		90	80.4%	N		97	86.6%	100%	N	75.6%	N	81.5%
Cassin's Finch-Aspen	100%	N	585,547		69.0%		838,827		98.9%	150%	N	46.0%	N	65.9%
Cassin's Finch-Mixed Conifer	100%	N	571,458		72.3%		780,251		98.8%	150%	N	48.2%	N	65.8%
Cassin's Finch-Piñon-Juniper	100%	N	1,546,642		73.8%		1,962,744		93.7%	150%	N	49.2%	N	62.5%
Cassin's Finch-Ponderosa Pine	100%	N	584,267		58.6%		956,751		95.9%	150%	N	39.0%	N	63.9%
Cassin's Finch-Spruce-Fir	100%		345,207		90.2%		381,261		99.7%	150%	N	60.2%	N	66.4%
Cordilleran Flycatcher-Aspen	100%	N	793,095		73.3%		1,071,818		99.1%	100%	N	73.3%		99.1%
Cordilleran Flycatcher-High Elev Riparian	100%	N	145,528		76.3%		187,945		98.5%	100%	N	76.3%		98.5%
Cordilleran Flycatcher-Mixed Conifer	100%	N	589,644		72.4%		804,800		98.9%	100%	N	72.4%		98.9%
Cordilleran Flycatcher-Ponderosa Pine	100%	N	542,126		58.3%		891,460		95.8%	100%	N	58.3%		95.8%
Cordilleran Flycatcher-Spruce-Fir	100%		1,566,239		93.6%		1,669,161		99.8%	100%		93.6%		99.8%
Dusky Flycatcher-Aspen	100%	N	13,568		57.4%		23,004		97.2%	150%	N	38.2%	N	64.8%
Dusky Flycatcher-High Elev Riparian	100%	N	203,577		82.3%		244,310		98.8%	150%	N	54.9%	N	65.9%
Dusky Flycatcher-Mountain Shrubland	100%	N	555,150		50.8%		1,043,512		95.6%	150%	N	33.9%	N	63.7%
Dusky Flycatcher-Piñon-Juniper	100%	N	1,541,223		74.0%		1,952,428		93.8%	150%	N	49.3%	N	62.5%
Dusky Flycatcher-Ponderosa Pine	100%	N	19,746		55.0%		34,154		95.1%	150%	N	36.7%	N	63.4%
Dusky Grouse-Aspen	100%	N	823,867		72.5%		1,125,967		99.0%	200%	N	36.2%	N	49.5%
Dusky Grouse-Mixed Conifer	100%	N	639,500		72.4%		873,261		98.9%	200%	N	36.2%	N	49.4%
Dusky Grouse-Mountain Shrubland	100%	N	571,814		50.7%		1,078,614		95.7%	200%	N	25.4%	N	47.8%
Dusky Grouse-Ponderosa Pine	100%	N	590,245		58.7%		965,124		95.9%	200%	N	29.3%	N	48.0%
Dusky Grouse-Spruce-Fir	100%		1,688,211		93.5%		1,801,464		99.8%	200%	N	46.8%	N	49.9%
Flammulated Owl	100%	N		19	76.0%			23	92.0%	110%	N	69.1%	N	83.6%
Grace's Warbler-Ponderosa Pine	100%	N	7,820		56.6%		13,376		96.8%	150%	N	37.7%	N	64.5%
Gray Flycatcher-Piñon-Juniper	100%	N	1,409,065		75.6%		1,741,778		93.4%	100%	N	75.6%		93.4%
Gray Vireo-Piñon-Juniper	100%	N	959,794		78.1%		1,129,402		91.8%	100%	N	78.1%		91.8%
Juniper Titmouse-Piñon-Juniper	100%	N	1,441,347		75.7%		1,777,481		93.3%	110%	N	68.8%	N	84.8%
Lewis's Woodpecker	100%	N		11	12.4%	N		38	42.7%	110%	N	11.2%	N	38.8%
Mexican Spotted Owl	100%	N		17	81.0%	N		18	85.7%	100%	N	81.0%	N	85.7%
Northern Goshawk - nesting	100%	N		206	89.6%			218	94.8%	110%	N	81.4%	N	86.2%
Northern Goshawk-Aspen	100%	N	562,101		76.1%		732,217		99.1%	110%	N	69.2%		90.1%
Northern Goshawk-High elevation riparian	100%	N	50,546		75.7%		65,952		98.7%	110%	N	68.8%	N	89.8%
Northern Goshawk-Mixed Conifer	100%	N	458,516		72.9%		623,282		99.1%	110%	N	66.3%		90.1%
Northern Goshawk-Mountain Shrub	100%	N	19,410		57.9%		32,341		96.5%	110%	N	52.7%	N	87.8%
Northern Goshawk-Piñon-Juniper	100%	N	7,426		60.8%		11,661		95.4%	110%	N	55.2%	N	86.7%
Northern Goshawk-Ponderosa	100%	N	395,320		59.1%		640,106		95.8%	110%	N	53.8%	N	87.1%

	100% Goals, Future Scenario									Local PIF Goals, Future Scenario				
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Percent of goal	Compatible only Goal Met	Percent of goal
Olive-sided Flycatcher-Aspen	100%	N	709,444		74.2%		947,990		99.2%	200%	N	37.1%	N	49.6%
Olive-sided Flycatcher-High Elev Riparian	100%	N	22,222		67.2%		32,683		98.8%	200%	N	33.6%	N	49.4%
Olive-sided Flycatcher-Lodgepole Pine	100%	N	567,760		85.5%		660,890		99.6%	200%	N	42.8%	N	49.8%
Olive-sided Flycatcher-Mixed Conifer	100%	N	578,933		72.4%		791,412		98.9%	200%	N	36.2%	N	49.5%
Olive-sided Flycatcher-Mountain Shrubland	100%	N	20,645		57.3%		34,667		96.3%	200%	N	28.7%	N	48.1%
Olive-sided Flycatcher-Ponderosa Pine	100%	N	556,420		58.9%		906,133		95.9%	200%	N	29.4%	N	48.0%
Olive-sided Flycatcher-Spruce-Fir	100%		1,195,966		93.3%		1,278,310		99.8%	200%	N	46.7%	N	49.9%
Pinyon Jay-Piñon-Juniper	100%	N	1,569,988		74.0%		1,986,019		93.6%	200%	N	37.0%	N	46.8%
Purple Martin	100%	N		43	67.2%			60	93.8%	100%	N	67.2%		93.8%
Pygmy Nuthatch-Mixed Conifer	100%	N	519,198		71.7%		715,816		98.8%	110%	N	65.2%	N	89.8%
Pygmy Nuthatch-Ponderosa Pine	100%	N	565,676		58.8%		921,610		95.9%	110%	N	53.5%	N	87.2%
Red-naped Sapsucker-Aspen	100%	N	580,617		69.1%		830,821		98.9%	110%	N	62.8%	N	89.9%
Red-naped Sapsucker-High Elev Riparian	100%	N	38,731		57.5%		65,471		97.2%	110%	N	52.3%	N	88.3%
Red-naped Sapsucker-Mixed Conifer	100%	N	419,519		73.5%		563,772		98.8%	110%	N	66.8%	N	89.8%
Red-naped Sapsucker-Mountain Shrubland	100%	N	144,005		45.9%		298,493		95.1%	110%	N	41.7%	N	86.5%
Red-naped Sapsucker-Ponderosa Pine	100%	N	562,704		58.6%		921,156		95.9%	110%	N	53.2%	N	87.2%
Williamson's Sapsucker-Mixed Conifer	100%	N	580,475		72.7%		789,753		99.0%	110%	N	66.1%		90.0%
Williamson's Sapsucker-Ponderosa Pine	100%	N	546,016		59.0%		887,714		95.9%	110%	N	53.6%	N	87.2%
Williamson's Sapsucker-Spruce-Fir	100%		1,604,148		93.7%		1,709,188		99.8%	110%	N	85.1%		90.7%

	High Risk Goals, Baseline Scenario									High Risk Goals, Future Scenario								
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal
Band-tailed Pigeon-Aspen	330,814 ha		311,484		94.2%		419,217		126.7%	330,814 ha		306,796		92.7%		418,120		126.4%
Band-tailed Pigeon-Mixed Conifer	233,541 ha		228,150		97.7%		295,417		126.5%	233,541 ha		223,671		95.8%		294,258		126.0%
Band-tailed Pigeon-Mountain Shrubland	243,169 ha		150,513		61.9%		304,884		125.4%	243,169 ha		152,418		62.7%		299,990		123.4%
Band-tailed Pigeon-Piñon-Juniper	495,837 ha		425,878		85.9%		614,524		123.9%	495,837 ha		439,415		88.6%		598,350		120.7%
Band-tailed Pigeon-Ponderosa Pine	213,526 ha		157,781		73.9%		264,763		124.0%	213,526 ha		160,576		75.2%		256,490		120.1%
Band-tailed Pigeon-Spruce-Fir	406,190 ha		485,419		119.5%		515,813		127.0%	406,190 ha		483,244		119.0%		515,494		126.9%
Black Swift	31 occ			47	151.6%			58	187.1%	31 occ			47	151.6%			58	187.1%
Black-throated Gray Warbler-Piñon-Juniper	39,661 ha		1,525,359		3846.0%		1,968,284		4962.8%	39,661 ha		1,506,528		3798.5%		1,890,507		4766.7%
Boreal Owl	61 occ			90	147.5%			97	159.0%	61 occ			90	147.5%			97	159.0%
Cassin's Finch-Aspen	245,647 ha		593,402		241.6%		845,050		344.0%	245,647 ha		585,547		238.4%		838,827		341.5%
Cassin's Finch-Mixed Conifer	228,714 ha		585,455		256.0%		786,316		343.8%	228,714 ha		571,458		249.9%		780,251		341.2%
Cassin's Finch-Piñon-Juniper	606,394 ha		1,565,111		258.1%		2,043,962		337.1%	606,394 ha		1,546,642		255.1%		1,962,744		323.7%
Cassin's Finch-Ponderosa Pine	288,886 ha		581,347		201.2%		977,468		338.4%	288,886 ha		584,267		202.3%		956,751		331.2%
Cassin's Finch-Spruce-Fir	110,745 ha		347,292		313.6%		381,712		344.7%	110,745 ha		345,207		311.7%		381,261		344.3%
Cordilleran Flycatcher-Aspen	59,228 ha		806,483		1361.7%		1,077,710		1819.6%	59,228 ha		793,095		1339.1%		1,071,818		1809.7%
Cordilleran Flycatcher-High Elev Riparian	10,451 ha		146,361		1400.5%		188,249		1801.3%	10,451 ha		145,528		1392.5%		187,945		1798.3%
Cordilleran Flycatcher-Mixed Conifer	44,580 ha		607,766		1363.3%		810,618		1818.3%	44,580 ha		589,644		1322.7%		804,800		1805.3%
Cordilleran Flycatcher-Ponderosa Pine	50,956 ha		539,862		1059.5%		911,201		1788.2%	50,956 ha		542,126		1063.9%		891,460		1749.5%
Cordilleran Flycatcher-Spruce-Fir	91,613 ha		1,575,886		1720.2%		1,669,747		1822.6%	91,613 ha		1,566,239		1709.6%		1,669,161		1822.0%
Dusky Flycatcher-Aspen	419 ha		13,882		3313.1%		23,440		5594.3%	419 ha		13,568		3238.2%		23,004		5490.2%
Dusky Flycatcher-High Elev Riparian	4,375 ha		205,213		4690.6%		244,584		5590.5%	4,375 ha		203,577		4653.2%		244,310		5584.2%
Dusky Flycatcher-Mountain Shrubland	19,321 ha		561,316		2905.2%		1,077,449		5576.6%	19,321 ha		555,150		2873.3%		1,043,512		5400.9%
Dusky Flycatcher-Piñon-Juniper	36,841 ha		1,559,771		4233.8%		2,032,524		5517.0%	36,841 ha		1,541,223		4183.5%		1,952,428		5299.6%
Dusky Flycatcher-Ponderosa Pine	635 ha		19,380		3052.0%		35,024		5515.6%	635 ha		19,746		3109.6%		34,154		5378.6%
Dusky Grouse-Aspen	523,736 ha		837,994		160.0%		1,132,735		216.3%	523,736 ha		823,867		157.3%		1,125,967		215.0%
Dusky Grouse-Mixed Conifer	406,859 ha		659,188		162.0%		879,473		216.2%	406,859 ha		639,500		157.2%		873,261		214.6%
Dusky Grouse-Mountain Shrubland	519,371 ha		578,691		111.4%		1,112,990		214.3%	519,371 ha		571,814		110.1%		1,078,614		207.7%
Dusky Grouse-Ponderosa Pine	463,449 ha		587,407		126.8%		985,693		212.7%	463,449 ha		590,245		127.4%		965,124		208.3%
Dusky Grouse-Spruce-Fir	831,684 ha		1,700,263		204.4%		1,802,060		216.7%	831,684 ha		1,688,211		203.0%		1,801,464		216.6%
Flammulated Owl	14 occ			19	135.7%			23	164.3%	14 occ			19	135.7%			23	164.3%
Grace's Warbler-Ponderosa Pine	243,833 ha		7,777		3.2%		13,527		5.6%	243,833 ha		7,820		3.2%		13,376		5.5%
Gray Flycatcher-Piñon-Juniper	32,971 ha		1,423,843		4318.5%		1,818,280		5514.8%	32,971 ha		1,409,065		4273.7%		1,741,778		5282.8%
Gray Vireo-Piñon-Juniper	813,752 ha		965,394		118.6%		1,191,179		146.4%	813,752 ha		959,794		118.0%		1,129,402		138.8%
Juniper Titmouse-Piñon-Juniper	195,408 ha		1,456,046		745.1%		1,856,944		950.3%	195,408 ha		1,441,347		737.6%		1,777,481		909.6%
Lewis's Woodpecker	48 occ			11	22.9%			38	79.2%	48 occ			11	22.9%			38	79.2%
Mexican Spotted Owl	11 occ			17	154.6%			19	172.7%	11 occ			17	154.6%			18	163.6%
Northern Goshawk - nesting	120 occ			207	172.5%			222	185.0%	120 occ			206	171.7%			218	181.7%
Northern Goshawk-Aspen	572,945 ha		573,287		100.1%		736,261		128.5%	572,945 ha		562,101		98.1%		732,217		127.8%
Northern Goshawk-High elevation riparian	51,811 ha		51,042		98.5%		66,089		127.6%	51,811 ha		50,546		97.6%		65,952		127.3%
Northern Goshawk-Mixed Conifer	487,982 ha		474,570		97.3%		626,826		128.5%	487,982 ha		458,516		94.0%		623,282		127.7%
Northern Goshawk-Mountain Shrub	25,985 ha		19,576		75.3%		32,968		126.9%	25,985 ha		19,410		74.7%		32,341		124.5%
Northern Goshawk-Piñon-Juniper	9,480 ha		7,607		80.2%		11,905		125.6%	9,480 ha		7,426		78.3%		11,661		123.0%
Northern Goshawk-Ponderosa	518,464 ha		397,021		76.6%		654,266		126.2%	518,464 ha		395,320		76.3%		640,106		123.5%

	High Risk Goals, Baseline Scenario									High Risk Goals, Future Scenario								
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal
Olive-sided Flycatcher-Aspen	895,383 ha	N	720,811		80.5%	Y	952,850		106.4%	895,383 ha	N	709,444		79.2%	Y	947,990		105.9%
Olive-sided Flycatcher-High Elev Riparian	30,983 ha	N	22,458		72.5%	Y	32,751		105.7%	30,983 ha	N	22,222		71.7%	Y	32,683		105.5%
Olive-sided Flycatcher-Lodgepole Pine	621,627 ha		567,754		91.3%	Y	661,159		106.4%	621,627 ha		567,760		91.3%	Y	660,890		106.3%
Olive-sided Flycatcher-Mixed Conifer	749,217 ha	N	597,039		79.7%	Y	796,740		106.3%	749,217 ha	N	578,933		77.3%	Y	791,412		105.6%
Olive-sided Flycatcher-Mountain Shrubland	0									0		20,645				34,667		
Olive-sided Flycatcher-Ponderosa Pine	884,820 ha	N	554,526		62.7%	Y	925,563		104.6%	884,820 ha	N	556,420		62.9%	Y	906,133		102.4%
Olive-sided Flycatcher-Spruce-Fir	1,200,119 ha	Y	1,201,916		100.2%	Y	1,278,853		106.6%	1,200,119 ha		1,195,966		99.7%	Y	1,278,310		106.5%
Pinyon Jay-Piñon-Juniper	311,388 ha	Y	1,588,039		510.0%	Y	2,068,693		664.4%	311,388 ha	Y	1,569,988		504.2%	Y	1,986,019		637.8%
Purple Martin	34 occ	Y		43	126.5%	Y		61	179.4%	34 occ	Y		43	126.5%	Y		60	176.5%
Pygmy Nuthatch-Mixed Conifer	0									0		519,198				715,816		
Pygmy Nuthatch-Ponderosa Pine	107,567 ha	Y	563,245		523.6%	Y	941,710		875.5%	107,567 ha	Y	565,676		525.9%	Y	921,610		856.8%
Red-naped Sapsucker-Aspen	28,668 ha	Y	588,363		2052.3%	Y	836,906		2919.3%	28,668 ha	Y	580,617		2025.3%	Y	830,821		2898.1%
Red-naped Sapsucker-High Elev Riparian	2,298 ha	Y	38,998		1697.0%	Y	65,728		2860.2%	2,298 ha	Y	38,731		1685.4%	Y	65,471		2849.0%
Red-naped Sapsucker-Mixed Conifer	19,468 ha	Y	428,300		2200.0%	Y	567,809		2916.6%	19,468 ha	Y	419,519		2154.9%	Y	563,772		2895.9%
Red-naped Sapsucker-Mountain Shrubland	10,705 ha	Y	148,101		1383.5%	Y	307,636		2873.8%	10,705 ha	Y	144,005		1345.2%	Y	298,493		2788.4%
Red-naped Sapsucker-Ponderosa Pine	32,769 ha	Y	560,028		1709.0%	Y	940,929		2871.4%	32,769 ha	Y	562,704		1717.2%	Y	921,156		2811.1%
Williamson's Sapsucker-Mixed Conifer	44,449 ha	Y	599,101		1347.8%	Y	794,961		1788.5%	44,449 ha	Y	580,475		1305.9%	Y	789,753		1776.8%
Williamson's Sapsucker-Ponderosa Pine	51,554 ha	Y	543,991		1055.2%	Y	906,918		1759.2%	51,554 ha	Y	546,016		1059.1%	Y	887,714		1721.9%
Williamson's Sapsucker-Spruce-Fir	95,384 ha	Y	1,615,856		1694.1%	Y	1,709,717		1792.5%	95,384 ha	Y	1,604,148		1681.8%	Y	1,709,188		1791.9%

	Medium Risk Goals, Baseline Scenario								Medium Risk Goals, Future Scenario							
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal
Band-tailed Pigeon-Aspen	827,034 ha	N	311,484		37.7%	N	419,217		50.7%	827,034 ha	N	306,796		37.1%	N	418,120		50.6%
Band-tailed Pigeon-Mixed Conifer	583,852 ha	N	228,150		39.1%	N	295,417		50.6%	583,852 ha	N	223,671		38.3%	N	294,258		50.4%
Band-tailed Pigeon-Mountain Shrubland	607,923 ha	N	150,513		24.8%	N	304,884		50.2%	607,923 ha	N	152,418		25.1%	N	299,990		49.4%
Band-tailed Pigeon-Piñon-Juniper	1,239,592 ha	N	425,878		34.4%	N	614,524		49.6%	1,239,592 ha	N	439,415		35.5%	N	598,350		48.3%
Band-tailed Pigeon-Ponderosa Pine	533,815 ha	N	157,781		29.6%	N	264,763		49.6%	533,815 ha	N	160,576		30.1%	N	256,490		48.1%
Band-tailed Pigeon-Spruce-Fir	1,015,475 ha	N	485,419		47.8%	N	515,813		50.8%	1,015,475 ha	N	483,244		47.6%	N	515,494		50.8%
Black Swift	47 occ	Y		47	100.0%	Y		58	123.4%	47 occ	Y		47	100.0%	Y		58	123.4%
Black-throated Gray Warbler-Piñon-Juniper	99,152 ha	Y	1,525,359		1538.4%	Y	1,968,284		1985.1%	99,152 ha	Y	1,506,528		1519.4%	Y	1,890,507		1906.7%
Boreal Owl	92 occ			90	97.8%	Y		97	105.4%	92 occ			90	97.8%	Y		97	105.4%
Cassin's Finch-Aspen	614,116 ha		593,402		96.6%	Y	845,050		137.6%	614,116 ha		585,547		95.4%	Y	838,827		136.6%
Cassin's Finch-Mixed Conifer	571,785 ha	Y	585,455		102.4%	Y	786,316		137.5%	571,785 ha		571,458		99.9%	Y	780,251		136.5%
Cassin's Finch-Piñon-Juniper	1,515,984 ha	Y	1,565,111		103.2%	Y	2,043,962		134.8%	1,515,984 ha	Y	1,546,642		102.0%	Y	1,962,744		129.5%
Cassin's Finch-Ponderosa Pine	722,215 ha	N	581,347		80.5%	Y	977,468		135.3%	722,215 ha	N	584,267		80.9%	Y	956,751		132.5%
Cassin's Finch-Spruce-Fir	276,862 ha	Y	347,292		125.4%	Y	381,712		137.9%	276,862 ha	Y	345,207		124.7%	Y	381,261		137.7%
Cordilleran Flycatcher-Aspen	148,070 ha	Y	806,483		544.7%	Y	1,077,710		727.8%	148,070 ha	Y	793,095		535.6%	Y	1,071,818		723.9%
Cordilleran Flycatcher-High Elev Riparian	26,128 ha	Y	146,361		560.2%	Y	188,249		720.5%	26,128 ha	Y	145,528		557.0%	Y	187,945		719.3%
Cordilleran Flycatcher-Mixed Conifer	111,449 ha	Y	607,766		545.3%	Y	810,618		727.3%	111,449 ha	Y	589,644		529.1%	Y	804,800		722.1%
Cordilleran Flycatcher-Ponderosa Pine	127,390 ha	Y	539,862		423.8%	Y	911,201		715.3%	127,390 ha	Y	542,126		425.6%	Y	891,460		699.8%
Cordilleran Flycatcher-Spruce-Fir	229,033 ha	Y	1,575,886		688.1%	Y	1,669,747		729.0%	229,033 ha	Y	1,566,239		683.9%	Y	1,669,161		728.8%
Dusky Flycatcher-Aspen	1,046 ha	Y	13,882		1327.2%	Y	23,440		2240.9%	1,046 ha	Y	13,568		1297.1%	Y	23,004		2199.2%
Dusky Flycatcher-High Elev Riparian	10,937 ha	Y	205,213		1876.3%	Y	244,584		2236.3%	10,937 ha	Y	203,577		1861.4%	Y	244,310		2233.8%
Dusky Flycatcher-Mountain Shrubland	48,303 ha	Y	561,316		1162.1%	Y	1,077,449		2230.6%	48,303 ha	Y	555,150		1149.3%	Y	1,043,512		2160.4%
Dusky Flycatcher-Piñon-Juniper	92,102 ha	Y	1,559,771		1693.5%	Y	2,032,524		2206.8%	92,102 ha	Y	1,541,223		1673.4%	Y	1,952,428		2119.9%
Dusky Flycatcher-Ponderosa Pine	1,588 ha	Y	19,380		1220.4%	Y	35,024		2205.5%	1,588 ha	Y	19,746		1243.5%	Y	34,154		2150.8%
Dusky Grouse-Aspen	1,147,244 ha	N	837,994		73.0%		1,132,735		98.7%	1,147,244 ha	N	823,867		71.8%		1,125,967		98.2%
Dusky Grouse-Mixed Conifer	895,587 ha	N	659,188		73.6%		879,473		98.2%	895,587 ha	N	639,500		71.4%		873,261		97.5%
Dusky Grouse-Mountain Shrubland	1,179,885 ha	N	578,691		49.1%		1,112,990		94.3%	1,179,885 ha	N	571,814		48.5%		1,078,614		91.4%
Dusky Grouse-Ponderosa Pine	1,035,667 ha	N	587,407		56.7%		985,693		95.2%	1,035,667 ha	N	590,245		57.0%		965,124		93.2%
Dusky Grouse-Spruce-Fir	1,822,752 ha		1,700,263		93.3%		1,802,060		98.9%	1,822,752 ha		1,688,211		92.6%		1,801,464		98.8%
Flammulated Owl	21 occ			19	90.5%	Y		23	109.5%	21 occ			19	90.5%	Y		23	109.5%
Grace's Warbler-Ponderosa Pine	609,583 ha	N	7,777		1.3%	N	13,527		2.2%	609,583 ha	N	7,820		1.3%	N	13,376		2.2%
Gray Flycatcher-Piñon-Juniper	82,427 ha	Y	1,423,843		1727.4%	Y	1,818,280		2205.9%	82,427 ha	Y	1,409,065		1709.5%	Y	1,741,778		2113.1%
Gray Vireo-Piñon-Juniper	2,034,381 ha	N	965,394		47.5%	N	1,191,179		58.6%	2,034,381 ha	N	959,794		47.2%	N	1,129,402		55.5%
Juniper Titmouse-Piñon-Juniper	488,520 ha	Y	1,456,046		298.1%	Y	1,856,944		380.1%	488,520 ha	Y	1,441,347		295.0%	Y	1,777,481		363.9%
Lewis's Woodpecker	71 occ	N		11	15.5%	N		38	53.5%	71 occ	N		11	15.5%	N		38	53.5%
Mexican Spotted Owl	16 occ	Y		17	106.3%	Y		19	118.8%	16 occ	Y		17	106.3%	Y		18	112.5%
Northern Goshawk - nesting	179 occ	Y		207	115.6%	Y		222	124.0%	179 occ	Y		206	115.1%	Y		218	121.8%
Northern Goshawk-Aspen	1,147,244 ha	N	573,287		50.0%	N	736,261		64.2%	1,147,244 ha	N	562,101		49.0%	N	732,217		63.8%
Northern Goshawk-High elevation riparian	129,527 ha	N	51,042		39.4%	N	66,089		51.0%	129,527 ha	N	50,546		39.0%	N	65,952		50.9%
Northern Goshawk-Mixed Conifer	895,587 ha	N	474,570		53.0%	N	626,826		70.0%	895,587 ha	N	458,516		51.2%	N	623,282		69.6%
Northern Goshawk-Mountain Shrub	64,963 ha	N	19,576		30.1%	N	32,968		50.8%	64,963 ha	N	19,410		29.9%	N	32,341		49.8%
Northern Goshawk-Piñon-Juniper	23,699 ha	N	7,607		32.1%	N	11,905		50.2%	23,699 ha	N	7,426		31.3%	N	11,661		49.2%
Northern Goshawk-Ponderosa	1,035,667 ha	N	397,021		38.3%	N	654,266		63.2%	1,035,667 ha	N	395,320		38.2%	N	640,106		61.8%

Medium Risk Goals, Baseline Scenario										Medium Risk Goals, Future Scenario									
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal
Olive-sided Flycatcher-Aspen	1,147,244 ha	N	720,811		62.8%	N	952,850		83.1%	1,147,244 ha	N	709,444		61.8%	N	947,990		82.6%
Olive-sided Flycatcher-High Elev Riparian	77,458 ha	N	22,458		29.0%	N	32,751		42.3%	77,458 ha	N	22,222		28.7%	N	32,683		42.2%
Olive-sided Flycatcher-Lodgepole Pine	698,238 ha	N	567,754		81.3%		661,159		94.7%	698,238 ha	N	567,760		81.3%		660,890		94.7%
Olive-sided Flycatcher-Mixed Conifer	895,587 ha	N	597,039		66.7%	N	796,740		89.0%	895,587 ha	N	578,933		64.6%	N	791,412		88.4%
Olive-sided Flycatcher-Mountain Shrubland	0		20,664				35,425					20,645				34,667		
Olive-sided Flycatcher-Ponderosa Pine	1,035,667 ha	N	554,526		53.5%	N	925,563		89.4%	1,035,667 ha	N	556,420		53.7%	N	906,133		87.5%
Olive-sided Flycatcher-Spruce-Fir	1,822,752 ha	N	1,201,916		65.9%	N	1,278,853		70.2%	1,822,752 ha	N	1,195,966		65.6%	N	1,278,310		70.1%
Pinyon Jay-Piñon-Juniper	778,470 ha	Y	1,588,039		204.0%	Y	2,068,693		265.7%	778,470 ha	Y	1,569,988		201.7%	Y	1,986,019		255.1%
Purple Martin	50 occ	N		43	86.0%	Y		61	122.0%	50 occ	N		43	86.0%	Y		60	120.0%
Pygmy Nuthatch-Mixed Conifer	0		535,568				721,140					519,198				715,816		
Pygmy Nuthatch-Ponderosa Pine	268,917 ha	Y	563,245		209.5%	Y	941,710		350.2%	268,917 ha	Y	565,676		210.4%	Y	921,610		342.7%
Red-naped Sapsucker-Aspen	71,669 ha	Y	588,363		820.9%	Y	836,906		1167.7%	71,669 ha	Y	580,617		810.1%	Y	830,821		1159.3%
Red-naped Sapsucker-High Elev Riparian	5,745 ha	Y	38,998		678.8%	Y	65,728		1144.1%	5,745 ha	Y	38,731		674.2%	Y	65,471		1139.6%
Red-naped Sapsucker-Mixed Conifer	48,671 ha	Y	428,300		880.0%	Y	567,809		1166.6%	48,671 ha	Y	419,519		862.0%	Y	563,772		1158.3%
Red-naped Sapsucker-Mountain Shrubland	26,763 ha	Y	148,101		553.4%	Y	307,636		1149.5%	26,763 ha	Y	144,005		538.1%	Y	298,493		1115.3%
Red-naped Sapsucker-Ponderosa Pine	81,924 ha	Y	560,028		683.6%	Y	940,929		1148.5%	81,924 ha	Y	562,704		686.9%	Y	921,156		1124.4%
Williamson's Sapsucker-Mixed Conifer	111,123 ha	Y	599,101		539.1%	Y	794,961		715.4%	111,123 ha	Y	580,475		522.4%	Y	789,753		710.7%
Williamson's Sapsucker-Ponderosa Pine	128,884 ha	Y	543,991		422.1%	Y	906,918		703.7%	128,884 ha	Y	546,016		423.7%	Y	887,714		688.8%
Williamson's Sapsucker-Spruce-Fir	238,461 ha	Y	1,615,856		677.6%	Y	1,709,717		717.0%	238,461 ha	Y	1,604,148		672.7%	Y	1,709,188		716.8%

	Low Risk Goals, Baseline Scenario									Low Risk Goals, Future Scenario								
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal
Band-tailed Pigeon-Aspen	1,147,244 ha	N	311,484		27.2%	N	419,217		36.5%	1,147,244 ha	N	306,796		26.7%	N	418,120		36.5%
Band-tailed Pigeon-Mixed Conifer	895,587 ha	N	228,150		25.5%	N	295,417		33.0%	895,587 ha	N	223,671		25.0%	N	294,258		32.9%
Band-tailed Pigeon-Mountain Shrubland	972,677 ha	N	150,513		15.5%	N	304,884		31.3%	972,677 ha	N	152,418		15.7%	N	299,990		30.8%
Band-tailed Pigeon-Piñon-Juniper	1,983,347 ha	N	425,878		21.5%	N	614,524		31.0%	1,983,347 ha	N	439,415		22.2%	N	598,350		30.2%
Band-tailed Pigeon-Ponderosa Pine	854,105 ha	N	157,781		18.5%	N	264,763		31.0%	854,105 ha	N	160,576		18.8%	N	256,490		30.0%
Band-tailed Pigeon-Spruce-Fir	1,624,761 ha	N	485,419		29.9%	N	515,813		31.8%	1,624,761 ha	N	483,244		29.7%	N	515,494		31.7%
Black Swift	62 occ	N		47	75.8%			58	93.6%	62 occ	N		47	75.8%			58	93.6%
Black-throated Gray Warbler-Piñon-Juniper	158,644 ha	Y	1,525,359		961.5%	Y	1,968,284		1240.7%	158,644 ha	Y	1,506,528		949.6%	Y	1,890,507		1191.7%
Boreal Owl	122 occ	N		90	73.8%	N		97	79.5%	122 occ	N		90	73.8%	N		97	79.5%
Cassin's Finch-Aspen	982,586 ha	N	593,402		60.4%	N	845,050		86.0%	982,586 ha	N	585,547		59.6%	N	838,827		85.4%
Cassin's Finch-Mixed Conifer	895,587 ha	N	585,455		65.4%	N	786,316		87.8%	895,587 ha	N	571,458		63.8%	N	780,251		87.1%
Cassin's Finch-Piñon-Juniper	2,196,457 ha	N	1,565,111		71.3%		2,043,962		93.1%	2,196,457 ha	N	1,546,642		70.4%	N	1,962,744		89.4%
Cassin's Finch-Ponderosa Pine	1,035,667 ha	N	581,347		56.1%		977,468		94.4%	1,035,667 ha	N	584,267		56.4%		956,751		92.4%
Cassin's Finch-Spruce-Fir	442,980 ha	N	347,292		78.4%	N	381,712		86.2%	442,980 ha	N	345,207		77.9%	N	381,261		86.1%
Cordilleran Flycatcher-Aspen	236,912 ha	Y	806,483		340.4%	Y	1,077,710		454.9%	236,912 ha	Y	793,095		334.8%	Y	1,071,818		452.4%
Cordilleran Flycatcher-High Elev Riparian	41,805 ha	Y	146,361		350.1%	Y	188,249		450.3%	41,805 ha	Y	145,528		348.1%	Y	187,945		449.6%
Cordilleran Flycatcher-Mixed Conifer	178,319 ha	Y	607,766		340.8%	Y	810,618		454.6%	178,319 ha	Y	589,644		330.7%	Y	804,800		451.3%
Cordilleran Flycatcher-Ponderosa Pine	203,824 ha	Y	539,862		264.9%	Y	911,201		447.1%	203,824 ha	Y	542,126		266.0%	Y	891,460		437.4%
Cordilleran Flycatcher-Spruce-Fir	366,453 ha	Y	1,575,886		430.0%	Y	1,669,747		455.7%	366,453 ha	Y	1,566,239		427.4%	Y	1,669,161		455.5%
Dusky Flycatcher-Aspen	1,674 ha	Y	13,882		829.3%	Y	23,440		1400.2%	1,674 ha	Y	13,568		810.5%	Y	23,004		1374.2%
Dusky Flycatcher-High Elev Riparian	17,500 ha	Y	205,213		1172.7%	Y	244,584		1397.6%	17,500 ha	Y	203,577		1163.3%	Y	244,310		1396.1%
Dusky Flycatcher-Mountain Shrubland	77,285 ha	Y	561,316		726.3%	Y	1,077,449		1394.1%	77,285 ha	Y	555,150		718.3%	Y	1,043,512		1350.2%
Dusky Flycatcher-Piñon-Juniper	147,364 ha	Y	1,559,771		1058.5%	Y	2,032,524		1379.3%	147,364 ha	Y	1,541,223		1045.9%	Y	1,952,428		1324.9%
Dusky Flycatcher-Ponderosa Pine	2,541 ha	Y	19,380		762.7%	Y	35,024		1378.4%	2,541 ha	Y	19,746		777.1%	Y	34,154		1344.1%
Dusky Grouse-Aspen	1,147,244 ha	N	837,994		73.0%		1,132,735		98.7%	1,147,244 ha	N	823,867		71.8%		1,125,967		98.2%
Dusky Grouse-Mixed Conifer	895,587 ha	N	659,188		73.6%		879,473		98.2%	895,587 ha	N	639,500		71.4%		873,261		97.5%
Dusky Grouse-Mountain Shrubland	1,179,885 ha	N	578,691		49.1%		1,112,990		94.3%	1,179,885 ha	N	571,814		48.5%		1,078,614		91.4%
Dusky Grouse-Ponderosa Pine	1,035,667 ha	N	587,407		56.7%		985,693		95.2%	1,035,667 ha	N	590,245		57.0%		965,124		93.2%
Dusky Grouse-Spruce-Fir	1,822,752 ha		1,700,263		93.3%		1,802,060		98.9%	1,822,752 ha		1,688,211		92.6%		1,801,464		98.8%
Flammulated Owl	28 occ	N		19	67.9%	N		23	82.1%	28 occ	N		19	67.9%	N		23	82.1%
Grace's Warbler-Ponderosa Pine	975,332 ha	N	7,777		0.8%	N	13,527		1.4%	975,332 ha	N	7,820		0.8%	N	13,376		1.4%
Gray Flycatcher-Piñon-Juniper	131,883 ha	Y	1,423,843		1079.6%	Y	1,818,280		1378.7%	131,883 ha	Y	1,409,065		1068.4%	Y	1,741,778		1320.7%
Gray Vireo-Piñon-Juniper	2,196,457 ha	N	965,394		44.0%	N	1,191,179		54.2%	2,196,457 ha	N	959,794		43.7%	N	1,129,402		51.4%
Juniper Titmouse-Piñon-Juniper	781,632 ha	Y	1,456,046		186.3%	Y	1,856,944		237.6%	781,632 ha	Y	1,441,347		184.4%	Y	1,777,481		227.4%
Lewis's Woodpecker	89 occ	N		11	12.4%	N		38	42.7%	89 occ	N		11	12.4%	N		38	42.7%
Mexican Spotted Owl	21 occ	N		17	81.0%			19	90.5%	21 occ	N		17	81.0%	N		18	85.7%
Northern Goshawk - nesting	239 occ	N		207	86.6%			222	92.9%	239 occ	N		206	86.2%			218	91.2%
Northern Goshawk-Aspen	1,147,244 ha	N	573,287		50.0%	N	736,261		64.2%	1,147,244 ha	N	562,101		49.0%	N	732,217		63.8%
Northern Goshawk-High elevation riparian	207,244 ha	N	51,042		24.6%	N	66,089		31.9%	207,244 ha	N	50,546		24.4%	N	65,952		31.8%
Northern Goshawk-Mixed Conifer	895,587 ha	N	474,570		53.0%	N	626,826		70.0%	895,587 ha	N	458,516		51.2%	N	623,282		69.6%
Northern Goshawk-Mountain Shrub	103,942 ha	N	19,576		18.8%	N	32,968		31.7%	103,942 ha	N	19,410		18.7%	N	32,341		31.1%
Northern Goshawk-Piñon-Juniper	37,919 ha	N	7,607		20.1%	N	11,905		31.4%	37,919 ha	N	7,426		19.6%	N	11,661		30.8%
Northern Goshawk-Ponderosa	1,035,667 ha	N	397,021		38.3%	N	654,266		63.2%	1,035,667 ha	N	395,320		38.2%	N	640,106		61.8%

Low Risk Goals, Baseline Scenario										Low Risk Goals, Future Scenario									
Name	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal	Goal	Protected & Compat Goal Met	Area (ha)	Occs	Percent of goal	Compatible only Goal Met	Area (ha)	Occs	Percent of goal
Olive-sided Flycatcher-Aspen	1,147,244 ha	N	720,811		62.8%	N	952,850		83.1%	1,147,244 ha	N	709,444		61.8%	N	947,990		82.6%
Olive-sided Flycatcher-High Elev Riparian	123,933 ha	N	22,458		18.1%	N	32,751		26.4%	123,933 ha	N	22,222		17.9%	N	32,683		26.4%
Olive-sided Flycatcher-Lodgepole Pine	698,238 ha	N	567,754		81.3%		661,159		94.7%	698,238 ha	N	567,760		81.3%		660,890		94.7%
Olive-sided Flycatcher-Mixed Conifer	895,587 ha	N	597,039		66.7%	N	796,740		89.0%	895,587 ha	N	578,933		64.6%	N	791,412		88.4%
Olive-sided Flycatcher-Mountain Shrubland			20,664				35,425					20,645				34,667		
Olive-sided Flycatcher-Ponderosa Pine	1,035,667 ha	N	554,526		53.5%	N	925,563		89.4%	1,035,667 ha	N	556,420		53.7%	N	906,133		87.5%
Olive-sided Flycatcher-Spruce-Fir	1,822,752 ha	N	1,201,916		65.9%	N	1,278,853		70.2%	1,822,752 ha	N	1,195,966		65.6%	N	1,278,310		70.1%
Pinyon Jay-Piñon-Juniper	1,245,552 ha	Y	1,588,039		127.5%	Y	2,068,693		166.1%	1,245,552 ha	Y	1,569,988		126.1%	Y	1,986,019		159.5%
Purple Martin	67 occ	N		43	64.2%			61	91.0%	67 occ	N		43	64.2%	N		60	89.6%
Pygmy Nuthatch-Mixed Conifer			535,568				721,140					519,198				715,816		
Pygmy Nuthatch-Ponderosa Pine	430,267 ha	Y	563,245		130.9%	Y	941,710		218.9%	430,267 ha	Y	565,676		131.5%	Y	921,610		214.2%
Red-naped Sapsucker-Aspen	114,670 ha	Y	588,363		513.1%	Y	836,906		729.8%	114,670 ha	Y	580,617		506.3%	Y	830,821		724.5%
Red-naped Sapsucker-High Elev Riparian	9,192 ha	Y	38,998		424.3%	Y	65,728		715.1%	9,192 ha	Y	38,731		421.4%	Y	65,471		712.3%
Red-naped Sapsucker-Mixed Conifer	77,873 ha	Y	428,300		550.0%	Y	567,809		729.2%	77,873 ha	Y	419,519		538.7%	Y	563,772		724.0%
Red-naped Sapsucker-Mountain Shrubland	42,820 ha	Y	148,101		345.9%	Y	307,636		718.4%	42,820 ha	Y	144,005		336.3%	Y	298,493		697.1%
Red-naped Sapsucker-Ponderosa Pine	131,078 ha	Y	560,028		427.3%	Y	940,929		717.8%	131,078 ha	Y	562,704		429.3%	Y	921,156		702.8%
Williamson's Sapsucker-Mixed Conifer	177,796 ha	Y	599,101		337.0%	Y	794,961		447.1%	177,796 ha	Y	580,475		326.5%	Y	789,753		444.2%
Williamson's Sapsucker-Ponderosa Pine	206,214 ha	Y	543,991		263.8%	Y	906,918		439.8%	206,214 ha	Y	546,016		264.8%	Y	887,714		430.5%
Williamson's Sapsucker-Spruce-Fir	381,537 ha	Y	1,615,856		423.5%	Y	1,709,717		448.1%	381,537 ha	Y	1,604,148		420.4%	Y	1,709,188		448.0%