CHAPTER 6

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

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INTRODUCTION

The Southwest is home to a diverse assemblage of plant and animal species largely, due to the complex topography, geology, soils, and climate patterns that occur throughout the region. The unique combination of environmental factors and natural disturbance processes inherent to the Southwest make this area one of the most biologically rich regions in the U.S. (Morin 1995, Flather et al. 1997, Flather 1998, Bender et al. 2005). Fifteen distinct ecoregions are represented within the SWReGAP area, as defined by The Nature Conservancy's (TNC) Terrestrial Global Assessment Units, Ecoregions and Major Habitat Types (TNC 2005) which include modifications to original work done by Bailey (1995). These ecologically derived landscape units are: Columbia Plateau (southern edge), Sierra Nevada (eastern edge), Great Basin, Mojave Desert, Sonoran Desert, Utah-Wyoming Rocky Mountains, Wyoming Basins (southern edge), Utah High Plateau, Colorado Plateau, Southern Rocky Mountains, Apache Highlands, Arizona-New Mexico Mountains, Chihuahuan Desert, Central Shortgrass Prairie, and Southern Shortgrass Prairie. The natural land cover of the region is largely dominated by shrub/scrub ecological systems (37% of the region), followed by grassland/herbaceous systems (23%), evergreen forests (22%), barren lands (5%), woody wetlands (3%), deciduous forest (2%), mixed forest (<1%) and emergent herbaceous wetlands (<1%). Agricultural areas compose 5.6% of the region, altered or disturbed areas (1.5%), developed areas (1.1%), and open water (0.8%).

These natural systems, however, face many threats that affect not only the biological resources within them, but the human populations that may directly or indirectly depend on their sustainability. Adverse factors include prolonged drought, invasive plant and animal species (e.g., cheatgrass, Russian thistle, tamarisk, European starling), over-utilization by livestock, altered fire regimes, increased land development and recreational demands, soil erosion, stream channelization, consumptive water use, oil and gas exploration, habitat fragmentation and conversion, over-harvesting of certain plants and animals, population isolation, and disease (e.g., bark beetles, Chronic Wasting Disease, West Nile Virus), all of which present significant management and ecological challenges encompassing range-wide to local scales. Not all of the stressors necessarily occur range-wide, and some may only affect local areas or have impacts within a specific state. Additionally, certain ecological systems and wildlife species may be more vulnerable to environmental disturbances than others. The seamless 5-state data sets created by SWReGAP provide a unique combination of information and a framework that can be used to identify some of these issues and assist with the implementation of conservation efforts at multiple scales.

MANAGEMENT IMPLICATIONS OF SWREGAP ANALYSIS

The goal of GAP is to identify two elements of biodiversity - land cover types and terrestrial vertebrate species - that are in need of conservation, allowing for the appropriate conservation action to take place before they become the focus of regulatory authority. The analysis is a coarse filter approach that provides a tool and framework that may identify the need for finer scale studies. Using quantitative geographic criteria, this coarse filter approach provides for the delineation of species' habitat and ecological systems for use in conservation planning. A primary assumption with gap analysis is that Status 1 and 2 lands are preferred because of the level of protection afforded these areas. However, the ecological condition of these protected areas may be such that the full range of the region's biodiversity is not fully protected. Status 3 and 4 lands may provide the conditions necessary for certain species and may provide better habitat than that which occurs on Status 1 and 2 lands. Furthermore, individual species respond differently to management practices. We recognize that protection does not always equate to conservation success; for example recent global amphibian declines have occurred both within and outside protected areas (Green 2005). Gap analysis provides a preliminary indication of the long-term maintenance of these elements of biological diversity. Further analyses of area requirements, isolation, or disturbance regimes necessary for maintaining populations, can be used to supplement the results of gap analysis.

A criticism of past gap analyses has been the lack of regional data sets and the problem of edge-matching existing GAP data sets. SWReGAP provides the first formal effort to address these concerns through a regional gap analysis. We encourage each state to consider not only the conservation status of ecological systems and species within their respective states, but also from a regional context. Likewise, it is important to consider what this 5-state region contributes to an ecological system's or terrestrial vertebrate species' management and conservation status relative to other neighboring states and Mexico, as many of the species' ranges extend beyond the SWReGAP project area. Threshold values for conservation protection were used to identify ecological systems and animal habitat distributions with low representation in Status 1 and 2 lands. Low representation in conservation lands, however, includes some elements that are restricted to and are relatively rare within the 5-state region (or state), as well as those that are peripheral to the region (or state). Conservationists and managers are encouraged to consider both, because in some cases, the protection of elements at the edge of their range may capture important components of biodiversity (Channell and Lomolino 2000, Holt and Keitt 2005, Jaeger et al. 2005).

Throughout the 5-state region, 11.5% of the total land base has been identified as providing protection for biodiversity in Status 1 and 2 lands. The majority of this (46%) is managed by BLM (largely associated with National Monuments), followed by U.S. Forest Service (25%), U.S. Fish & Wildlife Service (11%), and National Park Service

(11%). Forty ecological systems and 309 terrestrial vertebrate species have less than 10% of their regional distribution within Status 1 and 2 lands (See Tables 6-1 and 6-2). See Chapter 5, Table 5-1 for the list of ecological systems and Appendix 5-15 for the list of terrestrial vertebrate species. An additional 36 ecological systems and 107 terrestrial vertebrate species have greater than 10% of their distribution, but less than 500 km^2 total area within Status 1 and 2 lands (Tables 6-1 and 6-2). See Table 5-1 and Appendix 5-15 in Chapter 5 for ecological system and terrestrial vertebrate species lists. Ecological systems and terrestrial vertebrate species that have less than 10% of their distribution or less than 500 km^2 absolute areal coverage in Status 1 and 2 lands may be under-represented and point to "gaps" in their conservation (Schrupp et al. 2000). Although other major land stewards in the region (e.g. private (comprising 30% of the 5-state area), tribal (9%), and state land board (7%)) may not always achieve the legal mandate for conservation management, their lands may in fact provide protection for certain species and land cover types. It is important to consider the potential that each land steward may provide as a partner in conservation, particularly at local and ecoregional scales. Cooperation and collaboration among local, state, federal, and tribal governments, non-governmental organizations, universities, and private individuals is encouraged to effectively sustain the species and ecological systems of this region.

As a separate effort, but in parallel with SWReGAP, each of the five states recently completed their State Wildlife Action Plans (SWAP) (AGFD 2005, CDOW 2005, NMDGF 2005, NDOW 2005, UDWR 2005). These strategies identify species of greatest conservation need (SGCN) and key habitats specific to each state. Also included in these reports is detailed information about the threats facing the different habitat types. The CWCS is a useful companion to SWReGAP for prioritizing ecological systems and species that require focused conservation efforts both within and between the Southwest states. The development of crosswalks between each state's key habitats and SWReGAP's land cover legend would be one way to maximize these two resources for future projects. It should be noted, however, that further review of the SGCNs is needed as each state identified their species using different methods.

We identified three categories of management concern to prioritize ecological systems and terrestrial vertebrate species that may require additional attention. The criteria used for these categories are the following: first priorities are ecological systems and predicted animal habitats with distributions of <1% within Status 1 and 2 lands; second priorities are those with between 1 and 10% in Status 1 or 2 lands; and third priorities are those with >10% but <500 km^2 in Status 1 or 2 lands. We applied these criteria to each state to enumerate their respective priority conservation concerns (Tables 6-1 and 6-2).

Table 6-1. Number of Ecological Systems of priority conservation concern identified within the SWReGAP project area and by state. (See Chapter 5, Table 5-1 for the list of relevant ecological systems.)

Priority	Criteria	Region	AZ	CO	NV	NM	UT
	Ecological System Distribution in Status 1 & 2 Lands						
First	<1%	6	7	12	0	8	6
Second	Between 1-10%	34	25	22	12	39	23
Third	>10% and < 500 km^2	36	23	22	41	26	29

Table 6-2. Number of modeled terrestrial vertebrate species in Southwest Regional Gap Analysis Project and Species of Greatest Conservation Need identified by each state in Comprehensive Wildlife Conservation Strategies by priority of concern. (See Chapter 5, Appendix 5-15 for the list of relevant animal species.)

Priority	Criteria	Region		AZ		CO		NV		NM		UT	
	Animal Species Habitat in Status 1 & 2 Lands	SWReGAP	SGCN	SWReGAP	SGCN	SWReGAP	SGCN	SWReGAP	SGCN	SWReGAP	SGCN	SWReGAP	SGCN
First	<1%	25	11	25	9	50	9	13	0	44	6	13	0
Second	Between 1-10%	284	190	168	116	260	62	72	20	400	63	115	25
Third	>10% and < 500 km^2	107	84	133	109	63	13	141	41	96	34	123	28

Priority Conservation Concerns By State

Arizona

For Arizona, 13.4% of the state's total land base is categorized as Status 1 and 2 lands. The majority of this (38%) is managed by BLM, followed by U.S. Forest Service (19%), National Park Service (19%), U.S. Fish & Wildlife Service (17%), and Department of Defense and/or Department of Energy (3%). All other stewards manage approximately 1% or less of Arizona's Status 1 and 2 lands.

Arizona has 7 ecological systems with <1% of their distribution in Status 1 and 2 lands (Table 6-1). Twenty-five ecological systems have between 1 and <10% of their distribution in Status 1 and 2 lands. An additional 23 ecological systems have >10% but <500 km^2 (<50,000 ha) of their distribution in Status 1 and 2 lands, 19 of these have <100 km^2 (<10,000ha).

For Arizona, there are 25 species with less than 1% of their predicted habitat in Status 1 and 2 lands (Table 6-2). Of these 25 species, 9 species were identified as SGCN. There are 168 species with less than 10% of their predicted habitat in Status 1 and 2 lands, 116 of which are SGCN species. There are 133 species (109 SGCN) with more than 10% of

their predicted habitat in Status 1 and 2 lands and <500 km^2 (<50,000 ha), 87 of these have <100 km^2 (<10,000ha).

The primary habitats identified in Arizona's CWCS are: Lower Colorado Sonoran Desert Scrub, Upland Sonoran Desert Scrub, Chihuahuan Desert Scrub, Mohave Desert Scrub, Semi-desert Grassland, Plains & Great Basin Grassland, Subalpine Grassland, Chaparral, Madrean Evergreen Forest, Great Basin Conifer Forest, Montane Conifer Forest, Subalpine Conifer Forest, Alpine Tundra, Wetlands/Springs, Streams/Rivers, Lakes/Reservoirs, and Human-dominated landscapes (AGFD 2005).

Colorado

For Colorado, 10.2% of the state's total land base is categorized as Status 1 and 2 lands. The majority of this is managed by U.S. Forest Service (53%), followed by BLM (21%), National Park Service (9%), State Wildlife Areas (8%), State Land Board (4%), The Nature Conservancy (3%), and Native American Land (2%). All other stewards manage approximately 1% or less of Colorado's Status 1 and 2 lands.

Colorado has 12 ecological systems with less than 1% of their distribution in Status 1 and 2 lands (Table 6-1), 8 of these have no representation at all in these areas. The three ecological systems of highest priority within the state are: *Western Great Plains Cliff and Outcrop* (S008), *Southern Rocky Mountain Juniper Woodland and Savanna* (S074), and *Western Great Plains Sand Prairie* (S089). Twenty-two ecological systems have between 1 and <10% of their distribution in Status 1 and 2 lands. An additional 22 ecological systems have more than 10% but <500 km^2 (<50,000 ha) of their distribution in Status 1 and 2 lands, 11 of these have <100 km^2 (<10,000ha).

For Colorado, there are 50 species with less than 1% of their predicted habitat in Status 1 and 2 lands, 9 being identified as SGCN (Table 6-2). There are 260 species (62 SGCN) with less than 10% of their predicted habitat in Status 1 and 2 lands. There are 63 species (13 SGCN) with more than 10% of their predicted habitat in Status 1 and 2 lands and <500 km^2 (<50,000 ha), 32 of these have <100 km^2 (<10,000ha).

Fourteen key habitats were identified in the Colorado Division of Wildlife's CWCS, which are the following: Aspen, Eastern Plains Rivers, Exposed Rock, Foothills/Mountain Grasslands, Grass-forb Dominated Wetlands, Midgrass Prairie, Open Water, Playas, Pinyon-Juniper, Ponderosa Pine, Sagebrush, Shortgrass Prairie, Shrub Dominated Wetlands, and Western Rivers (CDOW 2005).

New Mexico

For New Mexico, 6.3% of the state's total land base is categorized as Status 1 and 2 lands. The majority of this (41%) is managed by U.S. Forest Service, followed by BLM (34%), National Park Service (8%), U.S. Fish & Wildlife Service (8%), Local Land Trust Preserve/Easement (5%), and State Wildlife Reserves (3%). All other stewards manage approximately 1% or less of New Mexico's Status 1 and 2 lands.

New Mexico has 8 ecological systems with <1% of their distribution in Status 1 and 2 lands (Table 6-1). New Mexico has 39 ecological systems with between 1 and 10% of their distribution in Status 1 and 2 lands. An additional 26 ecological systems have >10% but <500 km^2 (<50,000 ha) of their distribution in Status 1 and 2 lands, 16 of these have <100 km^2 (<10,000ha).

For New Mexico, there are 44 species with less than 1% of their predicted habitat in Status 1 and 2 lands, 6 being identified as SGCN (Table 6-2). There are 400 species (63 SGCN) with less than 10% of their predicted habitat in Status 1 and 2 lands. There are 96 species (34 SGCN) with more than 10% of their predicted habitat in Status 1 and 2 lands and <500 km^2 (<50,000 ha), 54 of these have <100 km^2 (<10,000ha).

Nineteen key habitats were identified in New Mexico's CWCS effort with 9 terrestrial types identified (NMDFG 2005). New Mexico's CWCS relied on the SWReGAP land cover map for terrestrial habitat types and created its own aquatic habitat classification. NMDGF grouped several SWReGAP land cover types because of ecological similarity and ease of use. Key habitats identified within the CWCS are Chihuahuan Semi-Desert Grassland, Intermountain Basins Big Sagebrush Shrubland, Madrean Encinal, Madrean Pine-Oak/Conifer-Oak Forest and Woodland, Riparian, Western Great Plains Sand Sagebrush Shrubland, Western Great Plains Shortgrass Prairie, Rocky Mountain Alpine-Montane Wet Meadow, and Rocky Mountain Montane Mixed Conifer Forest and Woodland.

Nevada

For Nevada, 14.7% of the state's total land base is categorized as Status 1 and 2 lands. The majority of this is managed by BLM (59%), followed by U.S. Fish & Wildlife Service (22%), U.S. Forest Service (11%), and National Park Service (6%). All other stewards manage approximately 1% or less of Nevada's Status 1 and 2 lands.

There are no ecological systems with <1% of their distribution in Status 1 and 2 lands in Nevada (Table 6-1). Nevada has 12 ecological systems with between 1 and <10% of their distribution in Status 1 and 2 lands. Nevada has 41 ecological systems with >10% but <500 km^2 (<50,000 ha) of their distribution in Status 1 and 2 lands, 34 of these have <100 km^2 (<10,000ha).

For Nevada, there are 13 species with less than 1% of their predicted habitat in Status 1 and 2 lands, none were identified as SGCN (Table 6-2). There are 72 species (20 SGCN) with less than 10% of their predicted habitat in Status 1 and 2 lands. There are 141 species (41 SGCN) with more than 10% of their predicted habitat in Status 1 and 2 lands and <500 km^2 (<50,000 ha), 32 of these have <100 km^2 (<10,000ha).

Nevada's Department of Wildlife identified 27 key habitats in their SWAP: Intermountain Cold Desert Scrub, Mojave/Sonoran Warm Desert Scrub, Mojave/Mid-Elevation Mixed Desert Scrub, Sagebrush, Lower Montane Woodlands, Lower Montane Chaparral, Intermountain Conifer Forests and Woodlands, Sierra Conifer Forests and

Woodlands, Grasslands and Meadows, Aspen Woodland, Alpine and Tundra, Intermountain Rivers and Streams, Sierra Rivers and Streams, Mojave Rivers and Streams, Wet Meadows, Springs and Springbrooks, Mesquite Bosques and Desert Washes, Marshes, Lakes and Reservoirs, Desert Playas and Ephemeral Pools, Sand Dunes and Badlands, Cliffs and Canyons, Caves and Mines (Subterranean Landscapes), Exotic Grasslands and Forblands, Developed Landscapes, Agricultural Lands, and Barren Landscapes (NDOW 2005).

Utah

For Utah, 14% of the state's total land base is categorized as Status 1 and 2 lands. The majority of this is managed by BLM (66%), followed by U.S. Forest Service (14%), National Park Service (12%), and State Wildlife Reserves (6%). All other stewards manage approximately 1% or less of Utah's Status 1 and 2 lands.

Six ecological systems have less than 1% of their distribution in Status 1 and 2 lands (Table 6-1), four of these have no representation at all within these areas. Twenty-three ecological systems have between 1 and <10% of their distribution in Status 1 and 2 lands. An additional 29 ecological systems have >10% but <500 km^2 (<50,000 ha) of their distribution in Status 1 and 2 lands, 10 of which have <100 km^2 (<10,000ha).

For Utah, there are 13 species with less than 1% of their predicted habitat in Status 1 and 2 lands, none being identified as SGCN (Table 6-2). There are 115 species (25 SGCN) with less than 10% of their predicted habitat in Status 1 and 2 lands. There are 123 species (28 SGCN) with more than 10% of their predicted habitat in Status 1 and 2 lands and <500 km^2 (<50,000 ha), 35 of these have <100 km^2 (<10,000ha).

Ten key habitats were identified in Utah's Division of Wildlife Resources CWCS: Aspen, Grassland, Lowland Riparian, Mountain Riparian, Mountain Shrub, Shrub-steppe, Water–Lentic (standing), Water–Lotic (flowing), Wet meadow, and Wetland (UDWR 2005).

ADDITIONAL DATA NEEDS AND ANALYSES

Land Cover

The SWReGAP land cover data set provides a seamless representation of land cover for the 5-state region based on satellite imagery from the time period of 1999-2001.   The data set has many uses beyond the gap analysis conducted for SWReGAP. As noted in Chapter 2, no land cover map is perfect, and when possible land cover maps can and should be updated and improved. With this in mind, we suggest the following for future work related to the SWReGAP land cover data set:

- **Refined mapping of targeted land cover classes and/or regions.**
  The SWReGAP land cover data set was created based on the premise that there is value in landscape data covering large geographic regions. Some ecoregions and land cover classes within the 5-state region may have greater importance for conservation of biodiversity than others. We suggest that the SWReGAP land cover data set be refined by focusing additional attention on these select ecoregions and/or land cover classes. In other words, the SWReGAP land cover data set may be used as a stratifier for finer scale mapping of specific land cover classes (e.g. riparian classes), or updated to reflect additional information regarding the spatial distribution of land cover in the region. Furthermore, at finer scales it may be possible to include information pertaining to relative 'condition classes' within land cover types, which would greatly improve the overall utility of the land cover data set for species habitat modeling.

- **Map accuracy assessment.**
  Chapter 2 provides a detailed description of the map validation procedure used to assess the quality of the land cover data set. While we used an approach that provides a quantitative measure of map quality using withheld samples, and fuzzy set analysis, this is not an assessment of map accuracy. Assessing map accuracy is an expensive and time-consuming exercise and one of great importance. Map users will have greater confidence in the map product if a more robust assessment of map accuracy is performed. Such an assessment should be based on a design using sufficient and unbiased samples (Stehman and Czaplewski 1998, Congalton and Green 1999). The completion of a formal map accuracy assessment could be conducted as a separate and independent exercise if additional data and financial resources were made available.

- **Extend and edge-match land cover data to neighboring states.**
  While SWReGAP encompasses a large geographic area covering several ecoregions, it is nevertheless bounded by neighboring states - some of which have been recently mapped and edge-matched to the SWReGAP land cover data set with good success (see SHRUBMAP Project, available from: http://sagemap.wr.usgs.gov/). We believe that the degree to which the SWReGAP

land cover data set can be edge-matched to adjoining states and Mexico depends on using standardized mapping legends and mapping methods. We recommend further research in improving and standardizing the mapping legend (i.e. ecological systems) and mapping methodologies (i.e. decision trees) used by SWReGAP.

- **Assessment of land cover change over time.**
  The SWReGAP land cover data set represents the status of land cover in the 5-state region at one period in time. This provides a great deal of information about biodiversity in the region (see Chapter 5) and its implications for land management. An important methodological objective in SWReGAP was to make the procedures as transparent and readily interpretable as possible. We suggest further research in assessing and monitoring land cover change over time. This may involve additional research into "backcasting" land cover in time to assess changes that have occurred to date, and anticipating future mapping efforts that utilize SWReGAP data to monitor land cover into the future.

Predicted Animal Habitat Distributions

The SWReGAP data set provides data and habitat models for the entire 5-state region. From a regional standpoint, the habitat modeling data sets provide the opportunity for a wide variety of stakeholders to look at species habitat conservation over wide expanses and entire ecoregions. Further work with this data set is suggested and includes:

- **Habitat model refinement is needed to provide end-users information beyond the standard presence/absence level provided.**
  Habitat model refinement is needed as new information becomes available and as experts provide new information to the process. These refinements should also include the use of species occurrence points and an inductive modeling approach. Refinements in the modeling process could also lead to the extension of the current presence/absence models to include preferred habitat or to provide probabilities of occupancy for the suitable habitat. Additionally, models could be refined to address spatially explicit considerations related to contiguity and adjacency of habitat elements.

- **Accuracy assessment of the habitat models and end user validation.**
  Habitat models should be the subject of accuracy assessment and validation. A statistically driven accuracy assessment is warranted for this data set and would provide end-users information regarding the accuracy of the models and the potential errors within each model. Model validation will occur if and when these models are incorporated into the conservation planning and other natural resource planning efforts. Further, testing the habitat models will provide additional insight into the accuracy and usefulness of the models. Various data sets are available within and between states and we encourage the use of these data to provide an indication of the accuracy of the SWReGAP habitat models.

- **Analysis of animal guilds determined necessary for conservation.**

Guilds, focal species, and functional groups of species may provide a better surrogate to conservation in some parts of the region. USFWS Region 2 for example, has identified specific conservation targets that may serve as the functional groups. The Species of Greatest Conservation Need lists, already derived by state wildlife agencies, may also provide a starting point for this process. This concept needs to be further pursued and tested for application.

- **Incorporation into the Comprehensive Wildlife Conservation Strategy format.**
  State Comprehensive Wildlife Conservation Strategies provide a blueprint for state conservation. Gap data is well suited to assist state agencies in current and future planning. There is a need for further outreach to the agencies and to work collaboratively with them to incorporate GAP data within the agencies and to modify GAP data based on agency input.

- **Further collaboration between GAP personnel and agencies charged with conservation of our natural resources.**
  There is a need for collaboration between land management agencies and natural resources agencies (state and federal) to better incorporate gap analysis data sets into the planning efforts of these agencies. This would also help facilitate the understanding of GAP personnel on specific needs and uses of spatial data sets by these land managers. Collaboration could include the identification of guilds or suites of species that better identify conservation opportunities or risks within a smaller landscape.

- **Demonstrate successful use of the data sets in conservation applications and identify associated limitations or inaccuracies.**
  Gap analysis data sets provide a useful tool for obtaining information in the larger ecological context particularly for large land stewards and agencies responsible for the management of natural resources or developing multiple-species habitat conservation plans.

Land Stewardship

The SWReGAP land stewardship data set provides stewardship and management status data for the entire 5-state region. This layer provides the context for conducting the final gap analysis. From a regional standpoint, the land stewardship data set provides the opportunity for stakeholders to look at stewardship and management status over large landscapes including entire ecoregions. Suggestions for further work related to this data set include the following:

- **Incorporate changing stewardship and management goals within the region.**
  Stewardship and management status are evolving constantly throughout the region. Management plans, such as the Region 3 forest management plan updates, change periodically, thus affecting that status of the stewardship data set and subsequent gap analyses. Changes such as these should be incorporated iteratively into the land stewardship data set to reflect the most current conditions.

- **Work with land stewards to incorporate actual land management beyond the intent identified within the GAP process.**
  Documentation and intent are not always the driving factor in actual parcel management. Additionally, there are efforts in place that may not meet GAP standards for long term maintenance but certainly affect the conservation landscape. Condition of the managed land has a significant effect on the conservation potential of that landscape.

- **Institutionalize the stewardship data set with state or federal agencies for future modification**.
  The land stewardship data set evolves continuously as parcels change ownership and protection management mandates are updated. These changes may be most readily incorporated if the data set is institutionalized and becomes a standard for use by agencies at the regional or state level.

- **Conduct outreach to provide context of the data set and potential uses and misuses.**
  Outreach is needed to work with agencies and organizations to use gap analysis data to identify conservation opportunities and pursue conservation objectives with all potential partners. For example, public outreach may help to identify opportunities for potential land swapping and boundary adjustments to maximize economic benefit while maintaining areas important for conservation.

- **Provide a more detailed assessment of conservation status.**
  The definitions supporting the four biodiversity management status categories may benefit from re-evaluation. Because of the regional focus of this project we were not able to achieve this aspect though the need is stronger now than before. Individual species and land cover types behave differently and may need more focused individual attention. Additionally, there is a perception in some agencies that Status 3 lands are inferred to be in 'poor' condition, which is not necessarily true. Likewise, Status 1 and 2 lands may not be in 'good' condition.

Gap Analyses

The gap analyses should be responsive to changes in the input data sets. When the land cover, habitat models, or land stewardship are modified substantially there should be a concerted effort to revise the input data sets and reanalyze for gaps in biodiversity conservation. A streamlined system to document, archive, and run the analyses would need to be maintained and developed to facilitate such updates.

It is important to recognize that many land cover types and terrestrial vertebrate species are relatively common throughout the region and are associated with many diverse land stewards. Having minimal representation in Status 1 and 2 lands does not necessarily mean there is currently a "gap" in protection, but that the long-term trends and conditions

of these land cover types and species should probably be monitored now and in the future.

FUTURE DIRECTIONS FOR GAP

Regional analyses are important for range-wide conservation of species. As more regional data sets become available through the Northwest GAP and Southeast GAP efforts, conservation partners will be provided a more complete picture on species conservation. Analysis will be possible within entire ecoregions, and such analyses will inform individual state efforts. Further utility in these data sets will be enhanced if topics such as ecosystem services, ecological economics, and adaptive management are included.

One objective of SWReGAP is to provide end users with data sets that can be used and modified to fit within user needs. Part of that objective is met by providing the majority of the source data used for these analyses on-line (http://fws-nmcfwru.nmsu.edu/swregap/ and http://earth.gis.usu.edu/swgap/index.html). Many of the tools created for this project are similarly available. The USGS GAP Portal will also provide internet access to SWReGAP data sets for viewing or downloading (http://gapanalysis.nbii.gov). All of these provide unique opportunities for both informative and research use of SWReGAP data.

Application of SWReGAP data into the conservation planning effort has already occurred at varying levels within state and federal agencies. An outreach effort has been initiated to provide agencies with help in understanding and implementing SWReGAP data in their conservation activities. The outreach provides background on the gap analysis project, assistance in implementing the data in other analyses, and cooperative identification of new projects in which SWReGAP data can be utilized. Current and future efforts that use or plan to use SWReGAP data include the development of multi-species habitat conservation plans at the county level (Clark County, Nevada and Pima County, Arizona), the Forest Stewardship Program's Spatial Analysis Project (Utah Division of Forestry, Fire, and State Lands), and the development of the Region 2 Conservation Targets Database (USFWS). These efforts further enhance the SWReGAP data set, providing an even greater foundation for future work by other agencies. For example, state wildlife agency use of SWReGAP animal habitat models should extend beyond the comprehensive wildlife conservation strategies to planning efforts of state land offices, parks, and other state agencies. SWReGAP data is well suited to provide the foundation of meaningful conservation at many levels.

SWReGAP collaborators are pursuing further analyses and conservation applications using SWReGAP data for fire modeling, alternative future analyses, and historic habitat change analyses. Ecoregional gap analyses such as those completed for the Colorado Plateau Ecoregion (Boykin et al. 2008, Ernst and Prior-Magee 2008, Langs et al. 2008) and Sonoran Desert Ecoregion (Thomas et al. In Review) provide context for

conservation at the ecoregional level. Maintaining updates to the current land cover data set over time may, with the cooperation of land management agencies, be managed by the Intermountain Region Digital Image Archive Center (IRDIAC).

SWReGAP data provides another tool for land managers to use in conservation planning and application in concert with current and future data sets (e.g., TNC Ecoregion Analysis, State Wildlife Action Plans).   These and other tools when combined with human intellect have the capacity to provide for long term conservation in the Southwest.