The Nature Conservancy
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Ecoregional Assessment Results for Arizona

Information for Arizona's Comprehensive Wildlife Conservation Strategy that can be derived from ecoregional analyses

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Introduction

Among the eight required elements to be addressed in each state's wildlife conservation strategy are two that involve determining priority places for conservation work:

(2) Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in [Element] 1; and,
(4) Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions.

In 1996, The Nature Conservancy began developing ecoregion-based conservation assessments for the entire United States and portions of the 31 other countries in which the Conservancy works. Assessments are science-based attempts to determine how much and what parts of the landscape are needed to maintain biological diversity over the long term. They require large amounts of data and a wide array of agency, academic, institutional, Tribal, and private-sector expertise.

Ecoregions are large areas of land and water – on the scale of tens of millions of acres – that are characterized by distinct plant communities, species, and environmental conditions such as climate and landforms. The Nature Conservancy used the U.S. Forest Service ECOMAP framework (Bailey 1994, 1995, 1998) as the basis for delineating North American ecoregions, making minor modifications where regional data sets or expertise resulted in enhanced boundaries for conservation-based analyses.

Analyses have been completed for the five ecoregions that include Arizona (Figure 1): Arizona-New Mexico Mountains (TNC 1999), Sonoran Desert (Marshall et al. 2000), Mohave Desert (TNC 2001), Colorado Plateau (Tuhy et al. 2002), and Apache Highlands (Marshall et al. 2003). The reports and some associated data for these are publicly available online (azconservation.org). Combined, the five analyses represent the most comprehensive state-wide identification of areas where enhanced conservation management is needed to maintain the viability of the region's native biodiversity. With their extensive integration and synthesis of traditional and contemporary empirical data, ecoregional assessments also represent a new source of information to better frame conservation issues, and support development of conservation strategies.

Methods

There are four fundamental components of the ecoregional assessment methodology that distinguish this analysis and associated data set (Groves et al. 2000, 2002):

1) Identification of ***conservation targets*** including ecological systems and a broad group of species that comprehensively represent an ecoregion's biological diversity.
2) Identification of ***conservation goals*** that serve as a hypothesis for the number and distribution needed to maintain long-term viability of each conservation target.
3) Assessment of ***viability*** for conservation targets to minimize inclusion of data on non-viable locations or species' for which viability is questionable.
4) Identification of ***conservation areas*** sufficient in size and distribution to capture ecological variation and to meet conservation goals for targets.

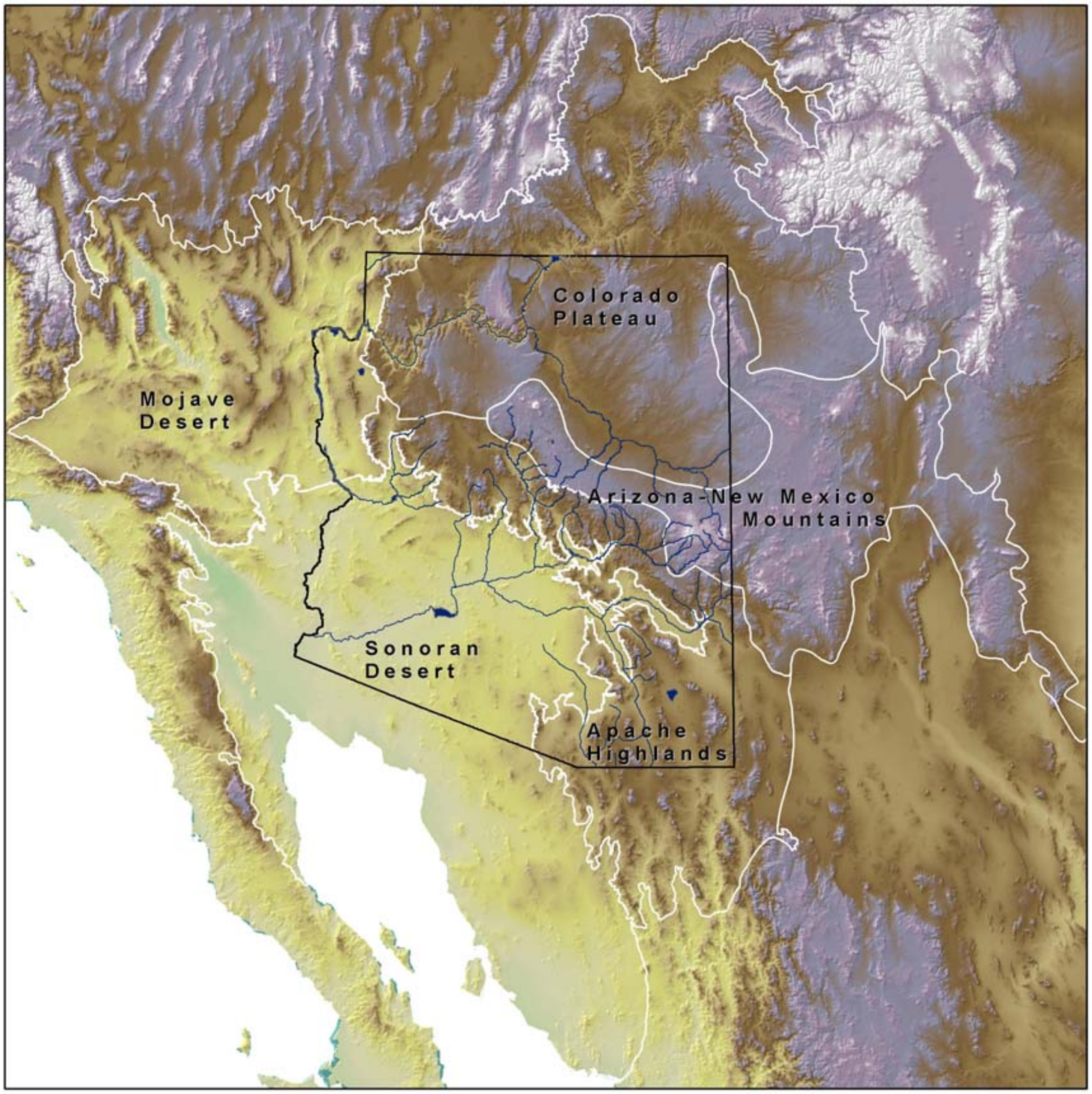

Figure 1. Arizona and the five ecoregions that encompass it.

Conservation Targets

Conservation targets are identified based on the coarse filter – fine filter approach (Groves et al. 2000). This method integrates two scales of biological organization: ecological system level and species level. The underlying assumption of this approach is that the viability of species is maximized when ecological processes are maintained at the system level and adequate habitat – both in distribution and minimum patch size – is maintained at the species level.

For the coarse filter a seamless data set of ecological systems is used and all systems across an ecoregion have equal conservation value. For example, a commonly-used data set to derive ecological systems is plant community data from the USGS Gap Analysis Program. For these data all plant communities would be selected as conservation targets and the conservation status of creosote-bursage desertscrub would have equal value to that of an aspen stand. Analyzing biological organization at this scale enables one to factor in the role of ecological processes, or the dominant disturbance regimes, such as fire and flooding, that play an important role in maintaining the structure and function of ecological systems that perpetuate biological diversity.

For fine filter conservation targets individual species are selected based on criteria such as rarity, conservation status, habitat requirements (e.g., minimum area/dispersal requirements), and the availability of data. The premise of the fine filter is to analyze the organisms that might "fall through the cracks" if only ecological systems were evaluated. Implicit in the fine filter is that species' distributions often overlap several ecological systems or, conversely, have very narrow habitat requirements within a particular ecological system and, therefore, might not be adequately captured in a coarse filter analysis. The selection of species is necessarily biased by available data.

For those parts of the ecoregions that lap into Arizona, conservation targets used in the assessments included 270 animal species and 266 plant species (not counting multiple subspecies used as separate targets). They represent all major taxonomic groups (Figure 2) and range from the rarest to most common (Figure 3).

Distribution of target species was determined by using point locality information from Arizona's Heritage Data Management System and its counterparts in neighboring states, along with natural history museum specimen data. Biological experts, including many AGFD staff, supplemented these data with information on the distribution of viable habitat for particular species. Within Arizona, approximately 10,000 point localities for these species were incorporated in the spatial analyses.

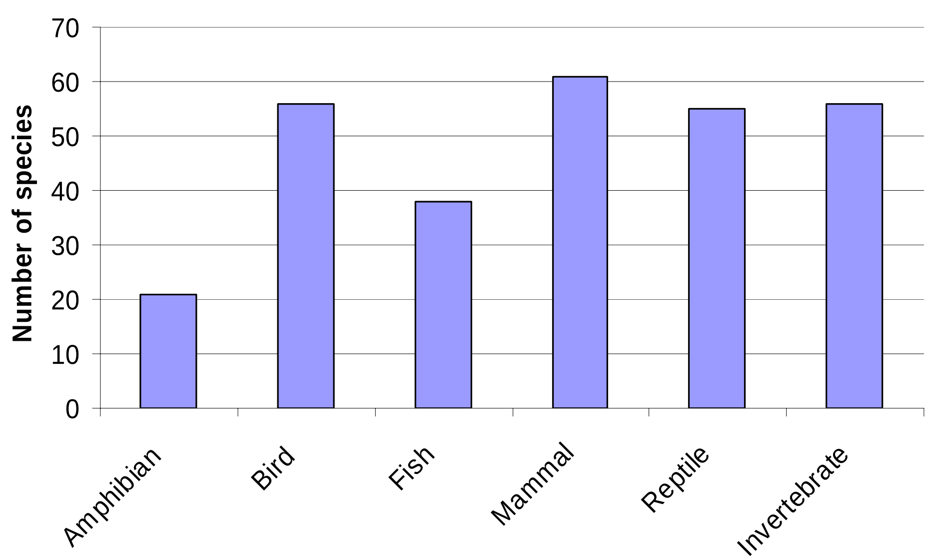

Figure 2. Representation of taxonomic groups among Arizona wildlife species targets.

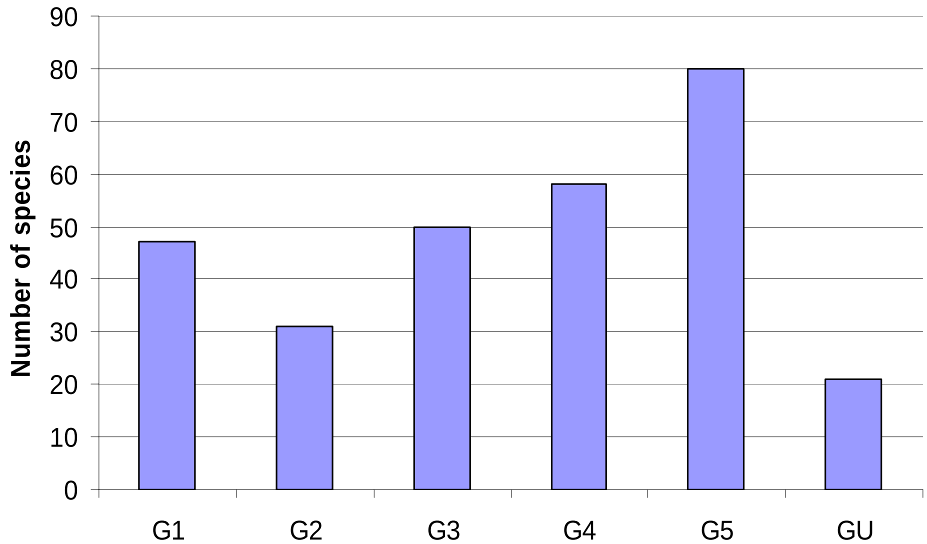

Figure 3. Representation of global rarity ranks among Arizona wildlife species targets. Ranks range from G1 (very rare) to G5 (most common), with GU representing unranked species.

Conservation Goals

Conservation goals are identified for both coarse filter and fine filter targets. They are used for two purposes in ecoregional assessments: first as a hypothesis for the number and distribution of each conservation target needed to maximize its viability over the long-term; and, second as an accounting unit to aid in determining the degree to which the identification of conservation areas meets established conservation goals. Conservation goals are typically expressed as a number and distribution of populations for species, and as an overall acreage, minimum patch size, and geographic distribution for ecological systems.

Viability Assessment

Viability assessments are used to minimize inclusion of particular geographic areas within an ecoregion that no longer support viable ecological systems or occurrences of conservation targets. Viability is assessed by one or more of the following methods; (1) review of Heritage Program evaluations of species occurrences; (2) review of the temporal distribution of target occurrence records for records lacking recent verification; (3) development of “cost surfaces” that depict variation in levels of infrastructure such as urban development, tilled agricultural areas, mines, and roads, to predict where species viability might be impaired; and (4) contemporary expert input on the selection of targets and distribution of high-quality species habitat.

Conservation Area Selection

Conservation areas represent locations on the landscape that (1) contain ecological systems of sufficient size and functioning to maintain ecological processes, and (2) contain populations of target species in sufficient number and distribution to maximize long-term viability. Conservation areas represent the integration and synthesis of conservation target data, conservation goals, and assessments of target viability. Conservation areas were identified using combination of computer analyses and manual delineation for ecoregional assessments completed prior to 2001. The GIS-based site selection algorithm, SITES (Andelman et al. 1999), was the primary tool used to identify conservation areas for assessments completed after 2001.

Results

For this report, we integrated the data and results for all five ecoregions, then clipped them to the extent possible to the area within Arizona's boundaries.

The analyses identified 147 areas that qualify as conservation priorities in Arizona (Figure 4). These comprise about 27 million acres of land, 37% of the state (see Table 1 for details by ecoregion).

Table 1. Process and results for ecoregional analyses. Numbers given here include all data for each ecoregion, and thus have more than are found solely within Arizona.

	AZ-NM Mountains	**Sonoran Desert**	**Mohave Desert**	**Colorado Plateau**	**Apache Highlands**
Year completed	1999	2000	2001	2002	2003
Agencies, universities, tribes involved	not recorded	54	32	40	30
Experts involved	100	110	65	65	75
# Coarse filter targets	149	78	135	113	26
# Fine filter targets	199	353	634	248	223
# Species localities incorporated	3,314	3,547	not recorded	3,000	4,587
How derived conservation goals	Numeric goals based on target rarity	Numeric goals based on target rarity	Numeric goals based on target rarity and distribution	Numeric goals based on target rarity and distribution	Numeric goals based on target rarity and distribution
How viability assessed	Heritage occurrence ranks, expert input	Expert input	Heritage occurrence ranks, expert input	Heritage occurrence ranks, expert input, recent records, cost surface	Heritage occurrence ranks, expert input, recent records, cost surface
Portfolio assembly method	Expert input, computer analysis, manual delineation	Expert input, computer analysis, manual delineation	Expert input, computer analysis, manual delineation	Program SITES, with expert refinement	Program SITES, with expert refinement
# Conservation areas identified	52	100 landscape, 79 small site	367	107	90
Portion of ecoregion within conservation areas	24%	42%	38%	36%	40%
Total ecoregion area (acres)	29,952,000	55,200,000	32,389,000	48,535,000	29,820,000
States involved	Arizona, New Mexico, Texas	Arizona, Sonora, California, Baja Calif.	Arizona, California, Nevada, Utah	Arizona, Utah, New Mexico, Colorado	Arizona, Sonora, New Mexico, Chihuahua

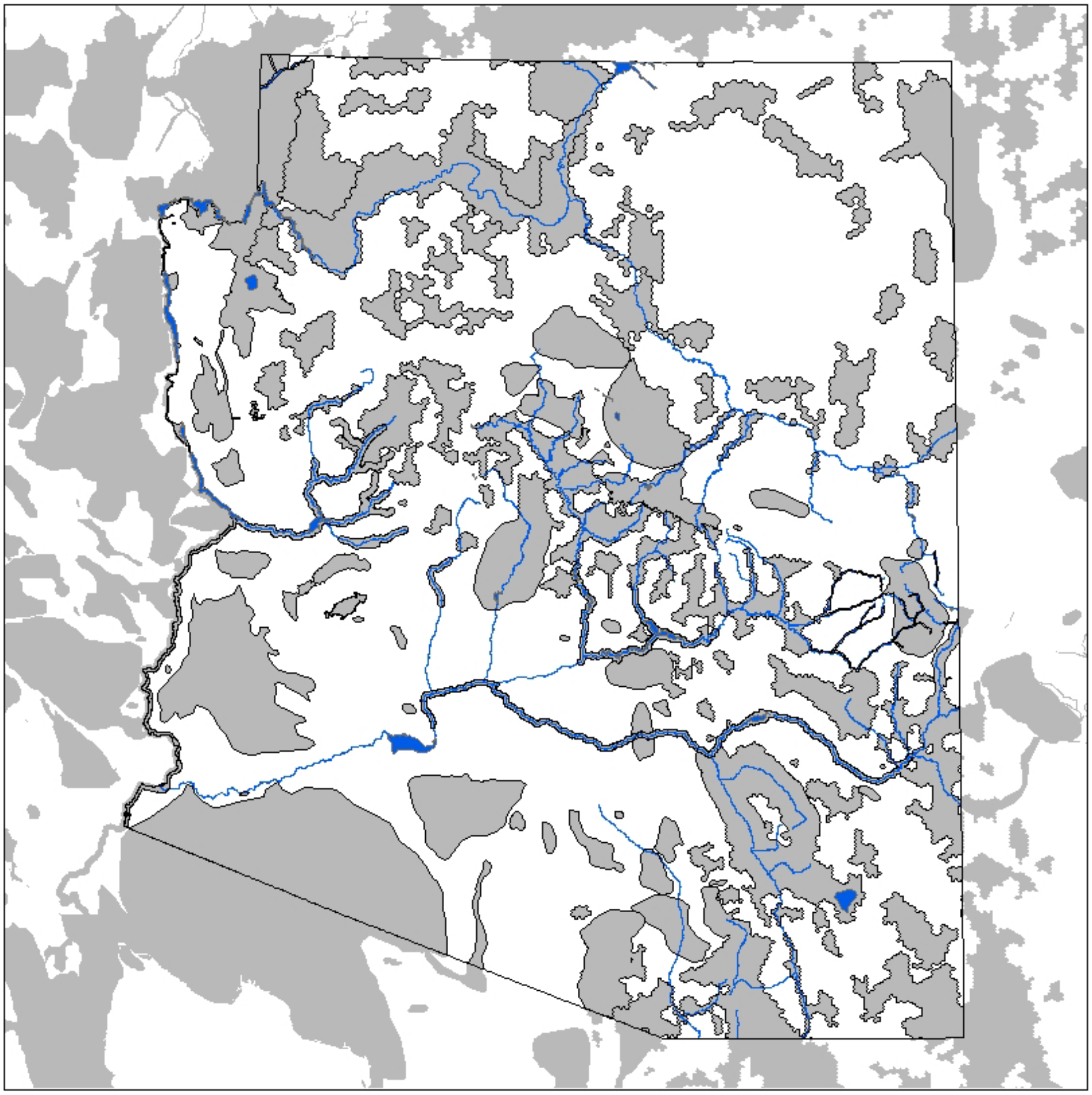

Figure 4. The portfolio of conservation areas identified within Arizona. Major rivers shown for reference only, though some delineate the cores of conservation areas focused on aquatic and riparian species and communities.

Discussion

A comparison of these conservation areas with the Arizona's biotic communities, as described by Brown (1994) and mapped by Brown and Lowe (1980), shows that the conservation areas encompass all 14 of the biomes in the state (Table 2). Compared to their statewide distribution, the proportion of each biome represented within the conservation areas ranges from 24% to 100%.

Table 2. Biotic community representation in the conservation areas. Community ("biome") names, numbers, and mapping from Brown (1994) and Brown and Lowe (1980). Data for the "portfolio" of conservation areas represents combined area of all occurrences.

Biome Name	Biome Number	Arizona (Acres)	Portfolio (Acres)	% in Portfolio
Alpine Tundras	111.5	1,365	1,366	100%
Petran Subalpine Conifer Forest	121.3	240,807	131,129	54%
Petran Montane Conifer Forest	122.3	4,711,421	2,055,837	44%
Great Basin Conifer Woodland	122.4	13,167,482	4,852,494	37%
Madrean Evergreen Woodland	123.3	1,895,750	1,144,885	60%
Interior Chaparral	133.3	3,117,850	1,190,697	38%
Subalpine Grassland	141.4	61,673	45,964	75%
Plains and Great Basin Grassland	142.1	9,832,164	2,378,221	24%
Semidesert Grassland	143.1	7,042,140	3,487,016	50%
Great Basin Desertscrub	152.1	5,696,914	1,798,952	32%
Mohave Desertscrub	153.1	3,542,427	1,760,739	50%
Chihuahuan Desertscrub	153.2	1,278,674	387,884	30%
Sonoran Desertscrub- Lower Colorado River Subdivision	154.11	11,838,920	4,001,115	34%
Sonoran Desertscrub- Arizona Upland Subdivision	154.12	10,507,767	3,927,244	37%
TOTAL		72,935,356	27,163,544	37%

Comparison with a map of perennial streams shows that the conservation areas encompass 66% of Arizona's perennial stream length, for a total of 4,900 stream miles. It includes what is likely the best remaining habitat for all of the state's native fish species, along with the associated riparian areas, when compared to a TNC mapping of fish distribution.

Comparison with a recent statewide map of grassland habitat (Schussman and Gori 2004) shows that the conservation areas encompass 27% of Arizona's highest quality native grasslands, along with 55% of the restorable native grasslands.

These ecoregional assessments identify which parts of the landscape would, if managed well, most effectively maintain all of Arizona's native species. Since they were built around more than 250 animal species, including both rare species and those native game species of conservation concern (like pronghorn and scaled quail), they also match well with the national criteria.

The results can contribute to the strength of the state conservation strategy in several ways. They show where habitat types can be best protected while also protecting the known localities of rare and sensitive species. They give a landscape-level prioritization for developing land protection projects, and they provide a conservation analysis that crosses state and national borders to identify the most effective places for cross-boundary actions.

Literature Cited

Andelman, S., I. Ball, F. Davis, and D. Stoms. 1999. SITES v. 1.0: an analytical toolbox for designing ecoregional conservation portfolios. Manual prepared for The Nature Conservancy. http://www.biogeog.ucsb.edu/projects/tnc/toolbox.html

Bailey, R.G. 1994. Ecoregions of the United States (revised map). U.S.D.A. Forest Service. Washington D.C.

Bailey, R.G. 1995. Descriptions of the Ecoregions of the United States. Second Edition. U.S.D.A. Forest Service Miscellaneous Publication Number 1391. Washington, DC.

Bailey, R.G. 1998. Ecoregions Map of North America: Explanatory Note. Prepared in Cooperation with The Nature Conservancy and the U.S. Geological Survey. U.S.D.A. Forest Service, Miscellaneous Publication Number 1548. Washington, DC.

Brown, D.E., ed. 1994. Biotic Communities: Southwestern United States and Northwestern Mexico. University of Utah Press, Salt Lake City, UT.

Brown, D.E., and C.H. Lowe. 1980. Biotic communities of the Southwest (map). U.S.D.A. Forest Service General Technical Report RM-78, Fort Collins, CO.

Groves, C., L. Valutis, D. Vosick, B. Neely, K. Wheaton, J. Touval, and B. Runnels. 2000. Designing a geography of hope: a practitioner's handbook for ecoregional conservation planning. The Nature Conservancy, Arlington, VA.

Groves, C.R., D.B. Jensen, L.L. Valutis, K.H. Redford, M.L. Shaffer, J.M. Scott, J.V. Baumgartner, J.V. Higgins, M.W. Beck, and M.G. Anderson. 2002. Planning for biodiversity conservation: putting conservation science into practice. Bioscience 52: 499-512.

Marshall, R.M., S. Anderson, M. Batcher, P. Comer, S. Cornelius, R. Cox, A. Gondor, D. Gori, J. Humke, R. Paredes Aguilar, I.E. Parra, S. Schwartz. 2000. An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion. Prepared by The Nature Conservancy Arizona Chapter, Sonoran Institute, and Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora with support from Department of Defense Legacy Program, Agency and Institutional partners. 146 pp.

Marshall, R.M., D. Turner, A. Gondor, D. Gori, C. Enquist, G. Luna, R. Paredes Aguilar, S. Anderson, S. Schwartz, C. Watts, E. Lopez, P. Comer. 2004. An Ecological Analysis of Conservation Priorities in the Apache Highlands Ecoregion. Prepared by The Nature Conservancy of Arizona, Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora, agency and institutional partners. 152 pp.

Schussman, H., and D. Gori. 2004. An ecological assessment of the Bureau of Land Management's current fire management plans: materials and recommendations for future fire planning. Report to Bureau of Land Management, Arizona State Office, Phoenix, Arizona. 101 pp.

The Nature Conservancy (TNC). 1999. Ecoregional conservation analysis of the Arizona - New Mexico Mountains. The Nature Conservancy of New Mexico, Santa Fe. 151 pp.

The Nature Conservancy (TNC). 2001. Ecoregion-based conservation in the Mojave Desert. The Nature Conservancy of Nevada, Las Vegas. 367 pp.

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, Utah. 110 p. + appendices.