

Chapter 1:
Introduction

In

Ecological and Biological Diversity of National Forests in Region 3

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SAVING THE LAST GREAT PLACES ON EARTH

EXECUTIVE SUMMARY

We summarized existing regional-scale biological and ecological assessment information from Arizona and New Mexico for use in the development of Forest Plans for the eleven National Forests in USDA Forest Service Region 3 (Region 3). Under the current Planning Rule, Forest Plans are to be strategic documents focusing on ecological, economic, and social sustainability. In addition, Region 3 has identified restoration of the functionality of fire-adapted systems as a central priority to address forest health issues. Assessments were selected for inclusion in this report based on (1) relevance to Forest Planning needs with emphasis on the need to address ecosystem diversity and ecological sustainability, (2) suitability to address restoration of Region 3's major vegetation systems, and (3) suitability to address ecological conditions at regional scales.

We identified five assessments that addressed the distribution and current condition of ecological and biological diversity within Region 3. We summarized each of these assessments to highlight important ecological resources that exist on National Forests in Arizona and New Mexico:

- Extent and distribution of potential natural vegetation types in Arizona and New Mexico
- Distribution and condition of low-elevation grasslands in Arizona
- Distribution of stream reaches with native fish occurrences in Arizona
- Species richness and conservation status attributes for all species on National Forests in Arizona and New Mexico
- Identification of priority areas for biodiversity conservation from Ecoregional Assessments from Arizona and New Mexico

Analyses of available assessments were completed across all management jurisdictions for Arizona and New Mexico, providing a regional context to illustrate the biological and ecological importance of National Forests in Region 3. For example, we identified several ecologically important potential natural vegetation types that occur predominately on Region 3 National Forests – ponderosa pine forest, Madrean encinal woodland, interior chaparral, and mixed conifer forest (Chapter 3). Understanding the regional context of the biological and ecological resources managed by Region 3 – both the distribution and condition of those resources – is a necessary pre-requisite to the identification of management strategies that would enable Region 3 to attain ecosystem diversity and ecological sustainability goals. Moreover, multiple land managers share management responsibility for some of the same resources across Arizona and New Mexico; regional data and syntheses provide a starting point for identifying areas where collaborative restoration would be feasible and an effective means of addressing land health issues that span jurisdictional boundaries.

Syntheses of several other assessments illustrate the importance of National Forests within Arizona. For example, based on an assessment of native fish habitat, headwater streams in Region 3 National Forests contain more native fish habitat with higher levels of species richness than streams managed by any other landowner. Our analysis also identified stream reaches on each National Forest that might appropriately be managed to

maintain native fishes based on contemporary occurrences. Based on the Arizona Grasslands Assessment, we summarized the distribution and condition of low-elevation grasslands (5,000 ft. and below) on National Forests in Arizona. As a statewide assessment, it provides valuable context for identifying appropriate grassland management strategies, as some of the best native-dominated grasslands remaining in Arizona overlap National Forests. The assessment also identifies areas where grassland restoration is most feasible. The Forest Plan revision process provides an important opportunity to develop strategies that will maintain grasslands in good condition or enhance those in need of restoration to maximize Region 3's ability to meet sustainability goals for this important regional ecosystem type.

As with vegetation systems, it is important to address species sustainability at appropriate scales. We aggregated existing information on species occurrences on each Region 3 National Forest to develop a regional database with consistent attributes that are useful in addressing species diversity and conservation needs within Forest Plans. The database can be used to quickly identify potential species of management concern for each Forest. Importantly, the database can also be used to distinguish species that might appropriately be considered at multi-forest scales for planning, management, and monitoring activities.

Ecoregional conservation assessments provide an important starting point for evaluating overall ecosystem diversity and ecological sustainability. These large-landscape assessments synthesize numerous datasets and identify a network of areas that are vital to the sustainability of biodiversity in the region. Our analysis of ecoregional assessment information demonstrated significant overlap between the network and National Forest lands in Arizona and New Mexico, demonstrating the important role Region 3 Forests play in maintaining the region's biological diversity. The assessments also point to priority geographies on National Forest lands where the role of natural disturbance processes in maintaining ecosystem diversity, and the compatibility of land management activities and land-use allocations, should be evaluated to maximize options for attaining ecological sustainability goals.

The assessments analyzed in this report provide basic information on the status and distribution of ecosystems and species that occur throughout Region 3 Forests. The data provide a starting point for understanding the range of biological and ecological elements that would need to be addressed during the Forest Plan revision process. Regional-scale assessment information provides a context for understanding the role USFS plays in managing regional-scale resources and how proposed management strategies will affect the balance of those resources both on USFS lands and the region as a whole.

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Introduction

The 11 National Forests of the U.S. Forest Service (USFS) Southwestern Region (Region 3) will begin revising their Forest Management Plans (forest plans) in the near future. The new National Forest Management Act (NFMA) planning regulations [published in the *Federal Register* on 5 January 2005 (70 Fed. Reg. 1023)] that will be used in the revision of forest plans within Region 3 emphasize the importance of ecological, social, and economic sustainability as the overall goal in forest planning. Forest plans will be strategic in nature and will describe desired future conditions for ecological, social, and economic components. A central focus of the ecological sustainability component is restoring and maintaining ecosystem health (structure and function) as a means to maintain the plant and animal communities that depend on them. Additionally, the planning regulations provide a framework for maintaining species diversity by identifying and developing provisions for species whose continued existence may be of concern. In addition to the planning regulations, Region 3 has identified strategic priorities for forest plans. A central priority is the restoration of the ecological functionality of southwestern forests and rangelands, with a primary focus on the functionality of fire-adapted systems.

A key need within the plan revision process is the availability of timely and relevant scientific information on the ecosystems, biological processes, and species that occur on Region 3 Forests. In preparation for this, Region 3 developed a *Strategic Approach to Meet Regional Priorities and Prepare for Forest Plan Revisions* that identified tools, techniques and information “to conduct analyses needed to support the regional and national central priority of restoring the functionality of fire-adapted systems,” and to revise forest plans. In 2004, The Nature Conservancy entered into a cost-share agreement with Region 3 to conduct ecological analyses and gather pertinent scientific information relating to the needs identified by Region 3. This collaborative project aims to prepare relevant scientific background information relating to three primary objectives:

1. **Assessment of Assessments**, a review of information developed since creation of the previous Land and Resource Management Plans that will enable the Forest Service to satisfy information standards established under new planning regulations and to ensure that the best available scientific information is integrated into the development of forest plans.
2. **Determining the Historical/Natural Range of Variation** for major vegetation types and the biological diversity they harbor. HRV characterizations provide a baseline for evaluating the short- and long-term effects of natural and anthropogenic disturbances on forest resources. The historical range of variation in disturbance regimes, and climatic effects on those regimes, is the foundation for developing models of vegetative change.
3. **Developing Models of Vegetation Change** for major southwestern vegetation types. Development of ecological models for vegetation types will enable the Forest Service to evaluate management activities and better incorporate the role of ecological processes in forest management.

This report provides a summary and analysis of existing, relevant ecological assessments (Objective 1) pertinent to forest plans in Region 3. In order to provide consistent information

across Region 3, a priority has been placed on identifying and analyzing assessments conducted at large spatial scales, such as state or regional levels. Also, the assessments included in this report are directly related to the ecosystem health, functionality, and species diversity objectives in the planning regulations and Region 3's strategic priorities. Assessments relating to the following types of information relevant to forest planning needs are included:

- Distribution and extent of potential natural vegetation types (PNVTs)
- Distribution and condition of grassland systems
- Distribution of native fish species
- Conservation status of plant and animal species on Region 3 Forests
- Conservation areas and targets associated with Ecoregional Assessments

Details about the specific assessments used for analyses are provided in Chapter 2 (Methods).

A primary focus of this report is to identify the important biological values that occur on National Forests in Region 3. This information may be useful as part of the forest planning process for evaluating the suitability of current management activities and land management designations, identifying ecological characteristics that may be considered in developing desired conditions, and identifying species that may need special consideration due to continuing threats to their existence.

Because understanding ecosystem structure and functions, as well as species diversity, requires information at several scales, this report provides analysis of assessment information at two scales. Chapter 3 provides a detailed analysis of the assessments across major landowners within Region 3, as well as comparisons amongst individual National Forests. Chapters 4 -15 provide a detailed analysis of the assessment information for each National Forest in Region 3 (National Grasslands on the Cibola National Forest are considered in a separate chapter).

Chapter 2:

Methods

In

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Introduction

This report utilizes existing ecological assessment information to identify and summarize important biological values that exist on the 11 U.S. Forest Service (USFS) Southwestern Region (Region 3) National Forests. The individual assessments analyzed in this report were included based on their geographic scale and relevance to the development of forest plans. Assessments conducted at broad geographic scales (regional or state level) and across multiple or all National Forests were included to provide as consistent information as possible for each National Forest. Additionally, we included assessments that were closely associated with the ecological sustainability (ecosystem and species diversity) focus of the National Forest Management Act (NFMA) planning regulation, and Region 3's central priority of restoring the functionality of fire-adapted systems. Descriptions of each assessment analyzed in this report, including a summary of its content, the methods used to create it, its geographic scale, and specific details regarding its analysis are provided below.

In general, the ecological information within each assessment was characterized by major landowners across Region 3 (see Chapter 3; including all of New Mexico and Arizona), as well as for each National Forest within Region 3 (see Chapters 4-15; Grasslands of the Cibola National Forest are considered in a separate chapter). For these analyses, the following two geographic information systems (GIS) data layers were utilized in addition to the assessment data:

1. A land ownership layer developed using data from the Arizona Land Resource Information Service (ALRIS; <http://www.land.state.az.us/alris/index.html>) and the New Mexico Resource Geographic Information System Program (RGIS; <http://rgis.unm.edu/>). ALRIS and RGIS data layers were edge-matched using topological editing procedures and management attributes were cross-walked. Land ownership categories included: US Forest Service, Bureau of Land Management, Department of Defense, National Park Service, Private, State Trust, Tribal, US Fish and Wildlife Service and Other. The 'Other' category included non-federal parks, Valle Calderas National Preserve, county lands, Department of Energy, USDA Research, State Game and Fish, and unnamed areas.
2. National Forest administrative boundaries, including ranger districts.

Due to the occurrence of non-USFS owned lands within the administrative boundaries, the calculation of area or stream lengths relating to National Forest lands may differ between these two scales of analysis. All geo-spatial analyses were conducted using ArcGIS 9.0/9.1 (ESRI; Redlands, CA).

I. Potential Natural Vegetation Types

The distribution of potential natural vegetation types (PNVTs) on Region 3 National Forest lands and across land owners throughout Arizona and New Mexico was analyzed. Potential natural vegetation types are coarse-scale groupings of ecosystem types that share similar geography, vegetation, and historic ecosystem disturbances such as fire, drought, and native herbivory. PNVTs were used to summarize vegetation for this analysis because of their relevance to the characterizations of historic range of variability and vegetation models being developed for PNVTs in preparation for the forest planning process.

To determine PNVTs for Region 3 Forests and throughout Arizona and New Mexico, geo-spatial vegetation data were obtained from The Southwest Regional Gap Analysis Project (SWReGAP). SWReGAP is a collaborative project covering five states (Arizona, Colorado, Nevada, New Mexico and Utah) coordinated by the U.S. Geological Survey's Gap Analysis Program (GAP; USGS National Gap Analysis Program 2004). Parts of the Oklahoma Gap Analysis Program (OK-GAP; USGS National Gap Analysis Program) and the Texas Gap Analysis Program (TX-GAP; USGS National Gap Analysis Program) data were used to analyze PNVTs on Region 3 National Grasslands in Oklahoma and Texas, respectively.

The geo-referenced spatial dataset of SWReGAP is based on multi-season data acquired from Landsat 7 Enhanced Thematic Mapper 30m satellite imagery, coincident digital elevation models, and extensive field observations. The OK-GAP data are based on Thematic Mapper I imagery from 1991- 1993 and field reconnaissance. For more information regarding OK-GAP refer to the following website: <http://www.biosurvey.ou.edu/gap-ok.html>. The TX-GAP data is generated from Multi-Resolution Land Characteristics Consortium's hyper-clustered Landsat Thematic Mapper satellite imagery. For more information regarding TX-GAP see the final report at ftp://ftp.gap.uidaho.edu/products/Texas/report/TX_GAPReport.pdf.

Land cover (vegetation) types from SWReGAP, OK-GAP, and TX-GAP data were modeled and/or interpreted by each state team and described as ecological systems or map classes as developed by NatureServe. (For information on NatureServe and ecological systems see <http://www.natureserve.org>. For information on the SWReGAP map classes see http://earth.gis.usu.edu/swgap/legend_desc.html.) Ecological systems are based on ecological and geographical groupings of vegetation associations as defined by the National Vegetation Classification System (<http://biology.usgs.gov/npsveg/nvcs.html>).

A total of 135 ecological system types were identified from the SWReGAP, OK-GAP, and TX-GAP for all of Arizona, New Mexico, and the Region 3 National Grasslands in Oklahoma and Texas. These ecosystem types were then aggregated and cross-walked to 30 PNVTs identified by The Nature Conservancy (TNC) ecologists. A cross-walk between these ecosystem types and TNC-designated PNVTs can be found in Appendix 2-A. In addition, descriptions of each PNVT can be found in Appendix 2-B.

It should be noted that SWReGAP data have not been accuracy tested, and some errors with this dataset are known. Therefore, these inaccuracies may be compounded by our ecosystem type grouping and cross-walk process. However, this cross-walk allows for a comprehensive look at

PNVTs across the southwest region and hence, is a valuable tool for comparing PNVTs of Region 3 Forests and other landowners within Arizona and New Mexico. Also, it should be noted that SWReGAP, OK-GAP, and TX-GAP data may not be appropriate for use at fine spatial scales.

Other data sources considered for these analyses but not utilized include: Brown, Lowe, and Pase (1980); USFS General Ecosystem Survey; USFS Terrestrial Ecosystem Survey; and the USFS Region 3 mid-scale vegetation maps currently being developed. Data from Brown, Lowe, and Pase (1980) and the General Ecosystem Survey were deemed too coarse in scale for these analyses. The USFS Terrestrial Ecosystem Survey data and USFS Region 3 mid-scale vegetation maps were not completed at the time of this project for all Region 3 National Forests, and were therefore not utilized. Furthermore, data from the General Ecosystem Survey, Terrestrial Ecosystem Survey, and mid-scale vegetation maps do not extend beyond Forest Service boundaries and were therefore not available for comparisons between PNVTs of Region 3 Forests and other landowners in Arizona and New Mexico.

Total area and distribution of PNVTs were calculated for each Region 3 National Forest and compared amongst other Region 3 Forest and to other landowners in Arizona and New Mexico using the land ownership layer for Region 3 described above.

II. Distribution and Condition of Grasslands

The Arizona Statewide Grassland Assessment (grassland assessment, Schussman and Gori 2004, Gori and Enquist 2003; available at <http://www.azconservation.org>) was used to identify the extent, distribution, and condition of former and current grasslands that exist across land ownerships and on each National Forest within Arizona. This statewide assessment (which also includes the portions of southwest New Mexico and Mexico that are within the Apache-Highlands Ecoregion; Figure 2-1) was developed through a combination of expert-based mapping and intensive, quantitative field sampling to verify and improve accuracy. Grassland condition was assessed and assigned to condition classes based on native/non-native grass dominance and cover, shrub cover, and erosion severity. For the purposes of this analysis, condition classes were aggregated into five grassland condition types (Table 2-1).

The Arizona Grasslands Assessment was limited to low-elevation grasslands (< 5000 ft.), and so does not address all grasslands (particularly montane grasslands) that exist within Arizona. Also, approximately 32% of grasslands within the state, predominately on Native American Trust Lands, were not assigned to a condition type. Therefore, these areas were excluded from all percentage calculations associated with relative abundance of grassland classes. In addition, this analysis only includes portions of the grassland assessment in Arizona and New Mexico and does not include the Mexican portion of the assessment. Due to differences in the approach and scale used to classify vegetation, the distribution and extent of grasslands identified by the grassland assessment likely vary from other vegetation assessment and mapping projects, such as the SWReGAP. Comparable data were not available for most of New Mexico.

Detailed descriptions of the grassland categories that exist in Arizona and New Mexico (i.e. desert, Great Basin, Colorado Plateau, Plains, and Montane grasslands), their ecology, and general changes from historic conditions were provided by Finch (2004). This resource provides valuable information for understanding the changes in grassland structure and function documented in the Arizona Grassland Assessment.

In Chapter 3, the Arizona Grasslands GIS-based layer (available at <http://www.azconservation.org>) was used, along with the land ownership layer (described above), to identify the distribution and condition of grasslands amongst major landowners and each National Forest in Arizona. In Chapters 4-15, the grasslands layer was overlaid on the administrative boundaries for each National Forest to identify the location and extent of grasslands of varying condition types amongst ranger districts.

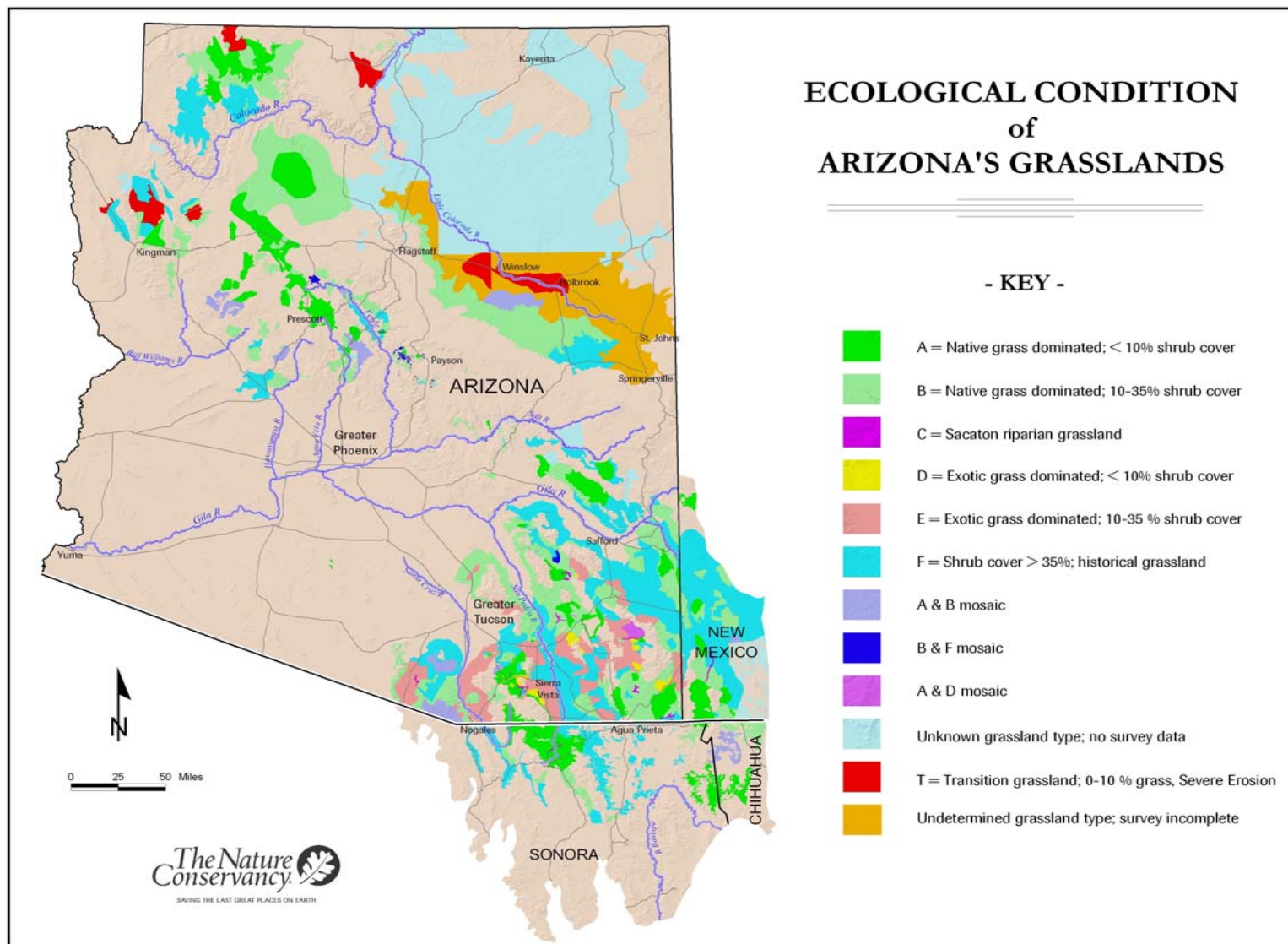


Table 2-1. Grassland types identified in the Arizona Grasslands Assessment (Schussman and Gori 2004, Gori and Enquist 2003) based on native/non-native perennial grass dominance and cover, shrub cover, and soil erosion severity.

Grassland Type	Description
Open Native Grassland	A grassland with <10% shrub cover and herbaceous component is predominantly native perennial grasses and herbs.
Restorable (Shrub Invaded) Native Grassland	A grassland with 10-35% total shrub cover and mesquite or juniper cover < 15% whose herbaceous component is predominantly native perennial grasses and herbs.
Non-native Grassland	A grassland with herbaceous component dominated by non-native perennial grasses. Includes both open (<10% shrub cover) and shrub invaded (10-35% total shrub cover of mesquite and juniper cover > 15%) grassland types.
Former Grasslands	A grassland that has been converted to shrub land, with > 15% canopy cover of mesquite and juniper and/or > 35% total shrub cover, and little or no perennial grass cover.
Transition Grasslands	A grassland with <5% canopy cover of perennial grasses and/or severe soil erosion problems.

III. Riparian and Freshwater Systems and Species

The Arizona Statewide Freshwater Assessment (Turner and List, *In Prep*; available at www.azconservation.org) was used to summarize the occurrence and distribution of stream reaches with native fish occurrences across major landowners and National Forests in Arizona. This assessment was developed for use in regional planning and includes occurrence information for 33 native fish species (Table 2-2) in streams across all of Arizona. Point localities for each species from 1975 and later were obtained from a variety of sources, including the Arizona Game and Fish Department's (AGFD) Heritage Data Management System, the SONFISHES database (Fagan and others 2002), US Fish and Wildlife Service (Sponholtz and others 2003), U.S. Forest Service, and the AGFD native fish program. For each species, these point localities were mapped to perennial stream reaches on a 1:100,000 scale linear hydrography layer for Arizona to approximate the extent of occupied habitat. This process accounted for biologically significant breaks in stream continuity, including dams and ephemeral reaches. Additionally, the assessment integrated the distributions for all 33 native fishes into a single geo-spatial data layer that represents the number of native fish with occurrences on stream reaches across Arizona. While this analysis currently includes only Arizona (including the Kaibab, Coconino, Prescott, Tonto, Apache-Sitgreaves National Forests, and the Coronado National Forest in Arizona), a similar data set for New Mexico is currently being developed and results from that analysis may be incorporated into this document .

In Chapter 3, this geo-spatial data was overlaid on landownership information from the Arizona Land Resource Information Service and the New Mexico Resource Geographic Information system (see description above) to determine the distribution (number of stream miles) of stream reaches with varying numbers of native fish species occurrences for nine major landowners and six individual National Forests in Arizona. In areas where streams serve as the boundary between landowners for a distance greater than five miles, one-half of the length of that stream reach was attributed to each landowner.

The Freshwater Assessment data was also used, along with a data layer representing the administrative boundaries of each National Forest, to identify and summarize the distribution of each species on stream reaches within each National Forest (Chapters 4-15). It is recognized that at these relatively fine scales, reaches with identified occurrences of various native fish species in the Freshwater Assessment may differ from current native fish distributions. Thus, each National Forest was given the opportunity to review the information in the Freshwater Assessment to identify stream reaches that differed from known current conditions. These differences are addressed and the information is used to demonstrate the types and magnitude of changes in native fish distributions that have occurred on National Forests within the last 30 years. In addition, information from Olden and Poff (2005) was used, where applicable, to characterize the long-term changes in distributions for native fish that occur on National Forest lands. It is important to note that the stream mile lengths for these analyses, based on Forest boundaries, differ from those presented in Chapter 3, which are based on land ownership information.

Table 2-2. Common names, scientific names, and status under the Endangered Species Act (ESA) for 33 native fishes included in the Arizona State-wide Freshwater Assessment (Turner and List, *In Prep*).

Common Name	Scientific Name	ESA Status ^A
Longfin Dace	<i>Agosia chrysogaster</i>	SC
Mexican Stoneroller	<i>Campostoma ornatum</i>	SC
Desert Sucker	<i>Catostomus clarki</i>	SC
Bluehead Sucker	<i>Catostomus discobolus</i>	
Sonora Sucker	<i>Catostomus insignis</i>	SC
Flannelmouth Sucker	<i>Catostomus latipinnis</i>	SC
Little Colorado Sucker	<i>Catostomus sp.</i>	
Zuni Mountain Sucker	<i>Catostomus yarrowi</i>	
Beautiful Shiner	<i>Cyprinella formosa</i>	LT
Desert Pupfish	<i>Cyprinodon macularius</i>	LE
Machete (Pacific Tenpounder)	<i>Elops Affinis</i>	
Humpback Chub	<i>Gila cypha</i>	LE
Sonora Chub	<i>Gila ditaenia</i>	LT
Bonytail Chub	<i>Gila elegans</i>	LE
Gila Chub	<i>Gila intermedia</i>	PE
Headwater Chub	<i>Gila nigra</i>	
Yaqui Chub	<i>Gila purpurea</i>	LE
Roundtail Chub	<i>Gila robusta</i>	PS
Virgin River Chub	<i>Gila seminuda</i>	LE
Yaqui Catfish	<i>Ictalurus pricei</i>	LT
Virgin Spinedace	<i>Lepidomeda mollispinis mollispinis</i>	PS
Little Colorado Spinedace	<i>Lepidomeda vittata</i>	LT
Spikedace	<i>Meda fulgida</i>	LT
Striped Mullet	<i>Mugil Cephalus</i>	
Apache (Arizona) Trout	<i>Oncorhynchus apache</i>	LT
Gila Trout	<i>Oncorhynchus gilae</i>	LE
Woundfin	<i>Plagopterus argentissimus</i>	LE
Gila Topminnow	<i>Poeciliopsis occidentalis occidentalis</i>	LE
Yaqui Topminnow	<i>Poeciliopsis occidentalis sonoriensis</i>	LE
Colorado Pikeminnow	<i>Ptychocheilus lucius</i>	LE
Speckled Dace	<i>Rhinichthys osculus</i>	PS
Loach Minnow	<i>Tiaroga cobitis</i>	LT
Razorback Sucker	<i>Xyrauchen texanus</i>	LE

^AC = Candidate, LE = Listed Endangered, LT = Listed Threatened, SC= Species of Concern, PS = Partial Status

IV. Plant and Animal Species Richness

The R3 Species Database was used to examine the plant and animal species richness on each Region 3 Forest and the conservation status of these species. The R3 Species Database was developed collaboratively by Region 3 staff, species experts, and The Nature Conservancy to address information needs associated with forest plan revisions. It was compiled from several Regional and Forest level datasets into one database that consists of updated and consistent information across taxa regarding state, federal, non-government, and USFS conservation statuses, and identifies the National Forest(s) a species inhabits. The R3 Species Database incorporates information on all terrestrial and aquatic vertebrates that are known to inhabit Region 3 National Forests. It also includes known crustacean, clam, insect, plant and snail species that are of conservation concern. Table 2-3 lists the taxonomic groups and species' attributes included in the R3 Species Database. More information regarding the R3 Species Database can be found at <http://www.azconservation.org>.

Table 2-3. List of taxa and species' attributes included in the R3 Species Database. The R3 Species Database includes all amphibian, bird, fish, mammal, and reptile species that are known to occur on Region 3 National Forest Service lands, and species of conservation concern for crustaceans, clams, insects, plants and snails.

Taxa Included in R3 Species Database	The R3 Species Database Fields
<ul style="list-style-type: none">• Amphibian• Bird• Crustacean• Clam• Fish• Insect• Mammal• Plant• Reptile• Snail	<ul style="list-style-type: none">• General Taxonomic Group• NatureServe Unique Identifier Number• NatureServe Scientific Name• Synonyms• NatureServe Common Name• Other Common Names• NatureServe Global Conservation Status (G-rank)• NatureServe Subnational Conservation Status (S-rank) for Arizona• NatureServe Subnational Conservation Status (S-rank) for New Mexico• NatureServe Subnational Conservation Status (S-rank) for Oklahoma• NatureServe Subnational Conservation Status (S-rank) for Texas• Federal Listing Status under Endangered Species Act• Arizona State Status (Arizona Native Plant Law 1983, Wildlife of Special Concern in Arizona 1996)• New Mexico State Status under Wildlife Conservation Act (1978) and Endangered Plant Species Act (1985)• Oklahoma State Status of Threatened, Endangered and Species of Special Concern• Texas State Status of threatened fish and wildlife• U.S. Forest Service Region 3 Sensitive Species (Updated 2000)• U.S. Forest Service Region 3 Proposed Sensitive Species (2005)• U.S. Fish and Wildlife Service Birds of Conservation Concern• Partners in Flight Watch List• Species Occurrence on each National Forest in Region 3

Conservation status information for the R3 Species Database was gathered from USFS data as well as from NatureServe, U.S. Fish and Wildlife Service, Arizona Game and Fish Department, New Mexico Department of Game and Fish, Oklahoma Department of Wildlife and Conservation, Texas Parks and Wildlife Department, and Partners in Flight. It is important to note that nomenclature (NatureServe is the standard used in the database) and conservation statuses can change over time. Data regarding species presence by National Forest were based on datasets maintained by USFS personnel and were reviewed by biologists and other resource staff on each Region 3 Forest. Because the accuracy of these data is dependent upon the quality of the source datasets and the review by a limited number of personnel in each Forest, data gaps may exist in the R3 Species Database.

Because the R3 Species Database was developed specifically for Region 3 National Forests, it was not possible to summarize species information across landowners for Chapter 3. However, information in the R3 Species Database was used to summarize plant and animal information for each Region 3 Forest and National Grasslands in Chapters 4-15. Additionally, the species that occur on each forest, along with the associated conservation status attributes, were included as an appendix within each individual Forest chapter.

Species Richness — Occurrence information from the R3 Species Database was used to identify the numbers of species, by taxon, that occur on each National Forest.

Federally listed threatened, endangered, and candidate species — Under the Endangered Species Act (1973) the U.S. Fish and Wildlife Service designates a suite of species as federally threatened or endangered. Also of importance are those species that are currently being considered for the status of threatened or endangered (including candidate or proposed species). The R3 Species Database was used to determine the federally listed endangered, threatened, candidate or proposed species (status determined as of 1 May 2005) that inhabit each Region 3 National Forest.

Arizona, New Mexico, Oklahoma, and Texas state conservation status — Included in the R3 Species Database are the Arizona, New Mexico, Oklahoma, and Texas state conservation statuses for plant and animal species. The designations for each state are:

- In Arizona, Wildlife of Special Concern (WSC) status may be assigned to species whose occurrence is or may be at risk in the state, as described by the Arizona Game and Fish Department (1996). WSC status does not include plant species. The Arizona Department of Agriculture assigns special state status for plant species under the Arizona Native Plant Law (1993) which includes: highly safeguarded (HS), salvage restricted (SR), export restricted (ER), salvage assessed (SA), and harvest restricted (HR).
- The New Mexico Game and Fish Department designates special state status to both wildlife and plant species as threatened or endangered.
- The Oklahoma Department of Wildlife and Conservation assigns species with the rank of endangered, threatened, or of special concern.
- Texas Parks and Wildlife Department considers fish or wildlife indigenous to Texas endangered if listed on: (1) the United States List of Endangered Native Fish and Wildlife; or (2) the list of fish or wildlife threatened with statewide extinction as filed by the director of the department.

The R3 Species Database was used to identify, by taxon, the numbers of species that have special state conservation status as of 1 May 2005, that occur on each National Forest.

NatureServe global conservation status ranking — The R3 Species Database includes NatureServe global rankings that reflect the conservation status of species from a global perspective. These ranks are primarily based on three biological attributes: the number of species occurrences; the total overall abundance of the species; and the overall size of the geographic range of the species (Natural Heritage New Mexico 2005). Global conservation status rankings are determined by NatureServe based on data provided by Natural Heritage Programs and Conservation Data Centers. The global conservation status rankings are: GX = presumed extinct; GH = possibly extinct; G1 = critically imperiled; G2 = imperiled; G3 = vulnerable; G4 = apparently secure; G5 = secure; GNR = not ranked; GU = unrankable; T = infraspecific taxon (subspecies, race, variety). The numbers of species by taxon occurring on each National Forest and assigned to each global conservation status ranking as of 1 May 2005 were identified.

NatureServe subnational conservation status ranking — The R3 Species Database incorporates NatureServe subnational rankings for Arizona, New Mexico, Oklahoma, and Texas for species that have rankings assigned to them. The NatureServe subnational conservation status ranking reflects the conservation status of a species from a local perspective, characterizing the relative rarity or risk of a species' population within each state. Rankings are based on the estimated or actual number of extant occurrences of the species within a state and other aspects such as threats, trends and abundance (Natural Heritage New Mexico 2005). The subnational conservation status rankings are: SX = presumed extirpated; SH = possibly extirpated; S1 = critically imperiled; S2 = imperiled; S3 = vulnerable; S4 = apparently secure; S5 = secure; SNA = not applicable; SNR = not ranked; SU = unrankable. Some species in the R3 Species Database have a subnational conservation status ranking from one or more states (Arizona, New Mexico, Oklahoma, and Texas), while some species do not have a subnational conservation status ranking from any state. The numbers of species, by taxon, assigned to each subnational conservation status as of 1 May 2005 were identified.

Potential Species-of-Concern — According to the interim directives published in the Federal Register on March 23, 2005 (70 Fed. Reg. 14637), which supplement the NFMA planning regulations (70 Fed. Reg. 1023), each National Forest may consider a category of species called "species-of-concern" as part of the new forest plans. The interim directives suggest determining species-of-concern by their NatureServe Global conservation rank. Any species with a NatureServe global conservation rank of G1, G2, G3, T1, T2, or T3 and not listed as federally endangered or threatened, may be considered a species-of-concern. Federally designated candidate or proposed species may also be considered species-of-concern. The R3 Species Database was used to identify potential species-of-concern for each Region 3 National Forest using the criteria listed above.

Potential Species-of-Interest — Another category of species addressed in the interim directives is species-of-interest. According to the sustainability directive in the Forest Service Handbook (FSH 1909.12 chapter 40) that supplements the new NFMA planning regulations, this category may include state-listed threatened and endangered species; birds on the U.S. Fish and Wildlife

Service's "Birds of Conservation Concern National Priority" list; S1 and S2 ranked species in the NatureServe ranking system; and other species of regional or local concern due to significant threats, declining populations, or rarity (FSH 43.22b). For this analysis, if a National Forest occurs in one state, the state conservation status from that state was considered. If a National Forest occurs in more than one state, species that have special state conservation status in any of those states were included as a potential species-of-interest. Based on these criteria, a suite of potential species-of-interest were identified for each Region 3 National Forest, using information from the R3 Species Database. We did not include 'other species of regional or local concern due to significant threats, declining populations, or rarity' as suggested in the interim directives, due to the subjective nature of this determination. Species listed as federally threatened or endangered, or included in species-of-concern were not included as potential species-of-interest.

Birds of conservation concern — In 2002, the U.S. Fish and Wildlife Service Division of Migratory Bird Management identified 131 bird species and subspecies as Birds of Conservation Concern for those species that were likely to become federally threatened or endangered under the Endangered Species Act if conservation measures were not taken. The R3 Species Database was used to identify the bird species with this designation for each National Forest.

Partners in Flight Watch List — Partners in Flight (PIF), a cooperative effort involving governmental agencies and non-governmental organizations dedicated to the conservation of birds that inhabit terrestrial habitats, developed a Watch List that contains bird species whose populations are thought to be of management concern and are believed to be in need of monitoring. The PIF Watch List consists of three categories of conservation status for bird species, including: species with multiple causes for concern across their entire range; species that are moderately abundant or widespread with declines or high threats; and species with restricted distribution or low population size. For more information about PIF and their Watch List refer to the website at <http://www.partnersinflight.org/>. The R3 Species Database was used to identify the bird species on the PIF Watch List as of 1 May 2005 for each National Forest.

Accidental species in the R3 Species Database — The R3 Species Database includes several species of birds that are designated as occurring on one or more Region 3 National Forest, but are considered 'accidental' according to The Sibley Guide to Birds (2001) and NatureServe Explorer (<http://www.natureserve.org/explorer/>). Accidental species are those thought to be out of their normal distributional range for the species' known over-wintering or breeding grounds, or migratory path. Because it is unlikely that more than a few individuals of these species occur on a National Forest at any given time, analyses in this report did not include accidental species.

Extirpated Species – Species that are known to be extirpated on individual Forests are not included in the R3 Species Database, but are identified in the individual Forest chapters. This information is based on species experts, forest biologists, scientific literature and wildlife databases that include NatureServe Explorer (<http://www.natureserve.org/explorer/>) and Biota Information System of New Mexico (<http://fwie.fw.vt.edu/states/nm.htm>).

V. Ecoregional Assessment Conservation Areas and Conservation Targets

The results of eight ecoregional assessments (Bell and others 1999, 2004 Marshall and others 2000, 2004, Neely and others 2001, The Nature Conservancy 2001, 2005, Tuhy 2002) were used to identify the extent and distribution of conservation areas across land ownerships in Arizona and New Mexico. Ecoregional assessments are science-based efforts to identify the minimum set of areas (conservation areas) on the landscape that are necessary to maintain the biological diversity of the ecoregion.

Ecoregions are large, contiguous units of land or water defined by ecological and environmental elements, rather than geo-political boundaries, and typically contains geographically distinct assemblages of species, natural communities, and environmental conditions. Because ecoregions typically include large proportions of ecosystem, community, and species distributions, they are useful for conservation planning. Ecoregional assessments rely on a comprehensive scientific analysis to identify conservation areas sufficient in size and distribution to maintain the biological diversity of the entire ecoregion. As an initial step, assessments identify conservation targets, a subset of organisms and ecological systems that comprehensively represent the ecoregion's biological diversity. Targets include ecological systems, typically represented by plant communities and supporting ecological processes, and a broad range of species representing major taxonomic groups, which often serve as surrogates for other species. For each conservation target, a conservation goal is determined that defines the number, spatial distribution, and spatial extent of viable occurrences of the target necessary to maintain its existence. An iterative process relying on computer software and expert review was used to identify a suite of areas that most efficiently meet the conservation goals for all conservation targets within the ecoregion. These conservation areas, collectively called a conservation portfolio, represent the most current and scientifically robust hypotheses on the magnitude and distribution of areas on the landscape necessary to protect the biodiversity of the region.

In general, ecoregional assessments serve several conservation, management and scientific purposes, including:

1. A spatial hypothesis on how to maximize the viability of a region's native species and ecological systems.
2. A spatial delineation of the areas where land-uses and land management activities should be evaluated to identify and minimize potential adverse effects to the viability of species and ecological systems.
3. A spatial delineation of priority areas that land managers and others interested in promoting conservation should evaluate first to ensure that disturbance processes that perpetuate native ecological systems (e.g., fire, flooding) are maintained at a scale, frequency, and intensity that falls within the historical range of variation.
4. A network of cross-jurisdictional priorities that could serve as a basis for collaboration and the use of limited resources to maximize conservation values.

While nine ecoregional assessments overlap Arizona and New Mexico (Figure 2-2), information from eight ecoregions was synthesized as part of this analysis. The Central Shortgrass Prairie Ecoregional Assessment (The Nature Conservancy 1998), which overlaps a small portion of

northeast New Mexico (not including any National Forest lands), was not included in this analysis. As part of a regional data rollup effort, The Nature Conservancy merged conservation area information from six individual assessments (Apache Highlands, Arizona-New Mexico Mountains, Colorado Plateau, Mojave Desert, Sonoran Desert, and the Southern Rocky Mountains) into a single regional geo-spatial data layer (<http://www.azconservation.org>). This dataset includes conservation area boundaries and attributes for the conservation targets that occur within each conservation area in those ecoregions. The assessments for Chihuahuan Desert Ecoregion, which overlaps a small part of the Lincoln National Forest, the Southern Shortgrass Prairie Ecoregion, which includes portions of the Santa Fe National Forest and Cibola National Grasslands, were included individually.

Data from the ecoregional assessments were used, along with the land ownership GIS-based layer and National Forest boundary layer (see descriptions above), to identify the extent and distribution of overlap of conservation areas and major landowners (Chapter 3) and each Forest in Region 3 (Chapters 4 - 15). Additionally, the individual targets associated with each conservation area were identified for each Forest. To determine how conservation areas overlap with current land-use designations on each National Forest, conservation areas were overlaid with designated wilderness areas, inventoried roadless areas, and other areas with special designations (e.g. research natural areas, zoological-botanical areas).

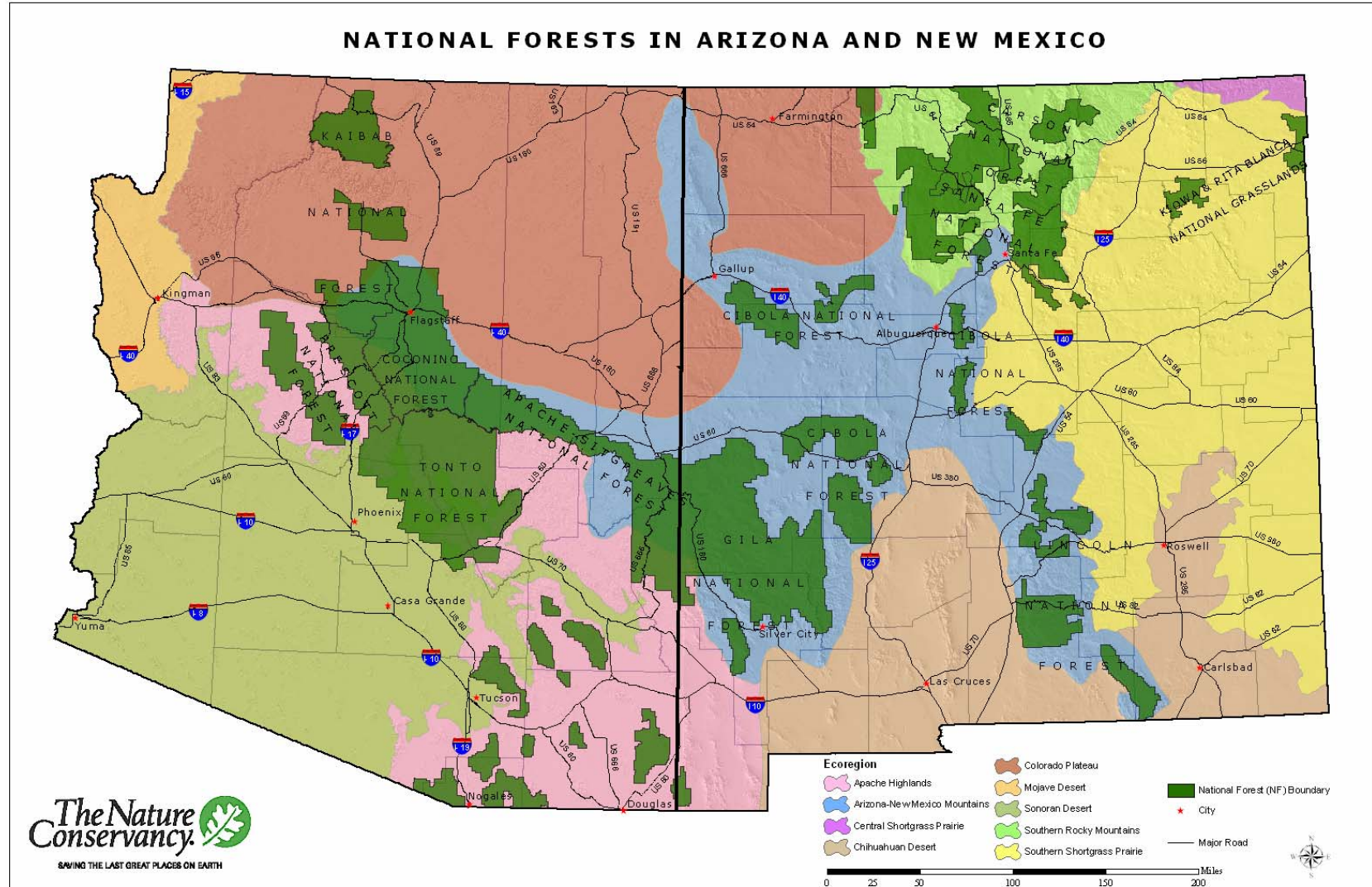


Figure 2-2. Overlap of The Nature Conservancy ecoregions and U.S. Forest Service Region 3 lands in Arizona and New Mexico.

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Appendix 2-A: Potential Natural Vegetation Types (PNVTs) cross-referenced to Southwest Regional GAP Analysis Project (SWReGAP), Oklahoma GAP Analysis Project (OK-GAP), and Texas GAP Analysis Project (TX-GAP) ecosystem types.

PNVT (Number of Land Cover Types)	SWReGAP, OK-GAP, and TX-GAP Land Cover Types
Alpine and tundra (3)	Rocky Mountain Alpine Bedrock and Scree Rocky Mountain Alpine Fell-Field Rocky Mountain Dry Tundra
Aspen forest and woodland (2)	Inter-Mountain West Aspen-Mixed Conifer Forest and Woodland Rocky Mountain Aspen Forest and Woodland
Barren (2)	Bare Soil Barren Lands, Non-specific
Cottonwood willow riparian forest (7)	Western Bottomland Forests Western Great Plains Riparian Woodland and Shrubland Invasive Southwest Riparian Woodland and Shrubland North American Warm Desert Riparian Mesquite Bosque Temporary Flooded Cold-Deciduous Woodland Temporary Flooded Microphyllous Shrublands Temporary Flooded Temperate Grasslands with Sparse Cold-Deciduous Woodlands
Desert communities (15)	Chihuahuan Mixed Salt Desert Scrub Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub Chihuahuan Succulent Desert Scrub Mojave Mid-Elevation Mixed Desert Scrub North American Warm Desert Active and Stabilized Dune North American Warm Desert Badland North American Warm Desert Bedrock Cliff and Outcrop North American Warm Desert Pavement North American Warm Desert Playa North American Warm Desert Volcanic Rockland North American Warm Desert Wash Sonora-Mojave Creosotebush-White Bursage Desert Scrub Sonora-Mojave Mixed Salt Desert Scrub Sonoran Mid-Elevation Desert Scrub Sonoran Paloverde-Mixed Cacti Desert Scrub
Disturbed/altered (2)	Recently Burned Recently Mined or Quarried
Gallery coniferous riparian forest (1)	Rocky Mountain Sub-alpine-Montane Riparian Woodland
Great Basin / Colorado Plateau grassland and steppe (16)	Colorado Plateau Blackbrush-Mormon-tea Shrubland Colorado Plateau Mixed Bedrock Canyon and Tableland (not with Mixed Conifer) Inter-Mountain Basins Greasewood Flat Inter-Mountain Basins Juniper Savanna Inter-Mountain Basins Mat Saltbush Shrubland Inter-Mountain Basins Mixed Salt Desert Scrub

PNVT (Number of Land Cover Types)	SWReGAP, OK-GAP, and TX-GAP Land Cover Types
	Inter-Mountain Basins Montane Sagebrush Steppe Inter-Mountain Basins Playa Inter-Mountain Basins Semi-Desert Grassland Inter-Mountain Basins Semi-Desert Shrub Steppe Inter-Mountain Basins Shale Badland Inter-Mountain Basins Volcanic Rock and Cinder Land Inter-Mountain Basins Wash Invasive Annual and Biennial Forbland Invasive Annual Grassland Southern Colorado Plateau Sand Shrubland
Great Plains grassland (24)	Annual Graminoid or Forb Vegetation Extremely Xeromorphic Deciduous Shrubland Grama – Buffalograss Prairie Gypsum Grasslands Intermittently Flooded Temperate or Subpolar Grassland Lowland Mixed Evergreen – Drought Deciduous Shrubland Medium – Tall Bunch Temperate or Subpolar Grassland Microphyllous Evergreen Shrubland Midgrass Prairie Midgrass Sand Prairie Midgrass Sandsage Prairie Sandsage Prairie Sandsage Savanna Semi-permanently Flooded Temperate or Subpolar Grassland Shinnery Oak Shrubland Short Sod Temperate or Subpolar Grassland Southern Rocky Mountain Juniper Woodland and Savanna Tall Sod Temperate Grasslands Temperate or Subpolar Grassland with a Sparse Shrub Layer Western Great Plains Cliff and Outcrop Western Great Plains Foothill and Piedmont Grassland Western Great Plains Mesquite Woodland and Shrubland Western Great Plains Sandhill Shrubland Western Great Plains Shortgrass Prairie
Interior chaparral (4)	Coahuilan Chaparral Great Basin Semi-Desert Chaparral Mogollon Chaparral Rocky Mountain Gambel Oak-Mixed Montane Shrubland (Not with Mixed Conifer)
Madrean encinal woodland (2)	Madrean Encinal Madrean Pinyon-Juniper Woodland
Madrean pine-oak woodland (1)	Madrean Pine-Oak Forest and Woodland
Mixed broad leaf deciduous riparian forest (3)	North American Warm Desert Riparian Woodland and Shrubland Rocky Mountain Bigtooth Maple Ravine Woodland Rocky Mountain Lower Montane Riparian Woodland and Shrubland
Mixed conifer forest (5)	Madrean Upper Montane Conifer-Oak Forest and Woodland

PNVT (Number of Land Cover Types)	SWReGAP, OK-GAP, and TX-GAP Land Cover Types
	Recently Logged Areas Rocky Mountain Cliff and Canyon Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
Montane grassland (1)	Rocky Mountain Sub-alpine Mesic Meadow
Montane Willow Riparian Forests (2)	North American Warm Desert Lower Montane Riparian Woodland Rocky Mountain Sub-alpine-Montane Riparian Shrubland
No Value (1)	No Value
Oklahoma Oak Woodland (1)	Eastern Red Cedar – Oak Woodland
Pinyon-juniper woodland (6)	Colorado Plateau Pinyon-Juniper Shrubland Colorado Plateau Pinyon-Juniper Woodland Great Basin Pinyon-Juniper Woodland Recently Chained Pinyon-Juniper Areas Rocky Mountain Lower Montane-Foothill Shrubland (Not with Montane Conifer) Southern Rocky Mountain Pinyon-Juniper Woodland
Ponderosa pine (1)	Southern Rocky Mountain Ponderosa Pine Woodland
Sagebrush shrubland (3)	Colorado Plateau Mixed Low Sagebrush Shrubland Inter-Mountain Basins Active and Stabilized Dune Inter-Mountain Basins Big Sagebrush Shrubland
Semi-desert grasslands (8)	Apacherian-Chihuahuan Mesquite Upland Scrub Apacherian-Chihuahuan Piedmont Semi-Desert Grassland Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub Chihuahuan Gypsophilous Grassland and Steppe Chihuahuan Sandy Plains Semi-Desert Grassland Chihuahuan-Sonoran Desert Bottomland and Swale Grass Invasive Perennial Grassland Madrean Juniper Savanna
Shinnery Oak Shrubland (1)	Shinnery Oak Shrubland
Spruce-fir forest (4)	Rocky Mountain Lodgepole Pine Forest Rocky Mountain Sub-alpine Dry-Mesic Spruce-Fir Forest Rocky Mountain Sub-alpine Mesic Spruce-Fir Forest and Rocky Mountain Sub-alpine-Montane Limber-Bristlecone
Sub-alpine grassland (1)	Southern Rocky Mountain Montane-Sub-alpine Grassland
Texas Oak Woodland (2)	Cold Deciduous Woodland Temperate Broad-leaved Evergreen Shrubland
Texas Pinyon-Juniper (1)	Round Crowned Temperate or Subpolar Needle-leaved Evergreen Woodland

PNVT (Number of Land Cover Types)	SWReGAP, OK-GAP, and TX-GAP Land Cover Types
Urban and agricultural area (7)	Agriculture Crop – Warm Season Cropland (irrigated, row, herbaceous, etc.) Developed, Medium - High Intensity Developed, Open Space - Low Intensity Improved/Introduced Pasture – Warm Season Residential/ Industrial
Water (5)	Lake/Reservoir Open Water Pond Riverine Water
Wetland/cienega (4)	North American Arid West Emergent Marsh Rocky Mountain Alpine Wet Meadow Western Great Plains Saline Depression Wetland Wetland

Appendix 2-B: Descriptions of potential natural vegetation types (PNVTs).

Alpine and Tundra – Alpine conditions begin around 10,600 ft. Alpine areas are typically barren with sparse vegetation including grasses, forbs, lichens and low shrubs. Unstable substrates, exposure to high winds, and short growing season make it difficult for plants to establish and grow in these areas. Barren areas include rocky outcroppings, scree slopes, and open fell-fields. Open fell-fields may include the following species: mountain sandwort (*Arenaria capillaries*), black and white sedge (*Carex albonigra*), Payson's sedge (*Carex paysonis*), Ross's avens (*Geum rossii*), Bellardi bog sedge (*Kobresia myosuroides*), twinflower sandwort (*Minuartia obtusiloba*), Asian forget-me-not (*Myosotis asiatica*), nailwort (*Paronychia pulvinata*), wherry (*Phlox pulvinata*), creeping sibbaldia (*Sibbaldia procumbens*), and moss campion (*Silene acaulis*). Within the alpine region, tundra can be found on gradual to moderate slopes, flat ridges, valleys, and basins, where there is fairly stable soil. The tundra system is typically characterized by low-growing, perennial graminoids and forbs. Rhizomatous, sod-forming sedges are the dominant graminoids, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs. Dominant species include sagebrush (*Artemisia arctica*), sedges (*Carex* spp.), tufted hairgrass (*Deschampsia caespitosa*), fescue grasses (*Festuca* spp.), Ross's avens (*Geum rossii*), Bellardi bog sedge (*Kobresia myosuroides*), wherry (*Phlox pulvinata*), and alpine clover (*Trifolium dasyphyllum*).

Aspen Forest and Woodland – Aspen forest and woodlands are found in montane and sub-alpine zones at elevations ranging from approximately 5,000 to 10,000 ft., but occasionally at lower elevations in some areas. These upland forests and woodlands are dominated by quaking aspen (*Populus tremuloides*) and may or may not have a significant conifer component, depending upon successional status. The understory structure may have shrubs and an herbaceous layer, or just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Some of the species typically found associated with aspen include Arizona peavine (*Lathyrus arizonica*), meadow rue (*Thalictrum fendleri*), deer's ears (*Swertia radiata*), yarrow (*Achillea lanulosa*), violet (*Viola canadensis*), paintbrush (*Castilleja* spp.), arnica (*Arnica montanum*), and several grasses and sedges (*Poa* spp. and *Carex* spp.). Distribution of this PNVT is limited by several factors including soil type, adequate soil moisture required to meet its high evapotranspiration demand, the length of the growing season or low temperatures, and major disturbances that clear areas of vegetation and stimulate root sprouting and colonization.

Barren – Areas where there is less than approximately 15% vegetation cover and accumulation of earthen materials.

Cottonwood Willow Riparian Forest – This system is typically found at lower elevations along rivers and streams in unconstrained valley bottoms. Dominant woody species include cottonwood spp. (*Populus* spp.), willow species (*Salix* spp.), and mesquite spp. (*Prosopis* spp.). Various grasses and forbs are also present. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded and the water table can be severely depleted. In addition, many of the areas with this PNVT have experienced an increase in invasive species such as salt cedars (*Tamarix* spp.), and Russian olive (*Elaeagnus angustifolius*). The vegetation is dependent upon seasonal flooding and high water tables for germination, growth and survivorship of the woody dominants.

Desert Communities – This PNVT spans several types of desert communities, and desert provinces including the Sonoran, Chihuahuan, Great Basin and Mojave. Vegetation types and density will vary with geographic location, precipitation, and topography. Some areas within this PNVT may be barren with an abundance of sand, rock, gravel, scree or talus. Other areas may have sparse to dense vegetation cover that includes succulent species, desert grasses, desert scrub, and some herbaceous cover. Some species occurring in desert communities include: catclaw acacia (*Acacia greggii*), triangleleaf bursage (*Ambrosia deltoidea*), white bursage (*Ambrosia dumosa*), mesquite (*Prosopis* spp.), desert ironwood (*Olneya tesota*), saltbush (*Atriplex* spp.), creosote (*Larrea tridentata*), iodine bush (*Allenrolfea occidentalis*), splitleaf brickellia (*Brickellia laciniata*), desert broom (*Baccharis sarothroides*), desert willow (*Chilopsis linearis*), Apache plume (*Fallugia paradoxa*), cheesebush (*Hymenoclea salsola*), barrel cactus (*Ferocactus* spp.), hedgehog cacti (*Echinocereus* spp.), cholla and prickly pear (*Opuntia* spp.) saguaro (*Carnegiea gigantea*), salt grass (*Distichlis spicata*), rice grasses (*Oryzopsis* spp.), and dropseed grasses (*Sporobolus* spp.).

Disturbed/Altered – Areas that are barren or have relatively low vegetation cover due to some form of human alteration or management regime.

Gallery Coniferous Riparian Forest – Found at montane to sub-alpine elevations (5,000 to 11,000 ft) in the Rocky Mountains and Sierra Madre Occidental, this “canyon bottom forest” system contains many of the woody species that occur in the conifer and aspen woodlands adjacent to montane streams. This PNVT experiences periodic flooding and high water tables. Dominant tree species typically include sub-alpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), Douglas-fir (*Pseudotsuga menziesii*), blue spruce (*Picea pungens*), quaking aspen (*Populus tremuloides*), narrowleaf cottonwood (*Populus angustifolia*), bigtooth maple (*Acer gradidentatum*); box elder (*Acer negundo*), alder (*Alnus oblongifolia*), willows (*Salix* spp.), Gambel oak (*Quercus gambelii*), Ponderosa pine (*Pinus ponderosa*), and Rocky Mountain juniper (*Juniperus scopulorum*).

Great Basin / Colorado Plateau Grassland and Steppe – In general, this PNVT is found at lower elevations with vegetation coverage consisting of mostly grasses and interspersed shrubs. Grass species may include but are not limited to: Indian ricegrass (*Achnatherum hymenoides*), threeawn spp. (*Aristida* spp.), blue grama (*Bouteloua gracilis*), fescue spp. (*Festuca* spp.), needle and thread grass (*Hesperostipa comata*), spike fescue (*Leucopoa kingii*), *Muhlenbergia* spp., James’ galleta (*Pleuraphis jamesii*), and Sandberg bluegrass (*Poa secunda*). Shrub species may include but are not limited to: sagebrush (*Artemisia tridentata* spp.), saltbush (*Atriplex* spp.), *Ephedra*, snakeweed (*Gutierrezia*), winterfat (*Krascheninnikovia lanata*), one-seeded juniper (*Juniperus monosperma*), and wax currant (*Ribes cereum*).

Great Plains Grassland -- This PNVT is characterized by mixed grass to tall grass prairie found on moderate to gentle slopes. Rain, temperature and soils limit this PNVT to lower elevations. This PNVT is mostly dominated by one or some of the following species: big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), mountain muhly (*Muhlenbergia montana*), green needlegrass (*Nassella viridula*), western wheatgrass (*Pascopyrum smithii*), sand dropseed (*Sporobolus cryptandrus*), blue grama (*Bouteloua gracilis*), needle and thread grass (*Hesperostipa comata*), or New Mexico feathergrass (*Hesperostipa neomexicana*). This PNVT may also include areas that are dominated by low cover grasses and forbs.

Interior Chaparral – This PNVT is typically found on mountain foothills and lower slopes where low-elevation desert landscapes transition into wooded evergreens. Interior chaparral consists of mixed shrub associations including but not limited to the following species: Manzanita spp. (*Arctostaphylos* spp.), crucifixion thorn (*Canotia holacantha*), desert ceanothus (*Ceanothus greggii*), mountain mahogany (*Cercocarpus montanus*), little-leaved mountain mahogany (*Cercocarpus intricatus*), Antelope bushes (*Purshia* spp.), silktassles (*Garrya* spp.), Stansbury cliffrose (*Purshia stansburiana*), shrub live oak (*Quercus turbinella*), and sumacs (*Rhus* spp.)

Madrean Encinal Woodland – Found in the Madrean Province, this PNVT occurs on foothills, canyons, bajadas and plateaus between the semi-desert grasslands and Madrean pine-oak woodlands. This PNVT is dominated by Madrean evergreen oaks such as Arizona white oak (*Quercus arizonica*), Emory oak (*Quercus emoryi*), gray oak (*Quercus grisea*), Mexican blue oak (*Quercus oblongifolia*), and Toumey oak (*Quercus toumeyi*). Madrean pine, Arizona cypress, pinyon and juniper trees and interior chaparral species may be present, but do not co-dominate. The ground cover is dominated by warm-season grasses such as threeawns (*Aristida* spp.), blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*), Rothrock grama (*Bouteloua rothrockii*), Arizona cottontop (*Digitaria californica*), plains lovegrass (*Eragrostis intermedia*), curly-mesquite (*Hilaria belangeri*), green sprangletop (*Leptochloa dubia*), muhly grasses (*Muhlenbergia* spp.), or Texas bluestem (*Schizachyrium cirratum*).

Madrean Pine-Oak Woodland – Found in the Madrean province, this PNVT is dominated by open to closed canopy of evergreen oaks such as Arizona white oak (*Quercus arizonica*), alligator juniper (*Juniperus deppeana*), Chihuahua pine (*Pinus leiophylla*) and other various pines with a grassy understory. Madrean pine-oak woodlands usually occupy foothills and mountains ranging from approximately 4000 to 7000 ft. in elevation. Climate generally consists of mild winters and wet summers with mean annual precipitation ranging from about 10 to 25 inches; half of the precipitation typically occurs in summer, with the remainder occurring during the winter and spring.

Mixed Broad Leaf Deciduous Riparian Forest – Located in the Madrean and Chihuahuan provinces, mixed broadleaf deciduous riparian forests are found along rivers and streams starting at low elevations (approximately 4,000 ft.) and climbing up to montane elevations of approximately 9,000 ft. The vegetation is a mix of riparian woodlands and shrublands with a variety of vegetation associations. The dominant vegetation is likely to depend upon a suite of site-specific characteristics including elevation, substrate, stream gradient, and depth to groundwater. For example, one vegetation association is dominated by bigtooth maple with mixed stands of Gambel oak, some

scattered conifers and possibly some quaking aspen (*Populus tremuloides*). Other sites can be dominated by a mixture of the following woody species: boxelder, narrowleaf cottonwood, Fremont cottonwood (*Populus fremontii*), Arizona sycamore (*Platanus wrightii*), velvet ash (*Fraxinus velutina*), Arizona walnut (*Juglans major*), Arizona cypress (*Cupressus arizonica*) and willows (*Salix exigua* and others). The forest often contains oaks (*Quercus gambelii*, *Q. emoryi*, *Q. arizonica*) and conifers (*P. ponderosa*, *Juniperus deppeana*) from upstream and adjacent uplands. Exotic species such as Russian olive (*Elaeagnus angustifolia*) and salt cedar (*Tamarix* spp.) are common in some stands, especially at lower elevations. Vegetation can be dependent upon annual or periodic flooding for growth and reproduction, especially at lower elevations.

Mixed Conifer Forest – This PNVT spans a variety of dominant and co-dominant species in both dry and mesic environments in the Rocky Mountain and Madrean Provinces. In the Rocky Mountains, montane conifer forests may be found at elevations between 5,000 and 10,000 ft., situated between ponderosa pine, pine-oak, or pinyon-juniper woodlands and spruce-fir or sub-alpine conifer forests. Dominant and co-dominant vegetation varies in elevation and moisture availability. In the lower and drier elevation portions within this PNVT, Gambel oak (*Quercus gambelii*) and ponderosa pine (*Pinus ponderosa*) may co-dominate. In higher and more mesic areas ponderosa pine may co-dominate with Douglas fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*). Other vegetation that may be present but does not co-dominate in these higher and mesic areas include Englemann spruce (*Picea engelmannii*) and Colorado blue spruce (*Picea pungens*). In the Madrean Province, this PNVT can be characterized by large and small-patch forests and woodlands dominated by Douglas fir or white fir with Madrean oaks such as silverleaf oak (*Quercus hypoleucoides*) and netleaf oak (*Quercus rugosa*). The understory vegetation is comprised of a wide variety of shrubs, grasses, graminoids (sedges, etc.), and forbs; the compositions depends on soil type, aspect, elevation, disturbance history and other factors.

Montane Grassland – This PNVT is typically found at sub-alpine elevations (9,000 ft. and higher) on gentle to moderate gradient slopes. Soils are usually moist throughout the year. Dominant vegetation cover includes forbs with some graminoids. Common species found in this PNVT include but are not limited to: fleabane spp. (*Erigeron* spp.), asters (*Asteraceae* spp.), bluebells (*Mertensia* spp.), *Penstemon* spp., lupine spp. (*Lupinus* spp.) and goldenrods (*Solidago* spp.).

Montane Willow Riparian Forest – This PNVT stretches along various elevational gradients from lower elevations (3,500 ft.) in mountain canyons and valleys to higher mountainous elevations (10,000ft.). At lower elevations this PNVT can be found along perennial and seasonally intermittent streams. Here, the dominant woody vegetation includes cottonwood spp. (*Populus* spp.), Arizona sycamore (*Platanus wrightii*), Arizona Walnut, (*Juglans major*), velvet ash (*Fraxinus velutina*), and soapberry (*Sapindus saponaria*). Shrubs include willow spp. (*Salix* spp.), cherry (*Prunus* spp.) and Arizona alder (*Alnus oblongifolia*). At higher elevations, this PNVT is found along streambanks, seeps, fens, and isolated springs. At higher elevations, this PNVT are shrub and herb dominated. Dominant shrubs include alder spp. (*Alnus* spp.), birch spp. (*Betula* spp.), redosier dogwood (*Cornus sericea*), and a variety of willow spp. (*Salix* spp.).

Oklahoma Oak woodland – This PNVT can be found on portions of Region 3 National Grasslands. It is dominated by blackjack oak (*Q. marilandica*) and post oak (*Q. stellata*) with a savanna-like structure at the boundaries with the tall grass prairie and denser canopies occurring away from the forest grassland transition. This woodland type occurs throughout the Great Plains region on xeric sites with sandy soils.

Pinyon-juniper Woodland – Mostly found on lower slopes of mountains and in upland rolling hills at approximately 4,500 to 7,500 ft. in elevation. Most common pinyon pine is the Colorado pinyon (*Pinus edulis*), with singleleaf pinyon (*Pinus monophylla*) occurring in limited areas. One-seed juniper (*Juniperus monosperma*) is most common in Arizona and New Mexico; however, there are areas with Utah juniper (*Juniperus osteosperma*) and Rocky Mountain juniper (*Juniperus scopulorum*). In addition, annual and perennial grasses and graminoids, forbs, half-shrubs and shrubs can be found beneath the woodland overstory.

Ponderosa Pine – The ponderosa pine forest is widespread in the Southwest occurring at elevations ranging from 6,000-9,000 ft on igneous, metamorphic, and sedimentary parent soils with good aeration and drainage, and across elevational and moisture gradients. The dominant species in this system is Ponderosa pine (*Pinus ponderosa*). Other trees, such as Gambel oak (*Quercus gambelii*), Douglas-fir (*Pseudotsuga menziesii*), pinyon pine (*Pinus edulis*), and juniper spp. (*Juniperus* spp.) may be present. There is typically a shrubby understory mixed with

grasses and forbs, although this type sometimes occurs as savannah with extensive grasslands interspersed between widely spaced clumps or individual trees. This system is adapted to drought during the growing season, and has evolved several mechanisms to tolerate frequent, low intensity surface fires.

Sagebrush Shrubland -- This PNVT is dominated by big sagebrush (*Artemisia tridentata*) and ranges from the state of Washington east to the Dakotas, and south as far as Arizona and New Mexico. Within the southwest sagebrush shrubland primarily occurs in northern Arizona and northwestern New Mexico adjacent to Great Basin grassland and pinyon juniper woodland PNVTS. While big sagebrush is the dominant species other shrubs such as broom snakeweed and shadscale (*Atriplex confertifolia*) are common, as are grassland species such as blue grama (*Bouteloua gracilis*). Shrubland sites in the southwest are usually found on deep well-drained valley bottom soils between 4,800 and 5,800 ft. with precipitation ranging between 10 to 18 inches per year.

Semi-desert Grassland – Semi-desert grassland occurs throughout southeastern Arizona and southern New Mexico at elevations ranging from 3,000 to 4,500 ft. These grasslands are bounded by Sonoran or Chihuahuan desert at the lowest elevations and woodlands or chaparral at the higher elevations. Species composition and dominance varies across the broad range of soils and topography that occur within the two states. Dominant grassland associations/types are black grama (*Bouteloua eriopoda*) grassland, blue grama (*Bouteloua gracilis*) grassland, tobosca (*Hilaria mutica*) grassland, giant sacaton (*Sporobolus wrightii*) grassland, mixed native perennial grassland, and non-native perennial grassland. Shrubs also occupy these grasslands and their abundance and species composition also varies.

Shinnery Oak Woodland – This PNVT is can be found on portions of Region 3 National Grasslands. This PNVT is found in the western regions of the Great Plains on primarily sandy soils. The dominant vegetation type is shinnery oak also known as Harvard oak (*Quercus harvardii*). Other vegetation that may be present includes a variety of grasses such as bluestems (*Andropogon gerardi*), grama species (*Bouteloua* spp.), and sand dropseed (*Sporobolus cryptandrus*). Also may be present may be present are yucca spp. (*Yucca* spp.); mesquite species (*Prosopis* spp.); catclaw acacia (*Acacia greggii*), and sand sage (*Artemisia filifolia*) and other vegetation.

Spruce-fir Forest – Also known as sub-alpine conifer forests, spruce-fir forests range in elevation from 9,000 to 11,500 ft. along a variety of gradients including gentle to very steep mountain slopes. Englemann spruce (*Picea engelmannii*) and sub-alpine fir (*Abies lasiocarpa*) or corkbark fir (*Abies lasiocarpa* var. *lasiocarpa*) dominate this PNVT either mixed or alone. Douglas-fir (*Pseudotsuga menziesii*) along with mixed conifer and quaking aspen (*Populus tremuloides*) stands may also be present in this system for long periods without regeneration. Herbaceous species may include but are not limited to red baneberry (*Actaea rubra*), starry false Solomon's seal (*Maianthemum stellatum*), fleabane (*Erigeron eximius*), blackberry (*Rubus pedatus*), and sub-alpine lupine (*Lupinus arcticus* spp. *Subalpinus*). Natural disturbances in this PNVT are blow-downs, insect outbreaks and stand replacing fires.

Sub-alpine Grassland - Also referred to as montane grasslands, this system occurs at elevations ranging from 8,000-11,000 ft., and often harbors several plant associations with varying dominant grasses and herbaceous species. Such dominant species may include Parry's oatgrass (*Danthonia parryi*), Arizona fescue (*Festuca arizonica*), Thurber's fescue (*Festuca thurberi*), pine dropseed (*Blepharoneuron tricholepis*), Kentucky bluegrass (*Poa pratensis*), small camas (*Camassia quamash*), various sedges (*Carex* spp.), shooting star (*Dodecatheon jeffreyi*), fowl manna grass (*Glyceria striata*), Sierra rush (*Juncus nevadensis*), Rocky Mountain iris (*Iris missouriensis*), Parry's bellflower (*Campanula parryi*), California false hellebore (*Veratrum californicum*), and bulrush spp. (*Scirpus* and/or *Schoenoplectus* spp). Trees may occur along the periphery of the meadows, which may include southwestern white pine (*Pinus strobiformis*), Englemann spruce (*Picea engelmannii*), and sub-alpine fir (*Abies lasiocarpa*). Some shrubs may also be present. These meadows are seasonally wet, which is closely tied to snowmelt. They typically do not experience flooding events.

Texas Oak Woodland – This PNVT can be found on small portions of Region 3 National Grasslands. This PNVT includes the Harvard oak or shinnery oak (*Quercus harvardii*) shrubland alliance, honey mesquite (*Prosopis glandulosa*) woodland alliance, and post oak-black jack oak (*Quercus stellata* – *Quercus merilandica*) woodland alliances.

Texas Pinyon-juniper Woodland – This can be found on small portions of Region 3 National Grasslands. This PNVT includes the following species: ashe juniper (*Juniperus ashei*), alligator juniper (*Juniperus deppeana*), one-

seed juniper (*Juniperus monosperma*), red berry juniper (*Juniperus erythrocarpa*), pinyon pine (*Pinus edulis*), and a few oak spp. (*Quercus* spp.)

Urban and Agricultural Area – Dominated by urban development and land used for agricultural purposes.

Water – Areas with water including reservoirs, rivers, and streams.

Wetland/Cienega – This PNVT is associated with perennial springs or headwater streams where groundwater intersects the surface and creates pools of standing water, sometime with channels flowing between pools. Often soils in the area are highly saline. Distribution and types of vegetation vary due to a gradient in saturated soils and salinity. Some vegetation types found in wetland/cienegas include salt grass (*Distichlis spicata*), yerba mansa (*Anemopsis californica*), and sacaton in more saline areas; in saturated soils are rushes, sedges, flat sedges and spike rushes and deep pools support a variety of aquatic vegetation. This PNVT also includes high elevation (3,500 – 11,000 ft.) meadows with subsurface flows dominated by herbaceous cover.

Chapter 3:
**Ecological and Biological Assessments Across Major Landowners in
Arizona and New Mexico**

In
Ecological and Biological Diversity of National Forests in Region 3

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The Nature Conservancy



SAVING THE LAST GREAT PLACES ON EARTH

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Introduction

Within Arizona and New Mexico, the US Forest Service (USFS) Region 3 National Forests include a broad range of ecological components, including a large diversity of vegetation systems, ranging along elevational gradients from deserts to alpine/tundra, and the species that depend on these systems. In addition, many important aquatic and riparian systems, some of the most threatened in the nation, occur on Region 3 National Forests. While these important ecological systems and species are distributed across many landowners in the Southwest, Region 3 National Forests contain relatively large proportions of certain systems and species. Identifying these systems and species may be useful in planning efforts that focus on ensuring ecological sustainability across the region.

In this chapter, existing regional (Arizona and New Mexico) scale assessment information was used to highlight the ecological importance of Region 3 National Forests within the context of major landowners in Arizona and New Mexico. Additionally, important ecological components of individual National Forests were identified. Four existing regional-scale assessments were used to examine the ecological diversity and conservation opportunities on Region 3 National Forests relative to other landowners. These include assessments relating to the distribution of potential natural vegetation types (PNVTs), distribution and condition of grasslands, distribution of native fish occurrences, and the distribution of conservation areas identified through ecoregional assessments. A fifth data source, the R3 Species Database, contains species diversity information specific to Region 3 National Forests and was used to compare and highlight animal and plant diversity amongst Region 3 National Forests.

I. Potential Natural Vegetation Types

The relative distribution of potential natural vegetation types in Arizona and New Mexico across the various major landowners was assessed. (Refer to Chapter 2, Appendix 2-A and 2-B for a listing and descriptions of PNVTs). Total acreage of each PNVT was also compared amongst the 11 Region 3 National Forests lands in Arizona and New Mexico. Region 3 National Grasslands in New Mexico, Oklahoma and Texas were not included in either of these analyses.

To conduct these analyses two geo-spatial datasets (described in detail in Chapter 2) were utilized:

- 1) The Southwest Regional Gap Analysis Project (SWReGAP; USGS National Gap Analysis Program 2004). The SWReGAP data are a geo-spatial vegetation dataset based on multi-season data from satellite imagery (Landsat ETM+) and digital elevation models (DEM) from 1999-2001. Ecosystem cover types from SWReGAP were aggregated and cross-walked to PNVTs (see Chapter 2, Appendix 2-A for cross-walk details). Although the accuracy of SWReGAP data have not been assessed, the dataset serves as the most recent and complete data source for all of Arizona and New Mexico at the time of this analysis.

Furthermore, because SWReGAP is built upon remote sensing data, inaccuracies are likely to be found when used at finer spatial scales. Therefore, SWReGAP data may be best suited for regional assessments rather than for project planning or district level analyses.

- 2) The second dataset used was the landownership GIS-based layer. This data layer was generated from information from the Arizona Land Resource Information Service (<http://www.land.state.az.us/alris/index.html>) and the New Mexico Resource Geographic Information System Program (<http://rgis.unm.edu/>). Major landowner categories included in this data layer were: Bureau of Land Management, Department of Defense, National Park Service, private, State Trust, tribal, US Fish and Wildlife Service, USDA Forest Service, and other (which included Bureau of Reclamation, non-federal Parks, Valle Calderas National Preserve, County Lands, Department of Energy, USDA Research, State Game and Fish, and unnamed lands).

Results indicate that Region 3 manages the highest relative proportions of nine of the 25 PNVTs analyzed (36%) across all major landowners in Arizona and New Mexico. These nine PNVTs and the proportions that Region 3 Forests collectively manage for include: aspen forest and woodland (64%), interior chaparral (43%), Madrean encinal woodland (42%), Madrean pine-oak woodland (59%), mixed conifer forest (68%), montane grasslands (47%), ponderosa pine forest (63%), spruce-fir forest (58%) and sub-alpine grasslands (52%; Table 3-1).

Results also demonstrate the diversity and distribution of PNVTs across Region 3 National Forests, and identify which Forests manage large proportions of certain PNVTs within Region 3 (Table 3-2). For example, the Carson National Forest manages the largest proportion of aspen forest and woodlands (35%), gallery coniferous riparian forests (100%), montane grasslands (97%), spruce-fir conifer forests (49%), sub-alpine grasslands (37%), and wetland/cienegas (84%) across all Region 3 Forests. The Cibola National Forest (not including the National Grasslands in New Mexico, Oklahoma or Texas) has the largest proportion of Great Plains grasslands (61%), mixed-broadleaf deciduous riparian forests (34%), and pinyon-juniper woodland (21%). The Coconino National Forest contains the largest proportion of alpine/tundra (80%) and Great Basin/Colorado Plateau grassland and steppe (23%). The Coronado manages 26% of the Madrean encinal found on Region 3 National Forests. The Gila manages the largest proportion (30%) of ponderosa pine forests. The Kaibab National Forest manages 50% of the sagebrush shrubland on Region 3 lands. The Santa Fe National Forest contains the largest proportion of mixed conifer forests (32%) across Region 3. The Tonto National Forest manages the largest proportion of cottonwood willow riparian forests (41%), desert communities (76%), interior chaparral (40%), Madrean pine-oak (41%), montane willow riparian forests (20%), and semi-desert grasslands (37%) on Region 3 Forests. As discussed earlier, these results are based on SWReGAP data that may not be inaccurate at Forest level spatial analyses.

Table 3-1. Approximate area (in acres) of potential natural vegetation types (PNVTs) in Arizona and New Mexico across major landowners. The Other landowner category in this table includes: Bureau of Reclamation, non-federal parks, Valle Calderas National Preserve, county lands, Department of Energy, USDA Research, State Game and Fish, and unnamed lands. USFS Region 3 National Grasslands in New Mexico, Oklahoma and Texas were not included in this analysis. Data used to generate this table came from The Southwest Regional Gap Analysis Program (SWReGAP) and the landownership GIS-based layer. Note that accuracy testing has not been conducted for SWReGAP data. See Chapter 2 for further information regarding these datasets.

Potential Natural Vegetation Type	US Forest Service	Bureau of Land Management	Department of Defense	National Park Service	Private	State Trust	Tribal	US Fish and Wildlife Service	Other
Alpine/Tundra	1,600	0	0	0	6,100	0	0	0	0
Aspen Forest and Woodland	335,900	500	0	3,400	93,200	2,200	75,900	0	11,600
Barren	0	26,900	13,000	100	35,900	14,900	196,400	2,100	300
Cottonwood Willow Riparian Forest	19,500	74,800	14,900	7,100	219,500	55,600	389,000	28,500	11,000
Desert Communities	1,018,300	8,593,300	3,537,800	1,321,000	3,418,000	3,340,700	3,429,500	1,583,200	252,800
Disturbed/Altered	83,300	9,200	600	6,000	218,200	37,200	47,800	5,600	400
Gallery Coniferous Riparian Forest	100	0	0	0	1,100	0	100	0	0
Great Basin/ Colorado Plateau Grassland and Steppe	684,400	2,853,400	23,000	572,300	5,695,500	2,599,300	12,175,500	43,200	18,500
Great Plains Grassland	316,800	1,270,300	29,000	10,000	16,055,000	3,158,400	181,000	14,100	11,400
Interior Chaparral	1,345,900	414,600	33,800	31,300	590,500	350,800	333,100	6,400	11,000
Madrean Encinal Woodland	2,736,200	518,800	151,400	34,400	1,259,800	609,300	1,165,200	14,800	2,200
Madrean Pine-Oak Woodland	831,900	20,200	1,700	5,000	89,200	30,100	438,400	100	200
Mixed Broad Leaf Deciduous Riparian Forest	42,600	36,200	5,000	4,200	115,800	17,300	65,500	7,900	4,300
Mixed Conifer Forest	1,216,300	33,900	2,700	43,500	225,900	13,800	191,000	1,000	52,000
Montane Grassland	17,200	0	0	0	16,900	0	2,300	0	0
Montane Willow Riparian Forest	17,300	14,400	800	600	42,800	11,500	12,100	100	4,100
Pinyon-Juniper Woodland	3,375,200	2,872,700	22,300	556,700	4,442,500	1,505,300	5,647,800	19,000	51,600
Ponderosa Pine Forest	5,835,300	112,500	16,400	94,200	1,408,400	147,000	1,588,900	900	44,100
Sagebrush Shrubland	134,500	685,200	1,600	66,300	642,100	184,700	977,200	21,200	11,700
Semi-desert Grassland	1,642,300	8,013,000	1,463,300	99,000	7,996,600	5,914,600	951,900	321,000	185,000
Spruce-fir Forest	355,200	35,000	1,000	7,000	128,200	2,300	72,000	300	10,000
Sub-alpine Grasslands	311,700	13,900	200	2,500	183,400	10,700	55,700	0	27,000
Urban/Agriculture	20,800	35,100	49,200	2,300	4,119,500	219,000	334,900	5,600	23,900
Water	25,300	25,000	2,300	79,100	122,000	900	38,100	15,600	55,500
Wetland/Cienega	8,900	9,500	200	400	35,000	7,100	6,800	2,900	1,100

Table 3-2. Approximate area (in acres) of potential natural vegetation types (PNVTs) across 11 Region 3 National Forests in Arizona and New Mexico. Region 3 National Grasslands in New Mexico, Oklahoma and Texas were not included in this analysis. Data used to generate this table included The Southwest Regional Gap Analysis Program (SWReGAP) and the landownership GIS-based layer. Note that SWReGAP data have not been tested for accuracy and is derived from remote sensing; therefore, analyses at the individual National Forest scale may be inaccurate. See Chapter 2 for further information regarding these datasets.

Potential Natural Vegetation Type	Apache-Sitgreaves	Carson	Cibola (Mt. Districts)	Coconino	Coronado	Gila	Kaibab	Lincoln	Prescott	Santa Fe	Tonto
Alpine/Tundra	0	300	0	1,200	0	0	0	0	0	0	0
Aspen Forest and Woodland	29,000	118,400	13,500	18,300	6,600	90,300	7,700	6,100	0	46,000	100
Barren	0	0	0	0	0	0	0	0	0	0	0
Cottonwood Willow Riparian Forest	0	300	1,000	200	5,300	0	0	1,000	200	3,600	7,900
Desert Communities	800	0	19,900	23,000	173,800	4,700	11,000	3,200	10,100	0	771,900
Disturbed/Altered	3,000	3,800	100	10,400	200	9,200	10,300	3,200	500	36,600	5,900
Gallery Coniferous Riparian Forest	0	100	0	0	0	0	0	0	0	0	0
Great Basin/ Colorado Plateau Grassland and Steppe	62,500	51,200	113,400	159,400	13,900	115,900	100,600	1,200	13,900	43,000	9,400
Great Plains Grassland	0	25,000	191,900	0	0	0	0	19,800	0	80,200	0
Interior Chaparral	18,000	32,800	9,500	76,800	151,400	48,800	19,500	53,200	368,400	23,400	543,900
Madrean Encinal Woodland	275,300	0	18,900	219,600	723,900	396,500	500	331,600	370,200	100	399,700
Madrean Pine-Oak Woodland	16,600	0	600	29,700	139,200	32,100	2,900	162,200	103,500	300	344,800
Mixed Broad Leaf Deciduous Riparian Forest	100	2,300	14,300	300	800	200	0	8,900	400	5,400	9,800
Mixed Conifer Forest	146,300	189,500	74,100	31,000	26,800	157,200	70,600	123,100	0	392,700	5,100
Montane Grassland	0	16,600	0	0	0	0	0	100	0	500	0
Montane Willow Riparian Forest	2,500	2,000	2,700	3,100	3,600	1,500	0	5,700	3,300	600	6,200
Pinyon-Juniper Woodland	381,700	278,200	724,800	290,000	100	578,300	640,100	70,800	138,400	269,600	3,300
Ponderosa Pine Forest	926,400	408,000	508,900	814,600	65,400	1,754,600	555,100	68,500	98,400	505,400	130,100
Sagebrush Shrubland	700	58,000	700	100	0	200	67,200	0	0	7,800	0
Semi-desert Grassland	74,100	200	41,000	106,800	406,300	47,900	6,800	204,000	146,500	100	608,600
Spruce-fir Forest	18,500	174,900	10,700	7,200	0	17,900	20,800	17,600	0	87,400	0
Sub-alpine Grasslands	56,800	113,900	1,600	31,900	0	10,200	26,800	14,600	0	55,800	0
Urban/Agriculture	1,200	2,900	1,200	6,700	300	200	1,700	100	1,600	500	4,400
Water	2,000	200	300	2,700	200	300	300	0	100	1,500	17,700
Wetland/Cienega	0	7,400	1,100	0	0	0	0	0	0	300	0

II. Distribution and Condition of Grasslands

The Arizona Statewide Grasslands Assessment (Schussman and Gori 2004, Gori and Enquist 2003) was used to summarize the extent of low elevation historic grasslands and their current condition by major landowners within Arizona and the portion of the Apache Highlands ecoregion that falls within New Mexico (See Chapter 2, Figure 2-1). The Mexico portion of the Grassland Assessment was not included in this analysis. In addition, grasslands on National Forests within the assessment area were summarized for each Forest. This included all of the Kaibab, Coconino, Prescott, Tonto, Apache-Sitgreaves, and Coronado National Forests in Arizona, and a small portion of the Gila National Forest in New Mexico.

The Grassland Assessment used a combination of expert mapping and intensive field verification and vegetation sampling to identify low elevation (< 5000 feet) historic grasslands in Arizona and determine their current condition. Montane grasslands were not included in the assessment. Current grassland condition was assessed based on relative dominance of native/non-native species, degree of encroachment by woody species, and erosion severity. Based on these factors, grasslands were assigned to five condition types: open native, restorable native, former, non-native, and transitional (see Chapter 2, Table 2-1, for detailed descriptions of these condition types). The current condition of grasslands in parts of the assessment area was not determined.

The extent and current condition of grasslands were determined for major landowners within the analysis area using landownership information from the Arizona Land Resource Information Service and the New Mexico Resource Geographic Information system. Detailed information about this data layer is provided in Chapter 2. For this analysis, areas were calculated for each major landowner as well as for each National Forest. It is important to note that the acreages calculated for National Forests in this section of the report which are based strictly on landownership, differ from acreages presented within the individual Forest chapters (Chapters 4-15), which are based on administrative boundaries and include lands owned by other landowners. Areas where current grassland conditions are undetermined are not included in percentages of grassland conditions by landowner.

The Grasslands Assessment identified over 26.6 millions acres of low elevation grasslands (< 5000 feet) within the analysis area (Table 3-3). Tribal lands, privately owned lands, and state trust lands contain the largest acreages of these grasslands. Nearly 2 million acres (7.5%) fall on National Forest lands. Within the National Forests, the Coronado, Coconino, and Apache-Sitgreaves National Forests have the largest acreages of low elevation grassland.

Overall, over 2.9 million acres (18.4%) of grasslands in the analysis area remain in open native condition (Table 3-4). Substantial portions of historic grasslands have experienced some shrub encroachment (restorable native, 37.6%), but can be restored to open native condition, while other portions (30.6%) have experienced significant shrub encroachment and probable conversion to shrubland (former grasslands). Compared to overall

conditions in the analysis area, grasslands on National Forests have higher proportions in open native (20.0%) and restorable native condition (58.5%), and lower proportions that have converted to shrublands (12.4%). The proportion of grasslands on National Forests dominated by non-native grasses is similar to the overall assessment area. However, nearly all non-native grasslands on National Forest occur on the Coronado National Forest, primarily due to the presence of Lehman (*Eragrostis lehmanniana*) and Boer (*Eragrostis chloromelas*) lovegrasses.

Table 3-3. Area (acres) identified as low elevation (<5000 feet) historic grasslands (Schussman and Gori 2004, Gori and Enquist 2003) for nine major landowners and seven National Forests in Arizona and parts of New Mexico that fall within the Apache Highlands Ecoregion. Grassland areas are based on all identified historic grasslands areas, even if the current condition was not determined.

Landowner	Total Acres	% of Assessment Area	Grassland Acres	% of Total Grassland Area
Bureau of Land Management	13,103,000	17.3	3,627,900	13.6
Department of Defense	2,848,700	3.8	59,500	0.2
US Fish and Wildlife Service	1,710,800	2.3	115,500	0.4
National Park Service	2,567,300	3.4	334,400	1.3
Other	304,300	0.4	21,500	0.1
Private	13,836,000	18.3	6,872,300	25.8
State Trust	9,789,400	12.9	5,460,800	20.5
Tribal	20,109,400	26.6	8,186,600	30.7
US Forest Service				
Apache-Sitgreaves N.F	2,013,200	2.7	347,000	1.3
Coconino N.F	1,831,300	2.4	365,100	1.4
Coronado N.F.	1,717,900	2.3	726,400	2.7
Gila N.F.	117,400	0.2	10,000	<0.1
Kaibab N.F	1,541,900	2.0	153,300	0.6
Prescott N.F	1,254,100	1.7	271,600	1.0
Tonto N.F	2,865,400	3.8	119,100	0.4
US Forest Service Total	11,341,200	15.0	1,992,400	7.5
Total	75,610,100	100.0	26,670,900	100.0

Table 3-4. Current condition of low elevation (< 5000 feet) grasslands for nine landowner categories and seven National Forests in Arizona and parts of New Mexico that fall within the Apache Highlands Ecoregion (from Schussman and Gori 2004, Gori and Enquist 2003). Areas with undetermined current condition are not listed or included in percentage calculations.

Landowner	Grassland Condition									
	Open Native		Restorable Native		Former		Non-native		Transitional	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Bureau of Land Management	404,500	12.2	1,101,300	33.1	1,569,800	47.2	18,800	0.6	234,800	7.1
Department of Defense	8,900	14.9	600	1.0	1,200	2.0	48,900	82.0	0	0.0
US Fish and Wildlife Service	3,100	2.7	13,000	11.3	3,800	3.3	95,600	82.8	0	0.0
National Park Service	1,400	1.0	6,400	4.5	131,000	91.9	2,500	1.8	1,200	0.8
Other	500	5.7	4,400	50.0	2,000	22.7	600	6.8	1,300	14.8
Private	1,230,700	23.4	1,862,100	35.4	1,210,700	23.0	646,000	12.3	313,100	5.9
State Trust	747,100	16.5	1,722,100	38.0	1,453,300	32.0	497,500	11.0	117,400	2.6
Tribal	220,100	25.3	317,000	36.4	324,000	37.2	0	0.0	10,500	1.2
US Forest Service										
Apache-Sitgreaves N.F	0	0.0	236,400	72.6	89,100	27.4	0	0.0	0	0.0
Coconino N.F	3,800	1.4	244,100	90.5	21,800	8.1	0	0.0	0	0.0
Coronado N.F.	180,200	24.8	317,500	43.7	75,700	10.4	153,000	21.1	0	0.0
Gila N.F.	9,000	90.0	0	0.0	1,000	10.0	0	0.0	0	0.0
Kaibab N.F	0	0.0	23,100	83.1	0	0.0	0	0.0	4,700	16.9
Prescott N.F	129,400	47.6	116,900	43.0	23,100	8.5	2,100	0.8	0	0.0
Tonto N.F	27,000	22.7	85,700	72.0	6,300	5.3	0	0.0	0	0.0
US Forest Service Total	349,400	20.0	1,023,800	58.5	217,100	12.4	155,100	8.9	4,700	0.3
Total	2,965,700	18.4	6,050,700	37.6	4,912,900	30.6	1,465,000	9.1	683,000	4.2

III. Distribution of Stream Reaches with Native Fish Occurrences

The Arizona Statewide Freshwater Assessment (Turner and List, *In Prep*; available at www.azconservation.org) was used to summarize the occurrence and distribution of stream reaches with native fishes across major landowners and National Forests in Arizona. This assessment was developed for use in regional planning and includes occurrence information for 33 native fish species. Point localities for each species from 1975 and later, obtained from a variety of sources (see Chapter 2 for more details), were mapped to perennial stream reaches on a 1:100,000 scale linear hydrography layer for Arizona. Native fish occurrences were mapped to stream reaches which approximate the bounds of currently occupied habitat. However, it is recognized that at finer scales these reaches may differ somewhat from current native fish distributions. These differences are addressed on a forest by forest basis in the individual Forest chapters (Chapters 4-15). At the large statewide scale of this analysis, this data set provides the most current and useful information available for understanding the distribution of important stream reaches for native fishes. This analysis includes only Arizona. However, a similar data set for New Mexico is currently being developed, and results from that analysis may be incorporated into this document when available.

The Freshwater Assessment includes a database that integrates the distribution of all 33 native fishes into a single data layer that represents number of native fish species with occurrences on stream reaches across Arizona. This information was used along with landownership information from the Arizona Land Resource Information Service and the New Mexico Resource Geographic Information system (detailed information about this geo-spatial data layer is provided in Chapter 2) to determine the distribution (number of stream miles) of stream reaches with varying levels of native fish richness by major landowners and for individual National Forests in Arizona. In areas where streams serve as the boundary between landowners for a distance greater than five miles, one-half of the length of that stream reach was attributed to each landowner. More detailed information on the species and stream reaches with occurrences are provided in individual Forest chapters (Chapters 4-15).

Approximately 3,650 miles of stream reaches within Arizona have had occurrences of native fish species in the last 30 years, with the number of species with occurrences on stream reaches ranging from one to nine (Figure 3-1). Of major landowners in the state, the largest number of stream miles with native fish occurrences occurs on USFS lands, followed by Tribal and privately owned lands (Table 3-5). Together, these three landowner categories account for more than 75% of the stream miles with native fish occurrence in Arizona. While tribal lands tend to have more stream miles at low native species richness, National Forest lands tend to have the largest number of stream miles with high native fish richness (Figure 3-2). Overall, 50% of the stream miles with occurrences of five or more native fish species occur on Forest lands. Within National Forests, the Apache-Sitgreaves and Tonto National Forests have the majority of stream miles with native fish occurrences, including a large portion of the stream miles with occurrences of a large number of native fish species. However, the Coconino and Prescott National Forests also have noteworthy areas with occurrences of a high number of native fish species.

Of all native species in Arizona, fish may have suffered the largest losses (Minckley & Deacon, 1968; Williams and others 1985; Minckley & Rinne 1991; Olden & Poff 2005). Arizona has been ranked first among states in the proportion of native freshwater species at risk of extinction (Stein 2002). Olden and Poff (2005) documented substantial changes in the abundances of lower

Colorado River Basin species that occur on USFS lands in Region 3. For example, the following species have shown population declines: the Gila topminnow (36.8% decline), Apache trout (26.9% decline), speckled dace (16.5% decline), Gila chub (15.9% decline), and desert sucker (13.5% decline). However, some species have shown population increases, such as the longfin dace and Sonora (11.4% and 8.2%, respectively).

The causes of decline are many and have varied over time and space. Demands placed upon the region's limited water supplies are increasing as Arizona's population continues to grow, suggesting that activities occurring outside Forest boundaries could play an increasing role in the status of resources USFS is responsible for managing in a sustainable manner. Regional assessment data summarized here demonstrate the important role USFS plays in managing native fish habitat. Changes documented in native fish distribution combined with increasing pressure on limited water supplies indicate that native fish, watershed, and ground-water management may be an important focal area for comprehensive evaluation in forest plan revisions.

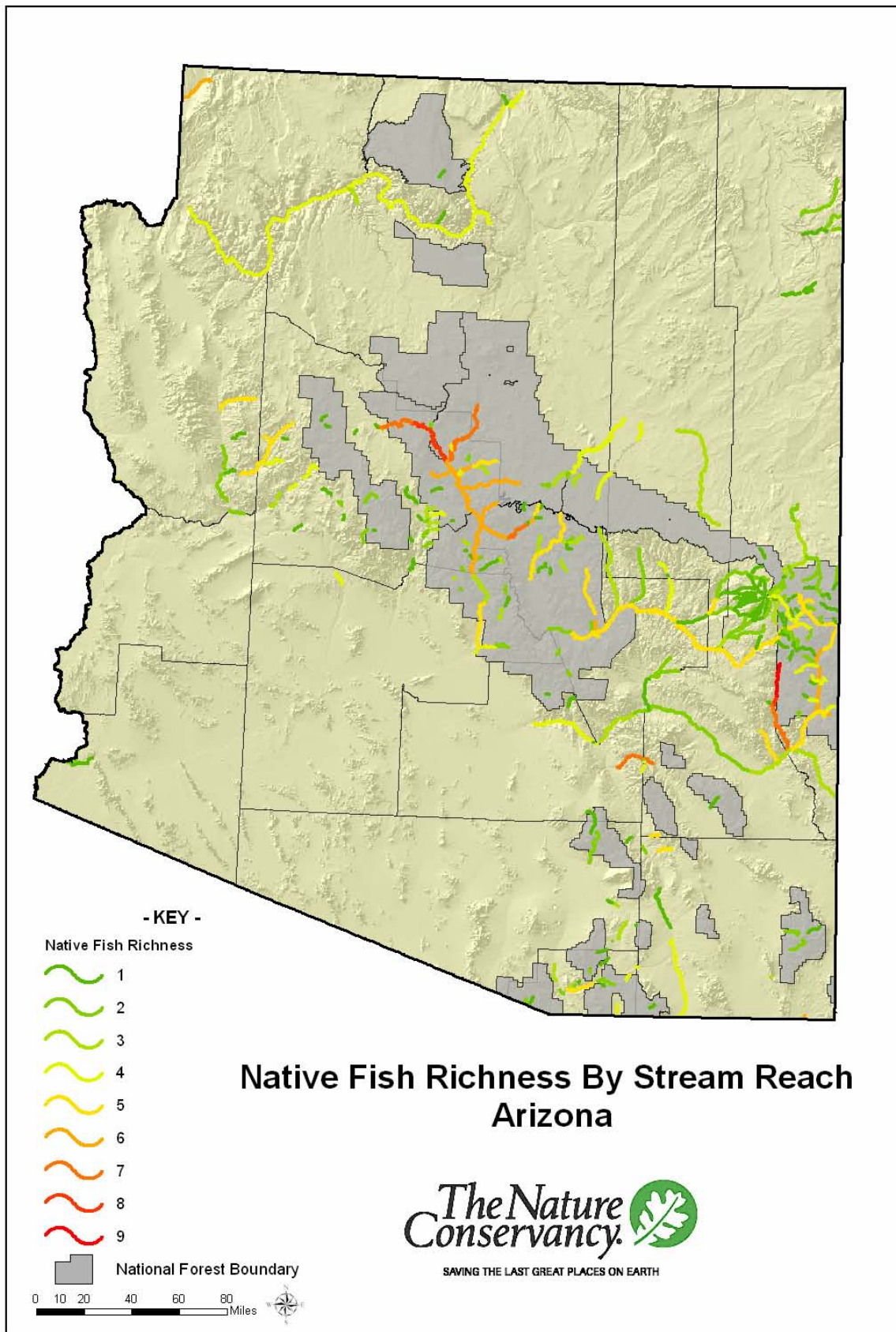


Figure 3-1. Stream reaches with occurrences of a varying number of native fish species (1-9) in Arizona.

Table 3-5. Approximate length (miles) of stream reaches with varying numbers of native fish species occurrences (1-9) for nine major landowner categories and six National Forests in Arizona. Native fish occurrences in stream reaches were determined based on occurrence information from 1975 and later.

Landowner	<i>Native Fish Richness</i>									Total
	1	2	3	4	5	6	7	8	9	
Bureau of Land Management	29	63	88	51	52	13	11	0	0	307
Department of Defense	0	4	0	0	0	0	0	0	0	4
US Fish and Wildlife Service	0	36	25	0	0	2	0	0	0	63
National Park Service	27	71	5	207	0	1	0	0	0	311
Other	1	5	9	19	2	0	5	0	0	41
Private	93	141	163	95	78	37	63	19	7	696
State Trust	25	20	24	44	27	1	2	0	0	143
Tribal	229	305	103	140	168	2	9	6	2	964
US. Forest Service										
Apache-Sitgreaves N.F	95	87	21	97	87	34	4	0	10	435
Coconino N.F	0	13	18	7	12	53	21	7	0	131
Coronado N.F.	34	41	0	0	0	0	0	0	0	75
Kaibab N.F	4	0	0	0	0	0	0	0	0	4
Prescott N.F	13	13	3	2	0	13	17	12	0	73
Tonto N.F	43	43	69	13	130	84	21	0	0	403
US. Forest Service Total	189	197	111	119	230	183	63	19	10	1121
Total	593	842	528	675	557	239	153	44	19	3650

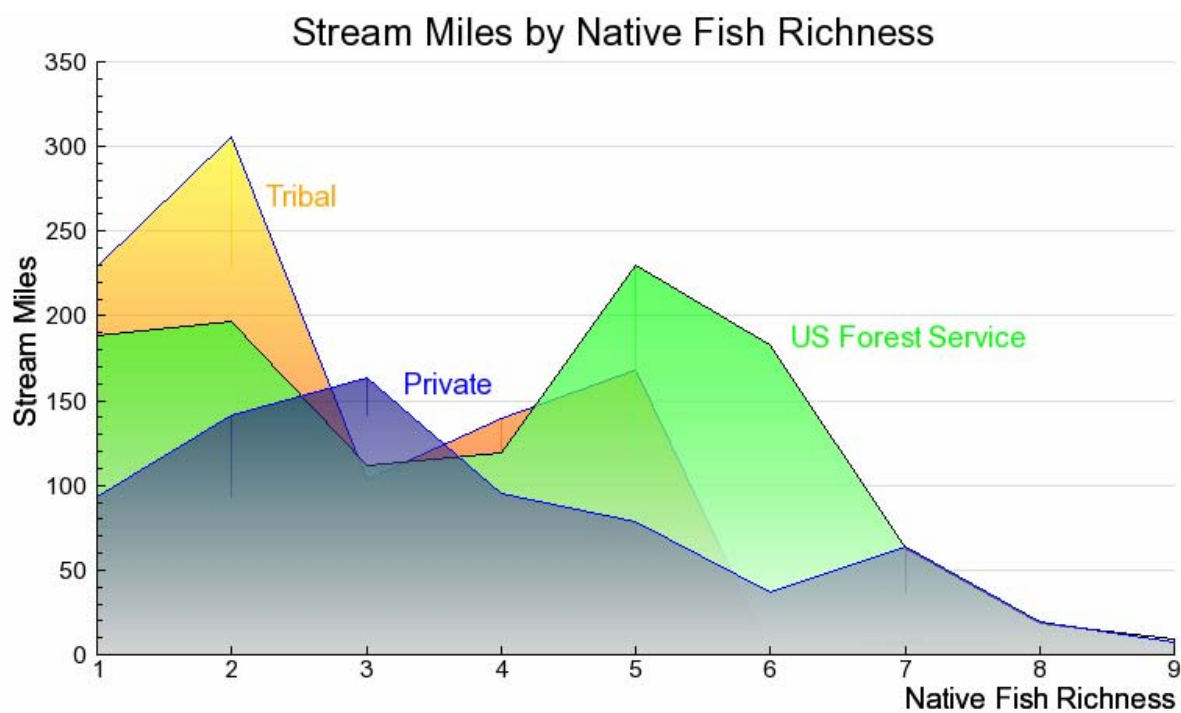


Figure 3-2. Approximate length (miles) of stream reaches with varying numbers of native fish species occurrences (1-9) for the three landowners (Forest Service, tribal, and private) with the most miles of stream with native fish occurrences.

IV. Ecoregional Assessments and Conservation Areas

The results of eight ecoregional assessments (Bell and others 1999, 2004 Marshall and others 2000, 2004, Neely and others 2001, The Nature Conservancy 2001, 2005, Tuhy 2002) were used to identify a network of areas important for sustaining the viability of the region's species and ecological systems across landownerships in Arizona and New Mexico. The individual areas that make up the network are referred to as conservation areas. Ecoregional assessments are comprehensive and systematic efforts to identify the minimum network of conservation areas on the landscape that are necessary to maintain the biological diversity of the ecoregion.

Ecoregions are large, contiguous units of land or water defined by ecological and environmental elements, rather than geo-political boundaries, and typically contain geographically distinct assemblages of species, natural communities, and environmental conditions. Because ecoregions typically include large proportions of ecosystem, community, and species distributions, they are useful for conservation planning. The ecoregional assessment process includes the identification of conservation targets (including species, ecological systems, and important biological features) that represent the biological diversity within the ecoregion. Conservation goals (including distribution, size and minimum number of viable occurrences) are established for each conservation target within the ecoregion. An iterative process is used to identify a network of conservation areas that most efficiently meets the conservation goals for all conservation targets within the ecoregion. These conservation areas, collectively called a conservation portfolio, represent the most current and scientifically robust hypotheses on the magnitude and distribution of areas on the landscape necessary to protect the biodiversity of the region. A more detailed description of the ecoregional assessment process can be found in Chapter 2, and the specific methods used for each ecoregion can be found within the ecoregional assessments. Many of the assessments are available for download at <http://www.azconservation.org>.

In general, ecoregional assessments serve several conservation, management and scientific purposes, including:

1. A spatial hypothesis on how to maximize the viability of a region's native species and ecological systems.
2. A spatial delineation of areas where land-uses and land management activities should be evaluated to identify and minimize potential adverse effects to the viability of species and ecological systems.
3. A spatial delineation of priority areas that land managers and others interested in promoting conservation should evaluate first to ensure that disturbance processes that perpetuate native ecological systems (e.g., fire, flooding) are maintained at a scale, frequency, and intensity that falls within the historical range of variation.
4. A network of cross-jurisdictional priorities that could serve as a basis for collaboration and the efficient use of limited resources to maximize conservation values.

While nine ecoregional assessments overlap Arizona and New Mexico (See Chapter 2, Figure 2-2), information from eight ecoregions was synthesized as part of this analysis. The Central Shortgrass Prairie Ecoregional Assessment (The Nature Conservancy 1998), which overlaps a small portion of northeast New Mexico (not including any National Forest lands), was not

included in this analysis. As part of a regional data rollup effort, The Nature Conservancy merged conservation area information from six individual assessments (Apache Highlands, Arizona-New Mexico Mountains, Colorado Plateau, Mojave Desert, Sonoran Desert, and the Southern Rocky Mountains) into a single regional data layer (<http://www.azconservation.org>). This dataset includes conservation area boundaries and attributes for the conservation targets that occur within each conservation area in those ecoregions. The assessments for Chihuahuan Desert Ecoregion, which overlaps a small part of the Lincoln National Forest, the Southern Shortgrass Prairie Ecoregion, which includes portions of the Santa Fe National Forest and Cibola Grasslands, were included individually.

The amount of overlap between conservation areas from the eight ecoregional assessments and major landowners within Arizona and New Mexico was calculated using landownership information from the Arizona Land Resource Information Service and the New Mexico Resource Geographic Information system. Detailed information about this geo-spatial data layer is provided in Chapter 2. It is important to note that the acreages calculated for National Forests here, based strictly on landownership, differ from those presented within the individual Forest chapters (Chapters 4-15), which are based on administrative boundaries and include lands owned by other landowners.

Nearly 57 million acres (37.6%) of land within Arizona and New Mexico have been identified as part of the network of conservation areas (Figure 3-3). The majority of these acres occur on private (29.7%), Region 3 US Forest Service (17.1%), and Bureau of Land Management (15.8%) lands (Table 3-6). However, the highest percentage overlap with conservation areas occurs on US Fish and Wildlife Service (93.1%), National Park Service (83%), and the Department of Defense (72.4%) lands, followed by US Forest Service (47.1%). Within National Forests, the Tonto (1,349,500 acres), Coconino (1,294,700 acres), Coronado (1,067,200 acres), and Gila (1,016,200 acres) National Forests have the largest acreages within conservation areas, while the Coconino (70.7%), Coronado (62.1%), and Santa Fe (58.8%) National Forests have the highest proportion of their lands overlapping with conservation areas.

Conservation Areas in Arizona and New Mexico

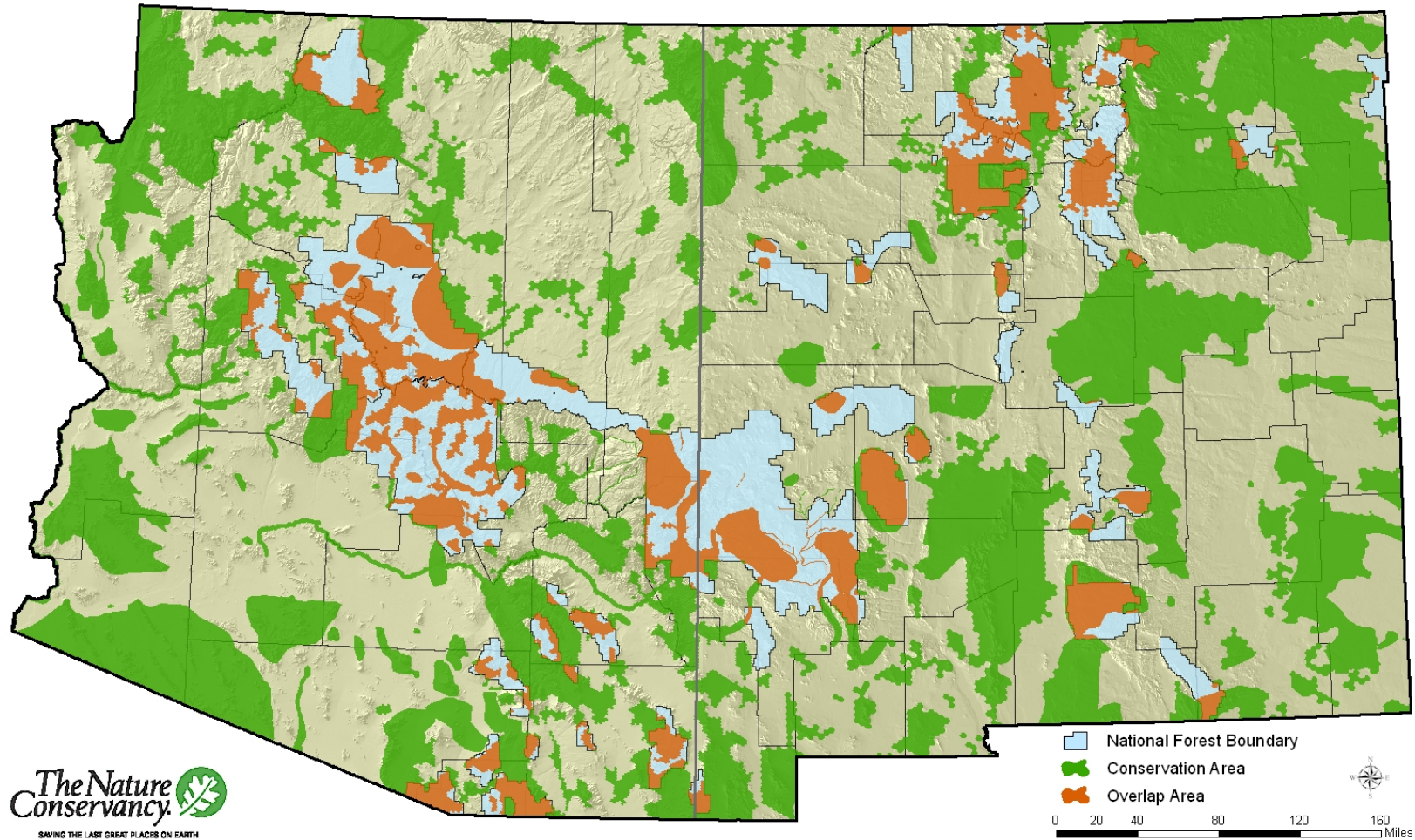


Figure 3-3. Conservation areas from eight ecoregional assessments in Arizona and New Mexico showing overlap with National Forest boundaries.

Table 3-6. Overlap between conservation areas from eight ecoregional assessments with major landowners and 11 National Forests in Arizona and New Mexico.

Landowner	Total Acres Overlapped by Conservation Areas	% in Conservation Areas	% of All Conservation Areas
Bureau of Land Management	8,940,200	34.9	15.8
Department of Defense	3,876,500	72.4	6.8
US Fish and Wildlife Service	1,950,300	93.1	3.4
National Park Service	2,448,100	83.0	4.3
Other	366,200	46.3	0.6
Private	16,834,500	35.7	29.7
State Trust	6,372,300	35.0	11.2
Tribal	6,244,700	22.2	11.0
US Forest Service			
Apache-Sitgreaves N.F	943,500	46.9	1.7
Carson N.F.	769,000	51.7	1.4
Cibola N.F.	683,300	39.1	1.2
Coconino N.F	1,294,700	70.7	2.3
Coronado N.F.	1,067,200	62.1	1.9
Gila N.F.	1,016,200	31.1	1.8
Kaibab N.F	547,200	35.5	1.0
Lincoln N.F.	539,600	49.3	1.0
Prescott N.F	560,500	44.7	1.0
Santa Fe N.F.	918,100	58.8	1.6
Tonto N.F	1,349,500	47.1	2.4
US Forest Service Total	9,688,800	47.5	17.1
Total	56,721,700	37.6	100.0

Discussion

This synthesis of existing regional assessment information highlights the ecological components that exist on National Forests and places them in context of other major landowners in Arizona and New Mexico. This information may be useful in identifying the opportunities and challenges that National Forests across the region face in developing forest plans that meet the ecological sustainability standard of the new forest planning rule [36 CFR sec. 219.10(b)]. In addition, the synthesis also provides a comparison of the ecological components across individual Forests. Each Forest contains ecological components that are either unique or occur disproportionately on their lands.

Potential Natural Vegetation Types

Within Arizona and New Mexico, Region 3 National Forests contain large proportions of several PNVTs that support unique plant and animal species. For example, according to SWReGAP data (note limitations of these data discussed earlier in this Chapter), Region 3 (led by the Carson, Gila, and Tonto National Forests) manages more high elevation PNVTs (aspen forest and woodlands, Madrean pine-oak, mixed conifer forests, montane grasslands, ponderosa pine forests, spruce-fir forests, and sub-alpine grasslands) than other major landowners in the Southwest. Also, Region 3 manages more interior chaparral (led by the Tonto National Forest) and Madrean encinal (led by the Coronado National Forest) than other landowners. It is obvious that Region 3 National Forests have an important role to play in maintaining the sustainability of these systems and the species that depend on them. Within the forest planning process, it may be important to consider the range of ecological processes that shaped historic conditions within these PNVTs, and evaluate the ability of current management actions to support ecosystem and species diversity. By understanding the context in which these PNVTs exist on National Forests, this information can be used to identify processes and conditions that support sustainability, formulate strategic goals, and evaluate the need to change management to meet the goal of ecological sustainability across the region.

According to the Arizona Grasslands Assessment (Schussman and Gori 2004) National Forests within the Southwest contain a relatively small proportion of low elevation (< 5000 feet) grasslands compared to other landowners. While a similar proportion of grasslands on National Forests remain in open native condition compared to other landowners, the proportions of other grassland conditions differ from other landowners in notable ways. For example, it is apparent that grasslands for all landowners, including National Forests face significant threats from encroachment by woody species as noted by the high proportion of grasslands in restorable native and former grassland conditions. However, on National Forests, a smaller proportion of these encroached grasslands have undergone a type conversion to shrublands while a larger proportion retains the potential for restoration to open native condition. Amongst National Forests, the Apache-Sitgreaves has seen a larger proportion of its grasslands converted to shrublands. The Coronado National Forest, due to the threats from non-native lovegrasses, has the largest proportion of non-native grasslands.

Based on the documented loss of grasslands region-wide, the need for appropriate maintenance and restoration goals and management to arrest declines is paramount. Based on this analysis, the Coronado, Prescott, Apache-Sitgreaves, Coconino, and Tonto National Forests, with their large acreages of open native and restorable grasslands, can make a significant contribution to regional sustainability of grasslands by identifying and evaluating the drivers of grassland change and developing strategic goals that would provide for the restoration and maintenance of this important ecological system.

Protecting and restoring grasslands in the Southwest from encroaching shrubs and non-native grasses are some of the major challenges landowners, including USFS, face in maintaining the ecological and biological integrity of grassland systems. Brunson and others (2001) suggest that prescribed burns can be utilized to reduce shrub cover when sufficient fuel loads are present, which may require rest from grazing. According to Schussman and Gori (2004), some

grasslands in Arizona could be burned with only three growing seasons or less of rest, while other sites would require longer periods of rest to build adequate fuel loads. In contrast, fire may not be a useful approach when attempting to control the spread of non-native grasses. Because some non-native grasses may spread further when burned and the general lack of information of how many non-native grasses respond to fire, Schussman and Gori (2004) suggest using caution when burning areas dominated by non-native grass species such as Lehmann lovegrass (*Eragrostis lehmanniana*), Boer lovegrass (*Eragrostis chloromelas*) and especially cheatgrass (*Bromus tectorum*).

Freshwater Species and Systems

It is widely recognized that native freshwater fishes in the United States are highly imperiled, and Arizona and New Mexico have some of the highest percentages of threatened fish species (85% and 30%, respectively; Warran and Burr 1994). It is thought that the first and most dramatic decline in native fishes in the Southwest occurred between 1890 and 1935 as a result of intensive water management, introduction of non-native species, and the construction of dams (Mueller and Marsh 2002, Olden and Poff 2005). Today, many native fish species in the Southwest have limited distributions, making their continued viability particularly vulnerable to local and regional threats. Within Arizona, National Forests have a vital role in assuring the sustainability of these species. Amongst major landowners, National Forests have the largest proportion of stream miles with occurrences of one or more of 33 native fish species. The Apache-Sitgreaves and Tonto National Forests, in particular, have substantial stream miles with native fishes. Compared to other landowners, National Forests have a greater proportion (as much as one-half) of the stream miles with high native fish species richness. From a planning perspective, these areas, which are identified in individual Forest chapters (Chapters 4-15) may serve as important areas in considering the sustainability of aquatic vertebrate species. Given the magnitude and rate of loss of native fishes in the Southwest, and the potential role Region 3 can play in maintaining biodiversity of freshwater systems, it is vital that these systems and the species that depend upon them are an integral component of the ecological sustainability of forest plans.

Ecoregional Assessments

The ecoregional assessments that address Arizona and New Mexico provide a useful regional perspective on areas important for sustaining biodiversity. They also point to the role that National Forest lands play in maintaining biodiversity in the region. The degree of overlap between ecoregional conservation areas and National Forests in Arizona and New Mexico underscores the important ecological values that exist on National Forests lands. Nearly one-half of National Forest lands overlap conservation areas, representing over 17% of all conservation areas in the two-state region, which is the second highest percentage of any landowner overlap. Nearly all Region 3 National Forests have significant areas of overlap, led by the Tonto, which has the largest acreage (1,349,500 acres) and proportion (2.4%) of overlap.

The suite of conservation areas, when considered as a whole, represents not only priority locations in these two states for maintaining biodiversity, but also the minimum area on the landscape needed to maintain the region's biodiversity. As such, the suite of areas is intended to be highly strategic and can provide important leverage for maintaining biodiversity at large, ecoregional scales. Furthermore, none of the identified conservation areas should be considered inconsequential for maintaining biodiversity at an ecoregional scale. Each conservation area is important and should be evaluated in terms of currently allowable uses and activities and their associated impacts to biodiversity. In some cases, analyses of this type may indicate the need for management change.

It is important to note that these conservation areas do not necessarily imply the need for special protections; nor does it necessitate blanket restriction of activities within these areas. Rather, conservation areas can be viewed as priority areas for assessment of impacts associated with ongoing uses and activities and determination of their compatibility with sustaining biodiversity at ecoregional scales. From the perspective of forest planning for the maintenance of ecosystem and species diversity, conservation areas can serve several important functions. First, they can be used as an analysis tool for assessing land use suitability. Second, they can be used to help determine appropriate objectives for individual management areas; for example, managing ecosystem characteristics and processes within the historic range of variability. Third, they can aid in identifying specific plan components, including management objectives and guidelines, for species whose sustainability is threatened.

To further aid in planning efforts, each conservation area has associated with it a number of conservation targets (species, vegetation systems, and ecological features), which are representative of the biodiversity in the area. An analysis and breakdown of these conservation targets is provided for each National Forest in the individual Forest chapters (Chapters 4-15). These conservation targets and the threats they face can be used to analyze and address the likely impacts of current management on ecological sustainability in terms of both ecosystem and species diversity. These targets can also aid in identifying and characterizing the need for management change and evaluating new management strategies for addressing sustainability, i.e., maintaining both ecosystem and species diversity.

Given the regional perspective of the ecoregional assessments and the strategic nature of the conservation areas, use of conservation areas and conservation targets as analysis tools for addressing the threats facing biodiversity can provide a key step, within the context of forest planning, in sustaining the ecosystems and species that exist in the region.

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**Chapter 6:
Ecological & Biological Diversity of the Kaibab National Forest**

In

Ecological and Biological Diversity of National Forests in Region 3

**Bruce Vander Lee, Ruth Smith, and Joanna Bate
The Nature Conservancy**



SAVING THE LAST GREAT PLACES ON EARTH

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Introduction

The Kaibab National Forest is one of 11 National Forests within U.S. Forest Service (USFS) Southwestern Region (Region 3). This Forest is located in north-central Arizona and encompasses approximately 1,541,900 acres (623,985 hectares), which comprises approximately 7.5% of the total area of all Region 3 Forests, excluding the Cibola National Grasslands. Elevation on the Kaibab ranges from approximately 5,500 ft. (1,676 m) to 10,418 ft. (3,175 m) at the summit of Kendrick Peak. The Kaibab contains three distinct land units managed by the North Kaibab, Tusayan, and Williams Ranger Districts. The Kaibab National Forest is well-known for its proximity to Grand Canyon National Park. The North Kaibab Ranger District borders the north rim of the Grand Canyon, while the Tusayan Ranger District borders the south rim. The Williams Ranger District lies adjacent to the Coconino and Prescott National Forests.

The Kaibab National Forest contains unique ecological and biological aspects relative to other National Forests in and outside of the Region. For example, the Kaibab contains the largest contiguous ponderosa pine forests in the United States. This forest system type provides important habitat for many species that are unique and limited in geographic distribution, such as the Kaibab squirrel (*Sciurus aberti kaibabensis*), a subspecies of the Abert's squirrel (*Sciurus aberti*). The Kaibab National Forest also supports one of the densest populations of Northern goshawks (*Accipiter gentiles*) known in the lower 48 states. This predatory species has been petitioned to the U.S. Fish and Wildlife Service (USFWS) in the recent past for consideration under the Endangered Species Act of 1973.

The goal of this chapter is to synthesize information from existing regional-scale assessments to identify important ecological and biological values that occur on the Kaibab National Forest and highlight information that may be pertinent to forest planning. Information from five assessments was synthesized for the Kaibab National Forest, including:

- Distribution and extent of potential natural vegetation types (PNVTs)
- Distribution and condition of grassland systems
- Distribution of native fish species
- Plant and animal species richness and their conservation statuses
- Conservation areas and targets associated with Ecoregional Assessments

These types of information may be useful within the forest planning process for evaluating the suitability of current management activities and land management designations, identifying ecological characteristics that may be considered in developing desired conditions, and identifying species that may need special consideration because of continuing threats to their existence. Detailed descriptions of these datasets and the methods used to analyze them are available in Chapter 2. A summary and analysis of these assessments and how the Kaibab National Forest compares to other major landowners in the Southwest (Arizona and New Mexico) and other National Forests in Region 3 is provided in Chapter 3.

Results

I. Potential Natural Vegetation Types within the Kaibab National Forest

Information from the Southwest Regional Gap Analysis Project (SWReGAP; USGS National Gap Analysis Program 2004) was used to characterize the distribution of potential natural vegetation types (PNVTs) on the Kaibab National Forest. PNVTs represent the climax vegetation type that would dominate a site under natural disturbance regimes and biological processes. PNVTs were used to summarize vegetation for this analysis because of their relevance to the characterizations of historic range of variability and vegetation models being developed for PNVTs in preparation for the forest planning process. For this analysis, the extent and proportion of each PNVT on the Kaibab was summarized, as well as the proportion of each PNVT within Region 3 that occurs on the Kaibab. More detailed information on the data and methods used in this analysis can be found in Chapter 2, and comparisons of PNVTs on the Kaibab to other Region 3 Forests and landowners in the Southwest is available in Chapter 3.

Sixteen PNVTs were identified on the Kaibab National Forest (Figure 6-1; see Appendices 2-A and 2-B, respectively, for the cross-walk of SWReGAP land cover types to PNVTs and detailed descriptions of each PNVT). The two most common PNVTs, pinyon-juniper woodlands (41.5%) and ponderosa pine (36.0%), comprise approximately 78% of the vegetation systems on the Kaibab National Forest (Table 6-1). Great Basin/ Colorado Plateau grassland and steppe encompasses the next largest portion (6.5%) of the Forest, while mixed conifer forest (4.6%) and sagebrush shrubland (4.4%) comprise the subsequent largest areas on the Kaibab, respectively. The remaining 11 PNVTs combined cover approximately 6% the Forest.

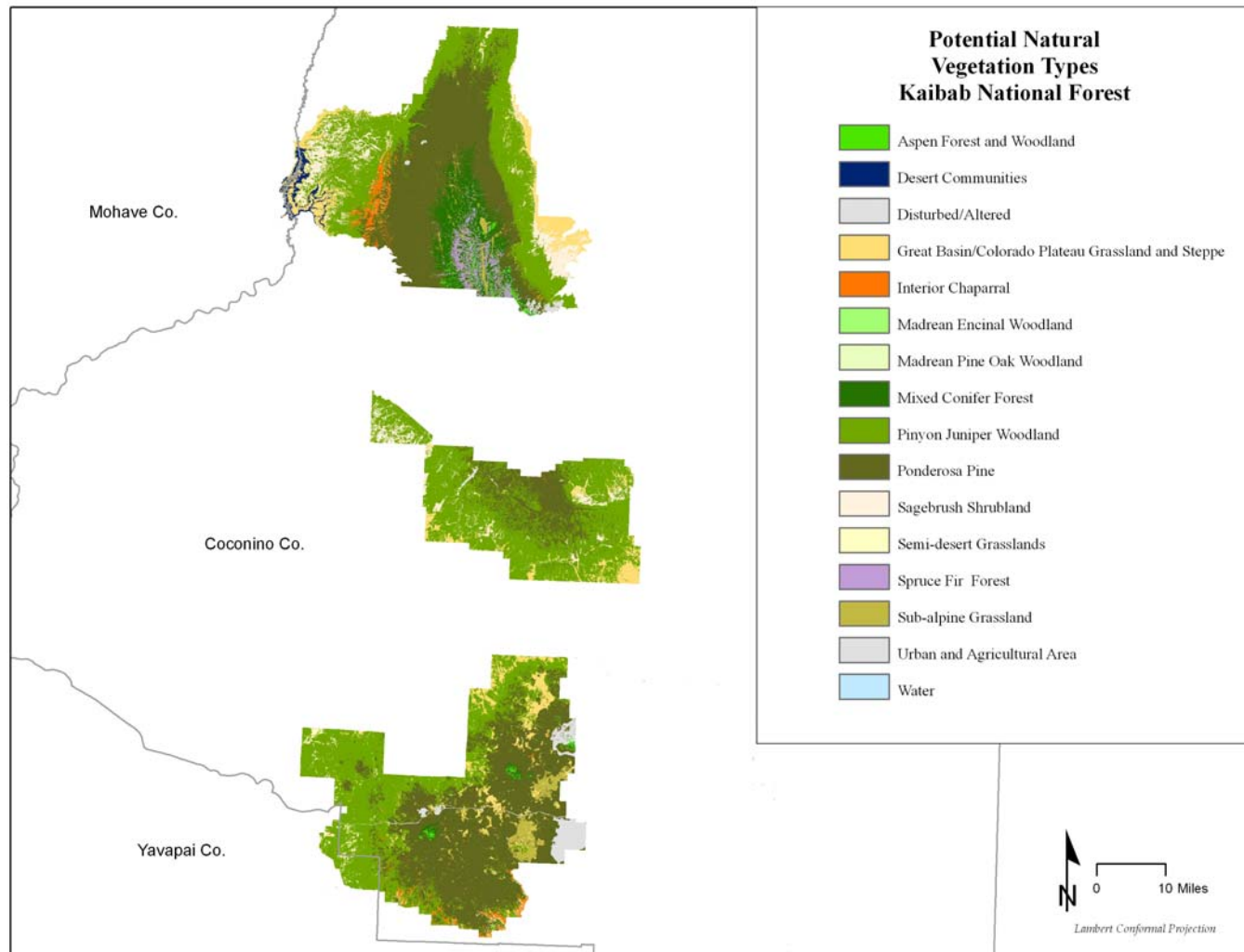


Figure 6-1. Distribution of potential natural vegetation types on the Kaibab National Forest. The map was created using data from the Southwest Regional Gap Analysis Project (SWReGAP; U.S. Geological Survey National Gap Analysis Program. 2004). SWReGAP vegetation types were aggregated and converted to potential natural vegetation types. See Chapter 2 for more information regarding methods used. SWReGAP data have not been accuracy tested and is based on satellite imagery. Therefore, SWReGAP may not be appropriate at fine spatial scales.

Table 6-1. Approximate area (in acres) and percent of total area of potential natural vegetation types on the Kaibab National Forest, based on data from the Southwest Regional Gap Analysis Project (SWReGAP). SWReGAP land cover types were aggregated and converted to potential natural vegetation types. These values likely differ from other vegetation assessments due to differences in scale and methodology. See Chapter 2 for more details on methods.

Potential Natural Vegetation Type	Total Area (acres)	Percent of Total Area (%)
Aspen Forest and Woodland	7,700	0.5
Desert Communities	11,000	0.7
Disturbed/Altered (quarries and mines)	10,300	0.7
Great Basin/ Colorado Plateau Grassland and Steppe	100,600	6.5
Interior Chaparral	19,500	1.3
Madrean Encinal Woodland	500	<0.1
Madrean Pine-Oak Woodland	2,900	0.2
Mixed Conifer Forest	70,600	4.6
Pinyon-juniper Woodland	640,100	41.5
Ponderosa Pine	555,100	36.0
Sagebrush Shrubland	67,200	4.4
Semi-desert Grassland	6,800	0.4
Spruce-fir Forest	20,800	1.3
Urban and Agricultural Area	1,700	0.1
Water (open water)	300	<0.1
Total	1,541,900	

The Kaibab National Forest comprises approximately 7.5% of the total area of Region 3 National Forests, but manages large percentages of certain PNVTs. For example, the largest proportion (50%) of sagebrush shrublands on Region 3 National Forests can be found on the Kaibab National Forest (Figure 6-2). In addition, the Kaibab manages 19% of pinyon-juniper woodlands, nearly 15% of the Great Basin/Colorado Plateau grassland and steppe, approximately 12% of interior chaparral, and nearly 10% of ponderosa pine forests found across all of Region 3 Forest lands (not including Region 3 National Grasslands).

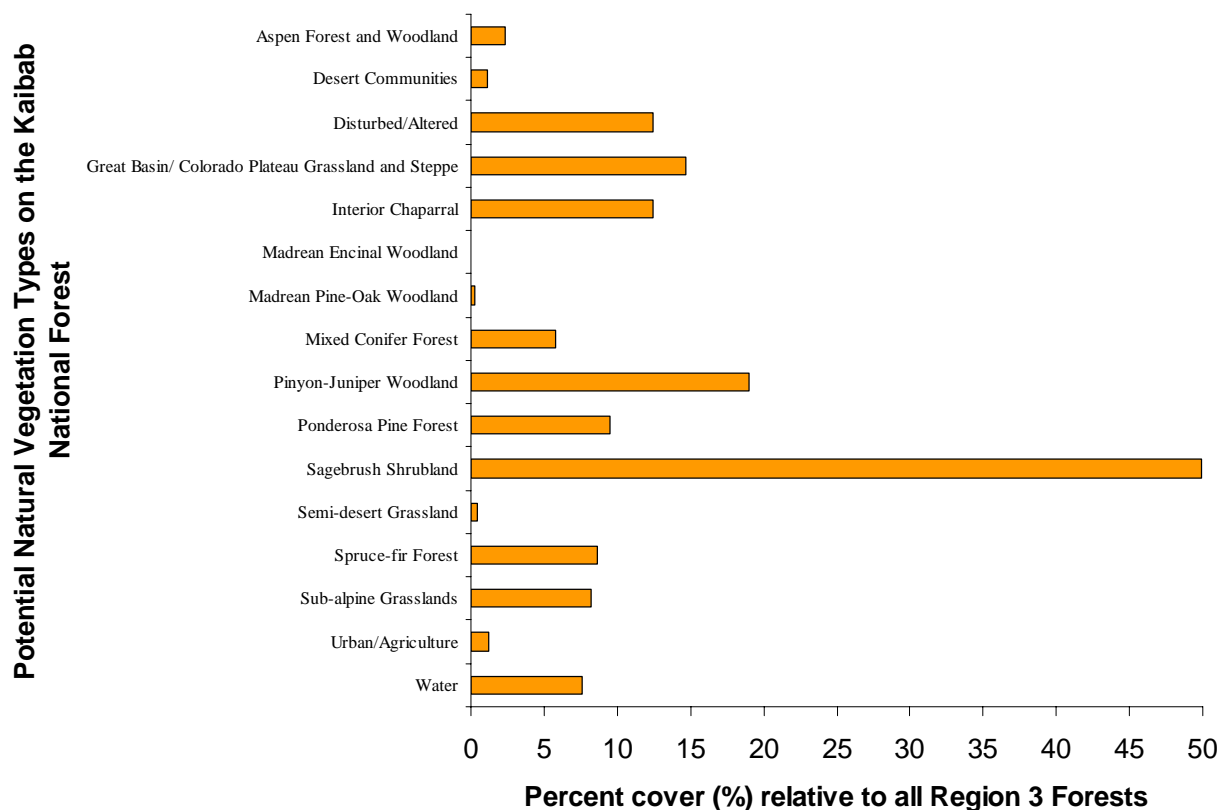


Figure 6-2. Percent of each potential natural vegetation type that occurs on the Kaibab National Forest in relation to all Region 3 National Forests combined. Analysis was conducted using data from the Southwest Regional Gap Analysis Project (SWReGAP), which has not been accuracy tested.

II. Distribution and Condition of Grasslands

The Arizona Statewide Grassland Assessment (Schussman and Gori 2004, Gori and Enquist 2003; available at <http://www.azconservation.org>) was used to identify the extent, distribution, and condition of historic and current low-elevation (<5000 ft) grasslands on the Kaibab National Forest. This statewide assessment (which also includes the portions of southwest New Mexico and Mexico that are within the Apache-Highlands Ecoregion; Figure 2-1 in Chapter 2) was developed through a combination of expert-based mapping and intensive, quantitative field sampling to verify and improve accuracy. Grassland condition was assessed and assigned to condition classes based on native/non-native grass dominance and cover, shrub cover, and erosion severity. For the purposes of this analysis, condition classes were aggregated into five grassland condition types (Table 2-1 in Chapter 2): open native, restorable native, non-native, former, and transitional grasslands. More detailed information on the data and methods used in this analysis can be found in Chapter 2, and analyses comparing the extent and distribution of grasslands on the Kaibab to other Region 3 Forests and landowners in the Southwest are available in Chapter 3. It is important to note that high elevation/montane grasslands which occur on the Kaibab National Forests were not addressed by the Grassland Assessment and are not included in these analyses.

The Arizona Grassland Assessment identified approximately 27,900 acres of extant grasslands on the Kaibab National Forest (Figure 6-3, Table 6-2), representing 1.7% of the Forest. An additional 129,300 acres (8.1% of the Forest) of historic grasslands were identified; however, the current condition of these grassland areas (Figure 6-3) was not determined and these acres are not included in percentage calculations. The majority (82.1%) of grasslands on the Kaibab are in restorable native condition, with the remainder (17.9%) in transitional grassland condition (Table 6-2). Among areas with known current conditions, the Kaibab National Forest manages 1.5% of all grasslands. Within the known areas, the Kaibab also manages 2.1% of restorable grasslands, and almost all transitional grasslands (99.2%) that occur on National Forests in Arizona.

The largest proportions of identified grasslands on the Kaibab National Forest occur on the Williams (44.1%) and Tusayan (38.0%) Ranger Districts (Table 6-2). All of these grasslands were identified as being in restorable native condition, meaning that they have been encroached by shrubs and woody species, but have the potential to be restored to open native condition. These areas are part of a large grassland complex on the Coconino Plateau that includes significant areas of open native and restorable grasslands. The North Kaibab District includes a small area (5,000 acres) of transitional grasslands. These grasslands have very little perennial grass cover and often suffer from severe erosion issues that make it unlikely that they can be restored to healthy grassland conditions.

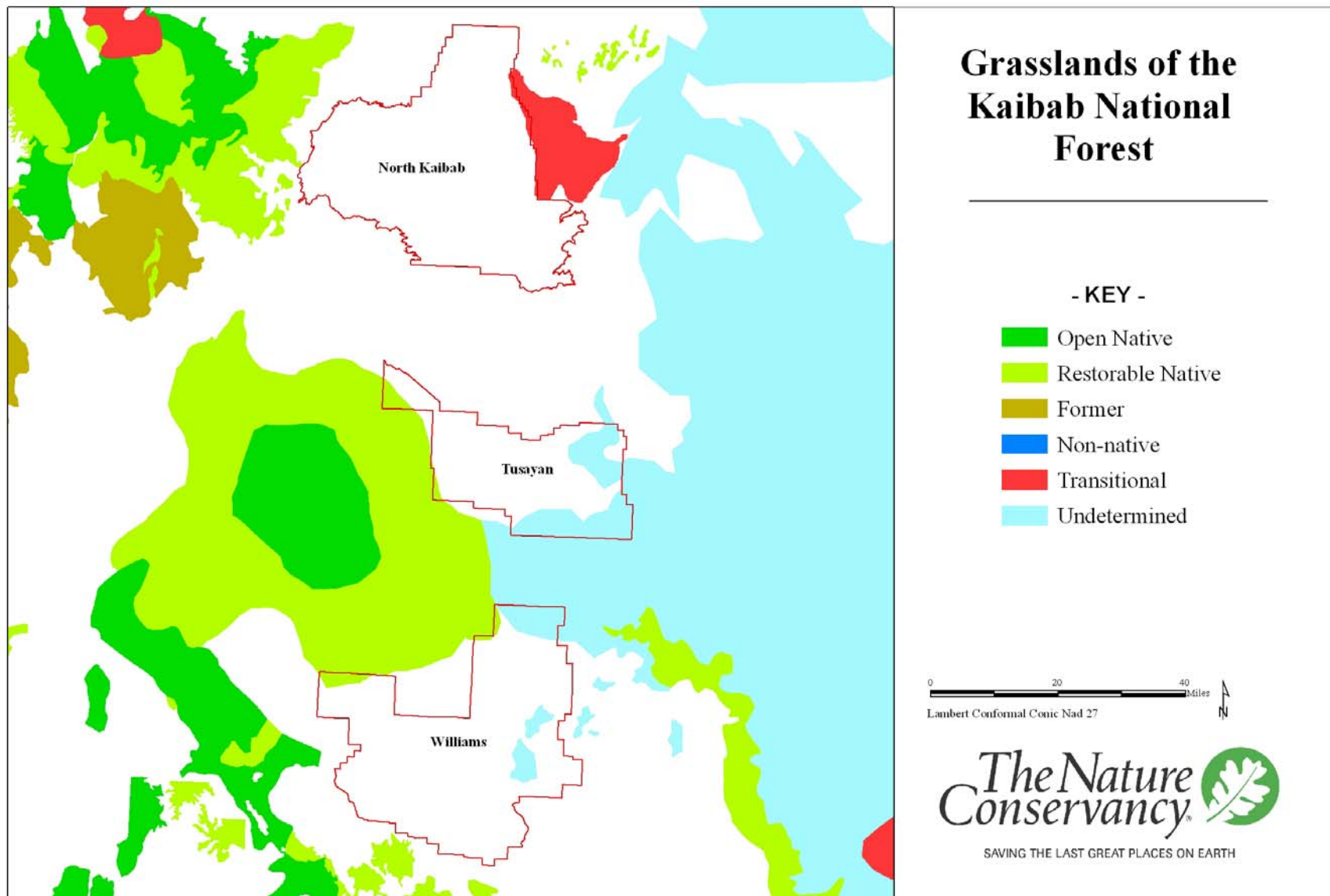


Figure 6-3. Grassland types, based on condition, on three ranger districts on the Kaibab National Forest in Arizona (from Schussman and Gori 2004, Gori and Enquist 2003).

Table 6-2. Acres of grasslands in two condition types occurring on three ranger districts on the Kaibab National Forest in Arizona (from Schussman and Gori 2004, Gori and Enquist 2003).

District	Grassland Type					
	Restorable Native		Transitional		Total	
	Acres	% ^A	Acres	% ^A	Acres	% ^B
North Kaibab	0	0.0	5,000	100.0	5,000	17.9
Tusayan	10,600	100.0	0	0.0	10,600	38.0
Williams	12,300	100.0	0	0.0	12,300	44.1
Total	22,900	82.1	5,000	17.9	27,900	100.0

^A Percent of grasslands on ranger district in grassland condition type

^B Percent of grasslands on Kaibab National Forest on each ranger district

III. Riparian and Freshwater Systems and Species

The Arizona Statewide Freshwater Assessment (Turner and List, *In Prep*; available at www.azconservation.org) was used to summarize the occurrence and distribution of stream reaches with native fish occurrences across major landowners and National Forests in Arizona. This assessment was developed for use in regional planning and includes occurrence information (1975 to present) for 33 native fish species (Table 2-2 in Chapter 2) in streams across all of Arizona. This information was used to identify and summarize the occurrences of each native fish species on stream reaches within the Kaibab National Forest and to summarize the number of native fish species with occurrences on stream reaches on the Forest. More detailed information on the data and methods used in this analysis can be found in Chapter 2, and information comparing the extent of native fish occurrences on the Kaibab to other Region 3 Forests and landowners in the Southwest is available in Chapter 3.

According to the Arizona Freshwater assessment, approximately 17 miles of perennial streams occur on the Kaibab National Forest, including 11 miles of Kanab Creek and 4 miles of North Canyon Wash on the North Kaibab Ranger District, and 2 miles of Sycamore Creek on the Williams Ranger District. One native fish species, Apache trout, has occurrences within North Canyon Wash. Overall, the Kaibab National Forest accounts for 0.9% of the perennial streams and 0.3% of the stream reaches with native fish occurrences that exist on National Forests in Arizona, and approximately 2% of stream reaches with occurrences of Apache trout.

While the Kaibab National Forest has limited native fish occurrences compared to other National Forests in Arizona, the introduced population of Apache trout that occurs in North Canyon Wash on the Kaibab Plateau has played an important role in the ongoing recovery of the federally threatened Apache trout in Arizona. This location has served as a refugium of genetically pure Apache trout, which have been used to re-introduce and establish new populations within the species' historical range. These efforts have helped moved the species towards the USFWS recovery goal of 30 self-sustaining populations.

IV. Plant and Animal Species Richness

The R3 Species Database was used to characterize the conservation status of species on the Kaibab National Forest and to develop potential lists of threatened and endangered species, species-of-concern, and species-of-interest that might be considered in forest planning. The R3 Species Database was created by combining several existing datasets into a single database that provides updated and consistent attributes for species that occur on Region 3 Forests, including taxonomy, NatureServe conservation status rankings, state and federal endangered species listings, and other pertinent conservation status rankings. The database includes all terrestrial and aquatic vertebrate species, and plant and invertebrate species that may be of conservation concern. Non-native aquatic vertebrate species were not included in these analyses. More detailed information on the data and methods used for analysis in this section of the report can be found in Chapter 2. The complete list of species used in this analysis and their conservation status attributes is provided in Appendix 6-A.

The R3 Species Database includes 412 species that are known to inhabit the Kaibab National Forest (Figure 6-4, a complete list is provided in Appendix 6-A). This number is conservative in terms of overall species diversity as it may not account for all vertebrate species that may occur in this area, and is not comprehensive for plant and invertebrates. It is also important to note that the number and type of species inhabiting the Kaibab National Forest likely changes over time.

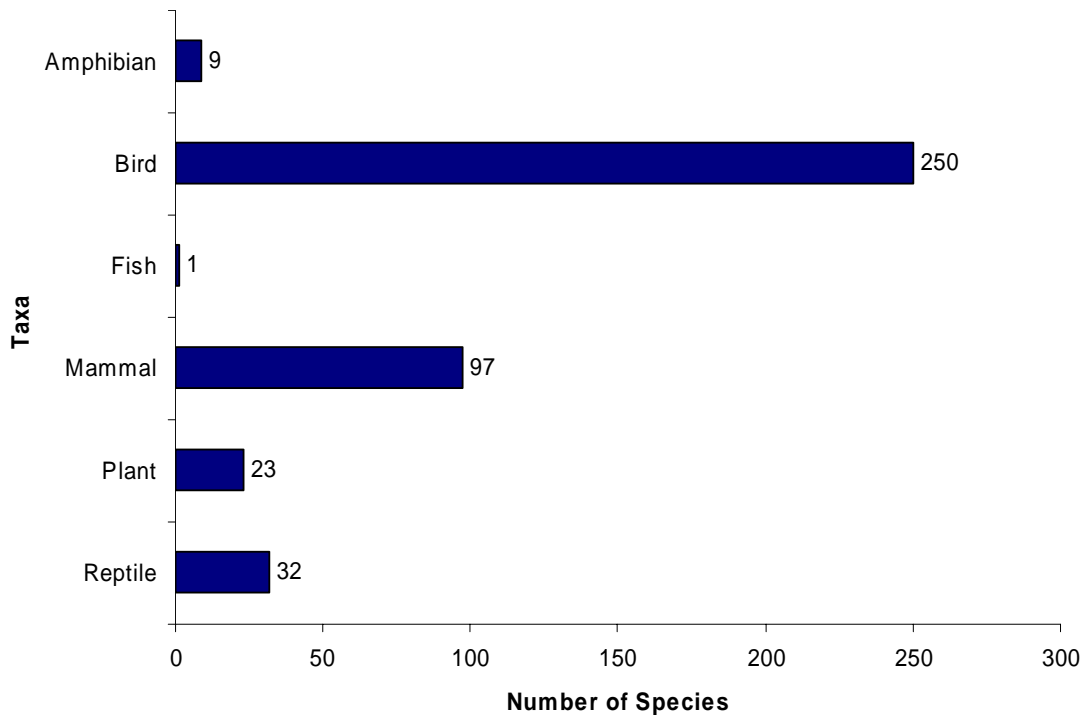


Figure 6-4. Number of species, by taxon, that inhabit the Kaibab National Forest based on data from the R3 Species Database. The R3 Species Database includes all known terrestrial and aquatic vertebrates, but only known invertebrates and plants of management concern that inhabit Region 3 Forests. For this analysis, of the aquatic vertebrate species, only natives were included. Because of the limitations of the R3 Species Database (see Chapter 2 for complete description of the database), the numbers reported in these results are conservative.

Threatened and Endangered Species Listings

Federal Listing under the Endangered Species Act — The U.S. Fish and Wildlife Service lists species that have federal status as endangered or threatened under the Endangered Species Act of 1973. Among the species that occur on the Kaibab National Forest, the California condor (*Gymnogyps californianus*) is listed as endangered, while the bald eagle (*Haliaeetus leucocephalus*), Mexican spotted owl (*Strix occidentalis lucida*), and Apache trout (*Oncorhynchus gilae apache*) are listed as threatened. The Fickeisen Hedgehog-Cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) is a candidate for listing, while the American peregrine falcon (*Falco peregrinus anatum*) was delisted in 1999.

Arizona state listing — Twenty-six species with state conservation status, as designated by the Arizona Game and Fish Department, occur on the Kaibab National Forest. Currently, there are 17 animals designated as Wildlife of Special Concern (WSC) and 9 plant species that are highly safeguarded (HS) or salvage restricted (SR) on the Forest. Birds comprise one-half (50%) of all species with state conservation status on the Forest. Refer to Appendix 6-A for a complete list of species with conservation status in Arizona.

NatureServe Conservation Status Rankings

NatureServe Global Conservation Status Rankings (G-ranks) — Thirty-two species (7.8%) of 412 on the Kaibab National Forest were ranked with a NatureServe global conservation rankings of G1/T1, G2/T2, or G3/T3, indicating the species is vulnerable or imperiled across its entire range (Table 6-3). Three hundred sixty-nine species (89.6%) were ranked as G4/T4 or G5/T5 species. These are species that are considered ‘apparently secure’ or ‘secure’ respectively across the entire range. Ten species (2.4%) of 412 were not included in this analysis because they were not assigned a NatureServe global conservation rank.

Table 6-3. Number of species, by taxon, that inhabit the Kaibab National Forest with the various global rankings assigned by NatureServe. Ten species are not included in this table because they do not have an assigned global conservation status rank.

Global Ranking ^A	Amphibian	Bird	Fish	Mammal	Plant	Reptile	Total
G1	0	1	0	0	1	0	2
G2	0	0	0	0	6	0	6
G3	1	0	0	2	8	0	11
G4	0	15	0	8	1	1	25
G5	8	225	0	67	0	26	326
T1	0	0	0	0	4	0	4
T2	0	0	0	1	1	0	2
T3	0	2	1	3	1	0	7
T4	0	3	0	4	1	1	9
T5	0	2	0	3	0	4	9
TU	0	1	0	0	0	0	1

^AG1 = critically imperiled; G2 = imperiled; G3 = vulnerable; G4 = apparently secure; G5 = secure; GU = unrankable; T = infraspecific taxon (subspecies or varieties).

NatureServe National conservation status rankings (N-ranks) — Thirty-five species (8.5%) of 412 were ranked with a NatureServe national conservation status of N1, N2, or N3, indicating the species may be vulnerable or imperiled within the United States (Table 6-4). The majority, 356 species (86.4%), were ranked as N4 or N5 species. These are species whose populations are considered ‘apparently secure’ or ‘secure’ respectively within the United States. Ten species (2.4%) were not included in this analysis because they were not assigned a NatureServe national conservation rank.

Table 6-4. Number of species, by taxon, that inhabit the Kaibab National Forest with the various national rankings assigned by NatureServe. Ten species are not included in this table because they do not have an assigned national rank.

National Ranking ^A	Amphibian	Bird	Fish	Mammal	Plant	Reptile	Total
N1	0	1	0	0	5	0	6
N2	0	0	0	1	7	0	8
N3	1	4	1	9	6	0	21
N4	0	30	0	11	1	4	46
N5	8	209	0	66	0	27	310
NNA	0	4	0	1	0	0	5
NNR	0	1	0	0	4	1	6

^AN1 = critically imperiled; N2 = imperiled; N3 = vulnerable; N4 = apparently secure; N5 = secure; NNA = not applicable; NNR = not ranked.

Subnational conservation status ranking (S-ranks) — One-hundred and eleven species (27.0%) on the Kaibab National Forest had rankings that merit conservation concern (S1, S2, S3, SX) at the subnational (state) level (Table 6-5). The California condor, the only species ranked as SX, has been reintroduced into Arizona and is reproducing successfully in the wild. Two hundred forty-four species (64%) were considered secure or apparently secure (S5 and S4, respectively). The remaining 27 species (7%) were assigned SNA or SNR rankings. Twenty-nine of the 412 species were not assigned a subnational conservation rank by Arizona Natural Heritage, and therefore not included in this analysis. See Appendix 6-A for the complete list of species with their associated S-ranks.

Table 6-5. Number of species, per taxon, currently inhabiting the Kaibab National Forest that are assigned to the various subnational rankings by the Arizona Natural Heritage. Twenty-nine of the 412 species were not assigned a subnational conservation rank by Arizona Natural Heritage, and therefore not included in this analysis.

State Ranking ^A	Amphibian	Bird	Fish	Mammal	Plant	Reptile	Total
S1	0	22	0	4	6	0	32
S2	1	19	0	2	7	3	32
S3	0	25	1	14	5	1	46
S4	0	40	0	23	0	5	68
S5	6	112	0	39	0	20	177
SX	0	1	0	0	0	0	1
SNA	1	13	0	1	0	0	15
SNR	0	4	0	1	5	2	12

^AS1 = critically imperiled; S2 = imperiled; S3 = vulnerable; S4 = apparently secure; S5 = secure; SX = presumed extirpated; SNA = not applicable; SNR = not ranked.

Other Conservation Rankings

Birds of Conservation Concern —According to the R3 Species Database, the Kaibab National Forest, is home to at least 250 birds, of which 22 (approximately 9%) are listed by the U.S. Fish and Wildlife Service as a Bird of Conservation Concern (Error! Reference source not found.). In all, the U.S. Fish and Wildlife Service lists 131 species of Birds of Conservation Concern, and 16% of these inhabit the Kaibab National Forest. Three of these species also have special conservation status under the state of Arizona (as WSC).

Partners in Flight Watch List — Of the 100 bird species currently on the Partners in Flight Watch List, 23 (23%) can be found on the Kaibab National Forest (Error! Reference source not found.). This comprises 9% of the known 250 bird species that inhabit the Kaibab. Seven species overlap with the U.S. Fish and Wildlife Service Birds of Conservation Concern list

Table 6-6. Bird species on the Partners in Flight Watch list or the U.S. Fish and Wildlife Service Birds of Conservation Concern list that inhabit the Kaibab National Forest.

<u>Diurnal Raptors</u>	<u>Tyrant Flycatchers</u>
American peregrine falcon* (CC)	Greater pewee (CC)
California condor (P)	Olive-sided flycatcher (P)
Ferruginous hawk* (CC)	Willow flycatcher (P)
Northern harrier (CC)	
Swainson's hawk (P)	<u>Shrikes and Vireos</u>
	Arizona Bell's Vireo (CC)
<u>Shorebirds</u>	Gray vireo
Long-billed curlew (CC)	Loggerhead Shrike (CC)
Wilson's Phalarope (CC)	
<u>Upland Game Birds</u>	<u>Jays, Crows, and Allies</u>
Blue Grouse (P)	Pinyon jay (P)
<u>Pigeons and Doves</u>	<u>Mimids – Catbirds, Mockingbirds and Thrashers</u>
Band-tailed pigeon (P)	Crissal thrasher (CC)
<u>Owls</u>	<u>Wood Warblers</u>
Burrowing owl (CC)	Black-throated gray warbler (CC)
Flammulated owl	Grace's warbler
	Hermit warbler (P)
<u>Goatsuckers and Swifts</u>	Olive warbler (CC)
White-throated swift (P)	Red-faced warbler
	Virginia warbler (P)
<u>Hummingbirds</u>	<u>Emberizine Sparrows and Allies</u>
Calliope hummingbird (P)	Baird's sparrow*
Costa's hummingbird (P)	Black-chinned sparrow
Rufous hummingbird (P)	Brewer's sparrow (P)
	Cassin's sparrow (CC)
<u>Woodpeckers</u>	Lark bunting (CC)
Lewis's woodpecker	McCown's longspur (P)
	Sage sparrow (CC)

(P) Bird species on the Partners in Flight Watch list
(CC) USFWS Bird of Conservation Concern
* AZGF Wildlife of Special Concern (WSC)
Species in bold appear on both lists

Potential Species Lists for Forest Planning

The R3 Species Database was used to identify species that might potentially be considered as species-of-concern and species-of-interest as defined in the USFS planning directives. For the purposes of this analysis, the definitions used to categorize species were similar, but not identical, to the definitions provided in the directives.

1. Threatened and Endangered Species
 - a. Listed as a threatened or endangered species under the Federal Endangered Species Act
2. Species-of-concern were defined as species that fall in one or more of the following categories:
 - a. NatureServe G/T-rank of three or less
 - b. Proposed or candidate species under the Federal Endangered Species Act
 - c. Recently (<5 years) de-listed under the Federal Endangered Species Act
 - d. Has been petitioned for federal listing and for which a positive “90-day finding” has been made
3. Species-of-interest were defined as species that fall in one or more of the following categories:
 - a. NatureServe N-rank of N1/N2, or S-rank of S1/S2 in Arizona
 - b. Listed as Wildlife of Special Concern or a plant species with state status in Arizona
 - c. Identified as a priority species in the Arizona Comprehensive Wildlife Conservation Strategy
 - d. On the U.S. Fish and Wildlife Service Birds of Conservation Concern National Priority List

In particular, the directives provide further criteria that can be used in considering species-of-interest, such as trends, rarity, ranges, and public interest. However, this information was not available in the R3 Species Database and is beyond the scope of this analysis

Threatened and Endangered Species — The U.S. Fish and Wildlife Service lists species that have federal status as endangered or threatened under the Endangered Species Act of 1973. Currently, one endangered and three threatened species from two distinct taxonomic groups inhabit the Kaibab National Forest (Table 6-7).

Table 6-7. Endangered and threatened species, designated under the Federal Endangered Species Act of 1973, that currently inhabit the Kaibab National Forest. The table includes common names that are recognized by NatureServe.

Taxa	Endangered	Threatened
Bird	California Condor	Bald Eagle Mexican Spotted Owl
Fish		Apache Trout

Potential species-of-concern —The Kaibab National Forest hosts at least 29 potential species-of-concern across four distinct taxonomic groups. Plants comprise the largest proportion of potential species-of-concern, approximately 72.4%; mammals represent 20.7% of the potential species-of-concern, while amphibians and birds each constitute 3.4% of the total (Table 6-8). These results are based on the R3 Species Database, which may not include all vertebrate species, and is not comprehensive for plants and invertebrates.

Table 6-8. Potential species-of-concern on the Kaibab National Forest. NatureServe scientific and common names are provided, with synonyms in parentheses.

Taxa/Scientific Name	Common Name	G/T-Rank	ESA Status	Recently De-listed
Amphibians				
<i>Spea hammondi</i>	Western Spadefoot	G3		
Birds				
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	T3		Yes
Mammals				
<i>Idionycteris phyllotis</i>	Allen's Big-Eared Bat	G3		
<i>Microtus longicaudus leucophaeus</i>	White-Bellied Long-Tailed Vole	T3		
<i>Microtus mogollonensis Navaho</i> (<i>Microtus mexicanus navaho</i>)	Navajo Mexican Vole	T2		
<i>Myotis occultus</i>	Occult Little Brn. Myotis Bat	G3		
<i>Ovis canadensis mexicana</i>	Desert Bighorn Sheep	T3		
<i>Sciurus aberti kaibabensis</i>	Kaibab Squirrel	T3		
Plants				
<i>Actaea arizonica</i> (<i>Cimicifuga arizonica</i>)	Arizona Bugbane	G2		
<i>Arenaria aberrans</i>	Mt. Dellenbaugh Sandwort	G3		
<i>Astragalus ampullarius</i>	Gumbo Milkvetch	G2		
	Hevron's Milkvetch			
<i>Astragalus cremnophylax</i> var. <i>hevronii</i>	(Marble Canyon Milkvetch)	T1		
<i>Astragalus cremnophylax</i> var. <i>myriorrhaphis</i>	Cliff Milkvetch	T1		
<i>Astragalus rusbyi</i>	A Milkvetch (Rusby's Milkvetch)	G3		
	Kaibab Indian Paintbrush			
<i>Castilleja kaibabensis</i>	(Kaibab Paintbrush)	G2		
	Arizona Rabbit-Brush			
<i>Chrysothamnus molestus</i>	(Tusayan Rabbitbrush)	G3		
<i>Erigeron saxatilis</i>	Rock Fleabane	G3		
<i>Eriogonum mortonianum</i>	Morton Wild Buckwheat	G1		
<i>Eriogonum thompsoniae</i> var. <i>atwoodii</i>	Atwood Wild Buckwheat	T1		
<i>Hedeoma diffusa</i> (<i>Hedeoma diffusum</i>)	Flagstaff Pennyroyal	G3		
<i>Hymenoxys rusbyi</i>	Ruby's Bitterweed	G3		
	Park Pincushion Cactus			
<i>Pediocactus paradinei</i>	(Kaibab Pincushion Cactus)	G2		
	Fickeisen Hedgehog-Cactus			
<i>Pediocactus peeblesianus</i> var. <i>fickeiseniae</i>	(Fickeisen Pincushion Cactus)	T1	Candidate	
<i>Penstemon distans</i>	Mt. Trumbull Beardtongue	G2		
<i>Penstemon nudiflorus</i>	Flagstaff Beardtongue	G2		
<i>Penstemon ophianthus</i>	Arizona Beardtongue	G3		
<i>Rosa stellata</i> ssp. <i>abyssa</i>	Grand Canyon Rose	T2		
<i>Senecio bigelovii</i> var. <i>bigelovii</i>	Nodding Ragwort	T3		
	Western Flame Flower			
<i>Talinum validulum</i>	(Tusayan Flame Flower)	G3		

Potential species-of-interest — At least 263 potential species-of-interest (representing four taxonomic groups) occur on the Kaibab National Forest (Figure 6-5). Birds make up the largest proportion (approximately 79%) of potential species-of-interest. Mammals comprise 17.1% of the total, while reptiles comprise 2.3%, and amphibians make up approximately 1.5%. The species used in this analysis for Kaibab National Forest are listed in Appendix 6-A, and the potential species-of-interest are identified.

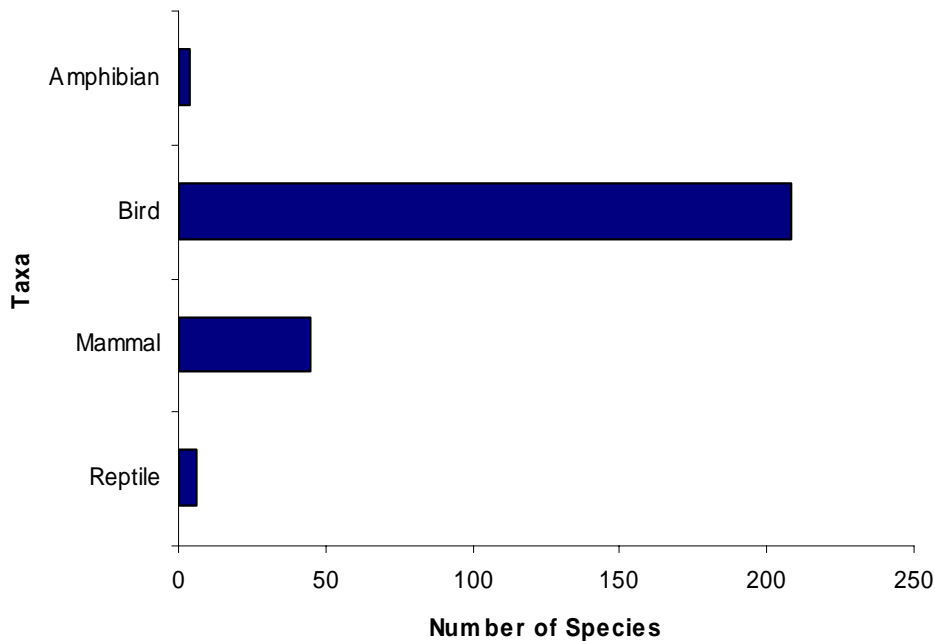


Figure 6-5. The number of potential species-of-interest, by taxa, that currently inhabit the Kaibab National Forest. Species were considered potential species-of-interest if they fell into one or more of the following categories: special state conservation status (WSC, HS, and SR in Arizona); listed as a species of concern or priority species in the AZ State Comprehensive Wildlife Conservation Strategies; on the U.S. Fish and Wildlife Service Birds of Conservation Concern National Priority list; or NatureServe national or subnational conservation rank of N1, N2, S1, or S2. These are the criteria listed in the published Forest Service draft directives (FSH 1909.12 Chapter 40) for determining species-of-interest. Species that were federally endangered or threatened, or that were determined to be potential species-of concern were not included as potential species-of-interest.

Summary – Almost three-quarters (71.8%) of all species on the Kaibab National Forest were identified as falling within categories defined by the USFS planning directives (Table 6-9). While only 7% were identified as potential species-of-concern, approximately 64% were identified as potential species-of-interest. In addition to the criteria used to define these categories, the R3 Species Database includes additional conservation status information, such as species listed on the Region 3 Sensitive Species List. All but two species on the Region 3 Sensitive Species List that inhabit Kaibab National Forest were captured within the categories defined by the directives.

Table 6-9. Number of species identified as endangered or threatened, species-of-concern, species-of-interest, or no category for the Kaibab National Forest based on information in the R3 Species Database.

	Endangered and Threatened		Species-of- Concern		Species-of- Interest		No Category		Total
	#	%	#	%	#	%	#	%	
Amphibians	0	0	1	11.1	4	44.4	4	44.4	9
Birds	3	1.2	1	0.4	208	83.2	38	15.2	250
Fish	1	100	0	0.0		0.0	0	0.0	1
Mammals	0	0	6	6.2	45	46.4	46	47.4	97
Plants	0	0	21	91.3		0.0	2	8.7	23
Reptiles	0	0	0	0.0	6	18.8	26	81.3	32
Total	4	0.9	29	7.0	263	63.8	116	28.2	412

V. Ecoregional Assessment Conservation Areas and Conservation Targets

Ecoregional assessments are science-based efforts to identify the minimum set of areas (conservation areas) on the landscape that are necessary to manage to maintain the biological diversity of the ecoregion. The ecoregional assessment process includes the identification of conservation targets (including species, ecological systems, and important biological features) that represent the biological diversity within the ecoregion. Conservation goals (including distribution, size and minimum number of viable occurrences) are established for each conservation target within the ecoregion. An iterative process is used to identify a suite of conservation areas that most efficiently meets the conservation goals for all conservation targets within the ecoregion. A more detailed explanation of the ecoregional assessment process is provided in Chapter 2. For this report, the results of these ecoregional analyses were used to identify the extent and distribution of conservation areas and overlap with ranger districts, wilderness areas, and non-wilderness inventoried roadless areas on the Kaibab National Forest. The conservation targets associated with each overlapping conservation areas were also identified.

Eight individual conservation areas from ecoregional assessments overlap the Kaibab National Forest (Figure 6-6, Table 6-10), totaling 558,500 acres, or 34.9% of the Forest. Conservation area overlap on individual districts ranged from 26.9% of the Tusayan district to 40.2% on the North Kaibab (Table 6-11). Overall, 15.7% of the total area of these eight conservation areas overlaps the Kaibab. For two (Bill Williams Mountains and Kaibab Plateau) of the eight overlapping conservation areas, more than half of the conservation area overlaps the Kaibab (Table 6-10).

Over 75% of the area of the Kaibab National Forest overlapped by conservation areas does not have specific land use designations (Table 6-12), while approximately 20% of the overlap area is wilderness area and 3% is non-wilderness roadless area. Almost all (99.9%) of wilderness areas

and nearly a third (29.9%) of non-wilderness roadless areas overlap with conservation areas. Nearly a third (29.9%) of areas that are not in either category also overlap conservation areas.

Conservation targets were summarized for all eight conservation areas that overlap with the Kaibab National Forest. A total of 200 conservation targets occur within these conservation areas (Figure 6-7). Of these, 99 (49.5%) are ecological systems, communities or features, while 101 (40.5%) are individual species. Fifty-five (27.5%) targets are associated with riparian and aquatic systems, while 145 (72.5%) are associated with terrestrial habitats (Table 6-13). A complete listing of all conservation targets by taxonomic group for the Kaibab is provided in Appendix 6-B and conservation targets for each conservation area are provided in Appendix 6-C.

Table 6-10. Conservation areas (N=8) that overlap three ranger districts on the Kaibab National Forest, acres of overlap, and the percentage of each conservation area overlapping the Kaibab National Forest in Arizona.

Conservation Area	Ranger Districts ^a	Overlap (Acres)	% of Conservation Area
Aubrey Valley Northeast	W	300	0.2
Bill Williams Mountains	W	81,600	100.0
Cataract Creek	T	12,600	7.0
Grand Canyon	NK,T	210,400	7.2
Kaibab Plateau	NK	112,100	50.4
Paria	NK	17,600	4.3
San Francisco Peaks	W	93,500	23.6
Sycamore & Oak Creek Canyons	W	30,500	14.8

^aNK = North Kaibab, T = Tusayan, W = Williams

Table 6-11. Extent of overlap between ecoregional conservation areas and five ranger districts on the Kaibab National Forest in Arizona.

District	Number of Conservation Areas	Overlap (Acres)	Percent of District
North Kaibab	3	263,400	40.2
Tusayan	2	89,200	26.9
Williams	4	205,900	33.6
Kaibab N.F Total	8 ^a	558,500	34.9

^aThe Grand Canyon conservation area overlaps both the North Kaibab and Tusayan Ranger Districts.

Table 6-12. Overlap between conservation areas, wilderness areas, and non-wilderness roadless areas on the Kaibab National Forest in Arizona.

Designation	Acres within Conservation Areas	% of Conservation Areas	% of Designated Areas
Wilderness Area	114,300	20.5	99.9
Inventoried Roadless Area	15,900	2.8	29.9
Neither Designation	428,300	76.7	29.9

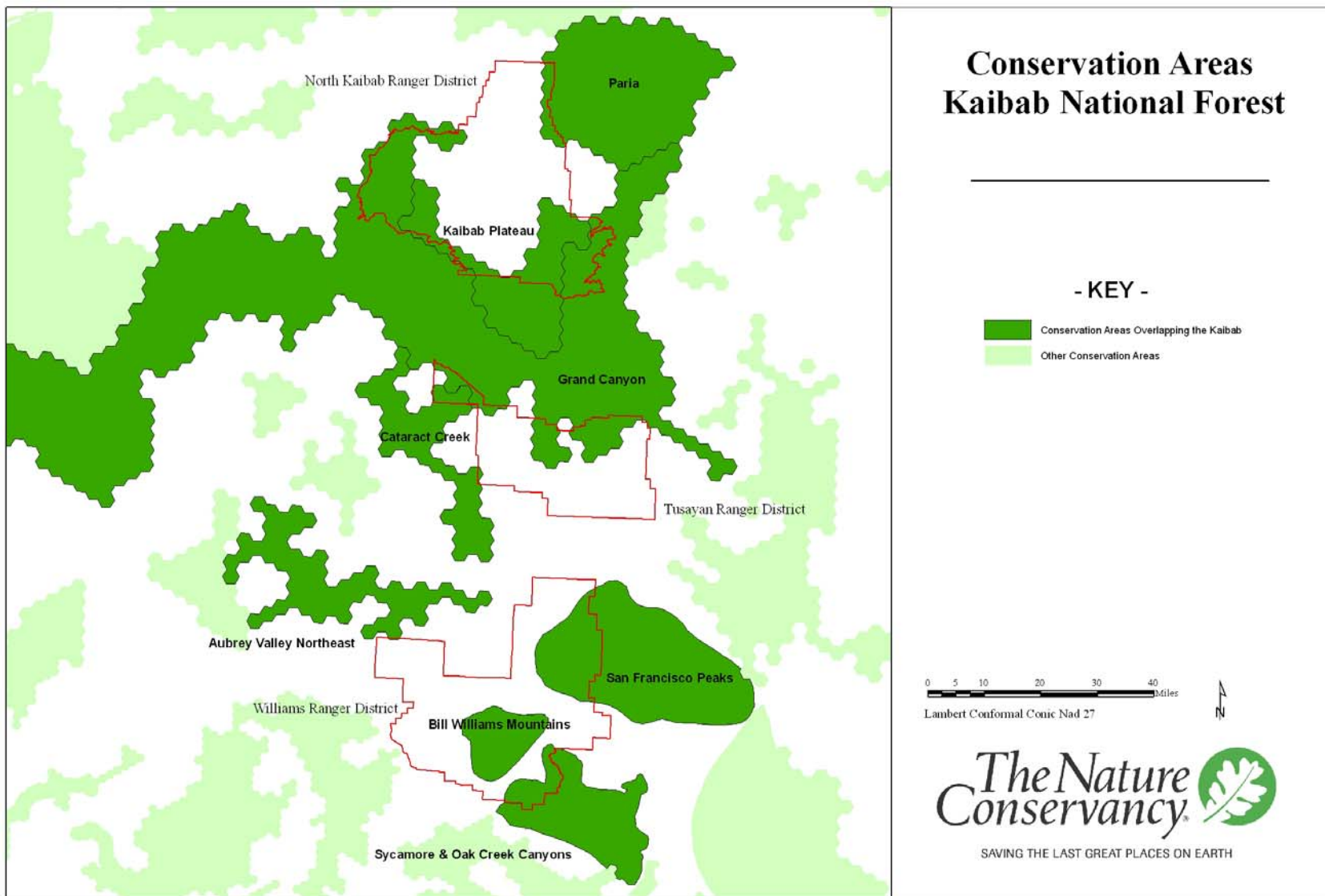


Figure 6-6. Conservation areas (N=8) that overlap the Kaibab National Forest in Arizona.

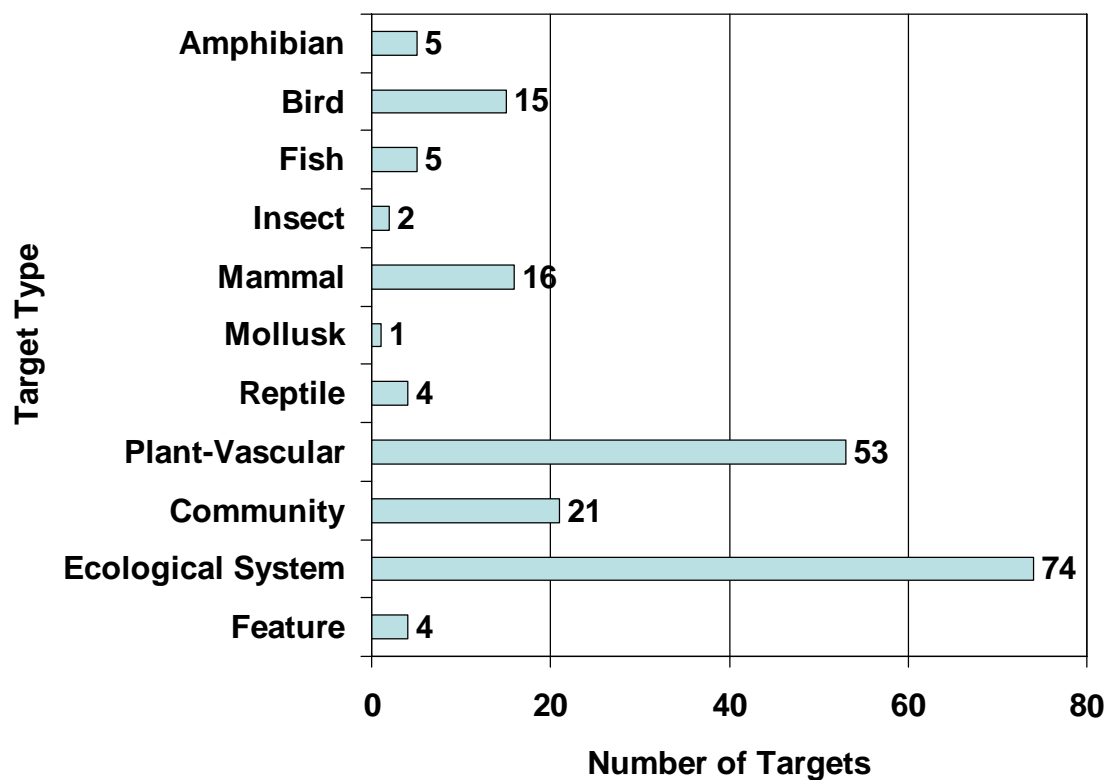


Figure 6-7. Number of conservation targets, by type, that occur on eight conservation areas overlapping the Kaibab National Forest in Arizona.

Table 6-13. Number of conservation targets associated with aquatic/riparian and terrestrial habitats for eight conservation areas that overlap the Kaibab National Forest in Arizona.

Conservation Area	Habitat		Total
	Aquatic/ Riparian	Terrestrial	
Aubrey Valley Northeast	3	2	5
Bill Williams Mountains	4	10	14
Cataract Creek	5	5	10
Grand Canyon	19	48	67
Kaibab Plateau	7	15	22
Paria	9	17	26
San Francisco Peaks	1	31	32
Sycamore & Oak Creek Canyons	7	17	24

Discussion

Systems Diversity

According to Southwest Regional Gap Analysis Project (USGS National Gap Analysis Program 2004), pinyon-juniper woodlands and ponderosa pine forests cover over three-quarters of the Kaibab National Forest. Both systems are ecologically important, provide critical habitat to a variety of plant and animal species, and face several threats. For example, pinyon-juniper woodland, which is largely restricted to southwestern United States (Arizona, Colorado, New Mexico, Nevada, and Utah), provides habitat for many species, like the pinyon jay (*Gymnorhinus cyanocephalus*), that depend primarily on this habitat type for its existence. More recently, the health of pinyon-juniper woodlands are being threatened across Region 3 lands, primarily due to the combined interactions of drought, bark beetle invasions, and altered fire regimes. The Kaibab National Forest manages approximately 20% of all pinyon-juniper woodlands across all Region 3 National Forests and therefore, has the opportunity to play an important role in maintaining the health of this system and sustaining the populations of species that depend upon this system for their survival.

Ponderosa pine forests are primarily restricted to western North America. The Kaibab National Forest includes parts of the largest contiguous ponderosa pine forests in the United States. The Kaibab also claims the densest population of Northern goshawks known in the lower 48 states, a species which primarily inhabits these ponderosa pine forests. There are several other species and subspecies on the Forest, such as the Kaibab squirrel, that also largely depend upon the health of the ponderosa pine system on the Kaibab National Forest. The risks that this system faces, especially that of catastrophic fires, have been the focus of many recent research efforts in the Southwest. With much research and attention focused on maintaining the health of ponderosa pine forests in the Southwest, the Kaibab National Forest has the opportunity to utilize the most recent scientific information and robust methodologies to ensure the health of this system and the species it supports.

The Kaibab National Forest also manages nearly 50% of all sagebrush shrubland found on Region 3 Forest lands. This system supports a myriad of sagebrush-obligate bird species, some of which are of conservation concern. For example, the Brewer's sparrow, a species that inhabits the sagebrush shrubland is on the Partners in Flight Watch List as a species that is '...moderately abundant or widespread with declines or high threats'. Another sagebrush-obligate species, the sage sparrow, is a USFWS Bird of Conservation Concern. Degradation, fragmentation and overall loss of this system is believed to be the major threats negatively impacting the populations of such birds (Knick and others 2003), and likely other taxa inhabiting this system. Given that half of this system lies within the Kaibab National Forest boundaries, the Forest has the opportunity to maintain the viability of sagebrush-obligate species on Region 3 National Forests by mitigating or reducing the threats to sagebrush-shrublands.

Grasslands

Grasslands in the Southwest typically maintain high levels of diversity for both plants and animals. In part, this is a result of the blending of several biogeographical regions (Parmenter and others 1995) and the resultant mixing of species from northern and southern regions. Also, southwestern grasslands tend to lie adjacent to other habitat types and, along with grassland-specialist species, are used by generalist species from adjacent habitats (Parmenter and Van Devender 1995). Notably high diversity of many widespread animal groups, including invertebrates (grasshoppers, termites, and ants) and vertebrates (rodents) are associated with southwestern grasslands. The richness of these species found on southwestern grasslands is tied to the species composition, habitat structure, and productivity of the plant community (Arenz and Joern 1996, Lawton 1983).

Changes in the structure and function of grassland systems have been noted as the primary cause of the loss of native diversity within grasslands (Stacy 1995). Finch (2004) identified and summarized the major threats to grassland biodiversity as the loss of natural fire cycles, overgrazing by livestock, prairie dog eradication, exotic grasses, shrub encroachment, erosion, and habitat fragmentation. The Arizona Statewide Grasslands Assessment documented several of these factors as threats to grasslands on the Kaibab National Forest. In particular, over 80% of grasslands on the Kaibab whose current condition were assessed are shrub invaded. Increases in shrub cover within grasslands can significantly affect species richness. While the diversity of some groups, such as birds, may actually increase due to increased vertical structure associated with shrubs or trees (Knopf and Scott 1990) these change are generally associated with increases in habitat generalists and a sharp decline in grassland specialists (Knopf 1992).

A key characteristic of shrub-invaded grasslands is its restoration potential. The potential to restore shrub-invaded grasslands is affected by a complex web of interacting physical and biological factors that include climate, topography, grazing, introduced/invasive species, and fire. Shrub cover can be reduced with prescribed burns when sufficient fuels are present to carry a fire of adequate intensity (Gori and Backer 2005). Often, the fuels required to allow fires of adequate intensity to achieve this goal are lacking, and areas must be rested from grazing to allow fuels to accumulate. The number of growing seasons of rest needed to accumulate these fuels varies from site to site. Schussman and Gori (2004) estimated that 44% of sites in Arizona could be burned with three growing seasons or less of rest, while the remainder of grasslands would need longer periods of rest.

While the proportion of grasslands on the Kaibab National Forests is relatively small, the statewide perspective provided by the Grasslands Assessment illustrates the importance of these grasslands in Arizona. The grasslands on the Tusayan and Williams Ranger Districts are part of a large grassland complex on the Coconino Plateau (Figure 6-3). This complex includes large contiguous blocks of open native and restorable grasslands. As noted by Finch (2004), maintaining grasslands at sufficient scales is vital for supporting grassland-dependent species, as habitat fragmentation has detrimental effects on grassland biodiversity. In addition, dynamics of neighboring ecosystems can have an effect on grasslands, making them more susceptible to conversion.

According to the Arizona Grasslands Assessment, grasslands that have exceeded a threshold of 35% shrub cover have undergone a type conversion from grassland to shrubland. While this grassland condition was not documented on the Kaibab National Forest by the Grasslands Assessment, it is important to note that this transition from restorable to former grassland conditions can result in a likely permanent loss of grassland systems and the species that depend on them. Even given long periods (50 years) of grazing rest (Hennessey and others 1983), it is unlikely that these former grasslands can be restored to open native conditions. While increases in perennial grass cover may occur (Valone and others 2002) at certain sites based upon soil type, erosion and shrub species composition, it is unlikely that these sites will accumulate sufficient fine fuels to carry a fire intense enough to reduce shrub cover and restore open grassland conditions.

Species Richness and Conservation Status

The R3 Species Database includes conservation status information for 412 species that inhabit the Kaibab National Forest. Because the database is not comprehensive for plants and invertebrates, this does not represent the overall diversity of the Forest. However, the database does serve as a useful tool for identifying species that might, because of their conservation status, need to be addressed within forest planning. According to NatureServe rankings, 32 species that occur on the Kaibab are vulnerable or imperiled across their entire range. Significantly more (111 species) are ranked as being vulnerable or imperiled within Arizona. While only four species listed under the Endangered Species Act were identified, 29 species were identified as potential species-of-concern. Species-of-concern are those for which ‘management actions may be necessary to prevent listing under the Endangered Species Act’ according to forest planning directives. An additional 263 species were identified as potential species-of-interest, which, according to the directives, are species for which ‘management actions may be necessary or desirable to achieve ecological or other multiple-use objectives.’ Overall, a significant portion (>70%) of the species that inhabit the Kaibab National Forest were identified as species that might need to be considered within forest planning. It is important to note that this was only an initial assessment based on information in the R3 Species Database, and the actual species to be considered will be based on additional information.

A major threat for many plant and animal species identified as being of conservation concern is the degradation and loss of habitat. Maintaining healthy vegetation systems that serve as important habitat can be a critical first step in sustaining viable populations of species of conservation concern on the Kaibab National Forest. The assessments in this report provide essential information on the systems and locations on the Kaibab that are necessary to manage for maintaining system and species diversity. For instance, the analysis of PNVTs highlighted the important vegetation systems that occur on the Kaibab, which include sagebrush shrublands, pinyon-juniper woodlands, and ponderosa pine forests. The species richness and conservation assessment highlighted those species that are of federal, state and local conservation concern. The conservation areas, identified through ecoregional assessments, identify and delineate areas on the landscape that provide the greatest opportunity for sustaining these systems and species.

All three ranger districts on the Kaibab are overlapped by two or more conservation areas. Just as important, a large proportion of several of the conservation areas fall within the Kaibab. These conservation areas include 200 conservation targets, including 101 individual species. The specific locations where conservation areas overlap the Kaibab highlight important places for the conservation of ecosystem and species diversity on the Forest and within the region. These areas of overlap represent the most viable locations on the Kaibab for sustaining the suite of species, ecological systems, and biological processes that are represented by the conservation targets associated with each conservation area that overlaps the Kaibab National Forest.

Relevance to Forest Planning

This analysis of existing regional assessment information identifies important biological and ecological characteristics of the Kaibab National Forest. This information serves as a first step in addressing the ecological sustainability component of the forest plan process under the new National Forest Management Act planning regulations, both in terms of ecosystem and species diversity. It may be also be useful in understanding the current condition of ecological resources on the Kaibab, identifying ecological characteristics that may be useful in defining desired future conditions, and identifying changes in management necessary to sustain biodiversity. For example, the analysis of ecosystem data demonstrates the variety of systems that occur on the Kaibab, and identifies systems (and their associated species diversity) for which the Kaibab has disproportionate responsibility within the context of Region 3, such as the sagebrush shrublands and pinyon-juniper forests. This analysis also demonstrates the importance of grasslands on the Kaibab within a landscape context. The restoration of grasslands on the Kaibab to an open native grassland condition, along with the ecological functions that support them, will help promote the large-scale sustainability of an important grassland complex within the Southwest.

Along with ecosystem diversity, these results demonstrate the diversity of species that occur on the Kaibab. The identification of a suite of potential species-of-concern and species-of-interest suggests that there are many species whose viability may need to be addressed beyond just providing for healthy ecosystems. The specific needs of these species, as well as their distribution at National Forest and regional scales, may need to be considered to sustain them.

Ecoregional assessments provide a strategic, regional perspective on maintaining biodiversity at large, ecoregional scales that may be useful in forest planning. The suite of conservation areas identified in the ecoregional assessments represents the minimum area on the landscape needed to maintain the region's biodiversity and may serve as priority areas for considering the impacts of management on ecological sustainability. Used within a forest planning context, consideration of conservation areas incorporates, by default, a regional perspective on ecological sustainability and demonstrates consideration of sustainability issues at scales beyond its boundaries.

Within the forest planning framework, it may be useful to evaluate currently allowable land uses and activities within conservation areas and determine associated impacts to biodiversity. A synthesis of conservation area overlap with wilderness areas and non-wilderness inventoried roadless areas on the Kaibab demonstrates the wide variety of current management emphases and activities that occur within conservation areas. While nearly all of wilderness area on the

Forest occurs within a conservation area, the largest proportion of conservation area overlap falls on areas with neither of these designations. It is apparent that achieving biodiversity sustainability on the Kaibab cannot be accomplished entirely within existing designated special areas, and must be accomplished within the varied uses and activities that occur on the Forest. For forest planning purposes, it may be useful to determine the compatibility of forest management and uses within conservation areas with desired biodiversity goals, and identify changes that may be needed to achieve sustainability within these areas.

While the above example focused on wilderness and roadless areas, it is important to note that conservation areas do not imply the need for special protections or blanket restriction of activities. Rather, conservation areas can be viewed as priority areas, based on the large scale perspective of ecoregional assessments, for assessing the impacts of ongoing or planned uses and activities in regards to their compatibility with sustaining biodiversity at regional scales. To aid in these planning efforts, each conservation area has associated with it a suite of conservation targets (species, vegetation communities, and ecological systems, and features) that are representative of the biodiversity in that area. Evaluation of the environmental and ecological needs of these conservation targets, including both the habitats and ecological processes that support them, as well as identifying threats to their sustainability can be used to assess the compatibility of ongoing or planned activities in these areas.

For example, the Bill Williams Mountains conservation area encompasses 81,500 acres on the Williams District of the Kaibab National Forest. This conservation area does not overlap with any wilderness areas, roadless areas, or other areas with special designations. Fourteen conservation targets, including six individual species, four specific ponderosa pine communities, two ecological systems, and one wetland feature (Table 6-14), are associated with the Bill Williams Mountains conservation area. These targets can be used as a tool to assess the compatibility of current or planned activities within the conservation area with sustainability goals. For example, it may be useful to evaluate current conditions of the ponderosa pine communities and aspen, and montane mixed forest systems within this conservation area relative to the historic range of variability and, if necessary, identify potential changes in management that may move these systems to within historic ranges. Similarly, by identifying the ecological needs of species conservation targets and threats to their sustainability, the compatibility of current activities can be assessed. For example, threats facing targets within the Bill Williams Mountains conservation area include human disturbance, herbivory (e.g. grazing and trampling of riparian/aquatic areas), catastrophic events (fire and flooding), and erosion. It may be useful to evaluate management prescriptions within the conservation area and if necessary, identify changes in allowed activities or uses that may reduce or mitigate these threats.

Table 6-14. Conservation targets (N=14) associated with the Bill Williams Mountains conservation area in Arizona.

Taxonomic Group / Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
Amphibian				
<i>Hyla wrightorum</i>	Mountain Treefrog	Aquatic/Riparian	G4	
Bird				
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Terrestrial	G3	LT
<i>Accipiter gentilis</i>	Northern Goshawk	Terrestrial	G5	
Fish				
<i>Catostomus insignis</i>	Sonora Sucker	Aquatic/Riparian	G3	SC
Plant-Vascular				
<i>Potentilla multifoliolata</i>		Terrestrial	G4	
<i>Talinum validulum</i>	Western Flame Flower	Terrestrial	G3	
<i>Cimicifuga arizonica</i>	Arizona Bugbane	Aquatic/Riparian	G2	
Community				
Ponderosa Pine Forest Community (4 specific occurrences)		Terrestrial	GU	
Ecological System				
Aspen Forest		Terrestrial	GU	
Montane Mixed Forest		Terrestrial	GU	
Feature				
Important ephemeral wetland that is seasonally wet and dry.		Aquatic/Riparian	GU	

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Appendix 6-A. Plants and animals of the Kaibab National Forest. Refer to Chapter 2 for more information on how the data was generated for this table. Also, see information regarding the R3 Species database at www.azconservation.org.

NatureServe Scientific Name ^A	NatureServe Common Name ^A	Potential Species List ^B	G- rank	N-rank	AZ S-rank	ESA Status	AZ State Status ^C	AZ CWCS ^D	Birds of Conserv. Concern ^E	Partners in Flight Watch List ^F
<i>Ambystoma tigrinum</i>	Tiger Salamander		G5	N5	S5					
<i>Bufo cognatus</i>	Great Plains Toad		G5	N5	S5					
<i>Bufo punctatus</i>	Red-Spotted Toad	SOI	G5	N5	S5			X		
<i>Bufo woodhousii</i>	Woodhouse's Toad		G5	N5	S5					
<i>Hyla arenicolor</i>	Canyon Treefrog	SOI	G5	N5	S5			X		
<i>Pseudacris triseriata</i>	Western Chorus Frog	SOI	G5	N5	S5			X		
<i>Rana catesbeiana</i>	Bullfrog		G5	N5	SNA					
<i>Rana pipiens</i>	Northern Leopard Frog	SOI	G5	N5	S2		WSC	X		
<i>Spea hammondi</i>	Western Spadefoot	SOC	G3	N3						
<i>Accipiter cooperii</i>	Cooper's Hawk	SOI	G5	N5B	S4			X		
<i>Accipiter gentilis</i>	Northern Goshawk	SOI	G5	N4B	S3		WSC	X		
<i>Accipiter striatus velox</i>	Sharp-Shinned Hawk	SOI	T5	N5B				X		
<i>Actitis macularia</i>	Spotted Sandpiper	SOI	G5	N5B	S3S4			X		
<i>Aechmophorus occidentalis</i>	Western Grebe		G5	N5B	S3					
<i>Aegolius acadicus acadicus</i>	Northern Saw-Whet Owl	SOI	TU	NNR				X		
<i>Aeronautes saxatalis</i>	White-Throated Swift	SOI	G5	N5B	S5			X		X
<i>Agelaius phoeniceus</i>	Red-Winged Blackbird	SOI	G5	N5	S5			X		
<i>Aimophila cassinii</i>	Cassin's Sparrow	SOI	G5	N4N	S4			X	X	
<i>Aimophila ruficeps</i>	Rufous-Crowned Sparrow	SOI	G5	N5	S4			X		
<i>Aix sponsa</i>	Wood Duck	SOI	G5	N5B	S2B S3N			X		
<i>Alectoris chukar</i>	Chukar	SOI	G5	NNA	SNA			X		
<i>Ammodramus bairdii</i>	Baird's Sparrow	SOI	G4	N3B,N2N	S2N		WSC	X	X	X
<i>Ammodramus savannarum</i>	Grasshopper Sparrow		G5	N5B	S3					
<i>Amphispiza belli</i>	Sage Sparrow	SOI	G5	N5	S4			X	X	
<i>Amphispiza bilineata</i>	Black-Throated Sparrow	SOI	G5	N5	S5			X		
<i>Anas acuta</i>	Northern Pintail	SOI	G5	N5B	S2B S5N			X		

^A NatureServe common and scientific names are used unless highlighted in bold.

^B TE = Listed as Threatened or Endangered under the Endangered Species Act, SOC = potential species-of-concern, SOI = potential species-of-interest

^C HS = Highly Safeguarded, SR = salvage restricted, WSC= Wildlife of Special Concern

^D Listed as priority species in the Arizona Comprehensive Wildlife Conservation Strategy

^E Birds of Conservation Concern National Priority List

^F Partners in Flight Watch List Category

NatureServe Scientific Name ^A	NatureServe Common Name ^A	Potential Species List ^B	G- rank	N-rank	AZ S-rank	ESA Status	AZ State Status ^C	AZ CWCS ^D	Birds of Conserv. Concern ^E	Partners in Flight Watch List ^F
Anas americana	American Wigeon	SOI	G5	N5B	S1B S5N			X		
Anas clypeata	Northern Shoveler	SOI	G5	N5B	S1B S5N					
Anas crecca	Green-Winged Teal	SOI	G5	N5B	S3B S5N			X		
Anas cyanoptera	Cinnamon Teal	SOI	G5	N5B	S5			X		
Anas discors	Blue-Winged Teal	SOI	G5	N5B	S2B S5N			X		
Anas platyrhynchos	Mallard	SOI	G5	N5B	S5			X		
Anas strepera	Gadwall	SOI	G5	N5B	S5			X		
Anthus rubescens	American Pipit	SOI	G5	N5B	S2B S5N			X		
Aphelocoma californica	Western Scrub-Jay		G5	N5	S5					
Aquila chrysaetos	Golden Eagle	SOI	G5	N5B	S4			X		
Archilochus alexandri	Black-Chinned Hummingbird	SOI	G5	N5B	S5			X		
Ardea herodias	Great Blue Heron		G5	N5B	S5					
Asio otus	Long-Eared Owl	SOI	G5	N5B	S2B S3S4N					
Athene cunicularia hypugaea	Burrowing Owl	SOI	T4	N4	S3			X	X	
Auriparus flaviceps	Verdin		G5	N5	S5					
Aythya affinis	Lesser Scaup Duck	SOI	G5	N5B	S5N			X		
Aythya americana	Redhead	SOI	G5	N5B	S4			X		
Aythya collaris	Ring-Necked Duck	SOI	G5	N5B	S5			X		
Aythya marila	Greater Scaup Duck	SOI	G5	N5B	S1N			X		
Aythya valisineria	Canvasback Duck	SOI	G5	N5B	S1B S4N			X		
Baeolophus ridgwayi	Juniper Titmouse		G5	N5	S5					
Baeolophus wollweberi	Bridled Titmouse	SOI	G5	N4	S4			X		
Bombycilla cedrorum	Cedar Waxwing	SOI	G5	N5	S3S4N			X		
Bombycilla garrulus	Bohemian Waxwing		G5	N5B						
Botaurus lentiginosus	American Bittern	SOI	G4	N4B	S1S2		WSC	X		
Branta canadensis	Canada Goose	SOI	G5	N5B	S4N			X		
Bubo virginianus	Great-Horned Owl		G5	N5	S5					
Bucephala albeola	Bufflehead	SOI	G5	N5B	S5N			X		
Bucephala clangula	Common Goldeneye	SOI	G5	N5B	S5N			X		
Buteo albonotatus	Zone-Tailed Hawk	SOI	G4	N4B	S4			X		
Buteo jamaicensis	Red-Tailed Hawk		G5	N5B	S5					
Buteo lineatus	Red-Shouldered Hawk	SOI	G5	N5B				X		
Buteo platypterus	Broad-Winged Hawk	SOI	G5	N5B				X		
Buteo regalis	Ferruginous Hawk	SOI	G4	N4B	S2B S4N		WSC	X	X	

NatureServe Scientific Name ^A	NatureServe Common Name ^A	Potential Species List ^B	G- rank	N-rank	AZ S-rank	ESA Status	AZ State Status ^C	AZ CWCS ^D	Birds of Conserv. Concern ^E	Partners in Flight Watch List ^F
Buteo swainsoni	Swainson's Hawk	SOI	G5	N5B	S3			X		X
Calamospiza melanocorys	Lark Bunting	SOI	G5	N5B	S1B S5N			X	X	
Calcarius mccownii	Mccown's Longspur	SOI	G4	N4B	S2N			X		X
Calcarius ornatus	Chestnut-Collared Longspur	SOI	G5	N5B	S3N			X		
Calidris mauri	Western Sandpiper	SOI	G5	N5B	S1N			X		
Calidris minutilla	Least Sandpiper	SOI	G5	N5B	S5N			X		
Callipepla gambelii	Gambel's Quail		G5	N5	S5					
Calypte costae	Costa's Hummingbird	SOI	G5	N5B,N4N	S5			X		X
Campylorhynchus brunneicapillus	Cactus Wren		G5	N5	S5					
Caprimulgus vociferus	Whip-Poor-Will	SOI	G5	N5B, NNRN	S4			X		
Cardellina rubrifrons	Red-Faced Warbler	SOI	G5	N4B	S4			X	X	X
Cardinalis cardinalis	Northern Cardinal		G5	N5	S5					
Carduelis pinus	Pine Siskin		G5	N5	S5					
Carduelis psaltria	Lesser Goldfinch	SOI	G5	N5	S5			X		
Carduelis tristis	American Goldfinch	SOI	G5	N5	S1B S5N					
Carpodacus cassinii	Cassin's Finch	SOI	G5	N5	S4			X		
Carpodacus mexicanus	House Finch	SOI	G5	N5	S5			X		
Carpodacus purpureus	Purple Finch	SOI	G5	N5B	S1S2N			X		
Cathartes aura	Turkey Vulture	SOI	G5	N5B	S5			X		
Catharus guttatus	Hermit Thrush	SOI	G5	N5	S5			X		
Catharus ustulatus	Swainson's Thrush	SOI	G5	N5B	S1			X		
Catherpes mexicanus	Canyon Wren	SOI	G5	N5	S5			X		
Catoptrophorus semipalmatus	Willet	SOI	G5	N5B	SNA			X		
Certhia americana	Brown Creeper	SOI	G5	N5	S5			X		
Ceryle alcyon	Belted Kingfisher	SOI	G5	N5B	S2B S5N		WSC	X		
Charadrius vociferus	Killdeer	SOI	G5	N5B	S5			X		
Chondestes grammacus	Lark Sparrow	SOI	G5	N5B	S5			X		
Chordeiles acutipennis	Lesser Nighthawk	SOI	G5	N5B	S5			X		
Chordeiles minor	Common Nighthawk	SOI	G5	N5B	S5			X		
Cinclus mexicanus	American Dipper	SOI	G5	N5	S3			X		
Circus cyaneus	Northern Harrier	SOI	G5	N5B	S1S2B S5N			X	X	
Cistothorus palustris	Marsh Wren	SOI	G5	N5B	S2B S3S4N			X		

NatureServe Scientific Name ^A	NatureServe Common Name ^A	Potential Species List ^B	G- rank	N-rank	AZ S-rank	ESA Status	AZ State Status ^C	AZ CWCS ^D	Birds of Conserv. Concern ^E	Partners in Flight Watch List ^F
Coccythraustes vespertinus	Evening Grosbeak	SOI	G5	N5	S3			X		
Colaptes auratus	Northern Flicker	SOI	G5	N5B	S5			X		
Columba livia	Rock Dove		G5	NNA	SNA					
Contopus cooperi	Olive-Sided Flycatcher	SOI	G4	N4B	S4			X		X
Contopus pertinax	Greater Pewee	SOI	G5	N4B	S4			X	X	
Contopus sordidulus	Western Wood-Pewee	SOI	G5	N5B	S5			X		
Corvus brachyrhynchos	American Crow	SOI	G5	N5B	S5			X		
Corvus corax	Common Raven	SOI	G5	N5	S5			X		
Cyanocitta stelleri	Steller's Jay	SOI	G5	N5	S5			X		
Dendragapus obscurus	Blue Grouse	SOI	G5	N5	S3			X		X
Dendroica coronata	Yellow-Rumped Warbler	SOI	G5	N5B	S5			X		
Dendroica graciae	Grace's Warbler	SOI	G5	N5B	S5			X	X	X
Dendroica nigrescens	Black-Throated Gray Warbler	SOI	G5	N5B	S5			X	X	
Dendroica occidentalis	Hermit Warbler	SOI	G4	N4N5B, NNRN	SNA			X		X
Dendroica petechia	Yellow Warbler	SOI	G5	N5B	S4			X		
Dendroica townsendi	Townsend's Warbler	SOI	G5	N5B	SNA			X		
Egretta thula	Snowy Egret	SOI	G5	N5B	S1B S4N		WSC	X		
Empidonax hammondi	Hammond's Flycatcher	SOI	G5	N5B	S1B S2S3N			X		
Empidonax oberholseri	Dusky Flycatcher	SOI	G5	N5B	S4			X		
Empidonax occidentalis	Cordilleran Flycatcher	SOI	G5	N5B				X		
Empidonax traillii	Willow Flycatcher	SOI	G5	N5B	S1		WSC	X		X
Empidonax wrightii	Gray Flycatcher	SOI	G5	N5B	S5			X		
Eremophila alpestris	Horned Lark	SOI	G5	N5B	S5			X		
Euphagus cyanocephalus	Brewer's Blackbird	SOI	G5	N5B	S5			X		
Falco columbarius	Merlin	SOI	G5	N4B	SNRN			X		
Falco mexicanus	Prairie Falcon	SOI	G5	N5B	S4			X		
Falco peregrinus anatum	American Peregrine Falcon	SOC	T3	N3B	S4		WSC	X	X	
Falco sparverius	American Kestrel	SOI	G5	N5B	S5			X		
Fulica americana	American Coot		G5	N5B	S5					
Gallinago delicata	Wilson's Snipe	SOI	G5	N5B	S1B S4N			X		
Gavia immer	Common Loon	SOI	G5	N4B,N5N	S2N			X		
Geococcyx californianus	Greater Roadrunner		G5	N5	S5					
Geothlypis trichas	Common Yellowthroat	SOI	G5	N5	S4			X		

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Glaucidium gnoma californicum	Northern Pygmy Owl		T4	N4N5						
Gymnogyps californianus	California Condor	TE	G1	N1	SX	E	WSC	X		X
Gymnorhinus cyanocephalus	Pinyon Jay		G5	N5	S5					X
Haliaeetus leucocephalus	Bald Eagle	TE	G4	N5B	S2S3B S4N	T	WSC	X		
Himantopus mexicanus	Black-Necked Stilt	SOI	G5	N5B	S2					
Hirundo rustica	Barn Swallow	SOI	G5	N5B	S5			X		
Icteria virens	Yellow-Breasted Chat	SOI	G5	N5B	S4			X		
Icterus bullockii	Bullock's Oriole	SOI	G5	N5B	SNRB			X		
Icterus cucullatus	Hooded Oriole	SOI	G5	N5B	S5			X		
Icterus galbula	Baltimore Oriole		G5	N5B						
Icterus parisorum	Scott's Oriole	SOI	G5	N5B	S5			X		
Junco hyemalis	Dark-Eyed Junco	SOI	G5	N5	S5			X		
Junco hyemalis caniceps	Gray-Headed Junco		T5	N5B						
Lanius excubitor	Northern Shrike	SOI	G5	N4B,N5N	S2N			X		
Lanius ludovicianus	Loggerhead Shrike	SOI	G4	N4	S4			X	X	
Larus delawarensis	Ring-Billed Gull	SOI	G5	N5B	S5N			X		
Larus pipixcan	Franklin's Gull	SOI	G4	N4B	SNA			X		
Leucosticte atrata	Black Rosy Finch		G4	N4						X
Limnodromus scolopaceus	Long-Billed Dowitcher	SOI	G5	N5B	S3S4N			X		
Loxia curvirostra	Red Crossbill		G5	N5	S4					
Megascops kennicottii	Western Screech Owl	SOI	G5	N5	S5			X		
Melanerpes formicivorus	Acorn Woodpecker	SOI	G5	N5	S5			X		
Melanerpes lewis	Lewis's Woodpecker	SOI	G4	N4B	S4			X	X	X
Meleagris gallopavo	Wild Turkey		G5	N5	S5					
Melospiza lincolnii	Lincoln's Sparrow	SOI	G5	N5B	S3B S5N			X		
Melospiza melodia	Song Sparrow	SOI	G5	N5	S5			X		
Mergus merganser	Common Merganser Duck	SOI	G5	N5B	S3S4			X		
Mimus polyglottos	Northern Mockingbird	SOI	G5	N5	S5			X		
Molothrus ater	Brown-Headed Cowbird	SOI	G5	N5	S5			X		
Myadestes townsendi	Townsend's Solitaire	SOI	G5	N5	S5			X		
Myiarchus cinerascens	Ash-Throated Flycatcher	SOI	G5	N5B	S5			X		
Myiarchus tyrannulus	Brown-Crested Flycatcher	SOI	G5	N4B	S4			X		
Myioborus pictus	Painted Redstart	SOI	G5	N4B	S4			X		
Nucifraga columbiana	Clark's Nutcracker	SOI	G5	N5	S5			X		

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Numenius americanus	Long-Billed Curlew	SOI	G5	N5B	S1B S3S4N				X	
Nycticorax nycticorax	Black-Crowned Night Heron	SOI	G5	N5B	S3			X		
Oporornis tolmiei	Macgillivray's Warbler	SOI	G5	N5B	S4			X		
Oreoscoptes montanus	Sage Thrasher	SOI	G5	N5B	S5			X		
Otus flammeolus	Flammulated Owl	SOI	G4	N4B	S4			X	X	X
Oxyura jamaicensis	Ruddy Duck	SOI	G5	N5B	S5			X		
Pandion haliaetus	Osprey	SOI	G5	N5B	S2B S4N		WSC			
Passer domesticus	House Sparrow		G5	NNA	SNA					
Passerculus sandwichensis	Savannah Sparrow	SOI	G5	N5B	S5			X		
Passerella iliaca	Fox Sparrow	SOI	G5	N5B	S2N			X		
Passerina amoena	Lazuli Bunting	SOI	G5	N5B	S4			X		
Passerina caerulea	Blue Grosbeak	SOI	G5	N5B	S5			X		
Passerina cyanea	Indigo Bunting	SOI	G5	N5B	S3			X		
Patagioenas fasciata	Band-Tailed Pigeon	SOI	G4	N4B	S5			X		X
Petrochelidon fulva	Cave Swallow		G5	N4B						
Petrochelidon pyrrhonota	Cliff Swallow	SOI	G5	N5B	S5			X		
Peucedramus taeniatus	Olive Warbler	SOI	G5	N4B	S4			X	X	
Phainopepla nitens	Phainopepla	SOI	G5	N5	S5			X		
Phalacrocorax auritus	Double-Crested Cormorant	SOI	G5	N5B	S5			X		
Phalaenoptilus nuttallii	Common Poorwill	SOI	G5	N5B	S5			X		
Phalaropus tricolor	Wilson's Phalarope	SOI	G5	N5B	S1B S5N			X	X	
Pheucticus melanocephalus	Black-Headed Grosbeak	SOI	G5	N5B	S5			X		
Picoides dorsalis	American Three-Toed Woodpecker	SOI	G5	N5	S3			X		
Picoides pubescens	Downy Woodpecker	SOI	G5	N5	S4			X		
Picoides scalaris	Ladder-Backed Woodpecker		G5	N5	S5					
Picoides villosus	Hairy Woodpecker		G5	N5	S5					
Pinicola enucleator	Pine Grosbeak	SOI	G5	N5	S1		WSC			
Pipilo chlorurus	Green-Tailed Towhee		G5	N5B	S3B S4N					
Pipilo erythrophthalmus	Eastern Towhee		G5	N5						
Pipilo fuscus	Canyon Towhee		G5	N5	S5					
Pipilo maculatus	Spotted Towhee	SOI	G5	N5	S5			X		
Piranga flava	Hepatic Tanager	SOI	G5	N5B	S4			X		
Piranga ludoviciana	Western Tanager	SOI	G5	N5B	S5			X		
Piranga rubra	Summer Tanager	SOI	G5	N5B	S4			X		

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Plegadis chihi	White-Faced Ibis	SOI	G5	N4B	SNRB S2S3N			X		
Podiceps nigricollis	Eared Grebe	SOI	G5	N5B	S3B S5N			X		
Podilymbus podiceps	Pied-Billed Grebe	SOI	G5	N5B	S5			X		
Poecetes gambeli	Mountain Chickadee	SOI	G5	N5	S5			X		
Poliophtila caerulea	Blue-Gray Gnatcatcher	SOI	G5	N5B	S5			X		
Poocetes gramineus	Vesper Sparrow	SOI	G5	N5B	S5			X		
Porzana carolina	Sora	SOI	G5	N5B	S4			X		
Progne subis	Purple Martin	SOI	G5	N5B	S4			X		
Psaltiriparus minimus	Bushtit		G5	N5	S5					
Quiscalus mexicanus	Great-Tailed Grackle	SOI	G5	N5	S5			X		
Rallus limicola	Virginia Rail	SOI	G5	N5B	S4			X		
Recurvirostra americana	American Avocet	SOI	G5	N5B	S2			X		
Regulus calendula	Ruby-Crowned Kinglet	SOI	G5	N5B	S5			X		
Regulus satrapa	Golden-Crowned Kinglet	SOI	G5	N5	S3			X		
Riparia riparia	Bank Swallow	SOI	G5	N5B	SNR			X		
Salpinctes obsoletus	Rock Wren	SOI	G5	N5	S5			X		
Sayornis nigricans	Black Phoebe	SOI	G5	N5	S5			X		
Sayornis saya	Say's Phoebe	SOI	G5	N4N	S5			X		
Selasphorus platycercus	Broad-Tailed Hummingbird	SOI	G5	N5B	S5			X		
Selasphorus rufus	Rufous Hummingbird	SOI	G5	N5B	SNA			X		X
Sialia currucoides	Mountain Bluebird	SOI	G5	N5	S5			X		
Sialia mexicana	Western Bluebird	SOI	G5	N5	S5			X		
Sitta canadensis	Red-Breasted Nuthatch		G5	N5	S4					
Sitta carolinensis	White-Breasted Nuthatch		G5	N5	S5					
Sitta pygmaea	Pygmy Nuthatch		G5	N5	S5					
Sphyrapicus nuchalis	Red-Naped Sapsucker	SOI	G5	N5B	S4			X		
Sphyrapicus thyroideus	Williamson's Sapsucker		G5	N5B	S4					
Spizella arborea	American Tree Sparrow	SOI	G5	N5B	S1N					
Spizella atrogularis	Black-Chinned Sparrow	SOI	G5	N5	S5			X	X	X
Spizella breweri	Brewer's Sparrow	SOI	G5	N5B	S5			X		X
Spizella passerina	Chipping Sparrow	SOI	G5	N5B	S5			X		
Stelgidopteryx serripennis	Northern Rough-Winged Swallow	SOI	G5	N5B	S5			X		
Stellula calliope	Calliope Hummingbird	SOI	G5	N5B	SNA			X		X
Sterna caspia	Caspian Tern	SOI	G5	N4N5B,	S1N			X		

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				N4N						
<i>Sterna forsteri</i>	Forster's Tern	SOI	G5	N5B	S2N			X		
<i>Sterna hirundo</i>	Common Tern	SOI	G5	N5B				X		
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	TE	T3	N3	S3S4	T	WSC	X		
<i>Sturnella magna</i>	Eastern Meadowlark	SOI	G5	N5	S5			X		
<i>Sturnella neglecta</i>	Western Meadowlark	SOI	G5	N5	S5			X		
<i>Sturnus vulgaris</i>	European Starling		G5	NNA	SNA					
<i>Tachycineta bicolor</i>	Tree Swallow	SOI	G5	N5B	S3			X		
<i>Tachycineta thalassina</i>	Violet-Green Swallow	SOI	G5	N5B	S5			X		
<i>Thryomanes bewickii</i>	Bewick's Wren		G5	N5B	S5					
<i>Toxostoma crissale</i>	Crissal Thrasher	SOI	G5	N5	S5			X	X	
<i>Toxostoma rufum</i>	Brown Thrasher	SOI	G5	N5	S1N					
<i>Tringa flavipes</i>	Lesser Yellowlegs	SOI	G5	N5B	SNA			X		
<i>Tringa melanoleuca</i>	Greater Yellowlegs	SOI	G5	N5B	S3N			X		
<i>Troglodytes aedon</i>	House Wren	SOI	G5	N5B	S5			X		
<i>Troglodytes troglodytes</i>	Winter Wren	SOI	G5	N5	S2S3N			X		
<i>Turdus migratorius</i>	American Robin	SOI	G5	N5	S5			X		
<i>Tyrannus verticalis</i>	Western Kingbird	SOI	G5	N5B	S5			X		
<i>Tyrannus vociferans</i>	Cassin's Kingbird	SOI	G5	N5B	S5			X		
<i>Tyto alba</i>	Barn Owl		G5	N5	S5					
<i>Vermivora celata</i>	Orange-Crowned Warbler	SOI	G5	N5B	S3B S5N			X		
<i>Vermivora luciae</i>	Lucy's Warbler	SOI	G5	N5B	S5			X		
<i>Vermivora ruficapilla</i>	Nashville Warbler	SOI	G5	N5B	SNA			X		
<i>Vermivora virginiae</i>	Virginia's Warbler	SOI	G5	N5B	S5			X		X
<i>Vireo bellii arizonae</i>	Arizona Bell's Vireo	SOI	T4	N4B	S4				X	
<i>Vireo gilvus</i>	Warbling Vireo	SOI	G5	N5B	S5			X		
<i>Vireo plumbeus</i>	Plumbeus Vireo	SOI	G5	N5B	S5			X		
<i>Vireo vicinior</i>	Gray Vireo	SOI	G4	N4B	S4			X	X	X
<i>Wilsonia pusilla</i>	Wilson's Warbler	SOI	G5	N5B	SNA			X		
<i>Xanthocephalus xanthocephalus</i>	Yellow-Headed Blackbird	SOI	G5	N5B	S5			X		
<i>Zenaidura macroura</i>	Mourning Dove	SOI	G5	N5	S5			X		
<i>Zonotrichia leucophrys</i>	White-Crowned Sparrow	SOI	G5	N5B	S1B S5N			X		
Meleagris gallopavo mexicana	Gould's Wild Turkey	SOI						X		
<i>Oncorhynchus gilae apache</i>	Apache Trout Intraspecific.	TE	T3	N3	S3	T	WSC	X		

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Myotis evotis evotis	Long-eared Myotis									
Ammospermophilus leucurus	White-Tailed Antelope Squirrel		G5	N5	S5					
Antilocapra americana	Pronghorn	SOI	G5	N5	S5			X		
Antrozous pallidus	Pallid Bat	SOI	G5	N5	S4S5			X		
Bassariscus astutus	Ringtail	SOI	G5	N5	S5			X		
Canis latrans	Coyote	SOI	G5	N5	S5			X		
Castor canadensis	American Beaver	SOI	G5	N5	S4			X		
Chaetodipus formosus	Long-Tailed Pocket Mouse		G5	N5	S5					
Chaetodipus intermedius intermedius	Rock Pocket Mouse	SOI	T5	N5	S5			X		
Conepatus leuconotus	White-backed Hog-Nosed Skunk	SOI	G4	N3	S4			X		
Corynorhinus townsendii	Townsend's Big-Eared Bat		G4	N4	S3					
Corynorhinus townsendii pallescens	Pale Lump-nosed Bat		T4	N4	S3S4					
Cynomys gunnisoni	Gunnison's Prairie Dog	SOI	G5	N5	S5			X		
Dipodomys merriami	Merriam's Kangaroo Rat	SOI	G5	N5	S5			X		
Dipodomys microps celsus	Chisel-Toothed Kangaroo Rat	SOI	T4	N4	S3			X		
Dipodomys ordii	Ord's Kangaroo Rat	SOI	G5	N5	S5			X		
Eptesicus fuscus	Big Brown Bat		G5	N5	S4S5					
Erethizon dorsatum	North American Porcupine	SOI	G5	N5	S4S5			X		
Euderma maculatum	Spotted Bat	SOI	G4	N3N4	S1S2		WSC	X		
Eumops perotis californicus	Greater Western Mastiff Bat	SOI	T4	N3	S1S2			X		
Idionycteris phyllotis	Allen's Big-Eared Bat	SOC	G3	N3N4	S2S3					
Lasionycteris noctivagans	Silver-Haired Bat		G5	N5	S3S4					
Lasiurus borealis	Eastern Red Bat		G5	N5						
Lasiurus cinereus	Hoary Bat		G5	N5	S4					
Lepus californicus	Black-Tailed Jack Rabbit		G5	N5	S5					
Lynx rufus	Bobcat	SOI	G5	N5	S5			X		
Mephitis macroura	Hooded Skunk	SOI	G5	N4	S4			X		
Mephitis mephitis	Striped Skunk	SOI	G5	N5	S5			X		
Microtus longicaudus	Long-Tailed Vole	SOI	G5	N5	S4			X		
Microtus longicaudus leucophaeus	White-Bellied Long-Tailed Vole	SOC	T3	N3	S3			X		
Microtus mogollonensis	Mogollon Vole	SOI	G4	N5	S5			X		
Microtus mogollonensis navaho	Navajo Mexican Vole	SOC	T2	N2	S1		WSC	X		
Mus musculus	House Mouse		G5	NNA	SNA					
Mustela frenata	Long-Tailed Weasel		G5	N5	S3					

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Myotis californicus	California Myotis Bat	SOI	G5	N5	S4S5			X		
Myotis ciliolabrum	Western Small-Footed Myotis Bat		G5	N5	S3					
Myotis evotis	Long-Eared Myotis Bat		G5	N5	S3S4					
Myotis occultus	Occult Little Brn. Myotis Bat	SOC	G3	N3N4	S3			X		
Myotis thysanodes	Fringed Myotis Bat		G4	N4N5	S3S4					
Myotis velifer	Cave Myotis Bat		G5	N4	S4					
Myotis yumanensis	Yuma Myotis Bat		G5	N5	S3S4					
Nasua narica	White-Nosed Coati	SOI	G5	N4	S4			X		
Neotoma albigula	Western White-Throated Woodrat	SOI	G5	N5	S5			X		
Neotoma cinerea	Bushy-Tailed Wood Rat	SOI	G5	N5	S5			X		
Neotoma lepida	Desert Wood Rat		G5	N5	S5					
Neotoma mexicana	Mexican Wood Rat	SOI	G5	N5	S5			X		
Notiosorex crawfordi	Crawford's Desert Shrew	SOI	G5	N5	S4S5			X		
Nyctinomops macrotis	Big Free-Tailed Bat	SOI	G5	N3N4	S2S3			X		
Odocoileus hemionus	Mule Deer	SOI	G5	N5	S5			X		
Onychomys leucogaster	Northern Grasshopper Mouse		G5	N5	S5					
Ovis canadensis	Desert Bighorn Sheep	SOI	G4	N4	S4			X		
Ovis canadensis canadensis	Rocky Mountain Bighorn Sheep	SOI	T4	N4				X		
Ovis canadensis mexicana	Desert Bighorn Sheep	SOC	T3	N3N4	S3S4			X		
Pecari tajacu	Collared Peccary		G5	N5	S5					
Perognathus flavescens	Plains Pocket Mouse		G5	N5	S4					
Perognathus flavus	Silky Pocket Mouse		G5	N5	S5					
Perognathus longimembris	Little Pocket Mouse		G5	N5	S5					
Perognathus parvus	Great Basin Pocket Mouse		G5	N5	S4					
Peromyscus boylii	Brush Mouse	SOI	G5	N5	S5			X		
Peromyscus crinitus	Canyon Mouse		G5	N5	S4					
Peromyscus eremicus	Cactus Mouse		G5	N5	S5					
Peromyscus maniculatus	Deer Mouse	SOI	G5	N5	S5			X		
Peromyscus truei	Pinyon Mouse		G5	N5	S5					
Pipistrellus hesperus	Western Pipistrelle	SOI	G5	N5	S5			X		
Procyon lotor	Northern Raccoon	SOI	G5	N5	S4			X		
Puma concolor	Puma	SOI	G5	N5	S4			X		
Reithrodontomys megalotis	Western Harvest Mouse	SOI	G5	N5	S5			X		
Sciurus aberti	Abert's Squirrel	SOI	G5	N5	S5			X		

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Sciurus aberti kaibabensis	Kaibab Squirrel	SOC	T3	N3	S3			X		
Sorex merriami leucogenys	Merriam's Shrew	SOI	T5	N5				X		
Sorex nanus	Dwarf Shrew	SOI	G4	N4	S1S2			X		
Sorex vagrans	Vagrant Shrew		G5	N5						
Spermophilus lateralis	Golden-Mantled Ground Squirrel		G5	N5	S5					
Spermophilus spilosoma	Spotted Ground Squirrel	SOI	G5	N5	S4			X		
Spermophilus variegatus	Rock Squirrel		G5	N5	S5					
Spilogale gracilis	Western Spotted Skunk		G5	N5	S5					
Sylvilagus audubonii	Desert Cottontail		G5	N5	S5					
Sylvilagus floridanus	Eastern Cottontail		G5	N5	S5					
Sylvilagus nuttallii pinetis	Nuttall's Cottontail Rabbit	SOI	T5	N5	SNR			X		
Tadarida brasiliensis	Brazilian Free-Tailed Bat	SOI	G5	N5	S3S4			X		
Tamias cinereicollis	Gray-Collared Chipmunk		G4	N4	S4					
Tamias dorsalis	Cliff Chipmunk		G5	N5	S5					
Tamias minimus	Least Chipmunk		G5	N5	S4					
Tamias umbrinus	Uinta Chipmunk		G5	N5	S4					
Tamiasciurus hudsonicus	Red Squirrel	SOI	G5	N5	S5			X		
Taxidea taxus	American Badger	SOI	G5	N5	S5			X		
Thomomys talpoides	Northern Pocket Gopher		G5	N5	S4					
Urocyon cinereoargenteus	Gray Fox	SOI	G5	N5	S5			X		
Ursus americanus	Black Bear	SOI	G5	N5	S5			X		
Neotamias minimus consobrinus	Kaibab Least Chipmunk									
Thomomys talpoides kaibabensis	Kaibab Northern Pocket Gopher									
Neotamias minimus arizonensis	White Mountains Least Chipmunk									
Myotis ciliolabrum melanorhinus	Western Small Footed Myotis									
Myotis thysanodes thysanodes	Fringe-tailed Myotis									
Myotis volans interior	Long-legged Myotis									
Myotis yumanensis yumanensis										
Tadarida brasiliensis mexicana	Mexican Free-tailed Bat									
Actaea arizonica	Arizona Bugbane	SOC	G2	N2	S2		HS			
Arenaria aberrans	Mt. Dellenbaugh Sandwort	SOC	G3	N2N3	SNR					
Astragalus ampullarius	Gumbo Milkvetch	SOC	G2	N2	S1					
Astragalus cremnophylax var. hevronii	Hevron's Milkvetch	SOC	T1	N1	S1					

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Astragalus cremnophylax var. myriorrhaphis	Cliff Milkvetch	SOC	T1	N1	S1		SR			
Astragalus rusbyi	A Milkvetch	SOC	G3	N3	S3					
Castilleja kaibabensis	Kaibab Indian Paintbrush	SOC	G2	N2	S2					
Chrysothamnus molestus	Arizona Rabbit-Brush	SOC	G3	N3	S3					
Clematis hirsutissima var. hirsutissima	Clustered Leather Flower		T4	NNR	SNR					
Erigeron saxatilis	Rock Fleabane	SOC	G3	N3	S3					
Eriogonum mortonianum	Morton Wild Buckwheat	SOC	G1	N1	S1		SR			
Eriogonum thompsoniae var. atwoodii	Atwood Wild Buckwheat	SOC	T1	N1	S1		SR			
Hedeoma diffusa	Flagstaff Pennyroyal	SOC	G3	N3	S3		SR			
Helianthus arizonensis	Arizona Sunflower		G4	N4	SNR					
Hymenoxys rusbyi	Ruby's Bitterweed	SOC	G3	NNR	SNR					
Pediocactus paradinei	Park Pincushion Cactus	SOC	G2	N2	S2					
Pediocactus peeblesianus var. fickeiseniae	Fickeisen Hedgehog-Cactus	SOC	T1	N1N2	S1S2	C	HS			
Penstemon distans	Mt. Trumbull Beardtongue	SOC	G2	N2	S2		SR			
Penstemon nudiflorus	Flagstaff Beardtongue	SOC	G2	N2N3	S2S3					
Penstemon ophianthus	Arizona Beardtongue	SOC	G3	N3N4	S2					
Rosa stellata ssp. abyssa	Grand Canyon Rose	SOC	T2	NNR	S2		SR			
Senecio bigelovii var. bigelovii	Nodding Ragwort	SOC	T3	NNR	SNR					
Talinum validulum	Western Flame Flower	SOC	G3	N3	S3		SR			
Aspidoscelis tigris	Western Whiptail		G5	N5	S5					
Aspidoscelis velox	Plateau Striped Whiptail		G5	N5	S5					
Crotalus molossus	Blacktail Rattlesnake	SOI	G5	N5	S5			X		
Crotalus viridis cerberus	Arizona Black Rattlesnake	SOI	T5	N5	S5			X		
Crotalus viridis lutosus	Great Basin Rattlesnake		T5	N5	S4?					
Crotaphytus collaris	Collared Lizard		G5	N5	S5					
Diadophis punctatus	Ringneck Snake		G5	N5	S4					
Elgaria kingii nobilis	Arizona Alligator Lizard		T4	N4	SNR					
Eumeces multivirgatus epipleurotus	Variable Skink		T5	N4N5	SNR					
Eumeces obsoletus	Great Plains Skink		G5	N5	S5					
Eumeces skiltonianus	Western Skink	SOI	G5	N5	S2					
Gambelia wislizenii	Longnose Leopard Lizard		G5	N5	S5					
Holbrookia maculata	Lesser Earless Lizard		G5	N5	S5					

NatureServe Scientific Name ^A	NatureServe Common Name ^A	Potential Species List ^B	G- rank	N-rank	AZ S-rank	ESA Status	AZ State Status ^C	AZ CWCS ^D	Birds of Conserv. Concern ^E	Partners in Flight Watch List ^F
Hypsiglena torquata	Night Snake		G5	N5	S5					
Lampropeltis getula	Common Kingsnake		G5	N5	S5					
Lampropeltis pyromelana	Sonoran Mountain Kingsnake	SOI	G5	N4	S4			X		
Lampropeltis triangulum	Milk Snake	SOI	G5	N5	S2					
Masticophis taeniatus	Striped Whipsnake		G5	N5	S4					
Phrynosoma hernandesi	Short-Horned Lizard	SOI	G5	N5	S2			X		
Phrynosoma platyrhinos	Desert Horned Lizard		G5	N5	S5					
Pituophis catenifer	Gopher Snake		G5	N5	S5					
Rhinocheilus lecontei	Longnose Snake		G5	N5	S5					
Salvadora hexalepis	Western Patchnose Snake		G5	N5	S5					
Sauromalus obesus	Chuckwalla		G5	N5	S4					
Sceloporus graciosus graciosus	Northern Sagebrush Lizard		T5	NNR	S3S4					
Sceloporus magister	Desert Spiny Lizard		G5	N5	S5					
Sceloporus undulatus	Fence/ Prairie/ Plateau Lizard		G5	N5	S5					
Sonora semiannulata	Ground Snake		G5	N5	S5					
Tantilla planiceps	Western Black-Headed Snake		G4	N4						
Thamnophis elegans	Western Terrestrial Garter Snake		G5	N5	S5?					
Urosaurus ornatus	Tree Lizard		G5	N5	S5					
Uta stansburiana	Side-Blotched Lizard		G5	N5	S5					

Appendix 6-B. Conservation targets (n=200), by target type, that occur on one or more of eight conservation areas that overlap the Kaibab National Forest in Arizona.

Target Type / Scientific Name	Common Name	Habitat Type	# of Conservation Areas	Conservation Areas ^A
Amphibian				
<i>Hyla wrightorum</i>	Mountain Treefrog	Aquatic/Riparian	3	2,7,8
<i>Rana pipiens</i>	Northern Leopard Frog	Aquatic/Riparian	1	4
<i>Rana yavapaiensis</i>	Yavapi Leopard Frog	Aquatic/Riparian	1	8
Bird				
<i>Accipiter gentilis</i>	Northern Goshawk	Terrestrial	3	2,7,8
<i>Empidonax traillii extimus</i>	Southwest Willow Flycatcher	Aquatic/Riparian	2	4,6
<i>Falco peregrinus</i>		Terrestrial	3	4,5,6
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Terrestrial	1	4
<i>Picoides tridactylus</i>		Terrestrial	1	5
<i>Sphyrapicus thyroideus</i>	Williamson's Sapsucker	Terrestrial	1	5
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Terrestrial	4	2,5,7,8
Fish				
<i>Catostomus insignis</i>	Sonora Sucker	Aquatic/Riparian	1	2
<i>Gila cypha</i>	Humpback Chub	Aquatic/Riparian	1	4
<i>Gila robusta</i>	Roundtail Chub	Aquatic/Riparian	2	4,8
<i>Xyrauchen texanus</i>	Razorback Sucker	Aquatic/Riparian	1	4
Insect				
<i>Ceuthophilus yavapai</i>		Terrestrial	1	4
<i>Metrichia volada</i>	Page Spring Micro Caddisfly	Aquatic/Riparian	1	8
Mammal				
<i>Corynorhinus townsendii</i>	Townsend's Big-Eared Bat	Terrestrial	1	4
<i>Cynomys gunnisoni</i>	Gunnison's Prairie Dog	Terrestrial	1	7
<i>Euderma maculatum</i>	Spotted Bat	Terrestrial	2	4,6
<i>Idionycteris phyllotis</i>	Allen's Big-Eared Bat	Terrestrial	2	4,5
<i>Lasiurus blossevillii</i>	Western Red Bat	Terrestrial	1	4
<i>Mustela frenata arizonensis</i>		Terrestrial	2	7,8
<i>Myotis lucifugus occultus</i>	Arizona Myotis	Terrestrial	2	7,8
<i>Ovis canadensis nelsoni</i>	Desert Bighorn Sheep	Terrestrial	2	4,6
<i>Sciurus aberti kaibabensis</i>	Kaibab Squirrel	Terrestrial	1	4

Target Type / Scientific Name	Common Name	Habitat Type	# of Conservation Areas	Conservation Areas ^A
<i>Sorex nanus</i>	Dwarf Shrew	Terrestrial	2	5,7
Mollusk				
<i>Oxyloma sp</i> (Vasey's Paradise)		Terrestrial	1	4
Plant-Vascular				
<i>Agave sp nov</i>		Terrestrial	1	4
<i>Argemone arizonica</i>	Arizona Prickle-Poppy	Terrestrial	1	5
<i>Asclepias welshii</i>	Welsh's Milkweed	Terrestrial	1	6
<i>Astragalus atwoodii</i>	A Milk-vetch	Terrestrial	1	4
<i>Astragalus beathii</i>	Beath Milk-vetch	Terrestrial	2	4,6
<i>Astragalus cremnophylax var cremnophylax</i>	Sentry Milk-vetch	Terrestrial	1	4
<i>Astragalus cremnophylax var hevronii</i>	Hevron's Milkvetch	Terrestrial	1	4
<i>Astragalus lentiginosus var. Trumbullensis</i>		Terrestrial	1	4
<i>Astragalus troglodytus</i>	Creeping Milk-vetch	Terrestrial	2	7,8
<i>Botrychium crenulatum</i>	Crenulate Moonwort	Terrestrial	1	7
<i>Camissonia exilis</i>	Cottonwood Spring Suncup	Terrestrial	1	6
<i>Castilleja kaibabensis</i>	Kaibab Indian Paintbrush	Terrestrial	1	5
<i>Chrysothamnus molestus</i>	Arizona Rabbit-Brush	Terrestrial	1	7
<i>Cimicifuga arizonica</i>	Arizona Bugbane	Aquatic/Riparian	2	2,8
<i>Cymopterus megacephalus</i>	Long-Leaf Spring-Parsley	Terrestrial	1	4
<i>Erigeron saxatilis</i>		Terrestrial	2	7,8
<i>Euphorbia aaron-rossii</i>		Terrestrial	2	4,6
<i>Flaveria macdougalii</i>	Grand Canyon Flaveria	Terrestrial	1	4
<i>Gentiana barbellata</i>	Perennial Fringed Gentian	Terrestrial	1	7
<i>Hedeoma diffusum</i>		Terrestrial	1	8
<i>Hesperodoria salicina</i>	Willow glow-weed	Terrestrial	1	4
<i>Heuchera eastwoodiae</i>	Senator Mine Allum-Root	Terrestrial	1	8
<i>Hymenoxys helenioides</i>	Intermountain Bitterweed	Terrestrial	1	7
<i>Pediocactus bradyi</i>	Brady Pincushion Cactus	Terrestrial	2	4,6
<i>Pediocactus paradinei</i>	Park Pincushion Cactus	Terrestrial	2	5,6
<i>Pediocactus peeblesianus var fickeiseniae</i>	Fickeisen Hedgehog-Cactus	Terrestrial	1	4
<i>Penstemon clutei</i>	A Beardtongue	Terrestrial	1	7
<i>Penstemon distans</i>	Mt. Trumbull Beardtongue	Terrestrial	1	4
<i>Phacelia glechomifolia</i>	Pennyroyal-leaf Scorpion-weed	Terrestrial	1	4
<i>Phacelia peritylodes var. Laxiflora</i>	Nodding-flower Scorpion-weed	Terrestrial	1	4
<i>Phacelia petrosa</i>		Terrestrial	1	4

Target Type / Scientific Name	Common Name	Habitat Type	# of Conservation Areas	Conservation Areas ^A
<i>Phacelia serrata</i>	Serrate Phacelia	Terrestrial	1	7
<i>Pinus aristata</i>	Bristlecone pine	Terrestrial	1	7
<i>Potentilla multifoliolata</i>	Many-leaf Ivesia	Terrestrial	3	2,7,8
<i>Psorothamnus arborescens var pubescens</i>		Terrestrial	2	4,6
<i>Rosa stellata ssp abyssa</i>	Grand Canyon Rose	Terrestrial	1	4
<i>Salvia dorrii ssp mearnsii</i>		Terrestrial	1	8
<i>Sclerocactus sileri</i>	Siler's Fish-hook Cactus	Terrestrial	1	6
<i>Senecio franciscanus</i>	San Francisco Peaks Groundsel	Terrestrial	1	7
<i>Silene rectiramea</i>	Grand Canyon Catchfly	Terrestrial	1	4
<i>Talinum validulum</i>	Western Flame Flower	Terrestrial	3	2,7,8
Reptile				
<i>Heloderma suspectum</i>	Gila Monster	Terrestrial	1	4
<i>Lampropeltis pyromelana</i>	Sonoran Mountain Kingsnake	Terrestrial	1	8
<i>Thamnophis eques megalops</i>	Mexican Garter Snake	Aquatic/Riparian	1	8
<i>Thamnophis rufipunctatus</i>	Narrowhead Garter Snake	Aquatic/Riparian	1	8
Community				
Douglas Fir Forest Community (specific)		Terrestrial	1	7
Hanging Garden		Aquatic/Riparian	2	4,6
Netleaf Hackberry / Bluebunch Wheatgrass Woodland		Aquatic/Riparian	1	4
Ponderosa Pine Forest Community (specific)		Terrestrial	3	2,7,8
Ecological System				
Alpine Tundra		Terrestrial	1	7
Aspen Forest		Terrestrial	2	2,7
Desert Grassland and Shrub-Steppe		Terrestrial	4	1,3,4,6
Little Colorado River Headwater and creek, low and intermediate, intermittent		Aquatic/Riparian	1	4
Little Colorado River Headwater and creek, montane and above, intermittent		Aquatic/Riparian	1	4
Little Colorado River Large and extra large river, low and intermediate, perennial		Aquatic/Riparian	1	4
Little Colorado River Small and medium river, low and intermediate, intermittent		Aquatic/Riparian	1	4
Middle Colorado - San Juan Rivers Headwater and creek, low and intermediate, intermittent		Aquatic/Riparian	5	1,3,4,5,6
Middle Colorado - San Juan Rivers Headwater and creek, low and intermediate, perennial		Aquatic/Riparian	4	3,4,5,6
Middle Colorado - San Juan Rivers Headwater and creek, montane and above, intermittent		Aquatic/Riparian	5	1,3,4,5,6
Middle Colorado - San Juan Rivers Headwater and creek, montane and above, perennial		Aquatic/Riparian	2	4,5
Middle Colorado - San Juan Rivers Large and extra large river, low and intermediate, perennial		Aquatic/Riparian	2	4,6
Middle Colorado - San Juan Rivers Small and medium river, low and intermediate, perennial		Aquatic/Riparian	3	3,4,6

Target Type / Scientific Name	Common Name	Habitat Type	# of Conservation Areas	Conservation Areas ^A
Mixed Desert Shrubland		Terrestrial	3	3,4,6
Mixed Salt Desert Scrub		Terrestrial	2	4,6
Mohave Desert Scrub		Terrestrial	2	4,6
Montane Mixed Forest		Terrestrial	4	2,4,5,7
Montane Riparian Woodland and Shrubland		Aquatic/Riparian	1	5
Montane Shrubland		Terrestrial	2	4,5
Pinyon-Juniper Woodland		Terrestrial	5	1,3,4,5,6
Playa		Aquatic/Riparian	1	1
Ponderosa Pine Forest and Woodland		Terrestrial	2	4,5
Riparian Woodland		Aquatic/Riparian	3	4,5,6
Sagebrush Shrubland		Terrestrial	3	4,5,6
Semi-Desert Chaparral		Terrestrial	2	3,4
Feature				
Important ephemeral wetland that is seasonally wet and dry.		Aquatic/Riparian	1	2
Native Fish Assemblages		Aquatic/Riparian	1	4
Sagebrush Steppe		Aquatic/Riparian	2	3,6

^A1 = Aubrey Valley Northeast, 2 = Bill Williams Mountains, 3 = Cataract Creek, 4 = Grand Canyon, 5 = Kaibab Plateau, 6 = Paria, 7 = San Francisco Peaks, 8 = Sycamore & Oak Creek Canyons

Appendix 6-C. Conservation targets associated with eight conservation areas that overlap the Kaibab National Forest in Arizona.

Conservation Area/ Target Type	Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
Aubrey Valley Northeast					
Ecological System		Middle Colorado - San Juan Rivers Headwater and creek, montane and above, intermittent	Aquatic/Riparian	GU	
		Pinyon-Juniper Woodland	Terrestrial	GU	
		Middle Colorado - San Juan Rivers Headwater and creek, low and intermediate, intermittent	Aquatic/Riparian	GU	
		Playa	Aquatic/Riparian	GU	
		Desert Grassland and Shrub-Steppe	Terrestrial	GU	
Bill Williams Mountains					
Amphibian	<i>Hyla wrightorum</i>	Mountain Treefrog	Aquatic/Riparian	G4	
Bird	<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Terrestrial	G3	LT
	<i>Accipiter gentilis</i>	Northern Goshawk	Terrestrial	G5	
Fish	<i>Catostomus insignis</i>	Sonora Sucker	Aquatic/Riparian	G3	SC
Plant-Vascular	<i>Potentilla multifoliolata</i>	Many-leaf Ivesia	Terrestrial	G4	
	<i>Talinum validulum</i>	Western Flame Flower	Terrestrial	G3	
	<i>Cimicifuga arizonica</i>	Arizona Bugbane	Aquatic/Riparian	G2	
Community		Ponderosa Pine Forest Community (4 specific occurrenes)	Terrestrial	GU	
Ecological System		Aspen Forest	Terrestrial	GU	
		Montane Mixed Forest	Terrestrial	GU	
Feature		Important ephemeral wetland that is seasonally wet and dry.	Aquatic/Riparian	GU	
Cataract Creek					
Ecological System		Semi-Desert Chaparral	Terrestrial	GU	
		Middle Colorado - San Juan Rivers Headwater and creek, low and intermediate, perennial	Aquatic/Riparian	GU	
		Mixed Desert Shrubland	Terrestrial	GU	
		Middle Colorado - San Juan Rivers Headwater and creek, low and intermediate, intermittent	Aquatic/Riparian	GU	
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	

Conservation Area/ Target Type	Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
Feature		Headwater and creek, montane and above, intermittent			
		Middle Colorado - San Juan Rivers Small and medium river, low and intermediate, perennial	Aquatic/Riparian	GU	
		Semi-Desert Chaparral	Terrestrial	GU	
		Pinyon-Juniper Woodland	Terrestrial	GU	
		Desert Grassland and Shrub-Steppe	Terrestrial	GU	
		Sagebrush Steppe	Aquatic/Riparian	GU	
Grand Canyon					
Amphibian	<i>Rana pipiens</i>	Northern Leopard Frog	Aquatic/Riparian	G5	
Bird	<i>Empidonax traillii extimus</i>	Southwest Willow Flycatcher	Aquatic/Riparian	G2	LE
	<i>Falco peregrinus</i>	Peregrine Falcon	Terrestrial	G4	PS:LE
	<i>Haliaeetus leucocephalus</i>	Bald Eagle	Terrestrial	G4	PS:LT, PDL
Fish	<i>Xyrauchen texanus</i>	Razorback Sucker	Aquatic/Riparian	G1	LE
	<i>Gila cypha</i>	Humpback Chub	Aquatic/Riparian	G1	LE
	<i>Gila robusta</i>	Roundtail Chub	Aquatic/Riparian	G3	PS
Insect	<i>Ceuthophilus yavapai</i>		Terrestrial	GU	
Mammal	<i>Corynorhinus townsendii</i>	Townsend's Big-Eared Bat	Terrestrial	G4	PS
	<i>Euderma maculatum</i>	Spotted Bat	Terrestrial	G4	
	<i>Idionycteris phyllotis</i>	Allen's Big-Eared Bat	Terrestrial	G3	
	<i>Sciurus aberti kaibabensis</i>	Kaibab Squirrel	Terrestrial	G3	
	<i>Lasiurus blossevillii</i>	Western Red Bat	Terrestrial	G5	
	<i>Ovis canadensis nelsoni</i>	Desert Bighorn Sheep	Terrestrial	G4	
	<i>Oxyloma sp (Vasey's paradise)</i>		Terrestrial	GU	LE
	<i>Heloderma suspectum</i>	Gila Monster	Terrestrial	G4	
Mollusk					
Reptile					
Plant-Vascular	<i>Astragalus atwoodii</i>	A Milk-vetch	Terrestrial	GU	
	<i>Phacelia perityloides var Laxiflora</i>	Nodding-flower Scorpion-weed	Terrestrial	GU	
	<i>Astragalus beathii</i>	Beath Milk-vetch	Terrestrial	G2	
	<i>Astragalus cremnophylax var hevronii</i>	Hevron's Milk-vetch	Terrestrial	G1	
	<i>Astragalus cremnophylax var cremnophylax</i>	Sentry Milk-vetch	Terrestrial	G1	LE
	<i>Psorothamnus arborescens var pubescens</i>		Terrestrial	G2	
	<i>Rosa stellata ssp abyssa</i>	Grand Canyon Rose	Terrestrial	G2	
	<i>Phacelia glechomifolia</i>	Pennyroyal-leaf Scorpion-weed	Terrestrial	G2	

Conservation Area/ Target Type	Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
Community	<i>Penstemon distans</i>	Mt. Trumbull Beardtongue	Terrestrial	G2	C
	<i>Hesperodoria salicina</i>		Terrestrial	G2	
	<i>Pediocactus peeblesianus</i> var <i>fickeiseniae</i>	Fickeisen Hedgehog-Cactus	Terrestrial	G2	
	<i>Silene rectiramea</i>	Grand Canyon Catchfly	Terrestrial	G1	LE
	<i>Pediocactus bradyi</i>	Brady Pincushion Cactus	Terrestrial	G1	
	<i>Flaveria macdougalii</i>	Grand Canyon Flaveria	Terrestrial	G2	
	<i>Euphorbia aaron-rossii</i>		Terrestrial	G1	
	<i>Agave sp nov</i>		Terrestrial	GU	
	<i>Cymopterus megacephalus</i>	Long-Leaf Spring-Parsley	Terrestrial	G2	
	<i>Astragalus lentiginosus</i> var <i>Trumbullensis</i>		Terrestrial	GU	
	<i>Phacelia petrosa</i>		Terrestrial	GU	
		Hanging Garden	Aquatic/Riparian	G2	
		Netleaf Hackberry / Bluebunch Wheatgrass	Aquatic/Riparian	G2	
		Woodland			
		Little Colorado River Large and extra large river, low and intermediate, perennial	Aquatic/Riparian	GU	
		Mixed Desert Shrubland	Terrestrial	GU	
		Mixed Desert Shrubland	Terrestrial	GU	
		Little Colorado River Headwater and creek, montane and above, intermittent	Aquatic/Riparian	GU	
		Ponderosa Pine Forest and Woodland	Terrestrial	GU	
Ecological System		Mixed Salt Desert Scrub	Terrestrial	GU	
		Little Colorado River Headwater and creek, low and intermediate, intermittent	Aquatic/Riparian	GU	
		Riparian Woodland	Aquatic/Riparian	GU	
		Mohave Desert Scrub	Terrestrial	GU	
		Pinyon-Juniper Woodland	Terrestrial	GU	
		Montane Shrubland	Terrestrial	GU	
		Ponderosa Pine Forest and Woodland	Terrestrial	GU	
		Desert Grassland and Shrub-Steppe	Terrestrial	GU	
		Ponderosa Pine Forest and Woodland	Terrestrial	GU	
		Little Colorado River Small and medium river, low and intermediate, intermittent	Aquatic/Riparian	GU	
		Middle Colorado - San Juan Rivers Large and extra large river, low and intermediate, perennial	Aquatic/Riparian	GU	

Conservation Area/ Target Type	Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
Feature		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, montane and above, perennial			
		Montane Mixed Forest	Terrestrial	GU	
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, montane and above, intermittent			
		Mixed Salt Desert Scrub	Terrestrial	GU	
		Desert Grassland and Shrub-Steppe	Terrestrial	GU	
		Montane Shrubland	Terrestrial	GU	
		Ponderosa Pine Forest and Woodland	Terrestrial	GU	
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, low and intermediate, perennial			
		Pinyon-Juniper Woodland	Terrestrial	GU	
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, low and intermediate, intermittent			
		Middle Colorado - San Juan Rivers Small and medium river, low and intermediate, perennial	Aquatic/Riparian	GU	
		Semi-Desert Chaparral	Terrestrial	GU	
		Sagebrush Shrubland	Terrestrial	GU	
		Native Fish Assemblages	Aquatic/Riparian	GU	
Kaibab Plateau					
Bird	<i>Falco peregrinus</i>	Peregrine Flacon	Terrestrial	G4	PS:LE LT
	<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Terrestrial	G3	
	<i>Sphyrapicus thyroideus</i>	Williamson's Sapsucker	Terrestrial	G5	
	<i>Picoides tridactylus</i>	American Three-toed Woodpecker	Terrestrial	G5	
Mammal	<i>Sorex nanus</i>	Dwarf Shrew	Terrestrial	G4	
	<i>Idionycteris phyllotis</i>	Allen's Big-Eared Bat	Terrestrial	G3	
	Plant-Vascular	<i>Castilleja kaibabensis</i>	Kaibab Indian Paintbrush	Terrestrial	
<i>Argemone arizonica</i>		Arizona Prickle-Poppy	Terrestrial	G1	
<i>Pediocactus paradinei</i>		Park Pincushion Cactus	Terrestrial	G2	
Ecological System		Sagebrush Shrubland	Terrestrial	GU	
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, low and intermediate,			

Conservation Area/ Target Type	Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
		perennial Pinyon-Juniper Woodland	Terrestrial	GU	
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, low and intermediate, intermittent			
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, montane and above, perennial			
		Ponderosa Pine Forest and Woodland	Terrestrial	GU	
		Riparian Woodland	Aquatic/Riparian	GU	
		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, montane and above, intermittent			
		Montane Riparian Woodland and Shrubland	Aquatic/Riparian	GU	
		Montane Shrubland	Terrestrial	GU	
		Ponderosa Pine Forest and Woodland	Terrestrial	GU	
		Riparian Woodland	Aquatic/Riparian	GU	
		Montane Mixed Forest	Terrestrial	GU	
Paria					
Bird	<i>Empidonax traillii extimus</i>	Southwest Willow Flycatcher	Aquatic/Riparian	G2	LE
	<i>Falco peregrinus</i>	Peregrine Falcon	Terrestrial	G4	PS:LE
Mammal	<i>Ovis canadensis nelsoni</i>	Desert Bighorn Sheep	Terrestrial	G4	
	<i>Euderma maculatum</i>	Spotted Bat	Terrestrial	G4	
Plant-Vascular	<i>Sclerocactus sileri</i>	Siler's Fish-hook Cactus	Terrestrial	G2	
	<i>Psoralea argophylla</i>		Terrestrial	G2	
	<i>Euphorbia aaron-rossii</i>		Terrestrial	G1	
	<i>Camissonia exilis</i>	Cottonwood Spring Suncup	Terrestrial	G1	
	<i>Pediocactus paradinei</i>	Park Pincushion Cactus	Terrestrial	G2	
	<i>Pediocactus bradyi</i>	Brady Pincushion Cactus	Terrestrial	G1	LE
	<i>Asclepias welshii</i>	Welsh's Milkweed	Terrestrial	G1	LT
	<i>Astragalus beathii</i>	Beath Milk-vetch	Terrestrial	G2	
Community		Hanging Garden	Aquatic/Riparian	G2	
Ecological System		Middle Colorado - San Juan Rivers	Aquatic/Riparian	GU	
		Headwater and creek, montane and above, intermittent			
		Pinyon-Juniper Woodland	Terrestrial	GU	

Conservation Area/ Target Type	Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
Feature		Sagebrush Shrubland	Terrestrial	GU	
		Mohave Desert Scrub	Terrestrial	GU	
		Mixed Desert Shrubland	Terrestrial	GU	
		Mixed Salt Desert Scrub	Terrestrial	GU	
		Middle Colorado - San Juan Rivers Small and medium river, low and intermediate, perennial	Aquatic/Riparian	GU	
		Middle Colorado - San Juan Rivers Large and extra large river, low and intermediate, perennial	Aquatic/Riparian	GU	
		Middle Colorado - San Juan Rivers Headwater and creek, low and intermediate, intermittent	Aquatic/Riparian	GU	
		Desert Grassland and Shrub-Steppe	Terrestrial	GU	
		Middle Colorado - San Juan Rivers Headwater and creek, low and intermediate, perennial	Aquatic/Riparian	GU	
		Riparian Woodland	Aquatic/Riparian	GU	
		Sagebrush Steppe	Aquatic/Riparian	GU	
	San Francisco Peaks				
Amphibian	<i>Hyla wrightorum</i>	Mountain Treefrog	Aquatic/Riparian	G4	LT
Bird	<i>Accipiter gentilis</i>	Northern Goshawk	Terrestrial	G5	
	<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Terrestrial	G3	
Mammal	<i>Sorex nanus</i>	Dwarf Shrew	Terrestrial	G4	
	<i>Cynomys gunnisoni</i>	Gunnison's Prairie Dog	Terrestrial	G5	
	<i>Mustela frenata arizonensis</i>		Terrestrial	GU	LT
	<i>Myotis lucifugus occultus</i>	Arizona Myotis	Terrestrial	G3	
Plant-Vascular	<i>Hymenoxys helenioides</i>	Intermountain Bitterweed	Terrestrial	G3	
	<i>Senecio franciscanus</i>	San Francisco Peaks Groundsel	Terrestrial	G1	
	<i>Penstemon clutei</i>	A Beardtongue	Terrestrial	G2	
	<i>Talinum validulum</i>	Western Flame Flower	Terrestrial	G3	
	<i>Pinus aristata</i>	Bristlecone Pine	Terrestrial	G3	
	<i>Potentilla multifoliolata</i>	Many-leaf Ivesia	Terrestrial	G4	
	<i>Phacelia serrata</i>	Serrate Phacelia	Terrestrial	G3	
	<i>Botrychium crenulatum</i>	Crenulate Moonwort	Terrestrial	G3	
	<i>Astragalus troglodytus</i>	Creeping Milk-vetch	Terrestrial	G2	
	<i>Chrysothamnus molestus</i>	Arizona Rabbit-Brush	Terrestrial	G3	

Conservation Area/ Target Type	Scientific Name	Common Name	Habitat Type	Global Rank	ESA Status
Community	<i>Erigeron saxatilis</i>		Terrestrial	G3	
	<i>Gentiana barbellata</i>	Perennial Fringed Gentian	Terrestrial	G3	
		Ponderosa Pine Forest Community (8 specific occurrences)	Terrestrial	GU	
Ecological System		Douglas Fir Forest Community (specific)	Terrestrial	GU	
		Montane Mixed Forest	Terrestrial	GU	
		Alpine Tundra	Terrestrial	G4	
		Alpine Tundra	Terrestrial	G4	
		Aspen Forest	Terrestrial	GU	
Sycamore & Oak Creek Canyons					
Amphibian	<i>Rana yavapaiensis</i>	Yavapi Leopard Frog	Aquatic/Riparian	G4	
	<i>Hyla wrightorum</i>	Mountain Treefrog	Aquatic/Riparian	G4	
Bird	<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Terrestrial	G3	LT
	<i>Accipiter gentilis</i>	Northern Goshawk	Terrestrial	G5	
Fish	<i>Gila robusta</i>	Roundtail Chub	Aquatic/Riparian	G3	PS
Insect	<i>Metrichia volada</i>	Page Spring Micro Caddisfly	Aquatic/Riparian	GU	
Mammal	<i>Mustela frenata arizonensis</i>		Terrestrial	GU	
	<i>Myotis lucifugus occultus</i>	Arizona Myotis	Terrestrial	G3	
Reptile	<i>Lampropeltis pyromelana</i>	Sonoran Mountain Kingsnake	Terrestrial	G5	
	<i>Thamnophis eques megalops</i>	Mexican Garter Snake	Aquatic/Riparian	G3	
	<i>Thamnophis rufipunctatus</i>	Narrowhead Garter Snake	Aquatic/Riparian	G3	
Plant-Vascular	<i>Talinum validulum</i>	Western Flame Flower	Terrestrial	G3	
	<i>Salvia dorrii ssp mearnsii</i>		Terrestrial	G3	
	<i>Astragalus troglodytus</i>	Creeping Milk-vetch	Terrestrial	G2	
	<i>Cimicifuga arizonica</i>	Arizona Bugbane	Aquatic/Riparian	G2	
	<i>Heuchera eastwoodiae</i>	Senator Mine Allum-Root	Terrestrial	G3	
	<i>Hedeoma diffusum</i>		Terrestrial	G3	
	<i>Erigeron saxatilis</i>		Terrestrial	G3	
	<i>Potentilla multifoliolata</i>		Terrestrial	G4	
Community		Ponderosa Pine Forest Community (5 specific occurrences)	Terrestrial	GU	