Chapter 6:

Ecological & Biological Diversity of the Kaibab National Forest

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Ecological and Biological Diversity of National Forests in Region 3

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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.

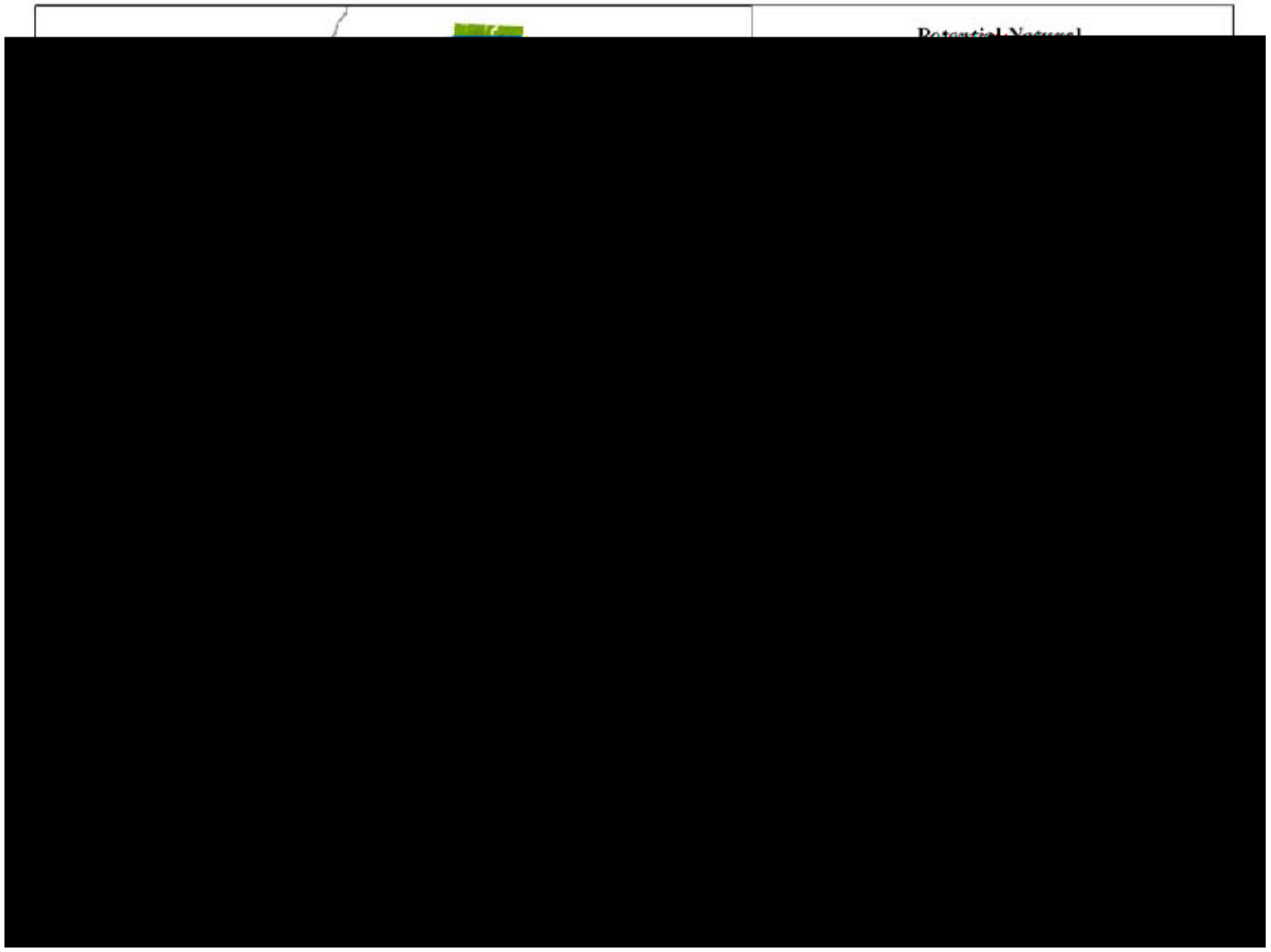


Figure 6-1. Distribution of potential natural vegetation types on the Kaibab National Forest. The map was created using data from the Southwest Regional Gap Analysis Project (SWReGAP; U.S. Geological Survey National Gap Analysis Program. 2004). SWReGAP vegetation types were aggregated and converted to 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).

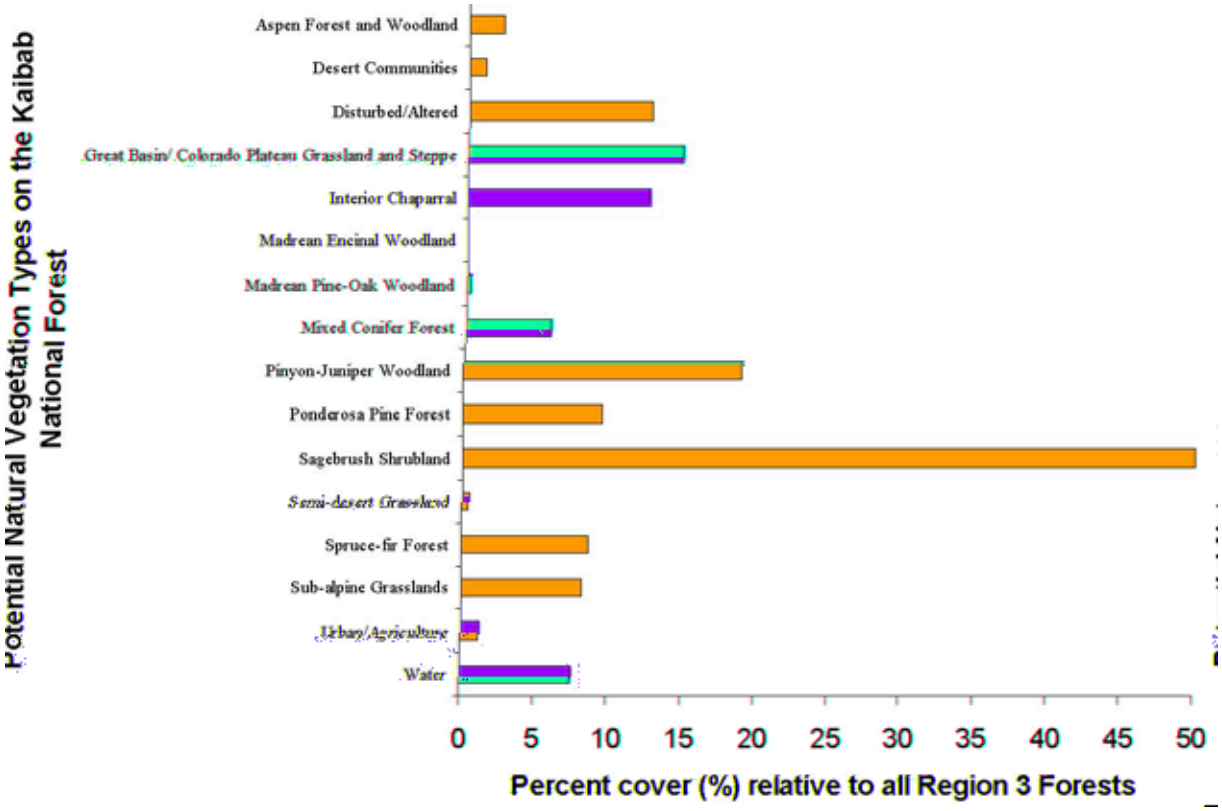


Figure 6-2. Percent of each potential natural vegetation type that occurs on the Kaibab National Forest in relation to all Region 3 National Forests combined. Analysis was conducted using data from the Southwest Regional Gap Analysis Project (SWReGAP), which has not been accuracy tested.

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.

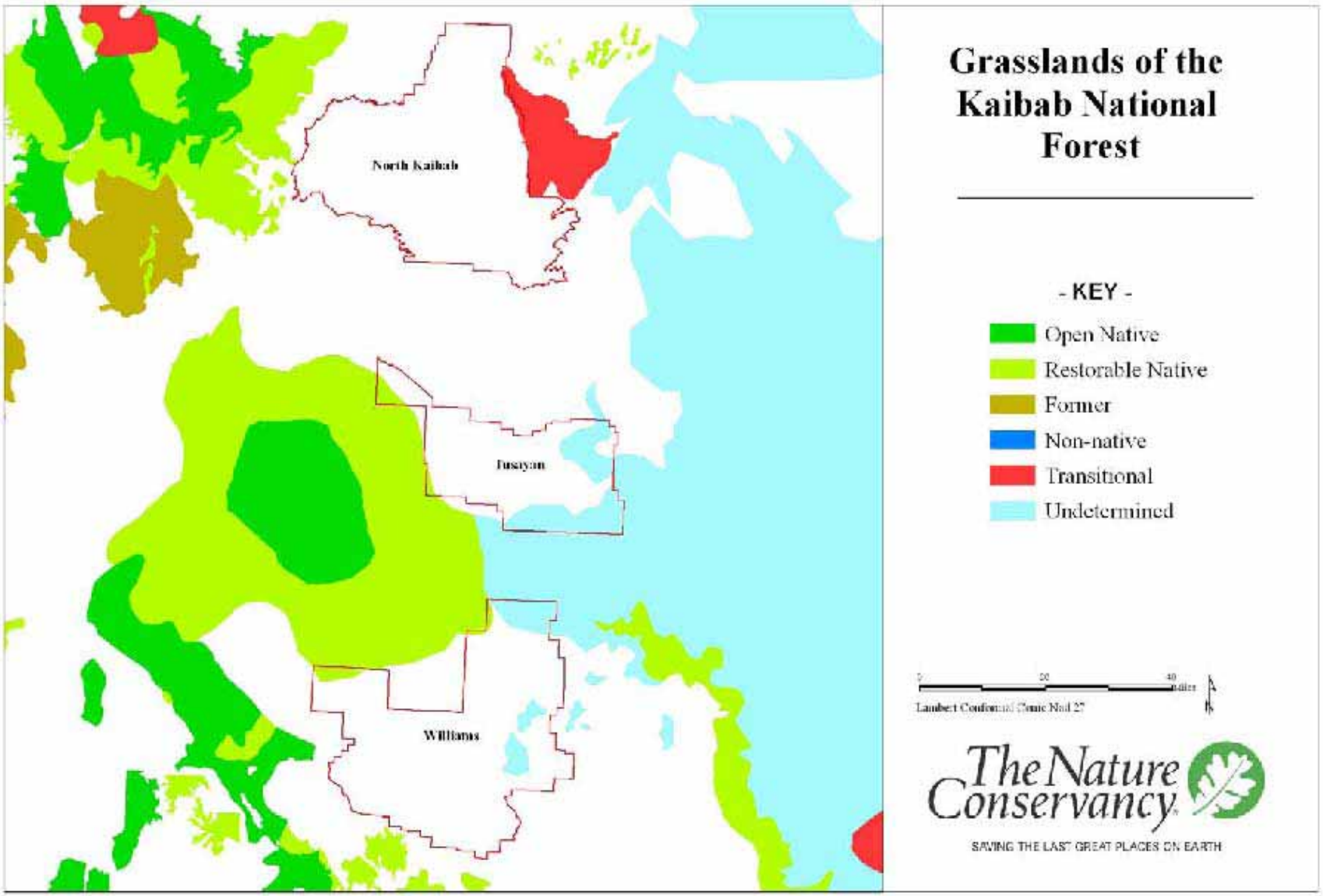


Figure 6-3. Grassland types, based on condition, on three ranger districts on the Kaibab National Forest in Arizona (from Schussman and Gori 2004, Gori and Enquist 2003).

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).

	Grassland Type					
	Restorable Native		Transitional		Total	
Districts	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	28.0
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.

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**

[A]G1 = 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**

[A]N1 = critically imperiled; N2 = imperiled; N3 = vulnerable; N4 = apparently secure; N5 = secure; NNA = not applicable; NNR = not ranked.

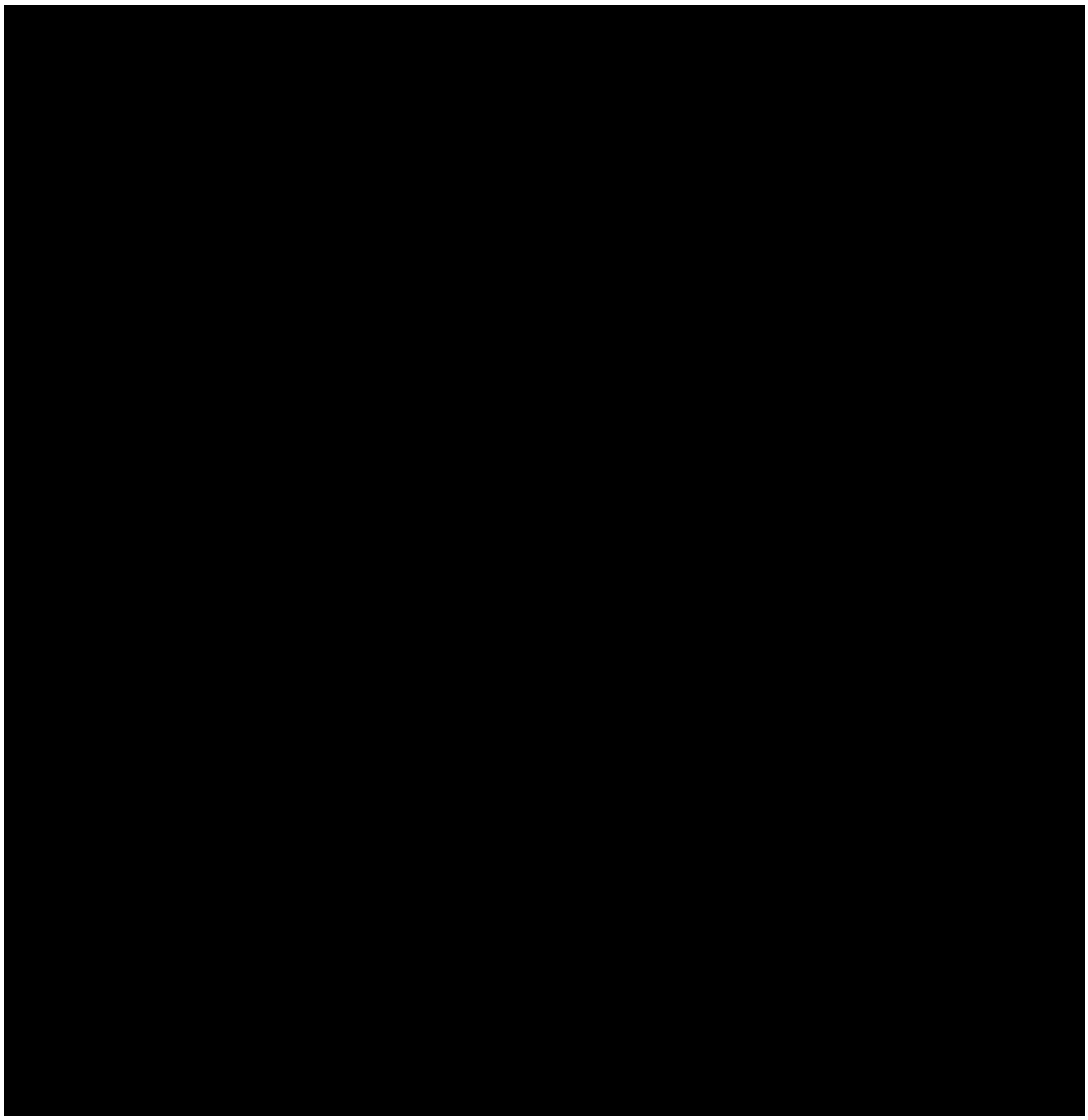
Subnational conservation status ranking (S-ranks) — One-hundred and eleven species (27.0%) on the Kaibab National Forest had rankings that merit conservation concern (S1, S2, S3, SX) at

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.



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				
Spea hammondii	Western Spadefoot	G3		
Birds				
Falco peregrinus anatum	American Peregrine Falcon	T3		Yes
Mammals				
Idionycteris phyllotis	Allen's Big-Eared Bat	G3		
Microtus longicaudus leucophaeus	White-Bellied Long-Tailed Vole	T3		
Microtus mogollonensis Navaho (Microtus mexicanus navaho)	Navajo Mexican Vole	T2		
Myotis occultus	Occult Little Brn. Myotis Bat	G3		
Ovis canadensis mexicana	Desert Bighorn Sheep	T3		
Sciurus aberti kaibabensis	Kaibab Squirrel	T3		
Plants				
Actaea arizonica (Cimicifuga arizonica)	Arizona Bugbane	G2		
Arenaria aberrans	Mt. Dellenbaugh Sandwort	G3		
Astragalus ampullarius	Gumbo Milkvetch	G2		
Astragalus cremnophylax var. hevronii	Hevron's Milkvetch (Marble Canyon Milkvetch)	T1		
Astragalus cremnophylax var. myriorrhaphis	Cliff Milkvetch	T1		
Astragalus rusbyi	A Milkvetch (Rusby's Milkvetch)	G3		
Castilleja kaibabensis	Kaibab Indian Paintbrush (Kaibab Paintbrush)	G2		
Chrysothamnus molestus	Arizona Rabbit-Brush (Tusayan Rabbitbrush)	G3		
Erigeron saxatilis	Rock Fleabane	G3		
Eriogonum mortonianum	Morton Wild Buckwheat	G1		
Eriogonum thompsoniae var. atwoodii	Atwood Wild Buckwheat	T1		
Hedeoma diffusa (Hedeoma diffusum)	Flagstaff Pennyroyal	G3		
Hymenoxys rusbyi	Ruby's Bitterweed	G3		
Pediocactus paradinei	Park Pincushion Cactus (Kaibab Pincushion Cactus)	G2		
Pediocactus peeblesianus var. fickeiseniae	Fickeisen Hedgehog-Cactus (Fickeisen Pincushion Cactus)	T1	Candidate	
Penstemon distans	Mt. Trumbull Beardtongue	G2		
Penstemon pudiflorus	Flagstaff Beardtongue	G2		
Penstemon [illegible]	Arizona Beardtongue	G2		

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.

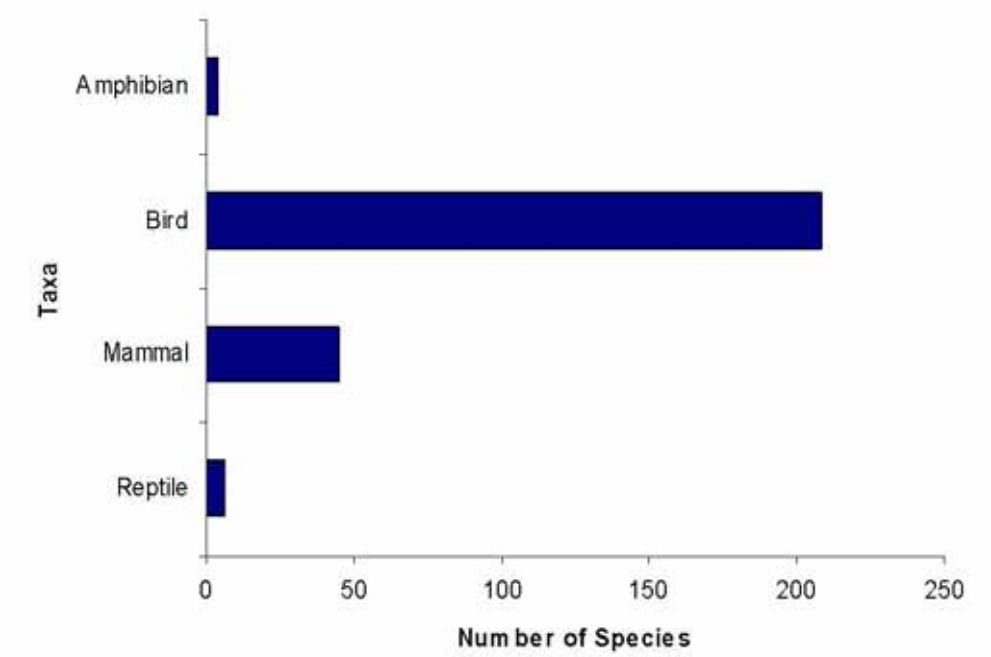


Figure 6-5. The number of potential species-of-interest, by taxa, that currently inhabit the Kaibab National Forest. Species were considered potential species-of-interest if they fell into one or more of the following categories: special state conservation status (WSC, HS, and SR in Arizona); listed 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 Cateory		
	#	%	#	%	#	%	#	%	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	62	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.
San Franscisco Peaks	W	93,500	23.6
Sycamore & Oak Creek Canyons	W	30,500	14.8

[a]NK = 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

[a]The Grand Canyyon 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

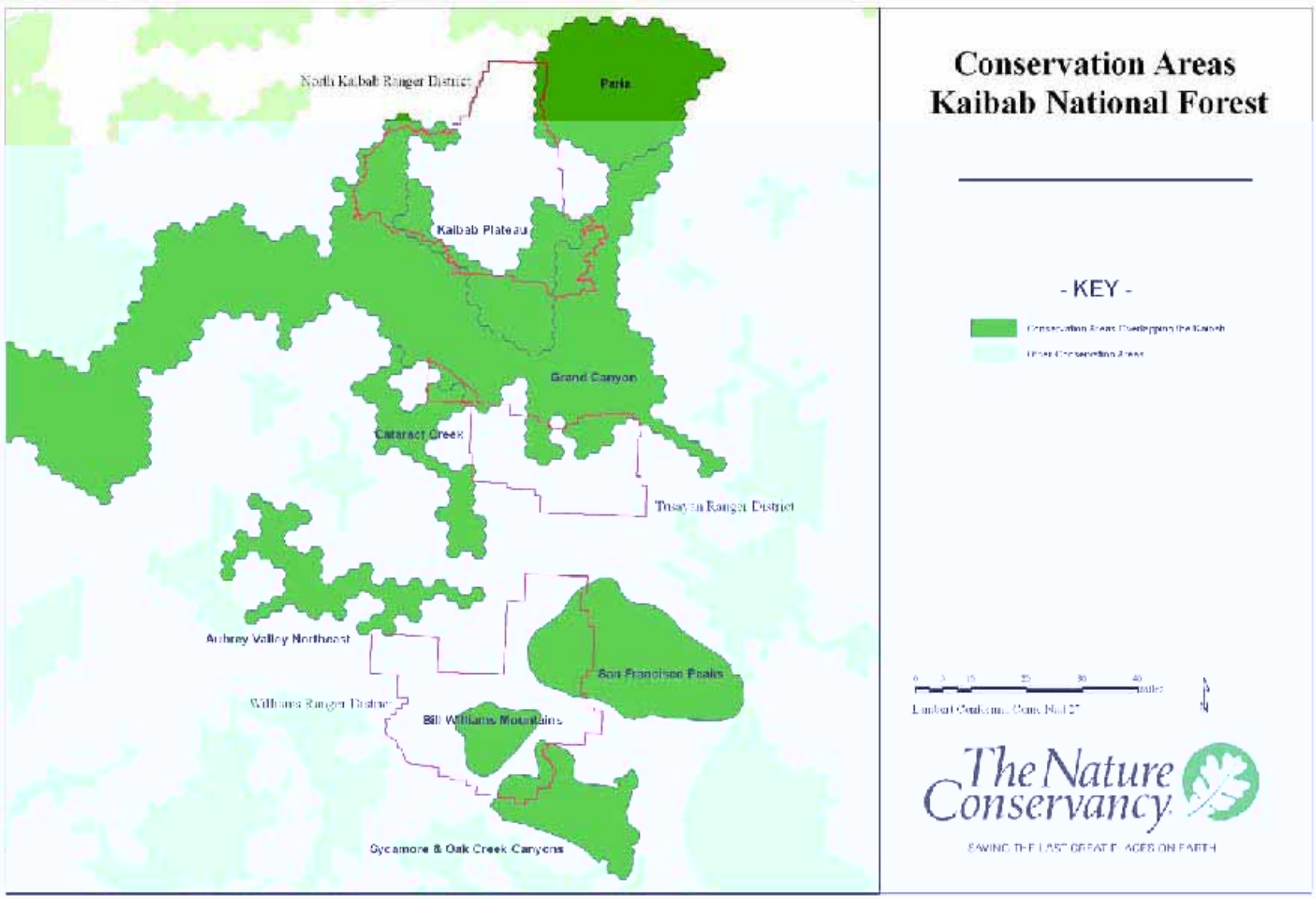


Figure 6-6. Conservation areas (N=8) that overlap the Kaibab National Forest in Arizona

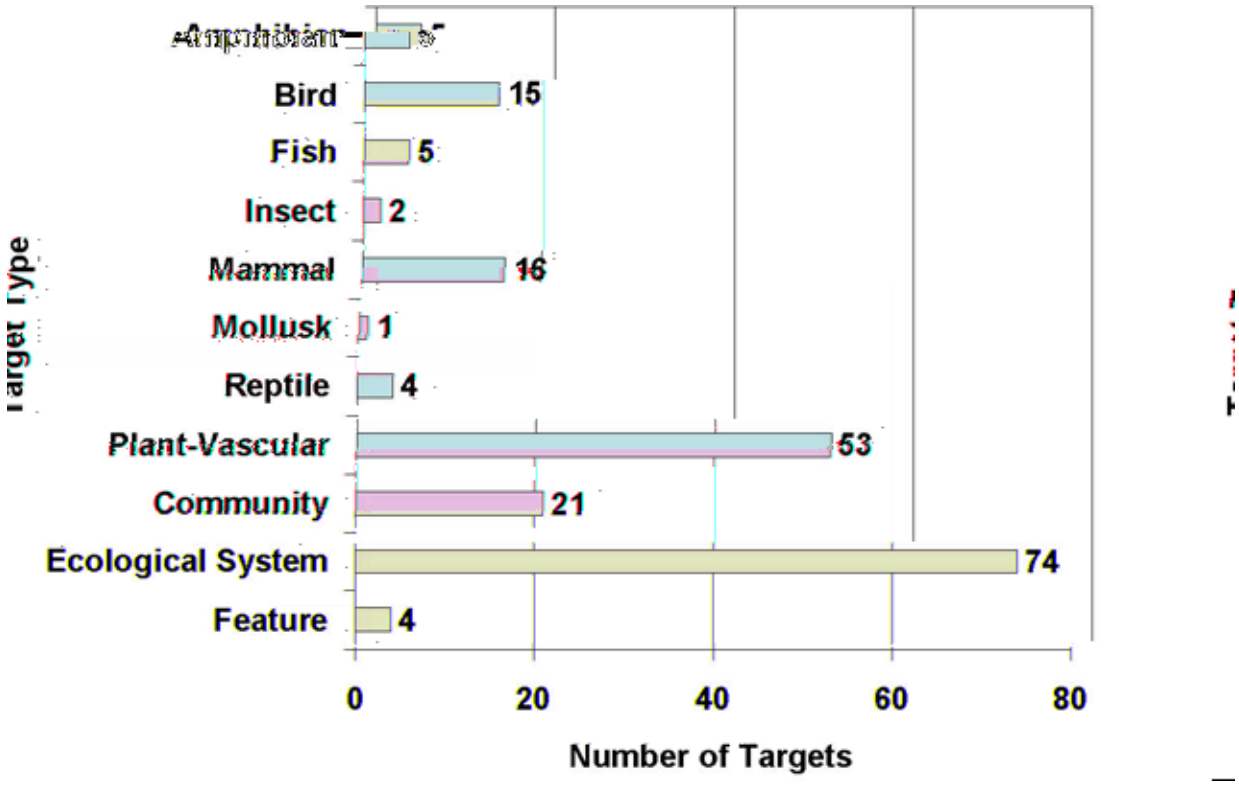


Figure 6-7. Number of conservation targets, by type, that occur on eight conservation areas overlapping the Kaibab National Forest in Arizona.

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.

	Habitat		
Conservation Area	Aquatic/Riparian	Terrestrial	Total
Aubrey Valley Northeast	3	2	5
Bill Williams Mountains	4	10	1104
Cataract Creek	5	5	
Grand Canyon	19	48	
Kaibab Plateau	7	15	
Paria	9	17	
San Franscisco Peaks	1	31	
Sycamore & Oak Creek Canyons	7	17	

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

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

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

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