

Arizona Partners in Flight Bird Conservation Plan

Marjorie J. Latta, Arizona Partners in Flight Co-chair
Carol J. Beardmore, Western Regional Coordinator, Partners in Flight
Troy E. Corman, Arizona Partners in Flight Co-chair
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EXECUTIVE SUMMARY

JUSTIFICATION

Continental and local declines in many bird populations have led to concern for the future of migratory and resident birds. The reasons for declines are complex. Habitat loss, modification and fragmentation, loss of wintering and migratory habitat, and brood parasitism have been implicated. In 1990, the National Fish and Wildlife Foundation brought together federal, state, and local government agencies, foundations, conservation groups, industry and the academic community to form a program to address the problem. Thus, Partners in Flight was conceived as a voluntary, international coalition dedicated to “keeping common birds common” and “reversing the downward trends of declining species.” The Arizona Working Group of Partners in Flight (APIF) developed this plan as part of the national Partners in Flight effort.

PURPOSE

Effective and efficient ecological management involves determining which species and habitats are most in need of conservation. This plan identifies priority species and habitats, and establishes objectives for bird populations and habitats in Arizona. The plan focuses on microhabitat requirements of priority species, but also identifies landscape scale requirements. Conservation actions are recommended and partnerships are identified to accomplish the objectives.

SCOPE

Of the more than 280 breeding bird species in Arizona, 43 priority species, in 13 major habitats are addressed here. Associate species that will benefit from management actions are listed with each priority species. Coordinating conservation by habitat enables land managers to efficiently focus on a set of priority birds and specific habitat characteristics they need.

OBJECTIVES AND STRATEGIES

Biological objectives are identified in each habitat to provide a target for ecological planning and implementation, and a benchmark for measuring success. Habitat strategies are identified to support the population objectives and describe the condition, amount and location of the habitat where management is needed.

EVALUATION OF PROGRESS

Research and monitoring needs are listed that relate directly to management questions. We intend this to be a dynamic document that will be revised as new information surfaces. Thus, we envision research and monitoring fulfilling a critical link in the adaptive nature of this plan.

COORDINATION

Many partners were instrumental in writing this document. However, coordination among existing and new partners is needed for the plan to succeed. Information in this plan can easily be linked with other landscape level management programs. Discussions regarding integration have already begun nationally with the North American Waterfowl Management Plan and Shorebird groups. International coordination is well under way with Canada and Mexico and coordination of projects across international boundaries is planned for the implementation phase. Although this plan is specific to birds, coordination with other species groups will progress from implementation.

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I. INTRODUCTION

Continental and local declines in many bird populations have led to concern for the future of migratory and resident bird species. The reasons for declines are complex. Habitat loss, modification and fragmentation, loss of wintering and migratory habitat and brood parasitism have been implicated. Scientists and the concerned public agree that a coordinated, cooperative conservation initiative focusing on nongame landbirds is needed.

In late 1990, the National Fish and Wildlife Foundation brought together federal, state, and local government agencies, foundations, conservation groups, industry and the academic community to form a program to address the problem. Thus, Partners in Flight (PIF) was conceived as a voluntary, international coalition of government agencies, conservation groups, academic institutions, private businesses, and citizens dedicated to “keeping common birds common” and reversing the downward trends of declining species. State working groups soon followed and Arizona Partners in Flight (APIF) was initiated in 1991. As with the national program, the APIF working group consists of participants from state and federal agencies, conservation groups, academic institutions, private organizations and individuals. APIF efforts are focused within Arizona, and with adjacent states and Mexico. The goals for APIF are the same as those of the national program: to direct resources to the conservation of nongame landbirds and their habitats through cooperative efforts in monitoring, research, management, education, and international cooperation.

Effective and efficient ecological management involves determining which species and habitats are most in need of conservation. This plan identifies priority species and habitats, and establishes objectives for bird populations and habitats in Arizona. The plan focuses on microhabitat requirements of priority species, but also identifies landscape scale requirements. Conservation actions are recommended and partnerships are identified to accomplish the objectives.

Partners in Flight bird conservation plans are being written for all western states and are intended to complement the successful North American Waterfowl Management Plan and the recently initiated National Shorebird Conservation Plan and North American Colonial Waterbird Conservation Plan. Resident game birds are often not covered by these plans because their needs are being met by state agencies and conservation groups. However, it is ecologically and economically sensible to coordinate with representatives of other bird groups when implementing actions. Discussions of waterfowl, shorebirds, colonial water birds and/or resident game birds may be included in these plans as they contribute to the ecological picture of the landbird or habitat being addressed.

Partners in Flight recognizes there are gaps in our knowledge of Arizona’s birds. However, our intention is to assemble the best and most current scientific information into a format that land

managers and landowners can use to put ideas into action. When new information becomes available it will be incorporated into this plan. Thus, we consider this a dynamic document in which adaptive management will play a large role.

This Bird Conservation Plan was developed by many people offering input in planning meetings and as reviewers. Planning meetings were held by State Chairs and focused on habitat groups functioning under the umbrella of the Western Working Group of the U.S. Partners in Flight program. Planning meetings were open to anyone who had an interest in bird conservation and were designed to solicit information that would form the core of the plan. An important result of planning meetings was to capture scientific data and personal observations that were not available in the scientific literature. This information is especially important because local variations can dictate different needs and approaches.

II. STATE OF KNOWLEDGE OF ARIZONA BIRDS

A. Historical Perspective

Arizona has long attracted naturalists and been known as one of the premier birding areas in North America. The juxtaposition of multiple biogeographic provinces creates a complex natural environment that supports a diverse avifauna. Not surprisingly, a tremendous wealth of information has been collected on Arizona's birds.

The first published descriptions of Arizona avifauna date back to the mid 1800s and are based on collections made by U.S. Government expeditions. Although the primary purpose of these expeditions was to determine boundaries, find railroad routes or assess geological wealth, the government was also interested in documenting the region's biotic resources. The expeditions always had naturalists, physicians and surgeons (often one person) who collected and catalogued biological specimens and kept detailed notes on the plants and animals encountered on these explorations.

Biological inventory of the Southwest was underway as early as 1820, when naturalists such as Thomas Say (now honored by Say's Phoebe) accompanied an expedition through what is today New Mexico. In the mid-1840s, the United States expanded its boundaries westward, acquiring new lands that had to be surveyed, mapped and described. At this point, military expeditions began in earnest (Brown and others 1994). S.W. Woodhouse reported on birds seen along the Colorado River as part of Captain Sitgreaves' topographical survey of northern New Mexico and Arizona (Woodhouse 1853). Kennerly and Mollhausen, physicians and naturalists attached to the survey of the Pacific Railroad Route, described "new" birds collected between Albuquerque, NM and San Francisco, CA during the winter of 1853-54 (Baird 1854). Baird described "Birds of the Boundary" in the zoology report for the United States and Mexican Boundary Survey (Baird

1859). Henry Henshaw, the ornithologist of the George Wheeler Geographic Survey West of the 100th Meridian, reported on bird collections made in 1871-1874 in the Southwest, including Arizona (Henshaw 1875). Edgar Mearns served as physician-naturalist with the International Boundary Commission from 1892-94. Although Mearns was primarily interested in mammals, he described the overall biota (Mearns 1907).

By the late 1800s, general exploration surveys ended. Thereafter, most surveys were restricted to geographic areas for which there was little biological knowledge. This marked the beginning of the collecting period. Many collectors were assigned to field stations by the Smithsonian Institution. One such collector was Elliott Coues, a surgeon in the U.S. Army assigned to Fort Whipple (north of Prescott, AZ) in 1864. Coues' assignment was to collect and prepare specimens of wildlife from the Rio Grande to the Colorado River. His publications, including one on the birds of Fort Whipple (Coues 1866), were among the first scientific papers on southwestern wildlife. C. Hart Merriam, M.D., was part of the Death Valley Expedition of 1891. The Expedition's ornithological report included notes on birds observed in parts of northwestern Arizona (Fisher 1893b).

Many natural history studies of birds were conducted in Arizona in the late 1800s and early 1900s. One landmark study, C.H. Merriam's biological survey of the San Francisco Mountain region, which reported on the distribution of species from the alpine zone to the desert of the Little Colorado River (Merriam 1890). Ornithological studies were occurring around the state, including work in the Catalina Mountains (Scott 1886), Huachuca Mountains (Swarth 1904), Santa Rita Mountains (Bailey 1923), San Francisco Mountain region (Hargrave 1932) and Grand Canyon (McKee 1936). Swarth (1929) and Phillips (1939) designated "faunal areas" in Arizona on the basis of birds. Later, Brandt (1951) described the birds and habitats of southeastern Arizona. Since then, studies too numerous to describe here have been conducted on Arizona's birds.

Only two bibliographies of the ornithological work done in Arizona have been published. Swarth (1914) compiled the first list of publications relating to Arizona ornithology, about 300 titles from the mid 1800s to 1913. Anderson (1972) updated Swarth's early effort.

The first thorough compilation of Arizona's avifauna was published in the mid-1960s (Phillips and others 1964). "The Birds of Arizona" remains the only full treatment of Arizona's birds. Phillips and others (1964) critically reviewed and reported all bird records for the state and revealed important information gaps. Recently, Glinski (1998) assembled current knowledge on the 42 Arizona raptors. The Arizona Breeding Bird Atlas project, conducted by the Arizona Game and Fish Department, is in progress. The results of this systematic statewide project will provide the most comprehensive and up-to-date information on all of Arizona's breeding birds.

Many of Arizona's diverse and unique habitats have been surveyed and studied for birds. Below are two lists of some of the larger or more community based studies in the state, either ongoing or

completed, where detailed information can be found on specific areas in Arizona. A brief description of each study can be found in Appendix G.

B. General Inventory Studies and Publications

1. The Birds of Arizona (Phillips and others 1964)
2. The Annotated Checklist of the Birds of Arizona (Monson and Phillips 1981)
3. Arizona Breeding Bird Atlas (AZ Game and Fish Dept.)
4. SPARC (San Pedro Avian Resources Conservation, BLM Sierra Vista)
5. Birds of the Lower Colorado (Rosenberg and others 1991)
6. Grand Canyon Birds (Brown and others 1987)
7. Grand Canyon riparian birds (Sogge and others 1998)
8. Birds of the Northern Black Mesa (C. LaRue)
9. Sensitive species locality information for Arizona (HDMS AGFD)
10. SE Arizona grasslands bird study (C. Bock)
11. Winter grassland bird study (C. Gordon).
12. Birds of the Sky Islands (B. Block)

C. General Long-term Surveys

1. Breeding Bird Survey Routes
2. Christmas Bird Counts (National Audubon Society)
3. Raptor Counts (Hawk Watch International)
4. San Pedro MAPS station (Bureau of Land Management)
5. Urban Raptor Surveys (AGFD Region VI)
6. BBird Sites (Breeding Biology Research and Monitoring Database, USFWS)

D. Research, Inventory and Monitoring Needs

Identifying gaps in information is part of the Partners in Flight planning process. For each of the priority species chosen in the plan, a list of recommended research was made. Included in the research recommendations are inventory and monitoring needs where necessary. Lists from each of the states in the Western Working Group of Partners in Flight were combined to help researchers better understand where information gaps are for priority birds across the West. Research questions will be posted on the National Partners in Flight web page for access on the world wide web. This widespread access presents an excellent opportunity for graduate students and other researchers to focus on gathering information that can be directly applied to the conservation of these species. Universities in the West will be provided a list of recommended research as state plans are completed.

III. BIRD PRIORITIZATION

A. Purpose

Effective and efficient ecological management involves determining which species and habitats are most in need of conservation. The Arizona Partners in Flight (APIF) species prioritization process was designed as a tool for this important task. Priority species selected for discussion in the present version of the Arizona bird conservation plan were chosen using a prioritization process (described below) as the initial scoring tool, and the knowledge of local experts to refine the priority list. We recognize that there are gaps in our knowledge of Arizona birds. However, we intend the Arizona bird conservation plan to be a “dynamic and ever changing” document that will continually incorporate new information.

Partners in Flight initially focused on only neotropical migratory birds or birds that migrate from North American breeding grounds to wintering areas in Mexico and Central and South America. As the national program has progressed, emphasis has expanded to include all breeding, wintering, and resident landbirds. Migratory waterfowl and shorebirds are not currently included in the APIF Bird Conservation Plan. Waterfowl conservation needs are presently being addressed by other conservation groups. How other groups’ efforts relate to the APIF goals will be discussed in section VI of this plan.

Following the national Partners in Flight expanded emphasis, the Arizona plan concentrates on the birds that will be most positively influenced by management as well as those species with the greatest immediate threat of extirpation. In many cases, management of habitat groups will provide protection for suites of priority species and allow land managers to participate in critical conservation. This approach often results a lesser financial burden than single-species management practices.

B. Process and Rankings

The APIF Inventory and Monitoring subcommittee developed 11 criteria to prioritize bird species most in need of conservation efforts. The criteria are a combination of six national PIF criteria and the five criteria developed by the APIF Inventory and Monitoring Subcommittee. The criteria included Arizona-dependent and Arizona-independent factors. The Arizona-independent criteria are constant over a species’ range and do not vary by species. The Arizona dependent criteria were ranked by the APIF Inventory and Monitoring Subcommittee.

Population trend, one of the national criteria (but not used here), was based on data from Breeding Bird Survey (BBS) routes conducted since 1970. The national population trend scores were not used in Arizona’s prioritization process because of inadequate BBS routes in Arizona prior to 1991. To create a ranking of priority species more representative of the current status of birds in

the state, state experts were assembled and together generated new population trend scores for each of Arizona's landbirds. Priority species that occur peripherally in Arizona, but have stable populations in the core of their ranges, will be recommended for a “monitor” list.

Criteria

Within each criterion, a species was given a rank score ranging from one to five, with one being the least critical rank and five the most critical. Definitions for each of the scores can be found in Appendix A. All of Arizona's native landbirds were scored using this prioritization process.

The 11 criteria designated for Arizona's ranking process are:

1. **Relative Abundance (RA)** - the abundance of a bird, in appropriate habitat within its entire range, relative to other bird species. This criterion gives an indication of a species' vulnerability to cataclysmic environmental changes. A low score would indicate a higher relative abundance, therefore reducing the risk of complete extirpation from losses in one or more regions. Higher scores indicate a lower relative abundance, thus more vulnerability to drastic losses or population changes. This criteria was used for both wintering and breeding bird ranks.
2. **Arizona Abundance (ABA)** - This criterion gives the same measure of vulnerability as in relative abundance but solely within Arizona's state boundaries. The true abundance of many of Arizona's birds is not known, however, scores were generated using available abundance information within preferred habitats. Used for breeding birds only.
3. **Breeding Distribution (BD)** - Overall breeding distribution. High scores indicate localized breeding, thus a higher likelihood of serious decline from drastic environmental changes. Low scores indicate wide breeding distribution, therefore less likelihood of extirpation. Used for breeding birds only.
4. **Arizona Breeding Distribution (ABD)** - Similar to breeding distribution, but within Arizona state boundaries. Used for breeding birds only.
5. **Winter Distribution (WD)** - Overall winter distribution. This criterion is similar to those of breeding distribution. Used for wintering and resident birds only.
6. **Arizona Winter Distribution (AWD)** - Similar to winter distribution but within Arizona state boundaries. Used for wintering and resident birds only.

7. **Threats on Breeding Grounds rangewide (TB)** - Two factors are considered here: ecological specialization (including future threats) and habitat loss/disruption. This is described as a combination of the amount of habitat (or conditions necessary for survival and reproductive success) that has been lost in the past (since the late 1940s) with the amount that is anticipated to be lost in the future. High scores indicate either a large loss of habitat or a species that is an extreme ecological specialist. Low scores indicate a stable or increasing habitat or a species that is an ecological generalist. Used for both breeding and wintering birds.
8. **Threats on Breeding Grounds in Arizona (TBA)** - Similar criterion to those of threats on breeding grounds rangewide, but within Arizona boundaries.
9. **Threats - Non-breeding (TW)** - Similar criterion to breeding grounds. Used for wintering birds only.
10. **Threats on Winter Grounds in Arizona (TWA)** - Similar to threats on breeding grounds in Arizona. Used for wintering birds only and their wintering grounds in Arizona.
11. **Importance of Arizona to each species (IA)** - High scores in this category indicate that a large proportion of a breeding range occurs within Arizona, or a species is using a habitat that is only available in Arizona. Used for both breeding and wintering birds.

Species Rank

Based on the scoring process within each of the 11 prioritization criteria, a ranked list of all of Arizona's native landbirds was developed (Appendixes A, B, C, and D). Species were divided into two lists: breeding and wintering. Birds that scored equally are listed together and separated from the next rank by a double line.

C. Priority Species

Method of Selection

Priority bird species in Arizona were selected using first the prioritization scheme and second by qualitative, informed decisions based on local expert input. Based on the criteria described in Appendixes A and C, the highest score a bird could receive in the prioritization process would be 40 for breeding birds (8 criteria times the highest score of 5) and 35 for wintering birds (7 criteria times the highest score of 5). Breeding and wintering birds that scored 20 or higher were selected initially for consideration as priority species. This resulted in a preliminary list of potential

priority bird species or the top 45% of breeding and wintering birds from the lists in Appendix B and D.

From these two lists, the APIF Inventory and Monitoring Subcommittee assigned each species to one or more of Arizona's habitat groups. After habitat groups were defined (described in section IV), the highest priority species within each habitat group were discussed and selected during APIF meetings.

The PIF priority bird lists are not produced to replace the Federal Endangered Species list. Rather, they are intended to be used as a tool by government agencies and conservation organizations to help prioritize bird species that should be considered in Conservation Agreements.

D. Research, Inventory and Monitoring Needs

Prioritization of Arizona's birds will be reevaluated as new information is learned. Major revisions to the prioritization scores will be conducted approximately every five years. However, amendments may be made at any time. As research questions are answered, and monitoring efforts increase, our knowledge about the status of birds will undoubtedly increase and prioritization scores will change.

IV. HABITAT

A. Habitat Naming Scheme

In the West, vegetation associations are mostly uniform within specific habitats and as most things in nature, do not end at state boundaries. Many of the states within the Western Working Group (WWG) region have habitats in common, with the exception of certain habitats in California and Alaska. To coordinate across boundaries and strive for similar biological objectives for shared species, the WWG partners developed a common, general nomenclature for habitat groups. Each state in the WWG will define the habitat categories with the specific differences in their state but will base their hierarchies on the Western Working Group habitat headings.

Extensive habitat classification at the community and association level was defined in the Southwest by Brown (1980) (Fig.1). This is the most complete and comprehensive classification of habitats available today and was used in conjunction with the WWG habitat categories to define the Arizona Partners in Flight habitat groups. Figure 1 can assist in locating APIF habitat categories on the ground. A crosswalk between APIF habitat types and Brown and others (1979) biotic communities is provided in Appendix E. Arizona habitat groups and a brief list of the key plant species, are shown in Table 1. Scientific names of plant species are listed by habitat type in Appendix F.

B. Priority Habitat Selection

In an effort to be more effective with on-the-ground management, a subset of priority habitats was selected for the initial version of the Arizona plan. Selection was based on several criteria as well as the personal knowledge of local experts. The following criteria were considered for the initial habitat selection: historical loss, conversion of native habitat, availability of data, remaining habitat, potential for beneficial management, number of high priority species, current and historical land use, importance to breeding and wintering birds, and value to Arizona to avifauna. The priority habitats selected were: Low Elevation Riparian, High Elevation Riparian, Desert Grasslands, and Pine. Other major Arizona habitats were added after the initial selection and are identified in the body of this plan. Priority species were selected for all major habitats in Arizona.

C. Species Link with Habitats

Of the list of high ranking species, a subset of priority species was selected on which to concentrate for the initial version of Arizona's plan. In addition to the prioritized species criteria (Appendixes A and C), several other factors were considered when selecting our target species such as the knowledge of local experts and the complexity of the habitat. Structural components act as subsets of the larger habitat and can attract a different set of bird species. More complex

habitats, such as riparian and forested habitats, will have more components, and therefore may have more representative bird species than less complex habitats, such as grassland. In habitats where structural diversity is lower, priority scores and local knowledge were primarily used to identify priority species.

Figure to be added later

Figure 1. Biotic Communities in Arizona after Brown and Lowe (1980).

Table 1. Arizona Partners in Flight Habitat Group Descriptions

APIF HABITAT HEADINGS	KEY PLANT SPECIES
FORESTS AND WOODLANDS	
Spruce-Fir	Engelmann spruce, corkbark fir, Douglas-fir, white fir, bristlecone pine, aspen
Mixed Conifer	blue spruce, Engelmann spruce, white fir, subalpine fir, corkbark fir, southwestern white pine (limber pine), ponderosa pine, Douglas-fir, aspen
Aspen	aspen
Pine	ponderosa pine matrix (may include some Douglas-fir, Gambel oak, pinyon pine and/or juniper, aspen and white fir)
Pinyon-Juniper	pinyon pine and/or juniper, (may include Rocky Mountain juniper, Utah juniper, one-seed juniper, alligator juniper, California juniper, Rocky Mountain pinyon, single-leaf pinyon , Mexican pinyon), Arizona cypress
Pine-Oak (Madrean)	Chihuahuan pine, Apache pine, ponderosa pine, alligator bark juniper, pinyon pine, Gambel's oak, Emory oak, silver-leaf oak
SHRUBLANDS	
Desertscrub 1. Mohave 2. Sonoran 3. Chihuahuan	Joshua tree, creosotebush, saltbush saguaro, mesquite, ironwood, paloverde, creosotebush, jojoba, crucifixion-thorn acacia, brittlebush whitethorn acacia, creosotebush, tarbush, soap-tree yucca
Cold Desertscrub	sagebrush, blackbrush, shadscale, greasewood
Chaparral	shrub live oak, manzanita, mountain-mahogany, cliffrose
GRASSLANDS	
Desert Grasslands	semidesert grassland (scattered sotol, agave, yucca, mesquite), Sonoran savanna grassland (scattered mesquite, ironwood, paloverde)
High Elevation Grasslands	sub-alpine, montane meadows (graminoids, bunchgrasses, perennial forbs, Bitterbrush), Great Basin grassland (w/scattered PJ), plains grassland (buffalograss, sagebrush, rabbitbrush, western wheatgrass, indian rice grass, grama, dropseeds)
WETLANDS	
Riparian Wetlands Forested/Woodland a. low elevation (<4,000 ft) b. high elevation (>4,000 ft) Other Wetlands 1. Freshwater Marshes 2. Open Water	cottonwood, willow, mesquite, walnut, ash, hackberry, seepwillow, some tamarisk, arrowweed; also includes vegetated desert (mesquite, ironwood, paloverde) washes sycamore, narrow-leaf cottonwood, willow, dogwood, ash, walnut, box elder, alder, aspen, shrubby cinquefoil; includes scrub willow marshes, cienegas, lake and pond edges (duckweeds, cattail, rushes, sedges) reservoirs, lakes, rivers

APIF HABITAT HEADINGS	KEY PLANT SPECIES
ALPINE	tundra, alpine meadows, boulder fields (above 11,000 ft) (golden avens, bristlecone pine, corkbark fir, Engelmann spruce, gooseberry currant)
CLIFF/ROCK/BARE GROUND	cliff, canyon wall, rock outcrop, talus slope, sand dune
URBAN/AGRICULTURAL	residential (ornamental plantings, yards, ponds, lakes, and canals), parks (city parks, golf courses, cemeteries), rural (scattered farm buildings, shelterbelts, sewer and settling ponds, pastures, feedlots), cultivated woodlands (orchards, tree farms), crop land, disturbed areas (plowed fields, fallow fields, bulldozed land)

D. Habitat History, Current Condition and Management

Historical changes in habitat and its current condition are addressed in the habitat summaries. Present management practices and historical information were considered when conservation recommendations were made for each priority species. Habitat strategies are identified to facilitate achieving population objectives. Habitat strategies identify the necessary condition, amount and configuration of the habitat to best support the priority species. Positive changes in habitat health are already visible in several areas of the state where habitat management has been a primary focus. Some areas along the San Pedro and Lower Colorado River have been successfully rehabilitated into healthy, productive riparian areas. Monitoring of optimal bird habitat will be necessary to keep an accurate assessment of current conditions and appropriate management actions.

E. Research, Inventory and Monitoring Needs

Although Arizona benefits from several statewide landscape level habitat studies (Brown and others 1979), there remains a need to have more detailed habitat assessments especially on secondary riparian habitat and habitat conditions in urbanizing areas. In some instances, it may be necessary to do an inventory of the habitat to get a more accurate idea of what exists in relation to what is needed. For example, a complete inventory should be done for riparian habitat, including remote sensing data and/or aerial photography comparisons, to identify how much riparian habitat exists and which areas of the state need the most aggressive management. Current landscape level mapping tools, such as Geographic Information Systems (GIS), are effective in assessing the amount of extant habitat but cannot assess the condition. An accurate evaluation of habitat condition, especially for riparian, grasslands and forests, is needed. In some instances, ground truthing may be necessary along with remote sensing to acquire the best information possible. As growth continues at a rapid pace in Arizona, monitoring trends in land use statewide, especially in urbanizing areas, is also suggested. Research, inventory and monitoring needs specific to each habitat are given in individual chapters.

V. PRIORITY BIRD SPECIES BY HABITAT; INFORMATION AND RECOMMENDATIONS

A. *Spruce-Fir Habitat*

1. Habitat Description, Status and Importance

Dominant tree species in the spruce-fir habitat type include Engelmann spruce, subalpine fir, corkbark fir, Douglas-fir, white fir, bristlecone pine, blue spruce, and aspen. Dwarf juniper, red elderberry, creeping mahonia, currant, raspberry, snowberry, shrubby cinquefoil, Fendler ceanothus, and smooth sumac are found in the sparsely vegetated shrub layer (Pase and Brown 1982a, Pase and Brown 1982b).

The area of the Petran Subalpine Conifer Forest and Petran Montane Conifer Forest types as calculated from the Brown and others (1982) cover map totals 2,003,641 ha (4,950,929 ac) (Brown 1982). Douglas fir acreage in Arizona is approximately 52,611 ha (130,000 ac), while the mixed spruce-fir type is approximately 44,517 ha (110,000 ac). Aspen stands are roughly 31,971 ha (79,000 ac) and wet meadows total 6,030 ha (14,900 ac)(Spencer 1966).

The spruce-fir type is found on the Kaibab Plateau, San Francisco Peaks, White Mountains, Chuska Mountains, Mogollon Rim, and in the highest elevations of southeastern Arizona (Neff and others 1979). This habitat type occurs from about 2000-3800 m (6600-12,500 ft) depending on latitude, but is best represented from 2300-3500 m (7500-11,500 ft) (Pase and Brown 1982a, Pase and Brown 1982b).

These areas are much colder and wetter than most other habitats in Arizona. They accumulate anywhere from 460-1000 mm (18-37 in) of annual precipitation, with the lower elevation montane conifer forest receiving this moisture primarily during the growing season as rain. The precipitation in higher elevation subalpine conifer forest occurs as 60% snow during the winter months. The frost-free growing season ranges from 75-120 days (Pase and Brown 1982a, Pase and Brown 1982b, Spencer 1966). These environmental conditions support a unique assemblage of flora and fauna, including the most southern range extensions for many species more common to the north.

Historical uses of this type include commercial logging, livestock grazing and recreation. Douglas fir and Engelmann spruce represent 5% each of saw timber volume (Spencer 1966). True firs represent only 3% of saw timber volume (Spencer 1966). Livestock grazing occurs throughout these areas but cattle concentrate their use in wet meadows, aspen stands, and on edges of closed canopy forest stands. Recreational activities primarily include hunting, camping, and hiking which take place during the spring, summer, and fall. There are also several ski areas in this habitat type, adding winter season recreation.

Since most of this habitat type is under public ownership and managed by the U.S. Forest Service, the potential for conservation action could be high if multiple use mandates are accommodated.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in spruce-fir habitat. A table at the end of the Spruce-Fir section highlights species habitat needs in a quick reference format (Table 2).

SWAINSON'S THRUSH (*Catharus ustulatus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for Swainson's Thrush are: Red-naped Sapsucker, Three-toed Woodpecker, Gray Jay, Mountain Chickadee, House Wren, Hermit Thrush, American Robin, Dark-eyed Junco, Pine Grosbeak, Red Crossbill, Pine Siskin.

Distribution: Swainson's Thrushes are high elevation birds, typically found in coniferous forests throughout their range during the breeding season. Their summer range includes Alaska, south across Canada to Newfoundland, and in the lower contiguous United States in the northeast (Maine to West Virginia) and in the west, from Colorado and Montana west to California and south through the intermountain forest region (Terres 1996). In Arizona, the Swainson's Thrush is a rare (though at times locally common) summer resident of the cork-bark fir forest in the San Francisco Peaks area and in the White Mountain region (Monson and Phillips 1981). It is a fairly common spring migrant throughout the state, particularly in the south and west, arriving from its winter range of southern Mexico and Argentina (Terres 1996). A rarely-sighted fall migrant, with most records occurring along the southern border, chiefly in upper elevations of basin and range mountains (Monson and others 1964).

Ecology: Swainson's Thrushes begin their migration north from Central and South America in April, and pass through Arizona between April and June. They glean food from the forest floor, foliage, and branch surfaces, eating insects, spiders, fruits, berries, beetles, and worms (DeGraaf and others 1991, Terres 1996). A cup nest is usually constructed of twigs, sedges, mosses, ferns, and leaves, lined with lichens and dead leaves (Terres 1996). Nests are located 2-20' above ground, most often on a horizontal branch close to the trunk of a small coniferous (at times deciduous) tree or bush. At times, willows are used for nest locations. Swainson's Thrushes are rare cowbird hosts (Terres 1996).

Habitat Requirements: Swainson's Thrushes typically prefer coniferous forests, but will use high elevation willow and/or alder thickets along lowlands/shaded streams and aspen forests.

Nesting has been documented in alder-scrub willow thickets near Greer (AGFD in prep.) Preference is given to damp forests or forests adjacent to water. Such habitats provide proper nesting habitat and summer nutritional needs. Alternative habitats include willow/alder thickets, aspen forests, and other deciduous trees along streamsides. Understory and forest floor habitats are important for nesting and feeding respectively; other structural habitat requirements include dense clumps of vegetation, multiple forest layers, downed logs, and the presence of a herbaceous layer.

Habitat and/or Population Objectives:

Population Objective

1. Maintain current distribution in subalpine/corkbark fir forests in the White and San Francisco Peaks.

Habitat Strategy

1. Maintain dense herbaceous and shrub layers in moist subalpine-fir forests.
2. No net loss of moist subalpine-fir forest with dense herbaceous and shrub layers.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Modification of habitat from thinning projects may be detrimental to Swainson's Thrush if treatment results an evenly spaced forest without dense clumps of trees. Timber harvesting may be a threat to local populations in the Chuska Mountains (AGFD in prep.). Other threats to this species include thinning fires that remove understory and floor structure and catastrophic fire in mixed-conifer forests. Grazing that reduces the herbaceous layer and seedheads, thereby reducing insect populations can eliminate a critical food source for Swainson's Thrush. Livestock and elk overgrazing of riparian regeneration may also cause threats to Swainson's Thrush habitat, especially in the White Mountain drainages in Arizona (AGFD in prep.). Expansion of recreational development, such as ski areas, may also pose a threat to this species.

Swainson's Thrush management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss and/or Modification:

1. Incorporate irregular thinning, leaving random clumps of dense saplings or of vegetation in lower to middle forest layer.

Fire:

1. Prescribed fire should incorporate mosaic of treatments, leaving scattered untreated areas and associated floor debris (i.e. logs).
2. Use appropriate prescribed fire management and where feasible, fuel reduction practices to reduce risk of catastrophic fires.

Grazing:

1. Incorporate grazing utilization standards where necessary to maintain herbaceous layer and seed heads that support insects for Swainson's Thrush diet.

Recommended Research:

1. Determine most critical nesting and foraging habitat components in Spruce-Fir forests.
2. Determine whether Spruce-Fir is the most critical habitat or most highly used habitat for Swainson's Thrush in Arizona.
3. Estimate populations.
4. Conduct surveys to determine presence/absence in areas of the state with known Swainson's Thrush habitat.

PINE GROSBEAK (*Pinicola enucleator*)

Associated Species: Other species that may use similar habitat components or respond positively to management for Pine Grosbeak are: Northern Saw-whet Owl, Broad-tailed Hummingbird, Gray Jay, Clark's Nutcracker, Red-breasted Nuthatch, Ruby-crowned Kinglet, American Robin, Dark-eyed Junco, Red Crossbill, Pine Siskin.

Distribution: Pine Grosbeaks are residents of boreal forests of northern Europe, Russia, Alaska, Canada, and western United States. In the United States, they breed along the Rocky Mountains south to Arizona. They are uncommon permanent residents in the coniferous forests of the White Mountains, and they have also been documented in the Sierra Anchas and the Santa Catalina Mountains outside of the breeding season (Ward 1993). Breeding in Arizona has been primarily recorded in the White Mountains. Winter sightings also include two from the south rim of the Grand Canyon (Monson and Phillips 1981, Phillips and others 1964). Pine Grosbeaks move southward only in times of food scarcity, not, as commonly thought, due to severe climatic conditions (Terres 1996). They are not regular migrants.

Ecology: As described by their scientific name (*enucleare* = take kernels out), this largest grosbeak removes seeds from pine cones or shells. Pine Grosbeaks usually forage in trees; at times they will feed on the ground. Primary foods include seeds and buds from pines,

firs, maples, spruces, and grasses; fruit (berries, crabapples); mast; and insects (grasshoppers, caterpillars, beetles, flies) (Terres 1996). They will flock at times outside of the nesting season. In flocks, they tend to favor more open conditions, occasionally using juniper trees for their food source (berries) in winter (Terres 1996). Food can be stored in gular (throat) pouches, unique to grosbeaks.

Pine Grosbeaks nest in spring. Evidence of nesting has been found in early June in the White Mountains (ABBA, unpubl.data). Nests are loose, open, and constructed of twigs. They are often lined with grass or other soft material (lichens, rabbit fur). Placement of nests is usually in the crotch of a fir or spruce tree, and at times a shrub, 6-30' above ground level, in thick foliage (Terres 1996). Females lay two to six eggs in May or June and incubate them for 13-14 days. Juveniles fledge at approximately 20 days post hatch (Ward 1993).

Habitat Requirements: Pine Grosbeaks are primarily residents of spruce-fir forests, but are known to spend their summers along borders between openings and coniferous woods adjacent to streams and ponds and at times along the edges of fields (Terres 1996, Ward 1993). Preference is given to coniferous stands with large trees and low to intermediate canopy cover, usually near an edge (DeGraaf and others 1991). In winter, they may also be found south of their breeding range, in deciduous woodlands, in fruit trees, or at bird feeders. They will descend to feed in lush meadows; though they are usually observed perched on the topmost spire of a tall spruce (Phillips and others 1964).

Habitat and/or Population Objectives:

Population Objective

1. Maintain the current distribution in Spruce-fir habitat in the White Mountains (Mt. Baldy) of Arizona.

Habitat Strategy

1. Maintain Spruce-fir forests near water and edge in stands of large conifers with low to intermediate canopy cover and high structural heterogeneity.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The Pine Grosbeak is not listed by the U.S. Fish and Wildlife Service as being in jeopardy or likely to become threatened. It was listed in the AGFD's *Threatened Native Wildlife in Arizona* (1988); this document has been replaced by the Department's *Wildlife of Special*

Concern in Arizona (1996, draft) and the Pine Grosbeak is no longer listed. Although threats to its primary habitat are suspected, substantial population declines from historical levels have not been documented (Ward 1993). The biology and status of this species in Arizona's coniferous forests is not well known. Catastrophic wildfires that remove overstory of cone-producing trees are a risk to Pine Grosbeaks as well as logging operations that remove mature trees. The impacts of various timber harvest and management practices on grosbeak habitat requirements and nesting success need to be determined. Important breeding areas need to be monitored to ensure long-term stability of populations. Natural history information is lacking for this species in Arizona and it is suggested that research be conducted to determine habitat and foraging needs and breeding chronology.

Pine Grosbeak management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss:

1. No large scale removal of overstory Engelmann spruce.
2. Promote management actions that reduce fire risk.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research:

1. Collect natural history information for Arizona (habitat, foraging needs, breeding chronology).

GOLDEN-CROWNED KINGLET (*Regulus satrapa*)

Associated Species: Other species that may use similar habitat components or respond positively to management for Golden-crowned Kinglet are: Red-naped Sapsucker, Steller's Jay, Mountain Chickadee, Red-breasted Nuthatch, Ruby-crowned Kinglet, Hermit Thrush, Yellow-rumped Warbler, Dark-eyed Junco, Pine Siskin, Red Crossbill.

Distribution: The Golden-crowned Kinglet's breeding range extends from Guatemala north to southwest Alaska then east to Newfoundland. This bird's winter range includes generally its entire breeding range and south throughout the United States into northeastern Mexico, excluding most of Florida and the deserts of southwestern Arizona, southern Nevada, and southeastern California (Gilligan and others 1994, Ingold and Galati 1997, Kessel and Gibson 1978). In Arizona the Golden-crowned Kinglet breeds in the northeastern half of the state from the Kaibab Plateau east to the Chuska Mountains south along the Mogollon Rim down to the Santa Catalina and Chiricahua Mountains. Winter range in Arizona extends

slightly west of the breeding range in lower elevations and the lower Colorado River Valley (Monson and Phillips 1981, Rosenberg and others 1991).

Ecology: Golden-crowned Kinglets probably leave their lower elevation wintering grounds in Arizona by early April; the exact dates are difficult to determine because most of their range in Arizona is used year-round. Timing of fall migration is also difficult to detect but they have been found in northern Mexico by November (Howell and Webb 1995). Golden-crowned Kinglets migrate later in the fall than other insectivores, probably because they feed on insects under bark and in buds (Thobaben and others 1987).

Golden-crowned Kinglets feed on small insects, mites, spiders and eggs of these arthropods during the breeding season and on some fruit and seeds in the winter. They glean insects from the surface of leaves, under bark and on tips of branches. They hover to eat prey on the underside of leaves (Franzreb 1984). Most foraging occurs at the mid to upper canopy layer (Sabo 1980).

Habitat Requirements: Golden-crowned Kinglet breed primarily in subalpine spruce-fir, mixed conifer, deciduous, and single-species stands. They prefer to nest near water or edges of clearings in closed or open canopies. Density of understory is not important (Beedy 1981, Franzreb and Ohmart 1978, Peck and James 1987). In Arizona, Golden-crowned Kinglets sometimes nest in riparian cottonwood and Goodding willow stands (Rosenberg and others 1991).

Detailed nesting information is lacking for Arizona, but elsewhere in their range Golden-crowned Kinglets nest solitarily in dense stands of conifers such as black and white spruce and balsam fir. Nest heights ranged from 2.5-20 m (8-65 ft) (avg. 15.3 m or 50 ft) in the upper crown (Ingold and Galati 1997, Peck and James 1987). Nests are uncommonly parasitized by brown-headed cowbirds, probably because of aggressive territorial defense by female Golden-crowned Kinglets (Friedman 1971, Galati 1991).

Habitat and/or Population Objectives:

Population Objectives

1. Maintain an increasing or stable breeding population density of 17-30 pairs /40 ha using baseline data (Carothers and others 1973, Franzreb and Ohmart 1978) in the San Francisco Mountain area, the White Mountains, and the Chuska Mountains.
2. Establish an increasing or stable trend in the spruce-fir habitats in the Sky Islands of southeastern Arizona (Santa Catalina, Chiricahua and Pinaleno Mountains).

Habitat Strategy

1. No net loss of mature, dense, moist, old growth (> 150 yrs. old) spruce-fir forests with a moss and lichen component and canopy cover >40% in Arizona. Minimum patch size currently unknown in Arizona. Although little is known about the necessary surrounding habitat matrix, fragmentation was shown to have negative effects on population density in Colorado (Thompson 1994a and 1994b).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Human disturbance has caused nest abandonment but these birds were observed to build another nest the following day (Galati 1991). Golden-crowned Kinglet populations appear to be influenced by cold winters and heavy snowfall in the northern and high elevation extent of their ranges (Larrison and Sonnenberg 1968). Logging has been shown to have an adverse effect (Franzreb and Ohmart 1978, Wetmore and others 1985) from removal of larger trees. Catastrophic fire that eliminates the overstory may also have adverse effects on Golden-crowned Kinglets.

Golden-crowned Kinglet management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Avoid large scale removal of overstory and larger trees.
2. Manage forests to reduce fire risk (controlling fuel build-up, etc.).

Recreation

1. Minimize human activity around breeding sites during nesting season (April-June).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Document nesting chronology in Arizona.
2. Determine extent of use of adjacent habitats (esp. mixed conifer and high elevation riparian).

THREE-TOED WOODPECKER (*Picoides tridactylus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for Three-toed Woodpecker are: Hairy Woodpecker, Northern Flicker, Olive-sided Flycatcher, Violet-green Swallow, Brown Creeper, House Wren, Hermit Thrush, Dark-eyed Junco.

Distribution: Three-toed Woodpeckers occur from Scandinavia and Siberia south locally to mountains in Europe, China, and Japan. In North America, this woodpecker occurs from northern Alaska east to Newfoundland and south locally in mountains to Oregon, Nevada, New Mexico, South Dakota, Minnesota, Michigan, New York and northern New England (AOU 1998). It wanders casually south of these locations. In Arizona it is resident on the Kaibab Plateau, Chuska Mountains, San Francisco Peaks and locally south to Williams and east above the Mogollon Rim to the White Mountains (ABBA unpubl. data, Monson and Phillips 1981).

Ecology: This woodpecker has strong breeding site tenacity with the same pair sometimes remaining together all year and in successive years for more than one breeding season (Ehrlich and others 1988, Kaufman 1996). In Arizona, the nesting season begins in mid- to late May and continues through at least mid-July (ABBA unpubl. data). Smith (1980) states that it is the only woodpecker in spruce-fir forests capable of making cavities in the dense wood of living spruce trees. A new nesting cavity is excavated each year by both sexes, but mainly by the male (Baicich and Harrison 1997, Kaufman 1996,). The average nest cavity is 0.6-4.6 m (2-15 ft) high, rarely above 12.2 m (40 ft) (Baicich and Harrison 1997, Johnsgard 1979). Three-toed Woodpeckers typically nest in dead or dying trees. McClelland (1979) found that the nest trees retained more than 75 percent of their bark, had no dead needles remaining on their branches, and still had 10-80 percent of their limbs. These features, along with intact tops, indicated that the trees had been dead two to six years (McClelland 1977). This species normally exists at low density of one to two pairs per 40 ha (100 ac), unless the food supply is very good (e.g. after fires and insect outbreaks) when density can be as high as one pair per 0.4 ha (1 ac) (Colorado Division of Wildlife, Wildlife Species Database (CDOW WSDB), Koplín and Baldwin 1970).

The Three-toed Woodpecker plays an important role in the control of bark beetles (Koplín and Baldwin 1970, Massey and Wygant 1954). Massey and Wygant (1954) found spruce beetles comprised 65 percent of the diet of this woodpecker in Colorado. Other food items includes ants, wood-boring and lepidopteran larvae, fruits, and cambium (Scott and others 1977). This species is specialized to forage on insects in the bark of trunks of freshly killed spruce (Koplín 1969), although it will also occupy undisturbed stands of virgin forest where there are old trees with diseased or decayed hearts (Johnsgard 1979).

Habitat Requirements: The Three-toed Woodpecker prefers spruce-fir forests in the southern Rockies, but where boring insect populations are high due to tree disease or fire, it may also occur in ponderosa pine, Douglas-fir and lodgepole pine forests (Andrews and Righter 1992, Crockett and Hansley 1978, Koplín 1969). Snags of conifers are used for feeding, nesting, roosting, and perching (Evans and Conner 1979, Scott and others 1977). Snags that have been dead less than three years are critical (Yanishevsky and Petring-Rupp 1998). Evans and Connor (1979) reported that in northeastern United States the optimum dbh for nesting is 35-38 cm (13.8-15 in) with a range of 30-46 cm (11.8-18 in). Territory size averages 30.4 ha (75 ac) (Bull and others 1980, Evans and Conner 1979).

Habitat and/or Population Objectives:

Population Objective

1. Maintain current distribution in Engelmann Spruce and Subalpine Fir in the San Francisco Peaks, Chuska Mountains, Kaibab Plateau, and locally on the Mogollon Rim and in the White Mountains.

Habitat Strategy

1. Maintain key habitat components in Engelmann Spruce and Subalpine Fir forests including: snags > 12 in (Evans and Connors 1979) for nesting and trees averaging a dbh of 25 in (Keller 1987) for foraging.
2. Maintain patches \geq 75 ac of diseased or burned areas for foraging (Bull and others 1980, DeGraaf and Shigo 1985, Evans and Connor 1979).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Timber harvesting (even-aged and partial cutting), salvage logging, firewood cutting, habitat fragmentation, and suppression of wildfire threaten the habitat of this woodpecker. Periodic fires are apparently important to Three-toed Woodpeckers, and population densities increase the first three years following fire (Taylor and Barmore 1980). Numbers of nests declined dramatically three to five years post fire (Caton 1995). The positive response of this woodpecker to fire is probably due to the creation of snags that served as habitat for insect prey species (Caton 1995). In all studies, abundance of the Three-toed Woodpecker declined significantly after clearcut logging (Hutto and others 1992). This species also declined significantly after partial cutting in 50 percent of studies reviewed by Hutto and others

(1992). This woodpecker appears to be adversely affected by silvicultural thinning (Brawn and Balda 1988).

Three-toed Woodpecker management issues are listed below in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Allow some natural fires (e.g. lightning strikes) in spruce-fir, mixed conifer, and ponderosa pine to burn, especially in wilderness areas.
2. Limit salvage logging after fires or insect kills in spruce-fir, mixed conifer, and ponderosa pine habitats.

3. Coordination of Recommendations and Opportunities in Spruce-Fir

The primary concern for priority species in Spruce-Fir is loss of habitat. Forest thinning practices, especially ones that result in even-aged treatments, or large-scale removal of overstory and mid-story canopy are management issues for all four priority species. Management practices that may reduce or eliminate snags are the primary issues for Three-toed Woodpeckers. Loss of habitat from catastrophic fires becomes increasingly probable if fire suppression practices continue. Using prescribed fire management practices to reduce fuel loads is recommended for all four spruce-fir species. Leaving random clumps of dense saplings and scattered untreated areas with associated floor debris such as logs, is recommended for Swainson's Thrush. Grazing of the herbaceous layer and the subsequent reduction of insect populations may eliminate critical food sources for Swainson's Thrush.

The priority species recognized in Spruce-Fir habitat all use low to mid-story level for nesting and foraging. Golden-crowned Kinglets will also use the uppermost canopy for foraging and usually nest in the mid- to upper canopy. Understory and forest floor habitats are important for Swainson's Thrush for nesting and feeding, respectively. Nearby or associated deciduous woodlands with cottonwood/willow stands and riparian shrublands with willow/alder thickets will often be used as secondary habitat by all four species.

Since most of this habitat type is under public ownership and managed by the U.S. Forest Service, the potential for conservation action could be high if multiple use mandates are accommodated. Threats to this habitat are minimal compared to habitats undergoing active timber harvest, heavy grazing, and outright loss from development. However, management efforts can be focused in specific areas. The damp climate characteristic of Spruce-Fir forests helps reduce the risk of natural fires, although in dry years, the risk of fire increases due to higher occurrence of fires in the surrounding drier pine forests. As recreation continues to increase, the risk of fire also increases. Reduction of fuel load and prescribed burning can help alleviate this risk; however, it is

important to maintain residual structural diversity in dead and down material with prescriptions to sustain habitat diversity. Recreation in Arizona forests is on the rise (C. Taylor pers. comm.) and higher elevation forests are targeted for skiing during winter months and hunting, camping, and hiking in the spring, summer, and fall. Recreational development, such as ski areas and summer homes, may also contribute to loss and modification of spruce-fir habitat. Limiting the concentration and placement of recreational activities during peak breeding season (April-June especially during dry years) may help reduce the risk of wildfire and human disturbance during these critical months.

Table 2. Spruce-Fir Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Swainson's Thrush	-corkbark fir	-understory and ground cover fairly dense, -multi-layered forest composition. -favor patchy openings adjacent dense forests.	-cooler and moister microclimate -elevation 8500-10,800 ft	-early to mid successional stages adjacent to denser stands
Pine Grosbeak	-Engelmann spruce	-open/disturbed areas near forests -upper canopy (using high cone producing trees) -forage in forest edge	-elevation 9400-11,500 ft	-need mosaic of forest edge, dense canopy, openings -mid to late successional
Golden-crowned Kinglet	-Engelmann spruce, corkbark fir	-mature forests, closed canopy, edges of clearings -will use forests with dense or no understory.	-elevation 8500-11,500 ft	-mid-late successional stage forests
Three-toed Woodpecker	-Engelmann spruce, corkbark fir, snags, or dying trees	-open canopy, with a high snag density	-elevation 8500-11,500 ft	-late successional, associated with recently burned areas, (1-3 post burn)

Table 3. Special Factors for Spruce-Fir Priority Species

Priority Species	Special Factors
Swainson's Thrush	-diet of insects, spiders, and fruit -least terrestrial of Northern American Thrushes -often killed by television towers -rare cowbird host -nest in shrubs or low in coniferous trees

Pine Grosbeak	-diet of seeds, cones, buds, berries; some insects during nesting season -ridiculously tame -irregularly migratory due to shortage of food source
Golden-crowned Kinglet	-insectivorous, some fruit and seeds -rare cowbird host
Three-toed Woodpecker	-wood-boring insects > 75% of diet -strong breeding site tenacity

B. *Mixed Conifer Habitat*

1. Habitat Description, Status and Importance

Mixed conifer is a common forest habitat in northern Arizona found primarily in the White Mountains, the Mogollon Rim and on the Kaibab Plateau, with limited distribution on mountain islands in southeastern Arizona. Similar habitats are found throughout the Rocky Mountains. Mixed conifer forest intergrades with ponderosa pine forest at lower elevations (1830 to 2440 m, 6000 to 8000 ft), where it forms inclusions in canyons and on north slopes. Most mixed conifer stands are between 2440 m (8000 ft) and 3050 m (10,000 ft). At its upper limits the mixed conifer series merges and then gives way to the spruce-subalpine fir and bristlecone-limber pine series of the boreal Rocky Mountain subalpine forest. About 1.1 million acres of mixed conifer forests and associated spruce-fir and aspen forests are found in Arizona and New Mexico (Conner and others 1990, Van Hooser and others 1992).

Mixed conifer stands are variable, and may constitute one of the more complex plant associations known. Some stands may consist of only two species, while others may be comprised of as many as eight associates. Overstory species include white fir, Rocky Mountain Douglas-fir, blue spruce, quaking aspen, Gambel oak, ponderosa pine, and southwestern white pine at higher elevations, with Engelmann spruce, blue spruce, and subalpine fir intergrading at the highest elevations.

Mature mixed conifer forests are often dense, with high canopy cover and heavy litter accumulation that restricts undergrowth. Where openings in the canopy are caused by blowdowns, road construction, fires or other disturbances, a rather depauperate understory flora may develop (mountain snowberry, raspberry, strawberry, nodding and mountain brome, tufted hairgrass, rough bentgrass, and figwort).

Quaking aspen is an important associate throughout the more mesic montane conifer forests. The shade-intolerant aspen, which reproduces chiefly from root sprouts, produces a flourishing colony in stands once the overstory conifers have been removed by fire, blowdown, or logging.

The mixed conifer forest was not used heavily by Native Americans, though it provided some materials for ceremonies and daily living. The forests provide commercial and noncommercial products, opportunities for recreation and important wildlife habitat. Logging and livestock grazing are commercial interests, though this forest type produces less timber and less forage than ponderosa pine forests. The forested watersheds receive relatively large amounts of precipitation for the Southwest, and are the headwaters for most of Arizona's major rivers.

Conservation Issues for Mixed Conifer Habitat

Logging: Mixed conifer represents only 3% of the commercial forest area in Arizona (Spencer 1966). Douglas fir represents 5% of the saw timber volume, while true firs represent only 3% (Spencer 1966). Early logging generally consisted of individual tree selection. Accelerated logging in the 70s and 80s targeted stands of large trees, particularly favoring removal of ponderosa pines in mixed conifer, and concern developed over the loss of old-growth trees and stand diversity.

Fire: Fire had a major role in establishing most mixed conifer stands, and in maintaining their composition and structure. Aggressive fire suppression over the past 100 years has allowed Douglas-fir and true firs to develop in the understory of many pine stands, leading to an increase in this forest type. In many cases, fire suppression and selection of pines for harvest have resulted in type conversions of stands from pine to mixed conifer. Fire suppression has also resulted in an increase of fuel loadings, and a higher susceptibility to catastrophic fire. Lightning or human-caused fires during dry and/or windy conditions usually result in total kill of all vegetation. Grasses and forbs are quick to take over a burned area and plant succession begins again. The size and distribution of aspen patches provide a living map of fire history or insect outbreaks.

Aspen component: Pockets of aspen stands exist in high elevation, mesic areas of the mixed conifer forest. These forest stands provide plant and structural diversity within the forest and are very important to breeding birds. Johnson (1993) estimated that aspen in the Southwest has decreased by 90,000 ha (222,000 ac), or 46%. Fire exclusion and heavy ungulate grazing has contributed to this decline. In many cases, true firs get established in the understory, then outgrow and shade out the aspen trees.

Seedling Survival: Seedlings are exposed to many hazards that reduce survival, including voles, pocket gophers, rabbits, hares, big game, domestic livestock, snowmold, and drought. New growth of white fir, corkbark fir, and Engelmann spruce trees is killed by growing-season frosts. Seedlings of white fir, Douglas-fir, Engelmann spruce, and especially corkbark fir are killed or injured by solarization when grown in full sunlight (Ronco and others 1983).

Insects: As forest diversity and amount diminishes, maintaining the existing habitat becomes increasingly important. Natural occurrences, such as insects, can become potentially destructive when combined with other threats such as fire suppression, and logging. If the threat of insects becomes a major factor in the structure and content of forests, then management actions may be necessary. The following are some of the insects that may cause concern. Bark beetles cause the most damage, and include the spruce beetle, Douglas-fir beetle, fir engraver, Arizona fivespined engraver, and mountain pine beetle. Major defoliators include the western spruce budworm on Douglas-fir, Engelmann spruce, corkbark fir, and white fir; Douglas-fir tussock moth on corkbark

fir, white fir, and Douglas-fir; and the western tent caterpillar on aspen. Many other insects cause damage to foliage, cones, and seeds (Ronco and others 1983).

Pathogens: Naturally occurring pathogens may be a result of the continual manipulation of our natural forests. As with insects, control of pathogens may be necessary if the forest diversity and maintenance is threatened. All coniferous species in mixed conifer stands are infected by dwarf mistletoes; though damage is generally limited, it may be locally severe. Especially serious are Douglas-fir dwarf mistletoe and southwest dwarf mistletoe. Other major diseases are fungal trunk and root rots, which affect all tree species.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in mixed conifer habitat. A table at the end of the Mixed Conifer section highlights species habitat needs in a quick reference format (Table 4).

NORTHERN GOSHAWK (*Accipiter gentilis atricapillus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for Northern Goshawk are: Wild Turkey, Flammulated Owl, Williamson's Sapsucker, Northern Flicker, Steller's Jay, Pygmy Nuthatch, Western Bluebird, American Robin, Solitary Vireo, Grace's Warbler, Western Tanager, and Red Crossbill.

Distribution: The Northern Goshawk is Holarctic in distribution. In North America it occurs primarily in boreal forest, but the species also ranges far to the south in montane forest of the western United States and Mexico. The most widespread subspecies (*A.g. atricapillus*) occurs from the northeastern United States across the boreal forests of Canada to Alaska, and southward through upland forests of the western United States. Two other weakly differentiated subspecies are variously accepted in North America: *A.g. laingi* in forests on islands and along the coast of extreme northwestern United States and Canada to southeast Alaska (AOU 1957, Palmer 1988), and *A.g. apache* in montane forests of southeastern Arizona, southwestern New Mexico and northern Mexico (Hubbard 1978, Wattel 1973, Whaley and White 1994).

Ecology: Goshawks are generally non-migratory. However, in the northern portion of their range, large southward migrations occur during winters when prey are limiting (Doyle and Smith 1994, Mueller and Berger 1967, Mueller and others 1977). In the southwestern United States, there is evidence that goshawks move to lower elevation habitats or remain on or near

their breeding home range for the winter (Beier 1997, Ingraldi 1998, Reynolds pers. comm.).

Goshawks are believed to be monogamous (Newton 1979), although a few instances of “divorce” have been documented (Detrich and Woodbridge 1994, Reynolds and others 1994). Goshawks generally breed at 3 years, when they achieve full adult plumage. McGowan (1975) hypothesized that subadult females are only able to breed in years of high prey availability.

Goshawks have large breeding home ranges (570 – 3,500 ha) with males’ home ranges generally larger than females’ (Squires and Reynolds 1997). Nest areas within home ranges are defended. Home ranges (but not nest areas) of adjacent pairs may overlap, especially in habitats where nesting populations are at or near saturation (Reynolds and Joy 1998). One to 8 alternate nests may be maintained in a breeding home range. One nest may be used in sequential years, but often an alternate is selected (Squires and Reynolds 1997). Goshawks typically initiate breeding activities in March. Egg-laying usually occurs between late April and early May and hatching between late May and early June. Females may forage in and around the nest stand during the nestling period, but males still provide most of the prey. Only the female directly feeds the young prior to fledging, which usually occurs in July. Fledglings are dependent on their parents for approximately 6 weeks, while they complete feather growth and learn to hunt (Squires and Reynolds 1997). For the first 3 weeks, fledglings tend to stay in or close to the nest stand (Kennedy and others 1994). Dispersal is abrupt, with males dispersing a few days earlier than females (Ingraldi 1998, Kenward and others 1993a,b).

Squires and Reynolds (1997) reported goshawk breeding density estimates from North American populations ranging from less than 1 pair up to 11 pairs per 100 km². Productivity in North America ranges from 1.4 to 3.9 young per successful nest (Squires and Reynolds 1997).

Goshawks prey on a variety of birds and mammals. Reptiles and insects are taken occasionally. Diets differ among populations as prey availability changes regionally and seasonally (Squires and Reynolds 1997). Important prey in the Southwest include cottontails, tree squirrels, ground squirrels, chipmunks, grouse, columbids, woodpeckers, jays, and robins (Reynolds and others 1992).

Habitat Requirements: Goshawk nesting habitat has been extensively described. Generally, goshawk nest sites are in mature and old growth forest stands with relatively high canopy closure (e.g. Austin 1993, Crocker-Bedford and Chaney 1988, Ingraldi and MacVean 1995, and Kennedy 1988). Across the West, goshawks use a wide variety of forest types, but in the

Southwest, goshawks primarily use ponderosa pine and mixed conifer forests, although use of other forest types (e.g. spruce-fir, Madrean oak woodland, pinyon-juniper woodland) has also been documented (e.g. Snyder 1995, USFWS 1998). In the West, goshawks nest in both deciduous trees (e.g. cottonwoods, aspen) and conifers (USFWS 1998). In the Southwest, goshawks frequently nest in ponderosa pines. Goshawks build large stick nests which are often placed on a horizontal limb close to the trunk in the low portion of the tree's canopy (Snyder and Snyder 1998). In an Arizona study in ponderosa pine habitat (Ingraldi and MacVean 1995), goshawks selected nest sites with higher canopy density, larger diameter stems and a higher frequency of large (≥ 30.5 cm (12 in) dbh) stems. Nest sites also had more ground litter. Nest trees were taller, had smaller live crown ratios, tended to be part of a clump of trees with interlocking crowns, and were on the lower third of a slope. These results were similar to Kennedy's (1988) findings in New Mexico.

Foraging habitat has been less studied. Goshawks have been observed hunting in a diversity of habitats, varying from large openings to dense forests. However, limited evidence suggests goshawks preferentially forage in forests with closed canopies (Austin 1993, Beier and Drennan 1997, Bright-Smith and Mannan 1994).

Reynolds and others (1992) described habitat relationships of primary goshawk prey in the Southwest; some prey species prefer forest openings, but most use mature and older forests. In Arizona, Beier and Drennan (1997) radio-tracked foraging goshawks to determine whether hawks selected foraging habitat based on prey abundance or forest structure. Goshawks apparently did not select foraging sites based on prey abundance; indeed, abundances of some prey were lower on used than on contrast plots. Goshawks selected foraging sites with higher canopy closure, greater tree density, and greater density of large trees (> 40.6 cm (16 in) dbh). These results were consistent with the hypothesis that goshawk morphology and behavior are adapted to hunting in moderately dense, mature forests and that prey availability, as influenced by forest structure, is more important than prey density in habitat selection.

Few goshawk studies in North America have investigated winter habitat use. In Arizona, Beier (1997) found adult goshawks wintered in ponderosa pine forest and pinyon-juniper woodlands during two winters. In general, females remained in ponderosa pine in the general vicinity of their nest stands throughout both winters. Most male goshawks moved 5-10 miles from the nesting area and generally into the closest pinyon-juniper woodlands, although one male moved up into the nearest mixed-conifer forest. Most males made return trips to their nesting areas during the winter and did not establish a distinct winter range. The females appeared to exhibit more overwinter fidelity to the nest stand than males. Unlike Beier and Drennan's (1997) breeding season study, Beier (1997) found winter foraging habitat selection

could not be discerned based on vegetation structure. Used vs. unused areas were similar, with used habitat having slightly more medium-sized trees and denser canopy.

Habitat and/or Population Objectives:

Population Objectives

1. Maintain current distribution in montane conifer forests in Arizona (ponderosa pine, mixed conifer, and spruce-fir habitats).
2. Manage for 5-10 pairs per 100 square km across entire range in suitable habitat in AZ.
3. Maintain stable populations in such areas as: Kaibab Plateau, central Mogollon Rim, White Mtn., Chuska Mtns. (Navajo Nation), and the southeastern Sky Islands.

Habitat Strategy

1. Maintain old growth and mature forest with scattered small openings, a relatively open understory, a well developed herbaceous and shrub layer, large snags and large dead and down woody material. Maintain a relatively dense canopy in nest areas.
2. Maintain a minimum of 180-year rotation before the final timber harvest.
3. For specific habitat recommendations refer to the following documents:
 - a) Reynolds, Richard T.; Grahame, Russell T.; Reiser, M. Hildegard; and others 1992. *Management recommendations for the northern goshawk in southwestern United States*. Gen. Tech. Rep. RM-217. Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 90 p.
 - b) Arizona Game and Fish Department review of U.S. Forest Service strategy for managing northern goshawk habitat in the southwestern United States. 1993. Arizona Game and Fish Department, Phoenix, Arizona.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Timber harvest practices that remove older, larger trees and simplify forest stand structure, management practices that remove dead and downed trees, and catastrophic fire are the primary management issues facing the Northern Goshawk today. Grazing that reduces or eliminates the herbaceous layer and degrades prey habitat is also a management concern. Northern Goshawks are sensitive to disturbance during the nesting season thus human activities in known nest areas and post fledging family areas (PFA) should be limited. Active management including fuel reduction programs that thin from below and use fire to

maintain structural diversity in forest stands is recommended. Management practices that retain and promote large trees are also encouraged.

Northern Goshawk management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Grazing

1. Follow allowable use guidelines to maintain herbaceous layer to support Northern Goshawk prey base.
2. Follow livestock levels and seasonal use dates as outlined in the management of northern goshawks in the *Management recommendations for the northern goshawk in southwestern United States* document (USFS 1996).

Fire

1. Implement fuel reduction programs that thin from below, focus on small tree component, and achieve a clumpy distribution.
2. Manage forests to maintain large snags and trees, dead and down woody material and an uneven-aged forest.

Silvicultural Practices

1. Manage forests to retain and promote larger and older trees and promote uneven-aged forest stands.
2. Thin from below, focus on small tree component and maintain clumpy distribution.

Recreation

1. Limit human activities during nesting season (March 1-September 30) in nest areas and post fledging family areas.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Evaluate the effectiveness of the Forest Service's current Northern Goshawk Guidelines (USFS 1996).
2. Evaluate effects of "featured species" (i.e. Mexican Spotted Owl) habitat management guidelines on Northern Goshawks.
3. Determine how changes in forest structure and landscape patterns affect population viability (from the Birds of North America Species Account).
4. Determine role of insects, diseases, wildfires and other natural disturbances in sustaining desired forest conditions (from the USFS Technical Report RM-217).

5. Collect goshawk demographic information (from the USFS technical report RM-217).
6. Determine Northern Goshawk foraging habitat preferences in various forest types (from the Birds of North America Species Account).
7. Develop improved monitoring procedures to determine population trends.
8. Study Northern Goshawk wintering biology.

MEXICAN SPOTTED OWL (*Strix occidentalis lucida*)

Associated Species: Other species that may use similar habitat components or respond positively to management for Mexican Spotted Owl are: Northern Goshawk, Whiskered Screech-Owl, Whip-poor-will, Arizona Woodpecker, Virginia's Warbler, Red-faced Warbler, Painted Redstart, and Hepatic Tanager.

Distribution: The Mexican Spotted Owl is distributed over a broad geographic area in the southwestern United States. However it is not uniformly distributed throughout its range. It occurs in disjunct locations that correspond to isolated mountain systems and canyons in southern Utah, Colorado, Arizona, New Mexico, and Mexico. In Arizona, it primarily occurs in mixed conifer and ponderosa pine-Gambel oak forests and canyons above and below the Mogollon Rim, and in the Madrean pine-oak forests and canyons of the sky island mountain ranges in the southern part of the state (Block and others 1995).

Ecology: The owl, described as a "perch and pounce" predator, primarily consumes small to medium-sized rodents such as woodrats, peromyscid mice, and microtine voles. It also preys on bats, birds, reptiles, and arthropods (Forsman 1976, Ward and Block 1995). This species nests on cliff ledges, stick nests built by other birds, and in tree cavities (Fletcher and Hollis 1994, Ganey 1988). Females normally lay one to three eggs in late March or early April and incubate for approximately 30 days. The eggs usually hatch in early May. Nestling owls generally fledge in four to five weeks after hatching in early to mid-June (Ganey 1988). Fledgling dispersal occurs usually from mid-September to early October. Predation by avian predators (e.g. Great Horned Owls, Northern Goshawks) and starvation from low abundance and availability of prey species are primary mortality factors (Ganey 1988). Seasonal movement patterns are variable. Some are year-round residents, some show shifts in habitat-use patterns, and some migrate short distances (i.e. 19-49 km or 12-31 mi) during the winter. Home ranges are also variable ranging from 261-1550 ha (645-3831 ac). During the nesting season most activity (i.e. nesting/roosting and foraging) occurs within an "activity center" of approximately 242 ha (600 ac) (Block and others 1995).

Habitat Requirements: In northern portions of the range, including southern Utah, southern Colorado, far northern Arizona and in New Mexico, owls occur primarily in steep

walled rocky canyons with conifer inclusions (Rinkevich 1991, Willey 1993). Along the Mogollon Rim in Arizona and New Mexico, primary habitat use is within mixed conifer forests, ponderosa pine-Gambel oak forests, rocky canyons, and associated riparian forests (Fletcher and Hollis 1994). In southern Arizona and Mexico, Madrean pine-oak forests and canyons provide primary habitat for the owl (Duncan and Taiz 1992, Ganey and Balda 1989). Forest stands used for roosting and nesting often contain mature to old-growth stand characteristics. The forest stands are typically uneven-aged, multistoried, have dense canopy cover, and contain large diameter trees, snags, and downed logs (Block and others 1995).

Habitat and/or Population Objectives:

Population Objectives:

1. Maintain current distribution in montane conifer forests in AZ (ponderosa pine with an understory of Gambel's oak, Madrean pine/oak, and mixed conifer).
2. Follow population and habitat objectives for each Recovery Unit as outlined in the Mexican Spotted Owl Recovery Plan (USDI Fish and Wildlife Service 1995).

Habitat Strategy

1. Use existing habitat recommendations in the Mexican Spotted Owl Recovery Plan with the most updated Recovery Team recommendations.
2. For specific management recommendations by recovery unit and by habitat type, refer to the Mexican Spotted Owl Recovery Plan:

USDI Fish and Wildlife Service. 1995. Recovery plan for the Mexican spotted owl: Vol.I. Albuquerque, New Mexico. 172 pp.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues and Conservation Recommendations

Timber harvest, particularly even-age management, and catastrophic fire over large forested areas are the primary management concerns which can adversely alter owl habitat through habitat fragmentation and the reduction in mature and old-growth forest characteristics (i.e. key for roosting and nesting). In addition, livestock and ungulate grazing (e.g. alteration of prey/nesting/roosting habitat) and recreation (e.g. disturbance to nesting birds) are other key management issues. Management guidelines in the 1995 Mexican Spotted Owl Recovery Plan, and Block and others 1995, focus on protection and maintenance of nesting/roosting

habitat, maintenance of habitat for prey species, and limiting of disturbance during the nesting season.

Mexican Spotted Owl management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Silvicultural Practices

1. Manage forests for uneven forest structure.
2. Follow silvicultural guidelines in the Mexican Spotted Owl Recovery Plan.

Fire

1. Light burning of fuel buildup in Protected Activity Centers (PACs) only during nonbreeding season and as described in Protected Activity Center guidelines in the Mexican Spotted Owl Recovery Plan. (USFWS 1995).
2. Implement a fire abatement program to allow treatment of fuel build-up and avoid catastrophic fire. (USFWS 1995).

Human Disturbance

1. No construction of buildings, roads or trails in PACs during breeding season (USFWS 1995).
2. Construction of buildings, roads or trails in PACs during non-breeding season considered on a case-specific basis (USFWS 1995).
3. Seasonal closures of specifically designated recreation activities should be considered in extreme circumstances (USFWS 1995).

Grazing

1. Monitor grazing use by livestock to determine any changes in the relative composition of herbaceous and woody plants to maintain habitat for owls and their prey.
2. Implement and enforce grazing utilization standards that attain good to excellent range use standards (USFWS 1995).
3. Protect or restore riparian communities, emphasizing those located in protected and restricted areas (USFWS 1995).

OLIVE-SIDED FLYCATCHER (*Contopus borealis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Olive-sided Flycatcher are: Flammulated Owl,

Williamson's Sapsucker, Purple Martin, Violet-green Swallow, Pygmy Nuthatch, and Grace's Warbler.

Distribution: The Olive-sided Flycatcher's breeding range extends throughout western North America from western and central Alaska and central Yukon, south through the Sierra Nevada Mountains to northern Baja California and through the Rocky Mountains into northern Arizona and western Texas (Altman 1997). Eastward it extends across Canada and into northeastern United States. The Olive-sided Flycatcher's winter range extends southward as far as southeastern Brazil and western Peru with most of its wintering grounds in northwestern Venezuela, the Andes Mountains of north and western South America, and Panama (Altman 1997). In Arizona, its range is limited to north of the Mogollon Rim in higher elevation ponderosa pine and mixed conifer forests.

Ecology: Arrival on breeding grounds is generally late across its range from mid-April to late May in Arizona. Late arrival has been attributed to a higher abundance of their primary diet source, flying insects, especially honey bees (Bryant 1975, Ehrlich and others 1988, Robins 1970). The earliest nesting record in Arizona was an occupied nest found on 11 June near Happy Jack, and the latest record was a nest with young found on 1 August near Green's Peak in the White Mountains (ABBA unpubl. data). Males are vigorous defenders of their territory and nest area (Altman 1997, Ehrlich and others 1988). Nests are generally placed high up in the tree (usually coniferous), distant from the main trunk, on a horizontal branch (DeGraaf and Rappole 1995, Ehrlich and others 1988, Harrison 1975). The open cup nest is constructed of twigs, lichens, moss, and pine needles, lined with fine grasses, lichens, and rootlets and held firmly to the branch with spider webs (Bent 1942, Ehrlich and others 1988). Departure to the wintering grounds occurs early across the flycatcher's range, with most birds leaving breeding areas in late August through late September. This early departure may be a result of the extreme distances they travel to wintering grounds (Altman 1997). Olive-sided Flycatchers travel farther in migration than any other North American breeding flycatcher (Murphy 1989).

Habitat Requirements: In Arizona, the Olive-sided Flycatcher is primarily associated with mixed conifer forests, subalpine forests with Engelmann spruce, pure ponderosa pine forests and montane riparian wetlands with aspen, Douglas-fir, white fir and ponderosa pine (T. Corman, AGFD, pers. observ.). They prefer forest edges and openings either natural or man-made, and tend to increase in density as canopy cover decreases. Olive-sided Flycatchers have been linked to burned areas of mixed conifer and ponderosa pine (Altman 1997, Blake 1982, Lowe and others 1978). A correlation between higher densities of insects and early post-burn areas has been suggested by the presence of other insectivorous birds such as the Western Wood-Pewee and Townsend's Solitaire (Granholm 1982). The

association with burned areas may not only be for the abundance of prey but for the open and edge physiognomy in these areas as well as abundant singing and foraging perches.

Habitat and/or Population Objectives:

Population Objectives

1. Increase the current population density to at least 3 birds/40 ha (or 100 ac) (Lowe and others 1978) in mixed conifer in Arizona.
2. Increase distribution across historical range in Arizona.

Habitat Strategy

1. Maintain and/or create openings that mimic natural disturbances (i.e. early post-burn area, insect infestations, blow-down areas, etc.) with 0-39% canopy closure (Verner 1980), tall trees with dead tops and/or tall snags.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The lack of natural history information for this species has made assessment of declines difficult. Loss of extensive tracts of montane evergreen forests on the wintering grounds and habitat loss through conversion to non-forest and younger successional stages on breeding grounds have been suggested as possible factors (Altman 1997). Also, management practices that alter natural fire regimes may reduce the post-fire habitat preferred by the flycatcher. Recent management practices, such as prescribed burns, that attempt to mimic natural fire regimes do create more edge and open areas, but may not capture all necessary components and resources used by the Olive-sided Flycatcher. These practices may not benefit the species as much as expected. Large territory sizes and strong site fidelity on both breeding and wintering grounds have also been speculated to contribute to declines in Olive-sided Flycatchers (Altman 1997).

Olive-sided Flycatcher management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Maintain or create tall snags for perches.
2. Apply presettlement restoration treatments to appropriate Olive-sided Flycatcher habitat.

Silvicultural Practices

1. Manage forests for uneven forest structure (see Goshawk Guidelines).
2. Manage salvage logging areas to retain tallest snags.

Fire

1. Apply Goshawk guidelines for fire regime.
2. When considering prescribed burns, protect large (61 cm (24 in) dbh plus) trees.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Investigate landscape-scale habitat relationships.
2. Collect natural history and status information for Arizona range.
3. Investigate possible habitat loss on wintering grounds (Marshall 1988).
4. Evaluate insect control and effects on Olive-sided Flycatchers.
5. Monitor Olive-sided Flycatcher productivity in managed habitats to compare census data.
6. Determine the most appropriate fire treatment for Olive-sided Flycatcher in Mixed Conifer habitat.

3. Coordination of Recommendations and Opportunities in Mixed Conifer habitat

Loss and/or alteration of habitat are the primary management issues for all three priority species in mixed conifer habitat. Silvicultural practices that simplify stand structure and remove snags are major issues for two species and habitat loss from conversion to non-forest or young forest is a major issue for the third species. Fire management concerns differ somewhat for these three species. For Northern Goshawk and Mexican Spotted Owl, manipulation of forest structure using fire to thin from below and maintain the overstory canopy is recommended. The Olive-Sided Flycatcher, however, prefers openings and early post burn areas that create openings and edge. Unlike the Goshawk and Spotted Owl, Olive-sided Flycatchers tend to decrease in density as canopy cover increases. All three species prefer larger, older trees and recommendations to use prescribed burns to maintain larger trees, reduce fuel build-up to avoid catastrophic fire are included for all three species. Human disturbance during nesting season is discouraged, especially in Protected Activity Centers for the Mexican Spotted Owl and in nest areas and post fledging family areas for Northern Goshawks.

Combined, these three priority species, as well as all associate species, use the entire range of structural levels represented in mixed conifer from the herbaceous layer to the top of the canopy. Managing for varying habitat requirements in the same habitat can present challenges in some instances but in this case, the priority species are using different parts of the same forest and can be managed for simultaneously. The Olive-sided Flycatcher will be drawn to forest openings, and

will benefit from downed logs, burned areas and snags. The Goshawk and Spotted Owl need the densest part of the forest where trees are clumped and have thick canopies for nesting. Open areas with downed logs, and snags will also be used for locating prey and perching, respectively. The combination of different tree species that comprise mixed conifer allows a wider diversity of birds to use this habitat. This is evident when looking at the priority birds of mixed conifer. The ponderosa pine component is extremely important for nesting Goshawks; Ponderosa pine-Gambel oak forests in northern Arizona and Madrean pine-oak forests in southeastern Arizona are key habitat associations for the Spotted Owl; and Olive-sided Flycatchers are associated with nearly all tree species found in mixed conifer habitat.

Table 4. Mixed Conifer Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Northern Goshawk	-ponderosa pine, aspen, and Douglas-fir (as dominants) with varying combinations of typical mixed conifer tree species -openings with grasses, forbs and shrubs important for prey	-mature forests with interspersed openings -moderately dense to dense over story for nesting -fairly open mid and understory -snags and dead and down (plucking posts, observation perches, prey habitat)	-drainages important (nest tree base often in lower third of drainage) -nest often level with ridge -elevation spans entire range of mixed conifer	-mosaic of dense stands interspersed with openings with a wide variety of patch sizes. -edge (roads, forest cuts) good for prey availability wide variety of successional stages with the majority in the mature to old growth stage -irregular tree spacing
Mexican Spotted Owl	-Douglas-fir (most dominant), with varying combinations of typical mixed conifer tree species	-dense canopy closure -dense midstory layer -scattered to no understory -sparse ground cover -many dead and down logs	-cool microclimate -steep-sided canyons -elevation 2440-3048 m (8000-10,000 ft) -aspect often shade-facing	-clumpy, irregular tree spacing -need woody/downed debris for prey base -catastrophic fire very bad
Olive-sided Flycatcher	-Douglas-fir, white fir, aspen, blue spruce, Arizona white pine	-associated with forest openings and forest edges -semi-open stands with low canopy cover -prefers area with numerous dead trees	-elevation 2135-3045 m (7000-10,000 ft) -associated with wooded shores of rivers, ponds, and beaver ponds because	-often occur at edge of early post-burned areas for foraging and singing -need live mature pines for nesting. -most common in patchy areas of closed and open habitats

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
		and dead limbs for singing and hunting perches. -snag density relatively high	of downed snags and possibly an increase in insects.	-patch size does not seem to be important, but snags important. -most common in mixed conifer where selective overstory removal have occurred in the White Mts. of AZ. -most common where tall conifers overlook ridges and canyon tops.

Table 5. Special Factors for Mixed Conifer Priority Species

Priority Species	Special Factors
Northern Goshawk	-use multiple nest stands within same territory
Mexican Spotted Owl	-presence of mistletoe creates witches broom clumps that Mexican Spotted Owl will nest in -need presence of openings and a herbaceous layer for prey base -use center of activity areas (land managers may want to protect center of activity areas) -Great horned owl is frequent predator -presence of key hardwoods to aid in preferred cool microhabitat conditions
Olive-sided Flycatcher	-dietary: flying insects, esp. bees and wasps -highly territorial on breeding and wintering grounds -high degree of foraging specialization - only sallies for insects - no gleaning from leaves or ground -strong site fidelity in both breeding and wintering grounds -declines may also be related to destruction of wintering habitat (from high site fidelity) -need snags higher than surrounding canopy -rare cowbird host

C. Aspen Habitat

1. Habitat Description, Status and Importance

Aspen is the most widely-distributed native North American tree species, growing in diverse environments, regions, and communities (DeByle and Winokur 1985). In the western United States, aspen is one of the most common trees, where its range coincides closely with Douglas fir. In some areas, aspen forms extensive pure stands. In others, aspen is a numerically minor component of the forest landscape, and can be found in ponderosa pine, lodgepole pine, and mixed conifer communities. This section will focus on aspen associated with mixed conifer forests.

There are approximately 200,000 ha (495,000 ac) of aspen in the Southwest; most (160,000 ha or 400,000 ac) lies in New Mexico. A large portion of the remainder (32,000 ha or 79,000 ac) can be found in the Mogollon rim—White Mountain area of Arizona, with fewer hectares yet found in the San Francisco Peaks and Kaibab Plateau areas.

Aspen generally doesn't form large, pure stands in the Southwest; typically, there are small stands associated with larger stands of mixed conifer, at times forming conspicuous margins surrounding grassland meadows (DeByle and Winokur 1985). In addition, there are single or small groups of aspen interspersed between mixed conifer forests. Mixed conifer forests have an elevational range between 2450-3800 m (8040-12,470 ac) (Brown 1982), and aspen can be interspersed at all elevations.

Aspen is the principal successional pioneer tree after fire or other forest disturbance. The shade-intolerant aspen reproduces primarily from root sprouts, producing an early seral colony in conifer stands which have had the overstory removed by fire, blowdown, or logging (Brown 1982). Although aspen produces seeds, nearly all reproduction occurs through root suckering. Seeds establish only under extremely favorable conditions (Patton and Jones 1977).

Aspen stands typically have a maximum life span of 200 years. Once a canopy of aspen has been established, the density and vigor of new sprouts decreases (Patton and Jones 1977). Suckers are usually sparse and of poor vigor beneath an intact forest canopy, regardless of canopy species. Mature aspen, therefore, tend to have an understory of shade-tolerant conifers. Without a hot fire or heavy cutting to remove the overstory and create conditions for early seral renewal, the stand will change over time to one dominated by conifers (Patton and Jones 1977).

Impacts to the health of aspen forests can occur at nearly all growth stages. Repeated heavy browsing in the first several summers and during the initial growth period can eliminate a well-stocked sucker stand, leaving the parent root network depleted and unable to generate more suckers (Patton and Jones 1977). Beyond the juvenile stage, the predominant threat to aspen

health is disease, particularly canker. Ungulate use will scar the tree bole, increasing the tree's susceptibility to canker infections. In addition, black leaf spot fungus and western tent caterpillar outbreaks can severely impact foliage production and stand health (Patton and Jones 1977; DeByle and Winokur 1985). Clonal variations of aspen suckers can actually have different responses to cutting, diseases, and fire; some aspen clones may not produce a flourishing seral community after such disturbances (Tew 1981).

Herbaceous species tend to be more abundant in a mixed conifer stand interspersed with aspen than in a pure aspen stand or other openings (Brown 1982). Primary grasses and forbs associated with aspen stands include nodding, mountain, and fringed brome, wheatgrasses, bluegrass, asters, bracken fern, fleabanes, Missouri and few-flowered goldenrod, grassleaf peavine, American vetch, Rocky Mountain iris, lupines, sneezeweed, cutleaf coneflower, yarrow, mintleaf beebalm, and geraniums. Common understory shrubs include gooseberries, currants, Arizona rose, mountain and roundleaf snowberry, and Arizona and bearberry honeysuckle (Brown 1982).

Fire suppression has resulted in difficulty in the maintenance of aspen clones. This has posed a major threat to the future of aspen forests, since only 5% of aspen stands in Arizona are in the young stages. Young trees, too, are a major browse source. Therefore, unless stands are regenerated by burning or cutting, aspen acreage in the Southwest, including Arizona, will gradually decline (Patton and Jones 1977). Within the mixed conifer forest type, it is of primary importance to have a good distribution of aspen of a variety of age classes, intermingled within the conifers to provide sources for continual regeneration of aspen. In addition, proper livestock stocking rates and wild ungulate populations which do not severely impact young stands should be a management goal as well.

Clear-cutting an old, deteriorated, poorly stocked aspen stand produces relatively few suckers; the network of live roots necessary for dense regeneration has become sparse. Instead, managers should concentrate on a complete removal of a well-stocked aspen forest to produce vigorous suckers (Patton and Jones 1977). Maximum sprouting after timber cuts occurred when the harvest was in spring (Tew 1981). Cutting in summer and fall produces sparser sprouting densities; however, densities were not significantly different from the seasonal cuttings after four years (Tew 1981).

Leaving slash on sites to discourage animal use and to provide protection from snow does not appear to be beneficial to the health of a seral aspen stand. Root suckering is inhibited by the shading effect of large amounts of slash left after treatment. While it is encouraged to avoid concentrations of logging slash, a complete clean-up is not mandated (Shepperd 1996).

Prescribed fire offers an economic and environmentally acceptable means of rejuvenating aspen. Prescribed fire needs to be of moderate to high intensity, to ensure that overstory mortality and

removal is adequate to stimulate aspen suckering (Brown and DeByle 1989). Sucker response to low severity fires was poor; too few aspen were killed, and the overstory remained (Brown and DeByle 1989). In mixed conifer stands, the most important factor affecting redevelopment of aspen following fire is to ensure that conifer competition is significantly reduced (Brown and DeByle 1989).

2. Species Description, Objectives and Recommendations

Below are detailed descriptions of the Aspen habitat priority bird species. At the end of the Aspen habitat section, species habitat needs are highlighted in a quick reference format (Table 6).

RED-NAPED SAPSUCKER (*Sphyrapicus nuchalis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Red-naped Sapsucker are: Warbling Vireo, Tree Swallow, Violet-green Swallow, Downy Woodpecker, Evening Grosbeak, Broad-tailed Hummingbird, Blue Grouse, House Wren, Yellow-rumped Warbler, Orange-crowned Warbler, American Robin, Hermit Thrush, and Northern Saw-whet Owl.

Distribution: Red-naped Sapsuckers are rather common summer residents throughout the Canadian zone forests between the Sierra Nevada and Rocky mountain ranges (Phillips and others 1964, Terres 1996). They nest in the Rocky Mountain region of the United States through central Arizona, northern New Mexico, and extreme west Texas and winter in the extreme southern part of their summer range to southern California, most of Arizona (excluding the Sonoran desert zones), southern New Mexico, and in Baja and northwestern Mexico (DeGraaf and others 1991, Terres 1996). The breeding range in Arizona includes deciduous and deciduous/coniferous forests along and north of the Mogollon Rim and in the White Mountains (Monson and Phillips 1981, Phillips and others 1964).

Ecology: Red-naped Sapsuckers nest in deciduous trees, primarily aspen, within mixed deciduous or deciduous/coniferous forests often near water (Ehrlich and others 1988, Terres 1996). In Arizona, nest dates range from early May to mid-July (ABBA unpubl. data). Generally, the male selects the nest site, preferring live trees affected by heartrot, which facilitates excavation and leaves the nest cavity encased in harder surrounding wood (Ehrlich and others 1988, DeGraaf and others 1991). At times, dead trees are used for cavity sites, usually spruces or other conifers (Terres 1996). The same nest tree can be used perennially, but Red-naped Sapsuckers excavate a new hole each year (DeGraaf and others 1991). Cavity excavation usually takes between six and ten days, and the resulting cavity is typically 1.25" diameter at entrance, 8" depth, and 4" width at bottom, and is usually located 20' above

ground (Terres 1996). Both females and males incubate and brood, with the male incubating/brooding at night (Ehrlich 1988).

Red-naped Sapsuckers drill horizontal rings of small holes (sapwells) around deciduous trees (willows, cottonwoods, aspens, walnuts) and extricate sap and the soft cambium layer (Phillips and others 1964, Terres 1996). They will also feed on a variety of insects, primarily ants, attracted to the sapwells (DeGraaf and others 1991). Other insects consumed include moths of the forest tent caterpillar, spruce budworm, and other bark and tree insects (DeGraaf and others 1991). They will also feed on buds, fruit, berries, and nuts, at times caching nuts and fruit (Ehrlich and others 1988). Red-naped Sapsuckers also may guard sapwells from other birds and small mammals (Ehrlich and others 1988). Red-naped Sapsuckers can interbreed with yellow-bellied sapsuckers; rarely, they hybridize with Williamson's sapsuckers (Terres 1996).

Habitat Requirements: Red-naped Sapsuckers prefer mixed deciduous or deciduous/coniferous woods near water for nesting (Terres 1996). They favor, as summer habitat, groups of large aspens near heads of higher elevation canyons (Terres 1996). Dead or live trees with heartrot are preferred for nesting trees (DeGraaf and others 1991) to facilitate excavation. Minimum dbh for nest trees is 25.4 cm (10 in) and minimum height is usually 4.6 m (15 ft) (Thomas and others 1979). Typically, a diverse deciduous or deciduous/coniferous forest structure providing suitable diameter trees for nesting, insect diversity, and sap sources are selected. Density of Red-naped Sapsuckers in Arizona has been reported as 10-20 birds per 40 ha (100 ac) (Yanischevsky and Petring-Rupp 1998).

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable population trend and current distribution in Arizona.

Habitat Strategy

1. Manage for groups of aspen stands of different age classes (33% in seedling stage, 33% in sapling/pole and 33% old growth/mature), in a larger forest complex, to ensure continual availability of older trees and snags (> 25 cm (10 in) dbh) for nesting. Use fire or silvicultural treatments to ensure continual regeneration of new stands.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The Red-naped Sapsucker is not listed by the U.S. Fish and Wildlife Service as being in jeopardy or likely to become threatened. It is also not listed in the Arizona Game and Fish Department's *Wildlife of Special Concern in Arizona* (AGFD in prep.). However, possible threats to its primary habitat include the gradual decline in mature aspen stands and mixed deciduous forests adjacent to water sources, and forest pest control efforts undertaken by land management agencies. Current knowledge is lacking about the impacts of various timber harvest and management techniques on habitat requirements and nesting success of Red-naped Sapsuckers. Monitoring of sapsuckers in these timber harvest areas is recommended. Additional monitoring in known breeding areas in Arizona is also recommended to ensure long-term stability of Red-naped Sapsucker populations.

Red-naped Sapsucker management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Promote silvicultural and fire management practices that support aspen regeneration.

Specific management recommendations for Aspen habitat from Patton and Jones (1977) include:

In Conifer-Aspen Mixtures:

1. Patches may be clearcut to stimulate aspen suckering.
2. In dwarf mistletoe-infected patches of conifers, a clearcut may be implemented as a safety measure. Aspen suckers are likely to occupy these clearcuts.
3. In a healthy and productive mixed conifer-aspen stand, management can emphasize mixed conifer timber production, with aspen as only a minor stand constituent. Aspen suckers on landings and in other openings will tend to maintain aspen presence on the site.

Aspen Canopies with Coniferous Understories:

1. Aspen canopy trees may be healthy, and the conifers can be cut to increase the herbaceous layer. Eventually it will be necessary to reproduce the aspen.
2. Conifers can outproduce aspen on many sites. On such sites, the aspen may be cut to release the conifers. The operation will produce gaps in the coniferous understory that will often be filled by aspen suckers, maintaining aspen presence on the site.

3. Aspen can outproduce conifers on some sites. The aspen may be clearcut and the understory removed, maintaining aspen dominance.

Aspen Stand With No Coniferous Understory:

1. Decadent stands may have a high aesthetic value. To maintain that value, small patches, totaling about 30% of the stand, may be clearcut, and stands rotated at 15-20 year intervals.

Decadent Aspen Stands:

1. Aspen snags and decadent trees are needed to maintain bird species diversity and abundance. In logging operations, some decadent trees should be left as nesting and feeding sites for these species.

Grazing

1. Monitor ungulate impacts from local herd units and adjust management practices to reduce impacts if any.
2. Implement appropriate livestock rates and enforce them.

Implementation Opportunities:

1. Incorporate Red-naped Sapsucker needs in forest management plans
2. Monitor and adjust elk and livestock use in Aspen stands to meet Red-naped Sapsucker needs.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING:

Recommended Research:

1. Determine optimal/minimum patch size and tree diameter at breast height (dbh) for Red-naped Sapsuckers.
2. Determine importance of snags and dead limbs for drumming.
3. Determine importance the shrub and herbaceous layer.
4. Determine importance of adjacent riparian areas.
5. Study wintering habitat needs of Red-naped Sapsuckers.

3. Coordination of Recommendations and Opportunities in Aspen

Although we have only recognized one priority species in aspen habitat, this is an extremely important forest type for many birds in Arizona and across the habitat range. Because aspen is a successional species, and almost always associated with other forest types, one of the biggest challenges for managers is maintaining existing stands and ensuring that regeneration of new stands is always occurring. Loss of preferred aspen habitat is the primary threat for Red-naped Sapsuckers. Aspen has been repeatedly documented as the principal nesting substrate for Red-naped Sapsuckers (Johnsgard 1979, Scott and others 1977, Zeiner and others 1990). Essentially, if we manage for a continual supply of mature aspen forests, we will manage for Red-naped Sapsuckers. Red-naped Sapsuckers require mature or large trees (> 25 cm (10 in) dbh) for nesting and prefer trees infected with heartrot. Since the lifespan of aspen trees is relatively short (approx. 200 yrs) compared to most mixed conifer species, avoiding conifer invasion requires active management. The management dilemma lies in how to maintain larger trees but also allow for regeneration of root suckers. Without eliminating or reducing the canopy, root suckers will not get established and conifers will eventually replace the mature aspen (Patton and Jones 1977). Clearcutting mature aspens stands will undoubtedly reduce nesting substrate for sapsuckers. However, in some instances this may be the best method to retain aspen at the site. Removal of non aspen trees is also recommended to allow for sprouting of aspen to take place (Walters and others 1982). Fencing new aspen sprouts is necessary to protect them from grazing ungulates. Prescribed fire is likely the most economical and accepted way to clear areas of mixed conifer and/or aspen being managed for aspen. Fires must be moderate to high intensity to be most effective.

Threats to aspen forests continue into the sapling stage, as young aspens are highly palatable to browsing ungulates. Ungulates continue to be a threat as trees mature by scarring trees and thus increasing the likelihood of canker infections. Monitoring ungulate impacts and adjusting management practices to reduce impacts, is recommended. Implementing appropriate livestock rates is also essential.

Table 6. Aspen Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Red-naped Sapsucker	-aspen -common understory is bracken fern and a diverse herb/grass layer	mature live stands large enough to create cavities.	elevation - 1980-3048 m (6500-10,000 ft), lower elevations likely in drainages and north facing slopes	-mature to old aspen stands -frequently use adjacent riparian areas of alder and willow to forage

Table 7. Special Factors for Aspen Priority Species

Priority Species	Special Factors
Red-naped Sapsucker	-dietary - sap eaters -highly migratory woodpecker (Neotropical Migratory Bird) -also descend to lower elevation in winter.

D. Pine Habitat

1. Habitat Description, Status and Importance

For this purpose, pine forest refers to northern Arizona Ponderosa Pine Forests, including pure ponderosa pine, and pine with Gambel oak (referred to as pine-Gambel oak).

Distribution: Spencer (1966) estimated that approximately 1,489,248 ha (3,680,000 ac) of commercial ponderosa pine forests exist in Arizona, representing approximately 5% of the total land area of the state. Over 65% of the area is in National Forest ownership (Conner and others 1989). The largest continuous stand of ponderosa pine in the world extends across central Arizona and New Mexico. It extends along the southern margin of the Colorado Plateau, and north of the Mogollon Rim as an unbroken band of trees about 40-65 km (25-40 mi) wide and nearly 480 km (298 mi) long (Cooper 1960). It occupies much of the mountain and plateau country above 1980 m (6500 ft), replaced by Douglas-fir, white fir, and other species above 2590 m (8500 ft).

Dominant Composition: The major vegetation associations that occur in northern and central Arizona are:

Ponderosa pine with a Gambel oak understory: This pine subset occurs on a wide variety of elevational and climatic ranges, most commonly found on warm dry slopes. The oak usually comes in after a site disturbance, such as fire or logging. New Mexican locust is often another understory species.

Ponderosa pine with intermingled groups of aspen: This type is found mostly on the west and north sides of the San Francisco Peaks, and is generally found in mesic or moist conditions. Small groups of aspen are found in pine and mixed conifer stands on the Mogollon Rim and the Kaibab Plateau. Firs are overtaking many of these stands and shading out the aspen. Johnson (1993) estimated that aspen in the Southwest has decreased by 89,840 ha (222,000 ac), or 46%. Fire exclusion and heavy livestock grazing have contributed to this decline.

Ponderosa pine with a ponderosa pine understory: Relatively pure stands of ponderosa pine. Ponderosa pine regeneration is dominant and occupies more than 75% of the site but may sometimes have inclusions of Douglas-fir, white fir, and Gambel oak. In other parts of the state (lower elevation, dryer), this habitat may be associated with netleaf oak. Also, as moisture and elevation decrease, ponderosa pine intergrades with Rocky Mountain juniper, alligator juniper, and Utah juniper.

Community composition varies widely with geographic location, soils, elevation, aspect, and successional status. Ponderosa pine may be either a climax or a seral species, depending on

elevation and precipitation. In climax forest, ponderosa pine stands are made up of many small, even-aged groups rather than growing in a true uneven-aged structure. Large disturbances may result in large even-aged stands (Burns and Honkala 1990).

Disturbances have influenced the distribution of ponderosa pine stands, with fire the primary factor. Where fires are frequent, the fire-resistant bark protects older trees, while firs and young pines are killed. Ponderosa pine has thus become a dominant seral species across large areas at mid-elevations. Aggressive fire control over the past 80 years has resulted in Douglas-fir and true firs developing in the understory on the more mesic or moist sites. In many cases, fire suppression and selection of pines for harvest have resulted in type conversions of stands from pine to true fir stands (Burns and Honkala 1990).

Historical Uses: The ponderosa pine forest provided a source of food, building, and other raw materials for Native Americans. The area was lightly settled by Europeans before 1848. After the Civil War, livestock raising became a dominant industry as the railroads opened up markets to the east. The railroads also opened up the region to timber and mining activities (Glover 1984). With European settlement in the 1800s, it has been important to the economic and social development of the southwestern region. The ponderosa pine forest was heavily cut in the late 1800s to supply railroad ties, fuelwood, building material, and mine timbers (Teclé and Covington 1991). The forested watersheds were also good sources of water for settlers, as well as for communities in the desert valleys below.

Management Issues: Ponderosa pine is the dominant commercial timber species in Arizona. Early logging generally consisted of individual tree selection. Accelerated logging in the 1970s and 1980s targeted stands of large trees and concern developed over the loss of old-growth stands.

Fire suppression and overgrazing have contributed to the development of dense stands of young to middle-aged timber, which are more susceptible to high intensity stand replacing fires, due to the increase in laddering (small trees carry fire into the crowns of large trees), and increases in insect and pathogen outbreaks. Other changes due to increased density include a decrease in water availability and run-off, changes in wildlife habitat and decreases in forage quality and quantity.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in pine habitat. A table at the end of the Pine section highlights species habitat needs in a quick reference format (Table 8).

NORTHERN GOSHAWK (*Accipiter gentilis atricapillus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Northern Goshawk are: Wild Turkey, Flammulated Owl, Mexican Spotted Owl, Williamson's Sapsucker, Northern Flicker, Steller's Jay, Pygmy Nuthatch, Western Bluebird, American Robin, Solitary Vireo, Grace's Warbler, Western Tanager, and Red Crossbill.

Distribution: The Northern Goshawk is Holarctic in distribution. In North America it occurs primarily in boreal forest, but the species also ranges far to the south in montane forest of the western United States and Mexico. The most widespread subspecies (*A.g. atricapillus*) occurs from the northeastern United States across the boreal forests of Canada to Alaska, and southward through upland forests of the western United States. Two other weakly differentiated subspecies are variously accepted in North America: *A.g. laingi* in forests on islands and along the coast of extreme northwestern United States and Canada to southeast Alaska (AOU 1957, Palmer 1988), and *A.g. apache* in montane forests of southeastern Arizona, southwestern New Mexico and northern Mexico (Hubbard 1978, Wattel 1973, Whaley and White 1994).

Ecology: Goshawks are generally non-migratory. However, in the northern portion of their range, large southward migrations occur during winters when prey are limiting (Doyle and Smith 1994, Mueller and Berger 1967, Mueller and others 1977). In the Southwestern United States, there is evidence that goshawks move to lower elevation habitats or remain on or near their breeding home range for the winter (Beier 1997, Ingraldi 1998, Reynolds pers. comm.).

Goshawks are believed to be monogamous (Newton 1979), although a few instances of "divorce" have been documented (Detrich and Woodbridge 1994, Reynolds and others 1994). Goshawks generally breed at 3 years, when they achieve full adult plumage. A few cases of subadult females (birds between 1 and 2 years of age with primarily juvenile plumage) have been documented (e.g. Henny and others 1985, Younk and Bechard 1994). No cases of breeding subadult males have been reported and one study suggested these young males are physiologically incapable of breeding (Hoglund 1964). McGowan (1975) hypothesized that subadult females are only able to breed in years of high prey availability. Several cases of both male and female young adult birds (between 2 and 3 years of age with primarily adult plumage) have been reported (McGowan 1975, Reynolds and others 1994, Younk and Bechard 1994).

Goshawks have large breeding home ranges (570–3,500 ha or 1410-8650 ac) with males' home ranges generally larger than females' (Squires and Reynolds 1997). Nest areas within

home ranges are defended. Home ranges (but not nest areas) of adjacent pairs may overlap, especially in habitats where nesting populations are at or near saturation (Reynolds and Joy 1998). One to 8 alternate nests may be maintained in a breeding home range. One nest may be used in sequential years, but often an alternate is selected (Squires and Reynolds 1997). Males do most of the foraging while females appear to select the nest site, do most of the nest building, incubating and brooding, feed the young, and defend the nesting area. Goshawks typically initiate breeding activities in March. Egg-laying usually occurs between late April and early May and hatching between late May and early June. Females may forage in and around the nest stand during the nestling period, but males still provide most of the prey. Only the female directly feeds the young prior to fledging, which usually occurs in July. Fledglings are dependent on their parents for approximately 6 weeks, while they complete feather growth and learn to hunt (Squires and Reynolds 1997). For the first 3 weeks, fledglings tend to stay in or close to the nest stand (Kennedy and others 1994). Dispersal is abrupt, with males dispersing a few days earlier than females (Kenward and others 1993a,b; Ingraldi 1998).

Squires and Reynolds (1997) reported goshawk breeding density estimates from North American populations ranging from less than 1 pair up to 11 pairs per 100 km². Productivity in North America ranges from 1.4 to 3.9 young per successful nest (Squires and Reynolds 1997).

Goshawks prey on a variety of birds and mammals. Reptiles and insects are taken occasionally. Diets differ among populations as prey availability changes regionally and seasonally (Squires and Reynolds 1997). Important prey in the Southwest include cottontails, tree squirrels, ground squirrels, chipmunks, grouse, columbids, woodpeckers, jays and robins (Reynolds and others 1992). Goshawks are described as short duration sit-and-wait predators. They travel through the forest in a series of short flights, punctuated by brief periods of prey searching from elevated hunting perches (Squires and Reynolds 1997).

Habitat Requirements: Goshawk nesting habitat has been extensively described. Generally, goshawk nest sites are in mature and old growth forest stands with relatively high canopy closure (e.g. Austin 1993, Crocker-Bedford and Chaney 1988, Ingraldi and MacVean 1995, Kennedy 1988). Across the West, goshawks use a wide variety of forest types, but in the Southwest, goshawks primarily use ponderosa pine and mixed conifer forests, although use of other forest types (e.g. spruce-fir, Madrean oak woodland, pinyon-juniper woodland) has also been documented (Snyder 1995, USFWS 1998). In the West, goshawks nest in both deciduous trees (e.g. cottonwoods, aspen) and conifers (USFWS 1998). In the Southwest, goshawks frequently nest in ponderosa pines. Goshawks build large stick nests which are often placed on a horizontal limb close to the trunk in the low portion of the tree's canopy (Snyder and Snyder 1998). In an Arizona study in ponderosa pine habitat (Ingraldi and

MacVean 1995), goshawks selected nest sites with higher canopy density, larger diameter stems and a higher frequency of large (≥ 30.5 cm (12 in) dbh) stems. Nest sites also had more ground litter. Nest trees were taller, had smaller live crown ratios, tended to be part of a clump of trees with interlocking crowns, and were on the lower third of a slope. These results were similar to Kennedy's (1988) findings in New Mexico.

Foraging habitat has been less studied. Goshawks have been observed hunting in a diversity of habitats, varying from large openings to dense forests. However, limited evidence suggests goshawks preferentially forage in forests with closed canopies (Austin 1993, Beier and Drennan 1997, Bright-Smith and Mannan 1994).

Reynolds and others (1992) described habitat relationships of primary goshawk prey in the Southwest; some prey species prefer forest openings, but most use mature and older forests. In Arizona, Beier and Drennan (1997) radio-tracked foraging goshawks to determine whether hawks selected foraging habitat based on prey abundance or forest structure. Goshawks apparently did not select foraging sites based on prey abundance; indeed, abundances of some prey were lower on used than on contrast plots. Goshawks selected foraging sites with higher canopy closure, greater tree density, and greater density of large trees (> 40.6 cm (16 in) dbh). These results were consistent with the hypothesis that goshawk morphology and behavior are adapted to hunting in moderately dense, mature forests and that prey availability, as influenced by forest structure, is more important than prey density in habitat selection.

Few goshawk studies in North America have investigated winter habitat use. In Arizona, Beier (1997) found adult goshawks wintered in ponderosa pine forest and pinyon-juniper woodlands during two winters. In general, females remained in ponderosa pine in the general vicinity of their nest stands throughout both winters. Most male goshawks moved 5-10 miles from the nesting area and generally into the closest pinyon-juniper woodlands, although one male moved up into the nearest mixed-conifer forest. Most males made return trips to their nesting areas during the winter and did not establish a distinct winter range. The females appeared to exhibit more overwinter fidelity to the nest stand than males. Unlike Beier and Drennan's (1997) breeding season study, Beier (1997) found winter foraging habitat selection could not be discerned based on vegetation structure. Used vs. unused areas were similar, with used habitat having slightly more medium-sized trees and denser canopy.

Habitat and/or Population Objectives:

Population Objectives:

1. Maintain current distribution in montane conifer forests in Arizona (ponderosa pine, mixed conifer, and spruce-fir habitats).

2. Manage for 5-10 pairs per 100 square km across entire range in suitable habitat in AZ.
3. Maintain stable populations in such areas as: Kaibab Plateau, central Mogollon Rim, White Mtn., Chuska Mtns. (Navajo Nation), and the southeastern Sky Islands.

Habitat Strategy

1. Maintain old growth and mature forest with scattered small openings, a relatively open understory, a well developed herbaceous and shrub layer, large snags and large dead and down woody material. Maintain a relatively dense canopy in nest areas.
2. Maintain a minimum of 180-year rotation before the final timber harvest.
3. For specific habitat recommendations refer to the following documents:
 - a) Reynolds , Richard T.; Grahame, Russell T.; Reiser, M. Hildegard; and others 1992. *Management recommendations for the northern goshawk in southwestern United States*. Gen. Tech. Rep. RM-217. Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 90 p.
 - b) Arizona Game and Fish Department review of U.S. Forest Service strategy for managing northern goshawk habitat in the southwestern United States. 1993. Arizona Game and Fish Department, Phoenix, Arizona.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Timber harvest practices that remove older, larger trees and simplify forest stand structure, management practices that remove dead and downed trees, and catastrophic fire are the primary management issues facing the Northern Goshawk today. Grazing that reduces or eliminates the herbaceous layer and degrades prey habitat is also a management concern. Northern Goshawks are sensitive to disturbance during the nesting season thus human activities in known nest areas and post fledging family areas (PFA) should be limited. Active management including fuel reduction programs that thin from below and use fire to maintain structural diversity in forest stands is recommended. Management practices that retain and promote large trees are also encouraged.

Northern Goshawk management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Grazing

1. Follow allowable use guidelines to maintain herbaceous layer to support Northern Goshawk prey base.
2. Follow livestock levels and seasonal use dates as outlined in the management of northern goshawks in the *Management recommendations for the northern goshawk in southwestern United States* document (USFS 1996).

Fire

1. Implement fuel reduction programs that thin from below, focus on small tree component, and achieve a clumpy distribution.
2. Manage forests to maintain large snags and trees, dead and down woody material and an uneven-aged forest.

Silvicultural Practices

1. Manage forests to retain and promote larger and older trees and promote uneven-aged forest stands.
2. Thin from below, focus on small tree component and maintain clumpy distribution.
3. Observe seasonal restrictions regarding timber harvest activities.

Recreation

1. Limit human activities during nesting season (March 1-September 30) in nest areas and post fledging family areas.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Evaluate the effectiveness of the Forest Service's current Northern Goshawk Guidelines (USFS 1996).
2. Evaluate effects of "featured species" (i.e. Mexican Spotted Owl) habitat management guidelines on Northern Goshawks.
3. Determine how changes in forest structure and landscape patterns affect population viability (Squires and Reynolds 1997).
4. Determine role of insects, diseases, wildfires and other natural disturbances in sustaining desired forest conditions (from the USFS Technical Report RM-217)
5. Collect goshawk demographic information (From the USFS Technical Report RM-217).
6. Determine Northern Goshawk foraging habitat preferences in various forest types (Squires and Reynolds 1997).
7. Develop improved monitoring procedures to determine population trends.
8. Study Northern Goshawk wintering biology.

OLIVE-SIDED FLYCATCHER (*Contopus borealis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Olive-sided Flycatcher are: Flammulated Owl, Williamson's Sapsucker, Purple Martin, Violet-green Swallow, Pygmy Nuthatch, and Grace's Warbler.

Distribution: The Olive-sided Flycatcher's breeding range extends throughout western North America from western and central Alaska and central Yukon, south through the Sierra Nevada Mountains to northern Baja California and through the Rocky Mountains into northern Arizona and western Texas (Altman 1997). Eastward it extends across Canada and into northeastern United States. The Olive-sided Flycatcher's winter range extends southward as far as southeastern Brazil and western Peru with most of its wintering grounds in northwestern Venezuela, the Andes Mountains of north and western South America, and Panama (Altman 1997). In Arizona, its range is limited to north of the Mogollon Rim in higher elevation ponderosa pine and mixed conifer forests.

Ecology: Arrival on breeding grounds is generally late across its range from mid-April to late May in Arizona. Late arrival has been attributed to a higher abundance of their primary diet source, flying insects, especially honey bees (Bryant 1975, Ehrlich and others 1988, Robins 1970). The earliest nesting record in Arizona was an occupied nest found on 11 June near Happy Jack, and the latest record was a nest with young found on 1 August near Green's Peak in the White Mountains (ABBA unpubl. data). Males are vigorous defenders of their territory and nest area (Altman 1997, Ehrlich and others 1988). Nests are generally placed high up in the tree (usually coniferous), distant from the main trunk, on a horizontal branch (DeGraaf and Rappole 1995, Ehrlich and others 1988, Harrison 1975). The open cup nest is constructed of twigs, lichens, moss, and pine needles, lined with fine grasses, lichens, and rootlets and held firmly to the branch with spider webs (Bent 1942, Ehrlich and others 1988). Departure to the wintering grounds occurs early across the flycatcher's range, with most birds leaving breeding areas in late August through late September. This early departure may be a result of the extreme distances they travel to wintering grounds (Altman 1997). Olive-sided Flycatchers travel farther in migration than any other North American breeding flycatcher (Murphy 1989).

Habitat Requirements: In Arizona, the Olive-sided Flycatcher is primarily associated with mixed conifer forests, subalpine forests with Engelmann spruce, pure ponderosa pine forests and montane riparian wetlands with aspen, Douglas-fir, white fir and ponderosa pine (T. Corman, AGFD, pers. observ.). They prefer forest edges and openings either natural or man-made, and tend to increase in density as canopy cover decreases. Olive-sided Flycatchers have been linked to burned areas of mixed conifer and ponderosa pine (Altman 1997, Blake 1982, Lowe and others 1978). A correlation between higher densities of insects

and early post-burn areas has been suggested by the presence of other insectivorous birds such as the Western Wood-Pewee and Townsend's Solitaire (Granholtm 1982). The association with burned areas may not only be for the abundance of prey but for the open and edge physiognomy in these areas as well as abundant singing and foraging perches.

Habitat and/or Population Objectives:

Population Objectives

1. Increase the current population density to at least 3 birds/40 ha (100 ac) (Lowe and others 1978) in mixed conifer in Arizona.
2. Increase distribution across historical range in Arizona.

Habitat Strategy

1. Maintain and/or create openings that mimic natural disturbances (i.e. early post-burn area, insect infestations, blow-down areas, etc.) with 0-39% canopy closure (Verner 1980), tall trees with dead tops and/or tall snags.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The lack of natural history information for this species has made assessment of declines difficult. Loss of extensive tracts of montane evergreen forests on the wintering grounds and habitat loss through conversion to non-forest and younger successional stages on breeding grounds have been suggested as possible factors (Altman 1997). Also, management practices that alter natural fire regimes may reduce the post-fire habitat preferred by the flycatcher. Recent management practices, such as prescribed burns, that attempt to mimic natural fire regimes do create more edge and open areas, but may not capture all necessary components and resources used by the Olive-sided Flycatcher. These practices may not benefit the species as much as expected. Large territory sizes and strong site fidelity on both breeding and wintering grounds have also been speculated to contribute to declines in Olive-sided Flycatchers (Altman 1997).

Olive-sided Flycatcher management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Maintain or create tall snags for perches.
2. Apply presettlement restoration treatments to appropriate Olive-sided Flycatcher habitat.

Silvicultural Practices

1. Manage forests for uneven forest structure (see Goshawk Guidelines).
2. Manage salvage logging areas to retain tallest snags.

Fire

1. Apply Goshawk guidelines for fire regime.
2. When considering prescribed burns, protect large (61 cm (24 in) dbh plus) trees.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Investigate landscape-scale habitat relationships.
2. Collect natural history and status information for Arizona range.
3. Investigate possible habitat loss on wintering grounds (Marshall 1988).
4. Evaluate insect control and effects on Olive-sided Flycatchers.
5. Monitor Olive-sided Flycatcher productivity in managed habitats to compare census data.
6. Determine the most appropriate fire treatment for Olive-sided Flycatcher in Pine habitat.

Outreach Needs:

1. Request breeding locations from local birders.

CORDILLERAN FLYCATCHER (*Empidonax occidentalis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Cordilleran Flycatcher are: Red-faced Warbler, Painted Redstart, Hermit Thrush, and MacGillivray's Warbler.

Distribution: Cordilleran Flycatcher breeds from southeastern Washington, southwestern Alberta, northern Idaho, western Montana, Wyoming, and western South Dakota south (generally east of the Cascades and Sierra Nevada) to northern California, Nevada, central and southeastern Arizona, the Mexican highlands to Oaxaca (west of the Isthmus of Tehuantepec), Puebla and west-central Veracruz, and east to western Nebraska (rarely), central Colorado, central New Mexico, and western Texas (AOU 1989). Winter range is described as southern Baja California and northern Mexico south through the breeding range. Casual winter visitor to central California and southern Arizona (AOU 1989). They are

common summer residents in the boreal and transition zones throughout central and eastern Arizona (Monson and Phillips 1981). Recently, Cordilleran Flycatchers were observed nesting locally on the Kaibab Plateau (ABBA unpubl. data)

Ecology: The “Western” Flycatcher was split recently into the Pacific Slope Flycatcher (*E. difficilis*, previously *E.d. difficilis*) and the Cordilleran Flycatcher (*E. occidentalis*, previously *E. d. hellmayri*) (AOU 1989). The split of the species was based on differences in vocalizations and allozyme frequencies, and their sympatric distribution in the Siskiyou region of northern California (Johnson and Marten 1988). Phillips (1994) disputes the acceptance of these two forms as separate species. In the field, the only distinguishing characteristic between the two is the call note of the male.

In Arizona, the Cordilleran Flycatcher arrives on the breeding grounds in mid-May and leaves in September. Nest height varies from 0-9 m (0-30 ft). Their nest is a cup of green and dried leaves and moss, with finer leaves, bark strips lining the cup. Cordilleran Flycatchers are rare cowbird hosts.

Cordilleran Flycatchers prefer shady conditions, even during migration. Foraging occurs beneath the crowns of the trees; look-out and singing posts are well beneath the leafy canopy and shaded, though they may be up to 12 m (40 ft) off the ground (Grinnell and Miller 1944).

Habitat Requirements: Cordilleran Flycatcher breeding habitat includes spruce, fir, aspen, and pine forests, preferably in moist and shaded forests. It also inhabits hollows, canyon bottoms, and riparian woodlands. Natural nest sites include rock crevices, niches formed by scars in trunks (especially aspen), tree roots, cavities in small trees, and in forks of small branches (Ehrlich and others 1988, Paine and Martin 1995). They are also known to nest on rafters and out-buildings. Rock crevices provided 27%, live aspen trees 23%, and aspen snags 12% of nest sites in studies on the Mogollon Rim (Paine and Martin 1995).

Rosenstock (1996) described habitat relationships of breeding birds in northern Arizona pine forests and found significant relationships between the abundance of Cordilleran Flycatchers and several habitat characteristics. Cordilleran Flycatchers increased with increasing canopy cover and were most abundant in stands with > 50% canopy cover. They were also more abundant in stands with more homogenous canopy. Cordilleran flycatchers were most abundant in stands with 5-20% of pine basal area in 1-5 inch (2.5-12.4 cm) dbh stems. Abundance was also correlated with within-stand variability of pine dbh. Cordilleran Flycatchers increased with snag density, and were most abundant in stands with > 3 snags per acre. Flycatchers were also most abundant in stands with > 20% of snags in decay class

2 (Thomas 1979; large limbs and stubs present, upper 10% of bole may be broken off, bark starting to slough, base solid).

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable or increasing population density.

Habitat Strategy

1. Maintain dense canopy closure in mid-to late-successional stages of dense, shady forest habitat with an understory of oak and sufficient dead and down trees for nesting substrate.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Breeding Bird Survey data indicate an increase in Cordilleran Flycatchers in both the western and central regions based on the years 1966-1993 (Stokes and Stokes 1996). However, there are some factors that could potentially have negative impacts on this species. Concerns about the loss of suitable habitat and habitat components ideal to the Cordilleran Flycatchers are primarily: loss of snags and downed logs for nesting and the loss of closed canopy causing reduction in cool microclimate that they are most frequently associated with.

Cordilleran Flycatcher management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Manage for >2 snags per 0.4 ha (1 acre) in pine cover type (Rosenstock 1996).
2. Manage for >383 ponderosa pines per 0.4 ha (1 acre) in pine cover type with stands having a high degree of variability of size classes of which <20% are smaller than 5" dbh (Rosenstock 1996).
3. Manage for >200 ponderosa pines per 0.4 ha (1 acre) in pine-Gambel oak cover type with stands having a high degree of variability of size classes of which <20% are smaller than 5" dbh (Rosenstock 1996).
4. Avoid management practices that will reduce or degrade Cordilleran Flycatcher nesting habitat (i.e. mechanical thinning of canopy and snags, prescribed fire that may decrease canopy etc.).
5. Promote longevity of snags.

Implementation Opportunities

1. Encourage wildlife biologists and/or land managers to consider Cordilleran Flycatcher habitat needs in project analyses.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine important landscape-scale habitat relationships.
2. Study wintering habitat needs.
3. Determine microhabitat needs for Cordilleran Flycatchers.

Outreach Needs

1. Request local birders to report breeding locations.
2. Provide information to land managers about habitat needs.

PURPLE MARTIN (*Progne subis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Purple Martin are: American Kestrel, Lewis' Woodpecker, Olive-sided Flycatcher, Tree Swallow, Violet-green Swallow, Pygmy Nuthatch, Western Bluebird, Mountain Bluebird.

Distribution: Breeds from southwestern British Columbia south to Baja California; and from northeastern British Columbia to New Brunswick south to Mexico, the Gulf Coast, and southern Florida. Local in the Rocky Mountains but avoids most other mountainous areas (DeGraff and others 1991). Winters in South America east of the Andes from Venezuela south to northern Bolivia and southeastern Brazil (Ehrlich and others 1988). In Arizona, they breed across the Mogollon Plateau region, extending to Williams, Mount Trumbull, the Natanes Plateau, the Sierra Anchas, and the Prescott region. Purple Martins are also found in the Chiricahua Mountains but absent from other mountains of southern Arizona. They use saguaro associations of south-central Arizona west to the Ajo Mountains and north to near Picacho, Florence, Roosevelt Lake, and the lower San Pedro Valley. Purple Martin are rare outside their breeding ranges (Phillips and others 1964).

Ecology: Purple Martins arrive in Arizona in early April and remain until early October (Phillips and others 1964). They feed on flying insects taken on the wing often at altitudes over 50 m (164 ft), and may occasionally feed on the ground. Food items include ants, wasps, beetles, grasshoppers, stink bugs, treehoppers, dragonflies, moths, butterflies, mosquitoes, horseflies, robber flies, etc. Typically, they don't forage when temperatures are

less than 9° C (48° F) or in the rain. If cold or adverse weather lasts more than 3-4 days, mortality can be substantial (Brown 1997). They drink and bathe on the wing (Ehrlich and others 1988). They gather in enormous premigratory communal roosts at the end of summer, which may include up to 100,000 birds (Ehrlich and others 1988).

Purple Martins nest in tree cavities excavated by woodpeckers, and occasionally in cliff niches. They use colonial birdhouses in the eastern United States but have not adapted to these in the West, where they tend to nest singly (Brown 1997, Phillips and others 1964). The nest is made up of grass, leaves, mud, feathers, and occasionally has a dirt rim to keep eggs from rolling out. Fresh green leaves added during incubation are thought to be used for their pesticidal properties. Cowbird parasitism is very rare; however, competition with House Sparrows and Starlings for nest sites can be high.

Considered as two subspecies in Arizona, exhibiting ecological races. Martins inhabiting the saguaro deserts (*P.s. hesperia*, used tentatively by Phillips 1964) are of decidedly smaller size than those found in north and central Arizona (*P.s. arboricola*). The two habitats (and distributions) are in close proximity in the Roosevelt and Coolidge Lake areas.

Habitat Requirements: In general, Purple Martins inhabit open and cut over woodlands, open grassy river valleys, meadows around pools, shores of lakes, marsh edges, agricultural lands, saguaro deserts, parks and towns. They prefer habitats near open water. In Arizona pine forests, martins prefer areas with a high snag density, adjacent to or in open areas. The lack of Martins in apparently suitable nesting habitat suggests still unknown habitat requirements in Arizona forests.

Habitat and/or Population Objectives:

Population Objective

1. Maintain and/or increase the current distribution and current level of breeding activity in ponderosa pine forests from the South Kaibab National Forest east along the Mogollon Rim to the White Mountains.

Habitat Strategy

1. Maintain tall (150 to 200 ft) snags (Sharp 1992) in forest openings and close to water.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The Purple Martin was on the Audubon Society's Blue List from 1975-1981, and on the Special Concern list 1982-1986. Forestry practices that removed snags greatly reduced the availability of natural nest sites. Purple Martins do not use colonial nest boxes in western states, and suffer from a lack of nest sites in many areas. House Sparrows and Starlings compete for nest cavities and can cause local extinction. Brawn and Balda (1988) state that the Purple Martin has nearly been extirpated from the ponderosa pine forest since fire suppression has resulted in much denser conditions and logging has reduced the number of snags and large old trees. Currently, Purple Martins nests only in clusters of old, dead pines containing numerous woodpecker holes. Pesticide use on wintering grounds may be a potential threat.

Purple Martin management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Create snags where possible and promote longevity of existing large snags by raking duff away from snag or otherwise protecting the snags, before prescribed burns.
2. Use prescribed fire and mechanical thinning to reduce tree densities.
3. Manage natural and prescribed fires create openings in forests.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine Purple Martin distribution to learn more about habitat relationships.
2. Determine nest structure needs, and further explore their use of artificial structures. Will Purple Martins in Arizona use a vertical-nesting pole with multiple nesting holes rather than a typical Martin House?
3. Study diet.
4. Collect information on colonial nesting.
5. Collect information on premigratory communal roost habitat requirements.

Outreach Needs:

1. Request local birders to report breeding and roost locations.
2. Provide information to land managers about habitat needs.

3. Coordination of Recommendations and Opportunities in Pine

As with so many bird species, the loss of habitat is the primary issue for priority birds in pine habitat. Since pine is the primary commercial forest type, birds of the pine forests face potentially rapid habitat loss, in addition to threat of catastrophic fires and continued human development of pine forests in Arizona. Three of the priority birds selected in pine habitat require snags as a critical component of their habitat structure. Managing for snag recruitment trees, creating snags, and promoting longevity of existing snags is recommended for three species (Olive-sided Flycatcher, Cordilleran Flycatcher and Purple Martin). All four species require older, taller trees for nesting, foraging, perching and roosting. Promoting larger and older live trees is also recommended for all pine priority species.

Using fire as a management tool to create desired forest conditions and reduce fuel load, is recommended as an efficient method for all four species. Forest thinning will benefit the Purple Martin and the Olive-sided flycatcher. On the other hand, the Northern Goshawk and the Cordilleran Flycatcher require a dense canopy for nesting, for foraging and for maintenance of moist forest conditions. The use of fire as a management tool would not only allow managing for specific structural aspects throughout forest stands, but can also increase the density of insects immediately following fire. This is an additional benefit since three of the priority species in pine habitat are insectivores. Silvicultural practices recommended in the Northern Goshawk Guidelines such as protecting large trees, retaining the tallest snags, and maintaining uneven aged and clumpy forest stands will benefit all four species and are recommended.

Grazing may have an adverse effect on prey base for the Northern Goshawk as well as on insect prey of the other three species. Human activity in nest areas during the breeding season, including road building and recreation, could adversely affect nesting Northern Goshawks and is discouraged.

Table 8. Pine Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Northern Goshawk	-ponderosa pine, mixed conifer, spruce-fir, aspen.	-dense canopy (nesting) -interspersed small openings -snags, downed logs and woody debris -open understory with an herbaceous-shrubby component (foraging) -mid-aged to mature and old forests	-drainages important (nest tree base often in lower third of drainage and nest often level with ridge)	-associated with drainages, trails, primitive roads or small clearings
Olive-sided Flycatcher	-ponderosa pine, Douglas-fir,	-multi-level, mature forest, fairly open canopy, "clumpiness" -dead branches for foraging -live mature pines for nesting -snags important	-may occur on higher areas of slopes	-often occur at edge of early post-burned areas for foraging and singing -most common in patchy areas of closed and open habitats -patch size does not seem to be important -most common in mixed conifer where selective overstory removals have occurred (White Mts) -most common where tall conifers overlook ridges and canyon tops.
Cordilleran Flycatcher	-ponderosa pine, Douglas-fir, maple, oak, aspen	-dense canopy closure -mid-late successional	-drainages to create a cool microclimate	
Purple Martin	-ponderosa pine	-open canopy -open midstory cover -open understory cover -high snag density	-large snags, cavities -open space for flying	-snags need to be close to or in open areas -just above and below the Mogollon Rim

Table 9. Special Factors for Pine Priority Species

Priority Species	Special Factors
Northern Goshawk	-primarily monogamous -may maintain up to 8 alternate nests in a breeding home range -important prey are rabbits, squirrels and a variety of birds
Olive-sided Flycatcher	-prefers forest edges and openings -arrival on breeding ground is generally late (may be as late as June) -maintain large territories and have high site fidelity
Cordilleran Flycatcher	-need snags and downed trees for nesting -rare cowbird host
Purple Martin	-often prefers habitat near open water -prefers tall snags adjacent to open areas

E. Pinyon-Juniper Habitat

1. Habitat Description, Status and Importance

The pinyon-juniper habitat type is one of the most widespread habitats in the southwestern United States (Brown 1994, LaRue 1994), extending over large areas of Utah, Colorado, Arizona, Nevada, and New Mexico (Balda and Masters 1980, Tueller and others 1979; Fig. 1). The total acreage estimates range widely (between 43 and 100 million ac) depending on the definition of pinyon-juniper woodland; the latter figure includes juniper-invaded grasslands. In Arizona, there are approximately 5,328,711 ha (13,167,460 ac) of pinyon-juniper habitat (Brown 1994).

Pinyon-Juniper is a cold-adapted evergreen woodland situated above desert or grassland vegetation and below ponderosa pine forests (Pieper 1977); 1500-2300 m (4650-7130 ft) (Brown 1994). The habitat is characterized by varying co-dominance of juniper and pinyon pine. Junipers are often the more abundant of the two dominant species, but pure stands of either species may occur. Often, as elevation and moisture increase, pinyon pines increase, juniper decrease, total tree density increases, and trees become larger in stature (LaRue 1994, Pieper 1977). Typically, Juniper is dominant at lower elevations with pinyon dropping out completely at the lowest elevation of juniper occurrence.

Several species of juniper are dominant or co-dominant, including Rocky Mountain juniper, Utah juniper, one-seed juniper, alligator juniper, and California juniper. The most common pinyon is Rocky Mountain pinyon, while single-leaf pinyon and Mexican pinyon also occur (Consult Brown 1994, LaRue 1994 and Pieper 1977 for distributional information on the individual species). Understory is variable from completely open to quite dense, especially where sagebrush is present. The stature of pinyon-juniper rarely exceeds 12 m (37 ft) in height. Typically, pinyon-juniper exhibits an open woodland arrangement with well-spaced trees. However, depending on site variables, pinyon-juniper may range from an openly-spaced savanna to a closed forest.

Although soils underlying pinyon-juniper vary, they often are shallow, rocky and low in fertility and are derived from a wide range of parent material including: granite, basalt, limestone, sandstone, and shale (Pieper 1977).

As many as 73 species of birds have been reported to use pinyon-juniper habitat (Balda and Masters 1980). Pinyon-Juniper is also important as a seasonal habitat for elk and mule deer. Human uses of pinyon-juniper are for firewood, pinyon nuts, fence posts, charcoal, railroad ties, mining timbers, and livestock forage (Tueller and others 1979). Increasingly, pinyon-juniper is being recognized for its aesthetic, cultural, threatened and endangered species (Hualapai Mexican Vole, cactus species, 4 threatened and endangered plants (Welch's milkweed, sentry milk-vetch, Navajo sedge, and Jones' cycladenia), watershed, and recreational values (Gottfried 1994, Tueller

and others 1979). The culture and history of many rural and indigenous populations are connected to pinyon-juniper ecosystems (Gottfried and others 1994).

Wide-scale conversion of pinyon-juniper woodlands to grasslands began after World War II. However, due to fire suppression, large areas of former grassland have also been invaded by juniper. Encroaching juniper are usually found at a lower elevation than pinyon. There is no evidence that pinyon-juniper woodlands with mature pinyon trees 100-200 years old were formerly a grassland invaded by trees (Little 1977).

Conversion was accomplished by various methods including: cabling, bulldozing, hand chopping, grubbing, and burning. Dragging a chain between two dozer tractors was frequently the method of choice. Seeding with grass, especially crested wheatgrass, followed. Widespread conversion has decreased primarily because of high costs and low cost-benefit ratio but also to prevent destruction of archaeological sites (Hart Schwartz pers. comm., Lanner 1981). In Arizona, 485,624 ha (1.2 million ac) of pinyon-juniper were treated in this way from 1950-1961 (Gottfried and others 1994, Little 1977). This conversion occurred in two habitat types: grasslands, mostly at lower elevations where juniper had invaded, and pinyon-juniper woodlands. Conversion of natural pinyon-juniper woodlands to grasslands in the Southwest has included destruction of mature pinyon trees on at least a few hundred thousand acres (Little 1977). Seeding to improve forage has generally proved unsuccessful over large areas and is dependent on annual precipitation, amount of limestone in the soil, pretreatment tree cover, and soil nitrate-nitrogen content (Gottfried and others 1994). In one study, an undisturbed pinyon-juniper stand had greater cover of grasses and forbs than a cabled area after 20 years (Gottfried and others 1994).

The impact of pinyon-juniper conversion on native wildlife has been documented (Swenson 1977 and others). Mule deer and elk use was highest on undisturbed pinyon-juniper (Swenson 1977). The natural pinyon-juniper has wider diversity and higher individuals of bird species (with the exceptions of wintering flocking species) than converted areas (Swenson 1977).

Historic grazing practices have also had an effect both adjacent to and within the pinyon-juniper woodland matrix. These practices have reduced the site potential through soil and vegetation degradation. Soil compaction contributes to or causes increased soil erosion, decreased water infiltration, and reduced soil fertility. The loss of a continuous herbaceous cover especially in adjacent grasslands due to overgrazing has produced a situation where stands do not have enough fuel to carry a fire and eliminate young trees. Fire control has contributed also by allowing small trees to successfully out-compete grasses for water, nutrients and light. Grazing and erosion cause drying of surface soils, which favors deep-rooted species rather than grasses (Gottfried and others 1994).

Selective removal of pinyon will most likely have a serious impact on the breeding bird community (Balda and Masters 1980). Both pinyon and juniper play key roles in maintaining the integrity,

survival, and propagation of at least some components of the bird community. Both tree species provide different bird requisites at different times of the year (Balda and Masters 1980).

Removal of trees from illegal fuelwood cutting is also likely to have deleterious effects on the bird species that depend on this habitat. New roads are created from this practice causing increased soil erosion, and removal is usually focused on the large juniper trees which provide the primary food source in this system.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in pinyon-juniper habitat. A table at the end of the Pinyon-Juniper section highlights species habitat needs in a quick reference format (Table 10).

GRAY FLYCATCHER (*Empidonax wrightii*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Gray Flycatcher are: Plumbeous Vireo, Juniper Titmouse, Bewick's Wren, Pinyon Jay, Western Scrub-Jay, Black-throated Gray Warbler, Ash-throated Flycatcher, Western Bluebird, and Scott's Oriole.

Distribution: The Gray Flycatcher breeds in western North America from extreme southern British Columbia (Okanagan Valley), southcentral Washington, central and eastern Oregon, south-central Idaho, and southeastern Wyoming south through western and southern Colorado, eastern California, northern and east-central Arizona, and western New Mexico (AOU 1983). In Arizona, it breeds from the Arizona Strip region and the Navajo and Hopi nations south and east to the Bradshaw Mountains and northeastern Graham and central Greenlee Counties (McCarthy and Corman 1996). Its wintering grounds extend from southeastern California and central Arizona south along the Pacific Slope and interior of Mexico to Nayarit, southern Baja California, and Oaxaca (Howell and Webb 1995). In Arizona, it winters locally along the lower Colorado River, near the town of Kirkland, in the lower Verde River drainage south and east to the town of Sasabe, along the San Pedro River Valley, and very locally to the base of the Chiricahua Mountains (Monson and Phillips 1981).

Ecology: In Arizona, spring migration begins in late March, peaks in late April and early May, and continues with stragglers (rarely) to late May. The primary food for Gray Flycatchers is insects, including: butterflies, moths, bees, grasshoppers, and beetles. The scanning perches are on top of shrubs or small trees, and the flycatching airspaces are close to the ground. The flycatcher often will capture insects on the ground or on low plants

(Ryser 1985). From late May through July, nests are placed primarily 0.6 - 3.4 m (2 - 11 ft) high in a shrub or crotch of a juniper or pinyon pine (Terres 1980; ABBA unpubl. data). When nesting in juniper woodlands, the nest is largely made of strips of juniper bark and is therefore well camouflaged (ABBA unpubl. data). Estimated density of Gray Flycatchers ranges from 19-29 pairs per 100 ha (247 ac) (T.W. Haislip *in* Friedmann and others 1977; LaRue 1994). T.W. Haislip (*in* Friedmann and others 1977) documented moderate Brown-headed Cowbird nest parasitism in local populations in Oregon. In Arizona, fall migration begins in mid-August and continues through mid-October.

Habitat Requirements: Gray Flycatchers breed in semi-arid woodlands and brushy areas that include pinyon pine and/or juniper woodlands, tall sagebrush/greasewood plains, and open ponderosa or Jeffrey pine forests with pinyon and/or juniper understory. Nesting elevations range from approximately 1400-2300 m (4500-7500 ft), very locally to 2750 m (9000 ft) in Arizona (C. LaRue pers. comm.) and 3350 m (11,000 ft) in California (Small 1994). In Arizona, Gray Flycatchers are most common in larger and taller stands of pinyon pine and/or juniper with open understory sometimes interspersed with sagebrush, cliffrose, and barberry (ABBA unpubl. data). They may need some ground cover to support insect populations for foraging. Gray Flycatchers winter in arid scrub, edge or open riparian woodlands, and mesquite bosques usually below 1400 m (4500 ft) in Arizona.

Habitat and/or Population Objectives:

Population Objective

1. Maintain population density of >7 pairs per 40 ha (100 ac) (Masters 1979 1.8-3.6 pairs/40 ha (100 ac), LaRue 1994 7.6-11.5 pairs/40 ha (100 ac)) in Pinyon-Juniper on the Mogollon Rim and the Colorado Plateau.

Habitat Strategy

1. Manage for pinyon-juniper forests with pinyon to juniper ratio of 1:1 or higher and at least a 13% canopy cover (13%-26% canopy cover, LaRue 1994).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Breeding habitat loss and modification of Pinyon-Juniper woodlands has occurred through chaining, clearing, and burning of large, mature woodland tracts for livestock and ungulate forage, house and road development, and fuelwood cutting. Overgrazing by elk and livestock reduces groundcover, inhibits regeneration of shrubs, and increases local cowbird populations. Unitt (1987) suggests there may be an increase in cowbird nest parasitism rates of Gray Flycatchers which may become a serious problem in the future. In Arizona, winter

habitat loss includes removal of large tracts of pinyon-juniper woodlands for agriculture, grazing, and fuelwood cutting. Possible threats on wintering grounds in Mexico are largely unknown.

Gray Flycatcher management issues are listed in italics. Below each issue are Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Discourage clearing of large mature tracts of woodland habitat.
2. Encourage small-scale openings.

Grazing

1. Manage grazing pressure (for cattle and elk) to maintain shrub component and grass cover.

Commercial Operations

1. Manage for small-scale openings.
2. Seasonal restriction on fuelwood collection (personal and commercial).
3. Restrict cutting of larger pinyon pines and junipers.

Brown-headed Cowbird Parasitism

1. Maintain appropriate levels of livestock grazing in prime nesting habitat especially during nesting season (May through July).

Implementation Opportunities

1. Consider habitat needs in agency plans and projects, including stewardship projects.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Identify cowbird parasitism rates and their effect on productivity.
2. Identify possible threats on wintering grounds.
3. Quantify breeding habitat.
4. Determine effects of fuelwood harvest, fire, and grazing on habitat requirements.
5. Determine current population density in AZ.

Outreach Needs

1. Educate agency and public of the importance of pinyon-juniper habitat to birds as well as its economic and cultural values.
2. Provide information about the habitat requirements of pinyon-juniper birds to woodcutters and agency personnel.

PINYON JAY (*Gymnorhinus cyanocephalus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Pinyon Jay are: Hairy Woodpecker, White-breasted Nuthatch, Northern Flicker, Cassin's Kingbird, Mountain Chickadee, Clark's Nutcracker (foraging).

Distribution: Range of the Pinyon Jay is tied primarily to the distribution of pinyon-juniper woodlands of the Southwest and Intermountain regions of the United States. They breed as far north as central Montana and south to Baja California (Balda and Bateman 1971, Ligon 1978, Marzluff and Balda 1992). In Arizona, Pinyon Jays are permanent residents of pinyon-juniper woodlands and lower ponderosa pine forests in the northern and central part of the state (Balda and Bateman 1971), ranging east to Natanes Plateau, west to the Hualapai Indian Reservation, south possibly to Prescott area, and north to Mount Trumbull (Phillips and others 1964). Pinyon Jays are nonmigratory but may exhibit irregular nomadic movements of hundreds of miles outside normal range during fall and winter when pine seed crops are poor (Balda and Bateman 1971, Phillips and others 1964, Westcott 1964).

Ecology: Pinyon Jays are very early nesters, initiating egg-laying as early as February. Typically, they nest in pinyon-juniper woodlands but will also nest in ponderosa pine forests (approx. 2135 m (7000 ft), Balda and Bateman 1971, Marzluff and Balda 1992). Large flocks (up to 250 individuals) nest communally in traditional breeding areas. Courtship begins in November and pairs form in January-February. Pair bonds are long-term and mates interact throughout the year (Balda and Bateman 1971). Highly synchronous flock nest building begins late February to mid-March. Females incubate, but both parents feed nestlings. Older fledglings are fed by parents and helpers. Young attain independence at 16 weeks. Pairs will renest up to five times in a breeding season if earlier nesting attempts fail (Marzluff and Balda 1992). Most birds breed at age two and have an average lifespan of five years (Marzluff and Balda 1992).

Breeding is apparently triggered by abundant pinyon pine seeds which are harvested in fall and early winter and cached in breeding areas for use during late winter and early spring. Pinyon pine seeds provide the primary source of reproductive energy for nesting Pinyon Jays (Balda and Bateman 1971, Marzluff and Balda 1992). In years following poor pinyon production, breeding is delayed until April or May when other foods, primarily insects, become common (Ligon 1971). Pinyon Jays will also feed on ponderosa pine seed, fruits, eggs, nestlings, lizards. They feed on the ground, in foliage and hawk for insects (Balda and Bateman 1971).

The Pinyon Jay is a gregarious and highly socialized species. Large, highly integrated flocks are maintained year-round and use well-defined home ranges during most years. During poor seed crop years, individuals and flocks have been observed in southern Arizona as well as at treeline in northern Arizona harvesting limber pine seed (Phillips and others 1964, Westcott 1964, Balda and Bateman 1971). Largest flocks (100s to over 1000 birds) (Bent 1964) seen in late summer and winter.

Habitat Requirements: Food availability seems to be the most important factor determining colony breeding site selection (Gabaldon 1979). Open cup nests (usually one nest/tree) are placed in ponderosa pine, pinyon pine, Gambel's oak, juniper, and occasionally blue spruce trees. Nests are typically 1-8 m (3-26 ft) high and tend to be south-facing (Gabaldon 1979, Marzluff and Balda 1992). Gabaldon (1979) found nest trees were taller and had higher foliage density than surrounding trees. Gabaldon (1979) also found jays avoided trees with abundant pine cones, perhaps because these might attract predators. Many nests were located along roads and Gabaldon (1979) found these nests to have higher reproductive success. Balda and Bateman (1971) studied a well defined flock of about 250 birds which maintained a 21 km² (8 mi²) home range which included ponderosa pine forest, pinyon-juniper woodland and grassland. This flock used a traditional nesting area of about 95 ha (230 ac) (Balda and Bateman 1971).

Communal seed caching areas are discrete and located within a flock's home range. Generally, cache sites are sparsely vegetated, have good drainage and a southern exposure. Thus, these areas are snow-free or first to melt. Birds also tend to cache seeds close to tree trunks where less snow accumulates. Not only do these sites allow for easy retrieval of cached seeds during the early nesting season, but they also provide good conditions for seed germination. Many cached seeds are not consumed and germinate (Ligon 1971). Balda (1987:525) described the relationship between the pinyon jay and pinyon pines as "...one of the best coevolved, mutualistic plant-vertebrate examples known...".

Habitat and/or Population Objectives:

Population Objective

1. Maintain an increasing or stable population trend and distribution throughout pinyon-juniper woodlands in the Colorado Plateau and the Mogollon Rim physiographic areas.

Habitat Strategies

1. Maintain large, cone bearing pinyon trees (75 years or older, Little 1977) in a minimum of 7 sq mi patches (Balda and Bateman 1971) in mature pinyon juniper woodlands or pure pinyon pine woodlands.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

According to Breeding Bird Survey data, Arizona had the highest average statewide density for the Pinyon Jay from 1965-1979 (Robbins and others 1986). However, analyses of these data did not reveal any significant trends for this species. Balda and Marzluff's (1992) data for an intensively studied pinyon jay population in Flagstaff, from 1972-1986, indicated a declining population.

Three major factors, which vary annually, affect the long-term success of Pinyon Jay populations: size of pinyon pine crops, amount of nest predation, and harshness of the physical environment, particularly the amount of snow during the nesting season (Marzluff and Balda 1992). Although we have no control over the latter, the first two factors can be influenced by human activities. Primary management concerns related to these include: 1) habitat loss due to urbanization, as documented in the Flagstaff vicinity (Marzluff and Balda 1992), as well as to management of pinyon-juniper woodlands (e.g. chaining, burning) and potential habitat loss from *Ips* beetle invasion of stressed pinyon trees, 2) abundance of mature pinyon pine trees which provide the primary source of food for breeding pinyon jays and which can also be affected by land management practices, and 3) increasing numbers of American Crows and Common Ravens (important nest predators) in Pinyon Jay breeding areas near urban areas (also documented in the Flagstaff area) (Marzluff and Balda 1992).

Pinyon Jay management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Nest Predation

1. Consider local Common Raven control if their increased numbers are affecting nest success.

Habitat Loss/Habitat Assessment

1. Maintain extensive stands of pinyon with emphasis on cone-producing trees.
2. Limit collection of cone-producing pinyon trees for fuelwood (75 yr or older, Little 1977).
3. Identify and retain traditional home ranges.
4. Inventory pinyon-juniper structural stage distribution to determine how many mature stands (preferred by Pinyon Jay) exist.
5. Reduce *Ips* beetles by reducing the number of slash piles (winter hibernaculums).

Soil Erosion

1. Encourage small-scale openings to reduce erosion in denser, mature stands.
2. Use appropriate livestock and/or wild ungulate stocking rates or densities to promote grass and herbaceous growth.

Implementation Opportunities

1. Consider habitat needs in Agency plans and projects.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING:

Recommended Research

1. Determine amount of mature pinyon woodlands in Arizona.
2. Determine if Common Raven nest predation is a serious problem.
3. Determine the effects of fragmentation of nesting stands on Pinyon Jays.
4. Determine the landscape ecology configuration needs for species (i.e. fragmentation, edge effects).
5. Evaluate the effects of human pine nut harvest on Pinyon Jay's food availability.

Outreach Needs

1. Educate agency and public of the importance of pinyon-juniper habitat to birds as well as the economic and cultural values.
2. Give information about the habitat requirements of pinyon-juniper birds to woodcutters and agency personnel.
3. Educate agency and public on the unique traits of Pinyon Jays (i.e. communalism/mutualism, the "Johnny Appleseed" of the bird world).

GRAY VIREO (*Vireo vicinior*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Gray Vireo are: Ash-throated Flycatcher, Juniper Titmouse, Bushtit, Bewick's Wren, Blue-gray Gnatcatcher, Black-chinned Sparrow, and Scott's Oriole.

Distribution: The Gray Vireo breeds from Southern California (locally) and northwestern Baja California, southern Nevada, southern Utah, and southern Colorado south through western and central New Mexico, and isolated localities in the Texas and Oklahoma panhandles, and also southwestern Texas and northwestern Coahuila (A.O.U. 1983, Small 1994, Andrews and Richter 1992, Wauer 1973, Phillips and others 1964). In Arizona, Gray Vireos breed at mid-elevations from the Grand Canyon region east across the Navajo Nation

and south through the Mogollon escarpment into the southeastern portions of the state (ABBA unpubl.data, Brown and others 1984, LaRue in prep, Phillips and others 1964). Gray Vireos are rare migrants throughout the state (Brown and others 1984, Phillips and others 1964). They winter mainly in northern Mexico, southern Baja California and rarely in southern Arizona and the Big Bend region of Texas (AOU 1983, Howell and Webb 1995, Wauer 1973).

Ecology: The Gray Vireo arrives in southern Arizona in early April and northern Arizona in late April. They depart these regions in early and late September respectively (LaRue in prep, Phillips and others 1964). Gray Vireos are primarily insectivorous during the breeding season. During the winter, they are frugivorous and rely almost entirely on fruit of elephant trees (Bates 1992). They typically nest low in a small tree or shrub 0.5-2.0 m (2-6 ft) above ground (Ehrlich and others 1988). Young fledged at 13-14 days. Gray Vireos are known hosts of the Brown-headed Cowbird. Gray Vireos tend to occur at naturally low population densities.

Habitat Requirements: Gray Vireos breed in Arizona in open mature pinyon-juniper woodlands on canyon and mesa slopes from 975-2075 m (3200-6800 ft) in elevation. A broadleaf shrub component is typically present, often comprised of Utah serviceberry and single-leaf ash. Gray Vireos may also breed in situations dominated by a chaparral component (T. Corman, AGFD, pers. observ.). In northeastern Arizona, they were absent from woodland stands greater than 280 trees/ha (2.5 ac) (LaRue 1994).

Habitat and/or Population Objectives:

Population Objectives

1. Maintain stable or increasing populations across their range in Arizona.

Habitat strategy

1. Maintain an open pinyon-juniper woodland with a shrubby understory, especially on moderate rocky slopes.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Apparently some population declines of Gray Vireos have been noted in California (Small 1994) and the species is on Arizona's Wildlife of Special Concern list (AGFD 1996 draft). Although it is a known cowbird host, no negative impacts have been clearly identified at this time. The apparent extreme winter dietary specialization as well as the tendency to occur in

low densities, confers some intrinsic vulnerability which could result in population declines. Because of their tendency to occupy undisturbed canyon and mesa slopes, Gray Vireos may be relatively immune to habitat-related population declines. In general, life history of the Gray Vireo is still poorly known.

Gray Vireo management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Fire Suppression

1. Manage fire to maintain existing gray vireo habitat matrix and to prevent stands from becoming too dense.

Brown-headed Cowbird Parasitism

1. Discourage development of additional livestock water sources to reduce the number of cowbirds in Gray Vireo habitat.
2. Discourage highly intensive, short-term grazing that may greatly alter habitat structure and increase the presence of cowbirds.

Implementation Opportunities

1. Consider habitat management needs of Gray Vireo in agency plans and local projects.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the effects of Brown-Headed Cowbird parasitism.
2. Study Gray Vireo habitat selection.
3. Collect missing general natural history of Gray Vireo.
4. Determine natural fire regime/interval in successful breeding areas.
5. Restart the Forest Service pinyon-juniper initiative to acknowledge the benefits and uses of pinyon-juniper habitat.

Outreach Needs

1. Educate agency and public of the importance of pinyon-juniper habitat to birds as well as the economic and cultural values.
2. Give information about the habitat requirements of pinyon-juniper birds to woodcutters and agency personnel.

BLACK-THROATED GRAY WARBLER (*Dendroica nigrescens*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Black-throated Gray Warbler are: Plumbeous Vireo, Juniper Titmouse, Bewick's Wren, Pinyon Jay, Western Scrub-Jay, Ash-throated Flycatcher, Western Bluebird, and Scott's Oriole.

Distribution: The Black-throated Gray Warbler's breeding range extends from southwestern British Columbia south through the coastal states to northern Baja California. Eastward it extends from eastern Oregon through southern Idaho and Wyoming south to southeastern Arizona, southwestern New Mexico, extreme west Texas (breeding status unknown in Guadalupe Mountains), and northeastern Sonora, Mexico (Dunn and Garrett 1997, Guzy and Lowther 1997). The Black-throated Gray Warbler winters in Baja California, on the Pacific Slope and interior of Mexico, and in small numbers along the West and Gulf coasts of the United States (Guzy and Lowther 1997). In Arizona, this species is found breeding north of the Mogollon Rim and south through eastern Arizona, west to the Baboquivari and Bradshaw Mountains, Grand Canyon Region, and the Hualapai Mountains (ABBA unpubl. data, Monson and Phillips 1981). The Black-throated Gray Warbler is an uncommon winter resident in Phoenix, Tucson, and the Babaquivari Mountains (Monson and Phillips 1981).

Two races of Black-throated Gray Warblers are distinguished by differences in wing length, amount of white in tail, and song. *Dendroica nigrescens nigrescens* breeds from northwestern California to southwestern British Columbia, and *D. n. halseii* breeds in eastern Oregon and Washington south through Arizona, New Mexico, and Sonora, Mexico (Morrison 1990, Oberholser 1930). The former race winters in California and Arizona south to northern Mexico, while the latter winters only in Mexico (Morrison 1990). Some authors recognize these two races as distinct subspecies: genetic differences between Black-throated Gray Warblers of Washington and Arizona are as great as those between Townsend's warblers and hermit warblers (Bermingham and others 1992).

Ecology: The Black-throated Gray Warbler is a short-to-medium-distance Neotropical migrant whose migration route follows the coast and mountain ranges of western North America (Curson and others 1994, Guzy and Lowther 1997). Spring arrival dates in southern Arizona range from mid-March through May, and departure dates range from late July through October. Spring arrival dates in northern Arizona range from mid-April through May, and departure dates range from mid-July through early October (Phillips and others 1964). Nesting records from Arizona include: 12 nests with eggs found 4 May-19 June, with the majority of these nests found between 17 and 26 May (n = 7; Bent 1953); an occupied nest on 15 May 1993 in the Hualapai Mountains; a nest with young on 28 May 1995 in Coconino National Forest; and a nest with young on 10 July 1997 north of the

Kaibab National Forest on the Arizona (ABBA unpubl. data). Breeding Bird Atlas data suggest that the Black-throated Gray Warbler's breeding season begins in April in the southern part of their range (an adult was seen carrying food on 9 May 1993, and an adult was seen feeding recently fledged young on 19 May 1995) and extends into August (recently fledged young observed on 7 August 1996). The Black-throated Gray Warbler builds a deep cup nest of leaves, cocoons, oak mast, paper shreds, bark, and other plant material, and it is frequently lined with small feathers of other bird species (Harrison 1979). They typically raise one brood a year, though they may double-brood in some areas (e.g. Monterey County, California; Roberson and Tenney 1993).

The Black-throated Gray Warbler's diet consists almost exclusively of insects, especially caterpillars (Dunn and Garrett 1997). They primarily forage at the mid-canopy level by gleaning foliage, or occasionally by hover gleaning and sallying for flying insects (Dunn and Garrett 1997). This species is not social during the breeding season, but will join mixed-species flocks with other insectivorous birds during winter and migration (Dunn and Garrett 1997). Known predators of adults include Sharp-shinned Hawks and Cooper's Hawks (Reynolds and Meslow 1984), and likely predators of eggs and young include jays, crows, and snakes (Bent 1953, Grinnell and Storer 1924). There is little information on the extent which brown-headed cowbirds affect Black-throated Gray Warblers. Bent (1953) reported that brood parasitism was not a problem for this species, but recent reports suggest that parasitism rates are higher than previously thought or are increasing. Research from four different locales in the western United States suggests parasitism rates between 11% and 21% (see Guzy and Lowther 1997). Thirteen percent of Black-throated Gray Warbler family groups (n = 30) reported by the Arizona Breeding Bird Atlas (ABBA unpubl. data) had a fledgling cowbird.

Habitat Requirements: In northern Arizona, the Black-throated Gray Warbler is primarily associated with pinyon pine and juniper woodlands (occasionally with scattered ponderosa pine) and mixed oak-pine woodlands. In southern Arizona, this species occupies oak-alligator juniper woodland, Chihuahuan pine, Mexican pinyon pine, Emory oak, and Arizona white oak, as well as other mixed oak-conifer associations along canyons and steep slopes (Balda 1969, Dunn and Garrett 1997). Breeding habitat is frequently characterized by a brushy undergrowth of scrub oak, ceanothus, manzanita, or mountain mohogany (Dunn and Garrett 1997). During spring and fall migration, these warblers can be found in a variety of forest, woodland, scrub, and thickets similar to that used during the breeding season (AOU 1983), as well as desert washes and desert riparian areas (Troy Corman, pers. observ.). Individuals that winter in Arizona are primarily associated with cottonwood-willow and sycamore-mesquite vegetation (Monson and Phillips 1981). In addition, Black-throated Gray Warblers have become more common as winter residents in shade trees of urban areas, such as Phoenix and Tucson (Troy Corman, AGFD, pers. observ.).

Little information is available on microhabitat characteristics of nest sites. Nests are typically placed on a horizontal tree branch or near the main stem of a shrub (Harrison 1979). Of seven nests found in southeastern Arizona, six were in white or Emory oak and one was in juniper, average nest height was 7.5m (24.5 ft) (range 3.6-12.2 m or 12-40 ft), and nests were 1.2-3.0 m (4-10 ft) from the tree trunk (Harrison 1984). Other nests found in Arizona include one from the Chiricahua Mountains that was in a dense mistletoe clump, 0.46 m (1.5 ft) high and 0.86 m (3 ft) from the trunk of a scrub oak, and one from northern Arizona that was 3.25 m (10.5 ft) high in a juniper tree and 0.78 m (2.5 ft) from the trunk (ABBA unpubl. data).

Habitat and/or Population Objectives:

Population Objective

1. Maintain a population density of 11.5 pairs /40 ha (100 ac) (7.6-15.3 pairs/40 ha, LaRue 1994) in Pinyon-Juniper woodlands on the Mogollon Rim and Colorado Plateau.

Habitat Strategy

1. Manage for pinyon-juniper forests with a pinyon to juniper ratio of 1:1 or higher and at least a 13% canopy cover (13%-26% canopy cover, LaRue 1994).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

There is little information on overall population trends for the Black-throated Gray Warbler. Breeding Bird Survey (BBS) data suggest steady or slightly increasing numbers from 1966-1991 (Peterjohn and others 1995). This species does not appear to be greatly impacted by human activities and will occupy areas that have been altered. However, there have been no detailed studies of responses to habitat alteration, such as changes in densities, breeding success, and habitat use (Guzy and Lowther 1997). Techniques used for improving pasturelands, such as the removal of overstory trees from pinyon-juniper woodland, may adversely affect habitat use by Black-throated Gray Warblers (Sedgwick 1987). Continued alteration and loss of habitat may have cumulative effects unidentified to date. For example, land management practices that increase contact between Black-throated Gray Warblers and brown-headed cowbirds may have a substantial impact on breeding success.

Black-throated Gray Warbler management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Discourage clearing of large mature tracts of habitat.
2. Encourage small-scale openings in pinyon juniper woodlands.

Brown-headed Cowbird Parasitism

1. Manage livestock numbers to reduce the number of cowbirds in pinyon-juniper woodlands.
2. Discourage highly intensive, short-term grazing that may alter habitat structure and increase the presences of cowbirds.

Commercial Operations

1. Limit seasonal cutting of pinyon trees (May through July), especially larger sized trees.

Ips Beetles Outbreak

1. Reduce *Ips* beetles by reducing the number of slash piles (winter hibernaculums).

Implementation Opportunities

1. Educate agency and public of the importance of pinyon-juniper habitat to birds as well as the economic and cultural values.
2. Give information about the habitat requirements of pinyon-juniper birds to woodcutters and agency personnel.
3. Consider Black-throated Gray Warbler habitat needs in Agency plans and projects.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Research the general natural history of the Black-throated Gray Warbler including: breeding biology, foraging biology (species role in limiting number of devastating insects in pinyon), and habitat requirements.
2. Determine habitat selection parameters to assess how fuelwood harvest may affect the Black-throated Gray Warbler.
3. Determine cowbird parasitism rates and effects on Black-throated Gray Warblers.

JUNIPER TITMOUSE (*Baeolophus griseus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Juniper Titmouse are: Ash-throated Flycatcher, Gray

Vireo, Pinyon Jay, Western Scrub Jay, Black-throated Gray Warbler, Western Bluebird, Scott's Oriole.

Distribution: Resident from southeastern Oregon, northeastern Nevada, southeastern Idaho, southern Wyoming, central Colorado, and extreme Oklahoma south (east of the Sierra Nevada) to southeastern California, central and southeastern Arizona, extreme northeastern Sonora, southern New Mexico, and extreme western Texas (AOU 1998). In Arizona, it is a fairly common to common resident in the northeastern, northern, central, and locally southeastern portions of the state. The range extends west to Mount Trumbull and the Cerbat, Hualapi, Bradshaw, Superstition, Galiuro, and Chiricahua Mountains (Monson and Phillips 1981).

Ecology: An obligate inhabitant of pinyon-juniper woodlands (Andrews and Righter 1992, Behle 1985, Phillips and others 1964, Small 1994). Occurs as singles or pairs and does not typically form conspecific flocks although it does occur in mixed-species flocks (Phillips and others 1964). Balda (1987) states that Juniper Titmouse are "major pine seed predators" that may consume "large numbers of seeds." Bradfield (1974) observed it feeding on juniper seeds in the fall. It is likely largely insectivorous during the warmer half of the year. An obligate secondary cavity nester. Of 13 active nests found as part of the Arizona Breeding Bird Atlas, nine (79 %) were in junipers (T. Corman, AGFD, pers. observ.). Nesting dates ranged from 15 May to 30 June. Nest cavity heights were from 1.12 m to 4.40 m. The diameter (dbh) of the nest trees varied from 14-48 cm (5.5-1.5 in). It is probably not subject to brood parasitism by Brown-headed Cowbirds. Breeding densities from three study sites over two years in central Arizona ranged from 28.7 to 52.0 pairs per 40 ha (100 ac) which made up 23.5% to 43.6% of the total breeding bird density (Masters 1979). In a similarly study using identical methods in northeastern Arizona (LaRue 1994) reported 7.6 to 11.5 pairs per 40 hectares comprising 7.4% to 17.7% of the total breeding bird density.

Habitat Requirements: The Juniper Titmouse is highly restricted to pinyon-juniper woodlands (Andrews and Righter 1992, Balda and Masters 1980, Behle 1985, Bradfield 1974, Phillips and others 1964, Small 1994). It occasionally wanders into other habitats (usually riparian) within its range that are adjacent to or near pinyon-juniper woodlands during the nonbreeding season (Andrews and Righter 1992, Bradfield 1974, Brown and others 1984, Phillips and others 1964, Small 1994, Sogge and others 1998). The Juniper Titmouse is virtually unknown as a transient outside of the range cited above (Rea 1983, Rosenberg and others 1991, Witzeman and others 1997). Tree density in two Pinyon-juniper breeding bird investigations that examined stands supporting breeding titmice (LaRue 1994, Masters 1980) ranged from 155 to 380 trees per hectare. Canopy cover of one study (LaRue 1994) varied from 11 % to 26%. Combined, these studies indicate that the proportion of the

breeding bird density the titmouse contributes to tends to drop with increasing tree density, increasing total bird density, increasing proportion of junipers, and increasing canopy cover.

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable or increasing population trend within current range and distribution.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Formerly known as Plain Titmouse (*Parus inornatus*). However it has recently been split (AOU 1997) into two species, with the interior forms being called the Juniper Titmouse and those populations west of the Sierra Nevada called the Oak Titmouse (*B. inornatus*). Most available information on the “Plain Titmouse” (e.g. Ehrlich and others 1988) is based on studies of the Oak Titmouse in California. Therefore, little is known specifically for the Juniper Titmouse. Because it is clearly associated with mature pinyon-juniper woodlands, management activities that favor these stands will benefit this species. Investigations to determine specific habitat requirements and basic natural history are needed.

Juniper Titmouse management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Discourage clearing of large mature tracts of habitat.
2. Encourage small-scale opening of habitat.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine specific habitat requirements, habitat use and basic natural history for this subspecies.

3. Coordination of Recommendations and Opportunities in Pinyon-Juniper

The key issues for pinyon-juniper birds seem to stem from habitat changes over the past 50 years. This conversion has resulted in increased livestock grazing, and consequently, a reduction in ground cover and shrub regeneration, and an increased presence of Brown-headed Cowbirds.

Three of the priority species in pinyon-juniper habitat are cowbird hosts and parasitism rates appear to be increasing for all three species (Gray Flycatcher, Gray Vireo and Black-throated Gray Warbler). Although there is no evidence to date that these species are declining from parasitism, it is suggested that adverse effects are likely if the rate of parasitism continues to increase. Loss and/or alteration of habitat, especially larger cone-bearing pinyons, is the primary concern for the fourth species, the Pinyon Jay.

Clearing large tracts of mature trees using chaining, bulldozing, or cabling methods are not common management practices anymore. However, they do still occur in some areas. Loss of habitat today is more likely to be caused by lack of fire, fuelwood cutting of larger trees, and from overgrazing that prevents shrub regeneration. All four priority species suffer from loss and alteration of pinyon-juniper woodlands. It is recommended that seasonal restrictions on fuelwood collections be implemented for both personal and commercial use, and that limits on collection of larger trees, especially cone-producing pinyon (>75 yrs), also be set.

Whether to burn is a question that is being asked across the Southwest over many habitats. In pinyon-juniper, fire suppression has resulted in stands becoming extremely dense causing a reduction in the herbaceous and shrub layer and an increase in soil erosion. All four priority species use the shrubby component in pinyon-juniper habitat and prefer openings between older, taller trees. Burning or mechanical thinning that creates small openings but retains the larger trees is recommended for this habitat. Openings can alleviate soil erosion by allowing the herbaceous layer to grow and stabilize the shallow rocky soils common to pinyon-juniper woodlands. Burning of slash piles is also recommended to eliminate winter hibernaculums of the *Ips* beetle, that commonly target pinyon trees that are stressed due to drought or over crowding by junipers.

Urbanization has had the most negative effect on the Pinyon Jay. More and more developments moving into existing Pinyon Jay breeding areas have eliminated important habitat and mature cone producing trees that are essential to Pinyon Jay survival. Urbanization has also brought an increased number of crows and ravens, the primary predators of the Pinyon Jay. Inventory of the existing stands of mature pinyon-juniper is recommended to better assess limitations to pinyon tree harvest, if necessary.

Table 10. Pinyon-Juniper Priority Species Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Gray Flycatcher	-primary: pinyon pine and/or juniper, with an open overstory of ponderosa -secondary: sagebrush, greasewood	-larger stands of PJ with open understory, some areas with sagebrush, -nest height 0.5-3.0 m (2-9 ft) -may need some ground cover to support insect populations for foraging -larger taller stands of sagebrush and greasewood	-elevation 1375-2285 m (4500-7500 ft), locally to 2750 m (9000 ft)	-mid to late successional stages -edge effect and fragmentation do not appear to be an issue
Pinyon Jay	-breeds in pinyon and ponderosa pine -usually in pinyon-juniper where pinyon is dominant	-over 85% of nests found in bottom half of canopy (Balda and Bateman 1971) -commonly in extensive stands of pinyon-juniper with open physiognomy -may increase as mid and understory decrease	-nest and cache on south side of trees -elevation 1525-2285 m (5000-7500 ft) -may key in on warmest microclimate for nesting	-mid-late successional (pine nuts in mature trees) -use extensive stands for foraging, colony may have up to a 13 sq km (8 sq mi) home range (Balda and Bateman 1971)
Gray Vireo	pinyon-juniper with broad-leaved shrubs - Utah serviceberry, single-leaf ash	-open, not in stands greater than 280 trees/ha (2.5 ac) -usually nest and forage at <2 m (29 in.-8 ft) (CA FS)	-rocky, drier sites -moderate to steep slopes (canyon/mesa slopes), -elevation 975-2075 m (3200-6800 ft)	-not usually found in chained/young pj; -patch size small. -Plumbeous Vireo move in when structure is denser, patch size larger. -need more info.
Black-throated Gray Warbler	-mostly pinyon -also commonly occurs in Madrean oak/ pine-oak in southeastern AZ w/ shrub component	-in taller and denser PJ woodland -usually nest 2'-15' (0.6-4.5m)(Zeiner and others 1990) -low to mid-story nester. -prefers relatively heavy conifer cover (Morrison 1982) -forage most often in pinyon (LaRue pers. comm.)	-not found where juniper becomes dominant. -in PJ, usually between 1980-2440 m (6500-8000 ft) in AZ. -Locally below 1980 m (6500 ft) in PJ. -commonly found in lower elevations in se AZ habitats.	-may prefer woodlands w/ interspersed shrubby openings -successional stage: mid to late pinyon woodland -unknown if fragmentation has an effect on species.
Juniper Titmouse	-pinyon-juniper woodlands -may use riparian habitat if adjacent	-taller pinyon and juniper trees.	-drop out with increasing tree density or too few trees	late successional pinyon-juniper woodlands

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
	to pinyon-juniper			

Table 11. Special Factors for Pinyon-Juniper Priority Species

Priority Species	Special Factors
Gray Flycatcher	-Brown-headed Cowbird host (maybe increasing) -insectivore low forager - often ground gleaner -possibly semicolonial -poorly represented by Breeding Bird Survey (BBS) routes -a high priority species for most states it breeds in
Pinyon Jay	-roost and nest colonially up to 250 individuals -only one nest per tree, usually -communal feeders of fledglings between 3-6 weeks old -long-term pair bonds -co-evolved with pinyon trees -may suffer from common raven predation
Gray Vireo	-frequent cowbird parasitism -low foliage gleaner for insects
Black-throated Gray Warbler	-Brown-Headed Cowbird parasitism occurs, but effect unknown -forages low to mid canopy, foliage gleaner
Juniper Titmouse	-pinyon-juniper obligate -occurs mainly as single or pairs but not flocks -consume large quantities of pine seeds -secondary cavity nester

F. Madrean Pine-Oak Habitat

1. Habitat Description, Status and Importance

For the purpose of this document, Madrean Pine-Oak habitat refers primarily to the mountain regions of southeastern Arizona below the Mogollon Rim including: the Chiricahua, Santa Rita, Baboquivari, Tumacuacori, Huachuca, Santa Catalina, Pinaleno, and the Pinal Mountains. This group of isolated islands are commonly known as the Madrean Sky Island Archipelago and extend into northern Mexico and New Mexico (Brown 1982). There are approximately 40 sky islands between the Mogollon Rim and the Sierra Madre Occidental in Mexico, all located east of the Sonoran Desert with scattered locations north of Safford. Elevation ranges extend from approximately 1200-2200 m (3980-7250 ft). Precipitation varies seasonally with more than 200 mm (8 in) falling from May through August and an average of 200 mm (8 in) more throughout the year (Brown 1982).

Dominant pine species in the pine-oak woodlands of these isolated mountain islands include Chihuahua, Apache, and Arizona (ponderosa) Pines, alligator bark juniper, and Mexican pinyon. Dominant oak species are Emory, Arizona white, Mexican blue, Gambel, silver-leaf and netleaf (Brown 1982, Kruse and others 1996). The pine-oak regions are interspersed with a mosaic of shrubs, grasses and succulents. Grasses may include side-oats grama, woolspike and cane bluestem (Kruse and others 1996).

The sky islands are inland regions made up of a series of mountains and valleys (Warshall 1994). These mountain islands are separated by valleys of desert and grasslands which create a virtual “sea” of impassable habitat for many species. Conversely, the vertical diversity of the sky islands consists of stacks of biotic communities with a mixture of flora and fauna from the Neotropic/Holarctic and Neotropic/Nearctic, respectively (Walter 1979). The Madrean archipelago also spans three major climactic zones (tropical, subtropical, and temperate) and has relatively high relief (1525 m; 5000 ft) compared to other mountain/valley complexes (Warshall 1994). Marshall (1957) described the pine-oak woodlands as the “heart” of the Madrean archipelago. On most of the island mountains, the pine-oak woodlands sit between the encinal or live oak woodlands and pine forest. This core area is home to several of Arizona’s “priority” bird species including the Buff-breasted Flycatcher, Thick-billed Parrot and the Mexican Spotted Owl.

Although many of the mountain ranges of the sky islands are parallel to each other, and have almost identical habitat characteristics and elevation ranges, bird species do not occur uniformly across the range. Warshall (1994) described how the Mexican chickadee is resident in the Chiricahua Mountains but has never been found in the Pinalenos only 55 km (35 mi) away. Why are birds and other animals found on one range and not the other? This question as well as many

others are what has made this series of island mountains both a wealth of biodiversity and a mystery to those that study them.

Historical uses that may have modified that natural landscape of the sky island were primarily farming, hunting, fuelwood harvesting and burning (Spoerl and Ravesloot 1994). Current management of the Madrean Archipelago has shifted from the harvesting of resources to ecosystem management that maintains system integrity (DeBano and Ffolliott 1994). A conference on the Biodiversity and Management of the Madrean Sky Island Archipelago, encouraged that institutional barriers be eliminated and that more efforts of international cooperation be encouraged for this region (DeBano and Ffolliott 1994). Coordinated efforts between the United States and Mexico were initiated in a formalized partnership between the Arizona Game and Fish Department (AGFD) and the Centro Ecológico de Sonora (CES) in 1993. This partnership has created opportunities for field work, training, technical assistance and financing for wildlife management and conservation in Sonora and adjacent lands in Arizona (Abarca and others 1994). Many other agencies and organizations have since come forward with funding for conservation of these resources.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in madrean pine-oak habitat. A table at the end of the Madrean Pine-Oak section highlights species habitat needs in a quick reference format (Table 12).

MONTEZUMA (MEARNS') QUAIL (*Cyrtonyx montezumae mearnsi*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Montezuma Quail are: Eastern (Azure) Bluebird, Rufous-crowned Sparrow, Canyon Towhee.

Distribution: Montezuma Quail breeding range extends northward from southern, central, and northern Mexico into the United States to the mountains of southwest Texas, southwest New Mexico, and southeast Arizona. In Arizona, birds are most numerous in southern part of the state in the Baboquivari, San Luis, Parjarito, Atascosa, Tumacacori, Santa Rita, Patagonia, Huachuca, Chiricahua, and Peloncillo mountains, with lesser numbers in the Mule and Whetstone mountains. This species can also be found with some regularity below the Mogollon Rim in the areas of Eagle Creek, Blue River, San Francisco River, Black River, and the White River (Brown 1989). Occasionally, they have been found in areas up to 3050 m (10,000 ft) on Escudilla Mountain, Green's Peak, and Mount Baldy (Phillips, and others 1964).

Ecology: Montezuma Quail begin pairing in late February and March (Yeager 1966, 1967).

Males attract females during the pairing period through the use of “buzz” calls. During this time, some fighting occurs between males. Male territories may not be fully established until May or June (Bishop 1964). Actual nesting does not begin until late June, July, or even August. The nesting period closely coincides with the onset of the summer rains. Nests are constructed in dense grass cover and are protected from the elements either by overhanging cover of a tree or tall grasses (Wallmo 1954). Although nest sites can range from cool, moist canyon bottoms to hot arid slopes, dense grass cover is characteristic at most sites. The egg hatching period can range from late July to late September with a peak in early to mid-August (Brown 1989). The chicks immediately leave the nest to forage with their parents. The brood is reared by both parents. Daily activities are usually limited to foraging and roosting within a home range of about 15 acres (Brown 1978). Montezuma Quail feed exclusively on the ground predominantly on bulbs and tubers, particularly the bulbs of wood sorrel and tubers of flat sedges. Other foods include a wide variety of forb (e.g. lupine, spurge, milk pea) and grass (e.g. paspalum) seeds, particularly those which set seed after the summer rains. These plant species provide the bulk of the quails yearlong food supply on which it depends (Brown 1989).

Habitat Requirements: Montezuma Quail habitat in Arizona is comprised predominately of Madrean evergreen woodlands of oaks and pines. The typical landscape is open woodland containing Emory oak, Mexican blue oak, Arizona oak, and less commonly gray oak, Toumey oak, alligator juniper and one-seed juniper. The understory is typically comprised of bunchgrasses such as sideoats grama, cane beardgrass, wolftail, sprangletop, and Texas bluestem (Brown 1989). Optimum habitat has a tree crown cover of about 30 percent with a lush understory of grasses and forbs (Brown 1982). These habitats have a warm temperate climate in which freezing temperatures do not normally occur more than 125 to 150 nights during the year. Summer precipitation is an essential component of Montezuma Quail habitat. The summer rainfall pattern is of key importance in producing the grasses and forbs that provide the food and cover (e.g. nesting cover) for this species. A mean of 10 inches or more precipitation during July through September is needed to produce dense nesting cover and food sources for successful reproduction and survival. Montezuma Quail are also found in riparian communities, occasionally ponderosa pine forests, and more rarely in subalpine forests and meadows. In these situations, the presence of dense bunchgrasses along with sedges and bulbs are also important (Brown 1989).

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable or increasing population trend with evaluations in ten year increments, beginning in 1999.

2. Maintain at least the current distribution in Arizona.

Habitat Strategy

1. Maintain current habitat in optimal condition as described in habitat requirements.
2. Provide corridors of habitat that allow appropriate cover for dispersal between patches of suitable habitat.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Overgrazing of understory grasses and forbs which provide food and cover for Montezuma Quail is the major management issue affecting this species (Brown 1989, Brown 1982). Investigators have agreed that livestock can adversely affect the distribution and density of Montezuma Quail through the destruction of food resources and nesting cover, and that the species has disappeared from heavily grazed areas (Leopold and McCabe 1957, Miller 1943, O'Connor 1939, Wallmo 1954). Management recommendations for Montezuma Quail should be related to the amount of rainfall each year, with grazing and hunting being limited more during years of low rainfall. Loss of the grass component of pine-oak woodlands would be detrimental to Montezuma quail. Using fire to maintain grass and control shrubs from becoming too dense is suggested.

Montezuma Quail management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Grazing

1. Review current grazing guidelines and adjust management where necessary.
2. Adjust grazing duration and intensity annually depending on rainfall, and reduce or refrain in dry years to ensure necessary quail habitat is not eliminated.

Fire

1. Only low intensity, patchy fire when necessary to maintain grass component and control shrub component.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Gather information on annual precipitation and breeding success rates and population numbers.
2. Develop a (non-lethal) census method.

3. Study the grazing and hunting effects on population level.
4. Study fire effects on population level.

BAND-TAILED PIGEON (*Columba fasciata*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Band-tailed Pigeon are: Northern Goshawk, Flammulated Owl, Whiskered Screech-Owl, Northern Pygmy-Owl, Acorn Woodpecker, Hairy Woodpecker, Northern Flicker, Steller's Jay, Mexican Chickadee, Yellow-rumped Warbler, Grace's Warbler, Red-faced Warbler, Olive Warbler, Western Tanager and Scott's Oriole.

Distribution: The Band-tailed Pigeon ranges from extreme southern Alaska, through the mountains of British Columbia and the Pacific Northwest southward through the Coast Ranges, Cascades and Sierra Nevada, the Rocky Mountains through the mountains of southeastern Arizona, the Sierra Madre Occidental of Mexico south through the mountains of Central and South America at least to southern Ecuador.

In Arizona, the interior race of the Band-tailed Pigeon *Columba fasciata fasciata* is a fairly common summer resident in mountains from northwestern to southeastern Arizona. Most Band-tailed Pigeons of the interior race winter in Mexico primarily in the pine-oak woodlands of the Sierra Madre Occidental (Tacha 1994).

Ecology: Pair bonds usually form early in the spring and pairs remain together through the nesting season. One egg is normally laid in a stick nest. Two or more broods may be raised each year apparently depending on food availability. Band-tailed Pigeons may nest opportunistically depending on food resources. They can be semi-colonial and are gregarious away from the nesting area (Ehrlich and others 1988). Some of their primary food choices are acorns, mulberries, elderberries, currants and pine seeds.

Throughout the northern and western portions of its Arizona range, the Band-tailed Pigeon is present generally from May through October but may, in good years at least, be resident in central and southeastern Arizona (Monson and Phillips 1981). Spring migration may begin as early as March and Fall migration in September. Banding studies have shown that Band-tailed Pigeons have high site fidelity to nesting areas (Tacha 1994). Nests usually are located in conifers 4-12 m (15-40 ft) above ground (Tacha 1994) although some nests are constructed at the fork of a low horizontal limb in oaks (Fowler, in Bent 1932). Like nests of other members of the dove family, the nest is loosely constructed of twigs. Nesting may occur at the edge of dense forest, at the heads of canyons or in open forest habitats.

Habitat Requirements: Band-tailed Pigeons nest in forested areas and feed primarily in oak forest and meadows primarily on acorns and berry crops such as manzanita, madrone and elderberry. Dependent on oaks, they are rare in pure ponderosa forest. The Arizona distribution, for this reason, is considered patchy (Monson and Phillips 1981).

Habitat and/or Population Objectives:

Population Objective

1. Achieve an increasing population trend and maintain the current distribution.

Habitat Strategy

1. Maintain current habitat quantity, quality and distribution.
2. Limit prescribed burns especially in cases where berry producing shrubs such as manzanita and madrone occur.

Population Strategy

1. Review hunting bag limits and season dates annually, to adjust to data gathered regarding harvest, surveys and recruitment.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Western populations of Band-tailed Pigeons have declined over the past 30 years but trends of the interior populations are not well understood (Tacha 1994). Earlier population declines appear to have been noticed from hunting harvest data. As a result, a season reduction and thus harvest reduction was secured (Tacha 1994). Other declines are thought to be due to habitat loss. Clear-cutting of old growth forests and herbicide use to control understory species in tree plantations are considered primary factors (Tacha 1994). Management of the interior population (Four Corners population) is shared by New Mexico, Arizona, Colorado, Utah and the U.S. Fish and Wildlife Service. The Pacific Flyway Study Committee annually reviews harvest figures and adjusts season frameworks for harvest for this population. The draft management plan of 1998 identifies objectives to develop indices for population status, trends and annual recruitment as well as investigations of food habits, mineral requirements and specific habitat needs. Information on mortality factors such as disease and hunting are needed. There have been comparatively few recent studies on this species and research is considered a primary need (Tacha 1994).

Band-tailed pigeon management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Hunting

1. Since population numbers fluctuate with food availability and nesting success, hunting season should continue to be delayed until most of the young are fledged.

Silvicultural Practices

1. Avoid clear cut timber harvest of oaks.

Fire

1. Keep fuel loads to a minimum to avoid catastrophic fires but maintain the berry-producing shrubs.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine current population numbers (surveys and monitoring).
2. Determine the specific habitat needs for this species (in Pine-Oak).
3. Monitor species in areas with and without salvage logging to determine effects.

THICK-BILLED PARROT (*Rhynchopsitta pachyrhyncha*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Thick-billed Parrot are: Cooper's Hawk, Apache Goshawk, Northern Pygmy-Owl, Steller's Jay, Mexican Chickadee, Pygmy Nuthatch, Grace's Warbler, and Olive Warbler.

Distribution: The Thick-billed Parrot occurred historically as far north as southeastern Arizona and southwestern New Mexico, but its primary range is from the Sierra Madre Occidental of Mexico south as far as Michoacan. The last historic records for a United States population were in 1938 in the Chiricahua National Monument and in 1964 in the Animas Mountains of New Mexico (Snyder and others 1994). While no breeding records exist for the historic United States population, the species was apparently an annual resident of the Chiricahua Mountains at the turn of the century and may have bred there. The population that currently exists in Mexico is considered endangered, although breeding parrots can still be found just 80 km (50 mi) from the United States border. The species' main breeding range is in western Chihuahua and eastern Sonora south into central Durango. In winter, the birds normally range from Durango southward. Releases of wild-caught birds in Arizona from 1986-1993 resulted in some breeding and reasonably good survival, but the

released population is not considered self-sustaining as yet. Released birds have ranged from the southeastern mountains as far north as the Mogollon Rim country. No good population estimate is available for the birds in Mexico, but Lammertink and others (1996) have offered a rough estimate of 500-2000 pairs.

Ecology: The Thick-billed Parrots is a cavity nesting, temperate-adapted parrot species that feeds mainly on pine cones, but also takes acorns, buds of conifers, and other foods in lesser amounts. They breed late in the year (normally July to October) presumably to take advantage of the timing of the fruiting of conifers. Most nests are in old flicker holes or in natural cavities in conifer snags. They generally travel in flocks and often exhibit V-formations and line formations in flight. Thick-bills nest only at high elevations, above 2000 m (6550 ft), and normally roost at similar elevations. Several raptors pose a threat to the Thick-billed Parrot including: Red-tailed Hawk (*Buteo jamaicensis*), Northern Goshawk (*Accipiter gentilis*), and Peregrine Falcon (*Falco peregrinus*), but they also suffer predation at the roosts and nests from ring-tailed cats (*Bassariscus astutus*)

Habitat Requirements: The Thick-billed Parrot is dependent on mature high-elevation conifer forests, both for food and nest sites. Primary foods in the breeding season include southwestern white pine, Arizona pine, and Durango pine, which are all high elevation species. They can persist in partially degraded forests, as long as snags are still present for nesting and enough big trees persist to offer an adequate cone base for food. Population density studies show a strong relationship to the maturity of forests.

Habitat and/or Population Objectives:

Population Objective

1. To establish one stable population in the historic range in Arizona by 2010.

Habitat Strategy

1. Maintain mature pine oak forests (with pines > 75 yr or cone producing) within historical range.

Population Strategy

1. Coordinate with Mexico on increasing their population to provide birds for reintroduction in Arizona.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

In Mexico, Thick-billed Parrots are threatened by cutting of old growth forests, and to some extent by illegal harvest for the pet trade and aviculture. In the United States, the historic population was stressed heavily by shooting (Snyder and others 1994). Efforts are now underway to protect some crucial forest areas in Mexico from further cutting, but the prospects of success are unsure. Release efforts in the United States were sufficiently encouraging to merit a follow-up, but confiscated and captive-reared birds are not advisable for the release due to disease and behavioral problems (mainly for captive-reared birds). Future releases should involve wild-caught birds deliberately translocated to Arizona without exposure to exotic disease problems if the appropriate source population can be identified.

Thick-billed Parrot management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat loss/alteration

1. Help Mexico boost their populations, and protect existing habitat.
2. Protect existing suitable habitat in Arizona for potential reintroduction.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING:

Recommended Research

1. Determine the migratory habits of wild populations.
2. Study the possibility and feasibility of brood manipulations (i.e. removing young early in nesting stage, captive rearing them, and then returning them at a later stage).
3. Determine if Goshawks are a threat to Thick-billed Parrots in Mexico.
4. Determine if a migrant or a resident population is more likely to survive a second reintroduction in Arizona.
5. Develop methods for translocation of wild-caught birds that will not put the source population at risk.

MEXICAN SPOTTED OWL (*Strix occidentalis lucida*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Mexican Spotted Owl are: Northern Goshawk, Whiskered Screech-Owl, Whip-poor-will, Arizona Woodpecker, Virginia's Warbler, Red-faced Warbler, Painted Redstart and Hepatic Tanager.

Distribution: The Mexican Spotted Owl is distributed over a broad geographic area in the southwestern United States. However, it is not uniformly distributed throughout its range. It occurs in disjunct locations that correspond to isolated mountain systems and canyons in southern Utah, Colorado, Arizona, New Mexico, and Mexico. In Arizona, it primarily occurs in mixed conifer and ponderosa pine-Gambel oak forests and canyons above and below the Mogollon Rim, and in the Madrean pine-oak forests and canyons of the sky island mountain ranges in the southern part of the state (Block and others 1995).

Ecology: The owl, described as a “perch and pounce” predator, primarily consumes small to medium-sized rodents such as woodrats, peromyscid mice, and microtine voles. It also preys on bats, birds, reptiles, and arthropods (Forsman 1976, Ward and Block 1995). This species nests on cliff ledges, stick nests built by other bird, and in tree cavities (Ganey 1988, Fletcher and Hollis 1994). Females normally lay one to three eggs in late March or early April and incubate for approximately 30 days. The eggs usually hatch in early May. Nestling owls generally fledge in four to five weeks after hatching in early to mid-June (Ganey 1988). Fledgling dispersal occurs usually from mid-September to early October. Predation by avian predators (e.g. Great Horned Owls, Northern Goshawks) and starvation from low abundance and availability of prey species are primary mortality factors (Ganey 1988). Seasonal movement patterns are variable. Some are year-round residents, some show shifts in habitat-use patterns, and some migrate short distances (i.e. 19-49 km; 12-31 mi) during the winter. Home ranges are also variable ranging from 261-1550 ha (645-3831 ac). During the nesting season most activity (i.e. nesting/roosting and foraging) occurs within an “activity center” of approximately 242 ha (600 ac) (Block and others 1995).

Habitat Requirements: In northern portions of the range, including southern Utah, southern Colorado, far northern Arizona and New Mexico, owls occur primarily in steep walled rocky canyons with conifer inclusions (Rinkevich 1991, Willey 1993). Along the Mogollon Rim in Arizona and New Mexico, primary habitat use is within mixed conifer forests, ponderosa pine-Gambel oak forests, rocky canyons, and associated riparian forests (Fletcher and Hollis 1994). In southern Arizona and Mexico, Madrean pine-oak forests and canyons provide primary habitat for the owl (Duncan and Taiz 1992, Ganey and Balda 1989). Forest stands used for roosting and nesting often contain mature to old-growth stand characteristics. The forest stands are typically uneven-aged, multistoried, have dense canopy cover, and contain large diameter trees, snags, and downed logs (Block and others 1995).

Habitat and/or Population Objectives:

Population Objectives:

1. Maintain current distribution in montane conifer forests in AZ (ponderosa pine with a Gambel's oak, Madrean pine/oak, and mixed conifer).
2. Follow population and habitat objectives for each Recovery Unit as outlined in the Mexican Spotted Owl Recovery Plan (USFWS 1995).

Habitat Strategy

1. Use existing habitat recommendations in the Mexican Spotted Owl Recovery Plan with the most updated Recovery Team recommendations.
1. For specific management recommendations by recovery unit and by habitat type, refer to the Mexican Spotted Owl Recovery Plan:

USDI Fish and Wildlife Service. 1995. Recovery plan for the Mexican spotted owl: Vol.I. Albuquerque, New Mexico. 172 pp.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues and Conservation Recommendations

Timber harvest, particularly even-age management, and catastrophic fire over large forested areas are the primary management concerns which can adversely alter owl habitat through habitat fragmentation and the reduction in mature and old-growth forest characteristics (i.e. key for roosting and nesting). In addition, livestock and ungulate grazing (e.g. alteration of prey/nesting/roosting habitat) and recreation (e.g. disturbance to nesting birds) are other key management issues. Management guidelines in the 1995 Mexican Spotted Owl Recovery Plan, and Block and others 1995, focus on protection and maintenance of nesting/roosting habitat, maintenance of habitat for prey species, and limiting of disturbance during the nesting season.

Mexican Spotted Owl management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Silvicultural Practices

1. Manage forests for uneven forest structure.
2. Follow silvicultural guidelines in the Mexican Spotted Owl Recovery Plan.

Fire

1. Light burning of fuel buildup in Protected Activity Centers (PAC's) only during nonbreeding season and as described in Protected Activity Center guidelines in the Mexican Spotted Owl Recovery Plan. (USFWS 1995).
2. Implement a fire abatement program to allow treatment of fuel build-up and avoid catastrophic fire. (USFWS 1995).

Human Disturbance

1. No construction of buildings, roads or trails in PACs during breeding season (USFWS 1995).
2. Construction of buildings, roads or trails in PACs during non-breeding season considered on a case-specific basis (USFWS 1995).
3. Seasonal closures of specifically designated recreation activities should be considered in extreme circumstances (USFWS 1995).

Grazing

1. Monitor grazing use by livestock to determine any changes in the relative composition of herbaceous and woody plants to maintain habitat for owls and their prey (USFWS 1995).
2. Implement and enforce grazing utilization standards that attain good to excellent range use standards (USFWS 1995).
3. Protect or restore riparian communities, emphasizing protected and restricted areas (USFWS 1995).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Research the "floater" (new generation) individuals, to determine if there is habitat nearby that they use, or whether they disperse great distances.
2. Investigate management strategies that may reduce the possibility of catastrophic fire, but maintain important habitat components (USFWS 1995).
3. Investigate effects of recreation vehicles, etc. on sites used by owls (USFWS 1995).
4. Investigate how grazing affects the prey base in habitats used by spotted owls (USFWS 1995).

BUFF-BREASTED FLYCATCHER (*Empidonax fulvifrons*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Buff-breasted Flycatcher are: Northern Goshawk (Apache), Arizona Woodpecker, Greater Pewee, Western Wood-Pewee, Mexican Jay, Plumbeous Vireo, Hutton's Vireo, and Grace's Warbler.

Distribution: Currently, this small flycatcher's breeding range extends from southeastern Arizona south locally and intermittently through the Sierra Madres and adjacent mountain ranges of Mexico with disjunct populations south to central Honduras (AOU 1983, Howell and Webb 1995). The Buff-breasted Flycatcher historically occurred north to central Arizona near Prescott and east to Fort Apache and west-central New Mexico (Hubbard 1970, Phillips and others 1964). Since 1980, it has been documented nesting in the United States only very locally in the Chiricahua, Huachuca, Santa Rita, and Santa Catalina mountains of southeastern Arizona (Bowers and Dunning 1994, Morrison and Martin 1997). Populations in Arizona, northern Sonora and western Chihuahua withdraw south during the winter, otherwise, winter range is basically the same as breeding (AOU 1983, Bowers and Dunning 1994). Some populations may move to adjacent habitats at lower elevation during the winter (Bowers and Dunning 1994).

Ecology: Spring arrival of Buff-breasted Flycatchers in Arizona begins as early as late March, peaking in April, with stragglers through mid-May. As expected, insects make up the diet of this species, which include ants, wasps, true bugs, beetles, grasshoppers, moths, and spiders (Bowers and Dunning 1994, Cottam and Knappen 1939). It captures prey items in flight, using short sallies from tree branches, bushes, or weed stems. Buff-breasted Flycatchers often fly to the ground to take ants and other insects (Bowers and Dunning 1994). Nesting activity in Arizona has been documented from early May (rarely as early as 10 April) through mid-August (Bowers and Dunning 1994, Morrison and Martin 1997). Mean average nest height is 8 m (25 ft) with a range of 2-14 m (7-46 ft) (Bowers and Dunning 1994, Morrison and Martin 1997). In Arizona, most nests are constructed in Apache and Chihuahua pines, with significantly fewer found in ponderosa pine, alligator juniper, Arizona sycamore, Arizona white oak, and Douglas-fir (Bowers and Dunning 1994, Morrison and Martin 1997). Many nests are constructed under overhanging branch or other cover. This may reduce heat lost from the incubating bird at night (Bowers and Dunning 1984), act as rain shelters, and/or deter nest parasitism by cowbirds (Morrison and Martin 1997). Pairs in Arizona continue nesting attempts until successful or until it is too late in season to nest. A few pairs have been noted initiating five nests in one season (Bowers and Dunning 1994, Morrison and Martin 1997). There is usually no second clutch if the first nesting attempt proves to be successful (Bowers and Dunning 1994). Fall migration in Arizona is from mid-August through late September (Bowers and Dunning 1994).

Habitat Requirements: During migration and winter, the Buff-Breasted Flycatcher is sometimes found in lowland riparian habitats. It breeds in wide mountain canyons with open growth of pines and/or oaks, usually with open understory of grasses and small trees or burned forest with patches of living pines (Bowers and Dunning 1994). In Arizona, typical tree species include Chihuahuan, Apache, ponderosa, and southwestern white pines; alligator

juniper; pinyon pine; Douglas-fir; Arizona sycamore; and Arizona white and silverleaf oaks. In Arizona, nesting has been documented at elevations that range from 1950-2850 m (6411-9350 ft) (Bent 1942, Bowers and Dunning 1994); down to 600 m (1968 ft) in Honduras (Monroe 1968). Morrison and Martin (1997) describe optimal breeding habitat for Buff-breasted Flycatchers in Arizona as having a relatively gradual slope (about 10%), and open forest. They define an open forest as having canopy cover 20% above 10 m (33 ft), 20% cover at 5-10 m (16-33 ft), and < 10% cover below 5 m (16 ft). Typical canopy species are Apache and Chihuahua pine of medium-age structural stage (trees 30-45 cm; 12-18 in dbh) or older (Morrison and Martin 1997). These forests should have an open understory of oak, with about 80-85 small oaks (10-20 cm; 4-8 in dbh) per hectare (2.5 ac), and oak canopy cover of about 1% at 0-1 m (0-3 ft), about 5% at 1-2 m (3-7 ft), about 15% at 2-5 m (7-16 ft), about 9% at 5-10 m (16-33 ft), and negligible above 10 m (33 ft). Ideally, these forest patches should be > 150 m (492 ft) wide, because larger patches of forest tend to promote greater reproductive success and higher probability of occupancy (Morrison and Martin 1997).

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable or increasing population trend and current distribution.

Habitat Strategy

1. Protect known breeding locations from recreational development.
2. Manage habitat for open understory of oaks and a grassy herbaceous layer.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Concerns include breeding habitat loss and modification by recreational development and unregulated livestock grazing. In many areas, fire suppression has created unfavorable breeding conditions through increased density of understory vegetation (Morrison and Martin 1997). Fire suppression has also caused catastrophic fires which have consumed historical breeding locations. Artificially elevated densities of jays near U.S. Forest Service campgrounds increases nest predation of nearby populations of Buff-breasted Flycatchers (Morrison and Martin 1997). It has been suggested that intense birding pressures (e.g. daily visits, tape playing) could be detrimental to the nesting success of local populations in southeastern Arizona (Bowers and Dunning 1994, Morrison and Martin 1997). Information on wintering ecology and status of this species in Mexico and Central America is almost

entirely lacking. This may be because high-elevation forests in Mexico have been heavily logged in the past and are presently subject to overgrazing (Bowers and Dunning 1994).

Buff-breasted Flycatcher management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Fire

1. Encourage periodic, low intensity ground fires to control growth of understory woody species.

Predation

1. Monitor campgrounds where jays are common.
2. Inform campers about how feeding jays near campgrounds may increase nest predation of Buff-breasted Flycatchers by attracting them to nest areas. Put up informative signs.

Over Grazing

1. Suggest only light and limited seasonal grazing to avoid elimination of herbaceous layer and maintain moderate shrub layer.

Recreation

1. Educate birders that tape playbacks and daily visits have a negative impact on nesting success of many bird species, including Buff-breasted Flycatchers.
2. Avoid development of campgrounds in known breeding locations.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Conduct more surveys in adjacent mountain ranges.

EASTERN (AZURE) BLUEBIRD (*Sialia sialis fulva*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Eastern (Azure) Bluebird are: Northern Goshawk (Apache), Acorn Woodpecker, Arizona Woodpecker, Northern Flicker, Bridled Titmouse, White-breasted Nuthatch, Montezuma Quail, Black-throated Gray Warbler, Hutton's Vireo, Ash-throated Flycatcher and Scott's Oriole.

Distribution: This subspecies of the Eastern Bluebird is a year-round resident from south-central Arizona (Santa Rita, Pajaritos, and Huachuca mountains) south along the Sierra Madre Occidental to Guerrero (AOU Checklist 1957). During breeding, it is found in the mountains of southern Arizona south to Jalisco, Oaxaco and Vera Cruz (Bent 1949 from AOU Checklist 1931). Monson (1981) lists the following areas for breeding: Huachuca Mountains west to the Pajaritos; the Chiricahua Mountains; Happy Valley east of the Rincon Mountains in Pima and Cochise Counties; and at Bear Canyon in the Santa Catalina Mountains. Recently, (1993, '94, '96 and '97) in both Pima and Cochise Counties, breeding has been confirmed through the Arizona Breeding Bird Atlas Project.

Ecology: The Azure Bluebird is a resident of southeastern Arizona and essentially non-migratory (Monson 1981). It is an occasional cooperative breeder-- young from previous broods help at the parent's nest (Ehrlich and others 1988). Frugivorous and insectivorous, its diet includes earthworms, snails, and other invertebrates as well as berries. The young are fed primarily insects, which are caught "on the wing" by the adults. In the winter, berries are the most important food source (Ehrlich and others 1988). Bluebirds are secondary cavity nesters, often using woodpecker-excavated holes, but will also use crevices, cracks and natural cavities in trees and rocks. Nests consist of a loose cup of grass, weed stems, pine needles, and twigs, occasionally with hair or feathers (DeGraaf and Rappole 1995, Ehrlich and others 1988, Phillips and others 1964). As a cavity nester, it is a rare cowbird host (Ehrlich and others 1988, Woodward 1979).

Habitat Requirements: The Azure Bluebird is found at elevations of 1000-2000 m (3280-6560 ft) in the pine-oak forests of southeastern Arizona (Monson and Phillips 1981, Phillips and others 1964). It has also been found at lower elevations, nesting in cottonwoods at Patagonia, Arizona, but not in recent years (Monson and Phillips 1981, T. Corman, pers. observ.). Oaks are the primary tree species utilized, including Emory, Arizona white, silverleaf and Mexican Blue oaks mixed with some Apache and Chihuahua pine. They frequent areas of open canopy with scattered trees, forest edges, and burned or cut-over woodlands (DeGraaf and Rappole 1995). The mid- understory is open and ground cover is mainly forbs and grasses with low foliage and stem densities. Snag density is high, as the species is a secondary cavity nester and uses mature to late succession forest patches for both foraging and nesting. During winter, small flocks may wander from breeding areas and can sometimes be found in the Tucson area, but usually remain in the mountains (Monson 1981, Russell and Monson 1998).

Habitat and/or Population Objectives:

Population Objective

1. Maintain or increase current population numbers and distribution and allow for population expansion into restored habitats.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The distribution of this subspecies across the landscape is patchy and localized, but may have always been so, as this excerpt from Swarth (1914) *in* Bent (1949) indicates “rare in summer in the high mountains of extreme southern Arizona, not of common occurrence in either of these mountain ranges where *S. Mexicana bairdi* [Western Bluebird] is the common breeding bluebird”. Adults require low perches for hawking and catching insects near the ground (Ehrlich and others 1988). Nest cavities are also low, often within meters of the ground (Russell and Monson 1998). An abundance of snags are needed for nesting, therefore uncontrolled fuelwood cutting and the taking of larger trees results in loss of nesting substrates. Felling dead trees and removing dead branches decreases availability of cavities and low perches and increases competition with other cavity nesting species (Ehrlich and others 1988). Ligon (1969) also suggests that the availability of cavities may limit this species, possibly because they begin breeding activities later than other cavity nesters.

Because this species is insectivorous, mainly aerial, loss of grasses and forbs due to heavy grazing pressure may result in lowered food supply, although light grazing may enhance habitat by decreasing the shrub layer (Ligon 1969). Where both fire and grazing have been excluded, heavy undergrowth and dense foliage may be responsible for the scarcity of this bird (Ligon 1969). In open park-like forests of northern Mexico, the bluebird is more common (Marshall 1963 *in* Ligon 1969). Ligon (1969), referring to the Southwestern Research Station in the Chiricahua Mountains, reported that “heavy grazing by cattle near the research station has destroyed much of the undergrowth, producing a more open woodland than is found in areas where both fire and cattle have been excluded”. This information was collected in 1965 and it is uncertain if this population of bluebirds is still present at the research station, although they are seen occasionally and in small numbers in the surrounding areas.

Management should include low intensity fires which will: 1) “fire prune” oaks, thus making them less susceptible to larger wildfires; 2) result in a mosaic of vegetation; 3) be of such an intensity to maintain openness of habitat, allowing more growth of forbs and grasses; and 4) decrease shrub layer. Research needs include determination of tree size needed for nesting, cavity size and availability, including identification of competitors (starlings?), and cavity

height requirements (much of this information is known for the bluebirds in the eastern United States, but research comparing the needs of this subspecies is lacking). Nest box programs have been very successful in the eastern United States for bluebirds, but their use in the West is not common. Ligon (1969) reported that within two days of placement of a nest box, it was occupied by a pair of Azure Bluebirds that successfully reared young from the box. Research is needed on nest box usage to determine if a nest box program should be implemented in certain areas. Since this bird has disappeared from some areas of southeastern Arizona, research on abundance and reproductive success could be useful in determining population centers.

Eastern (Azure) Bluebird management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Reduce large scale fuelwood cutting, limit certain size take.
2. Implement a nest box program.

Grazing

1. Encourage only light, seasonal grazing.

Fire

1. Increase prescribed (low intensity) burning to maintain mature, cavity-producing trees.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Nesting information on: tree size, cavity size and availability, including identification of competitors (starlings?), and cavity height requirements.
2. Nest box usage to determine if a nest box program should be implemented in certain areas.
3. Research on abundance and reproductive success could be useful in determining population centers.

3. Coordination of Recommendations and Opportunities in Madrean Pine-Oak

Improper or over grazing appears to be a critical management issue for four of the six priority species in pine-oak habitat. Grazing for long periods of time or intense grazing over a short period can eliminate the herbaceous layer. The primary food source for four of the six priority species is

found in the herbaceous layer including; insects, forbs, worms, tubers, snails and small mammals. Montezuma Quail are highly dependent on a dense forb and grass layer for food, cover and nesting. Some shrubby component is important for berry production for Band-tailed Pigeons. But, controlling the density of shrubs is recommended to maintain the forb and grass component. Some grazing may be beneficial to help control the shrub layer. However, proper timing and intensity of grazing, perhaps only seasonally, is most important. Using fire to maintain a healthy grass layer and to reduce fuel buildup that may lead to catastrophic fire, is recommended for all priority species.

Human disturbance during the nesting season is most critical for the Mexican Spotted Owl. Specific recommendations advise that no disturbances should occur in Protected Activity Centers (PAC's) during the nesting season and in some instances during the non-breeding season. Recreation areas can both attract birds, by providing open areas within dense forests, and disturb birds, by providing a place where people congregate that may have otherwise been undisturbed. For Buff-breasted Flycatchers, ironically, it is birders themselves that are known to disrupt them, by playing tapes to "call in" birds for a closer look. Educating birders and other "curious" people about the negative impact tapes can have, especially during the nesting season, is recommended. Recreation areas, especially campgrounds, have resulted in increased predation of Buff-breasted Flycatchers by artificially elevating densities of Jays. Educating campers with informative signs, about the threats to other birds caused by feeding jays, is recommended.

Hunting is not an issue commonly seen for most of our priority species but it played an important role in the status of two of the pine-oak priority species. The Band-tailed Pigeon is still hunted in Arizona. Declines today however, are thought to be more from deforestation rather than from over-hunting. Although bag limits are reviewed each year for Band-tailed Pigeons, more aggressive management of the habitat needs to take place to increase the population of Band-tailed Pigeons in Arizona. The Thick-billed Parrot historically suffered from unregulated and subsistence hunting in Arizona. Massive deforestation of large, cone-bearing trees, the primary food source for Thick-billed parrots, was also a major factor in population declines. These stresses combined with illegal harvest of the remaining birds for the pet trade, wiped the Thick-billed Parrot completely out of Arizona. As with the Band-tailed Pigeon, the issue today is primarily loss of forest habitat, both in Arizona and in Mexico. After an unsuccessful attempt at reintroduction in Arizona in 1986, the focus is now on increasing the existing wild birds remaining in Mexico and protecting existing habitat in Arizona. If population numbers increase sufficiently in Mexico, another reintroduction attempt will likely be made with wild-caught birds, instead of captive-reared birds (as was done the first time) in the near future.

Table 12. Madrean Pine-Oak Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Buff-breasted Flycatcher	-Apache and Chihuahua pines, Arizona pine (ponderosa) - scattered juniper and oak	-moderate canopy for nesting, open for foraging -higher stem density near nest, less important for foraging -herbaceous ground cover needed for insects	-wide, flat bottom drainages, and top of mesas -generally low slope, -elevation 1830-2590 m (6,000-8,500 ft)	-patch size > 150 m (490 ft) wide -high fragmentation may deter Buff-breasted Flycatcher -edge effect: negative for nesting; higher predation, positive for foraging -local, patchy distribution across landscape - late successional for nesting (with periodic ground fires), mid-succ. for foraging
Mexican Spotted Owl	Douglas-fir, Az pine (ponderosa), larger oaks	-high closed canopy -relatively high foliage and stem density for roosting	-cool micro-climate -steep-sided canyons -elevation 1160-2590 m (3800-8500 ft) -aspect often shade-facing	-late, mature to old-growth successional -need woody/downed debris nearby for prey base -catastrophic fire very bad -low intensity fire may be good to reduce continuity of fuel
Eastern (Azure) Bluebird	-Mexican blue oak, Emory oak, AZ white oak, silver-leaf, Apache and Chihuahua pine, AZ sycamore	-open canopy with space between trees -low open midstory and an open understory -ground cover is grass and forbs -leave or maintain snags, needs cavities	-elevation 1065-2286 m (3500-7500 ft)	-patchy/local occurrence across the landscape -fire good to maintain openness, and allow more forbes -mature to late successional stage in open stands
Montezuma Quail	-Emory oak, blue oak, AZ white oak, native perennial grasses	-open oak canopy, but crown cover of >20% is optimal (R.Brown 1982) low shrubby component -ground cover perennial grasses, moderately dense low to moderate stem	-foothills to steep slopes, canyons, rolling hills -may be more on moderate slope than flat areas -elevation 1250-2285 m (4100-	-wide spread distribution but low density fire good when low intensity and patchy -drought affects productivity -need connecting corridors between suitable habitat

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
		density in oaks	7500 ft)	
Band-tailed Pigeon	-Apache, Chihuahuan and Arizona pines, AZ white oak, silver-leaf oak, Emory oak, Gambel oak, alligator-bark juniper	-a mixture of mature acorn-producing trees and a shrubby component.	-elevation 1371-2590 m (4500-8500 ft) (will go higher outside of pine-oak habitat) -commonly seen in drainages	-wide spread but local distribution - drought reduces mast crop of acorns -medium to late successional for nesting and acorn forage
Thick-billed Parrot	-pine (Chihuahuan, Arizona (ponderosa), Apache)	-need snags for nesting	-elevation 1675-2590 m (5500-8500 ft) -mountain slopes and canyons (follow food)	- peripheral, primary found in Chiricahua Mts. -catastrophic fires can cause loss of habitat -mid-late successional; need cone-bearing trees

Table 13. Special Factors for Madrean Pine-Oak Priority Species

Priority Species	Special Factors
Buff-breasted Flycatcher	<ul style="list-style-type: none"> -insectivore -nest frequently in campgrounds because understory is kept relatively open -brood parasitism low, jay predation high -often in clumpy groups, may be a factor of habitat
Mexican Spotted Owl	<ul style="list-style-type: none"> -will use several different foraging areas -use center of activity areas (land managers may want to protect center of activity areas.) -need small mammal prey base -need low human disturbance, especially during nesting -Great Horned Owl is frequent predator -monogamous and have individual territories
Eastern (Azure) Bluebird	<ul style="list-style-type: none"> -insectivorous, frugivorous -cavity nesters
Montezuma Quail	<ul style="list-style-type: none"> -dietary needs: tuber roots, acorn, grass seeds, insects -late nester (July - Sept.), following summer rains and subsequent grass growth -need specialized techniques to census spp.
Band-tailed Pigeon	<ul style="list-style-type: none"> -eat acorns, mulberries, elderberries currants, pine seeds -colonial nesting is unusual, will forage in groups of 6-20 individuals (Brown 1989) -hunting may pose potential threat
Thick-billed Parrot	<ul style="list-style-type: none"> -diet mainly pine nuts -nomadic -sensitive to humans - hunting may have contributed to decline -monogamous -flocking for foraging

SHRUBLANDS

G. *Mohave Desertscrub*

1. Habitat Description, Status and Importance

The Mohave Desert is the smallest of the four North American desert biomes and lies between the Great Basin and Sonoran deserts. Little of the Mohave Desert proper is in Arizona, but enough of Arizona lies adjacent to it and is intermediate in vegetation, soil type, and rainfall patterns to make it a significant biome in the state. The Mohave Desert is found only in the northwest corner of Arizona, but the areas along the Colorado River are in a transition zone between Sonoran and Mohave and are difficult to separate.

There are 18 - 26 days of annual precipitation in these areas, most occurring during winter and early spring and averaging approx. 35-130 mm (1.5-5.5 in) (MacMahon 1979; McKell 1985). Brown (1982) cites an annual precipitation of 46 mm (1.85 in) at Death Valley and as high as 253 mm (10 in) at Pierce Ferry, AZ. The elevational range of the Mohave Desertscrub biome is broader than other desertscrub biomes; 75% of the area lies between 610-1220 m (2000-4000 ft), with a biome range of 300-1675 m (985-5495 ft), hence the term "high desert".

Dominant plants of the Mohave include creosotebush, all-scale, brittlebush, desert holly, and white burrobush. The Joshua tree is the most famous endemic, having a near circular range around the edges of the Mohave Desert.

In Arizona, the Mohave Desert can be difficult to separate from Sonoran Desertscrub. Plant species characteristic of Sonoran desertscrub include ironwood, blue palo verde, and chuparosa. Other Sonoran plants are bitter condalia, emory dalea, smoketree, longleaf ephedra, crucifixion thorn, western honey mesquite and jojoba. The northern limits of these species in eastern California coincide with a shift to Mohave species. These include spiny menodora, sages, desert senna, Mohave dalea, Fremont dalea, goldenhead, and scalebroom.

Cacti are well-represented in Mohave Desertscrub. Many are widely distributed, but some endemics include Engelmann hedgehog, silver cholla, Mohave prickly pear, beavertail cactus, many-headed barrel cactus, and *Neolloydia johnsonii*. Subspecies of the following cacti are restricted to Mohave Desertscrub: Buckhorn cholla (var. *multigeniculata*), Parish cholla (var. *parishii*), and *Coryphantha vivipara* (var. *desertii*).

Approximately 80-90 annuals are endemic to Mohave Desertscrub, most being winter annuals. Of the few summer annuals, most germinate in response to rain in August and September (monsoon season). Winter annuals germinate in response to rain between late September and early

December. The critical rainfall arriving in one storm should exceed 24 mm (.96 in) to produce abundant germination.

Brown and others (1979) named five major series within the Mohave Desertscrub. The creosotebush series is mostly below about 1220 m (4000 ft) where *Larrea* occurs on the bajadas and well-drained sandy flats. The most prevalent co-dominant in this series is *Ambrosia dumosa*. Other co-dominants are Anderson thornbush, spiny hopsage, paperbag bush, and shadscale. Diamond cholla occurs only in this *Larrea-Atriplex confertifolia* community.

The Shadscale series is dominated by Shadscale. This transitional community between Great Basin desertscrub and Mohave is tolerant of most extremes in temperature and rainfall and various other extreme conditions including salt content of the soil.

One or more species of *Atriplex* characterize the Saltbush community. In addition, there is a common association with other salt-tolerant plants from the family Chenopodiaceae, such as pickleweed and alkali weeds. In the southern areas of the Great Basin and northern areas of the Mohave, plant associations are dominated by blackbrush, considered a community transitional between these two biomes.

The Joshua Tree series is perhaps best known in the Mohave, but because of its limited occurrence it is not used to characterize most of the biome. Except for the southeastern margin, this species is found along the edges of almost the entire Mohave Desert on cooler, moister upslopes. The Joshua Tree is found in sandy, loamy or fine gravelly soils with minimal runoff, indicating its requirement for increased moisture.

Several bird species use the habitat of Mohave Desertscrub but perhaps some of the most common Arizona birds found in this habitat are Bendire's Thrasher, Le Conte's Thrasher, Costa's Hummingbird and Scott's Oriole. All of the above species are currently stable in Arizona. Since only a small portion of Mohave Desertscrub falls in Arizona, these species should be watched more closely in both California and Nevada, where more of this habitat occurs. For a more detailed description of this habitat and a list of the priority species that use it, see the state Partners in Flight Bird Conservation plans of California and Nevada.

H. *Sonoran Desertscrub*

1. Habitat Description, Status and Importance

Arizona contains more Sonoran Desertscrub habitat than any other state in North America, putting Arizona in a position of great responsibility for protecting and maintaining this habitat. This unique ecosystem is home to many Sonoran Desertscrub obligate species. Although few species are in immediate danger of extirpation and only one bird species made “priority status,” the continued population growth and urban expansion in Arizona pose real and immediate threats to many of the obligate species. This section is organized differently than other sections of the plan to better identify the importance of Sonoran Desertscrub to Arizona’s bird species. We will address some of the currently known threats and identify those bird species that may be directly affected by them in the near future. The term desert and desertscrub are used interchangeably here and have the same meaning.

The Sonoran Desertscrub habitat is located in the region immediately surrounding the Gulf of California in the extreme southwestern portion of the United States. It occurs in southwestern Arizona, southeastern California, most of Baja, California and the western half of the State of Sonora, Mexico. In Arizona, the Sonoran Desertscrub encompasses 40,540 square miles (10,499,850 ha; 25,945,600 ac) (Shreve and Wiggins 1964); which accounts for approximately 34% of the total habitat range. Only Sonora, Mexico has a larger percentage (41%) of Sonoran Desertscrub habitat.

Sonoran Desertscrub habitat is characterized by low and unevenly distributed rainfall that ranges from 0-13 inches per year. In Arizona, summer and winter are the primary precipitation periods, with the majority of precipitation falling in the summer (Brown 1982). Other common characteristics include low humidity, high air temperatures with great daily and seasonal ranges, soil with low organic content and high mineral salt content, and sporadic stream flow (Shreve and Wiggins 1964).

The Sonoran Desertscrub habitat lies below 915 m (3000 ft) except for the narrow band along the eastern edge of Arizona which reaches 1050 m (3450 ft). Vegetation within this biome differs from the other deserts by the greater presence of tree species, truly large cacti and succulent constituents. The Sonoran Desertscrub exceeds the Mohave, Chihuahuan, Great Basin deserts in number and variety of life forms and diversity of plant communities.

Brown (1982) divided the Sonoran Desertscrub habitat into five subdivisions but only two, the *Lower Colorado River Valley* and the *Arizona Upland* occur in Arizona. The following are descriptions of the plant communities found within these two Arizona subdivisions.

a. **Lower Colorado River Valley Subdivision** is the largest and most arid subdivision of the Sonoran Desert, and is dominated by two communities; creosotebush-white bursage and saltbush. The creosotebush-white bursage series occurs over broad valleys and decreases in importance as the slope increases (such as on bajadas or sloping plains). The dominant plants (as expected) are creosotebush and white bursage. Other plant species include big galleta, indigo bush, longleaf ephedra and desert buckwheat.

Before cultivation, the saltbush series was the most widespread community in the Gila Valley, Arizona (Brown 1982). The soil is finer and water retention capacity greater than the creosote-white bursage series (Brown 1982). The saltbush series is found on gently sloping lands. Common plants found within this community include all-scale, narrow leaved wingscale, lycium, globe mallow species, burrowweed, and creosotebush.

In addition to the preceding communities, the Lower Colorado River Valley subdivision also includes the following communities: creosotebush-big galleta and mixed scrub series. As the name implies, the creosotebush-big galleta series is dominated by creosotebush and the big galleta, a shrub-like grass. This series occurs primarily on sandy plains or dune situations. The mixed scrub series occurs along washes and provides for a more diverse array of vegetation due to the increased moisture regime. This series intergrades within other series especially the creosote-white bursage series. The primary vegetation has greater structural diversity, characterized by blue paloverde, ironwood, smoketree as well as shrubs like desert lavender, jojoba and indigo bush.

Bird species typical of Lower Colorado River Valley Subdivision are: Le Conte's Thrasher, Black-throated Sparrow, Verdin, Loggerhead Shrike, Lesser Nighthawk and Black-tailed Gnatcatcher.

b. **Arizona Upland Subdivision** represents some of the most commonly recognized habitat in the Sonoran Desert. More than 90% of this Subdivision occurs on slopes, broken ground and multi-dissected sloping plains (Brown 1982). It is dominated by tree species that were confined to drainages in the Lower Colorado River Valley Subdivisions as well as an abundance of cacti species. This community is noted for its rich diversity of bird species (Brown 1982). There are three communities within the Arizona Upland Subdivision; paloverde-cacti-mixed scrub, creosotebush-crucifixion thorn, and jojoba-mixed scrub. The paloverde-cacti-mixed scrub series is the most extensive of the three series (Brown 1982). Dominant plant species within this series include; little-leaf paloverde, blue paloverde, saguaro, mesquite, ironwood, desert hackberry, whitethorn acacia, ocotillo, triangle-leaf bursage, little-leaved rattany, and prickly pear, pincushion, hedgehog, and barrel cacti.

The jojoba-mixed scrub series is best developed in the transition zone between Sonoran Desertscrub and interior chaparral (Brown 1978). Because its distribution is almost completely within the Sonoran Desert (Hastings and others 1972) it is included as a Sonoran Desertscrub series regardless of its "chaparral-like" physiognomy. This series is dominated by jojoba.

The creosotebush-crucifixion thorn series is particularly common on limestone substrates at the northern and eastern edges of the Sonoran Desert (Brown 1982). This series can intergrade into semi-desert grassland habitat. The dominant plant species are crucifixion thorn, creosotebush and acacia species.

Bird species typical of the Arizona Upland Subdivision are: Harris Hawk, White-winged Dove, Roadrunner, Mourning Dove, Verdin, Cactus Wren, Black-tailed Gnatcatcher, Phainopepla, Gambel's Quail, Costa's Hummingbird, Gilded Flicker and Gila Woodpecker.

2. Current Threats to Sonoran Desertscrub Habitat and Sonoran Desert Dependant Birds

Impacts of Growing Urbanization on Sonoran Desertscrub Nesting Birds

Conversion to urbanized landscapes is an increasing threat to the Arizona Upland subdivision of Sonoran Desert Scrub. Population growth in Arizona, especially Maricopa and Pima counties, has been dramatic. Between 1980 and 1996, Arizona grew by 64.3 percent. During this period, the population in Pima County increased by 46.9 percent. This growth is expected to continue with the population in Pima County projected to increase to 854,330 by the year 2000, to exceed 1 million by the year 2009, and to double by the year 2050 (Pima Association of Governments 1997).

The resulting conversion of native vegetation to housing and business developments may affect some bird species more than others. Those bird species that are sensitive to urbanization should be tracked for several reasons: 1) the current rates of urbanization are great, 2) these species may become rare in the future if conversion of desert scrub to urban development continues at the present rate, and 3) responses of these species to development may provide an indication of how well attempts to minimize the impacts of urban development are working.

Overall, bird species sensitive to urbanization include cavity nesters, insectivores, ground nesting species, and many species that feed on the ground or in low shrubs (Beissinger and Osborne 1982). In Arizona, Black-throated Sparrows and Black-tailed Gnatcatchers, in particular, are associated with undisturbed native vegetation (Germaine 1995). These two species do not occur in even low density housing developments, and have been found sensitive to urbanization by every study in Tucson (Emlen 1974, Frederick 1996, Germaine 1995, Mills and others 1989, Stenberg 1988, Tweit and Tweit 1986). We should monitor these two species in urbanizing areas. Several

other species have been found sensitive to urbanization in one or more of the following studies: Emlen (1974), Tweit and Tweit (1986), Mills and others (1989), Stenberg (1988), Germaine (1995), and Frederick (1996). These include Northern Flicker, Pyrrhoxia, Verdin, Gambel's Quail, Ash-throated Flycatcher, Greater Roadrunner, Rufous-winged Sparrow, and Ladder-backed Woodpecker. They also occur more frequently in natural open spaces than other land use types along the river corridors of Tucson (except Gambel's Quail, and including Brown-crested Flycatcher, Abert's Towhee, Brown Towhee, Black-chinned Hummingbird, and Phainopepla) (Frederick 1996). Four other Sonoran Desert species that should be considered for monitoring include Purple Martin, Le Conte's Thrasher, Elf Owl, and Lesser Nighthawk. Casual observations suggest these species are less abundant in urban areas. In addition, their natural history characteristics are typical of those birds that are generally sensitive to urbanization.

Impacts of Fire in the Arizona Upland subdivision of the Sonoran Desert

In recent years, impacts of fires in the Sonoran Desert have increased over historic levels (McLaughlin and Bowers 1982, Schmid and Rogers 1988). Prior to widespread anthropogenic impacts, the sparsity of ground cover and the open spacing between shrubs and trees limited the spread of fires that did ignite in the desert via lightning strikes. This historic lack of fires resulted in a plant community in the Sonoran Desert which is not adapted to fire in the same way as some of the other plant communities found in the state, e.g. ponderosa pine forests, chaparral, and grasslands (Narog and others 1995, Thomas 1991). The widespread establishment of red brome and other exotic annuals has increased ground cover in the desert and thus promotes fire spread (Narog and others 1995, Schmid and Rogers 1988). The number of fires has also increased due to increased human caused fires (Schmid and Rogers 1988).

Although specific impacts of fires vary depending on many factors, desert fires do directly kill many plants (Bunting and others 1980, Cave and Patten 1984, McLaughlin and Bowers 1982, Rogers 1985, Thomas 1991). There is also evidence to suggest that the increased frequency of fires in the Sonoran Desert may be changing the structure and species composition of some areas. Saguaro, other cacti and some perennial trees and shrubs, such as paloverde and bursage, are frequently killed and slow to recover after a fire, while other species such as catclaw, creosote, and jojoba recover more quickly (Brown and Minnich 1986, McAuliffe 1997, Narog and others 1995, Rogers 1985). This type of disruption can be predicted to impact bird and other wildlife communities (as by loss of nest cavities in saguaros), as well as negatively impacting the aesthetics of this habitat and perhaps causing irreparable damage to this plant community which in many ways typifies Arizona.

Impacts of Grazing on Sonoran Desertscrub Habitat

Grazing in the Sonoran Desert has progressed over the last several hundred years from smaller, somewhat confined areas of intensive grazing to large expanses of intensive grazing (Nabhan and Holdsworth 1998). Years of overstocking on public and private lands have impacted the composition and condition of Sonoran Desertscrub habitat. The effects of grazing on Sonoran Desertscrub habitat will vary from site to site depending on several factors. These include soil type, plant community, rainfall and the intensity and duration of grazing. Removal of herbaceous cover increases runoff and decreases the water-holding capacity of some soils. In general, clayey and sandy soils with few rocks are more susceptible to erosion from both wind and water. Clay/loam upland soils become ineffective users of summer rainfall when the herbaceous cover is removed.

Plant communities are largely determined by soil types. In plant communities where there are low diversity and few forage species, such as the creosote/bursage community, there is little change in vegetation from continuous heavy grazing. However, where a more diverse plant community exists, continuous heavy grazing will result in the removal of palatable species (grasses, forbs and some shrub species) and the subsequent spread of exotic species, usually non-palatable forbs and woody plants. Grazing, regrazing and trampling will damage vegetation and soil. Periods of rest are vital for plants to regenerate; however, desertscrub habitat recovers slowly so habitat may never fully recover from intensive and extensive grazing.

Three types of grazing regimes are authorized on public lands in the Sonoran Desert. Perennial allotments that permit year-long grazing of perennial vegetation at an established stocking rate, stocking of ephemeral allotments which enables the land manager to take advantage of abundant growth of annual plants averaging 3 out of 10 years and perennial-ephemeral allotments which combine these two types.

Impacts of Burro Browsing on Sonoran Desertscrub Habitat

Desert vegetation in some areas, particularly in western Arizona, is subject to heavy browsing by feral burros. Like birds, burros tend to concentrate in desert washes, at least during times of drought or extreme heat. Seegmiller and Ohmart (1981) found that mesquites and paloverdes were among the most important food items of burros along the Bill Williams River and noted the particularly destructive and wasteful methods by which burros feed on paloverdes. In areas along the Colorado River overused by burros, no small paloverde branches remain within their reach. For small trees, this means that only a trunk remains. Such heavy browsing is particularly detrimental for paloverdes because of their poor regenerative abilities.

This long-term damage to desert vegetation may be expected to have direct impacts on birds. The insect abundance associated with trees and shrubs along desert washes is an important source of food for wildlife. Paloverdes, ironwoods, and mesquites in particular appear to harbor large

numbers of insects when leaves are present, and even more when flowering. Birds depend upon these resources during the critical times of spring migration and nesting (Mills and others 1991). In addition, birds particularly favor paloverdes for nesting. Of 579 nests analyzed by the Arizona Breeding Bird Atlas project in Sonoran Desert habitat during 1994-1996, 269 (46%) were in washes and 203 (35%) were in paloverdes (ABBA unpubl. data). Of the 269 nests within washes, 139 (52%) were in paloverdes.

Arizona Breeding Bird Atlas data also revealed that birds that nest in paloverde trees commonly do so at heights within the reach of browsing burros. Though the average height of paloverdes that contained a nest was 5.0 m (16.5 ft), the average height of nests was only 2.0 m (6.5 ft), with a median of 1.8 m (6 ft). Burros can reach to at least this height and can pull down branches that extend even higher. Many birds prefer to nest near the outer edges of paloverdes among smaller branches. Mean distance from the trunk for nests in paloverdes was 1.35 m (4.5 ft). We have observed that in areas heavily used by burros, no small branches remain below 2 m (6.5 ft) on any paloverdes. Bird nesting sites are disappearing in these areas and recruitment of young trees for future nesting sites is nonexistent.

3. Species Descriptions, Objectives and Recommendations

The bird species identified in this section do not meet the APIF requirements for “priority” status (except for Cactus Ferruginous Pygmy-Owl), but are described here as indicators of Sonoran Desertscrub habitat health. At the end of the Sonoran Desertscrub habitat section, a table outlines bird species habitat needs in a quick reference format (Table 14).

CACTUS FERRUGINOUS PYGMY-OWL (*Glaucidium brasilianum cactorum*)

Associated Species in Sonoran Desert: Other species that may use similar habitat components or respond positively to management for the Cactus Ferruginous Pygmy-owl are: Harris’s Hawk, Gila Woodpecker, Gilded Flicker, Gambel’s Quail, Curve-billed Thrasher, Black-tailed Gnatcatcher, Phainopepla, Cactus Wren, Verdin, Elf Owl, Pyrrhuloxia, Ash-throated Flycatcher, Abert’s Towhee, Hooded Oriole, and Scott’s Oriole.

Associated Species in Lowland Riparian: Other species that may use similar habitat components or respond positively to management for the Cactus Ferruginous Pygmy-owl are: Lucy’s Warbler, Bell’s Vireo, Brown-crested Flycatcher, Bewick’s Wren, Hooded Oriole, Gila Woodpecker, Yellow Warbler, Yellow-breasted Chat, Yellow-billed Cuckoo, Ladder-backed Woodpecker.

Distribution: The Cactus Ferruginous Pygmy-Owl occurs from lowland central Arizona south through western Mexico to the States of Colima and Michoacan, and from southern

Texas south through the Mexican States of Tamaulipas and Nuevo Leon. South of these regions and through Central America, *G.b. ridgwayi* replaces *G.b. cactorum* (Fisher 1893a, Friedmann and others 1950, Johnsgard 1988, Karalus and Eckert 1974, Oberholser 1974, Phillips and others 1964, van Rossem 1937, Schaldach 1963, de Schauensee 1966). In Arizona, its range is limited to Sonoran desertscrub and riparian habitats below 1220 m (4000 ft) in elevation in central and southern Arizona.

Ecology: Pygmy-owls are considered non-migratory throughout their range, having been reported during the winter months at Organ Pipe (Johnson unpubl. data 1976, 1980, T. Tibbitts pers. comm. 1997), Rillito Creek near Camp Lowell at present-day Tucson (Bendire 1888), and Sabino Canyon (USFS unpubl. data). Currently, the earliest nesting record in Arizona is from the collection of five eggs on April 12th, recorded in the United States National Museum (USNM 1996). Due to the small population size and secretive nature of Cactus Ferruginous Pygmy-Owls in Arizona, information is limited. However, recent studies in Arizona have documented copulation on March 31, with egg laying estimated to have taken place between April 6 and April 11, 1996. Working backwards from a confirmed fledging event, the latest record of egg laying is estimated to have been between May 31-June 5 in Tucson, Arizona (Abbate and others 1996). Cactus Ferruginous Pygmy-Owls nest in a large cavity in a tree or large columnar cactus. These cavities may be naturally formed (e.g. knotholes) or excavated by woodpeckers. Nest lining material may or may not be used. Cavities are variously lined with nesting materials or left unlined (Abbate and others 1996, Breninger 1898, Proudfoot 1996). Juveniles remain in close proximity to adults until dispersal. While data is limited, studies indicate that juvenile Cactus Ferruginous Pygmy-Owls have dispersed at least four miles in Texas and two miles in Arizona from their natal sites before establishing their own territories (Proudfoot 1996, S. Richardson pers. comm., AGFD 1997).

Habitat Requirements: In Arizona, the Cactus Ferruginous Pygmy-Owl is primarily associated with the Arizona Upland Subdivision of the Sonoran Desert, below (1220 m) 4000 ft in elevation. Generally, vegetation at these sites includes both species and structural diversity, with well-developed ground cover, mid-story, and canopy layers. The density of the vegetation is likely required to provide an adequate prey base for the Cactus Ferruginous Pygmy-Owl, as well as cover from aerial predators. In riparian areas, plant species may include Fremont cottonwood, willow species, hackberry, and mesquite species. Within Sonoran desertscrub, plant species generally include saguaro, mesquite, paloverde, and ironwood. While the Cactus Ferruginous Pygmy-Owl was historically considered to be a riparian species, little is known about its use of standing water. For Cactus Ferruginous Pygmy-Owls occurring in Sonoran desertscrub, only three observations of direct water use by pygmy-owls for drinking or bathing have been documented (Abbate and others 1996). Cactus Ferruginous Pygmy-Owls within the Tucson, Arizona area, as well as some of those

at Organ Pipe Cactus National Monument, occur in close proximity to residential developments in low density housing areas not exceeding one house per 3.3-40 acres where those developments occur adjacent to larger, undeveloped tracks of desertscrub habitat (M. Richardson pers. comm., USFWS 1997).

Habitat and/or Population Objectives:

Population Objective

1. Maintain and increase current population in suitable habitat.

Habitat Strategy

1. Protect known breeding locations from disturbance (i.e. recreation, development etc.).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The lack of natural history information for this species has made species management difficult. Riparian and Sonoran desertscrub habitat losses are considered a primary factor in the decline of this species, as well as an on-going threat (Abbate and others 1996, Bahre 1991, Brown and others 1977, Rea 1983, Stromberg 1993, Stromberg and others 1992, Szaro 1989, Willard 1912). Current development pressure around major metropolitan areas, such as the city of Tucson, is resulting in on-going habitat losses (Abbate and others 1996, M. Richardson pers. comm., USFWS 1997). Additionally, increased recreational use and an invasion of nonnative grasses in Organ Pipe Cactus National Monument, increases the risk of habitat loss through wildfire (H. Smith in litt. 1996).

Cactus Ferruginous Pygmy-Owl management issues are listed in italics. Below each issue are Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Restore, maintain riparian and high quality saguaro, paloverde, ironwood, mesquite habitats.

Urbanization

1. Incorporate owl habitat needs into regional planning.
2. Encourage native landscaping, especially in areas adjacent to natural open space.
3. Maintain larger tracks of existing native habitat.

Human Disturbance

1. Educate bird enthusiasts and recreationists on possible sensitivity and encourage them to avoid known breeding areas.

Fire

1. Implement full fire suppression in suitable habitat.
2. Reduce fuel loads along roadways to lower risk of fire.

Implementation Opportunities

1. Increase coordination with local government planning.
2. Identify funding sources for research (especially in Mexico).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Increase research in Sonora, Mexico to determine distribution and genetic relationship between the Arizona and the Mexican species.
2. Conduct comprehensive surveys throughout AZ uplands and riparian habitat.
3. Determine the limiting factor in existing riparian habitat.
4. Investigate juvenile dispersal, home breeding range, wintering range, and habitat use by banding and telemetry.
5. Investigate methods to prevent high intensity fires in Sonoran Desert (specifically red brome).
6. Continue to collect natural history information (specifics on prey base).

NOTE: The remainder of species identified in this Sonoran desertscrub habitat section have NOT been identified as priority species and are currently stable. However, each of them is dependent on Sonoran desertscrub habitat for its survival and may be at risk in the near future as urbanization and to some extent fire, continue to consume this habitat. Since Arizona contains more Sonoran desertscrub habitat than any other state in the nation, we have a high responsibility to the birds dependent on it. The following species are included here as “red flags” for this unique desert habitat.

COSTA’S HUMMINGBIRD (*Calypte costae*)

Associated Species: Other species that may use similar habitat components or respond positively to management for Costa’s Hummingbird are: Ladder-backed Woodpecker, Curve-billed Thrasher, Ash-throated Flycatcher, Verdin, Black-tailed Gnatcatcher, Cactus Wren, White-winged Dove, Phainopepla, and Scott’s Oriole.

Distribution: The Costa's Hummingbird occurs in most of the lower Sonoran and limited portions of the upper Sonoran life zones of western North America. It is much less common but widespread in the Mohave desertscrub habitat (Baltosser and Scott 1996). Geographically, this translates primarily to western Arizona, southern California and limited portions of Nevada and Utah. In California, Costa's Hummingbird habitat extends as far north as Santa Barbara County along the coast; inland the northern extension coincides with the Mohave desert range extending east into southern Nevada to the Utah border. The range extends south through the western half of Arizona and into the western half of the States of Sonora and Sinaloa in Mexico. The breeding range extends further south in Baja covering the entire peninsula as well as all the islands in the Gulf of California larger than 30 km² (Baltosser and Scott 1996). The non-breeding range remains unchanged south of the Mexican border, with the exception of a southward extension along mainland Mexico to the State of Jalisco. North of the border, the wintering range for Costa's Hummingbird shrinks south and west withdrawing from Nevada and concentrating along the western Arizona border except for pockets around Phoenix and Tucson. Within California, the range shrinks southward along the coast.

Within Arizona, breeding habitat for the Costa's Hummingbird stays strictly within the Sonoran desertscrub habitat, rarely exceeding 1000 m in elevation. This coincides primarily with southwestern and southcentral Arizona. Breeding occurs in the Mohave desertscrub along the Nevada border and lower Grand Canyon region and a few scattered sites in southeastern part of the State (Baltosser and Scott 1996). Postbreeding range recently reconfirmed to include lower slopes of Huachuca Mountains (S. Williamson and T. Woods in litt.) and the upper San Pedro River (D. Krueper pers. comm.). Wintering range also includes Sonoran desertscrub habitat.

Ecology: Most birds arrive in desert in October/November wintering locally in desertscrub habitat; increasing in numbers and range until they reach the peak of breeding activity in March/April (Baltosser and Scott 1996). Most birds leave desert areas by May-June or earlier (Baltosser and Scott 1996, Monson and Phillips 1981). From June through August, limited numbers of Costa's Hummingbirds can be found in the lower elevations in the mountain foothills. The earliest known nesting date was January 29 (nest with eggs) while the latest evidence was nest building on June 3 (ABBA unpubl. data).

Costa's Hummingbirds have been recorded nesting predominately in southwestern and southcentral Arizona below 3300 ft. Fewer records have been recorded from the SE quadrant of the State. Nesting has been confirmed north of Phoenix southeast to Tucson. In addition, breeding has been confirmed in isolated locations such as the Grand Canyon and the extreme southeastern corner of the State (near the New Mexico border) (ABBA unpubl. data). No breeding has been recorded in the NE quadrant of the State (ABBA unpubl. data).

Costa's Hummingbirds typically build nests in a shrub or tree approximately 1-2 m above ground; the support structure can be living or dead and considerable variation occurs among habitat types. In Arizona, the most common nest plant is foothill paloverde, followed by jojoba, blue paloverde, ironwood, canyon ragweed, hopbush and goldenweed (ABBA unpubl. data, Baltosser and Scott 1996). The nest is composed primarily of small pieces of plant material and feathers fastened with spider web (Baltosser and Scott 1996). Plant material can include bark, small leaves, flower bud scales, ball-like flower heads, bits of lichen, dandelion or thistle heads, and other downy material.

Primarily nectar feeders, the two most important plant species for the Costa's Hummingbird are chuparosa and ocotillo. Chuparosa has a lengthy flowering period and is the most reliable and productive of midwinter nectar sources (Scott 1994). Some populations can flower for 6 months from fall through spring breeding period (Baltosser and Scott 1996, Rea 1983, Weathers 1983). Ocotillo has a much shorter (3-4 week) but predictable flowering season in March/April (Baltosser and Scott 1996, Waser 1979). Other nectar sources include: desert lavender, thornbush (*Lycium*), creosotebush, fairy duster, foothill paloverde, saguaro, desert willow, ironwood, desert honeysuckle, barestem larkspur and Mojave beardtongue (Baltosser and Scott 1996). Although there is little information, all hummingbirds (including Costa's) supplement their diet with insects presumably to satisfy protein requirements. Female hummingbirds require additional protein during egg-laying and when feeding young (Brice and Grau 1991).

Habitat Requirements: Costa's Hummingbirds breed primarily in Sonoran desertscrub habitat and within the United States, Arizona has the greatest concentration of desertscrub (Shreve and Wiggins 1964). Only the State of Sonora, Mexico, has a higher percentage of desertscrub habitat. In Arizona, Costa's Hummingbirds occur along desert washes, bajadas or mesas. They are extremely xerophilous (adapted to hot, dry environments). Baltosser and Scott (1996) described the following three plant associations where Costa's can be found: 1) dry washes lined with foothill paloverde, blue paloverde, catclaw acacia, ironwood, and smoketree or filled with shrubs such as creosotebush, jojoba, desert lavender and chuparosa; 2) steep rocky slopes with ocotillo and foothill paloverde; 3) gently sloping bajadas covered with saguaro, creosotebush, and cholla cacti. Costa's Hummingbirds select drier desertscrub even when adjacent to riparian habitat (Brown 1992, Szaro and Jakle 1985). Winter flowering of a few key species such as chuparosa may be crucial, allowing Costa's Hummingbird to persist with little interference from other hummingbird species (Baltosser and Scott 1996).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Population levels for Costa's Hummingbirds are relatively stable and the bird is still common throughout much of its' range (Baltosser and Scott 1996). However, the Sonoran desertscrub which constitutes the primary habitat for the Costa's Hummingbird is facing increasing threats from habitat modification (Baltosser and Scott 1996). Urbanization is increasing at an alarming rate and the Costa's appears to have limited adaptive capability to non-native vegetation and hummingbird feeders (Baltosser and Scott 1996). Whether this is due to direct competition with the more aggressive Anna's Hummingbird or other reasons is unknown. Grazing is a second impact to desertscrub habitat. Grazing impacts on the Costa's Hummingbird are unknown; although some nectar plants are thorny and resistant to grazing, shrub seedlings and herbs can be affected (Baltosser and Scott 1996). Similarly, browsing by feral burros, especially of foothill paloverdes, may greatly reduce Costa's preferred nesting substrate. Fire is a third element to impact the Costa's habitat. The introduction of non-native grasses into desertscrub habitat has increased fire potential. The desertscrub habitat is not fire-adapted and many tree species used for nesting are impacted. On the other hand some forage species such as chuparosa appear to respond well to fire (Baltosser and Scott 1996). Although current population trends for the Costa's Hummingbird are stable; the exponential rate of desertscrub habitat conversion raises concerns for the future stability of species dependent upon Sonoran desertscrub habitat.

Costa's Hummingbird management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Encourage maintenance of native vegetation.
2. Encourage landscaping with native vegetation.
3. Discourage unsustainable livestock management practices.
4. Manage burros before habitat is damaged.
5. Encourage fencing to keep feral animals and cattle out of prime costa's habitat.

Fire

1. Implement full suppression.
2. Reduce fuel loads along roadways.

Implementation Opportunities

1. Plant and maintain more native vegetation, especially tubular flowers.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine if Costa's Hummingbirds will come to urban areas to use native vegetation.
2. Determine what the limiting factors are for Costa's in urban areas.
3. Study where Costa's Hummingbirds winter.
4. Determine if there are any factors outside of AZ that could affect species on wintering grounds and on migration routes.

GILDED FLICKER (*Colaptes chrysoides*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Gilded Flicker are: Purple Martin, Brown-crested Flycatcher, American Kestrel, Ash-throated Flycatcher, Verdin, Western Screech-Owl, Elf Owl, White-winged Dove, Gila Woodpecker, and Scott's Oriole.

Distribution: The Gilded Flicker is resident from extreme southeastern and Baja California, southeastern Nevada, through central Arizona to northwest Mexico (Sonora and Sinaloa) from sea level to about 900 m (2955 ft). Throughout most of their range, Gilded Flickers are confined to desert scrub with large cacti (saguaro, organ pipe, cardon and hecho). In the northeastern portion of their range (southeastern and central Arizona) Gilded Flickers use riparian woodlands (cottonwood/willow) where large cacti are absent.

Ecology: The nesting period spans from February to June with nests frequently found in the upper 3 m (10 ft) of a giant cactus (Winkler and others 1995). Nest heights range from 2.5-12 m (8-40 ft), generally around 4.5 m (15 ft) (Bent, 1939). Cottonwoods, willows and snags are used where giant cacti are absent. From 3 to 5 eggs are laid indicating a lower reproductive rate than Northern Flicker (*Colaptes auratus*). Old nests are used by other species such as flycatchers and owls. Food includes ants and their larvae, other insects and fruit (e.g. cactus fruits). Flickers may cause some damage to pecan and walnut plantations (Winkler and others 1995). Gilded Flickers "suffer greatly from nest competition from" European Starlings (*Sturnus vulgaris*) (Winkler and others 1995).

Habitat Requirements: In Arizona the Gilded Flicker is primarily associated with saguaro and to a lesser extent with cottonwood at the edges of its range. Saguaros provide nesting substrate and food. Populations are densest where saguaros are abundant.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The spread of European Starlings into the desert Southwest has apparently caused declines in Gilded Flicker populations due to their intense competition for nest cavities. Large scale removal of desert scrub vegetation for subdivisions and agriculture, and the lack of recruitment of saguaros, has eliminated habitat for this species. Increased urbanization has, in some instances, increased the negative publicity towards woodpeckers in general due to their noisy vocalizations and destruction of expensive, planted saguaros. Conversion of cottonwood/willow riparian habitat to agriculture and invasion of the exotic salt cedar has likewise reduced the amount of habitat available, especially along the Colorado River. The spread of non-native grasses into desert scrub habitats has introduced fire where plants are not fire-adapted causing conversion from shrublands to grasslands. This is particularly true in Sonora where over 10% of the total land surface has been converted to non-native buffel grass spp. The rapid spread of red brome into Arizona desertscrub presents a similar threat.

Gilded Flicker management issues (potential) are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Encourage landowner/manager to maintain large saguaros and to protect all age classes for mature stands in the future.
2. Developers should be encouraged to leave larger tracts of saguaros (green-belts and open space).
3. Increase recruitment of saguaros.

Fire

1. Implement full suppression to maintain older saguaros.
2. Reduce fuel loads along roadways to reduce fire risk.

Implementation Opportunities

1. Educate general public about beneficial aspects of woodpeckers and how they can humanely discourage them from damaging property.
2. Control the number of starlings (gilded flicker competitors).
3. Educate stables and feedlots to control amount of available grain (encouraging starlings).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the age/size-class needs of saguaros that are used for nesting.
2. Determine the minimum habitat requirement for species.
3. Determine if Gilded Flickers are adaptable to artificial nest sites.
4. Determine if competition for nest cavities is a limiting factor for Gilded Flickers.
5. Study the extent Gilded Flickers kill saguaros, and other impacts to saguaros.

RUFIOUS-WINGED SPARROW (*Aimophila carpalis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Rufous-winged Sparrow are: Cactus Wren, Curve-billed Thrasher, Black-throated Sparrow, Verdin, Black-tailed Gnatcatcher, Phainopepla, Pyrrhuloxia, and Northern Cardinal.

Distribution: In the United States, the Rufous-winged Sparrow is resident only in southcentral Arizona. It then occurs south through Sonora to central Sinaloa in Mexico. In Arizona it ranges from near Winkelman and southwest of Florence, southeast to Mammoth, and south to Nogales and west through the Tohono O'odham Nation and the Saucedo Mountains in Maricopa County (Monson and Phillips 1981; Arizona Breeding Bird Atlas, unpublished data). During eruptions, the Rufous-winged Sparrow has been found east to Sierra Vista, Tombstone and Saint David, Elgin and Gardner Canyon wash east of the Santa Rita Mountains, and west to Quitobaquito (Monson and Phillips 1981).

Ecology: The Rufous-winged Sparrows is non-migratory. It may be heard singing any time of the year, but in normal (dry) years, singing occurs from June or July to mid-September (Bent 1968). Territory size varies depending on resource availability and range from less than 0.5 ha (1 ac) to more than 1 ha (2 ac) per pair (Phillips *in* Bent 1968). Rufous-winged Sparrows have been found nesting from mid-April to mid-September with the bulk of nesting after initiation of summer rains in July. April and May nesting likely occurs only during those years with higher precipitation during the winter and early spring (ABBA unpubl. data, Bent 1968). Nests are often placed in desert hackberry, graythorn, cholla, mesquite, and clumps of mistletoe in paloverde between 0.15-2.5 m (0.5-8.2 ft) (Phillips *in* Bent 1968). In riparian and mesquite dominated habitats, cowbird brood parasitism has been as high as 50 percent (Bent 1968). During the nesting season a large proportion of the food includes small caterpillars and grasshoppers. They also catch low-flying insects in short sallies and glean others from the stems of small plants such as burroweed (Bent 1968). Food at other seasons presumably consists largely of grass and weed seeds (Bent 1968).

Habitat Requirements: Phillips (*in* Bent 1968), characterizes the habitat of Rufous-winged Sparrow as grass and thorny brush. This includes lush Sonoran Desert and washes with palo verde, ironwood, mesquite, desert hackberry, cholla, saguaro, burroweed and scattered grasses, as well as, semidesert grassland mixed with shrubby mesquite and acacia (Bent 1968). Rufous-winged Sparrows formerly preferred the Sonoran Savanna Grassland (Brown 1982), a habitat that has undergone a drastic reduction in Arizona and Sonora. It will also use shrub-dominated, former cropland and riparian bottomland, as long as grass is a major component (Phillips *in* Bent 1968). This species seems to prefer the flatter portions of the habitat and apparently does not use the steeper hillsides. Formerly more common in the Tucson Basin, Rufous-winged Sparrows disappeared for nearly 50 years from that area as a result of overgrazing (Phillips and others 1964). They were rediscovered in the Tucson Basin in 1936.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Conservation of the Rufous-winged Sparrow requires protection of grassland habitats particularly in core areas. While formerly common throughout the Tucson Valley, much of the core area for Rufous-winged Sparrow has been converted into urbanized habitats. Substantial portions of Rufous-winged habitat are subject to future development. Tubac Rita Ranch and other developments north of Nogales will also displace birds, therefore core areas will become of increasing importance in the future. Improper grazing that reduces or eliminates prime grass habitat will negatively effect Rufous-winged Sparrow population numbers and is strongly discouraged. Restrictions on floodplain development and retention of natural plant communities in floodplains will contribute positively to the conservation of this species.

Rufous-winged Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss/Alteration

1. Grazing management on state and federal administered lands that use alternate grazing regimes or light to moderate utilization in prime habitat.
2. Maintain blocks of habitat between developments or green belts within developments.
3. Maintain current management in core areas such as the Santa Rita Experimental Range and the Buenos Aires N.W.R., Saguaro National Park and Tucson Mountain Park. Additional core areas could be maintained on Tohono O'odham lands around

San Xavier Mission, along the western flanks of the Baboquivari and Coyote Mountains, and on the eastern and southern flanks of the Silver Bell Mountains.

Implementation Opportunities:

1. Coordinate with land managers to maintain appropriate levels of grazing.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine how urbanization affects this sparrow.
2. Study what causes sparrow irruptions.
3. Determine if predation is a problem.
4. Study to what extent Brown-headed Cowbird parasitism affects this species.
5. Determine if Rufous-winged Sparrows breed twice in different habitats (do populations in Sonoran Desert breed later in desert grassland?).
6. Determine if fragmentation affects this species.

LE CONTE'S THRASHER (*Toxostoma lecontei*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Le Conte's Thrasher are: Lesser Nighthawk, Black-throated Sparrow, Black-tailed Gnatcatcher, Verdin, Loggerhead Shrike, and Greater Roadrunner.

Distribution: The Le Conte's Thrasher's breeding range currently extends from Southern Nevada and Southwestern Utah to Southeastern California and Western/Southwestern Arizona, northeastern Baja and northwestern Sonora (AOU 1983, Sheppard 1996). This thrasher is uncommon and local throughout its range and is not known to be migratory (Phillips and others 1964, Rosenberg and others 1991, Sheppard 1996). Earlier accounts have documented the Le Conte's Thrasher in Central and parts of Southeastern Arizona as well (Mearns 1886, Merriam 1895).

Ecology: Nesting generally occurs from February to June (Gilman 1904, Sheppard 1996) and several clutches are raised (Ehrlich and others 1988). Nests built of twigs and lined with two layers of flowers and fibers are commonly found in dense cholla cactus, creosote and palo verde (Ehrlich and others 1988, Gilman 1909, Merriam 1895).

Habitat Requirements: Nearly all *Toxostoma* species occur within the Colorado River basin (Mearns 1886). Le Conte's Thrasher inhabits sandy desert washes, flats and dunes (Phillips and others 1964, Rea 1983). Surrounding vegetation is typically *Ambrosia/Atriplex*

with some *Prosopis* and Cholla species (Rea 1983). Along the Gila River, areas inhabited by Le Conte's are mostly dominated by creosotebush (Monson and Phillips 1964). The Le Conte's Thrasher is the only avian species diagnostic of this sparsely vegetated Lower Colorado River Valley Subdivision of Sonoran Desertscrub (Brown 1994). This species forages entirely under desert shrubs (Sheppard 1996). Comparatively, the Crissal Thrasher (*T. crissale*) is common to dense *Prosopis* stands and forages within the branches of these bushes as well (Gilman 1909, Rea 1983).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Very little is known about the biology/ecology of the Le Conte's Thrasher. The decline of this thrasher's breeding range is largely attributed to habitat degradation involving the destruction of substrate, litter and shrubs. Shooting (near urban areas), DDT spraying (primarily in Mexico) and the improper use of some types of mist nets by ornithologists (60 mm mesh) may also be important factors in the decline of this species (Sheppard 1996). The Le Conte's Thrasher has been designated as a Species of Special Concern by the California Department of Fish and Game and as a Category 2 candidate for possible listing by the USFWS (Sheppard 1996). Management recommendations would involve setting aside large areas of appropriate desert habitat. Although no steps have been taken to set aside habitat for this species, many conservation areas currently in existence and in planning may also meet the needs of Le Conte's Thrasher (Sheppard 1996).

Le Conte's Thrasher management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Human Disturbance

1. Protect known at-risk breeding territories.
2. Avoid RV use on BLM land during Le Conte's Thrasher breeding season.

Loss of Habitat

1. Protect large tracts of optimal Le Conte's Thrasher desert habitat.

Implementation Opportunities

1. Restore abandoned agricultural fields.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine if Le Conte's Thrasher's will respond positively to rehabilitated farmland.

2. Conduct surveys in high-use areas with good thrasher habitat.
3. Evaluate use of artificial nest trees in areas where suitable sites may be limiting.
4. Determine the limiting factors for species, and why they are so locally distributed.
5. Study population and range trends.

PURPLE MARTIN (*Progne subis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Purple Martin are: Brown Crested Flycatcher, Gila Woodpecker, Gilded Flicker, American Kestrel, Northern Cardinal, House Finch, Elf Owl.

Distribution: The Purple Martin breeds from southwestern British Columbia south to Baja California; and from northeastern British Columbia to New Brunswick south to Mexico, the Gulf Coast, and southern Florida. Local in the Rocky Mountains but avoids most other mountainous areas (DeGraff and others 1991). Winters in South America east of the Andes from Venezuela south to northern Bolivia and southeastern Brazil (Ehrlich and others 1988). In Arizona, breeds in the Transition Zone of open habitats of the entire Mogollon Plateau region, extending to Williams, Mount Trumbull, the Natanes Plateau, the Sierra Ancha, and the Prescott region. Also found in the Chiricahua Mountains but absent from other mountains of southern Arizona, the Grand Canyon, and the northeast. Also in saguaro associations of south-central Arizona west to the Ajo Mountains and north to near Picacho, Florence, Roosevelt Lake, and the lower San Pedro Valley. It is infrequently observed outside their breeding range in the state.

Ecology: Purple Martins arrive in Arizona in early April and remain until early October (Phillips and others 1964). In the Arizona Upland subdivision of the Sonoran Desert, Purple Martin's nest primarily in old woodpecker holes in larger and older saguaros (Phillips and others 1964). Most nests are placed in the main stem of the saguaro within 3 m of the top (Brown 1997) and no more than one pair per saguaro has been found in Arizona (Brown 1997). Purple Martins also nest in tree cavities excavated by woodpeckers, and occasionally in cliff niches. They use colonial birdhouses in the eastern United States but have not adapted to these in the west, where they tend to nest singly (Brown 1997, Phillips and others 1964). The nest is made up of grass, leaves, mud, feathers, and occasionally has a dirt rim to keep eggs from rolling out. Fresh green leaves added during incubation are thought to be used for their pesticidal properties. Cowbird parasitism is very rare.

Purple Martins feed on flying insects taken on the wing often at altitudes over 50 m (164 ft), and may occasionally feed on the ground. Food items include ants, wasps, beetles, grasshoppers, stink bugs, treehoppers, dragonflies, moths, butterflies, mosquitoes,

horseflies, robber flies, etc. Typically, they don't forage when temperatures are less than 9° C (48° F) or in the rain. If cold or adverse weather lasts more than 3-4 days, mortality can be substantial (Brown 1997). They drink and bathe on the wing (Ehrlich and others 1988). They gather in enormous premigratory communal roosts at the end of summer, which may include up to 100,000 birds (Ehrlich and others 1988).

Considered as two subspecies in Arizona, exhibiting ecological races. Martins inhabiting the saguaro deserts (*P.s. hesperia*, used tentatively by Phillips, 1964) are of decidedly smaller size than those found in north and central Arizona (*P.s. arboricola*). The two habitats (and distributions) are in close proximity in the Roosevelt and Coolidge Lake areas.

Habitat Requirements: Purple Martins in the Upper Sonoran Desert are closely associated with saguaro forests. They will forage and roost in areas adjacent to cactus forests, including towns, parks, lakes and ponds. In central and southeastern Arizona, Martins inhabit open and cut over woodlands, open grassy river valleys, meadows around pools, shores of lakes, marsh edges, agricultural lands, parks and towns. Where trees are the nesting substrate, they prefer stands with both living and dead trees (Brown 1997). Purple Martins need a high old-growth snag density adjacent to or in open areas preferably near open water.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Audubon Society Blue List 1975-1981, Special Concern 1982-1986. Increased development and fire in Upland Sonoran Desert habitat could pose threats to *P.s. hesperia*, by reducing nest site availability in large saguaro forests. Forestry practices that removed standing dead trees greatly reduced the availability of natural nest sites for *P.s. arboricola*. Since they do not use colonial nest boxes in western states, they suffer from a lack of nest sites in many areas. House Sparrows and European Starlings compete for nest cavities and can cause local extirpation. Brawn and Balda (1988) state that the Purple Martin has nearly been extirpated from the ponderosa pine forest since fire suppression has resulted in much denser conditions and logging has reduced the number of snags and large old trees. Currently nests only in clusters of old, dead pines containing numerous woodpecker holes. Pesticide use in South America is a potential threat to wintering birds.

Purple Martin management issues, in Upland Sonoran Desert habitat, are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Encourage landowner/manager to maintain large saguaros and to protect all age classes for mature stands in the future.
2. Urge developers to leave larger tracts of saguaros (green-belts and natural open space).
3. Increase recruitment of saguaros.
4. Promote county land planning to minimize impacts on adjacent natural habitats and encourage natural components.

Fire

1. Reduce fuel build-up in Upland Sonoran Desert habitats to protect against catastrophic fire.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Research the population distribution of Purple Martins to learn more about habitat range.
2. Determine if pesticides are a threat in Upland Sonoran Desert habitat.
3. Study what specific prey items are used.
4. Study colonial nesting and competitive interactions with other species.
5. Study premigratory communal roost habitat requirements and localities.

Outreach Needs:

1. Discourage starlings around possible or known martin nesting areas to reduce competition.
2. Educate stables and feedlots to control amount of available grain (encouraging starlings).
3. Request local birders to report breeding and roost locations.
4. Provide information to Land Managers about habitat needs.

4. Coordination of Recommendations and Opportunities in Sonoran Desertscrub

Unlike many of Arizona's major habitats, we are in a rather unique situation with Sonoran Desertscrub habitat in that much of it is still in good condition and most of the birds using it are stable. We are in a position of being proactive and have the opportunity to prevent or slow down impending habitat loss by recognizing the threats now before it is too late. It is also our responsibility to protect Sonoran Desert in Arizona, since we have more than one third of its entire range and by far, the most Sonoran Desert in all of the continental United States.

The battle between urban growth and conservation of natural resources has escalated nationwide and Arizona is no exception. Urban growth combined with nonnative grasses that provide fuel to this non-fire-adapted habitat, could destroy this unique ecosystem over time if we don't have some measures in place to prevent this from happening. The clues are already reaching us as we learn more about Sonoran Desertscrub birds that disappear from habitat that appears adequate but lies on the edge of urban areas (Emlen 1974, Tweit and Tweit 1986, Mills and others 1989, Stenberg 1988, Germaine 1995, Frederick 1996). The conflict is only too real for the residents of Tucson as many fight for the right to develop in what has been identified as key habitat for the endangered Cactus Ferruginous Pygmy-Owl. The pygmy-owl was the only bird recognized as a real "priority" in Sonoran Desertscrub habitat at this time. Recommendations were also made for the five other species that are currently stable but highly dependent on this habitat for their survival.

For the Cactus Ferruginous Pygmy-Owl, habitat loss is the primary threat. Restoring and maintaining existing habitat is recommended for not only the Pygmy-Owl, but for all Sonoran Desertscrub dependent species. Maintaining existing habitat includes reducing the risk of wildfire. Roadsides are perhaps the most common place for desert wildfires to start due to increased amounts of brush that accumulate in these disturbed areas, and from burning cigarettes thrown out of car windows. Recommendations for full fire suppression where possible, and reduction of fuel loads along roadways, are made for all species.

The issue of urbanization will likely increase for more and more species as we continue to develop into natural areas. To maintain a healthy diversity of birds, as well as other wildlife, regional planning should incorporate the habitat needs of key species. Where development is inevitable, maintaining large tracts of natural, native open space adjacent to urban areas and using native vegetation when replanting is recommended. Education of bird enthusiasts and other recreationists about the possible sensitivity of human disturbance to the Cactus Ferruginous Pygmy-Owl, is also recommended.

Table 14. Sonoran Desertscrub Priority Species and Habitat Needs

Bird Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
<p>Cactus Ferruginous Pygmy-Owl (priority)</p>	<p>-(in Arizona Upland) Saguaro, ironwood, paloverde, mesquite, cholla, creosote, bursage</p>	<p>(in Arizona Upland) -prefer dense foliage from ground to canopy -moderate to high ground cover appears to be needed for prey base -high plant species diversity -diverse structure including a large shrub or tree component. (See AGFD Cactus Ferruginous Pygmy-Owl Tucson habitat study.)</p>	<p>-below 1220 m (4000 ft) -may be associated with water due to increase prey base (increase water sources near residential areas. -flats to upper alluvial fans (bajadas)</p>	<p>-fragmentation effects unknown -patch size - rough estimates : 4-8 ha (10-20 ac) territory in breeding season up to 80+ ha (200+ ac) in non-breeding season (Tucson, Organ Pipe) -late successional stage</p>
<p>Costa's Hummingbird (not priority)</p>	<p>paloverde, saguaro, mesquite, ocotillo, wolfberry, catclaw acacia, chuparosa, ironwood, creosote, desert-willow, jojoba</p>	<p>-prefer small, dense trees or shrubs, (ave. 4.3 m (14 ft) tall, ABBA unpubl. data) -nest on lower half of trees (especially paloverde) ave. 2.2 m (7.2 ft) (ABBA unpubl. data)</p>	<p>-population more productive in wet winters from availability of more flowering vegetation and subsequent higher availability of insects. -may construct nests later in season away from sun exposure.</p>	<p>-fragmentation. - not necessarily a factor -found most commonly in ecotone between riparian and desert flats (in LCRV) -mid- to late successional stages -appears to forage and nest in (close) proximity to tubular flowers</p>
<p>Gilded Flicker (not priority)</p>	<p>saguaro, paloverde, mesquite, ironwood</p>	<p>-use saguaro (roughly) over 80 years old</p>	<p>-larger saguaros mainly occurring on southerly and westerly facing slopes</p>	<p>-drop out in urban areas, unlike Gila Woodpecker -fire eliminating older, and larger saguaros could become a threat</p>
<p>Purple Martin (not priority)</p>	<p>saguaro, ironwood, mesquite, paloverde, graythorn, desert hackberry, triangle-leaf bursage, cholla</p>	<p>-use saguaro (roughly) over 80 years old, with many cavities</p>	<p>-larger saguaros mainly occurring on southerly and westerly facing slopes</p>	<p>-prefer areas with denser and older stands of saguaros -can use urban/rural edge if stands of saguaros are present -historically roosted in large cottonwoods, now commonly found (post breeding) on electrical wire</p>

Bird Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Le Conte's Thrasher (not priority)	creosotebush, white bursage, paloverde, mesquite (velvet and honey), smoketree, ironwood, saltbush	-dense low to mid-story shrubby trees that are isolated in open areas	-slope- flat or little topography -in AZ, the majority of them occur below 305 m (1000 ft)	-fairly local in occurrence -need isolated, scattered trees for nesting and perches -need open ground for running
Rufous-winged Sparrow (not priority)	paloverde, mesquite, bursage, graythorn, prickly pear, desert hackberry, cholla, barrel cactus	-nest in lower third of trees -usually occur where ground cover and understory are present in above average percentages	-annual precipitation may influence range (affecting grass and understory component) -Sonoran Desert habitat may be a secondary habitat (primary habitat being in area with more consistent grasses) -gentle to flat slopes	-populations are not continuous, local depending on grass and understory component -successional stages: mid would be primary, early would be secondary

Table 15. Special Factors for Sonoran Desertscrub Priority Species

Bird Species	Special Factors
Cactus Ferruginous Pygmy-Owl (priority)	<ul style="list-style-type: none"> -needs cavities (secondary cavity nester); may need higher density of cavities. -competition with other secondary cavity nesters
Costa's Hummingbird (not priority)	<ul style="list-style-type: none"> -this species does not benefit as much from urban feeders as other hummingbird species (i.e. Anna's, Black-chinned) -closely tied to native vegetation -majority of males leave the nesting areas by late spring
Gilded Flicker (not priority)	<ul style="list-style-type: none"> -nest cavity competition with starlings and screech owls may be a factor -since Gilded Flicker construct larger cavities, they sometimes cause saguaro to die -tend not to excavate cavities in the same saguaros as Gila Woodpeckers, which may represent competition for nesting saguaros
Purple Martin (not priority)	<ul style="list-style-type: none"> -colonial nesters -secondary cavity nesters -long distance migrants -need old, large saguaros with many cavities -may be associated with Gila Woodpeckers -nest later than all other saguaro cavity breeders which may aid in avoiding competition
Le Conte's Thrasher (not priority)	<ul style="list-style-type: none"> -very sensitive to human disturbance -primarily ground-feeding (cursorial) predator -can use more open and dryer habitat more effectively than similar species -will commonly use same nest tree but build new nest each year
Rufous-winged Sparrow (not priority)	<ul style="list-style-type: none"> -associated with grass, forbes, and denser understory (in good years of winter rains) -feeds on insects, seeds -is eruptive in some years

I. Chihuahuan Desertscrub

1. Habitat Description, Status and Importance

The Chihuahuan Desertscrub habitat makes up a small portion of Arizona's southeast corner encompassing 5175 km² (1998 mi²). The majority of this arid habitat lies in north-central Mexico extending into southern New Mexico and portions of southwest Texas. Distinct boundaries are somewhat difficult to define due to the recent dynamic conversion back to semidesert grassland (Brown 1982). Chihuahuan Desertscrub habitat in Arizona ranges from approximately 914-1402 m (3000-4600 ft). in elevation. Precipitation ranges from 70-500 mm (3-20 in.) per year, with up to 80 % falling between mid-June to mid-September (Shreve and Wiggins 1964).

Physiognomy of this desertscrub suggests primarily basins, outwash plains, low hills, and bajadas. Plant composition is relatively homogeneous overall consisting of three dominant shrub species: creosotebush, tarbush and whitethorn acacia (Brown 1982), although local concentrations of varying compositions exist over several portions of the desert. Low leaf succulents may include lechuguilla, agave (*A. falcata*) and *Hechtia sp.* (Shreve and Wiggins 1964). Larger succulents such as pringle barrel cactus emerge southward, below the Rio Nazas (Shreve and Wiggins 1964).

Along the northeast slopes of the Chiricahua Mountains, Chihuahuan Desertscrub lies adjacent to interior chaparral habitat and on occasion, this desertscrub meets Madrean evergreen woodland. In southeast Arizona along the San Pedro River, Sonoran Desertscrub is gradually replacing the Chihuahuan Desertscrub (Brown 1982). This is evident in areas where both white-thorn acacia, a Chihuahuan desertscrub indicator, and teddy bear cholla, a Sonoran desertscrub species, occur side by side.

Since a much more significant portion of Chihuahuan Desertscrub habitat falls in New Mexico, a more detailed description of the habitat and the birds that use it, can be found in the New Mexico Partners in Flight State Bird Conservation Plan.

J. *Cold Desertscrub*

1. Habitat Description, Status and Importance

The cold desertscrub habitat is a type typical of arid continental interiors. As such, it is widespread in the vast rain shadows of western North America and central Asia where annual precipitation is usually below 250 mm (Brown 1982). It often occurs as monotonous expanses of low widely spaced shrubs in regions with cold harsh winters. Various authorities have used such labels for it as Great Basin Desertscrub, Great Basin-Colorado Plateau Sagebrush Semi-desert, and Western Intermountain Sagebrush Steppe in regional plant community classifications (Brown 1982, Lowe 1964, West 1983). In Arizona, it occurs on the Colorado Plateau north of the Mogollon Rim. Much of the Navajo and Hopi Nations and the Arizona "Strip" (northwestern Arizona) is dominated by this habitat (Lowe 1964). It covers approximately 2.1 million hectares (5.3 million ac) of land in Arizona (Kuchler 1964) at elevations from 914 to 2133 m (3000 to 7000 ft).

Cold desertscrub is a structurally and floristically simple habitat. The primary perennial plant species, big sage, often occurs in monotypic stands. Other typical shrub species include black sage, fourwing saltbush, and shadscale. Sand sage, greasewood, blackbrush, and other shrubs may occur to varying degrees depending upon site specific characteristics. Grasses particularly grama, galleta, needlegrass, Indian rice grass and wheatgrass often appear as part of the herbaceous component although they are usually not abundant. The exotic annual cheatgrass is well established in many areas. Microphytic soil crusts of mosses lichen algae and fungi are often conspicuous and important biotic features in this habitat (West 1983)

Past and current post-Columbian uses of this habitat have been primarily agricultural in nature. It is used principally for livestock production throughout its range. It typically is not converted to crop production except in those areas conducive to dry farming or irrigation. In some regions, surface coal mining is an economically and ecological important use. Other uses include winter range for big game herds, recreation and land development (West 1983).

Throughout its range cold desertscrub is largely intact. This is in spite of the uses noted in the preceding paragraph. Grazing is widely considered to have altered the amount and composition of the various plant components (West 1983). The presence of cheatgrass has made some areas susceptible to wildfire which in some regions (because such fires tend to be a stand replacing phenomenon) has become a management concern of considerable importance (Whisenant 1990).

Bird diversity and density is typically low in cold desertscrub (Wiens and Rotenberry 1981). This is most likely due to its structural and floristic simplicity (MacArthur and MacArthur 1961, Rotenberry 1985, Wiens and Rotenberry 1981, Willson 1974). Usually a given stand will support three to six species of breeding birds. Species that are typical of this habitat include Sage Thrasher,

Sage Sparrow, and Brewer's Sparrow. In fact the breeding ranges of these three species in Arizona are restricted to this habitat (T. Corman pers. observ.). Additional bird species frequently using this habitat are the Horned Lark, Northern Mockingbird, Rock Wren, Loggerhead Shrike, Vesper Sparrow, Black-throated Sparrow and others (Monson and Phillips 1981). Because blacktail jackrabbits (*Lepus californicus*) are typical inhabitants of cold desertscrub, this habitat is likely of considerable importance to Golden Eagles in Arizona. Lark Buntings appear to be irruptive breeders in cold desertscrub outside of their usual range (Andrews and Righter 1992, AOU 1998) which suggests that they may occasionally breed in this habitat in Arizona.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each of the priority cold desertscrub habitat bird species.

SAGE THRASHER (*Oreoscoptes montanus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Sage Thrasher are: Sage Sparrow, Brewer's Sparrow, Horned Lark, Lark Sparrow, Loggerhead Shrike, and Black-throated Sparrow.

Distribution: The Sage Thrasher breeds from eastern Washington, Oregon and California east to Montana and south to northern Arizona and New Mexico. It winters from southwestern Arizona, southern New Mexico and Western Texas south into Mexico (Peterson 1990). In Arizona, Sage Thrashers breed in the northeast (Phillips and others 1964) with breeding recently documented in the northwest (ABBA unpubl. data). They migrate widely in open plains but movements are poorly understood (Phillips and others 1964).

Ecology: Typically, Sage Thrashers arrive on breeding grounds in early April (LaRue 1994, Woodbury and Russell 1945). Departure from breeding grounds occurs in September and October. They may depend heavily on arthropods in summer (Ehrlich and others 1988) and on juniper fruit in winter (Balda and Masters 1980). Active nests with eggs have been found by 31 May but fledglings have been observed by 30 May (ABBA unpubl. data), which suggests that nest building and egg laying likely occur in early to mid-May. Fledglings have been found as late as 21 July (ABBA unpubl. data). Apparently, only a single brood is raised (Woodbury and Russell 1945). Nests are built in low dense shrubs or small dense trees. In Arizona, nests have been found in big sage, sand sage, saltbush, cliffrose, Fremont barberry and even ornamental pyrocantha (ABBA unpubl. data, LaRue pers. observ.). Heights of four nest shrubs varied from 0.85-2.45 m (2.75-8.0 ft) and breeding elevations in Arizona range from 1525-2130 m (5000-7000 ft) (ABBA unpubl. data).

Habitat Requirements: The Sage Thrasher is a breeding obligate of cold desertscrub but a generalist within the habitat (Wiens and Rotenberry 1981). In Arizona, it primarily occupies big sagebrush but occurs in areas of sandsage, saltbush and greasewood (ABBA unpublished data, Woodbury and Russell 1945, Phillips and others 1964, LaRue 1994). Breeding densities in Arizona may vary from 0.9-9.5 pairs per 40 ha (100 ac).

Habitat and/or Population Objectives

Population Objective

1. To achieve at least 10 pair/40 ha (100 ac) (LaRue 1994) throughout current (1999) cold desertscrub distribution.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Rangewide, the 20-year Breeding Bird Survey trends for Sage Thrashers appear stable (Sauer and others 1996). However, the only declines noted in this survey occurred on Arizona's Mogollon Rim and the Colorado Plateau. Therefore, Arizona's population may be declining slightly. Large scale drastic reduction of shrubs may be detrimental (especially from burning). Where treatment of sage habitat is necessary, it was recommended by Castrale (1982 fr. USFS 1994) that manipulation be done in patches or strips 100 m (328 ft) wide and that large patches or strips 100-200 m (328-656 ft) of untreated habitat be left for thrasher habitat. This mosaic pattern provides edge while maintaining adequate patches of preferred sage habitat. The U.S. Forest Service (1994) reported that loss of large shrubs will eventually eliminate this bird as a breeder in that area. Although this species is considered a sagebrush obligate, they also occupy reclaimed mine spoil in Arizona that has been replanted with saltbush. This may be an indication that management practices that promote cold desertshrub establishment could be beneficial to Sage Thrashers (LaRue pers. observ.).

Sage Thrasher management issues are listed in italics. Below each issue are the Arizona Partners in Flight conservation recommendations.

Habitat Loss or Alteration

1. If treatments are necessary, they should be done in narrow strips or small blocks to maintain a mosaic pattern of edge and useable habitat.
2. Fragmentation of sagebrush habitat should not exceed 50 percent, especially where conversion would result in grasslands or agriculture (Wiens and Rotenberry 1985 fr. Yanishevsky and Petring-Rupp 1998)

Fire

1. Avoid burning or removing > 50 percent of sagebrush habitat to maintain adequate habitat for Sage Thrashers.

SAGE SPARROW (*Amphispiza belli nevadensis*)

Associated Species: Other bird species that may use similar habitat components or respond positively to management for the Sage Sparrow are: Sage Thrasher, Brewer's Sparrow, Horned Lark, Lark Sparrow, Loggerhead Shrike, and Black-throated Sparrow.

Distribution: Sage Sparrow's breed from central Washington to eastern Oregon and southwest Idaho, western and central Wyoming, throughout most of Nevada and Utah except for southeast and southwest portions respectively, to western Colorado and locally south-central Colorado, northwest New Mexico and the extreme northeastern Arizona. Local breeding also occurs in extreme northeast and east-central California. Sage Sparrows winter locally from southern Nevada, southwest Utah, throughout Arizona except for extreme northeast, west-central and southeastern New Mexico, to western Texas and into central Chihuahua Mexico to southeast California and eastern Baja California (Martin and Carlson 1998).

Ecology: Five distinct subspecies of Sage Sparrow's have been recognized, of which only two are migratory. Only the subspecies *nevadensis* occurs in Arizona and migrates farthest north of the two migratory subspecies (Martin and Carlson 1998). Breeding Bird Survey (BBS) trend information shows a decline in this species throughout most western regions from (1966-1996) (Sauer and others 1996).

In Arizona, Sage Sparrows arrive on breeding grounds mid-late April to early May. Confirmed nesting dates in Arizona range from 13 May-14 July (ABBA unpubl. data). They move to wintering grounds in Arizona along the Colorado River valley by late September-early October (Martin and Carlson 1998). Open cup nests are built primarily in shrubs toward the center stalk and occasionally on the ground under a shrub (Ehrlich and others 1988, Yanishevsky and Petring-Rupp 1998). Nests are constructed with twigs and coarse grasses and lined with finer grasses, weed bark and softer materials (Ehrlich and others 1988). Sage Sparrow's feed on the ground and glean from inside shrubs. Diet consists mostly of insects, spiders and seeds (Ehrlich and others 1988, Yanishevsky and Petring-Rupp 1998). Young sparrows are fed mainly insects. Sage Sparrows are uncommon cowbird hosts but parasitism may occur in areas where sagebrush has been removed for agriculture, grazing or development (Martin and Carlson 1998).

Habitat Requirements: The Sage Sparrow is closely associated with pure stands of big sagebrush throughout their range (Rich 1978, Rotenberry and Wiens 1978, Wiens and Rotenberry 1981) or stands intermingled with bitterbrush, saltbush, shadscale, rabbitbrush or greasewood (Martin and Carlson 1998). Big sagebrush is the most common shrub used for nesting in Arizona (ABBA unpubl. data). Larger shrubs with more canopy are usually selected over smaller, more sparse shrubs (Petersen and Best 1985) although nests are usually placed at 1 m (3.2 ft) or below. These preferred habitats are usually semi-open with evenly spaced shrubs (Martin and Carlson 1998). Sage Sparrows may be dependant on water availability and precipitation. Zeiner and others (1990) found that captive sparrows required more succulent foods or available water to survive and hatching rate of wild birds was found to be related to annual precipitation by Rotenberry and Wiens (1991).

Habitat and/or Population Objectives

Population Objective

1. To achieve an average of 40 pairs /40 ha (100 ac) (Yanishevsky and Petring-Rupp 1998) throughout the current (1999) sagebrush range.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Habitat loss and alteration, fire, and human disturbance are the major management issues for Sage Sparrows. The close association with sagebrush habitat and their relatively small range put Sage Sparrows at risk from catastrophic events that would greatly reduce sagebrush habitat. Conversion of Sage Sparrow habitat for agriculture and removal of big sagebrush to increase grasses for grazing is thought to have contributed to recent declines of this species (Braun and others 1976). Alteration of native habitat or shrub removal, and invasion of exotic grasses such as cheatgrass, caused Sage Sparrows to abandon previously used habitats (Wiens 1985, Wiens and Rotenberry 1985). Fire that results in reduced sagebrush may alter nesting behavior during second and third years (Wiens 1985, Wiens and Rotenberry 1985), however first year post burn habitats showed increases in nest survival and nestling growth rate (Petersen and Best 1987). Human invasion into Sage Sparrow habitats may introduce additional predators such as feral cats and exotic animals such as goats and other grazers. These species could impact Sage Sparrow use of adjacent habitat and contribute to declines (predation). Generally, disturbance to native grasses and removal of sagebrush habitat will likely threaten the long-term success of this species and is discouraged. Treatments of sagebrush, chemical or otherwise, should avoid the nesting season, grazing effects should be monitored and adjusted if destruction of habitat is occurring and fire use should be limited.

Sage Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight conservation recommendations.

Habitat Loss and Alteration

1. Avoid removal and alteration of sagebrush habitat and native grasslands, especially in known Sage Sparrow breeding areas, to reduce the risk of habitat loss and exotic plant invasions.

Fire

1. Avoid burning or removing > 50 percent of sagebrush habitat to maintain adequate habitat for Sage Sparrows.

Human Disturbance

1. Discourage human development in known breeding areas to reduce predation from feral cats and other domestic animals.

BREWER'S SPARROW (*Spizella breweri*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Brewer's Sparrow are: Sage Sparrow, Sage Thrasher, Horned Lark, Lark Sparrow, Loggerhead Shrike, and Black-throated Sparrow

Distribution: The Brewer's Sparrow breeds from extreme southwestern Canada south through the interior western United States. A disjunct population breeds in northwestern British Columbia and southwestern Yukon (Peterson 1990). In Arizona, it breeds across the northern Navajo Reservation (Phillips and others 1964) with recent widespread nesting discovered across northwestern Arizona and in central Apache county (ABBA unpubl. data).

The Brewer's Sparrow migrates widely across Arizona in open situations and winters (often abundantly) in Sonoran and Mojave desertscrub in western and southern Arizona (Phillips and others 1964). It winters very rarely on the Navajo nation in cold desertscrub below 6000 ft (LaRue pers. observ.).

Ecology: It arrives on Arizona breeding grounds as early as late March (Phillips and others 1964) but more typically in early April (Woodbury and Russell 1995). Brewer's Sparrows depart these areas by late October (LaRue pers. observ.). Arthropods are likely the primary food during the breeding season (Ehrlich and others 1988). Nests are usually in a low shrub (ABBA unpubl. data) and are cup nests (Ehrlich and others 1988). Uncommon cowbird hosts. Brewer's Sparrows like to nest in scattered pairs. Usually two broods are raised in a

single nesting season. Nest building may begin as early as 4 May and a second brood may fledge as late as 27 July (ABBA unpubl. data). Breeding densities vary from 5-533 individuals per square km (247 ac) (Rotenberry and Wiens 1980, Wiens and Rotenberry 1981) and 3-9 pairs per 40 ha (100 ac) (LaRue 1994). Densities of migrants in riparian scrub (tamarisk) on the Navajo Nation have been found as high as 500 individuals per 40 ha (100 ac) (LaRue 1994). Breeding territories vary from 0.65-1.25 ha (1.5-3.0 ac) (Wiens and others 1985).

Habitat Requirements: Brewers Sparrows breed exclusively in cold desertscrub, primarily sagebrush but also in saltbush, shadscale, and greasewood (Wiens and Rotenberry 1981, Medin 1990). Elevation of nesting sites in Arizona ranged from 1550-2070 m (5085-6790 ft) (ABBA unpubl. data). Nests are typically built in sagebrush. Ten of twelve nests in Arizona were in sagebrush (ABBA unpubl. data). Nest shrub heights varied from 0.45-1.55 m (1.5-5.0 ft) (ABBA unpubl. data).

Habitat and/or Population Objectives

Population Objective

1. To achieve at least 10 pair/40 ha (100ac) (LaRue 1994) throughout the current (1999) cold desertscrub distribution.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Twenty years of Breeding Bird surveys have documented declines in breeding populations in 14 of 15 regions (Sauer and others 1996). However, the only region showing a population increase is the Colorado Plateau which is where Arizona's breeding population is found. Brewer's Sparrows may respond negatively to shrubland alterations (Wiens and Rotenberry 1985). However, it did occupy reclaimed mine spoil at 3.3 pair per 40 ha (100 ac) with cool season grasses and saltbush densities of 4700 plants per ha (2.5 ac) (LaRue 1994). Because it is a widespread cold desertscrub species that exploits a variety of shrub species, it may respond positively to practices which increase shrub densities. Likewise, practices that reduce or eliminate shrub density and cover, especially big sage, may be detrimental (Wiens and Rotenberry 1985). The widespread declines through most of its breeding range may spread to the Colorado Plateau and Arizona's population. Monitoring to detect such declines is warranted.

Brewer's Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight conservation recommendations.

Habitat Loss or Alteration

1. If treatments are necessary, they should be done in narrow strips or small blocks to maintain a mosaic pattern of edge and useable habitat. Leave strips of sagebrush in all stages at least 100 m (328 ft) wide (USFS 1994 fr. Yanishevsky and Petring-Rupp 1998).
2. Fragmentation of sagebrush habitat should not exceed 50 percent, especially where conversion would result in grasslands or agriculture (Wiens and Rotenberry 1985 fr. Yanishevsky and Petring-Rupp 1998)

3. Coordination of Recommendations and Opportunities in Cold Desertscrub

Management issues for Cold Desertscrub bird species are very similar since the primary habitat for all three priority birds is sagebrush. Habitat loss or alteration poses the biggest threat to these species. Although there remains large tracts of sagebrush in northern Arizona, removal of big sagebrush to increase grasses for grazing may continue to reduce this habitat and allow further invasion of exotic grasses. Generally, disturbance to native grasses and removal of sagebrush habitat will likely threaten the long-term success of these species and is discouraged. Fire also contributes to habitat loss for all three priority species. However, Sage Sparrow showed increases in nest survival and nestling growth rate during the first year post so may initially benefit from fire. Fire that reduces more than 50% of sagebrush habitat is strongly discouraged. Treatments of sagebrush, chemical or otherwise, should avoid the nesting season, grazing effects should be monitored and adjusted if destruction of habitat is occurring and fire use should be limited. Human invasion into sagebrush habitats may introduce additional predators such as feral cats and exotic animals such as goats and other grazers. Effects of human disturbance in known nesting habitat for either of the three priority species, should be monitored and adjustments made where necessary and feasible.

K. *Chaparral*

1. Habitat Description, Status and Importance

Arizona interior chaparral, located in the central portion of Arizona, occurs at 1200-1800 m (4000-6000 ft) elevation with isolated stands occurring as low as 1066 m (3500 ft) and as high as 2200 m (7000 ft) (Shiflet 1994). This habitat occurs in a band extending southeast to northwest through the central part of the state just south of the Mogollon Rim (Cable 1975). More specifically, Shiflet (1994) describes the distribution as “extending from the Hualapai and Aquarius Mountains on the west, southeast along the foothills below the Mogollon Rim through the Bradshaw, Mazatzal, Sierra Ancha, Apache, Pinal, and Santa Teresa Mountains, plus small patches on the Galiuro, Catalina, and Rincon Mountains.” Estimates of area in Arizona vary from 1.2-3.4 million ha (3-6 million ac) (Brown 1982, Cable 1975, Shiflet 1994).

Arizona interior chaparral consists of leathery-leaved and predominantly evergreen shrubs which grow three to seven feet high in dense stands (Brown 1982, Shiflet 1994). The most dominant species is the turbinella oak or shrub live oak which comprises anywhere from 70-90 % of total vegetation (Brown 1982, Shiflet 1994). The second most abundant species is pointleaf manzanita (Shiflet 1994). A variety of other characteristic species include mountain mahogany, jojoba, ceanothus, sugar sumac, and buckhorn (Cable 1975, Knipe and others 1979, Brown 1982, Shiflet 1994).

Historical uses of chaparral include settlement by prospectors and miners as early as the 1860s (Cable 1975). Recreational use of chaparral is limited by accessibility and lack of recreational facilities (Brown and others 1974). Chaparral conversion is a management practice where stands of chaparral are converted to grassland to increase forage for livestock and wildlife (Brown and others 1974). Currently, threats to this habitat also include an increase in human development and construction of new recreational hiking trails.

Priority bird species for chaparral habitat in Arizona are the Black-chinned Sparrow and Virginia's Warbler. Species accounts and management recommendations will follow in the next plan update.

GRASSLANDS

L. Desert Grassland Habitat

1. Habitat Description, Status and Importance

1. **Sonoran Savanna Grassland** is a subtropical, fire climax grassland found between 90-1000 m (295-3280 ft) elevation on level plains and larger river valleys on deep fine-textured soils. Overgrazing virtually eliminated this habitat in Arizona by 1900 and in Sonora by 1940. Certain areas in the Altar and Santa Cruz Valleys were considered examples of this habitat type but only a few exceptions remain. Once dominated by Rothrock grama and various three awns, much of the range of this grassland type has now been converted to thornscrub (Brown 1994). This conversion has resulted in negative impacts to several avian species. Rufous-winged Sparrow disappeared from the Tucson area by 1890 and was not relocated until 1915. Masked Bobwhite was extirpated from the state by the turn of the century (Phillips and others 1964). The range of Crested Caracara was also greatly reduced at this time (Brown 1994).

Total area estimates are not available and this habitat type is not included on the Biotic Communities map (Fig. 1). Extensive areas of this habitat type are being restored on the Buenos Aires NWR and other small segments remain throughout the former range from the Tohono O'odham lands in the west to the Tucson Basin and south along the Santa Cruz River.

2. **Semidesert Grassland** is a biseasonal (summer and winter) or summer precipitation grassland found between 1100-1400 m (3608-4595 ft). Winters are generally mild with freezing temperatures generally occurring fewer than 100 days per year. This grassland occurs above, adjacent to or as enclosed drainages within the Chihuahuan Desertscrub and below the Madrean Evergreen Woodland or Plains Grassland.

Originally composed primarily of perennial bunch grasses, continuous grazing has shifted the composition of many areas to low growing sod grasses such as curly mesquite or, where the summer rainfall is low, to annuals (Brown 1982). Tobosa and black grama are presently the most characteristic species of this habitat but many other grass species are present. Dry-tropic shrub species such as mesquite, soap tree yucca and ocotillo were natural elements but are now found in greater densities due to overgrazing and fire suppression (Brown 1994).

Overgrazed during the latter part of the 19th century and subject to moderate to heavy grazing pressures at present, much of this habitat type has been converted to shrubs, half-shrubs or cacti (Bahre 1977, Hastings and Turner 1965, Wilkin and Galante 1987). This grassland type was the most extensive and has suffered the greatest extent of loss. The San Pedro, Sulphur Springs and San Simon Valleys were once vast seas of Semidesert Grassland, where now only remnants remain

around the edges. The lower parts of the Sonoita Valley are representative of this type and grade upward in elevation into Plains Grassland.

Semidesert Grassland is the primary habitat in Arizona of the Cassin's Sparrow. Rufous-winged Sparrows can occur at their upper limits here and Grasshopper Sparrows at their lower limits. Other bird species include Swainson's Hawk, Prairie Falcon, Eastern Meadowlark and Western Kingbird.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in desert grassland habitat. A table at the end of the Desert Grassland section highlights species habitat needs in a quick reference format (Table 16).

APLOMADO FALCON (*Falco femoralis septentrionalis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Aplomado Falcon are: Swainson's Hawk, Chihuahuan Raven, Western Kingbird, Scott's Oriole, Eastern Meadowlark.

Distribution: The Aplomado Falcon's breeding range extends north from South America through Central America into southern Mexico through the states of Veracruz, Chiapas, Campeche, and Tabasco into southwestern United States including New Mexico and Texas and formally Arizona (Brown and Amadon 1968, Hector 1987).

Ecology: In Arizona, the Aplomado Falcon was a common breeder prior to the 1900s (Phillips and others 1964). However, only two sightings were confirmed between 1910 and 1940 (Corman 1992), the latest in southeastern Arizona near St. David. No sightings have been confirmed since then (Corman 1992) and the species is now considered extirpated from Arizona. Reintroductions that began in Texas in 1985 appear to now be successful in producing wild born birds (Dunkeson 1998).

Aplomado Falcons migrate from their winter ranges by early February. Exact arrival and departure dates are difficult to determine because Aplomado Falcons have not been studied on their winter range. Timing of fall migration is also difficult to detect. In Arizona, winter range could potentially include the grasslands of central and southeast part of the state (Ward and others 1995).

Aplomado Falcons feed during dusk and dawn on birds, especially doves and blackbirds. They also commonly eat reptiles, lizards, rodents, bats, frogs, and large insects. These falcons have been observed hunting in pairs, especially fledglings and adults hunting birds. They also commonly hunt like an accipiter, surprising their prey by approaching at low-level rather than hovering and making a steep dive (Brown and Amadon 1968, Hector 1986, Jimenez 1993).

Habitat Requirements: The Aplomado Falcon breeds primarily in open grassland, arid open woodlands and desert habitats. They often use an old hawk or raven twig nest near the top of a low mesquite tree or yucca and line it with grass. Nests are commonly found 2.5-7.5 m (8-25 ft) above ground. Two to 4 eggs are laid in March, April, or May. Suitable breeding habitat in Mexico has been described as having an average inter-tree distances of 30 m (98 ft), average tree densities of 19-40 ha (47-100 ac), average tree height of 9 m (30 ft), and 92% ground cover at 0.7 m (2.3 ft) off the ground and 70% at 0.5 m (1.5 ft) off the ground (Hector 1988, Montoya and others 1997, USFWS 1992). Detailed nesting information is lacking for Arizona.

Habitat and/or Population Objectives:

Population Objective

1. Resurrect the 12-step reintroduction process in Arizona by the year 2005.
2. Establishing a viable population by the year 2049, by natural dispersal if reintroduction is not feasible.

Habitat Strategy

1. Manage current suitable habitat for the natural expansion of northern Chihuahua population into Arizona.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Aplomado Falcon populations have declined drastically over much of their range during this century from a number of causes. Habitat loss and alteration are the primary management issues for this species today. Brush encroachment and agricultural conversion of open grasslands, and egg shell thinning resulting from organochlorine pesticide poisoning are cited as the primary factors for this falcon's decline (Mora and others 1997). Other factors contributing to their decline may be degradation of riparian habitats and the subsequent reduction in prey for Aplomado Falcons, which may result in negative effects on productivity and survival (USFWS 1992).

Efforts to reintroduce the Aplomado Falcon in southwestern United States have recently shown promising results. Early attempts met with heavy adult falcon mortality but recent reintroductions have shown higher survival rates and successful nesting (Cade 1991, Endangered Species Bulletin 1997, Perez and Zwank 1995, Perez and others 1996). If reintroduction attempts are made again, priority should be given to releases in areas where there is strong public support and where opportunities of conflict with the public is minimal (Corman 1992).

Aplomado Falcon management issues are listed in italics. Below each issue are the Arizona Partners in Flight conservation recommendations.

Habitat loss and alteration

1. Incorporate allowable grazing utilization levels throughout all grasslands to maintain the long-term sustainability of grassland habitat.
2. Enforce established grazing regulations on state and federal lands.
3. Establish natural fire regime to maintain open grassland habitat with a tree component for nesting.
4. Establish Conservation Easements - provide information to developers about leaving native grassland areas in larger developments.
5. Maintain nest platform availability through placement of artificial nest platforms and protection of existing stick platforms.

Pesticide Use

1. Reduce or eliminate pesticide use in potential reintroduction release areas to guard against prey base being contaminated.
2. Measure contaminant loads of principal Aplomado Falcon prey at potential release sites.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine amount and location of potentially suitable nesting habitat in Arizona prior to reintroduction efforts.
2. Evaluate potential of reintroduction sites based on quantitative measurements of prey and nesting habitat.
3. Conduct surveys for nesting birds in the state of Sonora Mexico to determine possibility of starting a captive breeding program with Mexico's birds.
4. Evaluate the financial and physical logistics of developing a captive breeding population in conjunction with the Peregrine Fund.

BOTTERI'S SPARROW (*Aimophila botterii*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Botteri's Sparrow are: Cassin's Sparrow, Eastern Meadowlark.

Distribution: The Botteri's Sparrow was historically more common in Arizona before 1895, when its range spanned west to the Altar Valley and north to Fort Grant. It was also found in the Oracle area in 1940. This sparrow is currently found during the summer from the southeastern corner of Arizona, west to the Buenos Aires National Wildlife Refuge and east to extreme southwestern New Mexico. The species also occurs in the extreme southern tip of Texas and south to central Mexico. It probably winters in central Mexico, but winter range information is lacking. There are no winter records of Botteri's Sparrows from Arizona. Two subspecies exist in the United States, *A.b. arizonae* in southeastern Arizona and adjacent New Mexico, and *A.b. texana* in Texas (National Geographic Society 1987).

Ecology: Botteri's Sparrows arrive in Arizona during the latter part of May and leave by the end of September. They spend most of their time scurrying along the ground and through grass. Males sing from the top of a tree, bush or other perch, but not from the ground. Nests are usually built in June and are built on the ground with grasses.

Habitat Requirements: Botteri's occupy savanna-type grassland habitats, especially those with scattered shrubs or trees. In Arizona, they favor giant sacaton or other tall grass with mesquite, graythorn or catclaw. In Texas, they occupy salt-grass habitats with some yucca, prickly pear or mesquite. In Mexico, they prefer open grasslands with widely scattered live oaks or other trees (Monson 1968).

Habitat and/or Population Objectives:

Population Objective

1. To achieve an average of .68 individuals per ha (2.5 ac) (Webb and Bock 1996) from the Altar Valley east to New Mexico and south of Interstate 10.

Habitat Strategy

1. Maintain mature sacaton grasslands, mesquite grasslands and tobosa swales from the Altar Valley east to New Mexico and south of Interstate 10.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

This species was less ecologically restricted and more widespread in the lush grasslands prior to general overgrazing of the 1880s and 1890s (Phillips and others 1964). Botteri's Sparrows prefer dense grasslands with a scattered shrub/tree component. Threats to habitat are brush encroachment as a result of overgrazing and fire suppression, extreme reduction in grass stem density from poor grazing management, loss of sacaton grasslands from ground water pumping, and increasing numbers of suburban developments.

Botteri's Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Grazing

1. Maintain a mosaic of ungrazed sacaton stands in different stages of postfire succession to facilitate nest site availability and dispersal of fledglings (Webb and Bock 1996).

Fire

1. Burn at 10-20 year intervals to maintain optimal habitat. Habitat quality will begin to degrade after 20 years, therefore, burning at or before 20 yr interval is recommended.

Habitat Loss and Alteration

1. Protect diverse grasslands on slopes and areas adjacent to mature sacaton for foraging (Webb and Bock 1996).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Monitor Botteri's for long term to determine population trends (Webb and Bock 1996).
2. Study winter range and habitat use of United States populations in northern Mexico (Webb and Bock 1996).

CASSIN'S SPARROW (*Aimophila cassinii*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Cassin's Sparrow are: Botteri's Sparrow, Grasshopper Sparrow and Loggerhead Shrike.

Distribution: The Cassin's Sparrow summers from southern Nebraska and Wyoming to central Texas and New Mexico, and is resident from central Texas and New Mexico south to central Mexico, including its range in Arizona (National Geographic Society 1987). Its range in Arizona includes southeastern Arizona grasslands south of the Mogollon Rim and Salt River, east of the Baboquivari Mountains. Elsewhere, it is irregular, depending on random rainy periods (Monson and Phillips 1981, Phillips and others 1964).

Ecology: The Cassin's Sparrow is primarily resident in southeastern Arizona (Monson and Phillips 1981). Nesting dates range from late July to early September. They are more numerous during years of higher precipitation, and during good years, will begin singing in early March and continue through mid-April. Singing then drops off until the onset of the summer monsoons in July or August. Male flight song is initiated from an elevated perch, rather than from the ground. The cup-shaped nest is built on the ground and made of forbs, grass, and occasionally flowers and is lined with fine grass, rootlets and hair. The nests are built in a bunch of grass, at the foot of small shrub, and above ground in low branches of cactus or bush. The Cassin's diet consists of insects during breeding season; grass and forb seeds during rest of year (Ehrlich and others 1988). They apparently do not require free water and are uncommon cowbird hosts.

Habitat Requirements: Cassin's Sparrows inhabit arid grasslands with scattered shrubs, cactus, and/or mesquite, often in extensive savannah areas. Breeding habitat includes grassland or shortgrass prairie with scattered bushes, mesquite, cactus, or yucca.

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable or increasing population density over a 5-10 year cycle.

Habitat Strategy

1. Manage for a minimum of 2.0 ha (5-plus ac) blocks of dense *Grama* spp. and bunchgrasses within a 16 ha (40 ac) block of mixed grass and shrubs. This is projected to provide suitable breeding habitat for Cassin's Sparrows. These 16 ha (40 ac) blocks of moderate to high quality habitat should be evenly distributed throughout 4045 ha (10,000 ac) blocks of contiguous grassland from the Altar Valley east to the New Mexico state line and south of the Gila River.
2. Maintain at least 250 blocks of suitable breeding habitat, as described above, per 4045 ha (10,000 ac) block of contiguous grassland.

2. Maintain or improve grassland habitats to provide the following number of 4045 ha (10,000 ac) blocks, containing at least 250 plus blocks of suitable breeding habitat, in the following locations by the year 2010:

- (5) Buenos Aires National Wildlife Refuge (NWR)
- (3-6) San Rafael Grasslands
- (6-12) Empire Cienega Riparian Conservation Area and Sonoita Valley
- (5) San Simon Valley

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Habitat modification concerns for Cassin's Sparrows result from dense brush encroachment as a result of overgrazing and fire suppression, and extreme reduction in grass stem density from overgrazing. Habitat loss due to subdivision of grasslands for human developments is also a growing concern.

Habitat Loss and Alteration

1. Maintain blocks of habitat between developments or green belts within developments.

Grazing

1. Implement grazing management, on state and federal administered lands, that uses alternate grazing regimes or light to moderate utilization in prime habitat.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine minimum patch size to provide specific sizes needed for protection and restoration.
2. Determine the responses of Cassin's Sparrows to different management techniques.
3. Study the winter range and habitat use of Cassin's Sparrows.
4. Conduct an inventory of wintering areas and evaluate their quality and protection to assess how wintering areas affect Cassin's Sparrow populations.

RUFIOUS-WINGED SPARROW (*Aimophila carpalis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Rufous-winged Sparrow are: Cactus Wren, Curve-billed Thrasher, Pyrrhuloxia, Varied Bunting, Canyon Towhee and Scott's Oriole.

Distribution: The Rufous-winged Sparrow is resident in the United States only in a restricted area in southcentral Arizona. A Sonoran Desert representative of the *Aimophila* group, it ranges from near Winkelman and southwest of Florence, south to Nogales and west through the Tohono O'odham Nation; Saucedo Mountains in Maricopa County and probably to Sonoyta, Sonora (Monson and Phillips 1981, ABBA unpubl. data).

During eruptions, the Rufous-winged Sparrow has bred east to the San Pedro River at Sierra Vista (Christmas Bird Count 1973-74), Tombstone and Saint David, Elgin and Gardner Canyon wash east of the Santa Rita Mountains, and west to Quitobaquito (Monson and Phillips 1981). The range in Mexico extends through the lowlands of Sonora into central Sinaloa.

Ecology: Rufous-winged Sparrows normally breed after initiation of summer rains from late June into September, but may also nest in May during years with high spring rainfall. Nests are often placed in desert hackberry at 0.6-2 m (1.97-6.6 ft), cholla, mesquite and clumps of mistletoe in paloverde (Phillips *in* Bent 1968).

Territory size varies depending on resource availability and range from less than 0.5 ha (1 ac) to more than 1 ha (2.5 ac) per pair (Phillips *in* Bent 1968). Rufous-winged Sparrows are non-migratory. In riparian and mesquite dominated habitats, cowbird parasitism is considered to be a threat (Phillips *in* Bent 1968).

Habitat Requirements: Phillips (*in* Bent 1968), characterizes the habitat of Rufous-winged Sparrow as grass and brush. Plant species mentioned in association with Rufous-winged Sparrow include desert hackberry, burroweed, cholla and tobosa and Rothrock grama (Phillips *in* Bent 1968). Mesquite is frequently present.

Rufous-winged Sparrows formerly preferred the Sonoran Savanna Grassland (Brown 1982), a habitat that has undergone a drastic reduction in Arizona and Sonora. It also uses a wide range of desert grassland and dense Sonoran desert habitats. It will also use shrub-dominated, former cropland and riparian bottomland, as long as grass is a major component (Phillips *in* Bent 1968). This species seems to prefer the flatter portions of the habitat and apparently does not use the steeper hillsides. Formerly more common in the Tucson Basin,

Rufous-winged Sparrows disappeared for nearly 50 years from that area as a result of overgrazing (Phillips and others 1964). They were rediscovered in the Tucson Basin in 1936.

Habitat and/or Population Objectives

Population Objective

1. Maintain a stable or increasing population density over a 5-10 year cycle.

Habitat Strategy

1. At least 5000 pair within core habitat of the Santa Rita Experimental Range and the surrounding area (approx. 80,935 ha or 200,000 ac).
2. Improve the 80,935 ha (200,000 ac) surrounding the Santa Rita Experimental Range (distributed over the Avra Valley, Saguaro National Park, and the Tohono O'odham) to prime Rufous-winged Sparrow habitat conditions as described in the Rufous-winged Sparrow habitat requirements section of this plan.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Conservation of the Rufous-winged Sparrow would require protection of grassland habitats particularly in core areas. Current management in several of these areas, the Santa Rita Experimental Range and the Buenos Aires NWR, Saguaro National Park and Tucson Mountain Park, is probably sufficient to maintain these populations. Other core areas could be maintained on Tohono O'odham lands around San Xavier Mission, along the western flanks of the Baboquivari and Coyote Mountains, and on the eastern and southern flanks of the Silver Bell Mountains.

While formerly common throughout the Tucson Valley, much of the core area for Rufous-winged Sparrow has been converted into urbanized habitats. Substantial portions of Rufous-winged habitat are subject to future development. Green Valley is one of the fastest growing communities in southeastern Arizona. Housing developments are likely to occupy current Rufous-winged Sparrow habitat in the near future. Tubac Rita Ranch and other developments north of Nogales will also displace birds, therefore core areas will become of increasing importance in the future. Restrictions on floodplain development and retention of natural plant communities in floodplains will also contribute to the conservation of this species.

Rufous-winged Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Implement grazing management, on state and federal administered lands, that uses alternate grazing regimes or light to moderate utilization in prime habitat.
2. Maintain blocks of habitat between developments or green belts within developments.
3. Limit development and retain natural plant communities in floodplains.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine how urbanization affects this sparrow.
2. Study what causes sparrow irruptions.
3. Determine if predation is a problem.
4. Study to what extent Brown-headed Cowbird parasitism affects this species.
5. Determine if Rufous-winged Sparrows breed twice in different habitats (do populations in Sonoran Desert breed later in desert grassland?).
6. Determine if fragmentation affects this species.

BAIRD'S SPARROW (*Ammodramus bairdii*)- Wintering Only

Associated Species: Other species that may use similar habitat components or respond positively to management for the Baird's Sparrow are: Aplomado Falcon, Horned Lark, Sprague's Pipit, Savannah Sparrow, Grasshopper Sparrow, Chestnut-collared Longspur and Eastern Meadowlark.

Distribution: This species breeds from southern Alberta, Saskatchewan, and Manitoba south to central and eastern Montana, South Dakota, southern North Dakota and west-central Minnesota. The known winter range of Baird's Sparrow extends from west Texas, southwestern New Mexico, southeastern Arizona and northwestern Sonora to the Mexico states of Durango and Coahuila, and Chihuahua (AOU 1983, Bent 1968). In Arizona, it winters very locally in grasslands within 80 km (50 mi) of the Sonora border from the Buena Vista NWR, Sonoita plains, San Rafael Valley, upper San Pedro River valley, and southern Sulphur Springs valley (C. Gordon pers. comm., Monson and Phillips 1981). The Arizona portion of its winter range also closely matches the breeding range of the Arizona Grasshopper Sparrow (*A.s. ammolegus*).

Ecology: This species arrives in its northern prairie breeding grounds between late April and early June. Its nest is constructed on the ground with breeding commencing in early June and some continuing to mid-August (Goossen and others 1993). This sparrow arrives

in Arizona as early as mid-August (usually mid-October) and departs as late as early May (usually early April) (Phillips and others 1964).

Habitat Requirements: Baird's Sparrow prefers ungrazed or lightly grazed short-grass and mid-grass prairie (Brown and others 1979) habitat without trees or shrubs on the breeding grounds and appears to prefer this habitat on the wintering ground as well (Cartwright and others 1937). If sufficient thatch and ground cover are present without a mat of vegetation, this habitat provides the necessary cover for concealment from raptors and also grass seed for foraging. Baird's Sparrow prefers rolling hill country on the wintering grounds probably because these rocky soils do not produce a vegetation mat. Baird's Sparrow appears to be sedentary on the wintering ground, staying in a small "home range" and surviving if conditions are adequate (Gordon pers. comm.). Activities such as grazing, which reduces thatch, cover and seed crop, reduce habitat carrying capacity for Baird's Sparrow and if grazing is heavy, could likely cause winter mortality. In consecutive drought years, which are common in the Southwest, habitat impacts can be severe enough to affect the total population. Baird's Sparrow appears to be most common on ungrazed areas and nearly absent from areas that receive more than moderate grazing, although they may persist in lightly grazed areas of less desirable grass such as Lehmann's Lovegrass and bluestem.

Little is known about habitat patch size although there are records of birds in relatively small patches of 40 ha or less (100 ac) of suitable habitat. Fire may play a role in creating suitable habitat by reducing brush and increasing grass vigor, although there are few references to fire in the literature (Bent 1968, Cartwright and others 1937).

Habitat and/or Population Objectives:

Population Objective

1. Maintain or increase the current wintering population density over a 5-10 year cycle.

Habitat Strategy

1. A minimum of 2.5 ha (6-plus ac) blocks of dense *Grama spp.* and bunchgrasses within a 16 ha (40 ac) block of mixed grass and shrubs. This is projected to provide suitable breeding habitat for Baird's Sparrows. These 16 ha (40 ac) blocks of moderate to high quality habitat should be evenly distributed throughout 4045 ha (10,000 ac) blocks of contiguous grassland from the Altar Valley east to the New Mexico state line and south of the Gila River.
2. Maintain at least 250 blocks of suitable breeding habitat, as described above, per 4045 ha (10,000 ac) block of contiguous grassland.

3. Maintain or improve grassland habitats to provide the following number of 4045 ha (10,000 ac) blocks, containing at least 250 plus blocks of suitable breeding habitat, in the following locations by the year 2010:
 - (5) Buenos Aires National Wildlife Refuge (NWR)
 - (3-6) San Rafael Grasslands
 - (6-12) Empire-Cienega Riparian Conservation Area and Sonoita Valley
 - (5) San Simon Valley

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The majority of Baird's Sparrows are thought to winter in the Mexican states of Chihuahua and Durango. Most of the United States winter range (approx. 90%) is on private and Arizona state Trust lands. Much of the San Rafael grassland experienced heavy grazing pressure in 1995 and 1996, and little suitable habitat remains. Without an increase in rainfall there is a likelihood that these areas will continue to show little improvement. However, when wetter conditions return, range management can provide increased habitat for Baird's Sparrow. In the Sonoita and San Pedro Valleys there is a more permanent problem. In addition to heavy grazing impacts on some parts of these grasslands, urbanization is growing. This situation is unfortunately irreversible, even with increased rainfall and improved range management.

Habitat degradation and habitat loss are the only real threats facing Baird's Sparrow as a wintering species in Arizona. Habitat degradation can be addressed by range management in prime pastures. Maintaining prime habitat in times when populations are forced into secondary habitats, such as in times of severe drought, could benefit this species.

Baird's Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss and Alteration

1. Maintain prime habitat in times when populations are forced into secondary habitats, especially during severe droughts.

Grazing

1. Implement grazing management, on state and federal administered lands, that uses alternate grazing regimes or light to moderate utilization in prime habitat.
2. Avoid long duration and heavy grazing in prime habitat.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine minimum patch size to provide specific sizes needed for protection and restoration.
2. Study the reproductive success of Baird's in different habitats i.e. native and non-native grasslands and cropland (Jones and Green 1998).
3. Determine the responses of Baird's to different management techniques.
4. Study the winter range and habitat use of Baird's Sparrows (Jones and Green 1998).
5. Conduct an inventory of wintering areas and evaluate their quality and protection to assess how wintering areas affect Baird's populations (Jones and Green 1998).

GRASSHOPPER SPARROW [both wintering (*Ammodramus savannarum perpallidus*) and breeding (*A.s. ammoregus*)]

Associated Species: Other species that may use similar habitat components or respond positively to management for the Grasshopper Sparrow are: Baird's Sparrow, Savannah Sparrow and Sprague's Pipit.

Distribution: The Arizona Grasshopper Sparrow breeds in Arizona from southern Pima County (Empire-Cienega Riparian Conservation Area and Buenos Aires National Wildlife Refuge) through Santa Cruz and Cochise County into northern Sonora (Nogales and Cananea). The core areas are in Plains Grassland (Brown 1982) in the San Rafael Valley straddling the Mexican border, the upper elevations of the Sonoita Valley, the Mexican portions of the upper San Pedro Valley and the eastern flanks of the Sulphur Springs Valley. There is a recently discovered separate population (unknown subspecies) breeding in the Chino Valley in Yavapai Co (ABBA unpubl. data). In winter, migrant Grasshopper Sparrows of the western race (*A.s.perpallidus*) occupy the same range as the breeding race from Buenos Aires Ranch in the Altar Valley in the west, north to near Interstate 10, east into New Mexico and south well into Mexico. A portion of this population retreats into Sonora and south.

Ecology: Like its congener the Baird's Sparrow, the Grasshopper Sparrow has cryptic coloration and crouches rather than flies when predators approach. These grassland species require abundant thatch and dry grass for concealment (Lima and Valone 1991). Arizona Grasshopper Sparrows normally breed during the summer rainy season in July and August. Their nests are built into the bases of grass clumps, using the dense dead grass that accumulates around the bottom of bunch grass for concealment (Smith 1968).

During the breeding season, grasshoppers and other insects make up the bulk of the diet but during the colder months, when insect activity is low, grass seed becomes the primary food item (Ehrlich and others 1988). Grasshopper Sparrow populations may be cyclical, responding to dry and wet cycles. On the Empire Ranch (Empire Cienega RCA), the population declined steadily through a period of drought from 1993-1996 (J. Whetstone pers. comm.). A similar decline was noted on the Gray Ranch in New Mexico during the same period but had been preceded by a gradual increase during the previous five-year wet period. (S.O. Williams III pers. comm.).

Habitat Requirements: The Grasshopper Sparrow prefers pure grassland habitat without trees or emergent shrubs (Bock and Bock 1988). Grasshopper Sparrows can tolerate moderate grazing but prefer ungrazed areas dominated by mid-height bunch grasses (Bock and Webb 1984). During the fall of 1996, Grasshopper Sparrows were found to be fairly common on the lightly grazed Davis Pasture on the Empire Ranch (Empire Cienega RCA) and on the highway right of way (Whetstone and Gordon, unpublished data) but was absent from the adjacent Hilton Pasture that had been heavily grazed (about 60-80% use). They appear to be sedentary on the wintering ground, staying in a small "home range" and surviving if conditions are adequate (Gordon pers. comm.).

Habitat and/or Population Objectives

Population Objective

1. Maintain or increase current breeding and wintering densities over a 5-10 year cycle.

Habitat Strategy

- 1a. Wintering Grasshopper Sparrows: Manage for a minimum of 2.5 ha (6-plus ac) blocks of dense *Grama* spp. and bunchgrasses within a 16 ha (40 ac) block of mixed grass and shrubs. This is projected to provide suitable breeding habitat for wintering Grasshopper Sparrows. These 16 ha (40 ac) blocks of moderate to high quality habitat should be evenly distributed throughout 4045 ha (10,000 ac) blocks of contiguous grassland from the Altar Valley east to the New Mexico state line and south of the Gila River.
- 1b. Breeding Grasshopper Sparrows: (*A. s. ammoregus*): the 6-acres blocks should be primarily ungrazed or lightly grazed, dense bunchgrass, three-awns and bluestems with available singing perches.
2. Maintain or improve grassland habitats to provide the following number of 4045 ha (10,000 ac) blocks, containing at least 250 plus blocks of suitable breeding habitat, in the following locations by the year 2010:

- (5) Buenos Aires National Wildlife Refuge (NWR)
- (3-6) San Rafael Grasslands
- (6-12) Empire-Cienega Riparian Conservation Area and Sonoita Valley
- (5) San Simon Valley

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Conservation of Grasshopper Sparrow populations is dependent on healthy grassland habitat (Bock and Bock 1988, Bock and Webb 1984, Knopf 1994). Grazing management that rotates pastures and allows periods of rest so that thatch can build up under bunchgrasses would be necessary to improve conditions for both breeding and wintering populations. Reduced utilization levels, particularly during the breeding season, would benefit the local race. Alter grazing regimes to make maximum use of prime grasslands during the late spring and early summer. During this time, the bulk of the wintering birds have left and the summer rains have not yet begun, thus breeding activity has not yet been triggered. It is important to reduce grazing during extended periods of drought to prevent winter die-offs in sparrow populations.

The Public Land portions of habitat for virtually the entire wintering population of Baird's Sparrow and the breeding and wintering population of Grasshopper Sparrow, is within BLM's Tucson Field Office, Coronado National Forest's Nogales, Sierra Vista and Douglas Ranger Districts and Buenos Aires NWR.

The most critical threat facing a large portion of the range of these grassland species is conversion of grassland to ranchettes and other suburban development. Much of the Sonoita Valley and the Upper San Pedro Valley is private land that is rapidly being developed for real estate interests.

Grasshopper Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Grazing

1. Maintain prime habitat in times when populations are forced into secondary habitats, such as in times of severe drought.
2. Avoid grazing at all during breeding season.

Fire

1. Burn Grasshopper Sparrow habitat in late winter to reduce shrubs.

Habitat Loss/Development

1. Revegetate with bunch grasses.
2. Avoid development and agricultural practices in prime Grasshopper Sparrow habitat since these disturbances will eliminate the sparrow (USFS 1994).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the home range and breeding territory size for the Arizona race of Grasshopper Sparrows.
2. Study the function of the 2 separate songs.
3. Study the winter ecology of Grasshopper Sparrows in Arizona.
4. Determine if the Arizona population is a source or sink population.
5. Monitor the subspecies across their range to determine if they are self sustaining and how important Arizona is to this population.

3. Coordination of Recommendations and Opportunities in Desert Grassland

Time is ticking for grassland birds in the Southwest as the warm climate and open country draw more and more people, and southwest towns prepare for their ever-growing human populations. Increasing urban development into what was once vast, open grassland country, coupled with continued grazing pressure, are the primary causes of habitat loss and alteration for southeastern Arizona grassland birds. Conversion of grasslands into agriculture has also contributed to the loss of native Arizona grasslands. All six priority grassland species have suffered and continue to be threatened by the changes taking place in the remainder of Arizona's grassland habitats.

One advantage to managing grassland habitat, is that structurally it is relatively simple. Unlike riparian habitat and some forested habitats, grassland can recover relatively quickly from fire and improper grazing if given resting time. Periodic fire and even light grazing may actually enhance grassland habitat and help control woody species encroachment. For some species however, any grazing on arid grasslands may cause a decrease in abundance, as is the case for the Grasshopper Sparrow in southeastern Arizona (Saab and others 1995). Four of the six priority species prefer scattered trees and/or shrubs, and the remaining two species prefer pure, dense grasslands without trees or shrubs. Prescribed fire is one method recommended to promote healthy, open grassland habitat for Grasshopper and Baird's Sparrows and maintain and control the amount of woody species for the Aplomado Falcon and Botteri's, Cassin's and Rufous-winged Sparrows. Correct timing and location of prescribed fire are critical management elements, as most grassland species nest on the ground. More importantly, improved range management and maintenance of prime

habitat locations, especially during drought years, is highly recommended for all 6 priority species.

Two of the priority species, Grasshopper Sparrow and Baird's Sparrow, winter in Arizona's desert grasslands. Two subspecies of the Grasshopper Sparrow alternate use of this habitat for breeding and wintering. Moderate to heavy grazing negatively effects both wintering grassland species as the thatch, cover and seed necessary to survive the winter, are all reduced. Little to no grazing is recommended on prime Grasshopper and Baird's Sparrow habitat. Habitat impacts are especially harmful in consecutive drought years and may affect the total population. Recommendations to improve range management and maintain prime habitat locations, are also made for these wintering species.

Several protected areas in the state will provide some consistent habitat for Arizona's grassland birds. These include: the Buenos Aires National Wildlife Refuge, the Empire-Cienega Riparian Conservation Area, the Santa Rita Experimental Range, Saguaro National Park and Tucson Mountain Park. Continued management of these areas for grassland habitat and better management and protection of grasslands outside these areas, is necessary to provide adequate, essential habitat for Arizona's desert grassland birds.

Table 16. Desert Grasslands Priority Species and Habitat needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Aplomado Falcon	-grasses -yucca or mesquite savannah (for nesting)	-open grassland w/scattered tall yucca and/or mesquite		fragmentation/patch size a factor -edge effects great horned owl predation -fire beneficial to maintain habitat
Botteri's Sparrow	-bunchgrasses, Sacaton -shrub component	-ground cover (tall, high stem density)	-bajadas and floodplains	-fire- increased productivity (prey) -flooding in Sacaton - nutrient importation, soil moisture
Cassin's Sparrow	-grasses (Gramas, three-awns, Sporobolus) -shrub component (whitethorn acacia, mesquite, ocotillo, yucca)	-ground cover (important but not quantified - grasses, not forbs)		-disturbance - fire -at or nearing climax
Rufous-winged Sparrow	-grasses (Gramas, three-awns, Sporobolus, Tobosa) -shrub component (mesquite) -(also common in upland Sonoran Desert without grassland) ed. notes	-ground cover (bunchgrasses) -canopy (partial with grass understory)	-elevation \leq 1220 m (4000 ft) to lower elevation limits of grassland -flat to rolling hills	-fire-negative, reduces/eliminates woody cover
Baird's Sparrow	-bunchgrasses (Gramas, three-awns, lovegrasses, bluestem)	-ground cover -thatch/high density -no canopy	elevation 915-1525 m (3000-5000 ft) -rolling grasslands (slopes)	-periodic fire to suppress woody cover
Grasshopper Sparrow (wintering)	-bunchgrasses (Gramas, three-awns, lovegrasses, bluestem)	-ground cover -thatch/high density -no canopy	elevation 915-1525 m (3000-5000 ft) -no slope necessary	-periodic fire to suppress woody cover
Grasshopper	-bunchgrasses	-ground cover	elevation 915-	-periodic fire to

Sparrow (breeding)	(Gramas, three-awns, lovegrasses, bluestem)	-thatch/high density -no canopy	1525 m (3000-5000 ft)	suppress woody cover
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Table 17. Special Factors for Desert Grassland Priority Species

Priority Species	Special Factors
Aplomado Falcon	-needs foraging perches
Botteri's Sparrow	-sensitive to overgrazing
Cassin's Sparrow	-rainy season breeder
Rufous-winged Sparrow	-sensitive to overgrazing
Baird's Sparrow	-sensitive to overgrazing or mowing (cover reduction) -associated with Sprague's Pipit and wintering Grasshopper Sparrow -extremely limited range
Grasshopper Sparrow (wintering)	-cyclical populations -sensitive to fire
Grasshopper Sparrow (breeding)	-cyclical populations -sensitive to fire (pre-nesting)

M. High Elevation Grassland Habitat

1. Habitat Description, Status and Importance

The northern part of Arizona is in the Colorado Plateau Province, which is a large uplifted block composed primarily of horizontally layered sedimentary rocks. The mean surface of the Plateau lies between elevations of 1500-1800 m (4920-5900 ft). Several large mesas and mountain ranges rise above the Plateau to elevations as high as 3682 m (12,080 ft) at the San Francisco Peaks. Other significant high elevation mesas and ranges include the White Mountains, Carrizo Mountains, Chuska Mountains, Navajo Mountain, Black Mesa, Defiance Mesa, and the Kaibab Plateau. The climate is continental, with cold winters and hot summers. Precipitation ranges from as low as 15 cm (6 in) around Page to 1000 mm (40 in) or more on the higher mountains. A wide variety of grassland-dominated vegetation occurs in northern Arizona. These can be grouped for convenience into two major types, upland grasslands and desert grasslands. These two grasslands lie on opposite sides of the arid-humid boundary, where potential evapotranspiration equals precipitation (Rowlands 1993). This boundary is also reflected by the lower elevational limits of the Ponderosa Pine community, and the lower limits of the montane zone (Spence and others 1995).

Grasslands are relatively simple in physiognomy. The dominant grasses are either bunchgrasses or turf - (sod-) forming grasses. Generally, the grass layer is less than a meter tall. Cover can vary from almost 100% in relict undisturbed sites to less than 10% in low elevation arid sites. Litter is an important component of most grasslands. The interspaces between clumps or mats of grass is generally occupied by cryptogamic crusts and scattered forbs. Forbs are relatively unimportant at lower more arid sites, and increase in importance with increasing elevation. In some high elevation sites forbs can share dominance with grasses and sedges. These sites have traditionally been called montane meadows. Shrubs become important at lower elevations where semi-arid and arid grasslands occur adjacent to or interspersed with shrub-dominated vegetation. Although the grasslands of northern Arizona are not well studied, extensive work has been done on similar vegetation in adjacent New Mexico and southeast Utah (Dick-Peddie 1993, West 1983).

a. Subalpine-Alpine Grasslands/Montane Meadows

Upland grasslands in northern Arizona comprise all grass-dominated sites from the lower limits of the montane zone (2000-2200 m or 6560-7220 ft) up to alpine tundra in the White Mountains and San Francisco Peaks. The area occupied by this vegetation type is not known, but is relatively small, probably less than 20,230 ha (50,000 ac) in northern Arizona. Brown (1982) recognized two types, montane meadows and subalpine-alpine grasslands. Although there are some differences between the two, there are many intergradations, and more similarities than differences. All these grasslands can be defined as grass-dominated or grass-forb dominated sites within or above the montane zone. They generally occur as clearings in coniferous woodlands and forests, although the understory of

much of the ponderosa pine forests also consists of grass-dominated vegetation. The distribution of these grasslands is controlled by a combination of soil conditions, microclimates and possibly fire.

High elevation subalpine grasslands occur primarily in the White Mountains, where extensive tracts above 2600 m (8530 ft) are dominated by low-growing bunchgrasses in the genera *Festuca* (especially *F. arizonica*) *Calamagrostis*, *Muhlenbergia*, and *Poa* (Brown 1982). A wide variety of perennial forbs are also found. The growing season is relatively short (<100 days), and is often interrupted by frosts. Winter temperatures are mostly below freezing, and a moderate to extensive snowpack usually develops. Late-melting snow in hollows and drainages may be one of the principal factors maintaining grasslands below the timberline. Cold air drainage is a characteristic feature of these sites during the growing season.

At somewhat lower elevations in mixed conifer and ponderosa pine communities, grasslands occur as scattered clearings. Relatively poorly drained soils, lingering snow pack and disturbance are principal controlling factors. Climates tend to be somewhat warmer and drier than higher elevation sites, and the growing season can extend to 120-150 days. Many of the same grass and forb genera occur, and often shrubs, such as Bitterbrush (*Purshia tridentata*), become important. The extensive parks on the Kaibab Plateau are transitional between subalpine grasslands and montane grasslands, as they occur at subalpine elevations but share many species and life-forms with lower elevation meadows and clearings. These parks are especially rich in grass genera and species (Rasmussen 1941, Warren and others 1982). Throughout upland sites, grasslands tend to be adjacent to coniferous forests on drier or better drained and rockier sites, and wet meadows dominated by wetland graminods, in particular species of *Carex* and *Juncus*, on poorly drained lower sites.

Since the late 1800s most examples of upland grassland have been extensively altered by human activities. Fire suppression has been widespread since the early 1900s in coniferous forests and woodlands, which often leads to an increase in woody vegetation such as shrubs. Suppression can also result in invasion of grasslands by conifers from adjacent forests and woodlands. However, a more pervasive disturbance than fire suppression is domestic livestock grazing. Most if not all examples of upland grasslands in northern Arizona have been grazed by either sheep or cattle. Long-term heavy grazing can cause a variety of changes, including decreases in plant cover, increases in bare ground and erosion, and shifts in species composition from palatable grasses to less palatable shrubs and forbs. Currently, very little is known about the status of upland grasslands and meadows in northern Arizona. Another recent factor which may have potentially major affects is the urban sprawl developing around Flagstaff and other cities. Meadows, grasslands and other clearings in the coniferous forests in these areas are often completely converted to housing or other construction developments.

b. *Plains/Great Basin Grasslands*

Desert Grasslands occur in northern Arizona between 2000-1200 m (6560-3940 ft) in the lowest elevations around Page. They cover a much larger area than upland grasslands, although there are no current estimates for acreage. Brown (1982) recognized two different types, one primarily in the southeastern part of the state he called the Plains Grassland, with scattered areas on the Coconino Plateau transitional to the next, and the second in the northern part, which he termed the Great Basin Grassland. Dick-Peddie (1993) called grasslands in adjacent northwestern New Mexico desert grassland. To the north, West (1983) termed this type a shrub-steppe, reflecting the presence of shrubs which are common in many examples. Many of these terms are ambiguous, so Spence preferred the term Colorado Plateau cold-temperate lowland grassland (Spence and others 1995). These grasslands are neither Plains nor Great Basin in origin, as they support a unique assemblage of grasses, forbs and shrubs. Similarities with Plains Grasslands include the presence of Buffalograss and various Grama species in the northeast. Similarities with Great Basin Grasslands to the north and northwest include the presence of Sagebrush and Rabbitbrush species, and Western Wheatgrass. Another common species further north, Muttongrass becomes an important species at higher elevations in northern Arizona. The grasslands of the Colorado Plateau support a wide variety of both bunch and sod-forming species, including three-awn, indian ricegrass, needle-and-thread, blue grama, Galleta, and several species of dropseeds. The physiognomy of most these grasslands consists of scattered bunchgrasses, often interspersed with mats of sod-formers, scattered forbs (principally annuals), and scattered low shrubs. Litter is an important component of most desert grasslands, and cryptogamic crusts and mosses (primarily species of *Syntrichia* and *Didymodon*) are common.

Climates that support desert grasslands vary greatly, due primarily to topography and elevation. At low elevations along the Colorado River and Little Colorado River precipitation can be as low as 15-20 cm (6-8 in), while at the upper limits near the arid-humid boundary precipitation can reach 40 cm (16 in). Snow is common in the winter, but a continuous snowpack rarely develops or lasts more than a few weeks. The growing season varies from 120-200 days depending on elevation, and most areas supporting grassland have at least 150 days a year. Edaphic factors play an important role in controlling the distribution of desert grasslands. At the lowest elevations grasses are primarily restricted to areas with abundant fines, especially of eolian sands. Rocky or clay sites at these elevations tend to be dominated by shrublands, although grasses can still be important. This is probably primarily because grasses are less drought-tolerant than shrubs, and generally do less well than shrubs where precipitation falls below ca. 20-25 cm (8-10 in). At higher elevations in the study area grasses become more widespread, and can occur on a variety of substrates.

Virtually all examples of the desert grassland in northern Arizona have been affected by grazing activities and fire suppression. This is one of the most important communities for grazing of domestic livestock, and has been continuously used since the introduction of sheep in the 1600s by Navajo pastoralists, and cattle by more recent European-American settlement. With the continuous heavy grazing many grasslands have become seriously degraded. Palatable bunchgrasses tend to decline first, and often completely disappear. Unpalatable woody species, cacti and exotics then tend to either increase or move in and replace the native grasses. Many grasslands have been or are still being converted to shrub-steppe, where shrubs often dominate. In sandy sites loss of grass cover can initiate renewed wind erosion and the formation of dunes. These blow-out sites tend to become dominated by shrubs, especially mormon-teas or sand-oak. In other areas with heavy grazing, native grasses are gradually replaced by shrubs from nearby shrublands, or become dominated by weedy invasive shrubs such as Snakeweed or Rabbitbrush. Many of these changes may be irreversible (cf. West and others 1984). Effects of these changes on the avifauna of grasslands in northern Arizona are not well studied. In a study in similar grasslands at and near Capitol Reef National Park, Willey (1994) showed differences in habitat complexity and bird communities between relict and grazed grasslands. Relict sites had larger bunchgrasses with greater cover and litter, particularly in the standing dead material associated with older bunchgrasses.

The roles of fire and climate change are less well known. Recurrent cool-intensity fires characteristic of herbaceous vegetation tend to favor grass-dominated vegetation at the expense of shrubs, and fire suppression may have caused local conversions of grasslands to shrublands or mixed shrub-steppe. The effects of the recent warming trend of the last century are even less well known. This warming trend has been suggested as a cause for the invasion of pinyon-juniper woodlands into shrub or grass-dominated vegetation throughout the west. However, very little work has been done on this phenomenon. In a study on the recent history of grazed grasslands at Capitol Reef National Park in south-central Utah, Cole and others (1997) found little evidence for a climate-induced change. They showed a change from primarily bunchgrasses, principally Needle-and-thread, to sod-grasses and shrubs since the late 1800s, and suggested that these changes were caused by intensive grazing over the last century.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in high elevation grassland habitat. A table at the end of the High Elevation Grassland section highlights species habitat needs in a quick reference format (Table 18).

SWAINSON'S HAWK (*Buteo swainsoni*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Swainson's Hawk are: Mountain Plover, Golden Eagle,

Northern Harrier, American Kestrel, Prairie Falcon, Mourning Dove, Burrowing Owl, Common Nighthawk, Say's Phoebe, Horned Lark, Common Raven, Loggerhead Shrike, Vesper Sparrow, Lark Sparrow, Eastern Meadowlark, and Western Meadowlark.

Distribution: Swainson's Hawks are New World raptors, breeding only in North America and wintering in South America. In North America, they are distributed from the southern half of Alberta eastward to southeastern Saskatchewan/southwestern Manitoba, and south to the western United States and northern Mexico. The United States distribution includes appropriate habitat from east of the Cascades through shortgrass prairie country (western Minnesota south to western Texas), west and south through New Mexico and Arizona. Pockets of breeding Swainson's Hawks occur in Alaska, the Yukon, Missouri, and California (England and others 1997). A small population of non-breeding summering Swainson's Hawks occurs in Florida (Terres 1996). In Arizona, Swainson's Hawks are found in suitable open grassland habitat, in open desertscrub habitats which sustain a grassland component, and open agricultural lands (Glinski and Hall 1998). Swainson's Hawks usually nest less commonly on the Colorado Plateau than in the basin and range grasslands in southeastern Arizona; however, a significant population does breed in the Hualapai Valley (Glinski and Hall 1998). The shift from lowland desert into agricultural lands has modified Swainson's Hawk distribution somewhat, by attracting birds to these agricultural lands for food source (insects), particularly during migration (Glinski and Hall 1998).

Ecology: Swainson's Hawks begin their migration, in large flocks, north from South America (primarily Argentina) in March, and migrate through Arizona primarily in April. During migration, their primary food source is insects, with grasshoppers and beetles being among the favored prey (Glinski and Hall 1998, England and others 1997). Swainson's Hawks are also attracted to swarms of bats (Terres 1996). While breeding, small mammals (ground squirrels, pocket gophers, voles, deer mice), lizards, and snakes as well as insects are prey items. Often, Swainson's Hawks are found foraging in agricultural fields immediately following harvest or flood irrigation, where prey items are forced into the open. While Swainson's Hawks rely mainly on aerial foraging, they are adept at running and capturing prey on the ground (Coconino National Forest 1998). Stick nests are constructed in scattered, lone trees within grassland or agriculture landscapes, deciduous trees along stream courses, or in open woodlands (England and others 1997). Typical nest trees in Arizona are cottonwood, juniper species, mesquite, ironwood, and oak. Atypical nest tree or plant species include catclaw acacia, palo verde, taller cholla, and saguaro (Glinski and Hall, 1998). Often, the same nest is repaired and reused annually (Terres 1996, Williams and Matteson 1948).

Habitat Requirements: Swainson's Hawks prefer open grassland or open agricultural fields which have a scattering of taller trees or trees along a riparian corridor for roosting, nesting, and perching. Scrub/brush areas are not preferred, as Swainson's Hawks require shorter grass species or crops for foraging. Agricultural land which contains crops taller than native grasses are not utilized until harvest/post-harvest (England and others 1997).

Habitat and/or Population Objectives:

Population Objective

1. Increase population numbers to 1-20 pairs per 100 km² (England and others 1997) in suitable high elevation grassland habitat.

Habitat Strategy

1. Manage Plains and Great Basin Grasslands to reduce small woody shrubs and maintain grass cover capable of carrying fire.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The primary management issue associated with Swainson's Hawks in North America is habitat loss and alteration (Glinski and Hall 1998, England and others 1997). Habitat loss and alteration can be a result of several factors, including conversion of grassland to scrubland from domestic livestock grazing and historical fire suppression, complete removal of grassland through agricultural development, and rural subdivision of private property into residential areas (Glinski and Hall 1998, England and others 1997). Domestic livestock grazing often reduces the grass component and allows for increased competition from undesirable shrubs; this issue is prevalent across all high elevation grassland landscapes in Arizona (Glinski and Hall 1998). Exotic plants introduced through historical grazing practices (i.e. camelthorn, Russian thistle), to a lesser degree, may have an effect on Swainson's Hawk populations, reducing the grass component and elevating the landscape topography to a level unsuitable for foraging. Historical fire suppression often modifies grasslands to shrub-dominated land. While agricultural development of desert scrub may provide additional habitat for Swainson's Hawks, such development in historical grasslands often reduce the quality of such habitat (England and others 1997). Increased residential development in tracts of grasslands fragments and may remove key components of Swainson's Hawk habitat.

Management recommendations include: 1) establish a prescribed fire management regime across public lands, and encourage private landowners to adopt a fire management system; 2)

purchase conservation easements across private land which contain expanses of grassland habitat; 3) educate private landowners and developers regarding grassland habitat maintenance and the importance of conserving scattered trees in the landscape; and 4) encourage land managing agencies to conserve grassland and nest trees.

Perhaps beyond the scope of this document, but worthwhile mentioning, is the significant adverse effect of widespread pesticide use and subsequent contamination of Swainson's Hawk prey items in their wintering grounds of Argentina and other South American countries (Glinski and Hall 1998, England and others 1997).

Swainson's Hawk management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat loss and alteration

1. Incorporate allowable grazing utilization levels throughout all grasslands to maintain the long-term sustainability of grassland habitat.
2. Enforce established grazing regulations on state and federal lands.
3. Establish natural fire regime to maintain open grassland habitat.
4. Establish Conservation Easements - provide information to developers about leaving native grassland areas in larger developments.
5. Implement the Natural Resources Conservation Service (NRCS) backyard conservation programs to maintain natural/native grassland habitat, especially nest trees.

Implementation Opportunities

1. Inform private landowners on the importance of isolated or clumps of nest trees/shrubs to Swainson's Hawks.
2. Establish Conservation Easements - provide information to developers about leaving native grassland areas in larger developments.
3. Inform private landowners how to maintain natural/native grassland habitat.
4. Conduct a natural history class on grasslands and provide teachers credit.
5. Educate the public on their potential to contribute to overall maintenance of habitat.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the basic breeding distribution, nest occupancy and productivity of Swainson's Hawks in Arizona.

2. Determine the specific habitat requirements of Arizona Swainson's Hawks in high grasslands habitats. Study what habitat characteristics they are keying into (i.e. grass height, mixture of grassland and agriculture).
3. Determine the historical breeding distribution of Swainson's Hawks in Arizona. Investigate what the grasslands were like during pre-historic/pre-settlement times.
4. Determine if a man-made nesting structure could be developed that Swainson's Hawks would use.
5. Test Swainson's Hawks on a regular basis for contaminants/pesticides and possible impacts on reproduction.
6. Conduct more effective monitoring of demographics in high elevation grassland and currently used habitats to better understand specific habitat needs.

FERRUGINOUS HAWK (*Buteo regalis*)

Associated Species: Mountain Plover, Golden Eagle, Northern Harrier, American Kestrel, Prairie Falcon, Mourning Dove, Burrowing Owl, Common Nighthawk, Say's Phoebe, Horned Lark, Loggerhead Shrike, Vesper Sparrow, Lark Sparrow, Eastern Meadowlark, Western Meadowlark, Common Raven.

Distribution: The Ferruginous Hawk occurs generally throughout western North America, from southern Canada into central Mexico and the Great Plains to the Pacific (Bechard and Schmutz 1995). Only the central portion of this range is occupied year-round; north of this region is occupied only during breeding season, and south of it is the wintering range. In Arizona the Ferruginous Hawk occurs year-round in the northern half of the state, and during winter in the southern half (Glinski 1998).

Ecology: In Arizona, the Ferruginous Hawk begins courtship as early as the first week in March; eggs or small young occur in early May, and most young fledge between 19 June and 6 July (Glinski 1998, Ramakka and Woyewodzic 1993). Ferruginous Hawk nests are unmistakable, large structures, built of large coarse sticks. In a Utah study, Murphy and others (1969) measured one nest at 48 inches across and 43 inches thick. Ramakka and Woyewodzic (1993) reported that in northwestern New Mexico nests were placed on rock piles, cliffs, ground, and in trees. Young Ferruginous Hawks remain in the nest for about 45 days (Murphy and others 1969). Reported chronologies for the Navajo Reservation in Arizona (K. McCoy and P. Ryan pers. comm.), central Utah (Murphy and others 1969), and southeastern Arizona (Hubbard 1972) are similar. Ferruginous Hawks have up to 5 or 6 young in some years, which is a high reproductive rate compared to other buteos. However, this may compensate for the fact that Ferruginous Hawks seem to be irregular in their use of

nesting areas. Olendorff (1993) presented a summary of 20 Ferruginous Hawk diet studies range-wide, and concluded that this raptor eats mainly rabbits, ground squirrels, and pocket gophers. In the Southwest, the limited information on diet suggests prairie dogs and rabbits are important (Hall and others 1988, K. McCoy pers. comm.). During winter, Arizona receives an influx of Ferruginous Hawks from northern latitudes. Information exists on the population trend of this influx, or the importance of Arizona to wintering Ferruginous Hawks is lacking.

Habitat Requirements: Olendorff (1993) summarized the potential natural vegetation types of 17 major Ferruginous Hawk study areas range-wide as grassland (48%), shrub-grassland (37%), pinyon-juniper woodland (8%), and shrubland (6%). In Arizona, the open scrublands and woodlands, grasslands, and Semidesert Grasslands throughout the northern and southeastern parts of the state are the haunts of breeding Ferruginous Hawks (Glinski 1998). During winter this raptor selects the same areas, and also resides in agricultural areas state-wide, but Schmutz (1987) reported Ferruginous Hawks do not use cultivated lands for nesting. The Plains Grasslands south of the Mogollon Rim were probably more important historically than present conditions would suggest. The smaller patches of Plains Grassland coupled with more abundant surface water and adjacent wooded mountains favored human settlement. The larger areas of Great Basin Grassland are more remote, sustain less surface water, and frequently border the plantless "badlands" like the Painted Desert. This area of Great Basin Grassland and Desertscrub is the stronghold for the present population of Ferruginous Hawks in Arizona. Other habitats of likely importance for the Ferruginous Hawk include the grassland and open desertscrub lands adjacent to the rimrock canyons that feed the Little Colorado River. A place presently occupied by breeding Ferruginous Hawks, but seeming to offer the least habitat potential in Arizona, is the Hualapai Valley north of Kingman. Casual observations on the relative abundance of Ferruginous Hawks during winter suggests that fallow farm fields are more commonly selected habitats than native grasslands, and agriculture may play a key role in survival of these birds (Glinski 1998).

Habitat and/or Population Objectives:

Population Objective

1. Increase current populations to allow for expansion into historical habitats.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

There has never been a systematic search in Arizona for breeding Ferruginous Hawks (Glinski 1998). Information has been gathered in some areas, usually federally managed, that

are being considered for management actions that necessitate an inventory of wildlife to assess potential impacts. Rodents such as prairie dogs probably were an important factor in the historical distribution of the Ferruginous Hawk in Arizona and elsewhere. The black-tailed prairie dog was eliminated from southeastern Arizona by the late 1930s, and Gunnison's prairie dog populations were severely reduced throughout their eastern and northern Arizona range (Hoffmeister 1986). The demise of these dog towns probably was significant in diminishing the range and population of the Ferruginous Hawk in Arizona. The likely decline in productivity of the grassland ecosystem in the Southwest, due to erosion and other factors, must also have played an important role. Encroachment of brush in areas that once were relatively grassy (Hastings and Turner 1965) has afforded greater cover for potential prey, and perhaps tips the balance in favor of escaping prey instead of capturing predator. And, as Hastings and Turner (1965) and others have pointed out, the climatic shift to a warmer and drier period has contributed to the shift from open grasslands to scrublands.

Ferruginous Hawk management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Rodent Control (chemical, shooting, etc.)

1. Reduce chemical rodent control of prairie dogs, especially in suitable Ferruginous Hawk nesting habitat.
2. Consider prairie dog re-introduction in historic colony areas, where feasible.

Illegal Take

1. Work with Native Americans to increase availability of feathers for ceremonial purposes while decreasing impact on wild population.
2. Encourage USFWS to simplify feather repository program.
3. Consider creating a local repository/distribution process.
4. Inform the public about the ecological benefits of eagles and other raptors.
5. Increase enforcement of current regulations on collecting/permitting process.

Habitat Loss/alteration

1. Restoration of grassland on abandoned cropland in current breeding range.
2. Use fire and or other mechanical treatments to reduce woody and exotic species encroachment in grassland.
3. Encourage conservation easements in suitable Ferruginous Hawk habitat.
4. Encourage habitat incentive programs where appropriate.

Human Disturbance

1. Restrict or limit (wherever feasible) human activities including construction of occupied dwellings and new road development, near active nests within a 0.5-1.0 mile buffer depending on topography (K. McCoy pers. comm.).

Implementation Opportunities

1. Explore partnership opportunities for conservation easements, funding, etc.
2. Meet with tribal leaders to develop educational plan, re: raptors.
3. Investigate legalities of feather acquisition (road kill, rehabilitators, molting, etc.).
4. Publish findings of above in local newspapers.
5. Conduct a natural history class on grasslands and provide teachers credit.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Study the winter ecology of Ferruginous Hawks.
2. Study dispersal of breeding individuals.
3. Determine Ferruginous Hawk response to management efforts (prairie dog control, etc.).
4. Determine if Ferruginous Hawk will use artificial nest platforms frequently enough to boost populations.
5. Determine if Ferruginous Hawk nest on ground.
6. Study prey abundance/population level interaction.
7. Study basic breeding distribution, nest occupancy and productivity in Arizona.

BURROWING OWL (*Athene cunicularia*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Burrowing Owl are: Ferruginous Hawk, Golden Eagle, Prairie Falcon, Horned Lark, Common Raven, Loggerhead Shrike, Lark Sparrow, Black-throated Sparrow, Sage Sparrow, Eastern Meadowlark, and Western Meadowlark.

Distribution: The Burrowing Owl is found from southern British Columbia to the eastern edge of the Great Plains, in Texas, Louisiana, and Florida, south to Central America. It is migratory, but only in certain areas of its range; this includes the northern areas of the Great Plains and Great Basin (Haug and others 1993, Johnsgard 1988). This species is found in open, dry grasslands, agricultural and range lands, and desert habitats often associated with burrowing mammals (Haug and others 1993). They also inhabit grass, forb, and open shrub stages of pinyon pine and ponderosa pine habitats (Zeiner and others 1990). Although the Burrowing Owls in northern Arizona are thought to migrate, owls in southern Arizona are

predominantly non-migratory (Brown in press, Haug and others 1993, Jacobs 1986, Phillips and others 1964).

Ecology: In the northeastern portion of the state, records suggest they arrive in the breeding grounds around mid-March and migrate out by mid-October (Jacobs 1986).

Burrowing Owls nest in burrows in the ground, often in old ground squirrel burrows, kangaroo rat mounds, and coyote, fox, and badger dens. In parts of its range, these owls are known to dig their own burrow, but in Arizona, they are thought to prefer excavations of other animals (deVos 1998, Haug and others 1993). They are also known to use artificial burrows (Brown in press, Haug and others 1993). The owls commonly perch on fence posts or on top of the mounds outside of their burrow. They are active day and night, but are usually less active in the peak of the day (Haug and others 1993).

Their nesting season begins in mid-March to April. The owls often decorate the outside of their burrow and line their nest with an assortment of dry materials, such as cow and horse manure, coyote scat and cotton (Brandt 1951, Brown pers. observ., Haug and others 1993). When inside the burrow and disturbed, the owls, especially the young owls, can utter sounds that closely mimic the buzzing of a rattlesnake (Brown pers. observ., Haug and others 1993).

These owls tend to be opportunistic feeders. Large arthropods, mainly beetles and grasshoppers, comprise a large portion of their diet. Small mammals, especially mice, rats, gophers, and ground squirrels, are also important food items. Other prey animals include: amphibians, reptiles, scorpions, young cottontail rabbits, bats, and birds, such as sparrows, Horned Larks, and Mourning Doves (Estabrook and Mannan 1998, Glover 1953, Haug 1993, Phillips and others 1964). Consumption of insects increases during the breeding season.

Habitat Requirements: In Arizona, this owl is predominately associated with prairie dog towns and round-tailed ground squirrel populations (Brown in press, deVos 1998). Both of these burrowing mammals provide two key habitat elements: 1) burrows and 2) reduced plant cover around the burrows (deVos 1998). Other areas where they might be found are along washes and irrigation canals, vacant lots in urban and rural areas, and near water tanks or corrals on rangelands (Brown in press, deVos 1998). As mentioned, in the western portion of their range, this species typically relies on other burrowing animals to create burrows within which they can live. Thus in the western states, the presence of a nest burrow seems to be a critical habitat requirement for this species (Haug and others 1993).

Habitat and/or Population Objectives:

Population Objective

1. Manage for an increasing population and distribution in high elevation grassland habitats.

Habitat Strategy

1. Manage for prairie dog towns > 20 ha (50 ac) (Pezzolesi 1994) distributed in suitable grassland habitat on the Colorado Plateau.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The Burrowing Owl is threatened in many areas throughout its distribution and is considered to be declining throughout a majority of its range (Second International Burrowing Owl Symposium, 1998). In Arizona, Burrowing Owls have no special listing. This species is threatened by prairie dog and ground squirrel control programs, plague (indirectly), conversion of natural habitat, agricultural pesticides, and overgrazing of rangelands (resulting in a more woody species composition, destruction of burrows, reduction of prey) (Brown in press, deVos 1998, Haug and others 1993, Phillips and others 1964). DeVos (1998) emphasized the importance of the conservation and management of Arizona's native grasslands to the conservation of the Burrowing Owl.

Burrowing Owl management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations:

Rodent Control (chemical, shooting, etc.)

1. Minimize lethal prairie dog and ground squirrel control.
2. Inform the public and ranchers in key Burrowing Owl habitat, of the value of rodents to owls and other bird populations.
3. If control is necessary, transplant a source population elsewhere or use control methods, including rodenticides only for specific time frames and applications.
4. Reintroduce prairie dogs in suitable habitat where populations of prairie dogs have been eliminated.

Insecticide Application

1. Limit use within 250 m (820 ft) of active nesting burrows (Haug and others 1993). Encourage using an insecticide that is less lethal to Burrowing Owls.

Habitat Loss/Alteration

1. Encourage maintenance of natural open space in new developments.
2. Vegetation management through fires and grazing to maintain the low herbaceous habitat and increase prey base required by Burrowing Owls.
3. Encourage grazing management regimes that include support of burrowing mammals.

Implementation Opportunities:

1. Education: inform public and land managers of the round squirrel-prairie dog and Burrowing Owl relationship.
2. Conduct a pilot study of reintroduced prairie dogs in unoccupied historical habitat.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Design and implement a systematic inventory process for all suitable habitat in Arizona.
2. Determine what Burrowing Owls eat in High Elevation Grasslands. Do they require healthy populations of insects and small mammals in concert?
3. Study whether the population stability of Burrowing Owls is related to rainfall, grasshopper, and/or small mammal fluctuations.
4. Study Burrowing Owl movements in Arizona. (i.e. dispersal, migration etc.).
5. Determine if the northeast Arizona population is a migrant population.

GRASSHOPPER SPARROW (*Ammodramus savannarum*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Grasshopper Sparrow are: Northern Harrier, Swainson's Hawk, Sprague's Pipit, Baird's Sparrow, Cassin's Sparrow (wintering), Savannah Sparrow, Chestnut-collared Longspur (wintering), McCown's Longspur (wintering), Eastern Meadowlark.

Distribution: The Grasshopper Sparrow breeds from southern Canada south to California, Nevada, Utah, Colorado, New Mexico, Texas, Arkansas, Mississippi, Alabama, and Georgia. There are isolated populations (subspecies) in southeastern and central Arizona, southwestern New Mexico, southcentral Texas and central Florida (AOU 1998). The Arizona Grasshopper Sparrow (*A.s. ammolegus*) breeds in Arizona from southeastern Pima County (Buenos Aires N.W.R.) east through Santa Cruz and southern Cochise County and south into northern Sonora (ABBA unpubl. data, Russell and Monson 1998). There is also a

separate population (unknown subspecies) breeding in the plains grasslands of Chino Valley in Yavapai County (ABBA unpubl. data, Monson and Phillips 1981).

Ecology: These grassland species require abundant thatch and dry grass for concealment (Lima and Valone 1991). Grasshopper Sparrows in Arizona normally breed during the summer rainy season in July and August (ABBA unpubl. data). From first arrival through incubation, the male maintains a definite territory, however, after the young hatch, territorial defense declines (Bent 1968). Their nests are often partially domed with dry grass and placed in a depression on the ground at the base of grass clumps or other vegetation so the rim is nearly flush to the ground (Bent 1968, Dawson 1923). It often uses the dense dead grass that accumulates around the bottom of bunch grass for concealment (Smith 1968). This species often raises two broods per year (Bent 1968, Kaspari and O'Leary 1988, Wiens 1969, Wray and others 1982). Brood parasitism rates are generally low probably because nest are more cryptic (Elliot 1977).

During the breeding season, this species is insectivorous. Judd (1901) examined stomachs collected from February to October, finding animal food to average 63 percent (mostly insects, also spiders, myriapods, snails, and earthworms). Joern (1988) cited four species of grasshoppers as the sparrow's main prey in Nebraska. Caterpillars are also important, comprising 70 percent of the nestlings diet (Wiens 1969) During the colder months, when insect activity is low, grass seed becomes the primary food item (Ehrlich and others 1988). Grasshopper Sparrow populations may be cyclical, responding to dry and wet cycles.

Habitat Requirements: The Grasshopper Sparrow prefers pure grassland habitat without trees or emergent shrubs (Bock and Bock 1988). Grasshopper Sparrows can tolerate moderate grazing but prefer ungrazed areas dominated by mid-height bunch grasses (Bock and Webb 1984). In Arizona, this species was found to be fairly common on the lightly grazed grassland, but was absent from the adjacent heavily grazed (about 60-80% use) (Whetstone and Gordon, unpublished data). Habitat requirements in Arizona should include a minimum of 2.5 ha (6.2 ac) blocks of dense grama spp. and bunchgrasses within a 16 ha (40 ac) block of mixed grass and shrubs, all of which are primarily ungrazed or lightly grazed. Plant species should be primarily dense bunchgrass, three-awns, and bluestems with available singing perches (scattered shrubs, fences, etc.). In Arizona, Bock and Webb (1984) measured the percentage shrub cover in Grasshopper Sparrow habitat at 4.5 percent.

Habitat and/or Population Objectives:

Population Objective

1. Maintain stable population in Chino Valley, Arizona (Yavapai County).

Habitat Strategy

1. Protect and maintain current habitat condition, amount and distribution in Chino Valley.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Conservation of Grasshopper Sparrow populations is dependent on healthy grassland habitat (Bock and Bock 1988, Bock and Webb 1984, Knopf 1994). Grazing management that rotates pastures and allows periods of rest so that thatch can build up under bunchgrasses would be necessary to improve conditions for both breeding and wintering populations. Reduced use levels, particularly during the breeding season, would benefit the local race. Alter grazing regimes to make maximum use of prime grasslands during the late spring and early summer. During this time, the bulk of the wintering birds have left and the summer rains have not yet begun, thus breeding activity has not yet been triggered. It is important to reduce grazing during extended periods of drought to prevent winter die-offs in sparrow populations.

The Grasshopper Sparrow's irregularity and apparently low site fidelity suggest that more habitat may be needed to sustain the population that the birds occupy in any single year. Effective conservation of the sparrow may require conservation of more habitat than a short-term survey of the species' distribution would imply (USFS 1994).

Grasshopper Sparrows in southeastern Arizona avoid recently burned native or exotic grassland sites for \geq to two year postburn (Bock and Bock 1992, Bock and Webb 1984). Aid (1990) reported that this species was largely absent through one post-fire growing season in the semidesert grasslands of Arizona. Grasshopper Sparrows abandoned a lush midgrass prairie when wildfire eliminated all the shrubs (Bock and Bock 1982).

In the more arid and fragile grasslands of the western half of the United States, the species is reduced by grazing and invasion of exotic weeds and is eliminated by agriculture and urbanization (USFS 1994). The most critical threat facing a large portion of the range of this and other grassland species in Arizona is conversion of grassland to ranchettes and other suburban development. Much of the Sonoita Valley and the upper San Pedro Valley is private land that is rapidly being developed for real estate interests.

Grasshopper Sparrow management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Consider habitat incentive programs for private land to limit the amount of urban and suburban sprawl into critical grassland habitat.
2. Reduce or manage grazing especially during tall grass reproduction July-early October or monsoon season to allow required habitat to exist and remain into the Spring.

Implementation Opportunities

1. Encourage conservation easements, especially with private landowners and ranchers in Sonoita/San Rafael Valleys.
2. Inform private landowners of Natural Resources Conservation Service (NRCS) Habitat Incentive Programs and encourage them to participate.
3. Coordinate with Borderland groups on managing for Grasshopper Sparrows.
- 4.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the home range and breeding territory size for the Arizona race of Grasshopper Sparrows.
2. Determine the best timing/methods for grazing and fire in high elevation grass that will minimize effects on Grasshopper Sparrows.
3. Study the function of the 2 separate songs.
5. Determine if the Chino Valley population is subspecifically different from the southeastern Arizona population.
6. Study the winter ecology of Grasshopper Sparrows in Arizona.
7. Determine if the Arizona population is a source or sink population.
8. Monitor the subspecies across their range to determine if they are self sustaining and how important Arizona is to this population.

3. Coordination of Recommendations and Opportunities in High Elevation Grassland

Virtually all examples of the high elevation grassland habitat in Arizona have been affected by grazing activities, conversion to agriculture and fire suppression. Urban sprawl around Flagstaff and other cities is a growing concern and is also contributing to the loss of this important habitat. The loss and alteration of grassland habitat is the primary issue effecting all four priority species. Clearly, a reevaluation of the current grazing utilization levels needs to be done. Enforcing established grazing regulations on state and federal lands to maintain long-term sustainability of grassland habitat is also recommended. Reduction of grazing during tall grass reproduction is especially important for Grasshopper Sparrows.

Protection of existing grasslands is still within our reach. Habitat incentive programs that encourage private landowners to maintain native grassland habitat and nest trees are available and

recommended. Establishing Conservation Easements for developers is also recommended to maintain native grasslands in larger developments. Fire suppression has contributed to encroachment of woody species into open grassland areas. Reintroduction of fire management that will maintain a low herbaceous layer but allow for a small shrub component, will benefit all four priority birds.

Three of the priority species, Swainson’s Hawk, Ferruginous Hawk and Burrowing owl, depend on small mammals as their primary food source. Factors contributing to the loss of prey such as chemical and mechanical (shooting) rodent control, and improper grazing are discouraged. Using insecticides that may be lethal to both Burrowing Owls and their prey is discouraged. Limiting use of any insecticide within 250 m (820 ft) of active Burrowing Owl nests is suggested.

Table 18. High Elevation Grassland Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Ferruginous Hawk	-scattered, isolated junipers for nesting	-sparsely vegetated grassland -nest on elevated areas	elevation: 1495-1890 m (4900-6200 ft)	-nest sites in isolated junipers, ledges, knolls, rock outcrops or pillars, cliffs faces, -nests are placed in open with grand view. -shows no preference for shading
Swainson’s Hawk	-more grass and less small woody shrubs than Ferruginous Hawk habitat -sparse shrublands, small, open woodlands (BNA) -nest trees include: cottonwood, catclaw acacia, tall cholla, juniper	-will forage in agriculture fields, but the crop cannot be taller than local grass; prey difficult to locate -nest in small trees in smaller clumps, wind breaks, woody washes esp. when adjacent to Red-Tailed Hawk.	elevation 1495-2135 m (4900-7000 ft) (locally to 9500 ft in White Mountains, TEC pers. observ.)	-prefer large expanses of grasslands with interspersed trees or large shrubs -primarily a tree nester, but also nest on utility poles, windmills
Burrowing Owl	-grasses and plant communities in early succession	-grasses and plant communities in early successional stage -rock outcrops that attract burrowing mammals to provide burrows	-elevation 1495-2135 m (4900-7000 ft) -little to no slope	-dry, open, shortgrass, treeless plains, often associated with burrowing mammals (BNA). -Need perches: fencepost, mounds, powerlines, etc. -early successional stage (grassland)

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Grasshopper Sparrow	-plains lovegrass, sacaton sp., black grama, vine mesquite, little bluestem, agave	taller 30-50 cm (12-20 in) mixed tall bunchgrass and turf grass or sodgrass (J. Spence pers. comm.)	elevation 1495-1980 m (4900-6500 ft)	-moderately open grassland areas w/patchy bare ground, flat to gently rolling hills. -some level of shrub component -territory size not sure in AZ, but in BNA 0.6 - 1.4 ha. from eastern North America -need low perches such as fences, posts, tall grass, low shrubs

Table 19. Special Factors for High Elevation Grassland Priority Species

Priority Species	Special Factors
Ferruginous Hawk	-occur where larger populations of prairie dogs, ground squirrels, rabbits, and pocket gophers exist -high sensitivity to human disturbance around nests
Swainson's Hawk	-eat grasshoppers during migration and on wintering grounds -have a wider variety of food sources than Ferruginous Hawk: i.e. lizards, snakes, birds, ground squirrels, voles, pocket gophers, -non-breeders hunt communally and eat primarily insects -not as sensitive to human activity as Ferruginous Hawk
Burrowing Owl	-limited to areas with active small and/or burrowing mammals -food: insects (grasshoppers, crickets, beetles) and small mammals, herps, birds
Grasshopper Sparrow	-during breeding season feed on grasshoppers, and other insects. -during winter feed primarily on grass seeds -sing two entirely separate songs

WETLANDS

N. Low Elevation Riparian Habitat

1. Habitat Description, Status, and Importance

Riparian associations are those which occur in or adjacent to drainageways and/or floodplains, and which are characterized by species and/or life forms different than the immediately surrounding non-riparian climax (Lowe 1964). The drainages may have permanently flowing water, be intermittent, or seldom or never flow; nevertheless, soils are generally deeper and soil moisture higher in these areas than in adjacent uplands and a distinctly different flora is supported (Ohmart and Anderson 1982). Riparian associations have been classified in various ways (Lowe 1964, Lowe and Brown 1973, Brown and Lowe 1974, Brown and others 1980, Minkley and Brown 1982, and Szaro 1989). For this PIF plan, we have used a generalized classification system recognizing Deciduous Forest Woodlands (Lowe 1964, Lowe and Brown 1973), which we have separated into “Low Elevation Riparian Habitat” and “High Elevation Riparian Habitat,” based on differences in the most common tree species and the bird communities. We have defined an elevation of approximately 1200 m (4000 ft) as the dividing elevation between these two habitat types; however, the change in vegetation and corresponding avian communities is gradual and also depends on the geographical location within Arizona, slope, aspect, soil type, and other factors. We have included “Xeric Riparian” desert washes in our discussion of Low Elevation Riparian Habitat because of their uniqueness as compared to surrounding desert and their importance to many wildlife species.

a) **Xeric Riparian/Desert Washes** are distributed as winding strips through lower elevations of the Sonoran, Mohave, Chihuahuan, and Great Basin Deserts. Although rainfall is low in these desert areas (generally less than 30 cm (12 in) per year) slope, topography, soil types, and the amount, distribution, and intensity of rainfall all contribute to the development of this habitat type by channeling run-off into defined channels. Washes may have flowing water for a short period after rains, but normally have no surface water. The acreage of desert washes is difficult to calculate and is unknown at this time. Washes are more distinctive from surrounding desert in terms of vegetation composition and structure in the Sonoran desert than in the other three North American deserts. Thus, in Arizona, distinctive wash vegetation is most developed in the southwestern part of the state. Within the Sonoran Desert, primary trees of dry arroyos and washes include paloverde, mesquite, catclaw, ironwood, smoketree, desert willow, and netleaf hackberry (Lowe 1964). In the Chihuahuan Desert, wash vegetation is somewhat less complex than that in the Sonoran Desert, with paloverde and ironwood being notable in their absence (Ohmart and Anderson 1982). The Mohave Desert has few trees as compared to the Sonoran. Even in large washes in the Mohave, desert willow, mesquite,

and catclaw are among the few trees found (Lowe 1964). Although riparian communities in the Great Basin Desert are well developed along major waterways (e.g. the Colorado in far northern Arizona), the xeric riparian vegetation along washes is limited and structurally similar to the Mohave Desert.

Historically, desert washes were not heavily impacted by human activity due to harshness of conditions and lack of perennial waters. More recently, sand and gravel operations, urbanization, and ORV use have joined grazing in impacting, and causing conservation concerns for these valuable habitats.

Mesic Riparian / Deciduous Forest Woodlands are found along waterways with perennial to ephemeral surface or sub-surface water which wind through desert regions of the southwestern United States and northern Mexico. In areas with ephemeral flow, deciduous woodlands are generally restricted to areas of the Sonoran and Chihuahuan Deserts that have winter and spring flows critical for leafing, seed set, and germination of cottonwood, willow and other deciduous trees (Minckley and Brown 1982). In Arizona, lowland riparian woodlands are typically found below the Mogollon Rim, in the central and southern portions of the state, at elevations of 30-1200 m (100-4000 ft). Riparian woodlands comprise a very limited geographical area that is entirely disproportionate to their landscape importance, recreational value, and immense biological interest (Lowe and Brown 1973). It has been estimated that only 1% of the western United States historically constituted this habitat type, and that 95% of the historic total has been altered or destroyed in the past 100 years (Krueper 1993, 1996).

The plant community in a low-elevation riparian area depends largely on flood regimes and the level of the water table. Severe flooding, with prolonged inundation and/or scouring, or prolonged periods of desiccation periodically alter riparian areas, often resulting in drastic changes in the vegetation. In areas with reliable spring flows, riparian woodlands are structurally dominated by large, winter deciduous, broadleaf trees, which commonly reach heights of 15-30 m (50-100 ft). Dominant tree species include cottonwood, willow, sycamore, ash, and walnut (Lowe 1964). Dominant species farther from the water table, in some disturbed areas, or as an understory to deciduous trees include seepwillow, mesquite, desert willow, arrowweed and saltbush. Introduced salt cedar is now common in most riparian areas in the Southwest. Salt cedar benefits from more stable flows, including summer flows as often occur below water storage reservoirs, as compared to native species which are more adapted to seasonal flood regimes (Minckley and Brown 1982). Salt cedar is also fire adapted, which gives it an advantage over many native species in human-impacted riparian areas. Historical associates of riparian woodlands included extensive marshes, swamps and floodplains with cattail, bulrush, giant reed, common reed, and arrowweed along the Gila and Colorado rivers and some of the other major drainages in

southern Arizona. Most of this associated habitat has been lost due to water diversions, pumping and other human impacts.

Riparian woodlands are among the most severely threatened habitats within Arizona. These areas have been heavily used by people throughout history because of the availability of water and the retreats they offered from the surrounding desert. Impacts intensified with European settlement of the Southwest, and in recent times, dams, water pumping and diversions, clearing for agriculture or development, grazing, recreation, wood cutting, and other human induced disturbances have severely impacted and fragmented riparian communities (Szaro 1989). Maintenance of existing patches of this habitat, and restoration of mature riparian deciduous forests should be among the top conservation priorities in the state.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in low elevation riparian habitat. A table at the end of the Low Elevation Riparian section highlights species habitat needs in a quick reference format (Table 20).

COMMON BLACK-HAWK (*Buteogallus anthracinus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Common Black-Hawk in Low Elevation Riparian Habitat are: Summer Tanager, Cooper's Hawk, Yellow Warbler, Gila Woodpecker and Cassin's Kingbird.

Distribution: The major portion of the Common Black-Hawk's range is south of the United States (Schnell and others 1986). It occurs northward from the coastal district of northwestern Peru on the Pacific through northwestern Guayana on the Atlantic coast across Central America and most of Mexico and into the southwestern United States (Schnell and others 1986). In the United States, records of nesting black-hawks occur in southwest Utah, Arizona, western New Mexico and southwest Texas (Schnell 1979). The majority (80 - 90%) of Common Black-hawks occur in Arizona (Schnell 1976, Boal and Mannan 1996). Black-Hawks occur in Arizona along the Bill Williams River watershed and in Arizona and New Mexico along the Gila River watershed; both locations occurring between 600-1800 m (1970-5900 ft). Most nests are along streams draining Mogollon Rim (central Arizona), Virgin River and Big Sandy River drainages (northwestern Arizona), upper Bill Williams River (western Arizona), upper and middle Gila River (central and eastern Arizona and western New Mexico), and upper and middle Salt River (central and eastern Arizona)

(Schnell 1994). The number of nesting pairs of Black-Hawks in the United States is estimated at 220 - 240 nesting pairs (Schnell 1994).

Ecology: Common Black-Hawks arrive as early as 5 March but more typically the second week of March (Schnell and others 1986, Schnell 1994). Nest site selection and building occurs in the first week after arrival (Schnell and others 1986). Eggs are laid approximately one month after arrival and hatch at the end of May (Schnell and others 1986). The incubation period is approximately 38 days (Schnell 1979). Common Black-Hawks fledge 40-50 days after hatching and are self-sufficient about 45-60 days after leaving the nest (Schnell and others 1986). Common Black-Hawks leave the nesting area around mid-October.

The Common Black-Hawk hunts in a “perch-hunting” behavior for a variety of prey species including invertebrates, fish, frogs and larvae, reptiles, birds and small mammals (Schnell 1979, Schnell and others 1986, and Schnell 1994). Perches used for hunting vary from boulders and rocks in streams to branches up to 15 m (50 ft) in height (Schnell 1979). Common Black-Hawks forage on prey that is most abundant and available (Schnell 1994). They appear to require a diverse array of both aquatic and semi-aquatic prey (Millsap 1981). However, the lowland leopard frog (*Rana yavapaiensis*) is one of the black-hawks primary prey items in Arizona.

Habitat Requirements: In the southwestern United States, this riparian obligate prefers mature gallery forests along perennial streams (Porter and White 1977, Millsap 1981, Schnell and others 1988). Common Black-Hawks are found in the following communities described by Brown and others (1980): cottonwood-willow series (1224.53) of Sonoran Riparian Deciduous Forest, the cottonwood-willow series (1223.21) and mixed broadleaf series (1223.22) of the Interior Southwestern Riparian Deciduous Forest, and the cottonwood-willow series (1222.31) and mixed broadleaf series (1222.32) of the Rocky Mountain Riparian Deciduous Forest (Schnell 1994, Boal and Mannan 1996). Black-Hawks are less common along intermittent streams, probably due to a lack of nest sites (Schnell 1979) and consistent food availability. They prefer perennial streams of low to moderate gradient < 30 cm (12 in) deep with riffles, and perches including exposed boulders and low branches (Schnell 1979, Schnell 1994).

Common Black-Hawks prefer to nest in large trees (23-30 m, 75-100 ft) found in groves rather than isolated trees (Schnell 1979, Millsap 1981, Schnell 1994). In Arizona and New Mexico, the nest tree species are mainly cottonwoods and sycamore. Other nest tree species reported include ash, Arizona walnut, alder, Gooding willow, emory oak, ponderosa pine, Douglas fir, and mesquites (Boal and Mannan 1996, Schnell 1994). They usually nest in cottonwood and sycamore trees in the crotch of the main trunk but occasionally in side

branches (Schnell 1994). The average nesting height is 15-18 m (49-59 ft) and dbh ranges from .72-1.15 m (2.35-3.75 ft) (Schnell and others 1986). Territories are irregularly spaced along riparian drainages (Schnell 1994). Although most territories are not adjacent to one another, inter-nest spacing of 355 m was recorded in one case (Schnell 1994).

Habitat and/or Population Objectives:

Population Objective

1. To maintain current population numbers and enable population growth to allow for expansion into restored habitats.

Habitat Strategy

1. Ensure and maintain viable, self-sustaining populations distributed throughout major Arizona drainages, excluding the Lower Colorado River and Lower Gila River drainages, with no net loss of habitat.
2. Increase the amount of suitable habitat by 25% in 25 years and by 100% in 50 years by encouraging natural events that promote regeneration of cottonwood, sycamore, ash, and other riparian trees.

Assumptions:

1. There is available habitat throughout the historic range.
2. Habitat loss and degradation are the major threats to Common Black-Hawks.
3. By increasing habitat as above, we will have a viable, self-sustaining population.
4. We can achieve suitable habitat in 25-50 years.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Threats to Common Black-Hawks include the alteration and loss of riparian habitat through damming, diversion, channelization, phreatophyte control, agriculture, groundwater consumption, and livestock grazing that eliminates regenerative seedlings (Schnell and others 1986 and Schnell 1994). Other potential threats to Common Black-Hawks and their habitat include mineral extraction, exotic plant species invasions, changes in prey composition, and urban development (review in Boal and Mannan 1996). Disturbance from human presence has been documented to cause occupants to call aggressively and leave nests (Schnell 1994). Chronic intrusion such as a parking lot built in the nest area has caused permanent nest abandonment (Schnell 1994). Additionally, contaminants from agriculture, mining, and fire suppression may have an adverse impact on the prey base (Schnell and others 1986).

The highest priority for management of this species is conserving and improving health of existing riparian areas and for rehabilitating historic riparian corridors (Schnell 1994). Good water quality is important to support a prey base. Avoiding causes of poor water quality such as heavy metals, agricultural runoff, mine tailings, pesticides, acid rain, domestic livestock in creeks, poor watershed conditions, and trash from urban areas may be necessary. Recent die-offs of ranid frogs may be a “red flag” as to the diminishing quality of riparian areas in Arizona. Die-offs of ranid frogs, particularly the lowland leopard frog, could have serious effects on Common Black-hawks, as these amphibians make up a large portion of the black-hawks diet. Changes in habitat conditions such as damming, diverting, and draining rivers and streams as well as introduction of non-native sport fish, and amphibians (i.e. bull frogs and crayfish), and the increased invasion of exotic plant species have contributed to ranid frog declines (Sredl and others 1997). Most recently, the discovery of a fairly new fungus to Arizona, the Chytrid fungus, has been implicated for three major die-offs of lowland leopard frogs during the winter of 1998-1999 (M. Sredl, AGFD, pers. comm.). Further studies are necessary to determine the origin of this fungus, but land managers should be on the alert for possible die-offs in riparian areas.

Reducing or eliminating livestock grazing may be necessary where replacement nest tree recruitment is lacking (Schnell 1994). Creation of small impoundments near nest trees or placement of perches over impoundments may increase prey abundance near the nest (Schnell and others 1986, Schnell 1994). The protection of riparian tree seedlings, from livestock grazing, for three to five years, may be necessary for recruitment of nest trees. It will take a minimum of 30-40 years for these trees to grow large enough for a Common Black-Hawk to use for nesting (Schnell and others 1986).

Common Black-hawk management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Water Diversion

1. Avoid or minimize water diversions that decrease or eliminate perennial flow to Common Black-hawk habitat.
2. Avoid flood-control practices that reduce water availability to riparian habitat.

Habitat Loss

1. Reduce or avoid activity such as: riparian travel, work, grazing, etc. in areas that have less than 2 year-old seedlings becoming established.
2. Locate urban development away from riparian areas and associated floodplain.
3. Work with landowners to restore, establish and maintain habitat through conservation easements, incentive programs, etc.

Water Quality

1. Encourage high water quality (reduce high turbidity, heavy metals, agricultural runoff, etc.). Good water quality is needed to ensure adequate prey items.

Human Disturbance

1. Wherever possible, manage human visitation to minimize disturbance during the breeding season.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the impact of human disturbance on nest success of Common Black-Hawks.
2. Determine the minimum patch size necessary to sustain Common Black-Hawks.
3. Determine what constitutes a viable population.
4. Determine basic information needs: habitat requirements, territory fidelity, recruitment, dispersal patterns, and winter range use.
5. Determine factors limiting prey availability
6. Study the origin of the Chytrid fungus implicated in major die-offs of ranid frogs.

WESTERN YELLOW-BILLED CUCKOO (*Coccyzus americanus occidentalis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Western Yellow-billed Cuckoo are: Cooper's Hawk, Black-chinned Hummingbird, Brown-crested Flycatcher, Yellow Warbler, Bullock's Oriole, Summer Tanager, Indigo Bunting and in limited locations (generally in se Arizona) the Gray Hawk, Mississippi Kite, Violet-crowned Hummingbird, Northern Beardless-Tyrannulet, Tropical Kingbird and Thick-billed Kingbird.

Distribution: Western Yellow-billed Cuckoos historically bred throughout the western United States, north to southern British Columbia. Currently, they breed in disjunct riparian habitats in California, southern Nevada, Utah, southern Wyoming southward into northern Mexico. They winter in tropical deciduous and evergreen forests of northern South America south to Peru, Bolivia and Argentina (Ehrlich and others 1988). It is estimated that fewer than 700 breeding pairs remained in the western United States in 1984 (Laymon and Halterman 1987).

In Arizona, the Western Yellow-billed Cuckoo is an uncommon to fairly common breeder in riparian habitats, primarily below the Mogollon Rim in the Colorado and Gila River drainages (Phillips and others 1964). The largest concentrations are in the Upper Santa Cruz,

San Pedro, Verde, Bill Williams and Gila River drainages of central and southeastern Arizona (Krueper in press).

Ecology: Western Yellow-billed Cuckoos are the latest arriving summer breeding migrant in Arizona. They arrive during the first week of June and typically depart by late August or early September. These cuckoos feed almost entirely on large insects including grasshoppers, cicadas, katydids, caterpillars (primarily hairy defoliating or “tent building” caterpillars), and if food stressed (Laymon pers. comm.) berries and fruit (Ehrlich and others 1988). They typically nest on a horizontal limb from 2-7.5 m (6-25 ft) above the ground, but nests have been found as low as .6 m (2 ft) and as high as 30.5 m (100 ft) (Laymon pers. comm.) mostly in willow or in other dense deciduous vegetation close to water as well (Zeiner and others 1990). Unlike Old World cuckoos, Yellow-billed Cuckoos are not parasitic. Although there are some records of eggs being laid in the nests of other species, this is believed to be in response to an overabundant food source (Nolan and Thompson 1975). They are not a known host for Brown-headed Cowbirds. Cuckoos typically raise one brood per year, but are capable of raising up to three broods. Young fledge within six to seven days and can fly within one week of fledging (Laymon pers. comm.).

Habitat Requirements: A riparian obligate species found in highest occurrences and density in cottonwood/willow associations. Yellow-billed Cuckoo’s require “ a minimum of 10 ha (25 ac) of broad-leafed forest at least 100 m (109 yds) wide (Gaines, 1974), and at least 1 ha (2.5 ac) of dense nesting habitat per pair” (Laymon and Halterman 1989). Marginal habitat is described as “a minimum of 4 ha (10 ac) of broad-leafed forest at least 50 m (165 ft) wide, and at least 0.5 ha (1.25 ac) of dense nesting habitat” (Laymon and Halterman 1989). Multiple pairs of cuckoos can be found in wider strips (> 100 m (109 yds) wide and > 25 ha (62 ac) patches) of habitat versus narrow strips, where pairs are distributed more widely (Laymon pers. comm.). In Arizona, pairs are usually distributed approximately every 0.8 km (0.5 mi) in large blocks of contiguous habitat (Krueper pers. comm.) Cuckoos will occasionally occupy heavily vegetated rural areas adjacent to riparian, and mesquite bosques in the absence of large stands of contiguous riparian habitat (Krueper pers. comm.).

Habitat and/or Population Objectives:

Population Objective

1. To achieve at least 25 self-sustaining populations (625 pairs, est. 25 pairs/population) by 2015 in the following locations: 3 in the San Pedro River (Sierra Vista to confluence with the Gila), 3 in the Santa Cruz River (Sonoita Creek to Tucson), 3 in the Colorado River Tribal Lands (Lower Colorado River), 3 in Santa Maria/Big Sandy River area, 3 in Verde River (Salt/Verde confluence to Cottonwood), 1 in Sonoita Creek (Patagonia to Santa Cruz), 1 in Cienega Creek (I-10 south to Empire Ranch), 1 in Gila/Colorado River

confluence (Yuma), 1 at Imperial National Wildlife Refuge (NWR) (Lower Colorado River), 1 at Cibola NWR (Lower Colorado River), 1 at the Bill Williams NWR (Refuge to the Colorado River), 1 at the Havasu NWR (Colorado River), 1 at the San Bernadino NWR, 1 at the Buenos Aires NWR (Arivaca Creek), 1 in the San Francisco River (New Mexico to Gila River confluence including Blue River).

2. To achieve at least 40 self-sustaining populations or 1000 pairs by 2050 in the above noted locations.

Habitat Strategy

1. Maintain or increase a multi-tiered, mid-upperstory lowland riparian habitat, consisting mainly of the plant species identified in the lowland riparian habitat description.
2. The habitat should be at least 500 linear miles of the above described habitat in at least 0.8 km (0.5 mi) segments, distributed over the following seven major drainages and associated tributaries (San Pedro, upper Santa Cruz, Bill Williams, Gila, lower Colorado, Salt, Verde and Virgin rivers), to provide for a more stable population of cuckoos than currently exists.

Assumptions:

1. We can maintain or increase suitable low elevation riparian habitat and have identified the plant species that Western Yellow-billed Cuckoos require.
2. If we provide 805 km (500 linear mi) of suitable habitat in 0.8 km (0.5 mi) segments, cuckoo populations will stabilize.
3. We can increase the population in 15 years. We can reach 1000 pairs in 50 years.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

There has been a drastic reduction in breeding range within the past 60 years due to riparian habitat alteration or destruction (Laymon and Halterman 1987). Western Yellow-billed Cuckoos are listed as endangered on several state wildlife lists. Habitat loss is the primary reason for declines of this species, including clearing of land for agriculture, overgrazing, fire, urbanization, and flood control. Pesticide use, primarily on the wintering grounds in Latin America is suspected of causing thin egg shells and of killing individuals directly. In both Latin America and the United States, pesticide use may reduce the availability of insect prey (Laymon pers. comm.). An unusually long period of above 34°C (120°F) temperatures on the Bill Williams River may have caused food stress for cuckoos during the summer of 1994. Cuckoos on the Bill Williams River were easily disturbed that year and abandoned nests during the 1994 breeding season, but this behavior has not been seen in cuckoos in

California (Halterman and Laymon 1995, Laymon pers. comm.) Krueper (in press) reports that cuckoos will abandon nests if disturbed repeatedly. Riparian habitat corridors are important for dispersal and migration. Large contiguous blocks (> 100 m (109 yds) wide and > 25 ha (62 ac) of cottonwood-willow riparian forests are more valuable than smaller, fragmented patches of habitat.

Yellow-billed Cuckoo management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss and Modification

1. Establish a "no net loss" policy.
2. Eliminate destruction (i.e. grazing; off-road vehicle use) of existing native cottonwood-willow dominated riparian forests (Patten 1998).
3. Encourage the use of buffer zones between riparian habitats and adjacent development.
4. Establish corridors between "islands" of suitable habitat.
5. Manage for large, contiguous blocks of habitat (> 15 ha) in conjunction with removal of competing exotic species (i.e. saltcedar) (Laymon and Halterman 1987).

Lack of Recruitment (of cottonwood-willow forests)

1. Closely monitor grazing impacts on cottonwood and willow seedlings in riparian systems and reduce or remove grazing when seedlings are being impacted.
2. Maintain flow regimes that mimic natural level and timing of high and low water to allow accumulation of sediments and subsequent establishment of seedlings.
3. Promote natural regeneration from seed sources. Augment with plantings (> 15 ha) when necessary (Laymon and Halterman 1987).
4. Reduce or eliminate recreational impacts and disturbance to nursery beds during and after seedling establishment.

Pesticide Use

1. Limit or eliminate use of pesticides adjacent to riparian areas.
2. If used, apply locally to avoid drift into adjacent habitat (i.e. not broad applications).

Demographics (low colonization potential due to fragmented breeding localities)

1. Establish riparian corridors and "island" habitats to allow natural dispersal and recolonization of historic habitats.
2. Establish target areas near existing occupied habitat for restoration, before focusing on areas farther away.

Human Disturbance

1. Avoid intense and repeated human disturbance from nesting areas especially from 20 May through 1 September.

Implementation Opportunities

1. Increase enforcement of access into restricted areas.
2. Increase cooperation between state and federal agencies and private organizations regarding Yellow-billed Cuckoo habitat.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Develop a monitoring program to determine current population trends.
2. Monitor known populations and habitat quality, especially in southeast Arizona where the largest populations are located.
3. Prey base identification - Is there any difference (quality or quantity) in different habitat types or across their range?
4. Determine what the extent of quality habitat (cottonwood-willow) is in portions of the cuckoo's historical range where it no longer occurs.
5. Determine if and how much cuckoo's use nontraditional habitat - i.e. orchards?
6. Determine the diet of cuckoos in Arizona.
7. Determine if commonly used levels of pesticides are harmful to Yellow-billed Cuckoos. Are they being exceeded?
8. Determine if breeding habitat requirements differ on a regional basis.
9. Determine if revegetated sites have the same occupancy rate as naturally regenerated areas - all other characteristics being relatively equal (stand age, spp. composition, stand size etc.).
10. Determine if revegetated sites (natural or anthropomorphic) have the same occupancy rate as unaltered sites - all other characteristics being relatively equal (stand age, spp. composition stand size etc.).

SOUTHWESTERN WILLOW FLYCATCHER (*Empidonax traillii extimus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Southwestern Willow Flycatcher in Low Elevation Riparian Habitat are: Bell's Vireo, Yellow-breasted Chat, Yellow Warbler, Song Sparrow and Western Yellow-billed Cuckoo. Although these species may occur in similar habitat to the Southwestern Willow Flycatcher, they are not necessarily indicators for the species but are indicators for potential flycatcher habitat.

Distribution: The Willow Flycatcher breeds across most of the United States, with the exception of the southern states and the central plains. The Southwestern Willow Flycatcher is one of four or five subspecies of the Willow Flycatcher (Unitt 1987, Browning 1993), with a breeding range that includes southern California, Arizona, extreme southern Nevada and Utah, New Mexico, southwestern Colorado and western Texas. Formerly, this subspecies was a common breeder in most willow-dominated riparian areas in Arizona (Phillips and others 1964). In 1997, it bred at only 45 sites statewide (McCarthy and others 1998). The sites range in elevation from less than 90 m (300 ft) to over 2440 m (8000 ft) (Sferra and others 1997). "Southwestern Willow Flycatcher populations are extremely small and vulnerable to extirpation; > 75% of extant flycatcher locations are occupied by an estimated five or fewer territorial males" (USFWS 1996). The Southwestern Willow Flycatcher most likely winters in Mexico, Central America, and northern South America (AOU 1983, Howell and Webb 1995, Phillips 1948, Ridgely 1981, Ridgely and Tudor 1994, Unitt 1987).

Ecology: Southwestern Willow Flycatchers arrive in breeding habitat in late April or early May, and may be present until late August or early September. Individuals may move away from territories as early as July. Their presence and status can be confused by the migrating individuals of northern subspecies passing through Southwestern Willow Flycatcher breeding habitat. The nest is a compact cup constructed in a fork or on a small horizontal branch, approximately 1-12 m (3-40 ft) above ground in a medium-sized bush or small tree, typically with dense vegetation above and around the nest (Brown 1988, Sferra and others 1997, Whitfield 1990). This flycatcher subspecies usually nests within close proximity to water. The incubation period is approximately 12 days, with a nestling period of 12-14 days (Whitfield 1990). Typically, one brood of young is raised per year (Whitfield 1990), but multiple nesting attempts are not uncommon (McCarthy and others 1998). The Southwestern Willow Flycatcher is often the victim of predation and cowbird brood parasitism (Brown 1988, Sferra and others 1997, Sogge 1995, Sogge and others 1997, Whitfield 1990).

Foraging within, above, and adjacent to dense riparian vegetation, the Willow Flycatcher usually takes insects on the wing and gleans them from foliage (Bent 1963). Half the prey items from one study include Hymenoptera (ants, bees, and wasps), Diptera (true flies) and Hemiptera (true bugs) (Drost and others 1997). Because of their large size, odonates (dragonflies and damselflies) are also important components of the Willow Flycatcher diet (Drost and others 1997).

Habitat Requirements: The Southwestern Willow Flycatcher is a riparian obligate that requires dense habitats along rivers, streams, or other wetland areas usually with surface water, where 3-10 m tall willows, seepwillow, arrowweed, buttonbush, alder or other shrubs

and trees are present, often with a scattered overstory of cottonwood (Phillips 1948, Unitt 1987, Whitfield 1990). The Southwestern Willow Flycatcher also nests in thickets dominated by tamarisk and Russian olive (Hubbard 1987, Sogge 1995), and has been found nesting in box elder in adjacent New Mexico. Plant species seems less important than the presence of dense lower and midstory vegetation, with small twigs and branches for nesting. Surface water or saturated soil is almost always at or adjacent to nest sites, except in dry years (Sferra and others 1997).

Habitat and/or Population Objectives:

Population Objective

1. Increase current self-sustaining population numbers in the Lower Colorado, Upper Little Colorado River, and increase the viable populations along the Upper Gila and entire San Pedro River, Verde River and Middle Salt River.
2. Allow for expansion into restored habitats.

Habitat Strategy

1. Manage potential habitat to achieve structural and vegetation characteristics necessary to support increasing numbers of breeding Southwestern Willow Flycatcher pairs within 5-20 years. Suitable structural characteristics may be achieved through restoring, maintaining, enhancing and creating habitat.
2. Within the historic range, increase suitable habitat and improve/enhance existing potential habitat to support at least 2 viable, self-sustaining populations.
3. Reduce cowbird parasitism rate to less than 20% at each site.
4. Reduce predation rate to less than 20% per site until population is increased or stable.

Assumptions:

1. By maintaining current populations, we will have a better chance for populations to expand into suitable unoccupied habitat.
2. 5-20 years is adequate time to achieve habitat necessary for Southwestern Willow Flycatchers.
3. We can restore suitable habitat. Southwestern Willow Flycatchers will occupy restored habitat. We can determine what a viable population is.
4. Based on Black-Capped Vireo population and habitat viability assessments, Southwestern Willow Flycatchers will respond similarly to a reduction in cowbird parasitism.
5. A 20% predation rate is sustainable, if the cowbird parasitism rate is low.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The Southwestern Willow Flycatcher has suffered extensive loss and modification of riparian breeding habitat due to: urban, recreational, and agricultural development, water diversion and impoundment, channelization, livestock grazing, and hydrological changes resulting from these and other land uses (Sferra and others 1997, Tibbitts and others 1994, USFWS 1993). Breeding habitat at Roosevelt Lake which includes two of the larger populations in Arizona, will be inundated by rising lake levels with the raising of Theodore Roosevelt Dam (USFWS 1996). Lake Mead populations were flooded in 1996-1997 and habitat there was almost absent in 1997 (M. Sogge pers.comm.). Many nesting sites are threatened by cowbird brood parasitism (Sferra and others 1997, Sogge 1995, Unitt 1987, USFWS 1993), with potential for low genetic variability, high inbreeding, and population extirpation due to stochastic events. Pesticide use in areas adjacent to breeding sites poses a potential threat. Some breeding sites are susceptible to damage from fire (Paxton and others 1996).

Southwestern Willow Flycatcher management issues are listed in italics. Below each issue are Arizona Partners in Flight Conservation Recommendations.

Habitat Loss and Modification

1. Establish a "no net loss" policy.
2. Work with land managers to maintain and increase suitable riparian habitats.
3. Promote regeneration of native species in riparian habitats.
4. Encourage the use of buffer zones between riparian habitats and adjacent development.
5. Restore natural reaches of riparian habitat by restoring intervening degraded segments.
6. Promote establishment of areas of slow/back waters.
7. Manage for large, contiguous blocks of habitat rather than for small fragmented areas.
8. In urbanizing areas, promote retention of riparian areas.

Water Management

1. Manage water diversions and groundwater withdrawal to maintain streamside vegetation.
2. Mimic natural stream flow regimes including periodic flood events.

Brown-headed Cowbird Parasitism and Predation

1. Reduce cowbird parasitism rate to less than 20% at each site.
2. Continue to monitor nests to record incidence of parasitism.

3. Evaluate effectiveness of cowbird trapping at present locations by monitoring nests for parasitism and reproductive success.
4. Implement cowbird trapping programs where parasitism rates are greater than 20%.

Pesticides

1. Determine impact of pesticide use on Willow Flycatcher reproduction adjacent to riparian areas.
2. Limit or eliminate use of harmful pesticides adjacent to riparian areas.
3. If used, apply in a manner that avoids drift, according to directions (i.e. not broad applications).

Implementation Opportunities

1. Involve numerous state, federal and private organizations to conduct population surveys.
2. Inform federal and state land management agencies on practices beneficial to Willow Flycatchers and other riparian obligate species.
3. Encourage private and public partnerships for fencing and habitat restoration through federal, state and nongovernment programs (USFWS Partners for Wildlife, AGFD Stewardship Program, Natural Resources Conservation Service (NRCS), etc.).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research:

1. Continue statewide surveys to identify breeding locations and suitable habitat.
2. Monitor nests to determine nesting success, parasitism rates, and predation rates.
3. Color band individuals each year to determine status, territory size, site fidelity, natal and adult dispersal and renesting attempts.

LUCY'S WARBLER (*Vermivora luciae*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Lucy's Warbler are: Elf Owl, Gila Woodpecker, Bell's Vireo, Varied Bunting and Abert's Towhee and in limited situations (generally SE Arizona) the Cactus Ferruginous Pygmy-Owl. NOTE: Although these species occur in habitat used by Lucy's Warblers, their presence is not an indicator of Lucy's Warbler presence.

Distribution: The Lucy's Warbler breeds from extreme southeastern California and northeastern Baja California east to central New Mexico, extreme western Texas and northern Chihuahua. The western part of its range extends north to southern Utah, Nevada and possibly southwestern Colorado. (Bent 1963, Curson and others 1994, Griscom and

Sprunt 1957, Harrison 1984). Lucy's Warblers winter in central western Mexico, south to Jalisco and Guerrero (Curson and others 1994, Ehrlich and others 1988, Griscom and Sprunt 1957).

Currently in Arizona, Lucy's Warbler is a common resident of low elevation mesquite bosques, cottonwood-willow forests and densely vegetated xero-riparian washes in southern and central Arizona (Johnson and others 1997, Phillips and others 1964, Swarth 1914, Terres 1991). They are also found in mid-elevation ash-walnut-sycamore-live oak associations (Phillips and others 1964). In the 1950s it became scarce along the lower Colorado River valley but, has since recovered (Monson and Phillips 1981, Rosenberg and others 1991). Lucy's Warblers also inhabit mountain foothills in southeastern Arizona (Brandt 1951, Griscom and Sprunt 1957, Phillips and others 1964).

Ecology: One of the earliest non-wintering warblers to arrive, Lucy's Warbler returns to Arizona in mid to late March (Curson and others 1994, Johnson and others 1997, Phillips and others 1964, Terres 1991). It breeds in some of the densest concentrations of any noncolonial nesting species in North America (Johnson and others 1997). Arizona Breeding Bird Atlas (ABBA) information has confirmed breeding activity between 5 April and 15 August (ABBA unpubl. data). Known dates of egg-laying (in Arizona) range from 13 April to 27 June (Johnson 1997). Fledging times for young are virtually unknown (Bent 1963, Curson and others 1994, Terres 1991). Recent ABBA information recorded fledging dates for Lucy's Warblers between May 13 and August 15 (ABBA, unpubl. data). Brown (1994) estimated the fledging time as 11 days after hatching. Adults depart following fledging in mid-July through mid-August (Curson and others 1994, Monson and Phillips 1981). Birds lingering until September are thought to be juveniles or transients (Griscom and Sprunt 1957, Rosenberg and others 1991).

Lucy's Warblers are primarily insectivorous (Bent 1963, Ehrlich and others 1988, Griscom and Sprunt 1957, Terres 1991); feeding on mesquite and desert shrubs at low to mid foliage levels (Curson and others 1994). In 553 observations on the lower Colorado River, Lucy's Warblers gleaned insects from foliage greater than 60% from 68 stomach samples. Rosenberg and others (1991) identified mainly caterpillars, beetles, and leafhoppers with smaller numbers of spiders, ants and wasps. Yard (1996) studied Lucy's Warbler's diet in the Grand Canyon and found them to be a generalist insectivore, feeding primarily on leafhoppers, beetles (coleoptera), hymenopterans (ant, bees and wasps) and spiders.

Lucy's Warblers are one of two cavity nesting warblers in North America (Ehrlich and others 1988, Rosenberg and others 1991). They nest behind loose bark, in old woodpecker cavities, flood debris, abandoned verdin nests (Brandt 1951, Chapman 1907) and holes in riverbanks (Griscom and Sprunt 1957, Harrison 1984, Pearson 1913). Brandt (1951)

reported nests in yucca and elderberry. Arizona Breeding Bird Atlas (ABBA unpubl. data) recorded nests in agave and on a bridge. Nest height ranges from .6-6 m (2-20 ft) but averages 1.5-3.5 m (5-11 ft) above the ground (Bent 1963, Chapman 1907, Curson and others 1994, Griscom and Sprunt 1957). Harrison (1984) reported nest heights (sycamore) of 6, 9 and 12 m (20, 30 and 40 ft respectively) in Cave Creek, Arizona.

Rosenberg and others (1991) thought that cavity nesting reduced the incidence of cowbird parasitism in Lucy's Warblers. But Bent (1963), Harrison (1984), and Terres (1991) all noted cowbird parasitism in this species. The Gila Woodpecker was also noted as a predator on eggs (Bent 1963, Griscom and Sprunt 1957, Harrison 1984). Predators cited from early reports include wood rats, snakes (Howard 1899) and lizards (Dawson 1923 and Bent 1939). This species has been impacted by loss of habitat through conversion to agriculture or residential use, wood cutting, and by modification of stream flows.

Habitat Requirements: Although classified as a generalist, the preferred habitat for Lucy's Warbler is dense mesquite (Bent 1963, Brandt 1951, Curson and others 1994, Griscom and Sprunt 1957, Harrison 1984, Johnson and others 1997, Rea 1983, Rosenberg and others 1991, Terres 1991). Lucy's Warblers will also use salt cedar, screwbean mesquite and cottonwood willow (non-gallery) (Rosenberg and others 1991). Lucy's Warblers breed in lower densities in the mesquites of the upland scrub and desert grassland, especially in the xero-riparian vegetation along desert washes (Johnson and others 1997). Physiognomy of Lucy's winter habitat is low scrub and weedy fields in coastal foothills and lower mountain slopes of central western Mexico (Curson and others 1994)

Habitat and/or Population Objectives:

Population Objectives

1. Maintain existing Lucy's Warbler distribution and densities.
2. Within 20 to 50 years, ensure self-sustaining populations in at least four of the major drainages and tributaries in Arizona: Gila River including the San Pedro, Lower Colorado River, Verde River and Salt River, and continue to maintain existing distribution and densities.

Habitat Strategy

1. Maintain existing habitat and increase total amount of habitat.
2. Avoid urban development within a 100 m (328 ft) buffer of suitable Lucy's Warbler habitat.

Assumptions:

1. If habitat is maintained, population levels will not decline.

2. Presence of viable Lucy's Warbler populations in four distinct drainages will ensure continued survival of species.
3. Protection of habitat in urban areas will slow or halt further habitat declines.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The Lucy's Warbler was selected for inclusion in this report primarily as a representative of the cavity nesting guild (Lucy's Warbler is a secondary cavity nester) in a declining habitat type (mesquite bosque). Rea (1983) estimated that historically, several thousand pairs of Lucy's Warblers inhabited the Gila River Indian Reservation, but since the late 1970s and early 1980s, only scattered pairs have been found. Mesquite habitat continues to decline (Rea 1983, Rosenberg and others 1991) as a result of conversion to agriculture and urban development. Degradation and loss of riparian mesquite habitat has extirpated some local populations, however, current habitat losses do not appear to present a threat to this species as a whole (Johnson and others 1997). Although Lucy's Warblers have suffered serious declines, they have made a comeback on the lower Colorado River (Rosenberg and others 1991). Rosenberg and others (1991) speculated that Lucy's Warblers' ability to use salt cedar has minimized some impacts from the loss of mesquite habitat along the lower Colorado River. However, continued habitat losses will result in increased declines of Lucy's Warbler and other species dependent upon this community.

Lucy's Warbler management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss and Modification

1. Encourage a "no net loss" policy for mesquite bosques.
2. Work with land management agencies and developers and/or private land owners to promote retention of mesquite bosques.
3. Where harvest of fuelwood is legal, promote sustainable harvest instead of widespread, indiscriminate clearing of bosques.

Groundwater/Disruption of Natural Flooding

1. Work with land management agencies and local governments to avoid or minimize groundwater pumping.
2. Promote groundwater recharge projects to offset groundwater depletion.

3. Work with land management agencies, developers, and private landowners to avoid future drainage diversions and/or manipulations and minimize their impacts.
4. Work with Federal agencies (Federal Emergency Management Agency (FEMA) and COE) to reestablish natural floodplains along major drainage systems.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine viable population size and current population distribution of Lucy's Warblers in Arizona.
2. Monitor nesting populations to determine if cowbird parasitism is a threat.
3. Determine if natural nest site availability is a limiting factor; are Lucy's adaptable to artificial structures?

3. Coordination of Recommendations and Opportunities in Low Elevation Riparian

All four Low Elevation Riparian species have suffered from loss and modification of their riparian habitat. Habitat losses result primarily from urban, suburban and agricultural conversion. Habitat modification results from water diversion and impoundment, channelization, excessive livestock grazing, and other changes resulting in the disruption of natural water flow regimes and lack of regeneration of trees from seed sources. Human disturbance from recreational uses is mentioned as a management issue for three of the four riparian species. Pesticide use in areas adjacent to breeding sites poses a potential threat for three species. Low colonization potential due to fragmented populations and low total population numbers affects two species. Water quality is an issue for one species.

Taken together, the species described above use vegetation in all height classes in a riparian forest or woodland and a gradient of moisture regimes from permanent flowing water to a drier bosque situation. The similarity of issues for these species and their associates indicates that a similar and possibly an overlapping approach to their conservation could be used. Existing riparian vegetation is at a premium especially if it includes all representative height classes. Even riparian habitat that has had one or more components impacted, such as an area where the mature cottonwoods are senescent or the understory has been defoliated, can be restored. These types of riparian areas should be protected from the above habitat modifications. Cottonwood-willow forests can be restored by managing for seed germination and seedling establishment, allowing natural regeneration to occur. After trees have attained a certain height and vigor, some low level impacts can be withstood. Diverting water or physically changing the river bed presents a situation that makes restoration more difficult if not impossible. Reestablishment of natural riparian systems should be sought.

Buffer areas between riparian habitat and developments should be considered. At this time we have no specific information on how wide a buffer should be. However, local factors such as runoff, slope, change of vegetation composition, and level of disturbance, should all be considered when determining buffer width. Connectivity of habitat should also be considered, especially for determining which areas to restore. Long stretches of riparian habitat would provide for more territories and fewer avenues for predators and cowbirds. Cuckoos (15 ha; 42 ac. home range) and Common Black-Hawks (355 m, 1100 ft between nests) have the largest territory requirements of this group of species.

Pesticide use can account for direct mortality of birds and can reduce the amount and/or kind of insect prey base. Pesticides should not be used in riparian habitat or adjacent to it if drift into the habitat is possible.

Yellow-billed Cuckoos and to lesser extent Common Black-Hawks are sensitive to human disturbance during the breeding season. Human disturbance from recreation, including birdwatching, should be eliminated or controlled to prevent this type of loss. Breeding seasons for cuckoos and black-hawks do not coincide, with cuckoos arriving in June and leaving by August and black-hawks nesting from March to mid-October.

Maintaining a quality of water in the riparian systems and a minimum flow is a consideration particularly for the Common Black-Hawk because it feeds on aquatic prey. Since frogs are some of the best indicators of habitat health, it is recommended that land managers watch for potential die-offs of any frogs, especially lowland leopard frogs, and take immediate action to identify the cause. Declines in lowland leopard frog populations may have direct negative effects on Common Black-hawk populations. Direct pollution of riparian systems should be prevented. Poor watershed conditions that lead to agricultural and mining runoff, high sediment loads, and high turbidity should be remedied.

Table 20. Low Elevation Riparian Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Common Black-Hawk	-sycamore, cottonwood (mature) -gallery riparian trees (for nesting) -prefers groves of trees rather than single trees		elevation 305-1830 m (1000-6000 ft) -open water/mesic riparian close to nest (for prey base) -high water quality (prey sensitive to pesticides) -requires perennial stream	-late successional stage -important to plan for new/future gallery forest structure; regeneration and recruitment of large trees needed -proximity to foraging areas important.
Western Yellow-billed Cuckoo	-primarily cottonwood/willow (highest occurrence and density) -high "patchiness" (visually-3 dimensional quality) -Vertical/horizontal quality -can use very linear strips -tiered canopy -low gradient topography -pairs of Western Yellow-billed Cuckoo's usually distributed approx. every 0.4-0.8 km (.25 - 0.5 mi) apart in contiguous habitat	-does not require dense understory -requires mid-high level canopy, dense		-require all successional stages <i>except</i> for the earliest -broader floodplains > 100 m (109 yds) wide -vegetation and path sizes of > 25 ha (62 ac).
Southwestern Willow Flycatcher	-native to exotic -single species to multi-species -box elder, tamarisk, willow, Russian olive, alder	-dense, midstory and understory	-almost always associated with surface water/mesic nearby -elevation 30-1220 m (100-4000 ft) and 2285-2745 m (7500-9000 ft) -low gradient	-broad(er) floodplain -structure appears to be more important than seral stage (from sapling up, not a seedling stage).
Lucy's Warbler	-mesquite, willow, cottonwood -Secondary cavity nester (may influence distribution)	-dense midstory	-elevation up to 1980 m (6500 ft) (ed. notes, > 90% well below)	

Table 21. Special Factors for Low Elevation Riparian Priority Species

Priority Species	Special Factors
Common Black-Hawk	-prey items: crayfish, frogs, snakes, suckers and other fish
Western Yellow-billed Cuckoo	-late spring arrival -eat primarily hairy defoliating or “tent building” caterpillars -need larvae to feed young -very sensitive to human disturbance -fragmented/patchy distribution may hinder colonization of new sites
Southwestern Willow Flycatcher	-cowbird parasitism -high nest failure/predation -low overall population size- very fragmented -possible demographics and distribution problems
Lucy’s Warbler	-can use exfoliating bark as a “cavity” -early breeding (gone by late July), therefore, productivity may be tied to winter/spring precip. -secondary cavity nester -single clutch per year (?) -potential to artificially augment nest sites (?)

O. High Elevation Riparian Habitat

1. Habitat Description, Status and Importance

Pre-Columbian distribution of all riparian habitat has been estimated as only 2% of the total state’s land mass (P. Hardy pers. comm.). But as a result of damming of waterways, diversions, and overexploitation of riparian woodlands, coupled with excessive extraction of groundwater, total riparian land in Arizona comprises approximately 113,000 ha (279,200 ac) (Babcock 1968). High

elevation riparian habitat undoubtedly makes up a small fraction of the remaining riparian habitat. It can be found principally in the southeastern, eastern and northern parts of the state, with limited occurrence in western Arizona. High elevation riparian habitat typically is found in steep, narrow canyons, drainages or in mountain meadows at altitudes between 1200-3350 m (4000-11,000 ft). The habitat's defining element is the frequent if not permanent presence of water, such as a stream, river, creek, lake, or spring. High elevation riparian habitat has been damaged by overgrazing and recreation. Heavy livestock grazing has been noted as the major cause of excessive habitat disturbance in Southwestern riparian areas (Ames 1977). Studies on the effects of grazing in these habitats have documented the reduction in both the numbers and biomass of plant species (Gregory 1981), trampling of vegetation (Kaufman and others 1984), and changes in structure (Ryder 1980). The existence of high elevation riparian areas that are ungrazed is usually due to restrictions on public lands, private landowners' interest, or to topography that prohibits livestock access. Some of the most remarkable ungrazed high elevation sites in Arizona are Sonoita Creek, Ramsey Canyon, and Fossil Creek.

The tree species indicative of high elevation riparian habitat are: maple, sycamore, walnut, willow, cottonwood, alder, box elder, ash, aspen, Douglas-fir, white fir, oak and cypress. However, riparian forests infrequently reach a mature state due to disturbance, primarily flooding. Flood events that cause stream migration, erosion, and sediment deposition alter the patterns and type of vegetation found in high elevation riparian habitats. These habitats are well-adapted to flood disturbances so the effect of an individual event is relative. However, destructive floods are usually associated with another type of disturbance such as excessive grazing, timber harvesting, recreation, or land conversion above drainages.

High elevation riparian habitat in Arizona takes on special importance due to the low rainfall experienced throughout the state. Riparian areas act as migration corridors, water sources, cover, and food source areas for many species of wildlife. Challenges to conservation arise from the high productivity of riparian systems and from the many forces competing for riparian resources. In Arizona, high elevation riparian Habitats are sought out for recreational purposes by the state's residents. The paucity of water resources also causes land management decisions to favor human benefits (recreation, drinking water, irrigation, livestock use) over riparian resource conservation. Potential for conservation action depends especially on the ability to influence the land management activities of public agencies but also the capability to provide incentives to private landowners for restoration of degraded riparian habitats.

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in High Elevation Riparian habitat. A table at the end of the High Elevation Riparian section highlights species habitat needs in a quick reference format (Table 22). The descriptions of two low elevation riparian species, Southwestern

Willow Flycatcher and the Common Black-Hawk, are repeated here for the convenience of the reader. Each account may vary in detail since not all factors affect these species in both habitats.

COMMON BLACK-HAWK (*Buteogallus anthracinus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Common Black-Hawk in High Elevation Riparian Habitat are: Cooper's Hawk, Elf Owl, Violet-crowned Hummingbird, Acorn Woodpecker, Brown-crested Flycatcher, Cassin's Kingbird, Thick-billed Kingbird, Painted Redstart, Summer Tanager and Hooded Oriole.

Distribution: The major portion of the Common Black-Hawk's range is south of the United States (Schnell and others 1986). It occurs northward from the coastal district of northwestern Peru on the Pacific through northwestern Guayana on the Atlantic coast across Central America and most of Mexico and into the southwestern United States (Schnell and others 1986). In the United States, records of nesting black-hawks occur in southwest Utah, Arizona, western New Mexico, and southwest Texas (Schnell 1979). The majority (80-90%) of Common Black-hawks occur in Arizona (Boal and Mannan 1996, Schnell 1976). Black-Hawks occur in Arizona along the Bill Williams River watershed and in Arizona and New Mexico along the Gila River watershed; both locations occurring between 600-1800 m (1970-5900 ft). Most nests are along streams draining Mogollon Rim (central Arizona), Virgin River, and Big Sandy River drainages (northwestern Arizona), upper Bill Williams River (western Arizona), upper and middle Gila River (central and eastern Arizona and western New Mexico), and upper and middle Salt River (central and eastern Arizona) (Schnell 1994). The number of nesting pairs of Black-Hawks in the United States is estimated at 220-240 nesting pairs (Schnell 1994).

Ecology: Common Black-Hawks arrive as early as 5 March but more typically the second week of March (Schnell 1994, Schnell and others 1986). Nest site selection and building occurs in the first week after arrival (Schnell and others 1986). Eggs are laid approximately one month after arrival and hatch at the end of May (Schnell and others 1986). The incubation period is approximately 38 days (Schnell 1979). Common Black-Hawks fledge 40-50 days after hatching and are self-sufficient about 45-60 days after leaving the nest (Schnell and others 1986). Common Black-Hawks leave the nesting area around mid-October.

The Common Black-Hawk hunts in a "perch-hunting" behavior for a variety of prey species including invertebrates, fish, frogs and larvae, reptiles, birds, and small mammals (Schnell 1979, Schnell 1994, Schnell and others 1986). Perches used for hunting vary from boulders and rocks in streams to branches up to 15 m (50 ft) in height (Schnell 1979). Common

Black-Hawks forage on prey that is most abundant and available (Schnell 1994). They appear to require a diverse array of both aquatic and semi-aquatic prey (Millsap 1981). However, the lowland leopard frog (*Rana yavapaiensis*) is one of the black-hawks primary prey items in Arizona.

Habitat Requirements: In the southwestern United States, this riparian obligate prefers mature gallery forests along perennial streams (Millsap 1981, Porter and White 1977, Schnell and others 1988). Common Black-Hawks are found in the following communities described by Brown and others (1980): cottonwood-willow series (1224.53) of Sonoran Riparian Deciduous Forest, the cottonwood-willow series (1223.21) and mixed broadleaf series (1223.22) of the Interior Southwestern Riparian Deciduous Forest, and the cottonwood-willow series (1222.31) and mixed broadleaf series (1222.32) of the Rocky Mountain Riparian Deciduous Forest (Boal and Mannan 1996, Schnell 1994). Black-Hawks are less common along intermittent streams, probably due to a lack of nest sites (Schnell 1979) and consistent food availability. They prefer perennial streams of low to moderate gradient < 30 cm (12 in) deep with riffles, and perches including exposed boulders and low branches (Schnell 1979, Schnell 1994).

Common Black-Hawks prefer to nest in large trees (23-30 m, 75-100 ft) found in groves rather than isolated trees (Millsap 1981, Schnell 1979, Schnell 1994). In Arizona and New Mexico, the nest tree species are mainly cottonwoods and sycamore. However, other nest tree species reported include ash, Arizona walnut, alder, Gooding willow, emory oak, ponderosa pine, Douglas fir, and mesquites (Boal and Mannan 1996, Schnell 1994). They usually nest in cottonwood and sycamore trees in the crotch of the main trunk but occasionally in side branches (Schnell 1994). The average nesting height is 15-18 m (49-59 ft) and dbh ranges from .72-1.15 m (2.35-3.75 ft) (Schnell and others 1986). Territories are irregularly spaced along riparian drainages (Schnell 1994). Although most territories are not adjacent to one another, inter-nest spacing of 355 m (1165 ft) was recorded in one case (Schnell 1994).

Habitat and/or Population Objectives:

Population Objective

1. To maintain current population numbers and enable population growth to allow for expansion into restored habitats.

Habitat Strategy

1. Ensure and maintain viable, self-sustaining populations distributed throughout major Arizona drainages, excluding the Lower Colorado River and Lower Gila River

- drainages, with no net loss of habitat.
2. Increase the amount of suitable habitat by 25% in 25 years and by 100% in 50 years by encouraging natural events that promote regeneration of cottonwood, sycamore, ash, and other riparian trees.

Assumptions:

1. There is available habitat throughout the historic range.
2. Habitat loss and degradation are the major threats to Common Black-Hawks.
3. By increasing habitat as above, we will have a viable, self-sustaining population.
4. We can achieve suitable habitat in 25-50 years.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Threats to Common Black-Hawks include the alteration and loss of riparian habitat through damming, diversion, channelization, phreatophyte control, agriculture, groundwater consumption, and livestock grazing that eliminates regenerative seedlings (Schnell and others 1986 and Schnell 1994). Other potential threats to Common Black-Hawks and their habitat include mineral extraction, exotic plant species invasions, changes in prey composition, and urban development (review in Boal and Mannan 1996). Disturbance from human presence has been documented to cause occupants to call aggressively and leave nests (Schnell 1994). Chronic intrusion such as a parking lot built in the nest area has caused permanent nest abandonment (Schnell 1994). Additionally, contaminants from agriculture, mining, and fire suppression may have an adverse impact on the prey base (Schnell and others 1986).

The highest priority for management of this species is conserving and improving health of existing riparian areas and for rehabilitating historic riparian corridors (Schnell 1994). Good water quality is important to support a prey base. Avoiding causes of poor water quality such as heavy metals, agricultural runoff, mine tailings, pesticides, acid rain, domestic livestock in creeks, poor watershed conditions and trash from urban areas, may be necessary. Recent die-offs of ranid frogs may be a "red flag" as to the diminishing quality of riparian areas in Arizona. Die-offs of ranid frogs, particularly the lowland leopard frog, could have serious effects on Common Black-hawks, as these amphibians make up a large portion of the black-hawks diet. Changes in habitat conditions such as damming, diverting, and draining rivers and streams as well as introduction of non-native sport fish, and amphibians (i.e. bull frogs and crayfish), and the increased invasion of exotic plant species have contributed to ranid frog declines (Sredl and others 1997). Most recently, the discovery of a fairly new fungus to Arizona, the Chytrid fungus, has been implicated for three major die-offs of lowland leopard frogs during the winter of 1998-1999 (Sredl, AGFD, pers. comm.). Further studies are

necessary to determine the origin of this fungus, but land managers should be on the alert for possible die-offs in riparian areas.

Reducing or eliminating livestock grazing may be necessary where replacement nest tree recruitment is lacking (Schnell 1994). Creation of small impoundments near nest trees or placement of perches over impoundments may increase prey abundance near the nest (Schnell and others 1986, Schnell 1994). The protection of riparian tree seedlings from livestock grazing for three to five years may be necessary for recruitment of nest trees. It will take a minimum of 30-40 years for these trees to grow large enough for a Common Black-Hawk to use for nesting (Schnell and others 1986).

Common Black-hawk management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Water Management

1. Avoid or minimize water diversions that decrease or eliminate perennial flow to Common Black-hawk habitat.
2. Avoid flood-control practices that reduce water availability to riparian habitat.

Habitat Loss

1. Reduce or avoid activity such as: riparian travel, work, grazing, etc. in areas that have less than 2 year-old seedlings becoming established.
2. Locate urban development away from riparian areas and associated floodplain.

Water Quality

1. Encourage high water quality (reduce high turbidity, heavy metals, agricultural runoff, etc.). Good water quality is needed to ensure adequate prey items.

Human Disturbance

1. Wherever possible, manage human visitation to minimize disturbance during the breeding season.

Implementation Opportunities

1. Encourage conservation easements and habitat incentive programs to help restore, establish and maintain riparian habitat.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the impact of human disturbance on the success of Common Black-Hawks.

2. Determine the minimum patch size necessary to sustain Common Black-Hawks.
3. Determine what constitutes a viable population.
4. Determine basic information needs: habitat requirements, territory fidelity, recruitment, dispersal patterns, and winter range use.
5. Determine factors limiting prey availability, especially ranid frogs.

Outreach Needs

1. Inform bird watching groups and other recreational users of Common Black-Hawk sensitivity to human disturbance.

ELEGANT TROGON (*Trogon elegans*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Elegant Trogon are: Sulphur-bellied Flycatcher, Cordilleran Flycatcher, Dusky-capped Flycatcher, Blue-throated Hummingbird, White-eared Hummingbird, Painted Redstart, and Hepatic Tanager.

Distribution: The Elegant Trogon occurs primarily in Mexico, Latin America, and Costa Rica (AOU 1983:364). The northernmost portion of the population is partially migratory, with birds breeding in a few mountain ranges in southeast Arizona (AOU 1983:49). North of Mexico, the only populations of Elegant Trogons occur in Arizona. In Arizona, it is a fairly common summer resident of the Huachuca, Santa Rita, and Chiricahua mountains, occurring locally in the Pajaritos and Atascosa mountains and Guadalupe Canyon (Monson and Phillips 1981).

Ecology: Elegant Trogons typically arrive on their breeding grounds in southeastern Arizona in early April to late May, but sometimes also in June (Taylor 1979-1983). Although not normally migratory, most leave Arizona in the winter, departing in late September or early October (Taylor 1978). They feed by flycatching or gleaning a wide variety of flying insects such as butterflies, moths, cicadas, praying mantis', and grasshoppers (Cottam and Knappen 1939). Berry fruits are also eaten if available (Taylor 1978). Trogons typically nest in a cavity excavated by a flicker or woodpecker but will also use natural cavities in trees and earthen banks (Ehrlich and others 1988). In Arizona, cavities are most often found in sycamores at an average height of 7.5 m (25 ft), and are typically within 300 m (328 yds) of perennial water (Taylor 1980-1983). Clutch size is 2-4 eggs, with two common in Arizona (Taylor 1980-1983). The brood is split after fledging, with females tending female fledges and males tending male fledges (Taylor 1979-1983; Hall 1996).

Habitat Requirements: In southeast Arizona, Elegant Trogons commonly nest in heavily vegetated riparian canyons with pine-oak uplands from 1515-2120 m (5045-7060 ft) elevation (Taylor 1983), but have been located at elevations as low as 1080 m (3600 ft) and as high as 2580 m (8600 ft). Trogon abundance is positively associated with increasing cover by sycamore riparian and edge vegetation, juniper and pine riparian vegetation, pinyon riparian and edge vegetation, and juniper upland vegetation. They also prefer decreasing cover by Fremont cottonwood and oak riparian, Douglas-fir upland, and mesquite, walnut, and mountain mahogany edge vegetation (Hall 1996). Taylor (1980-1983) reported that Elegant Trogons were associated with the presence of surface water, but Hall (1996) was unable to find a statistically significant difference (although there was a positive trend) in Elegant Trogon abundance with increasing persistence of water. The home range of male Elegant Trogons ranged from 220-575 m (726-1898 ft) long according to Taylor (1979). Further study by Hall (1996) indicated a range from 63-315 ha (155-780 ac) for individual breeding males during all reproductive stages. Hall (1996) suggested a few additional factors that may explain why Elegant Trogons only occur in the southernmost Arizona mountains including intolerance to colder climates, lack of summer rainfall and proximity to Mexican wintering grounds.

Habitat and/or Population Objectives:

Population Objective

1. Maintain the current distribution and numbers of individuals in Arizona, with no net loss of existing birds.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Birdwatchers travel from all over the world and across North America to see Elegant Trogons. Monson (1974) stated that the Elegant Trogon was “undoubtedly the most sought-after bird in Arizona.” Disturbance by people during the nesting period may be one of the greatest potential threats to the species in Arizona. Taylor (1979) listed several factors that may negatively impact Arizona’s Elegant Trogons in the future, including: continued development of recreation sites; the use of photography in conjunction with birdwatching; road maintenance conducted with heavy equipment; and camping and hiking in areas where Elegant Trogons nest. Taylor (1979) suggested several steps to mitigate threats to Elegant Trogons in Arizona including: 1) the protection of one canyon in each mountain range where Elegant Trogons occur in the greatest numbers; 2) designation of South Fork of Cave Creek in the Chiricahuas as a National Zoological Area; 3) the restriction of vehicle use in Sunnyside Canyon in the Huachuclas; 4) dispersed camping restrictions in Madera Canyon in

the Santa Ritas; and 5) bans on the use of tape recorders playing Elegant Trogon calls, on photography equipment next to nests, and on people approaching nest sites. The U.S. Forest Service has implemented conservation steps 2 and 3 (and step 5 to a certain extent in South Fork)(Hall 1996). Additionally, further information on the status of the species and its habitats in the body of its range is needed to develop conservation recommendations.

Elegant Trogon management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Human Disturbance

1. Discourage recreational development (i.e. campgrounds, cabins, hiking trails, roads, etc.) in known Elegant Trogon nesting areas.
2. Limit recreational activities (i.e. birdwatching, hiking, camping) in known Elegant Trogon nesting areas during the nesting season.
3. Discourage the use of tape playback of Elegant Trogon calls during the nesting season.

Habitat Loss

1. Maintain and increase suitable riparian habitats.
2. Promote regeneration of native species in riparian habitats.
3. Manage for large, contiguous blocks of habitat rather than small fragmented areas.

Implementation Opportunities

1. Protect one canyon in each mountain range where Trogons occur in the greatest numbers.
2. Designate South Fork of Cave Creek in the Chiricahuas as a National Zoological Area.
3. Restrict vehicle use in Sunnyside Canyon in the Huachuclas.
4. Disperse camping restrictions in Madera Canyon in the Santa Ritas.
5. Limit and discourage the use of tape recorders playing Trogon calls, on photography equipment next to nests, and on people approaching nest sites.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Research Recommendations (from Kunzmann and others 1998)

1. Determine what the effects of management activities are on Elegant Trogon numbers.
2. Study how Elegant Trogons in southeastern Arizona relate to other avian species.
3. Determine where Elegant Trogons migrate to from southeastern Arizona.
4. Study pair bond information and lifetime reproductive success.
5. Study What the sexual differences are in habitat use.

SOUTHWESTERN WILLOW FLYCATCHER (*Empidonax traillii extimus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Southwestern Willow Flycatcher in High Elevation Riparian Habitat are: Red-naped Sapsucker, Dusky Flycatcher, Swainson's Thrush, American Robin, Gray Catbird, MacGillivray's Warbler, Green-tailed Towhee, Lincoln's Sparrow, and Brewer's Blackbird. Although these species may occur in similar habitat as the Southwestern Willow Flycatcher, they are not necessarily indicators for the species but are indicators for potential flycatcher habitat.

Distribution: The Willow Flycatcher breeds across most of the United States, with the exception of the southern states and the central plains. The Southwestern Willow Flycatcher is one of four or five subspecies of the Willow Flycatcher (Browning 1993, Unitt 1987), with a breeding range that includes southern California, Arizona, extreme southern Nevada and Utah, New Mexico, southwestern Colorado, and western Texas. Formerly, this subspecies was a common breeder in most willow-dominated riparian areas in Arizona (Phillips and others 1964). In 1997, it bred at only 45 sites statewide (McCarthy and others 1998). The sites range in elevation from less than 90 m (300 ft) to over 2440 m (8000 ft) (Sferra and others 1997). "Southwestern Willow Flycatcher populations are extremely small and vulnerable to extirpation; > 75% of extant flycatcher locations are occupied by an estimated five or fewer territorial males (USFWS 1996)." The Southwestern Willow Flycatcher most likely winters in Mexico, Central America, and northern South America (AOU 1983, Howell and Webb 1995, Phillips 1948, Ridgely 1981, Ridgely and Tudor 1994, Unitt 1987).

Ecology: Southwestern Willow Flycatchers arrive in breeding habitat in late April or early May, and may be present until late August or early September. Some individuals may move away from territories as early as July. Their presence and status can be confused by the migrating individuals of northern subspecies passing through Southwestern Willow Flycatcher breeding habitat. The nest is a compact cup constructed in a fork or on a small horizontal branch, approximately 1-12 m (3-40 ft) above ground in a medium-sized bush or small tree, typically with dense vegetation above and around the nest (Brown 1988, Whitfield 1990, Sferra and others 1997). This flycatcher subspecies usually nests within close proximity to water. The incubation period is approximately 12 days, with a nestling period of 12-14 days (Whitfield 1990). Typically, one brood of young is raised per year (Whitfield 1990), but multiple nesting attempts are not uncommon (McCarthy and others 1998). The Southwestern Willow Flycatcher is often the victim of predation and cowbird brood parasitism (Brown 1988, Sferra and others 1997, Sogge 1995, Whitfield 1990).

Foraging within, above, and adjacent to dense riparian vegetation, the Willow Flycatcher usually takes insects on the wing and gleans them from foliage (Bent 1963). Half the prey items from one study include Hymenoptera (ants, bees, and wasps), Diptera (true flies) and Hemiptera (true bugs) (Drost and others 1997). Because of their large size, odonates (dragonflies and damselflies) are also important components of the Willow Flycatcher diet (Drost and others 1997).

Habitat Requirements: The Southwestern Willow Flycatcher is a riparian obligate that requires dense habitats along rivers, streams, or other wetland areas usually with surface water, where 3-10 m tall willows, seepwillow, arrowweed, buttonbush, alder, or other shrubs and trees are present, often with a scattered overstory of cottonwood (Phillips 1948, Unitt 1987, Whitfield 1990). The Southwestern Willow Flycatcher also nests in thickets dominated by tamarisk and Russian olive (Hubbard 1987, Sogge 1995), and has been found nesting in box elder in adjacent New Mexico. Plant species seems less important than the presence of dense lower and midstory vegetation, with small twigs and branches for nesting. Surface water or saturated soil is almost always at or adjacent to nest sites, except in dry years (Sferra and others 1997).

Habitat and/or Population Objectives:

Population Objective

1. Increase current self-sustaining population numbers in the Lower Colorado, Upper Little Colorado River, and increase the viable populations along the Upper Gila and entire San Pedro River, Verde River and Middle Salt River.
2. Allow for expansion into restored habitats.

Habitat Strategy

1. Manage potential habitat to achieve structural and vegetation characteristics necessary to support increasing numbers of breeding Southwestern Willow Flycatcher pairs within 5-20 years. Suitable structural characteristics may be achieved through restoring, maintaining, enhancing and creating habitat.
2. Within the historic range, increase suitable habitat and improve/enhance existing potential habitat to support at least 2 viable, self-sustaining populations.
3. Reduce cowbird parasitism rate to less than 20% at each site.
4. Reduce predation rate to less than 20% per site until population is increased or stable.

Assumptions:

1. By maintaining current populations, we will have a better chance for populations to expand into suitable unoccupied habitat.

2. 5-20 years is adequate time to achieve habitat necessary for Southwestern Willow Flycatchers.
3. We can restore suitable habitat. Southwestern Willow Flycatchers will occupy restored habitat. We can determine what a viable population is.
4. Based on Black-Capped Vireo population and habitat viability assessments, Southwestern Willow Flycatchers will respond similarly to a reduction in cowbird parasitism.
5. A 20% predation rate is sustainable, if the cowbird parasitism rate is low.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

The Southwestern Willow Flycatcher has suffered extensive loss and modification of riparian breeding habitat due to: urban, recreational, and agricultural development, water diversion and impoundment, channelization, livestock grazing, and hydrological changes resulting from these and other land uses (Sferra and others 1997, Tibbitts and others 1994, USFWS 1993). Breeding habitat at Roosevelt Lake, which includes two of the larger populations in Arizona, will be inundated by rising lake levels with the raising of Theodore Roosevelt Dam (USFWS 1996). Lake Mead populations were flooded in 1996-1997 and habitat there is almost absent (M. Sogge pers. comm.) Many nesting sites are threatened by cowbird brood parasitism (Unitt 1987, USFWS 1993, Sogge 1995, Sferra and others 1997), with potential for low genetic variability, high inbreeding, and population extirpation due to stochastic events. Pesticide use in areas adjacent to breeding sites poses a potential threat. Some breeding sites are susceptible to damage from fire (Paxton and others 1996).

Southwestern Willow Flycatcher management issues are listed in italics. Below each issue are Arizona Partners in Flight Conservation Recommendations.

Habitat Loss and Modification

1. Establish a "no net loss" policy.
2. Work with land managers to maintain and increase suitable riparian habitats.
3. Promote regeneration of native species in riparian habitats.
4. Encourage the use of buffer zones between riparian habitats and adjacent development.
5. Restore natural reaches of riparian habitat by restoring intervening degraded segments.
6. Promote establishment of areas of slow/back waters.
7. Manage for large, contiguous blocks of habitat rather than for small fragmented areas.
8. In urbanizing areas, promote retention of riparian areas.

Water Management

1. Manage water diversions and groundwater withdrawal to maintain streamside vegetation.
2. Mimic natural stream flow regimes including periodic flood events.

Brown-headed Cowbird Parasitism and Predation

1. Reduce cowbird parasitism rate to less than 20% at each site.
2. Continue to monitor nests to record incidence of parasitism.
3. Evaluate effectiveness of cowbird trapping at present locations by monitoring nests for parasitism and reproductive success.
4. Implement cowbird trapping programs where parasitism rates are greater than 20%.

Pesticides

1. Determine impact of pesticide use on Willow Flycatcher reproduction adjacent to riparian areas.
2. Limit or eliminate use of harmful pesticides adjacent to riparian areas.
3. If used, apply in a manner that avoids drift, according to directions (i.e. not broad applications).

Implementation Opportunities

1. Involve numerous state, federal and private organizations to conduct population surveys.
2. Inform federal and state land management agencies on practices beneficial to Willow Flycatchers and other riparian obligate species.
3. Encourage private and public partnerships for fencing and habitat restoration through federal, state and nongovernment programs (USFWS Partners for Wildlife, AGFD Stewardship Program, Natural Resources Conservation Service (NRCS), etc.).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Continue statewide surveys to identify breeding locations and suitable habitat.
2. Monitor nests to determine nesting success, parasitism rates, and predation rates.
3. Color band individuals each year to determine status, territory size, site fidelity, natal and adult dispersal and renesting attempts.

MACGILLIVRAY'S WARBLER (*Oporornis tolmiei*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the MacGillivray's Warbler are: Broad-tailed Hummingbird, Red-naped Sapsucker, Dusky Flycatcher, Cordilleran Flycatcher, Swainson's Thrush, Hermit Thrush, American Robin, Orange-crowned Warbler, Red-faced Warbler, Green-tailed Towhee, and Lincoln's Sparrow.

Distribution: The MacGillivray's Warbler breeds from southeastern Alaska, southwest Yukon, northern British Columbia, southern Alberta, northwestern Saskatchewan and southwest South Dakota south, primarily in the mountains, to southern California, central Arizona, and southern New Mexico (DeGraff and others 1991). Populations are less common in the southern limits of its breeding range and more disjunct in the prairies and the southwestern United States. The winter range of the species is defined as the Pacific slopes and highlands of Central America from northern Mexico through Panama (Bent 1953, Ridgely and Gwynne 1989).

Ecology: *Oporornis tolmiei monticola* (Phillips) is the breeding race, which is rarely seen in Arizona away from the breeding grounds, making long flights between the mountains and Mexico. Northern Arizona sees the arrival of this species typically in May, leaving in late August to September, with a few records from October. MacGillivray's Warbler is a summer resident of *Ribes*-willow, and fir and maple thickets of the Canadian Zone of the White mountains, locally on the Mogollon Rim, the San Francisco, Bill Williams, Pinaleno, and Chuska mountains, and very locally on the Kaibab Plateau (Monson and Phillips 1981, Martin 1993, Arizona Breeding Bird Atlas, unpublished data). This warbler nests close to ground in dense shrubbery (Ehrlich and others 1988) and prefers dense, moist, brushy habitat (DeGraff and others 1991). The cup nest is concealed by shrubs and undergrowth. Uncommon host of the Brown-headed Cowbird.

MacGillivray's feed almost entirely on insects, including true bugs, leaf hoppers, beetles, bees, wasps, and ants (Shuford 1993). Earlier observations included: click, dung, and flea beetles; alfalfa weevils; and caterpillars (Bent 1953, Oberholser 1974). Forages by gleaning in leaves on the ground (Mengel 1964) or among branches and leaves of trees and shrubs (Hutto 1981, Miller and others 1972). Foraging heights are generally in the lower shrubs and branches of trees within a meter of the ground, with most activity occurring at < 3 m (10 ft).

MacGillivray's are common transients in southwestern Arizona, common in fall in shrublands from the Lower Sonoran to Canadian Zone in the brushy and wooded parts of the state (Phillips and others 1964).

Habitat Requirements: MacGillivray's Warbler prefers dense low shrubs and trees, often in mountain forests and shrubby hillsides, and moderate cover, common in riparian habitats

and wet thickets. In northern Arizona, their nesting habitat is primarily patches of small firs and short maple and *Ribes*-willow-alder thickets, usually in the lower portion of high elevation drainages (Martin 1993). These areas are usually more moist than the surrounding areas.

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable or increasing population trend within current range and distribution.

Habitat Strategy

1. Maintain current MacGillivray's Warbler habitat.
2. Increase MacGillivray's Warbler habitat within 10 years.

Assumptions:

1. We can maintain current habitat.
2. There is a negative population and habitat trend.
3. If we increase habitat, populations will increase.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Data conflict on population trends. Declines have been reported in Idaho (Dobkin 1994), southern California (Shuford 1993), and in five western states (based on BBS routes, DeSante and George 1994). These same authors reported increases in Montana (Dobkin 1994) and northern coastal mountains (Shuford 1993). Predictions suggest logging in the Pacific Northwest will benefit the species, while livestock grazing may destroy migration, wintering, and breeding habitat. May benefit from development in Central America that creates second growth (Hutto 1981). Exposure to acetate (used in insecticides) caused severe depression of cholinesterase activity in the brains of these warblers. Exposure to carbaryl and tichlorfon based insecticides had only minor effects (Zinkl and others 1977).

MacGillivray's Warbler management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Implement management practices that will stimulate the necessary shrubby habitat components such as prescribed fire and vegetation manipulation.
2. After habitat manipulation, encourage planting of native species.

Frequency of disturbance regimes (Fire and other natural disturbances)

1. Reestablish the natural fire regime; remove excessive fuel build-up before introducing fire into the habitat. Replant with native seeds.
2. Manage upland and riparian soil conditions to improve water infiltration and retention. This will reduce peak flow and increase base flows in riparian habitats, which will be beneficial during drought years.

Human Disturbance

1. Time livestock and human impacts to avoid the nesting season.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Monitor habitat and population trends.
2. Determine if elk browsing on young maples and oaks is a problem for MacGillivray's on the Mogollon Rim.
3. Determine if MacGillivray's are affected by human disturbances (i.e. hiking trails, camping near nest etc.).
4. Determine if Brown-headed Cowbird parasitism is a threat.

RED-FACED WARBLER (*Cardellina rubrifrons*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Red-faced Warbler are: Mexican Spotted Owl, Blue-throated Hummingbird, Red-naped Sapsucker, Williamson's Sapsucker, Cordilleran Flycatcher, House Wren, Townsend's Solitaire, Hermit Thrush, American Robin, Warbling Vireo, Orange-crowned Warbler, Yellow-rumped Warbler, MacGillivray's Warbler, Green-tailed Towhee, and Dark-eyed Junco.

Distribution: This warbler's winter range includes central-west Mexico around Sinaloa and Durango south to the highlands of Mexico, Guatemala, and occasionally western Honduras. Summer range extends from central-west Mexico to central Arizona, while most breeding takes place in Arizona and southwestern New Mexico (Curson and others 1994). The Red-faced Warbler is casual to southwestern Texas during migration and a vagrant elsewhere in Texas, southern California and Nevada.

In Arizona, the Red-faced Warbler is common from the San Francisco and Bill Williams mountains, south along the Mogollon Rim and White mountains and through the Sky Island mountains of southeastern Arizona (Monson and Phillips 1981).

Ecology: The Red-faced Warbler is a short distance migrant, moving through the mountains of central and western Mexico. They frequently migrate with other warblers. Red-faced Warblers arrive at their breeding grounds in early to mid- April. Fall migration begins as early as July and lasts through mid-September (Martin and Barber 1995). A noted ground-nester, Red-faced Warblers nests are usually located on a steep bank and concealed under a fallen log, rock, or grass clump (Curson and others 1994). The nest is fashioned into a loose cup from pine needles, bark, dead leaves or plant stems. Red-faced Warblers feed on insects on outer conifer branches, but also sally for insects.

Habitat Requirements: Red-faced Warblers prefer pine-oak forests and Engelmann spruce and Douglas-fir stands, principally in steep, sloping canyons. Less frequently found in aspen and oak thickets (Monson 1957b). Elevations typically range from 2000-3000 m (6560-9840 ft). Winter habitat in southern Mexico and Guatemala is comprised mainly of pine, oak, alder, arbutus, and other broad-leaved trees.

Habitat and/or Population Objectives:

Population Objective

1. Maintain a stable or increasing population trend within current range and distribution.

Habitat Strategy

1. Avoid any loss of current habitat.

Assumptions:

1. Populations are stable.
2. Stability is linked to habitat availability; current available habitat is sufficient to maintain populations.
3. Habitat loss is the main threat to Red-faced Warblers.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Habitat loss and human disturbance are the primary issues for Red-faced Warblers. Habitat loss is a continued threat as long as logging continues on the breeding grounds. Red-faced Warblers were absent from forest plots that had been selectively logged for 2 years or more

(Szaro and Balda 1979 a,b). Human disturbance at the nest and roost sites commonly occurs when researchers attempt to watch the birds for periods of time. Since Red-faced Warblers are aggressive defenders of their nest and territory, any intrusion near the nest area will cause males to chip loudly, providing cues for predators about nest locations (Martin and Barber 1995). Continuous and vigorous defense behavior may cause nestlings to leave the nest prematurely (Martin and Barber 1995). It is highly recommended that researchers and curious birders take precaution around Red-faced Warbler nests.

Red-faced Warbler management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Maintain buffer strip, 100 m (328 ft) or to the slope break, of no timber harvesting, for suitable habitat areas in or adjacent to riparian habitat.

Human Disturbance

1. Avoid nest areas during nesting season.
2. If researching the bird, observe at a distance far enough not to evoke defense behaviors by Red-faced Warblers.

Implementation Opportunities

1. Educate birders and researchers about the negative effects visitation to nest sites can have.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the distribution of current populations.
2. Define buffer area sizes more closely.
3. Determine current threats to the population (including humans).
4. Monitor habitat trends (increasing, stable, decreasing).
5. Determine habitat use during Spring and Fall.
6. Migration ecology and habitat use.
7. Wintering and breeding ecology of Red-faced Warbler in Mexico.

3. **Coordination of Recommendations and Opportunities in High Elevation Riparian**

Habitat loss and alteration are by far the most serious issues for all types of riparian habitats. All five species identified for high elevation riparian habitat have suffered from some form of habitat loss and/or alteration. Losses stem primarily from recreation and livestock grazing and to a lesser

degree from urban, suburban, and agricultural conversion, as is the case in low elevation riparian areas. Habitat modification has been caused by the same factors effecting other riparian habitats such as water diversion and impoundment, channelization, excessive livestock grazing, alteration of natural water regimes, and lack of regeneration of trees from seed sources. Human disturbance is recognized as a management issue for four species, Common Black-Hawk, Elegant Trogon, MacGillivray's Warbler and Red-faced Warbler, and may cause nest abandonment for two of them (Common Black-hawk and Elegant Trogon) if it occurs during the nesting season. The two species most closely associated with water, (Southwestern Willow Flycatcher and Common Black-Hawk), may be affected by use and/or misuse of chemical contaminants in or adjacent to riparian areas. Nest parasitism is a management issue for the Southwestern Willow Flycatcher but doesn't appear to be a threat to the other four priority species. Water quality is an important issue for one species.

Protecting and enhancing existing riparian habitat is essential for all five species and their associates. Regeneration of native riparian vegetation, creation of buffer zones between riparian habitat and adjacent development or timber harvest, and management of large tracts of contiguous habitat are some recommended approaches.

Human disturbance is primarily from recreation in and adjacent to riparian areas. High elevation riparian areas are popular recreation sites when summer temperatures reach well over 100° F in the highly populated desert cities of Phoenix and Tucson. Discouraging additional recreational development such as campgrounds, hiking trails, and cabins, and managing human visitation such as birdwatching and research during nesting season is recommended.

Pesticide use can account for direct mortality of birds and can reduce the amount and/or kind of insect prey base. Where it is necessary to use pesticides, it is recommended they be used in a manner that avoids drift into riparian areas.

Maintaining a quality of water in the riparian systems and a minimum flow is a consideration particularly for the Common Black-Hawk because it feeds on aquatic prey. Since frogs are some of the best indicators of habitat health, it is recommended that land managers watch for potential die-offs of any frogs, especially lowland leopard frogs, and take immediate action to identify the cause. Declines in lowland leopard frog populations may have direct negative effects on Common Black-hawk populations. Direct pollution of riparian systems should be prevented. Poor watershed conditions that lead to agricultural and mining runoff, high sediment loads, and high turbidity should be remedied.

Parasitism is primarily a threat to cup-nesting birds and is an especially important management issue for the Southwestern Willow Flycatcher. Reducing the rate of parasitism may require

cowbird trapping for Southwestern Willow Flycatchers, especially where the parasitism rate is >20%.

Table 22. High Elevation Riparian Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Common Black-Hawk	-sycamore, cottonwood (mature) -gallery riparian trees (for nesting)	-large, tall trees -prefers groves of trees rather than single trees	elevation 305-1830 m (1000-6000 ft) -open water/mesic riparian close to nest (for prey base) -high water quality (prey sensitive to pesticides) -requires perennial stream	-late successional stage -important to plan for new/future gallery forest structure; regeneration and recruitment of large trees needed -proximity to foraging areas important.
Elegant Trogon	-sycamores and oaks for nesting -pine-oak woodlands	-nest in large sycamores and oaks -prefer dense riparian vegetation and upland	-1515-2120 m (5045-7060 ft) -may prefer canyons with perennial waterflow	-canyons with high cover of riparian veg -prefer areas with decreasing amount of Fremont cottonwood and oak
Southwestern Willow Flycatcher	-native to exotic -Single species to multi-species -box elder, tamarisk, willow, Russian olive, alder	-dense, midstory and understory	-almost always associated with surface water/mesic nearby -elevation 30-1220 m (100-4000 ft) and 2285-2745 m (7500-9000 ft) -Low gradient	-broad(er) floodplain -structure appears to be more important than seral stage (from sapling up, not a seedling stage).
MacGillivray's Warbler	-mesic/marshy willow thickets -Wet meadows/edges -ribes sp. (Gooseberry) -nests under new growth of Gambel oak, snowberry	-needs dense understory	-elevation 1830-2745 m (6000-9000 ft)	-associated w/riparian habitat at the edges of conifer and deciduous forests.
Red-faced Warbler	-maple, oak, sycamore, willow (and	-midstory important, dense	-elevation 2135-2745 m (7000 -9000	-mostly in steep canyons

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
	associated conifers)	preferred -not nec. tied to dense understory	ft) -Steep gradients -sloped riparian edges	canyons

Table 23. Special Factors for High Elevation Priority Species

Priority Species	Special Factors
Common Black-Hawk	-prey items: crayfish, frogs, snakes, suckers and other fish
Elegant Trogon	-closely associated with Arizona Woodpecker, Dusky-capped Flycatcher and Sulphur-bellied Flycatcher -eat wide variety of food: insects, caterpillars, grapes, cherry, lizards
Southwestern Willow Flycatcher	-cowbird parasitism -high nest failure/predation -low overall population size- very fragmented -Possible demographics and distribution problems
MacGillivray's Warbler	-obligate understory (dense) nester -primarily breed in the White Mountains and locally above the Mogollon rim, in a relatively small geographic area
Red-faced Warbler	-ground nester

P. *Freshwater Marshes*

1. Habitat Description, Status and Importance

The occurrence of freshwater marshes in a state renowned for its dry, parched deserts may seem incongruous. It is true, in fact, that compared to most other western states, this habitat in Arizona is a rarity. This results largely from a lack of recent glaciation, general aridity, high evaporation and siltation rates, and the steep gradients of much of the topography (Brown 1982). However, this scarcity and the wide variety of marsh habitats that result from Arizona's diverse landscapes, make this habitat disproportionately valuable for wildlife. Generally, marshes are areas of permanent to semi-permanent fresh water, characterized by relatively shallow depths and extensive coverage of submergent and emergent plants such as duckweeds, cattail, rushes, and sedges. Popular uses for this habitat are: recreation (fishing, canoeing/kayaking, hunting, birdwatching), water protection, livestock grazing, flood retention, wildlife habitat, and ground water recharge. Several species of plants and animals are highly dependant on Freshwater Marsh habitat including: Huachuca Water-umbel, Yuma Clapper Rail, all leopard frogs (except Rio Grande), Mexican Garter Snake, Desert Pupfish, Gila Topminnows, Squawfish, chub spp., California Black Rail, American Bittern, Least Bittern, Peregrine Falcon, Bald Eagle, Osprey, Least Tern, and Yellow Mud Turtle.

Freshwater marshes may be found throughout the state, but are particularly notable in four physiographic regions: White Mountains, San Francisco Plateau (Colorado Plateau and Mogollon Rim), Southeastern (Mexican Highlands and Chihuahuan Desert), Lower Colorado River drainage (Sonoran and Mohave deserts).

1. White Mountains. Marshes in this high elevation region are classified primarily as arctic-boreal wetlands (Brown 1982) and occur mostly at elevations from 2,600-2,850 m (8530-9350 ft). Some occurred naturally but most are a result of impoundment of streams or wet meadows for stock waters, irrigation retention, or recreation. Most are fairly small, less than 50 ha, or comprise the shallow portions of larger lakes. Principal emergent plant species are beaked sedge, hardstem bulrush, northern manna grass, and common spikerush. Common submergent plants are common bladderwort, variableleaf pondweed, shortspike watermilfoil, water buttercup, and water smartweed (Fleming 1959, Piest 1982).

Marsh habitats at these high elevations are similar to those much farther north in the United States and Canada. The bird communities also show affinities to northern latitudes, with some species reaching the southern limit of their breeding range in this area (e.g. American Green-winged Teal, American Wigeon, Ring-necked Duck, and Wilson's Phalarope). Characteristic breeding species are Pied-billed Grebe, Eared Grebe, Mallard, Northern Pintail, Cinnamon Teal, American Green-winged Teal, Redhead, Ruddy Duck, American Coot, Sora Rail, Red-winged Blackbird, and Yellow-headed Blackbird. Fleming (1959) estimated that this area accounts for more than 70 percent of the waterfowl produced in Arizona.

Most marshes in the White Mountains are contained within the Apache-Sitgreaves National Forest and the White Mountain Apache Reservation. Grazing by livestock and elk has resulted in some degradation of marsh habitat, and irrigation drawdowns compromise the wildlife values of some marshes. Disturbance from recreational boating and fishing poses a threat to wildlife at some marshes. The Apache-Sitgreaves National Forest currently has a Wetlands Management plan that identifies priority wetlands for enhancement opportunities. This document will assist in focusing management efforts where they are needed most.

2. San Francisco Plateau. This region is comprised primarily of ponderosa pine forests north of the Mogollon Rim to near the town of Williams. Marshes in this area are located generally at elevations of 2000-2300 m and are classified by Brown (1982) as montane marshlands. Most were naturally formed within volcanic depressions and, by Arizona standards, may be quite large. Mormon Lake, at 2000 ha, is the largest natural water body in the state. These wetlands range from seasonally flooded flats to deep, permanent marshes and provide some of Arizona's best examples of natural wetlands in an intact condition. The largest concentration occurs atop Anderson Mesa southeast of Flagstaff.

Common emergent plant species are hardstem bulrush, common spikerush, and smartweeds. Common submergent plants are pondweeds, shortspike watermilfoil, and Canadian waterweed (Brown 1985). Characteristic breeding bird species are pied-billed grebe, mallard, northern pintail, cinnamon teal, redhead, ruddy duck, great blue heron, American coot, red-winged blackbird, and yellow-headed blackbird. This and the White Mountain region are the two most significant areas of duck nesting in Arizona.

Most of the marshes in this area are within National Forests, primarily the Coconino. Overgrazing within the marshes and on the watersheds by livestock (Myers 1982) and elk, introduction of non-native fish and crayfish, and human recreational disturbance all contribute to habitat degradation in some areas.

3. Southeastern. Marshes in this area occur primarily in the Sulphur Springs Valley, San Simon Valley, along Babocomari Creek, and the San Rafael Valley. Additional areas are found along the

San Pedro River and the upper Gila River (Brown 1985). Surrounding vegetation communities are classified primarily as Chihuahuan desert scrub and semidesert grassland (Brown 1982). Wetlands that occurred naturally in this region were playas, cienegas, and artesian wells. Many have diminished in size or have been lost entirely due to lowering of water tables from groundwater pumping and arroyo cutting. These losses have been somewhat replaced by the construction of irrigation tailwaters, pumpback ponds, and stock ponds.

Dominant aquatic vegetation includes sacaton grass, cattail, and sedge. This region hosts one of the few remaining United States populations of Mexican ducks, which was once one of the most common nesting species in southeastern Arizona marshes. Other bird species representative of marshes in this region are Common Yellowthroat, Great Blue Heron, Red-winged Blackbird, and Song Sparrow.

Most marshes in this region are privately owned and are susceptible to continued degradation by groundwater pumping, drainage, and overgrazing.

4. Lower Colorado River valley. Davis Dam marks the end of the Colorado River's route through rugged canyonlands and the beginning of a more leisurely flow along the final portion of its journey through broad alluvial valleys. Marsh habitats along the lower Colorado River occur as backwaters and sidechannels, both natural and manmade, as well as impoundments, irrigation drains, and seepage from unlined canals. Brown (1982) classifies these wetlands as Sonoran interior marshlands; elevations are less than 200 m. Most are dependent upon the river for water either through direct connections, seepage, or maintenance of high water tables. Usually included within this physiographic region is the Gila River below Painted Rock Dam, though marshes along this stretch are much smaller in number and extent.

Southern cattail, California bulrush, and common reed are dominant emergent species (Todd 1986), and sago and leafy pondweeds, water milfoils, holly-leaved naiad, common pondmat, and bladderwort are common submergent species (Minckley 1979). These low elevation marshes provide the primary breeding habitat in Arizona of many bird species including Western and Clark's Grebes, Great and Snowy Egrets, Least Bitterns, Common Moorhens, Yuma Clapper Rails, Virginia Rails, California Black Rails, and Marsh Wrens.

It is a matter of some debate whether man's activities have resulted in a net increase or decrease of the extent and quality of marsh habitats along the lower Colorado River (Rosenberg and others 1991). Some contend that annual flooding created and rejuvenated large expanses of marshes within the flood plain. Others believe that the annual scouring and sedimentation, along with high rates of evaporation, did not favor the establishment of marsh habitats. Regardless, existing marshes are faced with threats from continuing efforts to dredge, straighten, and riprap the river's banks. Flooding in the 1980s and early 1990s has recently led to more pressure to increase these

activities, which would result in losses of large amounts of marsh habitat (Rosenberg and others 1991). Boating, pollutants, and wildfire pose additional threats to marsh habitats and wildlife (Todd 1986).

2. Species Descriptions, Objectives and Recommendations

Below are detailed descriptions for each priority bird species in freshwater marsh habitat. A table at the end of the Freshwater Marshes section highlights species habitat needs in a quick reference format (Table 24).

YUMA CLAPPER RAIL (*Rallus longirostris yumanensis*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the Yuma Clapper Rail in freshwater marsh are: Red-winged Blackbird, Yellow-headed Blackbird, Pied-billed Grebe, Common Moorhen, Song Sparrow, Common Yellowthroat, Virginia Rail, Western Grebe, American Coot, Least Bittern, Marsh Wren, Green Heron.

Distribution: Eddleman and Conway (1998) recognize 21 subspecies of clapper rails distributed, primarily in coastal areas, from the northeastern United States to Peru and Brazil. Distribution of the Yuma Clapper Rail, the subspecies found in Arizona, includes areas of suitable habitat along the Lower Colorado River in Arizona and California, the Colorado River delta in Sonora and Baja California Norte. Populations also occur around the Salton Sea, California, the Cienega de Santa Clara in northwestern Sonora, and in fewer numbers along the Gila River in southwestern Arizona. Yuma Clapper Rails will also inhabit other scattered freshwater marshes in western Arizona, southeastern California, and northern Mexico (Todd 1986, Eddleman 1989). In Arizona, the considerable majority of the Yuma Clapper Rails are found in marshes along the lower Colorado River. Clapper rails have also been found consistently in scattered patches of habitat along the Gila River upstream from the Colorado River to near Phoenix. Intermittent sightings have been recorded in other marsh areas such as Picacho Lake, along the Salt River near Phoenix, and recently as far northeast as Tavasci Marsh along the Verde River near Clarksdale (Todd 1986, Eddleman 1989, and unpublished survey information).

Ecology: Previously, clapper rails that nested in Arizona were thought to migrate south into Mexico in winter (Todd 1986). Yuma Clapper Rails are now thought to be non-migratory (Eddleman 1989, Eddleman and Conway 1998). Winter distribution has been difficult to delineate, both for the Yuma subspecies and for the species as a whole, because the rails are difficult to observe and vocalization rates decline substantially in winter (Eddleman 1989, Eddleman and Conway 1998). Yuma Clapper Rails also disperse more and individual birds

use larger areas in winter (Eddleman 1989, Conway and others 1993). In Arizona, nesting occurs between early March and late July (Eddleman 1989). Breeding season territory seems to be reused by the same birds in successive years (Eddleman and Conway 1998). Clapper rails are most vocal during early portions of the breeding and nesting season; thus, tape-playback surveys are most successful during this period (i.e. April-May in Arizona, Conway and others 1993). Clapper rails give a variety of calls, but their loud “clatter” call is among the most common and diagnostic. Yuma Clapper Rails are omnivorous; their diet is known to include crayfish, insects, fresh water clams, fish, frogs, tadpoles, spiders, leeches, prawns, plant matter, and to lesser degrees small mammals, birds, reptiles, and eggs (Eddleman 1989, Ohmart and Tomlinson 1977, Todd 1986). The major food sources in Arizona tend to peak in availability during the rail’s hatching and rearing period, while there is a low in availability during the winter, possibly contributing to the rail’s increased movements (Eddleman and Conway 1998).

Habitat Requirements: Most clapper rails use areas of saline water in mangrove swamps, salt marshes, and tidal wetlands; however, the Yuma Clapper Rail is unique in that it lives and nests in freshwater marshes (Eddleman and Conway 1998). Todd (1986) describes Yuma Clapper Rails as requiring a moist to wet substrate, usually with rather dense vegetation at least 40 cm (16 in) in height. Flooded areas are important, but generally the rails use areas of shallow water (<30 cm or <12 in) near shore. Areas with gradual slopes between the dry land and the flooded areas are used more than areas with steep land-water gradients. In areas where rails are found further from shore, decadent, lodged vegetation of previous-years growth of cattails or bulrush usually provide above-water substrate which facilitates foraging and provides support for nests. Other studies, including Smith (1975) and Eddleman (1989) report similar findings. Most studies of Yuma Clapper Rails have indicated a preference for areas dominated by cattails and bulrush (Anderson and Ohmart 1985, Conway and others 1993, Eddleman 1989, Smith 1975, Todd 1986). Within such areas, Yuma Clapper Rails seem to use areas of varying stem densities, perhaps depending on availability, season, and the definitions of density used (Anderson and Ohmart 1985, Conway and others 1993, Smith 1975, Todd 1986).

Conway and others (1993) found seasonal differences in use areas related to amount of overhead cover, proximity to a plant edge, and proximity to dry upland areas. They concluded that the rails used densely vegetated marshes with shallow water for nesting, but more open areas in winter, and that a variety of mixed age stands of emergent vegetation containing shallow open water pools were selected for year round use.

Although larger marshes provide habitat for a greater number of Yuma Clapper Rails, large patch sizes may not be required to support smaller populations. Todd (1986) stresses the importance of small habitat patches. He documents Yuma Clapper Rails in agricultural drain

areas along the Gila River where individual rails had <0.04 ha (~1.0 ac) of marsh emergent or shoreline cover, and other small sloughs totaling only about 4 ha (~10 ac) but supporting at least 12 clapper rails. Whether these were source or sink populations was not identified. Anderson and Ohmart found marsh size (2-29 ha or ~5-72 ac) was unrelated to rail density. Smith (1975) reported average territory size of 1.4 ha (3.5 ac), and Eddleman (1989) found average seasonal home ranges varying from about 3 ha (7.5 ac) during incubation to over 20 ha (49 ac) in post-breeding periods and winter.

Habitat and/or Population Objectives

Population Objective

1. Maintain or increase current populations and distribution.

Habitat Strategy

1. Protect existing habitat along the Gila River, down stream from its confluence with the Salt River and along the Lower Colorado River down stream from Davis Dam.
2. Create and maintain additional suitable habitat along the Salt River, down stream from the Stewart Mountain Dam and at Picacho Reservoir.
3. Increase consideration of the Yuma Clapper Rail at federal and state wildlife refuges through the preparation and implementation of Clapper Rail management plans at each refuge containing clapper rail habitat (Eddleman 1989, USFWS 1983).

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Yuma Clapper Rails are one of three subspecies of clapper rail classified as endangered. As for many endangered species, assuring the maintenance of adequate amounts of quality habitat is probably the key to their survival. In natural systems marsh habitat is constantly changing in its distribution and condition due to scouring floods, regrowth of vegetation, then senescence and drying of the marsh. The vast majority of Yuma Clapper Rail's habitat today is not natural, but along the highly managed lower Colorado River, below dams, or in areas of irrigation or canal run-off. Thus, management of marsh habitat for Yuma Clapper Rails is important. Conway and others (1993) recommends active manipulation of marshlands, through burning or flooding, on a 4- to 5-year cycle to ensure a complex mosaic of patchily distributed environments and mixed age class vegetation. Yuma Clapper Rails respond well to appropriate water level manipulations (Eddleman and Conway 1994). Water level manipulations should be gradual, and should be minimized during the nesting and

rearing seasons (April-June) to minimize the possibility of flooding occupied territories and nests or completely drying areas, either of which might cause site abandonment (Eddleman 1989, Smith 1975). The need for gradual increase in water level may pose management challenges in areas where waterfowl are also being managed for.

A better understanding of the status of Yuma Clapper Rails in Mexico is important because the majority of the species' total population is probably in northwestern Mexico, with much of it in the Cienega de Santa Clara. The possible disposal of salt from a desalination plant into water flowing into the Cienega, and/or a loss of the inflow into the Cienega, by direct diversion into the Gulf of California, are the largest threats to the habitat in Mexico in the future (Eddleman and Conway 1998).

Selenium contamination of crayfish and sediments along the lower Colorado which can lead to elevated liver selenium levels that produce a moderate to high risk of hatchling defects is another area of concern and potential management issue (Eddleman and Conway 1998).

Yuma Clapper Rail management issues are listed in italics. Below each issue are Arizona Partners in Flight Conservation Recommendations.

Habitat Loss or Alteration

1. Maintain a mosaic of uneven aged marsh vegetation and avoid mechanical manipulation during breeding season (April-June).
2. Maintain, restore, and create etc. fresh water marsh habitat.
3. Where habitat is lost through required river maintenance, creation of additional habitat should take place as a mitigation measure (Eddleman 1989).

Water Management

1. Avoid rapid water level fluctuation during nesting season, esp. In April-June.
2. Work closely with waterfowl management groups to avoid impact to Yuma Clapper Rail habitats.
3. Coordinate with the Bureau of Reclamation to assure a continued water supply to the Cienega de Santa Clara in Sonora of adequate quantity and quality to maintain the existing habitat.
4. Assure that dams along the lower Colorado River maintain a constant flow of water at a rate sufficient for the maintenance of Yuma Clapper Rail breeding habitat (Conway and others 1993, USFWS 1983).

***A NAFTA agreement may eliminate agricultural and desalinization water from the Cienega.

Implementation Opportunities

1. Coordinate with refuges managers, Bureau of Reclamation biologists, land managers etc. to better manage for Yuma Clapper Rail.
2. Carry out a program of public conservation education and planning advice directed towards preservation of rail habitat (USFWS 1983).
3. Work with wastewater plant managers to plan for clapper rail management (create ponds and habitat adjacent to flood plain).
4. Use draglines or small river dredges to create channels in drying marshes (Todd 1986).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Continue annual call-count surveys of breeding populations (USFWS 1983).
2. Survey the amount of breeding habitat available once every 5 years (USFWS 1983).
3. Study the winter distribution and migratory status of Yuma Clapper Rail and determine how migratory they really are.
4. Evaluate selenium levels in various populations and use captive birds to determine levels of tolerance (Eddleman 1989).
5. Experimentally manipulate Clapper Rail habitats using carefully designed studies and evaluate Clapper Rail response (Eddleman 1989). Manipulations may include burning and small scale dredging.
6. Determine if periodic burning of habitat is beneficial or detrimental.
7. Study the general biology of crayfish on the lower Colorado River and the effect of various management practices on this important Clapper Rail food resource (Eddleman 1989).
8. Determine the status and the threats to the Mexican population. (Use information about the Cienega water to determine status and threats to Mexican population).
9. Coordinate with Mexico to design and implement a monitoring program at all important wetlands near the Colorado River delta (Eddleman 1989).

CALIFORNIA BLACK RAIL (*Laterallus jamaicensis coturniculus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the California Black Rail are: Red-winged Blackbird, Yellow-headed Blackbird, Pied-billed Grebe, Song Sparrow, Common Yellowthroat, Virginia Rail, Western Grebe, Least Bittern, Marsh Wren, Green Heron.

Distribution: The California Black Rail occurs in coastal areas of California near San Francisco Bay, irregularly south along the coast to northwest Baja California, and inland at

the Salton Trough in southern California and along the lower Colorado River (Eddleman and others 1994). In Arizona, most black rails occur at Mittry Lake and adjacent seepage marshes along the Gila Gravity Main Canal, and at Imperial National Wildlife Refuge (Repking and Ohmart 1977). A small, disjunct population occurs at the Bill Williams river delta (Rosenberg and others 1991). As opposed to the eastern black rail, this subspecies is apparently nonmigratory (Flores and Eddleman 1991, Repking and Ohmart 1977).

Ecology: Flores and Eddleman's (1991) study at Mittry Lake provides the bulk of our knowledge of the ecology of the California Black Rail in Arizona. This study showed the nesting period to be from late March to late July. Nests are generally constructed of cattails and are consistently placed in shallow water areas with < 25% of the substrate covered with water. Nest success was high at Mittry Lake and evidence of double brooding was found, indicating a high reproductive potential. Recaptures of juveniles was low, an indication of either high juvenile predation or post juvenile dispersal. Adult mortality is apparently low. In contrast to eastern black rails which are presumed to be active at night, California Black Rails are essentially diurnal. They eat a wide variety of invertebrates including beetles, earwigs, grasshoppers, and snails, as well as bulrush and cattail seeds. Home ranges are small, averaging about 0.50 ha (1.25 ac) for males and 0.44 ha (1.0 ac) for females, demonstrating a high degree of site fidelity.

Habitat Requirements: Todd (1977) states that the black rail is a bird of the wet meadows, and this may best describe the habitats preferred by the California Black Rail along the Colorado River. They nest in areas with high stem densities and canopy coverage in shallow water (< 3cm) close to shorelines (Flores and Eddleman 1995). Such areas are typically dominated by finer stemmed emergent vegetation such as California and three-square bulrushes, rushes, and grasses (Flores and Eddleman 1991, Repking and Ohmart 1977, Todd 1977). Cattails are commonly used but in less proportion than their availability (Flores and Eddleman 1991). Preference for shallow water makes black rails more vulnerable to water level increases than other rails and restricts them to marshes with stable water levels.

Habitat and/or Population Objectives:

Population Objective

1. Protect and maintain existing populations along the lower Colorado River, south of the Bill Williams River delta.
2. Increase population numbers to at least 100 to 200 pairs in Arizona and adjacent lands in California.

Habitat Strategy

1. Maintain current suitable habitat and hydrology at appropriate locations within Imperial National Wildlife Refuge and at Mittry Lake.
2. Create additional suitable habitat which includes three square and California bulrush and cattails and maintain water levels within this habitat at a few centimeters (<3), covering about 10% of the ground, at select locations such as Cibola and Imperial National Wildlife Refuges.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Loss and degradation of habitat is the primary threat faced by the California Black Rail (Evens and others 1991). In Arizona, the black rail's extremely limited distribution makes it particularly vulnerable to these threats. Fortunately, containment of almost all its entire known distribution in Arizona within Imperial and Bill Williams River National Wildlife Refuges and Mittry Lake Wildlife Area affords a large measure of protection to its habitats. However, they still remain vulnerable to accidental or uncontrollable water level fluctuations, dredging operations, canal lining (to prevent seepage), and wildfire (Todd 1980). Consideration of the specific habitat requirements of this species should be given high priority when evaluating the potential impacts of proposed projects. Creation of habitats that would be maintained as moist soil or shallow water units would be highly beneficial to black rails (Flores and Eddleman 1991), and should be pursued. Restoration of old river meanders at Cibola National Wildlife Refuge affords such opportunities, and is being considered. The black rail's apparent high level of productivity and juvenile dispersal may enable relatively quick colonization of new habitats. No comprehensive survey for black rails has been conducted in Arizona since 1974, and our knowledge of this species' status, trends, and distribution is critically out-of-date. A survey of habitats along the lower Colorado River, including Mexico, should be given high priority. Research should be directed towards obtaining additional information on black rail nesting biology and productivity and on the long-term effects of selenium (Flores and Eddleman 1991).

California Black Rail management issues are listed in italics. Below each issue are the Arizona Partners in Flight Conservation Recommendations.

Water Management

1. *Maintain hydrology of current occupied habitat, beware of ground water pumping in area.*
2. Consider water control structures in areas with potential habitats.

3. Avoid dredging in existing or potential California Black Rail habitat and limit effects to current or potential rail habitat during dredging projects.
4. Discourage efforts to line canals where seepage has created Black Rail habitat.
5. Target Cibola NWR as possible habitat creation.

Implementation Opportunities

1. Coordinate with Cibola NWR (Island Unit) - "old river meander" project to create habitat for California Black Rail.
2. Include shallow water habitats in management plans.
3. Coordinate with California Fish and Game for additional habitat restoration and creation opportunities along the lower Colorado River.

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research

1. Determine the status and distribution of California Black Rails.
2. Determine the migratory status in United States and Mexican populations.
3. Study the dispersal patterns, if any.
4. Determine if contaminants are a problem and if so, which ones.
5. Develop a standardized survey protocol and conduct surveys along the lower Colorado River on a regular basis.
6. Coordinate with Mexican biologists to evaluate the status and conservation needs of Black Rails near the Colorado River delta.
7. Investigate dispersal patterns of juvenile birds.
8. Evaluate the occurrence of contaminants, particularly selenium, in Black Rails.
9. Investigate Black Rail nesting biology to provide insight into Black Rail productivity and possible long-term population trends.

AMERICAN BITTERN (*Botaurus lentiginosus*)

Associated Species: Other species that may use similar habitat components or respond positively to management for the American Bittern are: Pied-billed Grebe, Virginia Rail, Sora, Common Yellowthroat, Song Sparrow, Yellow-headed Blackbird.

Distribution: The American Bittern's breeding range currently extends from the mid-United States northward into Canada (AOU 1983). Earlier sources report the breeding range as extending farther south (Palmer 1962) and into Mexico (Banks and Dickerman 1978). American Bitterns winter range is limited to the southern coastal plains and wetlands and Mexico (AOU 1983, Root 1988), though earlier sources report the wintering range extending

throughout the southern United States and Mexico (Palmer 1962). Prior to 1915, the American Bittern was reported to nest in along the Mogollon Plateau in northern Arizona (Phillips and others 1964)

Ecology: Varying with latitude, arrival on breeding grounds is generally from March to May (Gibbs and others 1992). In northern Arizona, numbers were noted to increase primarily in late May (Mearns 1890). Nests are lined with grass and built on trampled mats of sedge, reeds or cattail (Bent 1926) surrounded by dense stands of emergent vegetation (Gibbs and others 1992). Depending on latitude, migration to wintering grounds may be from early spring to late fall (Gibbs and others 1992). American Bitterns have not been documented as nesting in Arizona since 1915 (Phillips and others 1964). Several factors may have contributed to creating and eradicating a breeding population in Arizona. Lake Mormon, the largest natural body of water in Arizona, was originally only a moist meadow centered by a sink. It became a lake after the introduction of cattle caused the area to silt in the sink. The lake continued to grow into the mid 1900's, developing vast stands of cattails and attracting many recreationists and egg-collectors (Brown 1994, Fleming 1959, Phillips and others 1964). In the 1950s, subnormal winter precipitation caused the lake to dry up (Fleming 1959). Since the 1960s, the water level has fluctuated widely and deterred the re-establishment of many aquatic plants (Fleming 1959, Brown 1985).

Habitat Requirements: In Arizona, the American Bittern was known to nest in marsh areas along the Mogollon Rim. Preferred marshes are large (Brown and Dinsmore 1986), characterized by shallow water and large expanses of tall emergent vegetation such as cattail, bulrush and smartweed (Manci and Rusch 1988, Rosenberg and others 1991). In comparison to the Least Bittern, the American Bittern utilizes a wider variety of emergent vegetation compositions that are less dense (Gibbs and others 1992).

Habitat and/or Population Objectives:

Population Objective

1. We are refraining from setting population objectives for American Bitterns at this time due to the uncertainty about the amount of adequate habitat left to sustain them. We will reevaluate the need for a population objective in subsequent versions of this plan after habitat strategies have been established.

Habitat Strategy

1. Create and maintain at least 10 marsh habitat areas > 10 ha (25 ac) in size with dense growth of cattail and bulrush, and water levels < 10 cm (4 in), evenly distributed in the White Mountains and above the Mogollon Rim.

IMPLEMENTATION RECOMMENDATIONS AND OPPORTUNITIES

Management Issues with Conservation Recommendations

Very little is known about the biology/ecology of the American Bittern. Management recommendations, therefore, are largely based on studies of similar bittern species. The decline and continent-wide northward shrinking of the bittern's breeding range is largely attributed to habitat degradation, hunting, and water contaminants such as acid precipitation (Gibbs and othes 1992), siltation and eutrophication. Plans to improve habitat at Mormon Lake include rotational grazing timed for waterfowl nesting seasons (Brown 1985). It is unlikely, however, that the American Bittern will return to nest in Arizona until water levels at Mormon Lake allow for the re-growth of the noted vast stands of emergent vegetation (Phillips and others 1964) and other robust emergents, and shallow water is maintained to support this vegetation.

American Bittern management issues are listed in italics. Below each issue are Arizona Partners in Flight Conservation Recommendations.

Habitat Loss

1. Develop and implement habitat management practices that support bitterns; maintaining freshwater wetlands > 10 ha (2.5 ac) (Brown and Dinsmore 1986) and supporting state and national wildlife refuges where the highest concentrations of bitterns breed and winter.

Water Quality

1. Protect freshwater marsh areas from chemical contaminants and manage to control siltation and eutrophication.
2. Maintain shallow water levels (< 10 cm (4 in)) in freshwater marshes.

Implementation Opportunities

1. Coordinate with refuges managers, Bureau of Reclamation biologists, land managers etc. to better manage for American Bittern.
5. Work with wastewater plant managers to plan for American Bittern management (create ponds and habitat adjacent to flood plain).

EVALUATION OF ASSUMPTIONS: RESEARCH AND MONITORING

Recommended Research: (from the BNA account: Gibbs and others 1992)

1. Develop standardized survey methods for monitoring bittern populations and habitat availability.
2. Basic breeding biology of bitterns including: diet, home range, habitat requirements, mating systems, mortality rates and dispersal.
3. Identify migration routes, stopover sites, and wintering areas.
4. Monitor contaminant levels in birds and their eggs throughout their range (Gibbs and others 1992).

3. Coordination of Recommendations and Opportunities in Freshwater Marshes

Freshwater marshes are not numerous in Arizona, nor are all of them natural systems. Despite that fact, they provide essential habitat to an important group of bird species. The Yuma Clapper Rail, California Black Rail, and American Bittern depend on specific characteristics of freshwater marsh habitat to exist. Habitat loss, water quality, and water management are the primary concerns for all three freshwater marsh priority species listed above.

Human activities have both destroyed and created marsh habitat in Arizona. In the higher elevation marshes of the White Mountains and San Francisco Plateau, loss and degradation of marsh habitat has been caused primarily from grazing of ungulates in the marshes, irrigation drawdowns, and recreational disturbance. In southeastern Arizona and along the Lower Colorado River Valley, loss of marsh habitat has been attributed to annual flooding of marshes, groundwater pumping, and dredging and straightening of river banks. Boating, pollutants, grazing, and wildfire also pose threats to marshes in these areas. Some argue, however, that annual flooding created and rejuvenated large expanses of marsh habitat within the floodplain. Ungulate grazing should be eliminated in marsh habitat. Limiting recreational activities in known nesting areas of priority species should be implemented. Dredging of existing or potential priority species habitat is discouraged.

Marsh habitat creation and improvement are essential management actions needed to support marsh species in Arizona. All three priority species would benefit from creation and restoration of marsh habitat. The American Bittern no longer exists in Arizona as a result of habitat loss and is in need of aggressive marsh management across its breeding range to increase current population numbers. Projects providing essential marsh habitat and maintaining known breeding habitat for all three priority species are encouraged. Creation of habitat in protected areas, such as the Cibola NWR, is recommended.

Creation of marsh habitat must be combined with proper management of water levels to be suitable for marsh birds. All three priority birds require very low levels of water (usually < 10 cm) and are negatively affected if water fluctuation occurs too quickly, especially during the nesting season

(usually April-June). Both groundwater pumping and flooding of marsh areas can be detrimental to marsh nesting birds and are discouraged. Conflicts with waterfowl management are possible in shared habitats and coordination with waterfowl management groups is recommended.

Table 24. Freshwater Marsh Priority Species and Habitat Needs

Priority Species	Vegetation Composition	Vegetation Structure	Abiotic Factors	Landscape Factors
Yuma Clapper Rail	-primarily cattail, <i>Ludvegia</i> sp., some bulrush	-mosaic/uneven-aged, dense marsh vegetation interspersed with open water of varying depths (see LCR biological opinion and C. Conway 1995) -dense cattail w/ dry hummocks, dry edges for nesting, >30 stems/m	-elevation: primarily <305m (1000 ft), locally populations up to 1065 m (3500 ft) -need low fluctuation of water, esp. during the nesting season.	-large continuous marsh 7.6 to 43 ha (18.5-105 ac) Tacha and Brawn, Rosenberg and others) -maybe found nesting locally in marshes. -primarily found in areas with shallow water with moist soils and edges. -all stages of marsh important for species.
California Black Rail	-California bulrush, three-square bulrush, cattail -significantly higher stem density of California bulrush, 3-square bulrush, and cattails.	-large mats of three-square bulrush w/ stable water levels at about 3 cm (1.2 in), covering 10% of the ground (Rosenburg and others) -dense stands of short rush spp.	-elevation <500 ft -water depth <2.5 cm (1 in) with 10-25 % of substrate cover with water. -gentle sloping shoreline w/ cover -non-flowing water (from seepage)	-territory size is estimated to be >0.4 ha/pair (1 ac) (Eddleman pers. comm.), usually non-linear in shape -significantly closer to edge. -can not tolerate water fluctuations, unless near adequate cover (Eddleman)
American Bittern	-cattail, bulrush -primarily tall, emergent vegetation	-high cover-water matrix -dense stands of cattail and bulrush -may nest in upland vegetation around marsh basin	-prefer water depths <10 cm (4 in) -prefer moist soil edges with varying densities of vegetation. -exclusively freshwater habitats	-use a wide variety of wetland cover-types -will use less densely vegetated sites -prefer larger wetlands usually > 4 ha (10 ac) but will occur in smaller ones.

Table 25. Special Factors for Freshwater Marsh Priority Species

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Priority Species	Special Factors
Yuma Clapper Rail	-primarily crayfish eaters (which is an introduced species) -possible disturbance from boaters and Jetskiers -range seems to be expanding north
California Black Rail	-switches diet from mostly invertebrates in nesting season (spiders, beetles, ants, leafhoppers, snails) to seeds of bulrush and cattail in winter. Body mass severely reduced in winter; bird more vulnerable at this time. -very limited distribution for species (15 miles of Colorado River between Mittery Lake and Imperial NWR., San Francisco Bay area -high potential productivity but populations are limited by available habitat. -In AZ, predation rate is low to none compared to other populations where predation rate is high.
American Bittern	-when foraging, avoids even aged stands of older, dense, or dry vegetation (Gibbs and others 1992) -mostly asocial, but may migrate in small groups -when alarmed, will stand with bill towards sky, wings tucked in and sway with the breeze to blend in with surrounding vegetation. -rarely perch in trees like other herons do -chicks fed regurgitated food -nest kept dirtied with food particles and excrement

Q. Open Water

1. Habitat Description, Status and Importance

Excluding areas associated with marshes, significant areas of open water in Arizona were originally confined to the mainstream portions of the Colorado River. Currently, this habitat classification would also include 5 major reservoirs on the Colorado River, 8 on the Gila River and its tributaries, and a number of smaller reservoirs scattered about the state.

While comprising a vast amount of area, most reservoirs receive little use by birds. This probably results from their excessive depths, steep shorelines, extreme fluctuations in water levels, and disturbance from recreationalists. Use in most areas is from migrant and wintering waterfowl, primarily for resting and as refuge from hunting. But, open water areas in Arizona are important to several other species of birds including: loons, grebes, cormorants, phalaropes, swallows, gulls and terns. Even resident and migrating Peregrine Falcons will often forage in areas near open water. Reservoirs of small to moderate size tend to be of the most value to ducks (Brown 1982), and some of the highest densities may be found on urban lakes in the winter.

Perhaps because of their location along a migration corridor and their proximity to marsh and oceanic habitats, reservoirs along the lower Colorado River receive more bird use than reservoirs elsewhere in the state. Rosenberg and others (1991) believed that the value of the lower Colorado River to waterbirds, particularly those associated with deep-water habitats, has increased since river management began. Moderation of water flows and creation of reservoirs have resulted in permanent areas of open water where originally such areas were of limited extent and less stable. Particularly common on reservoirs and along the mainstream are common loons, Western and Clark's Grebes, American Wigeons, Buffleheads, Common Goldeneyes, Common Mergansers, and Ring-billed Gulls. Most of these species apparently find the food resources they need in open water areas to sustain themselves largely within this habitat. Rosenberg and others (1991) note "The almost annual occurrence of rare ducks (e.g. scoters, Oldsquaws, and Barrow's Goldeneye), Jaegers, Sabine's Gulls, and other typically oceanic species is associated with the formation of large lakes and deep channels... Waterbirds dispersing from the Gulf of California, such as blue-footed and brown boobies, brown pelicans, and magnificent frigatebirds, also are attracted to these large bodies of water."

Channelized segments of the Colorado River receive little use by birds, and increased pressure to channelize more of the river because of recent flooding would adversely affect many species. Competition for space with recreationalists and increased development of recreation areas pose additional threats to birds in open water habitats (Rosenberg and others 1991).

R. *Alpine*

1. Habitat Description, Status, and Importance

In the southwestern United States, alpine tundra is usually found in small summit areas above timberline (Pase 1994). Alpine tundra vegetation consists primarily of low-growing woody shrubs, herbaceous plants, lichens, and mosses, which are all adapted to a brief growing season. Each year, all of these plant, and animal, forms are subjected to a variety of severe environmental conditions including below freezing temperatures, physiological drought, and intense sunlight. Other environmental factors include strong ground wind forces and avalanche (Lowe 1964).

According to Pase (1994), the only well-developed alpine tundra in Arizona occurs on San Francisco Mountain north of Flagstaff. However, he also noted that the summit of Mount Baldy in the White Mountains contains a small area of alpine grassland. These two areas are quite isolated, not only from each other, but also from the nearest alpine areas in the Rocky Mountains, which are several hundred kilometers away.

San Francisco Mountain (which is often commonly referred to as the San Francisco Peaks) contains approximately 5 km² of alpine habitat above its timberline which is at approximately 3500 m (11,485 ft) (Pase 1994). This alpine area consists of three major habitat types. One, alpine meadow, contains developed soil that can support a variety of vascular plants. Another, boulder field, contains a mixture of large, layered, and overlapping rock in smaller rocks that provides some protection for vascular plants. Talus, the third type, contains little developed soil and less protection from exposure, and, thus, few vascular plants. At the lower border with the subalpine forest, the alpine zone can contain fingers or islands of bristlecone pine (*Pinus aristata*), corkbark fir (*Abies lasiocarpa* var. *arizonica*), and Engelmann spruce (*Picea engelmanni*).

Alpine meadows in Arizona occupy a small portion of alpine habitat and they are relatively dry compared to alpine habitat of other locations (Lowe 1964). Most of the vascular plants of alpine habitat are found in alpine meadows. Golden avens (*Geum turbinatum*) is the dominant plant in the *Geum-Carex* association which is the most prevalent association in the alpine meadow habitat. However, other mat forming plants also occur in alpine meadows. Several other forbs, sedges, and grasses occur in these meadows.

Boulder fields contain most of the shrubs occurring in alpine habitat (Pase 1994). The most common is gooseberry currant (*Ribes montigenum*) and more rare is bearberry honeysuckle (*Lonicera involucrata*). A few forbs, grasses, and sedges also occur in the boulder fields, but not to the extent of the alpine meadows.

Talus contains a variety of lichens, such as *Rhizocarpon geographicum*, and mosses (Lowe 1964; Pase 1994). Vascular plants are represented much less than in alpine meadows and boulder fields. According to Pase (1994), only two vertebrates, the American Pipit (*Anthus spinoletta alticola*) and the deer mouse (*Peromyscus maniculatus*) are known to breed in alpine habitat in Arizona. Lowe (1964) reported that the American Pipit nests in the alpine meadow habitat and specifically indicated that the nesting also occurs in what he referred to as "alpine quasi-tundra" on Mount Baldy. Phillips and others (1964) reported records of water pipits from the "top of the White Mountains" in Arizona from July to October 9.

Probably largely due to its isolation, remoteness, and lack of extractable resources, alpine habitat in Arizona has received relatively few impacts from human activity. However, recreation probably represents the greatest current threat to this habitat, and impacts from this human activity have occurred. For example, portions of the San Francisco Peaks are closed to human recreation use to protect the threatened San Francisco Peaks groundsel (*Senecio franciscanus*).

S. Cliff/Rock/Bare Ground

1. Habitat Description, Status and Importance

Towering stone monuments that seem to reach the sky surrounded by a vast sea of open space, typifies a picture of the Southwest. Arizona is home to much of this habitat, and at first glance may appear to have little or no wildlife value at all. Large cliff areas and rocky hills and outcroppings are actually important nesting and roosting sites for a number of Arizona's bird species.

The natural ledges and crevices in cliff faces provide many raptor species with safe nest sites away from most predators. Natural caves and overhangs provide birds with climatic relief from the scorching Arizona sun. Two falcon species, Prairie Falcon and Peregrine Falcon, depend on Arizona's numerous cliffs and rock outcroppings for their nest sites. These steep structures provide vantage points for locating prey as well as top-of-the-world roosting sites. Cliff faces are shared with Common Ravens, Golden Eagles, Turkey Vultures, Black Vultures and California Condors, and where adjacent to water, Bald Eagles and Cliff Swallows.

Rock outcroppings, talus slopes and open ridges also provide important nesting and roosting habitat for some of Arizona's passerine species. Rock Wren, as their name implies, can frequently be seen hopping about rocky hillsides in search of insects or seeking out natural cavities for nesting. The unmistakable descending whistle of the Canyon Wren echoing in the steep walled canyons of the West assures us we are in a place of beauty. Like the Rock Wren, Canyon Wrens spend most of their time scurrying around rocky cliffs in search of insects, or selecting a natural cave or crevice to hide their nest in. These cool havens are also home to the fastest swift in North

America, the White-throated Swift. But you're not likely to see their feather-filled nests, as they are tucked deep in a rocky crevice safe from harm. On the rocky and talus slopes of semi-arid and arid regions, Common Poorwill conceal their eggs in a scrape on the ground, barely visible among the surrounding rocks. Other species that live and nest among the rocks are Chukar and in higher elevation areas above timberline, the hardy American Pipit.

The bare or sparsely vegetated areas as well as fallow fields in agricultural areas, support some of Arizona's common and not-so-common bird species. The well-known cry of the killdeer can be heard at the edge of town in fallow fields as well as in the heart of urban areas. Usually associated with open space, this ground-nesting species often seeks out habitat with scattered rocks to help camouflage their buff-colored eggs. Another bare ground species that was recently confirmed as an Arizona breeding species (ABBA unpubl. data) is the Mountain Plover. Although they breed in sparse grassland, and are frequently associated with heavily grazed areas, they winter in fallow agriculture fields and bare ground areas in southern Arizona. Other species associated with barren lands of Arizona are the Horned Lark and Burrowing Owl. Horned Larks are sometimes one of the only species seen in these areas, nesting on the ground in a shallow depression. They survive on spiders, snails and grass seeds. Burrowing Owls also inhabit these areas and are frequently associated with ground squirrels, burrows and prairie dog towns. Decline of prairie dog populations has contributed to the decline of Burrowing Owls. In Winter, American Pipits, Vesper Sparrows and McCown's Longspurs are frequently observed foraging in open and bare areas of Arizona.

T. Urban/Agriculture

1. Habitat Description, Status and Importance

In an arid state such as Arizona, agricultural land and urban areas provide breeding, migrating, and/or wintering birds with food, cover, and/or water that historically only existed locally along riparian corridors and temporary ponds and playas. However, since the majority of this habitat is artificial, it would be incorrect to list priority species even though some bird species may now prefer it, especially during the winter.

Relatively large numbers of migratory raptors winter in Arizona, with many species concentrating in agricultural areas. Ferruginous Hawks, Prairie Falcons, and Northern Harriers are common winter visitors to irrigated and fallow fields. The majority of wintering populations of Mountain Plovers in Arizona are found in fallow fields or sod farms. Chestnut-collared and McCown's Longspurs are frequent winter visitors to cut or fallow agricultural land in southeastern Arizona. Alfalfa fields appear to be a favorite wintering locality for Short-eared Owls in the state. The largest wintering populations of Sandhill Cranes in the state extensively use agricultural fields for feeding and resting. Some of the most abundant wintering bird species in agricultural areas are sparrows (Vesper, Savannah, and White-crowned), blackbirds (Yellow-headed, Brewer's, and Red-winged), Horned Larks, American Pipits, and Western Meadowlarks.

Agricultural land is used much less by birds during the breeding season. However, some of our highest concentrations of Burrowing Owls in the state are along field edges, as well as, ditch and canal burms. Irrigated alfalfa and grain fields are used extensively for nesting by Red-winged Blackbirds. Fallow fields are frequently used by nesting Horned Larks and Western Meadowlarks. Irrigations run-off ponds provide nesting habitat for locally breeding American Avocet and Black-necked Stilts. During spring and fall, irrigated farm fields and irrigation run-off ponds support large numbers of migrating shorebirds, ducks, and White-faced Ibis.

Probably the biggest threat to the long-term productivity of Arizona's agricultural lands lies in the increased pressure upon prime lands from residential and commercial development. As Arizona's human populations grow, land prices will continue to grow as well. Simple economics will make it more difficult for a farmer to stay on his land in the face of increasingly lucrative offers to sell and subdivide. While efforts to make housing developments more "wildlife friendly" are commendable and worth continuing, the overall loss of land potential can never be completely mitigated.

Loss of native habitat to urbanization is an ever increasing sight in Arizona. However, there are a few "urban" birds that greatly benefit from this switch. Increased urbanization during the last century has allowed the Inca Dove and Great-tailed Grackle to move into Arizona and become some of the most abundant birds in cities and towns. Even high-rise buildings often support a few

migrating and wintering Prairie and Peregrine Falcons where they frequently prey on the urban Rock Doves. Urban areas bring with it shade trees and shrubs (many that are exotic to Arizona); additional availability of open water such as canals, lakes, and large wastewater ponds; and irrigated grassy parks and golf courses. Most of these habitats seasonally attract birds.

In an arid regions, urban shade tree and shrubs are used commonly by migrating and wintering passerines, which subsequently attract Cooper's and Sharp-shinned Hawks. Locally, Harris's and Cooper's Hawks are some of the most common nesting raptors in urban settings in Arizona. Open water, especially at urban lakes and wastewater ponds attract large numbers of migrating and wintering waterfowl, shorebirds, ibis, herons, and egrets. These same water bodies are locally favored for nesting by Black-bellied Whistling-Ducks, Killdeer, American Avocet, and Black-necked Stilts. The construction of bridges and underpasses has allowed Cliff Swallows and locally Barn Swallows to become common to abundant urban breeding birds. With its exotic trees, shrubs, and flowers and the introduction of hummingbird feeders, urban areas support the largest densities of resident Anna's Hummingbirds in the state. Until the early 1960's, Anna's Hummingbirds were only winter visitors to Arizona

VI. PUBLIC AWARENESS AND EDUCATION

This plan will only be effective if we can reach the appropriate audiences and if they use the information gathered here. Although this plan is written primarily for land owners and managers, the Partners in Flight message about bird conservation can be presented to a much broader audience. In this section, we identify target audiences and ways to reach them to convey our messages. The Information and Education Subcommittee of the Arizona Partners in Flight working group has identified an overall goal with some basic messages that we would like to convey. We will use this goal and these messages, through various programs and projects, to inform not only land managers about bird conservation, but also the general public, government officials and educators. The goals and objectives identified previously will remain in place but will be continuously modified as we accomplish tasks identified in our subcommittee meetings.

Arizona Partners in Flight Information and Education Goal:

To support, encourage, and or develop attitudes and behaviors that support/promote the conservation of native bird populations, especially those declining, and the habitats upon which they depend.

Themes and Messages that support the Arizona Partners in Flight Goal:

1. *Birds are intrinsically worth conserving.*

Messages: For people, birds are worth conserving for recreation (bird watching), economic gain, cultural traditions, aesthetic beauty and consumption. For the ecosystem, birds are worth conserving because they are indicators of habitat health, are food web participants and contribute to world-wide diversity.

2. *Each bird population depends on habitat.*

Messages: A diversity of native habitats is necessary to maintain a diversity of native birds. Some species are habitat generalists, some are habitat specialists and some have specific and multiple seasonal needs (breeding, migration, and wintering).

3. *It is our responsibility to take care of habitat.*

Messages: Habitat is necessary for long-term survival, and we ultimately depend on it. Our quality of life may be affected by the quality of our habitats. Because we are the species that has the most capability to positively or negatively affect habitat, we have a moral obligation to conserve it.

Target Audiences

Four groups have been identified as target audiences.

1. Educators/Children, Multi-cultural and multi-lingual.
2. Resource Managers (includes ranchers, foresters, biologists, private landowners)
3. County/City Governments, Chambers of Commerce and Politicians.
4. General Public

A. Goal: Inform and Educate Target Audiences

Objective

1. To identify different ways to get the APIF messages out to each of the target audiences.

EDUCATORS/CHILDREN, MULTI-CULTURAL AND MULTI-LINGUAL AUDIENCE.

Strategy: Use presentations and audio visual technology. Use the existing APIF slideshows and provide training for teachers who want to use it. Have the Heritage Grant Coordinator give APIF slideshow presentation when applicable (i.e. Heritage grants issued to schoolyard habitat projects and environmental education curriculum). APIF members may present slideshow to local Audubon chapters, environmental education resource centers, wildlife rehabilitation groups and other interested groups.

Strategy: Use the latest technology such as web sites, television (Arizona Wildlife Views Series), channel 33 (Spanish speaking), EMG (Educational Management Group) and PBS channels to inform educators about Partners in Flight programs and the status of the Bird Conservation Plan.

Strategy: Use printed materials and displays. Exhibit them at the Arizona Game and Fish Wildlife building and at the State and County Fairs and other special events such as the Mill Avenue Fair, REI, Popular outdoor outfitters, Public Libraries and conservation institutions. Provide materials people can take home such as bookmarks, magnets, etc. Materials available for schools like WILD Kids, Songbird Blues Box, Parking meter fundraiser.

RESOURCE MANAGERS (RANCHERS, FORESTERS, BIOLOGISTS, PRIVATE LANDOWNERS) AUDIENCE.

Strategy: Reach resource managers by writing a letter and sending it out through different mailing lists as well as the internet, with a message about APIF, the Bird Conservation Plan and the goals of the plan. Information will be drawn from a variety of sources; have certain agencies and groups review a draft letter. State how the plan will help avoid species from possibly being listed as threatened and endangered.

Strategy: Disseminate the APIF message through newsletters and scientific publications.

Strategy: Prepare standard talk to be given at Wildlife Society Meetings, ranching conferences.

Strategy: Implement In-Service training and Field Workshop. Organize an annual interagency field workshop about Partners in Flight and bird conservation.

COUNTY/CITY GOVERNMENTS AND POLITICIANS AUDIENCE.

Strategy: Get a list of names and addresses of city council members and county representatives.

Strategy: Develop avenues to get our information to politicians and city council members. Determine methods for dissemination.

Strategy: Create an informational brochure (8-sided) or handbook to be disseminated to county, cities, and politicians. Information to be included in brochure: Goal, themes specific to Arizona, what APIF is doing in the state, convince them that it will not hurt but

instead enhance the economy, maybe highlight a conservation project in a certain habitat for an example, conservation easements, how can this work for them, mention conservation plan. Subheadings for brochure: *Why are birds important?*, *How Can Birds Help Your Community?* (birds can be beneficial to the local economy), *What's Been Done?* (San Pedro, Patagonia) and other success stories, *Why Partners In Flight?*

Strategy: Develop information packets about conservation and ecotourism. Identify the parts of packet and contact possible financial supporters.

GENERAL PUBLIC

Strategy: Cultivate and integrate with media contacts by updating and expanding the PIF television segment and incorporate it into the University of Arizona "The Desert Speaks" program.

Strategy: Coordinate with University radio stations to advertise Partners in Flight message to get students and professors more involved in conservation.

Strategy: Write at least two newspaper articles annually regarding 1. Partners in Flight conservation efforts and 2. International Migratory Bird Day

Strategy: Increase Arizona Partners in Flight presence at annual events by giving Partners in Flight presentations at:

1. Natural History Weekends
2. A.A.L.E annual conference
3. National Watchable Wildlife Conference in Albuquerque in 1998

Strategy: Increase awareness at community leadership clubs/organizations/civic groups

Strategy: Establish Speakers Bureau.

B. Goal: Cultivate and Maintain Partnerships

Objective: To exchange newsletter information.

Strategy: APIF newsletter, send info on APIF to other newsletters: A.A.L.E., FOCUS WILD, Audubon, AZ League of Cons. Voters, AAA, Capitol Times, Env. Groups, People for the West.

Objective: To implement a training exchange.

Strategy: Work with Colorado Bird Observatory to implement Birds Beyond Borders in Arizona.

Objective: To implement a conference and presentation exchange.

Objective: To collaborate on events. - e.g. AGFD and USFWS and White Mtn. Apache

Strategy: In-kind donations: ask businesses to help with food, equipment, etc.

C. Goal: Raise Sufficient Funds to Support our Arizona Partners in Flight Message

Objective: To encourage the public to support Teaming With Wildlife (TWW)/Conservation and Reinvestment Act (CARA).

Strategy: Send letters to legislators, businesses; add TWW/CARA info on our PIF cards.

Strategy: Educate public on TWW/CARA.

Objective: To support full-time interagency coordinator.

Strategy: Work with partners to get a financial commitment on an annual basis to support PIF coordinator.

Objective: To use in-kind volunteer effort to match for external dollars.

Strategy: Contact local utility companies, (Salt River Project (SRP), Arizona Public Service (APS), to print PIF brochures. Incorporate utility company logos on brochure as an incentive.

Objective: To develop funding resources.

Strategy: Distribute funding resource directory developed by the WWG to partners requesting funding information.

Strategy: Contact the Environmental Fund for AZ (website address: learnweb.com/learnweb/azeenet).

Objective: To facilitate international funding sources.

Strategy: Access the Symbiota Directory (directory of international funding)

VII. PROGRESS EVALUATION

Setting population objectives and habitat strategies for priority species provides clear targets with which to measure our progress. The time frame for reaching our objectives will vary depending on several factors including: the condition of the habitat necessary to sustain the priority species, the level of our knowledge about species requirements, and the capability of the land owner or land manager to manage for the species. Conservation recommendations listed with management issues will provide direction for land managers to reach the goals of the habitat strategies. Research questions are generally similar and broad for species with limited information. For those birds that we have more information for, research questions have a narrower focus. All research questions listed in the plan address information gaps that will have direct application to land managers, thus a constant feedback of new information will keep the plan current.

To assist us in achieving our population objectives and habitat strategies, our next step will be to develop an implementation schedule. This will identify the possible parties for specific projects, provide a timeline for when projects should be completed and indicate budget estimates for each project. As the Partners in Flight program moves forward, we will continue to bring on new partners and remain open to new ideas and approaches for better habitat management. In the implementation phase, coordination with other bird conservation groups (i.e. waterfowl, shorebirds, colonial waterbirds) will increase. The formation of area-specific bird partnerships similar to the North American Waterfowl Management Plan Joint Ventures, will likely evolve from this increased coordination. Planning, implementation, and evaluation will remain the most integral parts of this process. We view evaluation as an essential step in the success of the effort. Joined with planning and implementation, evaluation provides the link back to making planning more specific and implementation more effective than before.

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Appendix A Criteria for Prioritizing Arizona's **Breeding** Native Terrestrial Birds

1. **RA - Relative Abundance**

- | | |
|---------------|---|
| 1 - Abundant | Species which can be observed in quantity in their habitat any day in the proper season without any special search |
| 2 - Common | A species which several representatives should be noted daily in appropriate habitat |
| 3 - Uncommon | An uncommon species might require searching in a specially favorable locality with resulting discovery of scattered pairs or isolated small colonies. |
| 4 - Rare | A rare species is not often encountered when looked for but is not considered unusual when it is found. |
| 5 - Very rare | A very rare species is one that might not be encountered except by chance in several days of search. |

2. **ABA - Arizona Abundance** (when present and within preferred habitats)

(same as for Global Abundance)

3. **BD - Breeding Distribution**

1 - Very widespread	76-100% of North America including Mexico
2 - Widespread	51-75% of North America including Mexico
3 - Intermediate	26-50% of North America including Mexico
4 - Local	11-25% of North America including Mexico
5 - Very Local	<1-10% of North America including Mexico

4. **ABD - Arizona Breeding Distribution**

1 - Very widespread	76-100% of Arizona
2 - Widespread	51-75% of Arizona
3 - Intermediate	26-50% of Arizona
4 - Local	11-25% of Arizona
5 - Very Local	<1-10% of Arizona

5. **TB - Threats on Breeding Grounds Rangewide**

1 - No known threat	Habitat increasing or stable, or an ecological generalist.
2 - Minor threat	Habitat loss between 1% and 10%, or a moderate ecological generalist.
3 - Moderate threat	Habitat loss between 11% and 25%, or a moderate ecological specialist.
4 - Extensive threat	Habitat loss between 26% and 50%, or an ecological specialist.
5 - Extirpation likely	Habitat loss between 51% and 100%, or an extreme ecological specialist.

6. **TBA - Threats on Breeding Grounds in Arizona (Based on historic records)**

1 - No known threat	Habitat increasing or stable, or an ecological generalist.
2 - Minor threat	Habitat loss between 1% and 10%, or a moderate ecological generalist.
3 - Moderate threat	Habitat loss between 11% and 25%, or a moderate ecological specialist.
4 - Extensive threat	Habitat loss between 26% and 50%, or an ecological specialist.
5 - Extirpation likely	Habitat loss between 51% and 100%, or an extreme ecological specialist.

7. **TW - Threats on Winter Grounds**

1 - No known threat	Habitat increasing or stable, or an ecological generalist.
2 - Minor threat	Habitat loss between 1% and 10%, or a moderate ecological generalist.
3 - Moderate threat	Habitat loss between 11% and 25%, or a moderate ecological specialist.
4 - Extensive threat	Habitat loss between 26% and 50%, or an ecological specialist.
5 - Extirpation likely	Habitat loss between 51% and 100%, or an extreme ecological specialist.

8. **IA - Importance of Arizona to Each Species**

1 - Very low	<1% of species' total breeding distribution
2 - Low	1-10% of species' total breeding distribution
3 - Moderate	11-25% of species' total breeding distribution
4 - High	26-50% of species' total breeding distribution
5 - Very High	51-100% of species' total breeding distribution

9. **Sum = Total of Criteria Scores**

Appendix B
 Prioritized List of Arizona's **Breeding** Native Terrestrial Birds

Species	RA	ABA	BD	ABD	TB	TBA	TW	IA	Sum
Willow Flycatcher (<i>extimus</i>)	5	5	5	5	5	5	3	5	38.00
Northern Bobwhite (<i>ridgwayi</i>)	5	5	5	5	4	4	4	5	38.00
Western Yellow-billed Cuckoo	4	4	4	4	5	5	5	4	35.00
Southwestern Bald Eagle	4	4	2	5	4	4	4	5	32.00
Cactus Ferruginous Pygmy-Owl	4	5	4	5	4	5	3	2	32.00
Clapper Rail (<i>yumanensis</i>)	2	5	3	5	3	4	4	5	31.00
Yellow Warbler (<i>sonorana</i>)	2	2	5	4	4	4	5	5	31.00
Mexican Spotted Owl	4	4	4	3	4	3	4	4	30.00
Black Rail	4	4	4	5	4	4	4	1	30.00
Northern Goshawk (<i>apache</i>)	4	3	2	3	5	4	3	5	29.00
Ferruginous Hawk	4	4	3	5	4	4	3	2	29.00
Lucy's Warbler	2	2	5	3	4	4	4	5	29.00
Botteri's Sparrow	4	3	4	5	3	4	3	2	28.00
Buff-breasted Flycatcher	4	5	4	5	3	3	3	1	28.00
Mountain Plover	4	5	4	5	4	1	4	1	28.00
Grasshopper Sparrow (<i>ammolegus</i>)	3	2	2	5	4	4	3	5	28.00
Cassin's Sparrow	4	3	4	4	4	4	3	2	28.00
Bobolink	2	5	3	5	4	4	4	1	28.00
Five-striped Sparrow	4	4	5	5	4	2	3	1	28.00
Rufous-winged Sparrow	4	3	5	5	4	2	3	2	28.00
Whip-poor-will (<i>arizonae</i>)	3	3	4	4	3	3	3	4	27.00
Long-billed Curlew	3	5	4	5	3	3	3	1	27.00
Lucifer Hummingbird	3	5	5	5	3	2	3	1	27.00
Veery	2	5	3	5	3	4	4	1	27.00
Swainson's Thrush	3	5	2	5	3	4	4	1	27.00
Le Conte's Thrasher	4	4	5	4	3	1	3	3	27.00
Violet-crowned Hummingbird	3	4	4	5	3	3	3	1	26.00
White-eared Hummingbird	3	5	4	5	4	1	3	1	26.00
Buff-collared Nightjar	3	5	3	5	3	3	3	1	26.00
Gray Hawk	3	4	3	5	3	4	3	1	26.00
Northern Harrier	4	5	1	5	4	2	4	1	26.00
Northern Goshawk (<i>atricapillus</i>)	4	3	2	3	4	4	3	3	26.00
Thick-billed Kingbird	3	4	4	5	3	3	3	1	26.00

Species	RA	ABA	BD	ABD	TB	TBA	TW	IA	Sum
Red-faced Warbler	3	3	4	3	3	3	3	4	26.00
Gray Vireo	3	3	4	3	3	3	3	4	26.00
Bendire's Thrasher	3	2	5	3	3	2	3	5	26.00
Green-tailed Towhee	3	3	3	4	3	4	3	2	25.00
Abert's Towhee	2	2	5	3	3	2	3	5	25.00
Arizona Woodpecker	3	3	4	5	3	1	3	3	25.00
Elegant Trogon	3	4	3	5	3	3	3	1	25.00
Costa's Hummingbird	3	2	5	3	3	2	3	4	25.00
Mississippi Kite	3	4	3	5	3	3	3	1	25.00
Marsh Wren (<i>aestuarinus</i>)	2	2	2	5	3	3	4	4	25.00
Eastern Meadowlark (<i>liliana</i>)	1	2	3	3	4	4	3	5	25.00
Gilded Flicker	3	2	4	3	3	2	3	5	25.00
Purple Martin (<i>hisperia</i>)	2	2	2	4	4	3	3	5	25.00
Bell's Vireo (<i>arizonae</i>)	3	2	3	3	3	3	3	5	25.00
MacGillivray's Warbler	3	4	3	4	2	4	3	2	25.00
American Redstart	2	5	2	5	3	4	3	1	25.00
Rose-throated Becard	3	5	3	5	3	2	3	1	25.00
Gray Flycatcher	3	3	4	3	3	3	3	3	25.00
Hammond's Flycatcher	2	5	3	5	3	3	3	1	25.00
Dusky Flycatcher	2	4	3	4	3	3	3	2	24.00
Three-toed Woodpecker	4	4	1	5	3	3	3	1	24.00
Williamson's Sapsucker	3	3	4	3	3	3	3	2	24.00
Lewis' Woodpecker	2	3	4	4	4	2	3	2	24.00
Elf Owl (<i>whitneyi</i>)	3	2	4	3	3	2	3	4	24.00
Burrowing Owl	4	4	1	3	4	3	3	2	24.00
Common Black-Hawk	4	3	3	4	3	3	3	1	24.00
Red-naped Sapsucker	2	3	4	3	3	3	4	2	24.00
Sage Sparrow	3	3	4	4	3	2	3	2	24.00
Olive Warbler	3	3	3	4	3	3	3	2	24.00
Sulphur-bellied Flycatcher	3	3	3	5	3	2	4	1	24.00
Gray Catbird	2	4	2	5	3	4	3	1	24.00
Hooded Oriole	2	3	3	3	3	4	3	2	23.00
Greater Pewee	3	3	3	4	3	3	3	1	23.00
Olive-sided Flycatcher	3	4	1	4	3	3	4	1	23.00
Green Kingfisher	3	5	2	5	2	3	2	1	23.00
Blue-throated Hummingbird	3	3	4	4	3	2	3	1	23.00

Species	RA	ABA	BD	ABD	TB	TBA	TW	IA	Sum
Harris's Hawk (<i>superior</i>)	3	3	2	4	3	3	3	2	23.00
Eastern Bluebird (<i>fulva</i>)	2	3	2	5	2	3	2	4	23.00
Hutton's Vireo	3	2	3	4	3	3	2	3	23.00
Zone-tailed Hawk	4	3	2	3	3	3	3	2	23.00
Virginia's Warbler	2	2	4	3	3	2	3	4	23.00
Townsend's Solitaire	3	3	3	3	3	3	3	2	23.00
Flammulated Owl	3	3	3	3	3	3	3	2	23.00
Northern Beardless-Tyrannulet	3	3	3	4	3	3	3	1	23.00
Plumbeous Vireo	3	2	2	3	3	3	3	3	22.00
Grace's Warbler	3	2	3	3	3	3	3	2	22.00
Painted Redstart	3	2	3	3	3	3	3	2	22.00
Summer Tanager	2	2	3	3	3	4	3	2	22.00
Pyrrhuloxia	3	2	3	4	3	2	3	2	22.00
Varied Bunting	3	3	3	4	3	2	3	1	22.00
Black-chinned Sparrow	3	3	3	3	3	2	3	2	22.00
Yellow-headed Blackbird	2	3	3	4	3	2	3	2	22.00
Pine Grosbeak	3	4	2	5	2	3	2	1	22.00
Pinyon Jay	3	2	3	3	3	2	3	3	22.00
Cordilleran Flycatcher	2	2	4	3	3	3	3	2	22.00
Magnificent Hummingbird	3	3	3	4	3	2	3	1	22.00
Purple Martin (<i>arboricola</i>)	2	2	2	4	3	3	3	3	22.00
Broad-billed Hummingbird	3	2	3	4	3	3	3	1	22.00
Prairie Falcon	3	3	3	2	4	2	3	2	22.00
Osprey	3	4	1	5	3	2	3	1	22.00
Loggerhead Shrike	3	2	2	2	4	3	4	2	22.00
Golden-crowned Kinglet	3	3	3	4	3	3	2	1	22.00
American Dipper	3	3	3	4	3	2	3	1	22.00
Mexican Chickadee	2	3	3	5	3	2	3	1	22.00
Clark's Nutcracker	3	3	3	5	3	1	3	1	22.00
Sage Thrasher	3	3	4	4	2	1	2	2	21.00
American Pipit	2	4	3	5	2	1	3	1	21.00
Orange-crowned Warbler	3	3	2	5	2	3	2	1	21.00
Black-throated Gray Warbler	3	2	3	2	3	3	3	2	21.00
Hepatic Tanager	3	3	1	3	3	3	3	2	21.00
Rufous-crowned Sparrow	3	2	3	3	3	2	3	2	21.00

Species	RA	ABA	BD	ABD	TB	TBA	TW	IA	Sum
Brewer's Sparrow	2	2	3	4	4	2	3	1	21.00
Savannah Sparrow	2	3	1	5	3	3	3	1	21.00
Lincoln's Sparrow	2	3	2	5	2	4	2	1	21.00
Scott's Oriole	3	2	3	2	3	2	3	3	21.00
Cassin's Finch	2	3	3	4	3	3	2	1	21.00
Gila Woodpecker	2	2	4	3	3	2	3	2	21.00
Whiskered Screech-Owl	3	2	3	5	3	1	3	1	21.00
Peregrine Falcon	4	3	1	2	4	2	4	1	21.00
Crested Caracara	3	4	1	5	3	1	3	1	21.00
Sharp-shinned Hawk (<i>velox</i>)	3	3	1	3	4	3	3	1	21.00
Cooper's Hawk	3	3	1	2	4	3	3	2	21.00
Swainson's Hawk	3	3	2	3	3	2	3	2	21.00
Pygmy Nuthatch	2	2	3	3	3	3	3	2	21.00
Black-billed Magpie	2	4	3	5	2	2	2	1	21.00
Tree Swallow	2	4	1	5	3	3	2	1	21.00
Cassin's Kingbird	3	2	3	3	3	2	3	2	21.00
Brown-crested Flycatcher	3	2	2	3	3	3	3	2	21.00
Tropical Kingbird	1	4	2	5	2	3	2	1	20.00
Mountain Bluebird	2	2	3	3	3	2	3	2	20.00
Hermit Thrush	3	2	2	3	3	3	3	1	20.00
Crissal Thrasher	3	2	4	2	3	1	3	2	20.00
Western Tanager	2	2	3	2	3	3	3	2	20.00
Indigo Bunting	1	4	3	4	2	3	2	1	20.00
Red Crossbill	3	3	2	3	2	3	3	1	20.00
Evening Grosbeak	3	3	3	4	2	2	2	1	20.00
Broad-tailed Hummingbird	2	2	3	3	3	2	3	2	20.00
Band-tailed Pigeon	3	3	3	3	2	2	2	2	20.00
Golden Eagle	3	3	2	3	3	3	2	1	20.00
White-tailed Kite	3	4	1	5	2	2	2	1	20.00
Western Bluebird	2	2	3	2	3	3	3	2	20.00
Black-tailed Gnatcatcher	3	2	3	3	3	1	3	2	20.00
Bridled Titmouse	2	2	3	4	3	1	3	2	20.00
Mountain Chickadee	2	2	3	3	3	2	3	2	20.00
Long-eared Owl	3	4	1	4	2	2	3	1	20.00
Cactus Wren	2	2	3	3	3	1	3	2	19.00
Curve-billed Thrasher	3	2	3	3	3	1	3	1	19.00

Species	RA	ABA	BD	ABD	TB	TBA	TW	IA	Sum
Phainopepla	3	1	3	2	3	2	2	3	19.00
Yellow-breasted Chat	2	2	2	3	3	3	3	1	19.00
Black-headed Grosbeak	2	2	3	2	3	3	3	1	19.00
Lazuli Bunting	2	3	3	3	2	3	2	1	19.00
Canyon Towhee	2	2	3	3	3	2	2	2	19.00
Vesper Sparrow	3	3	2	3	2	3	2	1	19.00
Black-throated Sparrow	3	2	3	2	2	2	3	2	19.00
Yellow-eyed Junco	2	2	3	5	2	2	2	1	19.00
Brewer's Blackbird	2	2	3	3	2	3	2	2	19.00
Bullock's Oriole	2	2	2	2	3	3	3	2	19.00
Belted Kingfisher	2	4	1	4	2	3	2	1	19.00
Northern Saw-whet Owl	2	4	2	4	2	2	2	1	19.00
Greater Roadrunner	3	3	2	2	3	1	3	2	19.00
Common Ground-Dove	3	3	2	3	3	1	3	1	19.00
Verdin	2	2	3	3	3	1	3	2	19.00
Gray Jay	3	3	2	5	2	1	2	1	19.00
Dusky-capped Flycatcher	2	2	2	4	3	2	3	1	19.00
Vermilion Flycatcher	3	2	1	3	3	3	2	2	19.00
Acorn Woodpecker	2	2	2	3	3	2	3	2	19.00
Steller's Jay	2	2	3	3	2	2	2	2	18.00
Mexican Jay	3	2	3	4	2	1	2	1	18.00
Red-breasted Nuthatch	2	3	2	4	2	2	2	1	18.00
Bewick's Wren	2	2	3	2	3	1	3	2	18.00
Lark Sparrow	3	2	2	2	3	2	3	1	18.00
Western Meadowlark	1	2	2	2	3	3	3	2	18.00
Bronzed Cowbird	3	3	3	4	1	2	1	1	18.00
Lesser Goldfinch	2	2	3	2	2	3	2	2	18.00
Common Poorwill	3	2	3	2	2	2	3	1	18.00
Northern Pygmy-Owl	2	3	2	3	2	2	2	2	18.00
Barn Owl	3	3	1	2	4	1	3	1	18.00
Inca Dove	3	1	3	4	2	1	2	2	18.00
Ash-throated Flycatcher	2	2	3	2	2	2	2	3	18.00
Black Phoebe	2	2	1	3	3	2	3	2	18.00
Downy Woodpecker	2	4	1	4	2	2	2	1	18.00
Anna's Hummingbird	2	2	4	3	1	2	1	3	18.00

Species	RA	ABA	BD	ABD	TB	TBA	TW	IA	Sum
Black-chinned Hummingbird	2	2	3	2	2	3	2	2	18.00
Ruby-crowned Kinglet	2	2	2	3	2	3	2	1	17.00
Yellow-rumped Warbler	2	2	3	3	2	3	1	1	17.00
Blue Grosbeak	3	2	2	3	2	2	2	1	17.00
White-crowned Sparrow	1	3	2	5	2	2	1	1	17.00
Western Screech-Owl	2	2	3	1	3	1	3	2	17.00
Common Nighthawk	2	3	1	3	3	2	2	1	17.00
White-winged Dove	1	1	3	3	2	3	2	2	17.00
Black Vulture	1	4	1	5	2	1	2	1	17.00
Canyon Wren	2	2	2	2	3	1	3	2	17.00
Brown Creeper	2	2	1	3	2	3	2	2	17.00
Western Kingbird	2	2	3	1	2	2	3	2	17.00
Western Wood-Pewee	2	2	2	2	2	2	3	2	17.00
Ladder-backed Woodpecker	2	2	2	3	2	2	2	2	17.00
Spotted Towhee	1	2	2	2	3	2	2	2	16.00
Northern Rough-winged Swallow	3	2	1	3	2	2	2	1	16.00
Violet-green Swallow	2	1	2	2	2	2	3	2	16.00
Say's Phoebe	3	2	2	2	2	1	3	1	16.00
Hairy Woodpecker	3	2	1	3	2	2	2	1	16.00
Common Yellowthroat	1	2	1	3	3	3	2	1	16.00
Warbling Vireo	2	2	1	3	2	2	3	1	16.00
Blue-gray Gnatcatcher	2	2	2	2	3	2	2	1	16.00
Juniper Titmouse	2	2	3	2	1	1	2	3	16.00
Scrub Jay	2	2	3	2	2	1	2	2	16.00
White-throated Swift	3	1	3	1	2	1	2	2	15.00
House Wren (<i>brunneicollis</i>)	1	2	1	3	3	2	1	2	15.00
Northern Flicker	1	2	2	2	2	3	1	2	15.00
Rock Wren	3	2	2	1	2	1	2	2	15.00
Song Sparrow	1	1	1	3	3	4	1	1	15.00
Pine Siskin	1	2	2	4	1	3	1	1	15.00
Lesser Nighthawk	2	1	2	2	2	2	2	1	14.00
Chihuahuan Raven	2	1	3	4	1	1	1	1	14.00
White-breasted Nuthatch	2	2	1	2	2	2	2	1	14.00
Northern Cardinal	1	2	2	3	2	2	1	1	14.00
Chipping Sparrow	1	2	1	2	2	3	2	1	14.00
Cliff Swallow	2	1	1	3	2	1	2	1	13.00

Species	RA	ABA	BD	ABD	TB	TBA	TW	IA	Sum
Barn Swallow	1	2	1	3	1	2	2	1	13.00
Bushtit	2	2	2	2	2	1	1	1	13.00
Dark-eyed Junco	1	2	1	3	2	2	1	1	13.00
American Crow	1	2	1	4	1	1	1	1	12.00
Killdeer	1	2	1	2	2	2	1	1	12.00
House Wren (<i>parkmanii</i>)	1	2	1	3	1	2	1	1	12.00
American Robin	1	2	1	3	1	2	1	1	12.00
Great-tailed Grackle	2	1	3	2	1	1	1	1	12.00
Northern Mockingbird	2	1	2	1	1	2	1	2	12.00
Red-winged Blackbird	1	1	1	3	2	2	1	1	12.00
American Kestrel	1	2	1	1	2	1	2	1	11.00
Great Horned Owl	2	2	1	1	1	1	1	1	10.00
House Finch	1	1	2	1	1	1	1	2	10.00
Turkey Vulture	1	1	1	1	2	1	2	1	10.00
Red-tailed Hawk	1	2	1	1	1	1	1	1	9.00
Horned Lark	1	2	1	1	1	1	1	1	9.00
Brown-headed Cowbird	1	1	1	1	1	1	1	1	8.00
Common Raven	1	1	1	1	1	1	1	1	8.00
Mourning Dove	1	1	1	1	1	1	1	1	8.00

Categories AB, BD, TB, and TW and their values are based on, Setting Neotropical Migratory Bird Conservation Priorities For States And Physiographic Regions Within The U.S., Bradley and others and Rankings For USFS Southwestern Region, Bradley.

Appendix C
Criteria for Prioritizing Arizona's **Wintering** Native Terrestrial Birds

1. **RA - Relative Abundance**

- | | |
|---------------|---|
| 1 - Abundant | Species which can be observed in quantity in their habitat any day in the proper season without any special search |
| 2 - Common | A species which several representatives should be noted daily in appropriate habitat |
| 3 - Uncommon | An uncommon species might require searching in a specially favorable locality with resulting discovery of scattered pairs or isolated small colonies. |
| 4 - Rare | A rare species is not often encountered when looked for but is not considered unusual when it is found. |
| 5 - Very rare | A very rare species is one that might not be encountered except by chance in several days of search. |

2. **WD - Winter Distribution**

- | | |
|---------------------|--|
| 1 - Very widespread | Southern latitudes of the U.S. through Central America into northern South America; or all of South America |
| 2 - Widespread | Southern latitudes of the U.S. through Central America; or southern Central America into most of South America |
| 3 - Intermediate | Throughout Mexico; the entire Caribbean Basin and Caribbean Slope of Central America and southern Mexico; the Middle American highlands; or the entire Amazon Basin |
| 4 - Local | Caribbean Basin alone; Caribbean slope of Central America; Pacific slope of Middle America; the Mexican highlands; or the Andean Ridge of northern South America |
| 5 - Very Local | Bahamas only; Guatemala, Honduras, and Nicaragua highlands; states of Jalisco, Colima, Michoacan, and Guerrero in Mexico; Southern Sonora and southern Baja California in Mexico |

3. **AWD - Arizona Winter Distribution**

- | | |
|---------------------|--------------------|
| 1 - Very widespread | 76-100% of Arizona |
| 2 - Widespread | 51-75% of Arizona |
| 3 - Intermediate | 26-50% of Arizona |
| 4 - Local | 11-25% of Arizona |
| 5 - Very Local | < 1-10% of Arizona |

4. **TW - Threats on Winter Grounds**

- | | |
|------------------------|---|
| 1 - No known threat | Habitat increasing or stable, or an ecological generalist. |
| 2 - Minor threat | Habitat loss between 1% and 10%, or a moderate ecological generalist. |
| 3 - Moderate threat | Habitat loss between 11% and 25%, or a moderate ecological specialist. |
| 4 - Extensive threat | Habitat loss between 26% and 50%, or an ecological specialist. |
| 5 - Extirpation likely | Habitat loss between 51% and 100%, or an extreme ecological specialist. |

5. **TWA - Threats on Winter Grounds in Arizona**

- | | |
|------------------------|---|
| 1 - No known threat | Habitat increasing or stable, or an ecological generalist. |
| 2 - Minor threat | Habitat loss between 1% and 10%, or a moderate ecological generalist. |
| 3 - Moderate threat | Habitat loss between 11% and 25%, or a moderate ecological specialist. |
| 4 - Extensive threat | Habitat loss between 26% and 50%, or an ecological specialist. |
| 5 - Extirpation likely | Habitat loss between 51% and 100%, or an extreme ecological specialist. |

6. **TG - Threats on Breeding Grounds Rangelwide**

- | | |
|------------------------|---|
| 1 - No known threat | Habitat increasing or stable, or an ecological generalist. |
| 2 - Minor threat | Habitat loss between 1% and 10%, or a moderate ecological generalist. |
| 3 - Moderate threat | Habitat loss between 11% and 25%, or a moderate ecological specialist. |
| 4 - Extensive threat | Habitat loss between 26% and 50%, or an ecological specialist. |
| 5 - Extirpation likely | Habitat loss between 51% and 100%, or an extreme ecological specialist. |

7. **IA - Importance of Arizona to Each Species**

- | | |
|---------------|---|
| 1 - Very low | < 1% of species' total winter distribution |
| 2 - Low | 1-10% of species' total winter distribution |
| 3 - Moderate | 11-25% of species' total winter distribution |
| 4 - High | 26-50% of species' total winter distribution |
| 5 - Very High | 51-100% of species' total winter distribution |

8. **Sum = Total of Criteria Scores**

Species in italics are not considered neotropical migratory birds

Appendix D
 Prioritized List of Arizona's **Wintering** Native Terrestrial Birds

Species	RA	WD	AWD	TW	TWA	TB	IA	Sum
Baird's Sparrow	4	4	5	4	4	4	2	27.00
<i>Ferruginous Pygmy-Owl</i>	4	4	5	3	5	4	1	26.00
<i>Spotted Owl</i>	4	4	3	4	3	4	4	26.00
Sprague's Pipit	4	4	5	3	4	3	2	25.00
Cassin's Sparrow	4	4	5	3	4	4	1	25.00
<i>Rufous-winged Sparrow</i>	4	5	5	3	2	4	2	25.00
McCown's Longspur	3	4	5	4	4	4	1	25.00
Chestnut-collared Longspur	3	4	4	4	4	4	1	24.00
Mountain Plover	4	4	4	4	1	4	2	23.00
Bendire's Thrasher	3	5	2	3	2	3	5	23.00
<i>Le Conte's Thrasher</i>	4	5	4	3	1	3	3	23.00
Black-throated Gray Warbler	3	4	5	3	4	3	1	23.00
<i>Abert's Towhee</i>	2	5	3	3	2	3	5	23.00
<i>Five-striped Sparrow</i>	4	4	5	3	2	4	1	23.00
Ferruginous Hawk	4	3	3	3	2	4	3	22.00
Costa's Hummingbird	3	4	3	3	2	3	4	22.00
Gray Vireo	3	5	5	3	1	3	2	22.00
Grasshopper Sparrow	3	3	4	3	4	4	1	22.00
<i>Bald Eagle</i>	4	2	3	4	2	4	2	21.00
Northern Goshawk	4	2	3	3	3	4	2	21.00
Long-billed Curlew	3	4	5	3	2	3	1	21.00
Burrowing Owl	4	1	4	3	3	4	2	21.00
Blue-throated Hummingbird	3	4	5	3	2	3	1	21.00
Elegant Trogon	3	3	5	3	3	3	1	21.00
Williamson's Sapsucker	3	3	3	3	4	3	2	21.00
<i>Arizona Woodpecker</i>	3	3	5	3	1	3	3	21.00
Gilded Flicker	3	4	2	3	2	3	4	21.00
Northern Beardless-Tyrannulet	3	3	5	3	3	3	1	21.00
Hammond's Flycatcher	2	4	5	3	3	3	1	21.00
Dusky Flycatcher	2	4	5	3	3	3	1	21.00
Gray Flycatcher	3	4	4	3	3	3	1	21.00
Solitary (Plumbeus) Vireo	3	3	5	3	3	3	1	21.00
Olive Warbler	3	3	5	3	3	3	1	21.00
Black-chinned Sparrow	3	4	4	3	2	3	2	21.00
Sage Sparrow	3	4	3	3	2	3	3	21.00

Species	RA	WD	AWD	TW	TWA	TB	IA	Sum
Short-eared Owl	4	1	4	4	2	4	1	20.00
Magnificent Hummingbird	3	3	5	3	2	3	1	20.00
Red-naped Sapsucker	2	3	2	4	4	3	2	20.00
<i>Three-toed Woodpecker</i>	4	1	5	3	3	3	1	20.00
<i>Pinyon Jay</i>	3	3	3	3	2	3	3	20.00
Loggerhead Shrike	3	3	2	4	2	4	2	20.00
Painted Redstart	3	3	5	3	2	3	1	20.00
Eastern (Lilian's) Meadowlark	1	3	3	3	4	4	2	20.00
Purple Finch	3	3	5	2	3	3	1	20.00
Northern Harrier	4	1	2	4	2	4	2	19.00
Cooper's Hawk	3	2	2	3	3	4	2	19.00
Lewis' Woodpecker	2	3	3	3	2	4	2	19.00
<i>Gila Woodpecker</i>	2	4	3	3	2	3	2	19.00
<i>Clark's Nutcracker</i>	3	3	5	3	1	3	1	19.00
<i>Mexican Chickadee</i>	2	3	5	3	2	3	1	19.00
<i>Pygmy Nuthatch</i>	2	3	3	3	3	3	2	19.00
<i>Winter Wren</i>	3	3	5	2	2	3	1	19.00
Marsh Wren	2	2	3	4	2	4	2	19.00
<i>American Dipper</i>	3	3	4	3	2	3	1	19.00
Phainopepla	3	3	3	2	2	3	3	19.00
Northern Shrike	4	2	5	3	1	3	1	19.00
<i>Pyrrhuloxia</i>	3	3	3	3	2	3	2	19.00
Lazuli Bunting	2	4	5	2	3	2	1	19.00
<i>Rufous-crowned Sparrow</i>	3	3	3	3	2	3	2	19.00
Lark Sparrow	3	3	3	3	2	3	2	19.00
Lark Bunting	2	3	3	3	2	4	2	19.00
Swamp Sparrow	3	3	5	2	3	2	1	19.00
Yellow-headed Blackbird	2	3	3	3	2	3	3	19.00
Prairie Falcon	3	2	2	3	2	4	2	18.00
Peregrine Falcon	4	1	2	4	2	4	1	18.00
<i>Mountain Chickadee</i>	2	3	3	3	2	3	2	18.00
<i>Bridled Titmouse</i>	2	3	4	3	1	3	2	18.00
<i>Black-tailed Gnatcatcher</i>	3	3	3	3	1	3	2	18.00
Townsend's Solitaire	3	3	2	3	2	3	2	18.00
<i>Crissal Thrasher</i>	3	4	2	3	1	3	2	18.00
Green-tailed Towhee	3	3	2	3	2	3	2	18.00
Brewer's Sparrow	2	3	2	3	2	4	2	18.00
Black-throated Sparrow	3	3	3	3	2	2	2	18.00

Species	RA	WD	AWD	TW	TWA	TB	IA	Sum
Fox Sparrow	3	2	5	2	3	2	1	18.00
<i>Pine Grosbeak</i>	3	2	5	2	3	2	1	18.00
Osprey	3	1	4	3	2	3	1	17.00
<i>Harris's Hawk</i>	3	2	2	3	2	4	1	17.00
<i>Crested Caracara</i>	3	1	5	3	1	3	1	17.00
Band-tailed Pigeon	3	3	4	2	2	2	1	17.00
<i>Inca Dove</i>	3	3	4	2	1	2	2	17.00
Common Poorwill	3	3	4	3	1	2	1	17.00
<i>Acorn Woodpecker</i>	2	2	3	3	2	3	2	17.00
Yellow-bellied Sapsucker	2	2	5	3	2	2	1	17.00
<i>Black-billed Magpie</i>	2	3	5	2	2	2	1	17.00
<i>Verdin</i>	2	3	3	3	1	3	2	17.00
<i>Cactus Wren</i>	2	3	3	3	1	3	2	17.00
Eastern Bluebird	2	2	5	2	3	2	1	17.00
Western Bluebird	2	3	2	3	2	3	2	17.00
Mountain Bluebird	2	3	2	3	2	3	2	17.00
Sage Thrasher	3	3	3	2	1	2	3	17.00
<i>Curve-billed Thrasher</i>	3	3	3	3	1	3	1	17.00
Orange-crowned Warbler	3	3	3	2	2	2	2	17.00
<i>Canyon Towhee</i>	2	3	3	2	2	3	2	17.00
White-throated Sparrow	2	3	5	1	3	2	1	17.00
<i>Yellow-eyed Junco</i>	2	3	5	2	2	2	1	17.00
<i>Red Crossbill</i>	3	2	3	3	3	2	1	17.00
<i>White-tailed Kite</i>	3	1	5	2	2	2	1	16.00
Sharp-shinned Hawk	3	1	2	3	2	4	1	16.00
Golden Eagle	3	2	2	2	3	3	1	16.00
Merlin	4	2	2	3	2	2	1	16.00
<i>Common Ground-Dove</i>	3	2	3	3	1	3	1	16.00
<i>Greater Roadrunner</i>	3	2	2	3	1	3	2	16.00
Long-eared Owl	3	1	4	3	2	2	1	16.00
Anna's Hummingbird	2	4	3	1	2	1	3	16.00
Green Kingfisher	3	2	4	2	2	2	1	16.00
Vermilion Flycatcher	3	1	4	2	2	3	1	16.00
Ash-throated Flycatcher	2	3	4	2	2	2	1	16.00
Northern Rough-winged Swallow	3	3	4	2	1	2	1	16.00
<i>Gray Jay</i>	3	2	5	2	1	2	1	16.00
<i>Steller's Jay</i>	2	3	3	2	2	2	2	16.00
<i>Mexican Jay</i>	3	3	4	2	1	2	1	16.00

Species	RA	WD	AWD	TW	TWA	TB	IA	Sum
<i>Bewick's Wren</i>	2	3	2	3	1	3	2	16.00
Golden-crowned Kinglet	3	2	3	2	2	3	1	16.00
Blue-gray Gnatcatcher	2	3	3	2	2	3	1	16.00
Hermit Thrush	3	2	2	3	2	3	1	16.00
Savannah Sparrow	2	2	2	3	2	3	2	16.00
Lincoln's Sparrow	2	2	2	2	3	3	2	16.00
Brewer's Blackbird	2	2	3	2	2	2	3	16.00
Cassin's Finch	2	2	3	2	3	3	1	16.00
Lesser Goldfinch	2	3	3	2	2	2	2	16.00
<i>Evening Grosbeak</i>	3	2	4	2	2	2	1	16.00
White-winged Dove	1	3	5	2	1	2	1	15.00
<i>Barn Owl</i>	3	1	2	3	1	4	1	15.00
<i>Western Screech-Owl</i>	2	3	1	3	1	3	2	15.00
<i>Whiskered Screech-Owl</i>	2	3	5	1	1	2	1	15.00
<i>Northern Pygmy-Owl</i>	2	2	3	2	2	2	2	15.00
White-throated Swift	3	3	3	2	1	2	1	15.00
<i>Black Phoebe</i>	2	1	2	3	2	3	2	15.00
Say's Phoebe	3	3	2	3	1	2	1	15.00
Tree Swallow	2	2	4	2	1	3	1	15.00
<i>Plain Titmouse</i>	2	3	2	2	1	2	3	15.00
Rock Wren	3	3	2	2	1	2	2	15.00
Common Yellowthroat	1	2	3	2	3	3	1	15.00
Western Meadowlark	1	2	2	3	2	3	2	15.00
Bronzed Cowbird	3	3	5	1	1	1	1	15.00
<i>Northern Saw-whet Owl</i>	2	2	3	2	2	2	1	14.00
<i>Ladder-backed Woodpecker</i>	2	2	2	2	2	2	2	14.00
<i>Hairy Woodpecker</i>	3	1	3	2	2	2	1	14.00
<i>Scrub Jay</i>	2	3	2	2	1	2	2	14.00
Brown Creeper	2	1	3	2	2	2	2	14.00
Ruby-crowned Kinglet	2	2	2	2	2	2	2	14.00
American Pipit	2	2	3	3	1	2	1	14.00
Cedar Waxwing	2	2	3	2	2	2	1	14.00
Spotted Towhee	1	2	2	2	2	3	2	14.00
Vesper Sparrow	3	2	2	2	2	2	1	14.00
<i>Black Vulture</i>	1	1	5	2	1	2	1	13.00
<i>Downy Woodpecker</i>	2	1	3	2	2	2	1	13.00
<i>Chihuahuan Raven</i>	2	3	4	1	1	1	1	13.00
<i>Red-breasted Nuthatch</i>	2	1	3	2	2	2	1	13.00

Species	RA	WD	AWD	TW	TWA	TB	IA	Sum
<i>Canyon Wren</i>	2	3	2	1	1	2	2	13.00
Yellow-rumped Warbler	2	3	2	1	1	2	2	13.00
Song Sparrow	1	1	3	1	3	3	1	13.00
Belted Kingfisher	2	1	2	2	2	2	1	12.00
<i>White-breasted Nuthatch</i>	2	1	2	2	2	2	1	12.00
Northern Mockingbird	2	2	2	1	2	1	2	12.00
<i>Northern Cardinal</i>	1	2	3	1	2	2	1	12.00
Chipping Sparrow	1	2	2	2	2	2	1	12.00
White-crowned Sparrow	1	2	1	1	2	2	3	12.00
Turkey Vulture	1	1	3	2	1	2	1	11.00
Northern Flicker	1	2	1	1	2	2	2	11.00
<i>American Crow</i>	1	2	4	1	1	1	1	11.00
<i>Bushtit</i>	2	2	2	1	1	2	1	11.00
Red-winged Blackbird	1	1	3	1	2	2	1	11.00
<i>Great-tailed Grackle</i>	2	3	2	1	1	1	1	11.00
American Robin	1	1	2	1	2	1	2	10.00
Brown-headed Cowbird	1	2	3	1	1	1	1	10.00
American Kestrel	1	1	1	2	1	2	1	9.00
Killdeer	1	1	2	1	1	2	1	9.00
House Wren	1	1	2	1	2	1	1	9.00
Dark-eyed Junco	1	1	1	1	2	2	1	9.00
<i>House Finch</i>	1	2	1	1	1	1	2	9.00
Pine Siskin	1	1	2	1	2	1	1	9.00
<i>Great Horned Owl</i>	2	1	1	1	1	1	1	8.00
Red-tailed Hawk	1	1	1	1	1	1	1	7.00
Mourning Dove	1	1	1	1	1	1	1	7.00
Horned Lark	1	1	1	1	1	1	1	7.00
<i>Common Raven</i>	1	1	1	1	1	1	1	7.00

Categories AB, TB, WD, and TW and their values are based on, Setting Neotropical Migratory Bird Conservation Priorities For States And Physiographic Regions Within The U.S., Bradley and others, and Rankings For USFS Southwestern Region, Bradley.

Appendix E
Arizona Partners in Flight Habitat Groups with
Brown, Lowe, and Pase Biotic Community Categories

FORESTS AND WOODLANDS

Spruce-fir - Petran Subalpine Conifer Forest; Subalpine Scrubland
Mixed Conifer - Petran Montan Conifer Forest; Petran Subalpine Conifer Forest
Aspen - Petran Montan Conifer Forest; Petran Subalpine Conifer Forest
Pine - Petran Montane Conifer Forest
Pinyon-Juniper - Great Basin Conifer Forest
Pine-Oak - Madrean Evergreen Woodland; Madrean Montane Conifer Forest

SHRUBLANDS

Desertscrub
1. Mohave - Mohave Desertscrub
2. Sonoran - Sonoran Desertscrub
3. Chihuahuan - Chihuahuan Desertscrub
Cold Desertscrub - Great Basin Desertscrub
Chaparral - Interior Chaparral

GRASSLANDS

Desert Grasslands - Semidesert Grassland; Sonoran savanna Grassland
High Elevation Grasslands- Subalpine Grassland and Montane meadow Grassland; Plains and Great Basin Grassland.

WETLANDS

Riparian Wetlands
1. Forested/Woodland
a. low elevation - Sonoran Riparian Deciduous Forest and Woodland; Sonoran Oasis Forest and Woodland
b. high elevation - Montane Riparian Wetland; Great Basin Riparian Wetland
2. Shrubland - Sonoran Riparian Scrubland, Sonoran Riparian Deciduous Forest and Wetland; Montane Riparian Wetland; Great Basin Riparian Wetland
Other Wetlands
1. Freshwater Marshes - Montane, Plains, and Great Basin Marshland; Sonoran Interior Marshlands and Submergent Communities
2. Open Water - no Biotic Community designation

ALPINE - Alpine Tundra

CLIFF/ROCK/BARE GROUND - no Biotic Community designation

URBAN/AGRICULTURAL - no Biotic Community designation

Appendix F
Scientific and Equivalent Common Names of Plants by Habitat Type.

FORESTS AND WOODLANDS

Spruce-Fir

<u>Scientific Name</u>	<u>Common Name</u>
<i>Abies lasiocarpa</i>	Subalpine fir
<i>Abies lasiocarpa</i> var. <i>arizonica</i>	Corkbark fir
<i>A. concolor</i>	White fir
<i>Berberis repens</i>	Creeping mahonia
<i>Ceanothus fendleri</i>	Fendler ceanothus
<i>Juniperus communis</i>	Dwarf juniper
<i>Picea Engelmanni</i>	Engelmann spruce
<i>Pinus aristata</i>	Bristlecone pine
<i>P. pungens</i>	Blue spruce
<i>Populus tremuloides</i>	Aspen
<i>Potentilla fruticosa</i>	Shrubby cinquefoil
<i>Pseudotsuga menziesii</i>	Douglas fir
<i>Ribes</i> spp.	Currents
<i>Rhus glabra</i>	Smooth sumac
<i>Rubus</i> spp.	Raspberries
<i>Sambucus microbotrys</i>	Red elderberry
<i>Symphoricarpos</i> spp.	Snowberries

Mixed Conifer

<u>Scientific Name</u>	<u>Common Name</u>
<i>Abies concolor</i>	White fir
<i>Abies lasiocarpa</i>	Subalpine fir
<i>Abies lasiocarpa</i> var. <i>arizonica</i>	Corkbark fir
<i>Picea engelmanni</i>	Engelmann spruce
<i>Picea pungens</i>	Blue spruce
<i>Pinus ponderosa</i>	Ponderosa Pine
<i>Pinus strobiformis</i>	Southwestern white pine
<i>Populus tremuloides</i>	Quaking aspen
<i>Pseudotsuga menziesii</i>	Rocky Mountain Douglas-fir
<i>Quercus gambelli</i>	Gambel oak

Aspen

<u>Scientific Name</u>	<u>Common Name</u>
<i>Agropyron spp.</i>	Wheatgrass spp.
<i>Aster spp.</i>	Asters
<i>Bromus spp.</i>	Brome spp.
<i>Erigeron spp.</i>	Fleabanes
<i>Geranium spp.</i>	Geranium
<i>Helenium spp.</i>	Sneezeweed
<i>Iris missouriensis</i>	Rocky Mountain iris
<i>Lathyrus graminifolia</i>	Grassleaf peavine
<i>Lonicera</i>	Honeysuckle spp.
<i>Lupinus spp.</i>	Lupine spp.
<i>Milfoil</i>	Yarrow
<i>Monarda menthaefolia</i>	Mintleaf beebalm
<i>Pinus ponderosa</i>	Ponderosa Pine
<i>P. Contorta</i>	Lodgepole Pine
<i>Poa spp.</i>	Bluegrass spp.
<i>Populous tremuloides</i>	Quaking aspen
<i>Pseudotsuga menziesii</i>	Douglas fir
<i>Pteridium aquilinum</i>	Bracken fern
<i>Ribes spp.</i>	Currants
<i>Ribes spp.</i>	Gooseberry
<i>Rosa Arizona</i>	Arizona rose
<i>Rudbeckia laciniata</i>	Cutleaf coneflower
<i>Solidago missouriensis</i>	Missouri goldenrod
<i>S. sparsiflora</i>	Sparse-flowered goldenrod
<i>Symphoricarpos spp.</i>	Snowberry spp.
<i>Vicia americana</i>	American vetch

Pine

<u>Scientific Name</u>	<u>Common Name</u>
<i>Abies concolor</i>	White fir
<i>Juniperus scopulorum</i>	Rocky Mountain juniper
<i>J. deppeana</i>	Alligator juniper
<i>J. oseoasperma</i>	Utah juniper
<i>Picea pungens</i>	Blue spruce
<i>Pinus strobiformis</i>	Southwestern white pine
<i>Populus tremuloides</i>	Quaking aspen

Pseudotsuga menziesii Rocky Mountain Douglas-fir
Quercus gambelli Gambel oak

Pinyon-Juniper

<u>Scientific Name</u>	<u>Common Name</u>
<i>Artemisia spp.</i>	Sagebrush
<i>Asclepias welshii</i>	Welsh's milkweed
<i>Astragalus cremnophylax var cremnophylax</i>	Sentry milk-vetch
<i>Carex specuicola</i>	Navajo sedge
<i>Cycladenia humilis var jonesii</i>	Jones' cycladenia
<i>Pinus ponderosa</i>	Ponderosa pine
<i>Juniperus spp.</i>	Juniper
<i>J. sopulorum</i>	Rocky Mountain juniper
<i>J. osteosperma</i>	Utah juniper
<i>J. monosperma</i>	One-seed juniper
<i>J. deppeana</i>	Alligatorbark juniper
<i>J. californica</i>	California juniper
<i>Pinus edulis</i>	Rocky Mountain pinyon
<i>P. monophylla</i>	Singleleaf pinyon
<i>P. cembroides</i>	Mexican pinyon

Pine-Oak (Madrean)

<u>Scientific Name</u>	<u>Common Name</u>
<i>Bothriochloa barbinodis</i>	Cane bluestem
<i>Bouteloua curtipendula</i>	Side-oats grama
<i>Elyonurus barbiculmis</i>	Woolspike
<i>Juniperous deppeana</i>	Alligatorbark juniper
<i>Pinus cembroides</i>	Mexican pinyon
<i>P. engelmannii</i>	Apache pine
<i>P. leiophylla var. chihuahuana</i>	Chihuahua pine
<i>P. ponderosa var. arizonica</i>	Arizona ponderosa pine
<i>Quercus arizonica</i>	Arizona white oak
<i>Q. emoryi</i>	Emory Oak
<i>Q. gambelii</i>	Gambel oak
<i>Q. hypoleucoides</i>	Silver-leaf oak
<i>Q. oblongifolia</i>	Mexican blue oak
<i>Q. rugosa</i>	Netleaf oak

SHRUBLANDS

Desertscrub

Mohave Desertscrub

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acamptopappus shockleyi</i>	Goldenhead
<i>Allenrolfea occidentalis</i>	Pickleweed
<i>Atriplex hymenelytra</i>	Desert Holly
<i>Atriplex polycarpa</i>	All-scale
<i>Atriplex confertifolia</i>	Shadscale
<i>Canotia holacantha</i>	Crucifixion Thorn
<i>Cassia armata</i>	Desert Senna
<i>Cercidium floridum</i>	Blue Palo Verde
<i>Coleogyne ramosissima</i>	Blackbrush
<i>Condalia globosa</i>	Bitter Condalia
<i>Coryphantha vivipara</i> var. <i>desertii</i>	-
<i>Echinocactus polycephalus</i>	Many-headed Barrel Cactus
<i>Echinocereus englemanni</i> var. <i>chrysocentrus</i>	Englemann Hedgehog
<i>Encelia farinosa</i>	Brittlebush
<i>Ephedra funerea</i>	-
<i>E. trifurca</i>	Longleaf Ephedra
<i>Grayia spinosa</i>	Spiny Hopsage
<i>Justicia californica</i>	Chuparosa
<i>Hymenoclea salsola</i>	White Burrobush
<i>Larrea tridentata</i>	Creosotebush
<i>Lepidospartum latisquamum</i>	Scalebroom
<i>Lycium andersonii</i>	Anderson thornbush
<i>Menodora spinescens</i>	Spiny Menodora
<i>Neolloydia johnsonii</i>	-
<i>Olneya tesota</i>	Ironwood
<i>O. acanthocarpa</i> var. <i>acanthocarpa</i>	Buckhorn Cholla
<i>Opuntia basilaris</i>	Beavertail Cactus
<i>Opuntia echinocarpa</i>	Silver Cholla
<i>O. erinacea</i>	Mohave Prickly Pear
<i>O. ramosissima</i>	Diamond Cholla
<i>O. stanleyi</i> var. <i>parishii</i>	Parish Cholla
<i>O. whipplea</i> var. <i>multigeniculata</i>	Buckhorn cholla
<i>Prosopis glandulosa</i> var. <i>torreyana</i>	Western Honey Mesquite

<i>Psorothamnus arborescens</i>	Mohave Dalea
<i>P. emoryi</i>	Emory Dalea
<i>P. Fremontii</i>	Fremont Dalea
<i>P. Spinosa</i>	Smoketree
<i>Salazaria mexicana</i>	Paperbag bush
<i>Salvia funerea</i>	Sage spp.
<i>S. mohavensis</i>	Sage spp.
<i>Simmondsia chinensis</i>	Jojoba
<i>Suaeda</i> spp.	Alkali weeds
<i>Yucca brevifolia</i>	Joshua Tree

Sonoran Desertscrub

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acacia greggii</i>	Cat-claw Acacia
<i>Ambrosia dumosa</i>	White Bursage
<i>A. Deltoidea</i>	Triangle-leaf Bursage
<i>Atriplex</i> spp.	Saltbush
<i>Canotia holocantha</i>	Crucifixion Thorn
<i>Carnegiea gigantea</i>	Saguaro
<i>Cercidium microphyllum</i>	Foothill Palo Verde
<i>Echinocactus platyacanthus</i>	Barrel cactus
<i>Encelia farinosa</i>	White Brittlebush
<i>Fouquieria splendens</i>	Ocotillo
<i>Larrea tridentata</i>	Creosotebush
<i>Olneya tesota</i>	Ironwood
<i>Opuntia</i> spp.	Cholla
<i>O. phaeacantha</i>	Prickly Pear
<i>Simmondsia chinensis</i>	Jojoba.

Chihuahuan Desertscrub

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acacia neovernicosa</i>	Whitethorn Acacia
<i>Agave lechuguilla</i>	Lechuguilla
<i>A. falcata</i>	-
<i>Echinocactus platyacanthus</i>	Barrel cactus
<i>Ferocactus pringlei</i>	Pringle Barrel Cactus
<i>Flourensia cernua</i>	Tarbush

<i>Hechtia sp.</i>	-
<i>Larrea tridentata</i>	Creosotebush

Cold Desertscrub

<u>Scientific Name</u>	<u>Common Name</u>
<i>Agropyron sp.</i>	Wheatgrass
<i>Artemisia filifolia</i>	Sand sage
<i>Artemisia nova</i>	Black sage
<i>Artemisia tridentata</i>	Big sage
<i>Atriplex canescens</i>	Fourwing saltbush
<i>A. confertifolia</i>	Shadscale
<i>Bromus tectorum</i>	Cheatgrass
<i>Bouteloua sp.</i>	Gramma grasses
<i>Coleogyne ramosissima</i>	Blackbrush
<i>Hilaria sp.</i>	Galleta grasses
<i>Oryzopsis sp.</i>	Indian Rice Grass
<i>Sarcobatus vermiculatus</i>	Greasewood
<i>Stipa sp.</i>	Needlegrasses

Chaparral

<u>Scientific Name</u>	<u>Common Name</u>
<i>Arctostaphylos pungens</i>	Pointleaf manzanita
<i>Ceanothus spp.</i>	Ceanothus
<i>Cercocarpus montanus</i>	Mountainmohagany
<i>Quercus turbinella</i>	Shrub live oak
<i>Rhamnus spp.</i>	Buckhorn
<i>Rhus trilobata</i>	Sugar sumac
<i>Simmondsia chinensis</i>	Jojoba

GRASSLANDS

Desert Grasslands

Sonoran Savanna Grassland

<u>Scientific Name</u>	<u>Common Name</u>
<i>Aplopappus tenuisectus</i>	Burrowweed
<i>Aristida spp</i>	Three awns
<i>Bouteloua rothrockii</i>	Rothrock Grama

<i>Celtis pallida</i>	Desert Hackberry
<i>Condalia lysiooides</i>	-
<i>Hilaria mutica</i>	Tobosa
<i>Opuntia fulgida</i>	-
<i>Semidesert Grassland</i>	

<u>Scientific Name</u>	<u>Common Name</u>
<i>Bouteloua eriopoda</i>	Black Grama
<i>Fouquieria splendens</i>	Ocotillo
<i>Hilaria berlangeri</i>	Curly Mesquite
<i>Hilaria mutica</i>	Tobosa
<i>Prosopis</i> spp.	Mesquite
<i>Yucca elata</i>	Soaptree Yucca

High Elevation Grasslands

Subalpine-alpine Grasslands/Montane Meadows

<u>Scientific Name</u>	<u>Common Name</u>
<i>Calamagrostis</i> spp.	-
<i>Festuca</i> spp.	Fescues
<i>Poa</i> spp.	Bluegrasses
<i>Muhlenbergia</i> spp.	Muhleys

Plains/Great Basin Grassland

<u>Scientific Name</u>	<u>Common Name</u>
<i>Aristida fendleriana</i>	Three-awn
<i>Artemesia</i> sp.	Sagebrush
<i>Bouteloua gracilis</i>	Blue Grama
<i>B. curtipendula</i>	Side-oats Grama
<i>Buchloe dactyloides</i>	Buffalograss
<i>Chrysothamnus</i> sp.	Rabbitbrush
<i>Ephedra</i> sp.	Mormon-tea
<i>Elymus smithii</i>	Western Wheatgrass
<i>Gutierrezia sarothrae</i>	Snakeweed
<i>Hilaria jamesii</i>	Galleta
<i>Poa fendleriana</i>	Muttongrass
<i>Quercus havardii</i>	Sand-oak
<i>Stipa comata</i>	Needle-and-thread grass

<i>Stipa hymenides</i>	Indian Ricegrass
<i>Sporobolus airoides</i>	Alkali sacaton
<i>S. contractus</i>	Dropseed
<i>S. cryptandrus</i>	Sand Dropseed

WETLANDS

FORESTED/WOODLANDS

Low Elevation Riparian

Xeric Riparian or Desert Washes

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acacia</i> spp.	Cat-claw
<i>Celtis reticulata</i>	Netleaf Hackberry
<i>Cercidium</i>	Palo Verde
<i>Chilopsis linearis</i>	Desert Willow
<i>Dalea sinosa</i>	Smoketree
<i>Lycium</i>	Cilindrillo
<i>Olneya</i>	Ironwood
<i>Prosopis</i> spp.	Mesquite
<i>Tamarix</i>	Salt Cedar
<i>Zizyphus</i>	Graythorn

Low Elevation Riparian / Mesic Riparian and Deciduous Forest Woodlands

<u>Scientific Name</u>	<u>Common Name</u>
<i>Alnus</i>	Alder
<i>Arundo donax</i>	Giant reed
<i>Atriplex</i>	Saltbush
<i>Baccharis</i>	Seepwillow
<i>Chilopsis</i>	Desert willow
<i>Fraxinus</i> spp.	Ashes
<i>Juglans</i>	Walnut
<i>Phragmites cummunis</i>	Common Reed
<i>Pinus ponderosa</i>	Ponderosa pine
<i>Platanus</i>	Sycamore
<i>Populus</i> spp.	cottonwoods
<i>Prosopis</i> spp.	Mesquites
<i>Pseudotsuga menziesii</i>	Douglas fir

<i>Quercus emoryi</i>	Emory oak
<i>Salix</i>	Willow
<i>Scirpus spp.</i>	Bulrushes
<i>Tamarix</i>	Salt cedar
<i>Tessaria</i>	Arrow-weed
<i>Typha dominguensis</i>	Cattail

High Elevation Riparian

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acer spp.</i>	Maples
<i>Platanus spp.</i>	Sycamores
<i>Juglans spp.</i>	Walnuts
<i>Salix spp.</i>	Willows
<i>Populus spp.</i>	Cottonwoods
<i>Alnus spp.</i>	Alder
<i>Acer negundo</i>	Box elder
<i>Fraxinus spp.</i>	Ash
<i>Populus tremuloides</i>	Aspen
<i>Pinus ponderosa</i>	Ponderosa pine
<i>Pseudotsuga menziesii</i>	Douglas-fir
<i>Abies concolor</i>	White fir
<i>Quercus spp.</i>	Oaks
<i>Cupressus spp.</i>	Cypress

Other Wetlands

Freshwater Marshes

White Mountains

<u>Scientific Name</u>	<u>Common Name</u>
<i>Carex rostrata</i>	Sedge
<i>Eleocharis macrostachya</i>	Spikerush
<i>Glyceria borealis</i>	Northern mannagrass
<i>Myriophyllum exalbescens</i>	Watermilfoil
<i>Polygonum amphibium</i>	Water smartweed
<i>Potamogeton gramineus</i>	Pondweed
<i>Ranunculus aquatilis</i>	Water buttercup
<i>Scirpus acutus</i>	Hardstem bulrush

Utricularia vulgaris Bladderwort

San Francisco Plateau

<u>Scientific Name</u>	<u>Common Name</u>
<i>Eleocharis macrostachya</i>	Spikerush
<i>Elodea canadensis</i>	Waterweed
<i>Myriophyllum exalbescens</i>	Watermilfoil
<i>Polygonum spp.</i>	Smartweeds
<i>Potamogeton spp.</i>	Pondweeds
<i>Scirpus acutus</i>	Hardstem bulrush

Southeastern Arizona

<u>Scientific Name</u>	<u>Common Name</u>
<i>Sporobolus airoides</i>	Sacaton grass
<i>Typha spp.</i>	Cattail
<i>Carex spp.</i>	Sedge

Lower Colorado River Valley

<u>Scientific Name</u>	<u>Common Name</u>
<i>Myriophyllum brasiliense</i>	Watermilfoil
<i>Myriophyllum spicatum</i>	Watermilfoil
<i>Najas marina</i>	Holly-leaved naiad
<i>Phragmites australis</i>	Common reed
<i>Potamogeton foliosus</i>	Pondweed
<i>Potamogeton pectinatus</i>	Pondweed
<i>Scirpus californicus</i>	California bulrush
<i>Typha domingensis</i>	Southern cattail
<i>Utricularia spp.</i>	Bladderworts
<i>Zannichellia palustris</i>	Common pondmat

ALPINE

<u>Scientific Name</u>	<u>Common Name</u>
<i>Abies lasiocarpa var. arizonica</i>	Corkbark fir
<i>Geum turbinatum</i>	Golden avens
<i>Lonicera involucrata</i>	Bearberry honeysuckle
<i>Picea engelmanni</i>	Engelman Spruce

Pinus aristata

Rhizocarpon geographicum

Ribes montigenum

Bristlecone pine

Lichen

Gooseberry currant

Appendix G
Arizona Surveys and Studies Summary and Reference List

1. **The Birds of Arizona 1964.** A complete book the status of the birds of Arizona up to and including 1960. Includes 126 distributional maps, 12 color plates and 51 color photographs. Phillips, A.R., J. Marshall and G. Monson 1964.
2. **The Annotated Checklist of the Birds of Arizona 1981.** An updated checklist from the original book The birds of Arizona 1964. Brief statewide listings of locations of Arizona birds up to and including 1980. Includes subspecies, historic changes, and habitat requirements. Monson and Phillips 1981.
3. **Arizona Breeding Bird Atlas.** Study of the status and distribution of breeding birds in Arizona from years 1993-2000. Arizona Game and Fish Dept., 2221 W. Greenway Rd, Phoenix, AZ 85023
4. **San Pedro Avian Resources Conservation Program (SPARC).** The Bureau of Land Management has been conducting an intensive avian inventory and monitoring program within the San Pedro Riparian National Conservation Area since May 1986. Methods employed have included point count and line transect censusing, migration monitoring, mist-netting during winter and migration seasons, and M.A.P.S. (Monitoring Avian Productivity and Survivorship). For information on the avian program, contact the BLM San Pedro NCA office in Sierra Vista at (520) 458-3559.
5. **Birds of the Lower Colorado.** A summary of the status, distribution and ecology of birds in the lower Colorado River Valley. K.V. Rosenberg, R.D. Ohmart, W.C. Hunter, and B.W. Anderson. 1991. The University of Arizona Press, Tucson. 416 pp.
6. **Grand Canyon Birds.** A book of all historical records of birds found in the Grand Canyon Region up until 1987. Each bird listed has a short description of the general area and habitat it was found in. Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon birds. Univ. Of Arizona. Press, Tucson, AZ. 302 pp.
7. **Grand Canyon Riparian Birds 1998.** Three-year study of riparian bird community in the Grand Canyon. Primary focus was on the influence of habitat parameters on species richness, composition and abundance. Comparison of four survey techniques was done (point counts, walking counts, floating counts and spot mapping). Also includes specifics on the diet of 5 insectivores and an annotated checklist of all birds found.
8. **Birds of the Northern Black Mesa.** An overview of historical and environmental changes and their effects on bird species on the Northern Black Mesa area of the Navajo Nation in

Northern Arizona. Habitats include: Great Basin Desert scrub, pinyon-juniper woodland and mixed-conifer woodland. Charles T. LaRue, 1994. *The Great Basin Naturalist*. 63pp.

9. **Sensitive Species Locality Information for Arizona.** Statewide locality based information on sensitive species. Current bird list includes Southwestern Willow Flycatcher, Yuma Clapper Rail, Bald Eagle, Peregrine Falcon, Western Yellow-billed Cuckoo, Mexican Spotted Owl and Northern Goshawk. Contact Arizona Game and Fish Department Heritage Data Management System (HDMS), Habitat Branch, 2221 W. Greenway Road, Phoenix, AZ, 85023.
10. **Southeastern Arizona Grasslands.** Several studies done during the 1980s and 1990s focusing primarily on the effects of fire, grazing and exotic plant species on southeastern Arizona grassland birds. See Bock papers in literature cited.
11. **Winter Grassland Study:** An on-going look at southeast Arizona grassland birds. Primary species include the followin: Grasshopper Sparrow, Baird's Sparrow, Cassin's Sparrow, Savannah Sparrow and Vesper Sparrow. Information includes population abundance and population density, and between year and within year site fidelity.
12. **Birds of the Sky Islands.**
13. **Breeding Bird Survey (BBS) Routes.** The North American Breeding Bird Survey is a large-scale survey of North American birds . It is a roadside survey, primarily covering the continental United States and southern Canada, although survey routes have recently been initiated in Alaska and northern Mexico. The BBS was started in 1966, and the over 3,500 routes are surveyed in June by experienced birders. The primary objective of the BBS has been the estimation of population change for songbirds. There are sixty-four designated routes in Arizona. To obtain BBS information for any state contact: U. S. Department of the Interior Patuxent Wildlife Research Center, 11410 American Holly Drive, Laurel, MD, 20708 or visit the website at: <http://www.mbr-pwrc.usgs.gov/bbs/bbs.html>.
14. **Christmas Bird Counts.** Annual all-day census of early-winter bird populations. Provides information on local trends in bird populations. National Audubon Society. Contact local chapters for more information.
15. **Raptor Counts.** Annual Fall migration studies at Lipan Point (since 1991) and Yaki Point (since 1998) at the Grand Canyon. Other studies include 17 migration sites around the western United States including 1 site at Vera Cruz, Mexico. Annual reports are available to the general public. Contact HawkWatch International PO Box, 660 Salt Lake City UT 84110-0660. (800) 726-4295
16. **San Pedro MAPS station.** See SPARC description (#4)

17. **Urban Raptor Surveys:** Information collected in and around urban areas of Phoenix and Tucson, Arizona. Data collected since 1993, during November and December on raptor locations, species identification, and abundance. Information is mapped and put into a Geographic Information System (GIS) database. Arizona Game and Fish Department. Regions V (Tucson) and VI (Mesa).

18. **BBIRD Sites.** This national program (BBIRD = Breeding Biology Research and monitoring Database) provides standardized field methodologies for studies of nesting success in birds. Nest success, productivity, and habitat of nongame birds is monitored at randomly-located plots across North America. Point counts are used to index population size at plots. Vegetation sampling is also conducted at nest sites, non-use plots, and point counts. To obtain a copy of the BBIRD protocol contact Thomas E. Martin at Biological Resources Division, Montana Cooperative Wildlife Research Unit, University of Montana, Missoula, Montana 59812.