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Inventory and Assessment of Avifauna and a Monitoring Protocol Proposal for Tonto National Monument, Arizona

Katherine L. Hiatt and William L. Halvorson

Technical Report No. 62

United States Geological Survey
Cooperative Park Studies Unit
The University of Arizona • Tucson, Arizona

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February 1999

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Executive Summary

In assessing the avifauna and in developing a monitoring protocol for Tonto National Monument (Tonto NM), general surveys or censuses were conducted from September 1992 to July 1995. Historical records were augmented with data collected during the study period to inventory all bird species. A field checklist of birds in the monument was updated in 1995–1996 as part of this project. Future surveyors should be aware of the species not seen during this study, and managers should ensure documentation of these birds.

The proposed protocol gives the monument and the National Park Service 2 methods to monitor breeding bird species at Tonto NM over time. These methods will provide a means to detect changes in occurrence and relative numbers of most bird species through a standardized data collection and management program.

Many factors were considered in designing this monitoring program, including topography, vegetation, coordination with other ongoing floral and faunal inventory and monitoring, local area development, Tonto NM staff qualifications, funding availability, location of cultural features within the monument, and determination of bird species to monitor. We reviewed the history of avifaunal studies in the monument and found that staff made management decisions based on a 36-year-old field checklist, a more questionable 16-year-old field checklist, or from information in an inconsistent wildlife observation card system. The monument has an inadequate and somewhat outdated avian literature collection and limited access to a good library because of the monument's remote location. There was no systematic monitoring program prior to this study. The present staff does not have a dedicated position to manage resources, either cultural or natural, and it is unlikely such a position will exist in the near future. There is no annual funding set aside for an avian monitoring program. Current and impending threats to monument resources and local avifauna include development of recreational facilities adjacent to the monument, increased visitation to the monument, lack of basic information on local avifauna, and competition by nonnative bird species with native birds. These threats cannot be assessed without implementation of the proposed monitoring program.

We found that some birds such as nocturnal species (e.g., owl and goatsucker species), birds that use cliff areas primarily (e.g., turkey vulture, white-throated swift), or large birds (e.g., hawk species) that occur in low numbers are difficult to survey accurately with the proposed bird monitoring techniques. While the arrangement of census points and the road survey may pick up occurrence of these species, relative numbers may be difficult to determine without designing a more specific monitoring method.

Ten census or point count monitoring stations were established and a road survey designed in early 1994; the stations and road survey were used to census birds in 1994–1995. The point count method and road survey were selected to coincide with established census methodology used by

the U.S. Department of Agriculture, Forest Service. This was an important design consideration, because national forest land surrounds the monument and data derived from this program could potentially be used to determine local or regional trends.

A search for voucher specimens in numerous national and Southwestern U.S. museum collections, the development of a bibliographic database using Pro-Cite® software, and the start of an avian monitoring project photo-collection were completed during the study period and will aid future bird research at the monument.

We recommend future censuses, data analyses, and overall monitoring program management be done by a professional scientist or, if feasible, a National Park Service integrated inventory and monitoring team until Tonto NM has qualified staff and funding to do the required work in a consistent manner. Data management of the overall integrated inventory and monitoring program at Tonto NM should be a top research/resource management priority. Observations and all monitoring data should be put into a comprehensive database so that future researchers and managers can base wildlife decisions on facts. Other important studies needed in the monument include focused research on the (1) riparian corridor, (2) effects of nest parasitism on local avifauna, and (3) competition between nonnative species and native bird species within the monument. Tonto NM staff can continue to perform a number of bird-related activities to improve information gathering in the monument. The staff is encouraged to get involved with state programs and may wish to solicit additional library and project help for the bird program from a state National Audubon Society chapter, the American Birding Association volunteer program, or other sources identified in Appendix 10.

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Introduction

This handbook is designed to help Tonto National Monument (Tonto NM), National Park Service (NPS), Southern Arizona Group (SOAR), and other researchers who will record and monitor what bird species are present in the monument and who will assess changes in the avian community. A monitoring protocol was selected that can be used on an annual basis to determine presence or absence and relative numbers of birds within Tonto National Monument.

The monument was established in 1907. Tonto NM is managed by the U.S. Department of the Interior, NPS, and the site protects both cultural resources, (Salado Indian cliff dwellings and related archeological sites dating c. 1300–1450 A.D.), and natural resources. Land surrounding the monument is managed by the U.S. Department of Agriculture, Forest Service (USFS), Tonto National Forest (Tonto NF).

Tonto NM is located 8 km southeast of Roosevelt Dam on Arizona State Highway 88 (Apache Trail) in central Arizona (Appendix 1). It is 3.2 km east of the small unincorporated town of Roosevelt; population approximately 1,100–1,200 (J. Ryan, personal communication). The monument is also about 8 km north of the Superstition Wilderness Area. Tonto NM is approximately a 45-minute drive from Globe, a 1-hour drive from Payson, or a 3-hour drive from either Phoenix or Tucson, currently the 2 largest metropolitan areas in the state. The region offers both a variety of recreational opportunities and a retreat from urban life.

Several impending threats or factors may have already altered or may possibly affect the avian community at Tonto NM. Visitation has increased dramatically since 1935 when the monument was transferred from the USFS to the NPS. Visitation was relatively low and access to the monument was challenging in earlier years. Travel was difficult via the scenic Apache Trail from Phoenix, an often heavily rutted and somewhat hazardous road. The portion of Highway 88 that bisects the monument and the park entrance road were both dirt roads in those days and infrequently traveled. The park entrance road was first graveled in 1952; the Apache Trail from 16 km east to the park entrance remained a graded dirt road for a while longer (J. Ryan, personal communication). Today Highway 88 (passing through the monument) is paved, and the Apache Trail southeast of Roosevelt Dam has been improved and better graded. A section of it remains unpaved, but with modern transportation this does little to slow down visitors.

Since 1935, visitor statistics have been maintained by NPS staff. Annual visitation has increased from 5,542 in 1935 to 66,033 in 1995. The average monthly visitation for March–June 1995 was 8,128. This figure is somewhat misleading, because the vastly reduced visitation in June brings the average down considerably. The spring "rush" is in February–April, with March having the heaviest visitation (12,450 in 1995). May has about 50% the visitation of March; June has about 33% as much as March (J. Ryan, personal communication). Evidently, the highest visitation period occurs during the early part of the breeding season, when resident birds and some neotropical migrants mate and raise their first brood. At this time, we do not know how or even if visitation, visitor programs, or maintenance activities affect the breeding success of local birds.

Grazing in the Tonto Basin began about 1875 and according to Croxen (1926), "...cattlemen, always anxious to spread out and find newer and better ranges for their cattle soon brought small herds to these mountains, growing these herds into larger ones, while larger herds were driven in at later dates." Croxen added, "Cliff Griffin says that from 1894 to 1904, after the great herds of cattle had grazed over the Salt River country, there was no rooted grass, only browse and annuals remaining." After this grazing impacts appear to have partially decreased, but some grazing continued until 1942, when most of the monument was fenced. Deadman Canyon, Honey Butte, parts of the northern section, and upper Cave Canyon down to the spring continued to be used by cattle. The monument provided water for area cattle, and a pipeline was installed from the spring to a trough southwest of the entrance road near Highway 88 (Various authors, n.d.). In many of the Southwestern Monuments Superintendents (Custodian) Monthly Reports there are references to a water pipeline and to Cooper's (a local rancher) stock tank. There are also miscellaneous notes about Lyall's (another area rancher) stock and pack animals (National Park Service, various dates). In 1974, the monument was closed to grazing, and fence construction began. "The east boundary fence was completed in May 1979, and the entire monument was enclosed on 6 November 1981" (Jenkins et al. 1995). Today damage from human development sites are still visible in the monument particularly in the northernmost portion. These areas are "...characterized by different vegetation or, in a few locations, remain bare. Recent road construction, houses and other improvements have impacted the monument by creating disturbed patches and corridors that encourage the introduction and spread of nonnative plants" (Jenkins et al. 1995). Jenkins et al. (1995) noted that "...the density and sizes of shrubs have increased dramatically in the past 4-6 decades throughout much of the monument" and "...that saguaro has become much more numerous on favorable south-facing slopes." While grazing is still permitted on adjacent national forest lands, there appears to be little trespass grazing today in the monument. The impacts of past grazing and historic or current land uses within and next to the monument on local avifauna have never been measured. Few bird studies have been conducted in conjunction with habitat use, species diversity, density, or demographics in Tonto NM.

During more recent years, the Tonto Basin, where Tonto NM is located, has experienced a sharp increase in the development of facilities and services in the Roosevelt Lake Recreation Area under the Central Arizona Project, Plan 6. The recreation area is managed by the USFS, Tonto NF. Roosevelt Lake, one of several lakes within the recreation area, is a reservoir 37 km long and 3 km wide at its widest. The 7,015-ha lake is impounded by the largest masonry dam in the world, which was completed in 1911. It is fed by the Salt River to the east and Tonto Creek from the north. Most of the present modifications and construction are on Tonto NF lands surrounding the lake. Major construction of marinas, a visitor center, employee housing and offices, campgrounds, and picnic areas is nearing completion within proximity to Tonto NM. Major improvements to the dam were completed in 1996. The lake water level will be raised 4.5 m with the completion of the dam renovation, if water is available (Tonto Basin Ranger District, personal communication). One of the largest areas being developed is Windy Hill, which upon completion will have a 360-unit campground, 4 boat-launch ramps with 18 lanes and a parking area for 450 vehicles with trailers. This development is adjacent to the 55-ha parcel of Tonto NM north of Highway 88, known locally as the "North 40" or "Lower 40." In some locations, the new Windy Hill access road will come within 15 m of the north boundary. Following completion of improvements to the Roosevelt Dam and subsequent rising lake level the northernmost boundary

of the "North 40" parcel will be within 200 m of the waterfront. It is possible that water-associated bird species will begin using this area in the future. Effects from this development on local birds and other fauna are unknown at this time.

There is lack of information and some concern about the predation of year-round resident breeding birds and of migratory songbirds by brood parasites at Tonto NM. There is also a lack of data about nest or other competition between native species and nonnative bird species within the monument. We found brood parasites, including bronzed cowbird (*Molothrus aeneus*) and brown-headed cowbird (*Molothrus ater*), and nonnative species including European starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*) in the monument during this study. Cowbird predation has been implicated in a number of declines in populations of birds, particularly neotropical migrants, several of which breed in the monument. In 1994, the NPS initiated and the Kern River Research Group began implementing a pilot 2-year study of 8 NPS areas to address the problems with and effects of cowbird predation and to analyze the need for eradication of this species, if warranted. Results of this study may have implications on management of the brown-headed cowbird at Tonto NM in the future. We know brood parasites and nonnative species are present in the monument, but their distribution, population, and effect on local birds is unknown. Long-term monitoring at Tonto NM can help managers identify where these birds are located and may help to evaluate associated problems with local avifauna.

Historically, the monument has had few comprehensive avian studies. The first bird report was written in June 1935, shortly after the monument was transferred to the NPS (Steen 1935). Steen's list included 30 breeding bird species and 3 bird species "seen only occasionally." He noted the presence of Louisiana tanager (*Piranga ludoviciana*) [western tanager] in the monument as well as in nearby Roosevelt, and presumed that they nested in the area. Although he noted the proximity of the Sierra Anchas as cause for these birds to be in the area, it is highly unlikely that they bred in the monument; rather they were probably migrating to the mountains and stopped in the Roosevelt area in late May. Gordon Philp published the next list in 1939, 4 years later. He recorded 28 species between 4 November and 16 December 1938. Because the list was compiled during the late fall and early winter, many breeding species were omitted and other species considered only winter visitors. In the December 1938, Southwestern Monuments, Monthly Report, Philp stated, "...the evening was devoted to the preparation of bird study skins." It is unclear if he was helping his 3 visitors with their collection or if they were preparing Tonto NM specimens. We do not know the location of these specimens or if they were from the monument. There were few recorded bird observations and no known detailed bird studies done in the monument between 1939 and the early 1950s. For a brief period Tonto NM staff reported to the Regional Naturalist via the Annual Wildlife Report. Bird references and information were scant in these reports. Many of the references were solely for Gambel's quail, obviously the most abundant species in the monument. We presume this was also due to the importance and value of quail species as game birds. Generic bird and other wildlife observations during this period continued to be reported, albeit irregularly, to the Southwest Monuments' (NPS) office, then located in Globe, through official custodian or superintendent's monthly reports. G. G. Welles began working on a bird checklist in December 1954. In 1955, he produced one with over 40 species and Sharp (1955) reported this in the January Narrative Report for Tonto NM. In the 1955, Biennial Wildlife Report the checklist, "...includes 89 species exclusive of water birds

which sometimes fly over the monument from Roosevelt Lake" (Sharp 1955). Lyndon L. Hargrave, NPS collaborator in archeology and ornithology, compiled the first official bird field checklist for Tonto NM (Hargrave 1959). The list was published by the Southwest Parks and Monuments Association (SPMA) and contained 91 species, but breeding birds were not individually designated. Additionally, many bird voucher specimens were collected in the monument by Hargrave in 1959–63. We presume these were intentionally killed for the study, or obtained as a result of an accident or naturally caused death. Originally stored at the monument, many of these specimens were moved to the NPS Western Archeological and Conservation Center (WACC) in Tucson in 1994 for conservation, accession, and storage. Hargrave revised his checklist 31 December 1962 and the new list contained 132 species with an additional, hypothetical list of 14 bird species. He further updated this list on 30 June 1963 after more study in the monument. The list of 1963 had 142 species with 10 additional species on a hypothetical list. Following Hargrave's research, there appears to be a gap or inconsistency of data collection and information regarding bird species in the monument until the late 1970s. Monument staff updated the bird checklist in 1979. That list had 143 bird species but did not provide information on hypothetical species and contained questionable seasonal status and abundance designations for certain species. It is unknown how the 1979 list was developed or if scientists or other professionals were consulted to verify species. In the 1992 Tonto NM fact sheet (National Park Service 1991), staff indicated there were 142 bird species in the monument. Wauer (1993) summarized that Tonto NM had 143 species, of which 89 were listed as permanent or summer residents, and assumed to nest. Of those 89 species, none were water birds, 10 were hawks and owls, and 6 were warblers.

Many of the discrepancies between checklists may be attributed to changes in taxonomic nomenclature and the "lumping and splitting" of various species by the American Ornithologists Union (AOU) since the first Tonto checklist was assembled. A recent example of such a change is the northern flicker. When this project began, red-shafted, yellow-shafted and gilded flickers were considered "forms" of northern flicker (*Colaptes auratus*). Today the red-shafted and yellow-shafted are still forms of northern flicker and the gilded flicker (*Colaptes chrysoides*) is now considered a separate species (American Ornithologists Union 1995). Both gilded flicker and northern flicker, red-shafted form have been found in the monument, and observations were made of hybridization between the 2 species. Hybrids can confuse the unskilled observer and cause misidentification of a species. Other discrepancies seem to be a simple case of omission of information referred to in previous checklists or in hypothetical lists. Still others are presumably a result of misidentification of species by visitors, staff, or even researchers. Indeed, Hargrave removed the gray vireo (*Vireo vicinior*) from previous hypothetical lists, citing it was confused with and misidentified as the similar-looking Bell's vireo (*Vireo bellii*). Similarly, during this study we found in several cases there were insufficient historical records or observations to make an accurate determination of presence, absence, seasonal status, or seasonal abundance for certain species. Information to update the field checklist will be, at least partially, derived from the proposed monitoring program and should help staff or future researchers with similar problems.

The NPS is responsible for the management of natural resources in a manner that conserves them unimpaired for future generations (Van Horn et al. 1992). The NPS manages lands that can

provide control areas for evaluating the effects of habitat alteration on environmental change. The need to continue and expand the inventory, assessment, and monitoring of birds is identified in the 1994 Resources Management Plan (RMP) for Tonto National Monument (Project Statement TONT-N-07). Additionally, bird monitoring is closely associated with Project TONT-N-10 in the RMP, Develop Program to Integrate Long-term Monitoring of Ecosystem Health. Lack of basic data on avian species or the insufficient understanding of park ecosystems and threats to them is an NPS servicewide issue. There was no monitoring program for birds in the monument prior to the start of this program. Presently, there is no coordination of bird studies nor monitoring programs between Tonto NM, the USFS, Tonto NF, or other area landowners, nor with any other federal or state agencies. An integrated long-term monitoring program will help Tonto NM preserve and protect park resources as mandated in the Organic Act of 1916.

The detection of changes in relative abundances of breeding bird species is a consideration in establishing a monitoring program for Tonto NM. Of equal importance is the inventory of all bird species at the monument and the determination of their seasonal distribution; therefore, all birds will be counted. This information is important for maintaining an accurate and more informative field checklist. The monument staff currently make management decisions and provide bird information to visitors and others based on a well-done (yet taxonomically outdated) 36-year-old checklist or use the less reliable 16-year-old checklist. We found the wildlife observation card system inconsistent, and several of the historic records were questionable or had vague or no descriptions. Until now, there has not been a systematic, repeatable method to determine if or how the avian community structure has changed over time nor if there are yearly changes.

From September 1992 to July 1995 investigators from the U.S. Geological Survey, Cooperative Park Studies Unit at The University of Arizona, researchers from The University of Arizona, and staff from Tonto NM inventoried and recorded birds seen or heard in the monument. Most records were made during the breeding season February–July, but we also made some fall and winter observations. We prepared an updated field checklist that attempts to determine the presence or absence, seasonal status, and seasonal abundance of individual species within the monument, using historic records and observations, current literature, and monitoring information collected during this study. Not all bird species from Hargrave's 1963 list were seen or heard by staff and researchers during the study period. Seven new species, not found on previous checklists, were identified including 1 federally listed endangered species, the spotted owl, Mexican form (*Strix occidentalis lucida*) and 1 species on the list of Wildlife of Special Concern in Arizona, the yellow-billed cuckoo (*Coccyzus americanus*). We discovered references to chukar (*Alectoris chukar*), which was once found in the monument. The Arizona Game and Fish Department apparently released some of these birds into the area sometime between April 1954 and July 1957 and a few individuals were seen in the monument (National Park Service 1954). The tree sparrow (*Spizella arborea*) [American tree sparrow] was mentioned in the January 1955, Superintendent's Monthly Report. The American tree sparrow's range includes the Tonto NM area, but this record is questionable because it lacks a full description of the birds heard or seen. Two other species, red-breasted nuthatch (*Sitta canadensis*) and black-and-white warbler (*Mniotilta varia*) were mentioned in the October 1963, Tonto NM, Superintendent's Monthly Report. Abert's towhee (*Pipilo aberti*) was previously recorded from the Roosevelt

Lake area but had not been recorded in the monument. We found adults and juveniles in the riparian area and residential area and presume this species breeds here. The 1995 checklist contains species either currently present or for which historic records exist. Species are designated as hypothetical in cases where there are 5 or fewer observations or records (historical or current). A number of nesting records for various species and brood parasitism on Bell's vireo by a brown-headed cowbird were noteworthy during the research period. We observed both small groups and sizeable flocks (30 + or -) of brown-headed cowbirds, at various times, in the residential area and along the riparian corridor between this area and the visitor center. We made an effort, when feasible, to photograph habitat types, nests, eggs, nestlings, and some adult bird species, while attempting to disturb birds as little as possible. Monitoring can help determine if such species are still in the monument, if they breed here, and when they occur seasonally.

In response to a recent NPS servicewide initiative, we developed a bird bibliographic database using Pro-Cite computer software. This database contains over 350 citations and will provide Tonto NM staff with basic literature for future research as well as information for interpretive program purposes. We trained monument staff on use and maintenance of the bibliographic database in December 1995 using Pro-Cite version 2.1.1. for DOS.

We compiled individual species summaries for those birds found in the monument and some from the surrounding area in notebook form using WordPerfect version 6.0a computer software. The summaries contain preliminary information on observations, related literature, and special notes for each bird species, but are not a completed work. Staff and future researchers can add information to the individual species accounts to enhance management's overall knowledge of birds found in and around Tonto NM.

During the first year of the study, we conducted general surveys and recorded observations throughout the monument. We used the point count or variable circular plot methods at 10 stations in the monument, and designed a road survey along a 4.8 km transect in 1994-1995. Census counts using these methods provided preliminary information on presence and absence and relative abundances for birds during the breeding period. With the proposed long-term monitoring program and further research, park resource managers will be able to detect changes in abundance of birds and have a better understanding of seasonal distribution. Through an integrated inventory and monitoring program, managers could discover causes of change to the avian community structure that may be a result of physical or biological influences, adjacent land use practices, monument management activities, or other human or biological factors.

Study Area

Tonto National Monument is 453 ha and is located in the southern Tonto Basin of central Arizona, within 76 km of the Mogollon Rim escarpment (Appendix 1). The monument is situated on the south side of Roosevelt Lake in Gila County and surrounded by national forest land. Park elevations range from 701 m at the north boundary to 1,189 m in the southwest corner. Honey Butte, a prominent feature in the monument rises to 1,066 m along the eastern boundary. Large, but relatively shallow caves are found at the higher elevations and in Cave and Cholla Canyons are Upper and Lower ruins, the main Salado dwelling sites. "The monument is located in the Central Highlands geological subdivision of the Basin and Range Physiographic Province. Tonto National Monument (sic) is dominated by the characteristic Central Highlands fault-block mountain ranges adjacent to a deep valley bottom that is filling with material eroded from the mountains." Chronic ([1983] cited in Jenkins, et al. [1995]). The steepest slopes within the monument are an estimated 65–75%, most of which are found in Cave Creek, Cholla, or Deadman Canyon. There are shallow drainages in the monument and relatively flat terrain on the top of Honey Butte and above the ruins as well as north of the housing area and in the "North 40."

The vegetation is dominated by jojoba (*Simmondsia chinensis*) followed by foothill paloverde (*Cercidium microphyllum*) and brittlebush (*Encelia farinosa*) (Brian 1991). Other common plants include teddy-bear cholla (*Opuntia bigelovii*), saguaro (*Carnegiea gigantea*), sotol (*Dasylirion wheeleri*), banana yucca (*Yucca baccata*), century plant (*Agave chrysantha*), ocotillo (*Fouquieria splendens*), a few scattered red-berry juniper (*Juniperus erythrocarpa*) and several native and nonnative grass species (Jenkins et al. 1995). See Appendix 2 for a map of the vegetation of Tonto NM. For a complete description of vegetation classifications found in Tonto NM refer to Brown (1982).

The climate of Tonto NM varies annually, with mild winters ranging from 5° C to summertime temperature averages of approximately 37° C, with an occasional extreme temperature higher. There are typically 2 rainy seasons, January–February and July–September (Tonto National Monument 1996). Average annual precipitation is approximately 38 cm at the monument visitor center, where data are gathered by park staff (Tonto NM staff, personal communication). Approximately 38% of the annual precipitation in the monument occurs between April and October, although the months April–July are usually very dry. Light snow during the winter is typical (Jenkins et al. 1995).

Methods

"There are no universal 'off the shelf' technologies available to assess ecosystem health. What and how to monitor resources must be discovered. The 'vital signs' of park ecosystems need to be identified, techniques developed to monitor them, normal conditions defined, and treatments developed to mitigate human impacts on ecosystems. However, implementation of natural resource monitoring is a perpetual operational matter, like visitor center operations and facilities maintenance..." (National Park Service 1990). We designed a monitoring program with primary objectives to (1) provide relative abundance information on breeding birds by using consistent census methods; (2) help determine the presence and absence of all bird species in the monument; (3) minimize disturbance to cultural resources and to the public; (4) use an easily repeatable, consistent, and cost-effective census method; (5) address information needs of park staff; and (6) be expandable.

Breeding bird censuses are the first priority for the proposed monitoring program. While it is important to recognize that censuses can be conducted any time during the year, monitoring during migration or for wintering species shall be secondary to gathering breeding bird information for the Tonto NM program. Breeding problems are major causes of North American bird population declines (Askins et al. 1990). A complete description of censusing and monitoring techniques and associated problems with each type are presented in Bibby (1994), Ralph and Scott (1981), Ralph et al. (1983) and other literature. Monitoring during migration periods can tell us which birds are using Tonto NM for "stopovers," places that can be extremely critical to the survival of many species (Manley et al. 1993). Overall censusing during the breeding period, as well as winter censusing (e.g., Audubon Christmas Bird Count) can give an index to changes over a several-year period. Long-term monitoring of birds should use current standard techniques that reduce variables affecting the census results, be repeatable, meet assumptions of the method(s) selected, and produce analytical information useful to land managers. Results from different seasons or separate years can be compared if management is interested in this type of data.

Absolute densities were initially considered necessary to detect any significant changes in the population structure at Tonto NM. Large sample sizes (number of sightings for each species) are necessary to accurately determine species densities (van Riper et al. 1988). Verner and Ritter (1988) have shown that a minimum of 100 detections are necessary to accurately determine bird densities from selected census methods. There are few bird species that occur in the monument in sufficient numbers to obtain enough data within a cost-effective period. For Tonto NM, relative abundance figures should meet current management objectives. The monument as a whole represents only a small sample (453 ha) of the larger Tonto Basin vegetative structure, and individual vegetation subassociations represented in the monument are often small. For these reasons, assumptions at the population level cannot be adequately made.

Several methodologies were considered, selected, or rejected for a variety of reasons. Census methods include point count, spot mapping, area search, strip census, and Emlen's variable width

belt transect. Demographic monitoring methods include constant effort mist netting and nest search. Other methods include the Audubon Christmas Bird Count, Breeding Bird Survey, and the Breeding Bird Atlas. Comparisons of several of these methods are described in the table from Ralph et al. (1993).

Monitoring Methods Considered

The following is a brief description of some of the currently used census or demographic techniques. Advantages and disadvantages of implementation in developing a monitoring program for Tonto NM are provided.

Spot Map

Advantages. It is the most accurate in terms of measuring the density of birds on a plot especially for monogamous birds. It can be used to measure 1 species or all species on a plot. This method also works well with coordinated studies (R. Mannan, personal communication).

Disadvantages. While this method is current and widely used, it is very time consuming. It should be repeated 10–12 times per year. Determining the composite map after 10–12 mapping sessions is difficult because (1) males that are recorded may be unmated individuals, not territorial males singing; (2) in some bird species males quit singing during breeding; (3) birds may shift when re-nesting. Because this mapping is usually done on relatively small plots, the mapper may not be mapping the entire home range of certain species, which may extend beyond the plot. This method is not applicable for all species nor for all seasons and is inefficient in terms of required effort to adequately complete. Statistics generally cannot be applied to this method (R. Mannan, personal communication).

Why Not Selected. This method is time consuming and expensive. There is currently no trained personnel to do such labor intensive monitoring at the monument.

Area Search

Advantages. More complete coverage of a defined area is searched. Best for demographic studies and gathering nesting information. Can be incorporated using volunteers, providing census takers are properly trained and capable of identifying all species in a given area (R. Mannan, personal communication).

Disadvantages. Very time consuming and costly in terms of person-hours spent searching. Birds can be counted more than once as a census taker moves through the area (R. Mannan, personal communication).

Why Not Selected. Cost ineffective for present staff and funding situation.

Table. Census and demographic monitoring methods.

	Census			Demographic	
	Point count	Spot map	Area search	Mist nets	Nest search
Variables and characters					
Index to abundance	yes	yes	yes	yes	partly
Density	no	yes	no	no	partly
Survivorship (adult)	no	no	no	yes	no
Survivorship (juvenile)	no	no	no	yes	partly
Productivity	no	no	no	yes	yes
Recruitment	no	no	no	yes	no
Habitat relations	yes	yes	yes	little	partly
Clutch size	no	no	no	no	yes
Predation/parasitism	no	no	no	no	yes
Individuals identified	no	no	no	yes	yes
Breeding status known	no	yes	no	partly	yes
General characters					
Habitat types measured	all	some	most	some	few
Habitat specificity	good	good	good	fair	good
Rare species measured	many	few	many	some	few
Canopy species measured	all	all	all	some	few
Area sampled known	partly	yes	yes	partly	yes
Size of area sampled	moderate	small	small	large	small
Training necessary	much	much	moderate	much	much
Observer error potential	high	high	moderate	moderate	moderate
Use in non-breeding	yes	no	yes	yes	no
Cost per data point	low	high	low	high	very high
Applicable scale	broad	local	broad	broad	local

Mist Nets

Advantages. The best method for studying the demographics in a population of birds within a specified area. The researcher can capture and examine birds for signs of parasites and general health, and for morphological and physiological differences between species; gather genetic information by taking and analyzing blood samples and determine habitat condition (e.g., adequate food resources to percentage of body fat in captured birds). Individuals may be marked, and bird behavior may be examined using mist netting or other capture techniques. This method takes advantage of foraging, territorial, nesting, nest defense, mobbing behavior as well as migration, roost sites, and mating locations within the study area (R. Mannan, personal communication).

Disadvantages. Capture techniques often must involve several researchers to set up and monitor a series of net arrays and process capture data. Birds are potentially subjected to mishandling, injury, or vulnerable to predators while in the nets or during removal from nets. This method is costly in terms of equipment needed and time. Mist nets are best for passerine birds but are not effective for other bird species. Other techniques are better for capturing flocking birds, social birds, and raptors (R. Mannan, personal communication).

Why Not Selected. There is currently no qualified bird bander on the staff at Tonto NM. This method is considered too labor intensive and costly for the monitoring program at Tonto NM given present staff qualifications and funding.

Nest Search

Advantages. Good for surveying difficult species with large territories or with large home ranges (e.g., peregrine falcon, spotted owl) (R. Mannan, personal communication).

Disadvantages. It is difficult to put in the time required to search for nests on large plots (i.e., 404 ha). Nests can be difficult to locate, especially those of secretive species. This method is applicable only during the nesting season. The searcher can never be 100% certain he or she has located all nests within the study area (R. Mannan, personal communication).

Why Not Selected. This method is considered too labor-intensive and costly for the monitoring program at Tonto NM given present staff qualifications and funding.

Strip Census

Advantages. This method is easily applied to an area of study. Each census can provide an estimate of species within the area of concentration. It can be done in all seasons although variance may be great due to flocking by certain species. The census taker can pick up species that visit every once in awhile but can also take a general average of regular species in the area over time. This technique can be applied in similar vegetation plots to compare similarities and differences in each area (R. Mannan, personal communication).

Disadvantages. The sample strip may not be representative of the area the person is surveying. The census taker may underestimate the density of inconspicuous species along the strip, and there would be incomplete coverage. It can be difficult to listen, observe, and record species heard and seen along the strip because the surveyor is walking mostly in steep and rocky terrain.

Behavior of certain species may be influenced by the census taker moving along the strip (e.g., moving towards or away from the observer). The accuracy of the strip census depends on the ability of the observer to hear and see birds, as well as estimate distances from them to the bird. Visibility can be a problem especially in dense vegetation. Other influences affecting the accuracy of this method depend on (1) species in the area; (2) how long it takes for observer to walk the strip; (3) time of day (R. Mannan, personal communication).

Why Not Selected. Much of the monument has steep, rugged terrain. Topography can influence the bird species composition of a forest and the observer's ability to detect birds and estimate distances. Census results can also be affected by the slower rate of travel on rugged terrain. Density figures may be higher than results obtained from censuses in similar habitat on level terrain because of the greater likelihood of double recording individuals and of recording species that sing infrequently (Dawson 1981). Several plots have thick vegetation that may affect the rate of speed a census is completed and the ability of the observer to see or hear species. The monument lacks trained personnel to complete census work.

Emlen's Variable Width Transect

Advantages. This method tries to solve problems of interspecific variability by allowing the observer to record species at variable widths from the center of the strip transect. It is a sensitive method in that the census taker can count anything they hear or see. It is efficient, applicable to large areas and applicable in all seasons (R. Mannan, personal communication).

Disadvantages. Assumes complete coverage inside the inflection point, or the point at which the observer no longer is able to hear a species. Distances from the observer to a bird may be miscalculated. There may be bird movement before detection, and observation may be difficult while moving along the transect. Larger samples are needed, which can be difficult to obtain for uncommon and rare species (R. Mannan, personal communication).

Why Not Selected. See strip census description above.

Breeding Bird Atlas

Advantages. A national censusing effort, the Breeding Bird Atlas (BBA) is a program coordinated by the Arizona Game and Fish Department. Biologists and volunteers examine a 25.9-km² study block using the nest search method. Begun in 1993, the BBA is a 7-year statewide program. Study blocks represent approximately 17% of the state (T. Corman, personal communication).

Disadvantages. There is incomplete coverage for the state using the BBA and the focus on nesting species eliminates the potential to collect data on migrants and winter visitors in individual locales.

Why Not Selected. The nearest BBA block to Tonto NM is the Windy Hill Block (3277) located on the north side of Roosevelt Lake and east of Windy Hill in the Armour Gulch/Cottonwood Wash area (T. McCarthy, personal communication). There are differences in

vegetation and elevational gradients between the BBA block and the monument, and possibly fewer human influences on the BBA block.

Breeding Bird Survey

Advantages. The second, continent-wide bird censusing program is the well known Breeding Bird Survey (BBS). Developed and tested in 1965, it is designed to detect changes and trends in avian populations. The survey has shown in recent years dramatic declines in several bird species both local and on a nationwide basis (Peterjohn 1994).

Disadvantages. While effective in many cases, the BBS does not necessarily reflect local conditions and is often criticized for lack of coverage in some areas and in certain habitats, or for being sporadic at best, particularly in remote areas of the West. The BBS does collect data during the breeding season but censuses are conducted along roadsides, where certain species are apt to be overlooked along a particular route if they are secretive or rare. Because BBS data are subject to natural variability and sampling error, a large sample of routes is needed to average local variations and reduce the effects of sampling error (Peterjohn 1994).

Why Not Selected. There is no BBS route along the section of Highway 88 that passes through the monument. The closest BBS route to Tonto NM is the Phoenix Salt/Verde River count (T. Corman, personal communication).

Christmas Bird Count

Advantages. The third well-established, nationwide program for censusing birds is the National Audubon Society (NAS), Christmas Bird Count (CBC). The CBC counts all species within a specific time frame in late December in thousands of locations across the country. Volunteers, usually organized by local Audubon clubs, take part in a daily count noting the number of species and number of individual birds in a given area. This information is helpful to determine winter residents and non-breeding bird visitors in a given area and provides some additional seasonal distribution and seasonal abundance data. Results are analyzed and presented annually in an edition of the *National Audubon Society Field Notes*, the NAS journal.

Disadvantages. There is incomplete coverage of areas for the CBC, particularly in some inaccessible areas of the West; therefore, information on local populations may not be available or trends may be skewed. This method will not pick up all known breeders from the monument. Several of the breeding birds at Tonto NM are neotropical migrants and are not present in the monument during winter months.

Why Not Selected. The Tonto Basin and Tonto NM are not currently included in any CBC (B. Bradley and T. Corman, personal communication). It may be difficult, but not necessarily impossible for the monument to get enough volunteers to have a Christmas Bird Count. The NAS requires a long-term commitment to collecting data after a count is established in an area. It is understandable why coverage is easier when centered around major urban centers.

Monitoring Methods Selected

The 3 methods we used and recommend for the Tonto National Monument monitoring program, in prioritized order are point count or fixed station; road survey, and if the program is expanded, the variable circular plot. The following is a list of advantages and disadvantages for each method and a brief description why each was selected:

Point Count or Fixed Station

Advantages. This method is similar to the strip census described above except that it is done from a fixed station with a pre-defined radius. Generally the census taker will wait 1–3 minutes to begin the census once he or she has reached the center of the plot. The counting is done for 8–10 minutes, which standardizes the census-taking period. This method reduces observer influence on species, because the observer remains stationary during the census period. The longer census period allows more time for observation disadvantages such as the inability to see or hear secretive species in dense vegetation (R. Mannan, personal communication).

Disadvantages. There is a greater chance that the observer will count the same bird more than once, which will inflate abundance values (R. Mannan, personal communication).

Why Selected. It is relatively easy for a census taker to complete in a short period of time. Staff can get relative abundance figures for species from just a few replications. With appropriate training, current park staff may be able to complete censuses in the future. The point count is the recommended standard, and its implementation is recommended for the USFS (Ralph et al. 1993). It is possible that data from the monument program can be extracted to compare regional information with the Tonto National Forest. The point count method seems to be one of the more popular "industry standards" for censusing avifauna nationwide because of its cost effectiveness and ease of implementation. Until improved and more precise censusing techniques are developed or until additional funding is available to complete more comprehensive demographic studies, we recommend the point count method.

Road Survey

Advantages. A road survey technique was selected to inventory and census species sometimes difficult to locate using the point count or fixed station method (e.g., raptors). The road survey is along Highway 88, a secondary road extending along the south side of Roosevelt Lake. It takes approximately 1 hour to complete. The use of a vehicle to conduct the road survey saves valuable time and covers a larger area than a comparable foot survey. As the Roosevelt Lake and Dam area continues to be developed, road usage will probably increase and the road could be widened. Changes, if any, to the species along this route may be of interest for future management of the area.

Disadvantages. Difficulties with hearing over traffic noise can be significant. Density figures will not be obtained from road-side point counts.

Why Selected. We decided the road survey was an easy way to detect those species (e.g., hawks, common raven) that have larger territories or ranges extending beyond but still including

portions of the monument. The road survey cuts across the monument and includes some lands managed by the USFS, Tonto NF.

Variable Circular Plot

Advantages. Applicable during any season. Capable of detecting rare or secretive species if enough time is spent at a given station. Variation in the detection distances among species is addressed (R. Mannan, personal communication).

Disadvantages. Either an experienced census taker can use this method, or staff must go through a more extensive training period (R. Mannan, personal communication). Current monument staff do not have the skills to use this method unless intensive training can be given and staff are committed to collecting data annually.

Why Selected. Not selected for the current monitoring program; however, the point count stations can easily be used here and the variable circular plot method applied. Flagging can assist the census taker to determine accurate distances within the plot and along its perimeter. An experienced census taker can use this method and provide the monument with some different information than that derived from the point count method.

Selection of Monitoring Stations

Ten census points or monitoring stations were selected. Temporary wooden stakes were installed and marked on the sides with a number and code (e.g., KLH-TBP-1) within the monument in early 1994. Permanent markers were installed in early 1996 using rebar and oval, metal tags numbered 217-224 and stamped with TBP (Tonto Bird Plot). Rebar and tags were not installed at Upper and Lower ruins, but we numbered both for mapping and census taking purposes (see plot descriptions below). Census counts using both methods provided preliminary information on presence, absence, distribution, and relative abundance for breeding birds, as well as general information on many non-breeding birds during the study period.

How were monitoring stations selected? We chose station locations where monitoring activity would not disturb cultural features and where monitoring will not be intrusive during public visitation periods. Most of the monitoring plots are located in various subassociations of Arizona Upland vegetation. The Interior Chaparral Series vegetation is not represented in this program. The Interior Chaparral Series, mountain mahogany-shrub-live oak-desert needlegrass (*Cercocarpus montanus-Quercus turbinella-Stipa speciosa*) subassociation areas are difficult to access because of the high elevation, lack of trails, and steep, rocky terrain. The chaparral represents only a small fraction of the total monument vegetation composition. The other stations are comprised of varying elevational gradients from 700 m at the northernmost plot to 1,033 m at the Upper Ruin plot. Monitoring stations are found along existing trails, secondary, and abandoned roads, as well as at Upper and Lower ruins. Monitoring stations are a minimum of 300 m apart. Census takers can collect data easier at the fixed stations when not preoccupied with where they are walking, particularly since most of the monument has fairly

rugged, rocky terrain (Dawson 1981). The arrangement of the monitoring stations are such that an individual census taker can complete data collection within the 3-hour time frame immediately after sunrise in 2 consecutive mornings. Plot #217-TBP (Northernmost Plot) was selected because of its proximity to the scheduled Windy Hill development adjacent to the northern boundary of the monument. Plot # 218-TBP (Middle of the Old Road Plot) was selected to determine if changes in vegetation following closure of a section of the old park entrance road and old Highway 88 affect species diversity and abundance. Both Plots #217-TBP and #218-TBP are located in the "North 40" near the Windy Hill development and where there may be a threat to local avifauna by illegal hunting. Plot #219-TBP (Park Entrance and Highway 88 Plot) is aptly named and found in the bajada on the south side of the highway within the monument. Plot #220-TBP (Residential Area Plot) was established adjacent to the employee housing area and maintenance facility to monitor potential human influences on local birds. Supplemental feeding (e.g., hummingbird feeders, bird seed, garbage) by residents either deliberately or inadvertently occurs in this area. A similar plot, #221-TBP (Picnic Area Plot), though in a lesser-used area, is adjacent to the designated picnic site, where supplemental feeding may also occur. Plot #222-TBP (Pump house Plot) is located along the road and a portion of this plot includes a portion of the Cave Creek Canyon riparian area near the pump house. Because riparian areas are the most threatened habitat in the Southwest (see Ohmart 1994), plot #223-TBP (Deciduous Riparian Plot) was set up in the deciduous riparian woodland below the spring on Upper Ruin Trail. After preliminary examination, this plot appears to have the highest diversity of species on a year-round basis. Monitoring bird diversity and abundance at this station is critical to help ascertain the overall health of the riparian ecosystem. This plot also overlaps mammal, reptile, amphibian, insect, and vegetation study plots, completed in recent years. Plots #219-222-TBP are also along the entrance road transect used in the mammal, reptile, and amphibian studies done in 1993-95. Station #224-TBP (Upper Riparian Area at South Boundary Fence Plot) represents riparian vegetation different from the larger deciduous riparian plot and often contains fairly long lasting pools of water. Station #225-TBP (Upper Ruin Plot) and #226-TBP (Lower Ruin Plot) represent the 2 highest elevations for this monitoring program. They were also selected because of the cultural features and because of their cliff face, cave, and rock habitats. Completion of censuses at all 10 stations requires 2 mornings. A third morning can be used for the road survey, which takes approximately 1 hour to complete.

The second monitoring method, a road survey transect was designed in the spring of 1994. It begins approximately 3.2 km east of the monument near milepost 248 on Highway 88 and extends 1.6 km west of the monument, ending just east of the town of Roosevelt. Route 88 is a secondary, 2-lane highway. The route bisects the monument and includes the power line found on the south side of Highway 88. The entire route passes through Arizona Upland vegetation with several significant riparian drainages along the road. Prior to the Plan 6 development, Highway 88 had little traffic, except perhaps on weekends. During the study period there was, at times, heavy construction traffic and recreational traffic. Recreational traffic was especially heavy on weekends and holidays. The road survey provided some preliminary information on presence, absence, and distribution for breeding birds and some non-breeding birds, especially

those species (e.g., red-tailed hawk, common raven) with broad territories or ranges. This survey method also helped determine species that frequently hunt, perch, guard territories, or forage from tall posts such as the power lines and telephone poles/wires such as American kestrel (*Falco sparverius*), western kingbird (*Tyrannus verticalis*), and purple martin (*Progne subis*).

Species with Special Monitoring Needs

Some of the avian species that cannot be adequately monitored by using the point count method or the proposed road survey method may be of concern as indicators of change in the monument. Development of special census techniques for these groups can be examined as the monitoring program is expanded or refined.

Raptors

Censusing certain large raptorial birds such as turkey vulture (*Cathartes aura*), zone-tailed hawk (*Buteo albonotatus*) and red-tailed hawk (*Buteo jamaicensis*) may require special effort. It is now well known that large raptors respond to environmental change as a result of natural and man-caused change because they are at the top of the food chain. Additionally, some small raptor species "...serve as good barometers of natural or man-made environmental changes for several reasons: they are relatively abundant, widely distributed, and reflect the environmental health of an area as expressed in number of herbivorous prey and the condition of vegetation" (Johnson-Duncan 1988). Small raptors (e.g., American kestrel) have (1) "smaller territories that are more easily censused and population densities that are often relatively high", and (2) "their relatively large numbers allow statistical treatment of population estimates to determine population trends" (Johnson-Duncan et al. 1988). However, Bibby (1992) determined that "counting breeding and non-breeding raptors poses special problems as most are found at low densities and often use specialized (sic) nesting habitat in remote and inaccessible areas."

Owls

Johnson-Duncan (1988) found that because owls are largely crepuscular or nocturnal, "...the incidence of human contact and direct persecution is lessened, allowing easier detection of population fluctuations (sic) attributable to environmental changes such as habitat degradation or contamination of food chains." Special techniques may need to be developed to census owls in the monument. All currently known owls at Tonto NM are nocturnal. Spotted-owl (Mexican form) (*Strix occidentalis lucida*) was observed and video-taped in the monument in 1988 and 1989 but was not heard or seen during this study (see Species of Management Concern). While the ferruginous pygmy-owl, cactus form (*Glaucidium brasilianum cactorum*) is diurnal, there are only questionable records from the monument for this species. Owls and other nocturnal birds were inventoried but not systematically censused during the 1993–95 study. Some use of playback recordings was attempted. Great-horned owl (*Bubo virginianus*) responded in a majority of the tests, thus preventing further playback attempts. No conclusive results were reached. For a complete description of owl censusing techniques and associated problems using various methods see Bibby et al. (1992); Johnson et al. (1979, 1981); Johnson-Duncan et al. (1988); and Ralph and Scott (1981, 1993).

Goatsuckers, Oilbirds, and Allies

Very little is known about the ecology of the goatsucker family. Within Tonto NM, common poorwill and lesser nighthawk have been heard and/or seen during general night surveys and

during test censuses using playback recordings. It may be possible to detect these species if evening censuses are conducted using the point count method at each monitoring station. Methods need to be developed or perhaps others used to conduct censuses of these birds.

Hummingbirds

Nesting female hummingbirds are extremely difficult to identify in the field. Since male hummingbirds may leave the monument shortly after nesting begins, hummingbird activity on monitoring plots should be noted, but species determination should not be made unless call notes are heard and used to determine species.

***Empidonax* spp. Flycatchers**

These birds are difficult to visually identify in the field. *Empidonax* spp. flycatchers, although currently not known to nest within monument, sometimes occur during migration. Most records for this group are historic. Visual identification to species should not be attempted; leave identification on data forms at the generic (*Empidonax*) level (Phillips et al. 1964; Monson and Phillips 1981) unless songs and calls are heard and positively identified.

Cliff-dwelling Species

It may be important for managers in the future to monitor colony-nesting/roosting species such as white-throated swift (*Aeronautes saxatalis*) as well as turkey vulture to (1) ascertain the effects of these species occupation of Upper and Lower ruins; (2) determine effects of nest building and defecation on adobe walls of the ruins and other cultural features; and (3) discover if there are visitor effects on the ecology and nesting success of these birds.

Riparian Obligate Species

During the last 100 years, at least 95% of the riparian habitats in the West have been altered or destroyed as a result of human influence (Ohmart 1994). Riparian bird communities are especially important habitats because overall avian density and diversity is very high compared with surrounding habitats and because many rare and endangered bird species are found there (Johnson et al. 1987). It is important to monitor avian species specifically linked to the riparian areas at Tonto NM because of these reasons. Several species found during the study are restricted to riparian habitats, including but not limited to Bell's vireo, Abert's towhee, bronzed cowbird (*Molothrus aeneus*), and yellow-billed cuckoo (see Appendix 8). Because the size of the deciduous riparian woodland at Tonto NM is small in comparison to other similar habitats, management should consider development of a more in-depth study of the riparian habitat and of the species found there. Perhaps an alternative monitoring method that would yield demographic information is warranted for this habitat type.

Migrants, Transients, and Species in Limited Numbers

For the current monitoring program, migrants and transients will be noted and can be counted separately from breeding birds in the total number of individuals column on census data forms. In addition, several species of birds only occur at limited sites or in limited numbers. For example, the purple martin appears to be present in limited numbers in some stands of saguaros. Purple martins were detected only during general surveys and road surveys and only occasionally

flying over a few plots during point count censuses. Nesting was discovered in 1995. Western and Cassin's kingbirds (*Tyrannus verticalis* and *T. vociferans*) were detected during road surveys and seen on the wires along Highway 88 and again, infrequently during point counts. No kingbird nests were discovered during 1993-94. Two pairs of western kingbird were observed, apparently nest building in the upper portion of 2 of the metal power towers along the road survey route in 1995 near Highway 88, west of the entrance road. Some of the species in this group were detected infrequently at the 10 point count monitoring stations but were often seen during road surveys. Additional work with the avifauna of Tonto NM may disclose the status of migrants and transients, which may in turn require the development of special monitoring methodology to detect changes in these species.

Secretive Species

Many bird species have secretive behavior: crissal thrasher (*Toxostoma crissale*), Abert's towhee, hummingbird species (when nesting), and white-winged dove (*Zenaida asiatica*). Detection itself is difficult unless they are singing on breeding grounds; determining their relative abundance may be even more difficult using the selected methods.

Species of Potential Management Concern

Species descriptions below are adapted from Ehrlich et al. (1988), National Geographic Society (1983), or Robbins et al. (1983), unless otherwise noted.

Nonnative Species

An exotic or nonnative species is one "...occurring in a given place as a result of direct or indirect, deliberate, or accidental actions by humans" (National Park Service 1991). NPS policy strives to protect and preserve all species of native flora and fauna within park areas. NPS policy regarding nonnative species is addressed in NPS-77. Management of populations of nonnative plant and animal species, up to and including eradication, will be undertaken wherever such species threaten park resources or public health. High priority will be given to the management of nonnative species that have a substantial impact on park resources and that can reasonably be expected to be successfully controlled (National Park Service 1991). We do not know everything about the biology of nonnative species found at Tonto NM. We also do not know the disruptive potential of these species on native wildlife, what level of damage by these nonnatives is acceptable, or proper or effective control methods for these species. Further study of this group and their impacts on monument resources is recommended.

Sturnidae: Starlings and Allies Family

European Starling (*Sturnus vulgaris*)

For a complete description and account of this species, see Appendix 8.

Passeridae: Old World Sparrow Family

House Sparrow (*Passer domesticus*)

For a complete description and account of this species, see Appendix 8.

Federal Threatened or Endangered Species or Species on List of Wildlife of Special Concern in Arizona

The Endangered Species Act of 1973 was enacted to assist federal agencies in carrying out conservation programs to protect endangered and threatened plant and wildlife species. Managers must insure that their actions do not compromise the existence of these types of animals and plants or damage habitat used by such species (U.S. Fish and Wildlife Service 1991). A separate, annotated list of Wildlife of Special Concern in Arizona is maintained by the Arizona Game and Fish Department (Arizona Game and Fish Department 1995). Monument staff must be aware of the presence of such species. Employees should be careful to record all pertinent information regarding these species, especially nesting information, and notify appropriate U.S. Fish and Wildlife specialists for management recommendations. A more detailed search, research project,

or monitoring program may be necessary if these species are detected in the future. Management should work closely with the U.S. Fish and Wildlife Service, Ecological Services Field Office in Phoenix, and with the Arizona Game and Fish Department to monitor this group.

Accipitridae: Kites, Eagles, Hawks, and Allies Family

Bald Eagle (*Haliaeetus leucocephalus*)

Federally threatened species in the Southwest (U.S. Fish and Wildlife Service, unpublished data). Identified on list of listed, proposed, or candidate Category 1 species for Gila County, Arizona (U.S. Fish and Wildlife Service, unpublished report). On state list of Wildlife of Special Concern in Arizona (Arizona Game and Fish Department, unpublished data). Both resident and wintering eagles occur in Arizona. The USFS has an active nest watch program for the bald eagle in the Roosevelt Lake/Salt River area, where there is a small resident population. There are few historic observations of bald eagle in the monument but no breeding records. Birds may occasionally pass over the monument en route to the lake or river. Bald eagles were seen several times during this study but all records were from the immediate vicinity of Roosevelt Lake and outside the monument.

Morphology: Adult distinctively dark brown overall with a white head and tail. Immature bird dark with various amounts of light mottling. Feet are bare of feathers. It takes 4–5 years for a bald eagle to reach full adult plumage.

Behavior: Susceptible to human disturbances, especially during nesting. Locks talons and somersaults in aerial display during courtship. Often found in heavy concentrations particularly in the U.S. northwest and Alaska congregating at communal perches and foraging areas. An often quiet bird, eagles also nest in loose colonies.

Habitat: Found along rivers and streams and needs habitat with large trees, snags, or cliffs nearby for nesting. Long-term pair bond. Preys on fish primarily but, also waterfowl, carrion, and small mammals.

Similar Species: Adult golden and bald eagles are easily distinguished. Separation of immatures is more difficult. Immature golden eagle has a broad white tail band, while adult has a narrower white tail band. Immature bald eagle is blotchy white on the underwing and tail, especially after the first year. Golden eagle soars with wings slightly uptilted while bald eagle flies flat-winged.

Song: Rapid sharp chips, softer than golden eagle call.

Falconidae: Caracaras and Falcons Family

Peregrine Falcon (*Falco peregrinus anatum*)

Federally listed as endangered (35 Federal Register 16047, 13 October 1970; 35 Federal Register 8495, 2 June 1970) without critical habitat (U.S. Fish and Wildlife Service 1991). Identified on list of listed, proposed, or candidate Category 1 species for Gila County, Arizona (U.S. Fish and Wildlife Service, unpublished report). On the list of Wildlife of Special Concern in Arizona (Arizona Game and Fish Department, unpublished data). As of January 1996, a U.S. Fish and Wildlife Service proposal to delist the peregrine was to be released for public comment (DeStefano 1996). As of 19 March 1996, this species cannot be delisted until the public moratorium is lifted (T. Tibbitts, personal communication). Only 1 observation was recorded for the monument during the study; however, this species is presumed to be an uncommon migrant. Nesting has not been discovered in the monument.

Morphology: The adult peregrine has a black crown, nape, and wedge extending below the eye, forming a helmet. Wings are long and pointed. Plumage on the back and wings varies, depending on subspecies.

Behavior: A very swift flier, stoops to capture prey at speeds up to 200 mph. Adult male and female may roost together and hunt cooperatively. Feeds on other birds, especially doves, pigeons, shorebirds, waterfowl, and passerines.

Habitat: Found in open habitats from tundra, savanna, and coastal areas to high mountains, open forests, and tall buildings in urban areas.

Similar species: The peregrine falcon lacks the dark axillary feathers of the prairie falcon. The prairie falcon has moustache stripes on the sides of its head, not a helmeted appearance as in the peregrine.

Song: The peregrine's call is a series of long, slurred notes.

Cuculidae: Cuckoos, Roadrunners, and Allies Family

Yellow-billed Cuckoo (*Coccyzus americanus*)

Category 3B bird species (U.S. Fish and Wildlife Service 1989). Identified on the list of Wildlife of Special Concern in Arizona (Arizona Game and Fish Department, unpublished data). This species has distinct riparian habitat requirements and is found in small, localized populations. Threats to the remaining populations in central and southern Arizona include modification and loss of habitat from vegetation clearing, stream diversions, water management, agriculture, and urbanization (Arizona Game and Fish Department 1988). Recorded as a new species for the monument during this

study. Only 2 records exist and nesting was not discovered. Management should be watchful of this species' presence and/or nesting in the future.

Morphology: The yellow-billed cuckoo has a brownish-gray back, long tail with white spots in a pattern on the underside. Bill is yellow at the base. Front is white and primaries are rufous.

Behavior: An occasional brood parasite, especially during outbreaks of prey items such as tent caterpillars. Sometimes feeds on bird eggs, frogs, lizards, berries, and fruit.

Habitat: Most often found in open woodland, streamside thickets of willow and alder, and orchards.

Similar Species: The mangrove and black-billed cuckoos' ranges do not overlap the yellow-billed cuckoo in the area of Tonto NM.

Song: The unusual call is a distinctive, staccato *kuk-kuk-kuk* that slows to end in a *kakakowlp-kowlp*.

Strigidae: Typical Owl Family

Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*) Cactus form

Proposed federal Category 1 endangered species (U.S. Fish and Wildlife Service, unpublished data). Identified on list of listed, proposed, or candidate Category 1 species for Gila County, Arizona (U.S. Fish and Wildlife Service, unpublished report). On list of Wildlife of Special Concern in Arizona (Arizona Game and Fish Department, unpublished data). Status and relative abundance are unknown in the monument. Historic, possibly unreliable records from Tonto NM exist.

Morphology: Long tail, reddish with dark or dusky bars. Crown streaked with upper body parts gray-brown. Eyes are yellow with black nape spots resembling eyes on back of head.

Behavior: Diurnal. Late nesting in June and July has been reported for this species. Flies with quick, unmuffled wing beats. Unknown if it breeds within monument. Often jerks tail up and down when perched. Nests in cavities, often old woodpecker holes.

Habitat: Desert washes, riparian woodland, canyons, and stands of saguaros. Rare in the United States.

Similar Species: Found at lower elevations than northern pygmy-owl. Elf owl and northern pygmy-owl are nocturnal. Elf owl has shorter tail than ferruginous pygmy-owl.

Song: Most common call is a rapid, repeated *took*, most often heard at dawn and dusk.

Spotted Owl (*Strix occidentalis lucida*)

Mexican form

Federal threatened species (56 Federal Register 56344; 4 November 1991) without critical habitat (U.S. Fish and Wildlife Service 1991). Identified on list of listed, proposed, or candidate Category 1 species for Gila County, Arizona (U.S. Fish and Wildlife Service, unpublished report). This subspecies is on the list of Wildlife of Special Concern in Arizona (Arizona Game and Fish Department unpublished data). Two previous records exist for the monument. No birds were seen during this study.

Morphology: Dark eyes and lacks ear tufts. Large brown owl with white spots over body, back, and head, with yellow bill.

Behavior: Chiefly nocturnal. Male calls from perch near nest before and after copulation. May be winter resident and is an altitudinal migrant. Lifetime site tenacity by pairs. Pairs do not breed every year. Female broods young and is fed by male. Intolerant to even moderately high temperatures, due to thick plumage.

Habitat: Found in coniferous forests (old growth fir) and woodlands (especially shaded, steep-walled canyons), frequently on north-facing slopes with dense canopy. Uses cliff sites for nesting if in wooded canyons, but also old platform nests built by eagles, hawks, or ravens).

Similar Species: The similar barred owl's range does not overlap with the spotted owl Mexican form in Arizona.

Song: The spotted owl's call sounds like a series of dog-like barks.

Game Birds

Several game bird species are found in Tonto NM during the year or were recorded historically in the monument or area including: band-tailed pigeon (*Columba fasciata*), wild turkey (*Meleagris gallopavo*), Gambel's quail (*Callipepla gambelii*), white-winged and mourning doves (*Zenaida macroura*). It is unknown at this time how hunting affects monument resources. Hunting is permitted on adjacent national forest land. During 1993–95, we heard gun shots frequently while in the field and found shotgun shell casings along the eastern boundary within the monument. On several occasions we found small flocks of mourning doves feeding in the "North 40" area, adjacent to the ongoing Windy Hill recreational area development. While

management should continue to note these activities, we do not feel they currently pose a serious threat to monument resources.

Brood Parasites

Cowbirds are becoming a serious problem throughout the United States due to the historical increase in open habitats where they feed (Terborgh 1989). Brood parasites such as the brown-headed and bronzed cowbird lay their eggs in the nests of other species, frequently a much smaller, less aggressive species. The host parents are forced to incubate and feed the hatchling and juvenile, often at the expense of their own young. Brood parasite hatchlings and juveniles often push out or deliberately kill their siblings. Brood parasitism by brown-headed cowbirds is known to occur in at least 220 host species (Friedmann and Kiff 1985). Brown-headed cowbirds have been known to cause declines in certain species of songbirds, including yellow warbler (*Dendroica petechia*) and Bell's vireo, both of which are found in the monument. Yellow warbler is in the top 3 species targeted by brown-headed cowbirds (*Molothrus ater*) (Ehrlich, Dobkin, and Wheye 1988). The following bird species are of concern because of their brood parasitism behavior and presence in the monument.

Emberizidae: Emberizid Family

Bronzed Cowbird (*Molothrus aeneus*)

For a complete description and account of this species, see Appendix 8.

Brown-headed Cowbird (*Molothrus ater*)

For a complete description and account of this species, see Appendix 8.

Other Species of Concern

Some species are limited to certain areas of the monument or certain limited resources scattered throughout the monument. Other species are restricted by the distribution of riparian habitat within the monument (e.g., Bell's vireo). The phainopepla (*Phainopepla nitens*) is a good example of a species limited by food resources. Because of their strict diets, this bird feeds and nests near areas with sufficient mistletoe and other berries. The phainopepla is largely restricted to xeroriparian habitats along washes throughout the monument where berry-producing plants are most plentiful.

Accipitridae: Kites, Eagles, Hawks, and Allies Family

Zone-tailed Hawk (*Buteo albonotatus*)

Included in Hargrave's 1963 revised bird checklist and on the 1979 checklist, we did not find any observation cards or other records for this species. A single individual and frequently a pair were seen regularly in the vicinity of Honey Butte and along the

eastern boundary during this study. We did not confirm breeding within the monument.

Morphology: Black body with black-and-white banded tail in adult. Bill is yellow. Immature has some white spotting on the breast.

Behavior: Turkey vulture mimic. Flies with wings uptilted and often with turkey vultures. Feeds on small mammals, reptiles, and birds.

Habitat: Wooded canyons and along rivers.

Similar Species: The turkey vulture is somewhat larger than the zone-tailed hawk. The turkey vulture adult has a red head and whitish bill. Look for yellow bill and black head on adult zone-tailed hawk.

Song: None. Call is a squealing whistle.

Vireonidae: Vireo Family

Bell's Vireo (*Vireo bellii*)

For a complete description and account of this species, see Appendix 8.

Ptilogonatidae: Silky Flycatcher Family

Phainopepla (*Phainopepla nitens*)

For a complete description and account of this species, see Appendix 8.

Conclusion and Management Recommendations

Generally speaking, the monument avifauna appears to be fairly well known, but the ecology and seasonal distribution within the monument is poorly understood. The use of riparian areas and water sources by birds is not completely known. The potential impacts that the Roosevelt Lake construction has had and the increase in visitation to the area need to be examined with regards to local bird abundance and diversity. The relationship of key habitats and avian use of these habitats still needs to be assessed.

Many of the current bird censusing methodologies available are either too complicated or too costly to implement at Tonto NM. The current monument staff lacks a dedicated position in resource management and would be hard pressed to implement a comprehensive monitoring program. Funding for a more intensive monitoring program beyond that recommended here is unlikely in the near future. Training can be both costly and time consuming and is too cumbersome given the present staff's qualifications and workload. An extensive long-term monitoring program would be difficult to maintain in a consistent manner.

A complete monitoring program should include a combination of both population and demographic studies (Ralph et al. 1993). The proposed methods will only provide information on presence and absence and relative numbers of bird species, not absolute densities. Demographic information is needed and will yield more useful data in terms of recruitment, parasitism rates, and nesting success of local bird species.

Ideally, if funding and staffing are available, censuses should be made at all 10 monitoring stations as addressed under Season for Censusing. Road surveys should be done a minimum of 3 times during the breeding season. Because this monitoring program demands a somewhat heavy workload and commitment on current monument personnel, Tonto NM management and SOAR should consider having an individual or teams of biologists or resource management personnel from the state or other NPS area conduct annual censuses. Preference should be given to those persons who will be able to provide continuity and consistency to the program until the time when monument staff can conduct such census work. Managers must be aware that a qualified graduate student or scientist from one of the Arizona universities may not be available to conduct the program every year nor have the funding to complete such work.

We recommend the monument do the following:

Contract a professional to monitor all 10 point count stations and do the road survey intensively for 3 years, then once every 5 years. Have a professional analyze data to determine trends, if any.

An evaluation of the effectiveness of the program recommended here will be needed at a later date to see if the methods selected meet Tonto NM management needs and goals. Managers may desire to contract researchers to experiment with other monitoring techniques addressed in the

Monitoring Methods Considered and Selected section, particularly with a demographic census type.

Additionally, professional specialists should be contracted to complete the projects below in the following order of priority:

1. Integrate geographic information systems data from Tonto NM and develop a comprehensive database for collecting and storing monitoring program information; general observations records; and voucher specimen information in a usable format. Consult The University of Arizona, Advanced Resources Technology Lab for advice, design, and format.
2. Focused study on avifauna of the riparian area (#223-TBP) designed to identify and count all birds in this corridor.
3. Focused study on effects of nest parasitism to local avifauna (especially on neotropical migrants).
4. Focused study on competition between nonnative species and native bird species within the monument.

Additionally, Tonto NM staff should consider the following as staffing and funding allow:

1. Use caution while conducting visitor programs and maintenance related activities during the breeding season and avoid causing disturbances around suspected nest sites. This is especially important during drought years, when nesting success is often low and added stress can cause nest failure.
2. Continue working with researchers to coordinate further bird studies and monitoring with other vegetation and faunal monitoring.
3. Continue adding observation records to the monument observation card system but improve quality of entries by insisting on more detailed descriptions, particularly for rarer species. Encourage visitor involvement. There is little information regarding seasonal abundance for most species. Dates for migrants and nesting dates for breeding species are very important and need to be obtained.
4. Update and maintain accuracy of the bibliographic database using Pro-Cite software. Augment database with new bird literature from professional journal articles and publications, the National Park Service, USGS-Biological Resources Division (former National Biological Service), Arizona Game and Fish Department, and other agencies as needed.
5. Continue adding information to species summaries notebook but make sure this information is eventually included in a manageable database for analysis purposes.

6. Continue to take or obtain quality diagnostic photographs of bird species within the monument, and experiment with the Trailmaster camera to get these photos. Photos should include adults, subadults, juveniles, nestlings, hatchlings, eggs, nests, and habitat where possible without intrusion during nesting. Refer to the field cross-reference list and photo notebooks to determine photo needs.
7. Cooperate with Tonto NF, Wildlife Biologist, Roosevelt Ranger District and discuss issues affecting local avifauna.
8. Update field checklist regularly and have it reviewed by professional ornithologists and advanced birders (e.g., Arizona Bird Committee) for accuracy.
9. Contact electronic mail coordinator to receive current bird information from NPS Migratory Birds at NP—WASO and WR NPS Migratory Birds at NP—WR bulletin boards using cc:Mail.
10. February 4, 1999 Cooperate with state agencies to provide them with information from the proposed monitoring at Tonto NM to improve knowledge of distribution and nesting information for birds in the state, particularly those species on the list of Wildlife of Special Concern in Arizona.
11. Review *American Birds*, Southwestern Region Highlights section from 1955 to present. Include all Tonto NM, Roosevelt, Roosevelt Lake, or Globe references in individual species summary sheets.
12. Continue gathering accurate weather station information and make data available to researchers. Develop database for weather information.
13. Duplicate spotted-owl video (see E. Colyott) for monument's permanent library. Enter video information in Pro-Cite bibliography.

Monument staff can seek help from researchers and professionals to complete the following, if funds and staff permit. We recommend these be done only if the above objectives are met:

- Do winter bird censuses at all 10 monitoring stations.
- Analyze habitat types and physical attributes of all 10 monitoring stations.
- Get involved in the state of Arizona Partners in Flight program.
- Seek additional information on the state Breeding Bird Atlas program from Arizona Game and Fish Department.
- Gather and analyze seasonal distribution data for all species, but especially breeding birds within the monument.
- Experiment with new bioacoustics monitoring technique for censusing birds.

Monitoring Protocols

The following is modified from van Riper et al. (1988) and Ralph et al. (1993):

Personnel

A single observer who is capable of identifying monument birds by sight and song should be used. Although more than 1 person may be involved in censusing, this adds another variable when comparing Tonto NM censuses to most censuses in the literature, unless the census is conducted as a training session. In addition, if 2 individuals census 1 plot, then all plots should be censused with 2 persons to reduce the variables in the study design. It is best if the same person censuses all plots, further reducing the variables. However, if this is impractical, it is a good practice to use person A on 1 plot and person B on another; then on the following census, switch personnel and compare results. An observer unfamiliar with any of the birds should conduct practice sessions (i.e., practice at a few of the monitoring stations and identify the birds encountered) before attempting actual censuses. Training of personnel should be conducted before each field season. In addition to outdoor practice sessions, listening to tapes of local bird songs and calls and testing staff members of their visual identification skills should be conducted by a skilled monument staff member, competent birder, or scientist prior to the census season. Customized tapes can be made of breeding birds at Tonto NM by monument staff if equipment and money is available and will greatly enhance the training process prior to taking censuses. The field checklist and monitoring handbook should be carefully studied by all personnel involved in the monitoring program.

Materials and Equipment

The following are essential for monitoring birds:

- Point count data form (Appendix 5)
- Road survey data form (Appendix 6)
- Monitoring stations location map (Appendix 3) and directions to plots included in this handbook
- Pencils (No. 2 preferred)
- Celsius thermometer
- Clipboard
- Bird recordings [*A Field Guide to Western Birds* (Peterson 1990) or *Field Guide to the Birds of North America* (National Geographic 1988) accompanying CDs or cassette tapes are recommended] [Note: CDs usually provide better quality recordings.]
- Tape recorder with microphone or CD player
- Binoculars (7 or 8 X 40 or 10 X 50; or similar size and power optics, good under low light conditions are recommended)
- Spotting scope (60 mm with zoom lens) with a car window mount
- Bird field guide [*A Field Guide to Western Birds* (Peterson 1990); *Field Guide to the Birds of North America* (National Geographic 1988), or *A Guide to Field Identification Birds of North*

America (Robbins et al. 1983) are recommended. It can be helpful to use all 3 guides when there are confusing field marks for an individual bird.]

Season and Timing of Monitoring

April is the best month to begin censusing in the monument. In the southwestern United States or coastal southern California, where 90% of the species have begun nesting activities by mid to late March, the starting date could be April 1 or 10 (Ralph et al. 1993). No single census will detect all of the breeding bird activity, since some species, especially in this part of the country, breed as early as January or February and as late as August, while some summer residents do not arrive in the monument until April or May (K. Hiatt, unpublished data). Some species are known to breed year-round in Arizona if conditions are optimal, such as the lesser goldfinch which has a prolonged and irregular breeding season from January to November (Monson and Phillips 1981).

Ideally, point counts should start in the third or fourth week of March and extend into June. Censuses can be done 3 times per month during the breeding season or 1 census during each 10-day period during a given month. This interval allows at least 1 weekend for making up for inclement weather, and divides the month into 3 approximately equal portions. It also provides a basis for direct comparison between stations (Ralph et al. 1993). The road survey should be done 3 times during the breeding season beginning in late March with no longer than a 2-week break between censuses. It should take about 2 hours on 2 consecutive mornings to complete all 10 stations and approximately 1 hour to complete the road survey. The timing of the census of each route should be kept constant from year to year; it should not differ by more than 7 days from the date of the first count. The start of the count should not differ by more than 30 minutes from that of the first year. If possible, the same observer should census the route every year (Ralph et al. 1993).

Census Conditions and Rules

Certain census conditions and rules apply when conducting point counts or the road survey. The following conditions must be met before a valid census can be conducted:

(Adapted from van Riper et al. 1988)

- Wind is 16 km per hour or less
 - It is not raining heavily; light rain, mist is OK
 - No one (visitors, staff, or census taker) has walked on or through the census point/monitoring plot within a 30-minute period prior to the count.
 - Only 1 observer conducts each census. No additional persons may accompany the observer unless the census is considered a training session and is so labeled on the data sheet.
 - The avian census must be the only priority of the count. No other business should be conducted (e.g., collecting plants, transporting materials) that affects the pace at which you cover the census route or interferes with your identification of birds.
1. Advise all monument divisions of upcoming census and make census schedule available to all staff so that conflicting activities (e.g., maintenance repairs, ruins tours) do not disturb

census counts. If possible, close monument road to traffic while censusing points between the entrance gate at Highway 88 and the visitor center.

2. Wear earth tones (browns, greens, dark blues, grays), rather than brightly colored (red, yellow, whites, etc.) clothing, of natural fibers (i.e., no nylon). This includes hats. Do not wear jewelry.
3. Breeding bird surveys begin at or before sunrise according to the Phoenix sunrise/sunset table (Appendix 7). In general, on the more open plots, bird activity begins just before sunrise and tapers off within 3 hours after sunrise. In the census points/monitoring stations in the higher riparian area of Cave Canyon and in the deciduous woodland, activity starts later, especially on cool mornings. Plots at the Upper and Lower ruins should be done early because the sun hits these steep slopes earlier than it reaches some of the lower riparian and canyon sites. Plots #217-TBP to #222-TBP can easily be done in 1 morning. Due to extended hiking time, the Upper and Lower ruins stations and plots #223-TBP and #224-TBP can be done on the second morning with the third morning available for the census taker to complete the road survey.
4. Censusing the same plot 2 days in a row, or with only 1 or 2 days between censuses, allows a check on how much variation is occurring in census results. By alternating census takers on plots; you can check for variability in censusing rather than in breeding bird populations. By providing the second census taker with a map of the birds observed on the previous census, an additional check on integrity of the censusing methodology can be made. Waiting 3 or more weeks between censusing on a given plot increases the probability of individual birds leaving or entering the plot during the interim.
5. Prior to official censusing, all 10 point count stations should be inspected annually to maintain monitoring stations. Make sure rebar and plot tags are in good shape and note any disturbances in the area. Flagging marking 50 m north and south and 50 m east and west from the center of the plot can be done prior to the annual census period to aid census taker in determining limits of each plot.

Census Methods

Point count

1. Use a separate data form for each point count/variable circular plot at monitoring stations (see Appendix 5). Follow instructions for completing form in Appendix 5.
2. Stand in the center of the monitoring station at or near the tagged rebar. Record all birds heard or seen within a 50 m radius of where you are standing. Note general compass direction of each individual bird seen or heard. Indicate on the data sheet if the bird was seen or heard. If heard, indicate if the bird is a singing male or if the bird is calling. Record sightings and sounds for a period of 10 minutes. Pause only to confirm the identification of a bird.

3. Record all sightings of breeding species seen or heard within the plot. Tally the number of individuals seen for each species. Generally count only those birds detected in the area directly to the sides of or in front of the observer. Do not count birds detected behind you unless you are certain that you did not count that individual bird earlier.
4. Birds should be counted if they are in vegetation, on the ground, or in flight. Flying birds may be counted at any height, as long as they are over the monitoring station within the 50 m radius of where you are standing.
5. Avoid counting the same bird more than once. In some instances several different species of birds or a family of the same species may be in the same bush or tree at the same time. For example, if you see a bird fly into a bush ahead of you, list it. If a bird of the same species flies out, it is reasonable to assume this is the same bird unless you see another of the same species at the bush. If you cannot reasonably assume that you have already counted a particular individual bird consider it a separate sighting. Be careful with counting species that flock (e.g., house finch) and try to get as accurate a count as possible.
6. Birds may be detected by song if songs or call notes are clearly heard and recognized. Try to visually locate the singing bird. If the bird cannot be seen, try to estimate the distance and list it as a sighting only if you are reasonably certain it is within the plot. Be careful with kinglets, gnatcatchers, thrushes, wrens, and orioles because females of these species often sing, with frequent repetition.
7. Record on the data sheets both nonbreeding and breeding species seen within the plot and outside the plot. Do not spend time tallying the number seen if it interferes with counting breeding species, but a rough estimate may be included at the end of the day. Remember: The goal is not the largest count possible but the most accurate count possible. Do not list a bird unless you are sure of its identification, and do not include birds outside the plot because you think that you do not have enough. An inflated count is as deceptive as a deflated count. The accuracy and integrity of the count can only be maintained by rigorously following the established count procedures, thereby minimizing variations in methodology.
8. If a bird is seen or heard but not identified before it leaves the monitoring station area, it is recorded as an unknown individual. If the genus is known, but not the species, indicate this on the data form (e.g., unknown dove) or lump together (e.g., hummingbird spp.). Unknowns are counted as individual species in richness and diversity tabulations only if it was certain that the bird species was different from all others observed during that particular census.
9. Remember: individual census results can be affected by denseness of vegetation, slope, or other conditions.
10. Record nest-building and other similar activities. Indicate nest locality on the data sheets by drawing a sketch of the plot and indicating compass direction.

11. Movements of birds within the plot are useful to determine direction or territory. Use an arrow and draw a rough sketch of the plot to indicate individual bird's movements. Be sure to indicate compass direction and distances.
12. Become familiar with song mimics such as members of the Mimidae family (thrashers, northern mockingbird) and members of the Troglodytidae family (cactus, rock, canyon, and Bewick's wrens), all of which are found in the monument and can be confusing to personnel conducting the census.

Road survey

1. Use 1 data form for the entire road survey and follow the instructions for completing the form (see Appendix 6).
2. Begin within the 3-hour time frame after sunrise and plan to finish within that time frame. This census should take an average of 1 hour. You should start at the approximately the same time for each subsequent census (e.g., 1 hour after sunrise). Larger birds, especially vultures and hawks are not as active as other birds at or before sunrise. They require warm air currents to soar, and this usually does not occur until sometime after sunrise. However, do not wait too late in the morning, because temperatures can be very hot early in the day in May and June. Smaller birds, such as purple martins and western kingbirds appear to be more active earlier in the morning than the larger bird species. If you wait too long, your chances of detecting the smaller birds using the wires and power towers along the route may diminish.
3. Begin at Milepost 248 on Highway 88 and Forest Service Road 83 (T.3N, R.12E, Sec 1 on Windy Hill USGS topographical map and see Appendix 4). Note any birds on the metal power towers and associated wires along the south side of Highway 88. Begin with Power Pole #1-East on the data sheet and drive west along Highway 88, recording all birds seen or heard along the route. Note any birds heard or seen as you drive along the route. Record birds seen crossing Highway 88 and reference their location to a power tower (e.g., greater roadrunner ran east to west across Highway 88 halfway between power pole 3 West and 4 West).
4. Record any nest-building behavior, adults incubating or feeding young, nestlings, fledglings, juveniles, or adults in the vicinity of the towers and along the route. Spend enough time at each tower to determine species but proceed at a steady rate along the route. Be extremely careful when pulling off the side of Highway 88, as shoulders are almost non-existent in most places.
5. Use a spotting scope (suggest 60 mm with zoom or better) attached to a car window mount or use binoculars with sufficient power to see tower tops clearly (suggest 10 X 50) to determine species, if needed. Some red-tail hawk adults and juveniles can be confused with other hawk species, particularly in the early spring during migration.
6. Avoid counting the same bird more than once.

Data Management

Data management for the monitoring program includes (1) data input derived from point counts at monitoring stations, (2) data input derived from road survey censuses, (3) general observation cards (NPS Form 10-257), and (4) general nest records.

Point Count and Road Survey Data Forms

Point count data forms are designed to allow rapid, accurate tallying of the number of birds detected during point counts at monitoring stations and the road survey. A data form for each census method and detailed instructions for their completion are found in Appendices 5 and 6.

Data forms are collected immediately following each census. Data will be entered into a Tonto NM database management system using either dBase IV or Fox Pro or other convertible database application.

Reporting of data is done each year with tables, graphs, and written comments. Format for reporting should follow current NPS report format guidelines and manuscript review. Data are orally presented each year of monitoring to the entire park staff to obtain input from all divisions on potential impacts (e.g., shifts in species distributions or numbers on a particular plot). If 3 consecutive station counts show a continuing drastic reduction in numbers of any breeding bird species, professional scientists should be contacted immediately (Johnson 1995).

Annual Report

An annual report, similar in style and content to the Organ Pipe Cactus National Monument, Ecological Monitoring Program Annual Report 1993 (National Park Service 1995) should be prepared and submitted for review to appropriate researchers and NPS offices.

General Observations (Staff/Visitors)

The completion of Form 10-257, the NPS wildlife observation card, should be encouraged. Monument staff should emphasize to visitors and other interested persons the need to obtain additional records on birds in the monument to update the field checklist and to determine if changes are occurring with various species. It is especially helpful to future researchers to obtain records of particularly secretive or rare species, provided that the information on these forms is very specific. Drawings, sketches, comments on plumage, age, behavior, nests and vegetation will help researchers determine if a particular record is reliable.

Voucher Information

A list of institutions and universities having specimens from Tonto NM or the immediate area is provided to the monument in notebook form. Curators and/or Collection Managers from these institutions were contacted during 1994-95. Additional information is pending from several of these institutions. One institution required payment to complete a search for specimens from Tonto NM or Gila County. Because there was no guarantee that this collection contained Tonto NM or Gila County specimens, we did not request a search during this study.

Bibliographic Database

An extensive bibliography was compiled by the NPS, WACC library staff, and the CPSU/UA staff in 1992. Searches were done in park files as well as in BIOSIS, AGRICOLA, Zoological Record On-Line, and Dissertation Abstracts bibliographic databases (Bennett 1992). In addition to these 111 citations, we developed a bird-specific bibliographic database using Pro-Cite software, which in June 1996 had 370 citations relating to the inventory and monitoring project. Park staff can easily augment this database as can future researchers. Format for data entry should conform to:

Mallos Woods, D., ed. 1994. Pro-Cite in the National Park Service. Department of the Interior, National Park Service, Library Advisory Committee, Washington, D.C. 1 volume.

Directions and Descriptions of Monitoring Stations and Road Survey

The 10 monitoring stations are set up in a systematic manner to allow a broad sample of the monument, while at the same time, to reduce the probability of censusing the same birds twice. All plots are a minimum of 300 m apart from an adjacent plot and in some cases are more than 500 m from another station (e.g., Upper or Lower Ruin plots). All plots are 100 m in diameter. The observer stands at the center of the plot during each point count census. The road survey is 5 km along Highway 88. Initially, monitoring stations were numbered KLH-Temporary Bird Plot (TBP)-#1-9. A tenth plot was established after the others. Permanent tags numbering #217-TBP to #224-TBP were later installed. The Upper and Lower ruins were never numbered because of their cultural features. Each monitoring plot description includes information on elevation at the center of the plot.

Figures 1-11 describe the 10 monitoring stations and the road survey transect to use in the recommended monitoring program. Census takers should also refer to Appendices 2-4.



Figure 1. Middle of Old Park Road in "North 40" Plot (formerly KLH-TBP-1). General area is within the "North 40" of the monument along the old entrance road that extends north and south. From metal gate near the Tonto NM main entrance sign located on the north side of Highway 88, walk north to the stake in the middle of the road. The center of Plot #218-TBP is 150 m from the gate. The area is a lower bajada and slopes gradually north towards Roosevelt Lake. The vegetation is the foothill paloverde-wolfberry-jojoba subassociation of the Arizona Upland. Important species are *Cercidium microphyllum*, *Prosopis velutina*, *Simmondsia chinensis*, and *Acacia greggii*. Elevation is 828 m.



Figure 2. Northernmost Plot (formerly KLH-TBP-2). Also within the "North 40" area, this is the northernmost plot in the monument. Plot #217-TBP is west of and relatively close to Mammal Grid #1. This plot is 300 m north (18° magnetic or 5° true) of the middle of old park road in "North 40" plot [#218-TBP] (see above). Plot is north of old Highway 88, which bisects the "North 40" area of the monument east to west. North bearing taken on line with small, sharply pointed peak in the Sierra Ancha Mountains. The plot center is 400 m north of the metal gate described above. Stake is on the north side of a cholla that stands about 2 m. A small *Carnegiea gigantea* is located on the western edge of the plot. Elevation is 700 m. The vegetation is the foothill paloverde-wolfberry-jojoba subassociation of the Arizona Upland. Important species are *Cercidium microphyllum*, *Prosopis velutina*, *Lysium fremontii*, and *Opuntia* spp. This plot is located in an alluvial plain and is very open with seasonal grasses below and between vegetation.



Figure 3. Park Entrance and Highway 88 Plot (formerly KLH-TBP-3). Plot #219-TBP is 150 m south of intersection of the park entrance gate and monument road. The stake is on the west side of the road and 11 m from the center of the road at 294° (true north). Center of the road is the center of the plot. The vegetation is the foothill paloverde-wolfberry-jojoba subassociation of the Arizona Upland. Important species are *Cercidium microphyllum*, *Prosopis velutina*, *Simmondsia chinensis*, and *Acacia greggii*.

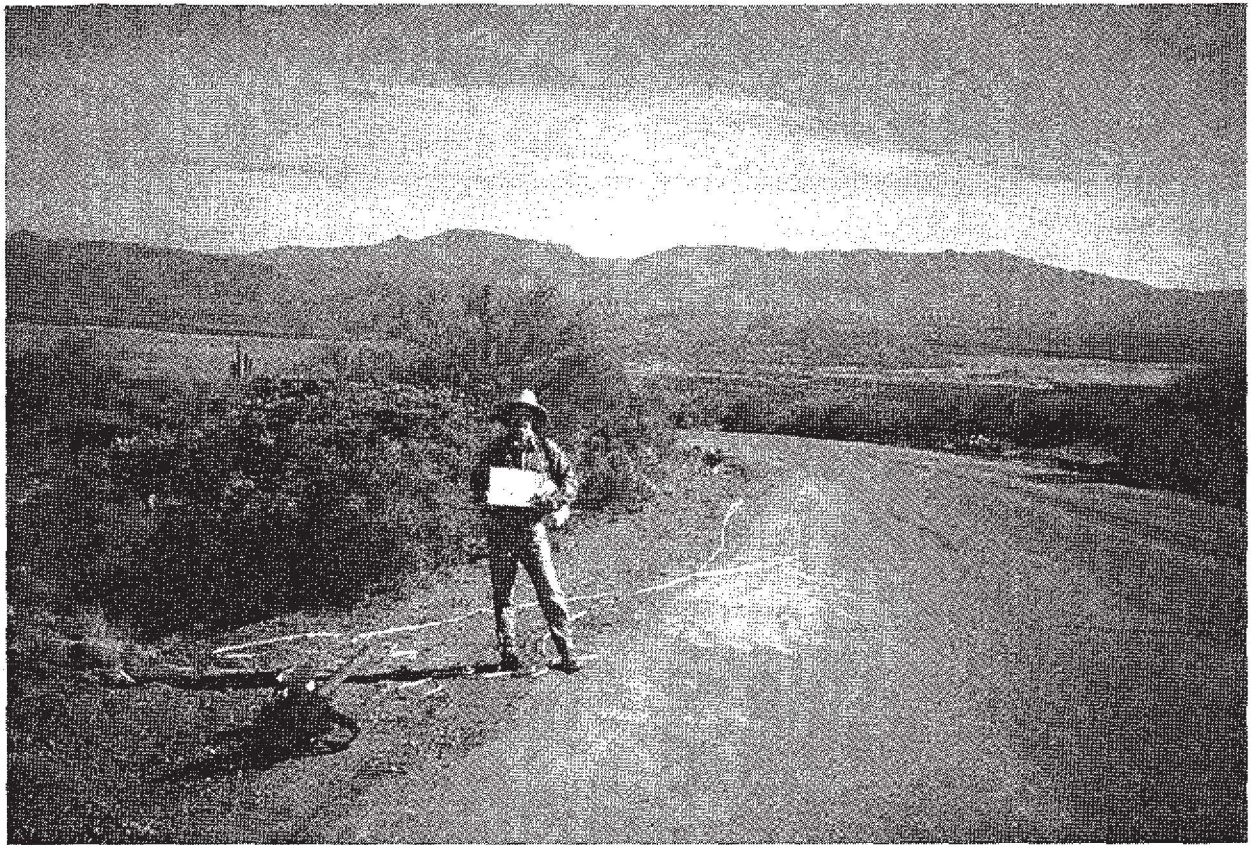


Figure 4. Residential Area Plot (formerly KLH-TBP-4). Plot #220-TBP is 550 m south of the monument main entrance gate (near Highway 88), along the monument road. General vicinity of the plot is west of the housing area. Center of the plot is the center of the road. Stake is 16.5 m west of the center of the road at 292° WEST (true north) on the west side of a jojoba (*Simmondsia chinensis*). The vegetation is the foothill paloverde-wolfberry-jojoba subassociation of the Arizona Upland. Important species include *Cercidium microphyllum*, *Simmondsia chinensis*, *Lycium fremontii*, *Opuntia* spp. and *Carnegeia gigantea*.

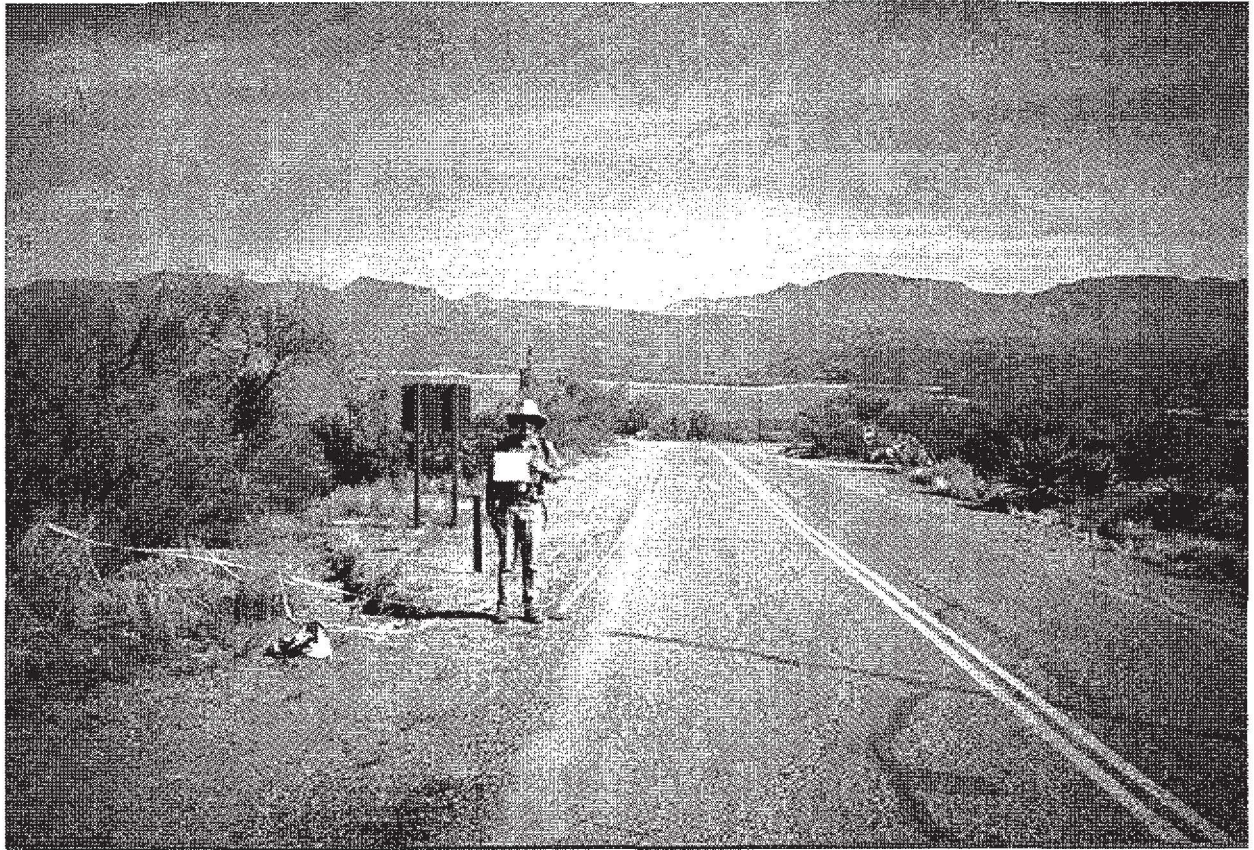


Figure 5. Picnic Area Plot (formerly KLH-TBP-5). Plot #221-TBP includes part of the picnic area and part of the Cave Canyon riparian drainage. This station is 300 m south of the Residential Area Plot (#220-TBP) and is approximately halfway between the entrance and exit driveways of the picnic area along the monument road. Stake is 10.5 m from the center of the road and 292° WEST of the center of the road. Center of the plot is the center of the road. The vegetation is the jojoba-brittlebush-broom snakeweed-wild buckwheat subassociation of the Arizona Upland. The important species are *Simmondsia chinensis*, *Encelia farinosa*, *Gutierrezia sarothae*, *Opuntia bigelovii*, and *Dasyllirion wheeleri*.



Figure 6. North of Pump house Plot (formerly KLH-TBP-6). Plot #222-TBP is 300 m south of the Picnic Area Plot (#221-TBP) next to a telephone pole and near a cable box. The telephone pole is the last one on west side of the road north of the pump house and near the drain pipe that runs under the roadway (Cave Canyon drainage). The stake is 6.5 m from the center of the road at 290° under a mesquite. The vegetation is the jojoba-velvet mesquite-catclaw association of the desert riparian scrub association, mesquite series. The most important tree species is *Prosopis velutina*, particularly on the east side of the plot. Steep, east- and west-facing hillsides on either side of the plot are covered with Arizona Upland vegetation with *Cercidium microphyllum*, *Simmondsia chinensis*, *Encelia farinosa*, and *Lycium fremontii*.



Figure 7. Deciduous Riparian Plot (formerly KLH-TBP-7). Plot #223-TBP is located near the center of the deciduous riparian community along Upper Ruin Trail. The stake is 52.5 m south from the locked gate and fence line south of the trailhead. The stake is located 2.75 m west from the center of the trail on a slight hillside in tall grass (watch for snakes!). The center of the trail is the center of the plot. The vegetation is the Arizona sycamore-Arizona walnut-Blue wild rye-Net-leaf hackberry subassociation of the Interior Riparian Deciduous Woodland. The important species are *Platanus wrightii*, *Juglans major*, and *Celtis reticulata*.



Figure 8. Upper Ruin Plot (formerly KLH-TBP- 8). Located at Upper Ruin. There is no rebar and tag for this plot, but the plot is number TBP-225 for mapping and information purposes. The center of the plot is at the NPS benchmark on the rock southeast of the ruins near the entrance gate. The vegetation is the globe mallow-desert straw-desert needlegrass-Lehmann's lovegrass-jojoba subassociation of the Arizona Upland. The important species are *Simmondsia chinensis*, *Prosopis velutina*, and *Sphaeralcea emoryi*, *Stipa speciosa*, and *Eragrostis lehmanniana*.

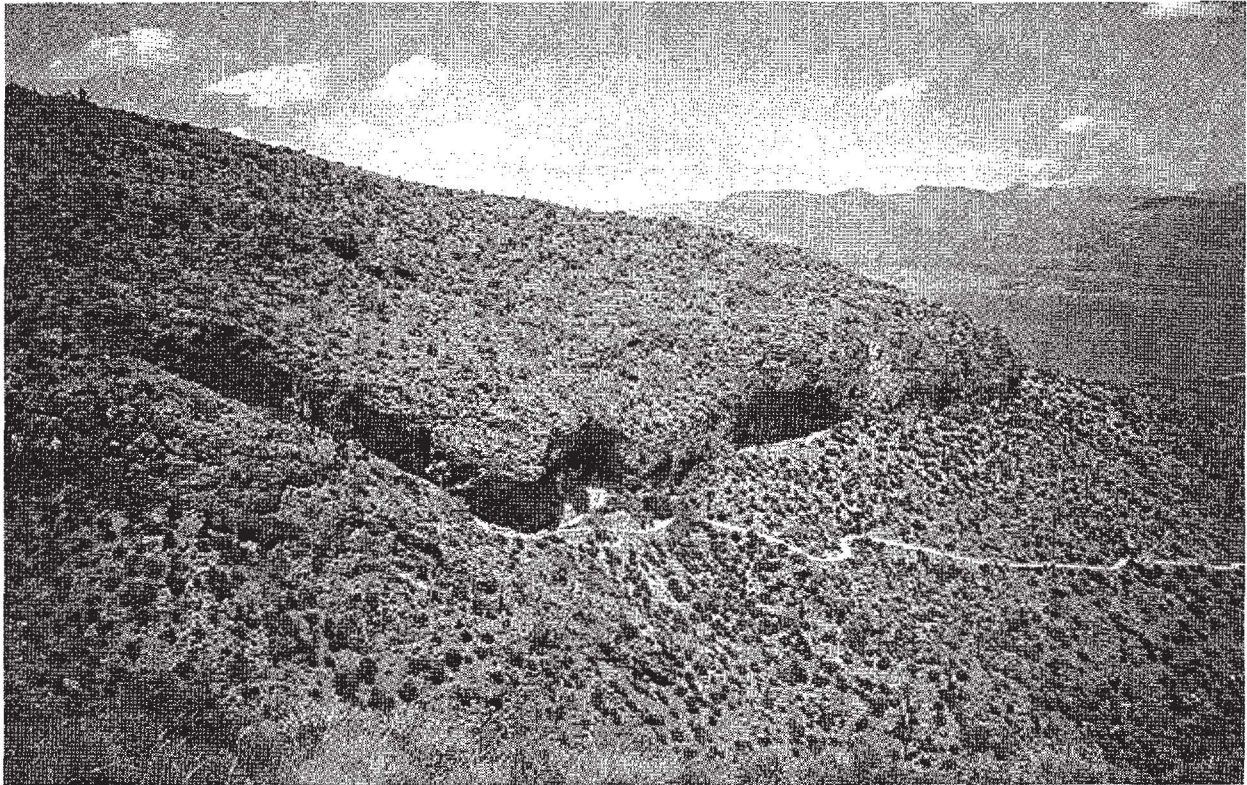


Figure 9. Lower Ruin Plot (formerly KLH-TBP-9). The plot is located at Lower Ruin. There is no rebar or number for this plot, however, the plot is numbered TBP-226 for mapping and information purposes. Stand at the top of the handrail. The vegetation is the jojoba-foothill paloverde-three-awn-spike moss subassociation of the Arizona Upland. The important species are *Simmondsia chinensis*, *Cercidium microphyllum*, *Prosopis velutina*, *Opuntia bigelovii*, and *Carnegiea gigantea*.

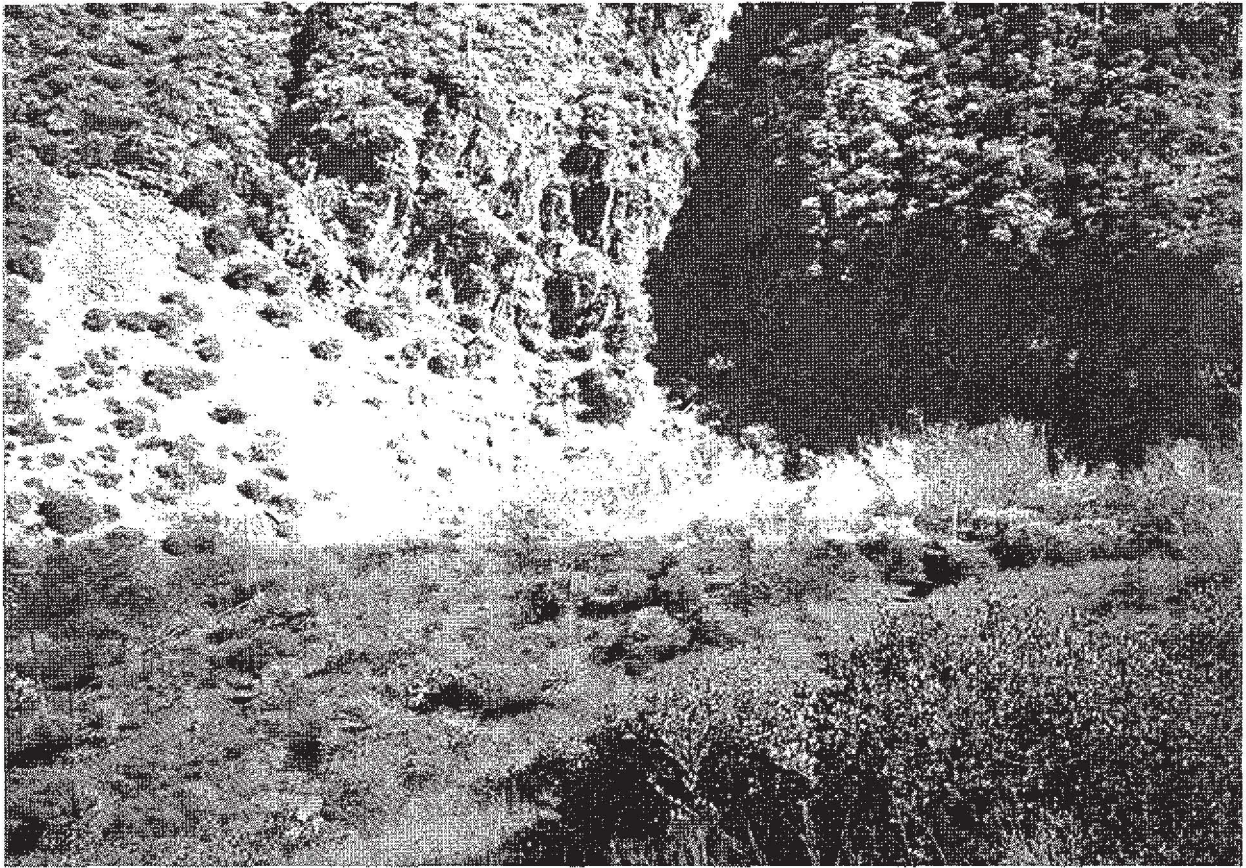


Figure 10. Upper Riparian Area at South Boundary Fence Plot (formerly KLH-TBP-10). Plot #224-TBP at the southern end of Cave Canyon is near the south boundary fence, along Upper Ruin Trail. The center of the plot is marked by rebar located 7.7 m from the boundary fence. The vegetation is the jojoba-velvet mesquite-catchlaw subassociation of the desert riparian scrub association, mesquite series. The important species are *Prosopis velutina*, *Dasyllirion wheeleri*, *Acacia greggii*, *Juniperus erythrocarpa*, and *Simmondsia chinensis*.

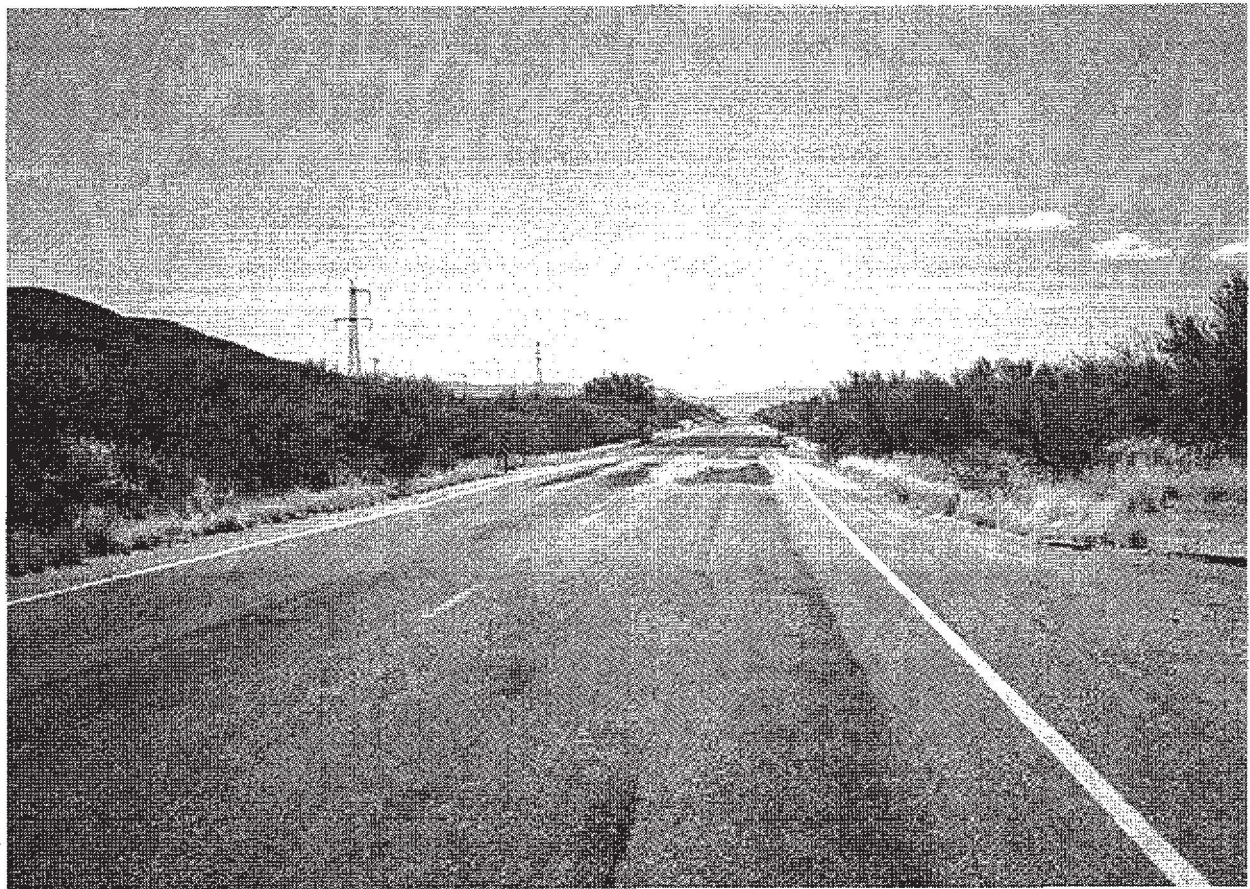


Figure 11. Road Survey. See description above under Methods section and Appendix 4. Highway 88 is a gently rolling, secondary 2-lane road along the southern end of Roosevelt Lake. The survey begins on a dirt, tertiary USFS road. Highway 88 bisects the northern end of the monument, and the survey continues west to approximately the entrance to the Bureau of Reclamation compound east of the town of Roosevelt. Large metal power towers and lines are located along the route at approximately 0.16 km intervals on the south side of the road. The vegetation that is traversed is the Arizona Upland with *Cercidium microphyllum*, *Carnegiea gigantea*, and a host of other shrubs and cacti. Several mesquite-dominated riparian areas associated with large drainages are along the route.

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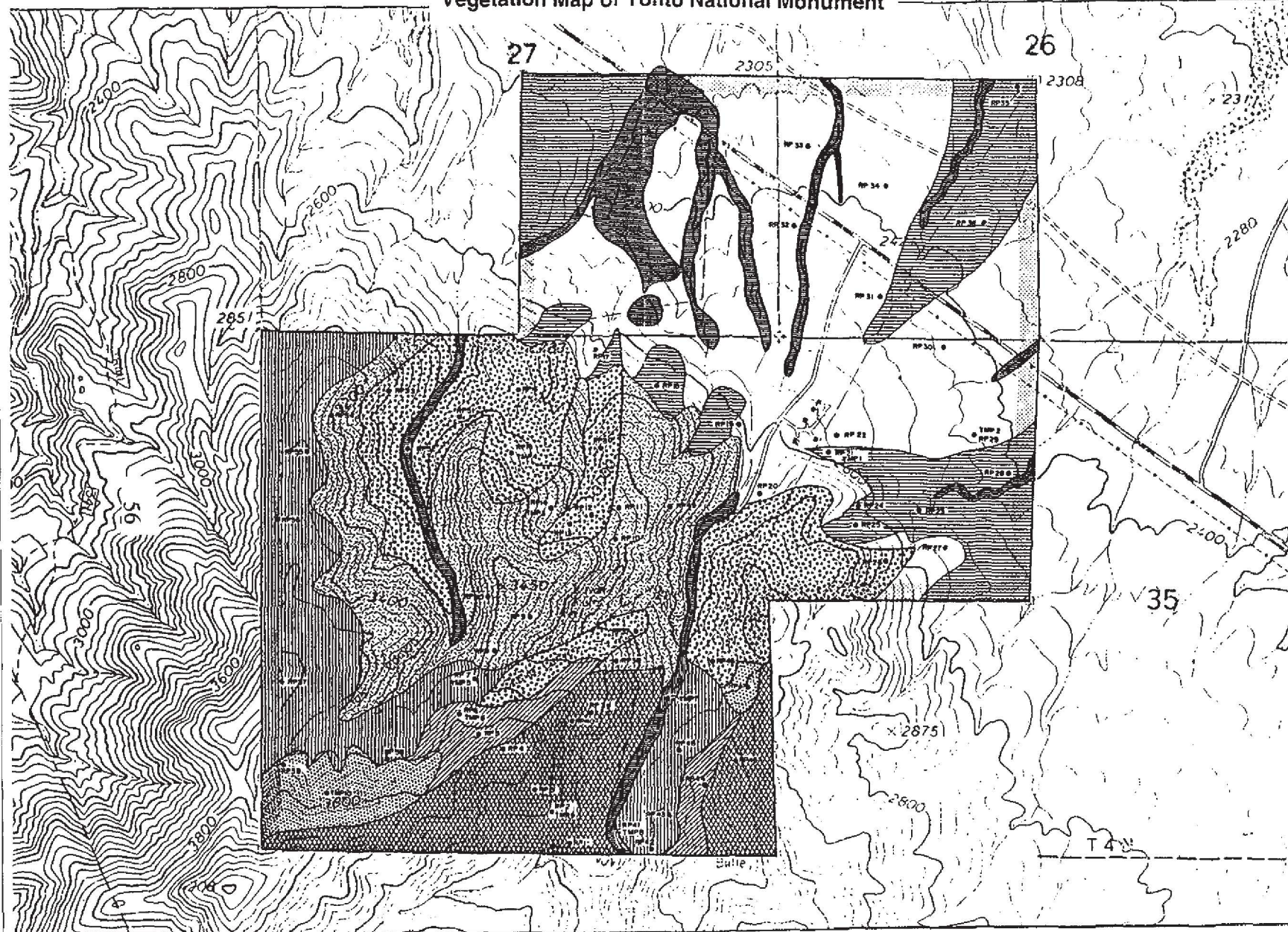
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GILA COUNTY, ARIZONA



Appendix 2
Vegetation Map of Tonto National Monument



KEY TO THE VEGETATION MAP*

- SONORAN WOODLAND**
124 7121 Sich-Prva-Acsp
- INTERIOR CHAPARRAL**
133 3421 Cemo-Duro-Sisp
- GRASSLAND - SCRUB**
143 1551 Spem-Sisp-Spo-Sich
143 1552 Dura-Gula-Bacu-Spem
- ARIZONA UPLANDS**
154 1231 Sich-Lyfe-Gula
154 1232 Cemo-Lyfe-Sich
154 1234 Sich-Erfa-Gula
154 1235 Sich-Cemo-Arpa-Seda
154 1236 Spem-Sich-Bacu

- INTERIOR RIPARIAN DECIDUOUS WOODLAND**
225 2221 Phor-Juma-Erfa-Cere

- RPS Relief Plots
• RMP Permanent Monitoring Plots

*Refer to list for species code list.
(Classification follows Whittaker et al., 1966 and Brown 1982.)



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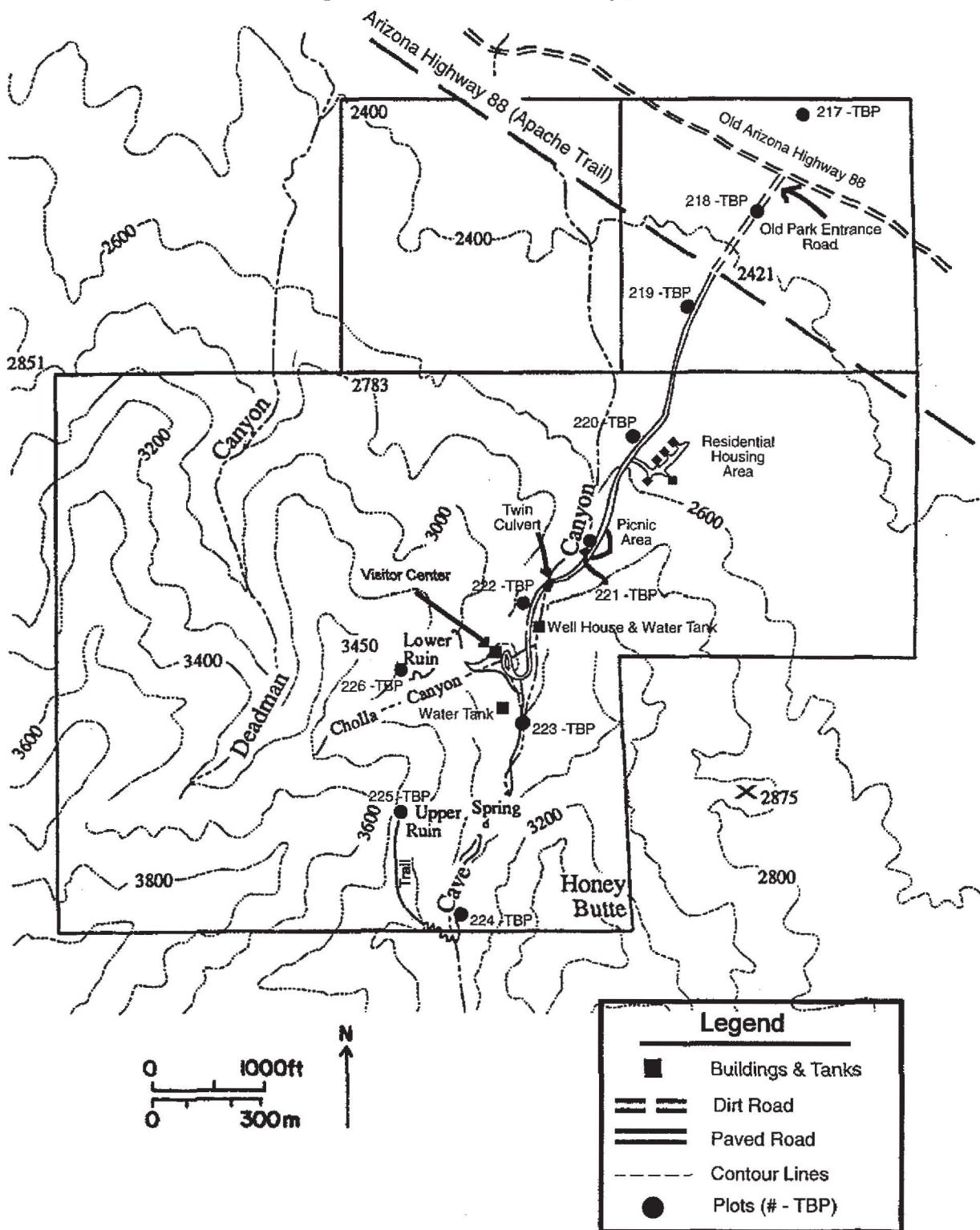
TONTO NATIONAL MONUMENT

Gila County, Arizona
National Park Service, Department of Interior

LEGEND

- NPS Boundary
--- Power Line
● Well & Pump House
● Water Tower
--- Water Trough
--- Corral Guard
--- Cave
--- Structure
--- Spring
--- Trail
--- Fenceline
--- Paved Road
--- Improved Dirt Road
--- Dirt Road

Appendix 3
Monitoring Stations Location Map, Tonto NM



Appendix 5

Point Count Data Form

The following field data form is to be photocopied and used in the actual monitoring fieldwork. The form is designed to allow rapid, accurate tallying of the number of birds detected during point count (or variable circular-plot) monitoring. Instructions and data form are adapted from Johnson (1995). Using a No. 2 lead pencil, complete the top portion of the form as follows:

1. Observer. Record your name. Only 1 observer conducts each census. No additional persons may accompany the observer unless the census is considered a training session and is so labeled.
2. Date. The date (month, day, year) that the census is conducted.
3. Time start. Record the time that you actually begin the census. Use military time (24-hr clock).
4. Time end. Record the time that you actually finish the census. Use military time (24-hr clock).
5. Location. Write the number of the study plot that you are monitoring. Use a separate data form for each study plot.
6. Vegetation type. Write the association or subassociation of the study site. See the Plots description section of this report for specific information.
7. Weather. Record the following data concurrently with "Time start" (above):
 - (a) Temperature. Using the thermometer, measure the atmospheric temperature in degrees centigrade.
 - (b) Wind speed. Estimate the average wind speed in miles per hour. If there are gusts, indicate this also. Censusing can only be conducted when wind speed is 10 mph or less.
 - (c) Cloud cover. Estimate the percent of cloud cover or, if foggy, the horizontal visibility.
 - (d) Precipitation. Indicate precipitation, if any (e.g., heavy dew, mist, drizzle, showers, steady or intermittent, etc.). Censusing can only be conducted when it is not raining.
8. Other animal species observed. Record the common name of any other animal observed on the plot or, if taxonomy is known, include the genus and species.

9. Comments. Record any general observations you feel may be relative to the validity of the census (e.g., any loud noise that may frighten birds, passing traffic, etc.).

The remainder of the data form contains areas to record the specifics of birds observed on the plot during the census. The form has been designed to contain up to 50 entries, using both sides. As you conduct the census, record the following information for birds observed:

1. Species. Record the genus and species of any bird observed during the census. (Use Appendix 8), as well as the Field Guide to the Birds of North America (National Geographic Society 1987) or comparable field guide to help identify taxonomy. If taxonomy is unknown, record the common name.
2. Observed. Check only one box in this column. If the bird is observed:
 - (a) on the plot, check the box, "On Pl."
 - (b) off the plot, check the box, "Off Pl."
 - (c) not during census, check the box, "NC".
3. Behavior. Record the activity of the bird observed (e.g., foraging, resting, in flight, etc.). If activity includes nesting or courtship display, see step 4, below.
4. Number seen. Record the number of birds observed for this species. If you detect a flock, estimate the number of individuals, record this, and circle the number.
5. Age/Sex. Record the age of birds seen, if known. Valid age categories are adult (A), juvenile (J), nestling (N), and hatchling (H). Also record the sex, if known.
6. Nesting? Record "Y" if you observe nest-building activity or a completed nest for this species, or "N" if you do not.
7. Courtship display? Record "Y" if you observe courtship display for this species, or "N" if you do not. If uncertain, note behavior specifics.

Upon completion of the census, total the number of birds observed for each species and record this in the left margin, next to the species' name. Total only those birds observed on the plot, that is, "On Pl." checked in second column. (Birds observed off-plot and on or off-plot not during actual census ("NC") are recorded only for documentation and are not included in the actual census data.

Tonto NM Monitoring Program—Avian Species Point Count Data Form

Observer _____

Date (mm/dd/yy) ____/____/____

Time start (2400) _____

Time end (2400) _____

Location (study site name) _____

Vegetation type _____

Weather: _____

Temperature (°C) _____

Wind speed (mph) _____

Cloud cover _____

Precipitation _____

Other animal species observed _____

Comments: _____

	Species	Observed	Behavior	Number seen	Age Sex	Nesting?	Courtship display?
	Spp	On Pl. Off Pl. Off NC	Describe...	##	A, J, N, H M/F	Y/N	Y/N
1		☐ ☐ ☐					
2		☐ ☐ ☐					
3		☐ ☐ ☐					
4		☐ ☐ ☐					
5		☐ ☐ ☐					
6		☐ ☐ ☐					

	Species	Observed	Behavior	Number seen	Age Sex	Nesting?	Courtship display?
	Spp	On Pl. Off Pl. Off NC	Describe...	##	A, J, N, H M/F	Y/N	Y/N
7		☐ ☐ ☐					
8		☐ ☐ ☐					
9		☐ ☐ ☐					
10		☐ ☐ ☐					
11		☐ ☐ ☐					
12		☐ ☐ ☐					
13		☐ ☐ ☐					
14		☐ ☐ ☐					
15		☐ ☐ ☐					
16		☐ ☐ ☐					
17		☐ ☐ ☐					
18		☐ ☐ ☐					

	Species	Observed	Behavior	Number seen	Age Sex	Nesting?	Courtship display?
	Spp	On Pl. Off Pl. Off Pl. NC	Describe...	##	A, J, N, H M/F	Y/N	Y/N
19		☐ ☐ ☐					
20		☐ ☐ ☐					
21		☐ ☐ ☐					
22		☐ ☐ ☐					
23		☐ ☐ ☐					
24		☐ ☐ ☐					
25		☐ ☐ ☐					
26		☐ ☐ ☐					
27		☐ ☐ ☐					

Please make certain that all entries are accurate to the best of your knowledge. Information from these data forms will be compiled and analyzed to determine trends in avian populations at Tonto National Monument.

Appendix 6
Tonto National Monument Avian Species
Road Survey Data Form

The following field data entry form is to be photocopied and used in monitoring fieldwork. The data form is designed to allow rapid, accurate tallying of the number of birds detected during road survey monitoring. Instructions are in part adapted from Johnson (1995). Using a No. 2 lead pencil, complete the top portion of the form as follows:

1. **Observer.** Record your name. Only 1 observer conducts each census. No additional persons may accompany the observer unless the census is considered a training session and is so labeled.
2. **Date.** The date (month, day, year) that the census is conducted.
3. **Time start.** Record the time that you actually begin the census. Use military time (24-hr clock).
4. **Time end.** Record the time that you actually finish the census. Use military time (24-hr clock).
5. **Location.** Write road survey.
6. **Vegetation type.** Write the association or subassociation(s) of the study site. See Plots/Road Survey description section of this report for specific information.
7. **Weather.** Record the following data concurrently with "Time start" (above):
 - (a) **Temperature.** Using the thermometer, measure the atmospheric temperature in degrees centigrade.
 - (b) **Wind speed.** Estimate the average wind speed in miles per hour. If there are gusts, indicate this also. Censusing can only be conducted when wind speed is 10 mph or less.
 - (c) **Cloud cover.** Estimate the percent of cloud cover or, if foggy, the horizontal visibility.
 - (d) **Precipitation.** Indicate precipitation, if any (e.g., heavy dew, mist, drizzle, showers, steady or intermittent, etc.). Censusing can only be conducted when it is not raining.
8. **Other animal species observed.** Record the common name of each species observed along the transect. If known, record the genus and species on the data form next to the common name.

9. Comments. Record any general observations you feel may be relative to the validity of the census (e.g., any loud noise that may frighten birds, passing traffic, etc.).

The remainder of the data form contains areas to record the specifics of birds observed along the road transect during the census. As you conduct the census, record the following information for birds observed:

1. Species. Record the most current common name (refer to the AOU Checklist of North American Birds and supplements) for any bird observed during the census (See also, Appendix 8 and field guides. The addition of proper taxonomic names will assist researchers in analyzing data in the future, should there be a common name discrepancy.
2. Observed. Check only 1 box in this column. If the bird is observed:
 - (a) on the plot, check the box, "On Pl."
 - (b) off the plot, check the box, "Off Pl."
 - (c) not during census, check the box, "NC".
3. Behavior. Record the activity of the bird observed (e.g., foraging, resting, in flight, etc.). If activity includes nesting or courtship display, see step 4, below.
4. Number seen. Record the number of birds observed for this species. If you detect a flock, estimate the number of individuals, record this, and circle the number.
5. Age/Sex. Record the age of birds seen, if known. Valid age categories are adult (A), juvenile (J), nestling (N), and hatchling (H). Also record the sex, if known.
6. Nesting? Record "Y" if you observe nesting activity for this species, or "N" if you do not.
7. Courtship display? Record "Y" if you observe courtship display for this species, or "N" if you do not. If uncertain, note behavior specifics.

Upon completion of the census, total the number of birds observed for each species and record this in the left margin, next to the species' name. Total only those birds observed along the road survey transect during the actual census, that is, "On Pl." checked in second column. (Birds observed off-plot and on or off-plot not during actual census ("NC") are recorded only for documentation and are not included in the actual census data.

**Tonto National Monument
Avian Species
Road Survey Data Form**

Observer _____

Date (mm/dd/yy) ____/____/____

Time start (2400) _____

Time end (2400) _____

Vegetation type _____

Weather:

Temperature (°C) _____

Wind speed (mph) _____

Cloud cover (%) _____

Precipitation _____

Other animal species observed _____

Comments _____

**Tonto National Monument - Avian Species Road Survey Data Form -
Page 1**

POWER POLE ID CODE	TIME (24 Hr Clock)	SPECIES	NUMBER	BEHAVIOR	NESTING (#)	NOTES
E-1						
E-2						
E-3						
E-4						
E-5						
E-6						
E-7						
E-8						
E-9						
E-10						
E-11						

**Tonto National Monument - Avian Species Road Survey Data Form -
Page 2**

POWER POLE ID CODE	TIME (24 Hr Clock)	SPECIES	NUMBER	BEHAVIOR	NESTING (#)	NOTES
E-12						
E-13						
E-14						
E-15						
E-16						
E-17						
E-18						
E-19						

**Tonto National Monument - Avian Species Road Survey Data Form -
Page 3**

POWER POLE ID CODE	TIME (24 Hr Clock)	SPECIES	NUMBER	BEHAVIOR	NESTING (#)	NOTES
W-1						
W-2						
W-3						
W-4						
W-5						
W-6						
W-7						
W-8						
W-9						
W-10						

Please make certain that all entries are accurate to the best of your knowledge. Information from these data forms will be compiled and analyzed to determine trends in avian populations at Tonto National Monument.

Appendix 7
Phoenix Sunrise/Sunset Chart

SUNRISE AND SUNSET AT PHOENIX, ARIZONA
MOUNTAIN STANDARD TIME

NO. 1021

DAY	JAN.		FEB.		MAR.		APR.		MAY		JUNE		JULY		AUG.		SEPT.		OCT.		NOV.		DEC.	
	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.
1	7 32	5 31	7 24	5 59	6 57	6 25	6 16	6 48	5 40	7 11	5 19	7 32	5 22	7 42	5 40	7 28	6 02	6 54	6 22	6 13	6 46	5 37	7 14	5 20
2	7 32	5 32	7 24	6 00	6 56	6 25	6 15	6 49	5 39	7 11	5 19	7 33	5 22	7 42	5 41	7 27	6 02	6 53	6 23	6 12	6 47	5 36	7 15	5 20
3	7 33	5 33	7 23	6 01	6 54	6 26	6 14	6 50	5 38	7 12	5 19	7 34	5 23	7 42	5 42	7 26	6 03	6 51	6 23	6 10	6 48	5 35	7 15	5 20
4	7 33	5 34	7 22	6 02	6 53	6 27	6 12	6 50	5 37	7 13	5 19	7 34	5 23	7 42	5 42	7 25	6 04	6 50	6 24	6 09	6 49	5 34	7 16	5 20
5	7 33	5 34	7 21	6 03	6 52	6 28	6 11	6 51	5 36	7 14	5 18	7 35	5 23	7 41	5 43	7 25	6 04	6 49	6 25	6 08	6 50	5 33	7 17	5 20
6	7 33	5 35	7 21	6 04	6 51	6 29	6 10	6 52	5 35	7 14	5 18	7 35	5 24	7 41	5 44	7 24	6 05	6 47	6 26	6 06	6 51	5 32	7 18	5 20
7	7 33	5 36	7 20	6 05	6 49	6 29	6 08	6 53	5 35	7 15	5 18	7 36	5 24	7 41	5 44	7 23	6 06	6 46	6 26	6 05	6 52	5 31	7 19	5 20
8	7 33	5 37	7 19	6 06	6 48	6 30	6 07	6 53	5 34	7 16	5 18	7 36	5 25	7 41	5 45	7 22	6 06	6 45	6 27	6 04	6 53	5 31	7 19	5 20
9	7 33	5 38	7 18	6 07	6 47	6 31	6 06	6 54	5 33	7 17	5 18	7 37	5 25	7 41	5 46	7 21	6 07	6 43	6 28	6 02	6 54	5 30	7 20	5 20
10	7 33	5 39	7 17	6 08	6 46	6 32	6 05	6 55	5 32	7 17	5 18	7 37	5 26	7 40	5 47	7 20	6 08	6 42	6 29	6 01	6 55	5 29	7 21	5 21
11	7 33	5 39	7 16	6 09	6 44	6 33	6 03	6 56	5 31	7 18	5 18	7 38	5 27	7 40	5 47	7 19	6 08	6 40	6 29	6 00	6 55	5 28	7 22	5 21
12	7 33	5 40	7 15	6 10	6 43	6 33	6 02	6 56	5 30	7 19	5 18	7 38	5 27	7 40	5 48	7 18	6 09	6 39	6 30	5 59	6 56	5 28	7 22	5 21
13	7 33	5 41	7 14	6 11	6 42	6 34	6 01	6 57	5 30	7 20	5 18	7 38	5 28	7 39	5 49	7 17	6 10	6 38	6 31	5 57	6 57	5 27	7 23	5 21
14	7 32	5 42	7 13	6 12	6 40	6 35	6 00	6 58	5 29	7 20	5 18	7 39	5 28	7 39	5 49	7 16	6 10	6 36	6 32	5 56	6 58	5 26	7 24	5 21
15	7 32	5 43	7 12	6 12	6 39	6 36	5 58	6 59	5 28	7 21	5 18	7 39	5 29	7 39	5 50	7 14	6 11	6 35	6 32	5 53	6 59	5 26	7 25	5 22
16	7 32	5 44	7 11	6 13	6 38	6 36	5 57	6 59	5 27	7 22	5 18	7 39	5 30	7 38	5 51	7 13	6 12	6 34	6 33	5 54	7 00	5 25	7 25	5 22
17	7 32	5 45	7 10	6 14	6 36	6 37	5 56	7 00	5 27	7 23	5 18	7 40	5 30	7 38	5 51	7 12	6 12	6 32	6 34	5 53	7 01	5 25	7 26	5 22
18	7 31	5 46	7 09	6 15	6 35	6 38	5 55	7 01	5 26	7 23	5 18	7 40	5 31	7 37	5 52	7 11	6 13	6 31	6 35	5 51	7 02	5 24	7 26	5 23
19	7 31	5 47	7 08	6 16	6 34	6 39	5 53	7 02	5 25	7 24	5 18	7 40	5 31	7 37	5 53	7 10	6 14	6 29	6 36	5 50	7 03	5 24	7 27	5 23
20	7 31	5 48	7 07	6 17	6 32	6 39	5 52	7 02	5 25	7 25	5 18	7 41	5 32	7 36	5 54	7 09	6 14	6 28	6 36	5 49	7 04	5 23	7 28	5 24
21	7 30	5 49	7 06	6 18	6 31	6 40	5 51	7 03	5 24	7 25	5 19	7 41	5 33	7 36	5 54	7 08	6 15	6 27	6 37	5 48	7 05	5 23	7 28	5 24
22	7 30	5 50	7 05	6 19	6 30	6 41	5 50	7 04	5 24	7 26	5 19	7 41	5 33	7 35	5 55	7 06	6 16	6 25	6 38	5 47	7 06	5 22	7 29	5 25
23	7 30	5 51	7 04	6 20	6 28	6 42	5 49	7 05	5 23	7 27	5 19	7 41	5 34	7 35	5 56	7 05	6 17	6 24	6 39	5 46	7 07	5 22	7 29	5 25
24	7 29	5 52	7 03	6 20	6 27	6 42	5 48	7 05	5 23	7 27	5 19	7 41	5 35	7 34	5 56	7 04	6 17	6 23	6 40	5 45	7 07	5 22	7 29	5 26
25	7 29	5 53	7 02	6 21	6 26	6 43	5 47	7 06	5 22	7 28	5 20	7 42	5 35	7 33	5 57	7 03	6 18	6 21	6 40	5 44	7 08	5 21	7 30	5 26
26	7 28	5 54	7 00	6 22	6 24	6 44	5 45	7 07	5 22	7 29	5 20	7 42	5 36	7 33	5 58	7 02	6 19	6 20	6 41	5 42	7 09	5 21	7 30	5 27
27	7 28	5 55	6 59	6 23	6 23	6 45	5 44	7 08	5 21	7 29	5 20	7 42	5 37	7 32	5 58	7 00	6 19	6 18	6 42	5 41	7 10	5 21	7 31	5 28
28	7 27	5 55	6 58	6 24	6 22	6 45	5 43	7 08	5 21	7 30	5 20	7 42	5 37	7 31	5 59	6 59	6 20	6 17	6 43	5 40	7 11	5 21	7 31	5 28
29	7 26	5 56	6 58	6 25	6 20	6 46	5 42	7 09	5 20	7 31	5 21	7 42	5 38	7 30	6 00	6 58	6 21	6 16	6 44	5 39	7 12	5 21	7 31	5 29
30	7 26	5 57			6 19	6 47	5 41	7 10	5 20	7 31	5 21	7 42	5 39	7 30	6 00	6 56	6 21	6 14	6 45	5 38	7 13	5 20	7 32	5 30
31	7 25	5 58			6 18	6 48			5 20	7 32			5 40	7 29	6 01	6 55			6 46	5 37			7 32	5 30

Add one hour for Daylight Saving Time if and when in use.

Appendix 8
**Tonto National Monument
Common Breeding Birds**

The following descriptions are adapted from: National Geographic Society (1983); Ehrlich, Dobkin, and Wheye (1988); and Robbins et al. (1983). Also, see the 1995 Field Checklist of Birds of Tonto National Monument .

Cathartidae: Vulture Family

Turkey Vulture (*Cathartes aura*)

Common summer resident. Breeding in the monument is presumed. Migratory, usually arriving in the monument sometime in March. Often roosts in Upper Ruin and in large trees in the riparian zone in Cave Canyon. A large group (21) was seen roosting together near the cattle tank northwest of residential area during this study.

Morphology: Large dark brown bird with broad wings. Adults have red head; juveniles have grayish head. Bill whitish. White is visible on underside of wings in flight.

Behavior: Soars with uptilted wings. Flocks with other vultures; occasionally red-tailed hawks and zone-tailed hawks when foraging. Finds food using sense of smell.

Habitat: Rocky canyons and open country.

Similar Species: Zone-tailed hawk is smaller and has a black head with yellow bill. Eagles soar with flattened wing spread and are larger, with a large yellow bill. Black vulture does not occur in the monument.

Song: None

Accipitridae: Kites, Eagles, Hawks, and Allies Family

Cooper's Hawk (*Accipiter cooperii*)

Probably breeds regularly, but in small numbers within the monument. Various pairs breeding in the riparian woodland along Upper Ruin Trail were noted on historic observation records. Nesting confirmed during this study. Other individuals may be present in the monument during migration or winter.

Morphology: Adult male has gray back with contrasting dark crown, red eyes, and

horizontal rufous streaking across the breast. Adult female slightly larger than male and has brown backs, brown streaking across the breast and yellow eyes. Juveniles resemble adult females. Wings are short and rounded and the tail is banded and rounded.

Behavior: Preys on smaller passerine birds and some mammals, hunting throughout the riparian woodland and adjoining mesquite bosque and the Cave Creek drainage.

Habitat: Open deciduous woodland and wood margins; along riparian areas and coniferous forests.

Similar Species: Sharp-shinned hawk does not breed in the area but may be seen during periods of migration. Sharp-shinned hawk is slightly smaller than the Cooper's and has a squarish tail while the Cooper's tail is rounded. Cooper's hawk also has a slightly larger head and a white terminal tail band.

Song: None. Call is a series of 15–20 *kaks*.

Red-tailed Hawk (*Buteo jamaicacensis*)

Common breeder in the monument. Probably breeds on or near Honey Butte and in the ruins. Several pairs were observed nesting in several of the large power towers along the Highway 88 easement during road surveys.

Morphology: Large-bodied buteo. The many color morphs of the red-tailed hawk make identification somewhat confusing. An adult bird has a distinct rufous tail above and pinkish below visible during flight and while perched. Dark belly band is also a helpful field mark. An immature often has fine barring on the tail.

Behavior: Often uses artificial perches to hunt from (e.g., telephone poles). Rarely hovers. Nests often in woodland but generally feeds in open country. Is frequently seen soaring over open areas.

Habitat: Open country and woodland. Most widespread buteo.

Similar Species: Red-tailed hawk is distinguished from other buteos by the dark belly band, red tail in the adult, and by dark axillaries.

Song: None. Call is a high scream. Call is imitated by other birds.

Falconidae: Caracara and Falcon Family

American Kestrel (*Falco sparverius*)

Probably an uncommon breeder in the monument. There are historic records of nesting birds above Lower Ruin. A pair was seen in Deadman's Canyon and east of the monument during the 1993–95 bird study, but no nests were discovered.

Morphology: Small falcon with pointed wings. Male has blue-gray back, red breast, and a red circle on top of the head, while the female is rust overall without a red circle on the head. Both sexes have 2 dark vertical lines extending from the eye and ear on either side of the head in a distinctive pattern. From below, a row of translucent spots on the trailing edge of wings may be visible.

Behavior: Often hunts from elevated perch such as a telephone poles and wires. Frequently hovers over prey then dives. Bobs head to gauge predator or prey. Feeds on small birds as well as reptiles, small mammals, and insects.

Habitat: Found in open country and cities. Nests in saguaros and other natural cavities. May use ruins for roosting.

Similar Species: Other falcons are much larger in body size. Note differences in facial patterns in other falcons as well.

Song: High pitched killy, killy, killy.

Phasianidae: Partridges, Grouse, Turkeys and Quail Family

Gambel's Quail (*Callipepla gambelii*)

Common breeder in the monument, in virtually all locations. Found throughout the monument in areas with good cover, except perhaps on the highest peaks. Often in riparian areas and usually near a permanent water source. Probably most abundant in years with good rains.

Morphology: Gray above, with prominent tear-shaped plume. Sides are chestnut and lack scaling on underparts. Male has dark forehead, black throat, black patch on belly. Juvenile is tan and gray with pale mottling and streaking, less scaling.

Behavior: Very gregarious, often occurs in large groups called coveys (20–40 individuals) in fall and winter and roosts in bushes or low, dense trees. Most frequently feeds and stays at ground level with bimodal pattern of morning and late afternoon foraging separated by a long quiet period.

Habitat: In desert scrub and riparian corridors or thickets. Usually near a permanent water source.

Similar Species: Scaled and California quails. Occasionally hybridizes with California and scaled quails where habitat and range overlaps, but neither species occurs in Tonto NM.

Song: Includes grunts and cackles and a plaintive *qua-el*. Also a loud querulous *chi-ca-go-go*, high pitched with four notes.

Columbidae: Dove Family

White-winged Dove (*Zenaida asiatica*)

Presumably breeds in the monument. Occurs in low numbers during the breeding season. Individuals seen, but no nests were discovered during the 1993-95 study.

Morphology: Large white wing patches in flight. When sitting, only a thin white line is visible on edge of folded wing.

Behavior: Nests singly in marginal habitat or in colonies in good habitat.

Habitat: In the southwestern United States, habitat includes native brush, cacti, riparian areas, paloverde, oak-juniper forests, salt cedar (tamarisk), citrus orchards, and residential shade trees.

Similar Species: Mourning and Zenaida doves. White-winged dove is distinguished by white wing patch and shorter rounded tail. Zenaida dove is not known to occur at the monument.

Song: Call is a drawn-out, cooing call, *who-cooks-for-you*, with many variations.

Mourning Dove (*Zenaida macroura*)

Fairly common in the monument, though in small numbers during the breeding season. Most often seen and/or heard around the residential area, along the entrance road and around permanent water sources such as the spring on Upper Ruin Trail or the cattle tank west of the housing area. Small flocks of less than 20 seen occasionally in the "North 40" area.

Morphology: Slender dove with long, pointed tail. Wings dark spotted.

Behavior: Distinct whistling can be heard in flight, and flight is direct and swift. Common in large flocks when foraging.

Habitat: Common in suburban, woodland, and farm areas. Near a water source in the desert. Winters south to central Panama.

Similar Species: White-winged dove is slightly larger and has large white wing patches and rounded tail in flight. Unlike other members of the Columbidae family, mourning dove has a long, pointed tail.

Song: Call is a *ooah-ooo-oo-oo*, 4–6 minutes.

Cuculidae: Cuckoos, Roadrunners, Anis Family

Greater Roadrunner (*Geococcyx californianus*)

Fairly common in the monument from the visitor center to the "North 40" in Cave Creek Canyon and in open flat areas.

Morphology: Adult has a very long, white-edged tail, a bushy crest that is elevated when startled. Bird is brown-and-white streaked and has a thick bill.

Behavior: Roadrunner is a ground-dwelling bird but will roost in or escape to desert trees or small cacti to avoid predators. Feeds largely on reptiles, rodents, insects, and small birds. Able to fly short distances.

Habitat: Desert scrub and mesquite. Occasionally in chaparral.

Similar Species: Other cuckoos are arboreal and lack the bushy crest, thick bill, and strong legs.

Song: Low-pitched *cooing* sound, descending in pitch.

Strigidae: Typical Owl Family

Western Screech-owl (*Otus kennicottii*)

Probably fairly common within the monument. Often heard during night surveys. We presume it breeds within the monument, but no nests were discovered during this study.

Morphology: Small tufted owl with a dark bill. Western screech-owl has yellow eyes and is generally grayish-streaked overall.

Behavior: Nocturnal. Feeds mainly on insects, reptiles, amphibians, small rodents and birds. Hunts from perch, swooping out over open areas, but usually close to trees.

Habitat: Woodlands, especially oak and riparian areas, in scrub, and orchards. Nests in tree or other cavities often competing with other species for nest sites.

Similar Species: Eastern screech-owl does not overlap in range with western screech-owl within the monument. Whiskered screech-owl generally is found at higher elevations. May be distinguished from whiskered screech-owl by call.

Song: Series of 4–10 slow, low-pitched whistles. One call is a series of accelerated whistles, the other is a short trill followed by a longer trill.

Great Horned Owl (*Bubo virginianus*)

Common breeder in the monument. Frequently heard throughout Cave Creek Canyon and near the residential area during the breeding season and easily attracted when using playback recordings. Occasionally seen during early morning.

Morphology: Great horned owl is large and has conspicuous ear tufts. White throat is distinctive. Generally streaked with grayish-brown overall, with barring on breast and tail.

Behavior: Mostly nocturnal. Hunts for fairly large prey such as skunks, quail, rabbits.

Habitat: Nests in trees, caves, or on the ground. Found in a broad variety of habitats, from woodlands and open desert, to cities.

Similar Species: Distinguished from long-eared owl by bulkier body and white throat.

Song: Call is a series of 3–8 loud, deep-pitched hoots. The second and third hoots are generally more rapid.

Elf Owl (*Micrathene whitneyi*)

Found throughout the monument, especially near saguaros and in the Cave Creek riparian drainage. Common during the summer but uncommon to absent in other seasons. Apparently migrates south for winter, returning to the monument usually in mid to late February.

Morphology: Smallest owl in the monument. Elf owls lack ear tufts and have yellow eyes and short tails. Underparts are buffy with indistinct streaking.

Behavior: Strictly nocturnal, although may be seen roosting occasionally during the day, especially in drainages and thickets. Also roosts in cavities in saguaros during the day.

Habitat: Saguaro deserts, canyons, and sometimes foothills. Nests in cavities in trees and saguaros.

Similar Species: Northern and ferruginous pygmy-owls have much longer tails in comparison to elf owl.

Song: Call is a descending *tu-tu-tu, tu-tu-tu-tu* whistle.

Caprimulgidae: Goatsucker Family

Lesser Nighthawk (*Chordeiles acutipennis*)

Uncommon (?) in the monument and generally seen in open, relatively flat areas, especially the "North 40" area. Usually seen at or near dusk or in the very early morning.

Morphology: Long, pointed wings with a white bar across the primary wing feathers near tip. Upperparts are pale and more mottled. Throat is white in males, usually buffy in females and juveniles. Underparts are buffy, with faint barring. Male has white tail band. Female lacks tail band, and wing bar is buffy. Juvenile wing bar can be almost indistinct or generally small.

Behavior: Migratory. Flight is more fluttery than that of the common nighthawk. Flies low over open areas searching for food. Often perches on roadsides or seen flying over ponds. Feeds primarily on insects on the wing. May become torpid when food becomes scarce or in cold weather.

Habitat: Open desert and country, scrubland and savanna. Winters in northwest Mexico south to central South America.

Similar Species: The white wing-bar is closer to body on the common nighthawk. Flight is less fluttery in common nighthawk. Can be distinguished from other nightjars by call.

Song: A distinctive low trill.

Common Poorwill (*Phalaenoptilus nuttallii*)

Common throughout monument, most often in Cave Creek drainage, along Upper Ruin Trail, and adjoining hillsides. Heard calling frequently throughout canyon during late spring and summer. Overwintering within monument is unknown.

Morphology: Small nightjar with short, rounded tail and short, rounded wings. White-tipped outer tail feathers of both sexes is limited. Juvenile has buffy collar.

Behavior: Roosts on ground, flying up to catch insect prey, returning to same location or close-by, or skims low over ground to feed. Ejects pellets. Frequently seen along roads. Hibernates in cold weather. May overwinter in monument.

Habitat: Found in sagebrush, woodlands, coastal chaparral hillsides, open semi-arid lands, brush, prairie, and rocky canyons.

Similar Species: Body is smaller and wings/tail are shorter and more rounded than in other goatsucker species. Common poorwill generally replaces whip-poor-will in range in the West.

Song: Song is a whistled *poor-will*. Within close range a slight *ip* note at the end of the song can be heard.

Apodidae: Swift Family

White-throated Swift (*Aeronautes saxatalis*)

Common, though in small numbers, in monument and concentrated at Upper and Lower ruins, where it breeds in crevices above the ruins. Also, probably breeds in overhangs in upper Deadman's Canyon. A few winter records are known from the monument, but the majority of these swifts probably migrate south after the breeding season, returning in February and March.

Morphology: Small, cigar-shaped bird with long, narrow, pointed wings. Black above with white throat and black-and-white underparts.

Behavior: Flies rapidly with fast wing beats. Very acrobatic while hunting for insects on the wing. Often vocal during flight as well, especially when returning to nest site.

Habitat: Rocky canyons, cliffs, and mountains. Nests in crevices and usually in colonial groups up to 12 pairs. Courtship and copulation are in the air, and often male and female appear to "tumble" toward the ground during mating.

Similar Species: The violet-green swallow has shorter and broader wings and does not have bi-colored underparts. Vaux's swift has a darker belly and flanks.

Song: Call is a shrill twitter.

Trochilidae: Hummingbird Family

Black-chinned Hummingbird (*Archilochus alexandri*)

Common throughout the Cave Creek Canyon drainage, frequently nesting over or near water.

Morphology: Throat of the male is black and purple when seen in good light. Female and juvenile generally have dusky or greenish streaked throat. Juvenile male may begin to show violet spot at base of throat in fall. Belly is white and sides are greenish.

Behavior: Nest is often built on a branch overhanging a stream. Courtship display by male includes swinging side to side in a pendulum motion, flying upwards, then diving in a figure-8 pattern above female.

Habitat: Found in lowlands and low mountains, open woodland, riparian areas, arid scrub, gardens, parks, and chaparral. Nest is often constructed on limbs overhanging water or near water, sometimes on smaller herbs or on a vine.

Similar Species: Female and juvenile birds are nearly indistinguishable from females and juveniles of other species of hummingbirds. Male has black chin, with purple iridescence below, against a white upper breast. Bill droops slightly and is fairly long. Tail has more black, and is less white in the outer rectrices than in Costa's or Anna's. Black-chinned hummingbird pumps its tail more than a Costa's or Anna's.

Song: Call is a slurred *thew*.

Anna's Hummingbird (*Calypte anna*)

There are few records of this species in the monument; however, it may be an earlier breeder than other hummingbirds and thus has not been noticed as often. May be found in the riparian area of Cave Creek Canyon near the spring, as well as other locations. Nesting confirmed in 1995.

Morphology: Adult male is distinguished by a bright red head and throat. Underparts are grayish, washed with green. Outer tail rectrices are white. Back is metallic green. Female may show some red spots at base of throat, but these may be indistinguishable in poor light. Juvenile lacks color on throat, but immature male may show some red flecks on crown and throat.

Behavior: Male often sings from a perch. Male courtship flight describes an arc of vertical circle in front of female; rising high, plummeting with a loud chirp sound. He then rises straight up above female, hovers facing her, and sings briefly. The male chases the female to the nest location and hovers back and forth in tight arcs over the female.

Male defends food resources during nonbreeding seasons. In some areas, Anna's breeds in late winter or early spring. Some individuals may overwinter if artificial food resources are readily available. May hybridize with Costa's.

Habitat: Abundant in coastal lowlands of California. Range has expanded into southern Arizona and north along the Pacific coast. Found in chaparral, gardens, open woodland, and urban areas. Nest is constructed of spider webs, plant down, small leaves, feathers, and lichens.

Similar Species: Anna's hummingbird appears generally larger and chunkier than Costa's or black-chinned hummingbirds. Neck of Anna's looks bulkier. May be distinguished by voice.

Song: Song by male only is a series of squeaky and raspy notes. Both sexes have a sharp chip note. Chase call is a series of rattling, dry notes.

Costa's Hummingbird (*Calypte costae*)

Probably common throughout the Cave Creek Canyon drainage and around Upper and Lower ruins. Nesting is presumed.

Morphology: Female is indistinguishable from other female hummingbirds. Adult male has purple crown, throat, and gorget that extends down sides of neck.

Behavior: Male courtship flight is a u-shaped pattern with the bird rising up 100', then passing over female and shooting downward with a shrill continuous whistle or shriek, apparently of vocal origin. May hybridize with Anna's where range overlaps. Costa's is migratory. Male leaves breeding grounds while female is still incubating.

Habitat: Desert, dry brushy foothills, and chaparral. Builds nests in yucca sometimes and constructs nest using plant down, forb leaves, bud scales, bark, and distinctly grayish in appearance. Nests are often away from water sources.

Similar Species: Female is not safely distinguished from Costa's or Anna's in general, although adult female Anna's often shows some red spots on throat and is slightly larger than Costa's. Male is told apart by crown and throat color and presence of gorget from Anna's and black-chinned hummingbird. Costa's has rounded outer tail rectrices.

Song: Call is a rapid ticking.

Picidae: Woodpeckers and Allies Family

Gila Woodpecker (*Melanerpes uropygialis*)

Common throughout the monument. Very vocal and easily detected. A cavity-nesting species that probably competes with several other bird species for nest sites within the monument, especially in saguaros, which are limited in numbers.

Morphology: Black-and-white barred back and rump. Male has red cap; female red nape only.

Behavior: Nests in excavated saguaro cactus hole. Frequently reuses nest hole made the previous year. Competes for nest sites with northern flicker, starling, owls, kestrel, and merlin. Young are fed for prolonged period following fledgling.

Habitat: Found throughout the monument, particularly where there are stands of saguaros. Also, found in semidesert and riparian areas, and towns in desert regions.

Similar Species: The gila woodpecker is distinguished from the northern flicker by its red cap (or nape in female). Gila woodpecker lacks facial moustache, spotted belly, and white rump patch visible in flight of northern flicker.

Song: A rolling *churr* and a loud, sharp, high-pitched *yip*, often in a series.

Ladder-backed Woodpecker (*Picoides scalaris*)

Found generally in riparian areas and mesquite. Most often seen around the visitor center, along the entrance road, and near the pump house. Infrequently seen during this study.

Morphology: Adult has black-and-white barred back, spotted sides. Face and undersides is buffy or grayish. Face is marked with black lines. Adult male has red crown.

Behavior: Exhibits some territorial displays such as crest raising, tail spreading, bobbing and turning, bill directing and raising. Cavity-nesting species, often in dead or decaying trees and sometimes in poles or posts. Female forages higher in vegetation than male generally. Feeds on insects and cactus fruit.

Habitat: Found in pinon-juniper woodland, pine oak, pine savanna, towns, deserts, dry scrub, and riparian areas.

Similar Species: Nuttall's woodpecker, which resembles the ladder-backed, does not occur in the monument.

Song: Call is a sharp *pik*, similar to the call of the downy woodpecker.

Northern Flicker (*Colaptes auratus*), Red-shafted form and
Gilded Flicker (*Colaptes chrysoides*)

The gilded flicker is more commonly seen in the monument than northern flicker, red-shafted form, but both are present. Hybridization between the 2 was observed in the monument. Generally found in or near single plants or stands of saguaro cactus.

Morphology: This is a jay-sized woodpecker with distinct spots on the breast, a white rump visible during flight, and a moustache. Wing linings are either reddish or golden depending on the species and intermediate in coloration for hybrids.

Behavior: Most terrestrial of all North American woodpeckers, often feeds on ants on the ground. Prefers snags, but will nest in a variety of cavities including cacti, posts, poles, banks, houses, barns, and boxes.

Habitat: Found in a wide variety of habitats across the country. In the West, flickers may be found in deciduous areas, desert, riparian and other areas with scattered trees and cacti.

Similar Species: Northern flicker, red-shafted form and gilded flicker may hybridize in areas with overlapping range. Gila woodpecker lacks facial moustache, spotted belly, and white rump patch visible in flight.

Song: Loud *wik-wik-wik-wik* and *wick-er, wick-er, wick-er* or single, loud *klee-yer*.

Tyrannidae: Tyrant Flycatcher Family:

Say's Phoebe (*Sayornis saya*)

Common breeder in the monument. Frequently nests in eaves around houses in residential area, around the visitor center, and in crevices around both Upper and Lower ruins.

Morphology: Grayish-brown overall with a darker head. Belly and undertail coverts are rusty. Juvenile has 2 cinnamon wing bars.

Behavior: Typical flycatcher hunting method. Swoops down from elevated perch (e.g., telephone pole or power line) snaps up insect and returns to same perch location. Frequently pumps and spreads tail. Flight is somewhat fluttery in appearance. Highly migratory, although some may remain in the monument during the winter (?).

Habitat: Dry open areas, cliffs, around dwellings, and bluffs. Nests often around buildings.

Similar Species: Adult male vermilion flycatcher is easily distinguished from Say's phoebe by bright red belly and crown. Female vermilion flycatcher has a streaked breast

and dark eye patch. Black phoebe has a contrasting black breast against a white belly. Say's phoebe may also be distinguished by call and song. Both vermilion flycatcher and black phoebe are more often found around water. Say's phoebe prefers drier, sunnier areas.

Song: Song is a slurred *chu-weer* and *pippety-chee*. Call is a faintly whistled *pee-ee*, somewhat down slurred.

Ash-throated Flycatcher (*Myiarchus cinerascens*)

Presumed to be fairly common throughout the monument. Especially fond of nesting in teddy-bear cholla (*Opuntia bigelovii*). While no nests were discovered, family groups of adults and juveniles/immatures were observed during the study.

Morphology: Grayish-brown above with dark crest. Throat and breast pale gray, belly and undertail coverts pale yellow. Dusky tail shows entirely reddish inner webs and brown tips. Mouth lining is pinkish.

Behavior: Cavity-nesting species uses old woodpecker holes, fence post holes, old cactus wren nests. Will defend territory like kingbirds do against hawks. A typical flycatcher darts out from a perch, snaps up a flying insect, then returns to often the same perch.

Habitat: Regularly seen in the mesquite-lined washes. Found in desert, chaparral, and woodlands.

Similar Species: The ash-throated flycatcher has a thinner bill, and its underparts are generally paler than the brown-crested flycatcher. Also, the ash-throated flycatcher has reddish feathers in inner webs of tail compared to none in the dusky-capped flycatcher. May also be distinguished by voice.

Song: A burry *ka-brick* or *ka-wheer*, accented on the second syllable. Song is a series of these sounds.

Brown-crested Flycatcher (*Myiarchus tyrannulus*)

Presumed to be fairly common and to breed throughout the monument. Range overlaps with ash-throated flycatcher in the monument. The brown-crested is a cavity-nesting species while the ash-throated builds a nest often in cacti such as chollas.

Morphology: This is another tyrant flycatcher with grayish-brown above and a dark crest. Throat and breast grayish, belly and undertail coverts pale yellow.

Behavior: See description above for ash-throated flycatcher.

Habitat: The brown-crested flycatcher nests in saguaro and other cavities, such as those made by other birds in Arizona sycamore.

Similar Species: The brown-crested flycatcher has a slighter, thicker bill than the ash-throated flycatcher and a different call. Fuscous is wider in tail of brown-crested. Brown-crested is slightly larger than ash-throated.

Song: Harsh *eeerrr* note, rising then falling. Also has a *whit* call.

Western Kingbird (*Tyrannus verticalis*)

Commonly seen on wires and power towers along Highway 88 and over the open bajada; less often further south in the monument.

Morphology: Black tail with white outer rectrices is diagnostic. Bird has grayish head, yellow belly with dark wings and tail. Throat and breast are pale gray. Orange-red crown patch is usually concealed. Juvenile has somewhat more olive on back, and wing covert edges are more buffy.

Behavior: Frequently perches on fences, telephone poles and wires. Hunts for prey usually from an elevated perch, swoops down on prey, snaps it up, and returns to the same perch location.

Habitat: Open country, agricultural areas, riparian woodland, and savanna, along streams with scattered trees. Nests usually on horizontal branch close to trunk.

Similar species: Cassin's kingbird has a darker gray head and upper breast with contrasting white chin. Cassin's outer tail rectrices lack white seen in western kingbird. Black tail separates western kingbird from *Myiarchus* sp. flycatchers.

Song: Common call is a sharp *whit*.

Hirundinidae: Swallow Family

Purple Martin (*Progne subis*)

Abundance unknown, but we presume this species may be found in small numbers in the monument. Competition for saguaro nest sites with other cavity-nesting birds may be a limiting factor in the abundance of this species. Individuals and some pairs often seen perched on telephone or power wires along Highway 88 during the breeding season but absent the rest of the year. Population may be declining in the West due to competition with European starling or other species for nest sites. Species migrates to northern South America.

Morphology: Adult male is a deep, purplish blue, glossy in appearance. Female and juvenile are grayer below. First spring male has some purple feathers below. Tail is forked.

Behavior: Flight pattern is characterized by short gliding, alternating with rapid flapping. Hunts for flying insect prey on the wing. Migratory.

Habitat: Found in open country, rural areas, savanna especially near water. In the East and the Midwest, purple martins often nest colonially; however, in the West, they usually nest in old woodpecker holes in dead trees or cacti.

Similar Species: Purple martin is the only overall dark swallow in North America.

Song: Song and calls are low-pitched, liquid, rolling twitters.

Corvidae: Jays, Magpies, and Crow Family

Common Raven (*Corvus corax*)

Common throughout the monument. A pair has nested for multiple years at the north end of the cliff near Lower Ruin. Also recorded nesting in the power towers along Highway 88 during this study. A congregation of 20 birds was seen feeding in a newly seeded area at Windy Hill during the construction period. A pair was frequently seen in the housing area and photographed raiding garbage at 1 of the residences during the 1993–95 study.

Morphology: Large black bird with wedge-shaped tail. Common raven has a thick dark bill.

Behavior: Long-term pair bonds. Nest is often reused perennially. Acrobatic courtship display by male. Male and female often soar together, wing tips touching during courtship; also perch, preen, and bill each other. Sometimes caches food temporarily and occasionally hunts cooperatively in groups. Communally roosts in winter.

Habitat: Open country, often near mountains, rugged coastal areas, deserts, near heavy timber. Nests in old hawk or owl nests, cavities in cliffs, on power towers or other human structures.

Similar Species: Told from other corvids by wedge-shaped tail and characteristic croaking call. Larger than Chihuahuan raven. Distinguished from other black birds by body and bill size. Flaps less and soars more in flight than American crow.

Song: Call is a long-drawn out croak. May also make gurgling croak sounds.

Remizidae: Verdin Family

Verdin (*Auriparus flaviceps*)

Common throughout the monument. Breeding confirmed, many new and old nests found during study.

Morphology: Dull-gray plumage with chestnut shoulder patches, yellow head and throat. Juvenile is brown-gray overall. Small body with a finely pointed bill.

Behavior: Feeding style is similar to chickadees, often hanging upside down in vegetation. Nest is spherical, and verdin builds breeding as well as roosting/winter nests. Often forages in family groups in the nonbreeding season.

Habitat: This species regularly occurs in desert scrub, riparian, and creosote bush habitats.

Similar Species: The common bushtit has a longer tail and lacks yellow head and chestnut wing patches.

Song: Call is a series of rapid *chip* notes, while song is a three note whistle, the second note higher.

Troglodytidae: Wren Family

Cactus Wren (*Campylorhynchus brunneicapillus*)

Common breeder throughout the monument. Very noisy and sometimes gregarious. Frequently seen around the visitor center parking area, picnic area, and residential area.

Morphology: Dark cap with white eye line and barred wings. A large wren with spotted breast and a buff-colored belly.

Behavior: Builds football-shaped nest most often in cholla cactus. Uses nest for breeding and roosting; pairs resident year round on territories.

Habitat: Can be seen or heard in almost any part of the monument, but is particularly abundant in desert and lower canyon areas. Nesting has been reported as early as January in some areas of its range, but early dates from Tonto NM are unknown (?)

Similar Species: Streaked back, barred wings, white eye line, and dark cap distinguish the cactus wren from the sage thrasher.

Song: Low-pitched, harsh, rapid *cha cha cha cha cha*. Distinctive call heard any time of day or year in desert habitats.

Rock Wren (*Salpinctes obsoletus*)

Common in the rocky portions of the monument, on steep hillsides, near Upper and Lower ruins. Generally found in higher elevations in the monument than cactus wren but about the same as the canyon wren.

Morphology: Generally grayish and spotted on back. Pale breast has faint streaking. Rock wren has a contrasting cinnamon rump and barring and a dark band on the tail.

Behavior: Frequently bobs head and bobs as it walks. Like other wrens, is highly inquisitive, defends territory vigorously, and holds tail up frequently.

Habitat: Arid and semiarid canyons, valleys with rock outcroppings, sunny talus slopes, scrublands, dry washes. Builds nest in holes or rock crevices and often leaves a trail of small pebbles to nest entrance.

Similar Species: Bewick's wren lacks dark terminal tail band and buffy tail tips and pale, streaked breast.

Song: A variety of trills, buzzes, or a loud clear descending whistle, slowing at the end. Call is a buzzy *tick-ear*.

Canyon Wren (*Catherpes mexicanus*)

Common on the steep hillsides, talus slopes, and around Upper and Lower ruins. One or more was seen and/or heard almost every visit to either of the ruins. Frequently sings from atop adobe walls.

Morphology: Brown wren with clear, white throat and breast, and chestnut-colored belly.

Behavior: Found in canyons, rock cliffs, near water. Extracts insects in rock crevices with long thin bill. Bobs head from side to side sometimes.

Habitat: Canyons and mountains with cliffs, rock faces, or boulders are the preferred habitat of this species. Occasionally found in suburbs with old stone buildings or other structures having suitable nest sites. Found in and around Upper and Lower ruins of the monument.

Similar Species: Differs from other wren species with distinct white throat and breast, and long straight bill. Song is easily recognized.

Song: A descending series of liquid *tee's* and *tew's*. Call is a sharp *jeet*.

Muscicapidae: Muscicapid Family

Blue-gray Gnatcatcher (*Polioptila caerulea*)

Overlaps range within monument with black-tailed gnatcatcher. Found throughout in chaparral and scrub areas and near riparian drainages. Field identification can be confused with black-tailed gnatcatcher.

Morphology: Adult male is grayish-blue on back with paler underparts. Female is paler gray overall. Tail is black-edged with white. Underside of tail is mostly white. Breeding male has black line at sides of crown, and both sexes have a white eye-ring.

Behavior: Nervous bird, flits around in vegetation. Flicks tail sideways often. Common cowbird host.

Habitat: Common in woodland, thickets, and chaparral, deciduous forest, swamps, scrub and desert. Nest usually saddles a horizontal limb or a fork of a tree. Nest is typically covered with insect and spider silk, covered on outside with lichen bits, and lined with fine materials.

Similar Species: Breeding male black-tailed gnatcatcher has a black cap and nape. Underside of black-tailed gnatcatcher is darker than blue-grays. Differences in calls may help distinguish blue-gray from black-tailed gnatcatcher.

Song: Song is a series of wheezy, but melodious warbles, often vireo-like. Call is a thin, nasal *pwee*.

Black-tailed Gnatcatcher (*Polioptila melanura*)

Range overlaps with the blue-gray gnatcatcher within the monument. Field identification can be confused between this species and the blue-gray gnatcatcher.

Morphology: Blue-gray above, grayish-white below, with a black cap on male and mostly black tail.

Behavior: Very active bird with tail flicking up and down or side to side. Nest is usually in fork of small shrub; compact of plant materials bound with insect and spider silk.

Habitat: Occurs at lower elevations, in riparian, desert scrub, and creosote bush habitats.

Similar Species: Black-capped gnatcatcher has longer bill than black-tailed, and white eye-ring is more distinct.

Song: Rapid series of *jee* notes on one pitch and a raspy *cheeeh*.

Mimidae: Mockingbirds, Thrashers, and Allies Family

Northern Mockingbird (*Mimus polyglottos*)

Common in the monument, especially from the visitor center, north. Detailed winter observations will help determine this species' presence and status in monument during these months.

Morphology: Adult is grayish overall with 2 distinct white wing bars easily seen during flight.

Behavior: Some individuals are partially migratory, while others may overwinter in some areas. Very vocal singer, often the loudest on a plot. Actively defends territory from all predators. Often wags tail. Male usually builds nest while female usually lines it. Male may sing in the spring intermittently for 24-hours per day. Rare brown-headed cowbird host, sometimes a bronzed cowbird host.

Habitat: A habitat generalist. May be located in a broad range of open or partially open habitats. Abundant in suburban locations.

Similar Species: Sage thrasher has a streaked breast, belly, and undertail coverts, and a white-tipped tail. Told from other members of the Mimidae family by bold white wing patches seen in flight.

Song: One of the finest songsters in the bird world. Capable of mimicking the songs and calls of other bird species as well as human or artificial sounds.

Curve-billed Thrasher (*Toxostoma curvirostre*)

Commonly seen and heard in all areas of the monument except perhaps the highest elevations. Early breeder, often the first clutch is laid in late February or early March within the monument.

Morphology: Mottled breast, large, dark, curved bill; breast spots indistinct. The subspecies *palmeri* is generally found in most parts of Arizona.

Behavior: Builds bulky twig nest, most often in spiny shrub or cactus. Is an occasional cowbird host. Pair remain throughout year in same area used for nesting. Destroys cactus wren roosting nests if found within thrasher territory. Found often near water source.

Habitat: Commonly found in streamside brush, canyons, semiarid brushlands, and in the residential area of the monument.

Similar Species: Bill is more highly curved than Bendire's. Curve-billed thrasher from extreme southeastern Arizona to Texas in the subspecies *curvirostre*, is heavily mottled below and has pale wing bars and conspicuous white tips on tail.

Song: Song is varied, and phrases are not separated. The rapid *whit, wheet* call, sometimes 3-noted, is more distinctive.

Crissal Thrasher (*Toxostoma crissale*)

Generally not widespread in the monument, but frequently found in the proper habitat. Most have been seen in the Cave Creek Canyon drainage and the housing area. Winter resident.

Morphology: Fairly large thrasher with a distinctly down-curved bill, rufous rump. Perhaps less obvious is the dark moustachial line on side of face. Brownish gray overall.

Behavior: Very secretive, easily startled, rarely flies, and song is rarely heard. Uses thick underbrush or base of vegetation for cover. Will eject cowbird eggs from nest if parasitized. Digs for its food and eats mostly insects and fruit. Mainly terrestrial; however, male will sing from an elevated perch.

Habitat: In valleys and dense vegetation, canyons, mesquite and willows along streams and washes. Nest is cup-shaped and built in dense willows, mesquite, or sagebrush.

Similar Species: Bendire's thrasher is not known to occur within the monument. Curve-billed thrasher lacks rufous rump and dark moustachial stripe and is less secretive.

Song: Slower than curve-billed thrasher song, rambling but musical. Calls include a whistled *toit-toit-toit* and sometimes a repeated *chideery*.

Ptilogonatidae: Silky Flycatcher Family

Phainopepla (*Phainopepla nitens*)

Common throughout the monument in spring and early summer, fairly common to uncommon rest of year. Often in close association with mistletoe. A few unmated individuals may remain in the monument following the first breeding period.

Morphology: Solid, shiny-black male contrast with the lighter, grayish female and juvenile. Crest, red eye, and long tail are distinguishing features. White patches on wings are visible in flight.

Behavior: Feeds chiefly on insects on the wing and mistletoe berries. Fluttery flight, often very high. Nests early in desert areas, then migrates to moister habitats to raise a second

brood. Some individuals migrate altitudinally, while others migrate latitudinally or longitudinally. Breeds in loose colonies. Territory is often large around a clump of mistletoe berries but may consist of only the nesting tree where food is more scarce. It is unknown where the phainopepla that breed in the monument go to raise their second brood.

Habitat: Arid scrub, especially along streams and washes, mesquite brushland. In late spring it moves to a cooler, wetter habitat.

Similar Species: Solid black coloration distinguishes the phainopepla from a waxwing, which has a similar body form.

Song: Raspy song, is rarely heard and call note is a low-pitched, whistled *wurp*.

Sturnidae: Starlings and Allies Family

European Starling (*Sturnus vulgaris*)

Uncommon in monument. Was seen around the residential area and along Highway 88 during this study. Threat to native cavity-nesting bird species due to its aggressive behavior and size.

Morphology: Adult breeding bird is iridescent black with a yellow bill. Juvenile is gray-brown above, paler below, with a brown bill. In fresh fall plumage, adult bird feathers are white-tipped or buff, and bird appears speckled.

Behavior: Often seen in flocks after breeding season, occasionally with blackbirds and grackles. This species is aggressive and noisy and often ousts native cavity-nesting birds. May be winter resident, although individuals tend to wander south. Males outnumber females in many populations, and there are occurrences of polygyny in this species.

Habitat: Found in a variety of habitats across the United States, frequently around human development and settlements.

Similar Species: Blackbirds are similar, but the starling may be identified in flight by short, squarish tail, stocky body, and short, broad-based, pointed wings.

Song: Song consists of squeaky notes, but starling imitates the songs of other birds. Call notes include chirps, warbles, squeaks, and twittering.

Vireonidae: Vireo Family

Bell's Vireo (*Vireo bellii*)

Some populations in the United States may be declining due to riparian habitat destruction or brood parasitism by cowbirds. Common cowbird host but may reject cowbird eggs by building second nest level over them. Common in the Cave Creek Canyon drainage. Restricted to riparian areas within the monument. Migratory. One case of parasitism by brown-headed cowbird confirmed during this study.

Morphology: Plumage is variable depending on location. Southwestern form is grayish to greenish-yellow above and grayish-white to yellowish-white below. This vireo has pale, white wing bars and indistinct, white spectacles.

Behavior: Feeds in dense brush and is very nervous and active. Fearless around nest location.

Habitat: Found in thickly vegetated areas near open water. Common in moist woodlands, bottomlands, and mesquite.

Similar Species: Habitat differs from other vireo species. Spectacles, longer tail, and less prominent wing bars, and size can distinguish this vireo from ruby-crowned kinglet. Ruby-crown kinglet does not breed in monument but may be present during migration and in winter.

Song: Song is a set of fast, harsh, scolding notes.

Emberizidae: Emberizid Family

Lucy's Warbler (*Vermivora luciae*)

Seen and heard in the Cave Creek Canyon drainage and other small drainages. Presumed to breed in monument. Need to confirm. Cavity-nesting species.

Morphology: Pale gray above, whitish below with a rufous crown patch and rufous rump patch distinct on male.

Behavior: Occupies old woodpecker holes, nesting in cavities, banks, and deserted verdin nests. Is only 1 of 2 North American hole-nesting warblers (and prothonotary) and is largely insectivorous. Much of this species' biology is yet unknown.

Habitat: Possibly more abundant in early, rather than late, summer, this species is found in desert scrub, along desert washes, and near springs and open water.

Similar Species: Other warblers lack combination of reddish crown patch and rump.

Song: A short, lively trill followed by lower, whistled notes: *weeta weeta weeta che che che*. Call is a sharp *chink*.

Yellow Warbler (*Dendroica petechia*)

Generally found in the riparian area near the spring along Upper Ruin Trail. Within the monument it may be restricted to this area only, or near other water sources. One of the top 3 hosts of cowbirds.

Morphology: Adult male is a bright yellow with pale rufous streaking on breast and belly. Adult female is a pale greenish-yellow overall. Both sexes have dark eyes and small, thin, straight bills. Immature resembles adult female but may be paler or even grayish sometimes. Plump, short-tailed warbler.

Behavior: Frequently bobs tail. Gleans insects off bark, hawks or hover-gleans for food. Male forages higher in trees generally than female. Male pursues female for several days during courtship. May reject cowbird egg by burying it at bottom of nest.

Habitat: Moist areas, open woodland, in willows and alders, gardens, orchards, and suburbs.

Similar Species: Only warbler with all yellow face and dark eye. Yellow spots on tail and lack of white on body or wings help distinguish it from other warblers.

Song: Series of 7 clear, sweet notes. Sweet-sweet-sweet-I'm-so-sweet song.

Northern Cardinal (*Cardinalis cardinalis*)

Common throughout the monument, especially in riparian areas, washes, and the residential area.

Morphology: Conspicuous crest; cone-shaped reddish or orangish bill. Male is bright red overall with a black face. Female is olive to buffy brown overall, with red-tinged wings, tail, and crest.

Behavior: Both sexes sing year round. This species is nonmigratory and has expanded its southwest range in the United States in recent years.

Habitat: Seen in riparian and mixed mountain scrub habitats.

Similar Species: Differs from pyrrhuloxia in geographical range, overall red color of body in males. Also, pyrrhuloxia has a yellowish and strongly, curved bill to distinguish it from female and juvenile northern cardinal.

Song: A liquid whistling with variations, including cue-cue and cheer-cheer-cheer and purty-purty. Common call is a sharp *chink*.

Canyon Towhee (*Pipilo fuscus*)

One of the most common species in the monument. Formerly called brown towhee. Year-round resident, although some individuals may migrate some (?).

Morphology: Brown to gray-brown above, buffy throat bordered by streaks, and rusty undertail coverts. Interior populations are paler, with rust crown and a dark spot in the center of the breast, while Pacific coast birds are darker and have a dark crown.

Behavior: Common in brush, chaparral, wooded canyons, also around picnic areas, buildings and residential gardens. Feeds on ground using double-scratch foraging method. Female is not easily flushed from nest. Canyon towhee exhibits mouse-run behavior like other towhees.

Habitat: Found in riparian, desert scrub, and mixed mountain shrub habitats.

Similar Species: Abert's towhee has black face and is generally found at lower altitudes than canyon towhee.

Song: Mellow chipping trill; calls include a sharp *chiup*. Reunion call when 2 or more towhees unite is easily heard.

Abert's Towhee (*Pipilo aberti*)

Found in most riparian areas in the monument. Year-round resident (?). Common cowbird host.

Morphology: Body is overall cinnamon brown with buffy underparts. Face is black.

Behavior: Hops and kicks with both feet to find insects below leaves and debris. Secretive and easily flushed. Stays mostly on the ground in thick vegetation and dense underbrush. Forms long-term pair bonds on permanent territories. Male and female sing duets.

Habitat: Dense brushy areas, desert scrub, riparian thickets and woodland, especially near water.

Similar Species: Canyon towhee generally frequents drier habitat than Abert's. Note black face and buffy undertail coverts to distinguish it from canyon towhee.

Song: Song is a series of *peek* notes with the final trill, more guttural than canyon towhees. Call is a loud, sharp *peek*.

Rufous-crowned Sparrow (*Aimophila ruficeps*)

Most often seen on talus and steep, rocky hillsides in the monument, and around Upper Ruin. Year-round resident.

Morphology: Gray head with dark reddish crown, with distinct white eye ring. This sparrow has a rufous line extending back from eye, and a single black whisker stripe on each side of face. Arizona form is more reddish overall than others.

Behavior: Territories are often clumped and female stays close to nest, often feigning injury to distract predators. Does not flock in winter, but post-breeding family groups often stay together.

Habitat: Found on rocky hillsides with mixed mountain shrubs or higher elevation desert scrub.

Similar Species: Lacks white wing bars of chipping sparrow and has a long, rounded tail.

Song: Song is a rapid, bubbling series of chip notes, and its call is a sharp *dear*, usually in a series.

Black-throated Sparrow (*Amphispiza bilineata*)

Widespread in the monument. Common cowbird host.

Morphology: White eyebrow and whisker stripe with black throat, breast, and lores. Upper body pale brownish-gray, without streaks or wing bars. Juvenile lacks black throat, has grayish head and streaked breast but is distinguished by white eye stripe similar to adult.

Behavior: Timing of breeding may be related to rainfall and available food. Requires water to drink in summer and autumn until rains start. Uses water in green vegetation and insects otherwise. Breeding biology is not well known.

Habitat: Found in open areas of creosotebush and desert scrub habitats. Prefers rocky slopes. Nests often in snakeweed.

Similar Species: Extent of white on tail is greater than in the sage sparrow.

Song: Highly variable singer. Series of clear notes followed by a trill. Calls are indistinct tinkling notes.

Bronzed Cowbird (*Molothrus aeneus*) Description includes Lowther (1995).

Uncommon (?), but several pairs may be present in monument each year. Usually seen in residential area. Because this species is near the northernmost portion of its range in Arizona, it is probably migratory. Brood parasite. Courtship has been observed in the residential area; however, parasitism is presumed but not documented in the monument.

Morphology: Male is black with bronze gloss. Wings and tail are blue-black. Thick neck ruff on male gives a hunchback appearance. Female is duller, and juvenile is dark brown. Bill is thick and shorter than head. Iris is red.

Behavior: Brood parasite of at least 82 species, favoring orioles. Female often pierces host eggs and previously laid cowbird eggs. Gregarious, flocking at all seasons except during breeding (25–30, sometimes up to 400) with other blackbirds. Male has elaborate courtship display including throwing head back, ruffling neck feathers, quivering wings, and walking stiffly. May also spread and bend tail, arch wings, bend head down, and bounce up and down while calling.

Habitat: Common in riparian areas and human settlements.

Similar Species: Bronzed cowbird has larger bill and a wheezier, shorter version of brown-headed cowbird song. Red iris distinguishes it from brown-headed cowbird as well.

Song: Call is a harsh, guttural *chuck*. Song is a series of gurgling notes.

Brown-headed Cowbird (*Molothrus ater*)

Common in monument, especially in the Cave Creek Canyon drainage and around the residential area. Flocks of 30 or more have been recorded in the housing area. Brood parasite. Documented parasitism on Bell's vireo in the monument.

Morphology: Adult male has blackish back and brown head. Female is brownish gray overall. Bill is heavy and tail is uptilted when bird is walking on ground. Young bird resembles adult female and has faint breast streaking.

Behavior: Gregarious, often seen in large flocks, particularly while foraging. Frequently flocks with grackles and starlings in the winter. Female lays eggs in the nests of mostly ground-nesting species, especially warblers but also orioles and other migratory songbirds.

Habitat: Common in agricultural areas, parks, gardens, deciduous forests, woodland edge, and grasslands. Often in association with cattle and bison.

Similar Species: Grackle is much larger, with longer tail than the brown-headed cowbird. Adult bronzed cowbird has red eyes, while this species has brown eyes.

Song: Song is a thin whistle. Also makes a variety of other gurgling sounds.

Hooded Oriole (*Icterus cucullatus*)

Found in riparian habitat and around the residential area in the monument. Potential cowbird host.

Morphology: Adult breeding male is bright yellow to orangish-yellow, with a black face and throat. Tail and back are black, and wings are black with 2 whitish wing bars. Adult female is overall yellowish and much paler. Juvenile resembles adult female.

Behavior: Hooded Oriole pulls fibers from yucca plants and palms to construct nests. Often builds several nests including one in which eggs are laid. Nest is pendulous. Frequent bronzed cowbird host.

Habitat: Riparian areas, suburbs, orchards, near palms, mesquite, deciduous woodland, and arid scrub. Nests around human habitation or in bushes or trees, especially palm or yucca.

Similar Species: Scott's oriole adult male has all black head, throat, and back, and is usually more yellow than orange-colored. Wing patch in Scott's oriole is yellow, as opposed to white in hooded oriole.

Song: Song is a series of throaty whistles, rattles, metallic trills and warbling. Call is an ascending *sweep* or *wheet* sound.

Fringillidae: Fringilline and Cardueline Finch Family

House Finch (*Carpodacus mexicanus*)

Common in monument, especially in and around the residential area. Year-round resident.

Morphology: Brown cap with bib, forehead, and rump of varying shades of red, orange, or yellow. This bird has a square tail, and the bib lacks streaking.

Behavior: Occasionally appropriates other species' nests. Uses twigs, grass, debris, leaves, and hair for nest, which are often re-used for later broods. Feeds predominantly on seeds, including food for its young. Range in the West is expanding. May compete with house sparrow. Flocks in nonbreeding season.

Habitat: In a variety of habitats, including human settlements. Prefers arid scrub, open woodland, cultivated land, and urban areas.

Similar Species: Lacks distinct ear patch and eyebrow of Cassin's and purple finches. Song of more strident notes than purple finch.

Song: High-pitched, of varied 3-note phrases, ending with a nasal *wheer*. A whistled *wheet* is its common call note.

Lesser Goldfinch (*Carduelis psaltria*)

Presumed to breed in the monument but unconfirmed to date. Flocks of lesser goldfinch along with American goldfinch and pine siskin may be seen occasionally during the winter.

Morphology: Adult male has greenish back and black forehead, black wings and tail. Adult female is duller yellow underneath. Immature male lacks full black cap. Juvenile resembles adult female. All have a white wing patch at base of primaries.

Behavior: During courtship male spreads wings widely and flaps them rapidly while singing. Fond of salt and frequently found near water sources, especially during dry seasons. Highly gregarious, especially in winter, and may flock with other goldfinches or pine siskin.

Habitat: Weedy and cultivated fields, open deciduous woodland and riparian areas, woodland borders, and gardens. Nest is cup-shaped and compact and built in shrubs or trees usually.

Similar Species: American and Lawrence's goldfinches are not known to breed in the monument but may be seen during winter months. Note yellow in flight feathers and at base of tail, plus more streaking in pine siskin.

Song: Song is similar to American goldfinch but scratchier. Call is a plaintive *tee-yee*, descending.

Passeridae: Old World Sparrow Family

House Sparrow (*Passer domesticus*)

Breeding is presumed but unconfirmed in the monument. Frequently seen in and around the residential area, but seldom elsewhere in the monument. May outcompete native cavity-nesting bird species within the monument because of its more aggressive behavior. Will kill nestlings and juveniles of other species and take over nest sites.

Morphology: Adult breeding male has gray crown, chestnut nape, black bib, and black bill. Adult female has streaked back, buffy eye stripe, and an unstreaked breast. Juvenile resembles adult female.

Behavior: Aggressive. House sparrow builds ball-shaped nest sometimes in the forks of trees or on a branch. Nest is often ratty-looking with bits of paper or garbage (e.g., cigarette filters, toilet paper) used to line nest. Commonly attracted to seed feeders and uncovered scrap food or garbage. House sparrow is often found in fairly large flocks in many areas.

Habitat: Found in a variety of habitats, such as cultivated fields, woodland edges, and most often around human habitation.

Similar Species: Other sparrows are often less conspicuous than the house sparrow, especially around humans. The bill of the house sparrow is slightly larger and its legs are somewhat shorter than native sparrow species.

Song: House sparrow song is a series of monotonous, *chirps* or *cheeps*.

Appendix 9

Sources for Additional Federal, State, and Local Bird Information

American Birding Association
Executive Director
P. O. Box 6599
Colorado Springs, CO 80934
719/578-9703
email: gregb@aba.org

Arizona Game and Fish Department
2221 W. Greenway Road
Phoenix, AZ 85023-4399
602/942-3000

Bob Bradley
Co-Coordinator Phoenix/Salt River Christmas Bird Count
see Maricopa Audubon Society

Troy Corman
State Coordinator, Breeding Bird Atlas
c/o Arizona Game and Fish Department
602/789-3508

Cornell Lab of Ornithology
159 Sapsucker Woods Road
Ithaca, NY 14850
607/254-BIRD

Museum of Northern Arizona
3001 N. Fort Valley Road
Flagstaff, AZ 86001
520/774-5213 X245

National Audubon Society (Christmas Bird Count Program)
700 Broadway
New York, New York 10003
212/979-3000

National Park Service
cc:Mail bulletin board
SOAR NPS Migratory Birds at NP-SOAR

North American Rare Bird Alert
Phoenix, AZ 602/832-8745
Tucson, AZ 520/798-1005

Northern Arizona University
Biology Department
P.O. Box 5640
Flagstaff, AZ 86011
520/523-2381

Ornithological Societies of North America
P. O. Box 1897
Lawrence, KS 66044-8897

Partners in Flight - Arizona
c/o Arizona Game and Fish Department
Nongame Branch
602/789-3500

Maricopa Audubon Society
P.O. Box 15451
Phoenix, AZ 85060
Dwayne Fink, President
602/967-9202

The Phoenix Arizona Bird Alert
National Birding Hotline Cooperative
Subscribe by sending the following message via Internet to
BIRDWEST@ARIZvm1.CCIT.ARIZONA.EDU
SUBSCRIBE BIRD_RBA (Your full name)
Note: Except for long-distance phone charges, access to the NBHC is free.

Susan Sferra
Passerine Birds Program Coordinator
c/o Arizona Game and Fish Department
602/942-3000

U.S. Forest Service
Tonto National Forest
ATTN: Forest Supervisor
2324 East McDowell Road
P.O. Box 5348
Phoenix, AZ 85010

Tucson Audubon Society
Audubon Nature Shop
300 E. University Boulevard #120
Tucson, AZ 85705
520/629-0510

The University of Arizona
Department of Ecology and Evolutionary Biology
310 Biological Sciences - West
The University of Arizona
Tucson, AZ 85721
520/621- 1588

The University of Arizona
School of Renewable Natural Resources
C. P. Patrick Reid, Director
325 Biological Sciences - East, The University of Arizona
Tucson, AZ 85721
520/621-7255

U.S. Fish and Wildlife Service
Arizona Cooperative Fish and Wildlife Research Unit
Dr. Eugene Maughan, Unit Leader
104 Biological Sciences - East, The University of Arizona
Tucson, AZ 85721
520/621-1959

U.S. Geological Survey, Biological Resources Division (formerly National Biological Service)
Cooperative Park Studies Unit/The University of Arizona
125 Biological Sciences-East
Tucson, AZ 85721
520/670-6885 or 6886

Craig Woods
Wildlife Biologist
U.S. Forest Service
Tonto National Forest
Tonto Basin Ranger District
HC02 Box 4800
Roosevelt, AZ 85545
520/467-3200

The cover photograph was taken October 4, 1935, in Saguaro National Monument by the first National Park Service photographer, George Alexander Grant (1891-1964).



As the nation's principal conservation agency, the U.S. Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting fish, wildlife and plants, preserving the environmental and cultural values of national parks and historic places, and providing for enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.