
Urban environments and the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*): a profile of endangerment of a species

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Abstract

The Ferruginous Pygmy-Owl (*Glaucidium brasilianum* [Gmelin]) is one of the most common and widely distributed of western hemisphere owls in tropical and subtropical North and South America. The Arizona population of this species, which consists of fewer than 50 known individuals, is listed as an Endangered Species. Throughout its range, the Ferruginous Pygmy-Owl is commonly a bird of edges—including riparian corridors—and occurs from sea level to more than 1,200 m. During the first 50 years after its discovery in the United States in 1872, there were numerous observations, specimens collected, and mentions of the species in ornithological literature. Earlier accounts and specimens show the species was common in cottonwood-willow (*Populus-Salix*) and mesquite (*Prosopis*) forest and woodland along Rillito Creek and tributaries near Tucson; Salt River and tributaries near Phoenix; and much of the Gila River. Today, most of the known Arizona birds are found in areas with low density suburban housing built in desertscrub or xeroriparian locations.

Although declining numbers were not reported until the 1950s and 1960s, the sparsity of observations and specimens suggests a drastic reduction in its numbers in Arizona beginning in the 1920s. A large increase in water diversion projects occurred along the state's lowland rivers from the 1920s through the 1940s with consequential loss or degradation of the species primary, wet riparian nesting habitat. By the 1940s, irrigation canals in the Phoenix region were being lined with cement or buried in underground aqueducts, replacing tree-lined earthen canals that earlier supported populations of the owl. Few records and no specimens have been recorded for the Phoenix region since the early 1950s. Two records from Catalina Estates in the foothills near Tucson during the 1940s were indications of the species' ability to live in suburban environments in Arizona. A 1948 specimen from the Catalina Estates was 1 of only 2 specimens collected in Arizona during the 1940s. The largest known viable breeding population in Arizona today is in saguaro-paloverde-ironwood (*Carnegiea-Cercidium-Olneya*) habitat located in low density housing areas of suburban northwest Tucson.

In this paper we present the historic habitat and distribution, and the current status of the Cactus Ferruginous Pygmy-Owl, a subspecies, in Arizona. We also review some management and conservation planning options available to assist in protecting the economic integrity of the Tucson and Pima County (unincorporated area outside of Tucson) human population while simultaneously providing for the needs of the endangered owl. We conclude that compelling evidence indicates that most of the former habitats of the owl in the Phoenix area have been so modified by the expanding human population that little could ever be done to encourage a return of the birds. The best opportunities for providing conservation efforts on behalf of the owl in Arizona are in the greater Pima County area. A Regional Habitat Conservation Plan process offers the best available mechanism to protect and provide for recovery of the species by establishing biological goals and objectives for the species, clearly understanding the ecological needs of the species in the area, providing a funding mechanism for compensating landowners for land required by the owl, and reducing existing uncertainties in the landowner community.

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INTRODUCTION

The potential for conflicts between endangered species and growing urban centers is dramatically exemplified in the case of the Cactus Ferruginous Pygmy-Owl vs. Tucson and Phoenix, Arizona. In the Tucson area, where the owls continue to occur, albeit in very low numbers, urban development is occurring in habitats that are important nesting areas for a population remnant that was formerly much larger. In the Phoenix area, the owl has not been seen for almost 30 years and has apparently been extirpated from central Arizona habitats that were once the northernmost frontier of the owl's distribution (Millsap and Johnson 1988). In both cities, most members of the private development community, as well as city, county, and state management agencies, are experiencing the protective edicts of the Endangered Species Act (ESA) for the first time. Confusion, anger, and often a fear of economic losses characterize the development community, while some environmental activist groups celebrate yet another victory in the pursuit of restricting urban growth.

Nobody believes that this small owl will stop metropolitan growth in Tucson and Phoenix. There is, however, every reason to believe that some remaining habitats that have been planned for development will be set aside for the owl, while other areas currently classified as unspoiled Sonoran Desert and considered not as important for the "recovery" of the species, will ultimately be developed. Such a scenario is provided for within the law of the land. For example, 1982 revisions to the ESA allowed for an "incidental take" provision in Section 10 of the Act. In recent years, the habitat conservation planning program under Section 10(a)(1)(B) of the ESA has provided a vehicle for resolution of conflicts within communities where economic development seems to be stymied by the existence of 1 or more listed species. A creative and flexible conservation program, often referred to as a Habitat Conservation Plan (HCP), a Regional Habitat Conservation Plan (RHCP), or a Multiple Species Habitat Conservation Plan (MSHCP) is prepared as a strategy for reducing or resolving conflicts over resources and habitats while protecting the species of concern.

In this paper we present information on the historic habitat and distribution, and the current status of the Cactus Ferruginous Pygmy-Owl in Arizona. We also review some management and conservation planning options available to assist in protecting the economy of the Tucson metropolitan area while simultaneously providing for the needs of the endangered owl.

FERRUGINOUS PYGMY-OWLS

Distribution

The Ferruginous Pygmy-Owl occurs throughout most of the tropical and sub-tropical North American non-montane areas except the southeastern U.S., central Mexican Plateau, and West Indies (Burton 1984). Disjunct populations of this small diurnal owl occur throughout South America from its northern tip to as far south as Tierra del Fuego (Grossman and Hamlet 1964; Ginn 1984; Sibley and Monroe 1990). The species consists of 11 - 15 named subspecies, depending on the reference consulted (Peters 1940; Clark et al. 1978; Howard and Moore 1991; Freethy 1992). Some experts consider certain taxa as subspecies of *G. brasilianum* while others treat those same taxa as separate species. Several recent discussions have been published on the taxonomy of several taxa in the *Glaucidium brasilianum-jardinii-nanum-minutissimum*-etc. complex with various authors differing considerably (Fjeldsa and Krabbe 1990; Sibley and Monroe 1990, 1993; Howell and Robbins 1995; Robbins and Howell 1995; Robbins and Stiles 1999). Specimen records and life history information for most of the races of the Ferruginous Pygmy-Owl are sporadic to basically nonexistent, depending on the subspecies. This is particularly unfortunate for such a widely-distributed, pantropical American species. Both in the United States and Mexico, specimen collection and early studies of the Cactus Ferruginous Pygmy-Owl were truncated prematurely, leaving inadequate information about its life history and an incomplete history of its occurrence.

Throughout its range, the Ferruginous Pygmy-Owl is a widely-distributed bird, occurring in a variety of habitats from arid to humid. Our studies show it is commonly a bird of ecotones and edges of clearings, often found along banks of rivers, streams, and in xeroriparian ecosystems along dry washes. In the American tropics it also occurs around towns, orchards, and other agricultural areas (e.g. de Schauensee 1970; French 1991). It occurs along streams from Mexico (Sutton 1951; Warner and Mengel 1951; Binford 1989) into South America (RRJ). In Mexico it inhabits a wide elevational range, from sea level to 1,200 m in the west and to 300 m or more in the east (Friedmann et al. 1950). Johnson has found it in coconut and banana plantations near sea level outside Cihuatalan on the Colima-Nayarit border. In South America, some of the densest populations occur along mid-sized to small perennial streams, both near villages and in remote areas (R.R. Johnson, unpublished field notes 1989).

The northernmost subspecies, Cactus Ferruginous Pygmy-Owl, was named by van Rossem (1937). It occurs from the North American Southwest, south through northern Mexico to Michoacan, Nuevo

Leon, and Tamaulipas (Friedmann et al. 1950; American Ornithologists Union 1957). *G. b. ridgwayi* replaces *G. b. cactorum* from central Mexico through Central America (Friedmann et al. 1950; Johnsgard 1988).

Habitat of the Cactus Ferruginous Pygmy-Owl

Early ornithologists found the Cactus Ferruginous Pygmy-Owl almost exclusively along streams and rivers in the United States, both in Arizona (Bendire 1892; Gilman 1909; Phillips et al. 1964) and Texas (Oberholser 1974; Rappole and Blacklock 1994). It was considered a preferential riparian nesting species in the southwestern U.S. by Johnson et al. (1977, 1987). Historically it bred largely in wet riparian habitats, e.g. Fremont cottonwood (*Populus fremontii*)-Goodding willow (*Salix gooddingii*)-mesquite (*Prosopis* spp.) forest and mesquite woodland along Rillito Creek—the Gila, Salt, and Santa Cruz rivers—and major tributaries (Bendire 1892; Gilman 1909; L. Hargrave pers. com.; A. Phillips pers. com.). Bendire (1888, 1892) separated nesting of the Cactus Ferruginous Pygmy-Owl in riparian mesquites from the Elf Owl's (*Micrathene whitneyi*) nesting in upland saguaros (*Carnegia gigantea*).

The U.S. population has narrower ecological and elevational amplitudes than some more southerly races. In Arizona, the Cactus Ferruginous Pygmy-Owl rarely occurs below 300 m (1,000 ft) or above 1,000 m (3,280 ft.) elevation. It formerly occurred throughout much of the Gila River drainage in the Sonoran Desert lowlands of central, southeastern, and the eastern section of southwestern Arizona (state regional designations follow Monson and Phillips [1981], desert and other ecosystem classification follow Brown et al. [1980]). It was found east to the Santa Cruz River and Rillito Creek near Tucson; west to Agua Caliente near Gila Bend and Cabeza Prieta Tanks on the Cabeza Prieta National Wildlife Refuge; north and east along the Salt River through Phoenix to below Stewart Mountain Dam, and north to New River (Fisher 1893; Gilman 1909; Swarth 1914; Phillips et al. 1964; Monson and Phillips 1981). Several recent sight records exist from the San Pedro River and Chihuahuan Desert localities in eastern Arizona, but we know of no historical or recent specimens or photographs from this region. The species is absent from New Mexico (Bailey 1928; Hubbard 1978), but occurs in southern Texas. Its Texas range historically included the lower Rio Grande valley and the King Ranch in Kenedy Co. (Griscom and Crosby 1926; Oberholser 1974). Most of the known Texas population is now restricted to the Norias Division of the King Ranch (Falls 1973; Wauer et al. 1994; Proudfoot and Johnson *in press*).

One of the earliest reports of the Cactus Ferruginous Pygmy-Owl from a region without permanent

or intermittent streams lined with cottonwoods and/or mesquites was from Organ Pipe Cactus National Monument, in southwestern Arizona (Groschupf et al. 1988). There, the species was found in the late 1940s along Alamo Wash, an ephemeral stream course with major trees consisting of mesquite, ironwood (*Olneya tesota*), palo verde (*Cercidium* spp.), and saguaros (Hensley 1951, 1954). During this same period, a specimen was taken 6 Jan 1948 by A. R. Phillips in the Catalina Estates of the Santa Catalina foothills near Tucson. This was also in saguaro-palo verde vegetation but in the vicinity of houses, irrigated vegetation, and backyard ponds and was one of the earliest indications of the species' ability to live in suburban environments in Arizona. A second Catalina Estates report for this period was the observation of a single male on 12 Apr 1950 (Brandt 1951). Despite 8 seasons in southeastern Arizona (between 1935 and 1948), Brandt did not find the species at Fort Lowell or elsewhere along Rillito Creek where the owl had been reported as common earlier.

Status in Arizona

Today, fewer than 50 individual birds are known in Arizona, most of them from sparsely settled suburban desertscrub or xeroriparian locations. The precipitous decline of this subspecies has resulted in its being listed by the U.S. Fish and Wildlife Service as an Endangered Species in Arizona (U.S. Fish and Wildlife Service 1997). Determining where, when, and why the Cactus Ferruginous Pygmy-Owl began to decline in numbers and range is difficult. In retrospect, inadequate information apparently led to a lapse of several decades between the actual decline of Cactus Ferruginous Pygmy-Owl populations and recognition and reporting of this decline. The best information available suggests to us that the major decline occurred from at least the 1920s, and by the 1950s the species was extremely rare in Arizona. The species is not generally difficult to find, being diurnal and often calling for hours at a time, loudly enough to be heard for 300 m or more.

Human-induced changes in streamflow, groundwater, and watersheds have eliminated or drastically modified most lowland wet riparian habitats in Arizona since 1890 (Johnson and Carothers 1982; Knopf et al. 1988; Johnson and Simpson 1988). The Cactus Ferruginous Pygmy-Owl is now restricted largely to xeroriparian paloverde (*Cercidium* spp.)-mesquite-acacia (*Acacia* spp.) and upland habitats, e.g. saguaro desertscrub, often with ironwood or mesquite located near desert washes (Johnson and Haight 1984, 1985; Millsap and Johnson 1988; Monson 1998). Early Arizona records that mentioned this species occurrence in upland habitats provided insufficient specific site information to preclude the

possibility of specimens having been collected in xeroriparian sites, or perhaps even wet riparian sites in foothill habitats (e.g. Fisher 1893, Howell 1916). Fisher's note mentioned saguaros along the New River adjacent to cottonwood-mesquite and other riparian vegetation along the river but did not indicate the owls were using the saguaros. Howell took a specimen in the foothills of the Santa Catalina Mountains, but from a cottonwood tree at a spring.

Examination of museum and publication records for specimens of the Cactus Ferruginous Pygmy-Owl taken in Arizona, from its discovery in the United States until the current time, shows a clear decrease in collection of birds and eggs over time. By breaking the period of specimen collection from 1872 to 1961 into 30-year increments, one finds that the number of specimens taken during each of the 30-year periods is roughly half of that taken during the previous period (Table 1).

Exploratory Period: 1872-1901. Accounts during the late 1800s and early 1900s described the status of this subspecies in the United States as common to fairly common: "quite common at New River, thirty-five miles NW of Phoenix, Ariz., in June, 1892" (Fisher 1893:199). Bendire's accounts of finding birds and nests of the species referred to it as a common bird, saying he "took several in 1872 in the heavy mesquite thickets bordering Rillito [*sic*] Creek, near . . . Tucson" (Bendire 1892:409).

During this period there was increased clearing of river bottoms for irrigated fields and towns—for Phoenix on the Salt River and Tucson on the Santa Cruz and Rillito Rivers. Water for irrigation was diverted by earthen dams into unlined ditches, resulting in little direct change in the riparian cottonwood-willow gallery forests and mesquite woodlands on the banks of southwestern rivers. These unlined ditches served as artificial streams, providing habitat for aquatic organisms, e.g. invertebrates, fishes, and amphibians. Trees and shrubs growing along their banks provided riparian avian habitat (Johnson 1972), including for the Cactus Ferruginous Pygmy-Owl. An early account stated that "among the growth of cottonwood that fringe the Gila and Salt rivers of Arizona this owl is of common occurrence . . . and since trees planted by man have become large enough to afford nesting sites for woodpeckers, this Owl has gradually worked its way from the natural growth of timber bordering the rivers to that bordering the banks of irrigating canals until now it can be found in places ten miles from the rivers" (Breninger 1898:128).

Dam Construction Period: 1902-1931. Along the undammed Gila River, the species was "fairly numerous . . . not wild and the observer may approach as near as ten or fifteen feet" (Gilman 1909:148). The first extensive Arizona checklist

reported the Cactus Ferruginous Pygmy-Owl from "the valley of the upper Gila River, and its tributaries (Salt River, Santa Cruz River, etc.), where it is not uncommon" (Swarth 1914:31). The excitement of finding a new species for the United States and collection of the owl perhaps diminished somewhat during this period. However, a more direct impact was felt from the passage of the National Irrigation Act of 1902, providing for large-scale reclamation projects throughout the Southwest. During the early 1900s large dams were constructed on the Salt and Gila rivers. The first project was construction of Roosevelt Dam, from 1906 and 1911, below the confluence of Tonto Creek with the Salt River. This resulted in cessation of natural downstream flows and consequential degradation and loss of most riparian Cactus Ferruginous Pygmy-Owl habitat in the Phoenix region. While collection of specimens in the Tucson and Gila River regions remained relatively constant—where dams had not been built—collecting in Phoenix practically ceased.

Riverine Desertification Period: 1932-1961. Construction of large dams was continuing along the Salt and Gila rivers, resulting in loss of almost all cottonwood-willow gallery forests and much of the mesquite woodland—prime Cactus Ferruginous Pygmy-Owl habitat. Additionally, unwise land use practices in the Tucson region had drastically altered the flow regimes in the Rillito and Santa Cruz drainages (Hastings 1959; Hastings and Turner 1965). In both watercourses the streams had changed from permanent to intermittent, deeply downcut streambeds had been accompanied by heavily eroded banks, and riparian vegetation had been degraded or destroyed (Johnson and Carothers 1982; Betancourt and Turner 1988; Johnson and Simpson 1988). During this period Allan R. Phillips, Arizona's leading ornithologist, searched extensively for the species but succeeding in collecting only 4 specimens, 2 in Tucson and the last 2 known specimens for the Phoenix region (A. R. Phillips pers. comm.). Although the demise of the species had begun much earlier, it was finally recognized in Arizona's most authoritative avifaunal book as "local and generally sparse resident of Lower Sonoran Zone in central-southern and central Arizona . . . now rare and local at Tucson where it was formerly much more numerous" (Phillips et al. 1964).

Decline of the Owl in Arizona

Examination of specimens and the literature show that, starting in the 1920s and despite what seemed an upsurge in ornithological activity in the state, there was a definite decline in specimens collected and publication of records of the Cactus Ferruginous Pygmy-Owl in Arizona. This hiatus in the specimen record exists despite the fact that there was an

increase in numbers of professional ornithologists and resident laymen with ornithological interests working in central and southern Arizona (Johnson et al. 1997a).

This decline was at least suspected by several active field ornithologists in Arizona and Texas by the 1950s. Blue Point Cottonwoods is located on the Salt River, approximately 2 miles upstream from its confluence with the Verde River and 30 miles upstream from downtown Phoenix (Johnson and Simpson 1971). The last 2 specimens of the Cactus Ferruginous Pygmy-Owl for the Phoenix region were collected here in 1949 and 1951 by A. R. Phillips. Yet, as late as the mid- 1960s the species was reported in literature from this area, where it had not been recorded for more than a decade (Phillips et al. 1964). In reference to Fort Lowell and other Tucson region locations where the species once had been reported as common, "it is now rare and local at Tucson, where it was formerly much more numerous" (Phillips et al. 1964:52). Still, it was not considered threatened or endangered even as late as the early 1970s (U.S. Fish and Wildlife Service 1973). The critical nature of the plight of the Cactus Ferruginous Pygmy-Owl was noted after more than 25 years of searching for the species in the North American Southwest, and Arizona in particular when, "in our opinion this species has been extirpated as a regular nesting species in the southwest by destruction of most of the suitable nesting riparian habitat" (Johnson et al. 1979:51). Thus, it was the late 1970s and 1980s before literature reported the decline that was obvious by the 1950s (Monson and Phillips 1981). A similar drastic decline was reported in at least some populations in Texas during this same period, especially along the lower Rio Grande Valley (Oberholser 1974).

More recently, reports have documented severe declines in both distribution and abundance, especially throughout the species' historic range in Arizona. The subspecies *cactorum* "has been reported from only a few locations in Arizona during the past twenty years with no persistent populations known at present" (Hunter 1988). Between 1953 and the 1990s, Johnson made innumerable trips to Rillito Creek, the areas where Bendire collected the first specimens for the U.S. in 1872 and several additional specimens were collected over the following 50 years. Between 1960 and 1990, Johnson visited all historic sites in Arizona from which records were available; finding the species at only 2 Arizona localities, Organ Pipe Cactus National Monument and Blue Point Cottonwoods. Annotated checklists for birds of central and southern Arizona show either documentation of increasing rareness and/or lack of adequate knowledge of the species. For southeastern Arizona (including Tucson), earlier

checklists listed the species as a rare resident (Davis and Russell 1979, 1984), more recently adding the phrase "not found every year" (Davis and Russell 1990:98). For the Phoenix region, an early checklist stated "formerly casual resident; present status unknown" (Demaree et al. 1972:31), but more recently devoted an entire paragraph to the discussion of its demise (Witzeman et al. 1997).

Several factors probably played a role in this precipitous decline. There were drastic changes in the ecology of the riverine valleys where the species was found during the later 1800s and early 1900s. These changes were at least partially due to water projects, grazing, and urbanization (Hastings 1959; Phillips and Monson 1964; Hastings and Turner 1965; Johnson and Carothers 1982). There was a large increase in water diversion projects along the state's lowland rivers from the 1920s through the 1940s and consequential degradation of the species primary nesting wet riparian habitat. By the 1950s, irrigation canals in the Phoenix region were being lined with cement or buried in underground aqueducts, replacing the tree lined earthen canals that earlier supported populations of the owl (Breninger 1898; Johnson 1972). Concern has been expressed about competition for nest sites between Cactus Ferruginous Pygmy-owls and other cavity-nesting species, especially the introduced European Starling (*Sturnus vulgaris*) (Table 2). However, there appear to be large numbers of unoccupied cavities in areas seemingly suited to the Cactus Ferruginous Pygmy-Owl, but without owls present.

Massive destruction of the species' habitat occurred during the late 1800s and into the 1900s, apparently extirpating the entire population from the Phoenix region. Urban development in the Phoenix region now spreads for approximately 60 miles across the length of the Salt River Valley and in places is approximately 35 miles wide. Approximating 800 mi² in size and with a human population approaching 3 million, this formidable barrier isolates the Lower Salt River Recreation Area (including Blue Point Cottonwoods), New River, and Cave Creek. Reinvasion of the region by these small, sedentary owls is almost entirely cut off by a vast "island" of urban and suburban habitat—houses, paved streets, and parking lots (Johnson and Haight 1998). Another factor for the Phoenix region is that this is the northern extreme for the range of not only the Cactus Ferruginous Pygmy-Owl, but the species as a whole.

As more suitable owl habitat, Tucson contrasts with Phoenix in several factors. Approximating 200 mi²—1/4 the size of Phoenix and with a population of approximately 700,000, less than 1/4 that of Phoenix, Tucson has retained a more rural landscape. Its major streams have not been dammed and

more "natural areas" have been maintained in the outlying sections of town. These include the Tucson and Rincon Mountain districts of Saguaro National Park, Coronado National Forest, various Pima County park areas and low density suburban housing. Tucson is also closer to the major population of the Cactus Ferruginous Pygmy-Owl in Mexico and to the Tohono O'odham Indian Reservation, where several observations of the species have been recently reported (Benesh and Rosenberg 1997).

The Cactus Ferruginous Pygmy-Owl is a bird of riparian zones and other ecotones or edges of clearings (our earlier studies). Urban environments may be considered artificial or human-created riparian environments because of supplemental water supplied to landscaping. Whether water in the stream channel, pond, or stock tank is ephemeral, intermittent, or perennial we generally find an increased food base compared to the surrounding uplands. Near Tucson the few remaining breeding pairs are usually in areas where there is supplemental water for plants and/or livestock. In Texas, successfully breeding pairs are usually near a stock tank (G. Proudfoot pers. comm.). The increased food base afforded by supplemental water seems to be critical to breeding success, and the owls have been occasionally observed drinking or bathing (D. Abbate pers. comm.).

Other factors may also have been at work. A species at the northern periphery of its range, such as the Cactus Ferruginous Pygmy-Owl in the southwestern U.S., may be recorded as a breeding species for 1 or more years at an outpost and then retract to the south again. The records from New River and Agua Caliente might fit this category. As pointed out for other southwestern owl species, it is difficult to decide if a reported change in populations and/or range is due to a "real change" or to the fact that a long standing phenomenon has finally been recognized (Barlow and Johnson 1967). This has been largely due to the lack of ornithological observers in large areas of the Southwest in contrast to the more heavily populated East.

SUMMARY AND CONCLUSIONS

The urban environs of the Cactus Ferruginous Pygmy-Owl present both problems and opportunities related to the management of this endangered species. A major threat to the continued existence of the Cactus Ferruginous Pygmy-Owl in Arizona is the absence of adequate scientific information. Priorities for investigation should include population and distribution surveys to learn the range of habitats utilized by Cactus Ferruginous Pygmy-Owls in Arizona, and inventories to determine the

most productive environs in the state. Additional studies should include dietary analyses and continued use of telemetry and banding to learn about dispersal movements, habitat use, and mortality of individuals, continuing and expanding ongoing work by the Arizona Game and Fish Department (Abbate et al. 1996, Wilcox et al. 1999).

We believe the existing data on Cactus Ferruginous Pygmy-Owls adequately chronicle the regional decline of a species and further document that this decline may be attributable to human-caused modifications of the landscape. There is no question that in the grand scheme of things, species come and go. Indeed, such is the nature of the evolutionary process. However, when the disappearance of a species can be directly linked to human activities that if suspended or altered would provide relief to that species, the terms and conditions of the ESA demand that efforts be made to arrest and/or reverse the decline. In the case of the Cactus Ferruginous Pygmy-Owl in Arizona, certain "recovery" opportunities and constraints limit options for what can be done in any attempt to reverse the declining trend in population numbers.

For example, in the Phoenix area, we believe compelling evidence exists to indicate that the former habitats of the owl have been so modified by the expanding human population that little could ever be done to encourage a return of the birds to this area. All of the authors of this report have recently been involved in extensive searches for the owl in the Phoenix area, and none have been encountered. It is our opinion that further searches for the owl in Phoenix are likely to be unproductive. However, it is possible that scattered individuals may drift into the area and that surveys may occasionally find them. We believe that, because their habitats have become so fragmented, the area may not support even a remnant viable population. However, if future surveys should find a viable population, we need to reconsider the issue. For now, conservation efforts for the owl in Arizona should be focused south of Phoenix.

In the Tucson area (including southern Pinal County), south to the international border and west to Organ Pipe Cactus National Monument, occupied breeding habitat for the owl continues to exist. This is especially apparent in areas where urban development is not dense (1 house or fewer / 3-5 acres) and in isolated areas to the west and south of Tucson on the Tohono O'odham Indian Reservation. Since the listing of the species in 1997, intensive searches for the species in the Tucson area by biologists employed by the Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and private consultants have been very productive, and we now know that the area supports substantially more owls than

was suspected at the time of the listing. Thus, it is the greater Pima County area where the opportunities for conserving this owl are greatest. We believe that development and implementation of a Regional Habitat Conservation Plan offers the best available mechanism to protect and provide for recovery of the species by establishing biological goals and objectives for the species, clearly understanding the ecological needs of the species in the area, providing a funding mechanism for compensating landowners for land required by the owl, and reducing existing uncertainties in the landowner community.

Although the Habitat Conservation Planning (HCP) process has been demonstrated to work in many communities for a variety of species, it is not without conflict—often communities are polarized with developers on one side and preservationists on the other. By careful organization of the planning process and willing participation by the landowner groups most affected by the listed species, flexible and adaptive plans can be forged. Previous HCPs have demonstrated a large degree of success in significantly reducing the burden of endangered and threatened species listings on landowners and other non-federal entities by providing efficient mechanisms for compliance, distributing the economic impacts of conservation throughout the community, and bringing a broad range of landowner activities under the legal protection of the Habitat Conservation Plan.

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Table 1.—Cactus Ferruginous Pygmy-Owl skin and egg sets collected in Arizona by 30-year increments.

Period	Tucson Region		Gila R. Region		Phoenix Region		Total Specimens	
	Skins	Eggs	Skins	Eggs	Skins	Eggs	Skins	Eggs
1872-1901	7+ ^a		2		12	9	21+	9
1902-1931	8		3 ^b	1	1		12	1
1932-1961	3				3		6	

^aSeveral collected near Ft. Lowell (Coues 1872; Bendire 1888, 1892).

^bTwo skins and 1 live bird (Gilman 1909).

Table 2. Potential nest site competitors.

Common Name	Arizona	Texas
PRIMARY NESTING SPECIES (Cavity excavators)		
1. Gila Woodpecker	•	
2. Golden-fronted Woodpecker		•
3. Ladder-backed Woodpecker ^a	•	•
4. Gilded Flicker	•	
SECONDARY NESTING SPECIES (Nest in cavities excavated by other species)		
1. American Kestrel	•	•
2. Eastern Screech-Owl		•
3. Western Screech-Owl	•	
4. Cactus Ferruginous Pygmy-Owl	•	•
5. Elf Owl	•	•
6. Ash-throated Flycatcher	•	•
7. Great Crested Flycatcher		•
8. Brown-crested Flycatcher	•	•
9. Purple Martin ^b	•	
10. Black-crested Titmouse		•
11. Carolina Wren		•
12. Bewick's Wren ^c	•	
13. European Starling	•	•
14. Lucy's Warbler ^d	•	
15. House Sparrow ^e	•	•

^a Does not nest in saguaros, its cavities are apparently too small for Cactus Ferruginous Pygmy-Owl unless cavity enlarged after woodpecker abandons it (RRJ).

^b Lowland subspecies (*Progne subis hesperia*) nests only in saguaros (Brown 1997).

^c Does not nest in saguaros (RRJ).

^d Usually nests under loose bark, natural cavities, etc. rather than in abandoned woodpecker cavities (Johnson et al. 1997b).

^e Occasionally builds nest in woodpecker cavity near human habitation (RRJ).