

**R. Roy Johnson
Jean-Luc E. Cartron
Lois T. Haight
Russell B. Duncan
Kenneth J. Kingsley**

Chapter 2:

A Historical Perspective on the Population Decline of the Cactus Ferruginous Pygmy-Owl in Arizona

The cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) was discovered in the U.S. by Bendire in 1872 in the Tucson area (Coues 1872). During the next five decades, naturalists collected many specimens of this owl and typically described the subspecies as common or fairly common along some streams and rivers of central and southern Arizona. A common view among regional ornithologists is that the cactus ferruginous pygmy-owl's Arizona population sharply declined around 1950 (see Monson and Phillips 1981). As a result of a petition (Galvin et al. 1992), the cactus ferruginous pygmy-owl became federally listed as Endangered in Arizona in 1997 (U.S. Fish and Wildlife 1997). In retrospect, however, many questions remain on the magnitude and timing of the population decline. In this chapter, we review early records of cactus ferruginous pygmy-owls from the published literature, U.S. Forest Service files, and museum specimen collections. Evidence of a sharp population decline dating back to the early 20th century exists for the Phoenix area, including the lower Salt River. Along the lower and middle Gila River Valley, a severe population decline is also apparent but its timing is uncertain. In southern Arizona, changes in the overall status of the owl are more difficult to detect in part due to the lack of baseline information. However, along Rillito Creek and the Santa Cruz River in particular, an early population

decline is also probable. Along these two rivers, and along the Salt and Gila rivers, the owl's population decline could have coincided with intensive woodcutting and the construction of the first dams, causing deforestation and reduced waterflow early in the 20th century. The current status of the cactus ferruginous pygmy-owl population in Arizona is also addressed in Chapter 3.

1. A species at the edge of its range

The ferruginous pygmy-owl (*G. brasilianum*) reaches the northern edge of its distribution in Arizona and Texas. Using the scissor-tailed flycatcher (*Tyrannus forficatus*) and the indigo bunting (*Passerina cyanea*) as examples, Brown (1984) notes that the abundance of a species tends to decline from the center to the edge of the range. Towards the edge, the distribution of a species also tends to be more patchy (Brown 1984). Despite historical accounts describing the cactus ferruginous pygmy-owl as common or fairly common at various locations in Arizona (see below), it is difficult to determine what the overall status of the owl was in the state. It is unknown whether the owl was found throughout its geographic range in Arizona (Fig. 2-1), which extended north to New River, just north of Phoenix; east to Geronimo along the Gila River, and

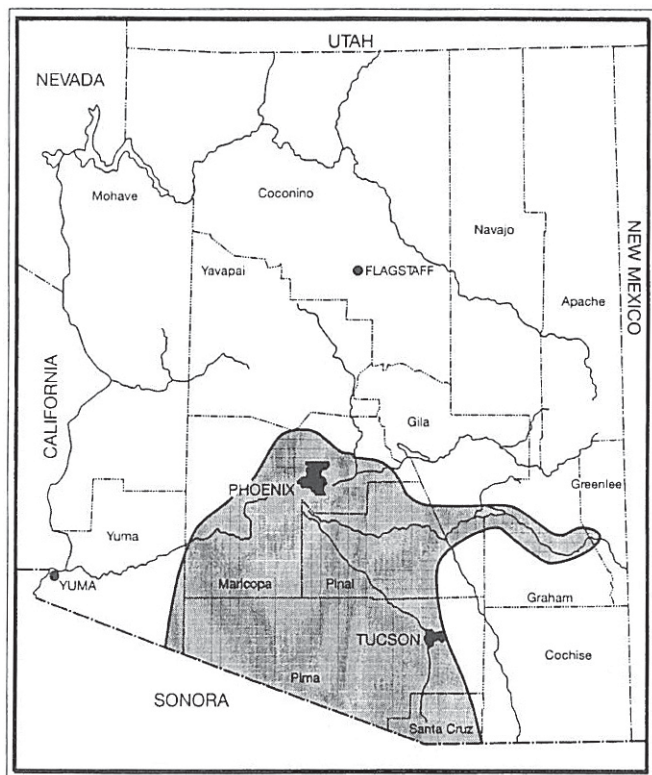


Figure 2-1. Map showing the approximate range of the cactus ferruginous pygmy-owl in Arizona (based on data from Fisher 1893, Phillips et al. 1964, Monson and Phillips 1981, Hunter 1988). Note the extended distribution to the east along the Gila River. Whether the range truly extends this far east is based on two unconfirmed reports in the 1970s and 1980s (Hunter 1988, T. Corman pers. comm.).

possibly even to the confluence of the Gila and San Francisco rivers; and west to Agua Caliente and the desert ranges of Yuma County (Fisher 1893, Gilman 1909, Swarth 1914, Aiken 1937, Phillips et al. 1964, Monson and Phillips 1981, Hunter 1988). Alternatively, this bird may have shown an insular population structure characterized by the local occurrence of distinct subpopulations, its absence in other parts of the range reflecting natural discontinuities in vegetation structure and composition and/or topographic conditions.

2. The historical importance of riparian areas

Judging from historical accounts by early ornithologists, the cactus ferruginous pygmy-owl was once frequently encountered in cottonwood (*Populus fremontii*) forests, mesquite (*Prosopis velutina*)-cottonwood woodlands, and mesquite bosques along the Gila and Salt rivers in central Arizona, and along the Santa Cruz River and Rillito Creek near Tucson

(Bendire 1888, Breninger 1898, Gilman 1909, Swarth 1914). The owl was also recorded in Sonoran desert scrubland, but in this habitat it was apparently found in areas supporting pockets of xeroriparian and riparian vegetation (Fisher 1893, Howell 1916, Kimball 1921). At New River, for instance, Fisher (1893) described the cactus ferruginous pygmy-owl as “quite common” in thickets of intermixed mesquite and saguaro (*Carnegiea gigantea*) cacti. Elsewhere in the desert, the presence of this bird may have been more infrequent, as Kimball (1921) concluded that, overall, it was rare in the Santa Catalina foothills. Furthermore, Breninger (1898) differentiated the nesting habits of the elf owl (*Micrathene whitneyi*) and the cactus ferruginous pygmy-owl, the former alone, in his opinion, occupying saguaro cavities. At the same time, it should be noted that most early surveys were probably conducted along rivers, the harsh climate and limited water supply reducing coverage of surveys in the desert. Recent observations of the owl in upland desertscrub (see Chapter 3) indeed suggest that the cactus ferruginous pygmy-owl may have been overlooked in this habitat during the late 19th and early 20th centuries. Overall the owl cannot presently be considered an obligate riparian bird in Arizona, yet it seems that river valleys and washes probably were its primary habitat before the population decline occurred.

3. Population decline and local extirpations

It is generally reported that the Arizona population of cactus ferruginous pygmy-owls started to decline sharply around 1950 (Monson and Phillips 1981, Abbate et al. 1996). However, many riparian areas had already been altered before they were ever surveyed by naturalists (Phillips and Monson 1964, see also below). Other areas, where the cactus ferruginous pygmy-owl had been reported around the turn of the century, were apparently not surveyed again for decades (Johnson et al. unpubl. ms.). The lack of information means that the owl population decline could have begun earlier. By the early 1950s, the cactus ferruginous pygmy-owl was already regarded by some as rare (e.g., Brandt 1951). The apparent population decline was later also recognized by Phillips et al. (1964), Johnson et al. (1979), Monson and Phillips (1981), and Hunter (1988). The cactus ferruginous pygmy-owl was even described as extirpated “except possibly in the Organ Pipe Cactus National Monument region” (Monson and Phillips 1981). Between 1971 and 1988, fewer than 20 credible cactus ferruginous pygmy-owl sightings were recorded (Hunter 1988). Although these records showed that the owl could still

be found at various locations, no persistent breeding population was known anywhere in the state.

With the use of broadcast surveys in recent years, more owls have been recorded in northwestern Tucson and elsewhere in southern Arizona (see Chapter 3). Several nesting pairs were identified chiefly in the Tucson area (Abbate et al. 1996, Wilcox et al. 1999). Thus, new questions arise concerning the true magnitude and long-term significance of the population decline reported earlier. However, a sharp population decline ultimately resulting in the extirpation of the owl appears certain for two general areas: the Phoenix area, including the lower Salt River and New River, and the lower and middle Gila River. Elsewhere, the magnitude of any population decline is confounded by the lack of baseline information, especially in desertscrub, and the recent increase in sampling effort resulting in more detections (see Chapter 3).

Central Arizona

The cactus ferruginous pygmy-owl was once a common inhabitant of the cottonwood groves in the Salt River Valley (Breninger 1898). As previously mentioned, it was also “quite common” at New River (Fisher 1893). On several occasions between 1892 and 1905, Breninger collected skins and eggs in the Phoenix area. Additional specimens were secured during that period by Fisher, Lusk, Campbell, and Bennett (Johnson et al. unpubl. ms.).

Only three specimens of cactus ferruginous pygmy-owls were collected along the Salt River after 1905. Initially, the decline in the number of specimens collected in the Phoenix area may be in part attributed to the fact that soon after the turn of the century, and until about 1930, ornithologists shifted their attention toward Tucson (Johnson et al. unpubl. ms.). However, the decline becomes especially revealing after 1930, when several resident ornithologists began to collect and publish work conducted near Phoenix. Mostly during the 1930s and 1940s, Lyndon Hargrave studied the birds of the Salt River Valley, publishing occasional notes and collecting specimens from the region (Johnson et al. unpubl. ms.). During that same period, Allan Phillips and Lewis Yaeger collected in the area. Vic Housholder worked in the area from the 1930s through the 1950s.

The small number of specimens collected, despite the presence of increasing ornithological activity after 1930, suggests a sharp, early population decline of the cactus ferruginous pygmy-owl in the Phoenix area, including the lower Salt River (Johnson et al. unpubl. ms.). The specimen of cactus ferruginous pygmy-owl that Hargrave collected in 1933 below Stewart Mountain Dam proves that the owl still occurred locally at this time. Later, when Phillips and Yaeger worked in the region, they collected owl specimens in

1949 and 1951, which are among the last known collected in the state. As late as 1964, the owl was reported as still occurring at the mouth of the Verde River and eastward along the Salt River (Phillips et al. 1964). However, at that second location it had in fact not been recorded for more than a decade (Johnson et al. unpubl. ms.).

Following Phillips, Johnson and Simpson (1971) started intensive record keeping and specimen collection at one location near the mouth of the Verde River along the Salt River, known as Blue Point Cottonwoods (BPC). The work of all these ornithologists along the Salt River was nearly continuous over seven decades, and it shows the extirpation of the owl from that location by the early seventies (Millsap and Johnson 1988). After the last record in 1971, numerous attempts to find another owl even using playback recordings have been unsuccessful.

The cactus ferruginous pygmy-owl was also “common” along the lower and middle Gila River (Breninger 1898). Breninger encountered enough individuals of this species to notice its gradual expansion along irrigation canals. Writing about owl species he recorded along the lower and middle Gila River at Agua Caliente, Sacaton, and Blackwater, Gilman (1909) later described the cactus ferruginous pygmy-owl as “fairly numerous.” Although Agua Caliente alone is mentioned in his account of this owl, Gilman also collected specimens at the other two locations (Johnson et al. unpubl. ms.). At Blackwater, he collected two females, one in January 1908, the other in March of that same year. The dates given for those specimens, together with information contained in two written accounts by Gilman (Gilman 1909, Rea 1983) indicate that he encountered the cactus ferruginous pygmy-owl in all seasons. In retrospect, his work strongly suggests that the cactus ferruginous pygmy-owl was present along an extensive stretch of the lower and middle Gila River. Besides the three specimens Gilman collected and the nesting pair he described from Agua Caliente, one specimen had earlier been secured by Judson (Johnson et al. unpubl. ms.).

Unfortunately, the population status of the cactus ferruginous pygmy-owl along the middle and lower Gila River was not assessed again until 1963, at which time Rea (1983) began to survey the avifauna of the Gila River Indian Reservation, including Sacaton and Blackwater. Rea’s work showed that the owl was now extirpated on the reservation. Interestingly, none of his Native American consultants recognized this bird from specimens, thus suggesting that the extirpation had occurred long before his study.

Southern Arizona

Records of cactus ferruginous pygmy-owls in southern Arizona exist for the Tucson area and, after 1949,

for Organ Pipe Cactus National Monument as well (Hensley 1954). Due to the lack of baseline information, recent owl records from other locations, such as Sycamore Canyon in Santa Cruz County or the Tohono O'odham Reservation (Stejskal 1981, Taylor 1995, Johnson et al. unpubl. ms.), are difficult to interpret.

After Bendire's discovery of the cactus ferruginous pygmy-owl in 1872 and his description of this bird as common at Fort Lowell (now Tucson) along Rillito Creek, there were specimens collected at that same location on several occasions between 1872 and 1916 (Brewster 1883, Howell 1916, Johnson et al. unpubl. ms.). One specimen was also collected along the Santa Cruz River (Brown 1884). Scott (1886) referred to the owl as a bird "not uncommon about Tucson." However, from the 1920s through the 1940s, with two possible exceptions - skins collected in 1922 by Kimball and a reported observation in 1949, both at an unspecified location in the Tucson area (Johnson et al. unpubl. ms.)-, the owl was not mentioned from Rillito Creek or the Santa Cruz River in the literature, nor was any specimen collected. For example, Brandt (1951) worked in southeastern Arizona between 1935 and 1948, but he found no cactus ferruginous pygmy-owl along Rillito Creek. We are not aware of any record showing the presence of the owl along Rillito Creek or the Santa Cruz River since the 1940s.

While an early extirpation seems probable along Rillito Creek and the Santa Cruz River, the owl continued to be recorded in Sabino Canyon and elsewhere in the Santa Catalina Mountains at regular intervals through the 1970s (e.g., Kimball 1921, Brandt 1951, Davis 1974, Demaree 1976, Johnson et al. unpubl. ms.). Phillips et al. (1964) reported a population decline near Tucson but this population decline is not well documented. In recent years, broadcast surveys have led to the discovery of a breeding population of owls in the Tucson area (see Chapter 3). The fact that pygmy-owls are now found in desertscrub rather than riparian areas further confounds any effort to evaluate the magnitude and timing of a population decline in the Tucson area.

4. Habitat loss and alteration along floodplains

Reasons for the population decline and local extirpations of the cactus ferruginous pygmy-owl have been called speculative by some (Rea 1983, Hunter et al. 1987). Peripheral populations may be at a higher risk of sporadic local extinction. In birds, there is evidence suggesting that after periods of environmental stress, population density declines proportionally more at the edge of the range (Mehlman 1997). Furthermore, the contraction or expansion of the range documented for several North American birds of prey (e.g., Phillips

et al. 1964, Weidensaul 1989, Williams 1997) underscores the dynamic nature of geographic boundaries. The relative instability of peripheral populations may help explain why the largely tropical ferruginous pygmy-owl seemingly experienced a population decline in Arizona, at the very northern edge of its distribution.

While biogeography may have played an important role, it is generally recognized that loss of habitat was one, if not the, primary causal factor (Johnson et al. 1979, Johnson and Haight 1985, Hunter 1988, Millsap and Johnson 1988). The coincidental occurrence of habitat loss and population decline was witnessed both in Texas and in Arizona (see Oberholser 1974, Johnson et al. unpubl. ms.). Where the pygmy-owl's habitat has been preserved in Texas, a sizeable population still occurs (Mays 1996).

The history of riparian habitats in Arizona has been called one of "destruction" (Phillips and Monson 1964) and "desertification" (Johnson and Simpson 1988). Indeed, it is now estimated that since the end of the 19th century, at least 90% of all the original vegetation along Arizona's rivers has disappeared due to human activities (Johnson and Carothers 1982, Fleishner 1994). Some rivers which once had a perennial flow of water are now dry over the lower part of their course. In many areas, their banks are lined with exotic tamarisk (*Tamarix* spp.) or are almost devoid of vegetation (Hastings and Turner 1965, Johnson 1979, Rea 1983, Tellman et al. 1997). The severe population decline of several bird species, such as the southwestern willow flycatcher (*Empidonax traillii extimus*) (Unitt 1987, Taylor and Littlefield 1986, U.S. Fish and Wildlife 1995, Sogge et al. 1997) and the yellow-billed cuckoo (*Coccyzus americanus*) (Laymon and Halterman 1987) over the entire Southwest has been linked to the disappearance of riparian habitat. In parts of their range, Lucy's warblers (*Vermivora luciae*) have clearly suffered from the loss of mature bosques caused by woodcutting and diminishing water tables (Rea 1983, Johnson et al. 1997).

In modern times, the growth of cities throughout the Southwest has been placing increasing demands on regional watersheds (Tellman et al. 1997). Groundwater pumping and water diversion in particular represent important threats to riparian woodlands (e.g., Johnson and Carothers 1982, Tellman et al. 1997). Yet, although some riparian landscapes have been drastically altered during the last several decades, many others were lost around the turn of the 20th century. The history of southwestern rivers is indicative of early human-related changes that caused severe deforestation and reduced waterflow. An early population decline of the cactus ferruginous pygmy-owl along the Gila, Santa Cruz, and Salt rivers would have coincided with a severe loss of riparian areas.

Gila River

During the first half of the 19th century, the flow of water was perennial along most of the Gila River's course (Dobyns 1981). Below its confluence with the Salt River, the river reached 200 yards in width (see Tellman et al. 1997). The banks were described as supporting tall cottonwoods and willows (*Salix* spp.) as well as abundant wildlife that included "flights of white brant [snow goose] . . . geese, and ducks, with many signs of deer and beaver" (Emory 1848). Javelinas, otters, turkeys, and mountain lions were also described (Tellman et al. 1997). Islands in the middle of the river sheltered numerous beaver; fish were abundant (Tellman et al. 1997). Some fish, such as the Colorado squawfish (*Ptychocheilus lucius*), weighed nearly 50 pounds, and, along with the razorback sucker (*Xyrauchen texanus*) in the Salt River, supported commercial fishing (Minckley 1973).

While the Pima and Maricopa Indians who lived along the banks of the Gila must have somewhat affected this river, drastic changes in the surrounding vegetation and the flow of water did not occur until the arrival of the first Anglo-Americans (Dobyns 1981, Tellman et al. 1997). The activities of the newcomers included intensive beaver trapping, cattle grazing, and mining. Beaver trapping caused the many pools behind their dams to disappear along with the wildlife they had supported. Overgrazing led to the loss of vegetation and an increase in soil erosion. Mining caused water pollution and diversion, as well as deforestation in order to produce fuel and mine timbers. In 1876, for instance, untold miles of mesquite thickets were harvested to produce charcoal (Tellman et al. 1997). The water table dropped substantially due to diversion and groundwater pumping. A canal built by farmers in 1887 at Florence significantly reduced waterflow downstream. Beginning in 1921, several dams were built that further reduced waterflow and ended seasonal flooding, thus preventing the regeneration of native vegetation (Tellman et al. 1997). Rea (1983) describes riparian areas along the Gila River during Gilman's time as already affected by humans and "rapidly deteriorating."

The Santa Cruz River and Rillito Creek

Historically, the flow of water in the Santa Cruz River was mostly perennial from the river headwaters in the San Rafael Valley to north of the Tucson Mountains (Tellman et al. 1997). Early accounts describe a river lined with cottonwood trees, willows, and walnuts (*Juglans major*), and occasional forests of huge mesquite trees (Froebel 1859, Swarth 1905, Willard 1912). Swamps created by springs occurred at several locations and supported lush vegetation (Dobyns 1981). Wildlife was abundant and diverse with the local

occurrence of tortoises, waterfowl, beaver, muskrats, and large mammals such as grizzly bears and bobcats (Tellman et al. 1997).

The banks of Rillito Creek, historically a main tributary of the Santa Cruz River, supported large cottonwoods (Surgeon General's Office 1875). There was a marsh near Fort Lowell. Evidently, the vegetation along the Santa Cruz was lush in 1872 when Bendire (1888) collected his first cactus ferruginous pygmy-owl specimens. In his succinct description of the habitat, he refers to the presence of "heavy mesquite thickets."

During Bendire's time, the banks of the Santa Cruz River and Rillito Creek were already beginning to change (see Tellman et al. 1997). As trees were cut to provide domestic and industrial fuelwood for the growing city of Tucson, the banks of the Santa Cruz River suffered heavy deforestation. Swarth (1905) and Willard (1912) both describe giant mesquite trees, many of them sixty feet high, with a thick understory of hackberry (*Celtis* spp.) and other thorny bushes, along the Santa Cruz on the Papago Indian Reservation (now known as the San Xavier District of the Tohono O'odham Reservation), but Swarth adds that the location of the mesquite grove on the reservation "is the only reason for the trees surviving as long as they have, since elsewhere every mesquite large enough to be used as firewood has been ruthlessly cut down, to grow again as a straggly bush."

Salt River

In the absence of drought, the flow of the Salt River was once perennial, with pools created by beaver dams (B. Foltz, pers. comm.). The river banks were lined with cottonwood, mesquite, and willow trees (Tellman et al. 1997). Humans first impacted the river system with woodcutting and water diversion for agricultural needs. Initially, human-caused changes in the vegetation along the Salt River may have been less dramatic than on the Gila and Santa Cruz rivers. Yet, during the first decade of the century, the Salt River Project was initiated and the construction of the first of four dams on the Salt River east of its confluence with the Verde River was completed as early as 1911 (Tellman et al. 1997). By the end of the 1930s, the other three dams had been built. Together, those dams turned the lower Salt River into a string of lakes and prevented the regeneration of the native vegetation (Tellman et al. 1997).

5. Blue Point Cottonwoods: a glimpse of the past

BPC occurs on the Tonto National Forest between Stewart Mountain Dam (Saguaro Lake) and Granite

Reef Dam. Located approximately 50 km upstream from downtown Phoenix and 3 km upstream from the confluence of the Verde and Salt rivers, the area extends for nearly 2 km and supports the most extensive native cottonwood-mesquite habitat remaining along the lower Salt River. In a preliminary report, Johnson and Simpson (1971) describe a large stand of mature cottonwoods with mesquite understory and a marsh of open water located in an abandoned meander of the Salt River and lined with arrowweed (*Pluchea sericea*) and tamarisk. In the marsh, dense stands of cattail (*Typha domingensis*) grow along with duckweed (*Lemna* sp.) and a rare water fern for the region (*Azolla* sp.). On the desert hills and flats immediately adjacent to the riparian and aquatic habitats is semi-arid Arizona Upland and Lower Colorado River Valley vegetation that includes washes lined by xeroriparian habitat (Brown et al. 1980, Johnson et al. 1984). Despite the presence of a dam upstream to control flooding, the area is thought to resemble many riparian habitats of the past (Johnson and Simpson 1971, Rea 1983).

To study the local bird community, Johnson and Simpson delineated a 250 acre (100 ha) plot that extended 1.6 km along the marsh with a maximum width of .8 km. The study area consisted of seven basic habitats (Table 2-1) which together contributed to the diversity and complexity of the habitat. The study area was surveyed from 1969 until the early 1980s. Of 208 avian species recorded within the plot's boundaries, 69 were breeding (Table 2-2). Among them, the least bittern (*Ixobrychus exilis*), Cooper's hawk (*Accipiter cooperii*), elf owl (*Micrathene whitneyi*), black-chinned hummingbird (*Archilocus alexandri*), brown-crested flycatcher (*Myiarchus tyrannulus*), vermilion flycatcher (*Pyrocephalus rubinus*), common raven (*Corvus corax*), and blue grosbeak (*Guiraca caerulea*) also once bred along the Gila River on the Gila River Indian Reservation (Rea 1983). Presumably, the extirpation of these species on the reservation coincided with the loss of their habitat (e.g., the tall stands of cottonwood or willow trees with well developed understory for the

Cooper's hawk and the brown-crested flycatcher, and the marshy areas for the least bittern). At BPC, where these same habitat types have persisted, the birds mentioned above still occurred when the study ended. Even so, some species, including the common black-hawk (*Buteogallus anthracinus*) and the cactus ferruginous pygmy-owl, ceased to occur on the study plot, arguably as a result of the more general loss of riparian vegetation statewide.

Although total ecological losses due to human activities since the arrival of European settlers will never be fully known, the long-term study conducted at BPC, together with historical descriptions of riparian landscapes, offers a glimpse of past riverine conditions. The history of BPC between 1969 and 1995 also provides insight on the fragile nature of riparian habitats and the associated impact of human activities. During that period, grazing by cattle and horses had a sometimes deleterious effect on the native ecosystem. Cattails in the marsh were devoured by cattle during some years, leaving no cover for several species of aquatic and marsh birds (e.g. pied-billed grebe [*Podilymbus podiceps*], least bittern, common moorhen [*Gallinula chloropus*], American coot [*Fulica americana*], and common yellowthroat [*Geothlypis trichas*]). Permittee grazing was removed from the plot in 1977-1978 (Goldfield allotment permit canceled permanently in 1981) but trespass grazing continued into the 1990s. During the 1970s, the area was fenced, but fences to the north were destroyed by recreationists and fences to the south were destroyed by floods.

The pulsing action of flooding alternating with periods of non-flooding is an essential process in maintaining natural riparian ecosystems in the Southwest (e.g., Molles et al. 1998). However, when these natural processes are interrupted by dams, such as those along the Salt River, floods may then become destructive to riparian ecosystems (Johnson and Carothers 1982). Such is the case with BPC. During the late 1970s and early 1980s, several years of heavy winter rains resulted in large spring-water releases by the Salt River Project from upstream dams. During the

Table 2-1. Habitat types on the Johnson-Simpson study plot.

Type	Acres	Hectares
Closed canopy mesquite bosque	80	32
Open canopy mesquite bosque	45	18
Mesquite bosque w/ cottonwood overstory	15	6
Old river bed (sand, rocks, scattered mesquites, shrubs, cacti, and other perennials)	50	20
River and banks	25	10
Marsh	7	3
Upland (ridges dissected by washes w/ xeroriparian vegetation)	28	11
Total	250	100

Table 2-2. Breeding birds on the study plot at Blue Point Cottonwoods (data from Phillips et al. 1964, Johnson and Simpson 1971, Johnson et al. 1987, Johnson unpubl. data, and L. L. Hargrave & A. R. Phillips unpubl. field notes).

Species common name ^a	Breeding habitat ^b	Local status ^c	Riparian dependency ^d	Number of breeding pairs on plot
Pied-billed grebe	M	SR	OBL	1 (some years)
Least bittern	M	SR	OBL	2
Great blue heron ^e		PR	OBL	1
Green heron	CE	SR	OBL	3
Osprey ^{e,f}		WR	OBL	1 (extirpated)
Bald eagle	C	ON	OBL	1 (winters 71-72, 88-89)
Cooper's hawk	C	PR	OBL	1
Common black-hawk	C	SR	OBL	1 (extirpated)
Harris's hawk	C	PR	PREF	1 (some years)
Red-tailed hawk	C	PR	FAC	1
American kestrel	CF	PR	PREF	2
Gambel's quail	DFW	PR	PREF	Fluctuates, 1-7 coveys
Sora	M	ON	OBL	1 (summer 1951)
Common moorhen	M	SR	OBL	Varies, up to 4
American coot	M	SR	OBL	Varies, up to 6
Killdeer	E	ON	PREF	2
White-winged dove	CWF	SR	PREF	74±
Mourning dove	CWF	PR	PREF	99±
Yellow-billed cuckoo	C	SR	OBL	3
Greater roadrunner	ACDFW	PR	PREF	3
Barn-owl	C	PR	PREF	1
Western screech-owl	CW? ^g	PR	PREF	230±
Great-horned owl	C, Cliffs	PR	PREF	2
Ferruginous pygmy-owl	CW	PR	PREF	Extirpated
Elf owl	F	SR	NON	7
Lesser nighthawk	F	SR	NON	10+
Common poorwill	F	SR	NON	4+
Black-chinned hummingbird	CW	SR	OBL	11±
Costa's hummingbird	DF	SR	NON	2+
Gila woodpecker	CFDW	PR	PREF	16
Ladder-backed woodpecker	CW	PR	OBL	16
Gilded flicker	CD	PR	FAC	5
Black phoebe	ERM	PR	OBL	3
Vermilion flycatcher	CW	SR	OBL	1 ^h
Ash-throated flycatcher	CFW	PR	PREF	24
Brown-crested flycatcher	C	SR	OBL	15
Western kingbird	C	SR	OBL	2
Northern rough-winged swallow	R	SR	OBL	7
Cliff swallow	R	SR	OBL	Remains of 33 old nests
Common raven	R	PR	PREF	1
Verdin	DW	PR	PREF	109±
Bushtit	D	Vagrant		1 (nested 1973)
Cactus wren	F	PR	FAC	9
Rock wren	F	PR	NON	2
Bewick's wren	C	PR	OBL	2
Black-tailed gnatcatcher	D	PR	FAC	5
Curve-billed thrasher	CFW	PR	PREF	4
Crissal thrasher	W	PR	OBL	7
Phainopepla	DW	WR	PREF	19
European starling	CF	WR	PREF	26
Bell's vireo	EW	SR	OBL	14
Lucy's warbler	CW	SR	OBL	510±
Yellow warbler	C	SR	OBL	3
Common yellowthroat	M	SR	OBL	6
Yellow-breasted chat	E	SR	OBL	4

(con.)

Table 2-2. Con.

Species common name ^a	Breeding habitat ^b	Local status ^c	Riparian dependency ^d	Number of breeding pairs on plot
Summer tanager	C	SR	OBL	4
Northern cardinal	DW	PR	OBL	11
Blue grosbeak	E	SR	OBL	3
Canyon towhee	F	PR	NON	1+
Abert's towhee	CW	PR	OBL	25±
Black-throated sparrow	F	PR	NON	2
Song sparrow	EM	PR	OBL	20
Red-winged blackbird	E	PR	OBL	15±
Bronzed cowbird	CW	SR	OBL	2+
Brown-headed cowbird	ALL	SR	PREF	10± females
Hooded oriole	CW	SR	OBL	Extirpated ⁱ
Bullock's oriole	CW	SR	OBL	12±
House finch	CDW	PR	FAC	30±
Lesser goldfinch	C	SR	OBL	18
Totals: 69 species				1,527+ pairs

^aAfter 7th ed. A.O.U. Checklist (1998).

^bBreeding Habitat: A=Abandoned river channel of sand and rock with sparse desert scrub; C=Fremont cottonwood (*Populus fremontii*)-Goodding willow (*Salix gooddingii*); D=desert washes; E=water edge, including mesquite (*Prosopis velutina*), arrowweed (*Pluchea sericea*) & seepwillow (*Baccharis salicifolia*) [see R]; F=foothills, largely saguaro (*Cereus giganteus*)-palo verde (*Cercidium* sp.)-bursage (*Ambrosia* sp.) and mixed cacti; M=marsh vegetation, largely cattails (*Typha domingensis*), bulrushes (*Scirpus* spp.), common reed (*Phragmites*), water fern (*Azolla* sp.), duckweed (*Lemna minor*); R=riverbank and cliffs (sand, soil & rocks in contrast to vegetation in E); W=mesquite woodland (bosque), including *Acacia* spp.

^cStatus on study plot, may differ from Salt River Valley in general: ON=occasional nester; PR=permanent resident; SR=summer resident; WR=winter resident.

^dAfter Johnson et al. 1987.

^eFeeding territory only, nesting off of study plot.

^fLast seen nesting in this area by Werner, summer 1951 (not Johnson, as stated by Phillips et al. 1964). Hargrave (pers. comm.) knew it as a relatively common nester on transmission lines along the Salt River between Roosevelt Dam and Mesa and Robinson (1930) recorded a pair nesting at Canyon Lake.

^gExtrapolation from random censusing of displaying pairs in open and closed-canopy mesquite and cottonwood gallery forest with mesquite understory (Johnson et al. 1981).

^hVermilion flycatchers (*Pyrocephalus rubinus*) were here in numbers during the 1940s and 1950s but after 1 pair bred in 1969, they disappeared from the plot until after a large burn in the late 1980s or early 1990s when at least 2 pairs returned.

ⁱEarlier records showed the hooded oriole (*Icterus cucullatus*) more common than the Bullock's oriole (*I. bullockii*). In 1969, the last pair of hooded orioles was recorded nesting at BPC (Johnson unpubl. data). Phillips suggests that this may be largely due to an increase in brood parasitism by the bronzed cowbird on hooded orioles. This would not, however, explain the increase in the Bullock's oriole population.

early spring of 1978, 1979, and 1980, flows of 2.5 m to 3.5 m or more in depth flooded most of the Hargrave-Phillips-Johnson study area. Although mesquite trees were rarely damaged, some mature cottonwoods and many of the seepwillow (*Baccharis salicifolia*), arrowweed, and other riparian shrubs were uprooted. The marsh was greatly damaged from scouring of cattails, common reeds (*Phragmites australis*), bulrushes (*Scirpus* spp.), and other herbaceous or semi-woody plants. However, the receding water also left seed beds and many cottonwood and willow seedlings later grew into medium-sized trees during the 1980s.

In the Southwest, the lack of regular natural flooding also contributes to the accumulation of debris and an increase in both frequency and intensity of fire in riparian areas (Crawford et al. 1993, Stuever 1997). At BPC, fire is presently one of the most damaging factors. Several fires of 25 acres or more during the mid to late 1980s burned much of the study area.

Although many of the mesquites recovered, or partially recovered, several small stands of cottonwoods disappeared. As shown by recent visits, the larger stands along the marsh escaped damage and continue to thrive.

Most lowland riparian habitats in Arizona have suffered a substantial loss in biological diversity and a reduction in the population density of native plants and animal species. In the past, many riparian areas apparently shared the same habitat complexity and bird species richness of BPC. Even the documented changes in the local vegetation at BPC due to grazing, fires, and human-caused flooding serve as a reminder of the potential magnitude of human impacts on riparian habitats. The population decline of the cactus ferruginous pygmy-owl and other species associated with riverine ecosystems in Arizona may be viewed as symptoms of this broader problem created by human interruption of natural riparian processes along southwestern lowland river systems.

References

- Abbate, D., A. Ditty, S. Richardson, and R. Olding. 1996. Cactus ferruginous pygmy-owl surveys and nest monitoring in the Tucson Basin Area, Arizona. Final Rep. International Enhancement #U95503. Phoenix, AZ: Arizona Game and Fish Department.
- Aiken, C. E. H. 1937. Birds of the Southwest. Colorado College Publications General. Series No. 212.
- American Ornithologists' Union [A.O.U.]. 1998. Check-list of North American birds, 7th ed. Washington, D.C.: American Ornithologists' Union.
- Bendire, C. E. 1888. Notes on the habits, nests and eggs of the genus *Glaucidium* Boie. Auk 5:366-372.
- Brandt, H. 1951. Arizona and its bird life. Cleveland, OH: Ohio Bird Research Foundation.
- Breninger, G. F. 1898. The ferruginous pygmy-owl. Osprey 2:128.
- Brewster, W. 1883. On a collection of birds lately made by Mr. F. Stephens in Arizona. Bulletin of the Nuttall Ornithological Club 7:21-36.
- Brown, D. E., C. H. Lowe, and C. P. Pase. 1980. A digitized systematic classification for ecosystems with an illustrated summary of the natural vegetation of North America. Gen. Tech. Rep. RM-73. Fort Collins, CO: U.S. Department of Agriculture, Rocky Mountain Forest and Range Experiment Station.
- Brown, H. 1884. Notes on file at the University of Arizona Ornithology Collection.
- Brown, J. H. 1984. On the relationship between abundance and distribution of species. American Naturalist 124:255-279.
- Corman, T. E., neotropical migratory bird coordinator, Arizona Game and Fish Department, Phoenix. [Personal communication]. April 1998.
- Coues, E. 1872. A new bird to the United States. American Naturalist 6:370.
- Crawford, C. S., A. C. Cully, R. Leuthenser, M. S. Sifuentes, L. H. White, and J. P. Wilber. 1993. Middle Rio Grande ecosystem: Bosque biological management plan. Albuquerque, NM: U.S. Fish and Wildlife Service.
- Davis, W. A. 1974. American Birds 28:88-89.
- Demaree, S. 1976. Audubon Field Notes 25:890.
- Dobyns, H. F. 1981. From fire to flood: historic human destruction of Sonoran Desert riverine oases. Anthro. Pap. #20. San Jose, CA: Ballena Press.
- Emory, W. H. 1848. Notes of a military reconnaissance. New York, NY: H. Long and Brother.
- Fisher, A. K. 1893. The hawks and owls of the United States in their relation to agriculture. U.S. Department of Agriculture, Div. Ornithol. and Mammal. Bull. 3:1-210.
- Fleishner, T. L. 1994. Ecological costs of livestock grazing in western North America. Conservation Biology 8:629-638.
- Foltz, H. B., pioneer, Phoenix, Arizona Territory. [Personal communication]. 1975.
- Froebel, J. 1859. Seven years travel in Central America, Northern Mexico, and the Far West of the United States. London: Richard Bentley.
- Galvin, P., D. C. Carlton, M. Pyott, R. Silver, and K. Suckling. 1992. Petition to list the ferruginous pygmy-owl *Glaucidium brasilianum cactorum*, as a federally endangered species. Luna, NM. 14 p.
- Gilman, M. F. 1909. Some owls along the Gila River in Arizona. Condor 11:145-150.
- Hargrave, L. L., professor of biology, Prescott College, Prescott, AZ. [Personal communication]. 1973.
- Hargrave, L. L., and A. R. Phillips. Unpubl. field notes. Available from R. R. Johnson.
- Hastings, R. J., and R. M. Turner. 1965. The changing mile: an ecological study of vegetation change with time in the lower mile of an arid and semiarid region. Tucson, AZ: University of Arizona Press.
- Hensley, M. M. 1954. Ecological relations of the breeding bird populations of the desert biome in Arizona. Ecological Monographs 24:185-207.
- Howell, A. B. 1916. Some results of a winter's observations in Arizona. Condor 18:209-214.
- Hunter, W. C., R. D. Ohmart, and B. W. Anderson. 1987. Status of breeding riparian-obligate birds in southwestern riverine systems. Western Birds 18:10-18.
- Hunter, W. C. 1988. Status of the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) in the United States and northern Mexico. Phoenix, AZ: U.S. Department of Interior, Fish and Wildlife Service. 13p.
- Johnson, R. R. 1979. The Lower Colorado River: a western system. Pp. 41-55. In: Proceedings of the 1978 national symposium on strategies for protection and management of floodplain wetlands and other riparian ecosystems. Gen. Tech. Rep. GTR-WO-12. Washington, D.C.: U.S. Department of Agriculture, Forest Service.
- Johnson, R. R., B. T. Brown, L. T. Haight, and J. M. Simpson. 1981. Playback recordings as a special avian censusing technique. Pp. 68-75. In: Ralph, C. J., and J. M. Scott, eds. Estimating numbers of terrestrial birds. Studies in Avian Biology No. 6, Cooper Ornithological Society.
- Johnson, R. R., and S. W. Carothers. 1982. Riparian habitat and recreation: interrelationships and impacts in the Southwest and Rocky Mountain Region. Eisenhower Consortium Bull. 12:1-31. Fort Collins, CO: U.S. Department of Agriculture, Rocky Mountain Forest and Range Experiment Station.
- Johnson, R. R., S. W. Carothers, and J. M. Simpson. 1984. A riparian classification system. Pp. 375-382. In: California riparian systems: ecology, conservation, and productive management. Berkeley, CA: University of California Press.
- Johnson, R. R., J.-L. E. Cartron, R. B. Duncan, K. J. Kingsley, and L. T. Haight. 1999. Cactus ferruginous pygmy-owl records in Arizona: evidence of an early population decline. Manuscript in preparation.
- Johnson, R. R., and L. T. Haight. 1985. Status of the ferruginous pygmy-owl in the southwestern United States. Abstracts, 103rd Stated Meeting of the American Ornithologists' Union, Arizona State University, Tempe, Arizona.
- Johnson, R. R., L. T. Haight, and J. M. Simpson. 1979. Owl populations and species status in the southwestern United States. Pp. 40-59. In: Schaeffer, P., and S. M. Ehler, eds. Owls of the west: their ecology and conservation. Proceedings of the National Audubon Society. George Whittel Education Center, Tiburon, California.
- Johnson, R. R., L. T. Haight, and J. M. Simpson. 1987. Endangered habitats versus endangered species: a management challenge. Western Birds 18:89-96.
- Johnson, R. R., and J. M. Simpson. 1971. Important birds from Blue Point Cottonwoods, Maricopa County, Arizona. Condor 73:379-380.
- Johnson, R. R., and J. M. Simpson. 1988. Desertification of wet riparian ecosystems in arid regions of the North American Southwest. Pp. 1383-1393. In: Whitehead, E. E., C. F. Hutchinson, B. N. Timmermann, and R. G. Varady, eds. Arid lands: today and tomorrow. Boulder, CO: Westview Press.
- Johnson, R. R., H. K. Yard, and B. T. Brown. 1997. Lucy's Warbler (*Vermivora luciae*). In: Poole, A., and F. Gill, eds. The birds of North America, No. 318. Philadelphia, PA: Academy of National Sciences; Washington, D.C.: American Ornithologists' Union.
- Kimball, H. H. 1921. Notes from southern Arizona. Condor 23:57-58.
- Laymon, S. A., and M. D. Halterman. 1987. Can the western subspecies of the yellow-billed cuckoo be saved from extinction? Western Birds 18:19-25.
- Mays, J. L. 1996. Population size and distribution of cactus ferruginous pygmy-owls in Brooks and Kenedy counties, Texas. Thesis. Kingsville, TX: Texas A&M University.
- Mehlman, D. W. 1997. Change in avian abundance across the geographic range in response to environmental change. Ecological Applications 7:614-624.
- Millsap, B. A., and R. R. Johnson. 1988. Ferruginous pygmy-owl. Pp. 137-139. In: Glinski, R. L., B. G. Pendleton, M. B. Moss, M. N. LeFranc, Jr., B. A. Millsap, and S. W. Hoffman, eds. Proceedings of the Southwest raptor management symposium and workshop. Scientific Technical Series 11. Washington, D.C.: National Wildlife Federation.
- Minckley, W. L. 1973. Fishes of Arizona. Phoenix, AZ: Arizona Game and Fish Department.
- Molles, M. C., Jr., C. S. Crawford, L. M. Ellis, H. M. Valett, and C. N. Dahm. 1998. Managed flooding for riparian ecosystem restoration. BioScience 48:749-756.
- Monson, G., and A. R. Phillips. 1981. Annotated checklist of the birds of Arizona. Tucson, AZ: University of Arizona Press. 240 p.

- Oberholser, H. C. 1974. The bird life of Texas. Austin, Texas: University of Texas Press. 1069 p.
- Phillips, A. R., and G. Monson. 1964. Historic changes and conservation of Arizona habitats. Pp. xiii-xvii. In: Phillips, A. R., J. Marshall, and G. Monson. The birds of Arizona. Tucson, AZ: University of Arizona Press.
- Phillips, A. R., J. Marshall, and G. Monson. 1964. The birds of Arizona. Tucson, AZ: University of Arizona Press.
- Rea, A. M. 1983. Once a river. Tucson, AZ: University of Arizona Press. 285 p.
- Robinson, W. H. 1930. Our friendly birds. Chandler, AZ: Chandler Arizonan.
- Scott, W. E. D. 1886. On the avifauna of Pinal County with remarks on some birds of Pima and Gila counties, Arizona. Auk 3:421-432.
- Sogge, M. K., T. J. Tibbitts, and J. R. Petterson. 1997. Status and breeding ecology of the southwestern willow flycatcher in the Grand Canyon. Western Birds 28:142-157.
- Stejskal, D. 1981. American Birds 35:967.
- Stuever, M. C. 1997. Fire induced mortality of Rio Grande cottonwood. Master's thesis. Albuquerque, NM: University of New Mexico.
- Surgeon General's Office. 1875. A report on the hygiene of the U.S. Army with descriptions of military posts. Circular 8. Washington, D.C.: U.S. War Department, Surgeon General's Office.
- Swarth, H. S. 1905. Summer birds of the Papago Indian Reservation and of the Santa Rita Mountains, Arizona. Condor 7:22-28.
- Swarth, H. S. 1914. A distributional list of the birds of Arizona. Pacific Coast Avifauna 10:1-133.
- Taylor, R. C. 1995. A birder's guide to southeastern Arizona. American Birding Association.
- Taylor, D. M., and C. D. Littlefield. 1986. Willow flycatcher and yellow warbler response to cattle grazing. American Birds 40(5):1169-1173.
- Tellman, B., R. Yarde, and M. G. Wallace. 1997. Arizona's changing rivers: how people have affected the rivers. Tucson, AZ: Water Resources Research Center, College of Agriculture, University of Arizona.
- Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137-162.
- U.S. Fish and Wildlife Service. 1995. Final ruling determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694-10715.
- U.S. Fish and Wildlife Service. 1997. Final ruling determining endangered status for the cactus ferruginous pygmy-owl. Federal Register 62(46):10730-10746.
- Weidensaul, S. 1989. North American birds of prey. London: Quantum Books.
- Wilcox, R. L., S. Richardson, and D. Abbate. 1999. Habitat characteristics of occupied cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) sites at the suburban/rural interface of north Tucson, Arizona. Unpubl. Report. Region V wildlife program. Tucson, AZ: Arizona Game and Fish Department. 30 p.
- Willard, F. C. 1912. A week afield in southern Arizona. Condor 14:53-63.
- Williams, S. O., III. 1997. New Mexico Bird Records Committee Report for 1996. New Mexico Ornithological Society Bulletin 25:75-87.