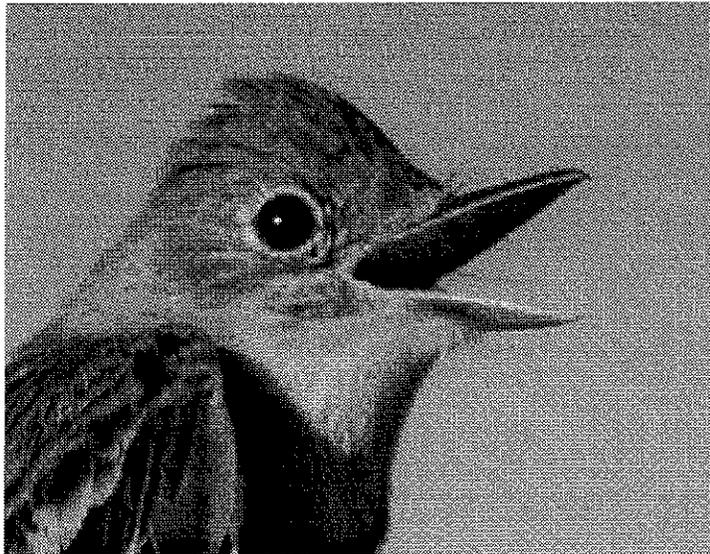


**Distribution and Breeding Productivity of the
Southwestern Willow Flycatcher along the Colorado River
in the Grand Canyon
- 1996 -**



Southwestern Willow Flycatcher. Photograph by Michael Moore.

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SUMMARY

We monitored historic and current southwestern willow flycatcher (*Empidonax traillii extimus*) sites along the Colorado River corridor, emphasizing the reach from Glen Canyon Dam to Cardenas Marsh (River Mile [RM] 71). We surveyed for flycatchers by moving through or adjacent to riparian habitat patches, broadcasting flycatcher songs from hand-held tape players, and listening and looking for willow flycatchers. We detected 7 willow flycatchers - 3 migrants, two territorial but non-breeding males, and one breeding pair. The migrants were found between RM 46 and RM 71; the non-breeding males established territories at RM 50.5 Left [L] and RM 51.4 L; and the breeding pair was at RM 50.5 L. Brown-headed cowbirds (*Molothrus ater*) were present at all willow flycatcher locales, but unlike previous years, did not parasitize the one flycatcher nest monitored. The breeding pair at RM 50.5 L abandoned the first nest before building another close by and subsequently successfully fledged at least one, and maybe two, young flycatchers, making this the second consecutive year of successful fledging at this site (one known young fledged at this site in 1995). The breeding male at RM 50.5 L was color-banded to permit identification in following years. In addition, another study conducted for the Bureau of Reclamation by a contractor, discovered 18 territorial willow flycatchers along the lower Colorado River at the boundary between Grand Canyon National Park and Lake Mead National Recreation Area. In this group, four successful nests were found, producing 9 fledged young. This represents the first known nesting of willow flycatchers in this stretch, and is the highest density of breeding birds known along the lower Colorado River. However, the number of southwestern willow flycatchers along the Colorado River corridor in Grand Canyon National Park and Glen Canyon National Recreation Area remains very low and may become locally extirpated. We recommend development of an integrated willow flycatcher management plan, continued willow flycatcher monitoring in the historical sites in Grand Canyon, expanded surveys in the western end of the park bordering Lake Mead, recreation closures at known or potential flycatcher breeding sites during the breeding season, and continuation of the current cowbird monitoring program at Grand Canyon National Park.

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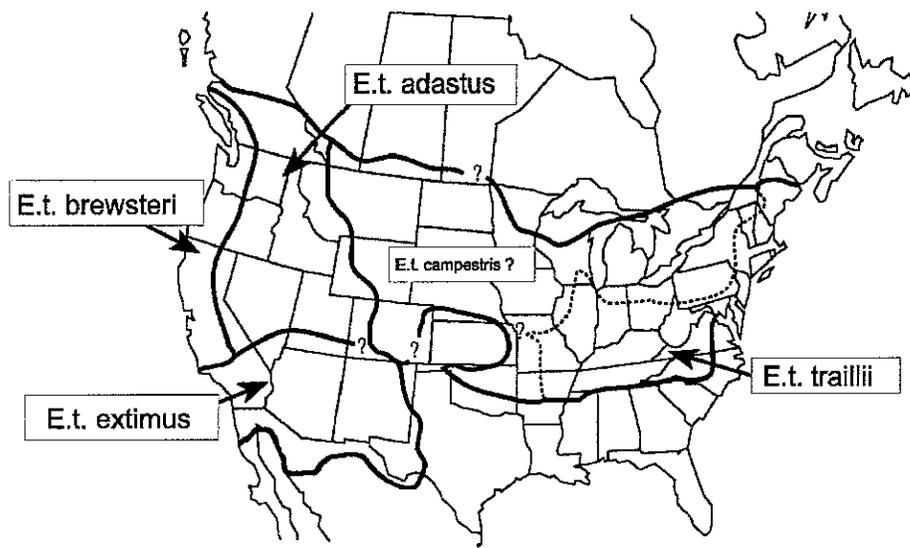
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INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*) is one of several recognized subspecies of the willow flycatcher (Unitt 1987, Browning 1993), a neotropical migrant that breeds across much of North America (Figure 1). The various subspecies of willow flycatcher nest in a variety of mesic sites including bushy meadows and riparian communities. The southwestern race is a riparian obligate, preferring cottonwood-willow associations and in many portions of the Southwest, including Grand Canyon, it nests in tamarisk-willow associations. Historical Grand Canyon nesting sites have been characterized by thickets of 10 m tall tamarisk (*Tamarix ramosissima*), mixed with willows (*Salix* spp.) and seep willows (*Baccharis* spp.). These patches of riparian habitat are located in a wide, slow-moving stretch of river with an associated eddy or backwater slough supporting a structurally varied canopy of emergent vegetation near the nest site (Brown and Trosset 1989, Tibbitts *et al.* 1994, Sogge *et al.* 1995). The southwestern willow flycatcher has declined throughout its range in recent decades, possibly due to a number of factors including loss and fragmentation of riparian habitat, loss of wintering habitat, invasion of riparian habitat by the exotic tamarisk, brood parasitism by brown-headed cowbirds (*Molothrus ater*), and predation (Hunter *et al.* 1987, Unitt 1987, Hunter *et al.* 1988, Whitfield 1990, Harris 1991, Rosenberg *et al.* 1991; USFWS 1993).

Figure 1. Breeding ranges of willow flycatcher (*Empidonax traillii*) subspecies. Modified from Browning (1993).



The U.S. Fish and Wildlife Service (USFWS) proposed to list the southwestern subspecies as endangered (USFWS 1993) along with critical habitat (including portions of the Colorado River in the Grand Canyon). A 1995 listing decision designated the subspecies as endangered (USFWS 1995), but postponed critical habitat designation. The states of Arizona, New Mexico, and California comprise most of the southwestern willow flycatcher's historic and current range. Each of these states lists the species as endangered (Arizona Game and Fish Department 1988, New Mexico Department of Game and Fish 1988, California Department of Fish and Game 1991).

Willow flycatchers were once distributed along most major river systems in Arizona (Phillips 1948, Unitt 1987). However, in the 10 years prior to 1993, only three areas within the state (one of which was the Grand Canyon) were known to support nesting southwestern willow flycatchers. Beginning in 1993, the Arizona Partners in Flight program (led by the Arizona Game and Fish Department) coordinated intensive state-wide inventories for breeding southwestern willow flycatchers. In 1993, 42-56 territorial flycatchers were found, as well as 10 active nests (Muiznieks *et al.* 1994). During 1994, surveyors found approximately 120 territorial males (77 of which were known to be paired with one or more female), with breeding verified at 62 territories (Sferra *et al.* 1995). Unfortunately, confirmed breeding success was very low - only 10 documented successful nests statewide in 1994. The situation improved in 1995, with 83-87 territorial flycatchers found, and 62 pairs of birds documented. Nesting efforts statewide included 56 known nesting attempts and 27 successful nests producing a minimum of 57 fledged young (Spencer *et al.* 1996).

Prior to initiation of the state-wide surveys in 1993, it appeared that the Grand Canyon was one of the last and largest willow flycatcher breeding areas in the state. This was worrisome because the Grand Canyon population was very low and appeared to be declining. In 1986, Brown (1988) found 11 males (a singing male was assumed to represent a breeding pair, although only two nests were found). Since then, the breeding population declined to only 2 breeding pairs in 1991 (Brown 1991), 2 pair in 1992 (Sogge and Tibbitts 1992), and 2 pair in 1993 (Sogge *et al.* 1993). In 1994, 4 breeding pairs were found, all within the River Mile (RM) 50-52 L reach (river mile designations based on Stevens 1983, and sides L and R represent the river location as the viewer looks downstream), but all nesting efforts were unsuccessful (Sogge and Tibbitts 1994). During 1995, one breeding pair was found and successfully fledged one young, which represents the only known recruitment into the population since 1992 (Sogge *et al.* 1995).

Although the recent state-wide Partners in Flight surveys have shown that the Grand Canyon willow flycatcher population constitutes a smaller proportion of the total *E.t. extimus* population than once thought, the population remains of concern due to the documented decline and current low population level. In addition, the willow flycatchers breeding in the canyon are subject to very high rates of nest parasitism by brown-headed cowbirds, with subsequent reproductive failure (Sogge *et al.* 1993, Brown 1994, Sogge and Tibbitts 1994, Sogge 1995). Cowbird nest parasitism is known to be a factor in the decline of willow flycatchers throughout the southwest (Tibbitts *et al.* 1994), but the Grand Canyon population is particularly affected. Since 1992, only one nest has been known to

successfully produce any fledgling willow flycatchers within the entire Colorado River corridor in the Grand Canyon.

The willow flycatchers in the Grand Canyon are clearly of management concern. To continue monitoring the status and distribution of this flycatcher along the Colorado River corridor, the National Park Service (Grand Canyon National Park, Glen Canyon National Recreation Area, and Organ Pipe Cactus National Monument), the USFWS, the National Biological Service, and the U.S. Bureau of Reclamation Glen Canyon Environmental Studies (GCES) office supported surveys from 1992 through 1995. The Colorado Plateau Research Station at Northern Arizona University coordinated the project, which was funded by the GCES. In 1996, the interagency approach was again used, with Grand Canyon NP as the lead agency in coordinating monitoring efforts and once again GCES provided funding.

Field activities in 1996 focused on finding and monitoring breeding activity at historic and recent breeding sites and designed to meet the following four objectives:

1. Continue to monitor breeding willow flycatchers in the Grand Canyon.
2. Continue to assess impacts of cowbird nest parasitism
3. Assess the loss or modification of habitat due to the 1996 experimental flood flows.
4. Continue to assess habitat use patterns, particularly nest site characteristics, at known breeding sites .

This report is based on the results of willow flycatcher monitoring conducted during the 1996 breeding season, and compares these results with data obtained from previous surveys.

METHODS

We determined willow flycatcher presence by sightings and song detections made primarily from 0330 to 1000 hrs daily, when male song rates are the greatest (Unitt 1987). We conducted a few surveys at dusk, a period when willow flycatchers may display a secondary peak of singing (Weydemeyer 1973, Unitt 1987). We followed the standardized willow flycatcher survey protocol detailed in Tibbitts et al. (1994), which involves broadcasting taped willow flycatcher songs and calls in order to elicit a verbal response (singing) from any nearby territorial willow flycatcher. This technique also allows positive species identification of the responding bird's song by comparison to the "known" willow flycatcher tape.

Surveyors walked through, or adjacent to, surveyed habitats whenever possible. Where terrain or dense vegetation prohibited walking surveys, we made observations from boats drifting slowly past the habitat patch. After broadcasting willow flycatcher songs for 15-30 seconds (from a hand-held cassette player), surveyors listened approximately 1-3 minutes for a response. This procedure was repeated every 20-50 meters throughout each survey site.

We monitored willow flycatcher breeding efforts along the Colorado River corridor from Triple Alcoves (RM 46) downstream to Cardenas Marsh (RM 71), emphasizing historic and recent willow flycatchers breeding sites. These sites included Saddle Canyon to Kwagunt Creek, Lava Chuar, and Cardenas Marsh (Brown 1988, 1991; Sogge and Tibbitts 1992, Sogge et al. 1993, Sogge and Tibbitts 1994). We also conducted a few flycatcher surveys below Cardenas.

At historically occupied sites, singing males were often detected in early morning without the need for tape playback. At these sites, extra time was spent monitoring the habitat patches for spontaneously vocalizing willow flycatchers in order to (1) determine number and gender of willow flycatchers present, (2) determine approximate territory and use areas, and (3) observe flycatcher behavior.

During observation periods we determined nesting status by nest inspection on each initial and subsequent monitoring trip, noting clutch size, number and age of young, and presence of cowbird eggs or young. We monitored nests no more than once each day and examined nests using a microvideo camera mounted on a telescoping rod. To assess the threat of cowbird parasitism, we recorded the presence of cowbirds at all surveyed patches, and noted cowbird behavior and any willow flycatcher response.

RESULTS

Survey Effort

We conducted 6 trips, performing 59 total surveys between 08 May and 21 July 1996 (Table 1); 39 surveys were conducted from land, 15 from boat, and 5 using both techniques. Most surveys were conducted between Triple Alcoves and Cardenas Marsh, and all historic breeding sites in this stretch were visited at least three times during the breeding season. We surveyed 24 different habitat patches during a total of 58 survey hours, most of which were prior to 1000 hrs. Appendix 1 provides a detailed summary of the location, timing, and personnel of each survey. Appendix 2 provides details on the affiliations of each surveyor.

Table 1. Summary of timing and area of emphasis of willow flycatcher monitoring trips in the Grand Canyon, 1996

Dates of Survey Trip	Area of Emphasis
06 May - 20 May	Triple Alcoves (RM 46) to Cardenas (RM 71)
29 May - 09 June	Triple Alcoves (RM 46) to Cardenas (RM 71)
17 June - 28 June	Triple Alcoves (RM 46) to Cardenas (RM 71)
01 July - 08 July	Triple Alcoves (RM 46) to Cardenas (RM 71)
10 July - 16 July	RM 50.5 L to RM 51.4 L
21 July	RM 50.5 L

Willow Flycatcher Detections

Resident Breeders

We found breeding willow flycatchers at only one site, and this site supported only one breeding pair. Details on this site and breeding territory are presented below.

Location: River Mile 50.5 L (Refer to Figure 2)
Habitat: A relatively large patch of dense, tall tamarisk adjacent to a small backwater area and sandbar (Refer to Figure 3).

Territory A: Refer to Figure 2. We first observed a territorial bird at this territory on 08 May. The resident male was spontaneously singing from exposed perches between 0500-0645 in the same area in the patch that the breeding pair occupied in 1995. At this time, we could find no evidence of additional birds or of nest construction activities in the patch. On June 1, we found a pair of willow flycatchers, with the female incubating three flycatcher eggs. At this time, a second territorial bird adjacent to the pair was counter-singing in response to the territorial male. At times, vocalization flurries seemed to suggest that two pair may be in the area, but this was not substantiated, and the final decision was that one pair and a territorial male were present. On 11 June, the pair was still present, with the female still incubating, and the unpaired male still counter-singing. No nest observation was conducted during this visit. During a visit on 20 June, both birds of the pair were seen, as was the unpaired territorial male. However, the nest was now abandoned, with one flycatcher egg remaining in the nest, and a half shell found directly below the nest on the ground. No evidence of nest construction was observed, yet the pair still exchanged greeting calls and were found in the same territory. Upon our return on 3 July, the old nest was still unoccupied, and a new nest built 5 m from where the old nest was discovered. The male was seen feeding the female while she incubated, and from her behavior, it seemed that young birds were hatching. A subsequent checking of the nest confirmed that two young flycatchers (estimated at 0-1 days old) and one egg were present. The unpaired male was still present. When we next returned to the territory on 12 July, nestlings estimated to be 9-11 days were seen flapping in the nest and both adults were feeding them. We were able to capture and color-band the paired male, but not the female. Finally, on July 21, an observer stopped by the nest territory to try to determine if fledgling birds were present. While no fledglings were documented, two to three birds were seen foraging continuously in the area well into the mid-morning hours. This suggests that the adults were engaging in more intensive foraging activities than they would if they were without young. Since only nine days earlier, two nestlings were seen about to fledge, odds are good that at least one bird survived to leave the nest.

Figure 2. Aerial photograph of the willow flycatcher site at River Mile 50.5 L, along the Colorado River, Arizona, 1996. Location and approximate boundaries of breeding territory (blue polygon), and the location where the unpaired male flycatcher was usually detected (blue circle) are indicated. Base photograph is enlarged (250% size of original photograph) from Negative 38-3, U.S. Bureau of Reclamation series taken 5-29-95 (1:4800 scale). River flow is from page bottom to top.

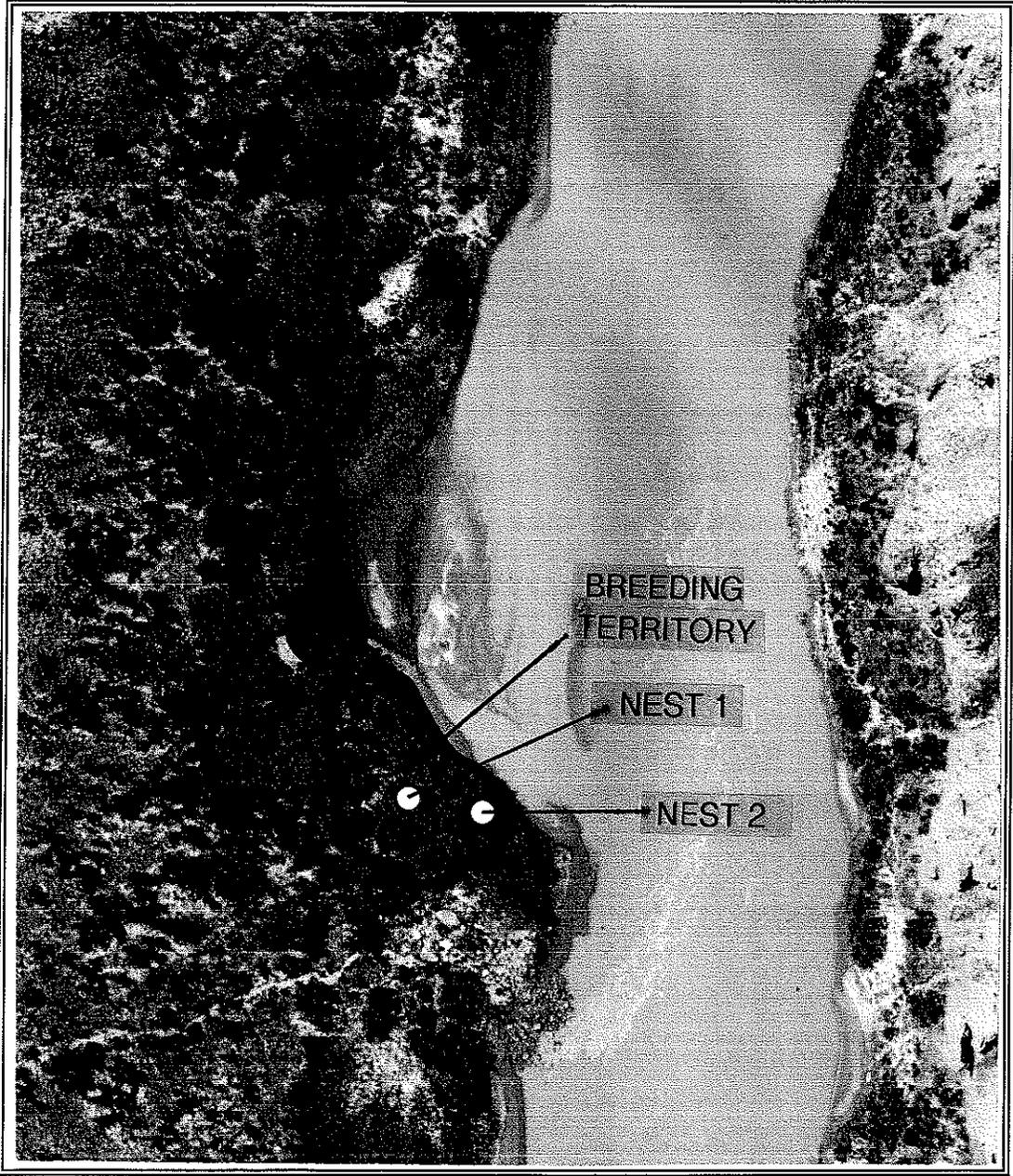


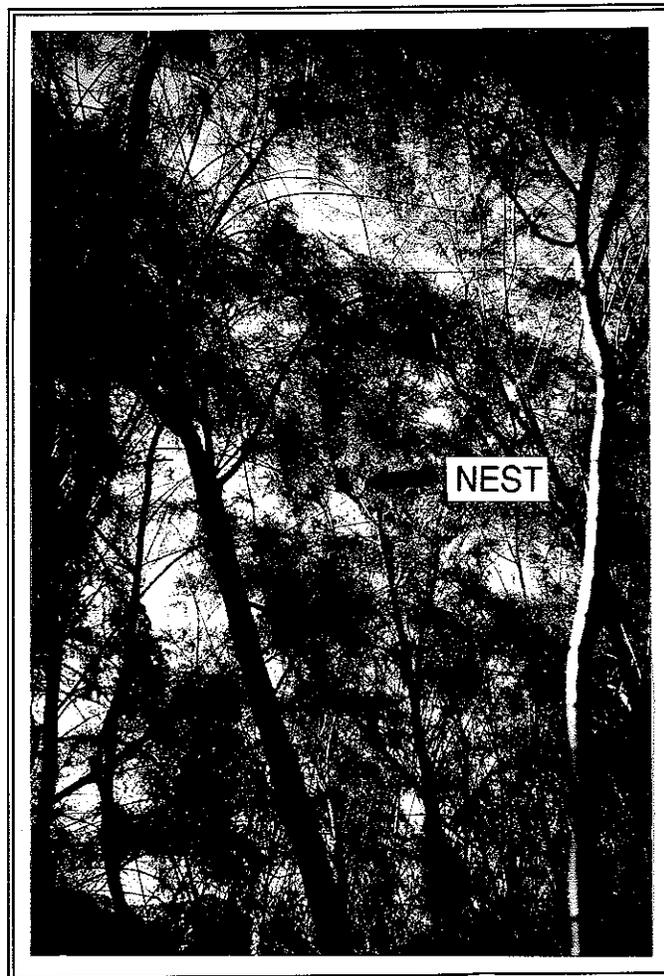
Figure 3. Lateral view of the willow flycatcher breeding site at River Mile 50.5 L, along the Colorado River, Arizona, 1996. Note the dense structure of the tamarisk dominant tamarisk overstory, as well as the band of willows on the upstream edge of the patch. River flow is from page left to right. Photograph was taken October 1996.



Nest Location

The first willow flycatcher nest that was found was placed 5 m high in a 5 cm dia., 7 m tall tamarisk. The nest was placed amongst small branches and was difficult to find and observe. The nest tree was approximately 20 m from the closest point of the river. The second nest was built 6 m from the first, in the direction of being closer to the water. The nest height was again, ca 5 m tall, being placed in a 3 cm dia., 6 m tall tamarisk (Figure 4). A good view was difficult to gain on this nest too, as it was placed in the middle of a clump of small branches. The water's edge was about 14 m from the nest tree.

Figure 4. View of the interior of the breeding territory at RM 50.5 site. Note the dense tamarisk overstory, and the flycatcher nest in the center of the photo. Photograph was taken October 1996.



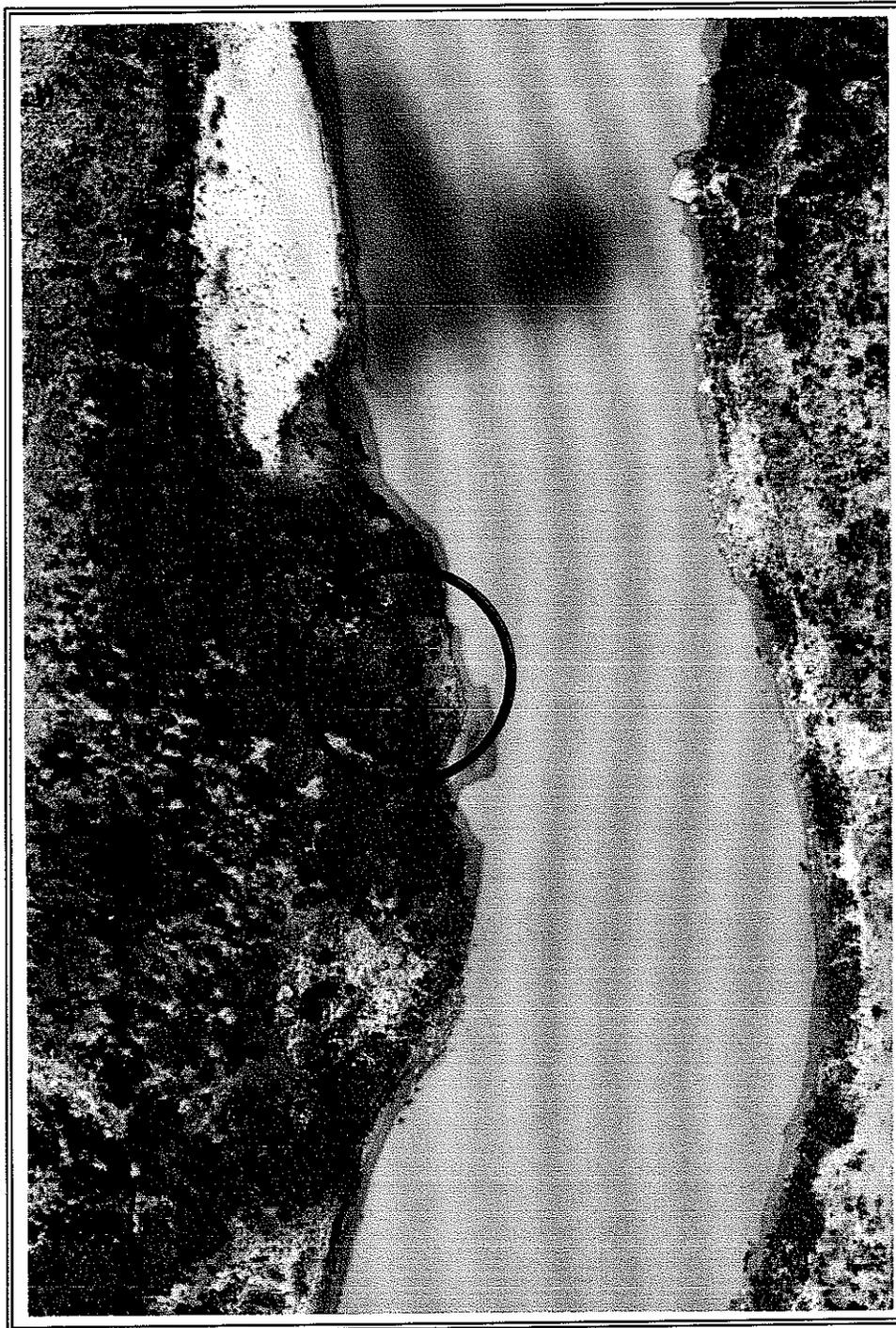
Territorial Non-breeders

We found two male willow flycatchers that established territories but did not pair with mates (details follow).

River Mile 50.5 L: We first noted the unpaired male at RM 50.5 L (see Figure 2) on 1 June, when it was countersinging with the adjacent paired male. The unpaired male was detected again on 11 June, 19 - 20 June, 3 July, and 12 - 13 July. Despite intensive observation, no female or nest was found in this territory. By mid-June, this unpaired male sang regularly only in the very early morning (before 0500 hrs), and was difficult to detect later in the day.

River Mile 51.4 L: This male was first observed on 1 June, singing from within one of the 1994 breeding territories at RM 51.4 L (see Figure 5). It was detected again on 11 June and 20 June. On 04 July, the bird was not detected in this patch, although a singing bird was briefly seen and heard just 200 m upriver of the patch on the same side of the river immediately following the survey at 51.4 L. This upriver sighting is consistent with observations made by two simultaneous observers in 1995 confirming that the bird was moving upriver and singing from a riparian patch at RM 51.3 L. Despite intensive observation, no female or nest was found in this territory.

Figure 5. Aerial photograph showing site (circled) where unpaired male willow flycatcher established territory at RM 51.4 L along the Colorado River, Arizona, 1996. Base photograph is enlarged (250% size of original photograph) from Negative 38-6, U.S. Bureau of Reclamation series taken 5-29-95 (1:4800 scale). River flow is from page bottom to top.



Migrants

We found three willow flycatchers that were singing in riparian patches between 31 May and 3 June. Birds that sang in response to tape playback were assumed to be males, although females have been known to sing on occasion, particularly in response to broadcast song tapes (Seutin 1987, Sogge *unpubl. data*). In that these birds were not seen interacting with other flycatchers, no nest-building was observed, and they were not found on any subsequent visits, we consider these birds to be migrants (details follow).

River Mile 46.7 - Triple Alcoves: A bird was first noted on May 31 at the downriver end of the patch. It repeatedly responded to the tape playback from 0510 until 0900 hrs., although it also vocalized spontaneously with "fitz-bews", "whitts", and "creets". The pitch and rate of the song seemed relatively high and fast to some of the experienced observers, leading to the possibility that this individual may have been of another willow flycatcher subspecies.

River Mile 56.0 - Kwagunt Marsh: A bird responded on 2 June immediately upon the first play of the tape, singing from the thin willow strip that lies upslope of the narrow backwater slough at the site. It changed perches every 1-3 mins, moving approximately 50 m up and down the patch, and singing from high, exposed perches.

River Mile 71.0 - Cardenas Marsh: On 3 June, one bird responded to the tape from the middle of the same patch that contained the 1993 breeding site. It frequently changed perches, alternating songs with various calls, with many of them being unsolicited.

Habitat and Patch Size

Willow flycatchers were detected only in the tamarisk and willow dominated riparian vegetation along the river corridor (usually termed the New High Water Zone [NHWZ]). Willow flycatchers did not establish territories in the mesquite, acacia, hackberry, and redbud-dominated habitats higher on the slopes (often termed Old High Water Zone [OHWZ]). The amount of NHWZ vegetation at flycatcher sites ranged from 0.4 to 0.6 ha (Table 2). Breeding and unpaired territorial willow flycatchers did not use the entire habitat patch in which they were found, at least during the course of our observations (Table 2).

Table 2. The area and shape factor* of New High Water Zone (NHWZ) vegetation in the habitat patches where willow flycatcher territories were detected, and the size of the breeding territory (as determined by observing interactions between adjacent flycatchers, and mapping where resident flycatchers moved within the patch) along the Colorado River, Arizona in 1995. Values given are in hectares.

SITE	Patch Size (ha of NHWZ)	Shape Factor*	Breeding Territory Size (ha)
#1 RM 50.5 L	0.6	Patch = 0.33 Territory = 0.51	0.2
#2 RM 51.4 L	0.6	Patch = 0.52	Not applicable

*Shape factor is a measure of how circular a given object is. Shape factor is calculated as:

$$\text{Shape Factor} = (4\pi \times \text{Area}) \div \text{Perimeter}^2$$
A perfect circle has a shape factor of 1.00, and a line has a shape factor approaching zero. The more linear a patch or territory, the smaller the shape factor.

Willow Flycatcher Song Patterns

Resident territorial male flycatchers regularly sang as early as 0305 hrs, and sometimes as late as 2000 hrs. As in previous years, the most vociferous males were: (a) unpaired; (b) adjacent to other singing males; or (c) paired. Males early in the breeding season. No female song was observed this year.

Brown-headed Cowbird Activity and Willow Flycatcher Response

As in past years, brown-headed cowbirds were found at virtually every site occupied by breeding, territorial, or migrant willow flycatchers. Female cowbirds were often present (accompanied by one or more courting males), and were occasionally seen moving slowly through the habitat patches, a characteristic indicative of a cowbird searching for host bird nests. Cowbirds sometimes came within a few meters of the resident flycatchers. On several occasions resident willow flycatchers confronted cowbirds with aggressive actions such as flying directly at the cowbird, loud *whitting*, and bill-clacking.

The willow flycatcher nest at RM 50.5 L was not brood parasitized this year, although the female flycatcher abandoned the nest for unknown reasons sometime between 11 and 19 June. The nest contained three willow flycatcher eggs at the time of abandonment, and the replacement nest built 6 m away was not parasitized. The female flycatcher was observed vigilantly defending the nest from female cowbirds, which may have contributed to the lack of brood parasitism. As a side note, the successful nest from 1995 remained intact in the immediate vicinity. This nest was checked throughout 1996 and was not shown to contain any cowbird eggs.

DISCUSSION

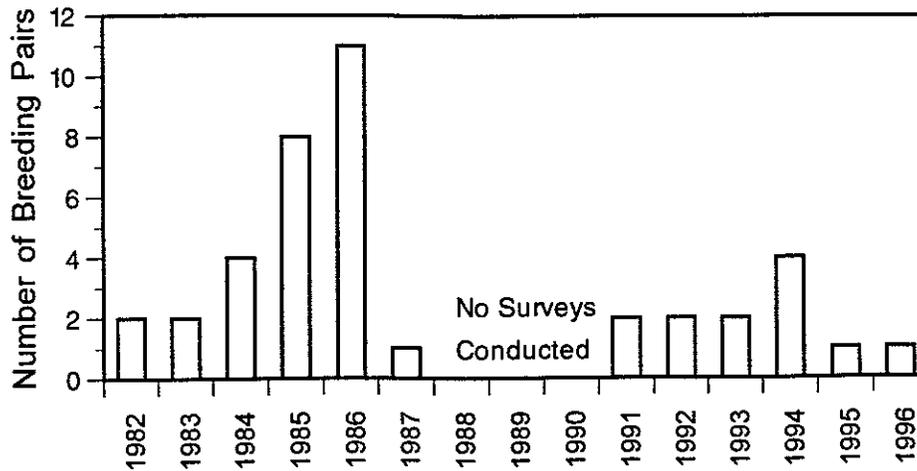
Willow Flycatcher Status - Numbers and Distribution

Three male willow flycatchers established territories in the Grand Canyon in 1996, one fewer than 1995, two fewer than 1994, but more than were detected from 1991 to 1993 (Brown 1991, Sogge et al. 1993). Unfortunately, only one of the three males paired and nested. Both of the unpaired males held territories in the same place as 1995, which was the location of 1994 nesting territories. Willow flycatchers bred only at RM 50.5 L a site where flycatchers nested in 1993 - 1995 (Sogge et al. 1993, Sogge and Tibbitts 1994, Sogge et al. 1995).

It is difficult to accurately compare population trends derived from our 1992 - 1996 survey efforts with Brown's estimates of flycatcher numbers from 1982 - 1991. The reasons for this are several. First, our survey methods (tape-playback) differed from Brown's (1991) general walking and floating surveys. Also, Brown's (1991) high counts of singing willow flycatchers from 1985 through 1987 were based on single trip surveys conducted in late May or early June (Brown 1991), allowing no positive verification that all birds detected were actually attempting to breed. In fact, Brown typically found only two nests each year from 1982 - 1987 (although four nests were found in 1985), further suggesting that not all singing flycatchers represented a nesting attempt. Also, these detections were made near the peak period of willow flycatcher migration through the region (Unitt 1987) and at a time during which numerous migrants (as many as 18 in 1994) have been detected in the Grand Canyon (Sogge and Tibbitts 1994). Recent surveys have also documented that in some years a large percentage of the territorial willow flycatchers in the Grand Canyon are unpaired males (Sogge and Tibbitts 1994, Sogge et al. 1995). Following extensive willow flycatcher color-banding and demography studies in Arizona in 1996, it has also become clear that females regularly sing, often in a manner that would be mistaken for a territorial male (Sogge, unpublished data). Thus, although Brown (1987, 1991) extrapolated that each singing male represented a breeding pair, many of the willow flycatchers that he detected might have been migrants, unpaired males, or even females. This means that comparison of the numbers of territorial willow flycatchers and determination of 1982 - 1996 population trends within the Grand Canyon must be interpreted with caution and with the above considerations in mind.

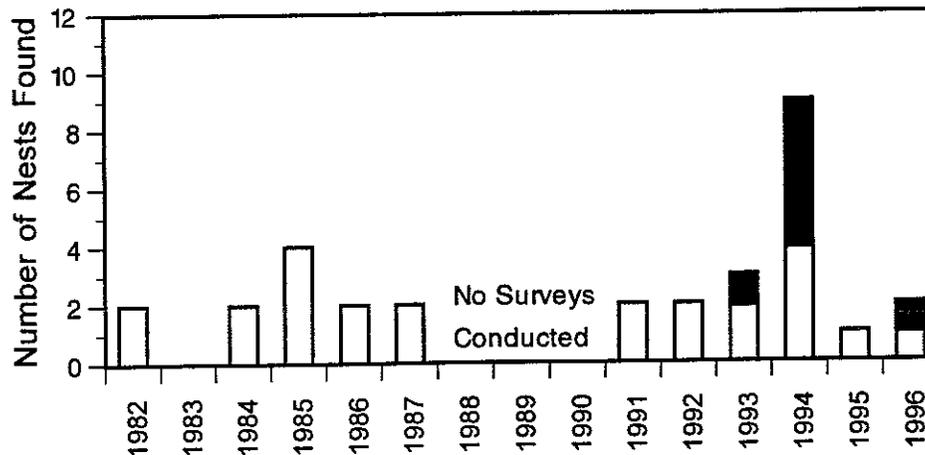
However, if we consider the number of breeding pairs that we found to be roughly analogous to the number of singing male flycatchers (and assumed breeding pairs) found pre-1992 (when tape playback was not used: Brown 1991), then our 1995 and 1996 totals of one pair each year are the lowest numbers detected since monitoring began in 1982 (Figure 6). The number of territorial males detected in 1996 (three) lies below the average found since 1982 (mean = 3.8 ± 3.2 territorial males per year; range = 2 - 11).

Figure 6. The number of breeding willow flycatcher pairs detected along the Colorado River corridor in the Grand Canyon, Arizona: 1982-1996. Surveys from 1992-1996 used tape-playback; those prior to 1992 did not. Pre-1992 surveys varied in timing and degree of effort. No surveys were conducted from 1988-1990.



Because unpaired territorial males have no chance to contribute to recruitment in the local flycatcher population, the best indicator of the flycatcher breeding status within the canyon is the actual number of active nests found and the number of successful nests. In both 1995 and 1996, we found only one flycatcher nest - the lowest number reported since 1983 (Figure 7). However, the one nest in 1995 was successful, leading to the first known willow flycatcher fledgling since 1992, and the one nest in 1996 produced at least one fledgling and probably two.

Figure 7. The number of willow flycatcher nests detected along the Colorado River corridor in the Grand Canyon, Arizona: 1982-1996. Shaded areas represent known re-nesting attempts (following failed previous nests) within the same territory. Surveys prior to 1992 varied in timing and degree of nest search effort. No surveys were conducted from 1988-1990.



Our 1996 results documented the continuing problem of a high percentage of unpaired territorial males. Two of the three (67%) territorial males in the Grand Canyon did not secure a mate and were unable to breed. A high proportion of unpaired males is one of the factors contributing to the low productivity observed among willow flycatchers in the Grand Canyon during the last four years (Sogge and Tibbitts 1994). Furthermore, if unpaired territorial males were common in the 1980s as they were this year, the 1986 high count of 11 singing males (Brown 1991) should not be interpreted as 11 breeding pairs.

The continued low resident population level makes the willow flycatchers in the Grand Canyon susceptible to extirpation by stochastic events (such as severe weather or fire), brown-headed cowbird nest parasitism (see Brown-headed Cowbird Impact section below), or natural attrition. In fact, the canyon population may not be self-sustaining, but rather composed (partially or primarily) of willow flycatchers produced elsewhere that disperse to set up breeding territories in the canyon. This hypothesis is supported by the increase in breeding pairs between 1993 (two pair) and 1994 (four pair), even though no willow flycatcher young were produced in the canyon during 1993.

The breeding male at 50.5 L was color-banded this year, permitting us to determine if the same bird returns in 1997. However, since the nest site during the last 3 years has been at the precise same location (+/- 5 m), it seems likely that it's the same male returning year after year. If this is true, odds are that this bird will have reached its' life expectancy limit by 1997, since passerine birds have short life expectancies. Expansion of banding studies to include both adults and nestlings could help determine if resident breeding birds, and birds fledged in the canyon, return in subsequent years.

Willow Flycatcher Breeding Biology

Willow flycatcher breeding habitat, nest site, clutch size and breeding chronology at the RM 50.5 L nest were similar to those characterized in the Grand Canyon by Brown (1988, 1991), Sogge and Tibbitts (1992), Sogge et al. (1993), and Sogge and Tibbitts (1994), and for willow flycatchers breeding at lower elevations in other parts of Arizona (Muiznieks *et al.* 1994, Sferra *et al.* 1995, Spencer *et al.* 1996).

Discovery of Breeding Southwestern Willow Flycatchers in the Lower Grand Canyon/Upper Lake Mead

In 1996, the Bureau of Reclamation contracted for an extensive southwestern willow flycatcher survey for the lower Colorado River extending from Lake Mead to Yuma. This survey was done to gather data for a formal consultation with the U.S. Fish and Wildlife Service relating to dam operations on the Lower Colorado. As a result of this survey, 18 territorial willow flycatchers were discovered in the areas near the boundary between Grand Canyon

National Park and Lake Mead National Recreation Area. In this group of 18 birds, 4 successful nests were found, producing 9 fledged young (McKernan, *pers. comm.*). This represents the first known nesting of willow flycatchers in this stretch, and the highest density of breeding flycatchers from Lake Mead to Yuma (4 of 6 known successful nests were in Lake Mead). All nests were located along the river in coyote willow and Gooding's willow riparian patches, with 20 - 90 cm of standing water underneath the nest trees. In addition to the flycatchers verified nesting at the Lake Mead delta area, at least four singing willow flycatchers were heard throughout the breeding season in the dense willow riparian habitat in Grand Canyon National Park (Figure 8) between Columbine Falls (RM 274 R) and the boundary buoy (RM 277 R). Although this area was not within McKernan's study area and it was not possible to devote sufficient time to verify nesting, it is assumed that these willow flycatchers represented breeding pairs. That these 4 pairs were present until mid-July suggests that breeding did likely occur in this stretch. Some interesting results from this study include the fact that none of the 4 monitored nests were parasitized by cowbirds, although a maximum number of 12 cowbirds was seen at one site. However, this number was relatively small compared to other sites along the lower Colorado River.

These results suggest that in 1997, more effort should be undertaken to survey for willow flycatchers in the extensive riparian corridors that exist from RM 240 to RM 280 in the lower Grand Canyon. Surveys done from 1992 to 1994 in this same stretch failed to uncover any breeding willow flycatchers, although a migrant bird was detected at RM 260.1 L and an unpaired male was found at RM 276.7 R.

Figure 8. Example of dense willow riparian where singing willow flycatchers were detected throughout the 1996 breeding season. Site is located at approximately RM 275 R, across from Columbine Falls, Colorado River in lower Grand Canyon, Arizona. Photograph taken September 1996. Note the power boat in river center for scale. River flow is from page right to left.



Vocalization Patterns and Characteristics

While no quantitative data was gathered this year on song rates, in general, male willow flycatcher song rate patterns were similar to those described by Unitt (1987), Brown (1991), Sogge and Tibbitts (1992), Sogge *et al.* (1993), Sogge and Tibbitts (1994), and Sogge *et al.* (1995). Song rates are highest for unpaired males and paired males with a neighboring singing male. Song rate declines later in the season, and when birds are paired and have active nests (except in the very early morning when even a paired male will frequently sing). During any part of the breeding season, males with active nests may sing very infrequently and may not sing in response to a tape-broadcast call (Tibbitts *et al.* 1994).

Recent information from studies in central Arizona with color-banded birds have demonstrated that, at least at some sites, female song occurs much more frequently than previously thought (Sogge, unpubl. data). This phenomena was seen mostly where territorial birds are clustered together in riparian patches. Although other people have also noted female song in willow flycatchers (Seutin 1987, Sogge *et al.* 1995, M. Whitfield, *pers. comm.*), the recently documented extent of female song suggests care in interpretation of general tape-playback surveys in terms of the number of males present at a site. However, given that since 1992 each willow flycatcher detection in the Grand Canyon has received extensive detailed follow-up and multiple site visits, any misinterpretation of population size caused by female song is unlikely.

Brown-headed Cowbird Impacts

Cowbirds were present at all sites where flycatchers established territories. Indeed, cowbirds are found throughout the entire Colorado River corridor from Glen Canyon Dam downstream to Lake Mead (Johnson and Sogge 1993, 1995). While cowbirds were present at all sites, the lone nest did not get parasitized either in 1995 and 1996. Historically, approximately half of the flycatcher nests examined in the canyon during the 1980s were parasitized by cowbirds (Brown 1988, 1994), and more than half were parasitized in 1993 and 1994 (Sogge *et al.* 1993, Sogge and Tibbitts 1994). Taken together, these data show that cowbird parasitism of flycatcher nests along the river corridor has been a pervasive, long-term problem. Given that: (a) riparian habitat along the river corridor has remained stable or improved over the last decade (Carothers and Brown 1991); and (b) recreation closures at breeding sites probably minimize human disturbance to nesting flycatchers; then nest-parasitism by cowbirds seems to be the most imminent direct threat to the breeding population of flycatchers within the canyon. Other threats may occur outside of the breeding range and season, but are not within the scope of our project.

The most notable of these outside threats is the fact that sex ratios are skewed towards very few available females in the canyon. Poor recruitment in recent years may have been the cause for this. As is the case for most small

neotropical migrant songbirds, the willow flycatcher is relatively short-lived (average lifespan is approximately 3-4 years) and has high juvenile mortality. Thus, if the flycatchers currently breeding in the Grand Canyon produce few or no young for several breeding seasons, there will be no new flycatchers to replace the older breeders that die. It is possible that southwestern willow flycatchers from other areas could settle in the Grand Canyon area, given time and serendipitous dispersal.

Female cowbirds usually lay 14-16 eggs per nesting season but are capable of laying up to 77 eggs (Jackson and Roby 1992, Holford and Roby 1993). This high fecundity requires a high energy (and calcium) intake, forcing cowbirds to forage where food (seeds, grain, and insects) is concentrated. Brown-headed cowbirds typically demonstrate a daily cycle of movement between foraging areas (during mid-day) and breeding areas (at night and early morning). Radio-tracking of cowbirds in California showed that cowbirds spent mornings parasitizing nests in riparian zones and then commuted 2-7 km in the late morning and afternoon to one or more prime feeding sites such as horse corrals and pack stations (Rothstein *et al.* 1984). Without concentrated food sources such as pack stations, cowbirds would probably not be found in an area.

There are mule and horse corrals at several sites in the Grand Canyon, and Johnson and Sogge (1993, 1995) clearly demonstrated that cowbirds are concentrating at several corrals (and other areas such as the Desert View parking lot) along the South Rim, where they feed in late morning and afternoon. An ongoing cowbird study in 1996 demonstrated that in addition to stock areas, resident bird feeders in Grand Canyon Village are an additional concentration source for cowbirds (C. Drost, *pers. comm.*). These concentrated food sources are close enough (4-6 km) to the river corridor, that cowbirds could easily be moving between the two areas (S. Rothstein, *pers. comm.*). In addition, livestock grazing (which attracts cowbirds) is common on Forest Service, Bureau of Land Management, and tribal lands along the North and South Rims. Also, cowbirds associate and forage with the buffalo herds at House Rock State Buffalo Ranch (Sogge, unpublished data), which is only 7.5 km from the RM 50.5 site. Thus, many human-related activities attract cowbirds to within close proximity of current (and potential) flycatcher breeding habitat.

Effects of 1996 Experimental Habitat/Beach Building Flow and Interim Flows

The Bureau of Reclamation conducted an experimental high release of water from the Glen Canyon Dam from 26 March to 2 April 1996. This 7-day test flow of 45,000 cfs was designed to restore sandbars and backwaters that had become affected by erosion of shoreline and accumulation of fine sediments in the main channel during the 5 years of interim flows prior to this. The U.S. Fish and Wildlife Service prepared a Biological Opinion (U.S. Fish and Wildlife Service 1996) relating to this event that identified reasonable and prudent measures to be taken to protect southwestern willow flycatchers and their habitats. To meet these requirements, the Glen Canyon Environmental

Studies Office (GCES) undertook a series of monitoring efforts to document impacts to historical willow flycatcher territories in the Grand Canyon (Stevens et al. 1996).

The maximum flood stage did not reach the base of any historical nest trees at any of the sites. At RM 50.5 L and RM 65.3 L, less than 0.5 m was scoured along the river's edge as a result of the flood. The sites at RM 51.4 L and RM 65.3 L experienced aggradation by 1.0 to 1.5 m in small portions along the river, and Cardenas RM 71.0 L showed little effect. There was no reduction in branch height diversity of maximum foliage height at any site, and no changes were observed in vegetation composition at nest stands. The main impact from the flood occurred from scouring and/or filling in of adjacent marshes. Proportions of these marshes lost varied from 13.2% to 81.7%. However, these marshes contain plants that are adapted to a disturbance regime and the marshes were observed to be recovering rapidly in 1996. The importance of these adjacent marshes to willow flycatchers is unknown. They have rarely been seen foraging over these marshes prior to 1996, and foraging observations in 1996 support the assertion that no limitation in food resources occurred as a result of the 1996 test flow. In summary, the 1996 test flow resulted in no biological significant impacts to the willow flycatcher population in the Grand Canyon.

Interim flows guidelines for the operation of Glen Canyon Dam dictate minimum and maximum flow releases of approximately 8,000 and 20,000 cfs, respectively, and restrict the ramping rate (the rate of flow change). The immediate potential effect of interim flows in 1996 was negligible compared to the scouring and aggradation that occurred from the 1996 test flow. Since willow flycatcher nests and/or nest substrate (e.g., the nest tree or bush) were not affected by the 45,000 cfs flow, one would not expect any direct mortality to occur from water levels of 20,000 cfs interim flows.

The most likely flow-related impacts would result from long-term habitat changes along the Colorado River corridor. Such indirect impacts could include habitat expansion or fragmentation, changes in plant species composition, and changes in patch size or configuration. Each of these has potential effects on willow flycatcher breeding ecology, but prediction of effects is difficult. Flow-related vegetation changes would occur over a long period of time and are not within the scope of this study, but may be addressed by the long-term Grand Canyon Monitoring Program currently being developed. Determination of indirect impacts of interim flows is also complicated by the fact that the willow flycatcher appears to be declining on a regional level, and as a neotropical migrant, locally breeding flycatchers are subject to many environmental factors outside of the river corridor. It may be virtually impossible to separate external factors from flow-related effects.

MANAGEMENT CONSIDERATIONS AND RECOMMENDATIONS

Continued Monitoring

The U.S. Fish and Wildlife Service recently listed the southwestern willow flycatcher as an endangered species (USFWS 1995). This status as an endangered species, coupled with the small size and apparent widespread decline of the subspecies, demonstrate the need for continued monitoring along the Colorado River corridor. Such monitoring will provide valuable information needed to continue tracking population trends, and to further define habitat use, potential threats, and management options.

We recommend continued willow flycatcher monitoring in 1997, and each year thereafter until the Grand Canyon population is lost or the species is recovered on a regional scale. Grand Canyon National Park should take the lead in coordinating and conducting the monitoring program, and utilize the approach used in 1996 (concentrating on historic and recent breeding sites). In addition, more effort should be undertaken in 1997 to survey the extensive riparian corridors that exist from RM 240 to RM 280 in the lower Grand Canyon. We recommend a cooperative field effort drawing upon experienced volunteers from other agencies such as the U.S. Fish and Wildlife Service and the Arizona Game and Fish Department, and cooperating with the ongoing work by the lower Colorado Bureau of Reclamation study and the Hualapai Tribe avian studies.

Human-related Impacts

Willow flycatchers may be affected by human-related activities within the river corridor. Recreation use of the canyon has the potential of impacting the flycatchers by degrading riparian habitat. However, current recreation management practices in Grand Canyon National Park and Glen Canyon National Recreation Area are designed to minimize degradation of the riparian community. Therefore, it is unlikely that habitat alteration associated with recreation is a significant threat to willow flycatchers. However, data from future vegetation and recreation monitoring programs should be used to regularly re-evaluate this potential threat.

The repeated passage of oar and motor boats near breeding territories could cause disturbance to willow flycatchers. From 1992 to 1996, we observed no changes in behavior when boats floated or motored past the patches where birds were breeding, and at this time there is no evidence to suggest any negative effect by passing boats.

Willow flycatchers may also be disturbed by noise and activity associated with nearby campers. Taylor (1986) found a possible correlation between recreational activities and decreased riparian bird abundance. Blakesley and Reese (1988) reported the willow flycatcher (probably *E. t. adastus*) as one of seven species negatively associated with campgrounds in riparian areas in northern Utah. There is significant potential of such disturbance because flycatcher breeding areas are usually adjacent to sandy beach areas, which are often popular camping sites (although all breeding sites were closed to recreation from 1993 to 1996: see below). The fact that willow flycatchers formerly bred within approximately 100 m of camping areas such as Cardenas suggests that they are generally tolerant of low-level human activity that is not directly adjacent to or within the breeding territory. However, repeated human presence within a territory or in close proximity to a nest could cause birds to abandon a territory or nest, or lead to nest failure due to reduced nest attendance. Perhaps the most significant potential impact of camping is creation of trails through habitat patches, and other direct impacts on vegetation.

Other human-related impacts are possible. For example, grazing has been shown to reduce the quality of riparian flycatcher habitat (Taylor 1986, Sanders and Flett 1989). Although grazing does not occur at any of the sites where territorial willow flycatchers were found in the Grand Canyon, grazing does occur on some non-National Park Service lands along the river corridor and major tributaries (Kanab Creek, Paria River, Havasu Creek, Little Colorado River, etc.). Such grazing may be reducing potential flycatcher habitat.

Restricted Use and Closures of Nesting Habitat

The 1993 - 1996 recreation closures instituted at RM 50 - 52 and Cardenas appear to have precluded direct human-related impacts to the nesting willow flycatchers, at least at levels detectable by our monitoring. Because there is continued potential for such human disturbance if protective closures are lifted, Grand Canyon National Park should continue to implement closures that will minimize possible disturbance during the breeding season. We recommend the following actions:

- (1) Keep the river recreation community and park visitors informed of the status and importance of the willow flycatchers along the Colorado River. Enlist their support of, and adherence to, measures taken to protect flycatchers from recreational disturbance.
- (2) Close the following areas to all non-research uses beginning 05 May. The closures should last at least 75 days. The exact date of ending the closures should be determined based on the known or suspected breeding activity of resident flycatchers, as determined by the breeding surveys.

Sites: RM 50 - 52 L

(3) Immediately close any new area(s) where resident willow flycatchers are found (paired or unpaired). The closure should last at least 75 days, or until a follow-up visit fails to find flycatchers present.

(4) Research other than the willow flycatcher monitoring program should be discouraged at these sites during the closure periods. If possible, potential research should be discussed with the flycatcher program coordinator(s), to determine if it could negatively impact the flycatcher or the monitoring effort. All researchers (and field crew) conducting work at closure sites should be briefed on how to avoid disturbance to the flycatchers: avoid camping within 100 m of a nest site; avoid prolonged, loud noises or activity near flycatcher territories; use care when moving through vegetation in order to avoid damaging nests, impacting vegetation, or disturbing flycatchers; and immediately leave an area if flycatchers give alarm calls (*whitts*).

Closures should be advertised in the river guide newsletters, in park literature, and by the backcountry permit office.

We wish to note that the river guides and the river community were very supportive of the park's flycatcher conservation actions, and played a crucial role in informing park visitors about flycatcher ecology and threats to survival.

Cowbird Control Program

The cowbird population in the canyon is significant and dispersed throughout the Colorado River riparian zone (Johnson and Sogge 1993, Brown 1994, Johnson and Sogge 1995). Control of cowbirds can have beneficial effects on the breeding success of willow flycatchers, and for many other parasitized species in the canyon as well.

Many examples of effective cowbird removal programs exist. Trapping has significantly reduced local populations of cowbirds, and increased populations of rare and endangered species such as Kirtland's warblers (*Dendroica kirtlandii*; Mayfield 1977), least Bell's vireo (*Vireo bellii pusillus*; Beezley and Rieger 1987, J. Griffith, pers. comm.), black-capped vireo (*Vireo atricapillus*) and golden-cheeked warbler (*Dendroica chrysoparia*; J. Cornelius, pers. comm.), and southwestern willow flycatchers (J. Griffith and M. Whitfield, pers. comm.). Many other bird species also show increases when local cowbird populations are reduced (Laymon 1987). Laymon (in litt.) and Whitfield (in litt.) reported that cowbird nest parasitism of southwestern willow flycatchers at the Kern River Preserve declined from 65% to 20% after only one year of cowbird trapping, and remained low the following year.

We recommend that Grand Canyon National Park evaluate the potential for a cowbird control program, as outlined in Johnson and Sogge (1993), involving cowbird trapping at pack animal corrals along the South Rim. Grand

Canyon National Park should also consider setting up cowbird traps at known willow flycatcher breeding areas. Trapping along the corridor would entail significant logistical planning, preparation, and trap operation, but could significantly decrease cowbird impacts at the sites.

Additional Cowbird Monitoring

We strongly support the recommendations made by Johnson and Sogge (1993, 1995) regarding continued and expanded cowbird monitoring in the Grand Canyon. In summary, these recommendations are: (1) continue monitoring cowbird abundance at Grand Canyon pack stations; and (2) use radio-telemetry to determine movement patterns of pack station cowbirds, to see if these cowbirds are dispersing to the river corridor. Recommendation 2 is of particular importance, in that it will provide information as to the effectiveness of "rim-based" cowbird control as a means to reduce cowbird nest parasitism along the river corridor and tributaries with riparian habitats. Cannon Corporation, in association with the National Park Foundation, has recently funded a project, which was begun in 1996, that will meet these objectives and provide important information for future management.

We further recommend that agencies and tribes that manage lands adjacent to the Grand Canyon institute similar cowbird monitoring and control efforts. This is particularly true where livestock grazing, horse and mule corrals, or buffalo ranch activities occur. It is important to determine if these activities are attracting cowbirds and providing food and other conditions that support a local breeding population. If so, cowbird control could reduce impacts to nearby breeding willow flycatchers, as well as a number of other neotropical migrant birds.

Develop a Willow Flycatcher Management Plan

We recommend that Grand Canyon National Park take the lead in coordinating and developing an integrated southwestern willow flycatcher management plan. This plan would address flycatcher management and protection needs over a 5-year time frame, and would provide detailed recommendations, options, and tools to guide flycatcher monitoring, research, and management. Items to be addressed should include monitoring needs, prioritized research needs, cooperative monitoring and research efforts, habitat conservation and protection measures (including closures, fire response plans, etc.), measures to minimize human disturbances, protocols for notification of appropriate personnel if and when new flycatcher breeding sites are discovered, and all other topics relevant to conservation and management of the willow flycatcher along the Colorado River. In developing the plan, Grand Canyon National Park should work with Lake Mead National Recreation Area, Glen Canyon National Recreation Area, the Navajo Nation, and the Hualapai Tribe to assure an effective, integrated, and cooperative approach to dealing with willow flycatcher issues along the river corridor.

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APPENDIX 1

Summary of 1996 Southwestern Willow Flycatcher survey effort along the Colorado River corridor in Grand Canyon National Park, Arizona. Patch refers to the location of each vegetation patch surveyed (by River Mile and river left/right). If the entire extent of a patch was surveyed, only one number is given (usually near the center of the patch). If only a portion of a large patch or vegetation strip was surveyed, the beginning and ending points are indicated. Method refers to whether surveys were conducted from land, boat, or both. A tape-broadcast Willow Flycatcher song was used to elicit response during all surveys. Flycatcher survey personnel for each patch are listed under Observers.

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
46.7 R	5/31/96	0508	0628	Land	Jim Petterson, Rob Marshall, Tim Tibbitts
46.7 R	5/31/96	0720	0915	Land	Rob Marshall, Tim Tibbitts
46.7 R	6/19/96	0504	0610	Land	Jim Petterson, Lawrence Abbott
47.2 R	5/31/96	0725	0735	Land	Jim Petterson
47.2 R	6/19/96	0720	0730	Land	Jim Petterson, Lawrence Abbott
47.5 R	5/31/96	0740	0743	Boat	Jim Petterson
47.8 - 48.2 R	5/31/96	0747	0803	Boat	Jim Petterson
48.5 R	5/31/96	0813	0823	Boat	Jim Petterson
48.5 R	6/19/96	0805	0810	Boat	Jim Petterson, Lawrence Abbott
48.8 - 49.1 L	5/31/96	0851	0900	Boat	Jim Petterson
49.3 R	5/31/96	0904	0907	Boat	Jim Petterson
49.3 R	6/19/96	0824	0829	Boat	Jim Petterson, Lawrence Abbott
50.0 R	5/31/96	0918	0929	Boat	Jim Petterson
50.1 L	5/31/96	0934	0951	Land	Jim Petterson
50.1 L	6/19/96	0850	0857	Boat	Jim Petterson, Lawrence Abbott
50.3 L	5/31/96	1004	1020	Land	Jim Petterson
50.5 L	5/8/96	0532	0601	Land	Jim Petterson, John Spence
50.5 L	5/31/96	1030	1035	Boat	Jim Petterson
50.5 L	5/31/96	1530	1635	Land	Tim Tibbitts
50.5 L	6/1/96	0530	1010	Land	Jim Petterson, Tim Tibbitts
50.5 L	6/1/96	1630	1700	Land	Jim Petterson, Tim Tibbitts, Rob Marshall
50.5 L	6/11/96	0517	0606	Land	John Spence, John Grahame
50.5 L	6/19/96	0930	1130	Land	Jim Petterson, Lawrence Abbott
50.5 L	6/19/96	1645	1857	Land	Jim Petterson, Lawrence Abbott
50.5 L	6/20/96	0530	1113	Land	Jim Petterson
50.5 L	7/3/96	0520	0932	Land	Jim Petterson, Mark Wunner
50.5 L	7/3/96	1715	1745	Land	Jim Petterson, Mark Wunner

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
50.5 L	7/12/96	1700	1745	Land	Jim Petterson, Eben Paxton, Charles Drost
50.5 L	7/13/96	0500	0600	Land	Jim Petterson, Eben Paxton
50.5 L	7/21/96	0900	1030	Land	Larry Stevens
51.3 L	7/4/96	0705	0830	Both	Jim Petterson
51.3 L	7/13/96	0800	0830	Both	Jim Petterson, Eben Paxton
51.4 L	5/8/96	0702	0744	Land	Jim Petterson, John Spence
51.4 L	6/1/96	0600	0910	Land	Rob Marshall
51.4 L	6/11/96	0718	0801	Land	John Spence, John Grahame
51.4 L	6/20/96	0520	1020	Land	Lawrence Abbott
51.4 L	7/4/96	0520	0640	Land	Jim Petterson, Mark Wunner
51.4 L	7/13/96	0845	0910	Land	Jim Petterson, Eben Paxton
52.7 R	6/2/96	0525	0540	Land	Jim Petterson, Tim Tibbitts, Rob Marshall
56.0 R	6/2/96	0640	0815	Land	Jim Petterson, Tim Tibbitts, Rob Marshall
56.0 R	6/21/96	0525	0625	Land	Jim Petterson, Lawrence Abbott
56.0 R	7/5/96	0508	0540	Land	Jim Petterson
65.3 L	6/3/96	0520	0600	Land	Jim Petterson, Tim Tibbitts, Rob Marshall
65.3 L	6/22/96	0517	0544	Land	Jim Petterson, Lawrence Abbott
65.3 L	7/6/96	0515	0535	Land	Jim Petterson
71.0 L	6/3/96	0740	0945	Land	Jim Petterson, Tim Tibbitts, Rob Marshall
71.0 L	6/22/96	0745	0849	Land	Jim Petterson, Lawrence Abbott
71.0 L	7/6/96	0738	0812	Land	Jim Petterson
191.2 R	6/8/96	0530	0605	Both	Jim Petterson, Tim Tibbitts, Rob Marshall
191.2 R	6/27/96	0615	0637	Both	Jim Petterson
192.0 L	6/8/96	0615	0630	Boat	Jim Petterson, Tim Tibbitts, Rob Marshall
192.0 L	6/27/96	0645	0700	Boat	Jim Petterson
194.0 L	6/27/96	0725	0745	Both	Jim Petterson
196.5 - 197.4 R	6/8/96	0735	0930	Land	Tim Tibbitts
197.2 L	6/27/96	0825	0830	Boat	Jim Petterson
197.6 L	6/8/96	0755	0800	Boat	Jim Petterson, Rob Marshall
197.6 L	6/27/96	0838	0845	Boat	Jim Petterson
198.0 R	6/8/96	0810	0830	Land	Jim Petterson, Rob Marshall
198.0 R	6/27/96	0515	0630	Land	Lawrence Abbott

APPENDIX 2

1996 Colorado River Willow Flycatcher Survey Personnel.

Lawrence Abbott, Volunteer, Modesto, CA

Charles Drost, National Biological Service, Colorado Plateau Research Station, NAU, Flagstaff, AZ

John Grahame, National Biological Service, Colorado Plateau Research Station, NAU, Flagstaff, AZ

Rob Marshall, U.S. Fish & Wildlife Service, Arizona Ecological Services State Office, Phoenix, AZ

Eben Paxton, National Biological Service, Colorado Plateau Research Station, NAU, Flagstaff, AZ

Jim Petterson, Grand Canyon National Park, Grand Canyon, AZ

John Spence, Glen Canyon National Recreational Area, Page, AZ

Larry Stevens, Glen Canyon Environmental Studies Program, Bureau of Reclamation, Flagstaff, AZ

Tim Tibbitts, Organ Pipe Cactus National Monument, Ajo, AZ

Mark Wunner, Grand Canyon National Park, Grand Canyon, AZ