

**Status of the Southwestern Willow Flycatcher  
along the Colorado River in Grand Canyon National Park - 1995**

Cooperative Agreement: 8030-8-0002

Project Name: SOUTHWESTERN WILLOW  
FLYCATCHER MONITORING



Photo courtesy of Audubon Encyclopedia of  
North American Birds

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Short Title of Work: 1995 WILLOW FLYCATCHER MONITORING REPORT

Funded By: Glen Canyon Environmental Studies, Bureau of Reclamation

Supported By: The Bureau of Reclamation  
Glen Canyon Environmental Studies Program  
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Flagstaff, AZ 86002-2459

Submitted To: Resource Management  
Grand Canyon National Park  
Grand Canyon, AZ

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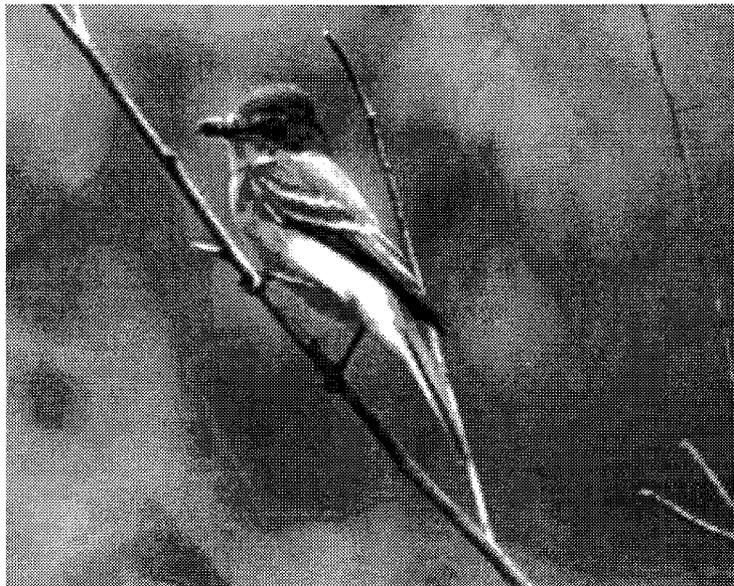
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## SUMMARY

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 5 willow flycatchers - three territorial but non-breeding males, and one breeding pair. The non-breeding males established territories at RM 50.5 Left [L], 51.4 L, and 65.3 L; the breeding pair was at RM 50.5 L. Brown-headed cowbirds (*Molothrus ater*) were present at all willow flycatcher locales, and parasitized the one flycatcher nest that we found (this cowbird egg was later missing from the nest). The breeding pair at RM 50.5 L successfully fledged one young flycatcher, the first willow flycatcher known to be fledged in the canyon since 1992. The number of territorial and breeding southwestern willow flycatchers along the Colorado River corridor in Grand Canyon National Park remains critically low, and the population may be lost. We recommend future flycatcher monitoring, recreation closures at known or potential flycatcher breeding sites during the breeding season, and establishment of a cowbird monitoring and control program at Grand Canyon National Park pack animal corrals and mule stations.

*This report may be cited as follows: Sogge, M.K., T.J. Tibbitts, C. van Riper III, and T. May. 1995. Status of the Southwestern Willow Flycatcher along the Colorado River in Grand Canyon National Park - 1995. Summary Report. National Biological Service Colorado Plateau Research Station/Northern Arizona University. 26 pp.*

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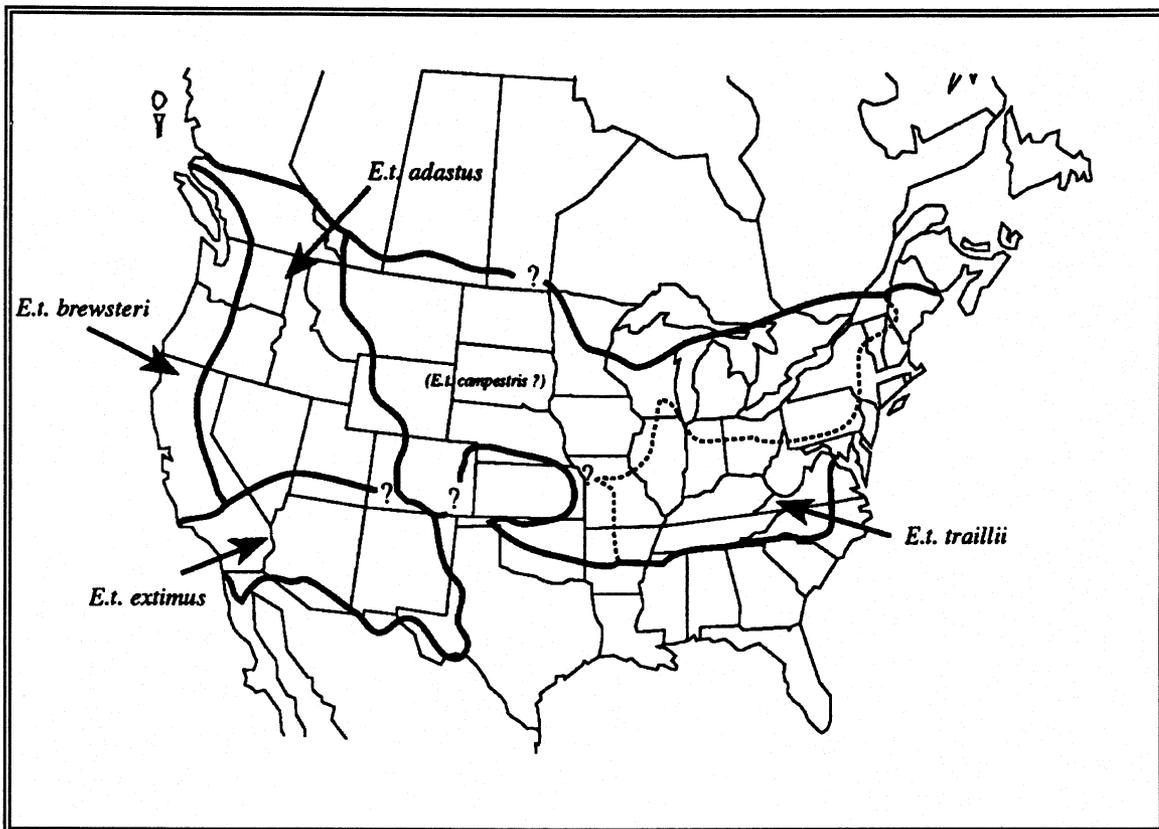
## ACKNOWLEDGMENTS

This project would not have been possible without the cooperation of many persons in many agencies. Logistical support was provided by Grand Canyon National Park, Glen Canyon National Recreation Area, the National Biological Service Colorado Plateau Research Station at Northern Arizona University (CPRS/NAU), and the U.S. Bureau of Reclamation Glen Canyon Environmental Studies (GCES) office. Particular thanks to David Wegner (GCES Program Manager), Mark Law (Grand Canyon National Park River Subdistrict Ranger), and Susan Cherry (Grand Canyon National Park Ranger). Park rangers, river boatmen and their assistants made the trips safe, enjoyable, and more productive. The efforts of Jim Petterson (Grand Canyon National Park, Division of Resources Management) were vital to the project. The field crew (see Appendix 2) worked incredibly hard under difficult field conditions - it was only through their excellent work that this project was a success. In particular, we would like to thank Jim Petterson, Susan Sferra, and Britta Muiznieks, who took time out from very busy schedules to lend their expertise and efforts. For the third consecutive year, Lawrence Abbott contributed his dedication, skill, and endless good humor to many days of monitoring. We thank Lawrence's family for their patience with his long absences while in the field. Linda Sogge reviewed earlier drafts of this report and made many helpful suggestions. We also want to express our gratitude to the Grand Canyon river guides and rafting company staff, and the many visitors who were understanding and supportive of our research and conservation efforts (including beach closures). The river guides and staff continue to play an important role in the conservation of this species by interpreting the story of the willow flycatcher and its plight to the park visitors boating the canyon.

## 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). A riparian obligate species, the flycatcher generally nests in cottonwood-willow associations or similar riparian communities, although in some portions of the Southwest it will nest in tamarisk. 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 (*Tamarix* spp.), 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; U.S. Fish and Wildlife Service 1993).

Figure 1. Breeding ranges of willow flycatcher (*Empidonax traillii*) subspecies. Modified from Browning (1993), who supported designation of distinct *E.t. campestris* (north and west of the dotted line in *E.t. traillii* range).



The U.S. Fish and Wildlife Service (USFWS) proposed to list the southwestern subspecies as endangered (USFWS 1993) 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.

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). Since then, the breeding population declined to only two breeding pairs in 1991 (Brown 1991), two pair in 1992 (Sogge and Tibbitts 1992), and two pair in 1993 (Sogge et al. 1993). In 1994, four breeding pair were found, all within the River Mile (RM) 50-52 reach (river mile designations based on Stevens 1983), but all nesting efforts were unsuccessful (Sogge and Tibbitts 1994).

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.

Our 1995 monitoring program differed significantly from our 1992 - 1994 survey efforts, in that we did not perform extensive surveys along the entire river corridor. Instead, we focused almost primarily on finding and monitoring breeding activity at historic and recent breeding sites. Thus, our 1995 efforts were designed to meet the following three objectives:

1. Continue to monitor breeding willow flycatchers in the Grand Canyon.
2. Continue to assess impacts of cowbird nest parasitism, and the loss or modification of habitat due to fluctuating flows.
3. 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 1995 breeding season, and is the last in the series of reports arising from our 1992-1995 monitoring program. Sogge and Tibbitts (1992), Sogge et al. (1993), Sogge and Tibbitts (1994), and Sogge (1995) detailed previous flycatcher monitoring efforts associated with this project. Grand Canyon National Park, the GCES program, and the Colorado Plateau Research Station are working together to assure continued flycatcher monitoring during 1996.

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## 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 above Lees Ferry and 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) gather song rate data without the influence of tape playback, (2) determine number and gender of willow flycatchers present, (3) determine approximate territory and use areas, and (4) observe flycatcher behavior.

During observation periods we recorded male singing rate (songs/minute) to provide information on daily and seasonal variation in song rates. 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 only 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.

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## RESULTS

### Survey Effort

We conducted 38 surveys between 21 May and 08 July 1995 (Table 1); 32 surveys were conducted from land, five from boat, and one combining both methods. 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 14 different habitat patches during a total of 45 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, 1995

Dates of Survey Trip	Area of Emphasis
21 May - 29 May	Triple Alcoves (RM 46) to Cardenas (RM 71)
03 June - 11 June	Triple Alcoves (RM 46) to Cardenas (RM 71)
16 June - 24 June	Triple Alcoves (RM 46) to Lava Chuar (RM 65.3)
28 June	Glen Canyon Dam to Lees Ferry
01 - 08 July	Triple Alcoves (RM 46) to Lava Chuar (RM 65.3)

## 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.

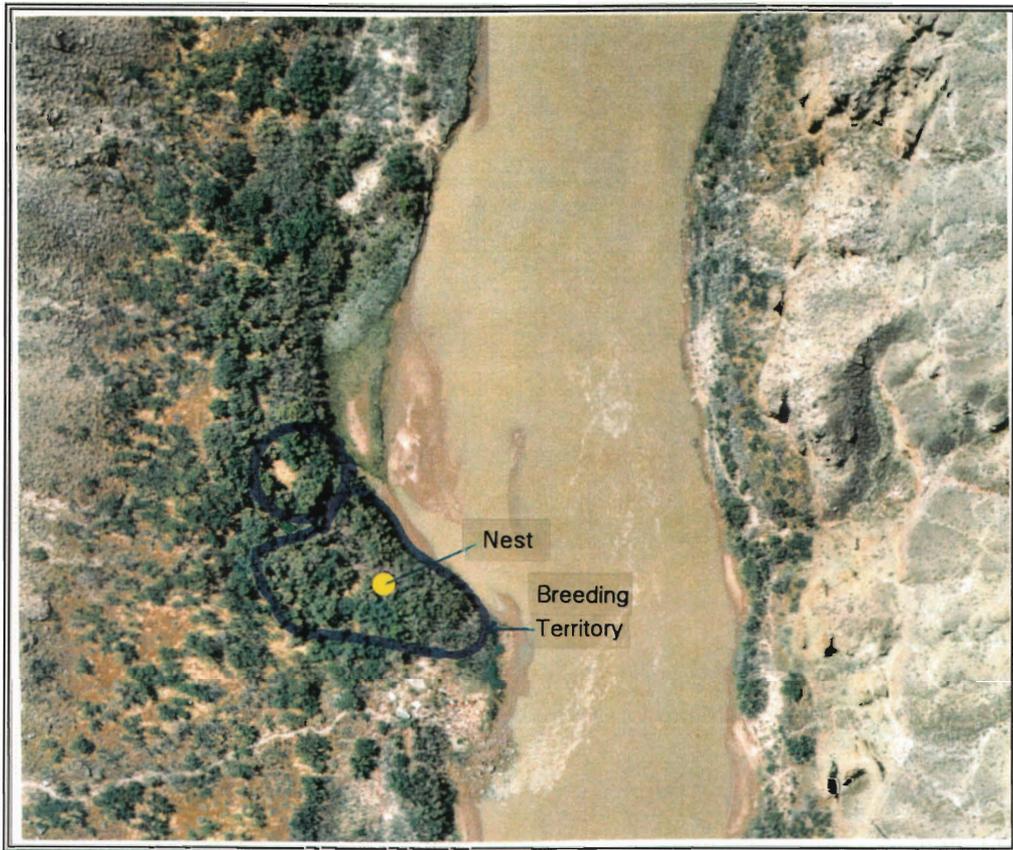
Location: River Mile 50.5 L (Refer to Figure 2)  
Habitat: A relatively large patch of dense, tall tamarisk adjacent to a small backwater area and sandbar.

Territory A: Refer to Figure 2. We first observed birds at this territory on 22 May. The resident male was counter-singing in response to the resident male at the non-breeding territory (described on page 9). We also found a female in the territory. On 23 May, we found a willow flycatcher nest with one cowbird egg. During a visit on 04 June, both birds of the pair were seen and their nest contained three flycatcher eggs; the cowbird egg was no longer present. Upon our return on 19 June, the nest was checked and contained two young flycatchers (estimated at 3-4 days old). When we next returned to the territory on 02 July, both adults were feeding one fledged flycatcher. This fledgling was doing a limited amount of foraging (sallying and hawking for insects), but was staying within 10 m of the nest site and primarily being fed by the parent birds. We found no evidence of a second fledgling, even though we stayed at the site until 04 July.

### Nest Location

The willow flycatcher nest that we found was placed 6 m high in a 12-14 m tall tamarisk. The nest was placed on the side of the tamarisk trunk, not in the smaller branches that supported green foliage. As a result, this nest was relatively exposed and easy to see from three sides and below. The nest plant was approximately 20 m from the closest point of the river.

Figure 2. Aerial photograph of the willow flycatcher site at River Mile 50.5 L, along the Colorado River, Arizona. 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 200% 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.



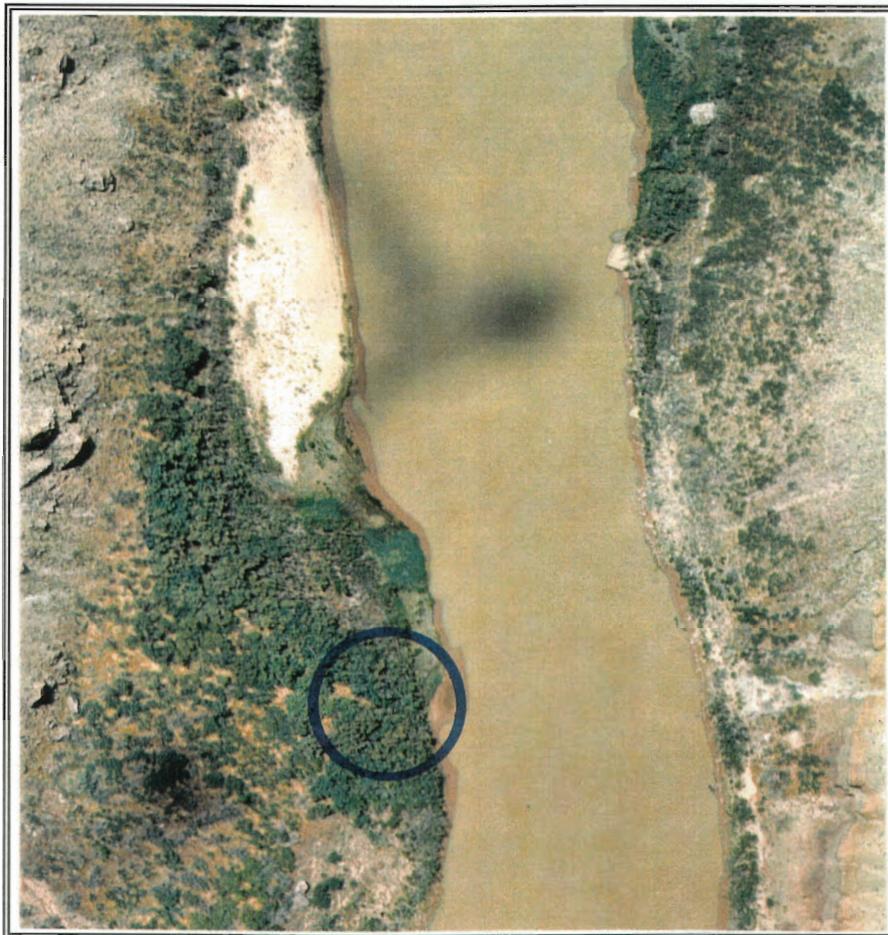
### *Territorial Non-breeders*

We found three 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 22 May, when it was countersinging with the adjacent paired male. The unpaired male was detected again on 23 May, 04 - 06 June, 18 - 20 June, and 02 - 03 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 23 May, singing from within one of the 1994 breeding territories at RM 51.4 (see Figure 3). It was detected again on 06 June, 18 June, 02 July and 04 July. Despite intensive observation, no female or nest was found in this territory. Although this male was usually found at RM 51.4, it would sometimes fly upstream and sing from a riparian patch at RM 51.3. This movement was confirmed by two observers, one in each patch, in radio contact with one another.

Figure 3. Aerial photograph showing site (circled) where unpaired male willow flycatcher established territory at RM 51.4 L along the Colorado River, Arizona, 1995. Base photograph is enlarged 200% 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.



*Territorial Non-breeders (continued)*

River Mile 65.3 - Lava Chuar: One male willow flycatcher established a territory and sang throughout much of the breeding season at RM 65.3 L (near Lava Chuar: Figure 4), but did not attract a mate. We first observed this male on 24 May, and it was present and singing strongly on 07 June, and 21-22 June. On 04 July, it responded to our survey tape (but only by *whitting*). Despite many hours of intense observation and nest searching, no female or nest was found in this territory.

Figure 4. Aerial photograph showing site (circled) where unpaired male willow flycatcher established territory at RM 65.3 L along the Colorado River, Arizona, 1995. Base photograph is enlarged 200% from Negative 45-2, U.S. Bureau of Reclamation series taken 5-29-95 (1:4800 scale). River flow is from page bottom to top.



### 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 3).

Table 2. The area and shape factor* of New High Water Zone (NHWZ) vegetation in the habitat patches where willow flycatchers territories were detected, and the size 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 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
#3 RM 65.3 L	0.7	Patch = 0.35	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 0350 hrs, and sometimes as late as 2000 hrs. The most vociferous males were: (a) unpaired; (b) adjacent to other singing males; or (c) paired males early in the breeding season. This year, we observed and recorded singing by the female at RM 50.5. The female song was a very soft, quiet *fitz-bew*, given when she was close to the nest and her mate was countersinging with the unpaired male a short distance away.

### Brown-headed Cowbird Activity and Willow Flycatcher Response

Brown-headed cowbirds were found at virtually every site occupied by breeding or territorial 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. On 7 June, at RM 65.3 L, we observed several instances where a cowbird usurped one of the resident (unpaired) flycatcher's frequent song perches (a tall dead branch rising above the canopy). When this occurred, the flycatcher relocated to the far upstream end of the habitat patch, where it rarely spent any time unless "displaced" in this way by a cowbird.

The willow flycatcher nest at RM 50.5 was brood parasitized early in the breeding cycle. When first found, the nest contained only a single cowbird egg (no flycatcher eggs had yet been laid). Interestingly, this cowbird egg was absent 12 days later, at which time the nest contained only three willow flycatcher eggs.

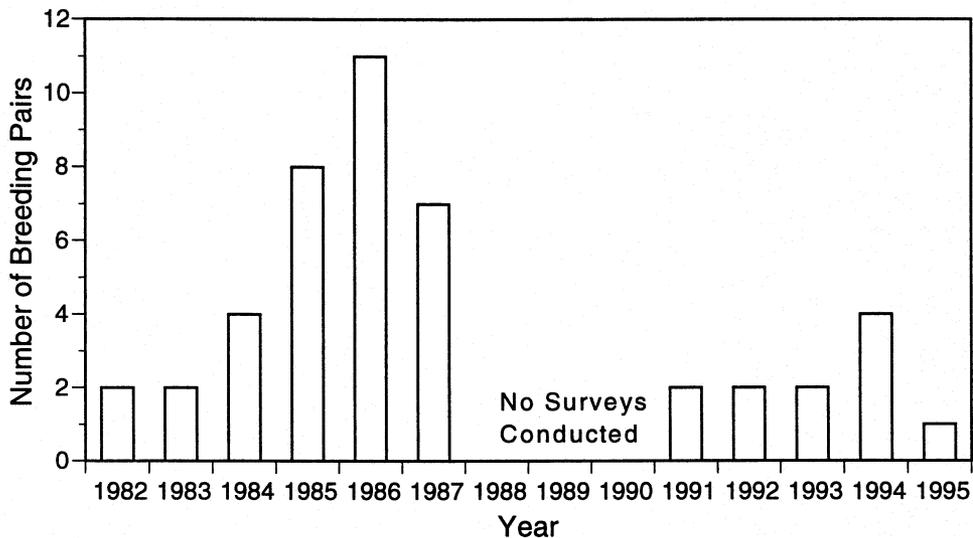
## DISCUSSION

### Willow Flycatcher Status - Numbers and Distribution

Four male willow flycatchers established territories in the Grand Canyon in 1995, one fewer than 1994 but more than were detected from 1991 to 1993 (Brown 1991, Sogge et al. 1993). Unfortunately, only one of the four males paired and nested. Two of the three unpaired males had territories at the location of 1994 nesting territories. The unpaired Lava Chuar male was found at the same site as an unpaired 1994 male (and is assumed to be the same male). Willow flycatchers bred only at RM 50.5, a site where flycatchers nested in 1993 and 1994 (Sogge et al. 1993, Sogge and Tibbitts 1994).

Because our 1992 through 1995 survey methods differed from those used in pre-1992 surveys (Brown 1991), we can not directly compare our data with Brown's estimates of flycatcher numbers. 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 total of one pair is the lowest number detected since monitoring began in 1982 (Figure 5). The number of territorial males detected in 1995 (four) compares more favorably with the average found since 1982 (mean =  $4.6 \pm 3$  territorial males per year; range = 2 - 11).

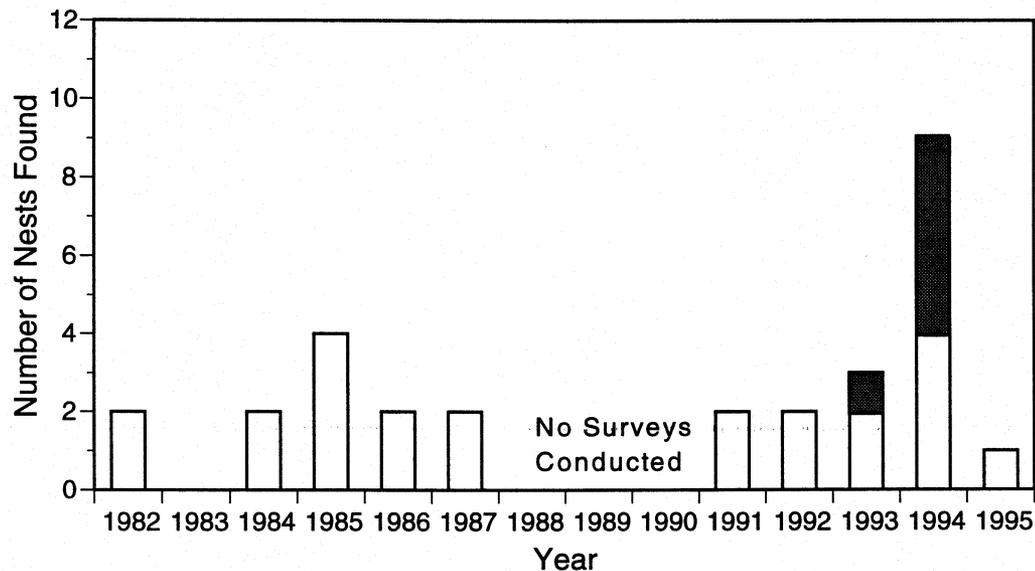
Figure 5. The number of breeding willow flycatchers pairs detected along the Colorado River corridor in the Grand Canyon, Arizona: 1982 - 1995. Surveys from 1992 - 1995 used tape-playback; those prior to 1992 did not. Pre-1992 surveys varied in timing and degree of effort. No surveys were conducted from 1988 - 1990.



Because unpaired territorial males do not contribute to reproduction of 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 1995, we found only one flycatcher nest - the lowest number reported since 1983 (Figure 6). However, this one nest was successful, leading to the first known willow flycatcher fledgling since 1992.

Another disturbing aspect of our 1995 results is the high percentage of unpaired territorial males. Three of the four (75%) 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 three 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.

Figure 6. The number of willow flycatchers nests detected along the Colorado River corridor in the Grand Canyon, Arizona: 1982-1995. Shaded areas represent known renesting attempts (following failed nests) within the same breeding season. Surveys prior to 1992 varied in timing and degree of survey effort. No surveys were conducted from 1988 - 1990.



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. Long-term studies of color-banded 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 RM 50.5 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).

#### Vocalization Patterns and Characteristics

Male willow flycatcher song rate patterns were similar to those described by Unitt (1987), Brown (1991), Sogge and Tibbitts (1992), Sogge et al. (1993) and Sogge and Tibbitts (1994). 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).

Although in past years we have suspected that female willow flycatchers were occasionally singing in some territories in the Grand Canyon, this is the first year that we have been able to verify female song. We observed the female flycatcher at the RM 50.5 singing several soft *fitz-bews* while perched close to the nest. The female song was similar to that of male willow flycatchers, as reported by Seutin (1987) for female willow flycatchers in Canada. Female song is probably fairly common (M. Whitfield, *pers. comm.*) but is difficult to verify without color-banded birds and intensive field observations.

### 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). Cowbirds initially parasitized the RM 50.5 willow flycatcher, but this cowbird egg was later replaced by three willow flycatcher eggs. It is unlikely that the breeding flycatchers physically ejected the cowbird egg from the nest. Rather, the flycatchers may have built a new nest bottom over the top of the cowbird egg, as has been recorded in other areas (M. Whitfield, *pers. comm.*).

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 is 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.

If these high rates of cowbird parasitism continue, the resultant decrease or failure in flycatcher productivity may lead to the extirpation of the canyon willow flycatcher population. 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. 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 Interim Flows

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). Interim flows could potentially directly impact willow flycatchers by drowning nests and/or destroying nest substrate (e.g., the nest tree or bush). We observed neither of these effects. Due to the height (at least 3.5 m above ground level) of the flycatcher nests found we found from 1992 to 1995, even water levels of 20,000 cfs would not cause nest inundation. The tamarisk patches in which the flycatchers nested would not be directly damaged at 20,000 cfs.

Daily water fluctuations could potentially erode the river banks and patch substrate, causing vegetation loss. We have not observed any such effects at willow flycatcher breeding sites during the last four years, but long-term erosional effects should be considered and possibly modeled with data from on-going Glen Canyon Environmental Studies beach erosion research program.

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 Glen Canyon Environmental Studies vegetation research and monitoring efforts currently underway. 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.

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## 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 1996, 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 1995 (concentrating on historic and recent breeding sites). 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.

### 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 1995, 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 1995: 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 - 1995 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. Despite the breeding-season closure at Cardenas, we regularly see signs of recreation and human use there, including an extensive trail network through the habitat where flycatchers previously bred. We do not know if these activities may have indirect negative impacts at breeding sites. Because there is continued potential for such human disturbance if protective closures are lifted, and in order to encourage the recolonization of the Cardenas site, 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  
RM 65.3 L (Lava Chuar)

(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. Closure notices should also be posted at the sites, and along trails leading to the closure areas, to discourage people from camping at or visiting the area. The latter is particularly important, in that closures were not posted in 1993 and there were several occasions when hikers violated the closure at Cardenas.

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 (to be conducted in 1996) which 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.

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## APPENDIX 1

Summary of 1995 Southwestern Willow Flycatcher survey effort along the Colorado River corridor in Glen Canyon National Recreation Area and 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
(-8.3) - (-8.5) R	6/28/95	0900	0910	Land	John Grahame
-6.1 R	6/28/95	1000	1005	Boat	John Grahame
(-2.9) - (-3.4) R	6/28/95	0930	0940	Boat	John Grahame
46.1 - 46.9 R Triple Alcoves	5/22/95	0500	0700	Land	Jim Petterson, Susan Sferra
46.5 R Triple Alcoves	6/04/95	0500	0700	Land	Tim Tibbitts, Lawrence Abbott
46.5 R Triple Alcoves	6/17/95	0515	0700	Land	Lawrence Abbott, Britta Muiznieks
46.5 R Triple Alcoves	7/02/95	0502	0626	Land	Jim Petterson, Don Henry
50.5 L	5/22/95	0900	0920	Land	Susan Sferra, Jim Petterson
50.5 - 51.5 L	5/23/95	0510	0718	Land	Susan Sferra
50.5 L	5/23/95	0515	0530	Land	Jim Petterson
50 .5 L	6/04/95	0800	0810	Land	Tim Tibbitts, Lawrence Abbott
50.0 - 50.4 L	6/06/95	0725	0805	Boat	Lawrence Abbott
50.1 - 50.4 L	6/17/95	0840	0910	Boat	Lawrence Abbott, Britta Muiznieks
50.0 - 50.4 L	6/18/95	0550	0730	Land	Lawrence Abbott
50.5 L	7/02/95	1140	1155	Land	Jim Petterson, Don Henry
50 .5 L	7/03/95	0506	0516	Land	Jim Petterson, Don Henry
50.5 L	7/04/95	0437	0530	Land	Jim Petterson, Don Henry
51.3 L	6/06/95	0500	0708	Both	Lawrence Abbott
51.4 L	5/23/95	0718	1048	Land	Susan Sferra

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
51.4 L	6/05/95	1600	1806	Land	Tim Tibbitts
51.4 L	6/06/95	0420	0830	Land	Tim Tibbitts, Lawrence Abbott
51.4 L	6/18/95	1815	1905	Land	Lawrence Abbott
51.4 L	7/02/95	0835	1010	Land	Jim Petterson, Don Henry
51.5 L	7/04/95	0432	0535	Land	Jim Petterson
52.0 L	5/24/95	0550	0610	Land	Susan Sferra, Jim Petterson
65.3 L Lava Chuar	5/24/95	0810	1044	Land	Susan Sferra, Jim Petterson
65.3 L Lava Chuar	6/06/95	1645	1815	Land	Lawrence Abbott, Tim Tibbitts
65.3 L Lava Chuar	6/07/95	0425	0645	Land	Tim Tibbitts, Lawrence Abbott
65.3 L Lava Chuar	7/04/95	1030	1100	Land	Don Henry
71.0 L Cardenas	5/25/95	0510	0650	Land	Susan Sferra, Jim Petterson
71.0 L Cardenas	6/07/95	1515	1740	Land	Tim Tibbitts
71.0 L Cardenas	6/08/95	0450	0650	Land	Lawrence Abbott, Tim Tibbitts
136.0 R	5/26/95	0555	0650	Land	Jim Petterson, Susan Sferra
143.0 R	6/09/95	0515	0640	Land	Tim Tibbitts, Lawrence Abbott
196.0 R	5/27/95	0515	0720	Land	Susan Sferra, Jim Petterson
198.0 R	5/27/95	0814	0851	Land	Jim Petterson, Susan Sferra
197.5 - 198.0 R	6/10/95	0520	0700	Land	Lawrence Abbott, Tim Tibbitts
204.7 - 204.8 L	6/10/95	0945	0950	Boat	Lawrence Abbott, Tim Tibbitts

## APPENDIX 2

Names and affiliations of the 1995 Colorado River willow flycatcher monitoring field personnel.

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