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Southwestern Willow Flycatcher (*Empidonax traillii extimus*)
Surveys along the Colorado River
in
Grand Canyon National Park
and
Glen Canyon National Recreation Area
- 1992 -

Summary Report
December 7, 1992

Prepared by:

Mark K. Sogge
Ecologist

National Park Service Cooperative Park Studies Unit
Northern Arizona University, Flagstaff, AZ

and

Timothy Tibbitts
Ecological Services, U.S. Fish and Wildlife Service
Phoenix, AZ

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ABSTRACT

We conducted surveys for the southwestern willow flycatcher (*Empidonax traillii extimus*) in riparian habitats along the Colorado River corridor from Glen Canyon Dam to Lake Mead (River Mile (RM) 261). Surveys were conducted by moving through or adjacent to riparian habitat patches, listening and looking for willow flycatchers. Observers broadcast willow flycatcher songs from hand-held tape recorders in order to elicit responses from resident flycatchers. We detected seven willow flycatchers - three unpaired individuals and two breeding pairs. The unpaired individuals were detected in tamarisk (*Tamarix chinensis*) patches at RM -11.2 Left (L) (Ferry Swale Campground), RM 51.4 L, and RM 191.1 Right (R). These unpaired individuals may have been unsuccessfully attempting to find mates. Both pairs of willow flycatchers were found at RM 71 L (Cardenas Marsh). Only one pair showed evidence of successful breeding - we observed three eggs on our first survey and three nearly-fledged young on the second visit. There was no evidence of brown-headed cowbird (*Molothrus ater*) parasitism at this nest. The number of southwestern willow flycatchers along the Colorado River corridor in Grand Canyon National Park and Glen Canyon National Recreation Area is apparently very low, appears to be continuing to decline, and may be in serious trouble. We recommend future monitoring, recreation closures at known flycatcher breeding sites during the breeding season, and establishment of a cowbird monitoring program at Grand Canyon National Park pack mule stations and manure disposal sites.

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INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*) is a riparian obligate species, nesting in cottonwood-willow associations or similar riparian communities. The southwestern willow flycatcher has declined in recent decades. This decline is believed to be 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). The southwestern willow flycatcher is listed by the U.S. Fish and Wildlife Service (USFWS) as a candidate category 1 species (56 FR 58804), and the USFWS was petitioned in January 1992 to list the subspecies as endangered. In September 1992, the USFWS published a positive 90-day finding on this petition (USFWS 1992). That finding obligates the USFWS to determine whether or not listing is warranted, by January 30, 1993. 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).

Although once distributed along most major river systems in Arizona (Phillips 1948, Unitt 1987), only three areas are known to have been occupied by nesting southwestern willow flycatchers in the past ten years. These are the lower San Pedro River, the Verde River near Cottonwood, and the Colorado River in Grand Canyon National Park (Hunter et al. 1987, Unitt 1987, Brown 1988 and 1991). Of these areas, Grand Canyon National Park contained the greatest known number of willow flycatchers during the 1980's, with a maximum estimate of 11 males (a singing male was assumed to represent a breeding pair) in 1986 (Brown 1988).

However, even this small number has apparently declined in recent years, to only two singing males/pairs in 1991 (Brown 1991).

As a result of this decline in willow flycatchers, Grand Canyon National Park, Glen Canyon National Recreation Area, the U.S. Fish and Wildlife Service, and the U.S. Bureau of Reclamation Glen Canyon Environmental Studies office expressed an interest in additional surveys to determine the number and distribution of willow flycatchers in 1992. The National Park Service Cooperative Park Studies Unit at Northern Arizona University (CPSU/NAU) coordinated the project, which was funded by the Glen Canyon Environmental Studies office.

This project was designed to meet the following objectives:

1. Continue to monitor willow flycatcher numbers in the Grand Canyon.
2. Continue to assess potential threat from cowbird parasitism, and the loss or modification of habitat (due to fluctuating flows).
3. Continue to assess habitat use patterns, particularly nest site characteristics, including habitat patch size and vegetation parameters.
4. Survey additional habitat, beyond that covered in previous surveys.
5. Utilize improved methods (e.g., tape song playbacks) and timing (optimized for each major portion of the river corridor) to maximize the likelihood of detection of breeding willow flycatchers.

This report is based on the results of willow flycatcher surveys conducted during the 1992 breeding season. Grand Canyon National Park, Glen Canyon National Recreation Area, and the Glen Canyon Environmental Studies office have agreed to support additional surveys during 1993 and 1994. Therefore, this document is being presented as a status report, rather than a final project report. Future reports, based on additional years of sampling, will allow

more quantitative analyses than are possible based only on this first year.

METHODS

Willow flycatcher presence was determined by sightings and song detections made from approximately 0530 to 1100 daily, when male song rates are the greatest (Unitt 1987). In some cases, surveys were also conducted at dusk, a period during which willow flycatchers may display a secondary peak of singing (Weydemeyer 1973, Unitt 1987). In order to maximize the likelihood of detecting willow flycatchers, surveyors used tape-broadcast songs of willow flycatchers; a proven method for eliciting a vocal response from nearby resident flycatchers (Seutin 1987, England et. al. 1988). This also allowed positive 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, observations were made from boats drifting slowly past the habitat patch. Willow flycatcher songs were broadcast for 15-30 seconds (from a hand-held cassette player), after which the surveyor listened approximately 1-3 minutes for a response. This procedure was repeated every 30-50 meters throughout each survey site.

Surveys were conducted throughout the Colorado River corridor from Glen Canyon Dam downstream to Lake Mead (RM 261). Most surveys were conducted between the dam and Diamond Creek. All areas surveyed by Brown (1988 and 1991) were resurveyed, with emphasis given to the two areas identified by Brown as occupied by willow flycatchers: Saddle Canyon to Kwagunt Creek, and Cardenas Marsh.

All locations of singing/territorial willow flycatchers were

recorded, and flycatchers which were detected were intensely observed to detect nesting activity. Male singing rate (songs/minute) was recorded during this observation period, to provide information on daily and seasonal variation in song rates. Nesting status was verified by nest inspection, and on the subsequent survey trips. Clutch size, number and age of young, and presence of cowbird eggs or young were noted. Nests were monitored only once each survey trip and were examined using a telescoping mirror to eliminate a human scent trail directly to the nest.

To assess the threat of cowbird parasitism, observers monitored flycatcher nest areas for the presence of cowbirds, and noted cowbird behavior and willow flycatcher response.

RESULTS

Survey Effort

Surveys were conducted between 16 May and 27 July, 1992. We surveyed 138 habitat patches during a total of 253 survey hours. The vast majority of surveys were conducted in the morning, and by walking through the habitat patches (Table 1). Almost all sites were surveyed twice during the breeding season. Appendix I provides a detailed summary of the location, timing, and personnel of each survey. Appendix II provides details on the affiliations of each surveyor.

Table 1. Summary of Willow Flycatcher Survey Effort

METHOD	Survey Effort 0400-1000 hrs	Survey Effort 1000-1400 hrs	Survey Effort 1400-2000 hrs
Land	156 hrs 16 min	33 hrs 6 min	47 hrs 23 min
Boat	14 hrs 57 min	7 hrs 43 min	2 hrs 27 min
Total	166 hrs 43 min	37 hrs 4 min	49 hrs 31 min

Willow Flycatcher Detections

We detected seven willow flycatchers - three unpaired individuals and two breeding pairs. The unpaired individuals were detected in tamarisk patches at River Mile (RM) -11.2 L (Ferry Swale Campground), RM 51.4 L, and 191.1 R. Both pairs of willow flycatchers were found at RM 71 L (Cardenas Marsh). Summaries of each detection are presented below, listed by site in river mile and side (R=right, L=left) sequence (based on Stevens 1983).

Site #1: Refer to Map 1 and Figure 1

Location: RM -11.2 L (Ferry Swale). 15 June 1992 0750 hrs

Habitat: Dense tamarisk, five to seven m high.

A single willow flycatcher was observed in the dense tamarisk stand immediately upstream from the Ferry Swale campsite. This individual was detected after broadcast of the taped flycatcher call. The bird was seen moving through the understory, approximately 1.5 m above the ground, but did not respond vocally. After about 10 seconds, the flycatcher moved off through the vegetation, and was not detected again. The bird was observed in good light from about 10 m away. Although visual confirmation of willow flycatchers is difficult, the fact that the bird was attracted to the tape broadcast song confirms the identification. Although it is possible that the bird was of the migrant races (*Empidonax traillii brewsteri* or *E. t. adastus*), these have usually passed through the Grand Canyon before this date (Unit 1987). Thus, the bird was probably an *E. t. extimus*. This bird was not detected during follow-up surveys on 20 and 21 July 1992.

Map 1. Topographic map showing location of habitat patch at willow flycatcher Site #1 (Ferry Swale: River Mile -11.2 L). Exact location of flycatcher sighting is encircled. Base map is Lee's Ferry to Glen Canyon Dam, by Catch and Release Calendars.

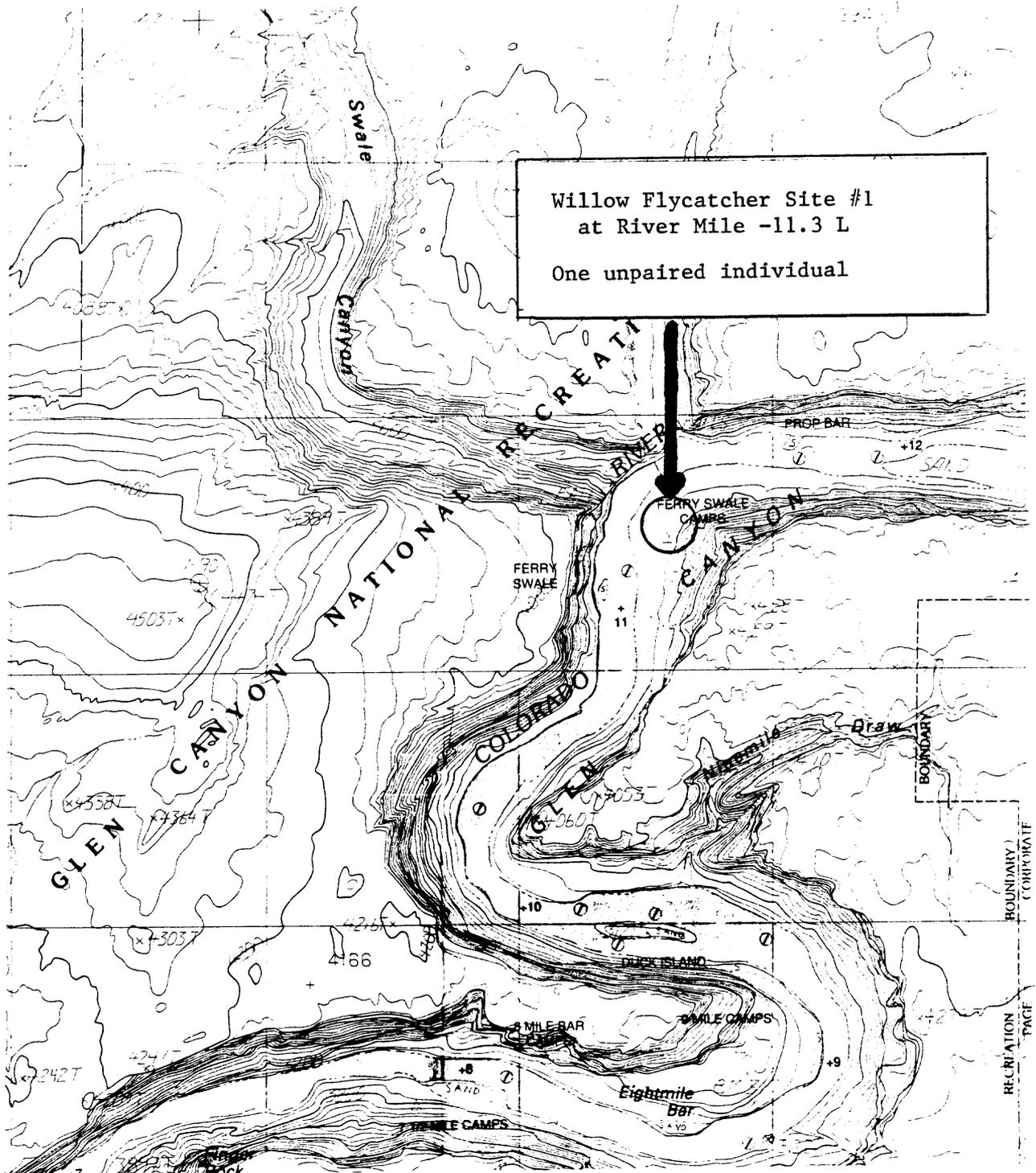
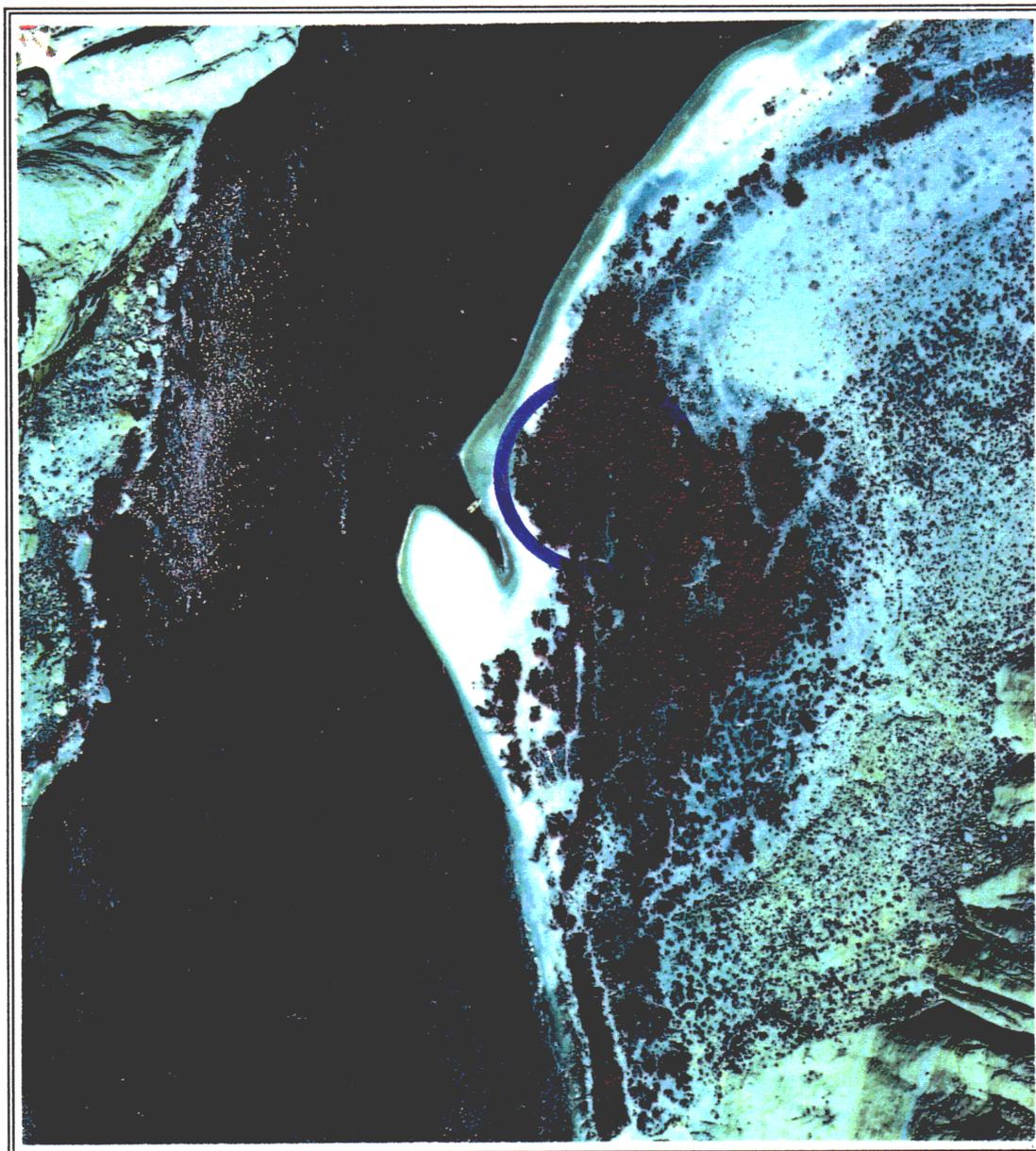


Figure 1. Aerial photograph showing location of habitat patch at willow flycatcher Site #1 (Ferry Swale: River Mile -11.2 L). Exact location of flycatcher sighting is encircled. River flow is from page top to bottom.



Site #2: Refer to Map 2 and Figure 2

Location - RM 51.4 L 24 June 1992 1315 hrs

Habitat: tamarisk patch with willow along edge, near small marsh

A single willow flycatcher was first detected as it gave a "whit" call in response to a broadcast flycatcher song. During the remainder of the day, and the following morning, it was observed repeatedly by several surveyors. The bird was observed moving through the vegetation, giving "whit" calls and foraging, but there was no evidence of a mate or nest. No follow-up visit to this site was possible, in that the bird was detected during the final survey trip. As with the bird at Site #1, this was probably not a migrant, but rather an *E. t. extimus*.

Map 2. Topographic map showing location of habitat patch at willow flycatcher Site #2 (River Mile 51.4 L). Exact location of flycatcher sighting is encircled. Base map is USGS topographic map Nankowep Mesa, AZ.

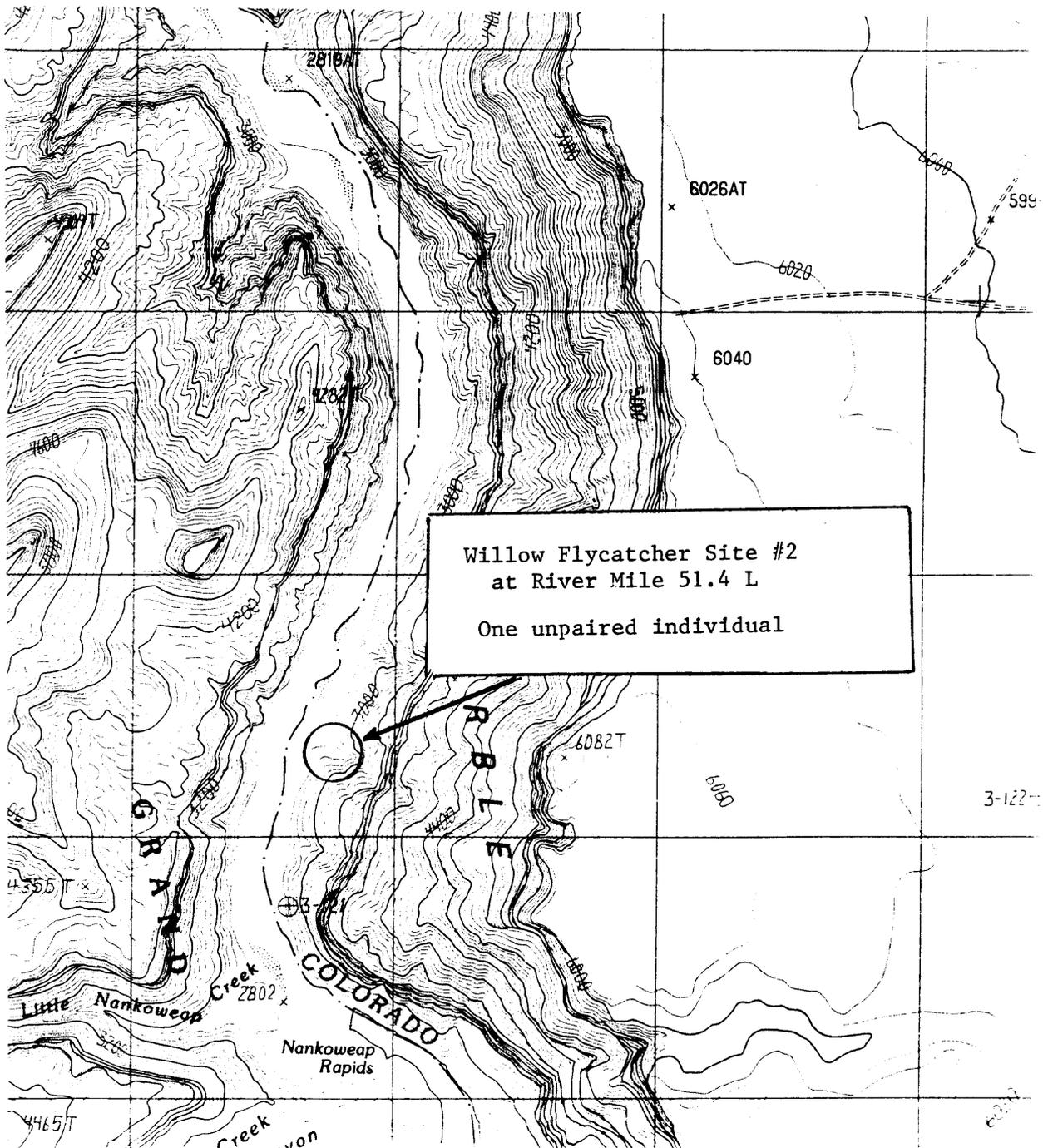
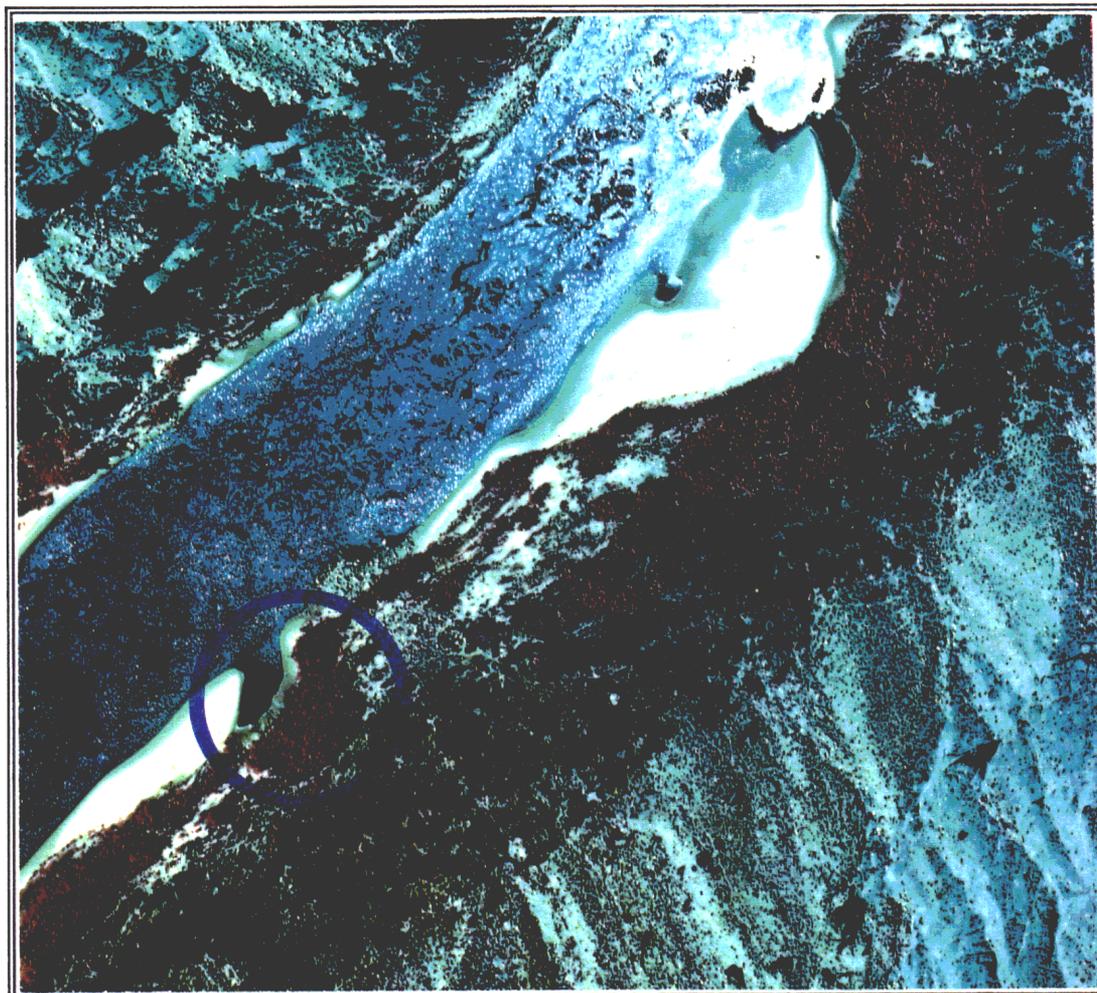


Figure 2. Aerial photograph showing location of habitat patch at willow flycatcher Site #2 (River Mile 51.4 L). Exact location of flycatcher sighting is encircled. River flow is from page top to bottom.



Site #3: Refer to Map 3 and Figure 2b

Location - RM 71 L (Cardenas Marsh - West pair) 4 June 1992
1925 hrs

Habitat: Dense tall tamarisk patch bordered by willow, baccharis, and small marshy area. Tall Gooding's willow (*Salix gooddingii*) nearby.

This pair was first discovered when the female responded with an alarm "whit" to a broadcast call in the evening. The following morning we observed a male singing and foraging in the tamarisk patch. Throughout the morning, at approximately 20 minute intervals, the female would emerge from the tamarisk patch to forage. After watching the female re-enter vegetation several time, we carefully approached the area where we suspected a nest was located.

We found the willow flycatcher nest 3.5 m up in a 4.5 m tall tamarisk. The nest was located 1.5 m from the top of the vegetation canopy, 7 m from the nearest edge of the habitat patch, and 7 m from the river's edge. Nest contents were examined using an extendable mirror, and the nest contained three willow flycatcher eggs. Although the territorial male and female flycatchers stayed nearby and emitted alarm calls ("whits"), they returned to normal activity shortly after we left the vicinity of the nest.

The nest was checked again during a second visit on 27 June. The adult male and female were still present, and the nest still contained three willow flycatcher nestlings (almost ready to fledge). One nestling jumped from the nest as it was being checked with the mirror. The chick was successfully replaced in the nest. On 29 June, one of the chicks was out of the nest, and being attended to by the parent birds. Two other chicks were still in the nest. A subsequent hike to Cardenas on 27 July

Map 3. Topographic map showing location of habitat patch at willow flycatcher Site #3 and #4 (Cardenas Marsh - River Mile 71 L). Exact location of flycatcher sighting is encircled. Base map is USGS topographic map Desert View, AZ.

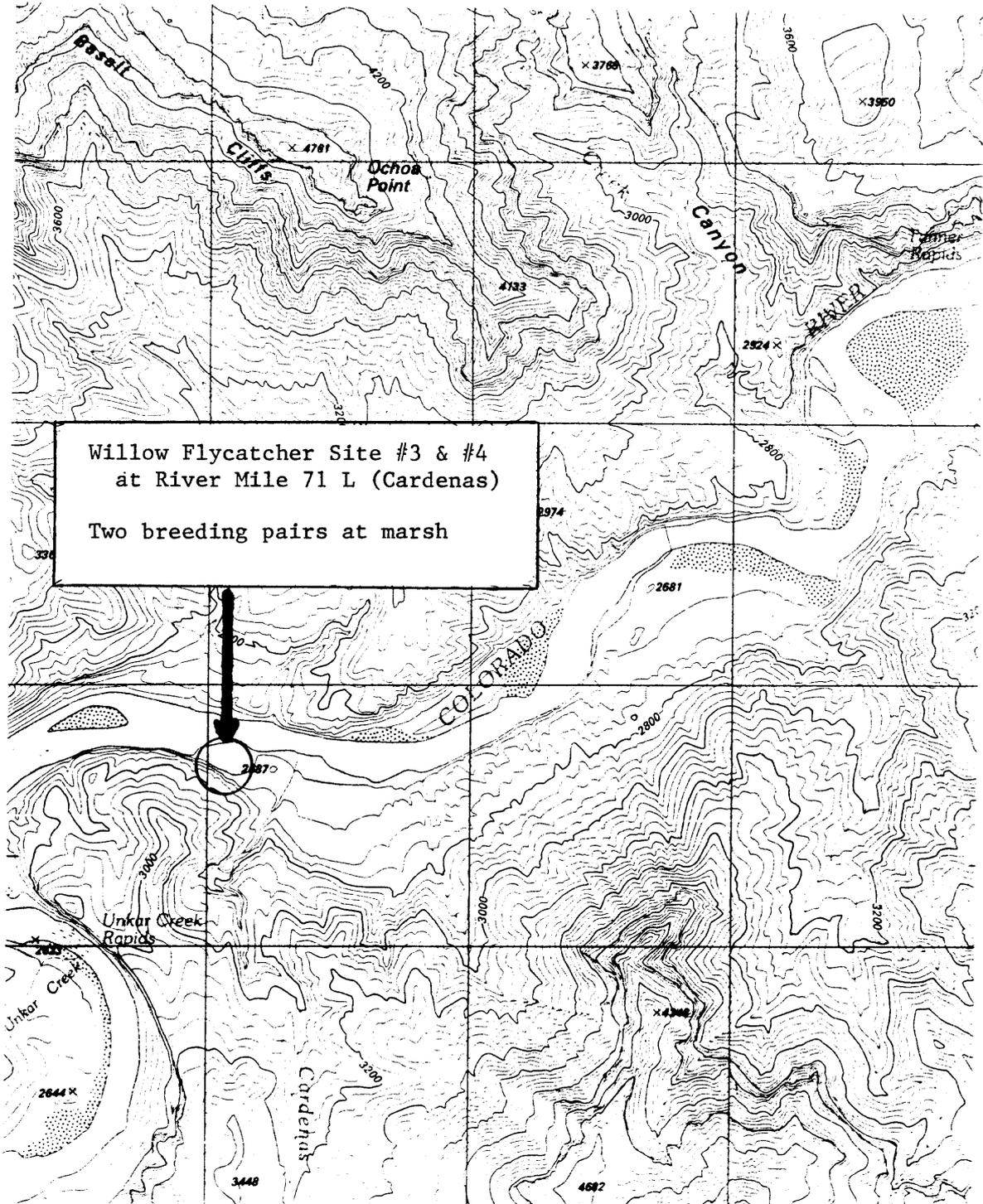
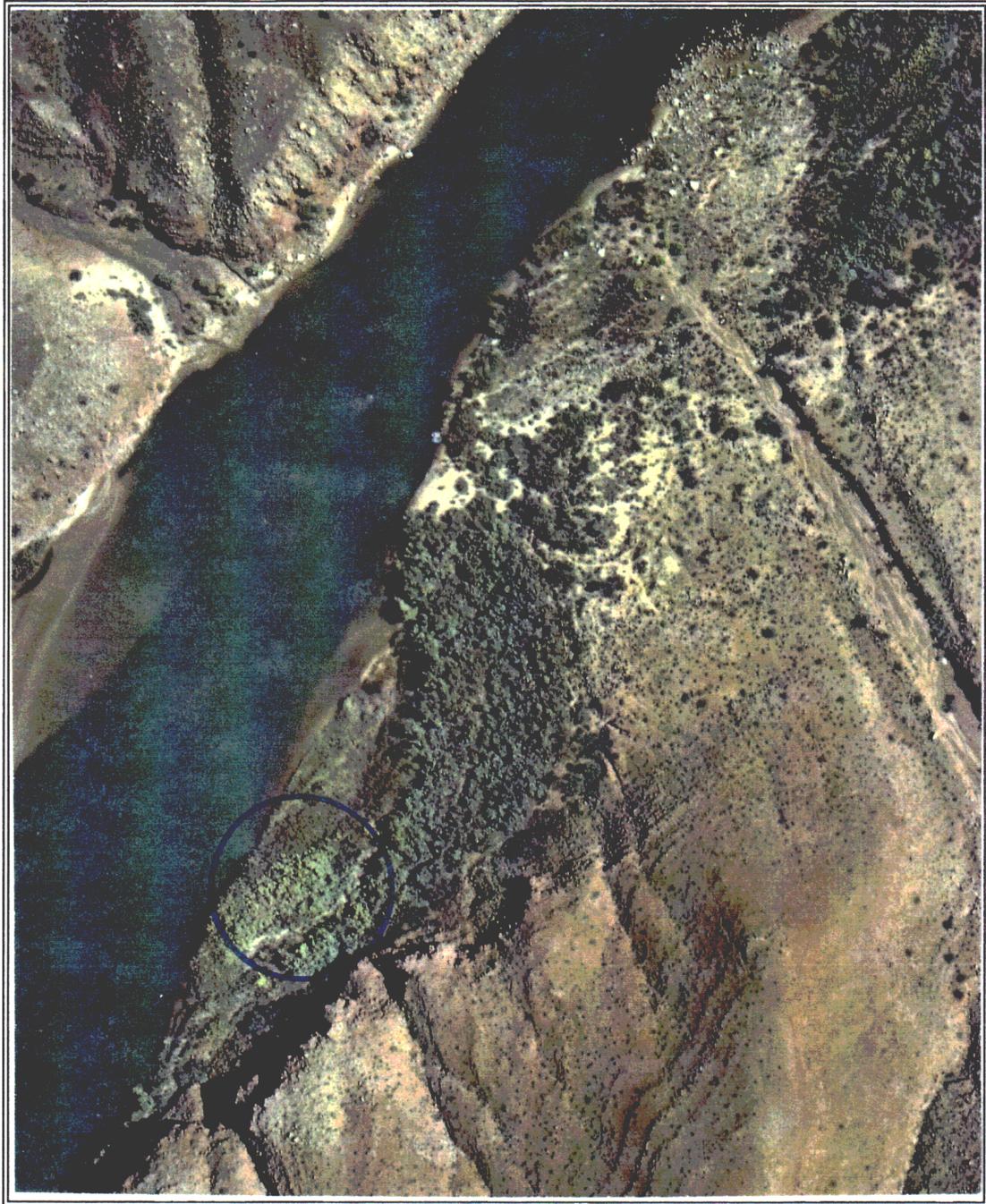


Figure 2b. Aerial photograph showing location of habitat patch at willow flycatcher Sites #3 and #4 (Cardenas Marsh, RM 71 L). Exact location of flycatcher sightings is encircled. River flow is from page top to bottom.



found an adult and at least one fully feathered, flying young bird. What may have been a second young bird (or possibly the same individual) was observed approximately 40 m southeast of the tamarisk patch.

Site #4: Refer to Map 3 and Figure 2b

Location - RM 71 L (Cardenas Marsh - East pair) 5 June 1992
0600 hrs

Habitat: Dense tall tamarisk patch border by willow, baccharis, and small marshy area. Tall Gooding's willow nearby.

A singing male was first detected early on the morning of 5 June. This male was singing loudly from a variety of song perches in the area, primarily using the tall Gooding's willows along the southern edge of the habitat patch. There was no indication of a female in the territory, despite two days of intense observation. On 27 June, the male was again observed singing, but had shifted activities to the northwest. This brought him immediately adjacent to the West pair, actually within the same tamarisk patch. The male was also now paired with a female.

The flycatchers were observed moving near and about a partially completed nest structure, and responded with alarm to surveyors that approached the nest. However, the nest contained no eggs and a positive identification as a flycatcher nest was not possible. The flycatchers resumed normal behavior shortly after the surveyors left the vicinity of the nest. During the 27 July visit to the marsh, the nest appeared abandoned and showed no sign of use. In addition, no adult or young willow flycatchers were found. Thus, there was no sign of successful breeding for the East Cardenas pair.

Site #5: Refer to Map 4 and Figure 3.

Location - RM 191.1 R 18 June 1992 1710 hrs

Habitat: Dense tamarisk patch, five to seven m high.

A single willow flycatcher was first detected as it gave a "whit" call in response to a broadcast flycatcher song. During the remainder of the day, and the following morning, it was observed repeatedly by two surveyors. The bird was observed moving through the vegetation, giving "whit" calls and foraging, but there was no evidence of a mate or nest. No follow-up visit to this site was possible. As with the flycatcher at Site #1, this was probably not a migrant, but rather an *E. t. extimus*.

Map 4. Topographic map showing location of habitat patch at willow flycatcher Site #5 (River Mile 191.1 R). Exact location of flycatcher sighting is encircled. Base map is USGS topographic map Vulcan's Throne, SW.

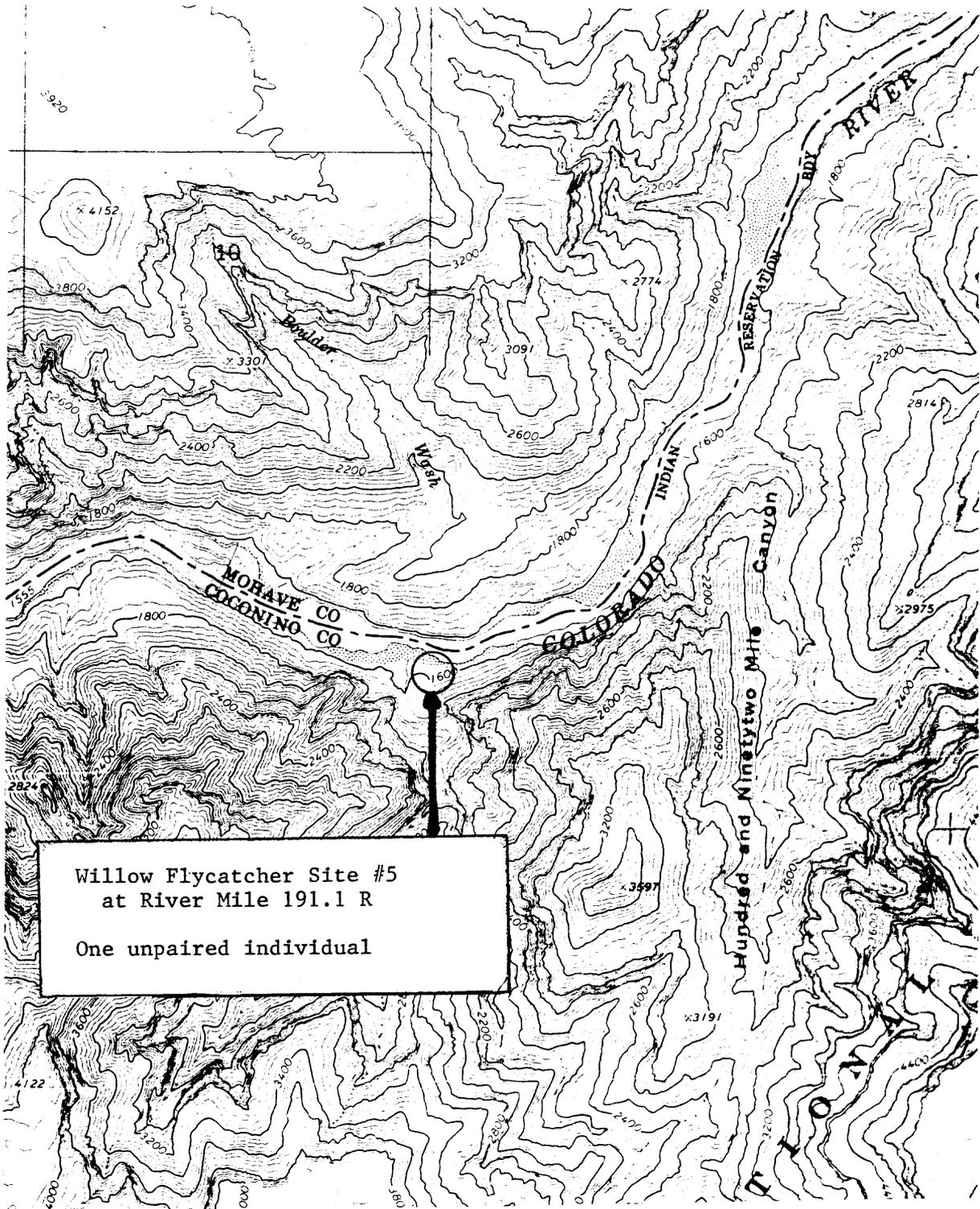
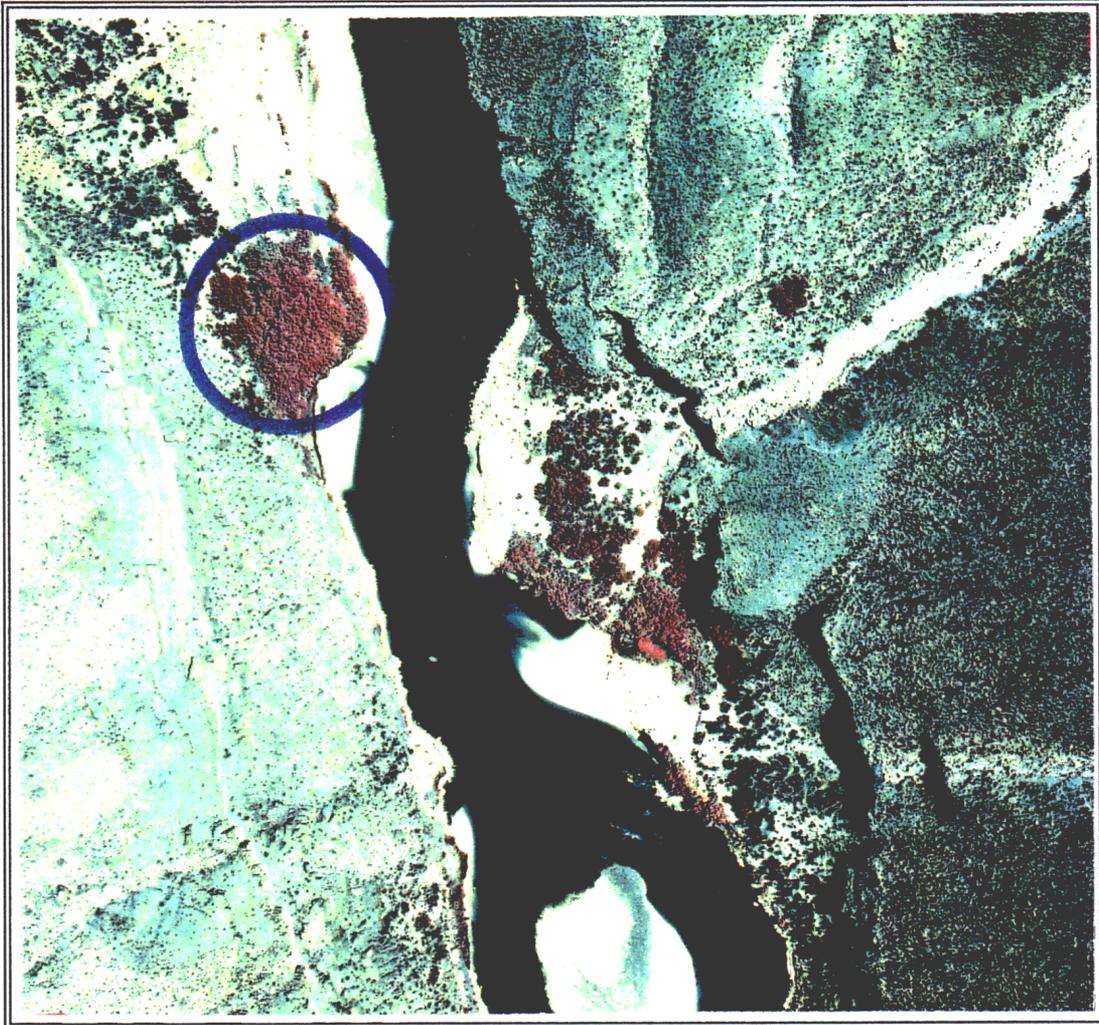


Figure 3. Aerial photograph showing location of habitat patch at willow flycatcher Site #5 (River Mile 191.1 R). Exact location of flycatcher sighting is encircled. River flow is from page top to bottom.



Willow Flycatcher Song Patterns

Singing male willow flycatchers were detected only at Cardenas Marsh, where both males sang regularly. The Cardenas males vocalized using a combination of "fitz bew" and "whits". At no time were females observed singing, although they regularly gave "whit" calls.

Males were heard singing as early as 0500 hrs, and as late as 1940 hrs. The East Cardenas male sang later in the evening than the West Cardenas male, but only before it had paired with a female. Once paired, the East Cardenas male rarely sang past the early afternoon. The East male sang before finding a mate, and through what appeared to be early courtship. The West male sang while eggs were in the nest, but did not sing when the nest contained chicks. Additional quantitative data on song rates will be presented in future reports pending a larger sample size of singing males.

Brown-headed Cowbird Activity and Willow Flycatcher Response

Brown-headed cowbirds were commonly observed flying over or perched in many of the habitat patches surveyed during this study. Cowbirds were also observed at each of the sites where willow flycatchers were found, except for Site #5 (RM 191.1 L). Female cowbirds were commonly present at the willow flycatcher sites, often accompanied by one or more males that were actively courting the females. Females were occasionally observed moving slowly through the habitat patches, a characteristic indicative of a search for host bird nests.

Cowbirds were observed at willow flycatcher sites while flycatchers were present, and were sometimes only a few meters away from the flycatchers. At no time did we observe the flycatchers respond to the presence of cowbirds.

No cowbird eggs or young were found in the willow flycatcher nest of the West Cardenas pair. However, one cowbird egg was found in a nearby yellow-breasted chat (*Icteria virens*) nest.

DISCUSSION

Survey Methodology

The methods used in this study were successful in detecting both breeding and unpaired flycatchers. Two territorial males at Cardenas (Sites #3 and #4) were detected before song tapes were played - e.g., they were already singing when the surveyors approached their territories in early morning. Although it is true that singing male flycatchers are readily detected even at a distance of 50 meters, it is likely that the three non-paired individual flycatchers (at Sites #1, #2, and #5) would not have been detected if taped calls had not been used. These three willow flycatchers were first detected by their response to the tape broadcast songs. Therefore, surveys conducted following the techniques of earlier surveys are probably biased toward finding fewer flycatchers. This is important in interpreting past surveys, in that earlier methods may have underestimated the number of willow flycatchers.

Multiple surveys at each site are also important. For example, no birds were found during the first surveys at Sites #2 and #5, yet flycatchers were present during the second surveys. Thus, a single earlier survey would have projected a smaller minimum number of flycatchers. Conversely, second visits to willow flycatcher sites can verify or refute possible breeding efforts or success (as for Sites #1, #3 and #4).

Surveys conducted by walking through the habitat patches are also more productive, in terms of the probability of detecting non-singing willow flycatchers. Flycatchers at Sites #1 and #3 were not detected until the surveyors were moving (and broadcasting taped calls) from within the midst of the habitat patches.

Surveys conducted from the river would probably not have elicited a response from these birds, again leading to fewer detections. Also, male song decreases after pairing with a female and as the breeding season progresses (Stafford and Valentine 1985, this study - see below). Surveys conducted while walking through the habitat have a much better chance of visually detecting a quiet male (or female) bird than do surveys conducted from the river, particularly if wind is a problem. Walking surveys also allow more thorough coverage of wide habitat patches.

Several of these problems with earlier survey methodology were noted by Brown (1991). The methodology used in 1992 overcomes these problems, and should be used in future surveys.

Willow Flycatcher Status - Numbers and Distribution

We found willow flycatchers in portions of the river beyond where they were previously known to be present (Brown 1988 and 1991). The detection at Site #1 is the first willow flycatcher found above Lees Ferry since the 1950's, and the flycatcher found at Site #5 was detected further downstream than any in the past surveys (see summary in Brown 1991).

The 1992 minimum estimate of 7 willow flycatchers is higher than the estimate in 1991 (4 individuals), yet lower than surveys conducted from 1985 to 1987 (7-11 males/pairs; Brown 1991). In that our methods differed from those used in past surveys, precise comparison with previous estimates of the number of flycatchers is not possible. However, because of a potential bias of previous surveys to detect fewer flycatchers, it is likely that past surveys using our current techniques would have detected more birds. Thus, there has certainly been an overall reduction in the number of willow flycatchers between 1985 and 1992, perhaps even greater than a simple comparison of survey numbers suggests.

Although we found more flycatchers more widely distributed than in 1991, there were fewer breeding sites than in previous years. Former breeding areas at Saddle Canyon and River Mile 50.7 (Brown 1991) were not occupied by breeding pairs in 1992. All known 1992 breeding activity occurred at Cardenas Marsh. This reduction of known breeding areas is a cause for concern in that declining populations often show a successive loss of groups of individuals from distinct portions of their range.

Willow Flycatcher Breeding Biology

Breeding habitat and nest location of the Cardenas Marsh flycatchers were similar to characteristics noted by Brown (1988). The dates of territory occupancy and incubation of eggs (early June), and raising of young (through late June) are within the range typical for breeding willow flycatchers in the Grand Canyon - early June to mid-July (Brown 1988).

The clutch size (three eggs) of the one nest at Cardenas Marsh is the same as the average noted for *E. t. extimus* along the Colorado River (Unitt 1987). Although only one young bird was observed to have fledged from the Cardenas nest, the other two chicks probably fledged on the same or following day, in that for most songbirds, nest mates typically fledge over a short period of time. The average number of young southwestern willow flycatchers fledged from a nest is not known.

Vocalization Patterns and Characteristics

The "fitz-bew" song given by territorial male willow flycatchers at Cardenas Marsh followed the general pattern described in Unitt (1987), and recorded from willow flycatchers in other areas. However, there appeared to be a difference in dialects - the Cardenas birds made a distinctly longer (more syllables) and more "rolling" "fitz-bew" than was found in the songs of the birds from the pre-recorded tapes (typically Rocky Mountain or East

Coast specimens). We recorded several hours of Cardenas male flycatcher songs and calls. These tapes will be forwarded to the Borror Laboratory of Bioacoustics at Ohio State University. Dr. Sandra Gaunt will analytically compare the Cardenas flycatcher vocalizations with those of other subspecies of willow flycatchers, to determine if they are a distinct dialect.

Male willow flycatcher song rates and daily/seasonal patterns were also similar to those described by Unitt (1987) and Brown (1991). However, early in the season the males at Cardenas sang throughout the morning and into the late afternoon. Before pairing with a female, the male at East Cardenas also sang through late evening. Song rate for both males dropped later in the season.

These song rate patterns have important implications with regard to survey methodology. Surveys conducted early in the breeding season will probably detect territorial males, because they are highly vocal and vocalizations carry for considerable distances. Early surveys can be conducted later in the morning, and perhaps in early afternoon, since territorial males will still probably be singing. However, later surveys should be conducted primarily in morning, when males still sing. Late season surveys also have a greater chance of simply not detecting resident males, since male song is reduced or absent.

Brown-headed Cowbird Impacts

Although we found no cowbird eggs or young in the one willow flycatcher nest found during this study, approximately half of the flycatcher nests examined in the study area during the 1980s were parasitized by cowbirds (Brown 1988). It is likely that cowbirds continue to represent a stress on the productivity of breeding willow flycatchers in the canyon.

Effects of Interim Flows

The potential direct effects of interim flows on willow flycatchers include (a) drowning of birds, (b) drowning of nests, or (c) destruction of nest substrate (e.g., the nest tree or bush). We observed none of these effects. The likelihood of drowning of birds is very low, in that willow flycatcher activity over or immediately adjacent to open water was minimal. Due to the height (3.5 m above ground level) of the flycatcher nest found in this study, it is also unlikely that interim flow water levels could cause nest inundation. The tamarisk patch in which the flycatcher nest was located appears to be rooted at least 1 m above the level of high flows observed during this study. Thus, interim flow water levels would not cause damage or destruction of the nest substrate.

The most likely flow-related impacts to the willow flycatchers along the Colorado River Corridor would result from habitat changes. 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. Determination of indirect impacts of interim flows is also complicated by the fact that (a) the willow flycatcher appears to be declining on a regional level, and (b) 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/habitat change effects.

MANAGEMENT CONSIDERATIONS AND RECOMMENDATIONS

Continued Monitoring

The U.S. Fish and Wildlife Service was formally requested (in January 1992) to list the southwestern willow flycatcher as an endangered species, and must determine whether or not the listing is warranted, by January 30, 1993. This potential of listing as an endangered species, coupled with the small size and apparent widespread decline of this willow flycatcher population, demonstrate the need for continued monitoring along the Colorado River corridor. Such surveys will provide valuable information needed to continue tracking population trends, and to further define habitat use and potential threats.

We recommend continued willow flycatcher surveys in 1993 and 1994. These surveys should be coordinated by the Cooperative Park Studies Unit at Northern Arizona University (CPSU/NAU), and utilize the same methodology as the 1992 surveys.

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 passage of oar and motor boats near breeding territories could cause disturbance to willow flycatchers. Although no studies have specifically examined this question, we observed no changes in territorial male behavior when boats floated or motored past the birds at Cardenas. Additional data collected during future surveys may provide quantitative evaluation of such effects, but at this time no evidence suggests 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 in that the only remaining known breeding area - Cardenas - is also a popular camping area. Sites #1 and #2 were also at or near camping areas. The fact that willow flycatchers are found near these camping areas suggests that they are generally tolerant of nearby human activity. 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.

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 willow flycatchers were found in this or previous studies, grazing does occur on some reservation lands along the river corridor, and could be negatively effecting the regional flycatcher population by reducing potential habitat.

Restricted Use and Closures of Nesting Habitat

Because there is a potential for human disturbance to nesting willow flycatchers, steps should be taken to eliminate possible disturbance during the breeding season.

We recommend the following actions:

- (1) educate the river recreation community and park visitors 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 Cardenas Marsh to all non-research uses beginning 15 May. The closure should last at least 60 days. The exact date of ending the closure should be determined based on the breeding activity of resident flycatchers, as determined by the breeding surveys.
- (3) close the campsite near RM 51.4 to all non-research uses beginning 15 May. The closure should last at least 60 days. The exact date of ending the closure should be based on the breeding activity of resident flycatchers, as determined by the breeding surveys.
- (4) immediately close any new area(s) where willow flycatchers are found. The closure should last at least 60 days, or until a follow-up visit fails to find flycatchers present. The exact date of ending the closure should be based on the breeding activity of resident flycatchers, as determined by the additional surveys.

Closures should be advertised in the river guide newsletters, in park literature, and by the backcountry permit office. Closure notices should also be posted along trails leading to the closure areas, to discourage people from camping at or visiting the area.

Some may argue that closure of willow flycatcher breeding areas is not necessary. However, considering (1) the number of willow flycatchers is extremely low and declining, (2) the extremely limited distribution and number of breeding pairs, (3) that any loss of or reduction of productivity would probably have very negative ramifications, and (4) that the effect of human-related impacts is not well known, closure of known or suspected breeding sites is warranted.

Cowbird Control and Monitoring Program

The cowbird population in the canyon appears to be large, but is relatively dispersed once they are in the riparian zone. Control of cowbirds may have beneficial effects on the number of willow flycatchers, and for many other parasitized species in the canyon.

Although some studies have demonstrated success at control of cowbirds, and an associated increase in local willow flycatcher numbers, there are three issues that must be addressed when considering cowbird control within the river corridor - (1) compatibility of control with the National Park Service mission, goals, and guidelines, (2) effectiveness of control techniques, and (3) difficulties associated with each technique.

The issue of compatibility with NPS missions and goals is best decided by the managers responsible for the resources in Grand Canyon National Park and Glen Canyon National Recreation Area. The issues of effectiveness and difficulties are discussed briefly below for several potential control methods that have been suggested in the past.

One idea is to reduce the number of cowbirds in the riparian zone by shooting them with pellet guns. This approach suffers from several drawbacks including:

- (a) the difficulty of accurately hitting cowbirds, particularly from a distance that would avoid disturbance to flycatchers,
- (b) the difficulty in actually killing enough cowbirds to significantly reduce the local population (which is dispersed once they are in the riparian zone),
- (c) the necessity to have a "shooter" present at the flycatcher nest site(s) at all times,
- (d) the assumption that cowbirds will be detected and killed before they find and parasitize a host nest,
- (e) the possibility of a negative public impression and reaction to a "violent" technique.

Another suggestion is to utilize bird mist-nets to capture cowbirds in the riparian zone. This approach also has several drawbacks including:

- (a) mist nets are non-selective; that is, any bird moving through the area in which the net is set has a chance to become caught. Thus any bird, including a willow flycatcher, could be captured. Capture and removal from a net can be stressful, and some mortalities would be expected. This exposes non-targeted species to potential negative impacts.
- (b) mist nets are biased in terms of the species they are most likely to catch - species moving quickly through the area at the height of the nets. It could be difficult to place the nets in a manner to maximize effectiveness on cowbirds, which are often in the upper canopy, and
- (c) the necessity to have a net attendant present at the capture areas whenever nets are in use.

A third possibility is the use of cowbird traps - essentially food-baited cages - to capture cowbirds. This technique has several advantages over the previous methods:

- (a) traps have been successfully used in other areas,
- (b) traps can be set and left attended for several days,
- (c) they are relatively selective, in that foods favored primarily by cowbirds are used as bait, and
- (d) traps can be placed in the immediate vicinity of flycatcher nest, with negligible likelihood of impacting the flycatchers.

However, traps also have limitations and drawbacks:

- (a) traps will have to be transported to the sites, and checked and reset regularly,
- (b) trapped cowbirds must be disposed of humanely, and
- (c) traps work most effectively in areas where cowbirds concentrate.

The potential of problems associated with any cowbird control program necessitates careful consideration of alternatives and potential impacts. Of the three alternatives outlined above, live-trapping has the greatest potential for success and the least potential for negative impacts to the willow flycatchers. Brown-headed cowbirds are known to parasitize willow flycatcher nests in the Grand Canyon, and are a potential threat to the willow flycatchers along the river corridor. Pack mule stations within the Park may be providing important foraging centers for cowbirds, as has been shown for stock areas in California. Therefore, a survey program should be developed to determine the degree to which cowbirds utilize pack mule stations, pack mule feed storage areas, and pack mule manure disposal sites within the Park. This program should be designed for implementation by Grand Canyon Resources Management and Ranger staff. If pack areas in the Park are contributing to cowbird success in the Grand Canyon, a potential cowbird management program should be developed.

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LITERATURE CITED

- Arizona Game and Fish Department. 1988. Threatened native wildlife in Arizona. Arizona Game and Fish Department publication. Phoenix, Arizona. 32 pp.
- Blakesley, J.A. and K.P Reese. 1988. Avian use of campground and noncampground sites in riparian zones. *Journal of Wildlife Management* 52:399-402.
- Blancher, P.J. and R.J. Robertson. 1985. Predation in relation to spacing of Kingbird nests. *Auk* 102:654-658.
- Brown, B.T. 1988. Breeding Ecology of a Willow Flycatcher Population in Grand Canyon, AZ. *Western Birds* 19 (1):25-33.
- Brown, B.T. 1991. Status of Nesting Willow Flycatchers along the Colorado River from Glen Canyon Dam to Cardenas Creek, Arizona. Endangered Species Report No. 20 to the U.S. Fish and Wildlife Service, Phoenix, Arizona. 34 pp.
- California Department of Fish and Game. 1991. Endangered and threatened animals of California. State of California, The Resources Agency, Department of Fish and Game. Sacramento, California. 5 pp.
- DeSante, D. 1982. Nests and nest predation in landbirds. *Point Reyes Bird Observatory Bulletin* 59:1-9.
- England, A.S., Sogge, M.K. and C. van Riper III. 1988. Avian species of management concern: Mill and Deer Creek drainages, Tehama County, California. National Park Service, CPSU/UC Technical Report 33.
- Gottfried, B.M. and C.F. Thompson. 1978. Experimental analysis of nest predation in an old-field habitat. *Auk* 95:304-312.
- Harris, J.H. 1991. Effects of Brood Parasitism by Brown-headed Cowbirds on Willow Flycatcher nesting success along the Kern River, California. *Western Birds* 22 (1):13-26.
- Hunter, W.C., R.D. Ohmart, and B.W. Anderson. 1987. Status of breeding riparian-obligate birds in southwestern riverine systems. *Western Birds* 18:10-18.
- Hunter, W.C., R.D. Ohmart, and B.W. Anderson. 1988. Use of exotic saltcedar (*Tamarix chinensis*) by birds in arid riparian systems. *Condor* 90:113-123.
- Klimstra, W.D. and J.L. Roseberry. 1975. Nesting ecology of the Bobwhite in southern Illinois. *Wildlife Monographs* 41.

- New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. Santa Fe, New Mexico.
- Phillips, A.R. 1948. Geographic Variation in *Empidonax traillii*. Auk 65:507-514.
- Roseberry, J.L. and W.D. Klimstra. 1970. The nesting ecology and reproductive performance of the Eastern Meadowlark. Wilson Bull. 82:243-267.
- Rosenberg, K.V., R.D. Ohmart, W.C. Hunter, and B.W. Anderson. 1991. Birds of the lower Colorado River valley. University of Arizona Press, Tucson, Arizona.
- Sanders, S.D. and M.A. Flett. 1989. Montane riparian habitat and willow flycatchers: threats to a sensitive environment and species. USDA Forest Service General Technical Report PSW-110.
- Seutin, G. 1987. Female Song in Willow Flycatchers (*Empidonax traillii*). Auk 104: 329-330.
- Stevens, L. 1983. The Colorado River in Grand Canyon - A Guide. Red Lakes Books, Flagstaff, AZ. 115 pp.
- Stoddard, H.L. 1931. The Bobwhite Quail. Scribner's, New York.
- Taylor, D.M. 1986. Effects of Cattle Grazing on Passerine Birds Nesting in Riparian Habitats. Journal of Range Management 39:254-258.
- Unitt, P. 1987. *Empidonax traillii extimus*: An endangered subspecies. Western Birds 18(3):137-162.
- U.S. Fish and Wildlife Service. 1992. Notice of 90-day finding on a petition to list the southwestern willow flycatcher *Empidonax traillii extimus* as endangered. Federal Register 57:39664-39668 (September 1, 1992).
- Weydemeyer, W. 1973. Singing habits of Traill's Flycatcher in northwestern Montana. Wilson Bull. 85:276-282.
- Whitfield, M.J. 1990. Willow Flycatcher reproductive response to brown-headed cowbird parasitism. Masters Thesis, California State University, Chico, California. 25 pp.
- Willis, E.O. 1973. Survival rates for visited and unvisited nests of Bicolored Antbirds. Auk 90:263-267.

APPENDIX I

Summary of 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. Tape (y/n) indicates whether a tape-broadcast willow flycatcher song was used to elicit response. Flycatcher survey personnel for each patch are listed under "Observers". Surveys which detected willow flycatchers are shaded.

PATCH	DATE	TIME START	TIME STOP	METHOD	TAPE (Y/N)	OBSERVERS
(-14.5)-(-14.0) R	6/15/92	0540	0620	Land	Y	Mark Sogge, Clive Pinnock
(-14.0) R	7/20/92	0535	0555	Land	Y	Mark Sogge
(-13.8)-(-13.4) L	6/15/92	0625	0645	Both	Y	Mark Sogge, Clive Pinnock
(-13.4) L	7/20/92	0600	0610	Land	Y	Mark Sogge
(-12.7)-(-12.4) R	6/15/92	0650	0725	Land	Y	Mark Sogge, Clive Pinnock
(-12.5) R	7/20/92	0615	0655	Land	Y	Mark Sogge, Clive Pinnock
(-11.2)-(-10.8) L Ferry Swale	6/15/92	0735	0840	Land	Y	Mark Sogge, Clive Pinnock
(-11.2) L Ferry Swale	7/20/92	0705	0800	Land	Y	Mark Sogge, Clive Pinnock
(-10.2)-(-9.8) L	6/15/92	0900	0925	Land	Y	Mark Sogge, Clive Pinnock
(-8.7)-(-8.2) R	7/20/92	0905	0955	Land	Y	Mark Sogge
(-8.7) L	7/20/92	0825	0900	Land	Y	Mark Sogge
(-8.4)-(-8.1) R	7/21/92	0640	0710	Land	Y	Mark Sogge
(-7.5) L	7/21/92	0715	0730	Land	Y	Mark Sogge
(-7.2)-(-6.9) L	6/15/92	0945	1005	Land	Y	Mark Sogge, Clive Pinnock
(-7.0)-(-6.7) L	7/21/92	0740	0815	Land	Y	Mark Sogge, Clive Pinnock
(-6.5) R	7/21/92	0820	0845	Land	Y	Mark Sogge, Clive Pinnock
(-6.2) R	7/21/92	0848	0858	Land	Y	Mark Sogge
(-3.2)-(-3.7) R	7/21/92	0911	0930	Land	Y	Mark Sogge, Clive Pinnock
(-2.6)-(-2.2) L	7/21/92	0930	0945	Land	Y	Mark Sogge
0 R Paria River	6/21/92	0450	0625	Land	Y	Mark Sogge, Sid England
(-0.3)-(-0.4) R	7/19/92	0505	0625	Land	Y	Mark Sogge
Lonely Dell Ranch to Bridge at the Paria River	7/19/92	0710	0805	Land	Y	Mark Sogge

PATCH	DATE	TIME START	TIME STOP	METHOD	TAPE (Y/N)	OBSERVERS
0.9-1.2 R Paria River Beach	7/19/92	0630	0655	Land	Y	Mark Sogge
3.2-3.7 L	6/21/92	0828	0903	Land	Y	Sid England
5.0-5.2 R	6/21/92	0930	0942	Boat	Y	Sid England, Matt Johnson, Susan Sferra
5.8 R	5/29/92	1142	1148	Boat	Y	Matt Johnson
5.8-5.9 R	6/21/92	0952	1010	Both	Y	Sid England, Matt Johnson, Susan Sferra
6.3-6.9 L 7.1-7.3 R	6/21/92	1040	1122	Boat	Y	Sid England, Matt Johnson, Susan Sferra
31 R South Canyon Vasey's Paradise	6/21/92	1530	1611	Land	Y	Sid England
31.5 R	5/30/92	0520	0529	Land	Y	Mark Sogge, Matt Johnson
31.6 R	5/30/92	0511	0520	Land	Y	Mark Sogge, Matt Johnson
31.7 R	5/30/92	0503	0511	Land	Y	Mark Sogge, Matt Johnson
33.9 L	5/30/92	0750	0830	Land	Y	Mark Sogge, Matt Johnson
35.0 L	5/30/92	0845	0849	Boat	Y	Mark Sogge, Matt Johnson
37.1 L	5/30/92	0906	0913	Boat	Y	Matt Johnson
38.5 L	5/30/92	0925	1018	Land	Y	Mark Sogge, Matt Johnson
38.5 L	6/21/92	1729	1742	Boat	Y	Sid England, Matt Johnson, Susan Sferra
38.7 L	6/21/92	1744	1752	Boat	Y	Sid England, Matt Johnson, Susan Sferra
38.9-40.7 R	6/21/92	1759	1817	Boat	Y	Sid England, Matt Johnson, Susan Sferra
40.0-40.8 R Upriver from Buckfarm	6/22/92	0515	0640	Land	Y	Matt Johnson, Susan Sferra
40.8-40.0 R Upriver from Buckfarm	6/22/92	0645	0711	Boat	Y	Matt Johnson, Susan Sferra
40.8 L	6/22/92	0715	0727	Land	Y	Matt Johnson
40.8 L	6/22/92	0715	0727	Boat	N	Susan Sferra
41.0-42.0 R Buckthorn Canyon	6/22/92	0509	0840	Land	Y	Sid England
41.5-42.5 L	6/22/92	0850	1110	Land	Y	Matt Johnson
42.1 R	6/22/92	0842	0855	Land	Y	Susan Sferra, Helen Yard
42.3-43.0 R	6/22/92	0915	1045	Boat	Y	Sid England, Susan Sferra
46.0 R From Triple Alcoves upriver 1 km	6/1/92	0445	0615	Land	Y	Mark Sogge
46.4 R	5/31/92	0500	0800	Land	Y	Matt Johnson
46.4 L	5/31/92	0900	1000	Land	Y	Matt Johnson
45.0-46.7 L	6/23/92	0545	0905	Land	Y	Susan Sferra
45.4-46.7 R	6/23/92	0530	0735	Land	Y	Matt Johnson

	DATE	TIME START	TIME STOP	METHOD	TAPE (Y/N)	OBSERVERS
46.7-45.7 R	6/22/92	1820	1950	Land	Y	Matt Johnson
46.8 R Triple Alcoves	5/31/92	0455 0820	0525 0845	Land	Y	Mark Sogge
46.8 R Triple Alcoves	6/1/92	0445	0615	Land	Y	Matt Johnson
46.7-48.1 R Triple Alcoves - Saddle Cyn	6/22/92	1817	1920	Land	Y	Sid England, Susan Sferra
46.7-48.5 R Triple Alcoves - Saddle Cyn	6/23/92	0514	0855	Land	Y	Sid England
46.7-46.8 R	6/23/92	0800	0915	Land	Y	Matt Johnson
47.0 R	5/31/92	0530 0810	0540 0820	Land	Y	Mark Sogge
47.2 R Saddle Cyn	6/1/92	0540	0805	Land	Y	Mark Sogge
48.6-49.2 R	6/23/92	0915	1010	Land	Y	Sid England
49.5 R	6/23/92	1210	1245	Land	Y	Matt Johnson, Susan Sferra
49.5-51.0 L	6/25/92	0530	0845	Land	Y	Matt Johnson
50.2-49.8 R	6/23/92	1852	2005	Land	Y	Sid England
50.7-48.7 L	6/2/92	0500	0950	Land	Y	Mark Sogge
50.7-49.8 L	6/1/92	1835	1940	Land	N	Mark Sogge
49.8-50.2 R	6/24/92	0535	0651	Land	Y	Sid England, Helen Yard
50.0-50.2 L	6/23/92	1747	1845	Land	Y	Susan Sferra
50.0-51.0 L	6/24/92	0502	1003	Land	Y	Susan Sferra
50.2-50.6 L	6/23/92	1850	1955	Land	Y	Matt Johnson
50.5 L	6/2/92	0500	0750	Land	Y	Matt Johnson
50.5 R	6/2/92	1840	1918	Boat	Y	Mark Sogge, Matt Johnson
50.6 L	6/1/92	0640	0700	Boat	Y	Matt Johnson
50.6 L	6/1/92	0700	0810	Land	Y	Matt Johnson
50.7-51.7 L	6/3/92	0505	0535	Boat	Y	Mark Sogge
51.7-50.8 L	6/3/92	0540	0800	Land	Y	Mark Sogge
51.7-50.8 L	6/3/92	0840	0905	Boat	N	Mark Sogge
51.0 L	6/2/92	0450	0520	Boat	Y	Matt Johnson
51.0 L	6/2/92	0530	0900	Land	Y	Matt Johnson
50.0-51.7 L	6/24/92	0700	0954	Boat	Y	Sid England
50.9-52.0 L	6/24/92	0510	0935	Land	Y	Matt Johnson
53.7-55.6 L	6/4/92	0530	0815	Land	Y	Mark Sogge
53.7-55.7 R and L	6/3/92	1840	1930	Boat	Y	Mark Sogge
53.7-55.9 R	6/4/92	0530	0900	Land	Y	Matt Johnson

PATCH	DATE	TIME START	TIME STOP	METHOD	TAPE (Y/N)	OBSERVERS
53.8-54.5 L	6/26/92	0541	0645	Boat	Y	Sid England, Susan Sferra
53.9-54.5 R	6/26/92	0540	0630	Land	Y	Matt Johnson
54.6-54.9 R	6/26/92	0650	0702	Boat	Y	Matt Johnson, Sid England
54.7-55.0 L	6/26/92	0702	0716	Boat	Y	Matt Johnson, Sid England
54.9 L	6/26/92	0602	0725	Land	Y	Susan Sferra
55.3-55.0 L	6/25/92	1900	1957	Land	Y	Sid England
55.1 L	6/26/92	0732	0848	Land	Y	Susan Sferra
55.0-55.3 R	6/25/92	1912	2000	Land	Y	Susan Sferra
55.3-55.8 R	6/26/92	0740	0920	Land	Y	Matt Johnson
55.4-55.9 L	6/26/92	0739	0927	Land	Y	Sid England
55.8 R	6/3/92	0625	0745	Land	Y	Matt Johnson
55.8-55.3 R	6/25/92	1845	1955	Land	Y	Matt Johnson
56.9 L	6/26/92	1020	1029	Boat	Y	Matt Johnson, Sid England, Susan Sferra
58.3 R	6/26/92	1040	1048	Boat	Y	Matt Johnson, Sid England, Susan Sferra
58.5 L	6/26/92	1054	1107	Boat	Y	Matt Johnson, Sid England, Susan Sferra
60.8 R	6/27/92	0515	0535	Land	Y	Matt Johnson
61.8 R	6/27/92	0615	0620	Boat	Y	Matt Johnson
63.8-64.0 L	6/27/92	0655	0715	Boat	Y	Matt Johnson, Sid England
64.2 L	6/27/92	0718	0730	Boat	Y	Matt Johnson
64.8-65.4 L	6/27/92	0743	0830	Both	Y	Matt Johnson, Sid England, Susan Sferra
66.8-67.2 L	6/27/92	0840	0925	Both	Y	Matt Johnson, Sid England, Susan Sferra
67.8-68.0 L	6/27/92	0938	1033	Land	Y	Matt Johnson
68.5-72.5 L Cardenas Marsh	6/5/92	0600	1030	Land	N	Mark Sogge
70.8 L Cardenas	6/5/92	0600	0745	Land	Y	Matt Johnson
71.0-70.7 L Cardenas	6/28/92	0520	0715	Land	Y	Sid England
70.8 L Cardenas	7/27/92	0930	1700	Land	Y	Mark Sogge, Matt Johnson
87.5 R Bright Angel Creek	5/16/92	1230	1500	Land	Y	Charles Drost, Doree Stonebreaker, John Weisheit
98 R Crystal Creek	5/16/92	1715	1745	Land	Y	Charles Drost
98 R Crystal Creek	6/13/92	1715	1935	Land	Y	Tim Tibbitts, Laura Ellison
98 R Crystal Creek	6/14/92	0440	0725	Land	Y	Tim Tibbitts, Laura Ellison
108.3 R Bass Camp	6/14/92	1100	1200	Land	Y	Tim Tibbitts, Laura Ellison

PATCH	DATE	TIME START	TIME STOP	METHOD	TAPE (Y/N)	OBSERVERS
108.6 R Shinumo Cyn	5/17/92	0545	0730	Land	Y	Charles Drost
108.7 R Lower Shinumo Canyon	6/14/92	1735	1900	Land	Y	Tim Tibbitts, Laura Ellison
108.7 R Upper Shinumo Creek	6/15/92	0530	0635	Land	Y	Tim Tibbitts, Laura Ellison
108.7 R Lower Shinumo Creek	6/15/92	0635	0750	Land	Y	Tim Tibbitts, Laura Ellison
116.6 L Elve's Chasm	5/17/92	1130	1300	Land	Y	Charles Drost
116.5 L Elve's Chasm	6/15/92	0900	1030	Land	Y	Tim Tibbitts, Laura Ellison
119.5 L	5/17/92	1500	1545	Land	Y	Charles Drost
119.7 L	5/17/92	1550	1610	Both	Y	Charles Drost, John Weisheit
122.7 L Forster Cyn	5/18/92	0545	0750	Land	Y	Charles Drost
123 L Forster Cyn	6/15/92	1100	1200	Land	Y	Tim Tibbitts, Laura Ellison
125 L Fossil Cyn	5/18/92	0945	1005	Both	Y	Charles Drost, John Weisheit
125.3 L Below Fossil Canyon	5/18/92	1015	1050	Land	Y	Charles Drost
131.7 R Galloway Cyn	5/18/92	1235	1415	Land	Y	Charles Drost
133.7 R Tapeats Creek	5/19/92	0545	1330	Land	Y	Charles Drost, John Weisheit, Doree Stonebreaker
133.8 R Tapeats Creek (lower part)	5/18/92	0625	0725	Land	Y	Charles Drost
133.8 R Upper Tapeats	6/15/92	1640	1855	Land	Y	Tim Tibbitts, Laura Ellison
133.8 R Lower Tapeats	6/16/92	0500	0630	Land	Y	Tim Tibbitts, Laura Ellison
136.2 R Deer Creek	5/20/92	0830	0915	Land	Y	Charles Drost
136.2 R Deer Creek	5/20/92	0930	1045	Land	Y	Charles Drost
143.4 R Kanab Creek	5/20/92	1300	1500	Land	Y	Charles Drost
143 L and R	5/20/92	1215	1225	Boat	Y	Charles Drost, John Weisheit
143.5 R Kanab Creek	6/16/92	0830	0930	Land	Y	Tim Tibbitts, Laura Ellison
166.5 L National Cyn	5/21/92	0610	0820	Land	Y	Charles Drost

PATCH	DATE	TIME START	TIME STOP	METHOD	TAPE (Y/N)	OBSERVERS
168 R Fern Glen	5/21/92	1145	1245	Both	Y	Charles Drost
168-169 R Vicinity of Mohawk Cyn	6/16/92	1740	1850	Land	Y	Tim Tibbitts
169.5-171 L Mohawk Cyn	6/16/92	1700	2000	Land	Y	Laura Ellison
169.5-171 L Above Mohawk Canyon	6/16/92	1855	1905	Land	Y	Tim Tibbitts
169.5-170 R Mohawk Canyon	6/17/92	0445	0650	Land	Y	Tim Tibbitts, Laura Ellison
171.5 L Mohawk Canyon	6/17/92	0719	0803	Land	Y	Laura Ellison
179.3 L Prospect Cyn	5/22/92	0545	0945	Land	Y	Charles Drost
179.3 L Warm Springs	5/22/92	0925	0950	Land	Y	Charles Drost
177.7 L Lava Falls/ Prospect Cyn	6/17/92	0950	1030	Land	Y	Tim Tibbitts, Laura Ellison
179.4 L Lava/Prospect	6/17/92	1700	1830	Land	Y	Tim Tibbitts, Laura Ellison
179.4 L Lava/Prospect	6/18/92	0445	0623	Land	Y	Tim Tibbitts, Laura Ellison
183.4 L Beecher Springs	5/22/92	1130	1315	Land	Y	Charles Drost
183.5 L Beecher Springs	6/18/92	0725	0835	Land	Y	Tim Tibbitts, Laura Ellison
187 R Whitmore Trail	5/22/92	1430	1530	Land	Y	Charles Drost
188 R Whitmore Wash	6/18/92	1005	1200	Land	Y	Laura Ellison
187.5-188 R Whitmore Wash	6/18/92	1000	1210	Land	Y	Tim Tibbitts
191.1 R	6/18/92	1710	1835	Land	Y	Tim Tibbitts
191.5-192 L	6/18/92	1700	1930	Land	Y	Laura Ellison
191.2 R	6/19/92	0505	0915	Land	Y	Tim Tibbitts, Laura Ellison
193.3 L	6/19/92	1115	1210	Land	Y	Tim Tibbitts, Laura Ellison
194 L	5/23/92	0530	0730	Land	Y	Charles Drost
196 R	5/23/92	0800	0900	Both	Y	Charles Drost, John Weisheit
195.5-196 R	6/19/92	1720	1930	Land	Y	Laura Ellison
196-196.4 R	6/19/92	1730	1930	Land	Y	Tim Tibbitts
196-196.4 R	6/20/92	0450	0630	Land	Y	Tim Tibbitts, Laura Ellison
196.5-198 R&L	5/23/92	0905	0945	Boat	Y	Charles Drost, John Weisheit

PATCH	DATE	TIME START	TIME STOP	METHOD	TAPE (Y/N)	OBSERVERS
197-198 L Parashant Cyn	5/23/92	0950	1230	Both	Y	Charles Drost, John Weisheit
197.5-198 R Above Parashant	6/20/92	0745	0900	Land	Y	Laura Ellison
198.5 R Parashant Cyn	5/23/92	1630	1830	Land	Y	Charles Drost
198.5-197 R Parashant Cyn	5/24/92	0600	0945	Land	Y	Charles Drost
198-198.5 L Parashant	6/20/92	0745	0850	Land	Y	Tim Tibbitts
198.5-204.3 Both R and L	5/24/92	1035	1220	Boat	Y	Charles Drost, John Weisheit
202 L	5/24/92	1125	1145	Land	Y	Charles Drost
204.3 R Spring Canyon	5/24/92	1220	1420	Land	Y	Charles Drost, John Weisheit
204.4 R Spring Canyon	6/20/92	1710	1930	Land	Y	Laura Ellison
204.4 R Spring Canyon	6/21/92	0446	0645	Land	Y	Tim Tibbitts, Laura Ellison
204.8-205 L Below Spring Canyon	6/21/92	0715	0900	Boat	Y	Tim Tibbitts, Laura Ellison
208.6 L Granite Park	5/24/92	1830	2000	Land	Y	Charles Drost
208.6 L Granite Park	5/25/92	0515	0830	Land	Y	Charles Drost
208.8 L Granite Park	6/21/92	0910	1015	Land	Y	Tim Tibbitts, Laura Ellison
213.3 L Marsh below Pumpkin Springs	5/25/92	1110	1140	Land	Y	Charles Drost
215.6 L Three Springs Canyon	5/25/92	1210	1610	Land	Y	Charles Drost
215.5 L Three Springs Canyon	6/21/92	1725	1930	Land	Y	Tim Tibbitts, Laura Ellison
215.6 R Three Springs	5/26/92	0545	0700	Land	Y	Charles Drost
219.2 R Trail Canyon	5/26/92	0900	1130	Land	Y	Charles Drost
225.7 L Diamond Creek	5/27/92	0630	0900	Land	Y	Charles Drost
259.4-259.9 L	6/26/92	0505	0540	Both	Y	Mark Sogge
259.6 R	6/26/92	0430	0730	Land	Y	Tim Tibbitts
260.1 L Quartermaster Canyon	6/26/92	0545	0645	Land	Y	Mark Sogge

APPENDIX II

List of Willow Flycatcher Survey Personnel.

Clay Bravo, Wildlife Management Department, Hualapai Tribe
Charles Drost, National Park Service CPSU/U.C.Davis
Laura Ellison, National Park Service CPSU/NAU, Flagstaff
A. Sidney England, University of California, Davis
Matthew Johnson, National Park Service CPSU/NAU, Flagstaff
Clive Pinnock, Glen Canyon National Recreation Area
Susan Sferra, Nongame Branch, Az Game and Fish Department
Mark Sogge, National Park Service CPSU/N.A.U., Flagstaff
Tim Tibbitts, U.S. Fish and Wildlife Service, Phoenix
Helen Yard, Glen Canyon Environmental Studies

APPENDIX III

The following four pages show data sheets used during this study.

GRAND CANYON BIRD DATA

Patch: _____ Date: _____ % Wind: _____ mph Observers: _____ Time Start: _____ Time Stop: _____ Temp: _____ °C

Cloud Cover: _____ Method: BOAT LAND BOTH

BIRD	POPULATION SIZE (in/out)				BREEDING BEHAVIOR (in only)						COMMENTS			
	Pr	♂	♀	Imm	YY	Unk	Shg	Terr Aggr	Court	Nest Bldg		Food Carry	Nest Found	Feed Pldg
YBCU														
BCHU														
LBWO														
WFL														
BLPH														
AITL														
BCFL														
WEKI														
BEWR														
BGGN														
NOMO														
PHAI														
EUST														
BEVI														
LUMA														
YEMA														
COYE														
YBCH														
SUTA														
BLGR														
LARU														
IRBU														
SOSP														
BHCO														
HOOR														
NOOR														
HOFI														
LEGO														

Appendix III - continued

Willow Flycatcher Sighting Form

Date: _____ Observer(s): _____

Patch: _____ Time: _____

Sighting #: _____ Temp: _____ Wind: _____

Detected Before Playback? _____ Responded to Playback? _____

Type of Initial Detection: Visual / Aural / Both

Fill out song rate data sheet if appropriate

Number of Birds Detected in this "Territory": _____

Sexes (if known) _____ Young of Year ? _____

Degree of Certainty of Species ID: Absolute / Probable / Possible

Describe Quality of Detection (how far/long seen, lighting, etc):

Describe Bird's Behavior (how utilizing habitat):

General Habitat Description: _____

Nest Found ? (If yes, fill out nest data sheet) : _____

Cowbirds in Area? _____ How Many?: _____

Describe Behavior of Cowbirds: _____

Describe Willow Flycatcher Response to Cowbirds: _____

Comments: _____

Make a sketch of the area (using the back of this form or an aerial photo) to show location of patch, key landmarks, general vegetative characteristics, Willow Flycatcher location/movements, nest site, etc.

Appendix III - continued

Willow Flycatcher Nest Site Data Form

Date: _____ Observer(s): _____

Patch : _____ Sighting #: _____

Number of Birds Observed in this "territory": _____

How Was Nest Found?: _____

Nest Fully Constructed? _____

If not, describe state of construction: _____

Number of Eggs: WIFL _____ BHCO _____

Number of Young: WIFL _____ BHCO _____

Age of Young (describe): _____

Description of Nest Location (draw sketch on back or indicate on aerial photo: _____

General Description of Nest Habitat: _____

Nest Substrate (plant species): _____

If the nest is still active, estimate the following from a distance, being careful to avoid disturbance to the nest. If the nest is no longer active, measure accurately using a meter tape and meter stick.

Nest Hght (m): _____ Substrate Hght: _____ Veg. Height: _____

Nest Azimuth (relative to center of substrate): _____ (deg.)

Distance From Nest to:

Substrate Center: _____ Canopy Top: _____ Substrate Edge: _____

Nearest Edge of Veg Type: _____ Nearest Edge of Patch: _____

River: _____ Other Water: _____ Describe: _____

Are the above measurements estimated _____ or measured _____?

Were photos taken of the nest or nesting habitat? _____