Status of the Southwestern Willow Flycatcher along the Colorado River between Glen Canyon Dam and Lake Mead

- 1993 -

Summary Report

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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) 277), and in the lower sections of selected tributaries. 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 13 willow flycatchers - six unpaired individuals, one possible non-breeding pair, one breeding pair, and what appeared to be one male with two breeding females. The unpaired individuals were detected at RM -8.8 Left (L), RM 46.5 Right (R) (Saddle Canyon/Triple Alcoves), RM 71.0 L (Cardenas), RM 260.1 L (Quartermaster) and RM 276.7 R [Lees Ferry = RM 0]. The unpaired birds at Cardenas and RM 276.7 may have been unsuccessfully attempting to find mates, in that they were detected at the same site on more than one day. The remaining unpaired flycatchers were probably migrants, but may have been unpaired summer residents. Breeding activity occurred at RM 50.5 L and RM 71 L (Cardenas Marsh). Brown-headed cowbirds (*Molothrus ater*) parasitized each of the three active flycatcher nests that we found, and as a result no willow flycatcher young were produced. The number of southwestern willow flycatchers along the Colorado River corridor in Grand Canyon National Park and Glen Canyon National Recreation Area remains very low. With continued cowbird-induced breeding failure, 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.

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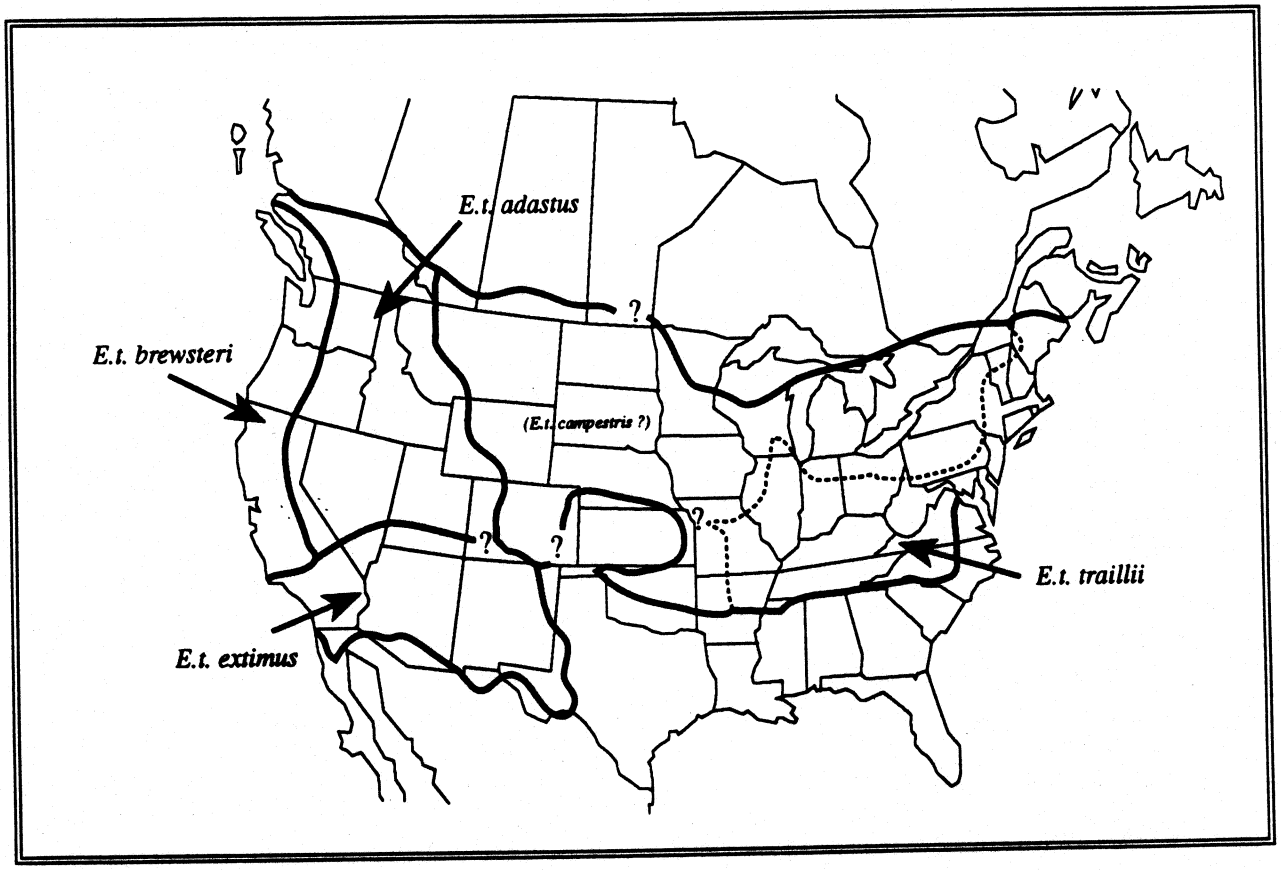
ACKNOWLEDGEMENTS

This project would not have been possible without the cooperation of many persons and many agencies. Logistical support was provided by Grand Canyon National Park, Glen Canyon National Recreation Area, the NPS Cooperative Park Studies Unit at Northern Arizona University (CPSU/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 trip safe, enjoyable, and more productive. Assistance from Grand Canyon National Park and Glen Canyon National Recreation Area resource management staff, particularly John Ray (GRCA) and Clive Pinnock (GLCA), was vital to the project. The flycatcher surveyors (see Appendix II) 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 Dave Krueper, Matthew Johnson, James Sedgwick, Reed Tollefson, and Brad Valentine, who took time out from very busy schedules to lend their expertise and efforts at no cost. Lawrence Abbott contributed his dedication, skill, and good humor to many miles of survey. We also want to express our gratitude to the Grand Canyon river guides and rafting company staff, who were understanding and supportive of our research and conservation efforts (including beach closures). These guides and staff played a vital role in the conservation of this species by interpreting the story of the willow flycatcher and its plight to the many park visitors boating the canyon.

INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*) is one of several distinct, recognized subspecies of the willow flycatcher (Unitt 1987, Browning 1993), a species that breed across much of North America (Figure 1). A riparian obligate species, the flycatcher nests in cottonwood-willow associations or similar riparian communities. 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; USFWS 1993).

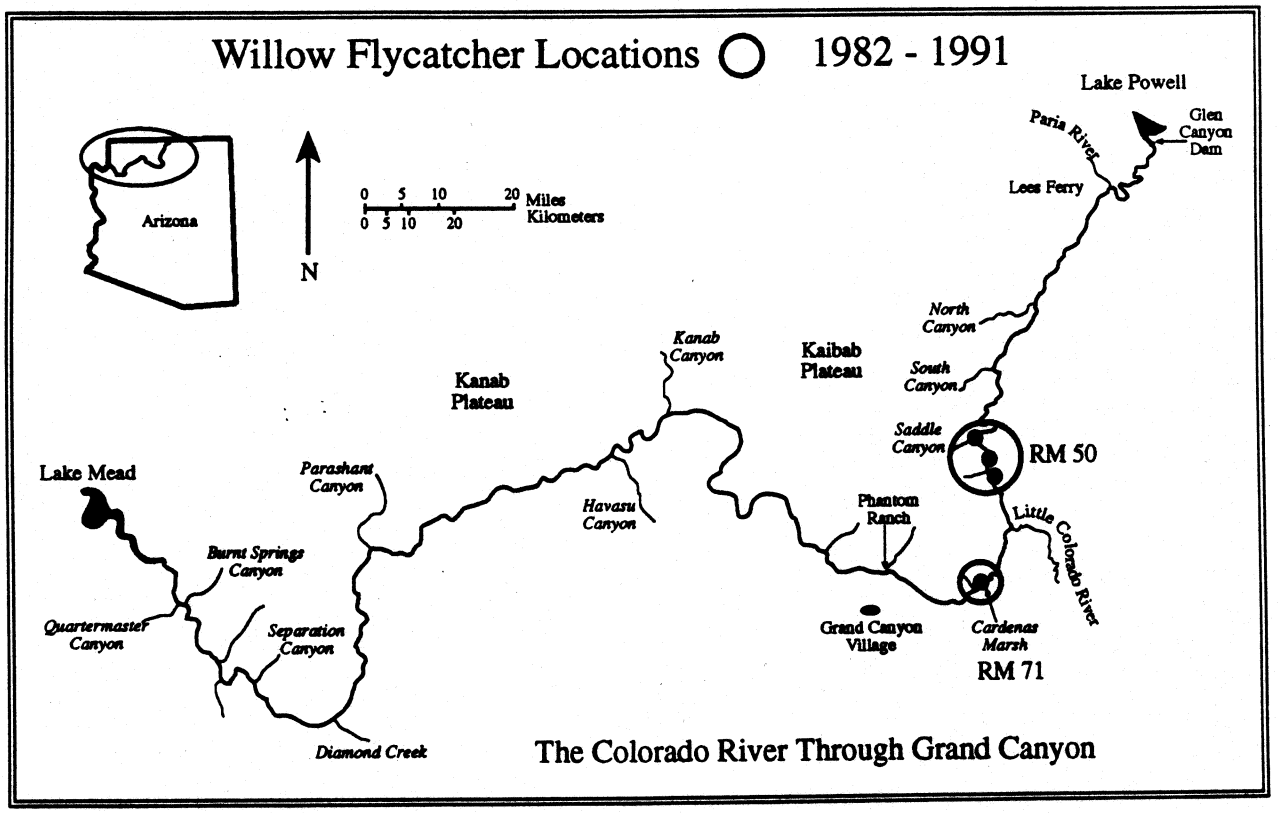
Figure 1. Breeding ranges of willow flycatcher (*Empidonax traillii*) subspecies. Modified from Browning (1993), who supported designation of distinct *E.t. campestris* (north and west of the dotted line in *E.t. traillii* range).



The southwestern willow flycatcher is a U.S. Fish and Wildlife Service (USFWS) candidate category 1 species (USFWS 1991). The USFWS proposed to list the subspecies as endangered (USFWS 1993). A final listing decision is anticipated by spring 1994. 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 were known to support nesting southwestern willow flycatchers. Of these, Grand Canyon National Park contained the greatest known number 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), clustered primarily in two areas along the river corridor (Figure 2). However, even this small breeding population has apparently declined in recent years, to only two breeding pairs in 1991 (Brown 1991) and one pair in 1992 (Sogge and Tibbitts 1992).

Figure 2. Locations on the Colorado River, Arizona (circled) where willow flycatcher were detected from 1982-1991 (based on Brown 1991).



To continue monitoring the status and distribution of southwestern willow flycatchers along the Colorado River corridor, 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 supported additional surveys in 1993. 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 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, including habitat patch size and vegetation parameters.
4. Survey additional habitat, beyond that covered in previous surveys.
5. Utilize a standardized technique designed to maximize the likelihood of detection of breeding willow flycatchers.

This report is based on the results of willow flycatcher surveys conducted during the 1993 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 1994 and 1995. Therefore, this document is 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 year's data.

METHODS

We determined willow flycatcher presence by sightings and song detections made primarily from 0530 to 1100 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). In order to maximize the likelihood of detecting willow flycatchers, surveyors broadcast (from hand-held tape recorders) taped songs of willow flycatchers, a proven method for eliciting a vocal response from nearby resident flycatchers (Seutin 1987, Sogge and Tibbitts 1992, Tibbitts and Sogge 1993). 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, 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 conducted surveys throughout the Colorado River corridor from Glen Canyon Dam downstream to Lake Mead (RM 277: river mile designations based on Stevens 1983), emphasizing the areas identified as potential willow flycatchers breeding sites: Saddle Canyon to Kwagunt Creek, and Cardenas Marsh (Brown 1988, 1991; Sogge and Tibbitts 1992).

We recorded all locations of singing/territorial willow flycatchers, and intensely observed flycatchers to locate nesting activity. 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 survey 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 telescoping mirror to eliminate a human scent trail directly to the nest and avoid other potential disturbance.

To assess the threat of cowbird parasitism, observers recorded the presence of cowbirds at all surveyed patches, and noted cowbird behavior and any willow flycatcher response.

RESULTS

Survey Effort

We surveyed 164 habitat patches during a total of 246.5 survey hours (Table 1) between 24 May and 21 July. We conducted most surveys 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. Total surveys and survey hours conducted during 1993 southwestern willow flycatcher survey effort in Grand Canyon National Park and Glen Canyon National Recreation Area, Arizona. Type refers to whether the surveys were conducted by walking adjacent to or through the habitat (Land), floating past in a boat or kayak (Boat), or a combination of these (Both).

	TIME SURVEY CONDUCTED						TOTAL	
	Before 1000 hours		1000-1600 hours		After 1600 hours			
TYPE	# surveys	# hours	# surveys	# hours	# surveys	# hours	# surveys	# hours
Land	144	163.8	13	10.3	24	27.3	181	201.4
Boat	66	24.2	5	0.8	6	1.9	77	26.9
Both	18	17.4	0	0.0	1	0.8	19	18.2
TOTAL	228	205.4	18	11.1	31	30.0	277	246.5

Willow Flycatcher Detections

We detected willow flycatchers at seven sites along the river corridor (Figure 3). In total, we found 13 willow flycatchers - six unpaired individuals, one possible non-breeding pair, one breeding pair, and what appeared to be one male with two breeding females (Table 2). The unpaired individuals were detected in at RM -8.8 L, RM 46.5 R (Saddle Canyon/Triple Alcoves), RM 71.0 L (Cardenas), RM 260.1 L (Quartermaster) and RM 276.7 R. We believe the unpaired individuals at Cardenas and RM 276.7 may have been unsuccessfully attempting to find mates, because they were detected at the same site on more than one day. The remaining unpaired flycatchers were detected only once and were probably migrants. Willow flycatchers bred only at RM 50.5 L and RM 71 L (Cardenas Marsh). Details of each detection are presented below, listed by site in river mile sequence.

Figure 3. Sites (circled) where willow flycatchers were detected along the Colorado River, Arizona, 1993.

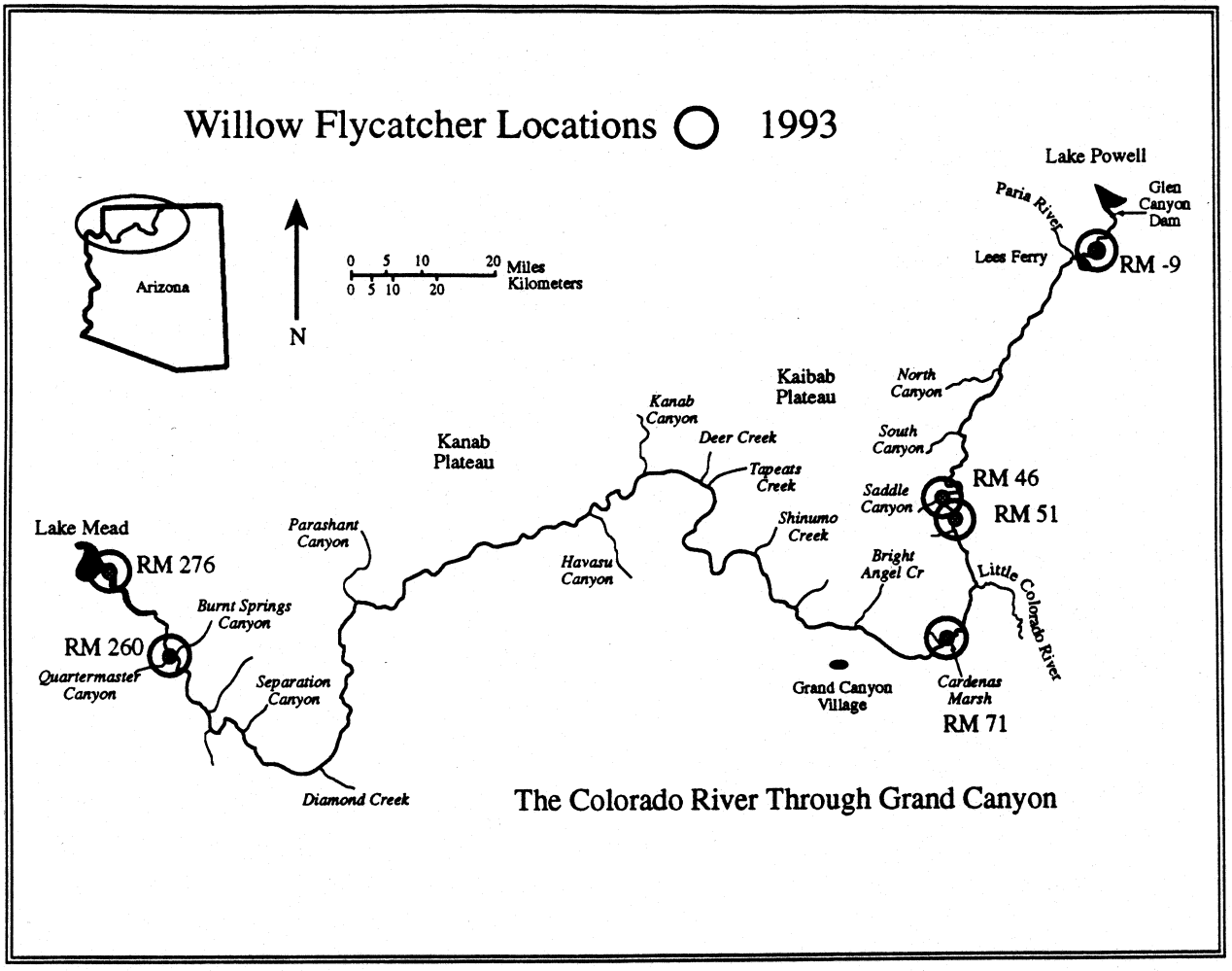


Table 2. Summary of 1993 willow flycatcher detections along the Colorado River in Grand Canyon National Park and Glen Canyon National Recreation Area, Arizona.

SITE	Date	Number Singing Males	Total Birds Detected	Cowbirds Present	Site Elevation (m)	Nest Found ?	Comments
#1 RM -9 L	7 June	0	2	Yes	1010	No	Observed together 7 June, but not found 8 June. Possible non-breeding pair. May be birds from RM -8.8.
#2 RM -8.8 R	8 June	1	1	Yes	1010	No	Singing bird detected 19 May, nonvocal bird on 8 June. May be a bird from RM -9.
#3 RM 46.5 R	10 June	0	1	Yes	910	No	Both captured separately in mist nets during avian monitoring project. None detected at this site during 5 days of flycatcher surveys. Possible migrants or non-breeding residents.
Saddle Cyn	9 July	0	1	Yes			
#4 RM 50.5 L	30 May	1	1	Yes	910	Yes	Located Nest #1.
	31 May	1	3	Yes			One pair plus 3rd bird of unknown gender.
	11 June	1	2	Yes		Yes	Nest #1 with cowbird chick
	18 June	1	2	Yes		Yes	Discovered Nest #2 with cowbird chick. Only 1 male ever detected. Possible polygyny?
	30 June	0	2	Yes			Two flycatchers seen feeding fledgling cowbird.
#5 RM 71.0 L	16 May	1	1	No	850	No	Singing male detected by avian monitoring crew.
Cardenas Marsh	2 June	2	3	Yes		Yes	One pair with nest (no eggs), and 1 adjacent unpaired singing male.
	3 June	2	3	Yes		Yes	Same as above, 1 egg in nest.
	12 June	2	3	Yes		Yes	Nest now has 3 eggs.
	19 June	1	2	Yes		Yes	Pair feeding nestling (possible cowbird). Unpaired male gone.
	30 June	1	1			Yes	Singing male only. Nest abandoned, with unhatched cowbird egg remaining in nest.
#6 RM 260.1 L	28 May	1	1	Yes	325	No	Male responded to tape playback twice 28 May, but not detected on 29 and 31 May, or 13 and 14 June. Probable migrant.
Quartermaster Cyn							
#7 RM 276.7 R	17 May	1	1	No	325	No	Male singing for 2 days. Not detected on 8 July, therefore probable unpaired male.
	18 May	1	1	Yes		No	
TOTAL		6 singing males	13 total birds			3 nests	5 resident, breeding birds. Breeding activity at only two sites. Three nests, but no flycatcher young fledged. Remainder probably non-breeding, unpaired, or migrant birds.

Site #1: Refer to Figures 4, 5, and 6.

Location: RM -9; 7 June 1993; 1115 hrs

Habitat: A small wetland area with cattails. Dense tamarisk in wet area. Some tall (4-6 m high) Goodding's willow (*Salix gooddingii*) behind marsh.

A single willow flycatcher responded to a tape broadcast call by flying into view, perching and foraging. Surveyors observed the bird from about 10 m away, in good light, for several minutes. While this bird was under observation, another flycatcher gave *whitt* calls from the vegetation directly behind. When surveyors entered the vegetation to look for nests, both flycatchers were observed together and continued *whitting*. Neither bird sang during our observation period, therefore we can not absolutely confirm identification as willow flycatchers. However, both birds had field marks characteristic of, and made *whitt* calls similar to, willow flycatchers. Therefore, we believe the birds to be willow flycatchers. We found no evidence of a nest or breeding activity.

The birds were not detected during a survey on the following day (8 June), despite several hours of observation. Due to mechanical difficulties with park boats, and scheduling conflicts with other park activities, we were unable to visit to this site again until 21 July, at which time we found no willow flycatchers.

Although it is possible that these birds were of the migrant races (*Empidonax traillii brewsteri* or *E. t. adastus*), these races have usually passed through the Grand Canyon before this date (Unit 1987), thus we believe these birds were probably *E. t. extimus*. In addition, these birds showed no aggression to each other, suggesting they may have been a pair (willow flycatchers are usually aggressive, and do not pair or travel together during migration). Unfortunately, because subsequent visits to the site were delayed, we can not be certain of taxonomic, residence, or breeding status of these two birds.

Figure 4. Topographic map of willow flycatcher Sites #1 (River Mile -9 L) and #2 (RM -8.8 R), along the Colorado River, Arizona. Locations of flycatcher sightings are circled. Base map is Lee's Ferry to Glen Canyon Dam, by Catch and Release Calendars.

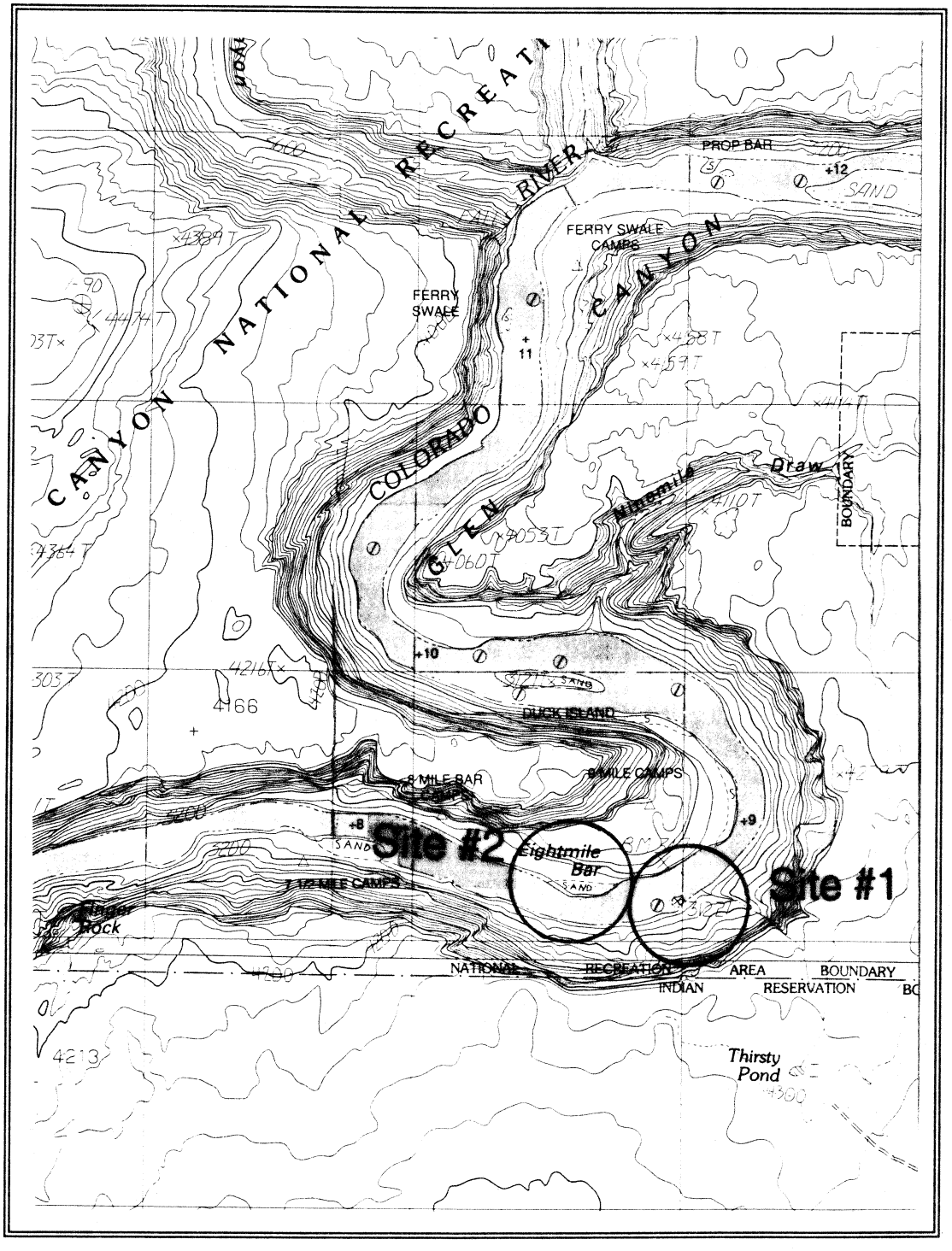


Figure 5. Aerial photograph of willow flycatcher Sites #1 (River Mile -9 L) and #2 (RM -8.8 R, Colorado River, Arizona). Locations of flycatcher sightings are circled. River flow is from page bottom to top.

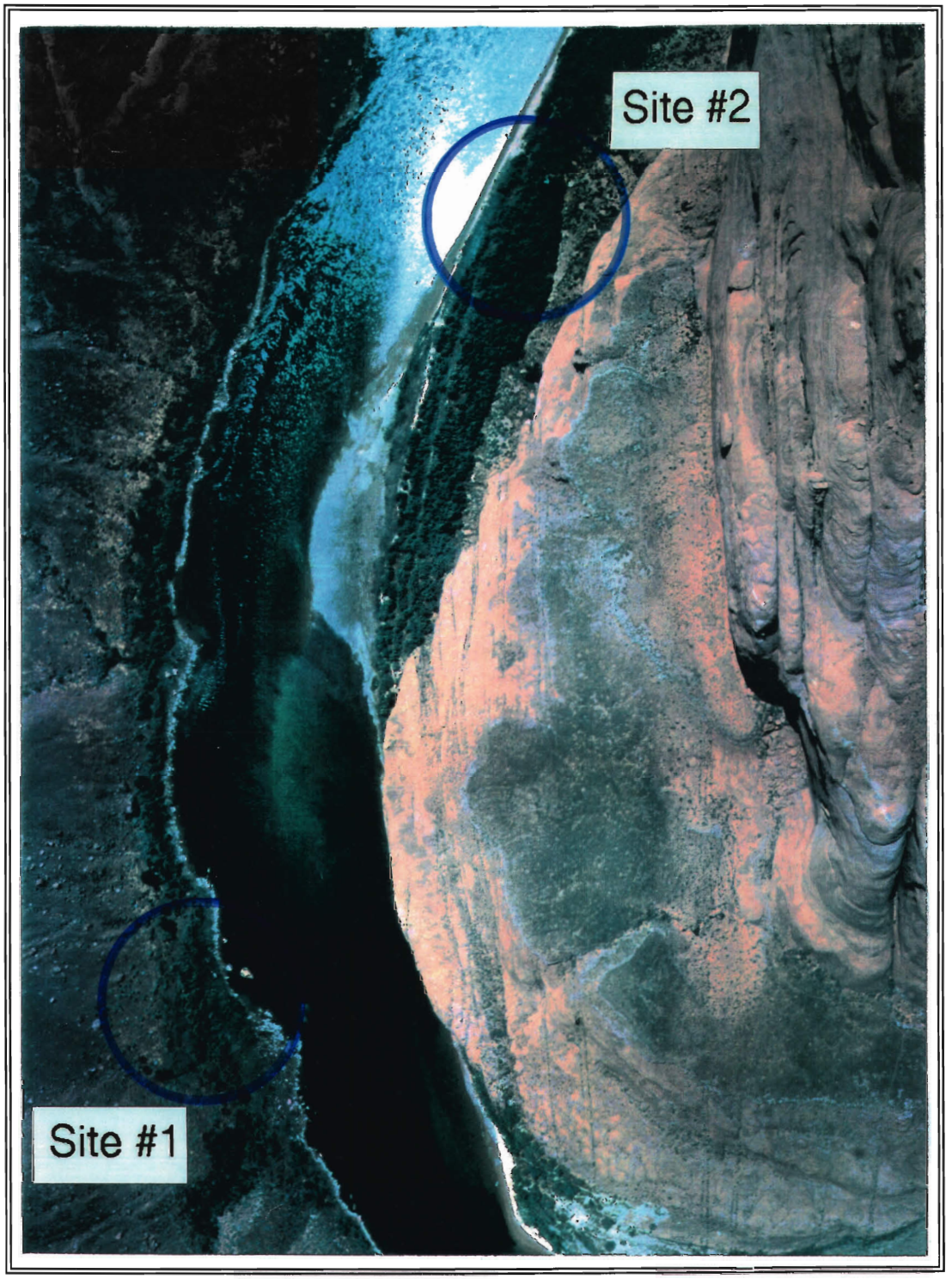


Figure 6. Photograph of willow flycatcher Site #1 (River Mile -9 L, Colorado River, Arizona). View is of upstream end of habitat patch, looking south.

Site #2: Refer to Figures 4 and 5.

Location: RM -8.8 L; 8 June 1993; 0900 hrs

Habitat: Tamarisk patch with seep-willow (*Baccharis spp.*) along river's edge.

Clive Pinnock (Glen Canyon National Recreation Area) first detected a singing (presumed male) willow flycatcher at this sight on 19 May, during the park's annual breeding bird surveys. The flycatcher *fitz-bewed* three or four times from dense tamarisk, then flew upriver when approached. Clive did not find any flycatchers during his next breeding bird survey at the site on 2 June.

However, on 8 June an *Empidonax* flycatcher flew toward surveyors in response to a broadcast willow flycatcher song. The bird perched near the observers, then flew into dense vegetation and was not seen again. We could not conduct a follow-up visit to this site until 21 July (for reasons explained under Site #1), at which time we detected no flycatchers. The flycatcher did not vocalize, and because visual confirmation of willow flycatchers is difficult, we can not absolutely confirm its identification. However, the bird was observed at close range (less than 3 m), in good light, and bore all usual field marks of a willow flycatcher. Its attraction to the tape-broadcast song supports this identification, and its presence when migrant flycatchers should not be present strongly suggests that it was *E. t. extimus*.

It is possible that a male willow flycatcher may have been resident at the site, since there are multiple sightings at this location (although no flycatcher was detected here during the second general bird survey). The bird(s) detected here may also have been one of the same individuals detected on 9 June at RM -9 L. Given that none of the birds along the river were color-banded, it is impossible to be certain of the resident status or individual identity of birds detected here. We describe this detection separately from the RM -9 site, but can make no firm judgement as to resident status or whether it is the same, or a different, bird as at RM -9.

Site #3: Refer to Figures 7, 8 and 9

Location: RM 46.5 R (Saddle Canyon); 10 June 1993; 0830 hrs
9 July 1993; 0830 hrs

Habitat: Dense tall tamarisk patch, with scattered short willow and narrow strip of wetland/horsetail along river's edge.

Saddle Canyon/Triple Alcoves is one of four major study sites where mist-netting is conducted as part of an on-going Grand Canyon avian community monitoring project (not part of the willow fycatcher monitoring effort). At this site, on two separate occasions, avian community monitoring staff captured *Empidonax* flycatchers that appeared to be willow flycatchers. In each case, the bird bore all field marks indicative of a willow flycatcher. Morphological measurements (Table 3) also suggest identification (based on Pyle *et al.* 1987) as willow flycatcher or alder flycatcher (*Empidonax alnorum*). However, alder flycatchers are not known to occur in the Grand Canyon (Brown et. al. 1987). Therefore, we feel it reasonable to consider both of the captured birds as willow flycatchers. Subspecies identification was not possible, therefore we do not know if the birds were *E.t. extimus*.

Table 3. Morphological measurements of two willow flycatchers mist-netted at RM 46.5 R.

Date Captured	Wing Chord (mm)	Tail Length (mm)	Tarsal Length (mm)	Bill Length (mm)	Weight (g)
10 June	67.5	59.0	20.9	13.6	12.5
9 July	68.0	60.0	19.0	12.2	11.0

This site has appropriate breeding habitat and has a history of previous breeding activity (Brown 1988). However, given that no willow flycatchers were detected at this site during five days of formal surveys conducted over the course of the breeding season (see Appendix I), and that the avian monitoring project staff did not recapture the same birds or detect any singing flycatchers during nine days of work (during the flycatcher breeding season) at this site, it is unlikely that either of the captured birds were resident. Therefore, although it is possible that breeding activity occurred undetected at this site, we think it more likely that the birds were either unpaired *E.t. extimus*, or were migrants (although most migrants would be expected before or after these dates).

Figure 7. Topographic map of willow flycatcher Site #3 (River Mile 46.5 R: Saddle Canyon and Triple Alcoves, Colorado River, Arizona). Location of flycatcher captures is circled. Base maps are USGS topographic maps Buffalo Ranch, Point Imperial, Tatahatso Point, and Nankoweap Mesa, AZ.

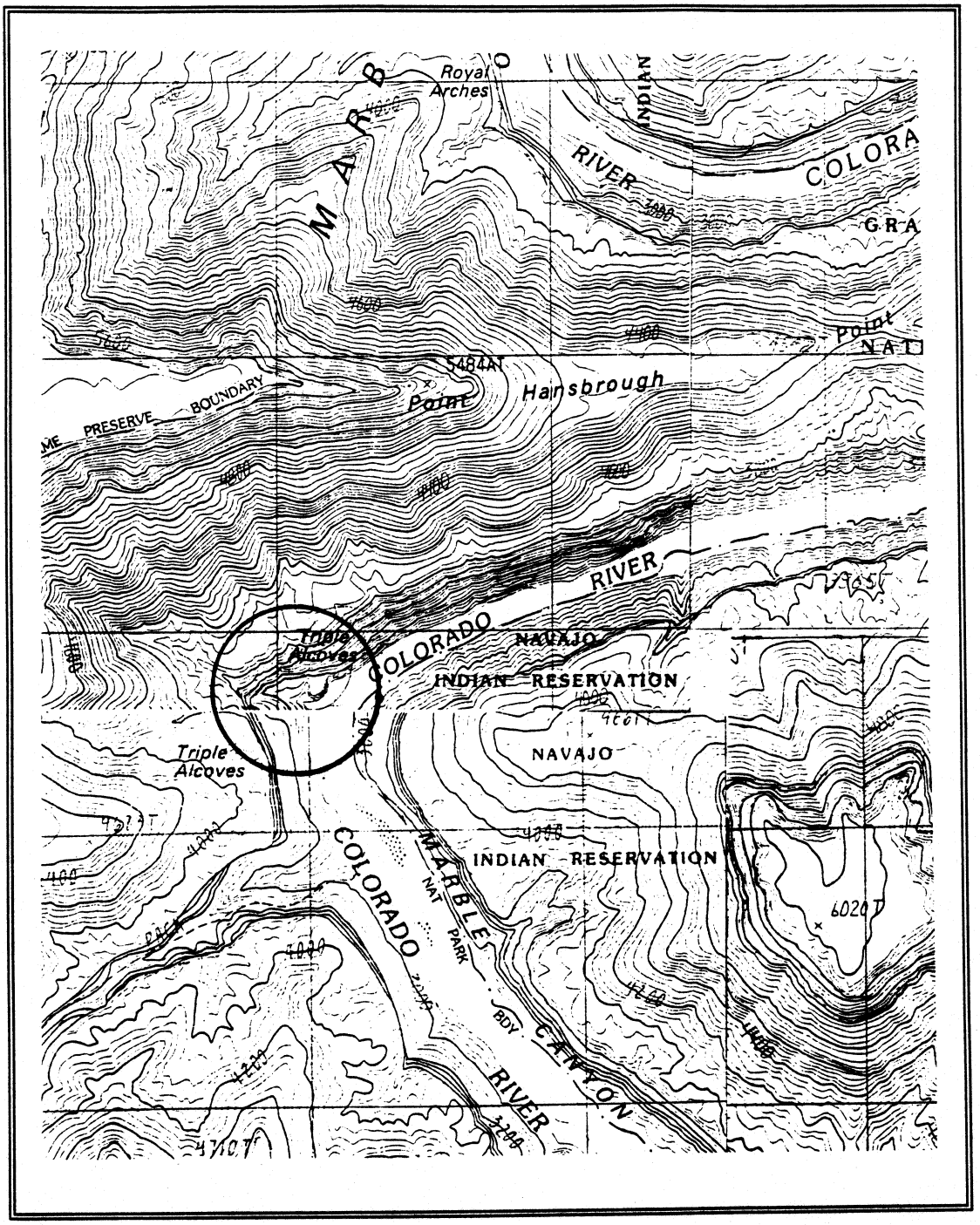


Figure 8. Aerial photograph of willow flycatcher Site #3 (River Mile 46.5 R - Saddle Canyon and Triple Alcoves, Colorado River, Arizona). Location of flycatcher captures is circled. River flow is from page bottom to top.

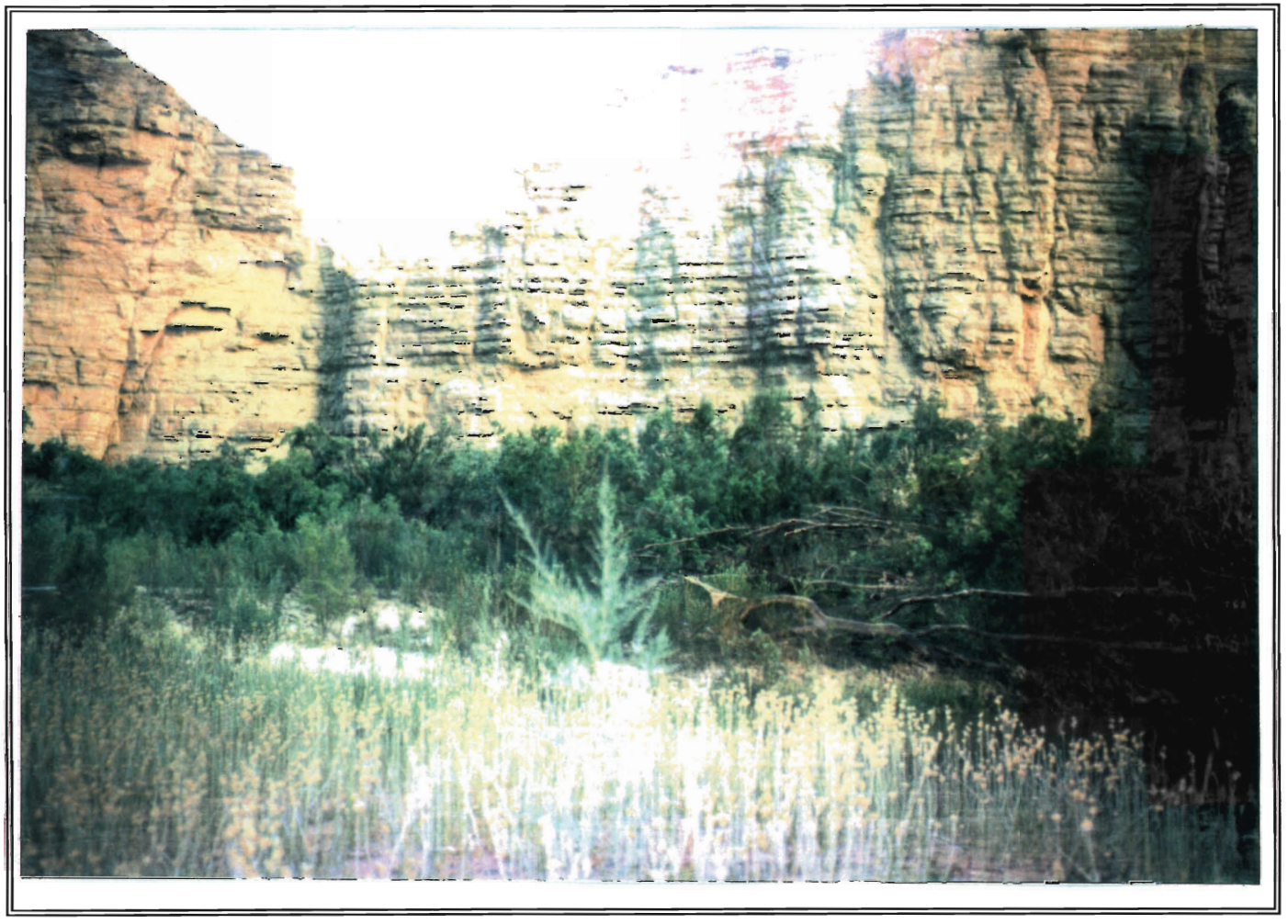


Figure 9. Photograph of willow flycatcher Site #3 (River Mile 46.5 R, Saddle Canyon/Triple Alcoves, Colorado River, Arizona). View is of middle section of habitat patch, looking north.

Site #4: Refer to Figures 10, 11, 12 and 13

Location: RM 50.5 L; 30 May 1993; 0620 hrs

Habitat: Dense tall tamarisk patch bordered by small sandy "bay". Some scattered willows (*Salix spp*) throughout and along border of sandbar, with *Equisetum* common.

The nature and pattern of flycatcher detections and nest activity at this sight present an interesting puzzle. Observations are presented first, followed by several interpretations.

On 30 May, a single bird gave a *whitt* call from within the dense tamarisk. Surveyors played a willow flycatcher song tape and the bird responded by *whitting* and moving closer. Later that morning, two birds were heard *whitting* and giving "greeting calls" (multiple, rapid *whitts* or *brrrrt*, verifying presence of a pair.

We found a nest (Nest #1) in a tall (7 m), very large canopied tamarisk, on a branch approximately 4.5 m high and 3 m from the center of the tamarisk. The nest was 10 m from the nearest edge of the patch, and 15 m from the closest water (see Figure 11). Only 2 m from the canopy top, the nest was relatively exposed, and contained two willow flycatcher eggs and one brown-headed cowbird egg.

On 31 May, we repeatedly observed two willow flycatchers at the same general site, and at the nest. At one point, a third willow flycatcher approached the nest, began *whitting*, and was chased out of the nest area by one of the other flycatchers. The remaining flycatcher *whitted* from nearby as this interaction occurred but did not participate in the chase. The following morning (1 June) the male willow flycatchers sang repeatedly.

To increase the likelihood that the nest at RM 50.5 would successfully produce young flycatchers, we decided to remove the cowbird egg from the willow flycatcher nest at the next possible opportunity (when a ladder could be brought to the site). On 11 June, a surveyor accessed Nest #1 OOg a free-standing ladder and found a newly-hatched cowbird, and one willow flycatcher egg that was partially buried in the nest bottom. The cowbird was removed, leaving only the single flycatcher egg. A flycatcher returned to and shading the nest after the cowbird chick was removed.

On 18 June, surveyors found Nest #1 empty, with no sign of activity. The flycatcher egg last seen on 10 June was no longer present. Following broadcast of a taped flycatcher song, two willow flycatchers gave *whitt* calls from approximately 20 m west of Nest #1. Surveyors spent several hours observing flycatchers in this area and discovered an active nest.

This second nest (Nest #2) was located in a 6 m tall, spindly tamarisk, approximately 15 m from Nest #1 (see Figure 11). Nest #2 was 4 m above ground, approximately 2 m below the canopy, 8 m from the nearest edge of the patch, and 10 m from the closest water. The adults repeatedly carried food to the nest, which contained an 8-10 day old brown-headed cowbird chick.

During a final survey on 30 June we found both adult willow flycatchers feeding a fledged cowbird (estimated 7-10 days post-fledging) in the tamarisk near Nest #2. The nest itself showed no sign of other activity, although the adult flycatchers responded with alarm calls (*whitts*) when the nest was approached. The adult flycatchers also *whitted* when the surveyors approached the juvenile cowbird, which was in the same general area as the nest.

The fact that the two nests were active over such a short time span eliminates the possibility that the same female was responsible for both nests. There was not sufficient time (8 days) between the 10 June (when Nest #1 was known to be active) and 18 June (when Nest #2 was found active) visits for the female flycatcher to build a second nest (3-4 days), lay a clutch of eggs (2-3 days), incubate (14 days), and raise an 8-10 day old cowbird. In fact, another female must have been already incubating eggs in Nest #2 on 11 June, when we know Nest #1 was active. In addition, the cowbird chicks in each nest were approximately the same age. Thus, there were clearly two breeding females at the RM 50.5 site, each on nests that were only about 15 meters apart.

The question remains as to how many males were present at the site. There are two possibilities: (1) there were two males (thus two pairs) present at the site, with adjacent territories and nests within 15 m of each other; or (2) there was one polygynous male defending one territory that included two females, each of which nested.

Because the flycatchers were not color-banded, it is not possible to know the identity of each bird observed over the season, or if the same male (or female) was observed every time. We do know that three individuals were once observed simultaneously. However, over the course of 5 days at the site, we never observed more than one singing male at a time. This strongly suggests that only one male was present, because male willow flycatchers are very aggressive and territorial, and sing loudly and consistently when neighboring males are present (M. Whitfield and B. Valentine, pers. comm.; Sogge and Tibbitts 1992). During the interaction involving a chase near the nest, neither bird sang, an indication that they were possibly both females.

Thus, the RM 50.5 site probably included one polygynous male with two breeding females. Polygyny among willow flycatchers is not common, but it is known to occur in other populations (B. Valentine and J. Sedgwick, pers comm.). Polygyny may be favored under the conditions occurring in the canyon, where population size is small and sex ratios may be skewed.

Figure 10. Topographic map of willow flycatcher Site #4 (River Mile 50.5 L, Colorado River, Arizona). Location of flycatcher sighting is circled. Base map is USGS topographic map Nankoweap Mesa, AZ.

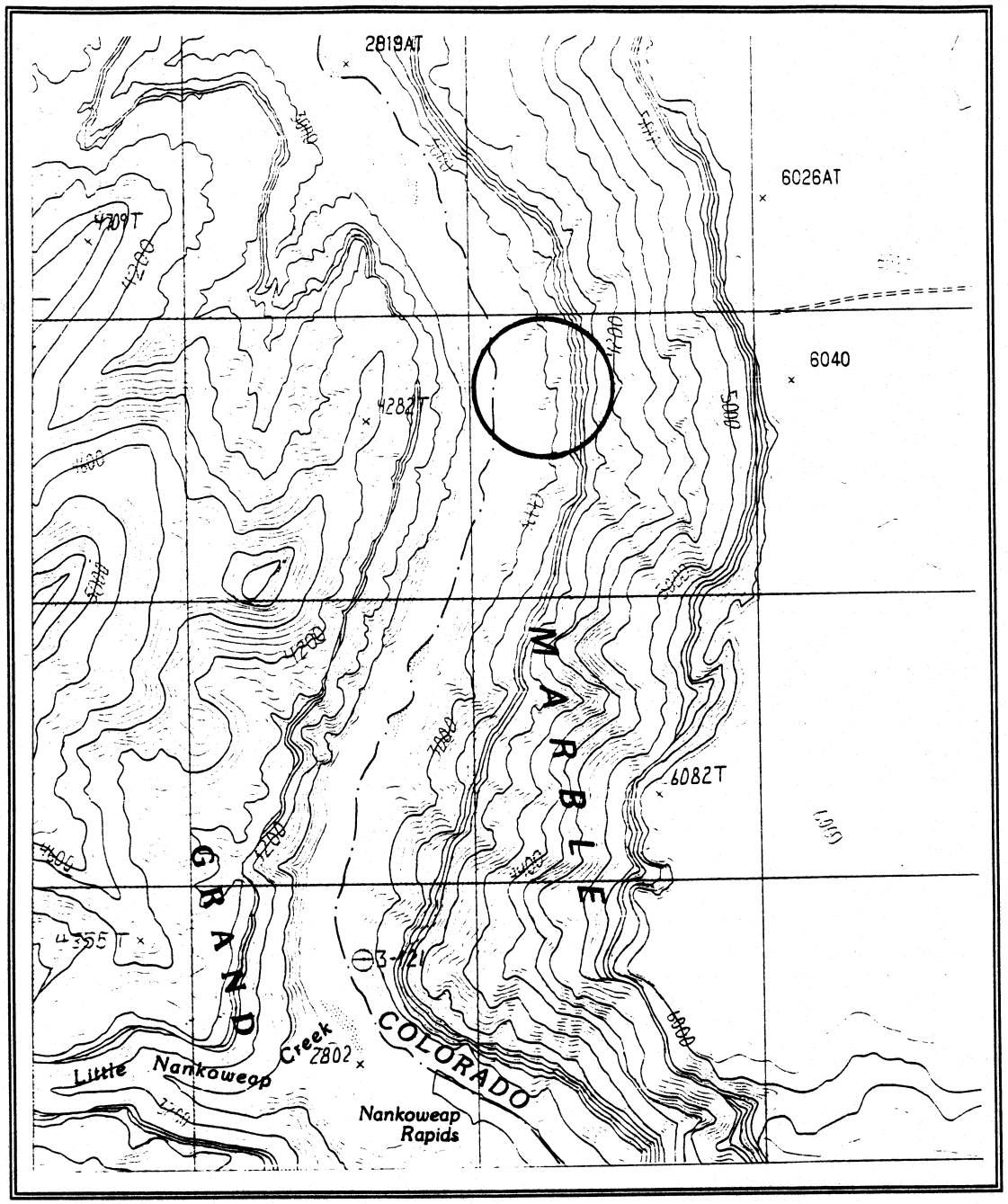


Figure 11. Aerial photograph of willow flycatcher Site #4 (River Mile 50.5 L, Colorado River, Arizona). Location of flycatcher sighting is circled. River flow is from page bottom to top.

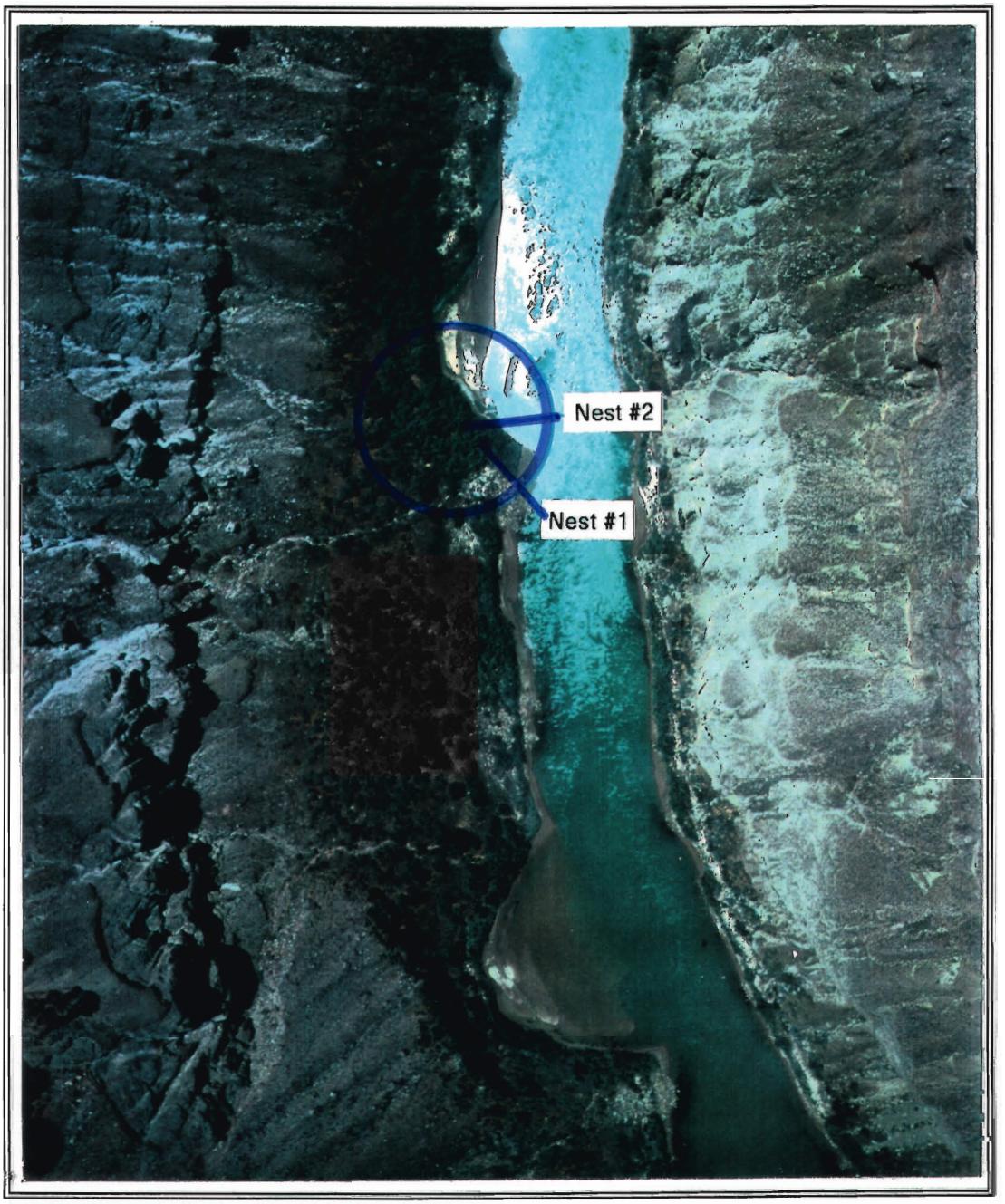


Figure 12. Photograph of willow flycatcher Site #4 (River Mile 50.5 L, Colorado River, Arizona). View is of upstream end of habitat patch, looking east. Photo taken from river.

Figure 13. Photograph of willow flycatcher Site #4 (River Mile 50.5 L, Colorado River, Arizona). View is of center of habitat patch (looking upstream). Photo taken from sandbar at downstream end of site.

Site #5: Refer to Figures 14, 15, 16, and 17

Location: RM 71 L (Cardenas Marsh); 16 May 1993; 0800 hrs

Habitat: Dense tall tamarisk patch bordered by willow, *Baccharis*, and small marshy area. Tall Goodding's willow nearby.

On 16 May, the avian community monitoring project crew made a brief (15 min) stop at Cardenas Marsh, and heard a male willow flycatcher singing from the dense tamarisk patch west of the marsh area. This is the earliest date that willow flycatchers have been heard singing at this site. On 2 June, surveyors detected two singing males, both in the dense tamarisk noted above. One was paired with a female (in the west portion of the patch), while the other male (to the east) appeared to be unmated. All three birds were observed foraging in the tamarisk canopy and in the adjacent open sand/brush area.

On 2 June, surveyors found a newly-built nest in the western portion of the patch, located in a spindly, 6 m tall tamarisk, in the fork of a branch 3.7 m above the ground. The nest was 16 m from the nearest edge of the tamarisk patch, and 16 m from the nearest water (the river). When found, the nest appeared fully constructed but empty. On 3 June, the female willow flycatcher was seen on the nest and laid the first egg.

Both males and the female were observed repeatedly on 3 June. The males were singing strongly, and the unpaired male was singing almost constantly. A short visit on 12 June found the nest still active, containing three eggs, one of which appeared to be a cowbird egg. On 19 June, surveyors returned to find only the "west" pair. The unmated "east" male was no longer evident. Throughout 19 and 20 June, surveyors noted the willow flycatcher pair foraging in and around the nest area, and carrying food to the nest. The nest contained a very young (day 0-1) chick, and an unhatched egg (which could not be seen clearly enough for positive identification). Although we could not be certain, the chick appeared to be too large in relation to the nest cup for a willow flycatcher. Therefore, we believe it was a young cowbird. Because of the placement of the nest (high in a fragile branch), we could not examine and remove the chick without damaging the nest and the remaining (possibly flycatcher) egg.

The final survey of this site occurred on 30 June and 1 July. The flycatcher nest was abandoned, and contained only an unhatched cowbird egg. We observed only one adult bird - a male that sang repeatedly and foraged throughout the area. No other flycatchers or juvenile cowbirds were seen, suggesting that the nest failed to produce any young. The nest structure showed little wear and there was very little feather down and trampling in the nest bottom, indicating that the nestling (cowbird?) may have died (cause unknown) early in the nestling stage.

Figure 14. Topographic map of willow flycatcher Site #5 (Cardenas Marsh - River Mile 71 L, Colorado River, Arizona). Location of flycatcher sighting is circled. Base maps are USGS topographic maps Cape Royal and Desert View, AZ.

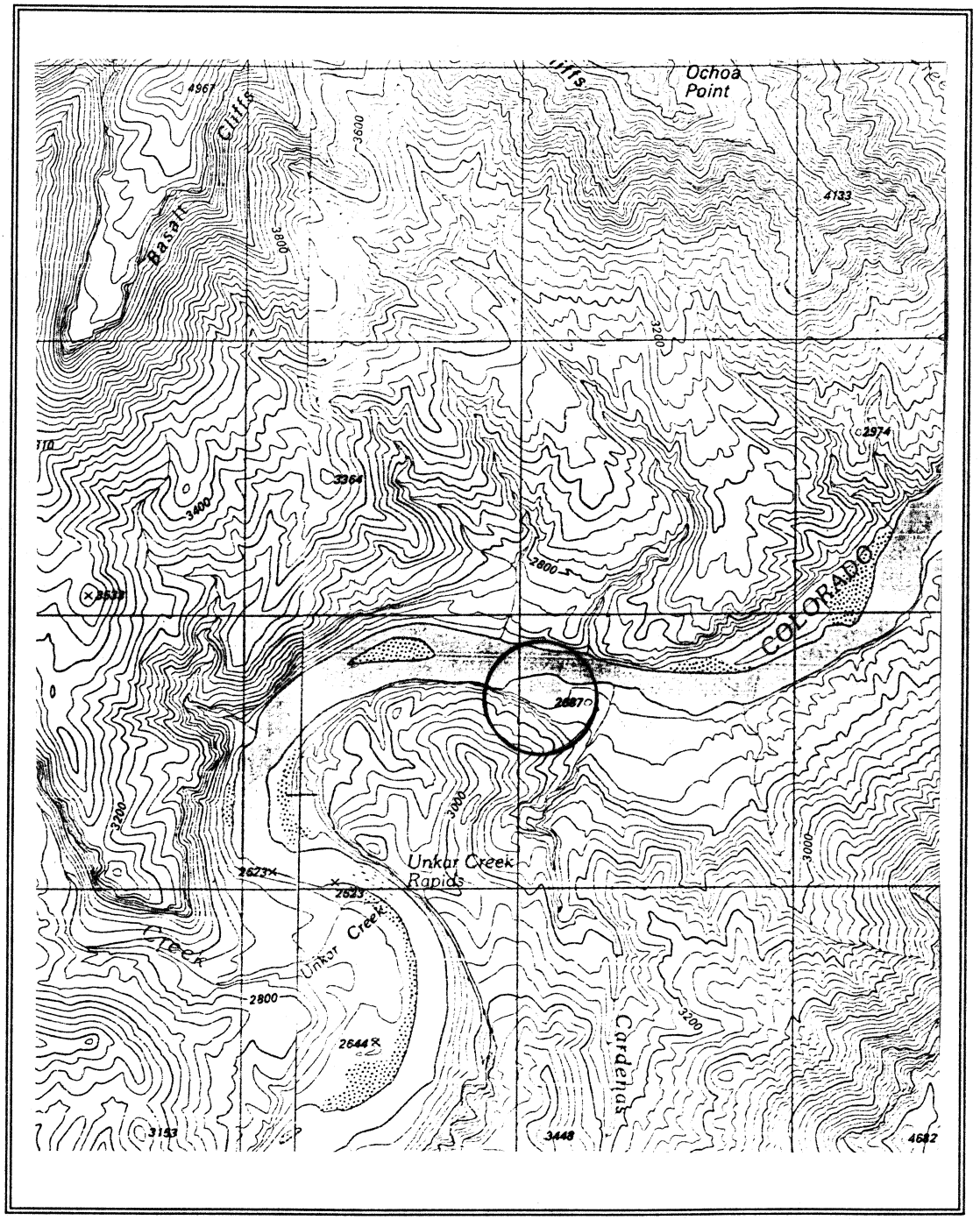


Figure 15. Aerial photograph of willow flycatcher Site #5 (Cardenas Marsh - River Mile 71 L, Colorado River, Arizona). Location of flycatcher sighting is circled. River flow is from page bottom to top.

Figure 16. Photograph of willow flycatcher Site #5 (River Mile 71.0 L, Cardenas Marsh, Colorado River, Arizona). View is of center of habitat patch (looking north). Photo taken from hillside on south edge of site.

Figure 17. Photograph of willow flycatcher Site #5 (River Mile 71.0 L, Colorado River, Arizona). View is of center of habitat patch (looking northeast). Photo taken from the ridge above south edge of site.

Site #6: Refer to Figures 18, 19, 20

Location: RM 260 L (Quartermaster Cyn); 28 May 1993; 0740 hrs

Habitat: Very dense patch of tall Goodding's willow (4-5 m) and tamarisk (3-4 m). Steep sandy banks. Perennial stream bisects patch. Large cattail marsh area behind riparian strip.

This flycatcher responded to a tape-broadcast song along the periphery of the patch at 0740 hrs. The bird initially sang repeatedly from within the vegetation, then flew to an exposed perch in a snag along the river shore. It remained for 4-5 minutes, repeatedly singing (*fitz-bews*) and *whitting*. We returned to the site later in the day. At 1700 hrs, the male was silent until we played a flycatcher tape. The male immediately responded with soft *creet* calls, then approached and sang repeatedly. The flycatcher continued to sing for several minutes after we stopped playing the tape.

The following day (29 May), we returned to the site but did not detect the flycatcher during tape-playback, nor during two hours of observation from several locations within and adjacent to the patch. The area was surveyed again on 31 May, 13 June, and 14 June, but no flycatchers detected. We believe this willow flycatcher was a migrant, because it was detected on one day in May (when migrant willow flycatchers are expected), and never on subsequent surveys.

Figure 18. Topographic map of willow flycatcher Site #6 (River Mile 260 L; Quartermaster Cyn, Colorado River, Arizona). Location of flycatcher sighting is encircled. Base maps are USGS topographic maps Quartermaster, and Devils Slide Rapid, AZ.

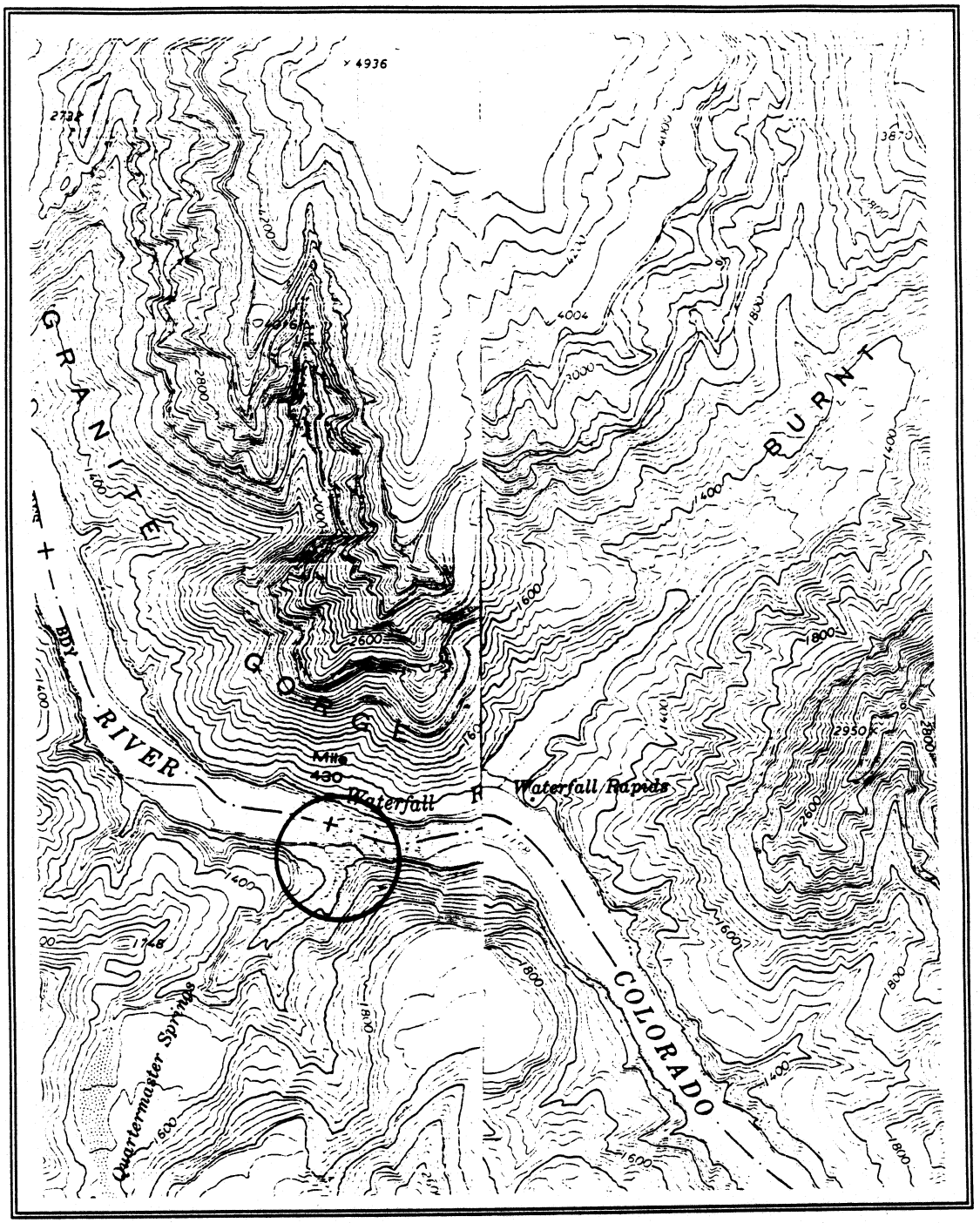


Figure 19. Aerial photograph of willow flycatcher Site #6 (River Mile 260 L; Quartermaster Canyon, Colorado River, Arizona). Location of flycatcher sighting is encircled. River flow is from page bottom to top.

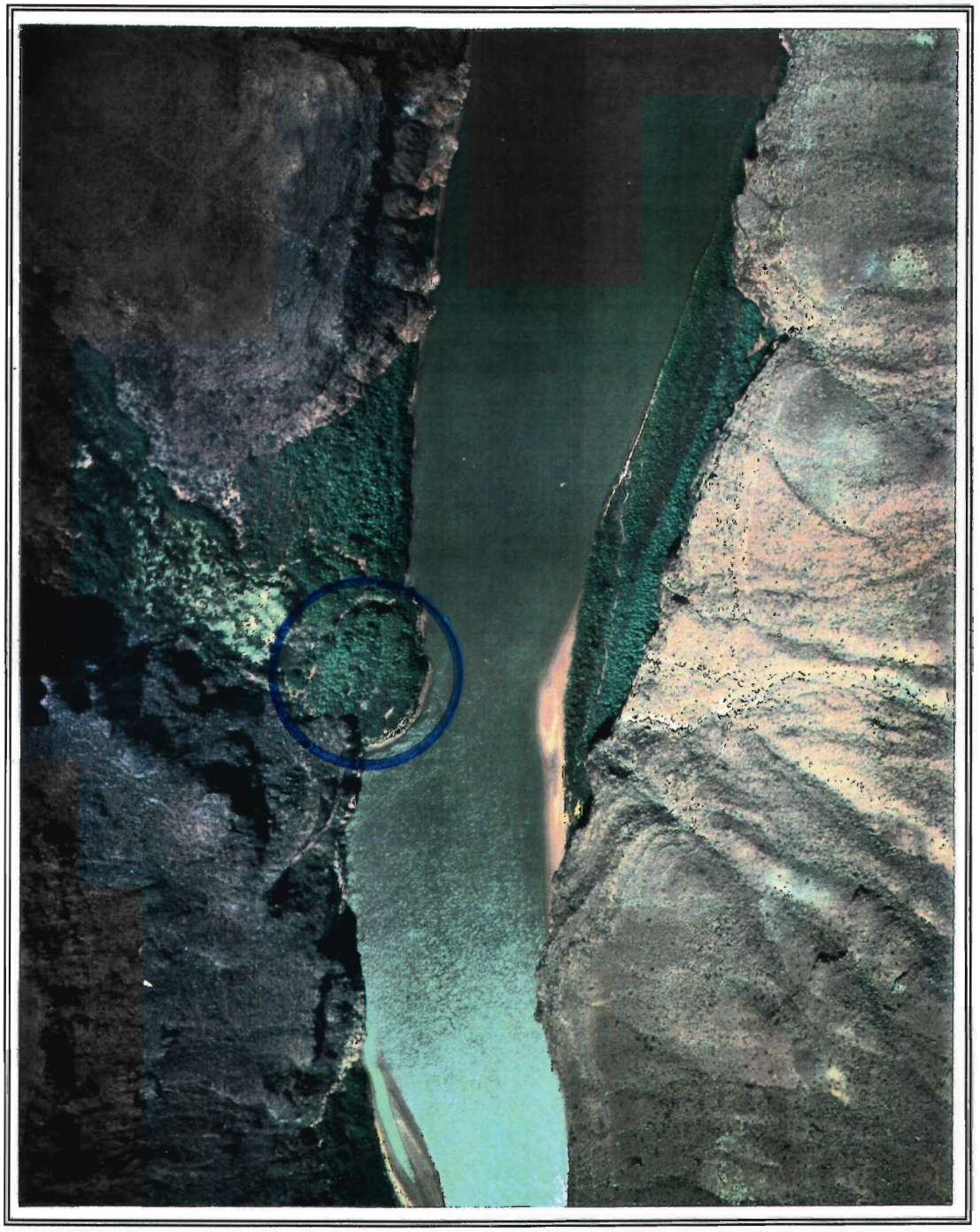


Figure 20. Photograph of willow flycatcher Site #6 (River Mile 260 L; Quartermaster Canyon, Colorado River, Arizona). View is of center of habitat patch (looking south). Photo taken from the river.

Site #7: Refer to Figures 21, 22, 23, 24

Location: RM 276.7 R; 17 June 1993; 1015 hrs

Habitat: Dense, tall coyote willow and Goodding's willow, flooded at base by rising water of Lake Mead (as shown for nearby habitat in Figure 24). Approximately 6-8 m of trees exposed above water line.

Surveyors initially heard this bird singing from approximately 100 m away, while they were at a nearby habitat patch at 1005 hrs. When surveyors approached the patch (1015 hrs), the flycatcher was no longer singing. Approximately 2 minutes after surveyors began playing a flycatcher tape, the male responded by moving nearby and *whitting*. After the tape was stopped, the male flew high in a willow and sang until after the surveyors left at approximately 1100 hrs.

Surveyors observed the flycatcher throughout the following morning (18 June; 0630 - 1030 hrs) at the same site. While one surveyor watched the flycatcher, another moved upstream to approximately RM 275.9 R (precise locations are difficult to determine in many sections of the lower river) and played a flycatcher tape. The flycatcher immediately flew upstream and was lost from sight by the first observer. At the same time, a male flycatcher approached the upstream RM 275.8 surveyor (playing the tape) and sang repeatedly. Approximately 10 minutes after the RM 275.8 surveyor stopped playing the tape, the flycatcher flew downstream. At the same time, a male reappeared at RM 276.7. This suggests that it was the same bird at both locations. This was a very still morning, and the sound of the tape playback from RM 275.8 was clearly audible to the surveyor at RM 276.7, and thus also to the flycatcher. Willow flycatchers are known to be very aggressive and territorial, and could readily move between these two locations to respond to a perceived intruding/neighboring male.

We observed no other flycatchers, and no other evidence of pairing or nesting at this site during these two days. Given that it acted territorial on two consecutive days during a period when migrants are extremely unlikely and moved a significant distance in response to the tape, but was not detected during a follow-up survey on 8 July, we believe the flycatcher may have been attempting to establish a breeding territory but did not procure a mate and breed at the site. However, because some breeding flycatchers do not respond during surveys, particularly later in the breeding season, there is a possibility that breeding could have occurred undetected in the area.

Figure 21. Topographic map of willow flycatcher Site #7 (River Mile 276.7 R, Colorado River, Arizona). Location of flycatcher sighting is circled. Base map are USGS topographic maps Columbine Falls, and Snap Canyon West, AZ.

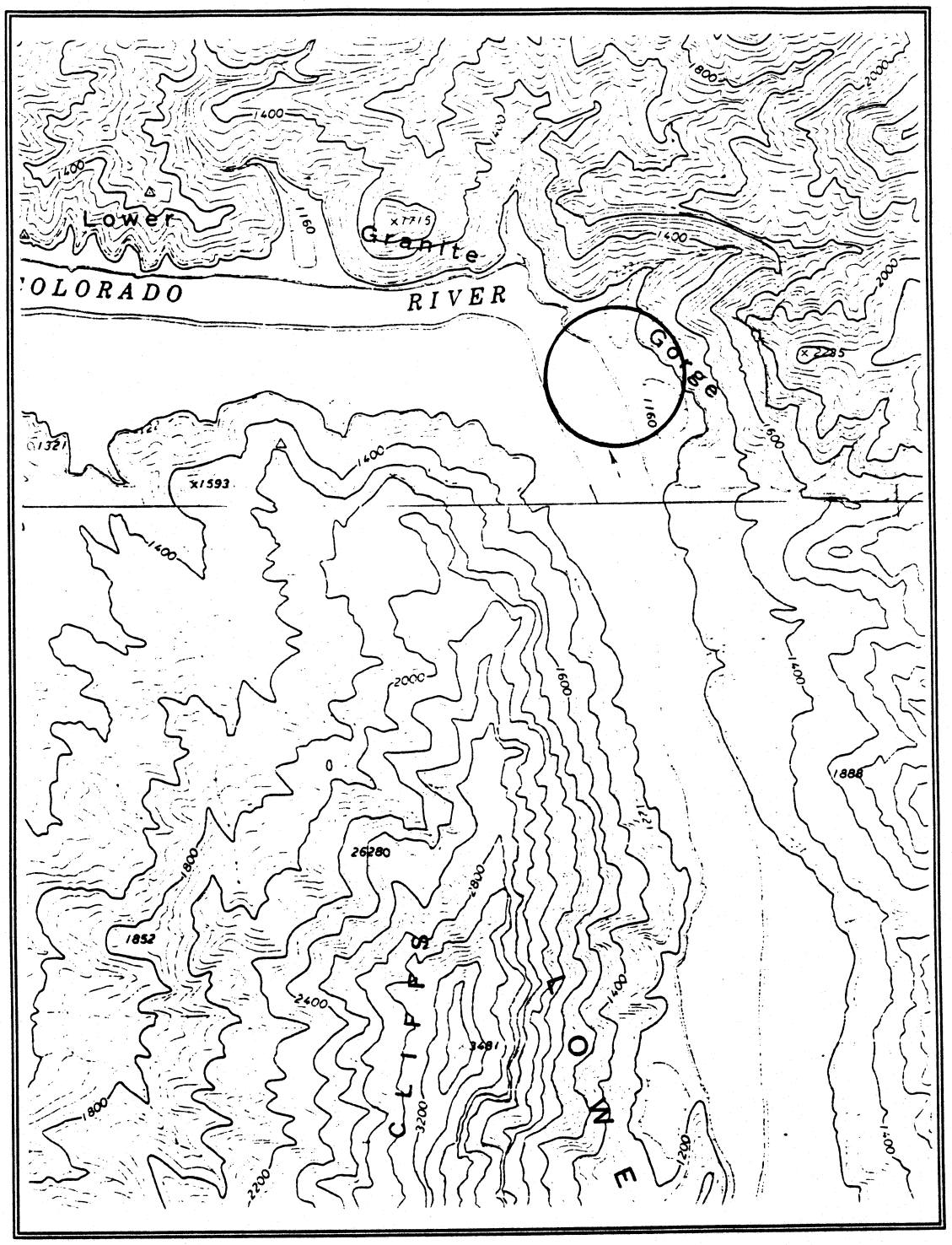


Figure 22. Aerial photograph of willow flycatcher Site #7 (River Mile 276.7 R, Colorado River, Arizona). Location of flycatcher sighting is circled. River flow is from page bottom to top.

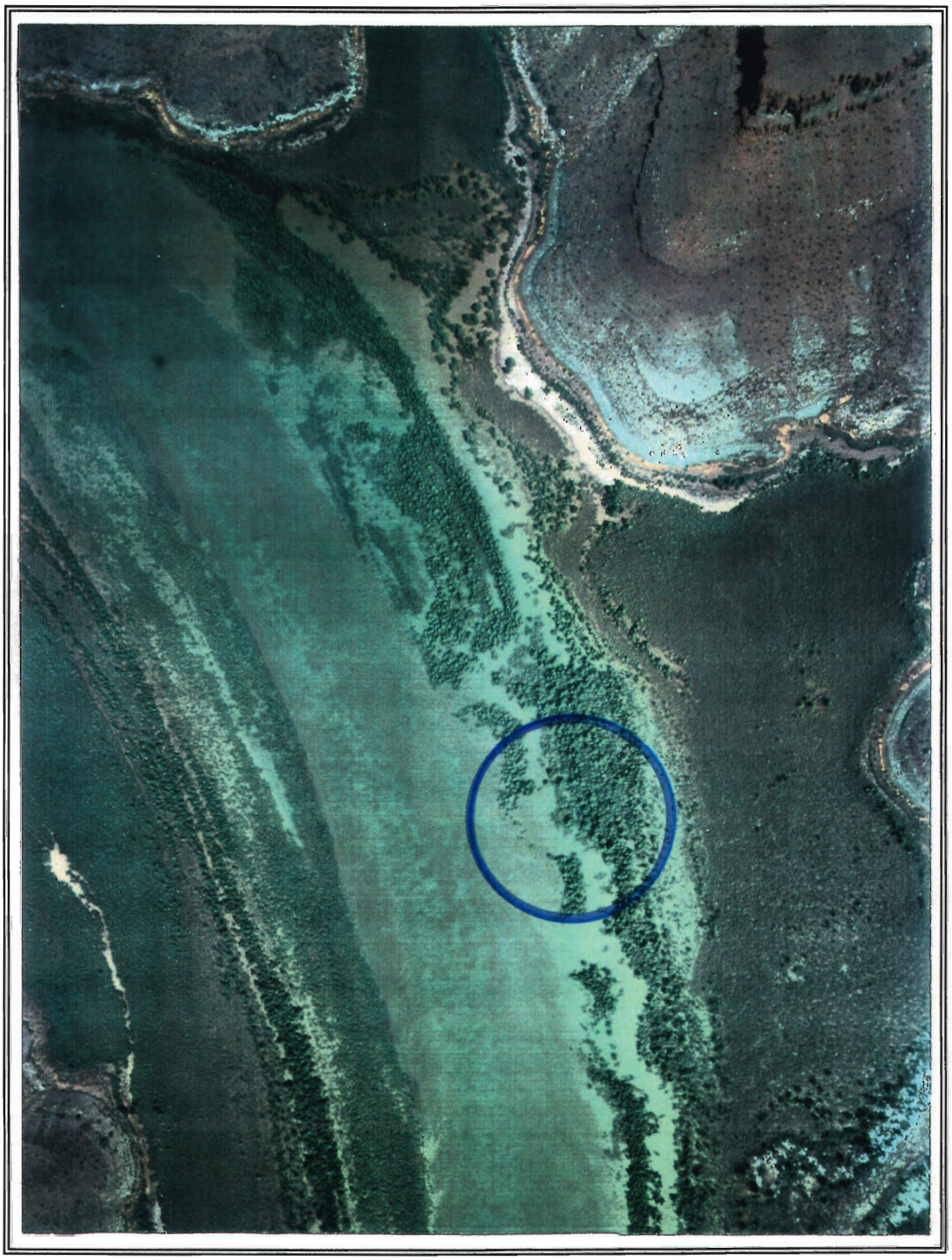


Figure 23. Photograph of riparian vegetation along lower river corridor. View is looking downriver (north) from bluff near Columbine Falls (RM 274.4 L, Colorado River, Arizona). Willow flycatcher Site #7 (River Mile 276.7 R) is visible in distance, and indicated with an arrow.

Figure 24. Photograph of riparian vegetation along lower river corridor. Note that the rising water from Lake Mead has inundated the lower portions of the habitat. Photograph taken near Columbine Falls (RM 274.4 L, Colorado River, Arizona).

Habitat Patch Size

Willow flycatchers were detected only in the New High Water Zone (NHWZ): tamarisk and willow dominated riparian vegetation along the river corridor, typically 0-8 m above average water level. We never found willow flycatchers in the mesquite, acacia, hackberry, and redbud-dominated habitats higher on the slopes (often termed Old High Water Zone [OHWZ]), suggesting it has little habitat value for this species. The amount of NHWZ vegetation at flycatcher sites ranged from 0.5 - 1.2 ha (Table 4). Breeding willow flycatchers did not use the entire habitat patch in which they nested, at least during the course of our observations (Table 4).

Table 4. The area of New High Water Zone (NHWZ) vegetation in the habitat patches where willow flycatchers were detected, and the extent of the area actually used by breeding flycatchers ("used area" as determined by mapping where resident flycatchers moved within the patch) along the Colorado River, Arizona in 1993. Values given are hectares.

SITE	Patch Size (ha)	"Used Area" (ha)
#1 RM -9	1.0	n/a
#2 RM -8.8	1.2	n/a
#3 RM 46.5 (Saddle Cyn)	0.8	n/a
#4 RM 50.5	0.5	0.3
#5 RM 71 (Cardenas)	0.9	0.2
#6 RM 260	0.7	n/a
#7 RM 276.7	0.7	n/a

Willow Flycatcher Song Patterns

We found singing male willow flycatchers at five sites along the river corridor. All males vocalized using a combination of *fitz-bew* and *whitts*. At locations with known breeding pairs, we saw no evidence of female song, although they regularly gave *whitt* calls, particularly when surveyors were in close proximity to a nest. However, since flycatchers were not color-banded, we can not be sure all singing birds were male.

Males sang as early as 0520 hrs, and as late as 1914 hrs. Several males sang spontaneously, prior to any tape playback. The most vociferous males were: (a) unpaired; (b) adjacent to other singing males; or (c) paired males early in the breeding season. Late in the breeding season, mated males with active nests often failed to sing, even in response to tape playback (although they usually *whitted*, see below). Additional quantitative data on

song rates will be presented in future reports pending a larger sample size of singing males and quantitative acoustical analyses.

Whitting was the most common vocalization of paired willow flycatchers. *Whitts* were heard regularly throughout the day, particularly when flycatchers or surveyors were close to the nest, or when a flycatcher tape was played at a site. Among willow flycatcher pairs, a bird at or near a nest would *whitt* when the other flycatcher approached the nest (e.g., to feed the young). *Whitts* were so common among breeding pairs that it would be difficult to spend much time in an active territory without hearing such a call.

Brown-headed Cowbird Activity and Willow Flycatcher Response

We commonly observed brown-headed cowbirds near or within many of the habitat patches surveyed during this study, including virtually every site where willow flycatchers were found. Female cowbirds were often present (accompanied by one or more courting males), and 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 away from the resident flycatchers. On several occasions resident willow flycatchers confronted and chased cowbirds away from the proximity of the nest by aggressive actions such as flying directly at the cowbird, loud *whitting*, and bill-clacking.

Cowbird eggs or young were found in all three active willow flycatcher nests. In each case, this caused reproductive failure, in terms of production of willow flycatcher young. In fact, the only known young bird successfully raised by flycatchers this year was a fledgling brown-headed cowbird.

DISCUSSION

Survey Methodology

Our methods were successful in detecting both breeding and unpaired flycatchers. We found the territorial male at Site #5 and the male at Site #7 before song tapes were played - *e.g.*, they were already singing when the surveyors first approached their territories. However, the other flycatchers (at Sites #1, #2, #4, and #6) may not have been detected if taped calls had not been used. Therefore, our protocol should be used for future surveys.

Multiple surveys at each site are also important. For example, we did not detect flycatchers during the first surveys at Site #7, yet did during the second survey. A single earlier survey would have underestimated the number of flycatchers. Single surveys or observations of willow flycatchers are of limited use for indicating local status of *E.t. extimus*, because other races may be present in *extimus* range during much of its breeding season (see discussion of migration schedule *in* Unitt 1987). Second or repeated visits can determine breeding status and success, and should be timed to encompass the period from approximately 15 June - 15 July (Unitt 1987, this study).

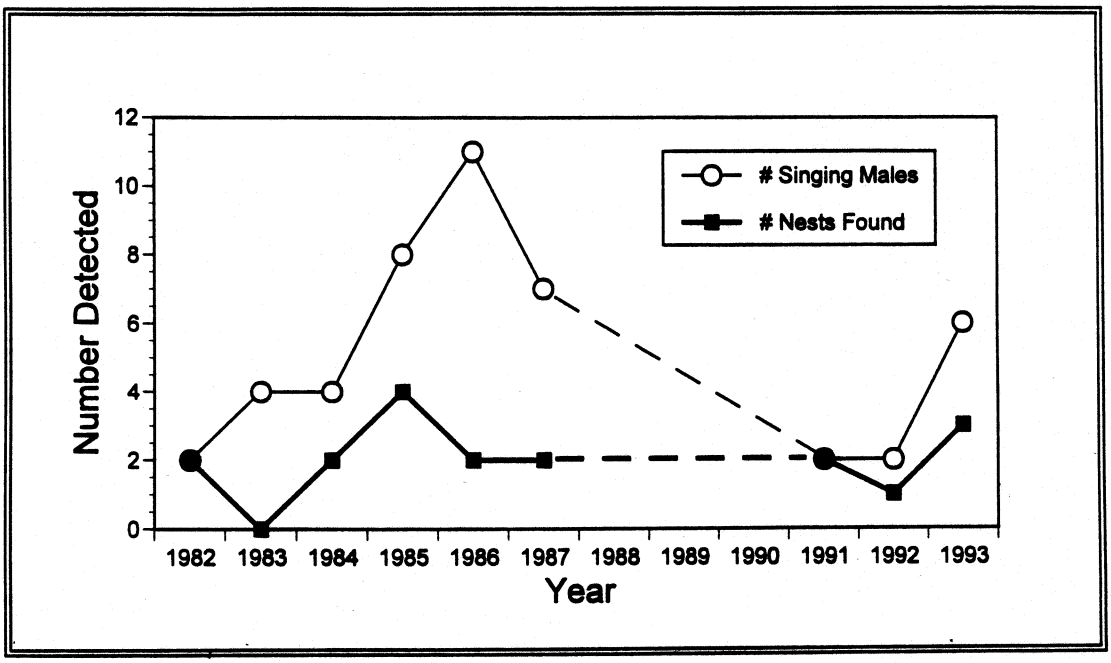
Surveys conducted by walking through the habitat patches are also preferable, in terms of the probability of detecting non-singing willow flycatchers. Flycatchers are sometimes not detected until the surveyors are within the midst of the habitat patches. Surveys conducted from the river would probably not have elicited a response from these birds, again leading to fewer detections. Also, song rate decreases, and the frequency of calling (*whitts*) increases, after males pair with a female and as the breeding season progresses (Stafford and Valentine 1985; Sogge and Tibbitts 1992; J. Sedgwick and M. Whitfield, pers. comm.; this study). Surveys conducted while walking through the habitat have a much better chance of visually detecting a quiet male (or female) bird, and of hearing *whitt* calls, than do surveys conducted from the river. When on a floating raft, the sound of water sometimes causes significant background noise that interferes with aural detections. Walking surveys also allow more thorough coverage of wide habitat patches.

Willow Flycatcher Status - Numbers and Distribution

We detected willow flycatchers at two sites (#4 and #5) where they had repeatedly been found during the past 10 years (Brown 1991, Sogge and Tibbitts 1992). However, we found flycatchers in portions of the river where they had not been detected in recent years. For example, this is only the second time since the 1950's that willow flycatchers have been found above Lees Ferry (the first time was reported by Sogge and Tibbitts [1992]). In addition, the flycatchers at Sites #6 and #7 were found further downstream than any previous sightings within the Grand Canyon.

Our total count of 13 willow flycatchers is the highest since 1986, when 13 flycatchers were also found (Brown 1991; Figure 25). Because our 1992 and 1993 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 males detected before a tape was broadcast to be roughly analogous to the number of singing male flycatchers detected pre-1992 (when tape playback was not used), then our 1993 total of 3 singing males is lower than the numbers detected in the 1980s, but greater than 1991 and 1992 (Brown 1991, Sogge and Tibbitts 1992).

Figure 25. The number of singing males willow flycatchers (open circles) and willow flycatcher nests (closed squares) detected along the Colorado River corridor in the Grand Canyon, Arizona: 1982-1993. Broken lines indicate years when no surveys were conducted.



Not all singing male flycatchers are necessarily summer residents (some are migrants), and not all potential summer residents actually pair and breed, therefore the best indicator of the flycatcher breeding status within the canyon is the actual number of active nests found. In 1993, we found three active nests - the greatest number of nests since 1985 (Figure 25). Although more than the two nests in 1991 (Brown 1991) and one in 1992 (Sogge and Tibbitts 1992), three is still a precariously small number and does not imply that the willow flycatcher breeding population in the canyon is significantly increasing. The fact that all three nests failed to produce any willow flycatcher young neutralizes any optimism resulting from this slight increase in known nests.

We found nests at two different sites - RM 50.5 and Cardenas (RM 71). The RM 50.5 site is within one of the two primary flycatcher breeding areas noted by Brown (1988), but flycatcher nests had not been found here since the mid-1980's, despite intensive search efforts in 1991 and 1992 (Brown 1991, Sogge and Tibbitts 1992). Cardenas, on the other hand, has been the most consistent breeding location in the canyon, with nests found there during all surveys from 1982 - 1993. In fact, it was the only site where breeding occurred in 1991 and 1992 (Brown 1991, Sogge and Tibbitts 1992).

The increased number of active nests and the reoccupation of a historic breeding site suggest there is hope that willow flycatchers may continue to breed in the canyon in the near future. However, the low population level makes the flycatcher 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. 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 and nest locations were similar to those characterized by Brown (1988, 1991) and Sogge and Tibbitts (1992). The dates of territory occupancy and incubation of eggs (late May and early June) are slightly earlier than the range previously noted for breeding flycatchers in the Grand Canyon (early June to mid-July: Brown 1988, Sogge and Tibbitts 1992). However, they are within the range expected given increasing years of survey effort.

The clutch size (three eggs) of the nest at Cardenas Marsh is the same as the average for *E.t. extimus* along the Colorado River (Unitt 1987, Brown 1988, Sogge and Tibbitts 1992). Clutch sizes of the other two nests are not comparable because of cowbird nest parasitism. Clutch size in other willow flycatcher populations is typically 3-4 eggs/clutch (Holcomb 1972; Sanders and Flett 1989, McCabe 1991).

Vocalization Patterns and Characteristics

The *fitz-bew* song of territorial male willow flycatchers and unpaired/migrant flycatchers responding to tape playback followed the general pattern described in Unitt (1987), and recorded from willow flycatchers in other areas. However, canyon birds detected in 1992 and 1993 appear to have a difference in song dialect than commercially available recordings of other flycatcher races (typically Rocky Mountain or East Coast specimens).

Southwestern willow flycatchers in the canyon have a distinctly longer, more protracted, and more "rolling" *fitz-bew*. Several of the 1993 surveyors have extensive experience with willow flycatcher populations outside of the canyon and noted that the canyon birds sounded distinctly different from willow flycatchers of other races but similar to *E.t. extimus* from other parts of its range.

Thus, it may be possible to differentiate (with experience or acoustic analytical equipment) songs of *E.t. extimus* from some other races. This would be an extremely useful management tool, in that it would allow an effective, non-intrusive method of distinguishing subspecies. However, theories of distinct subspecies dialects must be quantitatively tested. To this end, we continue to record male southwestern willow flycatcher songs and calls in the Grand Canyon, and elsewhere it its range. Once a sufficient sample of males is obtained, the Borror Laboratory of Bioacoustics at Ohio State University will assist with analytical comparison of the southwestern willow flycatcher vocalizations with those of other subspecies, to determine if there are distinct dialects.

Male willow flycatcher song rates and daily/seasonal patterns were also similar to those described by Unitt (1987), Brown (1991), and Sogge and Tibbitts (1992). Song rates were 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. 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.

These song rate patterns have important implications with regard to survey methodology. In general, surveys conducted early in the breeding season will probably detect territorial males, because they are probably unpaired or without an active nest, and thus highly vocal at that time. Early-season surveys can therefore be conducted later in the morning, and perhaps in early afternoon, because territorial males will probably still be singing. However, mid- and late-season surveys should be conducted primarily in early morning, when males that are still singing will be doing so at the greatest rate. Late-season surveys also have a greater risk of not detecting resident males at all, because male song is reduced or absent at that time.

Once resident flycatchers are paired and have active nests (typically, but not always, later in the season), singing may be greatly reduced or absent. However, paired male and female flycatchers with active nests *whitt* throughout the day. Therefore, surveyors should be particularly familiar with, and attentive for, willow flycatcher *whitt* and greeting calls during all times of the breeding season.

Brown-headed Cowbird Impacts

Cowbirds were present at every site where willow flycatchers were found. Indeed, cowbirds are common throughout the entire Colorado River corridor from Glen Canyon Dam downstream to Lake Mead (Johnson and Sogge 1993).

All three willow flycatcher nests found in 1993 were parasitized by brown-headed cowbirds. Historically, approximately half of the flycatcher nests examined in the canyon during the 1980s were also parasitized by cowbirds (Brown 1988). Taken together, these data shows 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 minimize any human disturbance to nesting flycatchers; then nest-parasitism by cowbirds seems to be the most imminent threat to the breeding population of flycatchers within the canyon. Other threats may occur outside of the breeding range and season, but such threats are not under the control of the National Park Service.

If the extremely high rates of cowbird parasitism noted by Brown (1988) and in this study continue, the resultant decrease or failure in flycatcher productivity may lead to the extirpation of the canyon willow flycatcher population. As with most small neotropical migrant passerines, the willow flycatcher is relatively short-lived (3-4 years) and has high juvenile mortality. Thus, if the flycatchers currently breeding in 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 (as discussed above, 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) 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, and specifically to the two flycatcher breeding sites, that cowbirds could easily be moving between the two areas (Table 5; 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.

Table 5. The distance (km) from known cowbird foraging centers along the South Rim of the Grand Canyon to the Colorado River corridor and to known southwestern willow flycatcher breeding site.

SITES	DISTANCE
Grand Canyon Village and Sunset Drive mule and pack corrals to closest point of Colorado River corridor	5 km
Yaki Point mule and horse corrals to closest point of Colorado River corridor	4 km
Desert View to Cardenas Marsh (flycatcher breeding site)	6.5 km

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 in this study, it is unlikely that interim flow water levels could cause nest inundation, even at 20,000 cfs. The tamarisk patches in which the flycatcher nests were located are rooted at least 1 m above the level of high flows observed during this study. Thus, interim flow water levels would not likely cause damage or destruction of the nest substrate.

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

The most likely flow-related impacts to the willow flycatchers 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/habitat change effects.

MANAGEMENT CONSIDERATIONS AND RECOMMENDATIONS

Continued Monitoring

The U.S. Fish and Wildlife Service published a proposed rule to list the southwestern willow flycatcher as an endangered species USFWS 1993), and a final listing decision is expected by the spring of 1994. This potential of listing 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 surveys in 1994 and 1995, with increased emphasis in the area from Glen Canyon Dam to Lees Ferry. Surveys should be coordinated by the National Biological Survey Colorado Plateau Research Station (formerly Cooperative Park Studies Unit at Northern Arizona University), and utilize the same methodology as the 1992 and 1993 surveys. The U.S. Bureau of Reclamation has provided funding that assures continuation of surveys through 1995. The U.S. Fish and Wildlife Service and Arizona Game and Fish Department have indicated that staff time to assist with surveys and coordination are expected to be available again in 1994-95.

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. In both 1992 (Sogge and Tibbitts 1992) and 1993, we observed no changes in behavior when boats floated or motored past the patches where birds were breeding. 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 at known breeding areas - both RM 50 and Cardenas are popular camping sites (although both were closed to recreation in 1993: see below). Some of the other sites 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 non-National Park Service lands along the river corridor and major tributaries (Kanab Creek, Paria River, Havasu Creek, etc.), and could be negatively affecting the regional flycatcher population by reducing potential habitat.

Restricted Use and Closures of Nesting Habitat

The 1993 recreation closures instituted at RM 50.5 and Cardenas appear to have precluded human-related impacts to the nesting willow flycatchers. Because there is continued potential for human disturbance if such closures are lifted, the parks should continue to eliminate 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 15 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 -9.0 to RM -8.0 (both sides of river)
RM 50 - 52 L
RM 71 L (Cardenas)

We recommend closure of the RM -9 area based on: (a) the presence of appropriate willow flycatcher habitat; and (b) the presence of a willow flycatcher pair at the appropriate time during the breeding season. Closure may help provide conditions suitable for breeding in the near future.

(3) immediately close any new area(s) where potentially- breeding willow flycatchers are found. 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 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 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. 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 nest cowbird parasitism of southwestern willow flycatchers at the Kern River Preserve declined from 65% to 20% after only one year of cowbird trapping.

We recommend that Grand Canyon National Park institute a cowbird control program in 1994, as outlined in Johnson and Sogge (1993), involving cowbird trapping at pack stations along the South Rim, where cowbirds congregate. Grand Canyon National Park and Glen Canyon National Recreation Area should also consider setting up cowbird traps at known willow flycatcher breeding areas, particularly if researchers will be present at the sites for long periods (exceeding 4 days). 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) 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.

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 I

Summary of 1993 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
(-14.7)-(-14.2)L	6/7/93	0700	0725	Land	Matt Johnson, John Grahame
(-14.4)-(-13.5)L	6/7/93	0730	0815	Land	Matt Johnson, John Grahame
(-13.0)-(-12.4)L	6/7/93	0822	0905	Land	Matt Johnson, John Grahame
(-11.5)-(-10.9)L	6/7/93	0850	0920	Land	Matt Johnson
(-11.2)-(-10.7)	6/7/93	0939	0958	Land	Matt Johnson
(-9.8)-(-9.2)L	6/7/93	1005	1035	Land	Matt Johnson, John Grahame
(-9.0)-(-8.5)L	6/7/93	1105	1140	Land	Matt Johnson, John Grahame
(-9.0)L	7/21/93	0800	0915	Land	Matt Johnson
(-8.9)-(-8.0)R	6/7/93	1150	1240	Land	John Grahame, Clive Pinnock
(-8.8)R	7/21/93	0930	1100	Land	Matt Johnson
(-7.1)-(-6.8)L	6/8/93	0940	1000	Land	John Grahame, Clive Pinnock
(-6.5)R	6/8/93	1010	1030	Land	John Grahame, Clive Pinnock
(-6.4)R	6/8/93	1030	1040	Boat	John Grahame, Clive Pinnock
(-4.1)-(-4.0)L Water Holes Canyon	6/8/93	1220	1240	Land	John Grahame, John Spence
(-3.6)-(-3.2)R	6/8/93	1050	1105	Land	John Grahame, Clive Pinnock
(-3.5)-(-3.0)L	6/8/93	1140	1210	Land	John Grahame, Clive Pinnock
0.0R Lees Ferry Launch Site	5/27/93	0515	0615	Land	Lawrence Abbott
0.0R Lees Ferry Launch Site	5/27/93	0640	0650	Land	Susan Sferra
0.5R From bridge to mouth of Paria	6/15/93	0620	0705	Land	Lawrence Abbott, Brad Valentine
1.0R Paria River Beach	5/27/93	0510	0620	Land	Susan Sferra

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
38.5L	5/28/93	0723	0730	Land	Lawrence Abbott
38.5-38.7L Martha's Camp	5/28/93	0650	0732	Land	Susan Sferra, Lawrence Abbott
40.9L	5/28/93	0800	0810	Land	Lawrence Abbott, Susan Sferra
41.5R Royal Arches	5/28/93	0920	0940	Land	Lawrence Abbott
41.5-42.5L Royal Arches	5/28/93	0950	1100	Land	Lawrence Abbott
41.5-42.5R	5/28/93	0930	1100	Land	Susan Sferra
42.5-42.9L	5/28/93	1650	1800	Land	Lawrence Abbott
42.9-43.2L	5/28/93	1640	1800	Land	Susan Sferra
43.2L	6/16/93	0632	0642	Land	Mark Sogge, Brad Valentine
43.4-43.7L	6/16/93	0554	0625	Land	Mark Sogge, Brad Valentine
43.6-43.7L	5/28/93	1825	1900	Land	Lawrence Abbott, Susan Sferra
44.5-44.7L	6/16/93	0510	0600	Land	Lawrence Abbott
44.8L	6/16/93	0612	0620	Land	Lawrence Abbott
44.9L	6/16/93	0635	0700	Land	Lawrence Abbott
45.1-45.4R	6/16/93	0816	0846	Land	Mark Sogge
45.2-45.7L	6/16/93	0825	0910	Land	Lawrence Abbott
45.5R	6/16/93	0852	0859	Land	Mark Sogge
45.6-46.6R	6/16/93	0925	0956	Land	Mark Sogge
45.8-46.0L	5/29/93	0500	0540	Land	Susan Sferra
45.9-46.6L	6/16/93	0922	1020	Land	Lawrence Abbott
46.0L	6/16/93	0755	0806	Land	Mark Sogge, Brad Valentine
46.2-46.7R	5/29/93	0630	0900	Land	Susan Sferra
46.3-46.6L	5/29/93	0520	0720	Land	Lawrence Abbott
46.4-46.5R Triple Alcove	5/29/93	1630	1735	Land	Lawrence Abbott
46.4-46.5R Triple Alcove	5/29/93	0945	1030	Land	Lawrence Abbott
46.5R Triple Alcove	6/17/93	0538	0640	Rand	Lawrence Abbott

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
46.6-46.7R Triple Alcoves	6/16/93	0835	1130	Land	Brad Valentine
46.7R Saddle Canyon	5/29/93	1635	1715	Land	Susan Sferra
46.7R Saddle Canyon/ Triple Alcoves	5/29/93	1745	1754	Land	Susan Sferra
46.7R Saddle Canyon	6/30/93	0453	0632	Land	Susan Sferra
46.7R 0.5 mile downstream from Saddle Canyon	6/29/93	1750	1844	Land	Jim Sedgwick
46.7R 0.5 mile downstream from Saddle Canyon.	6/30/93	0455	0543	Land	Jim Sedgwick
46.7-47.0L	5/29/93	0830	0850	Land	Lawrence Abbott
46.8-47.2L Includes Saddle Canyon Delta	6/17/93	0545	0650	Land	Mark Sogge
47.2-47.7L	6/17/93	0550	0650	Land	Brad Valentine
47.3R	6/17/93	0735	0746	Land	Mark Sogge
47.3L	6/17/93	0730	0753	Land	Lawrence Abbott, Brad Valentine
47.5R	6/17/93	0748	0755	Land	Mark Sogge
47.8-48.3R	6/17/93	0802	0955	Land	Brad Valentine
47.9-48.0R	5/29/93	1820	1900	Land	Susan Sferra, Lawrence Abbott
48.0-48.3R	6/17/93	0805	0905	Land	Lawrence Abbott
48.3-48.5L	6/17/93	0930	1010	Land	Lawrence Abbott
48.4R	6/17/93	0820	0826	Land	Mark Sogge
48.6R	6/17/93	0835	0850	Land	Mark Sogge
49.6R	6/17/93	1033	1044	Land	Mark Sogge
49.6-50.3L	6/18/93	0537	0750	Land	Brad Valentine
49.6-50.2L	6/18/93	0755	0940	Land	Brad Valentine
50.0-50.5L	5/30/93	0505	0651	Land	Susan Sferra
50.0-50.5L	5/30/93	1830	1920	Land	Susan Sferra
50.0-50.5L	5/31/93	0515	0700	Land	Lawrence Abbott

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
50.4-51.3L	6/18/93	0555	0712	Land	Mark Sogge
50.5-51.6L	5/31/93	0506	1040	Land	Susan Sferra
50.5-51.8L	5/30/93	0610	0900	Land	Lawrence Abbott
50.5-51.8L	5/30/93	1700	1830	Land	Lawrence Abbott
51.2L	6/1/93	0600	0900	Land	Susan Sferra
51.3L	6/18/93	0551	0833	Land	Lawrence Abbott
51.6R	6/19/93	0654	0702	Boat	Mark Sogge
52.8R	6/19/93	0730	0750	Land	Mark Sogge
53.1R	6/19/93	0801	0815	Land	Mark Sogge
54.5L	6/19/93	0855	0920	Land	Lawrence Abbott
54.6R	6/19/93	0855	0912	Land	Brad Valentine
55.5L	6/19/93	0931	0951	Land	Mark Sogge
55.6R	6/19/93	0940	1010	Land	Brad Valentine
55.6-55.7L	6/19/93	0935	1005	Land	Lawrence Abbott
55.7R	6/19/93	1016	1050	Land	Brad Valentine
70.5L	6/3/93	1705	1815	Land	Lawrence Abbott
70.7-71.0L	6/3/93	0700	0900	Land	Susan Sferra
70.7R	6/3/93	1800	1845	Land	Susan Sferra
70.7L	6/4/93	0525	0705	Land	Lawrence Abbott
70.7-71.0L	6/4/93	0530	0635	Land	Susan Sferra
71.0L Cardenas Marsh	6/2/93	0511	0930	Land	Susan Sferra
71.0L Cardenas Marsh	6/3/93	0550	0640	Land	Susan Sferra
71.0L Cardenas Marsh	6/20/93	0805	0851	Land	Lawrence Abbott, Brad Valentine
72.0L	6/4/93	0755	0830	Land	Susan Sferra
72.0L	6/4/93	0800	0830	Land	Lawrence Abbott
89.0R Bright Angel Creek	6/4/93	1600	1715	Land	Susan Sferra, Lawrence Abbott
91.0R	7/4/93	0545	0745	Land	Matt Johnson
91.5L	7/4/93	0515	0715	Land	Jeri DeYoung

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
98.1R Crystal Creek	5/26/93	1630	1800	Land	Tim Tibbitts, Dave Krueper
98.1R Crystal Creek	5/27/93	0510	0715	Land	Tim Tibbitts, Dave Krueper
108.5R Lower Shinumo Creek	5/27/93	1615	1820	Land	Tim Tibbitts, Dave Krueper
108.5R Lower Shinumo Creek	5/28/93	0500	0850	Land	Dave Krueper
108.5R Upper Shinumo Creek	5/28/93	0530	0850	Land	Tim Tibbitts
108.5R Shinumo Creek	6/13/93	1700	1930	Land	Laura Ellison
108.5R Shinumo Creek	6/14/93	0510	0700	Land	Reed Tollefson
108.5R Upper Shinumo Creek	6/14/93	0530	0930	Land	Laura Ellison
131.5R 1.5 miles up Stone Creek	6/14/93	1700	1930	Land	Laura Ellison
131.5R	6/15/93	0440	0650	Land	Reed Tollefson
131.5R 1.5 miles up Stone Creek	6/15/93	0500	0930	Land	Laura Ellison
133.7R Tapeats #2	5/28/93	1730	1820	Land	Tim Tibbitts
133.7R Tapeats Creek	5/29/93	0615	0815	Land	Dave Krueper
133.7R Tapeats #3	5/29/93	0640	0810	Land	Tim Tibbitts
133.7R Tapeats #3	5/29/93	1400	1740	Land	Tim Tibbitts, Dave Krueper
133.7R Tapeats #1,2,3	5/30/93	0525	0745	Land	Tim Tibbitts

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
133.75R "Upper Tapeats". Approx. 3 miles up to Thunder River.	6/15/93	1714	1930	Land	Laura Ellison
133.75R "Upper Tapeats"	6/16/93	0545	0945	Land	Laura Ellison
133.8L	5/30/93	0510	0800	Both	Dave Krueper
136.0R Deer Creek	5/30/93	1130	1245	Land	Tim Tibbitts, Dave Krueper
136.0R Deer Creek	6/16/93	0900	1030	Land	Reed Tollefson
136.0R	6/17/93	0500	0900	Land	Reed Tollefson
136.0R Deer Creek	6/17/93	0500	0525	Land	Laura Ellison
136.0R 1.5 miles up Deer Creek	6/17/93	0540	0900	Land	Laura Ellison
136.0R Deer Creek	7/3/93	0530	0700	Land	Matt Johnson
145.5R	7/4/93	1215	1315	Land	Matt Johnson
156.8L Havasu Canyon Creek to Mooney Falls	5/31/93	0550	1100	Land	Tim Tibbitts, Dave Krueper
156.8L Havasu Canyon	6/18/93	0555	0900	Land	Reed Tollefson
156.8L Havasu Canyon Creek to Beaver Falls	6/18/93	0550	0900	Land	Laura Ellison
165.8-166.4L	5/31/93	1600	1630	Boat	Tim Tibbitts, Dave Krueper
165.8-166.4L	6/1/93	0450	0600	Land	Tim Tibbitts
166.4L National Canyon 0.25-0.5 mile up cyn	6/1/93	0510	0545	Land	Dave Krueper
167.5-168.0R	6/1/93	0740	0820	Both	Tim Tibbitts, Dave Krueper
169.0-170.0R/L	6/1/93	0820	0840	Boat	Tim Tibbitts, Dave Krueper
170.0-171.0R/L	6/1/93	0850	0930	Both	Tim Tibbitts, Dave Krueper
174.5R	6/2/93	0430	0610	Land	Tim Tibbitts, Dave Krueper

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
182.6L	6/2/93	0810	0830	Land	Tim Tibbitts, Dave Krueper
186.1R	6/18/93	1737	1800	Boat	Laura Ellison
191.0R	6/18/93	1830	1915	Land	Laura Ellison
191.0R	6/19/93	0500	0620	Land	Laura Ellison
191.1R	6/2/93	1725	1820	Land	Tim Tibbitts, Dave Krueper
191.1R	6/3/93	0500	0645	Land	Tim Tibbitts, Dave Krueper
191.1R	6/18/93	1900	2000	Land	Reed Tollefson
191.1R	6/19/93	0510	0610	Land	Reed Tollefson
192.0-197.0R/L	6/19/93	0825	1025	Boat	Laura Ellison
194.0L	6/3/93	0715	0735	Boat	Tim Tibbitts, Dave Krueper
194L	6/19/93	0830	0845	Boat	Reed Tollefson
197.0-198.0R	6/3/93	0740	1040	Both	Tim Tibbitts, Dave Krueper
197.0-198.0R	6/4/93	0630	0740	Land	Tim Tibbitts, Dave Krueper
197-198R - I	6/19/93	0850	0900	Boat	Reed Tollefson
197-198R - II	6/19/93	0910	0920	Boat	Reed Tollefson
197-198L - I	6/19/93	0930	0945	Boat	Reed Tollefson
197-198L - II	6/19/93	1015	1025	Boat	Reed Tollefson
198R	6/19/93	1000	1015	Boat	Reed Tollefson
198.0R	6/20/93	0515	0630	Land	Laura Ellison, Helen Yard
198.0R	7/5/93	0526	0730	Both	Matt Johnson, Jeri DeYoung
204.0R	6/20/93	0800	0900	Land	Laura Ellison
204.3R Spring Canyon	6/4/93	0845	0945	Land	Dave Krueper
204.3R Spring Canyon	7/5/93	1912	2000	Land	Matt Johnson
204.3R Spring Canyon	7/6/93	0530	0730	Land	Matt Johnson
204.5L	6/20/93	0855	1000	Land	Reed Tollefson
204.5-205.0L	6/4/93	0845	1000	Land	Tim Tibbitts
208.0L	6/20/93	1007	1017	Boat	Laura Ellison
208R	6/20/93	0930	0945	Boat	Reed Tollefson

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
243.0R	5/26/93	0530	0555	Land	John Grahame
243.2R	6/13/93	0548	0613	Land	Mark Sogge, Andrew Hands
243.2L	5/26/93	0600	0615	Land	John Grahame
243.3L	6/13/93	0625	0656	Land	Mark Sogge, Andrew Hands
246.0L	6/13/93	0715	0826	Land	Mark Sogge, Andrew Hands
247.5L	6/13/93	0853	0904	Land	Mark Sogge, Andrew Hands
248.3R Surprise Canyon	5/26/93	0636	0652	Land	Mark Sogge
249.0L	5/26/93	0640	0650	Land	John Grahame
249.0L	6/13/93	0916	0936	Land	Mark Sogge, Andrew Hands
249.2L	5/26/93	0700	0720	Land	John Grahame
249.2-249.3R	6/13/93	0550	0610	Land	John Grahame
249.3R	5/26/93	0702	0722	Land	Mark Sogge
250.6L	6/13/93	0945	0955	Land	Mark Sogge, Andrew Hands
251.0R	5/26/93	0730	0746	Land	Mark Sogge
251.0R	6/13/93	0620	0630	Boat	John Grahame
252.0L Reference Point Creek	6/13/93	1005	1025	Land	Mark Sogge, Andrew Hands
252.1-252.4R	6/13/93	0640	0700	Land	John Grahame
252.2L	5/26/93	0754	0820	Land	Mark Sogge
252.3R	5/26/93	0755	0825	Both	John Grahame
255.4-255.5R	6/13/93	0715	0745	Land	John Grahame
255.4R Salt Creek	5/26/93	0836	0900	Land	Mark Sogge
256.2-256.8L	5/26/93	0910	0945	Land	Mark Sogge
256.3L	5/26/93	0840	0845	Boat	John Grahame
256.6L	5/26/93	0905	0925	Land	John Grahame
256.2-257.0L	6/14/93	0549	0647	Both	Mark Sogge, Andrew Hands
256.8-256.9R	6/13/93	0755	0820	Boat	John Grahame
257.0R	5/28/93	0705	0805	Land	John Grahame
257.1R	5/26/93	0945	1020	Both	Mark Sogge, John Grahame

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
257.1L	6/14/93	0650	0656	Boat	Andrew Hands
257.5L	6/14/93	0702	0707	Boat	Mark Sogge, Andrew Hands
257.5-258.0R	6/13/93	0820	0850	Both	John Grahame
257.6L	5/28/93	0605	0618	Land	Mark Sogge
257.7L	6/14/93	0708	0714	Boat	Mark Sogge, Andrew Hands
257.8L	5/27/93	1725	1735	Boat	Mark Sogge
257.7R	5/28/93	0620	0640	Both	John Grahame
257.8L	5/28/93	0620	0625	Boat	Mark Sogge
258.3L	5/28/93	0635	0705	Land	Mark Sogge
258.5R	5/28/93	0650	0705	Land	John Grahame
258.5-258.8L	6/14/93	0718	0731	Boat	Mark Sogge, Andrew Hands
259.2R Burnt Spring Canyon, 1/4 mile to heron rookery	6/13/93	0910	0930	Land	John Grahame
259.2R Burnt Spring Canyon, above rookery 1/2 mile to area of large willows.	6/13/93	0930	1025	Land	John Grahame
259.3-259.9L	6/14/93	0736	0756	Both	Mark Sogge, Andrew Hands
259.4L	5/28/93	0716	0732	Both	Mark Sogge
260.1L Quartermaster	5/28/93	0735	0745	Land	Mark Sogge
260.1L Quartermaster	6/13/93	1105	1110	Boat	Mark Sogge
260.1L Quartermaster	6/14/93	0803	0825	Land	Mark Sogge, Andrew Hands
260.1-260.2R	6/14/93	0555	0625	Both	John Grahame
260.6-261.1R	6/14/93	0635	0700	Boat	John Grahame
260.7R(A)	5/28/93	0845	0905	Land	Mark Sogge
260.7R(B)	5/28/93	0845	0920	Land	John Grahame
260.8L	5/28/93	0910	0925	Land	Mark Sogge
260.9L	6/14/93	0830	0833	Boat	Mark Sogge, Andrew Hands

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
261.2-262.0L	6/14/93	0835	0854	Boat	Mark Sogge, Andrew Hands
262.3-264.0L	5/30/93	1915	2000	Both	John Grahame
262.4-263.7L	6/14/93	0859	0947	Boat	Mark Sogge, Andrew Hands
262.5R	5/30/93	1915	1923	Land	Mark Sogge
262.6R	5/30/93	1924	1930	Boat	Mark Sogge
262.8R	5/30/93	1931	1936	Boat	Mark Sogge
263.0-264.3R	5/30/93	1938	2015	Boat	Mark Sogge
263.6-263.9L	6/15/93	0533	0545	Boat	John Grahame, Andrew Hands
263.8-264.1R Dry Canyon	6/14/93	0715	0740	Both	John Grahame
264.1-264.3L	6/15/93	0550	0630	Land	John Grahame, Andrew Hands
264.5R Dry Canyon	5/31/93	0525	0535	Boat	John Grahame, Mark Sogge
264.8-265.1L	6/14/93	0950	1003	Boat	Andrew Hands
264.8-266.0L	6/15/93	0645	0700	Boat	John Grahame, Andrew Hands
265.5-265.8L	5/29/93	0540	0555	Boat	Mark Sogge, John Grahame
265.5-268.0L	6/15/93	0708	0745	Boat	John Grahame, Andrew Hands
265.6-266.6R	6/14/93	0800	0905	Both	John Grahame
266.6-268.4L	5/29/93	0710	0825	Boat	Mark Sogge, John Grahame
266.9-268.0R	6/15/93	0753	0905	Both	John Grahame, Andrew Hands
268.1-268.8R	6/15/93	0910	0945	Both	John Grahame, Andrew Hands
268.5L	6/16/93	0525	0538	Boat	John Grahame, Andrew Hands
268.6-268.9L	5/29/93	0900	0930	Land	Mark Sogge
268.7L	6/16/93	0542	0549	Boat	John Grahame, Andrew Hands
269.0-269.2R	5/30/93	0545	0555	Boat	Mark Sogge, John Grahame
269.0-269.6R	6/17/93	0545	0620	Boat	John Grahame, Andrew Hands
269.3R	6/16/93	0604	0650	Land	John Grahame, Andrew Hands
269.8-270.0 Island in channel	5/30/93	0600	0610	Boat	Mark Sogge, John Grahame
269.8-270.5L	6/17/93	0625	0635	Boat	John Grahame, Andrew Hands
270.0-270.5L	5/30/93	0615	0635	Boat	Mark Sogge, John Grahame

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
270.0-270.8R	6/16/93	0705	0715	Boat	John Grahame, Andrew Hands
270.1-270.9R	5/30/93	0645	0715	Boat	Mark Sogge, John Grahame
270.7-271.7L	7/17/93	0640	0715	Boat	John Grahame, Andrew Hands
271.2-271.8L	5/30/93	0722	0757	Boat	Mark Sogge, John Grahame
271.2-272.4R	5/31/93	0600	0650	Boat	Mark Sogge, John Grahame
271.9-272.1L	5/30/93	0800	0810	Boat	Mark Sogge, John Grahame
271.9-272.1L	6/17/93	0720	0735	Boat	John Grahame, Andrew Hands
272.7-273.6L	6/17/93	0745	0805	Boat	John Grahame, Andrew Hands
273.1R	6/26/93	0719	0729	Boat	John Grahame, Andrew Hands
273.3-273.9L	5/30/93	0815	0845	Boat	Mark Sogge, John Grahame
273.3R	5/31/93	0655	0705	Boat	Mark Sogge, John Grahame
273.8L	7/8/93	0653	0655	Boat	John Grahame
274.0-275.2R	5/31/93	0710	0810	Boat	Mark Sogge, John Grahame
274.0-274.4R	7/8/93	0703	0720	Boat	John Grahame
274.3-274.4L Columbine Falls	5/30/93	0845	0855	Boat	Mark Sogge, John Grahame
274.3-274.6L Columbine Falls	6/15/93	0820	1010	Both	John Grahame, Andrew Hands
274.3-274.5L Columbine Falls	7/8/93	0631	0645	Boat	John Grahame
274.5L Columbine Falls	5/30/93	0915	1005	Land	Mark Sogge
274.5-274.6L Columbine Falls	5/30/93	0915	0920	Boat	Mark Sogge, John Grahame
274.5-274.9 Columbine Falls	6/17/93	0825	0835	Boat	John Grahame, Andrew Hands
274.4-275.3R	6/15/93	0722	0754	Boat	John Grahame, Andrew Hands
274.6-274.7L	7/8/93	0640	0649	Boat	John Grahame
274.6-275.4R	7/8/93	0724	0811	Boat	John Grahame
274.8-275.0L	5/30/93	0925	0940	Boat	John Grahame
274.8L	6/17/93	0845	0900	Boat	John Grahame, Andrew Hands
274.8-275.0L	7/8/93	0819	0826	Boat	John Grahame
275.1-275.2L	5/30/93	0945	0950	Boat	John Grahame

Appendix I - continued

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
275.1-275.5L	6/17/93	0910	0950	Land	John Grahame, Andrew Hands
275.6-276.0R	6/15/93	0758	0810	Boat	John Grahame, Andrew Hands
275.6-275.8R	6/18/93	0555	0610	Boat	John Grahame, Andrew Hands
275.6-276.1R	6/18/93	0630	0800	Boat	Andrew Hands
275.9-276.8R	7/8/93	0850	0910	Boat	John Grahame
276.0-276.9R	5/31/93	0818	0848	Boat	Mark Sogge, John Grahame
276.1-276.5R	6/18/93	0840	0910	Boat	John Grahame
276.1R	7/8/93	0545	0638	Boat	John Grahame

APPENDIX II

1993 Colorado River Willow Flycatcher Survey Personnel.

Lawrence Abbott, National Park Service CPSU/NAU, Flagstaff

Jeri DeYoung, National Park Service CPSU/NAU, Flagstaff

Laura Ellison, National Park Service CPSU/NAU, Flagstaff

John Grahame, National Park Service CPSU/NAU, Flagstaff

Andrew Hands, Grand Canyon National Park

Matthew Johnson, National Park Service CPSU/NAU, Flagstaff

Dave Krueper, Bureau Land Management, San Pedro River

Clive Pinnock, Glen Canyon National Recreation Area

Jim Sedgwick, U.S. Fish and Wildlife Service, Fort Collins

Susan Sferra, Nongame Branch, Arizona Game and Fish Department

Mark Sogge, National Park Service CPSU/NAU, Flagstaff

Tim Tibbitts, U.S. Fish and Wildlife Service, Phoenix

Reed Tollefson, Kern River Preserve, California

Brad Valentine, California Dept. of Forestry, Santa Rosa

APPENDIX III

Data sheets used during 1993 willow flycatcher surveys, Colorado River, Arizona

GRAND CANYON BIRD DATA

Patch: ________ Date: ________ Time Start: ________ Time Stop ________ Temp: ________ °C

Cloud Cover: ________ % Wind: ________ mph Observers: ________ Method: BOAT LAND BOTH

BIRD	POPULATION SIZE (in patch)						BREEDING BEHAVIOR							COMMENTS
	Pr	♂	♀	Imm	YY	Unk	Sing	Terr Aggr	Court	Nest Bldg	Food Carry	Nest Found	Feed Fldg	
BCHU														
WIFL														
BLPH														
ATFL														
BEWR														
BGGN														
BEVI														
LUWA														
YEWA														
COYE														
YBCH														
SUTA														
BLGR														
LABU														
SOSP														
BHCO														
HOOR														
NOOR														
HOFI														
LEGO														

GENERAL HABITAT DESCRIPTION/COMMENTS

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.

Willow Flycatcher Song Rate
Data Form

Date: _____ Observer(s):_____

Patch: _____ Sighting #: _____

Time Start: _____ Temp: _____
Time Stop: _____ Wind: _____ (mph)

Protocol -

Sit quietly in a location where you can watch, and hear, the bird. Wait 15 minutes after your last use of the tape playback call, to allow the bird to calm down after the "intrusion". On the form below, keep a tally of the number of song (FITZ-BEW) and calls (WHITT) that the bird makes. Record vocalizations for
2 consecutive minutes, once every 10 minutes (6 times/hour).

This data can be collected while you are observing the bird to determine breeding or nesting status, or just while you are watching a nest or a bird. Be sure that you are recording the songs of the appropriate individual bird.

TIME	Number of Songs	Number of Calls	Comments

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? _____