

GLEN CANYON NATIONAL RECREATION AREA

**BREEDING BIRDS ALONG THE COLORADO RIVER
THROUGH GLEN CANYON: THE 1995 REPORT
AND AN HISTORICAL PERSPECTIVE**

SEPTEMBER, 1995

FINAL REPORT

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SEPTEMBER, 1995

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Bryan Brown, who literally wrote the book on Grand Canyon birds, has been an enthusiastic and, of course, thoroughly knowledgeable, supporter of this work. It was he who suggested that we compare the results of our surveys to the baseline data from pre-dam surveys. When we needed some perspective, we called on Bryan, who guided us out of several periods of ignorance and confusion. His review of our draft report was especially detailed and helpful.

We were fortunate during the 1995 breeding season to have the services of a Student Conservation Association volunteer, D. Keith Crenshaw. Keith was a reliable and hardworking colleague on the river -- he always showed up on time to the 5:00 am surveys. When it came time to compile data and prepare tables and charts, he showed once again that he could do anything we asked of him, and do it well.

As with every project we have undertaken while employed by Glen Canyon Recreation Area, we have relied on the wide-ranging knowledge of John Spence for information, guidance, and review. We wish to especially thank him for his time and for the quality of his contributions.

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INTRODUCTION

The completion of Glen Canyon Dam in 1963 has profoundly altered the water quality, riparian processes, and hydrologic regimes of the approximately 16 miles of the Colorado River through Glen Canyon that remain below the dam. What is now a cold, clear river with strictly regulated discharges from the dam was formerly subject to widely fluctuating temperature, flooding frequency and sediment transport.

The operational history of Glen Canyon Dam can be divided into three distinct "eras" of water release. In the early and mid-1980s annual spring flood conditions caused "spike" flows of 45,000 cfs (cubic feet per second) or greater to occur. These periods of abnormally high release were in contrast to the normal "peaking power" releases which were seen from the summer of 1986 through the summer of 1991. On August 1, 1991, the Bureau of Reclamation began reducing the daily magnitude of fluctuations with the implementation of "interim flows," designed to protect downstream resources until the completion of an Environmental Impact Statement and Record of Decision.

Beginning in 1992, the Glen Canyon National Recreation Area Resource Management Division received funding from Glen Canyon Environmental Studies to conduct studies to determine the impact of the interim flows on the breeding bird community along the Colorado River through Glen Canyon. This report presents the results of the 1995 surveys and reviews the results of four years of study. We also, for historical interest, compare our results with records of the avian community that existed prior to the completion of the dam.

The objectives of this report are as follows:

1. Present and discuss the results of the 1995 Breeding Bird Survey.
2. Describe the breeding bird community along the Colorado River between Glen Canyon Dam and Lees Ferry based on the results of four years of Breeding Bird Surveys.
3. Consider what effect, if any, the interim flow regime may have had on the breeding bird community.
4. Review the records of the avian community that existed prior to the completion of the dam in order to compare them with the results of the current surveys.
5. Provide recommendations on future research and management practices that would benefit the breeding bird communities of Glen Canyon National Recreation Area.

THE NATURAL AND UNNATURAL HISTORY OF GLEN CANYON

The "labyrinthine gorge"*

Glen Canyon stretched 170 river miles prior to the inundation of all but the lower 16 miles following the completion of Glen Canyon Dam in 1963. William H. Behle, who with three associates made a boat trip through Glen Canyon 13-17 April 1947, describes a "comparatively quiet" stretch of river.

A number of circumstances make for a fairly rich avifauna. The canyon floor is in many places wide and varied. In addition to the river with its banks there are terraces, sometimes of large extent, numerous glens which gave the canyon its name, and many tributary canyons. Some of these side canyons are narrow, while others are wide. Some are dry and desert-like, while others have permanent streams. The vegetation varies widely from one environmental situation to another. Thus there are many habitats for permanently resident and summer resident species. Although the river fluctuates greatly throughout the year, usually numerous sand bars and river banks afford resting places for migratory shore and water birds... (Behle and Higgins 1959:8)

The 16-mile gorge

The river corridor that remains between the dam and Lees Ferry does not, nor did it ever, conform to the above description. The geomorphology and riparian habitats of this section are more similar to those of Marble Canyon downstream than to those of the former Glen Canyon upstream. The Colorado River here traverses a relatively narrow gorge with sheer cliffs rising 1000 feet and more, and usually within 100 horizontal feet of the waters edge. The "glens" of Glen Canyon never existed along this stretch of river; there are no terraces "of large extent;" the canyon floor is never "wide and varied;" and the only side canyon of any consequence above the confluence of the Paria River at Lees Ferry is Waterholes, which is a slot canyon and dry except during periods of rain.

Habitat changes since the completion of the dam

Today the river fluctuates relatively little, and without its former silt load to renew the sand bars and open river banks, there is little to attract migratory shore and water birds. Stands of mesquite and acacia, characteristic of the "Old High Water Zone" (OHWZ) in much of Grand Canyon, never existed above Lees Ferry (Turner and Karpiscak 1980). Hackberry, oak, apache plume, and New

*Woodbury 1958:1

Mexico Privet did exist in the OHWZ in Glen Canyon, but this habitat was probably poorly developed in the lower reaches due to the scouring nature of seasonal flooding through the gorge. What there was of this woody vegetation has been gradually disappearing due to the lack of new silt loads needed for regeneration.

Although some native coyote willow and Emory seepwillow are still present, the cottonwood and willow stands of the side canyons that pre-dam surveys found particularly productive for breeding birds never existed between Glen Canyon Dam and Lees Ferry. However, the lack of scouring seasonal floods has led to the creation of a "New High Water Zone" (NHWZ) of riparian vegetation. The NHWZ consists primarily of intermittent stands of dense tamarisk, and the result has been an overall increase in the amount of woody vegetation in the river corridor.

The effects of interim flows

In Grand Canyon the effects on this riparian habitat of four years of reduced maximum flows and daily flow fluctuations have been shown to be concentrated in a narrow band of new vegetative growth near the river's edge (Stevens and Ayers 1994). This appears to be the case in Glen Canyon as well. We have also observed that artificial marshes, created by the flooding of low-lying areas during peaking power releases before the initiation of interim flows, have dried out and declined. Some patches of herbaceous taxa, notably those dominated by reedgrasses (*Phragmites* spp.) may have expanded (John Spence, pers. comm).

The pre-dam surveys

The first scientific surveys of Glen Canyon were the John Wesley Powell expeditions of 1869-1870 and 1871-1872. Their observations of wildlife were limited to the larger game animals, "probably those that could be used for food" (Atwood et al. 1980:303). During the late twenties and early thirties, proposals were made to set aside much of the northern part of the Navajo Country as a national park. The National Park Service, recognizing the fact that the number of scientific investigations after those of Powell into Glen Canyon were few indeed, initiated a series of comprehensive scientific surveys into the area which collectively became known as the Rainbow Bridge-Monument Valley Expeditions (Crampton 1959).

The first of these was a boat trip that descended the San Juan and Colorado Rivers to Rock Creek from mid-June to mid-August of 1933. The results of this work were reported by Ansel F. Hall (1934). In 1936, from July 4 to July 22, a second boat expedition went from Hite to Lees Ferry. Bird sightings were recorded by Torrey Lyons, who was also a member of the 1933 expedition. His records indicate that he surveyed the birds from shore at river mile 13 (3 miles downstream from where the dam was built 25 years later) and at several locations around Lees Ferry (Woodbury and Russell 1945:5).

Angus M. Woodbury, whose Birds of the Navajo Country (1945) gives a detailed account of the results of the Rainbow Bridge-Monument Valley expeditions, was in charge of the ornithological work for the last two San Juan/Colorado River survey trips in this series. In 1937, from July 3 through July 13, Woodbury descended the San Juan and Colorado Rivers as far as Rock Creek Canyon. In 1938, from July 29 through August 11, he was accompanied by his future co-author, Henry Norris Russell, and together they surveyed the rivers all the way to Lees Ferry.

In 1957, the National Park Service initiated a salvage program for the Glen Canyon area preparatory to the construction of Glen Canyon Dam. After a reconnaissance trip, 8-14 August 1957, by Woodbury and his staff, Woodbury published an annotated checklist of the birds of the proposed Glen Canyon Reservoir area (Woodbury 1958). His data was from various sources, including published and unpublished manuscript records.

Birds were also observed by Harold Higgins and Gerald Smith on a river trip extending from July 1 to August 9, 1958 from Hite to Lees Ferry. Since the results of their trip were not included in Woodbury's 1958 report, William H. Behle, who had himself made a similar trip in mid-April of 1947 (Behle 1948), published with Higgins in 1959 an annotated checklist of the birds which concentrated on areas adjacent to the Colorado River and its tributaries. This publication included a number of previously unpublished bird observations from Woodbury and Russell's field notes from their 1938 expedition (Behle and Higgins 1959; Atwood et al. 1980:305).

A post-dam survey

The only attempt to conduct a comprehensive post-dam survey of the area was initiated in June of 1971, when Brigham Young University and Northern Arizona University undertook the Environmental Impact Studies for the Navajo and later in 1972 and 1973 for the proposed Kaiparowits Generating Stations. Their results, including observations from Lees Ferry and Lake Powell, are summarized in Atwood et al. (1980). Atwood states that due to methodological limitations "data pertaining to avian seasonal population trends ... are only suggestive" (p. 312). However, Atwood includes a comprehensive literature review which makes this report particularly valuable.

A necessary caution

In this report we will be comparing the results of pre-dam and post-dam studies of Glen Canyon avian communities with the results of our four year of surveys. Apparent differences could have more than one explanation. For example, if a species described as a common summer resident in pre-dam surveys was not found to be common in our surveys, the species may indeed have declined or

disappeared due to habitat changes in our survey area as a consequence of the building of the dam. Or it may have declined region-wide as a function of factors unrelated to the building of the dam. Or the species may in fact never have been a common summer resident along this particular stretch of the Colorado River. An effort will be made in this report to look carefully at the pre-dam records for specific reference to the lower sixteen miles of Glen Canyon before the suggestion is made that the population in question has been affected, either positively or negatively, by the construction of Glen Canyon Dam.

METHODS

In 1995, as in the three previous breeding seasons, we used a 25-meter fixed radius point count. As described in Douglas (1992), prior to the 1992 survey work, color aerial photographs of the river corridor below Glen Canyon Dam were examined to select breeding bird plot locations from stretches of the river corridor containing substantial riparian growth. Areas selected were to be at least 250 meters in length and 20 meters in width. A well-developed shrub or tree overstory completed the criteria. Ten stands of riparian vegetation were chosen in 1992.

Census points were chosen by measuring (on the photograph) 50 meters from one end of each suitable transect area and 30 meters from the water's edge to establish a reference point. A randomly selected measurement between 1 and 10 meters was measured further into the riparian area, parallel to the river, to select the first actual sample point for that riparian strip. The second point was placed by measuring 150 meters from the first plot location, then adding the random 1 to 10 meters. Twenty plots were located in this manner in 1992. Based upon the 1992 field work, one plot (no. 11) was deleted prior to the 1993 season due to the paucity of birds at this location. Two additional plots were added in 1993, one in a return channel marsh at river mile -6.5, and the second at Lees Ferry at river mile -0.2. (Since the building of the dam, river miles are given as negative numbers upstream from river mile 0 at Lees Ferry.) These 21 plots and their corresponding river miles are shown on the map in Appendix 1. U.T.M. Northings and Eastings are also listed in Appendix 1.

Attempts were made to visit plots every other week from early May through mid-July during a Designated Survey Period. These were as follows:

Survey Period 1:	May 1 through May 14
"	" 2: May 15 " May 28
"	" 3: May 29 " June 11
"	" 4: June 12 " June 25
"	" 5: June 26 " July 9
"	" 6: July 10 " July 23

Surveys began as soon after first light as practicable and were concluded whenever possible by 9:30 am. A team of two or more observers (or up to four observers during training) moved to each plot and waited quietly for two minutes. Bird activities were monitored for 10 minutes in 1992, but the survey period was reduced to 5 minutes in 1993 and 1994. Birds were counted and recorded as being INPLOT (within a 25-meter radius) or OUTPLOT (outside the 25-meter radius) and were recorded whether seen or heard. Birds detected flying over the 25-meter radius plot were also counted and recorded as FLYOVERS.

The lack of a reliable boat with which to conduct the surveys forced abandonment of survey trips in each year except 1995, when a more reliable boat became available. The shaded areas in Appendix 2 indicate surveys and portions of surveys that were completed, 1992-1995. Note that surveys were not completed in 1992 for surveys 1, 5 and 6; in 1993 for surveys 1 and 6; and in 1994 for survey 2. (Also, Plot #21 did not exist and was not surveyed in 1992). Although these missing data sets have made it difficult to compare results across years, data from 1993, 1994, and 1995 is directly comparable for Survey Periods 3, 4 and 5 which were successfully completed in all three years. This data can be analyzed for significant differences in abundance between any two years for any given species or set of species using the two-tailed Wilcoxon Signed Rank Test, a simple non-parametric test for comparing the medians of two matched samples.

Since Survey Period 5 is partially missing in 1992 we cannot compare the data set from that year to the data set from 1993 to 1995. The data from 1992 is further handicapped for comparison purposes by the methodological changes in 1993 from a 10-minute count to a 5-minute count and the additions and deletions of plot locations. For these reasons we have not used the data from 1992 in our analyses for this report. Data from 1992 are included in the three previous Breeding Bird Survey reports (Douglas 1992, Spence and Pinnock 1993, and Grahame and Pinnock 1994):

RESULTS

Species detected

Appendix 3 lists all species detected over the four years of the survey and includes the four-letter species codes for each. Dates of unusual sightings are also given. In 1995, a total of 38 bird species was detected from all survey periods. This compares with 36 species in 1994, 37 in 1993, and 30 in 1992. These species totals include sightings from all surveys, even those that were not completed for all plots.

Eight species seen on the Breeding Bird Survey in 1995 had not been detected in any surveys from the previous 3 years (Table 1). None of these species showed any evidence of breeding along the river in 1995.

Table 1. Species seen during breeding bird surveys for the first time in 1995.

Species	Date(s)	Number(s)	Plots(s)
Turkey Vulture	6/6	2	4
Yellow-Billed Cuckoo	6/21	1	21
Gray Flycatcher	5/10	1	17
Red-winged Blackbird	6/20	1	1
Rufous-crowned Sparrow	7/19	1	12
Lazuli Bunting	5/9	1	10
	5/20	1	20
	5/24	1	21
	7/18	1	11
Bell's Vireo	6/6	1	9
Orange-crowned Warbler	5/10	2	19

Appendices 4, 5 and 6 give the totals by plot for the ten most common riparian breeders and the two corridor-breeding wrens detected for Survey Periods 3, 4 and 5 in 1993, 1994, and 1995 respectively. The totals are for all birds detected, whether INPLOT, OUTPLOT, or as FLYOVERS. The species order for all three tables is based on the rank order of detection from most often detected to least often detected for the combined 3-year period.

The total number of individuals detected of these twelve common species for these three survey periods was 470 in 1993, 499 in 1994, and 450 in 1995. The Wilcoxon test reveals no significant differences between any two years when these species are considered as a group.

Relative frequencies of detection

The data from the twelve species listed in Appendices 4-6 were used to calculate relative frequencies of detection among species. For each year, and for the combined average of all three years, these species were ranked from most frequently counted to least frequently counted for Survey Periods 3, 4, and 5 (Table 2). Relative frequency for each species was calculated as the proportion of the total number of birds observed of that species divided by the number for the species with the largest total proportion. This number was then multiplied by 100 to obtain the relative percentage.

Table 2: Relative frequency and rank order of detection for the twelve most commonly-detected species (excluding aerial insectivores; Survey Periods 3, 4 and 5 only; INPLOT + OUTPLOT + FLYOVERS). The right-hand column averages the results for all three years and determines the order of the list.

<u>Species</u>	<u>1993</u>		<u>1994</u>		<u>1995</u>		<u>3-year Average</u>	
	% Rel. Freq.	Rank	% Rel. Freq.	Rank	% Rel. Freq.	Rank	% Rel. Freq.	Rank
House Finch (HOFI)	100	1	100	1	100	1	100	1
Canyon Wren (CNWR)	66	2	63	2	44	2	59	2
Bewick's Wren (BEWR)	55	3	50	3.5	35	3.5	48	3
Ash-throated Flycatcher (ATFL)	50	5	50	3.5	35	3.5	47	4
Yellow-breasted Chat (YBCH)	44	6	31	5	12	9	29	5
Rock Wren (ROWR)	54	4	16	7	11	11	25	6
Brown-headed Cowbird (BHCO)	26	9	26	6	19	6	23	7
Mourning Dove (MODO)	30	8	13	8	25	5	22	8
Blue Grosbeak (BLGR)	37	7	11	9	17	7	20	9
Northern Oriole (NOOR)	14	11	6	11	13	8	11	10
Blue-gray Gnatcatcher (BGGN)	6	12	9	10	11	10	9	11
Black-chinned Hummingbird (BCHU)	18	10	3	12	6	12	8	12

Although within each survey year this analysis reveals more about relative detectability than real population comparisons (it is much easier to detect a House Finch or a Canyon Wren than it is to detect a Black-chinned Hummingbird, especially at a distance), major change in rank and/or relative frequency can be a means of detecting relative population changes among species from year to year.

Species Accounts

The following species accounts include all birds which available records indicate have bred or currently breed in the river corridor between Lees Ferry and the point approximately 16 miles upriver that is the present location of Glen Canyon Dam. The list is not restricted to riparian nesters, but includes species such as Canyon and Rock Wrens, White-throated Swift, Violet-green Swallow, Peregrine Falcon, and others which breed or have bred in the river corridor at or below the top of the cliffs. Spotted Sandpiper is also included, since its breeding status in Glen Canyon has been in question.

The results of our study by species are presented in this section. Where the sample size is large enough, we have calculated the mean number of detections for each species for each survey period, 1993 to 1995, regardless of whether only two or all three surveys were completed. The results are presented graphically, so that variances in detection rates over three breeding seasons can be seen.

An estimation of relative abundance is also made, following Phillips et al. (1964) and Monson and Phillips (1981). Their terms for this index are as follows:

abundant	= in numbers
common	= always to be seen, but not in large numbers
fairly common	= very small numbers, or not always seen
uncommon	= seldom seen, but not a surprise
sparse	= always a surprise, but not out of normal range
casual	= out of normal range

Since we are surveying breeding birds, their term "accidental," defined as "far from normal range, and not to be expected again," is not used in our study. A summary of our estimations of relative abundance during the breeding season, both pre-dam from the surveys and currently from our own data, is presented in Appendix 5.

Order Anseriformes
Family Anseridae
(Swans, geese and ducks)

Mallard (*Anas platyrhynchos*): Current breeding status: common. Pre-dam: undetected.

Detections of this species from our survey plots were uncommon, since only two plots had an open view of the river (Plots #3 and #21). Breeding was confirmed during the survey, however, when a Mallard duck was discovered on a nest with 10 eggs near Plot 13 on May 28, 1992. Ducks with young-of-the-year were also commonly seen on the river between Lees Ferry and the dam every year during the summer. Breeding of this species on the river has benefitted from interim flow operations. and is discussed in detail in our 1995 River Waterfowl Survey Report (Grahame and Pinnock 1995).

Before the completion of the dam, fluctuating seasonal flows, high turbidity, and a lack of *Cladophora glomerata*, a filamentous green alga which appears to be the focus of Mallard foraging activity in present-day Glen Canyon, made conditions unsuitable for breeding ducks of any kind. Behle and Higgins (1959:115) considered Mallard to be an uncommon transient on the river.

Common Merganser (*Mergus merganser*): Current breeding status: common. Pre-dam: undetected.

This species was rarely detected from our survey plots, but was commonly seen on the river throughout the breeding season in all years, 1992-1995. Mergansers have also benefitted from interim flows, as described in our 1995 River Waterfowl Report (op. cit.).

Common Merganser was not recorded from any pre-dam Glen Canyon surveys.

Order Falconiformes
Family Accipitridae
(Hawks and eagles)

Red-tailed Hawk (*Buteo jamaicensis*): Current breeding status: uncommon. Pre-dam: common.

Based on regular sightings of adult and fledgling Red-tailed Hawks in the first river mile below the dam, a breeding pair probably has a nest in the cliffs nearby. Our survey detected this species on June 8, 1992 from Plots #1 and #2; on June 29, 1994 from Plot #1 and #4; and on July 13, 1994 from Plot #4. Raptor surveys conducted on the river in 1994 and 1995 found no evidence of other any other breeding pairs between Lees Ferry and the dam (Chris Connella, pers. comm.).

Woodbury and Russell's field records from 1936 indicate that Red-

tailed Hawk was common along the Colorado River, July 4 to 23. One nest with young birds was recorded by Lyons. Higgins found this species to be abundant in Glen Canyon from July 1 to August 9, 1958 (Behle and Higgins 1959:117).

Golden Eagle (*Aquila chrysaetos*): Current breeding status: fairly common. Pre-dam: common.

Golden Eagles were seen only four times in four years of surveys. Single birds were seen on May 27, 1992 at Plots #1 and #9, and on May 28 at Plot #16. On June 6, 1995, an eagle was seen from Plot #10 soaring above the cliffs.

Despite our small number of sightings, two active Golden Eagle nests are known from the cliffs above the river through Glen Canyon. One is near Finger Rock at approximate river mile -7.3 right; the other is just downstream from Waterholes Canyon at approximate river mile -3.5 left (Clive Pinnock, pers. comm.).

All pre-dam surveys describe Golden Eagle as a common permanent resident (Atwood et al. 1980:315).

Family Falconidae
(Caracaras and falcons)

American Kestrel (*Falco sparverius*): Current breeding status: undetected. Pre-dam: probably uncommon.

American Kestrel was detected only twice in four years of surveys, and it may have been the same bird. On June 9, 1992, a kestrel was seen at Plot #19; less than 30 minutes later, one was recorded from Plot #20. There are no other recent records from the breeding season for this species between Lees Ferry and the dam.

This small falcon was apparently common in Glen Canyon as a whole before the completion of the dam and for at least a decade afterward. Woodbury and Russell's field notes from 1938 indicate regular sightings along the Colorado River, including one at mile 13, August 10, and six between mile 13 and Lees Ferry on the same date. Although these sightings from our survey area may have been migrants, in 1936 Lyons reported them fairly common throughout Glen Canyon between July 7 and 22 (Behle and Higgins 1959:118).

From 1971 through 1974 the BYU surveys found American Kestrel still very common throughout the Kaiparowitz Basin during the breeding season. Over 75 birds were seen at 31 sites, including Lees Ferry and Wahweap Creek (Atwood et al. 1980:316).

Peregrine Falcon (*Falco peregrinus*): Current breeding status: common. Pre-dam: insufficient data.

Since 1982, Peregrine surveys along the river corridor have found

three and sometimes four eyries in the cliffs overlooking the river between Lees Ferry and the dam. This falcon has also become a common breeder in the cliffs surrounding Lake Powell in the 1980s and 1990s (Connella and Pinnock 1995) .

Peregrines had been in serious decline since the 1940s and pre-dam surveys found little evidence that they were breeding anywhere in Glen Canyon. The only record is one was seen by Harold Smith near Wahweap Creek, mile 17, on August 6, 1958 (Behle and Higgins 1959:117). Given the late date there is no reason to assume that this bird was not a migrant. Our own database (GLCABIRD 1995) contains six sightings from July, 1963 by Alcorn in upper Glen Canyon, but none from the lower portion of the river. Porter and White (1973), in a study examining the ecology of the Peregrine Falcon and its competition with the Prairie Falcon in Utah, felt certain that the species formerly nested in Glen Canyon along the Colorado River and its side canyons. They also predicted correctly that with the construction of Lake Powell, the area would be more suited for peregrines than formerly. Overall, however, we lack sufficient data to determine the abundance status of Peregrine Falcon prior to the construction of the dam.

Prairie Falcon (*Falco mexicanus*): Current breeding status: undetected. Pre-dam: probably fairly common.

This species was never detected from our surveys, nor have we been able to locate records of any sightings from the Colorado River corridor during the breeding season since the construction of the dam. Prairie Falcon is known to be declining in Utah (Ehrlich et al., 1988:246; Behle et al. 1985:16).

Pre-dam records indicate that Prairie Falcon was a fairly common permanent resident along the San Juan and Colorado Rivers in Glen Canyon. Behle saw a single bird and two pairs between Hite and Lees Ferry in April of 1947 (Behle 1948:305). The Rainbow Bridge-Monument Valley Expeditions observed only five from their San Juan and Colorado Rivers trips, although three of those were observed on cliffs between miles 13 and 0 on August 10, 1938. (Behle and Higgins 1959:117).

Order Charadriiformes
Family Scolopacidae
(Woodcock, snipe and sandpipers)

Spotted Sandpiper (*Actitus macularia*): Current breeding status: undetected. Pre-dam: undetected.

Although not detected in our surveys, Spotted Sandpiper has been recorded regularly along the river in Glen Canyon in late June (GLCABIRD 1995). Since this species has never been detected earlier in the breeding season, we assume that these birds have dispersed from breeding sites further downstream. Brown et al.

(1987:184) found Spotted Sandpiper to be a fairly common summer resident in Grand Canyon; at least some of these birds were breeding, as indicated by adults carrying nesting material and the sighting of juvenile birds.

Behle and Higgins (1959:118) considered Spotted Sandpiper to be a sparse breeder on the Colorado River through Glen Canyon. Their examination of Woodbury's field notes from 1938 revealed that two or three were seen at mile 13, one between miles 13 and 0, and six at one-half mile below Lees Ferry on August 10. In the summer of 1958 Higgins found Spotted Sandpiper common along the Colorado River, but his surveys of the lower portion of Glen Canyon were also conducted in early August. There is no reason to assume that these birds had not also dispersed from breeding sites further downstream. Higgins found them in the mouths of many side canyons and concluded that they nested along the smaller streams. Since side canyons with small streams did not exist in the lower portion of Glen Canyon, Spotted Sandpipers probably did not breed in our survey area.

Order Columbiformes
Family Columbidae
(Pigeons and doves)

Mourning Dove (*Zenaida macroura*): Current breeding status: common; pre-dam: common.

Although not considered a colonial breeder (Ehrlich et al. 1988:278), our surveys found Mourning Doves to be concentrated in certain areas. Particularly productive was the patch containing Plots #1, #2, and #3, a terraced bench at the Ropes Trail Camps (river mile -14.2 to -14.3 right). Bryan Brown (pers. comm.) had found 14 nests in this area in 1984.

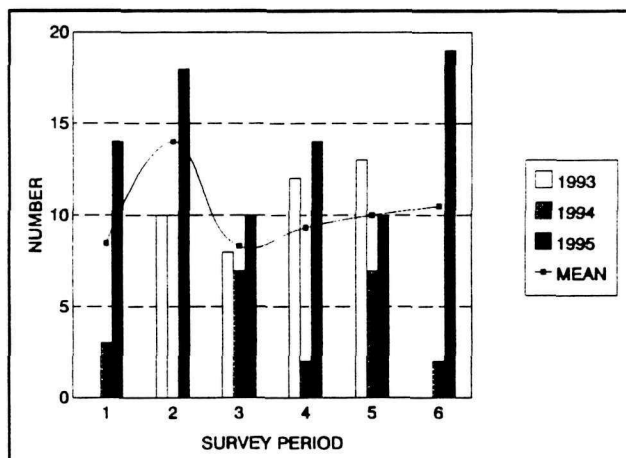


Figure 1: Mourning Dove (completed surveys only, 1993-1995)

In late April of 1994 a campfire fanned by high winds ignited the patch containing these plots. That summer Mourning Doves were no longer common in Plots #1 and #2 where the fire had burned with particular intensity, reducing much of the dense tamarisk stand to snags. Plot #3 was upwind of the campfire and burned as a less intense backfire -- most green vegetation was consumed by the fire, but many trees survived, and Mourning Doves continued to be detected there. This event may in part account for the overall

smaller numbers of detections in 1994 as compared to 1993 for Survey Periods 3, 4, and 5 (Figure 1); however, this difference does not reach significance at the $P \leq 0.05$ level ($T = 13$, $P = 0.0830$) perhaps due to the small sample size.

By the summer of 1995 new tamarisk growth had reached 2-3 meters in height, and Mourning Doves were again commonly detected at both plots. (A very exposed nest with four eggs was found in a snag approximately 3 meters from the center of Plot #1). There was a significant increase in the numbers of Mourning Doves detected overall in 1995 as compared to 1994 ($T = 14.5$, $P \leq 0.05$).

Also in the summer of 1995, rising water levels in Lake Powell forced the consistent release of larger amounts of water from Glen Canyon Dam than had been seen in the previous years of interim flows. A river waterfowl survey conducted on August 18 discovered that the river bank adjacent to Breeding Bird Plot #1 had been substantially eroded. Although we did not stop to investigate, it appeared from the river that several meters of NHWZ which had possibly been used for nesting by Mourning Doves had disappeared.

Higgins found Mourning Doves to be abundant in Glen Canyon in the summer of 1958. They were observed every day of the trip from July 1 to August 10 and occurred on the terraces and in the side canyons. Woodbury in 1938 saw two at mile 13, and three just above Lees Ferry on August 10. Woodbury's modest numbers in lower Glen Canyon suggest that although this species may have been abundant in Glen Canyon as a whole, it was probably common but not abundant in lower Glen Canyon where there were and are no vegetated side canyons and few large terraces.

Order Apodiformes
Family Apodidae
(Swifts)

White-throated Swift (*Aeronautes saxatalis*): Current breeding status: common. Pre-dam: common.

Almost all detections of this crevice-nesting species were FLYOVERS, as flocks of varying size range widely (Brown et al. 1987:199). Consequently, it seems to serve no function to analyze our data with respect to location. Instead, total numbers for comparable Survey Periods 3, 4, and 5 for each of the three years, 1993-1995, were calculated. In 1993, 48 swifts were detected; in 1994 the number dropped to 18; and in 1995 only 7 were counted.

Although these totals would suggest that real numbers of White-throated Swifts declined over three years in Glen Canyon, the apparent decline may be in part a function of a change in focus of the observers. In 1994 and 1995 we seldom scanned the skies for this species, recording their presence only when we noticed their calls and looked up to make a count. In contrast, one of the

regular observers in 1993, when asked, said that considerable effort was made in that year to scan for White-throated Swifts and other aerial species (Clive Pinnock, pers. comm.). As a result, no real decline in White-throated Swift numbers, 1993 to 1995, can be substantiated.

Behle and Higgins (1959:120) report many observations of this species from the field notes of Woodbury and Russell, 1936 through 1938. Although there are no specific observations given for the last 16 miles of Glen Canyon, it is likely that those observers too began to turn their attention to other species after numerous swift sightings.

Family Trochilidae
(Hummingbirds)

Black-chinned Hummingbird
(*Archilochus alexandri*): Current breeding status: common. Predam: common.

Riparian breeding birds range varying distances outside of the riparian zone. Black-chinned Hummingbirds, though nesting strictly in the NHWZ zone, are known to forage some distance away from their nests and into the desert scrub sometimes found on the terraces (Brown and Johnson 1987:14). We observed them frequently while walking between plots, as they flew by or were seen using the tallest point in a patch of tamarisk from which to hawk insects. They were more difficult to detect from deep inside dense stands of tall tamarisk, the vantage point for most of our surveys. The result was probably an undercounting of Black-chinned Hummingbird.

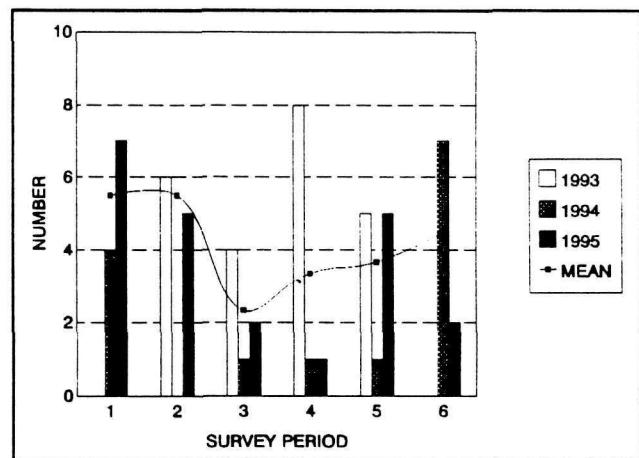


Figure 2: Black-chinned Hummingbird (completed surveys only, 1993-1995).

The large variability in numbers between survey periods and years (Figure 2) may or may not be a consequence of these difficulties in detectability. The Wilcoxon test does reveal a significantly greater number of Black-chinned Hummingbird detections in 1993 as compared to 1994. Note, however, that in Survey Period 6 of 1994, not included in the Wilcoxon test, the number detected was high, suggesting that breeding activity may have continued unusually late into the season. This is supported by observations of a nest at Lees Ferry from which young were fledged in the first week of October, an extraordinarily late nesting record for this species. There were no significant differences in detections between 1993 and 1995, nor between 1994 and 1995.

The only record of Black-chinned Hummingbird along the Colorado River before the dam is from Woodbury and Russell's field notes, one seen at mile 75, August 3, 1938 (Behle and Higgins 1959:121). Nevertheless, the authors considered it to be a common summer resident. Woodbury and Russell (1945:62) found it to be widespread and common in the desert, but probably more numerous near water.

Order Passeriformes
Family Tyrannidae
(Tyrant flycatchers)

Southwestern Willow Flycatcher (*Empidonax traillii extimus*):
Current breeding status: undetected. Pre-dam: probably uncommon.

The Southwestern Willow Flycatcher is a riparian obligate bird restricted to dense streamside vegetation in the southwestern United States. Fragmentation and loss of riparian habitat, and increased Brown-headed Cowbird brood parasitism, have led to a serious decline in breeding populations (Sferra et al. 1995). In March 1995, the USFWS listed *E.t. extimus* as an endangered species (Federal Register 60 (38): 10694).

Willow Flycatchers were not detected in any of our breeding bird surveys, 1992-1995. In the last three breeding seasons, additional surveys were conducted in an attempt to determine if this species was breeding at any location along the river in Glen Canyon. Although several detections of individuals were made in May of 1993 and 1994, these birds did not remain at the locations where they were observed, and were probably migrants.

Pre-dam surveys found the Southwestern Willow Flycatcher to be a common summer resident in river bank vegetation in Glen Canyon. Woodbury in 1938 observed two at mile 13 on August 10 and nine at one-half mile below Lees Ferry on August 11 (Behle and Higgins 1959:123). Higgins found this species to be common along the length of Glen Canyon in July and early August, 1958. Woodbury and Russell (1945:73) provide records of two nests at Lees Ferry: one found on August 11, 1938, and an earlier one on August 25, 1909.

All of the above records are from August, when Willow Flycatcher migrants are regularly seen in woody vegetation (Larue, in prep.; GLCABIRD 1995). Notable by its absence are records from Lyons 1936 mid-July survey of lower Glen Canyon. Although the nesting records from the Lees Ferry area indicate that this species was breeding there, it was probably an uncommon breeder in the sixteen miles above Lees Ferry, where dense streamside vegetation was rare.

Say's Phoebe (*Sayornis saya*): Current breeding status: uncommon.
Pre-dam: uncommon.

During Survey Periods 3, 4, and 5, Say's Phoebe was detected only 3 times in 1993, 4 times in 1994, and 5 times in 1995. It was

rarely detected in riparian areas, but seemed to prefer relatively wide terraces of mixed desert scrub with scattered trees and ledges for nesting. Plots #14 through #17 border a terrace of this description, and although Say's Phoebes were almost always observed in the open as we walked between plots, they were usually not detected from the plots themselves.

With the relative lack of appropriate habitat, this species is probably an uncommon breeder in Glen Canyon between Lees Ferry and the dam. It does, however, become more common at Lees Ferry itself, where there are larger areas of desert scrub, trees, and the presence of buildings suitable for nesting. Three active nests were found in the summer of 1995, two in buildings and one in a rock crevice.

Higgins reports that Say's Phoebes were common all along Glen Canyon in the summer of 1958, where they occurred in side canyons and on the terraces (Behle and Higgins 1959:123). Woodbury and Russell (1945:73) describe it as one of the most common and characteristic breeding birds of the Navajo Country, and a common bird along the banks of the Colorado River. Nevertheless, its preferred habitat was no more common in our survey area before the dam than it is today, and neither, probably, was Say's Phoebe.

Ash-throated Flycatcher
(*Myiarchus cinerascens*): Current breeding status: common. Pre-dam: common.

Ash-throated Flycatcher was detected in almost every plot every year for Survey Periods 3, 4, and 5 (Appendices 4-6). Figure 3 shows that this species was highly consistent in numbers detected from year to year and from survey period to survey period. The Wilcoxon test also shows no significant differences between years. This is a common and stable breeder in dense tamarisk stands along the river in Glen Canyon.

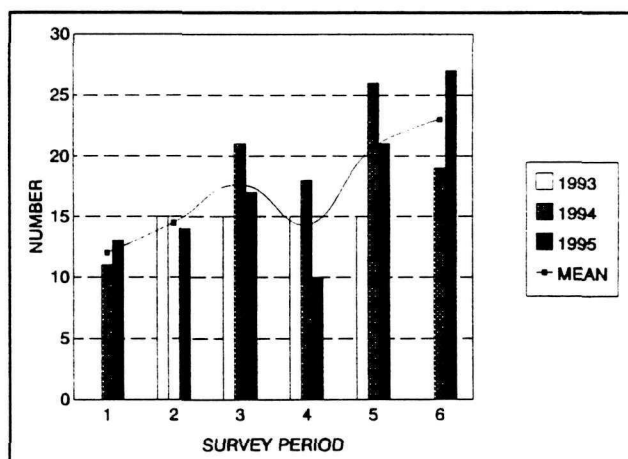


Figure 3. Ash-throated Flycatcher (completed surveys only, 1993-1995)

Pre-dam records are less consistent. Lyons' field notes from the Rainbow Bridge - Monument Valley expeditions reported it uncommon along the Colorado River July 4-22, 1936 (Behle and Higgins 1959:122). But Woodbury and Russell (1945:72) report that it was observed by their expeditions in many places along the Colorado River. Higgins reported that in 1958 this flycatcher was very abundant along the length of Glen Canyon and in side canyons, being observed every day of the trip, July 1 to August 9 (Behle and

Higgins 1959:122).

Family Hirundinidae
(Swallows)

Violet-green Swallow (*Tachycineta thalassina*): Current breeding status: common. Pre-dam: common.

During Survey Periods 3, 4, and 5, totals for this aerial insectivore were as follows: 116 in 1993, 110 in 1994, and 56 in 1995. Although Violet-green Swallows often forage at lower altitudes than do White-throated Swifts, and are thus more likely to be detected as FLYOVERS, the 50% reduction in numbers detected in 1995 may also be in part a function of a change in observer focus (see White-throated Swift species account). However, in 1994 it was observed that Violet-green Swallows were nesting in large numbers in old drill holes in the sandstone near the base of the dam; in 1995 it was observed that fewer swallows were nesting at these sites.

Behle and Higgins (1959:124) report that in July of 1936 Lyons saw the species frequently along the Colorado River, as did Higgins in July and August of 1958.

Cliff Swallow (*Petrochelidon pyrrhonota*): Current breeding status; undetected. Pre-dam: common.

Cliff Swallow was never detected in any of our breeding bird surveys 1992-1995. They were known to breed in cliffs within a few miles of the river corridor, however. A small colony was found in the spring of 1994 at the Coves area at Wahweap Bay on Lake Powell. Breeding activity was observed there again in 1995, although there were fewer active nests.

Higgins found this swallow common along many sections of Glen Canyon in July, 1958. Their mud nests could be seen attached high on the canyon walls (Behle and Higgins 1959:125). Once the dam was in place, silt and mud were no longer deposited along the shoreline of either the lake or the river during periods of spring runoff from the mountains. The lack of this resource probably explains the decline in Cliff Swallow populations in Glen Canyon. (In 1994, the colony at the Coves was using a small patch of mud being exposed at the back of the cove by temporarily decreasing lake levels to build their nests.)

Family Corvidae
(Jays, magpies, nutcrackers and crows)

Common Raven (*Corvus corax*): Current breeding status: common. Pre-dam: common.

Ravens were a common site soaring along the rims in Glen Canyon

during our surveys, especially in the last two years. During Survey Periods 3, 4, and 5, only 10 were detected in 1993, but 39 were detected in 1994, and 41 in 1995. At Plot #7, a family group of seven birds was observed (3 were easily recognizable as recently fledged young-of-the-year) perched in large tamarisk 50 meters upstream of the center of the plot.

Behle and Higgins (1959:125) describe this species as a common permanent resident around cliffs and in flight over the canyon. However, Woodbury's records from 1938 document only two between miles 41 and 25, August 8; three at mile 25, August 9; and four at one-half mile below Lees Ferry, August 11. In 1958, during five weeks in Glen Canyon, Higgins only noted them "on several occasions." These records suggest that ravens are probably more common today than they were during the years of these surveys.

Family Aegithalidae
(Bushtits)

Bushtit (*Psalttriparus minimus*): Current breeding status: sparse or irregular. Pre-dam: undetected.

The question of whether or not Bushtit bred in Glen Canyon was settled on March 15, 1995 when Dave Felley of the Colorado Plateau Research Station at Northern Arizona University found an active nest at Lees Ferry near the government trailers about 1/4 mile from the launch ramp. Adults were observed bringing food to the nest on April 17, and young were heard noisily begging for food from within the nest on April 25. The nest was empty on May 2 (GLCABIRD 1995).

Our own breeding surveys only occasionally detected Bushtits. None were recorded in 1992. In 1993, 3 were found on June 3 at Plot #15, and a total of 12 were found at four plots on June 18. In 1994, this species was only detected on July 14: a flock of 10 at plot #19, and one at plot #21. In 1995, the only records were one on May 10 from plot #11, and, on May 24, two at both plots #13 and #15. These records suggest that Bushtit may be a sparse or irregular breeder along the Colorado River through Glen Canyon.

There are no pre-dam records from Glen Canyon along the river corridor. Behle (1960:38) gives sightings from the Colorado River near Moab, and higher elevation records from the Kaiparowitz Plateau and from Navajo Mountain at various elevations.

Family Troglodytidae
(Wrens)

Rock Wren (*Salpinctes obsoletus*): Current breeding status: common. Pre-dam: common.

Like the Canyon Wren, this species builds its nest in rock crevices above the riparian zone. Most detections were by the male's song

heard outside of our plots, since Rock Wrens were seldom seen in vegetation. The numbers detected in 1993 were greater than those from 1994 or 1995 (Figure 4). The Wilcoxon test shows the differences to be significant (1994-93: $T = 23$, $P \leq 0.05$; 1995-93: $T = 21.5$, $P \leq .005$). There were no significant differences in detections between 1994 and 1995.

During the summer of 1958, Higgins found Rock Wrens to be abundant breeders on rocky areas and hillsides in many areas of Glen Canyon (Behle and Higgins 1959:126). The Rainbow Bridge-Monument Valley expeditions found it so common everywhere that most observers quit recording it (Woodbury and Russell 1945: 103). Rock Wren was recorded from Lee Ferry by Behle during his 1947 survey (Behle 1948:306) and by Higgins in 1958.

Canyon Wren (*Catherpes mexicanus*): Current breeding status: common. Pre-dam surveys: common.

Though not a riparian breeder, this species was a notable presence in all of our surveys, and was the second most commonly detected species. Canyon Wrens vocalized frequently (especially singing by the males) throughout the survey period. Nests are in rock canyons and outcrops (Ehrlich et al. 1988:444), but during the last survey period in particular (mid- to late July) family groups were commonly observed feeding in riparian areas close to the water.

Canyon Wren numbers detected during the three comparable survey periods were very similar for 1993 and 1995 (Figure 5). Although the difference between the higher numbers detected in 1994 compared to 1993 does not reach significance, the Wilcoxon test shows that numbers detected in 1995 were significantly less than those detected in 1994 ($T = 32$, $P \leq 0.05$). However, the numbers of Canyon Wrens detected in Survey Period 6 in 1995 (not included on the Wilcoxon test for Survey Periods 3, 4, and 5) were higher than

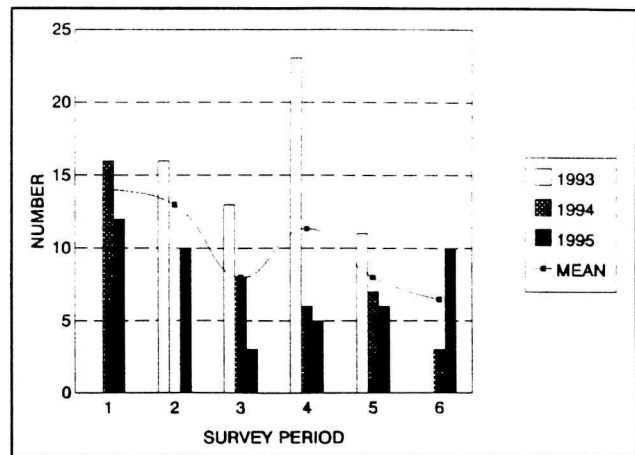


Figure 4: Rock Wren (completed surveys only, 1993-1995)

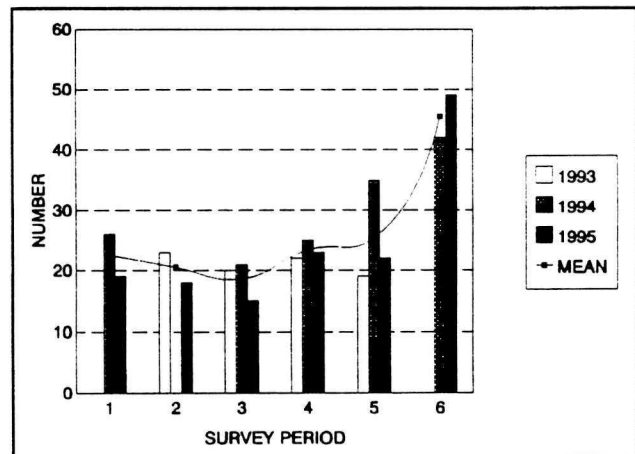


Figure 5: Canyon Wren (completed surveys only, 1993-1995)

those detected during the same period in 1994. The Canyon Wren may have bred later than usual in 1995.

Pre-dam surveys indicate that Canyon Wren was always common in Glen Canyon. Higgins found the species abundant along the entire length of Glen Canyon during the summer of 1958 (Behle and Higgins 1959:126), and in 1936 Lyons reported them common in Glen Canyon and its tributaries, July 4-22, from the mouth of the San Juan river to Lees Ferry (ibid.).

Bewick's Wren (*Thryomanes bewicki*): Current breeding status: common. Pre-dam: undetected.

The male of this species is a frequent and vigorous singer throughout the breeding season, and often perches at the highest point in a patch to do so. The great majority of detections were by song, especially OUTPLOT, so females went relatively undetected. Nevertheless, Bewick's Wren was the third most commonly counted bird during Survey Periods 3, 4, and 5 for the three-year period, 1993-1995.

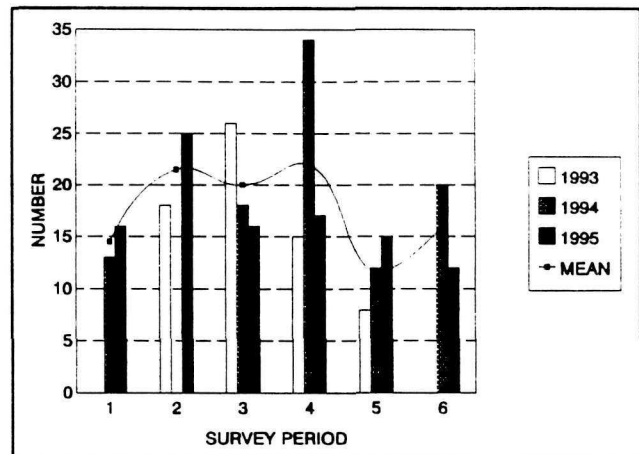


Figure 6. Bewick's Wren (completed surveys only, 1993-1995)

A particularly large number of Bewick's Wrens were seen in Survey Period 4 of 1994, when young-of-the-year were commonly observed (Figure 6). The same phenomenon was not observed in any survey period in 1995, although young-of-the-year were seen at various times, beginning in late May. The Wilcoxon test shows no significant differences in the detection of Bewick's Wrens between any two years, 1993-1995.

Remarkably, the pre-dam surveys describe only a single record near Glen Canyon. In Behle (1960:40) it is reported that Higgins saw a lone individual on 8 July, 1958 in a rose-willow-squaw-bush thicket in Seven Mile Canyon, one-half mile up from its junction with Glen Canyon at river mile 141. Woodbury and Russell (1945:99) report only its regular, though not abundant, occurrence in pinyon-juniper on the lower slopes of Navajo Mountain. Atwood et al. (1980:326), who reports on observations from Lees Ferry and at various locations around Lake Powell from 1971 to the fall of 1976 by Brigham Young University personnel, makes no mention of the species.

The Glen Canyon National Recreation Area Avian Sightings Database (GLCABIRD 1995) lists a sighting of a single Bewick's Wren in the

Rainbow Bridge area on 11 September, 1964, and another sighting (number not given) on 5 July, 1966 from Bullfrog Cave in Bullfrog Basin by B. Cornelius. Both of these sightings occurred after the dam was built but well before Lake Powell had filled, and both sightings were well upriver (or uplake) of the dam.

Brown et al. (1987:229) report that in the 1980s in Grand Canyon this wren was a permanent resident of lower elevation habitats, particularly the well-developed riparian areas of the river corridor, where it was common in summer. They describe the species as occurring in larger areas of riparian habitat from Glen Canyon Dam downstream to Cardenas Marsh, below which point it becomes very rare and localized. In Glen Canyon, Brown and Johnson (1987:75) found two nesting pairs in 1984 at their study site in the Old High Water Zone at river mile -7.4 left. No Bewick's Wrens were detected at the same location during the breeding season in 1985, but between one and two pairs were found in 1986 (Brown 1987:19), and one pair in 1987 (Brown 1988:19). From one to five pairs were found each year at the New High Water Zone study site at Lees Ferry.

The ongoing Grand Canyon Avian Monitoring Project has been banding birds since 1992 at Paria River Beach, approximately a mile downstream from river mile 0 at Lees Ferry. Their data indicate that Bewick's Wrens banded at that location and elsewhere in Grand Canyon during the breeding season were resident year-round (Mark Sogge, pers. comm.). Although we do not know for certain that this species did not breed in Glen Canyon prior to the construction of the dam, it does seem certain that since the creation of the NHWZ its presence has greatly increased during the breeding season.

Family Muscicapidae
(Kinglets, gnatcatchers)

Blue-gray Gnatcatcher
(*Polioptila caerulea*): Current breeding status: common. Pre-dam: common.

Blue-gray Gnatcatcher was only detected 9% as often as House Finch over the last three years of surveys for Survey Periods 3-5. It is probably not as uncommon as the overall small numbers of detections suggest. Although difficult to detect at a distance (only 27% of gnatcatcher detections were OUTPLOT, compared to 54% for House Finch), Blue-gray Gnatcatchers were detected regularly in all four survey

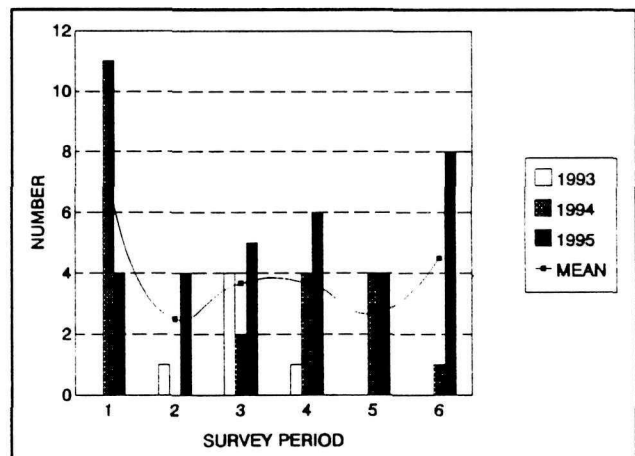


Figure 7: Blue-gray Gnatcatcher (completed surveys only, 1993-1995)

years from more than half of the survey plots (Appendices 4-6).

Numbers of Blue-gray Gnatcatchers detected in 1993 were low, but increased in 1994 and 1995 (Figure 7). The overall sample size was small, and these differences were not significant. In 1995 the number of detections in Survey Period 6 (not included in the Wilcoxon test) was particularly high.

Taking the problems of detectability into account, Blue-gray Gnatcatcher is probably a relatively common breeding bird in riparian areas along the river. However, this species is susceptible to the brood parasitism of Brown-headed Cowbirds. Of 28 nests found along the Colorado River in Grand Canyon, 1982 through 1987, 32.1% exhibited brood parasitism (Brown 1994:163).

Behle and Higgins (1959:127) considered Blue-gray Gnatcatcher to be a common summer resident on terraces and in river bank vegetation in Glen Canyon, but they only record a single specimen from the Colorado River (above Rock Creek). Woodbury and Russell (1945:111) considered it to be mostly a resident of pinyon-juniper forests, but that it had been reported from other habitats as well, including thickets on the Colorado River. No pre-dam records specific to our survey area are given.

Family Parulidae
(Wood-warblers)

Lucy's Warbler (*Vermivora luciae*): Current breeding status: uncommon. Pre-dam: probably uncommon.

The Lucy's Warbler numbers presented in Figure 8 are so small as to make statistical analysis impossible. In both 1993 and 1994 there were only three detections of this species in all surveys; in 1995 there were 16 detections. All observers on the river and at Lees Ferry noted the difference in 1995; in 1993 and 1994 Lucy's Warbler were observed to be virtually absent from the river corridor; in 1995 many riparian patches contained one or more singing males.

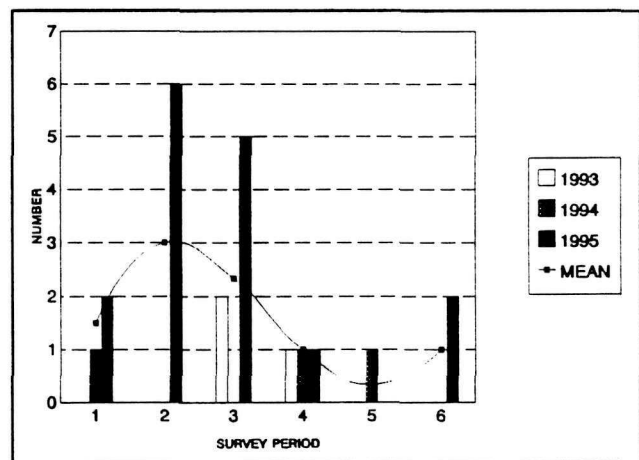


Figure 8: Lucy's Warbler (completed surveys only, 1993-1995)

In the 1980s, reliable observers found Lucy's Warbler to be a common breeder in dense tamarisk in the Lees Ferry area (Bryan Brown, pers. comm.; Natasha Kline, pers. comm.). Bryan Brown located six pairs in his 2.9 ha NHWZ study plot in 1985. Although

it is not possible to compare our results directly with Brown's, these records suggest that at least at Lees Ferry, Lucy's Warbler was probably more common in the 1980s than it has been in recent years.

Lucy's Warblers breed early, with peak nesting ($\geq 50\%$ of nests active) occurring from mid-April to mid-May (Brown 1994:165). Thus Woodbury's pre-dam records from August 8 and 10, 1938, of single birds one mile above Lees Ferry and one-half mile below Lees Ferry at the mouth of Paria Creek (Woodbury and Russell 1945:120; Behle and Higgins 1959:128), are too late to assign them the certain status of locally breeding birds. The only spring record is one seen at Lees Ferry on April 17, 1947 (Behle 1948:303). Higgins, whose trip through Glen Canyon from Ticaboo Canyon to Lees Ferry was also somewhat late in the season (July and early August of 1958), describes Lucy's Warbler as a common breeder along many stretches (Behle and Higgins 1959:128). Probably the lack of extensive riparian habitat in our survey area limited the occurrence of Lucy's Warbler above Lees Ferry.

Yellow Warbler (*Dendroica petechia*): Current breeding status: sparse. Pre-dam: probably sparse.

Other than one bird found on June 1, 1994 at Plot #9, Yellow Warbler was not detected in June or July from any of our survey plots 1992-1995.

The Grand Canyon Avian Monitoring Project conducted by the Colorado Plateau Research Station captured and banded birds monthly from 1993 to 1995 at the Paria Beach riparian area approximately one-half mile downstream from Lees Ferry. On July 19, 1993, they banded a male Yellow Warbler with a cloacal protuberance. On April 27, 1994, and again on May 23, 1995, single males with cloacal protuberances and single females with brood patches were captured and banded, indicating breeding activity at this patch for all three years (Mark Sogge, pers. comm.).

A weekly survey independent of their study which we conducted at this site found a pair of Yellow Warblers regularly from early May through mid-June in 1994 (the last sighting was of two birds, one a singing male, on June 17). In 1995 at least one singing male was detected every week from May 16 through June 7, after which this species was no longer seen or heard. No nests or young were detected at this location in either year.

In 1984, Brown found two breeding pairs of Yellow Warblers at his NHWZ study site just downstream from the launch ramp at Lees Ferry. In 1985, he found none at this site (Brown and Johnson 1987:76,77), but in 1986 a breeding pair was again found (Brown 1987:20). In 1987 two breeding pairs were located (Brown 1988:20).

Brown notes that Yellow Warblers most often place their nests high

in tamarisk at the river's edge, where many fall victim to the brood parasitism of the Brown-headed Cowbird. Of 22 Yellow Warbler nests located along the Colorado River in Grand Canyon between 1982 and 1987, 22.7% exhibited brood parasitism (Brown 1994:163).

Pre-dam surveys found Yellow Warbler to be a common breeder in streamside vegetation along the Colorado River through Glen Canyon. From July 1 to August 9, 1958, Higgins saw both adults and immatures nearly every day of the trip. Woodbury and Russell's field notes from the Rainbow Bridge-Monument Valley Expedition found references to two at one-half mile below Lees Ferry at the mouth of Paria Creek on August 10 and seventeen there on August 11 (Behle and Higgins 1959:128). Most of these birds were probably fall migrants, which begin to appear in our area by late July (LaRue, in prep.; GLCABIRD 1995). The lack of substantial riparian areas with large trees make it probable that Yellow Warbler was no more common in our survey area above Lees Ferry than it is today.

Common Yellowthroat (*Geothlypis trichas*): Current breeding status: uncommon. Pre-dam: uncommon.

Common Yellowthroats were not detected during our breeding bird surveys in either 1992 or 1993. In 1994, singing males were heard at Plot #1 on June 29, Plot #2 on May 26 and June 29, Plot #3 on June 15 and June 29, and Plot #4 on June 15. On May 12 one was heard on at Plot #21, but was not detected in subsequent surveys at that location.

During our survey of May 24, 1995, a male Common Yellowthroat was seen at Plot #21. On June 21, a pair was seen at this location, with the male carrying food to a spot 30 meters upstream from the center of our plot. A nest was found containing a single large Brown-headed Cowbird nestling. When the nest was checked the following day, the cowbird was not present. This species suffers one of the highest rates of Brown-headed Cowbird brood parasitism on the Colorado River. Of 9 nests found in Grand Canyon between 1982 and 1987, 5 were parasitized (Brown 1994:163).

Both male and female Common Yellowthroats continued to be seen at Plot #21 in Survey Periods 5 and 6 (July 6 and 19). The only other 1995 survey detections were a male Common Yellowthroat singing INPLOT at Plot #19 on May 24; and a female seen INPLOT and a male heard OUTPLOT from Plot #16 on July 6. This species is also known to have nested in both 1994 and 1995 at river mile -8.7 left (not one of our plot locations), a marshy area having the only known population of leopard frogs along the Colorado river in Glen Canyon.

In 1984, Brown found a breeding pair of Common Yellowthroats at his NHWZ study site just downstream of the launch ramp at Lees Ferry (Brown and Johnson 1987:76,77). In 1985 there were two breeding pairs at this site, one pair again in 1986 (Brown and Johnson

1987:20), but none in 1987 (Brown 1988:20).

Atwood et al. (1980:331) were surprised not to find Common Yellowthroats during their Lees Ferry surveys in 1973. "It is interesting that none were seen during this study. It is not known if this is because of the creation of Lake Powell or due to insufficient observations."

Prior to the creation of Lake Powell, all surveys found them common in Glen Canyon. Behle and Higgins (1959:128) review Woodbury's 1938 notes from the Rainbow Bridge-Monument Valley expedition which recorded 165 individuals seen, plus many others including 12 families (out of nest) at various points along the Colorado River. They also cite the following from our survey area: three at mile 13 on August 10; and four at one-half mile below Lees Ferry at the mouth of Paria Creek, August 11. Higgins found both adults and immatures in the willow fringe at Lees Ferry on August 8, 1958.

These August records from our survey area may have been migrants. Although Common Yellowthroats were undoubtedly common breeders in Glen Canyon as a whole before the dam, they were probably uncommon in lower Glen Canyon where the lack of side canyons and wider reaches above Lees Ferry made this section inhospitable to this marsh-loving species.

Yellow-breasted Chat (*Icteria virens*): Current breeding status: common. Pre-dam: common.

This large warbler, despite its colorful plumage, was usually only detected by the male's distinctive multi-part song. In 1995 this song was heard relatively infrequently during our surveys. In only the last survey period did numbers of detections exceed those from the previous two years (Figure 9). The Wilcoxon test confirms that 1995 numbers were significantly below those of 1994 ($T = 21$, $P \leq 0.01$) and 1993 ($T = 25$, $P \leq 0.05$). Over the course of the three breeding seasons for which we have comparable data, however, Yellow-breasted Chat was the fifth most commonly detected species, and should still be considered a common breeder in our survey area.

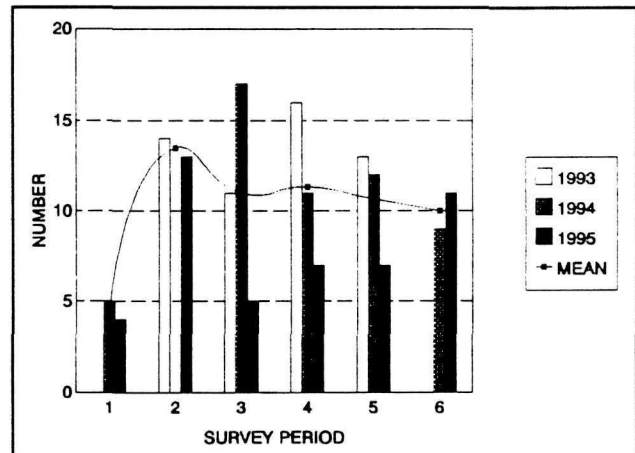


Figure 9: Yellow-breasted Chat (completed surveys only, 1993-1995)

In 1938 Higgins found them to be abundant breeders along the length of Glen Canyon. They were noted virtually every day of the trip in streamside vegetation (Behle and Higgins 1959). The field notes of Woodbury and Russell for 1938 note that 80 were counted from river

mile 50 to 1/2 mile below Lees Ferry between August 7 and 11. In 1973, a few years after the completion of the dam, the BYU study saw a total of 12 at Lees Ferry on 6, 7, and 14, 15 June.

These records suggest that Yellow-breasted Chat was probably more common both pre-dam and in the 1970s than it was found to be in our surveys. Brown's study of Brown-headed Cowbird brood parasitism in Grand Canyon found that four out thirty-seven chat nests exhibited brood parasitism (Brown 1994:163). Although this is a comparatively low rate, cowbirds could be an increasing factor limiting the breeding success of chats in Glen Canyon.

Family Emberizidae
Sub-family Cardinalinae
(Cardinals, grosbeaks, and buntings)

Black-headed Grosbeak (*Pheucticus melanocephalus*): Current breeding status: undetected (see text below). Pre-dam: undetected.

There is only one record of Black-headed Grosbeak from our surveys: the bird was seen at Plot #12 on June 1, 1994, a date consistent with northbound migration for this species (Brown 1987:254). There is no evidence that it breeds currently along the river corridor in Glen Canyon.

In the 1980s a series of cool, wet springs led to some unusual nesting records. A Black-headed Grosbeak nest was found by a member of Bryan Brown's team on June 13, 1984 at river mile 7.0 left in the NHWZ. Both male and female were singing near the nest, and the nest contained at least one egg (GLCABIRD 1995). On May 31, 1985, another active nest was found 40 meters upstream from the previous year's nest; it contained four eggs which both adults were observed incubating.

Woodbury and Russell (1945:135) indicate that Black-headed Grosbeak breeds at canyon heads and mountains mostly below the coniferous forest, but that it may descend into the streamside fringes of lower elevations. Their field notes indicate a single sighting between river miles 63 and 50 on August 5, 1938 (Behle and Higgins 1959:130). Higgins saw two individuals in Glen Canyon during the summer of 1958: one in the top of an oak near the mouth of Aztec Creek, river mile 68.5, on July 26; the other in willows at river mile 46 on July 30. There is, however, no historical evidence to indicate that Black-headed Grosbeak bred in our survey area other than Brown's records from the 1980s.

Blue Grosbeak (*Guiraca caerulea*): Current breeding status: common. Pre-dam: common.

Overall Blue Grosbeak numbers were down significantly in 1994 as compared to 1993 ($T = 20$, $P \leq 0.05$), but appeared to recover somewhat in 1995 (Figure 12). The data suggest that the recovery

was a late-season one, with low numbers in Survey Periods 3 and 4, but much higher numbers in Survey Periods 5 and 6. For Survey Periods 3, 4, and 5 taken together, the greater numbers in 1995 as compared to 1994 were not significant at the $P \leq 0.05$ level, but the sample size was not large.

Blue Grosbeak was the seventh most commonly detected species in 1993 and 1995, but as a consequence of the lower numbers in 1994, declined to ninth overall for the combined three years of surveys (Table 1). Nevertheless, over the course of the four years of the Breeding Bird Survey, Blue Grosbeak was detected almost every year in almost every stand of riparian vegetation in which we had plots, and remains a common breeder between Lees Ferry and the dam.

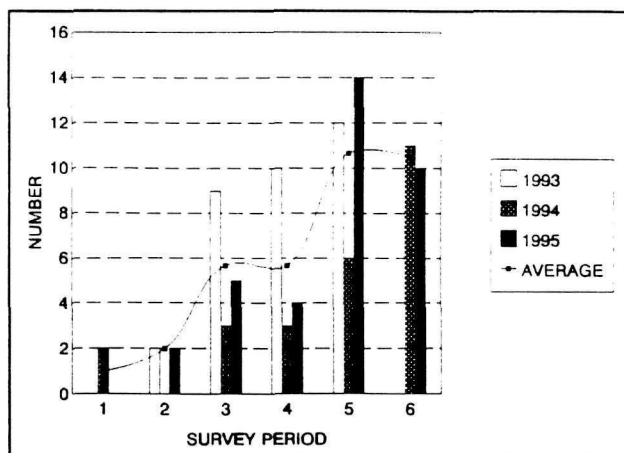


Figure 10: Blue Grosbeak (completed surveys only, 1993-1995)

A search for evidence of brood parasitism by Brown-headed cowbirds on June 23, 1995 found two inactive Blue Grosbeak nests in 3-meter tall coyote willow (*Salix exigua*) below Breeding Bird Plot #1. (One had fallen out of the tree and was collected.) The dam release that morning of 17,270 c.f.s. was typical for this period of rising waters in Lake Powell, but the water level was within a few inches of the base of the willows. This is one of the few pieces of evidence we have that even within the parameters of interim flows, there is at least a potential for a direct effect on nesting by larger flows.

Blue Grosbeak numbers bear watching for the additional reason that it is particularly susceptible to brood parasitism by Brown-headed Cowbirds. Three of the five grosbeak nests found by Brown (1994:163) along the Colorado River in Grand Canyon, 1982-1987, were parasitized. The reduced numbers of grosbeaks which we found in 1994 corresponded in time and location to an unusually large number of Brown-headed Cowbird detections, although we have not analyzed this correlation for statistical significance.

Woodbury and Russell (1945:136) found two Blue Grosbeaks at river mile 13, 9-10 August 1938; three near Lees Ferry, 17 July 1936 and 9-11 August 1938; and an additional fourteen birds seen including a nest and two nestlings, 10-11 August 1938. Higgins (Behle and Higgins 1959) found them to be abundant breeders along the length of Glen Canyon, usually in dense streamside vegetation, but occasionally on the terraces or up side canyons.

Sub-family Emberizinae
(Towhee, sparrows, and longspurs)

Rufous-sided Towhee (*Pipilo erythrophthalmus*): Current breeding status: probably casual. Pre-dam: probably casual.

This species was detected only three times in four years of surveys, all in 1993. Breeding is suspected in that year, however, since the detections were from three separate plots in the middle of the breeding season. On June 2, one was OUTPLOT at plot #8; on June 18, one was INPLOT on plot #13; and on July 6 one was INPLOT onn plot #20. All three of these areas are terraces with patches of dense cover.

The Rufous-sided Towhee is known to breed regularly in side canyons of Lake Powell where substantial oak thickets occur (GLCABIRD 1995). Behle (1959:131) describes it as a permanent resident in river bank vegetation along the Colorado River, and one of two seen at the mouth of Aztec Creek was collected on July 26, 1958. Russell saw eight at Navajo Creek Canyon on July 9, 1936, and Behle saw one at the mouth of Smith Fork on April 14, 1947.

Woodbury (1958:206) describes this towhee as primarily a resident of the mountain shrub belt, which sometimes descends to lower altitudes along streamsides. The winter of 1992-93 was unusually cold and wet, and our 1993 records may reflect a spring during which Rufous-sided Towhees descended into the Colorado River corridor in Glen Canyon to breed.

Sub-family Icteridae
(Meadowlarks, blackbirds and orioles)

Northern (Bullock's) Oriole (*Icterus galbula*): Current breeding status: uncommon. Pre-dam: uncommon.

Although Figure 10 seems to indicate high variability in the detection of Bullock's Orioles between survey periods and years, the sample size is small and the Wilcoxon test shows no significant differences between any two years. This species was seldom detected outside of two stands of vegetation: that in which Plots #1, #2, and #3 are found; and that in which Plots #8 and #9 are found (Plot #10 is part of this stand, but Bullock's Oriole was never detected there). Two nests were found on

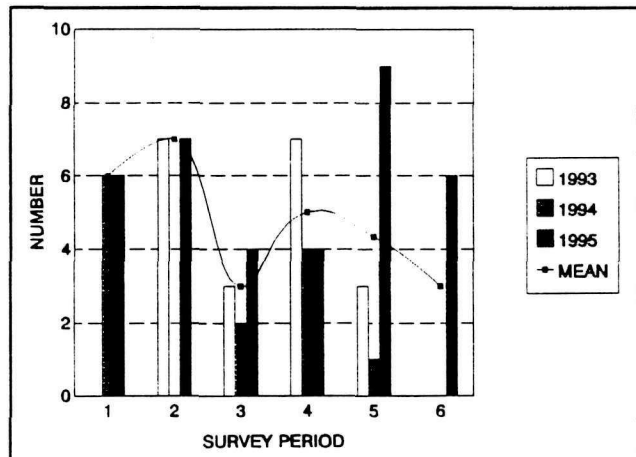


Figure 11: Northern (Bullock's) Oriole (completed surveys only, 1993-1995).

June 23, 1995 between Plots #1 and #2, although only one appeared to be active.

Brown et al. (1987:268) state that this oriole occurs uncommonly in the river corridor below Lees Ferry but commonly upriver in Glen Canyon. Given the limited distribution that we found and its infrequent detection from other plots, Bullock's Oriole must now be considered an uncommon breeder in Glen Canyon between Lees Ferry and the dam.

Although Behle and Higgins (1959:129) describe the Bullock's Oriole as a common summer resident, they give no sightings from Higgins survey in 1958. Woodbury, on his 1938 Rainbow Bridge - Monument Valley expedition, saw only 8 birds in 11 days of surveys on the San Juan and Colorado Rivers. All were well upriver of Lees Ferry except for two birds sighted one-half mile below Lees Ferry on August 11 (Woodbury and Russell 1945:131). Bullock's Oriole was probably no more common in our survey area before the construction of the dam than it is today.

Great-tailed Grackle (*Quiscalus mexicanus*): Current breeding status: uncommon. Pre-dam: undetected.

A small colony of Great-tailed Grackles has been observed in the vicinity of the Lees Ferry launch ramp for a number of years, although they were absent during the breeding season in 1994. Bryan Brown found this species to be breeding there in 1984 and 1985 (Brown 1987:76). They appear to take advantage of food resources provided by the large number of people launching Grand Canyon raft trips from this location. On August 18, 1995, what appeared to be a family group of 17 grackles was observed near Plot #21. At least two of the birds were downy young-of-the-year, and were observed being fed by adults.

Great-tailed Grackle has been expanding its range into Arizona from Mexico and west Texas for about 30 years, and first appeared in Grand Canyon in 1974. It had become a fairly common summer resident and visitor along the river by 1983 (Brown 1987:267).

The species was rarely detected from our surveys. Two were seen INPLOT at plot #18 on June 3, 1993, and one INPLOT on July 1, 1993. (Plot #21, added to the survey in 1993, is approximately 400 meters upstream from the launch ramp.)

There are no pre-dam records of Great-tailed Grackle from Glen Canyon.

Brown-headed Cowbird (*Molothrus ater*): Current breeding status: common. Pre-dam: uncommon.

The presence of this brood parasite on the river during the breeding season has been cause for concern (Brown 1994), and is

addressed in this report in the species accounts for Yellow Warbler, Common Yellowthroat, Blue Grosbeak, and Blue-gray Gnatcatcher. From 1993 to 1995 Brown-headed Cowbird was the seventh most commonly detected species for Survey Periods 3, 4, and 5. Numbers have not varied greatly from year to year, but there were unusually large numbers of detections in the last two survey periods of 1994 (Figure 11). For the combined data from Survey Periods 3, 4, and 5, however, the Wilcoxon test shows no significant differences between any two years.

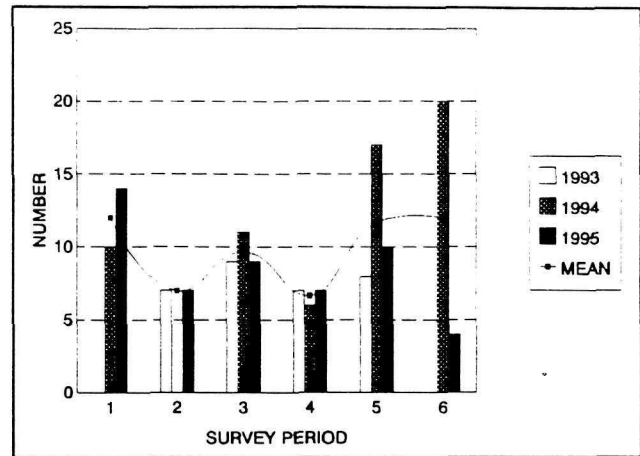


Figure 12. Brown-headed Cowbird (completed surveys only, 1993-1995).

Behle and Higgins (1959) describe the Brown-headed Cowbird as an uncommon transient in river bank vegetation. There is only one record from lower Glen Canyon: a Willow Flycatcher nest was found containing one rotten cowbird egg near Lees Ferry on 11 August, 1938 (Woodbury and Russell, 1945:75). A few other pre-dam records from the Colorado River through Glen Canyon upstream of our survey area further suggest that Brown-headed Cowbirds were probably present, though uncommon, during the breeding season. By 1973, when the BYU survey visited Lees Ferry, they observed one on 7 June in tamarisk and two on 15 June in brush (Atwood et al., 1980:332).

Family Fringillidae (Finches, goldfinches and crossbills)

House Finch (*Carpodacus mexicanus*): Current breeding status: abundant. Pre-dam: abundant.

From 1992 to 1995 this species was the most commonly detected bird in our surveys. This can be attributed at least in part to the fact that the House Finch has the earliest nesting season of all the riparian breeders in our survey area (Brown 1994:165). Young-of-the-year were commonly observed in even our first survey period (early May).

The number of House Finches only increases during the drier months of May and June, when they are attracted to water (Brown and Johnson 1987:4). Both sexes also sing, although the females sing a shorter song, and sing less frequently than do the males (Ehrlich et al. 1988:646). Even taking the high detectability and early nesting factors into account, House Finch is probably the most common riparian breeding bird between Glen Canyon Dam and Lees Ferry.

House Finches were more commonly detected in both 1994 and 1995 than in 1993 (Figure 13). The Wilcoxon test confirms that the differences were significant (1994-93: $T = 40$, $P \leq 0.05$; 1995-93: $T = 44$, $P \leq 0.05$).

Pre-dam surveys suggest that little has changed. Behle and Higgins (1959:131) report that Higgins found them abundant in Glen Canyon during the summer of 1958. They were observed nearly every day in streamside vegetation, on the terraces, and on the hillsides. Woodbury and Russell's field notes record that Lyons found them conspicuous and common between river miles 78 and 0 of the Colorado River, July 4 through July 22, 1936.

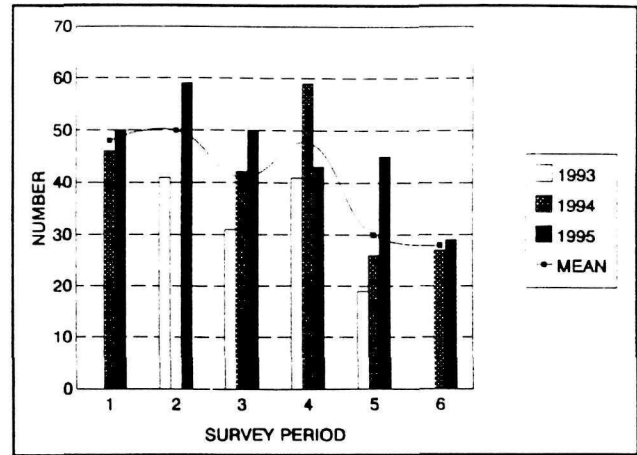


Figure 13: House Finch (completed surveys only, 1993-1995)

SUMMARY AND CONCLUSIONS

The effects of interim flows on the breeding bird community

Few direct effects of interim flows on the breeding bird community in Glen Canyon have been observed by this study. The small increase in Common Yellowthroat detections may be a function of the expansion and stabilization of patches of reedgrasses and cattails, but this is only conjecture. Two Blue Grosbeak nests were discovered in coyote willow which was subject to disturbance by higher than usual flows in the summer of 1995. One nest was inactive, and the other had fallen to the base of the tree, but the actual causes were undetermined.

Population increases since the completion of the dam

In comparing historical records to the results of our four years of breeding bird surveys, 1992-1995, we have had to be careful to consider only those records which correspond to the 16-mile stretch of Glen Canyon river corridor which remained after the completion of Glen Canyon Dam. This narrow gorge is atypical of the 173-mile long pre-dam Glen Canyon of wide reaches, broad terraces and extensive side canyons.

It is clear, however, that significant changes have occurred. Two species of waterfowl, Mallard and Common Merganser, have taken advantage of the clear water and restricted flows to become common breeders. Great-tailed Grackle, also not detected in pre-dam surveys, has been expanding its range west and north for 30 years, and has established a small breeding colony at Lees Ferry in the vicinity of the launch ramp.

Three and sometimes four Peregrine eyries have been active along the river corridor since at least 1982 when surveys for these birds began in Glen Canyon. Pre-dam surveys found little evidence of breeding Peregrines, which had been in serious decline since the 1940s.

Other species which have shown increases are Common Raven, which was common but has become more so, and Bewick's Wren, which is now common but was not recorded from our survey area before the construction of the dam. Bushtit was found to be breeding at Lees Ferry in 1995, and may breed elsewhere in the New High Water Zone, but was not detected in pre-dam surveys. Brown-headed Cowbird has also increased its presence along the river, and Common Yellowthroat, although a common cowbird host, appears to be benefitting from an increase in marshy and shrubby riparian breeding habitat resulting from the restricted flows from Glen Canyon Dam since 1992.

Other riparian breeders have adapted well to the dense stands of tamarisk that characterize the New High Water Zone below the dam.

Common in both pre-dam and current surveys were Mourning Dove, Black-chinned Hummingbird, Ash-throated Flycatcher, Blue-gray Gnatcatcher, and House Finch. Among cliff-breeders, Violet-Green Swallow and White-throated Swift have remained common.

Population decreases and brood parasitism by Brown-headed Cowbirds

The brood parasitism of the cowbird is a possible factor in the decline of Yellow and Lucy's Warblers, and may be limiting the breeding success of other species. Yellow Warbler probably no longer breeds successfully in our survey area, and Lucy's Warbler, a pair of which were observed feeding a fledgling cowbird at Lees Ferry, has become less common. Blue Grosbeak, the species exhibiting the highest rate of brood parasitism of all riparian breeders in Grand Canyon, declined in Glen Canyon in 1994 during a period when Brown-headed Cowbird numbers were particularly high.

The most significant loss from Glen Canyon as a whole is the Southwestern Willow Flycatcher. Now greatly reduced in numbers throughout its range, this endangered species was common in riparian areas throughout Glen Canyon before the construction of Glen Canyon Dam. Its particular susceptibility to the increased brood parasitism of the cowbird may have been a factor in its extirpation as a breeder from Lees Ferry, where it was common until at least the early 1970s.

Other population decreases

Known cowbird hosts are not the only species to have declined. Among raptors, Red-tailed Hawk is now an uncommon breeder in the cliffs, but was apparently common in pre-dam surveys. American Kestrel probably no longer breeds along the river corridor, but was at least an uncommon breeder in our survey area until recent years. Prairie Falcon was observed regularly in Glen Canyon in the past, but is no longer seen during the breeding season. Cliff Swallow was also a common breeder in Glen Canyon before the construction of the dam, but now only a small colony is known from The Coves at Wahweap Bay on Lake Powell.

MANAGEMENT RECOMMENDATIONS AND RESEARCH NEEDS

Population fluctuations and continued monitoring

Considerable variation in numbers from year to year have been shown for several species over the four years of our surveys. Such localized population fluctuations may be normal among riparian breeding birds in the southwest (Bryan Brown, pers. comm.), but it is essential that long-term monitoring be instituted in order that real population trends among these species may be determined. In addition, the possible effects on avian populations below the dam from changes Glen Canyon Dam operations can only be determined by continued monitoring.

Brown-headed Cowbirds and nest searches

Low overall numbers and significant fluctuations in populations between years of Lucy's Warbler, Common Yellowthroat, Blue Grosbeak Blue-gray Gnatcatcher and Yellow-breasted Chat are of particular concern. All five species are known cowbird hosts, susceptible to additional loss of reproduction due to Brown-headed Cowbird brood parasitism. In addition to the continued monitoring of breeding bird populations along the Colorado River, intensive nest searches should be initiated in the riparian corridor to determine rates of brood-parasitism by Brown-headed Cowbirds.

Vegetation sampling and analysis

Most birds are dependent upon specific structural vegetation types in which to breed. Brown and Johnson (1987:34) have shown that a wide range of vegetation structure is essential to the group of riparian obligates studied in Glen and Grand Canyons. In the case of the riparian habitat along the river corridor through Glen Canyon, habitat management is in part a function of controlled, fluctuating flows from Glen Canyon Dam.

Before any spike flow releases from the dam occur, a profile of vegetation structure should be taken at each breeding bird survey plot location. Data should include canopy height and volume, density, and basal area for woody taxa, and cover estimated by species for herbaceous taxa. Completion of this work before the inevitable habitat changes resulting from a spike flow would greatly increase our future ability to make informed management decisions on the potential effect of large flows on Glen Canyon's riparian breeding bird populations.

Expanded inventory and monitoring

Our review of the historical surveys of the birds of Glen Canyon have made it abundantly clear that the remaining river corridor is not the only part of Glen Canyon National Recreation Area that needs to be surveyed. Although much has been lost beneath the

waters of Lake Powell, much may remain. The Southwestern Willow Flycatcher, as well as other species which are no longer found below the dam, may still breed in the Escalante drainage, on the San Juan River, or in side canyons where suitable habitat still exists.

In 1992, a detailed workplan for such a project was developed by John Spence of the Glen Canyon National Recreation Area Resource Management Division (Spence 1992). Thirty-five years have passed since the last of the pre-dam surveys showed us how much there was to lose. Thirty-five years later we know very little about the avian resource which remains, and which we may still have the opportunity to protect.

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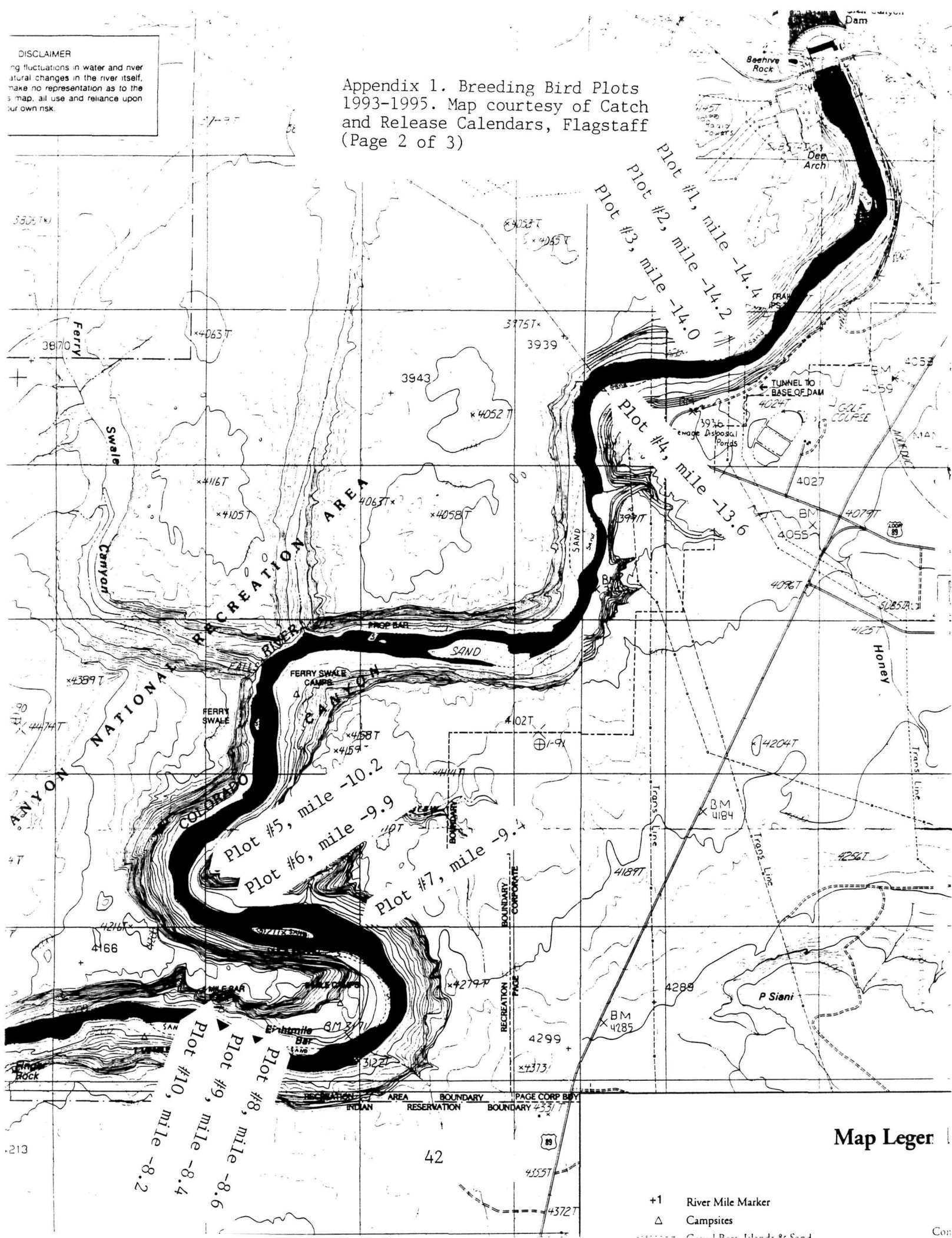
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APPENDIX 1. (Page 1 of 3) U.T.M. northings and eastings from Geographical Positioning System field survey. GPS unit and associated maps are coordinated with USGS maps 1927 North American Datum.

Plot #	Northing	Easting
1	4,085,774	456,393
2	4,085,751	456,247
3	4,085,704	456,009
4	4,085,389	455,580
5	4,082,240	452,970
6	4,082,131	453,163
7	4,082,045	454,003
8	4,081,290	453,496
9	4,081,375	453,277
10	4,081,472	453,060
11	4,080,876	451,201
12	4,080,700	451,030
13	4,080,915	450,522
14	4,077,598	451,217
15	4,077,536	450,941
16	4,077,542	450,673
17	4,077,602	450,471
18	4,077,452	450,228
19	4,077,361	450,002
20	4,077,265	449,744
21	4,079,973	448,119

ing fluctuations in water and river
natural changes in the river itself,
make no representation as to the
map, all use and reliance upon
our own risk.

Plot #1, mile -14.2
Plot #2, mile -14.0
Plot #3, mile -14.0



Map Leger

- +1 River Mile Marker
△ Campsites

APPENDIX 2. Surveys or portions of surveys completed, 1992-1995, indicated by shaded areas. Actual survey dates are at the bottom of the chart.

Plot #	Survey Period 1				Survey Period 2				Survey Period 3				Survey Period 4				Survey Period 5				Survey Period 6			
	5/1-5/14				5/15-5/28				5/29-6/11				6/12-6/25				6/26-7/9				7/10-7/23			
	92	93	94	95	92	93	94	95	92	93	94	95	92	93	94	95	92	93	94	95	92	93	94	95
1																								
2																								
3																								
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APPENDIX 3: Avian Species Detected During Breeding Bird Surveys 1992-1995 (all surveys) in A.O.U. order. Species codes are given in parentheses. Yes=detected more than 3 times. No=not detected. For species detected less than four times the format is as follows: number detected:date(month/day):Plot#.

<u>Species</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>
Common Merganser (COME) <i>Mergus merganser</i>	No	Yes	No	Yes
Mallard (MALL) <i>Anas platyrhynchos</i>	Yes	Yes	Yes	Yes
Wood Duck (WODU) <i>Aix sponsa</i>	1:6/8:1	No	No	No
White-faced Ibis (WFIB) <i>Plegadis chihi</i>	No	Yes	Yes	No
Great Blue Heron (GBHE) <i>Ardea herodias</i>	Yes	No	No	Yes
Snowy Egret (SNEG) <i>Egretta thula</i>	No	No	1:5/10:1	No
Killdeer (KILL) <i>Charadrius vociferus</i>	No	No	2:7/14:20	No
Mourning Dove (MODO) <i>Zenaidura macroura</i>	Yes	Yes	Yes	Yes
Turkey Vulture (TUVU) <i>Cathartes aura</i>	No	No	No	2:6/6:4
Red-tailed Hawk (RTHA) <i>Buteo jamaicensis</i>	Yes	Yes	Yes	No
Golden Eagle (GOEA) <i>Aquila chrysaetos</i>	1:5/27:1 1:5/27:9 1:5/28:16	No	No	1:6/6:10
Peregrine Falcon (PEFA) <i>Falco peregrinus</i>	Yes	Yes	Yes	Yes
American Kestrel (AMKE) <i>Falco sparverius</i>	1:6/9:19 1:6/9:20	No	No	No
Osprey (OSPR) <i>Pandion haliaetus</i>	1:6/24:3	No	No	No
Yellow-billed Cuckoo (YBCU) <i>Coccyzus americana</i>	No	No	No	1:6/21:21
Belted Kingfisher (BEKI) <i>Ceryle alcyon</i>	No	1:5/5:3	No	No
White-throated Swift (WTSW) <i>Aeronautes saxatalis</i>	Yes	Yes	Yes	Yes
Black-chinned Hummingbird (BCHU) <i>Archilochus alexandri</i>	Yes	Yes	Yes	Yes

Ash-throated Flycatcher (ATFL) <i>Myiarchus cinerascens</i>	Yes	Yes	Yes	Yes
Say's Phoebe (SAPH) <i>Sayornis saya</i>	Yes	Yes	Yes	Yes
Western Wood-Pewee (WWPE) <i>Contopus sordidulus</i>	1:5/27:2	No	No	1:6/8:16 1:6/8:17 1:6/8:19
Gray Flycatcher (GRFL) <i>Empidonax wrightii</i>	No	No	No	1:5/10:17
Common Raven (CORA) <i>Corvus corax</i>	Yes	Yes	Yes	Yes
Brown-headed Cowbird (BHCO) <i>Molothrus ater</i>	Yes	Yes	Yes	Yes
Red-winged Blackbird (RWBL) <i>Agelaius phoeniceus</i>	Yes	No	Yes	Yes
Northern Oriole (NOOR) <i>Icterus galbula</i>	Yes	Yes	Yes	Yes
Brewer's Blackbird (BRBL) <i>Euphagus cyanocephalus</i>	No	5:7/1:21 1:7/6:20	No	No
Great-tailed Grackle (GTGR) <i>Quiscalus mexicanus</i>	No	2:6/3:18 1:7/1:21	No	No
House Finch (HOFI) <i>Carpodacus mexicanus</i>	Yes	Yes	Yes	Yes
Lesser Goldfinch (LEGO) <i>Carduelis psaltria</i>	No	1:5/19:14	No	No
White-crowned Sparrow (WCSP) <i>Zonotrichia leucophrys</i>	No	Yes	Yes	Yes
Black-throated Sparrow (BTSP) <i>Amphispiza bilineata</i>	No	1:5/18:6	No	No
Rufous-crowned Sparrow (RCSP) <i>Aimophila ruficeps</i>	No	No	No	1:7/19:12
Rufous-sided Towhee (RSTO) <i>Pipilo erythrophthalmus</i>	No	1:6/2:8 1:6/18:11 1:7/6:20	No	No
Black-headed Grosbeak (BHGR) <i>Pheucticus melanocephalus</i>	No	No	1:6/1:12	No
Blue Grosbeak (BLGR) <i>Guiraca caerulea</i>	Yes	Yes	Yes	Yes
Indigo Bunting (INBU) <i>Passerina cyanea</i>	1:6/9:17 1:7/9:3 1:7/9:4	No	1:7/14:17	No
Lazuli Bunting (LABU) <i>Passerina ameona</i>	No	No	No	Yes
Western Tanager (WETA) <i>Piranga ludoviciana</i>	Yes	Yes	Yes	Yes

Violet-green Swallow (VGSW) <i>Tachycineta thalassina</i>	Yes	Yes	Yes	Yes
Loggerhead Shrike (LOSH) <i>Lanius ludovicianus</i>	No	No	1:7/13:2	No
Bell's Vireo (BEVI) <i>Vireo bellii</i>	No	No	No	1:6/6:9
Prothonotary Warbler (PRWA) <i>Protonotaria citrea</i>	No	No	1:5/26:1	No
Lucy's Warbler (LUWA) <i>Vermivora luciae</i>	Yes	Yes	Yes	Yes
Orange-crowned Warbler (OCWA) <i>Vermivora celata</i>	No	No	No	2:5/10:16
Yellow Warbler (YEWA) <i>Dendroica petechia</i>	Yes	Yes	Yes	Yes
Yellow-rumped Warbler (YRWA) <i>Dendroica coronata</i>	No	Yes	Yes	No
MacGillivray's Warbler (MGWA) <i>Oporornis tolmiei</i>	No	No	1:5/11:17	No
Common Yellowthroat (COYE) <i>Geothlypis trichas</i>	No	No	Yes	Yes
Yellow-breasted Chat (YBCH) <i>Icteria virens</i>	Yes	Yes	Yes	Yes
Wilson's Warbler (WIWA) <i>Wilsonia pusilla</i>	No	1:5/19:14	No	1:5/10:18
Northern Mockingbird (NOMO) <i>Mimus polyglottos</i>	No	2:7/6:19	1:6/29:2 1:6/29:3 1:7/14:14	No
Rock Wren (ROWR) <i>Salpinctes obsoletus</i>	Yes	Yes	Yes	Yes
Canyon Wren (CNWR) <i>Catherpes mexicanus</i>	Yes	Yes	Yes	Yes
Bewick's Wren (BEWR) <i>Thryomanes bewicki</i>	Yes	Yes	Yes	Yes
Bushtit (BUTI) <i>Psaltiriparus minimus</i>	No	Yes	Yes	Yes
Ruby-crowned Kinglet (RCKI) <i>Regulus calendula</i>	No	1:5/5:4 1:5/5:5 1:5/5:7	No	1:5/10:14 1:5/10:16
Blue-gray Gnatcatcher (BGGN) <i>Polioptila caerulea</i>	Yes	Yes	Yes	Yes
Hermit Thrush (HETH) <i>Catharus guttatus</i>	No	1:5/5:1	No	No
<u>Totals</u>	30	37	36	38

APPENDIX 4. Summary counts of all bird species by plots detected during the 1993 season, based on survey periods 3, 4, and 5 only (INPLOT + OUTPLOT + FLYOVERS). Species codes are given in Appendix 3. List is in A.O.U. order except for the bottom three rows: UNHU = unidentified hummingbird; UNSA = unidentified sandpiper; UNWA = unidentified warbler.

<u>Species</u>	<u>Plot</u>																					<u>Total</u>
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
COME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
MALL	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
MODO	4	4	1	0	1	2	3	3	4	0	0	0	0	0	0	0	1	0	0	2	3	28
RTHA	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
PEFA	0	0	0	0	2	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	6
WTSW	5	0	0	2	0	0	3	0	0	2	0	0	0	0	0	0	0	0	6	30	0	48
BCHU	2	3	5	0	0	1	0	0	0	0	0	2	0	2	0	1	1	0	0	0	0	17
ATFL	0	1	1	2	1	0	2	2	1	2	3	4	1	2	2	5	4	6	4	2	2	47
SAPH	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3	
CORA	0	0	0	1	2	3	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	10
BHCO	3	2	1	2	1	1	1	2	0	0	2	0	1	0	3	0	2	1	0	2	0	24
NOOR	3	3	0	1	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	13
BRBL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	6
GTGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	3
HOFI	5	5	5	2	8	3	3	5	4	5	1	2	1	4	10	2	14	4	5	3	4	95
RSTO	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	3
BLGR	2	1	1	3	0	2	2	0	1	1	0	2	1	3	0	3	1	2	3	3	4	35
VGSW	0	29	4	4	10	21	0	0	3	0	0	0	0	10	5	18	7	4	0	1	0	116
LUWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
YBCH	1	2	0	1	0	2	0	3	3	4	2	2	1	5	2	4	4	1	1	2	1	41
NOMO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
ROWR	1	0	6	3	0	3	2	1	2	2	4	3	8	1	0	2	3	1	3	2	4	51
CNWR	2	3	5	6	7	2	3	3	1	3	5	2	3	3	0	1	2	6	3	1	1	62
BEWR	2	2	4	2	3	2	1	1	1	0	5	4	2	1	6	5	0	2	3	3	3	52
BUTI	0	0	0	0	0	0	0	0	7	2	0	0	0	0	5	1	0	0	0	0	0	15
BGGN	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	1	0	0	5
UNHU	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
UNSA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
UNWA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

APPENDIX 5. Summary counts of all bird species by plots detected during the 1994 season, based on survey periods 3, 4, and 5 only (INPLOT + OUTPLOT + FLYOVERS). Species codes are given in Appendix 3. List is in A.O.U. order.

<u>Species</u>	<u>Plot</u>																					<u>Total</u>
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
MALL	4	1	0	0	0	0	1	0	0	0	4	1	0	0	0	0	0	0	0	0	1	12
MODO	6	3	3	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	17
RTHA	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
PEFA	0	0	0	0	1	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4
WTSW	6	5	0	1	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	18
BCHU	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
ATFL	1	4	1	1	3	4	4	1	2	3	2	5	6	4	3	7	3	5	4	2	2	67
SAPH	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	4
CORA	0	2	3	3	3	1	5	0	0	0	2	3	0	1	2	2	1	3	2	2	4	39
BHCO	3	6	2	7	2	0	1	3	1	0	2	2	2	0	1	0	2	0	0	0	0	34
NOOR	0	0	4	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	7
HOFI	9	8	4	9	16	7	6	4	4	2	6	2	3	5	4	3	11	8	6	10	7	134
BHGR	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
BLGR	0	0	1	1	2	1	1	0	0	1	2	1	0	0	0	0	0	2	0	0	2	14
VGSW	23	22	16	1	0	2	0	0	2	2	0	0	0	0	0	6	17	5	0	6	8	110
LUWA	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Yewa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
COYE	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
YBCH	2	4	6	1	0	1	0	2	3	2	1	1	0	1	3	3	5	2	1	2	1	41
NOMO	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
ROWR	1	2	2	2	0	1	4	2	0	2	0	0	1	0	0	0	2	2	0	0	0	21
CNWR	5	6	7	8	5	3	4	1	1	4	1	3	8	1	3	4	4	3	7	3	3	84
BEWR	3	1	2	4	4	5	2	3	3	2	6	4	1	3	4	7	5	2	1	2	2	66
BGGN	0	0	0	0	1	0	0	1	0	0	0	0	4	1	2	0	1	0	0	0	1	11

APPENDIX 6. Summary counts of all bird species by plots detected during the 1995 season, based on survey periods 3, 4, and 5 only (INPLOT + OUTPLOT + FLYOVERS). Species codes are given in Appendix 3. List is in A.O.U. order except for the bottom two rows: EMPI = unidentified *empidonax* flycatcher; UNID = unidentified to species.

<u>Species</u>	<u>Plot</u>																					<u>Total</u>
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
COME	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MALL	0	0	3	0	0	1	0	0	0	5	0	1	0	0	0	0	0	0	0	0	0	10
GBHE	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	3
MODO	4	2	2	4	1	1	0	2	2	0	0	0	0	1	4	2	3	2	1	2	1	34
TUVU	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
GOEA	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
PEFA	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4
YBCU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
WTSW	3	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	7
BCHU	0	0	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	8
ATFL	1	1	3	0	3	0	1	2	1	1	2	5	3	1	2	8	4	2	5	2	1	48
SAPH	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	5
WWPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	3
CORA	4	0	1	2	1	4	9	0	0	3	2	1	2	1	0	3	2	1	3	3	0	42
BHCO	1	1	7	1	1	2	0	2	0	0	0	0	0	2	2	1	5	1	0	0	0	26
RWBL	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NOOR	3	3	1	1	1	1	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	17
HOFI	7	11	9	3	7	8	7	2	4	5	4	1	4	7	4	12	8	7	14	8	6	138
BLGR	0	1	2	1	0	2	0	0	1	1	1	2	2	2	2	2	2	2	0	0	0	23
VGSW	7	13	6	1	0	0	0	3	0	1	0	0	0	0	2	5	10	2	0	6	0	56
BEVI	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
LUWA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	0	0	6
COYE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	5
YBCH	0	0	2	3	0	0	0	2	0	1	0	0	0	3	1	3	4	0	0	0	0	19
ROWR	0	3	1	1	0	0	1	2	1	0	0	0	0	2	0	0	1	0	0	0	2	14
CNWR	7	4	6	5	6	2	3	1	1	3	2	4	3	2	1	1	2	1	4	2	0	60
BEWR	1	5	1	2	1	4	5	5	2	5	2	0	0	0	3	4	2	4	2	0	0	48
BGGN	1	0	0	0	2	0	0	0	3	0	0	0	2	1	0	1	1	2	2	0	0	15
EMPI	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
UNID	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	5

APPENDIX 7. Summary of estimated abundances of birds which have bred or currently breed in the river corridor between Lees Ferry and the present location of Glen Canyon Dam.

Species	Pre-dam	Current
Mallard (<i>Anas platyrhynchos</i>)	undetected	common
Common Merganser (<i>Mergus merganser</i>)	undetected	common
Red-tailed Hawk (<i>Buteo jamaicensis</i>)	common	uncommon
Golden Eagle (<i>Aquila chrysaetos</i>)	fairly common	common
American Kestrel (<i>Falco sparverius</i>)	probably uncommon	undetected
Peregrine Falcon (<i>Falco peregrinus</i>)	insufficient data	common
Prairie Falcon (<i>Falco mexicanus</i>)	probably fairly common	undetected
Spotted Sandpiper (<i>Actitis macularia</i>)	undetected	undetected
Mourning Dove (<i>Zenaida macroura</i>)	common	common
White-throated Swift (<i>Aeronautes saxatalis</i>)	common	common
Black-chinned Hummingbird (<i>Archilochus alexandri</i>)	common	common
Southwestern Willow Flycatcher (<i>Empidonax traillii extimus</i>)	probably uncommon	undetected
Say's Phoebe (<i>Sayornis saya</i>)	uncommon	uncommon
Ash-throated Flycatcher (<i>Myiarchus cinerascens</i>)	common	common
Violet-green Swallow (<i>Tachycineta thalassina</i>)	common	common
Cliff Swallow (<i>Petrochelidon pyrrhonota</i>)	common	undetected
Common Raven (<i>Corvus corax</i>)	common	common

Bushtit (<i>Psaltiriparus minimus</i>)	undetected	sparse or irregular
Rock Wren (<i>Salpinctes obsoletus</i>)	common	common
Canyon Wren (<i>Catherpes mexicanus</i>)	common	common
Bewick's Wren (<i>Thryomanes bewicki</i>)	undetected	common
Blue-gray Gnatcatcher (<i>Polioptila caerulea</i>)	common	common
Lucy's Warbler (<i>Vermivora luciae</i>)	probably uncommon	uncommon
Yellow Warbler (<i>Dendroica petechia</i>)	probably sparse	sparse
Common Yellowthroat (<i>Geothlypis trichas</i>)	uncommon	uncommon
Yellow-breasted Chat (<i>Icteria virens</i>)	common	common
Northern (Bullock's) Oriole (<i>Icterus galbula</i>)	uncommon	uncommon
Great-tailed Grackle (<i>Quiscalus mexicanus</i>)	undetected	uncommon
Brown-headed Cowbird (<i>Molothrus ater</i>)	uncommon	common
Black-headed Grosbeak (<i>Pheucticus melanocephalus</i>)	undetected	undetected*
Blue Grosbeak (<i>Guiraca caerulea</i>)	common	common
Rufous-sided Towhee (<i>Pipilo erythrophthalmus</i>)	probably casual	probably casual**
House Finch (<i>Carpodacus mexicanus</i>)	common	common

* Nesting records from 1984 and 1985 (see species account)

** Probable breeding in 1993 (see species account)

