

**HUALAPAI TRIBE TRANSITIONAL MONITORING OF AVIAN POPULATIONS
IN LOWER GRAND CANYON: 1997**

DRAFT FINAL REPORT

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INTRODUCTION

Studies of avian communities in lower Grand Canyon by the Hualapai Tribe were initiated in 1993 and continued through 1997. The objectives of these studies were to describe avian abundances, distributions and diversities in lower Grand Canyon where relatively few studies had been previously done (Brown et al. 1987) and to determine, where possible, the effects of interim flows from Glen Canyon Dam on nesting birds. Since these studies were initiated, riparian vegetation at our sites have remained relatively stable except at the lower sites that are becoming inundated from Lake Mead waters. Since 1993, there has been no overall trend in avian population densities in lower Grand Canyon (Hualapai Tribe and SWCA, 1995).

In 1997, we continued to quantify avian abundances to better understand the natural variation in their populations and to attempt to assess the effects of the operation of Glen Canyon Dam on these resources. Here, we performed censuses of bird populations at five of the eight sites in 1997 that were previously sampled in 1993 to 1996. Due to logistical constraints, Glen Canyon National Recreation Area assumed responsibility for monitoring the other three sites above Diamond Creek in 1997. Their results will not be reported here.

The purposes of this study were twofold: 1) to estimate the abundance and species richness of birds nesting in the riparian zone of the Colorado River through the Hualapai Reservation, and 2) assess, where possible, the influence of interim flows from Glen Canyon Dam on these nesting birds.

BACKGROUND

Periodic fluctuations in the level of Lake Mead since the 1930s have strongly influenced the substrate and vegetation of the Colorado River corridor from Separation Canyon to the Grand Wash Cliffs (Carothers and Brown 1991) and are suspected to have caused several cycles of episodic change in the associated riparian bird communities. A single cycle of change would likely involve two phases: 1) avian colonization of emergent riparian vegetation as lake levels receded and flow fluctuations decreased, followed by 2) displacement of the resulting nesting bird community as lake levels increased. At present, the nesting

bird community of the river corridor from Separation Canyon to the Grand Wash Cliffs is approximately 10-12 years into the first phase of change. Changing lake levels and/or flow regimes will likely cause future changes in nesting bird use of the river corridor. For example, the current flow regime of steady high flows and rising lake levels have inundated a significant portion of lower riparian areas causing trees to die thereby reducing the future availability of nesting vegetation.

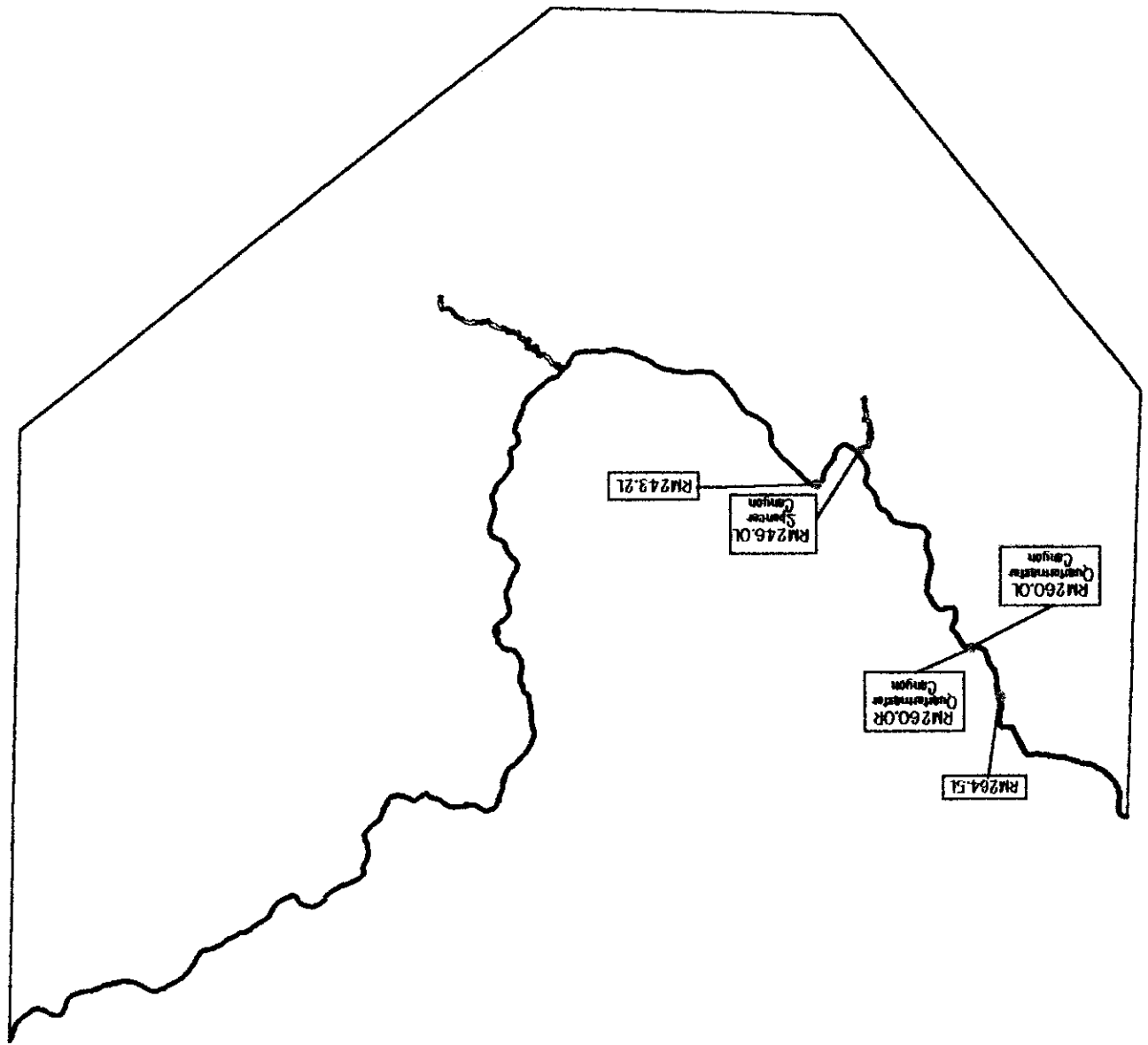
METHODS

Surveys for nesting birds were conducted at five sites along the Colorado River corridor between Diamond Creek and Pearce Ferry (Figure 1) April to June, 1997 using the point-count method (Ralph et al. 1983), where we counted all detectable birds at each 50 meter radius point during a five minute census period. The number of points per site varied from two to nine due to the size of the study sites (Table 1). Each site was surveyed three times during the nesting season except river mile 243.2L and Spencer Creek (river mile 246.0L) which were censused on only two occasions due to weather. Vegetation at these sites is dominated by tamarisk (*Tamarix chinensis*) with mixtures of coyote willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*) and arrowweed (*Tessaria sericea*).

From the survey data, we calculated the mean number of individuals counted for each species during the three surveys. Based on the size of the circular plot (50m radius) and the number of points (two to nine) we calculated the density of each species (number per hectare) and summed these values across species to get an overall density of birds at each site. We then multiplied this site density value by 40 to yield the site density on a per 40 hectare scale as was done in 1993 through 1996 (Hualapai Tribe and SWCA, 1993, 1994 and 1995; Christensen 1996).

We used Spearman Rank correlation analysis to examine the relationship between avian abundances across sites in 1996 and 1997. In addition, we used the paired-t test to determine whether avian abundances and densities varied significantly across sites between 1993 and 1997. The Wilcoxon Signed Ranks test would probably be more appropriate for the paired comparisons, but small sample sizes precluded its use.

Avian Monitoring Sites



0 6.9 13.8 Miles

Table 1. Avian survey site locations for the Hualapai studies in FY 1996.

LOCATION	RIVER MILE	NUMBER OF SURVEY POINTS	SIZE (ha)
Above Spencer Canyon	243.2-243.4L	2	2.3
Spencer Canyon	246.0L	3	2.2
Quartrmstr Canyon	260.1-260.3L	4	7.1
Waterfall Rapids	260.1-260.3R	2	3.4
Tincanebits Canyon	263.8-265.1L	9	47.1

Bird Surveys

A single observer conducted bird surveys between 05:00 and 09:30 AM. The points were established in 1996 with assistance from staff from the Glen Canyon National Recreation Area and were chosen to represent available habitats at each site. The survey objective was to detect and record singing males for those species that were primarily monogamous and exhibited type-A territories, and to detect and record all individuals for those species that were either polygamous, did not exhibit type-A territories, or did not exhibit vocal or visual sexual dimorphism. These surveys were performed in mid-April, mid-May and early June. Mr. Ryan Riley and Mr. Lawrence Abeita performed the censuses and began training an additional observer, Johnny Matuck.

A type-A territory is an all-purpose area, used for nesting and feeding by the pair, that is vocally advertised, physically defended, and from which all other individuals of the same species are assumed to be excluded. Therefore, monogamous type-A species were most easily censused by recording detections of

singing males (Mayfield 1981), with the assumption that each male represented a nesting pair and that all singing males were detected during the survey periods. For a discussion of avian territoriality, see Perrins and Birkhead (1983). Species that were either primarily monogamous or maintained type-A territories included: Western Screech-Owl, Ladder-backed Woodpecker, kingbird, Bewick's Wren, Marsh Wren, Blue-gray Gnatcatcher, Phainopepla, Northern Mockingbird, Crissal Thrasher, Bell's Vireo, Lucy's Warbler, Yellow Warbler, Common Yellowthroat, Yellow-breasted Chat, Summer Tanager, Blue Grosbeak, Lazuli Bunting, Indigo Bunting, Song Sparrow, and Hooded Oriole.

Species that did not maintain type-A territories included: Gambel's Quail, Mourning Dove, Black-chinned Hummingbird, Costa's Hummingbird, Great-tailed Grackle, Brown-headed Cowbird, House Finch, and Lesser Goldfinch. Ash-throated Flycatchers maintained type-A territories but did not exhibit visual or vocal sexual dimorphism, so that detections could not be assigned to a male or female. For this reason, Ash-throated Flycatcher detections were recorded as individuals.

RESULTS AND DISCUSSION

We used the point-count method for the first time in 1996 to estimate bird abundances in lower Grand Canyon and found fewer birds in 1996 compared to 1995. We cautioned that the apparent decline could be an artifact of using a new method for quantifying avian abundances (point-count versus the previous use of the absolute-count method). In 1997, however, using the point-count method, we counted many more birds than in 1996 or 1995 (Table 2). Thus, we are still apparently establishing the natural range of variation in this system. The only anomaly in 1997 was that there were more birds in 1995 at the Quartermaster Canyon site than in 1997.

Table 2. A comparison of the mean number of birds counted for each of the eight sites during the 1995 and 1996 surveys.

SITE	1995 MEAN #/SURVEY	1996 MEAN #/SURVEY	1997 MEAN #/SURVEY
Above Spencer	60.4	36.0	56.0
Spencer Canyon	79.2	61.8	140.0
Quartrmstr Canyon	138.1	57.0	105.0
Waterfall Rapids	52.2	31.0	68.2
Tincanebts Canyon	317.0	260.8	375.1
TOTALS	646.9	446.6	744.3

There was a significant correlation between the mean number of birds counted per survey across sites in 1996 and 1997 ($r=0.90$, $p< 0.05$). Thus, although there were more birds at each site in 1997 compared to 1996, the pattern of which sites supported more and fewer birds remained. Below, we discuss which species have appeared to increase and why this may be so.

Avian densities (adjusted per 40 hectares for comparison) varied significantly between 1996 and 1997 ($t= -4.47$, $p= 0.011$, $df= 4$). Numbers in 1997 were the highest seen since these surveys were begun in 1993, while the lowest numbers were observed in 1994 (Table 3). While there was a significant difference from 1996 to 1997, there was no clear trend between 1993 and 1997 toward increasing or decreasing numbers (Table 3) further supporting our contention that we are still trying to delineate the natural variation in avian populations nesting in lower Grand Canyon.

Researchers in the field did, however, note an increase in the general biological productivity in the canyon in 1997 as evidenced by unusual flowering of native and non-native vegetation (J. Spence, personal communication). This productivity probably resulted from greater precipitation in 1997 compared to 1996, for example and may have indirectly affected bird abundances.

Table 3. A comparison of bird densities across the five Hualapai sites between 1993 and 1997.

SITE	1993 MEAN #/40 HECTARES	1994 MEAN #/40 HECTARES	1995 MEAN #/40 HECTARES	1996 MEAN #/40 HECTARES	1997 MEAN #/40 HECTARES
Above Spencer	1200.0'	808.7	1,048.4	916.4*	1420.0*
Spencer Canyon	1765.0'	1238.2	1,265.2	1048.8*	2,368.0*
Quartrmstr Canyon	1060.0'	662.5	773.6	726.8*	1,336.0*
Waterfall Rapids	600.0'	336.5	613.6	414.2*	1,736.0*
Tincanebts Canyon	403.0'	302.6	268.8	1604.4*	2,124.0*
TOTALS	6,243.0	4,259.3	5,049.6	6,265.4	8,984.0*

' values estimated from Hualapai Tribe and SWCA, 1995, Fig. 16, p.37.

* point-count method (versus absolute-count method; Emlen 1971)

In the following sections, we will compare data from 1997 to that of 1996 for each site separately. We will also attempt to relate how operation of Glen Canyon Dam may affect avian densities in lower Grand Canyon.

Above Spencer (RM 243.2L)

There was no significant difference in avian community composition between 1996 and 1997 (Chi-square goodness of fit; $X^2 = 15.1$, $p = 0.44$, $df = 15$). Three species, however, that were counted in 1996 were not present in 1997 (Northern Oriole, Wilson's Warbler and Costa's Hummingbird). Conversely, Mourning Dove, House Finch and Say's Phoebe were present in 1997 and not in 1996. Thirteen species were counted in both years (Table 4).

There was no significant difference at river mile 243.2L in the number of birds counted per survey in 1997 compared to 1996 ($t = -2.67$, $df = 1$, $p = 0.23$). Several species did increase in the 1997 counts however. Bewick's Wren, Common Yellowthroat, Yellow-breasted Chat and Bell's Vireo increased appreciably from 1996 to 1997 (2.3, 5.0, 2.1 and 2.5 fold respectively). Ash-throated Flycatcher was the only species found to decline. There was, on average, a substantial increase in the number of birds counted per survey from 1996 to 1997 (Figure 2).

Table 4. Results of the 1997 transitional avian monitoring at the site above Spencer Creek (river mile 243.2L).

SITE	SPECIES	MEAN #/SURVEY	DENSITY (#/HA)
Above Spencer (RM 243.2L)	Lucy's Warbler	23.0	14.6
	Blue-gray Gnatcatcher	6.0	3.8
	Bewick's Wren	6.0	3.8
	Bell's Vireo	5.0	3.2
	Common Yellowthroat	3.0	1.9
	Yellow- breasted Chat	3.0	1.9
	Song Sparrow	2.0	1.3
	Say's Phoebe	2.0	1.3
	Lesser Goldfinch	2.0	1.3
	Black-chinned Hummingbird	1.0	0.6
	House Finch	1.0	0.6
	Ash-throated Flycatcher	1.0	0.6
	Mourning Dove	1.0	0.6
Total Number of Individuals		112.0	
Mean Number Per Survey		56.0	
Mean Bird Density for the Site		35.5/ha	

RM243.2L

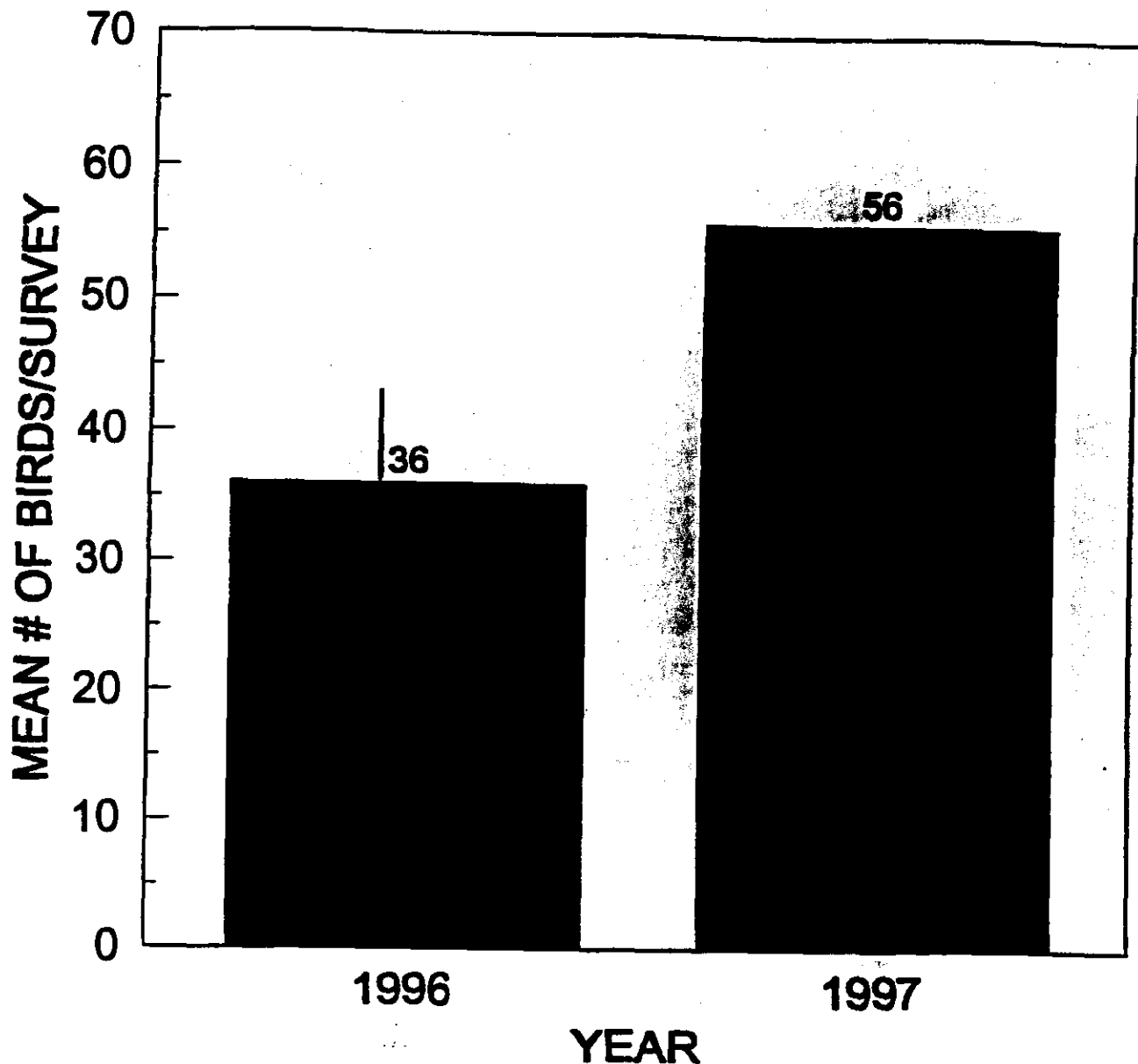


Figure 2. A comparison of the mean number ($\pm$ one standard error) of birds counted per survey at RM243.2L in 1996 versus 1997. Only two surveys were performed in 1997 due to weather while three were performed in 1996. These results are for all stations combined.

Spencer Canyon

Community composition varied significantly at Spencer Canyon between 1996 and 1997 ($X^2 = 36.75$, $p = 0.006$, $df = 18$). Five species were counted in 1997 but not in 1996 (Canyon Wren, Red-tailed Hawk, Summer Tanager, Phainopepla and Hooded Oriole), and three species counted in 1996 were not present in 1997 (White-throated Swift, Great-tailed Grackle and House Finch). Eighteen species were counted in 1997 and 16 in 1996 (Table 5).

Although there was a substantial increase in the number of birds counted in 1997 compared to 1996, this difference was not statistically significant ($t = -2.39$, $p = 0.25$, $df = 1$; Figure 3). Lucy's Warbler, Yellow Warbler, Bell's Vireo and Yellow-breasted Chat increased dramatically from 1996 (4.6, 6.7, 2.4 and 3.8 fold respectively; Table 5). Potential reasons for the change in composition and the increase in abundance of birds in lower Grand Canyon (as this pattern occurred at each of the five study sites) are 1) loss of habitat due to high releases from Glen Canyon Dam and a concomitant rise in the elevation of Lake Mead had a concentrating effect on avian populations, 2) natural variation in avian population abundances or 3) more precipitation and greater general productivity. Future studies will hopefully provide more insight into avian population dynamics in lower Grand Canyon.

SPENCER CREEK

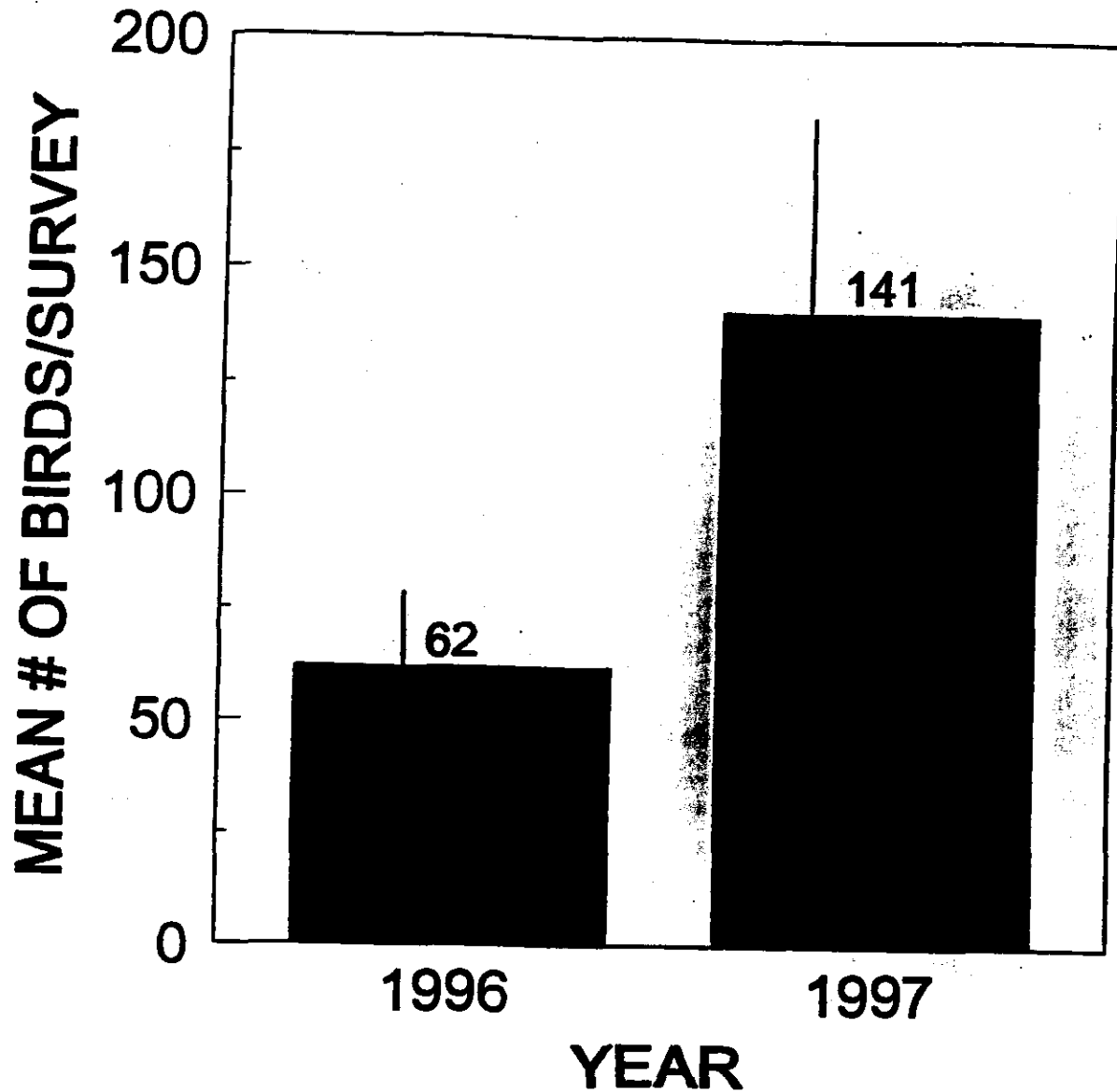


Figure3 . A comparison of the mean number ($\pm$ one standard error) of birds counted per survey at Spencer Creek in 1996 versus 1997. Only two surveys were performed in 1997 due to weather while three were performed in 1996. These results are for all stations combined.

Table 5. Results of the 1997 transitional avian monitoring at the Spencer Canyon site (river mile 246.0L).

SITE	SPECIES	MEAN #/SURVEY	DENSITY (#/HA)
Spencer Canyon	Lucy's Warbler	34.0	14.4
(RM 246.0)	Yellow Warbler	31.0	13.2
	Bell's Vireo	16.0	6.8
	Yellow-breasted Chat	15.0	6.4
	Blue-gray Gnatcatcher	9.0	3.8
	Bewick's Wren	9.0	3.8
	Ash-throated Flycatcher	4.0	1.7
	Common Yellowthroat	4.0	1.7
	Canyon Wren	3.0	1.3
	Phainopepla	3.0	1.3
	Costa's Hummingbird	2.0	0.8
	Black-chinned Hummingbird	2.0	0.8
	Summer Tanager	2.0	0.8
	Hooded Oriole	2.0	0.8
	Song Sparrow	1.0	0.4
	Red-winged Blackbird	1.0	0.4
	Lesser Goldfinch	1.0	0.4
	Red-tailed Hawk	1.0	0.4

Table 5 Continued:

Total Number of Individuals	280
Mean Number Per Survey	140.0
Mean Bird Density for the Site	59.2/ha

Quartermaster Canyon

Community composition varied significantly at Quartermaster Canyon between 1996 and 1997 ($X^2 = 61.03$, $p < 0.001$, $df = 24$). Ten species that were not counted in 1996 were present in 1997 at Quartermaster Canyon (Black-chinned Hummingbird, Canyon Wren, Say's Phoebe, Black Phoebe, Ash-throated Flycatcher, Common Raven, Hooded Oriole, Lincoln's Sparrow, Rough-winged Swallow and Summer Tananger). Six species that were present in 1996 were not found in 1997 (Brown-headed Cowbird, Western Wood Peewee, White-crowned Sparrow, Purple Martin, Wilson's Warbler and Solitary Vireo). The number of species found at Quartermaster Canyon increased from 15 in 1996 to 20 in 1997 (Table 6).

The average abundance of birds counted per survey was substantially greater in 1997 compared to 1996, but not significantly so ($t = -6.5$, $p = 0.097$, $df = 1$; Figure 4). Say's Warbler, Blue-gray Gnatcatcher and Yellow-breasted Chat increased substantially in 1997 compared to 1996 (3.6, 3.3 and 4.3 fold respectively; Table 6). Yellow Warbler and House Finch were the only species to decline in 1997.

QUARTEMASTER CANYON

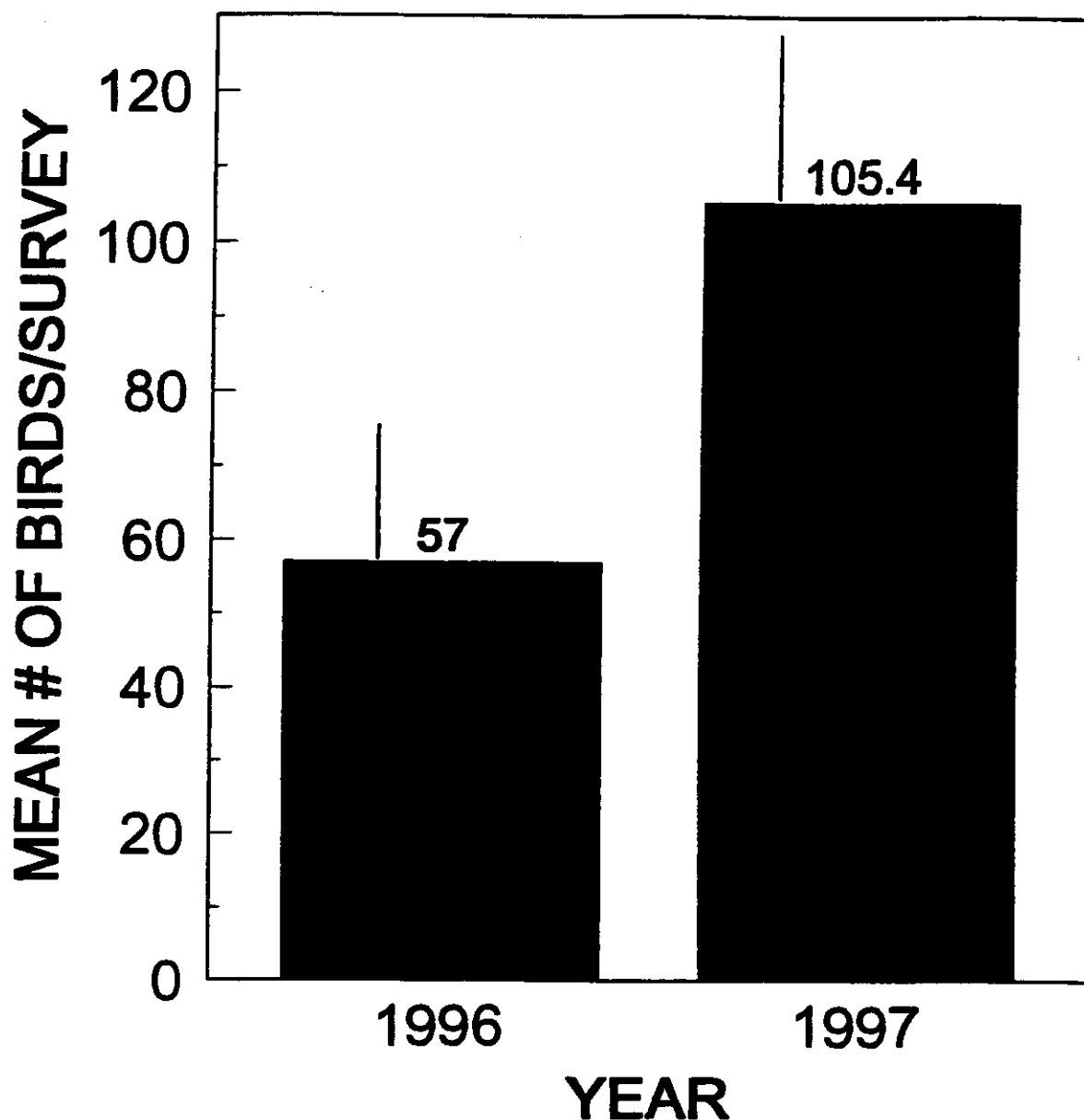


Figure 4. A comparison of the mean number ($\pm$ one standard error) of birds counted per survey at Quartermaster Canyon in 1996 versus 1997. Three surveys were performed in both years. These results are for all stations combined. These results are for all stations combined.

Table 6. Results of the 1997 transitional avian monitoring at the Quartermaster Canyon site (river mile 260.1L).

SITE	SPECIES	MEAN #/SURVEY	DENSITY (#/HA)
Quartermaster Canyon (RM 260.1L)	Lucy's Warbler	32.0	10.2
	Bell's Vireo	12.6	4.0
	Bewick's Wren	8.6	2.7
	Yellow-breasted Chat	8.6	2.7
	Song Sparrow	7.3	2.3
	Blue-gray Gnatcatcher	6.6	2.1
	Common Yellowthroat	6.0	1.9
	Black-chinned Hummingbird	3.3	1.1
	Ash-throated Flycatcher	3.3	1.1
	Canyon Wren	3.3	1.1
	Rough-winged Swallow	2.6	0.8
	House Finch	2.0	0.6
	Say's Phoebe	1.4	0.4
	Black Phoebe	1.4	0.4
	Yellow Warbler	1.4	0.4
	Common Raven	1.4	0.4
	Hooded Oriole	1.4	0.4
	Lesser Goldfinch	0.6	0.2

Table 6 Continued:

	Lincoln's Sparrow	0.6	0.2
	Summer Tananger	0.6	0.2
Total Number of Individuals		316	
Mean Number Per Survey		105.0	
Mean Bird Density for the Site		33.4/ha	

Waterfall Rapids

Avian community composition did not vary significantly from 1996 to 1997 ($X^2 = 12.22$, $p = 0.66$, $df = 15$). Five species were found in 1997 but not in 1996 (Yellow Warbler, Ash-throated Flycatcher, Brown-headed Cowbird, Mourning Dove and Western Tananger) while three species were found in 1996 but not in 1997 (Common Raven, White-crowned Sparrow and Say's Phoebe). Fifteen species were counted in 1997 and 13 were found at Waterfall Rapids in 1996 (Table 7).

Significantly more birds were counted per survey in 1997 compared to 1996 at the Waterfall Rapids site ($t = -4.45$, $p = 0.047$, $df = 2$; Figure 5). Numbers of Common Yellowthroat, Lucy's Warbler and Bell's Vireo increased substantially from 1996 to 1997 (3.9, 2.9 and 2.2 fold respectively; Table 7). No species declined in numbers from 1996 to 1997 except those that were absent.

Table 7. Results of the 1997 transitional avian monitoring at the Waterfall Rapids site (river mile 260.1R).

SITE	SPECIES	MEAN #/SURVEY	DENSITY (#/HA)
Waterfall Rapids (RM 260.1R)	Lucy's Warbler	19.4	12.4
	Bell's Vireo	10.0	6.4
	Blue-gray Gnatcatcher	6.6	4.2
	Yellow-breasted Chat	6.6	4.2
	Bewick's Wren	5.4	3.4
	Common Yellowthroat	5.4	3.4
	Song Sparrow	4.0	2.5
	Yellow Warbler	3.0	1.9
	Black Phoebe	2.0	1.3
	Canyon Wren	1.4	0.9
	Black-chinned Hummingbird	1.4	0.9
	Mourning Dove	1.2	0.8
	Brown-headed Cowbird	0.6	0.4
	Western Tanager	0.6	0.4
	Ash-throated Flycatcher	0.6	0.4
Total Number of Individuals		202	
Mean Number Per Survey		68.2	
Mean Bird Density for the Site		43.4/ha	

WATERFALL RAPIDS

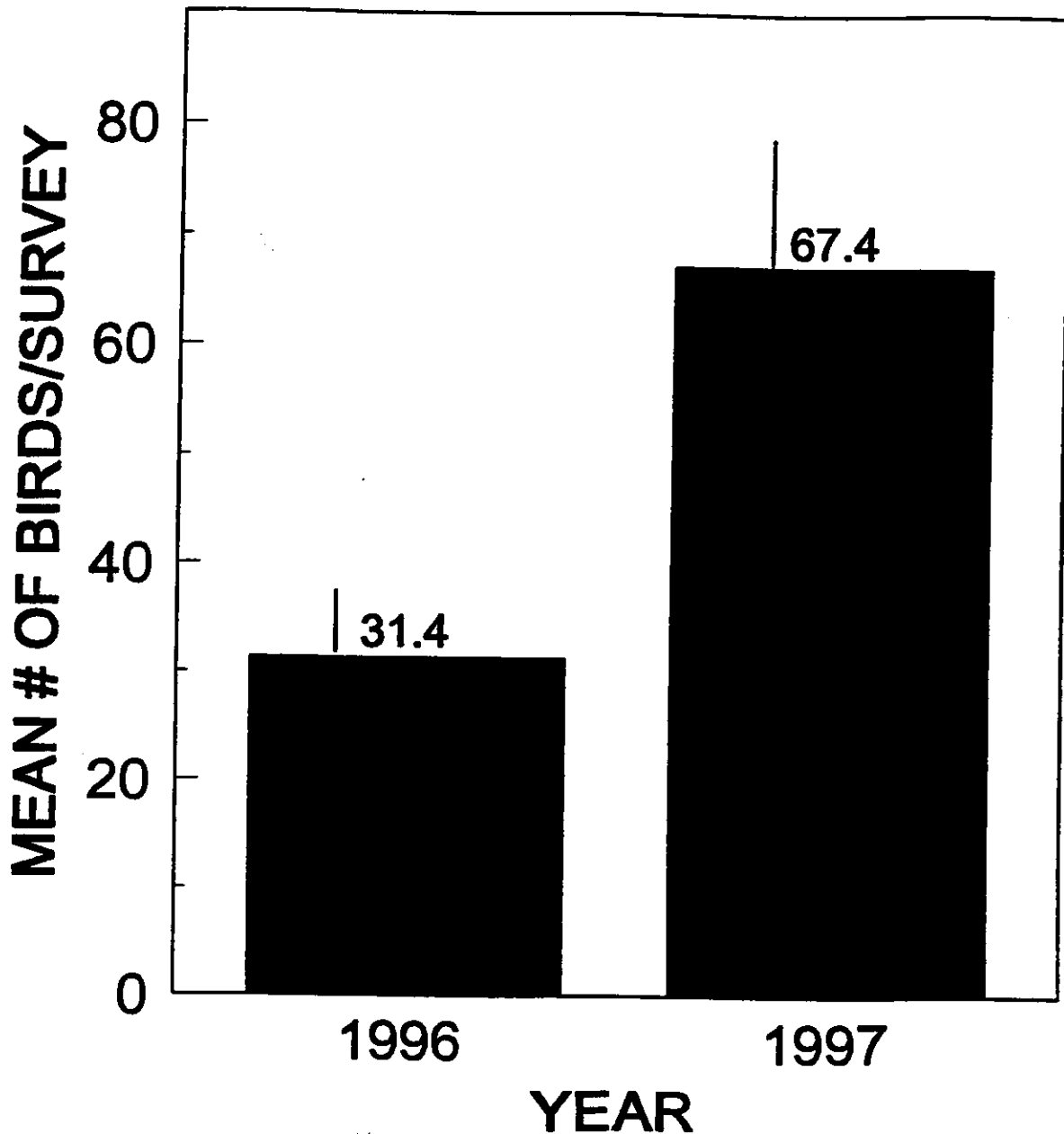


Figure 5. A comparison of the mean number ($\pm$ one standard error) of birds counted per survey at Waterfall Rapids in 1996 versus 1997. Three surveys were performed in both years. These results are for all stations combined.

Tincanebits Canyon

Community composition varied significantly from 1996 to 1997 at the Tincanebits Canyon site ($X^2 = 179.85$, $p < 0.001$, $df = 32$). Nine species counted in 1997 were not found at this site in 1996 (Turkey Vulture, Mallard, Phainopepla, Rock Wren, Mourning Dove, Black-chinned Hummingbird, Rough-winged Swallow, Pinyon Jay and Summer Tananger). Nine species that were found at Tincanebits Canyon in 1996 were not found in 1997 (White-crowned Sparrow, Yellow-rumped Warbler, Wilson's Warbler, Violet-green Swallow, Brewer's Sparrow, Ladder-backed Woodpecker, Costa's Hummingbird, Western Wood Peewee and Great-tailed Grackle). Twenty-seven species were identified in both 1996 and 1997 (Table 8).

Mean number of birds counted per survey was substantially higher in 1997 compared to 1996 at the Tincanebits Canyon site, but not significantly so ($t = -3.53$, $p = 0.072$, $df = 2$; Figure 6). Red-winged Blackbird, Lucy's Warbler and Brown-headed Cowbird increased substantially from 1996 to 1997 (4.4, 2.1 and 3.5 fold respectively; Table 8). Numbers of Yellow Warbler, Common Yellowthroat, Say's Phoebe and Lesser Goldfinch declined slightly in 1997. As mentioned previously, we believe that the loss of habitat at upper Lake Mead due to rising lake levels has concentrated the birds into the remaining habitats.

TINCANEBITS CANYON

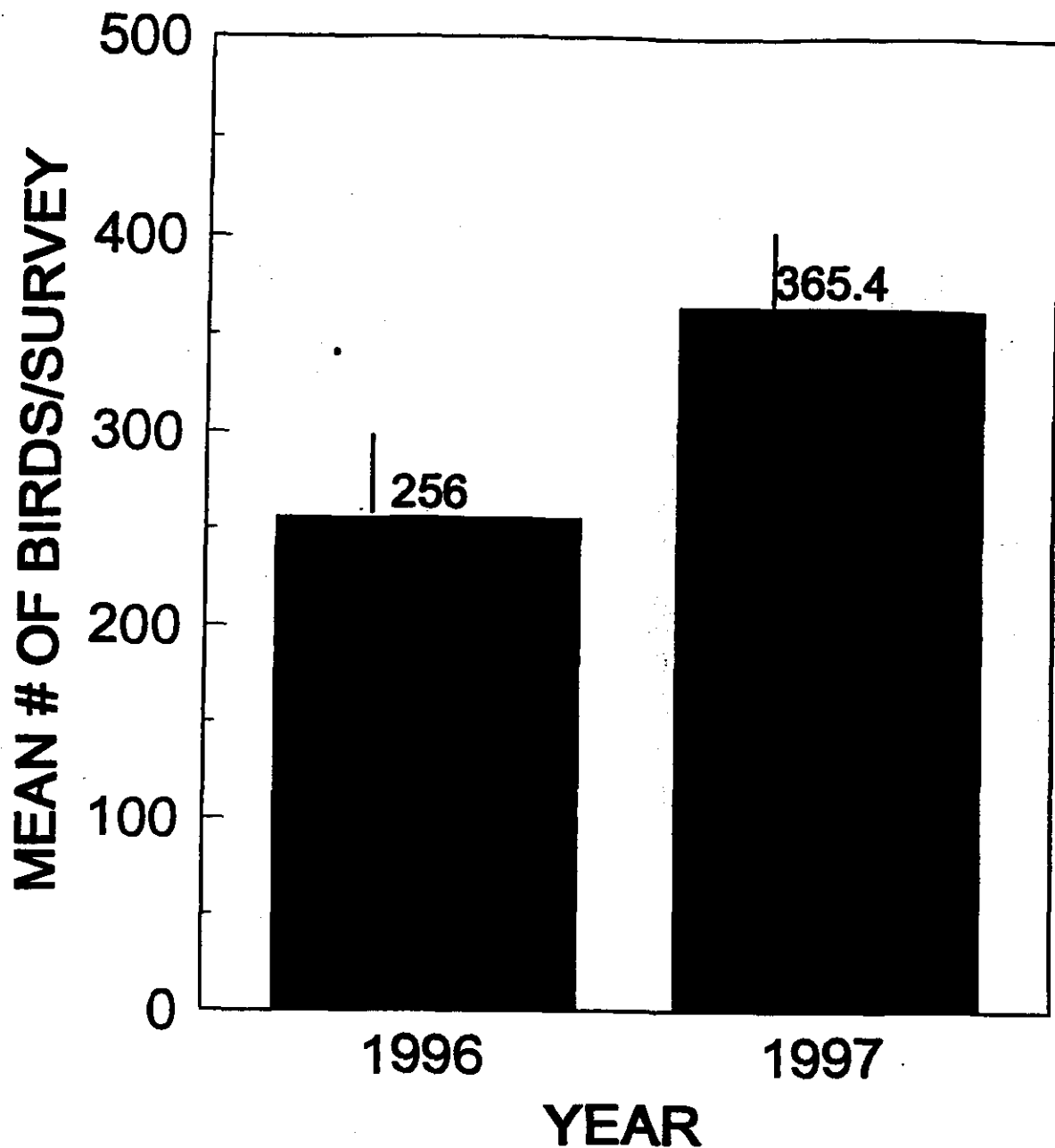


Figure 6. A comparison of the mean number ($\pm$ one standard error) of birds counted per survey at Tincanebits Canyon in 1996 versus 1997. Three surveys were performed in both years. These results are for all stations combined.

Table 8. Results of the 1997 transitional avian monitoring at the Tincanebits Canyon site (river mile 264.5L).

SITE	SPECIES	MEAN #/SURVEY	DENSITY (#/HA)
Tincanebits Canyon (RM 264.5L)	Lucy's Warbler	102.6	14.5
	Song Sparrow	76.7	10.9
	Bell's Vireo	33.4	4.7
	Bewick's Wren	32.0	4.5
	Yellow-breasted Chat	28.6	4.0
	Blue-gray Gnatcatcher	18.6	2.6
	Common Yellowthroat	17.4	2.5
	Brown-headed Cowbird	12.0	1.7
	Red-winged Blackbird	11.4	1.6
	House Finch	9.4	1.3
	Lesser Goldfinch	5.4	0.8
	Ash-throated Flycatcher	4.6	0.7
	Northern Mockingbird	3.4	0.5
	Mourning Dove	2.6	0.4
	Yellow Warbler	2.6	0.4
	Pinyon Jay	2.6	0.4
	Phainopepla	2.0	0.3
	Common Raven	2.0	0.3

Table 8 Continued:			
	Say's Phoebe	1.4	0.2
	Mallard	1.4	0.2
	Canyon Wren	0.6	0.1
	Rock Wren	0.6	0.1
	Rough-winged Swallow	0.6	0.1
	Western Tanager	0.6	0.1
	Summer Tanager	0.6	0.1
	Turkey Vulture	0.6	0.1
Total Number of Individuals		1,128	
Mean Number Per Survey		375.1	
Mean Bird Density for the Site		53.1/ha	

Effects of the Operation of Glen Canyon Dam on Avian Communities in Lower Grand Canyon.

During interim flows and prior to the current high, steady-flows from Glen Canyon Dam, riparian vegetation in lower Grand Canyon had remained stable (in area, basal area and composition) resulting in an abundance of habitats for nesting birds. High, steady-flows, however, have inundated near-shore vegetation and caused the elevation of Lake Mead to rise substantially reducing habitat availability thereby concentrating birds into the remaining vegetation. We caution, however, that we are still establishing the natural variation in avian abundances in lower Grand Canyon, and future monitoring will help to identify long-term trends in the dynamics of avian abundances. Since 1993, we have not identified any particular trend of increase or decrease.

RELEVANT LITERATURE

Anderson, L.S. and G.A. Ruffner. 1988. Effects of post-Glen Canyon Dam flow regime on the old high water line plant community along the Colorado River in Grand Canyon. Glen Canyon Environmental Studies, Salt Lake City. NTIS PB88-183504/AZ

Ayers, T. and Stevens, L. 1992. A proposal to monitor the effects of interim flows from Glen Canyon dam on riparian vegetation in the Colorado River downstream from Glen Canyon dam, Arizona.

Blake, J.G. 1978. Birds of the Lake Mead National Recreation Area. Lake Mead Tech. Rpt. No. 1, Coop. Park Studies Unit, Univ. of Nevada, Las Vegas. 218 pp.

Brian, N.J. 1988. Aerial Photography comparison of 1983 high flow impacts to vegetation at eight Colorado River beaches. Glen Canyon Environmental Studies Rept. No. 20, Salt Lake City.

Brown, B.T., G.S. Mills, R. Glinski, and B. Hoffman. 1992. Density of nesting peregrine falcons in Grand Canyon National Park, Arizona. Southwest Naturalist 5:2.

Brown, B.T. 1987a. Monitoring bird population densities along the Colorado River in Grand Canyon. Final Report, Glen Canyon Environmental Studies, U.S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, Utah. 26 pp.

Brown, B.T. 1987b. Ecology of riparian breeding birds along the Colorado River in Grand Canyon, Arizona. Ph.D. Diss., University of Arizona, Tucson. 66 pp.

Brown, B.T. 1988. Monitoring bird population densities along the Colorado River in Grand Canyon: 1987 breeding season. Final Report, Glen Canyon Environmental Studies, U.S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, Utah. 26 pp.

Brown, B.T. 1989. Breeding ecology of riparian birds along the Colorado River in Grand Canyon, Arizona. Tech. Rpt. No. 25, Coop. Park Studies Unit, Univ. of Arizona, Tucson. 42 pp.

Mills, G.S., J.B. Dunning, and J.M. Bates. 1991. The relationship between breeding bird density and vegetation volume. *Wilson Bulletin* 103:468-479.

Perrins, C.M., and T.R. Birkhead. 1983. *Avian ecology*. Blackie and Son Ltd., Glasgow, Scotland. 221 pp.

Phillips, B.G., A.M. Phillips, M. Theroux, J. Downs and G. Fryberger. 1977. Riparian vegetation of Grand Canyon National Park, Arizona. Mus. of Northern Ariz., Flagstaff, Az. Unpublished map.

Phillips, B.G., R.A. Johnson, A.M. Phillips III and N.J. Brian. 1986. Monitoring the effects of recreational use on Colorado River beaches in Grand Canyon National Park. Mus. Northern Ariz. Bull. Ser. 55, Flagstaff, AZ.

Phillips, B.G., A.M. Phillips III, and M.A. Schmidt-Bernzott. 1987. Annotated checklist of vascular plants of Grand Canyon National Park. Grand Canyon Natural History Assoc. Monogr. No. 7. Grand Canyon.

Pucharelli, M. 1988. Evaluation of riparian vegetation trends in the Grand Canyon using multitemporal remote sensing techniques. U.S.D>I. Bureau of Reclamation, Glen Canyon Environmental Studies, Rept. No. 18. NTIS No. PB88-183488.

Johnson, R.R, B.T. Brown, L.T. Haight, and J.M. Simpson. 1981. Playback recordings as a special avian censusing technique. *Studies in Avian Biology* 6:68-75.

Ralph, C.J., and J.M. Scott (Eds.). 1981. Estimating numbers of terrestrial birds. *Studies in Avian Biology* 6:1-630.

Ricklefs, R.E. 1979. *Ecology*, 2nd ed. Chiron Press, New York.

Rubin, D.M., J.C. Schmidt and J.N. Moore. 1990. Origin, structure, and evolution of a reattachment bar, Colorado River, Grand Canyon, Arizona. *Journal of Sedimentary Petrology*, 60:982-991.

Ruffner, G.A., N.J. Czaplewski, and S.W. Carothers. 1978. Distribution and natural history of some mammals from the Inner Gorge of the Grand Canyon, Arizona. *Journal of the Arizona-Nevada Academy of Science*, 13:85-91.

Schollander, P.F., H.T. Hammel, Edda D. Bradstreet and E.A. Hemmingsen. 1965. Sap pressure in vascular plants. *Science* 148:339-346.

Smith, S.D., A.B. Wellington, J.L. Nachlinger and C.A. Fox. 1991. Functional responses of riparian vegetation to streamflow diversion in the eastern Sierra Nevada. *Ecol. Appl.* 1:89-97.

Stevens, L.E. 1989. Mechanisms of riparian plant community organization and succession in the Grand Canyon, Arizona. Northern Arizona Univ., Ph.D. Dissertation, Flagstaff.

Stevens, L.E. and G.L. Waring. 1988. Effects of post-dam flooding on riparian substrates, vegetation and invertebrate populations in the Colorado River corridor in Grand Canyon, Arizona. Bureau of Reclamation Glen Canyon Environmental Studies Rept. No. 19, NTIS No. PB88-183488/AS.

Stevens, L.E. and T.J. Ayers. 1991. The impacts of Glen Canyon Dam on riparian vegetation soil stability in the Colorado River corridor, Grand Canyon, Arizona: 1991 draft annual report. Submitted to NPS CPSU, Northern Arizona University, Flagstaff.

Stevens, L. 1983. The Colorado River through Grand Canyon: A comprehensive guide. Red Lake Books, Flagstaff, Arizona. 107pp.

Szaro, R.C., and M.D. Jakle. 1982. Comparison of variable circular-plot and spot-map methods in desert riparian and scrub habitats. *Wilson Bulletin* 94:546-550.

Turner, R.M. and M.M. Karpiscak. 1980. Vegetation changes between Glen Canyon Dam and Lake Mead, Arizona. USGS Prof. Pap. 11-32. Washington.

United States Fish and Wildlife Service. 1991. Annual planning aid report.

Waring, G.L. 1991. Literature study of lower Grand Canyon scientific studies. Unpublished document.

Waring, G.L. and L.E. Stevens. 1988. The effect of recent flooding on riparian plant establishment in Grand Canyon. Bureau of Reclamation Glen Canyon Environmental Studies Rept. No. 21. NTIS OB88-183493/AS.

Watahomigie, L.J., M. Powsket and J. Bender. 1982. Ethnobotany of the Hualapai. Hualapai Bilingual Program, Peach Springs, Arizona.

Willson, M.F. and S.W. Carothers. 1979. Avifauna of habitat islands in the Grand Canyon. Southwestern Naturalist 24(4):563-576.

**B. ANNOTATED CHECKLIST OF KNOWN OR SUSPECTED NESTING
BIRDS IN THE COLORADO RIVER CORRIDOR FROM NATIONAL CANYON
TO PEARCE FERRY, ARIZONA**

This annotated checklist outlines those bird species known or strongly suspected to nest within the riparian corridor of the Colorado River. Only riparian or riverine-associated species that nest below the high-water mark of the river or Lake Mead have been included.

Species nesting on cliffs in close proximity to the river (swallows and White-throated Swifts) have been included, whereas species nesting on cliffs well above the high-water mark have not been included: Red-tailed Hawk (*Buteo jamaicensis*), Peregrine Falcon (*Falco peregrinus*), American Kestrel (*Falco sparverius*), and Common Raven (*Corvus corax*). Likewise, desert-nesting species that may occasionally venture into the riparian zone but are not known to nest there have not been included: Greater Roadrunner (*Geococcyx californianus*), Great Horned Owl (*Bubo virginianus*), Lesser Nighthawk (*Chordeiles acutipennis*), Cactus Wren (*Campylorhynchus brunneicapillus*), Rock Wren (*Salpinctes obsoletus*), Canyon Wren (*Catherpes mexicanus*), Black-tailed Gnatcatcher (*Polioptila melanura*), and Black-throated Sparrow (*Amphispiza bilineata*).

DEFINITIONS OF TERMS

The following terms describe the species' relative abundance and status at their peak abundance in optimal habitat at the proper time of year.

Abundant: The species is present in numbers, such that more than 50 individuals are usually detected in one day.

Common: The species is easily found and almost always to be seen; between 5 and 50 individuals are usually detected in one day.

Fairly common: The species is found on a daily basis, but in small numbers; 1 to 4 individuals are usually detected per day.

Uncommon: The species is seldom or infrequently seen, and not on a daily basis; no more than several individuals are usually detected per week.

Rare: Low probability of detecting the species, although it is not out of its normal range.

Permanent resident: Species is present in the study area throughout the year, although for some species different summer and winter populations may be involved. Assumed to nest at the proper season.

Summer resident: Species is present in the study area during the breeding season, and is assumed to nest.

SPECIES ACCOUNTS

Western Grebe (*Aechmophorus occidentalis*)

Apparently a common permanent resident on the impounded waters of Upper Lake Mead, where it is thought to nest. This species was taxonomically split in the 1980s to form both the Western Grebe and Clark's Grebe (*Aechmophorus clarkii*). Both species occur on Upper Lake Mead, although their status there is poorly understood. A large adult grebe seen with several young at RM 279 on August 27, 1978, was assumed to be a Western Grebe (Brown et al. 1987).

Great Blue Heron (*Ardea herodias*)

Common permanent resident throughout the study area, although most individuals seen in summer are not known to be nesting. The only known rookery is at Burnt Canyon, where 1 or 2 nests were active (contained eggs or young) each year from 1990 to 1993. The rookery was inactive (no eggs laid) in 1994. Great Blue Herons were not known to nest in the study area prior to the existence of Lake Mead (Brown et al. 1987).

Black-crowned Night-Heron (*Nycticorax nycticorax*)

Uncommon summer resident, primarily downstream of Separation Canyon where it nests in small rookeries. Black-crowned Night-Herons were not known to nest in the study area prior to the existence of Lake Mead (Brown et al. 1987).

Gambel's Quail (*Callipepla gambelii*)

Rare to uncommon, localized permanent resident from at least Parashant Canyon downstream to Pearce Ferry. The only quail detected during the study period was a single male at the Parashant Canyon site on April 11, 1994; however, a U.S. Geological Survey employee (Greg Dick) reported 3-4 Gambel's Quail on river right immediately upstream of Whitmore Rapid (RM 188) on approximately May 23, 1994.

American Coot (*Fulica americana*)

Fairly common permanent resident on the impounded waters of Upper Lake Mead; individuals seen upstream of Separation Canyon in summer are probably not nesting. Nesting on Upper Lake Mead was confirmed by the sighting of an adult with a single young at RM 278 on June 6, 1993; an American Coot nest containing at least 6

eggs being incubated by a female was discovered at Pearce Ferry on April 19, 1994.

Spotted Sandpiper (*Actitis macularia*)

Fairly common summer resident throughout the study area. Nesting is assumed to occur on open sandbars and beaches (Brown et al. 1987), although a nest has yet to be discovered along the river between National Canyon and Pearce Ferry.

Mourning Dove (*Zenaida macroura*)

Common summer resident throughout the study area. Mourning Doves build flimsy stick nests in tamarisk in the NHWZ and mesquite in the OHWZ.

Yellow-billed Cuckoo (*Coccyzus americanus*)

No cuckoos were detected during the study period in the study area, where this species has been assumed to be a rare and irregular summer visitor (Brown et al. 1987). However, sightings in summer 1992 suggest this species may be a rare summer resident (Timothy Tibbitts, U.S. Fish and Wildlife Service, pers. comm.).

Western Screech-Owl (*Otus kennicottii*)

Uncommon permanent resident assumed to be nesting, although a nest has yet to be discovered in the study area. One and occasionally two Western Screech-Owls vocalized repeatedly from the same large patch of tamarisk scrubland at RM 265R on May 23 and June 5, 1993; and again on April 17-18, May 5-7, and June 9-10, 1994. Screech-owl vocalizations were also detected in the Tincanebits Canyon study site (RM 264L) on May 7, 1994.

White-throated Swift (*Aeronautes saxatalis*)

Common to abundant summer resident throughout the study area, nesting in cracks and crevices in cliff faces (Brown et al. 1987).

Black-chinned Hummingbird (*Archilochus alexandri*)

Common summer resident throughout the study area, nesting almost exclusively in tamarisk in the NHWZ. Along the river upstream of Diamond Creek, patches of tamarisk less than 0.5 ha in area apparently are not suitable for nesting (Brown 1992).

Costa's Hummingbird (*Calypte costae*)

Common to uncommon summer resident throughout the study area, nesting in both the OHWZ and adjacent desert (Brown et al. 1987, Brown 1992). This species' abundance in the study area appears to vary from year to year, since males were common in the mid-to-late 1980s, no males were detected during the 1993 study period, and detections were uncommon during the 1994 study period.

Ladder-backed Woodpecker (*Picoides scalaris*)

Rare permanent resident throughout the study area, nesting in riparian areas with trees large enough to accommodate their cavity nests (Brown et al. 1987). This species was detected throughout the study area but was detected most often at the Tincanabits Canyon study site (RM 264L), where it may have been attracted to large numbers of dead and dying willow trees. No nest of this species has been found in the study area.

Black Phoebe (*Sayornis nigricans*)

Common permanent resident throughout the study area, building mud nests on cliffs and ledges directly over water.

Say's Phoebe (*Sayornis saya*)

Fairly common permanent resident throughout the study area, building nests on cliffs and ledges.

Ash-throated Flycatcher (*Myiarchus cinerascens*)

Common to fairly common summer resident throughout the study area, nesting in riparian areas with trees large enough to accommodate their cavity nests (Brown et al. 1987). Since trees of adequate size are relatively uncommon at locales where this species is common, nesting may also occur in cracks or crevices in cliff faces. However, no nest of this species has been found in the study area. The Ash-throated Flycatcher is easily confused with the Brown-crested Flycatcher (*M. tyrannulus*) which occurs irregularly but is not known to nest in the study area (Brown et al. 1987).

Kingbird sp. (*Tyrannus vociferans* and *verticalis*)

Cassin's and Western Kingbirds are uncommon summer residents nesting on both the North and South Rims and along tributaries to the river. Both species are uncommon along the river in summer, but no nest of either species has been found in the river corridor. The only kingbird record from the study period was a

single individual (which was not identified to species) at the Quartermaster Canyon study site on May 28, 1994.

Violet-green Swallow (*Tachycineta thalassina*)

Fairly common summer resident upstream of Diamond Creek, this species is a rare to uncommon summer resident downstream of Diamond Creek where nesting is assumed to occur in cracks and crevices in cliff faces, although no nest has been found along the river below National Canyon (Brown et al. 1987).

Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)

Common to abundant summer resident primarily downstream of Diamond Creek. This species typically constructs burrow nests in vertical dirt banks at the river's edge, such as those found at RM 260R in early June 1993. However, a small colony of Rough-winged Swallows was discovered using mud nests constructed on a cliff face and under rock ledges at RM 267R on June 15, 1988.

Bewick's Wren (*Thryomanes bewickii*)

Common permanent resident of both the NHWZ and OHWZ, apparently reaching its highest density in old-growth tamarisk. This is a cavity-nesting species, but when true cavities are unavailable it will nest in hollow logs or limbs, in crevices in tree trunks, or even on the ground under brush or driftwood piles.

Marsh Wren (*Cistothorus palustris*)

Rare permanent resident of the NHWZ and FLLZ whose distribution and status are poorly understood. Nesting is known to have occurred at Lees Ferry (Brown et al. 1987) and on portions of adjacent Lake Mead National Recreation Area (Blake 1978), but nesting in the study area between National Canyon and Pearce Ferry is unconfirmed. Singing males were detected at Columbine Falls in late June 1992 and at RM 264L in May 1993, but no nests were located. Large patches of apparently suitable habitat (i.e. dense stands of cattails) exist for this species downriver of Spencer Canyon, yet Marsh Wren detections in these areas are rare.

Blue-gray Gnatcatcher (*Polioptila caerulea*)

Common summer resident of both the NHWZ and OHWZ throughout the study area. Their cup-shaped nests are found in tamarisk, mesquite, and acacia.

Northern Mockingbird (*Mimus polyglottos*)

Uncommon summer resident, reported only from the OHWZ at Granite Park (RM 208L). No nests of this species have been found in the study area.

Crissal Thrasher (*Toxostoma dorsale*)

The status and distribution of this species are poorly understood. It appears to be a rare, possibly permanent resident throughout the study area although nesting has not been confirmed. Crissal Thrashers have been detected rarely in the study area during the nesting season at the Parashant Canyon (Brown and Johnson 1985), Waterfall Rapids, and Tincanabits Canyon study sites. This species may be more abundant in the nesting season than the findings of this study indicate because of their secretive nature and because males apparently curtail singing activity after early April.

Phainopepla (*Phainopepla nitens*)

Uncommon permanent resident throughout the study area, nesting in March and April. Most nests are located in the OHWZ in mesquite, acacia, and occasionally in clumps of mistletoe, but sometimes nests are located in tamarisk in the NHWZ. Phainopeplas are detected with regularity only at three localities: Spring Canyon (RM 204R), Granite Park (RM 208L), and 220-Mile Canyon.

Bell's Vireo (*Vireo bellii*)

Common to abundant summer resident of both the OHWZ and NHWZ throughout the study area. Their hanging, cup-shaped nests are found in tamarisk, mesquite, and occasionally other woody plants. Two simultaneously active Bell's Vireo territories were documented through contemporary contacts of singing males and discovery of concurrently active nests (each with eggs) in a discrete, isolated, 0.4 ha patch at the mouth of Spencer Canyon in May 1993. Therefore, average territory size in this patch was 0.2 ha (2,000 m²).

Lucy's Warbler (*Vermivora luciae*)

Common to abundant summer resident of both the OHWZ and NHWZ. Although normally a cavity-nesting species, their nests are also located in pseudo-cavities such as clumps of tamarisk debris, against a tree trunk under a broken limb, or even in rock crevices and ledges immediately adjacent to the riparian zone.

Yellow Warbler (*Dendroica petechia*)

Common summer resident of the NHWZ throughout the study area, although singing males are occasionally detected in well-developed stands of mesquite in the OHWZ. In the extremely large patches of tamarisk downriver of Tincanebits Canyon where Yellow Warblers have a choice of nesting either adjacent to the water or some distance from it, the great majority of territories were found at the water's edge. Their nests are found in tamarisk, willow, or rarely mesquite, usually high in the canopy.

Common Yellowthroat (*Geothlypis trichas*)

Common summer resident of the NHWZ throughout the study area. The highest Yellowthroat densities apparently occur in cattail marsh habitat, although high densities also occur in pure stands of young tamarisk that may be some distance from water. Yellowthroat nests are small, woven cups usually located less than 1 m above the ground or water.

Yellow-breasted Chat (*Icteria virens*)

Common summer resident of the NHWZ throughout the study area, although singing males are occasionally detected in well-developed stands of mesquite in the OHWZ. Their nests are conspicuous clumps of grass or the herb *Gnaphalium*, usually 2-3 m above ground. Two simultaneously active chat territories were documented through contemporary contacts of singing males and discovery of concurrently active nests (each with eggs) in a discrete, isolated, 0.4 ha patch at the mouth of Spencer Canyon in May 1993. Therefore, average territory size in that patch was 0.2 ha (2,000 m²).

Summer Tanager (*Piranga rubra*)

Rare to uncommon summer resident of well-developed patches of tamarisk or willow in the NHWZ throughout the study area. Singing males may be secretive and difficult to observe, but their songs can be detected at long distances. Tanager nests are usually located high in the canopy.

Blue Grosbeak (*Guiraca caerulea*)

Uncommon to fairly common summer resident in both the OHWZ and NHWZ throughout the study area. Grosbeak nests resemble chat nests, being relatively large cup nests constructed primarily of grass.

Lazuli Bunting (*Passerina amoena*)

Fairly common summer resident in the river corridor, where most individuals are detected in the NHWZ. Nesting very likely occurs on a regular basis, although no active nest has been confirmed.

Indigo Bunting (*Passerina cyanea*)

Rare summer resident of both the OHWZ, NHWZ, and FLLZ, although none were detected during the 1993 field season. A singing male assumed to be on territory was detected in late June 1992 at Separation Canyon; another singing male was detected at the Tincanabits Canyon study site (RM 264) on May 6-7, 1994. An active nest of this species in the study area has yet to be discovered.

Song Sparrow (*Melospiza melodia*)

Common to abundant permanent resident downstream of Separation Canyon, found entirely in fluctuating lake-level zone habitats on silt deposits at the head of Lake Mead. Song Sparrows have greatly increased in abundance since falling levels of Lake Mead have allowed the creation of large areas of suitable nesting habitat. It is now one of the two most abundant nesting species in the Upper Lake Mead area. A single male Song Sparrow was detected singing at the Parashant Canyon study site on May 22, 1994; this represents the only record of a singing male upstream of Separation Canyon in the study area.

Red-winged Blackbird (*Agelaius phoeniceus*)

Common permanent resident downriver of Spencer Canyon, where nesting is assumed to occur primarily in cattail marshes along the lake margin or perennial tributaries. An active nest has yet to be documented between National Canyon and Pearce Ferry.

Great-tailed Grackle (*Quiscalus mexicanus*)

Common summer resident of the NHWZ throughout the study area, but an active nest has not been documented between National Canyon and Pearce Ferry.

Brown-headed Cowbird (*Molothrus ater*)

Common summer resident of all riparian habitats throughout the study area. Cowbirds do not build their own nests, but lay eggs in the nests of host species which often successfully raise the cowbird young; brood parasitism by cowbirds is common between National Canyon and Pearce Ferry (Brown 1994). Oddly, no cowbird

eggs or young were detected in any of the 69 active passerine nests containing eggs or young discovered during the 1993 and 1994 study periods (sample size of active nests included: 7 Black Phoebe, 1 Say's Phoebe, 1 Bewick's Wren, 8 Blue-gray Gnatcatcher, 1 Phainopepla, 21 Bell's Vireo, 4 Lucy's Warbler, 2 Yellow Warbler, 7 Common Yellowthroat, 10 Yellow-breasted Chat, and 5 Song Sparrow nests).

Hooded Oriole (*Icterus cucullatus*)

Fairly common summer resident primarily in well-developed areas of tamarisk and willow in the NHWZ or FLLZ, but occasionally in areas of large mesquite or hackberry in the OHWZ. Oriole nests are graceful hanging baskets located high in the canopy; many oriole nests from previous seasons were observed throughout the study area.

House Finch (*Carpodacus mexicanus*)

Common to abundant summer resident of all habitats throughout the study area. Nests of this species may be more abundant but are difficult to find in the riparian zone where the few nests discovered were high in tamarisk foliage. Many finches nest in the adjacent desert, where most nests have been found in cholla cactus.

Lesser Goldfinch (*Carduelis psaltria*)

Fairly common to common permanent resident of all habitats throughout the study area. Most nests discovered have been relatively exposed cups of grasses located near the crowns of young tamarisks.