# Cooperative National Park Resources Studies Unit

## ARIZONA

TECHNICAL REPORT No. 13

AVIAN USE OF QUITOBAQUITO SPRINGS OASIS,
ORGAN PIPE CACTUS NATIONAL MONUMENT, ARIZONA

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COOPERATIVE NATIONAL PARK RESOURCES STUDIES UNIT
University of Arizona/Tucson - National Park Service

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ERRATUM TO TECHNICAL REPORT NO. 13

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FOREWORD, paragraph 2, lines 5 and 6 should read:

"...standing stopover habitat for avian migrants that 193 species of migrating and wintering birds and 220 total avian species have been recorded there (of approximately 275 species for the monument)."

# AVIAN USE OF QUITOBAQUITO SPRINGS OASIS, ORGAN PIPE CACTUS NATIONAL MONUMENT, ARIZONA

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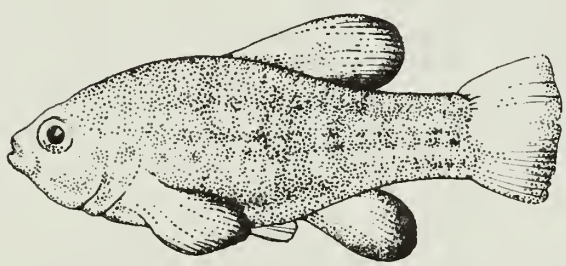

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# FOREWORD

Quitobaquito Springs, an oasis on the U.S.-Mexico International boundary near the center of the Sonoran Desert, lies within Organ Pipe Cactus National Monument. Two large springs, now flowing into a man-made pond of approximately 1.2 a, support this area which, because of its rich natural and cultural history, is one of the central attractions of this internationally recognized Man and the Biosphere Reserve. The neighboring Sonoyta River (approximately 1 mi south of the U.S.-Mexico boundary) is an intermittant stream, largely choked by saltcedar (Tamarix). Thus, Quitobaquito is the major perennial surface-water source in the area. Surrounding the pond is a 4.25 acre mesquite woodland (Prosopis velutina and P. pubescens) with numerous associated shrub and herbaceous species and scattered cottonwoods (Populus fremontii). The pond is probably best known as habitat for the only native population of Cyprinodon macularius, possibly a distinct subspecies of the desert pupfish, currently in the process of being proposed as an endangered species. Several plant species of the area are unknown elsewhere in the United States, and one aster (Machaeranthera arizonica) is endemic to Quitobaquito and one or two other localities along the Mexican border.

The riparian and aquatic vegetation of the oasis contrasts sharply with that of the surrounding desert (paloverde-bursage-cactus (including three Cereus species: saguaro, organpipe, and senita), creosotebush, and saltbush). Quitobaquito attracts a large number of bird and butterfly species. It provides such outstanding stopover habitat for avian migrants that 193 species of migrating ~~birds~~ and wintering birds and ~~220~~ total avian species have been recorded there. (Of approximately 275 species for the monument.) Among other interesting plant and animal species, the pond supports a population of uncommon Sonoran and Yellow mudturtles (Kinosternon sonoriense and K. flavescens).

Any appreciable water source in a desert is valuable to plants, humans and other animals. Quitobaquito is no exception. Although aboriginal conditions there are unknown, Quitobaquito undoubtedly was as important to prehistoric inhabitants of this arid region as it was to the Papago Indians, early explorers, soldiers, and settlers who modified the area and its vegetation. A small number of dying, domestic pomegranate and fig trees scattered amongst the mesquites, and remnants of an irrigation system, bear mute evidence of historic use before the area was acquired by the National Park Service in the 1950's. Scattered fencing and large bare areas remind the visitor that this was an important water source for cattle, horses, and burros until their removal in the 1960's and 1970's.

The current studies at Quitobaquito are designed to provide sound, scientific information for a management plan providing for the use and enjoyment of the natural and recreational resources of this unique desert oasis while leaving these outstanding resources unimpaired for future generations.

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ABSTRACT

Bird censuses were conducted on two paired riparian study plots by means of the spot-map method at Quitobaquito Springs oasis during the spring of 1983. The two-fold purpose of this study was to determine if the two management areas at the oasis were appropriate for birds and to provide a baseline description of the birdlife of the oasis. The wildlife resting plot had a higher density and diversity of breeding birds than the plot heavily used by visitors. Comparison of the diversity indices for these two plots indicated that this difference was only marginally significant. In contrast, the visitor use plot had a higher density and diversity of migrants than the wildlife resting plot; this was a highly significant difference which may be attributed to the presence of more cottonwood trees in the visitor use plot. There is no basis for having the two management areas located as they are with respect to avian use. Quitobaquito Springs oasis as a whole had a relatively low diversity of riparian breeding birds, apparently due to the small size of the riparian "island" and low habitat diversity.

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## ACKNOWLEDGMENTS

B. Mikus and H. Smith of the Organ Pipe Cactus National Monument provided support and assistance for this project. P.S. Bennett and R. C. Szaro reviewed the final draft of this report. L.P. Hendrickson edited the final manuscript. This study was funded by the National Park Service.

## INTRODUCTION

Quitobaquito Springs forms an oasis larger in extent than any other such situation in the central portion of the Sonoran Desert. The oasis provides open water surrounded by a zone of lush green vegetation which, in contrast to the surrounding arid habitats, serves as a strong attraction for birds. This attraction applies not only to water-dependent local resident birds, but to a large and diverse group of migratory birds which use the Quitobaquito area for stopover feeding and resting purposes. The oasis also attracts a number of rare vagrants such as wading birds and shorebirds. Quitobaquito Springs is recognized by the National Park Service as the premier locale for recreational bird-watching in Organ Pipe Cactus National Monument.

The presence of abundant surface water at Quitobaquito Springs has also been an attraction for man. Sand Papagos were using the site, at least on a seasonal basis, before European explorers visited the area (Bolton 1960, Nabhan et al. 1982). Aboriginal conditions at and around Quitobaquito remain unknown, but it is certain the Papagos, early explorers, soldiers, and later settlers modified the area and its vegetation. This was accomplished through the channeling and diking of the spring outflow, woodcutting for shelter and firewood, grazing of livestock, clearing of adjacent areas for agriculture, construction of dwellings, and the introduction of exotic plants for orchards and shade. Even the several large cottonwood trees (Populus fremontii), which are so important as nesting sites for some birds, were probably introduced during this period. After the monument was established in 1937, Papagos continued to live and farm at Quitobaquito. This continued until the 1950's when the National Park Service formally acquired the site.

As a result of historic disturbances, Quitobaquito Springs passed to National Park Service management in a highly disturbed condition. Photographs of the area from the first half of the twentieth century show a shallow and broad expanse of water surrounded by a largely open area with little woody vegetation. Shortly after National Park Service acquisition, the open water area was drained, bulldozed, and diked into a discrete pond. Human disturbances were prevented after this time, eliminating the shallow, gravelly, open shore zone which was formerly attractive habitat for migrant shorebirds and wading birds (Nabhan et al. 1982), and allowing a dense thicket of water-loving vegetation to develop around the pond. The development of dense riparian vegetation around the pond may, however, have increased the usefulness of the area to some resident breeding birds. In summary, the vegetation around Quitobaquito Springs has changed greatly within historic times.

In the early 1970's the National Park Service designated two management areas around the holding pond at Quitobaquito. This was the first positive management action to benefit birds by creating an undisturbed wildlife resting area. Although this area is closed to visitors, from the trails and other signs evident there it is certain that they occasionally enter it. A visitor-use area was established to the north of the pond, with trails, picnic tables, and other facilities. The management of these two areas has remained unchanged to the present (1983).

Any literature reference to the birds of Organ Pipe Cactus National Monument and vicinity is likely to mention Quitobaquito Springs, due to the attraction its well-developed riparian habitat has for migratory birds. However, the literature concerning Quitobaquito birds is distributed throughout many sources and is largely unavailable. Although Quitobaquito was visited as early as 1894 by ornithologists such as Edgar A. Mearns (Mearns 1907), Laurence Huey (1942) of the San Diego Museum of Natural History was the first ornithologist to do an in-depth study of birds at and around Quitobaquito. His paper concerns the vertebrates of the entire monument, but he cites specific records from the oasis itself. Max Hensley (1954) provided the most extensive historical information on the birds at Quitobaquito, identifying a total of 59 species of birds during his study there, 15 species of which were breeding. Phillips et al. (1964) in the Birds of Arizona also gave several important bird records for the area. Several birds at and around the springs were briefly mentioned by Cole and Whiteside (1965) in their general ecological reconnaissance of the area. Many bird records for Quitobaquito are presented in various issues of Audubon Field Notes and American Birds (1949 to present). Nabhan et al. (1982) mention the birds of Quitobaquito in a general fashion, comparing the diversity of species at Quitobaquito to that at Quitovac, a sister oasis 54 km south in Sonora, Mexico. They found that the birdlife at Quitovac is somewhat more diverse than that of Quitobaquito, which can be attributed to different management practices for the two sites.

The purpose of this report is twofold: 1) to compare bird density and diversity in the visitor use and wildlife resting areas to determine if they are appropriate management units; and 2) to provide a baseline description of the birdlife of the Quitobaquito Springs area and the relationship of these birds to present habitats for interpretive and scientific purposes.

## DESCRIPTION OF THE STUDY AREA

Quitobaquito Springs is an oasis at an elevation of 332 m near the extreme southwestern corner of Organ Pipe Cactus National Monument, Pima County, Arizona. The springs and pond area are only 100 to 300 m north of the international boundary between the United States and Mexico. Immediately to the south of the boundary is Mexican Highway 2; the noise from trucks on this road often makes it difficult to hear bird vocalizations at Quitobaquito.

Quitobaquito Springs and vicinity (Fig. 1) is thoroughly discussed by Bryan (1925), Brown et al. (1983), Nabhan et al. (1982) and others. In an approximately 400 x 400 m area of flat to slightly rolling terrain north of the international boundary are found the two perennial springs that flow through a series of ditches and weirs into a man-made diked pond measuring approximately 60 x 70 m. Located to the east of the pond is an improved gravel parking lot. Forming a north-to-south oblong around the pond is a densely-vegetated area, largely of mesquite (Prosopis velutina) with a cottonwood overstory in some places. The species and structural characteristics of the vegetation are summarized in Table 1.

The two study plots at the site consist of: 1) the wildlife resting plot south of the pond (0.88 ha in size) and 2) the visitor use plot to the

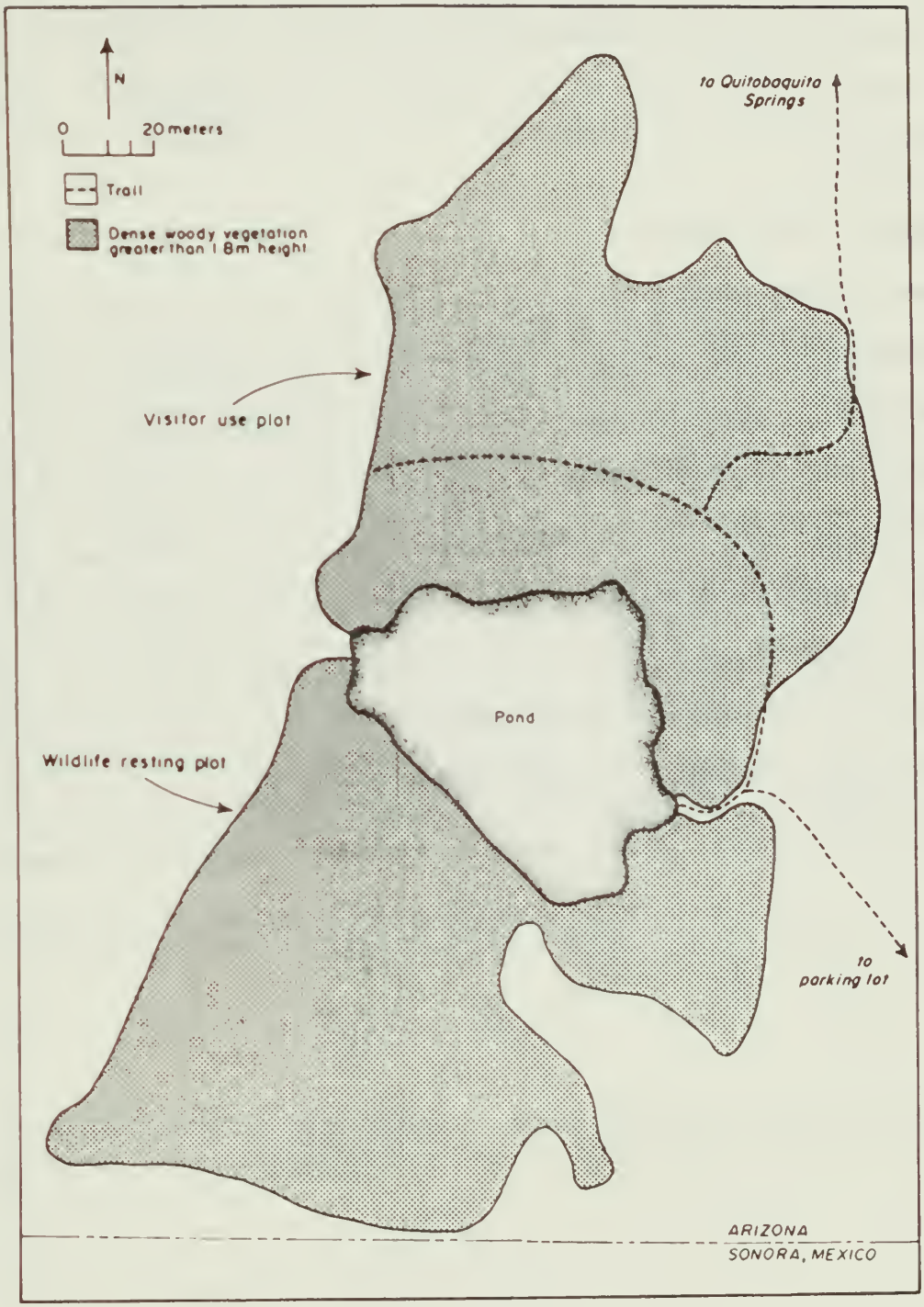


Figure 1. The paired study plots at Quitobaquito Springs oasis.

TABLE 1. Summary of the vegetative characteristics of the paired study plots at Quitobaquito Springs oasis.

| Parameter | Wildlife Resting Plot | Visitor Use Plot |
|---|---|---|
| Number of woody species | 18 | 15 |
| Number of cottonwood trees | 1 | 5 |
| Density/ha of woody plants (individuals) | 787 | 710 |
| Density/ha of mesquite (individuals) | 546 | 384 |
| Percent composition of mesquite | 81 | 54 |
| Mean maximum vegetation height (m) | 3.2 | 3.4 |
| Range of vegetation heights (m) | 1.8 - 9.1 | 1.8 - 12.2 |
| Total canopy volume ($m^3$) | 4727 | 4550 |
| Mesquite contribution to total canopy volume (%) | 82 | 67 |
| Cottonwood contribution to total canopy volume (%) | 1 | 11 |

north of the pond (0.82 ha in size). The vegetation of the two plots differs somewhat, the resting plot having a greater proportion of mesquite, whereas the visitor use plot has a larger proportion of cottonwood trees. Boundaries of the two plots were established at natural breaks in the dense riparian vegetation surrounding the pond.

The visitor use plot contains trails, picnic tables, and interpretive signs. The resting plot is largely undisturbed, except for the dirt road forming its southern border adjacent to the international boundary.

## METHODS

The two study plots were censused for breeding birds 14 times between March 28 and May 26, 1983, by means of the spot-map method (Kendeigh 1944, IBCC 1970, Best 1975). Migratory birds were censused by direct observation nine times between March 28 and May 26, 1983. The plots were censused between 0600 and 0700 hours and 1745 and 1845 hours, for a maximum of two censuses per day. The locations of singing males and all other birds were plotted on large-scale aerial photographs of the plots. If a composite map for a species showed a territory was partly within and partly outside of the study plot, only the portion of the territory within the plot boundaries was counted (Van Velzen 1972). Searches for active nests were carried out immediately after each spot-mapping session was completed in order to provide supplemental information on breeding birds. Actual nest counts are used in place of spot-map data to indicate breeding densities for White-winged and Mourning doves.

Bird species diversity was calculated from the formula H' = -sum of Pi log Pi, where Pi is the proportion of a given bird species present (Shannon and Weaver 1963, Pielou 1966). Evenness was calculated by the formula J' = H'/log S, where S is the number of species (Pielou 1966).

To determine the degree of significance between H' for each study plot, the variance of each H' value was determined from the formula

$$\text{var } H' = \frac{\text{sum of Pi } (\log \text{Pi})^2 - \text{sum of } (\text{Pi log Pi})^2}{N} + \frac{S-1}{2(N)^2}$$

with N being the number of territories. The H' values for the two plots were compared by t-test to see if they were significantly different, where

$$t = \frac{H'_1 - H'_2}{\text{var } H'_1 + \text{var } H'_2}$$

and

$$\text{degrees of freedom} = \frac{\text{var } H'_1 - \text{var } H'_2}{\frac{(\text{var } H'_1)^2}{N_1} + \frac{(\text{var } H'_2)^2}{N_2}}$$

If the value of t exceeded the 5 percent probability level, it was concluded that the diversities of the two plots differed (Poole 1974:392-3). The density of all species on both plots was rounded up to the nearest whole integer for the calculation of H' values. Degree-of-freedom values which were calculated at less than 1.0 were rounded up to 1.

## RESULTS AND DISCUSSION

### Breeding Birds.

The species, densities, and diversity indices of breeding birds in the two study plots at Quitobaquito Springs are indicated in Table 2. Both species diversity and density are greater in the wildlife resting plot. Comparison of the two diversity indices (H') indicated that the wildlife resting plot had a significantly greater diversity ($p < .05$) of breeding birds than the visitor use plot. However, if the Yellow-breasted Chat is not included as a breeding bird in the wildlife resting plot (the chat may not have bred in the plot--see text below), comparison of the resulting two diversity indices indicated no significant difference ($p > .05$). The difference between the wildlife resting plot and the visitor use plot must be regarded as only marginally significant under these circumstances.

The relatively small size of the two plots, in addition to the fact that they were restricted to woody riparian vegetation above 1.8 m in height, was responsible for the exclusion of several non-riparian species breeding nearby. These are identified as visitants to the study plots and include: Gambel's Quail, Costa's Hummingbird, Gila Woodpecker, Northern (Common) Flicker, Cactus Wren, Northern Mockingbird and House Finch (Table 2). The Brown-headed and Bronzed Cowbird, brood parasites which do not build their own nests but lay their eggs in other species' nests, were not found to breed on the study plots although it is assumed that they breed in the near vicinity. The wildlife resting plot contained half of a Western Kingbird territory (as indicated by spot-map data) although the actual nest was just outside the plot in a mature saguaro cactus (Carnegiea gigantea). An old hummingbird nest (species?) was found in a cottonwood tree in the visitor use plot, but was not included in Table 2.

The unusual situations existing for both the Yellow-breasted Chat and House Finch deserve special attention. According to the analysis of spot-map data, there was a valid chat territory in the wildlife resting plot, as sufficient detections were registered to include it as a breeding species. However, all of the chat vocalizations were recorded within a period of less than one week and no other evidence of nesting was observed, suggesting that the vocalizations were of birds in migration. It is also possible that a male was present for a time but left after unsuccessfully attempting to attract a mate. Nevertheless, the chat territory is included in Table 2 even though it would be the only known instance of its nesting in the monument. As many as five or more pairs of House Finches nested in cholla cactus (Opuntia spp.) to the west of the pond in a small wash. They are known to have used both of the study plots to some extent for a wide variety of purposes, from courtship to food gathering and post-fledging family grouping. As House Finches

TABLE 2. Breeding bird densities at Quitobaquito Springs oasis, Organ Pipe Cactus National Monument during the spring of 1983. Birds breeding in adjacent non-riparian areas but using the study plots to some extent are noted as visitants.

| Species | Wildlife Resting Plot (pairs) | Visitor Use Plot (pairs) | Both Plots (pairs) | Both Plots (pairs/40 ha) |
|---|---|---|---|---|
| Gambel's Quail | visitant | visitant | 0 | 0 |
| White-winged Dove[1] | 1.0 | 3.0 | 4.0 | 94.0 |
| Mourning Dove[1] | 2.0 | visitant | 2.0 | 47.0 |
| Costa's Hummingbird | visitant | visitant | 0 | 0 |
| Gila Woodpecker | visitant | visitant | 0 | 0 |
| Northern (Common) Flicker | visitant | visitant | 0 | 0 |
| Western Kingbird | 0 | 0.5 | 0.5 | 11.8 |
| Brown Crested Flycatcher (Wied's Crested) | 0 | visitant | 0 | 0 |
| Ash-throated Flycatcher | 1.0 | visitant | 1.0 | 23.5 |
| Vermilion Flycatcher | 1.0 | visitant | 1.0 | 23.5 |
| Verdin | 1.0 | 1.0 | 2.0 | 47.0 |
| Cactus Wren | visitant | visitant | 0 | 0 |
| Black-tailed Gnatcatcher | 1.0 | 1.0 | 2.0 | 47.0 |
| Northern Mockingbird | visitant | visitant | 0 | 0 |
| Curve-billed Thrasher | 0.5 | 0.5 | 1.0 | 23.5 |
| Phainopepla | 2.5 | 1.0 | 3.5 | 82.3 |
| Yellow-breasted Chat[2] | 1.0 | 0 | 1.0 | 23.5 |
| Brown-headed Cowbird | visitant | visitant | 0 | 0 |
| Bronzed Cowbird | visitant | visitant | 0 | 0 |
| Hooded Oriole | 1.0 | 1.0 | 2.0 | 47.0 |
| House Finch[2] | visitant | visitant | 0 | 0 |
| Total | 12.0 | 8.0 | 20.0 | 470.1 |
| Total Breeding Species | 10 | 7 | 11 | |
| H' values (diversity) | 0.9587 | 0.7943 | 0.9799 | |
| J' values (evenness) | 0.9587 | 0.8795 | 0.9410 | |

[1]The number of pairs for these two species was determined by an actual count of the number of nests present, not by spot-map data.

[2]See discussion in text regarding these species. The chat may actually not have bred in the study plot, although spot-map data indicated it did.

defend only the actual nest site and not the surrounding resources, they were not included in the on-site breeding list in Table 2.

The total avian breeding density of 470.1 pairs/40 ha in the two study plots (Table 2) is comparable to breeding densities of somewhat similar riparian areas of southern Arizona. Szaro and Jakle (1982) reported 388 pairs/40 ha (by spot-map method) in a less structurally diverse area along a tributary of the Gila River. The 476 pairs/40 ha reported by Gavin and Sowls (1975) along the San Pedro River is similar to the bird density at Quitobaquito, although species diversity was much higher along the San Pedro in a habitat that was comparable to that at Quitobaquito. The structurally diverse cottonwood riparian forests along the Verde River reported by Carothers et al. (1974) far exceed Quitobaquito in both breeding bird density (847 pairs/40 ha) and species diversity.

The diversity of breeding species at Quitobaquito Springs is small relative to the diversity seen at other Arizona riparian sites of larger size (Carothers et al. 1974, Gavin and Sowls 1975, Szaro and Jakle 1982). There are two possible, interrelated explanations for the lack of avian diversity at Quitobaquito: island biogeography theory and the lack of habitat diversity. The equilibrium theory of island biogeography states that the number of species present in an isolated habitat (i.e., island) will: 1) increase with increasing island size, 2) decrease with increasing distance to the nearest species source (larger, similar habitat), and 3) go through a continual turnover of species (MacArthur and Wilson 1963, Whitcomb et al. 1976, Brown and Gibson 1983). As a riparian island in a non-riparian sea of desertscrub, Quitobaquito exhibits all the characteristics of small island size. There were 11 species of birds breeding within the study plots at Quitobaquito during this study, compared to 13 and 28 species breeding in Arizona riparian areas of greater habitat diversity and size (Carothers et al. 1974, Gavin and Sowls 1975, Szaro and Jakle 1983).

Quitobaquito Springs exhibits high habitat homogeneity and hence a low habitat diversity. Because of this, many species' nesting habitat requirements are not present. In this case, it is difficult to separate the effects of small island size from the effects of low habitat diversity. Nevertheless, there are several species whose conspicuous absence may be explained by one of the two possibilities. Black Phoebe, Bell's Vireo, Lucy's and Yellow Warbler, Common Yellowthroat, Summer Tanager, Blue Grosbeak, Lazuli Bunting and Lesser Goldfinch are some of the species that breed at somewhat similar, though larger and more structuarlly diverse riparian areas in the Sonoran Desert.

Hensely (1954) noted 15 species of birds breeding at or near Quitobaquito Springs. Although his study plot was considerably larger than that of this study and therefore includes some non-riparian breeders, his work provides an interesting historical comparison to the present-day situation. Hensley recorded two breeding species at or near Quitobaquito that were not present during this study (but were recorded after the breeding bird census was completed): Killdeer and Crissal Thrasher. He likewise did not record several breeding species that are present (at least nearby) today, including Brown Crested (Wied's Crested) Flycatcher, Cactus Wren, and Black-tailed Gnatcatcher. The dense vegetation which has developed near the pond since Hensley's time may have benefitted some species at

the expense of others. It is clear, for example, that the elimination of open, gravelly shoreline habitat around the pond has been detrimental to Killdeer. However, the addition of other species is not so clearly explained given the continual and irregular turnover of species which is characteristic of the small island habitat size at Quitobaquito. Other species which are known to have historically nested at Quitobaquito on an irregular basis include American Coot, Northern Oriole (Wilt 1976), and Lark Sparrow (Huey 1942).

Migratory Birds.

The species, numbers, and diversity indices of migratory birds in the two study plots at Quitobaquito Springs are listed in Table 3 and Figure 2. Comparison of the diversity indices (H') of the two plots indicated that the visitor use plot had a highly significant ($p < .05$) greater diversity of migrants than the wildlife resting plot. The larger number of migrant individuals in the wildlife resting plot is due to the inclusion of a flock of 60 Brewer's Blackbirds during one census period; without them, the wildlife resting plot attracted only half the number of migrant individuals as the visitor use plot did. Although there is some question as to whether the Yellow-breasted Chat was a breeding species in the wildlife resting plot, it was included in Table 3 as a migratory species.

The greater diversity (and number) of migratory birds recorded in the visitor use plot is due to its greater diversity of habitats and greater canopy volume (Table 1). These differences are largely due to the presence of more mature cottonwood trees in the visitor use plot, which are highly attractive to migratory birds. Arizona riparian areas with cottonwood trees were found by Stevens et al. (1977) to contain more than 10 times as many migrants as adjacent non-riparian habitat.

Although migratory shorebirds were seen at Quitobaquito pond, none are included in Table 3. The shorebirds would almost invariably circle the pond looking for a place to land, and, finding no open, sandy or gravelly shoreline, would fly away (Nabhan et al. 1982). Spotted Sandpipers occasionally used the pond edge at and around the large cottonwood tree in the wildlife resting plot, but even there the pond edge constitutes poor overall shorebird habitat. Black-necked Stilts were also seen to circle the pond only to fly away because there was no suitable habitat at which to land. The development in recent years of dense vegetation around the shoreline at Quitobaquito pond has eliminated the open shoreline habitat needed by these birds. Hensley's (1954) observations indicate that shorebirds formerly used the pond edge to a greater extent than at present.

## CONCLUSIONS

The paired riparian study plots at Quitobaquito Springs oasis, the wildlife resting and visitor use plots, differ with respect to their use by breeding and migratory birds. A slightly higher density and diversity of breeding birds was found in the wildlife resting plot, although the difference was only marginally significant. The visitor use plot, in contrast, had a higher density and diversity of migratory birds, a highly significant difference. The two plots, although similar in size, exhibited habitat differences that may account for the differences in avian use. The difference in use by migratory birds can be explained by the presence of

TABLE 3. Migratory birds of Quitobaquito Springs, Organ Pipe Cactus National Monument, Arizona. Recorded during nine census periods from March 28 to May 25, 1983.

| Species | Wildlife Resting Plot (individuals) | Visitor Use Plot (individuals) |
|---|---|---|
| Sharp-shinned Hawk | - | 1 |
| Broad-billed Hummingbird | - | 1 |
| Olive-sided Flycatcher | - | 1 |
| Western Wood Pewee | - | 5 |
| Willow Flycatcher | - | 1 |
| Western Flycatcher | 5 | 20 |
| House Wren | - | 1 |
| Long-billed Marsh Wren | 1 | 2 |
| Ruby-crowned Kinglet | - | 3 |
| Hermit Thrush | - | 1 |
| Bell's Vireo | 2 | 5 |
| Warbling Vireo | 2 | 7 |
| Lucy's Warbler | 1 | 1 |
| Yellow Warbler | 2 | 2 |
| Yellow-rumped Warbler | 4 | 3 |
| Townsend's Warbler | 1 | 1 |
| Hermit Warbler | - | 1 |
| MacGillivray's Warbler | 12 | 6 |
| Common Yellowthroat | 1 | 0 |
| Wilson's Warbler | 17 | 30 |
| Yellow-breasted Chat[1] | 5 | 1 |
| Summer Tanager | - | 1 |
| Western Tanager | 3 | 4 |

TABLE 3. continued

| Species | Wildlife Resting Plot (individuals) | Visitor Use Plot (individuals) |
|---|---|---|
| Black-headed Grosbeak | 1 | 4 |
| Lazuli Bunting | 1 | 1 |
| Green-tailed Towhee | - | 1 |
| Chipping Sparrow | - | 1 |
| Lincoln's Sparrow | - | 3 |
| White-crowned Sparrow | 12 | 5 |
| Red-winged Blackbird | - | 1 |
| Brewer's Blackbird | 60 | 2 |
| Great-tailed Grackle | - | 5 |
| Northern Oriole | 2 | 2 |
| Total Number of Individuals | 132* | 123 |
| Total Number of Species | 18 | 32 |
| H' diversity index | 0.8603 | 1.2119 |
| J' evenness | 0.6853 | 0.8052 |

[1]Yellow-breasted Chat may have been a breeding species, although there is some question, and has been included here as a migrant as well.

*The large number of individuals in the wildlife resting plot is largely due to a single flock of 60 Brewer's Blackbirds during one count period.

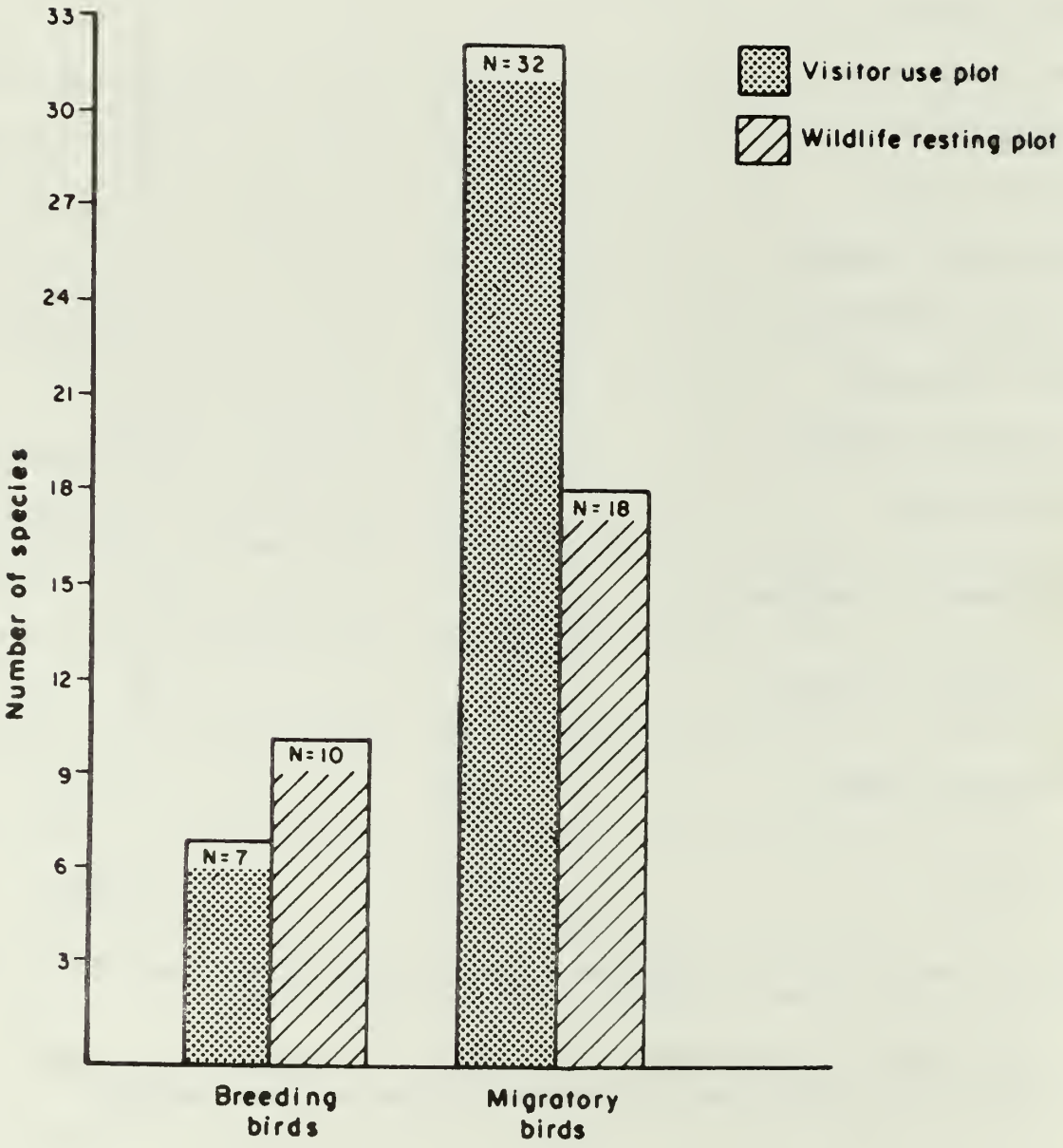


Figure 2. Comparison of the number of breeding and migratory birds in the two study plots at Quitobaquito Springs oasis.

more cottonwood trees in the visitor use plot which act to attract migrants. Differences in breeding bird density and diversity between the two plots are more difficult to explain. There is no basis for having the two management areas located as they are with respect to avian use.

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## APPENDIX I

Scientific Names of Birds Mentioned in the Text

| | |
|---|---|
| Sharp-shinned Hawk | *Accipiter striatus* |
| American Coot | *Fulica americana* |
| Gambel's Quail | *Callipepla gambelii* |
| Killdeer | *Charadrius vociferus* |
| Spotted Sandpiper | *Actitis macularia* |
| Black-necked Stilt | *Himantopus mexicanus* |
| White-winged Dove | *Zenaida asiatica* |
| Mourning Dove | *Zenaida macroura* |
| Costa's Hummingbird | *Calypte costae* |
| Broad-billed Hummingbird | *Cyanthus latirostris* |
| Gila Woodpecker | *Melanerpes uropygialis* |
| Northern (Common) Flicker | *Colaptes auratus* |
| Olive-sided Flycatcher | *Contopus borealis* |
| Western Wood Pewee | *Contopus sordidulus* |
| Willow Flycatcher | *Empidonax traillii* |
| Western Flycatcher | *Empidonax difficilis* |
| Western Kingbird | *Tyrannus verticalis* |
| Brown Crested Flycatcher (Wied's Crested) | *Myiarchus tyrranulus* |
| Ash-throated Flycatcher | *Myiarchus cinerascens* |
| Vermilion Flycatcher | *Pyrocephalus rubinus* |
| Black Phoebe | *Sayornis nigricans* |
| Verdin | *Auriparus flaviceps* |
| House Wren | *Troglodytes aedon* |
| Cactus Wren | *Campylorhynchus brunneicapillus* |
| Marsh Wren (Long-billed) | *Cistothorus palustris* |
| Ruby-crowned Kinglet | *Regulus calendula* |
| Black-tailed Gnatcatcher | *Polioptila melanura* |
| Hermit Thrush | *Catharus guttatus* |
| Northern Mockingbird | *Mimus polyglottos* |
| Curve-billed Thrasher | *Toxostoma curvirostre* |
| Phainopepla | *Phainopepla nitens* |
| Bell's Vireo | *Vireo bellii* |
| Warbling Vireo | *Vireo gilvus* |
| Lucy's Warbler | *Vermivora luciae* |
| Yellow Warbler | *Dendroica petechia* |
| Yellow-rumped Warbler | *Dendroica coronata* |
| Townsend's Warbler | *Dendroica townsendi* |
| Hermit Warbler | *Dendroica occidentalis* |
| MacGillivray's Warbler | *Oporornis tolmiei* |
| Common Yellowthroat | *Geothlypis trichas* |
| Wilson's Warbler | *Wilsonia pusilla* |
| Yellow-breasted Chat | *Icteria virens* |

| | |
|---|---|
| Summer Tanager | *Piranga rubra* |
| Western Tanager | *Piranga ludoviciana* |
| Black-headed Grosbeak | *Pheucticus melanocephalus* |
| Blue Grosbeak | *Guiraca caerulea* |
| Lazuli Bunting | *Passerina amoena* |
| Green-tailed Towhee | *Pipilio chlorurus* |
| Chipping Sparrow | *Spizella passerina* |
| Lark Sparrow | *Chondestes grammacus* |
| Lincoln's Sparrow | *Melospiza lincolnii* |
| White-crowned Sparrow | *Zonotrichia leucophrys* |
| Red-winged Blackbird | *Agelaius phoeniceus* |
| Brewer's Blackbird | *Euphagus cyanocephalus* |
| Great-tailed Grackle | *Quiscalus mexicanus* |
| Brown-headed Cowbird | *Molothrus ater* |
| Bronzed Cowbird | *Molothrus aeneus* |
| Northern Oriole | *Icterus galbula* |
| Hooded Oriole | *Icterus cucullatus* |
| House Finch | *Carpodacus mexicanus* |
| Lesser Goldfinch | *Carduelis psaltria* |

Addendum:

| | |
|---|---|
| Crissal Thrasher | *Toxostoma dorsale* |


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