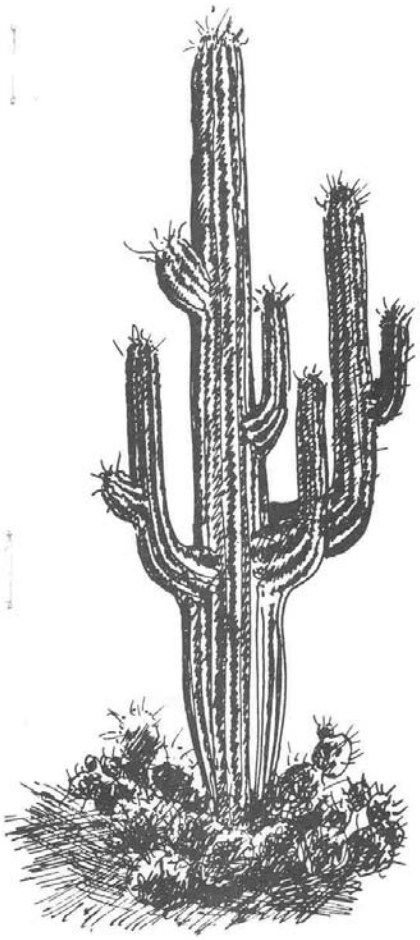

Cooperative National Park Resources Studies Unit

ARIZONA

TECHNICAL REPORT NO. 36

MAMMALS OF THE QUITOBAQUITO MANAGEMENT AREA, ORGAN PIPE CACTUS NATIONAL MONUMENT, ARIZONA

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University of Arizona/Tucson - National Park Service

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December 1990

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This study has been a team effort, involving staff and visitors at the Organ Pipe Cactus National Monument, staff of the Cooperative National Park Resources Studies Unit/University of Arizona (CPSU/UA), and students and staff of the Department of Ecology and Evolutionary Biology at the University of Arizona.

During the fall of the academic year of 1981-82, three graduate teaching assistants (James Munger, Rhonda Sidner and Joel Brown) cooperatively directed the field activities of 50 students in mammalogy who carried out many field investigations. Similar activities were carried out in the fall of 1982 and 1983 by Brown, Sidner and 70 additional mammalogy students. Additional help was provided in 1989 by Stephen Russ in surveying the mammal population at Williams Spring. To all we extend our gratitude.

INTRODUCTION

The Quitobaquito Management Area (QMA) bordered on the south by the United States - Mexico International Boundary, is in the southwestern part of the Organ Pipe Cactus National Monument. It is an area with several intermittent seeps and permanent springs (Figure 1). In places the seeps and springs result in permanent and semi-permanent pools. These subsurface waters supplement the soil moisture accrued from normal rainfall, and result in spectacular changes in vegetation.

The Quitobaquito Management Area and adjacent areas in Sonora, Mexico, appear to be similar to oases of North Africa or the Middle East. Brown et al. (1983) aggregated the water sources in the Management Area into seven units (Table 1). We added to each an estimate of the area showing significant vegetation changes from surrounding areas.

Permanent sources of free water are necessary for the existence of certain plants and animals. Among mammals, most bats and all carnivores and large herbivores need such water. In the QMA only Quitobaquito (0.26 hectares) and Williams Spring (3 sq m) provide a dependable water source.

Bats are a special case. Some (*Leptonycteris* and perhaps *Macrotus*) appear to be able to survive on water obtained from flower nectar and fruits. Others, such as *Pipistrellus* and various *Myotis*, can drink from tiny sources of water, even if the water is in a well or mine shaft many feet below the desert surface. Still others, having narrow wings and limited flight maneuverability, require a large open water surface, such as the pond at Quitobaquito, for drinking. The latter group includes various *Tadarida* and *Eumops*.

Large carnivores and herbivores can survive much of the year on water obtained from food and various temporary pools. In dry seasons, however, they are dependent upon permanent surface water sources.

Spring and seep waters that rarely appear as surface pools can supplement water from seasonal runoff and create areas of increased plant growth. Often these are extensive enough to be evident from aerial photographs. Such areas provide "islands" of microhabitat suitable for *Peromyscus eremicus*, *Neotoma albigula* and *Notiosorex*.

Three of the seep/spring areas of QMA are large enough to change densities of various rodents. These three, Quitobaquito, Aguajita Spring, and Williams Spring are discussed separately.

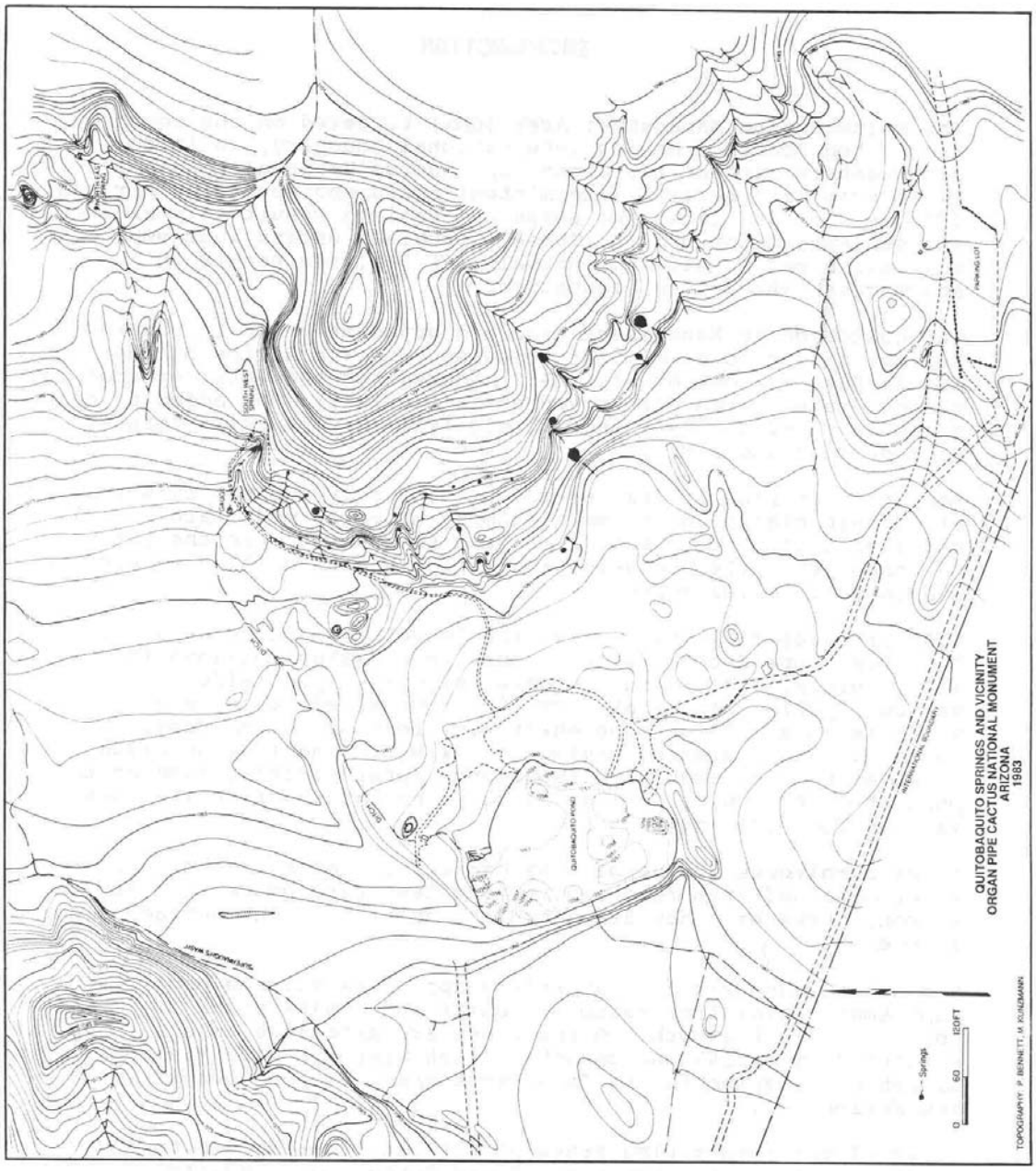

Figure 1. The Quitobaquito Management Area, Organ Pipe Cactus National Monument.

Table 1. Surface water sources in the Quitobaquito Management Area (modified from Brown et al. 1983). The "areas of influence" estimates were calculated during this study from aerial photos and field measurements.

Site Number	Name	Elev (ft)	Water	Area of Influence	Hectares
42	Aguajita Spring	1100	intermittent	open water vegetation	0 3.0±
43	Burro Spring	1160	intermittent	open water vegetation	0 <0.1
44	Muddy Spring	1140	intermittent	open water vegetation	0 <0.1
45	Quitobaquito Spring	1088	perennial	open water vegetation	0.26 7.28
46	Williams Spring	1095	perennial	open water vegetation	3 m^2 6.0±
47	Unnamed	1080	intermittent (?)	open water vegetation	0 0.03
48	Unnamed	1120	intermittent (?)	open water vegetation	0 0.25

The common and scientific names used in this report follow the usage in “Revised checklist of North American Mammals North of Mexico, 1986” compiled by Jones et al. (1986).

MAJOR OBSERVATIONS

The following are summaries of literature references and our visits to the Quitobaquito Management Area. The general arrangement is chronological.

QUITOBAQOITO SPRING

This is the only spring in the QMA that has a perennial supply of surface water adequate to support a population of fish. At present about 0.26 hectare of water surface is contained by an earthen dam. About 7.28 hectares of spring water-influenced vegetation (1.74 ha alkali soils and 5.54 ha of spring water-dependent vegetation) are also present (Figure 2). Details of the species present are discussed in reports by Cole and Whiteside (1965), Steenbergh and Warren (1977), Warren et al. (1981), and Johnson et al. (1983).

Quitobaquito has been an important source of water for humans for many years as well as integral to the survival of various native species of plants and animals. Just as the biota of many oases in North Africa and the Middle East have been greatly modified by humans, the biota in the QMA has also been manipulated. Perhaps we shall never know what the pre-human biota actually encompassed. Almost certainly some species were eliminated by early human activities in and around the area. Whether any mammals were exterminated is unclear. The presence of such large carnivores and herbivores as the grizzly and black bears, raccoon, coati and white-tailed deer may have been only "occasional visitors" and "accidental" for the past 2000 years. None are really dwellers in the desert and the oasis of the Quitobaquito Management Area isn't large enough to sustain breeding populations.

Human activities here and in widespread surrounding areas in the past 300 years have resulted in the extinction of the grizzly and the wolf in the region. Other species (e.g., javelina and coati) appear to occur only during periods of maximum geographic extent of their range.

When E. A. Mearns visited Quitobaquito from 25 January to 8 February 1894, he reported that "The settlement consisted of three adobe dwellings, a warehouse, and a corral at the springs, and a small house at the garden. From Quitobaquito Springs several streams flow into a shallow, artificial lake, the overflow from which is conducted by an acequia to an extensive field of wheat and white clover, bordered by fig trees and surrounded by a brush fence" (1907:118).

Note that this description emphasizes the major factor inherent in human use of oases throughout the deserts of the world-available water is diverted for the use of the human-preferred biota (domestic plants ... garden, wheat, white clover, figs ... as well as domestic animals ... corral...). The available spring water has been diverted for storage and distribution into a "shallow, artificial lake."

At that time Mearns and his associates took 12 *Peromyscus eremicus*, 1 *Peromyscus merriami*, 2 *Thomomys bottae*, 5 *Ammospermophilus harrisii*, 5 *Spermophilus tereticaudus*, 40 *Dipodomys merriami,* 7 *Dipodomys deserti*, 10 *Chaetodipus penicillatus* and a few other specimens that are now on deposit in the U.S. National Museum (USNM). Obviously the sample area included the adjacent desert as well as the spring-influenced area.

In 1934 (24-25 January) people from the Museum of Vertebrate Zoology (MVZ) at Berkeley visited the area. We have not checked to see if their original field notes are available. They deposited 11 *Neotoma albigula*, 3 *Peromyscus eremicus* and 3 *Dipodomys merriami* in the collection at MVZ.

C3 Cottonwood (*Populus*)
C4 Salt Grass (*Distichlis*)
C5 Grass (*Polypogon*)
C6 Salt Brush (*Atriplex*)
C7 Mesquite-Seep Willow (*Prosopis-Baccharis*)

This map is based on several on-site evaluations of plants and

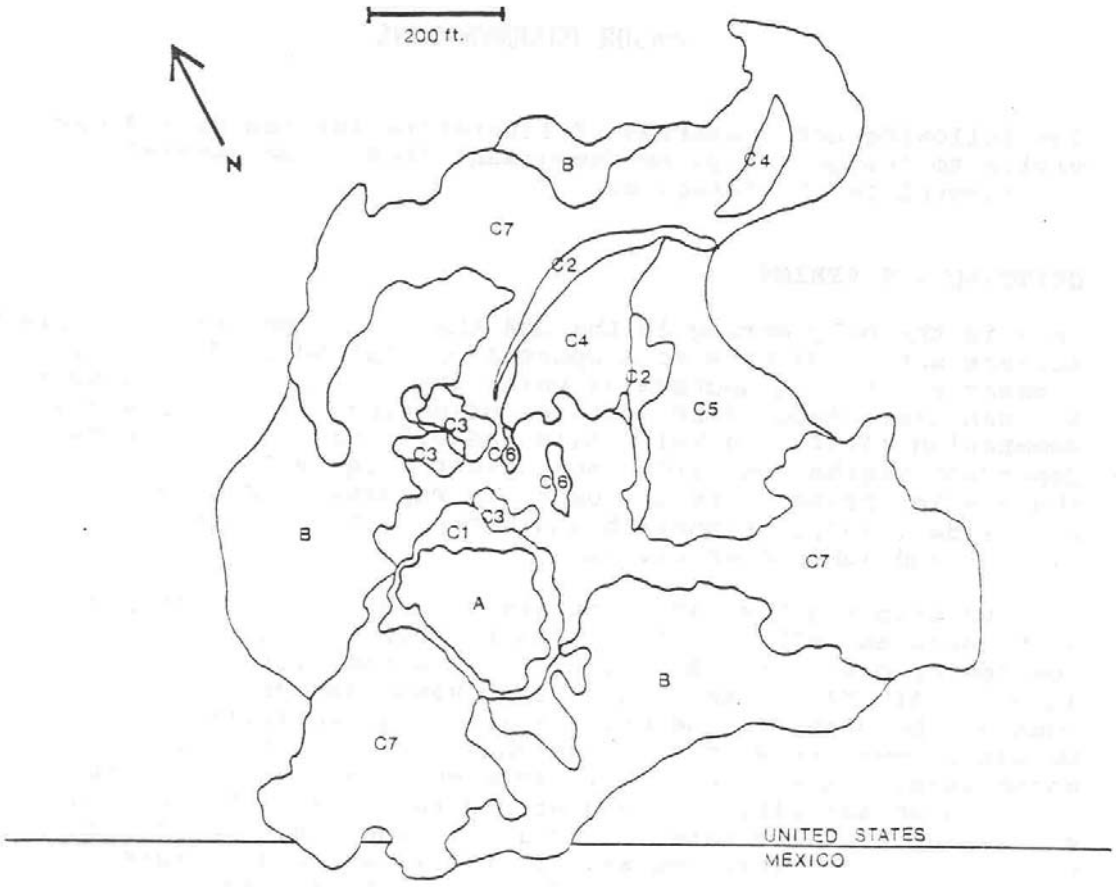

Figure 2. Vegetation at Quitobaquito Spring.

A Open water surface (0.6 acres, 0.26 hectares)
B Alkali Areas, (4.3 acres, 1.74 hectares)
C Spring water-dependent Vegetation Cover (13.7 acres, 5.54 hectares)
C1 Rush-Cattails (*Scirpus-Typha*)
C2 Spike Rush-Rush (*Eleocharis-Juncus*)
C3 Cottonwood (*Populus*)
C4 Salt Grass (*Distichlis*)
C5 Grass (*Polypogon*)
C6 Salt Brush (*Atriplex*)
C7 Mesquite-Seep Willow (*Prosopis-Baccharis*)

This map is based on several on-site evaluations of plants and ground cover made in 1983 by Yar Petryszyn.

Lawrence M. Huey (1942) visited the Quitobaquito Management Area during his survey of the fauna of the monument. Huey and an assistant made "three visits, aggregating 90 days" in 1939. They visited Quitobaquito March 4-9 (26 mammals collected), April 28May 1 (3 mammals collected) and November 26-30 (1 mammal taken). Species taken include *Myotis californicus, Pipistrellus hesperus, Neotoma albigula, Peromyscus eremicus, Thomomys bottae, Dipodomys merriami and Chaetodipus intermedius.* One mile to the east they took a *Dipodomys deserti*. These specimens are on deposit at the San Diego Society of Natural History Museum (SDSNH).

During the course of this study eight visits were made to the area, with special emphasis on determining use of the pond by bats and microhabitat distribution of rodents. A summary of the results follows (A-H). Voucher specimens are deposited at the University of Arizona (UA).

A. On the night of 26 September 1981 approximately 300 museum special traps were set at various locations around Quitobaquito. In the heavily vegetated areas only *Neotoma albigula* and *Peromyscus eremicus* were taken. On the adjacent hillsides and flats *Dipodomys merriami*, and three species of *Chaetodipus* (*C. intermedius, C. penicillatus and C. baileyi*) were taken. A mist net was set over part of the pond. Between 7:30 and 11:40 PM the following were taken: *Pipistrellus hesperus*, 3 males; *Macrotus californicus*, 1 female; *Eptesicus fuscus*, 5 males; *Tadarida femorosacca*, 5 males, 14 females; and *Eumops underwoodi,* 1 male, 2 females.

B. On 6 January 1983 forty live traps placed around the pond yielded 3 *Peromyscus eremicus* and 1 *Neotoma albigula*. Twenty traps set in the less vegetated area to the west yielded 3 *Dipodomys merriami*. Mist nets over the pond took 3 *Eumops underwoodi* and 2 *Tadarida femorosacca.*

C. On 18-20 March 1983 the following results were obtained. One hundred fifty snap traps set in the dense mesquite to the south of the pond captured 5 *Neotoma albigula* and 9 *Peromyscus eremicus*. Forty live traps set 100 yards to the east, on the sandy gravel area with cacti and brittle brush yielded 4 *Dipodomys merriami* and 1 *Chaetodipus penicillatus*. In two nights of netting a *Tadarida femorosacca* was the only bat taken.

D. Sampling done on 6-8 May 1983 produced the following. Mist netting at the pond (2 nights) captured *Pipistrellus hesperus*, 2 males, 1 female; *Antrozous pallidus*, 2 females; *Tadarida femorosacca,* 6 males, 19 females; and *Eumops underwoodi,* 6 males, 10 females. Live traps were set in the dense vegetation north of the pond (40 traps, 2 nights, mark/release) and south of the pond (30 traps, 1 night). Only *Neotoma albigula* (8 males, 16 females) and *Peromyscus eremicus* (5 males, 8 females) were taken. Petryszyn estimated that the density of *Neotoma* was 50 per hectare with a biomass of 7556 grams per hectare, a very high density. The cactus mice (*P. eremicus*) were estimated at 23 per hectare and a biomass of 412 g per hectare. In contrast, in the adjacent desert area *Neotoma* were found to be only 3 per hectare (405 grams per hectare) and *P. eremicus* were not taken. These traps were set primarily in the dense mesquite areas in an unsuccessful attempt to find Merriam's mouse (*Peromyscus merriami*).

E. Sampling on June 18-22, 1983 revealed: mist net over pond (2 nights)--*Pipistrellus hesperus,* 4 males, 17 females, 3 not determined; *Antrozous pallidus*, 1 female; *Tadarida femorosacca*, 22 males, 28 females; and *Eumops underwoodi,* 2 males, 2 females. Live traps were set for two nights both north and south of the pond (40 in each area). All animals caught the first night were marked before being released and second night recaptures were noted. North of the pond *N. albigula* (7 male, 8 females) *P. eremicus* (4 male, 3 female) were taken. Four of the 15 packrats had been marked earlier in the year. Trapping south of the pond yielded *N. albigula* (7 males, 6 females), *Peromyscus eremicus* (2 males, 7 females), *Chaetodipus penicillatus* (2 males and 2 females), and one *Ammospermophilus harrisii*. The Harris' antelope squirrel was taken near the western end of the southern trap line, near the edge of the dense vegetation while the *Chaetodipus penicillatus* were taken near the southeastern end of the southern trap line.

At this same time 12 three-pound coffee cans were buried with their tops at ground level. These were left in place until their removal was requested by the Organ Pipe Cactus National

Monument personnel. Removal was completed on 14 August. During this time 3 desert shrews were taken from one of the pitfalls, one on June 5 when the pitfalls were checked by Petryszyn and two on August 14 when the pitfall cans were removed (Petryszyn, 1987a).

F. On June 21-23, 1983, Rick Bowers set 40 traps in or near the rushes surrounding the pond and 40 in the mesquite to the east of the pond. Again, only *Neotoma albigula* and *Peromyscus eremicus* were taken.

G. Sampling of August 14-15, 1983, consisted of a mist net set up at a different angle across part of the pond. Only *Tadarida femorosacca* (5 males, 13 females) and *Eumops underwoodi* (1 male, 1 female) were taken. No traps were set at this time.

H. Sampling of September 23-25, 1983, incorporated two grids of 10 rows of 10 traps at intervals of 10 meters set and run two nights. All animals taken the first night were marked and released. The heavy vegetated area was dominated by *Neotoma albigula* and Peromyscus eremicus while the "desert" area was dominated by the Heteromyid rodents, especially Chaetodipus intermedius. Results are given in Table 2.

Additional traps set in various microhabitats resulted in the capture of a *Perognathus longimembris* in addition to *P. amplus, P. penicillatus, P. intermedius, Peromyscus eremicus* and *Neotoma albigula*. The *P. longimembris* is a new record for this area.

AGUAJITA SPRING

This spring is listed in the Brown et al. (1983) inventory as site number 42 (Table 1). Aguajita Spring is an area of several seeps with intermittent surface water. From aerial photographs an area of approximately 3 hectares surrounding the spring seems to have larger, denser woody vegetation than adjacent nearby desert areas. However, from the ground, it is evident that Heteromyid rodent habitat is present while the dense growth associated with high densities of *Peromyscus* and *Neotoma* absent.

The Aguajita spring area is the site of Plot 200 of Steenbergh and Warren (1977) report on natural community status on the monument. They reported that seep-weed, (*Suaeda*) and two species of saltbush (*Atriplex*) were the dominant plants. In February and May, 1976 they took 20 *Dipodomys merriami* and 4 *Chaetodipus penicillatus* on this site. Their comparative plot on higher terrain about 0.5 miles to the east, yielded 6 *Dipodomys merriami*, 5 *Chaetodiplus penicillatus*, 1 *Perognathus amplus* and 1 *Onychomys torridus*.

On 2 October 1981, two live trap grids (120 traps set at 10 meter intervals in 10 rows of 12 traps) were placed in the general area. One was in the wash among white thorn *(Acacia constricta)* and catclaw acacia *(Acacia greggii),* mesquite *(Prosopis juliflora)* and ironwood *(Olneya tesota).* The other was on adjacent, higher "flats" with triangle-leaf bursage *(Franseria deltoidea)* and creosote bush *(Larrea tridentata)* being the dominant plants.

In the wash *Neotoma albigula (4), Dipodomys merriami (2), Chaetodipus penicillatus (36),* and *Chaetodipus intermedius (3)* were taken. On the "flat" four species of pocket mice *Perognathus amplus (1), Chaetodipus penicillatus (12). Chaetodipus intermedius (9),* and *Chaetodipus baileyi (1)* were taken as were *Dipodomys merriami (13)* and *Neotoma albigula (1).*

The results of Steenbergh-Warren and of this study are summarized in Table 3. The results are not directly comparable since they involved different numbers of trap nights, different seasons of the year, different years and probably different microhabitats. Note, however, the absence of *Peromyscus* and the low numbers of *Neotoma* in all samples.

Table 2. Rodents captured in two live trap grids on the nights of 23 and 24 September, 1983 near Quitobaquito Spring. See text. (Total may not be the sum of Night 1 and Night 2 due to recaptured individuals on Night 2.)

	"Desert" Area			"Spring" Area		
	Night 1	Night 2	Total	Night 1	Night 2	Total
Dipodomys merriami	2	2	3	0	0	0
Perognathus amplus	1	1	1	0	0	0
Perognathus intermedius	22	15	26	0	0	0
Perognathus penicillatus	3	5	5	6	6	9
Perognathus baileyi	0	1	1	0	0	0
Peromyscus eremicus	0	0	0	11	12	18
Neotoma albigula	3	1	3	20	12	25
Total	31	25	39	37	30	52

Table 3. Results of live trap sampling in the Aguajita Spring area. See text.

Dates	"Spring" Steenbergh Feb. & May 1976	"Wash" (ms) Oct. 1981	"Higher" Steenbergh Feb. & May 1976	"Flats" (ms) Oct. 1981
Total trap nights	100	240	100	240
Dipodomys merriami	20	2	6	13
Perognathus baileyi	0	0	0	1
Perognathus penicillatus	4	36	5	12
Perognathus intermedius	0	3	0	9
Perognathus amplus	0	0	1	1
Neotoma albigula	0	4	0	1
Onychomys torridus	0	0	1	0
Total	24	45	13	37

Note also, the differences between Steenbergh and Warren's 1976 results and those of this study. Steenbergh and Warren found numerous *Dipodomys merriami* in the Spring/Wash area but very few of any other species in either site. In the 1981 study--sampling the same type of habitat with 2.4 times the trap nights--only two *D. merriami* were taken. Petryszyn, Brown and Harney (in progress) found similar results at Pozo Nuevo, ORPI.

The years 1974 through 1976 had relative low annual precipitation while 1978 through 1981 were relatively wet. During periods of higher rainfall, vegetation in the wash areas increases, and ceases to be preferred habitat for *D. merriami* while resulting in an increase in *Chaetodipus penicillatus*. During dry periods, herbaceous vegetation in the washes decreases significantly producing more open area and allowing *D. merriami* to recolonize.

WILLIAMS SPRING

Although the permanent water source at Williams Spring is only a small pool, approximately three square meters surrounded by a stand of dense reeds, the area effected by the seeps compares to that at Quitobaquito. At Williams Spring dense stands of woody vegetation are surrounded by extensive areas of alkali soils.

Because of the difficulties of backpacking live traps, only one sampling trip was made to Williams Spring. Eighty traps were set by Petryszyn and Steve Russ on April 27-29, 1989 at several locations at Williams Spring. Traps were reset in different locations at the spring during the second night.

Out of the 160 trap nights, captures consisted of *Peromyscus eremicus* (18), *Neotoma albigula* (12), *Dipodomys merriami* (2), *Chaetodipus penicillatus* (3), and *C. baileyi* (1). Results are similar to those at Quitobaquito: high densities of P. eremicus and *N. albigula* in the heavily vegetated areas; Heteromyids in the more open areas.

Other mammals observed in the area during that period of time were coyote (1), collared peccary (3), black-tailed jackrabbit (2), desert cottontail (1), and Harris' antelope squirrel (1). Scat and tracks of mule deer and gray fox were noted.

OTHER WATER SOURCES

As shown on Table 1 and listed in Brown et al. (1983) four other smaller water sources occur in the Quitobaquito Management Area. As far as mammals are concerned, these do not appear to be of much importance. Certainly they do not appear to support breeding populations of *Notiosorex* or other non-heteromyid rodents nor high densities of *Neotoma* or *Peromyscus*.

ADDITIONAL OBSERVATIONS

Dr. Bryan Brown (CPSU/UA) visited the area several times in 1983 and 1984. To date we have not seen his field notes.

Dr. R. Roy Johnson (CPSU/UA) made several trips to the management area while conducting a study of birds of the region. He reported that he saw no sign of badger, skunks, kit fox, gray fox, coati, javelina, rabbits, pronghorn or bighorn during his surveys made in 1983-1984 (personal communication).

Dr. Kenneth Kingsley, formerly with CPSU/UA, made a survey of insects in the QMA. He informed us in 1984 (personal communication) that during his surveys he never observed rabbits, carnivores other than coyotes and perhaps kit fox, nor artiodactyls other than mule deer.

Mr. Gary Nabhan, in recounting a trip to Quitobaquito apparently made in the late 1970's, bemoaned the fact that human modification and microhabitat modifications no longer are present. He argues that animal diversification is greatly reduced and points to the apparent decrease in bird species (Nabhan 1982:89-97). He provides some quantification as far as mammals are concerned in a paper he and others published in the Journal of Ethnobiology (Nabhan et al. 1982).

Petryszyn and Steve Russ, as part of the Sensitive Ecosystem Project (SEP), set two one-hectare grids consisting of 49 live traps each in Aquajita Wash on September 24-25, 1988. Only *Chaetodipus penicillatus (11)* were captured in the dense vegetation of the wash proper while *C. penicillatus* (13) and *Dipodomys merriami (2)* were captured in the less densely vegetated "flats". This trapping was conducted several months after a major flood scoured the wash.

ANNOTATED CHECKLIST

The following is a list of mammals known or thought to occur within the Quitobaquito Management Area.

1. Desert Shrew (*Notiosorex crawfordi*).
   Vouchers: Quitobaquito, 3 (UA).

The desert shrew is usually an inhabitant of desert grassland and oak-woodland areas. Only rarely is it found in the low desert. There it generally occurs in riparian habitats. The population at Quitobaquito is probably currently geographically isolated from others. Perhaps some remain along the Sonoyta River in Sonora, Mexico and in isolated canyons in the Ajo Mountains. A desert shrew was taken in a pitfall in Alamo Canyon (UA specimen). Certainly they occur to the east in the Baboquivari Mountains.

This shrew is so small (weight 4 to 5 grams) that it is rarely caught in traps. Skeletal material is often found in Barn Owl pellets in areas where these shrews occur. However, none were represented in a large number of pellets (50±) taken from a Barn Owl roost at Cipriano Well, about 4 miles north of Quitobaquito (notes, UA, 1984).

The earliest record is a mummy found in a bottle, by ORPI Chief Naturalist Larry E. Henderson in 1970. Between 18 June and 14 August 1983, Petryszyn caught three in a pitfall consisting of a 3 lb. coffee can buried with the top even with the ground surface. A total of 12 pitfalls (6 to the north and 6 south of Quitobaquito Spring) were placed in the area (Figure 3). All three *Notiosorex* were taken from the same pitfall (#N5), one on 5 July and two on 14 August. This particular pitfall was placed in a Woodrat runway in some of the densest vegetation present. It was at the overlap zone between salt grass and mesquites. Petryszyn speculated that a more sophisticated trapping system would reveal these tiny shrews throughout the heavily vegetated areas (Petryszyn, 1987a).

2. California Leaf-nosed Bat (*Macrotus californicus*).
   Vouchers: None.

One female was taken in a mist net at Quitobaquito on 26 September 1981 by Petryszyn and released. This species probably feeds over the area and drinks from the pond, especially in the dry season. However, no major rock crevices, caves or mine tunnels are known in the area so probably no day roosts are present. Feeding visits to the area most likely involve flights from the higher, more rugged ridges to the south, in Sonora.

3. Sanborn's Long-nosed Bat (*Leptonycteris sanborni).*
   Vouchers: None.

No record in the QMA. The nearest record is Pozo Nuevo, 6 miles to the north where one was netted at a water trough in the summer of 1979 (Cockrum, 1981).

This species feeds on flower nectar, pollen and fruit of columnar cacti as well as nectar of certain agaves in the desert area and only rarely feeds in the dense vegetation at Quitobaquito Spring. Like the preceding species, these bats have day roosts in caves, mine tunnels, or attics of buildings--none of which are found within the QMA.

4. Cave Myotis (*Myotis velifer*).
   Voucher: None.

No record. Nearest record is from Dripping Spring, 15 miles to the northeast (Cockrum, 1981). This is a possible summer visitor to the area, feeding over the vegetation and drinking from the pond. Day roosts are in caves or mine tunnels.

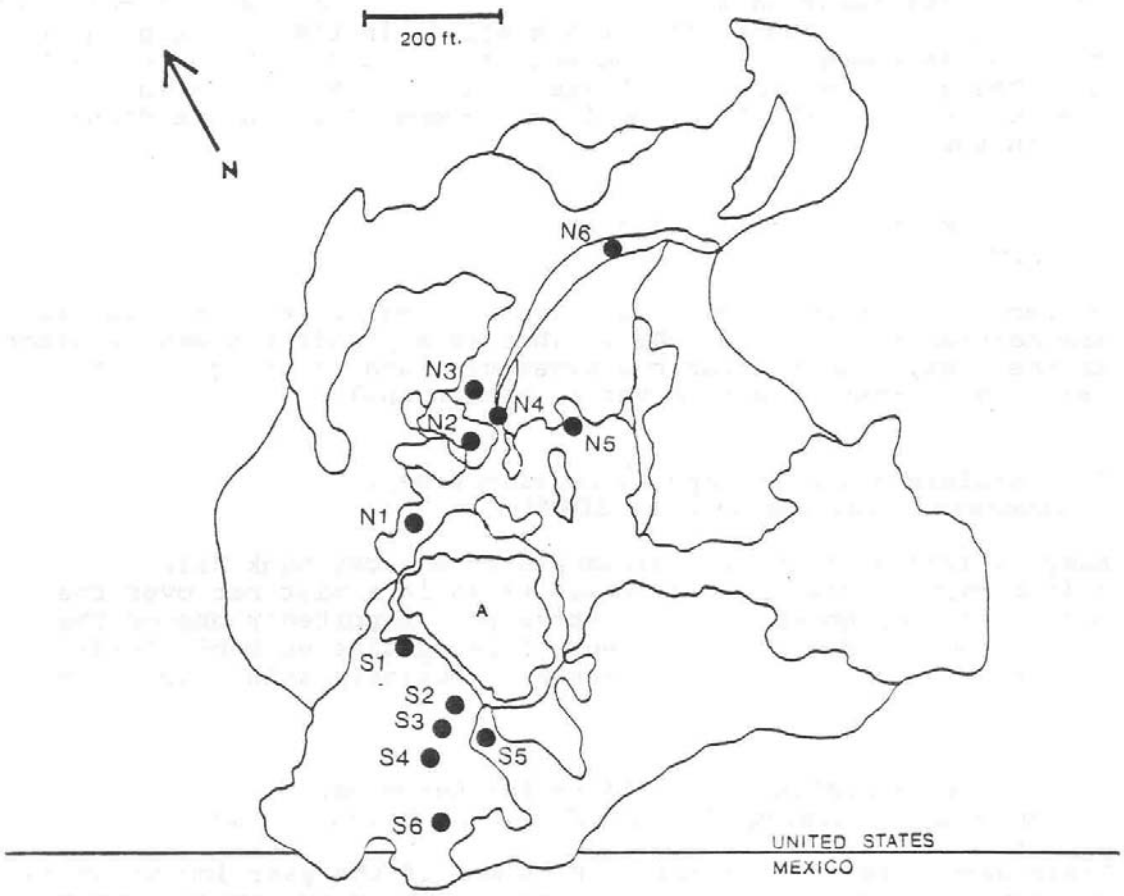

Figure 3. Placement of pitfall traps at Quitobaquito Spring. N signifies traps placed north of Quitobaquito Spring, S for those to the south. (*Notiosorex Crawfordi* captured at N.5).

5. California Myotis (*Myotis californicus*).
Vouchers: Quitobaquito 2 (SDSNH).

Huey (1942:359) found 2 individuals in a rocky bank near Quitobaquito. One individual was taken in a mist net over the pond on 26 September 1981 by Petryszyn. Reportedly one of the most common bats on the monument, this species probably feeds over most of the management area and routinely drinks from the pond.

6. Western Pipistrelle (*Pipistrellus hesperus*).
Vouchers: Quitobaquito, 1 (USNM), 1 (SDSNH), 3 (UA).

Taken many times and at different times of the year including 25 January 1894 (Mearns, 1907), 29 April 1939 (Huey, 1942), and May and September, 1979 (Cockrum, 1981).

On 26 September 1981, 63 were netted over Quitobaquito (UA notes). Additional netting on 18-19 June 1982 produced 4 males and 17 females while sampling on 6 May 1983 produced 3 individuals (UA notes).

The 1979-1983 records are from bats caught in a mist net and released. Day roosts are in hollows in trees, saguaros, under loose bark and even in tiny rock crevices. These are usually solitary in roosting behavior, only rarely being reported in clusters of several individuals.

6. Big Brown Bat (*Eptesicus fuscus*).
Vouchers: Quitobaquito, 2 (UA).

Netted over the pond at Quitobaquito on 15 September 1979, 2 (Cockrum, 1981); and 26 September 1981, 5 (Petryszyn, this study). These bats probably drink from the pond during most of the warmer months. They usually roost in small clusters, often in the hollow of a saguaro, in a rock crevice, or a similar place.

7. Hoary Bat (*Lasiurus cinereus*).
Vouchers: Quitobaquito, 1 (UA).

Netted over the pond on 16 September 1979 (Cockrum, 1981). This is a unique record for the monument. This species is probably a rare visitor to the region. Being a tree bat, it probably roosts, feeds and drinks in the Quitobaquito spring area.

Two other tree bats (*Lasiurus* borealis and *Lasiurus ega*) may eventually be recorded at Quitobaquito.

9. Pallid Bat (*Antrozous pallidus*).
Vouchers: None.

Taken in mist net, 6-7 May 1983 (2 females) and 19 June 1983 (1 female) by Petryszyn. This species probably takes water from the pond during most of the summer. Day roosts are sometimes under flat rocks on the surface of the ground as well as in rock crevices. Thus some may spend the day in the area.

10. Pocket Free-tailed Bat *(Tadarida femorosacca*).
Vouchers: Quitobaquito, 10 (UA).

This species has been netted over Quitobaquito as follows: May 1979 (1); 15-16 September 1979 (11 females) (Cockrum, 1981) and 26 September 1981 (5 males, 16 females); 6 January 1981 (2 males); 19 March 1983 (1 female); 6-7 May 1983 (6 males, 19 females); 18-19 June 1983 (22 males, 28 females) (Petryszyn, this study). Probably drinks from the pond on most warmer nights throughout the year. May have a day roost in crevices in the Sierra de Los Tanques to the south in Sonora. These reach elevations of 4560 feet.

11. Underwood's Mastiff Bat (*Eumops underwoodi*).
Vouchers: Quitobaquito 6 (UA).

This species has been netted over Quitobaquito as follows: 15 September 1979 (1 female) (Cockrum 1981); 26 September 1981 (2 males, 1 female); 6 January 1983 (2 males, 1 female); 19 March 1983 (1 male); 6-7 May 1983 (6 males, 10 females); 18-19 June 1983 (2 males, 2 females); 14-15 August 1983 (1 male, 1 female) (Petryszyn, 1987b). Habits probably similar to those of the pocketed free-tailed bat.

12. Desert Cottontail (*Sylvilagus audubonii*).
Vouchers: 1 USNM (Nelson, 1909).

Nelson (1909:225) reported specimens from Quitobaquito. Huey (1942) reported that they are "fairly common along wooded washes" near Quitobaquito.

During this study only a few cottontails were seen. These were observed along trails in the early evening hours and along the road from Aguajita Springs to the Junction of the Puerto Blanco Drive and Pozo Nuevo Road. Another was spotted near Williams Spring. Apparently population densities are currently low.

13. Black-tailed Jack Rabbit *(Lepus californicus).*
Vouchers: None.

Huey (1942) reported that they are "found over the greater part of the plains or valley floors" of the monument.

During the course of this study only three jack rabbits were seen in the QMA. One was sitting in a form under a small mesquite just west of Quitobaquito on the evening of 26 September 1981, while two were seen near Williams Spring on April 28, 1989.

14. Antelope Jack Rabbit *(Lepus alleni).*
Vouchers: None.

Huey (1942) reported that... "Jose Juan, the Papago Indian living at Quitobaquito, informed the writer that these large rabbits were rather common a few years ago but lately had almost disappeared, due no doubt, to rabbit plague." He reported sighting one 2 miles west of Quitobaquito.

None were observed in the QMA during this study. R. Roy Johnson saw one approximately 1 mi. E Aguajita Spring on two or three occasions in 1984 (personal communication). The area is probably at or near the western range of this species.

15. Harris' Antelope Squirrel (Ammospermophilus harrisii).
Vouchers: Quitobaquito, 5 (USNM); Aguajita Wash, 1 (UA); 1/4 mi. E. Quitobaquito, 1 (UA).

Between 25 January and 8 February 1894, Mearns (1907:306) found it to be common. Some were on rough granite hills, other on "flat river bottoms overgrown with creosote, sagebrush and greasewood." These observations were based on collections made in the region of Quitobaquito.

Huey (1942) reported these squirrels as never abundant anywhere on the monument, "but singly,...here and there. Their chief centers of habitation are near rock-bound hills."

One was live trapped and released 18 June 1983 by Petryszyn near Quitobaquito. Another was captured at Aguajita Wash on October 3, 1981. A third was seen April 28, 1989 at Williams Spring.

Populations in the past few years have been low and restricted to the more open rocky substrate regions. A few are seen on almost every trip but not in the dense vegetation of Quitobaquito spring.

16. Rock Squirrel *(Spermophilus variegatus).*
Vouchers: None.

No records. The nearest records are 15-25 miles away, in more rocky situations (Cockrum 1960, 1984; Petryszyn, personal observation). Any records from the QMA would be slight range extensions.

17. Round-tailed Ground Squirrel *(Spermophilus tereticaudus).*
Vouchers: Quitobaquito 5 (USNM).

Between January-February, 1894, 5 were collected by Mearns (1907). A colony occurs in the southwestern corner of the QMA, restricted to a flat area of sandy silt. Most colder months are spent in hibernation and in the warm months, most above ground activity is in the early morning. Thus few are observed.

18. Botta's Pocket Gopher *(Thomomys bottae).*
Vouchers: Quitobaquito Spring, 2 (USNM), 1 (SDSNH).

The only records for the management area have been from the heavily vegetated Quitobaquito Spring, Mearns (1907) collected 2 between January and February 1894 while Huey (1942) collected 1 in March 1939. None were seen here in the course of this study, although several attempts were made to find evidence of burrows. Another search should be made a day or two after an unusually heavy rain. For now, the status must be reported as *uncertain* but probably present.

19. Arizona Pocket Mouse (*Perognathus amplus*).
Vouchers: Quitobaquito, 1 (UA); 1 mi. N.E. of Quitobaquito, 1 (UA).

Steenberg and Warren (1977) trapped 1 in the Aguajita Spring area. During the course of this study 1 was collected in the Aguajita spring area in October of 1981 and 2 in the Quitobaquito area October 3, 1982 and September 23, 1983.

Found active in warm months, especially in creosote bush areas on more or less level ground. As indicated by Huey (1942) "not common near mesquite thickets nor large washes."

20. Little Pocket Mouse (*Perognathus longimembris*).
Vouchers: West side of Quitobaquito, 1 (UA).

Uncommon in the QMA, the smaller little pocket mouse has also been taken 0.5 mi. south of Pozo Nuevo Well (Petryszyn, 1987b). These are new records of occurrence for this species at organ Pipe Cactus National Monument. It occurs in more sandy situations on the QMA.

21. Bailey's Pocket Mouse (*Chaetodipus baileyi*).
Vouchers: West of Quitobaquito Spring, 1 (UA); Aguajita Spring Area, 1 (UA).

Three were taken in the Quitobaquito area (25-26 September, 1983), one in the Aguajita Spring area (4 October, 1981) and one at Williams Spring (27 April, 1989). Three more were collected on October 3, 1981 just north of the QMA at the Junction of Puerto Blanco and Pozo Nuevo Roads.

These rodents occur in habitats similar to those where other Chaetodipus species occur. They are not found in dense vegetation.

22. Desert Pocket Mouse (*Chaetodipus penicillatus*).
Vouchers: Aguajita wash, 2 (UA); Quitobaquito 10 (USNM), 2 (UA); 1/4 mi. N.E. Quitobaquito, 1 (UA); 1/2 mi. E. 1 3/4 mi. N. Quitobaquito, 2 (UA).

Steenbergh and Warren (1977) captured 9 in the Aguajita Spring area in February and May of 1976. A UA study in October 1981 produced 48 *C. penicillatus* (Table 3). Grids set at Quitobaquito on September 23-24, 1983 produced 14 *C. penicillatus* (Table 2). Three were captured at Williams Spring on April 27-28, 1989.

This is the common pocket mouse on the open sandy area throughout the desert floor of the QMA. They may occur under large mesquites and other trees but not in areas of dense ground cover.

23. Rock Pocket Mouse *(Chaetodipus intermedius).* Vouchers: Quitobaquito, 1 (SDSNM). 5 (UA); 1/4 mi. E. Quitobaquito, 1 (UA); 1 mi. N.E. Quitobaquito, 1 (UA).

Twenty-six C. *intermedius* were captured Sept. 23-24, 1983 just west of Quitobaquito Springs on a live trap grid (Table 2). In October of 1981, 12 were taken in the Aguajita Spring area (Table 3).

This species inhabits areas with rocky substrates. It rarely occurs in the same microhabitat as C. *penicillatus.* This species is locally common.

24. Desert Kangaroo Rat *(Dipodomys deserti).*
Vouchers: Quitobaquito area, 7 (USNM); 1 mi. E. Quitobaquito, 1 (SDSNH); Jct. of Puerto Blanco Drive and Pozo Nuevo Road, 1 (UA).

This kangaroo rat occurs on areas of loose sand. Thus it is similar in habitat requirements to *Perognathus longimembris.* They are rare on the management area.

25. Merriam's Kangaroo Rat *(Dipodomys merriami).*
Vouchers: Quitobaquito area, 40 (USNM), 3 (MVZ), 4 (SDSNH), 9 (UA).

Steenbergh and Warren (1977) collected 26 Merrian's kangaroo rats in the Aguajita area during February and May of 1976. A University of Arizona study in October, 1981 conducted in the same area produced 15 *D. merriami* (Table 3).

In September 23-24, 1983 two live trap grids in the Quitobaquito area produced three Merriam's kangaroo rats. At Williams Spring, two Merriam's kangaroo rats were taken on April 28, 1989.

This kangaroo rat is absent in areas of heavy vegetation but occurs on all but the most rocky parts of the remainder of the Management Area. It may well be the most common species of rodent here.

26. Cactus Mouse *(Peromyscus eremicus).*
Vouchers: Quitobaquito, 12 (USNM), 3 (MUZ), 3 (SDSNM), 12 (UA).

During this study this species was the most common rodent in the dense vegetation at Quitobaquito and Williams Spring.

Mearns (1907:434) reported that "at ...Quitobaquito it abounded in the huts and brush fences.... This mouse appeared very slender and light when compared in the flesh, with *Peromyscus merriami* and the latter was always found in fields and never in houses."

At present the cactus mouse is extremely rare (not taken in over two thousand trap nights) in the desert proper and in the small patches of larger trees around water sources other than Quitobaquito and Williams Spring. It is apparent that this species needs denser vegetation to survive. Possibly during years of heavy rainfall it could be found in other locations within the QMA.

27. Merriam's Mouse (*Peromyscus merriami*).

Vouchers: Quitobaquito, January 1894. 1 (USNM).

Mearns (1907:444) found "fields and brush fences were its habitat." His original description (Mearns 1896:2) stated "The skull most resembles that of *P. eremicus*...but differs notably in having the rostral portion relatively longer, the zygomatic arches wider anteriorly, and the brain-case more highly arched. Its larger size serves to identify the skull of this species at a glance, the two anterior molar teeth about equalling the lateral toothrow of *P. eremicus*. *Peromyscus merriami* and *P. eremicus* occur together at Sonoyta and Quitobaquito, on the Mexican line."

No Merriam's mice have been taken at Quitobaquito since the original collection. obviously many microhabit changes have occurred and this species may be locally extinct.

28. Southern Grasshopper Mouse *(Onychomys torridus*).

Vouchers: None. Nearest is 1 (UA) captured on September 22, 1984 at the Junction of Puerto Blanco and Pozo Nuevo Roads.

Steenberg and Warren (1977) captured one in the Aguajita area (Table 3). This insectivorous rodent is rarely found in the more arid parts of the desert. It is rare at Organ Pipe Cactus National Monument.

29. White-throated Woodrat (*Neotoma albigula*).

Vouchers: Quitobaquito, 1 (SDSNH), 11 (MUZ), 11 (UA).

Many white-throated wood rats were captured at Quitobaquito from 1981-83. Live trapping grids in the Aguajita area produced 5 in October of 1981. Twelve were captured at Williams Spring in April of 1989.

Mearns (1907:480) reported that (in 1892] "it was not uncommon, nesting about cacti and in brush fences." Huey took one in 1939. Our studies show this species to be present over most of the QMA and extremely dense around Quitobaquito Spring where we estimated that they reached densities of 50 per hectare ... a biomass of 7556 grams per hectare.

30. Coyote (*Canis latrans*).

Vouchers: Quitobaquito, 1939, 2 (MUZ); 1894, 2 (USNM).

During the course of this study coyotes were heard calling many times. Tracks and droppings were also common. One was sighted near Williams Spring on April 27, 1989 by Petryszyn. Obviously a breeding population of coyotes is successfully existing in the region, as it has for many years.

31. Kit Fox (*Vulpes macrotis*).

Vouchers: Quitobaquito, 1894, 1 (USNM).

In 1983 Kenneth Kingsley (verbal communication) observed a kit fox just northwest of Quitobaquito Spring. Others have not observed this species in recent years. It has probably never been common. Perhaps the almost constant roar of traffic on Mexican National Highway 2 has influenced, locally, the distribution of this species.

32. Gray Fox (*Urocyon cinereoargenteus*).
Vouchers: Quitobaquito, 1894, 1 (USNM); 1934, 1 (MVZ).

Observed by Petryszyn in March 1983 at Quitobaquito. From the number of scats and other sign it appears probable that there is a breeding population of gray foxes in the region.

33. Ringtail (*Bassariscus astutus*).
Vouchers: None.

Records. None. Ringtails are occasionally seen in rocky areas of the Ajo and Puerto Blanco Mountains (monument records); this species may occur in the rocky hills bordering the northwestern part of the QMA.

34. Badger (*Taxidea taxus*).
Vouchers: None.

Records. None. Badgers have been observed on other parts of the monument. They almost certainly occur in this region but voucher material is still needed.

35. Western Spotted Skunk (*Spilogale gracilis*).
Vouchers: None.

Records. None. The status of skunks in this area is unknown. No signs have been detected. Spotted skunks have been recorded from Bates Well, 25 miles to the north at a time that it was an active ranch. Some observations indicate that agriculture and ranching are necessary for sustained populations in grasslands and deserts. More information is needed.

36. Striped Skunk (*Mephitis mephitis*).
Vouchers: None.

No observations of skunks in this area were made during this study. However, striped skunks have been reported from the area in the past (monument records).

37. Mountain Lion (*Felis concolor*).
Vouchers: None.

Sight records, by park visitors, at Williams Spring in 1977 and at Quitobaquito on two or three occasions.

The mountain lion has such a large home range that occasional trips to the QMA from as far as the adjacent mountains are probably normal. However, the QMA is certainly not large enough to maintain a breeding population.

38. Bobcat (Felis rufus).
Vouchers: None.

Sight records common. Petryszyn saw one in the parking area at Quitobaquito in 1983. Many reports of scats and tracks are available. The bobcat probably can maintain a small breeding population in the Quitobaquito Management Area.

39. Collared Peccary (*Tayassu tajacu*).
Vouchers: None.

Records. None. Mearns (1907) reported that, in 1894, they found no javelina (collared peccary) west of Santo Domingo, Sonora [=1.5 mi. S of Boundary Monument #170--just northwest of Sonoyta]. Since that time sight records have been made at Bonito Well, some 5 miles to the northeast of the QMA. Three were sighted at Williams Spring by Steve Russ on April 28, 1989. Much collared peccary droppings were also observed at the springs at this time. Probably javelina are occasional visitors to the area.

40. Mule Deer (*Odocoileus hemionus).*
Vouchers: None.

Many sight records. Mearns (1907:210) reported that in 1892, bones and its peculiar antlers were frequently seen on both sides of the International Border in the hills surrounding Quitobaquito.

Petryszyn observed one to the north of the Quitobaquito Spring in 1983. In April 1983. K. J. Kingsley (personal communication) saw three approach from the northwest, apparently to drink.

41. Pronghorn *(Antilocapra americana).*
Vouchers: None

Sighted near Quitobaquito, 1939 (Huey, 1942). None were seen during the course of this study. Various sightings have been reported to the monument employees in the past few years. The Pronghorn is probably an occasional visitor to the area.

42. Mountain Sheep (Ovis *canadensis).*
Vouchers: None.

Mearns (1907:244) reported "Many horns were seen in the hills surrounding Quitobaquito, Pima County, Arizona, in 1894. A Bighorn had been lassoed by ranchmen at the pool at Quitobaquito shortly before our arrival."

None were seen in the area during this study.

DISCUSSION

The Quitobaquito Management Area contains various springs that make unusual habitats in the Sonoran Desert. However, the total area of influence is so small and diffuse that identification of habitats by the Brown, Lowe and Pase (1980) system is impossible. As has been pointed out by others (e.g., Warren et al. 1981:23) mapping units of less than 10 acres are really plots of individual species and not of vegetation types. Note the complex mixture of vegetation types shown in Figure 1 for the Quitobaquito Spring area.

As far as mammals are concerned, none are restricted to a single vegetation type. However, the dense vegetation associated with Quitobaquito Springs and pond as well as Williams Spring results in some noticeable effects on the populations of certain species. Mammals of the QMA can be divided into various groups, based on their use of free water, occurrence in dense vegetation or preference for open desert habitats. The following outlines some groupings.

I. All of home range in dense vegetation.
   A. Currently restricted to area
   B. Population densities in area much higher than in adjacent areas
   C. Population densities in area much lower than in adjacent areas

II. only part of home range in dense vegetation.
   A. Seasonal migrant
   B. Visit area for water C. Visit area
   for food D. Den or roost in area

III. Rarely, if ever, occur in dense vegetation.

Table 4 shows the number of species within certain grouping of mammals associated with the Quitobaquito spring area and the effect of dense vegetation and water on home range. The areas of "dense" vegetation associated with the other water sources in the area with the exception of Williams Spring are all so small as to have little influence on mammalian distribution.

In the Quitobaquito area two bats *(Tadarida femorosacca* and *Eumops underwoodi)* probably would not be present in the area if the large pond was absent. The pond provides a large surface area for the bats to swoop over while getting a drink. These particular bats are not capable of drinking from the other, much smaller seeps in the QMA. Furthermore, the transient tree bats (e.g., *Lasiurus cinereus*) probably would not be present if the large cottonwoods were absent.

The area, in all likelihood, contains an insular breeding population of desert shrews (*Notiosorex crawfordi*). It is also a place, along with Williams Spring, where greatly increased population densities of cactus mice (Peromyscus eremicus) and wood rats (*Neotoma albigula*) occur. These increased densities may in turn increase the number of predators such as bobcat, fox, and coyote that visit the area. sign in the form of scats and tracks of these predators were encountered frequently.

Conversely the dense vegetation results in decreased densities of the Harris' antelope squirrel (*Ammospermophilus harrisii*) and the desert pocket mouse (*Chaetodipus penicillatus*) and the almost complete absence of other pocket mice, kangaroo rats, jack rabbits and two other ground squirrels.

Of the larger mammals, the QMA probably serves as foraging and drinking sites as part of a larger home range. This is most certainly true of the larger carnivores and herbivores.

Table 4. Effect of dense vegetation and open water at Quitobaquito on mammal populations. See text for discussion. (H.R.= Home Range. Under I - A= restricted, B= increased, C=reduced. Under II - A= migrant, B= water, C= food, D= den.)

	No. species	I. Total H.R.			II. Part H.R.				III. No H.R.
		A.	B.	C.	A.	B.	C.	D.	
Desert Shrew	1	1							
Nectar-feeding Bat	1								1
Tree Bat	1				1	1	1	1	
Nook-roosting Bat	2					2	2	2	
Cave Bats	6					6			
Rabbit	1		1						
Jack Rabbits	2								2
Pocket Gopher	1		1						
Ground Squirrels	3			1					2
Kangaroo Rats	2								2
Pocket Mice	4			1					3
Cactus Mouse	1		1						
Grasshopper Mouse	1		1						
Merriam's Mouse	1		1 (?)						
Pack Rat	1		1						
Carnivores	9					9	9		
Herbivores	4					4	4		
Totals	41	2	5	2	1	22	16	3	10

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