Bats

Ami Pate

Objectives

The protocol does not provide an explicit objective. However, it states that the sampling tactics "should provide data that reflect, given a long enough time series, gross changes in bat diversity and numbers" (Petryszyn 1995).

Introduction

Bats comprise the second largest taxonomic group of mammals in the world; only the Order Rodentia has more species. The 28 species of bats recorded in Arizona represents the most diverse bat fauna of any state in the United States, other than Texas. Bats are an important component of ecological systems in the southwest U.S. The abundance and diversity of bats and their trophic position as secondary and primary consumers adds to the complexity in food webs in all but the driest of desert ecosystems. However, low reproductive rates and the need to seek specific conditions and microclimates for roosting and hibernating make bat populations vulnerable to declines (O'Shea, T.J. et al. 2003).

The bat monitoring program at OPCNM provides managers with information about what bat species are present in the monument; relative abundance and diversity at waterholes; gross differences between waterholes or changes over time, given either a long time series or drastic change; and baseline information on life history and natural history. Also, increased long-term development and alteration of roosting and foraging habitat in southwest Arizona and Mexico may change bat distribution and migration patterns. Protected lands such as OPCNM are important wildlife refuges, and can serve as reference points for altered landscapes in the surrounding region. A drastic or sustained decline in relative abundance or diversity would alert managers to abnormal conditions at OPCNM, or possibly elsewhere in the case of migratory species.

Twenty-six of the 28 species of Arizonan bats are insectivorous, with the other 2 species being nectar/fruit eaters (Hoffmeister 1986). The nectar/fruit eating bats serve as important pollinators for several species of large columnar cacti that are unique to the Sonoran desert, including saguaro, organ pipe, and senita cactus (Fleming 1996).

Twelve species of bats were found to occur in OPCNM as a result of surveys conducted during 1978–80 (Cockrum 1981). E. Lendell Cockrum described bat species occurrences, life histories, and habitats for the following: California leaf-nosed bat *(Macrotus californicus)*, western pipistrelle *(Pipistrellus hesperus)*, California myotis *(Myotis californicus)*, cave myotis *(Myotis velifer)*, big brown bat *(Eptesicus fuscus)*, hoary bat *(Lasiurus cinereus)*, Townsend's big-eared bat *(Corynorhinus townsendii)*, pallid bat *(Antrozous pallidus)*, Underwood's mastiff bat *(Eumops underwoodi)*, pocketed free-tailed bat *(Nyctinimops femorosaccus)*, and Brazilian free-tailed bat *(Tadarida brasiliensis)*. In addition, a large maternity colony of the lesser long-nosed bat *(Leptonycteris curasoae)* was discovered. The western mastiff bat *(Eumops perotis californicus)* and the Mexican long-tongued bat *(Choeronycteris mexicana)* were not yet verified in the monument at the time of the report, but were confirmed during later mist-netting projects to bring the total to 14 known bat species at OPCNM (Table 9-1).

Of these 14 species, one is designated as endangered under the U.S. Endangered Species Act (U.S. Fish and Wildlife Service, 2001)—*Leptonycteris curasoae*. Six of these species are designated as Species of Concern (former Category 2 candidates for listing under the Endangered Species Act): *Choeronycteris mexicana, Corynorhinus townsendii, Eumops perotis californicus, Eumops underwoodi, Macrotus*

Table 9-1. Bat species by family, acronym, and Endangered Species Act status, Organ Pipe Cactus N.M.

Phyllostomidae (American leaf-nosed bats)	Species	Acronym	ESA Status
Mexican long-tongued bat	*Choeronycteris mexicana*	CHME	Species of Concern
Lesser long-nosed bat	*Leptonycteris curasoae*	LECU	Endangered
California leaf-nosed bat	*Macrotus californicus*	MACA	Species of Concern
Vespertilionidae (Vespertilionid bats)			
Pallid bat	*Antrozous pallidus*	ANPA	
Townsend's big-eared bat	*Corynorhinus townsendii*	COTO	Species of Concern
Big brown bat	*Eptesicus fuscus*	EPFU	
Hoary bat	*Lasiurus cinereus*	LACI	
California myotis	*Myotis californicus*	MYCA	
Cave myotis	*Myotis velifer*	MYVE	Species of Concern
Western pipistrelle	*Pipistrellus hesperus*	PIHE	
Molossidae (Free-tailed bats)			
Western mastiff bat	*Eumops perotis californicus*	EUPE	Species of Concern
Underwood's mastiff bat	*Eumops underwoodi*	EUUN	Species of Concern
Pocketed free-tailed bat	*Nyctinimops femorosaccus*	NYFE	
Brazilian free-tailed bat	*Tadarida brasiliensis*	TABR	

californicus, and *Myotis velifer.*

Several factors make bats difficult creatures to study, resulting in limitations to gaining a detailed understanding of basic information pertaining to changes in abundance, life history parameters, and species diversity. Counting bats in a day roost or during evening exit flights from a day roost are a traditional method of monitoring bat populations. However, for many bat species this is not practical because (1) locations of roosts may not be known, (2) some species do not concentrate in large roosts, (3) some species move to other locations when disturbed, (4) some species move from roost site to roost site on a regular basis, (5) some species have sexually segregated roosts, and (6) often a roost may be used at the same time by several species. Many species that occur at OPCNM are known to roost singly or in small groups in cavities and crevices in rocks and plants, and may frequently change roost sites. Potential roost sites of this variety are countless in the rocky desert scrub and mountains of the monument. Therefore for western crevice and cavity-roosting bats, understanding life history and roosting behavior is very challenging (Bogan et al. 2003).

Although bats have fairly high urine-concentrating abilities, research on daily water budgets has shown that insect diets are not high enough in water content to preclude desert bats' reliance on free water (Carpenter 1969, Bassett 1982). Therefore, because bats need to drink water frequently, this allows for a means of sampling bat species diversity and relative abundance by using mist nets as traps, strung at water sources where bat activity is concentrated (Petryszyn 1995). Compared to other Southwest areas with local perennial streams and rivers, the lower Sonoran desert environment is well-suited to using waterhole mist-netting for capturing bats since during the hot spring and summer months, there are very few available surface water sites. Extended foraging times in the warm season by most desert bat species also maximizes the chances of capture (O'Shea 1977).

During Cockrum's 1978–80 survey, many water sources associated with livestock developments were mist-netted. Cattle grazing was allowed in OPCNM between 1915 and 1978, and with it came the associated wells and water developments (Brown et al. 1981). Although cattle were removed in the late 1970s, the NPS continued to supply water to several concrete troughs for wildlife use until the mid-1980s. The elimination of these artificial water sources and the closing of abandoned mines may have had some effect on bat distribution in the monument. At the present time surface water sources consist primarily of tinajas: natural bedrock tanks in drainages recharged by rainfall and run-off. Approximately 45 tinajas large enough to maintain water year-round have been inventoried, but most are intermittent or ephemeral, depending on location and annual precipitation.

In 1993, Yar Petryszyn was contracted to assess the current abundance and diversity of bats at OPCNM and to develop a long-term monitoring protocol. Six geographically dispersed, reasonably accessible water sources were chosen for long-term monitoring sites. Several, such as Wild Horse Tank and Tinaja Estufa, are natural tinajas with man-made enhancements (concrete dikes). Two permanent water sources exist in OPCNM, Quitobaquito Pond and Dripping Springs. Isolated intermittent tinajas with the capacity for retaining water in the hottest part of the year were chosen, where high concentrations of bats might be encountered. Quitobaquito pond was also mist-netted bimonthly 1993–1996 by Petryszyn as an independent research project on *E. underwoodi*.

Although mist-netting has its shortfalls, it provides about the only method (other than roost and flight counts) of determining the diversity and relative abundance of bats in a specific area. Even though the warm desert landscape of OPCNM may be conducive to productive mist-netting, it is important to realize the shortcomings of such a practice. Some of these are:

1. Not all species of bats have the same propensity to be netted. The echolocation ability of bats varies greatly from species to species, and some are more likely to pick up the presence of a net.

2. The ability to use certain water sources varies among bat species. Some are capable of using the smallest of waterholes, while those with narrow wings need a sizable expanse of water from which to drink.

3. The number of available water sources may change as variation in rainfall from year to year affects how much water is present. Presumably, the dispersion of bats increases with a greater number of water sources.

4. Variation in netting conditions may affect results. For example, changes in temperature, wind, barometric pressure, moonlight, and storms can effect bat foraging activity. There may be some conditions that cause many bats to remain

in their roost. Additionally, even a slight breeze can billow the nets, increasing the likelihood of detection by bats and therefore, decreasing the effectiveness of netting.

While these factors appear to preclude any chance of gathering data that are meaningful, they can be minimized to initiate a viable monitoring program that results in useful findings. The key concept in obtaining meaningful data is consistency, i.e., netting the same water source during the same period of time under the same conditions as much as possible. These tactics, coupled with using the same number and size of nets should provide data that reflect, given a long enough time series, gross changes in bat diversity and relative abundance. In order to minimize the unpredictable sampling variability because of these and other unknown factors, long-term monitoring methods were standardized as much as possible (Petryszyn 1995).

Other useful data from mist-netting includes life history information, including reproductive status, presence of parasites, injuries and scars, and foraging indicators such as presence of pollen or insect parts on bat fur. This information is especially useful in tracking the status of the maternity colony of the endangered *Leptonycteris curasoae*. Although *Leptonycteris* consume large quantities of cactus flower nectar and fruit, they appear to supplement this fluid intake by visiting tinajas. The species has been caught at every bat tinajas. This species has been caught at every netting site, and is especially numerous at Bull

Figure 9-1. *Leptonycteris curasoae* with yellow agave (*Agave deserti*) pollen on head and body, Bull Pasture, May 2004.

Pasture tinajas (Figure 9-1).

Methods

Six geographically dispersed, reasonably accessible water sources were chosen for long-term monitoring sites (Figure 9-3). Mist nets (2.6-m tall, black nylon , 4-shelf, 38 mm mesh) were used to capture bats at all study sites. Nets ranging from 2.4 to 9.1 m in length were placed at the edge of water or in a flyway near water at tinajas and pools. At Quitobaquito, a boat was used to set up a 36.6-m net across the middle of the pond. Nets were set in similar numbers and locations each year, at the driest time of year (May - July) during nights with little or no moonlight (see exceptions below). When possible, breezy nights were avoided, since bats can more easily detect mist nets when the netting material billows in the wind. Nets were opened at dusk, kept open 3-4 hours, and closed between 11 p.m. and midnight. Starting in 1997, netting conditions for each monitoring night were classified in 4 categories: Excellent (E) = no adverse conditions (wind, rain, moon), Good (G) = 1 adverse condition for less than 25% of net time, Fair (F) = 1 or more adverse condition less than 50% of net time, and Poor (P) = 1 or more adverse condition more than 50% of net time.

Nets were checked every few minutes throughout the evening and all captured bats were removed from the net and released on site after species identification, sex, age, weight, forearm and ear lengths, presence of ectoparasites and reproductive condition were recorded. Bats were processed and released as carefully and quickly as possible, to reduce stress or injury. From 1993 to 2005, only 4 mortalities out of a total of 3099 captures were recorded (0.1 %).

In 1996, two netting sessions were conducted; late spring/summer and post-monsoon. Although increased humidity and insect activity over water holes after monsoon rains can result in increased bat foraging, the effect of monsoon rains from year to year was found to be too unpredictable for long-term bat monitoring in the fall season. Not only are water sources dispersed, but storm patterns can cause poor netting conditions. From 1997 – 2005, bat monitoring was scheduled only in late spring/early summer; when water was limited to larger tinajas, and before monitoring sites dried up. One site, Estufa Tinaja frequently dries up in early spring, so it is sometimes netted in September during the post-monsoon dry period.

One site, Wild Horse Tank, was netted bimonthly over the course of a year (1997-98) to track bat activity in fall and winter months. In 1999-2001, selected sites were netted for 2 consecutive nights to measure the range of variability between nights.

All data were recorded on to standard field forms and later transferred to an electronic data base (MS Access). In this report, results may be expressed as total captures or captures per hour. The latter provides an index (i.e., relative abundance) that does not measure actual population numbers or density, but allows for examination of change over time. For a given monitoring occasion, the number of species recorded is equivalent to species richness and is the only index of diversity used in this report.

Study sites

The same geographic locations for mist netting have remained consistent since 1993, although minor shifts in location were made at 2 sites—Alamo Canyon and Bull Pasture—in order to find more reliable surface water (see methods). The sites represent the range of water source types and locations in the monument. Jacuzzi tinaja is a scoured rhyolite bedrock pool in an open section of South Alamo canyon (Figure 9-2); Bull Pasture is a very sheltered wide, shallow pool in the Ajo Mountains; Wild Horse Tank is an improved large capacity water source in the mountain foothills; Tinaja Estufa is an improved small capacity water source in the Bates Mountains; and Dripping Springs is a permanent pool in a cave in the Puerto Blanco Mountains. The non-spring sites have reliably held water until early summer,

Figure 9-2. Mist net at Jacuzzi Tinaja, South Alamo Canyon, June 2005.

except after the driest winters. The exception is Tinaja Estufa, which is exposed and frequently dries up by May, but is important because of its geographic location in the northwest part of the monument.

South Alamo Canyon
The site of the "Jacuzzi tinajas" is approximately 1 mile upstream of the confluence of the North and South forks of Alamo Canyon in the Ajo Mountains. A 5.5 m net is set with 3 poles forming a "V" at the front edge of the pool. In 2004 and 2005, a 2.4 m net was set with 2 poles (Figure 9-2).

This site replaced North Alamo Canyon's "Paisley tinaja" as a permanent monitoring site in 1998, because the South Alamo site is a higher capacity tank which holds water more reliably in the heat of summer.

Wild Horse Tank
This Diablo Mountains water source is a semi-permanent pool below a cliff with an artificial dam built in historic ranching days. The tank is half filled with gravel from storm run-off, which protects water from evaporation in the hot summer months. When full, the surface diameter of the pool is 10x17 m, the largest bat monitoring site outside of Quitobaquito Pond. The tank is in a very open flyway area.

Bull Pasture
Several protected tinajas are found in this lush middle elevation area of the Ajo Mountains. Sampling was conducted at tinajas in a drainage that empties into Estes Canyon. "Estes Canyon #2" was netted 1993-1996. In June 1997 this pool was nearly dry, and staff placed a net at the more protected "Estes Canyon #1" (informally known as "Deer Drop Tinaja"), situated below a 30 m pour-off below "Estes Canyon #2."

Bates Valley
The Bates Mountain Range in the northwestern corner of the monument contains 2 principal tinaja sites, Tinaja Estufa and Hidden Gorge Tinajas. Tinaja Estufa is located in an open drainage, and water dries up here more quickly than in the Ajo Mountains. Because of its remote location (the only site that requires an overnight backpack) and unreliable water levels, this site

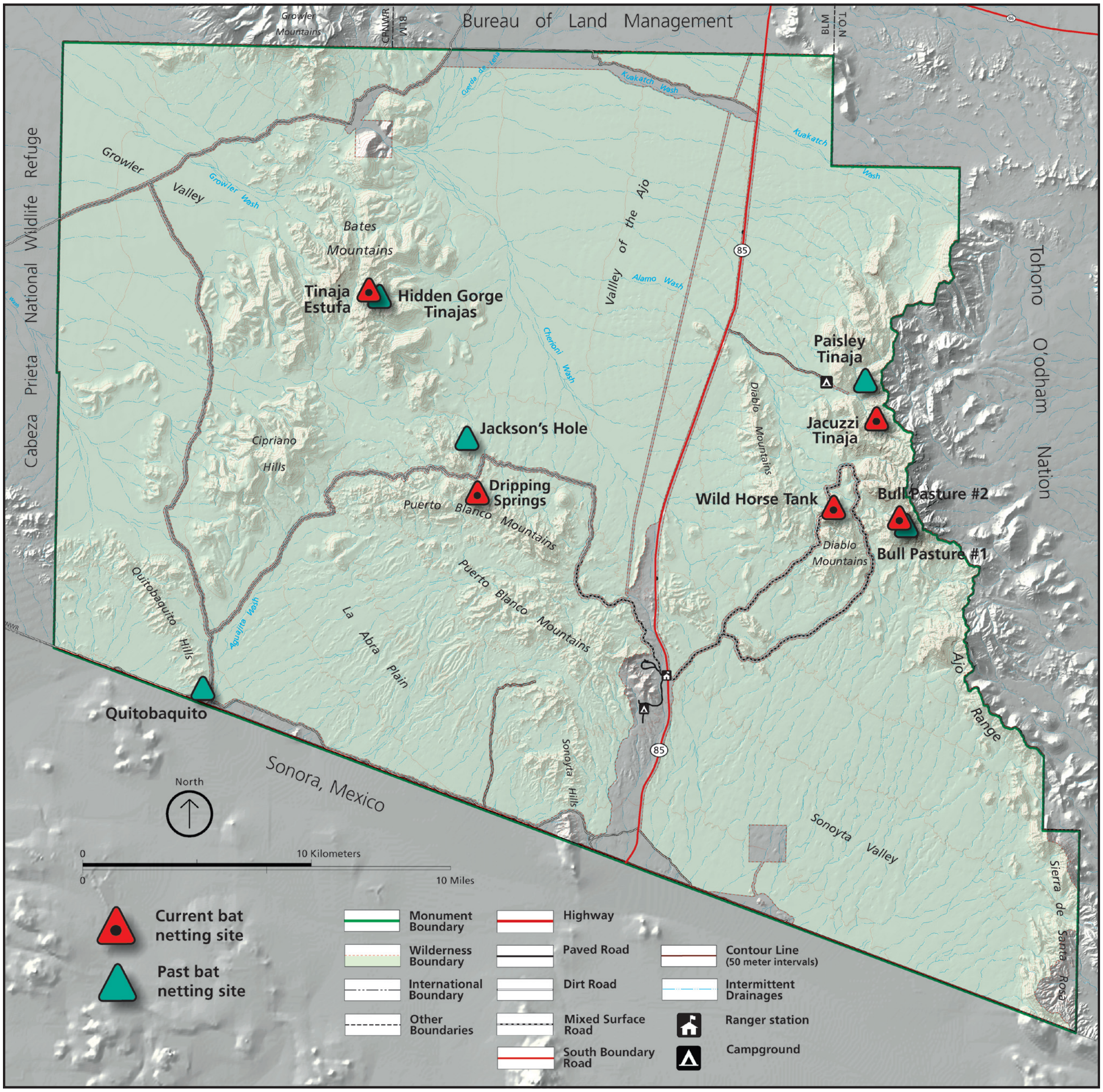


Figure 9-3. Bat mist netting sites at Organ Pipe Cactus N.M.

has not been netted in some years, or netted in the fall after monsoon rains. Attempts have been made to set mist nets at the nearby protected plunge pools of the Hidden Gorge Tinajas, but the terrain is too steep to support a successful net set over water.

Dripping Springs
This permanent seep under a rock overhang on a mountainous slope in the Puerto Blanco Mountains is difficult to sample because of the dense shrubby vegetation growth around the pool. The cave entrance is approximately 1.2 m wide and 2 m high, with the pool volume of 10 m^3. From 1993-1996, one 5.5-m net was oriented diagonally across the overhang opening, with 1 pole set uphill on top of a small cliff face. Starting in 1997, the 5.5-m net was set with 3 poles in a "V," with half the net across the front of the cave opening, and the other half close to the canyon slope. This alterned net set appeared to improve capture success. Due to the site's location on a heavily-used migrant and smuggling trail, water fouling and security issues have affected netting efforts over the years.

Quitobaquito Pond
This site is located at a 0.22 ha spring-fed pond. At this large open water site, bats in the Molossid (Freetail) family account for over 90% of the captures, while these free-tailed species are rarely caught at the other bat netting sites. At these southern Arizona locations, *E. underwoodi* has been observed and captured as it visits open ponds to drink on the wing. For this large, fast-flying bat, relatively large, open bodies of water may be important resources for drinking. Quitobaquito Pond is one of very few locations in the arid border area of south-central and southwestern Arizona where such water resources exist.

From 1993-2000, the pond was netted with a 36.6-m net and checked by boat. Also, bimonthly netting was conducted by Yar Petryszyn 1994-1995 for a banding project (Petryszyn et al. 1997). In June 2000, 4 Underwood's mastiff bat were fitted with small luminescent tags and observed by staff on nearby hilltops. In 2001-2002 the pond was netted extensively for an Underwood's mastiff bat radio telemetry project to determine foraging and roosting habitat (Tibbitts et al. 2002). Quitobaquito pond has not been netted since 2002 due to staff shortages and border security concerns.

Results
Tables 9-1 through 9-12 summarize bat mist net captures at all sites, 1993-2005. Only May-July netting sessions were used for analysis, for consistent comparison. Species composition has not varied significantly over 12 years of mist netting, except for Townsend's big-eared bat (*Corynorhinus townsendi*). This was a rarely caught species 1994-1996, but from 1997-2005 it was caught more frequently at all sites except for Estufa Tinaja and Quitobaquito (Figure 9-4).

Percent of total captures for all years by species is presented in Table 9-2. In general, the most numerous bats caught at non-Quitobaquito netting sites were the pallid bat (*Antrozous pallidus*), the big brown bat (*Eptesicus fuscus*), the lesser long-nosed bat (*Leptonycteris curasoae*) and the western pipistrelle (*Pipistrellus hesperus*).

Capture numbers for some individual species varied substantially from year to year, while others remained more stable. Notably, the big brown bat (*Eptesicus fuscus*) had a peak capture rate in 1999 and 2000 (Figure 9-4), especially at Bull Pasture, Dripping Springs and Estufa Tinaja. The most frequently caught bat, the western pipistrelle (*Pipistrellus hesperus*), had a peak capture rate in 2005; perhaps due to an all-time capture record per night of 68 individuals at Wild Horse Tank. Other species may be increasing. The California leaf-nosed bat (*Macrotus californicus*) started a gradual increase in capture rate in 1998, especially at Estufa Tinaja. The lesser-long nosed bat (*Leptonycteris curasoae*) has also been increasingly captured at mist net sites. In 2005, a record number of *Leptonycteris* were caught at the Bull Pasture site (N = 25). A record number of

Table 9-2. Percentange of total captures for all species at selected sites, all captures combined, 1993 - 2005, Organ Pipe Cactus N.M.

SITE:	BULL PASTURE	DRIPPING SPRINGS	TINAJA ESTUFA	NORTH ALAMO	SOUTH ALAMO	WILD HORSE
Total captures:	582	350	148	161	181	1,069
SPECIES	% of total:	% of total:	% of total:	% of total:	% of total:	% of total:
Antrozous pallidus	6	15	13	10	4	5
Choeronyteris mexicana	0	0	0	1	1	0
Corynorhinus townsendi	1	3	0	1	6	3
Eptesicus fuscus	19	21	28	5	4	10
Leptonycteris curasoae	29	4	5	15	7	8
Macrotus californicus	1	8	14	6	9	3
Myotis californicus	3	2	1	2	15	5
Myotis velifer	4	5	2	1	4	9
Pipistrellus hesperus	32	42	37	60	50	55
Tadarida brasiliensis	5	0	0	0	0	2

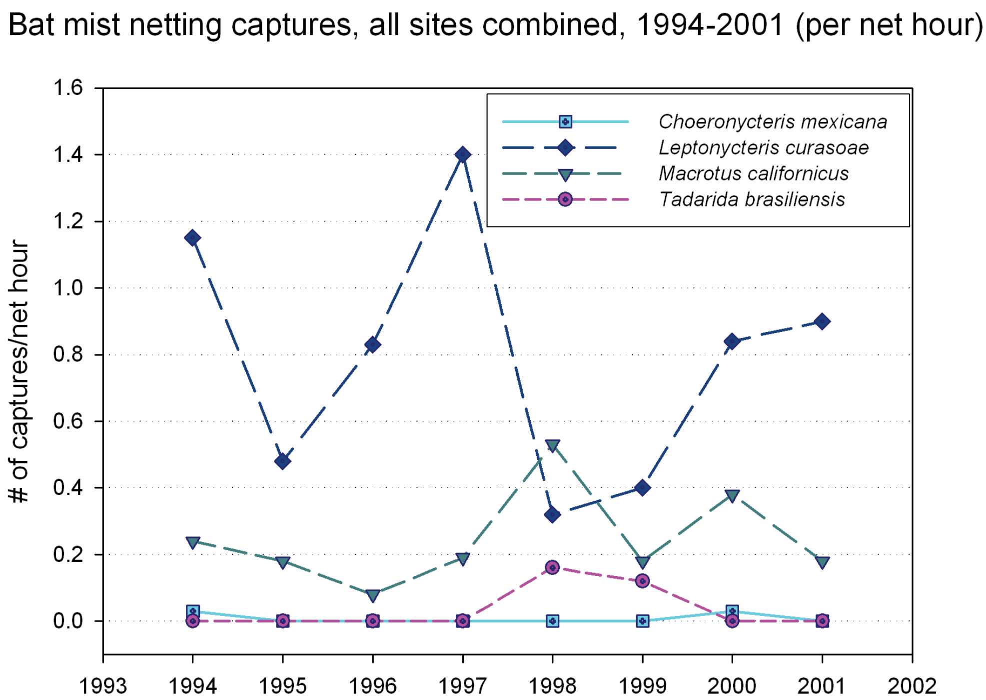
Leptonycteris were counted at the maternity roost in 2005.

From 1997-1998, Wild Horse Tank was netted in all 4 seasons to investigate bat activity in the cooler months (Figure 9-7). Several species were active in the winter of 1997-1998; in November 1997 *Antrozous pallidus, Corynorhinus townsendi, Eptesicus fuscus, Macrotus californicus* and *Pipistrellus hesperus* were captured (ending air temperature was 9° C); and in January 1998 *Antrozous pallidus, Corynorhinus townsendi, Eptesicus fuscus, Pipistrellus hesperus* and *Tadarida brasiliensis* were caught (temperatures were in the low 4° degrees C during this netting session).

In 1999-2001, Wild Horse Tank and Bull Pasture were netted for 2 consecutive nights to measure the range of variability between nights (also 2 consecutive nights at Dripping Springs in 1999 and at Tinaja Estufa in 2000). Resulting species composition and capture numbers were fairly similar between the consecutive nights (Figure 9-8), so the protocol was changed back to a single netting night to conserve staff time.

Sex ratios, for all sites and years combined, are summarized in Figure 9-10 and Table 9-4. Analysis of sex ratios per site (Tables 9-6, 9-8, 9-11, 9-12, 9-14, 9-16, 9-18) for all years combined can be useful to identify spatial preferences for foraging and roosting activity. For example, the predominance of *Myotis velifer* females at Wild Horse Tank and Dripping Springs, and *Macrotus californicus* females at North Alamo Canyon and Tinaja Estufa may indicate important maternity colonies in the area.

Capture time comparisons for all species combined and selected species are summarized in Figure 9-9. All non-Quitobaquito May and June netting nights were combined, 1994-2001. Captures dropped dramatically from 2300 – 0000. Since the majority of captures occur by 2300, staff has recently stopped netting slightly earlier than 0000 for backcountry travel safety; however, nets are opened for at least 3 hours. Four species had peak captures very early in the evening—*Pipistrellus hesperus, Myotis velifer, Myotis californicus, and Corynorhinus townsendi*. *Eptesicus fuscus* tended to be captured later in the evening. *Leptonycteris curasoae* peak captures occurred from 2100 – 2200.



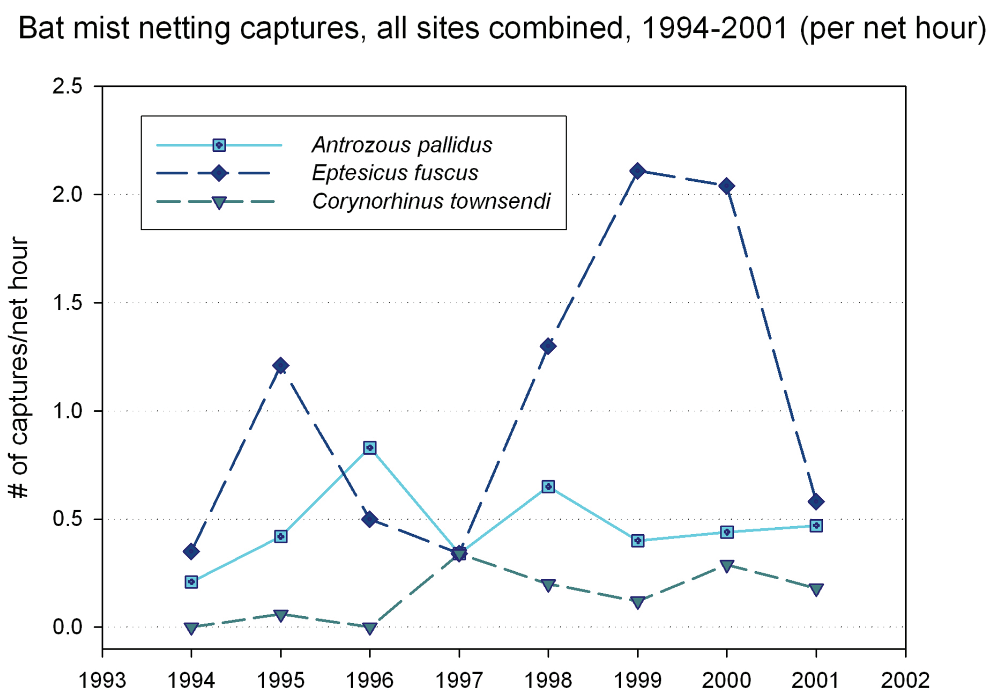


Figure 9-4. Bat mist netting captures for 7 species, per net hour, 1994-2005, Organ Pipe Cactus N.M. All sites outside of Quitobaquito Pond included in summary.

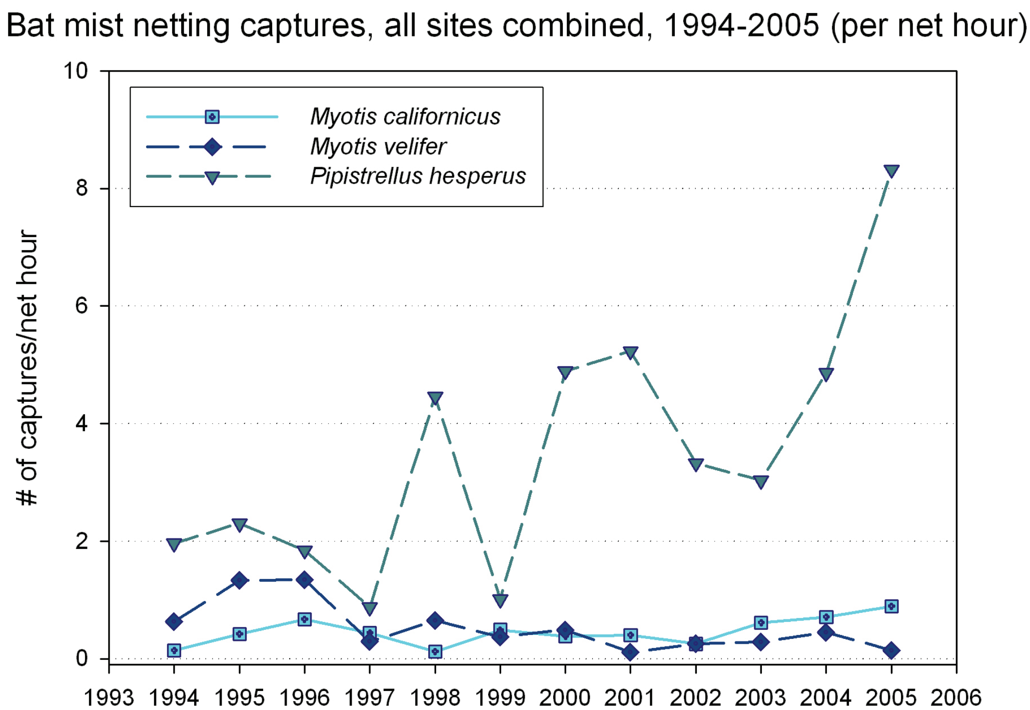


Figure 9-5. Bat mist netting captures for 3 species, per net hour, 1994-2005, Organ Pipe Cactus N.M. All sites outside of Quitobaquito Pond included in summary.

Discussion

SPECIES

Trends and observations for selected bat species are discussed in the following paragraphs.

Lesser long-nosed bat (Leptonycteris curasoae)

Females of the endangered nectar-feeding lesser long-nosed bat migrate to southern Arizona from central Mexico in April-May, following a corridor of flowering plants, and join other pregnant females in large maternity colonies. One of the largest colonies in the United States was discovered at OPCNM in 1969, and has been monitored by Arizona biologists and monument staff since the 1980s. In mid to late June young begin flying, and contribute to the nightly emergence flight. The colony usually reaches its peak size in late June and early July, when most adult females and their offspring are present. In July and August numbers fall off, as adults and young apparently disperse to other local roosts, and/or make more significant movements eastward and to higher elevations to feed on agaves, as saguaro and organ pipe food resources decline. A 2004-2005 study showed that 3 marked bats from the OPCNM roost moved eastward and were located in southeastern Arizona (Krebbs et al. 2005). This was the first evidence that bats from the southwestern corner of Arizona are moving to the mountains of southeastern Arizona in late summer.

The colony has increased substantially since the late 1980s and early 1990s. Colony size in that time period was estimated at 7,000-12,000 (Fleming et al. 1998). In 1997, June exit counts began increasing, with a peak of 37,800 in 2005.

Unlike other desert bat species, *L. curasoae*'s kidneys are not adapted to water conservation, due to a diet with high water content (Arizona Game and Fish Department 2003). Although this diet is thought to allow the species to be independent of free water, mist netting efforts at water sources in OPCNM have consistently captured *L.curasoae*. They have been caught at every water source, and constituted a large percentage of captures (29%) at one site, Bull Pasture in the Ajo Mountains. Some of the water sites are in natural flyways, but others are not, and the bats appear to be seeking drinking water during their visits there.

Most of the *L. curasoae* captures are lactating females in late-May/June, and often have fur marked with pollen and fruit from foraging. Juvenile males are sometimes caught in late June and July. Frequently when an individual is caught in the net, one or two other *L. curasoae* will keep flying nearby (evident by the species' distinctive wing flapping), which may be evidence of group foraging.

L. curasoae captures increased significantly 2000-2005, with a peak in 2004-2005, which may be due to the increase in colony size, or possibly due to a shift in foraging territory: the capture increase was mostly from the Bull Pasture site in the Ajo Mountains. A widespread reduction in saguaro and organ pipe blooms was documented informally by Arizona biologists in 2004, and many of the *L. curasoae* captures at Bull Pasture were covered in bright yellow, coarse textured, somewhat sticky *Agave deserti* pollen, instead of the more typical saguaro flower pollen which is a pale yellow, finer-grained and drier. As agave density increases in the higher elevations of the Ajo Mountains, more bats may have been seeking this resource in the absence of saguaro nectar and fruit. A 2004 radio telemetry project by Karen Krebbs of the Arizona-Sonoran Desert Museum also documented radio-tagged bats moving along bajadas on the west side of the Ajo Mountains, and ascending canyons (Krebbs 2005).

As a prolonged drought in the southwest may possibly influence cactus phenology, *L. curasoae* may experience stress from the high energetic cost of locating isolated patches of resources, and increased competition at these sites. A radio-telemetry study of the *L. curasoae* in southeast Arizona over a two-year period with a large change in flowering *Agave palmeri* found that the bats spent 120% more time foraging and 66% less time night roosting/resting during the year that the food resources were less plentiful (Ober et al. 2005). Increased energetic costs of increased foraging distances and decreased roosting may be even more stressful on pregnant and lactating females, and in the long-term may influence night and day roost site selection in the region.

Mexican long-tongued bat (Choeronycteris mexicana)

This species of nectar-feeding bat occurs at the extreme northern limit of its range in southern Arizona, with gravid females migrating from Mexico in May and June. Unlike *L. curasoae*, this species does not form large colonies, but roosts in rock shelters and small caves in groups of 15 or less; and they are known to be very sensitive to disturbance. In Arizona, it is considered a rare species and its range is primarily in higher elevations in the southeast portion of the state (Arizona Game and Fish Department 2003). In OPCNM, *C. mexicana* has been caught only 3 times: June 1994 (North Alamo Canyon), May 2000 (South Alamo Canyon), and May 2006 (South Alamo Canyon); all were lactating females.

California leaf-nosed bat (Macrotus californicus)

Studies in 1999-2000 at the nearby Barry Goldwater Air Force Range (partially now managed by the Sonoran Desert National Monument) documented year-round roosting in natural caves and abandoned mines by Macrotus californicus, and a maximum foraging range of 10 kilometers (Dalton 2001). Capture rates for this species began to increase gradually in 1998, and is most numerous at Estufa Tinaja in the Bates Mountains. Park staff have observed small colonies of Macrotus day roosting in historic ranch structures on the U.S./Mexico border, and in abandoned mines.

Females congregate in maternity colonies of varying size in May and June, and roosting bats are sensitive to disturbance (Arizona Game and

Fish Department 2001). Most all of the females caught at OPCNM sites in May – July months were gravid, lactating, or post-lactating which suggests long-term use of monument habitat for maternity colonies.

Townsend's big-eared bat (Corynorhinus townsendi)

This was a rarely caught species 1994-1996, but from 1997-2005 it was caught more frequently at all sites except for Estufa Tinaja and Quitobaquito (Figure 9-4). Only males have been caught at OPCNM. Females are known to congregate in maternity colonies in the spring and summer, while males tend to be more solitary (Monday 1993). Individual males were also caught in November 1997 and January 1998 during a special year-long netting effort at Wild Horse Tank.

Hoary bat (Lasiurus cinereus)

Only 2 hoary bats have been caught in the monument, a female in North Alamo Canyon in August 1995, and a male at Quitobaquito Pond in September 1997. These were probably migrating individuals; this species is associated with coniferous and deciduous forests and woodlands (Arizona Game and Fish Department 2004).

Underwood's Mastiff Bat (Eumops underwoodi)

The regionally uncommon species of *E. underwoodi* is encountered commonly in OPCNM, at Quitobaquito Pond. Underwood's is a little-studied bat of Mexico and Central America (Kiser 1995). The northernmost subspecies, *E. u. sonoriensis*, is limited in distribution to southern Arizona and Sonora, Mexico. In the U.S. it is known only from OPCNM and several other locales southwest of Tucson (Cockrum and Gardner 1960, Hoffmeister 1986, Petryszyn et al. 1996 and 2000). A two year banding study in 1994-1995 by Petryszyn indicated that Underwood's mastiff bat may be a small local population.

In 2000, OPCNM staff carried out a light-tagging project to gain preliminary indications of where the *Eumops* bats frequenting Quitobaquito are foraging and roosting. Visual observations suggested the bats were foraging over a fairly wide local area, including the Quitobaquito area, adjacent Aguajita Wash, desertscrub and hill slopes in both the United States and Mexico, the Rio Sonoyta, and along Mexico Highway 2. In the latter case, bats were observed foraging low over the highway, sometimes in the headlights of the busy truck traffic.

In 2001-2002, OPCNM staff initiated a radio-telemetry tracking project to determine foraging and roosting areas. Scientific literature on *Eumops* roosting behavior led staff to suspect that the large narrow-winged bats would possibly roost in high cliffs, where they could gain flight through a necessary 10m vertical drop. With the assistance of staff from the neighboring Pinacate Biosphere Reserve in Sonora, Mexico, three bats were tracked, with observers stationed or mobile on both sides of the border. Instead of the expected distant cliff roosts that staff expected to discover, all three bats were found to roost in saguaro cavities in the western part of the Rio Sonoyta valley, one to three miles south or southeast of Quitobaquito, near the northeastern corner of Pinacate Biosphere Reserve (Appendix G). The three bats also displayed comparable home ranges and foraging areas. All three ranged eastward and southward during probable foraging movements and traveled along the axis of the Rio Sonoyta valley, but ranged north and south onto adjacent bajadas and mountain slopes. All three incorporated the border town of Sonoyta, Sonora (a probable reliable source of insects drawn by urban lighting) in their home ranges (Tibbitts et al. 2002).

During the 2001-2002 radio telemetry project, staff netted Quitobaquito Pond 7 summer nights in order to capture *Eumops* for radio outfitting. Only 4 *Eumops* were captured during the 7 night netting effort, a very low amount compared to 1993-2000 monitoring results (Figure 9-6). Increased capture of the non-target Molossid *Nyctinomops femorosaccus* and associated activity at the net may have decreased the ability to capture *Eumops*, or the species may have experienced a true decline from 1994-1995. Quitobaquito Pond has not been mist-netted since 2002 due to border security concerns, as well as the logistical difficulty of processing 100s of *Nyctinomops femorosaccus* at a long net over water.

Possible future methods to determine current *Eumops* foraging and roosting status in the area without using mist nets include acoustic monitoring of echolocation calls with Anabat detector; also, *Eumops* emits a loud vocalization at a frequency audible to humans. Additionally, monument staff and Pinacate Biosphere Reserve personnel could annually relocate the roosting saguaros found during the telemetry project and check for dusk emergence at these plants and other saguaros with high cavities.

Brazilan free-tailed bat (Tadarida brasiliensis)
This Molossid species was rarely caught at tinaja sites in the monument. The narrow-winged high-flying species is less maneuverable than other insectivorous bats and requires a fairly large body of water for drinking. The Bull Pasture tinaja and Wild Horse Tank have a large water surface area at some times of the year, apparently large enough to attract *T. brasiliensis*. At Bull Pasture, 4 individuals were caught in early June 1999, a record 17 caught in late May 2003, and 9 were caught in late May 2004. At Wild Horse Tank, the species was caught in September 1997, January 1998, March 1998, May 1998 and August 1998. Out of a total of 51 individuals, only one female was captured. *T. brasiliensis* males may occur in southwest Arizona during seasonal migration movements, or on long-distance foraging visits from roosts in the region (McCracken 2003).

Human Disturbance
In recent years, disturbance to backcountry water sites by illegal migrants and smugglers has been an increasing worry to resource managers. Some illegal routes bypass water sources where trash is deposited and wildlife may be deterred from natural visitation. No evidence of migrants has been seen at Bull Pasture, Alamo Canyon and Tinaja Estufa sites, although Tinaja Estufa is located only 1 kilometer from a major migrant and smuggler trail. Wild Horse Tank occasionally receives illegal visitation, but no impairment to water quality has been observed. Dripping Springs is currently the most vulnerable wildlife water site in the monument, located on the path of a well-traveled migrant trail, and the site of repeated “lay-up” or rest area use.

During the June 2001 bat netting visit, resource management staff found the springs site in a severely degraded condition with large quantities of migrant and smuggler refuse around the springs, and the spring pool level one meter lower than normal (possibly due to groundwater conditions and/or migrant use of water for drinking). The surface of the water was completely covered with dead bees to a depth of several centimeters, along with decomposing organic matter, floating milk jugs and a large piece of plastic sheeting. The results from the bat netting demonstrated avoidance by bats due to the degraded condition of the water; capture success was much lower than in previous years, as was species richness: only 6 bats and 3 species were caught. (Summer 2001 bat netting results at other sites were consistent with previous years.) Staff returned to the springs in July 2001 for a site clean-up. By August 2001, the water level had risen significantly and bats were netted again. Captures were much higher than in June, with 14 bats and 6 species. In 2002, 55 bats consisting of 8 species were caught; this implies that bats were not deterred from returning to this important water site which in the hottest months may be the only water source within 270 square miles. Recent security restrictions have prevented staff from regular monitoring of spring conditions, and in 2004 and 2005, netting results were poor due to monsoon storms. Migrant traffic at the springs appears to be declining from 2001-2003 levels.

Conclusions
In conclusion, mist netting results from 1993-

2005 have shown consistent species composition and capture rates at all sites, which suggests that bat populations are likely stable at the monument. Protocol changes and experimentation over the years have resulted in a pared down, inexpensive mist net sampling design. Currently, the core 5 sites/1x per spring/summer schedule can help track gross changes in species richness, and relative abundance, as well as serve as a long-term inventory to detect rare or migrating species. A sustained decline or total absence of one or more species may point to anthropogenic or natural change in the monument's bat populations. As funding allows, this program can be augmented spatially or temporally to address new objectives and questions. Also, acoustic sampling would help monitor bat activity for individuals or species less prone to mist net capture, as well as allow monitoring of bat activity in foraging areas away from mountain water sources (O'Farrell 1999, Ellison 2005).

Recommendations

- Develop clear objectives for bat monitoring at OPCNM.
- Work with the Arizona bat group to develop and incorporate OPCNM bat data into a regional program for analyzing and interpreting bat monitoring data. This will increase the use of OPCNM data, provide a valuable context for and supplement to the data, and assist OPCNM with data analysis and interpretation.
- Work with the interpretation division to develop one or more stories using OPCNM bat data to educate the public about bat natural history and conservation.
- Incorporate acoustic (Anabat) recording in a revised bat monitoring strategy. Southwest biologists have compiled echolocation reference libraries of bat species vocalizations that can be used for acoustic identification. An Anabat ultrasonic detector linked to a laptop can detect bats that fly outside of the sampling capabilities of mist nets (O'Farrell 1999). Also, Anabat could be used to monitor bat activity on a larger landscape scale, in selected vegetation zones across the monument, using points or line transects (Ellison 2005). Both the Anabat II (frequency division) and Pettersson D240x (time expansion) ultrasonic bat detectors can be used during monitoring projects. Real-time recordings can quantify bat foraging activity and time-expanded recordings can identify bat species.
- Inspect and test water quality at Dripping Springs regularly during the hot spring months when water is critical to wildlife. Clear any illegal migrant or smuggler trash from area, and skim any decaying biological matter from the water.
- Inventory potential bat roosts (i.e. large natural caves and abandoned mines) in areas that may be impacted by migrant and smuggler activity, i.e. near low mountain passes in the Puerto Blanco and Ajo Mountains, and along major trails. Any significant colony sites should be targeted for extra resource protection and monitoring.

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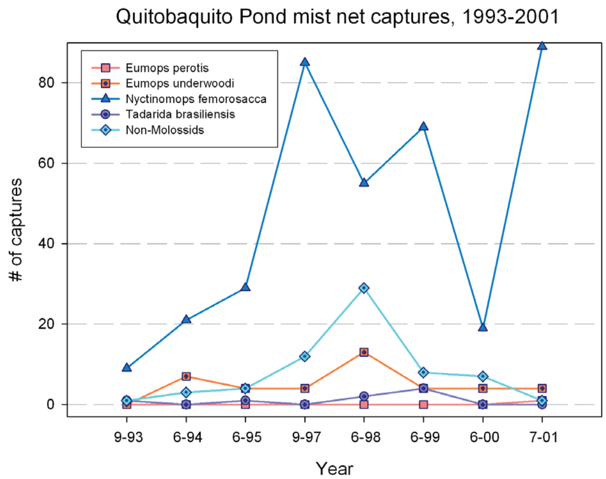


Figure 9-6. Quitobaquito Pond mist-netting captures, 1993-2001, Organ Pipe Cactus N.M.

Table 9-3. Percentage of total captures for all species at Quitobaquito Pond, all captures combined, 1993-2001, Organ Pipe Cactus N.M.

Quitobaquito species	Total captures	% of total
Antrozous pallidus	19	3.4
Eptesicus fuscus	22	3.9
Eumops perotis	1	0.2
Eumops underwoodi	52	9.2
Lasiurus cinereus	1	0.2
Macrotus californicus	1	0.2
Myotis californicus	9	1.6
Myotis velifer	4	0.7
Nyctinimops femorosaccus	420	74.5
Pipistrellus hesperus	26	4.6
Tadarida brasiliensis	9	1.6

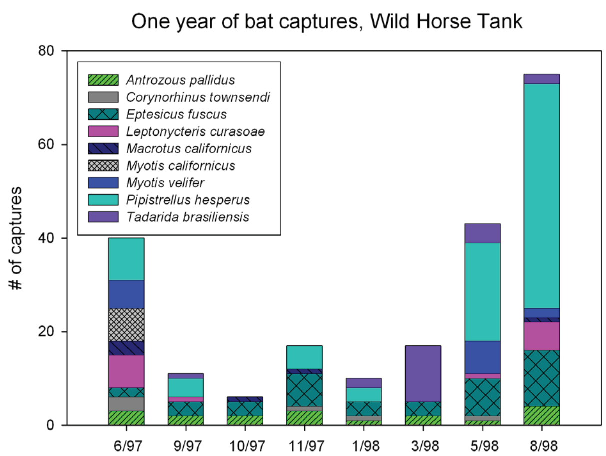


Figure 9-7. One year of bat captures at Wild Horse Tank, Organ Pipe Cactus N.M.

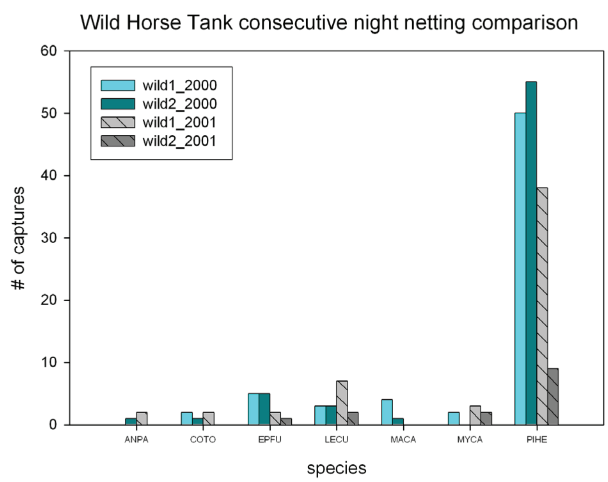
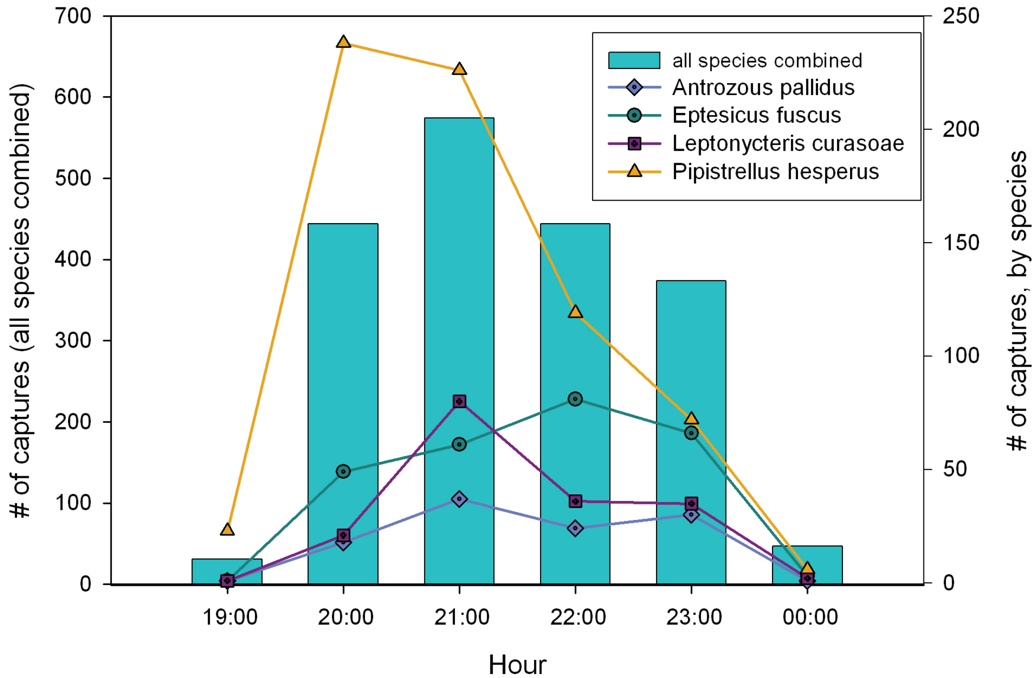


Figure 9-8. Comparison of consecutive night bat captures at Wild Horse Tank, 2000-2001, Organ Pipe Cactus N.M.



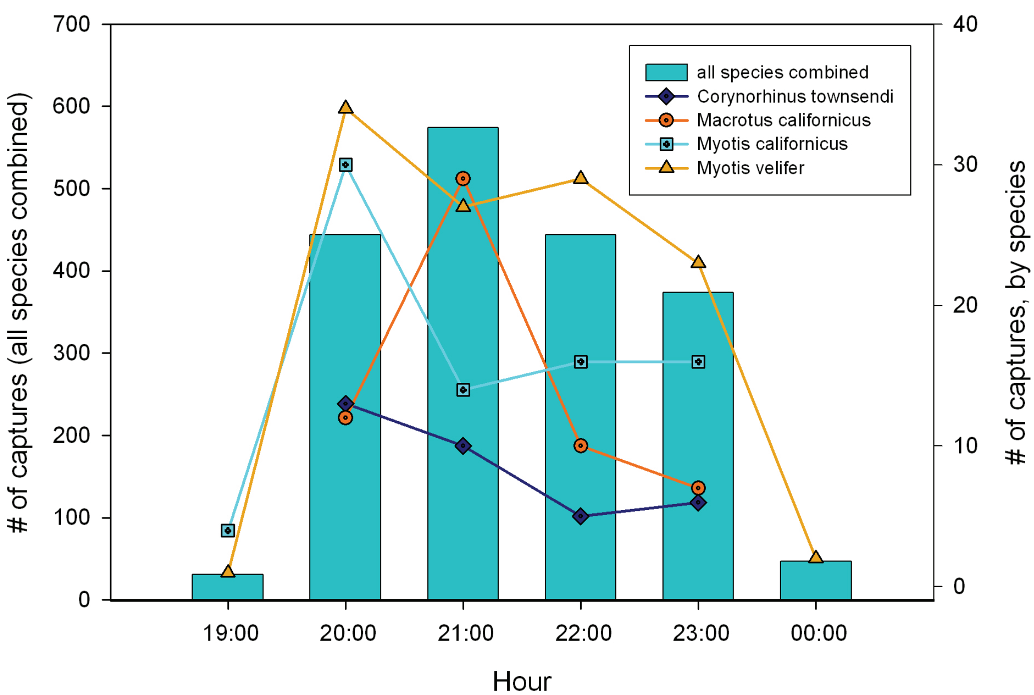


Figure 9-9. Capture time comparison, all species combined and selected species, 1994-2001 (all non-Quitobaquito Pond sites combined), Organ Pipe Cactus N.M.

Table 9-4. Sex ratios of 14 bat species for all sites, 1993-2005, Organ Pipe Cactus N.M.

SPECIES	Total	Female %	Male %
Antrozous pallidus	206	26	74
Choeronycteris mexicana	2	100	0
Corynorhinus townsendi	64	8	92
Eptesicus fuscus	372	32	68
Eumops perotis	1	100	0
Eumops underwoodi	52	50	50
Lasiurus cinereus	2	50	50
Leptonycteris curasoae	306	87	13
Macrotus californicus	109	54	46
Myotis californicus	123	62	38
Myotis velifer	153	66	34
Nyctinimops femorosaccus	420	59	41
Pipistrellus hesperus	1168	39	61
Tadarida brasiliensis	59	2	98

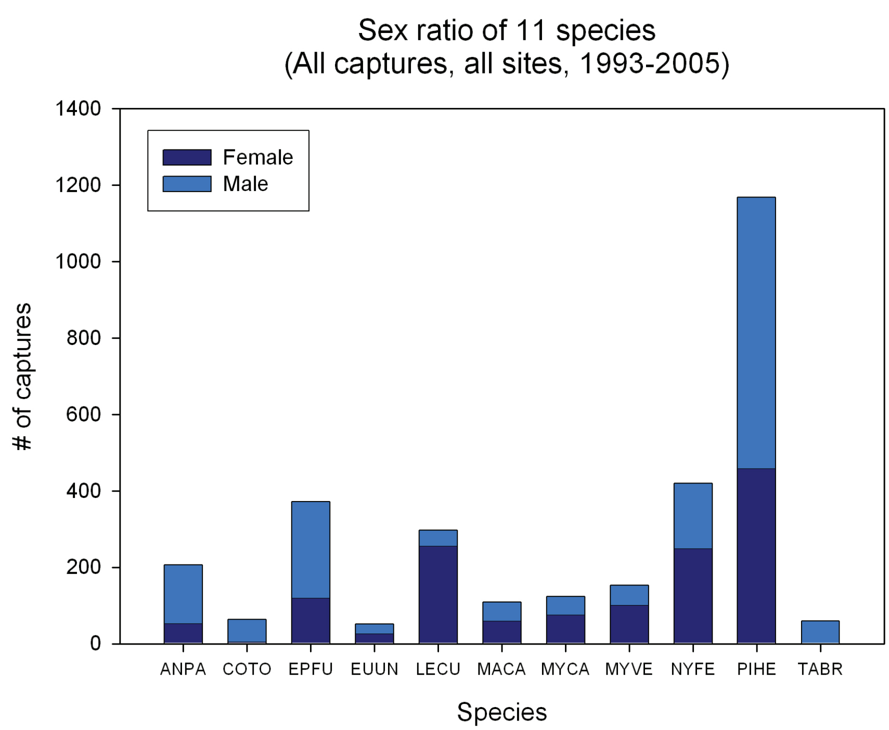


Figure 9-10. Sex ratios of 11 bat species for all sites, 1993-2005, Organ Pipe Cactus N.M.

Table 9-5. Bat mist netting results at Bull Pasture, 1993-2005, Organ Pipe Cactus N.M.

DATE	ANPA	COTO	EPFU	LECU	MACA	MYCA	MYVE	PIHE	TABR	Total
"Estes Canyon #2" Tinaja, above pour-off (Bull Pasture site #1)										
8/8/1993	2	0	1	19	0	0	12	20	0	54
6/6/1994	0	0	0	18	0	0	2	1	0	21
6/23/1995	4	0	3	4	0	2	5	21	0	39
6/18/1996	2	0	3	6	0	2	1	3	0	17
"Estes Canyon #1" Tinaja (aka "Deer Drop" Tinaja), below pour-off (Bull Pasture site #2)										
6/5/1997	3	1	1	21	0	0	0	1	0	27
6/25/1998	0	0	14	5	0	0	2	32	0	53
6/8/1999	1	1	14	5	1	0	0	2	1	25
6/9/1999	2	0	15	4	0	0	0	2	3	26
6/7/2000	3	0	12	6	0	1	0	15	0	37
6/8/2000	1	1	14	13	0	0	1	5	0	35
6/21/2001	4	1	8	6	1	4	0	37	0	61
6/22/2001	5	0	3	6	0	0	0	33	0	47
6/2/2002	1	0	9	13	0	1	0	2	0	26
5/21/2003	3	3	7	6	0	1	1	1	17	39
5/25/2004	2	0	4	11	1	0	0	2	9	29
6/4/2005	0	0	5	25	0	6	0	10	0	46
Total	33	7	113	168	3	17	24	187	30	582

Table 9-6. Sex ratios for Bull Pasture bat captures, 1993-2005, Organ Pipe Cactus N.M.

SPECIES	Total	Female %	Male %
Antrozous pallidus	32	3	97
Corynorhinus townsendi	7	0	100
Eptesicus fuscus	112	12	88
Leptonycteris curasoae	166	94	6
Macrotus californicus	2	0	100
Myotis californicus	16	75	25
Myotis velifer	23	35	65
Pipistrellus hesperus	181	44	56
Tadarida brasiliensis	29	0	100
Grand Total	568	47	53

Table 9-7. Bat mist netting results at Dripping Sprins, 1993-2004, Organ Pipe Cactus N.M.

DATE	ANPA	COTO	EPFU	LECU	MACA	MYCA	MYVE	PIHE	Total
5.5 m net, 2 poles, diagonal upslope net set across front of springs									
9/9/1993	5	0	2	0	0	0	1	4	12
6/7/1994	2	0	8	2	0	0	2	11	25
6/22/1995	2	0	2	0	1	0	2	10	17
6/11/1996	6	0	1	0	0	2	2	7	18
9/10/1996	1	0	3	2	0	0	0	1	7
5.5 m net, "V" set with 3 poles									
6/4/1997	0	2	2	0	0	1	0	7	12
6/22/1998	5	3	4	0	10	0	1	33	56
6/5/1999	2	1	19	1	1	0	5	10	39
6/6/1999	3	0	3	0	0	1	2	3	12
7/3/2000	5	3	12	2	3	2	0	26	53
6/19/2001	2	0	2	0	0	0	0	2	6
8/24/2001	3	2	1	4	2	0	0	2	14
7/1/2002	11	1	9	2	6	1	1	24	55
7/24/2003	5	0	2	1	2	0	0	8	18
Poor netting conditions, monsoon storm in 2004									
7/24/2004	1	0	3	0	2	0	0	0	6
Total	53	12	73	14	27	7	16	148	350

Table 9-8. Sex ratios for Dripping Springs bat captures, 1993-2004, Organ Pipe Cactus N.M.

SPECIES	Total	Female %	Male %
Antrozous pallidus	51	31	69
Corynorhinus townsendi	12	17	83
Eptesicus fuscus	72	65	35
Leptonycteris curasoae	14	57	43
Macrotus californicus	27	56	44
Myotis californicus	7	43	57
Myotis velifer	16	94	6
Pipistrellus hesperus	145	66	34
Total	344	59	41

Table 9-9. Bat netting results at Tinaja Estufa, 1993-2005, Organ Pipe Cactus N.M.

DATE	ANPA	EPFU	LECU	MACA	MYCA	MYVE	PIHE	Total
9/6/1993	0	4	1	1	1	1	1	9
9/7/1993	3	6	1	4	0	0	12	26
9/12/1996	2	5	0	2	0	0	1	10
5/3/2000	4	9	0	0	0	1	3	17
5/4/2000	0	11	0	2	0	0	5	18
9/22/2003	1	0	2	8	0	1	0	12
9/10/2005	9	6	3	4	0	0	28	50

Table 9-10. Bat netting results at Paisley Tinaja, North Alamo Canyon, 1993-1997, Organ Pipe Cactus N.M.

DATE	ANPA	CHME	COTO	EPFU	LECU	MACA	MYCA	MYVE	PIHE	Total
6-20-1995 = pool below Jacuzzi tinaja										
6/20/1995	0	0	0	2	1	2	0	7	3	15
6/23/1998	4	0	1	0	0	2	2	0	14	23
*5-18-99, 5-16-01, 5-19-03, 6-14-05 = fair netting conditions										
5/18/1999*	2	0	1	2	0	3	3	0	4	15
5/19/1999	1	0	0	1	2	0	4	1	2	11
5/28/2000	1	1	3	2	2	3	8	0	9	29
5/15/2001	0	0	2	0	1	2	2	0	13	20
5/16/2001*	0	0	0	0	3	2	0	0	13	18
5/19/2003*	0	0	1	0	0	1	2	0	4	8
6/17/2004	0	0	0	0	4	0	1	0	14	19
6/14/2005*	0	0	2	0	0	1	5	0	15	23
Total	8	1	10	7	13	16	27	8	91	181

Table 9-11. Sex ratios for Tinaja Estufa bat captures, 1993-2005, Organ Pipe Cactus N.M.

SPECIES	Total	Female %	Male %
Antrozous pallidus	18	39	61
Eptesicus fuscus	39	62	38
Leptonycteris curasoae	7	100	0
Macrotus californicus	21	76	24
Myotis californicus	2	100	0
Myotis velifer	3	100	0
Pipistrellus hesperus	52	46	54
Total	142	58	42

Table 9-12. Sex ratios for Paisley Tinaja, North Alamo Canyon, bat captures, 1993-1997, Organ Pipe Cactus N.M.

SPECIES	Total	Female %	Male %
Antrozous pallidus	15	47	53
Choeronyteris mexicana	1	100	0
Corynorhinus townsendi	1	0	100
Eptesicus fuscus	8	50	50
Lasiurus cinereus	1	100	0
Leptonycteris curasoae	24	71	29
Macrotus californicus	8	88	13
Myotis californicus	3	67	33
Pipistrellus hesperus	90	64	36
Total	153	65	35

Table 9-13. Bat netting results at Jacuzzi Tinaja, South Alamo Canyon, 1995-2005, Organ Pipe Cactus N.M.

DATE	ANPA	CHME	COTO	EPFU	LECU	MACA	MYCA	MYVE	PIHE	Total
6-20-1995 = pool below Jacuzzi tinaja										
6/20/1995	0	0	0	2	1	2	0	7	3	15
6/23/1998	4	0	1	0	0	2	2	0	14	23
*5-18-99, 5-16-01, 5-19-03, 6-14-05 = "fair" netting conditions										
5/18/1999*	2	0	1	2	0	3	3	0	4	15
5/19/1999	1	0	0	1	2	0	4	1	2	11
5/28/2000	1	1	3	2	2	3	8	0	9	29
5/15/2001	0	0	2	0	1	2	2	0	13	20
5/16/2001*	0	0	0	0	3	2	0	0	13	18
5/19/2003*	0	0	1	0	0	1	2	0	4	8
6/17/2004	0	0	0	0	4	0	1	0	14	19
6/14/2005*	0	0	2	0	0	1	5	0	15	23
Total	8	1	10	7	13	16	27	8	91	181

Table 9-14. Bat sex ratios for Jacuzzi Tinaja, South Alamo Canyon, 1995-2005.

SPECIES	Total	Female %	Male %
Antrozous pallidus	8	0	100
Choeronycteris mexicana	1	100	0
Corynorhinus townsendi	10	10	90
Eptesicus fuscus	7	57	43
Leptonycteris curasoae	13	92	8
Macrotus californicus	15	47	53
Myotis californicus	27	56	44
Myotis velifer	8	63	38
Pipistrellus hesperus	90	30	70
Total	179	40	60

Table 9-15. Bat netting results at Quitobaquito Pond, 1994-2001, Organ Pipe Cactus N.M.

DATE	ANPA	EPFU	EUPE	EUUN	LACI	MACA	MYCA	MYVE	NYFE	PIHE	TABR	Total
6/2/1994	0	1	0	7	0	0	0	0	21	2	0	31
6/5/1994	0	1	0	6	0	0	0	0	22	0	0	29
6/21/1995	0	1	0	4	0	0	0	0	29	3	1	38
6/6/1997	0	1	0	2	0	0	1	0	2	0	1	7
9/3/1997	4	5	0	4	1	0	1	0	85	1	0	101
6/24/1998	6	6	0	13	0	1	3	0	55	17	2	103
6/10/1999	0	2	0	4	0	0	3	2	69	1	4	85
6/28/2000	2	2	0	4	0	0	1	2	19	0	0	30
6/29/2000	3	3	0	4	0	0	0	0	20	0	0	30
7/22/2001	4	0	1	4	0	0	0	0	89	1	0	99
Total	19	22	1	52	1	1	9	4	411	25	8	553

Table 9-16. Sex ratios for Quitobaquito Pond bat captures, 1993-2001, Organ Pipe Cactus N.M.

SPECIES	Total	Female %	Male %
Antrozous pallidus	19	95	5
Eptesicus fuscus	22	64	36
Eumops perotis	1	100	0
Eumops underwoodi	52	50	50
Lasiurus cinereus	1	0	100
Macrotus californicus	1	100	0
Myotis californica	9	100	0
Myotis velifer	3	33	67
Nyctinomops femorosaccus	420	59	41

Table 9-17. Bat mist netting results at Wild Horse Tank, 1993-2005, Organ Pipe Cactus N.M.

DATE	ANPA	COTO	EPFU	LECU	MACA	MYCA	MYVE	PIHE	TABR	Total
8/9/1993	4		2	14	4	2	5	58	0	89
9/9/1993	7	1	3	0	0	0	0	20	0	31
6/4/1994	0	0	1	4	3	3	14	38	0	63
5/26/1995	1	1	13	3	0	5	8	4	0	35
6/13/1996	2	0	2	4	1	4	13	12	0	38
9/9/1996	1	0	1	0	1	0	1	2	0	6
6/3/1997	3	3	2	7	3	7	6	9	0	40
9/4/1997	2	0	3	1	0	0	0	4	1	11
10/1/1997	2	0	3	0	1	0	0	0	0	6
11/3/1997	3	1	7	0	1	0	0	5	0	17
1/28/1998	1	1	3	0	0	0	0	3	2	10
3/24/1998	2	0	3	0	0	0	0	0	12	17
5/28/1998	1	1	8	1		0	7	21	4	43
8/20/1998	4	0	12	6	1	0	2	48	2	75
5/10/1999	0	1	4	0	0	7	2	5	0	19
5/11/1999	2	0	11	1	1	1	2	5	0	23
6/5/2000	0	2	5	3	4	2	10	50	0	76
6/6/2000	1	1	5	3	1	0	5	55	0	71
5/23/2001	2	2	2	7	0	3	3	38	0	57
5/24/2001	0	0	1	2	0	2	0	9	0	14
7/21/2001	2	0	1	10	2	0	0	20	0	35
5/13/2002	1	10	0	0	0	1	2	14	0	28
5/20/2003	5	1	4	6	0	8	3	42	0	69
5/26/2004	4	0	0	0	0	1	5	14	0	24
7/7/2004	3	5	5	9	8	9	2	45	0	86
6/13/2005	3	5	6	0	0	2	2	68	0	86
Total	56	35	107	81	31	57	92	589	21	1069

Table 9-18. Sex ratios for Wild Horse Tank bat captures, 1993-2005.

SPECIES	Total	Female %	Male %
Antrozous pallidus	55	5	95
Corynorhinus townsendi	34	6	94
Eptesicus fuscus	105	11	89
Leptonycteris curasoae	79	80	20
Macrotus californicus	30	40	60
Myotis californicus	56	57	43
Myotis velifer	92	71	29
Pipistrellus hesperus	573	26	74
Tadarida brasiliensis	21	5	95