

Bat Surveys

**Forts Cronkhite, Barry and Baker
Marin Headlands
Golden Gate National Recreation Area**

June-September 1993

Prepared for:

Natural Resources
Golden Gate National Recreation Area
Fort Cronkhite, Bldg. 1056
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29 September 1993

1.0 INTRODUCTION

Thirteen species of bat are known to occur in Marin County, and thus potentially occur in the Marin Headlands area of Golden Gate National Recreation Area (GGNRA)(Table 1). One of these, Townsend's big-eared bat (*Plecotus townsendii*), is a Category 2 candidate for Federal listing under the Endangered Species Act. This species, plus the pallid bat (*Antrozous pallidus*), are considered Mammals of Special Concern by the California Department of Fish and Game.

The purpose of this study was to survey a number of man-made structures at Marin Headlands for use by bats, with a focus on military installations (batteries, bunkers, casemates, quonsets, and fire control stations). The hypothesis was that since many of these structures were cave-like, they could offer suitable roost sites. Of particular interest were roost sites for *A. pallidus* and *P. townsendii*.

2.0 METHODS

2.1 Structure Surveys

Selected structures were inspected for the presence of bats or bat sign (guano or characteristic staining). It is often possible to determine, based on distribution and pellet morphology, whether an area is being used as a day or night roost, and what species are present. Certain species, like *P. townsendii*, *A. pallidus* and the Mexican free-tailed bat, *Tadarida brasiliensis*, have distinctive guano, whereas others are more difficult to identify (e.g., it is not generally possible to distinguish among *Myotis* species, although it is possible to identify the genus).

Structures were designated as potential day roosts if they offered crevices or darkened, enclosed chambers, and as potential night roosts if they offered sheltered open surfaces and ready access.

2.2 Acoustic Surveys

Acoustic monitoring, using broad band ultrasound detectors to shift high frequency audible and ultrasonic calls down into the range of normal human hearing is typically the most effective method for obtaining a point index of bat activity. Observations of high acoustic activity can guide more intensive survey efforts such as netting or comparisons of activity levels (e.g., number of bat passes detected/unit time) at different potential foraging sites or flyways.

Since call intensities differ considerably among bat species and since atmospheric attenuation with distance increases rapidly with frequency in the ultrasonic (i.e., high frequency calls are not detectable beyond a short distance), detection radii will differ substantially among bat species. Thus overall acoustic activity comparisons among sites are counting primarily low to moderate frequency aerial pursuit foragers which generally have high intensity calls. Foragers with low call intensity such as foliage gleaners will be underrepresented. Fortunately, many local species fall in the former category, (e.g., *T. brasiliensis* which can be heard over long distances) and, unfortunately, some species of particular interest fall in the latter (e.g., *P. townsendii* is audible at ranges up to about 10m).

An additional considerably more labor intensive step in the analysis of recorded bat calls is species identification. While some common species (e.g., search phase calls of *T. brasiliensis*) in the coastal northern California fauna are acoustically distinctive and can be identified qualitatively in time expanded calls, there is broad overlap in call characteristics, particularly in the genus *Myotis*. There is also growing evidence of geographic variation in call characteristics within species. Quantitative analysis of recorded calls (e.g., minimum frequency, frequency at peak amplitude, pulse duration, interpulse interval) from unknown animals can circumscribe classes of call types which provide minimal estimates of the number of species present, but local data on call characteristics obtained from capture and release recordings of known individuals are needed to assign call types to species or species groups. While these critical background data are accumulating in other contexts, the scale of this project did not permit this level of analysis. Thus the work undertaken was limited to audio taping of bat calls at a limited sample of sites and a preliminary review of the tapes from which a qualitative assessment of the number of species is derived.

Acoustic surveys were conducted between 19:00 and 24:00 on September 24 and 26 at several stations expected to have bat activity. Since bats often forage in association with water or riparian vegetation, two stations were established at Rodeo Lake, and three along Rodeo Creek. Other stations included areas in the vicinity of known roost sites -- Buildings #940-946, #960, Battery Wallace -- and along the road leading to Battery Hill 129.

Monitoring was conducted using two Pettersson Elektronik bat detectors -- one D980 and one D940 -- and a Titley Electronics ANABAT. All were coupled to cassette recorders.

3.0 RESULTS

3.1 Structure Surveys

Sixty-four structures -- 46 military structures (15 batteries, 5 quonsets, and 26 bunkers, casemates or fire control stations), 14 buildings, 2 towers, and 2 cisterns -- were surveyed between June 22 and September 14, 1993 for the presence of bats or bat sign (see Table 2).

During these daytime surveys, bats (all *P. townsendii*) were located in three structures. A single male *P. townsendii* was found in bunker 1260, another male in Quonset C, and two (sex unknown) in Building 960 (the largest of the Three Sisters). Additionally, *P. townsendii* guano was found in six other structures -- Buildings 1077, 945 and 946 and bunkers 1130 and 1272, and Battery Townsley. With the exception of Buildings 960 and 1077, which had fairly substantial guano accumulations, suggesting night roosting or former day roosting by >10 animals, all the sites appeared to be used as night roosts or intermittent day roosts by one or two animals.

Small amounts of guano, most likely belonging to a *Myotis* species, was found in a few other structures (# 770, #1008, Batteries Alexander and Wallace, and the red house in Tennessee Valley). The largest accumulation was in Battery Wallace, which was confirmed during an evening survey on September 24 to be a night roost for the Yuma myotis, *Myotis yumanensis*. Relatively early in the evening (22:45) about 15 animals were night roosting in a side room off the northern tunnel of this battery.

3.2 Acoustic Surveys

During acoustic surveys, calls attributable to several different species were identified (Fig. 1). Most bat activity was recorded in the vicinity of Rodeo Lake and along the road leading to Battery Hill 129. Activity was limited at all other acoustic stations (along Rodeo Creek, near Battery Wallace, the Three Sisters and the buildings behind the theater). The majority of calls belonged to *T. brasiliensis*, which was feeding over Rodeo Lake and, along with other species, on the south facing chaparral covered slopes west of the Golden Gate Bridge. Although no other calls were identified with certainty in the limited analysis undertaken, their frequency characteristics suggest they belonged to a *Myotis* species (a peak frequency of ca. 45 KHz), and at least one medium frequency vespertilionid (most likely the big brown bat, *Eptesicus fuscus*, or *A. pallidus*)

4.0 DISCUSSION

The combined roost and acoustic surveys suggest that the dominant bat species in the Marin Headlands in the summer and early fall are *P. townsendii*, *M. yumanensis*, and *T. brasiliensis*. No maternity roosts for any species were found.

The *P. townsendii* roosting in man-made structures at the Headlands are likely predominantly males, and may be associated with a large maternity colony located in a barn on NPS land in Bolinas, about 14 air miles to the north, or with a closer colony whose whereabouts is still unknown (possibly Angel Island, where a colony was reported a number of years ago). *P. townsendii*, once fairly common in California, is currently known along the coast from only a few populations (Pierson and Rainey 1992). The two colonies of *P. townsendii* on GGNRA land (one in Bolinas and one in the Randall House), as far as we know, represent the largest remaining coastal population. The role of Marin Headlands in supporting this population is not known, but the relatively high use of the bunkers and buildings suggests it may be important.

Since *M. yumanensis* is the most commonly encountered species in Marin County, its presence at the Headlands is not surprising. It forages predominantly on emergent aquatic insects (Brigham et al. 1992, van Zyll de Jong 1985), and thus would be expected to be feeding over Rodeo Lake. The night roost identified at Battery Wallace suggests there is a day roost near by. Potential day roosting sites, accessible to bats and inaccessible to people, were available in a number of batteries.

T. brasiliensis, the species most tolerant of urbanization, is active in the Bay area year round. (It does not hibernate). This species is a strong, long distance flier, that can travel a number of miles from its roosting area to foraging grounds. Individuals are frequently found in San Francisco, and a colony has been reported from the elephant house at the San Francisco Zoo across the bay. The relatively large number of animals feeding over the chaparral, just north of the city, suggest that Marin Headlands may provide important foraging habitat for urban dwelling *T. brasiliensis*.

Of the 63 structures surveyed, 35 were assessed to offer potential day or night roosts for bats, yet only 14 showed any sign of use. The relatively limited use of apparently appropriate structures could be attributed to several factors. First, many of these structures receive very heavy human visitation. Given that human disturbance of roost sites is considered to be one of the primary factors limiting bat occupation of otherwise suitable roosts (McCracken 1988), it is not

surprising that some of the structures, particularly the more heavily visited batteries, are unoccupied.

Second, the interiors of many of the larger buildings, from which the public is excluded, are likely too cold (15°-18°C) to offer suitable summer daytime roosting conditions. Temperature is thought to be a primary factor in roost selection, with most bat species seeking warm (>21°C) summer roosts, particularly for maternity sites.

5.0 RECOMMENDATIONS

The majority of *P. townsendii* roost sites were in Fort Cronkhite and adjacent areas of Fort Barry. Consideration should be given to protecting those sites most obviously being used by this species: #1260, Quonset C, and #960 (the largest of the Three Sisters buildings). Protection would mean precluding human entry into #1260 and Quonset C, and the attic and basement areas of #960.

The greatest potential threat to bats roosting in man-made structures at the Marin Headlands is disturbance from human visitors. The extent to which human visitation is limiting bat occupancy of heavily visited structures is not known. There were, however, a number of apparently suitable structures, that were accessible to bats and not to humans (i.e., they were locked, but had small access holes), which were not being used by bats. The Headlands also offers suitable foraging habitat for bats, particularly in the moist creek drainages, in the somewhat sheltered valleys, and on the chaparral covered slopes. Recreational use that impacts these areas, particularly around Rodeo Lake, could potentially reduce available foraging habitat.

There is no apparent threat to the cultural resource posed by bats using man-made structures as roost sites. Unlike some other mammals, bats are not known to cause structural damage by chewing, and they do not build nests. Urine stains which are sometimes associated with roosting areas do not damage structures, and there are no known health risks associated with bat guano in the western U.S. (Constantine 1988). *P. townsendii*, the species most commonly encountered in the structures, generally forms relatively small aggregations (e.g., a colony of >175 animals is very unusual), has little odor, and is very quiet. As a consequence, their presence in structures often goes undetected.

This study addressed only summer use of potential roost sites at Marin Headlands. Having adequate winter sites are also critical to the survival of bat populations. Although bats in central and southern California do not appear to form the large hibernating aggregations typical of many species in colder regions, they do hibernate for days or weeks at a time, seeking sites with the coolest available, non-freezing temperatures. Since many of the military structures appeared too cool to provide optimum summer roosting conditions, they may be more appropriate as winter roost sites. Thus a winter survey of selected bunkers, batteries and buildings is recommended.

6.0 ACKNOWLEDGMENTS

This study was supported by a contract with the Golden Gate National Park Association. I would like to thank Daphne Hatch for support on all aspects of this project, William Rainey for guiding the acoustic work, and Mary Ellen Colberg, Christine Scott, and Patricia Winters for assistance in the field.

7.0 LITERATURE CITED

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Battery Hill 129 9/26/1993 ca 2300 hrs

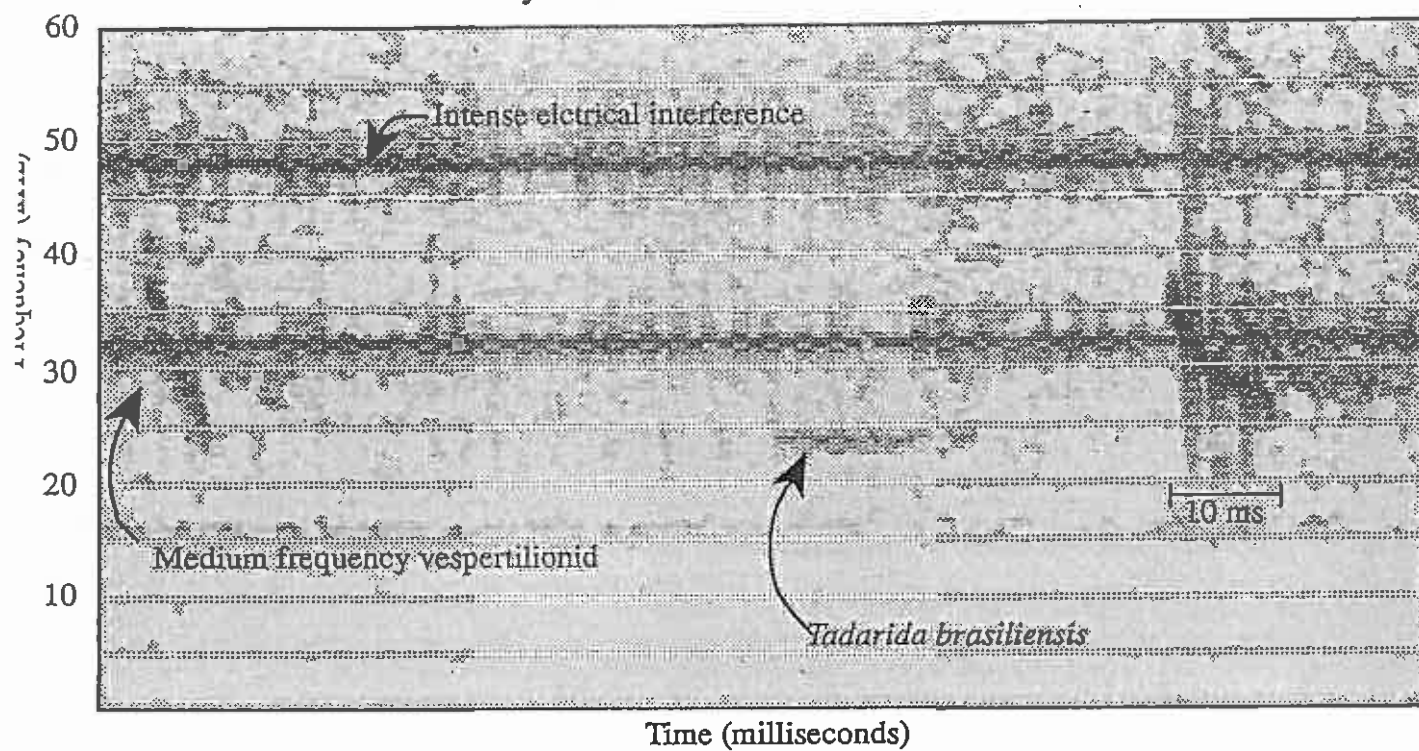


Fig. 1. Echolocation calls for two bat species at Marin Headlands.

Table 1. Bat Species known or expected from Golden Gate National Recreation Area

Family Molossidae

Tadarida brasiliensis (Mexican free-tailed bat) K

Family Vespertilionidae

Antrozous pallidus (pallid bat)¹ E
Eptesicus fuscus (big brown bat) E
Lasionycteris noctivagans (silver haired bat) E
Lasiurus blossevillii (= *borealis*) (red bat) E
Lasiurus cinereus (hoary bat) E
Myotis californicus (California myotis) E
Myotis evotis (long-eared myotis) E
Myotis lucifugus (little brown myotis) E
Myotis thysanodes (fringed myotis) E
Myotis volans (long-legged myotis) E
Myotis yumanensis (Yuma myotis) K
Plecotus townsendii (Townsend's big-eared bat)^{1,2} K

¹ California Department of Fish and Game, Mammal of Special Concern or Sensitive Species

² Candidate (Category 2) for listing under U.S. Endangered Species Act

K = Known (Identified this survey)

E = Expected

Table 2. Structures surveyed for bats at Marin Headlands

Structure	Date	Bats Present	Guano Present	Species	Potential Day Roost	Potential Night Roost	Temp. (Dry/Wet)
Fort Cronkhite							
# 1008	9/8/93	No	Yes	Myotis sp.	Yes	Yes	
# 1016	9/8/93	No	No		No	No	
# 1077 Bldg.	6/28/93	No	Yes	P. townsendii	Yes	Yes	15.75/12.5
# 1130	9/8/93	No	Yes	P. townsendii	Yes	Yes	15.5/14.0
# 1152	9/12/93	No	No		No	No	
# 1180 Bldg.	9/1/93	No	No		No	No	18.0/15.0
# 1183 Bldg.	9/1/93	No	No		No	No	
# 1185 Bldg.	9/1/93	No	No		No	No	
# 1186 Bldg.	9/1/86	No	No		No	Yes	
# 1194 Tower	9/1/93	No	No		No	Yes	
# 1197 Tower	9/1/93	No	No		No	Yes	
# 1260	9/12/93	Yes	Yes	P. townsendii	Yes	Yes	18.0/16.5
# 1272	6/22/93	No	Yes	P. townsendii	Yes	Yes	17.5/13.5
# 1272	9/1/93	No	Yes	P. townsendii	Yes	Yes	18.5/15.0
# 1274	6/22/93	No	No		No	No	
# 1275	6/22/93	No	No		No	No	
F.C. #1	6/22/93	No	No		No	No	
F.C. #2	9/1/93	No	No		No	No	
F.C. #3	9/1/93	No	No		No	No	
F.C. #4	9/1/93	No	No		No	No	
F.C. #5	9/1/93	No	No		No	Yes	18.5/15.0
Battery Townsley S	9/1/93	No	Yes		Yes	Yes	17.0/15.0
Battery Townsley N	9/8/93	No	No	P. townsendii	Yes	Yes	16.5/14.0
Quonset A	6/22/93	No	No		Yes	Yes	
Quonset A	9/1/93	No	No		Yes	Yes	
Quonset B	6/22/93	No	No		Yes	Yes	
Quonset C	6/22/93	Yes	No	P. townsendii	Yes	Yes	22.0/14.5
Quonset C	9/1/93	No	Yes	P. townsendii	Yes	Yes	21.0/16.5
Quonset D	6/22/93	No	No		No	No	
Fort Barry							
# 944 Bldg.	6/22/93	No	Yes	P. townsendii	Yes	Yes	
# 945 Bldg.	6/22/93	No	Yes	P. townsendii	Yes	Yes	
# 946 Bldg.	6/22/93	No	Yes	P. townsendii	Yes	Yes	
# 960 Bldg.	6/22/93	Yes	Yes	P. townsendii	Yes	Yes	
# 961 Bldg.	6/22/93	No	No		No	No	

# 962 Bldg.	6/22/93	No	No		No	No	
# 1358	6/28/93	No	No		No	No	
# 1365	6/28/93	No	No		Yes	Yes	17.0/13.75
Batt. Alexander	6/28/93	No	Yes	Unknown	No	Yes	18.0/14.0
Batt. Hill 129	9/12/93	No	No		No	Yes	
Batt. Mendell	6/28/93	No	No		No	Yes	
Batt. O'Rourke	6/28/93	No	No		No	No	
Batt. Rathbone-McL.	9/12/93	No	No		No	No	
Batt. Smith-Gultrie	6/28/93	No	No		Yes	Yes	15.0/13.0
Batt. Wallace	6/28/93	No	Yes	M. yumanensis	No	Yes	15.0/13.0
Dog Trail West	6/28/93	No	No		Yes	Yes	
F.C. #1	9/12/93	No	No		No	No	
F.C. #2	9/12/93	No	No		No	No	
F.C. #3	9/12/93	No	No		No	No	
Pt. Bonita #1	9/14/93	No	No		No	No	
Pt. Bonita #2	9/14/93	No	No		No	Yes	
Pt. Bonita Cisterns	9/14/93	No	No		Yes	Yes	

Fort Baker

# 433	9/13/93	No	No		Yes	Yes	
# 434	9/13/93	No	No		No	No	
# 570 Bldg.	9/14/93	No	No		Yes	Yes	
# 615 Bldg.	9/14/93	No	No		Yes	Yes	
# 770	9/13/93	No	Yes	Myotis sp.	Yes	Yes	
# 771	9/13/93	No	No		No	No	
# 778	9/13/93	No	No		No	No	
Batt. Cavallo	6/22/93	No	No		No	No	
Batt. Duncan	9/13/93	No	No		Yes	Yes	16.0/14.0
Batt. Kirby	9/12/93	No	No		Yes	Yes	
Batt. Spencer	9/13/93	No	No		No	No	
Batt. Wagner	9/12/93	No	No		Yes	Yes	16.5/14.0
Batt. Yates	9/14/93	No	No		No	No	
Mine Casemate	6/22/93	No	No		Yes	Yes	16.0/15.0
Ridge Battery	9/13/93	No	No		Yes	Yes	

Tennessee Valley

Red House	No	Yes	Myotis sp.	Yes	Yes	
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Appendix 1. Inventory of photographs taken of potential and actual bat roosts at Marin Headlands.

Photo #	Structure	Bats/Bat Sign
<u>Roll #1</u>		
1	#1077, Fort Cronkhite	Yes
2	Battery Wallace	Yes
3	Battery Wallace	Yes
4	Three Sisters	Yes
5	Battery Wallace	Yes
6	Battery Wallace	Yes
7	Battery Mendell	No
8	#1365, Fort Barry	No
9	Bird Rock	N.A.
10	#1358, Fort Barry	No
11	Battery Smith/Guthrie	No
12	Battery Smith/Guthrie	No
13	Battery Smith/Guthrie	No
14	Battery Alexander	Yes
<u>Roll #2</u>		
1	Buried Quonset A	No
2	Buried Quonset C	Yes
3	Buried Quonset A	No
4	F.C. #5, Fort Cronkhite	No
5	F.C. #4, Fort Cronkhite	No
6	F.C. #3, Fort Cronkhite	No
7	#1272, Fort Cronkhite	Yes
8	F.C. #2, Fort Cronkhite	No
9	F.C. #1, Fort Cronkhite	No
10	#1008, Fort Cronkhite	Yes
11	#1130 - Townsley Reserve	Yes
12	#1260, Fort Cronkhite	Yes
13	#1260- P. townsendii	
14	#1260- P. townsendii	
15	#1260- P.townsendii roost	Yes
16	#1152, Fort Cronkhite	No
17	#1180, Fort Cronkhite	No
18	#1183, Fort Cronkhite	No
19	#1185, Fort Cronkhite	No
20	#1186, Fort Cronkhite	No
21	F.C. #2, Fort Barry	No
22	F.C. #1, Fort Barry	No
23	F.C. #3, Fort Barry	No
24	#433, Fort Baker	No

Pierson - Bat Surveys, Marin Headlands

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