

Data Collection Protocol Yuma Bat (*Myotis yumanensis*)

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Introduction

The Yuma bat (*Myotis yumanensis*) is a small species (4.0g to 8.5g) with a gray, brown, or pale tan dorsum and a paler gray or tan venter; the ears, face, and wing membranes are often pale brown to gray (Nagorsen and Brigham 1993). This species can sometimes be confused with the little brown bat (*Myotis lucifugus*).

Why Survey Bats?

Bats make up about one-quarter of the mammalian species and constitute a substantial proportion of the mammalian biological diversity in the United States. For a variety of reasons relating to their natural history and differential vulnerability to some human impacts, an alarming 56 percent of the U.S. bat species were either listed as endangered or were under consideration for listing as of 1997. Bats now have the highest percentage of endangered or candidate species among all land mammals in the United States. Although Tuttle (in Fenton, 1992) remarked "Alarming declines of bat populations are increasingly documented," quantitative information on the population status of US and Canadian bat species is lamentably scarce. Altringham (1998) reported that "there is now considerable evidence that bat populations in many parts of the world are in decline, and that the range of many species has contracted", and Fenton (1998) stated that "habitat destruction is a major threat to the continued survival of many species of bats".

There is substantial evidence that impacted habitats result in smaller species diversity for bats (Fenton 1992), and may also result in much lower numbers for some species (Cumming and Bernard 1997), but less is known about the actual decrease in numbers over time. Furthermore, little focus is placed on bats in California because no bats are federally listed in California. They are frequently ignored in environmental documents such as environmental impact report (EIR)-type mandated inventories. For example, while bat habitats for special-status species are being lost in California, often inadequate or no mitigation is provided through the CEQA (California Environmental Quality Act) process (Johnston, 1999). Bats are more difficult to study than terrestrial small mammals (requiring different experience and specialized equipment), and have been relatively less studied. (Fenton, 1997).

Little is known about bats foraging over estuaries and tidal waters, but there is evidence that they do. Yuma bats forage over permanent streams, rivers and other

aquatic habitats with emerging insects. Dixie Pierson and William Rainey (pers. comm.) believe that some of the highest densities of western red bats (*Lasiurus blossevillii*) occur in the Delta, but data is lacking for bats in the North Bay and Suisun Bay areas. Data is also lacking for the South Bay, but bats observed foraging over Alviso Slough in the South Bay (pers. obs.) were likely Yuma bats. The evidence of hoary bats (*Lasiurus cinereus*) foraging over estuaries in Hawaii (Jacobs 1996) suggests this and other bat species also may forage over the San Francisco Bay estuaries. Although many bat species do not have well-defined foraging niches (Fenton et al. 1992), Dalquest (1947) reported that Yuma bats (*Myotis yumanensis*) foraged primarily over streams, rivers, and lakes. Aldridge (1986) found that Yuma bats fed primarily on midges (Chironomidae) in spring months, and in summer months they fed on mayflies (Ephemeroptera) and caddisflies (Trichoptera).

Surveying bats in the tidal areas of the San Francisco Bay will provide valuable information on the population trends of these lesser-known vertebrates that potentially play important roles in ecosystems. Furthermore, because Yuma bats likely bioaccumulate contaminants and heavy metals, the long term monitoring of Yuma bats could be an invaluable tool to help determine the health of the San Francisco Bay ecosystems.

Why Survey Yuma Bats?

Few longevity records are available for Yuma bats, but records for a closely related species, the little brown bat *Myotis lucifugus*, suggest that they often live in excess of 20 years (Griffin and Hitchcock 1965). Therefore, Yuma bats probably bioaccumulate mercury (Hg) and methylmercury (MeHg), and other heavy metals and contaminants if they forage over waterways with relatively high levels of these compounds. Any long-term trend in numbers could potentially be used as one of several indicators of the "health" of the sloughs or other tidal waters. Although staff at the United States Fish and Wildlife Service (USFWS) in California are using the Red-winged Blackbird (*Agelaius phoeniceus*) as an indicator species in Hg and MeHg contaminant studies, staff at the USFWS in Arizona recently used the Yuma bat for contaminant studies because of the aforementioned reasons (Velasco, unpublished report).

These studies help determine the health of the specific bodies of water that the birds or bats forage over. Coupled with contaminants assays, dietary information can help determine the biological pathways for contaminants (i.e., guano analysis can determine prey eaten by bats to help determine, temporally and qualitatively, the biological sources of contaminants). Because the Yuma bat is also a widespread species in the Bay Area and likely forages over tidal areas, this species is a good candidate to use as an indicator of intact habitats. Because it is relatively long-lived, the Yuma bat is a good tool for monitoring long-term trends in the flow of contaminants through the ecosystem.

Survey Procedures

This protocol encompasses both foraging data collected by acoustic surveying, and roosting data collected by emergence counts. Data are collected at semi-fixed stations at known roosts and foraging sites of Yuma bats that feed over the intertidal zone of the San Francisco Estuary.

Surveys of Bat Roosts

Appropriate survey sites should include tidal marshes and creeks that are within three miles of potential day roosts. Many anthropogenic structures, such as bridges and pump houses, occur along the bay that should be surveyed as potential roosting habitat. In addition, areas along the bay with well-developed riparian systems within three miles of tidal water (e.g., Coyote Creek) should also be surveyed for potential roosting habitat. Tidal areas that are greater than 3 miles from potential roosting sites should be avoided. Whereas Mexican free-tailed bats and other bat species may occur over these areas, Yuma bats are not likely to regularly forage this far from a roost. Potential habitat should be mapped to help estimate total potential numbers of Yuma bats occurring in association with tidal waters.

Sample Universe, Sample Sites, Sample Units

The sample universe comprises areas within 3 miles of tidal sloughs that provide potential roosting habitat.

At a minimum, two permanent roosting sites, of at least 50 individuals each, one in North Bay and one in South Bay, should be chosen for population monitoring. If two such roosting sites are not available, then four summer roosting sites of fewer numbers should be chosen. Sample units will be the number of bats emerging per roost site per night.

Sample Timing and Frequency

All Yuma bat roosts near designated reference areas should be monitored once a year in August, after the maternity season (April 15 -- July 31). Emergence counts of bats that depart nightly from roosts can be one of the most effective ways to estimate the number of bats occupying these sites. Emergence counts should be made repeatedly over several weeks to establish intra-colony variation in the number of bats present (Kunz 1999). For the first 2 years, roosts should be surveyed 4 times before young are volant (maximum adult population) and 4 times after young become volant (adult and young population). After census variation is established, roosts should be surveyed at least once before and once after young are volant. Because bats are relatively long-lived (e.g., little brown bats), populations may need monitoring for 10 years before trends can be reportable. Acoustical Surveys

Acoustic Surveys

Foraging bats emit a steady stream of echolocation calls that aid them in locating and capturing prey. With the appropriate ultrasonic detection equipment, biologists and volunteers are able to detect echolocating bats without interfering with their normal activities. Ultrasonic detectors provide data as “bat passes” per unit time, and often as specific recognizable species. A “bat pass” can be defined as a sequence of two or more echolocation calls registered as a bat passes within range of a microphone. Because detectors do not differentiate among several passes by the same bat and single passes by several bats, there is no simple correlation between passes and the number of bats present. Nor is any means currently known for evaluating this relation to provide access to population density data. Although most genera and many bat species differ in the frequency span, duration or shape of their cruising echolocation calls, the ability of bat detectors to discriminate between closely related taxa will vary with the type of detector and the experience and skill of the observer (Kunz 1999). Closely related species of *Myotis* can be difficult to separate.

The use of a bat detector to survey for bats can be enhanced when used in conjunction with other survey techniques such as capture with mist nets. As the system is available, Sonobat software will be used for acoustic surveying because it provides a higher resolution of sounds that should increase the accuracy of the acoustic data for *Myotis* species. Whereas Anabat uses zero-crossing, SonoBat records high resolution sonograms that facilitates greater qualitative call comparisons.

Equipment

☞☞ An Anabat II bat detector would be used with a ZCA module and Anabat 6 software installed in a DOS computer to monitor the echolocation calls.

☞☞ a macro net (30 m x 6 m) and pole system (Johnston 2000), or smaller mist nets (18 x 3 and 6 x 3) depending upon the situation.

☞☞ A Tuttle trap and hoop nets

Timing and Seasonality

Bats should be monitored from one-half hour after sunset to 01:00 (1 am).

Although activity levels during winter months are expected to be low, bats may be active during any month of the year including some of the warmer winter nights. Therefore surveys should be conducted for four nights per season per station (i.e., 16 samples per year per station). For the first two years, surveys should be done actively, that is, with an experienced bat biologist present to confirm species, as opposed to setting

up remote, unmanned stations. Improving the accuracy of the species identification through acoustic surveying demands that bats are initially captured and recorded. Therefore, in conjunction with acoustic surveying, a macro net (30 m x 6 m) and pole system (Johnston 2000), or smaller mist nets (18 x 3 and 6 x 3) depending upon the situation, should be set to capture and identify bat species at sample locations for the first season. A Tuttle trap and hoop nets would also be used near roosts to increase the capture rate. Bats should be banded for mark and recapture to provide information on the population structure of the colonies (e.g., the age classes).

Sample Universe, Sample Strata, Sample Units

The sample universe is composed of the airspace immediately above third-and forth-order channels, and echolocations are noted in terms of "passes per hour." For acoustic surveys, a minimum of two sample sites should provide 32 sample nights per year.

Personnel

Acoustic and mist net surveying can be accomplished with an experienced bat biologist (as defined by a Memorandum of Understanding with California Department of Fish and Game [CDFG]) and at least one CDFG-approved assistant.

Qualified persons without an MOU from CDFG to handle bats could make emergence surveys and operate and interpret data from unmanned bat detectors after the first two years of surveying. Therefore, at the designated reference sites, an Anabat II bat detector could be used with a ZCA module, delay switch, universal timer, cassette recorder and Anabat 6 software installed in a DOS computer to monitor the echolocation calls of bats for again, no less than four nights per season. At this point, the protocol may be modified to accommodate new information regarding designated reference sites and the timing of the surveys.

Data forms and surveying frequency

The data sheets will be used to record measurements for bats heard or caught during each survey period.

For the bat roost data, fields include the project number, location, ambient temperature, temperature of the roost if possible, habitat type, date and time of observation, observer(s), latitude, longitude, elevation, contact information for observer, species, distance of roost from entrance, date of data entry, county, description of locality, name of roost (if any), quadrangle name for USGS map, total number of bats observed, how observed, roost type, distance to nearest water source, type of water source, roost height, and estimated volume of guano pile.

For the bat netting data, fields include project number, location (latitude, longitude, elevation), ambient temperature, temperature of the roost if possible, habitat

type, date and time of observation, name of observer(s), contact information for observer, species, date of data entry, county, description of locality, quadrangle name for USGS map, how captured (size of net), distance to nearest water source, type of water source. For each individual, species, gender, reproductive status, forearm length, direction of flight, age, presence of parasites, and if guano or tissue samples were taken. . Bats caught in nets stretched across sloughs will be recorded as bats per hour per square meter of net.

Acoustic call sequences will be recorded and saved as digitized data on either the Anabat 6 or the Sonobat computer program. This foraging data will be organized as Yuma bat passes per hour and when appropriate, number of feeding buzzes per hour.

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