



Bat Inventory of Muir Woods National Monument

Importance: *Bats are both economically and ecologically important, providing ecosystem services such as predation of insects and pollination. Muir Woods National Monument (MUWO) contains natural features such as redwoods, Douglas fir, and Redwood Creek, that make suitable roosting and foraging habitat for numerous bat species.*

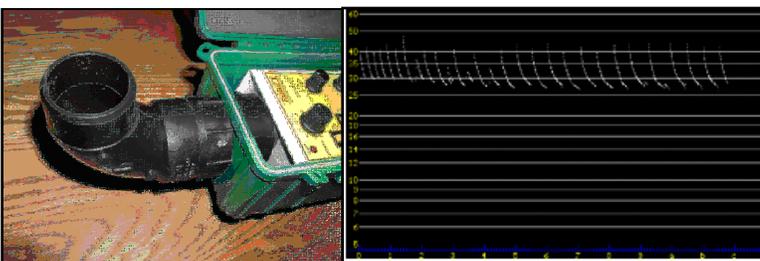
Biodiversity of bats in the United States is relatively low (45 species) compared to other groups of organisms. California's central coast is known to support 17 species, nine of which have special status under state or federal law as they are believed to be at risk. Bats are nocturnal and use inaccessible roost sites, making them difficult to study in the wild. In general, bat populations are declining because of direct and indirect human impacts including destruction of foraging and roosting sites. Most species also have very low reproductive rates, resulting in long recovery periods after population declines. In addition, many populations are constrained by a limited number of specific roosting sites for a large number of individuals. By identifying which species of bats use MUWO and how they use it, inventories of bats at MUWO can help the National Park Service (NPS) manage for the co-existence of bats and human visitors.



Townsend's big-eared bats are among ten bat species found in MUWO.

Inventory Methods: *Between 1999 and 2000, researchers utilized guano trapping, acoustic sampling, mist netting, and radio-tracking to detect bat activity and presence in MUWO.*

Researchers installed 26 guano traps in redwood hollows to identify roosting sites and to compare use between riparian and upland forest. Guano was collected once a month to evaluate seasonal activity and shifts in roost sites. Trees that showed the most use were mist-netted and acoustically monitored. Mist-netting allows researchers to handle animals to confirm species identification and to assess age, sex, and reproductive status. Researchers opened five mist nets for three hours on 24 nights. Researchers also performed acoustic sampling using an Anabat II bat detector system for 33 nights over a 24 month period.



An Anabat bat detector inside a waterproof box and a sample vocalization of a big brown bat with the time between each call removed.

The Anabat system detects ultrasonic echolocation calls and converts them into time/frequency graphs on a computer. These vocal signature graphs can be used to identify bat species by comparing calls recorded during previous mist-netting, calls recorded from bats visually identified at the time of recording, and by comparing calls with existing bat vocal signature library databases. In addition, a pilot radio-tracking project tracked three individual bats for 12 days to monitor day roosts and nightly activity.

Inventory Findings: Researchers identified 10 bat species foraging and/or roosting in MUWO (Table 1).

- Researchers captured nine species in mist nets and also detected the Mexican free-tailed bat acoustically.
- The Long-eared myotis and Pallid bat, known to occur in redwood forest habitat, were not identified in MUWO.
- Hollows in both riparian and upland areas receive regular use by bat species, although in this study bats seemed to select maternity roosts near the stream. This may be a result of particular features of a hollow or proximity to the creek.
- All species except Yuma myotis and hoary bat, notable riparian species, were detected in both riparian and upland habitat.
- Researchers captured silver-haired bats in redwood groves but never in hardwoods.
- Yuma myotis were not captured in the redwoods, although they were acoustically detected. As Yuma myotis are one of the most commonly captured bats in other studies, the low capture rate in MUWO may indicate unusually low numbers of the species in this setting.
- Seasonal distribution of bats differs by species. At least five species are probably year-round residents. Interestingly, two of these year-round species at MUWO, western red bat and silver-haired bat, are migratory in most parts of their range.
- The pilot radio-tracking project revealed that bats most commonly use habitat features associated with old-growth redwoods: bark crevices, anomalous features, and fire-scar hollows. This preliminary data may suggest that bats have more roosting potential in protected old-growth forest than in surrounding second-growth and developed areas.

Table 1. Bat species detected at MUWO during this inventory.

*Federal Species of Concern

**Both Federal and California Species of Concern

^Forest Service Sensitive Species

Common Name	Scientific Name
Yuma myotis	<i>Myotis yumanensis</i> *
Fringed myotis	<i>Myotis thysanodes</i> *
California myotis	<i>Myotis californicus</i>
Long-legged myotis	<i>Myotis volans</i> *
Silver-haired bat	<i>Lasionycteris noctivagans</i>
Big brown bat	<i>Eptesicus fuscus</i>
Western red bat	<i>Lasiurus blossevillii</i> ^
Hoary bat	<i>Lasiurus cinereus</i>
Townsend's big-eared bat	<i>Corynorhinus (=Plecotus) townsendii</i> **^
Mexican free-tailed bat	<i>Tadarida brasiliensis</i>

MUWO supports 10 of the 17 bat species expected to occur in California's central coast. The high species diversity associated with MUWO is unique to protected and ecologically intact areas. MUWO provides suitable habitat for foraging, roosting, and over-wintering species. Protecting large redwood trees in MUWO is the key to protecting bat fauna. The main threats to MUWO bats are human disturbance to maternity roosts and potential prescribed burning of the forest. Burns will likely be beneficial to bat species in the long term by creating new hollows, but researchers recommend surveys of areas prior to burning to reduce the potential for direct harm to bat species during a burn. The co-existence of bats and tourists at MUWO also depends on the continued diligence of staff to keep visitors on trails and away from hollows.

Additional Resources:

Heady, Paul A. and Winifred F. Frick. 2004. Bat Inventory of Muir Woods National Monument Final Report. Central Coast Bat Research Group. Online: <http://science.nature.nps.gov/im/units/sfan/Inventory/FinalInventoryReports/MUWO%20batrpt%20final7.04.pdf>.

Bat species found in other parts of Golden Gate National Recreation Area (of which MUWO is part) include all of those listed here with the exception of long-legged myotis and Townsend's big-eared bat and with the addition of little brown myotis.

Summary written by Alison Williams. For more information contact Marcus Koenen, Inventory and Monitoring Coordinator, National Park Service, San Francisco Bay Area Network, 415-331-5734. See: <http://science.nature.nps.gov/im/units/sfan/index.cfm>.