

# Endangered Species UPDATE

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# Diversity and Conservation of Bats In North America

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After years of neglect, fostered by misunderstanding and outright persecution, bats are finally being acknowledged as important components of biological diversity. In turn, there is increasing concern about their conservation status. This awakening of public interest and concern is coming none too soon, as many species of bats are widely believed to be imperiled by human actions.

Among mammals, bats are the second most diverse order (after rodents) and occur on all continents except for Antarctica (Kunz and Pierson 1994). Of the estimated 44 species living in the United States and Canada (North America as defined here; Jones et al. 1992), four species plus two subspecies of a fifth species are federally endangered, and at least 19 species, in whole or part, have been listed as federal Species of Concern (former

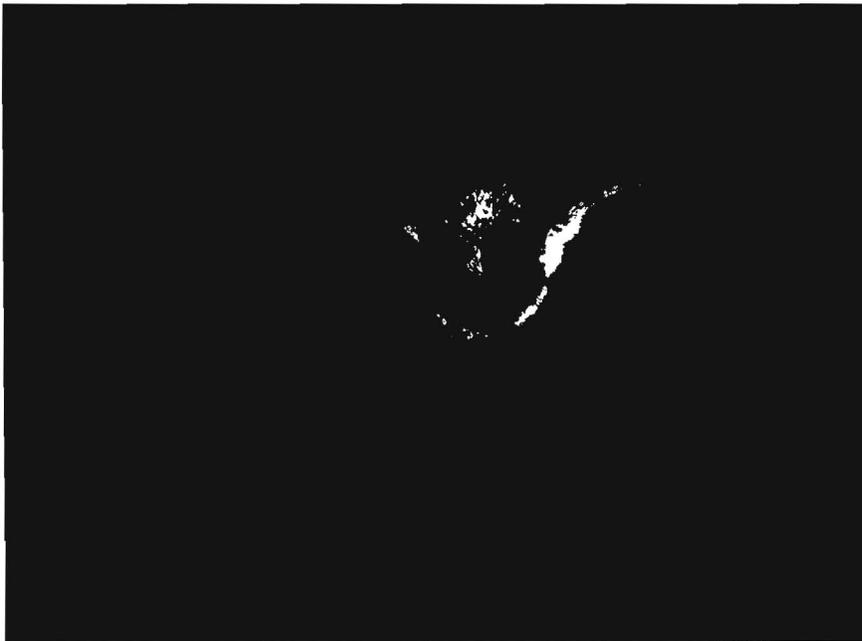
Category 2 Candidate Species; Fish and Wildlife Service 1994a). Bats face multiple threats of ignorance, suspicion, pesticide poisoning, roost destruction and closure, habitat loss, over-exploitation, and outright extermination. Cole et al. (1994) estimate that for bats worldwide, 1% (10 species) became extinct in the last 500 years, 3% are now endangered, 2% are vulnerable, 50% have stable population levels, and no assessment is possible for the remainder. This lack of information on status and trends of bat populations severely hampers our ability to develop meaningful management and conservation plans for bats.

In the last 40 years or so, our understanding of bat biology has grown enormously. Much of this growth has been furthered, if not actually precipitated, by new techniques

for the study of bats (e.g., Kunz 1988). Even the now-standard use of bird "mist" nets for capture and examination of free-flying bats is relatively recent. More recently, a variety of methods have emerged that allow us to "hear" bats by use of ultrasonic detectors, to "see" them with the aid of night-vision equipment, to study foraging and flight paths by applying small capsules of luminescent chemicals, and to track them by using miniaturized radio transmitters. These new methods are providing greatly enhanced details of the life history of bats, including information on roosting habits, which are critical to bat survival.

## Bat Diversity in North America

Most species of North American bats are insectivorous, have only one young per year in early summer, and hibernate during the winter (Barbour and Davis 1969). A few species are dependent on nectar and pollen for food, and several species undertake moderately long autumnal migrations to the south where their food resources are available in winter. Many bats roost in natural situations such as trees, rock crevices, and caves, but many also use buildings, bridges, and mines. Bats forage for food after darkness falls, in cities and towns and over fields and lakes. We often see them swooping around lights where they exploit dense clouds of insects that are attracted to the lights. Average life span for most North American bats is in the range of 5-10 years, and some have lived as long as 30 years (Hill and Smith



Long-legged myotis (*Myotis volans*) drinking over a pool of water. Photograph by J. S. Altenbach.

1984). They truly are not like rodents, with which they are frequently compared, and which are short-lived and reproduce prolifically. Bats seem to have evolved as moderately long-lived, intelligent creatures with a low reproductive potential and specialized senses, such as echolocation, that allow them to exploit the resources of the night.

Bats in North America belong to four different families: Mormoopidae, Phyllostomidae, Vespertilionidae, and Molossidae. The Mormoopidae are represented by a single species, the ghost-faced bat (*Mormoops megalophylla*), which is found in extreme southern Arizona and southern Texas (Hall 1981).

The Phyllostomidae, often called New World leaf-nosed bats, has five species that are known north of Mexico, at least seasonally. Three of these species are dependent on nectar and pollen. Two of these species, the Southern long-nosed bat (*Leptonycteris curasoae*) and Mexican long-nosed bat (*L. nivalis*), are categorized as Endangered by the Fish and Wildlife Service (1996). Both species enter the extreme southern United States in Arizona and New Mexico; the Mexican long-nosed bat also is found in the Big Bend region of Texas. There is little information on status and trends of the third nectarivore, the Mexican long-tongued bat (*Choeronycteris mexicana*), which is known (in the U.S.) from southern California, Nevada, Arizona, New Mexico, and the southern tip of Texas. It is a Species of Concern. The California leaf-nosed bat (*Macrotus californicus*), also a Species of Concern, occurs in southern Arizona, California, and extreme southern Nevada (Hall 1981). In the United States the California leaf-nosed bat occupies arid regions and depends on large night-flying insects (e.g., grasshoppers, katydids, dragonflies, moths, and beetles) for food (Ross 1967). Finally, there is a single enigmatic record of one of the three true vampires, the hairy-legged vampire (*Diphylla ecaudata*), from the Big Bend area of Texas. A solitary individual was found

in an abandoned railroad tunnel in Val Verde County in 1967 (Schmidly 1991).

The most diverse family of North American bats, in terms of species, is the Vespertilionidae. At least 32 species of this family (with about 300 species worldwide) occur in North America. Vespertilionidae includes most of the bats with which humans come in contact. The typical vespertilionid is small- to medium-sized, dark brown in color, insectivorous, and hibernates in the winter. The common big and little brown bats (*Eptesicus fuscus* and *Myotis lucifugus*) are typical representatives of this family. However, the family includes several larger species, including some that migrate to Central America, and several of the species are strikingly colored. *Myotis* is the most diverse genus and comprises at least 15 species in the United States. Many bats among the *Myotis* are aerial insectivores and capture insects in open spaces, others appear to be adapted to forage in more closed spaces, in and around vegetation, and some seem to prefer foraging over bodies of water, often exploiting hatches of insects emerging from water.

Other North American vespertilionids include Eastern and Western pipistrelles (*Pipistrellus subflavus* and *P. hesperus*) the smallest bats on the continent; seven species of large, tree-dwelling, migratory hoary and red bats and their relatives (*Lasiurus* spp.); four species of long-eared bats of the genus *Plecotus* (or *Corynorhinus*), *Idionycteris*, and *Euderma*; the pallid bat (*Antrozous pallidus*), which often feeds on terrestrial arthropods such as scorpions and centipedes; and the evening bat (*Nycticeius humeralis*) of the south-central U. S. With its large pinkish ears and striking white spots on a black background, the spotted bat (*Euderma maculatum*) is arguably the most attractive species of bat in North America.

Endangered vespertilionids in the U.S. (Fish and Wildlife Service 1994b) include two races or subspecies of

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*Cover:* Pallid bat (*Antrozous pallidus*) capturing a large desert centipede. Photograph by J. S. Altenbach.

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Townsend's big-eared Bat (*P. townsendii ingens* and *P. t. virginianus*), Indiana bat (*M. sodalis*), and gray bat (*M. grisescens*). The Hawaiian hoary bat (*Lasiurus cinereus semotus*) also is listed as federally endangered. In 1994 the Fish and Wildlife Service (1994b) listed an additional 14 taxa (species or subspecies), mostly *Myotis* or *Plecotus* (and its relatives) as Category 2 Candidate Species. Thus, at most sites in the United States where one encounters bats, probably half or more of the vesperilionid species are formally listed as Endangered or as Species of Concern.

The fourth family of bats occurring in the U. S. and Canada is the Molossidae, or free-tailed bats. Six species of molossids are known from North America. The most common is the Brazilian free-tailed bat (*Tadarida brasiliensis*), best known from Carlsbad Cave, New Mexico. This species historically formed huge roosting colonies numbering millions of bats across Texas, New Mexico, and Arizona. For example, as late as 1963 up to 30,000,000 Brazilian free-tailed bats roosted in Eagle Creek Cave, Arizona; within six years colony numbers were reduced to about 30,000 (Tuttle 1988), apparently by human vandalism and disturbance in the cave. This species currently reaches its largest aggregations in Texas, on the Edwards Plateau, where large colonies still exist (Schmidly 1991). Other North American molossids include the pocketed free-tailed bat (*Nyctinomops femorosaccus*) and the big free-tailed bat (*N. macrotis*) as well as three species of mastiff bats (*Eumops*). For the most part these species occur along the U.S.-Mexico border, although the big free-tailed bat is more widespread. Among North American molossids, all three species of *Eumops* and *Nyctinomops macrotis* were listed as Category 2 Candidate Species. All these

molossids have long, narrow wings and are capable of flying great distances. Most of these species migrate to the south in the winter but there are non-migratory populations of *T. brasiliensis* in California and across the southern sunbelt states.

### Threats to North American Bats

It is generally believed that bat populations have declined in recent decades in the United States and elsewhere (Kunz and Pierson 1994). Because bats have low reproductive rates and long generation times, and gather in large, vulnerable aggregations including significant portions of entire regional populations, they are very susceptible to elevated mortality or depressed recruitment. Disturbance to roost sites, vandalism, and habitat change have contributed to declines in populations of some species (Gillette and Kimbrough 1970). Contaminants have also played a role in bat declines (Clark et al. 1978, Clark 1981), and Pacific Island populations of some species have been severely affected because of their use as a human dietary item (Wiles and Payne 1986). Habitat modifications such as

urbanization, agriculture, and other land use practices may affect local insect populations and thus food resources of bats.

The five species of endangered North American bats roost in caves and owe their current plight to disturbance while in the roost and destruction or closure of roost sites (Kunz and Pierson 1994). For cavern-dwelling bats in North America, roosts are critical at two times of the year: in the summer when females often form large maternity colonies where they give birth and nurse the young; and in winter when the bats (both sexes) use caves as hibernating sites. Even if the disturbance is accidental, it can be life-threatening for bats, who enter hibernation with a finite energy reserve in the form of stored fat. Every disturbance that arouses a bat from hibernation consumes a portion of that stored energy. Frequent disturbances may result in bats being forced from hibernation before adequate insect resources are available to sustain them. Recognition of the importance of such roosts, followed by the development of gates that are "bat-friendly" but impervious to humans, have allowed some bat populations to begin to



Spotted bat (*Euderma maculatum*) captured at a site in northern Colorado. Photograph by L. Riedel.

recover from previous population lows.

Whether due to disturbance of roosts in caves or simply because of opportunistic exploitation, bats also form large colonies in abandoned mines. Due to the human safety hazard that abandoned mines represent there are active programs, many supported by state and federal funds, to close such mines. Hundreds, if not thousands, of these mines have been closed with no assessment of seasonal use by bats. Such closures, often involving the total sealing of a mine entrance, likely represent the primary threat to bats in some areas of the U.S. Fortunately, this situation is slowly changing and rigorous conservation programs are underway in several states, including Colorado (Kirk Navo, Colorado Division of Wildlife, personal communication) and New Mexico (J. Scott Altenbach, University of New Mexico, personal communication). Surveys for bats and bat sign should be done at different times of the year and if evidence of significant use is found the mine can be closed with a gate that allows bats, but not humans, to enter. Sheffield et al. (1992) have provided additional guidelines for the protection of bat roosts.

More recently, and with the aid of miniaturized radio transmitters, we have begun to learn the extent to which many species of bats depend on crevices and cavities in mature trees and snags in forests (for example, see Horst 1995). It appears that males of many species may roost solitarily within cavities or under the bark of trees, but females frequently form maternity colonies in tree cavities. Forest-management practices should strive to preserve some significant portion of mature, senescent, and dead trees. Even-aged stand management in which all old and dead trees are removed may result in a near-total loss of roosting habitat for forest-dwelling bats.

Bats also frequent human dwellings where they can present a challenging management situation. Bat colonies in buildings, especially historic structures, pose problems rang-

ing from the merely aesthetic (stains and odors) to potential degradation of the structure. Bat experts should be consulted in such cases for information on non-lethal methods of exclusion, as the use of poisons to remove bats also may be harmful to humans.

### **The Need for Information**

Conservationists and researchers specializing in bats have drawn attention to a need to develop bat inventory and monitoring programs nationwide, and considerable activity related to bat monitoring and conservation is developing at the state level. For many bat species we still do not have adequate information on distribution and occurrence and thus baseline surveys are necessary. For the great majority of the Species of Concern (former FWS Category 2 Candidate Species) we have little information on whether these species are actually declining and, if so, what the cause is. Thus, we have little or no guidance on the management or conservation actions that should be taken to protect bat species. It is particularly critical to begin to assemble information on the status of existing colonies of bats and on population trends. Site- and species-specific data may help avoid controversies about the status of species that can arise as a result of decisions based on incomplete information (e.g., Cockrum and Petryszyn 1991).

### **Bat Interest Groups Reflect Growing Public Concern**

For many years, the only "bat group" in North America was the North American Symposium on Bat Research. This informal but committed group, composed primarily of professional bat researchers, has held annual meetings since 1971 to report research findings and publishes a quarterly newsletter entitled *Bat Research News*. The preeminent bat conservation group in North America, and perhaps the world, is Bat Conservation International (BCI, P.O. Box 162603, Austin, TX 78716). Formed in 1982

by Dr. Merlin Tuttle, this organization has been a leader in providing educational material on bats to the public (e.g., Tuttle 1988), addressing threats and concerns facing bats, helping to develop conservation plans, and in helping to halt actions that are detrimental to bat populations. BCI publishes a newsmagazine called *Bats* that provides current information worldwide on bats and bat conservation. In recent years, organizations focused primarily on local concerns have been formed in several states. There also is now an electronic list server called Batline, from the University of New Mexico, for the exchange of information on bats.

### **Current Efforts by the National Biological Service**

The National Biological Service (NBS), soon to be merged with the U.S. Geological Survey, works with others to provide the scientific understanding and technologies needed to support the sound management and conservation of the nation's biological resources. Recognizing the increasing concern for bat conservation, the NBS has moved forward with several initiatives to help in addressing problems faced by bats. In 1995 the NBS sponsored a joint initiative of Bat Conservation International and the former U.S. Bureau of Mines to develop a Geographic Information System (GIS)-based analysis on the overlap of distribution ranges of 15 bat Species of Concern that were dependent at least in part on abandoned mines for roosts. The GIS also included locations of thousands of abandoned underground mine sites from the Bureau of Mine's mine location data system. The combined database produced maps showing areas of maximum overlap in numbers of bat species and mine locations throughout the United States. As various agencies embark on mine closure programs due to safety concerns, such information can help target regions for greater on-the-ground investigation and possible alternatives to closure, such as installing specialized gates that allow

*(Bats continued on UPDATE p. 14)*

(Bats continued from UPDATE p. 4)

access by bats but exclude humans. Additionally, expansion of new open pit operations in historic mining districts could reduce the availability of underground roosts in areas of high bat use, and identification of such regions with the GIS can facilitate experimentation with alternative artificial roosts in cooperation with the mining industry.

As part of its Species-at-Risk program, the NBS provided support in 1995 for a collaborative project to document bat biodiversity and habitat use in mature bottomland hardwood forests of North and South Carolina. Cooperators included the North Carolina Museum of Natural Sciences, North Carolina Natural Heritage Program, the Audubon Society, and The Nature Conservancy. The project focuses in particular on determining the relationship of foraging and roosting needs for the Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and the Southeastern Myotis (*Myotis austroriparius*), with emphasis on the Roanoke River Basin in North Carolina and the Francis Beidler Forest in South Carolina.

Finally, the Midcontinent Ecological Science Center of NBS has several ongoing studies examining aspects of bat distribution, ecology, roosting habits, and status and trends. In 1995 the center began an effort to investigate the feasibility of establishing a national bat status and trends program through the use of existing data on bat populations. This project will assemble records on colony size and other population-related data for all species of bats in the U.S. and its territories. This database will consist of published information, museum records, unpublished data supplied by biologists and others with such interests, and databases maintained by state and federal agencies and other organizations. These data will be analyzed for their ability to determine overall trends for a potential nationwide monitoring effort, and will provide recommendations for the design of future coordinated efforts in a final report summarizing what is known about the status of bat populations in the U.S.

We are interested in hearing from readers who can provide records on bat colony sizes for this database and analysis. For further information, please contact the principal investigators via e-mail (MBogan@unm.edu, Tom\_O'Shea@nbs.gov, or Laura\_Ellison@nbs.gov) or in writing (see addresses below).

Bats currently face severe and multiple threats to their continued existence, both in the U. S. and elsewhere. However, through refinements in technology and well-designed research and monitoring programs, coupled with the increasing number of people concerned about bats, many of the answers we need to begin developing meaningful conservation and recovery plans are becoming available. For many species, we know what needs to be done to conserve bat populations. What is needed is a mutual agreement that bats, and the ecosystems of which they are a part, are worth saving. That commitment, plus a willingness to share knowledge, overcome institutional barriers, and reach objective rational compromises, will help ensure that bats remain a functional part of worldwide ecosystems.

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