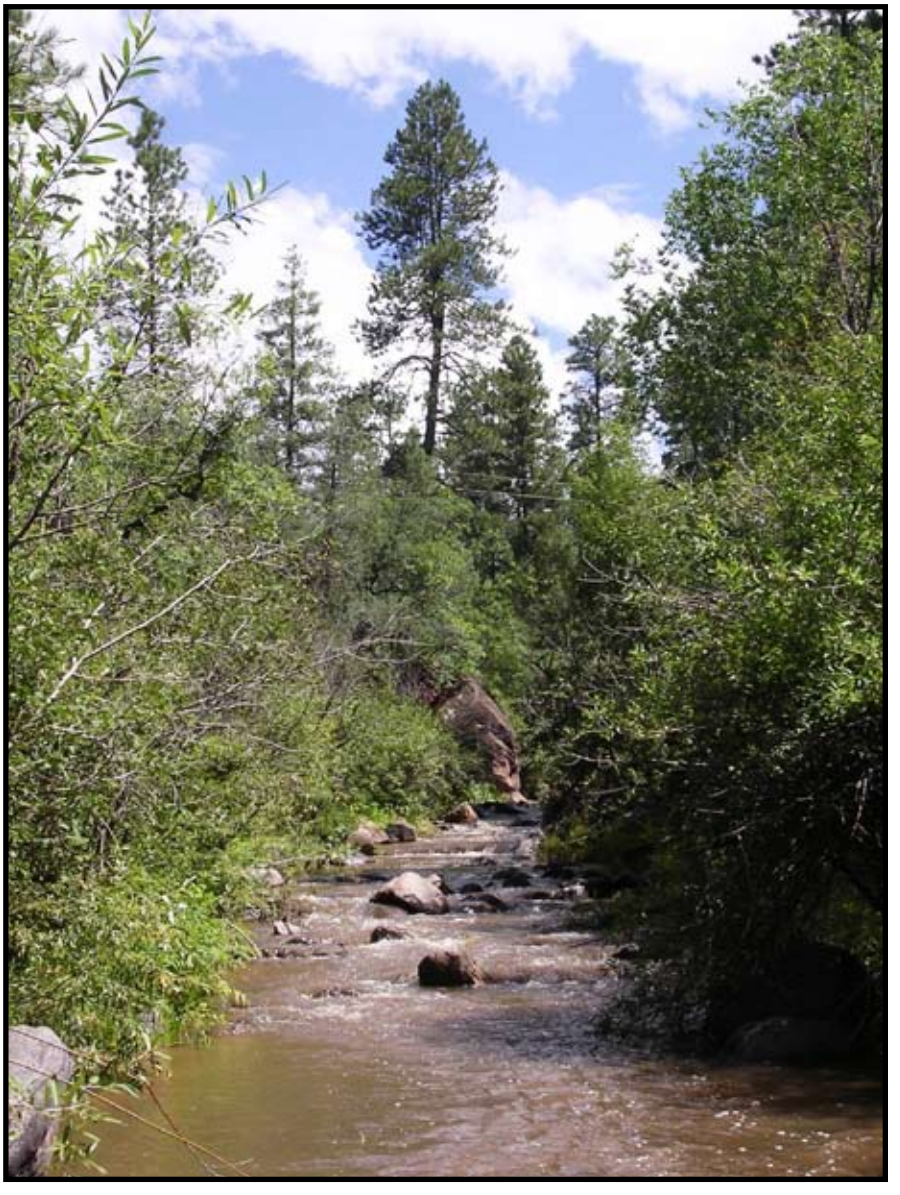
Technical Supplement 3D

Overview of United States Bats



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Cover photo: Bats contribute to the overall health of riparian ecosystems.

Advisory Note

Techniques and approaches contained in this handbook are not all-inclusive, nor universally applicable. Designing stream restorations requires appropriate training and experience, especially to identify conditions where various approaches, tools, and techniques are most applicable, as well as their limitations for design. Note also that product names are included only to show type and availability and do not constitute endorsement for their specific use.

Technical Supplement 3D

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Contents

Tables

Figures

Technical Supplement 3D

Overview of United States Bats

Introduction

In the past, bats (order *Chiroptera*) have been one of the most feared and misunderstood creatures (fig. TS3D–1). Today, as researchers are beginning to unravel the secrets of the world's only flying mammals, bats are declining worldwide. Misconceptions and folklore concerning bats have been passed along for generations, and unfortunately, this has led to the senseless killing of colonies of millions of bats, sometimes in a single destructive act. Most bats only produce one pup a year; therefore, recolonizing a decimated population and replenishing a once occupied cave may take decades. With thanks to extensive conservation and education, bats are making a comeback both in the United States and worldwide.

The diversity of bat species, the habitats they occupy, and their behavioral and social features are impressive (Fenton 1997). Occurring worldwide except for the Polar regions and a few isolated islands, there are more than a thousand known bat species, and this number continues to increase (Mickleburgh, Hutson, and Racey 2002; Engstrom and Reid 2003). Some species, such as Mexican free-tailed bats (*Tadarida brasiliensis*), undertake extensive seasonal migrations. Other species migrate for food, such as the long-nosed bats (*Leptonycteris* spp.) and the Mexican long-tongued bat (*Choeronycteris mexicana*), which are thought to travel along nectar corridors. Species such as endangered gray bats (*Myotis grisescens*) and Indiana bats (*M. sodalis*) migrate more locally between summer roosts and winter hibernacula. Elevational migration routes may also occur. They are thought to be a strategy of the spotted bat (*Euderma maculatum*), which lives in southwestern regions.

Figure TS3D–1 Southeastern bat (*Myotis austroriparius*)

Bats have an extraordinary dietary diversity. Different species feed specifically on insects, fish, frogs, blood, fruit, or nectar. In the United States, bats are voracious feeders on night-flying insects, and three species of nectar/pollen feeding bats live in the extreme southern regions bordering Mexico. Insectivorous species typically consume more than 50 percent of their body weight in bugs nightly (Harvey, Altenbach, and Best 1999). Consider the 20 million Mexican free-tail bats from Bracken Cave, Texas, the largest concentration of mammals in the world. They devour approximately 200 tons of pests a night. Only 150 big brown bats (*Eptesicus fuscus*) are required to protect farmers from 33 million corn rootworms (*Diabrotica* spp.) each summer Bat Conservation International (BCI) 2000. The pollinating species of bats in the Southwest is important for the survival of agaves and columnar cacti. The beneficial and economical role bats play for humans and ecosystems is clear.

Habitat

An increased availability of roost diversity usually corresponds to an increased population and diversity of bat species (Findley 1995). Cave bats or forest-dwelling species are generally colonial species that roost in caves, crevices, hollow trees, or under loose bark. The Indiana bat, for example, uses caves for hibernation during the winter months and tree cavities or beneath exfoliating bark of various trees in the summer (Kurta et al. 1992). Some cavity dwelling species will also use manmade structures such as mines, bridges, culverts, and bat houses (fig. TS3D–2). Several suitable roosts

in an area may provide a colony of bats with the necessary thermal variation required throughout the day and allow escape from parasites or predators (Lewis 1995).

Tree bat species typically roost solitarily or in small groups in foliage or moss at different canopy levels. Young red bats (*Lasiurus borealis*), for example, have been observed roosting higher in trees than adults (Constantine 1966). Studies have suggested that female and male bats use different habitats and roosting sites (Brigham 1991; Cryan, Bogan, and Altenbach 2000). Findley (1995) suggests that differences in morphology, flight maneuverability, and echolocation proficiency affect partitioning of foraging and roosting habitat between species. Thus, species, age, sex, reproductive condition, or migratory status may account for differences in roost and habitat selection among bats. Overall, a diverse landscape and forest stratification with a multifaceted arrangement of potential roosting and foraging areas, even in suburban areas, appears to be important for healthy bat populations (Evelyn, Stiles, and Young 2004).

Since fresh water is critical to their survival, bats are closely associated with riparian environments (Martin 2001) (fig. TS3D–3). Riparian areas are of particular importance to bats, possibly due to their high resource of flying insects (Barclay 1991), especially for species in arid regions (Bell 1980).

Riparian areas also offer an abundance of snags, which are important roosting sites for many species of bats. Tuttle (1976) suggests that roost selection may be determined by proximity to required resources such as water, forage areas, and hibernation sites, thus, reducing energy expenditure by reducing travel distance. For example, there is a decreased growth rate and higher mortality rate among juvenile gray bats where greater distance is traveled from roosting sites (caves) to their preferred foraging habitat, which is over water. Research also suggests that riparian zones act as important travel corridors, space for open flight, and forest edges which are frequently used for feeding and migration by some bat species (Wunder and Carey 1994).

Status and impacts

Of the 45 species of bats that occur in the continental United States and Hawaii, 6 species are considered to be federally endangered and 20 are species of concern (Harvey, Altenbach, and Best 1999). The International Union for Conservation of Nature and Natural Resources lists 10 bat species on the Red List of Threatened Species (IUCN 2002) (table TS3D–1). Species of concern, former category 2 candidates, are those sensitive species in which data pertaining to biological vulnerability and threat is not yet available to justify a

Figure TS3D–2 Maternal colony of Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) roosting beneath a concrete bridge

Figure TS3D–3 Healthy riparian areas are important to bats for roosting and foraging

threatened or endangered status. Due to their nocturnal behavior, capability of flight, and the frequent remote location of their roosts, bats are one of the most difficult groups to research and to monitor. Although many species of bats in the United States appear to be declining, little is known about the populations and ecology for many species (Arnett 2003; O'Shea, Bogan, and Ellison 2003).

Intentional killing, vandalism, cave exploration and commercialization, and closure of abandoned mine entrances have greatly reduced roosting habitat for many bat species in the United States (Harvey, Altenbach, and Best 1999). Disturbance to hibernating bats can be detrimental due to the potential loss of needed energy reserves, which must last until summer emergence. Endangered gray bats, for example, are especially vulnerable since 95 percent of the population hibernate in only 11 caves in the Southeast (Harvey, Altenbach, and Best 2001). Disturbance to maternal colonies when newborn are present may also be injurious to bats since frightened mothers may drop their young or abandon the roost (Harvey et al. 1999). Natural disasters such as flooding can also effect populations, but human disturbance is the primary cause of their decline.

Loss of healthy riparian systems, especially in the southwest where permanent water sources are in decline, also negatively impact bat populations. Use of pesticides and other toxicants may contaminate water and food sources, and the loss of mature trees and snags may limit roost availability. Other causes of decline may include clearcutting, strip mining, and human encroachment into dwindling habitats (Martin 2000).

Conservation

Fortunately, a greater understanding of these beneficial creatures has led to great strides in their conservation. For example, protection of caves and mines through properly designed gates has shown considerable success for endangered and sensitive species (Tuttle 1977; Tuttle and Taylor 1998) (fig. TS3D–4). Placement of artificial roosts in roost-deficient areas or where colonies have been evicted from homes or buildings has also been valuable to various bat species. Burke (1999), Brittingham and Williams (2000), and Arnett and Hayes (2000) attracted bats to flat-bottomed bridges by installing specially constructed bat boxes. Continued research, innovation, management, and education have been, and will be, critical for the future of this unique group of animals.

Nonprofit organizations such as BCI have been educating people, advancing research efforts, and establishing collaboration efforts around the world for 20 years. The North American Bat Conservation Partnership (NABCP) was established in 1999 to support continentwide conservation efforts. They formed an alliance of working groups, researchers, nongovernmental organizations, and state and Federal agencies from Canada, the United States, and Mexico. This partnership has identified conservation priorities through a strategic plan, which will guide the future direction of research, education, and management (Keeley, Fenton, and Arnett 2003).

Another collaboration, the Program for the Conservation of Migratory Bats between Mexico and the United States (PCMM), was developed in 1995 due to declining bat populations in Mexico. Its objectives are to protect and conserve migratory species and to sustain their ecological roles and evolutionary processes (Medellin 2003). Partnerships and collaboration efforts such as these have demonstrated their important role in curtailing the rapid decline of bats in the United States and worldwide.

Figure TS3D–4 Sauta Cave National Wildlife Refuge serves as critical protected habitat for gray and Indiana bats.

Table TS3D–1 General habitat, distribution, and status of federally protected bat species in the United States

Species	Status		U.S. distribution	General habitat
	USFW	IUCN		
Phyllostomatidae				
California leaf-nosed bat (*Macrotus californicus*)	SOC	VU	Southern CA, AZ extending into the southern tip of NV, and the extreme western portion of NM	Lowland desert habitat; abandoned mine tunnels may be used as day roosts and night roosts may include buildings, bridges, porches, or rock shelters
Mexican long-tongued bat (*Choeronycteris mexicana*)	SOC	LR/nt	Southern portion of CA, AZ, and southern tip of NM	Occupies a range of habitats from arid thorn shrub to tropical deciduous forest and mixed oak conifer; inhabits caves, buildings, and abandoned mines
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	FE	VU	South central and south eastern part of AZ and the extreme southern region of Mexico	Desert-scrub habitat; occupies abandoned mines and caves in areas consisting of agaves, yuccas, saguaros, and organ pipe cacti
Greater long-nosed bat (*Leptonycteris nivalis*)	FE	EN	Big Bend region of TX	Occupies a range of habitats from sparsely vegetated deserts to pine-oak woodlands; generally inhabits deep caverns, but will use hollow trees, mines, culverts, and buildings
Vespertilionidae				
Spotted bat (*Euderma maculatum*)	SOC	—	West central U.S.	Mostly occupies rocky arid to semiarid terrain such as desert, scrub areas, or ponderosa pine forest
Allen's big-eared bat (*Idionycteris phyllotis*)	SOC	—	Extreme southern NV, southern third of UT, throughout AZ, and the southwestern quarter of NM	Riparian habitats above 3,000 feet; common in coniferous forests and pine-oak forest canyons; maternity colonies of 30 to 150 individuals have been found in mine shafts, boulder piles, lava beds, and under bark of large ponderosa pine snags
Hawaiian hoary bat (*Lasiurus cinereus semotus*)	FE	—	Hawaiian Islands: Kauai, Oahu, Maui, and Hawaii	Coastal and lowland forested areas; on Kauai, occurs primarily in open wet areas near forests; roosts in trees or rock crevices
Southeastern bat (*Myotis austroriparius*)	SOC	—	Wide spread distribution in the Southeast	Roost primarily in caves in the North and in the South will utilize buildings, bridges, hollow trees; maternity colonies have been located mainly in caves and hardwood swamp areas
Western small-footed bat (*Myotis ciliolabrum*)	SOC	—	Western U.S.	Arid habitats associated with cliffs, talus fields, prairies; roosts in crevices, clay banks, beneath rocks in the ground, and under bark in barns; hibernates in caves and mines
Western long-eared bat (*Myotis evotis*)	SOC	—	Western U.S.	Coniferous forests, typically only at higher elevations in southern areas (between 7,000 and 8,500 feet) and semiarid shrublands, sage, chaparral, and agricultural areas; roost in tree cavities, beneath exfoliating bark of both living trees and dead snags., buildings, cliffs, and sink holes; pregnant bats often roost at ground level in rock crevices, fallen logs, and in the crevices of sawed-off stumps

Table TS3D–1 General habitat, distribution, and status of federally protected bat species in the United States—Continued

Species	Status		U.S. distribution	General habitat
	USFW	IUCN		
Gray bat (*Myotis grisescens*)	FE	EN	Cave regions of AR, MO, KY, TN, and AL	Year-round cave residents although different caves are utilized for winter and summer; hibernation sites are typically deep caves with large rooms capable of trapping cold air; maternal caves usually contain streams with configurations capable of trapping heat
Eastern small-footed bat (*Myotis leibii*)	SOC	—	Eastern U.S.	Hibernate in caves and mines often near entrances, cracks in the floor, and under rock slabs in quarries; use caves, buildings, and barns in summer
Arizona bat (*Myotis lucifugus occultus*)	SOC	—	Southwestern U.S.	Ponderosa pine, oak woodlands, riparian forest in desert areas; roosts buildings, crevices, bridges, rarely in mines
Indiana bat (*Myotis sodalis*)	FE	EN	Cave regions in the Eastern U.S.	Caves used in winter and maternal colonies inhabit hollow trees or under exfoliating bark usually in floodplain deciduous forests or upland stands adjacent to riparian or floodplain forests; generally several suitable trees are required for roost switching
Fringed bat (*Myotis thysanodes*)	SOC	—	Western U.S.	Oak and pinion woodlands most common, also ranges from fir-pine areas to desert-scrub; roosts in caves, mines, and buildings
Cave bat (*Myotis velifer*)	SOC	—	Southern KS, western OK, and the southwestern states	Cave regions from south central Kansas to central Texas, rocky canyons, and desert flood plains; summer roosting sites include caves, mines, and sometimes buildings and under bridges
Long-legged bat (*Myotis volans*)	SOC	—	Western U.S.	Forested mountainous regions usually at elevations of 4,000 to 9,000 feet most common, also stream arid and streamside environments; caves and mine tunnels used in winter, summer roosts are tree cavities, crevices and under bark, rock and stream bank crevices, and buildings
Yuma bat (*Myotis yumanensis*)	SOC	—	Western U.S.	Variety of habitats with a nearby permanent water source; most often roost in buildings or bridges, sometimes in mines or caves, bachelors sometimes use abandoned cliff swallow nests
Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)	SOC	VU	Southeastern U.S.	Historical distribution similar to that of cypress swamps; northern populations hibernate in caves and mines and more southern populations use cisterns or wells, maternal colonies utilize large hollow trees, abandoned homes and buildings, and bridges
Virginia big-eared bat (*Corynorhinus townsendii virginianus*)	FE	VU*	KY, NC, VA, WV	Limestone karst regions associated with mature hardwood forests; uses caves and abandoned mines as both summer maternity roosts and winter hibernacula, rock shelters
Ozark big-eared bat (*Corynorhinus townsendii ingens*)	FE	VU*	AR, OK, possibly MO	Limestone karst regions associated with mature hardwood forests; uses caves and abandoned mines as both summer maternity roosts and winter hibernacula

Table TS3D–1 General habitat, distribution, and status of federally protected bat species in the United States—Continued

Species	Status		U.S. distribution	General habitat
	USFW	IUCN		
Western big-eared bat (*Corynorhinus townsendii pallescens*)	SOC	VU*	Along the west coast	Roosts include abandoned buildings, bridges, and tunnels
Townsend's (Pacific) big-eared bat (*Corynorhinus townsendii*)	SOC	VU*	Western U.S.	Roosts include abandoned buildings, bridges, and tunnels
Molossidae				
Florida mastiff bat (*Eumops glaucinus floridanus*)	SOC	—	Southern tip of FL	Hardwood hammocks
Western mastiff bat (*Eumops perotis californicus*)	SOC	—	Southwest U.S.	Areas with natural springs; roosts in crevices high in cliffs
Underwood's mastiff bat (*Eumops underwoodi*)	SOC	LRnt	South central AZ	Organ Pipe Cactus National Monument, Baboquivari Mountains; roosts in woodpecker cavities within saguaro cacti
Big free-tailed bat (*Nyctinomops macrotis*)	SOC	—	Southwest U.S.	Rocky habitats; roosts in crevices in cliffs, known to use buildings
Mexican free-tailed bat (*Tadarida brasiliensis*)	—	LR/nt	Southern U.S. (largest populations in the West)	Occupy various habitats ranging from desert to pine-oak forests; utilize limestone caves and abandoned mines in the Southwest, manmade structures such as bridges and buildings in the Southeast, colonies also found in hollow trees

FE = Federally endangered
SOC = Species of concern
EN = Endangered
VU = Vulnerable
LR/nt = Lower risk/near threatened

Notes:
* Subspecies are not distinguished