

# INTRODUCTION

Nineteen of the 124 or more species of mammals inhabiting Colorado are bats. The unique life history characteristics of bats prevent many people from realizing that they comprise 15 percent of our native mammal fauna. Being fast fliers that are active at night, bats are mostly elusive to human detection except in the early evening hours when they can be seen foraging, or when they are observed in their roosting habitat. In addition, bats often roost in hard-to-reach, well-hidden places making human encounters with them rare. Threats to bats in Colorado and worldwide have led to multiple mortality events (O’Shea et al. 2016). Coupled with roosting and foraging habitat loss, these threats create the potential for declines in bat populations. Since the first edition of the Colorado Bat Conservation Plan in 2004, several new threats to bats have surfaced, and are addressed in this 2017 revision. Chief among these threats is the emergence of White-nose Syndrome, an infectious disease caused by an infectious fungus, *Pseudogymnoascus destructans*, which has killed millions of bats in eastern North America, and continues to make westward progression across the continent. Energy development has also become an elevated concern for many bat species, specifically wind and solar energy. Impacts from development of these energy resources to bats has the potential to increase exponentially as the country works towards advancing renewable energy methods and addressing the threats of climate change. Implementation of thoughtful conservation measures for bats will be needed to avert population declines, potential species listings, or worse, extinction events for these unique mammals.



Pallid bat. Photo by K. Navo

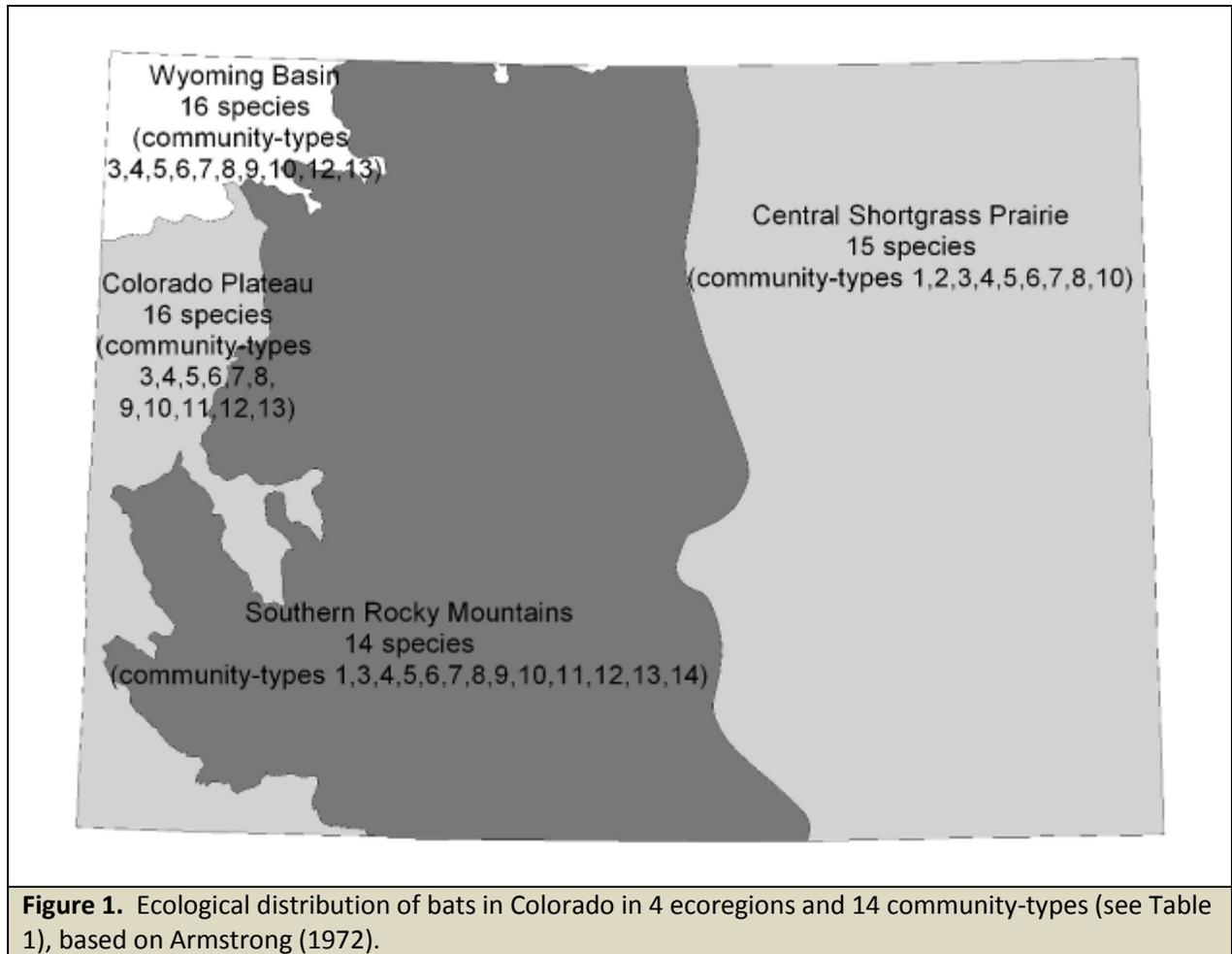
Most bats found in Colorado are relatively small, but wingspans of Colorado’s largest resident bat species, the big free-tailed bat (*Nyctinomops macrotis*), can reach 44 cm (16 in). The smallest bat species is the canyon bat (*Perastrellus hesperus*, 4-6 g), and the heaviest is the hoary bat (*Lasiurus cinereus*, up to 35 g). Bats are extraordinarily long-lived for their body size. For example, the little brown myotis (*Myotis lucifugus*) is capable of living more than 30 years in the wild (Cross 1976). Populations replace themselves rather slowly; in almost all species, females typically give birth to a single young per year. Although juvenile survival is high in the roost, once the young bats fly, mortality can be extremely high

(Humphrey and Cope 1976). Because many bat species in Colorado form concentrated colonies, give birth to only one young per year, and have the potential for high juvenile mortality, they are especially prone to threats from human encroachment, loss of habitat, and disturbance to roosts. They also spend more than half their lives in their roosting environment and, as such, are highly sensitive to disturbance and loss of roosting habitat, especially during reproductive and hibernation seasons. Bats in Colorado utilize a variety of roosts including caves, rock crevices, trees, and human-made structures such as mines, tunnels, bridges, and buildings.

For most species of Colorado bats, males and females segregate during the active summer months (Neubaum et al. 2006). Males form small bachelor colonies or roost singly, whereas females form larger colonies that range from a few individuals to as many as several thousand females and their young (Armstrong et al. 1994; Neubaum pers. comm.). Fall swarming involves high levels of bat activity throughout the night, with bats flying in and out of caves or mines. The reasons bats use caves or mines for swarming are not fully understood but the behavior could serve multiple social purposes, including mating and orientation of young bats for migration or with potential hibernacula (Veith et al. 2004), and the activity has been documented in Colorado (Navo et al. 2002; Englert 2008). The potential importance of swarming to the viability of bat species is largely unknown, but could be critical if, for example, it is shown to affect survival, reproduction, or the spread of diseases. Colorado bat species mostly hibernate locally, undergoing short seasonal migrations that may require moving to a higher elevation in order to find suitable winter roosts (Neubaum et al. 2006). Abandoned mines and caves are used as hibernacula by some species, particularly Townsend's big-eared bats (*Corynorhinus townsendii*; Ingersoll et al. 2010; Hayes et al. 2011). Rock crevices and talus are thought to be used as hibernacula as well (Neubaum et al. 2006).

Throughout history, bats have been misunderstood and vilified. This negative outlook stems from the lack of knowledge of a mammal that in many ways tests our sense of reality. The more we learn about their true biology, however, the less scary and more astonishing bats become. Conservation efforts for bats lag far behind those for more charismatic animals. Technological advances, such as the development of high frequency-scanning and recording devices (bat detectors) that have enhanced acoustic methodology, radio telemetry, pit tagging, and the use of satellites and global positioning systems, have allowed biologists to better understand the diversity, behavior, and ecology of bats.

In Colorado, efforts to promote bat conservation and increase public education have led to the protection of bat colonies, and are slowly changing the fear and hatred of bats into fascination and appreciation. Education, along with public support for conservation efforts, is essential in conserving bat populations and their roosting habitats, and thus maintaining their ecological role as the most significant vertebrates preying on nocturnal insects in Colorado and throughout North America. In an effort to establish needs and goals of bat conservation, the Colorado Committee of the Western Bat Working Group was established in 1998 (see Colorado's link on the Western Bat Working Groups website at <http://wbwg.org/>). Its mission is to provide guidance to private individuals, agencies, and other groups



**Figure 1.** Ecological distribution of bats in Colorado in 4 ecoregions and 14 community-types (see Table 1), based on Armstrong (1972).

to facilitate the conservation and management of bats and their habitats in Colorado. Bat conservation needs to be proactive in order to prevent sensitive species from becoming endangered or threatened. The Colorado Bat Conservation Plan revision summarizes the current state of knowledge of bats, continues to prioritize species-specific needs, identifies threats to bats in Colorado, provides goals for species conservation, and lists management recommendations and research needs to meet those goals. The Colorado Bat Working Group has also developed the Colorado Bat Matrix to identify and rank threats to bats in our state, which replaces the Species Ranking section found in the first edition of this plan (Ellison et al. 2004). This conservation plan is intended for dissemination to land management agencies in Colorado, those with an interest in bat conservation and research, and institutions responsible for managing natural resources in the state.

The Conservation Plan is structured to follow ecoregions found in Colorado. We provide a list of bat species found by ecoregion across the state (Figure 1.1, Table 1.1). Conservation Strategies focus on eight categories or activities generally tied to these ecoregions with each encompassing multiple issues important to bat populations in Colorado: (1) mining; (2) cave management (3) crevice management; (4) forest management; (5) rangeland management; (6) urban development; (7) diseases of bats; (8) energy

development. Additionally, guidance for scientific activities, considerations for bat roost protections are provided. Species status, population trends, and monitoring are discussed and an introduction to the Colorado Bat Matrix included helping managers address bat conservation issues. Finally, Colorado bat species account overviews are provided in the plan tailored towards knowledge gained from efforts conducted within the state whenever possible. Bats mark the presence of healthy, functioning ecological communities. We hope that the gaps in knowledge outlined in this document continue to provide direction for future bat research projects and management planning in the state of Colorado.

**Table 1.** List of 19 species of bats known to occur in Colorado and the community-types\* in which they occur (see Figure 1), based on Armstrong (1972).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Allen's lappet-browed bat ( <i>Idionycteris phyllotis</i> )			X				X	X						
Big brown bat ( <i>Eptesicus fuscus</i> )			X	X			X	X	X	X	X		X	
Big free-tailed bat ( <i>Nyctinomops macrotis</i> )					X	X								
Brazilian free-tailed bat ( <i>Tadarida brasiliensis</i> )					X	X								
California myotis ( <i>Myotis californicus</i> )				X		X	X							
Canyon bat ( <i>Parastrellus hesperus</i> )				X	X	X	X							
Eastern red bat ( <i>Lasiurus borealis</i> )			X											
Fringed myotis ( <i>Myotis thysanodes</i> )							X	X						
Hoary bat ( <i>Lasiurus cinereus</i> )			X				X	X	X	X	X		X	
Little brown myotis ( <i>Myotis lucifugus</i> )			X	X			X	X	X	X		X	X	
Long-eared myotis ( <i>Myotis evotis</i> )					X		X	X	X	X	X	X	X	
Long-legged myotis ( <i>Myotis volans</i> )				X			X	X		X		X	X	X
Pallid bat ( <i>Antrozous pallidus</i> )				X	X	X	X							
Silver-haired bat ( <i>Lasionycteris noctivagans</i> )			X				X	X	X	X	X		X	
Spotted bat ( <i>Euderma maculatum</i> )					X	X	X							
Townsend's big-eared bat ( <i>Corynorhinus townsendii</i> )				X	X	X	X	X						
Tri-colored bat ( <i>Perimyotis subflavus</i> )			X											
Western small-footed myotis ( <i>Myotis ciliolabrum</i> )	X	X		X	X	X	X	X						
Yuma myotis ( <i>Myotis yumanensis</i> )			X			X	X							
<b>TOTALS</b>	1	1	8	8	8	9	15	10	5	6	4	3	6	1

\*1 = Subhumid grassland; 2 = Plains wetland; 3 = Plains riparian woodland; 4 = Saxicoline brush; 5 = Sagebrush; 6 = Semidesert scrub; 7 = Pinyon-juniper woodland; 8 = Ponderosa pine woodland; 9 = Montane forest; 10 = Mountain meadow; 11 = Subalpine forest; 12 = Highland streambank; 13 = Aspen woodland; 14 = Alpine tundra/fellfield

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