

XI. SPECIES STATUS, POPULATION TRENDS, AND MONITORING

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Too little is currently known about basic biology and ecology of most species of bats in Colorado to provide evaluations of their status and population viability. While some work over the last 20 years has helped elucidate general distributions and protected some colonies across the state, there remain many questions and information gaps. Monitoring of bats presents many challenges to resource managers and researchers (see O’Shea and Bogan 2003, “Monitoring Trends in Bat Populations of the United States and Territories: Problems and Prospects” at <https://pubs.usgs.gov/itr/2003/0003/report.pdf>; Neubaum et al. 2017, <http://www.cnhp.colostate.edu/cbwg/>), yet estimating trends in bat populations is vital to preserving the biological diversity of Colorado. Understanding changes in populations is especially important for those species listed by the NatureServ/Colorado Natural Heritage Program (Master et al. 2012), most of which were formerly considered Category 2 candidates under the Endangered Species Act (ESA; USFWS 1994), to prevent the future need for listing as state or federal threatened or endangered species. In addition to these rankings, the State Wildlife Action Plan developed by Colorado Parks and Wildlife (CPW) lists 4 Tier 1 and 3 Tier 2 bat species that are considered to have some level of concern for their conservation in the state (CPW 2015). The following list of management projects, data gaps, and research needs is intended to help guide and focus the limited resources available for bat conservation in Colorado. These projects would provide valuable information to determine species status, and would help develop the tools required to monitor population trends and implement future conservation actions. Projects are not presented in order of priority but are grouped by subject matter.

DISEASE

- Research the diversity and distribution of fungi naturally occurring on bats in Colorado for White-nose syndrome (WNS) related planning and surveillance.
- Evaluate the potential of acoustic approaches to monitoring of bats at hibernacula and swarming sites for WNS surveillance.
- Develop survival estimates for all species whose populations are thought to be most vulnerable to declines from WNS in Colorado.
- Investigate the bacterial microbiota native to Colorado bat species to see if some inhibit



Bat with White-Nose Syndrome. Photo by S. Taylor.

fungal growth of *Pseudogymnoascus destructans*, such as *Streptomyces* (Hamm et al. 2017; Winter et al. 2017).

- Search for novel diseases carried by Colorado bats that currently have not been described.

CAVES AND MINES

- Provide a comprehensive evaluation of bat gates installed on caves and mines in Colorado.
- Complete the inventory of caves to identify and protect important bat colonies, especially in areas with high densities of significant cave and karst formation (such as the White River National Forest)
- Continue to survey, identify, and protect important bat roosts in abandoned mines on public and private lands in cooperation with active state and federal Abandoned Mine Lands closure programs.
- Determine the importance of caves and mines to hibernating bat populations.
- Evaluate potential impacts from high radon concentrations (>100 pCi/L) to bats roosting in uranium mines.
- Determine the extent and importance of “swarming” by bats at caves and mines.



Cave hibernacula. Photo by D. Neubaum.

ROOSTS

- Determine the winter roost status of all bat species thought to hibernate in the state.
- Determine the winter roost status for Brazilian free-tailed (*Tadarida brasiliensis*), and silver-haired bats (*Lasiorycteris noctivagans*), presumed to be migratory.
- Evaluate winter bat activity at locations not traditionally investigated, such as talus slopes, canyons, and cliff faces.
- Search for and document maternity roosts and hibernacula for all bat species listed in the CPW State Wildlife Action Plan, and federal agency sensitive species lists (see Table 11.1 and Section XIII. Species Accounts).
- Evaluate the amount of roost switching by maternity colonies of Colorado bat species, and determine the distances moved, the frequency of switching, and factors that trigger such movements.
- Evaluate the seasonal movements of Colorado bat species between summer nurseries and winter hibernacula, and define population units for conservation.
- Evaluate the potential of impacts to bats roosting in crevices by recreational climbing.

- Characterize rock crevice roosts used by bats and differentiate seasonal variation of microclimates at these roosts.
- Evaluate the use and importance of bridges as roost sites for bats in Colorado.
- Develop predictive occurrence maps for winter use by bats in Colorado to help guide future searches of hibernacula.
- Determine the types of seasonal roosts utilized by all species of concern, and the importance of each type of roost to long-term survival of each species.
- Investigate the use and importance of man-made structures used as roosts by species of concern.
- Determine the extent of “swarming” by bats at sites other than caves and mines in Colorado.
- Verify the roosting requirements of tree roosting bats, as reported from research elsewhere, in Colorado’s forests.
- Evaluate the potential of using artificial roosts in areas where the loss of natural roosts has been documented, and may be limiting population recovery.
- Evaluate the value of artificial bat houses in Colorado, and the potential role they could play in urban settings.
- Evaluate the potential of acoustic approaches to monitoring bats at important roost sites.
- Continue to develop new techniques and equipment to allow less intrusive monitoring of bat colonies.
- Develop long-term monitoring programs for the Brazilian free-tailed bat bachelor colony at the Orient Mine in the San Luis Valley (the largest bat roost in Colorado), and the maternity colony in Grand Junction.
- Establish monitoring programs for selected colonies of bat species listed in the CPW State Wildlife Action Plan, and federal agency sensitive species lists (see Table 11.1 and Section XIII. Species Accounts).

SPECIES STATUS

- Develop accurate range maps for all Colorado bat species.
- Determine the status of tri-colored bats (*Perimyotis subflavus*) in eastern Colorado.
- Determine the status of eastern red bats (*Lasiurus borealis*) in eastern Colorado.
- Determine the status of cave myotis (*Myotis velifer*) in southeastern Colorado.
- Determine the status of Allen’s big-eared bats (*Idionycteris phyllotis*) in western Colorado.
- Determine if acoustic records of western red bats (*Lasiurus blossevillii*) collected in western Colorado are misclassified or if the species actually occurs there.
- Determine the status of big free-tailed bats (*Nyctinomops macrotus*) in Colorado.
- Determine the winter status of spotted bats (*Euderma maculatum*) in Colorado.
- Establish an acoustic bat call library for Colorado, which is essential to document local distribution and foraging behavior of bats.

ENERGY

- Evaluate the extent to which wind energy development is impacting migrating bats in Colorado.
- Evaluate the potential impacts of large-scale solar energy development to bats in Colorado.
- Investigate the potential for entrapment and accumulation of contaminants by bats using oil and gas evaporative ponds.



Wind farm on public lands. Photo by C. Cryan.

MIGRATION

- Investigate seasonal migrations in elevation, rather than latitude, which may be used by many bat species in Colorado.
- Determine migratory patterns and important flyways of migratory bat species in Colorado. If important migratory corridors and flyways have already been identified, establish methods to protect, maintain, restore if necessary, and monitor them.
- Encourage and initiate interstate and international communication and coordination for conservation of our migratory bats, especially the Brazilian free-tailed bat. Explore the potential of a bat conservation partnership with bird conservation efforts (Partners In Flight)



Little brown myotis with radio transmitter attached. Photo by K. Keisling.

Table 11.1. Status of Colorado bat species as ranked by NatureServe and the Colorado Natural Heritage Program (NatureServ/CNHP), The Colorado Parks and Wildlife State Wildlife Action Plan (SWAP), Colorado Bureau of Land Management (BLM), Region 2 of the US Forest Service (USFS), and the US Fish and Wildlife Service (USFWS) as of December 2017. Conservation status of bat species, as defined by NatureServe, is ranked on a scale of 1–5 as follows: critically imperiled (G1), imperiled (G2), vulnerable (G3), apparently secure (G4), and demonstrably secure (G5). Assessment and documentation of status occurs at 3 geographic scales: global (G), national (N), and state/province (S). State Wildlife Action Plan ranks include Tier 1 for species of highest conservation priority and Tier 2 for species whose listing status is of concern but the urgency of action is deemed to be less. BLM and USFS rankings are given for sensitive species (SS) only as no threatened or endangered bat species currently exist in their management boundaries.

Common Name	Scientific Name	NatureServe/CNHP	SWAP	CPW	BLM	USFS	USFWS
Allen’s big-eared bat	<i>Idionycteris phyllotis</i>	G4 S1	Tier2		SS		
Big brown bat	<i>Eptesicus fuscus</i>	G5 S5					
Big free-tailed bat	<i>Nyctinomops macrotis</i>	G5 S1	Tier 2		SS		
Brazilian free-tailed bat	<i>Tadarida brasiliensis</i>	G5 S1					
California myotis	<i>Myotis californicus</i>	G5 S3					
Canyon bat	<i>Parastrellus hesperus</i>	G5 S4					
Eastern red bat	<i>Lasiurus borealis</i>	G3G4 S2S3B					
Fringed myotis	<i>Myotis thysanodes</i>	G4 S3	Tier 1		SS	SS	
Hoary bat	<i>Lasiurus cinereus</i>	G3G4 S3S4B	Tier 2			SS	
Little brown myotis	<i>Myotis lucifugus</i>	G3 S4	Tier 1				
Long-eared myotis	<i>Myotis evotis</i>	G5 S4					
Long-legged myotis	<i>Myotis volans</i>	G4G5 S5					
Pallid bat	<i>Antrozous pallidus</i>	G4 S4					
Silver-haired bat	<i>Lasionycteris noctivagans</i>	G3G4 S3S4					
Spotted bat	<i>Euderma maculatum</i>	G4 S2	Tier 1		SS	SS	
Townsend’s big-eared bat	<i>Corynorhinus townsendii</i>	G4 S2	Tier 1	SC	SS	SS	
Tri-colored bat	<i>Perimyotis subflavus</i>	G2G3 S2					Petitioned*
Western small-footed myotis	<i>Myotis ciliolabrum</i>	G5 S4					
Yuma myotis	<i>Myotis yumanensis</i>	G5 S3					

*Petition for listing 6/14/2016 with a 90 day substantial finding on 12/21/17.

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