Spotted Bat

Euderma maculatum

REGULATORY STATUS

USFWS: No special status
USFS R2: Sensitive
UWFS R4: Sensitive
Wyoming BLM: Sensitive
State of Wyoming: Nongame Wildlife

CONSERVATION RANKS

USFWS: No special status
WGFD: NSS4 (Bc), Tier III
WYNDD: G4, S1S2
Wyoming Contribution: LOW
IUCN: Least Concern

STATUS AND RANK COMMENTS

Spotted Bat (*Euderma maculatum*) is assigned a range of state conservation ranks by the Wyoming Natural Diversity Database (WYNDD) due to uncertainty about the species' range and population trends in the state.

NATURAL HISTORY

Taxonomy:

The genus *Euderma* is monotypic, and there are no known subspecies of Spotted Bat [1, 2].

Description:

In hand, Spotted Bat is unmistakable. Spotted Bat is among the largest of the vespertilionid bats, with a total length of 10.5–11.5 cm and a wingspan of 34–38 cm [2, 3]. In adults, the ventral side is white; the dorsal side is black with three large white spots, one at the base of the tail and one on each shoulder; and the ears and wing membranes are pink. Due to this unique coloration, Spotted Bat is occasionally referred to as Pinto Bat [4]. The ears are very large, long (45–50 mm), and wide. Males and females are similar in size and appearance. Young juveniles lack distinctive pelage [1], and the growth plates in the phalanges of juveniles are visible throughout the first summer [5]. Spotted Bat produces echolocation calls that are audible to humans (12 to 6 kHz) [3], which allows for detection and identification of flying individuals.

Distribution & Range:

Spotted Bat occurs throughout western North America from southern British Columbia, Canada south to Jalisco, Mexico [3]. Historically, few records were available for Spotted Bat, and the known range of Spotted Bat in the United States has subsequently expanded as sampling for bats has increased [1, 6, 7]. Spotted Bat occurs in northwestern, north-central, and southwestern Wyoming. Northern Wyoming marks the northeastern extent of known Spotted Bat range. All records for Spotted Bat in Wyoming occur in the Bighorn Basin in north central Wyoming and the lower portion of the Green River Basin in south central Wyoming [4]. Confirmed observations

have been documented in 7 of the 28 latitude/longitude degree blocks in Wyoming, although confirmed breeding has been documented in only 1 degree block [8].

Habitat:
Spotted Bat occupies a wide array of habitat types ranging from below sea level to 2,700 m in elevation, including desert shrublands; piñon-juniper (*Pinus edulis-Juniperus* spp.) forests; subalpine meadows; and coniferous forests composed of Ponderosa Pine (*P. ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), and White Fir (*Abies concolor*) [2, 3]. Regardless of habitat type, necessary habitat characteristics include large rock features, such as cliffs, with cracks and crevices for roosting that are near permanent water and open areas for foraging [2, 7, 9]. South-facing roosts may be particularly important for females [9], and Spotted Bat shows high fidelity to roost locations [3]. At night, Spotted Bat has also been observed roosting in trees between foraging bouts [2]. Man-made ponds for livestock may provide important sources of water and potential foraging habitat in arid areas [9]. Known locations of Spotted Bat in Wyoming conform to these habitat requirements and are near large cliffs or canyons with cracks or fissures, bare rock walls, and rocky ridges that provide suitable roost sites and are close to a permanent water source. It is suspected that roost availability near foraging areas drives occurrence patterns more than vegetation type, as vegetation surrounding roost sites varies [10]. There are no records of Spotted Bat in Wyoming during winter [2] and no known Spotted Bat hibernacula. It is unknown if the species migrates out of the state during winter or hibernates locally; winter range and hibernacula are poorly known overall.

Phenology:
Little is known about timing of migration or reproductive events of Spotted Bat. Breeding likely occurs in late summer [3], with females employing delayed implantation, or early spring [2]. In Texas, a pregnant female gave birth on 11 June, suggesting parturition likely occurs in May or June [1, 3]. Like many bat species, Spotted Bat likely produces a single altricial pup annually [1]. Little is known about migration patterns; individuals at lower elevations may not migrate, and southern populations may be active year-round [3].

Diet:
Spotted Bat feeds almost exclusively on flying moths (99.6% of diet), including species in the families Noctuidae, Lasiocampidae, and Geometridae [11]; the lower frequency of calls emitted by Spotted Bat may make them less detectible to their moth prey [12]. Beetles (Coleoptera), grasshoppers (Orthoptera), and other insects, including Hemiptera, are also consumed [1, 2, 11]. Spotted Bat tends to forage at greater heights than other bats (> 10 m above ground) [13], which may contribute to the few number of mist-net captures in general.

CONSERVATION CONCERNS

Abundance:
Continental: WIDESPREAD
Wyoming: RARE
Spotted Bat is rare range-wide, but may be locally abundant in suitable habitat, particularly in southern British Columbia and portions of Arizona, Utah, Texas, and Colorado [2, 3, 7, 14]. However, Spotted Bat typically represents a small proportion of captures (< 0.5%) overall [3] and comprises only a small proportion of total detections in studies of bats in Wyoming [15-18], which may indicate low abundance in the state [2]. The species was first documented in Wyoming in 1960 [19],

but only 2 records are available for Spotted Bat prior to 1990 [10]. Subsequent survey efforts have increased the number of known records in the state to approximately 100 as of 2014.

Population Trends:
Historic: UNKNOWN
Recent: UNKNOWN
Historic and recent population trends for Spotted Bat in Wyoming are unknown. Changes in the number of observations over time likely reflect survey effort rather than an increase in population size or distribution [2, 7].

Intrinsic Vulnerability:
HIGH VULNERABILITY
Spotted Bat occurs in disjunct, low density subpopulations, making local populations vulnerable to habitat changes or disturbances [2]. Although foraging habitat is variable, prominent rock features such as cliffs typically used for roosting are a relatively rare landscape feature [2, 3], and proximity of suitable roosting and foraging habitats likely limits Spotted Bat distribution [2, 7]. Additionally, the apparent specialization on specific moth species in the diet may further limit foraging habitat [2]. Spotted Bat is a long-lived species with very low reproductive rates and long generational turnover [1-3], which may limit population growth in the face of other stressors. Finally, Spotted Bat has been documented with rabies in California [20, 21]; although it is unknown to what degree the disease may impact populations.

Extrinsic Stressors:
SLIGHTLY STRESSED
Spotted Bat is potentially exposed to a number of extrinsic stressors; however, many of these still require targeted research in order to better understand if and to what degree they impact the species on a population level. Spotted Bat is sensitive to disturbance while roosting and may abandon a site if disturbed. Although roost sites tend to be remote, which may insulate them from disturbance, recreational rock climbing, water impoundment projects, and urbanization may have the potential to impact populations on a local scale [2, 3]. Furthermore, cliffs are the only roosting habitat in which reproductive females have been observed, indicating the importance of these features to the species [5]. Habitat alteration also poses an extrinsic threat to Spotted Bat, especially the loss or degradation of foraging habitat. Desertification from livestock overgrazing, conversion of wetlands to more xeric sites, and timber harvest in riparian areas may adversely impact the species in Wyoming by removing water sources or limiting insect prey. A potential threat to most bat species is pesticide use, which reduces food resources and may lead to acute poising or chronic effects; although it is unknown to what degree this affects Spotted Bat in Wyoming. Additionally, waste collection ponds and reserve pits from coal bed methane and oil drilling operations have the potential to negatively impact bats [2, 3]. Wind turbines have also impacted bat populations in many areas. Spotted Bat has not been significantly impacted to date, but it is possible that the species may be impacted if wind energy development occurs in areas of local species abundance. Although collection of Spotted Bat by humans was historically a chief threat to the species [2], permitting requirements by state agencies for take has likely limited this threat. Finally, white-nose syndrome (WNS) has affected bat populations in the eastern United States [22]. WNS does not currently exist in Wyoming and it is unknown if it affects Spotted Bat; natural history traits of Spotted Bat such as low density and small roost size may make Spotted Bat populations fairly resistant to WNS.

KEY ACTIVITIES IN WYOMING

In recent years, bats have received increasing research attention across North America and in Wyoming. To address concerns regarding potential WNS infection of bats in Wyoming, the Wyoming Game and Fish Department (WGFD) in cooperation with the Wyoming Bat Working Group authored "A strategic plan for white-nose syndrome in Wyoming" in 2011. This document presents a plan of action to minimize impacts of WNS if it is detected in Wyoming or adjacent states [22]. To facilitate early detection of the disease, WGFD requires researchers to use the Reichard Wing-Damage Index [23] to evaluate all bats captured during research activities for signs of WNS infection. WGFD conducts periodic surveys at known hibernacula throughout the state; however, no Spotted Bat hibernacula have been documented thus far. From 2008–2011 and 2012–2015, the WGFD conducted statewide inventories of bats in forested habitats and cliff and canyon habitats, respectively. Throughout the 8-year effort, 8 Spotted Bats were captured, representing 0–1.8% of captured bats annually, and Spotted Bat was detected acoustically 45 times throughout the known range of the species in Wyoming [15-18]. In 2015, WYNDD developed a bat monitoring plan and initiated survey activities at Bighorn Canyon National Recreation Area (BICA). The primary objective of this monitoring plan is to develop a baseline activity level or other index of abundance for bats that can be used to detect changes in populations within BICA through time. Surveys thus far have detected Spotted Bat acoustically in this area [24, 25]. In addition to research, conservation organizations and federal and state agencies have developed outreach and education materials to inform the general public of the importance of bats and concerns regarding the persistence of bats in the future.

ECOLOGICAL INFORMATION NEEDS

Little is known about Spotted Bat life history in general. The species would benefit from more data on reproductive habits as well as habitat requirements year-round, including documenting important roost locations. Wyoming likely represents the upper altitudinal limit for the species, and Spotted Bat populations in Wyoming may demonstrate different distribution and structure than populations in other portions of the range, which may be important to conservation and management efforts. Detailed information is needed on the distribution of Spotted Bat in Wyoming, including if and when the species migrates and the locations of hibernacula if Spotted Bat overwinters in the state. Information is also lacking on abundance and population trends in Wyoming. Finally, additional data are needed on how Spotted Bat is potentially impacted by extrinsic stressors in the state, including energy development and land management practices that may result in loss or degradation of both roosting and foraging habitat.

MANAGEMENT IN WYOMING

This section authored solely by WGFD; Nichole L. Bjornlie. Little is known about Spotted Bat in Wyoming. Consequently, management priorities for the species in the short-term will focus on addressing these data deficiencies, including data on presence, abundance, and population trends. In addition to on-going and future inventory projects for bats, WGFD, in collaboration with the Wyoming Bat Working Group and other state-wide partners, is implementing the North American Bat Monitoring Program that will use acoustic monitoring to assist with state and region-wide assessments of bat trends. However, given the rarity of Spotted Bat and its patchy distribution on the landscape, targeted survey efforts may be needed to adequately monitor population trends. Information on habitat requirements throughout the year and wintering locations of Spotted Bat, if it hibernates in the state, is needed, and additional priorities will

focus on further defining the distribution of the species and locating and monitoring roost locations. Habitat assessments will also be incorporated with survey efforts to better understand what influences species presence and distribution at a finer scale to help direct management and conservation efforts. Mist-net surveys will continue to implement WNS protocols and assessment in an effort to assist with early detection should the disease reach the state. Additional priorities will include updating and revising the Conservation Plan for Bats in Wyoming [5] as well as the Strategic Plan for WNS in Wyoming [22]. Finally, outreach and collaboration with private landowners will remain a priority to ensure conservation of bats and bat habitat.

CONTRIBUTORS

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REFERENCES

[1] Watkins, L. C. (1977) *Euderma maculatum*, *Mammalian Species 77*, 1-4.
[2] Luce, R. J., and Keinath, D. (2007) Spotted Bat (*Euderma maculatum*): a technical conservation assessment, p 52, Prepared for the USDA Forest Service, Rocky Mountain Region.
[3] Chambers, C., Herder, M., and Luce, B. (2005) *Euderma maculatum* Spotted Bat, In *Species Accounts*, p 5, Western Bat Working Group, http://www.wbwg.org.
[4] Buskirk, S. W. (2016) *Wild Mammals of Wyoming and Yellowstone National Park*, University of California Press, Oakland, California.
[5] Hester, S. G., and Grenier, M. B. (2005) A conservation plan for bats in Wyoming, Wyoming Game and Fish Department Nongame Program, Lander, WY.
[6] Woodsworth, G. C., Bell, G. P., and Fenton, M. B. (1981) Observation of the echolocation, feeding behavior, and habitat use of *Euderma maculatum* (Chiroptera: Vespertilionidae) in southcentral British Columbia, *Canadian Journal of Zoology 59*, 1099-1102.
[7] Luce, R. J., Bogan, M. A., O'Farrell, M. J., and Keinath, D. A. (2004) Species assessment for Spotted Bat (*Euderma maculatum*) in Wyoming, p 62, Wyoming Natural Diversity Database and USDI Bureau of Land Management, University of Wyoming, Laramie, WY.
[8] Orabona, A., Rudd, C., Grenier, M., Walker, Z., Patla, S., and Oakleaf, B. (2012) Atlas of birds, mammals, amphibians, and reptiles in Wyoming, p 232, Wyoming Game and Fish Department Nongame Program, Lander, WY.
[9] Chambers, C. L., Herder, M. J., Yasuda, K., Mikesic, D. G., Dewhurst, S. M., Masters, W. M., and Vleck, D. (2011) Roosts and home ranges of Spotted Bats (*Euderma maculatum*) in northern Arizona, *Canadian Journal of Zoology-Revue Canadienne De Zoologie 89*, 1256-1267.
[10] Priday, J., and Luce, B. (1999) New distributional records for Spotted Bat (*Euderma maculatum*) in Wyoming, *Great Basin Naturalist 59*, 97-101.
[11] Painter, M. L., Chambers, C. L., Siders, M., Doucett, R. R., Whitaker, J. O., Jr., and Phillips, D. L. (2009) Diet of Spotted Bats (*Euderma maculatum*) in Arizona as indicated by fecal analysis and stable isotopes, *Canadian Journal of Zoology 87*, 865-875.
[12] Fullard, J. H., and Dawson, J. W. (1997) The echolocation calls of the Spotted Bat *Euderma maculatum* are relatively inaudible to moths, *Journal of Experimental Biology 200*, 129-137.
[13] Navo, K. W., Gore, J. A., and Skiba, G. T. (1992) Observations on the Spotted Bat, *Euderma maculatum*, in northwestern Colorado, *Journal of Mammalogy 73*, 547-551.
[14] Storz, J. F. (1995) Local distribution and foraging behavior of the Spotted Bat (*Euderma maculatum*) in northwestern Colorado and adjacent Utah, *Great Basin Naturalist 55*, 78-83.
[15] Cudworth, N., Johnson, S., and Grenier, M. (2011) Inventories of Forest Bats in Northeastern Wyoming: Mist Netting, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Grenier, M. B., Ed.), pp 119-145, Wyoming Game and Fish Department.

[16] Abel, B., and Grenier, M. (2013) Inventory of Bats in Cliffs and Canyons of Western Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A., Ed.), pp 234-265, Wyoming Game and Fish Department.
[17] Yandow, L., and Grenier, M. (2014) Inventory of Bats Associated with Cliff and Canyon Habitats of Western Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., and Cudworth, N., Eds.), pp 253-284, Wyoming Game and Fish Department.
[18] Yandow, L., and Beard, L. (2015) Inventory of Bats Associated with Cliff and Canyon Habitats of Eastern Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Orabona, A. C., and Rudd, C. K., Eds.), pp 133-162, Wyoming Game and Fish Department.
[19] Mickey, A. B. (1961) Record of the Spotted Bat from Wyoming, *Journal of Mammalogy 42*, 401-402.
[20] Medeiros, J. L., and Heckmann, R. A. (1971) *Euderma maculatum* from California infected with rabies virus, *Journal of Mammalogy 52*, 858.
[21] Constantine, D. G., Humphrey, G. L., and Herbenick, T. B. (1979) Rabies in *Myotis thysanodes*, *Lasiurus ega*, *Euderma maculatum*, and *Eumops perotis* in California, *Journal of Wildlife Diseases 15*, 343-345.
[22] Abel, B., and Grenier, M. (2011) A strategic plan for White-nose Syndrome in Wyoming, p 27, Wyoming Game and Fish Department, Lander, Wyoming.
[23] Reichard, J. D., and Kunz, T. H. (2009) White-nose syndrome inflicts lasting injuries to the wings of little brown myotis (Myotis lucifugus), *Acta Chiropterologica 11*, 457-464.
[24] Keinath, D. A. (2005) Bat inventory of the Greater Yellowstone Network: final report, Prepared for the National Park Service by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
[25] Keinath, D. A., and Abernethy, I. (2016) Bat population monitoring of Bighorn Canyon National Recreation Area: 2015 progress report, Prepared for the Bighorn Canyon NRA by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

Figure 1: Ventral view of a Spotted Bat captured in Wyoming. (Photo courtesy of Shelly Johnson, WGFD)

Figure 2: North American range of *Euderma maculatum*. (Map from: Patterson, B. D., et al. (2007) Digital Distribution Maps of the Mammals of the Western Hemisphere, version 3.0, NatureServe, Arlington, Virginia.)

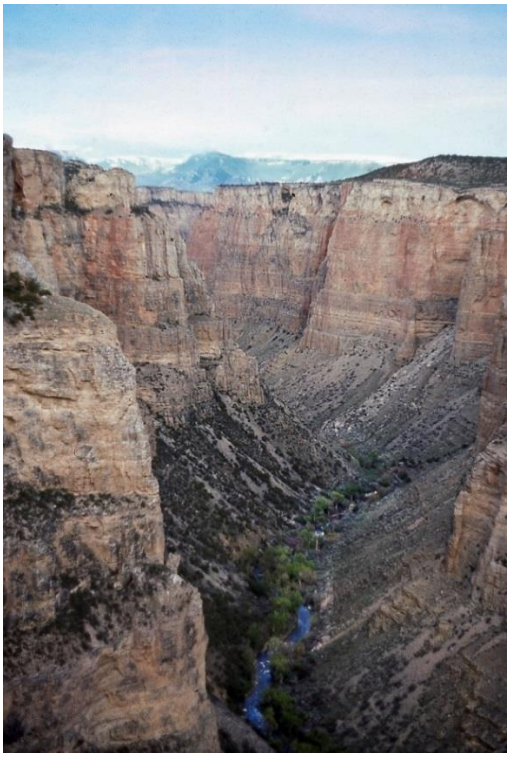

Figure 3: Spotted Bat habitat in Devil's Canyon in Bighorn Canyon National Recreation Area, Montana. (Photo courtesy of Robert J. Luce)

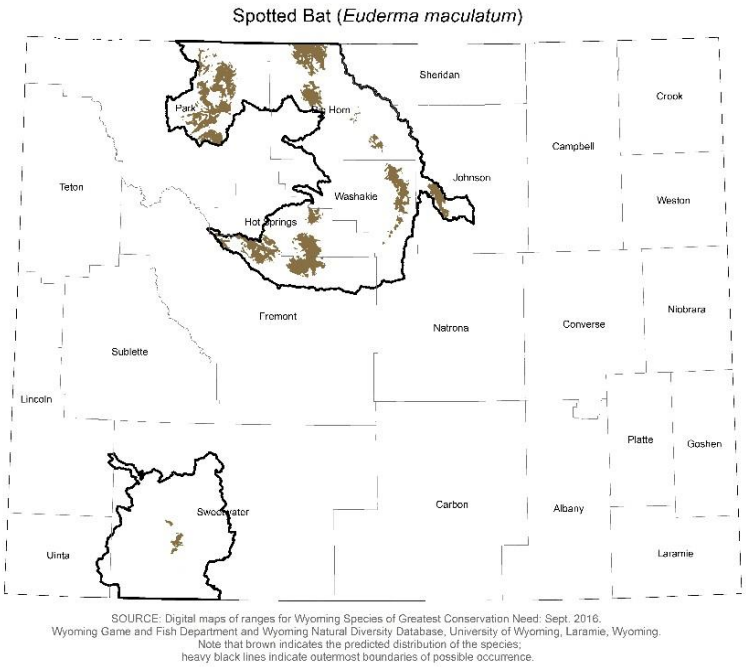

Figure 4: Range and predicted distribution of *Euderma maculatum* in Wyoming.

Figure 5: Dorsal view of a live-captured Spotted Bat showing the species' distinctive spots and coloring. (Photo courtesy of Shelly Johnson, WGFD)