Status Assessment of Arizona Black Rattlesnake (*Crotalus cerberus*) in New Mexico

Report to Share w/ Wildlife Program

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Bruce L. Christman[1]
Randy D. Jennings[2]
&
J. Tomas Giermakowski[3]

[1]Fort Collins, CO

[2]Gila Center for Natural History
Department of Natural Sciences
Western New Mexico University
Silver City, New Mexico

[3]Museum of Southwestern Biology
University of New Mexico
Albuquerque, NM

Project Objective

The objective of this study is to assess the current distribution, habitat associations, and prey availability of the Arizona Black Rattlesnake (*Crotalus cerberus*) in New Mexico.

Project Need

There are currently ten recognized species and subspecies of rattlesnakes in New Mexico. The Arizona Black Rattlesnake (*Crotalus cerberus*) is known from Catron and Grant counties from at least 17 confirmed locations (Figure 1, Table 1). These locations are represented by 19 museum specimens, a live specimen in captivity, and four observations (with photos). In addition, Klauber (1972, 1997) mentions Steeple Rock as another locality (without data). These limited data indicate that *C. cerberus* has a relatively small extent of known occurrence within New Mexico, despite the prevalence of seemingly suitable habitat throughout most of the Gila National Forest.

***C. cerberus*, Trail Canyon, Catron Co. NM.** Photo D. Burkett

Crotalus cerberus is known to occur in Arizona from the Hualapai Mountains across the Mogollon Rim at elevations of 900–3000 m (Brennan and Holycross 2006, Schuett et al. 2016) to west central New Mexico in Catron and Grant counties at elevations of 1860–2447 m (Klauber 1972, Mello 1978, Degenhardt et al. 1996, Klauber 1997, Christman et al. 2000, Rubio 2010) within the Arizona/New Mexico Mountains ecoregion. *Crotalus cerberus* occurs in Interior Chaparral, Great Basin Conifer Woodland, Madrean Evergreen Woodland, and Petran Montane Conifer Forest (Brown 1994, Brennan and Holycross 2006, Schuett et al. 2016). In Arizona, where *C. cerberus* occur at lower elevations into upper portions of Arizona Upland Desert-scrub, snakes are often encountered in riparian habitats to 900 m. Occurrence at such low elevations has not been documented in New Mexico, where the lowest elevation record is at 1860 m in Madrean Evergreen Woodland. In New Mexico *C. cerberus,* has been documented to occur at elevations from 1860–2447 m (6103–8029 ft.). In New Mexico *C. cerberus* has received little to no study and as a result most observations are anecdotal.

Until recently, this species was considered a subspecies of the Western Rattlesnake complex (*Crotalus viridis*); however, most biologists in both Arizona and New Mexico follow the most recent evidence that points to *C. cerberus* being a distinct species. Although Degenhardt et al. (1996) recognized *C. cerberus* as a subspecies of *C. viridis* and did not recognize differences in biology or distribution within the state, Crother et al. (2012) considered the species as distinct and summarized taxonomic changes proposed in the *C. viridis* group by Pook et al. (2000), Ashton and de Queiroz (2001), and Douglas et al. (2002); who all agree on *C. cerberus* being a distinct species. The Arizona Game and Fish Department recognizes *C. cerberus* as distinct from the Western Rattlesnake complex, and as such, the species is regulated as a game species with limited take of four per year. New Mexico Department of Game and Fish allows take of five per year for commercial collection and recently listed *C. cerberus* as a Species of Greatest Conservation Need (SGCN) in the State Wildlife Action Plan for New Mexico (SWAP 2016). Climate change is considered the greatest threat to continued persistence of *C. cerberus* (SWAP 2016). The potential effects of global climate change may have significant impacts to habitats, which may in turn have adverse effects on *C. cerberus* populations through time. Douglas et al. (2016) note that climate change in synergy with catastrophic wildfire can be an ecosystem converter. Catastrophic wildfire also is likely to adversely affect small mammal populations, which provide significant prey for adult *C. cerberus* (Douglas et al. 2016 and references therein). Furthermore, *C. cerberus* is a niche-reliant species (with respect to habitat) with limited ability to disperse with changes in habitat that are likely to occur with climate change. As changes occur, *C. cerberus* will only be able to move up in elevation rather than latitudinally (van Riper et al. 2014, Douglas et al. 2016). Projected range reductions with climate change range from 32 to 46% by 2099 (van Riper et al. 2014). Douglas et al. (2016) evaluated the genetics of *C. cerberus,* identifying four clades across its range with limited genetic interchange, suggesting further vulnerabilities to climate change.

Without detailed information on general status and distribution, land and resource managers cannot adequately address specific management concerns for any given species. Knowledge of SGCN abundance and distribution and the connectivity and condition of key habitats is of particular interest, as are studies that monitor the status of SGCN and identify and quantify factors limiting their populations. In the Share with Wildlife Call for Project Information (2018), *C. cerberus* was specifically listed as a species in need of review. Information from this work

will provide locality data and define a baseline distribution and habitat associations of, and prey availability for, *C. cerberus* in NM, which may help inform Agency management programs, help determine population status or limiting factors to populations, and help determine whether *C. cerberus* is in need of additional conservation efforts.

The earliest record of *C. cerberus* in New Mexico is one specimen from 31 July 1966, 2 miles west of Luna in Catron County. Then five more specimens were collected in the 1970's, two in the 1980's, two in 1995, 10 in 2000's, and 28 in the 2010's.

Methods

Survey methods included visual encounter surveys (VES) which involves walking through steep rocky habitats, poking under rocks and ledges looking and listening for snakes, and driving roads at night (during warm weather) that transect suitable habitat. For all surveys, basic abiotic data were collected including: weather, temperatures, search effort, aspect, and locality with Global Positioning System (GPS) using North American Datum 1983 in Universal Transverse Mercator. Additional relevant habitat data were collected (e.g., presence of rock piles, talus/ scree slopes, or drainages; distance to available water; and main vegetation types [e.g., Ponderosa, Pinon-Juniper, Madrean Evergreen Oak]). Snake observations, including *C. cerberus*, were recorded with GPS points, while search effort (time-spent and distance moved) was recorded via the tracking function of the GPS. All snakes captured were measured, weighed, their sex recorded, age evaluated based on size, and a PIT tag inserted for future identification. During handling, individual venomous snakes were restrained using either snake tubes or a squeeze box for safety of both snake and researcher. Photos were taken of all snakes and habitats where snakes were encountered.

Historic data were gathered using existing museum records and questioning state and federal wildlife biologists.

Additionally, all other amphibian and reptile species and potential prey were recorded. Small mammal trapping was conducted at select locations representative of habitats surveyed, to evaluate available prey species. All small mammals were identified and released at the point of capture. Other potential prey (lizards and birds) were identified via opportunistic observations.

Genetic samples, in the form of blood drawn from the caudal vein, were collected from most *C. cerberus* captured. Genetic samples have been deposited at the Museum of Southwestern Biology (MSB), in anticipation of future collaborative genetic research. Distribution data were also collected for other rattlesnake species that may have overlapping distributions: Prairie Rattlesnake (*C. viridis*), Rock Rattlesnake (*C. lepidus*), and Northern Black-tailed Rattlesnake (*C. molossus*).

Areas targeted for searches were rock outcrops with south, east, or west aspects with vegetation dominated by grasses, beargrass, yucca, and cacti indicating warmer, drier slopes that would be expected to have a greater number of snow free days during winter months when snakes would be denning.

Search areas included the following locations. In Catron County: San Francisco Mountains (Scenic overlook, Trail Canyon, San Francisco River West of Luna), San Francisco River North of Reserve, Willow Springs Canyon, FS rd 141West of Sheep Basin Divide, Chimney Rock Canyon, Cottonwood Canyon West of Campground, White Rocks Mountain, West of Mogollon, West Fork Gila River, South Fork Negrito Creek, Dry Blue Creek, Silver Peak East of Alma, Citizen Canyon, SA Creek, Trout Creek, and Canoves Creek. Grant County: Jack's Peak Big Burro Mountains, Brushy Mountain South of Mule Creek, and Mogollon Creek.

Results

We gathered historic data by checking *Crotalus viridis* data used in "Amphibians and Reptiles of New Mexico" (Degenhardt et al. 1996), which produced six records (1966–1988); searching MSB's database, which produced 12 records (1977–2016); and conversations with NMDGF biologists produced another record from 2016. Additional records were gathered from USFS biologists (J. Schofer and T. Hendricks), which resulted in new records for this report (Devil's Park, Trail Canyon, SA Creek).

Records of *C. cerberus* in New Mexico to date total 47 including: 23 museum specimens, 17 captured snakes, and 7 observations. These records are from 17 geographic locations (Table 1, Figure 1).

Collection dates for *C. cerberus* are from 26 April to 20 September with seasonal activity possibly a week or two earlier and a month later.

Table 1. *Crotalus cerberus* Localities for NM, 1966–2019, with year of collections, observations, or captures. Records that were confirmed or first observed during this project are shown in bold.

1. West of Luna, San Francisco River canyon, Catron County (1966, 1977, 1983. 1988, 2000, 2002, 2009, 2016, 2018)
2. **Dry Blue Creek, Catron County** (1995, 2000, **2019**)
3. Mogollon Creek, Gila Wilderness, Grant County (1972, 1974)
4. Mineral Creek, East of Mogollon, Catron County (1974)
5. FS Rd 35, San Francisco Mountains, Catron County (1974)
6. FS Rd 35, East of US 180, Catron County (1973)
7. San Francisco River at NM/AZ border, Catron County (2018)
8. Mother Hubbard Canyon at NM/AZ border, Catron County (2006)
9. **Trail Canyon, San Francisco Mountains, Catron County** (2011, 2016, **2019**)
10. **Head of SU Canyon, San Francisco Mountains, Catron County** (2016, **2019**)
11. Devil's Park /Apache Peak area, Catron County (2012)
12. Willow Springs Canyon, Catron County (2002)
13. **FS Rd 141, Catron County** (2016, **2019**)
14. Chimney Rock Canyon, Catron County (2012, 2014)
15. SA Creek, Catron County (**2019**)
16. **Brushy Mountain, Grant County (2019)**
17. Apache Box, Grant County (2000)

Over all for 2019, surveys were conducted at 30 sites over 33 days totaling 242 person hours of search effort from 4 April to 23 Oct 2019. Surveys resulted in detections of 14 *C. cerberus*, 13 *C. molossus*, and 3 *C. lepidus* (Table 2). Also detected were 10 Gophersnake (*Pituophis catenifer*), 10 Wandering Gartersnake (*Thamnophis elegans*), 1 Black-necked Gartersnake (*T. cyrtopsis*), 1 Sonoran Mountain Kingsnake (*Lampropeltis pyromelana*), 1 Ring-necked Snake (*Diadophis punctatus*), 1 Chihuahuan Nightsnake (*Hypsiglena janii*), and 1 Striped Whipsnake (*Masticophis taeniatus*). Some sites were visited more than once during spring and fall surveys.

Spring 2019 surveys

We expended 137 person hours of search effort at 18 localities where we found 8 *C. cerberus*, 9 *C. molossus*, one *M. taeniatus*, and one *P. catenifer* (Table 2). The *C. cerberus* were

found at five of the 18 locations surveyed (Table 2). Surveys were conducted on 4 and 26 April, 1–9 May, and 5 June 2019. Weather conditions during May surveys varied from ideal (clear and sunny with temperatures in the mid 70's to 80 F) to poor (windy with clouds and occasional snow flurries). Cooler temperatures resulted in lower encounter rates for snakes.

Summer and fall 2019 surveys

We expended 105 person hours of search effort at 14 localities where we found six additional *C. cerberus* at two locations (Table 2). Additionally, we detected 4 *C. molossus,* 1 *C. lepidus,* 9 *P. catenifer,* 10 *T. elegans,* 1 *T. cyrtopsis,* 1 *L. pyromelana,* 1 *D. punctatus,* and 1 *H. janii.* Some sites were visited during both spring and fall surveys.

While conducting surveys for Narrow-headed Gartersnake, which were not funded under this project, we also collected incidental data for other snakes including *C. cerberus.* These surveys were conducted 18–20 June (West Fork Gila River), 25–27 June (Negrito Creek, FS rd 141), and 2–3 July (Dry Blue River). Further surveys were conducted on 10 July (FS rd 141), 11 July (White Rocks Mt), 4–5 Sept (NM 159, Mogollon), 27–28 Sept (Cottonwood Canyon and Jack's Peak, Big Burro Mountains), and 23 Oct (Brushy Mountain) (Table 2).

Table 2. *Crotalus cerberus* Survey locations 2019, with detections.

1.	San Francisco River Canyon West of Luna, Catron County	0 detections
2.	San Francisco River North of Reserve, Catron County	3 *C. molossus*
3.	Dry Blue Creek, Catron County	4 *C. cerberus*
4.	Mogollon Creek, Grant County	1 *C. lepidus*
5.	Silver Creek/Spring Mountain, Catron County	0 detections
6.	Trail Canyon, San Francisco Mountains, Catron County	3 *C. cerberus*
7.	Big Canyon, San Francisco Mountains, Catron County	0 detections
8.	West of Prairie Point, San Francisco Mts., Catron County	2 *C. molossus*
9.	Prairie Point, San Francisco Mts., Catron County	0 detections
10.	SU Canyon, San Francisco Mountains, Catron County	2 *C. cerberus*
11.	Brushy Mountain, South of Mule Creek, Grant County	1 *C. cerberus*
12.	Chimney Rock Canyon, Catron County	0 detections
13.	Willow Springs Canyon, Catron County	2 *C. molossus*
14.	FS Rd 141 West of Sheep Basin Divide, Catron County	2 *C. cerberus*
15.	Citizen Canyon, Catron County	1 *C. molossus*
16.	SA Creek at FS Rd 216, Catron County	1 *C. cerberus*
17.	SA Creek FS Rd 19, Catron County	1 *C. cerberus*
18.	Canovas Creek, Catron County	0 detections

19. Trout Creek, Catron County	0 detections
20. Saliz Creek, Catron County	1 *C. molossus*
21. Cottonwood Canyon, Catron County	0 detections
22. Silver Peak, Catron County	0 detections
23. Negro Hill above Copper Creek, Catron County	0 detections
24. White Rocks Mountain, Catron County	0 detections
25. Steeple Rock Mountain, Grant County	0 detections
26. West Fork Gila River, Catron County	2 *C. molossus,* 1 *C. lepidus*
27. Jacks Peak, Big Burro Mountains, Grant County	0 detections
28. Black Creek Canyon, Grant County	1 *C. molossus*, 1 *C. lepidus*
29. South Fork Negrito Creek, Catron County	0 detections
30. NM Hwy 159, Alma to Mogollon, Catron County	0 detections

The presence of young snakes born last year from two locations indicate likely denning areas. However, no concentrations of snakes were observed. The two snakes found at two locations along SA Creek represent a range extension of approximately six miles north of previously known records for this species in New Mexico.

Distribution of *C. cerberus* in New Mexico

The distribution of *C. cerberus* and other rattlesnake species found in the greater Gila region (*C. viridis, C. lepidus,* and *C. molossus*) is shown in Figure 2. The Eastern Black-tailed Rattlesnake (*C. ornatus*) has been shown as *C. molossus* due to unresolved contact points and taxonomic history. *Crotalus ornatus* is known from the eastern portions of the Gila in the Black Range. *Crotalus cerberus* is primarily been found in Montane Conifer Forest and Mogollon Transition Conifer Forest with only a few records in Madrean Lower Montane Woodlands. *Crotalus molossus* is a generalist found from desert riparian areas to elevations exceeding 2440 m (8000 ft) in the Gila, but is more of a semi-montane species. *Crotalus cerberus* and *C. molossus* occur in syntopy across much of their common range in AZ and NM. Museum records and observations represented in Figure 2 show that *C. molossus* is found more commonly at lower elevations than *C. cerberus*, within Conifer Woodlands and Savannas and Madrean Lower Montane Woodlands, but has been recorded in Montane Conifer Forest. *Crotalus viridis* is

primarily a grassland species showing up along the fringes of the forested portions of the Gila in Conifer Woodlands and Savannas and Madrean Lower Montane Woodlands and has not been found in syntopy with *C. cerberus*. *Crotalus lepidus* is a mountain rock dweller that enters the desert transition zone and appears to have a slight overlap in distribution with *C. cerberus* in the southern slopes of the Mogollon Mountains.

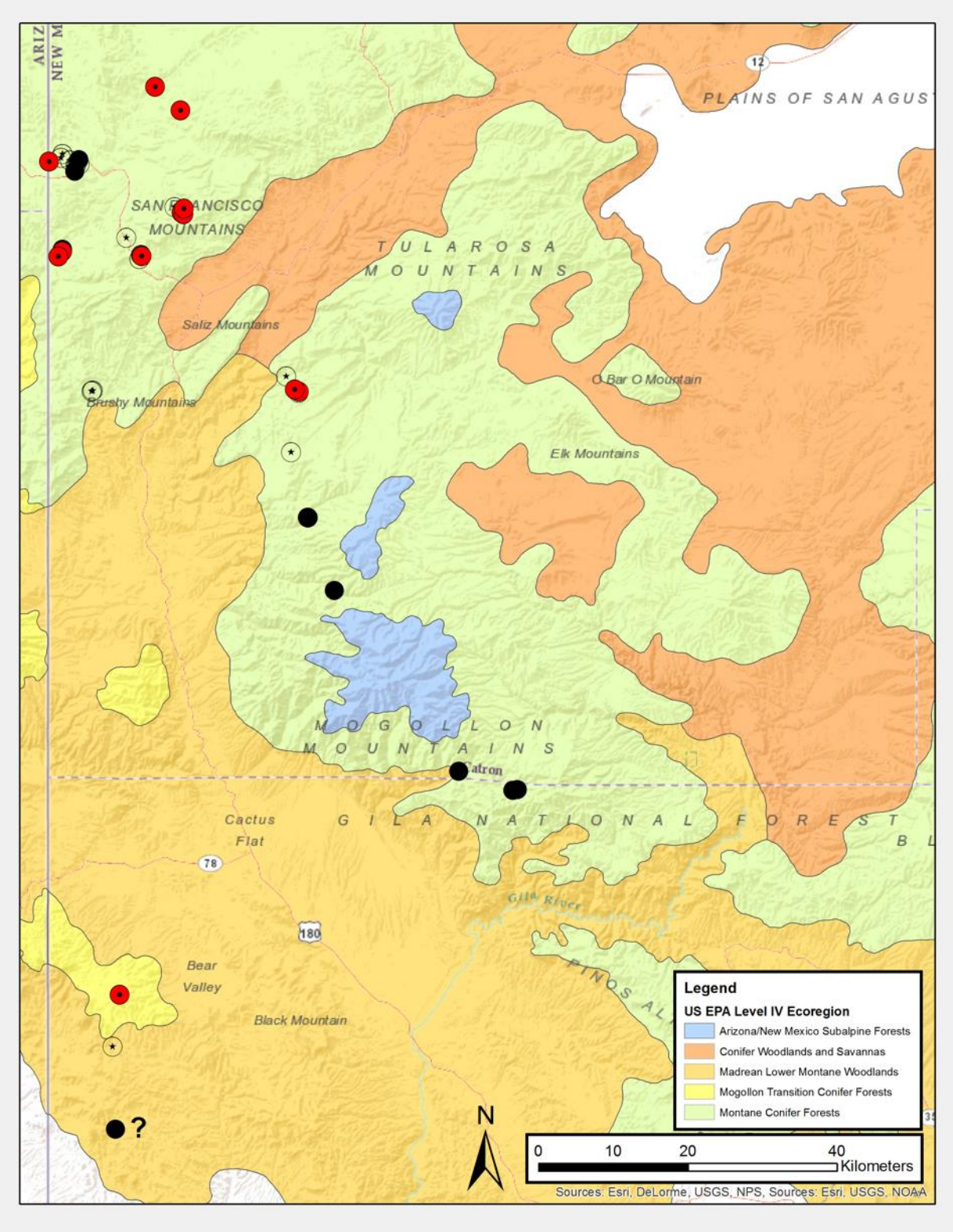

Figure 1. Known localities of *Crotalus cerberus* in southwestern New Mexico based on literature, museum specimens, and observations: 1966–1999 (black dots), 2000–2017 (open circles), and 2018–2019 (red dots).

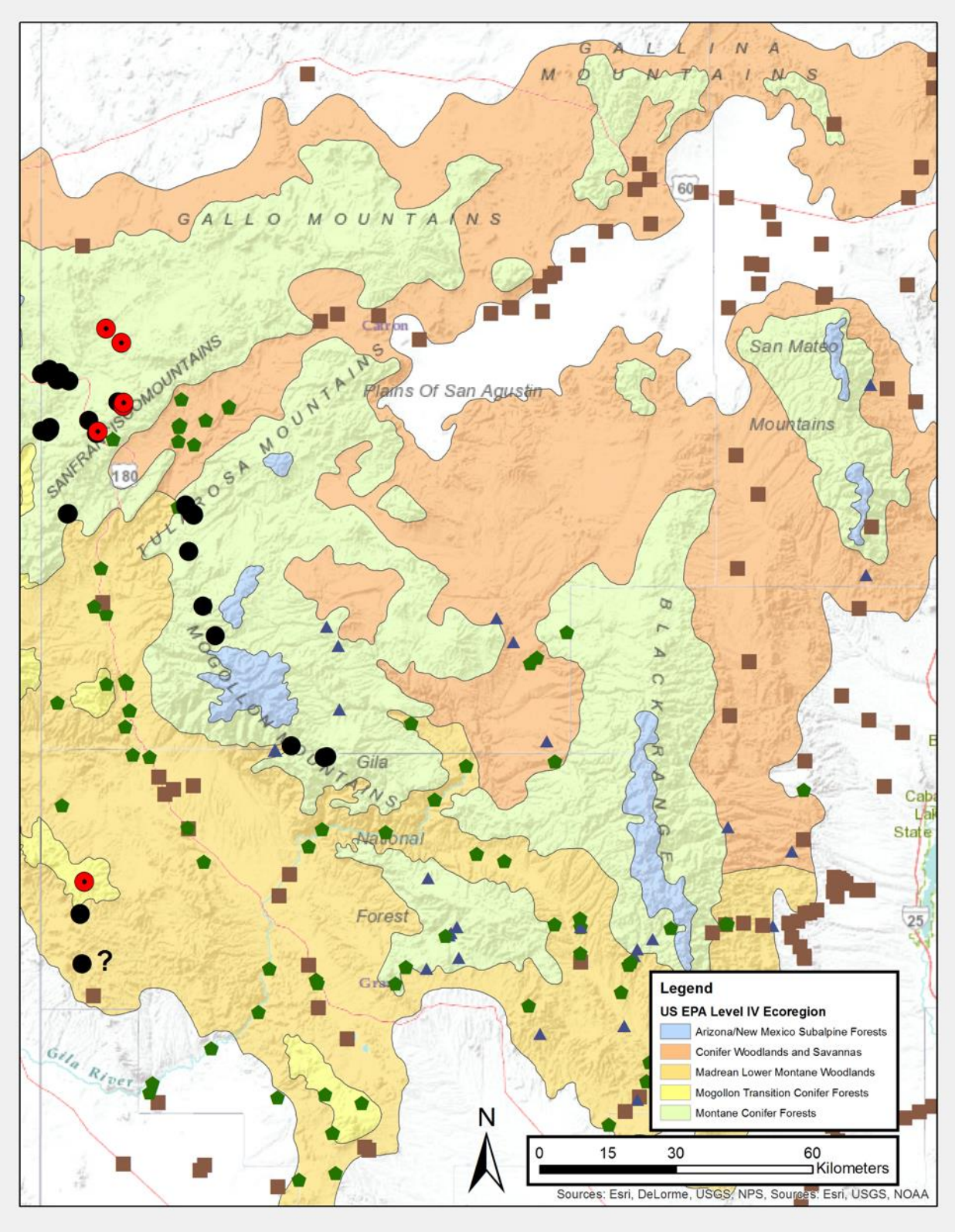

Figure 2. Distribution of rattlesnake species within the greater Gila region, New Mexico. Circles (*Crotalus cerberus*), squares (*C. viridis*), pentagons (*C. molossus*), triangles (*C. lepidus*).

Habitat associations

We observed *C. cerberus* in areas of south or southwest rock outcrops with Ponderosa Pine (*Pinus ponderosa*), Alligator Juniper (*Juniperus deppeana*), Oaks (*Quercus gambelii, Q. grisea, Q. turbinella*), Pinon Pine, and a variety of shrubs (Mountain Mahogany, *Cerocarpus* spp.; Wolfberry, *Lycium* spp.), grasses (muhly, *Muhlenbergia* spp.; grama, *Bouteloua* spp.), and cacti (pricklypear, *Opuntia* spp.; cholla, *Cylindropuntia* spp.; hedgehog cactus, *Echinocereus* spp.), as well as yucca (*Yucca bacata*), agave (*Agave parryi*), and Beargrass (*Nolina microcarpa*), during the spring. In the summer months, snakes were observed in Pinon-Juniper habitats and canyon bottoms.

The classification of Arizona/New Mexico Mountains (Figures 1 and 2) is based on level IV ecoregions from the national classification system by the U.S. Environmental Protection Agency (Omernik and Griffith 2014).

Prey Availability

Potential available prey for *C. cerberus* are lizards, small mammals and birds, with lizards being important prey for young snakes and a diet shift to small mammals and the occasional bird as snakes mature. While prey data are limited, we know that *C. cerberus* preys upon a variety of vertebrate animals. These include lizards: Plateau Lizard (*Sceloporus tristichus,* Schuett et al. 2002), Desert Spiny Lizard (*S. magister,* Loughran et al. 2012), Ornate Tree Lizard (*Urosaurus ornatus*, BLC *pers. obs.*), Chihuahuan Spotted Whiptail (*Aspedoscelis exsanguis,* Hulse 1973), Gilbert's Skink (*Plestiodon gilberti*, Amarello and Smith *pers. obs.*). They also include small mammals: Cactus Mouse (*Peromyscus eremicus*), Harris' Antelope Squirrel (*Ammospermophilus harrisii*), and White-Throated Woodrat (*Neotoma albigula*, Loughran et al. 2012); chipmunks (*Eutamias* [*Tamias*] sp., A. Holycross and T. Brennan *pers. comm.*) and likely squirrels. Birds include: a "desert quail" (likely Gambel's Quail, *Callipepla gambelii*; Meachum 1999), Ash-throated Flycatcher (*Myiarchus cinerascens*, Loughran et al. 2012), Pygmy Nuthatch (*Sitta pygmacea*, Schofer 2007) and American Robin (*Turdus americanus*, Vogrinc et al. 2017).

Figure 3. *Crotalus cerberus* juvenile with large food bolus, Mother Hubbard Canyon, Catron County, 2006.

During our investigation, we trapped Brush Mouse (*Peromyscus boylii*), Pinon Mouse (*P. truei*), Northern Rock Mouse (*P. nasutus*), American Deer Mouse (*P. maniculatus*), Stephens's Woodrat (*Neotoma stephensi*), Mexican Woodrat (*N. mexicana*), and Mogollon Vole (*Microtus mogollonensis*). We observed Abert's Squirrel (*Sciurus abertii*), Red Squirrel (*Tamiasciurus hudsonicus*), Cliff Chipmunk (*Tamias dorsalis*), and Rock Squirrel (*Spermophilus variegatus*) in the San Francisco Mountains (Catron County). Data shared with us (S. Liphart, MSB) from a small mammal survey at Brushy Mountain (South of Mule Creek, Grant County) revealed Brush Mouse (*P. boylii*), Pinon Mouse (*P. truei*), Rock Mouse (*P. nasutus*), White-throated Woodrat (*N. albigula*), and Silky Pocket Mouse (*Perognathus flavus*).

During surveys, we observed Plateau Lizard (*S. tristichus*) and Ornate Tree Lizard (*U. ornatus*) to be common at most sites. Less commonly observed were Many-lined Skink (*Plestiodon multivirgatus*), Clark's Spiny Lizard (*S. clarki*), and Mountain Short-horned Lizard (*Phrynosoma hernandesi*). We also observed droppings of *Neotoma* spp. at most sites. Birds were commonly observed and species diversity varied.

Color variation

Despite the common name of Arizona Black Rattlesnake, this species is highly variable in color and has the ability to alter its color over a short period of time (Schuett et al. 2016 and references). There is an ontogenetic shift in coloration (silver gray and brown as young of year) with a general darkening as snakes age (light brown and dark brown to nearly black as adults), but adult snakes in NM may not regularly express the black coloration observed in snakes found further west in Arizona. A female *C. cerberus* from near the border with Arizona (Figures 3 and 5), which has been in captivity for 13 years and is believed to be at least 15 years of age, has not shown any black coloration. Figure 4 shows variation in adult coloration.

Figure 4. Color variation in male *Crotalus cerberus* from Chimney Rock (top left), Dry Blue (top right), and SA Creek (bottom).

Figure 5. Adult female *Crotalus cerberus* from Mother Hubbard Canyon, approximately 15 years old (photo taken 2019). Same snake as shown in Figure 3, which was photographed in 2006.

Identification

Crotalus cerberus is most similar to the Prairie Rattlesnake (*C. viridis*), which is variable in color across its range in NM, and is sometimes be shades of reddish brown and tan. These two species can be easily separated by ventral coloration, with *C. cerberus* having a mottled venter and *C. viridis* having an un-mottled or immaculate venter as seen in Figure 6.

Crotalus cerberus is further identified by scale arrangement on the head. There are usually two loreal scales on each side (Klauber 1997, Stebbins 2003, Schuett et al. 2016), four or more internasals contact the rostral (Brennan and Holycross 2006), and an intervening scale between the prenasal and first supralabial (Klauber 1997, Schuett et al. 2016).

Figure 6. Ventral and dorsal coloration of *Crotalus cerberus* (top) and *C. viridis* (bottom).

Size

The size of *C. cerberus* varies throughout its range, with larger snakes found in central Arizona in the Catalina and nearby mountain ranges (slightly exceeding 1000 mm SVL). Snakes from more northerly portions of its range rarely exceed 800 mm. *Crotalus cerberus* exhibits sexual dimorphism typical of rattlesnakes with males a bit larger than females. Our data show males averaged 656 mm SVL (n=8) and females averaged 508 mm SVL (n=11, Figure 7). Sexual maturity in males is likely attained around 560 mm SVL (Goldberg 2002) and for females around 460 mm SVL (BLC *pers. obs.*); snakes under 500 mm (males) and 450 mm (females) are considered juveniles.

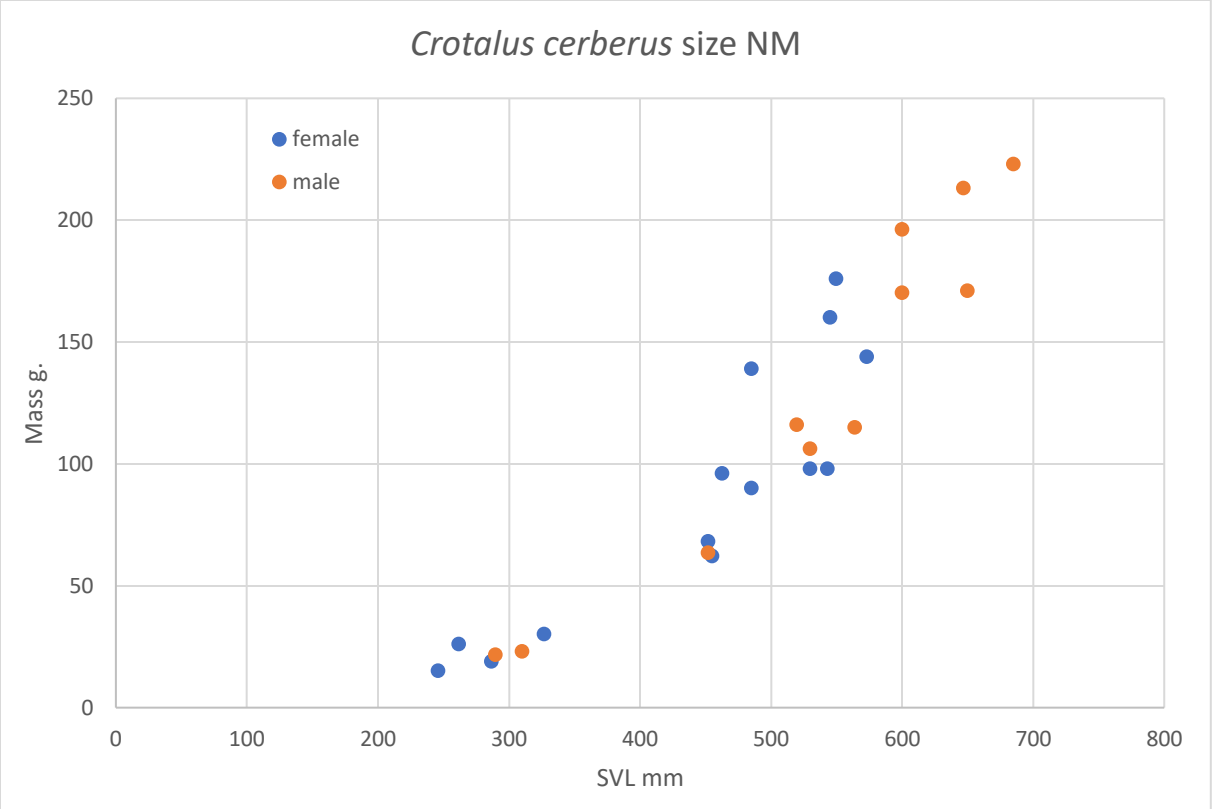

Figure 7. Size distribution of *Crotalus cerberus* in NM of 25 individuals (males n=8, females n=11).

Discussion

The distribution of *C. cerberus* in New Mexico seems to be associated with the eastern extent of the geology of the Mogollon Rim, but the presence of similar geology within the greater Gila Region within the Gila National Forest raises the question of why this species does not seem to be distributed more broadly across this habitat. Conversely, *C. lepidus* is found in the eastern half of the Gila Region but not in the western or across the Mogollon Rim in Arizona. The third species, *C. molossus*, is distributed across the range of the afore mentioned species.

Due to the higher elevations that *C. cerberus* occurs at, climate change is likely to have negative impacts. These impacts are likely to come in the form of stand-replacing wildfire. As humans work to restore forests to natural fire regimes, there are some activities that can be modified to limit the effects to *C. cerberus*. These include lighting burn piles from only one side to allow

snakes and other animals to escape, and educating fire personnel that rattlesnakes are a natural part of the landscape and should be left unmolested.

Further surveys are anticipated in 2020. These surveys are planned to occur in the San Francisco Mountains (Dillon Mountain), Gallo and Mangas mountains, Mogollon Mountains (Mogollon Creek and tributaries), and Glenwood Brushy Mountain.

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