This PDF file is a digital version of a chapter in the 2005 GWS Conference Proceedings. Please cite as follows:

Harmon, David, ed. 2006. *People, Places, and Parks: Proceedings of the 2005 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites.* Hancock, Michigan: The George Wright Society.

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Vertebrate Species Use of Cave Resources in the Carlsbad Caverns Region of the Chihuahuan Desert

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Caves are widely known to provide habitat for a variety of vertebrate species that spend all or significant portions of their life cycles inside the totally dark areas of the caves. It is less well known that caves, and particularly cave entrance areas, can provide an important resource for a wide variety of species. Especially in arid regions, caves may provide temporary relief from extreme temperature or low-humidity conditions. In addition, they may provide hiding places to escape predators, den sites, nest substrates, or hunting locations for predators. Many caves are located in extensive deposits of limestone and gypsum in the Chihuahuan Desert. These caves provide more moderate conditions of temperature and humidity that may be a critical resource for many species.

The Chihuahuan Desert covers a large area of southern New Mexico, western Texas, and the extreme southeastern corner of Arizona. This desert includes an even larger area of Mexico, extending far south in the central plateau. This research is limited to a portion of the Chihuahuan Desert in southeastern New Mexico, in the vicinity of Carlsbad Caverns National Park.

Methods

Data in this analysis were compiled from a variety of sources. The primary sources of information were in the unpublished records in the files of Carlsbad Caverns National Park and the Carlsbad Field Office of the Bureau of Land Management (BLM). Several Internet sites have extensive information on vertebrate species and their habitat usage and requirements. Other standard literature sources were also searched for relevant information.

Direct observations were made in both limestone and gypsum caves of this region. A variety of evidence can be used to indicate the presence of vertebrates in caves. Direct observations are a positive indication of the presence of a species in a cave. Mammal or bird nests also confirm a species' use of a cave. Feathers and recent egg shells confirm that these nests have been used recently. Tracks and scat provide evidence of a species in a cave. Skeletal evidence confirms that an animal was in a cave, but disarticulated skeletal material suggests that it may have been brought into a cave by a predator. Other skeletal material at the bottom of a drop suggests that a species was alive when it entered the cave, but it died as a result of the fall.

Results

The literature and files searches and personal observations provided 657 reports of at least 78 species of vertebrates in the caves of the Chihuahuan Desert in the vicinity of Carlsbad, New Mexico. Vertebrate species have been reported from 149 caves of this region. This

number includes 81 caves within Carlsbad Caverns National Park, 67 caves on land controlled by the Bureau of Land Management, and one cave on state of New Mexico land. A large number of observations were not specific but merely reported unidentified members of various groups of species. In addition to the confirmed observations for this region, literature reports were found documenting cave use by 26 other vertebrate species in the Chihuahuan Desert, 17 of which are present in the Carlsbad vicinity.

One way of analyzing the data was to determine the distribution of each species, or the number of caves in which each species is present. The horizontal axis of Figure 1 represents the number of vertebrate species that are found in the number of caves shown on the vertical axis. The largest numbers of species are reported from only one or two caves, and 63 of the species are reported from five or fewer caves. Two species have been reported in 30 different caves, but only 10 species have been reported from ten or more caves.

These data can also be used to describe the vertebrate diversity within caves (Figure 2). Most of these caves have records of relatively few vertebrates, with 97 caves having reports of only one or two species. Only nine caves have reports of ten or more species of vertebrates, and seven of these caves are within Carlsbad Caverns National Park. The cave in which the greatest number of reported species is Carlsbad Cavern, with 30 species.

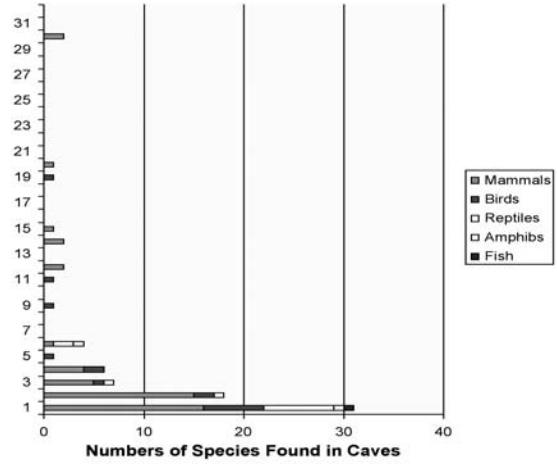


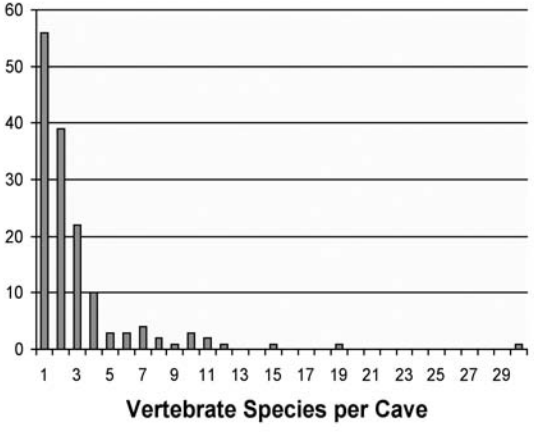
Figure 1. Distribution of vertebrate species found in caves of the Chihuahuan Desert near Carlsbad, New Mexico.

Mammals

Another way to look at these data is by breaking them down taxonomically. At least 49 species of mammals have been reported from 124 different caves in the Chihuahuan Desert near Carlsbad, New Mexico. The total number of species is ambiguous because of unspecified reports of *Myotis* spp., *Peromyscus* spp., *Neotoma* spp., and others. While these reports are likely to be the same species that have been reported in other caves, the possibility exists that they could represent additional species. The mammals reported from these caves represent six orders and 18 families. The orders represented by the most species are bats, carnivores, and rodents.

Most mammals have been reported from relatively few caves, with 33 species reported from three or fewer caves. Nine species have been reported from ten or more caves. The native species most commonly reported are the porcupine, ringtail, mountain lion, wood rat species, mule deer, and Townsend's big-eared bat. Prior to the creation of Carlsbad Caverns

Figure 2. Diversity of vertebrate species in caves in the Chihuahuan Desert near Carlsbad, New Mexico.



National Park, domestic goats were commonly grazed in this region, and their scat and bones are present in numerous caves, and the exotic Barbary sheep has been recorded in several caves.

Birds

Fewer bird than mammal species are reported to be using the caves of this part of the Chihuahuan Desert, with 15 species in 53 caves. These bird species represent seven orders and 12 families of birds. Three orders and eight families are represented by a single species. The orders Strigiformes and Passeriformes account for nine of the reported bird species. The order Falconiformes is based on a single, old record of a ferruginous hawk nesting in the entrance of Carlsbad Cavern (Bailey 1928).

The cave swallow is the most commonly reported bird species in these caves, with 48 records from 19 different caves, all but one of which are located within Carlsbad Caverns National Park. This species is also the most likely bird to go into caves to the limit of the twilight zone. Most other birds are likely to remain in better lighted areas closer to entrances. The great horned owl is also commonly reported, with 13 confirmed records in 11 different caves, and many unidentified owl records could be this species.

The relative lack of records for bird species could be the result of the inability of most cavers to identify birds to the species level or simply the failure to record common species. For example, the rock wren could easily be overlooked, but it is likely to be present at some time in almost every cave entrance of this vicinity.

Reptiles, amphibians, and fish

Reptiles are frequently encountered in the entrances of caves in this part of the Chihuahuan Desert. Eleven species of reptiles in two orders and five families have been documented in at least 35 caves. As with other classes of vertebrates, these numbers are uncertain because of numerous reports of unidentified snakes and lizards.

Rattlesnakes are the most commonly encountered reptile in these caves, with 15 confirmed records of three species in 14 different caves. An additional 16 reports of rattlesnakes in 13 caves did not identify the species. So far, western diamondback rattlesnakes have been reported only from BLM caves, and black-tailed rattlesnakes have been reported only from caves in Carlsbad Caverns National Park, although future surveys are likely to expand the known distribution of both of these species. Mottled rock rattlesnakes have been reported from caves in both areas. Reports of lizards in caves are surprisingly scarce, given their rela-

tive abundance in arid regions and their inclination to use crevices in rocks. There are only three confirmed records of lizard species, plus one unidentified lizard.

Relatively few amphibians have been reported from caves of this region, probably a consequence of the arid surface conditions. The two confirmed species, representing two orders and two families, have been recorded in nine caves. Most reports of amphibians are from stream conduit caves in the BLM gypsum karst areas east of the Guadalupe Mountains. No amphibians have been reported from caves in Carlsbad Caverns National Park. The most commonly reported amphibian is the tiger salamander, primarily from the gypsum caves. No cave-adapted amphibians are known from this region.

Only one fish, representing one family and one order, was reported in these caves, in a gypsum stream conduit where it was likely washed in from the surface. This fish was identified as a plains killifish, which is native to the Pecos River drainage.

Discussion

Vertebrate species are using these caves for a variety of reasons. Bats and birds use the caves as daytime roosts, nighttime roosts, and migratory roost sites. Many species of mammals and birds will use caves as nest or den sites. Wood rat nests have been reported in many caves (Mosch et al. 1991; Novack 2004; Allison 2004), but the species building the nests cannot be identified without visual confirmation. Bailey (1928) reported that mountain lions were using caves as den sites, and lions have been encountered in caves in this region (Parent 1998; Allison and Roemer 1998). Piles of small mammal bones may indicate the presence of carnivore den sites. Porcupine den sites have been noted in numerous caves (Fleming and Hummel 1977b; Hummel 1977), and live porcupines have been encountered (Pate 1992; Fleming 1977).

Several bird species are known to use caves in this vicinity for nest sites, with confirmed nesting for eight species: turkey vulture, ferruginous hawk, great horned owl, white-throated swift, Say's phoebe, cave swallow, rock wren, and canyon wren (Bailey 1928; Belski 1989; Fleming and Hummel 1977a; Lindsley 1967; Pate et al. 1995; Spangle and Thompson 1959). The cave swallow is the most common nesting bird in these caves, with nesting confirmed in at least 15 caves. Bats use several caves in this region as maternity colonies, the best known of which is Carlsbad Cavern.

Caves serve as hibernacula for a variety of species. As noted above, bats have been observed hibernating in several caves. The poorwill is the only bird known to hibernate, and it could use caves in this region as hibernation sites. It has been reported hibernating (not in a cave) at Carlsbad Caverns National Park (S. West, pers. comm.), and it has been observed in a crevice in a pit entrance to a cave in the park (P. Seiser, pers. comm.). It is likely that some reptiles and amphibians use caves as hibernacula, but there are no documented observations in the caves of the Carlsbad vicinity.

Caves in this arid region are likely to provide water sources for a variety of animals. Mule deer and bighorn sheep have been reported to get water from pools in caves in Slaughter Canyon (Bailey 1928; Welbourn 1978). It seems almost certain that other species are using these water sources, but if it has been observed, it was not reported.

Some species are apparently using caves as foraging sites. Bailey (1928) reported that white-footed mice were common throughout Carlsbad Cavern and were feeding on crickets and food dropped by tourists. Ringtails are likewise found in deep areas of Carlsbad Cavern (Bailey 1928; D. Pate, pers. comm.), and it seems likely that they are feeding on mice. This evidence of ringtail scat and a pile of swallow feathers suggests that the ringtail is preying on the cave swallows. Bailey (1928) also suggested that mountain lions were using a cave with a large entrance as a hunting site. A paralyzed mouse seen in the entrance of a cave on Carlsbad Caverns National Park had probably been bitten by a rattlesnake that was seen nearby (Reames and Barber 2003).

It seems likely that animals are using the caves to find relief from extreme conditions of high temperature and low humidity, and favorable microclimates within caves are likely to be deliberately selected by many species. However, there have been no direct physiological studies to confirm this hypothesis.

Numerous species of mammals have been identified through the presence of tracks or scat, indicating use of the cave. Birds and reptiles may also leave evidence of this type in caves. These observations could fall into the category of incidental use, and evidence of this sort cannot be interpreted to explain why the animal was in the cave.

Another category of use could be called unintentional use. Animal remains found at the bottom of entrance pits probably did not intend to enter a cave, and once in, they were unable to get out. In many cases, these animals would be killed by the fall. However, some species, particularly snakes and lizards, appear to survive relatively long drops. Skeletal material found in some caves suggests that these animals (or parts thereof) may have carried into the caves as prey items of carnivores. The location of jackrabbit and cottontail bones in small alcoves in a cave and the presence of ringtail tracks in these areas suggest that ringtails could have carried these animals into the cave. Deer legs found in a cave with a large entrance were probably brought into the cave by a large predator (Carrington 1999), and mountain lions are known to use this cave (Roemer 2000).

Conclusions and recommendations

The results of this study clearly demonstrate that caves of the Chihuahuan Desert are being used regularly by a wide variety of vertebrates. This level of usage and the documented types of usage by these species demonstrate that the caves provide a habitat feature that is important for many species. In an arid environment with extremes of high temperatures and low relative humidity, these caves could be critical to the survival of many vertebrates. Although none of the species observed in these caves are listed as threatened or endangered, their continued presence in the Chihuahuan Desert may depend on these cave resources.

With so many species depending on the caves of this region, it is imperative that management agencies, primarily the National Park Service and the Bureau of Land Management, maintain policies that provide protection for these species and their habitat requirements. Most caves in Carlsbad Caverns National Park are administratively closed, although three caves are open for commercial tours (including tours in undeveloped areas) and eight others are open for recreational caving. As noted above, Carlsbad Cavern has a high diversity of

species in spite of the heavy annual visitation. The Bureau of Land Management maintains a permit system for several of its caves, and there are some seasonal restrictions on visitation because of bats. However, many BLM caves are open for recreational caving with no restrictions.

Based on the evidence of vertebrate use in these caves, potential impacts on these wildlife species and their habitat requirements must be considered in any action affecting these caves. In addition, when these agencies are giving permits for recreational caving or for scientific research, they should provide the permittees with information about wildlife species using the caves and any precautions they should take to minimize impacts to these species.

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