

# Late Quaternary Brown Bear (Ursidae: *Ursus* cf. *arctos*) From a Cave in the Huachuca Mountains, Arizona

Nicholas J. Czaplewski

Oklahoma Museum of Natural History, University of Oklahoma, Norman, Oklahoma

Steve Willsey

Hereford, Arizona

**Abstract**—In 2008, Steve Willsey discovered the fragmentary cranium of a bear loose on the floor of a cave at about 2270 m elevation near the crest of the Huachuca Mountains. In 2009, we revisited the cave to examine the specimen with the intention of identifying the species. We photographed and measured the main pieces and left them in the cave. The skull is from an adult, probably male, with prominent sagittal crest. Bears are highly variable morphologically and their remains are difficult to identify. The morphological features and measurements of the Huachuca Mountains cranium are somewhat equivocal, but most available features indicate a brown bear, *Ursus* cf. *arctos*. Some parts are encrusted with carbonate and could be better examined after collection and preparation as well as comparison with late Pleistocene brown and black bears. Based on its state of preservation, the cranium possibly represents a late Pleistocene occurrence, which could be determined by radiometric dating. There is no previous fossil record of *U. arctos* in the Sky Islands, nor in the rest of Arizona, New Mexico, Chihuahua, or Sonora. Despite the lack of other fossil records in the region, this late Quaternary occurrence affirms the historic records of the species in the Apache Highlands before extirpation.

## Introduction

As with the dynamics of diverse indigenous cultures of Apacheria before colonization, an understanding of the present-day biodiversity of the Apache Highlands region can benefit from the temporal perspective of recent geological time (Martin 2005). The Quaternary fossil record may also inform certain management decisions. Historically, grizzly (brown) bears occurred throughout the Sky Islands region and beyond (see map of historic records in Brown, 1985:42-43; also in Brown and Davis 1995; Cortés-Calva 2000; Pavlik 2006). Most grizzly bears were killed out during the second half of the nineteenth century, with few surviving in the Southwest until the mid-twentieth century. The latest historical record in southwestern North America was about 1976 in northern Sonora (Gallo-Reynoso and others 2008). Black bears are known widely throughout Apacheria from late Pleistocene to the present day. We report an as-yet undated Quaternary occurrence of a probable brown bear, *Ursus* cf. *U. arctos*, in a high-elevation cave in the Huachuca Mountains, Cochise County, Arizona.

## Materials and Methods

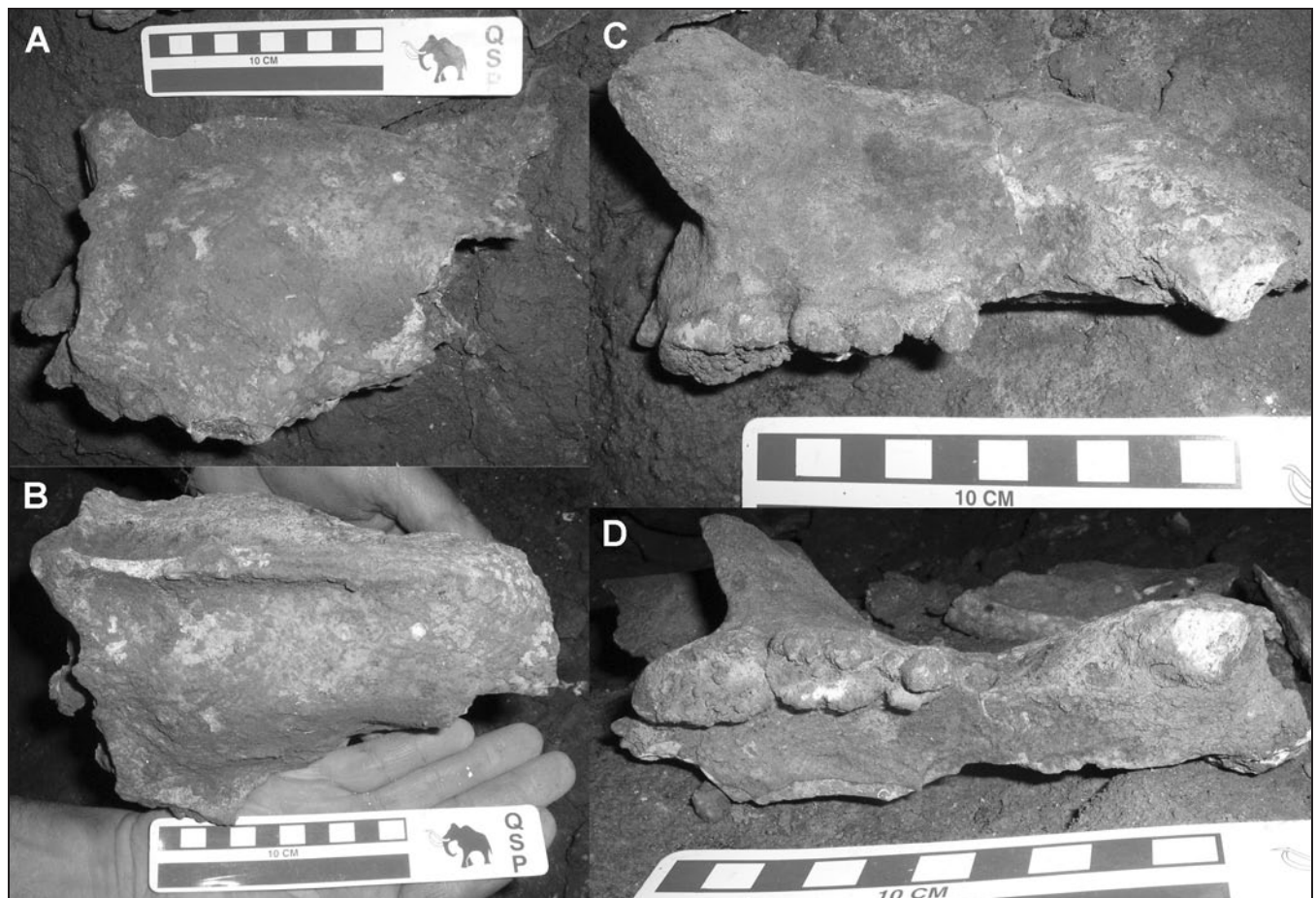
Steve Willsey discovered the fragmentary cranium of a bear loose on the floor of a cave at about 2270 m elevation near the crest of the

Huachuca Mountains, Arizona, in 2008. We revisited the cave in 2009 to examine the specimen with the intention of identifying the species. We photographed and measured the main pieces and left them in the cave. The skull has a prominent sagittal crest indicating an adult, probably male individual. Some parts are encrusted with carbonate and could be better examined after collection and preparation as well as direct comparison with late Pleistocene brown and black bears. Bears are highly variable morphologically and their remains are difficult to identify. In parts of North America, many black bears (*Ursus americanus*) were larger in the late Pleistocene and underwent a size reduction in the Holocene, further complicating the identification of fossil bears.

The cranium is broken into several pieces (fig. 1). The braincase is mostly intact and forms the largest piece with the ethmoid plate preserved anteriorly. Both zygomatic arches are broken away at their bases, the left mastoid, petrosal, and occipital condyle are missing. The sagittal crest is long, tall, and strong. A fragment of the right frontal bone includes the postorbital process. The right maxilla-premaxilla is broken into two pieces and includes the anterior root of the zygomatic arch. Several small pieces also are present. Teeth I1 and I2 are not preserved, while I3 and C1 are broken off at the alveolar rims but the root of each is present. Crowns of P4, M1, and M2 are present. Posterior to the canine, the maxilla and cheek teeth are encrusted with carbonate; however, at least two empty alveoli for small premolars are present, one posterior to C1 and one anterior to P4. P4 is encrusted with carbonate but appears to have a well-developed median accessory cusp. M2 is broadest anteriorly rather than at its midpoint.

---

In: Gottfried, Gerald J.; Ffolliott, Peter F.; Gebow, Brooke S.; Eskew, Lane G.; Collins, Loa C., comps. 2013. Merging science and management in a rapidly changing world: Biodiversity and management of the Madrean Archipelago III; 2012 May 1-5; Tucson, AZ. Proceedings. RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.



**Figure 1**—Portions of a Quaternary bear cranium from a cave in the Huachuca Mountains, Arizona. A-B, braincase in right lateral (A) and dorsal (B) views. C-D, right half of rostrum with parts of the jugal, palatine, premaxillary, and maxillary including the root of the upper canine, alveoli for small premolars, and intact P4-M1-M2, in lateral (C) and palatal (D) views. Much of the teeth and bone surface is encrusted with carbonate.

## Results and Discussion

Qualitative morphological characteristics of the cranium and teeth distinguish the Huachuca Mountains cranium as a member of the subfamily Ursinae (brown and black bears) rather than the Tremarctinae (short-faced and spectacled bears), which are also known as fossils in the Pleistocene and Pliocene epochs in the Sky Island region. Measurements of the cranium are provided in table 1. By comparison with recent brown and black bears from the Southwest (Hoffmeister 1986), the cave fossil shows similarities with both brown and black bears. In two qualitative characters the fossil matches brown bears: the median accessory cusp on P4 is normally present in brown bears *Ursus arctos* and normally absent in black bears, *Ursus americanus*; and the M2 being broadest anteriorly characterizes brown bears, whereas in black bears M2 is broadest at the midpoint. M1 dimensions of the fossil are consistent with grizzly bears in quantitative mensural characters that have been used previously to distinguish the two species (table 1), whereas M2 dimensions are larger than or consistent with the largest recent black bears (Miller and others 2009) but near the average for Sonoran brown bears. Gordon (1977) suggested that the M1 is greater than 20.4 mm long and 10.5 mm wide in grizzly bears and less in black bears; the Huachuca Mountains bear's M1 is 20.8 x 15.6 mm. The Huachuca Mountains bear's cranium is also larger in the few available comparative measurements than a late Pleistocene

fossil black bear from Papago Springs Cave, Canelo Hills, Arizona (Skinner 1942). The morphological features and measurements of the Huachuca Mountains cranium are somewhat equivocal but most available features indicate a brown bear, *Ursus cf. arctos*. Based on its state of preservation, the cranium possibly represents a late Pleistocene occurrence, which could be determined by radiometric dating. There is no previous fossil record of *U. arctos* in the Sky Islands, nor in the rest of Arizona, New Mexico, Chihuahua, or Sonora. If the fossil is collected, it could be cleaned of carbonate and repaired. It could then be compared with recent specimens from southwestern North America of black and brown bears, and also with late Pleistocene black bears with a view toward further discriminating the species.

The Huachuca Mountains fossil is important because it provides the first late Pleistocene fossil record of a probable brown bear in Apacheria and in all of Arizona, New Mexico, Chihuahua, and Sonora (Arroyo-Cabral and others 2002; Harris 1993, 2005, 2012; Mead and others 2005; Morgan and Lucas 2005; White and others 2010). Although they might not have been continuously contemporaneous in the region, this record indicates that three bears, *U. cf. arctos*, *U. americanus*, and *Arctodus simus* (giant short-faced bear; Czaplewski unpublished data) occurred in the Madrean Archipelago in the late Pleistocene. Stable isotope analyses indicate that short-faced bears were highly carnivorous and possibly specialized as scavengers compared to brown bears (Matheus 1995). Perhaps the presence of

**Table 1**—Measurements (in mm) of intact portions of the Huachuca Mountains, Arizona, fossil bear cranium compared with some of the same measurements published for recent bears in the Sky Islands region.

| Element measured                  | Huachuca Mts. <i>Ursus</i> cranium | <i>Ursus arctos</i> SON <sup>a</sup> | <i>Ursus arctos</i> CHI <sup>b</sup> | <i>Ursus arctos</i> AZ, NM <sup>c</sup> | <i>Ursus americanus</i> AZ, NM <sup>d</sup> |
|-----------------------------------|------------------------------------|--------------------------------------|--------------------------------------|-----------------------------------------|---------------------------------------------|
| Foramen magnum diameter           | [35] <sup>e</sup>                  |                                      |                                      |                                         |                                             |
| Breadth across occipital condyles | [71]                               |                                      |                                      |                                         |                                             |
| Braincase breadth                 | 109.3                              | 89                                   | 96.7<br>(95-98)                      |                                         |                                             |
| Maxillary toothrow length         | 119.7                              |                                      |                                      |                                         |                                             |
| C1 length                         | 22.0                               |                                      |                                      |                                         |                                             |
| C1 width                          | 15.6                               |                                      |                                      |                                         |                                             |
| P4-M2 length                      | 63.5                               | 56                                   |                                      | 74.07<br>(67.2-80.0)                    | 53.07<br>(50.1-57.6)                        |
| P4 length                         | 13.5                               | 19.2                                 | 21.7<br>(20.9-21.9)                  |                                         |                                             |
| P4 width                          | 11.4                               |                                      |                                      |                                         |                                             |
| M1 length                         | 20.8                               |                                      |                                      |                                         |                                             |
| M1 width                          | 15.6                               |                                      |                                      |                                         |                                             |
| M2 length                         | 29.1                               | 26.8                                 |                                      | 36.09<br>(33.1-39.9)                    | 25.31<br>(22.7-28.6)                        |
| M2 width                          | 16.6                               | 15.4                                 |                                      | 19.62<br>(18.2-20.5)                    | 15.08<br>(13.8-16.0)                        |

<sup>a</sup>One *U. arctos* of unknown sex from Sonora (SON) provided by Gallo-Reynoso et al. (2008).

<sup>b</sup>Mean and observed range of 3 male *U. arctos* from Chihuahua (CHI) provided by Anderson (1972).

<sup>c</sup>Mean and range of 10 male *Ursus arctos* from Arizona (AZ) and New Mexico (NM) provided by Hoffmeister (1986:tables 5.72, 5.73).

<sup>d</sup>Mean and range of 8 male *Ursus americanus* from Arizona and New Mexico (Hoffmeister 1986:tables 5.72, 5.73).

<sup>e</sup>Brackets [ ] indicate estimated measurement of broken element.

the carnivorous short-faced bear constrained the body size of grizzly bears in the Pleistocene.

Pavlik (2006) reviewed late Pleistocene records of black bears in the Huachuca Mountains and Sky Islands as well as many other aspects of their biology and conservation. He noted that black bears still occur in the Huachuca Mountains in modest numbers amid increasing pressure from human encroachment, habitat loss, and recent drought and fire. Although undated, the occurrence of a brown bear in the Huachuca Mountains at some time during the late Quaternary affirms the historic records of the species in the Apache Highlands before it was eradicated and lends support to estimates of the suitability of still-existing habitat there for the species (Povilitis 1995). We must adopt a cultural ecological moral to share this region with the bears and other living things, understand that they and we are integrative forces in the region, and pass on the same responsibilities to our children in the greater scheme of conserving bears across the region.

## Acknowledgments

We acknowledge the help of Brenda Haynes, Ellen Preiss, and Kyle Davies in the fieldwork and Juan Pablo Gallo Reynoso, Steve Pavlik, and Sheridan Stone for helpful comments on the manuscript.

## References

- Anderson, Sydney. 1972. Mammals of Chihuahua: taxonomy and distribution. *Bulletin of the American Museum of Natural History* 148: 149-410.
- Arroyo-Cabral, Joaquín; Polaco, O. J.; and Johnson, E. 2002. La mastofauna del cuaternario tardío en México. Pp. 103-123 in M. Montellano Ballesteros and J. Arroyo-Cabral (eds.) *Avances en los estudios paleomastozoológicos. Colección Científica, Serie Arqueología, Instituto Nacional de Antropología e Historia, México*, D. F.
- Brown, David E. 1985. *The Grizzly in the Southwest: Documentary of an extinction*. University of Oklahoma Press, Norman. 274 pp.
- Brown, D. E.; and Davis, R. 1995. One hundred years of vicissitude: Terrestrial bird and mammal distribution changes in the American Southwest, 1890-1990. Pp. 231-244 in *Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and northwestern Mexico*. Gen. Tech. Rep. RM-GTR-264. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 670 pp.
- Cortés-Calva, P. 2000. Familia Ursidae. Pp. 707-716 in S. T. Álvarez-Castañeda and J. L. Patton (eds.) *Mamíferos del Noroeste de México*. Centro de Investigaciones Biológicas del Noroeste, S. C.
- Gallo-Reynoso, Juan Pablo; Van Devender, T. R.; Reina-Guerrero, A. L.; Egido-Villarreal, J.; and Pfeiler, E. 2008. Probable occurrence of a brown bear (*Ursus arctos*) in Sonora, Mexico, in 1976. *Southwestern Naturalist* 53:256-260.
- Gordon, K. 1977. Molar measurements as a taxonomic tool. *Journal of Mammalogy* 58:247-248.
- Harris, Arthur H. 1993. Quaternary vertebrates of New Mexico. *New Mexico Museum of Natural History and Science Bulletin* 2:179-197.
- Harris, Arthur H. 2005. Caves as unique resources for Pleistocene vertebrate faunas. *New Mexico Museum of Natural History and Science Bulletin* 28:249-251.
- Harris, Arthur H. 2012. Pleistocene vertebrates of New Mexico and trans-Pecos Texas. Online: [www.utep.edu/leb/pleistNM/forword.htm](http://www.utep.edu/leb/pleistNM/forword.htm). [accessed 4 April 2012.]
- Hoffmeister, Donald F. 1986. *Mammals of Arizona*. University of Arizona Press and Arizona Game and Fish Department.
- Martin, Paul S. 2005. Ghostly grazers and sky islands. Pp. 26-34 in *Connecting mountain islands and desert seas: Biodiversity and management of the Madrean Archipelago II. Proceedings RMRS-P-36*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 631 pp.
- Matheus, Paul E. 1995. Diet and co-ecology of Pleistocene short-faced bears and brown bears in eastern Beringia. *Quaternary Research* 44:447-453.

- Mead, James I.; Czaplewski, N. J.; and Agenbroad, L. D. 2005. Rancholabrean (late Pleistocene) mammals and localities of Arizona. R. D. McCord (ed.) Vertebrate Paleontology of Arizona. Mesa Southwest Museum Bulletin 11:139-180.
- Miller, Edward H.; Mahoney, S. P.; Kennedy, M. L.; and Kennedy, P. K. 2009. Variation, sexual dimorphism, and allometry in molar size of the black bear. *Journal of Mammalogy* 90(2):491-503.
- Morgan, Gary S.; and Lucas, S. G. 2005. Pleistocene vertebrate faunas in New Mexico from alluvial, fluvial, and lacustrine deposits. *New Mexico Museum of Natural History and Science Bulletin* 28:185-248.
- Pavlik, Steve. 2006. *Ursus* in a Sky Island Range: The ecology, history, and management of black bears in the Huachuca Mountains of southeastern Arizona. 58 pp. Online: <http://blogs.nwrc.edu/pavlik/papers/>.
- Povilis, Tony. 1995. A nature reserve system for the Gila River-Sky Island region of Arizona and New Mexico: Some preliminary suggestions. Pp. 534-541 in Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and northwestern Mexico. Gen. Tech. Rep. RM-GTR-264. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 670 pp.
- Skinner, Morris F. 1942. The fauna of Papago Springs Cave, Arizona, and a study of *Stockoceros*; with three new antilocaprine from Nebraska and Arizona. *Bulletin of the American Museum of Natural History* 80(6):143-220.
- White, R. S.; Mead, J. I.; Baez, A.; and Swift, S. L. 2010. Localidades de vertebrados fósiles del Neógeno (Mioceno, Plioceno y Pleistoceno): una evaluación preliminar de la biodiversidad del pasado. Pp. 51-72 in F. E. Molina-Freaner y T. R. Van Devender (eds.) *Diversidad Biológica de Sonora*. Universidad Nacional Autónoma de México, México.