Pleistocene Vertebrate Fossils from Pinto Basin, Joshua Tree National Park, Mojave Desert, Southern California

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ABSTRACT

The Pinto Basin in Joshua Tree National Park is a recognized but largely unexplored site for Quaternary fossil remains. Lacustrine exposures in this area have yielded abundant but fragmentary Pleistocene vertebrate fossils. Remains consist primarily of isolated dental and distal appendicular elements. Large and small horses and camels are most commonly represented, but specifically diagnostic fossils are rare.

New studies initiated by the San Bernardino County Museum (SBCM), in cooperation with the Joshua Tree National Park Association, focus on renewed recovery and preservation of vertebrate fossils as well as their geologic and taphonomic context. More than 70 discrete fossil localities have been identified since early 2002. Fossils recovered during this period are housed at the SBCM in preparation for eventual long-term curation at the Park. GPS data were acquired for all new localities, for inclusion in the Park's digital overlay.

New discoveries include remains of *Canis* (wolf-sized) and a probable mammoth (cf. *Mammuthus*), both new records for the fauna. Teeth of extinct horses (*Equus*) exhibit morphology strongly suggestive of a Pleistocene age for the fossils; however, previous suggestions of a late Pleistocene (Rancholabrean) age are not supported at present. Most fossils occur as isolates, but some localized concentrations of fossils are indicative of more complete and extensive remains yet present in the subsurface.

Previous investigations in the region studied whether humans and extinct Pleistocene megafauna co-occurred in the area. The present study confirms the interpretation that Holocene artifacts present in Pinto Basin are associated with Pleistocene fossils because of deflation. Recommendations for future efforts to properly manage and conserve fossil resources include regular field inspection, ongoing laboratory analysis, and long-term preservation and storage in a federally recognized, accredited repository.

Figure 1. Distal metapodial of a small camel (*?Hemiauchenia*), recovered from the Pinto Basin region by H. Gregory McDonald of the National Park Service in April, 2001. This find led to renewed interest in effective management of paleontologic resources in Joshua Tree National Park.

Figure 2. Overview of the Pinto Basin region of Joshua Tree National Park. Paleontologists from the San Bernardino County Museum (at left) stand atop lacustrine beds of the informally-designated Pinto Formation. View is looking southeast.

BACKGROUND

The presence of vertebrate fossils in Pinto Basin was first documented by Campbell and Campbell (1935), who briefly mentioned the presence of mineralized vertebrate bones – mainly horse and camel. These authors noted that the fossils appeared to be derived from somewhat older sediments than the cultural materials, but nevertheless proposed that the artifacts and the vertebrate fossils might potentially be coincident temporally as well as geographically. However, a depositional hiatus between the cultural deposits and the older bone-bearing lacustrine sediments [the latter named the Pinto Formation by Scharf (1935)] was later proposed by Jefferson (1973, 1986). This interpretation proposed that sedimentary deflation due to eolian conditions winnowed cultural materials from mid-Holocene alluvium and redeposited these items onto the eroded surface of the Pinto Formation.

In the Pinto Wash region of the eastern Pinto Basin, Holocene lithic artifacts are found in association with fragmented, wind abraded and occasionally burned bone debris (Jefferson, 1973). These bones represent a relatively modern xeric fauna including *Gopherus* sp. cf. *G. agassizii* (desert tortoise), *Dipsosaurus dorsalis* (desert iguana), *Sauromalus obesus* (chuckwalla), Aves (birds), *Sylvilagus* sp. cf. *S. audubonii* (desert cottontail), *Lepus* sp. (jackrabbit), *Spermophilus* sp. (squirrel), *Neotoma* sp. (wood rat), *Canis* sp. cf. *C. latrans* (coyote), *Vulpes* sp. (fox), *Urocyon cinereoargenteus* (grey fox), *Lynx* sp. cf. *L. rufus* (bobcat), and *Ovis* sp. cf. *O. canadensis* (bighorn sheep) (Jefferson, 1991a).

In contrast, the Pleistocene fauna from the Pinto Basin consists primarily of extinct large mammals. These fossils are also fragmented and wind abraded, but are also dark in color and heavily permineralized; the latter condition clearly distinguishes the fossil bones from the more recent Holocene bones associated with cultural materials (Jefferson, 1991a). The fossils were recovered from generally horizontal, well-bedded claystones, sandstones and siltstones exposed in low bluffs along Pinto Wash. To the south and southeast, fluvio-lacustrine sediments originally interpreted to be laterally correlative with the fossil-bearing sediments are coarser, and underlie vesicular basalt flows of Tertiary (Miocene) age (Carter *et al*., 1987; Trent and Hazlett, 2002). These sediments are red in color, indicating heating by the Miocene basalts (Jefferson, 1991a). Since the fossils reported from the Pinto Basin date to the Pleistocene Epoch (Jefferson, 1973, 1986, 1991a), as confirmed herein, these fluvio-lacustrine sediments and the Pleistocene fossil-bearing lake sediments are preliminarily interpreted here to be distinct lithologic units.

Taxa previously reported from the Pleistocene lacustrine Pinto Formation include *Equus* sp. cf. *E. conversidens* (extinct small horse), *Equus* sp. (extinct large horse), *Camelops* sp. (extinct large llama-like camel), *Hemiauchenia* sp. (extinct North American llama), and *Ovis* sp. (sheep) (Jefferson, 1991a). However, as noted by Scott (1997), many of the records of *Equus conversidens* from the Mojave Desert are based upon insufficiently complete or diagnostic fossils, and so several of these records – including those from the Pinto Basin – are better referred to "*Equus* sp. (small)" with no species assignment. Extinct *Bison* has also been reported from the Pinto Basin (Jefferson, 1992), but the specimen in question is actually *Camelops* (Scott and Cox, 2002).

Figures 3 (left) and 4 (above). Quarry yielding multiple fossils of subadult llama (*?Hemiauchenia* sp.) (left); vertebra from the site (above). This site is significant, in that it indicates that relatively concentrated fossil deposits, rather than only isolated elements, are present in the area.

METHODS

The initial field survey was conducted in February, 2003; subsequent field efforts were conducted in April, 2004. New paleontologic resource localities identified during the field surveys were described, mapped and photodocumented in the field; field numbers were assigned in the field and recorded along with lithologic and stratigraphic descriptions. Locality data for each resource locality was recorded in the field through use of Global Positioning System (GPS) receivers. Use of the GPS units also enabled taphonomically important positional data to be registered, as the orientation of the fossil resource(s) relative to magnetic north can be recorded (see below).

Figure 7 (left). Fragment of tooth enamel plate, assigned to cf. *Mammuthus*. This find suggests a Pleistocene age for the assemblage.

Figure 8 (right). *Canis* sp. (wolf-size), lower incisor. This fossil is the first record of Pleistocene carnivorans from the Pinto Basin.

RESULTS

A total of more than 120 discrete fossil specimens (>500 total specimens, including fragments) were recovered from 37 *in situ* and 33 "float" resource localities during the surveys. These fossils are presently housed in the collections of the Division of Geological Sciences, SBCM, where detailed preparation and stabilization as well as more precise identification are currently underway. Fossils represented conformed with previously published faunal lists for the Pinto Basin (Jefferson, 1973, 1986, 1991a), although previously-unrecorded taxa were also identified (see "Discussion").

Figure 6 (right). LACM 3414/47255, broken fragment of right scapula of *Camelops* sp. including the supraglenoid tubercle and part of the coracoid process. Originally identified as a calcaneum fragment of *Bison*, this fossil was thought to indicate that the Pinto Basin assemblage dated to the Rancholabrean North American Land Mammal Age. Re-examination of this specimen in the collections of the Natural History Museum of Los Angeles County rejected this identification. As a result, the Pinto Basin fossils cannot be assigned to the Rancholabrean NALMA at present.

Figure 5 (left). Occlusal surface of an upper left premolar of an extinct large horse, *Equus* sp. The length of the protocone (indicated) suggests a Pleistocene age for this and associated fossils; earlier Pliocene equids generally exhibit shorter, more rounded protocones.

Figure 9 (right). Tertiary basalts overlying lacustrine sediments uplifted along the southern edge of Pinto Basin. Given the Pleistocene age of the vertebrate fossils, the baked lacustrine beds shown here are now interpreted to be distinct from the fossil-bearing beds. Geologist at lower right for scale.

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DISCUSSION

Field reconnaissance resulted in the recovery of several fossil specimens with scientific significance. As with previous investigations, horses and camels dominated the fossil fauna. However, some of the equid fossils provided clues as to the nature of the animals represented. These fossils were important in helping to confirm the Pleistocene age of the fossil assemblage. In particular, fossils from several localities exhibited features including tall, straight cheek teeth and broad enamel protocones that are characteristic of Pleistocene and later horses. Earlier Tertiary North American horses such as *Dinohippus* have short, longitudinally curved cheek teeth that are distinctly different from those observed in the sample from the Pinto Basin. Later Tertiary horses including *Equus (Plesippus) simplicidens* have taller cheek teeth than their forebears, but generally have small, rounded, simple protocones; broad protocones are most often a hallmark of Pleistocene horses. The presence of tall, longitudinally straight cheek teeth with broad protocones in the horse fossils from the Pinto Basin is therefore strongly suggestive of a Pleistocene age. Small horses are also represented in the fauna. As with previously recovered fossils from the Pinto Basin, however – and with small horse fossils from throughout the Mojave Desert (Scott, 1997) – these fossils were not diagnostic to species.

Of particular interest in the present fauna was the presence of a partial carnivoran incisor. This broken tooth closely resembles a large individual of the genus *Canis*. The tooth is larger than comparable specimens of modern *Canis latrans* (coyote) in the collections of the SBCM, and is similar in size to like elements of wolf (*Canis lupus*). Unfortunately the specimen is not sufficiently complete or diagnostic to enable determinations to be advanced as to whether it represents *Canis lupus* or the extinct dire wolf, *Canis dirus*. For the purposes of this study, it is considered "*Canis* sp. (wolf size)". No carnivorans are previously recorded from the Pinto Basin, and wolves are extremely rare from the fossil record of the Mojave Desert (Jefferson, 1991b), so this specimen is an important addition to the fossil records of both the local area and the broader geophysical region.

A large chunk of tooth enamel from a float locality represents the first record of extinct proboscidean (elephant) from the fossil record of the Pinto Basin. Unfortunately the specimen is not sufficiently complete to enable a confident generic determination at present; the fossil is here referred to cf. *Mammuthus*. If confirmed by additional finds, the presence of *Mammuthus* is significant for helping to confirm the Pleistocene age of the fossils, as mammoths are restricted to the Pleistocene in North America. The presence of a proboscidean fossil in the fauna suggests that additional field reconnaissance may result in the recovery of more complete remains of these extinct animals.

The fossils recovered during the field survey were generally found as isolated elements, a finding in agreement with previous studies (e.g., Jefferson, 1973, 1986). However, locality SBCM 5.10.21 was unique in this respect, as it yielded several bones and bone fragments from a single individual of juvenile small camel. This important finding suggests that other localities as yet unexposed and/or unrecognized in the eastern Pinto Basin region may also have potential to yield significant concentrations of fossils rather than isolates.

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