



Late Eocene (Chadronian) fossil mammals from the Palm Park Formation, Caballo Mountains, Sierra County, New Mexico

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LATE EOCENE (CHADRONIAN) FOSSIL MAMMALS FROM THE PALM PARK FORMATION, CABALLO MOUNTAINS, SIERRA COUNTY, NEW MEXICO

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ABSTRACT—The Palm Park Formation in the southern Caballo Mountains of Sierra County, New Mexico, is a volcanoclastic deposit overlain by the ~36 Ma Bell Top Formation. The vertebrate fauna of this formation includes: turtles (aff. *Stylenys* sp. and an emydid) and four identifiable mammal taxa (*Hyaenodon horridus*, *Hyracodon* sp., *Mesohippus* cf. *M. texanus* and *Merycoidodon presidioensis*). Much of the turtle material consists of vertebral elements and isolated shell fragments. *Hyaenodon horridus* is recognized from a maxillary fragment. Dentary fragments with damaged teeth indicate the presence of *Hyracodon* sp., and a dentary with cheek teeth documents the presence of *Mesohippus* cf. *M. texanus*. The most complete specimen from the Palm Park Formation is a partial skull of the oreodont *Merycoidodon presidioensis* that includes both maxillae. The fossil mammals from the Palm Park Formation indicate an early Chadronian age of ~36-37 Ma. They can be correlated to the Chadronian mammals from the Rubio Peak Formation in the Black Range of Sierra County. The total age range of the Palm Park Formation is likely ~ 36-38 Ma.

INTRODUCTION

Fossil mammals of Eocene age are known from various localities in New Mexico in the synorogenic deposits of the Laramide orogeny (Lucas et al., 1981; Lucas and Williamson, 1993; Lucas, 2001). These mammals well represent the Wasatchian and Duchesnean land-mammal “ages” (LMAs) and less extensively document the Bridgerian and Uintan LMAs. Fossil mammals of the Chadronian LMA, the youngest Eocene LMA, are also known from the volcanoclastic deposits that formed around the stratovolcanoes that preceded the ashflow tuff/caldera-collapse volcanism of the Oligocene. Lucas (1986a, b), Lucas and Williamson (1993) and Lucas et al. (1997) have documented some of these Chadronian mammals, which are from the Rubio Peak and Palm Park formations in Sierra County. Here, we provide detailed documentation of the Chadronian fossil mammals from the Palm Park Formation in the Apache Valley of the southern Caballo Mountains in Sierra County (Fig. 1). This augments earlier, preliminary reports on these fossil mammals by Lucas and Williamson (1993) and Lucas et al. (1997). In this article, NMMNH refers to the New Mexico Museum of Natural History and Science, Albuquerque.

GEOLOGICAL CONTEXT

Beginning with the first discovery in 1992, we have intermittently collected fossil vertebrates from the Palm Park Formation in the Apache Valley for nearly 20 years. Currently, 12 NMMNH fossil vertebrate localities have been identified in these strata, which are located in T16S, R4W (Table 1). The vertebrate-fossil-bearing interval in the Palm Park Formation is about 54 m thick, and its top is ~103 m below the contact of the Palm Park Formation with the overlying rhyolite tuff at the base of the Bell Top Formation (Fig. 1). Seager and Mack (2003) estimated the total thickness of the Palm Park Formation in the Caballo Mountains as ~630 m, so the fossil mammal localities are in the upper part of the formation.

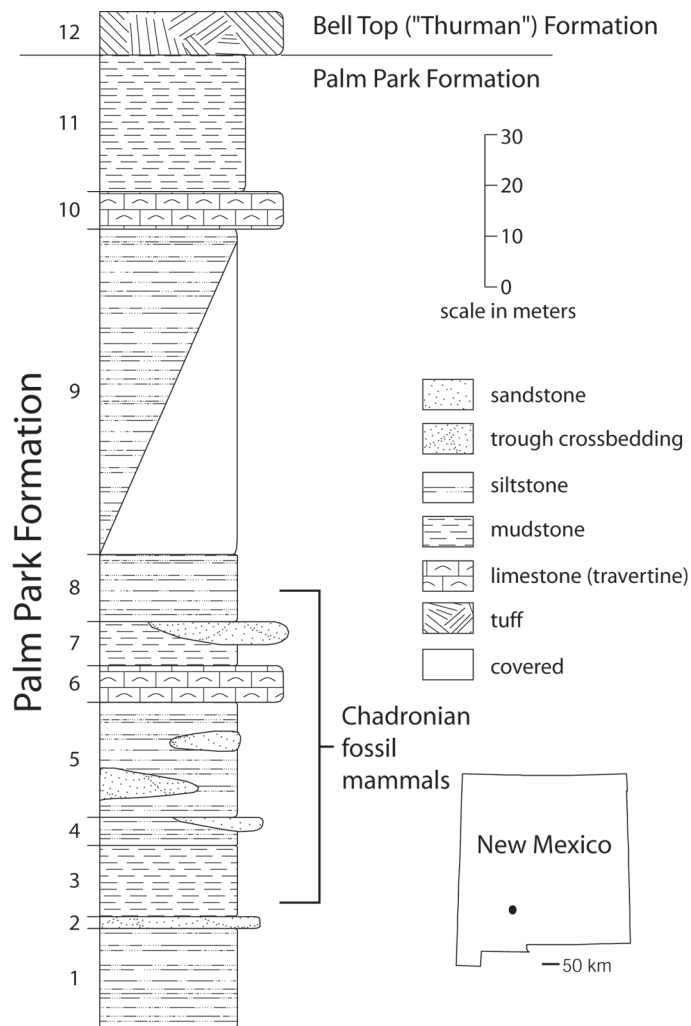


FIGURE 1. Stratigraphic section and map of New Mexico with stratigraphic range and location of Palm Park vertebrates highlighted.

TABLE 1. Complete list of vertebrate fossil localities from the Palm Park Formation, southern Caballo Mountains, Sierra County, NM, with taxa and specimen descriptions.

NMMNH locality	Vertebrate Taxa	Specimen Descriptions
2632	Hyracodontidae	dentary fragments
2633	<i>Hyaenodon</i>	maxillary fragments
3454	Testudines	(4) long bone fragments
3455	<i>Mesohippus</i> <i>Merycooidodon presidioensis</i>	single jaw fragment w/m1-m2 partial skull and postcrania
3456	Testudines	shell fragments
3457	Testudines	(4) bone fragments
3458	Mammalia	(4) long bone fragments
3459	Mammalia	(2) long bone fragments
3460	Mammalia	(1) rib fragment; (1) long bone fragment; (1) bone fragment
3461	Mammalia	(numerous) bone fragments
3462	Testudines	(numerous) shell fragments
3463	Mammalia	(numerous) bone fragments; tooth enamel of large mammal
	Testudines	shell and vertebrae fragments
	Mammalia	long bone fragments

PALEONTOLOGY

Reptilia

Testudines

At least two taxa of turtles are present at the Palm Park Formation localities in the southern Caballo Mountains. Most abundant are shell fragments and isolated limb and vertebral bones (NMMNH P-21360, P-26479, P-26480, P-26485, P-26487, P-26488, P-26492, P-26498) of a tortoise that Lucas and Williamson (1993) identified as aff. *Stylymys* sp. Also present are shell fragments of an emydid (NMMNH P-31533: H. Hutchinson, written commun., 2000). This material merits further study.

Mammalia

Hyaenodon horridus

NMMNH P-21361 from locality 2633 is a right maxillary fragment with M2 (Fig. 2A-C) that Lucas and Williamson (1993, fig. 13C-D) illustrated and identified as *Hyaenodon horridus*. The lack of M3 and extreme development of the carnassial are characteristic of *Hyaenodon*. Its relatively large size (M2: length = 22.5 mm, width = 13.8 mm) supports assignment to *H. horridus*, an early Chadronian-Orellan species (Mellett, 1977).

Hyracodon sp.

NMMNH P-21363 from locality 2632 consists of badly damaged dentary fragments with incomplete cheek teeth (Fig. 2D-I) that Lucas and Williamson (1993, p. 151, fig. 13G-I) illustrated and identified as cf. *Hyracodon* sp. We are more certain and assign these to *Hyracodon* sp. With an estimated m1-3 length of about 53 mm, these jaw fragments may belong to the early Chadronian species *H. petersoni* (cf. Prothero, 1996), but are too damaged for a species-level identification.

Mesohippus cf. *M. texanus*

NMMNH P-26500 from locality 3455 is a right dentary fragment with roots of p2-3 and complete p4-m1 (Fig. 2J-L). Lucas et al. (1997) described and illustrated this specimen, identifying it as *Mesohippus* cf. *M. texanus*. We accept this tentative assignment to the small, Duchesnean-early Chadronian species of *Mesohippus* (cf. McGrew, 1971; Prothero and Shubin, 1989).

Merycooidodon presidioensis

Lucas and Williamson (1993, fig. 13J-M) illustrated NMMNH P-21366, edentulous dentary fragments of an artiodactyl, but this specimen cannot be more precisely identified. At NMMNH locality 3455 we recently discovered NMMNH P-65179, which consists of a partial skull of an oreodont that includes the right P4-M3, left C-M3 (C-M1 are very damaged) (Fig. 2M-O) and some associated limb bone fragments. The teeth have derived features (note lack of P4 hypocone, lack of lingual cingula on molars), and the skull has diagnostic features (infraorbital foramen over P2, no facial vacuities) that preclude assignment to the genera *Aclistomyater*, *Oreonetes*, *Bathygenys*, *Miniochoerus* or *Limnetes* (cf. Lander, 1998; Stevens and Stevens, 1996, 2007). Closest resemblance is to *Merycooidodon presidioensis* of Stevens and Stevens (1996), which is also called *Prodesmatochoerus meekae* by Schultz and Falkenbach (1954), Wilson (1971) and Lander (1998).

Key features that justify this identification are size, relatively thick enamel on the cheek teeth, M1-M3 protocone completely selenodont, and protoselene extends towards the mesostyle approximately parallel to, but separated from the anterior crest of the metaconule by a transverse valley; P1-P4 length ~50% of P1-M3 length; M3 length/width = 1.79; and M3 width/height = 1.9 (cf. Stevens and Stevens, 1996; Lander, 1998). The Palm Park oreodont particularly closely resembles a specimen from the early Chadronian Airstrip local fauna of West Texas that Wilson (1971, fig. 3Q) identified as ?*Prodesmatochoerus* cf. *P. meekae*,

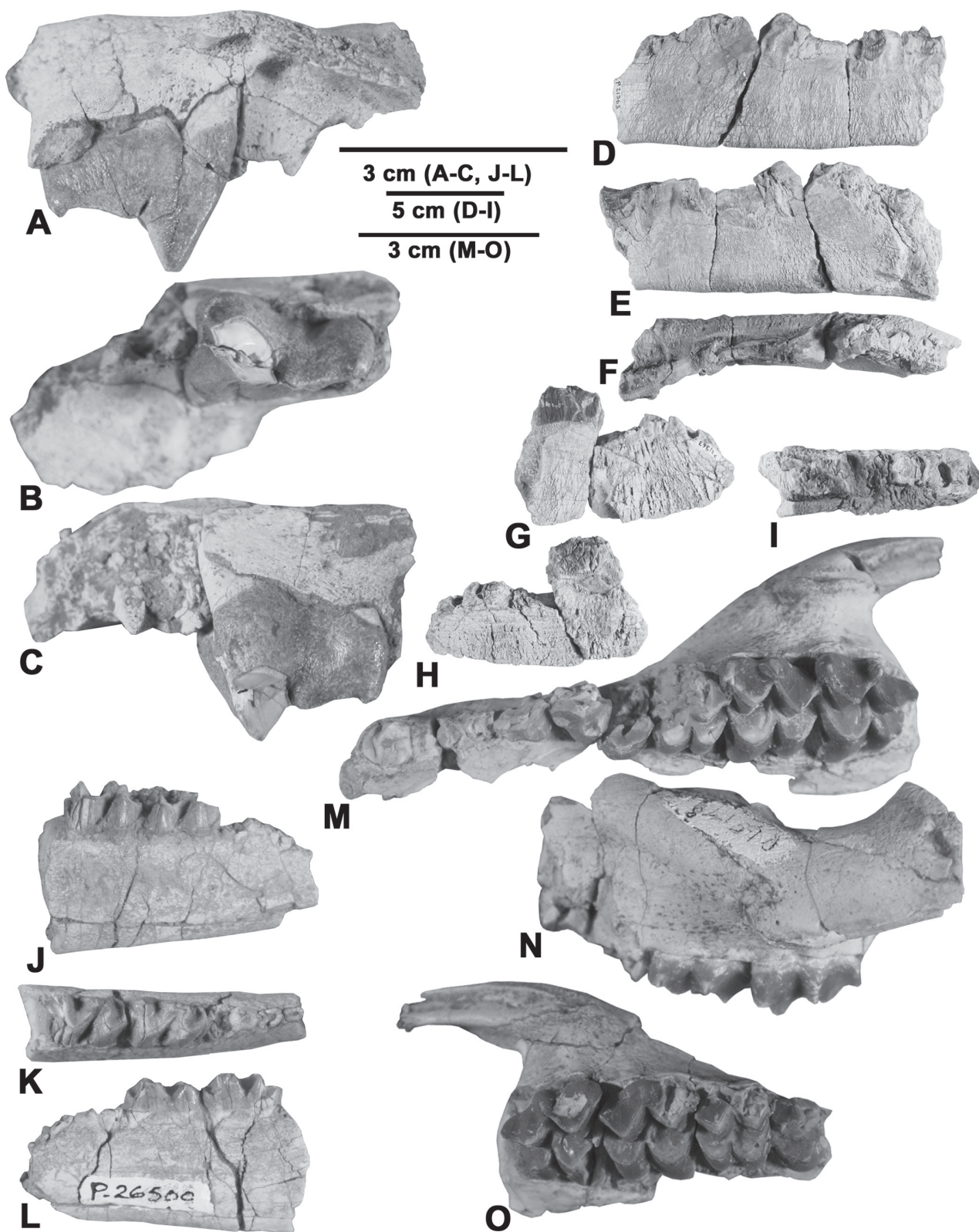


FIGURE 2. Fossil mammals from the Palm Park Formation in the Caballo Mountains. **A-C**, *Hyaenodon horridus*, NMMNH P-21361 from locality 2633, right maxillary fragment with M2 in **A**, lingual, **B**, occlusal and **C**, labial views. **D-I**, *Hyracodon* sp. from locality 2632, NMMNH P-21363, dentary fragments in **D**, **H**, lingual, **E**, **G**, labial and **F**, **I** occlusal views. **J-L**, *Meshippus* cf. *M. texanus*, NMMNH P-26500, right dentary fragment with p4-m1 in **J**, labial, **K**, occlusal and **L**, lingual views. **M-O**, *Merycoidodon presidioensis*, NMMNH P-65179, partial skull, left C-M3 in **M**, occlusal and **N**, lateral views, and **O**, right P4-M3 in occlusal view.

and that is the holotype of *Merycoiododon presidioensis* (Stevens and Stevens, 1996, p. 515).

Metrics of the maxillary teeth, in mm (* estimated measurement due to damage to the tooth): Right: P1, length = 10.0*; P2, length = 9.2*, width = 5.6*; P3, length = 10.4*, width = 10.6*; P4, length = 8.3*, width = 12.1; M1, length = 11.4, width = 13.6; M2, length = 15.3, width = 17.1; M3, length = 17.2, width = 18.3; Left: P1-4, length = 3.8*, M1-3, length = 4.2.

DISCUSSION

Lucas and Williamson (1993, p. 150-151, figs. 11-13) first documented some of the Chadronian fossil vertebrates from the upper part of the Palm Park Formation in the Apache Valley of the southern Caballo Mountains. They identified tortoise fossils plus the hyaenodontid creodont *Hyaenodon horridus* and the rhinoceros cf. *Hyracodon* sp. Lucas et al. (1997) added the horse *Mesohippus* cf. *M. texanus*, and we add the oreodont *Merycoiododon presidioensis* to the Palm Park fossil assemblage. The temporal ranges of these mammals overlap only in the early Chadronian, and they are most readily correlated to the Airstrip local fauna of West Texas, which is ~36 Ma, late early Chadronian *sensu* Prothero and Emry (2004). Within biochronological resolution, they are the same age as the Chadronian mammals from the Rubio Peak Formation in the Black Range reported by Lucas (1986a, b). The Palm Park fossil mammals are early Chadronian, ~36-37 Ma (Fig. 3).

The oldest radioisotopic age of tuffs in the Bell Top Formation, which overlies the Palm Park Formation, is ~35.8 Ma (Chapin et al., 2004). An early Chadronian age of about 36-37 Ma for the fossil mammals from the upper part of the Palm Park Formation is consistent with the Bell Top Formation being no older than ~36 Ma. Older K/Ar ages of 42, 43 and 51 Ma have been reported from the Palm Park Formation (Seager et al., 1975, table 1), but these appear to be too old, though the oldest age of the Palm Park Formation is not certain. However, it is likely to be no older than the lithologically very similar Rubio Peak Formation, which is in the same stratigraphic interval as the Palm Park Formation. The Rubio Peak Formation has been radioisotopically dated at no older than ~38 Ma (Chapin et al., 2004) and has yielded early Chadronian fossil mammals and a fossil of the Duchesnean brontothere *Duchesneodus* (Lucas, 1983, 1986a, b). Therefore, we conclude that the Palm Park and Rubio Peak formations are of late Duchesnean-early Chadronian age, ~38-36 Ma, based on existing radioisotopic ages and mammalian biochronology (Fig. 3).

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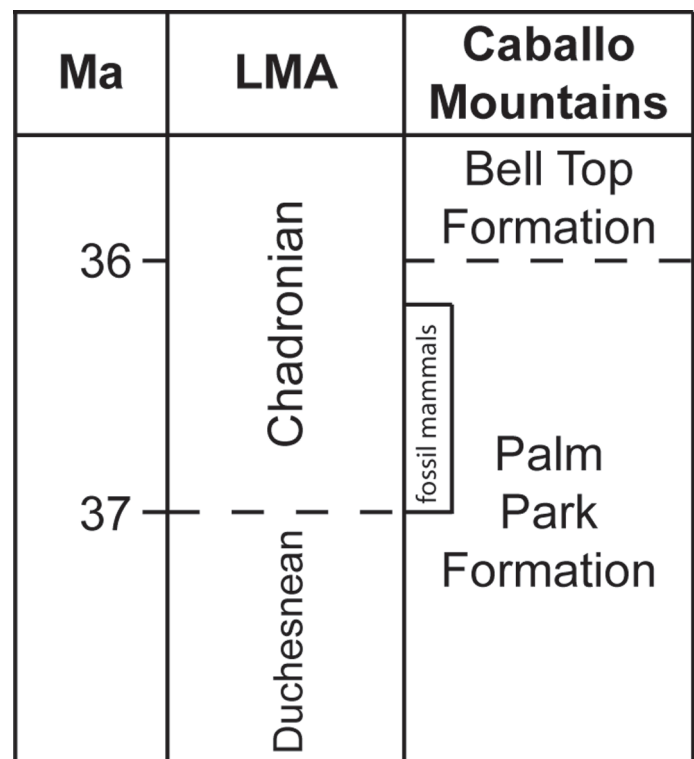


FIGURE 3. Correlation of the Palm Park Formation.

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Arctiodactyl hoof print molds in bedded ash-fall-tuff in the San Mateo Mountains in Socorro County New Mexico, July 1983. NMBGMR Photo Archive No. p-01234