The tapir *Tapirus* (Mammalia: Perissodactyla) from the late Pliocene (early Blancan) Tonuco Mountain Local Fauna, Camp Rice Formation, Doña Ana County, southern New Mexico

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Abstract

A mandible of a tapir (*Tapirus* sp.) from the late Pliocene (early Blancan North American land mammal age—NALMA), Tonuco Mountain Local Fauna (LF), Doña Ana County, southern New Mexico, is a significant addition to the small sample of fossil tapirs known from the late Cenozoic of New Mexico. The Tonuco Mountain tapir mandible is not identified to the species level because the diagnostic characters in the genus *Tapirus* are primarily found in the skull. It is most similar in size and morphological features to the mandible of the late Blancan species *Tapirus lunulatus* from Florida. The Tonuco Mountain LF consists of 17 species of vertebrates, including a mud turtle, two tortoises, a duck, and 13 species of mammals. Among mammals in this fauna, the camel *Camelops*, the peccary *Platygonus*, and the horse *Equus scotti* first appeared in North American early Blancan faunas at about 3.6 Ma, whereas the horses *Nannippus peninsulatus* and *Equus simplicidens* became extinct in New Mexico in the late Blancan at about 2.6 Ma. The association of these mammals, together with the absence of mammals of South American origin that first appeared in the American Southwest at about 2.7 Ma, restricts the age of the Tonuco Mountain LF to the late early Blancan, between 2.7 and 3.6 Ma. The fossils from the Tonuco Mountain LF are derived from sediments of the axial-fluvial lithofacies of the ancestral Rio Grande, referred to the Camp Rice Formation. The sediments in the lower 30 m of the Camp Rice Formation section containing the Tonuco Mountain LF, including the *Tapirus* mandible, are normally magnetized and correspond to the lowermost portion of the Gauss Chron (C2An.3n), above the Gilbert/Gauss boundary (younger than 3.58 Ma) and below the base of the Mammoth Subchron (C2An.2r; older than 3.33 Ma). The mammalian biochronology and magnetostratigraphy restrict the age of the Tonuco Mountain LF to between 3.3 and 3.6 Ma (early late Pliocene, late early Blancan). The tapir mandible from the Tonuco Mountain LF is the first record of *Tapirus* from the early Blancan (2.7–4.9 Ma) of North America. *Tapirus* had a restricted geographic distribution in the late Pliocene and earliest Pleistocene (late early and late Blancan; ~1.6–3.6 Ma) of temperate North America, occurring primarily in the southern United States from Florida to California, including New Mexico.

Introduction

Exposures of the Camp Rice Formation near Tonuco Mountain, also known as San Diego Mountain, Doña Ana County, southern New Mexico, have produced a fairly diverse late Pliocene (early Blancan NALMA) vertebrate fossil assemblage called the Tonuco Mountain Local Fauna (Morgan et al., 1998). Field work in this area in the 1990s by Jerry MacDonald and paleontologists and geologists from the New Mexico Museum of Natural History (NMMNH) and New Mexico State University (NMSU) recovered fossils of 16 species of vertebrates: a turtle, two tortoises, a bird, and 12 species of mammals. While conducting geologic field work in the spring of 2008, co-author Eric Gottlieb collected the lower jaw of a tapir (genus *Tapirus*) from the Camp Rice Formation in the same general area where the remainder of the Tonuco Mountain Local Fauna (LF) was recovered. No fossils of *Tapirus* were collected in the earlier work on the Tonuco Mountain LF, and tapirs are rare in the Pliocene and Pleistocene vertebrate record of New Mexico (Morgan and Harris, 2015; Harris, 2016). We describe and illustrate this tapir mandible, compare it with other Pliocene and Pleistocene species of *Tapirus* from North America, use biochronology and magnetostratigraphy to establish its age, and discuss the occurrence of tapirs in the Pliocene and Pleistocene of New Mexico.

Materials and Methods

Fossil tapirs from New Mexico are reported from three museums: New Mexico Museum of Natural History (NMMNH), University of Texas at El Paso (UTEP), and the Frick Collection at the American Museum of Natural History (AMNH-FM). Other abbreviations used are: BLM (U. S. Bureau of Land Management), FAD (First Appearance Datum), GABI (Great American Biotic Interchange), GPTS (Geomagnetic Polarity Time Scale), LF (Local Fauna), NALMA (North American land mammal age), and NMSU (New Mexico State University). Measurements and dental descriptions of tapir teeth follow Hulbert et al. (2009). Abbreviations for tooth positions...
are standard for mammals, with upper case letters designating upper teeth and lower case letters for lower teeth. For example, an upper fourth premolar is designated as P4, while a first lower molar is m1. Only premolars (P/p) and molars (M/m) are represented in the fossil record of tapirs from New Mexico. All measurements are in mm.

The Miocene/Pliocene and Pliocene/Pleistocene boundaries and subdivisions of the Pliocene and Pleistocene epochs follow Gibbard et al. (2010) and Gradstein et al. (2012). The names and boundaries of the geomagnetic chron and subchrons of the Geomagnetic Polarity Time Scale follow Berggren et al. (1995) and Gradstein et al. (2012). The definitions, boundaries, and subdivisions of the Blancan, Irvingtonian, and Rancholabrean North American land mammal ages follow Bell et al. (2004), with several minor changes in the boundaries between the subdivisions of the Blancan, specifically pertaining to the New Mexico record, from Morgan and Harris (2015).

**Locality and associated vertebrate fauna**

The Tonuco Mountain Local Fauna (LF) was named for a series of about 12 individual fossil localities of late Pliocene (early Blancan) age, located about 5 km southeast of Tonuco Mountain and 10 km northwest of Radium Springs, between Interstate Highway 25 and the Rio Grande, in northwestern Doña Ana County, southern New Mexico (Morgan et al., 1998; Fig. 1). Tonuco Mountain is also known as San Diego Mountain; the latter name was used in a previous geologic report on this area (Seager et al., 1971). The general vicinity where the Tonuco Mountain LF was collected is called Cedar Hill on the USGS Selden Canyon 7.5 minute topographic map (1982). The specific locality where the tapir jaw was collected is designated NMMNH locality L-8679 (Fig. 1). The approximate coordinates of the tapir locality are: 32°34' North latitude, 106°57' West longitude, and the elevation is 1,329 m (4,361 ft). The exact GPS coordinates and other field data for the tapir...
locality and the other sites where the Tonuco Mountain LF are found are archived in the NMMNH Paleontology Collection. The fossil localities where Tonuco Mountain LF are found are on land under the jurisdiction of the U. S. Bureau of Land Management (BLM) and the New Mexico State University (NMSU) Animal Science Ranch.

Seager et al. (1971, p. 18) first mentioned vertebrate fossils from the Cedar Hill/San Diego Mountain/Tonuco Mountain area in their study of the geology of San Diego Mountain. They stated that “...horse teeth, fragments of mastodont teeth, and miscellaneous bone fragments of medium-to-large size vertebrates have been recovered...” and “...are currently being studied by W.S. Strain, University of Texas at El Paso.” Strain, now deceased, never described these specimens, and Morgan et al. (1998) were unable to determine their whereabouts. In the 1990s, Jerry MacDonald from Las Cruces, New Mexico, field crews from the NMMNH, and co-author Greg Mack and his students from NMSU collected additional vertebrate fossils from the Tonuco Mountain/Cedar Hill area. Morgan et al. (1998) described these fossils as the Tonuco Mountain LF, composed of 16 species, including the mud turtle Kinosternon, the land tortoises Gopherus and Hesperotestudo, a duck (Anatidae), and 12 species of mammals (faunal list in Table 1). In the spring of 2008, Eric Gottlieb, then a geology graduate student at NMSU, discovered a lower jaw of the tapir Tapirus in an in-place sandstone bed of the Camp Rice Formation in the Cedar Hill area (Fig. 3). Tapirus is a new addition to the Tonuco Mountain LF, as no tapirs were identified in the original sample of this fauna (Morgan et al., 1998).

The Tonuco Mountain LF is mostly composed of large vertebrates, including numerous shell fragments of large tortoises and isolated teeth and postcranial elements of horses, camels, and proboscideans, as well as a few specimens of carnivores (Morgan et al., 1998). Fossils are not particularly common in this area, consisting primarily of isolated elements recovered through surface prospecting. Two proboscidean fossils, a partial lower jaw and a partial femur, were excavated from in-place deposits and preserved in plaster jackets. The most common mammals in the Tonuco Mountain LF are: two species of the horse Equus, E. scotti and E. simplicidens; one species each in the camel genera Camelops and Hemiauchenia; and a gomphotheriid proboscidean probably referable to the genus Rhynchotherium. The gomphotheria was previously referred to the genus Cuvieronius (Morgan et al., 1998). However, subsequent work has demonstrated that Cuvieronius is restricted to Pleistocene faunas (Irvingtonian and Rancholabrean NALMAs), and the similar Rhynchotherium occurs in North American faunas from the Hemphillian and Blancan NALMAs (Morgan et al., 2016). Giant land tortoises of the genus Hesperotestudo are also common members of the fauna. Two postcranial elements of rabbits (Leporidae) and two partial limb bones of ducks (Anatidae) are the only small vertebrate remains recovered from the Tonuco Mountain LF. Despite a concerted effort by NMMNH field crews to find small vertebrate fossils, no concentrations of smaller vertebrates were located in the predominantly coarse-grained sediments of the Camp Rice Formation in the Tonuco Mountain/Cedar Hill area.

### Geology

The fossils in the Tonuco Mountain LF, including the tapir mandible described here, were derived from sediments of the Camp Rice Formation southeast of Tonuco Mountain near Cedar Hill, in the western portion of the Jornada basin (Morgan et al., 1998). The Camp Rice Formation in southern New Mexico is primarily composed of sediments

<table>
<thead>
<tr>
<th>Reptilia</th>
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<th>Mammalia</th>
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<tbody>
<tr>
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of the axial-fluvial lithofacies of the ancestral Rio Grande (Mack et al., 1993, 1998). The Camp Rice Formation was originally named by Strain (1966) for strata in the Hueco bolson or basin in the Rio Grande valley of Trans-Pecos Texas south of El Paso, about 180 km southeast of the Tonuco Mountain/Cedar Hill area. A late Blancan vertebrate fauna named for the type area of the Camp Rice Formation, the Hudspeth LF (Strain, 1966), is somewhat younger than the Tonuco Mountain LF (Morgan et al., 1998). The Camp Rice Formation has subsequently been used as a map unit in the Mesilla, Jornada, and Hatch–Rincon basins in southern New Mexico (Seager et al., 1971; Seager and Clemons, 1975; Vanderhill, 1986; Mack et al., 1993, 1998). North of the Hatch–Rincon basin, in the Palomas and Engle basins in Sierra County, similar sediments forming the axial-fluvial lithofacies of the ancestral Rio Grande are referred to the Palomas Formation (Lozinsky and Hawley, 1986a, b; Mack et al., 1993, 1998); these strata contain both early and late Blancan vertebrate faunas (Morgan et al., 2011).

There are two published stratigraphic sections of the Camp Rice Formation in the Tonuco Mountain/Cedar Hill area (Mack et al., 1993; Morgan et al., 1998). Even though these sections were measured at different times, by different geologists, and in slightly different locations, they are remarkably similar in overall thickness and lithologic descriptions of the individual units. The stratigraphic section of Mack et al. (1993) included

![Figure 2. Stratigraphic section of the Camp Rice Formation from the Cedar Hill/Tonuco Mountain area, Doña Ana County, New Mexico, showing the lithology, stratigraphic position of key vertebrate fossils, including the tapir (*Tapirus*) mandible (NMMNH locality L-8679), and magnetostratigraphy (section modified from Mack et al., 1993; Morgan et al., 1998). The entire magnetostratigraphic section is within the Gauss Chron. K is the Kaena subchron and M is the Mammoth subchron. Other subchrons are designated by letters and numbers (e.g., 2An.3n), corresponding to the Geomagnetic Polarity Time Scale (Gradstein et al., 2012). NALMA is the abbreviation for North American land mammal age. Cl is the abbreviation for the Clarendonian NALMA.]

<table>
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Figure 2. Stratigraphic section of the Camp Rice Formation from the Cedar Hill/Tonuco Mountain area, Doña Ana County, New Mexico, showing the lithology, stratigraphic position of key vertebrate fossils, including the tapir (*Tapirus*) mandible (NMMNH locality L-8679), and magnetostratigraphy (section modified from Mack et al., 1993; Morgan et al., 1998). The entire magnetostratigraphic section is within the Gauss Chron. K is the Kaena subchron and M is the Mammoth subchron. Other subchrons are designated by letters and numbers (e.g., 2An.3n), corresponding to the Geomagnetic Polarity Time Scale (Gradstein et al., 2012). NALMA is the abbreviation for North American land mammal age. Cl is the abbreviation for the Clarendonian NALMA.
magnetic-polarity stratigraphy, which is discussed in more detail below. The stratigraphic section of Morgan et al. (1998) also indicated the position of key vertebrate fossils of the Tonuco Mountain LF.

The Camp Rice Formation is well exposed on the north- and northwest-facing escarpment of Cedar Hill, where it unconformably overlies red mudstones of the Miocene Rincon Valley Formation and is capped by a petrocalcic paleosol (Hawley et al., 1969; Seager et al., 1971). The two measured stratigraphic sections of the Camp Rice Formation at Cedar Hill are about 50 m in thickness, and consist primarily of sandstones (57%) and conglomerates (38%), with sandy mudstone (5%) as a minor component. Figure 2 is a composite of the two published stratigraphic sections for the Cedar Hill area, showing both the magnetostratigraphy (Mack et al., 1993) and placement of key vertebrate fossils (Morgan et al., 1998), including the stratigraphic position of the tapir mandible from site NMMNH L-8679. The jaw was collected ~20 cm above the modern wash base from a bed of poorly sorted and poorly consolidated, grayish-brown, conglomeratic sandstone of the Camp Rice Formation, and ~30 m above the projected contact with the underlying Rincon Valley Formation (Fig. 2). At the exposure, the alluvial stratum that contained the fossil is partly covered by finer-grained Quaternary colluvium eroded from the overlying outcrop, and is discernable from the latter by a greater abundance of predominantly matrix-supported gravel-to-pebble-size clasts, a more consolidated (clumpy) appearance, and a slightly steeper profile at the exposure (Fig. 3).

**Chronology**

**Biochronology**

Most of the vertebrate faunas from the Camp Rice Formation in southern New Mexico and southwestern Texas are referred to the Blancan NALMA on the basis of mammalian biochronology. The Blancan NALMA in the American Southwest has been subdivided into the following four intervals, with approximate age ranges in parentheses (Bell et al., 2004; with modifications from Morgan and Harris, 2015): earliest Blancan (~3.6–4.9 Ma); late early Blancan (~2.7–3.6 Ma); early late Blancan (~2.2–2.7 Ma); latest Blancan (~1.6–2.2 Ma). The boundary between the early and late Blancan at 2.7 Ma is slightly older than the revised Pliocene/Pleistocene boundary at 2.58 Ma (Gibbard, 2010). Among the mammals identified from the Tonuco Mountain LF, the following are indicative of the Blancan: the dogs (Canidae) *Canis lepophagus* and *Borophagus* sp.; the horses (Equidae) *Nannippus peninsulatus* and *Equus simplicidens*; the peccary (Tayassuidae) *Platygonus bicalcaratus*; and two camels (Camelidae), *Hemiauchenia blancoensis*.
and a large species of Camelops previously referred to C. traviswibitaei (Morgan and Harris, 2015). Baskin and Thomas (2016) recently synonymized C. traviswibitaei with the Rancholabrean species C. hesternus, but also indicated the presence of a large species of Camelops in Blancan faunas of western North America. This large and evidently undescribed species of Camelops is present in the Tonuco Mountain LF and many other New Mexico Blancan faunas (Morgan et al., 1998; Morgan and Harris, 2015).

Several species restrict the age of the Tonuco Mountain LF within the Blancan. Equus simplicidens is absent from very early Blancan faunas, appearing about 4 Ma, and became extinct in New Mexico in the early late Blancan at about 2.6 Ma. Nannippus peninsulatus has a similar biochronologic range, disappearing from New Mexico at about 2.6 Ma (Morgan and Harris, 2015). There are no records of E. simplicidens or N. peninsulatus in New Mexico from sites younger than the Gauss/Matuyama boundary (2.58 Ma). Both of these species are known from the Blanco LF in the Panhandle of Texas (Dalquest, 1975), which occurs in the lowermost Matuyama Chron (C2r.2r; 2.15–2.58 Ma; Lindsay et al., 1976), almost certainly in the older part of that time interval (~2.4–2.6 Ma). Platygonus and Camelops do not appear until the beginning of the late early Blancan (about 3.6 Ma; Lindsay et al., 1984). A second species of Equus from the Tonuco Mountain LF, E. scotti, is larger than E. simplicidens and has a different enamel pattern in the upper and lower cheek teeth. E. scotti is the typical large horse in southwestern early Irvingtonian faunas, including Tijeras Arroyo and Adobe Ranch from New Mexico, but is also fairly common in the Blancan (Morgan and Lucas, 2003; Morgan and Harris, 2015). E. scotti first appeared in New Mexico in late early Blancan faunas, including Tonuco Mountain from the Camp Rice Formation and Arroyo de la Parida, Cuchillo Negro Creek, and Elephant Butte Lake from the Palomas Formation (Morgan et al., 2008b; 2011).

The Tonuco Mountain LF lacks South American immigrant mammals that participated in the Pliocene phase of the Great American Biotic Interchange (GABI), and first arrived in the southwestern United States at the beginning of the late Blancan at about 2.7 Ma (Woodburne and Swisher, 1995; Woodburne, 2004, 2010; Morgan, 2008). The first appearance datum (FAD) of 2.7 Ma for South American immigrants in the American Southwest is based on the occurrence of xenarthrans (glyptodonts and mylodonid ground sloths) and/or cavimorph rodents (capybaras and porcupines) in one or more early late Blancan faunas in Arizona and New Mexico, in strata of the uppermost Gauss Chron just below the Gauss/Matuyama boundary at 2.58 Ma. Mammals of South American origin that first appeared in the American Southwest about 2.7 Ma include: the glyptodont Glyptotherium texanum (= G. arizonae; see Gillette et al., 2016) and the capybara Neocohoerus (=Phugatherium of Vucetich et al., 2015) dichroplax from the 111 Ranch Fauna in Arizona (Ahearn and Lance, 1980; Galusha et al., 1984) and Glyptotherium texanum and the mylodonid ground sloth Paramylodon garbani from the Pearson Mesa Fauna in New Mexico (Tomida, 1987; Morgan et al., 2008a). Biochronologic data restrict the age of the Tonuco Mountain LF to the late early Blancan, between 2.7 and 3.6 Ma, based on the first occurrence of Equus scotti, Camelops and Platygonus at about 3.6 Ma, the presence of Nannippus peninsulatus and Equus simplicidens which became extinct in New Mexico at about 2.6 Ma, and the absence of South American immigrants which first appeared about 2.7 Ma.

**Magnetostratigraphy**

A previous study of the magnetic-polarity stratigraphy of the Camp Rice Formation at Cedar Hill further refines the age of the Tonuco Mountain LF (Mack et al., 1993), and specifically the lower jaw of Tapirus reported here. Paleomagnetic samples confirm that the entire measured stratigraphic section (~50 m) of the Camp Rice Formation at Cedar Hill is within the Gauss Chron (C2An; 2.58–3.58 Ma; Mack et al., 1993; Fig. 2). The lower 30+ m of this section consists of a long interval of normal polarity that was correlated with the lower Gauss Chron (C2An.3n; between 3.33 and 3.58 Ma). The lowermost boundary of the Gauss Chron is not preserved in the Cedar Hill section because the Camp Rice Formation unconformably overlies the Miocene Rincon Valley Formation. The age of the base of the Cedar Hill section cannot be precisely dated but is younger than the boundary between the Gauss and Gilbert chron at 3.58 Ma.

The stratigraphic positions of key vertebrate fossil specimens of the Tonuco Mountain LF, which were found at four different levels (Morgan et al., 1998), are plotted together with the magnetostratigraphy (Mack et al., 1993) on Figure 2. The fossiliferous interval containing the Tonuco Mountain LF is above the base of the Gauss Chron (younger than 3.58 Ma) and below the top of the Kaena Subchron (C2An.1r; 3.04 Ma), providing an age range of approximately 3.0–3.6 Ma (Morgan et al., 1998). The site where the tapir mandible was collected (NMMNH L-8679) occurs in the lower 30 m of the Cedar Hill section of Mack et al. (1993). These strata are normally magnetized and correspond to the lowermost portion of the Gauss Chron (C2An.3n), above the Gilbert/Gauss boundary (3.58 Ma) and below the base of the Mammoth Subchron (C2An.2r; 3.33 Ma). The combination of magnetostratigraphy (lowermost Gauss Chron) and mammalian biochronology (late early Blancan) restricts the age of the tapir jaw to between 3.3 and 3.6 Ma.

**Systematic Paleontology**

Class MAMMALIA Linnaeus, 1758
Order PERISSODACTYLA Owen, 1848
Family TAPIRIDAE Gray, 1821
Genus TAPIRUS Brisson, 1762
Tapirus sp.

**Referred specimen**—NMMNH 63863, partial left dentary with p2–m2 (measurements in Table 2).

**Locality**—NMMNH locality L-8679, Tonuco Mountain Local Fauna, Camp Rice Formation, Tonuco Mountain/ Cedar Hill area, Doña Ana County, New Mexico (Fig. 1).

**Description**—NMMNH 63863 consists of a partial mandible of a medium-sized tapir with the p2–m2, lacking the lower incisors, canine, and third molar (m3), as well as the mandibular symphysis, ascending ramus, masseteric fossa, and mandibular angle (Fig. 4). The open alveolus behind the m2 and lack of wear on the posterior cingulum of the m2 indicates that the m3 had
Figure 4. Tapir (*Tapirus* sp.), partial left dentary with p2-m2, where p refers to premolar and m to molar (NMMNH 63863) from the early Blancan Tonuco Mountain Local Fauna, Doña Ana County, New Mexico in labial (A), lingual (B), and occlusal (C) views. All scale bars are 1 cm.

not erupted, but it had mineralized and was beginning to erupt. The p4 is fully erupted and in wear. This places it in the young adult stage of Hulbert et al. (2009). The remaining portion of bone preserves these features: 1) mental foramen and termination of the mandibular syn- physis are located ventral to p2; 2) ventral border of the ramus below the cheektooth series is strongly concave; 3) the dentary is deep and thick relative to tooth size; and 4) depth of the mandible is much greater below the molars than below the anterior premolars. The thickness of the jaw ventral to the p4–m3 is partially due to what appears to be a pathologic excess of bone deposited on the lower lingual surface of the dentary. This pathologic bone deposit also makes the ventral border of the ramus look more curved than it would be otherwise.

The teeth, especially the p2–p3 and m1, are far more worn than is usually observed in *Tapirus* at the young adult stage of dental eruption and wear (Fig. 4c). The transverse crests of the p4 and m2 are rounded and polished. This could have been caused by either a diet comprising more abrasive fodder than normal (or one contaminated long- term by grit or volcanic ash), or that the individual had pathologically soft tooth enamel. An alternate hypothesis for the unusual tooth wear is that eruption of the m3 began much later than normal. Whatever the cause for the unusually heavy wear, it was a long-term event, based on its uneven expression on the teeth: greatest in those teeth that erupted first (m1, p2, and p3), but still acting on the m2 and p4 that would have erupted a year or more after the p2 and p3. The underlying morphology of
the lower cheekteeth is that found on late Miocene and younger members of the genus *Tapirus*. The one possibly phylogenetically significant feature is a relatively strong posterior cingulum on the molars.

**Comparisons**—Based on tooth size (Table 2), NMMNH 63863 belongs to a medium-sized species of *Tapirus*, similar in size to the extant species *Tapirus terrestris* and *T. bairdii*, and the extinct species *T. lundeliusi* and *T. veroensis* (Hulbert, 2010). The premolar length (p2–p4) of 61.9 mm is within the observed range of these four species, together with the middle Miocene *Tapirus johnsoni*. The premolar length is about 20% greater than the largest individual of the small-sized late Miocene and earliest Pliocene (Hemphillian NALMA) species such as the extant *T. indicus*, the late Miocene *T. webbi*, and the Pliocene and Pleistocene *T. baysii* and *T. merriami* (Jefferson, 1989; Hulbert, 1995, 2010; Hulbert et al., 2009). In addition to size, *T. webbi* differs from NMMNH 63863 by its relatively narrow cheekteeth and shallow ramus (Hulbert, 2005). *T. johnsoni* differs from NMMNH 63863 by having the mental foramen located more anteriorly and less of a difference in jaw depth below the premolars and molars. Among North American *Tapirus*, NMMNH 63863 is most similar to *Tapirus lundeliusi* (late Blancan of Florida) in its combination of moderate size and morphologic features of the dentary, most notably its relative great depth ventral to the molars.

**Discussion**

**A brief review of *Tapirus* from New Mexico and the American Southwest**

Fossils of tapirs (*Tapirus*) are rare in the Pliocene and Pleistocene of New Mexico. In addition to the mandible from the Tonuco Mountain LF described here, only seven other fossil tapir specimens have been reported from the state (Vanderhill, 1986; Harris, 1993, 2016; Morgan and Harris, 2015). The most complete tapir fossils from New Mexico are two specimens referred to the large species *T. merriami* from the latest Blancan La Union Fauna (= Mesilla Basin faunule B of Vanderhill, 1986), from the Camp Rice Formation in the Mesilla basin in southern Doña Ana County. A partial articulated skeleton lacking the skull and jaws from the La Union Fauna (AMNH-FM 37301) is mostly unprepared and still preserved in a plaster jacket. Only the left humerus, radius, ulna, and metacarpals 2–4 of this specimen have been removed from the jacket and prepared. This skeleton is tentatively referred to *T. merriami* based on its large size, but the diagnostic dental features of this species cannot be evaluated because the skull was not preserved. A palate with right and left P1–M2 from the La Union Fauna (UTEP 33–42) is the only tapir fossil known from New Mexico that can be confidently identified to the species level. Dental features of this specimen indicate referral to *T. merriami* based on characters proposed by Jefferson (1989), in particular, large size and a submolariform P2 with a weakly developed protoloph. A third specimen of large *Tapirus* from the La Union Fauna consists of a dentary fragment with the roots of two teeth (UTEP 33-90). With the exception of the palate, the two other tapir fossils from the late Blancan La Union Fauna do not preserve the diagnostic dental characters of *T. merriami*, and are only tentatively referred to that species based on their large size and occurrence in the western United States.

Tapirs are unknown from faunas dating to the Irvingtonian NALMA (early to medial Pleistocene) in New Mexico, and the record of *Tapirus* from the Rancholabrean NALMA (late Pleistocene) in the state is sparse. Three Rancholabrean specimens from New Mexico are tentatively referred to the large species *T. merriami*: a fragment of a left dentary with the roots of m2 and m3 from the Albuquerque Gravel Pits in northern New Mexico (NMMNH 61715; Morgan and Harris, 2015); and two specimens from Eddy County in southeastern New Mexico, a third metatarsal from the Lost Valley site in Dry Cave (UTEP 1-827) and an upper incisor (I2) from Dark Canyon Cave (Harris, 1993, 2016). There is also a record of *Tapirus* from a cave in the Cornudas Mountains in Otero County in southern New Mexico, presumably of late Pleistocene age, although the nature of the fossil material is not known and the locality is questionable (Harris, 1993, 2016). Their large size and occurrence in the American Southwest suggest that Rancholabrean tapir fossils from New Mexico are probably referable to *T. merriami*.

Jefferson (1989) reviewed the fossil history of *Tapirus* from the region west of the Rocky Mountains, including California, southern Oregon, Arizona, and northern Mexico, but he did not examine any Pliocene or Pleistocene tapirs from New Mexico. Jefferson (1989) referred specimens of large tapirs from late Blancan and early Irvingtonian faunas in southern California (e.g., Anza-Borrego, Bautista Creek) to *T. merriami*, whereas smaller tapirs from the early Irvingtonian El Golfo Fauna in Sonora, northwestern Mexico were identified as *T. californicus*. Exclusive of California and New Mexico, fossils of a large *Tapirus*, probably referable to *T. merriami*, are known from four other southwestern Blancan faunas, all late Blancan: Hudspeth in southwestern Texas (Strain, 1966); 111 Ranch and San Simon in southeastern Arizona (Morgan and White, 2005); and Donnelly Ranch in southeastern Colorado (Hager, 1974).

### TABLE 2. Measurements of the lower dentition and dentary of *Tapirus* sp. from the early Blancan Tonuco Mountain LF, Doña Ana County, New Mexico. Abbreviations: l (length), w (width). Measurements of the depth of dentary were taken on the lingual (medial) surface. All measurements are in mm.

<table>
<thead>
<tr>
<th>Species, locality and catalog number</th>
<th>length of p2–p4</th>
<th>p2</th>
<th>p3</th>
<th>p4</th>
<th>m1</th>
<th>m2</th>
<th>depth of dentary below</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tapirus sp.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tonuco Mountain, NM</td>
<td>61.9</td>
<td>20.8</td>
<td>14.4</td>
<td>19.5</td>
<td>17.2</td>
<td>19.9</td>
<td>18.3</td>
</tr>
<tr>
<td>NMMNH 63863</td>
<td></td>
<td>21.7</td>
<td>19.2</td>
<td>23.7</td>
<td>20.3</td>
<td>50.5</td>
<td>58.3</td>
</tr>
</tbody>
</table>

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Large tapirs of late Blancan and early Irvingtonian age from the eastern United States, particularly Florida, have been referred to *Tapirus haysii* (Ray and Sanders, 1984; Hulbert, 1995, 2010). Hulbert (2010) described the medium-sized species *T. lundeliusi* from the late Blancan of Florida. Among the three recognized species of North American Blancan tapirs, *T. haysii*, *T. lundeliusi*, and *T. merriami*, the early Blancan *Tapirus* mandible from the Tonuco Mountain LF is most similar in size and morphological characters to *T. lundeliusi*. However, a referral to that species cannot be confirmed because the key morphological features distinguishing *T. lundeliusi* are in the skull, whereas only a lower jaw is known of the Tonuco Mountain tapir.

The tapir fossil from the late early Blancan (~3.3–3.6 Ma) Tonuco Mountain LF represents the oldest *Tapirus* known from New Mexico. A tapir reported from the Elephant Butte Lake Fauna from the Palomas Formation in Sierra County (Tedford, 1981) would also be late early Blancan in age based on the mammalian biochronology of that fauna (Morgan et al., 2011), but we have not been able to verify this record. *Tapirus* is unknown from the numerous Miocene faunas from the Albuquerque and Española basins in northern New Mexico (Morgan, 2015). After the Tonuco Mountain mandible, the next oldest tapirs from New Mexico are the three specimens of *T. merriami* from the latest Blancan La Union Fauna (~2.0–2.2 Ma).

The mandible of *Tapirus* from the Tonuco Mountain LF fills a long gap in the North American tapir record, between the small species *T. polkensis* from the late Miocene and earliest Pliocene (late Hemphillian; ~3–5 Ma) of Florida and Tennessee and *T. haysii*, *T. lundeliusi*, and *T. merriami* from the early Pleistocene (late Blancan; ~1.6–2.6 Ma; Jefferson, 1989; Hulbert et al., 2009; Hulbert, 2010). Based on the published fossil record of *Tapirus* from North America (Ray and Sanders, 1984; Jefferson, 1989; Cassiliano, 1999; Graham, 2003; Hulbert, 2010), the Tonuco Mountain tapir appears to represent the only known early Blancan specimen. In a biochronologic analysis of the mammalian fauna from the Fish Creek-Vallecito Creek section in the Anza-Borrego Desert, Cassiliano (1999) recorded at least five specimens of *Tapirus*, with the earliest record from the lower Matuyama Chron corresponding to the latest Blancan (~2.2 Ma). Blancan tapirs are more common in Florida than anywhere else in North America, but all of these records are late Blancan in age (Hulbert, 2010). Hulbert (2010) described the species *Tapirus lundeliusi* from several latest Blancan faunas in Florida, including Haile 7C, Haile 7G, and Inglis 1A. These three faunas are broadly correlative with the latest Blancan La Union Fauna in southern New Mexico (Morgan 2008), which has produced the large tapir, *T. merriami*. Early Blancan faunas appear to be absent in Florida, as this was a time period of warm temperatures and high sea levels that mostly inundated the Florida peninsula (Morgan, 1993).

**Paleoecology and biogeography**

The Tonuco Mountain fauna is predominantly composed of large species of ungulates, in particular, horses and camels, that preferred a grassland or savanna habitat, as well as numerous specimens of the giant land tortoise *Hesperotestudo*. Based on their abundance in other New Mexico Blancan faunas that sampled a savanna environment, it appears that land tortoises also favored grassland habitats. There is a minor component of freshwater species in the Tonuco Mountain LF, including the small mud turtle *Kinosternon* and ducks, and possibly the tapir. The occurrence of the Tonuco Mountain LF in sediments of the axial-fluvial lithofacies of the ancestral Rio Grande provides evidence for riparian conditions along a perennial river. Several species of living tapirs are found in the tropics of Central America and South America, where they prefer forested habitats along rivers, and are known to be semiaquatic (Hershkovitz, 1954).

The presence of giant land tortoises in the Tonuco Mountain LF indicates a warmer climate than present. Living giant tortoises do not dig burrows and cannot survive prolonged exposure to freezing temperatures, and are now found primarily in subtropical and tropical regions. Hibbard (1960) and many others since have used the presence of giant land tortoises of the genus *Hesperotestudo (= Geochelone)* in North American Pliocene and Pleistocene faunas to indicate the absence of freezing winter temperatures. Cassiliano (1997) reviewed the physiology, ecology, and distribution of the living species of giant land tortoises. His detailed analysis of the temperature-controlled geographic distribution of living giant land tortoises supported Hibbard’s (1960) original hypothesis that the presence of *Hesperotestudo (= Geochelone)* in a fossil site indicates the lack of prolonged freezing temperatures. In the early Irvingtonian (about 1 Ma), large species of land tortoises in the genera *Hesperotestudo* and *Gopherus* disappeared from the American Southwest, including New Mexico, probably indicating the onset of Ice Age climatic conditions with cooler winter temperatures (Morgan and Harris, 2015). Blancan vertebrate faunas from New Mexico, Arizona, and southwestern Texas, together with pollen and other paleobotanical data, indicate that the Pliocene climate in the American Southwest was considerably warmer and wetter than the Pleistocene and modern climate in this region (Thompson, 1991).

Graham (2003) proposed that temperature was not an important limiting factor in the Pliocene and Pleistocene distribution of tapirs in temperate North America. Instead, he suggested tapirs were very selective browsers, so-called “gap specialists,” and that they disappeared from the temperate portion of their New World range owing to the disappearance of their preferred habitat following the end of the Pleistocene about 11 ka. Graham's (2003) hypothesis was based primarily on the geographic distribution of several species of *Tapirus* during the Irvingtonian and Rancholabrean, when tapirs were found as far north as New York, Pennsylvania, Indiana, Illinois, Nebraska, and Oregon. Perhaps tapirs became adapted to cooler climates and feeding in temperate forests during the Ice Age climatic conditions of the medial and late Pleistocene, as *Tapirus* had a more southerly distribution in North America during the late Pliocene and early Pleistocene (Blancan).

With the exception of a few records, the occurrence of *Tapirus* in North American Blancan faunas is limited to the southern United States, including Florida, Texas, New Mexico, Arizona, and southern California. Moreover, most of these records are from the southernmost regions of those states, south of 35°N latitude. The largest number of Blancan faunas containing tapirs are from peninsular
records is from south (Mammalia, and -), as well as sp.) is reported from the late Pliocene, from Florida, the cotton rat -.

2. The presence of Equus scotti, Camelops, and Platygonus, all of which first appeared in the late early Blancan at about 3.6 Ma; and the absence of mammals of South American origin that participated in the GABI and first appeared about 2.7 Ma in the American Southwest (Morgan et al., 1998; Morgan and Harris, 2015). Paleomagnetic data for the lower 30 m of the stratigraphic section of the Camp Rice Formation containing the Tonuco Mountain LF (Mack et al., 1993), including the Tapirus mandible, further constrains the age of this fauna. These strata are normally magnetized and correspond to the lowermost portion of the Gauss Chron (C2An.3n), above the Gilbert/Gauss boundary (3.58 Ma) and below the base of the Mammoth Subchron (C2An.2r; 3.33 Ma). Thus, the magnetostratigraphy constrains the age of these strata to 3.33–3.58 Ma, consistent with the mammalian biochronology.

The tapir mandible from the Tonuco Mountain LF is the only record of an early Blancan (2.7–4.9 Ma) Tapirus known from North America. All other Blancan specimens of Tapirus are from the late Blancan (1.6–2.7 Ma).

Most of the classic Blancan faunas from western North America lack tapirs, including: Blanco and Cita Canyon from the panhandle of northwestern Texas (Dalquest, 1975; Schultz, 1977); the numerous Blancan faunas from the Meade basin in southwestern Kansas (Martin et al., 2000), Blancan faunas from Nebraska, with the lone exception of Big Springs (Schultz et al., 1975; Voorhies, 1987); and Hagerman in Idaho (Ruez, 2009). Except for Florida, which has more Blancan sites with Tapirus than the remainder of the United States combined, Blancan tapirs are rare in the southern states where they do occur. There are 40 Blancan faunas in New Mexico, only two contain Tapirus (Morgan and Harris, 2015), two tapir records in Arizona among 15 Blancan faunas (Morgan and White, 2005), and a single Blancan tapir locality in Texas (Strain, 1966). Surprisingly, there are no published Blancan records of Tapirus from Mexico (Lindsay, 1984; Miller and Carranza-Castañeda, 1984; Carranza-Castañeda, 2006), and no Blancan faunas are known from Central America.

Conclusions

A mandible with p2-m2 of a medium-sized species of tapir (Tapirus sp.) is reported from the late Pliocene (early Blancan NALMA), Tonuco Mountain LF, Doña Ana County, southern New Mexico. The mandible is similar in size and certain morphological features to the late Blancan species Tapirus hundelini from Florida (Hulbert, 2010), but is not referred to that species because the diagnostic species-level characters of the genus Tapirus are found in the skull which is not preserved in the New Mexico specimen.

Biochronology and magnetostratigraphy indicate an age of between 3.3 and 3.6 Ma (early late Pliocene; late early Blancan NALMA) for the Tonuco Mountain LF, including the Tapirus mandible. Mammalian biochronology suggests an age range of 2.7–3.6 Ma for the Tonuco Mountain LF, based on: 1) the presence of Equus scotti, Camelops, and Platygonus, all of which first appeared in the late early Blancan at about 3.6 Ma; and 2) the presence of the horses Equus simplicidens and Mammippus peninsulatus, which became extinct in New Mexico at about 2.6 Ma; and 3) the absence of mammals of South American origin that participated in the GABI and first appeared about 2.7 Ma in the American Southwest (Morgan et al., 1998; Morgan and Harris, 2015). Paleomagnetic data for the lower 30 m of the stratigraphic section of the Camp Rice Formation containing the Tonuco Mountain LF (Mack et al., 1993), including the Tapirus mandible, further constrains the age of this fauna. These strata are normally magnetized and correspond to the lowermost portion of the Gauss Chron (C2An.3n), above the Gilbert/Gauss boundary (3.58 Ma) and below the base of the Mammoth Subchron (C2An.2r; 3.33 Ma). Thus, the magnetostratigraphy constrains the age of these strata to 3.33–3.58 Ma, consistent with the mammalian biochronology.

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