PaleoBios 20(1):7–12, April 15, 2000

A Late Pleistocene biota from the Arco Arena site, Sacramento, California

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A small, Late Pleistocene biota was recovered from an excavation of a professional outdoor sports stadium adjoining the ARCO Arena in Sacramento, California. The fossils were recovered from overbank deposits in the less than 600,000 year old Riverbank Formation (Wagner, et al., 1981). This is one of a handful of Pleistocene sites in the northern half of California that include a significant number of genera and this site helps to give us a clearer picture of the Late Pleistocene paleoecology of the Sacramento Valley. The fossils include: Harlan's ground sloth, *Paramylodon harlani*; bison, *Bison antiquus*; coyote, *Canis* cf. *latrans*; horse, *Equus* sp.; camel, *Camelops hesternus*; a squirrel, cf. *Sciurus* sp.; an antelope (Antilocapridae) or deer (Cervidae); and mammoth, *Mammuthus* sp. Plant fossils include an unidentified leaf and a holly leaf cherry seed, *Prunus* cf. *ilicifolia*.

INTRODUCTION

On March 13, 1989, during the excavation phase of the construction of a professional outdoor baseball and football stadium in Sacramento, California, two observant workmen, Brian Fornoff and Pat Bello, were filling planters with the excavated substrate and noticed some broken bones. Two of the bones were initially identified by one of us (RPH) as the calcaneum of a camel, the other a whale humerus or tibia of a ground sloth. After comparison with the collection at the University of California Museum of Paleontology (UCMP) at Berkeley and with assistance from vertebrate paleontologist Donald Savage, the second bone was verified as a ground sloth tibia. Additional bones were subsequently found protruding from the side bank of the excavation and further collecting by the workmen and Sierra College field parties yielded a small, but significant Late Pleistocene biota. This site is one of a handful of Late Pleistocene sites in northern California and it gives us an important window into the Late Pleistocene paleoecology of the Sacramento Valley.

MATERIAL

Fossils recovered from the ARCO Arena site include *Paramylodon harlani* (Harlan's ground sloth), *Bison antiquus* (bison), *Canis* cf. *latrans* (coyote), *Equus* sp. (horse), *Camelops hesternus* (camel), cf. *Sciurus* sp. (squirrel), an antelope (Antilocapridae) or deer (Cervidae), and *Mammuthus* sp. (mammoth). Plant fossils include an unidentified leaf and a holly leaf cherry seed, *Prunus* cf. *ilicifolia*. All material is housed in the Sierra College Natural History Museum.

Abbreviations: Sierra College Natural History Museum fossils are: **VM, VMA, VMC, VMEL, VMO**. **VM** = Vertebrate, Mammal and the following letter(s) stand for preliminary designations, for example **A** = artiodactyl. **UCMP** is the designation for the University of California Museum of Paleontology, Berkeley.

GEOLOGY

The specimens were recovered from overbank deposits in the Riverbank Formation (Wagner, et. al., 1981) that range from pebble- to clay-sized fluvial sediment. The ARCO site fossils were found 4 to 9 meters below the present surface of the valley (Fig. 1).

Locality

The ARCO Arena site is located at 38° 39' 12" N latitude and 121° 30' 38" W longitude, north of Interstate 80 and east of Interstate 5 and is within sight of both highways (Fig. 2). It is north of the junction of the Sacramento and American Rivers, in Sacramento County, California.

The stadium site of the fossil locale adjoins the area just north of the ARCO Arena building and an underground passage that was to connect it to the playing field. The elevation of the surface of the site ranges between 3.05 and 4.6 meters above sea level. The site was reported as the Sacramento Sports Stadium locality by Jefferson (1991) and included a preliminary faunal list.

Horizon and Age

The Riverbank Formation has been found above a well-developed soil formed on the upper unit of the Turlock Lake Formation making the Riverbank Formation less than 600,000 years old. The age of the Riverbank Formation was considered to be 103,000 ± 6,000 years by Hansen and Begg (1970) based on dates of bones from both the Teichert and Davis sites using uranium and actinium series methods of dating. Whether this age applies to other faunas in the Riverbank Formation such as the ARCO Arena site

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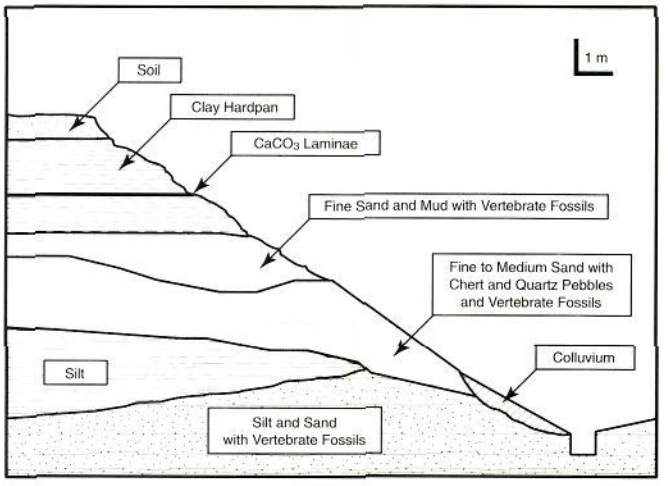

Fig. 1. Generalized stratigraphic section of the ARCO Arena site. Stratigraphic units often pinch out laterally.

cannot be determined at this time. Other Rancholabrean age faunas have been found in the Riverbank Formation (Junto and Croft 1967) and the formation may be either Illinoian or Wisconsinan in age (Marchand and Allwardt 1982).

SYSTEMATIC PALEONTOLOGY

Class: MAMMALIA Linnaeus 1758
Order: XENARTHRA Cope 1889
Family: MYLODONTIDAE Gill 1872
Paramylodon harlani Owen 1840

Referred specimens—VMA-1-C right upper first molariform tooth, VMA-4 partial left scapula, VMA 3-A diaphysis of left tibia, VMEL-40 neural arch of a thoracic vertebra, VMA-2-B right half of axis.

The upper first molariform (VMA-1-C) is oval in cross section with a single occlusal surface at right angles to the long axis of the tooth. The anteroposterior length of the tooth is 26.4 mm and the transverse width is 15.1 mm.

The partial scapula (VMA-4) includes the anterior portion of the glenoid fossa, and a complete acromiocoracoid arch. The acromiocoracoid arch preserves the articular facet for the clavicle and includes the coracoid foramen. The specimen is well ossified and from an adult. The acromiocoracoid arch has prominent muscle scars along its ventral edge. Width of the glenoid fossa is 67.9 mm which is smaller than the average of 72.3 mm recorded by Stock (1925) for specimens from Rancho La Brea.

The left tibia (VMA-3-A) is of a juvenile as both epiphyses are missing and consists only of the diaphysis. In addition to the absence of the epiphyses the incomplete ossification of the diaphysis as indicated by its porous, spongy texture is characteristic of an immature animal. Although an immature specimen, the proportions of the diaphysis are similar to adult mylodonts which are distinguished from megalonychids and nothrotheres by an extremely shortened tibia. The tibial crest is present, reduced in size and offset laterally as is typical of mylodont sloths. Length of the diaphysis is 163 mm, mediolateral width of the proximal end is 121.5 mm, anteroposterior length of the medial side of the proximal end is 93.5 mm, mediolateral width of the distal end is 108.8 mm and anteroposterior length of the distal end is 79.5 mm.

Other records of *Paramylodon* from the Riverbank Formation include a left tibia (UCMP 81277) and the proximal portion of a calcaneum (UCMP uncataloged) from Teichert Gravel Pit. The Teichert Pit is located approximately 16 km from the ARCO Arena.

Order: RODENTIA Bowdich 1821
Family: SCIURIDAE Fisher de Waldheim 1817
cf. *Sciurus* sp. Linnaeus 1758

Referred specimen—VMR-9 distal half of left humerus.

The specimen was compared with modern individuals of *Spermophilus* (F. Cuvier, 1825) and *Sciurus*. The distal portion of the deltoid crest is positioned more proximally on the shaft as in *Sciurus* and the shape and position of the entepicondylar bar more closely resembles that of *Sciurus* than *Spermophilus*. The specimen cannot be identified to genus with any certainty but is here referred to *Sciurus* based on the preserved portions. The only species of *Sciurus* known from California is *S. griseus*, the western gray squirrel.

Order: PROBOSCIDEA Illiger 1811
Family: ELEPHANTIDAE Gray 1821
Mammuthus sp. Brookes 1828

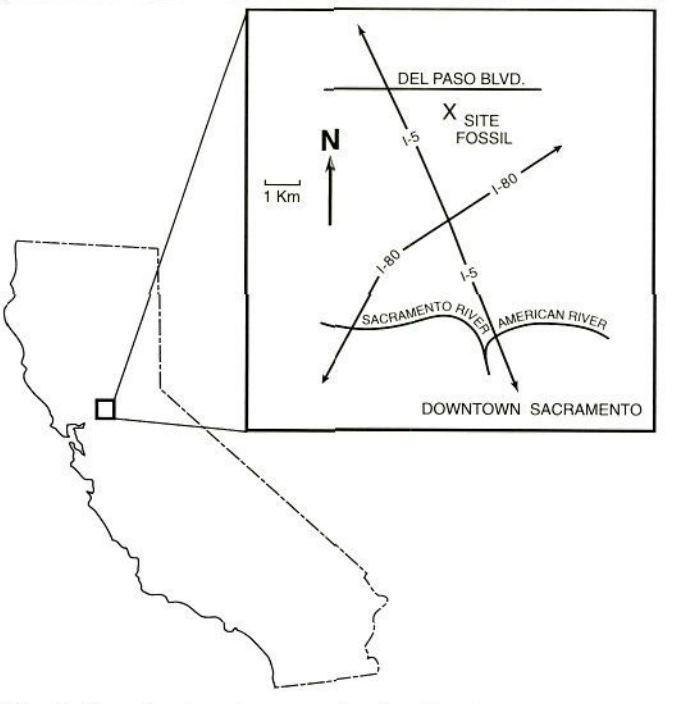

Fig. 2. Map showing the site of the fossil locality.

Referred specimen— VMEL-15 fragment of a tooth plate, fragments of tusk.

The fragment of a single tooth plate represents the unworn crown of a tooth.

Order: CARNIVORA Bowdich 1821
Family: CANIDAE Fischer de Waldheim 1817
Canis cf. *latrans* Say 1823

Referred specimen— VMC-10 shaft of a left humerus.

The specimen lacks both articular ends but preserves enough of the distal end to indicate the presence of the supratrochlear foramen typical of canids. Overall size and appearance compares favorably with coyote.

Order: PERISSODACTYLA Owen 1848
Family: EQUIDAE Gray 1821
Equus sp. Linnaeus 1758

Referred specimen— VMO-140 ascending ramus of right mandible.

This specimen was compared to the same portion of the jaw of *Equus*, *Camelops* and *Bison*. It most closely resembles *Equus* in size and morphology and lacks the elongated coronoid process of the other two genera.

Order ARTIODACTYLA Owen 1848
Family CAMELIDAE Gray 1821
Camelops hesternus Leidy 1873F

Referred specimens— VME-291 left calcaneum, VME 295 complete lumbar vertebra.

The *Camelops* calcaneum is complete except for the sustentaculum. Dimensions are: maximum length, 146.9 mm; length of tuber calcis, 93.7 mm; and anteroposterior dimension of the tuber calcis, 58.5 mm. Morphologically there are no features that distinguish the ARCO Arena specimen from specimens of *C. hesternus* with which it was compared. Comparison of the ARCO Arena specimen with samples of *C. hesternus* calcanea from Rancho La Brea and American Falls Reservoir (Fig. 3) shows that it falls into the lower end of the size range of the species.

Like the calcaneum the lumbar vertebra represents an individual at the small end of the size range for *Camelops hesternus*. The overall morphology compares well with other specimens of *Camelops* at the Idaho Museum of Natural History except for one difference. This specimen had a pair of small fossae, one on each side of the base of the anterior edge of the neural spine just posterior to the anterior zygapophyses. This was not observed in any other specimens examined.

Family: BOVIDAE Gray 1821
Bison antiquus Leidy 1852

Referred specimens— VME-296 left and right horn cores, VME-290 partial skeleton (letter designation after each specimen indicates the field identification): skull, dorsal portion (D); petrosal (Ta); anterior portion of left mandible (LL); mandible fragment with alveoli (b); left humerus minus proximal end (B); right ulna (S); left radius distal epiphysis (AAA); ulna and radius with distal epiphysis (GG); right ulnare (H); right lunar (C); metacarpal III/IV (D); metacarpal III/IV (A); right tibia minus proximal end (J); right calcaneum (E); left calcaneum tuber calcis (F); left astragalus (MM); right astragalus (Q); left naviculocuboid (JJ); second phalanx (SS); sesamoid (RR); thoracic vertebra (V); thoracic vertebra neural spine (QQ); ribs and rib fragments (HH) (II) (KK) (NN) (TT a,b) (K) (M) (L a,b,c); VM-38 portion of neural arch with posterior zygapophyses of lumbar vertebra four or five. Measurements of specimens are in Table 1.

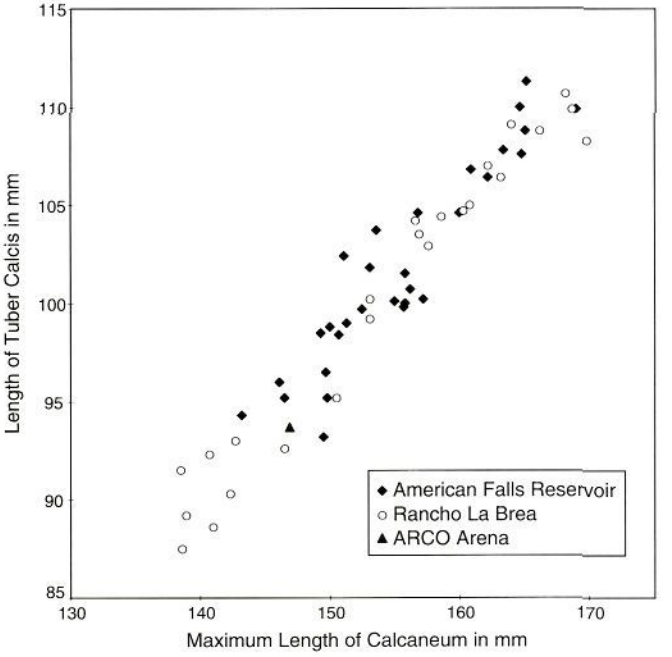

Fig. 3. Scatter diagram of *Camelops* calcaneum dimensions.

The two individuals of *Bison* were recovered at different levels. The pair of horn cores (VME-296) came from 8 meters below the surface while the partial skeleton (VME-290) came from 4 meters below the surface. The skeleton of VME-290 was disarticulated but in close association (Fig. 4). The length of the upper curve of the horn core of the partial skeleton is 394 mm and represents a larger individual than VME-296. The two horn cores of the second specimen (VME-296) are separate but the similarity in size and preservation indicate they represent a single individual. One horn core lacks the base and the other the tip thus limiting any complete set of measurements.

Dimensions of the burr on one horn core are dorsoventral 95.1 mm, antero-posterior 97.3 mm and circumference 305 mm. The almost equal dimensions fit McDonald's (1981) diagnosis for *Bison antiquus antiquus* and places

Table 1. Measurements in mm (rounded to nearest tenth) of associated skeleton of *Bison antiquus*, VME-290, from ARCO Arena. AP = anteroposterior, ML = mediolateral, PD = proximodistal.

VME-290-W Upper molar	
Crown Length	26.3
Mesodistal Lingual-labial	27.7
VME-290-B Right humerus minus proximal and distal end	
Medial AP depth	98.4
Lateral AP depth	59.1
ML width	93.9
VME-290-GG Left ulna-radius	
Length	318.3
AP depth proximal end	48.6
ML width proximal end	98.7
AP depth distal end	37.0
ML width distal end	70.5
VME-290-AAA Right distal epiphysis of ulna-radius	
AP depth	39.6
ML width	72.5
VME-290-C Right lunar	
AP depth	50.2
ML width	34.9
PD length	32.6
VME-290-C Right ulnare	
AP depth	43.7
ML width	26.1
PD length	34.8
VME-290-A Metacarpal 3 and 4	
Length	216.1
AP depth proximal end	41.8
ML width proximal end	72.9
ML width distal end	74.7
AP dimension trochlea	37.9
VME-290-J Right tibia minus proximal end	
Distal end: AP depth medial side	56.7
Distal end: AP depth lateral side	44.7
ML width distal end	73.4
VME-290-EE Right calcaneum	
Total length	163.8
Length of tuber calcis	108.5
AP width across fibular articulation	55.0
ML width	54.3
VME-290-JJ Left naviculocuboid	
AP depth	52.3
ML width	65.8

	VME-290-MM Left astragalus	VME-290-Q Right astragalus
Length of medial side	75.4	75.3
Length of lateral side	79.1	79.5
Width of distal end	51.6	54.3
Anteroposterior depth	40.3	41.8

this specimen at the lower end of the size range for a male (81–126 mm). It is still considerably larger than a female *B. antiquus* (53–79 mm). The circumference of 305 mm places the specimen in the midrange of males (233–392 mm) and well above the range of female (172–241 mm) *B. antiquus*. The ARCO Arena specimen has a prominent dorsal groove restricted to the distal 10–20% of the horn core, another feature listed by McDonald (1981) as characteristic of *B. antiquus*.

Family: ANTILOCAPRIDAE Gray 1866
or CERVIDAE Goldfuss 1820

Referred specimen- VM-68 distal portion right scapula.

The only indication of a small artiodactyl in the fauna is the presence of a distal half of a scapula. Not enough is preserved to permit further identification.

DISCUSSION

The only other major fauna from the Riverbank Formation is from the Teichert Gravel Pit (Jefferson 1991). Smaller faunas from the Riverbank Formation include those reported from the Davis Gravel Pit and Ehrhardt Avenue in Sacramento (Jefferson 1991). All of these faunas include the same large mammalian taxa present in the ARCO Arena fauna. The Teichert Gravel Pit fauna also includes numerous small mammalian species not present in the ARCO Arena fauna.

The ARCO Arena fauna contains genera and species typical of the late Pleistocene of California. The long temporal span of many of the taxa in the fauna does not permit any finer time resolution other than Pleistocene. The appearance of *Bison* in North America is used to define the beginning of the Rancholabrean (Kurten and Anderson 1980). Lundelius et al. (1987) consider the beginning of the Rancholabrean to be poorly dated and list dates between 0.2 and 0.55 Ma while Repenning (1987) uses an age of 0.4 Ma as its beginning. According to McDonald (1981) the earliest documented record of *Bison antiquus* is Sangamonian. The Sangamonian interglacial is correlated with the oxygen-isotope stage 5, about 125,000 to 75,000 yr B.P.

One of the phylogenetic trends in *B. antiquus* is an overall reduction in size during the Pleistocene and the eventual evolution of *B. bison* (McDonald 1981, Wilson 1992). An overall decrease in horn size for *B. antiquus* was illustrated by Guthrie (1970) but differences in horn size between males and females were not considered. As discussed above, one ARCO Arena specimen falls at the small end of the size range of males of *B. antiquus* while the other is at the larger end.

Most of the fauna present such as *Bison*, *Equus*, *Mammuthus*, and sloth represent open country grazers. Beyond the general inference that open grassland existed in the area, few other conclusions can be drawn. McDonald

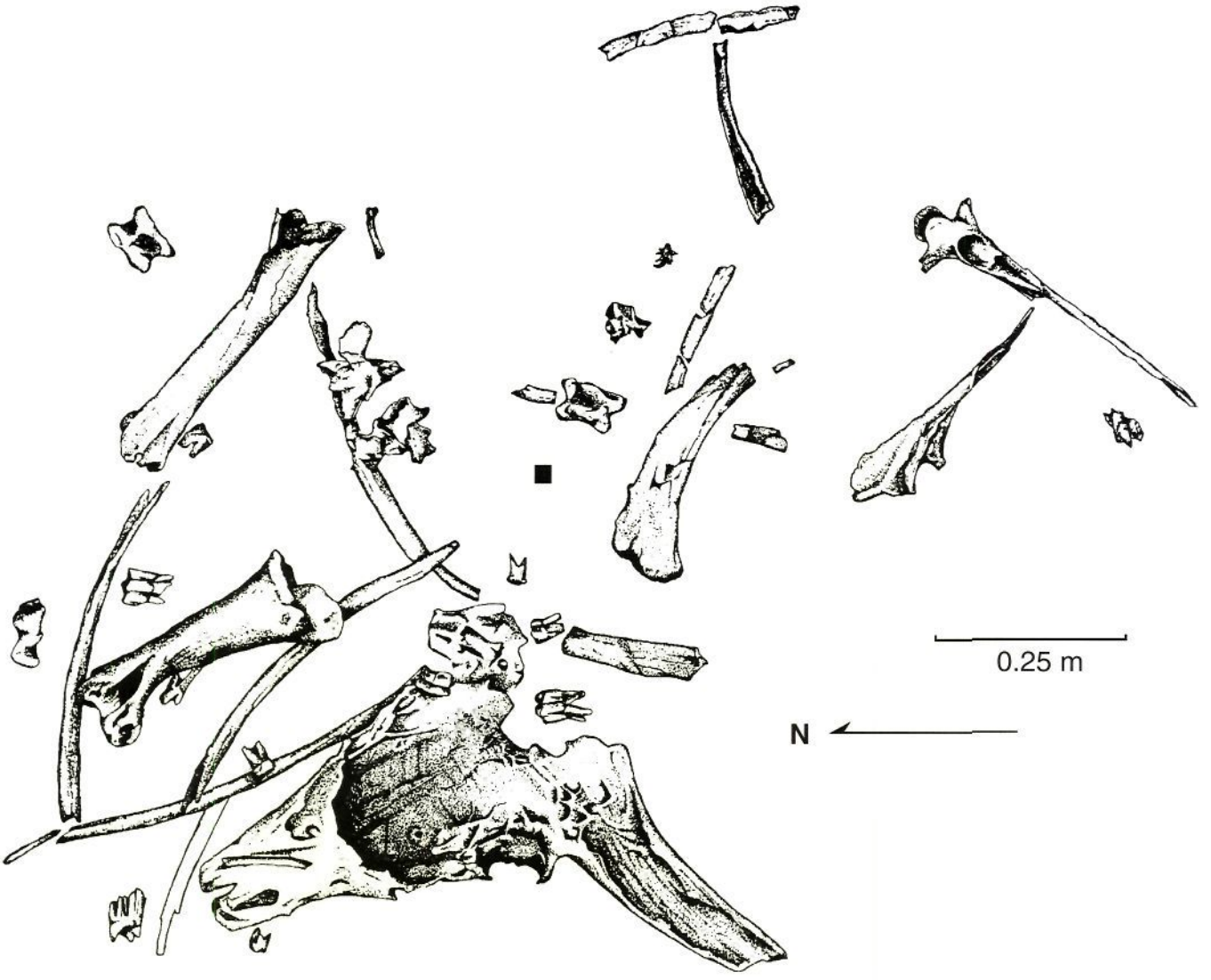

Fig. 4. Map showing distribution of *Bison* skeletal remains. Artwork by Ken Kirkland.

(1993) noted that the distribution of *Paramylodon harlani*in California tends to be concentrated in the lowland and coastal portions of the state and the location of the present record fits this pattern.

The two plants associated with the fauna are represented by an unidentified dicot leaf impression and a seed resembling *Prunus* cf. *ilicifolia* (Nuthall) Walpers. The seed may be from the local area or could have been transported to the site by fluvial activity. *Prunus ilicifolia* today occurs in canyons, slopes, shrublands, and woodlands (Hickman 1996) and its closest occurrence to the fossil site is an isolated northernmost population in Napa County (Little 1976). Presence of *Prunus* cf. *ilicifolia* at ARCO suggests that in the Late Pleistocene it grew within the drainage of the Sacramento River system. Hansen and Begg (1970) recorded the presence of *Platanus* (sycamore) and *Salix* (willow) at the Teichert site. Sycamore and willow are found today in riparian areas of the Sacramento Valley.

All of the taxa present in the fauna that can be identified with any degree of confidence were widely distributed in North America. All of the large taxa are present in numerous Late Pleistocene faunas. *Paramylodon harlani*, for example, ranged along the west coast as far north as the Olympic Peninsula and south into Mexico. It is known from over 60 localities in California alone (McDonald 1993) and ranged as far east as Florida. According to McDonald (1981) the primary range of *Bison antiquus* was the southwestern United States and Mexico with a major outlier in Florida. The ARCO Arena locality falls well within this initial primary range of the species and it is known from 15 other localities in California (McDonald 1981). Less widely distributed than the other two taxa,

Camelops is found in numerous localities in the western United States ranging as far north as Edmonton, Alberta, Canada (Burns and Young 1994) and south into Mexico (Mooser and Dalquest 1975). The ARCO Arena fauna contains species typically found in many faunas in the western United States during the Late Pleistocene.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the efforts of Brian Fornoff and Pat Bello which resulted in the presevation of this fauna. Landowner Greg Lukenbill graciously allowed Sierra College to excavate the site. Recovery of specimens was facilitated with the aid of ARCO workmen Brian Fornoff, Jim Lewis and Rick Skinner as well as Sierra College students Sandy Fussner, Tae Towers, Rainey O'Rourke, Mike Measures, Annette Roumage, Carrie Dawson, Mike Guebert, Bill Woods, Joe Smith, Brent Saunders, Tina Jeffers and Jenny Fitzgerald. ARCO workmen Andy Brophy, Jim Lewis and Rick Skinner donated specimens from the site. Don Savage, University of California, Berkeley, aided with the preliminary identifications of specimens. William Akersten kindly allowed us to utilize the collections in his care at the Idaho Museum of Natural History for comparison with the specimens described in this paper. Thanks go to James and Samuel Wilson for their help in graphic illustration.

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