

## *Arctodus simus* (Cope, 1879) from Riverside County, California

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### ABSTRACT

A left calcaneum and astragalus from an individual of *Arctodus simus* (Cope, 1879) were recovered during development mitigation in the city of Murrieta, Riverside County, California. Sediments in this area, attributed to an unnamed sandstone and conglomerate formation, consist of green, fine-grained sands, silts and micaceous clays. These sediments are assigned to the late Blancan and/or the Irvingtonian North American Land Mammal Ages. The remains of *A. simus* were recovered from below an ash horizon tentatively correlated with the Bishop Tuff (0.7 m.y. BP) and are considered to be Irvingtonian (early Pleistocene) in age.

Skeletal elements of *Arctodus simus* have been recovered from Pleistocene sediments throughout North America, except in the southeastern United States. In California, *A. simus* is known from several Rancholabrean localities, including Potter Creek Cave and Rancho La Brea, and early Irvingtonian sites at Vallecito Creek and Irvington. Sexual dimorphism is marked in this species; previously proposed subspecific distinctions are unwarranted. The specimens from Murrieta represent a large male.

### INTRODUCTION

Since 1974, the Division of Earth Sciences at the San Bernardino County Museum (SBCM) in Redlands, California, has conducted the Paleontologic Resource Assessment Program (PRAP). This Program is a response to Federal, State and local guidelines which recommend mitigation of adverse impacts to nonrenewable paleontologic resources caused by construction and land development. With the cooperation of developers, exposed fossils and fossil-bearing sediments are salvaged from land parcels targeted for excavation and development. All PRAP-generated fossiliferous materials are returned to the SBCM for preparation, curation and permanent storage.

PRAP salvage and mitigation was conducted during excavation and rough grading for the Morrison Homes project, County of Riverside Tract #23110, a subdivision of the California Oaks Planned Community project development in the city of Murrieta, Riverside County, California (Figure 1) from 1990 to 1991. More than thirty thousand vertebrate fossils of Pleistocene age were recovered from thirty-six localities during the course of this mitigation (Reynolds et al., 1990, 1991); these fossils are currently housed at the SBCM. The composite faunal list for the Morrison Homes project is presented in Appendix 1.

A left astragalus and calcaneum from this collection represent the extinct Pleistocene short-faced bear, *Arctodus simus*. This taxon has not previously been described from Riverside County.

### LOCALITY

SBCM 05.006.303, located approximately one km northeast of the city of Murrieta, Riverside County, California, at an elevation of roughly 381 m. This locality lies within the unsurveyed Temecula Land Grant (Figure 1). The locality's projected map coordinates are SW 1/4, SE 1/4, SW 1/4, Section 9, T.7S., R.3W., San Bernardino Base and Meridian.

### GEOLOGY AND AGE

The fossils were recovered from sediments of an unnamed sandstone and conglomerate formation which unconformably underlies the Pauba Formation and may unconformably overlie the Temecula Arkose in the Elsinore Fault Zone (Kennedy, 1977). Vertebrate fossils from this formation have been previously reported by Mann (1955), Kennedy (1977), Reynolds and Reynolds (1990), and Reynolds et al. (1990, 1991).

The unnamed sandstone formation has been described as consisting in part of pale greenish-yellow, medium-grained, friable, caliche-rich sandstone (Kennedy, 1977). Near its contact with the Wildomar Fault Zone northwest of Murrieta, this sandstone "grades laterally and abruptly to

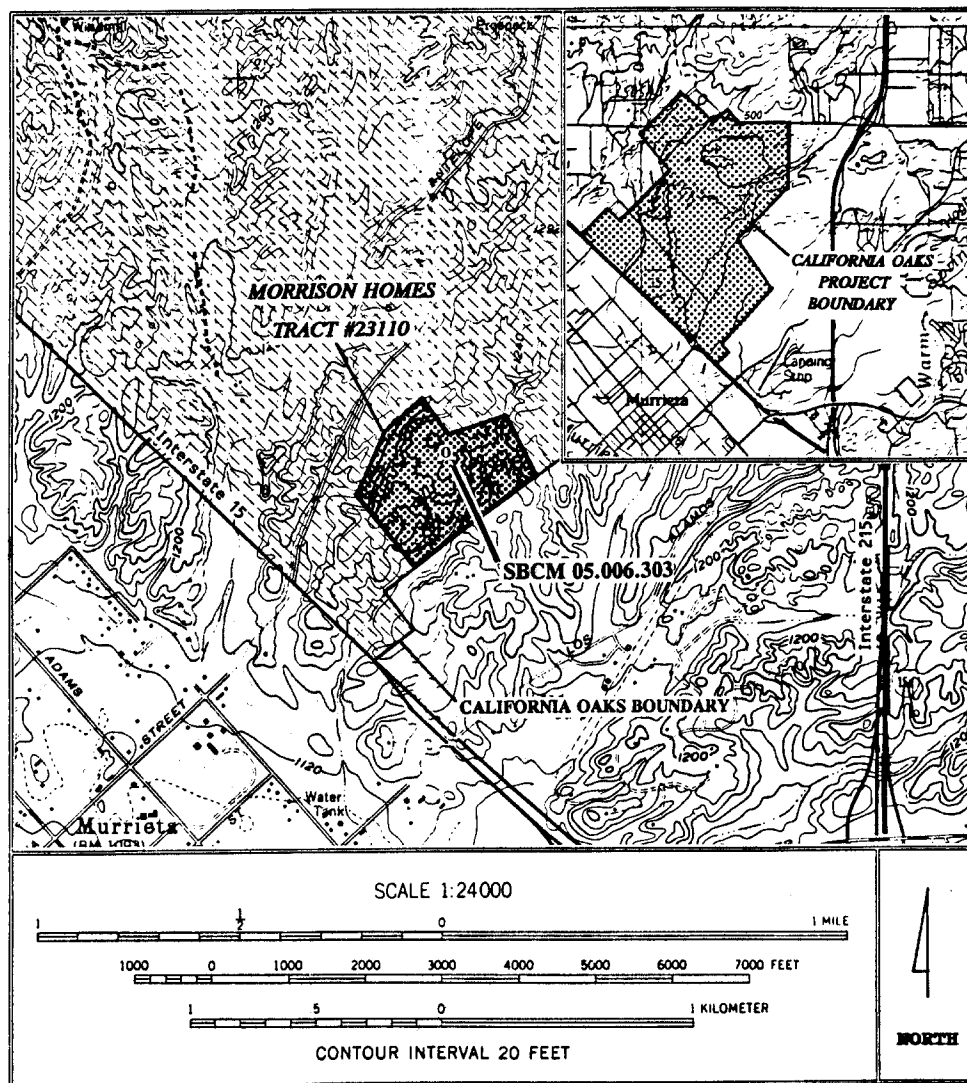


Figure 1. Location of locality SBCM 05.006.303 northeast of Murrieta. Base map: U.S. Geological Survey 7.5 minute, Murrieta, California topographic quadrangle, scale 1:24,000 (1953 edition, photorevised 1979).

a cobble-and-boulder conglomerate facies composed entirely of locally-derived plutonic, metamorphic, and volcanic clasts set in a coarse-grained brown sandstone matrix" (Kennedy, 1977, p. 5). Fossil-bearing sediments from the sandstone unit present at locality SBCM 05.006.303 were observed to consist of green, fine-grained sands, silts and micaceous clays with lenses of caliche.

An ash horizon, two to three meters in thickness, which is interstratified with exposures of the sandstone approximately three km northwest of Murrieta has been correlated with the widespread Bishop Tuff (Merriam and Bischoff, 1975; Kennedy, 1977). The Bishop Tuff

has been radiometrically dated at 0.7 m.y. BP (Merriam and Bischoff, 1975). Within the boundaries of the California Oaks project northeast of Murrieta, the stratigraphic sequence of sediments is reported to strike northwest and dip shallowly northeast; an ash horizon reported to be relatively high in this section has also been tentatively correlated with the Bishop Tuff (Reynolds et al., 1991), although no petrographic analyses or radiometric dates of this ash are available. The remains of *Arctodus simus* were recovered near the inferred base of the section, to the southeast, and are therefore presumably below the ash horizon (Reynolds et al., 1991).

Previous investigations (Reynolds et al., 1990, 1991) reported several taxa from the California Oaks area suggestive of a Blancan and/or an early Irvingtonian North American Land Mammal Age (NALMA) (Kurtén and Anderson, 1980; Savage and Russell, 1983; Lundelius et al., 1987; Repenning, 1987). These taxa included the Blancan forms *Paraneotoma fossilis*, *Mimomys* (*Ophiomys*) *parvus*, and *Hypolagus* sp.; the late Blancan/earliest Irvingtonian taxa *Sigmodon minor*, *Prodipodomys* sp. and *Platygonus bicalcaratus*; and the Irvingtonian taxa *Megalonyx wheatleyi*, *Microtus* sp. and *Mammuthus* sp. (Reynolds and Reynolds, 1990; Reynolds et al., 1990, 1991). The California Oaks assemblage was nevertheless determined to date to the late Irvingtonian NALMA, based upon the presence of the taxon *Clethrionomys* sp. near the base of the proposed stratigraphic section and the presumed correlation of the ash horizon with the Bishop Tuff (Reynolds et al., 1990, 1991).

There are difficulties with this interpretation. Within the California Oaks area, faunas of Blancan or Irvingtonian NALMA appear in general to be segregated into relatively discrete assemblages with little or no overlap. Locality SBCM 05.006.138, located 0.6 km due north of SBCM 05.006.303, yielded two tooth fragments attributed to *Microtus* sp. in association with *Prodipodomys* sp. and *Sigmodon minor* (Reynolds et al., 1991); however, field notes recorded during collection of fossils and sedimentary matrix from this locality cite potential contamination with other sedimentary samples. At none of the remaining 300+ localities in this area can direct associations of Blancan and Irvingtonian taxa be demonstrated. The apparent co-occurrence of Blancan and Irvingtonian taxa within the "fauna" (Reynolds et al., 1990, 1991) is probably an artifact of interpretation, resulting in most cases from the combination of two or more field numbers under a single SBCM locality number on the basis of geographic proximity. Consideration of the fossil material from the California Oaks area as a single fauna is therefore probably unwarranted.

The late Irvingtonian NALMA for the "fauna" is also problematic. Specimens assigned to *Clethrionomys* sp., reported from the lower part of the proposed sedimentary section (Reynolds et al., 1991) have been recently re-identified as the Blancan taxon *Mimomys* (*Ophiomys*) *parvus* (Repenning, pers. comm.

1993). An isolated tooth of *Clethrionomys* reported from the Murrieta area (Repenning, 1987) was recovered from the surface of a borrow pit and cannot be stratigraphically correlated to the ash horizon or to the remaining fossil assemblages. Based upon the available evidence, a restricted late Irvingtonian NALMA for the assemblage cannot be demonstrated.

It is possible that extensive faulting in the Murrieta area resulted in the discontinuous juxtaposition of Blancan and Irvingtonian sediments. This has been suggested previously (Reynolds and Reynolds, 1990) but may be a more extensive phenomenon than originally supposed. It is also possible that the fossils from the California Oaks area comprise a transitional Blancan/Irvingtonian assemblage representing faunal turnover across the Pliocene-Pleistocene boundary. Resolution of these biochronologic considerations must await more detailed stratigraphic analysis.

The fauna identified from the Morrison Homes property (Appendix 1) is comprised primarily of taxa indicative of a Pleistocene age, including *Microtus* sp. and cf. *Mammuthus* sp. (Reynolds et al., 1990, 1991). Specimens assigned to *Microtus* sp. were recovered in direct association with the remains of *Arctodus simus* from locality SBCM 05.006.303. The absence of the late Pleistocene taxon *Bison* sp. from a large mammal fauna dominated by presumed grassland forms (notably the extinct horse, *Equus* sp. cf. *E. bautistensis*) suggests deposition during the Irvingtonian NALMA (Kurtén and Anderson, 1980; Reynolds et al., 1990). The presence of the Blancan rabbit *Hypolagus* sp. in this otherwise Irvingtonian fauna is misleading; this taxon is represented by a single, somewhat abraded P<sup>2</sup> that appears to have been reworked from older strata (R.L. Reynolds, pers. comm. 1992). The remains of *A. simus* are therefore interpreted to date to the Irvingtonian NALMA.

## SYSTEMATIC PALEONTOLOGY

Class Mammalia Linnaeus, 1758

Order Carnivora Bowdich, 1821

Family Ursidae Gray, 1825

Subfamily Tremarctinae Kraglievich, 1926

Genus *Arctodus* Leidy, 1854

*Arctodus simus* (Cope), 1879

**Referred Material:** A2535-0757, left calcaneum; A2535-0758, left astragalus (Figure 2). Both specimens suffered damage from construction equipment prior to recovery. A2535-0757 lacks the medial portion of the cuboidal facet as well as most of the sustentaculum. A2535-0758 lacks the posterior portion of the sustentacular facet, as well as the medial ridge of the tibial articular surface.

### MATERIALS AND METHODS

The specimens from Murrieta were compared with similar material attributed to *Arctodus simus* from Rancho La Brea, Los Angeles, California; Rock Creek, Briscoe County, Texas; and Hay Springs, Sheridan County, Nebraska. Published metric descriptions (Kurtén, 1967) of specimens assigned to *A. pristinus* from Cumberland Cave, Allegany County, Maryland, were also considered. The fragmentary nature of the Murrieta material precluded comparison with some published data. Metric data were recorded using Mitutoyo Digimatic electronic digital calipers connected via a Mitutoyo MR100 cable to an NEC Multispeed laptop computer running the LESSOFT data acquisition program. Measurements were incorporated from Merriam and Stock (1925), Kurtén (1967) and von den Driesch (1976) where possible. Results are presented in Table 2.

### DISCUSSION

The size and morphology of the calcaneum and astragalus from Murrieta are similar to *Arctodus simus* from Rancho La Brea, Rock Creek and Hay Springs. The Murrieta material is substantially larger than equivalent tarsal elements assigned to *A. pristinus* from Cumberland Cave (Kurtén, 1967) and therefore cannot be relegated to this taxon.

*Arctodus simus* is well-known from Pleistocene deposits throughout most of North America, exclusive of the southeastern United States. Remains of *A. simus* have been described from Irvingtonian sediments in Texas and Nebraska as well as California. The reported Rancholabrean distribution of *A. simus* is more extensive, ranging from Mexico north to the Yukon and including occurrences in the continental United States from Pennsylvania to California (Kurtén and Anderson, 1980). The type locality for the species is Potter Creek Cave, California.

In California, *Arctodus simus* is known from several localities of Irvingtonian age, including

the type NALMA locality near Irvington in Alameda County (Stirton, 1939; Savage, 1951) and Vallecito Creek, San Diego County (Downs and White, 1968). The Irvington deposits have been dated at older than .7 m.y. BP (Lindsay et al., 1975). The Vallecito Creek section is older; paleomagnetic analyses have yielded an age of .8 - 1.5 m.y. BP (Opdyke et al., 1977).

The size of the Murrieta specimens plots near the large end of the Rancho La Brea distribution, and is similar to the "truly gigantic" specimens (Kurtén, 1967) of *Arctodus simus* from Hay Springs. Kurtén (1967) proposed that the taxon *A. simus* could be subdivided into two distinct subspecies; the larger subspecies, *A. s. yukonensis*, would be represented by the material from Irvington, Yukon, Alaska, and Hay Springs. The smaller *A. s. simus* would be represented from Rancho La Brea, Rock Creek and Potter Creek Cave. Voorhies and Corner (1982) suggested that this distinction was specific rather than subspecific. However, Cox (1991) indicated that new material from Rancho La Brea is as large or larger than the Hay Springs specimens. The presence of both large and small representatives of *Arctodus simus* from single localities at Rancho La Brea demonstrates that the species exhibited a greater degree of size variation than was previously known (Kurtén, 1967). Specific or subspecific designations within the taxon *A. simus* are unwarranted.

Several extant species of bears, including *Ursus americanus*, *U. arctos* and *U. maritimus* exhibit a great degree of size variation due to sexual dimorphism (Kurtén, 1955; Harlow, 1962; Manning, 1971; Pearson, 1975). Sexual dimorphism has also been reported in extinct bears including *U. spelaeus* (Kurtén, 1955) and *Tremarctos floridanus* (Kurtén, 1966). The range of variation exhibited by *Arctodus simus* can probably be attributed to sexual dimorphism. The individual from Murrieta is presumed to be a large male.

The presence of *Arctodus simus* in Riverside County has not been demonstrated previously. However, specimens from the county tentatively assigned to the genus *Arctodus* are present in the Frick Collection of the American Museum of Natural History (J.P. Alexander, pers. comm. 1992). This unpublished material is part of the El Casco fauna, an early Irvingtonian assemblage recovered from exposures of the San Timoteo Formation in Riverside County (Repenning, 1987). The presence of another ursid, "*Hyaenarctos*" (=

*Agriotherium*), in the San Timoteo Formation has also been previously reported (Frick, 1921). Until the remains presumed to represent *Arctodus* from the El Casco fauna are described and distinguished from *Agriotherium*, this record must remain unsubstantiated.

### CONCLUSIONS

Specimens representing a large, probably male individual of *Arctodus simus* have been identified from an unnamed sandstone and conglomerate formation near Murrieta, Riverside County, California. Diagnostic fauna recovered from this formation in association with the remains of *A. simus* suggest an Irvingtonian age for the fauna. However, a Blancan faunal component is also present from the rock unit. Biostratigraphic correlations of *A. simus* from Riverside County with occurrences of the taxon elsewhere in California must remain provisional pending more detailed geologic analyses of the unnamed sandstone formation.

### ACKNOWLEDGEMENTS

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APPENDIX 1. Composite Faunal List, Morrison Homes Project, Murrieta, California. Taxa recovered from locality SBCM 05.006.303 are marked with an asterisk (\*). In cases where a relatively less precise zoological category (such as a family) is marked with an asterisk, but more refined subdivisions within that category (such as individual genera or species) are not, the specimens from SBCM 05.006.303 could only be identified to the more general hierarchal category.

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*Plantae		plants
Mollusca		molluscs
	Bivalvia	bivalves
		clam
		snails
	Gastropoda	
*Chordata		chordates
	*Vertebrata	vertebrates
	*Amphibia	amphibians
	*Anura	frogs or toads
	Pelobatidae	spadefoot toads
	<i>Scaphiopus</i> sp.	spadefoot
	Hylidae	tree frogs
	<i>Hyla</i> sp.	tree frog
	*Reptilia	reptiles
	*Chelonia	turtles
	*Lacertilia	lizards
	*Iguanidae	iguanid lizards
	<i>Phrynosoma coronatum</i>	coastal horned "toad"
	* <i>Phrynosoma</i> sp.	horned "toad"
	*Sceloporinae	scepolorine lizards
	Teiidae	whiptails
	cf. <i>Cnemidophorus</i> sp.	whiptail
	*Scincidae	skinks
	* <i>Eumeces</i> sp.	skink
	*Anguidae	alligator lizards
	Gerrhonotinae	alligator lizards
	*Anniellidae	legless lizards
	* <i>Anniella</i> sp.	legless lizard
	*Serpentes	snakes
	*Colubridae	non-venomous snakes
	Viperidae	vipers
	Crotalinae	rattlesnakes
		birds
*Aves		
*Mammalia		mammals
	*Insectivora	insectivores
	*Talpidae	moles
	* <i>Scapanus</i> sp.	mole
	Soricidae	shrews
	<i>Sorex</i> sp.	shrew
	*Carnivora	carnivores
	Felidae	cats
	Mustelidae	mustelids
	<i>Taxidea</i> sp.	badger
	*Canidae	dogs
	<i>Canis</i> sp.	wolf
	* <i>Vulpes</i> sp.	fox

## Appendix 1 continued.

*Ursidae	bears
* <i>Arctodus simus</i>	short-faced bear
*Rodentia	rodents
*Sciuridae	squirrels
*Geomyidae	geomyid rodents
* <i>Thomomys bottae</i>	Botta's pocket gopher
* <i>Thomomys</i> sp.	pocket gopher
*Heteromyidae	heteromyid rodents
* <i>Perognathus</i> sp. (lg)	large pocket mouse
* <i>Perognathus</i> sp. (sm)	small pocket mouse
* <i>Dipodomys</i> sp. (lg)	large kangaroo rat
* <i>Dipodomys</i> sp. (sm)	small kangaroo rat
*Cricetidae	cricetid rodents
* <i>Peromyscus</i> sp.	deer mouse
<i>Onychomys torridus</i>	grasshopper mouse
* <i>Neotoma</i> sp.	wood rat
* <i>Microtus</i> sp.	meadow vole
*Lagomorpha	lagomorphs
*Leporidae	rabbits
Archaeolaginae	extinct rabbits
<i>Hypolagus</i> sp.	ancestral rabbit
*Leporinae	extant rabbits
<i>Sylvilagus</i> sp.	cottontailed rabbit
<i>Lepus</i> sp.	jackrabbit
*Artiodactyla	even-toed ungulates
*Camelidae	camels
* <i>Camelops</i> sp.	extinct camel
* <i>Hemiauchenia</i> sp.	llama
*Antilocapridae	antelopes
*? <i>Tetrameryx</i> sp.	extinct antelope
*Perissodactyla	odd-toed ungulates
*Equidae	horses
* <i>Equus</i> sp. cf. <i>E. bautistensis</i>	extinct large horse
* <i>Equus</i> sp. (sm)	extinct small horse
Proboscidea	proboscideans
Elephantidae	elephants
cf. <i>Mammuthus</i> sp.	extinct mammoth