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A diverse Rancholabrean vertebrate microfauna from southern California includes the first fossil record of ensatina (*Ensatina eschscholtzii*: Plethodontidae)

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ABSTRACT

Analysis of late Pleistocene fossils recovered from near the Huntington Beach, California (USA), pier (site LACM 7679) has revealed a diverse fauna dating to approximately 40 ^{14}C ka BP. Extinct megafauna (three genera) are present; however, a microfauna including three genera of fish, five genera of amphibians, twelve genera of reptiles, two genera of birds, and ten genera of small mammals dominates the assemblage in terms of diversity. Additional identification of seven genera of non-marine mollusks and various macro- and microscopic plant remains including grasses, three families of herbs, and seven genera of trees provides a wealth of information concerning the past ecology of what is currently a coastal dune field complex. During the Rancholabrean Period, the LACM 7679 locality was approximately 10 km inland from the Pleistocene coastline and contained lush riparian zones interspersed with coastal sage scrub, a few trees, and grasslands teeming with a variety of small and large animals.

We summarize results of analysis of fossil amphibian and reptile bones recovered from a recently excavated paleontological locality in southern California. Results of mammal, bird, fish, mollusk and pollen analysis are included as well. The Pacific City (LACM 7679) site is located approximately 1 km south of the Huntington Beach Pier and 1 km inland from the current shoreline (Fig. 1). The site lies in stabilized Pleistocene dune deposits consisting primarily of fine-grained fluvial sands with isolated deposits of silts and clays. These sediments are most likely associated with late Pleistocene channels of the Santa Ana River system (De Barros and Roeder, 2001). The microfauna in question was recovered from a thin, dark organic layer of fine-grained silts and clays within the broader light tan interbedded fluvial sand deposits.

The Pacific City development site includes several localities dating to the late Pleistocene based on the presence of Columbian mammoth (*Mammuthus columbi*), horse (*Equus* sp.) and bison (*Bison* cf. *antiquus*) bone specimens found spread across the upper layers of the property (De Barros and Roeder, 2001). Caliche associated with these megafaunal remains has been radiocarbon dated to 19,890 ± 120 ^{14}C yr BP (Beta-136197). A single freshwater mollusk shell recovered from the dark organic layer that produced the microfaunal remains discussed here (LACM 7679) has been AMS radiocarbon dated to 40,980 ± 800 ^{14}C yr BP (Beta-224795), firmly placing the deposit in the Rancholabrean Period of the Pleistocene. The diverse microfauna recovered from LACM 7679 includes a variety of small mammals, birds, reptiles, amphibians and fish.

Several late Rancholabrean herpetofaunas have been described from southern California. The most diverse and well-known collections come from the La Brea tar pits in central Los Angeles and are housed in the Page Museum (e.g., Brattstrom, 1953; LaDuke, 1991a,b; Stock, 1992). Brattstrom (1955) reported a small Pleistocene herpetofauna from Carpinteria. All of the species identified at Carpinteria are represented at Rancho La Brea. Hudson and Brattstrom (1977) and Miller (1971) have reported two other Rancholabrean herpetofaunas from Orange County, again duplicated at Rancho La Brea. In contrast, we report here that the LACM 7679 collection includes amphibian species neither represented at Rancho La Brea nor anywhere else in the continental United States. The LACM 7679 herpetofauna is summarized in Table 1.

Methods

A bulk sample of 1000 kg of fine-grained fossil-bearing sediments was collected in the field. These sediments were treated with a variety of defloculants and washed through 0.5-mm mesh. The resulting sands were sorted to remove any fossil remains.

Thomas Wake identified the fish, amphibian, and reptile remains using comparative osteological specimens housed in the UCLA Institute of Archaeology Zooarchaeology Laboratory (UCLAZL) and specimens on loan from the U.C. Berkeley Museum of Vertebrate Zoology (MVZ) and The Los Angeles County Museum of Natural

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Figure 1. Map of southern California including prominent mountain ranges and known Rancholabrean fossil herpetofaunas.

Table 1
Identified fish, amphibians and reptiles from LACM 7679.

Common name	Scientific name	NISP
3-spined stickleback	*Gasterosteus aculeatus*	3
Arroyo chub	*Gila* cf. *orcuttii*	8
Prickly sculpin	Cottus *cf.* asper	1
Arboreal salamander	*Aneides lugubris*	153
Ensatina	*Ensatina eschscholtzii*	7
Slender salamander	*Batrachoseps* sp.	21
Lungless salamanders	Plethodontidae	11
Western toad	*Bufo boreas*	1
Toad	*Bufo* sp.	6
True frog	*Rana* sp.	1
Western chorus frog	*Pseudacris regilla*	37
cf. W. chorus frog	Hylidae cf. *P. regilla*	37
Tree frogs	Hylidae	63
Frogs and toads	Anura	27
California legless lizard	*Anniella pulchra*	15
Southern alligator lizard	*Elgaria* cf. *E. multicarinata*	63
Fence lizard	*Sceloporus* sp.	20
Side-blotched lizard	*Uta stansburiana*	13
Lizards	Phrynosomatidae	19
Lizards	Lacertilia	40
Ring-necked snake	*Diadophis punctatus*	38
California kingsnake	*Lampropeltis* cf. *L. getula*	1
Racer	*Masticophis* sp.	4
Gopher snake	*Pituophis melanoleucus*	4
Long-nosed snake	*Rhinocheilus lecontei*	17
Garter snake	*Thamnophis* sp.	8
Non-venomous snakes	Colubridae	9
Snakes	Serpentes	53
Western pond turtle	cf. *Actinemys marmorata*	177
Total		857

History (LACM) collections. Osteological descriptions and illustrations in Bell et al. (1995), Bullock and Tanner (1966), Gobalet et al. (2005), Holman (1981, 1995, 2000, 2003), LaDuke (1991a,b), Wake (1963) and Wake et al. (1983) were also consulted.

The identified late Pleistocene herpetofauna from LACM 7679 includes 747 individual specimens (Table 1). Seventeen genera and twelve species representing nine families of amphibians and reptiles are identified. Small fishes representing three families are identified as well (Table 1). Many of the specimens are incomplete or exhibit wear where contact was made with other clasts or substrates during movement and deposition, making definitive identification difficult at times. Most of the worn specimens are referred to order, family, or genus levels where possible.

Each bone specimen was identified to the lowest taxonomic level possible. More detailed taxonomic assignment is limited to elements with sufficient distinguishing features allowing rapid identification to the given level. Bones lacking discrete identifiable features were sorted into broad size categories by class, or simply as representative of the vertebrata. For each discretely identifiable bone a series of data was recorded including provenience information, skeletal element, part of element, side, age, and modification. Data recorded regarding modification of bone specimens includes evidence of rolling, trampling or scratch marks. All specimens discussed here are curated at LACM (Accession #7679).

Results

Salamander remains ($n = 192$, 25.5%) dominate the LACM 7679 herpetofauna, followed closely by Pacific pond turtles (cf. *Actinemys marmorata*, $n = 177$, 23.8%). Frogs and toads (19.2%), and lizards (19.8%) follow in relative abundance. Snakes, all non-venomous

colubrids, represent 11.1% the LACM 7679 herpetological sample. The identified specimens are referred to taxonomically below.

Fish (Teleostei)

Remains of bony fishes ($n = 12$) are present in the sample of lower vertebrate fossils from Huntington Beach. Three genera and one species are represented. The identifiable remains represent the three-spined stickleback (*Gasterosteus aculeatus*, $n = 3$); a chub (*Gila* sp., $n = 8$), most likely the arroyo chub (*Gila orcuttii*); and a sculpin (*Cottus* cf. *asper*), most likely the prickly chub. Four specimens can be identified only as fragments of bony fish (Teleostei).

Three-spined Stickleback (*G. aculeatus*). One stickleback dorsal spine fragment, one dorsal pterygiophore, and one thoracic vertebra are identified. Sticklebacks have been identified from Rancho La Brea (Stock, 1992) and other southern California Pleistocene localities (Moyle, 2002).

Chub (*Gila* sp.). Eight vertebral centra are referred to the genus *Gila*. The vertebrae are clearly cypriniform, based on the architecture of the centrum (Gobalet et al., 2005). However, they lack the diagnostic characteristics of the only other cyprinid genus in the region, *Catastomus* and are therefore assigned to the genus *Gila* (Gobalet et al., 2005). The only chub species known from coastal southern California is the arroyo chub (*Gila orcutti*), reported from Pleistocene Rancho La Brea (Stock, 1992; Moyle, 2002).

Prickly sculpin (*Cottus* cf. *asper*). A single preopercular spine is referred to the genus *Cottus*. The spine is clearly cottid based on its architecture and is referred to prickly sculpin on the basis of evenly spaced, short, sharp upward-facing, spines running the length of the main spine. The terminal spines appear to be the upward turned, hook-like tip of the main spine. Prickly sculpins are known to occur well inland in freshwater river systems in southern California (Moyle 2002). The spine may represent the Pacific staghorn sculpin (*Cottus armatus*), which occurs in more coastal southern Californian contexts, but the finer spine features of the specimen do not match the available comparative material well.

Salamanders (Caudata)

Salamander remains are surprisingly common in the collection, constituting roughly 25% of the LACM 7679 herpetofauna. One family, the Plethodontidae (lungless salamanders), is represented by three genera: the arboreal salamander (*Aneides lugubris*), the slender salamander (*Batrachoseps* sp.) and the ensatina (*Ensatina escscholtzii*). Lungless plethodontid salamanders are fully terrestrial, most often encountered in moist talus or leaf litter, under rocks and logs in riparian zones. Western representatives of the Plethodontidae are direct developers and do not need to return to water to breed as do some of their eastern North American cousins. Plethodontid salamanders are represented at a variety of southern Californian Pleistocene sites (Brattstrom, 1953; Hudson and Brattstrom, 1977; Van Devender and Mead, 1978; Mead et al., 1985, 2004, 2006; LaDuke, 1991a; Stock, 1992;), but one species is unique to this site.

Plethodontidae

Arboreal salamander (*Aneides lugbris*). 153 identified specimens are referred to *A. lugubris*: 7 articulars, 20 dentaries, 5 femora, 1 fibula, 8 humeri, 1 ilium, 9 ischia, 11 maxillae, 1 nasal, 3 otics, 2 phalanges, 3 premaxillae, 2 tibiae, 1 atlas, 33 trunk vertebrae (2 juvenile), 16 caudal vertebrae, and 30 vertebral centra. Pleistsocene *Aneides* specimens are reported from Rancho La Brea (Brattstrom, 1953; Stock, 1992) and Newport Beach Mesa (Hudson and Brattstrom, 1977). Wake (1963) and Wake et al. (1983) describe and summarize the osteology of *A. lugubris*.

Ensatina (*Ensatina eschscholtzii*). Seven specimens are referred to *E. eschscholtzii*: 2 humeri, 1 femur, and 4 trunk vertebrae. Holman (1995, 2006) does not report the genus present in the southern Californian or western North American Pleistocene. These seven *E. eschscholtzii* specimens represent the first fossil record for the monotypic genus *Ensatina* in North America (Fig. 2).

All of the identified *Ensatina* specimens represent adults. The vertebrae are clearly plethodontid in form, with amphicoelus vertebral centrae (Wake, 1963). The four vertebrae all have broad, flat neural arch dorsal roofs, diapophyses and parapohyses fused nearly to the tip and extending laterally, widely divergent prezygapophyses, and a broadly concave anterior margin of the neural canal, all characteristic of *Ensatina* (Wake, 1963, 102, Fig. 1 — LACM 153445; Frolich, 1991).

The humerus is plethodontid in general form and relatively longer overall, characteristic of *Ensatina* (Wake, 1963:105). The *Ensatina* femur is relatively shorter compared to other plethodontids and less robust than *Aneides* (Wake, 1963:110).

Slender salamander (*Batrachoseps* sp.). Twenty-one identified specimens are referred to the genus *Batrachoseps*: 5 trunk vertebrae, 1 caudal vertebra, and 15 vertebral centra. The only reported Pleistocene record of *Batrachoseps* is from Tecolote Canyon on Santa Rosa Island (Mead et al., 2004), making the presence of the genus in the LACM 7679 fauna the first mainland Pleistocene fossil record for slender salamanders. The vertebrae reported here compare well with numerical parameters described by Mead et al. (2004) and Wake (1966). The 21 *Batrachoseps* specimens reported here represent the first reported fossil record for the genus in continental North America (Fig. 3).

Lungless salamanders (Plethodontidae). An additional eleven vertebral fragments are referred to the family Plethodontidae in the LACM 7679 collection. These specimens retain only enough diagnostic information (biconcave, or amphicoelus, vertebral centra) to classify them to the family level (e.g. Wake, 1963, 1966, 1970). Vertebrae from the only other salamander family reported from southern California—the Salamandridae, *Taricha torosa* —are readily distinguished from plethodontid vertebrae by the presence of an ossified anterior vertebral condyle and their more robust overall morphology (Wake, 1970).

Frogs and toads (Anura)

Together, frogs and toads constitute roughly 15% of the LACM 7679 herpetofauna. Three families are represented: the Bufonidae (true toads), the Hylidae (tree frogs), and the Ranidae (true frogs). Pleistocene frogs and toads are represented at a variety of southern Californian sites (Brattstrom, 1953; Hudson and Brattstrom, 1977; Van Devender and Mead, 1978; Stock, 1992).

Figure 2. Fossil *Ensatina* vertebrae from Huntington Beach (LACM 153444-47), modern comparative specimens, middle row.

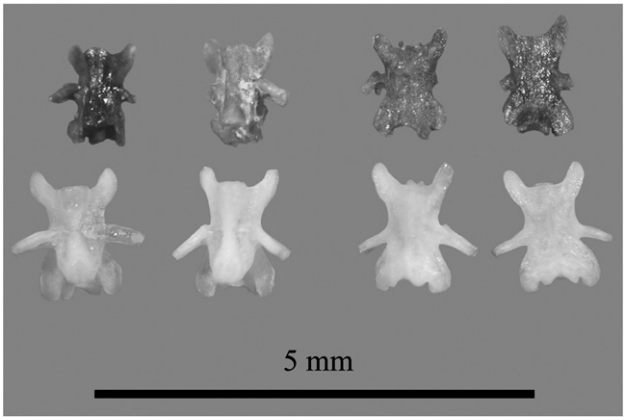

Figure 3. Fossil *Batrachoseps* vertebrae from Huntington Beach (LACM 153455-58), top row. Modern comparative specimens, bottom row.

Bufonidae

Western toad (*Bufo boreas*). Western toads are represented in the collection by a single proximal urostyle. The specimen in question conforms to parameters described by Holman (1995, 2003) and modern comparative specimens.

Toad (*Bufo* sp.). Bufonid toads are represented in the collection by six trunk vertebrae. These specimens clearly represent toads based on parameters described by Holman (1995, 2003) but are not identifiable to species.

Two species of *Bufo*, *B. boreas* and *B. californicus*, occur in southern California. *B. boreas* is relatively widespread and breeds in a variety of habitats, including streams, ponds, pools, lakes and reservoirs. The arroyo toad (*B. californicus*) is more closely tied to southern California's riparian zones and breeds primarily in brooks or streams. Arroyo toads are apparently less dependent or rainfall than western toads (Stebbins, 2003).

Hylidae

Pacific tree frog (*Pseudacris regilla*). Pacific tree frogs are represented in the collection by 37 identified specimens: 14 humeri, 5 ulnae, 1 dentary, 1 urostyle, 15 ilia, and 1 coracoid. The specimens in question conform to parameters described by Holman (1995, 2003).

Hylidae (cf. *P. regilla*). Small hylid specimens strongly resembling Pacific tree frogs are represented by 37 identified specimens: 30 femora and 7 humeri. The specimens in question conform to parameters described by Holman (1995, 2003) for various small hylids.

Hylidae. Small hylid specimens are represented in the collection by 63 specimens: 59 tibio-fibulae, 2 trunk vertebrae, 1 humerus and 1 ilium. The specimens in question conform to parameters described by Holman (1995, 2003) for various small hylids.

Ranidae

True frog (*Rana* sp.). A single atlas fragment is referred to the genus *Rana*. The specimen clearly represents a true frog based on broad, thin anterior surface of the vertebral centrum and the architecture of the ascending base of the neural arch. The only other southern California anurans of similar size, toads (*Bufo*) and spadefoot toads (*Spea*) have very different first vertebral morphologies (Holman, 2003).

Three species of true frogs are known from southern California—the California red-legged frog (*Rana draytoni*), the foothill yellow-legged frog (*Rana boylii*), and the southern mountain yellow-legged frog (*Rana muscosa*). *R. draytoni* and *R. boylii* are found in low altitude coastal and inland streams (Stebbins, 2003). *R. muscosa* is found only above 400 m (Stebbins, 2003). It is possible that a leopard frog (*R. pipiens*) could have been in the area 40 ka as well, as they range into the southern Great Basin (Stebbins, 2003).

Turtles (Testudines)

Pond turtles (Emydidae)

Western pond turtle (cf. *A. marmorata*). Fragments of turtle shell represent nearly 24% of the overall collection, yet only one individual is represented. All of the shell fragments are robust, yet fairly thin, a characteristic of the Emydidae (Holman, 1995). One cervical vertebra is identified. Western pond turtles have been reported from several sites in southern California (Brattstrom, 1953, 1955, 1958; Hudson and Brattstrom, 1977). The remains in question do not compare well to other Pleistocene turtles reported from southern California— tortoises, *Gopherus* sp. and *Gopherus agasizzi* (Miller, 1971; Brattstrom, 1958; Hudson and Brattstrom, 1977; Van Devender and Mead, 1978) and *Geochelone* (Fay, 1991).

Lizards and snakes (Squamata)

Lizard remains constitute roughly 19.7% of the total herpetofauna. Some 147 lizard bone fragments are identified, representing four families, five genera and three species. Eighteen bone specimens could not be identified beyond simply lizard (Lacertilia).

Anguidae

Southern alligator lizard (*Elgaria* cf. *multicarinata*). Southern alligator lizards are represented in the LACM 7679 collection by 63 specimens: 8 cranial scutes, dentary, 2 frontals, ilium, ischium, 2 maxillae, palatine, prefrontal, 2 quadrates, 2 tibiae, 19 trunk vertebrae, 1st sacral vertebra, 2nd sacra vertebra, 6 caudal vertebra, and 15 osteoderms. The southern alligator lizard is distinctive in its osteology (e.g. Brattstrom, 1953). The maxillae and palatine are large, bear conical teeth and match the available comparative specimens well.

Southern alligator lizards have been identified from several southern California sites including Rancho La Brea (Brattstrom, 1953, 1955; Stock, 1992) and Carpinteria (Brattstrom, 1955). *E. multicarinata* is currently the only anguid lizard in the greater Los Angeles Basin area (Stebbins 2003). Relict populations of alligator lizards are found in other southern California mountain ranges (*E. panamintina*, Stebbins, 2003), perhaps isolated as a result of the sierran orogeny. It is possible that the more northerly *E. coerulea* could have been present in the region during the Pleistocene if the climate was cooler and wetter, similar to that found in its current range.

Anniellidae

Legless lizard (*Anniella pulchra*). Legless lizards are represented in the collection by 15 specimens: 1 left surangular, 6 complete trunk vertebrae, 1 caudal vertebra, and 7 vertebral centra. *Anniella* are characterized by smoothly curving ventral surfaces on the vertebral centra (LaDuke, 1991a,b; Bell et al., 1995). *Anniella* is identified at Rancho La Brea (LaDuke, 1991a,b) and is currently found throughout southern California in sandy soils (Stebbins, 2003).

Phrynosomatidae

Fence lizard (*Sceloporus* sp.). Fence lizards are represented in the collection by 20 specimens: 9 dentaries, 5 maxillae, quadrate, humerus, ilium, and 3 vertebral centra. Sceloporus specimens are reported from several southern California Pleistocene sites (Brattstrom, 1953, 1955; Miller, 1971; Hudson and Brattstrom, 1977; Van Devender and Mead, 1978; Norell, 1986). Spiny lizards from coastal sites (usually *S. occidentalis*, Brattstrom, 1955; Miller, 1971; Hudson and Brattstrom, 1977) represent different species than those reported from inland desert sites (usually *S. magister*, Van Devender and Mead, 1978; Norell, 1986). Both desert (*S. magister*) and coastal (*S. occidentalis*) forms of spiny lizards have been identified at Rancho La Brea (Brattstrom, 1953). Several species of *Sceloporus* currently inhabit southern California and are separated by altitudinal and temperature/rainfall gradients (Stebbins, 2003).

Side-blotched lizard (*Uta stansburiana*). These lizards are represented in the LACM 7679 collection by 14 specimens: 8 dentary fragments, frontal, retroarticular, 2 trunk vertebrae, 1 upper caudal vertebra. Side-blotched lizards are currently widespread throughout southern California and are reported to be common in the Rancho La Brea Pleistocene fauna (Brattstrom, 1953).

Phrynosomatidae. Small spiny lizards are represented by 18 specimens: 1 fragmentary tooth-bearing bone, 1 scapula, 5 humerus fragments, 4 femur fragments, 4 pelvic fragments, 3 caudal vertebral centra, and 1 vertebral fragment. Specimens representing the spiny lizard/horned lizard family are reported in several southern California Pleistocene faunas (Brattstrom, 1953, 1955; Miller, 1971; Hudson and Brattstrom, 1977; Van Devender and Mead, 1978; Norell, 1986).

Some 83 snake specimens are identified in the collection, representing six genera, four species and one family (Colubridae). Snake specimens constitute 11.1% of the fossil herpetofauna reported here. Four specimens could be assigned only to the Serpentes. No rattlesnakes (Crotalidae), currently common in southern California, are identified.

Colubridae

California kingsnake (*Lampropeltis* cf. *getula*). A single complete midtrunk vertebra is referred to the genus *Lampropeltis*. Two species of kingsnakes inhabit southern California, the California kingsnake (*L. getula*) and the mountain kingsnake (*L. zonata*) (Stebbins, 2003). The vertebra matches both species based on comparisons with available material and drawings in Holman (1981, 2000) and LaDuke (1991a,b) in terms of genus-level characteristics. *L. getula* has been identified to species in southern Californian Pleistocene collections (Brattstrom, 1953; Hudson and Brattstrom, 1977; LaDuke, 1991a,b). California kingsnakes are widespread and relatively common in southern California whereas mountain kingsnakes are much more microhabitat specific, most commonly found under exfoliating granite slabs in rock outcrops associated with scrub, chaparral or upland forest plant communities (Stebbins, 2003). Such microhabitats are found nowhere near modern Huntington Beach.

Racer (*Masticophis* sp.). Four complete mid-trunk vertebrae are referred to the genus *Masticophis*. Three species of racers inhabit southern California, the coachwhip (*M. flagellum*), the striped racer (*M. lateralis*) and the common racer (*Coluber constrictor*) (Stebbins, 2003). The vertebra matches both species of *Masticophis* using available comparative material and drawings in Bullock and Tanner (1966), Holman (1981, 2000) and LaDuke (1991a,b). These generic-level characteristics separate *Masticophis* from *Coluber*. *Masticophis* has been identified in southern Californian Pleistocene collections (Brattstrom, 1953; Hudson and Brattstrom, 1977; LaDuke, 1991a,b). Both species of *Masticophis* are widespread and relatively common in southern California (Stebbins, 2003).

Gopher snake (*Pituophis catenifer*). Three trunk vertebrae and one basioccipital are referred to *P. catenifer*. Only one species of *Pituophis* inhabits California (Stebbins, 2003). The vertebrae match both available comparative material and drawings in Bullock and Tanner (1966), Holman (1981, 2000), and LaDuke (1991a,b) in terms of generic-level characteristics. Gopher snakes have been identified from Rancho La Brea (Brattstrom, 1953; LaDuke, 1991a,b), Newport Beach Mesa (Miller, 1971), and desert regions of southern California (Van Devender and Mead, 1978).

Garter snake (*Thamnophis* sp.). Eight trunk vertebra specimens are referred to the genus *Thamnophis*. At least two individual garter snakes are represented, an adult and a juvenile. A short, slender, caudal facing blade-like haemal process or hypapophysis distinguishes *Thamnophis* vertebrae. LaDuke (1991a,b:19–22) remarks on how notoriously difficult *Thamnophis* vertebrae are to identify to species. The vertebrae match both available comparative material and drawings in Holman (1981, 2000) and LaDuke (1991a,b) in terms of generic-level characteristics. Two species of garter snakes are currently found in southern California, the common garter snake (*T. sirtalis*) and the two-striped garter snake (*T. hammondii*). Both southern California species of garter snakes are hydrophilic, often encountered along streams or near ponds and rarely being found far from water sources (Stebbins, 2003).

Long-nosed snake (*Rhinocheilus lecontei*). Four trunk vertebrae are referred to *R. lecontei*. The vertebrae match both available comparative material and drawings in Holman (1981, 2000) and LaDuke (1991a,b) in terms of generic-level characteristics. One species of long-nosed snake inhabits southern California, preferring a variety of xeric habitats ranging from desert, to chaparral and mixed woodlands (Stebbins, 2003).

Ring-necked snake (*Diadophis punctatus*). Thirty-eight trunk vertebrae are referred to *D. punctatus*. The vertebrae match both available comparative material and drawings in Holman (1981, 2000) and LaDuke (1991a,b) in terms of generic-level characteristics. The vertebrae referred to *D. punctatus* here all lack haemal ridges and have a generally smooth ventral vertebral surface, characteristic of the genus (Holman, 1981, 2000). *Diadophis* is widespread throughout North America and prefers relatively moist microhabitats, often encountered in woodlands and in riparian zones (Stebbins, 2003). *D. punctatus* is known to consume *Batrachoseps*, among other small salamanders (Hubbard, 1903; Stebbins, 2003).

Colubridae. Another nine trunk vertebral centra are referred only to the Colubridae. Most of these vertebrae are fragmentary or have been tumbled and worn, making more specific identification difficult at best.

Discussion

The LACM 7679 fossil herpetofauna represents one of the most diverse late Rancholabrean assemblages reported from southern California and the entire southwestern portion of the United States. Only the herpetofauna from Rancho La Brea itself is more diverse in terms of numbers of genera represented (Brattstrom, 1953; LaDuke, 1991a,b; Stock, 1992). No other southern California collections report the combination of species seen in the LACM 7679 herpetofauna (Brattstrom, 1955; Miller, 1971; Hudson and Brattstrom, 1977; Van Devender and Mead, 1978; Wake, 2004), and some species are unique. The presence of *E. eschscholtzii* and *Batrachoseps* sp. in the LACM 7679 collection is noteworthy because these specimens represent the first fossil records for each genus for the Pleistocene of mainland southern California (see Mead et al., 2004).

The life histories of the species identified offer insight that can be used to reconstruct the late Pleistocene environment at and around the LACM 7679 site. Three amphibian and reptile species are strongly associated with riparian zones that exist around southern Californian perennial water sources, as are the two identified fish genera. The Pacific tree frog and western toads both need long-lasting pools of water in which to breed and are not found far from water. The Pacific pond turtle is also dependent on perennial water sources (Stebbins, 2003).

Ensatina, slender salamanders, and arboreal salamanders are most commonly found in and around wooded areas on north-facing slopes, along streams and near pond edges. Stands of sycamore and oak associated with water sources are particularly desirable for these plethodontid salamanders. Both Holocene southern California garter snake species are strongly associated with water sources (Stebbins, 2003). Ring-necked snakes prefer moist habitats in general (Stebbins, 2003: 200, 207).

The lizards and snakes identified in the LACM 7679 collection are less constrained by water demands than the more hydrophilic forms mentioned above. All of the snake genera and species identified at both sites could easily be encountered in a riparian zone but are just as common in chaparral or scrub habitats well away from water. Alligator lizards, fence lizards and side-blotched lizards can easily be encountered in either broad habitat zone and in many others.

No rattlesnake (*Crotalus* sp.) specimens are yet identified at LACM 7679. Several species of rattlesnakes inhabit southern California, with the greatest diversity in the drier and desert regions. The only rattlesnake identified to species from southern California Pleistocene deposits is the southern pacific rattlesnake (*Crotalus viridis*) at Rancho La Brea (Brattstrom, 1953; LaDuke, 1991a,b) and Newport Beach Mesa (Hudson and Brattstrom, 1977).

Analysis of the avian and mammalian microfauna from the LACM 7679 site produced a list of twelve genera and ten species (Table 2). Ten genera and eight species of mammals are identified ($n=48$), including two insectivores: the ornate shrew (*Sorex* cf. *S. ornatus*, $n=9$) and broad-footed mole (*Scapanus latimanus*, $n=1$). One rabbit, the brush rabbit (*Sylvilagus* cf. *S. bachmani*), tooth is present. Three bat (Chiroptera) specimens are present as well. Rodents dominate the collection of small mammal remains in terms of diversity, represented by seven genera and five species (Table 2). All of the birds and small mammals identified from the collection, with the exception of chipmunks (*Tamias*), are present near Huntington Beach today. Chipmunks in southern California tend to prefer higher altitudes and concomitantly cooler temperatures and higher relative rainfall amounts (Jameson and Peeters, 1988).

Two genera and species of birds are identified: California quail (*Callipepla californica*, $n=2$) and Virginia rail (*Rallus limicola*, $n=5$). The occurrence of Virginia rail strongly indicates the past presence of a stream/pond system and associated riparian zone.

The presence of a slow-moving body of water and associated riparian zone is confirmed by the identification of several freshwater and terrestrial molluskan species. Aquatic snails dominate the LACM 7679 molluskan collection, with three species constituting 88% of the identified assemblage (Table 3). An additional aquatic mollusk, the fingernail clam (*Pisidium* sp.) constitutes an additional 2.5% of the collection. Two terrestrial snails, the waxy tightcoil snail (*Pristiloma gabrielinum*) and the shoulderband snail (*Helminthoglypta tudiculata*), both commonly associated with moist plants and wooded areas, are identified, constituting 9.4% of the molluskan collection.

The environmental correlates of the LACM 7679 molluskan, mammalian and herpetological faunas are consistent with the available information concerning the paleoflora. Analysis of macro and micro-botanical remains from LACM 7679 provides information on the depositional environment and both local and regional paleovegetation (Fisk and Roeder, 2007). The dominant floral elements present are herbs (Compositae and/or Asteraceae, Chenopodiaceae) and grasses (Poaceae), together constituting greater than 60% of the palynoflora. Oaks (*Quercus*) and pines (*Pinus*) dominate identified tree pollen, together constituting only 3% of the palynoflora. Also represented are riparian species including willow (*Salix*), alder (*Alnus*), cottonwood (*Populus*), walnut (*Juglans*), and sycamore (*Platanus*), along with a few ferns (Pteridophyta), cattail (*Typha*), and an abundance of freshwater algal spores.

Table 2
Identified bird and mammal specimens from LACM 7679.

Scientific name	Common name	NISP
Callipepla californica	California quail	2
Rallus limicola	Virginia rail	5
Sorex cf. *S. ornatus*	Ornate shrew	9
Scapanus latimanus	Broad-footed mole	1
Sylvilagus cf. *S. bachmani*	Brush rabbit	1
cf. *Tamias* sp.	Chipmunk	2
Thomomys bottae	Pocket gopher	2
Dipodomys cf. *D. agilus*	Pacific kangaroo rat	2
Peromyscus cf. *P. maniculatus*	Deer mouse	7
Reithrodontomys megalotis	Harvest mouse	4
Neotoma sp.	Woodrat	12
Microtus californicus	California vole	8
Total		55

Table 3
Identified mollusk specimens from LACM 7679.

Scientific name	Common name	%	General habitat
Gyraulus parvus	Ram's horn snail	67.3%	Generally permanent aquatic habitat
Physella cf. *P. humerosa*	Tadpole snail	17.0%	Aquatic, common in clear creeks
Pristiloma gabrielinum	Waxy tightcoil snail	5.4%	Terrestrial, on moist plants
Helminthoglypta tudiculata	Shoulderband snail	4.0%	Wooded, under bushes and rocks
Fossaria parva	Pond snail	3.7%	Aquatic, on plants above water
Pisidium sp.	Fingernail clam	2.5%	Aquatic, freshwater, in sand or mud
Ariolimax sp.?	Land slug	0.01%	Terrestrial, moist plant debris near water

Together with the sedimentary and faunal records at this site, the paleoflora suggests vegetation associated with a flowing body of water within a broader stabilized dune field near the mouth of the ancestral Santa Ana River. Seasonal herbs and perennial dune grasses dominated the local vegetation at 40 ^{14}C ka BP. The regional vegetation included oak woodlands with occasional pines and junipers. The remaining elements in the paleoflora appear to represent a riparian vegetation regime.

Conclusions

The Rancholabrean herpetofauna from LACM 7679 is diverse and presents the first reported fossil record of *E. eschscholtzii* and the first mainland record of the slender salamander (*Batrachoseps* sp.) for the Pleistocene of southern California and mainland North America as a whole.

The broader late Pleistocene environment appears similar to that proposed for Rancho La Brea (Stock, 1992). The paleoclimate suggested by these samples is cooler and wetter than the modern climate of southern California, and perhaps more like coastal central California (Fisk and Roeder, 2007). Modern specimens represented in the LACM 7679 microfauna can all be found in the northern Santa Ana Mountains, near where the Santa Ana River currently runs between the Chino Hills and the Northern end of the Santa Ana Mountain range. The species composition of the LACM 7679 microfauna and flora suggests that mesic riparian zones were more widespread in southern California during the late Pleistocene, but still closely associated with drier sclerophytic scrub and chaparral habitats more common in the region today.

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