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The age and vertebrate paleontology of Labor-of-Love Cave, White Pine County, Nevada

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Abstract.—We report the first radiocarbon ages on vertebrate fossils from Labor-of-Love Cave, White Pine County, Nevada, based on purified collagen in teeth and bone, as well as a description of the cave's vertebrate paleontology. This cave was discovered in 1982 with the recovery of an associated partial skeleton of the extinct giant short-faced bear (*Arctodus simus*). Subsequent excavations in 1985 recovered additional fossil material of birds and mammals from stream deposits in the cave. These fossils, along with fossils collected from the surface during surveys in 2018, are reported here. Radiocarbon ages indicate that most fossil material was deposited in the cave before and during the Last Glacial Maximum (LGM; 21,441–27,774 cal yr BP) and eroded from stream deposits inside the cave following the LGM, presumably from increased precipitation and stream flow. The vertebrate assemblage includes 4 other extinct taxa including 1 carnivore (*Panthera atrox*) and 3 ungulates (*Equus* sp., *Oreamnos harringtoni*, *Euceratherium collinum*) and the first record of Canada lynx (*Lynx canadensis*) from the Great Basin. If contemporaneous, the assemblage as a whole indicates an open grassland/sagebrush/tundra environment in Spring Valley during the late Pleistocene, with coniferous forest on mountain slopes facing this valley and where the cave is situated. Although the entrance to the cave is now blocked by slumped talus and breakdown, in the Pleistocene it was likely a large accessible opening at the base of a limestone cliff, with stream flow emerging and flowing into the valley below during the late Pleistocene, when bears and other species possibly used the cave as a shelter or den.

Resumen.—Reportamos las primeras edades de radiocarbono en fósiles de vertebrados de Labor-of-Love Cave, White Pine County, Nevada, basados en colágeno purificado en dientes y huesos, así como una descripción de su paleontología de vertebrados. Esta cueva fue descubierta en 1982 con la recuperación de un esqueleto parcial asociado del extinto oso gigante de cara corta (*Arctodus simus*). Excavaciones posteriores en 1985 recuperaron material fósil adicional de aves y mamíferos de depósitos de arroyos en la cueva y, junto con los fósiles recolectados de la superficie durante los estudios en 2018, se informan aquí. Las edades de radiocarbono indican que la mayoría del material fósil se depositó en la cueva antes y durante el Último Máximo Glacial (UMG; 21,441–27,774 cal AP) y se erosionó de los depósitos de la corriente dentro de la cueva después de la LGM, presumiblemente por el aumento de la precipitación y el flujo de la corriente. El conjunto de vertebrados incluye otros cuatro taxones extintos, incluido un carnívoro (*Panthera atrox*) y tres ungulados (*Equus* sp., *Oreamnos harringtoni*, *Euceratherium collinum*) y el primer registro de lince canadiense (*Lynx canadensis*) de la Great Basin. Si es contemporáneo, el conjunto en su conjunto indica un entorno abierto de pastizales/artemisa/tundra en Spring Valley durante el Pleistoceno tardío, con bosques de coníferas en las laderas de las montañas frente a este valle y donde se encuentra la cueva. Aunque la entrada a la cueva ahora está bloqueada por el astrágalo hundido y la descomposición, en el Pleistoceno probablemente era una gran abertura accesible en la base de un acantilado de piedra caliza, con un flujo de corriente que emerge y fluye hacia el valle durante el Pleistoceno tardío, cuando los osos y otras especies posiblemente usaron la cueva como refugio o guarida.

Labor-of-Love Cave is a single-chamber cave formed by stream flow through limestone bedrock in the Schell Creek Range, White Pine County, Nevada (Fig. 1). It was first opened and explored by members of a caving organization in Ely, Nevada, the High Desert Grotto, over a series of visits from December 1981 to January 1982. When first exploring this cave, Grotto members began finding large bones along the stream bank and in pools towards the rear of the cave, which extends ~80 m into the limestone before disappearing further underground (Fig. 2). Recognizing the paleontological importance of this site, Grotto

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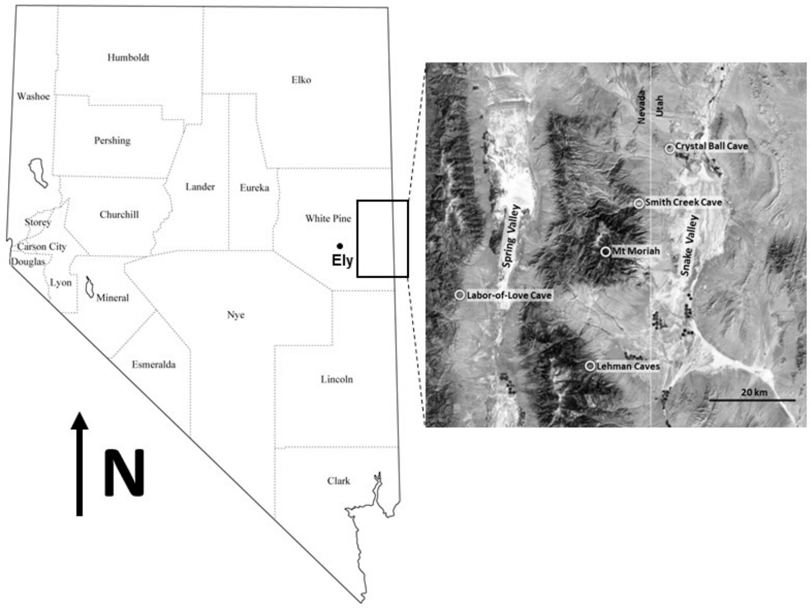

Fig. 1. Map of Nevada with inset showing the locations of Labor-of Love Cave and Smith Creek Cave (discussed in the text). The map of caves was taken from Google Earth Pro imagery (Google, DigitalGlobe 2017).

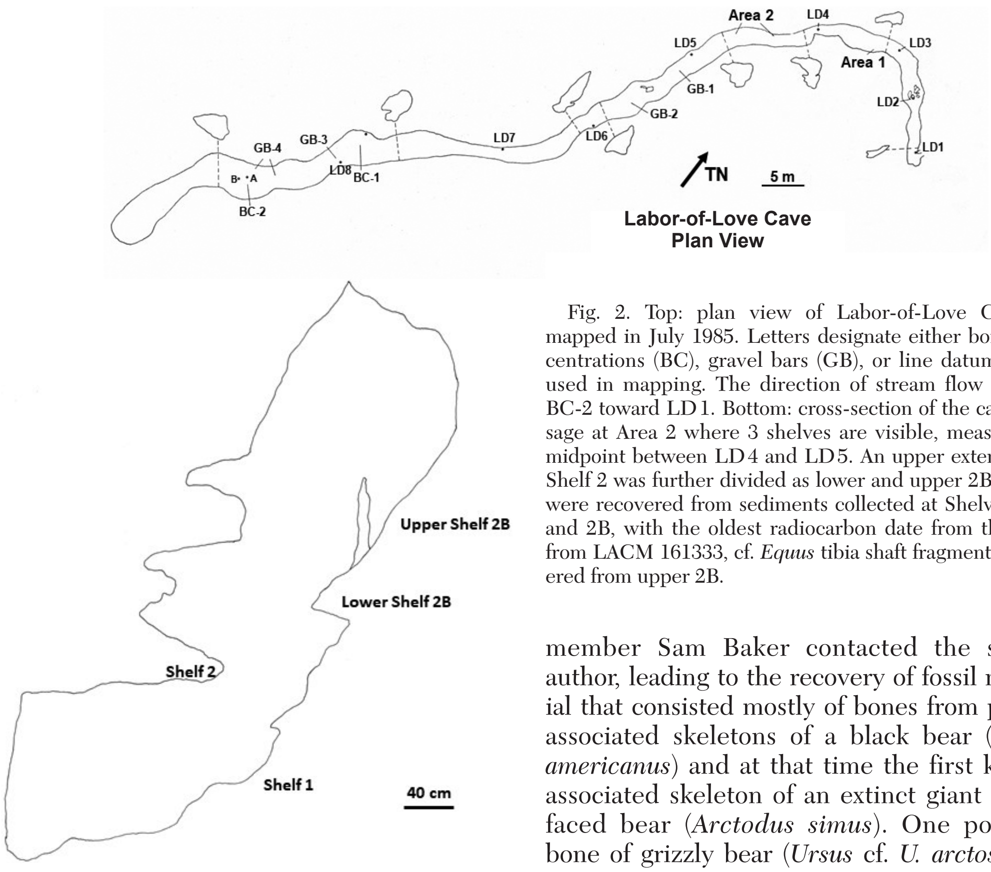

Fig. 2. Top: plan view of Labor-of-Love Cave as mapped in July 1985. Letters designate either bone concentrations (BC), gravel bars (GB), or line datums (LD) used in mapping. The direction of stream flow is from BC-2 toward LD 1. Bottom: cross-section of the cave passage at Area 2 where 3 shelves are visible, measured at midpoint between LD 4 and LD 5. An upper extension of Shelf 2 was further divided as lower and upper 2B. Bones were recovered from sediments collected at Shelves 1, 2, and 2B, with the oldest radiocarbon date from the cave from LACM 161333, cf. *Equus* tibia shaft fragment, recovered from upper 2B.

member Sam Baker contacted the senior author, leading to the recovery of fossil material that consisted mostly of bones from partial associated skeletons of a black bear (*Ursus americanus*) and at that time the first known associated skeleton of an extinct giant short-faced bear (*Arctodus simus*). One possible bone of grizzly bear (*Ursus* cf. *U. arctos*) also

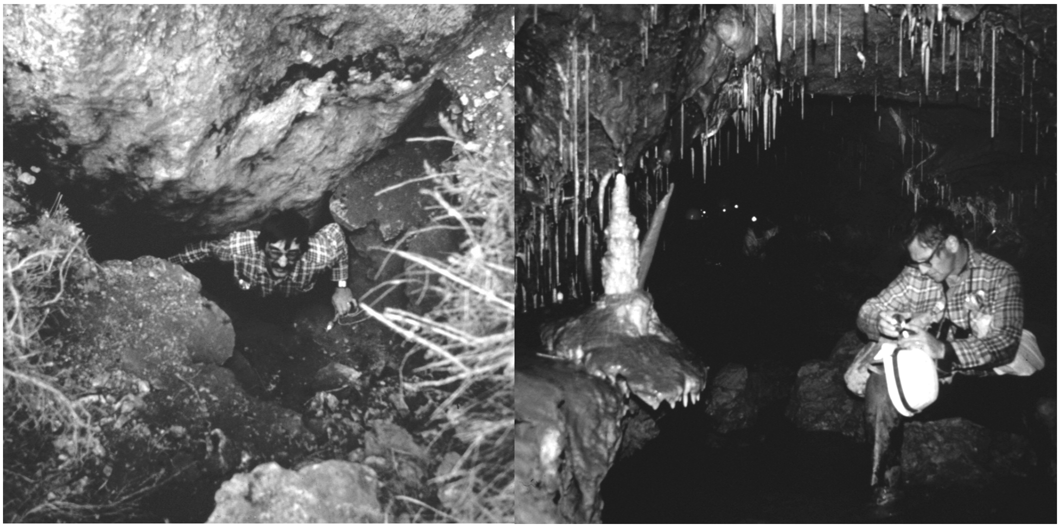

Fig. 3. Left panel: High Desert Grotto member Sam Baker standing in the crawlway at the base of the limestone cliff that leads to the entrance to Labor-of-Love Cave on 1 August 1982. This entrance is now protected by a U.S. Forest Service gate. Right panel: High Desert Grotto member Bob Swain adjusting his lamp in the passage near BC-1 on 1 August 1982. Note the undercut stalagmite on the left, situated on Shelf 1, where the stream bank has eroded.

was recovered. All of this material was described by Emslie and Czaplewski (1985) and deposited at the Los Angeles Museum of Natural History (LACM), California, under 2 locality numbers: LACM Locality 4949 (fossil material collected inside the cave) and LACM Locality 5044 (a small collection of fossils found by Grotto members while excavating a passage to open the cave; Fig. 3, left). Initial attempts at radiocarbon analysis of 2 bones from the bears failed to provide enough collagen for reliable dates at that time, possibly due to extensive leaching and long-term immersion of the bones in water.

Further research in the cave in summer 1985, including excavations at 2 areas along the stream channel, resulted in the recovery of additional fossil material that was also deposited at LACM, but until now this material has not been analyzed or reported. Shortly after this work was completed, the U.S. Forest Service installed a gate to protect the cave and its paleontological resources. In summer 2018, U.S. Forest Service personnel found additional bones along the stream channel in the cave and contacted the authors to request assessment of this cave and recommendations for future management. Subsequently, the cave was revisited on 26 July 2018 which resulted in a third collection of fossils from the stream bank and pools, all deposited at LACM. This third collection prompted the authors to complete a detailed analysis of the cave and its fossil contents as well as to attempt again to obtain radiocarbon ages on this vertebrate assemblage.

Here we present a description of all fossil material collected at Labor-of-Love Cave in 1985 and 2018. Excavation procedures and methods from 1985 are detailed below. We also now provide the first reliable radiocarbon ages on teeth and bone from this cave. The vertebrate fauna from this cave provides new records of late Pleistocene mammals in eastern Nevada, the east-central Great Basin.

CAVE EXCAVATIONS AND MAPPING

An initial description and map of Labor-of-Love Cave was provided by Emslie and Czaplewski (1985), as well as an analysis of the partial skeletons of the 2 bear species (*U. americanus* and *A. simus*), 1 bone of possible grizzly bear (*Ursus* cf. *U. arctos*), and some unidentifiable artiodactyl remains. At the time of this initial research, 2 areas of bone concentrations (BC) at the rear of the cave, BC-1 and BC-2, were mapped, and all exposed bones were collected on 1 August 1982 with the assistance of personnel from the Bureau of Land

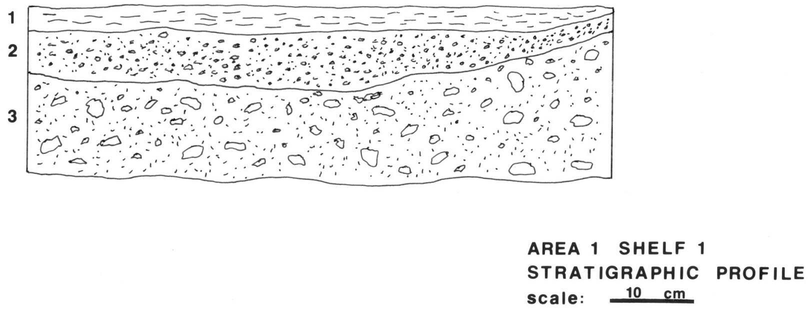

Fig. 4. Stratigraphic profile of sediments excavated at Area 1 Shelf 1, Labor-of-Love Cave, White Pine County, Nevada. All fossils recovered at this location were from the lower part of the gravel layer 2.

Management and the U.S. Forest Service, members of the High Desert Grotto, and 2 curators from LACM. Following this work, the intent of the senior author was to return to the cave in summer 1983 for more detailed mapping and sampling of exposed strata and gravel bars along the stream bank, but high water levels of the stream prevented entrance into the cave. However, in July 1985 water levels had receded and the cave was again accessible and further research was completed, including a more detailed map of the cave passage and a summary of the stratigraphy of cave sediments. Excavations were conducted in 2 locations, and sediments were screen washed in the cave stream to recover additional fossil remains, using window screen (0.16-cm mesh).

The cave was mapped by placing line datum (LD) points (large aluminum nails) along the cave passage from the entrance to BC-2 at the rear of the cave. A line was extended between datum points, its bearing recorded from true north using a Brunton compass, and cave width and height was measured at various points along the line while the map was sketched. Seven datum points were established in this manner, LD 1–7, with LD 1 located where the stream is first encountered when entering the cave from a crawlway at the base of the limestone cliff (Fig. 2).

During this mapping, it was noted that at least 3 flowstone shelves are evident at various points along the lateral sides of the cave passage. These shelves were designated Shelf 1, 2, and 3, with Shelf 1 as the lowest or closest to the current water level of the stream. Shelf 1 is undercut by the stream in several places, and some of the stalagmites situated on this shelf are tilted as a result of its gradual collapse (Fig. 3, right). A dense concentration of bone exposed on Shelf 1 was located near LD 3 and chosen for excavation and sampling, designated as Area 1 Shelf 1. Two additional datum points were established near this concentration to facilitate mapping of in situ bone: LD 3B and 3C. All bones longer than ~5 cm were measured from LD 3C for orientation, strike, and dip, using a Brunton compass. Excavated sediments were measured by volume and sieved in the stream with window screen. Excavations proceeded to a depth of 16 cm on this shelf before the matrix became too hard to excavate bones intact. A total of 22 liters (L) of sediments was screened in this manner, and all sediments and bone in the screen were saved for sorting in the laboratory. An additional 2.0 L of unscreened sediment also was saved. A total of 29 bones were measured in situ before excavations ceased due to difficulty in excavating them intact from the compacted matrix. A profile of the sediments on top of this shelf indicated that there are several stratigraphic layers: an upper silt (3 cm thick), a sand/gravel lens (6 cm thick), and a lower silt and rock (13 cm thick) overlying the flowstone shelf (Fig. 4). Most of the bone recovered was found at the interface between the sand/gravel and lower silt layer.

Excavations were next conducted at another location where bone was exposed at Area 2 near LD 4 (Fig. 2). All 3 flowstone shelves are visible at this location on either side of the cave passage, but bone was exposed only on Shelf 2, which could be further subdivided into Shelf 2 and 2B. An ungual phalanx (hoof) of *Equus* sp. was exposed on Shelf 2B (not collected), and no bone was visible on Shelves 1, 2, or 3. A second datum (LD 4B) was established near the bone concentration on Shelf 2B, and a cross section of the cave passage was mapped at this point (Fig. 2). Sediment (0.75 L) was collected from a lower section, and an additional 2.0 L was collected from an upper section of Shelf 2B for screening in the laboratory.

Bone and sediment in the pool at Gravel Bar (GB) 2 at BC-1 was sampled next. Numerous bones of artiodactyls and a mandible of *Lynx rufus* were exposed on the bottom of the pool and collected. Two liters of sediment was collected from the bottom of the pool and saved for screening in the laboratory, while an additional 15 L was screened in the cave. BC-2 at GB 4 was sampled by dividing it into 2 areas designated GB 4A and 4B, the former located just downstream from the main concentration of *Arctodus* bones in BC-2 that were collected in 1982. Fifteen liters of sediment was screened in this area, with an additional 15 L screened at 4B where bear phalanges and metapodia were recovered. It also was apparent at GB 4B that the bear bones were eroding in situ from the gravel lens exposed at this location. This completed the work in the cave.

On 26 July 2018, the senior author, D. Powell, L. Coats, and N. Bolton entered the cave to evaluate its contents and collect exposed fossil material. It was noted that the cave was relatively unchanged since the 1980s, with all major cave formations intact. The cave air temperature was measured to compare to measurements taken in 1985. Air temperatures in 1985 were 13.5 °C at LD 2, 11.5 °C at Area 2, and 11 °C at BC-2, indicating increasingly cooler temperatures toward the rear of the cave; in 2018 air temperature was recorded at 12 °C at BC-2, suggesting a warming of 1 °C since 1985. Water temperature of the stream was measured at 10.5 °C at Area 2 in 1985, and 11 °C in 2018. Line datum points were still present with orange flagging tape and labels. Newly exposed bones were observed in the stream pools at BC-1 and BC-2. A few other bones and isolated teeth were found at various points along the stream channel, some of which had been noted in 1985. These bones, as well as those in the pools at BC-1 and BC-2, were collected, and included an additional mandible of *U. americanus* and various fragmentary skeletal elements of *A. simus* from each pool, respectively. All bones were transported to LACM for accession with the rest of the collection from 1982 and 1985.

RADIOCARBON DATING

Initial attempts to obtain direct ages on the associated skeletons of *A. simus* and *U. americanus* from Labor-of-Love Cave in 1982 failed to provide reliable dates due to lack of sufficient collagen in the highly leached bones (Emslie and Czaplewski 1985). However, subsequent development of accelerator mass spectrometry (AMS) dating, which requires only a minute amount of purified collagen, now provides an opportunity to once again obtain radiocarbon ages on *A. simus* and other taxa represented in the vertebrate fauna at this locality. We selected primarily teeth for this analysis as they tend to preserve collagen better than bone. Nine teeth and one bone were selected from various locations in the cave for radiocarbon analysis by DirectAMS (Bothell, WA). All samples except one right lower third incisor of *A. simus* produced sufficient purified collagen for reliable analysis (Table 1). Radiocarbon ages were calibrated to cal yr BP using Calib 7.0.4 and the IntCal13 calibration curve (Stuiver and Reimer 1993) and are reported as 2σ ranges (Table 1).

FOSSIL IDENTIFICATIONS

All identifications given below and in Table 2 were completed by direct comparison using the skeletal collections of mammals and birds, and the vertebrate paleontological collections at the George C. Page and Los Angeles County Museum of Natural History (LACM), the University of California Museum of Vertebrate Zoology (UCMVZ) and Museum of Paleontology (UCMP), Berkeley, and the U.S. National Museum, Smithsonian Institution (USNM). Unless otherwise noted below, specific identifications were based on similarity in size and morphological features to modern and fossil skeletal material in the collections at the above museums. All fossil material is catalogued with LACM numbers given in parentheses after each specimen listed below. Upper and lower dentition are indicated by upper- and lowercase letters for incisors (I/i), canines (C/c), premolars (P/p), and molars (M/m) followed by the number of the tooth in the tooth row. Measurements were taken with digital calipers to the nearest 0.1 mm.

TABLE 1. Radiocarbon dates on selected specimens from Labor-of-Love Cave, White Pine County, Nevada. All ^{14}C ages were completed at DirectAMS (Bothell, WA), with D-AMS lab codes given below, and calibrated to cal yr BP with Calib 7.0.4 (Stuiver and Reimer 1993).

Lab code	Location in cave	Catalogue no.	Species	Element	Uncorrected ^{14}C	1σ error	Calibrated 2σ range (cal years BP)
032797	BC-2, GB 4A	LACM 122434	*Arctodus simus*	RI3	23,386	106	27,774–27,398
032796	BC-2, GB 4A	LACM 122434	*Arctodus simus*	Ri3	—	—	—
032792	BC-1, GB 3	LACM 161347	*Ursus americanus*	Lc1	22,321	110	27,011–26,217
032799	GB2	LACM 161327	*Euceratherium*	RM1	19,302	67	23,504–22,991
032793	GB2	LACM 161328	*Ovis* or *Oreamnos*	M2 or M3	21,998	97	26,486–25,970
032798	Area 1 Shelf 1	LACM 161329	*Euceratherium*	RM2	20,203	95	24,526–24,005
032794	Area 1 Shelf 1	LACM 161330	*Oreamnos*	LM1	17,916	82	21,936–21,441
032795	Area 1 Shelf 1	LACM 161331	*Ovis*	LM1	21,981	84	26,445–25,968
032800	Area 1 Shelf 1	LACM 161332	*Equus*	LM1 or M2	20,106	89	24,422–23,920
032801	Area 2 Shelf 2B	LACM 161333	cf. *Equus*	tibia shaft?	32,759	171	37,407–36,235

TABLE 2. List of taxa identified from Labor-of-Love Cave, White Pine County, Nevada. The 2 localities refer to fossils recovered from excavations of a crawlway to enter the cave (LACM 5044) and the main cave chamber and stream channel (LACM 4949). Some of the taxa listed here were first reported by Emslie and Czaplewski (1985). An asterisk (*) indicates extinct taxa, and a dagger (†) refers to extralimital taxa.

Locality and taxon	
LACM Locality 5044	
Mammalia	
†Yellow-bellied marmot	*Marmota flaviventris*
*Horse	*Equus* sp.
Deer/sheep/goat	Artiodactyla
LACM Locality 4949	
Aves	
American Kestrel	*Falco sparverius*
Hawk	*Buteo* sp.
Great Horned Owl	*Bubo virginianus*
Songbird	Passeriformes
Mammalia	
Shrew	*Sorex* sp.
Bat	Chiroptera
Ermine	*Mustela* cf. *M. erminea*
†Kit fox	*Vulpes* cf. *V. macrotus*
*Giant short-faced bear	*Arctodus simus*
Black bear	*Ursus americanus*
†Grizzly bear	*Ursus* cf. *U. arctos*
*American lion	*Panthera atrox*
†Canada lynx	*Lynx canadensis*
Bobcat	*Lynx rufus*
†Yellow-bellied marmot	*Marmota flaviventris*
Woodrat	*Neotoma* sp.
Vole	Microtinae
†Pika	*Ochotona princeps*
Hare	*Lepus* sp.
Cottontail	*Sylvilagus* sp.
*Horse	*Equus* sp.
Deer/sheep/goat	Artiodactyla
Deer	*Odocoileus* sp.
*Harrington's mountain goat	*Oreamnos harringtoni*
Bighorn sheep	*Ovid canadensis*
Sheep or goat	*Ovis* or *Oreamnos*
*Shrub-ox	*Euceratherium collinum*
Bison	cf. *Bison* sp.

SYSTEMATIC PALEONTOLOGY

LACM Locality 5044

Class Mammalia
Order Rodentia
Family Sciuridae
Marmota flaviventris

REFERRED MATERIAL.—Distal half right mandible with i1 (123867).

DISCUSSION.—The size and features of this specimen compare well with the modern species; *M. caligata* is slightly larger and more robust. Other characters used to distinguish *M. flaviventris* from other sciurid and *Marmota* species used here are described by Heaton (1985). Marmots are no longer present in the area of the cave, though 2 records were reported by Hall (1946) from the northern Snake Range.

Order Perissodactyla
Family Equidae
Equus sp.

REFERRED MATERIAL.—Right M2 (123866), right partial cheek tooth (123868).

Order Artiodactyla

REFERRED MATERIAL.—Lower incisor (123865), proximal fragment of left mandible (123864).

LACM Locality 4949

Class Aves
Order Falconiformes
Falco sparverius

REFERRED MATERIAL.—Area 1 Shelf 1: distal right tarsometatarsus (161478).

Buteo sp.

REFERRED MATERIAL.—Area 1 Shelf 1: ungual phalanx (161477).

Order Strigiformes
Bubo virginianus

REFERRED MATERIAL.—Area 1 Shelf 1: left tarsometatarsus missing ends (161479).

Order Passeriformes

REFERRED MATERIAL.—Area 1 Shelf 1: distal right tarsometatarsus (161480).

Class Mammalia
Order Insectivora
Family Soricidae
Sorex sp.

REFERRED MATERIAL.—GB 4B: proximal half right mandible without teeth (161474).

Order Chiroptera

REFERRED MATERIAL.—Area 1 Shelf 1: proximal radius (161475).

Order Carnivora
Family Mustelidae
Mustela cf. *M. erminea*

REFERRED MATERIAL.—GB 2: right mandible with c1, p2–m1 (161472).

MEASUREMENTS.—The specimen measures c1–m1 length, 13.0 mm, p2–m1 length, 11.4 mm, m1 length and breadth, 5.2 and 1.7 mm.

DISCUSSION.—Measurements of this specimen compare well in size to modern *M. erminea*. Three specimens of *M. frenata* were examined at LACM, and all were larger and had a broader m1 than 161472. Fossil records of *M. erminea* also have been reported from Smith Creek Cave, Snake Creek Burial Cave, and Owl Cave #1 in the Snake Range of eastern Nevada (Mead and Mead 1989).

Family Canidae
Vulpes cf. *V. macrotis*

REFERRED MATERIAL.—Area 1 Shelf 1: right M1 (161473).

MEASUREMENTS.—The M1 measures 9.3 mm from lateral to internal edges and 7.6 mm from mesial to distal.

DISCUSSION.—See Heaton (1985) for characters used here to distinguish *Vulpes* from *Urocyon*. This specimen is distinctly smaller than *Vulpes vulpes* and compares well in size and features to 2 other fossil *V. macrotis* from McKittrick Brea (California; Locality 138: LACM 2084, 9.8 and 7.9 mm, LACM 107698, 10.8 and 7.2 mm).

Order Ursidae
Family Tremarctinae
Arctodus simus

REFERRED MATERIAL.—GB 4, BC-2: right I3, humeral third of right scapula, 9 rib fragments, right metacarpal I (122434); GB 4A, BC-2: right i1 or 2 (122434); GB 4B, BC-2: left unciform, left pisiform, left scapho-lunar, right scapho-lunar, right navicular, distal right fibula, left metacarpal III, right metacarpal V, right metatarsal II, III, and V, 6 proximal phalanges, second phalanx, ungual phalanx (122434).

DISCUSSION.—These specimens were recovered from the same pool (BC-2) where an associated partial skeleton of *A. simus* was recovered in 1982 (Emslie and Czaplewski 1985). Identification to *A. simus* was confirmed with comparison to fossil material at Rancho La Brea. As none of the above reported elements were recovered in the

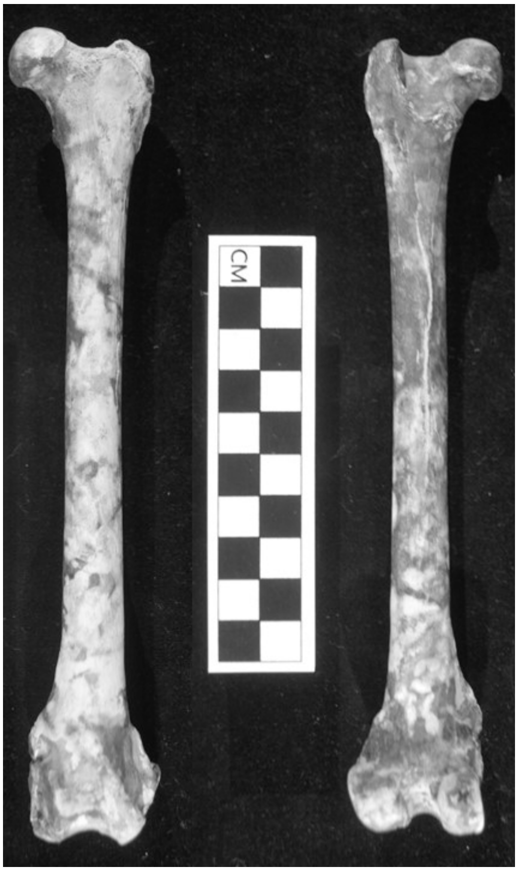

Fig. 5. Left femur (LACM 161468) referred to *Lynx canadensis* from Labor-of-Love Cave, Area 1 Shelf 1, in anterior (left) and posterior (right) views.

original collection, specimens 122434 likely represent the same individual recovered in 1982. The right I3 and i3 were submitted for radiocarbon analysis, but only the former specimen produced sufficient collagen for a date (Table 1).

Family Ursidae
Ursus americanus

REFERRED MATERIAL.—GB 3, BC-1: left mandible with c1 and m2 (161347); left C1 (161326).

MEASUREMENTS.—The m2 measures length, 19.7 mm, breadth, 12.5 mm.

DISCUSSION.—The mandible represents a larger individual compared to 2 matching mandibles (122435) recovered from BC-1 in 1982 and reported by Emslie and Czaplewski (1985). Specimen 161347 is slightly larger than those of 122435 and compares well in size and features to 2 modern male *U. americanus* (LACM 92304 and 38833). Specimen 161326 is slightly smaller than canines from 122435. The c1 from 161347 was consumed for radiocarbon analysis (Table 1).

Family Felidae
Panthera atrox

REFERRED MATERIAL.—Area 1 Shelf 1: proximal left radius (161469); second phalanx (161470).

MEASUREMENTS.—The radius shaft measures breadth, 18.7 mm, depth, 13.2 mm; the phalanx measures length, 28.3 mm, proximal breadth and depth, 15.4 and 13.0 mm.

DISCUSSION.—These specimens compare well in size and features to fossil specimens of *P. atrox* from Rancho La Brea, California, as well as to a skeleton of *P. leo* at LACM. The fossils were also compared to Pleistocene specimens of *Puma concolor* from Rancho La Brea and are distinctly larger than this California species. Characters used to distinguish *Panthera* and the specimens from Labor-of-Love Cave from *Smilodon* are from Merriam and Stock (1932).

Lynx canadensis

REFERRED MATERIAL.—Area 1 Shelf 1: complete left femur (161468; Fig. 5).

MEASUREMENTS.—See Table 3.

DISCUSSION.—This specimen is distinct from femora of male and female *L. rufus* by its longer, straight and slender shaft (Table 3). Measurements of 161468 overlap or are slightly larger than those from 3 modern specimens of extant *L. canadensis*, and are larger than those of *L. rufus*. This is the first fossil record of *L. canadensis* from Nevada, and the species has not been reported from any other Pleistocene deposit in the Great Basin (Grayson 2011). It previously has been reported from Pleistocene deposits in the Yukon, Alaska, Idaho, Utah, and Wyoming (Miller 1976, Kurtén and Anderson 1980).

Lynx rufus

REFERRED MATERIAL.—GB 2: left mandible with c1, p2–m1 (161460); left radius (161464); lumbar vertebra (61463); distal half left femur (161465); proximal right tibia (161466); Area 1 Shelf 1: right P4 (161462); left 2nd metatarsal (161467); GB 4A: right c1 (161461).

TABLE 3. Measurements of femora from modern specimens of male and female *Lynx canadensis* and *L. rufus* compared to the complete left femur (LACM 161468) referred to *L. canadensis* from Labor-of-Love Cave (LOL Cave), White Pine County, Nevada. All measurements follow the methods of von den Driesch (1976) and are given in millimeters, with mean and standard deviation (SD) provided by sex for *L. rufus*. UCMVZ = University of California Museum of Vertebrate Zoology, Berkeley, CA.

Catalogue number	Sex	Length	Proximal breadth	Proximal depth	Least breadth shaft	Least depth shaft	Distal breadth	Distal depth
Lynx canadensis								
UCMVZ 4362	F	205	33.8	15.5	13.3	11.4	27.4	29
UCMVZ 41067	F	186	30.4	14.1	11.6	9.7	25.1	25.5
UCMVZ 9519	M	204	33.3	15.6	13.5	11	27.8	29.3
Mean		198.3	32.5	15.1	12.8	10.7	26.8	27.9
SD		10.69	1.84	0.84	1.04	0.89	1.46	2.11
Lynx rufus								
LACM 31089	F	154.1	29	13.1	11	9.1	25.5	24
LACM 52229	F	164	28.3	14.1	11.9	9.6	24.4	23.6
LACM 31665	F	159	29	14.1	12	10.6	26.4	25
Mean		159.0	28.8	13.8	11.6	9.8	25.4	24.2
SD		4.95	0.40	0.58	0.55	0.76	1.00	0.72
LACM 712	M	169	28.7	14.3	11.9	9.8	25.1	26.1
LACM 45026	M	159	27.3	12.8	11.7	10	25.2	23.9
LACM 45027	M	168	30.5	14.5	11.8	10.3	27.5	26.9
LACM 52218	M	167	31.2	13.6	12.2	10.6	25.8	25.5
Mean		165.8	29.4	13.8	11.9	10.2	25.9	25.6
SD		4.57	1.77	0.77	0.22	0.35	1.11	1.27
LOL Cave								
LACM 161468		195	34	15.9	13.6	11.9	32.6	27.4

Order Rodentia
Family Sciuridae
Marmota flaviventris

REFERRED MATERIAL.—Area 1 Shelf 1: partial cranium (161360); right mandible with i1 (161361); 4 incisor fragments (161363–161366); left M3 (161372); right M3 (161373); right P4 (161368); left P4 (161367); 3 left m1 or m2 (161369–161371); proximal left ulna (161362); proximal right femur (161358); Area 2 Shelf 2B: right mandible with no teeth (161357); GB 2: 2 incisor fragments (161355–161356); GB 4A: right tibia (161359); 1 m upstream from LD 6: right I1 (161339).

DISCUSSION.—See Heaton (1985) for identification characters of *Marmota* used here. Numerus fossils of this species also were reported from most excavated layers at Smith Creek Cave, Snake Range, Nevada (Miller 1979), and Crystal Ball Cave, Snake Valley, Utah (Heaton 1985).

Family Cricetidae
Neotoma sp.

REFERRED MATERIAL.—Area 1 Shelf 1: maxilla with left M3 (161374); left maxilla with M2–3 (161375); 8 right M1 (161409–161416); 10 left M1; 5 right M2 (161431–161435); 3 left M2 (161419–161421); 3 right M3 (161450–161452); 2 left M3 (161444–161445); right mandible with i1 (161377); proximal right mandible without teeth (161378); 7 right m1 (161402–161408); 19 left m1 (161379–161397); 6 right m2 (161436–161441); 9 left m2 (161422–161430); 1 right m3 (161453); 3 left m3 (161446–161448); GB 2: 1 right M1 (161417); 1 left M1 (161418); 1 left M2 (161442); 1 right M3; 1 left M3 (161449); 4 left m1 (161398–161401), 1 right m2 (161443); 2 right m3 (161454–161455); GB 4A: left mandible with i1 (161376); right M1 (161418); left M2, left m1 and m2; Pool below LD 6 at GB 3: right mandible with i1 and m2 (161336); right femur without epiphyses (161337); right femur (161338).

Subfamily Microtinae

REFERRED MATERIAL.—GB 4A: left m1 (161457); left m3 (161458).

Order Lagomorpha
Family Ochotonidae
Ochotona princeps

REFERRED MATERIAL.—Area 1 Shelf 1: maxilla with left P4–M2 and right M3 (161348).

DISCUSSION.—We recognize that there are few dental characters available to identify the 2 species of *Ochotona* (*O. princeps* and *O. collaris*) in North America. Here we are basing our identifications on extant biogeography and prevalence of *O. princeps* in the Great Basin today. This species also was abundant in all excavated levels at Smith Creek Cave and Cathedral Cave, and its dung was recorded in packrat middens within Smith Creek Canyon, Snake Range, and elsewhere in southern Nevada (Miller 1979, Mead and Spaulding 1995, Jass 2009).

Family Leporidae
Lepus sp.

REFERRED MATERIAL.—Area 1 Shelf 1: distal left tibia (161349); right astragalus (161350); GB 2: proximal left third metatarsal (161351).

Sylvilagus sp.

REFERRED MATERIAL.—Area 1 Shelf 1: left p3 (161352); GB 2: right radius (161353); distal half left femur (161354); GB 3: right tibia missing proximal end (161335); juvenile left tibia missing distal end (161334).

Order Perissodactyla
Family Equidae
Equus sp.

REFERRED MATERIAL.—Area 1 Shelf 1: left M1 or M2 (161332); 21.8′ below LD 6: right deciduous I2 (161342).

MEASUREMENTS.—161332 measures length, 23.2 mm, and breadth, 22.8 mm.

DISCUSSION.—Specimen 161332 was consumed for radiocarbon analysis (Table 1).

cf. *Equus* sp.

REFERRED MATERIAL.—Area 2, upper Shelf 2B: proximal shaft fragment of left tibia (161333).

DISCUSSION.—Tentative identification based on size, thickness of bone, and shape compared to other fossil *Equus* tibiae from Rancho La Brea, California. This specimen was consumed for radiocarbon analysis (Table 1).

Order Artiodactyla

REFERRED MATERIAL.—Area 1 Shelf 1: distal mandible with no teeth (161534); GB 2: shaft of distal left humerus (161535); medial fragment of right innominate (161536).

Family Cervidae
Odocoileus sp.

REFERRED MATERIAL.—Area 1 Shelf 1: right deciduous P3 (161526); GB 2: juvenile distal left dentary with DP1–3 (161525).

Family Bovidae
Oreamnos harringtoni

REFERRED MATERIAL.—Area 1 Shelf 1: right M1 (161513); right M2 (161514); left M1 (161330); right radius missing distal end (161515); left metacarpal missing proximal end (161516); left metatarsal missing distal end (161517).

MEASUREMENTS.—161513 measures length and breadth, 14.9 and 14.1 mm; 161514 measures length and breadth, 20.1 and 15.4 mm; 161330 measures length, 18.3 mm, and depth of protocone and metaconule, 14.2 and 11.0 mm; 161515 measures proximal breadth and depth, 34.7 and 19.8 mm, and least breadth and depth of shaft, 22.3 and 13.5 mm; 161516 measures length, ~110 mm, and distal breadth and depth, 30.0 and 20.7 mm.

DISCUSSION.—See Mead and Lawler (1994) for identification criteria used here for this extinct species compared to the living *O. americanus*. These fossils compare well in size and features to specimens of *O. harringtoni* from Smith Creek Cave, Nevada, housed at LACM. Specimen 161330 was consumed for radiocarbon analysis (Table 1).

Ovis canadensis

REFERRED MATERIAL.—Area 1 Shelf 1: right M1 (161331), right M1 or M2 (161507); distal metacarpal (161512); proximal left metatarsal (161511); GB 2: proximal left radius (161509); proximal left metacarpal (161510); BC-1: left M3 (123785); Pool below LD 6 at GB 3: left radius with no proximal epiphysis (161344).

MEASUREMENTS.—161331 measures length, 19.2 mm, and depth of protocone and metaconule, 11.3 and 10.2 mm.

DISCUSSION.—Data in Mead and Lawler (1994) and from modern and fossil comparative specimens of both *Ovis* and *Oreamnos* were used to identify the Labor-of-Love Cave fossils as *Ovis*.

Ovis or *Oreamnos*

REFERRED MATERIAL.—Area 1 Shelf 1: petrosal (161506); right proximal ulna (161495); right distal radius (161494); 4 partial distal metapodia (161503–161505, 161537); 3 first phalanges (161496–161498); 2 second phalanges (161499–161500); 2 ungual phalanges (161501–161502); GB 2: fragment of upper molar (161328).

DISCUSSION.—These fossils are too fragmentary for generic identification. Specimen 161328 was consumed for radiocarbon analysis (Table 1).

Euceratherium collinum

REFERRED MATERIAL.—Area 1 Shelf 1: right M2 (161329, medial right mandible with m2 (161528); distal left tibia (161519); distal metapodia (161521); 1 partial distal metapodia (161522); left calcaneum (161520); right cuneiform (161530); right scaphoid (161529); right lateral malleolus (161518); first phalanx (161532); proximal end first phalanx (161523); second phalanx (161524); GB 2: right M1 (161327), medial left calcaneum (161531); second phalanx (161533); 1 m upstream of LD 6: 1st phalanx (161346); Pool below LD 6 at GB 3: distal metapodia encased in matrix (161345).

MEASUREMENTS.—161329 measures length, 27.8 mm, and depth of protocone and metaconule, 17.2 and 16.0 mm; 161528 m2 measures length and breadth, 28.1 and 15.5 mm; 161522 measures breadth and depth of end, 51.6 and 42.0 mm; 161518 measures length and depth, 25.8 and 21.0 mm; 161532 measures length, 58.5 mm, and proximal breadth and depth, 24.6 and 28.3 mm; 161523 measures proximal breadth and depth, 27.4 and 24.2 mm; 161524 measures length, 37.1 mm, and proximal breadth and depth, 20.8 and 17.0 mm; 161327 measures length, 22.6 mm (too fragmentary for breadth measurements); 161346 measures length, 58.7 mm, proximal breadth and depth, 24.0 and 27.4 mm, and distal breadth and depth, 21.6 and 16.9 mm; 161345 measures distal breadth, 37.5 mm.

DISCUSSION.—These specimens were identified based on similarities in size and morphological features to fossil *Euceratherium* specimens from San Josecito Cave, Mexico, housed at LACM, and Samwel and Potter Creek Caves, California, housed at UCMP. Specifically, the right m2 in specimen 161528 is nearly identical in morphology to a left m2 in specimen 192/8437 from San Josecito Cave. Further, the distal metapodia reported here compare well in size and characters to those from San Josecito Cave, including the size and shape of the lateral condyle. Additional comparisons were made with an m2 and distal metatarsal referred to *Ovibos* from Zaragosa Cave, Mexico (specimens not formally described). The m2 of this presumed *Ovibos* has a broader lateral re-entrant angle with an anterior occlusal edge remaining more squared laterally than in *Euceratherium* and the specimen from Labor-of-Love Cave. The distal metatarsal in *Ovibos* has a broader shaft and a distinct anterior groove, while the shaft is narrower with a shallow anterior groove in *Euceratherium*. The M2, 161327, was consumed for radiocarbon analysis (Table 1).

cf. *Bison* sp.

REFERRED MATERIAL.—Area 1 Shelf 1: right lateral malleolus (161527).

MEASUREMENTS: The specimen measures breadth and depth, 45.9 and 32.7 mm.

DISCUSSION.—This specimen is distinctly larger than those observed to be *Euceratherium* (see measurements for 161518 above) and compares well in size and features to *Bison* sp. If correct, this specimen represents a rare record of bison in the late Pleistocene of the Great Basin, where most records are from late Holocene archaeological contexts (Grayson 2006, 2011). At this time we know of no identification characters to adequately differentiate the morphology of the lateral malleolus of *Bison* from that of other large bovids and ovibovids.

DISCUSSION

Labor-of-Love Cave has yielded a diverse collection of vertebrates dominated by rodents, lagomorphs, carnivorans, and ungulates (Table 2). Five extinct species are represented, including 2 carnivorans (*A. simus* and *P. atrox*) and 3 ungulates (*Equus* sp., *O. harringtoni*, and *E. collinum*). Two other extant carnivorans were first reported from Labor-of-Love Cave by Emslie and Czaplewski (1985; *Ursus* cf. *U. arctos* and *U. americanus*) and are extralimital today. A third carnivoran, *L. canadensis*, represents the first fossil record for the Great Basin. This lynx also is rare in the fossil record within the 48 conterminous states, previously known only from Pleistocene deposits in Idaho, Utah, and Wyoming (Miller 1976, Kurtén and Anderson 1980). Other species in this collection are no longer found in this region of Nevada or are of limited occurrence, but these have been reported in other Pleistocene cave deposits in the Snake Creek Range (see below) and include *O. princeps*, *M. flaviventris*, *Vulpes* cf. *V. macrotis*, and *O. harringtoni*, indicating a widespread and common distribution of these species in this east-central region of the Great Basin. Hall (1946) documented 2 records of *M. flaviventris* sighted at Mt. Moriah and nearby Hendry Creek, northern Snake Range, and one record of *V. macrotis* in Spring Valley, the closest observations of these species to Labor-of-Love Cave (Fig. 1).

The stratigraphy and depositional history of fossils in Labor-of-Love Cave are complex. Most bones appear to be associated with gravel bars and gravel deposits along the cave passage. These gravel bars also extend below flowstone. Fine silt and sand layers above the gravel deposits indicate depositional periods with no or little stream flow, and some with gradual layering of sediments in pools of water. Most of these layers were eroded with subsequent increase in stream flow, which is probably when gravel layers and bones of the associated bear skeletons at BC 1 and 2 (GB 3 and 4) were exposed. Radiocarbon ages from teeth of *Arctodus* and *Ursus* at these bone concentrations indicate that the fossil deposits formed by ~26,000–27,000 cal yr BP. Farther downstream, GB 1 and 2 are slightly younger in age at ~23,000–26,000 cal yr BP. Area 1 Shelf 1 near the entrance of the cave produced ages of ~21,000–26,000 cal yr BP (Table 1). The in situ fossils recovered from this latter location, all within a gravel layer below silt deposits, further indicate that most fossils from the cave are from these gravel layers. Overall, these dates suggest erosion of cave sediments and exposure of bones during a period of increased moisture and meltwater that caused a higher volume of stream flow during postglacial warming following the LGM at ~26,500 cal yr BP. Few fossils were located on upper shelves in the cave, but one bone tentatively identified as cf. *Equus* sp. from Area 2 upper Shelf 2B had sufficient collagen to produce an age of ~36,000–37,000 cal yr BP, indicating that some pre-LGM deposits remain in the cave.

Taphonomic experiments with bone in streams indicate that most bone will orient with long axes parallel to the flow, depending in part on stream-flow energy as well as size,

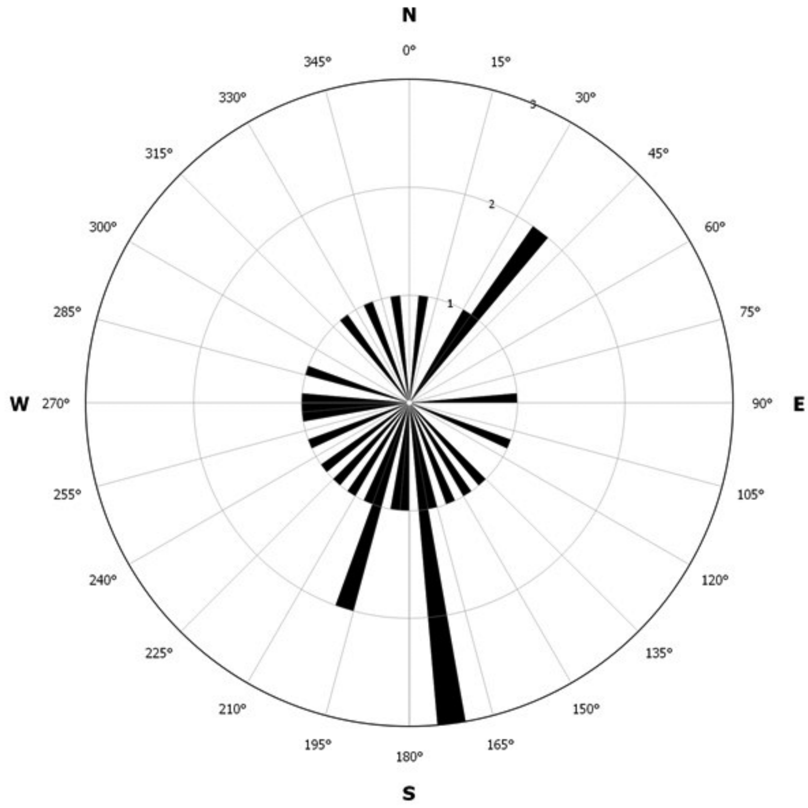

Fig. 6. Rose diagram indicating the orientation of 29 fossil bones measured in situ at Area 1 Shelf 1, Labor-of-Love Cave, White Pine County, Nevada, during excavations in 1985. While the majority of bones tend to orient toward 201° (SD = 90°), no significant directional trend was found (Rayleigh's z = 0.292, P = 0.0829).

density, articulation, and other factors of the bone (Lyman 1994). Statistics used to analyze 29 bones measured for orientation and dip at Area 1 Shelf 1 were calculated with package 'circular' (Agostinelli and Lund 2017) in R (R Core Team 2018), including functions *mean.circular*, *sd.circular*, and *rayleigh.test*. Bones tended to be oriented in the same direction, though not significantly so (mean orientation = 201°, SD = 90°; Rayleigh's z = 0.292, P = 0.0829; Fig. 6). In addition, the bones had a similar dip (6.3° below the surface, SD = 4.5°; Rayleigh's z = 0.997, P < 0.0001). A biplot showed that dip was unrelated to orientation. At Labor-of-Love Cave, the small and constricted passage with no side channels indicates that the current stream flowing through the cave has not changed course since fossil bones were deposited along its banks. Stream flow direction at Area 1 Shelf 1 is at approximately 50° to 60° of true north, but at a point just before the channel turns abruptly to approximately 130°. This bend causes the current speed to slow and thus results in deposition of larger and denser bones, with orientations ranging from perpendicular to parallel with the stream flow. The measurements recorded here are in accordance with this type of stream deposition of bone, with no significant orientation present among the 29 bones measured (Fig. 6).

The taphonomic and radiocarbon analyses provide support that the vertebrate fauna at Labor-of-Love Cave was largely contemporaneous. The fauna as a whole is consistent with both montane forested environments as well as open sagebrush steppe tundra that was typical of intermontane valleys in the Great Basin. Large pluvial lakes dominated many of these valleys following the LGM. Labor-of-Love Cave is located at a transitional zone today, at the base of large limestone cliffs overlooking Spring Valley. Based on the mixture of boreal/alpine species (*O. princeps*, *M. flaviventris*, *Mustela* cf. *M. erminea*), as well as lower-elevation, open-habitat species (*Vulpes* cf. *V. macrotis*, *P. atrox*, *Equus* sp., *E. collinum*), this fauna represents a non-analog vertebrate community not unlike other assemblages that date to the late Pleistocene in western North America.

The closest and best known late Pleistocene fossil locality to Labor-of-Love Cave is Smith Creek Cave, Smith Creek Canyon, Snake Range (Fig. 1). This site has yielded an extremely rich vertebrate fauna of mammals, birds, and herpetofauna (Howard 1952, Brattstrom 1976, Miller 1979, Mead et al. 1982). Packrat middens and plant remains from this cave and 6 other sites in this canyon, that range in age from >27,000 BP to modern, have been reported by Mead et al. (1982). Nearly all of the mammalian taxa identified at Labor-of-Love Cave have also been identified from Smith Creek Cave, except for *L. canadensis*, *Ursus* cf. *U. arctos*, *A. simus*, and *E. collinum*. Floral and faunal remains from all sites in Smith Creek Canyon led Mead et al. (1982) to conclude that montane glaciers had moved down to 2900 m elevation in the late Pleistocene and that this canyon had an open mixed pine forest of *Pinus flexilis*, *P. engelmannii*, and *P. longaeva*, along with sagebrush (*Artemisia* sp.) and various grasses and shrubs. Based on the vertebrate fauna, a similar environment can be inferred for the slopes below Labor-of-Love Cave and the network of small drainages flowing eastward into Spring Valley. A pluvial lake likely existed in Spring Valley as well as in Snake Valley (Mead et al. 1982).

Another rich late Pleistocene locality is Crystal Ball Cave, Snake Valley, Utah (Fig. 1). This site also has produced a mixture of boreal/alpine and open-habitat taxa, including *O. princeps*, *Lepus americanus*, *M. flaviventris*, *Lagurus curtatus*, *Martes americana*, *Equus* spp., and 2 camelids (Heaton 1985). Lehman Caves to the south of Labor-of-Love Cave (southern Snake Range; Fig. 1) also has produced abundant fossil remains of *Lepus* sp., *Marmota* cf. *M. flaviventris*, as well as bones of *V. macrotis*, *Antilocapra americana*, and Desert Tortoise (*Gopherus* cf. *G. agassizi*; Rozaire 1964). Two additional cave localities (Snake Creek Burial Cave and Cathedral Cave, both on the east side of the Snake Range) have important yet not fully published faunas (Mead and Mead 1989, Mead et al. 1992, Bell and Mead 1998, Jass 2009, 2011, Jass and Bell 2010, 2011).

CONCLUSIONS

We have presented the first radiocarbon ages on Labor-of-Love Cave, as well as new records of vertebrate taxa in this region of eastern Nevada, east-central Great Basin. Our results indicate that Labor-of-Love Cave had a large accessible entrance during the late Pleistocene with a spring flowing within at least part of this cave. A variety of large and small mammals used the cave, and it is possible that both *Ursus* spp. and *A. simus* visited the cave as a shelter or den, with individuals of these species dying in the cave and becoming buried in gravel and silt deposits. We infer that during a period of increased stream flow at the end of the LGM, these remains eroded from the gravel beds while the entrance of the cave became sealed by slump and rockfall until December 1981, when the entrance was uncovered and the fossils were discovered by High Desert Grotto members.

Most of the avian and mammalian vertebrate taxa from Labor-of-Love Cave also were reported from the extensive late Pleistocene deposits at Smith Creek Cave, along with other caves discussed previously. Exceptions include *A. simus*, *Ursus* cf. *U. arctos*, *L. canadensis*, and *E. collinum*. Thus, Labor-of-Love Cave has added new records of the rich late Pleistocene vertebrate fauna present in this region of eastern Nevada during the full and postglacial period. Most of what is currently known for this region of Nevada and the east-central Great Basin is from localities in the Snake Range, all located at the westernmost boundary of the massive Lake Bonneville system. Labor-of-Love Cave provides the needed expansion of known faunal reconstruction for a region that is more distant from the Snake Range. The diversity of species recovered from these caves likely was due in part to the caves' locations at transitional zones between valley bottoms with pluvial lakes and canyons with montane slopes of coniferous forest habitat.

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LITERATURE CITED

AGOSTINELLI, C., AND U. LUND. 2017. R package 'circular': circular statistics (version 0.4-93). https://r-forge.r-project.org/projects/circular/

BELL, C.J., AND J.I. MEAD. 1998. Late Pleistocene microtine rodents from Snake Creek Burial Cave, White Pine County, Nevada. Great Basin Naturalist 58: 82–86.

BRATTSTROM, B.H. 1976. A Pleistocene herpetofauna from Smith Creek Cave, Nevada. Bulletin of the Southern California Academy of Sciences 75:283–284.

EMSLIE, S.D., AND N.J. CZAPLEWSKI. 1985. A new record of giant short-faced bear, *Arctodus simus*, from western North America with a re-evaluation of its paleobiology. Contributions in Science, Natural History Museum of Los Angeles County, No. 371. 12 pp.

GRAYSON, D.K. 2006. Holocene bison in the Great Basin, western USA. Holocene 16:913–925.

GRAYSON, D.K. 2011. The Great Basin: a natural prehistory. University of California Press, Berkeley, CA. 418 pp.

HALL, E.R. 1946. Mammals of Nevada. University of California Press, Berkeley, CA. 710 pp.

HEATON, T.H. 1985. Quaternary paleontology and paleoecology of Crystal Ball Cave, Millard County, Utah: with emphasis on mammals and description of a new species of fossil skunk. Great Basin Naturalist 45: 337–390.

HOWARD, H. 1952. The prehistoric avifauna of Smith Creek Cave, Nevada, with a description of a new gigantic raptor. Bulletin of the Southern California Academy of Sciences 51, Part 2:50–54.

JASS, C.N. 2009. Pleistocene lagomorphs from Cathedral Cave, Nevada. PaleoBios 29:1–12.

JASS, C.N. 2011. Caves, arvicoline rodents, and chronologic resolution. Palaeontologia Electronica 14(3): 40A. 21 pp.

JASS, C.N., AND C.J. BELL. 2010. Desert tortoises (*Gopherus agassizii*) from Pleistocene sediments in Cathedral Cave, White Pine County, Nevada. Southwestern Naturalist 55:558–563.

JASS, C.N., AND C.J. BELL. 2011. Arvicoline rodent fauna from the Room 2 Excavation in Cathedral Cave, White Pine County, Nevada, and its biochronologic significance. Journal of Vertebrate Paleontology 31: 684–699.

KURTÉN, B., AND E. ANDERSON. 1980. Pleistocene mammals of North America. Columbia University Press, New York, NY. 442 pp.

LYMAN, R.L. 1994. Vertebrate taphonomy. Cambridge University Press, Cambridge, United Kingdom. 524 pp.

MEAD, E.M., AND J.I. MEAD. 1989. Snake Creek Burial Cave and a review of the Quaternary mustelids of the Great Basin. Great Basin Naturalist 49:143–154.

MEAD, J.I., C.J. BELL, AND L.K. MURRAY. 1992. *Mictomys borealis* (northern bog lemming) and the Wisconsin paleoecology of the east-central Great Basin. Quaternary Research 37:229–238.

MEAD, J.I., AND M.C. LAWLER. 1994. Skull, mandible, and metapodials of the extinct Harrington's mountain goat (*Oreamnos harringtoni*). Journal of Vertebrate Paleontology 14:562–576.

MEAD, J.I., AND W.G. SPAULDING. 1995. Pika (*Ochotona*) and paleoecological reconstructions of the Intermountain West, Nevada and Utah. Pages 165–186 *in* D.W. Steadman and J.I. Mead, editors, Late Quaternary environments and deep history: a tribute to Paul S. Martin. The Mammoth Site of Hot Springs, South Dakota Scientific Paper 3.

MEAD, J.I., R.S. THOMPSON, AND T.R. VAN DEVENDER. 1982. Late Wisconsinan and Holocene fauna from Smith Creek Canyon, Snake Range, Nevada. Transactions of the San Diego Society of Natural History 20:1–26.

MERRIAM, J.C., AND C. STOCK. 1932. The Felidae of Rancho La Brea. Carnegie Institution of Washington Publication 422.

MILLER, S.J. 1979. The archaeological fauna of four sites in Smith Creek Canyon. Pages 272–329 *in* D.R. Tuohy and D.L. Rendall, editors, The archaeology of Smith Creek Canyon, eastern Nevada. Nevada State Museum Anthropological Papers No. 17. Carson City, NV.

MILLER, W.E. 1976. Late Pleistocene vertebrates of the Silver Creek Local Fauna from north central Utah. Great Basin Naturalist 36:387–424.

R CORE TEAM. 2018. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

ROZAIRE, C. 1964. The archaeology at Lehman Caves National Monument. Nevada State Museum Report. Reno, NV.

STUIVER, M., AND P.J. REIMER. 1993. Extended ^{14}C database and revised Calib 3.0 ^{14}C age calibration program. Radiocarbon 35:215–230.

VON DEN DRIESCH, A. 1976. A guide to the measurement of animal bones from archaeological sites. Peabody Museum Bulletin 1, Harvard University, Cambridge, MA.

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