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QUATERNARY BADGER (MUSTELIDAE: *TAXIDEA*) FROM SNAKE CREEK BURIAL CAVE, NEVADA

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ABSTRACT

We report on the fossils of the North American badger, *Taxidea taxus* (Carnivora) recovered from Snake Creek Burial Cave (SCBC), White Pine County, Nevada. The natural trap cave with its large funnel-shaped entrance at the base of the southern Snake Range, east-central Great Basin, contains deposits with radiocarbon ages that span from a median 8,709 cal yr BP to 48,028 cal yr BP. Skeletal remains of *Taxidea* are not overly abundant in the deposit compared to other more common carnivorans such as the canids (e.g., foxes). Measurements of the cranial and postcranial remains fall somewhere in the medium range relative to extant badger specimens. Thus, this badger appears to have been of the typical size of extant members and not a large variety emblematic of many Late Pleistocene mammals. Macrobotanical remains from packrat middens in the east-central Great Basin suggest that subalpine and montane conifers grew on the lower mountain slopes and valley bottoms above high lake stands of Lake Bonneville. Given the right substrate, select species of subalpine and montane conifers, along with sagebrush and other shrubs, likely formed a continuous or near-continuous belt from the Wasatch Front of Utah to the Sierra Nevada of California/Nevada. Continued work on the faunas and floras from caves and packrat middens in the Snake Range (e.g., Smith Creek, Ladder, Combustion, Cathedral, Arches Caves) and low in the valley (e.g., SCBC, Garrison Cave) will help in the reconstruction of the Late Pleistocene biotic communities above the high stands of Lake Bonneville and how the biotic communities, including the badger, adapted to climate change.

INTRODUCTION

The North American badger, *Taxidea taxus* (Schreber, 1778) (Carnivora: Mustelidae) is a mesocarnivore and a major component of extant North American prairies, shrublands, desert grasslands, among other communities (Long, 1973). It is the only living member of the subfamily Taxidiinae, which is the most basal subfamily within the crown group Mustelidae (Koepfli et al., 2008; Sato et al., 2012; Law et al., 2018). American badgers were once grouped within the Eurasian badger subfamily Melinae; however, it is now understood that “badgers” are a polyphyletic grouping of musteloids that tend to share similar ecologies and appearances, including the honey badger (Mellivorinae), the ferret badgers (Helictidinae), and the stink badgers (*Mydaus*; Mephitidae) (Owen, 2006; Sato, 2016).

The endemic *Taxidea taxus* is extant over most of central and western USA, extending south into central Mexico and north into western Canadian provinces (Long, 1973). Relevant to the study here is that the badger is common throughout the Great Basin, both in Nevada (Hall, 1946) and Utah (Durrant, 1952) (Fig. 1). The diet of extant *Taxidea* is predominantly rodents, especially fossorial ground squirrels (e.g., *Callospermophilus, Otospermophilus*, *Xerospermophilus*, following Helgen et al., 2009) and prairie dogs (*Cynomys*), but the badger is also exceedingly opportunistic (Linsdale, 1938; Long, 1973).

Taxidiine badgers have a poorly understood fossil record that makes the study of early members of the subfamily difficult, yet noteworthy. Two genera of extinct taxidiines are known exclusively from the Hemphillian North American Land Mammal Age (NALMA), *Chamitataxus* and *Pliotaxidea*; the earliest occurrence of *Taxidea* is from the late Hemphillian. For discussions on the earliest age for *Taxidea*, see Drescher (1939), Hall (1944), Stock (1948), Wagner (1976), and Owen (2006). In contrast to its earliest occurrence along with that of its ancestors, *T. taxus* is common in late Quaternary (Rancholabrean NALMA) fossil assemblages over much of the continent, albeit never abundant in any one locality (Harris, 1985). The presence of *T. taxus* in Quaternary fossil localities is often used to imply that the local setting was an open biome, with sandy to gravel-dominated substrates, yet it is scarce in marshy and clayey soil environs due to its digging habits (Hall, 1946; Long, 1973). Fossorial mammals, such as *Taxidea,* are known to be sensitive to environmental change (Rowe and Terry, 2014), thus, further understanding the Quaternary locations of this badger in the Great Basin is of biogeographical, if not also paleoenvironmental, interest. Here we present the fossil *Taxidea* from Snake Creek Burial Cave (SCBC), White Pine County, Nevada, east-central Great Basin.

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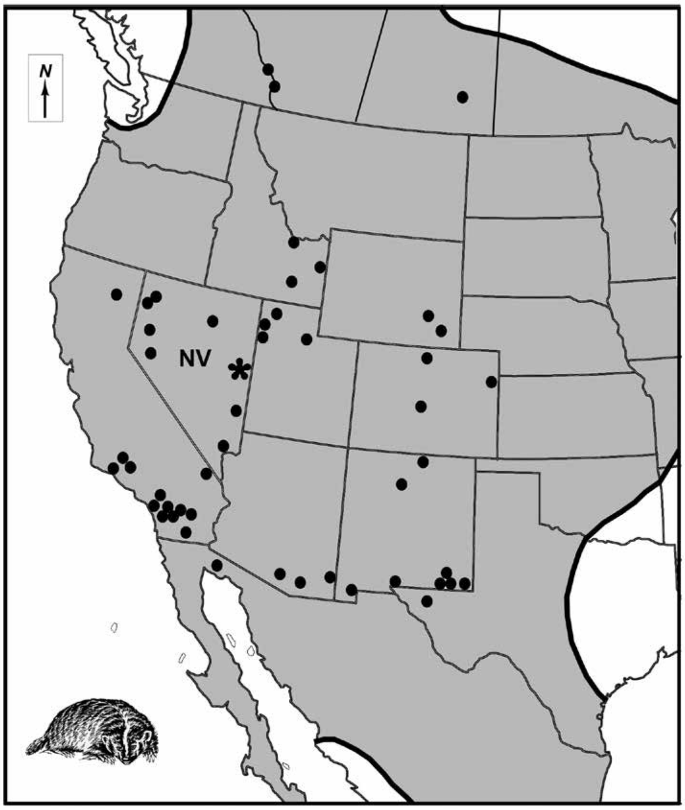

Figure 1. Western North American Pleistocene *Taxidea taxus* fossil localities as listed in Appendix 1. Present distribution of *Taxidea* covers most of the area on the map.

SNAKE CREEK BURIAL CAVE

SCBC is located at 1731 m elevation in a valley-bottom, open sagebrush setting just above and near the high stand of pluvial Lake Bonneville at its southwestern most extent to the southern Snake Range Mountains (Grayson, 1993; Reheis et al., 2014; Milligan and McDonald, 2017). When pluvial Lake Bonneville was at its highest stand during the Wisconsinan Glaciation (~18,000 yr BP; 1552 m; McGee et al., 2012) the beach was within about 5 km of the cave. The surface access to the cave begins as a large sinkhole that culminates to a hole that is approximately 0.5 by 1.0 m, which then drops 17 m to the sediment-filled room floor. The funnel-shaped sinkhole at the surface, and the bell-shaped free fall to the floor, have created a natural trap scenario for millennia (Mead and Mead, 1989).

Presence of extinct megafauna, such as *Camelops,* in this cave indicates a Rancholabrean NALMA for the deposit. Chronology of the fossil deposit continues to develop, but currently spans from approximately 8,700 to 48,000 calibrated radiocarbon years ago (see results).

Various taxonomic groups from the cave sediments are still in need of analysis and are ongoing. A nondescriptive presentation of the mustelid carnivores (including *Taxidea*) was presented in Mead and Mead (1985) and Mead and Mead (1989). Details about *Mustela* spp. were presented in an unpublished thesis by Fox (2014). The occurrence of the black-footed ferret (*Mustela nigripes*) was verified in Fox et al. (2017). Squamate reptiles were presented in Mead et al. (1989). Arvicoline rodents (voles) were presented in Bell and Mead (1998). A geometric morphometric study of a *Martes* (pine marten) cranium was part of an unpublished thesis (Meyers, 2007); a detailed presentation of all *Martes* cranial and postcranial remains from the deposit is ongoing. Canid remains were presented in an unpublished thesis (Palevich, 2005). Lagomorphs were analyzed for an unpublished thesis (Osterhaudt, 1999).

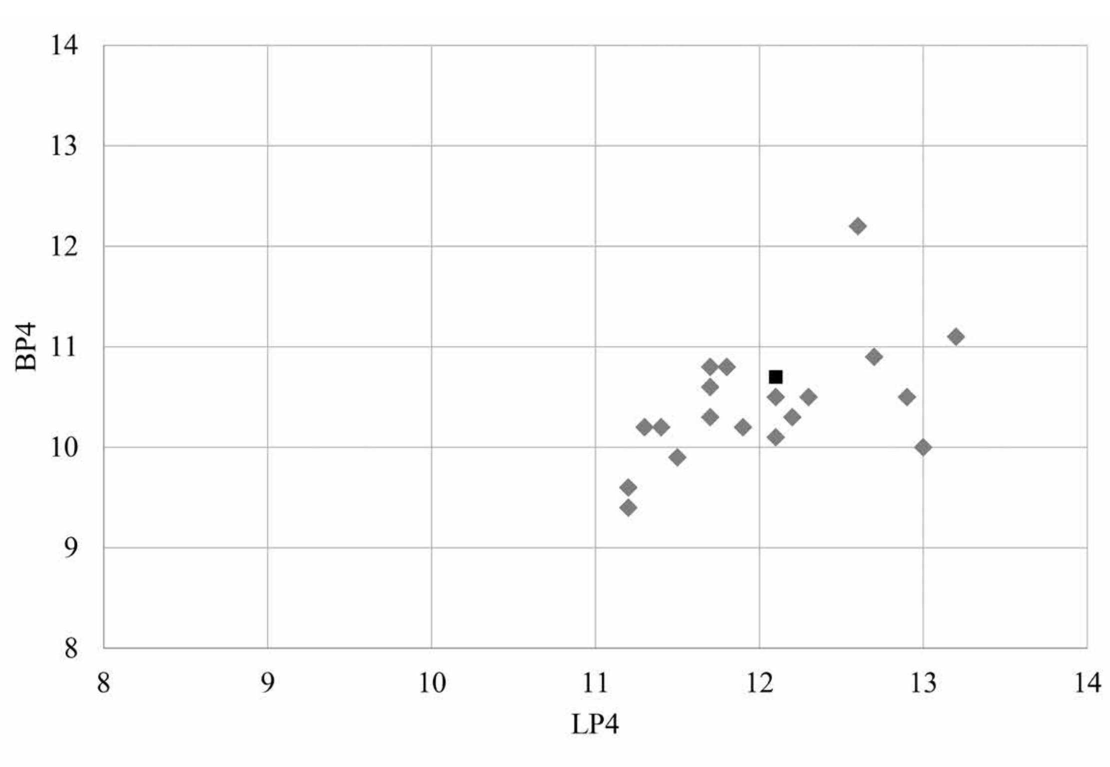

Figure 2. SCBC *Taxidea* upper fourth premolar length (LP4) vs. breadth (BP4) measurements (mm) compared to modern specimens. Square = SCBC; diamond = modern.

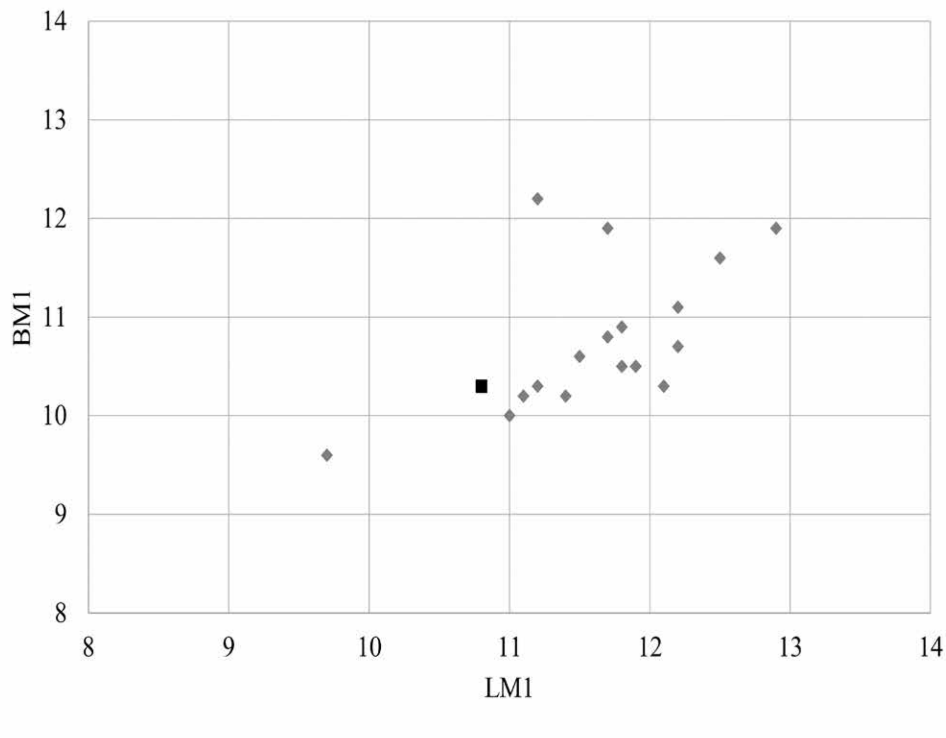

Figure 3. SCBC *Taxidea* upper first molar length (LM1) vs. breadth (BM1) measurements (mm) compared to modern specimens. Square = SCBC; diamond = modern.

Artiodactyl and horse fossils are the topic in an ongoing manuscript. Avian remains and additional radiocarbon dates were presented in Emslie and Mead (2023). Details about the *Taxidea* fossils are presented here.

METHODS

Fossils recovered from the excavations in 1984 and 1987 (see Mead and Mead, 1989) were curated into the collections of The Mammoth Site (Hot Springs, South Dakota; MSQ). The following specimens were recovered in the excavations. MSQ numbers are in parentheses. *Taxidea* skeletal elements consist of:1 L maxillary fragment with P4-M1 (10) (Fig. 7A, B); 2 mandible fragments including one L and one fused R+L fragment at symphysis (41-42); 2 R P4 and 2 L P4 (45-48); 2 axis (32-33) (Fig. 8); 2 pelvic fragments (49-50); 1 R humerus (11) (Fig. 7E, F); 4 R radius and 1 L radius, all immature, lacking proximal epiphyses (26, 34-37); 1 R and 2 L ulna, two lacking distal epiphyses (12, 43-44) (Fig. 7C, D); 3 R and 1 L femur, immature to lacking distal epiphyses (13, 19, 21, 27) (Fig. 8); 3 R tibia (38-40); 2 L astragalus (16, 53) (Fig. 8); 1 R and 2 L calcaneus (25, 51-52) (Fig. 8); 5 metacarpal (14, 18, 22); 1 metatarsal (15); 5 metapodial (24); 13 1^{st}-2^{nd} phalanx (17, 20, 23); 32 distal, 3^{rd} phalanx (54-64) (Fig. 8).

There is limited literature that provides linear skeletal measurements of *Taxidea*. Measurement methods for post-crania used here are based on Von Den Driesch (1976) and Samuels et al. (2013). We found the measurement methods in Samuels et al. (2013) on the ulna to be more ideal for graphing length vs. width, thus we use their methods to supplement those of Von Den Driesch (1976) for this element. Measurements of the maxilla follow Anderson (1970). Identifications presented here are based on the analysis using morphological characters and linear measurements from comparative specimens.

Anatomical and skeletal abbreviations: BM1, breadth of the upper first molar; BP4, breadth of the upper fourth premolar; FBD, femur greatest breadth at distal end; FBP, femur greatest breadth of the proximal end; FGL, femur greatest length; FSD, femur smallest breadth of diaphysis; HBD, humerus greatest breadth at distal end; HBP, humerus greatest breadth of the proximal end; HGL, humerus greatest length; HSD, humerus smallest breadth of diaphysis; L, left; LM1, length of the upper first molar; LMTR, length maxillary tooth row; LP4, length of the upper fourth premolar; R, right; UAPD, ulna midshaft anteroposterior diameter; UDAP, ulna depth across the processus anconaeus; UGL, ulna greatest length; ULOL, ulna length of the olecranon process; and USDO, smallest depth of the olecranon.

Institutional abbreviation: LACM, Los Angeles County Museum, California; MSCC, Mammoth Site Comparative Collection, The Mammoth Site of Hot Springs, South Dakota; MSQ, Mammoth Site Quaternary, The Mammoth Site of Hot Springs, South Dakota; SDSM R, South Dakota School of Mines Recent, Rapid City, South Dakota; UCLA, University of California, Los Angeles, California; USNM, United States National Museum, Washington, DC.

RESULTS

Chronology for the SCBC deposit has expanded greatly since first presented in Mead and Mead (1989). New calibrated radiocarbon dates analyzed directly on select taxa are presented in Emslie and Mead (2023) and here, which illustrate that ages span from a median 8,709 cal yr BP to 48,028 cal yr BP (Table 1). A date directly on *Taxidea* is 37,045 cal yr BP.

Table 1. Radiometric ages from Snake Creek Burial Cave, White Pine County, Nevada, southern Snake Range. Notes include provenience from original excavation (year excavated followed by test pit number and level from surface; Mead and Mead, 1989). Abbreviations: *, U-Th age analysis, see reference; Lv, level; TR, this report. Calibration of AMS ages based on OxCal 4.4.

Species Dated	14C Age yr BP	Median Age Cal yr BP	Cal Age Range yr BP	Lab	Reference and Notes
Bat guano	7,860±130	8,709	9,011-8,411	Beta 22169	Mead and Mead, 1989; Unit II
Wood	9,460±160	10,755	11,190-10,338	Beta 24643	Mead and Mead, 1989; Unit III
Canis lupus wolf	10,085±25	11,653	11,815-11,600	UCIAMS 260201	TR; metacarpal; 87-1, Lv 3
Equus horse	15,100±700*	-	-	-	Mead and Mead, 1989; Unit III
Centrocercus sage-grouse	23,050±100	27,322	27,609- 27,190	UCIAMS 256740	Emslie and Mead, 2023, 87-3, Lv 1
Nyctea scandiaca snowy owl	30,680±240	35,028	35,498-34,544	UCIAMS 256737	Emslie and Mead, 2023; 87-1; Lv 6
Taxidea; badger	32,660±300	37,045	38,133-36,274	UCIAMS 260205	TR; metapodial; Unit III
Lynx rufus; bobcat	32,900±310	37,406	38,759-36,505	UCIAMS 260202	TR; p/4 from mandible; 87-1
Nyctea scandiaca; snowy owl	33,710±340	38,619	39,501-37,507	UCIAMS 256738	Emslie and Mead, 2023; 87-1, Lv 7
Centrocercus sage-grouse	35,019±410	40,182	40,949-39,395	UCIAMS 256739	Emslie and Mead, 2023; 87-1, Lv 5
Martes marten	45,300±1400	48,028	52,330-45,135	UCIAMS 260206	TR; m/1; Unit III

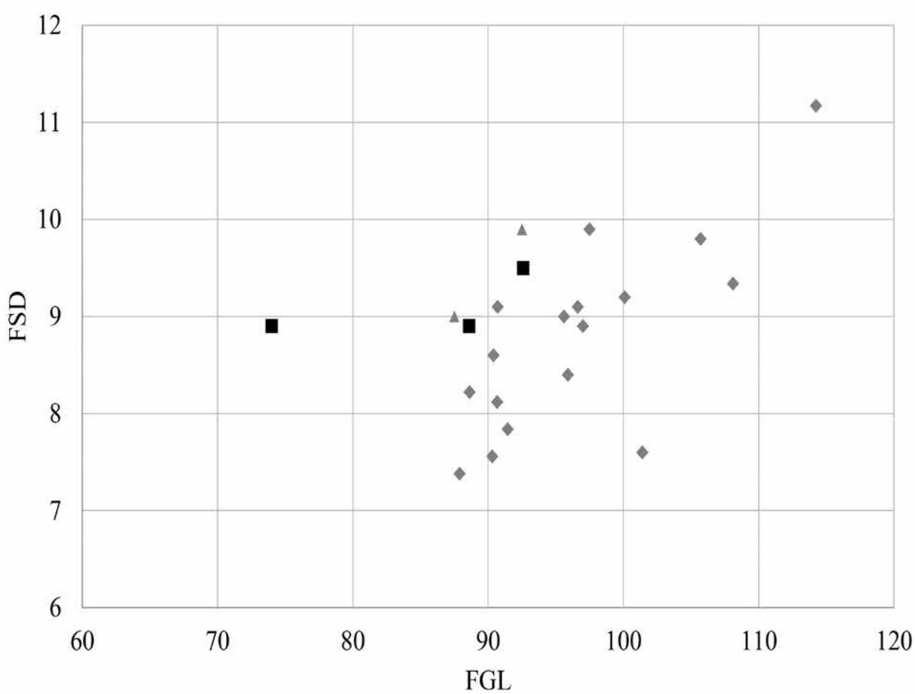

Figure 4. SCBC *Taxidea* femora greatest length (FGL) vs. smallest breadth of the diaphysis (FSD) measurements (mm) compared to modern specimens. Square = SCBC; diamond = modern; triangle = modern juvenile.

While presently confined to Eurasia, meline badgers inhabited North America in the pre-Pleistocene. For completeness, we compared the SCBC badger fossils to extant *Meles* and extinct North American melines using figures from Lavocat (1966), Wallace and Wang (2004), and Wolsan and Sotnikova (2013). Only two genera of meline badgers have been reported from North America, *Arctomeles* and *Ferinestrix*, which are known from cranial material that is early to middle Pliocene (Blancan NALMA; Tedford and Harington, 2003; Wallace and Wang, 2004; Wolsan and Sotnikova, 2013). The maxillary fragment from SCBC retains the upper left tooth row with P4, M1, and alveoli for P2-3 preserved. SCBC P4 is similar in size to the M1 in occlusal view, whereas the P4 of all melines is smaller than M1 (Wolsan and Sotnikova, 2013). SCBC P4 has a well-developed protocone, whereas all melines have a protocone that is small, ridge-like, or absent (Wolsan and Sotnikova, 2013). SCBC M1 is triangular in occlusal view similar to all known members of Taxidiinae (Owen, 2006). In contrast, the M1s of *Ferinestrix* and *Meles* are rectangular and that of *Arctomeles* is rhombus shaped. Additionally, SCBC M1 exhibits a labiolingually oriented crest formed by the epicrista that lies between the paracone and protocone, while the M1s of *Arctomeles*, *Ferinestrix*, and *Meles* share a complex anteroposteriorly oriented crest composed of the paraconule, protocone, and an elongate postprotocrista.

Cranial measurements of SCBC *Taxidea* fit well within the range of modern specimens (Table 2; Figs. 2 and 3). With the identification of the SCBC badger maxilla as taxidiine rather than meline, we compared SCBC badger skeletal material to another taxidiine badger, *Pliotaxidea*, using figures from Wagner (1976). The posterior margin of the SCBC M1 terminates in a blunt, rounded heel, rather than a sharp, elongate apex such as in *Pliotaxidea* (Wagner, 1976). Thus,

Table 2. Table of cranial measurements (mm) of *Taxidea taxus* from Snake Creek Burial Cave, White Pine County, Nevada, along with modern specimens. (*) denotes a minimal measurement from an unfused or fragmented element. (!) – denotes measurements from significantly worn teeth. Abbreviations in text.

Specimen	LP4	BP4	LM1	BM1	LMTR
MSQ 10	12.1	10.7	10.8	10.3	40.8
MSCC 10	11.2	9.6	11.2	10.3	39.0
MSCC 93	11.2!	9.4!	9.7!	9.6!	38.8!
MSCC 143	11.5	9.9	12.1	10.3	41.7
MSCC 388	11.7	10.6	11.9	10.5	40.6
MSCC 389	12.1	10.1	11.8	10.5	40.8
SDSM R 52	12.6	12.2	12.5	11.6	41.5
SDSM R 53	13.2	11.1	9.5!	11.5!	41.2
SDSM R 54	11.7	10.3	11.8	10.9	40.5
SDSM R 55	13.0*	10.0*	-	-	42.4
SDSM R 609	12.9	10.5	11.7	10.8	42.2
SDSM R 685	11.4	10.2	11.5	10.6	41.1
SDSM R 711	11.3	10.2	11.1	10.2	40.0
SDSM R 817	12.7	10.9	12.2	11.1	42.8
SDSM R 490	11.8	10.8	12.2	10.7	42.2
SDSM R244	11.8*	10.8	12.9	11.9	42.1
SDSM R 315	12.2	10.3	11.4	10.2	40.4
SDSM R 527	12.1	10.5	11.7	11.9	41.7
SDSM R 117688	11.7*	10.8	11.0	10.0	41.2
SDSM R 117689	11.9	10.2	11.2*	12.2	38.2
SDSM R 117690	12.3	10.5	-	10.9	-

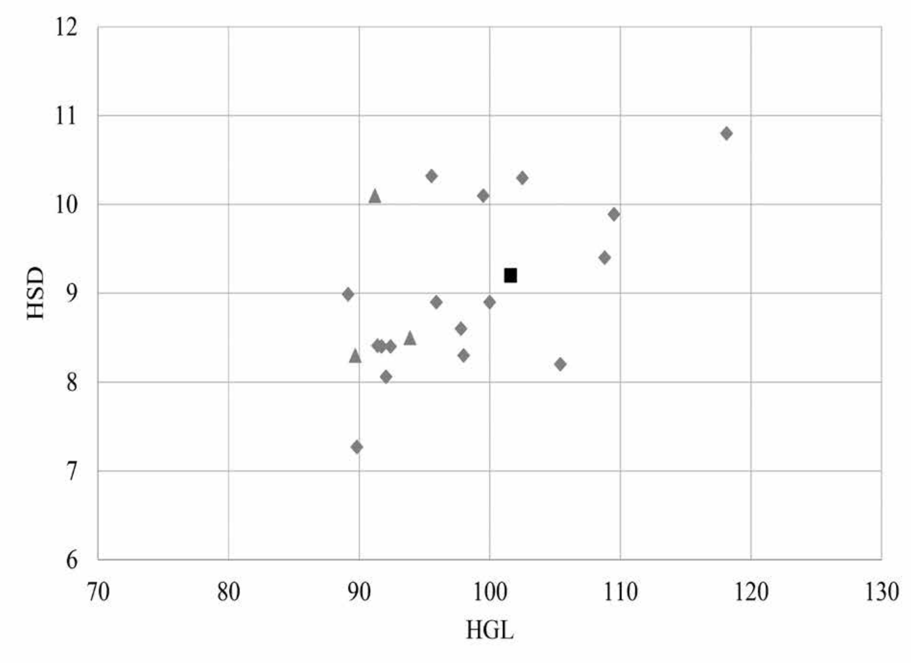

Figure 5. SCBC *Taxidea* humeri greatest length (HGL) vs. smallest breadth of the diaphysis (HSD) measure ments (mm) compared to modern specimens. Square = SCBC; diamond = modern; triangle = modern juvenile.

the SCBC specimen is identified as belonging to *Taxidea*.

Using modern comparative specimens and linear measurements (Tables 2–5), we were able to identify *Taxidea taxus* material from SCBC. Overall, the postcrania are short, stout, and that of a medium-sized carnivoran. We were able to rule out non-badger mustelids, as well as mephitids, based on the smaller size and more gracile postcrania of those taxa in relation to those of the badger. Additionally, we were able to rule out procyonids, canids, and felids based on the larger, longer, and thinner postcrania elements of those taxa.

For meline badgers, SCBC postcrania were only compared to *Meles* due to the lack of known North American meline postcrania. The SCBC badger humerus has a notably broad lateral supracondylar ridge that resembles the wide humeri of *Taxidea* rather than what is a comparably narrower humerus of *Meles*. The ulnae from SCBC have a long, protruding olecranon process, as observed on extant *Taxidea*, rather than the shorter morphology found on *Meles*. The badger phalanges and metapodials recovered from SCBC are particularly robust, an adaptation for heavy digging that can be attributed to *Taxidea*. Based on these characters, we propose that the SCBC badger specimens do not represent a late-surviving Quaternary North American meline badger.

Wagner (1976) states that the humerus of *Taxidea* has more developed deltoid and pectoral crests compared to *Pliotaxidea*, which is observed to be the case in the SCBC humerus (Fig. 7E–F). Based on these characters, we designated all SCBC badger skeletal remains as *Taxidea*. Additionally, the SCBC badger material shows no morphological evidence of being a distinct taxon from the only taxidiine badger species known from the Pleistocene, *Taxidea taxus;* and therefore, was designated as such.

The SCBC humerus (MSQ 11) fits within the upper size range of living juvenile *T. taxus*, making it a relatively large juvenile or immature individual (Table 4; Fig. 5; Fig. 8). The SCBC ulna (MSQ 12) is particularly large and robust compared to modern *Taxidea* specimens (Table 5; Fig. 6; Fig. 8), especially for an immature individual. MSQ 12 has a moderately long greatest length, but its depth is notably the greatest measurement of all other ulnae measured for this

Table 3. Table of measurements (mm) for the femur of *Taxidea taxus* from Snake Creek Burial Cave, White Pine County, Nevada, along with modern specimens. (*) – denotes a minimal measurement from an unfused or fragmented element. (/) denotes a measurement that was taken from fused and unfused elements of the same pair. Abbreviations in text.

Specimen	FGL	FSD	FBD	FBP
MSQ 19	92.6*	9.5	25*	31.2*
MSQ 21	92.8*	8.9	21.8*	27.8*
MSQ 13	74*	8.9	20.2*	24.9*
MSCC 389	100.1	9.2	24.3	29.2
MSCC 386	101.4	7.6	23.9	26.6
SDSM R 711	95.6	9	22.3	28.3
SDSM R 609	92.5*/97.5	9.9	21.1*/23.7	29.2
SDSM R 685	95.9	8.4	21.3	27.0
SDSM R 689	87.5*	9	20.6	24.8
SDSM R 468	105.7	9.8	23.4	30.1
SDSM R 817	97	8.9	22.5	27.1
MSCC 93	90.7	9.1	23.7	28.0
MSCC 10	90.4	8.6	24.1	28.8*
USNM 264140	114.2	11.17	27.16	-
LACM 52215	90.3	7.56	19.75	-
LACM 85731	91.4	7.84	19.77	-
UCLA 13768	96.6	9.1	23.03	-
UCLA 13974	90.6	8.12	21.56	-
UCLA 16002	87.8	7.38	19.93	-
UCLA 13971	88.6	8.22	21.28	-
UCLA 13057	108.1	9.34	23.48	-

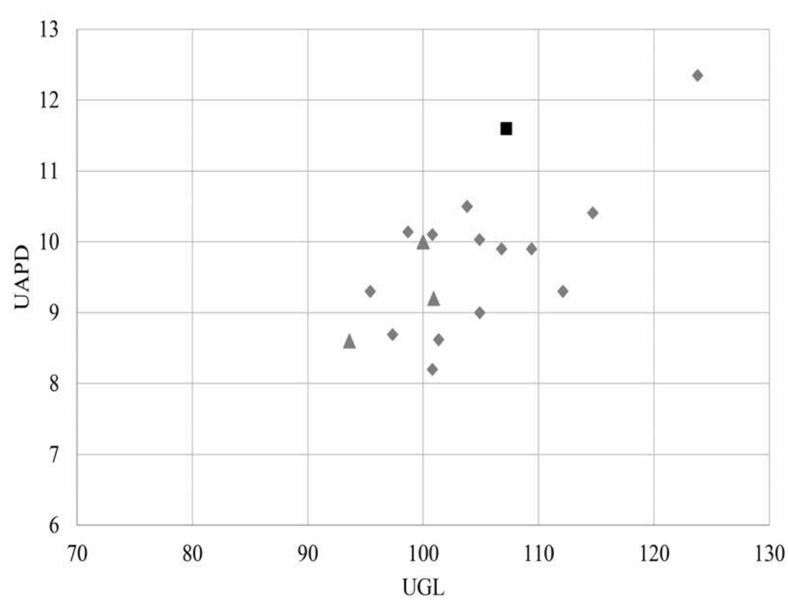

Figure 6. SCBC *Taxidea* ulnae greatest length (UGL) vs. midshaft mediolateral diameter (UAPD) measurements (mm) compared to modern specimens. Square = SCBC; diamond = modern; triangle = modern juvenile.

project. If the badger from SCBC had grown to maturity, based on its substantial ulna depth, it likely would have been a large individual.

There were three immature femora recovered. Measurements of SCBC femora are similar to modern specimens, except that MSQ 13 (small juvenile) is particularly shorter and thinner than both other fossil and modern specimens (Table 3; Fig. 4; Fig. 8). MSQ 21 is also from an immature individual, yet it has a distinctly robust anterior end, larger than typical adult badgers today (Fig. 8). All other SCBC skeletal measurements on *Taxidea* fall somewhere in the medium to small size range relative to extant badger specimens. Based on the overall measurements, most of the badgers recovered from SCBC appear to have been of typical size of the extant forms. The minimum number of individuals (MNI) of *Taxidea* recovered from SCBC is three based on three immature right radii from different proveniences (MSQ 34–36) and three immature right tibiae (MSQ 38–40).

DISCUSSION AND CONCLUSIONS

We present the analysis of the cranial and post-cranial remains of *Taxidea* from the Late Pleistocene deposits in SCBC. Calibrated radiocarbon ages analyzed directly on select avian and mammalian taxa confirm that the natural trap cave deposits represent the Wisconsinan pre-full glacial, late glacial, and earliest Holocene. Skeletal remains of *Taxidea* were not overly abundant in the deposit compared to other more common carnivorans, such as canids (e.g., foxes). The record of badger in SCBC is not surprising for both the Great Basin and the Intermountain West. Figure 1 displays the geographic distribution of Pleistocene-age localities (Table 6) yielding *Taxidea* (both *T. taxus* and *Taxidea* sp.) throughout western North America (see Harris 1985; https://www.utep.edu/leb/pleistNM/default.htm). All sites listed and shown in Figure 1 for western North America are within the historic range of *Taxidea* (Kyle et al., 2004); however, its range during the Late Pleistocene did extend further east than it occurs today (McDonald, 2002).

The immature state of most of the SCBC *Taxidea* remains is noteworthy and suggests to us that the avoidance of natural traps may be a learned behavior (White et al., 1984). However, the funnel-shaped sinkhole entrance is known to become coated with ice and snow during particularly harsh winter snowstorms, thus may have been more detrimental under select seasonal conditions (JIM field notes). *Taxidea* fossils from SCBC appear to indicate no notable size change in the species from the Pleistocene to today (Tables 2–5; Figs. 2–6), unlike several other extant Ice Age survivors,

Table 4. Table of measurements for the humerus of *Taxidea taxus* from Snake Creek Burial Cave, White Pine County, Nevada, along with modern specimens. Measurements in mm. (*) – denotes a minimal measurement from an unfused or fragmented element. (/) denotes a measurement that was taken from fused and unfused elements of the same pair. Abbreviations in text.

Humerus	HGL	HSD	HBD	HBP
MSQ 11	101.6*	9.2	34.2	22*
MSCC 389	102.5	10.3	34.4	25.4
MSCC 386	105.4	8.2	32.6	23.1
SDSM R711	97.8	8.6	32.5	23
SDSM R609	91.2*/99.5	10.1	33.8	19.4*/22.4
SDSM R685	89.7*/98	8.3	32.3	18.4*/21.6
SDSM R689	93.9*	8.5	34.6	19*
SDSM R468	108.8	9.4	35.2	25.6
SDSM R817	100	8.9	31.5	23.8
MSCC 93	95.9	8.9	31.7	22.6
MSCC 10	92.4	8.4	33.8	24.7
USNM 264140	118.14	10.8	37.8	-
LACM 52215	91.72	8.4	28.73	-
UCLA 13768	95.54	10.32	30.74	-
UCLA 13974	91.4	8.41	30.71	-
UCLA 16002	89.82	7.27	28.75	-
LACM 85731	92.05	8.06	28.15	-
UCLA 13971	89.16	8.99	30.39	-
UCLA 13057	109.51	9.89	36.13	-

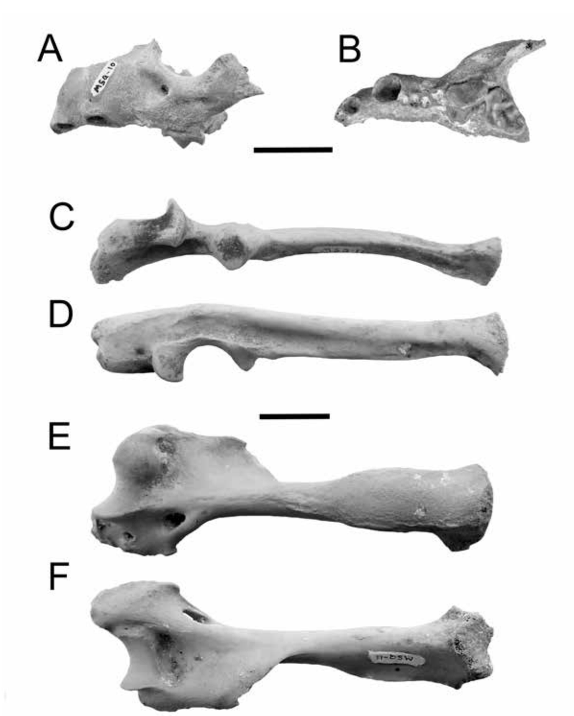

Figure 7. *Taxidea* cranial, humerus, and ulna from Snake Creek Burial Cave, White Pine County, Nevada. A, lateral and B, occlusal views of L maxillary fragment MSQ 10. C, anterior and D, lateral views of L ulna MSQ 12. E, anterior and F, posterior views of R humerus MSQ 11. Scale bars = 2 cm.

Table 5. Table of measurements for the ulna of *Taxidea taxus* from Snake Creek Burial Cave, White Pine County, Nevada, along with modern specimens. Measurements in mm. (*) – denotes a minimal measurement from an unfused or fragmented element. Abbreviations in text.

Ulna	UGL	UAPD	UDPA	USDO	ULOL
MSQ 12	107.2*	11.6	18.7	15.6	22.6
MSQ 44	111.7*	-	-	-	-
MSCC 389	109.4	9.9	17.1	12.5	19.5
MSCC 386	100.0*	10	17.3	14.2	20.1
SDSM R711	104.9	9	16.5	12.8	20.3
SDSM R609	103.8	10.5	16.7	12.5	19
SDSM R685	93.6*	8.6	15	11.7	19.3
SDSM R689	100.9*	9.2	17.1	13.4	20.4
SDSM R468	112.1	9.3	17.4	12.4	20.6
SDSM R817	106.8	9.9	15.3	11.5	20.3
MSCC 93	100.8	10.1	15.7	11.4	20.6
MSCC 10	100.8	8.2	16	12.7	19.4
USNM 264140	123.78	12.35	-	-	28.38
LACM 52215	101.33	8.62	-	-	18.26
UCLA 13768	104.88	10.03	-	-	21.15
UCLA 13974	98.68	10.14	-	-	22.67
UCLA 16002	97.34	8.69	-	-	18.45
UCLA 13971	95.41	9.3	-	-	16.57
UCLA 13057	114.71	10.41	-	-	24.73

such as *Bison*, *Martes*, *Ovis*, among others (Kurtén and Anderson, 1980). However, the sample size of badger is not ideal from SCBC. Further analysis of badger remains from additional caves should help to better understand the overall size range of Late Pleistocene *Taxidea* in the east-central Great Basin.

SCBC has not yielded fossils of *Cynomys*, thus badgers in this region would not have been preying on prairie dogs as they commonly do today elsewhere in the Intermountain West (Goodrich and Buskirk, 1998; Slobodchikoff et al., 2009). However, colonial ground squirrels, arvicoline voles, and other small rodent remains are plentiful, as well as lagomorphs in SCBC and other valley-bottom caves such as Crystal Ball Cave (60 km, 37 mi. north of SCBC; Heaton, 1987). In Nevada today, the badger is known to eat a variety of ground squirrels (*Urocitellus elegans*; *U. beldingi*; *U. townsendii*), pocket gophers (*Thomomys*), rabbits (*Lepus* and *Sylvilagus*), and various lizards (*Phrynosoma* and *Uta*) (Hall, 1946).

The environmental conditions of the Great Basin during the late Wisconsinan Glacial (~25,000 to 11,000 yr BP), Late Pleistocene, are unlike those observed there today. Alpine glaciers descended to below 2,800 m elevation in some of the larger mountain ranges (e.g., the southern Snake Range) while at the same time, pluvial lakes (such as Lake Bonneville) filled many of the extensive valley basins (Mifflin and Wheat, 1979; Benson and Thompson 1987; Grayson 1993, 2006; Reheis et al., 2014; Milligan and McDonald, 2017). Fossil plants for this period come from various lake and marsh deposits, along with dry caves and packrat middens (Thompson and Mead, 1982; Spaulding, 1990; Thompson, 1990).

Table 6. List of western North America localities that contain Quaternary *Taxidea* fossils. Assigned ages based on referenced author. Localities refer to dots in Figure 1.

Location	Locality Name	Age	Reference
Arizona			
	Papago Springs Cave	Late Pleistocene	Harris, 2008
	San Simon Fauna	Late Blancan	Harris, 2008
	Ventana Cave	Late Wisconsinan	Harris, 2008
California			
	Anza-Borego Desert State Park	Late Blancan to Irvingtonian	Harris, 2008
	Campbell Hill and Twentynine Palms Gravel Pit	Rancholabrean ? “Illinoinian”	Harris, 2008
	Carpinteria	Early Wisconsinan	Harris, 2008
	Diamond Valley Lake Local Fauna	Mid/Late Wisconsinan	Harris, 2008
	Kokoweef Cave	Late Wisconsinan/Holocene	Harris, 2008
	Maricopa	Late Wisconsinan	Harris, 2008
	McKittrick	Mid/Late Wisconsinan	Harris, 2008
	Mountain View Country Club	Late Wisconsinan	Harris, 2008
	Newberry Cave	Late Wisconsinan/Holocene	Harris, 2008
	Piute Ponds, Lake Thompson	Rancholabrean	Harris, 2008
	Pinto Basin JTNM	Early? Rancholabrean	Harris, 2008
	Potter Creek Cave	Early Holocene	Harris, 1985
	Rancho La Brea	Mid and Late Wisconsinan	Harris, 2008
	Schuiling Cave	Late Wisconsinan/Holocene	Harris, 2008
Colorado			
	Dutton	Late Pleistocene	Harris, 1985
	Chimney Rock Animal Trap	Late Wisconsin-Early Holocene	Hager, 1972
	Porcupine Cave	690,000 - 900,000 yrs	Anderson, 1996
Idaho			
	American Falls	”Probably Sangamonian”	Harris, 1985
	Booth Canyon		Akersten et al., 2002
	Moonshiner Cave	Post-glacial	Anderson, 1977
	Jaguar Cave	Late Pleistocene	Guilday and Adam, 1967
Nevada			
	Amy’s Rockshelter	Late Pleistocene	Miller, 1979
	Cathedral Cave	Mid-Late Pleistocene	Jass, 2007
	Centennial Parkway, Las Vegas Valley	Rancholabrean	Harris, 2008
	Hanging Rock Shelter	Late Pleistocene/Holocene	Grayson, 1988
	Hidden Cave	Holocene	Grayson, 1985
	Kachina Cave	Holocene	Miller, 1979
	Last Supper Cave	Late Pleistocene/Holocene	Grayson, 1988
	Mineral Hill Cave	Late Pleistocene/Holocene	Hockett and Dillingham, 2004
	O’Malley Shelter	Late Quaternary	Fowler et al., 1973
	Owl Cave #2	Late Quaternary	Turnmire, 1987
	Smith Creek Cave	Late Pleistocene	Harris, 1985

Location	Locality Name	Age	Reference
New Mexico			
	Big Manhole Cave	Mid/Late Wisconsinan	Harris, 2008
	Burnet Cave	Wisconsinan and Holocene	Harris, 2008
	Conkling Cavern	Late Wisconsinan/Holocene	Harris, 2008
	Dark Canyon Cave	Late Quaternary	Harris, 2008
	Dry Cave: Animal Fair	Late Pleistocene	Harris, 1985
	Dry Cave: Circus Route:	„Older than 11,880 on stratigraphic grounds”	Harris, 2008
	Dry Cave: Room of the Vanishing Floor	Early or Early/Mid Wisconsinan	Harris, 2008
	Isleta Cave 2	Late Wisconsinan and Holocene	Harris, 2008
	Jal	Late Wisconsinan	Harris, 2008
	Pendejo Cave	Late Quaternary	Harris, 2008
	San Antonio Cave	Medial Irvingtonian	Harris, 2008
	Shelter Cave	Mid/Late Wisconsinan/Holocene	Harris, 2008
	U-Bar Cave	Mid/Late Wisconsinan and Holocene	Harris, 2008
Oregon			
	Fossil Lake	„Probaly mid or possibly early Wisconsinan”	Harris, 1985
Texas			
	Sierra Diablo Cave	Mid/Late Wisconsinan/Holocene	Harris, 2008
Utah			
	Danger Cave	Late Pleistocene	Grayson, 1988
	Hogup Cave	Holocene	Aikens, 1970
	Silver Creek	Sangamonian	Harris, 1985
Wyoming			
	Bell Cave	Late Wisconsinan	Zeimens and Walker, 1974
	Horned Owl Cave	Late Pleistocene/Holocene	Harris, 1985
	Little Box Elder Cave	Late Wisconsinan and Holocene	Anderson, 1968, 1977
Alberta			
	Eagle Cave,	Late Pleistocene	Harrington, 2011
	Rats Nest Cave	Late Pleistocene	Harrington, 2011
Saskatchewan			
	Fort Qu’Appelle: (Bliss Gravel Pit-Echo Lake Gravel)	„Sangamonian (cf. Wisconsinan interstadial)”	Harris, 1985
	Saskatoon	Sangamonian or cf. Wisconsinan interstadial	Harris, 1985
Sonora			
	El Golfo	Irvingtonian	Harris, 2008

Macrobotanical remains from packrat middens suggest that subalpine and montane conifers grew on the lower mountain slopes and valley bottoms above high lake stands. Given the right substrate, select species of subalpine and montane conifers along with sagebrush and other shrubs, could have formed a continuous or near-continuous belt from the Wasatch Front of Utah to the Sierra Nevada of California/Nevada (Thompson, 1990). The recovery of sage-grouse from a number of caves in the region including SCBC suggest extensive stands of sagebrush and or sagebrush steppe in the valley (Emslie and Heaton, 1987; Grayson, 2006; Emslie and Mead, 2023). Taken together, this habitat description is what the badger inhabited above the Lake Bonneville shoreline, and below the level of glacial and peri-

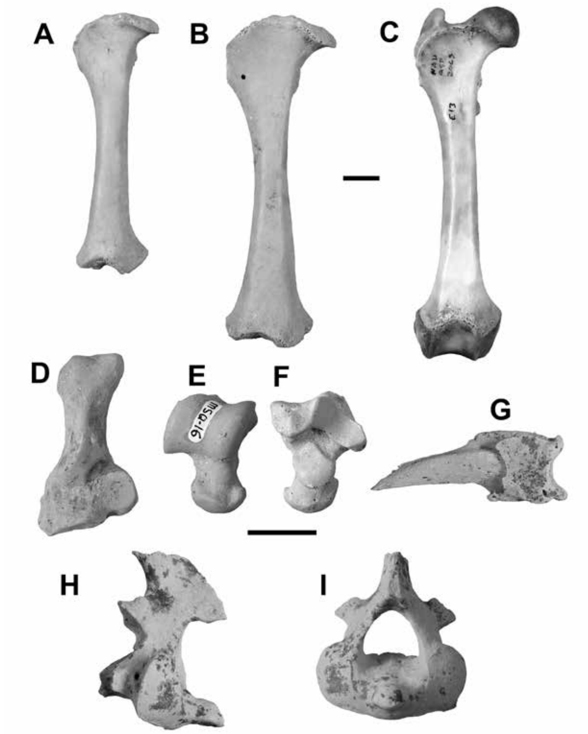

Figure 8. Taxidea postcranial elements from Snake Creek Burial Cave, White Pine County, Nevada. A, R juvenile femur (MSQ 13); B, R immature femur (MSQ 21); and C, R mature femur modern specimen (MSCC 389) anterior views. D, R calcaneus (MSQ 52) anterior (dorsal) view. E, anterior (dorsal) and F, posterior (plantar) views of L astragalus (MSQ 16). G, side view of distal (3rd) phalanx (MSQ 64). H, lateral and I, anterior views of axis (MSQ 32). Scale bars = 1 cm.

glacial zones of the highest peaks of the Snake Range. If there was a fairly continuous conifer-sagebrush steppe habitat east to west across the Great Basin, a number of mammalian species did not follow suite, indicating it was not a homogeneous biome across the Great Basin (see review in Grayson, 2006). Perhaps the Bonneville Basin provided a form of filter mechanism for select species, mainly montane mammals, such as the pika (*Ochotona*, Grayson, 1987, 2005). Each species reacted on its own to changes in climate from glacial to interglacial regimes (Brown, 1978; Grayson, 2006). As various species responded with change (extirpation, extinction, changes in mass, geographic distribution, skeletal morphology), the badger from the Great Basin did not seem to have necessitated such a response. Conversely, the Pleistocene *Taxidea* of Alaska, where they do not occur today, were distinctly larger (Anderson, 1977). Continued work on the faunas and floras from caves and packrat middens in the Snake Range (e.g., Smith Creek, Ladder, Combustion, Cathedral, Arches Caves) and low in the valley (e.g., SCBC, Garrison Cave) will help in the reconstruction of the Late Pleistocene biotic communities above the high lakes stands and how they adapted due to climate change to the current interglacial regime.

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