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PRELIMINARY REPORT ON A LATE PLEISTOCENE MICROFAUNA FROM WHUT CAVE, CIBOLA COUNTY, NEW MEXICO

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Abstract—Late Pleistocene and Holocene bone- and shell-bearing deposits on Mesa del Oro, Cibola County, New Mexico, were excavated and analyzed. Extralimital mammal species for the mesa include voles (*Microtus* sp.) and the sagebrush vole (*Lagurus curtatus*). Land snails that no longer live on the mesa include *Zonitoides arboreus*, *Pupilla muscorum*, *Pupilla blandi*, *Pupoides hordaceus*, *Vallonia cyclophorella*, *Vallonia gracilicosta* and *Gastrocopta pilsbryana*. Based on faunal changes stratigraphically, it appears that two distinct climatic periods are represented. The earlier levels contain a fauna indicative of wetter, boreal-like conditions similar to those found in the nearby mountains today. This suggests a boreal expansion downward to the lower elevations of the Mesa del Oro area. The higher levels have a fauna indicative of Great Basin climatic conditions with cooler temperatures and a more equable distribution of precipitation through the year.

INTRODUCTION

Whut Cave is on Mesa del Oro, approximately 65 km southwest of Albuquerque, New Mexico (Fig. 1). The site is significant because of the paucity of Pleistocene fossil localities in the northwestern part of the state. The nearest other Pleistocene fossil faunas are from the Isleta caves on the edge of the Rio Grande valley just south of Albuquerque (Harris and Findley, 1964); Sandia Man Cave on the north side of the Sandia Mountains (Hibben, 1941); and a Late Pleistocene-Early Holocene site in Chaco Canyon (Betancourt and VanDevender, 1981). The Whut Cave material provides another point for the overall analysis of paleoclimate, past plant and animal assemblages and Pleistocene dispersal routes. Currently, only the molluscan shells and microtine rodent teeth have been identified, but these comprise an important part of the fossil fauna and are particularly useful for providing information about the paleoclimate and flora. Whut Cave is part of the Pronoun Cave complex, which lies on the extreme northeastern corner of Mesa del Oro. Other caves—Witch Cave, Wye Cave, Hoo Cave and Heidi Cave—occur near Whut Cave and also contain evidence of rich bone deposits (Fig. 1).

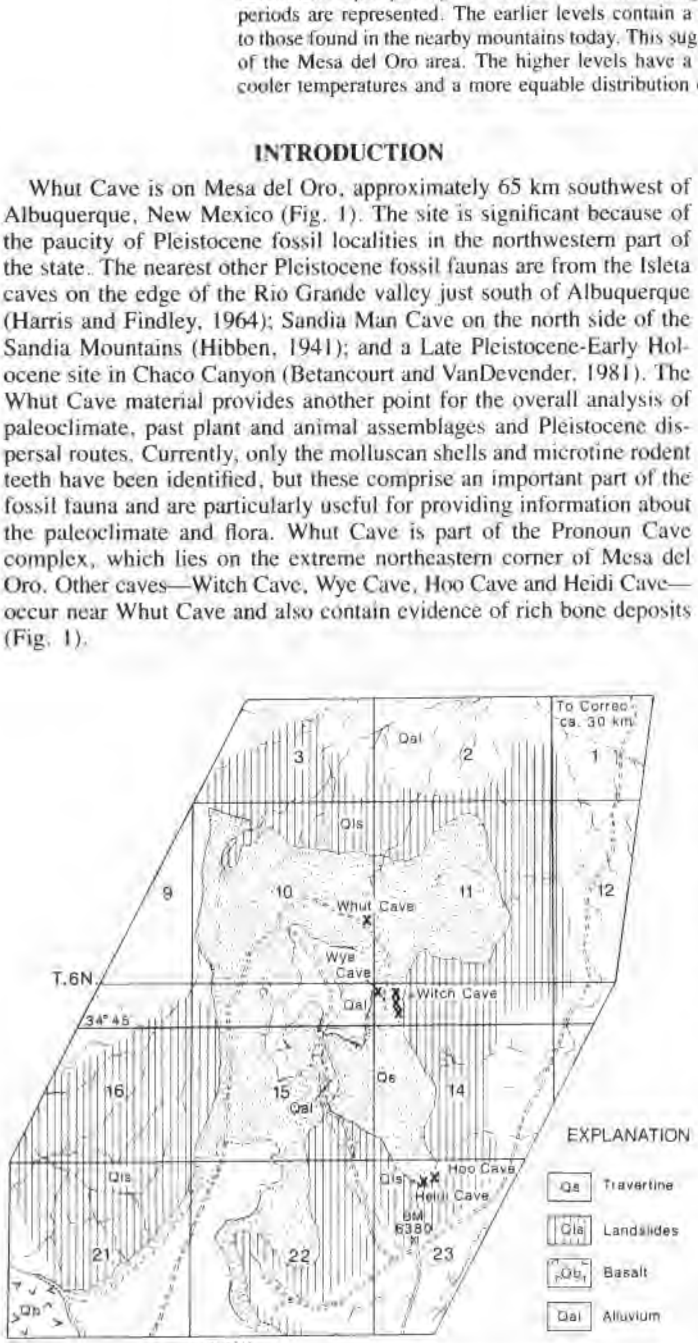

FIGURE 1. Pronoun Cave complex, north end of Mesa del Oro, Cibola County, New Mexico. Geology after Jicha, 1956.

Mesa del Oro is on the western side of the Lucero uplift and ranges from 1800 m to 2270 m elevation. The mesa consists of Cenozoic spring-deposited travertine and eruptive rocks. The travertine deposits are more specifically believed to be of early Pleistocene age. The travertine in the cave area reaches a maximum depth of 45 m and consists of 97.5% calcium carbonate (Jicha, 1956). The springs responsible for travertine deposition are no longer active except for a few small seeps on the northwestern side of the mesa. Whut Cave appears to be the remains of an actual spring issuance. The other caves were formed by fracturing and settling of the travertine.

The entrance to Whut Cave lies at an elevation of 2030 m (NE¼ SE¼ sec. 10, T6N, R5W) and is surrounded by sparse piñon-juniper woodland with one-seeded juniper (*Juniperus monosperma*) dominating. Common shrubs include desert sumac (*Rhus trilobata*), Mormon tea (*Ephedra viridis*), mountain mahogany (*Cercocarpus montanus*) and cholla (*Opuntia imbricata*). Dominant grasses are blue grama (*Bouteloua gracilis*), black grama (*Bouteloua eripoda*) and threeawn (*Aristida* sp.). Generally, the area is typical of a desert grassland. The mesa receives 25–30 cm of precipitation annually, with more than one-half falling between July and September (Hardy, 1941). Several of the caves show evidence of past human occupation, having been modified with crude rock work. The identity of the inhabitants and duration of occupation is not known at this time.

Whut Cave is a relatively small cave, extending only about 100 m west–northwest and about 50 m east–southeast of the present entrance, which measures about 61 cm in diameter. The entrance tunnel is vertical and drops about 4.5 m to a ledge, then about 4.5 m more to the bottom of the cave. At this point, the floor remains relatively level with fill material. Just below the present entrance is a man-made shaft that extends about 9 m vertically into the cave fill. The nature of this mining activity is not clear. The surface around the shaft is disturbed by digging and back-filling.

MATERIALS AND METHODS

In August 1984, an excavation pit measuring 1 m^2 was established about 30 m west of the present entrance chimney (Fig. 2). This then was mapped back to a datum point established on the cave wall below the entrance.

The excavation pit is on the cave floor below a ledge and fill cone of a completely filled chimney entrance, which apparently served as an entrance some time in the past (Fig. 2). Three walls of the pit are fill surfaces, and the fourth follows the natural cave wall. Between 1984 and 1986, sediments from 23 levels (each 4 cm in depth) were removed from the pit. Just below level 23, large rocks were encountered, preventing further excavation. At this time, both the original surface and bottom level were marked on the cave wall of the excavation pit. Volumes of fill material were consistent for all 23 levels. The nature

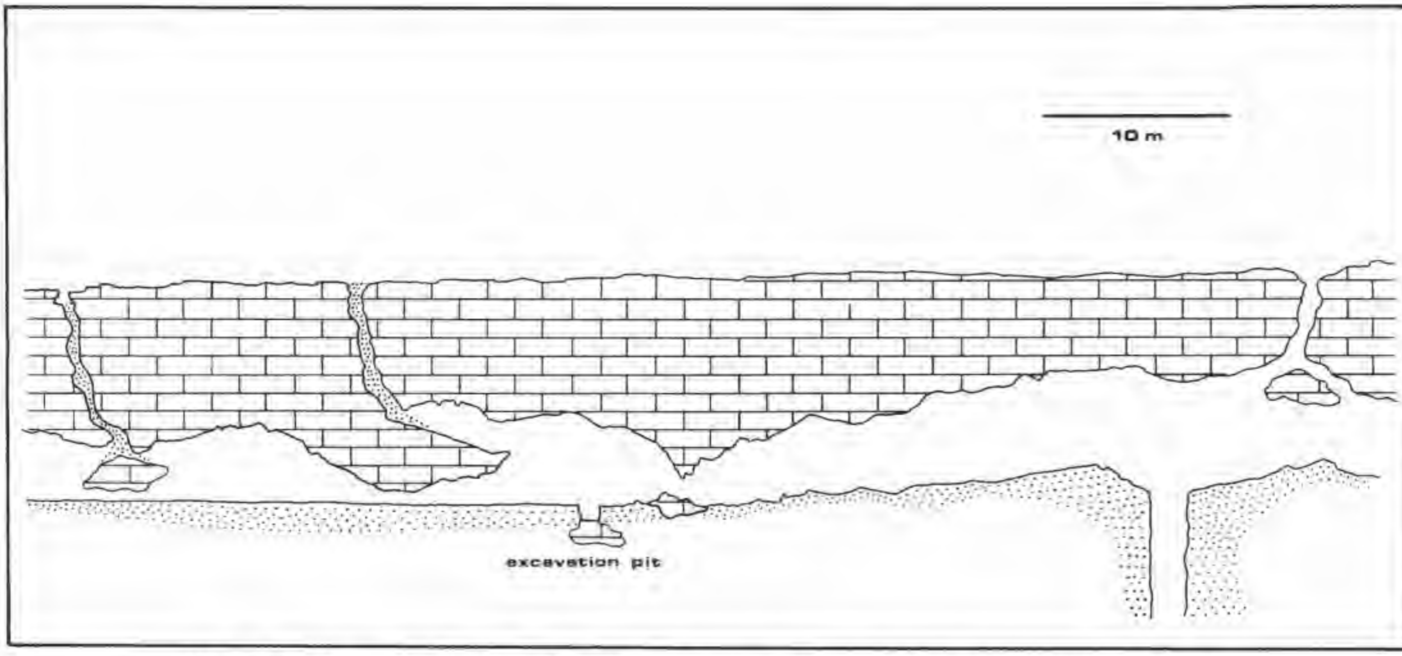

FIGURE 2. Schematic diagram of Whut Cave showing the present entrance, excavation pit and matrix-filled chimneys.

of the sediment, particle sizes and gravel volumes remained mostly constant throughout the excavation pit. Two exceptions were level 13, which contained a small volume of volcanic gravel and level 23, which contained some larger pebbles and cobbles. To standardize volume of the level–23 sample, a small amount of fill was excavated at the same level but lateral to the pit boundary.

The fill containing fossils was carefully screen-washed (1 mm mesh) and all bone, teeth, snail shells and seeds were removed for identification. Carbon samples were packaged in foil for future radiocarbon dating. All snail shells and microtine rodent teeth were catalogued into the collections of the New Mexico Museum of Natural History (NMMNH).

Material

Level 1: *Microtus* (vole) right M^2 (NMMNH-P8001); *Microtus* cf. *M. montanus* (montane vole) left M^1 (NMMNH-P8002); 46 *Succinea* sp. (NMMNH-MK 75); 1 *Zonitoides arboreus* (NMMNH-MK 76); 5 *Pupilla muscorum* (NMMNH-MK 79); 11 *Pupoides hordaceus* (NMMNH-MK 78); 16 *Vallonia cyclophorella* (NMMNH-MK 79).

Level 2: *Lagurus curtatus* (sagebrush vole) right M_1 (NMMNH-P8003) right M^1 (NMMNH-P8004); 18 *Succinea* sp. (NMMNH-MK 80); 2 *Pupilla muscorum* (NMMNH-MK 81); 9 *Pupoides hordaceus* (NMMNH-MK 82); 12 *Vallonia cyclophorella* (NMMNH-MK 83).

Level 3: *Lagurus curtatus* right M_1 (NMMNH-P8005), right M^2 (NMMNH-P8006); 17 *Succinea* sp. (NMMNH-MK 84), 1 *Zonitoides arboreus* (NMMNH-MK 86), 2 *Pupoides hordaceus* (NMMNH-MK 85).

Level 4: *Lagurus curtatus* left M^2 (NMMNH-P8007), 9 *Succinea* sp. (NMMNH-MK 87), 1 *Pupilla muscorum* (NMMNH-MK 89), 1 *Pupoides hordaceus* (NMMNH-MK 88), 1 *Vallonia cyclophorella* (NMMNH-MK 90).

Level 5: *Lagurus curtatus* left M_1 (NMMNH-P8008); 5 *Succinea* sp. (NMMNH-MK 91); 1 *Pupoides hordaceus* (NMMNH-MK 92).

Level 6: *Lagurus curtatus* right M_2 (NMMNH-P8009); 6 *Succinea* sp. (NMMNH-MK 93); 7 *Pupoides hordaceus* (NMMNH-MK 94); 6 *Vallonia cyclophorella* (NMMNH-MK 95).

Level 7: *Lagurus curtatus* right M^1 (NMMNH-P8010); 7 *Succinea* sp. (NMMNH-MK 96); 1 *Pupoides hordaceus* (NMMNH-MK 97); 3 *Vallonia cyclophorella* (NMMNH-MK 98); 1 *Vallonia gracilicosta* (NMMNH-MK 99).

Level 8: *Lagurus curtatus* left M^2 (NMMNH-P8011), left M^1 (NMMNH-P8012); 12 *Succinea* sp. (NMMNH-MK 100); 2 *Pupilla muscorum* (NMMNH-MK 101); 3 *Vallonia cyclophorella* (NMMNH-MK 102).

Level 9: *Microtus* sp. left M^1 (NMMNH-P8026), left M_1 (NMMNH-P8024); *Lagurus curtatus* left M^1 (NMMNH-P8013), left M^1 (NMMNH-P8030), right M^2 (NMMNH-P8020), left M^1 (NMMNH-P8014), left M^1 (NMMNH-P8017), right M^1 (NMMNH-P8018), left M_1 (NMMNH-P8019), left M_1 (NMMNH-P8021), left M_1 (NMMNH-P8023), right M_1 (NMMNH-P8029), left M_2 (NMMNH-P8015), right M_2 (NMMNH-P8022), left M_2 (NMMNH-P8028); 10 *Succinea* sp. (NMMNH-MK 103); 2 *Pupilla muscorum* (NMMNH-MK 104); 2 *Pupoides hordaceus* (NMMNH-MK 205).

Level 10: *Microtus* sp. left M^2 (NMMNH-P8034); *Lagurus curtatus* left M^1 (NMMNH-P8033), left M^1 (NMMNH-P8035), left M^1 (NMMNH-P8037), left M^2 (NMMNH-P8032), right M_2 (NMMNH-P8036); left M_2 (NMMNH-P8031); 20 *Succinea* sp. (NMMNH-MK 206); 2 *Pupilla muscorum* (NMMNH-MK 108); 4 *Pupoides hordaceus* (NMMNH-MK 207); 10 *Vallonia cyclophorella (NMMNH-MK 209).*

Level 11: *Microtus* sp. left M^1 (NMMNH-P8039), right M^2 (NMMNH-P8041); *Lagurus curtatus* right M^1 (NMMNH-P8038), left M^1 (NMMNH-P8040), left M_1 (NMMNH-P8042); 18 *Succinea* sp. (NMMNH-MK 110); 1 *Zonitoides arboreus* (NMMNH-MK 111); 2 *Pupilla muscorum* (NMMNH-MK 114); 1 *Pupoides hordaceus* (NMMNH-MK 112); 6 *Vallonia cyclophorella* (NMMNH-MK 113).

Level 12: *Lagurus curtatus* left M^2 (NMMNH-P8044), right M_1 (NMMNH-P8043); 17 *Succinea* sp. (NMMNH-MK 115); 3 *Zonitoides arboreus* (NMMNH-MK 116); 9 *Pupoides hordaceus* (NMMNH-MK 117); 7 *Vallonia cyclophorella*.

Level 13: *Microtus* sp. right M^1 (NMMNH-P8047), right M^2 (NMMNH-P8046); *Lagurus curtatus* left M^2 (NMMNH-P8045), left M^1 (NMMNH-P8057); 34 *Succinea* sp. (NMMNH-MK 119); 2 *Zonitoides arboreus* (NMMNH-MK 120); 2 *Vallonia cyclophorella* (NMMNH-MK 121).

Level 14: *Microtus* cf. *M. montanus* left M_1 (NMMNH-P8048); 48 *Succinea* (NMMNH-MK 122); 1 *Zonitoides arboreus* (NMMNH-MK 123); 24 *Pupoides hordaceus* (NMMNH-MK 124); 1 *Gastrocopta pilsbryana* (NMMNH-MK 126); 18 *Vallonia cyclophorella* (NMMNH-MK 125).

Level 15: *Microtus* sp. right M_2 (NMMNH-P8049); *Microtus* cf. *M. montanus* right M^1 (NMMNH-P8050); *Lagurus curtatus* left M^1 (NMMNH-P8051); 37 *Succinea* sp. (NMMNH-MK 127); 2 *Zonitoides arboreus* (NMMNH-MK 129); 5 *Pupoides hordaceus* (NMMNH-MK 128); 14 *Vallonia cyclophorella* (NMMNH-MK 130).

Level 16: *Microtus* sp. right M^2 (NMMNH-P8054), right M_2 (NMMNH-P8054); 42 *Succinea* sp. (NMMNH-MK 131); 2 *Pupilla muscorum* (NMMNH-MK 135); 23 *Pupoides hordaceus* (NMMNH-MK 132); 25 *Vallonia cyclophorella* (NMMNH-MK 133); 2 *Vallonia gracilicosta* (NMMNH-MK 134).

Level 17: 31 *Succinea* sp. (NMMNH-MK 136); 1 *Zonitoides arboreus* (NMMNH-MK 139); 26 *Pupilla muscorum* (NMMNH-MK 140); 31 *Pupoides hordaceus* (NMMNH-MK 137); 32 *Vallonia cyclophorella* (NMMNH-MK 138); 4 *Vallonia gracilicosta* (NMMNH-MK 137).

Level 18: *Microtus* cf. *M. montanus* right M^1 (NMMNH-P8055); *Lagurus curtatus* left M_1 (NMMNH-P8056); 36 *Succinea* sp. (NMMNH-MK 141); 2 *Zonitoides arboreus* (NMMNH-MK 142); 12 *Pupilla muscorum* (NMMNH-MK 143); 1 *Pupilla blandi* (NMMNH-MK 144); 31 *Popoides hordaceus* (NMMNH-MK 145); 66 *Vallonia cyclophorella* (NMMNH-MK 146); 4 *Vallonia gracilicosta* (NMMNH-MK 147).

Level 19: *Microtus* sp. right M^2 (NMMNH-P8059); *Microtus montanus* right and left dentaries with all molars present; 77 *Succinea* sp. (NMMNH-MK 148); 2 *Zonitoides arboreus* (NMMNH-MK 149); 104 *Pupilla muscorum* (NMMNH-MK 153); 6 *Pupilla blandi* (NMMNH-MK 154); 156 *Pupoides hordaceus* (NMMNH-MK 149); 369 *Vallonia cyclophorella* (NMMNH-MK 151); 2 *Vallonia gracilicosta* (NMMNH-MK 152).

Level 20: *Microtus* sp. right M^1 (NMMNH-P8062), right M^2 (NMMNH-P8063); *Lagurus curtatus* left M_1 (NMMNH-P8062); 89 *Succinea* sp. (NMMNH-MK 155); 1 *Zonitoides arboreus* (NMMNH-MK 157); 178 *Pupoides hordaceus* (NMMNH-MK 156); 129 *Pupilla muscorum* (NMMNH-MK 160); 5 *Pupilla blandi* (NMMNH-MK 161); 386 *Vallonia cyclophorella* (NMMNH-MK 158); 1 *Vallonia gracilicosta* (NMMNH-MK 159).

Level 21: *Microtus* sp. left M^1 (NMMNH-P8067), left M^1 (NMMNH-P8072), right M_2 (NMMNH-P8070); *Microtus* cf. *M. montanus* upper jaw with right M^2 (NMMNH-P8064), right M^1 (NMMNH-P8065), right M^1 (NMMNH-P8071), right M^3 (NMMNH-P8066), left M_1 (NMMNH-P8068), right M_2 (NMMNH-P8070); 154 *Succinea* sp. (NMMNH-MK 162); 1 *Zonitoides arboreus* (NMMNH-MK 163); 157 *Pupilla muscorum* (NMMNH-MK 166); 3 *Pupilla blandi* (NMMNH-MK 167); 198 *Pupoides hordaceus* (NMMNH-MK 164); 655 *Vallonia cyclophorella* (NMMNH-MK 165).

Level 22: 99 *Succinea* sp. (NMMNH-MK 168); 100 *Pupilla muscorum* (NMMNH-MK 172); 74 *Pupoides hordaceus* (NMMNH-MK 169); 377 *Vallonia cyclophorella* (NMMNH-MK 170); 1 *Vallonia gracilicosta* (NMMNH-MK 171).

Level 23: *Microtus montanus* right lower jaw with all molars present (NMMNH-P8074); *Lagurus curtatus* left M_1 (NMMNH-P8073); 139 *Succinea* sp. (NMMNH-MK 173); 2 *Zonitoides arboreus* (NMMNH-MK 174); 86 *Pupilla muscorum* (NMMNH-MK 176); 155 *Pupoides hordaceus* (NMMNH-MK 175); 420 *Vallonia cyclophorella* (NMMNH-MK 177); 2 *Vallonia gracilicosta* (NMMNH-MK 178).

RESULTS

Microtine rodent teeth are represented through almost all levels, but in generally low numbers (Fig. 3). The exceptions are level 21, which has 9 *Microtus* teeth and level 9, which has 16 *Lagurus* teeth. Based on the minimum number of individuals per level, there is a general trend for *Microtus* to dominate the lower and *Lagurus* to dominate the upper levels (Fig. 3). Snails are also much more abundant in the lower levels, often numbering greater than 500 individuals per level, compared to less than 100 individuals per level in the more recent sediments. A greater number of species occurs in the older sediments. Some species remain relatively constant throughout. For example, although *Zonitoides arboreus* is rare, it is present throughout the sediments. Others, like *Vallonia gracilicosta*, are rare, but less so in older sediments. *Pupilla blandi* makes a brief showing between levels 18–22 (Fig. 4). The montane snail *Gastrocopta pilsbryana* occurs only in level 14. The remaining species of snails follow the general trend of being more abundant in older than in more recent sediments. *Vallonia cyclophorella* is the most common snail in the deposits, but drops to less than 30 individuals per level above level 17 (Fig. 4). Similarly, *Pupilla muscorum* drops to less than 30 individuals per level above level 19 (Fig. 4). This same pattern holds true for *Pupoides hordaceus*, which is the second-most abundant snail in the fauna (Fig. 4). *Succinea* sp. shows a general drop in numbers above level 19, but shows greater abundance at upper levels than the other species (Fig. 4). In terms of relative abundance, *Succinea* sp. is the most abundant species between levels 1 and 16, with the exception of level 6, where it occurs in about equal numbers with *Vallonia cyclophorella* and *Pupoides hordaceus* (Table 1). Level 17 shows the most even distribution of the four dominant species. Then in levels 18–23, *Vallonia cyclophorella* increases dramatically, averaging more than 50% (Table 1). From levels 16–23, the relative abundance of *Pupoides hordaceus* tends to stabilize and averages 21% (Table 1).

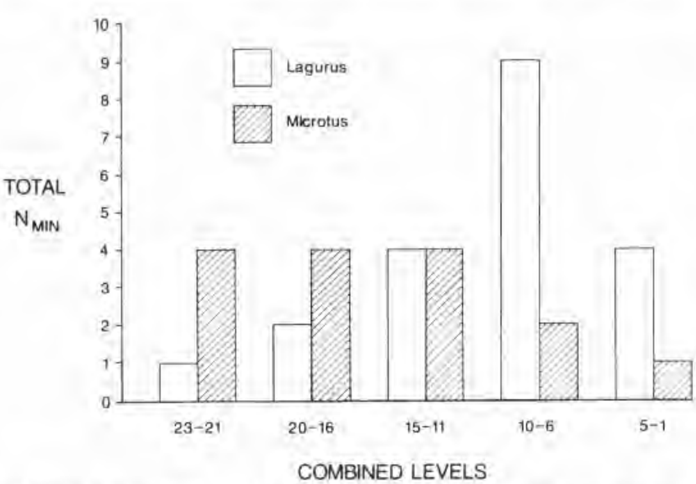

FIGURE 3. Minimum number of individuals of *Microtus* and *Lagurus* for combined levels. Minimum number is based on left and right molar frequencies.

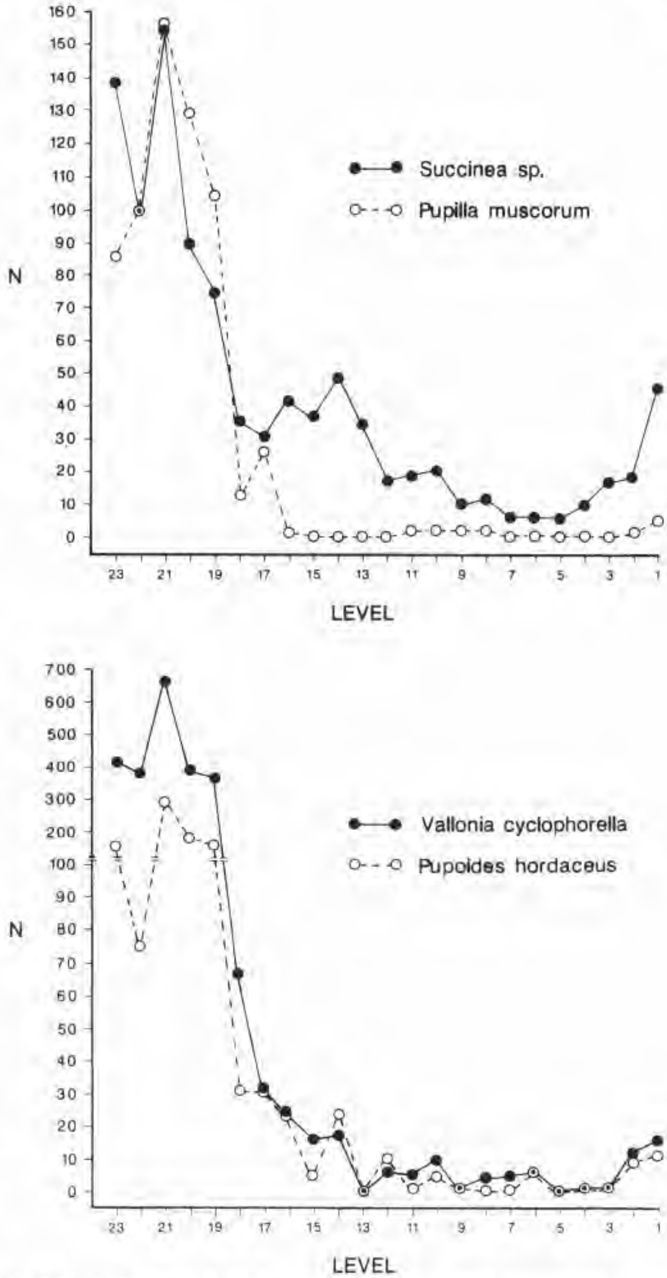

FIGURE 4. Distribution and abundances of the four most common snails through the 23 levels of excavation.

DISCUSSION

All snail species recovered from the cave are living in New Mexico today, although generally in higher or wetter environments. *Microtus* is also common in the mountainous areas of the state. So far, the only extralimital species for New Mexico from the cave deposits is the

TABLE 1. Total numbers and relative abundances of individuals of each species per excavation level.

Level	Number	Gastrocopta pilsbryana		Pupilla blandi		Pupilla muscorum		Pupoides hordaceus		Succinea sp.		Vallonia cyclophorella		Vallonia gracilicosta		Zonitoides arboreus	
	N	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1	79	-	-	-	-	5	.06	11	.14	46	.58	16	.20	-	-	1	.01
2	41	-	-	-	-	2	.05	9	.22	18	.44	12	.29	-	-	-	-
3	20	-	-	-	-	-	-	2	.10	17	.85	-	-	-	-	1	.05
4	12	-	-	-	-	1	.08	1	.08	9	.75	1	.08	-	-	-	-
5	6	-	-	-	-	-	-	1	.17	5	.83	-	-	-	-	-	-
6	19	-	-	-	-	-	-	7	.37	6	.32	6	.32	-	-	-	-
7	12	-	-	-	-	-	-	1	.08	7	.58	3	.25	1	.08	-	-
8	17	-	-	-	-	2	.12	-	-	12	.70	3	.18	-	-	-	-
9	14	-	-	-	-	2	.14	2	.14	10	.71	-	-	-	-	-	-
10	36	-	-	-	-	2	.06	4	.11	20	.56	10	.28	-	-	-	-
11	28	-	-	-	-	2	.07	1	.04	18	.64	6	.21	-	-	1	.04
12	36	-	-	-	-	-	-	9	.25	17	.47	7	.19	-	-	3	.08
13	38	-	-	-	-	-	-	-	-	34	.90	2	.05	-	-	2	.05
14	92	1	.01	-	-	-	-	24	.26	48	.52	18	.20	-	-	1	.01
15	58	-	-	-	-	-	-	5	.09	37	.64	14	.24	-	-	2	.03
16	94	-	-	-	-	2	.02	23	.25	42	.45	25	.27	2	.02	-	-
17	125	-	-	-	-	26	.21	31	.25	31	.25	32	.26	4	.03	1	.01
18	152	-	-	1	<.01	12	.08	31	.20	36	.24	66	.43	4	.03	2	.01
19	716	-	-	6	<.01	104	.15	156	.22	77	.11	369	.52	2	<.01	2	<.01
20	789	-	-	5	<.01	129	.16	178	.23	89	.11	386	.49	1	<.01	1	<.01
21	1268	-	-	3	<.01	157	.12	298	.24	154	.12	655	.52	-	-	1	<.01
22	651	-	-	-	-	100	.15	74	.11	99	.15	377	.58	1	<.01	-	-
23	804	-	-	-	-	86	.11	155	.19	139	.17	420	.52	2	<.01	2	<.01
Total		1		15		632		1023		971		2428		17		20	

sagebrush vole (*Lagurus curtatus*). This vole is a common inhabitant of sagebrush-grassland regions north of New Mexico; its closest occurrence is in southwestern Utah, about 500 km to the northwest.

None of the snails or microtine rodents recovered from Whut Cave appears to be living in the general area of the Pronoun Cave complex. It seems likely, though, that some *Succinea* should live there and may be present. *Microtus* sp., in particular *Microtus montanus*, currently is living within 160 km of Mesa del Oro in the mountains to the north. It inhabits meadows in montane forests (Findley et al., 1976). With the exception of *Succinea*, all the fossil snails are indicators of montane woodlands or generally mesic grasslands in New Mexico. *Zonitoides arboreus* is almost always associated with trees of upland regions (Metcalf, 1967). *Pupilla blandi* and *Pupilla muscorum* are also species of pine-fir and aspen woodlands in New Mexico. *Pupilla muscorum* also occupied grasslands of the Great Plains and southeastern New Mexico during Pleistocene time (Leonard and Frye, 1975). Ashbaugh and Metcalf (1986) suggest it was probably associated with marshes and springs at low elevations in southern New Mexico during the Pleistocene. The two species of *Vallonia* are more tolerant of drier grasslands and forest in New Mexico today. *Vallonia cyclophorella* is commonly found in pine-oak woodlands, but can be found to about 3636 m (Metcalf, 1967). *Vallonia gracilicosta* is more common in the eastern part of the state and tends to tolerate somewhat drier conditions than *Vallonia cyclophorella*. *Gastrocopta pilsbryana* is typical of pine-oak woodlands up to spruce-fir zones. Excluding *Succinea* sp., the most drought-tolerant species of the fauna is *Pupoides hordaceus*. It occurs in New Mexico almost exclusively in the piñon-juniper zone.

Both the microtine and snail fauna suggest the same basic pattern of a cool mesic environment with many boreal faunal and floral elements from level 23 through level 19; then a shift to cool, drier conditions through the higher levels. The cooler, drier conditions were probably much the same as found today in cold desert grasslands of the Great Basin where *Lagurus curtatus* presently exists. The occurrence of pine-oak woodlands on north exposures and drainages could account for persistence of woodland snails throughout the time period represented by the sediments.

Interpretation of the paleo-fauna of the upper levels of Whut Cave material is consistent with that of other western New Mexico Pleistocene faunas, such as the Isleta caves site. Unfortunately, dates currently are lacking for the northwestern sites, including this site, making detailed comparisons somewhat difficult. It seems likely that the same climatic conditions are responsible for extending the range of Great Basin faunas into northwestern New Mexico. The key climatic shift seems to involve temperature and seasonal distribution of precipitation, rather than significantly greater precipitation (Harris, 1987). A pattern of cooler temperatures and more evenly distributed moisture could drive the range of *Lagurus curtatus* into New Mexico. The shift in this weather pattern apparently was extensive enough at times during the Wisconsinan to produce some Great-Basin-like conditions as far southeast as Dry Cave (Eddy Co., New Mexico) (Harris, 1970) and southwest to the New Mexico bootheel (U Bar Cave; Hidalgo Co., New Mexico) (Harris, 1987). Further excavations of caves of the Pronoun Cave complex and attainment of chronological control by radiocarbon dates should help considerably in placing this site in the overall pattern of Pleistocene events in New Mexico.

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Cliff at Thoreau looking N/NE. Upper Petrified Forest and Owl Rock members of Chinle Formation (Upper Triassic) at base overlain by cliff of Jurassic Entrada Sandstone capped by limestone of Jurassic Todilto Formation. In the 1967 *New Mexico Geological Society Guidebook* (p. 133 and 162), strata here were mistakenly termed Wingate. Photograph taken 28 December 1988 by Paul L. Sealey.