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Paper Abstract Title:
A Paleoindian Sense of Place: Snapshots of the Early Holocene Environment of West-Central New Mexico

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The Water Canyon Paleoindian site near Socorro, New Mexico is directly associated with an extensive buried wet meadow deposit. While extant across the Pleistocene – Holocene transition and into the middle Holocene, this landscape-scale deposit arguably represented a persistent, regional wetland resource, not only for plants and animals, but Paleoindian groups as well. Today it represents an important proxy data archive for environmental, climatic and archaeological reconstruction. Our recent research efforts at the site have focused largely on the period from 8300 to 9600 radiocarbon years ago, and have generated dated pollen profiles, stable carbon isotope data sets, charcoal species identifications and both faunal and macrobotanical remains. These findings provide us with provocative glimpses into the environment, climate, bison ecology, and human diet during Late Paleoindian times.

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Plains Conference, Dello-Russo and Smith
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Title: **A Paleoindian Sense of Place: Snapshots of the Early Holocene Environment of West-Central New Mexico**

Abstract
The Water Canyon Paleoindian site near Socorro, New Mexico is directly associated with an extensive buried wet meadow deposit. While extant across the Pleistocene – Holocene transition and into the middle Holocene, this landscape-scale deposit arguably represented a persistent, regional wetland resource, not only for plants and animals, but Paleoindian groups as well. Today it represents an important proxy data archive for environmental, climatic and archaeological reconstruction. Our recent research efforts at the site have focused largely on the period from 8300 to 9600 radiocarbon years ago, and have generated dated pollen profiles, stable carbon isotope data sets, charcoal species identifications and both faunal and macrobotanical remains. These findings provide us with provocative glimpses into the environment, climate, bison ecology, and human diet during Late Paleoindian times.

Introduction
The finely dated Water Canyon pollen record provides a high resolution window into a small slice of the Early Holocene from 10,800-9300 and from a unique terrestrial perspective. The database consists of 28 pollen samples from three cores and three excavation units and the results are interpreted primarily as a record of local on site vegetation.

Core 10-6
The best preserved and longest core is 10-6 encompassing almost 2000 years, with a resolution of approximately 150 years between samples. The record includes three odd microfossils that are not spores or pollen, and only one is semi-identified—Microfossil 1 Concentricystes/ Pseudoschizaea. Microfossil 1 has been described from around the world in deposits as old as the Paleozoic and as young as recent, yet no living link has been found. It may represent a resting structure, cyst, or egg of any of a wide variety of invertebrate, insect, or other organisms (Scott 1992) or possibly an algal fossil.

Concentricystes/ Pseudoschizaea occurs in habitats composed of generally warm, wet terrestrial environments with strong seasonal fluctuations, such as marshes and swamps. The form has been identified in Arizona in prehistoric canals in the Phoenix Basin and a desert playa near Yuma, Arizona. Despite the lack of a positive identification, the insights into environments suggest that at Water Canyon, Microfossil 1 represents a strong seasonal signature that we infer to reflect hot summers, perhaps even hotter than today, and ephemeral saturated soils or standing water, which could reflect summer monsoons. While highly speculative, the other two microfossils may represent similar environments, as these co-occur with Microfossil 1, and then replace it suggesting gradational hydrological changes that favor one taxon over another.

Birch pollen is also emphasized as a sensitive indicator, even though the representation is too low for an on-site tree. Birch occurs as single pollen grains in black mat samples between 10,800 and 9300 cal yr B.P. and its presence suggests isolated trees growing nearby in wet and shady canyons or around springs, similar to modern Southwest birch habitats. No modern birch

specimens are listed in herbarium databases for Socorro County and the nearest record is to the north in Sandoval County A similar history of birch is seen in early Holocene pollen records from southern Arizona, while modern trees grow only at restricted mesic sites in northern Arizona (Martin 1963:55). These traces of birch indicate colder and wetter climates during the early Holocene, but after 9300 cal yr B.P. some environmental threshold was reached and birch retreated north.

Another distinctive taxon is ragweed type 2 that is interpreted to represent marshelder, scientific name *Iva*, a wet meadow species. In Core 10-6, a marshelder peak around 9800 cal yr B.P. suggests earlier marshy areas were succeeded by wet meadow borders along the two drainages cutting through the site as the site became drier.

Composite Record

Select pollen types evaluated as sensitive indicators of environmental change are combined from all contexts and graphed only by sample age and for the period with the greatest sample depth, ca. 11,000 to 5000 cal yr B.P. The statistical cluster analysis program CONISS (Grimm 1987) was used on a set of 9 taxa to zone the composite spectra. One transitional boundary at 9300 cal yr B.P., the top of the black mat,
divides the pollen spectra into two zones.

Zone 1 from 10,800 to 9300 cal yr B.P. registers a greater diversity of plant taxa, which implies a patchier landscape interpreted to reflect greater seasonality in precipitation and temperature. The assemblage indicates the early Holocene was a unique environment for which there is no modern analog.

This view is emphasized by interpretation of two subzones and in the oldest subzone, by the contrasting juxtaposition of the cold and wet birch indicator with the speculative interpretation of hot, wet summers based on the unknown microfossils.

During Zone 1 the small bowl of the site apparently sheltered woody shrubs from what were likely strong windy storms sweeping the plains to the east. Possible seasonal shallow pools and marshy areas along the site drainages created additional micro-environmental niches. Vegetation may have provided a natural blind for hunters to capture bison that might also have sheltered in the bowl, although the site straddles natural drainages flowing into the Socorro Mountains that were probably traveled by both hunters and animals.

A less diverse ecosystem with wet meadows along the drainage may have evolved at the site by 9300 cal yr B.P. as climate warmed.

Zone 2 is defined after 9300 cal yr B.P. The period is coarsely resolved by only 8 samples spanning 4300 years and likely contains greater variability than shown by the pollen samples. The zone is defined by the dramatic decrease in the diversity of pollen taxa and an increase in Cheno-am.

Zone 2 is interpreted to represent warmer and drier conditions similar to the modern desert grassland. The Cheno-am rise is a regional signature, although it is poorly dated. In southern Arizona, Cheno-am pollen increases after ca. 8000 cal yr B.P. (Martin 1963:58), and in the nearby San Agustin paleo lake record (Markgraf 1984), the rise occurs sometime after ca. 9800

cal yr B.P. Pollen analyzed from packrat middens in the Peloncillo Mountains in southwestern New Mexico (Holmgren 2006) show Cheno-am pollen increases sometime between 12,000 and 6000 cal yr B.P., which ,based on midden macrofossils, is probably saltbush (*Atriplex*).

Early Holocene Environments at Water Canyon: Comparison to Other Regional Records

The Water Canyon site has preserved an important record because of the detailed early Holocene resolution. The pollen and microfossil spectra suggest strong seasonality with perhaps hot, wet summers and cold winters. This interpretation is consistent with models of orbitally-induced changes in solar radiation, which retrodict early Holocene summer solar insolation values at 40° N latitude were 6-8% times greater than modern, and winter insolation was 8-10% lower (Berger and Loutre 1991; Kutzbach and Guetter 1986).

The Water Canyon view of wet summers corresponds to recent research from several packrat midden sites in the northern Chihuahuan Desert (Holmgren et al. 2007) that show an extensive Late Pleistocene desert grassland of C_4 herbs and grasses existed from central Texas to Arizona mostly south of 35° N latitude. The C_4 plants respond to summer rains and their dominance in fossil middens indicates the Southwest summer monsoon remained intact throughout the late Pleistocene and early Holocene. During the glacial period, this ecosystem was the northernmost grasslands in western North America to green-up in summer, which might explain the concentration of megafauna and Paleo Indian sites in the region (Holmgren 2007). At Water Canyon, the early Holocene record of bison and Paleo Indian artifacts may be a last glimpse of this grassland near its northern extent. The Water Canyon pollen data suggest the landscape was not homogenous, but fragmented into resource-rich mosaics.

Paleoecological records from lakes and bogs throughout the Southwest show the Early Holocene was a period of significant climatic variability. Between 12,000 and 10,000 cal yr B.P., in northern New Mexico and Colorado, treelines migrated upslope replacing subalpine meadows with mixed conifer forests (Carrara et al. 1991; Jiménez-Moreno et al. 2008), fire frequency increased in northern New Mexico forests (Anderson et al. 2008), and ponderosa pine, the signature monsoon conifer, expanded onto the Colorado Plateau (Anderson et al. 2000; Betancourt 1990).

Other regional indicators for strong summer monsoons during the Early Holocene include a distinct interval between approximately 11,000 and 9300 cal yr B.P. when shallow lakes filled regional playa basins. At Water Canyon this interval corresponds to deposition of the black mat.

The interpretation of cold winters in the Water Canyon record is less visible in other regional studies, except for the packrat midden synthesis (Holmgren et al. 2007). The northern Chihuahuan Desert packrat series show that modern dominant shrubs like acacia (*Acacia constricta* and *A. greggii*) ocotillo (*Fouquieria*), tarwart (*Flourensia*), and creosote (*Larrea*) were late arrivals in the Southwest appearing somewhat abruptly during the Mid-Holocene. Holmgren et al. (2007) believe that cold winters persisted in the southern Southwest delaying migration of desert shrubs. At Water Canyon, the shift to warmer and drier conditions occurs after 9300 cal yr B.P.

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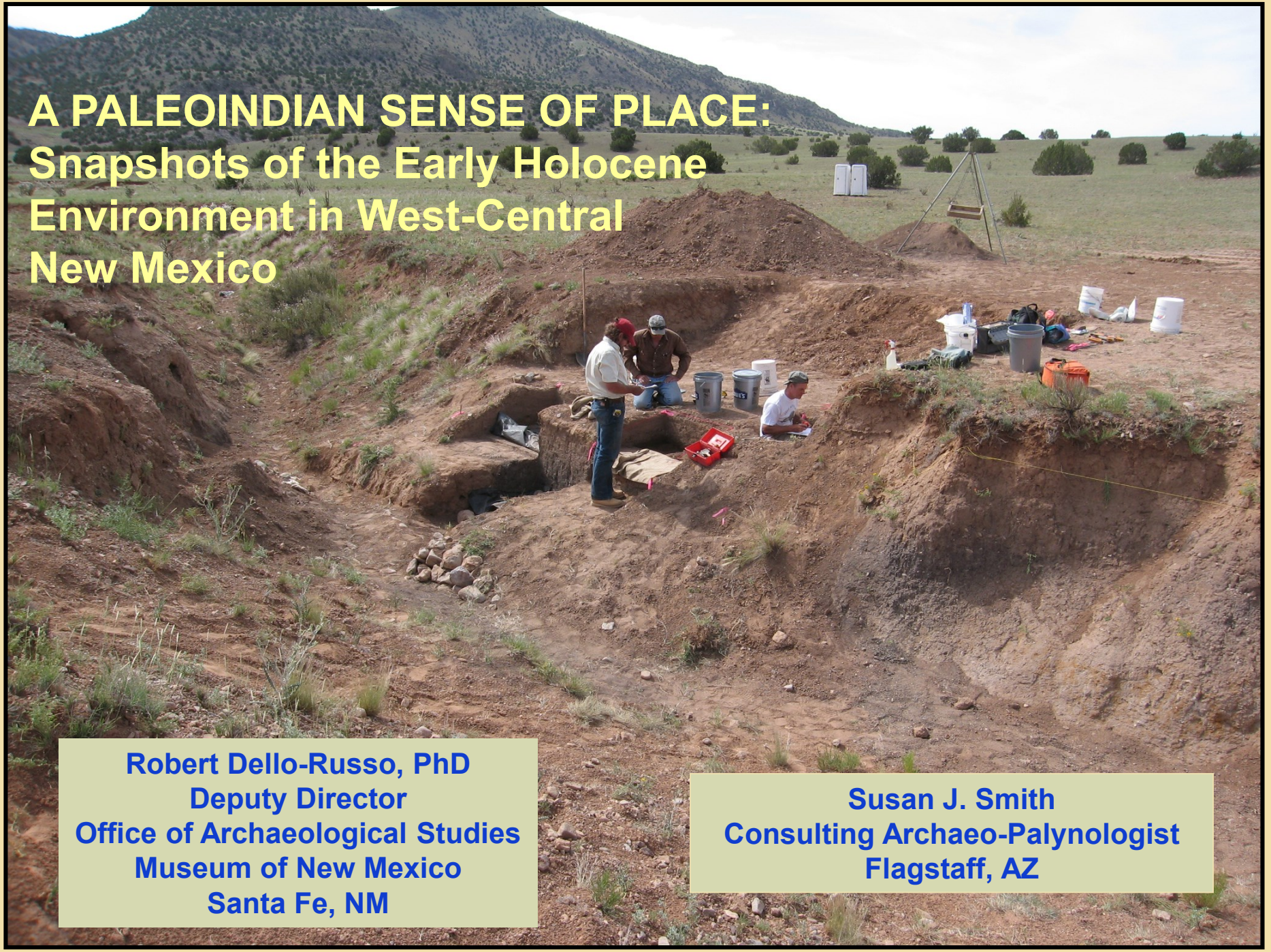

A PALEOINDIAN SENSE OF PLACE: Snapshots of the Early Holocene Environment in West-Central New Mexico

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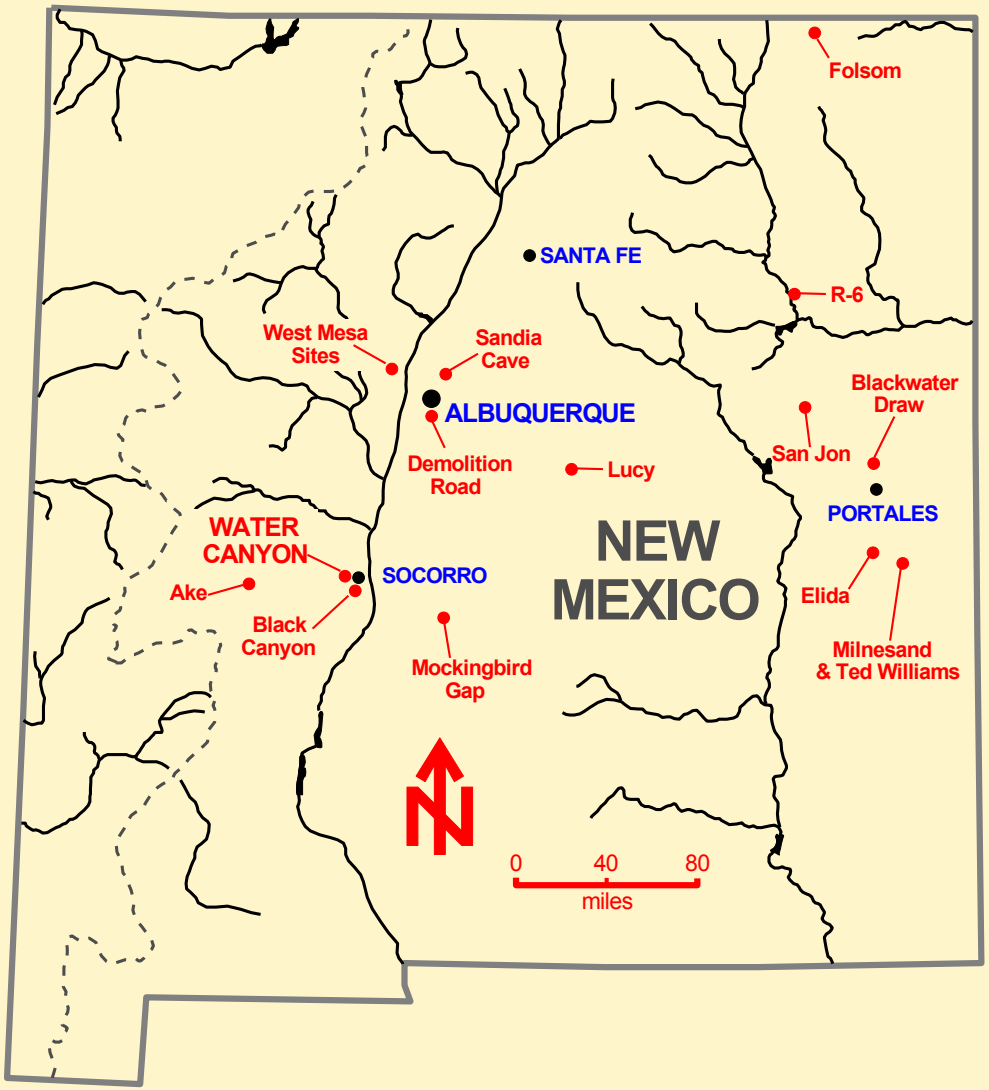
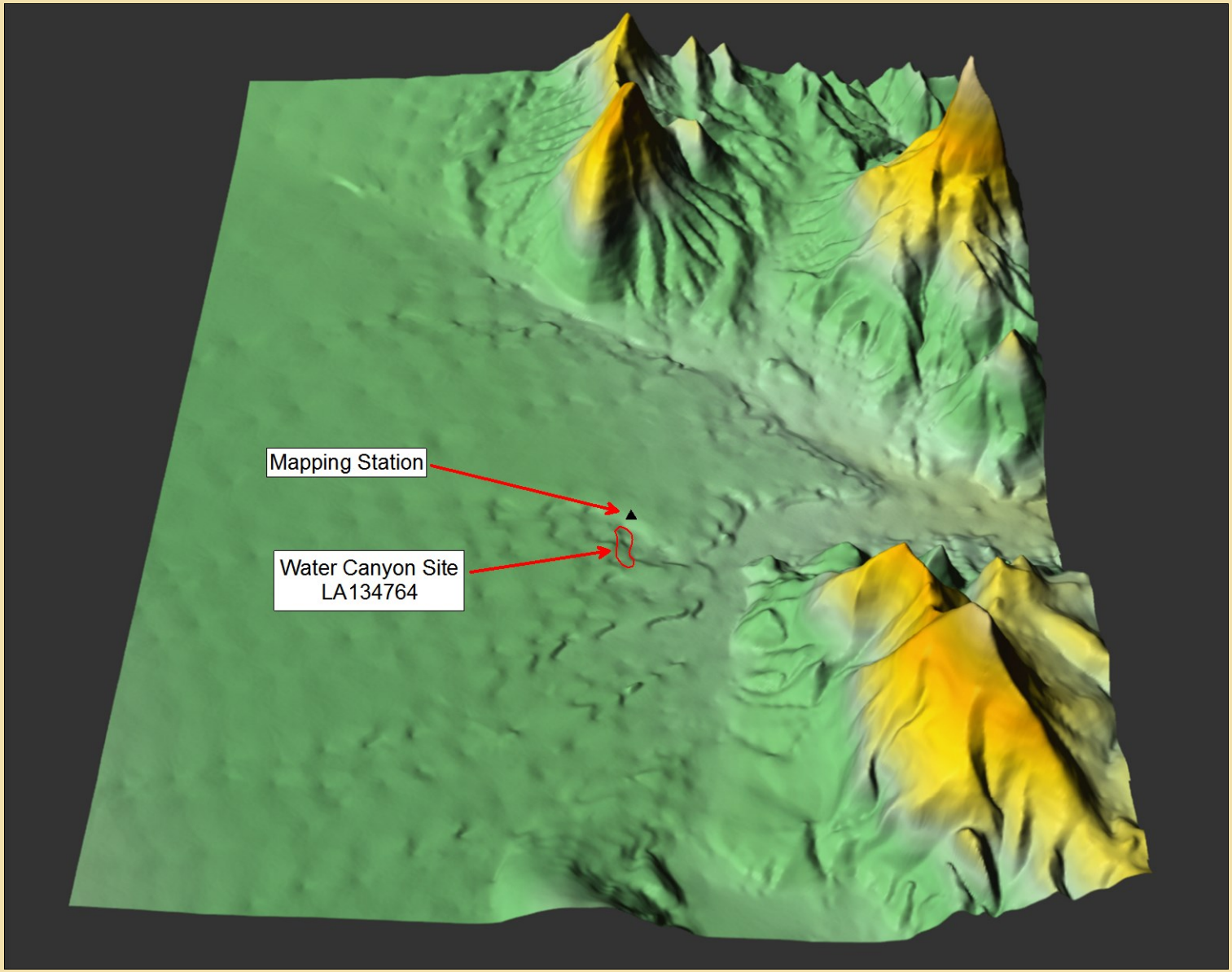
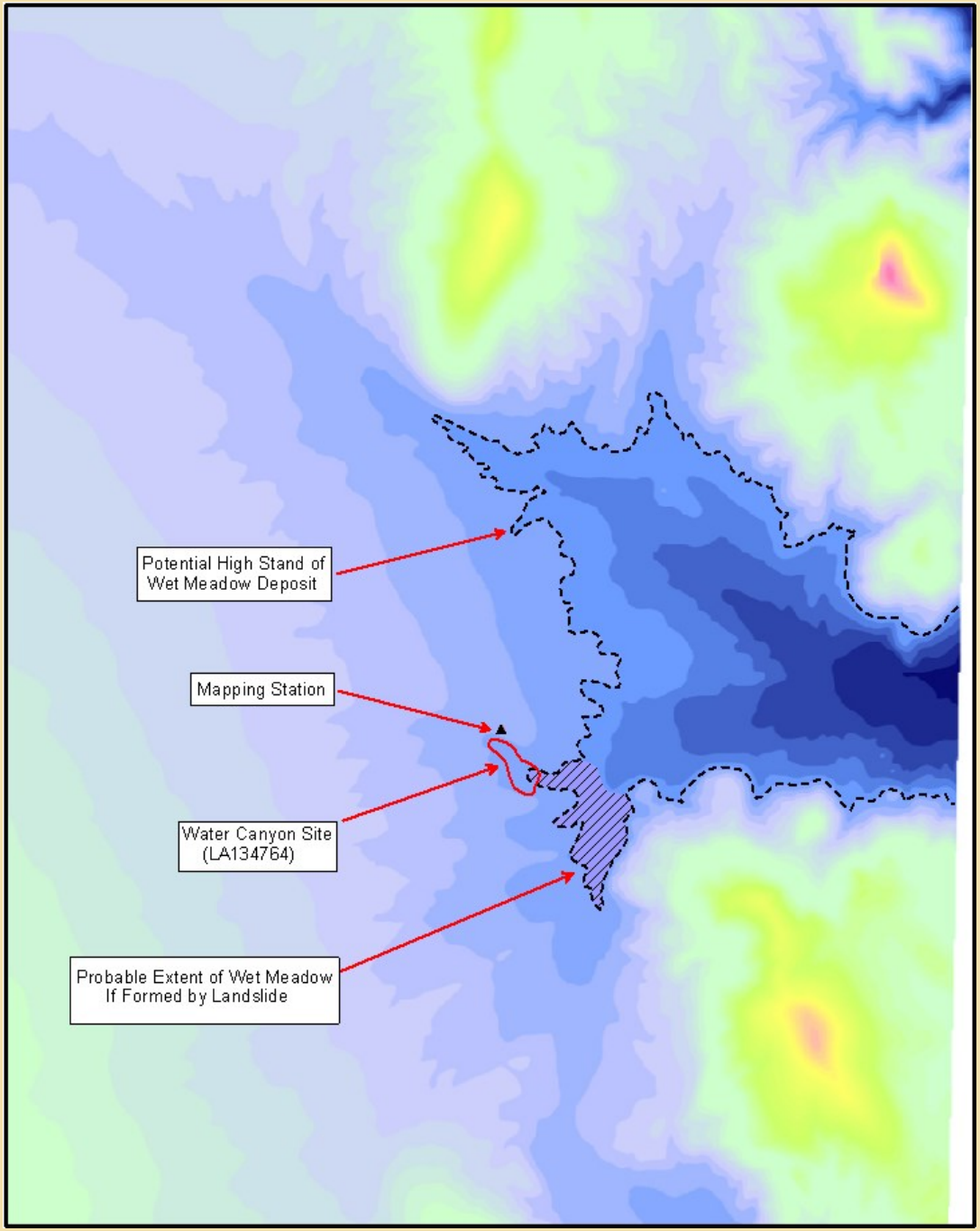


Some Excavated Paleoindian Sites in New Mexico



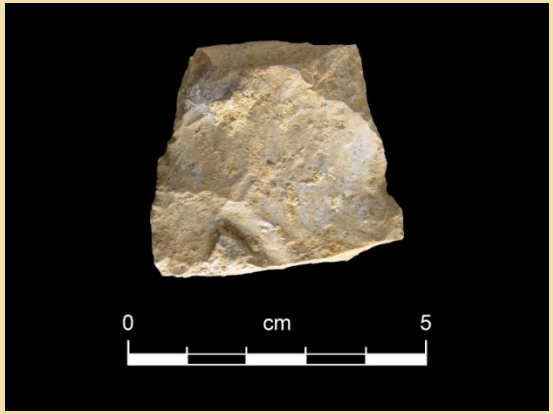
3-D Topography Surrounding Water Canyon Site


Potential High Stand of Wet Meadow Deposit
Mapping Station
Water Canyon Site (LA134764)
Probable Extent of Wet Meadow If Formed by Landslide

Wet Meadow Deposit in North Arroyo Wall / 2000

Bison Distal Femur in Wet Meadow Deposit

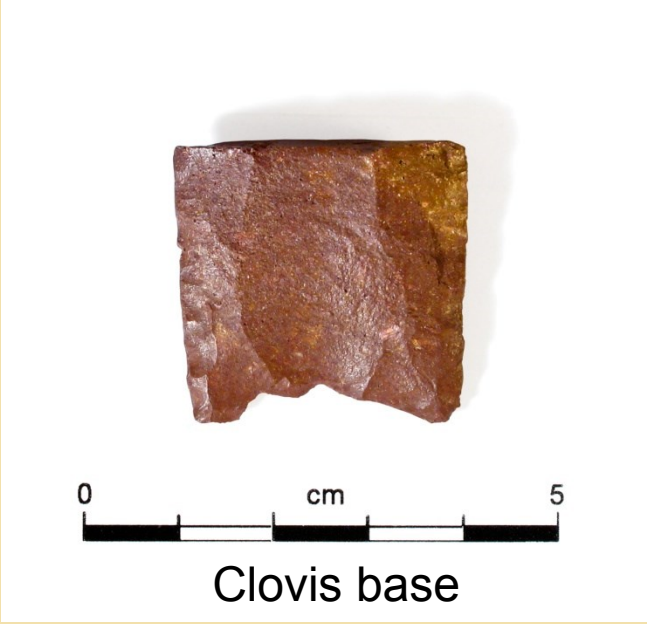
Bison occidentalis



Rhyolite Biface Fragment with Over-Shot Flake Scar

Scottsbluff base

Late Paleo mid-section?

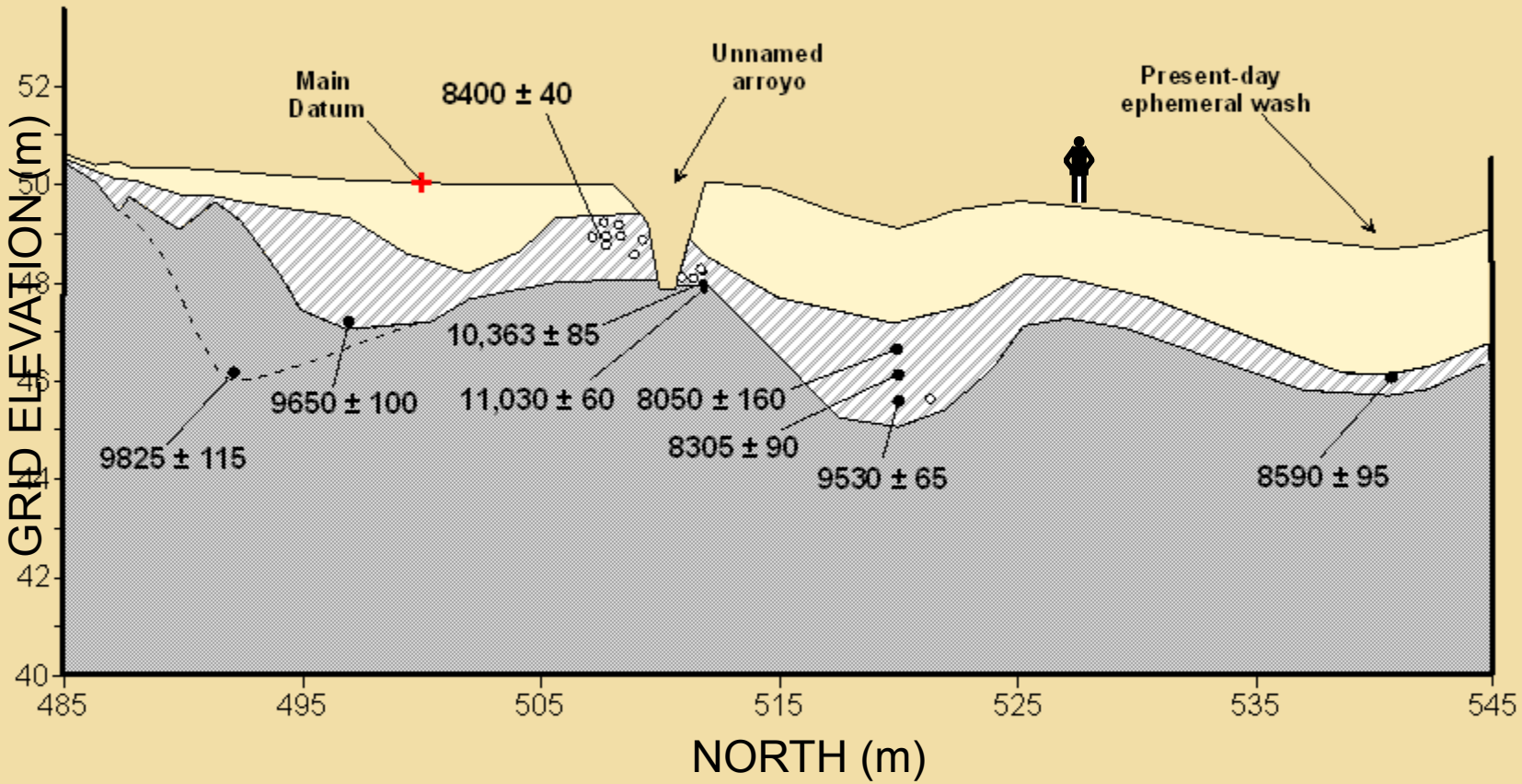


Clovis base

Diagnostic Artifacts from Water Canyon Site

Mechanical Soil Coring (2009 and 2010)

GENERALIZED NORTH-SOUTH SCHEMATIC REPRESENTATION of STRATIGRAPHIC PROFILE in LOCUS 1 / WATER CANYON SITE



Vertical scale of deposits exaggerated

Radiocarbon dates from the Water Canyon site – 2009 - 2011.

No.	Sample No.	Material Dated	Depth below ground surface (m)	Grid Elevation (m)	Date (RCYBP)	Date (Cal BP)	Period
1	A-15303	FS 26 (windmill pit sediment)	0.35-0.40	47.85-47.80	5600 ± 50	6385 ± 95	Early-Mid Archaic
2	A-15304	FS 27 (windmill pit sediment)	0.45-0.50	47.75-47.70	6500 ± 80	7490 ± 230	Early Archaic
3	Beta 281149	FS 46 (sediment)	1.27	48.056	7350 ± 50	8275 ± 30	Early Archaic / Late Paleo
4	A-15022	FS30 (sediment)	2.01	47.44	7820 ± 220	8700 ± 600	Early Archaic / Late Paleo
5	Beta 288067	FS 1059 charcoal	1.07	48.149	8280 ± 50	9280 ± 160	Late Paleo
6	Beta 292053	FS1037 (bone collagen)	---	48.31	8200 ± 40 (8400)	9155 ± 135 (9433)	Late Paleo
7	A-15341	Core 9-18	2.51-2.57	45.59-45.53	8590 ± 95	9660 ± 230	Cody Complex
8	A-15343	Core 9-11	2.85-2.90	45.73-45.68	8895 ± 65	9970 ± 230	Cody Complex
9	A-15021	FS29 (sediment)	1.79	47.66	9285 ± 85	10,460 ± 230	Cody Complex
10	A-15342	Core 9-11	2.93-2.98	45.65-45.60	9455 ± 110	10,775 ± 375	Cody Complex
11	A-15340	Core 9-15	2.47-2.53	46.61-46.55	9520 ± 135	10,825 ± 425	Late Paleo
12	AA-88078	FS24 (sediment)	n/a	47.43	9568 ± 62	10,925 ± 225	Late Paleo
13	A-15346	Core 9-15	2.53-2.61	46.55-46.47	9650 ± 100	10,975 ± 275	Late Paleo
14	AA-83855	FS31 (charcoal)	2.02-2.10	47.43-47.35	9750 ± 50	11,155 ± 85	Late Paleo
15	AA-88080	FS22 (sediment)	n/a	47.53	9763 ± 62	11,190 ± 120	Late Paleo
16	A-15345	Core 9-11	3.03-3.08	45.55-45.50	9805 ± 115	11,225 ± 500	Late Paleo
17	A-15344	Core 9-11	2.98-3.03	45.60-45.55	9825 ± 115	11,250 ± 500	Late Paleo
18	AA-88079	FS23 (sediment)	n/a	47.42	10,363 ± 85	12,300 ± 350	Folsom
19	AA-83854	FS32 (sediment)	2.16	47.29	11,030 ± 60	13,025 ± 175	Clovis

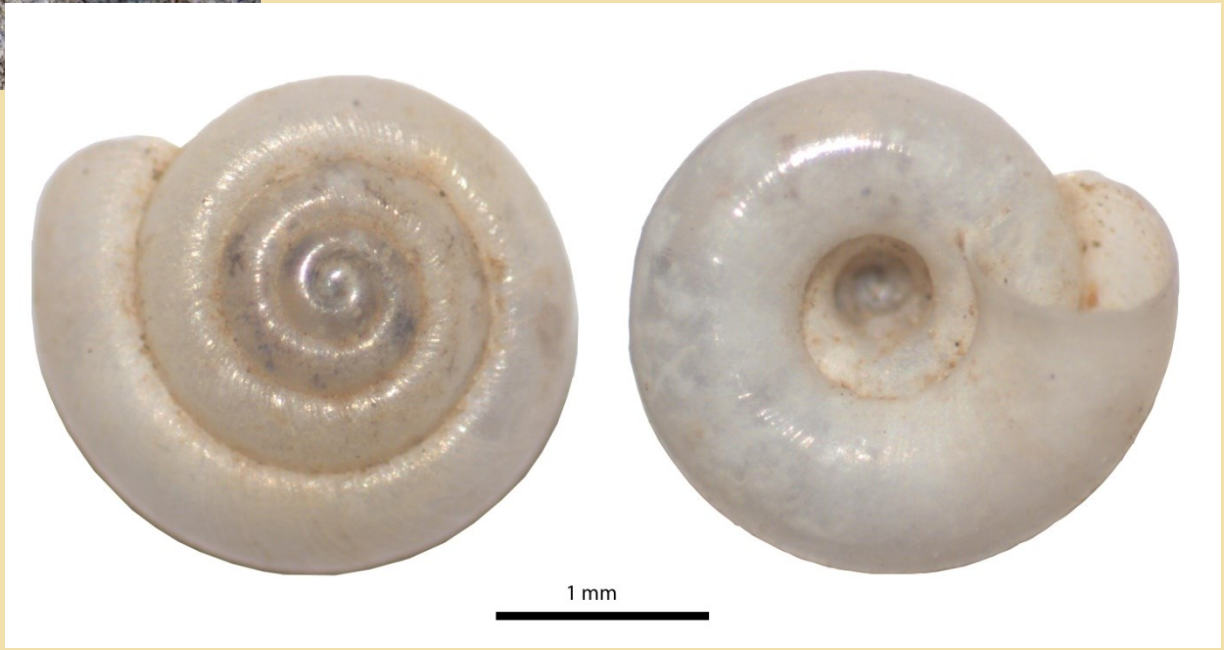
Juniper Savannah
1760 m, Water Canyon Site, NM

Fossil Snail Shells / Penny for Scale

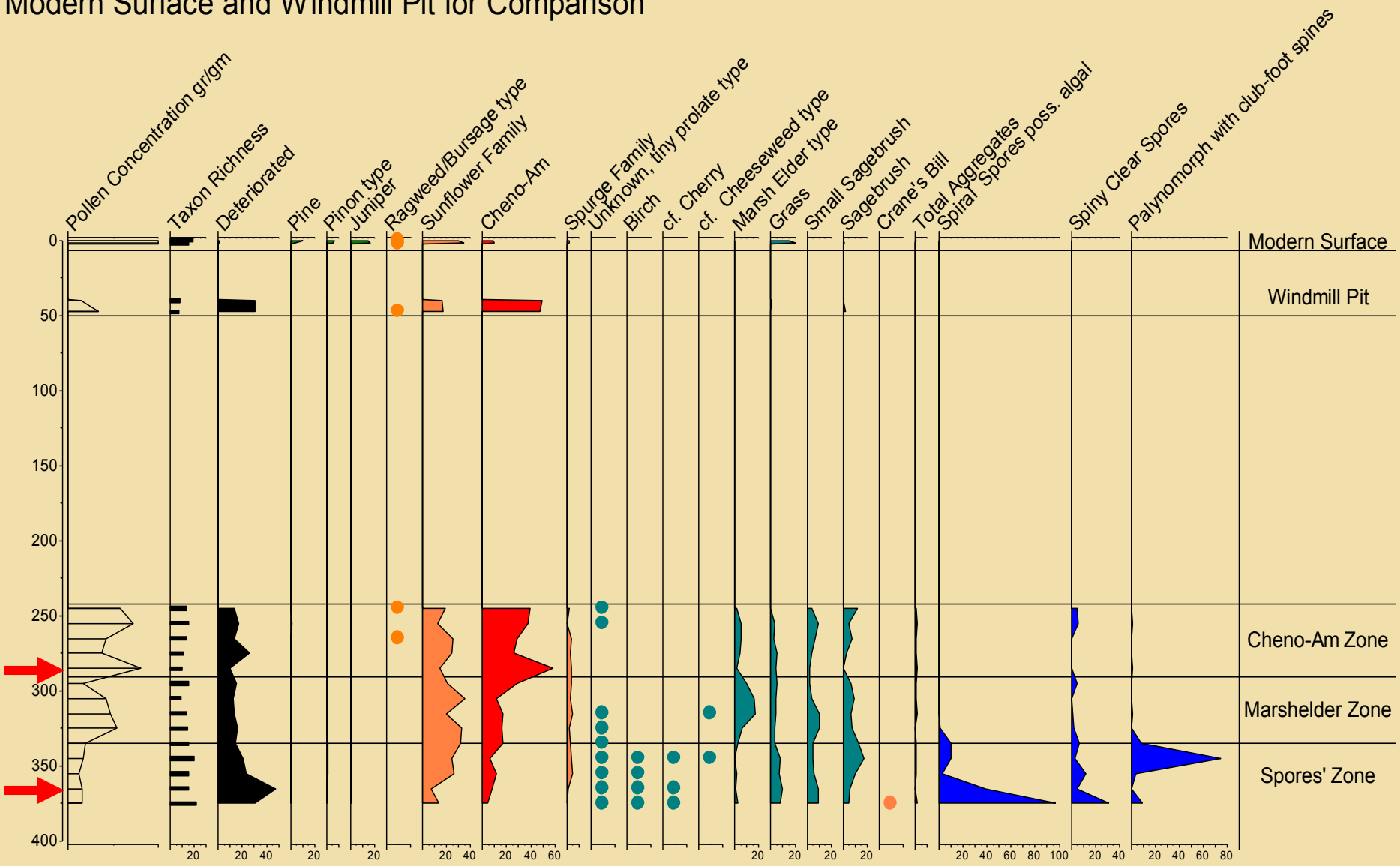
←

Hawaiia miniscula

→



Water Canyon Pollen Results from Core 10-6
Modern Surface and Windmill Pit for Comparison

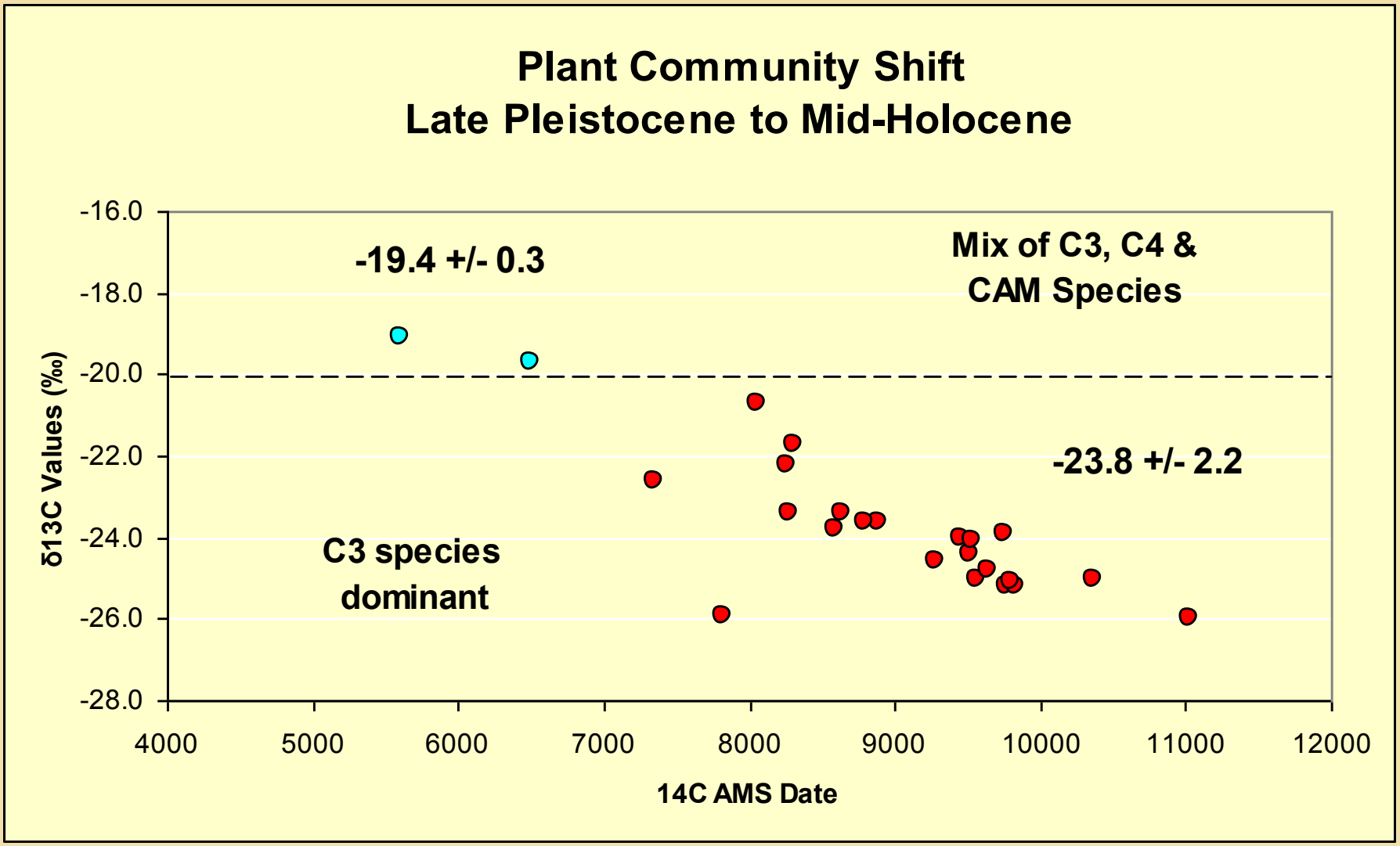


Wet Meadow

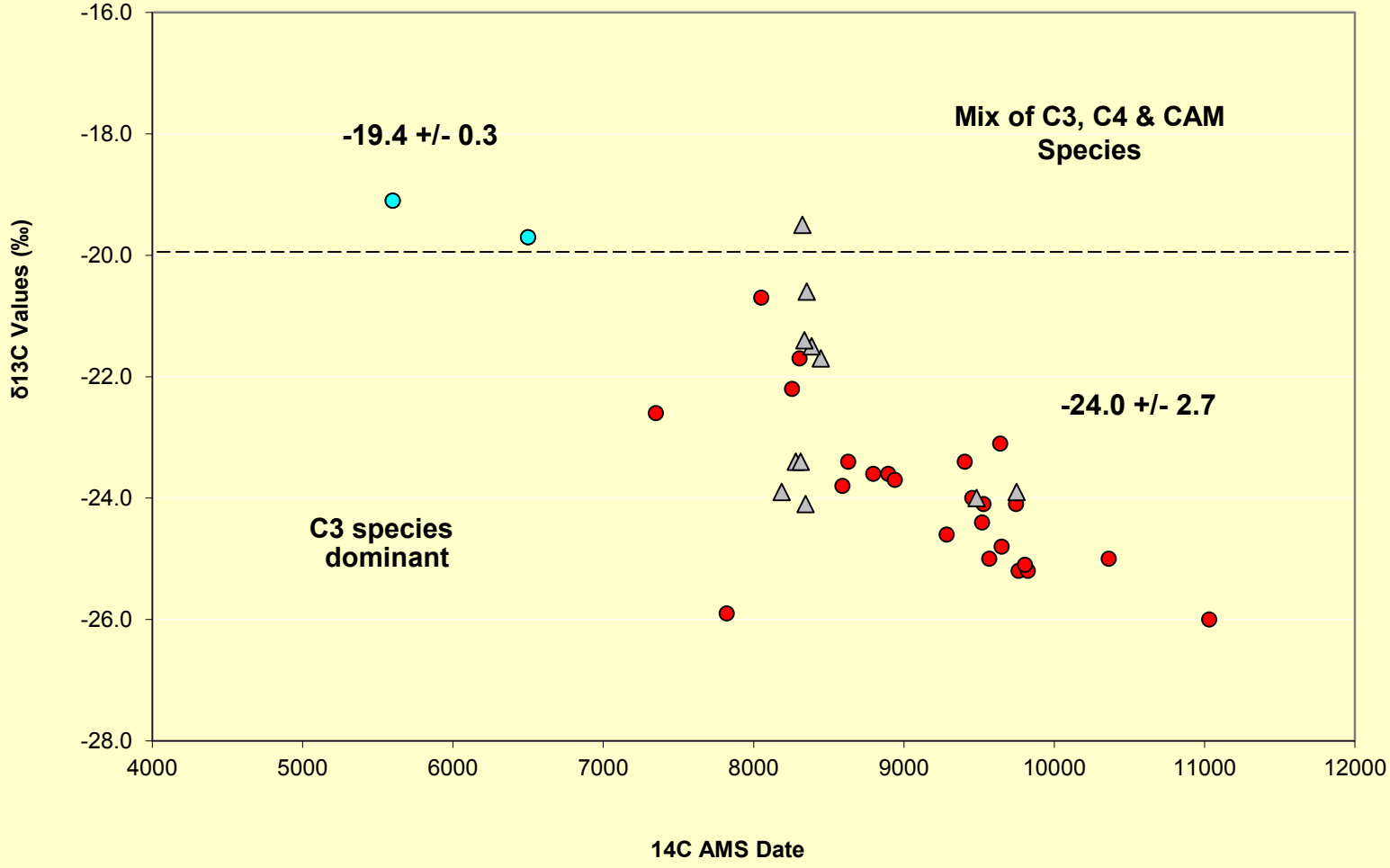
Sagebrush Steppe

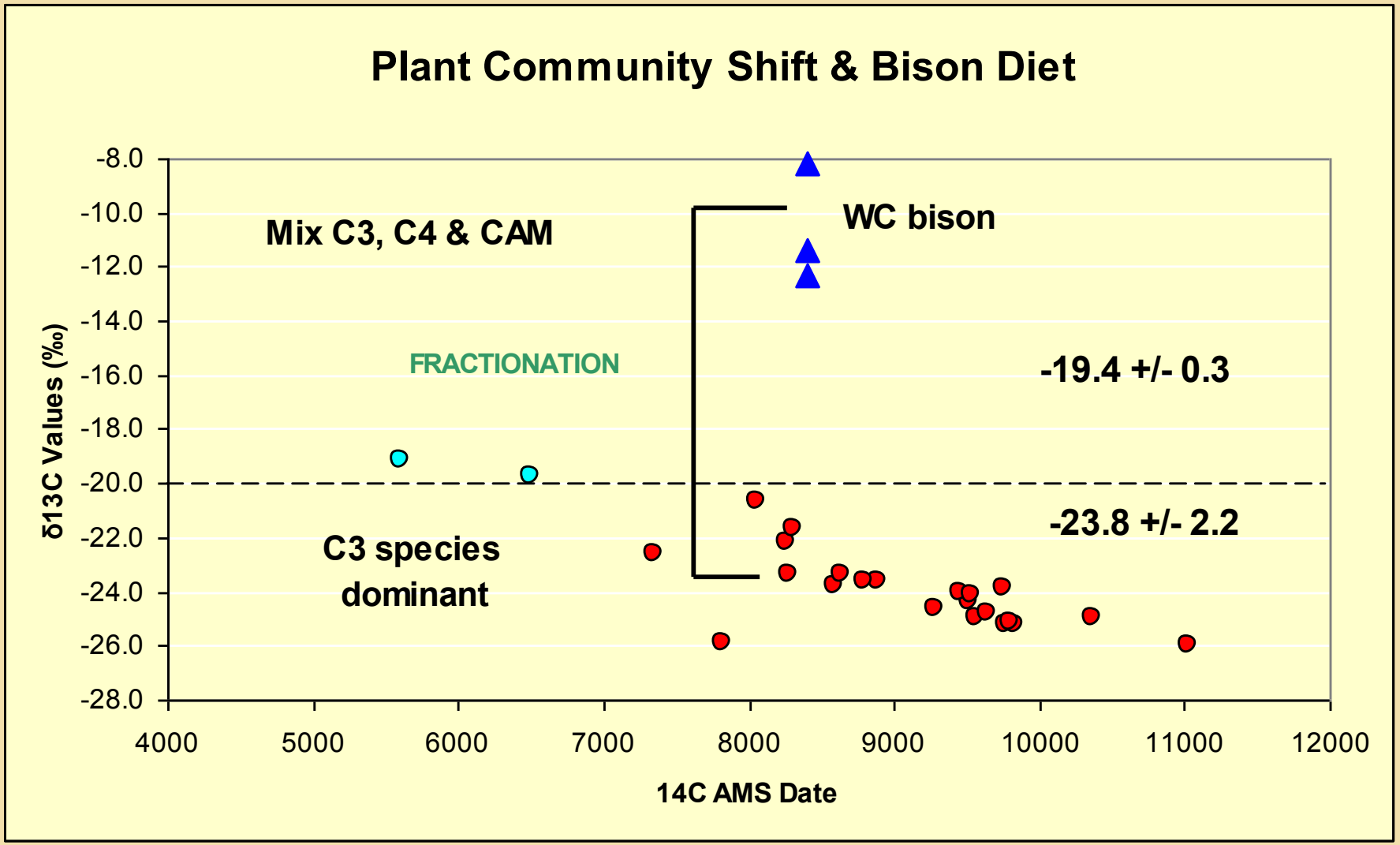
Rocky Mt. Maple
2440 m, Magdalena Mts., NM
(225 mi north)

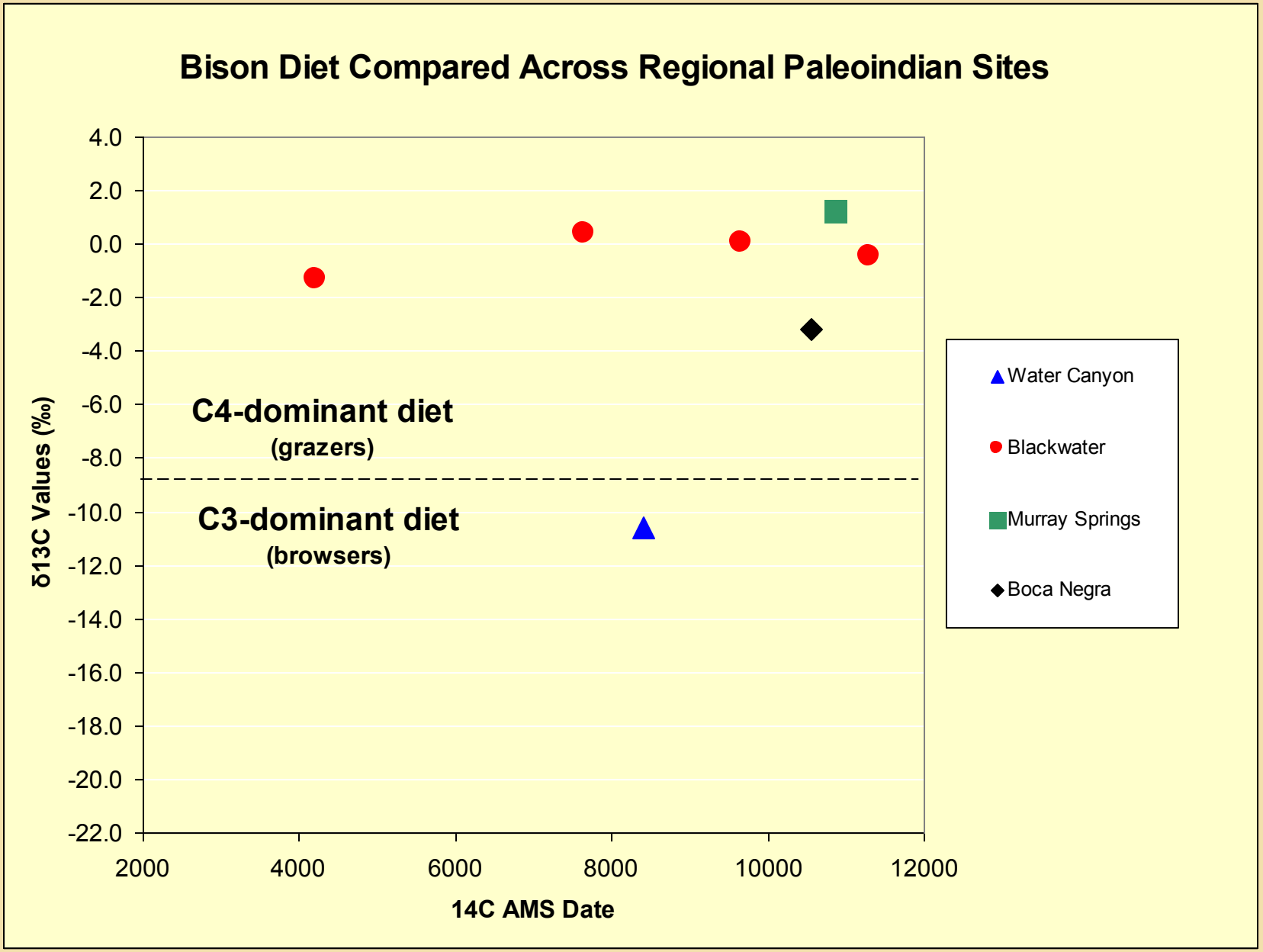
Bog Birch / Alamo Bog
2630 m, Jemez Mts., NM
(290 mi north)


Plant Community Shift
Late Pleistocene to Mid-Holocene
-19.4 +/- 0.3
Mix of C3, C4 &
CAM Species
-23.8 +/- 2.2
C3 species
dominant
δ13C Values (‰)
-16.0
-18.0
-20.0
-22.0
-24.0
-26.0
-28.0
4000
5000
6000
7000
8000
9000
10000
11000
12000
14C AMS Date

Plant Community Shift
Late Pleistocene to Mid-Holocene




Plant Community Shift & Bison Diet
-8.0
-10.0
-12.0
-14.0
-16.0
-18.0
-20.0
-22.0
-24.0
-26.0
-28.0
δ13C Values (‰)
Mix C3, C4 & CAM
WC bison
FRACTIONATION
-19.4 +/- 0.3
-23.8 +/- 2.2
C3 species dominant
4000
5000
6000
7000
8000
9000
10000
11000
12000
14C AMS Date


Bison Diet Compared Across Regional Paleoindian Sites
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
-16.0
-18.0
-20.0
-22.0
δ13C Values (‰)
C4-dominant diet
(grazers)
C3-dominant diet
(browsers)
2000
4000
6000
8000
10000
12000
14C AMS Date
Water Canyon
Blackwater
Murray Springs
Boca Negra

Water Canyon Paleoindian Site (LA134764)

Radiocarbon Dates for Deep Cores from 2010 Field Season

FS No.	Sample No.	Material Dated	Depth below ground surface (m)	Grid Elevation (m)	Date (rcybp)	Date (cal bp)	Period
80	A-15622	Sediment	2.40-2.50	46.08-45.98	8050 ± 160	8954	Late Paleo
82	A-15623	Sediment	2.60-2.70	45.88-45.78	8255 ± 140	9247	Late Paleo
84	A-15624	Sediment	2.80-2.90	45.68-45.58	8305 ± 90	9313	Late Paleo
87	A-15625	Sediment	3.10-3.20	45.38-45.28	8630 ± 85	9588	Late Paleo
88	A-15626	Sediment	3.20-3.30	45.28-45.18	8795 ± 75	9800	Late Paleo
91	A-15621	Sediment	3.50-3.60	44.98-44.88	9530 ± 65	10,832	Late Paleo


FIN
Hunter's Moon Rising Above Water Canyon
Paleoindian Site / November 2009
Thank-You!