Journal of Archaeological Science: Reports 2 (2015) 291–301

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: http://ees.elsevier.com/jasrep

The zooarchaeology of Bonneville Estates Rockshelter: 13,000 years of Great Basin hunting strategies

Bryan Hockett *

Bureau of Land Management, Nevada State Office, 1340 Financial Blvd., Reno, NV 89502, USA

ARTICLE INFO

Article history:
Received 31 December 2014
Received in revised form 16 February 2015
Accepted 25 February 2015
Available online 10 March 2015

Keywords:
Great Basin
Hunting
Climate change

ABSTRACT

Bonneville Estates Rockshelter (eastern Nevada) preserves a record of changing hunting patterns from the Paleoindian to the ethnohistoric periods. Diachronic changes in hunting patterns at Bonneville Estates, as well as a host of other cave and open-air sites from the Great Basin are compared with eight broad climatic phases recognized in the Great Basin. Recent studies of large-scale artiodactyl trapping structures and projectile point frequencies present a more complete picture of long-term shifts in hunting strategies in the Great Basin. Overall, there is much variability in the hunting of large and small game through time at individual sites, suggesting that local environmental and social conditions exerted considerable influence in micro and macro scale hunting patterns across the Great Basin. Creating an "average" Great Basin hunter by combining all the data analyzed here suggests limited artiodactyl hunting during the Paleoindian period followed by an upward trend in large game hunting through time. There is no significant drop in artiodactyl hunting intensity at any time over the last 5000 to 6000 years, despite major changes in climate and technology.

Published by Elsevier Ltd.

1. Introduction

Bonneville Estates Rockshelter (BER) is located in eastern Nevada along the western margins of Pleistocene Lake Bonneville at approximately 5200′ in elevation (Fig. 1). This elevation marks the high water stand of Pleistocene Lake Bonneville (Bonneville shoreline). BER was carved by Lake Bonneville between about 18,500 and 17,200 calendar years ago (cal BP) when the lake was at its highstand. Following the drop in Lake Bonneville water levels to 4850′ elevation (Provo shoreline) about 17,200 cal BP, BER began accumulating terrestrial sediments. During the Younger-Dryas (12,850–11,650 cal BP), Lake Bonneville carved the Gilbert shoreline (Benson et al., 2011).

Ted Goebel (Texas A & M University), Kelly Graf (Texas A & M University), and I led excavations inside BER from 2000 to 2009. Deeply stratified and well preserved deposits were recovered dating from the Late Pleistocene to the Recent climatic phases (Table 1). The full series of radiocarbon dates have yet to be published from BER, but Table 1 summarizes the 20 recognizable strata identified from the site, as well as their radiocarbon ages based on the dating of charcoal recovered from dozens of intact hearth features (e.g., Graf, 2007), as well as coprolites (Albush, 2010). Previous publications have summarized the BER stratigraphic, lithic, and faunal records from the Late Pleistocene and Middle Holocene-aged levels (Goebel, 2007; Graf, 2007; Hockett, 2007). In addition, Schmitt and Lupo (2012) recently published paleoecological interpretations of the BER faunal record based on *Rodentia* remains.

This paper has four goals: (1) report the artiodactyl, leporid, carnivore, large bird and insect remains from BER; (2) correlate changes in large and small animal hunting strategies at BER and other caves and open-air sites from the Great Basin with eight broad climatic phases recognized in the region; (3) combine these data with recent studies of large-scale artiodactyl trapping structures and projectile point frequencies to present a more complete picture of long-term shifts in hunting strategies in the Great Basin; and (4) briefly discuss the implications of these data for understanding the variability in subsistence practices that Great Basin archaeologists encounter at individual sites (micro-scale patterns) and from regional perspectives (macro-scale patterns).

2. Materials and methods

2.1. Brief description of climatic phases

The climatic phases listed in Table 1 are further characterized in Table 2. Briefly, relatively cool and wet conditions prevailed across much of the Great Basin during the Late Pleistocene and Early Holocene until approximately 9500 cal BP, although warm and wet conditions prevailed by 11,700 cal BP in the southern Great Basin (Hockett, 2000). The warmer and drier conditions of the Middle Holocene are discernible by 9500 cal BP, recognized by a changeover from mesic to xeric-adapted fauna at a number of key Great Basin sites, including Homestead Cave, Utah (Grayson, 2000a) and Bonneville Estates Rockshelter, Nevada (Hockett, 2007; Schmitt and Lupo, 2012), both

* Tel.: +1 775 861 6546.
E-mail address: b50hocke@blm.gov.

http://dx.doi.org/10.1016/j.jasrep.2015.02.011
2352-409X/Published by Elsevier Ltd.

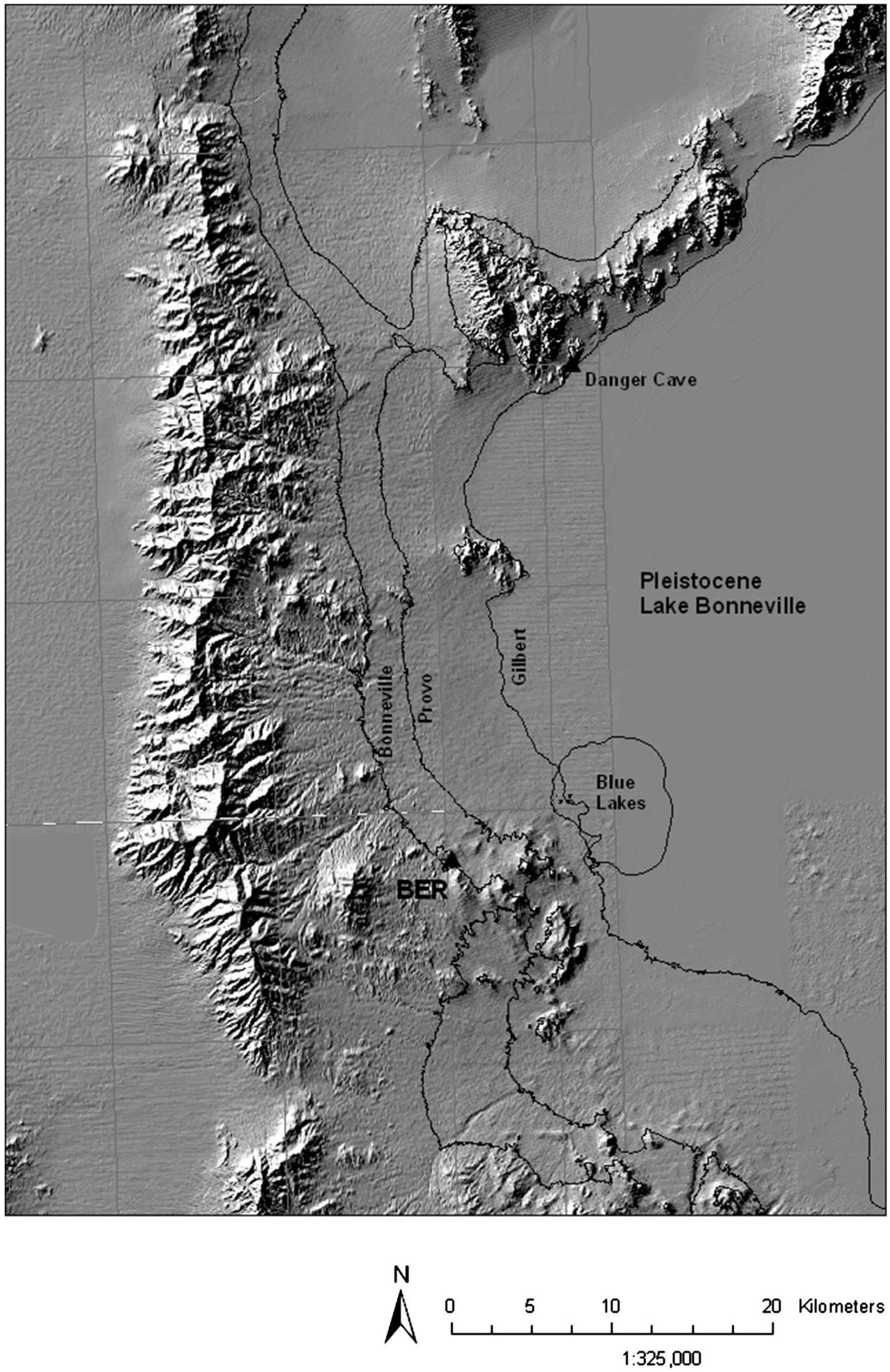

Fig. 1. General location of Bonneville Estates Rockshelter in relation to Danger Cave and the three latest Pleistocene shorelines of Lake Bonneville.

located in the northern Bonneville Basin, and Pintwater Cave, southern Nevada (Hockett, 2000). Middle Holocene climate appears to ameliorate after ca. 5800 cal BP, a likely reason why archaeological sites across many areas of the Great Basin are re-occupied following abandonment or reduced occupational densities, including Bonneville Estates Rockshelter (see below). The generally cooler and wetter climate of the Late Holocene, and especially the Neoglacial/Neopluvial between about 5100 and 2650 cal BP, saw the return of extensive marshland habitat across many areas of the northern and central Great Basin region, and was dubbed the "Good Times" by Elston (1982). Scott Mensing (2014) has been at the forefront of defining a millennial-scale drought in the Great Basin between about 2650 and 1650 cal BP, sandwiched between the Neoglacial and the globally-recognized Medieval Climatic Anomaly of 1650 to 650 cal BP. In the Great Basin, the Medieval Climatic Anomaly witnessed a switch from winter to summer precipitation that had rather profound effects on plant and animal distribution patterns and density (e.g., increases in grasses and bison [*Bison bison*] populations), as well as human economic and cultural change (e.g., the Formative Period [Fremont horticulture] in the eastern Great Basin). The summer precipitation pattern broke by 650 cal BP, with the last six to

Table 1
Climatic phases, their ages, and correlates to the BER strata.

CLIMATE PHASE	AGE (CAL BP)	BER strata
Little Ice Age (recent)	650–present	1–2
Medieval Climatic Anomaly	1650–650	3
Late Holocene Drought	2650–1650	4–7
Neoglacial (Neopluvial)	3500–2650	8
Early Late Holocene	5100–3500	9–10
Transitional	5800–5100	11–13
Middle Holocene	9400–5800	14–16
Late Pleistocene (Younger Dryas) & Early Holocene	12,850–9400	17–18
Pre-Younger Dryas	12,850–17,200	19–20[a]

[a] Strata 19–20 contain paleontological materials only.

seven centuries being dominated by relatively shorter-term shifts in seasonal precipitation and temperature swings, and the majority of moisture falling during the winter months in the northern and central Great Basin.

2.2. Faunal patterns at Bonneville Estates Rockshelter in relation to climatic cycles

Table 3 lists the Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) values for the Bonneville Estates artiodactyl, leporid, carnivore, large bird, and insect remains. The vast majority of artiodactyl bones recovered from Bonneville Estates consisted of extensively fractured long bones (see Fig. 2 below). This made species designation for many of these elements difficult because mountain sheep (*Ovis canadensis*), deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*) remains were all found throughout the deposits. It is clear that long bone processing for marrow extraction occurred inside the shelter, and that both the fractured long bones, as well as often-fractured long bone ends were deposited alongside each other. I therefore took a conservative approach at species identification, and only assigned such identifications to those long bone ends or shaft fragments that could be confidently assigned to a particular species. Because the long bone ends, foot bones, and mandibles/maxillae were typically found clustered together, the MNI values reported in Table 3 afford an accurate estimate of the actual numbers of individual artiodactyls recovered from each climatic cycle.

In contrast, the small animals, in particular leporids (rabbits and hares) and sage grouse (*Centrocercus urophasianus*) were processed differently than the artiodactyls. While the processing of individual artiodactyl carcasses resulted in the production of hundreds, and in some cases, thousands of long bone shaft fragments, most of the leporid and sage grouse bones were either complete or near-complete elements. As a result, using NISP values in the calculations below would have grossly overinflated the contribution of large game in relation to small game. In sites in which such vast differences in carcass processing

Table 3
Number of Identified Specimens (NISP) and Minimum Number Of Individuals (MNI; in parentheses) of artiodactyl, leporid, large bird, carnivore, and insects identified from Bonneville Estates Rockshelter.

	Climate phase							
Animal	LIA	MCA	LHD	NEO	ELH	TRANS	MH	LP/EH
Pronghorn	10(2)	30(1)	363(7)	10(1)	19(1)	16(3)	22(2)	7(1)
Mnt. sheep	2(1)	9(1)	8(3)	1(1)	2(1)	1(1)	8(2)	3(1)
Deer	0(0)	0(0)	2(2)	0(0)	0(0)	1(1)	1(1)	1(1)
Bison	3(2)	13(1)	2(1)	0(0)	5(1)	2(1)	1(1)	1(1)
Hare	4(1)	9(1)	149(14)	3(1)	6(2)	30(4)	9(1)	218(13)
Rabbit	0(0)	0(0)	1(1)	0(0)	0(0)	10(2)	55(6)	622(59)
Sage Grouse	0(0)	0(0)	0(0)	0(0)	0(0)	7(2)	22(2)	619(18)
Black bear	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(1)
Bobcat	0(0)	0(0)	0(0)	0(0)	2(1)	0(0)	12(1)	1(1)
Coyote	1(1)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Badger	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(1)	0(0)
Weasel	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(1)	9(3)
Katydids	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	21(21)

techniques are evident, MNI is a more accurate measure of relative contribution of large versus small game than NISP. Table 4 displays the small-game index (SGI) values (MNI leporids + sage grouse/MNI [leporids + sage grouse] + [artiodactyls]) for Bonneville Estates.

BER is the only site excavated to date in the Great Basin that contains a faunal record of human hunting strategies in which each of the eight climatic phases are represented from a single locale. These data demonstrate a paleobiological change from predominantly rabbits to a preponderance of hares across the Late Pleistocene/Early Holocene and Middle Holocene transition when the climate turned much warmer and drier. This change in representation of leporid genera from *Sylvilagus*/*Brachylagus* (cottontails/pygmy rabbits) to *Lepus* (jackrabbits or hares) at this time has been documented at a number of sites across the northern Great Basin (Grayson, 2000b). There are also a number of mesic-adapted animals in the Late Pleistocene/Early Holocene deposits that are much rarer or absent in the later-dating deposits, including sage grouse and black bear (*Ursus americanus*), as well as marmot (*Marmota flaviventris*), northern pocket gopher (*Thomomys talpoides*) and bushytail woodrat (*Neotoma cinerea*) (Schmitt and Lupo, 2012). The changeover from a more mesic "Pleistocene" fauna to a more xeric "Holocene" fauna occurs at BER by ca. 9500 cal BP (8300 ^{14}C BP), marking the beginning of the Middle Holocene in the northern Great Basin.

Four species of artiodactyls were hunted near BER: pronghorn, mountain sheep, deer, and bison. There is scant evidence for carnivore modification on the artiodactyl remains, while percussion marks from the breaking of long bones to extract marrow (Fig. 2), as well as stone tool cut marks are common, suggesting humans deposited nearly all of these bones inside BER.

Table 2
Characterization of Great Basin climatic phases used in this analysis. Age of the peak events in the recognized millennial-scale climatic cycles in the Bonneville Basin after Madsen (2000:169, Table XLIX) and Madsen et al. (2005:22, Table 2.1). The ages of the general climatic phases in Table 1 closely correspond to the peak climatic cycles presented in Madsen (2000) and Madsen et al. (2005).

Climate phase	Peak events	General description	Primary references
Little Ice Age (Recent)	650 cal BP	Predominantly winter-wet and seasonal	Madsen et al. (2005)
Medieval Climatic Anomaly	1550 cal BP	Summer wet; warm	Curry and James (1982)
Late Holocene Drought	2800 cal BP	Dry throughout much of Great Basin; possibly wet in northern Great Basin	Mensing (2014)
Neoglacial (Neopluvial)	n/a	Winter-wet; cool	Madsen et al. (2005)
Early Late Holocene	4100 cal BP	Winter-wet and seasonal	Madsen et al. (2005)
Transitional	5500 cal BP	Amelioration from the Middle Holocene	Thomas (2013)
Middle Holocene	8200 cal BP	Warm and dry	Madsen et al. (2005); Hockett (2007)
Late Pleistocene (Younger Dryas) & Early Holocene	9500, 10,200, 11,100 and 12,500 cal BP	Cool and wet (north); warm and wet (south)	Madsen et al. (2005); Hockett (2000)
Pre-Younger Dryas	>13,000 cal BP	Cool and wet	Madsen et al. (2005)

Fig. 2. Typical artiodactyl long bone fragmentation pattern at BER caused by hard hammer percussion in order to extract marrow. These specimens are from stratum 7 (Late Holocene Drought).

Pronghorn and mountain sheep were the most ubiquitous artiodactyls, as they were recovered in each of the eight climatic phases (Fig. 3). As has been discussed elsewhere, there is an upward trend in artiodactyl hunting during the warm and dry Middle Holocene/Transitional phases following a cool and moist Late Pleistocene/Early Holocene focus on smaller game (Hockett, 2007; Pinson, 2007; Janetski et al., 2012). Over the past 13,000 years, however, pronghorn, mountain sheep, and deer were most numerous in the Late Holocene Drought climatic phase of ca. 2650 to 1650 cal BP at BER. In addition, artiodactyl hunting was relatively strong during the ethnohistoric period (Little Ice Age climatic phase) of the last 700 years.

Hare (*Lepus* spp.) and cottontail (*Sylvilagus* spp.) bones were common, and similar to the large fauna there is scant evidence for any non-cultural modification to these bones. Owl pellets and carnivore scats were rare; leporid bones found with hair and fur packed within individual bone cavities were rare; and gastric digestion damage (e.g., thinning and polishing) was rare. As well, long bone diaphysis cylinders created by humans snapping the ends off long bones to extract marrow were relatively common (Fig. 4; see also Hockett, 1991, 1995). These data suggest that humans deposited the majority of leporid bones as food waste inside the shelter.

Leporids were hunted most frequently during the period 13,000 to 5800 cal BP. Hares were hunted in the same frequency during the warm and dry Middle Holocene as they were during the cool and moist Late Pleistocene/Early Holocene. Beginning about 5800 cal BP (Transitional phase), hare hunting remained at relatively low levels throughout the remainder of the Holocene. Cottontail hunting, however, dropped dramatically beginning in the Middle Holocene, which was probably influenced by fewer cottontails on the landscape near BER when the climate turned warm and dry after ca. 9500 cal BP; rabbit hunting remained at low levels thereafter. Leporid long bone cylinders created by snapping the ends off of these bones in order to consume marrow (Hockett, 1991; Schmitt, 1986) appear during the Late Pleistocene/Early Holocene (Fig. 4), indicating a long-standing (13,000 years) continuity in this dietary practice in the Great Basin.

Sage grouse was recovered prior to the Late Holocene (prior to ca. 5100 cal BP), especially during the Late Pleistocene/Early Holocene (Fig. 5; see also Hockett, 2007). Sage grouse bones may be separated into male and female samples based on size (Figs. 5–7), as males tend to be significantly larger than females (Grayson, 1977b). The fact that both males and females were captured together near BER suggests that these birds were hunted off leks during the mating season. Male sage grouse currently congregate on leks and perform their dances to attract females in the early Spring, during March and April (Wiley, 1973). It is possible, however, that the months in which lekking occurred differed during the Late Pleistocene near BER compared to today. In any case, the flat, wave-cut Lake Bonneville benches or beach terraces in front of BER and the surrounding landscape, together with dense stands of mature sagebrush as suggested by the presence of pygmy rabbit (*Brachylagus idahoensis*) remains at this time probably created ideal conditions for sage grouse leks, and early human foragers along the western margins of the lake were drawn here to hunt grouse at these times. A similar hunting strategy has been suggested during the early Late Holocene at Table Mountain in the Monitor Range of central Nevada (Thomas, 1988).

A variety of carnivores were recovered from BER, none in abundance. As mentioned, there is scant evidence for carnivore modification on any of the bones from the shelter apart from small rodents, and the paucity of carnivore remains, especially subadult individuals, suggests that carnivores were not denning inside the shelter. Of interest is the

Table 4
Small game index (SGI) values from Bonneville Estates Rockshelter. Values are based on Minimum Number of Individuals (MNI).

	Artiodactyls	Hares	Sage grouse	SGI
Climate phase				
Little Ice Age	5	1	0	.17
Medieval Climatic Anomaly	3	1	0	.25
Late Holocene Drought	13	4	0	.24
Neoglacial/Neopluvial	2	1	0	.33
Early Late Holocene	3	2	0	.40
Transitional	6	4	2	.50
Middle Holocene	6	14	2	.73
Late Pleistocene/Early Holocene	4	13	18	.89

Fig. 3. Artiodactyl mandible fragments from BER. Top row: mule deer (*Odocoileus hemionus*); middle row: mountain sheep (*Ovis canadensis*); bottom row: pronghorn (*Antilocapra americana*).

presence of a burned first phalanx of black bear in the Late Pleistocene deposits, as bear remains of any kind are rare throughout the Great Basin (Hockett and Dillingham, 2004).

Finally, well preserved specimens of the western longwing katydid (*Capnobotes occidentalis*) were lying in direct association with Late Pleistocene/Early Holocene-aged hearths in the western portion of the shelter. These specimens were undoubtedly human food leftovers; most were nearly whole and missing their back legs (see Hockett, 2007). Removing the back legs of grasshoppers prior to consumption is a common practice among humans in order to prevent the legs from becoming lodged in the esophagus, as well as to prevent the barbs protruding from the legs from damaging the throat (Taylor, 1975). A variety of insects were consumed ethnographically in the Great Basin including grasshoppers and crickets (Skinner, 1910), and the well preserved katydids of BER demonstrate that insects have been on the menu in this part of North America for 13,000 years.

Fig. 4. Lepus long bone diaphysis cylinders from stratum 18 (Late Pleistocene) at BER. Left to right: tibia, tibia, tibia, humerus, femur, femur.

Fig. 5. Sage grouse male and female proximal humeri from stratum 18 (Late Pleistocene) at BER demonstrating sexual dimorphism. Left to right: male, female, male, female.

2.3. Faunal patterns at additional Great Basin sites in relation to the climatic cycles

Table 5 displays either artiodactyl index values (MNI artiodactyls/MNI artiodactyls + MNI hares), artiodactyl NISP/century values (number of artiodactyl bones identified per century per climatic phase), or artiodactyl MNI/century values (number of artiodactyl individuals per century per climatic phase) (after Hockett, 2005) for nine caves, rockshelters, or open-air locales from the Great Basin, including Bonneville Estates Rockshelter. Faunal remains have been inconsistently reported in the Great Basin literature over the years; hence, different indices must be used at individual sites, but each index generates values that allow for relative comparisons of large and small game hunting patterns through time between these sites (Figs. 8–10).

Sites that contain Late Pleistocene/Early Holocene fauna that supplement the BER data include North Creek Shelter, Utah (Janetski et al., 2012), Paisley Caves, Oregon (Hockett and Jenkins, 2013), the Weed Lake Ditch Site, Oregon (Wriston, 2003), Danger Cave, Utah (Grayson, 1988), Spirit Cave, Nevada (Napton, 1997), and sites from the northwestern Great Basin (Oregon) (Pinson, 2007).

Middle Holocene-aged fauna that supplement the BER data include North Creek Shelter, the northwestern Great Basin, Hogup Cave, Utah (Aikens, 1970), Camel's Back Cave, Utah (Schmitt and Madsen, 2005), O'Malley Shelter, Nevada (Fowler et al., 1973), Sudden Shelter, Utah (Jennings et al., 1980), and Swallow Shelter, Utah (Dalley, 1976). The transitional climatic phase utilizes data from all of these sites plus Pie Creek Shelter, Nevada (McGuire et al., 2004) and Dirtyshame Rockshelter, Oregon (Grayson, 1977a).

Early Late Holocene-aged fauna that supplement the BER data include Swallow Shelter, Camels Back Cave, Pie Creek Shelter, Hogup Cave, Sudden Shelter, and O'Malley Shelter. Neoglacial/Neopluvial-aged fauna include BER, Sudden Shelter, Camels Back Cave, Hogup Cave, Pie Creek Shelter, Swallow Shelter, the northwestern Great Basin, James Creek Shelter, Nevada (Elston and Budy, 1990), and Gatecliff Shelter, Nevada

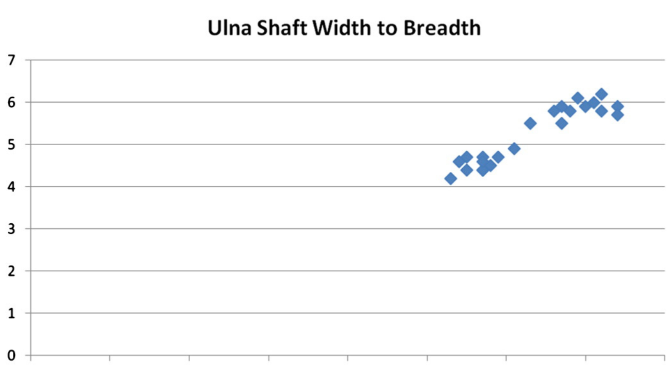

Fig. 6. Bimodal distribution of male and female sage grouse based on ulna shaft width (x-axis) to shaft breadth (y-axis). Male ulna shaft widths range between 6.6 and 7.4 mm; shaft breadths range between 5.5 and 6.2 mm. In contrast, female ulna shaft widths range between 5.3 and 6.3 mm; shaft breadths between 4.2 and 5.5 mm.

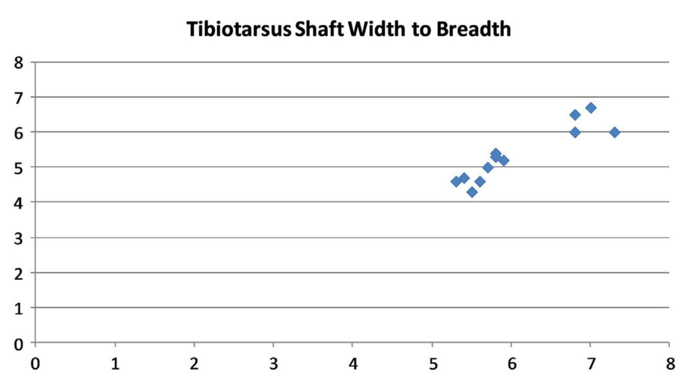

Fig. 7. Bimodal distribution of male and female sage grouse based on tibiotarsus shaft width (x-axis) to shaft breadth (y-axis). Male tibiotarsus shaft widths range between 6.8 and 7.4 mm; shaft breadths between 6.0 and 6.7 mm. In contrast, female tibiotarsus shaft widths range between 5.3 and 5.9 mm; shaft breadths between 4.3 and 5.4 mm.

Table 5
Summary of large game hunting trends for nine caves, rockshelters, or open-air sites in the Great Basin.

	Climate phase								
	LIA	MCA	LHD	Neo	ELH	Trans	MH	LP/EH	Value
Site/locale									
Bonneville Estates Rockshelter	.83	.75	.76	.67	.60	.50	.37	.11	Artio index
Northwestern Great Basin	.26	.01	.16	.19	.17	.06	.10	0.0	Artio index
Pie Creek Shelter	.20	.20	.30	.30	.46	.36	-	–	Artio index
Sudden Shelter	–	–	–	–	.64	.74	.74	–	Artio Index
Swallow Shelter	1.8	1.4	.7	2.2	.13	.03	.03	–	MNI/century
James Creek Shelter	0.0	6.8	2.6	3.1	–	–	–	–	NISP/century
O'Malley Shelter	2.0	.5	.1	–	.13	.17	.17	–	MNI/century
Hogup Cave	1.2	1.6	2.9	2.0	2.1	1.6	1.6	–	MNI/century
Camels Back Cave	2.2	9.1	3.9	–	1.8	.14	.75	–	NISP/century

(Thomas, 1983). Late Holocene Drought, Medieval Climatic Anomaly, and Little Ice Age fauna each utilize data recovered from BER, the northwestern Great Basin, Pie Creek Shelter, Swallow Shelter, James Creek Shelter, O'Malley Shelter, Hogup Cave, and Camels Back Cave.

2.4. Projectile point frequency data in relation to Great Basin climatic cycles

Further supplementing these faunal data are previously published projectile point frequencies per century for approximately two dozen subregions across Nevada (Hockett, 2009; Table 6 and Fig. 11). These data are based on the assumption that projectile points were used primarily to kill artiodactyls, and therefore changing frequencies through time also reflect changing intensities of hunters targeting large prey.

Most of the projectile point styles defined in the Great Basin generally correspond to different climatic cycles, suggesting that broad changes in climate are correlated with changes in point styles (see Table 6). This correlation may simply reflect stylistic changes within the same ethnic groups, or they may represent migrations of new peoples into the Great Basin. The primary point style that bucks this trend is the Elko Series point. Elko Series points (a dart point style) may be substantially older in the eastern and northern Great Basin subregions than in the western and central Great Basin subregions, although recent studies have questioned this broad interpretation (Hockett et al., 2014). Elko points are also occasionally found in the "Maggie Creek" phase along with arrow points, particularly in Fremont sites located in the eastern Great Basin, but most Elko points across the Basin date between approximately 4000 and 1500 years ago, and so they have been placed within this time frame for the purposes of this analysis.

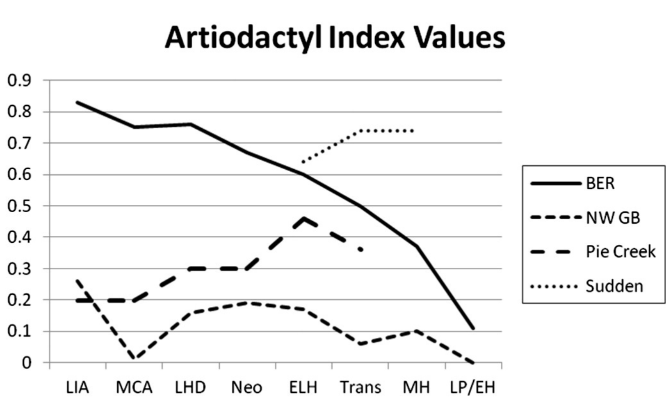

Fig. 8. Trends in large versus small game hunting patterns at Bonneville Estates Rockshelter (BER), open-air sites in the northwestern Great Basin (NW GB), Pie Creek Shelter (Pie Creek), and Sudden Shelter (Sudden) based on standard artiodactyl index values calculated per climatic cycle.

2.5. Large-scale trap features in relation to Great Basin climatic cycles

The wealth of data accumulating on the construction of large-scale trap features also serves as a proxy for changing intensities of artiodactyl hunting through time via communal hunts (Hockett, 2005; Jensen, 2007; Hockett and Murphy, 2009; Hockett et al., 2013). Many of these traps are associated with catastrophically shattered projectile points; in addition, "kill spots" containing dense concentrations of projectile points within or near these traps provide evidence for large-scale hunting of artiodactyls at these facilities (Hockett and Murphy, 2009). The relative ages of use of these traps can be estimated using point type chronology (Table 6).

Of the traps listed in Hockett and Murphy (2009) and Hockett et al. (2013), 89 contain projectile points in direct association with these features. The number of occurrences of the different projectile point types at each of these traps provides long-term estimates of the degree of large game hunting via trap construction and communal hunting of artiodactyls (Fig. 12).

3. Results: artiodactyl hunting intensity in relation to climate change in the Great Basin

How do the patterns of large and small game hunting in relation to climatic phases at BER compare to other sites across the Great Basin? The broad patterns observed within each climatic phase are briefly discussed below.

3.1. Late Pleistocene and Early Holocene subsistence fauna

Sites with good faunal preservation, including BER, North Creek Shelter, Paisley Caves and sites in the northwestern Great Basin suggest a strong emphasis on small game procurement relative to artiodactyl hunting during the cool and moist Late Pleistocene and Early Holocene.

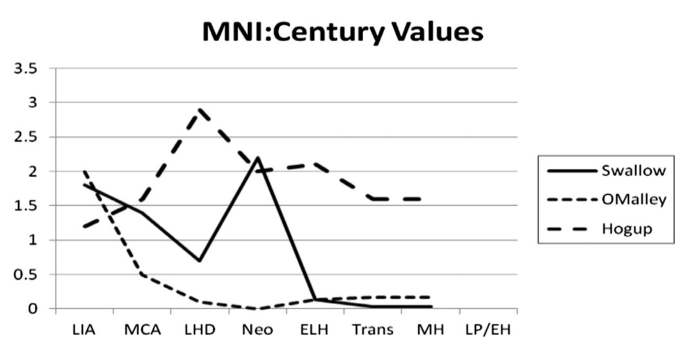

Fig. 9. Trends in large game hunting patterns at Swallow Shelter (Swallow), O'Malley Shelter (OMalley), and Hogup Cave (Hogup) based on number of artiodactyl individuals recovered per century within each climatic cycle.

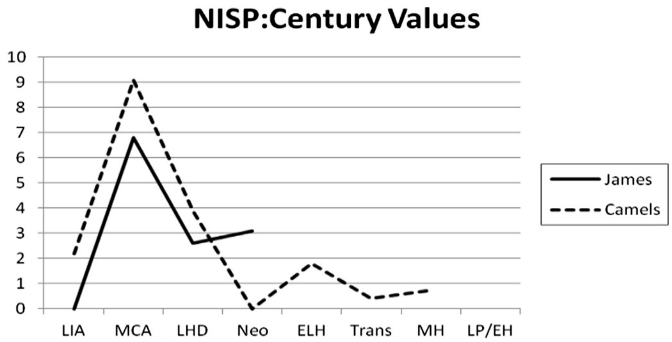

Fig. 10. Trends in large game hunting patterns at James Creek Shelter (James) and Camels Back Cave (Camels) based on number of identified artiodactyl specimens recovered per century within each climatic cycle.

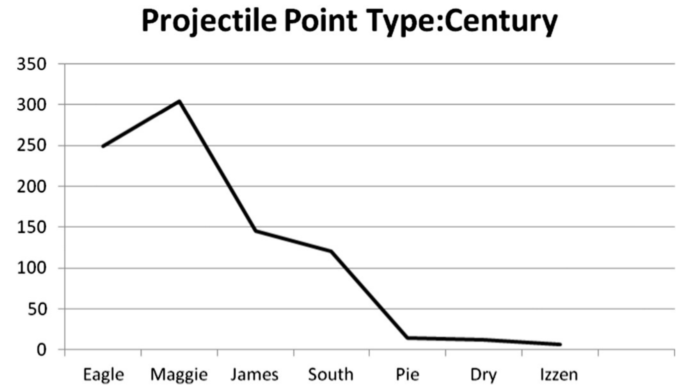

Fig. 11. Great Basin projectile point numbers per century. (After Hockett, 2009, 2010).

At BER, for example, the small game index, or SGI for the Late Pleistocene and Early Holocene occupations is .89 (Table 4), suggesting a heavy reliance on small game. The combined faunal assemblage from the sites analyzed here indicate high resource diversity, with large and small terrestrial mammals (bison, deer, mountain sheep, pronghorn, bear, hare, cottontail, and marmot), fish, birds (sage grouse and duck [*Anas* spp.]), and insects (katydids and mormon crickets [*Anabrus simplex*]) represented in sites such as BER, Paisley Caves, Danger Cave, the Weed Lake Ditch site, and Spirit Cave. In the western Nevada-northeastern California region at this time, Carpenter (2002:50) also noted that the "… taxonomic composition reflects a near complete reliance on small mammals, fish, and birds, which account for over 95% of the assemblage." The overall modest degree of large game hunting during the Paleoindian/Paleoarchaic Period may be a pan-American phenomenon (Speth et al., 2013).

3.2. Middle Holocene and Transitional subsistence fauna

The Middle Holocene, also known as the Altithermal (Antevs, 1948) (ca. 9400–5100 cal yr B.P.) may be generally characterized as displaying the beginnings of an upward trend in artiodactyl hunting across much of the Great Basin, as evidenced at BER, North Creek Shelter, Hogup Cave, Sudden Shelter, O'Malley Shelter, Gatecliff Shelter, Pie Creek Shelter, Dirtyshame Rockshelter, and sites from the northwestern Great Basin (Figs. 8–11). The SGI at BER dropped to .73 (Middle Holocene) and .50 (Transitional) for an average of .65 from its Late Pleistocene/Early Holocene high of .89, suggesting an increased emphasis on large game hunting (Table 4). Nevertheless, at BER in particular overall dietary diversity remains relatively consistent during this time (see also Albush, 2010). The emergence of communal artiodactyl hunting by the Transitional climatic phase (Fig. 12), based on the presence of Large Side-Notched (ca. 8500–6000 cal BP) point concentrations at or near existing drive lines and corrals is also evidenced at sites such as Mount Augusta, Cobre, Hill, Player Ridge, and Excelsior in the western and north-central Great Basin (Hockett et al., 2013). Projectile point frequencies for Large Side-Notched points found in open-air contexts are relatively low (Hockett, 2009:196, Fig. 3), but relatively high in cave and rockshelter contexts (Hockett, 2009:203, Fig. 10). These data agree with an upward trend and increasing reliance on artiodactyls during the Middle Holocene compared to the Late Pleistocene/Early Holocene time period.

Table 6
Correspondence of projectile point types with climatic cycles in the Great Basin.

Phase	Point style(s)	Climatic cycle(s)
Eagle Rock	Desert Side-Notched; Cottonwood	Little Ice Age
Maggie Creek	Rose Spring; Eastgate; Elko	Medieval Climatic Anomaly
James Creek	Elko; Martis	Late Holocene Drought; Neoglacial
South Fork	Gatecliff; Gypsum; Humboldt	Early Late Holocene
Pie Creek	Large side-notched; Pinto	Transitional; Middle Holocene
Dry Gulch	Western stemmed	Early Holocene; Late Pleistocene
Izzenhood	Western stemmed; Clovis	Late Pleistocene

3.3. Early Late Holocene subsistence fauna

Artiodactyl hunting continued to increase during the Early Late Holocene (ca. 5100–3500 cal yr B.P.) at BER, Swallow Shelter, Camels Back Cave, Pie Creek Shelter, and Hogup Cave compared to Middle Holocene levels (Figs. 8–10). This pattern is repeated across the northern tier of the Great Basin (McGuire et al., 2014). In contrast, artiodactyl hunting decreased or stayed relatively consistent with Middle Holocene levels at Sudden Shelter, Utah (Fig. 8) and O'Malley Shelter, Nevada (Fig. 9). Projectile point concentrations of Humboldt and Gatecliff series projectile points (ca. 6000–4000 cal BP) at valley and near-valley locations in the Spruce Complex area of northeastern Nevada, the Tunna Nosi region of western Nevada/eastern California, and Big Smoky Valley in central Nevada suggest a continuation and possible increase in communal pronghorn trapping in these regions through the Transitional and Early Late Holocene climatic phases during the South Fork Phase (Fig. 12). Upland communal hunting of bighorn sheep or deer is evidenced at several rock-walled and rock cairn drive lines, including Fort Sage, Mount Augusta, and Player Ridge (Hockett et al., 2013). Projectile point frequencies for Gatecliff and Humboldt points in open-air contexts show a 3-fold increase in frequency compared to Large Side-Notched points, and a moderate drop in frequency in cave and

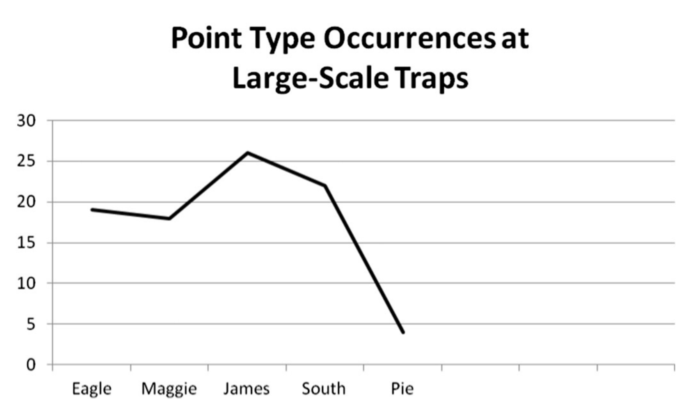

Fig. 12. Number of point type occurrences found at large-scale traps and kill spots in the Great Basin.

rockshelter contexts (Fig. 11; see also Hockett, 2009). These data suggest a continuing upward trend in artiodactyl hunting intensity during the Transitional/Early Late Holocene compared to Middle Holocene levels.

3.4. Neoglacial/Neopluvial subsistence fauna

The Neoglacial or Neopluvial climate fostered increasing surface water in the Great Basin between ca. 3500 and 2650 cal yr B.P. Lowland marshes expanded across much of the Great Basin, and a strong aggradation of sediments occurred along rivers and streams such as the Truckee River near Reno (Stoner et al., 2006). Two high-elevation sites (Sudden Shelter and Gatecliff Shelter) and one low-elevation site (Camels Back Cave) were largely abandoned during this time. Although the intensity of artiodactyl hunting was slightly lower at Hogup Cave (Fig. 9) and Pie Creek Shelter (Fig. 8), large game procurement remained relatively consistent with Early Late Holocene levels at Swallow Shelter (Fig. 9), James Creek Shelter (Fig. 10), and sites in the northwestern Great Basin (Fig. 8). At BER, the SGI dropped to .33, suggesting a greater reliance on large game compared to Early Late Holocene levels (Table 4). Additionally, communal artiodactyl hunting may have continued at relatively high levels based on numerous concentrations of Elko or Martis Series projectile points at Spruce Complex in northeastern Nevada, Tunna Nosi in western Nevada, and other drive line facilities in central, western, and northeastern Nevada during the James Creek Phase (Fig. 12; Hockett et al., 2013).

3.5. Late Holocene Drought subsistence fauna

Lowland marsh productivity decreased during the Late Holocene Drought (ca. 2650–1650 cal yr B.P.), and an increase in upland resource use is documented in many areas of the Great Basin (Delacorte, 2002). Upland resource use is aptly documented at sites such as Gatecliff Shelter which was reoccupied following its Neoglacial abandonment, and villages were constructed for the first time at the high altitude Alta Toquima and White Mountains sites (Bettinger, 1991; Thomas, 2013). In addition, some valley floor sites in Big Smoky Valley lying below upland sites such as Gatecliff Shelter and Alta Toquima were abandoned following their initial occupation during the Neoglacial (Brockway, 2014). Current research suggests that the "Late Holocene Drought" was actually a mesic event in the northern reaches of the Great Basin, and a xeric event in the central Great Basin (Mensing, 2014). Much variation is seen at individual sites during this period. BER appears to lie near the mesic-xeric boundary of this climatic phase, and large game hunting increased at this site, as well as at other lowland sites such as Camels Back Cave and Hogup Cave (Figs. 9–10). In contrast, reductions in artiodactyl hunting intensity are seen at Swallow Shelter (Fig. 9). Large game hunting increased at the upland Gatecliff Shelter site, but remained consistent with Neoglacial levels at James Creek Shelter, Pie Creek Shelter, and sites in the northwestern Great Basin (Figs. 8 and 10). Additionally, communal hunting of pronghorn continued at Spruce Complex, and recent dating of artiodactyl remains from the Locus 191 site in Little Smoky Valley, central Nevada, associated with a series of large-scale trap features squarely rest within the Late Holocene Drought time frame (Ed Stoner, personal communication, July 2014).

3.6. Medieval Climatic Anomaly subsistence fauna

The Medieval Climatic Anomaly (ca. 1650–650 cal yr B.P.) was a period of increasing summer rainfall which fostered the expansion of grass and bison (Curry and James, 1982), but these summer rains also increased erosional processes and decreased Great Basin lake levels (Nials, 1999; Grayson, 2011). Artiodactyl hunting intensity during this time must be assessed with a major change in hunting technology — the advent of the bow-and-arrow (Carpenter, 2002; Hockett, 2009, 2010; Hughes, 2003). Despite the widespread use of bow-and-arrow technology, artiodactyl hunting intensity was varied across the Great Basin. Large game hunting increased at Gatecliff Shelter, Swallow Shelter (Fig. 9), James Creek Shelter and Camels Back Cave (Fig. 10), and O'Malley Shelter (Fig. 9); remained consistent with Late Holocene Drought levels at Pie Creek Shelter and BER (Fig. 8); and reduced in intensity at Hogup Cave (Fig. 9) and sites in the northwestern Great Basin (Fig. 8). Communal kills of mountain sheep are indicated at Gatecliff Shelter Horizon 2 (ca. 800 cal BP), a pattern that differed from the individual sheep kills suggested during earlier times of occupation of the shelter (Thomas, 1983).

Projectile point numbers per century are highest for the Rose Spring/Eastgate Series compared to any other period in Great Basin prehistory (Fig. 11; Hockett, 2009, 2010). Interestingly, however, the communal hunting of artiodactyls may have been less frequent in some places in the Great Basin (Fig. 12). The Spruce Complex contains a single high-density Rose Spring/Eastgate projectile point concentration in eastern Nevada, while communal artiodactyl hunting continued at Anchorite Pass, western Nevada (Hall, 1990), and a pronghorn corral was constructed, perhaps for the first time, in southern Huntoon Valley in western Nevada (Parr, 1989).

Village sites and rockshelters both display relatively high diversity of faunal resources during this climatic cycle. The inhabitants of the Vista Site, located along the Truckee River in the Reno-Sparks area of western Nevada, exploited terrestrial mammals (deer, pronghorn, mountain sheep, coyote, bobcat, hare, cottontail), fish, and freshwater mussels (Schmitt, 1986). At South Fork Shelter, northeastern Nevada, residents enjoyed freshwater mussels (Heizer et al., 1968), including the construction of a 'mussel oven' (Spencer et al., 1987), as well as deer, mountain sheep, hare, cottontail, and marmot.

The summer-wet and relatively equable temperatures of the Medieval Climatic Anomaly had relatively profound effects on other aspects of Great Basin settlement and subsistence patterns. The summer-wet precipitation pattern enhanced the density of grasses, and bison expanded its range into the eastern and southern Great Basin (Curry and James, 1982; Grayson, 2006). Most bison kills from the Great Basin date to this time period (Grayson, 2006), adding bison to the menu at a number of sites in northeastern Nevada.

3.7. Little Ice Age subsistence fauna

The climate of the final phase of Great Basin prehistory prior to Euroamerican contact (ca. 650/500–150 cal yr B.P.) witnessed a return to a predominantly winter-wet and seasonal condition. There is no shortage of evidence for major restructuring in settlement and subsistence patterns across much of the Great Basin, including the abandonment of Fremont horticulture and villages in the eastern Great Basin, increased mobility seen in greater use of nonlocal toolstones at many sites, and changes in ceramic production from painted and utilitarian gray wares (Fremont) to a brown-to-brownish-red utilitarian ware (Intermountain Brownware).

Large game hunting is prevalent at several key cave and rockshelter sites such as BER, which witnessed its lowest SGI value of any time over the past 13,000 years (Table 4 and Fig. 8). The continuing upward trend toward artiodactyl hunting is also seen in the western Nevada/northeastern California region (Carpenter, 2002), across northern Nevada (McGuire et al., 2014), and at open-air sites such as Dry Susie Creek where both mountain sheep and elk (*Cervus elaphus*) were hunted along with waterfowl, rodents, leporids, and coyote (Reust et al., 1994). Communal artiodactyl hunting was an important component of the subsistence and settlement patterning of these late prehistoric foragers (Fig. 12). Construction of large-scale traps occurred for the first time in specific places such as Whisky Flat (Wilke, 2013), and communal pronghorn trapping either continued or resumed following a hiatus during the Medieval Climatic Anomaly at Spruce Complex, Tunna Nosi, Huntoon, Big Smoky Valley, Little Smoky Valley, and many other locales in eastern Nevada and the western Nevada/eastern California region

(Hockett et al., 2013). Projectile point frequencies of Desert Side-Notched points remain relatively high during this time period (Fig. 11; Hockett, 2009).

Numerous late 19th century and early 20th century ethnographies document a vast diversity of resource use, both plant and animal, by contact-era foragers of the Great Basin. These foragers did not 'rely' on small mammals and seeds for subsistence; rather, they exploited small seeds, larger seeds (pinyon nuts), roots, bulbs, berries, green leafy vegetables, rodents, rabbits, birds, fish, artiodactyls, and insects in seasonal rounds when specific foods became available and plentiful at specific times in specific places. These ethnographic accounts also point to likely knowledge gaps in the prehistoric archaeological record due to preservation and/or recovery biases. For example, although fish are rarely encountered in Late prehistoric sites in the north-central Great Basin, on May 9, 1828, Peter Skene Ogden made the following notes in his journal:

> We had not travelled more than eight miles when we reached the Unknown River [Humboldt River] and on reaching it we found thirty Indians employed in fishing salmon trout [Lahontan cutthroat trout], about eight inches in length, remarkably fine. They gave us all they had, about fifteen…We then descended down the stream, crossed over a large fork [North Fork of the Humboldt River]. Here we again found fifteen Indians fishing… (Williams, 1971:140).

4. Conclusion

A broad Great Basin perspective suggests that subsistence choices in the Great Basin were *influenced and constrained* by climate and ecological conditions in a number of important ways. For example, a diverse resource base was exploited during the cool-and-moist Late Pleistocene and Early Holocene when plant and animal productivity was relatively high for the Great Basin. Marsh-resource focused groups emerged who exploited a wide diversity of plant and animal foods, including fishing cultures who manufactured elaborate harpoons at places such as the Pyramid Lake Basin in western Nevada (Ting, 1983). A diverse, terrestrial-based diet is indicated at other sites near ancient Pleistocene lake shorelines, such as at BER near the western margins of Lake Bonneville, and the Paisley Caves within the Summer Lake Basin, Oregon. The Middle Holocene warm and dry period witnessed the beginnings of an upward trend in large game hunting, and a drop in population density (Louderback et al., 2010) in several regions of the Great Basin. Changes in mobility, demography, and subsistence occurred across the transition from the Middle Holocene to the Late Holocene between 6000 and 5000 cal BP as drought conditions ameliorated, including increases in human population densities, which may have been a factor leading to the development of the large-scale, communally-based trapping of artiodactyls, a pattern that continued throughout the remainder of Great Basin prehistory (Hockett et al., 2013). Large game hunting and high resource diversity continued during the cool and moist Neoglacial, which also witnessed reduced mobility and the construction of large, semi-permanent houses from the Carson Valley to the southern Black Rock Desert in western Nevada (e.g., Stoner et al., 2002; Estes, 2014) beginning about 3500 cal BP. The Late Holocene Drought could rightfully be termed the "Late Holocene Anomaly", as Great Basin paleoecologists and archaeologists are just beginning to define both its diverse climatic impacts on plant and animal resources, as well as its impacts on human populations. The relatively warm and summer-wet precipitation pattern of the Medieval Climatic Anomaly increased bison hunting as these animals expanded their range into the north-central Great Basin; this climate also made it ecologically possible for horticultural groups to expand northward into the Great Basin from the greater Southwest; horticultural groups also developed in Owens Valley in the extreme southwestern portion of the Great Basin (Eerkens, 2009). The last 700 years witnessed the exploitation of a wide diversity of resources, as well as a continuing reliance on communally-based large-scale trapping of artiodactyls across Nevada and eastern California.

Underneath these broad trends, however, the data suggest that no single subregion of the Great Basin can serve as a proxy or template for diachronic micro-trends in hunting strategies across the entire region. Whether these differences are related to plant and animal productivity between subregions, forager choices among a range of possible solutions to acquiring adequate nutrition, influences from neighboring subregions and ethnic populations, or a combination of factors remain open for additional studies and model building. And despite these historically contingent factors, significant long-term continuities have been documented across much of the region, including the communally-based large-scale trapping of artiodactyls that began as early as the Transitional climatic period, perhaps in response to increased population and contact among previously disparate groups. Once begun, this activity remained an important economic and social cultural norm until historic contact regardless of climate or technological innovation.

Acknowledgments

Thanks to David Hurst Thomas, Lee Lyman, Chris Hunt and several anonymous reviewers who read various drafts of this manuscript and improved its organization and focus.

References

Aikens, C. Melvin, 1970. Hogup Cave. Anthropological Papers 93. University of Utah Press, Salt Lake City.

Albush, Cassandra, 2010. Prehistoric Diet At Bonneville Estates Rockshelter. Unpublished MA Thesis, University of Nevada, Reno, Nevada.

Antevs, Ernst, 1948. Climatic changes and pre-white man. Univ. Utah Bull. 38, 168–191.

Benson, L.V., Lund, S.P., Smoot, J.P., Rhode, D.E., Spencer, R.J., Verosub, K.L., Louderback, L.A., Johnson, C.A., Rye, R.O., Negrini, R.M., 2011. The rise and fall of Lake Bonneville between 45 and 10.5 ka. USGS Staff Published Research Paper 726. University of Nebraska, Lincoln (http://digitalcommons.unl.edu/usgsstaffpub/726).

Bettinger, Robert L., 1991. Aboriginal occupation at high altitude: alpine villages in the white mountains of Eastern California. Am. Anthropol. 93, 656–679.

Brockway, Rocky, 2014. Changes in group composition during the Late Holocene in Central Nevada. Paper presented At The 34th Great Basin Anthropological Conference, Boise, Idaho.

Carpenter, Kimberley L., 2002. Reversing the Trend: Late Holocene Subsistence Change in Northeastern California. In: McGuire, K. (Ed.), Boundary lands: archaeological investigations along the California–Great Basin interface. Anthropological Papers No. 24. Nevada State Museum, Carson City, pp. 49–59.

Curry, Donald, James, Steven R., 1982. Paleoenvironments of the Northeastern Great Basin and Northeastern Basin Rim Region: a review of geological and biological evidence. In: Madsen, David B., O'Connell, James F. (Eds.), Man and environment in the Great Basin. Society For American Archaeology Papers No. 2, pp. 27–52 (Washington, D.C.).

Dalley, Gardiner, 1976. Swallow Shelter and associated sites. Anthropological Papers 96. University of Utah Press, Salt Lake City.

Delacorte, Michael G., 2002. Late prehistoric resource intensification in the Northwestern Great Basin. In: McGuire, K. (Ed.), Boundary lands: archaeological investigations along the California–Great Basin interface. Anthropological Papers No. 24. Nevada State Museum, Carson City, pp. 41–48.

Eerkens, Jelmer W., 2009. Privatization of resources and the evolution of prehistoric leadership strategies. In: Vaughn, K., Eerkens, J., Kantner, J. (Eds.), The Evolution of Leadership: Transitions In Decision Making From Small-Scale To Middle-Range Societies. School for Advanced Research Press, Santa Fe, pp. 73–96.

Elston, Robert G., 1982. Good times, hard times: prehistoric culture change in the western Great Basin. In: Madsen, David B., O'Connell, James F. (Eds.), Man And Environment In The Great Basin. Society For American Archaeology Papers No. 2, pp. 186–206 (Washington, D.C.).

Elston, Robert G., Budy, Elizabeth E., 1990. The archaeology of James Creek Shelter. Anthropological Papers 115. University of Utah Press, Salt Lake City.

Estes, Mark B., 2014. Home is where the hearth is: Late Holocene housepit features from the Black Rock Desert, Nevada. Paper presented At The 34th Great Basin Anthropological Conference, Boise, Idaho.

Fowler, Don D., Madsen, David B., Hattori, Eugene, 1973. Prehistory of southeastern Nevada. Desert Research Institute Publications In The Social Sciences 6 (Reno).

Goebel, Ted, 2007. Pre-Archaic and early Archaic technological activities at Bonneville Estates Rockshelter: a first look at the lithic artifact record. In: Graf, K., Schmidt, D. (Eds.), Paleoindian Or Paleoarchaic: Great Basin Human Ecology At The Pleistocene–Holocene Transition. University of Utah Press, Salt Lake City, Utah, pp. 156–186.

Graf, Kelly E., 2007. Stratigraphy and chronology of the Pleistocene to Holocene transition at Bonneville Estates Rockshelter, Eastern Great Basin. In: Graf, K., Schmidt, D. (Eds.), Paleoindian Or Paleoarchaic: Great Basin Human Ecology At The Pleistocene–Holocene Transition. University of Utah Press, Salt Lake City, Utah, pp. 82–104.

Grayson, Donald K., 1977a. Paleoclimatic implications of the Dirty Shame Rockshelter mammalian fauna. Tebiwa 9, 1–126.

Grayson, Donald K., 1977b. A review of the evidence for Early Holocene turkeys in the Northern Great Basin. Am. Antiq. 42, 110–114.

Grayson, Donald K., 1988. Danger Cave, Last Supper Cave, and Hanging Rock Shelter: the faunas. Anthropological Papers 66. American Museum of Natural History, New York.

Grayson, Donald K., 2000a. The Homestead Cave mammals. In: Madsen, David B. (Ed.), Late Quaternary Paleoecology in the Bonneville Basin. Bulletin 130. Utah Geological Survey, Salt Lake City, pp. 67–89.

Grayson, Donald K., 2000b. Mammalian responses to Middle Holocene climatic change in the Great Basin of the Western United States. J. Biogeogr. 27, 181–192.

Grayson, Donald K., 2006. Holocene bison in the Great Basin, Western USA. The Holocene 16, 913–925.

Grayson, Donald K., 2011. The Great Basin: A Natural Prehistory. University of California Press, Berkeley.

Hall, Matt 1990. The Oxbow Archaeological Incident: Investigations of 23 Locations Between Owens Valley, Eastern California, and Walker Basin, Southwestern Nevada. Manuscript on file, Eastern California Information Center. University of California, Riverside.

Heizer, Robert F., Baumhoff, M.A., Clewlow Jr., C.W., 1968. Archaeology of South Fork Shelter (NV-E1-11), Elko County, Nevada. Reports Of The University of California Archeological Survey 71 (Berkeley, California).

Hockett, Bryan, 1991. Toward distinguishing human and raptor patterning on leporid bones. Am. Antiq. 56, 667–679.

Hockett, Bryan, 1995. Comparison of leporid bones in raptor pellets, raptor nests, and archaeological sites in the Great Basin. N. Am. Archaeol. 16, 223–238.

Hockett, Bryan, 2000. Paleobiogeographic changes at the Pleistocene–Holocene boundary near Pintwater Cave, Southern Nevada. Quat. Res. 53, 263–269.

Hockett, Bryan, 2005. Middle and Late Holocene hunting in the Great Basin: a critical review of the debate and future prospects. Am. Antiq. 70, 713–731.

Hockett, Bryan, 2007. Nutritional ecology of Late Pleistocene to Middle Holocene subsistence in the Great Basin: zooarchaeological evidence from Bonneville Estates Rockshelter. In: Graf, Kelly, Schmidt, Dave (Eds.), Paleoindian Or Paleoarchaic: Great Basin Human Ecology At The Pleistocene–Holocene Transition. University of Utah Press, Salt Lake City, Utah, pp. 204–230.

Hockett, Bryan, 2009. 13,000 years of large game hunting in the Great Basin. In: Hockett, Bryan (Ed.), Past, Present, and Future Issues in Great Basin Prehistory: Papers in Honor of Don D. Fowler. Cultural Resource Series 20. Bureau of Land Management, Reno, pp. 169–204.

Hockett, Bryan, 2010. Back to study hall: further reflections on large game hunting during the Middle Holocene in the Great Basin. Am. Antiq. 75, 962–965.

Hockett, Bryan, Dillingham, Eric, 2004. Paleontological investigations at Mineral Hill Cave. Technical Report 18. Bureau of Land Management, Reno.

Hockett, Bryan, Jenkins, Dennis L., 2013. Identifying stone tool cutmarks and the pre-Clovis occupation of the Paisley caves. Am. Antiq. 78, 762–788.

Hockett, Bryan, Murphy, Timothy W., 2009. Antiquity of communal pronghorn hunting in the north-central Great Basin. Am. Antiq. 74, 708–734.

Hockett, Bryan, Creger, Cliff, Smith, Beth, Young, Craig, Carter, James, Dillingham, Eric, Crews, Rachel, Pellegrini, Evan, 2013. Large-scale trapping features from the Great Basin, USA: the significance of leadership and communal gatherings in ancient foraging societies. Quat. Int. 297, 64–78.

Hockett, Bryan, Hildebrandt, William R., King, Jerome H., 2014. Identifying dart and arrow points in the Great Basin: comment on Smith et al'.s "Points in time: direct radiocarbon dates on Great Basin projectile points. Am. Antiq. 79, 561–565.

Hughes, Susan, 2003. Beyond The Altithermal: The Role Of Climate Change In The Prehistoric Adaptations Of Northwestern Wyoming. University of Washington, Seattle, PhD Dissertation.

Janetski, Joel C., Bodily, Mark L., Newbold, Bradley A., Yoder, David T., 2012. The Paleoarchaic to early archaic transition on the Colorado Plateau: the archaeology of North Creek Shelter. Am. Antiq. 125–159.

Jennings, Jesse D., Schroedl, Alan R., Holmer, Richard E., 1980. Sudden Shelter. Anthropological Papers 103. University of Utah Press, Salt Lake City.

Jensen, Jill L. 2007 Sexual Division of Labor and Group-Effort Hunting: The Archaeology of Pronghorn Traps and Point Accumulations in the Great Basin. Unpublished MA Thesis, California State University, Sacramento.

Louderback, Lisbeth A., Grayson, Donald K., Llobera, Marcos, 2010. Middle-Holocene climates and human population densities in the Great Basin, Western USA. The Holocene 21, 366–373.

Madsen, David B., 2000. Summary and integration. In: Madsen, David B. (Ed.), Late Quaternary Paleoecology In The Bonneville Basin. Bulletin 130. Utah Geological Survey, Salt Lake City, pp. 165–175.

Madsen, David B., Oviatt, Charles G., Schmitt, Dave N., 2005. A geomorphic, environmental, and cultural history of the Camels Back Region. In: Schmitt, Dave N., Madsen, David B. (Eds.), Camels Back Cave. Anthropological Papers 125. University of Utah Press, Salt Lake City, pp. 20–45.

McGuire, Kelly R., Delacorte, Michael G., Carpenter, Kimberley L., 2004. Archaeological excavations at Pie Creek and Tule Valley Shelters, Elko County, Nevada. Anthropological Papers 25. Nevada State Museum, Carson City.

McGuire, Kelly R., Andrew Ugan, Kimberly Carpenter, and Laura Brink 2014 Trans-Holocene Subsistence-Settlement Change in Northern Nevada. In *Cultural Resource Investigations for the Ruby Pipeline Project in Nevada, Volume II: Prehistory of Nevada's Northern Tier: Results of the Data Recovery Program*, edited by William Hildebrandt, Kelly McGuire, Jerome King, Allika Ruby, and D. Craig Young, pp. 241–257. Report BLM1-3070(P), Manuscript on file, Bureau of Land Management, Elko, Nevada.

Mensing, Scott, 2014. Recent developments in Great Basin Holocene paleoclimate history. Paper Presented At The 34th Great Basin Anthropological Conference, Boise, Idaho.

Napton, Lewis K., 1997. The Spirit Cave mummy: coprolite investigations. Nev. Hist. Soc. Q. 40, 97–104.

Nials, Fred, 1999. Geomorphic Systems and Stratigraphy in Internally-Drained Watersheds of the Northern Great Basin: Implications for Archaeological Studies. Department of Anthropology, University of Nevada, Reno.

Parr, Robert, 1989. Archaeological Investigations At The Huntoon Pronghorn Trap Complex, Mineral County, Nevada. MA Thesis. University of California, Riverside.

Pinson, Arian, 2007. Artiodactyl use and adaptive discontinuity across the Paleoarchaic/Archaic transition in the Northern Great Basin. In: Graf, K., Schmidt, D. (Eds.), Paleoindian or Paleoarchaic: Great Basin Human Ecology At The Pleistocene–Holocene Transition. University of Utah Press, Salt Lake City, Utah, pp. 187–203.

Reust, Timothy, Smith, Craig S., Wright, H., 1994. The archaeology of the Dry Susie Creek Site, Elko County, Nevada. Technical Report 878. Mariah Associates, Inc, Laramie.

Schmitt, Dave N., 1986. Faunal analysis. In: Zeier, Charles D., Elston, Robert G. (Eds.), The Archaeology Of The Vista Site, 26WA3017. Nevada Department of Transportation, Carson City, Nevada, pp. 209–240.

Schmitt, Dave N., Lupo, Karen D., 2012. The Bonneville Estates Rockshelter rodent fauna and changes in Late Pleistocene–Middle Holocene climates and biogeography in the Northern Bonneville Basin, USA. Quat. Res. 78, 95–102.

Schmitt, Dave N., Madsen, David B., 2005. Camels Back Cave. Anthropological Papers 125. University of Utah Press, Salt Lake City.

Skinner, Alanson, 1910. The use of insects and other invertebrates as food by the North American Indians. J. N.Y. Entomol. Soc. 18, 264–267.

Spencer, Lee, Hanes, Richard C., Fowler, Catherine S., Jaynes, Stanley, 1987. The South Fork Shelter Site Revisited: Excavation at Upper Shelter, Elko County, Nevada. Cultural Resource Series No. 11. Bureau of Land Management, Reno.

Speth, John D., Newlander, Khori, White, Andrew A., Lemke, Ashley K., Anderson, Lars E., 2013. Early Paleoindian big-game hunting in North America: provisioning or politics? Quat. Int. 285, 111–139.

Stoner, Edward, Rusco, Mary K., Christian, L., 2002. A pá wa detdé' yí Village: the archaeology of the Sunridge Site (26Do439), Douglas County, Nevada. United States Environmental Protection Agency, San Francisco (Report).

Stoner, Edward, Ringhoff, Mary, Peterson, R., Sigler, Jennifer, 2006. The Archaeology Of The "Biggest Little City in the World": The Retrac Project, Reno, Washoe County, Nevada: Prehistoric Resources. Federal Highway Administration, Carson City, Nevada (Report).

Taylor, Ronald L., 1975. Butterflies In My Stomach: Insects In Human Nutrition. Woodbridge Press Publishing, Anaheim, California.

Thomas, David Hurst, 1983. Gatecliff Shelter. Anthropological Papers 59(1). American Museum of Natural History, New York.

Thomas, David Hurst, 1988. The Archaeology of Monitor Valley: 3. Survey and Additional Excavations. Anthropological Papers 66(2). American Museum of Natural History, New York.

Thomas, David Hurst, 2013. Alta Toquima: why did foraging families spend summers at 11,000 feet? In: Parezo, Nancy J., Janetski, Joel C. (Eds.), Archaeology In The Great Basin And Southwest. University of Utah Press, Salt Lake City, pp. 130–148

Ting, Peter C., 1983. Bone points from Pyramid Lake. Nev. Archaeol. 4, 10–17.

Wiley, R. Haven, 1973. Territoriality and non-random mating in Sage Grouse, *Centrocercus urophasianus*. Anim. Behav. Monogr. 6, 85–99.

Wilke, Philip J., 2013. The Whisky Flat Pronghorn Trap Complex, Mineral County, Western United States: preliminary report. Quat. Int. 297, 79–92.

Williams, Glyndwr, 1971. Peter Skene Ogden's Snake Country Journals: 1827–28 and 1828–29. The Hudson's Bay Record Society, London.

Wriston, Teresa, 2003. The Weed Lake Ditch Site: An Early Holocene Occupation On The Shore Of Pluvial Lake Malheur, Harney Basin, Oregon. MA Thesis. University of Nevada, Reno.