BACK TO STUDY HALL: FURTHER REFLECTIONS ON LARGE GAME HUNTING DURING THE MIDDLE HOLOCENE IN THE GREAT BASIN

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Hall's (this issue) comment to my paper published in American Antiquity five years ago (Hockett 2005) makes the following statements: (1) I calculated "depositional rates" for a series of Great Basin faunal assemblages; (2) my analysis did not account for atmospheric radiocarbon fluctuations; and (3) my paper argued "against an increase in hunting artiodactyls from the Middle to Late Holocene." He further argues that recalculation of the data I presented demonstrates that both large- and small-game hunting increased from the Middle to the Late Holocene. Hall is wrong on all accounts. I agree, however, that calibrated dates should now be used instead of the raw radiocarbon dates I used in my original paper. Using calibrated dates, however, does nothing to change the initial patterns I outlined five years ago. Three more recent papers (Hockett 2007, 2009; Hockett and Murphy 2009) on large game hunting in the Great Basin also corroborate my 2005 interpretations.

Comenta Mark Hall a mi artículo publicado hace cinco años, son erróneas. Analizando los datos de mi original utilizando los métodos sugeridos por él no cambia los resultados. Tres artículos adicionales publicados desde 2005 también corroboran mis interpretaciones originales.

Hall's (this issue) comment to my paper published in *American Antiquity* five years ago (Hockett 2005) makes the following statements: (1) I calculated "depositional rates" for a series of Great Basin faunal assemblages; (2) my analysis did not account for atmospheric radiocarbon fluctuations; and (3) my paper argued "against an increase in hunting artiodactyls from the Middle to Late Holocene." He further argues that recalculation of the data I presented demonstrates that both large- and small-game hunting increased from the Middle to the Late Holocene. Hall is wrong on all accounts.

First, I did not calculate "depositional rates" in my 2005 paper. Rather, I calculated simple averages of the numbers of artiodactyls recovered from a number of Great Basin caves and rockshelters occupied during the Middle Holocene (ca. 8,300 to 5,000 C-14 B.P.; or 9,400 to 5,700 cal B.P.) and the Late Holocene (ca. post-5,700 cal B.P. to present). Without going into needless detail of Hall's misrepresentation that I calculated "Poisson rates," I would simply note that mathematical averages and rates are not synonymous terms. An average is an arithmetic mean showing a rank-ordered standing. In contrast, a rate is a measure of something by its relation to a standard. I did not calculate the "depositional rate" of artiodactyls across the Middle and Late Holocene. Nor did I imply that such a rate could be meaningfully calculated given the archaeological data sets within which we generate interpretations.

My line of reasoning for calculating simple means for comparison purposes can be summarized like this: (1) The Middle Holocene in the Great Basin was an extended period of relatively warm and arid climatic conditions compared to the Late Holocene that followed; (2) major shifts in climate, such as the shift from relatively warm and arid Middle Holocene climate to relatively cool and moist Late Holocene climate, may be correlated with shifts in human behavior and technological developments, including shifts in hunting patterns in the Great Basin; (3) Great Basin caves and rockshelters are located in a wide variety of elevations and micro-topographic settings that are known to

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American Antiquity 75(4), 2010, pp. 962–965

influence the type and density of resources available to human hunters; (4) Great Basin caves and rockshelters were not continuously occupied through the millennia; instead, they were occupied sporadically for reasons we do not yet fully understand, and they were often abandoned or left unoccupied for long periods of time; (5) in order to interpret large-game hunting in the Great Basin through time, we should include sites that were occupied across the widest expanse of environmental settings rather than relying only on those sites occupied in lowland or upland or river settings; and (6) it may be useful to calculate an artiodactyl average that takes into account the period of time each site was inhabited by human hunters during specific climatic phases.

By utilizing this method, we may interpret whether certain animals were consistently targeted more often than others during these climatic episodes, even though the data represent a sample of a sample of a sample of a sample of a sample of a sample. That is, an archaeological site is a sample of the locations hunters occupied during a seasonal round; the animal remains they left behind in a site is a sample of the animals they procured while occupying the site; the animal remains preserved is a sample of those remains originally left behind; the animal remains recovered by archaeologists is a sample of the remains preserved; the animal remains identified is a sample of the remains recovered by archaeologists; and the animal remains analyzed and interpreted in a published paper is a sample of the total number of sites that have had their data analyzed and published.

So I prefer to use simple mathematics in my faunal analyses. I simply calculated the average number of artiodactyls recovered from a number of Great Basin caves and rockshelters that individually are located in a wide variety of ecological settings, and asked "During the time that each site was occupied, what was the average number of artiodactyls recovered and identified?" If the artiodactyl average is consistently higher during the Middle Holocene compared to the Late Holocene in individual sites, or vice versa, then we can use inductive reasoning to ask why this was the case, or we can use these data to test an hypothesis previously generated from a deductive model.

I did not use significant tests to compare the average values between the Middle Holocene and Late Holocene because, unfortunately, zooarchaeologists also cannot agree on consistent methods to analyze and report their data. Some data are reported as raw Number of Identified Specimens (NISP) counts only, while others report only Minimum Number of Individuals (MNI). For example, the artiodactyl averages for Sudden Shelter are reported as average MNIs, while those for Pie Creek Shelter are reported as average NISP values. Calculating artiodactyl averages (or the more popular "artiodactyl index" that compares ratios of artiodactyls to leporids) are both highly susceptible to error when NISP counts are used instead of MNIs due to potential differences in carcass processing and bone breakage by humans, as well as by post-depositional agents. I am not comfortable statistically comparing averages from two sites or two climatic phases when a mix of NISP and MNI values must be used to calculate the averages.

In calculating these averages, however, I used the raw radiocarbon dates in my 2005 paper. I was well aware of previous calibration curves utilized prior to the time I was researching this paper (pre-2003), as well as the controversies surrounding their acceptance and use. Recent calibration curves published since the time I was writing my paper by the IntCal working group (Reimer et al. 2004) and others are more refined and based on a wider array of proxy data than earlier versions. Hall is correct, and I agree with him, that calibrated dates should now be used in studies such as this.

Tables 1 and 2 display the average number of artiodactyl and small animal (leporid and fish) remains identified from Sudden Shelter and Pie Creek Shelter using calibrated dates. These data corroborate my 2005 conclusions, namely that: (1) at Sudden Shelter, the warm and arid Middle Holocene artiodactyl average (.031) dropped by 40 percent during the cool and moist Late Holocene, when it was .019. I also originally concluded in my 2005 paper, however, that within the Late Holocene, the artiodactyl average increased between about 3,300 and 3,800 years ago. The recalculations using calibrated dates show nearly exactly the same figures. As I originally stated, the leporid average remained relatively constant throughout (Table 1).

My original conclusions at Pie Creek Shelter were that (1) artiodactyl averages remained constant throughout the occupation of the site; and (2)

Table 1. Artiodactyl and Leporid Averages Per Year for Sudden Shelter Using IntCal04 Calibrated Dates.

	Middle Holocene Strata 1-10 9500-6100 cal BP	Transitional Strata 11-15 5700-4700 cal BP	Late Holocene Strata 16-22 4100-3600 cal BP
Artiodactyls			
MNI	104	19	16
#/year	.031	.019	.032
Leporids			
MNI	29	9	7
#/year	.009	.009	.014

Table 2. Artiodactyl, Leporid, and Fish Averages Per Year for Pie Creek Shelter Using IntCal04 Calibrated Dates.

	Component IV 5600-5100 cal BP	Component III 4500-2900 cal BP	Components II-I 2600-250 cal BP
Artiodactyls			
NISP	25	71	116
#/year	.05	.04	.05
Leporids			
NISP	45	100	441
#/year	.09	.06	.19
Fish			
NISP	55	156	686
#/year	.11	.10	.29

leporid and fish averages witnessed 2-fold and 3-fold increases, respectively, during the Late Holocene. This change, however, did not occur until the latter Late Holocene occupations. The recalculations using calibrated dates confirm these initial interpretations (Table 2).

Three recent manuscripts are relevant to the issues discussed here. In 2007, I published the initial results of faunal analysis at Bonneville Estates Rockshelter (BER) (Hockett 2007). At BER, small game including rabbits, sage grouse, and grasshoppers were important dietary components during the cool and moist Late Pleistocene and early Holocene, although artiodactyl hunting was not eschewed. Artiodactyl hunting was strongly represented during the Middle Holocene occupations, although these particular occupations correlate with short-term, cooler and wetter climatic episodes within the generally warm and arid Middle Holocene-aged deposits. This type of variability in artiodactyl hunting within the Mid-Holocene, associated with very short-term climatic events, has only begun to be explored.

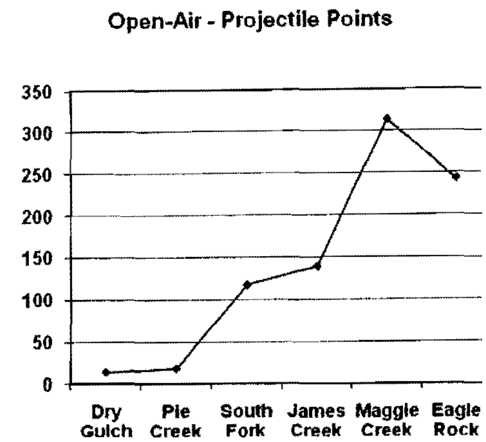

Figure 1. Average number of projectile points per phase per century identified from surface surveys across much of the Great Basin.

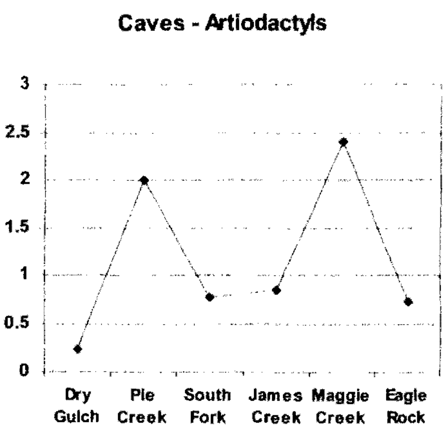

Figure 2. Average number of artiodactyls per phase per century recovered from 10 caves and rockshelters located across the Great Basin.

The 2005 discussion of communal pronghorn hunting was recently expanded (Hockett and Murphy 2009). In 2005, I did not argue "against an increase in hunting artiodactyls from the Middle to Late Holocene" across the entire Great Basin. Instead, I argued that the hunting of artiodactyls was variable in both space and time. Further, artiodactyl hunting was likely influenced by factors other than simple hunting preferences, such as the location of individual sites on the landscape (Hockett 2005:728). For example, during the warm and arid

Middle Holocene, artiodactyl populations occupying lowland habitats may have been negatively impacted to a greater degree than those populations living in upland habitats. In any case, the relevant message is that *communal pronghorn hunting in lowland valleys* began in the north-central Great Basin by 3,500 to 5,000 C-14 B.P. In addition, this hunting method appears to have remained an important social and subsistence activity right up to historic contact ca. 200 years ago.

Finally, I recently published a study of projectile point typology averages across much of the Great Basin, and compared these to artiodactyl averages for 10 cave and rockshelter sites (Figures 1 and 2; see Hockett 2009 for further details). Across much of the Great Basin, there was an increase in the artiodactyl average from the cool and moist Late Pleistocene/Early Holocene (Dry Gulch Phase) to the warm and arid Middle Holocene (Pie Creek Phase). The artiodactyl average drops at the onset of the cool and moist Late Holocene (South Fork Phase) and remains there (James Creek Phase) until the introduction of the bow-and-arrow ca. 1,500 – 2,000 years ago (Maggie Creek Phase). The artiodactyl average drops during the last 750 years of occupation prior to Euroamerican contact (Eagle Rock Phase), but is about as strong as the earlier Late Holocene components, which corroborates the communal hunting studies of Hockett (2005) and Hockett and Murphy (2009). Both the projectile point and artiodactyl bone averages display dramatic increases with the introduction of the bow-and-arrow (Maggie Creek Phase), suggesting that this technological development may have had a profound impact on the intensity of artiodactyl hunting in the Great Basin.

Acknowledgments. Thanks to Alison Rautman for helpful editorial suggestions. Hockett (2009) is available free of charge; download at http://www.blm.gov/nv/st/en/prog/more_programs/cultural_resources/reports.html

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Submitted March 6, 2010; Accepted April 1, 2010.