2008

Time-Averaged Deposits and Multi-temporal Processes in the Wyoming Basin, Intermontane North America: A Preliminary Consideration of Land Tenure in Terms of Occupation Frequency and Integration.

LuAnn Wandsnider
University of Nebraska-Lincoln, lwandsnider1@unl.edu

Time in Archaeology:

Time Perspectivism Revisited

Edited by

SIMON HOLDAWAY AND LUANN WANDSNIDER

THE UNIVERSITY OF UTAH PRESS
Salt Lake City

5

Time-Averaged Deposits and Multitemporal Processes in the Wyoming Basin, Intermontane North America:

A Preliminary Consideration of Land Tenure in Terms of Occupation Frequency and Integration

LuAnn Wandsnider
University of Nebraska–Lincoln

Archaeological time perspectivism encompasses the notion that archaeological deposits are formed through the operation of processes occurring at a variety of tempos over the short, medium, and long term (Bailey 1981, 1983, 1987, 2007, this volume). The processes involved may be behavioral, social, formational, organizational, or evolutionary, to name a few. Through their operation, material consequences may be immediate, lagged, or follow after some threshold is breached. Moreover, interaction may occur among and between different processes, depending on whether they operate at approximately the same scale (Bailey 1983; Fletcher 1995).

A corollary of the first statement is that different archaeological deposits, by virtue of their different temporal structures (Kirch 2005:414; Murray 2004), have potentially captured processes operating at different tempos. This corollary recognizes that modern (and ancient) surfaces are temporal mosaics (Bettis and Mandel 2002), with some local surfaces rather ancient and others more recent. It also recognizes that different landforms in close or far proximity to sediment sources will be differentially active, with consequences for the deposition and sealing of archaeological remains. For example, a surface that has been stable over a millennium has the potential to receive the fallout from a variety of processes operating at different tempos. On the other hand, on a very dynamic land surface, fast-tempo cultural processes, such as frequently occurring occupation events, may be well represented, whereas slower processes, for example, rarely (once-in-a-lifetime) occurring ritual events, may be more incompletely sampled.

Here, I explore the temporal structure and interpretive potential of deposits from throughout the Wyoming Basin (intermontane North America) that have been well documented through compliance archaeology. I assume that all of these deposits likely represent cumulative and spatial palimpsests (*sensu* Bailey 2007:204–207) manifesting different degrees of integration (Holdaway and Wandsnider 2006; see below). My goal is exploratory and follows from Murray's (1997; see also Olivier 2001; Bailey, this volume) observations that archaeology as a discipline still seeks the means to interpret social process over the medium to long term from the convoluted human/natural phenomenon that is the archaeological record. This exploration represents an exercise in pattern recognition as alluded to by Clarke (1973) and Binford (1977b) when they note

that theory building must follow the development of an understanding of archaeological subject matter. But, of course, we also recognize that the units we choose to describe archaeological phenomenon prefigure the kinds of interpretations that can be entertained (Ramenofsky and Steffen 1998; Wylie 1989). To escape this methodological conundrum requires that simultaneous efforts be made along the paths of theory building, pattern recognition, and unit formation and that the hermeneutic spiral be completed, with an eternal dialogue among and between theory building, unit construction, data collection, and interpretation evaluation (Hodder 1999). A consideration of these deposits, with coarse—and very coarse—temporal grain (see below), opens the door to inferences about short-, medium-, and longer-term processes of wider anthropological interest, for example, the development of different land tenure systems.

Translating this larger goal into concrete objectives, I first elaborate on the properties of the temporal structure of archaeological deposits and then discuss the potential processes that may contribute toward the character of Wyoming Basin archaeological assemblages. Next, I introduce the Wyoming Basin study area and then move to an analysis of the temporal structure of Wyoming Basin components especially focusing on occupation frequency and integration. Discussion follows on aspects of land tenure.

The Temporal Structure of Archaeological Deposits

Over the last 20 years, archaeologists have come to recognize and understand various properties of the temporal structure of deposits (Murray 2004). Binford (1978a; see also Ferring 1986) introduced the notion of temporal grain to describe deposits and explicitly recognizes this character as a convolution of the tempo of sedimentation and behavioral or cultural processes; coarse-grained deposits represent the accumulation of many, likely irresolvable cultural depositional events, whereas fine-grained deposits may preserve the remains of a short sequence of behavioral events (see also O'Neill and King 1998:7 and Schindel 1982 on resolution and microstratigraphic acuity in paleontology).

From the paleontological literature come other concepts. Time averaging refers to "fossiliferous units that represent extended periods of time and mixing of organisms from different habitats" (Behrensmeyer 1982:213); that is, the material consequences of behaviors from many agents are integrated over the time span during which the sedimentary envelope accumulated (Stern 1993, 1994a, 1995). As ecologists O'Neill and King (1998) and paleontologists Behrensmeyer and Schindel (1983) note, the degree and nature of time averaging set the grain or resolution of a deposit and, hence, the kinds of generating processes that can be interpreted.

Paleontologists have identified two other parameters describing overall deposit temporal structure. Behrensmeyer (1982) and Behrensmeyer and Schindel (1983) refer to the scope or total temporal time span represented in a deposit, as well as depositional gaps, owed to erosion or nondeposition, within a deposit. All of these parameters together—grain (influenced by time averaging), scope or span, and gaps—determine the kinds of processes and their tempos that are accessible through analysis of archaeological deposits, as emphasized by paleontologists and archaeologists (Bailey 2007, this volume; Murray 1997, 1999a, 2004; Stern 1993, 1994a).

Finally, Holdaway and I (2006) have recently called attention to the degree to which materials are *integrated* between occupation events, that is, remains from succeeding occupations are mapped onto or acknowledge remains from preceding occupations (see also Wandsnider 1992). For example, Bamforth, Becker, and Hudson (2005) find evidence that succeeding occupants of the Paleoindian Allen site in western Nebraska situated hearths and middens with respect to previously constructed features.

Paleontologists and archaeologists commonly rely on various standard chronometric tools to measure scope, gap, and grain. But within the resolution of these tools, other *taphochronometric* tools, which rely on the accumulation of traces by artifacts, features, and spaces over time (*sensu* Sullivan 1978, this volume), situationally permit a finer-grain temporal structure to be approached. For

TABLE 5.1. Model of Place History and Taphochronometric Indicators

Occupation		
Events	Grain or Span	Indicators
One	Short	Local tool source: high primary debitage/tertiary debitage ratio Little site structure Thermal features: charcoal and oxidation well preserved
	Medium	Thermal features: charcoal stains, little oxidation (Sharrock 1966)
	Long	Amorphous thermal features
Few	Short	Mean hearth area increases (Yellen 1977)
	Medium	Low fire-cracked rock (FCR)/thermal feature ratio
	Long	Unknown
Many	Short	Simple site structure Pit structures and other facilities (if anticipated reuse [Chatters 1987:343–346; Smith and McNees 1999]) Many hearth types (Yellen 1977) High standard deviation of hearth area High artifact/feature ratio
	Medium	High FCR/thermal feature ratio
	Long	Multiple modes of bone weathering (Behrensmeyer 1978) Complex site structure (Binford 1978a; O'Connell 1987; Wandsnider 1996) High thermal feature density High proportion of thermal features recycled into middens Overdeveloped anthropogenic A horizon (Eckerle and Hobey 1999) Low artifact/feature ratio

Note: With multiple events, artifact, core, and incomplete tool densities increase (Binford 1977a; Camilli 1988) and FCR fragment size decreases (Chatters 1987:345).

example, Holliday, Johnson, and Stafford (1999) consider the weathering profiles of faunal materials at Plainview and Firstview (American Great Plains) to argue for the relative contemporaneity (plus or minus 15 years, the temporal resolution of bone weathering) of these materials. Varien and Mills (1997) and Varien and Ortman (2005) consider the accumulation of sherds to estimate relative occupation spans of Puebloan sites in the American Southwest. Bamforth and colleagues (2005) consider accumulations of middens and hearths on an aggrading surface that was repeatedly visited at the Allen site. When dealing with aggradational and deflational deposits (e.g., Holdaway et al., this volume; Kelly 1988), archaeologists commonly employ such taphochronometric observations to strengthen interpretations of temporal grain finer than that accessible using standard chronometric tools, although often in an ad hoc manner. (For fluvial deposits, likely accumulating from multiple temporal planes, the use of taphochronometric tools to approach fine-grained interpretations is likely not valid, as discussed by Stern [1993, 1994a, 1995] in her analysis of Koobi Fora deposits.)

In what follows, I rely on a number of such tools (Table 5.1), each of them variously based in theory (e.g., radiocarbon dating [Newtonian physics]), empirical observation (e.g., repeatedly cleaned out hearths may grow), and intuition (e.g., the accumulation of features on a land surface). Because of space constraints, I will employ these tools without further substantiation, acknowledging that, in fact, such is critical. Indeed, many of these tools remain plausible, middle-range assertions. Only Yellen's (1977) observations on hearth "creep" and Behrensmeyer's (1978) observations on bone weathering have had some empirical scrutiny, but even that has been limited. Of course, available technology (e.g., the bow and arrow came into use here about 1800 BP; pemmican production, between 5000 and 3000 BP [Reeves 1990]), the nature of activities (e.g., retooling in anticipation of a major community hunt

as argued by Reher and Frison [1980] for the Vore site), season of occupation (with greater numbers of thermal features perhaps constructed in winter months), and other similar factors come into play when interpreting indicator values (as per Binford's [1980] comments on Yellen 1977). That is, these taphochronometric indicators are ambiguous, yielding nonspecific interpretations (but denying some interpretations [Wandsnider 2004]). Also, they very likely perform contextually, that is, differentially well in some contexts but poorly in others (Wandsnider 2004). For this reason, context-rich comparative (as opposed to simple diagnostic) analysis, undertaken here, is essential.

From notions of temporal structure come important implications for interpretation. Paleontologists (Behrensmeyer 1982; Behrensmeyer and Schindel 1983; Stern 1993, 1994a, 1995) contend that with fine-resolution geological deposits, one can begin to interpret fast-tempo processes, such as evolutionary changes in rapidly reproducing populations; fast-tempo processes, however, cannot be directly interpreted using coarse-grain geological deposits (also known in the spectral or sampling literature as the Nyquist effect). Thus, Stern (1993, 1994a) contends that discussions of behavioral and ecological processes at Koobi Fora are invalid, given the coarse grain (10,000-year span) of the deposits there. But by using various taphochronometric indicators on time-averaged aggradational and deflational deposits and the process-pattern strategy discussed below, temporal processes occurring at tempos faster than those resolvable geologically or chronometrically may be approached.

Processes and Place-Use Histories

Cultural anthropologists understand and describe hunter-gatherers in terms of how tasks are gendered and organized, how postmarital residence and inheritance are practiced, how identity and institutions are reproduced, the conditions under which sharing occurs, and so forth. Archaeologists, on the other hand, can see that hunter-gatherer technology has changed through time and can recognize that certain places have been extensively utilized or not. How each of these relates to larger issues such as the evolution of the cultural repertoire, in the instance of technology change, and issues of range compression or expansion or territoriality, in the case of persistent place use, remains to be argued. This discussion especially focuses on the latter, that is, regional place-use histories and their larger implications for understanding a multitemporal process we might gloss as land tenure.

Table 5.2 summarizes a variety of processes commonly reported on by anthropologists and others. As Butzer (1982), Bailey (1983), and archaeological Annaliste researchers (Bintliff 1991; Knapp 1992; Smith 1992) have emphasized, different processes unfold at different rates and become manifested over different lengths of time.

To diagnose temporal processes archaeologically, two strategies are available. The first depends on recognizing a sequence of conditions or states through time, with "time" monitored using standard chronometric tools and "condition" inferred from time-averaged assemblages. But the resolution of standard chronometric tools is only so fine, and here the second strategy becomes important. This strategy is seen in the study of spatial point processes (Gettis and Boots 1978; Graham 1980), where the task is to infer the generating process (operating at a particular frequency) from the distinctive pattern of points so produced by those processes. Here, I extend this same strategy to identify temporal/spatial processes responsible for distinctive patterning. The taphochronometric indicators discussed here work to inform on the operation of the temporal/spatial point processes that occur more rapidly than can be captured by standard chronometric indicators. The study presented here relies on both of these strategies, with standard chronometric tools used to order assemblages in time and taphochronometric tools utilized to approach "condition," as inferred from individual place-use histories.

Wyoming Basin

The Wyoming Basin, located in intercontinental northwestern North America (Figure 5.1), consists of a high plateau with many interconnecting smaller basins framed by the Wind River Mountains to the northeast, the Uinta Mountains to the south, and the Wyoming Overthrust Belt to the

TABLE 5.2. Processes by Length of Term over Which They Are Manifested

TERM	PROCESS	EXAMPLE/REFERENCE
Event Response		
Very short (subannual)	Mortuary preparations	Olivier 1999
Cyclical		
Very short (subannual)	Ritual cycle	
Short (annual–decadal)	Delayed reciprocity	Bailey 1983
	Logistical planning	Bailey 1983
	Monument use, maintenance	Olivier 1999
	El Niño climatic oscillation	
Intermediate (decadal–subcentury)	Territory expansion, contraction	
	Social reorganization, alliance reconfiguration	e.g., Nunamiut (Amsden 1977) !Kung (Wilmsen 1989)
	Market-based economic cycle	
	Ecological community reorganization	
Long (century)	Colonization, abandonment	
	Paleoclimatic reorganization	
Linear		
Short (annual–decadal)	Frontier evolution	Kealhofer 1999
Intermediate (decadal–subcentury)	Demographic infilling	Swedlund 1978
Long (centuries)	Technological change	e.g., Southern California (Broughton 2002)
Very Long (centuries–millennia)	Soil formation	e.g., Wyoming Basin (Eckerle 1997)
	Surface homogenization by biomechanics	e.g., Northern Rocky Mountains (Thoms 2007:504)

west (Fenneman and Johnson 1946). The Rock Springs Uplift is an anticline structure found in the southern-central portion of the basin. Landforms include cobble-mantled terraces, deflation basins, alkali flats, playas, dunes, and badland scarps (Love 1977; Thornbury 1965). Today, the area is best characterized as a cold semiarid desert with sagebrush steppe vegetation dominating in the west, mixed grasses occurring in the east, and saltbrush and greasewood occurring in drier portions of the interior basins (Küchler 1966). On the basin margins and the Rock Springs Uplift, mountain mahogany and other tree species reflecting generally moister conditions are found.

Paleoclimatic reconstructions indicate that climatic conditions have not always been as they are today, nor is climate uniform throughout the basin. As summarized by Eckerle (1997; see also Eckerle et al. 1999) for the basin proper, the Early and Middle Holocene was characterized by dry and drier conditions, evidenced by dune activation and deflation and accumulations of illuvial calcium carbonate. The development of oxidized B horizons or calcium carbonate horizons indicates localized surface stability. Cooler and moister conditions prevailed between 3300 and 1800 BP, when the Vonalee-Hiland paleosol developed in eastern portions of the basin. Drier conditions, indicated by reactivated dune sands, followed beginning as early as 2500 BP. From work in the Wind River Mountains, Fall, Davis, and Zielinski (1995) suggest that climatic shifts to cooler and moister conditions were first experienced at upper altitudes and later in the lower-altitude basins. In addition, west–east and south–north gradients in temperature and moisture are also seen.

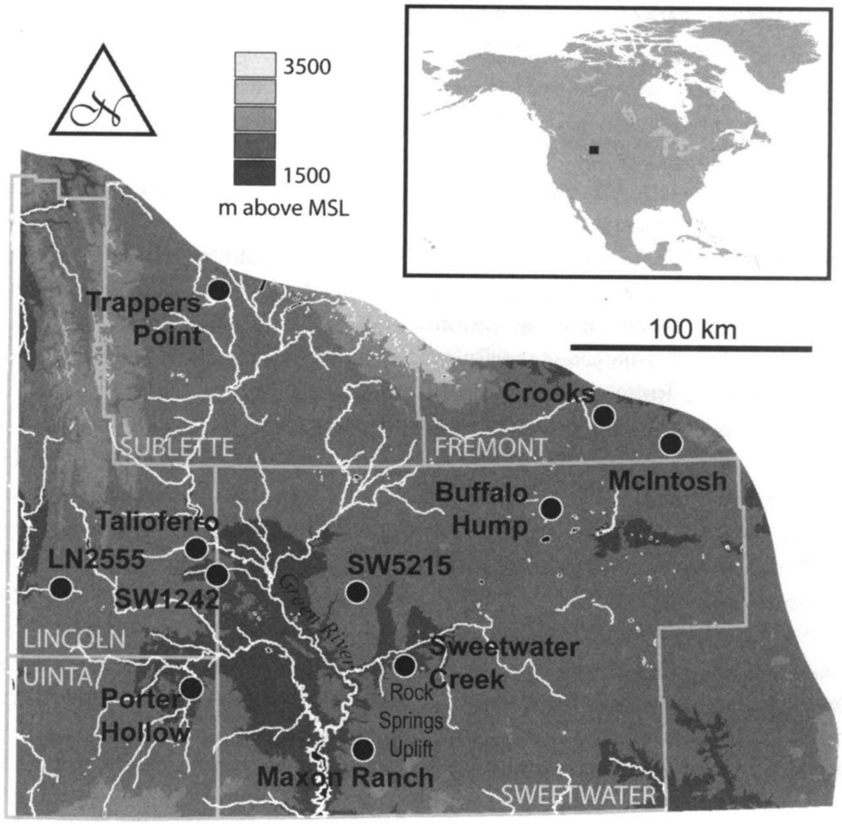


FIGURE 5.1. Wyoming Basin study sites.

The Wyoming Basin has been an arena for major research on past hunter-gatherer populations over the last 80 years, including pioneering work at the Finely site near Eden (Moss et al. 1951), which established a Paleoindian presence in the area, and on mass kill sites of bison (e.g., the Late Prehistoric Wardell site near Big Piney [Frison 1973]) and antelope (e.g., Austin Wash [Reiss and Walker 1982]). (See Eckerle et al. 1999 for a recent overview.) Most recently, compliance archaeological work prompted by major energy development has been responsible for a great deal of activity here.

Interpretations offered through this work reflect the great strides made in hunter-gatherer archaeology during the 1960s–1980s by archaeologists (e.g., Robert Bettinger, David Hurst Thomas) working in the nearby Great Basin, ethnoarchaeological work from around the world, and Binford's theorizing on hunter-gatherer organization. Creasman and Thompson (1997) have summarized the salient features of much of this work, offering a model of settlement/subsistence for the area. They report that paleobotanical and faunal indicators in general suggest a winter use of the higher-altitude sites and summer use of interior basin sites during both the Archaic and Late Prehistoric time periods. Other work notes the increase in interior basin seed processing during Late Prehistoric times (Smith 1988), along with increased evidence for mass kill events starting in the Late Archaic.

Here, as well, Ebert (1992) develops the notion of distributional archaeology, which explores multiscalar patterning in surface assemblages and interprets that patterning in terms of supragenerational systemic poses of hunter-gatherer groups. In addition, Harrell, Hoefer, and McKern (1997), Larson (1997a, 1997b), Waitkus and Eckles (1997), and Smith and McNees (1999) have addressed issues

TABLE 5.3. Wyoming Basin Cultural Chronology

Uncalibrated Radiocarbon Years (BP)	Period	Phase	Cultural Markers
650–150	Late Prehistoric	Firehole	Poorly known
1,800–650		Uinta	Major increase in radiocarbon dates, mass kill sites, bow and arrow technology, seed processing
2,800–1,800	Late Archaic	Deadman Wash	Trough in frequency of radiocarbon dates
4,300–2,800		Pine Springs	Peak in frequency of radiocarbon dates; appearance of stemmed/indented and corner-notched projectile points
6,500–4,300	Early Archaic	Opal	Pit structures, below-ground storage
8,500–6,500		Great Divide	Poorly represented
12,000–8,500	Paleoindian		Poorly represented

Source: Eckerle et al. 1999; Thompson and Pastor 1995.

of land use stability, especially during the Early Archaic, focusing on facilities that they argue were the focus of deliberate anticipated reuse over hundreds of years.

The analysis here relies on excavations carried out at archaeological sites in basin interior and upland marginal areas as well as on the Rock Springs Uplift as part of compliance activities. Because components dating to the Early and Late Archaic and Late Prehistoric are well represented in these data, with Paleoindian and recent components being poorly represented, I only focus on these intermediate time periods. In addition, the majority of the components discussed here come from the Opal (Early Archaic), Deadman Wash (Late Archaic), and Uinta (Late Prehistoric) phases as defined by Thompson and Pastor (1995; see Table 5.3). Thirty Early Archaic to Late Prehistoric components from 11 sites were excavated and reported on by Archaeological Services (Western Wyoming College), Mariah Associates, the Office of the Wyoming State Archaeologist, and the Bureau of Land Management during the 1980s and 1990s (Table 5.4, Figure 5.1). These state-of-the-art endeavors typically present careful descriptions of material culture—pit structure, thermal, and other features; chipped-stone, ground-stone, and bone artifacts; and faunal remains—along with palynological and macrobotanical studies. Importantly for my purposes, almost all include high-quality geomorphological and geoarchaeological analyses. Analyses conducted in the 1980s and 1990s paid very close attention to cultural chronology as well as functional matters; in the 1990s, issues of deposit formation history and settlement stability also were considered, and these are further elaborated on here.

Temporal Structure of Wyoming Basin Components

The temporal structure of individual site deposits is owed to both geomorphological factors and human land-use factors operating at many different time scales. Here, I first attempt to assess the nature of the geomorphic packages in which cultural materials were found, highlighting what they can tell us about the availability of that surface to accumulate cultural remains, that is, to record place-use histories. I next consider evidence for actual or realized place-use histories. The final result represents an attempt to recognize variation in place history at the supra-annual, generational, and supragenerational temporal scales.

Geomorphological Factors

Surface stability and sediment accumulation are controlled by both regional and local factors. Regionally, effective moisture and vegetation cover, especially that of grasses, correlate with surface stability (Eckerle 1997:142). These regionwide conditions are differentially expressed in local deposits, documented at archaeological and geological sites,

TABLE 5.4. Wyoming Basin Excavated Components by Basin Location

Site (ID)	Elevation (ft)	Component	Features	Radiocarbon Age (bp)	Period/Phase	Comment/ Reference
Interior Basin						
48LN1468 Talioferro	2,600	1	2	5290 ± 190	E.A. Opal	Horizontal and vertical components (Smith and Creasman 1988)
		2	2	5290 ± 190	E.A. Opal	
		3	6	1910 ± 110 2590 ± 90 2850 ± 90	L.A. Deadman Wash	
		4	9	1500 ± 70	L.P. Uinta	
		5	6	1310 ± 70	L.P. Uinta	
		6	4	1170 ± 60	L.P. Uinta	Pit structure
		7	3	960 ± 60	L.P. Uinta	
		8	0		Recent	
48SW1242	6,453	2	1	2170 ± 90	L.A. Deadman Wash	Hoefer 1986
		3	5	1540 ± 90 1550 ± 80	L.P. Uinta	
48UT401 Porter Hollow	6,500	1	1	10,090 ± 120	Paleoindian	Hoefer 1987
		2	9	2200 ± 80 2400 ± 80	L.A. Deadman Wash	
		3	0			
Rock Springs Uplift						
48SW2590 Maxon Ranch	7,400	1	9	6000 ± 130 6480 ± 90	E.A. Opal	Pit structure (Harrell and McKern 1986)
		2	12	4760 ± 130 4860 ± 110	E.A. Opal	Pit structure
		3	6	2250 ± 100 2180 ± 100	L.A. Deadman Wash	
		4	11	1140 ± 100	L.P. Uinta	
48SW5175 Sweetwater Creek	6,600	1	4	5130 ± 90	E.A. Opal	Pit structure; Components 1 and 2 difficult to separate in the field (Newberry and Harrison 1986)
		2	3	4380 ± 200	E.A. Opal	Vertical components
		3	1	3170 ± 60	L.A. Pine Spring	
48SW5215	6,860	1 (A)	4	5150 ± 100	E.A. Opal	Horizontal components (McKern 1987a)
		2 (B)*	4	1090 ± 60	L.P. Uinta	Reported as part of same component by author but considered separately here
		2 (C)*	4	990 ± 60	L.P. Uinta	Designated as component 3 here

TABLE 5.4. (cont'd) Wyoming Basin Excavated Components by Basin Location

SITE (ID)	ELEVATION (FT)	COMPONENT	FEATURES	RADIOCARBON AGE (BP)	PERIOD/PHASE	COMMENT/ REFERENCE
Basin Margin/Upland						
48FR1468 McIntosh	6,890	1	2	2770 ± 80	L.A. Deadman Wash	Horizontal components (Newberry and Hoefer 1987)
		2	1		L.A. Deadman Wash	
48FR1602 Crooks	6,920	1	4	4850 ± 70	E.A. Opal	Pit structure (McKern 1987b)
		2	9	4300 ± 70 4360 ± 90	E.A. Opal	Pit structures; one is a reconstruction of Component 1 PS
48LN2555	6,640	1	5	5260 ± 90	E.A. Opal	Vertical components (Reust et al. 1994)
		2	13	3070 ± 60 3180 ± 60 3250 ± 90 3420 ± 70	L.A. Pine Spring	
		3	5	1470 ± 70 2360 ± 90	L.P. Uinta L.A. Deadman Wash	
		4	0			
48SU1006 Trappers Point	7,300	7	1	4690 ± 110	E.A. Opal	Vertical components (Miller et al. 1999)
		5	7	5160 ± 210 5390 ± 70 5440 ± 80 5490 ± 60 5510 ± 160 5590 ± 100 5660 ± 100 5720 ± 70 5750 ± 80 5900 ± 160 6010 ± 130	E.A. Opal	Antelope bone abundant
		3	2	6180 ± 200 7880 ± 60	E.A.	
48SW5057 Buffalo Hump	6,770	1	4			Harrell 1989
		2	18	1480 ± 60	L.P. Uinta	Pit structures
		3	18	1250 ± 60 1290 ± 60	L.P. Uinta	Pit structure

Note: E.A. = Early Archaic, L.A. = Late Archaic, L.P. = Late Prehistoric.

as a consequence of the landform position of that location with respect to potential sources of sediment, local wind directions, and so forth.

Geomorphologists reporting on archaeological sediments routinely distinguish among those sediments deposited because of alluvial, eolian, colluvial, and fluvial processes as well as the nature of the contacts between sediment packages. In addition, it is useful to distinguish eluvial (accumulations of silts and clays owed to subsurface weathering) and illuvial (airborne dust that has leached into subsurface horizons) horizons and the paraconformities (deflated surfaces) that commonly cap them. Unfortunately, given the sandy nature of many of these deposits and the fact that archaeological work often precedes geomorphological sampling, the correspondence between archaeologically defined packages of sediments, that is, components, and their boundaries compared with chronostratigraphy defined by geomorphologists in the field and through laboratory analysis is sometimes modest. Here, I rely on these geomorphological interpretations to approach an understanding of surface stability as well as relative rates of sediment accumulation (Table 5.5, page 71.).

Abstracted from Table 5.5, Table 5.6 shows that there are the expectable trends in surface stability for components depending on site location. In the interior basin, deflation and aggradation are common, and stable surfaces or surfaces with slow aggradation are rare. In upland areas on the basin margins and the Rock Springs Uplift, sediment accumulation is generally slower and assisted by vegetation entrapment of fine sands, with some evidence of more rapid aggradation for Maxon Ranch (MR) Component 2 (referred to hereafter as Maxon Ranch-2 or MR-2).

At this point, actual values cannot be assigned to rates of accumulation or deflation. Also, it is unclear whether we can assume that basin upland "slow accumulation" is equivalent to basin interior "slow accumulation." Given the different moisture regimes seen in upland and interior basin areas (as reflected by modern vegetation), some differences in sediment accumulation rates under conditions of sparse vegetation likely exist. Table 5.7 reports on those components for which multiple radiocarbon dates, usually from thermal features, are available. Minimum number of radiocarbon occupations (statistically determined using OxCal 3.8 X^2 goodness-of-fit tests [Bronk Ramsey 2002]) and span of occupation history (determined by simply subtracting the maximum radiocarbon mean from the minimum and by using the OxCal 3.8 span calculation [Bronk Ramsey 2002]) are also presented. Discounting the old wood problem, Table 5.7 indicates that for deposits accumulating on stable or slowly aggrading surfaces, occupation grain values as determined using radiocarbon dates might be either small or large, reflecting actual occupation history. That is, stable surfaces have the potential to accumulate occupational remains over short (Buffalo Hump [BH]-3, Crooks [Crk]-2) or long (Trappers Point [TP]-3, Maxon Ranch-1) time spans, and both extremes as well as values between those extremes are reflected in the Wyoming Basin data. Talioferro (Tal)-3 has a complex deflational and aggradational geologic history. Not surprisingly, widely disparate radiocarbon dates from features are reported here. A similar situation may obtain for LN2555-3, but there is insufficient evidence that deflation has occurred. Rapid aggradation is reported for SW1242-3 and Maxon Ranch-2. For these components, minimal occupational grain is also small.

For present purposes, I will assume that for components developed on stable and slowly aggrading surfaces, the potential for a large occupational grain (as distinct from and constrained by geological grain) is high and that there may be some amount of integration in the materials that

Table 5.6. Components by Surface Stability and Basin Position (N = 29 Components for Which Information Is Available)

	Basin Location	
Surface Stability	Interior	Margin or Rock Springs Uplift
Deflation or deflation/ aggradation	4	0
Stable or slow aggradation	3	18
Rapid aggradation	3	1

TABLE 5.5. Deposit Interpretation by Site, Strata, and Components

Site	Topographic Position	Aspect	Stratum	Stratum Thickness (cm)	Emplacement	Component	Interpretation	Cultural Deposit Thickness (cm)	Reference
McIntosh	Ridge	No slope	B		Medithermal	1	Slow aggradation; eolian deposit; fine silts and clays suggest aggradation under vegetated conditions; unconformity attributed to early Medithermal drought at base	10–20	Miller in Newberry and Hoefer 1987
			B		Medithermal	2	No information	10–20	
Crooks[a]	Eolian plain	No slope	V		Early Neoglacial	1(A)	Slow aggradation; wet-phase eolian shadow aggradation in coarse sands derived from conglomerate; no fine sediments available to show illuvial/eluvial modifications	25	Miller in McKern 1987b
						2(BD)		25	
Talioferro[b]	Interfluvial ridge	E	A-N2		Neoglacial	1(A)	Deflation; rests in sediments that accumulated during a transition to wetter times; on a paraconformity; stereonet analysis suggests deposits are deflated and severely eroded	0–20	Miller in Smith and Creasman 1988
			A-N4		Neoglacial	2(A)	Associated with an eluvial development in top of a stratum that accumulated during wetter times; also possibly associated with a paraconformity, and cultural remains may represent deflation	30	
			A-N4S2		Medithermal	3(A)	Dune shadow-type aggradation	10	
			A-S3		Medithermal	6(A)	Dune shadow-type aggradation with significant organic content; likely remains from several occupations present	60	
		N	B-2		Medithermal	4(B)	Not analyzed by Miller but likely the same as Component 6(A) above (with differences owed to northerly exposure and near ridge crest position)	20	
						5(B)		20	
						7(B)		20	
			B4		Recent	8(B)	Not analyzed by Miller	20	

TABLE 5.5. (cont'd) Deposit Interpretation by Site, Strata, and Components

Site	Topographic Position	Aspect	Stratum	Stratum Thickness (cm)	Emplacement	Component	Interpretation	Cultural Deposit Thickness (cm)	Reference
LN2555[c]	Gently sloping bench	SW	F (4b)	5–10	Late Holocene	4	Rapid aggradation; eolian sand with little pedogenic alteration; much bioturbation	?	Frederick in Reust et al. 1994
			DE (4a)	25	Late Holocene	3	Rapid aggradation; eolian sand with little pedogenic alteration	?	
			C/D (3/4a)	0	Middle/Late Holocene	2	At interface between lower colluvial deposit and upper eolian deposit	?	
			CD (3)	20	Middle Holocene	1	Slow aggradation; colluvial deposit with a weak soil; much bioturbation	?	
SW1242[d]	Ridge	No slope	IV		Late Neoglacial	2	Slow aggradation; eolian deposit aggrading under mesic conditions	20	Miller in Hoefer 1986
			IV		Early Medith-ermal	3	Rapid aggradation; eolian deposit aggrading under relatively xeric conditions	25–60	
Sweetwater Creek	Low-relief ridge	SE	C		Neoglacial	3	Slow aggradation; eolian shadow deposit aggrading during mesic intervals; no uncon-formity	20–30	Miller in Newberry and Harrison 1986
					Neoglacial	2	Slow aggradation; eolian shadow deposit aggrading during mesic intervals; no uncon-formity	10–30	
					Neoglacial	1	Slow aggradation; eolian shadow deposit aggrading during mesic intervals; no uncon-formity	10–30	
SW5215	Slope	SW	5 lower		Neoglacial	1(A)	Slow (mesic condition) aggradation; vegeta-tion likely present; "lower" illuvial and eluvial weathering horizons present; no deflation	24	Miller in McKern 1987a
			5 upper		Medithermal	2(B)	Slow (mesic condition) aggradation; vegetation likely present; "upper" illuvial depositional and eluvial weathering horizons present; no unconformity, no deflation	23	
						2(C)			

TABLE 5.5. (cont'd) Deposit Interpretation by Site, Strata, and Components

SITE	TOPOGRAPHIC POSITION	ASPECT	STRATUM	STRATUM THICKNESS (CM)	EMPLACEMENT	COMPONENT	INTERPRETATION	CULTURAL DEPOSIT THICKNESS (CM)	REFERENCE
Maxon Ranch[e]	Finger ridge	SW	6	10	(Recent)	4	Fluvial deposit with organics suggesting moister conditions	10	Harrell and McKern 1986
			4	20–30	(Late Holocene)	3	Eolian/colluvial deposit with illuvial horizon; much rodent disturbance (the age of which is unspecified)	20–30	
			3	20		2	Eolian/alluvial deposit	20	
			2/3	0	Altithermal	1	Situated on alluvial fan deposit; overlain by eolian/alluvial deposit	5	
Buffalo Hump	Slope	NE	III?			1	No information	10?	Miller in Harrell 1989
			III		Medithermal	2	Eolian shadow deposits with illuvial/eluvial development	10–20	
			V		Medithermal	3	Eolian shadow deposits with illuvial/eluvial development	10–15	
			VII		Medithermal	4	Eolian shadow deposits with illuvial/eluvial development	10	
Trappers Point	Saddle	W	III	10–18	Altithermal	III	Slow eolian accumulation of fine silty sand; anthropogenic A horizon situated on loamy fine sand; some evidence for deflation	10–18	Eckerle and Hobey in Miller et al. 1999
			V	5–15	Altithermal	V	Slow eolian accumulation of fine silty sand; anthropogenic A horizon situated on compact eolian sand surface with polygonal cracks	5–15	
			VII	10–40	Early Neoglacial	VII	Slow eolian accumulation of fine silty sand; anthropogenic A horizon in lightly stained eolian sand	10–40	

TABLE 5.5. (cont'd) Deposit Interpretation by Site, Strata, and Components

SITE	TOPOGRAPHIC POSITION	ASPECT	STRATUM	STRATUM THICKNESS (CM)	EMPLACEMENT	COMPONENT	INTERPRETATION	CULTURAL DEPOSIT THICKNESS (CM)	REFERENCE
Porter Hollow		NW	4–5		Late Medithermal–Recent	3	Shallow shadow deposits aggrading in a vegetated context with eluvial developments	10–30	Miller in Hoefer 1987
			3–4		Medithermal	2	Shallow shadow deposits aggrading in a vegetated context; eluvial developments present	8–28	
			1/2	0	Neoglacial	1	Deflation; on disconformity between strata; conflated cultural remains possible	10	

[a] Crooks site assemblages include Component 1, with one pit structure (A), and Component 2, with two pit structures (B and D). Pit structure D was constructed over pit structure A. Miller reports cultural deposits as present in middle sands from a more arid, active period. But his figures (which show some inconsistencies reflecting the confusion between natural and cultural stratigraphy) suggest that pit structures A, B, and D were constructed when upper sands were deposited, during a more mesic phase.

[b] Taliaferro was excavated in two blocks, A and B, each with its own stratigraphy. In addition, different stratigraphies were documented in the northern and southern portions of Block A, distinguished here as A-N2, A-S3, and so forth. Although the stratigraphy reported by Miller for Block A is more finely resolved than that reported by Smith and Creasman, the units developed by the latter are used here.

[c] At 48LN2555, stratigraphy was defined by archaeologists in the field (Strata A–F) and also by Frederick (Strata 1–4).

[d] Component 2 at 48SW1242 was not completely excavated to the base of this unit.

[e] Stratum and component thicknesses interpreted from stratigraphy.

Table 5.7. Minimum Component Grain

Site	Component	Surface Activity	No. Radiocarbon Dates	No. Radiocarbon Events	Years Radiocarbon Span (Maximum Mean–Minimum Mean)	Years Radiocarbon Span (68.2% Confidence Interval)*
Basin Interior						
SW1242	3	Rapid aggradation	2	1	10	0–500
Porter Hollow	2	Stable/slow aggradation	2	2**	200	250–950
Talioferro	3	Deflation/ aggradation	3	2	940	1,150–2,050
Basin Margin						
Buffalo Hump	3	Stable/slow aggradation	2	1	40	0–390
Crooks	2	Stable/slow aggradation	2	1	60	0–600
LN2555	2	Stable/slow aggradation	4	>1	350	250–840
	3	Rapid aggradation	2	2	890	1,200–1,830
Trappers Point	3	Slow aggradation	2	2	1,700	1,860–2,960
	5	Slow aggradation	11	4	850	380–810
Rock Springs Uplift						
Maxon Ranch	1	Stable/slow aggradation	2	2	480	530–1,430
	2	Rapid aggradation	2	2	100	0–810
	3	Stable/slow aggradation	2	1	70	0–690
SW5215	2	Stable/slow aggradation	2	1	100	0–120

*OxCal v3.8 (Bronk Ramsey 2002); atmospheric data from Stuiver et al. 1998.

**OxCal uses a χ^2 test to evaluate the null hypothesis that two or more radiocarbon sample results are actually from the same sample, in this case, occupation event. (If they are from the same event, OxCal recommends combining the results prior to calibration.) For the Porter Hollow results, OxCal returns a value of $T = 3.1$, which, for $df = 1$, does not exceed the critical value of $T_{\alpha=.05} = 3.84$ but does exceed critical $T_{\alpha=.10} = 2.71$. On this basis, I argue that it is not impossible that two different radiocarbon events were sampled here.

accumulate during multiple occupation events. That is, the potential for many occupation events and also feature reuse to have occurred on these surfaces is quite high. In deflational settings, the potential for large occupation temporal grain is also present, but the integration of materials between occupation events is variable, depending on when deflation occurred, between or after occupation events. In rapid aggradation settings, small occupational grain is more likely, and, depending on how quickly different occupation events follow each other, components might appear archaeologically integrated.

In what follows, I compare and contrast components from basin interior and basin margin/upland settings because previous archaeological work suggests site usage in different seasons and because of the different depositional regimes found there. I also consider the nature of surface activity, for, as discussed above, surface activity constrains the degree to which materials may accumulate on the available surface.

Occupation or Place Histories

Geomorphological processes contribute to temporal grain, but so do occupation events. More than 40 years ago, Floyd Sharrock, then working at Pine Springs, nicely laid out the situation: "From the evidence, it was impossible to determine whether the [Component] 1 material represented one group which camped over an extended period of time or returned regularly to the site for a number of years, or if it represented sequent usage by several groups with no significant time elapse between" (1966:22). Using several taphochronometric indicators in concert, I attempt to parse aspects of place-use history so as to partially resolve the conundrum identified by Sharrock.

Pit structure presence/absence and form have been used to argue for various interpretations of place histories (Gilman 1987; Larson 1997a). For example, Larson discusses pit structure use by past Wyoming hunter-gatherers in terms of increased sedentism and increased emphasis on plant food storage, especially in the Early Archaic, when possible storage features are reported for pit structures. She argues that more mobile food-storage strategies were pursued in the Late Archaic and Late Prehistoric, when seed processing and mass harvests of herbivores increased, corresponding to a decrease in pit structure construction. Figure 5.2 reports pit structure dimensions by component and time period. As seen here, Early Archaic and Late Prehistoric pit structures are represented in this data pool. In general, larger pit structures are more shallow than smaller pit structures, but two patterns are visible, shallow-floored and deeper pit structures. Specifically referring to Buffalo Hump pit structures, Creasman and Thompson (1997:277) suggest that small, shallow pit structures with few subfloor features might represent brushy windbreaks around kitchen activity areas rather than actual structures, and they do not distinguish between the slightly more shallow and slightly deeper pit structures seen here. The Crooks site pit structures, both shallow and deep, contain many thermal features and only one feature identified by excavators as a possible storage feature. Larson (1997a) presents a more comprehensive overview of Wyoming pit structures, and those reported on here are generally consistent with her findings, that is, most pit structures are found in margin/upland areas and early pit structures tend to be larger (here, greater than 250 cm in diameter) whereas later ones are smaller.

Figure 5.3 graphs fire-cracked rock (FCR) density versus chipped-stone debitage (estimated by summing primary and tertiary flake totals) density, highlighting the differences in composition between basin and marginal or upland assemblages in general. (Density was calculated by dividing totals by amount of area excavated.) In general, higher debitage and FCR densities are found for interior components, and very low debitage and FCR densities are found on the basin margins. The differential availability of toolstone, with sites near the cobble-mantled terraces of the Green River (Love 1977) showing very high debitage and FCR densities, may explain most of this patterning. Also, for interior basin assemblages, as FCR density increases, so does debitage density (Tal-2 being an exception to this trend), suggesting that FCR- and debitage-generating activities were being conducted during the same occupation event. There is

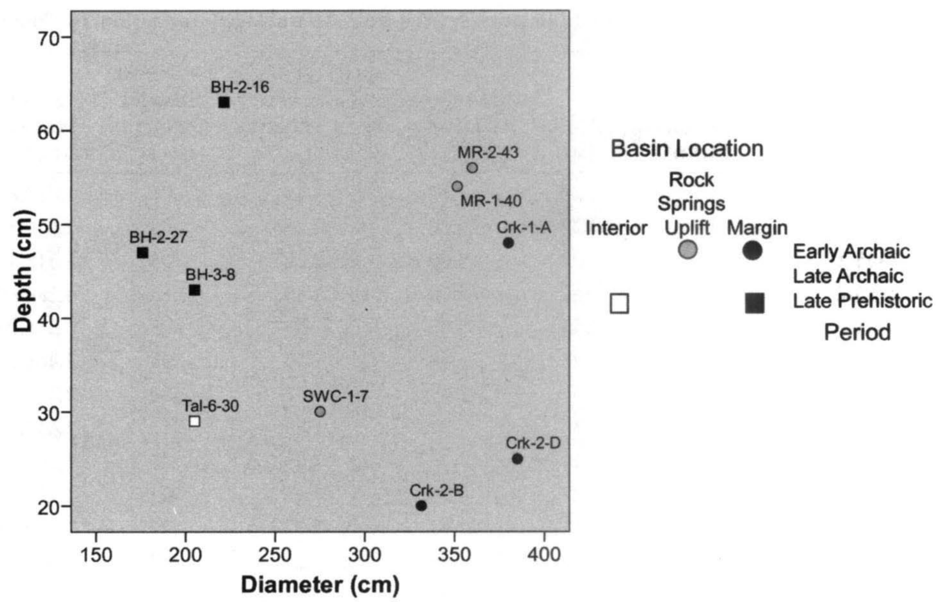


FIGURE 5.2. Pit structure dimensions by period and location. Symbol designations refer to component and feature identifiers. BH = Buffalo Hump, Crk = Crooks, MR = Maxon Ranch, SWC = Sweetwater Creek, Tal = Talioferro.

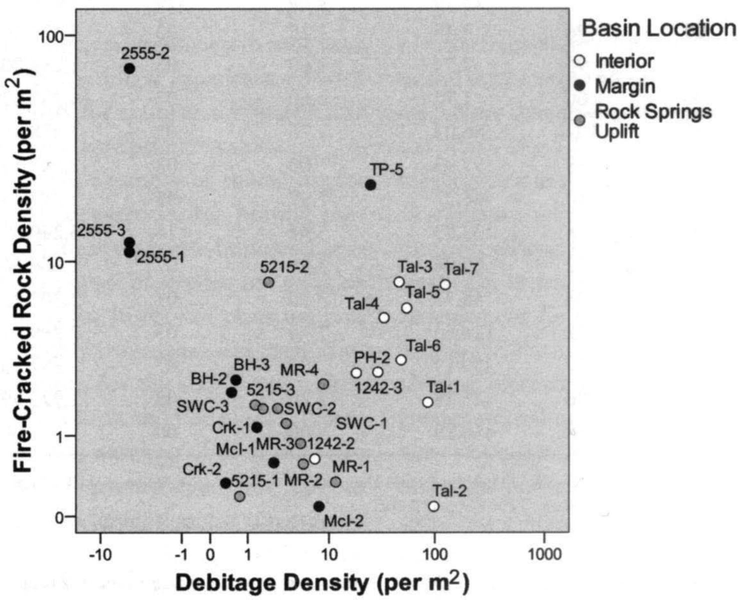


FIGURE 5.3. Fire-cracked rock versus debitage densities by location. Symbol designation refers to component identifier. Note logged axes. Debitage values for LN2555 components are not compatible with other debitage values and thus are not graphed here. 1242 = SW1242, 2555 = LN2555, 5215 = SW5215. BH = Buffalo Hump, Crk = Crooks, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

Table 5.8. Taphochronometric Indicators Derived from Assemblage Information, by Component

Site Component	Bone Weathering Mode	Area (m^2)	Debitage Density (per m^2)	Fire-Cracked Rock Density (per m^2)	External Hearth Density (per m^2)	Mean Hearth Area (cm^2)	Standard Deviation Hearth Area (cm^2)
1242-2	1	220	7.17	.59	.00	1,812.67	.00
1242-3	1	220	29.62	2.73	.02	2,670.87	3,224.87
2555-1	>1	102	−5.00	12.26	.05	1,318.47	869.91
2555-2	3	66	−5.00	71.83	.18	4,186.60	2,983.69
2555-3	3	154	−5.00	11.07	.03	3,558.04	1,091.27
5215-1	.00	48	.69	.10	.08	2,468.28	1,681.78
5215-2	.00	32	2.09	7.97	.13	2,317.57	2,504.72
5215-3	.00	36	1.33	1.69	.11	1,547.09	673.18
BH-2	1	219	.42	2.05	.03	1,206.11	671.66
BH-3	1	227	.56	2.45	.04	1,471.40	902.91
Crk-1	3	12	1.42	1.17	.00	3,700.48	2,855.03
Crk-2	>1	35	.26	.26	.00	2,075.88	1,674.39
McI-1	.00	60	2.45	.53	.03	2,379.92	.00
McI-2	>1	12	7.92	.00	.08	594.98	.00
MR-1	.00	115	11.66	.27	.09	3,498.90	2,159.11
MR-2	.00	115	5.40	.51	.10	2,647.93	1,490.41
MR-3	.00	100	5.07	.85	.06	3,263.70	1,632.23
MR-4	.00	100	8.78	2.32	.11	3,173.62	1,702.56
PH-2	>1	56	18.50	2.70	.16	1,096.97	836.85
SWC-1	.00	96	3.48	1.25	.03	3,426.20	1,672.66
SWC-2	.00	96	2.74	1.60	.03	1,258.80	.00
SWC-3	.00	60	1.75	1.60	.02	14,338.52	.00
Tal-1	.00	102	86.03	1.76	.02	1,888.99	.00
Tal-2	>1	58	97.93	.00	.03	2,047.12	113.49
Tal-3	3	116	46.77	7.97	.05	1,712.43	1,079.89
Tal-4	3	58	33.83	5.34	.16	3,240.89	3,266.45
Tal-5	3	92	55.04	5.98	.07	1,666.66	1,155.52
Tal-6	3	128	48.77	3.20	.02	2,302.23	3,464.50
Tal-7	3	92	124.63	7.74	.03	2,799.91	1,935.68
TP-3	>1	27	359.19	.00	.07	882.93	.00
TP-5	1	86	25.28	22.20	.08	1,922.99	1,372.11
TP-7	1	38	458.29	.00	.00	.00	.00

Note: 1242 = SW1242, 2555 = LN2555, 5215 = SW5215, BH = Buffalo Hump, Crk = Crooks, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

some evidence for a negative relationship between FCR and debitage density for the Rock Springs Uplift assemblages (Maxon Ranch, Sweetwater Creek [SWC], SW5215), perhaps reflecting that available toolstone could be used in heat-assisted processing or to make chipped-stone tools but not both. Trappers Point, located at a relatively high elevation but near the Green River, shows very high FCR and debitage densities.

Table 5.8 summarizes selected taphochronometric indicators suggested to be sensitive to occupation frequency and integration for artifact assemblages and features. Approximately a hundred primary variables, for example, excavated area,

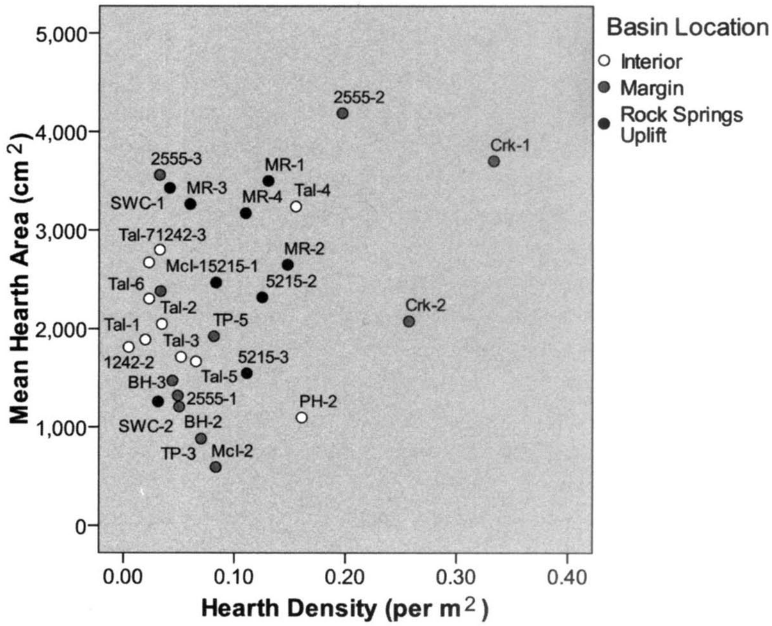


FIGURE 5.4. Mean hearth area versus hearth density by location. Symbol designation refers to component identifier. 1242 = SW1242, 2555 = LN2555, 5215 = SW5215. BH = Buffalo Hump, Crk = Crooks, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

chert primary debitage, and mean hearth area, were extracted from reports; I have experimented with another 70 indicators, for example, thermal feature density, derived from these primary values.

Hearths can serve a variety of functions, for food and material preparation, for heating purposes, for light, and for sweat baths. Ethnoarchaeological work across a range of settings has revealed trends that relate to the history of place use but, again, are likely highly contextual and even idiosyncratic. For example, for the arid Western Desert of Australia, Nicholson and Cane (1991) report a relationship between numbers of occupants and numbers of hearths, in part related to the number of sleeping fires, often large, that are constructed for warmth. Yellen's (1977) !Kung data indicate that specialized hearths (for head roasting, arrow preparation, etc.) are constructed on the margin of domestic areas and that such specialized hearths, corresponding to rare events, accumulate as occupation length increases. Fisher, Strickland, and Strickland (1989), reporting on their work with Efe camps, find no such pattern but do find several hearths in each dwelling. As well, hearths may go in and out of use to accommodate social and physical factors that arise as occupation continues (e.g., the Mask site [Binford 1978a]). Finally, hearths may increase in size as they are repeatedly used and cleaned out; Yellen's (1977) data for mapped !Kung campsites shows hearth "creep" with reuse. A fuller treatment of patterning in hearth size and spatial arrangement by context and occupation history is required but is not attempted here. Suffice it to say that increasing hearth density likely bespeaks greater overall occupation time. Hearth size, perhaps responsive to particular functions (sleeping fire, mass processing of roots) but also reflecting clean out events, may also inform on occupation history.

The remaining figures present information on thermal features with respect to other variables. In Figure 5.4, hearth mean area is graphed against overall hearth density. The Crooks components and Porter Hollow (PH)-2 have higher hearth densities, and the former have very high mean areas, compared with other components. For the Crooks

components, excavation occurred solely within the pit structures found there, so hearth density may appear inflated. The inferred season(s) of use, however, may be of interest; that is, perhaps the high hearth density relates to winter occupation events. In fact, perhaps because information pertains to interior space or because occupation did occur in the winter, no seasonal indicators are reported for these components, in contrast to other components where pollen, fauna, or macrobotanical remains offer some indication. In what follows, because of the likelihood of greater sensitivity to occupation history, I focus on external hearth density, calculated using the numbers of hearths occurring outside of pit structures or in components for which no pit structures are reported. The Crooks components are not represented in these graphs, and the aberrantly high mean hearth size for SWC-3 also precludes its display.

Figure 5.5a–d presents mean hearth size versus external hearth density coding components in a variety of ways. I first consider estimated numbers of occupation events determined using numbers of bone weathering modes and radiocarbon events (see Table 5.7). Although Lyman and Fox (1989) challenge the dating potential of bone weathering as initially argued for by Behrensmeyer (1978), southwestern Wyoming archaeologists find it useful to assess relative depositional contemporaneity or the degree to which different preservational regimes existed at a particular site. For example, for Trappers Point-5, researchers argue that the variation seen in bone surface weathering is owed to geomorphic rather than temporal factors (yet radiocarbon assay results would support that multiple occupations occurred here). For this reason, numbers of bone weathering modes were not considered for components with a deflational or deflation/aggradation history. (Bone weathering assessments are not reported for the Rock Springs Uplift components, and, furthermore, many hearths there were either lined [Sweetwater Creek components] or built into bedrock [MR-1: 100 percent hearths in bedrock; MR-2: 94 percent; MR-3: 83 percent; MR-4: 9 percent], so hearth area may not monitor actual occupation history in the same fashion as it does for other components.)

Figure 5.5a shows that low mean hearth sizes and low external hearth densities are reported for components for which only one occupation event can be determined. As mean hearth size increases, so does the number of estimated occupation events; likewise for external hearth density. The highest numbers of estimated occupation events correspond to those components with very high mean hearth areas and external hearth densities. Indeed, on the basis of qualitative analysis of multiple lines of evidence, Reust and colleagues (1994) explicitly state that LN2555-2 appears to represent several occupation events.

Figure 5.5b considers the same relationship, this time coding components according to surface activity. Reports, especially those from the 1990s and later, often discuss whether hearths might be deflated or the degree to which the remains on surfaces may represent a palimpsest (e.g., TP-3 [Francis and Sanders 1999:41]). Thus, we might expect components with a deflational history (Tal-1, Tal-2, Tal-3, Tal-7) to preserve relatively fewer hearths and therefore show an artificially depressed external hearth density. Tal-3 and Tal-7 (Figure 5.3) manifest relatively high FCR densities, consistent with the proposition that hearth features have deflated but FCR has persisted. Miller (in Smith and Creasman 1988) conducted a stereonet analysis of Tal-1 remains and concludes that it was seriously eroded and deflated. Some evidence for the deflation of cultural materials is also reported for Tal-2.

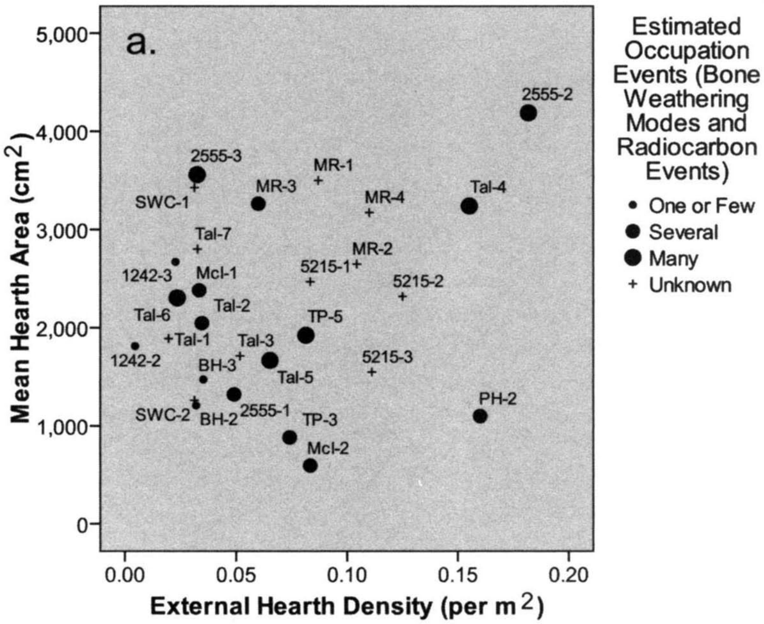
Figure 5.5c presents this information again, this time coding components for number of pit structures documented (symbol shape) and for the nature of the site structure (feature tethered, feature coincident, feature tethered/coincident, and feature negative). Gross aspects of site structure can be interpreted by looking at how lobes of high-density artifact, faunal, or FCR distributions (depicted using contour mapping) articulate with features. Typically, high artifact density corresponds to small artifacts accumulating as primary refuse (Metcalfe and Heath 1990; Simms and Heath 1990). If features appear to anchor such lobes (e.g., SW1242-2, Tal-3, Tal-4, Tal-5, Tal-6, Tal-7), then a simple structure, representing a limited span of occupation (hours, days), few occupants, and low debris-generation

activities, is indicated (Wandsnider 1996). On the other hand, high-density (likely, small) artifact areas are sometimes coincident with features (e.g., SW1242-3, TP-3). In this case, specialized hearths may have been constructed in midden areas that developed through extended occupation, as argued by Bamforth and colleagues (2005) for the Allen site. Alternatively, operational hearths may have been shifted to accommodate changing physical or social circumstances, as seems to have occurred at unconstrained open-air sites (in contrast to cave sites [Galanidou 1997b; Goreki 1991]) that were occupied for a day (or longer [Wandsnider 1996]). Both of these alternatives are congruent with an interpretation of a single but extended occupation. Finally, hearths associated with one occupation event may have been constructed, deliberately or not, in the primary refuse of an older occupation event or vice versa. Such an interpretation is consistent with repeated occupation events without integration of activities between those events. Interestingly, for some components, usually in basin margin or upland settings (e.g., LN2555-2, BH-3, MR-4), site structure that is both feature tethered and feature coincident is evident. A feature-negative pattern is reported for TP-5, meaning that features and high-density artifact concentrations seem to be mutually exclusive. Such a pattern may develop if hearth- and chipped-stone- or faunal debris–generating events occurred contemporaneously or visitors to a littered, nonabsorbent surface sought out unlittered work space. (TP-3 may manifest a similar pattern, but the area excavated here is both small and irregularly shaped, precluding a good assessment of site structure.)

In Figure 5.5c, many of the components with a simple, feature-tethered site structure are located in the lower-left quadrant of the graph. Generally more complex, feature-coincident or feature-tethered/coincident site structures are seen for components suggested in Figure 5.5a to have more complex occupation histories. In addition to deflated component Tal-7, components LN2555-3 and McIntosh (McI)-1 are exceptions to this trend. In these instances, perhaps function is trumping occupation history; that is, whatever activities occurred here over the short term, a few very large hearths were required. The more complex site structure apparent at BH-2 and BH-3 might be attributed to either higher occupant density or extended occupation length of the pit structures there, as opposed to reoccupation. Other components with pit structures (Tal-6, SWC-1; MR-2 is an exception) are also located in the left half of the graph. The location of pit structures may have constrained the location of other features and, with site reoccupation, may have invited feature reuse if sufficient time had elapsed for vermin to decline (Wandsnider 1992). Indeed, pit structure D (Crooks-2) was located directly above pit structure A (Crooks-1), indicating some integration here even between components.

If artifact and fauna minimum number of individuals (MNI) amounts might serve as a rough measure of amount of activity (as assumed by Dancey [1973] and argued by Varien and Ortman [2005]), then such densities are generally supportive of the trends reported above, as seen in Figure 5.6a–d. That is, higher relative densities are seen for components with complex occupation histories. (Relative densities were calculated by producing z-scores for density values according to geographic location. For example, density values for all Rock Springs Uplift components were standardized independent of the standardization conducted for interior basin or basin margin components, allowing for the gross control of differences in chipped stone sources, animal habitats, and so forth. Trappers Point components were considered with the basin margin classes of components for ground stone and mammal densities but with the basin interior components for FCR and debitage densities. Density z-scores were then classified.) Note that for chipped stone and FCR, just a few components have extremely high densities, so that the majority of the components appear to have moderate (z-score: -1 to 0) and high (z-score: 0 to 1) densities.

A simple sum of standardized ground stone, FCR, and MNI densities in Figure 5.7a again shows relatively high densities associated with those components that other evidence suggests had complex (longer or extended) occupation histories. The same is seen when chipped-stone debitage density z-scores are added to the preceding score (Figure



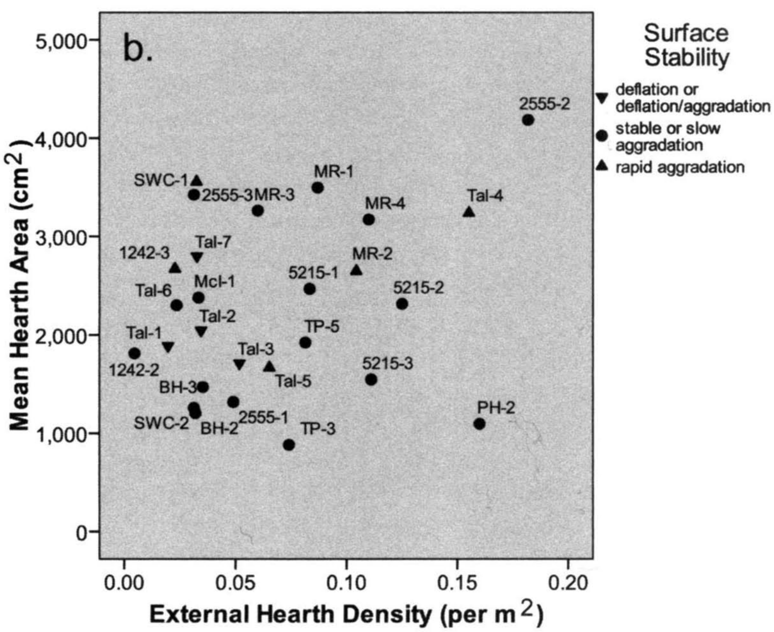


FIGURE 5.5. Mean hearth area versus external hearth density by (a) estimated minimum number of occupation events, (b) surface stability, (c) pit structures and site structure, and (d) seasonal indicators. Symbol designation refers to component identifier. 1242 = SW1242, 2555 = LN2555, 5215 = SW5215. BH = Buffalo Hump, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

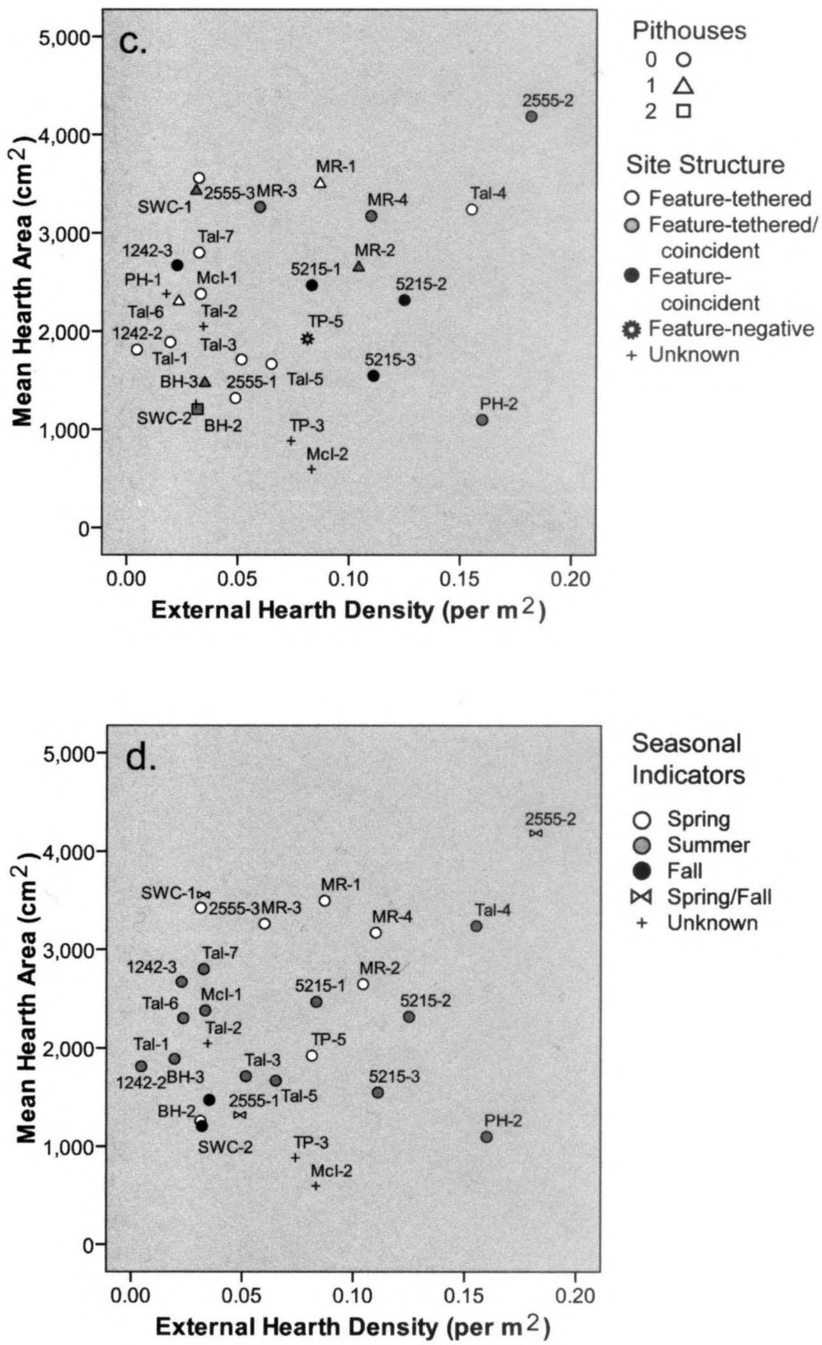


FIGURE 5.5 continued.

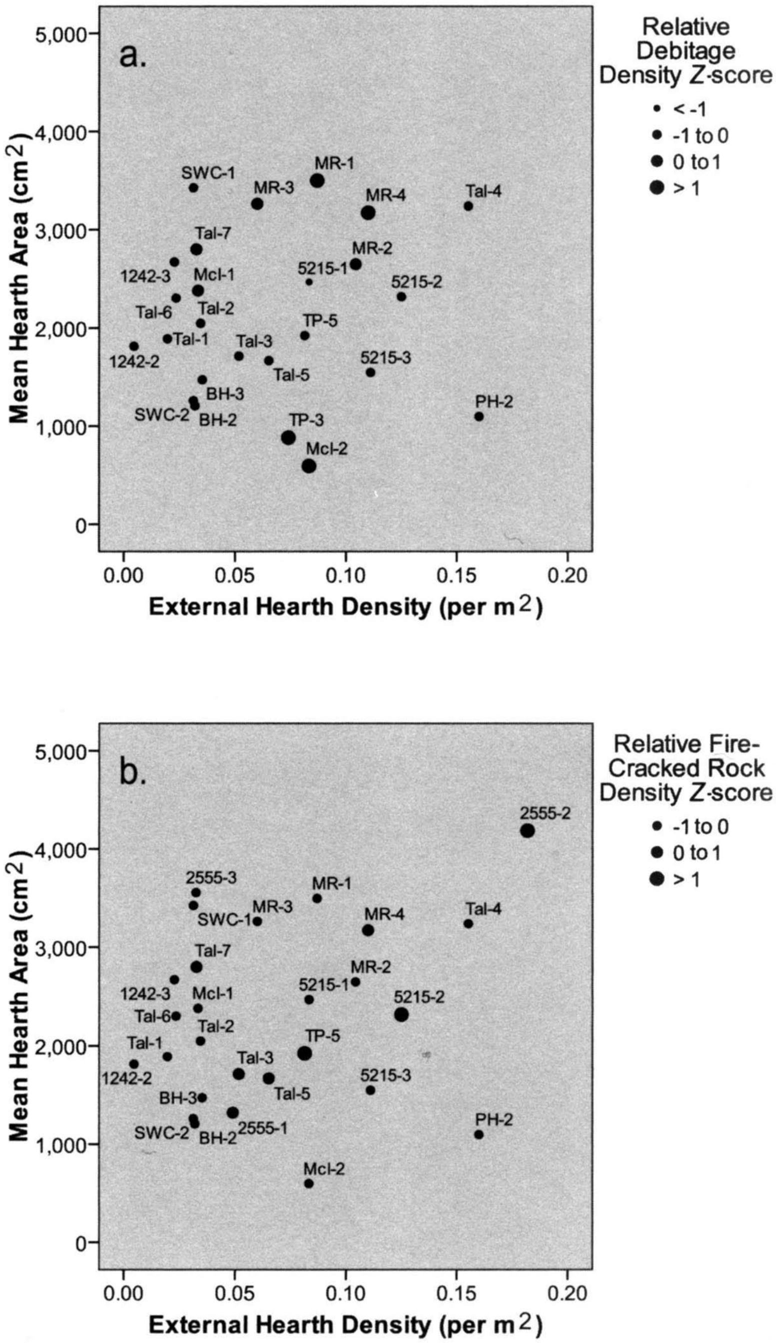


FIGURE 5.6. Mean hearth area versus external hearth density by (a) relative debitage density *z*-score, (b) relative fire-cracked rock density *z*-score, (c) relative ground stone density *z*-score, and (d) relative minimum number of individuals density *z*-score. Symbol designation refers to component identifier. 1242 = SW1242, 2555 = LN2555, 5215 = SW5215. BH = Buffalo Hump, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

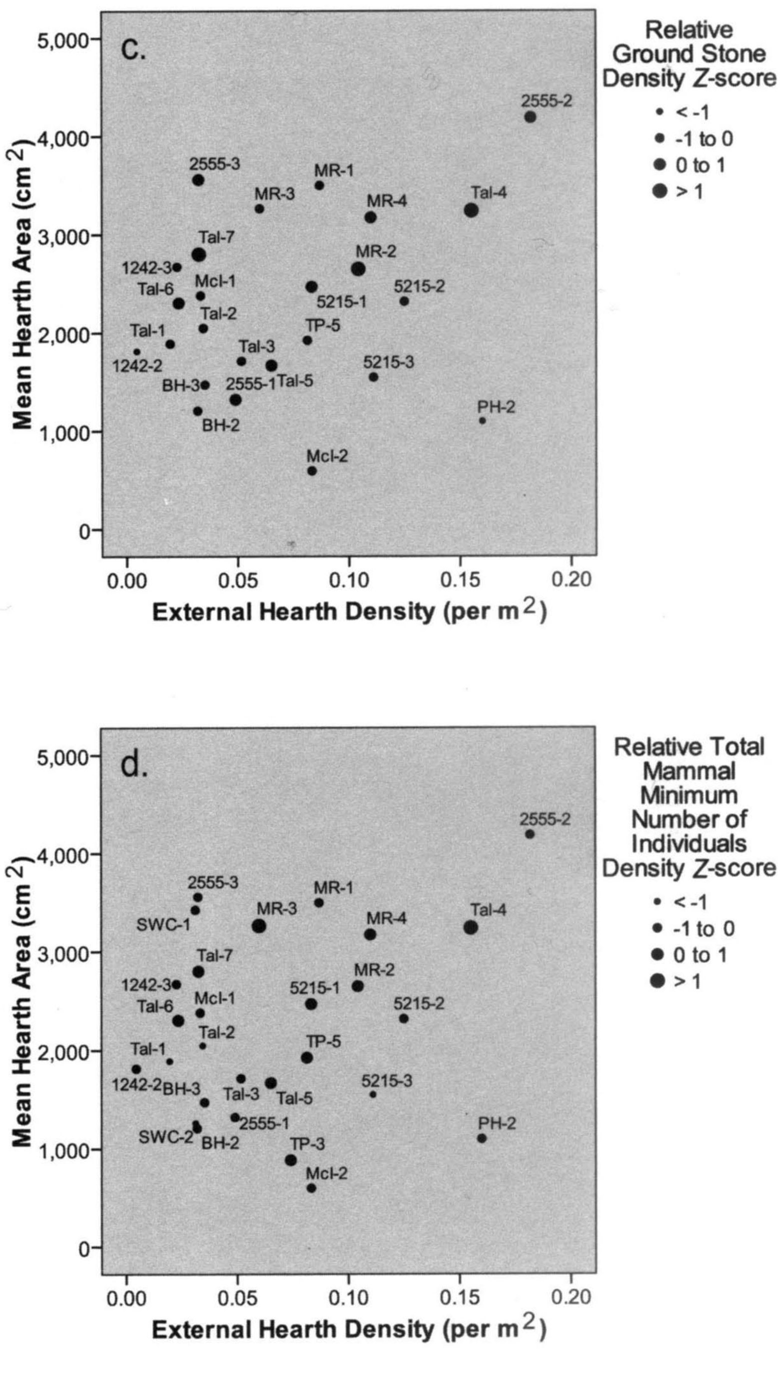


Figure 5.6 continued.

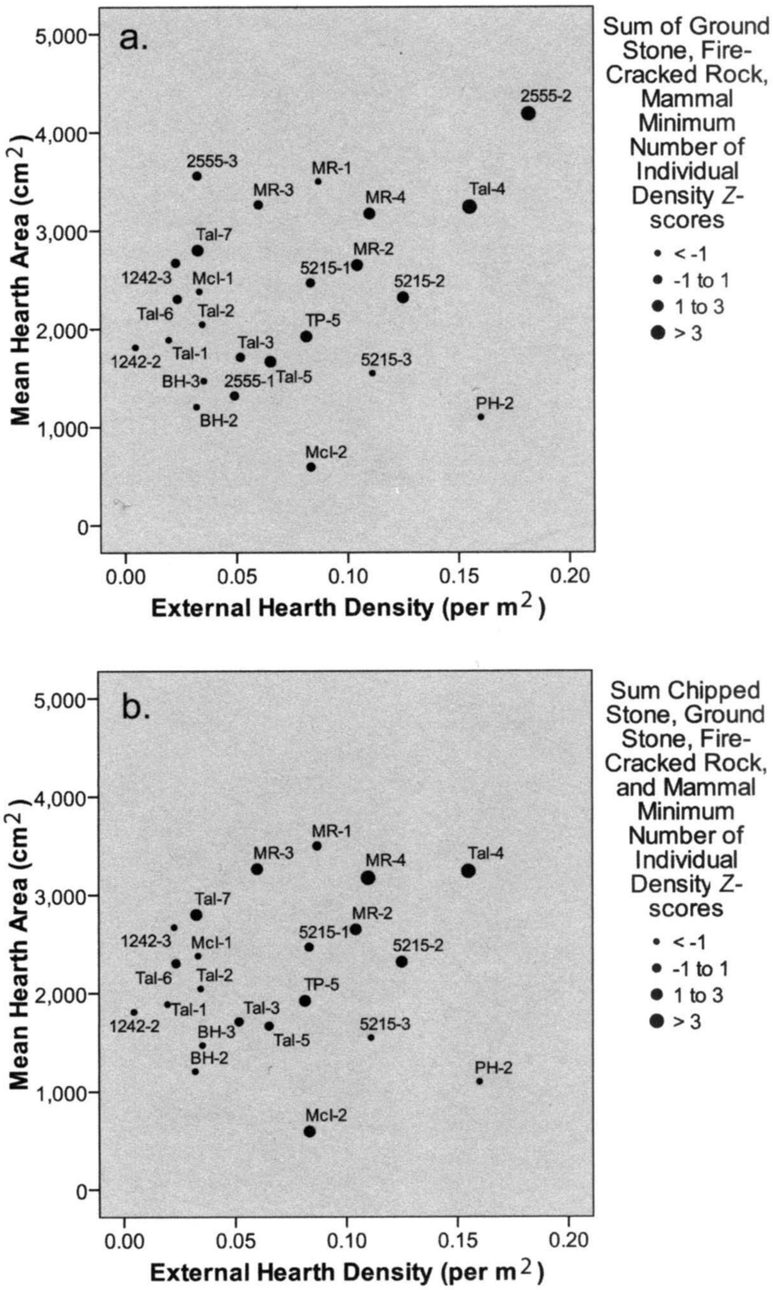


FIGURE 5.7. Mean hearth area versus external hearth density by (a) the sum of relative fire-cracked rock (FCR), ground stone, and minimum number of individuals (MNI) density *z*-scores; and (b) the sum of chipped stone, FCR, ground stone, and MNI density *z*-scores. 1242 = SW1242, 2555 = LN2555, 5215 = SW5215. BH = Buffalo Hump, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, Tal = Talioferro, TP = Trappers Point.

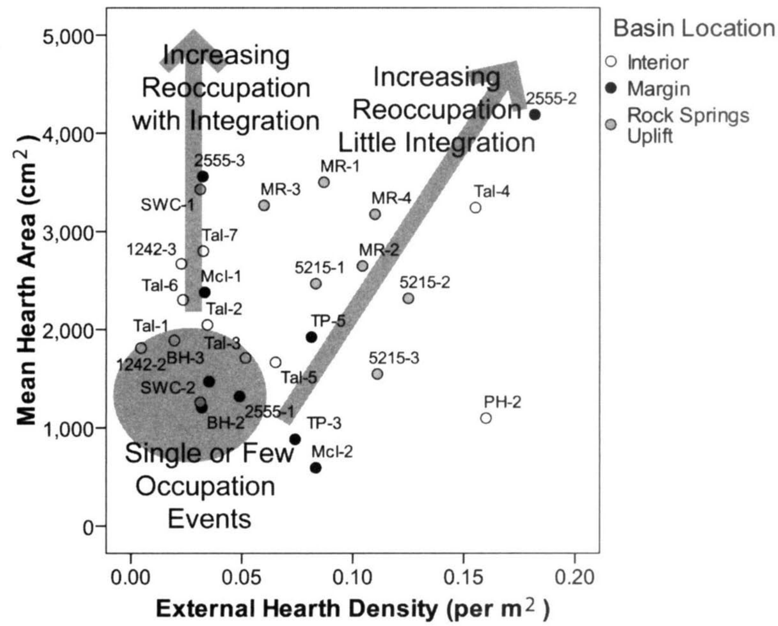


FIGURE 5.8. Occupation frequency and integration. 1242 = SW1242, 2555 = LN2555, 5215 = SW5215. BH = Buffalo Hump, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

5.7b). (Because of how chipped stone is reported, the LN2555 components are excluded here.)

Figure 5.5d considers these assemblages in terms of available seasonal indicators interpreted by Creasman and Thompson (1997) and augmented by individual site reports. Sweetwater Creek (SWC-1, SWC-2) and Maxon Ranch components as well as TP-5 have evidence for spring occupations; many of the interior basin components as well as SW5215 components and McI-1 show evidence (usually in the form of pollen) for summer occupations; and the Buffalo Hump components appear to be owed to fall occupation events. Of course, it is difficult to say if all occupation events responsible for a particular component occurred during only one particular season. The LN2555 components are interesting in this regard, in that both spring (fetal bones and eggshells) and fall (high charred seed counts) occupations are indicated. The Sweetwater Creek and Maxon Ranch components are also interesting because, as mentioned above, hearths here are often lined (Sweetwater Creek) or constructed in bedrock (Maxon Ranch). Perhaps particular spring tasks required a specific hearth environment. In terms of occupation history, there is no obvious patterning in terms of seasonal indicators.

Based on the patterns reported here, I offer the following interpretations in Figure 5.8. The lower-left quadrant cluster of components (along with McI-1 and LN2555-3) appear to reflect single (or a few) occupation events. The remaining components are the result of several or more occupation events. If features were reused and no new hearths were added to the surface, that is, reoccupation occurred with integration, then the low hearth densities but high mean hearth sizes seen in the upper-left quadrant would result. Reoccupation with little integration resulted, I suggest, in the components seen in the right half of the graph. The degree of reoccupation for these components is reflected by increasing values of external hearth densities, mean hearth areas, and artifact densities.

Discussion

Mark Varien (1999, 2002) and colleagues (Varien and Mills 1997; Varien and Ortman 2005) working in the prehistoric Puebloan American Southwest have relied on accumulations of common artifact

classes, primarily cooking vessel sherds, to measure the occupation spans of various kinds of architectural deposits. With these inferences, they have been able to approach interpretations of land tenure and evolving political economy there. Can similarly rich interpretations be offered for prehistoric hunter-gatherer land use in the Wyoming Basin?

The nature of the archaeological record here requires an explicit acknowledgment of geomorphological matters: How active were surfaces, and how might surface availability constrain occupation grain? Table 5.9 summarizes occupational histories for components by site and time period. Abstracted from Table 5.9, Table 5.10 indicates that for some components, geological factors apparently played little role. In the case of deflating and aggrading surfaces, that surfaces may have been "cleaned" by surface processes seems to have made no difference to potential reoccupants: Tal-1 and Tal-2 show little evidence for reoccupation. At Tal-3 and Tal-7, however, though hearth densities are likely artificially low because hearths have eroded away, FCR and chipped stone densities (as well as bone weathering modes, which were not entertained here in the initial analysis) suggest that several occupations occurred. It is difficult to assess the degree to which those occupational events were integrated.

In the case of stable surfaces, the picture is likewise mixed. Even though some surfaces were mostly stable or slowly aggrading, they received little in the way of reoccupation for components SW1242-2, SWC-2, LN2555-1, BH-2, BH-3, and TP-7. Other stable surfaces, however, perhaps because of their stability, witnessed multiple occupation events. In some cases, reoccupants apparently reused features (e.g., MR-3 [some integration], 2555-3, Crk-1, Crk-2, McI-1). But for other components (PH-2, SW5215-1, SW5215-2, MR-1, MR-4, LN2555-2, TP-3, TP-5), new features were added with reoccupation.

Table 5.11 elaborates further. For the components for which multiple radiocarbon assays were made, it shows that components likely owed to multiple nonintegrated occupations also show large spans in the radiocarbon dates. Where integrated occupations were inferred, typically the number of radiocarbon events determined for the two or more samples was found to be one. SW5215-2 is an exception to this trend; perhaps the two radiocarbon samples dated here refer to one of the many events that occurred here. The implication of this finding is that the degree of integration may be informing on the nature of reoccupation. Integrated occupation events may be closely spaced in time such that the same persons were involved (à la Yellen's [1977] Camps 3 and 7) or the facilities there were in good repair (à la Yellen's [1977] Camps 1 and 4). Such components may reflect a kind of short-term persistent place (*sensu* Schlanger 1992) use. Components analyzed as owed to nonintegrated reoccupation events may reflect locale reuse. That there exists a bit of a gap (Figure 5.8) between reoccupied but integrated components and components for which repeated occupation but no integration occurred suggests a very simple model of place and land use: single-use places, short-term persistent places, and locales that, for whatever reason, accumulated many single uses.

For rapidly aggrading contexts, in some cases location reuse occurred within the window of aggradation, resulting in complex, integrated deposits (SW1242-3, Tal-6, SWC-1). For other components (Tal-4, Tal-5, MR-2), it appears that reoccupation occurred at a slower pace than aggradation, resulting in preserved feature-tethered distributions of artifacts and high hearth and FCR densities.

And Figure 5.9 shows no simple pattern between water availability and place history. Talioferro, a low-elevation, interior basin site located near Slate Creek (which drains into the nearby Green River), shows evidence for single occupation events (Tal-1, Tal-2) and repeated occupation events both with (Tal-6) and without (Tal-4, Tal-5; possibly also Tal-3 and Tal-7) integration. That seven stacked and horizontal components were documented here indicates that something was bringing people back to this area. Investment in facilities here may have been unnecessary or, because of the inability to project future visits, not warranted. Similarly, the springs near Maxon Ranch site may have contributed to its attractiveness and may in part explain what appear to be repeated occupation events, but, it is interesting to note, there is little evidence for integration. On

TABLE 5.9. Summary of Occupation History by Site and Time Period

SITE (ELEVATION; NEAREST WATER SOURCE)	PERIOD		
	EARLY ARCHAIC	LATE ARCHAIC	LATE PREHISTORIC
Basin Interior			
SW1242 (6,453 ft; ephemeral)		2—Stable surface; few occupations	3—Aggrading surface; several integrated occupations (two radiocarbon dates but one radiocarbon event)
Porter Hollow (6,500 ft; ephemeral)		2—Stable surface; several occupations without integration (span: 250–950 years)	
Talioferro (2,600 ft; Slate Creek)	1, 2—Deflating surface; single (short) occupation	3—Deflating surface; few (short) occupations (span: 1,150–2,050 years)	4—Aggrading surface; many occupations without integration 5—Aggrading surface; several occupations without integration 6—Stable surface; several integrated occupations 7—Deflating surface; several occupations
Rock Springs Uplift			
SW5215 (6,860 ft; ephemeral)	1, 2—Stable surface; several occupations without integration (2—two radiocarbon dates but one radiocarbon event)		3—Stable surface; several occupations without integration
Maxon Ranch (7,400 ft; springs)	1—Stable surface; many occupations without integration (span: 530–1,430 years) 2—Rapidly aggrading surface; many occupations without integration (span: 0–810 years)	3—Stable surface; many occupations with some integration (two radiocarbon dates but one radiocarbon event)	4—Stable surface; many occupations without integration
Sweetwater Creek (6,600 ft; ephemeral)	1—Aggrading surface; several integrated occupations 2—Stable surface; single short occupation		

TABLE 5.9. (cont'd) Summary of Occupation History by Site and Time Period

Site (elevation; nearest water source)	Period		
	Early Archaic	Late Archaic	Late Prehistoric
Basin Margin			
LN2555 (6,640 ft; springs)	1—Stable surface; single occupation	2—Stable surface; many occupations without integration (span: 1,200–1,830 years)	3—Stable surface; several integrated occupations
Buffalo Hump (6,770 ft; ephemeral)			2, 3—Stable surface; single extended occupations (3—two radiocarbon dates but one radiocarbon event)
Crooks (6,920 ft; ephemeral)	1, 2—Stable surface; several integrated occupations (2—two radiocarbon dates but one radiocarbon event)		
McIntosh (6,890 ft; Crooks Creek)		1—Stable surface; several integrated occupations 2—Surface stability unknown; several occupations without integration	
Trappers Point (7,300 ft; Green River)	3—Stable surface; several occupations without integration 5—Stable surface; many occupations without integration (span 380–810 years) 7—Stable surface; likely single occupation		

Note: Format = "component number—surface activity; number of occupations and degree of integration" (see text). Note span indications for those components for which multiple radiocarbon dates were obtained.

TABLE 5.10. Components by Occupation History and Surface Activity

Occupation History	Surface Activity		
	Deflation/Aggradation	Stable	Rapid Aggradation
Single/few	Tal-1, Tal-2	1242-2, SWC-2, 2555-1, BH-2, BH-3, TP-7	
Several occupations (cannot assess integration)	Tal-3, Tal-7		
Several integrated occupations		MR-3 (some integration), 2555-3, Crk-1, Crk-2, McI-1	1242-3, Tal-6, SWC-1
Several nonintegrated occupations		PH-2, 5215-1, 5215-2, MR-1, MR-4, 2555-2, TP-3, TP-5	Tal-4, Tal-5, MR-2

Note: 1242 = SW1242, 2555=LN2555, 5215 = SW5215, BH = Buffalo Hump, Crk = Crooks, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

TABLE 5.11. Multiple Radiocarbon Dated Components (with 68 Percent Confidence Interval Span Determination) by Number of Radiocarbon Events and Nature of Integration

No. of Radiocarbon Events	Integration	
	Integrated	Not Integrated
1	1242-3 MR-3 (some integration) BH-3 Crk-2	5215-2
>1		PH-2: 250–950 years Tal-3: 1,150–2,050 years MR-1: 530–1,430 years MR-2: 0–810 years 2555-2: 1,200–1,830 years TP-5: 380–810 years

Note: 1242 = SW1242, 2555 = LN2555, 5215 = SW5215, BH = Buffalo Hump, Crk = Crooks, MR = Maxon Ranch, PH = Porter Hollow, Tal = Talioferro, TP = Trappers Point.

the other hand, the Buffalo Hump components, SWC-2, and SW1242-2, all located near ephemeral water and with little indication of reoccupation, may represent opportunistic and limited occupation events of the kind described by Yellen (1977) for Camps 5 and 6, where rare climatic events permitted occupation.

Finally, Table 5.9 focuses on particular sites through time. Sometimes components with similar histories are found, whereas at other sites, very different histories unfold, yielding components of very different character. For example, the three components described at SW5215 appear very similar during the Early Archaic as well as the Late Prehistoric. The same is true of the Late Prehistoric components of Buffalo Hump and the Early Archaic components at Crooks Creek. Others show more variable histories, as for Talioferro and LN2555.

There are too few data points to comment on patterns others have noted except cursorily. That is, the greater stability in Early Archaic land use associated with investments in facilities like pit structures and lined cylindrical hearths was nevertheless accompanied by single (Tal-1, Tal-2) or recurring use of places without integration (TP-3, TP-5). Similarly, the higher levels of mobility argued for the Late Prehistoric associated with mass harvests of large mammals and seed harvesting was also accompanied by the integrated recurring use of

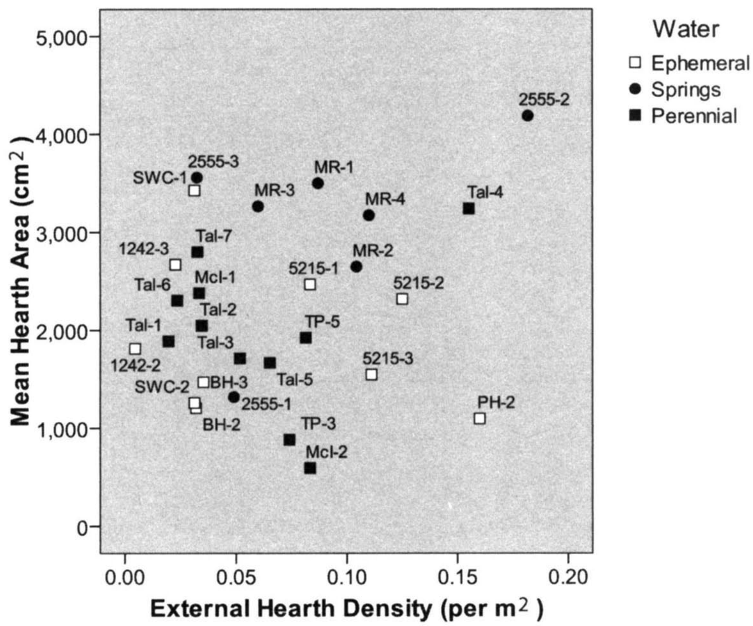


FIGURE 5.9. Mean hearth area versus external hearth density by water permanence. 1242 = SW1242, 2555 = LN2555, 5215 = SW5215. BH = Buffalo Hump, McI = McIntosh, MR = Maxon Ranch, PH = Porter Hollow, SWC = Sweetwater Creek, Tal = Talioferro, TP = Trappers Point.

places (e.g., Tal-6, LN2555-3). It is likely that technological organization and place histories speak to different temporal ranges and, thus, can nicely complement each other. With more information of this sort, as well as the rich context provided by a fuller treatment of the excavated materials, we may be in a better position to offer statements translating place histories into land tenure trends through time with the specificity Varien and colleagues have been able to achieve for the American Southwest.

Conclusion

Archaeological components are rich mines of temporal information, even in lieu of standard chronometric markers. Here, I have tried to use several taphochronometric indicators, still in need of refinement, to approach an understanding of place history for various Wyoming Basin components. Through the vehicle of place history, in conjunction with other archaeological information, it seems possible to approach reckonings of place-use histories as well as various ecological and social processes responsible for archaeological variation, as described by Bailey (1981, 1983, 1987, 2007). As applied to the Wyoming Basin, I have especially highlighted the role of geomorphological processes and how they affect grain (the potential span of time during which surfaces are available to record human activities), occupational grain (the span of time during which occupation actually occurs), and integration (the degree to which features are acknowledged and reutilized between occupational events).

Clearly, much work needs to be done in refining and calibrating the taphochronometric indicators we have. Equally important, however, is how to relate various place histories (along with other archaeological materials) to the short-, medium-, and long-term processes of interest to us. Here lies the great interpretative challenge of time perspectivism.

Acknowledgments

I thank Steven Creasman, Craig Smith, Lance McNees, and Cynthia Craven for sharing materials on which this chapter is based and hope that

I have not abused their ideas too greatly. Simon Holdaway introduced me to the theoretical package called "time perspectivism," which has helped immensely to move me beyond several impasses. James O'Connell provided the welcome prompt, "So what? What does this buy us?" Earlier versions of this chapter were presented at the University of Utah, Salt Lake City, at the Midwest Archeological Center, Lincoln, Nebraska, and in a graduate seminar in archaeology at the University of Nebraska–Lincoln; comments received at each venue were most useful. And Ann Ramenofsky, Julie Stein, and an anonymous reviewer provided useful comments on an earlier draft of this chapter—thank you.