Economic and Land-Use Implications of Prehistoric Fire-Cracked-Rock Piles, Northern Arizona

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Intensive archaeological survey of 14.5 sq km of the Upper Basin, an area located near the Grand Canyon's eastern South Rim in northern Arizona, has discovered 126 fire-cracked-rock piles that are surrounded by artifact scatters of varying size and assemblage composition. Because these phenomena are unprecedented in upland conifer ecosystems of the American Southwest, several hypotheses are explored regarding their formation histories. Analyses of artifact assemblages, botanical remains, pollen, and faunal remains recovered from four excavated sites indicate that they result from flaked-stone artifact production, ground-stone artifact reuse and recycling, ceramic-vessel-fragment recycling, and animal and plant processing. In addition, radiocarbon dates and temporally diagnostic projectile-points and ceramics imply that the sites differ in terms of frequency, intensity, and patterns of use, and with respect to the groups of people who formed them (Anasazi, Cohonina, Havasupai, or Hopi). Byproducts of a little-known, long-term land-use pattern in Southwestern prehistory (ca. A.D. *417–1650), these sites represent a key source of information for understanding how different sources of variability come to be expressed in archaeological landscapes.*

Introduction

The Upper Basin Archaeological Research Project was launched in 1989 to investigate patterns of variation in the economic prehistory of the Grand Canyon region. Previous research had predicted that the Upper Basin, which is a downfaulted section of the NE Coconino Plateau (Babenroth and Strahler 1945: 135; Barnes 1987: 381; Huntoon 1990: 265), should have evidence of extensive agricultural production and hunting and gathering activities (Effland, Jones, and Euler 1981; Rice, Effland, and Blank-Roper 1980; Schwartz, Kepp, and Chapman 1981). With these considerations in mind, a survey (inter-surveyor interval of 10 m) was designed to locate archaeological deposits relevant for determining the degree to which Upper Basin subsistence economies were mixtures of farming and foraging (Sullivan 1987; Whittlesey 1992).

Today the Upper Basin, which varies in elevation between 2256 m asl along the South Rim of the Grand Canyon to 1860 m asl at the base of the Coconino Rim (FIG. 1), is mantled by a pinyon-juniper woodland that is interspersed with patches of sagebrush and grass (Brewer et al. 1991; Rand 1965). This pattern (Cole 1990) developed well before the earliest traces (ca. 2000 B.C.) of human occupation in the Grand Canyon region (Emslie,

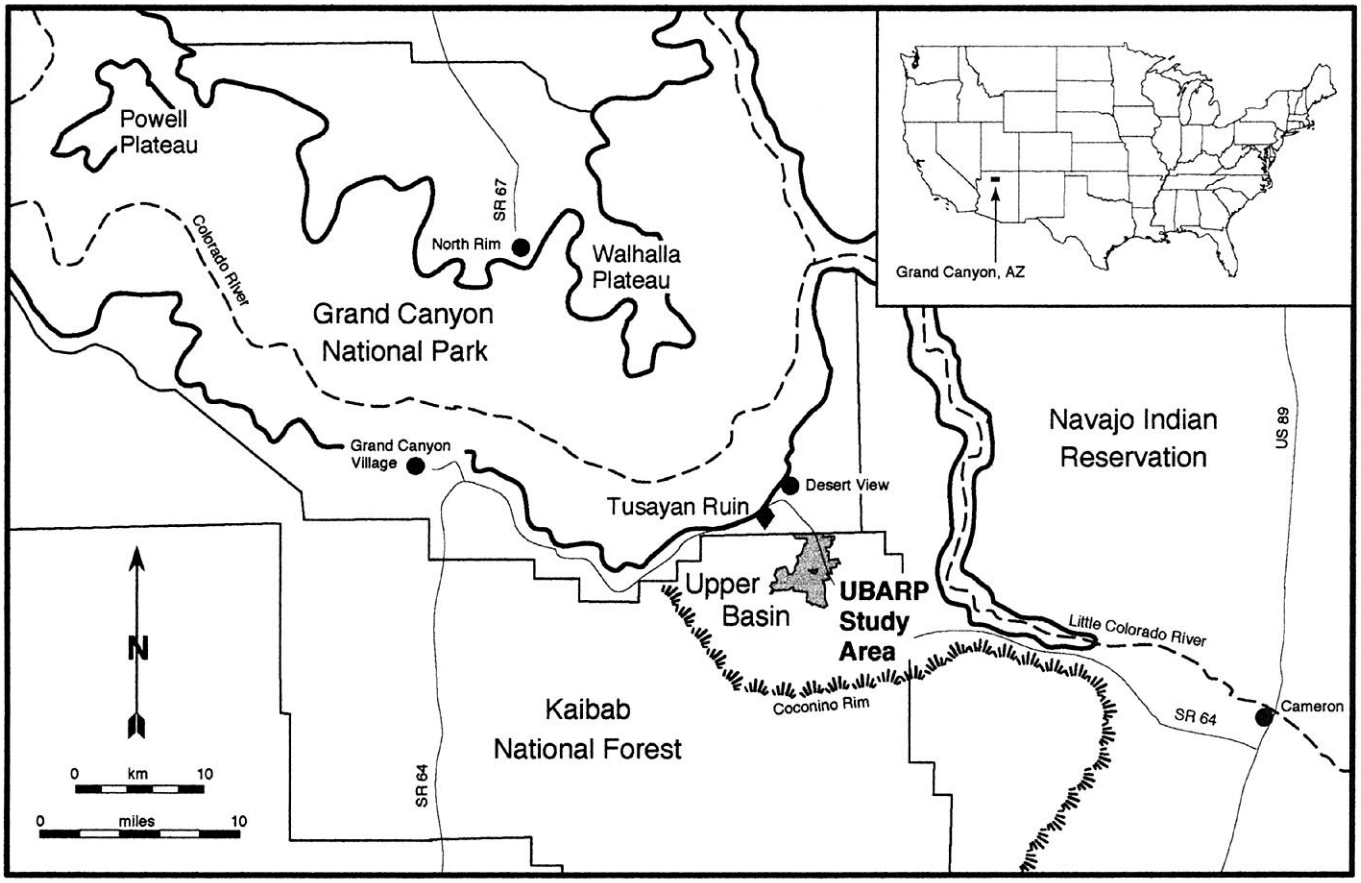

Figure 1. The Upper Basin and study area in Kaibab National Forest, northern Arizona.

Euler, and Mead 1987; Euler 1983; McNutt and Euler 1966).

Intensive survey of 14.5 sq km of the Upper Basin found 126 piles of fire-cracked rock (FCR), among other types of sites (Sullivan, Mink, and Uphus 2002), ranging between 1.0 and 8.0 m in length and 0.8 to 6.0 m in width,[1] invariably surrounded by scatters of ceramic, flaked stone, and ground-stone artifacts (FIG. 2). These archaeological phenomena are unprecedented in the Grand Canyon area (R. C. Euler, personal communication 1989; D. W. Schwartz, personal communication 1997) and, more broadly, have no counterparts in upland areas of Western Anasazi country (G. J. Gumerman, personal communication 1998). In addition, USDA Forest Service maps of our research area revealed no previously reported FCR piles whatsoever (with the possible exception of a single instance of a "scatter with amorphous rubble pile"). In view of their prevalence and evident interpretive potential, it became important to determine whether the fire-cracked-rock piles and their assemblages were related to prehistoric Grand Canyon livelihoods or to non-economic cultural practices.

Origins Hypotheses

One hypothesis is that Upper Basin FCR piles are spoil from relatively recent (late 19th or early–mid 20th century) Havasupai or Navajo purification rituals involving sweat lodges (Smithson and Euler 1994: 17–19; Kluckhohn and Leighton 1962). These activities use heated rocks that, after having cooled, are discarded immediately outside the sweat lodge. However, six FCR piles directly associated with the remains of known sweat lodges are less than 1 m in diameter, diffuse, and unaccompanied by ceramic or ground-stone artifacts. Hence, it is unlikely that the FCR piles in our sample represent the byproducts of such Native American ceremonies.

Although Figure 3 shows a strong correlation between length and width ($r = 0.798$, $p < 0.001$), "moundedness" of FCR piles varies considerably—some piles are low

1. Length is the largest measurement [m] of an FCR pile ($n = 106$, mean = 4.1 m, standard deviation = 1.3 m, median = 4 m). Width is second largest measurement [m] of an FCR pile taken perpendicularly to the first ($n = 106$, mean = 2.8 m, standard deviation = 1.2 m, median = 2.6 m).

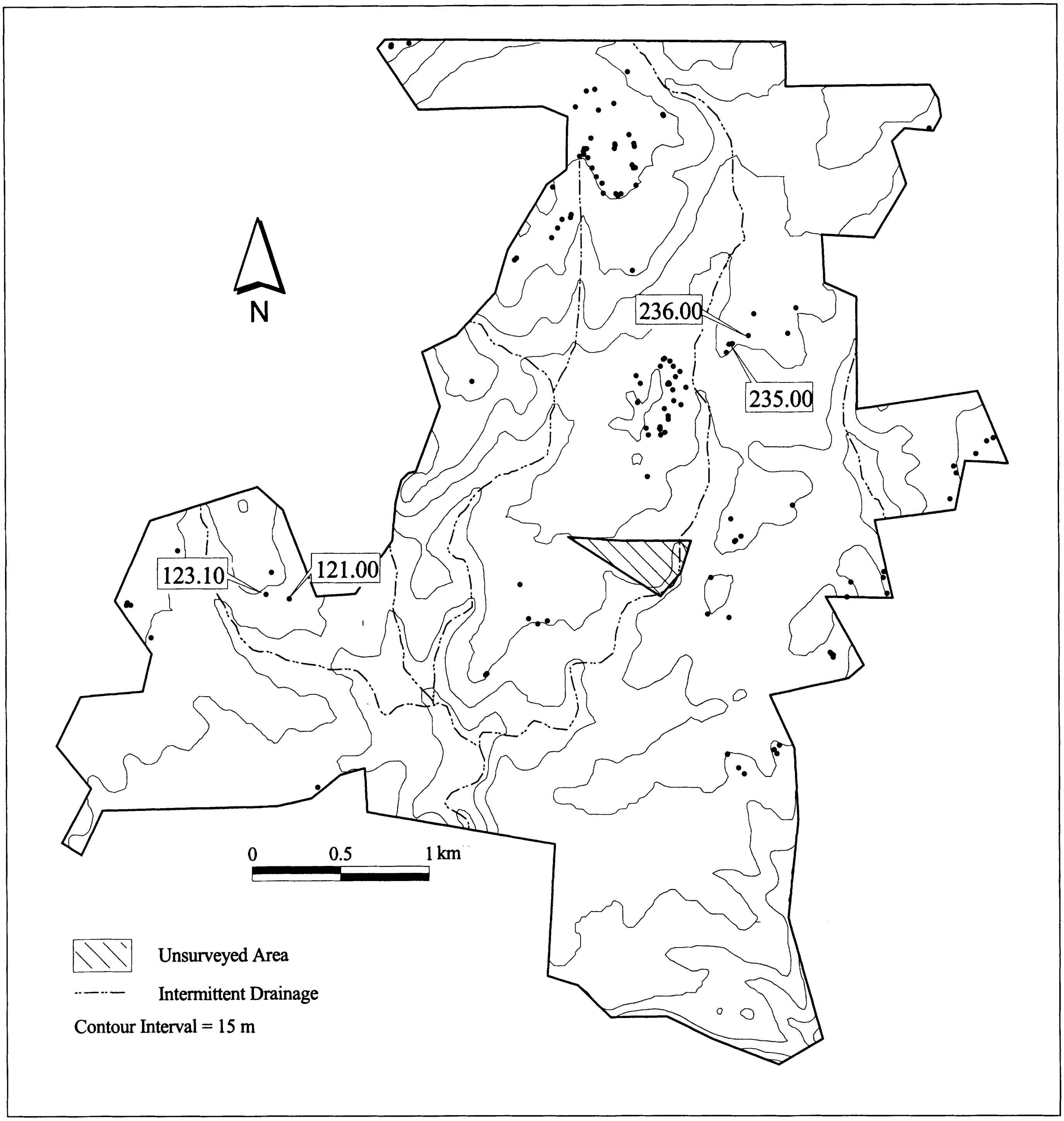

Figure 2. Locations of 126 FCR piles in the study area. Numbers in boxes refer to excavated sites.

humps less than 10 cm high whereas others are heaps nearly 50 cm high (FIG. 4). The composition of artifact scatters surrounding the piles is highly variable, as well, with some piles encircled by dense concentrations of lithic debitage, others by numerous ground-stone artifacts, and still others by high frequencies of sherds (Cook 1995). The piles are dissimilar, too, in terms of the colors (black to bluish-white) and sizes (from gravel and pebble to large cobble) of the FCR fragments themselves. Variation in the form of FCR piles, moreover, is not affected by their proximity to

Table 1. Surface properties of five excavated FCR piles in the Upper Basin (MU = Mapping Unit).

Site	*FCR pile number*	*Form*	*FCR density*	*FCR fragment Size*	*FCR fragment Color*
MU 121	1	Flat	Very low	Uniform	Uniform
MU 123.1*	1	Slightly mounded	Dense	Varied	Varied
MU 235	5	Slightly mounded	Dense	Varied	Uniform
MU 235	6	Flat	Low	Varied	Uniform
MU 236	1	Highly mounded	Very dense	Highly varied	Highly varied

*Architectural remains were within 30 m.

Table 2. Contexts, radiocarbon ages, and calibrated date-ranges (2 sigma) for specimens recovered from Upper Basin FCR-pile sites (MU = Mapping Unit).

Site	*Sample number*	*Material*	*Context*	*Age (years b.p.)*	*Date range* A.D.
MU 121	AA-17934	Charcoal	Slab-lined pit near FCR pile	1420 ± 50	549–682
MU 123.1	A-8235	Charcoal	Beneath FCR pile	660 ± 55	1275–1408
MU 123.1	A-8236	Burned log	Beneath FCR pile	820 ± 55	1050–1291
MU 123.1	AA-17935	Charred seeds	Pit on edge of FCR pile	325 ± 40	1447–1650
MU 235	Pitt-1060	Charcoal	South activity-surface	1580 ± 30	417–559
MU 235	Pitt-1043	Charcoal	North activity-surface	1210 ± 45	687–963
MU 236	Pitt-1045	Charcoal	FCR pile interior	610 ± 30	1299–1409
MU 236	Pitt-1044	Charcoal	Pit 8 m from FCR pile	625 ± 45	1288–1414

architectural ruins or to artifact scatters.[2] Thus, these surface archaeological data imply considerable independence among the sources of variability that influenced the piles' origins.

To unravel their histories, five FCR piles (FIG. 5) were selected for excavation because their surface properties (TABLE 1) suggested dissimilar formation patterns. Importantly, the bulk of radiocarbon dates obtained from material recovered from a variety of contexts (TABLE 2) falls between the late 8th and the early 17th centuries A.D. (FIG. 6), a period for which there is ceramic and tree-ring evidence of both perennial occupation and seasonal use of the Upper Basin (Sullivan 1995).

Excavation revealed that the five piles are neither grave markers nor doughnut-shaped mounds of FCR from large roasting pits, such as those documented by Robert C. Euler (1967) in the western reaches of Grand Canyon (cf. Dering 1999), and that each pile rests directly upon an ancient surface. Disassembly of the FCR piles at MU 123.1 and MU 236, in fact, disclosed that the soil under the piles is orange-red and hardened whereas that outside the piles is brown and unconsolidated. These observations support the idea that once wood had been reduced to coals, rocks (including discarded ground-stone artifacts; see Camilli and Ebert 1992: 121) were placed on them to absorb heat (cf. Stahl 1989: 182–183). Once heated, the rocks were stirred up and spread about periodically to maintain thermal radiation (Latas 1992). This interpretation explains the highly fragmented condition of the rocks and the pres-

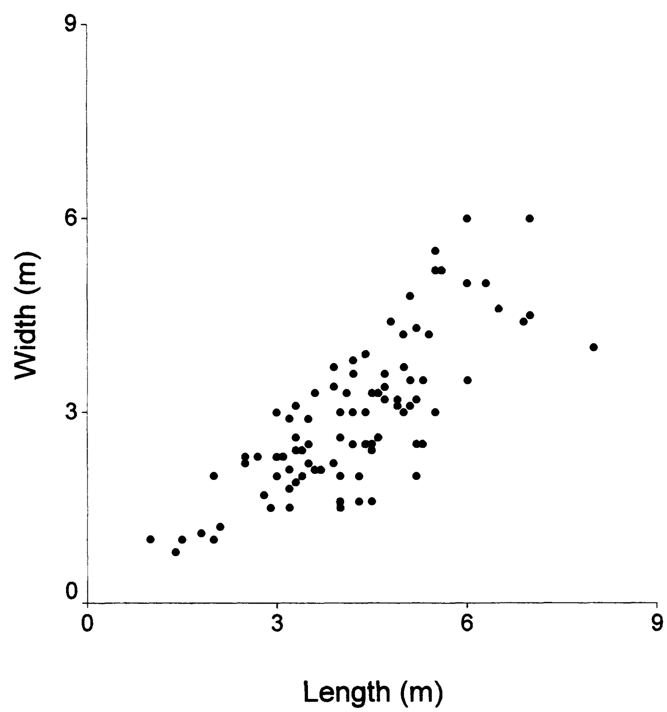

Figure 3. Scattergram of the lengths and widths of 106 FCR piles.

2. The median distance of a FCR pile from either an architectural site, an artifact scatter (sherds and lithics), or a lithic scatter is 35.1 m (n = 126, mean = 45 m, standard deviation = 35.6 m). No statistically significant differences were found in the median lengths or widths of FCR piles located within or beyond a 35.1 m radius of an architectural site, an artifact scatter, or a lithic scatter (for length, Mann-Whitney U = 1366.5, p = 0.871; for width, Mann-Whitney U = 1212.5, p = 0.254).

Figure 4. Large FCR pile (MU 323) that measures 6.5 m by 4.6 m and is approximately 0.5 m high.

Table 3. Attributes of five excavated FCR piles and four pit features in the Upper Basin (MU = Mapping Unit). MU 236 has two pits.

Site	*FCR Pile*	*Length (m)*	*Width (m)*	*Feature*	*Location*	*Diameter (cm)*	*Depth (cm)*
MU 121	1	8	7	None	–		
MU 123.1	1	7.3	5.4	Pit	Under pile	75	30
MU 235	5	7	4	Pit	In pile	60	30
MU 235	6	6.5	5	None	–		
MU 236	1	7	6.5	Pit	Adjacent to pile	90	20
				Pit	Adjacent to pile	70	15

ence of ash and charcoal throughout the piles. We suspect, furthermore, that variation in FCR-pile form and feature attributes (TABLE 3) can be ascribed to differences in duration of use (e.g., short at MU 121 vs. long at MU 236) or cycles of use (e.g., multiple at MU 123.1 vs. single at MU 235).

Archaeological Consequences of Food Acquisition

The contents of approximately 3.4 kg of organic material from 11 flotation samples (24.5 kg) recovered from the FCR piles and features at MU 123.1, MU 235, and MU 236 (TABLE 4) leave little doubt that they were used principally to process plants (Winter and Hogan 1986). For example, of the charred remains, which in all likelihood are contemporaneous with the FCR piles and features (Minnis 1981), 8.9% represent food, such as seeds (cactus, Indian rice-grass, cheno-ams, purslane, buckwheat, and juniper) and pinyon nuts (Sullivan 1992; see also Madsen 1986; Wandsnider 1997: 26). Another 3.1% are indirect food remains, such as inedible cone-scales (Lanner 1981: 49). Significantly, all of the charred food remains are of wild plants—not a single fragment of a domesticated plant has been identified even though this era was a time when maize

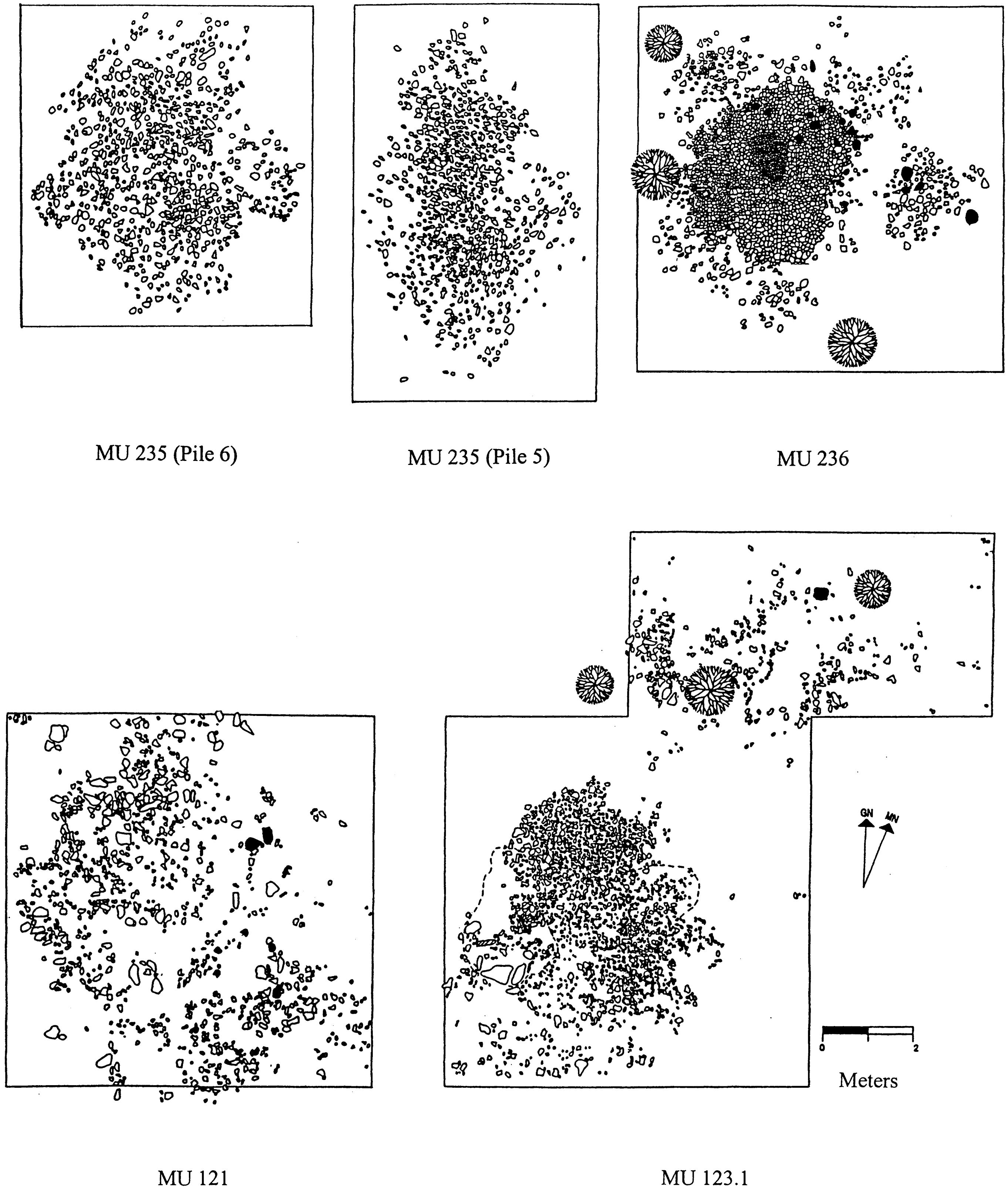

Figure 5. Plan views of excavated FCR piles (dashed line in plan of MU 123.1 indicates extent of an ash stain). Note variation among piles in the frequency of ground-stone artifacts (shown in black).

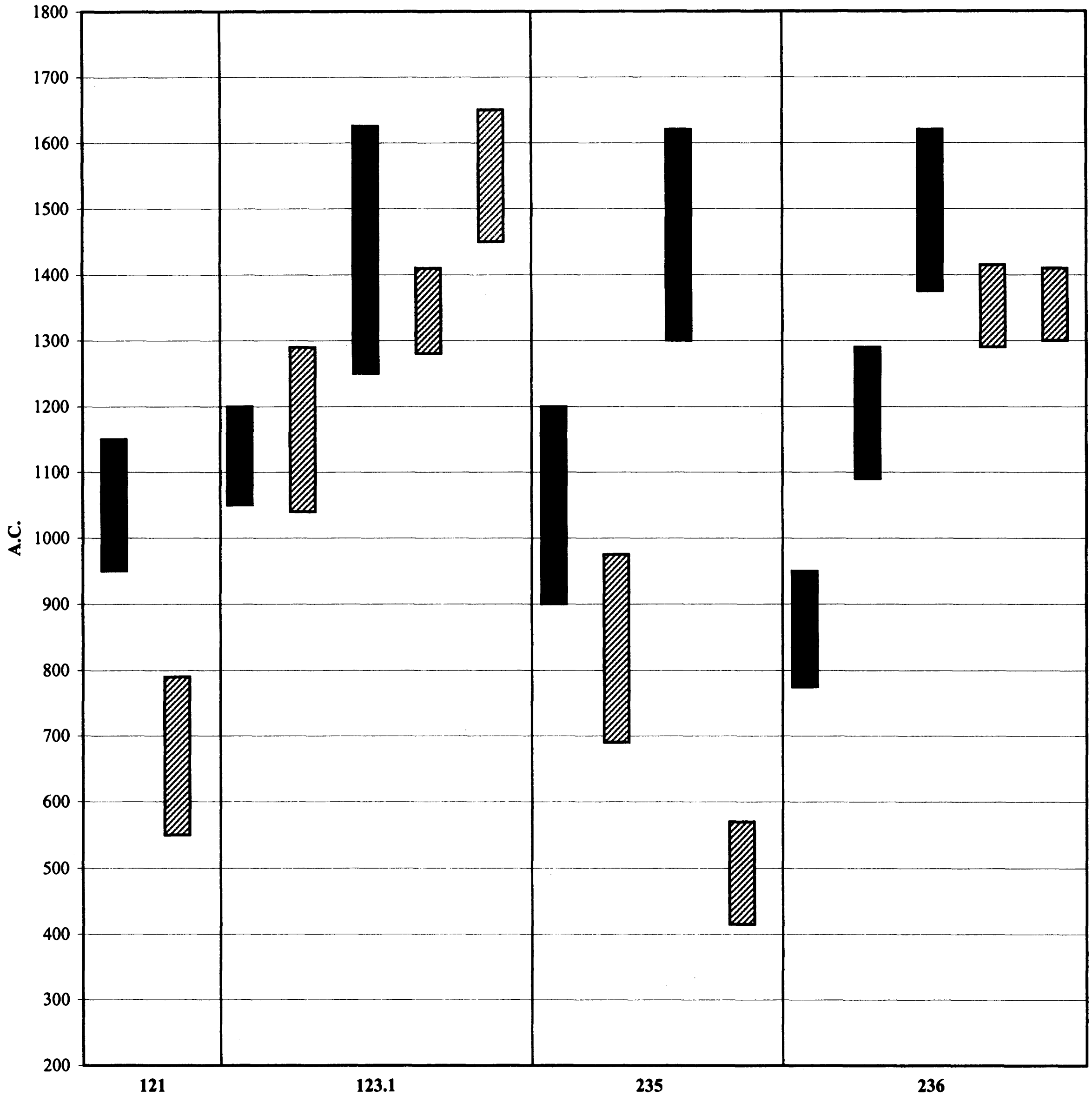

Figure 6. Ranges of diagnostic-ceramic production dates (black bars) and calibrated (2 sigma) radiocarbon determinations (hatched bars) among four FCR-pile sites.

Table 4. Aggregated macrobotanical data from excavated Upper Basin FCR piles and pits (MU = Mapping Unit).

Site	*Feature type*	*Light-fraction weight in g (number of samples processed)*	*Total identified remains*		*Economic remains*			
					Direct		*Indirect*	
			Charred	*Uncharred*	*Charred*	*Uncharred*	*Charred*	*Uncharred*
MU 123.1	Pit	406.4 (3)	313	77	36	6	11	–
	FCR pile	133.9 (2)	118	26	–	2	–	–
MU 235	FCR pile	1137.8 (2)	49	28	2	6	6	2
MU 236	Pits	1191.8 (3)	74	1	2	–	–	–
	FCR pile	496.1 (1)	33	3	12	–	1	–

was produced in the region (Cutler and Blake 1980; Hutira 1986; Sullivan 1987). That these and other processed wild-plant parts, as well as those of maize, have been found in floor-contact ceramic vessels recovered from several perennially and seasonally occupied settlements located throughout the Upper Basin (Sullivan and Ruter in press),

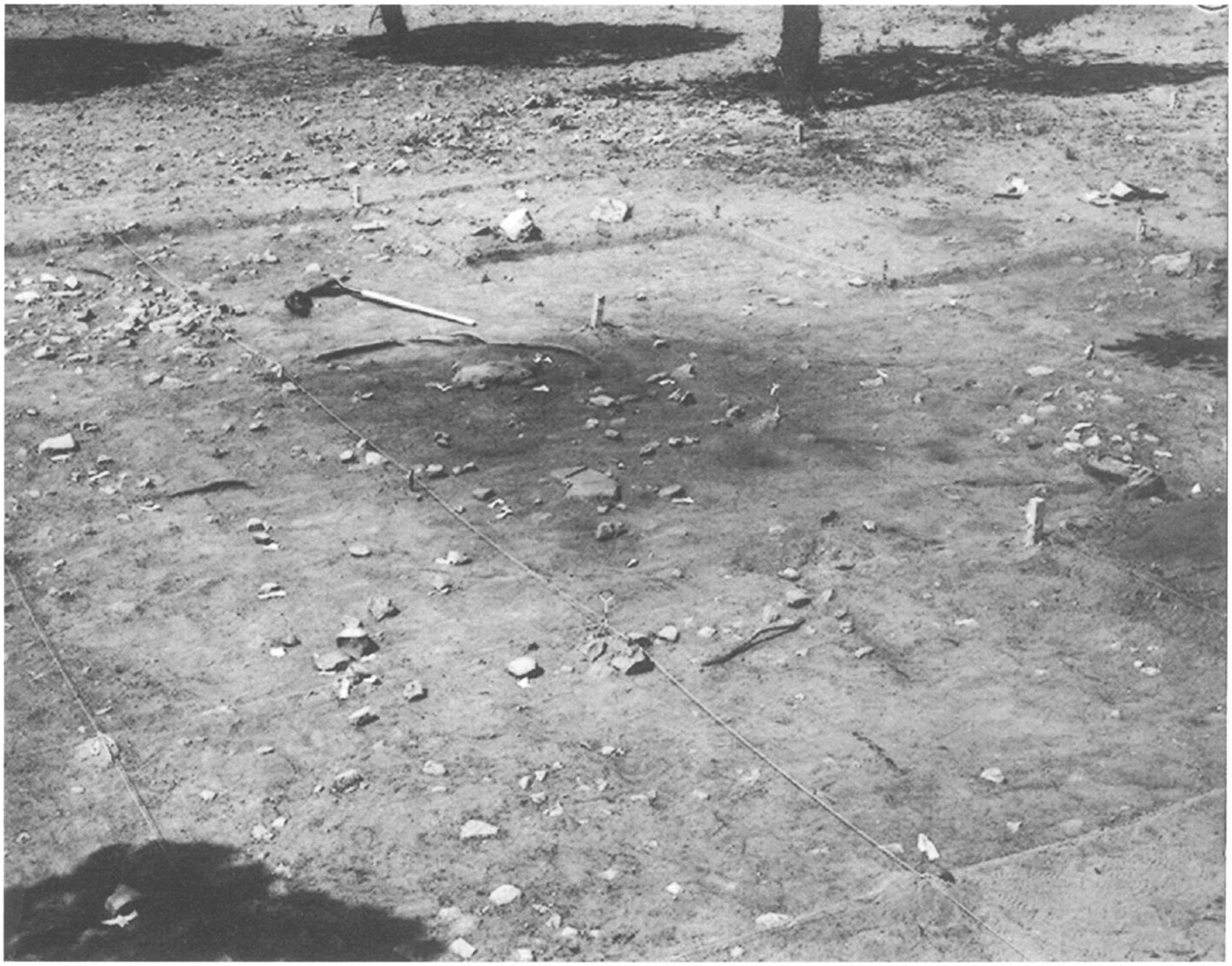

Figure 7. Oblique view of the Northern Array at MU 235 showing darkened soil with ground-stone artifacts marked by white tape.

supports the argument that the FCR piles and features were integral components of the region's food-production system.

Additionally, two in situ arrays of ground-stone, flaked-stone, and ceramic artifacts were discovered at MU 235 (Sullivan 1992: 216–221). Aggregates of cheno-am, grass, and ephedra pollen found in sediment samples collected under and around ground-stone tools at the Northern Array (no aggregates were found in nearby control samples) indicate that those plants were processed there (Bohrer 1981). Particularly noteworthy are dark stains that surround several metates and manos (FIG. 7). These soil discolorations ostensibly arose as people carried processed plants from the FCR piles to the artifact arrays for additional handling, trailing and subsequently treading soot and ash into the activity surface (cf. Weber and Seaman 1985: 205). Because pollen from cheno-ams, grass, and ephedra has been found at Upper Basin masonry ruins as well, further support is advanced for the inference that the FCR piles, associated features, and assemblages were involved in wild-plant processing, aspects of which are not reflected in the material record of the settlements where the edible portions of the plants were ultimately consumed.

Weighing no more than 32.5 g in total, 56 unidentifiable animal bones were recovered from the FCR piles and features (Cook 1995). Of these extremely small, fragmentary remains, 40 show traces of burning, suggesting that animal carcasses were likely processed on or in the vicinity of the thermal features, presumably with the multi-functional ground-stone tools that accompany the FCR piles

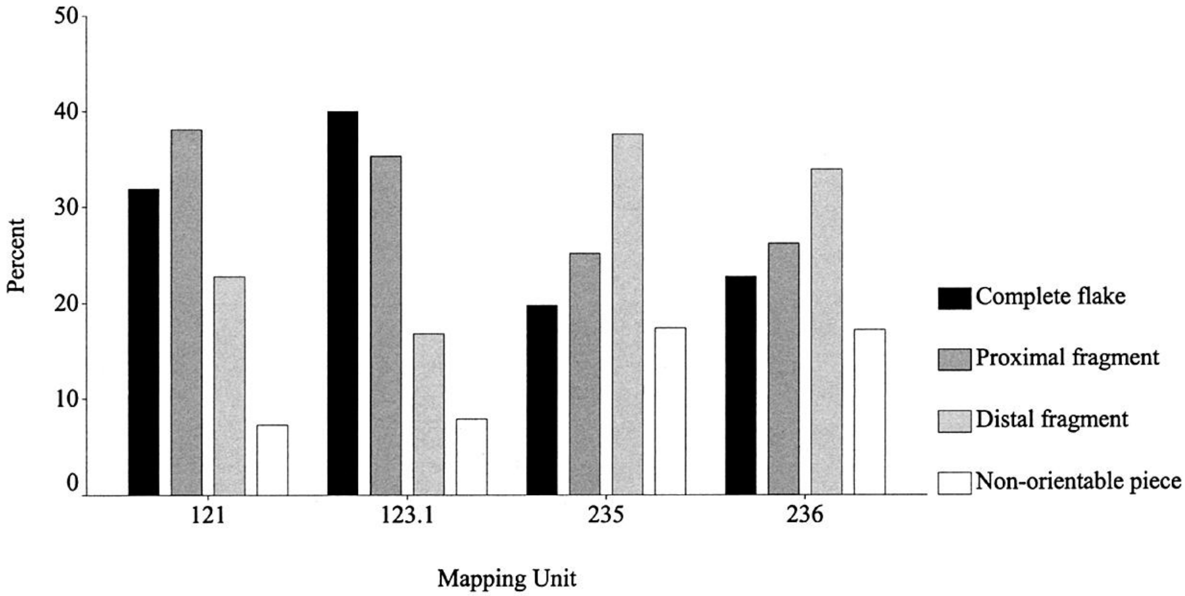

Figure 8. Bar charts of debitage assemblage variability among four FCR pile sites.

Table 5. Artifacts recovered from FCR-pile sites (MU = Mapping Unit) in the Upper Basin. IRP = Irregularly retouched pieces.

Site	*Recovery area (sq m)**	*Debitage*	*Tools* *IRP*	*Unifaces*	*Bifaces*	*Points*	*Cores (nuclei)*
MU 121	288	452	1	1	3	0	0 (2)
MU 123.1	368	745	4	2	8	4	2
MU 235	728	5409	10	28	166	29	23 (15)
MU 236	512	1981	2	4	40	17	7 (5)

*Maximum area examined by means of systematic surface collection and excavation.

(Euler and Dobyns 1983: 256; Yohe, Newman, and Schneider 1991; also Green 1981: 314). In striking contrast to the aforementioned plant-processing patterns, however, virtually no faunal remains have been recovered from excavations at coeval perennial or seasonal sites in the Upper Basin, which raises the intriguing possibility that processed animal carcasses were consumed in close proximity to the FCR piles themselves.

Artifact Production, Reuse, and Recycling

Distal and proximal flake-fragments dominate the debitage assemblages from MU 235 and MU 236 (FIG. 8), implying that they originated as a consequence of stone-tool manufacture (Sullivan and Rozen 1985). In fact, relatively high numbers (TABLE 5) of bifaces and projectile points in the tool assemblages of MU 235 (n = 195, 83.7%) and MU 236 (n = 57, 90.5%) support the specific inference that bifacial reduction was comparatively intensive at these two locations. In contrast, debitage assemblages from MU 121 and MU 123.1 are characterized by comparatively high percentages of complete flakes and proximal flake-fragments, indicating that unintensive core reduction and unintensive tool production were the principal objectives of lithic-artifact manufacture (Sullivan 2001).[3] This conclusion is sustained by the comparatively low number of bifaces and projectile points recovered from MU 121 (n = 3, 60% of the tool assemblage) and from MU 123.1 (n = 12, 61.7% of the tool assemblage). In fact, those tools have thin cross-sections and no cortex, which suggests that they had been produced elsewhere and then discarded subsequently in the areas that we investigated (Purtill 1995).

MU 123.1, MU 235, and MU 236 yielded 2, 23, and 7 artifacts, respectively, that technologically are cores or core fragments (Rozen and Sullivan 1989) but functionally could have served as "scraper planes" (Salls 1985) or "choppers" (James 1977). Use-wear for these pieces varies

3. Of the unifaces, five (one each from MU 121 and MU 123.1 and three from MU 235) had deep, denticulate edges that would have been effective in processing plant fibers such as yucca (Osborne 1965).

from extensive edge-crushing and edge-rounding to a well-developed edge-polish (Vaughan 1985), which is consistent with the inference that they were used to score cleavage lines in metates that then were deliberately broken apart (Wheeler 1965).

Metate fragments were dispersed widely throughout the Upper Basin and reused or recycled for various purposes (Simms 1983), as several lines of evidence indicate. First, the vast majority of metate fragments could not be refitted (TABLE 6). At MU 123.1, for instance, only metate margins were present—the interior sections had been removed (Cook 1995; see also Huckell 1986: 55). Second, several metate fragments were re-manufactured, by means of bifacial marginal retouch, into heavy-duty "chopping" tools. And third, metate fragments not infrequently were incorporated into FCR piles (e.g., MU 121 and MU 236).

By refitting Tusayan Grayware and Tusayan Whiteware sherds into larger fragments and comparing their aggregate weights to those of intact vessels from a nearby catastrophically abandoned settlement (Sullivan 1986: 64, 96, 111, 130), it is clear that FCR-pile ceramic artifacts represent only fractions (1.2% to 6.9% by weight) of complete vessels (TABLE 7; Cook 1995: 161). Hence, sherds rather than whole vessels were transported to and deposited at the FCR-pile sites (Sullivan, Skibo, and Van Buren 1991). These vessel fragments might have been involved in seed parching; in fact, the inside of one jar fragment from MU 235 did bear traces of such use (Sullivan 1992: 216). Interestingly, accounts of Havasupai edible-resource processing (Weber and Seaman 1985: 64) note that parched seeds are easier to grind and require fewer specialized ground-stone tools, which has obvious logistical advantages when plant processing occurs even a short distance from perennial settlements (Martin 1985).

Because of such extensive artifact recycling and reuse, original performance or functional attributes of ceramic vessels and ground-stone metates were obliterated or disregarded once the artifacts were removed from their consumption contexts and transported to production contexts (Sullivan 1996). At Upper Basin FCR-pile sites, therefore, jar sherds are unrelated to cooking (Varien 1999: 66–69) or to storage (Plog 1980: 18–19, 96), and slab metates and slab-metate fragments are unconnected to the processing of domesticated plants (Vierra 1993: 151).

Land Use and the Emergence of a Material Topography

The distribution of temporally-diagnostic projectile points recovered from artifact scatters associated with the FCR piles provides some tantalizing clues regarding shifting patterns of land-use (cf. Schlanger 1992: 107–109).

Table 6. Frequencies of ground-stone artifacts at FCR-pile sites located in the Upper Basin (MU = Mapping Unit).

Artifact	*MU 121*	*MU 123.1*	*MU 235*	*MU 236*
Mano	2	–	2	1
Mano fragment	1	2	1	1
Metate	1	–	2	–
Metate fragment	12	9	59	97
Total	16	11	64	99

For instance, ceramic-period points, such as Rose Springs Corner-Notched, Cohonina, Nawthis Side-Notched, and Bullcreek (FIG. 9; for type definitions, see Holmer 1986; Moore 1994; Thomas 1981), though common at Upper Basin masonry ruins, are rare at MU 235 and MU 236 (one and four specimens, respectively) and absent altogether from MU 121 and MU 123.1 (Purtill 1995). This pattern suggests that the organization of ceramic-period hunting technology did not involve FCR piles and supports the notion that, during this broad period (A.D. 750–1200), thermal features were used principally to process plant resources when the Upper Basin was "home territory" for groups of Grand Canyon Anasazi and Cohonina people (Sullivan, Mink, and Uphus 2002).

In contrast, late prehistoric or early protohistoric projectile points, representing such types as Sierran Desert Side-Notched, General Desert Side-Notched, and Cottonwood Triangular (FIG. 9), were recovered, with four from MU 123.1, eight from MU 235, and seven from MU 236. Not a single protohistoric period projectile point has been recovered from any excavated Upper Basin masonry ruin (Becher 1992; Haury 1931; Sullivan 1986: 47–190; Whittlesey 1992). This complementary distribution of points strongly implies that after A.D. 1200, when the Upper Basin was not occupied perennially, prehistoric and protohistoric long-distance foragers deliberately avoided architectural sites, which occasionally contain human remains and may have been burned, perhaps intentionally (Sullivan, Hanson, and Hawkins 1994).

Assuming that we have not been misled by spurious patterns of diagnostic ceramics (Sullivan, Becher, and Downum 1995) and radiocarbon dates, Figure 10 attests that MU 236 was used initially by the Grand Canyon Anasazi between A.D. 775 and 950. Then, during the next two and one-half centuries, all four FCR-pile sites were used—MU 121 by the Cohonina and MU 123.1, MU 235, and MU 236 by the Grand Canyon Anasazi. Thereafter, the latter three FCR-pile sites established by the Grand Canyon Anasazi were reused by either ancestral Hopi or their neighbors to the west, ancestral Havasupai, after the Upper Basin had ceased to be a location for peren-

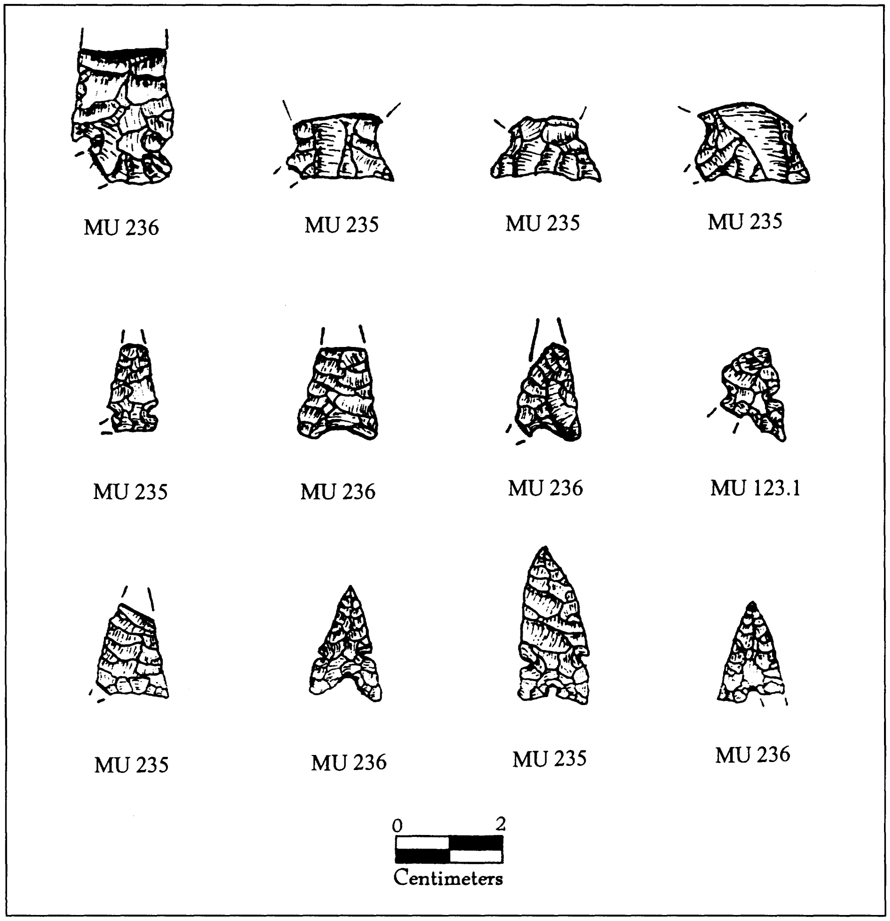

Figure 9. Projectile-point stylistic variability. Top row (left to right [all preceramic period]): Large Side-Notched and three Elko Corner-Notched. Middle row (left to right): Nawthis Side-Notched (ceramic period), two Bullcreek (ceramic period), and one Sierran Desert Side-Notched (late prehistoric or protohistoric period). Bottom row (left to right [all late prehistoric or protohistoric period]): Cottonwood Triangular, General Desert Side-Notched, Sierran Desert Side-Notched, and General Desert Side-Notched.

nial settlement (post-A.D. 1200; Euler 1992; Schwartz 1990). It is interesting to note that no FCR pile in our sample contains protohistoric ceramics exclusively and only MU 121, with San Francisco Mountain Gray Ware (Cohonina ceramics), was not reused by foragers from Cataract Canyon (the traditional home of the Havasupai) or the Hopi Mesas. Paralleling the projectile-point case discussed above, this pattern is indicative of avoidance behavior that was triggered when certain ceramics were encountered on the landscape.

The material topography created by FCR-pile-related activities raises some provocative speculation regarding aspects of cultural memory (cf. Anscheutz, Wilshusen, and Scheick 2001). For instance, by virtue of their ubiquity, FCR-pile sites were readily available for reuse or for artifact scavenging (Schlanger 1991). Knowledge of their locations and content variation would have facilitated decision-making because people would have had to guess far less about the nature of the terrain that they intended to exploit and about which tools would be needed to accomplish their economic objectives (Wandsnider 1992). Hence, a group's collective memory of the Upper Basin's archaeological record and its modifications over time would have been a vital element in planning the organization of technology and the allocation of labor.

Summary and Conclusions

When first encountered, the Upper Basin's 126 FCR piles were enigmatic because such archaeological phenomena had been unreported in upland conifer ecosystems of the American Southwest. Examination of their highly variable surface properties indicated that these FCR piles are

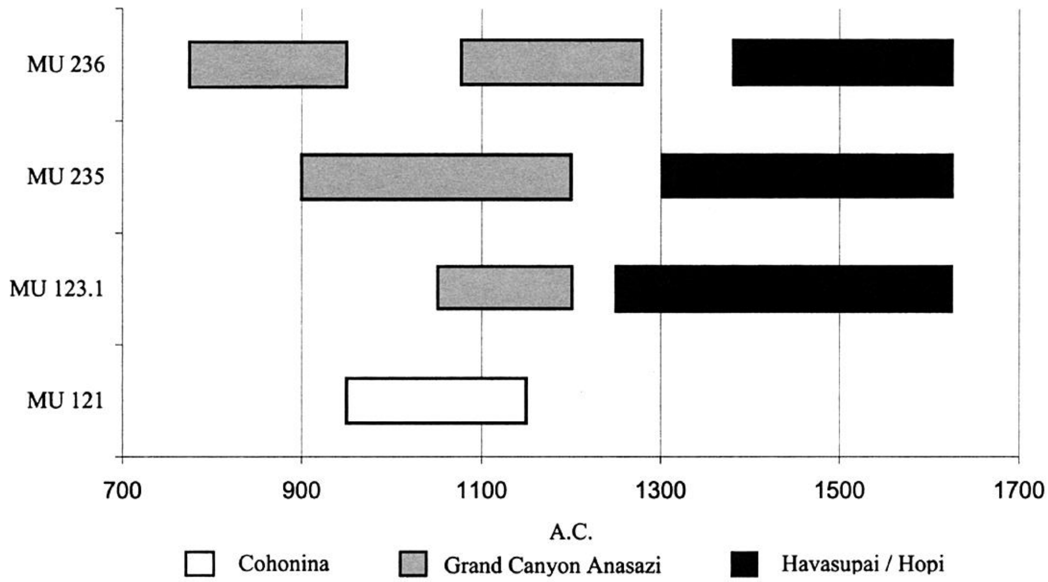

Figure 10. Formation histories for four FCR pile sites. Each tone represents the abundance of a specific ceramic ware: Cohonina by San Francisco Mountain Gray Ware, Grand Canyon Anasazi by Tusayan Gray Ware, ancestral Havasupai by Tizon Brown Ware, and ancestral Hopi by either Jeddito Plain Ware or Awatovi Yellow Ware.

Table 7. Frequencies (f) and weights (wt, in g) of ceramic wares from Upper Basin FCR-pile sites (MU = Mapping Unit).

	MU 121		*MU 123.1*		*MU 235*		*MU 236*	
Ceramics	*f*	*wt*	*f*	*wt*	*f*	*wt*	*f*	*wt*
Tusayan Gray Ware	33	96	6	78.5	467	1479.6	130	581.9
Tusayan White Ware	25	74.7	14	112	37	126	43	130.2
Tsegi Orange Ware	5	12	1	12.4	20	58.1	2	17.1
San Juan Red Ware	–	–	1	2	–	–	–	–
Little Colorado White Ware	–	–	–	–	21	104	11	47.5
Little Colorado Gray Ware	–	–	2	41.2	–	–	–	–
San Francisco Mountain Gray Ware	223	750	10	50.1	70	179.4	49	158
Jeddito Plain Ware	–	–	6	35	–	–	2	19.5
Awatovi Yellow Ware	–	–	6	19.5	7	150.6	42	350.1
Tizon Brown Ware	–	–	–	–	23	52.7	181	636.4
Unknown Brown Ware	6	5.9	–	–	–	–	–	–

not attributable to historical-period Native American rituals. Suspecting that they might have been involved in activities related to the livelihoods of the area's prehistoric occupants, five FCR piles were selected for excavation. It was discovered that, instead of being the archaeological consequences of roasting pits, Upper Basin FCR piles are the remains of surface thermal features that were used principally to process wild plants (presumably in bulk quantities). Analysis of FCR piles and their associated assemblages indicates, furthermore, extensive variation in the prevalence of flaked-stone tool manufacture, ground-stone tool reuse and recycling, ceramic-vessel-fragment recycling, and, secondarily, animal-carcass processing. By every measure, FCR piles and their artifact scatters were anything but "limited activity sites."

With the passage of centuries, reuse of abandoned features and recycling of discarded artifacts created the material topography that punctuates the Upper Basin today (Sullivan, Mink, and Uphus 2002). This topography enabled groups of local, short-distance foragers (ceramic-period Grand Canyon Anasazi or Cohonina) and non-local, long-distance foragers (protohistoric-period Havasupai or Hopi), who planned and acted on the basis of inherited accounts of unseen geographies, to acquire resources with minimal or negligible artifact-transport costs. Such regional-scale formation processes (Schiffer 1987: 99–114), which involved ever-increasing reduction of previously discarded artifacts, churning of features, and the smearing of spatially discrete occupational debris, contributed to the origination of a high degree of inter-site variation (Wandsnider 1998; Zedeño 1997). At some point, however, the Upper Basin's FCR piles were never reused, the material topography became inert, and the forms of lithic, ground stone, and ceramic artifacts ceased to be modified further. Although we may never ascertain conclusively why use of the FCR piles and their artifact scatters was discontinued, today they provide an unparalleled opportunity for learning about how different land-use patterns, involving the same terrain, were integrated into the prehistoric and protohistoric subsistence economies of the Grand Canyon area.

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Upon viewing the Upper Basin's fire-cracked-rock piles for the first time in July 1989, the late Robert C. Euler immediately recognized their interpretive potential and encouraged us to pursue their investigation relentlessly. This paper is dedicated to Bob, whose uncompromising standards of professional behavior and commitment to interdisciplinary research are a model for archaeologists worldwide.

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