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Part II

Investigations at the Pueblo Alto Complex

Chaco Canyon

Volume III

Part 2

Investigations at the Pueblo Alto Complex

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ARTIFACTUAL and BIOLOGICAL ANALYSES

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Front cover: Pueblo Alto and New Alto on the mesa overlooking Chaco Canyon to the southeast (Courtesy of David Brill ©1980).

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Chapter Seven

Adobe Roof Impressions from Pueblo Alto

Eric Ingbar

Introduction

The following study is an attempt to define architectural variability as indicated by adobe used in the roofs of rooms at Pueblo Alto. None of the rooms at Pueblo Alto have original intact roofs. Original roofs either weathered away and/or were torn apart for the wood contained in them. The major remnants of the roofs are the pieces of adobe that once lay on top, and between, the wood and brush structural elements of each roof. These bits of adobe are present in every excavated room at the site, but rarely have been examined in other than an impressionistic fashion. They do serve as indicators of roof construction methods, because the adobe was applied while plastic and contains casts of the materials it contacted. These impressions are incredibly detailed and provide adequate resolution to identify vascularization in plant stems, distinguish bark surfaces, and identify the plants involved.

Collections of excavated adobe were examined to determine roof construction in various rooms at the site. In all 678 pieces of adobe from 9 different rooms were examined. The adobe impressions examined were typed according to the kinds of materials impressed on them and the relationships of those impressions. This resulted in 26 different types that permitted between-room comparisons. Three different roof types were determined to have been present. Also, the impressions of various parts of corn plants (*Zea maize*) permitted inferences about seasonality of roof construction in at least one room (Room 142).

No great attempt was made to integrate the study with the volumes of information on Chacoan prehistory. Some inferences are drawn, but these are largely with reference to other studies of Chacoan architecture.

Methods

The adobe impressions examined came from nine rooms. Rooms 139, 142, 145, 146, and 147 form a room suite in the Central Roomblock (Figure I.2).

Rooms 110, 112, and 229 form a suite in the West Roomblock. Room 103, in the southern part of the West Roomblock, is the only room in its suite sampled and, hence, stands alone in this chapter.

For the most part, the adobe impressions examined were from the last roof; the impressions were recovered from above-floor stratigraphic levels. The only exception to this is Room 103, where some adobe impressions were excavated from between Floor 1 and Floor 2. These did not differ significantly from adobe impressions excavated from above-floor levels in the same room. So long as the impressions have not weathered, they form almost perfect casts of the material on which the plastic adobe was placed. Because collection of the impressions was incomplete, except in Room 139, it is difficult to tell how much of the adobe had weathered. There may be a systematic bias toward certain roof parts. In most of the rooms only "interesting" specimens were saved, and these may be lower, more protected, roof parts. For purposes of analysis it was assumed that all roof parts had an equal chance of being collected.

When one accounts for the amount of weathered adobe discarded as backdirt, the collector's bias in saving actual impressions, and the incomplete sampling of the saved collections, probably no more than 1-3 percent of the actual adobe in a roof was examined. Some rooms were definitely sampled more heavily than others (Rooms 139, 142, and 103), whereas others were probably not sampled enough (Rooms 112, 145, 146, and 147). What follows, then, is logically somewhat weak--the inferences are affected by small sample size, the collector's bias, differential preservation, and possibly differential destruction. The study is warranted, however, by virtue of the rather extensive collection of unweathered pieces (Tom Windes, personal communication), and, as the impressions collected are the only ones we have, we are compelled either to do something with them as they are or not study them at all.

The study was not a test of a preconceived, specific hypothesis. It was felt that such a goal, in the absence of any knowledge of adobe impressions as artifacts, would have been premature. Instead, the major goal was to learn something about adobe impressions as artifacts and their potential utility in the study of architecture, especially roof construction.

Initially, each piece of adobe was described. This soon proved to be unnecessary because regular patterns of impression were found; 26 types were sufficient to describe all the observed variability (Table 7.1). The size of each piece was measured (length, width, thickness--see Figure 7.1) to see if variation was related to thickness. This did not turn out to be the case. Diameters of logs were measured whenever impressions were encountered. A wire miter gauge provided accurate readings of any arc greater than approximately 60 degrees. Surface colors (matrix color) and plaster colors (if present) were noted on only a few samples. No comparisons were made using color. The percentages of each type by room provided a basis for reconstruction of the roof of each room and for room-to-room comparisons.

Table 7.1. Adobe impression types, with coding numbers.

Code	Adobe Impression Types
01	Splint impressions on one side, parallel to each other.
02	Splint impressions on one side, perpendicular to each other.
03	Splint impressions on two sides, parallel to each other.
04	Splint impressions on two sides, aligned perpendicularly to each other.
05	Splints on two sides, aligned obliquely to each other.
06	Splints parallel to beam, both on one side only.
07	Splints perpendicular to a beam, on one side only.
08	Splints on both sides, aligned parallel, on one side parallel to a beam.
09	Splints on both sides, aligned parallel, on one side perpendicular to a beam.
10	Splints parallel to a beam on one side, beam on edge perpendicular beam$_1$ and splints.
11	Splints and rods and beam, all parallel, on one side only.
12	Rods parallel, up to 1 cm apart, one side only.
13	Parallel beams on one side, perpendicular matting on the other side.
14	Splint impressions on both sides, aligned parallel to each other, with rod impressions perpendicular to splints on one side.
15	Parallel small rod impressions (approximately 0.5 cm in diameter) on one side only.
16	Small rod (or grasslike) impressions on one side, with perpendicular rod (up to 2 cm) impressions slightly above.
17	As 16 but with parallel rod(s) next to grasslike impressions.
18	True grasslike impressions.
19	Single beam impress, one side only.
20	Parallel rods with one rod perpendicular and slightly above.
21	Bark, grass, etc. mat, parallel to 1-cm rods.
22	Parallel rods on one side, matting on the other.
23	18 on one side, matting-junk on the other.
24	18 or 12, perpendicular to beam, matting on other side.
25	Two beams perpendicular to each other.
26	15 perpendicular to 15.

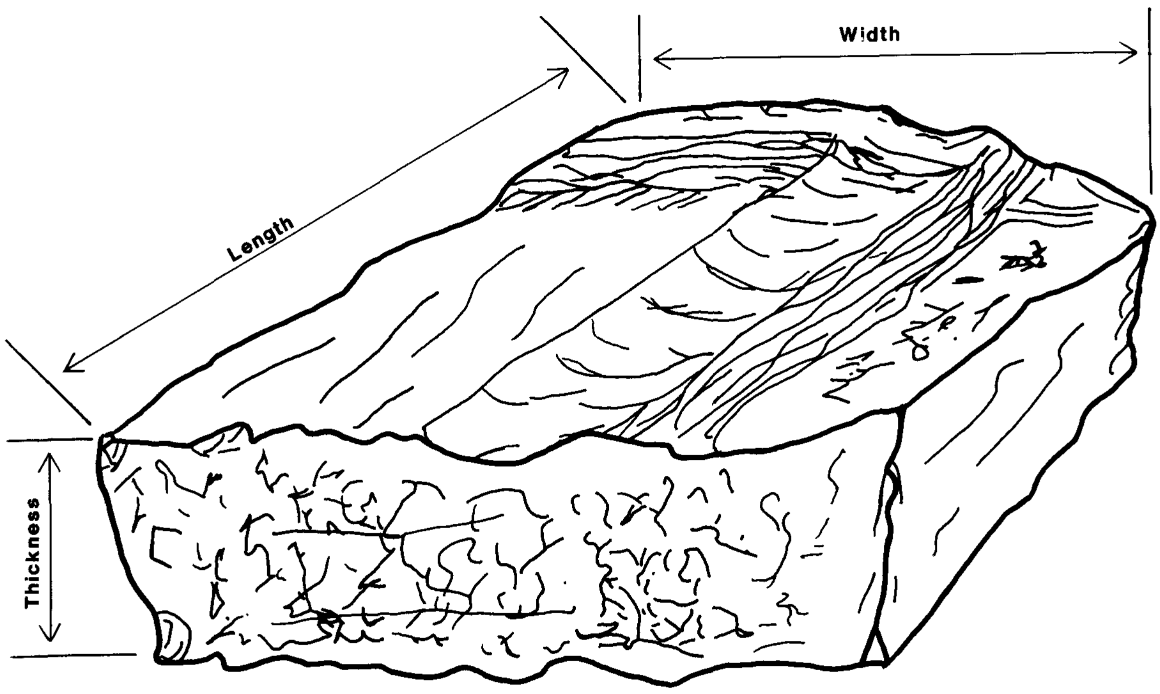

Figure 7.1. Hypothetical adobe impression, showing measurements taken (roughly the size of a real adobe impression).

Known Floor and Ceiling Types

No external roofs are extant in the Chaco area. A number of archeologists have described internal floor/ceiling structures, which in many ways are analogous to roofs (Judd 1959, 1964; Lekson 1984; Pepper 1920). Judd's (1964) work on the architecture of Pueblo Bonito probably describes the greatest number of different floor/ceiling types, but does not include some of significance with regard to the roofs at Pueblo Alto. No grand synthesis of Chacoan floor/ceiling construction has been produced, but Lekson's (1984) volume on Bonito phase architecture is probably the best single compendium of greathouse architectural forms at Chaco. His section on roof construction is relevant here, and the following discussion is largely taken from his work and that of Mindeleff (1891).

All floor/ceiling types discussed by Lekson contain vigas--large beams, generally of ponderosa pine (Pinus ponderosa), 25-40 cm in diameter, peeled and smoothed, which are usually set into wall sockets. Sometimes they are supported by pillars, pilasters, posts, or masonry piers, as well as by the walls. The vigas form the basic load-bearing structure of the floor/ceiling or roof. Latillas (see description below) are also occasionally employed in pairs instead of the larger single vigas.

On top of the vigas various combinations of materials are used (Table 7.2). Frequently, the first layer above the vigas is composed of latillas--paired (frequently tied with yucca string), interdigitating cross members, which run perpendicularly to the vigas and span them (Figure 7.2). Generally, latillas are peeled and smoothed ponderosa pine, 5-10 cm in diameter, although juniper (Juniperus sp.) and cottonwood (Populus sp.) are used occasionally (Judd 1964). Latilla sockets may be built into the stone facing or veneer of a wall, or the latillas put into place and the wall built around them. Although all rooms have vigas (because some support is needed for a roof or floor/ceiling), not all floor/ceilings have latillas. Latillas do serve a valuable structural function, however, by spreading the load evenly between the vigas and, when socketed into the walls, by partially supporting the load. On the negative side, they increase the dead load on the vigas and walls.

Floor/ceiling combinations with layers of vigas and latillas were almost invariably covered with a tertiary layer of juniper splints--riven from logs--approximately 1.3 m long, 0.5 cm thick and 4-5 cm wide. These were laid down on top of the latillas as a matting and were also pressed between pairs of latillas. On top of these a layer of adobe/mud was spread (no depth given by either Judd or Lekson), sometimes with bark or rubble mixed in. Earth was then packed on top of the adobe layer to seal the floor/ceiling and provide a durable work surface. Both the adobe/mud and earth added a good deal of load to the structure, but were essential to the functioning of the floor/ceiling.

Floor/ceiling types without latillas had either mats of closely laid (peeled and smoothed) willow rods, sometimes split into half-round rods (Judd 1964), or planks or brush. On top of these bark and adobe/mud was placed, followed by the usual layer of earth.

Table 7.2. Floor/ceiling types (from Lekson, 1977).

Type	First Layer	Second layer	Third layer	Fourth layer	Fifth layer
1	Vigas	Latillas	Juniper splints	Adobe/mud	Earth
2	Vigas	Latillas	Juniper splints	Adobe/mud and bark	Earth
3	Vigas	Latillas	Juniper splints	Adobe/mud, rubble & bark	Adobe/mud
4	Vigas	Latillas	Juniper splints	Adobe/mud and bark	Earth
5	Vigas	Willow rods	Bark	Adobe/mud and earth	Earth
6	Vigas	Planks	Bark	Adobe/mud and/or earth	
7	Vigas	Brush, misc. plants	Adobe/mud	Earth	

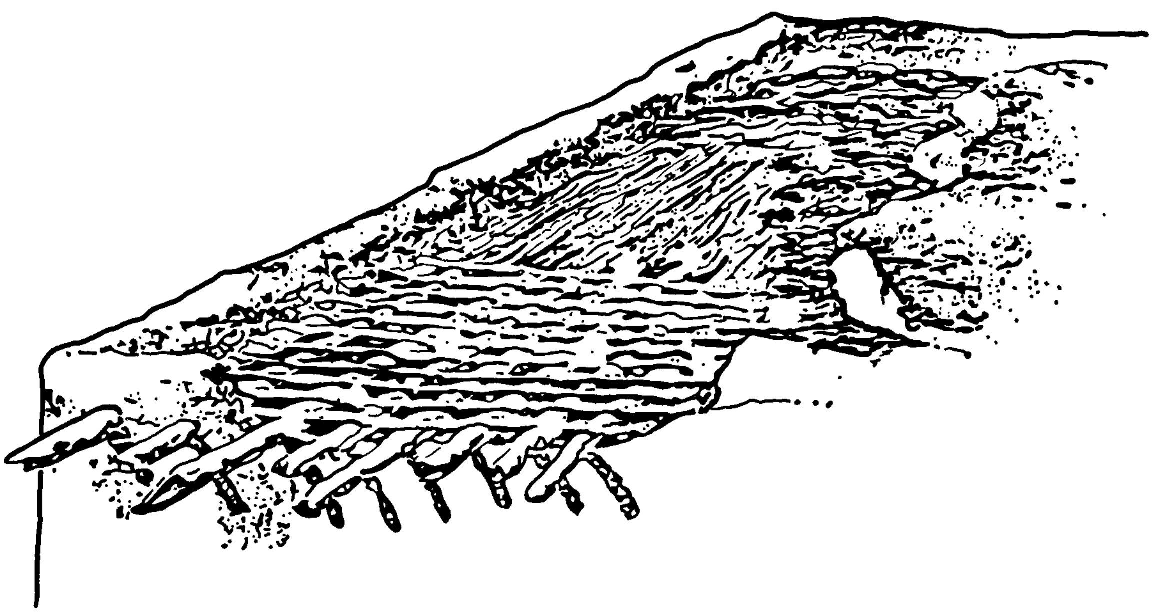

Figure 7.2. Cross section of a Zuni roof (from Mindeleff 1891).

One other floor/ceiling type is mentioned by Judd (1964) in the excavation notes for Pueblo Bonito. This type is essentially the same as the vigas, latillas, and splints types but has reed grass (*Phragmites communis*) mats instead of juniper splints.

There is much variation within the types presented in Table 7.2. Additional materials were often added to the various layers, especially to the upper (brushy) layers. Judd (1964) reports many floor/ceilings with patches of juniper splints in them.

The massive nature of puebloan floor/ceiling and roof construction has been mentioned above, but needs re-emphasis, for it is truly astounding. A floor/ceiling with 25 cm of fill above the vigas (as seen extant at Pueblo del Arroyo--personal observation) and a surface area of 18 m^2 would have a volume of 4.5 m^3. Using Erasmus' (1965) conservative figures of 1305 kg/m^2 for fill weight, the calculation shows that the fill of an 18 m^2 roof would weigh roughly 6,000 kg. Furthermore, such a figure is probably too low. As Erasmus also points out, this represents only about 20 man-hours of labor if the fill was carried from a source 100 m away. Of course, there are other time and energy expenditures, which are probably much greater, involved in the construction of a floor/ceiling or roof. The procurement and preparation of vigas and latillas, splints, etc., represent large investments of energy. But probably all of the figures agree with Lekson's (1984) estimates of Bonito-phase time and energy requirements for building walls. He estimates each cubic meter of wall required 20 man-days of labor.

Thus, eight floor/ceiling types are known. Each represents a substantial labor investment, as well as a massive agglomeration of materials. If anything, one would expect exterior roofs to be even heavier and better built, as they must take additional loads and weathering. The huge numbers of adobe impressions found at Pueblo Alto are, therefore, not truly extraordinary.

Roof Types at Pueblo Alto

Central Roomblock (Rooms 139, 142, 145, 146, and 147)

The Central Roomblock was the most heavily sampled area of the pueblo, particularly Rooms 139 and 142, which contained 58 percent of the adobe pieces from the site. The reconstruction of the roofs of these two rooms, which have the most adequate sample sizes, serves as a good starting point for inferences about the roofs of the less-sampled rooms (Table 7.3).

In Room 139 the predominant impression types were of juniper splints (Types 1, 3, 4, and 6), comprising 82 percent of the impressions examined. The beam (viga and latilla?) impressions from the room have a modal diameter of 6 to 7 cm--probably representing latillas, as it would be rare for the vigas to leave impressions, (unless paired latillas were used as

Table 7.3. Room number by type, n, and frequency.

	West Roomblock								Central Roomblock										
	Room 103		Room 110		Room 112		Room 229		Room 139		Room 142		Room 145		Room 146		Room 147		
Type	n	%	n	%	n	%	n	%	n	%	n	%	n	&	n	%	n	%	Total
1	2	2.2	7	14.0	3	11.1	5	11.4	82	39.2	28	15.1	0	0.0	0	0.0	0	0.0	
2	1	1.1	0	0.0	0	0.0	3	6.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
3	0	0.0	2	4.0	0	0.0	0	0.0	24	11.5	63	34.1	18	75.0	0	0.0	0	0.0	
4	0	0.0	2	4.0	0	0.0	2	4.5	41	19.6	51	27.6	0	0.0	18	75.0	3	12.5	
5	1	1.1	0	0.0	0	0.0	1	2.3	10	4.8	17	9.2	0	0.0	1	4.2	0	0.0	
6	0	0.0	0	0.0	0	0.0	1	2.3	26	12.4	9	4.9	0	0.0	0	0.0	0	0.0	
7	0	0.0	8	16.0	0	0.0	0	0.0	1	0.5	2	1.1	0	0.0	0	0.0	0	0.0	
8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.2	0	0.0	0	0.0	
9	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	2	1.1	0	0.0	0	0.0	0	0.0	
10	0	0.0	0	0.0	0	0.0	0	0.0	11	5.3	0	0.0	0	0.0	0	0.0	0	0.0	
11	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
12	2	2.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
13	7	7.7	3	6.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
14	2	2.2	0	0.0	0	0.0	0	0 0	0	0 0	12	6.5	0	0.0	0	0.0	0	0.0	
15	16	17.6	0	0.0	0	0.0	0	0.0	10	4.8	0	0.0	0	0.0	0	0.0	14	58.3	
16	3	3.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.2	
17	5	5.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
18	26	28.6	0	0.0	4	14.8	1	2.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
19	7	7.7	1	2.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	
20	0	0.0	0	0.0	0	0.0	0	0.0	2	1.0	0	0.0	0	0.0	0	0.0	0	0.0	
21	2	2.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
22	4	4.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	16.7	
23	7	7.7	27	54.0	20	74.1	31	70.5	0	0.0	0	0.0	5	20.8	5	20.8	1	4.2	
24	5	5.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
25	1	1.1	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	
26	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.2	
Totals	91		50		27		44		209		185		24		24		24		678

vigas as at Room 49, Pueblo del Arroyo). Because the roof was probably quite thick and heavy, the relative sparsity of beam impressions and their fairly small diameters indicate that the roof was supported by true vigas. If paired latillas were used, a great many of them would have been needed, and, hence, many more impressions would have been found. Thus, the first, second, and third layers of the roof were (respectively) vigas, latillas, and splints. A layer of adobe was then placed on top of the splints until they were covered with 3-5 cm of mud. Then, another layer of splints was laid down, sometimes perpendicularly to the first layer and sometimes parallel. Probably this second splint layer was put in place after the adobe had dried somewhat, as the impressions are usually fainter than those around beams and the first splint layer. This makes sense if one imagines trying to work on a large (26-m^2), gelatinous surface--it would be next to impossible to walk onto the middle of the roof while the adobe was wet.

On top of this second layer of splints was spread another layer of adobe with bits of bark and other detritus (corn stalks, twigs) mixed in. This served as the final layer of adobe. However, on top of some impressions a fine plaster layer was found. It resembles plaster used on the interior walls of rooms (Tom Windes, personal communication), and its presence is somewhat enigmatic. One possibility is that Room 139 had a shelf in it, like those found at Pueblo Bonito (Judd 1964), covered with adobe and plastered. At any rate, it is unclear what the plaster represents: a final waterproofing layer, sealing around a hatchway, or an interior shelf.

Room 142 had essentially the same roof type as Room 139. To test this a statistical hypothesis was framed: if the two roofs were basically the same, a Chi-square between the two should show no significant difference in patterning at a preset $p = .05$ level of confidence. The Chi-square of 91.65 with 12 degrees of freedom rejects H_0, suggesting significant differences between the two rooms. The statistical result, however, is not necessarily accurate; intuitively, and with regard to real constructional differences as evidenced by the impressions, it is the writer's opinion that the roofs were essentially the same.

Rooms 142 and 139 are adjacent to each other and may have been roofed in a single operation. A granulometric analysis of the adobe employed in analogous layers of the two rooms may be a way to test this proposition: similar sediment profiles may be hypothesized to represent an identical source.

Room 142 also contained impressions with casts of botanical materials. Particularly significant was one piece of adobe (FS 2715, Test Trench 1, Level 11), that contained a cast of a cornstalk and a corn leaf. Paul Knight (University of New Mexico, Department of Biology) identified the stalk as from a mature plant. The remarkable accuracy of the cast (vascularization was distinguishable) indicates that it was placed in the adobe while the stalk was still green. The implication of this is that the adobe was placed on the roof in the autumn, right after the corn had matured. Thus, the entire roof was probably constructed in the late summer or early fall. It is not clear whether this seasonality of construction applies to other rooms as well. If Room 139 and Room 142 had essentially the same roof, built over both rooms, then, clearly, 139 was also roofed in the fall. Times of construction of roofs of other rooms can only be estimated.

The subdivided portions of Rooms 139 and 142, which form Rooms 145 and 146, have roofs essentially similar to each other. Sample size was very small (n = 24) for both rooms, so it is hard to evaluate how similar the two rooms are to Rooms 139 and 142. The differences between the rooms appear to be minor: chiefly, the presence of Type 23 impressions in the samples from Rooms 145 and 146, which represents a different third layer above the first layer of splints, although the differences may be greater than this, and similarity may be an artifact of sample size. Perhaps the differences in materials were associated with room function or room size.

From the small sample examined, Room 147 appears to have had a fundamentally different roof from any other rooms in the Central Roomblock. The collection is dominated by casts of closely laid reeds (*Phragmites communis*). The reeds were apparently laid down in mats (as in floor/ceiling Type 5) above the latillas and then covered with adobe, bark, and more adobe. Some juniper splints may have been used as well, perhaps as patches. The difference between the roof of Room 147 and roofs of the other rooms in the Central Roomblock may be related to Room 147's function as the antechamber for Kiva 10. The relationship is not clear.

In sum, the Central Roomblock appears to have had two, possibly three, roof types. Rooms 139 and 142 had roofs, or a single roof, similar to floor/ceiling Type 2 but with an extra layer of juniper splints. Rooms 145 and 146 had roofs that may have been similar to the adjoining rooms (139 and 142), but this is not certain. The difference between 145 and 146 was slight--one had Type 3 impressions, the other Type 4, resulting from merely a different orientation of the second layer of juniper splints. Room 147, probably a special purpose room (Windes, Volume II of this report), had a very different roof from any of the other rooms.

West Roomblock (Rooms 110, 112, and 229)

The West Roomblock was rather lightly sampled. The number of pieces examined comprise only 18 percent of the total sample. Inferences are fairly weak with so small a sample, but the three rooms do show a high degree of uniformity (Chi-square of 41.3, df = 20, p = .03). Furthermore, only a few types of impressions (Types 1, 7, 18, and 23) account for most of the 121 adobe pieces. This suggests that the roofs on the three rooms were fairly uniform in composition.

The modal beam diameter for Room 110 was 8 cm. This is somewhat larger than the beams associated with the Central Roomblock and may indicate a greater reliance on heavier (single) latillas (vigas?). This may be due to the somewhat smaller size of the rooms in the West Roomblock (approximately 17 m^2), which might have needed fewer but larger beams to offset the difference in number. Then again, this may be due to differences in the types of roof that were used in the West and Central Roomblock.

The West Roomblock roofs (again, maybe a single roof) all were made of layers of splints placed upon latillas and covered with adobe, upon which a layer of mostly grass with a little brush was laid, and then a second layer of adobe, completing the roof except for any dirt piled on top.

This type of roof is markedly different from those in the Central Roomblock. It is definitely less massive in terms of the amount of woody material needed for its construction. Presumably, the roof requires less labor to build. Finally, the roof may have been less durable: grasses would serve little function as structural support--something a second layer of juniper splints, as in Rooms 139 and 142, would do quite well--but they may have served a "massing" function by providing a support for the last layer of adobe.

Room 103

Room 103 was fairly heavily sampled. The room had been divided in two some time during its occupation (Windes, Volume II of this report), and it was suspected that this might have caused a second, different-style, roof to be built. This did not appear to be the case, insofar as it would be possible to tell--the room would undoubtedly have been cleaned of the old roof. Room 103 had two floors in it, and some adobe impressions were found between Floors 1 and 2, which suggests that the roof was destroyed and then rebuilt. No differences between sub-Floor 1 and above-Floor 1 impressions were discernible.

The roof itself appears to have been made largely of reed mats and brushy materials--58 percent of the impressions bore reed marks (possibly slender willow rods, too). Only 7 percent of the impressions was of splints. This makes the roof quite similar to the roof of Room 147. But Room 103 had a much heavier roof, perhaps a result of its larger surface area (approximately 22 m^2). The constructional sequence for the roof might have been vigas; latillas (5-6 cm in diameter); reed mats--spacing between elements of from 0.5-1 cm; adobe (3-4 cm thick); grasses; brush; and more adobe. Splints may have been used as patches or around a hatchway.

The roof of Room 103 is an interesting hybrid between the West Roomblock type and the roof of Room 147. The use of reed matting in so large a room indicates that this construction style was considered adequate for large rooms as well as small ones. The use of grasses as an upper layer of fibrous material (perhaps instead of juniper bark?) in both the West Roomblock and Room 103 shows that the "grammar" of roof building may have been flexible--in one instance grasses are associated with a splint roof, in the other with a reed roof. Further work is necessary, however, to establish the validity of the reconstruction made in this paper.

Discussion

The 678 adobe impressions examined in the study, from 9 different rooms, indicate 3 or 4 roof types present at Pueblo Alto. The types of roofs are not unequivocally defined, because of the rather small number of samples examined and the uncertainties about puebloan architectural forms at Chaco Canyon. The three or four types presented above do provide a basis for further hypotheses: (1) whether these roof types really existed, (2) what sort of variability is present in the site as a whole--how many different roof types are present, and (3) what meaning roof-type variability might have--is it related to availability of resources, room function, room size, technical ability of the builders, structural properties of the edifice, constraints on time and energy, or some other unknown factor?

Probably the most important implication of the study is the seasonality of roof construction at Room 142. It clearly relates to (2) and (3), above, in that it indicates one possible axis of variability, season of construction, which, in turn, has implications for the social and technical parameters of construction. More findings at the same level of specificity--the individual room--of these sorts of parameters would help us to understand the architecture of Pueblo Alto in both its environmental and social contexts.

With regard to (1), further samplings of the adobe collected at Pueblo Alto would be a good start in determining the validity of the inferred roof types. Sampling of other rooms or sites would also provide a good check on the types of roofs possibly present at Pueblo Alto.

Further sampling at Pueblo Alto would also provide information needed for (2). Further roof types would have to be supported by reconstructions and inferences like those made in (1). Also, variability would have to be defined: how is it to be measured? By sediment profiles from the adobe used? By roof type? Further study along the lines of (1) is necessary before (2) can be undertaken. One possible line of interest is the granulometric analysis of the adobe used in various layers of roofs in different rooms. Especially in the two roomblocks, this might provide a way of determining whether roofs were erected over all the rooms at once or whether each room was roofed individually. (It also has implications for the amount of labor necessary.) Is roof adobe the same as wall mortar (West, Appendix MF-I for Volume I of this report).

Whatever approaches and standards are used, one is ultimately left with (3); what does variability mean? Variability may be due to increasing amounts of free energy in the population, or a change in social organization, or a change in environmental conditions, ad infinitum. Correlations of roof type with room size, room function, and other clearly "architectural" phenomena provide a good starting point for explaining variability. If no significant patterns are found, then one looks elsewhere for explanation, perhaps to such factors as population size and stress.

Aside from theoretical considerations, the study has some methodological hindsights to offer. A truly random collection, or a complete collection, of adobe bits bolsters the strength of any research on roof types. Furthermore, a binary coding system of impression types would be a good tool, because it would allow an ordinal-level scale to be constructed, and (depending on sample bias) more powerful statistical techniques could be employed in analysis. The Chi-squares calculated for almost every variable recorded do not relate well to the reality of the actual impression types. Now that some information on adobe impressions has been gathered, a more thoughtful approach is possible.

Finally, any further study of adobe impressions now has some guide to the caveats of considering impressions as artifacts. We still have not gone very far in explaining the meaning of roof type and architectural form in Chacoan structures: it is hoped that we can go further.

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Chapter Eight

Faunal Remains from Pueblo Alto

Nancy J. Akins

Introduction and Methods

Approximately 10 percent of the townsite of Pueblo Alto was excavated by the Division of Cultural Research, National Park Service. Most of this took place during the field seasons of 1976 through 1978. Around 50,000 bones were removed from the site and 30,509 of these were identified and computerized for this analysis. Those that were not analyzed were primarily from the Trash Mound (about 16,000) and Kiva 10 (about 2,700). A small number from external trenching and later wall clearing were also not analyzed.

Bones were identified on a year-by-year basis after each field season and the entire collection analyzed in 1981. Except for the *Reithrodontomys* and *Onychomys*, which were identified by W. B. Gillespie, the mammalian identifications were done by the author, primarily using complete skeletons from the archeological collections and road kills. Those for which we did not have comparative specimens were taken to the Museum of Southwestern Biology of the University of New Mexico Biology Department where UNM's collections were used for the identifications. Identifications were not made without comparative materials.

Aves materials, other than mature turkeys, were identified by Steve Emslie of the University of Northern Arizona and the Center for Western Studies. Dr. John Applegarth, University of New Mexico, provided the identification for the herpetological specimens. Fish remains were identified by Dr. William J. Koster.

This report will first cover the basic methods used; this includes the computer format and variables, brief definitions of those variables, and how the MNIs (minimum number of individuals) were calculated. Next, it will turn to the taxa found at the site, and these will be discussed in terms of economic status, where they occur naturally, and where they occurred within Chaco Canyon archeological sites as well as other considerations at the level of the taxon. With this background the variables will be discussed in detail, and any patterns will be explored. This will be followed by reports on the individual proveniences in the analysis and a summary of which kinds of deposits are the most worthwhile for the effort expended. Next will be a discussion of temporal change at Pueblo Alto. Finally, changes in exploitation over time will be considered along with their meaning in relation to the Chacoan system.

Recording of the Variables

Recognition that a large volume of faunal material would be produced by the excavations led to the development of a computer recording format for these materials. The format and coding can be found in Appendix MF-8.A. The variables are briefly defined below, and many are discussed in a later section.

Provenience Coding: The format for the provenience coding is a condensed version of the inventory recording system. It includes a site code, general provenience unit (e.g., Room 103), the general level category (fill, floor fill, etc.), a floor indicator (Floor 1, Floor 2, etc.), the layer/level number (Layer 1, Level 2), the level characteristic (aeolian, trash, etc.), the feature category and number (Firepit 1, Posthole 2, etc.), and, finally, the feature level category (fill, floor, etc.).

Classification: Identifications were made as specific as possible. A four-digit number indicates an identification to the species level, three to the generic level, and two to the order. A search of the literature had provided an idea of what species were expected, and the numerical sequence follows that presented in Findley et al. (1975). Several categories for unknown elements were used to record the size of the animal element represented.

The species identifications for several genera of rodents were added after the initial computerization after detailed examination by Akins or Gillespie.

Element: Element identifications were also as precise as possible. Those in which the exact identification could not be made were recorded as closely as possible (i.e., vertebrae, long bone fragment).

Portion Represented: Again, this was made detailed to help ensure the accuracy of the MNI counts generated. For example, long bone fragments were recorded as to whether they were shaft or end fragments and vertebrae fragments as to whether they were body, spine, or a combination of the two. Those coded as "mostly complete" had suffered only slight damage, and the missing fragment would not have been enough to add to the MNI counts.

Side: Axial was used to record skull and vertebral elements. All other elements were sided if possible.

Age: The very young group is defined as those animals that had not yet reached one-third of their mature size; immature as those one-third to two-thirds of adult size; young adults as those that were almost or adult in size but did not yet have their epiphyseal unions fused. This definition undoubtedly leads to some differences in the aging of body parts from a single individual as epiphyseal union is not uniform. Older adults were recorded whenever recognized, usually on the basis of extreme tooth wear.

How Aged: If the animal was not an adult, this variable recorded the criteria for the age assignment. The most commonly used were size and epiphyseal union, although porosity was occasionally used. Animals that are less than full-grown often have lighter and more porous bones. This criterion was used conservatively for elements with no epiphyses and which were too incomplete to be sized.

Butchering: When the butchering variables were devised, there were high expectations as to their utility. Unfortunately, few bones had indications of butchering. The identifications include a gross description of the method and the location of the butchering.

Checking: This recorded the condition of the bone that resulted from depositional circumstances. Bones exposed for a period of time exhibit small cracks and flaking called checking. The degree of this was recorded to acquire information on the rapidity and origin of refuse deposition.

Burning: The extent of the burning and degree or color of burn or "cooking brown" was recorded here. Examination of almost any group of bones from a single provenience reveals that some are a darker color. Several factors could account for this. The bones from immature animals often take on a darkish color, but this can be visually distinguished from "cooking brown." The "cooking brown" is more like a very slight scorch, and in partially burned bones the burned area may grade into a similar brown. Linda Cordell (personal communication, 1979) has suggested that the color may be due to a chemical change that occurs when the bone is cooked. Occasionally, complete proveniences of bones will be discolored; this was assumed to be due to soil or other conditions affecting the assemblage and was not recorded as "cooking brown." Whatever this particular condition means, it has been recorded and is treated as if it were the result of cooking, presumably boiling.

Animal Activity: This variable was an attempt to monitor both rodent and carnivore disturbance in individual proveniences and the site as a whole.

Evidence of Use: Like ground stone, lithics, and other archeological materials, bones are occasionally picked up and used, resulting in a small amount of "wear." Rather than treating these as bone tools, we recorded them here. These are thought to be the result of deliberate use by man rather than modifications resulting from acts of nature.

Miscellaneous Observations: This included several variables that were felt to be worthy of recording. The first, a purple staining, occurred infrequently and often on more than one bone in a provenience. This suggests that it is related to conditions of deposition. Pigment staining was also recorded. Rounding was added after two seasons of Pueblo Alto identifications had been made. It had been noted that many elements within a provenience exhibited rounding of the broken edges. Several conditions may have resulted in this: the movement of bones from natural causes could result in the rounding of some fragments of bone, other rounding might result from cooking, or as the result of passing through the digestive tracts of humans, canids, or turkeys.

Pathology: This was recorded as a matter of interest with the possibility of being used to monitor the general health of some species. Most of these were traumatic in nature and are more interesting than valuable.

Number of Fragments: Elements with identical identifications and characteristics were treated as a single unit and counted in this variable. Fresh breaks or breaks attributable to weathering were glued together so as not to exaggerate the counts. If an element was extremely fragmented but obviously one element, it was counted as one rather than the number of fragments that made up the bone.

Field Specimen Number: The FS number was assigned by the excavator. This was written on each bone or, if a number of bones had the same species and element assignments, these were bagged together with a slip of paper recording the FS and individual specimen number.

Individual Specimen Number: Each line on a coding form or computer card within an FS was given a sequential individual specimen number to aid in the retrieval of the bones.

Identification Method

After the bags from an area were located, these were sorted by provenience and then within each provenience unit from surface to subfloor. If more than one FS number represented a unit, these were identified in numerical sequence. This allowed for "bone matches" and an impression of what was going on within a unit. It also gives a nice sequence for the computer cards, which made it easy to visually inspect an area.

When a bag was opened, all elements were roughly sorted by taxon; usually cottontail, jack rabbits, prairie dogs, any distinctive rodents, and some grosser categories that would have to be broken down further (i.e., rodents, small mammals, medium mammals, large mammals, and birds). The unknowns were then checked against the known categories, such as rabbits. This done, the large and then the small rabbits, generally the two most abundant species, were sorted by element and recorded. This was continued as far as possible within the office. If the bone was to be taken to the Biology Department or sent out for identification, it was recorded as far as possible, with the classification left blank, and this was filled in once the identification had been made.

Each identified element was marked with the FS and specimen number and stored by species. It was felt that little else would be done with the bones themselves at the provenience unit level; further studies would be within the taxonomic classification, and they were stored to facilitate this.

Analytic Method

Once the computer cards had been punched they were entered into the main computer at the University of New Mexico Computing Center. Before analysis of the site began, the identifications other than the rabbits and prairie dogs were rechecked and corrections were made. The site was then divided up into what I considered to be logical analytic units, and each of these was looked at in turn. The result of this process is found in the section on Provenience Reports. SAS utility programs (Helwig and Council 1979) were used to generate the frequency tables found in this chapter.

The MNIs (minimum number of individuals) were calculated in one of two ways. For small samples (up to 150 elements) the relevant cases were sorted by taxon with the SAS SORT procedure and tabulated by hand. Each element, fragment, side, and age was checked for duplication and the maximum count used. If immature elements occurred in the sample and were not reflected in that maximum count, the appropriate number of immature individuals was added.

The MNIs for the larger samples were calculated by the computer. A PL 1 program written by Alan Rogers (University of New Mexico) tabulated the number of proximal, distal, and shaft portions for each side and age of all long bones plus various fragments of skulls, mandibles, scapulae, innominates, and complete skeletons (an example of this can be found in Appendix MF-8.B). These were then compared to determine which contributed the largest MNI. Again, if no immatures were included, this was compensated for.

Seasonality

Tentative suggestions regarding seasonality are admittedly subjective. The number and complexity of the variables considered (sample size, body parts represented, nature of the deposit and presence of seasonally available taxa to name a few) was beyond quantification. Yet, the potential of this kind of information is far too valuable to be simply dismissed, especially given the various interpretations of how and when Pueblo Alto was occupied.

Three "seasons" are considered in this study (spring, fall, winter). These were determined by when reproduction takes place among the three most common small mammals. According to Bailey (1931), births occur from June to October for Sylvilagus (cottontail) and Lepus (jack rabbit), and early May through July for C. gunnisoni (prairie dog). Thus, "spring" is the time when most of the immature specimens would be present. Given that births usually peak towards the beginning of the reproductive cycle and that the animals tend to be almost full size in 2-3 mos., we would expect to find very immature and immature individuals from May through August. "Fall" may still have a small number of immatures and would have a considerable number of young adults. This would be expected to continue into December or January. No, or very few, immature elements from these three species should be found in "winter" deposits (January through April) but young adult elements are still possible. Conaway et al. (1963) found that for S. floridanus (a species of rabbit found in the eastern portion of New Mexico) juveniles comprised 87 percent of the sampled population in November and December. A study by Hale (1949) found that the percentage of open proximal humerus epiphyses decreased sharply after mid-January, and by early May all were closed. Approximately 9 mos. were required for complete fusion of all elements.

The Taxa Represented

A fair number of the elements recovered from Pueblo Alto were not identifiable. Bone preservation at the site was good, but fine-screen recovery techniques in Plaza Grid 8, and all features produced tiny fragments that could not be identified. Some erosion of bone took place in the upper fill of the plaza and wall fall proveniences but, in general, even small rodent bones were well preserved.

Recovery varied from excavator to excavator depending on the individual method. The best recovery of small elements and taxa was from the western rooms, the Trash Mound booths, Plaza Grid 8, and Plaza 2.

Table 8.1 lists the taxa found in the analyzed sample from Pueblo Alto and their common names. Table 8.2 gives the number of elements for each taxon, the percentage of the total assemblage, the percentage of the identified specimens, and the absolute minimum MNI for the site sample. This minimum MNI was calculated by treating the whole site as a single sample; no divisions were made within the sample.

Bats

M. californicus

Bats are rarely recovered from archeological sites. These specimens were found articulated just above the floor in one of the excavated rooms.

Table 8.1. The taxa found at Pueblo Alto.

Mammals:	
Vespertilionidae	
Myotis californicus	california myotis
Leporidae	
Sylvilagus auduboni	desert cottontail
Sylvilagus nuttalli	Nuttall's cottontail
Lepus californicus	black-tailed jack rabbit
Lepus americanus	snowshoe hare
Sciuridae	
Ammospermophilus leucurus	white-tailed antelope squirrel
Spermophilus variegatus	rock squirrel
Cynomys gunnisoni	Gunnison's prairie dog
Sciurus aberti	Abert's squirrel
Geomyidae	
Thomomys bottae	Botta's pocket gopher
Heteromyidae	
Perognathus sp.	pocket mice
Dipodomys ordii	Ord's kangaroo rat
Dipodomys spectabilis	banner-tailed kangaroo rat
Cricetidae	
Reithrodontomys cf. *megalotis*	western harvest mouse
Peromyscus sp.	mice
Onychomys cf. *leucogaster*	northern grasshopper mouse
Neotoma cinerea	bushy-tailed woodrat
Neotoma stephensi	Stephens' woodrat
Neotoma albigula	white-throated woodrat
Microtus mexicanus	Mexican vole
Erethizontidae	
Erethizon dorsatum	porcupine
Canidae	
Canis sp.	
Canis latrans	coyote
Canis lupus	wolf
Canis familarus	domestic dog
Urocyon cinereoargenteus	gray fox
Ursidae	
Ursus arctos	grizzly bear
Mustelidae	
Taxidea taxus	badger
Felidae	
Felis rufus	bobcat
Cervidae	
Cervus elaphus	wapiti or elk
Odocoileus hemionus	mule deer
Antilocapridae	
Antilocapra americana	pronghorn
Bovidae	
Ovis-Capra	domestic sheep-goat
Ovis canadensis	mountain sheep

Table 8.1. (concluded)

Birds:	
Anatidae	
Anas platyrhynchos	mallard
Accipitridae	
Buteo sp.	
Buteo jamaicensis	red-tailed hawk
Buteo swainsoni	Swainson's hawk
Buteo lagopus	rough-legged hawk
Buteo regalis	ferruginous hawk
Aquila chrysaetos	golden eagle
Falconidae	
Falco sparverius	American kestrel
Phasianidae	
Callipepia squamata	scaled quail
Meleagridae	
Meleagris gallopavo	turkey
Gruidae	
Grus canadensis	sandhill crane
Columbidae	
Zenaidura macroura	mourning dove
Strigidae	
Otus aslo	screech owl
Trochilidae	hummingbirds
Picidae	
Colaptes auratus	flicker
Alaudidae	
Eremophila alpestris	horned lark
Icteridae	orioles
Corvidae	
Pica pica	black-billed magpie
Corvus corax	common raven
Gymnorhinus cyanocephalus	pinyon jay
Turidae	
Sialia currucoides	mountain bluebird
Sialia mexicana	western bluebird
Laniidae	
Lanius ludovicianus	loggerhead shrike
Hirundinidae	swallows
Fringillidae	
Pipilo chlorura	green-tailed towhee
Pipilo erythrophthalmus	rufous-sided towhee
Junco hyemalis	slate-colored junco
Amphibians and Reptiles:	
Pelobatidae	
Spea sp.	spadefoot toads
Iguanidae	
Sceloporus undulatus	plateau lizard
Phrynosoma douglassi	mt. short-horn lizard
Teiidae	
Cnemidophorus velox	plateau whip-tail
Colubridae	
Pituophus melanoleucus	gopher snake
Fish:	
Osteichthyes	
Gila sp.	bonytail

Table 8.2. Elements, percentages, and absolute minimum MNI for Pueblo Alto.

Taxon	No. Elements	% of Total	% of Identified	MNI
M. californicus	4	0.0	0.0	4
S. audubonii	5,909	19.3	34.9	131
S. nuttalli	1	0.0	0.0	1
L. californicus	4,798	15.7	28.3	69
L. americanus	1	0.0	0.0	1
A. leucurus	10	0.0	0.1	3
S. variegatus	2	0.0	0.0	1
squirrel sp.	4	0.0	0.0	2
C. gunnisoni	2,616	8.6	15.4	116
S. aberti	8	0.0	0.0	2
T. bottae	118	0.4	0.7	27
Perognathus sp.	14	0.0	0.1	2
D. ordii	134	0.4	0.8	16
D. spectabilis	18	0.1	0.1	3
Reithrodontomys sp.	3	0.0	0.0	2
Peromyscus sp.	739	2.4	4.4	135
Onychomys sp.	3	0.0	0.0	3
Neotoma sp.	55	0.2	0.3	1
N. cinerea	12	0.0	0.1	2
N. stephensi	3	0.0	0.0	1
N. albigula	4	0.0	0.0	2
M. mexicanus	1	0.0	0.0	1
E. dorsatum	1	0.0	0.0	1
Canis sp.	37	0.1	0.2	2
C. latrans	16	0.0	0.1	2
C. lupus	2	0.0	0.0	1
C. familiarus	11	0.0	0.1	2
U. cinereoargenteus	1	0.0	0.0	1
U. arctos	1	0.0	0.0	1
T. taxus	8	0.0	0.0	2
F. rufus	13	0.0	0.1	2
C. elaphus	1	0.0	0.0	1
O. hemionus	572	1.9	3.4	9
A. americana	167	0.5	1.0	4
Ovis-Capra	23	0.1	0.1	2
O. canadensis	145	0.5	0.9	5
A. platyrhynchos	3	0.0	0.0	1
Falconiformes	1	0.0	0.0	
Accipitridae	10	0.0	0.1	
Buteo sp.	120	0.4	0.7	
B. jamaicensis	126	0.4	0.7	11
B. swainsoni	6	0.0	0.0	1
B. lagopus	1	0.0	0.0	1
B. regalis	3	0.0	0.0	1

Table 8.2. (concluded)

A. chrysaetos	82	0.3	0.5	4
F. sparverius	14	0.0	0.1	2
Callipepla sp.	4	0.0	0.0	
C. squamata	3	0.0	0.0	1
M. gallopavo	987	3.2	5.8	18
G. canadensis	1	0.0	0.0	1
Z. macroura	4	0.0	0.0	1
O. asio	3	0.0	0.0	1
C. auratus	3	0.0	0.0	1
Trochilidae	1	0.0	0.0	
Passeriformes	16	0.0	0.1	
E. alpestris	17	0.0	0.1	3
Icteridae	7	0.0	0.0	4
Corvidae	1	0.0	0.0	
P. pica	12	0.0	0.1	3
C. corax	11	0.0	0.1	2
G. cyanocephalus	7	0.0	0.0	1
Sialia sp.	1	0.0	0.0	
S. currucoides	1	0.0	0.0	1
S. mexicana	1	0.0	0.0	1
Laniidae	1	0.0	0.0	1
L. ludovicianus	2	0.0	0.0	2
Hirundinidae	1	0.0	0.0	1
Fringillidae	7	0.0	0.0	
P. chlorura	1	0.0	0.0	1
P. erythrophthalmus	1	0.0	0.0	1
J. hyemalis	1	0.0	0.0	1
Spea sp.	1	0.0	0.0	1
Iguanidae	1	0.0	0.0	
S. undulatus	24	0.1	0.1	2
P. douglassi	2	0.0	0.0	1
C. velox	2	0.0	0.0	1
P. melanoleucus	1	0.0	0.0	1
fish	1	0.0	0.0	1
small-medium mammal	7,104	23.3		
rodent	171	0.6		
medium mammal	61	.2		
artiodactyl	2,328	7.6		
medium-large mammal	2,636	8.6		
Aves	427	1.4		
unknown	835	2.7		
Totals	30,509	100.0	100.0	630

This species is a crevice- and cave-dwelling species that is locally common from grassland and desert through the ponderosa pine zone (Findley et al. 1975). Presumably, they were roosting in this large, dark, interior room when either the roof timbers were removed and they were killed, or their means of entry was blocked and they died there.

Lagomorphs

Sylvilagus audubonii

The desert cottontail rabbit is found in the Chaco Canyon area today (Cully 1985; Findley et al. 1975). Twenty articulated skeletons of individuals that were trapped in abandoned structures or by wall fall were recovered from the site and confirm their ready availibility at the site.

More cottontail elements were recovered than any other species, 19.3 percent of the entire sample and 34.9 percent of the identified specimens. Use of this taxon at Pueblo Alto was greatest during Red Mesa and Gallup ceramic-associated times and fell during the latest period. It also had the highest rate of burning and "cooking brown" for the three small, economic mammals (20.3 percent).

Findley et al. (1975) have found that the length of the cheek tooth row against the depth of the dentary at the anterior alveolar notch of p4 at right angles to the tooth row will separate S. audubonii from the other two species of cottontail found in New Mexico. S. nuttalli and S. floridanus have proportionately longer alveolar lengths and have distinct distributions when plotted (Findley et al. 1975:85). The Pueblo Alto mandibles that were complete enough for measurement, and specimens identified to species from the Museum of Southwestern Biology at the University of New Mexico are plotted in Figures 8.1 and 8.2. Because only those from San Juan County were used, the number of identified specimens is low. The plots suggest that the S. audubonii found in Chaco Canyon prehistorically were slightly smaller than the samples measured at the Museum of Southwestern Biology.

Sylvilagus nuttalli

Nutall's cottontail does not occur in the immediate area today and was unlikely to have occurred prehistorically. It is an upland species that reaches its lower limits in well-developed, pinyon-juniper woodlands and in mesic, well-vegetated valleys (Harris 1963). The closest area of procurement, if the range were the same as that of today, would have been the Chuska Mountains (Findley et al. 1975).

A single specimen of this species is suggested by Figure 8.1. As there is some overlap in the identified S. audubonii and S. nuttalli specimens, the identifications of any other borderline cases would be tenuous.

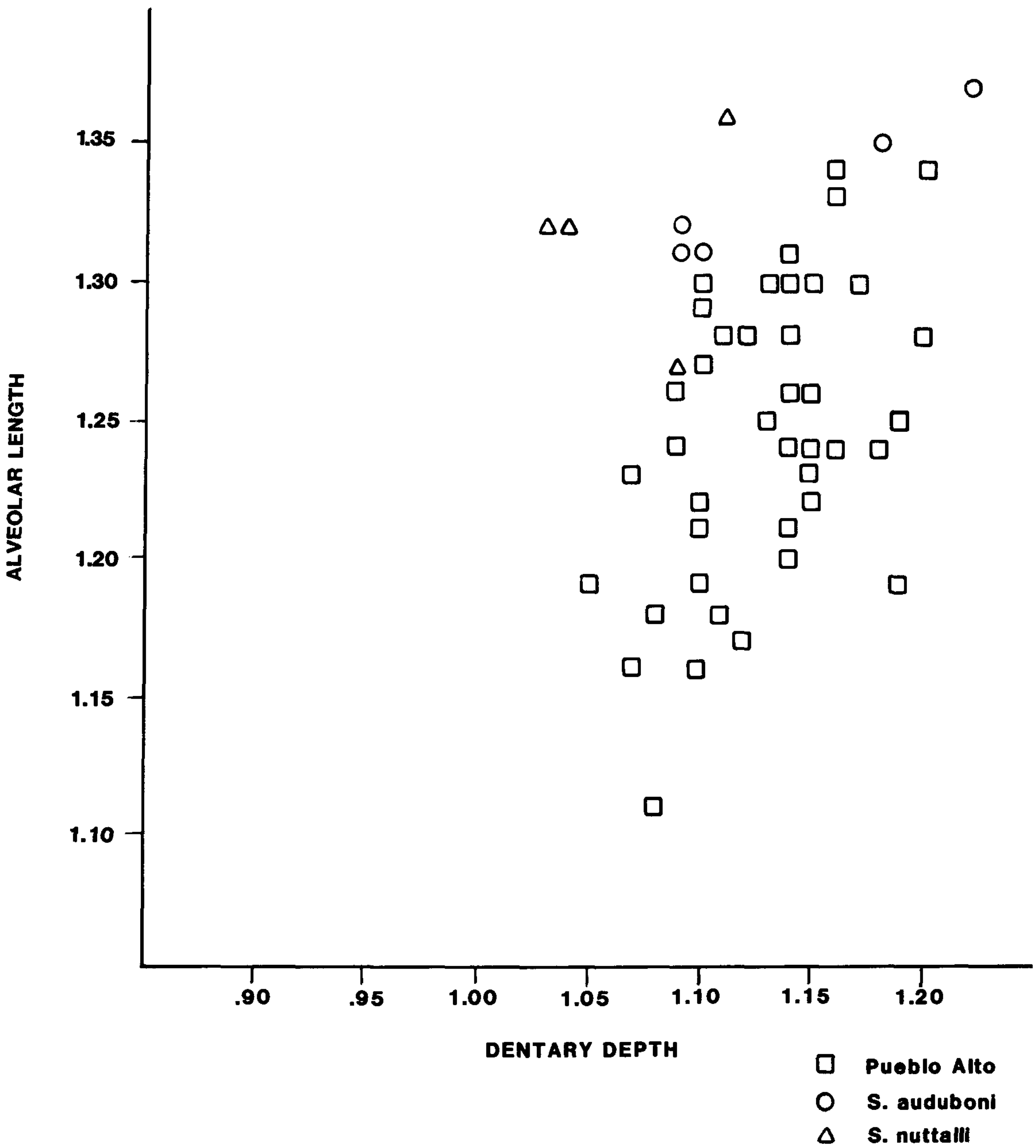

Figure 8.1. Comparison of right Sylvilagus mandible measurements to known specimens from San Juan County. (Measurements in cm)

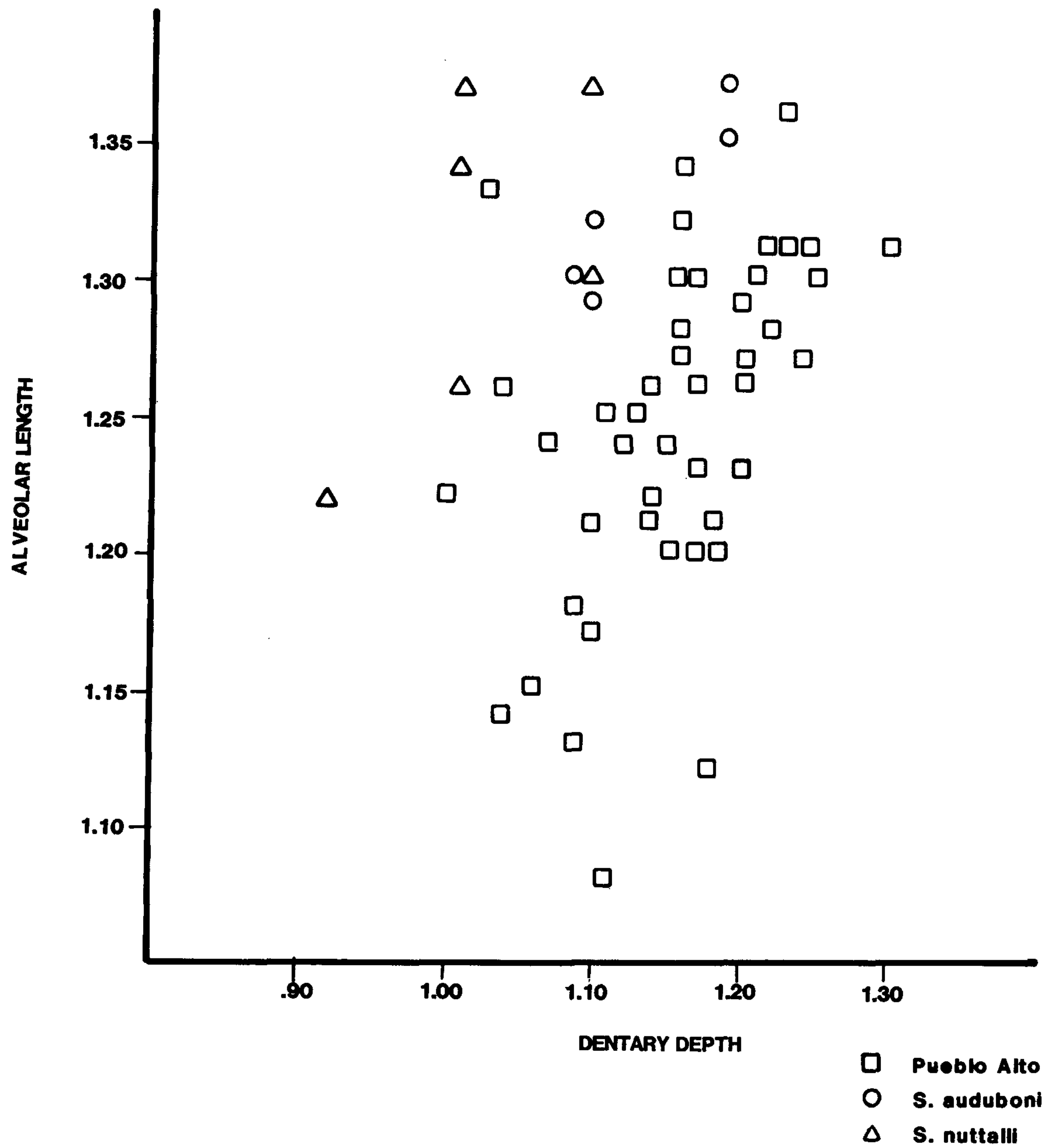

Figure 8.2. Comparison of left Sylvilagus mandible measurements to known specimens from San Juan County. (Measurements in cm)

Lepus californicus

The black-tailed jackrabbit occurs throughout the San Juan Basin and has been reported within the Park area by Cully (1985). It is most common in open shrub and shrub-grasslands, although there is a tendency to concentrate in areas where local rains have resulted in lush vegetative growth (Findley et al. 1975).

It is the second most abundant species found at Pueblo Alto and comprises 15.7 percent of the total sample and 28.3 percent of the identified specimens. Its peak use at Pueblo Alto was during Gallup ceramic-associated times where it comprised 30.2 percent of the identified specimens. Even at its lowest utilization, in Red Mesa deposits, jackrabbit comprised 28.6 percent of the identified specimens. This suggests a fairly heavy and remarkably constant reliance on this taxon throughout the occupation of the site.

One partial, articulated skeleton of this species was recovered in a location with other specimens that suggest ceremonial offerings rather than postoccupational deposition (Plaza Grid 30). Burning and "cooking brown" were the second highest for the three small economic mammals and totaled 17.7 percent.

Lepus americanus

An initial plotting of the Pueblo Alto *Sylvilagus* mandibles included this specimen. It was extremely large compared to the rest of the sample and originally thought to be a *S. floridanas*. After measuring known specimens of that taxon, it was obvious that this was not a *Sylvilagus*.

Snowshoe hares are mountain-forest dwellers and definitely not local. Bailey (1931) states that their New Mexico range was along the Sangre de Cristo Range on both sides of the Pecos River down to Santa Fe and down the San Juan and Jemez ranges west of the Rio Grande. It inhabits dense spruce-fir forests and is seldom seen.

None of this taxon has been previously reported for Chaco Canyon archeological sites. Harris (1963) found several elements of this species in the Navajo Reservoir District archeological collections and noted that they were probably long-distance imports from higher elevations.

Squirrels

Ammospermophilus leucurus

This small white-tailed antelope squirrel is common in Chaco Canyon today. Cully (1985) trapped them in bench, pinyon-juniper woodland, and

Pueblo Bonito locales. Their small size makes it unlikely that they were sought as a food source. They are easily trapped, and Bailey (1931) states that they are attracted by fields and gardens where they could do considerable damage to planted and ripening grains. Elements of this taxon were found in very low frequencies in all three time groupings at Pueblo Alto.

Spermophilus variegatus

Rock squirrels are also found in the canyon today (Cully 1985) and especially like broken terrain and rock areas for cover (Findley et al. 1975). Bailey (1931) suggests that these, too, could have been agricultural pests but only where fields were in close proximity to their preferred habitat. The larger size would have made them worthwhile as a food source.

While only the mandible of this species is readily identified to the species level, most other elements are so close to those of the prairie dog (*C. gunnisoni*) that separation is difficult. The few definite rock squirrel elements from Chaco Canyon were consistently larger but more gracile. The archeological specimens compared much more favorably to *C. gunnisoni*.

A mandible and a femur from Pueblo Alto were identified as *S. variegatus*. Other elements classified as *C. gunnisoni* or unidentified squirrel could possibly belong to this group, but the single mandible of this species out of a sample of 194 complete or near complete mandibles suggests that it was not important economically. Other Chaco Canyon sites containing this taxon include 29SJ 628 (Akins 1981f), Una Vida, Kin Nahasbas (Akins 1982, Akins and Bertram 1985), Kin Kletso, and Bc 288.

Sciurus aberti

Tassel-eared or Abert's squirrel is confined to ponderosa forests or mixed conifer forests containing ponderosa pine (Findley et al. 1975). The closest availability to Chaco would have been the Chuska Mountains, Zuni Mountains, Mt. Taylor, or the San Juan Mountains, all of which would have required transport from a fair distance. This in itself suggests that they were curiosities rather than subsistence items. The elements from Pueblo Alto included three mandibles, two radii, an ulna, a femur, and a fibula. This species has only been reported for recent excavations at Pueblo Alto and Una Vida (Akins 1982).

Squirrel species: This grouping contains a number of different situations. One specimen initially identified as spotted ground squirrel (*Spermophilus spilosoma*) could not be relocated for re-examination and was placed in this category. Another specimen, an ulna, was virtually identical to a black-tailed prairie dog (*Cynomys ludovicianus*), but this species is found so far east and south that such an identification was considered unlikely. Several other elements belonging to a similar squirrel were recovered from Una Vida. They are significantly larger than the *C. gunnisoni* recovered archeologically and those from the museum collections.

Many of the specimens in this group are potentially identifiable but the available comparative collections did not allow positive identifications.

Cynomys gunnisoni

The black-tailed prairie dog was the third most common species found at the site. Its presence in the Park area today, and three articulated skeletons at Pueblo Alto, suggest that it was abundant prehistorically. The overall percentage of elements and the MNI percentages increased steadily from Red Mesa through Late Mix ceramic associations. In the final time period its importance was nearly equal to or exceeded that of the other small economic mammals. Burning and "cooking brown" were fairly high for this taxon but not as high as for the other two small, economic mammals.

Rodents

Thomomys bottae

Botta's pocket gopher was trapped by Cully (1985) within the Park area. Bailey (1931) notes that they are generally valley dwellers, partial to sandy soil, and can be particularly destructive to agricultural crops where they tend to congregate. Quite a few, 118, were recovered from Pueblo Alto especially in deposits containing Late Mix ceramics. Many of the pocket gopher elements were from contexts that imply this species was eaten. Trash deposits (36.0 percent of those for which the variable was recorded, n = 114) had the most, followed by alluvium, aeolian (28.1 percent), mixed trash and natural fill (12.3 percent), structural rubble, floor or occupational fill of features (7.8 percent), and post-occupational feature fill (1.0 percent).

Again, as with the prairie dog (*C. gunnisoni*), these may have been trapped as agricultural pests. Its small size and its preference for underground life (Harris 1963) make it unlikely that this species was routinely sought as a food source. Burning or "cooking brown" was recorded for 9.3 per cent of the elements recovered, implying that at least some were eaten.

Perognathus species

None of the pocket mouse elements was identified to the species level. Both the plains pocket mouse (*P. flavescens*) and the silky pocket mouse (P. flavus) are present in the Canyon today and were both trapped near Pueblo Bonito and Pueblo Alto (Cully 1985). None of those from Pueblo Alto were articulated skeletons or burned, and some or all of the specimens could represent postoccupational burrowers. Again, very small size makes it unlikely that this taxon was specifically pursued.

Dipodomys ordii

Ord's kangaroo rat is one of the most common and widespread desert rodents in New Mexico (Findley et al. 1975). They are partial to friable soils such as those found in archeological sites. Three articulated skeletons were found at Pueblo Alto, and Cully (1985) recovered this species in all of his trap locations.

Bones from this small kangaroo rat were found in all fill types, suggesting they entered the archeological record in a variety of ways. A few were articulated skeletons of post-occupational burrowers (2.3 percent) and the rest were scattered parts. The most common fill association (recorded for 129 specimens) was mixed trash and natural fill (25.6 percent of the elements) followed by structural rubble (20.1 percent), floors and occupational feature fill (17.0 percent), trash deposits (16.3 percent), alluvium or aeolian (15.5 percent) and finally post-occupational feature fill (5.4 percent). A few of these were burned or "cooking brown," which suggests that they were used as a food resource, but their small size makes it unlikely that they were commonly pursued.

Dipodomys spectabilis

The larger banner-tailed kangaroo rat would have made a reasonable food source, but few bones of this taxon are recovered from Chaco Canyon archeological sites. They are present in the Park today (Cully 1985) and throughout most of the state, but they are strictly nocturnal (Bailey 1931), which may be one reason that they were seldom utilized. Over half of the elements recovered from Pueblo Alto were from Gallup ceramic associations, and the majority were from the western rooms.

Reithrodontomys cf. megalotis

An articulated skeleton of a western harvest mouse was found in Plaza 2 above the first surface, and two elements were recovered from Room 112. This species is widespread in New Mexico (Findley et al. 1975), and Cully (1985) found it in all of his trap locations. It is unusual that this taxon occurs so seldom in this collection.

Peromyscus species

Three species of Peromyscus are found in the canyon today: P. crinitis, the canyon mouse; P. maniculatus, the deer mouse; and P. truei, the pinyon mouse (Cully 1985). Cully's studies indicate much overlap in the distributions of the three species. His bench, Pueblo Bonito and Wash trapping locales recovered both *P. maniculatus* and *P. crinitis* while the Casa Chiquita and pinyon-juniper locales contained all three. It is quite likely that all three species are represented in the Pueblo Alto collection. Identification to the species level is difficult and of little relevance for the study of subsistence remains.

Peromyscus is the most abundant small-rodent taxon found at Pueblo Alto with 745 elements recorded. Almost 80 percent of these were from Gallup ceramic association proveniences, and most were from the western rooms. According to Bailey (1931), they generally live underground, among rocks, in camps or buildings, or on the ground surface under dense cover. There is some doubt as to whether they dig burrows themselves, although they do occupy the abandoned tunnels of pocket gophers.

Sixty-seven articulated skeletons of this taxon were recovered. Table 8.3 shows that the articulated skeletons, like the elements in general, were largely recovered from the western rooms. The majority of these were deeply buried. This, in conjunction with their preference for living in structures or under surface objects, suggests that they shared the site with humans or moved in soon after a room was abandoned. This is consistent with Bailey's (1931:145) observation that any cover is quickly taken possession of and "The scattered grain and bits of food about camp apparently deceived them into thinking they had found a permanent food supply." Their food consists mainly of seeds, grain, berries, insects, and even fresh meat.

Habits of the species indicate that the places where we should expect to find the remains of *Peromyscus* are places where food was stored, processed, or consumed. Thus, it is logical that most of this taxon would be found in the western rooms that have habitation features--especially in Rooms 103 and 110 with their mealing bins. It raises the possibility that the primary activities that took place in the northern rooms did not concern storage, preparation, or consumption of foods. The skeletons from that area were associated with the lower surfaces. Six were from wall trenches, one was from a rodent burrow, and the other from a lower surface.

Burning or "cooking brown" was recorded for 0.6 percent of this sample, which suggests that they were occasionally utilized for food or thrown into a firepit. Their small size and nocturnal habits make it more likely that this was incidental and probably related to extermination of a pest.

Single elements have a pattern of spatial distribution similar to the articulated skeletons. The western rooms accounted for 85.3 percent of the elements and the northern rooms, including Kiva 10, accounted for only 3.2 percent. The next highest was 3.3 percent from the Trash Mound.

Table 8.3. Distribution of articulated Peromyscus skeletons.

Provenience	Number	% of skeletons
Plaza Feature 1	1	1.5
Wall Clearing	1	1.5
Plaza 2	3	4.5
Plaza Grid 30	1	1.5
Room 103	28	41.7
Room 110	12	17.9
Room 112	9	13.4
Kiva 15	4	6.0
Room 138	5	7.5

The kind of deposit containing significant numbers of elements includes fill (14.6 percent), floor fill (34.6 percent), and features (46.7 percent). Over half (55.5 percent) were associated with first floors of structures, and only three were recovered from wall-clearing activities (0.4 percent).

Aeolian deposits contained 17.8 percent, trash only 3.1 percent, mixed deposits 21 percent, and structural rubble 10.4 percent. For the features (which included 46.7 percent of the total) 3.8 percent of these were recorded as occupational, 3.2 percent were from within plugged features, 2.7 percent as structural components of features, and 32.8 percent as postoccupational to the feature. The kinds of feature (again 46.7 percent of the total) containing elements from this taxon included firepits (0.1 percent), other pits (19.6 percent), postholes (0.6 percent), doorways (1 percent), wall niches (19.1 percent), heating pits (0.1 percent), mealing bins (2 percent), rodent burrows (1.1 percent), and wall trenches (1.4 percent).

Onychomys cf. leucogaster

The northern grasshopper mouse is also widespread in the state. It was trapped by Cully in all but his pinyon-juniper woodland locales (Cully 1985). The three elements recovered from the site were all from different proveniences.

Neotoma species

This group consists of woodrat elements that could not be identified to the species level. It includes nearly all of the postcranial elements for this genera and the cranial elements from immature individuals. Only the cranium and mandibles are generally identifiable to the species level.

A fair number of these were burned, n = 55 or 12.7 percent, suggesting that woodrats were used as a food source. Even Bailey (1931) found them very good eating. Woodrats are not burrowing rodents. The two articulated skeletons were both recovered during wall clearing.

Neotoma cinerea

The largest of the woodrats, the bushy-tailed woodrat is large enough to have been worthwhile pursuing, but it was seldom utilized. Cully (1985) trapped these in pinyon-juniper woodlands, and Bailey (1931) captured one at Pueblo Bonito. One articulated skeleton was found at Pueblo Alto. Bailey (1931) felt they were probably serious pests for food-storing aborigines and some of those from the site may have been, like *Peromyscus*, disposed of in self defense. A fair number were recorded as "cooking brown" (16.7 percent) and none was burned.

Neotoma stephensi

The smaller Stephen's woodrat has also been trapped at Chaco by Cully (1985) in all of his stations except Pueblo Bonito. Both Bailey (1931) and Findley et al. (1975) note this species' preference for rock accumulations in the pinyon-juniper zone. This suggests that the few specimens from Pueblo Alto may have been transported to the site. Too few were recovered to have been a significant food source.

Neotoma albigula

Cully (1985) does not report trapping or sighting the white-throated woodrat in Chaco. Findley et al. (1975) found them northeast of the canyon and 15 miles east of Crownpoint. They inhabit open areas from desert to mixed conifer forests and coexist with N. stephensi. There is no reason to suppose that these few individuals were imported.

Microtus mexicanus

A single articulated skeleton of a Mexican vole was recovered during wall clearing at Pueblo Alto. A partial skull was also collected during the second field season but it did not enter into the analysis.

This occurrence is unusual because the habitat of this species is montane grasslands in ponderosa and mixed conifer forests but occasionally descending down to pinyon-juniper woodlands (Findley et al. 1975). The closest recorded presences (Findley et al. 1975) are around Thoreau and Cottonwood Gulch. This species clearly does not belong in this locale, but the articulated skeleton and multiple specimens may suggest its presence closer than what has been reported.

Erethizon dorsatum

A single porcupine element was recovered. Although present in the area today (Cully 1985), they are relatively rare in archeological collections. The element from Pueblo Alto was found during wall clearing of Kiva 2. Given its sparse occurrence at the site, it is unlikely that this species was economically important.

Carnivores

Canis species

This grouping consisted of elements from the genus Canis that could not be identified to the species level. Over half of these were immature

(45.9 percent) or young adult (8.1 percent) elements. Many were isolated teeth (29.7 percent), foot elements (10.8 percent), or fragmentary long bones (20 percent).

Canis latrans

Coyotes are present in the canyon today (Cully 1985) and have been recovered from most archeological sites studied. The majority of the elements from this species were recovered from deposits that were Red Mesa in ceramic association (81.2 percent). The body parts included 43.7 percent skull fragments, 12.5 percent vertebrae, 12.5 percent front leg elements, and 25 percent rear leg elements. Burning was common--57.1 percent of the skull fragments were slightly burned, and a single phalanx was completely burned.

Canis lupus

Two wolf elements were recovered, a distal humerus and a proximal metatarsal. The metatarsal had been cut in half with a beveled cut and was completedly burned. Even though this species is not often found in archeological sites, Bailey (1931) shows its 1917 distribution as extending quite close to Chaco Canyon. The only other Chaco Canyon site from which this taxon has been reported was 29SJ 627 (Akins 1981g) where three elements, all dating to A.D. 920-1020 proveniences, were found.

Canis familiarus

Very few domestic dog bones were recovered from the site. Most (81.1 percent) were found during wall clearing, and like the domestic sheep-goat from the site, they may be the result of later use of the site area. The one element attributed to a Gallup-ceramic associated provenience was a small metacarpal. Site 29SJ 627 also contained elements of what appears to be a domestic dog that is smaller than those generally recovered from Chaco (Akins 1981g).

The few elements and relatively low percentages of carnivore gnawing found on other elements from the site (see Summary of the Variables Recorded) suggest that dogs were not very important to the inhabitants. With few exceptions, dog remains are infrequent throughout the occupation of Chaco Canyon and especially so in the later time periods. The peak, based on the percentage of identified elements in the assemblage, was ca. A.D. 850-1020. Small site faunal assemblages post-dating A.D. 1020 have totals that comprise less than 1 percent except for those at 29SJ 627 (ca. A.D. 1130-1220) when it reached 2.6 percent (Akins 1985:Table 7.11). There were few dogs anywhere in the canyon during the time Pueblo Alto was occupied.

Urocyon cinereoargenteus

The gray fox is present in Chaco today (Cully 1985) and is the most common of the foxes found in archeological collections. One element from this species was recovered from Pueblo Alto. This was a complete mandible that was plastered into the floor of a special-use room (Plaza Feature 1, Room 3). Ethnographically, fox skins are used in ceremonies by the Hopi (Bradfield 1973).

Ursus arctos

The range for grizzly bear once included many of the mountain areas surrounding the San Juan Basin, and some travel would have been required to procure them. A distal humerus was recovered during wall clearing at Pueblo Alto. It has an interesting archeological distribution within Chaco. Two Basketmaker III sites (29SJ 423 and Shabik'eshchee Village), both with great kivas, are the only non-greathouse sites to have this taxon reported (Akins 1981c and 1981d). Other occurrences include Pueblo Bonito (Judd 1954), Chetro Ketl (Brand et al. 1937), Kin Nahasbas (Akins and Bertram 1985), and Pueblo Alto.

Taxidea taxa

Badgers are found throughout the state and are most numerous where prairie dogs and other burrowing rodents are plentiful (Bailey 1931). The Hopi regard them as a medicine animal because of their digging and claim they raid cornfields (Bradfield 1973).

Badgers are one of the more common carnivores found in archeological assemblages. Eight elements were recovered at Pueblo Alto.

Felis rufus

The bobcat is still common in the canyon (Cully 1985) and is often recovered from archeological sites. Few elements were found at Pueblo Alto, and the majority of these (69.2 percent) were from Red Mesa ceramic-associated proveniences. The distribution of body parts is slightly unusual: 50 percent were cranial elements, 21.4 percent were phalanges, and the rest were scattered throughout the body. This may suggest that it was primarily the hides that were recovered. Complete burning was recorded for a third of the phalanges and "cooking brown" for a third of the skull elements.

Gallup proveniences, which include almost half of the elements, contain far fewer carnivore bones than would be expected from the sample size alone. Table 8.4 gives the species distribution by time period, and Table 8.5 gives the Chi-square results from comparing the number of carnivore elements with the total number of bones for that ceramic association. The

Table 8.4. The number of carnivore elements by ceramic association at Pueblo Alto.

Taxon	Red Mesa	Gallup	Late Mix	Wall Clearing
Canis sp.	11	6	19	1
C. latrans	13		1	2
C. lupus	1	1		
C. familiarus		1	1	9
U. cinereoargenteus		1		
Total canids	25	9	21	12
U. arctos				1
T. taxus		1	7	
F. rufus	9	2	1	1
Total carnivores	34	12	29	14
n ided. elements	2,436	8,013	5,826	662

Table 8.5. Statistical tests of the carnivore distributions.[a]

Taxon	X^2	df	p
Canis sp.	16.80	3	.00077
C. latrans	63.74	3	.00000
C. familiarus	175.16	3	.00000
Total canids	73.67	3	.00000
T. taxus	10.06	3	.00904
F. rufus	33.06	3	.00000
Total carnivores	87.36	3	.00000

[a]The number of elements in the taxon and the number of identified elements by ceramic association and wall clearing.

temporal distribution of carnivore bones within Pueblo Alto is not merely a function of the sample size.

As all of the tests are statistically significant (at the .05 level), we can suggest that there were differences in selection, disposal, or availability. Two explanations come to mind. It is possible that the locally available carnivore populations were significantly depleted by Gallup times when the canyon's human population was at its greatest. This would have been largely the result of human depletion of many of the natural food sources of such species as rabbits. In the Late Mix ceramic-association period, a decrease in the human population may have allowed an increase in the local carnivores, which is indicated by these tables. Wall clearing is included because almost all of the domestic sheep-goat elements were in this unit, which suggests very late use of the site area.

Alternatively, but not necessarily exclusive of the first suggestion, it is possible that carnivore remains received differential treatment within the site. With social organization at its most complex during Gallup ceramic-associated times, perhaps the constraints on the deposition or even the collection of carnivores had the effect of making them appear to be less utilized. Also, utilization may have been reserved for special purposes such as hides, that would have resulted in few elements being returned to the site. The greatest diversity in carnivore species occurred in the Gallup associated deposits when the number of elements was lowest, (5 species for 12 elements).

Artiodactyls

cf. Cervus elaphus

The range for elk includes most of the mountains surrounding the San Juan Basin (Findley et al. 1975), and it has been reported for numerous other Chacoan archeological sites. The presence of a single element, a central incisor, does not suggest heavy reliance. Artiodactyl teeth appear to have been collected or kept as curiosities. Isolated teeth are often found; 169 artiodactyl teeth and tooth fragments were recovered from Pueblo Alto that were not associated with mandible or maxilla fragments.

Odocoileus hemionus

Deer are still present in the canyon as well as throughout the San Juan Basin. At Pueblo Alto they peaked in both numbers and MNIs in the Gallup ceramic-association deposits, and the number of elements decreased slightly in the final time period. Estimates of the amount of meat consumed as calculated for the Trash Mound sample showed that this species contributed 27.9 percent of the total with 33.3 percent attributed to the unidentified artiodactyl group. This should not be taken to mean that a large number was utilized, but that relative to other taxa used for food, there was a fairly high reliance on deer during the time represented by those deposits.

Chi-square tests performed on the number of elements for the three principal artiodactyls (deer [O. hemionus], pronghorn [A. americanus], and mountain sheep [O. canadensis]) compared with the number of identified elements for each ceramic group suggest that the distribution over time was not static. Table 8.6 gives the number of elements and results of the contingency tests. Ironically, when the MNI totals were used on the whole table, it was not statistically significant at the .05 level. This once again points out that the relationship between the number of elements and the MNI is a complex and little understood one (Grayson 1978).

Antilocapra americana

The preferred habitats for pronghorn are open grassland basins and plateaus with adjacent rolling hills (Buechner 1950). Bailey (1931) states that pronghorn were abundant over the great arid plains of the northwestern portions of the state as late as 1883. This suggests that this taxon would have been within reasonable range for procurement. Studies of earlier Chacoan Anasazi sites (Akins 1985) suggest an initial greater reliance on and then a gradual decline in the use of this taxon over time.

Ovis canadensis

Although mountain sheep are now confined to high rugged mountains, their range was probably much greater prehistorically. Grinnell, quoted in Manville (1980:6), states that "In old times the wild sheep were not confined to what we call mountains but in many parts of their range lived in country not very different from that then commonly occupied by the mule deer--that is to say, about or near buttes, rough badlands or low rocky hills."

This species has been found in almost every recently analyzed Chacoan archeological site (Akins 1981a-g) and in fair numbers. These two observations suggest that bighorn sheep were readily available within the basin and not far from Chaco. Table 8.6 suggests that its importance overtook that of pronghorn during the latest use of the site.

Ovis-Capra

Domestic sheep-goat elements are our best evidence for historic use of the site. Many of these were recovered in wall-clearing efforts, but a few found their way into the upper fill of rooms. The elements resembled domestic sheep more than goat but have been left as indeterminant. With

Table 8.6. The artiodactyl distribution at Pueblo Alto.[a]

Taxon	Red Mesa	Gallup	Late Mix	X^2	df	p
O. hemionus	30	361	142	72.29	2	.00000
A. americana	50	45	63	43.24	2	.00000
O. canadensis	21	40	74	23.98	2	.00000
No. ided. elements	2,436	8,013	5,826			
Element distribution				147.8	4	.00000
MNI distribution				6.8	4	.14655

[a]Contingency tests consist of comparing the number of elements for each taxon with the number of identified elements by ceramic association. The element and MNI distributions used the three species as rows and ceramic associations as columns.

the exception of a partial vertebral column and one skull fragment, all of the elements were from front or rear limbs.

Wild Birds

Aves

The following section on birds relies heavily on a paper by Cully (1985). The terms used in the paper are defined as follows.

> Resident implies that a species is present year-round; migrant species are present for short periods during spring and/or fall, and summer or winter residents are present for longer periods in the specified season. Regular species can be found every year in the right season; irregular species, every other year; occasional, every 3-5 years and casual, less often than occasional. (Cully 1985:459-460).

The body part distribution and possible uses for these is summarized later. This section mainly consists of an evaluation of the availability of the species and where they have been recorded previously.

Anas platyrhynchos. The mallard is a casual migrant in Chaco Canyon (Cully 1985) but a common migrant in the San Juan Basin (Hubbard 1971). The three from Pueblo Alto are the only identification of this taxon to the species level for Chaco.

Falconiformes, Accipitridae, and Buteo species

These three identifications were those used by Emslie for elements that could only be identified to those levels. The elements are largely phalanges, carpals, and fragmentary limb elements.

Buteo jamaicensis. Red-tailed hawks are the only species of hawk reported as regular year-round residents of the Park (Cully 1985). Thus, it is not surprising that more elements of this taxon were recovered than any other bird except turkey (*M. gallopavo*). They are found in numerous Chacoan archeological sites from Basketmaker III through Pueblo III (Akins 1981a-g and Vivian and Mathews 1965). Henderson and Harrington (1914) report that the Tewa did not eat this species.

Buteo swainsoni. Cully (1985) does not list Swainson's hawk. Schmitt (1976) notes that it is casual to occasional along the San Juan River and locally uncommon in riparian woodlands to fairly common in pinyon-juniper woodlands and adjacent to riparian habitats. Pueblo Bonito (Judd 1954) and Chetro Ketl (Hargrave n.d.) are the only other two sites for which this species has been reported.

Buteo lagopus. Rough-legged hawks are not mentioned by Cully (1985) for Chaco or by Schmitt (1976) for the San Juan Valley. Hubbard (1978) states that this hawk migrates and winters almost statewide. It is locally fairly common in grasslands and open habitats, mainly at lower and middle elevations. It is most numerous today in the northeastern plains, but one was spotted in the San Juan Mountains. This suggests the possibility that this specimen was imported.

Buteo regalis. Uncommon regular to irregular residents (Cully 1985), ferruginous hawks appear to have been the second most common Buteo utilized by the Anasazi. They have been found in sites dating from Basketmaker III to Pueblo III but in fewer numbers than the red-tailed hawk.

Aguila chrysaetos. The golden eagle is now a regular uncommon migrant to the canyon (Cully 1985). Archeologically for Chaco Canyon sites other than Pueblo Alto, it is the most common raptor recovered. According to Vivian and Mathews (1965), next to the turkey it is the second most popular bird among modern groups of pueblos. Some were kept for feathers. In our sample it was most commonly used during the Red Mesa ceramic-association period and appears to have declined in use after that.

Falco sparverius. American Kestrels are other regular but uncommon year-round residents (Cully 1985) that are rarely found in archeological collections. They appear to have been utilized later in the Anasazi sequence with recorded occurrences in PII and PIII. A partial skeleton was recovered from Bc 51 (Hargrave n.d.) and elements from Pueblo Bonito, Talus Unit, Bc 236, and Kin Kletso. Recent excavations did recover a Falco sp. element from a Basketmaker III site (29SJ 423, Akins 1981d).

Callipepla and Callipepla squamata. Listed as uncommon to common residents of the canyon (Cully 1985), quail appear in surprisingly low frequencies in Chacoan archeological collections. The presence in many sites as one or two elements suggests that it was not regularly utilized as a food source.

Grus canadensis. The sandhill crane is not reported for Chaco Canyon (Cully 1985) or the San Juan River valley (Schmitt 1976). Hubbard (1978) notes that is is casual in the northwestern portion of the state. Archeologically, this taxon appears in sites from Basketmaker II on. The parts represented are nearly all from wings. Although only a single element is reported for the Pueblo Alto collection, 21 additional elements were recovered from the unanalyzed portion of the Trash Mound. With the exception of a cervical vertebra and an innominate, these, too, are wing or foot elements representing one or more birds.

Zenaidura macroura. A regular abundant summer resident, the mourning dove is found in all habitats at Chaco Canyon (Cully 1985). However, it is not often found archeologically. This suggests that the grey and brown feathers were not particularly prized by the canyon's inhabitants. Henderson and Harrington (1914) note that this taxon was used as food by the Tewa Indians.

Owls. Cully (1985) lists three species of owl for Chaco Canyon today. Bubo virginianus is a regular, uncommon, year-round resident, Glaucidium gnoma, an irregular migrant, and Asio otus a regular, uncommon resident. Only one owl species was found at Pueblo Alto, three elements from the screech owl (Otus asio). Hubbard (1978) records this species as resident northward, local to the San Juan valley, and it has been observed near Cuba, New Mexico. A partial skeleton from Bc 288 (Hargrave n.d.) may suggest its presence in Chaco prehistorically.

Trochilidae (?). A single dentary from a hummingbird was found at Pueblo Alto. Three species are found there today: black-chinned (Archilochus alexandri), a regular summer resident; broad-tailed (Selasphorus platycercus), a common summer resident; and rufous (Selasphorus rufus) a regular, uncommon, fall migrant.

Colaptes auratus. Cully (1985) reports the red-tailed flicker (Colaptes cafer) as a regular, uncommon migrant and winter resident. These two flickers are now lumped under the name yellow-shafted flicker (Colaptes auratus) (American Ornithologists' Union Checklist, 7th edition). Two ulnas and a tibiotarsus were found at Pueblo Alto.

Passeriformes

This group served as a catch-all for elements from this order that could not be identified further. Included were three skull fragments, a scapula, two humeri, five ulnas, a tarsometatarsus, two tibiotarsi, and two corocoids.

Eremophilia alpestris. The horned lark is a regular, abundant, year-round resident of the canyon. It is abundant in the shrub-grasslands on top of the mesa and surrounding the canyon but rarely seen in the canyon itself (Cully 1985). It is the most numerous of the smaller birds recovered from Pueblo Alto--16 elements in all. This includes a partially burned and articulated skeleton recovered from a posthole.

Icteridae. Included in this family are the blackbirds and the orioles. All seven specimens from Pueblo Alto were recovered from Plaza 2 and are probably orioles. Other than two elements of a red-winged or yellow-headed blackbird from Una Vida (Akins 1982), no other reports of this family have been found.

Cully (1985) lists several species of this family that these specimens could represent. The yellow-headed blackbird (Xanthocephalus xanthocephalus is an occasional spring migrant in the canyon and an uncommon but regular, spring migrant throughout the San Juan Basin. The red-winged blackbird (Agelaius phoeniceus) is listed as an occasional to casual, spring migrant, Scott's oriole (Icterus parisorum) as a casual, fall migrant, Bullock's oriole (Icterus galbula) a common, summer-breeding resident in the cottonwoods along the wash, and Brewer blackbird (Euphagus cyanocephalus) an irregular, uncommon migrant. Blackbirds are said to have been used as food by the Tewa (Henderson and Harrington 1914), but the circumstances of their deposition at Pueblo Alto suggest a ceremonial usage.

Corvidae. A single element, a phalanx that represents a jay other than the pinyon jay, was placed in this category. The two remaining jays include Steller's jay (Cyanocitta stelleri), a casual, winter resident and scrub jay (Aphelocoma coerulescens) an uncommon resident that is most common in the pinyon-juniper areas on top of Chacra Mesa during all seasons (Cully 1985).

Pica pica. The black-billed magpie is listed as a casual, winter resident at Chaco today (Cully 1985). At Pueblo Bonito four dentaries and premaxilla that had been cut off and bound together and a phalanx were found in Room 38 with 13 macaw skeletons. This suggests ceremonial use of this species. Pueblo Alto, where 13 elements were recovered, is the only recently excavated site to have this species. Magpies figure into the mythology of the Tewa (Henderson and Harrington 1914) and were used by the Hopi (Bradfield 1973) for the headdresses of warriors.

Corvus corax. The common raven, a year-round resident of the canyon (Cully 1985), is often found in archeological collections and appears to have been utilized throughout the occupation of the canyon.

Gymnorhinus cyanocephalus. Pinyon jays are year-round residents that occur most abundantly in pinyon-juniper woodlands (Cully 1985). Seven elements were recovered from Pueblo Alto.

Sialia species. Two species of bluebird are recorded for the canyon. The western bluebird (S. mexicana) is an occasional rare migrant, and the mountain bluebird (S. currucoides) a common, winter resident and uncommon, summer resident (Cully 1985). Both were found at Pueblo Alto as well as two elements not identified to the species level.

Laniidae and Lanius ludovicianus. This shrike is a common resident along the floodplain of the canyon (Cully 1985). It has not been reported for other Chacoan sites. At Pueblo Alto the Lanius ludovicianus specimens were articulated skeletons of birds, which were probably trapped in a room and died.

Hirundinidae. A single element of a swallow was recovered from Pueblo Alto. No other archeological reference to this genera in Chacoan collections has been found. Cully (1985) lists five species for the canyon today: barn swallow (Hirundo rustica), a regular, spring migrant; cliff swallow (Petrochelidon pyrrhonota), a regular, abundant, summer resident; tree swallow (Iridoprocne bicolor), a regular, spring migrant; bank swallow (Tachycineta thalassina), an occasional, spring migrant; and Riparia riparia, another occasional migrant.

Fringillidae. Three species of this family were found at Pueblo Alto, each represented by a single element. None have been reported from previously excavated sites. The green-tailed towhee (Pipilo chlorura) is a regular, uncommon migrant; the rufous-sided towhee (Pipilo erythrophthalmus) a regular, uncommon migrant and possible winter resident; and the slate-colored junco (Junco hyemalis) a common, winter resident.

A minimum of 26 species of wild birds (not including the turkey [M. gallopavo]) was recovered from Pueblo Alto whereas only 13 bird species (including the turkey, the macaw, and thick-billed parrot) were identified from Pueblo Bonito (Judd 1954). This is partially due to the large sample of identified bones, but much of the increased diversity at Pueblo Alto is also due to recovery techniques. At least nine of these species are small birds that have seldom been recovered in past archeological excavations. What may be more unusual is the absence of macaws and parrots from Pueblo Alto. At least one of these has been found at most of the other, excavated, great-houses (Una Vida, Pueblo Bonito, Kin Kletso, and Pueblo del Arroyo), all of which had much smaller samples than Pueblo Alto.

Use of wild birds falls into three categories: food, materials for blankets, and ceremonial. There are few specific references to human consumption of birds in the ethnographic literature. Vivian and Mathews (1965:22) have claimed that "no ethnographic references were found to the eating of any of these birds," referring to a table in which they list the most commonly utilized species, and Judd (1954:266) states that "...the Pueblos have always shunned winged creatures as a source of food." However, Henderson and Harrington (1914) state that both mourning doves and blackbirds were eaten by the Tewa, and Beaglehole (1936) notes that all species of birds were snared, suitable feathers were used for dance costumes, and the flesh of the larger birds was roasted and eaten by the Hopi. Most seem to agree that the hawks and eagles were not eaten (Beaglehole 1936; Henderson and Harrington 1914; Judd 1954; Vivian and Mathews 1965). This suggests that some species of birds may have been eaten, presumably those in the middle-sized range that were readily available and some smaller ones that may have been trapped near agricultural fields.

Feather blankets are most often found in connection with human burials (Akins 1986; Hitchcock 1941; Judd 1954; Kluckhohn and Reiter 1939; and Vivian n.d.). Judd (1954) notes that these are most common in PIII times and were still in use throughout the Hopi villages in 1881.

Schorger (1966:360) observed after the examination of a cloth that:

> The feathers used generally were the large wing and tail feathers of the turkey, and the pile was stripped from them and wrapped around the cord...The feather cords thus obtained were woven into a robe or blanket. The weave was not tight and the feathers remained quite fluffy.

These were used as shawls by day and bedding at night. It is not unreasonable to suppose that some of the birds represented at Pueblo Alto were used in making feather cloth, especially turkeys. They occur in quantity and early Spanish explorers did find extensive use of rabbit fur and turkey feather coverings in the Southwest (Schorger 1966).

Probably the most important use of wild birds was to provide feathers for ceremonies. Judd (1954) notes the importance of prayer sticks and that each ritual had its own kind of prayer stick:

> No two are precisely alike, but all or nearly all require feathers--feathers from designated parts of certain birds. Turkey feathers, and preferably wild turkey, are utilized most frequently, yet I would venture to guess that every other bird native to the Southwest, except possibly three carrion-feeders--the crow, raven and turkey buzzard--is likewise called upon (1954:262-263).

Vivian and Mathews (1965) list 25 birds (other than turkey, eagles, hawks, and parrots) that were used ethnographically as skins, feathers, or in carved representations. These include many that were available to the residents of Chaco Canyon and were found at Pueblo Alto. They also note that carved or stuffed birds of the smaller species are common on Zuni Shalako altars, and at Acoma the K'ashale altar was decorated with stuffed wrens and mockingbirds during scalp ceremonies. They note, too, that at Hopi the making of prayer sticks with feathers was an "overriding occupation, with these offerings being made for every conceivable purpose and on every occasion" (Vivian and Mathews 1965:21). Prayer feathers were also important parts of masks and ceremonial costumes, were used in altar arrangements, and were placed in fields at planting time.

Feathers were of primary and continual importance. Prayer sticks were "specially made and are expended within a few hours or, at most, within a few days of manufacture. Not only the wing but the downy feathers were used" (Judd 1954:262).

Ideally, these three kinds of use would result in different patterns of element recovery in archeological sites. Species used primarily for food should be represented by all edible body parts with only the heads and feet not utilized. Birds that were kept for their feathers and routinely plucked but not eaten would be found complete or disposed of ceremonially. This would most likely be those birds that are most common in sites--turkeys, eagles, and possibly some hawks as well as the macaws and parrots. Judd felt that the Bonitian hunters used methods very similar to that of the Hopi in which a rabbit was tied on top of a brush-covered pit, and eagles were thus lured within range, then felled with a club. A number of eagle and hawk sterna from Pueblo Bonito had keels that were dented by a single sharp blow, which had then healed. From this he deduced that they were kept for plucking. This could also account for the numerous turkey carcasses found in Chacoan sites (Akins 1981b). Articulated skeletons of few other species have been found. Judd (1954) found a red-tailed hawk (*B. jamaicensis*) on the floor of a room. Beaglehole (1936) states that eagles were immediately skinned and the body buried or thrown into a rock fissure. This may account for burials of that species.

Birds for which only specific feathers were collected might be expected to be represented by only certain body parts. Table 8.7 gives a rather gross distribution of body parts for all of the bird taxa recovered from Pueblo Alto.

The percentage of elements for each taxon is used. The skull bones included only the skull, dentary, and quadrate; axial included the vertebrae, ribs, furculum, pelvis, and sternum; wing elements included the coracoid and scapula to the wing tip; legs, the femur, tibiotarsus, fibula, and patella; and the feet, the tarsometatarsus to the terminal phalanges.

The table points out that very few species have anything resembling a normal distribution of body parts; turkey (M. gallopavo) and sparrow-hawk (F. sparverius) come the closest. Wings are vastly over-represented in most species, and some species are high in foot elements--mostly the hawks and the raven (C. corax).

Even the smaller birds are represented by mostly wing or foot elements but skull and axial parts are rarely identified to species. The hawks are generally similar with many wing and foot elements. Eagles show a mixed distribution, which may suggest different kinds of treatment, one very similar to the hawks where wings and feet are utilized and another utilizing whole birds.

No reference to the use of hawks' or other birds' feet was found in the literature reviewed, but articulated Buteo feet are found from Pueblo I sites on (Akins 1981a). In Plaza 1, Grid 30 at Pueblo Alto, a ceremonial cache of bird wings also contained many feet suggesting ceremonial use of those elements.

Overall, the distribution suggests that many of these species were used ceremonially for their feathers. This is more or less confirmed by the fact that little burning was found among the birds other than turkeys. Various amounts of burning and "cooking brown" were recorded for 5.6 percent of the red-tailed hawk (B. jamaicensis) elements and 8.4 percent of the eagle (A. chrysaetos) elements. All of the red-tailed hawk and half of the eagle elements involved were foot elements, mostly phalanges.

Although the number of elements is low, three of the midsized birds do have some burning. The magpie (P. pica) had one partially burned skull fragment (7.7 percent). The raven (C. corax) had the largest amount of all of the birds, only 45.4 percent were not burned or "cooking brown." The elements involved were all wing tips or phalanges. The pinyon jay (G. cyanocephalus) had a single, slightly burned scapula (14.3 percent).

The percentage of identified bird elements in the assemblage decreases after Red Mesa times--even when the Plaza 1, Grid 30 materials

Table 8.7. Percentages of body part elements for the bird taxa.

Taxon	Skull	Axial	Wing	Leg	Foot	Sample size
A. platyrhynchos			100.0			3
Falconiformes			100.0			1
Accipitridae			60.0		40.0	10
Buteo sp.		7.5	52.1	1.7	38.6	120
B. jamaicensis		0.8	54.7	1.6	42.8	126
B. swainsoni			100.0			6
B. lagopus					100.0	1
B. regalis			66.7	33.3		3
A. chrysaetos	9.6	7.2	63.8	9.6	9.6	82
F. sparverius	21.4	7.1	21.4	28.6	21.4	14
Callipepla sp.		50.0	25.0		25.0	4
C. squamata			66.7	33.3		3
M. gallopavo	5.3	33.6	22.4	30.0	8.7	987
G. canadensis			100.0			1
Z. macroura			75.0		25.0	4
Trochilidae	100.0					1
O. asio			66.7	33.3		3
C. auratus			66.7	33.3		3
Passiformes	18.7		62.4	12.5	6.2	16
E. alpestris	6.2	12.5	62.3	6.2	6.2	16[a]
Icteridae	100.0					7
Corvidae			100.0			1
P. pica	15.4		69.2		15.4	13
C. corax			72.7		27.2	11
G. cyanocephalus			85.7		14.3	7
Sialia sp.			100.0			1
S. currucoides				100.0		1
S. mexicana			100.0			1
Laniidae			100.0			1
L. ludovicianus						2[b]
Hirundinidae			100.0			1
Fringillidae	28.6	14.3	42.9	14.3		7
C. chlorura					100.0	1
P. erythrophthalmus	100.0					1
J. hyemalis			100.0			1
Aves (Alto unknowns)	2.6	28.3	4.7	1.6	1.9	427[c]
Expected[d]	6.4	44.1	22.1	7.8	19.5	

[a]One articulated skeleton (6.3%).
[b]Two articulated skeletons (100%).
[c]26% were unknown fragments and 33.9% were long bone fragments.
[d]The expected is the percentage of elements in a body accounted for by that portion.

are excluded. Table 8.8 presents this data. Turkey (*M. gallopavo*) is not included in these tallies.

To determine if selection for species was increasing or decreasing with time, the Shannon-Wiener function (Krebs 1972) and evenness (J) Pielou (1975) was used as a measure of uncertainty, where H = index of diversity, S = species, and p = proportion of members.

$$H = -\sum_{1=1}^{S} (p_1)\ (\log_2 P_1) \qquad J = \frac{H}{\log s}$$

The term uncertainty is used in favor of 'diversity'. Biologists are not sure what is measured by this index (see Green 1979:100; Pielou 1975:9). The increase in uncertainty suggests that there was less selectivity in the exploitation of wild birds species over time or that a wider area may have been exploited. If bird use was mainly ceremonial, this may also imply an increase in ceremonial requirements, or that users were less particular about the species utilized. The Red Mesa deposits with the Plaza 1, Grid 8 materials excluded have the lowest score and therefore the least uncertainty.

Turkeys

M. gallopavo

The turkey is by far the most abundant species of bird found in the Pueblo Alto collections; 987 elements were recovered. The vast majority of these (87.7 percent) were from the Late Mix ceramic associations at the site. These birds were undoubtedly utilized for their feathers, and whether or not they were used as a food source is a question open to debate.

The ethnographic record suggests that treatment was not uniform throughout the pueblos, but most appear not to have eaten this species. For the Zuni Pueblos, Coronado is said to have written that

> We found fowls, but only a few, and yet there are some. The Indians tell me that they do not eat these in any of the seven villages, but keep them merely for the sake of procuring the feathers. I do not believe this, because they are very good and better than those of Mexico. (Schorger 1966:34)

Henderson and Harrington (1914) note that the Tewa long ago domesticated this bird, or at least kept them in enclosures. "It is supposed that the birds in captivity were kept for ceremonial purposes, the feathers being used in various rites. This raises some doubt as to whether the captive birds were also used as food" (Henderson and Harrington 1914:35). Bandelier (Schorger 1966) also felt that the turkey was kept not so much

Table 8.8. Temporal distribution of wild birds at Pueblo Alto.

	CERAMIC ASSOCIATION			
	Red Mesa	Red Mesa[a]	Gallup	Late Mix
No. of bird elements	337	67	75	56
% of ided. elements	13.8	3.7	0.9	1.0
No. of species (s)	15	8	16	17
No. of individuals	47	24	39	29
Uncertainty (H)	2.9116	2.2147	3.4934	3.848
Evenness (J)	1.075	1.065	1.260	1.358

[a]Red Mesa without the Plaza Grid 30 materials included.

for its meat as for its feathers. Stephen (Bradfield 1973:238) records that at the Hopi villages "by mid-August, so many of their feathers had been used for prayer-sticks that the birds were plucked bare."

Alternatively, Schorger (1966:356) quotes Gallegos who wrote of the Piros (around 1581) making "catoles with buffalo meat and turkeys because they have large numbers of the latter."

In general, the ethnographic literature suggests that turkeys were not widely used as a food source. The best argument for the Chacoan Anasazi not using them primarily as a food source is in the economics of raising them. Turkeys are not native to the general vicinity. Schorger (1966) notes that the wild turkey's native habitat in New Mexico is along wooded streams in the mountains at elevations of 7,500 to 9,600 feet. This would suggest that most of those present in Chaco were a domestic variety. Turkeys are very destructive to crops, they scratch up planted corn and eat it from the stalk when ripe; and they would have to be confined for at least that portion of the year when crops were being raised. If they were turned out to forage for the remainder of the year, few would have been supported by the local vegetation and those would have still been in direct competition with human foraging. Turkeys also need water twice a day (Schorger 1966) and cannot depend on dew and food as a source of water. This means that the turkeys at the site would have to have been fed and watered throughout the year.

Supplying corn for even a few birds could have been a formidable task. Wild turkeys require about a half pound or 227 g of acorns per day (Schorger 1966). As nuts are generally a more concentrated form of food, it is probably safe to assume at least the same amount of corn or other grains were necessary. In return, the estimated amount of meat from a single bird is approximately 2,350 g of meat (Gillespie 1981). This leads to the conclusion that either the birds were kept for a purpose more important than subsistence (i.e., feathers for ceremonial use) or, if they were used as a food source, they were not kept at the site for long periods of time. These would have been raised elsewhere in an area with plenty of natural forage and transported to the canyon when mature or were hunted in their natural habitat.

A change in the use of this species can be seen at Pueblo Alto. Turkeys represent 0.1 percent of the identified specimens from Red Mesa, 0.8 percent of Gallup, and 15.1 percent of Late Mix ceramic-associated deposits. Eggshell is found throughout the site, but this in itself should not be taken as evidence of raising the birds. Eggs could have been transported to the site for special purposes. Judd (1954) notes that historically at Zuni chicken eggs were used as binders in mixing paints to be applied to wooden objects.

The presence of immature birds is far better evidence for turkey husbandry. Fifty-three immature elements were recovered from Pueblo Alto. None of these were from Red Mesa ceramic-associated deposits, 40 were from

Gallup proveniences (59.7 percent of the elements of that species for that time period), and 13 were from later proveniences (1.5 percent of the elements for that time period). The difference is not quite as dramatic when the number of individuals is used; 30 percent of the individuals in Gallup deposits and 12.5 percent of those in the later deposits were immature individuals.

The immature elements also have an interesting spatial distribution. Nearly all of those from the Gallup deposits came from two layers within the Trash Mound and the remainder from lower surfaces of Plaza 2. Those from the Late Mix deposits are scattered: two from Room 103, three from Room 109, one each from Rooms 142, 147, and Kiva 15, and five from Plaza Feature 1, Room 3. It may be more than a coincidence that 11 of the 13 were from floor-fill proveniences. Those from the northern rooms were the exceptions.

The Gallup-provenience immature individuals include five less than a week old and one 3-5 weeks old, and those from the Late Mix proveniences include two that were 2-3 days old, one 3 weeks old, one less than 4 weeks old, and two of unknown age. The unanalyzed portion of the Trash Mound (a Gallup ceramic association) also included parts of one other 3-day-old and two less than 3 weeks old.

Four cases of human alteration were recorded for this species. Two of these were tibiotarsus shaft fragments that also had evidence of use. This leaves only two possible cases of actual butchering, a cervical vertebra and a tarsal that had each been cut in half lengthwise. This is only 0.2 percent of the elements for this taxon, but it is comparable to the jackrabbit (Lepus), which is the closest to it in body size at 0.3 percent. The percentages are much higher for the artiodactyls.

This suggests that the initial processing, if the birds were consumed, was similar to that of the small mammals--either cooked in entirety or pulled apart at the joint areas. Later processing appears to have followed a pattern similar to that of the artiodactyls: the most common burning was complete, and the elements involved for both were usually the extremities. Of the 130 burned or "cooking brown" elements from this species at Pueblo Alto, all but two were from Late Mix associated proveniences (3 percent of the Gallup associations and 14.2 percent of the Late Mix associations).

In summary, during Gallup times there is some evidence for raising turkeys at the site, but the evidence for use of turkey as a food source is not convincing. The Trash Mound, which is the primary domestic refuse area for this period, contained few bones of this species (42 or 0.5 percent), and most of those were from immature birds (88.1 percent). One was burned completely and another was "cooking brown" (2.4 percent each).

For the Late Mix period there is less evidence for turkey raising, but there are so many more turkeys that we must postulate that the perspective on this species had changed, and they were eaten. The lack of immatures may suggest that a large proportion of the birds were brought into the site as full-grown individuals or that they were penned somewhere in the site that was not investigated. The pattern of burning is another line of evidence. Very few structures had more than one burned element of this taxon (Table 8.9). A rather large percentage of the burned bone came from Room 145, and these greatly influence the overall pattern of burning for the species. There is enough burning to suggest that some of these birds were being consumed and the method of cooking was roasting. This would result in burning or partial burning of the extremities and may not have affected the more muscle-bound elements. It must be emphasized that this pattern appears only in the very latest use of the site and that many of the proveniences labeled "Late Mix" in ceramic association do not have this pattern. This suggests that the change in perspective (i.e., that turkeys were a food source) took place within the Late Mix period and is reflected only in the upper fill of Room 103 for the western rooms and those rooms in the north that had layers interpreted as "roof fall."

Reptiles and Amphibians

Few reptile or amphibian bones were recovered from Pueblo Alto. Most were lizards common to the vicinity and probably deposited after the occupation of the site. These are mainly from two proveniences and are more a tribute to careful excavation in those areas than to the actual distribution at the site.

Spea species

A single spade-foot toad element was recovered from one of the western rooms. Spadefoot toad remains are more common in sites located in the canyon bottom (Akins 1981g and 1982, Gillespie 1981). They are sometimes found on sandy mesas, though not nearly as common there as in the canyon (Applegarth, personal communication, 1981). This element could also have been brought to the site by humans or other predators.

Iguanidae

This label was used for a single lizard element that could not be identified further.

Sceloporus undulatus

The plateau lizard was the most common lizard in the Pueblo Alto collection. The second most common lizard at Chaco Canyon today, it favors a habitat of cliff faces, large boulders, and ruin walls (Jones 1970). All but one of the specimens came from wall niches in Room 110 and the other from Plaza 2.

Table 8.9. Late Mix burning of turkey.

Provenience	% of prov. Turkey	% of all Burned Turkey	% complete Burn	% partial Burn	% slight Burned	% cooking Brown
Rm. 103	15.3	26.2	14.7	8.8	76.5	
Rm. 139	14.3	3.1		25.0	75.0	
Rm. 142	7.9	7.7	20.0	20.0	50.0	10.0
Rm. 145	32.5	40.0	78.8	7.7	13.5	
Rm. 147	5.4	2.3	33.3		66.7	
Kiva 10	13.3	3.1	100.0			
Total sample	13.2		54.6	10.0	33.8	1.5

Phrynosoma douglassi

Jones (1970) found the mountain short-horned lizard primarily in mixed grassland associations. Both elements from Pueblo Alto were from Plaza 2.

Cnemidorphorus velox

The plateau whip-tail lizard has been found at Pueblo Alto by Jones (1970). Both elements were from Plaza 2.

Pituophus melanoleucus

This single, gopher snake vertebra was recovered from the Trash Mound. This is the most common snake found in the canyon today. The single element and its location suggest cultural deposition.

Fish

Osteichthyes

Two fish elements were recovered from Pueblo Alto, and only one of these was part of the analyzed sample. A first vertebra of a species of *Gila*, either *Gila elegans* or *Gila robusta* (bonytail), was recovered from Plaza 2. This is a large minnow formerly common in the San Juan River. Two vertebrae of this species were recovered from the Mesa Verde occupation at Aztec (Gehlback and Miller 1961). The other was from the unanalyzed portion of Kiva 10 and was a fragment of a dentary of the long-nosed gar (*Lepisosteus osseus*).

Fish remains are uncommon in Chacoan sites. Parts of the lower dentary of another *Lepisosteus osseus* and 25 scales from the same genus were recovered at Kin Kletso (Vivian and Mathews 1965). Judd (1959) also reported gar scales from Pueblo del Arroyo, and Pepper (1920) an unidentified fish bone from Pueblo Bonito. More recent finds include some from Guadalupe (Pippin 1979) and Escalante (Halasi 1979).

Vivian and Mathews (1965) note that the nearest gar today are in the lower Pecos River and adjacent waters in New Mexico. They may also have occurred historically in the Rio Grande. Either way, such distant transport of these elements suggests that fish were of some importance, probably ceremonial.

Summary of the Variables Recorded

Faunal remains can provide more than a list of species used by the prehistoric inhabitants of a site. The kinds of information recorded in this study will be discussed in three broad categories. Processing--which can be examined through the distribution of body parts and the variables of butchering, articulations, and burning; cultural modification--through evidence of use, some butchering, and staining; and depositional processes--through checking, animal activity, and possibly rounding.

Processing

Processing began before an animal was returned to the site. Small mammals were much more likely to be brought back whole than were carnivores or artiodactyls. Ideally, this should be reflected in the distribution of body parts. To look at the body part distribution over time and monitor any major changes, three samples were chosen. Each of these is a major refuse deposit from a different ceramic association. Plaza 1, Grid 8, Surface 9, association represented the Red Mesa; the Trash Mound booths 4, 5, and 6, the Gallup deposits; and Kiva 10, levels 15 to 27, the Late Mix association.

Carnivore remains were too few for any valid comparisons (n = 10). All but one of the elements came from the Late Mix deposit and were almost evenly distributed throughout the body.

The small mammals for this comparison consist of cottontail (Sylvilagus), jackrabbit (Lepus), and prairie dog (Cynomys). Table 8.10 gives the percentages of the five major parts of the body. The expected is the percentages that would result if one complete body was divided into these parts and the percentages calculated. This assumes that each element is complete, and as Figure 8.3 shows, real samples do not conform to this assumption. The shapes of the three curves, one for each ceramic association, are similar and suggest that no major change in processing resulting in a difference in the body part distribution has taken place. There are three anomalies: the thoracic vertebrae and feet are under-represented, and the limbs are over-represented. The first is probably due to the friability of the thoracic vertabrae and ribs that comprise this portion of the body. The discussion on butchering practices and articulations will indicate that feet are the most common portions of the body to be discarded and, possibly, may not have made it into these refuse deposits. Also, many of these elements are so small that they would be recovered only with 1/16-in. screen, which was used for some parts of the Red Mesa and Gallup samples. The other differences are primarily due to how well the screening was done. Limb elements are especially susceptible to breakage and appear to be over-represented.

The artiodactyls were treated similarly. Figure 8.4 and Table 8.11 also use the unidentified artiodactyl and large mammal remains. The

Table 8.10. Small mammal body part distribution in percentages.

	Expected	Red Mesa	Gallup	Late Mix
Sample size (n)		242	2,045	1,491
Skull, cerv. verts.	6.9	21.1	25.7	23.9
T. verts, ribs, clav., sternum	22.4	16.9	17.1	19.4
L. verts, pelvis, cocc. verts.	7.5	20.7	13.2	10.6
Limbs: scap-radius and fem-fibula	9.2	29.7	31.6	41.4
Feet: carpals or tarsals to phal.	54.0	11.6	12.4	4.6

Table 8.11. Artiodactyl body parts distribution in percentages.

		Red Mesa		Gallup		Late Mix	
	Expected	a	b	a	b	a	b
Sample size (n)		7	284	191	447	48	1,290
Skull, cerv. verts.	7.4	14.3	3.2	30.4	9.7	33.3	6.2
T. verts, ribs etc.	24.1	14.3	51.0	2.6	10.9	10.4	36.7
L. verts, pelvis, etc.	8.0		6.3	1.6	2.8	6.2	8.5
Limbs	8.6		15.8	7.9	40.2	14.6	33.1
Feet	51.8	71.4	2.1	57.6	9.6	35.4	4.5
Unknown			21.5		26.9		11.0

a = deer (*O. hemionus*), pronghorn (*A. americana*), and mountain sheep (*O. canadensis*).

b = deer, pronghorn, mountain sheep, artiodactyl sp., and large mammal.

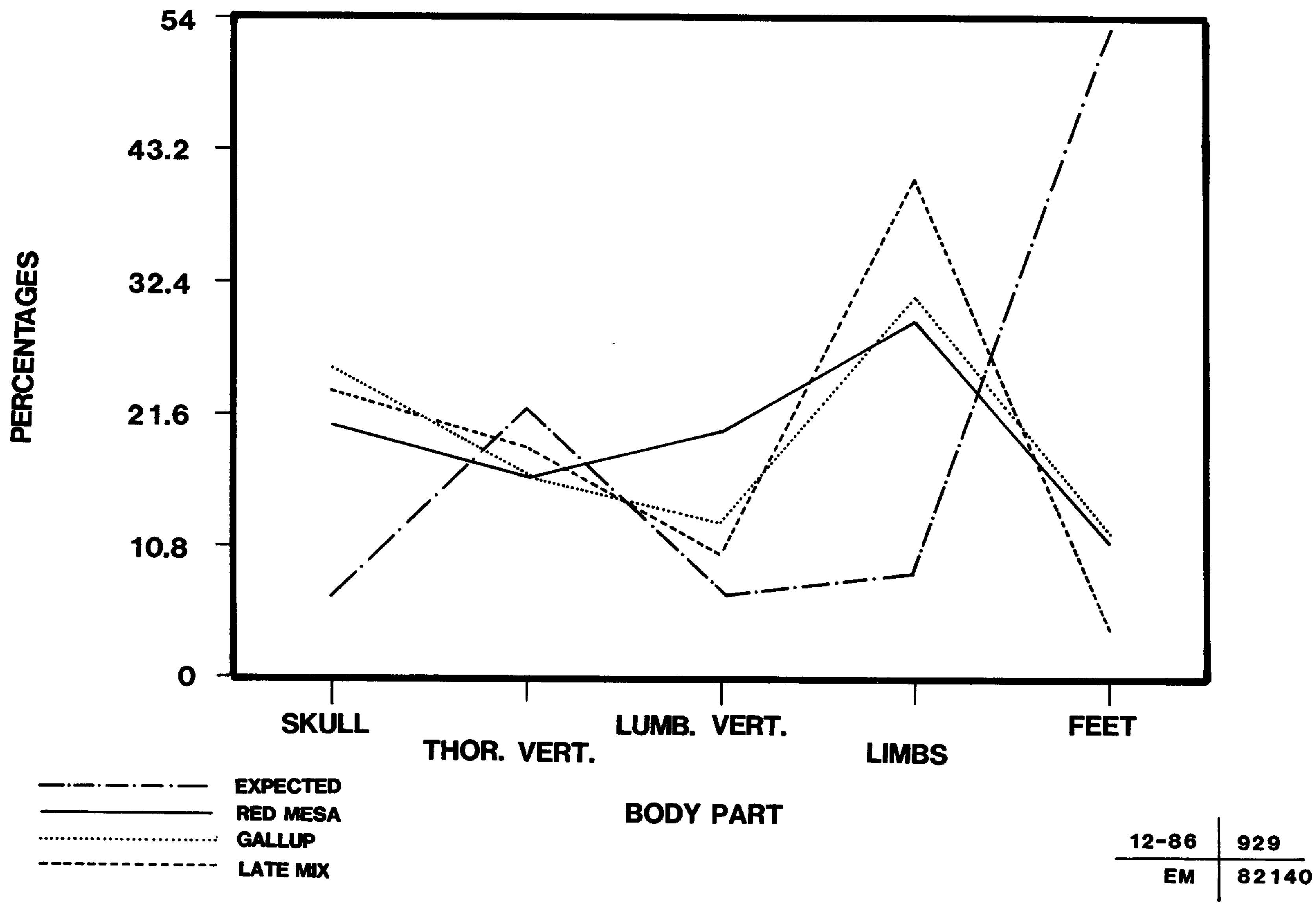

Figure 8.3. Small mammal body part distribution.

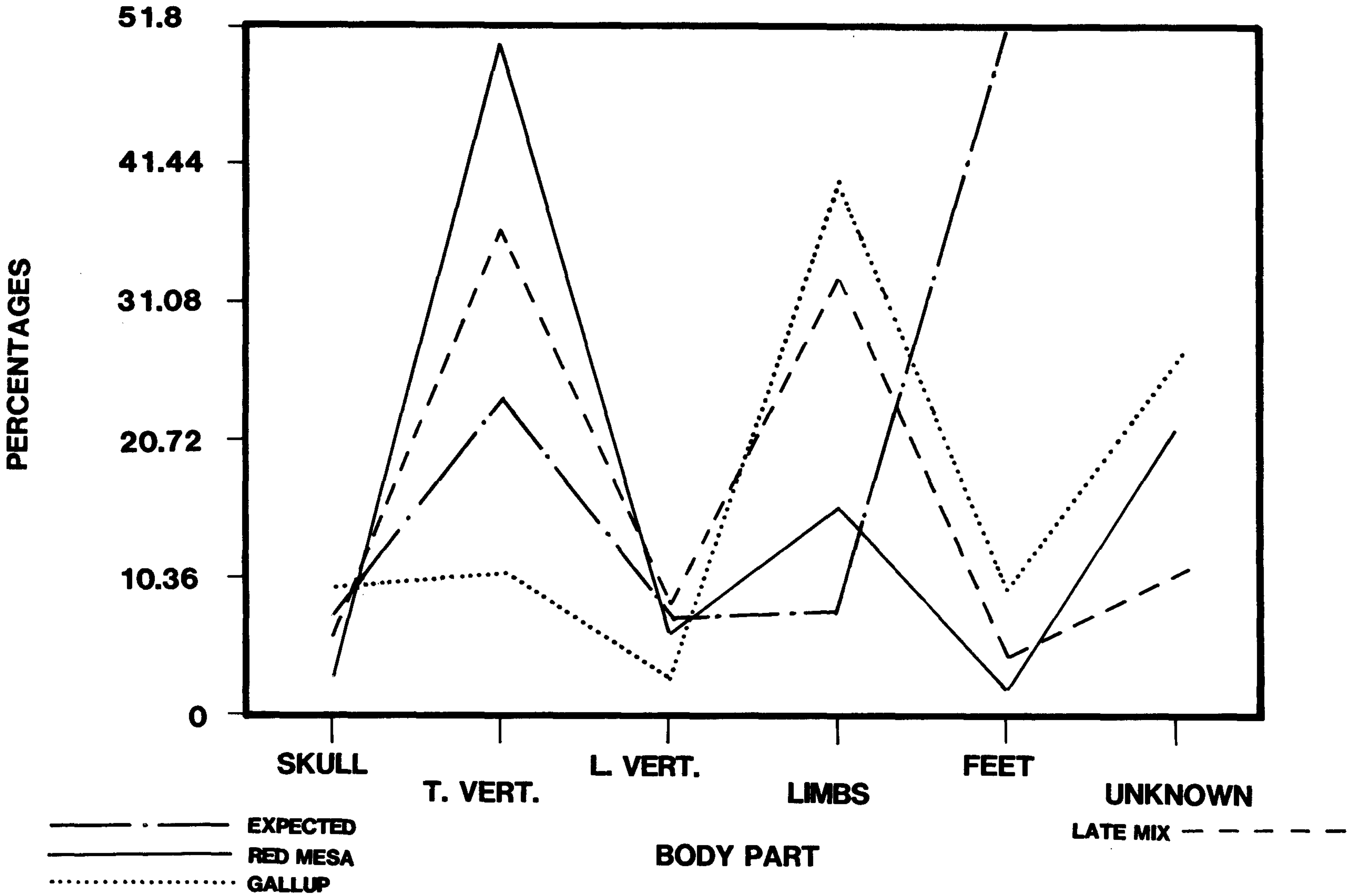

Figure 8.4. Large mammal body part distribution.

The sample sizes were too small for only the known artiodactyls to be used. Table 8.11 gives both of these to show which parts were unrepresented in the known groups. Figure 8.4 shows that there may have been some difference in procurement, especially during the Gallup ceramic associations. The lack of thoracic vertebrae, ribs, and lumbar vertebra-pelvis portions of the body in favor of limbs and feet may suggest either farther transport and/or efficiency in procurement, with these portions stripped of their meat and left behind.

Butchering

The kinds of butchering recorded included portions removed by cutting, chopping, and cuts; spiral fractures and possible "snaps" were not noted. Not all of the instances recorded were the result of processing for consumption. Those that were not will be discussed under cultural modifications.

Again, this discussion will center around body size with the divisions of small mammals, midsized animals, artiodactyls, and large mammals. Table 8.12 gives the breakdown of the taxa and types of butchering.

Table 8.13 gives the butchering and element information. For the small mammals it appears that the front limbs were disarticulated, usually by a diagonal cut at either the scapula, proximal humerus, radius, ulna, or even the proximal metacarpals. The most common areas of disarticulation were at the distal humerus and metacarpals. The rear legs could also be disarticulated--again by a diagonal cut at the midsection or distal end of the innominate, femur, tibia, or metatarsals. The calcaneus showed more modification than any other element. In most cases this appears to be the result of disassociating the tendons from this element. The low frequency of butchering for the small-mammal elements suggest that they were generally disarticulated without cutting the bone or processed whole.

Butchering evidence occurred infrequently on midsized animals and certainly not often enough for any patterning to emerge. The two more exotic carnivores, bear and wolf, were both represented by limb elements, which may suggest that they were either returned within a hide or for raw material for tools, with the distal humerus as a convenient point of disarticulation. Turkeys (*M. gallopavo*) had few modifications but these do suggest removal of a head for one and a foot for another. Most of the other Aves alteration could well be related to tool or bead manufacture.

The artiodactyls are more complex, as Table 8.13 shows. Again, some of these are likely to be the result of modification and debris from tool manufacture rather than butchering. According to White (1953), who studied butchering practices on bison and antelope, most disarticulation was achieved by smashing at the joint areas and was detected only by the notable absence of some parts. Even though some of the observed pattern may have been due to chewing by carnivores, it seems reasonable to assume

Table 8.12. Butchering by taxon.

Taxon	Diagonal Cut	Straight Cut	Chop	Light Cut	Heavy Cut	Total
Sylvilagus sp.	12	4		1		17
L. californicus	9	7				16
C. gunnisoni	1					1
C. lupus				1		1
U. arctos		1				1
O. hemionus	3	2	5	9		19
A. americana		2		2		4
Ovis-Capra		1		1		2
O. canadensis	1			7	3	11
M. gallopavo	1	1				2
Small-med. mammal	2	1		1		4
Artiodactyl	3	2	1	5	3	14
Med-large mammal	1	1		2		4
Aves	1			1		2
Totals	34	22	6	30	6	98

Table 8.13. Butchering location and type of body size.

Element	Diagonal Cut	Straight Cut	Chop	Light Cut	Heavy Cut	Proximal	Distal	Mid.	Prox & Mid.	In Half	Prox.& Dist.	Anterior	Posterior	Medial	Lateral	Combi-nation	No.
SMALL:[a]																	
Scapula	1						1					1					1
Humerus	1	2		1		4						3					4
Radius	1					1										1	1
Ulna	1	1				2						1					2
Metacarp.	3					3						3					3
Metatars.	4			1		3	2					5					5
Calcan.	4	8				2	2		3	3	1		3	2	7		12
Innom.	3						1	2						1	1		3
Femur	2					1	1					2					2
Tibia	2						1	1								1	2
Lng.bone	2	1					2	1								1	3
Totals	24	12		2		16	10	4	3	3	2	15	3	3	8	3	38
MID-SIZED:[b]																	
C. vert.	1							1									1
Humerus		1		1			2									2	2
Tarsal		1						1									1
Tibia				1				1									1
Lng.bone	1							1									1
Toals	2	2		2			2	4								2	6
LARGE:[c]																	
Antler		1					1										1
Mandible					1		1							1			1
T. vert.	3		1	1	1			1		1	3	1	1				6
L. vert.		2	1							2	1			1		1	3
Unk. vert.	1							1									1
Sacrum			2							2							2
Ribs	1			3	1	1		3			1						5
Humerus		1		1			2								1		2
Radius	1	1		2		2	2					1	1		1		4
Carpal				1				1									1
Metacarp.				7	1		8					2	1	2		2	8
Acc.mp.				1			1										1
Astrag.				1				1						1			1
Calcan.		1	2	1	1	1	1	2				3	1		1		5
Matatar.				2			2					1		1			2
Phalanx	1						1										1
Innom.		1		2				1						1			3
Femur		1					1					1					1
Tibia				2				2						1	1		2
Lng.bone		1		2	1			4									4
Totals	7	9	6	26	6	4	20	16		5	5	9	4	8	4	3	54

[a]small = Sylvilagus, Lepus, Cynomys, and unknown small-med mammal.
[b]medium = Canis sp., U. arctos, M. gallopavo, Aves.
[c]large = O. hemlonus, A. americana, O. canadensis, artiodactyl, med-large mammal.

that cutting through a fair-sized bone with a stone tool would have required far more effort than smashing it. The cuts found are more likely the result of the removal of tendons for use or to get to the joint in order to disarticulate a portion of the limb as opposed to cutting off a portion of the body. Given this, the removal of portions of an element are probably, in most cases, the result of modification for use. Exceptions would be the smaller elements with thin cortex such as carpals and vertebrae.

The kinds of deposits in which butchered remains were found also differed with body size. The small taxa were scattered throughout the site within quite a few structures whereas the larger ones were more likely to occur in refuse deposits. Table 8.14 gives this distribution.

A Chi-square test run on a contingency table of the small-large and room-refuse totals (Table 8.14 structure and trash total lines) was significant at the .05 level (X^2 = 10.28, df = 1, p = .00134) and does suggest a differential distribution. This is probably the result of dealing with two things: the small mammals as processing debris and the large as both processing debris and tool manufacture.

Articulation of Elements

Articulations were recorded whenever possible. Unfortunately, recording depended on the individual excavator to recognize these and bag them accordingly. Probable articulations were recorded when a bag contained elements from what appeared to be the same individual. This practice was confined to small collections within an FS and tends to result in even more under-representation of the larger units that were the trash deposits.

Table 8.15 gives a breakdown for the two major groups of mammals and the birds. The small-mammal distribution suggests that rear feet and front legs were the most likely parts to be discarded entirely. It also appears that the vertebrae and pelvis areas were also discarded; perhaps the meat was removed without damage to these body parts.

The artiodactyl elements are all feet and again suggest that this portion of the body was returned to the site.

With the exception of two axial parts from a turkey (*M. gallopavo*), the bird elements are all wings and a few feet. All but one of the hawk and eagle articulations came from a single ceremonial deposit (Plaza 1, Grid 30).

Some areas of the site had more articulations than others. Although this, too, is largely due to some excavators being more conscious of these, we can still suggest that some initial processing took place within the areas that were well recorded. The fill above Floor 4 in Room 103 had five rabbit articulations, both axial and limbs. Room 110 had 14 (mostly

Table 8.14. Location of elements exhibiting butchering marks by body size.

Structures:	Small	Medium	Large
Room: 103	14		1
110	5		3
138		1	1
142	1		
143	1		
145	1		6
146			1
147		1	
Kiva 15			1
Plaza Feat.1, Room 3	1		
Total	23	2	13
Trash Deposits:			
Trash Mound	5	1	10
Kiva 10			11
Kiva 13	2		3
Kiva 14		1	
Kiva 16			1
Plaza Grid 8	1		4
Plaza Grid 30	4		2
Total	12	2	31
Others:			
Plaza 1	1	1	1
Plaza 2	2		1
Wall clearing		1	8
Total	3	2	10
TOTALS	38	6	54

Table 8.15. Pueblo Alto faunal articulations.

Taxon	Cerv. Vert.	Thor. Vert.	l.ver. Pelvis	Cocc. Vert.	Rear Leg	Rear Foot	Front Wing	Front Foot	Unk. Foot	n
Sylvilagus	1	2	5	1	3	9	3	2		26
L. calif.		1	2	1		8	9	5		26
C. gunnisoni						2		1		3
Total small	1	3	7	2	3	19	12	8		55
O. hemionus						3		1	7	11
A. americana									1	1
Immat. artio.									1	1
Total large						3		1	9	13
Buteo sp.						1				1
B. jamicensis					4		10			14
B. swainsoni							1			1
A. chrysaetos							4	1		5
B. regalis							1			1
Raptor total					4		16	1		21
M. gallopavo		2			2		2			6
Other Aves		2			6		18	2		28

limbs) in various features, and Room 112 had seven limb and axial articulations. Plaza 2 contained five cottontail (Sylvilagus) leg and foot articulations.

The western rooms recorded 44 articulations, Plaza Grid 30 had 21, the Trash Mound had 9, the northern rooms had 8, Plaza 2 and Plaza Feature 1 had 4 each, the main plaza had 3, and Kiva tests had 2. Five cottontail (Sylvilagus) and jackrabbit (L. californicus) articulations were found during wall clearing and were not included in Table 8.15.

Burning

Variation in body size should result in different means of cooking, which, in turn, should be reflected in the patterns of burning. Small mammals could easily be cooked whole or in large portions in stews. This would result in "cooking brown" or discoloration of some but have no effect on the more muscle-bound elements. Roasting would also be possible and would again result in no burning of the more muscle-bound areas and partial burning on distal extremities and possibly the feet. Very few elements would be completely burned. For medium and large mammals, chunks could either be cut from the bone, or small portions containing bone could be boiled and result in no alteration or "cooking brown" of the smaller elements. These could also have been roasted and, again, result in partial burning of the ends of some elements.

Few cooking processes would lead to the high percentages of complete burning that are found. It seems reasonable that those found would be either small elements burned in the roasting process, discards that were thrown into the fire to keep things clean, or elements that were embedded in chunks of meat and were thrown into the fire after consumption.

The small mammal elements with more than 10 percent complete burning included cottontail (Sylvilagus)--radius, tarsals, phalanges, and innominates; jackrabbit (L. californicus)--tarsals; prairie dog (C. gunnisoni) --none; and for the small to medium mammals--vertebrae, scapulae, innominates, long bone, and unknown fragments. On the other hand, very few elements of these four taxa had less than 10 percent "cooking brown" and often more than 20 percent. This suggests that the predominant mode of cooking was boiling for the small mammals. So few elements were partially burned that it seems reasonable to suggest that the burned elements were largely discards. This large a percentage of burned vertebrae (small mammals n = 142 of which 25.3 percent were completely burned) would not be explained by any mode of cooking.

The carnivores occur in such low numbers that generalizations are difficult. Six foot elements, a skull fragment, three ribs, and a thoracic vertebra were burned. So few other elements were recovered that roasting is difficult to postulate. The skull and foot elements may have been returned to the site in pelts.

The large mammals, which are almost entirely artiodactyls, have more complete burning and much less "cooking brown" than do the small mammals. The elements with the most burning were generally limb and foot bones. The unidentified artiodactyls and large mammals differ from this largely in having more burning of axial parts (Table 8.16).

The bird elements most commonly completely or partially burned are also those with relatively low meat yield. Precooking discard is again the most reasonable rationale for this pattern (see Table 8.17).

Table 8.18 gives the burning for each taxon that had some burning and/or "cooking brown" and the percentages of each. Given these percentages, the best candidates for roasting (i.e., with partial and small amounts of burning) are the midsized birds, magpie (P. pica), raven (C. corax), and jay (G. cyanocephalus), and here the sample sizes are quite small.

To further investigate the phenomenon of burning the occupational fill of firepits and heating pits was examined. As with the site as a whole, the small mammal taxa had the most burning. More interesting is the difference in the instances of burning between the two classes of features. The firepits had far more complete burning and the heating pits more "cooking brown." Table 8.19 gives the percentages.

This suggests a difference in use for these two kinds of features. Firepits are large, more formal structures and could have been used repeatedly between cleanings. Heating pits are small, scooped-out pits that would not have held as large, or even multiple fires between cleanings. The multiple and prolonged use of the firepits may have resulted in more discards and more complete burning. Only the small mammals were a large enough sample to realistically consider which elements were discarded. Heating pits had a larger number of unknown fragments--15.3 to 2.1 percent and fewer front limb elements (14.5 percent as compared to 7 percent) and phalanges (5.4 percent to 2.1 percent). This may suggest more precooking discards for the firepits, but the samples are quite small and the trends are not all that clear.

The site was also divided into types of deposits to see how these varied. The categories included structure fill, plaza deposits, trash deposits, and wall clearing. These are not clear-cut categories; plaza and trash deposits under rooms were lumped with rooms, and some plaza deposits may have contained trash. Table 8.20 gives these provenience types and the percentages of burning within them.

Most of the burned and "cooking brown" bones came from the trash deposits and much of that was from the layers in the Trash Mound that are related to constructive activities. Table 8.21 gives some further breakdowns within these groupings. It shows that the Pueblo Alto Trash Mound is anomalous in its amount of burned bone. A larger percentage of the bone from the mound construction layers (Layers 1-20) was burned while the remaining portion (Layers 22-200) was quite similar to the trash-filled

Table 8.16. Large mammal and artiodactyl body parts with appreciable burning (≥ 10%).

Taxon	Body part	% partial	% complete	n =
Deer				
(*O. heminous*)	radius		14.3	21
	accessory metapodial		15.4	13
	carpal	2.5	7.5	40
	phalanges		14.5	131
	astragalus	22.2		9
Pronghorn				
(*A. americana*)	hyoid	50.0		2
	radius		40.0	5
	ulna		33.3	3
	carpals		46.1	13
	tarsals		40.0	5
	phalanges	3.7	14.8	27
	metatarsal	20.0		5
Mountain sheep				
(*O. canadensis*)	thoracic vert.		14.3	7
	ribs		21.4	14
	radius		33.3	9
	carpals		30.4	23
	metacarpal	5.6	16.7	18
	calcaneum	33.3		3
	astragalus		33.3	3
	tarsals		38.5	13
	phalanges		22.2	9
	patella		50.0	2
Unidentified				
artiodactyl	axis vertebra		16.7	6
	thoracic vertebra		12.7	55
	unknown vertebra	0.1	38.4	159
	ribs	0.5	26.1	617
	ulna	6.0	6.0	17
	metacarpal		16.7	6
	tibia		13.3	15
	metatarsal	16.7		6
	metapodial		27.3	11
	long bone	2.6	11.4	914
	unknown fragment		25.2	135
Large mammal	mandible	7.1	14.3	14
	scapula		75.0	4
	ribs	0.3	13.4	374
	humerus		50.0	4
	calcaneum		50.0	2
	long bone	1.0	17.7	1,053
	unknown fragment	0.9	15.0	1,069

Table 8.17. Bird body parts with appreciable burning (≥ 10%).

Taxon	Body part	% partial	% complete	n =
Turkey				
(*M. gallopavo*)	dentary		15.0	20
	vertebral column	13.3		15
	corocoid	25.0	10.0	40
	scapula	8.8	2.9	34
	humerus	13.3	10.0	30
	radius	16.7	20.0	30
	ulna	16.7	10.0	30
	carpometacarpus		11.5	26
	carpals	16.7		6
	digit	16.0	28.0	25
	femur	9.1	3.0	33
	tibiotarsus	5.1	5.1	59
	phalanges	4.9	27.9	61
	quadrate		25.0	4
Red-tailed hawk				
(*B. jamaicensis*)	tarsometatarsus	10.0		10
	phalanges	2.4	11.9	42
Eagle				
(*A. chrysaetos*)	coccyx. vertebra	100.0		1
	fibula		100.0	1
	phalanges	16.7	16.7	6
Magpie				
(*P. pica*)	skull	50.0		2
Raven				
(*C. corvax*)	digits	33.3	33.3	3
Aves	ulna	20.0	20.0	5
	innominate		20.0	5
	long bone	2.8	14.5	145
	unknown fragment	7.2	16.2	111

Table 8.18. Percentages of burning and "cooking brown" by taxon.

Taxon	None	Complete	Partial	Very slight	"Cooking brown"	n =
Sylvilagus sp.	79.7	6.9	0.3	0.7	12.4	5,909
L. californicus	82.3	4.3	0.5	1.0	11.8	4,798
C. gunnisoni	87.8	1.0	0.3	0.3	10.5	2,616
T. bottae	90.7	4.2		1.7	3.4	118
D. ordii	94.7	2.3			3.0	134
Peromyscus sp.	99.4	0.1			0.4	739
Neotoma sp.	87.3	7.3			5.4	55
N. cinerea	83.3				16.7	12
Canis sp.	97.1		2.9			37
C. latrans	68.7	6.2		25.0		16
C. lupus	50.0	50.0				2
F. rufus	85.7	7.1			7.1	13
O. hemionus	90.2	7.2	0.5	0.3	1.7	572
A. americana	86.8	9.6	1.2	0.6	1.8	167
Ovis-Capra	95.6	4.3				23
O. canadensis	77.9	17.9	1.4		2.8	145
B. jamaicensis	93.6	4.0	1.6		0.8	126
A. chrysaetos	91.6	2.4	2.4		3.6	82
M. gallopavo	86.8	7.2	1.3	4.5	0.2	987
Passiformes	87.5			6.2	6.2	16
P. pica	91.7		8.3			12
C. corax	45.4	9.1	18.2		27.3	11
G. cyanocephalus	85.7			14.3		7
Fringillidae	85.7				14.3	7
Small-med. mammal	65.3	18.0	0.3	0.1	16.3	7,104
Rodent	93.6	5.3			1.2	171
Artiodactyl	78.5	16.4	0.8	0.3	4.0	2,328
Med-large mammal	77.9	15.5	0.8	0.1	5.7	2,636
Aves	83.3	9.8	0.9	2.4	3.8	427
Unknown	74.0	18.7	0.6		6.7	835

Table 8.19. Percentages of burning and "cooking brown" from firepits and heating pits.

	n	None	Complete	Partial	Very slight	"Cooking brown
Small mammals:						
firepits	245	42.9	42.4	1.6	2.4	10.6
heating pits	158	38.0	29.1	1.3	1.1	29.7
Large mammals:						
firepits	10	80.0	20.0			
heating pits	12	33.3	50.0			16.7
Totals:[a]						
firepits	284	44.4	41.2	2.8	2.5	9.5
heating pits	191	40.8	28.3	1.0	1.6	28.3

[a]Total includes nonmammals and unknowns.

Table 8.20. Percentages of burning and "cooking brown" by provenience type.

	None	Complete	Partial	Barely	"Cooking brown"	n
Structures	87.1	5.0	0.6	1.0	6.2	12,123
Plaza areas	93.6	1.8	0.1	0.3	4.1	3,908
Trash deposits	64.5	18.1	0.5	0.3	16.5	12,990
Wall clearing	92.7	3.8	0.1	0.5	2.8	1,488

Table 8.21. Further breakdowns of the percentages of burning and "cooking brown" within provenience types.

	None	Complete	Partial	Barely	"Cooking brown"	n
Structures:						
fill	92.3	2.7	0.3	1.0	3.7	2,707
roof fall	76.7	19.2	1.9	2.0	0.2	1,236
floor fill	88.8	2.0	0.6	0.9	7.7	4,679
floor contact	82.9	0.5	0.5	4.9	11.2	205
features	84.3	6.3	0.6	0.6	8.1	3,296
Plazas:						
fill	92.4	2.2	0.3	0.2	4.9	1,740
floor fill	96.4	2.1	0.2	0.2	1.1	558
floor contact	93.0	1.8		0.5	4.6	338
features	94.4	0.6		0.4	4.6	1,101
Trash deposits:						
Trash Mound						
construction layers	32.9	55.3	0.4	0.1	11.3	2,942
remainder	71.4	8.7	0.6	0.5	18.8	5,829
pit structures	77.2	5.3	0.4	0.1	17.0	4,219

structures. Within the structures there is less in general fill than in the lower portions of the rooms.

Cultural Modifications

Bone provided the Anasazi with another form of raw material from which tools and ornaments were made. Although these are not covered by this study, the byproducts were found as well as fragments that were used without modification.

The most common forms of modification were straight cuts of Aves long bones--generally the tibiotarus, and the metapodials of cottontail (Sylvilagus) and jackrabbit (L. californicus). These elements were often used for beads and usually had little manufacture. Two of the four recorded instances for turkey (M. gallopavo) and possibly some of the rabbit metapodials may have been roughed-out beads. The turkey elements also had edge rounding and striations.

Tiny cuts on the proximal ulnas of several species of hawks from Plaza 1, Grid 30 would also fall into the cultural-use category. These suggest systematic disassociation and use of the wings (see Plaza 1, Grid 30).

Another variable recorded combinations of use without modification and byproducts of tool manufacture. Table 8.22 gives a breakdown of these by taxa and element for the entire site.

Edge rounding often results from use without modification. Almost all rounding was found on long bone fragments with a broken edge, and these were probably used briefly and discarded. One kind of striation found on large mammal elements is the result of splitting an element lengthwise to obtain long narrow pieces from which to make awls (see McKenna 1984:327-335 for a description of the process). On smaller elements it was the result of repeated attempts to cut the element with a dull flake. The combination of edge rounding and striations could represent either unfinished tools or waste materials that were used briefly.

Slight modification and polish are probably the results of unfinished tools or a tool made for an expedient situation that was used and discarded. The "other" category was used for a variety of situations. A mountain sheep (O. canadensis) scapula fragment had an unusual round hole, 2.8 cm in diameter, cut into the blade portion. A deer (O. hemionus) tooth was ground on the medial and lateral faces. Several long bone fragments had a series of small percussion scars along the edges.

Another result of cultural modification was found in a trash-filled pit in Plaza 1, Grid 30 (see section on Provenience Reports). The pit contained a number of articulated bird wings, mostly raptors. Some of these had very fine cuts lengthwise along the radius that may have resulted from removal of the skin and feathers.

Table 8.22. Evidence of use or manufacture.

Use/manufacture	n	Taxon	Element
Edge rounding	21		
	1	*L. californicus*	proximal radius
	2		tibia shaft fragment
	1	*F. rufus*	proximal humerus
	2	*O. hemionus*	antler fragments
	1		distal metacarpal
	1	*M. gallopavo*	tibiotarsus shaft fragment
	1		tibiotarsus shaft
	3	Small-med. mamm.	long bone shaft fragments
	2	Artiodactyl	rib shaft fragments
	1		innominate fragment
	3		long bone shaft fragments
	2	Med-large mamm.	long bone shaft fragments
	1		unknown fragment
Striations	9		
	1	*L. californicus*	tibia shaft fragment
	1	*M. gallopavo*	tibiotarsus shaft fragment
	1	Artiodactyl	metapodial shaft fragment
	4		long bone shaft fragments
	2	Med-large mamm.	long bone shaft fragments
Edge rounding and striations	12		
	1	*Sylvilagus*	distal femur
	1		proximal tibia
	1	Artiodactyl	rib shaft fragment
	7		long bone shaft fragments
	1		unknown fragment
	1	Med-large mammal	long bone shaft fragment
Slight modification	3		
	1	*L. californicus*	tibia shaft fragment
	1	*O. hemionus*	proximal radius
	1	Artiodactyl	rib shaft fragment
Polish	2		
	1	*L. californicus*	tibia fragment
	1	Med-large mamm.	rib shaft fragment
Other	8		
	1	*O. hemionus*	molar
	1	*O. canadensis*	scapula fragment
	1		proximal metatarsal
	5	Artiodactyl	long bone shaft fragments

Red or other colored pigments found on bones may be due to ceremonial deposition in some instances and chance accumulations of pigment in others. Table 8.23 gives the provenience, taxon, and elements on which this occurred.

An unusually large number of the stained artiodactyl, turkey, and Aves elements came from the roof-fall layers of the northern rooms.

Conditions of Deposition

With the exception of carnivore gnawing, some rodent gnawing, and some of the rounding, most of the variables discussed here generally developed after deposition had taken place.

Carnivore Gnawing

Chewing or gnawing on bone by carnivores results in tooth-puncture marks and/or small pits, chipping, and polish near the edges of more substantial bones. Countless elements may have been entirely ingested and crushed beyond recognition or deposited outside the site by dogs. However, few canid elements were found at the site, and this suggests that few dogs were kept. Therefore, we would expect the numbers of "chewings" recorded to be low.

Table 8.24 gives the percentages of carnivore chewings and the percentages of dog (C.familiarus) and Canis sp. in the total assemblage from other Chacoan archeological sites. With two exceptions, the percentage of chewing and dog elements is quite low, and Pueblo Alto has one of the lowest found.

Sixty-eight elements were recorded as displaying evidence of carnivore activity. When broken down by the three ceramic associations at Pueblo Alto, the percentages differ some. Red Mesa had 0.29 percent, Gallup 0.18 percent, and Late Mix 0.27 percent of the elements that were carnivore gnawed.

In summary it appears that dogs were kept in very low numbers at the site, and they had a variety of taxa in their diet, which may suggest scrounging for food. A portion of one immature canid was found scattered in Room 109, and two isolated, immature elements were all that were recovered. In a sample this large it is surprising and certainly suggests that few dogs were present and did not produce many young.

Rounding

A rather high correlation between rounding and "cooking brown" was noted; this indicates that it is from boiling and/or passing through a

Table 8.23. Pigment stained elements from Pueblo Alto.

Taxon	Element	Provenience
Sylvilagus	phalanx	Plaza 2, Storage Pit 1 (other stain)
L. californicus	radius	Plaza Grid 30, Other Pit 1
	tibia	Room 112, Floor 1, Other Pit 1
C. gunnisoni	mandible	Kiva 15
O. hemionus	antler fragment	OS 7, fill above Surface 1
	thoracic vert.	Room 139, roof fall
	lumbar vert.	Room 145, roof fall
Artiodactyl	2-rib fragments	Room 142, roof fall
	long bone frag.	Room 143, Floor 1, fill
		Room 142, roof fall
Large mammal	rib fragment	Room 142, roof fall
		Room 142, fill above Floor 7
		Plaza 2, fill above Surface 1
	long bone frag.	Room 143, roof fall
	unknown	Plaza 2, fill above Surface 5
A. chrysaetos	articulated wing	Plaza Grid 28
	phalanx	Plaza Grid 8, Surface 9 assoc.
M. gallopavo	scapula	Room 139, roof fall
	2 ribs	Room 139, 1-fill, 1-roof fall
	2 humeri	Room 139, 1-fill, 1-floor contact
	tarsometatarsus	Room 139, roof fall
	phalanx	Room 142, roof fall
	digit	Room 139, roof fall
	innominate	Room 139, roof fall
	femur	Room 142, roof fall
	tibiotarsus	Room 139, roof fall
	2 tibiotarsi	Room 142, roof fall
	corocoid	Room 139, fill
Aves	rib	Room 139, roof fall
	5 unknown frags.	Room 139, roof fall
	unknown fragment	Room 146, roof fall

Table 8.24. Percentages of chewed dog and Canis elements from Chaco sites.

Site		% chewed	% C. familiarus	% Canis sp.
BMIII	29SJ 423	0.3	0.1	0.5
	29SJ 1659	5.0	0.6	1.2
BM-PI	29SJ 724	0.2		0.2
	29SJ 299	3.5	1.3	0.3
	29SJ 628	0.1	0.3	1.4
PII	29SJ 1360	1.1	8.5	1.7
	29SJ 627	1.3	2.3	0.5
PII-III	Pueblo Alto	0.2		0.1
	Una Vida	0.3		0.2

Table 8.25. Rounding on faunal remains from Pueblo Alto.

Body size	% of total rounding	% of taxon that is rounded
Small mammal	85.4	2.9
Medium mammal	0.1	1.6
Large mammal	9.4	1.1
Turkey	0.1	0.1
Aves	1.8	1.7
Unknown	3.0	2.5

Table 8.26. Percentages of checked bone by provenience grouping.

Provenience	None	Slight	Moderate	Heavy	n
Structures	94.4	3.7	1.6	0.3	12,123
Plazas	75.3	13.9	7.7	3.1	3,908
Trash deposits	92.8	5.6	1.5	0.1	12,990
Wall clearing	71.9	9.1	11.9	7.1	1,488

digestive tract. Bone from human coprolites at Pueblo Alto usually exhibited both characteristics.

To determine what factors were responsible for the rounding, the locations were also considered. Trash deposits contained 64 percent, structures 34.1 percent, and Plaza 2 the remaining 1.9 percent of the rounded bone. Further broken down, the earliest trash unit, Plaza 1, Grid 8, had 17.2 percent of its elements rounded, the middle temporal unit or Trash Mound had 2.2 percent, and the latest, Kiva 10, had 0.9 percent rounded.

For both the structures and Plaza 2 the largest amounts occur in occupational deposits--floor fill, floor contact, and features. This further suggests a processing or a digestive cause; Table 8.25 tends to confirm this. The majority of the rounded elements are from small mammals, and the percentages of rounded elements for those taxa are also higher for the small mammals.

The amount of "cooking brown" associated with rounding was much higher for the small mammals (36.1 percent) and unknowns (40 percent), with less (19.7 percent) for the large mammals and none for Aves or turkey (M. gallopavo). The body parts for the large mammals that had both were a phalanx, an innominate fragment, three rib fragments, seven long bone shaft fragments, and an unknown fragment. Any of these may have been put into a stew or boiled for marrow.

Checking

Bone weathering or checking is an indicator of the rate of deposition. Rapidly deposited elements, such as those in trash deposits and intact structure deposits, should have little weathering, and the upper fill and plaza surfaces would be expected to have considerable amounts. To see if this holds true the site was again broken down into four groups, and the overall percentages for these are given in Table 8.26.

The results were as expected. Checking within the structures was recorded for 10.2 percent of the fill, 6.9 percent of the roofing materials, 4.9 percent of the floor fill, 1 percent of the floor contact, and 2.1 percent of the features. Fill in the plaza areas had 30.9 percent, floor fill 35 percent, surface contacts 22.4 percent, and features 10.7 percent of the bone checked. The Trash Mound had slightly more (8.2 percent) than the trash-filled structures (5.2 percent). From this we can deduce that floor fill in open areas and the upper fill in all areas are the most susceptible to weathering, and mounds tend to have more than do subterranean trash deposits.

When soil types were compared, the wall fall materials had the most (18 percent) followed by aeolian (13.1 percent), mixed aeolian and trash (11.2 percent), and trash (6.4 percent). The sequence suggests that it is indeed the rapidity of deposition that determines the amount of checking.

Also, if the rate of deposition is involved, smaller bones would be buried faster and would have less erosion than larger ones or may have disappeared completely. Table 8.27 shows that, on a site-wide basis, this is true for both the mammals and birds.

A study of bone weathering (Behrensmeyer 1978) of very large mammal elements in the Amboseli Basin of Southern Kenya found that checking equivalent to "light" could occur in up to 3 years, "moderate" in 2-15 years, and "heavy" in 6-15 or more years.

Rodent Gnawing

Rodent activity, as monitored by gnaw marks on bone, was recorded on 134 elements. It was presumed that the longer an element was exposed and the density of mice in the vicinity would determine how much was found Table 8.28 gives this breakdown. It shows that the areas within the site that have more than expected, based on sample sizes alone, are the floor fill, floors, and features within structures. The same is true for the distribution of *Peromyscus* and leads to the speculation that both of these monitor rodent activity in the provenience. Both are vastly under-represented in the trash deposits.

There seems to be a preference for elements of larger animals (deer [*O. hemionus*]--16 percent, pronghorn [*A.americana*]--1.2 percent, and domestic sheep/goat [*Ovis-Capra*]--13 percent) as opposed to the smaller ones (cottontail [*Sylvilagus*]--0.8 percent, jackrabbit [*L. californicus*] --0.4 percent, and prairie dog [*C. gunnisoni*]--0.9 percent).

Purple Staining

Purple stains on bone are occasionally found. Twenty-four cases were recorded for Pueblo Alto. The taxon distribution included two cottontail (*Sylvilagus*), five deer (*O. hemionus*), one pronghorn (*A. americana*), two red-tailed hawks (*B. jamaicensis*), three eagles (*A. chrysaetos*), one turkey (*M. gallopavo*), one owl (*O. asio*), eight artiodactyls, and one large mammal. In other words, there is a tendency for it to affect larger elements. Plaza 1, Grid 8, Other Pit 1 contained 37.5 percent of these, the fill of the north and west rooms each contained 12.5 percent, the roof-fall layers of the north rooms contained 16.7 percent, lower room floors and wall clearing each contained 8.3 percent, and the East Ruin Room 6 fill contained the remaining 4.2 percent of the purple stains. It did occur in a wide variety of locales with the only real clustering in Plaza 1, Grid 8.

The purple-stained elements were also widely distributed, ranging from antler to ribs. The only thing the staining correlates with is checking. Slight checking was recorded for over half of the bone with purple stains 20.8 percent, moderate for 25.9 percent, and heavy for 8.3

Table 8.27. Percentages of checked bone by body size.

Body size	% checked
Small rodents	2.0
Small mammals	5.0
Medium mammals	15.7
Large mammals	24.5
Small birds	3.8
Raptors	4.6
Turkeys	10.1
Unk. Aves	16.6
Unknown	13.0

Table 8.28. Rodent gnawing and the *Peromyscus* distribution at Pueblo Alto.

	% of gnawing	% expected[a]	Difference	% of *Peromyscus*
Structures:				
fill	15.6	10.5	+ 5.1	10.3
roof	1.5	2.4	− 0.9	0.2
floor fill	34.1	15.3	+18.8	33.7
floor contact	1.5	0.7	+ 0.8	0.6
features	30.4	10.8	+19.6	43.9
Plazas:				
fill	3.7	5.9	− 2.2	2.1
floor fill		1.8	− 1.8	0.9
surface contact		1.3	− 1.3	0.1
features		3.7	− 3.7	2.8
Trash deposits:				
Trash Mound	8.1	28.7	−20.6	3.3
other trashes		13.8	−13.8	1.3
Wall clearing:				
	5.2	4.9	+ 0.3	0.4

[a]Percentage of elements from those contexts.

percent, much more than for the sample as a whole. Exposure in combination with something in the soil appears to be the best explanation for this condition.

Provenience Reports

This section discusses the excavated materials from Pueblo Alto (Figure I.2), which are arranged in more or less logical units for comparative purposes. Brief descriptions of the faunal remains from each of these follows. Only the information pertinent at the provenience level is given. This generally included the counts, MNIs, immature elements, burning and "cooking brown," and checking. Other information is given when it is felt to be important in interpreting a unit of fill or room function. More detailed reports are on file at the Branch of Cultural Research, Albuquerque, New Mexico. This section attempts to apply what has been learned in the first two sections. The value of various kinds of excavations for production of meaningful faunal assemblages will be considered.

The "ceramic associations" for the proveniences were assigned by Windes (Volume I of this report) on the basis of rough-sort ceramic data. These are fairly gross, and refinement would aid in the information gained from these analyses. It should be remembered that there is not a direct temporal relationship between a ceramic and a faunal assemblage. Subsistence remains are processed and discarded rather rapidly, whereas ceramic vessels have considerably longer uses-lives as well as different depositional conditions. As a result, there is not only a lag in the time between the two, but a deposit that is mixed ceramically may not necessarily be mixed in terms of the faunal assemblage.

The current chronological equivalents of these at Pueblo Alto are: Red Mesa--about A.D. 1020-1050, Gallup--A.D. 1050-1100, and Late Mix--A.D. 1100-1140/1150. The Late Mix period has two distinct faunal distributions. The proportion of turkey remains increases dramatically in the late fill of some structures which suggests a change in subsistence from earlier Late Mix proveniences. Unfortunately the ceramic analysis did not examine these proveniences for corresponding differences in these assemblages. These will be pointed out in this section and further qualified in the temporal discussion.

Room Excavations

The major room excavations centered around two suites, one in the western portion of the site and the other in the north. By excavating units of interconnecting rooms we hoped that a complete picture of a functioning unit would be formed. The two areas contrast markedly. The western rooms were as expected. The plaza-facing rooms had habitation features such as firepits and mealing bins, and the central room and back storage room had few features. Numerous closely spaced floors were found in the habitation rooms, and good samples of bone were recovered from most of these. The northern rooms had few features, floors, and small samples of bone.

The Western Rooms

The excavated western rooms included the suite of Rooms 110, 112, and 229 plus Room 103, Room 109, and Kiva 15.

Room 103. Room 103 was the first of the large rooms at Pueblo Alto to be excavated. It functioned primarily as a habitation room for at least the upper three floors. A firepit high in the fill and dating to the fourteenth century and a single element of domestic sheep-goat suggest later disturbances in that portion of the room. The lower two floors (Floors 4 and 5) were construction-related. A total of 2,671 bones was recovered from the room. The provenience information for these can be found in Table MF-8.1.

The upper-floor associations comprised a large portion of the collection from this room. This unit of fill had the largest percentage of turkey (M. gallopavo) elements found in the western rooms, 13.6 percent. None of the sealed or occupational pits for this floor contained turkey, which may suggest that much of the fill from the room was associated with a different last use than these features. The lower floors had few elements. Floor 4 had the second largest number for the room and was unusual in that the number of prairie dog (C. gunnisoni) remains was quite low compared with all of the other provenience groupings for this room.

There are several interesting facts about the turkey remains from above the upper floor. Elements are especially numerous compared to the other rooms in this portion of the site; none exhibited evidence of butchering, and there were articulations with muscle splints, suggesting that not all were eaten.

Immature or young adult elements from cottontail, jackrabbit, and prairie dog were recorded for all of the surfaces. The variation may suggest different seasons of deposition (Table 8.29).

Observations on bone weathering are presented by the floor number in Table 8.30. All of these are extremely low, and even the lower two do not suggest open plaza-like surfaces or sheet trash. The percentages definitely suggest a sheltered location or rapid deposition for even the last filling of the room.

The presentation of burning is quite complex. Table 8.31 summarizes this information by recording only those taxa in which there was burning for each floor. The burning and "cooking brown" were lower than in most structure fill. Turkey (M. Gallopavo) had considerable burning and an unusual pattern; rarely is so much slight or partial burning found.

Room 109. This room was the small enclosure left at the south end of Room 110 when Kiva 15 was built into the room. At that time it functioned as a passageway from Room 112 and Room 229 into the plaza. No floor features were found. All fauna from the room were treated as one unit for analysis. The ceramic association was Late Mix. Table MF-8.2 presents the provenience information for Room 109.

Table 8.29. Percentages of immature and young adult elements from Room 103.[a]

	Sylvilagus		L. californicus		C. gunnisoni	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Fl.1 fill & assoc.	8.2	10.2	25.5	5.9	20.0	17.8
Fill, Fl. 1 contact & post-occ. feat. only	7.1	8.8	18.4	8.2	16.9	12.8
Floor 2 association		25.0				25.0
Floor 3 association				17.6		
Floor 4 association	11.7	6.7		6.4	15.8	5.3
Floor 5 association	16.7	50.0				25.0

[a]Numbered upper to lower floors.

Table 8.30. Number of elements and MNIs for Room 103.[a]

	Gallup & L.M.		Gallup		L.M.		Gallup																Red Mesa					
	Floor 1						Floor 2								Floor 3				Floor 4				Floor 5		Sub-floor		Totals	
	Fill etc		HP 1,		OP 4,5,7		Fill etc		OP 2		PH 4		HP 6,8		Fill etc		Occup.		Fill etc		Occup.		Fill		Fill			
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	354	7	8	1	12	1	25	2	7	1	16	1	2	1	7	1	2	1	119	3	7	1	6	1	2	1	567	22
L. californicus	153	5	1	1	1	1	11	2	2	1					17	2	2	1	109	4	11	1	20	1			327	19
C. gunnisoni	230	8	1	1	4	1	8	1	3	1	6	1			5	1			19	1	6	1	5	1			287	17
T. bottae	24	5																									24	5
Perognathus sp.	7	2																									7	2
D. ordii	16	2					2	1											1	1							19	4
D. spectabilis	1	1																									1	1
Peromyscus sp.	41	8(3)			3	1	14	7(5)	5	2					19	6(6)			75	20(7)	4	3	6	2			167	49
Neotoma sp.	4																										4	
N. cinerea	1	1																									1	1
N. stephensi	1	1																									1	1
T. taxus																			1	1							1	1
O. hemionus	12	1			3	1	4	1	1	1	4	1			4	1			6	1			1	1			35	8
A. americana	4	1									1	1							1	1							6	3
Ovis-Capra	1	1																									1	1
O. canadensis	1	1													1	1											2	1
Buteo sp.	1	1																									1	1
F. sparverius	3	1																									3	1
quail species	4																										4	
C. squamata	1	1																									1	1
M. gallopavo	220	6					2	1																			222	7
PASSIFORMES	1																										1	
E. alpestris	1	1																									1	1
S. currucoides	1	1																									1	1
S. mexicana	1	1																									1	1
HIRUNDINIDAE	1	1																									1	1
n unknowns	528		19		19		74		14		54		2		49		12		184		16		9		5		985	
% unknowns	32.7		64.3		45.2		52.8		43.7		66.7		50.0		48.0		75.0		35.0		36.4		19.1		71.4			
Totals	1,612	57	29	3	42	5	140	15	32		81	4	4	1	102	12	16	2	515	32	44	6	47	6	7	1	2,671	150
% of elements	60.3		1.1		1.6		5.2		1.2		3.0		0.1		3.8		0.6		19.3		1.6		1.7		0.3		99.8	
% checking	3.0						4.7						1.7						8.1				7.0		0.0			

[a]Number in parentheses represents articulated skeletons.

Table 8.31. Percentages of burning and "cooking brown" by taxon for Room 103.

Taxon	Unburned	Slight	Partial	Complete	"Cooking brown"
Floor 1:					
Sylvilagus sp.	96.0	0.3		3.2	0.5
L. californicus	96.8	1.9		0.6	0.6
C. gunnisoni	98.7				1.3
O. hemionus	86.7			13.3	
M. gallopavo	85.4	10.9	1.4	2.3	
Small to medium mammal	92.0	0.3	0.3	7.4	
Medium mammal (n = 5)	80.0			20.0	
Artiodactyl	94.7			5.3	
Large mammal	97.3			2.7	
Aves	94.4			5.6	
Unknown	97.1			2.9	
Total	94.6	1.8	0.2	3.0	0.4
Floor 2:					
Sylvilagus	88.0			4.0	8.0
L. californicus	92.3			7.7	
C. gunnisoni	94.1			5.9	
M. gallopavo (n=2)	50.0			50.0	
Small to medium mammal	92.7			5.4	1.8
Large mammal	98.5			1.5	
Total	94.5	0.4		0.4	2.7
Floor 3:					
Small to medium mammal	92.5			5.0	2.5
Total	97.6			1.7	0.8
Floor 4:					
Sylvilagus	93.6	3.2		0.8	2.4
L. californicus	94.2			2.5	3.3
C. gunnisoni	96.0				4.0
Small to medium mammal	93.1	1.4	1.4	2.8	1.4
Large mammal	95.6			4.4	
Total	95.2	0.4	1.4	1.6	1.1

Table 8.32 presents the number of elements and MNIs for Room 109. The taxa found in the room are similar to those from Room 103 above the first floor. The only new occurrence was that of a very immature canid spread throughout Layer 1 of the fill.

Immature elements comprised 17.8 percent of the cottontail (Sylvilagus) and 16.7 percent of the jackrabbit (L. californicus) specimens. Young adult elements were recorded for 10.7 percent of the cottontail, 25 percent of the jackrabbit, and 10 percent of the prairie dog (C. gunnisoni) specimens.

Table 8.33 presents burning and "cooking brown" for only those taxa in which it occurred. The percentages are higher than those for structures in general and may possibly indicate that some trash is mixed with the fill. The amount for turkey (M. gallopavo) is much lower than Room 103; however, when the Aves burned bone, probably turkey, is added to the turkey, the pattern is similar.

Room 110. After the walls of the kiva (15) and upper floor surface of Room 109 were removed, a large habitation room remained. Considering that Room 110 did not have the amount of postoccupational fill that the nearby rooms contained, it had a large number of bones--2,438. Table MF-8.3 presents the provenience information for the room, and Table 8.34 the element and MNI distribution. The upper floor, Floor 1, had nine replasterings with innumerable pits. Because of this complexity, the observations will generally be given in the discussion of each unit.

Floor 1. The first and largest unit consisted of the fill above the upper floor, the Floor 1 contact materials, and those pits whose fill had been considered postoccupational. The fill was coded as structural rubble and mixed trash and may represent intentional fill placed there to level the floor before Kiva 15 was constructed.

The turkey (M. gallopavo) frequencies are very low, resembling those of Floor 2 of Room 103. The large number of Peromyscus bones, including 8 skeletons and 19 individuals, suggests that some disturbance had taken place. With all of this, only 2.1 percent of the bone in this unit had been rodent gnawed and 0.2 percent carnivore gnawed. Several articulations and probable articulations were found.

There is a difference in the amount of burning between the fill and floor fill. This is not totally unexpected as the fill was recorded as as structural rubble and the floor fill as mixed aeolian and trash. Table 8.35 presents the burning and "cooking brown" for only those taxa in which it occurred. Burning in the features is low because this figure includes mostly postoccupational fill materials that were in the open pits, niches and doors.

Floor 1, Replasterings 1-4. Those features associated with replasterings of the upper floor that had occupational fill formed this

Table 8.32. Number of elements and MNIs for Room 109.

Taxon	Number	MNI
Sylvilagus sp.	28	3
L. californicus	12	2
C. gunnisoni	10	1
Neotoma sp.	1	
N. cinerea	2	1
Canis sp.	15	1
O. hemionus	8	1
A. americana	2	1
M. gallopavo	13	3 (2 immatures)
No. unknowns	34	
% unknowns	27.2	
Total	125	12

Table 8.33. Percentages of burning and "cooking brown" by taxon for Room 109.

Taxon	None	Complete	Partial	Slightly	"Cooking brown"
Sylvilagus sp.	85.7			7.1	7.1
L. californicus	75.0	8.3		16.7	
C. gunnisoni	90.0		10.0		
O. hemionus	87.5	12.5			
A. americana	50.0				50.0
M. gallopavo	92.6	7.7			
Med.-large mammal (n = 5)	80.0	20.0			
Aves (n = 19)	10.5	52.6	5.3	31.6	
Total	76.0	12.0	1.6	8.0	2.4

Table 8.34. Number of elements and MNIs for Room 110.

	Floor 1										Floor 2				Floor 3		Sub-floor			
	Fill etc.		Rep. 1-4		Rep. 5-6		Rep. 7-9		Plugged		Fill etc.		Features		all		fill		TOTALS	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	192	6	18	1	23	3	161	6	141	6	12	1	24	2	3	1	21	2	595	28
L. californicus	225	4	10	1	17	1	54	2	131	3	28	2	16	1			12	1	493	15
C. gunnisoni	79	4	14	2	3	1	11	2	24	4	2	1	2	1			3	1	138	16
T. bottae	2	1							1	1							1	1	4	3
Perognathus									1	1									1	1
D. ordii	29	2							4	1									33	3
D. spectabilis	4	1																	4	1
Peromyscus sp.	131(8)	19					4	2	32	7	17	3			2	1			186	32
Neotoma sp.	5	1							1	1			1	1					7	3
N. stephensi							1	1											1	1
Canis sp.																	1	1	1	1
C. familiarus	1	1																	1	1
F. rufus									2	1									2	1
C. elaphus											1	1							1	1
O. hemionus	18	1	3	1			28	1	5	1	6	1					1	1	61	6
A. americana							8	1											8	1
O. canadensis	1	1					4	1	1	1	1	1							7	4
Buteo sp.							2	1	1	1									3	2
A. chrysaetos							2	1									2	1	4	2
M. gallopavo	3	1																	3	1
Passeriformes	1																		1	
P. pica	2	1																	2	1
Iguanidae									1	1									1	1
S. undulatus	18	3							5	5									23	6
# unknowns	345		25		27		208		181		15		12		1		44		858	
% unknowns	32.7		35.7		38.6		43.1		34.1		18.3		21.8		16.7		51.8			
Total	1,056	46	70	5	70	5	483	18	531	32	82	10	55	5	6	2	85	8	2,438	131
% of room	43.3		2.9		2.9		19.8		21.8		3.4		2.2		.2		3.5			

Table 8.35. Percentages of burning and "cooking brown" by taxon for Room 110, Floor 1.

Taxon	None	Slight	Partial	Complete	"Cooking brown"
Sylvilagus sp.					
fill	93.7			6.2	
floor fill	78.4	0.7		3.0	17.9
features	89.5	5.3			5.3
L. californicus					
fill	93.3				6.7
floor fill	87.6		1.7	0.6	10.1
C. gunnisoni					
fill	80.0				20.0
floor fill	77.2	1.7			21.0
floor cont.(n = 1)				100.0	
features	80.0				20.0
T. bottae					
floor fill (n = 2)	50.0				50.0
Peromyscus					
features	96.9				3.1
P. pica (n = 2)					
floor fill	50.0		50.0		
Small to medium mammal					
fill	94.1				5.9
floor fill	84.9			1.1	14.0
floor contact	99.2				0.8
Medium mammal (n = 1)					
floor fill				100.0	
Medium to large mammal					
floor fill	88.2			11.8	
Unknown (n = 5)					
floor fill	80.0			20.0	
Totals					
fill	93.8			1.2	4.9
floor fill	85.8	0.6	0.3	1.7	11.7
floor contact	60.0			20.0	20.0
features	97.1	0.8			2.1

unit. Instances of burning and "cooking brown" are presented in Table 8.36.

Floor 1, Replasterings 5 and 6. Only three species were identified from this unit. Burning and "cooking brown" are presented in Table 8.37 for only those taxa in which it occurred.

Floor 1, Replasterings 7-9. The many pits associated with these replasterings resulted in a large number of elements (19.8 percent of the room). Burning and "cooking brown" are presented in Table 8.38 for only those taxa in which they occurred. Bone in this unit had less burning and "cooking brown" than the materials associated with other replasterings for this room. Even though 11 of the heating pits associated with these replasterings contained faunal remains none contained more than 6 elements and very few were burned, only 18.2 percent.

Plugged Wall Features and Structural Associations. This unit is a catch-all for features that could not be associated with a given replaster--vents, doors, wall openings, etc. It was far too large a group to ignore. There is probably some overlap with individuals from other sealed features, and there may be temporal differences. In contrast to all of the floor replaster groupings, immature elements of the three, small, economic species were common. Burning was quite uncommon for these features, even lower than in the upper fill of most structures. Table 8.39 presents these data for those taxa in which burning occurred.

Floor 2. Floor 2 was less complex. The fill, floor contact, and postoccupational fill pits were combined to form the first unit. It contains the only elk (*C. elaphus*) element from Pueblo Alto--an incisor. No burning was found.

Floor 2, Plugged Features. The remaining Floor 2 materials were from Firepit 1, Firepit 2, and the door elements that were recorded as structurally associated with this floor. Firepit 1 contained mostly cottontail elements, 62.5 percent of which were burned. Firepit 2 contained mostly jackrabbit. Burning was found for 35.7 percent of the elements.

Floor 3. This surface was associated with construction of the room walls. The only observation recorded was a single, checked element.

Subfloor. The surface trash predating the room construction did not contain many bones. Table 8.40 presents the burning and "cooking brown" for this unit.

Summary Observations. Room 110 contained very few immature elements for any surface, suggesting that most of the deposition was late winter or early spring related. Table 8.41 gives the percentages of immature and young adult elements.

Table 8.36. Percentages of burning and "cooking brown" by taxon for Room 110 upper floor replasterings 1-4.

Taxon	None	Complete	Partial	"Cooking brown"
Sylvilagus sp.	83.3	11.1		5.5
L. californicus	60.0	10.0	10.0	20.0
Small to medium mammal	88.9			11.2
Medium to large mammal	71.4	28.6		
Totals	82.9	4.8	0.9	11.4

Table 8.37. Percentages of burning and "cooking brown" by taxon for Room 110 upper floor replasterings 5-6.

Taxon	None	Complete	"Cooking brown"
Sylvilagus sp.	87.0	4.3	8.7
L. californicus	76.5	11.8	11.8
Small to medium mammal	72.7	22.7	4.5
Totals	81.4	11.4	7.1

Table 8.38. Percentages of burning and "cooking brown" by taxon for Room 110 upper floor replasterings 7-9.

Taxon	None	Complete	Partial	Slight	"Cooking brown"
Sylvilagus	88.2	1.9			9.9
L. californicus	94.4	1.8	1.8		1.8
C. gunnisoni	54.5	18.2			27.3
O. hemionus	92.8	7.1			
Small-med. mammal	92.0		1.0	1.0	7.0
Artiodactyl	80.9	9.5			9.5
Med.-large mammal	86.6	3.0			10.4
Unknown	85.7		7.1		7.1
Totals	89.2	2.0	0.5	0.7	7.6

Table 8.39. Burning and "cooking brown" by taxon for Room 110 upper floor unassociated plugged features.

Taxon	None	Slightly	Calcine	"Cooking brown"
Sylvilagus sp.	97.9			2.1
L. californicus	95.4	0.8		3.8
Small-med. mammal	98.6			1.4
Med.-large mammal	86.7		6.7	6.7
Unknown (n = 3)	66.7			33.3
Totals	97.4	0.2	0.2	2.3

Table 8.40. Percentages of burning and "cooking brown" by taxon for Room 110 subfloor.

Taxon	None	Partial	"Cooking brown"
L. californicus	83.3		16.7
Med.-large mammal	91.7	8.3	
Unknown	93.3	16.7	
Totals	94.1	3.5	2.3

Table 8.41. Percentages of immature and young adult elements for Room 110.

	Sylvilagus		*L. californicus*		*C. gunnisoni*	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Floor 1 assoc.	3.6	13.0	1.8	1.8	3.8	12.6
replasters 1-4		61.1				7.1
replasters 5-6		13.0		10.0		
replasters 7-9	0.6	4.3		1.8		9.1
Floor 2		8.3	3.6			50.0
Floor 2 occup. feat.		4.1				
Subfloor		4.7				

Table 8.42 gives a floor by floor comparison of checking for this room. There is a dramatic increase at the subfloor level and some increase for Floor 3. That for Floor 4 is similar to that found in the floor-fill layers of open plaza locations.

Room 112. Directly behind and opening into Room 110 is this large room with few floor features. After its initial use in association with Room 110, several steps leading to a high door entering Room 109 were built. This resulted in an unprepared use surface (Surface 1) that had no associated features. Table MF-8.4 gives the number of elements by provenience for this room.

The number of elements and MNIs are found in Table 8.43. Of note is the occurrence of Nuttall's cottontail (*S. nuttalli*) and of a snowshoe hare (*L. americanus*) mandible. Both of these are unique for Chaco and Pueblo Alto and undoubtedly represent long-distance transports.

Prairie dog (*C. gunnisoni*) is relatively numerous, and the frequencies are unusually high down to the lowest level. Room 103 also had high frequencies of this taxon above the first floor.

The Proveniences. All materials down to the use surface, Surface 1, were treated as one unit, and the fill between the surfaces, Floor 1 contact, and the postoccupational pits were lumped. Floor 2 and Floor 3 (Surface 2), and the subfloor fill each formed a unit.

The fill above Surface 1 has the largest sample from the room and is quite late, probably in the early A.D. 1100s. Compared to Room 103, the frequency of turkey (*M. gallopavo*) elements is low.

Observations. The distribution of immature and young adult elements for this room can be found in Table 8.44. These are quite frequent, and along with the abundance of prairie dog (*C. gunnisoni*) elements, suggest predominantly late spring and early summer deposits.

Checking was not common in any part of the room. Even the lowest layers had low percentages (Table 8.43) compared to the other rooms in this complex. Floor 1 and Floor 2 materials were quite protected and, possibly, the central location of the room mitigated the effects of weathering even when only stub walls were present.

Burning and "cooking brown" are summarized in Table 8.45 by the surface or floor for only those taxa in which they occurred. Floor 1 had the most burning, logically, as numerous floor burns were found. This was higher than most floor fill units from within structures. The "cooking brown" suggests some processing, and possibly the floor burns do represent the mechanism for cooking.

Articulated rodents were found in all but one unit of the fill and *Peromyscus* had the largest MNI of any taxon. There appears to be no

Table 8.42. Percentages of checked bone for Room 110.

Provenience	% checked
Floor 1	1.1
Replasterings 1-4	0
Replasterings 5-6	1.4
Replasterings 7-9	2.5
Unassociated	.4
Floor 2	4.9
Floor 3 (n = 6)	16.7
Subfloor	37.7

Table 8.43. Number of elements and MNIs for Room 112.[a]

	GALLUP/ LATE MIX		GALLUP				RED MESA				Totals	
	Above Surf. 1		Floor 1 Assoc.		Floor 2 Assoc.		Floor 3 Assoc.		Subfl. Assoc.			
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	244	7	61	5	73	5	45	2	89	7	512	26
S. nuttalli			1	1							1	1
L. californicus	133	4	104	3	178	4	52	1	96	3	563	15
L. americanus			1	1							1	1
A. leucurus	2	1									2	1
C. gunnisoni	165	11	90	7	110	7	16	2	50	4	431	31
T. bottae	1	1			2	1					3	2
Perognathus sp.	3	1									3	1
D. ordii	2	1									2	1
D. spectabilis	10	1									10	1
Reithrodontomys	2	1									2	1
Peromyscus sp.	108(3)	15	18(2)	5	104	8	3(1)	2	14(2)	5	247	35
Onychomys	1	1									1	1
Neotoma sp.	13	1									13	1
N. stephensi	1	1									1	1
Canis sp.			1	1	4	1			1		6	2
C. latrans									1	1	1	1
F. rufus									1	1	1	1
O. hemionus	20	1	5	1	2	1	2	1	1	1	30	5
A. americana	1	1	1	1	2	1	1	1			5	4
O. canadensis	1	1									1	1
A. chrysaetos									1	1	1	1
C. squamata	1	1									1	1
M. gallopavo	6	1	1	1			1	1			8	3
Z. macroura	1	1									1	1
Passeriformes	1										1	
E. alpestris	1	1	1	1							2	2
Fringillidae	1										1	
J. hyemalis	1	1									1	1
Spea sp.	1	1									1	1
No. unknowns	204		59		74		17		68		422	
% unknowns	22.1		17.2		13.5		12.4		21.1		18.6	
Totals	924	55	342	27	549	28	137	10	322	23	2,274	142
% of room	40.6		15.0		24.1		6.0		14.2		99.9	
% checked	4.4		0.6		0.7		5.1		5.8			

[a]Number in parentheses represents articulated skeletons.

Table 8.44. Percentages of immature and young adult elements from Room 112.

	Sylvilagus		L. californicus		C. gunnisoni	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Surf. 1 association	4.9	7.8	0.7	4.5	4.2	8.5
Floor 1 association	3.3	13.1		3.8	3.3	16.7
Floor 2 association	2.7	20.5	0.6	8.4	4.5	21.8
Floor 3, Surface 2 association	13.3		3.8		6.2	
Subfloor	2.2	6.7		7.3	2.0	6.0

Table 8.45. Percentages of burning and "cooking brown" by taxon for Room 112.

Taxon/Unit	None	Complete	Slight	Partial	"Cooking brown"
Sylvilagus					
Surface 1	97.9		0.4		1.6
Floor 1	88.7				11.3
Floor 2	94.5	1.4			4.1
Floor 3 (Surf.2)	91.1		4.4		4.4
Subfloor	93.1	2.2	1.2		3.4
L. californicus					
Surface 1	78.9		0.7		20.3
Floor 1	84.6		1.0		14.4
Floor 2	97.2	0.6			2.2
Subfloor	95.8		3.1		1.0
C. gunnisoni					
Surface 1	87.9				12.1
Floor 1	78.9				21.1
Floor 2	90.0	7.3	1.8		
Floor 3 (Surf.2)	93.7				6.2
Subfloor	96.0				4.0
Small to medium mammal					
Surface 1	81.7				18.3
Floor 1 (n = 36)	55.6		2.8		41.7
Floor 2	95.1				4.9
Artiodactyl					
Surface 1	90.5				9.5
Subfloor (n = 5)	86.7	13.3			
Medium to large mammal					
Surface 1	94.9	2.5			2.5
Floor 1 (n = 8)	75.0				25.0
Floor 3 (Surf.2) (n = 4)	75.0	25.0			
Aves					
Surface 1	80.0	20.0			
Unknown					
Floor 2 (n = 2)	50.0	50.0			
Totals					
Surface 1 (total)	91.4	0.2	0.2		8.1
fill (n = 230)	96.1			0.9	3.0
S.1 f.f.(n = 510)	89.8	0.2			10.0
S.1 feat.(n = 184)	89.7	0.5			9.2
Floor 1	82.4		0.6		17.0
Floor 2	95.8	0.5	0.4		3.3
Floor 3 (Surf.2)	95.6	0.7	1.5		2.2
Subfloor	95.6	1.2	1.2		1.9

correlation between the rodent gnawing and the number of rodent elements, articulations, or individuals.

Conclusions. In contrast to Room 110 there is good evidence of deposition of animals procured in spring or summer. Perhaps during the colder seasons processing, cooking, and consumption activities took place in the forward rooms with their fire and heating pits. Then, during the warmer months when the interior rooms would have been cool, some activities were carried out there.

Room 229. This small room directly behind Room 112 was undoubtedly a storage room. It contained few bones, which in itself suggests that few activities, other than storage, took place. Table MF-8.5 gives the counts and provenience breakdown for the room.

Table 8.46 gives the counts for each taxon and the MNIs for the room. The single element from the lower fill was a small-to-medium mammal long bone fragment that was lumped with the rest of the room.

Checking was present for 11 percent of the cases. Carnivore gnawing was comparatively high at 3.9 percent.

Cottontail (*Sylvilagus*) elements included 3.4 percent that were immature, 10.3 percent that were young adult, and 28.6 percent immature elements for prairie dog (*C. gunnisoni*).

Burning and "cooking brown" are presented in Table 8.47 for only those taxa in which they occurred. The sample is small, but the cottontail (*Sylvilagus*) and jackrabbit (*L. californicus*) percentages are similar to other large units of postoccupational fill.

Conclusions. There is little to suggest that much activity had taken place in this room. The immature elements do suggest that some of the fill was deposited in late spring or early summer.

Kiva 15. This kiva was constructed within Room 110 after about A.D. 1080 (Windes, Volume I of this report). The single, immature, canid bone from this structure's fill may be from the same individual that is scattered through the fill of Room 109. Table MF-8.6 gives the provenience information for this room.

The kiva was analyzed as two units that correspond to the Late Mix versus Gallup distinction. Table 8.48 gives the numbers and MNIs for the two groups. One of the more obvious features of the fill is the large number of cottontail skeletons. These came from Layer 7, just above the floor, and consisted of two immature, three young adult, and four adult individuals. The excavator felt the rabbits fell into the kiva and were unable to escape rather than being purposefully placed there. The age distribution suggests a spring to early fall episode or episodes.

Table 8.46. Number of elements and MNIs by taxon for Room 229.

Taxon	No.	MNI
Sylvilagus	58	5
L. californicus	17	1
C. gunnisoni	7	2
T. bottae	2	1
Peromyscus sp.	5	2
Neotoma sp.	1	1
O. hemionus	1	1
A. chrysaetos	1	1
E. alpestris	2	1
P. pica	1	1
No. unknown	32	
% unknown	25.2	
Totals	127	16

Table 8.47. Percentages of burning and "cooking brown" by taxon for Room 229.

Taxon	None	Complete	Partial	"Cooking brown"
Sylvilagus sp.	98.3	1.7		
L. californicus	94.1		5.9	
C. gunnisoni	57.1			42.7
Medium-large mammal	83.3	16.7		
Total	95.3	0.8	1.6	2.4

Table 8.48. Number of elements and MNIs by taxon for Kiva 15.[a]

Taxon	LATE MIX Fill, floor, postoccup. n	MNI	GALLUP Structural n	MNI	Total n	MNI
Sylvilagus sp.	115	13(9)	8	1	123	14
L. californicus	170	4	6	1	176	5
C. gunnisoni	50	3	4	1	54	4
T. bottae	6	1	1	1	7	2
D. ordii	1	1	3	2(1)	4	3
Peromyscus sp.	11	7(4)	7	1	18	8
Neotoma sp.	2	1			2	1
N. albigula	2	1			2	1
Canis sp.	1	1 immature			1	1
O. hemionus	16	1	1	1	17	2
A. americana	3	1			3	1
B. jamaicensis	1	1			1	1
M. gallopavo	14	1			14	1
Passiformes	1	1			1	1
No. unknown	193		21		214	
% unknown	32.9		41.2		33.6	
Totals	586	37	51	8	637	44

[a]Number in parentheses represents articulated skeletons.

The low frequency of turkey remains is similar to the distributions found in the fill of adjoining rooms. With the articulation discounted, there are approximately equal numbers of all three, small, economic mammals (cottontail, jackrabbit, and prairie dog). In general, the frequencies are most similar to those from the first fill unit of Room 110.

The Proveniences. The entire fill, floor, and postoccupational pits were treated as one unit. It is a comparatively small sample, which is difficult to explain as many of the surrounding rooms were filling at the same time and yet had many more elements.

Elements from both left and right artiodactyl forelimbs were recovered near the floor and possibly represent a unit--either of consumption or manufacture of tools. Several articulations were also noted.

Structural Associations. Materials from construction of the bench and walls comprised such a small sample that few comments can be made, especially considering the unknown origin of these materials.

Other Observations. Some immature and young adult elements were found (Table 8.49). The amount of checking was low for structure fill (7 percent for the fill and 11.8 percent for the structural elements).

Unlike the other rooms in the complex there is little difference in the amount of burning and "cooking brown" between the room fill and the floor fill. This may suggest that these activities or even consumption was not as likely to take place in kivas as in rooms or that it was kept clean of food debris. Table 8.50 presents the burning and "cooking brown" for only those taxa in which it occurred.

Conclusions. The faunal remains from this structure give few clues to kiva use. The only two suggestions possible are that less processing and consumption took place then in the rooms, and the pile of artiodactyl remains could suggest a bone-tool manufacturing area.

Discussion. Habitation versus special use or storage can be examined through both the quantity of faunal remains and patterns of burning. The suspected habitation rooms (103 and 110) do have the largest samples in the unit. Storage rooms would not be expected to have many, and Room 229 did not. Kiva 15, serving a socioreligious function, had a moderate sample (220 elements in the floor fill level), which may suggest that preparation and consumption were not as frequent there as in the habitation rooms.

Room 112 presents a problem. It is a central room with few features and no formal firepit and has been assumed to have served a storage function. However, there was a large number of bones, suggesting a more habitation-like function.

"Cooking brown" of bone is especially useful for the smaller taxa because they were more likely to be cooked whole or in large parts, as

Table 8.49. Percentages of immature and young adult elements for Kiva 15.

	Sylvilagus		*L. californicus*		*C. gunnisoni*	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Fill	20.9	27.8		9.4		8.0
Floor fill, etc.	7.4	22.2		8.4		8.1
Structural		37.5				25.0

Table 8.50. Percentages of burning and "cooking brown" by taxon for Kiva 15.

Taxon/Provenience	None	Complete	Partial	Slight	"Cooking brown"
Sylvilagus sp.					
Fill	95.4	2.3	1.1	1.1	
Floor fill & feat.	92.6	3.7			3.7
L. californicus					
Fill	96.1	3.9			
Floor fill & feat.	91.6	3.4	0.8	0.8	3.4
Structural	83.3	16.7		0.8	
C. gunnisoni					
Structural	50.0				50.0
Small to medium mammal					
Fill	71.4	25.0		3.6	
Floor fill & feat.	93.0	5.5	1.4		
Artiodactyl					
Floor fill & feat.	95.8	4.2			
Unknown (n = 2)					
Fill	50.0	50.0			
Totals					
Fill	94.1	4.7	0.4	0.8	
Floor fill & feat.	94.0	3.3	0.6	0.3	1.8
Structural	94.1			2.0	3.9

compared to the artiodactyls where meat would have been stripped from the bone. In some of the units (Rooms 110 and 112) there was an increase in the percentage of burning or "cooking brown" in the floor fill materials as opposed to the general fill of the rooms. This suggests that the few centimeters above the floors were actually living debris. The upper floor of Room 103 was an exception. The burning percentages were almost identical (within 0.1-0.6 percent) for cottontail and jackrabbit, but there was an increase for turkey (Table 8.29). The lower floors do show increases in burning, but the frequencies are still lower than expected (less than 10 percent).

The kiva and storage room both had low percentages of burning, similar to those of room fill in general. Kiva 15 did not have an increase near the floor, and the total burning was low. Room 229 had very few floor-fill elements, but there was a slight increase (more than 2.1 percent) in the percentage of burning.

Room 109, oddly enough since it was a passageway, had high frequencies of burning and "cooking brown." Room 110 had an increase in burning from fill to floor fill for the first floor, and Room 112 had a similar rate of high burning for Floor 1. This, in combination with several floor burns, suggests that some habitation functions were performed in Room 112. Other floors in the room have lower numbers of burned bones and may represent storage functions.

Table 8.51 puts the percentages of checked elements in a temporal framework with the percentages in the relative position of the floor number and reflecting contemporaneity of surfaces. From this perspective, the upper fill of Rooms 109 and 229 and Kiva 15 were not as protected as that from Rooms 103, 110, and 112. Periods of openness are also suggested for some.

The Northern Rooms

This group of rooms was difficult to interpret because the sample sizes were small, and the percentages of unknowns were usually fairly large. Included here are Rooms 138, 139, 143, 145, 146, 147, and Kiva 10.

Room 138. This small storage room located behind Room 139 provided very few bones. Materials from Test Trench 1, Layer 1, were lost in the field, but even with these the total would probably have been less than 40. Such a sample was not totally unexpected for a back storage room. Table MF-8.7 presents the provenience information and ceramic associations.

Table 8.52 gives the counts and MNIs for both floors. The domestic sheep/goat (Ovis-Capra) elements were found in the upper layer, and are the only domestic sheep-goat from this portion of the site. Most elements clustered in the southwest corner of the ruin.

Table 8.51. Summary of the checking found in the western rooms.

Phase	Room 103	Room 109	Room 110	Room 112	Room 229	Kiva 15
Late Mix	3.0					
		9.6				7.0
				4.4		
Gallup	4.7		1.1	0.6	11.0	
	1.7		1.4	0.7		
	8.1					
			2.5			
Red Mesa	7.0		4.9	5.1		
			16.7	5.8		
			37.7			

Table 8.52. Number of elements and MNIs for Room 138.[a]

	LATE MIX Floor 1		RED MESA Floor 2		Total	
	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	1	1			1	1
L. californicus	4	1	3	1	7	2
C. gunnisoni	1	1			1	1
Peromyscus			5(5)	5	5	5
Ovis-Capra	4	1			4	1
M. gallopavo	2	1	1	1	3	2
No. unknown	6		2		8	
% unknown	33.3		18.2		27.6	
Total	18	5	11	7	29	12

[a]Number in parentheses represents articulated skeleton.

The only immature elements were the domestic sheep/goat elements, but the sample size is so small that this is not suprising. No burning was found. Checking is quite high, 38.9 percent, with the domestic sheep/goat included, and 14.3 percent with it excluded. This is only slightly higher than most structure fill.

Rooms 139 and 145. These two rooms share a lower floor and have been analyzed together. A wall separated them into a large and a small room at the first floor level. The rooms had few features on the upper floor, Floor 1, and looked very much like storage rooms. Floor 2 was covered with pits, mostly other pits and heating pits, suggesting that the initial use was not for storage.

Table MF-8.8 gives the provenience counts for the rooms along with the ceramic associations assigned by Windes.

Two occurrences suggest that both rooms stood open and relatively undisturbed for a time before the roofs collapsed. On the floor of Room 139 two shrike (*L. ludovicianus*) skeletons were found. These small birds must have entered this room and, unable to find their way out, died there. In Room 145, the roof-fall layer contained the articulated skeletons of four bats (*M. californicus*). Findley et al. (1975) note that this species is a crevice- and cave-dwelling bat and should have been able to find the way out of the room if it were possible.

The majority of the faunal materials were recovered from the roof-fall layers, 72 percent of the total. Table 8.53 gives the number of elements and MNIs for the provenience groupings within the rooms. The Floor 1 associated units are quite different from those of Floor 2. Floor 1 has a pattern of high cottontail cottontail, low jackrabbit, and very high turkey. No turkey was found below Floor 1.

The Proveniences. The roof-fall layer for each of these rooms was treated separately to monitor possible rooftop activities. Floor 2 was divided by fill, floor contact, and postoccupational fill versus occupational and plugged features.

Room 139, Floor 1. Twenty elements were coded for the fill and floor fill of this unit. Unfortunately, because of the nature of the coding system, the roof-fall materials just above the floor are considered as floor fill.

Pigment staining was fairly commom in both units. Of the 11 stained elements from the fill unit, 8 were turkey, 1 was an artiodactyl, and 2 were Aves. Fifteen of the roof-fall elements were also stained and had a similar taxa distribution: nine turkey, four Aves, one deer, and one medium-to-large mammal element.

Burning was more common than in the western rooms, but no "cooking brown" was found. Table 8.54 gives a summary for those taxa in which it

Table 8.53. Element and MNI counts for Rooms 139 and 145.[a]

	LATE MIX								RED MESA					
	Room 139				Room 145				Room 139/145					
	Fl. 1 fill		Roofing		Fl. 1 fill		Roofing		Fl. 2 fill		Features		Totals	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
M. californicus							4	4(4)					4	4
Sylvilagus sp.	9	2	7	2	12	2	29	4(1)	20	2	18	1	95	13
L. californicus	1	1	6	1	2	1	6	2	19	1	6	1	40	7
C. gunnisoni	2	1	3	2	1	1	12	2	2	1	1	1	21?	8
S. aberti							1	1					1	1
T. bottae	1	1											1	1
D. ordii									1	1(1)	1	1	2	2
Peromyscus sp.			2	1			1	1					3	2
Canis sp.							2	1					2	1
C. latrans									3	1			3	1
O. hemionus			1	1			13	1	1	1			15	3
A. americana	1	1	1	1			20	2					22	4
O. canadensis			1	1			40	2					41	3
A. chrysaetos									1	1			1	1
M. gallopavo	18	1	28	1	1	1	159	2					206	5
O. asio							1	1					1	1
L. ludovicianus	2	2(2)											2	2
No. unknown	20		44		2		225		57		34		382	
% unknown	37.0		47.3		11.1		43.9		56.7		55.2		45.4	
Totals	54	9	93	10	18	5	513	23	104	8	60	4	842	
% of room	6.4		11.1		2.1		60.8		12.4		6.9			
% checked	3.7		2.2		5.5		4.5		9.6		1.7			

[a]Numbers in parentheses represents articulated skeletons.

Table 8.54. Percentages of burning for Room 139 fill.

Taxon/Provenience	None	Complete	Partial	Slight
Sylvilagus				
(n=7) roof fall	85.7	14.3		
(n=3) floor fill	66.7			33.3
A. americana				
(n=1) floor fill		100.0		
M. gallopavo				
(n=14) fill	78.6			21.4
(n=3) floor fill	66.7		33.3	
Artiodactyl				
(n=17) roof fall	58.8	11.8	17.6	11.7
(n=7) floor fill	71.4	14.3	14.3	
Medium to large mammal				
(n=6) roof fall	50.0	50.0		
(n=3) floor fill	33.3	66.7		
Aves				
(n=14) roof fall	64.3	35.7		
(n=4) floor fill	75.0	25.0		
Unknown				
(n=5) roof fall	40.0	60.0		
Totals				
(n=29) fill	86.2			13.8
(n=93) roof fall	77.4	17.2	3.2	2.1
(n=22) floor fill	63.6	22.7	9.1	4.5

occurred. The amount of burning in the floor fill unit definitely suggests a similarity to the roof-fall unit.

Room 145, fill. Although no roof-fall materials were coded for this room, Windes suggested that Layers 5 and 7 should be treated as such. These resulted in the largest sample for the rooms with only 18 elements left in the fill unit.

A large number of artiodactyl elements was found in the roof-fall layers. Most of these were foot or limb elements. This concentration of very similar elements and evidence of manufacture or use (13 instances) strongly suggest a bone-tool manufacturing or use area. Initial principal component analysis (see Appendix MF-8.C) of selected proveniences at Pueblo Alto consistently separated this unit from the other deposits. It was eventually dropped from these analyses because of the effect it had on the others. This, too, suggests that it was not a typical refuse deposit.

Another unusual aspect of this fill unit is the large number of turkey elements that appear to represent only two birds. All body parts were represented including a complete skull. Also notable was the presence of two, immature canid humerus fragments and a tassel-eared squirrel (*S. aberti*) dentary. This latter species is confined to ponderosa forest environs.

The small mammals have burning percentages that are similar to the upper fill in the western rooms. However, the artiodactyl and turkey have unusually high percentages and similar patterns of burning. Table 8.55 summarizes the burning for those taxa in which it occurred. No burning was found for the general fill unit.

Relatively large amounts of completely burned bone are characteristic of roof-fall layers (Rooms 139 and 145 make up about half of that fill type), of the construction layers of the Trash Mound, and of the fill of firepits (Table 8.19 and Table 8.21).

In this case, much of the burned bone was concentrated in a single level just above the floor and in level 0702 (Table 8.56). This lowest level and the floor-fill also contained 69.2 percent of the deer (*O. hemionus*), 90 percent of the pronghorn (*A. americana*), 97.6 percent of the mountain sheep (*O. canadensis*), and 98 percent of the artiodactyl elements, and indicates the activity or deposition took place in the room itself rather than on a rooftop.

Room 139/145, Floor 2, fill. The fill between Floors 1 and 2 and the nonoccupational fill of Wall Trench 1 and Other Pit 14 comprised this unit. Bone was fairly sparse. Burning is summarized in Table 8.57 for those taxa in which it occurred. Only the cottontail (*Sylvilagus*) shows a significant amount.

Room 139/145, Floor 2, Occupational Features. This unit included the pits whose fill was recorded as occupational, the plugged posthole,

Table 8.55. Percentages of burning by taxon for Room 145 roof-fall.

Taxon	None	Complete	Partial	Sight
Sylvilagus sp.	93.1	3.4		3.4
O. hemionus	76.9	15.4	7.7	
A. americana	60.0	30.0	5.0	5.0
O. canadensis	67.5	27.5	5.0	
M. gallopavo	67.3	25.8	2.5	4.4
Small-medium mammal	81.2	18.7		
Artiodactyl	60.5	34.2	5.2	
Medium-large mammal	81.2	12.5		6.2
Aves	75.0	25.0		
Unknown	85.7	14.3		
Totals	70.5	24.4	3.1	1.9

Table 8.56. Percentages of burning by layer-level in Room 145.

Layer-level	None	Complete	Partial	Slight	Sample size
0500	92.3	7.7			13
0506	100.0				5
0701	90.0			9.1	11
0702	75.6	21.8	2.6		78
0703	87.5			12.5	8
0704	91.7	8.3			12
0705	91.7	8.3			12
0706	100.0				21
0707	58.0	37.0	2.3	2.7	257
0700 fl. fill	80.0	10.5	8.2	1.0	95

Table 8.57. Percentages of burning and "cooking brown" by taxon for Room 139/145, Floor 2 fill.

Taxon	None	Slight	"Cooking brown"
Sylvilagus sp.	75.0	5.0	20.0
L. californicus	94.4		5.6
Small-medium mam.	97.0		3.0
Totals	93.3	1.0	5.7

Table 8.58. Percentages of burning and "cooking brown" by taxon for Room 139/145, Floor 2 feature.

Taxon	None	Complete	Partial	Slight	"Cooking brown"
Sylvilagus sp.	38.9	5.6			55.6
L. californicus	50.0	33.3			16.7
Small-med. mam.(n = 27)	55.5	18.5	7.4	3.7	14.8
Med.-large mam.(n = 2)		100.0			
Unknown (n = 2)		100.0			
Totals (n = 60)	50.0	20.0	3.3	1.7	25.0

Table 8.59. Percentages of immatures and young adult elements in Room 139/145.

	Sylvilagus		L. californicus		C. gunnisoni	
Provenience	imm.	y. adult	imm.	y. adult	imm.	y. adult
139 fill	33.3	11.1				50.0
139 roof fall	28.6	28.6		16.7	3.3	33.3
145 fill		16.7				
145 roof fall	13.8	17.2	33.3			25.0
Floor 2 fill		10.0				
Fl. 2 features		55.6			0.0	

Table 8.60. Number of elements and MNI for Room 142.

	Floor 1				Floor 2		Total	
	Fill		Roof fall					
	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	13	3	19	4	1	1	33	8
L. californicus	18	3	29	3	1	1	48	7
C. gunnisoni	4	3	14	2			18	5
T. bottae			1	1	1	1	2	2
O. hemionus			2	1			2	1
O. canadensis	1	1					1	1
M. gallopavo	13	2	113	3			126	5
E. alpestris					1	1	1	1
No. unknown	67		197		0		264	
% unknown	57.7		52.5				53	5
Totals	116	12	375	14	4	4	495	30

and two wall trenches. The majority of these (85 percent) came from heating pits, and this results in the large amount of burning and "cooking brown" in Table 8.58.

Observations. The three small mammals occurred in small numbers. Table 8.59 gives the age distribution for these.

Checking is given in Table 8.53. The unit with the most is the fill between the two floors. This could suggest that it was open at that time or that the fill was brought in. The amount of checking from the features on Floor 2 suggests protection, but some of this was probably due to the burning. In general, these are comparable to the percentages from the western room.

The total lack of animal activity in the form of rodent gnawing, and the few Peromyscus remains is suprising. It may be that what were stored were nonfood items not attractive to the rodents, or the storage facilities were good enough to exclude these mice.

Turkey (M. gallopavo) occurred in very high numbers above the first floors. This probably suggests late use of this portion of the site. The incidence of pigment on these bones is also interesting as it does not suggest consumption. Muscle splints were found in the Room 139 fill unit and both roof-fall layers. Burning for this taxon is comparable to that of the small economic taxa only in the Room 139 fill unit, and no butchering was found.

Room 142. Room 142 is a large room fronting another large room but with a long, narrow, "corridor" room fronting it. Its location suggests that it could have functioned as a habitation room, but the lack of floor features suggests a storage room. Table MF-8.9 gives the provenience information for this room. It was all Late Mix in ceramic association.

Table 8.60 gives the number of elements and MNI for each provenience unit. Only one unit in the room had much of a sample size. Again, as in Rooms 139 and 145, turkey appears only above the first floor and predominately in the layer referred to as roof fall. The percentage of unknowns is much higher than those from the western rooms.

Floor 1. The Floor 1 fill included the non-roof-fall from above the upper floor and a single element from Posthole 2. The roof-fall unit produced the largest number of bones from the room, over a third of the sample. It is similar to the roof-fall layer in Room 145 in that many of the elements were found near the floor and some were burned. However, unlike Room 145, artiodactyl parts were not common; turkey made up 30.1 per cent of the roof-fall elements.

Table 8.61 divides the burning by fill, floor fill, and "roof fall" to illustrate that there is a difference in the amount of burning. Most of the burned bone was found in the floor fill and "roof fall" levels, and most of those were completely burned. Again, because of the nature of the

Table 8.61. Percentages of burning and "cooking brown" by taxon for Room 142, Floor 1.

Taxon	Unit	None	Complete	Partial	Slight	"Cooking brown"
L. californicus (n = 5)	fill	80.0	20.0			
	roof fall	96.5	3.4			
O. canadensis (n = 1)	floor fill		100.0			
M. gallopavo						
	roof fall	91.1	1.8	1.8	4.4	0.9
Small to medium mammal (n = 2)	fill	50.0	50.0			
Artiodactyl						
	roof fall	79.6	18.4		2.0	
(n = 12)	floor fill	83.3	16.7			
Medium to large mammal	roof fall	52.9	35.3	5.9	5.9	
(n = 15)	floor fill	73.3	26.7			
Aves						
(n = 6)	fill	83.3				16.7
	roof fall	74.3	25.7			
Unknown						
(n = 22)	roof fall	38.2	66.7	1.5		
	floor fill	4.5	95.4			
Totals						
(n = 39)	fill	92.3	5.1			2.6
(n = 375)	roof fall	73.6	22.9	1.1	2.1	0.3
(n = 76)	floor fill	63.2	36.8			

Table 8.62. Percentages of immature and young adult elements for Room 142.

	Sylvilagus		*L. californicus*		*C. gunnisoni*	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Floor 1 fill	7.8	7.8	11.1	5.6		50.0
roof fall	5.3	15.8	3.4	13.8		21.4

coding system, many of the floor-fill elements were actually "roof fall" materials resting near the floor. The fill percentages are similar to those from the western rooms. Only those taxa in which burning or "cooking brown" was found are presented in the table.

Floor 2: The second floor produced only four bones. The *T. bottae* element was recorded as "cooking brown." No other observations were made.

Observations. Again the numbers are low. Table 8.62 gives the percentages of immature and young adult elements. Checking was high for the fill unit at 18.1 percent and low for the roof fall at 2.4 percent. None was recorded for Floor 2.

Rooms 143 and 236. This long narrow room fronting Room 142 contained a fair number of bones for its size. It had a number of floors very close together, and the features suggest that the last three uses (Floors 1-3) may have been for habitation. A jacal partition wall divided the room for the last four floors, and the western end was termed Room 236 for three of these. Although a separation was maintained by the excavators, these were lumped for the faunal analysis on the advice of Windes and because the sample sizes were so small. Table MF-8.10 presents the provenience information and ceramic association for these rooms. This room has the only Gallup proveniences for the north rooms.

Table 8.63 gives the counts and MNIs by provenience unit. Turkey occurs in relatively low frequencies, making up only 5.5 percent of the first unit. This is low compared to the other rooms in this complex and may suggest that it was abandoned before many of its neighbors. It is also missing the layer of "roof fall" with its many associated burned bones that was found with the last uses of Rooms 139, 142, and 145. Proveniences were divided primarily by floor. The samples were so small that the occupational features were lumped with the fill and floor-contact materials.

Floor 1, fill. This is by far the largest unit within this room and contained 60 percent of the sample. Also included was the fill of the wall niche, a wall trench, a doorway and a hole in the wall (the unnamed feature). Burning (Table 8.64) was rare; even the floor fill materials were on the low end. This may suggest that few of the elements were associated with the use of the room and less intense use argues against a preparation and consumption function. A special function is more likely. In the western rooms only the lower floors of Room 112, Room 229, and Kiva 15 had such low percentages of burning.

Room 143, Floor 2 and Room 236, Floor 4. The samples for each of these divisions were quite small so all were lumped. Two prairied dog elements were recorded as "cooking brown" (50 percent of that taxon and 10 percent of the unit total).

Table 8.63. Number of elements and MNIs for Rooms 143 and 236.[a]

	LATE MIX		GALLUP											
	Rm. 143 Fl.1 fill		Rm. 143-2 Rm. 236-4		Rm. 143-3 Rm. 236-5		Room 143 Fl. 4		Room 143 Fl. 5		Room 143 Fl. 6		Totals	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	64	6	6	1	7	1	13	2	2	1	4	1	96	12
L. californicus	55	4	3	1	3	1	4	1	1	1	2	1	68	9
A. leucurus	2	1											2	1
C. gunnisoni	50	7	4	1	8	2	19	2	2	1	1	1	84	14
T. bottae	3	2											3	2
D. ordii	2	1	1	1									3	2
Peromyscus sp.	2	2(1)	1	1(1)			1	1	1	1(1)			5	5
Onychomys sp.	1	1											1	1
Neotoma sp.	1	1											1	1
O. hemionus	2	1			1	1							3	2
A. americana	6	1			1	1							7	2
O. canadensis	2	1											2	1
A. chrysaetos	1	1											1	1
M. gallopavo	19	1											19	1
C. auratus	1	1											1	1
G. cyanocephalus	1	1											1	1
No. unknown	132		5		26		9		4		6		182	
% unknown	38.4		25.0		56.5		19.6		40.0		46.1		41.1	
Totals	344	32	20	5	46	6	46	6	10	4	13	3	479	56
% checking	11.6		5.0		0.0		2.1		0.0		0.0			

[a]Number in parentheses represents an articulated skeleton.

Table 8.64. Percentages of burning and "cooking brown" by taxon for Room 143, Floor 1.

Taxon	Provenience	None	Complete	Partial	Slight	"Cooking brown"
Sylvilagus sp.						
	fill	94.6			1.8	3.6
L. californicus						
	fill	95.8				4.2
	floor fill	88.0			4.0	8.0
C. gunnisoni						
	floor fill	84.2				15.8
M. gallopavo						
	fill	94.1		5.9		
Neotoma sp.						
	floor fill		100.0			
Small-med.						
mammal	fill	91.7		8.3		
	floor fill	93.1				6.9
	features (n=2)	50.0				50.0
Artiodactyl						
	fill	94.1				5.9
Aves	fill	83.3			16.7	
Totals	fill	96.0		1.0	1.0	2.0
	floor fill	93.0	0.8		0.8	5.5
	features	93.7				6.3

Room 143, Floor 3 and Room 236, Floor 4. Again, because of the small numbers, these two units and their features were lumped. Much of the material from the Room 236 floor was from a rodent burrow and may not be reflective of the unit.

Table 8.65 presents the burning and "cooking brown" for those taxa in which they occurred. This is the only floor in the room with a habitation-like total.

Room 143, Floor 4. This next floor continues the trend of small sample sizes. Table 8.66 gives the "cooking brown" for those taxa in which it occurred. No burning was found.

Room 143, Floors 5 and 6. These all had such small samples that the comments will be lumped here. Table 8.67 gives the burning and "cooking brown" for these floors.

Observations. The numbers are low for all floors. Table 8.68 gives the distribution of immature and young adult elements for the small economic taxa.

Conclusions. Overall, the small number of turkey elements and the lack of the burned bone layer found in Rooms 139, 142, and 145 suggest that the last use of Room 143 was different from that of those rooms or, more likely, that it was abandoned earlier. Only Floor 3 and possibly Floor 2 had burning and "cooking brown" percentages that are high enough to begin to suggest habitation.

Room 146. A fairly small sample of bones was recovered from this room, only 348 total. Small and featureless, it presumably functioned as a storage room during the use of the upper floor. Table MF-8.11 gives the provenience information, and Table 8.69 gives the counts and MNIs for the two units. Turkey occurs in frequencies similar to those in other roof-fall proveniences.

The Proveniences. Only two units were used. The non-roof-fall fill, Layers 1 and 2, comprised the first and the roof fall the second. Few elements were recovered from the fill unit. The roof fall had a few more but the total sample is still small especially considering that over 30 percent were not identifiable. Another 29.4 percent of the elements were turkey, although only two individuals were represented.

Immature elements were found for two taxa, cottontail (1 element or 9.1 percent) and the unidentified artiodactyl (1 element or 33.3 percent). Only jackrabbit had any burning. This was very slight and comprised 16.8 percent for that taxon and 2.2 percent for the entire assemblage. The lack of burning in this roof-fall layer suggests that it is not similar to the layers labeled as roof fall from Rooms 142, 139, and 145. The small sample and lack of burning and "cooking brown" suggest that this room did function as a storage room.

Table 8.65. Percentages of burning and "cooking brown" by taxon for Room 143, Floor 3.

Taxon	None	Complete	"Cooking brown"
Sylvilagus sp.	57.1		42.8
L. californicus	66.7	33.3	
Small-med mammal (n = 17)	82.3		17.6
Totals	84.8	2.2	13.0

Table 8.66. Percentages of "cooking brown" by taxon for Room 143, Floor 4.

Taxon	None	"Cooking brown"
Sylvilagus sp.	92.3	7.7
L. californicus	75.0	25.0
Small-med. mammal	83.3	16.7
Totals	93.4	6.5

Table 8.67. Percentages of "cooking brown" for by taxon for Room 143, Floors 5 and 6.

Floor	Taxon	None	"Cooking brown"
5	Small-med. mammal	33.3	66.7
5	Total	80.0	20.0
6	Total	100.0	

Table 8.68. Percentages of immature and young adult elements for Room 143.

	Sylvilagus		L. californicus		C. gunnisoni	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Floor 1 fill	6.2	14.1	3.6	7.3	8.7	26.1
Floor 2/4		16.6				
Floor 3/5		14.3		33.3	25.0	
Floor 4		5.9			5.3	5.3

Table 8.69. Number of elements and MNIs for Room 146.

	Floor 1					
	Fill		Roof fall		Total	
Taxon	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	4	1	11	2	15	3
L. californicus	1	1	12	2	13	3
C. gunnisoni			6	2	6	2
T. bottae			2	2	2	2
O. hemionus			5	1	5	1
O. canadensis	1	1	1	1	2	2
M. gallopavo	1	1	28	2	29	3
No. unknown	1		30		31	
% unknown	12.5		31.6		30.1	
Totals	8	4	95	12	103	16

Table 8.70. Number of elements and MNIs for Room 147.

	Fill		Layer 3		Firepit 1		Totals	
Taxon	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	17	2					17	2
L. californicus	54	3	14	1	10	1	78	5
C. gunnisoni	17	2	2	1			19	3
Neotoma sp.	1	1					1	1
O. hemionus	6	1					6	1
A. americana	8	1	1	1			9	2
O. canadensis	3	1					3	1
M. gallopavo	54	2	1	1			55	3
P. pica	4	1					4	1
No. unknown	115		10		17		142	
% unknown	41.2		35.7		63.0		42.5	
Totals	279	14	28	4	27	1	334	19

Room 147. This small square room, which opens into the corridor room, had a firepit and three heating pits and may represent a "clan" room. Only the upper floor was excavated, and two late dates were acquired. Table MF-8.12 gives the provenience breakdown.

Table 8.70 gives the counts and MNIs for the room. The turkey percentage is high enough to be representative of the latest occupation of Pueblo Alto, although the roof-fall materials of Rooms 142 and 145 have even higher frequencies of this species.

The Proveniences. The fill unit included all but Layer 3. Layer 1 was lumped with the roof-fall layer, Layer 2, because it only contained two elements. Layer 3, a layer of trash resting directly on the floor, was treated separately. Burning was the only observation recorded for Layer 3 and the firepit; any others will pertain to the main fill unit.

Observations. Immature and young adult elements were found only in the fill above Floor 1. Immature elements were recorded for cottontail (5.9 percent), and young adult for cottontail (23.5 percent), jackrabbit (3.7 percent), and prairie dog (5.9 percent).

Table 8.71 gives the burning and "cooking brown" for those taxa in which they occurred. The layers called roofing do not have the large numbers of burned bones that some of the other rooms in the complex had. As usual, the burning increases near the floor.

Conclusions. The faunal remains add little information about the function of this room. The increase in burning near the floor and the taxa present suggest domestic activities or at least consumption, which was not evident for Kiva 15. The large amount of turkey suggests late use, but the absence of the burned bone in the roof-fall layer is more like Room 146 directly to the west. Habitation should not be ruled out for this room.

Kiva 10. The large kiva in front of this complex of rooms was tested. It is one of the two areas at Pueblo Alto in which only a sample of the total number of bones was analyzed. This was mainly the result of a feeling by the analyst that the excavators did not recover the small elements of the common taxa and small mammals in general and thus biased the results. Fortunately, screening seems to have improved in the lower layers. The unanalyzed levels were chosen by Windes and comprised roughly 45.4 percent of the test.

The test was divided into four units, which correspond to the coded layer distinctions, except for the Levels 24-27 and Level 28 split, which were both coded as Layer 3. These were designated as Late Mix in ceramic association except for Level 28, which was Gallup.

Table 8.72 gives the counts and MNIs for Kiva 10. Turkey occurs only in the first unit and there in low frequencies (1.7 percent). This sug-

Table 8.71. Percentage of burning and "cooking brown" by taxon and provenience for Room 147.

Taxon	Unit	None	Complete	Partial	Slight	"Cooking brown"
Sylvilagus sp.	fill	90.0				10.0
	fl. fill	80.0				20.0
L. californicus	fill	88.9	5.5		5.5	
	Wall Niche	37.5				62.5
	fl. fill	85.7			10.7	3.6
	Layer 3	85.7				14.3
	Firepit 1	20.0	40.0			40.0
C. gunnisoni	fill	87.5				12.5
	Layer 3	50.0		50.0		
M. gallopavo	fl. fill	84.6			15.4	
A. americana	Wall Niche	50.0		50.0		
Small-med. mammal	fl. fill	88.9			5.6	5.6
	Layer 3	57.1				42.8
	Firepit 1	5.9	70.6		5.9	17.6
Artiodactyl	fill	78.2	17.4		4.3	
	fl. fill	83.3			16.7	
Med.-large mammal	fill	94.7	5.3			
Aves	fill	81.8	9.1		9.1	
Unknown	fill	75.0	25.0			
Totals	fill	90.4	6.0		1.8	1.8
	Wall Niche	73.9		4.3		21.7
	fl. fill	88.9			7.8	3.3
	Layer 3	75.0		3.6		21.4
	Firepit 1	11.1	59.2		3.7	25.9

Table 8.72. Number of elements and MNIs for Kiva 10.

	Levels 15-18		Levels 19-23		Levels 24-27		Level 28		Total	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	166	6	108	7	19	3	28	3	321	19
L. californicus	338	8	236	6	9	2	9	3	592	19
A. leucurus	1	1							1	1
C. gunnisoni	463	22	117	8	35	4	11	2	626	36
squirrel sp.			1	1					1	1
S. aberti					1	1			1	1
T. bottae	12	4	13	3	4	1	1	1	30	9
D. ordii	7	2	1	1	1	1			9	4
Peromyscus sp.			1	1	1	1			2	2
Neotoma sp.	1	1	1	1					2	2
C. latrans			1	1					1	1
T. taxus	2	1	5	1					7	2
F. rufus	1	1							1	1
O. hemionus	11	1	7	1	15	2	2	1	35	5
A. americana	5	2	5	1					10	3
O. canadensis	3	1	2	1					5	2
Buteo sp.							4	1	4	1
A. chrysaetos	1	1							1	1
F. sparverius	3	1	1	1					4	2
M. gallapavo	30	1							30	1
G. canadensis			1	1					1	1
PASSERIFORMES	2	1							2	1
E. alpestris					1	1	1	1	2	2
No. unknown	760		236		60		40		1,096	
% unknown	42.1		32.1		41.1		41.7		39.3	
Totals	1,806	54	736	35	146	16	96	12	2,784	117

gests that the deposition was not from the latest occupation of Pueblo Alto. The very high prairie dog frequency and MNI for the first unit is not duplicated in either the north or west rooms of Pueblo Alto. The only Chaco sites with anything approximating this was the fill of Kiva E at 29SJ 627 (Akins 1981g), which also had very high prairie dog and low cottontail, and 29SJ 626, Pitstructure 3, which was high in prairie dog, slightly lower in cottontail, and very low in jackrabbit remains. While the latter site was contaminated by canid scatological remains, largely prairie dog, it does provide some information on the availability of this species.

Prairie dogs are more frequent in later deposits from Chaco Canyon, and a number of factors may, and probably do, account for the increase. Expansion of agricultural fields would provide more habitat for these and other field pests. Even clearing land for agriculture favors an increase in number, and planted fields offer succulent grasses in early spring and fall when native plants are scarce. If modern farmers in the La Plata Valley were unable to control the number of pests using poison and irrigation water (Bailey 1931), they must have posed a considerable problem to the Anasazi (Akins and Bertram 1985).

One method of control may have been similar to ethnographically recorded Hopi rabbit hunts held when serious damage to crops occurred (Beaglehole 1936). The number of immature and young adult individuals in most assemblages with a large number of prairie dogs suggests that these hunts probably took place in early summer and were designed to remove these and other pests from their fields and prevent young plants from being demolished.

Seven of the eight badger (*T. taxus*) elements from Pueblo Alto were recovered from the first two divisions. This suggests that natural layers would have been better units of analysis than arbitrary divisions or levels. The equally rare sparrow hawk (*F. sparverius*) was also found in both units.

Observations. Table 8.73 gives the percentages of immature and young adult elements by taxon for each unit. Most of the deposits have immatures present and suggest some late spring to summer deposition. Except for the upper levels (7 percent), no checking was found in this structure. This suggests rapid or protected deposition.

Table 8.74 presents the burning and "cooking brown" for those taxa in which they occurred. The percentages are fairly high and suggest domestic activities. Also interesting is the dichotomy in cooking strategies this large sample shows. Small-bodied animals are most often "cooking brown," indicating they were part of a "pot" meal, whereas the medium and large mammals, if burned, are completely burned. As many of those elements are foot elements with little usable meat, they do not imply consumption.

Conclusions. An explanation of clearing fields of pests seems to best fit this deposit or series of deposits. In addition to prairie dogs, pocket gophers (T. bottae), cranes (G. canadensis), and horned larks

Table 8.73. Percentages of immature and young adult elements for Kiva 10.

	Sylvilagus		L. californicus		C. gunnisoni	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Levels 15-18	3.0	16.8	1.2	5.9	9.9	25.5
19-23	12.0	20.4	1.7	9.3	15.4	25.6
24-27	5.3	10.5		11.1	11.4	5.7
28		21.4	22.2			72.3

Table 8.74. Percentages of burning and "cooking brown" by taxon and level for Kiva 10.

Taxon	Level	None	Complete	Partial	Slight	"Cooking brown"
Sylvilagus sp.	15-18	74.7	4.8	0.6		19.9
	19-23	77.8	2.8			19.4
	24-27	57.9				42.1
	28	60.7	3.6			35.7
L. californicus	15-18	70.7	5.9	0.6		22.8
	19-23	89.8	4.7	0.4	1.3	3.8
	24-27	77.8				22.2
	28	44.4	11.1			44.4
C. gunnisoni	15-18	86.0	0.9	0.2		13.0
	19-23	77.8	1.7		0.8	19.7
	24-27	82.9	2.8			14.3
	28	81.8				18.2
T. bottae	15-18	85.7				14.3
D. ordii	24-27					100.0
C. latrans	19-23		100.0			
F. rufus	15-18		100.0			
A. americana	19-23	80.0	20.0			
M. gallopavo	15-18	86.7	13.3			
E. alpestris	24-27					100.0
Small-med.mamm.	15-18	67.8	9.7	0.2		22.3
	19-23	85.4	5.7	0.8		8.1
	24-27	81.2				18.7
	28	85.7	14.3			
Artiodactyl	15-18	89.3	3.1			7.6
	19-23	98.8	1.2			
	24-27	83.9				18.7
	28	84.6	7.7			7.7
Med-large mamm.	15-18	83.9	12.5			3.6
	19-23	57.1	38.1			4.8
	24-27	76.9	23.1			
Aves	15-18	85.3	5.9	8.8		
Unknown	15-18	61.8	38.2			
	19-23	62.5	37.5			
Totals	15-18	77.8	6.3	0.4		15.5
	19-23	85.5	5.0	0.3	0.5	8.7
	24-27	80.1	4.8			15.1
	28	76.0	5.2			18.7

(E. alpestris) are attracted to fields. Ample evidence for cooking of prairie dog, pocket gopher, and the larks suggest the pests were then returned to the site and eaten.

The fill was described as alternating lenses of dark gray soil with abundant, charred, vegetal fragments and dark brown, ashy, humic layers, which were interpreted as firepit fills alternating with conventional trash. The trash layers were said to contain much of the cultural debris.

North Rooms Discussion. The biggest difference between the north and west rooms is in the turkey remains. Although only Room 103 in the west had an appreciable amount of this taxon, all of the northern rooms had some and many had quite a few, especially those with the proveniences recorded as roof fall. Table 8.75 gives the number and percentage of turkey elements for the fill units and the percentage of burning. The turkey from Room 103 amounted to 13.6 percent of the elements. The MNIs for turkey are generally low with many elements representing each bird. Only one nonadult element was found in the north rooms, and this was approaching full size. The much smaller sample in the west produced very immature elements.

This table points out that, based on the percentage of turkey, three distributions exist. First, turkey is very low in Kiva 10. This may be due to either the fill being earlier (which is certainly true for the lower fill) or the difference between domestic trash and that which is found in the roof-fall layers. Second, the fill above the roof-fall layers is also fairly low for turkey, which ranges from 5.5-11.2 percent. Finally, there is a rather dramatic increase in the roof-fall layers with 19.3-52.5 percent of the elements being turkey. Looking at the percentages of burned turkey and the total burning for these units gives still different kinds of divisions. Burning is more common in Rooms 138-142, but turkey burning is high only in the roof layers of Rooms 139 and 145.

The three small economic taxa occur in relatively low frequencies, making patterning less clear. There does tend to be a slight predominance of cottontail as compared to jackrabbit and prairie dog in the fill and roof layers. In the kiva there is more jackrabbit than cottontail in the upper levels, but this reverses for the second and third units. This agrees with a general tendency throughout Chaco for cottontail to increase when turkey increases.

One area with an unusual pattern was Kiva 10, which is detailed in that section. The number of prairie dog was relatively high as was the number of immature elements for all three of the small economic taxa. It is suggested that this may be related to spring activities, that removed this and other taxa from the areas around the fields.

Problems relating to the nature of the roof-fall layers and an almost total lack of floor contact and feature materials make room function arguments pretty tenuous. Combined with the paucity of material from floor

Table 8.75. *M. gallopavo* and burning for the north rooms.

Provenience	n/% M. gallopavo	% *M. gallopavo* burned	% of total burned
Room 138 fill	2/11.1		
Room 139 fill and roof	46/31.3	33.3	22.2
Room 145 fill	1/ 5.8		22.6
Room 145 roof	159/31.0	32.7	29.5
Room 142 fill	13/11.2		36.8
Room 142 roof	113/52.5	8.9	26.4
Room 143 fill	19/ 5.5	5.9	7.0
Room 146 roof	28/29.5		2.2
Room 147 roof	54/19.3	15.4	11.1
Kiva 10, Levels 15-18	30/ 1.6	13.3	22.2

Table 8.76. Percentages of checked bone for the north rooms.

Room Number:	138	139	145	142	143	146	147	Kiva 10
Floor 1 fill	38.9	3.7	5.5	18.1	11.6	12.5	10.3	7.0
Roof fall	2.2	4.5	2.4					
Lower fill		9.6			5.0			
Features		1.7						

Table 8.77. Provenience unit divisions for pre-greathouse Alto.

	Rm. 50	Rm. 51	Rm. 142	Rm. 143	Rm. 146	P.G. 8	Unit
Surface No.						4	
		1		7		6	1
		2	3	8		8	2
	1	3	4	9	3	9	3,4
	2		5		4		5
			6		5		6
			7		6		7
			8				
			9		8		8

features, replasterings, and other indications of habitation, the few bones found further suggest less intense use. The absence or low numbers of Peromyscus remains and rodent gnawing suggest lack of scattered food scraps or whatever was attracting this species in the west. Because the western storage room was also low in these, a storage function is possible for the majority of these rooms.

In general, there was more weathering or checking of bone in the northern than in the western rooms. The northern roof-fall layer is, however, quite similar to the fill of the western rooms in the percentage of checked bone. Lower surfaces associated with the northern rooms are not common, but when they exist they do not show periods of prolonged openness (Table 8.76).

The nature of the levels classified as roof fall in this complex is worthy of discussion. There is enough variability in the distribution of species and burning to suggest that these are separate, unrelated units. For example, only Room 145 had large numbers of artiodactyl elements with evidence for manufacture or use of bone tools. Turkey remains appear to correlate with roof fall, in general, and have burning in some but not others. The fact that much of the burning in Room 145 was concentrated in one level near the floor must indicate something. It is hard to believe that burned bone would be more apt to settle to lower levels than unburned bone or that a roof would collapse in reverse. In short, this concentration is probably not the result of rooftop activities or collapsing roofs. The burned concentration near the floor would be better explained as living debris or a trash deposit left by the last occupants of Pueblo Alto who may have resided in a nearby unexcavated room or in the eastern portion of the site. This much burning is found only in the early layers of the Trash Mound and in the fill of firepits and suggests firepit dumps.

Other Rooms

Pre-Greathouse Rooms. The materials from the two small rooms and the surrounding plaza areas found beneath Rooms 142, 143, and 146 and those from the lower surfaces of Plaza 1, Grid 8 were analyzed together to investigate this early use of the site. All of these are Red Mesa in ceramic association and date to the early A.D. 1000s (Windes 1984), and these will be referred to as Pre-Alto.

Table MF-8.13 gives the counts and MNIs by taxon for each provenience considered. These were used to construct Table 8.77, which is a combination of Windes' (Volume II of this report) assessment of the contemporaneity of surfaces and matchings of taxa, mostly bird and immature artiodactyls. Rather than treating each of the 26 divisions found in Table MF-8.13 separately, these eight "units" are used for comparison of the variables recorded. The lumpings may not be exact but the logistics of using all 26 made this advisable. (See Table MF-8.13 for unit composition.)

The largest group from this table was divided into two units. Unit 4 consisted of only Layer 15, the trash fill of a large excavation. The other proveniences comprised Unit 3. Because much of the sample consisted of trash and little was contextual, it is treated by observation rather than as proveniences. The unit numbers go from the latest to the earliest.

Table 8.78 gives the element frequency and percentage for each taxon for comparison of the units. The carnivores are well represented in this early unit; 25 percent of the _Canis_ species, 56.2 percent of the coyote (_C. latrans_), 50 percent of the wolf (_C. lupus_, n = 2), and 14.3 percent of the bobcat (_F. rufus_) from Pueblo Alto were found here. This sample comprised 7.9 percent of the Pueblo Alto collection. For the bird species 1 of the 3 owl (_O. asio_), 4 of the 11 (36.4 percent) raven (_C. corax_), and all but 1 of the pinyon jay (_G. cyanocephalus_) from the site were found here.

Observations

Immatures. Table 8.79 gives the percentages of immature and young adult elements for the three small, economic taxa, pronghorn (_A. americana_), and the unidentifiable artiodactyls. These suggest that the rooms were used, during early spring and fall. This agrees with findings that suggest the construction of Pueblo Alto took place during these seasons.

Checking. Table 8.80 gives the precentage of checking for the units. Checking is relatively low. Unit 4 had remarkably little, which suggests rapid deposition.

Burning. Table 8.81 gives the burning and "cooking brown" percentages for selected taxa and those units in which these occurred. The amount and pattern of burning is consistent with most of the site. The alteration is generally "cooking brown," and burning is relatively low. This is interesting because the layers of the Trash Mound that should correspond to this unit contain a large amount of burning (46.2 percent completely burned) and very little "cooking brown" (1 percent). This suggests that the faunal remains scattered through Layers 1-8 of the Trash Mound may not be refuse from this particular area, may not be the same kind of refuse, or that the two are not contemporaneous.

Conclusions. Faunal remains from the two rooms, surrounding plaza areas, and a trash-filled pit predating Pueblo Alto or dating to the construction of Pueblo Alto are similar to those from Pueblo Alto as a whole and look like habitation refuse. The paucity of totally burned elements in all of these deposits contrasts with the deposits in the Trash Mound that date to about this same time and suggest they were not generated from this unit.

Table 8.78. Element counts and percentages for each unit of pre-greathouse Pueblo Alto.

Unit:	1		2		3		4		5		6		7		8		Total
Taxon	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	%
Sylvilagus sp.	7	11.7	81	19.3	150	18.7	132	16.4	21	28.4	21	20.2	16	19.3	3	4.1	17.8
L. californicus	10	16.7	70	16.6	144	18.0	79	9.8	20	27.0	15	14.4	9	10.8	17	23.3	15.0
A. leucurus							3	0.4									0.1
C. gunnisoni	3	5.0	14	3.3	14	1.7	10	1.2	1	1.3	8	7.7	4	4.8	10	13.7	2.6
T. bottae			2	0.5	1	0.1	2	0.2	1	1.3							0.2
D. ordii	2	3.3	1	0.2			2	0.2									0.2
Peromyscus sp.					1	0.1	2	0.2	1	1.3	5	4.4					0.4
N. cinerea							1	0.1									
Canis sp.					6	0.7			1	1.3			2	2.4			0.4
C. latrans			1	0.2	6	0.7							2	2.4			0.4
C. lupus			1	0.2													
F. rufus					1	0.1	1	0.1									0.1
O. hemionus							5	0.5			1	0.9					0.2
A. americana			3	0.7	5	0.6	2	0.2	1	1.3					29	39.7	1.6
O. canadensis					1	0.1							1	1.2			0.1
Buteo sp.			4	0.9	6	0.7											0.4
B. jamaicensis					9	1.1											0.4
A. chrysaetos			2	0.5	7	0.9	3	0.4			1	0.9					0.5
M. gallopavo									1	1.3							
O. asio					1	0.1											
E. alpestris					2	0.2	2	0.2									0.2
Corvidae			1	0.2													
P. pica					1	0.1											
C. corax					4	0.5											0.2
G. cyanocephalus					5	0.6	1	0.1									0.3
Fringillidae							1	0.1									
Unknown	38	63.3	240	57.1	437	54.5	561	69.6	27	36.5	53	51.0	49	59.0	14	19.2	58.5
Totals	60		420		801		806		74		104		83		73		

Table 8.79. Percentages of immature and young adult elements for pre-greathouse Pueblo Alto.

Unit	Sylvilagus		L. californ.		C. gunnisoni		A. americana	Artios
No.	imm.	y.ad.	imm.	y.ad.	imm.	y.ad.	imm.	imm.
1								42. 8
2		16.0		10.0			66.7	
3	0.7	8.7	2.1	8.3	7.1	7.1	40.0	16. 7
4		17.4	1.3	2.5		10.0		
5		19.0	5.0					
6		9.5				37.5		
7		6.2		11.1	25.0			
8				27.8		10.0	96.5	

Table 8.80. Checking from pre-greathouse Pueblo Alto.

Unit No.	% checked
1	3.3
2	11.7
3	7.1
4	1.8
5	8.1
6	3.8
7	6.0
8	10.9

Table 8.81. Percentages of burning and "cooking brown" by taxon for pre-greathouse Pueblo Alto.

Taxon	Unit	None	Complete	Partial	Slight	"Cooking brown
Sylvilagus sp.						
	2	74.1	9.9	1.2	1.2	13.6
	3	68.0	9.3	0.7		22.0
	4	72.0	1.5			26.5
	5	95.2				4.7
	6	80.9				11.4
	7	75.0				25.0
L. californicus						
	2	68.6	7.1	1.4		22.9
	3	66.7	11.1		2.1	20.1
	4	69.2	1.3			29.1
	5	65.0	5.0			30.0
	6	73.3				26.7
	7	66.7				33.3
	8	78.9	5.3		5.3	10.3
C. gunnisoni						
	2	85.7				14.3
	3	71.4	7.1			21.4
	4	80.0				20.0
	6	62.5				37.5
	7	25.0				75.0
	8	60.0				40.0
Small to medium mammals	2	76.0	6.2			17.7
	3	59.3	5.6			35.1
	4	81.7	2.0	0.3		15.9
	5	87.5				12.5
	6	56.4				43.4
	7	41.2	2.9		2.9	52.9
Artiodactyls						
	2	50.0	12.5			37.5
	3	79.2	8.3			12.5
	6					100.0
Totals	1	100.0				
	2	75.0	7.2	0.5	0.2	16.9
	3	65.7	7.7	0.6	1.1	24.8
	4	80.5	2.6	0.7		16.1
	5	85.1	1.3			13.5
	6	66.3				33.6
	7	60.2	2.4	1.2	1.2	34.9
	8	85.5	2.6		1.3	10.5

Plaza Feature 1. This small cluster of four rooms in the western portion of the plaza was a late addition to Pueblo Alto. The two rooms that were excavated (Rooms 3 and 4) are Late Mix in ceramic association and overlie plaza surfaces of Gallup associations as well as a layer of Red Mesa trash. Also included with this group is Kiva 13, which underlies Room 5 of this feature. No walls were found, but a test removed 4.16 m^3 of Gallup trash.

Three large ovens in Room 3 indicate that the structure was a special use area. A layer of ash on the eastern portion of the floor suggests that one of the unexcavated rooms in the complex may have continued in use with a similar function.

Few bones were recovered from the shallow, filled rooms (Table MF-8.14), and when these were broken down by component, the number of elements representing any one individual was quite small, except for Kiva 13. Table 8.82 gives the number of bones and MNIs for this group of structures.

The Proveniences

Room 3. The fill above the first floor contained many immature elements (Table 8.83). Those from Floor 2 were all adult elements but the sample is very small.

The ash layer in this room, Layer 4, contained a much higher percentage of burned bone than the rest of the room; 25.5 percent were burned and 4.2 percent were "cooking brown." Burning for the ovens was quite low; 16.7 percent completely burned and 8.3 percent "cooking brown." This may suggest that the ash in Layer 4 is not from a source with the same function as the ovens in Room 3. The burning pattern for Layer 4 is similar to that of firepits with much burning and little "cooking brown," whereas that in the ovens has lower burning and more "cooking brown," which may suggest frequent cleaning.

Room 4. Room 3 was entered through this room, which may have been more like a ramada than an actual room. Immature elements were found for cottontail (20 percent), and prairie dog (15.4 percent), and a young adult element for prairie dog (7.7 percent).

Observations

Checking. A number of elements showed signs of weathering. Much of this could have been due to the shallowness of the fill. The checking does suggest that Room 4 was open to erosion and very much like an open plaza location. Table 8.82 gives the percentage of checking by surface for each room and Kiva 13.

Table 8.82. Number of elements and MNIs for Plaza Feature 1.[a]

	LATE MIX						GALLUP		R. M.		L. M.		GALLUP/R. M.						GALLUP		Totals	
	Room 1 T.T. 1		Room 2 wall cl.		Room 3 Fl.1 fill		Room 3 Fl.2		Room 3 Fl.3-5		Room 4 Fl. 1		Room 4 Fl. 2		Room 4 Fl. 3		Room 4 Fl. 4		Kiva 13 test			
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	2(1)	2	4	1	10	3	3	1	16	2	5	2			3	1	5	1	68	4	116	17
L. californicus					33	3	3	1			8	1			1	1	4	1	1 24	6	173	13
A. leucurus					1	1															1	1
C. gunnisoni					40	2	11	1			13	2	3	1	1	1	4	1	15	2	87	10
T. bottae																			1	1	1	1
D. ordii					4	1	1	1													5	2
Peromyscus sp.					2	2(1)					1	1	2	1					6	2	11	6
U. cinereoargenteus							1	1													1	1
O. hemionus					2[b]				1	1	2	1					1	1	16	1	22	4
A. americana									2	1											2	1
O. canadensis					2	1			2	1									2	1	6	3
M. gallopavo	1	1			6	3													2	1	9	5
Z. macroura											1	1									1	1
PASSERIFORMES																			1		1	
E. alpestris					1(1)	1															1	1
P. pica																			1	1	1	1
Laniidae									1	1											1	1
Unknowns					52	34.0	11	36.7	19	46.3	34	53.1	9	64.3	7	58.3	8	36.4	283	54.5		
Totals	3	3	4	1	153	17	30	5	41	6	64	8	14	2	12	3	22	4	519	19	862	68
% checked	100.0		0.0		17.7		16.7		9.7		46.9		0.0		25.0		27.3		15.0			

[a]Number in parentheses represents an articulated skeleton.
[b]Antler.

Table 8.83. Percentages of immature and young adult elements from Plaza Feature 1, Room 3, Floor 1.

	Immature	Young adult
Sylvilagus sp.	30.0	10.1
L. californicus	3.0	54.5
C. gunnisoni	30.0	7.5

Burning. Room 3, largely because of the ash layer, had the most burning for the rooms. Kiva 13 had an unusually large amount of "cooking brown," which is consistent with the description of the fill as "kitchen sweepings." Overall, the patterns of burning are as expected: the small mammals had much of the "cooking brown," and the large species had most of the burning. Table 8.84 gives this information by floor and taxon.

Conclusions. The faunal remains do not shed any light on the function of these rooms. The large number of prairie dog and immature elements suggest some spring or early summer deposition.

Room 233. The plaza trench extending east from Room 103 encountered a previously unsuspected room. This late addition was trenched to just above the floor level, and the walls were outlined to determine its size. This resulted in only 48 bones. Table 8.85 gives the element counts, percentages, and MNIs for the test.

One of the cottontail elements was the only immature in the collection. Checking was about normal for upper room fill at 12.5 percent. Burning was also about what was expected with 95.8 percent unaltered and 4.2 percent completely burned.

The lack of turkey in this collection suggests that the room had been abandoned by or at about the same time as Room 103, Floor 2 and the first floors of Rooms 110 and 112; but frequencies are low.

East Ruin. The small room block east of Pueblo Alto and connected to it by Major Wall 1 was wall cleared, and one room with a small kiva built into it was excavated. Table MF-8.15 gives the provenience information, element counts, and ceramic associations. Overall, the number of elements is quite small, and almost half of these were not identifiable. Table 8.86 gives the element counts and MNIs for East Ruin. Turkey elements were not common, suggesting again that the rooms were not used late. Checking was frequent, not only in the wall-clearing proveniences but also in the fill of Kiva 14. Only the total burning and "cooking brown" for each unit are presented in Table 8.87. As in most rooms at Pueblo Alto, the instances of burning increased in the floor-fill layer as compared to the general fill.

Conclusions. There were so few elements from this entire unit that few conclusions could be reached. This in itself does suggest that the fill was primarily natural and the entire unit abandoned at one time.

General Room Discussion

A big problem when dealing with rooms is determining whether a deposit associated with a given floor is living debris or postoccupational refuse. Excavators rarely note a change in fill just above the floor, but frequently the number of elements recovered increases significantly as does the burning and "cooking brown." This logically suggests some sort

Table 8.84. Percentages of burning and "cooking brown" by taxon and provenience for Plaza Feature 1.

	None	Complete	Partial	Slight	"Cooking brown"
Room 1 total	100.0				
Room 2 total	100.0				
Room 3					
Fill above Floor 1					
Sylvilagus	90.0	10.0			
L. californicus	90.9	3.0		3.0	3.0
C. gunnisoni	97.5				2.5
O. hemionus	50.0	50.0			
M. gallopavo	83.3	16.7			
E. alpestris				100.0	
Small-med. mammal	62.1	34.5			3.4
Rodent	50.0	50.0			
Artiodactyl	80.0	20.0			
Med-large mammal	88.9	11.1			
Unknown	50.0	50.0			
Totals	85.0	11.8		1.3	2.0
Floor 2 assoc. total	100.0				
Floor 3 assoc.					
Sylvilagus			100.0		
Med-large mammal	66.7	33.3			
Totals	66.7	16.7	16.7		
Floor 4 assoc.					
Unknown					100.0
Totals	50.0				50.0
Floor 5 assoc.					
Totals	100.0				
Room 4					
Floor 1 assoc. total	100.0				
Floor 2 assoc. total	100.0				
Floor 3 assoc.					
Sylvilagus	66.7				33.3
Med-large mammal	50.0	50.0			
Totals	83.3	8.3			8.3
Floor 4 assoc.					
Sylvilagus	60.0				40.0
L. californicus	50.0			25.0	25.0
Totals	81.8			4.5	13.6
Kiva 13					
Sylvilagus	51.4	1.5		1.5	45.6
L. californicus	57.2	7.2			35.5
C. gunnisoni	53.3				46.7
T. bottae					100.0
O. hemionus	93.7				6.2
Laniidae					100.0
Small-med mammal	16.5				83.5
Artiodactyl	79.6	1.9	1.0		17.5
Med-large mammal	90.0	8.0			2.0
Aves	80.0	20.0			
Unknown	66.7	33.3			
Totals	59.7	6.2	0.2	0.2	33.7

Table 8.85. Number and percent of elements and MNIs for Room 233.

Taxon	n	%	MNI
Sylvilagus sp.	11	22.9	2
L. californicus	5	10.4	1
C. gunnisoni	2	4.2	1
Peromyscus sp.	8	16.7	2
C. squamata	1	2.1	1
Unknown	21	43.7	
Totals	48	100.0	7

Table 8.86. Number of elements and MNIs for East Ruin.

	Kiva 1		Rm. 2		Rm. 4		Rm. 5		Rm. 6		Rm. 7		Rm. 11		Rm. 12		K.14 fil		FP 1		OP 4		Totals	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	1	1	2	1					1	1	1	1			1	1	5	1	1	1	9	2	11	9
L. californicus	3	2	2	1	1	1			16	1			2	1	1	1	8	1	1	1	2	1	36	10
C. gunnisoni	1	1							2	1					1	1	2	2			2	1	8	6
D. ordii																	3	1			1	1	4	2
O. hemionus	1	1	1	1					1	ant.													3	2
A. chrysaetos													1	1									1	1
M. gallopavo															1	1	2	1					3	2
O. asio									1	1													1	1
No. unknown	13		4				1		15				1		2		11		4		14		65	
% unknown	68.4		44.4				100.0		41.7				25.0		33.3		35.5		66.7		50.0		45.8	
Totals	19	5	9	3	1	1	1		36	4	1	1	4	2	6	4	31	6	6	2	28	5	142	33
% checked			55.6		100.0		100.0		16.6		100.0		75.0		83.3		32.2				3.5			

Table 8.87. Burning and "cooking brown" by provenience for the East Ruin.

Provenience	None	Complete	Partial	Slight	"Cooking brown"
Kiva 1	94.7			5.3	
Room 6	91.7		2.8	5.6	
Room 11	75.0	25.0			
Kiva 14 fill	95.2				4.8
Floor fill	88.9	11.1			
Firepit 1		100.0			
Other Pit 4	85.7	14.3			

of change. The sample of room types from Pueblo Alto is small with only two good, habitation rooms, three or four storage rooms, and a number of undetermined function.

Regardless of the uncertain origin of these materials, they can give us general ideas on room function. The apparent habitation rooms from Pueblo Alto have large numbers of bones and a similar burning and "cooking brown" distribution. Those identified as storage rooms tend to have very small samples and little burning or "cooking brown." When we do encounter deposits such as the roof-fall layers in the northern rooms where a distinctive pattern of burning occurs, we can suggest origins. These patterns, in conjunction with other kinds of evidence, may be used to suggest possible functions of rooms whose uses are not as clear.

Rarely are room samples large enough for subsistence and change in subsistence to be addressed. This is best left to trash deposits. The real value in room excavations for faunal information comes in determining such things as the differences in firepit and heating pit fills in order to recognize these in other kinds of deposits, to determine how species such as Peromyscus are distributed and what their presence can mean, and to possibly identify seasonal use or deposition in structures.

Wall Clearing

This section discusses the elements recovered from outlining the walls of Pueblo Alto and the Rabbit Ruin. This kind of endeavor can have two purposes. It can help to determine the extent of historic use of a site and also what species are likely to be postoccupational or accidental additions to the archeological record. In the case of Pueblo Alto where we expect that a given species (turkey) could signify very late use of the site, it may give us information on abandonment and the last use, especially in untested areas of a site.

Pueblo Alto

To get an accurate plan of Pueblo Alto the walls were cleared or outlined by shallow trenches. Clearing the major ruin produced 907 elements. These have been divided into six geographical sections plus Major Wall 3 for comparison. Table MF-8.16 gives the structure numbers and counts that comprise each unit.

The average number of elements per room in the north and west rooms does agree with the findings from excavation: the west had a lot more in the upper fill. The southwest corner was a confusing area and more intensive work in the area probably resulted in the high average number of elements recovered.

Table 8.88 gives the counts, percentages, and MNIs for each section. There are some suprising differences. The large percentages of cottontail

Table 8.88. Element counts, percentages, and MNIs for wall clearing Pueblo Alto.[a]

	West			North			East			Southeast			Southcentral			Southwest			Major Wall 3			Totals	
	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	89(3)	65.9	8	45(1)	40.2	6	31	18.7	5	13	22.0	1	13(1)	10.3	4	32	11.0	4	2	9.5	1	225	29
L. californicus	14	10.4	1	18	16.1	2	37	22.3	3	10	16.9	2	12	9.5	2	115	39.5	5	2	9.5	1	208	16
C. gunnisoni	5	3.7	1	8(1)	7.1	2	5	3.0	3	9	15.2	1	7	5.6	2	27(1)	9.3	4				61	13
T. bottae	2	1.5	2							1	1.7	1										3	3
D. ordii	1	0.7	1	1	0.9	1										1	0.3	1				3	3
D. spectabilis							1	0.6	1													1	1
Peromyscus sp.	2	1.5	1				1(1)	0.6	1													3	2
Neotoma sp.				1	0.9	1	3	1.8	1							2	0.7	1				6	3
N. cinerea	1	0.7	1																			1	1
N. albigula													1(1)	0.8	1							1	1
M. mexicana	1(1)	0.7	1																			1	1
E. dorsatum							1	0.6	1													1	1
Canis sp.				1	0.9	1																1	1
C. latrans							1	0.6	1				1	0.8	1							2	2
C. familiarus										8	13.5	1				1	0.3	1				9	2
F. rufus													1	0.8	1							1	1
U. arctos										1	1.7	1										1	1
O. hemionus	2	1.5	1	1	0.9	1	4	2.4	1	4	6.7	1	18	14.3	1	6	2.1	1	2	9.5	1	37	7
A. americana				1	0.9	1	1	0.6	1				2	1.6	1	4	1.4	1	1	4.8	1	9	5
Ovis-Capra	2	1.5	1	2	1.8	1	3	1.8	1							11	3.0	1				18	4
O. canadensis				2	1.8		3	1.8					1	0.8	1	2	0.7	1	2	9.5	1	10	5
Buteo sp.													1	0.8	1							1	1
F. sparverius				1	0.9	1																1	1
M. gallopavo	1	0.7	1	6	5.3	1	16	9.6	1				4	3.2	1	5	1.7	1				32	5
P. pica													3	2.4	1							3	1
No. unknown	15	11.1		25	22.3		59	35.5		13	22.0		62	49.2		85	29.2		12	57.1		271	29.8
Totals	135		19	112		19	166		21	59		8	126		17	291		21	21		5	910	110
% checked	24.4			30.3			36.7			25.4			42.3			28.5			71.4				

[a]Number in parentheses represents articulated skeletons.

in the west and north sections are due to wall-fall kills, and some may represent accumulations left by raptors roosting on the walls. It is unusual that this occurs in only those two areas. The other sections to have more or less normal distributions of this taxon. The southwest corner, however, has an inordinately large number of jack rabbit elements, and only three of the proveniences in this unit have less than 30 percent of their total represented by this taxon.

Also unusual is the large percentage of deer elements in the south-central section. Half were from Other Structure 7, but even when this provenience is not included in the sample, this taxon represents 17 percent of the remaining sample.

Ovis-Capra, or domestic sheep-goat, was found in four of the seven sections, suggesting a fair amount of historic use of Pueblo Alto.

Turkey roughly corresponds with what was found in excavations from the north and west upper room fill. It is low in the west and higher in the north. The percentage in the eastern rooms is surprisingly high. The majority of the turkey from the eastern rooms (all but one) came from Rooms 177 and 183 and may suggest very late use of these two rooms. This taxon comprised 40 and 43.3 percent of the elements from the rooms.

Observations

Immatures. Table 8.89 gives the percentage of immature and young adult elements for the three small, economic taxa in the sections in which they occurred.

Checking. Bone weathering was expected to be high in the wall-clearing sample (Table 8.88).

Burning. The totals for each section are presented in Table 8.90. The southwest corner had the greatest amount and may suggest trashy fill but more likely is due to deeper excavation to outline these walls.

Conclusions. The examination of the wall clearing faunal remains has pointed out that there was historic use of the site, as seen from the domestic Ovis-Capra remains. The eastern section has significantly more M. gallopavo remains, which suggests that this area may contain the latest occupation of the site.

Rabbit Ruin

Wall clearing at the small ruin northwest of Pueblo Alto produced few bones, only 33 total. These are not included in the Pueblo Alto totals or the discussions of taxa or variables. The element counts and MNIs can be found in Table 8.91. The domestic sheep-goat remains from Room 11 show

Table 8.89. Percentage of immature and young adult elements from wall clearing.

	Sylvilagus		L. californicus		C. gunnisoni	
	imm.	y.ad.	imm.	y.ad.	imm.	y.ad.
West	13.4	3.4				20.0
North	4.4	4.4	5.6	5.6		25.0
East	9.7	6.4		10.8	20.0	40.0
Southeast		23.0	20.0			44.4
South central	8.3	16.7		8.3		14.3
Southwest	9.4		2.6	3.5	7.4	14.8

Table 8.90. Percentages of burning and "cooking brown" from wall clearing by area.

Section	None	Complete	Partial	Slight	"Cooking brown"
West	98.5	1.5			
North	94.6	5.4			
East	97.6	1.2			1.2
Southeast	96.6	1.7		1.7	
South-central	95.1	3.2	0.8	0.8	
Southwest	89.7	8.6		0.7	1.0
Major Wall 3	100.0				

Table 8.91. Number of elements and MNIs for Rabbit Ruin.

	Rm. 10		Rm. 11		Rm. 21		Rm. 24		Rm. 27		Rm. 29		Kiva 5		Unknown		Totals	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus	8	1	4	2	4	2					1	1					17	6
L. calif.	1	1					2	1									3	2
C. gunni.					1	1											1	1
A. amer.			1	1													1	1
Ovis-Capra			3	2													3	2
M. gallop.									1	1			1	1	1	1	3	3
No. unknown			2				1				2						5	
% unknown			20.0				33.3				66.7						15.1	
Totals	9	2	10	5	5	3	3	1	1	1	3	1	1	1	1	1	33	15

historic deposition, and the preponderance of rabbit (60.6 percent of the sample) suggest that the name of the ruin is appropriate.

Very little can be said about this sample, especially when it is so small. The presence of three M. gallopavo elements in the sample may suggest late use of this site.

Trash Deposits

Trash deposits can give us good information on subsistence and subsistence change from a site. The best of these are like the Pueblo Alto Trash Mound, carefully excavated by lenses rather than by arbitrary levels or gross layers. With this kind of sample, provided the frequencies are large enough, shifts in species use and abundance should be evident.

The Trash Mound

The large Trash Mound southeast of Pueblo Alto was first trenched, then six columns adjacent to the trench were excavated by layer. Only the materials from the columns or booths were identified and analyzed. This resulted in a sample of 8,771 bones. Windes (Volume II of this report) has estimated that the materials from the booths comprised approximately 0.5 percent of the entire mound.

To have an adequate sample for each unit considered, adjacent or nearby layers were often lumped. Table 8.92 gives these lumpings as well as the number of elements and MNI by taxon.

According to Windes, Layers 1 through 8 are Red Mesa in ceramic association, and the remainder are Gallup associated. He also notes that Layers 1 through 20 contain large amounts of construction debris (greater than 30 percent by weight).

Deer (O. hemionus) was by far the most common artiodactyl represented. Of the elements recorded, 64.7 percent were lower limbs and foot elements and 9.3 percent were antlers. There are numerous bird taxa represented, generally in low frequencies. The turkey (M. gallopavo) total is quite low compared to that of the small mammals and comprised only 0.5 percent of the sample. This is consistent with other Gallup associations within the site.

The percentages of unidentified elements are high throughout most of the mound, much higher than the west rooms and slightly higher than the north rooms. This may be a characteristic of dense trash.

Because there are so many layers, the mound will be discussed by observation rather than by layer. There does not appear to be any change in the relative use of the three small, economic mammals from earlier to later deposits, probably because of the short time involved. Windes (Volume II of this report) feels that the entire mound was deposited in less than 70 years.

Table 8.92. Number of elements and MNIs for the Pueblo Alto Trash Mound.

Layer:	1a		1b		1c		1-4, 8		9		9a		9b		9c		10		11	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	7	1	1	1	7	1	48	4	19	2	61	2	3	1	95	3	7	2	63	2
L. californicus							18	2	27	2	1	1			4	1	16	1	2	1
squirrel sp.																				
C. gunnisoni	1	1			1	1	27	4									13	1		
S. aberti																	1	1		
T. bottae							2	1											4	1
Perognathus sp.																				
D. ordii																	1	1	1	1
D. spectabilis							1	1												
Peromyscus sp.							5	2							1	1				
Neotoma sp.																				
N. cinerea																				
N. albigula																				
C. lupus									1	1										
F. rufus							1	1												
O. hemionus					1	1	3	1	1	1							2	1	5	1
A. americana							1	1	1	1					1	1			1	1
O. canadensis	3	1			1	1	10	1							3	1				
B. jamaicensis																				
B. regalis															1	1				
A. chrysaetos							1	1	1	1										
M. gallopavo																				
Z. macroura																				
Trochilidae																				
C. auratus																				
E. alpestris																				
C. corax																				
Fringillidae																				
P. chlorura																				
P. erythrophthalmus																				
P. melanoleucus																				
No. unknown	92		11		43		188		37		194		20		507		52		668	
% unknown	89.3		91.7		81.1		61.6		42.5		75.8		86.9		82.8		56.5		89.8	
Totals	103	3	12	1	53	4	305	19	87	8	256	3	23	1	612	8	92	7	744	7
% checked					5.7		4.2		3.3						0.2		2.2		0.4	

Table 8.92. (continued)

Layer:	13,15, 16,17		18		19,20		22		24/31,30		23,32		35		37		43		44	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	17	2	28	3	45	3	128	4	94	3	86	3	199	8	25	2	67	3	33	4
L. californicus	23	2	60	3	4	1			10	2	12	1	80	3	16	1	94	2	37	3
squirrel sp.	1	1																		
C. gunnisoni	7	1	7	1	13	1	12	1	8	1	5	1	67	7	1	1	17	1	1	1
S. aberti	2	1			2	1														
T. bottae											2	1	1	1						
Perognathus sp.																				
D. ordii													1	1			5	1		
D. spectabilis																				
Peromyscus sp.							3	1	1	1	1	1	5	3						
Neotoma sp.			2	1									1	1						
N. cinerea																				
N. albigula																				
C. lupus																				
F. rufus																				
O. hemionus	3	1	3	2	11	2	9	1	9	1	9	1	21	1	3	1	1	1	20	1
A. americana									5	1	1	1	7	1	1	1			1	1
O. canadensis	1	1			1	1	1	1			1	1	2	1	1	1	1	1	1	1
B. jamaicensis											2	1								
B. regalis																				
A. chrysaetos													2	1						
M. gallopavo	1	1											36	3						
Z. macroura																				
Trochilidae							1	1												
C. auratus																				
E. alpestris							2	1												
C. corax															1	1			2	1
Fringillidae																				
P. chlorura																				
P. erythrophthalmus																				
P. melanoleucus													1	1						
No. unknown	70		220		134		106		164		107		371		39		155		52	
% unknown	56.0		68.7		63.8		40.4		56.3		47.3		46.7		44.8		45.6		35.4	
Totals	125	10	320	10	210	9	262	10	291	9	226	11	794	32	87	8	340	9	147	12
% checked	8.8		5.9		10.9		3.0		5.7		4.0		1.6		13.7		12.0		6.8	

Table 8.92. (continued)

Layer:	45		46,47, 48,54		55		56		57		57/58		58		59,60,61		62		69	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	160	4	81	4	128	3	35	2	6	1	8	1	22	2	18	2	38	3	18	1
L. californicus	89	3	100	4	65	3	83	3	9	2	21	2	45	2	15	1	53	3	25	2
squirrel sp.															1	1				
C. gunnisoni	2	1	12	2	1	1	2	1	3	1	6	1	29	2	22	2	22	3	4	1
S. aberti																				
T. bottae																				
Perognathus sp.							1	1												
D. ordii			1	1																
D. spectabilis																				
Peromyscus sp.			1	1			2	1											1	1
Neotoma sp.			1	1															1	
N. cinerea																	2	1	1	1
N. albigula	1	1																		
C. lupus																				
F. rufus																				
O. hemionus	3	1	6	1	5	1	2	1	9	1	17	1	11	1	7	1	8	1	4	1
A. americana							1	1									3	1		
O. canadensis									1	1									2	1
B. jamaicensis																				
B. regalis																				
A. chrysaetos																				
M. gallopavo													2	2						
Z. macroura	1	1																		
Trochilidae																				
C. auratus																				
E. alpestris													1	1						
C. corax																				
Fringillidae	1	1																	1	1
P. chlorura																				
P. erythrophthalmus																	1	1		
P. melanoleucus																				
No. unknown	89		111		111		134		25		32		81		35		153		104	
% unknown	25.7		35.5		35.8		51.5		47.2		38.1		42.4		35.7		54.6		64.6	
Totals	346	12	313	14	310	8	260	10	53	6	84	5	191	10	98	7	280	13	161	9
% checked	0.6		4.0		5.5		15.8		13.2		17.8		12.0		16.3		15.3		13.0	

Table 8.92. (continued)

Layer:	70,71,72		74,76,78		81		82,96,97		85,92, 95,98		103		104		105,109, 110,111		113		122,123	
	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	25	2	24	3	38	3	13	1	20	1	10	1	61	3	25	2	57	3	12	1
L. californicus	30	2	17	1	13	1	10	1	11	1	10	1	31	2	34	3	38	2	18	1
squirrel sp.																				
C. gunnisoni	6	1	5	2	5	1	2	1	4	1	4	1	17	1	9	1	11	2	2	2
S. aberti													1	1						
T. bottae															2	1				
Perognathus sp.																				
D. ordii	1	1							1	1							2	1		
D. spectabilis																				
Peromyscus sp.													2	1			3	1		
Neotoma sp.																				
N. cinerea			1	1																
N. albigula																				
C. lupus																				
F. rufus																				
O. hemionus	9	1	2	1	9	1	3	1			9	1	9	1	6	1	4	1		
A. americana	1	1			3	1									1	1				
O. canadensis					3	1							1	1	1	1			1	1
B. jamaicensis					12	1									1	1				
B. regalis																				
A. chrysaetos									1	1										
M. gallopavo			1	1													1	1		
Z. macroura																				
Trochilidae																				
C. auratus													1	1						
E. alpestris	1	1																		
C. corax																				
Fringillidae	2												1	1						
P. chlorura	1	1																		
P. erythrophthalmus																				
P. melanoleucus																				
No. unknown	116		38		157		61		50		59		99		157		137		37	
% unknown	60.4		43.2		65.4		68.5		57.5		64.1		44.4		66.5		53.7		52.8	
Totals	192	10	88	9	240	9	89	4	87	5	92	4	223	1	236	11	253	11	70	5
% checked	25.5		13.6		59.2		14.6		8.0		16.3		14.2		12.3					

Table 8.92. (concluded)

	200 #	200 MNI	TOTALS Total No. Elements	TOTALS Maximum MNI	TOTALS Minimum MNI
Sylvilagus sp.	5	1	1,837	98	36
L. californicus	2	2	1,123	68	16
squirrel sp.			2	2	1
C. gunnisoni			348	51	12
S. aberti			6	4	1
T. bottae			11	5	3
Perognathus sp.			1	1	1
D. ordii			13	8	2
D. spectabilis			1	1	1
Peromyscus sp.			25	14	6
Neotoma sp.			5	3	1
N. cinerea			4	3	1
N. albigula			1	1	1
C. lupus			1	1	1
F. rufus			1	1	1
O. hemionus			224	35	3
A. americana			28	14	2
O. canadensis			35	18	1
B. jamaicensis			15	3	1
B. regalis			1	1	1
A. chrysaetos			5	4	1
M. gallopavo	1	1	42	9	3
Z. macroura			1	1	1
Trochilidae			1	1	1
C. auratus			1	1	1
E. alpestris			4	3	1
C. corax			3	2	1
Fringillidae			5	3	1
P. chlorura			1	1	1
P. erythrophthalmus			1	1	1
P. melanoleucus			1	1	1
No. unknown	8		5,024		
% unknown	50.0		57.3		
Totals	16	4	8,771	359	105

Observations

Immatures. Table 8.93 gives the percentage of immature and young adult elements for the three small, economic taxa and the season suggested by the distribution. For purposes here the term spring represents May through July deposits, fall represents August through November, and winter December through April. Again, these are admittedly subjective determinations, and several factors were considered. These included the sample size, frequencies of the taxa--especially those available only seasonally, the percentage of immature and young adult elements, and which elements were represented. It is largely the presence of immature elements that indicates a spring or fall deposit. Winter is the most likely season to be under-represented because intrusive immature elements or deposits representing more than one season would make it appear to be a fall or spring deposit. The absence of prairie dog (C. gunnisoni) in a deposit with a fair number of elements was felt to be strongly suggestive of winter because this taxon hibernates.

The assignment of seasons suggests that the initial building stage, represented by the west end of the mound (Layers 1-8), was largely done during spring, and the winter lenses within this suggest that it may have taken two to three seasons to accomplish. The lack of moisture during this time of year and the large number of spalls and rocks in the early layers suggest that this may represent a stage when rock was shaped for the walls, but the actual construction may not have begun until later, about Layer 9. This begins an era of work in the fall that could have utilized the late summer rains for mixing mortar (Layers 9-20+). Also in these layers are five of the eight tassel-eared squirrel (S. aberti) elements found at Pueblo Alto. This species lives in ponderosa pine or mixed conifer forests and could mark the bringing of roofing beams to the site.

Beginning with Layer 44, the sequences represent the various seasons and suggest some occupation and deposition throughout the annual cycle. This could represent as little as four years, but the relatively high checking suggests that more time was involved.

Checking. Table 8.92 gives the percentage of checked elements by the layer or layer lumping. The low percentages in the layers with construction debris are generally due to high percentages of burning in these layers. This tends to artificially lower the checking as burned bone rarely exhibits this characteristic. Periods of rapid deposition are indicated for Layers 22 through 35 and 44 through 55 and exposure or deposition from an exposed area in Layers 70, 71, 72, 81, and 200.

Burning. Tables 8.94 through 8.99 present burning and "cooking brown" for the important economic taxa and the total for each layer that exhibited these. As can be seen in any of these tables, the highest complete burning occurs in the construction debris layers (Layers 1-20). For the mound as a whole 24.3 percent were completely burned. This is matched only by some of the roof-fall layers in the north rooms (Room 145 at 24.4 percent, Room 139, Layer 0707 at 37 percent, Room 142 at 36.8

Table 8.93. Percentages of immature and young adult elements from the Trash Mound.

Layer No.	Sylvilagus imm.	Sylvilagus y.a.	L. californicus imm.	L. californicus y.a.	C. gunnisoni imm.	C. gunnisoni y.a.	Seasonal Estimate
1a							unknown
1b		100.0					unknown
1c		28.6					unknown
1-4,8[a]	10.4	20.8	5.6	16.7	7.4	29.6	spring
9	10.5	21.1		18.5			fall ?
9a		4.2		100.0			winter
9b							unknown
9c		5.6		25.0			winter
10	28.5	14.3		18.7	7.7	7.7	spring
11		1.6					winter
13,15,16,17		17.6	4.3	13.0		42.8	fall
18	10.7	10.7		11.7			fall
19,20		11.1				7.7	fall
22		10.2				16.7	fall
23,32		17.4				40.0	fall
24,30,31[b]		12.8				25.0	fall
35		7.0	1.2	3.7	1.5	25.4	fall
37		2.3					winter
43	1.5	23.9		1.1		23.5	fall
44	3.0	12.1		2.7			winter
45	1.2	6.2	1.1	6.7			winter
46,47,48,54	2.4	11.1		9.0	8.3	16.7	fall
55		4.7		4.6			winter
56		11.4		3.6			winter
57		16.7	11.1			33.3	fall
57/58						16.7	winter?
58	4.5				3.4	17.2	spring
59,60,61[c]					4.5	13.6	spring
62		5.2	1.9	3.8	9.1	36.4	spring
69							winter
70,71,72		12.0					winter
74,76,78[d]		4.2		5.9	20.0	20.0	fall
81	2.6	15.8		15.4		20.0	fall
82,96,97		15.4		30.0			winter
85,92,95,98		15.0					winter
103				20.0			fall
104	8.2	4.8		3.2	5.9	5.9	spring
105,109,110,111[e]		32.0	2.9	5.9		22.2	fall
113	7.0	22.8		7.7	9.1	9.1	spring
122,123		8.3		5.6	50.0		fall
200		20.0					unknown

[a]Layer 8 - fall.
[b]Layer 24 - winter.
[c]Layers 59 and 61 - winter.
[d]Layer 74 - winter.
[e]Layer 105 - spring.

Table 8.94. Burning and "cooking brown" for *Sylvilagus* species by Trash Mound layer.

Layer	n	None	Complete	Partial	Barely	"Cooking brown"
1a	7		100.0			
1c	7		100.0			
1,2,3,4,8	48	56.2	39.6		4.2	
9	19			10.3	21.0	68.4
9a	61	3.3	96.7			
9b	3	33.3	66.7			
9c	95	21.0	66.3	1.0		11.6
10	7	71.4	14.3			14.3
11	63	15.9	80.9	3.2		
13,15,16,17	28	67.9	25.0			7.1
19,20	45	73.3				26.7
22	128	57.0	5.5			37.5
23,32	86	31.4	3.5	2.3	2.3	60.5
24,30,31	94	43.6	3.2		1.1	52.1
35	199	56.3	4.5		3.0	36.2
37	25	84.0				16.0
43	67	49.2	7.5	1.5		41.8
44	33	75.6	9.1		3.0	12.1
45	160	92.5	3.1			4.4
46,47,48,54	81	75.3	6.2	1.2		17.3
55	128	82.8	12.5	1.6	0.8	2.3
56	35	88.6	2.9			8.6
57	6	50.0	16.7		16.7	16.7
57/58	8	62.5	25.0			12.5
58	22	68.2	4.5			27.3
59,60,61	18	83.3				16.7
62	38	86.8	2.6			10.5
69	18	83.3				16.7
70,71,72	25	96.0				4.0
74,76	24	70.8	8.3			20.8
81	38	78.9	10.5			10.5
82,96,97	13	76.9	7.7			15.4
85,92,95,98	20	45.0	15.0		10.0	30.0
103	10	70.0	10.0			20.0
104	61	73.8	3.3		1.6	21.3
105,109-111	25	76.0	4.0			20.0
113	57	89.5	5.3	1.7		3.5
122,123	12	66.7	16.7			16.7
200	5	60.0				40.0

Table 8.95. Burning and "cooking brown" for L. californicus by Trash Mound layer.

Layer	n	None	Complete	Partial	Barely	"Cooking brown
1,2,3,4,8	18	88.9				11.1
9c	4	75.0				25.0
11	2	50.0	50.0			
13,15,16,17	23	95.6	4.3			
18	60	98.3				1.7
19,20	4	50.0	25.0			25.0
23,32	12	58.3				41.7
24,30,31	10	20.0	30.0			50.0
35	80	55.0	7.5			37.5
37	16	56.2	6.2			37.5
43	94	30.8	3.2	1.1	3.2	61.7
44	37	62.2	18.9	2.7		16.2
46,47,48,54	100	80.0	8.0	1.0	2.0	9.0
55	65	80.0	15.4	1.5		3.1
56	83	75.9	2.4			21.7
57	9	55.6			22.2	22.2
57/58	21	57.1	19.0			23.8
58	45	82.2	13.3		2.2	2.2
59,60,61	15	86.7			6.7	6.7
62	53	83.0				17.0
69	25	60.0	12.0			28.0
70,71,72	30	73.3	10.0			10.0
74,76	17	35.3	17.6			47.1
81	13	84.6				15.4
82,96,97	10	80.0	10.0			10.0
85,92,95,98	11	45.4	18.2		9.1	27.3
103	10	70.0	20.0			10.0
104	31	48.4	32.3			19.3
105,109-111	34	50.0	23.5		2.9	23.5
113	39	71.8	15.4	2.6		10.3
122,123	18	44.4	22.2	5.6		27.8

Table 8.96. Burning and "cooking brown" for C. gunnisoni by Trash Mound layer.

Layer	n	None	Complete	Partial	Barely	"Cooking brown
1a	1		100.0			
1c	1		100.0			
1,2,3,4,8	27	81.5	14.8			3.7
10	13	69.2	7.7			23.1
18	7	71.4	28.6			
19,20	13	76.9	7.7			15.4
22	12	75.0				25.0
23,32	5	20.0	40.0			40.0
24,30,31	8	62.5				37.5
35	67	82.1	1.5		1.5	14.9
37	1					100.0
43	17	64.7				35.3
45	2	50.0				50.0
46,47,48,54	12	91.7				8.3
56	2	50.0				50.0
57/58	6	50.0			16.7	33.3
58	29	96.5			3.4	
59,60,61	22	90.9				9.1
62	22	86.4				13.6
69	4	75.0				25.0
70,71,72	6	83.3				16.7
74,76	5	20.0			20.0	60.0
81	5	80.0				20.0
85,92,95,98	4	50.0	25.0			25.0
103	4	25.0	25.0	25.0		25.0
104	17	47.1	17.6			35.3
122,123	2	50.0				50.0

Table 8.97. Burning and "cooking brown" for large mammals and artiodactyls. by Trash Mound layer.

Layer	Taxon	n	None	Complete	Partial	Barely	"Cooking brown"
1a	*O. canadensis*	3		100.0			
	artios.	64		100.0			
1c	*O. hemionus*	1		100.0			
	O. canadensis	1		100.0			
	artios.	19		100.0			
	med-large m.	8		100.0			
1-4,8	*O. hemionus*	3	66.7	33.3			
	O. canadensis	10	80.0	20.0			
	artios.	59	22.0	74.6	3.4		
	med-large m.	76	23.7	71.0	5.3		
9	*A. americanus*	1		100.0			
	med-large m.	7	57.1	42.9			
9c	*A. americanus*	1		100.0			
	O. canadensis	3		100.0			
	med-large m.	2		100.0			
10	*O. hemionus*	2	50.0	50.0			
	artios.	11	36.4	63.6			
	med-large m.	16	6.2	93.7			
11	*O. hemionus*	5		100.0			
	A. americanus	1		100.0			
	artios.	64	6.2	93.7			
	med-large m.	86	1.2	98.8			
13,15-17	artios.	20	80.0	20.0			
	med-large m.	6	83.3	16.7			
18	*O. hemionus*	3		100.0			
	artios.	21	23.8	76.2			
	med-large m.	13	15.4	69.2	7.7		7.7
19,20	*O. hemionus*	11	90.9				9.1
	artios.	60	83.3	5.0			11.7
	med-large m.	53	94.3	1.9			3.8
22	*O. hemionus*	9	88.9	11.1			
	O. canadensis	1		100.0			
	artios.	31	64.5	19.3			16.1
	med-large m.	19	94.7	5.3			
23,32	*A. americanus*	1					100.0
	artios.	18	55.6	22.2			22.2
	med-large m.	52	42.3	5.8			51.9
24,30,31	*O. hemionus*	9	88.9	11.1			
	artios.	37	86.5	5.4			8.1
	med-large m.	52	75.0	7.7			17.3
35	*O. hemionus*	21	90.5	4.7		4.7	
	artios.	76	85.5	7.9		1.3	5.3
	med-large m.	124	79.8	10.5			9.7
37	med-large m.	12	91.7				8.3
43	med-large m.	51	76.5	9.8	5.9		7.8
44	*O. hemionus*	20	75.0	25.0			
	artios.	17	29.4	29.4	5.9		35.3
	med-large m.	13	7.7	61.5			30.8
45	artios.	14	92.8				7.1
	med-large m.	9	66.7	22.2		11.1	
46-54	med-large m.	26	88.5	7.7	3.8		
55	artios.	3	66.7	33.3			
	med-large m.	18	77.8	22.2			
56	artios.	15	93.3	6.7			
	med-large m.	65	84.6	15.4			
57	med-large m.	33	84.8	15.1			
59,60,61	*O. hemionus*	7	85.7				14.3
	med-large m.	10	80.0	10.0	10.0		
62	med-large m.	33	90.9	9.1			
69	*O. hemionus*	4	50.0	25.0			25.0
	med-large m.	72	69.4	15.3			15.3
70,71,72	*O. hemionus*	9	77.8	22.2			
	artios.	34	85.3	11.8			2.9
	med-large m.	46	97.8	2.2			
74,76	med-large m.	9	33.3	22.2			44.4
82, 96,97	artios.	22	90.9	4.5	4.5		
	med-large m.	22	77.3	22.7			
85,92,95,98	artios.	7	57.1				42.9
	med-large m.	12	50.0	33.3			16.7
103	med-large	18	50.0	50.0			
104	*O. hemionus*	9	77.8	22.2			
	med-large m.	38	76.3	21.0	2.6		
105,109-111	artios.	37	94.6	2.7	2.7		
	med-large	45	60.0	28.9			11.1
113	artios.	19	94.7	5.3			
	med-large m.	33	60.6	27.3			12.1
122,123	med-large m.	5	80.0	20.0			

Table 8.98. Burning and "cooking brown" for small mammals by Trash Mound layer.

Layer	n	None	Complete	Partial	Barely	"Cooking brown
1a	27		92.6	7.4		
1c	12	25.0	66.7	8.3		
1,2,3,4,8	47	66.5	34.0			
9	26	92.3	7.7			
9a	194	7.7	92.3			
9b	19	68.4	31.6			
9c	504	9.1	38.5			52.4
10	24	83.3	12.5			4.2
11	515	6.4	93.4	0.2		
13,15-17	22	86.4	13.6			
18	186	84.9	10.7			4.3
19,20	21	52.4				47.6
22	44	38.6				61.4
23,32	26	34.6				65.4
24,30,31	73	27.4	4.1			68.5
35	155	54.8	9.7	0.6		34.8
37	25	80.0				20.0
43	80	37.5	8.7	1.2		52.5
44	22	59.1	9.1			31.8
45	66	84.8	7.6	1.5		6.1
46,47,48,54	81	80.2	12.3	2.5		4.9
55	90	68.9	21.1			10.0
56	50	90.0	8.0	2.0		
57	10	90.0	10.0			
57/58	15	86.7	6.7			6.7
58	30	70.0	6.7			23.3
59,60,61	20	95.0				5.0
62	89	80.9	4.5			14.6
69	17	64.7				35.3
70,71,72	28	78.6	3.6			17.9
74,76	20	45.0	5.0			50.0
81	19	94.7	5.3			
82,96,97	15	60.0	20.0			20.0
85,92,95,98	26	46.1	50.0			3.8
103	23	69.6	4.3			26.1
104	48	81.2	4.2			14.6
105,109-111	70	38.6	12.9			48.6
113	75	81.3	10.7			8.0
122,123	32	37.5	18.7			43.7
200	3	33.3				66.7

Table 8.99. Burning and "cooking brown" by Trash Mound layer.

Layer	None	Complete	Partial	Barely	"Cooking brown
1a		98.1	1.9		
1b		100.0			
1c	5.7	92.4	1.9		
1,2,3,4,8	50.2	46.2	2.0	0.7	1.0
9	83.9	16.1			
9a	7.0	92.8			
9b	65.2	34.8			
9c	11.6	43.1	0.2		45.1
10	62.0	31.5			6.5
11	6.6	93.0	0.4		
13,15-17	87.2	12.0			0.8
18	77.5	18.4	0.3		3.7
19,20	80.0	2.9			17.1
22	58.8	6.1			35.1
23,32	39.8	5.3	0.9	0.9	53.1
24,30,31	53.3	5.5		0.3	40.9
35	68.3	6.6	0.2	1.0	23.9
37	78.2	1.1			20.7
43	48.2	7.1	1.8	0.9	42.1
44	57.8	20.4	1.4	0.7	19.7
45	89.6	5.5	0.9	0.3	3.8
46,47,48,54	80.5	8.3	1.6	0.6	8.9
55	78.1	16.1	1.0	0.3	4.6
56	83.8	7.3	0.4		8.5
57	73.6	13.2		7.5	5.7
57/58	78.6	9.5		1.2	10.7
58	84.3	7.3		1.0	7.3
59,60,61	88.8	1.0	1.0	1.0	8.2
62	86.1	3.2			10.7
69	67.1	12.4			20.5
70,71,72	87.0	6.2			6.8
74,76	57.9	9.1			32.9
81	91.7	4.6	0.8		2.9
82,96,97	78.6	13.5	1.2		6.7
85,92,95,98	48.3	26.4		3.4	21.8
103	72.8	15.2	1.1		10.9
104	72.6	12.1		0.4	14.8
105,109-111	63.6	13.6	0.4	0.4	22.0
113	81.4	11.5	0.8		6.3
122,123	47.1	20.0	1.4		31.4
200	73.0				25.0

percent) and in the firepits of Rooms 110 (Firepit 1 80 percent, Firepit 2 23.3 percent) and 147 (59.2 percent). It suggests that these elements in the Trash Mound and possibly the north rooms are firepit dumps. Elements from heating pits at Pueblo Alto as a whole produced 28.3 percent completely burned and 28.3 percent "cooking brown" (n = 191). Firepits had a slightly higher complete burning (41.2 percent) and lower "cooking brown" (9.1 percent, n = 284). Although the layers with construction debris do resemble firepit contents, a pattern of equally high burning and "cooking brown" like that from the heating pits is seldom found in the mound. However, the presence of "cooking brown" may itself suggest that the bulk of the midden generation is more like the heating pits.

The central area of the mound is similar to other trash deposits around the site with low burning but higher "cooking brown." Kiva 10, for example, ranged from 4.8-6.3 percent completely burned and 8.7-18.7 percent "cooking brown." Kiva 13 had a higher percentage of "cooking brown" at 33.7 percent and low complete burning at 2.9 percent.

Only one of the layers examined had percentages as low as the fill of the rooms in general. This was Layer 81 with 91.7 percent of the elements unaltered.

Other observations. Animal activity was extremely low with 0.1 percent exhibiting rodent gnawing and another 0.1 percent carnivore gnawing. The low frequency of rodent gnawing suggests that it was not trash per se that was attracting rodents. The small amount of carnivore gnawing is consistent with the presence of few dogs at the site.

Projections. To assess the amount of faunal resources represented by the mound, the total number of elements was estimated. If we assume that the figure from the booths (8,771) and Windes' estimate that these comprised 0.5 percent of the volume of the mound are correct, and that the booths are representative of the density of the mound, the mound could contain 1,754,200 bones.

To put this into perspective, the entire mound was first treated as if it were a single sample which resulted in the minimum MNI in Table 8.92. Table 8.100 summarizes the estimated meat available and consumed for both the maximum and minimum MNIs (each layer calculated separately, then totalled) and how this translates into calories, man-days, man-years, and years estimated for the entire mound. Only the artiodactyls and the three principle, small, economic mammals were used. The totals would be slightly higher if the rodent taxa had been included. The amount of meat available and consumed for the entire Trash Mound has been treated as if it were a linear function of the amount of bone, which it is not. As with MNIs, it is a curvilinear relationship where less meat is represented per bone as the numbers rise.

Conclusions. The faunal remains suggest that the first increment of the mound, generated by shaping stones for the site construction, took place in spring or springs. Next came the building activities, which were

Table 8.100. Economic content of the Trash Mound.

Taxon	Grams[a]	Minimum MNI n	Minimum MNI Est.avail	Minimum MNI Est. cons.	Maximum MNI n	Maximum MNI Est.avail.	Maximum MNI Est.consum.
Sylvilagus sp.	382	36	13,752	13,752	98	37,436	37,436
L. californicus	1,100	16	17,600	17,600	68	74,800	74,800
C. gunnisoni	370	12	4,440	4,440	51	18,872	18,872
O. hemionus	28,100	3	84,300	46,610	35	983,500	145,280
A. americana	16,850	2	33,700	9,700	14	235,900	21,180
O. canadensis	28,100	1	28,100	24,880	18	505,800	49,850
Artios.							173,273
Totals			181,892	116,982		1,856,308	520,691
Calories (125/100g)			227,365	146,227		2,320,385	650,864
Man-days (200k/day)			1,136	731		11,602	3,293
Man-years			3.11	2.0		31.8	9.0
Est. whole mound man-years			622	400		6,360	1,800

[a]Grams and estimates based on Gillespie 1985.

fall related. Following this were rounds of activities with alternation of all three seasons. Nothing in the faunal remains suggests massive influxes of persons on a cyclical basis. The estimate of meat available from the maximum MNI is consistent with what a relatively small population (less than 100 persons) would have generated at the site in 70 years if only fresh meat were utilized.

The Plaza Kivas

Several previously unsuspected small kivas were encountered in the plaza tests on the east and west sides of the Pueblo Alto main plaza. These were Late Mix in ceramic association except for Kiva 17, which was Gallup. They were trash or mixed trash and aeolian filled. Kiva 16 was trenched to a shallow depth and produced a fair sample, and the southern edge of Kiva 17 was included in a test trench. The others were located and the walls traced at shallow depths. Table 8.101 gives the element counts, percentages, and MNIs for these tests. The numbers are generally too low for many conclusions.

Deer (*O. hemionus*) is the artiodactyl most represented in the samples. This is consistent with Pueblo Alto as a whole. Turkey (*M. gallopavo*) is relatively low in all of the tests. The percentages from Plaza Feature 4 and Kiva 14 are most similar to the upper fill of Room 143 (5.5 percent) and Plaza 2, Surface 2 (7.4 percent). The lower figures for Kivas 12 and 16 are similar to Room 103, Floor 2 (1.4 percent), the upper levels of Kiva 10 (3.8 percent), and Kiva 15 (2.4 percent). None of the tests have high enough percentages--such as those found in the upper fill of Rooms 139, 145, and 147--to suggest that this fill is from the latest use of the site.

Observations

Immatures. Table 8.102 gives the percentages of immature and young adult elements for each of the kiva tests.

Checking. Checking was relatively frequent for all of the kivas except for Kiva 17 where the sample size was small and no occurrences were recorded. This suggests that the upper fill of the structures was either open and exposed for a period of time and/or deposition was slow. Table 8.101 gives the percentage of checked bone for these kivas.

Burning. Burning and "cooking brown" for those taxa in which they occurred can be found in Table 8.103. There is a wide range in the amount of alteration in these structures. Kivas 12 and 14 were recorded as being mixed aeolian and trash in their fill, but the very low percentage of burning and "cooking brown" are very similar to the aeolian and structural rubble fill of the rooms. The percentage is slightly higher in Kiva 17, more like that of the floor fill of the rooms. "Cooking brown" was very high in Plaza Feature 4 and Kiva 16--very similar to that in the

Table 8.101. Number of elements and MNIs for some plaza kivas.

	Pl. Fea. 4			Kiva 12			Kiva 14			Kiva 16			Kiva 17		
	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI
Sylvilagus sp.	4	5.8	1	9	17.6	2	11	10.7	1	27	11.4	1	2	13.3	1
L. californicus	8	11.6	1	24	47.0	1	13	12.6	1	28	11.8	2	2	13.3	1
C. gunnisoni	2	2.9	1	1	2.0	1	1	1.0	1	18	7.6	3	5	33.3	2
T. bottae				1	2.0	1				3	1.3	1	1	6.7	1
D. ordii							1	1.0	1				1	6.7	1
Peromyscus sp.										4	1.7	3	1	6.7	1
O. hemionus	8	11.6	1	1	2.0	1	4	3.9	2	6	2.5	1			
A. americana							1	1.0	1						
O. canadensis							1	1.0	1	4	1.7	1			
A. platyrhynchos										1	.4	1			
Buteo sp.										1	.4	1			
M. gallopavo	5	7.2	1	1	2.0	1	7	6.8	1	3	1.3	1			
Unknowns	42	60.9		14	27.4		64	62.1		142	59.9		4	26.7	
Totals	69		5	51		7	103		9	237		15	15		7
% checked	13.1			25.5			29.1			20.7					

Table 8.102. Immature and young adult elements from the plaza kivas.

	Sylvilagus		L. californ.		C. gunnisoni	
	imm.	y. ad.	imm.	y. ad.	imm.	y. ad.
Plaza Feature 4				12.5		
Kiva 12				12.5		
Kiva 14		9.1				
Kiva 16		3.7		3.6	5.6	11.1
Kiva 17					20.0	20.0

Table 8.103. Percentages of burning and "cooking brown" for the plaza kivas.

Taxon	None	Complete	Partial	Slight	"Cooking brown"
Plaza Feature 4					
Sylvilagus sp.	25.0				75.0
L. californicus	87.5	12.5			
C. gunnisoni	50.0				50.0
O. hemionus	75.0				25.0
Small-med. mammal	54.2	8.3			37.5
Artiodactyl	40.0				60.0
Med-large mammal	25.0	37.5			37.5
Unknowns	75.0	25.0			
Totals	57.4	10.1			30.4
Kiva 12					
L. californicus	95.8	4.2			
O. hemionus		100.0			
Artiodactyl	66.7	33.3			
Totals	94.1	5.9			
Kiva 14					
L. californicus	92.3				7.7
D. ordii					100.0
Small-med mammal	66.7				33.3
Artiodactyl	96.5				3.4
Unknown	87.5	12.5			
Totals	93.2	1.0			5.8
Kiva 16					
Sylvilagus sp.	51.8			3.7	44.4
L. californicus	53.6				46.4
C. gunnisoni	61.1				38.9
O. hemionus	80.0				20.0
O. canadensis	50.0				50.0
M. gallopavo	66.7	33.3			
Small-med mammal	57.1	11.9			30.9
Artiodactyl	74.3	20.0			5.7
Med-large mammal	70.6	7.8	1.9		19.6
Aves	14.3	85.7			
Unknown	57.1	14.3			28.6
Totals	62.9	10.1	0.4	0.4	26.2
Kiva 17					
T. bottae					100.0
Small-med mammal	66.7				33.3
Totals	86.7				13.3

central section of the Trash Mound, Kiva 10, and Kiva 13. This suggests that these two units were used for dumping domestic refuse and that in "Late-Mix" times abandoned plaza kivas were used for that purpose.

Conclusions. Although none of these tests produced a large number of bones, it is possible to make a few suggestions. A relatively low percentage of turkey (*M. gallopavo*) suggests that none of the kivas was used for trash deposition by the very latest occupants of Pueblo Alto. The higher percentages are found in two of the eastern kivas--Plaza Feature 4 and Kiva 14. This may suggest that some of the eastern rooms were occupied slightly later than those in the west. Plaza Feature 4 was filled with materials that had a large amount of burning and "cooking brown," suggesting domestic refuse. It also had the lowest percentage of checking, suggesting fairly rapid deposition. On the other hand, Kiva 14 had very little burning and the highest checking. It may have fallen into disuse and filled in very similar manner to the western rooms and at approximately the same time. Kiva 12 would also have a similar history but may have been abandoned slightly earlier. It, too, had very little burning or "cooking brown," very low percentages of turkey (*M. gallopavo*), and high checking.

The western kivas show a similar dichotomy. Both are low in turkey remains, which suggests they may have been filling with the last use of most of the western rooms and Floor 2 of Room 103. Kiva 16 had much burning and "cooking brown," suggesting domestic refuse. There was also a fair amount of checking, which could be due to slower deposition than in Plaza Feature 4. Kiva 17 had such a small sample that it is difficult to say much about it. The burning was fairly low but higher than that of Kivas 12 and 14.

Loose's Test

A small test was made by R. Loose in the northeastern section of the plaza in 1974. This presumably hit the fill of a pitstructure and resulted in a collection of 63 bones. The test was labeled late Gallup in ceramic association by Windes.

Table 8.104 gives the number of elements, percentages, and MNIs. Such a small sample is not very reliable, but an attempt was made to relate it to other parts of the site.

The high percentage of cottontail (*Sylvilagus*) in this sample is fairly unusual and may be the result of the small sample size. Searching through other Pueblo Alto proveniences revealed six that were somewhat similar. All are Gallup in ceramic association and are presented in Table 8.105.

The rooms are more comparable to this test in time than are the Trash Mound layers that occurred toward the earlier portion of the mound.

Table 8.104. Number of elements, percentages, and MNIs for Loose's test.

	n	%	MNI
Sylvilagus sp.	19	30.1	4
L. californicus	5	7.9	1
C. gunnisoni	4	6.3	1
O. hemionus	1	1.6	1
A. americana	3	4.8	2
O. canadensis	4	6.3	1
M. gallopavo	3	4.8	1
C. corax	1	1.6	1
Unknowns	23	36.5	
Totals	63		12

Table 8.105. Species comparisons with other Gallup proveniences.

	Rm. 103 Fl. 2	Rm. 109 Fl. 1	Rm. 110 F.1(7-9)	Rm. 112 Fl. 1	Trash Md. L. 23,32	Trash Md. L.24,30,31
Sylvilagus	17.8	22.4	33.3	26.4	38.0	32.3
L. californicus	7.8	9.6	11.1	14.4	5.3	3.4
C. gunnisoni	5.7	8.0	2.3	17.8	2.2	2.7
M. gallopavo	1.4	10.4		0.6		

Observations

Immatures. The only immature elements recorded were for cottontail (*Sylvilagus*) and amounted to 10.5 percent. No young adult elements were found.

Checking. The amount of checking was low, 9.5 percent of the sample. Kiva 10 is the only other plaza kiva with less than 10 percent, and most had more than 15 percent. This suggests rapid deposition in this structure but is unusual for a shallow test.

Burning. The percentage of burning is fairly low, but similar totals were found in other trash-filled structures such as Kiva 10 and in some layers of the Trash Mound. For this test 87.3 percent were unaltered, 6.3 percent were completely burned, and 6.3 percent were "cooking brown."

Conclusions. The faunal materials from this test are similar to other Gallup deposits within the site. The percentages of checking and burning are not unlike other plaza kivas.

Plaza Tests

The main plaza at Pueblo Alto was tested by shallow trenching, deep trenching, and extensive areal excavations. For faunal remains the extensive areal excavations give the most information. Deep, confined tests often provide such small samples that the faunal remains can tell us little. Feature excavations such as that from Plaza 1, Grid 30 can be interesting and informative.

The Western Plaza Tests

Three deep trenches were excavated in the western portion of the plaza. Two of these ran east-west, one extending from Room 103 to Plaza Feature 1, Room 3, and the other in front of Room 104. The third was north-south from Circular Structure 1 to where it intersected the Room 104 trench. These were all dug down to sterile soil. The trenches also passed through Room 233, Kiva 16, and Kiva 17. Those materials are discussed in other sections. Table 8.106 gives the plaza grids and counts for these tests. It is based on correlations by the excavator and Windes' ceramic assessments (Volume II, Tables MF-E.30 and MF-E.31).

Table 8.107 gives the counts per taxon, percentages, and MNI for each surface. Individual grids had such small samples that the surface was used as the unit of analysis. Even when lumped, only Surface 1 had a reasonable sample. The presence of sparrow-hawk (*F. sparverius*) elements from the same side and same grid on Surfaces 2 and 3 suggests some mixing of those units.

Table 8.106. West Plaza Trench provenience information and counts.

	Grid Number						
Surface	116	117	301	302	303	307	Total
1	32	16	20	47		16	131
2			2	10			12
3				21	12		33
4	2					2	4
5	4			1	2	16	23
6			10	3		10	23
8	4			61			65
9			13				13
10			2		8		10

Table 8.107. Element counts, percentages, and MNIs for the West Plaza tests.

	Sur. 1			Sur. 2			Sur. 3			Sur. 4			Sur. 5		
	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI
Sylvilagus sp.	19	14.5	3	1	8.3	1	11	33.3	1	1	25.0	1	12	52.2	1
L. californicus	19	14.5		1	8.3	1	5	15.1	1				2	8.7	1
S. variegatus	1	0.8	1												
C. gunnisoni	17	13.0	3	1	8.3	1				1	25.0	1	2	8.7	1
T. bottae				1	8.3	1									
Peromyscus sp.	4	3.0	1	1	8.3	1							1	4.3	1
N. cinerea	1	0.8	1												
O. hemionus	1	0.8	1										1	4.3	1
O. canadensis	4	3.0	1				1	3.0	1						
A. chrysaetos															
F. sparverius				4	33.3	1	2	6.1	1						
M. gallopavo	5	3.8	1												
PASSERIFORMES				1	8.3										
No. unkknown	60	45.8		2	16.6		14	42.4		2	50.0		5	21.7	
Totals	131		13	12		7	33		4	4		2	23		5
% checked	40.1			8.3			12.1			0.0			13.0		

	Sur. 6			Sur. 8			Sur. 9			Sur. 10			Total	
	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	7	30.4	1	6	9.2	2	4	30.8	2	3	30.0	1	64	13
L. californicus	1	4.3	1	4	6.1	1	2	15.4	1	3	30.0	2	37	9
S. variegatus													1	1
C. gunnisoni							1	7.8	1				22	7
T. bottae													1	1
Peromyscus sp.	1	4.3	1										7	4
N. cinerea													1	1
O. hemionus	2	8.7	1	2	3.1	1							6	4
O. canadensis	1	4.3	1										6	3
A. chrysaetos				1	1.5	1							1	1
F. sparverius													6	2
M. gallopavo													5	1
PASSERIFORMES													1	1
No. unkknown	11	47.8		52	80.0		6	46.1		4	40.0	1	56	49.7
Totals	23		5	65		5	13		4	10		3	314	48
% checked	60.9			67.7			15.4			10.0				

Observations

Immatures. Table 8.108 gives the percentages of immature and young adult elements for the three small, economic taxa for those surfaces with which they occurred.

Checking. Plaza surfaces are generally exposed and not rapidly filled, so very high percentages of checking were expected. This was not the case for many of the surfaces in the tests. Only Surfaces 1, 6, and 8 have almost the amount expected (Table 8.107). This agrees with the excavators' assessment that a short time period was represented by each surface and that most of the surfaces were covered with intentional fill.

Burning. Burning and "cooking brown" were not common (Table 8.109). They do increase with two of the Red Mesa surfaces that are associated with construction debris and sheet trash.

Conclusions. These plaza trenches provide little faunal or subsistence information. However small the samples, there are suggestions that deposition during Gallup times was rapid or cleaning was frequent enough to minimize checking. The same was also true for the earliest Red Mesa surfaces. Burning did increase with these same two Red Mesa lenses and suggests a domestic kind of refuse.

The North Plaza Tests

The materials from the North Plaza included those recovered in a trench across the area and the upper fill from clearing Plaza 1, Grids 8 and 9 (the lower fill from these grids is discussed in the section on Pre-Alto). The grids included in this section are found in Table MF-8.17 along with the element counts.

For discussion these will be broken down into those from Surface 1, those from Surface 2, those from Surfaces 3 and 4, and those from Surfaces 5 and 6. Surface 1 contained mostly overburden, Surfaces 2 to 4 were spatially restricted and protected deposits, and those from Surfaces 5 and 6 were associated with a deflated area with large firepits and predominately Red Mesa ceramics. The surfaces are most likely Red Mesa associated, but some of the materials may be later. The sample sizes for all of these are small.

Table 8.110 gives the element counts, percentages, and MNIs for the North Plaza. The most interesting occurrences for the area were an articulated golden eagle (*A. chrysaetos*) wing covered with red ochre and a radius and ulna from a mallard (*A. platyrhynchos*). The proximity of these to several large, plaza firepits and to the Plaza 1, Grid 30 "bird pit" suggests that these elements may have been offerings. The two bobcat (*F. rufus*) elements, both from a mandible, and the articulated jackrabbit (*L. californicus*) skeleton may suggest the same thing.

Table 8.108. Percentages of immature and young adult elements for the West Plaza.

Surface	Sylvilagus imm.	Sylvilagus y.a.	L. californicus imm.	L. californicus y.a.	C. gunnisoni imm.	C. gunnisoni y.a.
1		21.0		10.5	5.9	11.8
3		45.4		20.0		
8	33.3			25.0		
9	25.0			50.0		100.0
10				33.3		

Table 8.109. Percentages of burning and "cooking brown" by West Plaza surface.

Surface	None	Complete	Partial	Slight	"Cooking brown"
1	93.1	4.6	0.8	0.8	0.8
2	100.0				
3	87.9	12.1			
4-6	100.0				
8	81.5	16.9	1.5		
9	84.6	7.7		7.7	

Table 8.110. Elements, percentages, and MNIs for the North Plaza.[a]

	LATE MIX									RED MESA				
	Surface 1			Surface 2			Sur. 3 & 4			Sur. 5 & 6			Total	
	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	19	41.3	2	4	6.3	1	5	7.5	1	12	20.3	2	40	6
L. californicus	7	15.2	1	7	11.1	1	7	10.4	1	6(1)	10.2	2	27	5
C. gunnisoni	4	8.7	1	3	4.8	1	6	9.0	1				13	3
Peromyscus sp.				3	4.8	1	1	1.5	1				4	2
F. rufus										2	3.4	1	2	1
O. hemionus				1	1.6	1				1	1.7	1	2	2
A. americana	2	4.3	1							1	1.7	1	3	2
A. platyrhynchos										2	3.4	1	2	1
Buteo sp.										1	1.7	1	1	1
A. chrysaetos										6	10.2	1	6	1
M. gallopavo	2	4.3	1	1	1.6	1							3	2
Z. macroura	1	2.2	1										1	1
Unknown	11	23.9		44	69.8		48	71.6		28	47.4		131	
Totals	46		7	63		6	67		4	59		10	335	27

[a]Number in parentheses represents an articulated skeleton.

Observations

Immatures. No immature and very few young adult elements were recovered.

Checking. Checking is presented by surface and grid (Table 8.111). The amount of checking demonstrates the effect of a protective wall and deeper overburden in Plaza 1, Grid 8, which has little checking. Grids that are more exposed and deflated have higher percentages. The Kiva 10 upper fill (Plaza 1, Grid 9 materials) had very little checking, which suggests rapid deposition.

Burning. The burning is similar to other plaza areas, infrequent with the largest amount associated with the Kiva 10 fill (Table 8.112).

Plaza 1, Grid 30

Testing for buried kivas in the northeast corner of the plaza revealed a small, irregular pit excavated into sterile, red clay. It contained a dense deposit of Red Mesa trash. Only the portion of the pit that fell into a meter-wide trench was removed. The unexcavated portion could contain an equivalent amount of additional material.

For presentation the materials were divided into three units. The first included those from above the third surface (about 19 elements) and some of the upper fill of the pit. Layer 7 in the pit comprised the largest unit, and Layer 10 represented materials at the bottom of the pit that were distinct from the upper layer.

Table 8.113 gives the number and MNIs for the test. The sample is fairly large and the trash quite dense. Based on Windes' volume estimate (Volume II of this report) of 0.873 m^3 meters for the excavated portion, the density of bone was estimated at 1,486.5 bones/m^3. For comparison, other densities at Pueblo Alto include 2,200 for the pit in Plaza 1, Grid 8, 435 for Kiva 10, 602 for the Trash Mound and 6,220 for a subfloor vent at Una Vida. Unlike in Plaza 1, Grid 8 and Una Vida, the sherd density from this pit was even greater than that of the bone.

Several aspects of the taxa distribution are unusual and interesting. Very high frequencies of cottontail (*Sylvilagus*) as compared to jackrabbit (*L. californicus*) are not common for the time period involved. This pattern is common for early Basketmaker III assemblages (29SJ 423 and 29SJ 1659) and very late deposits (29SJ 633). It was also found in the Red Mesa portion of the Pueblo Alto Trash Mound.

The large number of bird elements is also highly unusual; 30.1 percent of the elements were Aves. In fact, rather large percentages of the hawks and eagles from Pueblo Alto were recovered from this pit. Table 8.114 gives the percentage of the Pueblo Alto sample (elements) that were found in this pit. The materials from the pit represent only 2.9 percent of the total elements analyzed from Pueblo Alto.

Table 8.111. Percentages of checking for the North Plaza.

Provenience	% checked
Surface 1:	
Misc. plaza	100.0
Grid 8	47.8
Grid 22	78.3
Grid 26	100.0
Grid 38	0.0
Grid 48	100.0
Grid 51	100.0
Surface 2:	
Grid 8	12.5
Surfaces 3 and 4:	
Grid 8	100.0
Grid 9 (kiva fill)	4.5
Surfaces 5 and 6:	
Grid 27	14.2
Grid 28	92.7
Grid 29	100.0

Table 8.112. Percentages of burning and "cooking brown" for the North Plaza.

Surface	None	Complete	"Cooking brown"
1	97.8		2.2
2	90.5	3.2	6.3
3,4	83.6	3.0	13.4
5,6	98.3		1.7

Table 8.113. Number of elements and MNIs for Plaza 1, Grid 30.

	Surface 3		Layer 7		Layer 10		Totals	
	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	38	2	194	11	14	2	246	15
L. californicus	18	2	64	5	1	1	83	8
C. gunnisoni	2	1	1	1	2	1	5	3
T. bottae			1	1			1	1
D. ordii			7	1			7	1
Peromyscus sp.			6	2	1	1	7	3
F. rufus	1	1	2	1			3	2
O. hemionus	2	2	4	1			6	3
A. americana	1	1	1	1			2	2
O. canadensis	3	1					3	1
FALCONIFORMES	1						1	
Buteo sp.	7		101		1	1	109	1
B. jamaicensis	2	1	98	9			100	10
B. swainsoni			6	1			6	1
B. lagopus	1	1					1	1
B. regalis			2	1			2	1
A. chrysaetos	15	2	31	2			46	4
PASSERIFORMES	1	1					1	1
C. corax			3	1			3	1
Sialia sp.			1	1			1	1
No. unknown	61		163		34		258	
% unknown	39.9		23.8		64.1		29.1	
Totals	153	15	685	39	53	6	891	60

Table 8.114. Percentages of bird taxa found in Plaza 1, Grid 30.

Taxon	% of those from Alto
Buteo sp.	91.6
B. jamaicensis	79.4
B. swainsoni	85.7
B. lagopus	100.0
B. regalis	66.7
A. chrysaetos	55.4
C. corax	27.3
Sialia sp.	33.3

Observations

Immatures. The filling of the pit was probably a fairly discrete event rather than a gradual one. The low number of prairie dog (C. gunnisoni (Table 8.115) and few immatures of any taxon suggest a late fall or winter occurrence.

Butchering. Table 8.116 presents the information on butchering. The locations of those found on cottontail (Sylvilagus), jackrabbit (L. californicus), and mountain sheep (O. canadensis) are typical of the patterns for those taxa. Those for the Aves are not as commonly recorded. One reason may be that these small cuts in the joint area are so small that a microscope was necessary to detect them. This suggests that extreme care was taken to disarticulate the proximal radius and ulna from the humerus. The Swainson's hawk (B. swainsoni) radius had a different kind of cut. A long, microscopic cut was made for most of the length of the radius. This may be the result of removing the skin and feathers from the wing.

Checking. Again, if this pit represents a discrete fill event, little checking would be expected. Because the pit was not sealed, some could legitimately be found in the upper pit fill. The percentages recorded included 20.2 percent for Surface 3 fill, 9.9 percent in Layer 7, and 3.7 percent in Layer 10.

Burning. The overall percentages of burned and "cooking brown" elements are low (Table 8.117), similar to those found in the upper fill of rooms and rarely associated with trash deposits such as this. Almost all of the burning and "cooking brown" were associated with the three small, economic taxa and the small-to-medium mammals. Only one of the 296 avian elements was altered.

Articulations. Several articulations from the upper pit fill were not recorded because they were hastily removed by a workman. Lower ones were removed as units and the locations recorded. Table 8.118 gives only those that were known to have been articulations. One of the cottontail (Sylvilagus) articulations is quite unusual and suggests that about half of the rabbit was discarded. An innominate from this articulation had carnivore tooth punctures. Otherwise, it is apparent that mostly wings were discarded.

Discussion and Conclusions. Both the species distribution and butchering suggest that something unusual resulted in the contents of this pit. The Aves are over-represented, and the pattern of butchering is consistent enough to merit further investigation.

Table 8.119 gives the body-part distribution for all of the Aves materials from the test. It should be noted that 89.2 percent of the elements identified to the species level, and 90.8 percent of the Buteo species elements were complete, so duplication due to fragmentation is minimal. The percentages at the element level show some clustering; how-

Table 8.115. Percentages of immature and young adult elements in Plaza 1, Grid 30.

	Sylvilagus		*L. californicus*		*C. gunnisoni*	
	imm.	y.a.	imm.	y.a.	imm.	y.a.
Surface 3 fill		2.6	22.2			
Layer 7	1.0	22.7		3.1		
Layer 10		14.3				

Table 8.116. Butchering recorded for Plaza 1, Grid 30.

Provenience:	Taxon	Element	Butchering	Location
Floor 3 fill				
	O. canadensis	metatarsal	light cuts	distal medial
	A. chrysaetos	ulna	light cuts	proximal lateral
Layer 7:				
	Sylvilagus sp.	femur	portion removed diag. cut	distal
		calcaneus	portion removed diag. cut	distal
		calcaneus	portion removed str. cut	lengthwise in half
	L. californicus	calcaneus	portion removed str. cut	lengthwise in half
	B. jamaicensis	radius (3)	light cuts	proximal lateral
		ulna (9)	light cuts	proximal lateral
	B. swainsoni	radius	light cuts	lengthwise
	A. chrysaetos	ulna	light cuts	proximal lateral
	C. corax	ulna	light cuts	proximal lateral

Table 8.117. Percentages of burning and "cooking brown" by taxon for Plaza 1, Grid 30.

Taxon	Provenience	None	Complete	Slight	"Cooking brown"
Sylvilagus sp.	Surface 3 fill	94.7			5.3
	Layer 7	80.4	0.5	1.0	18.0
	Layer 10	85.7	14.3		
L. californicus	Layer 7	98.1		1.6	9.4
T. bottae	Layer 7			100.0	
F. rufus	Layer 7	50.0			50.0
Small-med. mam.	Surface 3 fill	66.7	33.3		
	Layer 7	98.5	1.5		
Aves (n = 1)	Surface 3 fill				100.0
Unknown (n = 24)	Layer 7	91.7			8.3
Totals	Surface 3 fill	97.4	0.6		2.0
	Layer 7	92.7	0.3	0.6	6.4
	Layer 10	96.2	3.8		

Table 8.118. Articulated elements from Plaza 1, Grid 30.

Provenience	Taxon	Body portion	Elements
Surface 3:			
	A. chrysaetos	2 left, 1 right	radius, ulna, carpometacarpus
Layer 7:			
	Sylvilagus sp.	right	humerus and ulna
		right and left	ribs, vertebrae, sacrum, innominates, femurs and tibias
	Buteo sp.		2 phalanges
			2 wing phalanges
	B. jamaicensis	4 left, 3 right	radius, ulna, carpometacarpus, carpals
			wing phalanges
		2 left, 1 right	radius and ulna
		4 right	tarsometatarsus and phalanges
	B. swainsoni	left	radius, ulna, carpometacarpus
	B. regalis	left	radius and ulna
	A. chrysaetos	right	radius and ulna

Table 8.119. Aves body part distribution from Plaza 1, Grid 30.

Element	Buteo n	Buteo &	B. jam n	B. jam &	B. swai. n	B. swai. &	B. lag. n	B. lag. &	B. reg. n	B. reg. &	A. chry. n	A. chry. &	Misc. n	Misc. &	Aves n	Aves &	Total n	Total &
Skull											5	10.9			2	7.7	7	2.4
Mandible											1	2.2			1	3.8	2	0.7
Sternum	2	1.8															2	0.7
Scapula											1	2.2					1	0.3
Corocoid											1	2.2	1	16.7			2	0.7
Furculum	1	0.9									1	2.2					2	0.7
Ribs															7	26.9	7	2.4
Radius			15	15.0	2	33.3			1	50.0	5	10.9	1	16.7	1	3.8	25	8.4
Ulna	2	1.8	16	16.0	2	33.3			1	50.0	3	6.5	2	33.3			26	8.8
Carpomet.	1	0.9	17	17.0	2	33.3					5	10.9	2	33.3			27	19.1
Carpal	25	22.9	8	8.0							4	8.7			2	7.7	39	23.2
W. phalanx	32	29.3	9	9.0							16	34.8			3	11.5	60	0.3
Innominate											1	2.2					1	0.3
Tibio.	1	0.9	8	8.0							1	2.2			1	3.8	3	1.0
Tarso.	1	0.9					1	100.0			1	2.2					11	3.7
Tarsals			2	2.0													2	2.7
Phalanx	44	40.4	25	25.0							1	2.2			2	7.7	72	4.3
Unknown															5	19.2	5	1.7
TOTALS	109		100		6		1		2		46		6		26		296	

ever, only when the body-part distribution is compared to the expected can the magnitude of the selection for parts be seen. Elements that are notably absent or hardly represented include the humerus, femur, and tibiotarsus. These elements were often used for tubular beads (personal observation).

Table 8.120 gives the approximate number of elements and percentage of body parts that should be found in any bird and the percentage found in our sample. Wing elements include the humerus to the wing tip; leg elements include the femur to the terminal phalanges; and all other elements were lumped under axial. Here it is evident that the wing parts are over-represented, legs slightly under-represented, and the axial parts vastly under-represented.

Taking this a step further, we used the 19 individual birds from Table 8.113 (10 B. jamaicensis, 1 B. swainsoni, 1 B. lagopus, 1 B. regalis, 4 A. chrysaetos) to calculate how many elements of each part should have been present if all elements and individuals were complete. Each wing was considered to be comprised of 10 elements, a leg of 20 elements, and axial parts of 55 elements. Thus, 19 birds should have 380 wing elements, 760 leg elements, and 1,045 axial elements. Table 8.121 indicates that wing parts are far more common than expected, and axial parts are far less common than expected. Leg elements come closest to what was expected. Table 8.122 gives the number of wings and legs represented by each taxon.

Of the hawks and eagles represented, only the red-tailed hawk (B. jamaicensis) is now a common resident of the canyon (Cully 1985, Scurlock 1969), and this may account for it being the most abundant in the group. The golden eagle (A. chrysaetos) is uncommon but resident, and this may account for its second place numerically. The other three taxa are not found in the canyon today but all are within range. Some may represent imports.

In conclusion, it appears that this pit represents a ceremonial deposit. Articulated bird wings were probably used in costumes or as fans as were the lower bird legs. Several ornaments from this pit also suggest a ceremonial deposit (Mathien 1985). A quartz crystal, a pendant, and beads of calcite, argillite, and Spondylus were all found.

The reason for this deposit and exact dating are open to speculation. The fact that the early layers of the Trash Mound have a very similar ratio of cottontail (Sylvilagus) to jackrabbit (L. californicus) elements and Pre-Alto has a different one may suggest that this pit and the Red Mesa construction layers in the Trash Mound are related. If this is true, the pit could represent either a ceremonial closing of the site that had existed before Pueblo Alto or, more likely, represents some event that was associated with the beginning of construction of a major site.

Table 8.120. Comparison of percentages of body parts expected to those found for Plaza 1, Grid 30.

Body part	No. expected	%	% found
Wing	20	17.4	59.8
Leg	40	34.8	29.7
Axial	55	47.8	8.9
Unknown			1.7

Table 8.121. Number of expected and found elements for Plaza 1, Grid 30.

Body part	No. expected[a]		No. found	
Wing elements	380	17.4%	177	60.8%
Leg elements	760	34.8%	88	30.2%
Axial parts	1,045	47.8%	26	8.9%
TOTALS	2,185		291	

[a]19 times the number of elements in each body part.

Table 8.122. Wings and legs for each taxon for Plaza 1, Grid 30.

	Wings		Legs	
Taxon	Left	Right	Left	Right
B. jamaicensis	10	8	4	4
B. swainsoni	1	1		1
B. lagopus				1
B. regalis	1			
A. chrysaetos	4	2	1	1
C. corvax		1		
Sialia	1			
TOTALS	17	12	5	7

The Eastern Plaza Tests

The plaza area fronting the eastern rooms was extensively cleared and one deep test made in the northeast corner. The overburden was removed by backhoe, and very little was recovered from the structural rubble. Except for the fill above Surface 1, the sample sizes are quite small.

In an attempt to detect activity areas, this portion of the plaza was divided into five units that roughly correspond to feature areas. The extreme northeast corner and deep test were considered Unit 1; the features and area between the test and Kiva 14 were Unit 2; the area between Kiva 14 and Plaza Feature 4 was Unit 3; the area between Plaza Feature 4 and Kiva 12 was Unit 4; and the southeast corner was Unit 5. Table MF-8.18 gives the proveniences and counts that made up each of the units.

Because the aim of these divisions was to identify possible activity areas or at least differences in the use of the areas, each unit will be treated separately, then comparisons will be made.

Unit 1. The single deep test for this portion of the plaza was located in this northernmost unit. Only Surface 1 was extensively cleared, and it resulted in a fair sample. It is interesting that both jackrabbit (*L. californicus*) and turkey (*M. gallopavo*) had fairly high percentages in this and the wall-clearing sample. Table 8.123 gives the counts, percentages, and MNIs for Unit 1.

Immatures. Only Surface 1 and Surfaces 10 and 11 had samples large enough for observations to be made. The Surface 1 materials were primarily from two layers just above the surface. Table 8.124 gives the percentages for Surface 1. The large percentages of immature elements in this unit are partially due to a relatively small sample size. All of the small, economic taxa elements from Surfaces 10 and 11 were mature.

Checking. Again, sample sizes make Surfaces 1 and 10 and 11 fill the most reliable. Checking from above Surface 1 (Table 8.125) is considerably lower than that from the west plaza tests, 17 percent as compared to 40.1 percent. This is primarily because the east plaza materials did not include much of the upper overburden, which was included with the west plaza tests.

Burning. Burning and "cooking brown" were low for each surface grouping (Table 8.126). Most of this was found in the small, economic taxa and small-to-medium mammals. The turkey (*M. gallopavo*) elements from the Surface 1 fill included 90.3 percent unburned, 6.4 percent partially burned, and 3.2 percent slightly burned.

Unit 2. Most of the elements from this unit were from the first surface. Sheer numbers of elements suggest that more activities were associated with Grids 125 and 273. This area had a number of pits and may

Table 8.123. Number of elements, percentages, and MNIs for East Plaza Unit 1.

	LATE MIX												GALLUP			RED MESA							
	Surface 1			Sur. 3 & 4			Sur. 5-6			Sur. 7 & 9			Sur. 10 & 11			W. trench			Profile			Totals	
	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	19	9.8	3				7	33.3	1	3	23.1	1	9	11.5	1							38	6
L. californicus	39	20.1	2	10	55.5	1	4	19.0	1	5	38.5	2	12	15.4	1				1	14.3	1	71	8
A. leucurus																			1	14.3	1	1	1
S. variegatus	1	0.5	1																			1	1
C. gunnisoni	20	10.3	4	6	33.3	1	1	4.7	1				5	6.4	1	1	11.1	1	1	14.3	1	34	9
D. ordii	2	1.0	1										1	1.3	1				1	14.3	1	4	3
Peromyscus sp.													1	1.3	1							1	1
O. hemionus				1	5.5	1	1	4.7	1				2	2.6	1							4	3
A. americana	1	0.5	1																			1	1
O. canadensis							1	4.7	1				2	2.6	1							3	2
M. gallopavo	31	16.0	1										1	1.3	1							32	2
C. auratus													1	1.3	1							1	1
Unknowns	81	41.7		1	5.5		7	33.3		5	38.5		44	56.4		8	88.9		3	42.9		149	43.8%
Totals	194		13	18		3	21		5	13		3	78		9	9		1	7		4	337	38

Table 8.124. Immature and young adult elements from East Plaza, Unit 1, Surface 1.

Taxon	% immature	% young adult
Sylvilagus sp.	10.5	15.8
L. californicus	2.6	7.7
C. gunnisoni	25.0	40.0

Table 8.125. Percentages of checked bone in East Plaza, Unit 1.

Surface	% checked
1 (Grid 35)	16.6
1 (Grid 272)	28.6
1 (35 & 272)	17.0
3	0
4	0
5	16.7
6	26.7
7	36.7
9	50.0
10,11	19.2
Wall Trench	44.4

Table 8.126. Summary of burning and "cooking brown" from East Plaza, Unit 1.

Surface	None	Complete	Partial	Slight	"Cooking brown"
1	95.9	0.5	1.0	0.5	2.1
3,4	100.0				
5,6	90.4			4.8	4.8
7,9	92.1			7.7	
10,11	93.6	2.6		2.6	1.3

have been the locus of several kinds of activity. Table 8.127 gives the element counts, percentages, and MNIs for this unit.

There is a lot of fluctuation from grid to grid in the percentages of the small economic mammals and turkey (*M. gallopavo*). Table 8.128 shows the effect of small sample sizes. Although the end result is essentially equal, there are large differences on a grid-to-grid basis.

Immatures. Although the frequencies are low and the excavator felt that the materials were not occupational, immatures were found among all three of the small mammals (Table 8.129).

Checking. The percentages of checked bone are given by the grid number (Table 8.130). The two northernmost grids have the least checking and probably had deeper overburden protecting the fill.

Burning. Burning was very infrequent for these grids. The only alteration recorded was "cooking brown" for a prairie dog (*C. gunnisoni*) element and an artiodactyl long bone fragment.

Unit 3. All of the materials from this group were associated with Surface 1. None of the grids had a very large sample. Table 8.131 gives the element counts, percentages and MNIs for this unit.

Immatures. A single prairie dog (*C. gunnisoni*) young adult element was found (16.7 percent).

Checking. Checking was again high except for one grid (Table 8.132).

Burning. Burning was very low with 98.8 percent unburned and a single completely burned unknown element.

Unit 4. Materials were recovered from Surfaces 1 and 2 in this unit. One grid, 115, produced most of the sample, 88.2 percent. Table 8.133 gives the element counts, percentages, and MNIs for this unit.

Immatures. No immature or young adult elements were found for the three small, economic taxa in this unit, but this is probably due to the small sample size.

Checking. The large percentage of checking (72.1 percent) suggests that Surface 1 was exposed for a fair amount of time. The amount for Surface 2 was low at 14.3 percent, which may have been due to the small sample or may indicate a much shorter period of exposure.

Burning. Burning was low for both surfaces. Surface 1 had 4.4 percent completely burned and 1.2 percent partially burned. For Surface 2 one element (14.3 percent) was completely burned.

Table 8.127. Number of elements, percentages, and MNIs for East Plaza, Unit2.

	Surface 1			Surface 2			Total	
Taxon	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	37	14.3	3	1	33.3	1	38	4
L. californicus	37	14.3	2				37	2
C. gunnisoni	41	15.8	3	1	33.3	1	42	4
D. ordii	4	1.5	2				4	2
Peromyscus sp.	1	0.4	1				1	1
Neotoma sp.	2	0.8	2				2	2
O. hemionus	1	0.4	1				1	1
O. canadensis	2	0.8	1				2	1
M. gallopavo	29	11.2	2				29	2
Unknown	105	40.5		1	33.3		106	
Totals	259		17	3		2	262	19

Table 8.128. Comparative percentages by grid, East Plaza, Unit 2.

Grid	*Sylvilagus*	*L. californicus*	*C. gunnisoni*	*M. gallopavo*	Sample size
55	7.2	20.8	13.6	10.4	125
75	4.2		4.2	12.5	24
273	30.0	13.7	18.7	2.5	80
274	10.0		26.7	36.7	30

Table 8.129. Percentages of immature and young adult elements for East Plaza, Unit 2.

Taxon	Immature	Young adult
Sylvilagus	2.7	24.3
L. californicus	2.7	32.4
C. gunnisoni	7.3	29.3

Table 8.130. Percentage of checking by grid for East Plaza, Unit 2.

Grid	%
55	24.8
75	54.2
273	21.3
274	53.3

Table 8.131. Number of elements, percentages, and MNIs for East Plaza, Unit 3.

Taxon	n	%	MNI
Sylvilagus sp.	1	1.2	1
L. californicus	6	7.2	1
C. gunnisoni	6	7.2	1
O. hemionus	1	1.2	1
O. canadensis	1	1.2	1
M. gallopavo	36	43.4	1
Unknown	32	38.5	
Totals	83		6

Table 8.132. Percentage of checking by grid for East Plaza, Unit 3.

Grid	% checked
93	50.0
95	47.0
273	13.3

Table 8.133. Number of elements, percentages, and MNIs for East Plaza, Unit 4.

	Surface 1			Surface 2			Total	
	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	1	1.5	1				1	1
L. californicus	1	1.5	1				1	1
C. gunnisoni	2	2.9	1	2	28.6	1	4	2
Canis sp.	1	1.5	1				1	1
O. hemionus	1	1.5	1	1	14.3	1	2	2
O. canadensis	1	1.5	1				1	1
M. gallopavo	17	25.0	2				17	2
Unknown	44	64.7		4	57.1		48	
Totals	68		8	7		2	75	10

Table 8.134. Number of elements, percentages, and MNIs for East Plaza, Unit 5.

	Surface 1			Surface 2			Total	
	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	13	38.2	1	2	16.7	1	15	2
L. californicus				2	16.7	1	2	1
C. gunnisoni	4	11.8	1	3	25.0	2	7	3
N. cinerea	1	2.9	1				1	1
O. canadensis				1	8.3		1	1
B. jamaicensis	1	2.9	1				1	1
M. gallopavo	1	2.9	1				1	1
Unknown	14	41.2		4	33.3		18	
Totals	34		5	12		5	46	10

Unit 5. Unfortunately, this unit had the smallest sample size for the east plaza. This area was separated from the northern grids by a jacal wall and had numerous sherds and lithics that suggest an activity area.

All but two of the cottontail (Sylvilagus) from Surface 1 were from an articulation consisting of six thoracic vertebrae and several ribs. The elements for both the Aves were ulnas, an unusual coincidence. Even more unusual was a large portion of a cranium of a mountain sheep (O. canadensis) found in the upper fill of Grid 175. Table 8.134 gives the element counts, percentages, and MNIs for this final unit.

Immatures. The only nonadult elements recorded were for the articulated cottontail (Sylvilagus) parts on Surface 1 of Grid 280. These accounted for 84.6 percent of that taxon.

Checking. Checking was lighter than for the more northern grids. Surface 1 had 20.6 percent of the bone checked and Surface 2 had 25 percent. This suggests that the area was protected by the jacal wall and/or deposition was rapid without much exposure.

Burning. This was again light with one prairie dog (C. gunnisoni) element recorded as "cooking brown" (2.9 percent) and an artiodactyl element that was completely burned (2.9 percent).

Conclusions. Comparisons of the units provide little information. Checking appears to be fairly random with some protection afforded by the walls. The species distribution for Units 1 and 2 are the most similar of any two units and may suggest that they were a single activity area. The large sample from Grid 55 is probably the result of much work put into defining the features in the area rather than intensity of use (Robert Powers, personal communication, 1982). This does contrast markedly with Unit 5, which also had numerous features but from which little bone was recovered.

Fair numbers of turkey (M. gallopavo) elements were found in many of the grids. Table 8.135 gives rough spatial locations and percentages of this species. The abundance of this taxon suggests late use of the area.

Burning was low in all of the units and, in this respect, is similar to the upper fill of rooms as opposed to domestic refuse.

The Southern Plaza Tests

Various tests and a trench across the southern portion of the plaza are included here for discussion. One thing that is very different from the other areas of the plaza discussed so far is that Surface 1 materials were recorded as Late Mix in ceramic association, and these immediately overlay Red Mesa materials with Surface 2. There were not the multiple surfaces found in the west, north, or east areas. This could be due to erosion as there were no protective walls in this area, or this part of the plaza may not have been used as intensively.

Three groupings will be used. Other Structure 6 forms one of these, and the Plaza Surfaces 1 and 2 are the others. Table MF-8.19 gives the provenience breakdown and ceramic associations for these.

Table 8.136 gives the element counts, percentages, and MNIs for each of these three groupings. They will be discussed separately as OS 6 and the plaza because a comparison between a plaza trench and wall clearing would not be too productive.

Other Structure 6. This unusually shaped structure was extensively cleared to determine its outline. The upper fill and structural rubble produced a good and unusual sample of bone. The percentage of prairie dog (*C. gunnisoni*) is extremely high, comparable only to the upper fill of Kiva 10, which had 25.6 percent of this taxon. Unlike Kiva 10 and all other proveniences with a moderate amount of prairie dog (*C. gunnisoni*), the percentages of cottontail (*Sylvilagus*) and jackrabbit (*L. californicus*) are very close. Generally, if prairie dog has a high percentage, then jackrabbit is almost as high or even higher and cottontail is relatively low.

The amount of turkey (*M. gallopavo*) is also small, especially compared to the wall-clearing sample and plaza tests in the eastern part of the site. This suggests that the structure may have been abandoned earlier than the east, possibly even in late Gallup times.

Immatures. Even though this is from wall clearing, the sample size is fairly large. The immature element percentages for cottontail (*Sylvilagus*) and prairie dog (*C. gunnisoni*) are similar. The large number of prairie dog (*C. gunnisoni*) and many immature elements indicate late spring to fall deposition. Table 8.137 give the percentages of immature and young adult elements for the three small, economic taxa.

Burning. The overall percentages of burning and "cooking brown" are quite low, again similar to upper room fill. Table 8.138 gives this information for those taxa in which they occurred.

The South Plaza. The sample sizes for both surfaces were small, and this prevents many statements. Less-than-mature elements were found in both units. Table 8.139 gives the percentages.

Checking. Checking was high for both surfaces; 36.8 percent for Surface 1 and 72.8 percent for Surface 2. The very large amount for Surface 2 suggests that this unit of fill was exposed for a long time.

Burning. Burning and "cooking brown" were low. Surface 1 had a small-to-medium mammal fragment completely burned (5.1 percent). The Surface 2 burning was all confined to the unidentified elements, resulting in 94.2 percent unaltered, 4.8 percent completely burned, and 1 percent "cooking brown."

Table 8.135. Percentages of turkey (M. gallopavo) by grid location, East Plaza.

Grid No.	%	Grid No.	%
35	12.8	272	100.0
55	10.4	273	2.5
75	12.5	274	36.7
95	51.5	275	13.3
115	28.3	276	0.0
135	0.0	277	0.0
155		278	0.0
175	0.0	279	33.3
196	0.0	280	0.0

Table 8.136. Number of elements, percentages, and MNIs for the South Plaza area.[a]

	LATE MIX						RED MESA				
	OS 6			Surface 1			Surface 2			Total	
	n	%	MNI	n	%	MNI	n	%	MNI	n	MNI
Sylvilagus sp.	37	15.2	2	4	21.0	2	21	20.4	1	62	5
L. californicus	33	13.6	2	2	10.5	1	9	8.7	2	44	5
C. gunnisoni	80	32.9	5	1	5.3	1(1)	1	1.0	1	82	7
T. bottae	2	0.8	1							2	1
D. ordii	5	2.0	2							5	2
Neotoma sp.	1	0.4	1							1	1
O. hemionus	7	2.9	1				5	4.8	1	12	2
A. americana	2	0.8	1				3	2.9	1	5	2
O. canadensis	1	0.4	1							1	1
A. chrysaetos							1	1.0	1	1	1
M. gallopavo	12	4.9	1							12	1
Unknown	63	25.9		12	63.1		63	61.2		138	
Totals	243		17	19		4	103		7	365	28

[a]Number in parentheses represents an articulated skeleton.

Table 8.137. Percentages of immature and young adult elements for OS 6.

	Immatures	Young adult
Sylvilagus sp.	13.5	43.2
L. californicus	3.0	6.1
C. gunnisoni	13.7	23.7

Table 8.138. Percentages of burning and "cooking brown" for OS 6.

	None	Complete	"Cooking brown"
L. californicus	90.9		9.1
C. gunnisoni	91.2		8.5
O. hemionus	85.7	14.3	
Unknown (n = 4)	25.0	75.0	
Totals	94.2	1.6	4.1

Table 8.139. Percentages of immature and young adult elements for the South Plaza.

	Sylvilagus		*L. californicus*		*C. gunnisoni*	
	imm.	y.a.	imm.	y.a.	imm.	y.a.
Surface 1	25.0	25.0				100.0
Surface 2						100.0

Plaza 2

Portions of five grids and OS 5 in the plaza to the east of Pueblo Alto were excavated. As many as 18 surfaces were identified in some of the grids. Most of these were dated by Windes as Late Mix ceramic association, with Gallup below Surface 7. Ceramic materials were scarce from this area, which made dating difficult.

The most noteworthy features of the area are OS 5--a staircase that underwent several modifications--and two large firepits built against the ruin wall and associated with the latest surface.

Table MF-8.20 gives the numbers of elements for Plaza 2 by the excavational unit or grid and the surface number. Table 8.140 gives the numbers and MNI counts by the surface number.

The Proveniences

Surface 1. The uppermost surface and its associated pits were responsible for over half of the faunal remains. This included overburden and wall fall, which added postoccupational elements, such as an immature cottontail (*Sylvilagus*) skeleton, to the collection.

The elements present suggest that some may have been the result of an activity area where small mammals were partially processed before cooking or taken into the site. Of the elements present 70.2 percent of the cottontail (*Sylvilagus*), 40.7 percent of jackrabbit (*L. californicus*), and 40 percent of the prairie dog (*C. gunnisoni*) were lower limb and foot elements. Some of these were articulated.

This unit of fill had the smallest percentage of unidentifiable fragments for the area. This may be due to a reduction in the amount of traffic through the area as compared to the lower surfaces or, more likely, the amount of postoccupational overburden.

The two large firepits associated with this surface (OP 2 and OP 3) both had relatively large numbers of bones. OP 3 contained two immature cottontail (*Sylvilagus*) skeletons high in the fill and a kangaroo rat (*D. ordii*) skeleton. Again, numerous lower limb and foot elements were found. Only one element was burned, a small, mammal, long bone fragment. OP 3 also contained many foot elements, but the total was only 17 percent. None of these was burned. The taxa, articulations, and lack of burning suggest that these postdated to the use as firepits.

Surface 2. The highest number of turkey (*M. gallopavo*) elements appears with this surface. Foot elements were again common for the three small, economic taxa (53.8 percent, 60 percent and 51.8 percent).

Surface 3. Grid 181 had a fish vertebra (*Gila* sp.) in the fill above this surface. This is one of only two fish elements found at Pueblo Alto.

Table 8.140. Number of elements and MNIs for Plaza 2.[a]

	Surface 1						Surf. 2		Surf. 3		Surf. 4		Surf. 5		Surf. 6		Surf. 7		Surf. 8		Surf. 9		Surf. 10		Surf. 11		Rest		Totals	
			OP 2		OP 3																									
Taxon	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI	n	MNI
Sylvilagus sp.	124	7(1)	29	4(2)	35	2	13	2	9	1	4	1	4	1	2	1					2	1	6	1			2	1	230	22
L. californicus	27	2	7	1			5	1	7	2					1	1	3	1	1	1	10	1	1	1			3	1	65	12
C. gunnisoni	30	3	15	2	1	1	27	3	11	2	3	1	3	1					6	2	2	1							98	16
T. bottae	5	1	4	1			1	1																					10	3
Perognathus sp.	2	1																											2	1
D. ordii	8	2	2	2(1)					1	1																			11	5
D. spectabilis			1	1																									1	1
Reithrodontomys	1	1(1)																											1	1
Peromyscus sp.	8	2(1)	3	1					1	1	3	1	1	1											3	1	1	1	20	8
Onychomys			1	1(1)																									1	1
Neotoma sp.	1	1	8	1																									9	2
N. cinerea							1	1																					1	1
Canis sp.																							1	1					1	1
C. familiarus													1	1															1	1
O. hemionus	1	1					2	1			2	1	1	1									1	ant					7	4
A. americana							1	1																					1	1
O. canadensis	1	1																											1	1
M. gallapavo							7	1															2	1	2	1	1	1	12	4
Passeriformes	3	1	1	1	1	1	1	1					1	1															7	5
Icteridae											7	4																	7	4
S. undulatus													1	1															1	1
P. douglassi			2	1																									2	1
C. velox	2	1																											2	1
Gila sp.									1	1																			1	1
No. unidentified	93		27		23		36		20		33		31		16		8		25		28		8		11		13		372	
% unidentified	30.4		27.0		38.3		38.3		40.0		63.5		72.1		84.2		72.7		78.1		66.7		42.1		68.7		65.0			
Totals	306	24	100	16	60	4	94	12	50	8	52	8	43	7	19	2	11	1	32	3	42	3	19	4	16	2	20	4	864	98
% checked			35.2				27.7		14.0		13.4		11.6		36.8		18.2		6.2		11.9		10.5		25.0		10.0			

[a]Number in parentheses represents an articulated skeleton.

Below this surface the sample sizes are so small that little can be pointed out, but the bird beaks deserve mention. The locations of these can be found in Table 8.141. Thirteen fragments of bird beaks from this small sample (37 bird bones total) is quite unusual. This particular part of the bird is not usually well preserved. For example, only 2 percent of the 987 turkey elements from Pueblo Alto were dentaries or dentary fragments from immature individuals.

The only reference relating to the use of this element was McKusick's (Hayes 1981) notation that three raven (C. corax) "scratchers" were found at Gran Quivira and a similar specimen from Bc 51 at Chaco Canyon. The only ethnographic reference found was for the Navajo, who used raven or crow beaks in the "Enemy Way" sing to symbolize the devouring of fallen foe by the scavenger bird. The use of those from Gran Quivira resulted in polish on the anterior tips. This was not found on the Plaza 2 specimens, but a ceremonial usage of these elements is still a possibility.

Observations

Immatures. Table 8.142 gives the percentages of immature and young adult elements found with those surfaces that had more than a few elements.

Checking. Checking ranged from high but typical for a plaza surface to relatively low. Compared to Surfaces 3, 4, and 5, Surface 6 has an interesting increase in the amount of checking; but this could be due to the small sample for this surface. Table 8.140 gives these percentages by surface.

Burning. Table 8.143 presents the percentages of burning and "cooking brown" for those taxa and surfaces that had these. The percentages are generally low and could support the idea of an initial processing area rather than a discard or food preparation/consumption area. As noted previously, only one element from the large firepits was burned.

Conclusions. This area of the site had an unusual array of species. Much of this was due to the peripheral location and to meticulous excavation. Two of the species of mice, the Icteridae, two lizard species, and the fish vertebra are all rare or anomalous finds. The presence of the bird beaks suggests that some sort of ceremony (or the discards from it) was habitually held here or that entrance to or exit from the main plaza during such events was from this area. The articulated rabbit feet from the first surface suggest that processing was done in that area for later use.

Table 8.141. Location of bird beaks in Plaza 2.

Surface	Grid	Taxon	Element	Fragmentation	Number
1	OP 1	Passeriformes	mandible	anterior fragment	1
2	201	Passeriformes	mandible	anterior fragment	1
4	181	Icteridae	maxillary	anterior fragment	4
4	181	Icteridae	mandible	anterior fragment	3
4	201	Aves	maxillary	anterior fragment	1
5	181	Passeriformes	mandible	anterior fragment	1
10	201	*M. gallapavo*	mandible	complete	1
11	OS 5	*M. gallapavo*	mandible	complete	1

Table 8.142. Percentages of immature and young adult elements from Plaza 2.

Provenience	Sylvilagus sp.		L. californicus		C. gunnisoni	
	Immature	y. adult	Immature	y. adult	Immature	y. adult
Surface 1	2.4	9.7		11.1	3.3	26.7
Other Pit 2	48.3	3.4	85.7	14.3	33.3	6.7
Other Pit 3	71.4	2.9				100.0
Surface 2	7.7	15.4		20.0	3.7	63.0
Surface 3			14.3	14.3		45.4

Table 8.143. Percentages of burning and "cooking brown" for Plaza 2.

Surface	Taxon	None	Complete	Partial	Slight	"Cooking brown"
1	*Sylvilagus*	99.5	0.5			
	L. californicus	97.1	2.9			
	Small-med. mamm.	97.5	2.5			
	Unknown	85.7		14.3		
	Total	99.0	0.8	0.2		
3	*Sylvilagus*	88.9	11.1			
	Total	98.0	2.0			
5	*Sylvilagus*	75.0				25.0
	Passeriformes				100.0	
	Small-med. mamm.	83.3				16.7
	Unknown	87.5	12.5			
	Total	88.4	2.3		2.3	7.0
6	*Sylvilagus*	50.0	50.0			
	Total	94.7	5.3			
9	Small-med. mamm.	95.2				4.8
	Total	97.6				2.4
10	*Sylvilagus*	83.3	16.7			
	Rodent					100.0
	Total	89.5	5.3			5.3
13	Small-med. mamm.	66.7	33.3			
	Total	88.9	11.1			

Chronological Variation

Numerical Comparisons

Pueblo Alto was built and occupied from roughly A.D. 1020 until around A.D. 1140 (Chapter 10, Volume 1, this report). Presumably, the occupation was long enough for there to have been some change in subsistence at the site. This would largely be the result of an increasing population within the canyon, which would have affected the local resources and forced the inhabitants to either intensify within their area of exploitation or to expand it.

Tables 8.144 and 8.145 give the counts and MNIs for the three ceramic associations and a mixed, unknown, or wall-clearing group. The MNIs are additive; they are the result of taking the more than 199 provenience units in the Provenience Reports section and computing the totals. This results in a maximum sample MNI that is based on very different aggregation methods (i.e., different proveniences were divided according to characteristics of the individual unit). The percentages for each of these are then graphed in Figures 8.5 and 8.6. The curves are quite different and, as Table 8.146 shows, there are differences in the rank (again based on the percentages) between elements and MNIs and from ceramic group to ceramic group. This is especially true of the Late Mix period.

To summarize briefly, the Red Mesa and Gallup curves indicate very similar utilization of the small mammal species. Cottontail is most numerous, followed by jackrabbit, then prairie dog. The Late Mix assemblage is quite different in that the curve for the number of elements suggests an almost equivalent use of all three species, and the MNI curve indicates that cottontail and prairie dog are almost equal with lesser amounts of jackrabbit. Red Mesa deposits do have more carnivore and raptor remains than later periods and fewer deer. The Gallup and Late Mix curves suggest similar use of the artiodactyls, mostly deer, with fewer numbers of pronghorn and mountain sheep. Turkey is abundant only in the Late Mix deposits.

To evaluate any of this information, it is necessary to consider where the sample is coming from. Table 8.147 gives the percentages of three ceramic associations. The nontrash fill of structures comprises the first; plaza deposits are generally from plaza areas, although some sheet trash is included in the Red Mesa sample; and trash is major trash deposits such as the Trash Mound or trash-filled structures but may predate Pueblo Alto proper.

Economic Comparisons

Looked at from an economic point of view, Table 8.148 and Figure 8.7 give the estimated meat available and consumed for a sample from each time

Table 8.144. Number of elements by ceramic association.

Taxon	Red Mesa		Gallup		Late Mix		Mixed		Total	
	n	%	n	%	n	%	n	%	n	%
M. californicus					4	0.1			4	
S. auduboni	1,006	41.3	3,234	40.3	1,435	24.6	234	34.8	5,909	34.9
S. nuttalli			1						1	
L. californicus	697	28.6	2,417	30.2	1,471	25.2	213	31.7	4,798	28.3
L. americanus			1						1	
A. leucurus	3	0.1	2		4	0.1	1	0.1	10	0.1
S. variegatus					1		1	0.1	2	
Squirrel sp.			2		2				4	
C. gunnisoni	178	7.3	992	12.4	1,379	23.7	67	10.0	2,616	15.4
S. aberti			6	0.1	2				8	
T. bottae	10	0.4	21	0.3	83	1.4	4	0.6	118	0.7
Perognathus sp.			5	0.1	9	0.1			14	0.1
D. ordii	14	0.6	61	0.8	55	0.9	4	0.6	134	0.8
D. spectabilis	1		14	0.2	2		1	0.1	18	0.1
Reithrodontomys					3				3	
Peromyscus sp.	51	2.1	596	7.4	88	1.5	4	0.6	739	4.4
Onychomys					3				3	
Neotoma sp.			26	0.3	23	0.4	6	0.9	55	0.3
N. cinerea	1		4		6	0.1	1	0.1	12	0.1
N. stephensi			2		1				3	
N. albigula			1		2		1	0.1	4	
M. mexicanus							1	0.1	1	
E. dorsatum							1	0.1	1	
Canis sp.	11	0.4	6	0.1	19	0.3	1	0.1	37	0.2
C. latrans	13	0.5			1		2	0.3	16	0.1
C. lupus	1		1						2	
C. familiarus			1		1		9	1.3	11	0.1
U. cinereoargenteus			1						1	
U. arctos							1	0.1	1	
T. taxus			1		7	0.1			8	
F. rufus	9	0.4	2		1		1	0.1	13	0.1
C. elaphus			1						1	
O. hemionus	30	1.2	361	4.5	142	2.4	39	5.8	572	3.4
A. americana	50	2.0	45	0.6	63	1.1	9	1.3	167	1.0
Ovis-Capra					5	0.1	18	2.7	23	0.1
O. canadensis	21	0.9	40	0.5	74	1.3	10	1.5	145	0.9
A. platyrhynchos	2	0.1			1				3	
Falconiformes	1								1	
Accipitridae	10	0.4							10	0.1
Buteo sp.	110	4.5	7	0.1	2		1	0.1	120	0.7
B. jamaicensis	109	4.5	15	0.2	2				126	0.7
B. swainsoni	6	0.2							6	
B. lagopus	1								1	
B. regalis	2	0.1	1						3	
A. chrysaetos	72	3.0	8	0.1	2				82	0.5
F. sparverius			6	0.1	7	0.1	1	0.1	14	0.1
Callipepla sp.					4	0.1			4	
C. squamata			2		1				3	
M. gallopavo	3	0.1	68	0.8	878	15.1	38	5.6	987	5.8
G. canadensis					1				1	
Z. macroura			2		2				4	
O. asio	1		1		1				3	
C. auratus			2		1				3	
Trochilides			1						1	
Passeriformes	1		4		12	0.2			17	0.1
E. alpestris	4		8	0.1	4	0.1			16	0.1
Icteridae					7	0.1			7	
Corvidae	1								1	
P. pica	1		5	0.1	3		3	0.4	12	0.1
C. corax	7	0.3	4						11	0.1
G. cyanocephalus	6	0.2			1				7	
Sialia sp.	1								1	
S. currucoides					1				1	
S. mexicana					1				1	
Laniidae	1								1	
L. ludovicianus					2				2	
Hirundinidae					1				1	
Fringillidae	1		6	0.1					7	
C. chlorura			1						1	
P. erythrophthalmu			1					s	1	
J. hyemalis			1						1	
Spea sp.			1						1	
Iguanidae			1						1	
S. undulatus			23	0.3	1				24	0.1
P. douglassi					2				2	
C. velox					2				2	
P. melanoleucus			1						1	
Gila sp.					1				1	
No. ided.	2,436	100.0	8,013	100.0	5,826	100.0	672	100.0	16,947	100
Unknowns	2,428	49.9	7,024	46.7	3,840	39.7	270	28.4	13,562	
Total No.	4,864		15,037		9,666		942		30,509	

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Table 8.145. MNI counts by ceramic association.

Taxon	Red Mesa		Gallup		Late Mix		Mixed		Total	
	n	%	n	%	n	%	n	%	n	%
M. californicus					4	0.6			4	0.2
S. auduboni	81	25.5	192	22.8	122	19.4	33	26.4	428	22.4
S. nuttalli			1	0.1					1	
L. californicus	54	17.0	145	17.2	86	13.7	18	14.4	303	15.8
L. americanus			1	0.1					1	
A. leucurus	1	0.3	1	0.1	3	0.5	1	0.8	6	0.3
S. variegatus					1	0.2	1	0.8	2	0.1
Squirrel sp.			2	0.2	2	0.3			4	0.2
C. gunnisoni	37	11.6	126	15.0	121	19.3	16	12.8	300	15.7
S. aberti			4	0.5	2	0.3			6	0.3
T. bottae	7	2.2	13	1.5	27	4.3	4	3.2	51	2.7
Perognathus sp.			3	0.4	3	0.5			6	0.3
D. ordii	6	1.9	21	2.5	20	3.2	4	3.2	51	2.7
D. spectabilis	1	0.3	2	0.2	2	0.3	1	0.8	6	0.3
Reithrodontomys					2	0.3			2	0.1
Peromyscus sp.	24	7.5	126	15.0	38	6.0	3	2.4	191	10.0
Onychomyes					3	0.5			3	0.2
Neotoma sp.			8	0.9	10	1.6	3	2.4	21	1.1
N. cinerea	1	0.3	3	0.4	5	0.8	1	0.8	10	0.5
N. stephensi			2	0.2	1	0.2			3	0.2
N. albigula			1	0.1	1	0.2	1	0.8	3	0.2
M. mexicanus							1	0.8	1	
E. dorsatum							1	0.8	1	
Canis sp.	2	0.6	3	0.4	4	0.6	1	0.8	10	0.5
C. latrans	5	1.6			1	0.2	2	1.6	8	0.4
C. lupus	1	0.3	1	0.1					2	0.1
C. familiarus			1	0.1	1	0.2	2	1.6	4	0.2
U. cinereoargenteus			1	0.1					1	
U. arctos							1	0.8	1	
T. taxus			1	0.1	2	0.3			3	0.2
F. rufus	7	2.2	1	0.1	1	0.2	1	0.8	10	0.5
C. elaphus			1	0.1					1	
O. hemionus	15	4.7	59	7.0	33	5.2	7	5.6	114	6.0
A. americana	15	4.7	22	2.6	18	2.9	5	4.0	60	3.1
Ovis-Capra					2	0.3	4	3.2	6	0.3
O. canadensis	7	2.2	26	3.1	22	3.5	5	4.0	60	3.1
A. platyrhynchos	1	0.3			1	0.2			2	0.1
Accipitridae	1	0.3							1	
Buteo sp.	2	0.6	3	0.4	2	0.3	1	0.8	8	0.4
B. jamaicensis	12	3.8	3	0.4	2	0.3			17	0.9
B. swainsoni	1	0.3							1	
B. lagopus	1	0.3							1	
B. regalis	1	0.3	1	0.1					2	0.1
A. chrysaetos	17	5.3	6	0.7	2	0.3			25	1.3
F. sparverius			2	0.2	3	0.5	1	0.8	6	0.3
C. squamata			2	0.2	1	0.2			3	0.2
M. gallopavo	3	0.9	21	2.5	49	7.8	6	4.8	79	4.1
G. canadensis					1	0.2			1	
Z. macroura			2	0.2	2	0.3			4	0.2
O. asio	1	0.3	1	0.1	1	0.2			3	0.2
C. auratus			2	0.2	1	0.2			3	0.2
Trochilides			1	0.1					1	
Passeriformes	1	0.3	2	0.2	7	1.1			10	0.5
E. alpestris	3	0.9	6	0.7	4	0.6			13	0.7
Icteridae					4	0.6			4	0.2
Corvidae	1	0.3							1	
P. pica	1	0.3	4	0.5	1	0.2	1	0.8	7	0.4
C. corax	3	0.9	3	0.4					6	0.3
G. cyanocephalus	2	0.6			1	0.2			3	0.2
Sialia sp.	1	0.3							1	
S. currucoides					1	0.2			1	
S. mexicana					1	0.2			1	
Laniidae	1	0.3							1	
L. ludovicianus					2	0.3			2	0.1
Hirundinidae					1	0.2			1	
Fringillidae	1	0.3	3	0.4					4	0.2
C. chlorura			1	0.1					1	
P. erythrophthalmus			1	0.1					1	
J. hyemalis			1	0.1					1	
Spea sp.			1	0.1					1	
Iguanidae			1	0.1					1	
S. undulatus			6	0.7	1	0.2			7	0.4
P. douglassi					1	0.2			1	
C. velox					1	0.2			1	
P. melanoleucus			1	0.1					1	
Gila sp.					1	0.2			1	
Total MNI	318		841		628		125		1,912	

Table 8.146. Rank orderings of taxa for elements and MNI by ceramic group.

Taxon	Red Mesa		Gallup		Late Mix	
	elem.	MNI	elem.	MNI	elem.	MNI
Sylvilagus sp.	1	1	1	1	2	1
Lepus sp.	2	2	2	2	1	3
C. gunnisoni	3	3	3	3	3	2
economic rodents	6	4	5	5	6	4
O. hemionus	5	5	4	4	5	6
A. americana	4	5	7	7	8	8
O. canadensis	7	7	8	6	7	7
M. gallopavo	8	8	6	8	4	5

Table 8.147. Percentage of elements by kind of deposit.

	Red Mesa	Gallup	Late Mix
Structure	5.3	37.9	47.9
Plaza	48.7	2.4	31.3
Trash Mound	45.9	59.7	20.7
n =	4,864	15,307	9,666

Table 8.148. Percentages of the estimated meat available and consumed.

Taxon	Red Mesa		Gallup		E. Late Mix		L. Late Mix	
	Avail.	Cons.	Avail.	Cons.	Avail.	Cons.	Avail.	Cons.
Sylvilagus sp.	2.3	5.9	3.1	8.8	3.7	6.8	2.1	5.3
Lepus sp.	6.6	17.0	7.5	21.3	10.6	19.6	6.1	15.3
C. gunnisoni	0.1	1.9	1.6	4.5	8.2	15.2	1.0	2.6
Economic rodents	0.5	1.2	0.4	1.1	0.9	1.5	0.1	0.2
O. hemionus	56.2	18.1	60.0	30.0	41.6	32.6	38.8	12.3
A. americana	33.7	11.1	14.4	9.7	12.5	7.8		
O. canadensis			12.0	14.3	20.8	5.2	38.8	1.1
Unknown artiodactyl		44.7		7.4		7.8		32.8
M. gallopavo			1.0	2.8	1.7	3.2	13.0	30.3
Total grams	50,012	19,432	234,142	82,427	135,116	73,008	72,336	28,666
No. of elements	916		4,514		2,688		470	
Large:small (x:1)	10.0	2.8	6.8	1.7	1.4	1.2	8.3	2.0

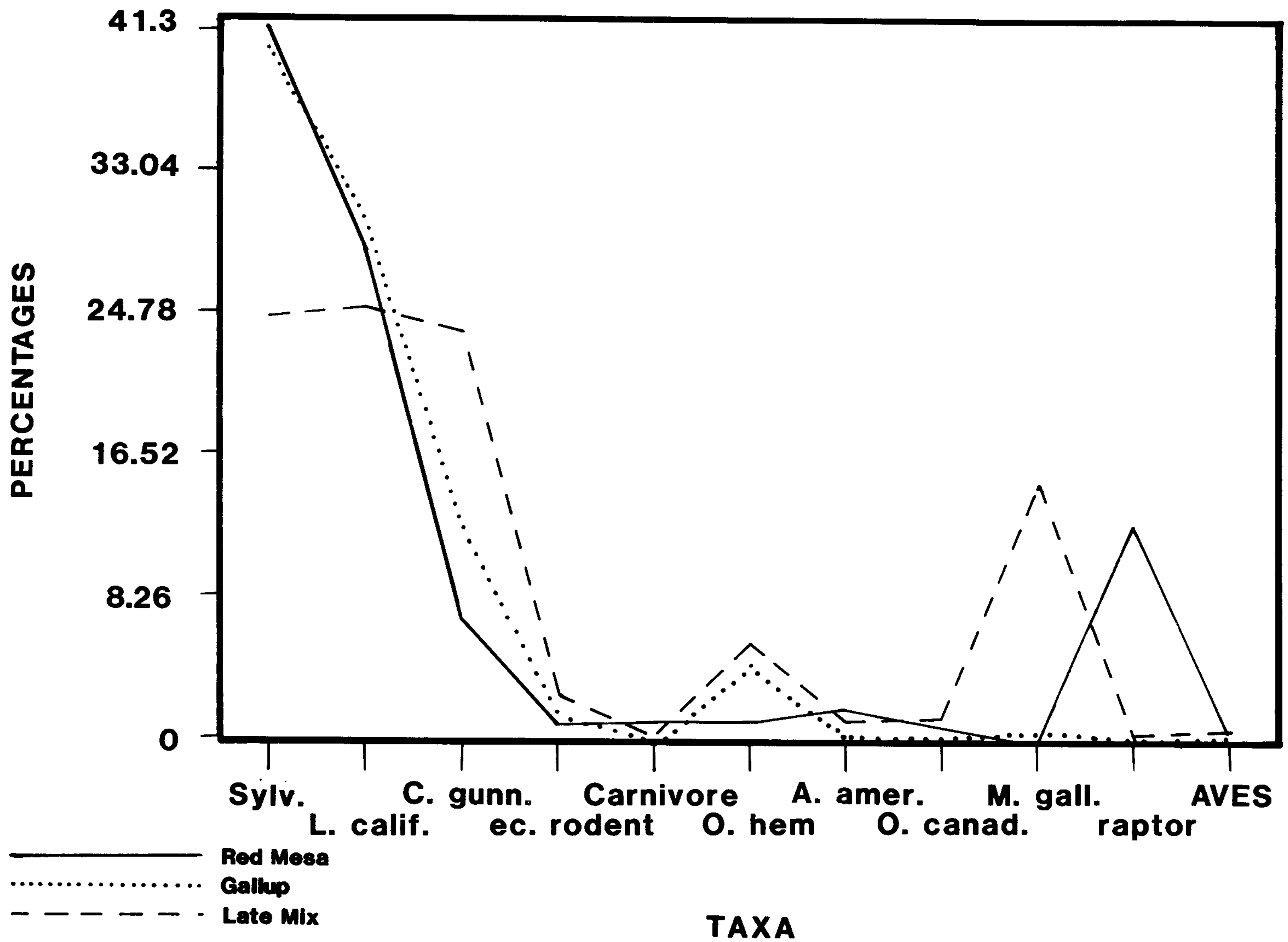

Figure 8.5. Percent of identified elements over time.

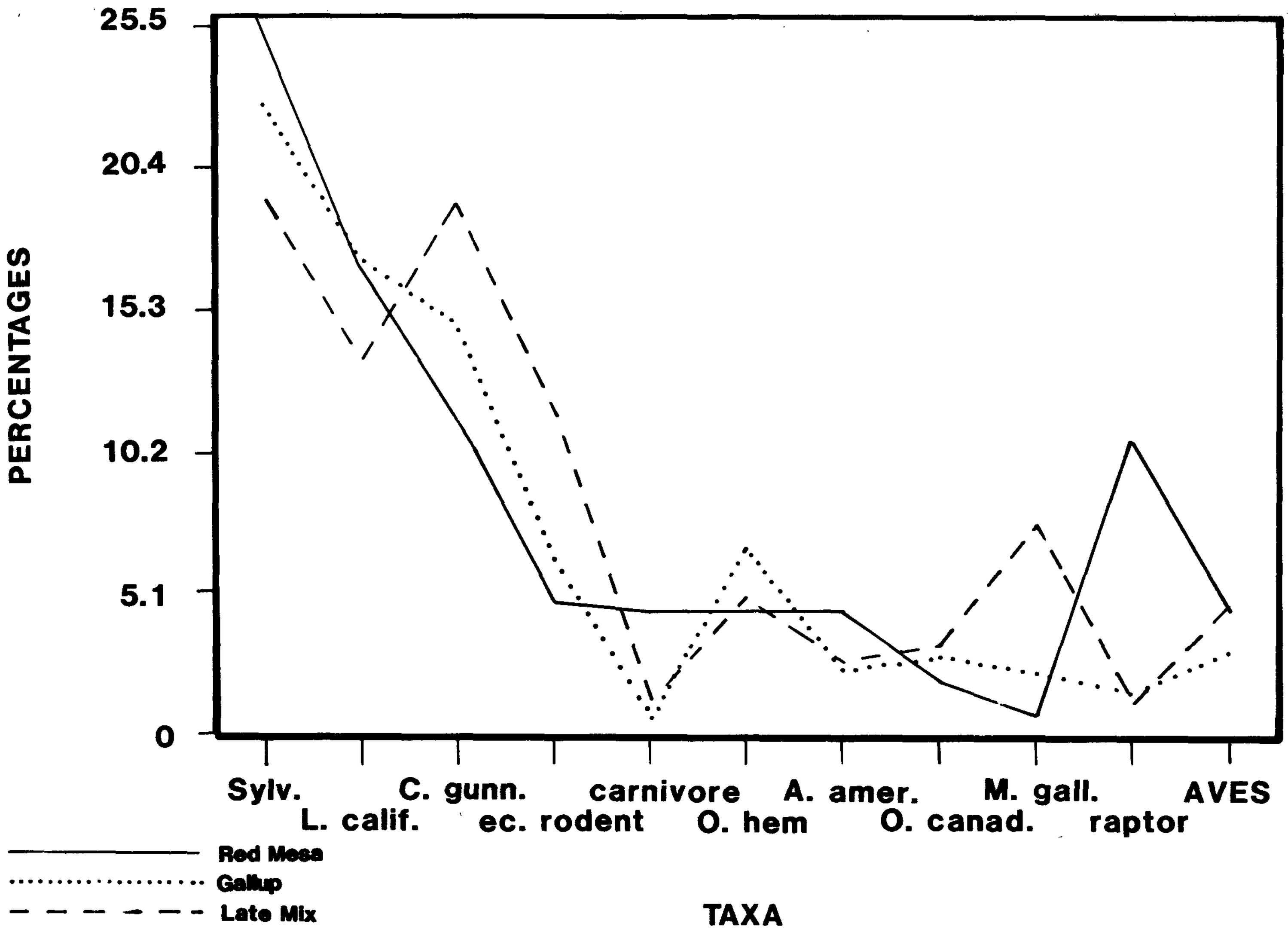

Figure 8.6. Percent of MNIs over time.

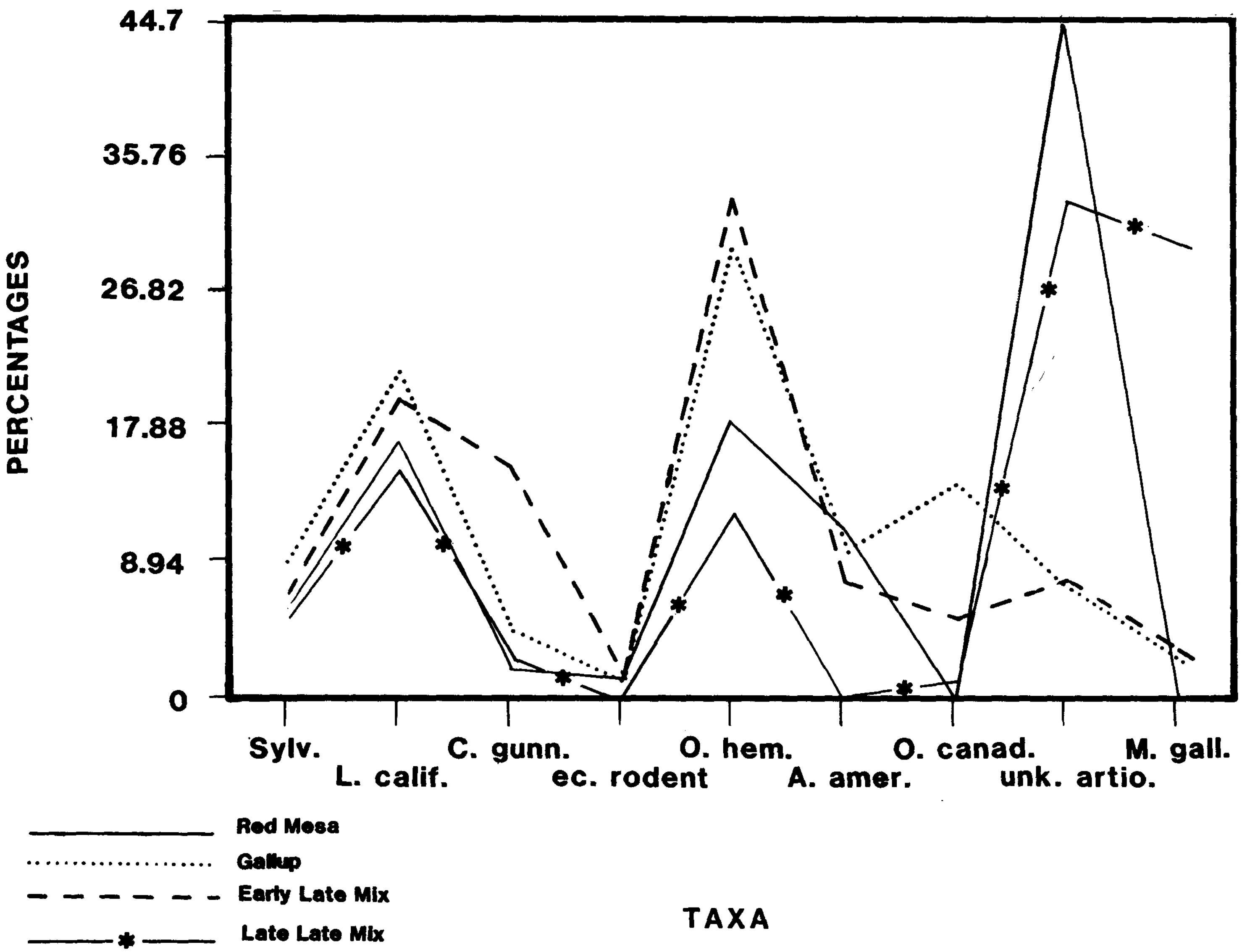

Figure 8.7. Percent of estimated meat consumed over time.

period. It is assumed that a complete animal is available for each MNI when calculating the meat available, while the calculations for the meat consumed use values for only those body parts represented in the assemblage. This is not at all satisfactory for several reasons. An attempt was made to use similar deposits and, although the stratigraphy for the Early Late Mix and Red Mesa deposits was similar to that of the Trash Mound or Gallup sample, the former were excavated in levels rather than by lenses. To compensate for this, the layerings were ignored completely and each was treated as a large block of trash. The Red Mesa sample consisted of the Plaza Grid 8, Surface 9 associated materials and Gallup of Booths 4, 5, and 6 of the Trash Mound. Late Mix is represented by a late and an early sample to illustrate the differences between the two. The Early sample was from Kiva 10, Levels 15 to 27 and the Late from the roof-fall layers from Rooms 142 and 146. These are primarily domestic refuse (except for the Late Late Mix, which is of unknown origin but may also be domestic trash).

Another problem is inherent in the calculation of the estimates (see Gillespie 1985 for the method). The estimates of meat consumed are highly dependent on the sample size--especially for the artiodactyls, which are low in frequency but produce very high meat estimates. The larger the sample size, the more identifiable specimens there are and, thus, body parts represented. The unknown artiodactyl contribution is calculated using only those body parts that cannot be accounted for by the known artiodactyl elements, which makes it dependent on the number of identified elements and how diverse they are in terms of parts of the body. The effect can be seen in both Table 8.148 and in Figure 8.7. This method is most relevant in determining the relative contribution of taxa that are not assumed to be 'shared' or have parts that are not likely to be 'curated.' Comparing large equivalent samples where there are no problems resulting from the aggregation method (i.e., how the proveniences are divided up for calculations of MNIs) is another possible use.

Multivariate Analyses

To delineate the effects of temporal variation, 48 of the best assemblages from Pueblo Alto were recorded (as Fauas). One of these was eventually dropped because it contained a bone-tool workshop and consistently plotted outside the other cases. The variables included the time period, provenience type, season, and the NISP percent of the total element assemblage and MNI for cottontail (_Sylvilagus_), jackrabbit (_L. californicus_), prairie dog (_C. gunnisoni_), the economic rodents, unknown small to medium mammals, carnivores, deer (_O. hemionus_), pronghorn (_A. americana_), mountain sheep (_O. canadensis_), unknown artiodactyls and large mammals, turkey (_M. gallopavo_), Aves, and unidentified Aves. The frequency matrix was then standardized to compensate for uneven sample sizes, using the formula (Alan Rogers, personal communication):

$$\frac{\sqrt{n_i\,(p_{ij} - p_j)}}{\sqrt{[p_j\,(1 - p_j)]}}$$

p = raw data
n = sample size

Table 8.149 gives the proveniences and sample sizes for the proveniences used. These were chosen on the basis of fairly large sample sizes, reasonably discrete units, and availability of chronological estimates. The format and the final data matrix can be found in Appendix MF-8.A.

These were subjected to a number of multivariate analyses. As has been noted, the site was occupied for a sufficient amount of time for changes in animal procurement to have occurred, and it is this change at a single site that is addressed here. The trends will be clearer if one looks at a number of assemblages rather than an additive sum for each time period.

Principal Components Analyses

The first of these to be discussed are a series of Princpal Components Analyses (SAS Proc Factor) which were used to identify similarities in the data and to produce a graphic display of the cases. Three factors were asked for but only the first two appear to be relevant. Three sets of variables were used. One included the common, small, economic taxa (cottontail, jackrabbit and prairie dog) and the economic rodents (those that may have been used as food). Another included the four previously noted, the three identified artiodactyls (deer, pronghorn, mountain sheep), and turkey. The third included all of the above and several others (see Appendix MF-8.C).

The matrix for this data set (the standardized frequencies--Appendix MF-8.A) produced no high correlations. One of the more interesting--which was unexpected but logical--was a relatively high (for this matrix) correlation between jackrabbit and the carnivores (.43). Carnivore elements are rare at Pueblo Alto but, when found, they appear with relatively high frequencies of jackrabbit. This suggests that these animals may have been procured during such activities as rabbit drives. A relatively strong but not unexpected correlation (.35) was found between prairie dog and the economic rodents. Prairie dog and many of the economic rodents were probably trapped as field pests. The highest correlation in the matrix was between turkey and the unidentified Aves materials (.65). This was entirely expected.

Table 8.150 summarizes the high scores for the unrotated factors for the three sets of variables as well as the amount of variance explained by these factors. As can be seen by both the variance explained and the factor-case plots in Appendix MF-8.D, using all of the taxa gives the best separation of the time periods. The first plot does suggest that the Early Late Mix period is the most distinct regarding small-mammal utilization. The cases in this group have high numbers of prairie dog and the economic rodents.

The second plot, which consists of the four, small-mammal taxa, three identified artiodactyls, and turkey shows a division between the Red Mesa and Gallup cases and the Late Mixes. This suggests some difference in the

Table 8.149. Proveniences used in the faunal assemblage data (Fauas).

Observation	Provenience	Sample size
	Trash Mound:	
1	Layer 10	92
2	Layer 11	744
3	Layer 18	320
4	Layer 22	262
5	Layer 35	794
6	Layer 37	87
7	Layer 43	340
8	Layer 44	147
9	Layer 45	346
10	Layer 55	310
11	Layer 56	260
12	Layer 58	191
13	Layer 62	280
14	Layer 69	161
15	Layer 81	240
16	Layer 104	223
17	Layer 113	253
18	Layers 1-4, 8	305
	East Plaza:	
19	Unit 1, Surface 1	194
20	Unit 2, Surface 1	259
21	Other Structure 6	243
22	Kiva 16	237
	Plaza Grid 30:	
23	Layer 7	153
24	Layer 10	685
25	Room 103: Floor 1, floor fill	938
26	Floor 2, floor fill	140
27	Floor 4, floor fill	515
28	Room 110: Floor 1, floor fill	1,023
29	Floor 1, replasters 7-9	483
30	Room 112: Surface 1, floor fill	721
31	Floor 1, floor fill	342
32	Floor 2, floor fill	549
33	Floor 3, floor fill	137
34	Floor 4, floor fill	322
35	Kiva 15, floor fill	332
36	Kiva 13	519
37	Room 142, roof fall	375
38	Room 143, Floor 1, floor fill	134
39	Room 146, roof fall	95
40	Room 147, Floor 1 associations	332
41	Kiva 10: Levels 15-18	1,806
42	Levels 19-23	736
43	Levels 24-27	146
44	Level 28	92
45	Room 146, Floor 3, floor fill	173
46	Plaza Grid 8, Surface 8 association	219
47	Plaza Grid 8, Surface 9 association	1,156

Table 8.150. Results of principal components analysis.

	Factor 1	Factor 2
Small economic:	.78 C. gunnisoni	.89 L. californicus
	.70 economic rodent	-.40 economic rodent
	-.68 Sylvilagus	
Variance explained:	16.6%	11.0%
Economic only/no unknowns:	.70 C. gunnisoni	.60 O. canadensis
	.59 economic rodent	.58 M. gallopavo
	-.60 Sylvilagus	.52 A. americana
Variance explained:	18.0%	15.7%
All taxa:	.75 C. gunnisoni	.82 M. gallopavo
	.55 L. californicus	.81 Aves
	.51 carnivores	-.50 L. californicus
	-.59 artio/large mammal	-.50 Sylvilagus
Variance explained:	22.5%	20.9%

utilization of the species that comprise the second factor--mountain sheep, turkey, and pronghorn. The final plot, using all taxa, is very similar to this except that the Late Late Mix and Early Late Mix separation is a little better.

Temporal Discriminant Analyses

Discriminant analyses (SPSS Discriminant) were then performed on the same data sets to find the linear functions that best differentiate the time periods. Here it must be reiterated that these temporal assignments were made strictly on the basis of a rough sort of the ceramics associated with a deposit. It is highly unlikely that subsistence remains and ceramic vessel deposition are governed by the same principles. Animals are generally procured, processed, then disposed of relatively rapidly, whereas ceramic vessels have longer use spans, and there are numerous factors leading to their deposition. As a result, there is logically a difference in the "ages" of different materials within any deposit, and complete congruence between the faunal and ceramics in a deposit should not be expected. Tables 8.151 and 8.152 summarize the high discriminant scores for each data set and show how the discriminant functions relate to the temporal groupings.

The first analysis using only the small, economic mammals agrees with the findings from the principal components analysis--that there was little difference between the time periods except that the Early Late Mix, with its large amounts of prairie dog, was fairly well separated out. The percentage of cases correctly classified was 68.09. See Appendix MF-8.D for the discriminant functions, plots, and classification results.

When the known artiodactyls and turkey were added to the data set, the percentage correctly classified increased to 78.7. In the plot for this data set (Appendix MF-8.D), the two Late Mix groups are clearly separated from each other and the rest, and the Red Mesa and Gallup cases are not distinguished. This is due to the high scores for function 2 prairie dog in the Early Late Mix cases and high scores for function 1 turkey, with a negative score for function 2 in the Late Late Mix cases. The Red Mesa and Gallup have nearly identical scores for function 1, and the only difference appears to be more mountain sheep with respect to deer in the Red Mesa cases and the third function. These differences were slight enough that 75 percent of the Red Mesa cases were classified as Gallup. This suggests that, regarding these cases and these variables, there is little or no change between these two time periods.

When all 13 taxa were considered, the cases correctly classified increased to 85.11 percent (Appendix MF-8.D). The primary difference between this and the last grouping is in function 3 where the Aves becomes quite important, especially in separating the Red Mesa and Gallup components. The Late Late Mix cases appear to be the most distinct--largely because of a high score for function 1, which is dominanted by turkey and

Table 8.151. Summary of temporal discriminant functions.

	Function 1	Function 2	Function 3
Small economic mammals:	.73 C. gunnisoni .71 economic rodent	.99 Sylvilagus	.67 C. gunnisoni -.65 economic rod.
Variance explained:	90.51%	9.0%	.49%
Economic without unknowns:	.90 M. gallopavo .37 L. californicus	.66 C. gunnisoni .66 economic rodent -.48 M. gallopavo	.70 O. canadensis -.95 O. hemionus
Variance explained:	57.1%	35.1%	7.7%
All taxa:	.90 M. gallopavo .73 unk. Aves .66 L. californicus .52 carnivores .66 small-med. mam.	.69 C. gunnisoni .69 economic rodent -.26 M. gallopavo	.98 Aves .67 small-med. mam .60 O. canadensis
Variance explained:	61.43%	26.00%	12.57%

Table 8.152. Summary of temporal groups and discriminant functions.

	Function 1	Function 2	Function 3
Small economic:			
Red Mesa	-.67	.30	-.17
Gallup	-.64	.07	.06
Early Late Mix	2.41	.11	.00
Late Late Mix	-.05	-1.06	-.05
Economic without unknowns:			
Red Mesa	-.86	-.48	1.10
Gallup	-.87	-.20	-.36
Early Late Mix	1.33	2.07	.08
Late Late Mix	3.35	-1.94	-.08
All taxa:			
Red Mesa	-.35	-.55	1.75
Gallup	-1.19	-.34	-.49
Early Late Mix	1.04	2.32	.07
Late Late Mix	4.65	-1.45	-.45

the unknown Aves. The Early Late Mix is distinguished by function 2, which is high in prairie dog and the economic rodents, and has a negative turkey score. Gallup is negative with respect to all three functions.

In summary, these analyses suggest that the Red Mesa and Gallup faunal assemblages are quite similar, the Early Late Mix differs from these primarily in the increased use of prairie dog, and the Late Late Mix from all the rest in its large amount of turkey.

Evaluation

Pueblo Alto is only one of the recently excavated sites in Chaco Canyon. It has the largest sample of bone and is by far the most complex; however, its place and importance can best be evaluated with respect to the other canyon sites. The assemblages from the small-site excavations and those from the greathouses, Pueblo Alto and Una Vida, exhibit similar patterning in the proportions of small and large mammals and in species use (Akins 1985)--a correspondence that suggests that the greathouse residents were utilizing the same species in the same manner as those inhabiting the small sites.

A detailed look at the small sites within the Marcia's Rincon area (Akins and Bertram 1985) suggests the following sequence of small-mammal utilization for the Chaco area. The initial occupation of the rincon, ca. A.D. 600-700, is characterized by very high percentages of cottontail in the faunal assemblages, probably reflecting the proximity and relative ease of capture of this species. Their high frequencies may also correspond with horticultural activities that provided an ideal habitat for rabbits. With time, and a denser human population, prairie dog and jackrabbit increase relative to the cottontail--possibly related to expanding field areas and hunting pressure on the rabbits. Prairie dogs, a prime field pest, would continue to multiply until measures to control their numbers would be needed or the fields would have to be abandoned. A decrease in the human population would allow a return to a more natural mixture of small-mammal species. Cross-cutting this sequence in small mammals is the overall canyon-wide increase in dependence on large mammals, which is also thought to reflect horticultural intensification and the need for scheduling of hunting activities (Speth and Scott 1985).

When the proposed human population and length of the site occupation are taken into consideration, Pueblo Alto appears to have more faunal remains than do the smaller sites. Preservation may be a factor, but it alone is not enough to account for the magnitude of difference. Except for sheet trash and plaza areas at the small sites, bone at both site types is well preserved from the artiodactyls down to small rodents. Exposure would affect samples from both site types. The percentages of unidentifiable elements and the amount of checking, crude indicators of exposure, are often lower at the small sites than at Alto. I suspect that at least part of the answer lies in the different patterns of trash deposition. When there is a formal feature, such as the mound at Pueblo Alto, where virtually all of the Gallup associated trash was deposited, the result is a concentration unparalleled at the small site in our sample. At the small sites trash is scattered in sheet middens, plazas, structures--virtually everywhere, and is compounded by archeological sampling, exposure, and proximity to the living area. The patterns are quite different and our recovery may reflect little more than the concentration of remains rather than the actual quantity.

An explanation based on influxes of nonresidents to Pueblo Alto on ceremonial occasions does not fit with the rest of the evidence from the faunal remains as well as one based on a stable residential population. If Pueblo Alto represents a large but normal habitation site, it should exhibit a sequence of small-mammal utilization similar to that found at the small sites. The area around Alto was not inhabited as early or as intensively as Marcia's Rincon; thus, the sequence of small-mammal use does not correspond exactly in time. Indeed, the assemblages most similar to the small-mammal configuration in the Pueblo Alto Red Mesa deposits are from 29SJ 629 dating between A.D. 850 and A.D. 950 and from 29SJ 299 between A.D. 600 and A.D. 700.

On the other hand, if, as suggested by some (Judge 1983; Windes, Volume I, this report), Pueblo Alto primarily performed a special function such as hosting ceremonies with only occasional or seasonal occupation, we might expect faunal assemblages far different from those left by the small-site, subsistence farmers. If the large sites were provided with animal foods, the kins of animals represented should be those that could be exploited efficiently through group hunts (such as the jackrabbit and pronghorn) rather than a sample of "garden fauna" that might be contributed by the area's farmers.

To determine if Pueblo Alto was basically different from the small sites in the small-mammal subsistence, the precentage of change in the utilization of cottontail, jackrabbit, and prairie dog from period to period was considered (Table 8.153). Although far from conclusive, it does appear that the same basic changes took place at Pueblo Alto as at the small sites: cottontail decreases through time and prairie dog increases. Only the jackrabbit behaves differently at Pueblo Alto; it is quite variable at the small sites and fluctuates very little at Pueblo Alto.

The structure of the Pueblo Alto Trash Mound has been identified as the best evidence for ceremonial get-togethers or feasting at the site (Windes, Volume I, this report). Table 8.153 separates the mound from the other Gallup deposits at the site to see if there are substantial differences. This perspective suggests that the Trash Mound is similar in composition to the Red Mesa deposits with more cottontail and less prairie dog than the other Gallup samples.

Some caution must be used when considering the Pueblo Alto Trash Mound layers as units of analyses. The faunal analysis sampled only the six booths or 1-m-square strat columns. The amount of fill removed from

Table 8.153. Change in element percentage.

Period	n	Percent of These Three			Percent Change from Preceding		
		Cotton-tail	Jack rabbit	Prairie dog	Cotton-tail	Jack rabbit	Prairie dog
Pueblo Alto:							
Red Mesa (A.D. 920-1020)	1,881	53.5	37.0	9.5			
Gallup (A.D. 1020-1120)	6,643	48.7	36.4	14.9	-4.8	-0.6	+5.4
Trash Mound	3,198	55.5	34.5	9.8	+2.0	-2.5	+0.3
Other Gallup	3,445	42.4	38.1	19.5	-11.1	+1.1	+10.0
Late Mix (A.D. 1120-1220)	4,285	33.5	34.2	32.2	-15.2	-2.2	+17.3
(comp. to Trash Mound)					-22.0	-0.3	+22.4
(comp. to other Gallup)					-8.9	-3.9	+12.7
Una Vida:							
A.D. 950-1050	1,141	45.8	35.5	18.7			
A.D. 1050-1220	297	35.7	46.5	17.8	-10.1	+11.01	-0.9
29SJ 299							
A.D. 600-700	70	52.8	38.6	8.6			
A.D. 780-820	86	41.9	46.5	11.6	-10.9	+7.9	+3.0
29SJ 627							
A.D. 1000-1050	895	47.3	46.4	5.4			
A.D. 1050-1080	239	22.6	76.5	0.8	-24.7	+30.1	-4.6
A.D. 1130-1220	359	15.0	42.6	42.3	-7.6	-33.9	+41.5
29AJ 629							
A.D. 850-950	543	50.1	36.6	13.2			
A.D. 975-1040	216	18.0	54.2	27.8	-32.1	+17.6	+14.6
A.D. 1100-1150	73	24.7	35.6	39.7	+6.7	-18.6	+11.9

most layers was small and sampled a spatially very restictive portion of the midden. It would be hard to make a case for representation on this basis. In spite of this, overall trends do show up in the midden samples, although with quite a bit of noise. Figure 8.8 graphs the small- and large-mammal percentages of the total assemblage, and Figure 8.9 the percentage of those three taxa by layer of cottontail, jackrabbit, and prairie dog. Both are overlain with Windes' interpretations of the depositional history of the midden. A third graph (Figure 8.10) compares the percentage of unidentified elements and checking.

Small-mammal percentages nearly always exceed those of the large mammals. In general, cottontail decreases and jackrabbit increases, although with a lot of fluctuation, again probably largely attributable to the nature of the sample. Fragmentation is greatest at both ends of the mound, which represents the extremes spatially as well as temporally.

The early deposits (construction phase) in the mound are characterized by large amounts of burned bone, which resulted in much of the fragmentation; very high small-mammal proportions; and more cottontail than many of the overlying layers. The middle layers, which have the highest density of bone, show relatively little fragmentation, high proportions of small mammals, and fluctuations in the proportions of the two rabbit species. The final redepositional/erosion section of the midden actually began several layers before Windes' designation--if fragmentation and erosion of bone is used as the indicator of this process. It shows an increase in fragmentation--mostly small mammals--and an increase followed by a decrease in cottontails. This decrease might be attributable to weathering (which reduced the identifiability of smaller taxa), although the amount of checking in the layers with decreased cottontail is no higher than in preceding layers.

From the perspective of the species used and frequency, it would be difficult to argue that the fauna represent the remains of ceremonial occasions or communal feasting. There is no indication that certain species were selectively hunted in proportions exceeding their availability. Communal hunting or provisioning of the celebrants by local farmers should result in some difference from the norm (the small-site spectrum). Communal hunting might also be manifest in a redundancy in both the species and the body parts. The more meaty portions of the large mammals would be better represented, and the small mammals might show different kinds of processing than at the small sites. Communal cooking should include more roasting. I simply cannot believe that feasting or providing for celebrants would not produce some difference in the faunal record.

The amount of redundancy can be examined in the relationship between the number of identified elements and the MNI. When compared to the number of identified elements (Figure 8.11), the layers suggested as resulting from feasting (Layers 45-56) do indeed deviate from the expected but in the opposite direction from that expected for communal eating or feasting. They indicate greater redundancy; in other words, there are fewer

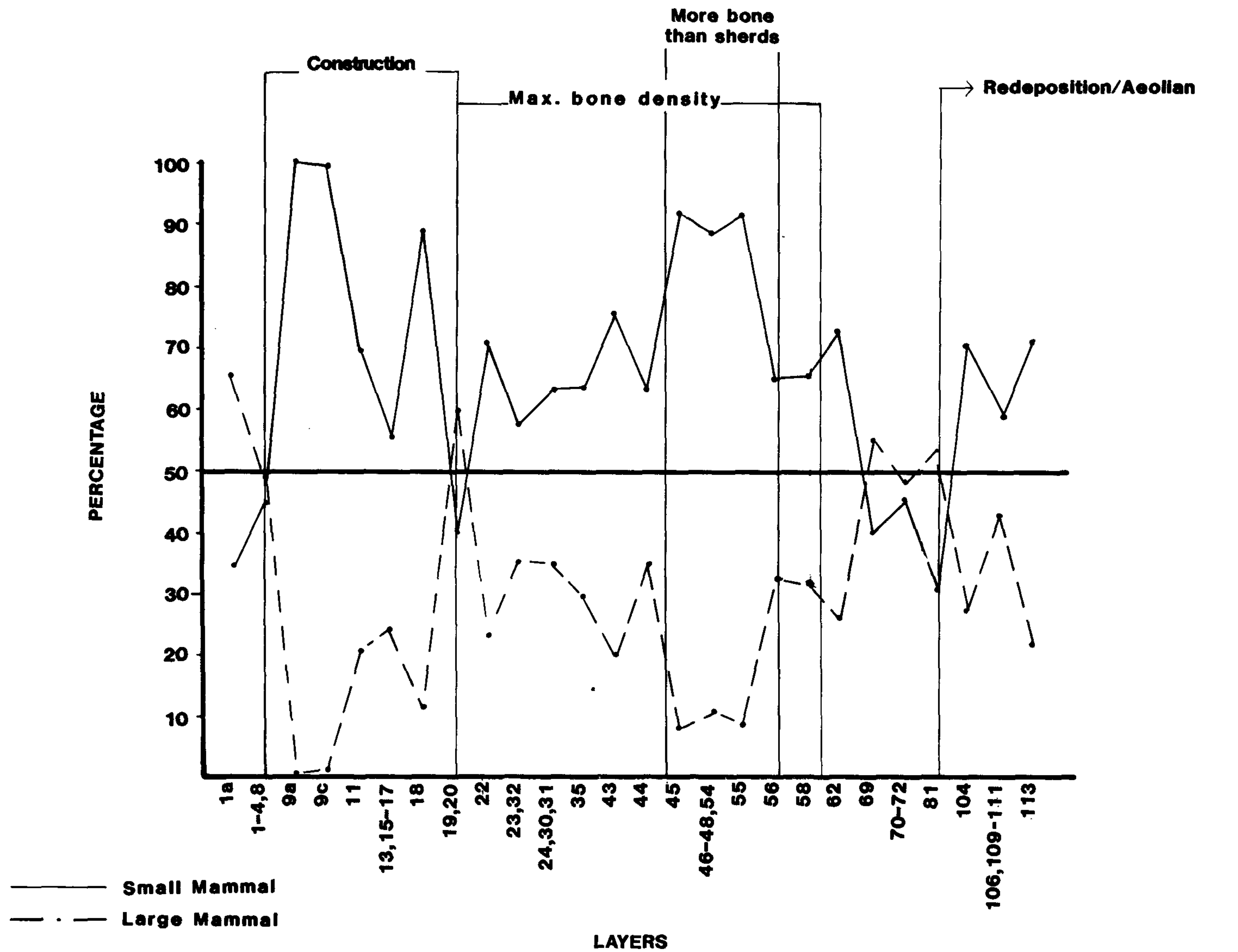

Figure 8.8. Pueblo Alto Trash Mound: percent of small versus large mammal elements (n > 100).

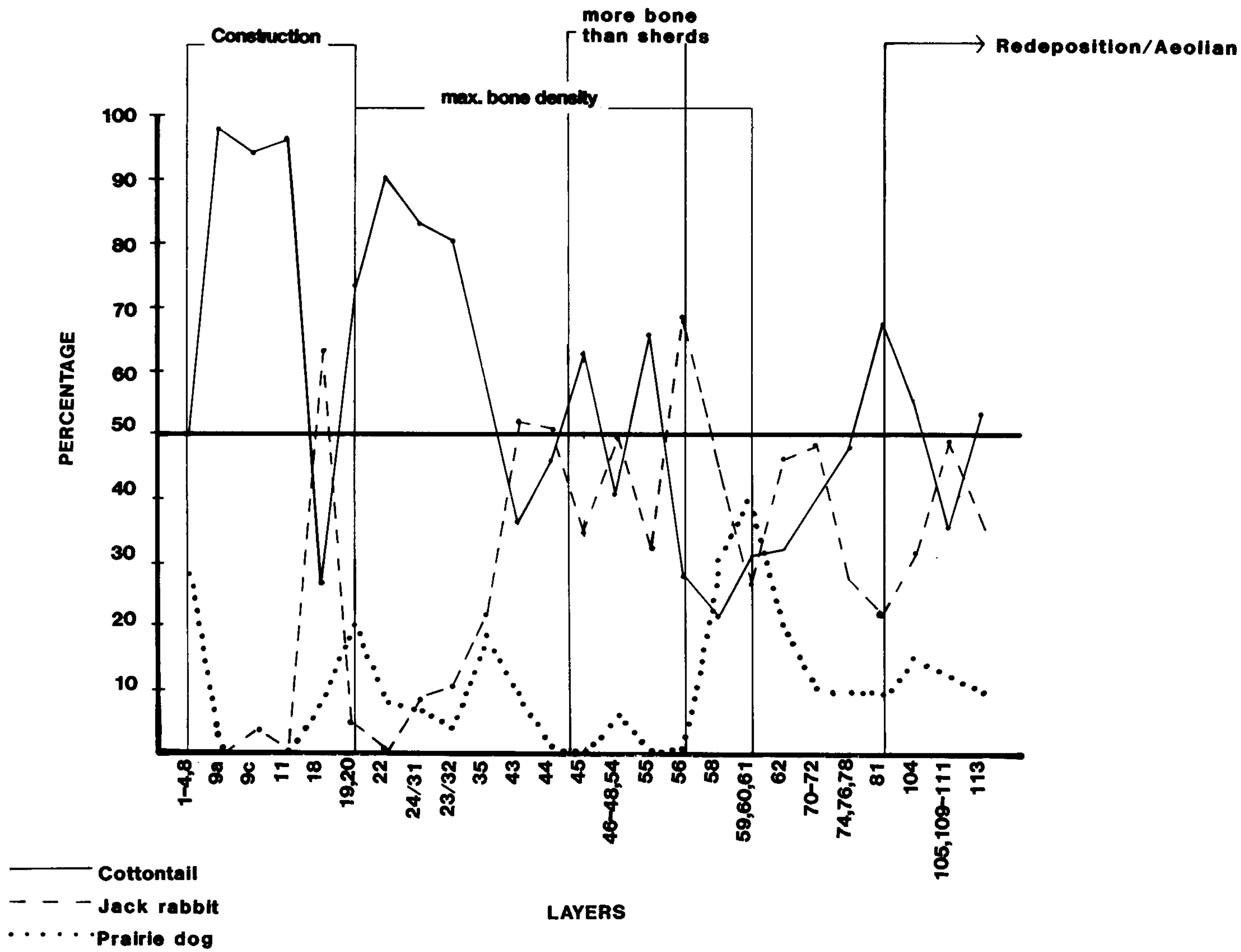

Figure 8.9. Pueblo Alto Trash Mound: percent of cottontail, jackrabbit, and prairie dog (n > 50).

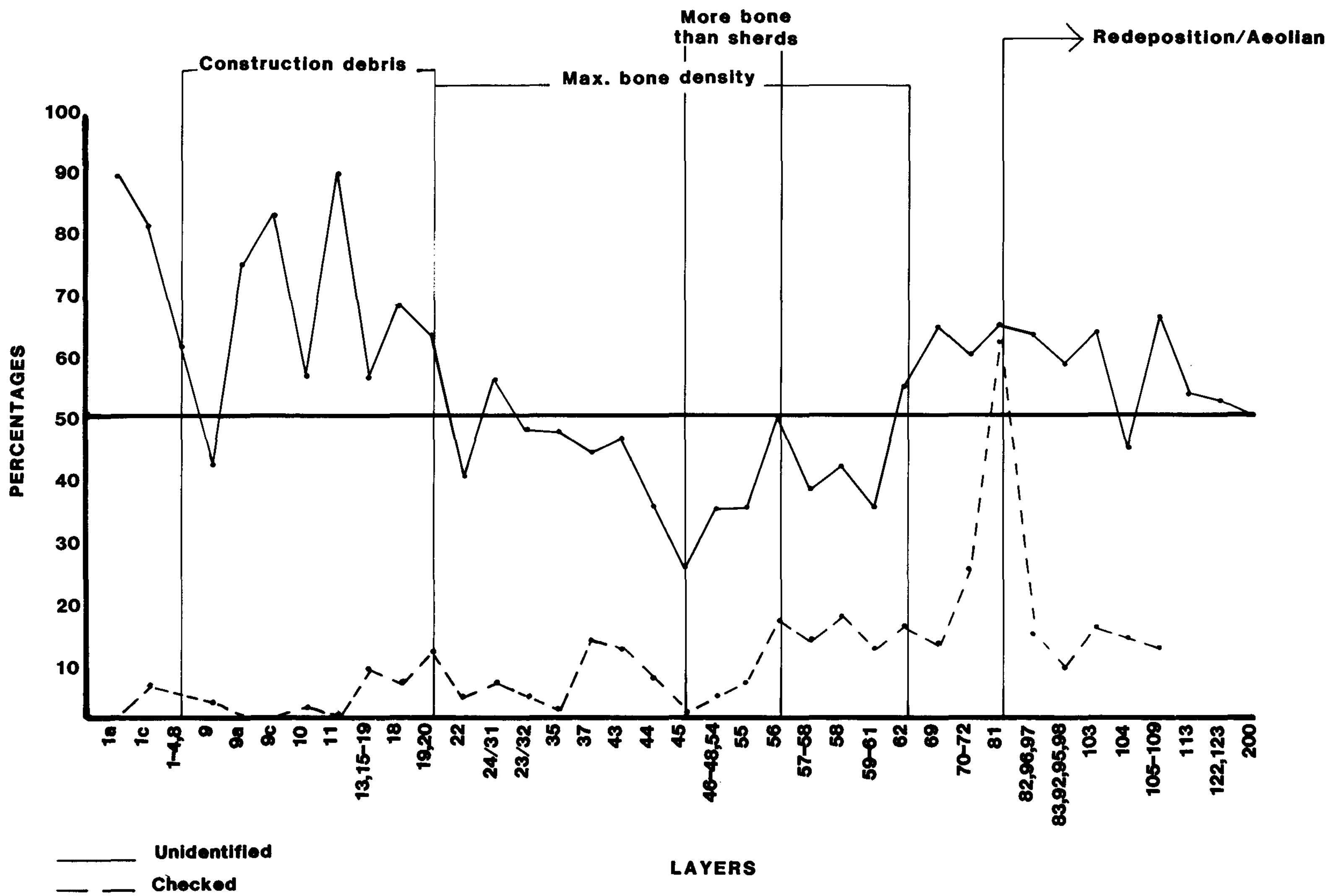

Figure 8.10. Pueblo Alto Trash Mound: percent of unidentified and check (n > 50).

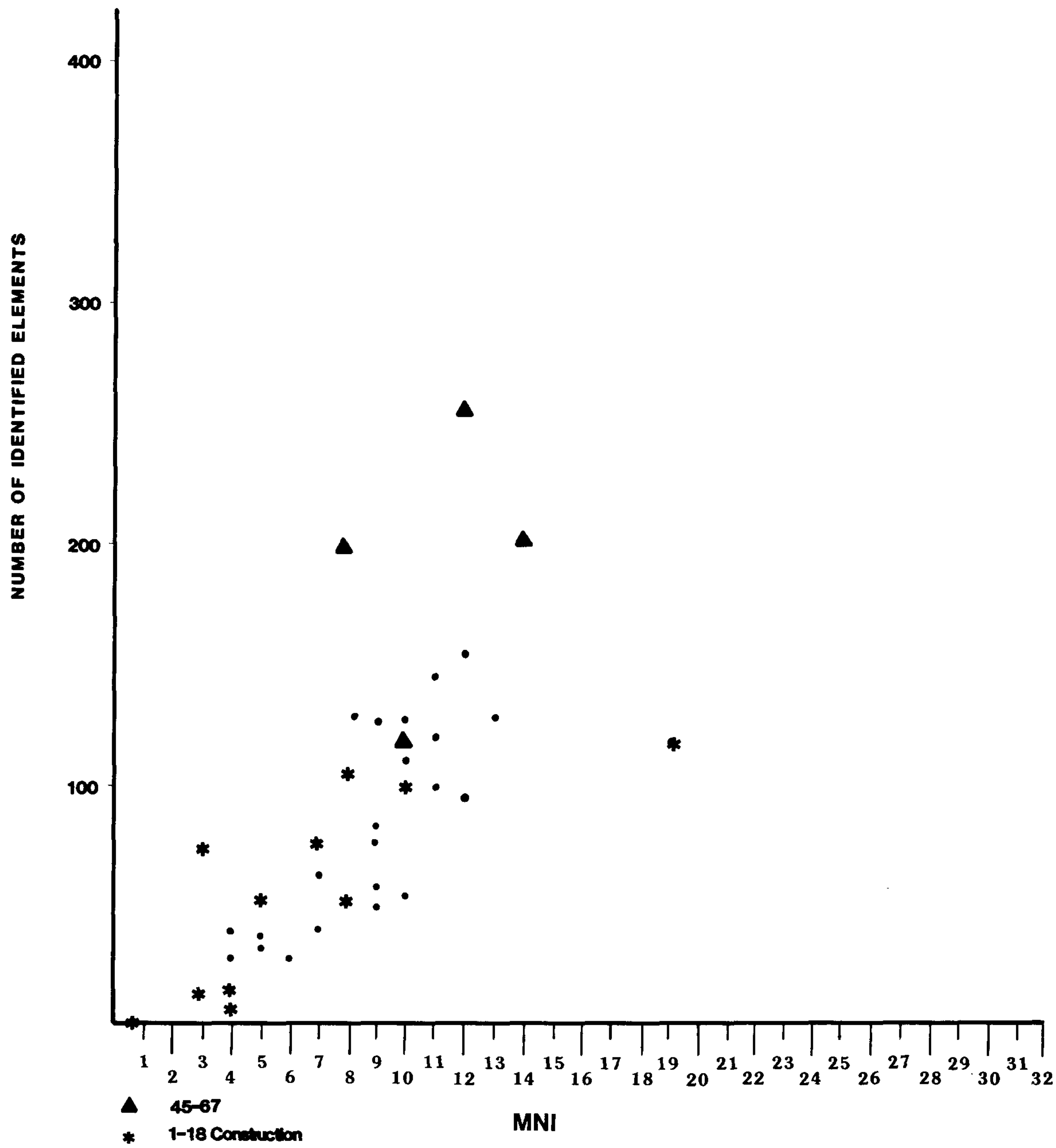

Figure 8.11. Number of identified elements/MNI.

individuals represented for the given number of elements than in the other layers of the mound. This is more suggestive of spatially segregated, small dumps by households than of the refuse left by a large number of people sharing food. In contrast, in Layers 1-4 and 8, containing the debris from construction activities--a time when provisioning of and communal eating by the builders would be a distinct possibility--the number of animals represented is quite high for the sample size.

Nor is there evidence for communal hunting or provisioning of the Pueblo Alto residents that can be seen by comparing the artiodactyl parts left at the small and large sites (Akins 1985:Tables 23 and 24). The part representations are quite similar.

In sum, the Pueblo Alto faunal remains are more consistent with a relatively large, resident population whose subsistence activities differed little from that of the small-site occupants. The observed differences are primarily in the quantity of bone, and explanations concerning the role of Pueblo Alto must take this into consideration.

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Chapter Nine

Bone Artifacts from Pueblo Alto

Judith Miles

Introduction

Bone artifacts are a quantitatively small artifact group in the Southwest. Because of the massive quantities of other material culture items such as sherds, lithics, and unworked bone, bone artifact analysis is often given a cursory review. The few numbers of bones recovered often frustrate analysts. However, the relationship to the cultural processes of their origin should not be ignored. Although this study does not attempt to revolutionize such analysis, it does go beyond simple lists of things and descriptions of form.

Pueblo Alto's prominent location, size, and collection of artifacts characterize it as an important component of the Chaco system. The site's bone tool complement is one of the largest from a Chacoan pueblo. The approximate 10 percent excavation of Pueblo Alto indicates that the total bone-artifact assemblage might be in the low thousands.

In many respects the true character of this artifact group remains concealed by the artifacts still buried there. This is especially important to note if one is interested in defining activity areas. Yet the collected assemblage reveals some of the cultural activities at Pueblo Alto while it also provokes suggestions about the unexcavated portion. For example, the artifact types are probably well represented and therefore, from a general functional perspective, may be compared with other canyon sites.

Pueblo Alto's assemblage is described in terms of size, types of artifacts, manufacturing technique, condition, faunal type, and distribution. Of particular interest are patterns in the assemblage that may be associated with the pueblo's status as a greathouse and how they differ from patterns at smaller sites.

Procedural Background

Data gathering by personal examination of each item was done in 1981 and 1982. An attribute list was adopted from McKenna (1980) with only minor revisions made after I sampled its utility. All of the data recorded are computerized. Both a hard copy and a computer disk are on file in the office archives of the National Park Service, Albuquerque, New Mexico.

The sampling strategy for excavation is extremely biased against a representative recovery of bone artifacts. It has been demonstrated in past Chaco Canyon investigations that between 80 and 90 percent of a site's bone artifacts and/or associated use areas are located in pithouses and kivas (McKenna 1984; Miles 1985, 1983d). Rooms and other locations are only minimally used for activities involving these artifacts. If this holds true for Pueblo Alto, in terms of spatial contexts, we are dealing with secondary-use areas of the site as kiva excavations were limited.

This investigation into bone artifacts oscillates between intra- and intersite analysis. The appropriateness of one over the other was determined by how crucial the lack of representative kiva material is to the accuracy of interpretation. For example, varieties of artifact types and faunal species are probably well accounted for in the site's assemblage, which makes intersite analysis possible. On the other hand, spatial distribution likely does not represent original use contexts, so establishing overall activity areas and comparing them with other sites cannot be confidently carried out.

The Inventory

Test excavations recovered 242 worked bone items (Tables 9.1 and 9.2). Descriptive names were assigned to each artifact following a classification compatible with previous studies (McKenna 1980; Miles 1985). For the most part, the classifications are straightforward (Table 9.3). However, two are rather vague and are described below. Most of the classes are represented in Plate 1.

Piercing tools are dominated by awls (95), including one awl-scraper, while the number of scrapers is far fewer (14). The count of nontools is also modest (16). At 102 pieces, fragments account for a good portion of the overall inventory. Table 9.3 provides a detailed breakdown of artifact classifications and their frequencies within broader functional types. Numbers of bone artifacts by category are similar to two other somewhat contemporary Chacoan sites studied thus far: 29SJ 629 (Miles 1983d) and 29SJ 627 (Miles 1985). Dissimilarities are noted from sites 29SJ 423 (Miles 1983a) and 29SJ 299 (Miles 1983c) where more nontools than tools were found, and at 29SJ 724 (Miles 1983b) where the array of nontool classes is different; bone artifact assemblages from these sites are at least 250 years older than those from Pueblo Alto and, thus, may represent contrasting functions within the evolution of the bone tool industry.

Table 9.1. Provenience of artifacts with strong structural associations.

Provenience	Artifact class	Temporal Designation A.D.[a]
Room 103		
Floor 1, floor fill	awls (2); fragment (1)	1100 - 1400
Floor 2, floor contact and floor fill	awl (1); fragment (1)	1050 - 1100
Floor 3, floor contact	fragment (1)	1050 - 1100
Floor 4, floor fill	multi-use tool (1)	1050 - 1100
Room 110		
Floor 1, floor fill	awls (2)	1050 - 1100
Floor 1, sealed pits	awl (1); antler flaker (1)	1050 - 1100
Floor 2, firepit 2	awl (1)	1050 - 1075
Room 112		
Floor 1, contact and floor fill	end scrapers (2)	1100 - 1140?
Room 139		
Floor 1, roof fall and floor fill	awl (1); fragment (1)	1100 - 1140
Floor 2, floor fill	fragment (1)	1020 - 1040
Floor 2, occupation fill of pits	awl (1); fragment (1)	1020 - 1040
Room 142		
Floor 1, roof fall and floor fill	awls (3); punch (1); fragment (1)	1100 - 1140
Room 143		
Floor 1, floor fill	awls (3); fragment (1)	1100 - 1140
Floor 4, floor fill	awl (1)	1050 - 1100
Floor 9, floor fill	fragment (1)	975 - 1040±
Room 145		
Floor 1, floor fill	awl (1)	1100 - 1140
Room 146		
Floor 1, roof fall and floor fill	awls (3)	1100 - 1140
Room 147		
Floor 1, roof fall and floor fill	awl (1); antler flaker (1); fragment (1)	1100 - 1140
Plaza Feature 1, Room 3		
Floor 1, contact	rubbing tool (1)	1140±
Plaza 1, Grid 273		
Occupational surface 1	pin (1)	1100 - 1140?
Plaza 1, Grid 30		
Occupational fill of Other Pit 1	fragment (1)	975 - 1040±

[a]Dates derived from ceramic associations by Windes (Volume II of this report).

Table 9.2. Architectural association of bone artifacts recovered from general fill deposits.

Structural provenience	Artifact classification	Temporal Designation A.D.[a]
Room 103		
Fill above Floor 1	fragments (2)	1100 - 1140
Room 109		
Fill above Floor 1	awls (2)	post - 1100
Room 112		
fill above Floor 1	whistles (2); finger ring (1); fragment (1)	1100 - 1140
fill above Floor 4	awl (1)	975± - 1040
Room 117		
wall clearing	awl (1)	1100 - 1140 (?)
Room 142		
fill above Floor 1	awl (1)	1100 - 1140
fill above Floor 2	awl (1)	1100 - 1140
Room 143		
fill above Floor 1	awls (2); fragments (3)	1100 - 1140
Room 145		
fill above Floor 1	awl (1); fragment (1)	1100 - 1140
Room 193		
wall clearing	fragment (1)	1100 - 1140
Room 202		
wall clearing	whistle (1)	1100 - 1140
Room 205		
wall clearing	fragment (1)	1100 - 1140
Kiva 2		
wall clearing	tubular bead (1)	1000 - 1140 (?)
Kiva 9		
wall clearing	fragment (1)	1000 - 1140 (?)
Kiva 10		
fill above Floor 1	awls (20); needle (1); end scrapers (3); tubular beads (5); pendants (2); fragments (34)	1080 - 1140 (mostly 1100 - 1140)

[a]Dates derived from ceramic associations by Windes (Volume II of this report).

Table 9.2. (continued)

Structural provenience	Artifact classification	Temporal Designation A.D.[a]
Kiva 12		
fill from wall clearing	awl (1)	1100 - 1140
Kiva 13		
fill above Floor 1	punch (1); fragment (1)	1050 - 1100
Kiva 14.		
fill from wall clearing	awls (3); fragment (1)	1080/1100 - 1140
Kiva 15		
fill above Floor 1	pin (1); fragments (2)	1100 - 1140
Kiva 16		
fill above Floor 1	awl (1); end scrapers (2); punch (1); fragments (6)	1100 - 1140
Plaza Feature 1, Room 3		
fill above Floor 1	tubular bead (1)	1140±
Plaza Feature 4		
fill above Floor 1	awl (1); fragment (1)	1080?/1100 - 1140
Other Structure 6		
fill from wall clearing	awls (2); tubular bead (1); end scraper (1); fragment (1)	1100 - 1140
Other Structure 7		
fill	awl (1)	1100 - 1140
Plaza 1		
Grid 8	fragment (1)	975+ - 1040
Grid 26	fragment (1)	1100 - 1140?
Grid 35	awl (1); fragment (1)	1100 - 1140?
Grid 75	fragment (1)	1100 - 1140?
Grid 95	fragment (1)	1100 - 1140?
Grid 274	awl (1)	1100 - 1140?
Grid 302	awl (1);	1050 - 1100?
	fragment (1)	1100 - 1140?

[a]Dates derived from ceramic associations by Windes (Volume II of this report).

Table 9.2. (concluded)

Structural provenience	Artifact classification	Temporal Designation A.D.[a]
Grid 307	fragments (2)	1100 - 1140; 1050 - 1100
Plaza 2		
Grid 201	fragments (2)	1100 - 1140
Major Wall 1		
wall clearing	fragment (1)	1100 - 1140 ?
Major Wall 3		
wall clearing[b]	awl (1)	1050 - 1100
Trash Mound		
Grid 99	fragment (1)	1050 - 1100
Grid 155	fragments (2)	1050 - 1100
Grid 183	awls (5); end scrapers (2); needle (1); fragments (4)	1050 - 1100
Grid 211	awls (2); pin (1); fragments (3)	1050 - 1100
Grid 239	awl (1); end scrapers (2); gaming piece (1); fragment (1)	1050 - 1100
Grid 267	awls (4); end scraper (1); fragments (2)	1050 - 1100
Grid 295	tubular bead (1); awl (1)	1050 - 1100
Grid 323	awls (2); awl-scraper (1); end scraper (1)	1050 - 1100
Unknown (slump area)	awls (9); rubbing tool (1); fragments (5)	1050 - 1100
Strat. column 3	awls (3); pin (1); rubbing tool (1); gaming piece (1); fragments (5)	1050 - 1100
Strat. column 4	awl (1)	1050 - 1100
Strat. column 5	awls (2); fragment (1)	1050 - 1100

[a]Dates derived from ceramic associations by Windes (Volume II of this report).
[b]Probably associated with Trash Mound deposits surrounding wall (Windes, Volume II of this report).

Table 9.3. Inventory of worked bone by classification within main functional types.

Functional type	Artifact classification	Number in Assemblage
Piercing tools		
	general awl forms	83
	ulna awls	11
	needles	2
	pins	4
	punches	3
	awl-scraper (counted as a multi-use tool below)	
Total		103
Scraping tools		
	humerus end scrapers	6
	general end scrapers	8
	awl-scraper (counted as a multi-use tool below)	
Total		14
Other tools		
	antler flakers	2
	multi-use tools	3
	rubbing tools	2
Total		7
Nontools		
	gaming pieces	2
	tubular beads	9
	whistles	2
	finger rings	1
	pendants	2
Total		16
Indeterminable items		102
Total Worked Bone		242

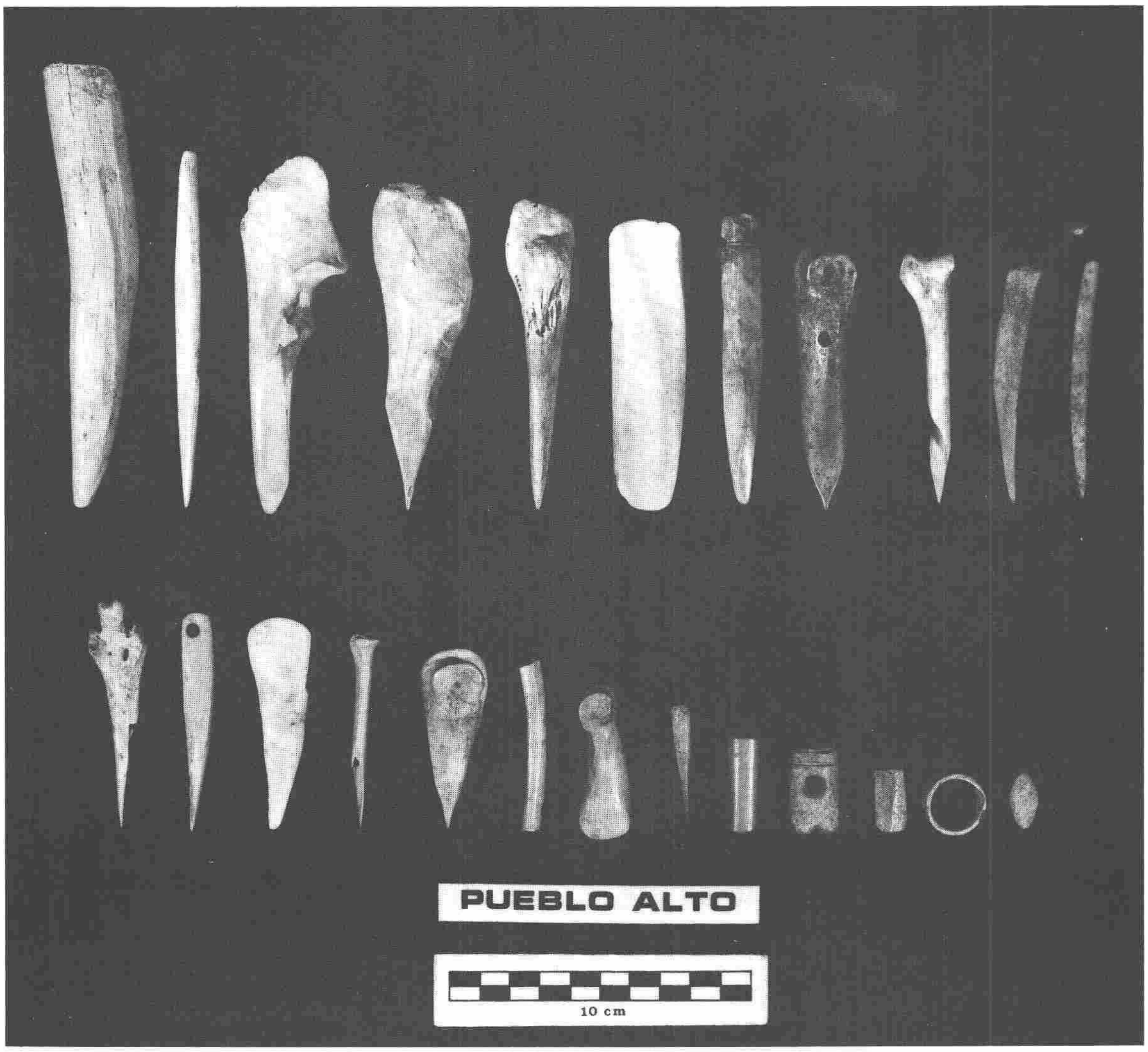


Plate 9.1. An assortment of Pueblo Alto bone artifacts.

The two classes requiring further description are rubbing tools and multi-use tools. These labels were determined based on the type of wear exhibited. The rubbing tools show an even wearing down of the utilized surface, which creates squared edges unlike the beveling seen on scraper ends. The rubbing tools in this collection share no other morphological similarities.

The wear marks on the multi-use tools are from more than one function, as the name indicates. One item has chipped, beveled edges characteristic of scraping and a long, low angle of the tip that is identical to plaiting tools. Another multi-use artifact has transverse striations at one end of the tool that suggest side-motion rubbing and/or mixing functions. The tip is also stained with a red pigment. The third multi-use tool has two functional ends. One end is in the classic awl form (tapered point), whereas the other is spatulate and has been used as a scraper. This tool is listed as an awl-scraper in some of the tables.

Measurements

Dimensions measured include length, width, thickness, diameter of functional tips (e.g., awl points and scraper ends), and diameter of circular open ends (e.g., ends of tubular beads). The measuring technique is explained in Miles (1985).

The descriptive statistics presented in Table 9.4 are the mean ($\overline{X}$), standard deviation (sd), range (R), and number (n) of individual artifacts. A few generalizations can be made from the measurements. First, needles tend to be comparable in length to awls, whereas pins are slightly shorter. This seems to be a common trend in most assemblages examined. Second, punches have broader tips, caused by the flattening effect of use, than do other piercing tools. Last, one tubular bead is somewhat large. Its length, 5.1 cm, is about 2 cm longer than the others, and its diameter of just over 1 cm is considered large in the class of tubular beads. Such size differences have led some analysts to separately label these as bone tubes (Hodge 1920).

A brief review of the statistics shows that there is a high standard deviation in the lengths and in tip diameters of awls and end scrapers. Interpretation of the statistics will center on awls because sample size of scrapers is inadequate.

At two sites that share an occupational overlap with Pueblo Alto (the Bis sa'ani community [Breternitz 1982] and site 29SJ 627 [Miles 1985]), categories of "long" and "short" awls were delineated. Breternitz (1982) suggests a functional disparity between these groups; it is implied by different tip forms and butt end modifications. Accordingly, I looked for a dichotomy in length in the bone artifacts from Pueblo Alto. But unlike those of the Bis sa'ani community and 29SJ 627, these awls display a strong tendency to one average length of 5-6 cm (Figure 9.1). The high standard deviation (sd = 2.50) in Pueblo Alto awl lengths is attributed to

Table 9.4. Dimensions of artifacts.

	Length (cm)	Width (cm)	Thickness (cm)	Diameter (mm)	Tip diameter (mm)	Scraping facet (cm)
Awls						
$\overline{X}$	7.2	1.1	0.5	1.1		
sd	2.5	0.48	0.44	0.52		
R	-16.4	0.4-2.2	0.1-3.6	0.4-3.6		
n	74	74	74	63		
Needles						
$\overline{X}$	7.6	1.0	0.5	0.5		
sd	0.85	0.0	0.07	---		
R	7.0-8.2	---	0.4-0.5	---		
n	2	2	2	1		
Pins						
$\overline{X}$	6.2	0.8	0.3	1.3		
sd	2.99	0.55	0.23	1.04		
R	3.9-9.6	0.4-1.4	0.2-0.6	0.6-2.5		
n	3	3	3	3		
Punches						
$\overline{X}$	7.0	1.4	0.6	2.5		
sd	1.55	0.27	0.15	0.87		
R	5.5-8.6	1.1-1.8	0.4-0.8	1.5-3.2		
n	3	3	3	3		
End scrappers						
$\overline{X}$	9.4	2.0	0.5	18.7		1.3
sd	3.26	0.67	0.09	9.15		0.80
R	4.9-15.7	1.3-3.4	0.3-0.6	7.8-34.1		0.3-2.3
n	9	9	8	8		6
Antler flaker						
$\overline{X}$	9.9	1.8	1.3	4.7		
sd	6.3	0.71	0.28	0.21		
R	5.4-14.3	1.3-2.3	1.1-1.5	4.5-4.8		
n	2	2	2	2		
Rubbing tools						
$\overline{X}$	4.7	2.9	0.7	---		
sd	2.14	1.61	0.6	---		
R	5.2-9.6	1.6-4.7	0.1-1.3	---		
n	3	3	3	0		
Gaming pieces						
$\overline{X}$	2.2	1.0	0.2	---		
sd	---	---	---	---		
R	---	---	---	---		
n	1	1	1	0		
Tubular beads						
$\overline{X}$	3.8	0.9	0.8	9.4	8.6	
sd	1.19	0.24	0.22	2.35	2.18	
R	2.6-5.1	0.6-1.1	0.5-1.0	5.9-11.0	6.0-10.7	
n	4	4	4	4	4	
Whistles						
$\overline{X}$	5.6	0.8	0.6	7.8	8.1	
sd	---	---	---	---	---	
R	---	---	---	---	---	
n	1	1	1	1	1	
Finger ring						
$\overline{X}$	2.1 (diam)	0.2				
sd	---	---	---			
R	---	---	---			
n	1	1	1			
Pendants						
$\overline{X}$	2.9	1.7	0.6			
sd	---	---	---			
R	---	---	---			
n	1	1	1			

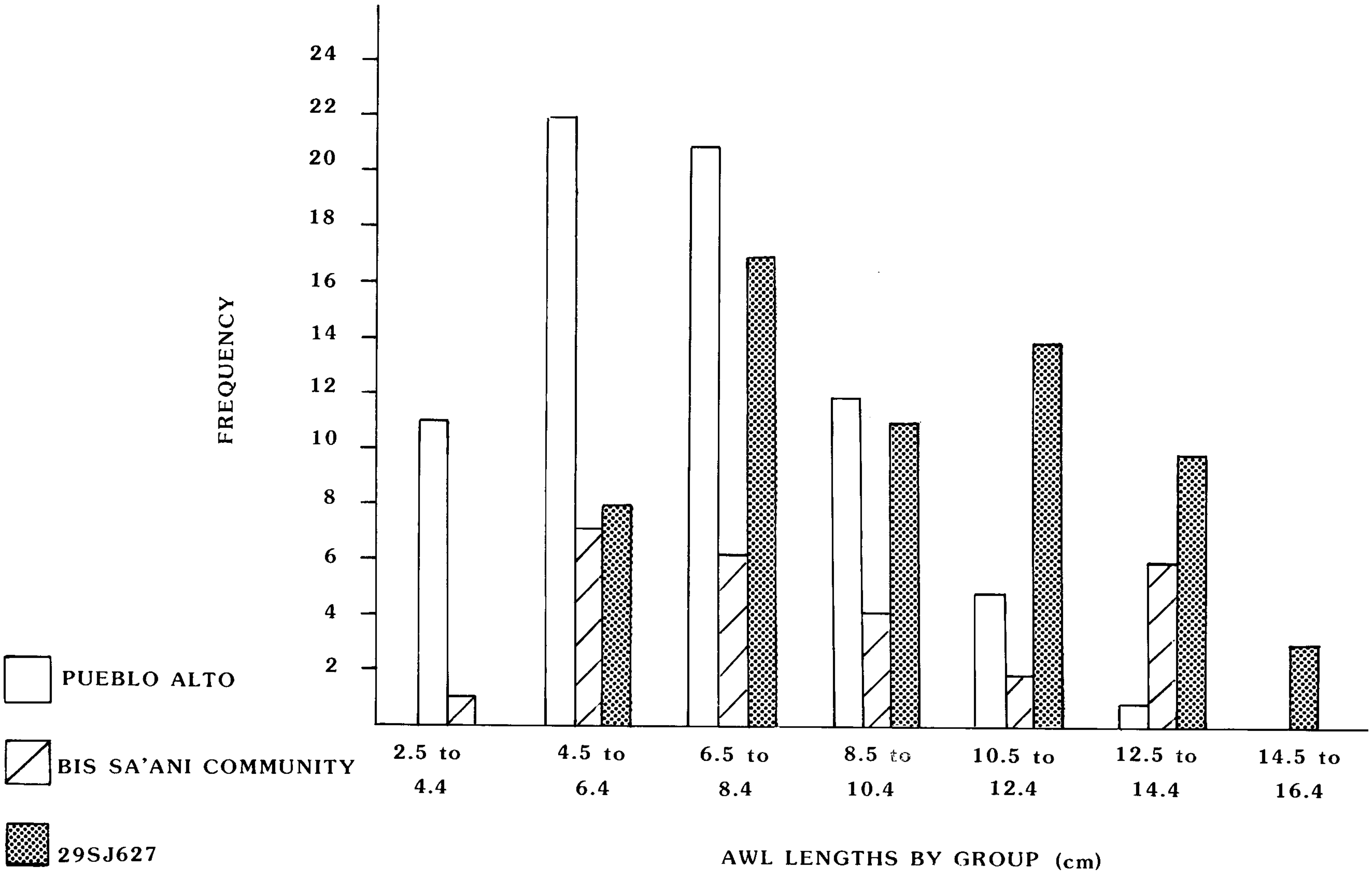


Figure 9.1. Awl lengths from three Chacoan communities: Pueblo Alto where n = 74, X = 7.2 cm, sd = 2.5 cm; 29SJ 627 where n = 63, X = 9.7 cm, sd = 2.8 cm; and Bis sa'ani where n = 27, X = 9.24 cm, sd = 3.93 cm.

the skewing effect of the few relatively long awls that were longer than 12 cm.

Another feature examined was the sharpness of awl tips. If the degree of sharpness is represented by distinct groups, it could be reasonably postulated that distinct functions were maintained. These data were recorded within ranges (Table 9.5). The distribution of awl-tip diameter is normal with a very strong central tendency around 1 mm. Because more than one cluster is not observed, meaningful distinctions of functions are not substantiated with the use of this variable.

Manufacture

The descriptions of the manufacturing processes are subsumed under three topics: general manufacture (primary and secondary production steps), special modifications such as carving of the bones' surfaces, and tip morphology. Tip morphology, however, is actually a combined result of manufacture and use.

Primary and secondary production steps that give bone artifacts their general shape are tabulated in Table 9.6. A key appended to the table describes each modification technique. The primary step results in the finished tool's general outline or shape and is usually the stage of the most alteration. The secondary step refines the outline only slightly.

The totals of the tabulated data reveal splitting and splintering (first step) and multidirectional grinding of rough edges (second step) as the most common techniques. This is found at other Chacoan sites (Breternitz 1982; McKenna 1984; Miles 1983a-d, 1985). What contrasts with other sites, especially those that have some overlap in time and comparably sized assemblages such as 29SJ 627 and 29SJ 629, is the greater proportion of tools, particularly awls, from Pueblo Alto that are diagonally cut/spirally fractured. It was previously argued that the method of primary alteration was largely determined by the most efficient means (Miles 1985)--in the case of awls it is longitudinal splitting. Pueblo Alto's evidence does not agree with this argument.

Special modifications are few. Most serve a definite functional purpose and are, in fact, characteristic of the tool type (e.g., needles have eyelets). Special modification of Pueblo Alto specimens appears in two forms--carved surfaces and circular perforations in bone shafts. All needle eyelets were made by drilling as were the single holes in the punch, both pendants, and one whistle. The much less common notched hole appears on the second whistle.

Scoring of a bone's surface is also common among particular artifact classes. For instance, gaming pieces often have crosshatchings on one surface, which is the case for the two specimens recovered from Pueblo Alto. Transverse scoring is also evident on the surface of one pendant and on the butt ends of an awl and a pin.

Table 9.5. Summary of measurements from tip diameters in awls.

Tip diameter (mm)	Frequency
0.0 - 0.4	1
0.5 - 0.9	24
1.0 - 1.4	30
1.5 - 1.9	6
2.0 - 2.4	0
2.5 - 2.9	0
3.0 - 3.4	1
3.5 - 3.9	1

$\overline{X}$ = 1.1 mm, sd = 0.52 mm, n = 63.

Table 9.6. Major bone modification techniques seen in bone artifacts.

	PRIMARY PRODUCTION CATEGORIES[a]						SECONDARY PRODUCTION CATEGORIES[b]		
	Longitudinal Bilateral Split	Indeterminable Split	Splintered	Whole	Diagonal cut/ Spiral fracture	Circumference Groove and Snapped	Transverse striae On tip and Longitudinal cut only	Multidirectional, General striae Overall	Highly polished Overall
Awls	11	25	32	9	17		15	77	2
Awl-scrapers			1				1		
Needles			2					2	
Pins	1		3				1	3	
Punches	1		2				1	2	
End scrapers	2	7	1		4		1	13	
Antler flakers		1		1				2	
Rubbing tools	1[c]			2		1[c]			
Multiuse tools			1					1	
Gaming pieces			2					2	
Tubular beads						9		8	1
Whistles		1				1		2	
Finger rings				1				1	
Pendants			1			1		2	
Totals	16	34	45	13	21	12	19	118	3

[a]Longitudinal bilateral split: element split longitudinally along sagittal plane, producing symmetrical halves.
Indeterminable split: initial split made longitudinally but location is indeterminable relative to the sagittal plane, resulting in sections that retain an articulative end.
Splintered: indiscriminate splitting of bone element resulting in splinters of shaft sections.
Whole: complete element except for secondary tip or edge refinement.
Diagonal cut/spiral fracturing: shaft cut or fractured diagonally to long axis of element.
Circumference groove then snapped: circumference incised perpendicular to long axis, then element snapped apart at place of groove.
[b]Transverse striae on tip and longitudinal cut only: self-explanatory.
Multidirectional, general striae overall: miscellaneous work on bone, including multidirectional striations about the tip and/or shaft and possibly some polish over a limited area and/or of limited intensity.
Highly polished overall: self-explanatory.
[c]Both steps performed on one tool.

The surface of one relatively short, humerus end scraper was distinctively carved into two rows of concentric rings. The circles are identical to those on a bone artifact found during minor excavations of Room 168 at Pueblo Bonito (Pepper 1920:Figure 141). Plate 9.2 is a side-by-side comparison of these two implements. They appear to be finished products, although it has been suggested that the circles could have been inlaid or the tool itself was being worked to yield small beads. The worn and polished edges of the carved design suggest that adornment was completed and the item put to use.

The tip shapes provide descriptive information of a general nature. Basically, the assemblage can be divided into two groups, pointed and blunt ends. In side view, pointed tips are tapered and are easily distinguished from blunt ones whose sides continue in straight form from the middle of the shaft to the tip end.

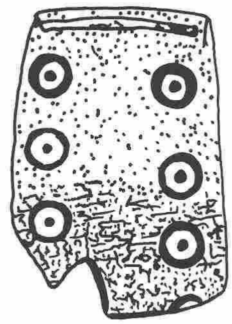
There are far more pointed tips than blunt, but then again, there are far more awls in the assemblage which, by definition, have pointed tips. The information in Table 9.7 provides more detailed categories within each of the two major groups, which are useful in interpretation of their function.

The views drawn in the column headings of Table 9.7 illustrate the type of motion the tools are put through during use. Awls are overwhelmingly of a consistent, tapered form with all sides of the point having received equal wear. This occurs when the tool is held perpendicularly to the material being worked or, if held at an angle, rotated to receive equal wear.

The exact direction of movement, whether rotational or vertical, can best be ascertained by a study of striations. The tips of only a few instruments (n = 9) show regular unilateral wear that is evidence of striae in only one direction. It can be argued that such wear results from movement in one consistently repeated direction, i.e., a single precise function. As for the awls with concave tips, their form appears to be determined by the natural form of the bone, not wear or manufacture. However, their shape is ideal for performing a primary reaming function. All of the reamer-type awls were incomplete, broken tool fragments.

Condition of the Bone

The condition of the assemblage is good, considering bone's susceptibility to deterioration and damage. The number of fragments from most of the Chacoan sites, regardless of assemblage size and including Pueblo Alto, is roughly one-half of the total worked bones recovered. As few as 15 specimens were severely eroded, whereas 160 show no signs of erosion. Minimal erosion was set in motion primarily by root etching, which appears on the rest of the artifacts (67). The few badly eroded pieces were recovered as single pieces from several locations at the site, although



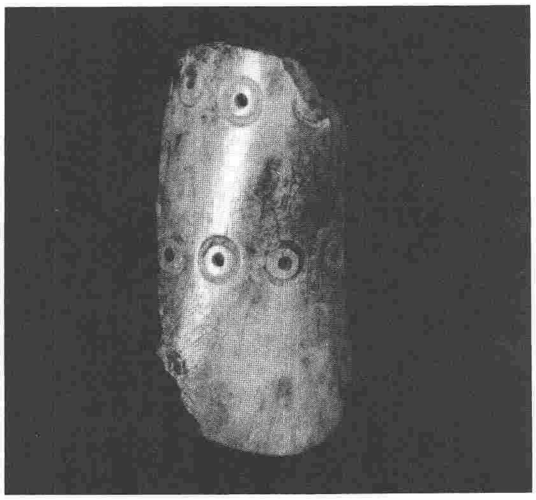
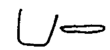
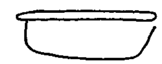


Plate 9.2. Distinctively carved and drilled humerus end scraper from Pueblo Alto and ornament from Pueblo Bonito.

Table 9.7. Tip end morphology.

	POINTED ENDS						BLUNT ENDS			
	Gradual Tapering Round tip	Gradual Tapering Flat tip	Gradual Tapering Faceted Flat tip	Abrupt Tapering Tip concave To inferior	Gradual Tapering Tip inferior Beveled	Gradual Tapering Tip exterior Beveled	Squared	Small Spatulate Ground Flat	Large Spatulate Ground Flat	Ground But not Reshaped
										
Awls	39	24		10	4	3				
Needles	1									
Pins	3					4				
Punches			3							
Awl-scrapers[a]	1							1		
End-scrapers							1	1	10	
Antler flakers	1		1							
Multi-use tools					1					1
Tubular beads										9
Whistles										2
Totals	45	24	4	10	5	4	1	2	10	12

[a]One tool with two functioning tip ends.

three items were from Kiva 10 and four from the Trash Mound. One awl in perfect condition was recovered from the fill of Firepit 2, Floor 2, Room 110.

Fauna

The unworked-faunal data base excludes bone artifacts; therefore, the information presented here does not duplicate the data used in Akins' faunal study (this volume). However, the faunal descriptions (e.g., species, element, side, age, sex, etc.) were determined by Akins during the course of her work.

When one considers the availability of the raw material, bone is exploited for tools and other instruments in few numbers. Unworked analyzed pieces total 30,509 from Pueblo Alto and are from a minumum of 65 species (Akins, this volume), whereas the 242 bone artifacts represent as few as 12 species. A predominance of rabbit elements in the unworked-faunal assemblage is countered by a predominance of artiodactyl bones in the worked assemblage (Table 9.8). Considering known species only, mule deer are the prime source animal for bone modification. Their utilization is almost exclusively for tools as opposed to such things as rings, whistles, tubular beads, and pendants (i.e., nontools).

The associations between artifact classes and fauna seen at many Chacoan sites also occur at Pueblo Alto (Table 9.9). For instance, tubular beads were consistently made from hollow bird bones, whereas a diverse assortment of species was selected for awl production.

The plentiful supply of local bone did not discourage acquisition of at least two "exotic" elements. Specifically, they are elk and mountain sheep elements, which were indigenous to the high mountains. Akins (this volume) noted that sheep may have been available closer to Chaco Canyon. They contributed only a minor portion to subsistence at Pueblo Alto.

Earlier Chacoan sites contained bone artifacts made from nonlocal sandhill crane and Canada goose elements (Breternitz 1982; Miles 1985, 1983b). The shift from bird bones to large mammals is interesting and may indicate use of or access to different environments between the earlier and later prehistoric occupations.

Spatial and Temporal Proveniences

Original prehistoric contexts are identified for 39 bone artifacts associated with certain architectural features at Pueblo Alto; it is assumed these areas were relatively undisturbed. The specific items and locations are in Table 9.1. Most were recovered from floor fill, roof fall, and floor contact. The remainder of bone artifacts were found in the dense trash-fill of Kiva 10 and in the Trash Mound (Table 9.2).

Table 9.8. Array of faunal taxa.

Taxa represented In worked bone Assemblage	Percentage of Taxon represented In unworked bone Assemblage	Percentage of Taxon represented In total worked Bone assemblage	Number of Worked bone Items	Percentage of Each taxon Modified into Bone tools
Sylvilagus species (cottontail rabbit)	19.4	1.2	3	0.1
Lepus californicus (jackrabbit)	15.7	6.2	15	0.3
Cynomys gunnisoni (Gunnisons prairie dog)	8.6	0.8	2	0.1
Canis species[a] (dog family)	0.2	0.8	2	3.0
Canis latrans (coyote)	<0.1	0.4	1	6.3
Taxidea taxus (badger)	<0.1	0.4	1	12.5
Artiodactyla[a]	10.6	57.9	140	4.3
Cervis canadensis (elk)	absent	0.4	1	100
Odocoileus hemionus (mule deer)	1.9	11.6	28	4.9
Antilocapra americana (pronghorn)	0.5	2.9	7	4.0
Ovis canadensis (mountain sheep)	0.5	0.4	1	0.7
Buteo species (hawk)	0.8	0.4	1	0.4
Meleagris gallopavo (turkey)	3.2	6.6	16	1.6
Unidentifiable:				
Small-to-medium mammal	23.3	5.4	13	0.2
Medium-to-large mammal	8.6	7.9	19	0.7
Aves	1.4	7.4	18	4.2
Unknown	2.7	5.0	12	1.4
Totals	94.5	100	242	

[a]Figures include counts for all species that are in this more general taxon; column totals do not reflect duplicate data or quantities less than 0.1 (<0.1) percent.

Table 9.9. Array of faunal taxonomy by artifact classification.

	Awls	Needles	Pins	Punches	Awl-Scrapers	End Scrapers	Antler Flakers	Multi-use Tools	Rubbing Tools	Gaming Pieces	Tubular Beads	Whistles	Finger Rings	Pendants	Fragments	Totals
Sylvilagus sp.	1														2	3
Lepus californicus	7											2			6	15
Cynomys gunnisoni	2															2
Canis species													1			1
Canis latrans	1															1
Taxidea taxus	1															1
Artiodactyl	42	2	2	1	1	8		1	2	1					43	103
Cervis canadensis															1	1
Odocoileus hemionus	8			1		3	2		1						13	28
Antilocapra americana	1					2									4	7
Ovis canadensis						1										1
Buteo species											1					1
Meleagris gallopavo	11										3				2	16
Small-to-medium mammal	5		1												7	13
Medium-to-large mammal	8		1	1						1				1	7	19
Aves	3										5				10	18
Unknown	4													1	7	12

Akins (this volume) suggests that the roof fall in Room 145 contains evidence of a bone tool manufacturing locus. She believes that the artiodactyl metapodials found there are not typical of normal, bone-refuse deposits. However, the long bones show no tool-preparation marks (longitudinal grooving), and there were no splitting tools (punches) nearby. She also notes some artiodactyl elements that evidence early preparatory tool-making, which were recovered from Room 139, adjacent to Room 145 (Akins, this volume). Their presence is diagnostic of awl-manufacturing areas (McKenna 1984). The roof-fall collection is probably a stockpile of raw material for bone artifacts with modification taking place at another location in the site.

Excavations did not expose much kiva floor area, and testing of these structures was minimal when compared to rooms. This sample bias probably resulted in a critical lack of information from kivas, as bone artifact "activity areas" have been linked to kivas at smaller, earlier sites (McKenna 1984; Miles 1985, 1983a, 1983d).

Sites comparable in terms of architecture (Pueblo Bonito and Aztec Ruins) and time (part of the Bis sa'ani community, Pueblo Bonito, Aztec Ruins, and Salmon Ruins) were looked to for sufficient data to provide a model for activity areas (Breternitz 1982; Irwin-Williams and Shelley 1980; Judd 1954; Morris 1928; Pepper 1920). Unfortunately, there is not enough information about their original time and space placements to create such a model. Without a representative sampling of other structural features, particularly kivas, and the lack of a model, the Pueblo Alto data are of limited value to intrasite, activity-area analysis.

Although specific use loci within Pueblo Alto cannot be identified at this point, general functional tasks can be defined at the site level and contrasted with other sites. Functional categories of the Pueblo Alto collection were compared with the same categories from other sites. These categories were arranged within a temporal framework. Proportions of a site's piercing tools, other tools, nontools, and fragments comprise the categories in the frame of reference (Figure 9.2). The contributing sites are 29SJ 423, 29SJ 627, 29SJ 724, 29SJ 299, and 29SJ 629, all located in Chaco Canyon. At least three trends were identified. These are (1) piercing tools are generally the most dominant in numbers after A.D. 700; (2) nontools constitute a larger percentage at sites occupied before A.D. 800; and (3) fragments usually comprise a large percentage of the artifacts at any time.

Pueblo Alto's assemblage is much the same with respect to trends 2 and 3. As a late Chacoan site, Pueblo Alto contains only a small quantity of nontools. The site's occupation comes at a time when contemporary settlements experience a slight rise in percent of nontool bone artifacts but frequencies are still low. Pueblo Alto's assemblage displays the same trend at even lower proportions. Also, at Pueblo Alto, a dominant group of fragment, piercing tools, were recovered especially during the early years of occupation.

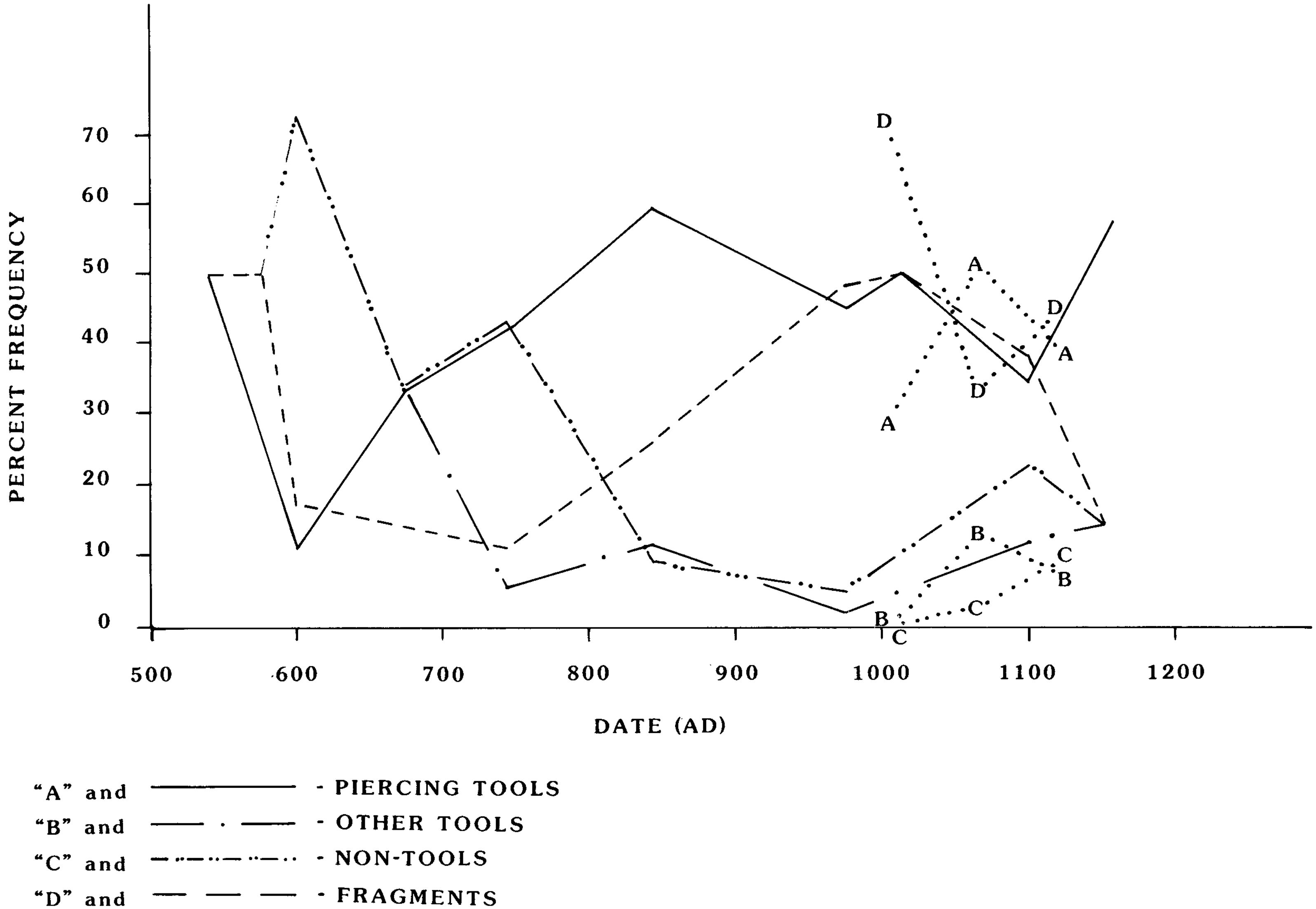


Figure 9.2. Percentage of artifact types among bone.
(NOTE: Lettered lines represent Pueblo Alto's assemblage.)

Because fragments constitute such a large proportion of Pueblo Alto's assemblage, it would be helpful to determine their original artifact types. To do this, diagnostic criteria of size and manufacturing evidence were used. In complete artifacts from all Chaco sites, nontool and tool lengths occur in two exclusive ranges. Therefore, those fragments larger than the largest nontools are probably tool fragments. The specific tool type is determined by the criterion of manufacturing evidence. Positive awl-manufacturing evidence is the presence of end tapering. Therefore, large fragments displaying end tapering are piercing tools and probably awls, given that specific type's attribute history. The data from fragments were collected from a one-third random sample of Pueblo Alto bone artifacts. Based on size, 65 percent could conceivably be tools. Of these, over 70 percent displayed tapering. This evidence provides strong argument that most Pueblo Alto fragments are awl remnants.

Summary

Essentially this analysis was performed on a site-level basis making only a few intersite comparisons where the information was readily available or when the intrasite approach was inadequate.

Bone artifacts are notoriously one of the smallest artifact groups recovered from archeological sites. Pueblo Alto's total of 242 is rather large for a single site assemblage but miniscule when compared to the counts of sherd, lithic, and faunal remains from most Anasazi sites. The site total is understandable, given the size of the structure and its intensive use. The general condition of the bone is relatively good with fragments accounting for just less than one-half of the overall assemblage.

For the most part, artifact classes (awls, scrapers, pendants, etc.) and their numbers are typical. Awls are the overwhelmingly dominant identifiable type, whereas all of the nontools combined--comprised mostly of ornaments--are the least frequent.

An average Pueblo Alto awl is 5-6 cm long, which is about 2 cm shorter than awls from other Chaco sites. Awls longer than 12 cm are present but few. Most of the remaining items are not of an unusual size. One exception might be a rather large, tubular bead that fits the description applied to "bone tubes" that may have served a different function from tube beads. Hodge (1920) suggests functions for bone tubes such as drinking or sucking, handles and preforms of flutes. Tubes in the Chaco world may be a late-site phenomenon as virtually none were found at the earlier sites studied but have been reported from the later site components of Pueblo Bonito (Pepper 1920), Aztec (Morris 1928), and Hawikuh (Hodge 1920).

The common canyon-wide awl manufacturing technique of longitudinal splitting found at earlier canyon sites and at the partially contemporary community of Bis sa'ani conforms to that seen at Pueblo Alto. A minor deviation from this at Pueblo Alto is evidence of use of the spiral fracture method as an initial step. The technique is most often used to make scrapers. It is less efficient in awl-making because the first break of the shaft results in a wide blunt tip, which then must be extensively reduced to obtain a point. Both controlled splitting and splintering render pointed tips requiring minimal grinding to finish the tools; the less precise technique, spiral fracturing, produces more wasted raw material.

With regard to faunal selections for bone artifacts, Pueblo Alto is once again similar to other Chaco sites. Bird bones were shaped into tubular beads, and artiodactyl long bones were the material base for most awls and scrapers. As elsewhere, there are many more species available onsite (as indicated by faunal remains) than are selected for modification. An in-depth look at species utilization in the canyon would be interesting and could shed some light on access to bone sources at different sites.

Activity areas involving bone artifacts were located in some of the tested portions of the pueblo. Five types of activity areas are possible: stockpile of preforms, manufacturing loci, use areas, storage places, and discard areas. Of these, one stockpile (Room 145) and another possible manufacturing area (Room 139) were noticed by Akins' (this volume). Rooms 143 and 139 have evidence of use and storage for most of the occupational range of the site. Room 103 also has a long-term association with bone artifacts, which does not change through the several remodelings of the room. These rooms and most of the others with less substantial evidence are thought to be habitational (Akins, this volume; Windes, Volume I of this report).

Instances of bone artifacts found in association with architectural features are few. Generally, discards occur intermittently and are highly dispersed within the trash-filled areas of the site. This makes spatial analysis tenuous at best.

Conclusions

Concluding remarks pertain to this assemblage as it (1) interprets a single site and (2) compares with the excavated small sites in the canyon. Problems with site representativeness are duly recognized. The only other large sites excavated were either done decades ago, before detailed records of context were recorded or sufficient information is not available in current reports. Therefore, there is no available data base analysis that can serve as a model for greathouse, bone-artifact collections.

Small-site analysis suggests that Pueblo Alto kivas probably housed most bone-artifact activities. However, some rooms did yield bone artifacts from relatively undisturbed contexts. If the small site evidence is applicable, these rooms are probably secondary to specialized loci in kivas. If so, additional excavation of kivas will reveal corroboratory evidence in the form of proportionally more bone artifacts than were recovered from the rooms.

Kiva excavation will predictably affect the quantities shown in Plate 9.2 in that most will be awls or awl fragments. Also, nontools, particularly ornaments, are found in greater number in kivas (Miles 1985), so their overall proportion will be more than currently seen. These trends, when incorporated into the existing curve in Figure 9.2, will bring Pueblo Alto's trajectory for both tools and nontools more in line with the curves summarizing other contemporary collections.

Artifact types present at Pueblo Alto are common throughout the canyon. Supplemental acquisitions via excavation could provide a data base for subtyping the more abundant tools such as awls. As it is, there are no discrete wear or size patterns that indicate subtypes, a strong indication that functional hybridization produced a typical, dominant form of awl.

Species identification provides information about Pueblo Alto's economic territory. The onsite, unworked bone appears to have been a stable resource base for bone artifacts, although two "exotic" species are from environments ranging from at least 40 to 100 miles distant. The few exotic elements suggest a slowly progressing, down-the-line trade or direct procurement on probably a one-time venture. There was no movement to expressly obtain nonindigenous species. Pueblo Alto's bone-tool industry survived by depending heavily on the local artiodactyl population.

Pueblo Alto's bone-tool tradition deviates from smaller sites and from those occupied earlier. Its assemblage is much larger than those of other sites, and the variety of artifact types is closely akin to contemporary pueblos rather than to Basketmaker III to Pueblo I occupations. However, the elite character sometimes applied to the Chaco greathouses is not reflected in the Pueblo Alto bone artifacts, with the exception of the carved humerus end scraper (Plate 9.2). Overall, Pueblo Alto's small bone tool industry was indifferent to whatever status they might have enjoyed as a "greathouse."

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Chapter Ten

The Use of Turkeys at Pueblo Alto Based on the Eggshell and Faunal Remains

Thomas C. Windes

Turkey remains and eggshells have been found throughout the Anasazi occupation of Chaco Canyon, but it was during the Bonito phase that they first comprised an important part of the faunal assemblage when the Large Indian Domestic Breed, possibly the only type found in Chaco Canyon (McKusick 1986a), may have been introduced from the west or north (McKusick 1971). Akins (this volume) has discussed at length the faunal remains at Pueblo Alto and has found that turkeys were present during the entire occupation of the site. In the early A.D. 1100 deposits, however, turkey bones greatly increased in frequency, marking the bird's broadened importance to the Pueblo Alto inhabitants. Large numbers of turkey bones from sites have led some professionals to infer onsite domestication (Hargrave 1971:91), but without evidence of pens, dung, eggshells, and the remains of young and immature birds, this is questionable. At Bc 288, for instance, a twelfth and thirteenth century site in Chaco Canyon, a huge quantity (2,209) of turkey feathers was recovered, but the absence of eggs, dung, and poults led McKusick (1971) to infer that turkeys were not bred at the site. A few immature poults found at Pueblo Alto (Akins, this volume) confirm domestication of the turkey at the site, but it is unknown to what extent domestication took precedence over birds gathered by other means (e.g., from hunting or capture).

The role of the turkey in Chaco prehistory is unclear but offers the potential for understanding some of the unusual events there. At this point, some familiarity with the wild and domestic turkey is germane. Except for the extreme southern areas of New Mexico and Arizona, where *Meleagris gallopavo mexicana* may be found, New Mexico, Arizona, and Utah are occupied solely by *M. g. merriami* and probably were so in the past (Schorger 1966:42-48). An extinct subspecies, *M. g. tularosa* found in Canyon del Muerto and Tularosa Cave might have once occupied identical territory as *M. g. merriami* only to be displaced by the latter (Schorger 1970). Hunting eliminated the turkey from much of New Mexico until its reintroduction in recent times (Lee 1955).

Merriam's turkey was originally found along all wooded streams and in the mountains of New Mexico. The wild turkey prefers a habitat in the

Transition Zone at elevations of 7,500-9,500 ft, although in the winter it may be found in lower terrain bordering the Upper Sonoran Zone (Schorger 1966:190, 234-235). The ancestral home of the wild turkey is placed by Ligon (1927:113-114; 1946:ix, 1-2) in the intermountain regions of the Southwest at elevations from 6,000-10,000 ft. Here, ponderosa pine provided an essential source of food and roosting safety. A certain amount of protective understory cover and food-producing annual plants were also important (Ligon 1946:2). The range of the turkey also coincides closely with pinyon and one or more species of oak (e.g., Gambel's oak) according to Ligon (1946:59). Water is required at least once or twice a day, and, therefore, turkeys are seldom found more than a mile or two from water (Schorger 1966:176-177; Spicer 1959:23-25). Nests are also generally located near water (Blakey 1937:6). Frank Hodge, Jr. (personal communication 1976), of the New Mexico Department of Game and Fish, believes water is more critical than ground cover for turkey survival.

Chaco Canyon has not been a good habitat for wild turkey for the past 2,000 years, although turkeys occasionally will cross dry, barren areas such as the San Juan Basin because of overpopulation (Schorger 1966:191; Spicer 1959:47-48). Authorities do not agree on the maximum seasonal movement for *M. g. merriami*, however. Spicer (1959:46) suggests 18 miles maximum but normally less than 10 miles, but Ligon (1946:8) believes a 25--40-mile migration is more accurate. If water were available, wild turkeys might have been present in Chaco Canyon. Nevertheless, if turkeys had resided there, they probably would have succumbed to hunting pressures by the Anasazi long before the Bonito phase. In all likelihood, the Anasazi never encountered wild turkeys in Chaco Canyon.

Presently, the turkey habitat nearest to Chaco Canyon is in the high mesa country southeast of Crown Point, New Mexico, farther east on Mt. Taylor, and in the Jemez Mountains. Wild turkeys were absent from the Chuska Mountains for about 50 years before their reintroduction in 1956, presumably as a result of hunting pressures, but were abundant in the Zuni Mountains (Spicer 1959:48). Since faunal sightings have been recorded in Chaco Canyon (about the last 20-25 years), turkeys have not been tallied by the park staff (Brian McHugh, personal communication 1977; Dabney Ford, personal communication 1986).

Two clutches a season seem to be the rule for laying hens, although they nest only once a year. Domestic hens may lay eggs all year (Schorger 1966:263) after a year's maturity. During laying, beginning in April or May and lasting for three to three and a half months, eggs are produced at a rate of about one every 36 hours. Incubation takes about 28 days. Although the size of a clutch varies, those of *M. g. merriami* range between 9 and 19 eggs (Schorger 1966:Table 20). Ligon (1946:35) believes the average is about 10 eggs and states that clutches larger than 12 eggs are exceptional. Only about 35 percent of the time does the wild turkey hatch its eggs (Schorger 1966:268). A brood usually results in a ratio of one hen for four to eight poults (Spicer 1959:35-36).

M. g. merriami eggs are ovate and creamy white, speckled with fugitive reddish brown spots (Schorger 1966:270-273). Shell weight, about one-tenth the egg weight, averages 7.25 gm for domestic eggs (Asmundson et al. 1943:36). Two complete eggshells of M. g. merriami in the National Museum of Natural History, Washington, weighed 7.29 and 8.70 gm. In the same collections were 18 eggshells of M. g. intermedia ranging between 5.47 and 9.18 gm (mean 6.98 gm) according to John S. Weske, Acting Chief of the Bird Section (personal communication 1977). The shells approximate 0.35 mm in thickness. M. g. Merriami egg size averages 49 by 69 mm (sample number unknown), although a group of seven found by Lyndon Hargrave in the White Mountains, Arizona, exhibited a mean of 48.8 by 66.4 mm (Ligon 1946:35).

Eggshell from the site offers additional evidence for interpreting the use of turkeys at Pueblo Alto. Eggshell was collected systematically at Alto, although the tiny fragments typical of the remains make the representativeness of the sample uncertain. Their fragmentary nature prevented precise species identification by ornithologist J. David Ligon of the University of New Mexico. The shell thickness, color, and curvature of most, however, indicate that the egg was large and, therefore, probably a turkey egg. In addition, finds of restorable eggs at Pueblo Alto were undoubtedly from turkeys. Previous assumptions about the ancestry of eggshell found in Chacoan sites probably were also based on the correspondence of color, size, and shape of the shell with turkey eggs.

Despite the recovery of about 1,942 eggshells from Pueblo Alto, their overall weight of 66.2 gm could account minimally for only a paltry 8-10 turkey eggs. Eggshell from Pueblo Alto was concentrated in the Trash Mound (1,083 shells weighing 40.4 gm) and the roof fall of a few rooms, although it occurred throughout the site (Table MF-10.1). The bulk of the eggshells were represented by four lots that accounted for 43 percent of all the eggshell recovered at Pueblo Alto (54 percent by weight). These lots probably represented between 5 and 6 eggs, and they came from the fallen wall and roof debris in Room 232 (174 pieces), above Floor 4 in Room 236 (222 pieces), and in two adjacent Trash Mound deposits, Layers 71 and 78 (440 pieces). Clear evidence for turkey residence in the form of pens, dung, and widespread masses of compacted eggshell was not uncovered. Possibly the impressions of a small, slab box (Feature 1) on Floor 4 of Room 236 may mark a small turkey pen because of the concentration of eggshell (222 pieces weighing 6.4 gm) nearby, although no dung was found. Rooftop occupation seems more likely, however, because of the amount of eggshell and turkey bone recovered from the roof debris in contiguous Rooms 103, 230, and 232. Turkey remains were also common in the roof fall of the Central Roomblock rooms at Pueblo Alto (Akins, this volume) but eggshell (20 pieces) was not.

Eggshell was most common in the Gallup Black-on-white ceramic deposits, which date between about A.D. 1050 and 1100. Turkey bones, however, were most frequent in the later deposits (A.D. 1100-1140 period), which reveal a large increase in turkeys over the earlier (Gallup) period (Akins 1985). This enigma is discussed below. Both eggshell (Table 10.1) and turkey remains from Pueblo Alto were infrequent in the earliest deposits,

Table 10.1. Eggshells recovered from Pueblo Alto by ceramic period.

Ceramic Period	Weight (gm)	Frequency
Red Mesa (A.D. 980+ - 1050)	0.31	26
%	0.47	1.34
Gallup (A.D. 1050-1100)	49.065	1408
%	74.07	72.50
Late Mix (A.D. 1100-1140)	16.87	508
%	25.47	26.16
Total	66.245	1942
%	100.01	100.00

dominated by Red Mesa Black-on-white ceramics (pre-A.D. 1040/1050). In the largest deposit of early trash excavated (Layer 15 in Plaza Grid 8), an inconsequential volume (1.0 m^3) compared to later trash deposits, no turkey bone was recovered despite a large faunal sample (804 bones), although 15 eggshells were collected.

The overwhelming number of turkey bones came from the early A.D. 1100s deposits. Turkey bones were most plentiful in the room roof deposits at the site, rather than in the fill of plaza kivas where the greatest volume of early A.D. 1100s trash was recovered. The rarity of turkey remains in kiva fill was also paralleled by the paucity of eggshell. Of the 5,826 identified bones from the early A.D. 1100s at Pueblo Alto, 987 (17 percent) were turkey (Akins, this volume). Calculation of the minimum number of individuals (MNI), however, reduces the proportion of turkey to 8 percent (49 of 628 MNI). Of all the identified turkey bones, the late remains comprised 88 percent of the total. The late eggshell, on the other hand, comprised only 26 percent of the total (25 percent by weight) (Table 10.1).

Although the earlier (Gallup) deposits yielded considerable eggshell, there was a surprising paucity of turkey bone. Out of 8,013 bones identified to a species from the period, only 68 (1 percent) were from turkeys (Akins, this volume). MNI counts increase the proportion of turkey to other species to 2.5 percent (21 of 841 MNI). Most of the immature turkey elements recovered (60 percent, or 30 percent of the MNI), however, came from Gallup deposits.

In the Trash Mound, in particular, eggshell was found throughout the Gallup units, which gives the impression that far more eggshell was represented than that based on minimal weight. The amount of A.D. 1000s eggshell may have been considerable if we consider that eggshell easily disintegrates by crushing, may have been recycled by the turkeys for the calcium [Mollie Struever (Toll), personal communication 1977], and probably often was missed in the 1/4-in. screening. Despite these potential biases, most of the eggshell was recovered from A.D. 1050-1100 deposits: 74 percent by weight and 73 percent by number (Table 10.1).

The number of immature birds and eggshells suggests that turkeys were domesticated at the site in the late A.D. 1000s, but that their use dramatically increased in the early A.D. 1100s. It is also noteworthy that burning and cooking discoloration of turkey bones became common in the early A.D. 1100s, although completely burned bones from the total bone assemblage were most frequent in the late roof remains (A.D. 1100s) and in the Trash Mound (A.D. 1000s). Eggshell, except in one instance, was not recovered in a burned condition and probably would not have been recognized as such in the field unless it were concentrated. Turkey bones from the Gallup deposits were not burned.

What do these differences mean? It is clear that turkeys are a significant part of the faunal assemblage in the early A.D. 1100s. The frequency of their burned bones suggests that they were being used for food, although the burning may not reflect roasting but rather processing and consumption of turkeys near firepits where scraps were discarded and burned. It is unlikely that the turkey bones on the roofs would have derived from elsewhere and been hauled to the roofs for disposal, thus, some roof-top cooking and food processing probably was likely in the early A.D. 1100s.

Because trash, including bones, was deposited into abandoned kivas, probably from the nearby roofs, it was unusual that turkey bones and eggshells were notably scarce in the trash-filled kivas but common in other places of trash disposal. Despite the widespread pattern of turkey remains in the room roof deposits, however, there were few turkey bones and eggshells in the Room 110/112/229 suite in the West Wing. This reinforces the possibility that kivas may have been undesirable places for depositing turkey scraps because Room 110 and a few adjacent rooms had been converted into kivas by the early A.D. 1100s. Perhaps roof entry into kivas required keeping the area clear of turkeys in the Room 110 area. It is difficult to know if turkey remains were deliberately kept away from kivas in the A.D. 1000s because the earlier trash was found in only two kivas: Kiva 13, which had more eggshell (22 pieces) for its small volume removed than the gigantic volume of late deposits excavated in Kiva 10 (6 pieces), and in Loose's court kiva, which did not yield eggshells. Kiva 13 and Loose's kiva yielded almost no turkey bones despite the abundance of faunal remains recovered in them.

The dramatic increase in burned bone in the early A.D. 1100s suggests a change in turkey use from earlier times. In addition, the widespread occurrence of eggshell in the Gallup period between A.D. 1050 and 1100, despite the near absence of turkey bones, suggests that turkeys may have been more common than the faunal evidence indicates and that the bones were not casually deposited with the midden or kiva trash. Therefore, it is suspected that some sort of ritual taboo may have been operative for the deposition of turkey remains during most of the occupation at Pueblo Alto.

Both Hargrave (Vivian and Mathews 1965:17) and McKusick (1971) believed that the inhabitants of Kin Kletso and Bc 288, respectively, were depended on an outside source for turkeys. Although evidence of confinement of other species of birds has been found in Bonito phase sites (e.g., Pepper 1920:194-195), it was rare for turkeys. Turkey droppings, but not eggshells, were listed in the American Museum of Natural History catalog for the second story of Room 92 in Pueblo Bonito. A room at Salmon Ruin, a Chacoan outlier on the San Juan River, did produce roosts, dung, and eggshells [Mollie Struever (Toll), personal communication 1977]; however, this probably was a later Mesa Verdean aviary. In Pueblo IV sites along the Rio Chama in northern New Mexico, turkey confinement and the accompanying dense heaps of dung were common. A turquoise gizzard stone from the crop of an Una Vida turkey suggests access to habitation areas and it may be that at Pueblo Alto turkeys were often left unrestrained. Unpenned turkeys nested in adobe-lined basins in the trash midden of a Basketmaker III site (Kidder and Guernsey 1919:52), which attests to their lack of restraint by at least some Anasazi groups.

Domestic turkeys are social creatures and may have preferred roosting on the Pueblo Alto roofs (Dabney Ford, personal communication 1986). Although they have a proclivity for destroying young crops, they would have stayed around Pueblo Alto for food scraps and water if not penned and probably would not have been pests in the fields that should have been planted at some distance from the site (Dabney Ford, personal communication 1986). On the other hand, McKusick (1986a:9) believes that turkeys would have been useful to rid the fields of pests. Ligon (1946:83), however, believes that lack of confinement would lead to mass desertions in the spring.

If greathouses served different functions, then possibly turkey domestication took on added importance at Pueblo Alto because of its proximity to the prehistoric roads. The absence of dog remains at Pueblo Alto, which were common remains in small, nearly contemporary sites (Akins, this volume), the lack of chewed bones in contrast to other sites where turkeys and dogs were found such as Antelope House (McKusick 1986b:147), and other aspects of Pueblo Alto suggest the specialness of the site.

What function did turkeys serve at Pueblo Alto? Often turkeys are considered a source of food and such may be the case in the early A.D. 1100s at Pueblo Alto (see Hargrave 1965 for avian meals at Mesa Verde). On the other hand, turkeys supplied the Anasazi with feathers for the manufacture of robes and blankets since as Basketmaker II times, and this was a widespread practice among all the pueblos visited by the Spanish after A.D. 1500 (Schroeder 1968:96-101). In addition, throughout Mexico the turkey served important socioreligious requirements and was associated with water--a theme found also among the historic Western Pueblos (DiPeso 1974:269-271).

According to McKusick (DiPeso 1974:273-274), turkey raising was a major industry at Casas Grandes, where they apparently were used for feathers and sacrifice but not for food. Special burial status for turkeys is found in numerous Anasazi site reports, including their burial with humans (Schorger 1966:24-40). Parallel status for prehistoric Anasazi turkeys is suggested by the placement of their uneaten bodies in Una Vida and Pueblo del Arroyo (Vivian and Mathews 1965:17), in kivas at Bc 50 between the firepit and ventilator (Hibben 1937:101), a pit at Bc 236 (Hargrave 1971:92), and just above pithouse floors at Bc 50 (Senter 1939) and 29SJ 299 (Windes 1976:16). Despite the lack of turkey bones in the Pueblo Alto Trash Mound, a turkey burial had been placed there.

Some feathers from Chetro Ketl and Bc 288 revealed heat treatment and other evidences of special use (McKusick n.d., 1971). A wealth of historical and ethnological records attests to the common puebloan use of turkey feathers for garments and in rituals, but only among Tanoan speakers were turkeys also used for food (Reed 1951:198-200, Schorger 1966:34-40). Interestingly, at Isleta wild turkeys were eaten but domestic ones were kept for their feathers (Parsons 1932:274), a pattern also noted at Grasshopper Pueblo (McKusick 1982:91-93). It seems apparent that use of turkey plumage by the Anasazi and Pueblo Indians for rituals and clothing shares a long history.

The distribution of prehistoric eggshells also seems to point to a ritual context, although this is not convincing. A high frequency of Chacoan shells was found in or next to firepits but the shells seldom were burned. It takes little heat to discolor an eggshell, so those in firepits evidently arrived there after abandonment of the firepit. At Casas Grandes, eggshells were found next to a plaza firepit (DiPeso 1974:283), and a single egg was buried with an old female (turkey or human was not specified) near a room firepit at Grasshopper (McKusick 1972:22)--only one of two samples of eggshells recovered from the site.

In summary, turkey remains and eggshells at Pueblo Alto suggest that turkeys were unimportant during the earliest construction and occupation in the early A.D. 1000s, although we cannot be certain of this because of the relatively limited cultural material recovered. The lack of turkey bones and the presence of eggshells in the largest early deposit sampled (in Plaza 1, Grid 8), however, suggest a pattern similar to the late A.D. 1000s at Pueblo Alto. Bones were also infrequent during the last half of the A.D. 1000s, but widespread eggshells and the recovery of several immature turkeys suggest an abundance of turkeys. Because of the rarity of turkey bones from this period, which suggests burial in some undiscovered ritual context, and their lack of burning, turkeys may have been kept primarily for ritual purposes (e.g., for their feathers). Their proposed increase in the A.D. 1000s may also reflect an increased use of the mountains surrounding the San Juan Basin for other resources (e.g., roof timbers for the greathouses), which would have brought the Chacoan Anasazi into more frequent contact with turkey habitats. This would suggest that turkeys were being hunted and captured rather than bred, or that there was a dichotomy of use between turkeys used for ritual and those used for domestic purposes (e.g., food and tools) as noted above for Grasshopper and Isleta Pueblo. Unfortunately, no distinction was made between domestic and wild turkey bones at Pueblo Alto, so either scenario is plausible. It also may be that young turkeys were captured to breed with domestic turkeys to preserve the red color of the ankle tarsi, which becomes black in a few generations of domestic life, a common Indian practice noted by Schorger (1970:169).

Finally, there was an apparent shift in the use of turkeys from earlier times at Pueblo Alto to the A.D. 1100s. Numbers increased, or, at least, turkey bones were more evident, and they may have become less important ritually. The distribution of bones across the rooftops, the use of bone tools (10 of the 11 awls recovered from Pueblo Alto came from the late deposits), and the high incidence of burning suggest nonritual processing. Ritual use, however, might still be important because of the noticeable rarity of turkey bones and eggshells in kiva trash deposits. If turkeys had become a food source in the early A.D. 1100s, the requirements to feed and water the flocks may have favored procurement from the wild or by trade rather than by domestication (Akins 1985:381). The reduction in proportions of eggshell and poults to turkey bones at the site may support this contention for the A.D. 1100s. The argument for the procurement of wild turkeys rather than raising domestice ones could be resolved by examination of the bones recovered from excavations (see McKusick 1986a).

Despite the lack of systematic recovery of turkey remains in many Chacoan sites, samples of bones from sites occupied after A.D. 1100 suggest the increased importance of turkey throughout Chaco Canyon because their remains comprise between 50 and 86 percent of the faunal assemblages (McKusick n.d., 1986a: Table 1). Differences between the A.D. 1000s and A.D. 1100s in the deposition of eggshell and turkey bones may confirm shifts in procurement, utilization, and depositional behavior that mirror other changes after A.D. 1100 in Chaco Canyon (see Volumes I and II).

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Chapter Eleven

Plant Utilization at Pueblo Alto: Flotation and Macrobotanical Analysis

Mollie S. Toll

Prehistoric subsistence relations were investigated at Pueblo Alto with the use of flotation and macrobotanical analyses. Botanical analyses were undertaken in part to provide detailed information on the range of subsistence-related domestic activities that took place in various room types, to contribute to the explication of both room function and site function over time at Pueblo Alto. Macrobotanical remains (largely Zea mays) were collected in the field from all proveniences excavated, and a systematic program of pollen and flotation sampling (based in part on results from Chaco village sites 29SJ 627 and 29SJ 629; Cully 1981, 1985b; Struever 1977; Toll 1981b) was followed. Selection of pollen and flotation samples for analysis was closely coordinated, and samples were analyzed from paired proveniences in many cases. Botanical analyses at village sites that developed before and at the same time as Pueblo Alto (principally 29SJ 627 and 29SJ 629) serve to illuminate both continuities and differences in subsistence activities between the small and large site types.

Methods

Samples Chosen for Analysis

Excavation at Pueblo Alto (1976-1979) focused on 11 rooms in the West and North Roomblocks (Figure 11.1). Also investigated in depth were Room 3 of Plaza Feature 1 containing enormous, possibly communal ovens, the east plaza (Plaza 2), and trash deposits in Plaza Grid 8, Kiva 10, and the Trash Mound. Although excavation was limited by budgetary constraints to "barely 10 percent of the primary greathouse architecture" (Windes Volume I, this report), a tremendous quantity of potential data was generated. Thousands of pollen and flotation samples were taken in an attempt to encompass the spatial and temporal variability present. Because many of the rooms at Pueblo Alto were very large, the grid system based on quadrants of quadrants, developed for the smaller rooms of village sites, was abandoned in favor of alternate meter-square grids. Thus, the number of

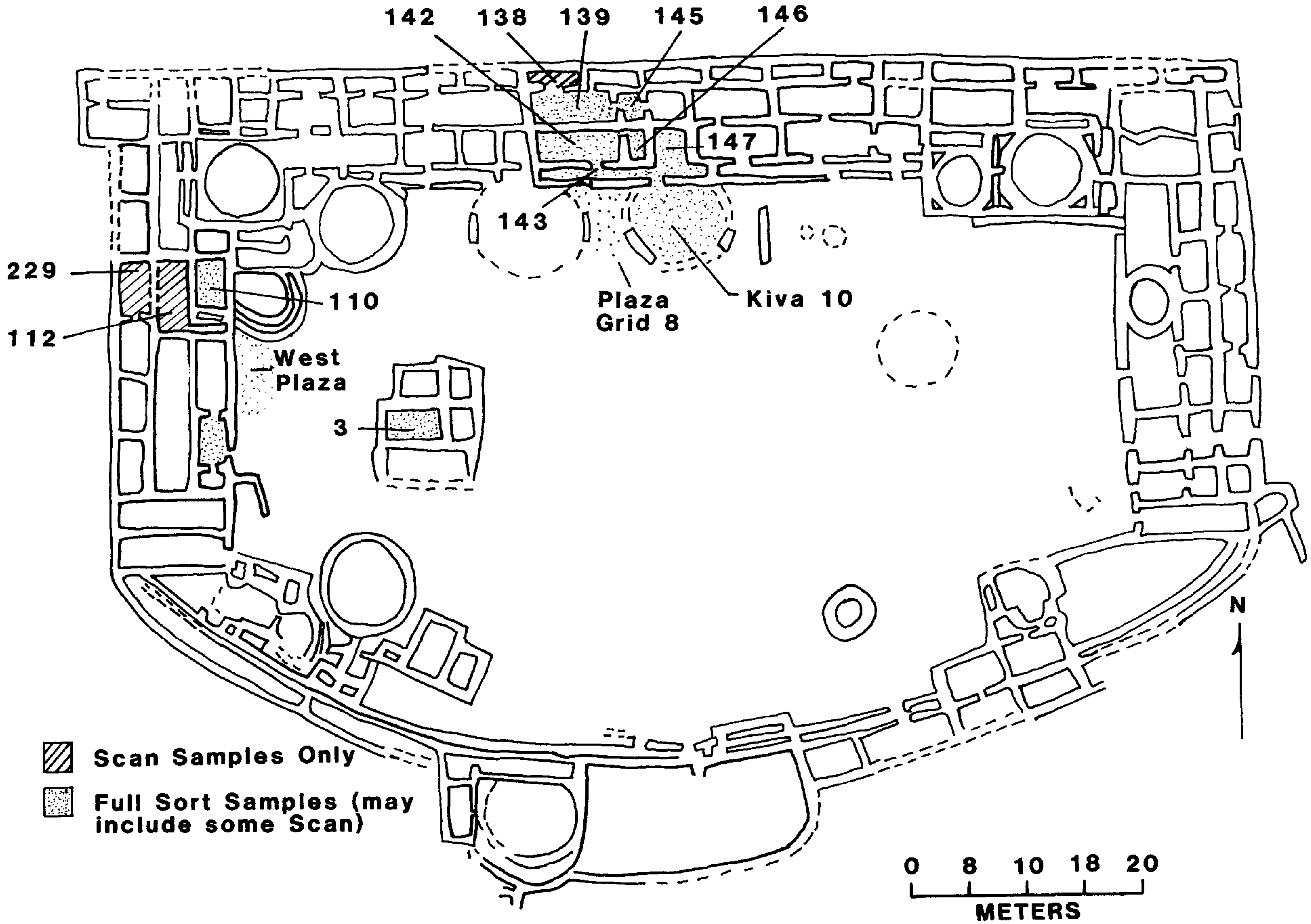

Figure 11.1. Provenience units excavated and sampled for botanical analysis.

floor samples varied with room size (8-18 samples) rather than being restricted to 8 samples per level in each room as at the village sites.

A two-level plan was devised to review a sizeable sample of floor locations at Pueblo Alto. Two rooms in each of the two excavated wings (Rooms 103 and 110 in the West Roomblock, and Rooms 139 and 145 in the North Roomblock) were selected for more intensive analysis: samples from floor grids (corresponding to pollen sample locations on Floor 1) were selected for complete sorting (Table 11.1). Samples from floors in eight other rooms were scanned, which netted information about presence or absence of specific taxa.

Features were of particular interest as these have been shown to be most likely to contain plant remains that can be related reliably to subsistence activities (Struever 1977). Large, lined firepits were relatively rare at Pueblo Alto, whereas heating pits were numerous. These two feature types were examined to determine whether full-scale, food-processing activities were confined to the few firepits (as suggested by Windes, 1984 and Volume I, this report). Other feature types investigated included mealing bins, and miscellaneous "other pits."

Analyzed flotation samples (124 full-sort and 59 scan samples) include floor, feature, and trash proveniences from each of the three principal time periods distinguished by an associated ceramic complex (Table 11.1). Pueblo Alto occupations coinciding with the initial building of the three main roomblocks (A.D. 1020-1040/1050) are dominated by Red Mesa ceramics and occupations from A.D. 1050-1100 by Gallup ceramics. The last period (from A.D. 1100 to abandonment) is characterized by a mixture of ceramic types from several locations outside Chaco and is termed Late Mix.

Flotation Procedures

Water flotation was carried out in Chaco Canyon during the excavation seasons of 1977 and 1978, by Lou Ann Jacobson, Marcia Donaldson, Mary Jo Windes, and Adrian White. The technique employed takes advantage of the simple principle that organic materials (particularly nonviable or charred ones) tend to be less dense than water and float or hang in suspension. When the soil matrix contains a high proportion of sand, as at Chaco, the sand particles sink rapidly in water, thus affording a clean separation of materials.

Sample volumes were measured in a graduated cylinder before flotation, so that botanical remains could be compared as to density.

Each sample was immersed in a bucket of water and the heavier particles allowed to settle out for a period of 30 to 45 seconds. The water was then poured through a fine screen (0.35-mm mesh). The bucket was filled and screened repeatedly until no appreciable amount of material was left floating or in suspension. This basic method has been used as long

Table 11.1. Flotation Samples Analyzed, Pueblo Alto.

Provenience Unit and Time Period[a]	Floor Grid	Floor FS	Heating Features[b] Type No.	Heating Features[b] FS	Other Features[c] Type No.	Other Features[c] FS	Trash[d] Type No.	Trash[d] FS
Room 103								
Floor 1	C	(no no.)						
Late Mix	D	(no no.)						
	E	(no no.)						
	D+F	(no no.)						
Floor 3	5	1262	HP 2	1305	MB 3	1301		
Gallup	9	1266	HP 4	1307				
	13	1269	HP 5	1308				
	15	1272						
	21	1283						
Floor 4					OP 1	1379		
Gallup					OP 11	1387		
Floor 5	1	1410						
Red Mesa	5	1414						
	9	1418						
	13	1422						
	17	1425						
	21	1443						
Room 110								
Floor 1	1	5506	FP 1	5572	OP 22	5597		
Gallup	5	5509	FP 2	5574	OP 35	5617		
	7	5511	HP 3	5658	OP 60	5734		
	9	5512	HP 6	5663	OP 67	5747		
	11	5513	HP 7	5665	MB 1	5433		
	13	5515	HP 14	5672	MB 3	5437		
	15	5516	HP 15	5674				
	17	5518	HP 16	5676				
			HP 17	5678				
Floor 2	1	1544	FP 1	1578				
Red Mesa	5	1548						
	9	1544						
	13	1560						
	17	1566						
	21	1572						
Room 113								
Floor 3	1	1593						
Red Mesa	5	1596						
	9	1598						
	13	1602						
	17	1605						
	21	1611						
Room 112								
Floor 1	1	7106(Scan)[e]						
Gallup	3	7063(Scan)						
	9	7069(Scan)						
	11	7071(Scan)						
	17	7079(Scan)						
	19	7127(Scan)						
	25	7086(Scan)						
	27	7087(Scan)						
Room 138								
Floor 1	1	7600(Scan)						
Late Mix?	3	7602(Scan)						
	5	7604(Scan)						
	7	7606(Scan)						
	9	7608(Scan)						
	11	7610(Scan)						

Table 11.1. (continued)

Provenience Unit and Time Period	Floor Grid	Floor FS	Heating Features Type no.	Heating Features FS	Other Features Type no.	Other Features FS	Trash Type no.	Trash FS
Room 139								
Floor 1	1	2473						
Late Mix?	5	2477						
	9	2481						
	13	2487						
	17	2491						
	21	2495						
	25	2499						
	29	2503						
	33	2507						
Floor 2	1	2566	HP 1	1305				
Red Mesa	5	2569	HP 3	2616				
	11	2572	HP 4	2618				
	13	2574	HP 12	2276				
	17	2578						
	21	2580						
	25	2584						
	29	2585						
	33	2588						
	A	2239						
	C	2241						
	E	2243						
	G	2245						
Room 142								
Floor 1	1	2750(Scan)						
Late Mix?	5	2756(Scan)						
	9	2672(Scan)						
	13	2768(Scan)						
	17	2774(Scan)						
	21	2780(Scan)						
	25	2786(Scan)						
	29	2792(Scan)						
	33	2797(Scan)						
Floor 3			HP 1	2959	OP 1	2961		
Red Mesa			HP 2	2960				
Floor 8			HP 1	7527				
Red Mesa								
Floor 9/10			HP 1	7504				
Red Mesa								
Room 143								
Floor 1	1	6783(Scan)						
Late Mix?	3	6784(Scan)						
	5	6785(Scan)						
	7	6786(Scan)						
Floor 2			HP 1	6896	OP 1	6893		
Gallup			HP 2	6898				
Room 236	9	6787(Scan)						
Floor 1	11	6788(Scan)						
Late Mix?	13	6789(Scan)						
Floor 4	1	6834(Scan)	FP 1	6840				
Gallup	3	6836(Scan)	HP 1	6851				
	7	6839(Scan)						
Room 145								
Floor 1	A	2160						
Late Mix?	B	2164						
	C	2168						
	D	2172						
	E	2176						
	F	2180						
	G	2184						
	H	2188						

Table 11.1. (concluded)

Provenience Unit and Time Period	Floor Grid	Floor FS	Heating Features Type no.	Heating Features FS	Other Features Type no.	Other Features FS	Trash Type no.	Trash FS
Room 146								
Floor 1	1	6032(Scan)						
Late Mix?	3	6034(Scan)						
	5	6036(Scan)						
	7	6038(Scan)						
Floor 3			FP 1	6097				
Red Mesa								
Room 147								
Floor 1	1	6281(Scan)	FP 1	6311				
Late Mix	5	6283(Scan)	HP 2	6304				
	7	6315(Scan)						
	9	6285						
	11	6317						
	13	6287						
	15	6289						
Room 229								
Floor 1	1	5849(Scan)						
Gallup	4	5853(Scan)						
	5	5855(Scan)						
	7	5858(Scan)						
	9	5861(Scan)						
	11	5864(Scan)						
	13	5867(Scan)						
	15	5870(Scan)						
	16	5845(Scan)						
Kiva 15								
Floor 1	1	5351	FP 1	5384				
Late Mix	5	5358						
	9	5364						
	13	5372						
Plaza Feature 1								
Room 3								
Floor 1	1	955(Scan)	FP 1	985				
Late Mix	3	956(Scan)	FP 2	801				
	12	959(Scan)						
	13	960(Scan)						
	22	963(Scan)						
	24	964(Scan)						
Plaza Grid 1								
Grid 302/303,Sur 6		5025						
Grid 301/303,Sur 7		5046						
Plaza Grid 8, Layer 15								
Layer 15							T	6616
Red Mesa							T	6618
Trash Mound								
Gallup							T	4757
							T	4762
							T	4769
							T	4774
							T	4775
Kiva 10							T	6552
Late Mix							T	6525
							T	6527
							T	6529

Total Full Sort Samples: 69 Floors — 42 Features, 8 OP — 11 Trash
2 Plaza surfaces — 9 FP, 3 OP
22 HP

TOTAL Scan Samples: 59 Floors

[a]Red Mesa = A.D. 1020–1040/50; Gallup = A.D. 1050–1100; Late Mix = A.D. 1100–1150/1200.
[b]HP = heating pit; FP = firepit.
[c]MB = mealing bin; OP = other pit.
[d]T = trash
[e]Scan = samples scanned rather than full sort.

ago as 1936 (Watson 1976) but did not become widely used for the recovery of subsistence data until the 1960s and 1970s (Bohrer and Adams 1977; Struever 1968).

The floating and suspended materials were dried indoors on newsprint. The dry samples were weighed and then sorted by particle size with the use of graduated geological screens (mesh sizes 1.0, 0.5, and 0.25 mm). The screen separation produces a rough sorting of seed types, which facilitates microscopic identification.

Microscopic Sorting and Presentation of Data: Full Sort Samples

In the case of full-sort samples, the entire sample was reviewed under a binocular, dissecting microscope at 10x. Seeds and other distinctive plant parts were removed and then counted and identified at 20 to 45x. The taxon was determined in most cases to genus or species level. The numerical coding system devised by Karen Adams (1978) for the San Juan Valley Archeological Project was used. Taxonomy and scientific nomenclature follow Martin and Hutchins (1980); common names are used according to the Field Guide to Native Vegetation of the Southwest Region (U.S.D.A. 1974). Several aspects of seed condition were recorded, including charring, color, and numerous categories of damage or deterioration. These attributes help in determining whether specific seeds are prehistoric or modern contaminants. Certain nonbotanical items (insect parts, bones, rodent or insect feces, snails) were retrieved and their relative abundance noted, with the hope of isolating causes of disturbance in the ethnobotanical record.

The entire volume of organic material recovered by flotation was examined under magnification for seeds and other identifiable plant specimens for most samples. Occasionally, the large number of seeds present required subsampling to economize on microscope sorting time. Materials from each of the four particle sizes (items caught by the three screens and those items passing through the smallest screen) were subsampled separately. The two largest sizes were sorted in their entirety in all but the very largest volume samples. A fraction (one-half to one-eighth) of the two smaller sizes was sorted, and the quantities of seeds retrieved multipled by the reciprocal (i.e., two in the case of one-half) to produce an approximation of the total of seeds expected to occur in the entire sample. To allow comparison between samples and between sites as to overall seed density or density of specific seed types, all seed counts were reduced to a common measure of number of seeds per standard unit volume. Most samples were a standard one-liter size, but others ranged from 200 to 1,100 ml. Seed counts were adjusted to reflect the number of seeds per one liter of soil. The adjusted value is reached by dividing the actual seed count (or the estimated seed count when subsampling has been used) by the proportion of standard sample size (actual sample size divided by one liter). Thus, for 8 Chenopodium seeds from a 670-ml sample:

$$8 \text{ seeds} \div 0.67 \text{ liter} = 11.9 \text{ seeds/liter}$$

In this report, the actual number of seeds separated and identified from a sample is given, as well as an adjusted number of seeds per liter (which takes into account any subsampling, as well as nonstandard sample sizes).

Microscopic Sorting and Presentation of Data: Scan Samples

The scanning method used here resulted in a great saving of microscope time (2-3 samples can be scanned per hour, whereas full sorting involves an overall average of 2 hours per sample). In scan samples, floated materials were treated differently according to particle size. In most samples, all remains larger than 1 mm (Screen Size 18) were examined under the binocular microscope. In the few very large samples, only the pieces caught in a 2.0-mm-mesh screen were examined in entirety. Screen 35 (0.5-mm mesh), and Screen 18 in the very large samples, were examined for two to ten minutes each. Materials from Screen 60 (0.25-mm mesh) and the bottom catching pan were not examined. Botanical contents encountered (or examples, for very numerous taxa) were removed and stored in a glass vial, along with any snails, eggshell, or bone. Seeds were not counted, but condition descriptors (charring, damage, etc.) were recorded for each taxon. Data from scan samples are presented simply as presence of specific taxa, noted as to whether all or some specimens are carbonized.

Because the scanning method used involves a full sorting of material larger than 2 mm, it provides a reliable review of the presence or absence of cultivated taxa. Past experience has shown that corn kernels and cob fragments (relatively common in flotation samples) and bean and squash remains (rare in flotation samples) are almost entirely restricted to the larger screen sizes. Wild taxa that occur in larger screens include *Juniperus* twigs and seeds, *Pinus edulis* nutshells and cone fragments, *Oryzopsis* caryopses, and *Opuntia* seeds and spines. Any of the above taxa occurring in substantial quantities in a flotation sample will almost always be encountered using the scanning technique, although very-low-frequency occurrences may involve fragmentary specimens that may be missed in smaller screens (pinyon has fallen into this category in a couple of test cases).

The majority of weed seeds range in size from 1.5-0.8 mm in maximum dimension and, hence, are recovered from Screens 18 and 35. Because these screen sizes are examined only partially, an incomplete picture of weed seed taxa is to be expected. Weed taxa, which often occur in high frequency (the Cheno-Ams, *Portulaca*, *Descurainia*, *Euphorbia*, and *Mentzelia*), are more likely to be encountered by scanning than those taxa occurring in low frequency (such as *Cycloloma*, *Physalis*, *Scirpus*, etc.) Clearly, there is a risk of selectively missing low-frequency occurrences of the more common weed taxa, also. In the two smallest screens, botanical remains are often completely absent, or else consist of fragments of seed types encountered in larger screens (predominantly weedy types in Screen 35). Rarely, low frequencies of small seed types such as *Descurainia* or *Sporobolus* will occur here without occurring also in the larger screens and would thus be missing from the spectrum of plant types observed by scanning.

For the time invested, scanning seems to provide relatively reliable presence and absence flotation data. The chief limitation lies in omission of low-frequency, small-dimension, seed types. Comparability of results from scanning and full sorting and the biases inherent in sitewide flotation data derived by conscious selection of sample locations known to be productive of plant debris are problems yet to be faced.

Macrobotanical Remains: Sampling and Analysis

Macrobotanical remains other than corn included Cucurbita seeds and rind, beans, prickly pear, yucca and juniper seeds, pinyon nutshell, puff-ball mushrooms, as well as collections of small weed and grass seeds (Table 11.2). All specimens other than corn were examined individually and catalogued. All materials were recorded as to taxonomic classification and condition (burned or unburned, whole or broken). Erosion or other postdepositional alterations that would affect size dimensions or taxonomic identification were also noted. Items were counted and measured if whole or more than half was present; when less than half of an item was present, it was counted and recorded as a fragment. Pristine, uncharred specimens (such as weed seed caches suspected of being rodent introduced) were noted as probable modern contaminants.

Because the computer-stored field inventory of Pueblo Alto corn specimens totaled 6,153 items, some sampling of the total collection was clearly needed. Specimens were selected in conference with Thomas C. Windes, Supervisory Archeologist, to represent the three, principal, occupational periods (Red Mesa, Gallup, and Late Mix) at Pueblo Alto. In all, 847 cobs were measured. Because measurable cobs were approximately half of the inventoried corn specimens, the total count of measureable cobs at Pueblo Alto is estimated to be somewhat greater than 3,000 cobs, and the sample analyzed represents 25-30 percent of these.

To be measurable, a cob had to retain its full circumference, though not its complete length. Standard cob measurements include number of kernel rows and cob diameter (the latter measured to the nearest 0.1 mm with hand-held calipers). Both attributes are measured in the middle of the cob when possible to avoid variabiity that may occur in the basal and tip regions (e.g., irregular arrangement of kernel rows, flaring of the base, and tapering of base and tip). Height and width of cupules (the individual cob units that hold a pair of side-by-side kernels) were measured using a binocular, dissecting microscope with an ocular micrometer. Both outside ("cupule") and inside ("cupule aperture") dimensions of this structure were measured. Cupule size and shape are useful in an analysis of corn because these parameters are relatively stable even under conditions of environmental stress. Glumes were lacking on most cobs, but

Table 11.2. Macrobotanical remains analyzed.[a]

	Corn		Squash		Beans	Yucca	Pinyon		
	Cobs	Kernels	Seeds	Rind	Number	Seeds	Nutshell	Other seeds	Miscellaneous
Room 50							1		
Room 51							2	3 *Juniperus*	
Room 103	42	2	4				2	>100 *Sporobolus* >100 *Cleome serrulata* >100 *Amaranthus* (No.?) *Euphorbia*, *Portulaca*	
Room 110	140	18							
Room 112							1	1 *Atriplex*	5 *Geastrum*
Room 142	100		6	5		17	6	6 *Opuntia*	
Room 143/236			10	3			3	4 *Juniperus*	
Room 145			1			2	1		
Room 146	45								
Kiva 10	200								
Kiva 13	100								
Kiva 15							10		
Plaza Grids 8 and 30	6				1				
Plaza Grid 35								>100 *Chenopodium watsonii*	
Plaza Feature 1	37							>250 *Chenopodium watsonii*	
Trash Mound	201					1	1		
Total number of items (including fragments)	871	20	21	8	1	20	27	>664	5

[a]Represents all materials collected during excavation, except for corn (ca. 30% sample).

on the few uneroded cobs measurement of glume width and height had to be substituted for those of the cupule. As they are not equivalent, glume attributes are tabulated separately from cupule attributes.

All measurements were performed according to descriptions by Nickerson (1953). Measurements on all burned cobs were increased by 21 percent (Doebley and Bohrer 1980) to compensate for shrinkage that occurs during charring (Cutler 1956). Also noted were overall cob shape, cross-sectional shape, configuration of rows (straight vs. spiral), presence of irregular or undeveloped kernel rows, and effects after discard (compression, erosion).

Width and thickness of kernels (all charred) were measured with calipers to the nearest 0.1 mm. Kernels were relatively rare at Pueblo Alto (20 were measured). Because kernel distortion is highly variable under different burning conditions (16-160 percent swelling; Pearsall 1980), kernel dimensions have less potential value than cob attributes in terms of characterizing maize grown over time at Pueblo Alto.

Results

Plant Taxa Recovered

Conifers

Juniperus monosperma (Engelm.) Sarg., juniper
Pinus edulis Engelm., pinyon pine

Although the distribution and abundance of conifer species during the prehistoric eras in Chaco have been extensively debated (Betancourt and Van Devender 1981; Douglass 1935; Hall 1975; Judd 1954), two taxa found at the lower elevational limit for conifers grow today in the immediate Chaco area. Juniper is present on the mesa immediately above and southwest of Marcia's Rincon; pinyon trees are more common at a slightly higher elevation on Chacra Mesa, a few kilometers to the east.

At Pueblo Alto, juniper remains other than wood consisted largely of charred twig segments and individual scale leaves and probably relate primarily to use of branches as fuel. Distribution is consistent with this interpretation (Table 11.3). Charred twigs were found almost exclusively in heating pits and firepits and in trash (dumpings from heating and cooking features may contribute a substantial portion of trash). Juniper remains found on floors were far more sparse and more likely to be unburned. Juniper wood comprised 32 percent of fuel in firepits, 16 percent in heating pits, and 19 percent in trash, according to charcoal identifications from 15 firepits, 36 heating pits, and 16 trash samples (Welsh 1979). Juniper is most commonly listed as a fuel or construction

Table 11.3. Distribution of *Juniperus* remains by provenience category, Pueblo Alto.

	Firepits		Heating Pit		Other pits		Trash		Floors		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Flotation (full sort)												
Twigs												
Samples	5	56	16	73	0	0	8	73	7	10	36	29
Samples charred	5		16		0		8		3		32	
(Scan)												
Samples									7	12	7	12
Samples charred									5		5	
Macroremains												
Twigs												
Locations	1										1	
Locations charred	1										1	
Seeds												
Locations	1								1		2	
Locations charred	0								0		0	

material in the ethnobotanical literature (Jones 1039:32-33); Stevenson 1915:93; Whiting 1939;62-63). Strong aromatic resins are present in the branches and berries of this conifer; this attribute is probably responsible for the use of juniper in ceremonial and medicinal contexts (Cook 1930:24; Reagan 1928:158; Robbins et al. 1916:39-40), and to relegation of the berries to food use as seasoning or a stress food (Castetter 1935:31-32; Swank 1932:50). Despite their strong taste, the berries provide a fair caloric return (216 calories per 100 grams, Wolfe et al. 1984). A single heating pit (HP3 on Floor 1 in Room 110) contained the only charred juniper seeds recovered at Pueblo Alto (no seeds were found at 29SJ 629). Uncharred seeds were recovered as macro-remains from a heating pit in Room 143, Floor 2, and from the related floor level in Room 236 (Floor 4, Grid 7). These may relate to medicinal use (several accounts mention roasting of green branches; Robbins et al. 1916:39-40; Stevenson 1915:55) or possibly food use (roasting or heating supposedly increased palatability; Castetter 1935:32; White 1944:561).

Pinyon has provided one of the more valuable wild food resources available for Southwestern peoples. The fall-ripening nut crop has a very high energy value (635 calories per 100 grams), higher than most other plant and animal foods used, including corn (Ford 1968:158,160). The nuts were estimated to be sufficiently valuable in the past that collecting trips of considerable distances were made by such groups as the Tewa (Robbins et al. 1916:41), Isleta (Jones 1930:37), and Zuni (Castetter 1935:40-42). Pinyon nuts were harvested and stored in the shell. The nuts were roasted in the shell before or after storage or left raw. Consequently, broken, empty nutshells could be expected to occur in and around firepits, heating pits, or storage facilities, and anywhere food processing may have taken place.

Evidence of pinyon nut consumption (usually minute fragments of shell, either charred or uncharred) was absent at 29SJ 627 and rare at 29SJ 629 (Struever 1977; Toll 1981b). By contrast, pinyon shell was recovered in more than one-third of all Pueblo Alto samples (and half of all heating pits and firepits; Table 11.4). Charred pinyon shell occurred exclusively in features and trash, whereas all nutshell from floor locations was uncharred. Recovery of tiny fragments of shell from human coprolites at Pueblo Alto confirms that these nutshell remains relate to food use (Toll 1981a). Rodent disturbance of food stores may also affect the final distribution of these remains. Casual observation suggests that rodent and human patterns of pinyon nut manipulation may be distinguishable. In some cases at least, small rodents chew a hole in the side of a nut and extract the "kernel" (leaving large chunks of shell), whereas humans often crunch up the whole nut and spit out (and obviously sometimes swallow) the tiny, indigestible, shell fragments.

Pinyon provides a preferred fuelwood and construction material, also. At Pueblo Alto use of pinyon wood for fuel was far less common than juniper (5 percent of fuel in firepits, 7 percent in heating pits, and 26 percent in trash; Welsh 1979).

Table 11.4. Distribution of *Pinus edulis* nutshells by provenience category, Pueblo Alto.

	Firepits		Heating Pit		Other pits		Trash		Floors		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Flotation (full sort)												
Samples	5	56	11	50	3	38	4	36	20	29	43	35
Samples charred	4		8		2		4		0		18	
(Scan)												
Samples									4	7	4	7
Samples charred									0		0	
Macroremains												
Locations	1		4		1		1		8		15	
Locations charred	1		1		0		0		0		2	

Non-conifer shrubs

Atriplex canescens (Pursh) Nutt., four-wing saltbush
Rhus sp., squawberry

Saltbush is found throughout the canyon area today but is most common in the canyon bottom where it has invaded areas of finer soil texture and higher alkalinity as the water table has dropped (Potter 1974). This shrub is widespread, also, in coarse, outwash soils at the base of cliffs, where it may dominate along with ricegrass and dropseed grasses (Potter 1974). Saltbush is also present in the vicinity of Pueblo Alto, but on these generally thin soils the plants are stunted and sparsely distributed. Occasional dunelike patches of deeper sand on the upland plateau show an increase of both saltbush and ricegrass.

Charred fruits of four-wing saltbush were found in firepits, heating pits, and trash at Pueblo Alto (Table 11.5). Dispersed grids on a single floor (Floor 2 in Room 139) contained both fruits and leaves; as this floor is 2.5 m deep and some of the remains are charred, there is reason to believe that the uncharred saltbush remains here are cultural, also. Chenopodiaceous wood (comprising *Atriplex* and *Sarcobatus*) was a major fuel component in all provenience types (that is, firepits, heating pits, and trash) at all time periods at Pueblo Alto (Welsh 1979). It is particularly common (78 percent of all identified pieces) in Red Mesa period heating pits. All charred saltbush remains in heating-pit, flotation samples also date to this early period. Fruits occur largely on younger branches; thus, the combination of evidence from flotation and charcoal identification indicates that smaller saltbush twigs were used as fuel in the heating pits.

The ethnographic record indicates that saltbush was used principally as a fuel (Hough 1897:42), with the resultant alkaline ashes saved for use as medicine and as a food dye (Castetter 1935:18; Robbins et al. 1916:54). Saltbush ash added to foods also was likely a source of critical dietary minerals such as calcium and iron (Kuhnlein 1981). Other medicinal or food uses involve the young tender leaves and immature blossoms (Stevenson 1915:44; Whiting 1939:18). Consequently, the presence of mature fruits is consistent with firepit or heating pit debris (and thus trash deposits also).

Charred *Rhus* seeds were found in two heating pits (Floors 3 and 8) in Room 142. These have not been recovered previously in Chaco, but they occur in human coprolites at Bis sa' ani, a Chacoan outlier 15 km to the northeast (Donaldson and Toll 1981a). Squawberry, or *Rhus trilobata* Nutt., grows on protected talus slopes and side canyons in Chaco today (Cully 1985a). The strong, flexible wood was used for basketry (Bohrer 1983) and various construction purposes (Krenetsky 1964:48; Stevenson 1915:81; Whiting 1939:84). The fall-ripening, aromatic, red berries were eaten raw or dried and ground (Castetter 1935:48-9). The fruits were also soaked in water to make "a slightly acid, refreshing drink" (Balls 1970:61-2), giving the shrub its other common name of "lemonade bush." The berries provide significant amounts of food energy (328 calories per

Table 11.5. Distribution of Atriplex remains in flotation samples, Pueblo Alto.

	Number & [Percent] of Heating Pits Total Heating Pits = 22	Number & [Percent] of Firepits Total Firepits = 9	Number & [Percent] of Floor Samples Total Floor Samples = 69	Number & [Percent] of Trash Samples Total Trash Samples = 11
Charred fruits	4[18]	1[11]	2[a][3]	3[27]
Uncharred fruits	---[b]	---	2[c][3]	---
Uncharred bracts	---	---	1[d]	---
Charred leaves	2[9]	---	1[c][1]	---
Uncharred leaves	2[9]	---	1[c][1]	---

[a]Room 142/236, Floor 1 (Scan samples).
[b]No Atriplex remains recovered.
[c]Room 139, Floor 2.
[d]Room 112, Floor 1 (Macro).

100 grams) plus potassium and vitamins A and C (Wolfe et al. 1984), though their texture and large seeds probably discourage consumption of large quantities.

Scirpus sp., bulrush

Members of the genus Scirpus generally require relatively uniform moisture. They tend to be perennials growing from creeping rootstocks in such riparian habitats as "marshes, stagnant ponds, stream banks and ditches" (Kearney and Peebles 1960:151). Although cattails (Typha latifolia L.) and sedges (Carex filifolia Nutt.) grow near seeps in Chaco Canyon today, no Scirpus has been observed or collected during the historic period (Cully 1985a).

A single, unburned, bulrush seed occurred in Grid 5 of Floor 5 in Room 103. Bulrush seeds were also present in floor and feature samples at 29SJ 627 and 29SJ 629 and at other puebloan sites in northwestern New Mexico (Salmon Ruin, Doebley 1981; Howiri Pueblo, Struever 1979; PM 224 on the Pittsburgh and Midway Coal Lease, Toll and Donaldson 1982). In all cases the seeds occur in very low frequency per sample.

It is unlikely that Scirpus achenes were used much for food; both the scattered and sparse distribution of seeds in archeological sites and ethnographic accounts of the uses of this taxon support this notion. Incidental presence of seeds in sites may relate to nonseed uses, such as consumption of raw roots and tender shoots (Swank 1932) or the manufacture of mats from leaves (as at Pueblo Bonito, Judd 1954; and at Salmon, Doebley 1981). Presence of this taxon in Chaco archeological sites is interesting, because one or both of the following are implied: either the prehistoric distribution of Scirpus was wider than it is today, or puebloan inhabitants intentionally collected this plant (from some distance) for some economic purpose.

Grasses

Oryzopsis hymenoides (Roem. & Schult.) Ricker, Indian ricegrass
Sporobolus sp., dropseed grass

Ricegrass and dropseed are common grasses in Chaco Canyon today. Both are present in all areas of the canyon with sandy soil but are most widespread in the upland plateaus (where Pueblo Alto is located) in the Hilaria-Bouteloua association (Potter 1974). Like several other cool-season grasses, Oryzopsis was considerably more abundant in the Southwest before the cattle boom of the 1880s and subsequent, widespread overgrazing (Bohrer 1975).

Oryzopsis produces a crop of relatively large (3-4-mm) and nutritious seeds in late May to June, a "critical time of the year for the hunter-gatherer and the agriculturalist" (Bohrer 1975:199). In a spring following a poor harvest from both wild and domestic crops, the availability of an early wild crop such as Indian ricegrass could be particularly important. Ricegrass is sensitive to winter precipitation and produces abundant crops only in springs following wet winters. In such years ricegrass grows almost in a monostand in predictable habitats (sand). In years with abundant late summer rains and late frost, a second, much smaller, crop of ricegrass may flower and mature seed (thereby dashing our hopes of using ricegrass remains as an indicator of spring food-gathering). Ricegrass seeds were found in small quantities in most provenience types at Pueblo Alto (Table 11.6). Concentration of burned seeds in heating pits may represent use of these features for ricegrass parching.

Nearly all ricegrass seeds located in full-sort and scan samples came from the North Roomblock. Exceptions include unburned seeds in trash and relatively shallow Plaza Feature 1 and a single location in the West Roomblock (Room 110, Floor 1, Heating Pit 17). Perhaps this unexplained pattern is responsible for the discrepancy in full-sort and scan results for floors. Only 7 percent of full-sort, floor samples contained ricegrass (1 out of 5 samples had charred seeds), compared to 22 percent of scan samples (7 out of 13 samples had charred seeds). West Roomblock locations make up a higher proportion of full-sort, floor samples (56 percent) than of scans (29 percent). The record of ricegrass use at Pueblo Alto (measured as a proportion of all samples, and a percentage of all seeds) is greater than observed at 29SJ 627, and less than that at 29SJ 629.

When ripe, _Sporobolus_ spp. caryopses drop with little encouragement from the surrounding glumes, "making harvesting easy and threshing unnecessary" (Whiting 1939:18). The ease of collecting the dropseeds offsets their small size (_S. cryptandrus_ seeds average 0.7 to 0.9 mm, and _S. contractus_ seeds are slightly larger). The _Sporobolus_ distribution parallels that of _Oryzopsis_ (Table 11.7). Most charred seeds were found in heating pits (lending support to the possibility of parching here) with a smaller amount in firepits; seeds in trash and most seeds on floors were unburned. Only two scan samples contained dropseed. A concentration of unburned _Sporobolus_ seeds (more than 100) was saved during excavation of Room 103 (Test Pit 5). These may be modern intrusives.

At Pueblo Alto, as at 29SJ 627 and 629, grass remains occur in very small numbers (less than 1 percent of all seeds at all three sites). However, the seeds are frequently charred and occur often in locations appropriate to food processing, and, consequently, there is good reason to link them to prehistoric subsistence activities.

Cacti and Succulents

Echinocereus sp., hedgehog cactus
Opuntia sp., prickly-pear cactus
Yucca sp., yucca

Table 11.6. Distribution of *Oryzopsis* seeds in flotation samples.[a]

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	1	28	1	0	30	2	6	0	38	
Seeds per liter	2	32.8	1	0	35.8	2	6.7	0	44.5	
% of all seeds per liter	T	1	T	0	1	T	T	0	T	
Number of samples	1	7	1	0	9	2	5	0	16	13
% of samples	11	32	13	0	21	18	7	0	13	22
Number of samples burned	1	7	0	0	8	0	1	0	9	7

[a]T = Less than 0.5%.

Table 11.7. Distribution of *Sporobolus* seeds in flotation samples.

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	26	47	0	0	73	17	152	0	242	
Seeds per liter	52	130	0	0	182	25	159.2	0	366.2	
% of all seeds per liter	3	4	0	0	4	4	3	0	3	
Number of samples	2	5	0	0	7	3	7	0	17	2
% of samples	22	23	0	0	17	27	9	0	14	3
Number of samples burned	1	4	0	0	5	0	1	0	6	2

The sweet fleshy fruits of several types of cacti were highly regarded as a wild food resource by several Southwestern peoples. Most types ripened in early fall, and there is frequent documentation of special collecting trips to areas known to have high densities of fruiting cacti (Havard 1895:116; Robbins et al. 1916:62; Stevenson 1915:69). Castetter (1935:26) reports that the genus Echinocereus has "the best flavored fruits of all the cacti," and that the Navajo speak of them as being "sweet and delicious, but scarce." In this genus, "the seeds are small and can be eaten along with the pulp" (Standley 1911:450). Hedgehog cactus occurs very sparsely in Chaco Canyon today, usually as isolated plants. Fleshy fruits of the prickly pear tend to be larger and more abundant. As the seeds are relatively large (2-7 mm), they were sometimes separated out before eating (Castetter and Underhill 1935:22-23), although they also survive whole in coprolites (Fry and Hall 1975:89; Stiger 1977). A small, dry-fruited species (Opuntia hystricina Engelm. & Bigel) grows today in Chaco. As fleshy-fruited prickly pears seem to be absent and hedgehog cacti rare during the present era, the archeological record of these two cacti at Pueblo Alto points to a wider natural distribution during the puebloan period, or to nonlocal collecting expeditions. Charred as well as uncharred seeds of both cactus types occurred in several provenience types at Pueblo Alto (Table 11.8).

Economically useful parts of yucca include the tough fleshy leaves grown in a basal rosette, the large fleshy fruits, and the root. This perennial shrub grows in habitats similar to those occupied by hedgehog and prickly pear (rocky areas with shallow soil, often in the the company of pinyon and juniper; Kearney and Peebles 1960:187). Yucca baileyi (Yucca navajoa J.M. Webber), a narrow-leaved yucca, has been collected in Chaco (Cully 1985a), but is not common. Definitive evidence of use of yucca leaves or fiber for basketry, matting, sandals, cordage, or weaving is lacking at Pueblo Alto. Charred pieces of two-ply twine were recovered (as in flotation sample No. 2959 from Room 142). Although gross morphology is consistent with yucca, positive elimination of alternative possibilities (agave, cotton) will require thin-section analysis (difficult with charred specimens). The caudex and root, rich in saponins and widely used for soap (Cook 1930:28; Hough 1897:39; Swank 1932:75) have yet to be recovered in identification form from a Chacoan site.

The principal, clearly identifiable archeological remnant of yucca use at sites of limited preservation is the seed. During preparation, the seeds were frequently separated from the fruit and discarded. These are large (usually greater than 8 mm) and, thus, recovered as macrobotanical remains as well as in flotation (Tables 11.8 and 11.9). Most seeds were uncharred and in relatively poor condition (as was the single yucca seed recovered in a late firepit at a village-level site: Room 5, Floor 1 at 29SJ 627; Struever 1977:67). All Pueblo Alto Yucca seeds were consistent with a broad-leaved yucca type (length ranged from 8-9.5 mm, thickness was greater than 1.5 mm except in the case of obviously shrunken seeds, and all bore coarse wrinkles; Knight 1978). However, the condition of these seeds is too poor to hazard speculations about use of nonlocal species of yucca.

Table 11.8. Distribution of cacti and yucca seeds by provenience type.

	Firepits Total Firepits = 9		Heating Pits Total Heating Pits = 22		Other Pits Total Other Pits = 8		Trash Total Trash = 11		Floors Total Floors = 69		Total Total n = 124	
	n samples[a]	n seeds	n samples	n seeds	n samples	n seeds	n samples	n seeds	n samples	n seeds	n samples	n seeds
Echinocereus												
Flotation	$\boxed{1}$	$\boxed{1}$	3	3	1	1	0	0	$\boxed{2}$	$\boxed{2}$	7	7
Opuntia												
Flotation	$\boxed{1}$	$\boxed{3}$	$\boxed{5}$	$\boxed{23}$	3	5	$\boxed{2}$	$\boxed{3}$	5[b]	12	16	46
Macro					1	6					1	6
Yucca												
Flotation	0	0	$\boxed{1}$	$\boxed{1}$	$\boxed{1}$	$\boxed{1}$	0	0	1	1	4	3
Macro					1	1	1	1	4	9	6	11

[a]Or number of locations (in the case of macroremains).
[b]Includes one sample with 3 unburned glocchid groups.
[c]$\boxed{}$ includes charred specimens.

Table 11.9. Distribution of cacti and yucca seeds from flotation by specific provenience.

	Echinocereus	Opuntia	Yucca
Red Mesa period:			
Room 139, Floor 2	+[a]	+[a]	
Room 142, Floor 3	+[a]	+[a]	+
Trash (Plaza Grid 8)		+	
Gallup Period:			
Room 103, Floor 3	+[a]		+[a]
Room 110, Floor 1	+[a]	+[a]	+[a]
Trash (Trash Mound)		+[a]	

[a]Some or all seeds carbonized.

Table 11.9 shows two aspects of the distribution of fruit-related remains for these three taxa. These taxa, which grow in roughly similar habitats and whose collection for food use corresponds generally in timing and technique, appear to be associated with one another at Pueblo Alto. Second, these taxa seem to cluster in certain room locations and time periods, rather than with any provenience category. Macrobotanical remains have been omitted from Table 11.9 because they seem to be biased due to one sharp-eyed excavator; eroded and often fragmentary seeds were collected exclusively by Wolky Toll in Rooms 142 and 145. These repeat flotation findings (in the case of prickly pear and yucca in Room 142, Floor 3) and indicate some association of yucca with the Late Mix period (in the case of mixed fill levels in Rooms 139 and 142). Lack of correspondence with any particular feature type (such as firepits or heating pits) is consistent with the role of these cactus and yucca seeds as discards, rather than directly utilized food products.

Edible Weeds

Amaranthus sp., pigweed
Chenopodium sp., goosefoot
Portulaca sp., purslane
Descurainia sp., tansy mustard
Mentzelia sp., stickleaf
Cleome sp., beeweed
Cycloloma atriplicifolium (Spring.) Coult., winged pigweed
Helianthus sp., sunflower
Physalis sp., groundcherry
Solanum sp., wild potato

Herbaceous weedy annuals play an important role in the wild food diets of native peoples of the Southwest, for they frequently supply a double crop of tender greens in the spring and abundant small seeds later in the summer or early fall. Weeds have an adaptive advantage under disturbed conditions and, thus, increase their usefulness to man by proliferating around human habitations, middens, and agricultural fields. Except where unusually good conditions allow retention of parts such as stems, leaves, and inflorescences (e.g., Antelope House, Ambrose 1986; Tularosa Cave, Cutler 1952; Bat Cave, Smith 1950), remains of the weedy annuals are recovered essentially by flotation and palynological techniques.

Three weed taxa in particular--*Chenopodium*, *Amaranthus*, and *Portulaca*--appear repeatedly in the ethnobotanical literature as substantial components in the wild food diet (Castetter 1935; Elmore 1944; Jones 1930). The pattern is repeated in flotation assemblages from archeological sites (Gasser 1978; Minnis 1982; Struever and Knight 1979), including those in Chaco Canyon (Struever 1977; Toll 1981b). In his tabulation of energy consumption during the historic period at San Juan Pueblo, Ford (1968:58) found that these three taxa comprised 38 percent by weight (though only 3 percent of calories--the greens are 82-86 percent water) of wild, gathered, food plants. The greens are chiefly valuable as a source of dietary minerals such as potassium and calcium (Wolfe et al. 1984), whereas the seeds have a significant (16-21 percent) protein content (Earle and Jones 1962).

Throughout the Southwest, young, tender, pigweed and goosefoot plants were collected in April and May and cooked as greens. Seeds gathered in the fall were frequently parched before grinding or storage. This processing step may be responsible for some charred seeds in the archeological assemblage. Although a large percentage of pigweed and goosefoot seeds in Chaco sites are unburned, the contemporary floral distribution of these genera (both are relatively sparse) does not suggest recent contamination as a probable major source for these unburned seeds. As at 29SJ 627 and 29SJ 629, Chenopodium seeds are far more abundant than Amaranthus (Tables 11.10 and 11.11). Both taxa at Pueblo Alto are most frequently charred in firepit and heating pit contexts.

Whereas pigweed and goosefoot are fairly bushy and calf- to waist-high, purslane is very low and succulent. The leaves have a pleasant tart taste that is due to small quantities of oxalic acid, and remain palatable over a period of many weeks. Plants were "gathered in large quantities in the summer" (Jones 1930:29) and often dried as winter greens (Krenetsky 1964:47). Because purslane seeds will ripen on a plant that has been pulled from the ground, plants hanging from a ceiling to dry might drop seeds to the floor below. Thus Portulaca seeds in the archeological record may be there both as a direct result of seed utilization and as an indirect product of use of herbage. At least some seeds are due to food use, as testified by the Portulaca seeds found in Pueblo Alto, Pueblo Bonito, and Kin Kletso coprolites (Toll 1981a). Purslane seeds were far less numerous at Pueblo Alto than at sites in Marcia's Rincon (where purslane was the single most abundant seed taxon at both 29SJ 627 and 29SJ 629). Purslane is widespread in Marcia's Rincon today; village inhabitants may have taken advantage of a locally plentiful resource, or abundance in the site may be due partly to postoccupational contamination. As at 29SJ 629, burned purslane seeds at Pueblo Alto are concentrated in firepit contexts (Table 11.12). In contrast to 29SJ 629, however, Pueblo Alto's heating pits and trash also contain substantial portions of charred purslane.

Like Indian ricegrass, tansy mustard is a wild resource whose distribution in time and space is patchy but quite predictable on a short-term time scale. It appears in abundance when its early spring moisture requirements are met but is sparse or absent in drier years. Mustard forms dense stands in the slightly alkaline, clayey soils of the canyon bottom and lower outwash slopes of Chaco Canyon (as in the springs following the wet winters of 1973 and 1978). Mustard greens, emerging as early as March, are among the first foods available in the new year and, consequently, have been recognized as an important spring crop (Balls 1970:25-6; Castetter and Underhill 1935:24). In early summer "the minute red-brown seeds...are shaken into baskets as soon as they are ripe" (Curtin 1949:84). The majority of Descurainia seeds recovered in Chaco have been unburned.

Table 11.10. Distribution of *Amaranthus* seeds in flotation samples.

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	21	59	26	0	106	10	99	0	215	
Seeds per liter	24.1	95.6	26.2	0	145.9	10	110.4	0	266.3	
% of all seeds per liter	2	3	8	0	3	2	2	0	2	
Number of samples	5	13	4	0	22	4	25	0	51	20
% of samples	56	59	50	0	52	36	36	0	41	34
Number of samples burned	4	6	1	0	11	1	2	0	14	2

Table 11.11. Distribution of *Chenopodium* seeds in flotation samples.

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	541	236	159	13	949	350	1,289	94	2,682	
Seeds per liter	579.9	467.9	175	13	1,235.8	357	1,885.8	110.3	3,558.9	
% of all seeds per liter	38	15	53	37	24	60	36	79	32	
Number of samples	5	17	4	1	27	3	52	2	84	27
% of samples	56	77	50	33	64	27	73	100	68	46
Number of samples burned	2	13	0	0	15	1	4	0	20	0

Table 11.12. Distribution of *Portulaca* seeds in flotation samples.

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	32	130	7	8	177	7	501	3	688	
Seeds per liter	40.8	185.1	19	8	252.9	8	565.4	3.5	829.8	
% of all seeds per liter	3	6	6	23	5	1	11	3	1	
Number of samples	7	12	3	1	23	5	43	1	72	21
% of samples	78	55	38	33	55	46	62	50	58	36
Number of samples burned	5	6	0	0	11	4	7	0	22	3

Although some or many of the seeds in archeological contexts may be postoccupational contaminants, mustard seeds are known to have been a puebloan food resource as seeds were recovered from coprolites at Pueblo Alto, Pueblo Bonito, and Kin Kletso (Toll 1981a), and the few charred seeds occur for the most part in proveniences associated with food preparation or in trash. Mustard seeds form a similar proportion of the total flotation assemblage (12-15 percent) at 29SJ 627, 29SJ 629, and Pueblo Alto. Charred mustard seeds are clearly concentrated in firepits at 29SJ 629, whereas they are prominent in heating pits and trash as well at Pueblo Alto (Table 11.13). As at 29SJ 627 and 29SJ 629, many Pueblo Alto floor samples contained mustard seeds, for the most part uncharred. However, in one of the few cases where scan data did not parallel full-sort results, not a single mustard seed was encountered in the 59 Pueblo Alto scan samples.

Stickleaf is another weed crop sensitive to winter and spring precipitation; some years it is abundant and others very sparse. Its present distribution in Chaco Canyon is different from that of mustard, as it favors sandier soils of the upper outwash slopes and mesa tops (Potter 1974). Mentzelia and Descurainia may respond to different patterns of available ground moisture (as, winter vs. early spring precipitation) or to different combinations of temperature and precipitation; abundance in one crop does not imply abundance in the other in the same year. The stickleaf seed crop matures later than does mustard (late May to June). The seeds have a high oil content of approximately one-third by weight (Earle and Jones 1962). Ethnographic reports indicate that "the ripe seeds were threshed on the spot" with a seed beater, and the dry seeds were stored without parching (Smith 1973:103). The seeds were prepared for eating either by parching and grinding or by grinding and boiling (Castetter 1935:34; Fewkes 1896:20). Consequently, we would expect to find Mentzelia seeds in both parched and unparched forms in contexts of food preparation or storage. Seeds at Pueblo Alto were found in several provenience categories but principally in heating features and on floors (Table 11.14). The Pueblo Alto flotation assemblage includes the first instances of recovery of fragile, charred, Mentzelia seeds in Chaco. This confirms both cultural association of this local food resource and the indication that preservation conditions are generally slightly better at Pueblo Alto compared to the shallower, alluviated, village sites.

Beeweed is a disturbed-ground weed with multiple economic uses. Young beeweed plants were "gathered and boiled for food" (Whiting 1939: 18), and "the large seeds used...to make a flour" (Jones 1930:26), while the plant was also boiled down to a thick black paste to be used as a pottery paint (Robbins et al. 1916:59; Stevenson 1915:82). Evidence of utilization of beeweed was entirely lacking at village site 29SJ 627, but seeds (including some that were charred) were found in very small numbers in feature and floor locations at 29SJ 629. At Pueblo Alto, beeweed seeds were generally found in small numbers, except for one concentration of 229 seeds on Floor 3 of Room 103 (Table 11.15). These seeds were all unburned and badly deteriorated. A large collection (probably several hundred) of unburned and deteriorated beeweed seeds was recovered as macrobotanical

Table 11.13. Distribution of *Descurainia* seeds in flotation samples.

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	201	34	10	3	248	7	519	19	793	
Seeds per liter	280.6	47.3	10	3	340.9	10	998.9	22	1,371.8	
% of all seeds per liter	18	1	3	9	7	2	19	16	12	
Number of samples	3	7	1	1	12	3	29	2	46	0
% of samples	33	32	13	33	29	27	42	100	37	0
Number of samples burned	1	5	0	0	6	2	2	0	10	0

Table 11.14. Distribution of *Mentzelia* seeds in flotation samples.

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	9	46	0	1	56	11	310	0	377	
Seeds per liter	13.5	97	0	1	111.5	11	345.2	0	467.7	
% of all seeds per liter	1	3	0	3	2	2	7	0	4	
Number of samples	4	5	0	1	10	4	19	0	33	12
% of samples	44	23	0	33	24	36	28	0	27	20
Number of samples burned	1	17	0	0	2	0	3	0	5	3

Table 11.15. Distribution of *Cleome* seeds in flotation samples.[a]

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	0	2	1	0	3	0	233	0	236	
Seeds per liter	0	2	1	0	3	0	261.1	0	264.1	
% of all seeds per liter	0	T	T	0	T	0	5	0	2	
Number of samples	0	2	1	0	3	0	4	0	7	3
% of samples	0	9	13	0	7	0	6	0	6	5
Number of samples burned	0	2	0	0	2	0	0	0	2	1

[a]T = Less than 0.5%.

remains from Floor 4 fill in Room 103; these are associated with a rodent hole and may have been retransported. It is unlikely that any of the seeds found at 29SJ 629 or Pueblo Alto are recent contaminants, as beeweed today appears to be limited to the wash and protected side canyons (Anne Cully, personal communication 1982; Potter 1974).

Several decades ago, Judd (1954:186) observed stands of beeweed growing in "flooded areas near Fajada Butte." Beeweed pollen was common in Chaco Canyon coprolites (found in 19 of the 28 samples with 200 pollen grains) and was the dominant taxon in four coprolites (Clary 1981). Although pollen might adhere to seeds, the quantities in which it is found in coprolites indicate that it was more likely ingested with whole plants, including flower parts (Martin and Sharrock 1964).

Cycloloma grows in scattered, sandy areas of grassland and pinyon-juniper associations. To date it has only been observed growing in small quantities in Chaco Wash (Anne Cully, personal communication 1982). Whereas the early- to midsummer crop of leaves was used medicinally by the Hopi (Whiting 1939:74), it is also reported that the "Indians made mush and cakes from ground-up seeds" available in late summer (Kearney and Peebles 1960:254). Winged pigweed seeds were slightly less common at Pueblo Alto than at 29SJ 629, but more often burned (Table 11.16; Toll 1981b). As at 29SJ 629, the majority were unburned seeds found on floor surfaces, and small numbers (many of them charred) were found in heating features. At 29SJ 627, very few Cycloloma seeds were recovered, all from features. _Cycloloma_ also occurs regularly in nearby sites (for instance, in 22 percent of samples at Salmon Ruin, Doebley 1981; and 70 percent of samples at Bis sa' ani, a Chacoan outlier, Donaldson and Toll 1982). _Cycloloma_'s record in Chaco area flotation assemblages suggests prehistoric utilization of this annual herb. The historic, ethnographic record of _Cycloloma_ use is scant, and possibly this taxon has been greatly reduced in floristic distribution (and economic importance) since the prehistoric period.

The common sunflower (in Chaco, _Helianthus annuus_ L., or _H, petiolaris_ Nutt.) has kernels very much smaller than those of cultivated species of the historic period. Nevertheless, they provide a valued food source high in oils and were encouraged, or cultivated, by several Southwestern groups including the Hopi (Whiting 1939:12) and the Chaco Navajo (Elmore 1944:87). The seeds were often parched and ground before consumption (Havard 1895:103; Heiser 1951:436-7). In addition, the pericarps were sometimes boiled to make a dark red or purple dye (Elmore 1944:87; Whiting 1939:87). Most sunflower achenes found at 29SJ 627, 29SJ 629 and Pueblo Alto (Table 11.17) were represented by unburned, longitudinal shreds of the achene (although charred whole achenes were found at all three sites). _Helianthus_ remains in this condition have been observed in human coprolites from Chaco Canyon sites (at Atlatl Cave and Pueblo Bonito; Toll 1981a). Achenes pounded or ground on a metate and achenes utilized by rodents for food would also be expected to show this pattern in the debris. Wild and cultivated sunflowers have been reported by Bailey (1931) as food for kangaroo rats (_Dipodomys_ spp.) and by Martin,

Table 11.16. Distribution of *Cycloloma* seeds in flotation samples.[a]

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	3	27	0	4	34	2	100	0	136	
Seeds per liter	4.9	32.1	0	4	41	2	104.6	0	147.6	
% of all seeds per liter	T	1	0	11	1	T	2	0	1	
Number of samples	2	5	0	1	8	1	16	0	25	12
% of samples	22	23	0	33	19	9	23	0	20	20
Number of samples burned	2	3	0	0	5	1	1	0	7	3

[a]T = Less than 0.5%.

Table 11.17. Distribution of *Helianthus* seeds in flotation samples.[a]

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	0	1	0	2	3	0	17	0	20	
Seeds per liter	0	1	0	2	3	0	19.9	0	22.9	
% of all seeds per liter	0	T	0	6	T	0	T	0	T	
Number of samples	0	1	0	1	2	0	10	0	12	2
% of samples	0	5	0	33	5	0	15	0	10	3
Number of samples burned	0	0	0	0	0	0	1	0	1	0

[a]T = Less than 0.5%.

Table 11.18. Distribution of *Physalis* seeds in flotation samples.[a]

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	5	41	1	0	47	3	31	0	81	
Seeds per liter	5	38.1	1	0	44.1	3	38.6	0	85.7	
% of all seeds per liter	T	1	T	0	1	1	1	0	1	
Number of samples	3	4	1	0	8	2	14	0	24	9
% of samples	33	18	13	0	19	18	20	0	19	15
Number of samples burned	2	2	0	0	4	0	0	0	4	1

[a]T = Less than o.5%.

Zim, and Nelson (1951:257-8) as food for pocket mice (Perognathus spp.). Thus, although there is clear evidence for food utilization of sunflowers by both Archaic and puebloan inhabitants of the canyon, the bulk of flotation remains from Pueblo Alto are ambiguous as to how (and by whom) sunflowers were used.

Physalis flourishes in sand dunes and other disturbed habitats and, consequently, increases around human habitations and agricultural fields. Groundcherry, in the same family (Solanaceae) as tomatoes, peppers, and tobacco, produces tart berries in mid to late summer. These are eaten fresh by various puebloan groups in the historic Southwest (Jones 1930:36; Robbins et al. 1916:59; Swank 1932:59; Whiting 1939:21), whereas the Zuni "boil then crush small quantities of the fruit for use as a condiment" (Castetter 1935:39). Groundcherry seeds found in very small quantities throughout Pueblo Alto (Table 11.18) compare well morphologically with the species common in Chaco Canyon today [P. hederaefolia var. cordifolia (Gray) Waterfall; Cully 1985a]. Charred specimens were found in several heating features, which links groundcherry with probable food use. An additional four seeds (including two charred ones, in Heating Pit 1 on Floor 2 of Room 139) are more consistent with the closely related Solanum sp. (nightshade or wild potato). The surface texture of these latter seeds is characterized by considerably coarser reticulations.

Miscellaneous weeds

Nicotiana attenuata Torr., coyote tobacco
Sphaeralcea sp., globe mallow
Plantago sp., Indian wheat, plantain
Corispermum sp., tickseed
Euphorbia sp., spurge
Cryptantha crassisepala, Torr. and Gray, plains hiddenflower
Phacelia sp., scorpionweed

Several additional weed species have nonfood or incidental economic roles, and others have undetermined roles or are suspected of being principally contaminants. Nicotiana is rare at Pueblo Alto, occurring only in four Floor 2 grids in Room 139 (3 percent of all full-sort samples and none of scans). Tobacco is more widespread at the village sites, occurring in 9 percent of 29SJ 627 samples and 15 percent of 29SJ 629 samples. Although all tobacco seeds recovered to date in Chaco are unburned, they are presumed to relate directly to prehistoric tobacco utilization, because of the plant's specialized growth requirements, which are absent in the vicinities of the sites. Wild tobacco grows in specific habitats such as sandy ground near streams and washes (Martin and Hutchins 1980: 1752), or shady spots in canyons (Paul Knight, personal communication 1979). To date it has not been seen in Chaco Canyon (Cully 1985a; personal communication 1982). The leaves contain nicotine and were smoked ceremonially by the Zuni and Apache (Reagan 1928:158-9; Stevenson 1915:95) Morris (1980:103) describes numerous quids composed of "finely prepared yucca fiber, carefully wrapped around cores of finely divided leaves and stems of tobacco (Nicotiana attenuata)" from a Basketmaker cave in northeastern Arizona. Occurrence of the unburned seeds at Chaco sites is reasonable evidence that some use (smoking and/or sucking "pastilles") was made of tobacco at the village sites. Tobacco may have been acquired by trade, or may have been cultivated (as by the Hopi; Whiting 1939:90).

Sphaeralcea, a member of the mallow family, is represented in Chaco Canyon by several species, growing generally in disturbed alkaline soils (Potter 1974). Several groups in the Southwest are noted as using the roots of perennial mallows for medicinal purposes; in most cases the root is mashed or boiled, and the resulting sap or tea applied or ingested for any variety of ailments (Curtin 1949:80-1; Krenetsky 1964:48; Swank 1932: 71-2; Whiting 1939:31, 85). The occurrence of mallow seeds in archeological sites is often limited to a very small number of unburned seeds and has been interpreted in these cases as recent contamination (Minnis 1982; Toll and Donaldson 1981, 1982). Burned mallow seeds occur in several samples at 29SJ 627, 29SJ 629, and Pueblo Alto (Table 11.19), which indicates clear association with prehistoric activity. In the absence of ethnographic records of food use, the small number of seeds seeds recovered are best construed as brought into the sites on plants collected and stored for medicinal purposes.

Plantago, a weedy perennial herb growing in disturbed areas, does not appear often in flotation assemblages. It is absent at the village sites, but occurs in three heating pits at Pueblo Alto and in each case is charred. Some minor or specialized economic role is suggested by this pattern of seed recovery. Either food or medicinal use could be involved, as both are recorded: the young leaves were collected and eaten by the Acoma and Laguna (Castetter 1935:42) whereas the mucilaginous seeds formed a later crop (Curtin 1949:96-7); the Isleta and Keres prepared a tea from the whole plant for stomach disorders (Jones 1930:38; Swank 1932:61).

Corispermum is an herbaceous annual that becomes a tumbleweed when it matures. It belongs to a large and widespread family with such members as Chenopodium, Salsola (Russian thistle) and Atriplex. Several species of Corispermum grow in New Mexico today, and all are thought to be introduced from Eurasia (Martin and Hutchins 1980:598-600). However, recent evidence in the form of direct accelerator dating (specimens as early as 14,500 B.P. ± 600 years; Betancourt et al. 1984) and the recovery by flotation of carbonized tickseeds at several sites in the Four Corners area (Bis sa' ani, Donaldson and Toll 1982; puebloan middens in southeastern Utah, Alan Reed, personal communication 1980; Tsaya Wash, Minnis 1982; Navajo Mines, Toll 1983; 29SJ 629, Toll 1981b; and Pueblo Alto, Table 11.20) confirm that a species was present in the Southwest before the historic era. As no economic uses are known for this taxon, its origin and function in puebloan archeological contexts must remain unknown for the time being. Two other members of the Chenopodiaceae occur very sporadically at Pueblo Alto; Monolepis occurs once in the uppermost floor of Room 110 and Suaeda twice on Floor 2 of Room 139. Both taxa lack records of economic utilization, but one burned seed links Suaeda to the prehistoric period, possibly as an accidentally burned contaminant.

Table 11.19. Distribution of *Sphaeralcea* seeds in flotation samples.[a]

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	2	10	0	1	13	1	12	0	26	
Seeds per liter	2	23.8	0	1	26.8	1	13.2	0	41.0	
% of all seeds per liter	T	1	0	3	1	T	T	0	T	
Number of samples	2	6	0	1	9	1	11	0	21	6
% of samples	22	27	0	33	21	T	T	0	17	10
Number of samples burned	2	5	0	0	7	1	2	0	10	2

[a]T = Less than 0.5%.

Table 11.20. Distribution of *Corispermum* seeds in flotation samples.

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	0	27	0	0	27	0	45	0	72	
Seeds per liter	0	31	0	0	31	0	48.5	0	79.5	
% of all seeds per liter	0	2	0	0	1	0	1	0	1	
Number of samples	0	3	0	0	3	0	18	0	21	5
% of samples	0	14	0	0	7	0	26	0	17	8
Number of samples burned	0	1	0	0	1	0	0	0	1	2

Table 11.21. Distribution of *Euphorbia* seeds in flotation samples.[a]

	Full Sort									Scan
	Firepits (n = 9)	Heating pits (n = 22)	Other pits (n = 8)	Mealing bins (n = 3)	ALL FEATURES (n = 42)	Trash (n=11)	Floors (n=69)	Plaza (n=2)	TOTAL (n=124)	Floors (n=59)
Actual number of seeds	406	3	0	0	409	16	14	0	439	
Seeds per liter	426.9	5	0	0	431.9	16	18.1	0	466	
% of all seeds per liter	28	T	0	0	8	3	T	0	4	
Number of samples	2	2	0	0	4	1	11	0	16	3
% of samples	22	T	0	0	T	T	6	0	13	5
Number of samples burned	0	1	0	0	1	0	0	0	1	0

[a]T = Less than 0.5%.

Spurge is a small-leaved annual growing close to the ground that produces its small carrot-shaped seeds in mid to late summer (Kearney and Peebles 1960:520). Several species of spurge are common in Chaco Canyon (Cully 1985a). Records of food use of this plant are limited to use of the root as a cornmeal sweetener by the Zuni (Stevenson 1915:51). Note, however, that the gathering of roots need not involve collection of the herbaceous, seed-bearing portion as well. Most known ethnobotanical uses of the entire plant involve the preparation of medicine (Krenetsky 1964:45; Reagan 1928:158). Spurge occurs in most provenience types at Pueblo Alto (Table 11.21). The abundance of these seeds at Pueblo Alto (4 percent of all seeds) is similar to 29SJ 627 (2 percent). At 29SJ 629, spurge seeds made up 14 percent of the assemblage. Because possible, prehistoric, economic uses are minimal, and local rodent food utilization is confirmed by the presence of seed fragments in rodent scats from flotation samples, we highly suspect that many (probably most) spurge seeds are contaminants. All seeds at 29SJ 627 and 29SJ 629 were uncharred, but a single specimen in a Pueblo Alto heating pit was carbonized.

Seeds of two unsavory local weeds are almost surely present in Pueblo Alto deposits as a result of modern (or possibly prehistoric) contamination. _Cryptantha_ is a bristly plant that inhabits dry, sandy, or gravelly soil. Most seeds in good condition were assignable to a common local species, _C. crassisepala_ (Torr. and Gray) Greene. Only medicinal uses are recorded in the ethnobotanical literature for the Hopi (Whiting 1939:88) and the Zuni (Stevenson 1915:45). Among the Keres, _Cryptantha_ is "considered a bad poisonous weed" (Swank 1932:24). _Phacelia_ has hairy, pinnatifid leaves, glandular pubescence, and a peculiar onion-like smell. Contact with the plant "causes dermatitis in susceptible persons" (Kearney and Peebles 1960:698). No economic uses of this taxon are noted, and it is probable that it was avoided. _Cryptantha_ seeds occurred in 5 percent of samples and _Phacelia_ in 2 percent. That none of these seeds were burned lends further support to the notion that they are intrusive.

Cultivars

Zea mays L., corn
Phaseolus vulgaris L., common bean
Cucurbita sp., squash

Remains of corn, the principal cultivated crop of the Anasazi, have the potential of informing on two very different levels. Corn has a very durable waste product (the cob), which is found in relative abundance throughout the site. Details of the gross quantitative occurrence of corn remains, by room type and provenience category, reveal how and when corn was used or discarded over time. Second, morphometrics of cobs can provide some clues about growing conditions and about genetic relationships with corn grown elsewhere in Chaco and at other sites in the San Juan Basin.

Corn is without a doubt the single most abundant plant-food taxon at Pueblo Alto in terms of the quantity of usable foodstuff represented by the remains recovered. Though corn may indeed have had top dietary importance at Pueblo Alto, it is important to recognize that its artifactual visibility is at least as much due to factors of differential deposition and preservation as to actual use. The actual plant part eaten, the kernel, represents only 1.4 percent of all seeds found in Pueblo Alto flotation samples, though only two weed taxa are more ubiquitous (Chenopodium, found in 68 percent of samples, and Portulaca, found in 58 percent, vs. Zea's 53 percent). Corn's predominance at Pueblo Alto is most evident among macrobotanical remains, where corn specimens form an overwhelming 97 percent of the 6,313 vegetal items inventoried in the field. Nearly all the macrobotanical materials are cobs, and nearly all of these are carbonized. The small segment of unburned corn remains includes cobs from Gallup and Late Mix associations in deep West Roomblock rooms (Room 103, 12 cobs; and Room 10, 21 cobs).

Corn parts other than cobs and kernels (stalks, husks, shanks, tassels) are rare at Pueblo Alto. Sheltered assemblages, such as those at Antelope House (Hall and Dennis 1986) and Sliding Rock (Struever 1981) in Canyon de Chelly, indicate that these parts are almost always deposited uncharred, so their survival in sites depends on excellent preservation conditions. Sufficient protection was apparently more prevalent at Salmon Ruin (Doebley and Bohrer 1983) and Bis sa 'ani (Donaldson and Toll 1982) than at Pueblo Alto. Because selective degradation may be responsible for absence of these materials, we cannot infer that corn was not brought to the site on plants or that tassels were not used ceremonially (especially given the widespread presence of corn pollen at Pueblo Alto; Cully 1985b). Identifiable corn residues in human coprolites from Room 110 at Pueblo Alto include only a tiny, carbonized, cob fragment (Toll 1981a). I see no reason to consider this as intentionally eaten, though unburned cob fragments in Salmon coprolites are interpreted as food (Doebley and Bohrer 1983:22). Fragments of corn kernel pericarp in coprolites from Pueblo Bonito (Toll 1981a) may owe their survival to slightly better preservation conditions (e.g., intact roofs).

A breakdown of Pueblo Alto's corn remains by provenience category reveals a significant association of corn debris with trash deposits and, secondarily, with those proveniences (heating features) probably producing the bulk of the trash. Corn from major trash deposits (the Trash Mound, Plaza Grid 8, and Kiva 10) comprises a fat 74 percent of the computer-inventoried, macrobotanical corn. The probable derivation of most Pueblo Alto corn remains from fuel usage is evident in the considerable discrepancy between kernel distribution and distribution of kernels plus cobs. The few carbonized kernels found in flotation are clearly associated with heating features (Table 11.22), whereas samples with cob parts are more widespread, particularly with respect to trash proveniences (Figure 11.2). If carbonized kernels represent food-processing accidents (vs. fuel use for cobs), we can expect kernels to be most evident in the locations of primary use. The apparent lead of heating pits over firepits as a locus for corn debris may be due to sampling error or differential survival in

Table 11.22. Distribution of *Zea* kernels in full-sort flotation samples.

	Total Kernels/liter All samples	Average Kernels/liter Per sample	Percent (%) Samples Found in
Features:			
Firepits [n=9]			
Heating Pits [n=22]	14.1	1.6	67
Other Pits [n=8]	88.5	4.0	68
All Features [n=42]	7.3	0.9	25
(inc. mealing bins)[a]	109.9	2.6	55
Trash [n=11]			
	18.0	1.6	27
Floors [n=69]			
	15.5	0.2	10
All Samples [n=124]			
(inc. mealing bins	143.4	1.2	27
and plaza)[a]			

[a]No kernels recovered from mealing bin or plaza surface samples.

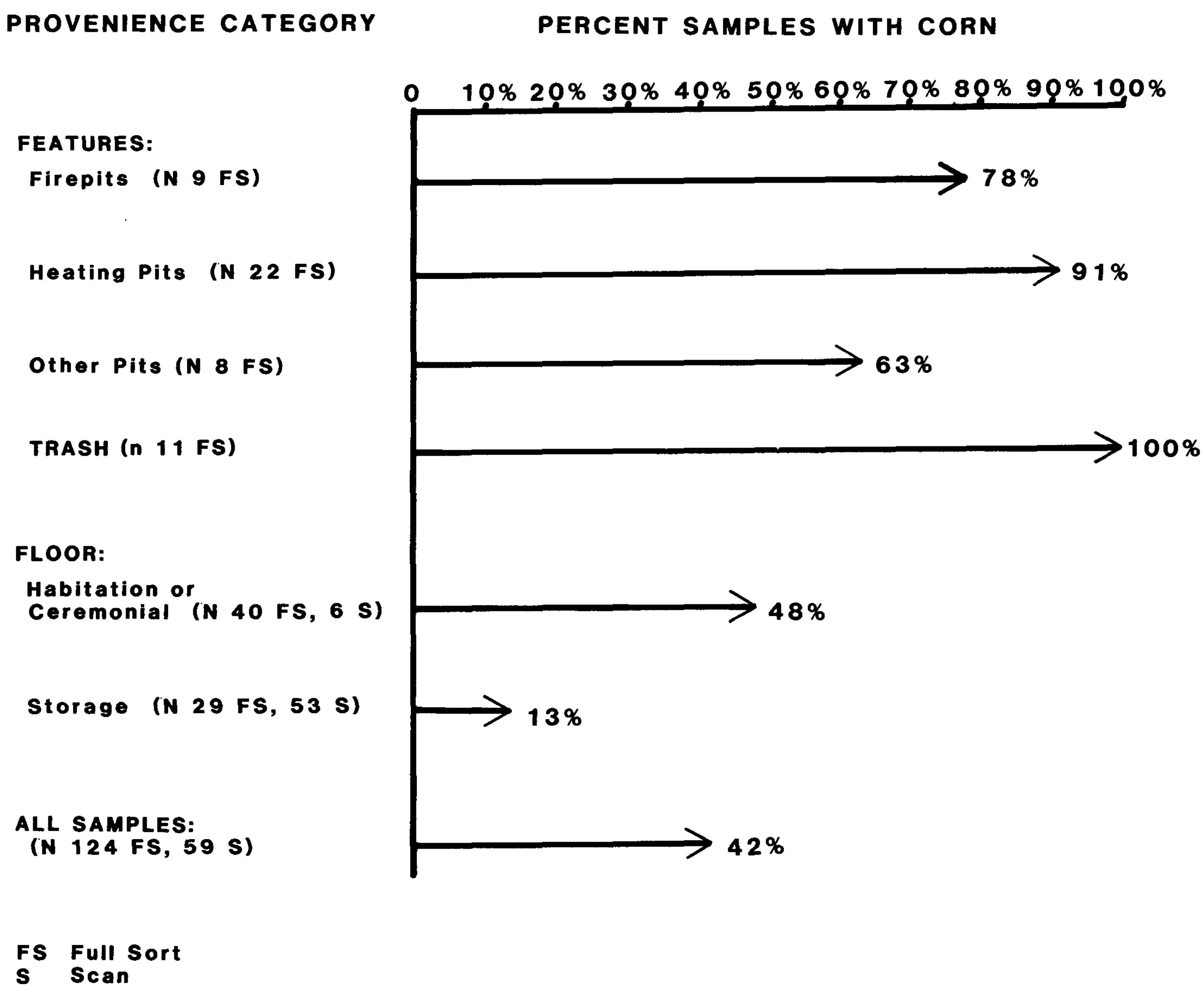

Figure 11.2. Presence of *Zea* cob or kernel remains in flotation.

the smaller (presumably less hot) fires of heating pits; there is no sound macrobotanical basis for implying any functional difference in the two heating-feature types.

Corn debris from proveniences other than trash or heating features shows a distribution echoed by other economic plant remains at Pueblo Alto and elsewhere. Corn remains are clearly more prevalent in habitation rooms, where the likelihood of plant processing is suggested by a variety of features, in comparison with featureless storage rooms (Figure 11.2).

The evolutionary path of corn has been a hot topic for nearly a century now, yet the literature is characterized more by quibbling than by consensus. Although the character, source, and timing of different genetic stock inputs may be forever debated, we can recognize some underlying trends. Corn, like the other major cultivated crops, is not indigenous to the Southwest but developed in Mexico and diffused northward. The earliest known Southwestern corn is at Bat Cave, dating to about 1000 B.C. (originally advertised as much earlier). This early type (Chapalote), a small-cob popcorn, "demonstrates greater range in size and overall lower productivity" than does later pueblo maize (Ford 1981:11). Cob populations with similar characteristics are found at other dry caves: Jemez, Tularosa, and Cordova. From 1000 to 500 B.C. we see even greater variability, including some more productive cobs; this is presumed to be due to genetic introgression of a close relative, teosinte (Ford 1981; Winter 1973) though no teosinte parts have been recovered north of Mexico.

From late Basketmaker II through Pueblo II, there are generally more 12- to 16-rowed cobs than later on. A major shift in cob row number is then observed (ca. A.D. 700 in southwestern New Mexico, between A.D. 1000-1100 at Mesa Verde, and ca. A.D. 1100 at Salmon Ruin). Hybridization of the developed Chapalote type with a new Mexican immigrant, an 8-rowed, flour corn, Mais de Ocho, is generally held responsible, though many date the postulated introduction of this low-rowed genotype to many centuries before the observed phenotypic shift. In many late Pueblo II and Pueblo III corn assemblages, the percentage of 8-rowed cobs increases (from about 8 to 20 percent or more; Winter 1973) while cob size likewise increases. Meanwhile, 12- to 16-rowed cobs fall off, and the average row number shifts from around 12 to 10. This broad pattern of continuity in corn morphology from late Basketmaker through Pueblo II, followed by a change to a lower-rowed Pueblo III type, is seen at site after site in the Anasazi area.

In this context, it is very interesting that corn from Pueblo Alto and other Chacoan sites does not fit smoothly into the general patterns observed in the region as a whole. Although Doebley and Bohrer (1983) find that Salmon's "Chacoan" occupation can be characterized by an average row number of 12, we find corn averaging 10 rows both within and surrounding Chaco Canyon, from Basketmaker III through Pueblo III (Table 11.23; also LA 18080 and LA 26749, Donaldson 1981a, 1981b; 29SJ 627, Struever 1977; H21-1 and H29-19, Struever and Knight 1979). At Pueblo Alto, the major change in row number over time is the shift from a very large pro-

Table 11.23. *Zea* cob morphometrics over time (11th-13th century) in the Chaco area.

	Row number						Cob diameter[a]			Cupule width[a]			Cupule aperture width[a]		
	8 or less	10	12	14+	n	$\bar{x}$	n	$\bar{x}$ mm	cv	n	$\bar{x}$ mm	cv	n	$\bar{x}$ mm	cv
Pueblo Alto Red Mesa phase A.D. 1020-1040/50	49	22	21	9	150	9.8	152	12.6	.244	71	6.7	.253	36	3.0	.215
29SJ 692[b] Main site occupation A.D. 925-1050	34	38	25	3	182	9.9	196	11.9	.275	196	6.2	.231			
Pueblo Alto Gallup phase A.D. 1050-1100	18	41	34	6	474	10.6	473	12.4	.224	116	6.1	.208	189	3.3	.272
Bis sa' ani[c] A.D. 1050-1100+	32	33	31	3	290	10.1	300	11.1	.229	292	5.5	.189			
Salmon Ruin[d] Chacoan occupation A.D. 1080/90-1130					50	11.9	11	16.0	.080				50	6.4	.128
Pueblo Alto Late Mix phase A.D. 1100-1150/1200	23	39	33	5	252	10.8	254	12.2	.227	64	6.1	.199	103	3.2	.285
29SJ 629[b] 12th century Kiva trash	17	67	17	0	6	10.0	6	9.6	.411	6	4.9	.449			
Salmon Ruin[d] Mesa Verde occupation A.D. 1180-1280					60	10.6	50	14.0	.181				60	7.2	.209

[a]Figures reflect 21% added to measurements of carbonized specimens to compensate for average shrinkage carbonization. Salmon cv's are approximate, as they are averages of the constituent subsample cv's.
[b]Toll 1981b.
[c]Donaldson and Toll 1982.
[d]Doebley and Bohrer 1980.

portion of 8-rowed cobs associated with the Red Mesa phase, to the largest proportion being 10-rowed cobs in the Gallup and Late Mix periods. The average row number increases slightly (from 9.8 to 10.8) rather than decreases.

Chaco area corn diverges notably from that at Salmon in the realm of cob and cupule size. Salmon cobs are considerably bigger; their decrease in diameter over time from an average of 16 to 14 mm is echoed by the smaller decrease from 12.6 to 12.2 mm at Pueblo Alto. Cobs at village site 29SJ 629 are smaller than Pueblo Alto's at any given time period, and Bis sa 'ani's are smaller yet. Over time Salmon cupules become wider as row number decreases. Pueblo Alto cupules are very much smaller than those at Salmon, and do not show a clear trend in shape change over time. And again, 29SJ 629 and Bis sa 'ani show diminutive features relative to Pueblo Alto.

More likely than any sort of racial variant occurring in the Chaco area, I suspect that the substantial morphological differences observed here can be attributed to poor growing conditions. Salmon, on the banks of the San Juan River, is located in a relative green belt of the arid Southwest; prehistorically as well as today, the river provides dependable moisture for crops. We know that moisture, temperature, and mineral stresses affect reduction in size of the plant as a whole as well as the cob and often result in irregular row configuration and undeveloped kernel rows (Denmead and Shaw 1960; Robins and Domingo 1953). Both irregular and unfilled rows are common in Chaco Canyon cobs, and smaller cob size may also reflect environmental factors that we know are poorer in the Chaco Canyon area (Cully et al. 1982; Schelberg 1982).

The morphometrics of Pueblo Alto _Zea_ specimens suggest some startling departures from both chronological and geographical patterns of corn variation described elsewhere. Great differences in specific attribute measurements bring up the question of whether individual analysts are indeed measuring the same characteristic in the same manner. But still more important, we are forced to pay attention to the fundamental difficulty of prehistoric corn analysis: that there is as yet no rigorous demonstration of the relationship of variability in corn cob size and shape measurements with genetic variation of individual plants or populations. Indeed, an ethnoarcheological study (Benz and Bye 1980) showed cob attributes frequently measured on archeological populations to be only partially successful at delimiting types recognized as distinct by those who grew them.

The cultivated bean record was surprisingly scant, considering the presumed relatively good preservation at Pueblo Alto. A single cotyledon was found in Plaza Grid 8 (Layer 15) during excavation, and another was recovered by flotation from a Gallup level (Layer 44) of the Trash Mound. Both specimens were charred and lacked seed coats. In spite of their poor condition, both could reasonably be identified as _Phaseolus vulgaris_. Species-level determination of Southwestern bean types is a relatively clear-cut matter--species overlap only slightly in constellations of size and shape parameters and possess distinctive morphological characters. Scarlet runner beans (P. coccineus) are very large and round; teparies (P. acutifolius) are small and flat with squared ends and have proportionately small hilums; and limas (P. lunatus) have a characteristic venation pattern and hilum conformation. The only real area for possible confusion is between nontypical teparies and some common bean types (Gasser 1980).

The known distribution of cultivated bean species in time and space leads us to expect only P. vulgaris in the Chaco Canyon area during the Anasazi period, although other species might conceivably arrive in the area as trade products. P. vulgaris is the most widely utilized of the food beans (prehistorically as well as currently) and can be raised in a wide range of conditions, from neutral to slightly alkaline soils and from sea level to elevations over 2,000 meters (Kaplan 1965a). Varieties of the scarlet runner beans, limas, and teparies were cultivated as far north as the Verde Valley in Arizona but never reached the Four Corners area during the Puebloan era (Kaplan 1965b). The two Pueblo Alto bean specimens were broken, but their interpolated sizes fall within the range given by Kaplan (1956) for P. vulgaris: length 0.74-1.85 cm, width 0.49-1.08 cm, and thickness 0.34-0.85 cm.

Three cultivated species of the genus Cucurbita, of tropical American origin, are known archeologically in the Southwest: C. pepo, C. moschata, and C. mixta. C. pepo appears to have been introduced the earliest (ca. 300 B.C. at Tularosa and Cordova Caves, Kaplan 1963; Martin et al. 1952; and ca. 1000 B.C. at Bat Cave; Ford 1981) and was the most widespread. C. moschata was never widespread in the Southwest prehistorically or during historic times (Cutler and Whitaker 1961:479). C. mixta began appearing in pueblo sites between A.D. 900-1100, but was never as widely distributed as C. pepo (Cutler and Whitaker 1961).

Squash seeds were found in 16 locations at Pueblo Alto (Table 11.24). A single charred seed was recovered from a heating pit in Room 110, Floor 1. All other seeds are unburned and are so badly deteriorated that identification is placed only at the genus level (Cucurbita sp.). Morphology (size, shape, color, and seed body and margin characteristics) is consistent with C. pepo; however, with seeds in this condition the possibility of inclusion of very eroded C. mixta seeds cannot be ruled out (Gasser 1980). Cucurbita rind (not recovered at 29SJ 627 or 29SJ 629) was carbonized in two out of the three instances in which it occurred at Pueblo Alto (Table 11.24). As with corn remains, the record of distribution of squash at Pueblo Alto must be pieced together with the use of both flotation and macrobotanical data. As at the village sites, most cucurbit remains occurred on floor levels at Pueblo Alto. In contrast to the village sites, there seems to be an association at Pueblo Alto with a single feature type, heating pits (the few charred squash remains occur in these). This is the only instance to date in Chaco Canyon where cucurbit debris may be related to a locus of processing (rather than secondary deposition).

Table 11.24. Distribution of Cucurbit remains.

	Heating Pits		Floors		Total	
	n	%	n	%	n	%
Flotation (full sort):						
Seeds						
Samples	2	9	1	1	3	2
Samples charred	1		0		1	
Rind						
Samples	1	5	0		1	1
Samples charred	1		0		1	
All parts						
Samples	3	14	1	1	4	3
Samples charred	2		0		2	
Macroremains:						
Seeds						
Locations	1		12		13	
Locations charred	0		0		0	
Rind						
Locations	1		1		2	
Locations charred	1		0		1	

Wood Used for Fuel and Construction

Wood use at Pueblo Alto is documented by two collections with very little functional overlap. Charcoal specimens from a sampling of 15 firepits, 36 heating pits, and 16 trash locations were identified by Welsh (1979). The proveniences were chosen by Tom Windes to reflect the array of primary and secondary deposits of fuel debris at Pueblo Alto. To the best of the excavators' consideration, the firepit and heating pit samples represent original use of these features for cooking and heating and not post-use fill. Trash proveniences probably largely reflect dumpings from heating features but may also include construction debris. A second collection includes specimens sent to the University of Arizona Laboratory of Tree-Ring Research for dating (Chapter 7 of Volume I, this report). This group is distinctive from the first in terms of size, condition, and function: the pieces tend to be larger, unburned, and from structural contexts.

Before taking a look at the composition of these collections, it is essential to face the fact that neither data set is truly representative of fuel or construction wood use, nor do both collections taken together accurately reflect wood used (or recovered) at the site as a whole. Most of the charcoal samples sent to Welsh comprised 10 specimens from a given location. In the majority of sampled proveniences, the quantity of charcoal present was low and pieces tended to be small; in these cases the sample, though small, is probably representative of the taxa present. In cases where larger pieces were present, these were frequently selected for tree-ring dating. This amounts to a systematic distortion of taxonomic composition of the larger heating features, as it is well known that taxon and specimen size tend to covary nonrandomly. Although Welsh's charcoal data give a fairly consistent picture of fuel use dominated by local nonconiferous shrubs (Table 11.25), the few cases where the Tree-Ring Lab has supplied species identifications for the same provenience (Room 146, Floor 3, Firepit 1; Room 147, Floor 1, Firepit 1; and Plaza Feature 1 ovens) indicate the addition of fuel elements that are almost entirely coniferous.

Architectural wood at Pueblo Alto is largely unburned and in place (posts, lintels). There are no intact or collapsed roofs, burned or unburned. On the other hand, unburned juniper splints (presumed to be roof debris) are common in room fill and were never included in either wood inventory. Cottonwood/willow pieces may be seriously underrepresented in construction contexts as the type is notoriously poor for tree-ring dating, is often recognizable on a gross morphological level, and was consciously omitted from specimens sent to the Tree-Ring Laboratory.

As at village sites 29SJ 627 and 29SJ 629, overall charcoal composition at Pueblo Alto is typified by major use of nonconiferous shrubs (with saltbush/greasewood the single largest component) and lesser use of local conifers (pinyon and juniper) and riparian woods (cottonwood/willow; Table 11.26). At Pueblo Alto principal use of saltbush/greasewood holds for all three provenience categories at all time periods (Table 11.27). Juniper is a major fuel component in all provenience types starting in the Gallup

Table 11.25. Species composition of charcoal vs. tree-ring specimens.[a]

	Charcoal (Welsh, 1979)		Tree-ring (Robinson, 1979)	
	n	%	n	%
Douglas fir	--	--	7	1
White fir	--	--	34	7
Ponderosa pine	2	T	248	51
Pinyon	68	11	151	31
Juniper	125	21	42	9
All conifers	195	32	482	99
Saltbrush/greasewood	322	53	--	--
Sage	28	5	--	--
Other nonconiferous shrubs	23	4	--	--
All nonconiferous shrubs	373	62	--	--
Cottonwood/willow	6	1	2	T
Miscellaneous	28	5	--	--
TOTAL	602		484	

[a]T = less than 0.5 percent.

Table 11.26. Charcoal composition percentages, Sites 29SJ 627, 29SJ 629, and Pueblo Alto.[a]

Site	Conifer	Nonconifer shrubs (saltbush)	Nonconifer shrubs All	Riparian	Unknowns
627 [n=98]	4	(88)	90	6	---
629 [n=120]	9	(63)	75	1	15
389 [n=602]	32	(53)	62	1	4

[a]Data adapted from Welsh (1979).

Table 11.27. Charcoal composition at Pueblo Alto, by provenience category and major time period.[a]

	Red Mesa															
	Firepits				Heating pits				Trash				All proveniences			
	Locations (n = 5)		Pieces (n = 70		Locations (n = 16)		Pieces (n = 155)		Locations (n = 3)		Pieces (n = 30)		Locations (n = 24)		Pieces (n = 255)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Juniperus	3	60	11	16	3	19	11	7	3	100	5	17	9	38	27	11
Pinus edulis	1	20	5	7	--	--	--	--	2	67	5	17	3	13	10	4
Total Conifers			16	23			11	7			10	34			37	15
Chenopepdiaceae *Atriplex/Sarcobatus*	4	80	49	70	16	100	121	78	3	100	17	57	23	96	187	73
Compositae *Artemisia*	1	20	1	1	4	25	10	6	--	--	--	--	5	21	11	4
Compositae *Chrysothamnus*	--	--	--	--	2	13	2	1	1	33	1	3	3	13	3	1
Rosaceae *Cowania*	--	--	--	--	--	--	--	--	1	33	1	3	1	4	1	T
Rosaceae *Prunus*	--	--	--	--	1	6	1	1	--	--	--	--	1	4	1	T
Total non-conifer shrub			50	71			134	86			19	63			203	80
Riparian *Populus/Salix*	--	--	--	--	1	6	1	1	--	--	--	--	--	--	1	T
Unknown	1	20	4	6	5	31	9	6	1	33	1	3	--	--	14	5

[a]T = less than 0.5%.

Table 11.27. (continued)

	Red Mesa/Gallup											
	Firepits				Trash				All proveniences			
	Locations (n = 2)		Pieces (n = 20)		Locations (n = 3)		Pieces (n = 30)		Locations (n = 24)		Pieces (n = 255)	
	n	%	n	%	n	%	n	%	n	%	n	%
Juniperus	1	50	1	5	1	100	2	20	2	67	3	10
Pinus edulis	--	--	--	--	1	100	2	20	1	33	2	7
Total Conifers			1	5			4	40			5	17
Chenopepdiaceae												
Atriplex/Sarcobatus	2	100	17	85	1	100	4	40	3	100	21	70
Rosaceae												
Cowania	1	50	1	5	--	--	--	--	1	33	1	3
Anacardiaceae												
Rhus	1	50	1	5	--	--	--	--	1	33	1	3
Total non-conifer shrub			19	95			4	40			23	76
Zea mays	--	--	--	--	1	100	1	10	--	--	--	--
Unknown	--	--	--	--	1	100	1	10	--	--	--	--

Table 11.27. (continued)

	Gallup															
	Firepits				Heating pits				Trash				All proveniences			
	Locations (n = 4)		Pieces (n = 34)		Locations (n = 13)		Pieces (n = 82)		Locations (n = 7)		Pieces (n = 70)		Locations (n = 24)		Pieces (n = 186)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
<u>Juniperus</u>	4	100	18	53	7	54	17	21	4	57	12	17	15	63	47	25
<u>Pinus edulis</u>	2	50	2	6	5	38	10	12	5	71	16	23	12	50	28	15
<u>Pinus ponderosa</u>	--	--	--	--	1	8	2	2	--	--	--	--	1	4	2	1
Total conifers			20	59			29	35			28	40			77	41
Chenopepdiaceae																
<u>Atriplex/Sarcobatus</u>	2	50	10	29	10	77	43	52	6	86	21	30	18	75	74	40
Compositae																
<u>Artemisia</u>	1	25	4	12	2	15	3	4	1	14	2	3	4	17	9	5
Compositae																
<u>Chrysothamnus</u>	--	--	--	--	--	--	--	--	2	29	2	3	2	8	2	1
Rosaceae																
<u>Cowania</u>	--	--	--	--	1	8	1	1	1	14	8	11	2	8	9	5
Oleaceae																
<u>Forestiera</u>	--	--	--	--	--	--	--	--	1	14	3	4	1	4	3	2
Anacardiaceae																
<u>Rhus</u>	--	--	--	--	1	8	2	2	--	--	--	--	1	4	2	1
Non-conifer shrub			14	41			49	59			36	51			99	53
Riparian																
<u>Populus/Salix</u>	--	--	--	--	--	--	--	--	1	14	1	1	1	4	1	1
Unknown	--	--	--	--	4	31	4	5	1	14	5	7	5	21	--	--

Table 11.27. (continued)

	Late Mix															
	Firepits				Heating pits				Trash				All proveniences			
	Locations (n = 4)		Pieces (n = 33)		Locations (n = 7)		Pieces (n = 49)		Locations (n = 5)		Pieces (n = 50)		Locations (n = 16)		Pieces (n = 132)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Juniperus	4	100	20	61	4	57	17	35	4	80	11	22	12	75	48	36
Pinus edulis	1	25	1	3	4	57	9	18	4	80	18	36	9	56	28	21
Total conifers			21	64			26	53			29	58			76	57
Chenopepdiaceae																
Atriplex/Sarcobatus	3	75	9	27	4	57	16	33	4	80	15	30	11	69	40	30
Compositae																
Artemisia	1	25	1	3	1	14	4	8	2	40	3	6	4	25	8	6
Rosaceae																
Cercocarpus	1	25	1	3	--	--	--	--	--	--	--	--	1	6	1	1
Non-conifer shrub			11	33			20	41			18	36			49	37
Riparian																
Populus/Salix	--	--	--	--	1	14	2	4	2	40	2	4	3	19	4	3
Unknown	1	25	1	3	1	14	1	2	1	20	1	2	3	19	3	2

Table 11.27. (concluded)[a]

	All Periods															
	Firepits				Heating pits				Trash				All proveniences			
	Locations (n = 15)		Pieces (n = 155)		Locations (n = 36)		Pieces (n = 286)		Locations (n = 16)		Pieces (n = 161)		Locations (n = 67)		Pieces (n = 603)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Juniperus	12	80	50	32	14	39	45	16	12	75	30	19	38	57	125	21
Pinus edulis	4	27	8	5	9	25	19	7	12	75	41	25	25	37	68	11
Pinus ponderosa	--	--	--	--	1	3	2	1	--	--	--	--	1	1	2	T
Total conifers			58	37			66	24			71	44			195	32
Chenopepdiaceae *Atriplex/Sarcobatus*	11	73	85	54	30	83	180	63	14	88	57	36	55	82	322	53
Compositae *Artemisia*	3	20	6	4	7	19	17	6	3	19	5	3	13	19	28	5
Rosaceae *Chrysothamus*	--	--	--	--	2	6	2	1	3	19	3	2	5	7	5	1
Rosaceae *Cowania*	--	--	--	--	1	3	1	T	2	13	10	6	3	4	11	2
Rosaceae *Cercocarpus*	1	7	1	1	--	--	--	--	--	--	--	--	1	1	1	T
Rosaceae *Prunus*	--	--	--	--	1	3	1	T	--	--	--	--	1	1	1	T
Oleaceae *Forestiera*	--	--	--	--	--	--	--	--	1	6	3	2	1	1	3	T
Anacardiaceae *Rhus*	--	--	--	--	1	3	2	1	--	--	--	--	1	1	2	T
Non-conifer shrub			92	59			203	71			78	48			373	62
Riparian *Populus/Salix*	--	--	--	--	2	6	3	1	3	19	3	2	5	7	6	1
Zea mays	--	--	--	--	--	--	--	--	1	6	1	1	1	1	1	T
Unknown	2	13	5	3	10	28	14	5	8	50	8	5	20	30	27	4

[a]T = less than 0.5%.

period. Pinyon use is lower and less widespread. Sage (Artemisia) is a fairly consistent but low-percentage component in all proveniences at all times.

Species composition of fuel and other wood use at Pueblo Alto seems to reflect both local availability of shrub and small tree taxa and preferences for certain wood characteristics for various functional applications. Prevalent major use of saltbush/greasewood in fuel contexts (particularly in the smaller heating pits where construction timber reuse is less likely) suggests a simple relation to resource availability and abundance. Saltbush is the dominant shrub in one of the most extensive, vegetative associations of the canyon--Atriplex-Oryzopsis-Sporobolus shrub grassland--found in deep sandy soils at the base of cliffs in the canyon bottom (near sites 29SJ 627 and 29SJ 629) and in some upland areas (Potter 1974). Saltbush is the major fuel type used in the Anasazi era elsewhere in the San Juan Basin where the shrub is a significant part of the landscape: to the northwest (Ford 1980; Minnis 1980; Toll 1984), and to the west (Minnis 1982). About 15 km east of Pueblo Alto in the Bis sa'ani community area, vegetation composition shifts significantly (Cully et al. 1982) such that sage is the principal shrub fuel (Donaldson and Toll 1982).

Coniferous wood is generally excellent fuel because of its relatively high resin content and density (Graves 1919) and was used wherever it was accessible throughout the San Juan Basin. In Chaco Canyon, the upland plateau of Chacra Mesa is strongly dominated by Juniperus, whereas Pinus edulis is a subdominant (Potter 1974), and both taxa are found in Anasazi assemblages throughout the canyon. Both taxa occur also in hearth proveniences at Tsaya Wash (Minnis 1982) within collecting distance of the Chuska foothills. At slightly lower elevations, only juniper (Ford 1980) or no coniferous wood at all (Minnis 1980; Toll 1984) are found. Although some have classified pinyon as the preferred fuel of the two taxa (Robinson 1967), greater apparent use of juniper in the San Juan Basin may reflect a combination of relative abundance at this altitude range and greater hardiness for construction purposes. Juniper heartwood contains natural preservatives (tropolones) that enable juniper posts to last at least 40 years, in contrast to 4-6 years for pinyon (Barger and Ffolliott 1972:25-26).

At Pueblo Alto, conifer fuel use increases steadily through time, while shrub use both decreases and becomes less diverse (Table 11.27). In the Red Mesa through Gallup periods, firewoods differ significantly in firepits vs. heating pits. Most fuel used during Pueblo Alto's building phases may have been shrubby wood burned in small heating pits, whereas coniferous firewood was confined primarily to the few bigger firepits. In the latest occupational period at Pueblo Alto, as coniferous material becomes a more prominent portion of all fuel used, the level of the firepit/heating pit difference diminishes. Windes (Chapter 6 of Volume I, this report) has suggested that site inhabitants pilfered roof and support beams for fuel late in the occupation of Pueblo Alto. Certainly the tree-ring data show close similarity of taxonomic composition of wood from construction contexts and larger pieces from the substantial burning features of the late period; this material is consistently coniferous, with nearly 60 percent comprising taxa (Douglas fir, white fir, and ponderosa pine) likely to be imports to Chaco Canyon.

The very low profile of riparian woods in the Chaco Canyon assemblages may well be unrepresentative of true use patterns. Cottonwood and willow are fast-growing, porous woods relatively low in heat value (Graves 1919) but well suited to manufacturing and construction uses because of their straightness and even grain. Elsewhere in the San Juan Basin, portions of wood assemblages high in riparian types are related to rooffall contexts (Tsaya, Minnis 1982) or unburned wood (Bis sa 'ani, Donaldson and Toll 1982). Riparian woods were apparently rarely used as fuel in Chaco (Table 11.26). All Populus/Salix-type charcoal at 29SJ 627 comes from a single provenience (Kiva C vent tunnel fill) that may well represent roofing debris. Systematic omission of this wood type from the sample submitted for tree-ring dating may explain its low incidence in construction contexts. Yet, note that in fuel contexts riparian woods at Pueblo Alto show only an insignificant increase with time (from 0.4 to 3.0 percent, and keep in mind that the total number of riparian pieces in Welsh's sample is 6); if cottonwood/willow figured more prominently in construction than our data show, it was not reused as fuel as widely as was coniferous material.

Discussion

It will be profitable at this point to review the nature and composition of the Pueblo Alto paleo-floral assemblage as a whole before moving on to the association of plant materials with specific proveniences within the site. On the broadest level, the Pueblo Alto flotation record repeats that at other sites in Chaco Canyon and the San Juan Basin. Composition is loaded heavily toward a short list of local weeds producing large crops of tiny seeds. At Pueblo Alto, approximately 70 percent of flotation seeds are weedy annuals: 53 percent include the major taxa goosefoot, mustard, and purslane; 12 percent include four others--stickleaf, spurge, pigweed, and beeweed; and the remaining 4 percent include 11 additional taxa.

Variations within the theme of annual-weed predominance can often be related to local flora and individual site characteristics. For instance, purslane, spurge, mustard, and stickleaf are abundant in the flora of Marcia's Rincon where sites 29SJ 627 and 29SJ 629 are located, and unburned seeds (at least some of which are probable contaminants) are common in site deposits. Purslane alone forms 36 percent of seeds at relatively shallow site 29SJ 629. These taxa tend to be less numerous and more frequently charred in Pueblo Alto's considerably deeper rooms. That is, a higher proportion of these seeds can be assigned to cultural usage at Pueblo Alto, and these taxa are not necessarily of lesser economic importance despite lower numeric level at this site.

A combination of better preservation conditions and a greater number of samples produces greater visibility of certain low-frequency, economic taxa at Pueblo Alto. Many taxa are more common at Pueblo Alto compared to the village sites: these include yucca, beeweed, juniper, pinyon, squawberry, saltbush, plantain, and hedgehog and prickly-pear cacti. On the other hand, the number of low-frequency taxa less common at Pueblo Alto is very low: bulrush, wild tobacco, and evening primrose.

Grasses make up a larger proportion (17 percent) of seeds recovered at Pueblo Alto, compared to the village sites (less than 2 percent at either). Ricegrass turns up with slightly greater frequency in Marcia's Rincon sites, but dropseed and unidentified grass seeds are both more numerous and more often carbonized at Pueblo Alto. Small, carbonized, and highly distorted seeds in a heating pit on Floor 2 of Room 139/145 constitute 94 percent of all unidentified grass seeds and 74 percent of total grass seeds at Pueblo Alto.

Perennial, economic taxa are commonly less frequent in flotation assemblages than their presumed economic significance would warrant. We assume reasonably that the reproductive strategy of these plants (production of fewer, larger seeds) plus greater size of the individual seeds resulted in fewer prehistoric escapees from the food preparation-consumption circuit. Although considerably more common at Pueblo Alto, such taxa (juniper, pinyon, saltbush, squawberry, yucca, cacti) still constitute only about 1 percent of all seeds.

The cultivar record is similar to others in Chaco Canyon and elsewhere in the San Juan Basin. The chief artifactual remains are carbonized corncob fragments, with very much smaller quantities of corn kernels, other corn parts, and cucurbits, and practically no beans. Gourds and cotton, which turn up in very well preserved assemblies at Pueblo Bonito, are absent from open Chaco sites excavated to date.

Botanical Data Applied to Provenience Units

West Roomblock

Rooms 103 and 110, large rooms with numerous features, are the only two rooms at Pueblo Alto showing good evidence of domestic activities. Both were occupied over a relatively long span of time. The earliest prepared surface in Room 103, Floor 5, appears to be an unused surface made when the walls were constructed (Volume II, this report). Flotation samples from floor grids contained small numbers of unburned seeds of common weed species (Table MF-11.1). Grid 5 contained charred corn cupules and a Scirpus (bulrush) seed, while Grid 9 also contained corn. These are clearly remains of cultural trash but may represent mixing from other levels. Later Floor 4 contained many features (mostly postholes and miscellaneous other pits, and only one heating pit). Two "other pits" contained no informative botanical remains (Table MF-11.1).

Floor 3 (Gallup period) is a living floor with three mealing bins and several centrally located heating pits (Figure 11.3). There is evidence of use of a wide variety of wild plant species. Several economic weeds occur (largely unburned) on floor grids and are consistently burned in heating pits; these include pigweed, goosefoot, winged pigweed, mustard, and purslane (Table MF-11.2). Yucca seeds and pinyon nut shell also occur burned in heating pits and unburned on the floor. The repertoire of economic products documented in this room is further fleshed out by hedgehog cactus and large quantities of beeweed seeds. Charred corn remains (including numerous kernels in the heating pits) are present throughout the room. Flotation contents of Mealing Bin 3 are unburned seeds of annual weed types found elsewhere in the room. It is not possible to determine whether the mealing bin contents relate to wild plant products ground here or to redeposited, general room debris (or postoccupational fill). Charcoal identifications from four heating pits on this floor indicate that a considerable portion of fuel in these little features was coniferous (25 percent juniper, 13 percent pinyon, and 6 percent ponderosa), whereas the single, largest, fuel component was saltbush/greasewood (38 percent; Welsh 1979). Flotation provides corroborative evidence of fuel use, with charred juniper twigs in all three heating pits and charred saltbush fruits in two. Floor 2 was not sampled.

The Late Mix surface (Floor 1) was also an occupational floor with several small heating pits but no formal firepit. Seeds on this floor were largely of common, weedy annuals with very few burned specimens (Table MF-11.3). A charred corn kernel turned up in Grid E, and low amounts of corn pollen were recovered from Grids C and E (Cully 1985b).

Room 110 contained three major floors. As in Room 103, the earliest (Floor 3) is without features and presumably not lived on. A central burn area on this floor corresponds with the two grids containing sparse, charred, flotation materials (Grids 9 and 13; see Table MF-11.4). For the most part, this floor netted small numbers of unburned seeds of common weeds. Features on Floor 2, of the Red Mesa/Gallup period, include a central, large, formal firepit. Evidence of economic activities related to this firepit was limited to charred corn kernels (Table MF-11.5). Fuel in this firepit and the secondary firepit on Floor 2 was almost entirely saltbush/greasewood (Welsh 1979). The few plant remains in Floor 2 grids were unburned weed seeds.

The upper, Gallup floor in Room 110 was complex with nine identifiable replasterings (most of which do not extend across the entire floor; Volume II, this report). Flotation samples represent the latest use of this floor (Figure 11.4). Features include large, bell-shaped, trash-filled pits and numerous small heating pits (associated with the earlier plasterings), a large, central, slab-lined firepit, and a series of mealing bins (in use until the abandonment of the floor). Two unusual wall niches (larger than the average Pueblo Alto door) served as storage facilities throughout use of both Floors 1 and 2 (Volume II, this report).

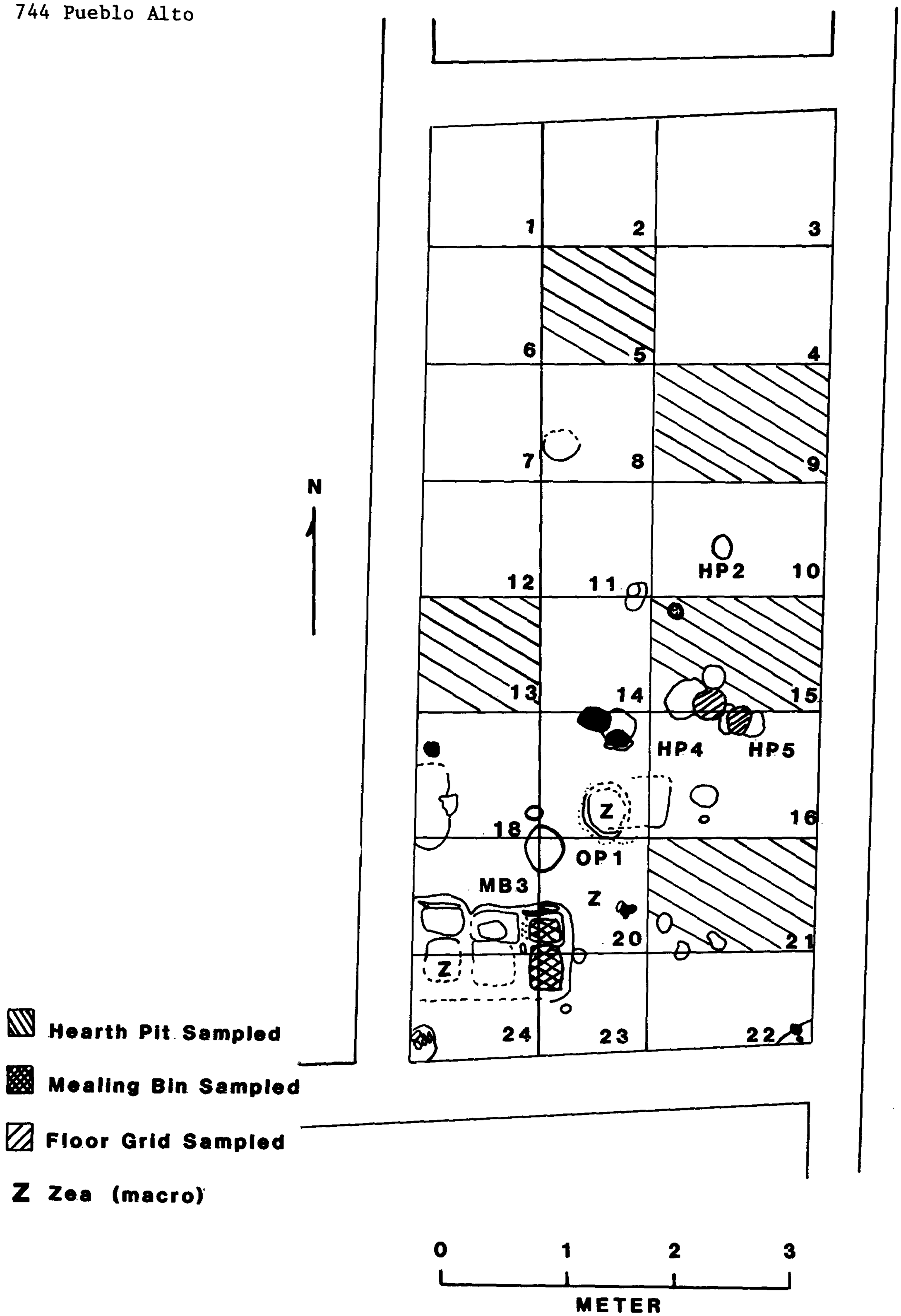

Figure 11.3. Sample locations, Room 103, Floor 3.

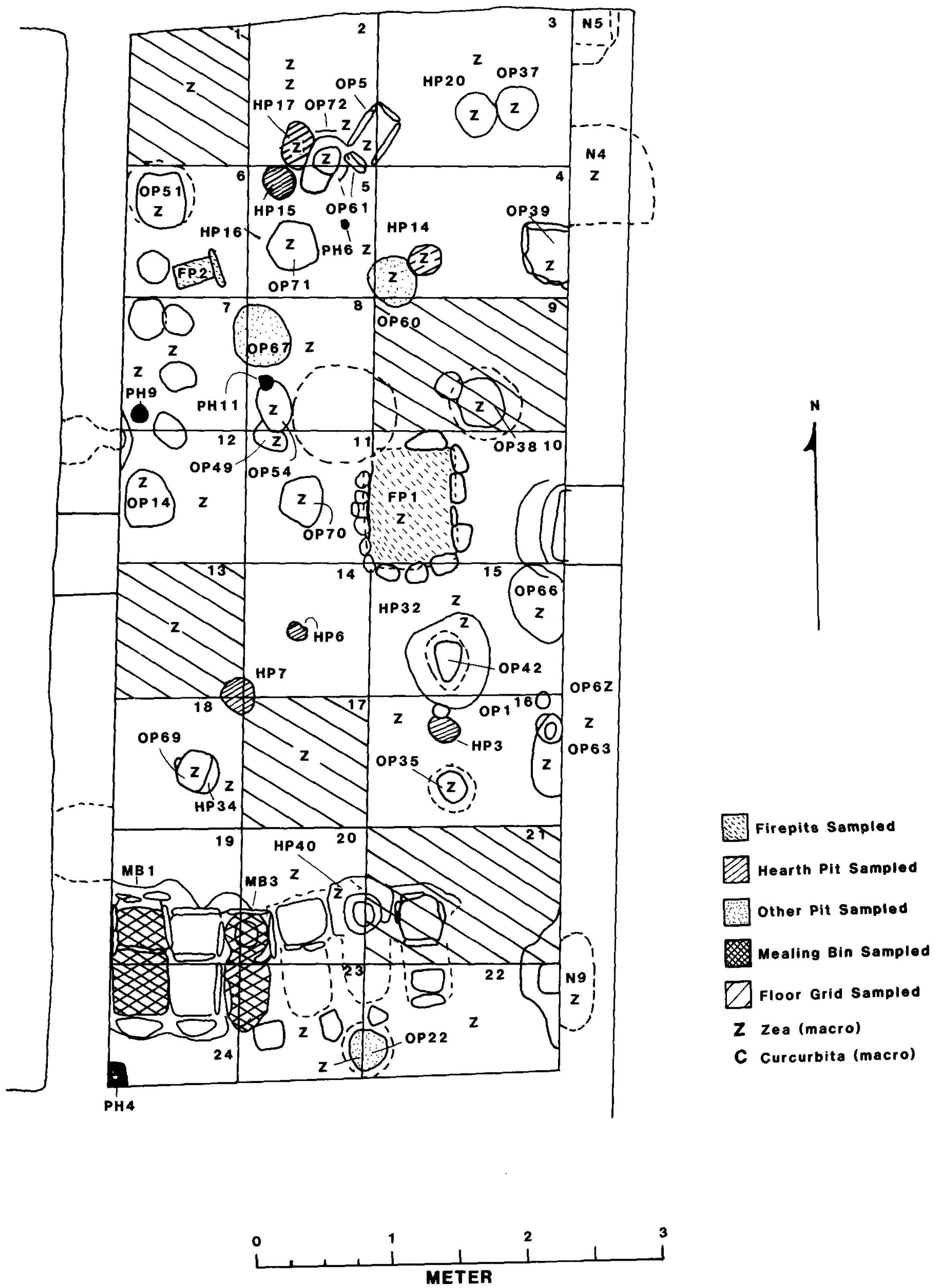

Figure 11.4. Sample locations, Room 110, Floor 1.

These niches contained some of the only unburned corncobs recovered at Pueblo Alto.

There are several similarities among the flotation records for the Gallup habitation floors in Rooms 103 and 110. Again, several economic species occur unburned in floor locations and burned in firepits or heating pits: pinyon, goosefoot, pigweed, winged pigweed, mustard, purslane, and (in Room 110) groundcherry (Tables MF-11.6 and MF-11.7). Again, beeweed and hedgehog cactus were recovered, and charred corn put in a consistent presence with kernels more common in features. Fuel use can be documented using both charcoal identification and flotation. In Room 110 the proliferation of heating features allows comparison of fuel use in firepits vs. heating pits (Table MF-11.8): saltbush/greasewood is the major component in heating pits (as in Room 103), whereas coniferous woods are more important in firepits.

Flotation samples from Room 110 mealing bins contained nothing, whereas pollen samples provided ample evidence of association of economic taxa (abundant corn pollen in all three mealing bin samples, plus cucurbit pollen in Bins 2 and 3, and beeweed and purslane in Bin 2; Cully 1985b). Economic pollen was abundant on Room 110 floor grids as well: corn, cucurbit, beeweed, purslane, and prickly-pear pollen corroborate flotation findings, whereas cattail pollen reveals evidence of an economic taxon not recovered by flotation (Cully 1985b). Ten human coprolites recovered from proveniences associated with Floor 1 all contained corn pollen, and pollen in two of them was over 90 percent corn (Clary 1981). Others with high pollen counts were dominated by Cheno-Ams or grasses. Macrobotanical remains were sparse in these same coprolites. Minute fragments of pinyon nutshell (coprolite from Posthole 47) are of interest because they confirm food use of a wild product found in numerous locations in the room.

Late in the Pueblo Alto building sequence, after Room 110 was abandoned, a kiva was built inside the room by the addition of two curved masonry walls and a new floor. Kiva 15 utilizes segments of the original Room 110 walls for its east and west sides. About 30 cm of fill separate the top floor of Room 110 from the Kiva 15 floor. The principal feature on this Late Mix floor is a large, central firepit. The firepit contained charred remains of several economic taxa typical of heating features at Pueblo Alto (pinyon nutshell, economic weed seeds, and both corn kernels and cupules; Table MF-11.9). Additional charred pinyon-shell fragments were recovered as macrobotanical remains. Characteristic of many of the Late Mix heating features at Pueblo Alto, fuel was largely coniferous in Firepit 1 (90 percent _Juniperus_) and also in the remodeled version (Firepit 2 had only three identifiable pieces, two _Juniperus_ and one _Pinus edulis_; Welsh 1979). Several items that appear to be related to the firepit occur in adjacent floor Grids 9 and 13; these include charred juniper twigs, mustard seeds, and purslane seeds. Unburned seeds of several weeds (goosefoot, stickleaf, and purslane) occur throughout the room, as do charred corn cupules. Pollen in Kiva 15 is dominated by Cheno-Ams, whereas there is no sign of corn (central Grids 5 and 9; Cully 1985b). The botanical record of Kiva 15 gives a picture of subsistence use less intense and less varied than in the Gallup living-room floors of the West Roomblock, but including the same principal features of pinyon, annual weeds, and corn.

Room 112 is a large room to the west of Room 110. These rooms were constructed and utilized as a paired unit (Volume II, this report). Room 112 contained none of the myriad domestic appurtenances common in Room 110 (mealing bins, firepits, heating pits, pot rests). Floor 1 is documented by a series of flotation scan samples. Seeds were sparse, and consisted largely of unburned weeds (Table MF-11.10). The few charred remains were clustered mostly in two central grids (17 and 19); these include juniper twigs, corn cupules, and two weeds. Corn pollen was also highest in the central area of Room 112 (14 percent, compared to 9 percent in the north section and 3 percent in the south; Cully 1985b). Charcoal from a burn area (No. 1) in Grid 23 included juniper (5 of 10 pieces) and dicot shrubs saltbush and snakeweed (4 of 10 pieces; Welsh 1979). Macrobotanical materials included a small, puffball mushroom species (Geastrum; William C. Martin, personal communication 1983) in a Floor 1 pit (Other Pit 3) and in subfloor (before-room construction) sheet trash. A single, pinyon-shell fragment was present in fill above floors (Layer 3, Level 2); this showed definite signs of rodent gnawing.

Room 229 is a smaller, third-tier room to the west of Room 112; it, again, is largely empty. The upper, Gallup floor was explored by means of a series of flotation scan samples. Botanical remains were even more scanty and less often charred than in the neighboring empty Room 112 (Table MF-11.10).

North Roomblock

Room 138, together with Room 144, adjoins Room 139/145 on the north side. Presumably these three rooms formed one of five "suites" when the backbone of the North Roomblock was constructed, ca. A.D. 1020 (Volume II, this report). This small, exterior room is thus "analagous in relative size and position to 'storage' rooms in small Anasazi house sites" (Volume II, this report). The uppermost floor in Room 138 was overlaid by approximately 2 m of rubble fill. The presence of roofing remains, including "abundant vegetal material of juniper bark and splints" (Volume II, this report) indicates that preservation of uncharred plant parts should be relatively good. A series of six grid samples from Floor 1 was scanned (Table MF-11.11). All seed remains were unburned, and with the exception of ricegrass in Grid 3, all seeds were common annual weeds. This assemblage is inconclusive as to room use (seed taxa may be economic and/or intrusive).

Room 139 was constructed in the Red Mesa period as a large room over 11 m long. The original floor (Floor 2) was peppered with 40 pits and trenches (Figure 11.5). Most pits were shallow and unlined; 13, designated as heating pits, were oxidized or contained sand and charred brush. No large formal firepit was present. Plant remains recovered by flotation

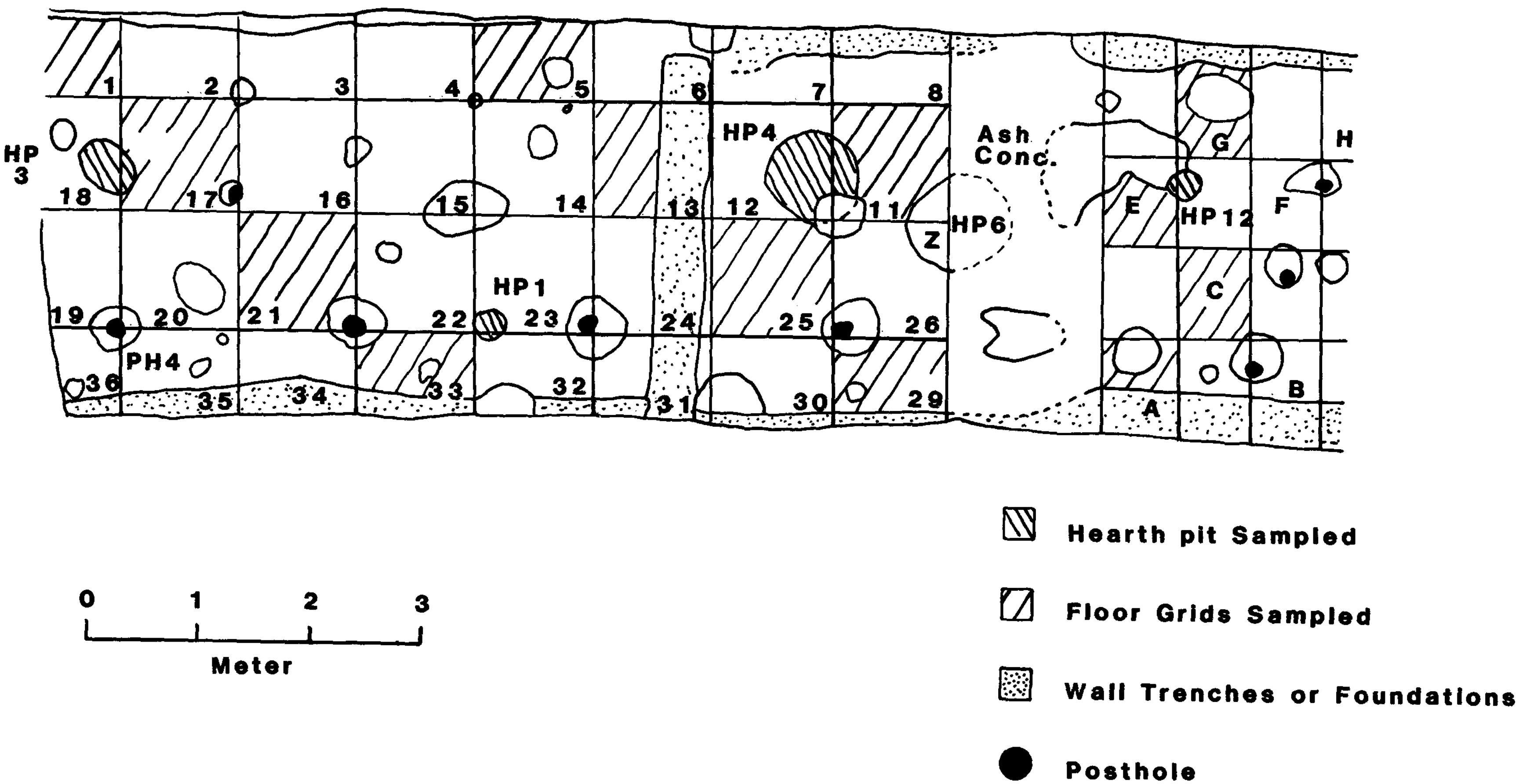

Figure 11.5. Sample locations, Room 139, Floor 2.

(from 13 floor grids and 4 heating pits) were abundant and varied and largely of clear economic association (Table MF-11.12). Cultivar remains included charred corn (both cupules and kernels) in several floor grids and all heating pits, and uncharred squash seeds in two floor locations and one heating pit. Pinyon nutshell was present in most floor grids and one heating pit. Prickly-pear seeds were scattered on the floor (and charred in two heating pits), whereas hedgehog cactus was represented on the floor and in two heating pits. Beeweed was present, and tobacco made its only appearance at Pueblo Alto (four floor grids), on this floor.

A variety of grasses and annual weeds were widespread; in nearly all cases the pattern is of unburned seeds on floors and burned specimens in the heating pits (this tends to confirm economic association of the unburned seeds, as well). This pattern is followed by dropseed, ricegrass, pigweed, goosefoot, mustard, purslane, groundcherry, and wild potato. In addition to identifiable, charred, dropseed and ricegrass remains, Heating Pit 1 contained nearly 1,400 charred and distorted grass seeds. Thus, there is good evidence that Heating Pit 1 (and probably HP 3 and HP 4 as well) was involved in processing (probably parching) of grass seeds. Although Heating Pits 1, 3, 4, and 12 all contain charred juniper twigs, fuel in another heating pit (HP 6) is composed entirely of saltbush/greasewood (Welsh 1979).

Room 139 was later subdivided into two rooms. At this point the larger, western part of the room goes by the name of Room 139, whereas the eastern portion is called Room 145. In both Rooms 139 and 145 the upper floor (Floor 1, with Late Mix ceramics just above) lacks any structural signs of domestic activities; postholes are the only major features. Consequently, room function is interpreted as storage or other nonhabitation use. Both flotation and pollen results differ slightly between the two rooms, however. In Room 139, flotation contents were varied and include several burned economics (pinyon, grasses, purslane, and corn cupules and kernels; Table MF-11.13), and low frequencies of corn pollen were recovered in the east and central sections (Cully 1985b). Within Room 145 flotation samples are fairly empty, and none of the specimens are charred (Table MF-11.14), whereas economic pollen taxa are entirely absent (Cully 1985b). As there are no obvious floor-related factors to implicate in this spatial differentiation of botanical data, we must consider possibilities such as intrusion from overlying, burned trash levels, and/or differences in care taken by excavators to distinguish floor-contact deposits from postoccupational trash. In Room 139, Layer 7 ("roof fall") directly overlies parts of Floor 1. Two *Yucca* seeds, recovered as macrobotanical remains from the bottom level of Layer 7 (very close to floor level), could easily have ended up in a "floor" flotation sample, for instance.

Rooms 142, 146, and 147 belong to the second tier of North Roomblock rooms added on to the south side of the original North Roomblock core (which includes Rooms 138 and 139/145) during the second construction phase at Pueblo Alto (Volume II, this report). Like Rooms 139 and 145, Room 142 began as a single, large, rectangular room and was later subdivided by a partition wall with the eastern end designated Room 146. Floors 3 and below (Rooms 142 and 146) predate construction of the rooms. They are outdoor surfaces associated with underlying and offset Rooms 50 and 51 and date to the Red Mesa period. Below later Room 142, heating pits on Floors 3, 8, and 9/10 all contained charred, corn remains (Table MF-11.15). Squash remains included charred rind recovered by flotation from Heating Pit 2, Floor 3, as well as uncharred seeds from Floor 7 fill and Floor 3 and charred rind in Heating Pit 2, Floor 4, recovered as macrobotanical materials. Heating pits on Floors 3 and 8 held a wide variety of economics, including pinyon, prickly pear, hedgehog cactus, ricegrass, and squawberry. Wild economic plants collected as macrobotanical remains include pinyon nutshell (Heating Pit 3 on Floor 8), prickly-pear seeds (Other Pit 1 on Floor 3), and yucca seeds (Floor 6, one seed; Floor 4, six seeds and eight fragments; and Other Pit 1 on Floor 3, one seed).

In addition to the apparent lower diversity of wild economic species, Floor 9/10 differs from the overlying Red Mesa floors in fuel use. Juniper forms a major fuel component in Heating Pit 1 on Floor 9/10, whereas three heating pits on Floor 8, two on Floor 4, and two on Floor 3 are consistently fueled by 90-100 percent saltbush/greasewood (Welsh 1979). Charred saltbush leaves and fruit in Floor 3 and 8 heating pits reiterate fuel use of this shrub, whereas charred and uncharred juniper twigs in Heating Pit 2, Floor 3, suggest that juniper may be an additional fuel not encountered in the charcoal samples. Below later Room 146, outdoor Firepit 1 on Floor 3 (continuous with the floor of same number below Room 142) contained a bare skeleton of economic plant products: charred pinyon nutshell and corn cupules. Charcoal from this firepit was largely (70 percent) saltbush/greasewood (Welsh 1979) which corresponded with fuel use in heating features below Room 142, on the same level.

Floor 1 in Room 142 contained only architectural features (eight postholes) and no ceramics; though Late Mix sherds were abundant in the floor fill, designation of this surface as a Late Mix provenience is necessarily tentative (Volume II, this report). Botanical remains were explored by means of a series of flotation scan samples (Table MF-11.11). With the exception of burned ricegrass and corn, remains were small quantities of unburned, annual-weed seeds. Macrobotanical materials from locations above Floor 3 provide evidence of utilization of a wider range of products, including squash (one seed in Floor 2 fill and one in Floor 1 fill), pinyon (nutshell fragments in Floor 3 fill and in three locations on Floor 2), and yucca (one seed on Floor 2). Economic pollen was limited to small percentages of corn in all three sampling sectors (east, west, and central; Cully 1985b).

Although Room 146 was constructed by subdivision of Room 142, Room 146 did not remain as part of a suite with its "parent" room (as in the case of Rooms 145 and 139) but had door access, instead, to Room 147 to the east. Again, chronological affiliation of Floor 1 can only be inferred architecturally and stratigraphically as Late Mix, because of lack of diagnostic ceramics (Volume II, this report). There were no structural features in Room 146; use is inferred as possible storage in conjunction with probable habitation or religious use of Room 147. Four scan samples reveal the association of two certain economics (pinyon and beeweed), whereas other unburned weeds are mostly common taxa of uncertain affiliation (goosefoot, pigweed, and purslane, plus sunflower; Table MF-11.16). Grass remains are common throughout the room and are in all cases charred; included are ricegrass, dropseed, and unidentified stems. Small carbonized seeds (e.g., Sporobolus or dropseed) are present in four floor grids. The abundant, charred grass remains appear to relate to Layer 3, a thin layer of carbonized trash that is probably a postoccupational, firepit dumping from outside the room (Volume II, this report). Corn remains in floor Grids 7 and 11 may also stem from such a trash deposit. Pollen in the east section of Room 147 included 5 percent corn and a single grain of prickly-pear pollen (Culley 1985b). The flotation sample from Grid 5 on the east side of the room also contained a prickly-pear seed; perhaps these are related. The presence of beeweed (Heating Pit 2) was not reiterated by pollen results.

Room 143/236 is a long corridor room facing the plaza and Kiva 10. The earliest prepared surfaces encountered here (Floors 9 and 10) predate construction of the room; these are outdoor plaza surfaces associated with underlying Rooms 50 and 51. Floors above relate to the corridor room, although the earliest of these (Floors 7 and 8) are nonuse surfaces. Floor 6 is the first functional floor in the room. Figure 11.6 may help to sort out the stratigraphic history and floor-numbering idiosyncrasies above this point. Principal later floors documented by flotation samples include Gallup Floor 2 in Room 143, used in conjunction with Floor 4 in Room 236, and Late Mix Floor 1 in both rooms (other floors are largely preparations for or remodelings of the principal floors). Although the room was probably used as a single entity at all times, a partition wall constructed with Floors 4/5 of Room 236 and Floors 2/3 of Room 143 and used through Floor 1 delimits the western half of the corridor (Grids 1-7) as "Room" 236, and the eastern half (Grids 8-13) as "Room" 143. As the partitioned segments were probably never rooms in their own right, the whole structure is better considered as Room 143/236 (Volume II, this report). Macrobotanical remains were recovered from Layer 13, a fill layer predating room construction and between "Floors" 8 and 9. These included Cucurbita sp. rind (both charred and uncharred fragments) in Grid 6 and corn in Grid 9.

Botanical remains on the partitioned Gallup floor included materials from several features on Floor 2, Room 143. Uncharred pinyon nutshell was common to all three flotation samples, and charred corn cupules were present in a heating pit (HP 2) and an "other pit" (OP 1; Table MF-11.17). Other Pit 1, of uncertain function, contained the widest variety of economic taxa, including beeweed and ricegrass. Several species of unburned weed seeds (pigweed, goosefoot, mustard, purslane, and ground cherry) occurred also in this pit; their association with an array of known economics increases the likelihood that the weeds are subsistence-related. An unburned juniper seed was collected during excavation of Heating Pit 4. At the east end of Room 143, Grid 13, raised 15-20 cm above the floor level in the remainder of the room, apparently served as a vestibule or

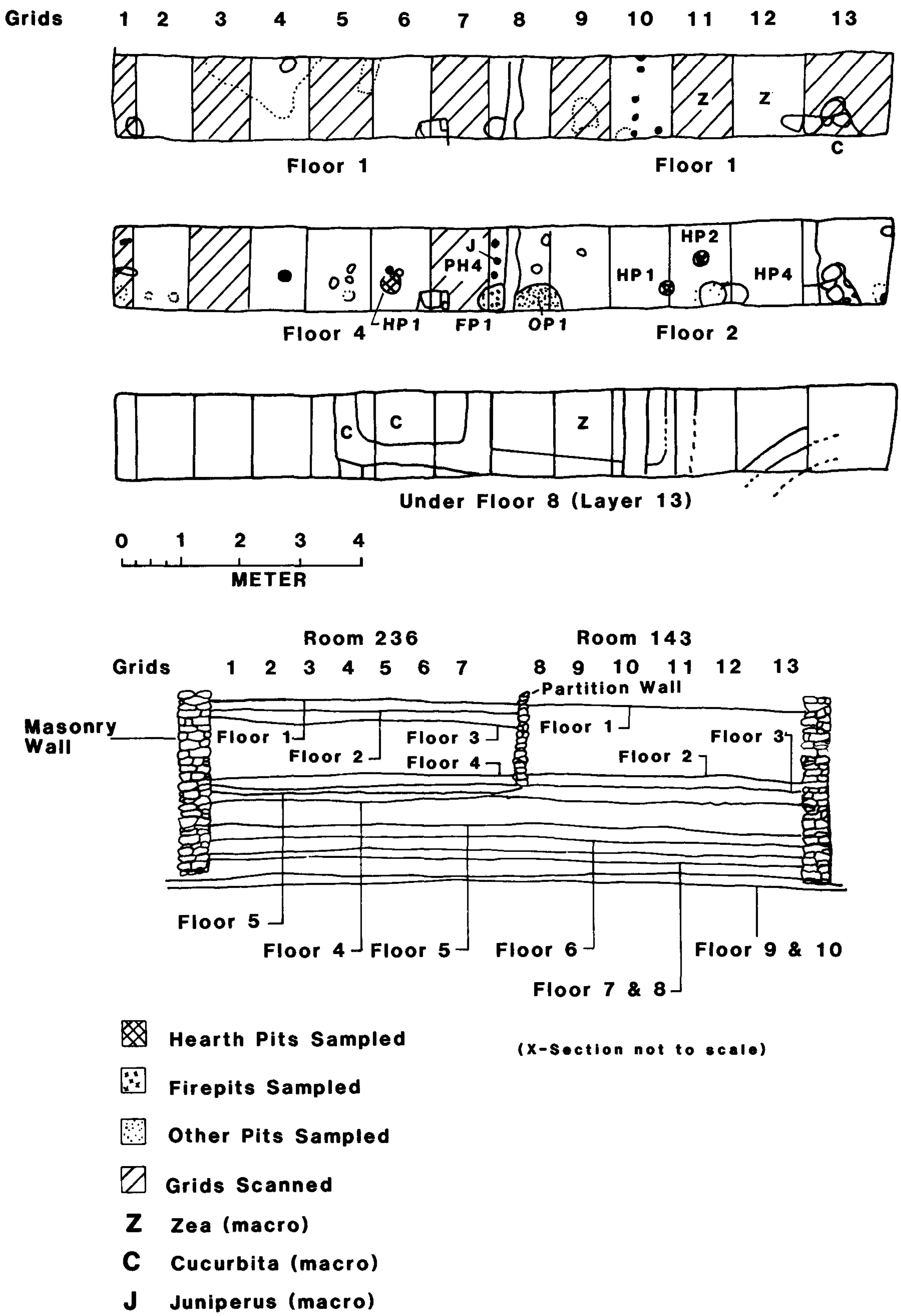

Figure 11.6. Sample locations and schematic section of floor stratigraphy, Room 143/236.

passageway between Room 147 (to the north) and Kiva 10 (on the plaza). On Floor 2 below Door 12 the excavator noted plant remains ("probable squash rind, a squash seed, a pinyon nut"; Volume II, this report). There is no subsequent record of the existence of these artifacts, however. A Cucurbita seed (FS 6354) was associated with Floor 2 preparation (possibly from redeposited trash fill).

On the other side of the partition wall in Room 236 (Floor 4), pinyon and corn were again common. Pinyon nutshell was recovered in flotation samples from Firepit 1 and Heating Pit 1 (and as macrobotanical remains from Heating Pit 1), and also in the three, scanned, floor grids (Table MF-11.18), as well as a Grid 5 rodent hole (macrobotanical sample No. 6854). All pinyon remains were uncharred except in the case of Heating Pit 1. Burned corn remains in Room 236 features included kernels as well as cupules. Juniper remains in Room 236 were charred (twigs) in the two sampled features and uncharred in Floor Grid 7 (twigs in the flotation scan sample and seeds recovered as macrobotanical remains). Charred saltbush fruits (found in Heating Pit 1 and on nearby floor Grid 7) may relate to fuel use of this shrub. Although the heating pits in the Room 143 segment of this floor are low in density and variety of economics, Heating Pit 1 in Room 236 has a substantial array of charred, economic species. Several of these taxa occur unburned in other feature and floor grid samples of this floor (e.g., ricegrass, pigweed, goosefoot, and mallow) which lends further support to the notion that the unburned specimens are cultural, rather than intrusive.

Floor 1 in Room 143/236 was probably in use along with other areas of the site that had Late Mix ceramic assemblages (diagnostic sherds are few on this floor). Botanical remains encountered in scanned, floor-grid samples are sparse, with the exception of Grids 7 and 9 (Table MF-11.18). These grids, on opposite sides of the jacal partition, both contain juniper twigs, and winged pigweed and beeweed seeds. Grid 9 contains a variety of charred, economic grasses and weeds. Grid 7 also contains burned, saltbush fruits, possibly related to the 30 percent saltbush/greasewood fuel in nearby Heating Pit 2 (Welsh 1979). Heating-pit fuel during this period of Room 143/236 use was largely coniferous: all charcoal examined from Heating Pit 1 was pinyon, whereas 70 percent in Heating Pit 2 was either pinyon or juniper (Welsh 1979). Corn pollen was present in low quantities both in a composite sample (from Grids 1, 3, and 5) and in Grid 12 (Cully 1985b), whereas the only occurrence of corn in flotation was in Grid 13. With the exception of this lone corn cupule, plant debris in this entryway area is not associated with Floor 1 traffic. An unburned Cucurbita seed (FS 6350) was recovered from deposits associated with step construction (again, probably redeposited trash).

The functional role of this oddly shaped room has been difficult to pin down. Windes (Volume II, this report) has noted certain attributes consistent with living quarters (principally the numerous heating pits on both the Gallup and Late Mix floors). The diversity of wild and cultivated botanical remains seems to confirm that varied subsistence activities took place here. It is worth noting that nowhere is this food and fuel debris present in great quantity, and its distribution is quite patchy (nearly absent in some grids and features). The role of Grid 13 as a probable vestibule or entryway to Kiva 10 seems well-agreed upon; perhaps the remainder of the room functioned at least intermittently as a kiva anteroom. Unusually high concentrations of fir pollen may be one sign of such a ceremonial link, as Cully (1985b) has pointed out in her pollen report.

Plaza

Plaza Feature 1 is a small roomblock standing alone in the midst of Plaza 1 (Figure 11.1). Construction took place fairly late in the evolution of Pueblo Alto, around A.D. 1100, when the three major roomblocks were already standing. Use of this structure was probably limited to a short span of as little as 20-30 years, according to ceramics, tree-ring, ceramics, tree-ring, and archeomagnetic dates (Chapter 8, Volume I, this report).

Excavation of Plaza Feature 1 focused on an enclosed room with well-preserved features and a prepared floor (Room 3) and a probable ramada area surrounded by low walls (Room 4). Room 3 was the source for all pollen and flotation samples analyzed and nearly all macrobotanical remains encountered during excavation. Room 3 is notable for three, enormous, masonry ovens (titled Firepits 1-3, but clearly morphologically distinct from the few features in Pueblo Alto rooms designated as firepits). Very hot fires burned in these ovens, as evidenced by reddening of adjacent floor and wall plaster. In contrast to most Pueblo Alto firepits and heating pits, fuel included large timbers of nonlocal conifers (fir and ponderosa pine; Chapter 7, Volume I, this report). The single floor associated with Room 3 was replastered as many as eight times in some areas; together with the presumed short duration of structure use, this argues for intensive use and some attention to upkeep.

Burned plant remains in scan samples from Room 3 floor grids do not correspond entirely with expectations based on feature distribution or overlying, carbonized trash and ash deposits (Table MF-11.19, Figure 11.7). Unburned plant remains are considered likely to be noncultural in Plaza Feature 1, as deposits are only about 40 cm deep (as opposed to many meters in most Pueblo Alto rooms). Grid 1 was well protected by wall fall and should not be contaminated by postoccupational trash (Volume II, this report); this scan sample contained several burned taxa (weeds and corn). Grids 3, 13 (largely outside the area covered by redeposited ash), and 12 contained no clearly prehistoric plant materials. This ash deposit lies immediately on the floor surface and may very likely be a source of charred, economic taxa in "floor contact" proveniences. Grid 24 lies within the boundary of this deposit, whereas Grid 22 is outside it; the presence of charred economics in these two grids may relate to Firepit 3 use in addition to, or instead of, the ash.

Two well-plastered ovens nearly a meter deep (Nos. 1 and 2) are situated side-by-side in the center of Room 3, while a third, shallower

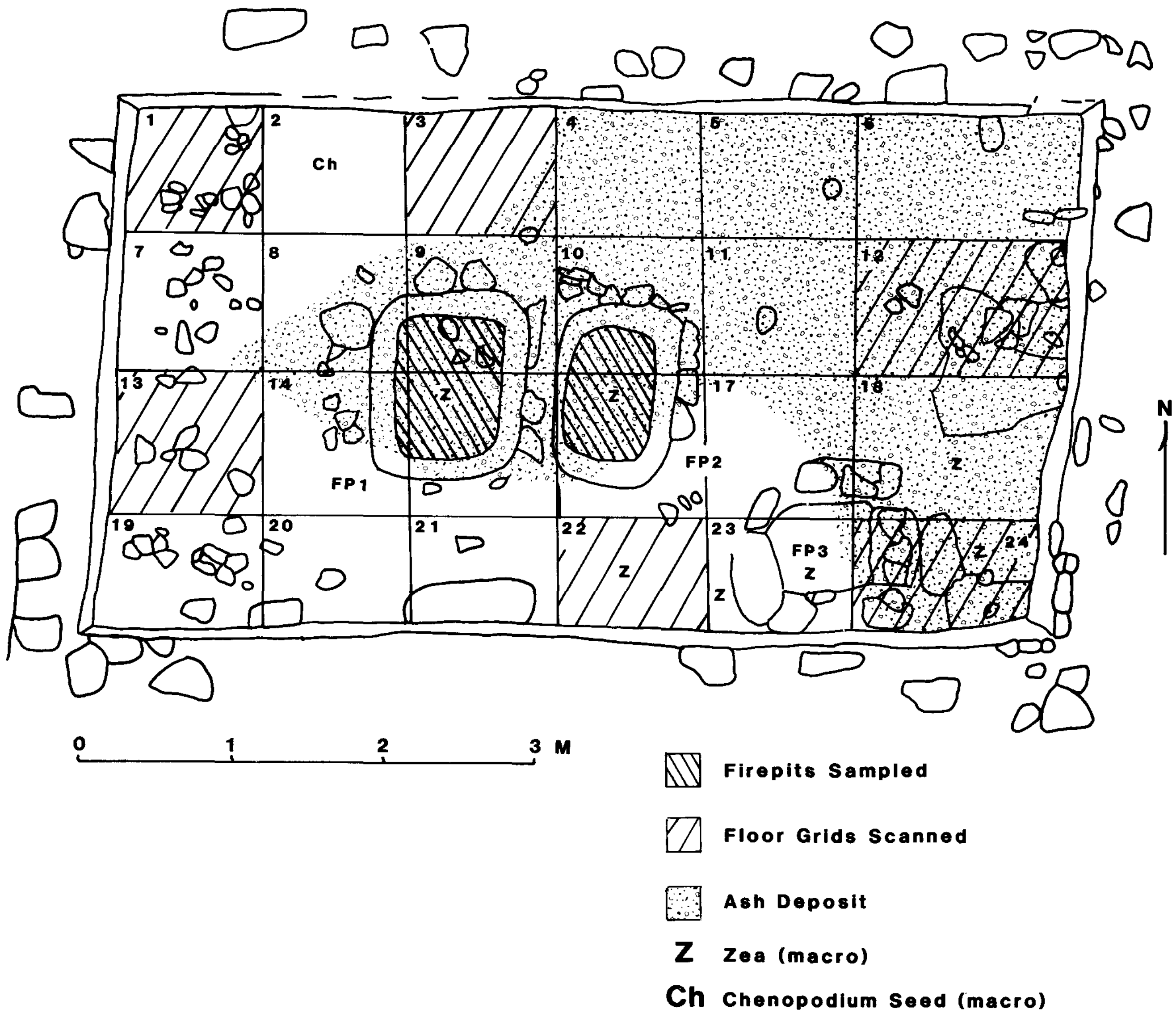

Figure 11.7. Sample locations, Plaza Feature 1, Room 3.

oven (No. 3) sits apart (Figure 11.7). The pair differ slightly from the single oven in firewood and plant debris. The two largest ovens were fueled largely by pinyon but with substantial quantities of ponderosa and juniper (Table 11.28). Firepit 3 was fueled predominantly by juniper. The sparse, charred, plant remains in Firepits 1 and 2 included juniper twigs, pinyon nutshell, and a few annual weed seeds (Table MF-11.20). A single corn kernel was present in the Firepit 1 flotation sample, along with cupules, whereas only five carbonized cob pieces were recovered as macrobotanical remains from the two ovens. In Firepit 2, more than one thousand, unburned, weed seeds (pigweed, mustard, and spurge) look suspiciously like postoccupational, rodent contamination, although no signs of such activity were seen during excavation (Volume II, this report). By contrast, much of the carbonized corn in Room 3 came from Firepit 3 (52 cob pieces recovered as macrobotanical remains). There may be some difference in how these heating features were used, with Firepits 1 and 2 fueled by hotter-burning woods (presumably in shorter supply) whereas corn debris was far more abundant in Firepit 3. It should be noted, however, that the supposition that Firepits 1 and 2 burned hotter may either suggest differential function or explain differential preservation of botanical remains. The omission of a flotation sample from Firepit 3 because of time constraints unfortunately eliminates that point of comparison between the two oven types.

Some specialized communal use is implied for Plaza Feature 1 by such factors as its central location, the unusually large size and morphology of the ovens, and the multiple floor plasterings (Volume II, this report). Similar large ovens in plaza structures occur elsewhere in Chacoan towns, for instance at Pueblo Bonito (Judd 1954) and Chetro Ketl (Lekson 1984). Communal functions suggested for these ovens have included pottery firing and specialized food preparation. The notion of ceramic kilns has been rejected because pit morphology is inconsistent with numerous ethnographic accounts and because expected debris ("waster" sherds, kiln props) is absent (Volume II, this report). Food preparation (for instance, green corn roasting or steaming, as at Zuni, Cushing 1920; or San Juan, Ford 1968) is still a reasonable possibility.

Sadly, the hot temperatures reached in the ovens (especially 1 and 2) and the shallow deposits mitigate against preservation of evidence of such use. Except for corn, botanical remains are few in Plaza Feature 1. Flotation remains include pinyon shell and charred, weed seeds of several taxa common in food preparation areas elsewhere at Pueblo Alto: pigweed, Cheno-Ams, stickleaf, mallow, purslane, and ground cherry. Corn remains are present in flotation samples from ovens and floor grids, are abundant as macrobotanical remains, and occur as pollen in three composite samples (Grids 1-8-13-20, 3-22, and 5-12-17-24; Cully 1985b). Cully also found beeweed and prickly-pear pollen in the west area (two seed taxa present elsewhere at Pueblo Alto but absent in Plaza Feature 1 flotation) and purslane in the east area. Thus, both pollen and flotation remains appear to point to wide-spectrum rather than specialized (e.g., solely corn) food preparation.

Table 11.28. Fuel composition, Plaza Feature 1, Room 3 firepits (number and percent of pieces of each taxon).[a]

	Tree-Ring Lab[b]						Other Charcoal[c]						
	PP	PN	JUN	WF	POP	Total	PN	JUN	A/S	ART	POP	UNK	Total
Firepit 1 Layer 3		9	1			10		3	1	4	2		10
Layer 4	19	29	4	2		54	7		2		1		10
n	19	38	5	2		64	7	3	3	4	3		20
%	30	59	8	3		100	35	15	15	20	15		100
Firepit 2 Layer 9	4	20	12		2	38							
Layer 8	1	32	7			40							
Layer 11		6	1			7							
Layer 6		2				2							
n	5	60	20		2	87							
%	6	69	23		2	100							
Firepit 3 Layer 8		1				1							
Layer 9			2			2							
n		1	2			3							
%		33	67			100							
All Firepits													
n	24	99	27	2	2	154	7	17	3	4	3	1	35
%	16	64	18	1	1	100	20	49	9	11	9	3	100

PP = *Pinus ponderosa* (ponderosa pine)
JUN = *Juniperus* sp. (juniper)
WF = *Abies concolor* (white fir)
POP = *Populus/Salix* (cottonwood/willow)
PN = *Pinus edulis* (pinyon)
A/S = *Atriplex/Sarcobatus* (saltbush/greasewood)
ART = *Artemisia* sp. (sage)

[a]Large "potentially datable" chunks of carcoal were sent to the tree-ring lab (they returned species identifications whether or not specimens dated) (see Volume I and II, this report), while a "representative sample" of the remaining charcoal was sent for identification to Stanley Welsh.
[b]Chapter 7, Volume I, this report.
[c]Welsh 1979.

The plaza area immediately east of Rooms 104 and 110 was explored by means of several test trenches. Flotation samples document two outdoor "floors," Surfaces 6 and 7 in the West Plaza. Both samples contain few seeds, all unburned common weed species (Table MF-11.20). Several factors may reasonably explain the paucity of cultural plant materials here. First, while in use these surfaces were protected only on the west by the roomblock and were constantly windswept. Similarly exposed, plaza areas at 29SJ 629 and Salmon Ruins also contained little in the way of cultural debris (Doebley 1981; Toll 1981b). Second, alluvial deposits here are relatively shallow (less than a meter in some areas) compared to those in rooms, which increases deterioration effects and probability of more recent contamination. Macrobotanical materials preserved in this area of the plaza consist entirely of relatively durable, charred corncobs. Most were recovered from a bell-shaped pit (Other Pit 1, Surface 4B) and a possible heating pit (Other Pit 2, Surface 8, near sterile), whereas a single specimen was on Surface 6.

Trash

Trash deposits from each of the three principal periods of Pueblo Alto occupation were examined. The early Red Mesa period was represented by debris in the vicinity of Plaza Grid 8, and the Gallup period by areas of the large Trash Mound to the southeast of the pueblo. Late Mix deposits were sampled in fill of Kiva 10, adjacent to Plaza Grid 8. These particular locations were chosen because they contain deposits of dense, domestic trash of clear chronological affiliation and with minimal post-depositional disturbance.

In Layer 15 in Plaza Grid 8, a few taxa from the wide array are clearly economic (charred juniper, pinyon, and corn in both samples; Table MF-11.20). Among weed seeds, the vast majority are unburned and appear to be good candidates for contaminants. For instance, only four goosefoot seeds in sample 6616 were charred, whereas the remainder looked like seeds recently transported by rodents or insects (cracked open, shiney, and with adhering calyx fragments). Prickly-pear and ricegrass seeds in this same sample also looked like rodent discards, and the *Cryptantha* seed is a definite intrusive. Macrobotanical remains from Layer 15 included charred corn and one of the few cultivated beans found at Pueblo Alto.

Most of the large Trash Mound accumulated during Pueblo Alto's Gallup occupational phase. Flotation samples contained small quantities of botanical debris, but most material was charred (Table MF-11.21). Nearly every specimen has economic potential and occurs regularly in food or fuel use contexts in the site. There is practically nothing in the way of contamination in these Trash Mound samples (a single *Phacelia* seed in Layer 56). As in the Red Mesa and Late Mix trash, corn is widespread (the only economic debris common to all samples). Kernels as well as cupules are present in every sample. Corn macrobotanical remains are abundant; nearly 4,000 specimens, or 63 percent of all Pueblo Alto corn, were recovered from the Trash Mound. Other economic taxa that occur less frequently in flotation are juniper and saltbush (probably related to fuel use), weeds (goosefoot, mustard, mallow, and purslane), and pinyon, prickly pear, and bean. Layer 44, particularly rich in flotation remains, has very high densities of other types of trash, especially charcoal and sherds (Volume II, this report).

Fill in Kiva 10 on the Plaza was deposited very late in Pueblo Alto's occupation. Again, quantities of plant debris in flotation are small, but most material is charred (Table MF-11.22). Corn and juniper are consistently present, whereas pinyon nutshell is absent. Several economic weeds are represented, though the array is certainly less varied than in the Gallup trash sample.

Discussion

Variation in the Floral Record Attributable to Provenience Categories

Provenience category seems to have a substantial effect on the disposition of botanical materials within a site; that is, certain items are more likely to turn up in certain kinds of locations. These distinctions are likely to correspond with locations where specific economic activities took place and with conditions of deposition and preservation. Such distinctions have chiefly been recognized at puebloan sites: with greater visibility of locational markers (walled rooms and features, planned trash mounds and plaza spaces) and greater sample size, internal variability is more evident (Bohrer 1980; Donaldson and Toll 1982; Struever 1977; Toll 1981b).

Consideration of the effects of provenience category on paleo-plant distribution is a logical first step to sorting out the significance of floral variability at Pueblo Alto. The main objective here is to characterize different types of debris (such as that from food processing, construction, or ceremonial activities) and determine where they occur. Awareness of such categories of floral debris will allow us to recognize instances of secondary deposition (such as trash fill in a mealing bin), and choose like-functional assemblages when examining spatial and temporal differentiation within the site.

On the broadest level, there seems to be a major distinction in the types of debris turning up on floors vs. that in heating features. Material on floors tends to be unburned, less well preserved, and more problematic with respect to assigning cultural or temporal affiliation. During use, floors are frequently swept clean of visible plant detrius, whereas the association of certain cultural material (cultivars and charred wild economics) can often be linked to overlying trash fill. Heating features, on the other hand, are frequently both the focus of food-processing activities and the receptacle for floor sweepings from such activities elsewhere in the room. The fire either will consume such plant artifacts entirely or preserve them indefinitely by carbonization.

Primary deposition in less-numerous mealing bins and storage facilities tends to resemble that on floors; although the opportunity for concentrating plant remains in these features exists, the material tends to be unburned and subject to degradation and rodent or insect infestation. Significantly, pollen preservation seems to follow a precisely opposite pattern: floors, mealing bins, and storage structures often provide information about economic activities involving plants, whereas hearths rarely do. Poor preservation is blamed on the alkaline environment fostered by wood ashes and often compounded by moisture trapped in clay- or slab-lined firepits.

At Pueblo Alto, as at 29SJ 627 and 29SJ 629, taxonomic diversity and increased occurrence of charred, economic plants are more characteristic of heating features than of floors (Table 11.29). The association of corn, ricegrass, and other taxa with heating features is clearly demonstrated by their considerably higher rate of occurrence in firepit and heating pit samples, as compared to sitewide occurrence. This patterning is most apparent at Pueblo Alto where better preservation has resulted in recovery of low-frequency items (such as pinyon nutshell) in more samples. Lack of overlying trash on most floors at Pueblo Alto also favors clear differentiation of floor-type assemblages from those in heating features.

Flotation remains in trash deposits show great similarity to those in heating features (Table 11.29) because most trash probably consists largely of firepit and heating-pit dumpings. Overall diversity of charred plant taxa is again higher than the sitewide average, and many of the same economic taxa associated with heating features show up in similarly high proportions in trash. Ricegrass is a notable exception, showing strong association with firepits and heating pits, but absent from all Chaco Canyon trash deposits examined to date. Several of the edible weeds (pigweed, winged pigweed, and possibly goosefoot and globemallow) seem to be unequally related to trash and heating features. At Pueblo Alto in particular, the presence of corn, juniper, pinyon, prickly pear, purslane, and mustard in trash probably derives essentially from food processing and fuel use in firepits and heating pits.

Two types of features built to contain fires have been distinguished at Chaco Canyon: firepits are larger and more formally prepared (usually slab- or adobe-lined), and heating pits are shallow and unlined. Firewood in firepits (often burned to ash, but including some sizeable branches) indicates that fires in these structures were hot and of long duration. Fuel in heating pits is largely shrubby and seldom burned to ash, indicating shorter duration fires with lower heat production. Flotation results provide substantial help in sorting out the question of whether these morphologically divergent feature types were used differently. Windes (1984) has suggested that cooking took place in firepits, whereas heating pits served to warm food or people.

At both 29SJ 627 and 29SJ 629 differential distribution of plant debris corroborates the notion that these features were used differently: corn and several wild economics were found in firepits, whereas the

Table 11.29. Taxonomic diversity and ubiquity by provenience category at 29SJ 627, 29SJ 629, and Pueblo Alto.

	29SJ 627[a]				29SJ 629[b]				Pueblo Alto			
	Heating features (n = 7)	Trash (n = 3)	Floors (n = 36)	All site (n = 75)	Heating features (n = 15)	Trash (n = 9)	Floors (n = 34)	All site (n = 74)	Heating features (n = 31)	Trash (n = 11)	Floors (n = 69)	All site (n = 124)
Average taxonomic diversity												
All taxa	5.9	4.3	4.7	5.6	8.9	8.2	9.5	9.7	8.3	6.4	6.4	6.3
Burned taxa only	2.7	3.0	0.7	1.5	4.7	2.4	1.3	2.7	5.9	4.1	0.9	2.4
Presence of specific charred economic taxa (percent samples)												
Zea mays	14	100	8	21	67	89	38	42	87	100	33	53
Juniperus	0	0	3	3	40	0[c]	9	12	68	73	4	26
Pinus edulis	0	0	0	0	0	0[c]	0	1	39	36	3	15
Oryzopsis	29	0	0	7	20	0	15	16	26	0	1	6
Opuntia	0	0	0	0	0	0	0	0	13	9	0	4
Amaranthus	29	0	3	9	7	0	3	3	32	9	3	11
Chenopodium	29	0	0	16	40	33	6	20	48	9	6	16
Portulaca	29	33	6	19	47	22	12	24	35	36	10	18
Descurainia	0	33	0	4	40	22	9	16	19	18	3	8
Cycloloma	0	0	0	0	0	0	0	0	16	9	1	1
Sphaeralcea	14	33	6	8	20	0	9	11	23	9	3	8

[a]Struever 1977.
[b]Toll 1981b.
[c]But found in trash-filled mealing bins, Pithouse 2.

smaller number of heating pits contained far less in the way of food detritus (Table 11.30). At Pueblo Alto, on the other hand, firepits and heating pits appear to have been used in very similar ways: the botanical assemblages are in both groups rich in variety and quantity of floral food and fuel debris. One food-processing task in particular that can be assigned to heating pits at Pueblo Alto is the parching of Indian ricegrass caryopses: carbonized ricegrass is associated with nearly one-third of all heating pits, though only 6 percent of all samples sitewide.

For several woody perennials used as fuel at Pueblo Alto, provenience association helps assign use status to flotation and macrobotanical remains. It is possible to demonstrate that juniper twigs and leaves (suspected to be chiefly byproducts of fuel use) are more likely to be associated with heating features where juniper wood was burned, whereas pinyon nutshell occurs more often in heating features which do not contain pinyon wood (Table 11.31).

Ethnographic analogy also indicates that saltbush fruits and leaves are probable fuel-use byproducts; these occur in fewer firepits (11 percent) than heating pits (32 percent) where saltbush wood was used more commonly as fuel.

Provenience association provides the clearest evidence of function in the case of floral material in human coprolites. The good fortune of preservation of such material at Pueblo Alto allows us to state unequivocally that pinyon nuts, mustard and purslane seeds, and corn passed through the digestive systems of some of Pueblo Alto's past residents (Toll 1981a). Coprolites from other sites add ricegrass, dropseed, sunflower, pigweed, and cultivated squash seeds to the list of plant foods consumed by Chaco Canyon inhabitants (Toll 1981a).

Functional Differentiation of Rooms and Areas within the Site

When botanically correlating activity patterns within sites, archeobotanists have generally been steered in one of two directions. In sites low on structural clues as to the areal extent and nature of activities, archeologists have looked to botanists for any information that will fill in those gaps; while in puebloan sites abounding with masonry walls and features, archeologists have generally named room types, and botanists have supplied data about plant remains associated with habitation, storage, or ceremonial activities. Here we have a trickier problem. Although Pueblo Alto is not the first pueblo to exhibit hybrid or enigmatic room types, there does seem to be an unusual preponderance of unfamiliar room conformations (viz., empty silos, exceptionally large rooms, and the so-called corridor rooms), together with a marked number of cases of functional change over time within individual rooms. The high degree of variability in room types, together with the small sample of rooms excavated at Pueblo Alto, create serious difficulties in clearly determining what floral characteristics covary with room function. I have decided to proceed as if room function were essentially unknown, by first defining

Table 11.30. Firepit and Heating Pit flotation assemblages compared.

	29SJ 627[a]		29SJ 629[b]		Pueblo Alto	
	Firepits (n = 5)	Heating Pits (n = 27)	Firepits (n = 10)	Heating Pits (n = 5)	Firepits (n = 9)	Heating Pits (n = 22)
Average taxonomic diversity						
All taxa	7.0	3.0	10.1	6.6	7.8	11.6
Burned taxa only	3.8	0	6.2	1.6	7.0	9.2
Presence of specific charred economic taxa (percent samples)						
Zea mays	20	0	90	20	67	86
Juniperus	0	0	40	40	56	73
Pinus edulis	0	0	0	0	44	36
Oryzopsis	40	0	20	20	11	32
Opuntia	0	0	0	0	11	14
Amaranthus	40	0	20	0	44	32
Chenopodium	40	0	60	20	22	56
Portulaca	40	0	70	0	56	27
Descurainia	0	0	60	0	11	23
Cycloloma	0	0	0	0	22	9
Sphaeralcea	20	0	30	0	22	23

[a]Struever 1977.
[b]Toll 1981b.

Table 11.31. Association of juniper and pinyon charcoal and non-wood remains in Pueblo Alto heating features.[a]

	Features With Juniper wood	Features Without Juniper wood	Features With Pinyon wood	Features Without Pinyon wood
WITH flotation of macroremains of the same taxon	4	1	2	3
WITHOUT flotation of macroremains of the same taxon	4	1	1	4

[a]In 5 heating pits and 5 firepits for which corresponding charcoal composition (Welsh 1979) and flotation data are available.

the floral assemblages that occur with some extreme room types and then discussing the implications of the botanical attributes of intermediary or mixed room types.

As a rare stroke of luck at Pueblo Alto, we have a small number of rooms in which there is an extensive record of plant debris associated both with a wide array of features and with floor surfaces, unconfused by overlying postoccupational trash. Here we see remarkable evidence of the patterning of plant-use activities within individual rooms. In each case, a constellation of economic species repeatedly occurs carbonized in heating features and then unburned on floors, in decreasing frequency with increasing distance from the greatest concentration of plant-processing features. In each room, three or four weeds occur in considerably greater abundance, but a wide variety of all economic types exhibit this burned-in-features/unburned-on-floors pattern (Table 11.32).

This patterning of plant remains would seem to earmark these occupational floors as classic habitation rooms with full-scale plant processing activities going on. Yet, a review of the site as a whole (Table 11.33) shows that we have a mere three instances (Gallup floors in Rooms 103, 110, and 143/236) where archeologists (Volume II, this report) and botanists are able to agree on designation of living room or habitation floors. Kiva 15, Plaza Feature 1, and four North Roomblock cases of mixed or uncertain room function all exhibit the characteristics of considerable density and diversity of plant-related activities. Although these rooms may have dubious status as habitation loci, some similar economic activities are demonstrated to have taken place, and there is clear contrast with the plant materials found in featureless rooms designated as storage areas.

At Pueblo Alto the dichotomy between abundant and diverse economic plant remains found in habitation rooms (or those rooms with numerous features) and sparse remains found in featureless storage rooms mirrors that seen at 29SJ 627 and 29SJ 629 (Struever 1977; Toll 1981b), as well as at Broken K Pueblo (Hill 1970). The diverse habitation-like assemblage of Kiva 15 repeats that found at 29SJ 629 and in several cases at Salmon Ruin (Bohrer 1980), but contrasts with the empty ceremonial rooms Hill (1970) found at Broken K.

Pollen results stratified by room type are very different from flotation results (Table 11.34), and their consideration leads directly into the question of chronological changes at Pueblo Alto. In her study of Pueblo Alto pollen, Cully (1985b) concluded that a high percentage and diversity of economic pollen types (including corn, squash, beeweed, purslane, prickly-pear cactus, and cattail) is associated with both living rooms (especially 110) and storage rooms (112, 229) of the Gallup occupation of the West Roomblock. Low overall percentage and diversity of economic pollen types is characteristic of both living rooms (143, 147) and storage rooms (139, 142, 145) of the Late Mix occupation of the North Roomblock and of Kiva 15 of the same occupation in the West Roomblock. Because pollen assemblages did not coincide with room functional or

Table 11.32. Occupation floors on which specific economic taxa occur burned in heating features and unburned on floors.

	West Roomblock		North Roomblock		
	Room 103, Floor 3 (Gallup)	Room 110, Floor 1 (Gallup)	Room 139, Floor 2 (Red Mesa)	Room 143, Floor 2/ Room 236, Floor 4 (Gallup)	Room 147, Floor 1 (Late Mix)
Pinus edulis	+	+	+	+	
Sporobolus			+		+
Oryzopsis			+	+	+
Chenopodium	+	+	+	+	
Amaranthus	+	+	+	+	
Descurainia	+	+	+		
Portulaca	+	+	+		+
Physalis		+	+		
Cycloloma	+	+	+	+	
Others	*Yucca*		*Opuntia* *Solanum*	*Sphaeralcea*	*Sphaeralcea* *Mentzelia*

Table 11.33. Taxonomic diversity and presence of key economic species by room type and site area.

West Roomblock	Average sample diversity: All taxa	Average sample diversity: Burned Taxa only	% samples with: Corn	% samples with: Pinyon
Living Room Floors:				
Room 103, Floor 3 (9 FS)	8.4	3.8	67	56
Room 110, Floor 1 (23 FS)	5.1	2.8	65	30
(32 FS)	6.0	3.1	66	38
Storage Room Floors:				
Room 112, Floor 1 (8 S)	1.8	0.8	25	0
Room 229, Floor 1 (9 S)	1.2	0.1	0	0
Room 103, Floors 4 and 5 (8 FS)	3.1	0.3	25	13
Room 110, Floor 3 (6 FS)	2.8	0.3	17	0
(14 FS, 17 S)	2.2	0.4	16	3
Ceremonial Room Floors:				
Kiva 15, Floor 1 (5 FS)	7.0	2.6	100	20
Mixed or Uncertain Function:				
Room 103, Floor 1 (4 FS)	5.0	0.8	25	0
Room 110, Floor 2 (7 FS)	1.3	0.1	14	0
Living Room Floors:				
Room 143, Floor 2/Room 236, Floor 4 (5FS, 3S)	7.3	2.0	50	100
Storage Room Floors:				
Room 138, Floor 1 (6 S)	3.0	0	0	0
Room 145, Floor 1 (8 FS)	3.1	0	0	25
Room 139, Floor 1 (9 FS)	5.1	2.1	33	11
(17 FS, 6 S)	3.7	0.8	13	13
Mixed or Uncertain Function:				
Room 139, Floor 2 (17 FS)	12.1	2.8	59	71
Room 142, Floors 3 and 8, (4 FS)	12.8	6.0	25	75
Room 146, Floor 3 (1 FS)	2.0	2.0	100	100
Room 147, Floor 1 (2 FS, 7 S)	7.1	3.6	44	0
Other				
Mixed or Uncertain Function:				
Plaza Feature 1 (2 FS, 6 S)	6.1	2.9	38	13

FS = Full sort sample.
S = Scan samples.

Table 11.34. Comparison of generalized pollen and flotation results by site area at Pueblo Alto.

Density and diversity Of economic taxa	West Roomblock	North Romblock	Other
Seeds and macroremains			
High	Room 103, Floor 1, H Room 110, Floor 1, H Kiva 15, Floor 1, C	Room 147, Floor 1, H/C?	Plaza Feature 1, H/C?
Low	Room 112, Floor 1, S Room 229, Floor 1, S	Room 139, Floor 1[a], S? Room 142, Floor 1, S Room 143, Floor 1, S?	
Pollen			
High	Room 110, Floor 1, H Room 112, Floor 1, S Room 229, Floor 1, S		Plaza Feature 1, H/C?
Low	Kiva 15, Floor 1, C	Room 139, Floor 1, S? Room 142, Floor 1, S Room 143, Floor 1, S? Room 145, Floor 1, S? Room 147, Floor 1, H/C?	

H = habitation floor.
S = storage (?) floor.
C = ceremonial

[a]This floor has a moderate amount of economic plant debris.

morpho-types so much as with chronology, we concluded that food preparation and storage activities shifted over time from the West Roomblock, to a centrally located plaza feature (contemporaneous with the barren North Roomblock upper floors, but exhibiting the high proportion and diversity of economic pollen types seen in Gallup rooms of the West Roomblock). The juxtaposition of flotation results from the same proveniences sampled for pollen analysis, and the addition of flotation data from other rooms and earlier occupations, provide some additional perspective on this functional framework. First, some full-range, habitation-type activities were going on in the North Roomblock as well during the earlier Red Mesa and Gallup occupations, and second, at least some varied plant use took place in the North Roomblock during Pueblo Alto's latest (Late Mix) occupation.

Time

Comparison of the occurrence of specific economic taxa in flotation samples over time at Pueblo Alto illustrates general chronological continuity in the usage of some plants and some shifts that may indicate significant adaptive and/or environmental changes. Retrieval of corn remains does not fluctuate greatly from the 50 percent mark but does show an inverse relationship with wild-plant usage, as observed also at Salmon (Doebley 1981). Ubiquity of corn remains is at its lowest in the Red Mesa period, when all categories of wild plants are used widely (Table 11.35). Ubiquity of corn increases steadily toward the Late Mix period, whereas wild-plant products as a whole dip in the Gallup period, then level off in the last occupation.

The Red Mesa period is marked by particularly high occurrence of some important wild perennials (pinyon, prickly pear, and hedgehog cactus) and certain weedy annuals (particularly sunflower). It is certainly notable that the Gallup period stands out as an episode of generally lowered plant use, because it includes large blocks of two living floors (Room 103, Floor 3, and Room 110, Floor 1) highlighted by remarkable abundance and diversity of both domesticated and wild-plant remains.

Although food use of pinyon nuts decreases over time at Pueblo Alto, coniferous fuel use (including pinyon) is steadily increasing in quantity and occurrence throughout the site (Table 11.36). Concomitantly, shrub fuel use decreases and becomes less variable. By the latest occupation, saltbush is practically the only shrub firewood in use.

Although corn increases in ubiquity over time at Pueblo Alto, cob size generally decreases (Table 11.36). This trend is in distinct opposition to that seen at Salmon (Doebley and Bohrer 1983) but is similar to the trend at nearby Bis sa'ani (Donaldson and Toll 1982).

Table 11.35. Ubiquity of selected economic taxa in specific time periods, compared with sitewide flotation results.

	Statewide occurrence[a]		Red Mesa period[b]			Gallup period[d]			Late Mix period[e]		
	% total Occurrence	% burned Only	% total Occurrence	% burned Only	In re sitewide Occurrence[c]	% total Occurrence	% burned Only	In re sitewide Occurrence	% Occurrence	% burned Only	In re sitewide Occurrence[c]
Zea	53	53	46	46	low	56	56	high	65	65	high
Perennials:											
Pinus edulis	35	10	49	16	high	30	20	low	6	6	low
Opuntia	13	4	30	8	high	11	4	--	0	0	low
Echinocereus	6	3	14	5	high	4	4	--	0	0	low
Grasses:											
Oryzopsis	13	7	22	14	high	0	0	low	18	12	high
Sporobolus	14	5	24	5	high	4	2	low	29	12	high
Annual Weeds:											
Chenopodium	68	16	81	22	high	57	20	low	59	12	low
Portulaca	58	18	59	8	--	50	22	low	59	29	--
Amaranthus	41	9	43	8	--	33	13	low	41	12	--
Descurainia	37	8	54	5	high	17	9	low	35	18	--
Mentzelia	27	4	38	0	high	11	0	low	35	12	high
Cycloloma	20	6	22	22	--	15	4	low	41	24	high
Physalis	19	3	32	3	high	13	2	low	12	6	low
Corispermum	17	1	32	0	high	20	4	high	0	0	low
Sphaeralcea	17	8	24	8	high	15	7	--	24	24	high
Helianthus	10	1	24	3	high	4	0	low	6	0	low

[a]Composition of sample: 69 floors, 42 features, 11 trash, 2 plaza = total of 123 samples (includes some proveniences of mixed or unclear chronological affiliation.

[b]Composition of sample: (Room 103, Floor 5; Room 110, Floor 3; Room 139/145, Floor 2; Room 142, Floors 3, 8, 9; Room 146, Floor 3; Plaza Grid 8) 25 floors, 10 features, 2 trash = 37 samples.

[c]Dash (--) indicates occurrence within 2% of sitewide level.

[d]Composition of sample: (Room 103, Floors 3, 4; Room 110, Floors 1, 2; Trash Mound) 19 floors, 22 features, 5 trash = 46 samples.

[e]Composition of sample: (Room 103, Floor 1; Room 147, Floor 1; Kiva 10; Kiva 15; Plaza Feature 1) 8 floors, 5 features, 4 trash = 17 samples.

Table 11.36. Overview of botanical assemblage characteristics over time.

Time	Cultivars	Wild plants	Wood
Red Mesa Phase A.D. 1020-1040/50	Corn: average row number ca. 10.	Perennial, grass, and weedy economics all relatively widespread	Coniferous fuel is minimal (15 %) and is associated predominantly with big firepits and trash. Most fuel is shrubby (80 %), largely saltbush but many other types used also.
Gallup Phase A.D. 1050-1100	Corn: average row number approaching 10; cobs slightly smaller than in Red Mesa phase.	Perennials, grass, and weedy economics all at their narrowest distribution level at Pueblo Alto	Major jump in importance of coniferous fuel (41 %), still associated strongly with fire-pits. Shrub fuel 53 % (largely saltbush).
Late Mix Phase A.D. 1100-1150/1200	Corn: more widespread; average row number ca. 11; cobs slightly smaller than in Gallup phase.	Perennials and some weedy species slightly lower than their sitewide occurrence. Grasses at peak use.	Coniferous fuel totals 57 %, now associated significantly with heating pits as well. Shrub fuel 37 %, little variety beyond saltbush.

Summary

A combination of luck and adequate and sensible sampling have provided us with a uniquely informative and comprehensive flotation data base for Pueblo Alto. Open but very deep masonry rooms allowed preservation of sufficient botanical materials to tell us a good deal about the array of plants exploited, for the variety of room types excavated at Pueblo Alto and the full period of occupation. Remains of pinyon nutshell are a particularly apt example: this critical resource is highly subject to postdepositional degradation and rarely occurs at open sites (including 29SJ 627 and 29SJ 629), whereas at Pueblo Alto pinyon is present in coprolites, macrobotanical remains, and in 35 percent of all flotation samples. Though present in low frequency, this widespread distribution provides an additional factor useful in distinguishing patterning of economic activities within the pueblo and over time.

Further, Pueblo Alto has escaped one of the major drawbacks of relatively rich floral assemblies, namely, obfuscation of patterning of cultural material by equally well-preserved, noncultural, plant remains or trash. Those floors with the greatest number and variety of both food-processing features and plant-food remains (e.g., Room 139, Floor 2) are miraculously free of immediately overlying postoccupational trash. Use of the scan procedure at Pueblo Alto has permitted the inclusion of blocks of samples from several empty rooms that would otherwise have been left out of the sampling scheme as an economy measure. The repeated low density and diversity of economic seeds in these rooms (112, 229, 138) are vital components in the argument that habitation rooms at Pueblo Alto were the locus of numerous and varied food-processing activities resulting in a recognizable distribution of seed remains.

Overall composition of the Pueblo Alto flotation and macrobotanical assemblage generally confirms the pattern seen elsewhere at this time period in and around Chaco Canyon (Donaldson and Toll 1982; Struever 1977; Toll 1981b) and throughout the San Juan Basin (Toll 1984). Seeds of edible, weedy annuals are the predominant components of the flotation assemblage. Although the list of included taxa is long, just three of these (goosefoot, mustard, and purslane) comprise 53 percent of all seeds recovered at Pueblo Alto. Stickleaf, spurge, pigweed, and beeweed comprise an additional 12 percent, but other weed taxa are not widespread and are present only in very low frequency.

At Pueblo Alto, the second most abundant taxonomic category, grasses, appears to be more prominent (17 percent of the total assemblage) than at Chaco village sites or elsewhere in the San Juan Basin. Yet, the bulk of grass seed turned up in a single heating pit, and omission of this one provenience brings site totals (81 percent weeds, 5 percent grasses) more closely in line with regional Pueblo I-III assemblages. Corn remains constitute the vast majority of all cultivars, as at other sites of the period. Charred cob fragments are the principal item found; these are small and widespread in flotation samples and larger and more clumped in distribution as macrobotanical remains. As is the case in all but the best-preserved situations, squash and bean remains are very rare.

Taxa more abundant at Pueblo Alto than at Chaco Canyon village sites include mostly low-frequency perennials such as yucca, juniper, pinyon, squawberry, saltbush, and hedgehog and prickly-pear cacti--plus two low-frequency, edible weeds, beeweed and plantain. Prominence of these taxa is easily linked to better preservation and greater sample size at Pueblo Alto, but may also relate to some underlying differences in adaptive orientation. Few taxa are less common at Pueblo Alto than at smaller Chaco Canyon sites; these include bulrush, wild tobacco, evening primrose, and cultivated beans.

In differentiating flotation and macrobotanical results by provenience category, the principal dichotomy observed is that between heating features (with numerous, carbonized, economic plant remains) and floor surfaces (with sparser, and usually unburned, floral debris). This patterning bears both on our interpretation of function and our notions of suitable sampling schemes. Although heating features reliably produce paleo-plant materials both more abundant and more clearly cultural, Pueblo Alto provides an excellent case in point for the reason flotation analysis should routinely include less-productive, cultural proveniences such as floors. In this unique situation of good preservation plus absence of overlying trash "noise," Pueblo Alto's floors and features viewed in concert provide internally corroborative evidence for the use of certain economic plant taxa and the disposition of food-processing activities throughout individual rooms and throughout the pueblo. The occurrence of carbonized, economic, seed taxa in several heating features and unburned on floors (decreasing in frequency with increasing distance from the heating features) is convincing evidence of the association of these taxa with food-processing techniques such as parching and boiling near the heating features. Repetition of the results in multiple features and floor grids within each room and in successive rooms is vital to our confidence in their validity.

Trash flora at Pueblo Alto bear many similarities to materials found in heating features (probably because most household debris consists largely of firepit and heating-pit dumpings). Firepits and heating pits, highly differentiated in terms of size, morphology, and fuel composition, nonetheless appear to have been used in very similar ways at Pueblo Alto. In contrast to essentially empty heating pits at Chaco Canyon village sites, Pueblo Alto's heating pits characteristically exhibit much the same high density and diversity of edible plant taxa found in firepits. The distribution of ricegrass provides an exception: charred ricegrass caryopses are highly associated with heating pits (in contrast to firepits) and are not found at all in trash.

A small number of habitation-room floors, thick with features and artifactual debris, exhibit distinctive patterning of economic plant remains appropriate to full-scale subsistence activities. At the other end of the scale, empty rooms presumed to have served for storage are generally empty of floral remains. This neat pattern, corroborating habitation/storage room dichotomies seen at other puebloan sites, is marred by a rather substantial zone of uncertainty between the extreme room types. Excavated rooms at Pueblo Alto include a substantial portion with some features and poorly prepared floors; these defy neat classification into habitation vs. storage functions, and probably represent hybrid or temporary use. Plant remains in these rooms include everything from sparse to moderate quantity and diversity of economic, floral debris. The one clear ceremonial context (Kiva 14, Floor 1) resembles habitation assemblages, as does Plaza Feature 1.

Changes in the quantity or nature of domesticated and wild-plant products used for food at Pueblo Alto over time are slight. The ubiquity of corn remains increases steadily over time, whereas some perennials (pinyon and cacti) diminish substantially, but the backbone of wild-food products (annual weeds and grasses) tapers off only slightly. Fuel use, on the other hand, changes dramatically over the course of Pueblo Alto's occupation. In the Red Mesa period, firewood is dominated by a variety of shrubby species, but by the Late Mix occupation coniferous fuel (including significant amounts of pinyon) has become the predominant component, and shrub fuel is both less important and nearly reduced to a single type, saltbush. Reliance on reused construction timber for fuel in the late period is the most logical explanation of this pattern. Although this implies a scenario of limited occupation of a partially abandoned site, floral debris provides evidence that subsistence activities continue in ample variety and intensity.

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Chapter Twelve

Coprolites from Pueblo Alto

Karen H. Clary

Introduction

A small sample (22) of Anasazi period, human coprolites from Pueblo Alto was analyzed for pollen (Clary 1983, 1984), macrobotanical remains (Toll 1981), and bone (Gillespie 1981). The analysis was conducted as part of a larger study of Chaco Canyon coprolites (46) from Pueblo Bonito (29SJ 387), Kin Kletso (29SJ 293), Atlatl Cave (29SJ 1156), and a Navajo period site (29SJ 1613) (Clary 1983, 1984). The coprolites from Pueblo Alto, Pueblo Bonito, and Kin Kletso are Anasazi in age (A.D. 920-1150), whereas those from Atlatl Cave are Archaic and those from the Navajo site are historic.

The data from the coprolite analysis were utilized in an intersite comparison of diet between Pueblo Alto and Pueblo Bonito and in a regional comparison of diet with Hoy House in Colorado (Scott 1979) and Antelope House, Canyon de Chelly, Arizona (Williams-Dean and Bryant 1975).

Classic Period Anasazi Diet at Pueblo Alto as Revealed by Coprolites

Pollen Remains

The remains in coprolites from Pueblo Alto did not differ to any appreciable extent from the coprolites either from the other Chaco Canyon pueblos or from Hoy House or Antelope House. An evaluation of the pollen in the coprolites reveals great similarity in human diet for all groups from which coprolites were studied. Apparent is a strong reliance on cultivars (maize in particular) and field weeds such as *Cleome sp.* (bee-weed) and Cheno-ams (Chenopodiaceae and Amaranthaceae). Maize pollen occurs in all of the Pueblo Alto and Pueblo Bonito samples (Clary 1983). High-spine Compositae (sunflower family), including *Helianthus sp.* or sunflower, Cheno-ams, low-spine Compositae, and grasses (Gramineae) also occur in high amounts. Hackberry (*Celtis sp.*) and squash (*Cucurbita sp.*) occur in low to moderate amounts in samples. Buckwheat (*Eriogonum sp.*), yucca (*Yucca sp.*), cactus (*Opuntia sp.*), gooseberry (*Ribes sp.*), and sedge (*Carex sp.*) are occasionally present. These five types, which occur in low amounts, are seasonally available, wild, edible plants (Clary 1983: 60). Pinyon (*Pinus edulis*) pollen exhibits the most variability, present in high amounts in Pueblo Alto samples and in relatively low amounts in Pueblo Bonito samples. In summary, the analysis of pollen from the Anasazi period coprolites indicates that inhabitants of Pueblo Alto consistently consumed cultivars and made substantial use of field weeds and semicultivated plants (Clary 1983:64). They also consumed available, wild, edible plants or parts of plants that belong to various taxa.

Macrobotanical Remains

Partly because of the small sample size of most of the Anasazi period coprolites, relatively few macrobotanical remains were recovered (Toll 1981). Frequent pinyon nutshell fragments indicate consumption of pinyons. Tansy mustard (*Descurainia sp.*) and purslane (*Portulaca sp.*) were the most common remains of weedy annuals. Semicultivars such as pigweed (*Amaranthus sp.*) and wild sunflower (*Helianthus sp.*) were also encountered. Two grass taxa, ricegrass (*Oryzopsis sp.*) and dropseed (*Sporobolus sp.*), were recovered in small quantities. Tissue fragments resembling corn kernel pericarp were encountered as well as maize seed coats (Toll 1981). Forty-seven percent of the Anasazi period samples were composed largely of a calcareous conglomerate with sand-grain inclusions, sandstone fragments, and sand (Gillespie 1981; Toll 1981). It is likely that these fragments are from grinding implements (Gillespie 1981) and may have been ingested with ground maize. Squash seed fragments (e.g. *Cucurbita pepo*) were common in two Pueblo Bonito coprolite samples (Toll 1981). Whereas the pollen analysis identified the most numerous range of plant taxa found in the coprolites, the macrobotanical analysis was useful in broadening the types recovered. Several of the taxa found in the pollen analysis were subsequently identified to genus (*Helianthus*, *Amaranthus*, *Sporobolus*, and *Oryzopsis*), and additional useful taxa were identified (*Descurainia*, *Pinus edulis*).

Faunal Remains

The faunal analysis of Chaco coprolites (Gillespie 1981) suggests that protein requirements were, to an extent, fulfilled by consumption of small mammals and birds. Also detected were some food preparation and consumption habits. For Chaco Canyon inhabitants, small game could have been a convenient and rich food source in view of the fact that the ratio of edible meat to live weight is high (Stahl 1982:826). Seventy-four percent of the Pueblo Alto coprolites contained the bones of small game, which indicates it was a consistent component of meals (Clary 1983:37; Gillespie 1981). The Anasazi period coprolites contained four identified genera of small mammals including two rabbits, desert cottontail (*Sylvilagus* cf. *audubonii*) and black-tailed jackrabbit (*Lepuscalifornicus*), prairie dog (*Cynomysgunnisonii*), and white-footed mouse (*Peromyscusmaniculatus*) (Gillespie 1981).

The most abundant identified specimens are cottontail, and bones from all parts of the body, including cranial elements, were consumed. In one sample, parts of skulls and mandibles of two prairie dogs are present, an adult and a juvenile. The juvenile indicates summer consumption. In two samples with cottontail remains, the remains of white-footed mouse were also found. One of the samples indicated that the entire individual was ingested (Clary 1983:39-40; Gillespie 1981).

A single element of jackrabbit, a proximal rib fragment, was identified. Given the abundance of cottontail, more jackrabbit remains might be anticipated in the samples despite the fact that the larger body size of jackrabbit would lessen the possibility of identifiable fragments being ingested and subsequently identified in coprolites (Gillespie 1981). Regarding the preparation of the small mammals for food, some of the bone appears to have been cooked, and some of it shows no sign of heat treatment (Gillespie 1981).

Conclusions

The data from the analysis of coprolites from Pueblo Alto is best understood in the context of intersite (Chaco Canyon) and regional comparisons (Clary 1983, 1984). The analysis of the coprolites was useful in the identification of certain elements and practices of the Anasazi pueblo dwellers in regard to diet and subsistence. The most notable information derived from the study of the Chaco coprolites is the fact that the inhabitants procured food from the widest range of food sources available. By the classic Bonito phase, maize and, by inference, maize agriculture was a dominant element in the lives of the Chacoans. The coprolite analysis is not useful in the determination of maize-growing locales or of quantities grown and consumed, but it does indicate that maize was consumed regularly, if not daily. The pueblo dwellers regularly consumed edible field weeds and semicultivars common to the region and available wild plant foods. Protein requirements were partially fulfilled by the consumption of small game that inhabited the pueblos and the canyon habitats.

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Chapter Thirteen

Human Skeletal Remains from Pueblo Alto

Nancy J. Akins

Excavations at Pueblo Alto recovered 1 partial burial and 33 fragments of human bone. The fragments may represent a minimum of 4 or as many as 20 individuals.

An infant burial (FS 470) was found during wall clearing activities by a workman. Only the top portion of the skull remained in place for recording. The skull was in the fill of the northwest wall niche of Kiva 7, 50 cm below the top of the wall. The body extended out into the room and was placed face up. A clavicle and several vertebrae were found in the skull case, indicating that some shifting of the bones occurred. No pit or associated artifacts remained in place.

The infant, 1 year old, plus or minus 4 months, was represented by fragments of the skull, 14 vertebrae, a left scapula fragment, a left clavicle, 15 ribs, portions of both humeri and radii, part of the left ulna, 1 carpal, and a phalanx.

An unfused metopic suture, cribra orbitalia in the fragmentary orbits, porotic hyperostosis and ribs with some erosion but no clear involvement were observed on the infant bones. The orbits have a number of small pores of questionable origin. Both parietals exhibit extensive trabecular overgrowth in areas 5.5 cm in diameter. The thickness of the bone was doubled by the spongy development. Some probable healing occurred on the anterior-inferior margin.

Porotic hyperostosis and cribra orbitalia are nonspecific pathologies that reflect an anemic condition caused by a diet low in iron, or one that inhibits the absorption of iron, and cultural factors such as weaning diarrhea. Lesions in younger children reflect the increased need for iron during periods of rapid growth (Goodman et al. 1984:31).

The location of this burial in relatively shallow fill and the shape of the skull suggest that it may postdate the Anasazi use of Pueblo Alto. The occipital portions of the skull have none of the flattening charac-

Table 13.1. Human bone from Pueblo Alto.

Burial:				
FS 470	Kiva 7, Wall Clearing		Infant 12+_4months	
Isolated Elements:				
Wall Clearing:				
FS 444	Room 203	R rib fragment	adult	
FS 464	North of Kiva 7	3 lumbar and 1 sacral vertabrae	adult	pathological
FS 591	OS 6, North Wall	R tibia, proximal epiphysis	child, 10 to 15 years	
FS 3112	Kiva 1	R and L tibias, metatarsal	infant, 6 months	
Plaza Feature 1:				
FS 923	Room 3, Layer 3	L temporal	adult male	
FS 974	Room 3, Floor 1	deciduous molar	child	
Plaza 1:				
FS 4217	Grid 28, Level 1	rib fragment	adult	
Plaza 2:				
FS 3405	Grid 221, Layer 2	third molar	adult	
Room 110:				
FS 1676	North door	molar fragment	adult	
Room 142:				
FS 2992	Floor 4, Heating Pit 1	deciduous molar	child	
Room 143:				
FS 6768	Layer 1	metacarpal shaft, tarsal	adult	
FS 6778	Layer 2	metacarpal shaft	adult	
Room 147:				
FS 6343	Wall Niche 4	innominate fragment, lumbar vertebra, metacarpal, 2 hand phalanges	adult female	
Kiva 10:				
FS 6500	Level 15	L scapula fragment	adult	
Trash Mound:				
FS 4809	Column 3, Layer 37	foot phalanx fragment	adult	
FS 4671	Column 6, Layer 113	metatarsal, foot phalanx, third molar	adult	
FS 4593	Grid 223, Level 6	hand phalanx	adult	
FS 4559	Grid 239, Level 14	molar	adult	
FS 4573	Grid 267, Level 6	molar	adult	
FS 4642	Slump 2	L femur shaft	adult female?	carnivore gnawed
FS 4643	Profile Cleaning	L ilium fragment	adult	

Table 13.2. Estimated number of individuals represented by the isolated fragments.

Minimum:

6-month-old infant
10-15-year-old child
adult male
adult female

Maximum:

Kiva 1	1	6-month-old infant
OS 6	1	10-15-year-old child
Room 203 and North of Kiva 7	1-2	adults
Plaza Feature 1	1	adult male
Plaza 1	1	adult
Rooms 143, 147, and Kiva 10	1-3	adults
Trash Mound	1-5	adults
Subtotal	7-14	

Teeth:

Plaza Feature 1	1	child
Plaza 2	1	adult
Room 110	1	adult
Room 142	1	child
Trash Mound	1-2	adults
Subtotal	5-6	
Total	12-20	

teristic of Anasazi infant skeletons. It may represent use of the site area by Navajo or other nomadic groups after the Anasazi abandonment.

Isolated fragments of human bone were found throughout the site (Table 13.1). If only the age and sex distribution are considered without regard for location, as few as four individuals are represented (a 6-month-old, a 10-15-year-old, an adult male, and an adult female). When the spatial distribution combines those in reasonable proximity, and isolated teeth are not included (Table 13.2), between 7 and 14 persons are suggested (1 infant, 1 adolescent, and from 7 to 18 adults). If isolated teeth are included, we can add two children and three or four more adults.

Twenty deaths is not many for a site that may have been occupied by up to 70 persons for over 100 years. Then again, only 10 percent of the site was sampled, and a functional cemetery, such as the burial rooms at Pueblo Bonito, may have been missed.

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Appendix A

Statistical Nomenclature

H. Wolcott Toll

Summary of statistics and symbols used in various chapters.

Statistic	Symbol	Derivation and Use	Reference
NOMINAL DATA			
Chi-square	X^2	Test for difference in occurrence of attributes among groups.	Siegel 1956:175
Contingency coefficient	C	Measures the strength of association based on the X^2 distribution and controls for sample size; directly comparable only for contingency tables of the same size.	Siegel 1956:196
Fisher's Exact Test	p	Calculates the probability (p) that two samples are the same for two variables; used for small samples.	Siegel 1956:96
Diversity	H'	Measures the distribution of items in various categories (types, species) in a given sample; based on the logs of the percents in the categories.	Pielou 1969:229
Evenness	J	Compares the maximum possible value of H' with the actual value to give an index of the evenness of distribution (0 = all in 1 category, 1 = same percent in each category).	Pielou 1969:229
Richness	s	Used in conjunction with H' and J; the number of categories present.	Pielou 1969:229
Coefficient of Jaccard	S_J	Gives an index of similarity between two groups based on the co-occurrence of attributes.	Sneath and Sokal 1973:131
ORDINAL DATA			
Spearman's Rank Order Coefficient	r_S	Gives a coefficient of correlation between two groups that can be ordered on the occurrence of some attribute, or one group ranked by two variables.	Siegel 1956:202
INTERVAL DATA			
Mean	$\bar{x}$	The average of a series of values.	
Coefficient of variation	CV	The standard deviation divided by the mean; gives a standardized value for variability expressed as a percent.	Thomas 1976:82
Standard deviation	sd	Measures the dispersion of cases around the mean and the variability of the sample; the percentage of cases falling within given numbers of standard deviations from the mean is known.	Kushner and DeMaio 1980
Student's t-test	t	Compares the means of two groups to determine whether the two are likely to be from the same or different populations.	Kushner and DeMaio 1980:156
F test	F	Compares the variance estimates for two samples as a ratio in order to determine whether or not the variances are the same; the result is compared to a known distribution.	Kushner and DeMaio 1980:175
ABBREVIATIONS			
degrees of freedom	df	Calculated variously for different statistics; concerns "the number of parameters that are allowed to vary" after "certain restrictions are placed on the data."	Kushner and DeMaio 1980:260 Siegel 1956:44
probability	p	Gives the likelihood that a larger value will be obtained for a certain statistic, given the df of the sample (see also Fisher's exact above).	

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Appendix B

List of Microfiche Appendices for Volume III

Index

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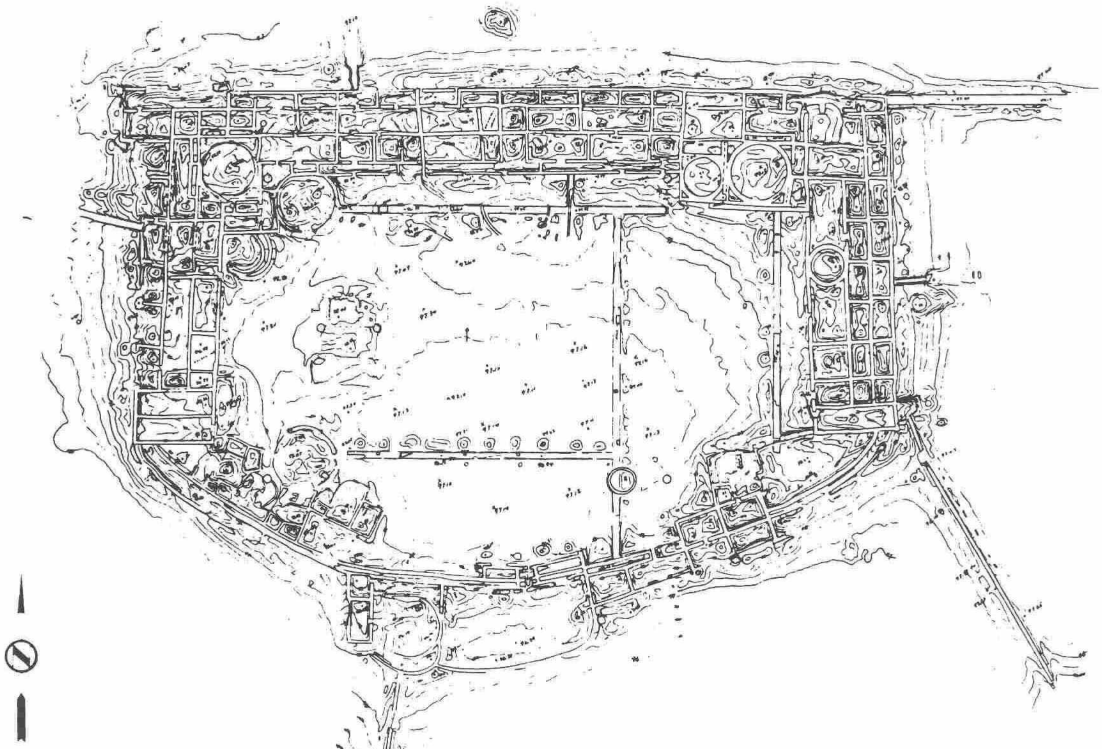

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