PECOS

From Folsom to Fogelson:

The Cultural Resources Inventory Survey of Pecos National Historical Park

CHAPTER 4:
CERAMIC CHRONOLOGY

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> *In the Rio Grande, as in other parts of the Southwest, pottery has proved, on preliminary reconnaissance, to be the most serviceable single criterion; the general ceramic history of the region has been worked out by strategic excavation. It remains to examine all the ruins in the area and, using pottery as our criterion, to rank them in proper chronological order.*
>
> Alfred Vincent Kidder, *The Pottery of Pecos*

Chronology is the foundation upon which all other archeological inference is based. Implicit in Kidder's stated objective of 70 years ago is the recognition that the archeologist must successfully control time before more explanatory research goals may be addressed. Knowledge of the timing and relative sequence of events in the past is critical to understanding the causes of those events, as well as the relationships between them.

This chapter presents a temporal framework for the occupation of pre- and protohistoric Puebloan sites within Pecos National Historical Park, based on ceramic data recorded by the Pecos survey. While historic Puebloan poly-chrome ceramics are used in construction of the site chronology in this chapter, other types of historic artifacts and documentary sources were not considered in assigning sites to time periods. The historic era chronology is treated explicitly in Chapter 10 (see also Ivey 1996 for a structural history of the Pecos mission).

Following a brief discussion of traditional northern Rio Grande chronologies and known chronometric dates from the park for the ancestral Puebloan period, the chapter describes the construction of a Pecos ceramic chronology that is independent of other cultural traits. Ceramic mean dating and ceramic probability dating are the primary methods used to partition time, with the best results achieved using the probability approach.

The purpose of the dating project is to date individual sites in an objective, consistent, and replicable manner. A related goal is to use ceramic data to classify Pecos sites into useful and appropriate temporal divisions in order to provide a structure in this report for monitoring change through time in variables such as settlement, lithics, and architecture. A distinction is drawn between the culture history of the Pecos area and the survey project chronology as a temporal classification method based solely on surface ceramic data. The chronology outlined here serves as a baseline for research questions framed in subsequent sections of the report.

Ceramic Typologies

In the American Southwest, concern with chronology can be traced to Kidder's systematic study of ceramics and stratigraphy at Pecos Pueblo (Kidder 1924; Kidder and Amsden 1931; Kidder and Shepard 1936), modeled after Nelson's (1914) stratigraphic excavations at nearby Pueblo San Cristobal. Kidder found that the forms and design styles of ceramics changed through time, providing a method for dating ceramic types relative to one another based on their vertical placement in the stratigraphy. Other early research on the ceramics and chronology of Pecos includes work by Amsden (Kidder and Amsden 1931) and by Shepard (1936, 1942), who described the Pecos pottery types and noted their relative occurrence in the stratified middens of Forked Lightning and Pecos Pueblos. Mera's (1933, 1934, 1935) regional syntheses were also instrumental in defining ceramic types and in establishing a cultural, spatial, and temporal sequence for the Rio Grande region.

When linked to the tree-ring record in the 1930s, pottery was recognized by archeologists as an even more sensitive indicator of the age of prehistoric sites. Ceramics found in association with dateable wood permitted more tightly controlled dates to be assigned to pottery types (Breternitz 1966; Smiley 1951; Smiley et al. 1953). Relying on the principle of cross-dating, other sites where these ceramic types were found could be fitted into the known temporal sequence.

Early Southwestern ceramic researchers recognized the value of decorated ceramic types as time markers, a function that they continue to fulfill today. Types are viewed simply as tools for achieving chronological goals and are not considered emic categories. Although the traditional ceramic types encompass much variation, they are still in wide use by archeologists working in the region. In contrast to other areas of the Southwest, ceramic types in the northern Rio Grande are defined on the basis of a combination of technological attributes—primarily paste and temper—with far less attention paid to particular design styles. Fortunately for this project, identifying ceramic types using technological characteristics works well for even the small sherds typically found on survey.

Rio Grande Chronologies

The Pecos Classification, the earliest chronology for the Southwest, was a product of the first Pecos Conference held in 1927 at Kidder's Pecos field camp. Despite its name and origin, however, the Pecos Classification (Kidder 1927) is no longer a valid temporal scheme for either Pecos or for the northern Rio Grande culture area. Researchers working in the area today follow Wendorf and Reed (1955), who proposed revisions to the original chronology to bring it more in line with the known prehistory of the northern Rio Grande region, which does not mirror the cultural sequence of areas farther west (Figure 4.1). In particular, Pecos does not have the time depth that Kidder originally sought when he began research at Pecos Pueblo. The Pecos Classification temporal designations of Basketmaker, Pueblo I and II were subsequently found to be absent, and therefore, inappropriate descriptions of cultural patterns at Pecos.

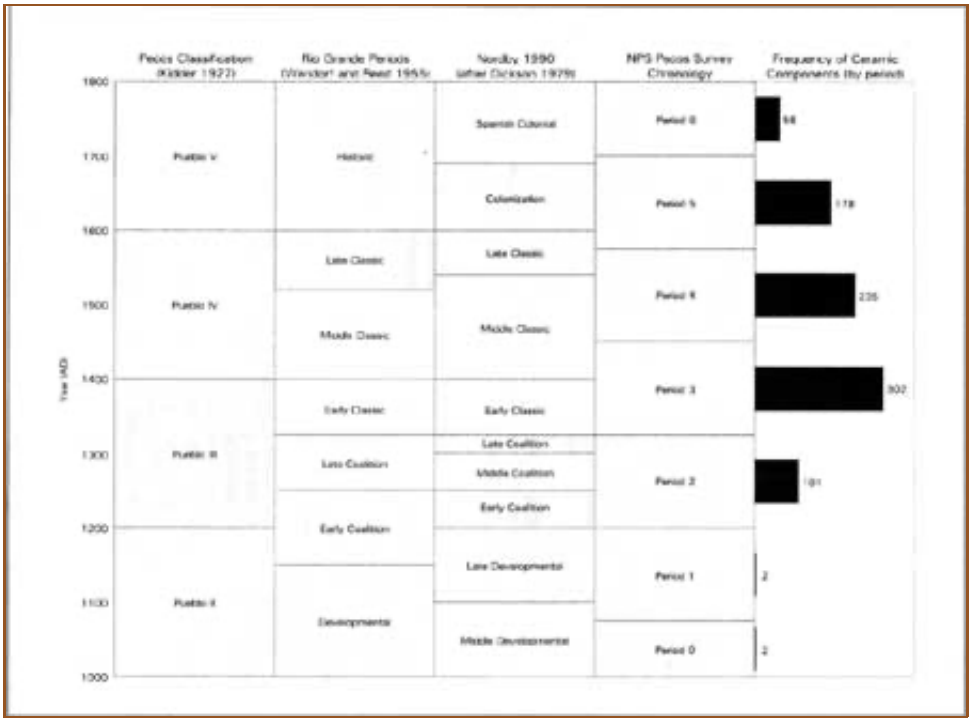


Figure 4.1. Comparison of temporal framworks for the northern Rio Grande region with the Pecos survey chronology and component frequencies. *(click on image for an enlargement in a new window)*

The Wendorf and Reed (1955) chronology identifies five major temporal periods, based on changes in settlement patterns, architecture, and artifacts: Preceramic, Developmental, Coalition, Classic, and Historic. Dickson (1979) later subdivided Wendorf and Reed's temporal periods based on survey work in the Galisteo Basin. An abbreviated summary of the Pecos culture history is discussed below. The chronology developed in this chapter does not encompass the Preceramic period (11,500 B.C.-A.D. 600). However, survey finds including an isolated Folsom point midsection in the Tecolote Range of the park attest to Paleoindian use of the Pecos landscape. (See Chapter 9, for more information on the Preceramic period.)

The early Developmental period in the northern Rio Grande area (A.D. 600-1200) is represented at Pecos by the presence of at least one small pithouse village beginning in A.D. 800. Ground-disturbing activities at Pecos National Historical Park in recent decades encountered three pithouses (PECO 53, 61, 207) approximately 1 m (3.3 ft) below ground with no surface indications of their presence (Nordby 1981; Nordby and Creutz 1993a). A fourth pithouse was located in the vicinity during later testing for a new maintenance building (Akins 1994:16-21). Indications of two other possible pithouses were noted in 1999 (Judy Reed, personal communication 1999).

Chronometric dates for the excavated pit houses establish occupation around A.D. 800-850 (Table 4.1). Archeomagnetic samples from the Sewerline Site (PECO 207) processed by Robert DuBois of the University of Oklahoma date to A.D. 840 ± 40. Three tree-ring dates were also obtained from PECO 207, with one cutting date of A.D. 801 (Robinson and Cameron 1991). Tree-ring dates from PECO 53 (Hoagland's Haven) indicate that the wood was cut in the years A.D. 832 and 841 (Nordby and Creutz 1993a). These sites are the only

documented early Developmental period sites within the park.

When considering the pithouses and the next known occupation at the oldest black-on-white pueblos, there seems to be a hiatus in occupation in the Upper Pecos Valley between A.D. 900 and 1000. No sites definitely date to this time period. However, excavations at Rowe (Cordell 1998) and at Forked Lightning (Kidder 1958) revealed small, underlying adobe structures that could possibly date to the eleventh century. The nature of these occupations is difficult to define since the adobe structures have been severely disturbed by the later, overlying pueblos.

Visibility may be a factor in explaining the apparent absence of sites from this time period, since earlier sites may be differentially affected by greater deposition. If structures at this time were built of adobe, walls may have melted and may be difficult if not impossible to recognize on the surface. Rather than projecting culture forward or backward in time, however, it may be that structural sites from this time period simply do not exist. Settlement patterns at this time could have been more mobile, with intermittent or seasonal use of the valley, although we would expect to see some ceramic evidence if people were present.

Later Developmental period occupations in the northern Rio Grande region include above ground structures and small pueblos with kivas. The ceramic hallmark of the late Developmental period is Kwahe'e Black-on-white, which dates to ca. A.D. 1050-1250 (McKenna and Miles 1991). Identified in part by the use of iron paint, Kwahe'e Black-on-white is easily distinguished from later Rio Grande White Ware types decorated with organic pigments. Only 15 sherds of Kwahe'e Black-on-white were recorded by the Pecos survey, perhaps signaling a relative absence of human settlement in the Pecos Valley during this time period. Excavations at Arroyo Hondo and Rowe pueblos have encountered a similar lack of Kwahe'e Black-on-white ceramics (Cordell 1998; Habicht-Mauche 1993). Elsewhere in the northern Rio Grande area, the Bandelier archeological survey (Powers and Orcutt 1999) recorded 1,101 Kwahe'e Black-on-white sherds, indicating greater occupation on the Pajarito Plateau at this time.

Table 4.1. Summary of chronometric dates from Pecos National Historical Park.

Site	Earliest Cutting Date	Latest Date	N	Method	Comments
Sewerline Site PECO 207 (LA 118808)	801	801 840 ± 40	3	Dendro Archeomag	
Hoagland's Haven PECO 53 (LA 14154)	832	841	17	Dendro	1 date cluster
Forked Lightning Pueblo PECO 226 (LA 672)	-	1148	8	Dendro	No in-site provenience. 904 is the earliest noncutting date.

Arrowhead Pueblo PECO 710 (LA 251)	1370	1392	60 Dendro	2 date clusters.
Pecos Pueblo PECO 228 (LA 625)	1299	1695	99 Dendro	4 date clusters

All dates are A.D. References: Nordby and Creutz 1993a; Robinson and Cameron 1991; Robinson et al. 1973; Smiley 1951; Smiley et al. 1953; Stallings 1933, 1937.

Note. See Appendix E for a summary of tree-ring dates collected in 1998 from Pecos Pueblo, the Pecos Church, and Kozlowski's Trading Post by Thomas Windes.

Forked Lightning, a coursed adobe pueblo with over a hundred rooms, has eight published tree-ring dates that fall between A.D. 904 and 1148, all from unprovenienced contexts (Table 4.1) (Robinson et al. 1973; Smiley et al. 1953). With one exception, the dates are *vv,* meaning that it is impossible to estimate the distance between the last ring and the true outside of the wood (Robinson et al. 1973:5). Because the dates reported by Smiley et al. (1953) were obtained from charcoal fragments, Kidder (1958:42) felt that these were unreliable and "almost certainly too early." This observation is borne out by the ceramics found on site, the predominant type being Santa Fe Black-on-white, which has a traditionally accepted beginning date of around A.D. 1175-1200. The lack of substantial numbers of Kwahe'e Black-on-white ceramics would also appear to indicate that the site was not founded before A.D. 1175. However, Kidder's excavations and the survey noted the presence of basket-impressed sherds, both utility and black-on-white ware, which tend to be associated with early proveniences (i.e., the Late Developmental period, A.D. 1000-1200) in the northern Rio Grande region.

Major settlement of the Pecos area began during Wendorf and Reed's Coalition period. In the northern Rio Grande area, the Coalition period (A.D. 1200-1325), particularly the latter part, has been widely characterized as a time of demographic upheaval. Migrants from the Colorado Plateau are thought to have pushed southward in search of favorable environmental conditions, spurred by more severe environmental fluctuations and by the "Great Drought" of A.D. 1275-1300 (Cordell 1989; Crown et al. 1996; Dean 1996; Rose et al. 1981). The presence of more sites in a previously sparsely settled landscape is the primary evidence for an influx of population to the Rio Grande Valley during the Coalition period (Stuart and Gauthier 1981). Nonetheless, clear indicators of migrant populations are unknown. Similarity of Rio Grande White Ware ceramic designs to Mesa Verde ceramic design styles is often mentioned (Collins 1975; Lang 1984; Mera 1935; Wendorf and Reed 1955), but this is more often a matter of casual speculation than systematic analysis.

During the Coalition period in the northern Rio Grande region, masonry and jacal roomblock structures are common. Kivas exhibit a variety of forms; round and square kivas are present, in both subterranean and within-roomblock locations. The initial appearance of agricultural features is proposed for this period (Cordell 1989; Woosley 1986). A diversification of ceramic types is noted, with a shift from mineral to organic paints. Santa Fe Black-on-white is

considered diagnostic. The best evidence for settlement during the early Coalition period in the Pecos area comes from Forked Lightning Pueblo and from an adobe structure underlying Rowe Pueblo, dated to A.D. 1240-1250. During the later Coalition period, as many as six pueblos of 50 rooms or more are known from the Upper Pecos Valley. In addition to Forked Lightning Pueblo and Rowe Pueblo, Black-on-white House, Shin'po, Loma Lothrop, and Dick's Ruin appear to have been inhabited at this time.

The Rio Grande Classic period (A.D. 1325-1600) is a time of population aggregation and the establishment of large-scale residential communities. Construction of multiroom and multi-storied pueblos surrounding central plazas, along with a more intensive commitment to agriculture, are indicative of increasing population size and sedentism. The increase in settlement size and shift towards aggregation is thought to be accompanied by heightened regional interaction and trade (Snow 1982; Wilcox 1991). Rio Grande Glaze Ware pottery predominates, sometimes hypothesized to have been made in imitation of western pueblo glaze ware ceramics such as St. Johns and Heshotauthla polychromes from the White Mountain Red Ware series of the Cibola area (Habicht-Mauche 1995; Spielmann 1998).

In the Upper Pecos Valley, Rowe Pueblo, Pecos Pueblo, and Loma Lothrop continue to be active communities during the Classic period. The sites of Arrowhead Pueblo and nearby Hobson-Dressler (not located within the present park boundaries) were founded during the early Classic period.

Arrowhead Pueblo is the most securely dated structure in the Upper Pecos Valley. A 100+ room masonry pueblo, the site was excavated in the 1930s and 1940s by W. C. Holden. A series of 60 tree-ring dates from the site cluster at A.D. 1370, the probable date of initial construction (Table 4.1) (Robinson et al. 1973:9). The large number of consistent cutting dates provides strong support that roof beams for the pueblo were cut during the nongrowing season, most likely between the fall of A.D. 1370 and the spring of A.D. 1371 (Thomas Windes, personal communication 1998). A later building episode is reflected in beams from a D-shaped corner kiva, apparently added to the pueblo around A.D. 1390 (Robinson et al. 1973:9).

However, an incongruence exists between the Arrowhead Pueblo tree-ring dates and the commonly accepted production span for the ceramic types recorded during excavation (Holden 1955). While the production interval of Glaze I (A.D. 1315-1425) spans the Arrowhead Pueblo tree-ring date range (A.D. 1370-1390), the presence of substantial quantities of supposedly earlier, Santa Fe Black-on-white ceramics (A.D. 1175-1350) is more difficult to reconcile. It is possible that Santa Fe Black-on-white was produced later than A.D. 1350, or alternately the tree-ring dates might reflect later construction or remodeling of structures built prior to A.D. 1350.

Given the large sample and the reliability of the tree-ring dates from Arrowhead Pueblo, it is most likely that Santa Fe Black-on-white was produced later in the Pecos area than is normally assumed. Tree-ring and archeomagnetic dates from Arroyo Hondo Pueblo in the Galisteo Basin (Habicht-Mauche 1993) provide additional evidence that Santa Fe Black-on-white vessels were produced in the northern Rio Grande region until around A.D. 1425, extending the known production span of the type to a total of 250 years.

Pecos Pueblo was founded by around A.D. 1400, as an aggregate community integrating population from the earlier, dispersed pueblos of the Pecos Valley. Given the longevity of Pecos Pueblo, it is not surprising that the 99 tree-ring dates from various contexts at the site range from A.D. 1300-1700 (Table 4.1) (Robinson et al. 1973:26-29). Clusters of cutting dates from several rooms suggest discrete construction episodes in A.D. 1433, 1434, 1501, and 1513 (Smiley et al. 1953) but represent only a portion of the 600-year time span Pecos Pueblo was occupied. Discrepancies in dates from the Pecos Pueblo proveniences (Robinson et al. 1973:29) indicate mixed deposits or reuse of old wood, throwing some doubt on the reliability of individual dates from the site. Windes (Appendix E) reports four new tree-ring dates in the A.D. 1400s for North Pueblo and one additional date of A.D. 1542 from South Pueblo.

Rio Grande Glaze Ware ceramics continued to be produced until about A.D. 1700, when locally made historic polychromes replaced the glazes. While the Puebloan historic polychromes are used in construction of the site chronology in this chapter, the Euro-American ceramics that appear shortly thereafter are not. Other types of historic artifacts and documentary sources were not considered in assigning sites to time periods. With the exception of the indigenous polychrome ceramics at the Euro-American homesteads, Pecos historic components are excluded here.

Background on the Survey Chronology

Based on the project research design (Head 1997a), the first step in the chronological analysis was to locate existing, comparative ceramic assemblages from securely dated, excavated contexts in the northern Rio Grande region. Following Orcutt's (1999a) approach to the Bandelier ceramic chronology, it was thought that this independent data might allow the Pecos assemblages to be assigned to more precise temporal periods through multiple regression analyses such as those employed by Kohler and Blinman (1987).

However, the search for ceramic assemblages from Pecos or contemporary assemblages from the northern Rio Grande area with associated absolute dates was not successful, because the relationship between existing collections of ceramics and the few absolute dates was often unclear. Many of the ceramic collections are poorly provenienced, and due to sampling methods and collection culling, are not complete assemblages. Further complicating the situation, the available tree-ring dates are often noncutting dates and come from sites with multiple occupations. Clearly, more excavations aimed at recovering complete assemblages from well-dated contexts are needed for a similar study to be successful in the Pecos area.

The Pecos Ceramic Assemblage

Sampling and Analytic Methods

As described in the methodology section of the report (Chapter 3), a noncollection approach to research was followed on this project. Sites were recorded by analyzing artifacts in the field. Typically, all ceramic artifacts within a scatter were inventoried, except in those instances (n=85) when more than 200 sherds were present. In such cases, the analyst set out stratified random sample grids until 400 sherds or 1 percent of the total estimated sherds in the scatter were recorded (whichever was less). This sampling procedure was adopted with two goals in

mind: to gain representative data on the overall scatter assemblage and to collect information on artifact density.

To obtain the most accurate dates possible for each site, the field recorders grouped the sherds analyzed at each site by ceramic type, according to descriptions provided in the ceramic field manual (available through National Park Service, Santa Fe). This method enables comparison of proportions of the different ceramic types in each assemblage. Since chronology was emphasized as a major goal in the project research design, ceramic types rather than other ceramic attributes such as temper or design styles were recorded. The ceramic type approach has the added advantage of comparability with previously published data. Preliminary judgmental dates were assigned by analysts in the field, using a simple method of bracketing the earliest and latest ceramic types present.

A potential source of inconsistency that should be acknowledged is the multiple ceramic analysts who participated in the project. During three seasons of work, eight different ceramicists classified and recorded ceramics in the field. Descriptions for distinguishing ceramic types were clear, and training and communication between analysts was high. However, any application of the ceramic type approach must recognize possible differences in the way sherds are classified by individuals.

The Ceramic Database

The resulting database consists of 631 ceramic samples from 487 sites with ceramics. Of the 631 total samples, 541 consist of the entire scatter, 85 are smaller samples of the entire assemblage, and five are samples of diagnostic or unusual items outside the established sample area. Aside from the five "items of interest" samples, all of the samples were treated equally as representative samples in construction of the chronology. The reader is referred to Chapter 3 for a more detailed discussion of the survey sampling strategy.

The nature of the Pecos ceramic assemblages presents some problems for dating sites. The prevalence of small surface assemblages with few diagnostic items lessened confidence in the date assignments for small assemblages in all of the methods discussed in this chapter. In fact, 27 percent (n=170) of the 631 ceramic assemblages have five or fewer dateable sherds. This pattern of small assemblage sizes is due in part to a disturbed landscape, since modern bulldozing was a common practice at Pecos that displaced sites and artifacts. (See discussion of vegetation removal, Chapter 5.) Prior visitation at many sites resulted in surface collection of ceramics. In addition, historic use of the Pecos landscape almost certainly impacted prehistoric sites. Finally, 23 percent of the Pecos sites (n=142) have no ceramics.

Aside from later landscape disturbance, the function of the prehistoric sites in question probably contributes more to the small size of the surface ceramic assemblages. The project site typology (Chapter 5), determined primarily by the presence or absence of architectural features, classified 600 of the Pecos sites as seasonal or special-use. Such sites were probably used only on a short-term or intermittent basis. Seasonal and special-use sites would be expected to have smaller artifact assemblages than full-time habitation sites, which may account for some of this patterning.

The large quantity of unidentifiable glaze ware sherds found at Pecos sites also restricts the

ceramic sample available for dating. Since the glaze ware sequence in the northern Rio Grande is distinguished largely on the basis of rim form, following Mera (1933), most glaze ware body sherds are not temporally diagnostic. In some cases, particular design elements or the quality of the glaze paint itself permits positive identification. However, 65 percent (n=5,957) of the glaze ware sherds encountered by the survey could not be identified by type. In small assemblages, body sherds could sometimes be matched stylistically or physically with dateable rim forms. In assemblages where multiple rim types were present, this was impossible.

Ceramic Wares and Chronologically Sensitive Types

The major ceramic types found within the park boundaries may be discussed under the broader heading of wares. A ware is defined as "a class of pottery whose members share similar technology, fabric, and surface treatment" (Rice 1987:484). Wares at Pecos include Rio Grande Gray Ware (Colton 1953), Pajarito White Ware (Cordell 1998; Habicht-Mauche 1993), Rio Grande Glaze Ware (Mera 1933, 1935), historic polychromes (Batkin 1987; Harlow 1973), and Apachean ceramics (Gunnerson 1968, 1969a). Within each ware, ceramic "types" are recognized as a "consistent association of attributes" (Rice 1987:484), including characteristic paste and tempers. Ceramic type classifications in the field followed published descriptions listed in Table 8.2. Table 4.2 provides the best available date ranges for the temporally diagnostic ceramic types, organized by ware. Most date intervals are derived from tree-ring information that brackets the earliest and latest contexts in which these ceramics are found. These temporally diagnostic types are the only ceramics used in the chronological analyses described in the remainder of the chapter.

The currently accepted tree-ring date ranges for the Rio Grande Glaze Ware types (see Table 8.2) (Eighth Southwestern Ceramic Seminar 1966; McKenna and Miles 1991; Mera 1933, 1935; Nordby 1990; Warren and Snow 1976) imply a measure of precision that simply may not exist for the ceramic types from the northern Rio Grande. Snow (1982, 1989, 1997) has suggested various revised date ranges that subsume the individual glaze ware types into early, middle, and late variants. While Snow feels that these larger groupings are better estimates of dates for the glaze ware sequence, sufficient new data have not yet accumulated to allow us to revise the long-standing glaze ware sequence for the northern Rio Grande region as a whole. Spielmann (personal communication 2000) has noted that Snow's (1997) dates may have some validity for the Salinas area. Until northern Rio Grande researchers with recent ceramic information from tightly controlled excavated contexts pool their data, it is difficult to evaluate which dates are most in need of revision.

Table 4.2. Date ranges for Pecos ceramic types.

Type Name	Start Date	End Date	Median
PAJARITO WHITE WARE[a]			
Kwahe'e Black-on-white	1050	1250	1150

Chupadero Black-on-white	1175	1540	1358
Santa Fe Black-on-white	1175	1350	1263
Pindi Black-on-white	1300	1350	1325
Galisteo Black-on-white	1300	1400	1350
Rowe Black-on-white	1300	1425	1363
Jemez Black-on-white	1300	1750	1525
Wiyo Black-on-white	1300	1400	1350
Biscuit A	1375	1450	1413
Biscuit B	1400	1550	1475
RIO GRANDE GLAZE WARE[b]			
Glaze I Agua Fria Glaze-on-red	1315	1425	1370
Glaze I	1325	1425	1375
Cieneguilla Glaze-on-yellow			
Sanchez Glaze-on-red, Glaze-on-yellow, Glaze polychrome			
Glaze I San Clemente Glaze polychrome	1315	1425	1370
Glaze II	1400	1450	1425
Largo Glaze-on-red, Glaze-on-yellow, Glaze polychrome			
Medio Glaze polychrome			
Glaze III Espinosa Glaze polychrome	1425	1490	1458
Glaze IV San Lazaro Glaze polychrome	1475	1515	1495
Glaze V Pecos Glaze polychrome	1515	1700	1608
Glaze V Puaray Glaze polychrome	1515	1650	1583
Glaze VI Kotyiti Glaze-on-red, Glaze-on-yellow, Glaze polychrome	1625	1700	1663
POLYCHROMES[c]			
Sakona Polychrome	1580	1700	1640
Tewa Polychrome	1650	1750	1700
Tewa Black-on-red	1650	1760	1705
Pojoaque Polychrome	1690	1800	1745
Ogapoge Polychrome	1720	1760	1740

[a]Data from Breternitz 1966; Habicht-Mauche 1993; McKenna and Miles 1991; Smiley et al. 1953; Stubbs and Stallings 1953.

[b]Data from Eighth Southwestern Ceramic Seminar 1966; Mera 1933, 1935; Nordby 1990; Warren and Snow 1976.

[c]Data from Batkin 1987; Harlow 1973.

The survey did not elect to group the individual glaze ware types into early, middle, and date variants as has been proposed by Snow (1997). The sequence of individual Glaze I through Glaze VI types appearing in successive stratigraphic levels continues to hold validity for Pecos (Kidder and Shepard 1936). It is certainly acknowledged that a great deal of work must be undertaken to refine the dating of the glaze ware types, mainly through the development of more secure dates derived from excavation. However, that was not the aim of the present survey, and the date ranges used in this chapter reflect the best available and most commonly-used glaze ware dates at the time the survey was undertaken.

Dating the Pecos Survey Sites

The second half of this chapter describes the specific methods used to date the Pecos survey sites. The project goals required sites to be dated individually, and assigned to a nonoverlapping sequence of time periods in order to track changes through time. The first approach discussed is mean ceramic dating, which provides valuable information about the temporal ordering of sites relative to one another. This section is followed by a discussion of probabilistic ceramic dating, the method that was ultimately used in the construction of a chronology for the Pecos survey.

The Mean Ceramic Date Approach

Mean ceramic dates are one approach to dating surface assemblages relative to one another. This simple statistical technique was used to determine the chronological placement of each Pecos assemblage, based on the relative frequencies of ceramic types with known date ranges (Table 4.2). First devised by South (1977) and tested using known production spans for Euro-American historic artifacts, mean ceramic dates have been used by other researchers to date pre-historic Southwestern ceramic assemblages (Christenson 1994; Goetze and Mills 1993; Kincaid et al. 1983; Mills 1988; Upham and Bockley 1989; Van Dyke 1997). In essence, the mean ceramic date formula creates a relative seriation of ceramic assemblages. One major advantage is that results are replicable and objective. Significantly, results are generally comparable to those generated by more complex methods of multivariate analysis, including multi-dimensional scaling (Mills 1988).

South's Mean Ceramic Date Formula

For each Pecos assemblage, the mean ceramic date was computed by multiplying the estimated median production date of each ceramic type by the frequency of that type, calculating the sum of the products of all types, and dividing by the total number of dated sherds in the assemblage (South 1977). For comparative purposes, several mean ceramic dates were calculated for the Pecos data, substituting sherd counts and sherd weights for measures of frequency, with both measures providing results that are close (most within 10 years). However, sherd counts proved easier to work with and seemed to provide more consistent results, so are used here. (Chapter 8 contains details of other ceramic attributes recorded by the survey, not used in the chronological analysis.)

Assumptions of Mean Ceramic Dating

Mean ceramic dating necessarily relies on several assumptions common to all seriations. First, breakage of pottery is assumed to occur soon after a ceramic type is first produced and is considered to occur in the same proportion as use. Mean ceramic dating also assumes that the frequency of a ceramic type can be approximated using a unimodal curve. As applied here, the mean ceramic date method equates type production spans with site occupation spans. Use of mean ceramic dates implies that the currently accepted date range for each ceramic type is a reasonable estimate of when the ceramics at a site were actually used.

A key consideration in the application of the mean ceramic date formula is which ceramic types to include. In most cases utility ware ceramics were not used for assigning sites to time periods because their assumed 400-year interval of production adds little to the refinement of the chronology. Omitting utility wares from the analysis also controls for some of the possible functional differences between sites. While changing styles of decorated ceramics have demonstrated chronological value, changes in utility wares are more likely to be influenced by functional constraints.

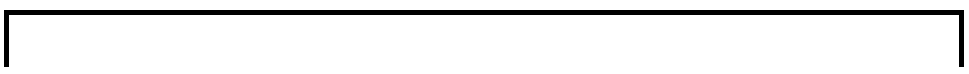
Method

A mean ceramic date was calculated for all Pecos assemblages having more than five dateable sherds. In similar analyses, Goetz and Mills (1993) and Christenson (1994) found that mean ceramic dates derived from only 5-10 dateable sherds closely approximate the mean ceramic date calculated using larger sample sizes, and significantly, the mean ceramic dates generated from independent tree-ring dates. Since many of the Pecos ceramic assemblages are small, a cut off of five sherds was chosen as a reasonable compromise between the need to obtain reliable mean ceramic dates and the desire to include as many sites as possible in the analysis.

Some Pecos sites have previous collections, and in these instances sample sizes were increased by analyzing those ceramic collections using the survey methodology. Ceramics collected by Kidder from surface contexts and curated by the Robert S. Peabody Museum of Archaeology at the Phillips Academy in Andover, Massachusetts, were included in this fashion. Surface collections by Fliedner (1981) and by Nordby (1990), currently stored at the National Park Service IMSF, that could be matched to known Pecos sites, were also reanalyzed using the present survey's recording format.

Mean Ceramic Date Findings

Mean ceramic dates for the Pecos sites (Table 4.3) were evaluated using descriptive and exploratory statistics in order to note patterning in the data. Figures 4.2 and 4.3 are stem-and-leaf diagrams of the mean ceramic dates assigned to each Pecos survey assemblage, ordered by decade and by two-decade intervals, respectively. Figure 4.4 presents the data as a histogram, organized by 50-year intervals. There is no strong overall directional trend in the data, although the patterning becomes clearer with large time groups, as seen in Figure 4.3, with each line representing two decades. Several suggestive natural breaks indicate relatively fewer sites between A.D. 1320-1330, during the A.D. 1500s, and after A.D. 1710.



177 3333

176

175 5

174 46

173

172

171 08

170 055555

169 09

168 5

167 4448

166 134

165 35

164 012669

163 000013489

162 3447

161 233

160 335588888888

159 49

158 29

157 467

156 2

155 5

154 35

153 3499

152 24499

151 122556689

150 34568

149 5559

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148 2389
147 00266
146 0002467899
145 012234459
144 12345678899
143 012234459
142 14566777889
141 3456898
140 033569
139 0003344678
138 02259
137 0012356689
136 044667899
135 00012459
134 15679
133 16699
132 08
131 1555
130 144679
129 19
128 011367888
127 88
126 33
```

Note: This figure provides a visual picture of the distribution of the mean dates as well as actual date values. It is read by combining the stem value on the left (decade) with leaf values on the right (individual years). For example, the bottom line of the diagram represents the decade A.D. 1260, with two mean dates of 1263 from two sites. Decades with no mean dates (1760) lack leaf values.

Figure 4.2. Stem-and-leaf diagram of the mean dates of the Pecos survey

assemblages by decade.

```
176 3333

174 465

172

170 05555508

168 509

166 1344448

164 01266935

162 3447000013489

160 335588888888233

158 2949

156 2467

154 355

152 244993499

150 34568122556689

148 23895559

146 0002467889900266

144 1234567889924888889

142 14566777889012234459

140 0335693456889

138 0222590003344678

136 0446678990012356689

134 1567900012459

132 0816699

130 1446791555

128 01136788819

126 3388
```

Note: This figure provides a visual picture of the distribution of mean dates. It is read by combining the stem value on the left (decades in 20-year intervals) with leaf values on the right (individual years). For example, the bottom line of the diagram represents the interval between 1260 and 1279, with two mean dates of 1263 and two mean dates of 1278. Each leaf value is a mean date from one site. Some resolution is lost by compressing dates into 20-year intervals; refer to Figure 1 for actual date values. Intervals with no mean dates lack leaf values.

Figure 4.3. Stem-and-leaf diagram of the mean dates of the Pecos survey assemblages, in 20-year intervals.

Table 4.3. Ceramic mean dates for the Pecos survey sites.

PECO Site No.	Component	Mean Date (A. D.)	PECO Site No.	Component	Mean Date (A. D.)	PECO Site No.	Component	Mean Date (A. D.)
4	1	1448	101	1	1460	252	1	1608
6	1	1350	103	1	1449	261	1	1519
8	1	1503	108	1	1594	265	1	1421
9	1	1382	109	1	1555	266	1	1431
10	1	1529	112	1	1603	274	1	1744
12	1	1403	115	1	1539	277	1	1773
13	1	1460	119	1	1773	279	1	1469
15	1	1638	120	1	1442	286	1	1674
16	1	1543	125	1	1685	293	1	1403
17	1	1470	126	1	1427	294	1	1341
20	1	1441	127	1	1468	301	1 / 2	1464
21	1	1539	129	1	1504	305	1	1488
22	1	1369	136	1	1396	307	1	1352
22	1	1705	138	1	1470	315	1	1389
23	1	1433	139	1	1516	316	1	1350
24	1	1315	144	1	1630	321	1	1624
25	1	1299	151	1	1746	322	1	1425
26	1	1304	157	1	1495	323	1	1400
30	1	1283	160	1	1414	331	1	1524
32	1	1315	163	1	1495	332	1	1306
35	1	1382	192	1	1390	333	1	1633
38	1	1287	193	1	1424	334	1	1483
40	1	1291	193	1	1512	335	1	1278

45	1	1705	196	1	1418	336	1	1653
48	1	1288	197	1	1366	337	1	1630
49	1	1512	201	1	1355	338	1	1434
50	1	1518	202	1	1369	343	1	1495
55	1	1631	203	1	1718	345	1	1608
57	1	1589	204	1	1346	349	1	1370
58	1	1378	213	1	1468	353	1	1608
60	1	1263	215	1	1281	362	1	1375
60	1	1699	218	1	1655	363	1	1398
61	1	1286	219	1	1415	366	1	1641
64	1	1646	220	1	1413	368	1	1613
71	1	1336	221	1	1508	369	1	1773
76	1	1280	223	1	1454	375	1	1605
81	1	1278	224	1	1426	377	1	1613
91	1	1623	226	1	1301	378	1	1627
92	1	1366	227	1	1405	382	1	1755
93	1	1364	228	1	1577	383	1	1630
94	1	1379	235	1	1649	391	1	1432
96	1	1331	238	1	1705	402	1	1416
97	1	1439	244	1	1664	403	1	1674
98	1	1373	245	1	1281	406	1	1710
99	1	1390	247	1	1574	406	1	1506
100	1	1515	251	1	1476	407	1	1516

PECO Site No.	Component	Mean Date (A. D.)	PECO Site No.	Component	Mean Date (A. D.)	PECO Site No.	Component	Mean Date (A. D.)
422	1	1674	531	1	1458	672	1	1678
434	1	1336	532	1	1634	677	1	1599
436	1	1443	538	1	1661	679	1	1462
437	1	1489	547	1	1458	680	1	1445
440	1	1705	550	1	1385	681	1	1427
444	1	1608	552	1	1482	683	1	1418
445	1	1428	554	1	1608	686	1	1469
451	1	1467	555	1	1367	687	1	1630
452	1	1339	562	1	1370	688	1	1603
454	1	1449	565	1	1347	695	1	1458
460	1	1315	568	1	1390	696	1	1460

461	1	1459	569	1	1263	697	1	1545
462	1	1427	577	1	1307	700	1	1382
463	1	1476	578	1	1288	701	1	1448
464	1	1529	579	1	1288	702	1	1394
465	1	1533	580	1	1311	708	1	1409
467	1	1499	581	1	1349	709	1	1524
468	1	1428	584	1	1452	710	1	1309
469	1	1360	588	1	1380	713	1	1624
473	1	1444	589	1	1394	714	1	1432
474	1	1466	590	1	1429			
476	1	1562	592	1	1371			
488	1	1458	594	1	1376			
490	1	1397	595	1	1350			
491	1	1406	596	1	1426			
492	1	1393	601	1	1419			
493	1	1351	602	1	1612			
494	1	1345	606	1	1705			
496	1	1582	608	1	1434			
497	1	1364; 1640	611	1	1515			
498	1	1663	613	1	1608			
499	1	1505	614	1	1605			
503	1	1690	616	1	1339			
506	1	1773	625	1	1534			
507	1	1700	631	1	1435			
510	1	1430	632	1	1368			
518	1	1642	639	1	1458			
519	1	1639	640	1	1646			
521	1	1376	649	1	1393			
522	1	1446	658	1	1608			
524	1	1372	660	1	1608			
525	1	1447	661	1	1511			
526	1	1576	663	1	1354			
527	1	1320	664	1	1359			
528	1	1304	668	1	1328			
529	1	1472	670	1	1522			

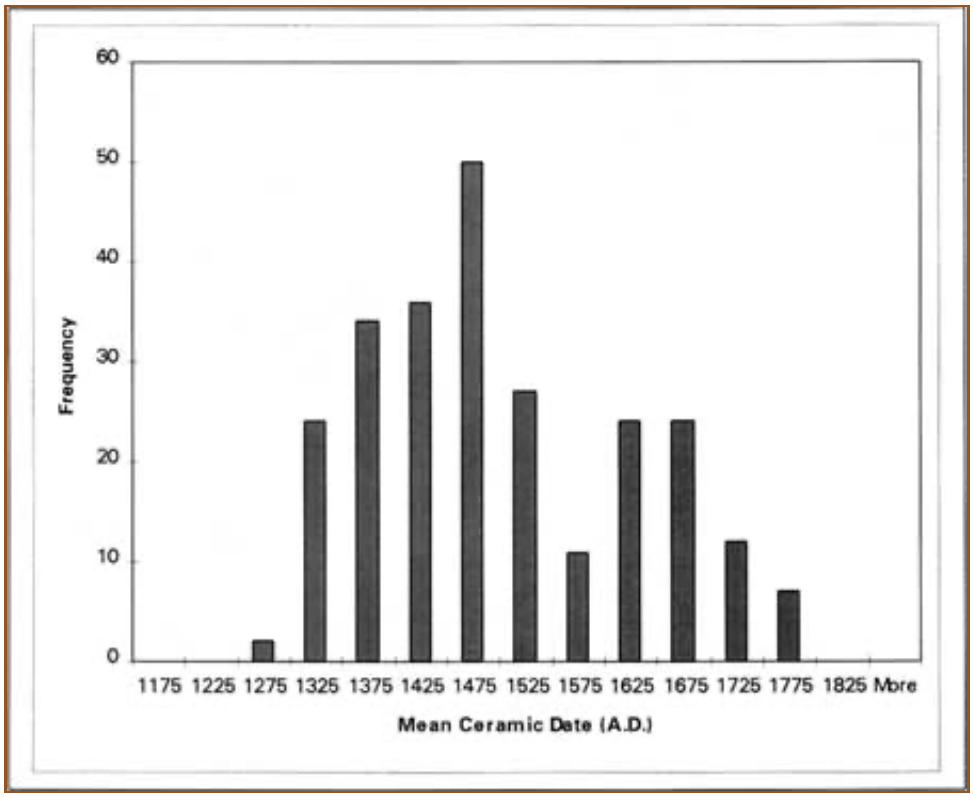

Figure 4.4. Histogram of the mean ceramic dates of the Pecos survey assemblages, by 50-year intervals. *(click on image for an enlargement in a new window)*

None of the mean ceramic dates precede the traditionally defined Coalition period, with the earliest dates occurring at A.D. 1263. Although the mean ceramic dates span a total of 510 years, the majority of the dates cluster in the fourteenth and fifteenth centuries. The densest part of the plots, suggesting the most intensive occupation, occurs from about A.D. 1340 to 1470. However, the single highest frequency of dates is in the A.D. 1600-1610 range (Figure 4.2). The plots reveal a relative lack of sites dated to the A.D. 1500s, with a resurgence of dates by A.D. 1600. Another notable gap occurs between A.D. 1718 and 1744.

Unfortunately, independent absolute dates are not available to test the accuracy of the Pecos survey mean ceramic dates. While Arrowhead Pueblo does have tree-ring dates, there is a mismatch between ceramics and tree-ring dates due to the probable later production of Santa Fe Black-on-white, discussed earlier in the chapter. The few unreliable noncutting dates from Forked Lightning Pueblo also do not coincide with the ceramic mean date from that site. However, in an independent test of the mean ceramic date method elsewhere in the Southwest, Christenson (1994) found that mean ceramic dates calculated from a sample of Kayenta ceramic types in northeastern Arizona provided results that were nearly as accurate as dendrochronology.

Ceramic Probability Dating

As single calendar year dates, mean ceramic dates do not address such complex issues as duration of occupation or the possible abandonment and reuse of sites. For this reason, a multivariate approach was desired that would create a seriation that could take into account the

duration of site use reflected in ceramic assemblage composition. In response to these problems, probabilistic ceramic dating was used to seriate the Pecos survey sites. This method was found to be much more effective than mean dating for creating replicable and objective temporal assignments for the sites.

Ceramic probability dating is an alternate method of seriation developed in order to partition time into manageable analytic divisions, drawing on previous work by Benedict (1996). Similar statistical approaches have been suggested for use with ceramics by Christenson (1994) and by Steponaitis and Kintigh (1993) for historic artifacts. These similar statistical methods for dating sites were encountered after the analysis was complete and were not used in the development of the probability method discussed here. As applied in this report, probabilistic dating is an approach originally devised to combine a series of radiocarbon dates from a site (Benedict 1996). It was applied here to the multiple ceramic types found in an assemblage. Probabilistic dating has utility as both a statistical and graphical technique. Although individual probability graphs were created for each of the Pecos sites, the method was more useful as a statistical technique in the goal of assigning a relative chronological placement to each of the sites.

Probability Assumptions

As with mean ceramic dating, a major assumption in the probability method used here is that the production of each ceramic type approximates a unimodal, symmetric curve. In this model, a ceramic type is expected to exhibit a gradual increase in quantity, reach a modal peak, and then decline through time. The statistical assumption of symmetry and unimodality is not unique to the approach adopted here, but is inherent to most traditional archeological seriations. In one case study, Ambler (1983) constructed frequency distributions for Kayenta ceramic types that demonstrated that most had normal, bell-shaped curves. However—as in any seriation method—this may not be a truly accurate model for all ceramics, because some ceramic types were probably more rapidly adopted or abandoned than others. Nonetheless, like the battleship-shaped curves used to create traditional seriations, unimodal normal curves have demonstrated utility for representing changing styles through time.

Method

A probability distribution was created for each ceramic type using known production spans derived from tree-ring dates from the northern Rio Grande region (Figure 4.5).[1] For this analysis, probability distributions were calculated using a normal distribution with a mean estimated from the median of the ceramic date range and a standard deviation estimated from the ceramic date range divided by four. This estimate of the standard deviation is based upon an assumption that the ceramic date range encompasses roughly 95 percent (±2SD) of the actual time span for a particular ceramic type. The approximated normal distribution for several ceramic types may be seen in Figure 4.6.

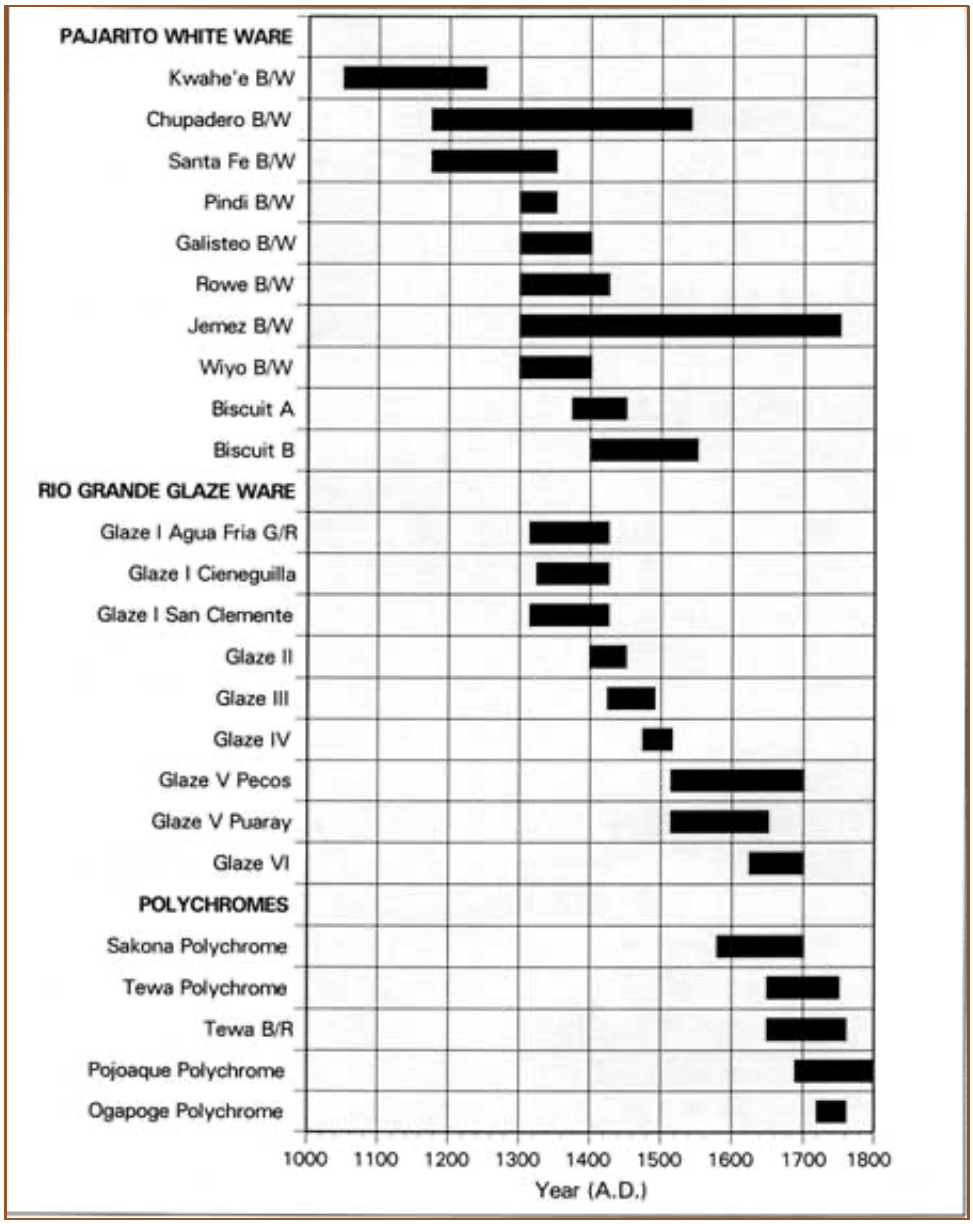

Figure 4.5. Bar chart of the date ranges for the Pecos ceramic types. *(click on image for an enlargement in a new window)*

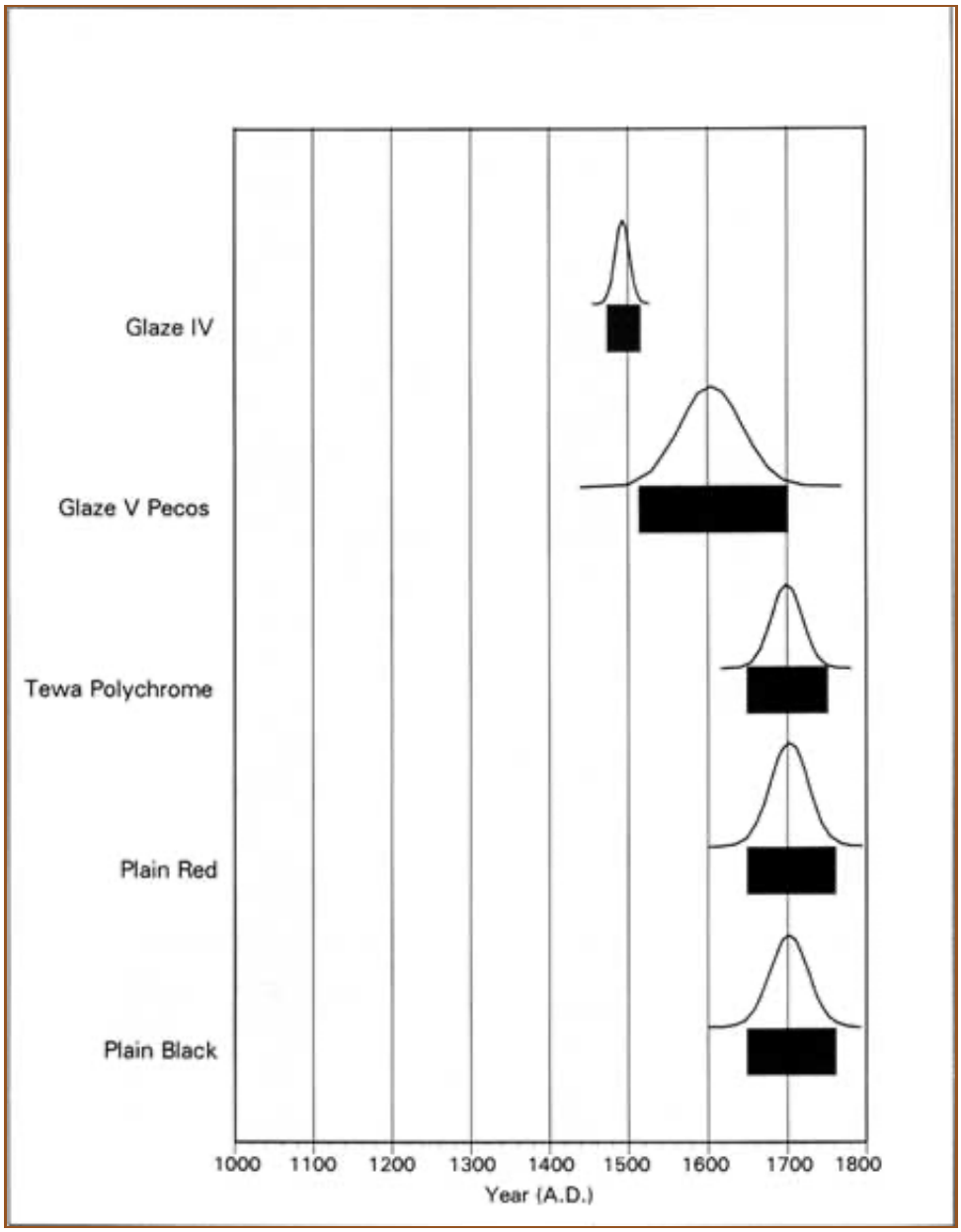

Figure 4.6. Examples of ceramic type date ranges and normal distributions. *(click on image for an enlargement in a new window)*

In this method, all of the discrete probability distributions for the ceramic types from a single assemblage are combined and weighted by the frequency of the type in the assemblage. In effect, the procedure treats each sherd as an individual probability distribution and merges all of the probability distributions in the assemblage to produce a composite probability curve for the assemblage as a whole. Figures 4.5 and 4.6 provide an important illustration of the influence of ceramic date ranges on the probability distributions. While short duration ceramic types like Glaze IV allow for differentiation between relatively short spans of time, longer duration ceramic types like Glaze V allow for effective differentiation only between longer periods.

The overall Pecos survey project goals called for segmenting the prehistoric occupation of

Pecos into discrete time periods and classifying sites into these periods for analysis. Thus, the next step in constructing the chronology involved segmenting the overall probability distribution for each assemblage by setting specific time intervals for calculation of the probabilities. For purposes of illustration only, Figure 4.7 demonstrates how the annual probabilities of the normal distribution for one ceramic type, Glaze V, may be aggregated into summed probabilities for 50-year intervals. (However, the analysis itself used 125-year intervals, as discussed below.) In a similar example at the site level (PECO 125), Figure 4.8 displays the individual ceramic type probabilities along with the summed and normalized (so that it sums to 1) probability distribution in 50-year intervals.

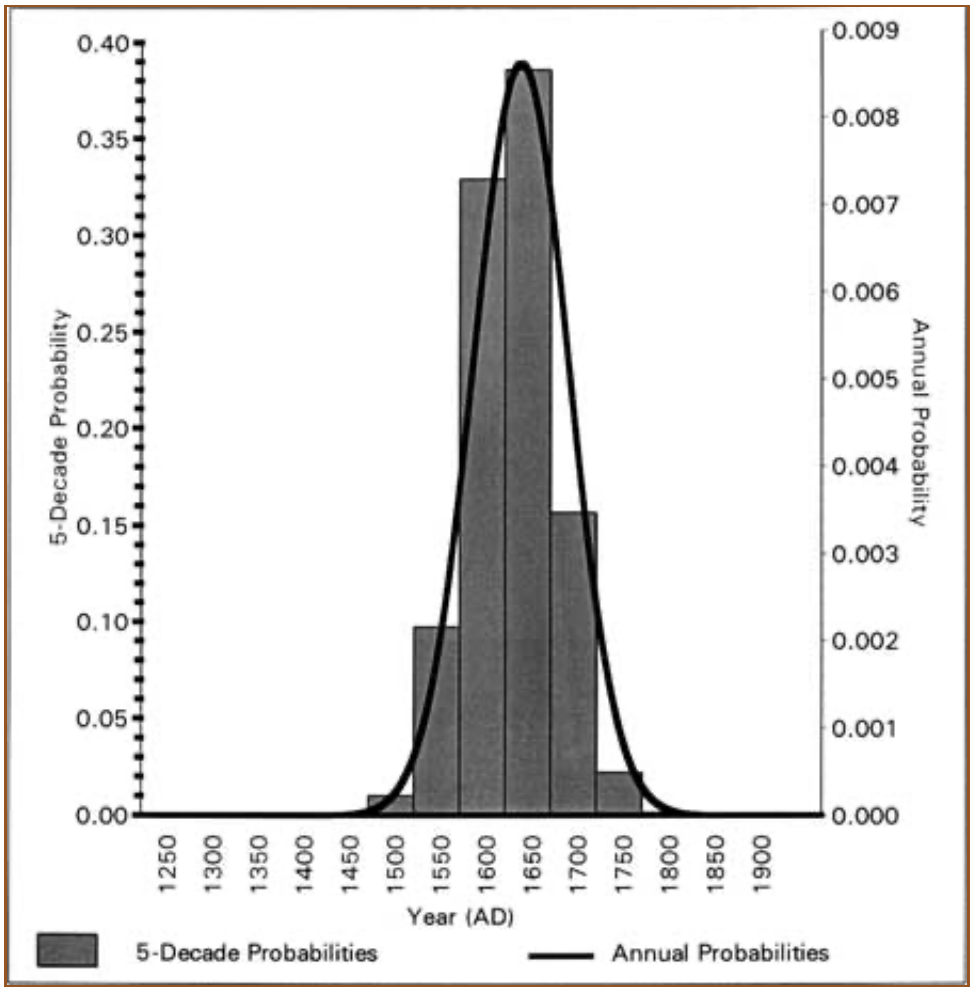

Figure 4.7. Annual and five-decade probabilities for Glaze V. *(click on image for an enlargement in a new window)*

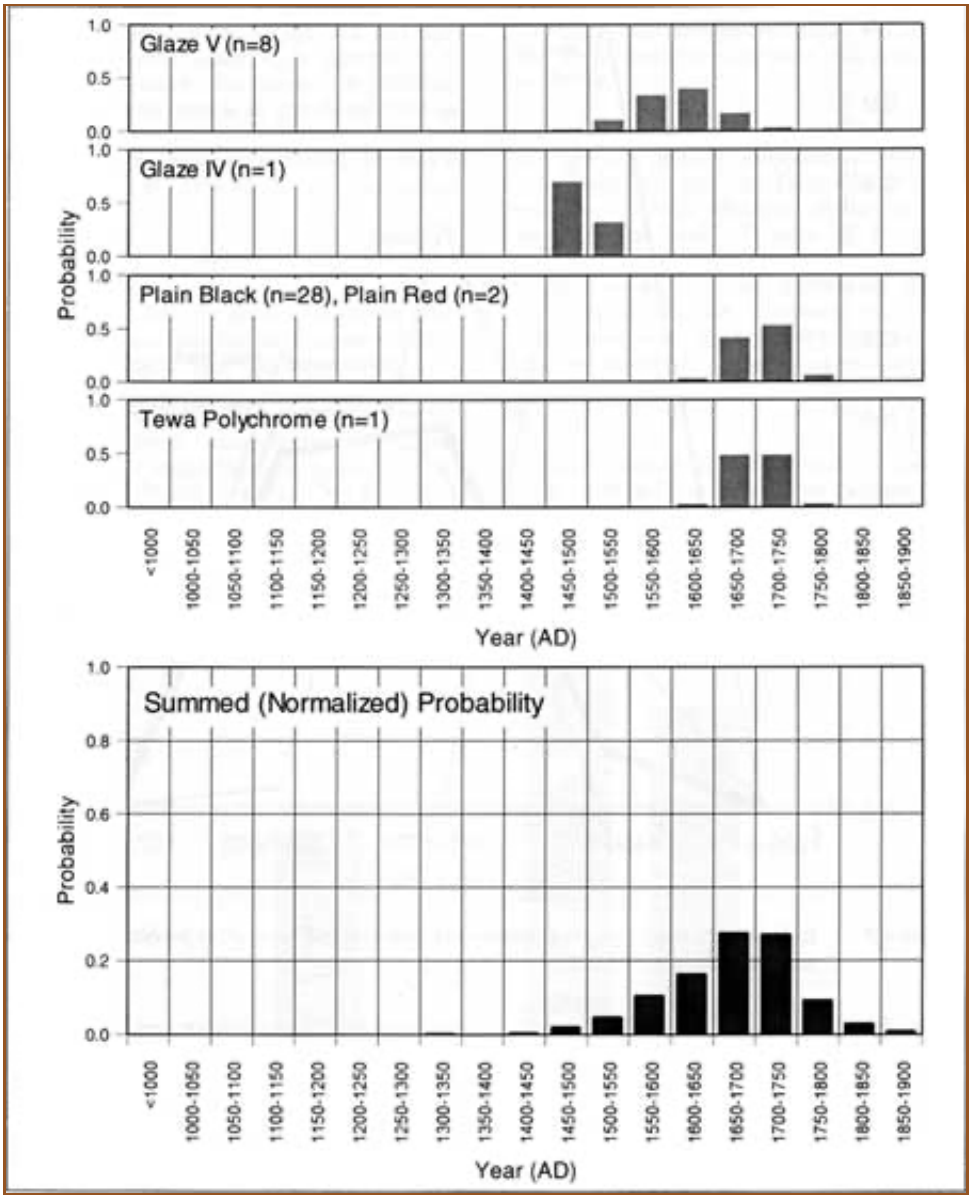

Figure 4.8. Individual ceramic type probabilities and resulting summed and normalized probability for PECO 125. *(click on image for an enlargement in a new window)*

Appropriate time intervals for this method are necessarily determined by the researcher's goals. For the Pecos sites, several increment ranges were tried, including 25, 50, 100, and 125 year spans. Due to the wide scope of the survey project, the nature of the small yet long-duration surface ceramic assemblages; and the broad research questions posed in Chapter 1, intervals of 125 years were selected as the most appropriate temporal divisions for this particular dating project. Although shorter temporal resolution is certainly desirable, the extended production spans of many of the decorated ceramics, including types such as Santa Fe Black-on-white, preclude assignment of more restricted date ranges to each site. Indeed, many of the subjective, preliminary dates assigned to sites in the field spanned almost the entire Puebloan occupational sequence at Pecos. Given the long duration of occupation at many sites, 125-year divisions were chosen as the most useful and meaningful analytical units

for addressing the research questions of this survey.

In order to integrate the project classification with chronologies developed by other researchers working in the northern Rio Grande region, the widely used A.D. 1325 transition date between the Coalition and Classic periods was maintained. In a further consideration, temporal periods of equal length were determined to be most useful for controlling for the variable of time in other analyses, including the population estimates presented in Chapter 7. The resulting chronological intervals are best regarded as convenient units that subdivide sites temporally for this project.

Combining all of the ceramic types from an assemblage into a single summed and normalized probability distribution is accomplished through application of the normal probability density function over a range of dates (125 years in this case).[2] This yields a discrete probability for each interval within the distribution. Summing and normalizing the assemblage distribution in this way provides a summary probability of occupation for each time period. The interval probability—or graphically, the area under the normalized curve for each interval—may be interpreted as the relative statistical likelihood that a site was occupied during a given time period. Figure 4.9 is an example of the individual ceramic type probabilities from one site (PECO 125) with the resulting, combined distribution, in bold.

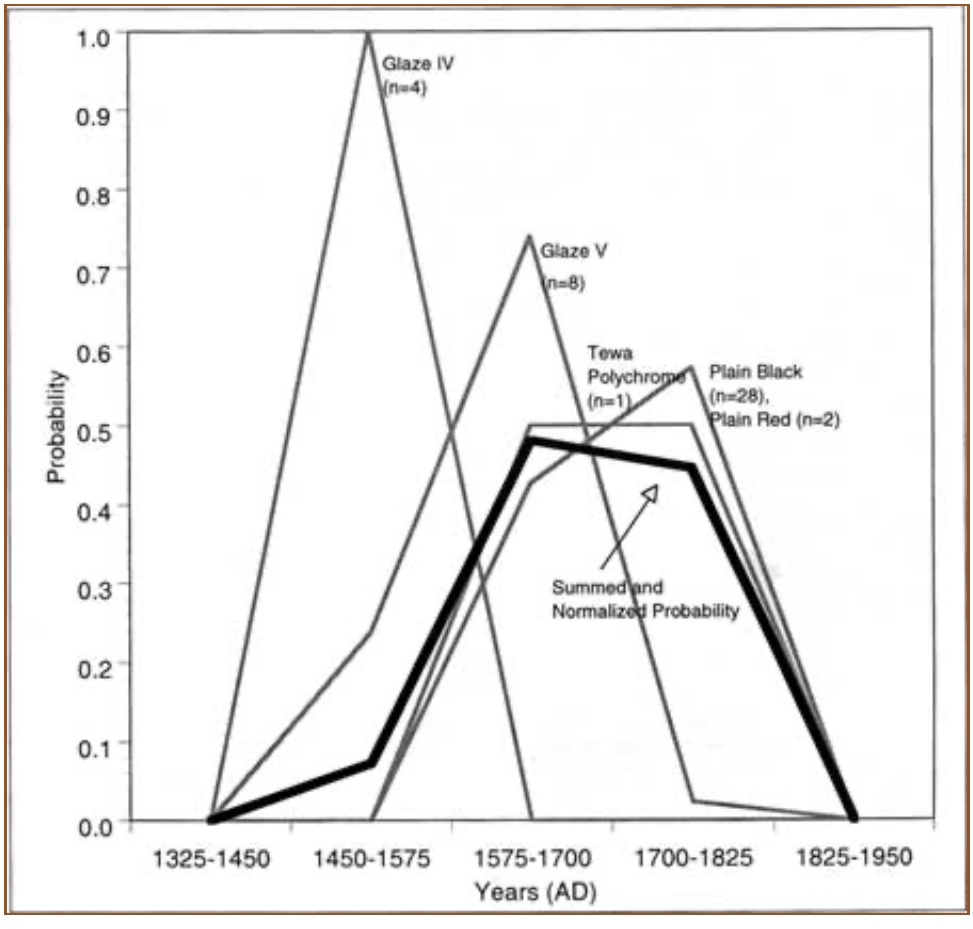

Figure 4.9. Individual ceramic type probabilities and summed and normalized probability in 125-year intervals for PECO 125. *(click on image for an enlargement in*

a new window)

Examination of the discrete probability distributions for a number of sites suggested that a threshold value of .20 would be appropriate for including a particular period in the interval of potential occupation, while not excluding sites with apparent long occupations. The definition of this threshold value has the effect of removing periods with a very small likelihood of occupation (<.20) from the total range assigned to a given site (in effect excluding the tails of the distribution). While this value is low for a single period, when summed over a sequence of periods, a reasonable level of confidence for the combined time span can be achieved. By using the .20 cutoff, sites were assigned to one or more temporal periods.

Interpreting Ceramic Probabilities

In the probability approach, sites that were occupied for long periods of time tend to have broader distributions, as their total summed and normalized probability for occupation (1.0) is spread out over a greater range. For long-duration sites, the likelihood of occupation during any one period is relatively small. Summed over several periods, the confidence is greater that the site was occupied at some time during that larger interval. In contrast, sites with short, restricted occupations display peaked distributions and have greater probabilities for a single time period. This pattern is a function of the ceramic types found at a particular site. For example, as seen in Figure 4.9 for PECO 125, a short duration ceramic type such as Glaze IV displays a narrow, peaked distribution, while a type with a longer production interval, Glaze V, is depicted by a broader and flatter distribution. In addition, infrequent ceramic types in an assemblage—such as Glaze IV in this example—do not contribute significantly to the combined probability distribution and may not be reflected in the final period assignments.

Dating Multicomponent Sites

Significantly, the probability approach can identify and date sites that have mixed deposits, meaning that more than one occupational component is represented by the surface artifacts. This ability contrasts with other types of seriation in which multiple components are lumped together into a single range of dates. Depicted graphically (Figure 4.10), the ceramic probability distribution for multicomponent sites exhibits marked bimodality, allowing the discrete occupations to be assigned to defined time periods. The establishment of a threshold level (.20) places the occupation hiatus below the cutoff for assigning a component to a particular time period.

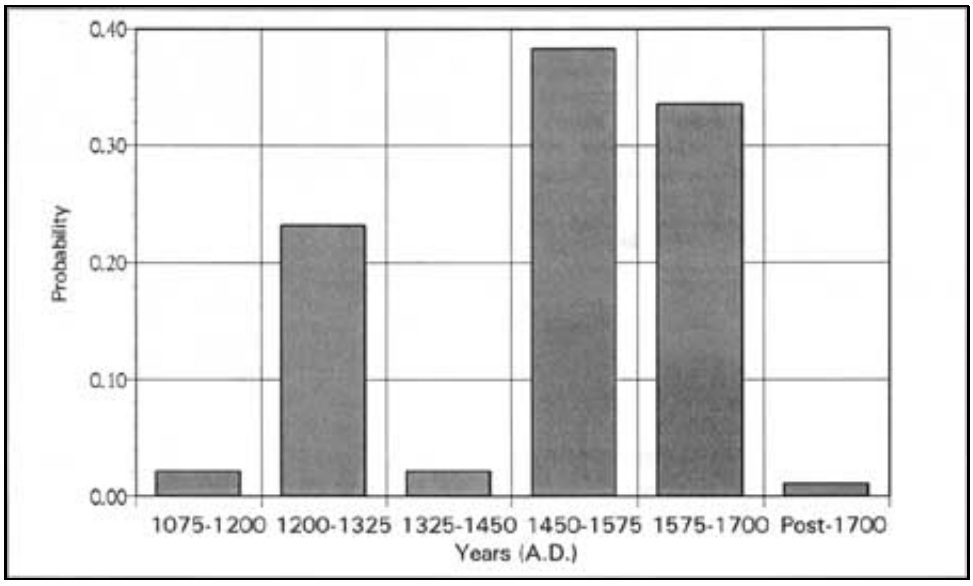

Figure 4.10. Bimodal probability distribution suggesting an occupational hiatus (PECO 334).

Thirty-three Pecos sites were found to have more than one ceramic component as indicated by the probability data (see Table 4.5). Four of these 33 sites were identified in the field as dual-component sites. Thirteen of the sites were recorded as single component sites with two date ranges and an intervening hiatus assigned in the field for the ceramic types. For the remaining sites, the probability method was able to determine possible gaps in site occupation that were not readily observable in the field.

Another advantage of the probability method is that small numbers of outlying ceramics that do not fit with the overall assemblage, including intrusive artifacts or possible heirloom vessels, have such small probability values in the combined distributions that they will not be misclassified as a separate component by this method.

Future work could refine the method described here by documenting the actual frequency distribution of each ceramic type. The development of empirical (as opposed to theoretical) probability distributions for the ceramic types would allow for an improved fit of the probability model to the archeological assemblages under consideration. A detailed literature search of excavation notes from relevant sites might determine actual percentages of ceramic types in successive stratigraphic levels, allowing the timing of each ceramic type to be more fully understood.

The Pecos Survey Chronology

The Pecos ceramic chronology, based on the probability analysis, is presented in Table 4.4, with seven resulting time periods (Periods 0 through 6). Table 4.5 provides the period assignments for each site. Structured at the component level, the chronology incorporates 477 field components from 473 sites. As defined by the survey, a component is an intrasite grouping of temporally and/or culturally related remains. A "1" in the columns for Pecos periods 0 through 6 indicates that, according to the probability data, the site component has an

interval probability greater than .20 and was likely occupied during that time period.

A confidence rating was given to all date assignments. Sites with a confidence rating of "2" are considered securely dated within the context of the survey data. These sites have five or more dateable sherds and the time period assignments are based solely on the probability data. Confidence code "1" is used for those sites dated with lower confidence. This category includes sites with fewer than five diagnostic sherds and sites that could only be dated on the basis of utility ware ceramics or nondiagnostic glaze ware body sherds, using the probability approach. Confidence level 1 sites also include components with fewer than five sherds recorded by the survey that could be dated using information from previous research or from curated collections (not probability data). The evidence for dates at confidence 1 sites is meager, but it was felt that the attempt to date these sites was warranted, rather than dismiss them out of hand. A total of 268 components is considered securely dated; 209 components are assigned low confidence dates.

Table 4.4. The Pecos survey chronology.

Ceramic Period	Dates (A.D.)	Number of Components	Percent
0	Pre-1075	2	0.2
1	1075-1200	2	0.2
2	1200-1325	101	11.5
3	1325-1450	302	34.4
4	1450-1575	235	26.8
5	1575-1700	178	20.3
6	Post-1700	58	6.6
Total		878	100.0

Note. The chronology incorporates 477 site components, some of which date to more than one time period. Period 0 was created to include known chronometric dates from the Pecos pithouse sites.

Table 4.5. Ceramic period assignments for the Pecos survey sites.

Key: Refer to text for a detailed description of how sites were assigned to periods and how confidence codes were determined. A "1" in columns P0-P6 signifies that the site was likely occupied during that period. Confidence ratings: 1 = low; 2 = high. Ceramic periods (all A.D.): P0 = pre-1075; P1 = 1075-1200; P2 = 1200-1325; P3 = 1325-1450; P4 = 1450-1575; P5 = 1575-1700; P6 = post-1700.

PECO Site No.	Comp.	Culture	P0	P1	P2	P3	P4	P5	P6	Confidence
4	1	Puebloan	—	—	—	1	1	—	—	2

5	1	Puebloan	—	—	—	—	1	—	—	1
6	1	Puebloan	—	—	—	1	1	—	—	2
7	1	Puebloan	—	—	1	1	—	—	—	1
8	1	Puebloan	—	—	—	1	—	—	—	2
9	1	Puebloan	—	—	—	1	—	—	—	2
10	1	Puebloan	—	—	—	1	—	—	—	2
11	1	Puebloan	—	—	—	1	1	1	—	1
12	1	Puebloan	—	—	1	1	—	1	—	2
13	1	Puebloan	—	—	—	1	1	—	—	2
14	1	Puebloan	—	—	—	—	1	—	—	2
15	1	Puebloan	—	—	—	—	1	1	1	2
16	1	Puebloan	—	—	—	1	1	1	—	2
17	1	Puebloan	—	—	—	1	—	—	—	2
20	1	Puebloan	—	—	—	1	1	—	—	2
21	1	Puebloan	—	—	—	1	1	1	—	2
22	1	Puebloan	—	—	—	1	—	—	1	2
23	1	Puebloan	—	—	1	1	—	—	1	2
24	1	Puebloan	—	1	1	1	—	—	—	2
25	1	Puebloan	—	—	1	1	—	—	—	2
26	1	Puebloan	—	—	1	1	—	—	—	2
29	1	Puebloan	—	—	—	1	—	1	1	2
30	1	Puebloan	—	—	1	1	—	—	—	2
32	1	Puebloan	—	—	1	1	—	—	—	2
35	1	Uknown	—	—	1	1	—	—	—	2
38	1	Puebloan	—	—	1	1	—	—	—	2
40	1	Puebloan	—	—	1	1	—	—	—	2
41	1	Puebloan	—	—	1	—	—	1	—	1
42	1	Puebloan	—	—	1	—	—	—	—	1
43	1	Puebloan	—	—	1	1	1	—	—	1
45	1	Puebloan	—	—	—	—	—	1	1	2
48	1	Puebloan	—	—	1	1	—	—	—	2
49	1	Puebloan	—	—	—	—	1	—	—	2
50	1	Puebloan	—	—	—	—	1	1	—	2
53	1	Puebloan/Euro-Am.	—	—	—	—	1	1	—	2
53	2	Basketmaker	1	—	—	—	—	—	—	2
55	1	Puebloan	—	—	—	—	1	1	1	2
57	1	Puebloan	—	—	—	—	1	1	—	2
58	1	Puebloan	—	—	1	—	—	1	—	2

60	1	Puebloan	—	—	1	—	—	1	—	2
61	1	Puebloan	—	—	1	1	—	—	—	2
61	2	Basketmaker	1	—	—	—	—	—	—	2
64	1	Euro-American	—	—	—	—	1	1	—	2
65	1	Puebloan	—	—	—	—	1	1	—	1
71	1	Puebloan	—	—	1	1	—	—	—	2
76	1	Puebloan	—	—	1	1	—	—	—	2
81	1	Puebloan	—	—	1	—	—	—	—	2
86	1	Puebloan	—	—	1	1	—	—	—	1
91	1	Puebloan	—	—	—	1	—	1	1	2
92	1	Puebloan	—	—	—	1	—	—	—	2
93	1	Puebloan	—	—	1	1	—	—	—	2
94	1	Puebloan	—	—	—	1	—	—	—	2
96	1	Puebloan	—	—	1	1	—	—	—	2
97	1	Puebloan	—	—	—	1	—	—	—	2
98	1	Puebloan	—	—	—	1	—	—	—	2
99	1	Puebloan	—	—	—	1	—	—	—	2
100	1	Puebloan	—	—	—	1	1	1	—	2
101	1	Puebloan	—	—	—	1	1	—	—	2
103	1	Puebloan	—	—	—	1	1	—	—	2
104	1	Puebloan	—	—	—	1	—	—	—	2
107	1	Puebloan	—	—	—	—	—	1	1	1
108	1	Puebloan	—	—	—	—	1	1	—	2
109	1	Puebloan	—	—	—	1	—	—	1	2
111	1	Puebloan	—	—	—	1	—	—	—	1
112	1	Puebloan	—	—	—	—	1	1	—	2
115	1	Puebloan	—	—	—	—	1	1	—	2
117	1	Puebloan	—	—	—	1	1	—	—	1
118	1	Puebloan	—	—	—	1	—	—	—	1
119	1	Puebloan	—	—	—	1	—	1	1	2
120	1	Puebloan	—	—	—	1	1	—	—	2
121	1	Puebloan	—	—	—	—	1	1	—	1
123	1	Puebloan	—	—	—	1	—	—	—	1
124	1	Puebloan	—	—	—	1	1	1	—	1
125	1	Puebloan	—	—	—	—	—	1	1	2
126	1	Puebloan	—	—	—	1	1	—	—	2
127	1	Puebloan	—	—	—	1	1	1	—	2
128	1	Puebloan	—	—	—	—	1	—	—	1
129	1	Puebloan	—	—	—	1	1	1	—	2

130	1	Puebloan	—	—	—	—	1	1	1	1
133	1	Puebloan	—	—	—	1	—	—	—	1
134	1	Puebloan	—	—	1	—	—	—	—	1
136	1	Puebloan	—	—	—	1	1	—	—	2
138	1	Puebloan	—	—	—	1	1	1	—	2
139	1	Puebloan	—	—	—	1	—	1	—	2
140	1	Puebloan	—	—	—	1	—	—	—	1
144	1	Puebloan	—	—	—	—	—	1	1	2
146	1	Puebloan	—	—	—	1	—	—	—	1
148	1	Puebloan	—	—	—	—	1	1	—	1
151	1	Puebloan	—	—	—	—	—	1	1	2
157	1	Puebloan	—	—	—	—	1	—	—	2
160	1	Puebloan	—	—	1	1	1	—	—	2
163	1	Puebloan	—	—	—	—	1	—	—	2
165	1	Puebloan	—	—	—	1	1	—	—	1
172	1	Puebloan	—	—	—	—	1	1	—	1
175	1	Hispanic	—	—	—	—	—	1	1	1
179	1	Puebloan	—	—	—	—	1	1	—	1
190	1	Puebloan	—	—	—	1	—	1	1	1
191	1	Puebloan	—	—	—	1	1	—	—	1
192	1	Puebloan	—	—	—	1	—	—	—	2
193	1	Puebloan	—	—	—	1	1	—	—	2
193	2	Puebloan	—	—	—	1	1	1	—	2
195	1	Puebloan	—	—	—	1	—	—	—	1
196	1	Puebloan	—	—	—	1	1	—	—	2
197	1	Puebloan	—	—	—	1	—	—	—	2
200	1	Puebloan/Apachean	—	—	—	—	1	—	—	1
201	1	Puebloan	—	—	—	1	—	—	—	2
202	1	Puebloan	—	—	—	1	—	—	—	2
203	1	Puebloan	—	—	—	—	—	1	1	2
204	1	Puebloan	—	—	1	1	—	—	—	2
206	1	Puebloan	—	—	1	1	—	—	—	1
212	1	Puebloan	—	—	—	1	1	—	—	1
213	1	Puebloan	—	—	—	1	1	1	—	2
215	1	Puebloan	—	—	1	1	—	—	—	2
218	1	Puebloan	—	—	—	—	1	1	—	2
219	1	Puebloan	—	—	—	1	1	—	—	2
220	1	Puebloan	—	—	—	1	1	—	—	2
221	1	Puebloan	—	—	—	1	1	—	—	2

222	1	Puebloan	—	—	—	1	1	—	—	1
223	1	Puebloan	—	—	—	1	1	—	—	2
224	1	Puebloan	—	—	—	1	1	—	—	2
226	1	Puebloan	—	—	1	1	—	—	—	2
227	1	Puebloan	—	—	—	1	—	—	—	2
228	1	Puebloan	—	—	—	1	1	1	—	2
229	1	Puebloan	—	—	—	1	—	—	—	1
230	1	Puebloan	—	—	—	1	1	—	—	1
233	1	Puebloan	—	—	—	1	1	—	—	1
235	1	Puebloan	—	—	—	—	1	1	—	2
238	1	Puebloan	—	—	—	—	—	1	1	2
242	1	Puebloan	—	—	—	—	—	—	1	1
243	1	Puebloan	—	—	—	—	1	1	—	2
244	1	Puebloan	—	—	—	—	—	1	1	2
245	1	Puebloan	—	—	1	1	—	—	—	2
246	1	Puebloan	—	—	—	1	—	1	—	2
247	1	Puebloan	—	—	—	—	1	1	—	2
248	1	Puebloan	—	—	—	—	—	1	1	1
251	1	Puebloan	—	—	—	1	—	1	—	2
252	1	Puebloan	—	—	—	—	1	1	—	2
254	1	Puebloan	—	—	—	1	1	1	—	1
259	1	Puebloan	—	—	—	—	1	1	—	1
260	1	Puebloan	—	—	—	1	1	—	—	1
261	1	Puebloan	—	—	—	—	1	1	—	2
262	1	Puebloan	—	—	—	1	—	—	—	1
263	1	Puebloan	—	—	1	1	—	—	—	1
264	1	Puebloan	—	—	—	1	—	—	—	1
265	1	Puebloan	—	—	—	1	1	—	—	2
266	1	Puebloan	—	—	1	—	1	—	—	2
267	1	Puebloan	—	—	1	—	—	—	—	1
268	1	Puebloan	—	—	1	1	—	—	—	1
269	1	Puebloan	—	—	1	1	—	—	—	1
270	1	Spanish	—	—	—	—	—	1	1	1
272	1	Puebloan	—	—	—	—	—	1	—	1
274	1	Puebloan	—	—	—	—	—	1	1	2
275	1	Puebloan	—	—	—	—	1	1	—	1
277	1	Puebloan	—	—	—	—	—	1	1	2
279	1	Puebloan	—	—	—	—	1	—	—	2
280	1	Puebloan	—	—	—	—	1	1	—	2

281	1	Puebloan	—	—	1	—	—	—	—	1
282	1	Puebloan	—	—	—	—	—	1	1	1
283	1	Puebloan	—	—	—	—	1	1	—	1
284	1	Puebloan	—	—	1	—	—	1	1	1
285	1	Puebloan	—	—	1	1	—	—	—	1
286	1	Puebloan	—	—	—	—	1	1	1	2
289	1	Puebloan	—	—	—	1	1	—	—	1
290	1	Puebloan	—	—	—	1	—	—	—	1
291	1	Puebloan	—	—	1	1	—	—	—	1
292	1	Puebloan	—	—	—	—	—	1	1	2
293	1	Puebloan	—	—	1	—	1	—	—	2
294	1	Puebloan	—	—	1	1	—	—	—	2
297	1	Puebloan	—	—	—	1	—	—	—	2
298	1	Puebloan	—	—	—	1	—	—	—	1
299	1	Puebloan	—	—	1	—	1	—	—	1
300	1	Puebloan	—	—	—	1	1	—	—	1
301	1	Puebloan	—	—	—	1	1	1	—	2
301	2	Plains?	—	—	—	—	1	—	—	2
303	1	Puebloan	—	—	—	1	—	1	1	1
305	1	Puebloan	—	—	—	—	1	—	—	2
307	1	Puebloan	—	—	—	1	—	—	—	2
308	1	Puebloan	—	—	—	—	1	—	—	1
310	1	Puebloan	—	—	1	1	—	—	—	1
311	1	Puebloan	—	—	—	—	1	—	—	1
312	1	Puebloan	—	—	1	1	1	—	—	1
313	1	Puebloan	—	—	—	1	1	—	—	2
315	1	Puebloan	—	—	—	1	—	—	—	2
316	1	Puebloan	—	—	—	1	—	—	—	2
317	1	Puebloan	—	—	—	1	—	—	—	1
318	1	Puebloan	—	—	1	—	—	—	—	1
319	1	Puebloan	—	—	—	—	—	1	—	1
321	1	Puebloan	—	—	—	—	1	1	—	2
322	1	Puebloan	—	—	—	1	—	—	—	2
323	1	Puebloan	—	—	1	1	1	—	—	2
325	1	Puebloan	—	—	—	1	—	—	—	1
326	1	Puebloan	—	—	1	—	—	—	—	1
327	1	Puebloan	—	—	—	1	—	—	—	1
331	1	Puebloan	—	—	—	—	—	1	—	2
332	1	Puebloan	—	—	1	1	—	—	—	2

333	1	Puebloan	—	—	—	—	1	1	—	2
334	1	Puebloan	—	—	1	—	1	1	—	2
335	1	Puebloan	—	—	1	—	—	—	—	2
336	1	Puebloan	—	—	—	—	1	1	—	2
337	1	Puebloan	—	—	—	—	—	1	—	2
338	1	Puebloan	—	—	1	1	1	—	—	2
343	1	Puebloan	—	—	—	—	1	—	—	2
344	1	Puebloan	—	—	—	1	1	—	—	1
345	1	Puebloan	—	—	—	—	1	1	—	2
347	1	Puebloan	—	—	1	1	—	—	—	1
348	1	Puebloan	—	—	1	—	1	1	—	1
349	1	Puebloan	—	—	1	1	1	—	—	2
351	1	Puebloan	—	—	—	1	1	—	—	1
352	1	Puebloan	—	—	1	1	—	—	—	1
353	1	Puebloan	—	—	—	—	1	1	—	2
354	1	Puebloan	—	—	1	1	—	—	—	1
355	1	Puebloan	—	—	1	1	1	—	—	1
357	1	Puebloan	—	—	—	—	1	1	—	2
358	1	Puebloan	—	—	—	1	1	1	—	1
359	1	Puebloan	—	—	—	1	1	—	—	1
360	1	Puebloan	—	—	1	1	—	—	—	1
362	1	Puebloan	—	—	—	1	—	—	—	2
363	1	Puebloan	—	—	—	1	—	—	—	2
364	1	Puebloan	—	—	1	1	—	—	—	1
365	1	Puebloan	—	—	—	—	1	1	—	1
366	1	Puebloan	—	—	—	—	—	1	1	2
368	1	Puebloan	—	—	—	1	—	1	1	2
369	1	Puebloan	—	—	—	—	—	1	1	2
373	1	Puebloan	—	—	—	—	—	1	1	1
375	1	Puebloan	—	—	—	—	1	1	—	2
376	1	Puebloan	—	—	—	—	—	1	1	1
377	1	Puebloan	—	—	—	—	1	1	—	2
378	1	Puebloan	—	—	—	—	1	1	—	2
380	1	Puebloan	—	—	—	—	1	1	—	1
381	1	Puebloan	—	—	—	1	—	—	—	1
382	1	Puebloan	—	—	—	—	—	1	1	2
383	1	Puebloan	—	—	—	—	—	1	—	2
384	1	Puebloan	—	—	—	1	—	—	—	1

385	1	Puebloan	—	—	1	1	—	—	—	1
386	1	Puebloan	—	—	—	1	—	—	—	1
387	1	Puebloan	—	—	—	1	—	—	—	1
388	1	Puebloan	—	—	—	1	—	—	—	1
390	1	Puebloan	—	—	—	1	1	1	—	1
391	1	Puebloan	—	—	—	—	1	—	—	2
392	1	Puebloan	—	—	—	1	—	—	—	1
394	1	Puebloan	—	—	—	—	—	1	1	1
398	1	Puebloan	—	—	1	—	—	1	—	1
399	1	Puebloan	—	—	—	—	1	1	—	1
400	1	Puebloan	—	—	—	1	—	—	—	1
402	1	Puebloan	—	—	—	1	1	—	—	2
403	1	Puebloan	—	—	—	—	—	1	1	2
404	1	Puebloan	—	—	—	—	1	—	—	1
405	1	Puebloan	—	—	—	—	1	—	—	1
406	1	Puebloan	—	—	—	—	1	1	1	2
407	1	Puebloan	—	—	—	—	1	—	—	2
422	1	Puebloan	—	—	—	—	—	1	1	2
430	1	Puebloan	—	—	—	1	1	—	—	1
432	1	Puebloan	—	—	—	1	1	1	—	1
433	1	Puebloan	—	—	1	1	—	—	—	1
434	1	Puebloan	—	—	1	1	—	—	—	2
435	1	Puebloan	—	—	—	1	1	1	—	1
436	1	Puebloan	—	—	—	1	—	—	—	2
437	1	Puebloan	—	—	—	1	1	—	—	2
438	1	Puebloan	—	—	—	1	1	1	—	1
440	1	Puebloan	—	—	—	—	—	1	1	2
441	1	Puebloan	—	1	—	—	—	—	—	2
442	1	Puebloan	—	—	—	—	—	1	1	1
443	1	Puebloan	—	—	—	1	1	—	—	1
444	1	Puebloan	—	—	—	—	1	1	—	2
445	1	Puebloan	—	—	—	1	1	—	—	2
448	1	Puebloan	—	—	—	1	1	—	—	1
449	1	Puebloan	—	—	—	1	—	—	—	1
450	1	Puebloan	—	—	1	—	1	—	—	1
451	1	Puebloan	—	—	—	1	1	—	—	2
452	1	Puebloan	—	—	1	1	—	—	—	2
453	1	Puebloan	—	—	—	1	1	—	—	1
454	1	Puebloan	—	—	1	1	1	—	—	1

457	1	Puebloan	—	—	—	1	1	1	—	1
458	1	Puebloan	—	—	—	—	—	1	1	1
460	1	Puebloan	—	—	1	1	—	—	—	2
461	1	Puebloan	—	—	—	1	—	1	—	2
462	1	Puebloan	—	—	—	1	1	—	—	2
463	1	Puebloan	—	—	—	1	1	—	—	2
464	1	Puebloan	—	—	—	—	1	—	—	2
465	1	Puebloan	—	—	—	1	1	—	—	2
466	1	Puebloan	—	—	—	1	—	—	—	1
467	1	Puebloan	—	—	—	1	1	1	—	2
468	1	Puebloan	—	—	—	1	—	—	—	2
469	1	Puebloan	—	—	—	1	—	1	—	2
470	1	Puebloan	—	—	1	1	—	—	—	1
471	1	Puebloan	—	—	1	—	—	—	—	1
472	1	Puebloan	—	—	—	1	1	—	—	1
473	1	Puebloan	—	—	—	1	1	—	—	2
474	1	Puebloan	—	—	—	1	1	—	—	2
476	1	Puebloan	—	—	—	—	1	1	—	2
479	1	Puebloan	—	—	—	—	—	1	1	1
482	1	Puebloan	—	—	1	1	—	—	—	1
488	1	Puebloan	—	—	—	1	1	—	—	2
489	1	Puebloan	—	—	—	—	1	—	—	1
490	1	Puebloan	—	—	—	1	—	—	—	2
491	1	Puebloan	—	—	—	1	1	1	—	2
492	1	Puebloan	—	—	—	1	1	—	—	2
493	1	Puebloan	—	—	1	1	—	—	—	2
494	1	Puebloan	—	—	1	1	—	—	—	2
496	1	Puebloan	—	—	—	1	1	1	—	2
497	1	Puebloan	—	—	—	1	—	—	—	2
498	1	Puebloan	—	—	—	1	—	1	—	2
499	1	Puebloan	—	—	—	—	1	—	—	2
500	1	Puebloan	—	—	—	1	1	1	—	1
501	1	Puebloan	—	—	1	1	—	—	—	1
503	1	Puebloan	—	—	—	—	—	1	1	1
505	1	Puebloan	—	—	1	1	—	—	—	1
506	1	Puebloan	—	—	—	—	—	1	1	2
507	1	Puebloan	—	—	—	—	—	1	1	2
508	1	Puebloan	—	—	1	1	1	—	—	1
509	1	Puebloan	—	—	1	1	1	—	—	1

510	1	Puebloan	—	—	—	1	1	—	—	2
511	1	Puebloan	—	—	—	—	1	1	1	1
513	1	Puebloan	—	—	—	1	—	—	—	1
515	1	Puebloan	—	—	—	—	—	—	1	1
516	1	Puebloan	—	—	—	1	1	1	—	1
518	1	Puebloan	—	—	—	—	—	1	1	2
519	1	Puebloan	—	—	—	—	—	1	—	2
521	1	Puebloan	—	—	—	1	—	—	—	2
522	1	Puebloan	—	—	—	1	1	—	—	2
524	1	Puebloan	—	—	—	1	—	—	—	2
525	1	Puebloan	—	—	—	1	1	—	—	2
526	1	Puebloan	—	—	—	—	1	1	—	2
527	1	Puebloan	—	—	1	1	—	—	—	2
528	1	Puebloan	—	—	1	1	—	—	—	2
529	1	Puebloan	—	—	—	1	1	—	—	2
530	1	Puebloan	—	—	—	1	1	—	—	1
531	1	Puebloan	—	—	—	1	1	—	—	2
532	1	Puebloan	—	—	—	—	—	1	—	2
533	1	Puebloan	—	—	—	1	1	—	—	1
534	1	Puebloan	—	—	—	1	—	—	—	1
536	1	Puebloan	—	—	1	1	—	—	—	1
537	1	Puebloan	—	—	—	—	1	1	—	1
538	1	Puebloan	—	—	—	—	—	1	—	2
539	1	Puebloan	—	—	—	1	1	—	—	1
540	1	Hispanic	—	—	—	—	—	1	1	2
546	1	Puebloan	—	—	—	1	—	1	1	1
547	1	Puebloan	—	—	—	1	1	—	—	2
549	1	Puebloan	—	—	—	1	—	1	1	1
550	1	Puebloan	—	—	—	1	—	—	—	2
551	1	Puebloan	—	—	—	1	—	1	1	1
552	1	Puebloan	—	—	—	1	1	—	—	2
554	1	Puebloan	—	—	—	—	1	1	—	2
555	1	Puebloan	—	—	—	1	—	—	—	2
558	1	Puebloan	—	—	—	1	—	1	—	1
559	1	Puebloan	—	—	—	1	—	1	—	2
560	2	Puebloan	—	—	—	—	1	—	—	1
561	1	Puebloan	—	—	—	1	—	—	—	1
562	1	Puebloan	—	—	—	1	—	—	—	2
563	1	Puebloan	—	—	1	1	—	—	—	1

565	1	Puebloan	—	—	1	1	—	—	—	2
566	1	Puebloan	—	—	—	1	1	1	—	1
567	1	Puebloan	—	—	—	1	1	—	—	2
568	1	Puebloan	—	—	—	1	1	—	—	2
569	1	Puebloan	—	—	1	—	—	—	—	2
570	1	Puebloan	—	—	—	—	1	—	—	1
571	1	Puebloan	—	—	1	—	—	—	—	1
573	1	Puebloan	—	—	—	1	1	1	—	1
574	1	Puebloan	—	—	—	1	1	—	—	1
576	1	Puebloan	—	—	—	1	—	—	—	1
577	1	Puebloan	—	—	1	1	—	—	—	2
578	1	Puebloan	—	—	1	1	—	—	—	2
579	1	Puebloan	—	—	1	1	—	—	—	2
580	1	Puebloan	—	—	1	1	—	—	—	2
581	1	Puebloan	—	—	1	1	—	—	—	2
582	1	Puebloan	—	—	1	—	—	—	—	1
583	1	Puebloan	—	—	—	1	1	—	—	2
584	1	Puebloan	—	—	—	1	1	—	—	2
585	1	Puebloan	—	—	—	1	—	—	—	1
587	1	Puebloan	—	—	—	1	—	—	—	1
588	1	Puebloan	—	—	—	1	—	—	—	2
589	1	Puebloan	—	—	—	1	—	—	—	2
590	1	Puebloan	—	—	—	1	1	—	—	2
591	1	Puebloan	—	—	—	—	1	—	—	1
592	1	Puebloan	—	—	1	1	1	—	—	2
594	1	Puebloan	—	—	—	1	—	—	—	2
595	1	Puebloan	—	—	—	1	—	—	—	2
596	1	Puebloan	—	—	—	1	1	—	—	2
598	1	Puebloan	—	—	—	1	1	—	—	1
599	1	Puebloan	—	—	—	1	1	—	—	1
601	1	Puebloan	—	—	—	1	1	—	—	2
602	1	Puebloan	—	—	—	—	1	1	1	2
603	1	Puebloan	—	—	—	1	1	—	—	1
604	1	Puebloan	—	—	—	1	—	—	—	1
605	1	Puebloan	—	—	1	1	—	—	—	1
606	1	Puebloan	—	—	—	—	—	1	1	2
607	1	Puebloan	—	—	1	1	—	—	—	1
608	1	Puebloan	—	—	—	1	1	—	—	2
609	1	Puebloan	—	—	1	1	—	—	—	1

610	1	Puebloan	—	—	—	—	1	—	—	1
611	1	Puebloan	—	—	—	1	1	—	—	2
612	1	Puebloan	—	—	—	—	—	1	1	1
613	1	Puebloan	—	—	—	—	1	1	—	2
614	1	Puebloan	—	—	—	—	1	1	—	2
616	1	Puebloan	—	—	1	1	—	1	—	2
617	1	Puebloan	—	—	—	1	—	—	—	1
618	1	Puebloan	—	—	—	—	1	—	—	1
621	1	Puebloan	—	—	—	1	1	—	—	1
623	1	Puebloan	—	—	—	1	1	1	—	1
624	1	Puebloan	—	—	—	1	1	1	1	1
625	1	Puebloan	—	—	—	—	1	1	—	2
626	1	Puebloan	—	—	—	1	1	1	—	1
629	1	Puebloan	—	—	—	1	—	—	—	1
630	1	Puebloan	—	—	—	1	—	—	—	1
631	1	Puebloan	—	—	—	1	1	—	—	2
632	1	Puebloan	—	—	—	1	—	—	—	2
634	1	Puebloan	—	—	—	1	1	—	—	1
635	1	Puebloan	—	—	—	—	1	1	—	2
638	1	Puebloan	—	—	—	1	1	1	—	1
639	1	Puebloan	—	—	—	1	1	—	—	2
640	1	Puebloan	—	—	—	—	—	1	—	2
641	1	Puebloan	—	—	—	—	1	1	—	1
642	1	Puebloan	—	—	—	1	1	—	—	1
643	1	Puebloan	—	—	—	—	1	—	—	1
644	1	Puebloan	—	—	—	1	1	1	—	1
645	1	Puebloan	—	—	—	1	—	—	—	1
646	1	Puebloan	—	—	—	1	—	1	1	1
649	1	Puebloan	—	—	—	1	—	—	—	2
653	1	Puebloan	—	—	—	—	1	1	—	1
656	1	Puebloan	—	—	—	1	—	—	—	1
657	1	Puebloan	—	—	—	1	1	1	—	1
658	1	Puebloan	—	—	—	—	1	1	—	2
660	1	Puebloan	—	—	—	—	1	1	—	2
661	1	Puebloan	—	—	—	1	1	1	—	2
662	1	Puebloan	—	—	1	1	—	—	—	1
663	1	Puebloan	—	—	—	1	—	1	—	2
664	1	Puebloan	—	—	—	1	—	—	—	2

665	1	Puebloan	—	—	—	1	—	—	—	1
666	1	Puebloan	—	—	—	1	1	—	—	1
667	1	Puebloan	—	—	—	—	1	—	—	1
668	1	Puebloan	—	—	1	1	—	—	—	2
669	1	Puebloan	—	—	—	1	1	—	—	1
670	1	Puebloan	—	—	—	—	1	1	—	2
671	1	Puebloan	—	—	—	1	1	1	—	1
672	1	Puebloan	—	—	—	—	—	1	1	1
676	1	Puebloan	—	—	—	—	1	1	—	1
677	1	Puebloan	—	—	—	—	1	1	—	2
679	1	Puebloan	—	—	—	1	—	1	—	2
680	1	Puebloan	—	—	—	—	1	—	—	2
681	1	Puebloan	—	—	—	1	—	—	—	2
682	1	Puebloan	—	—	—	1	1	—	—	1
683	1	Puebloan	—	—	—	1	1	—	—	2
684	1	Puebloan	—	—	—	—	1	1	—	1
685	1	Puebloan	—	—	—	1	—	—	—	1
686	1	Puebloan	—	—	—	1	—	—	—	2
687	1	Puebloan	—	—	—	—	1	1	—	2
688	1	Puebloan	—	—	—	—	1	1	—	2
689	1	Puebloan	—	—	—	1	1	—	—	1
690	1	Puebloan	—	—	—	—	—	1	—	2
692	1	Puebloan	—	—	—	—	1	1	—	1
693	1	Puebloan	—	—	—	—	1	1	—	1
694	1	Puebloan	—	—	—	—	1	1	—	2
695	1	Puebloan	—	—	—	1	1	—	—	2
696	1	Puebloan	—	—	—	1	1	—	—	2
697	1	Puebloan	—	—	—	1	1	1	—	2
698	1	Puebloan	—	—	—	—	1	1	—	2
699	1	Puebloan	—	—	—	1	1	—	—	2
700	1	Puebloan	—	—	1	1	—	—	—	2
701	1	Puebloan	—	—	—	1	—	—	—	2
702	1	Puebloan	—	—	—	1	—	—	—	2
703	1	Puebloan	—	—	—	1	—	—	—	1
704	1	Puebloan	—	—	—	—	1	—	—	1
705	1	Puebloan	—	—	—	1	1	—	—	1
706	1	Puebloan	—	—	—	1	—	—	—	1
707	1	Puebloan	—	—	—	—	1	1	—	1

708	1	Puebloan	—	—	1	1	—	—	—	2
709	1	Puebloan	—	—	—	1	1	1	—	2
710	1	Puebloan	—	—	1	1	—	—	—	2
711	1	Puebloan	—	—	—	—	1	1	—	1
712	1	Puebloan	—	—	—	—	1	1	—	1
713	1	Puebloan	—	—	—	1	—	1	—	2
714	1	Puebloan	—	—	—	1	1	—	—	2
715	1	Puebloan	—	—	—	1	—	—	—	1
716	1	Puebloan	—	—	—	1	—	—	—	1
717	1	Puebloan	—	—	—	1	1	—	—	1
718	1	Puebloan	—	—	1	1	—	—	—	1

Temporal Trends

Figure 4.1 presents a temporal comparison of the traditional northern Rio Grande culture historical frameworks and the Pecos survey chronology. The bar chart on the right side of the figure represents the number of Pecos ceramic components dated to each survey time period. The large increase in ceramic components between Period 1 and Period 2 (from 2 to 101) may reflect an influx of population to the Pecos area after A.D. 1200, an issue addressed in greater detail by Orcutt in Chapter 7. Between Period 2 and Period 3, the number of ceramic components at Pecos continues to increase threefold, from 101 to 302, indicating greater settlement during A.D. 1325-1450. The trend toward settlement aggregation at Pecos Pueblo beginning around A.D. 1400 almost certainly accounts for the drop in ceramic site components from 302 to 235 by Period 4 (A.D. 1450-1575). The decline in the number of sites continues in Period 5 (A.D. 1575-1700), diminishing to 178 ceramic site components. By Period 6 (after A.D. 1700), the number of Pecos Puebloan ceramic components declines even further to 58. These demographic and settlement trends are pursued further in Chapters 6 and 7.

Contemporaneity of the Early Pueblos

Probabilistic ceramic dating was used to conduct a more fine-grained assessment of the contemporaneity of the pueblos antecedent to Pecos Pueblo in order to understand the timing of each in relation to the others. Using the project site typology (Chapter 5), only those sites classified as pueblos (>6 rooms) or communal pueblos (>99 rooms) were used in this analysis. Pecos Pueblo, founded later, was excluded. A locational map of the pueblos may be found in Figure 1.3.

For the contemporaneity analysis, 25-year divisions were used instead of the 125-year intervals used to define the overall project chronology. Although the probabilities for each 25-year division became diminishingly small, the small sample (n=9) made it feasible to graphically examine each of the sites of interest (Figures 4.11, 4.12, and 4.13). A bar graph of the date ranges of the early pueblos calculated from the probability data also facilitates an assessment of contemporaneity (Figure 4.14).

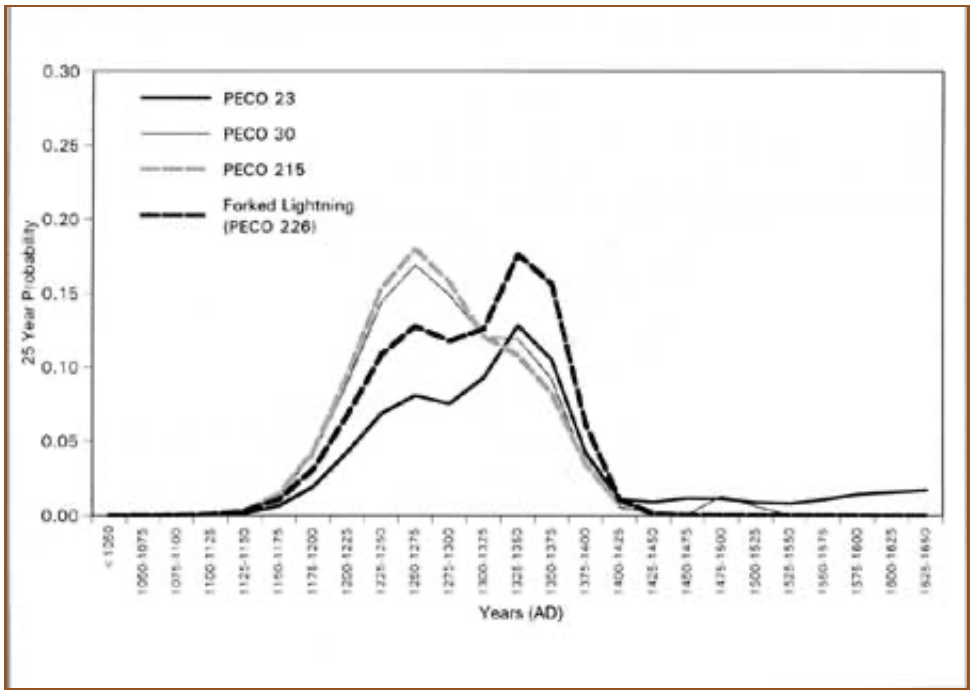

Figure 4.11. Twenty-five year probabilities for PECO 23, PECO 30, PECO 215, and Forked Lightning (PECO 226). *(click on image for an enlargement in a new window)*

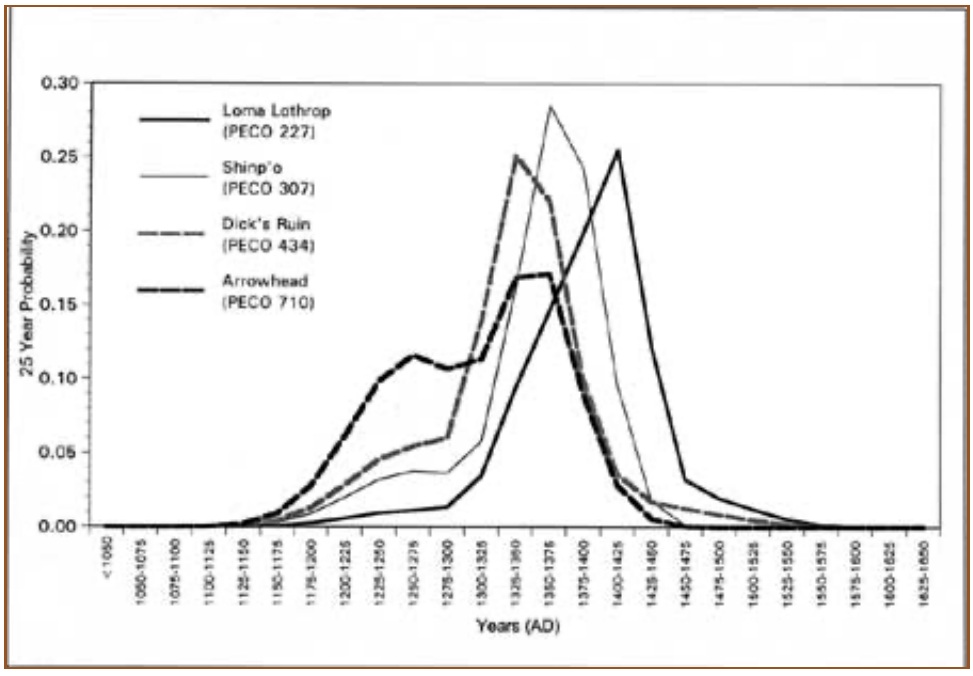

Figure 4.12. Twenty-five year probabilities for Loma Lothrop (PECO 227), Shin'po (PECO 307), Dick's Ruin (PECO 434), and Arrowhead (PECO 710). *(click on image for an enlargement in a new window)*

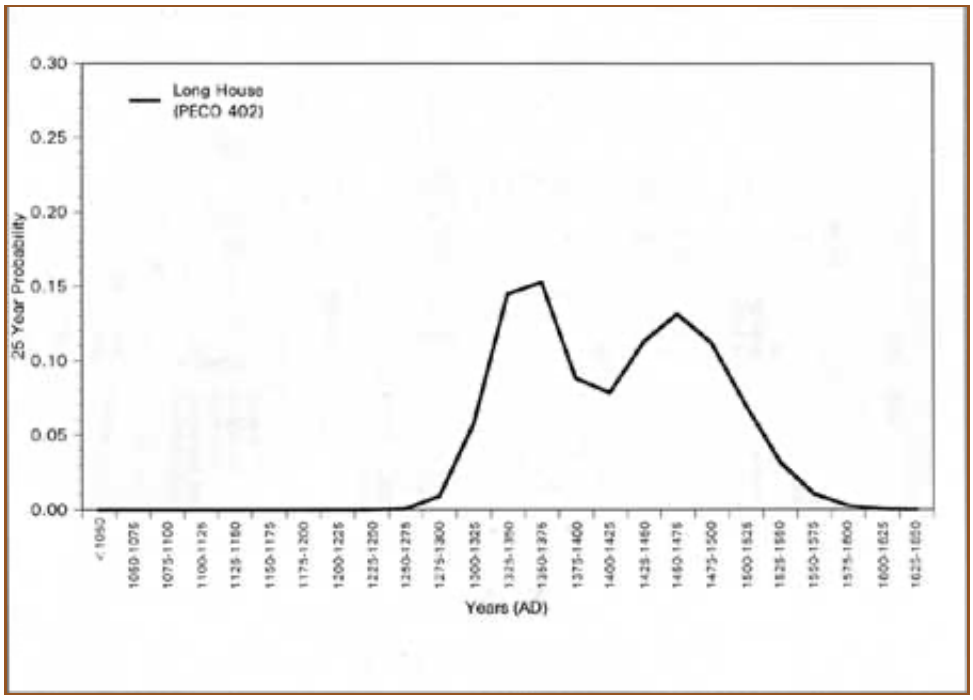

Figure 4.13. Twenty-five year probabilities for Long House (PECO 402). *(click on image for an enlargement in a new window)*

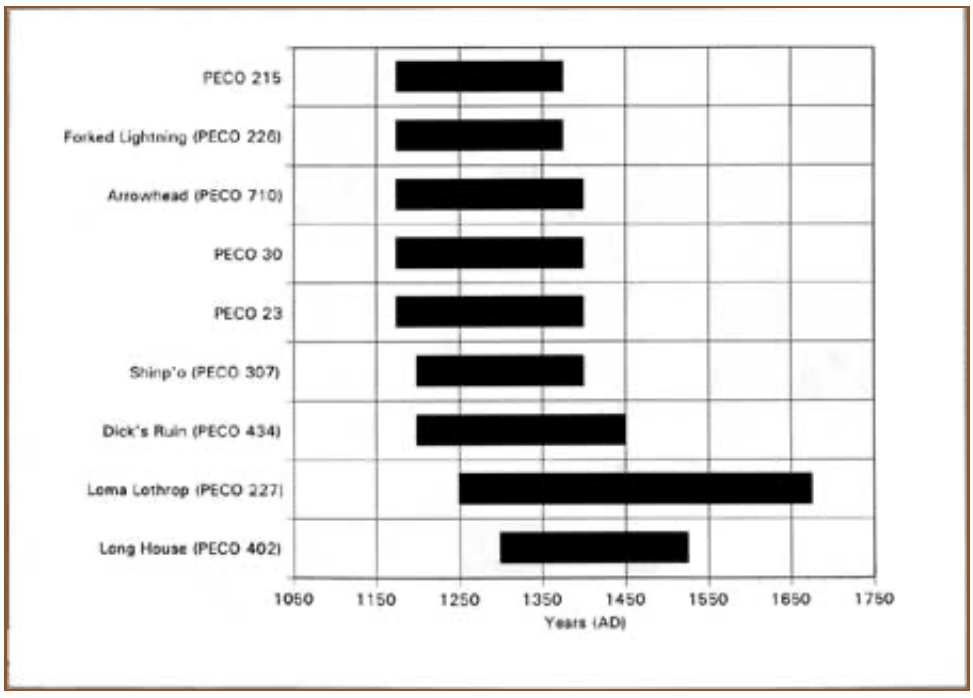

Figure 4.14. Early pueblo data ranges based on 25-year probabilities. *(click on image for an enlargement in a new window)*

Although Forked Lightning (PECO 226) is typically regarded as the earliest pueblo in the Upper Pecos Valley, the probability data reveal that two small, unnamed pueblos (PECO 215

and PECO 30) were most likely contemporaneous with Forked Lightning Pueblo (Figure 4.11). Located in the same general area of the park, these small pueblos are an architectural rarity within the Pecos Valley. Most structural sites recorded by the survey have only 1-2 estimated rooms. While wall alignments are not very apparent on the surface of PECO 215 and PECO 30, they are estimated to have 16 rooms and 45 rooms, respectively, based on extent of architectural rubble.

PECO 23, an unnamed pueblo with an estimated 10 rooms, displays a probability distribution which resembles that of Forked Lightning Pueblo. Radiocarbon dates from Rowe Pueblo that place initial occupation around A.D. 1250 (Cordell 1998) suggest that it was likely in use at the same time as Forked Lightning. In Kidder's estimation, Black-on-white House, underlying the extensive midden of the north terrace of Pecos Pueblo, was also contemporaneous with Forked Lightning Pueblo.

Forked Lightning Pueblo and PECO 215 were apparently the earliest pueblos to be abandoned, by at least the middle of the fourteenth century. According to the probability data, all of the other pueblos—including Dick's Ruin (PECO 434), Loma Lothrop (PECO 227), and Shin'po (PECO 307)—were still in use at the time of Forked Lightning Pueblo's abandonment (Figure 4.12). Due to sparse remaining surface ceramics, Arrowhead Pueblo (PECO 710) is showing up in these plots earlier than is probably correct. Dick's Ruin continues to be occupied into the A.D. 1400s, outlasting six of the other early pueblos, although simultaneous occupation continued at Loma Lothrop, and probably at Arrowhead Pueblo as well. A surprising finding indicated by the probability data is the length of time that Loma Lothrop continued to be used —well into the seventeenth century. Use of the site appears to have continued on a lesser scale at this time, perhaps in a seasonal or special-use capacity (see Chapter 5).

Dick's Ruin and Shin'po exhibit overall ceramic probability distributions that mirror one another, although Dick's Ruin was apparently established slightly earlier and occupied longer. While Dick's Pueblo is a completely black-on-white site, Shin'po has traces of early glaze ware. However, the very small ceramic assemblage from Shin'po limits further inferences about its timing in comparison to the other pueblos.

Long House (PECO 402, estimated 46 rooms) (Figure 4.13) has a probability distribution that is unlike any of the other pueblos. Showing a slightly bimodal distribution, the probability figures indicate that the site was initially settled by the A.D. 1300s and was contemporary with Dick's, Shin'po, Loma Lothrop, and probably Arrowhead Pueblo. It is significant that Long House is the only pueblo besides Pecos Pueblo that is dated to survey Period 4 (A.D. 1450-1575).

Conclusions

This chapter has incorporated two primary methods for assigning relative chronological placement to the Pecos survey sites. Mean ceramic dates provide a useful relative sequence of sites through time and are a rapid method for identifying temporal trends in a large dataset. Ceramic probability dating was found to have greater potential for chronology building using hundreds of surface ceramic assemblages. In contrast to traditional archeological seriations and to methods such as mean ceramic dating, the probability method estimates site occupation ranges at a defined threshold level, taking into account the presence and relative frequency of

multiple ceramic types. A significant advantage of the probabilistic approach is that it uses replicable and objective criteria for assigning sites to time periods defined by the researcher, thereby allowing comparison with standard chronologies and with other assemblages.

A fine-grained assessment of the contemporaneity and sequence of occupation of the early pueblos was conducted. Ceramic probability dating takes strides towards understanding the timing of these little-known but important sites.

Future work should continue to refine the probabilistic method and the chronology developed here by taking into account the unique trajectory of individual ceramic types, rather than treating each as an idealized normal distribution. More ceramics found in well-dated excavated contexts—ideally from short-term, single-component sites—are of course our best means for further improving the Pecos chronology.

Notes

1. While the probability distributions used in this analysis were generated in SPSS ver. 8.5, any program that can generate probabilities for segments of defined distributions (i.e., the normal distribution) may be used. Previously, probabilities have been calculated in Microsoft Excel, MathCAD Professional, and Mathematica ver.3.0

2. The formula for the normal probability density function is as follows:

$$Z = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}[(Y-\mu)/\sigma]^2}$$

Z = Height of curve at Y, given:

μ = Mean of Distribution

σ = Standard Deviation of Distribution

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