PRECONTACT POPULATION DECLINE AND COALESCENCE IN THE SOUTHERN SOUTHWEST

The Phoenix Basin was the heartland of the Hohokam regional system for nearly a millennium. Hundreds of miles of irrigation canals supported more than 20,000 people during the early 1300s, but the valley was devoid of inhabitants when the first Jesuit missionary visited the area in the 1690s (note all dates are A.D.). The magnitude of this population loss has been a topic of research for more than a century, yet there is still no widely accepted explanation. Furthermore, recent research has shown that the entire southern Southwest experienced a severe reduction in population prior to the arrival of Spaniards in the New World in 1540. Over the long term the American Southwest experienced population growth. What can account for such a dramatic reversal of this trend, and why is the decline so great in the southern Southwest? This proposal requests funding to investigate evidence of precontact population decline in the Phoenix Basin and three other areas in the southern Southwest. This research builds directly on work partly funded by NSF in the San Pedro Valley of southeastern Arizona.

Our San Pedro Valley research revealed a complex demographic history, and we found that a theoretical model of coalescence helped us to understand the interrelationship of late precontact demographic processes. In the American Southeast, a similar coalescent society model has been applied to the early historic period when population decline and related disruptions led to cultural reorganization and formation of aggregated, multi-ethnic and multi-lingual communities. We postulate that a variety of social stresses stimulated the formation of coalescent communities in the Southwest by 1250 to 1300. The process of coalescence-possibly in conjunction with environmental changes-may have contributed directly to a demographic reversal. Factors causing this decline may have included warfare, nutritional stress, and unhealthy living conditions which lowered fertility rates and/or increased mortality. Although aspects of coalescence likely varied among the valleys of southern Arizona, this process may have contributed to population decline throughout the region.

Five study areas provide a valuable window to the process of precontact depopulation in the southern Southwest. The primary research zones include two well-studied areas: the Phoenix Basin (the Hohokam core area) and the Tonto Basin (a portion of the Hohokam periphery). The secondary research zones, Perry Mesa and Safford Basin, are located northwest and east of the Phoenix Basin, respectively. Previous research in the Phoenix and Tonto basins has documented strongly contrasting evidence of the nutritional status and physical condition of contemporaneous populations in these two areas, yet both were ultimately depopulated. Perry Mesa is considered a secondary zone because existing data are more limited, but there is strong evidence in the defensive settlement locations that warfare may have been a dominant social concern in that region. The Safford Basin is also less known but there is strong evidence that migrants played an important role in demographic and social processes in this valley during late precontact times. The San Pedro Valley has already yielded important information on our research issues and will provide valuable comparative data for the present study.

Multiple factors contribute to the expectation that significant headway can be achieved in addressing this large topic that has frustrated so many previous researchers. First, finer scale ceramic seriation is now available. Second, over the past decade theoretical and methodological advances have enhanced our understanding of key social processes such as migration, warfare, and specialized production and exchange that affected settlement systems within entire valleys. Finally, our GIS capabilities, which include a database of all known large sites from the late precontact and protohistoric Southwest, provide a potential for demographic modeling that is much more sophisticated than has been possible previously.

THE TIMING OF POPULATION DECLINE

Recent demographic analyses show more than one thousand years of sustained population growth, a brief stasis, and beginning in the early 1300s, a striking decline in overall population (Figure 1). The Museum of Northern Arizona (MNA), the Center for Desert Archaeology (CDA), and Geo-Map, Inc. developed the *Coalescent Communities GIS Database* (Wilcox, Doelle, and Hill 2003) to provide a firm, empirical grasp on demographic change in the macroregion that includes Arizona, New Mexico, southern Colorado and Utah, in the United States and northern Sonora and Chihuahua in Mexico (henceforth glossed as the Southwest). Our goal is to compile size, temporal, and locational data for every settlement in the Southwest with more than 12 rooms, dating between 1200 and 1700. Regional populations are estimated from these room counts at a chronological resolution of 50 years. Thus far, almost 3,500 sites with nearly 6,000 temporal components are included, allowing us to identify robust demographic trends.

Figure 1 highlights two time periods, the earlier period (1300-1350) is when this database shows the start of population decline (see also Doelle 2000), and the later period (1500-1550) is when European

diseases could have begun to affect Southwestern demography. Several previous researchers have accounted for Southwestern population decline as a result of European pathogens (e.g., Dobyns 1966; Ezell 1963; Reff 1981, 1991), but these empirical data counter such explanations. The substantial time interval between these periods makes it clear that population decline began well before European diseases could have been a causal factor. We are left with the challenging problem of finding internal causes to account for this dramatic population loss-particularly because it follows such an extended period of growth. This is the challenge that previous researchers have failed to meet. We believe that an approach targeting specific analyses on multiple geographic scales and refined temporal resolution promises significant new insights. We propose to apply an improved chronology, based on a ceramic seriation developed in the San Pedro Valley, to the study of local demographic processes in south-central Arizona. A critical first element is defining the appropriate spatial scales for these analyses.

SPATIAL SCALES OF POPULATION DECLINE

The *Coalescent Communities* GIS database allows us to conduct a time-series analysis of population distribution over the Southwest macroregion (Figures 2-4). At this scale, distinct northern and southern regions are apparent (Wilcox, Gregory, and Hill 2003). Furthermore, during the 14th century a "demographic fault zone" opened up between the southern and northern Southwest. Thereafter, each region followed different demographic trajectories. If we reexamine our data in this simple north-south framework (Figure 5), we gain insight into how to prioritize research efforts toward the ultimate goal of explaining the macroregional pattern shown in Figure 1.

The decline is especially dramatic in the southern Southwest (Figure 6). Populations in this region began a decline shortly after 1300, and by 1450 archaeologically visible populations had virtually disappeared from this region. The fate of these missing thousands and the underlying causes of this remarkable decline are still contested issues despite intensive research (Abbott 2000, 2003; Chenault 2000; Doyel 1991, 1995; Henderson and Hackbarth 2000). Environmental degradation, flood, drought, and social pressure are possible factors, but no single variable can account for the disappearance of roughly 40,000 people from an area spanning 100,000 square kilometers, particularly in a region where previous settlement was characterized by deep sedentism (e.g., Abbott and Foster 2003; Craig 2001; Fish et al. 1994; Fish and Fish 1992; Haury 1976). Furthermore, people did not return to settled agricultural life in this region for nearly two centuries, and destination areas for this population have yet to be adequately documented. Explanation of this level of population decline a century before the arrival of the Spanish requires consideration of factors other than the disease and hardship associated with European contact.

Explanation of regional population decline will require detailed analyses of cultural and biological processes affecting demography at a local scale. While trends throughout the southern Southwest indicate cumulative large-scale consequences, specific demographic processes were expressed differently in local settlement (cf. Ammerman et al. 1973). Focusing on the entire southern Southwest obscures important local variability between central and peripheral areas that underwent different processes of decline. Therefore, based on the very productive research we recently completed in the San Pedro (Figure 6A), we believe that selecting a sample of areas representing a range of cultural and environmental contexts is an effective research strategy. The proposed study areas include the Phoenix Basin, the Tonto Basin, Perry Mesa, and the Safford Basin (see Figure 6B-E, respectively). Although each study area experienced different specific demographic processes, communities in each area coalesced in the late 13th century and in less than century experienced substantial population reductions. By approximately 1450 each area was devoid of archaeologically visible settlement. Considering this evidence, two multi-faceted research questions will be addressed by the proposed project:

1) What was the tempo and spatial variability of population decline?
2) What were the cultural and biological factors that contributed to this decline?

The theoretical background for addressing these research questions is discussed in the next section and a model is presented with test implications for the four study areas.

POPULATION DECLINE AND COALESCENCE

Population Decline

Although population loss in the southern Southwest appears dramatic upon initial inspection, a surprising result of the demographic analysis is the potentially gradual pace of this decline. At the resolution of 50-year intervals employed in the *Coalescent Communities* database, rates of decline across

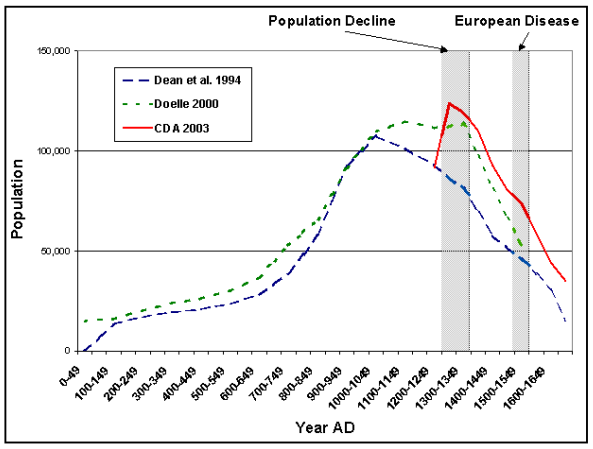

Figure 1. Population estimates for the North American Southwest showing macro-regional decline preceding European contact.

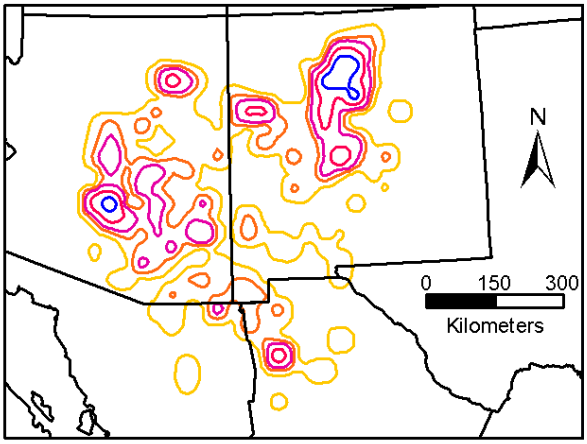

Figure 2. Population density from AD 1300-1350. Contours lines from light to dark represent 10, 50, 100, 250, and 500 persons per 100 square km.

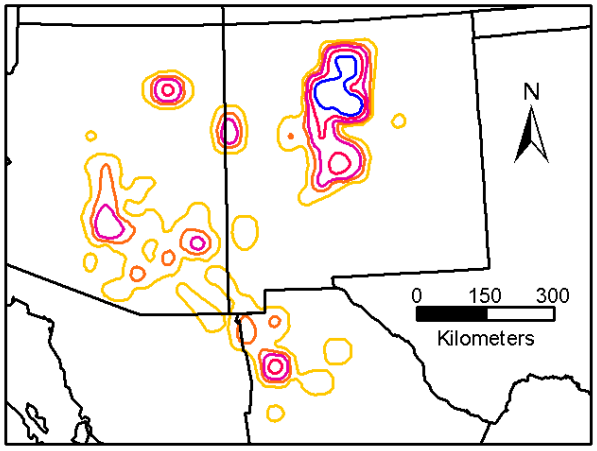

Figure 3. Population density from AD 1400-1450. Contours lines from light to dark represent 10, 50, 100, 250, and 500 persons per 100 square km.

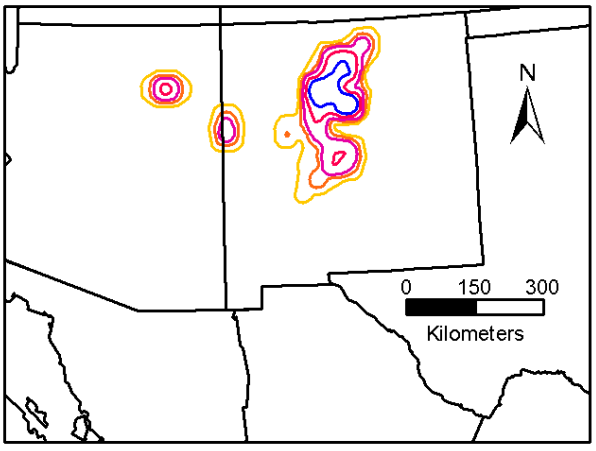

Figure 4. Population density from AD 1450-1500. Contours lines from light to dark represent 10, 50, 100, 250, and 500 persons per 100 square km.

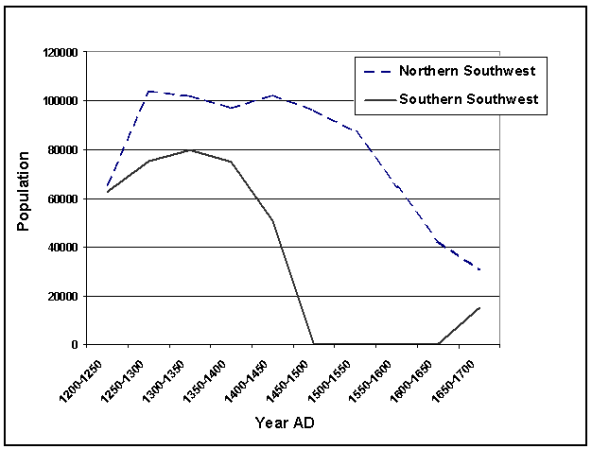

Figure 5. Population estimates by region showing different trajectories of decline.

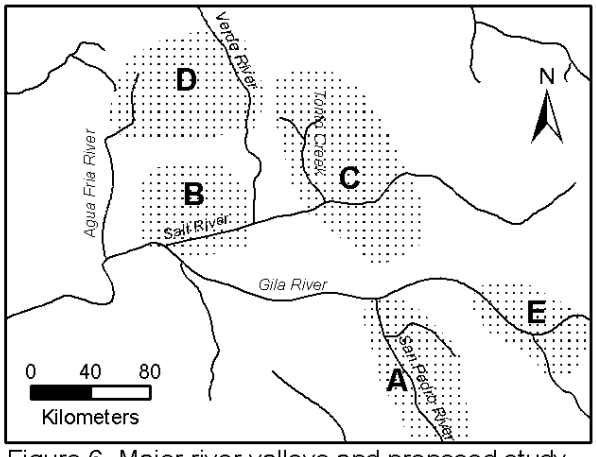

Figure 6. Major river valleys and proposed study areas in southern Arizona.

the Southwest never exceeded approximately 5 persons per thousand per year. Slow population decline prior to regional abandonment is demonstrated at the local level in the lower San Pedro study. These rates of population change are low by modern standards and are well within the range of decline that might be attributed to slight changes in fertility and mortality. For example, Cowgill (1975) argues that changes in fertility or mortality of 10 to 15 percent could reverse a demographic trend, of the magnitude seen in the Southwest, from positive to negative growth. Thus, at a refined temporal resolution this archaeologically dramatic 'event' may be seen as a gradual process resulting from a combination of biological and behavioral changes at multiple scales (cf. Dean et al. 1985).

Fertility rates are highly variable and subject to control by precontact populations. Fertility regulation has been suggested for populations facing nutritional and social stresses related to coalescence (Dumond 1965; Englebrecht 1987; Jackson 1994; Kowalewski 2003). Increased mortality has been linked to the agricultural intensification and social disruption that accompany the aggregation of populations (e.g., Lallo et al. 1980; Longacre 1973; Milner 1991; Martin 1994). Based on Mississippian burial data, Eisenberg (1991) argues for an decrease in health and stamina, particularly among those critical to the reproductive success of the social group, leading to a failure in the generational transmission of cultural knowledge and ultimate cultural termination (cf. Shennan 2000). Evidence from skeletal populations indicates that aggregation and agricultural intensification in the Phoenix Basin (Abbott 2003; Fink 1988; Fink and Merbs 1991; Hartman 1988:242-243; Martin 1994; Sheridan 2003; Van Gerven and Sheridan 1994) led to deteriorating health that may have contributed to a similar process of population decline.

Despite growing evidence of immigration into the southern Southwest from the ancestral Puebloan world (e.g., Clark 2001; Lyons 2003), current estimates do not indicate population growth in destination areas. This unexpected finding raises important questions about the number of people involved and the demographic trajectory of indigenous societies absorbing immigrants. The CDA San Pedro study has documented a complex process of immigration and integration with local communities, followed by gradual population decline. We propose to apply similar techniques in related study areas to identify the scale and timing of migration, interaction with indigenous groups, and ensuing population change.

A process of internal population decline compensated by immigration has been frequently postulated for early agricultural societies (Cohen and Armelagos 1984; Dumond 1997; Feinman et al. 1985; Hassan 1981:234-250; Kowalewski 2003). Hassan describes a dynamic in multiple regions wherein population decline, due to unfavorable health conditions in nucleated settings, was offset by immigration of rural groups. This combination led to increasing density of population aggregates while regional population declined. Similar processes appear likely in the southern Southwest as migration and coalescence corresponded with regional population loss (cf. Abbott and Foster 2003).

Only when the full range of demographic factors affecting fertility, mortality and migration are assessed will we be able to understand the causes of population decline. The inadequacy of current explanations is a result of the search for overly uniform explanations and incomplete synthesis of evidence of these demographic factors. Equivalent levels of chronological resolution in each study area are needed to compare settings. Furthermore, it will be necessary to develop an improved accounting of the early 15th century inhabitants, in order to identify whether they made lifestyle changes that rendered them less archaeologically visible (Nelson 1999; Nelson and Hegmon 2001), or whether they emigrated from the region. It is our expectation that the disappearance of precontact populations from the southern Southwest resulted from a combination of factors played out in different areas over several generations.

Coalescence

At approximately the same time Southwestern population began to decline there was a corresponding trend toward increased settlement size and a decrease in the number of settlements. Southwestern archaeologists have described this process as one of reorganization or aggregation (e.g., Adler 1996; Spielmann 1998). A related trend was heightened levels of migration during the same interval (Adams 2002; Ahlstrom et al. 1995; Di Peso 1958; Haury 1958; Lekson et al. 2002; Mills 1998; Riggs 2001; Roney 1995; Woodson 1999). Migration and settlement aggregation in the Southwest occurred in a context of social, economic and ideological change, that together constitute a process of coalescence (Ethridge and Hudson 1998, 2002; Kowalewski 2001, 2003). Coalescence and population decline were closely linked in the American Southeast, and it is likely that these processes were also related in the Southwest. In order to understand the disappearance of the Hohokam it will be necessary to understand the temporal and spatial dimensions of the coalescent context in which it occurred.

Kowalewski (2001, 2003) developed the concept of coalescent society to describe indigenous early historic populations in the American Southeast (Ethridge and Hudson 1998, 2002; Kowalewski 2001, 2003), where native populations were decimated by European diseases and threatened with extinction by European expansion. Facing demographic collapse, remnants of different social groups came together to form new communities.

Coalescence is not synonymous with aggregation, but includes a wide range of related social, economic, and demographic processes. Based on a cross-cultural study, Kowalewski (2001) lists the following processes and behaviors associated with coalescent societies:

- Population aggregation/nucleation;
- Formation of multi-ethnic and multi-lingual communities;
- Heightened concern for security reflected in settlement location and fortification;
- Intensification of subsistence and exchange systems;
- Enhancement of community integration reflected in settlement layout, kin group organization, and formation of egalitarian ideologies;
- Formation of collective leadership institutions, including councils and confederacies; and
- Increased interaction at a macro-regional scale

Kowalewski (2001) considers the coalescent society one possible response to heightened external pressure, particularly stress related to warfare, population decline, and migration. In the Southwest, initial coalescence occurred in the late 13th century, and was associated with widespread population movement (as noted above) and possibly heightened levels of conflict (e.g., LeBlanc 1999; Rice 1998; Rice and LeBlanc 2001; Schaafsma 2000; Wallace and Doelle 2001; Wilcox and Haas 1994). The trend toward decline in the Southwest is not evident until the early 14th century. Thus, in the proposed study areas, coalescence may have contributed to population loss, and a complex relationship may have existed between these two processes.

Many attributes of the coalescent societies model characterize communities in the southern Southwest during this interval. Villages developed around and within platform mound settlements such as Pueblo Grande in the Phoenix Basin, Casa Grande in the middle Gila Valley, Flieger Ruin in the lower San Pedro Valley, and Schoolhouse Point in the Tonto Basin.

Recent research has established the multi-cultural and potentially multi-linguistic character of several of these communities (Clark 2001; Lyons 2003; Woodson 1999). This mixing of previously segregated populations was the direct and indirect result of the abandonment of the Kayenta and Tusayan regions in the late 13th century. The southward movement from these areas to perennial river valleys triggered a complex migration process that impacted much of the Southwest, including the proposed study areas. The farther the analytical net is cast using new methods to track social groups through time and space (Clark 2001; Lyons 2003; Stark et al. 1998; Stone 2003), the more complicated the social map that emerges for this interval. Migration was an important catalyst in coalescence, generating economic pressure and causing social disruption on a large scale.

The coalescent society model represents a synthesis of the cooperation/conflict dialogue that has emerged in Southwestern archaeological literature over the past decade. Much of the evidence of the latter is derived from architecture and settlement patterns that demonstrate an increased emphasis on defense (e.g., LeBlanc 1999; Rice 1998; Rice and LeBlanc 2001; Wallace and Doelle 2001; Wilcox and Haas 1994). Other researchers have focused on the development of new integrative ideologies with inclusive membership such as the *katsina* religion (Adams 1991) and the Southwest Regional Cult (Crown 1994; but see Plog and Solometo 1997 for the role of conflict in ritual change). Such sodalities likely served to integrate immigrants and local groups. There is also abundant evidence for economic intensification in food production and intraregional and interregional exchange. Wills (2003) characterizes this period as one in which large populations, forced to aggregate for defensive purposes, intensified food production in the vicinity of their settlements. Although this strategy protected crops from raiding and other external threats, it ultimately led to degradation of local environments. In the Phoenix Basin, more extensive canal systems were built to meet the subsistence requirements of a growing population. Despite such efforts, research suggests that populations experienced severe nutritional stress during this interval (Abbott 2003; Fink 1988; Fink and Merbs 1991; Hartman 1988:242-243; Martin 1994; Sheridan 2003; Van Gerven and Sheridan 1994).

Intensification of exchange is evident in nearly every material class by the early 14th century. In the southern Southwest, specialized production and intensive intraregional exchange of utilitarian ceramics is evident (Abbott 2000; Miksa and Heidke 1995; Stark et al. 1995). In the San Pedro Valley, Salado

polychrome pottery (also known as Roosevelt Red Ware) was produced by part-time specialists for intrabasinal exchange (Castro-Reino et al. 2003). Although procurement sources vary, the dramatic increase in obsidian over time within the lower San Pedro Valley is mirrored in the Tonto and the Phoenix basins. Tracking changes in these material correlates of interaction, within and among the study areas, will be critical to modeling the coalescence process in the southern Southwest.

A Model Linking Coalescence and Demographic Decline

Muller (1997) presents a model of demographic decline and organizational continuity in the precontact Mississippian world that has implications for the study of precontact Southwestern depopulation. Based on excavated burial data, he estimates rates of population change, finding slow negative growth in most groups. Using these estimates he finds that, beginning with a population of 1000, most communities would have been critically depopulated after 200 years. He argues for a pattern of coalescence in which "small groups often passed out of separate existence by being absorbed into surviving larger polities" (Muller 1997:354). He notes that as numbers declined through time, remnant populations joined existing groups to remain socially and economically viable, so that community size remained fairly constant even as the number of communities decreased.

Using improved chronological control and techniques for tracking social groups in the southern Southwest, we propose to test implications of an hypothesis of gradual population decline in a context of coalescence similar to Muller's. If population decline is related to coalescence it should be evident in social and biological changes visible in the archaeological record. In the model we propose for the southern Southwest, immigrants created conditions of increased conflict and competition over resources as they entered a region characterized by a diverse and extensive subsistence strategy among communities on the margins of the Hohokam system. This pressure encouraged dispersed local groups to forego extensive strategies and to concentrate on more intensive and defensible crop production. In addition, groups with Hohokam affiliation may have retreated to the Phoenix Basin core.

The combination of increased conflict with immigrants and diet narrowing due to agricultural intensification led to increased mortality and/or decreased fertility. Changes in mortality/fertility caused a demographic transition from population growth to slow decline that was probably not evident to anyone at the time. Population decline led to changes in the demand for labor to maintain irrigation systems, and the presence of immigrants may have provided a supply of labor over which local groups competed. In addition, the availability of immigrant labor may have affected the numbers of children desired.

Over time, declining population, especially in peripheral areas where community size was smaller to begin with, led to further coalescence as remnant groups moved to join still viable communities. This process of small-scale movement and community reorganization resulted in a blending of previously separate enculturative traditions as migrants and locals co-resided and intermarried. As regional ties broke down, the last viable communities in the region attempted to maintain social and economic interaction with other groups, leading to increased inter-valley exchange. Finally, unable to maintain important irrigation systems, community functions and marriage networks, a much reduced terminal population abandoned the region to join other groups to the north and/or south. The model described here presents the following test implications for each study area:

1) Changes in economic interaction and behavioral traditions indicate:
    - Early increased competition and conflict over resources as immigrants arrive
    - Later decreasing competition and increased cooperation (exchange)
    - More mixing of enculturative traditions at later sites
    - Increased interregional interaction over time
2) Bioarchaeological evidence of health stress that would affect mortality and/or fertility include:
    - Evidence of poor nutrition
    - Evidence of increased infectious disease
    - Evidence of trauma associated with conflict
3) Spatial variability in settlement through time is evident in:
    - Increasingly defensive location and construction of sites as immigrants arrive.
    - Consolidation into fewer communities around remaining irrigation systems.
    - Contraction of settlement to locations with ease of access to other remnant groups.

Evaluation of the test implications described here is dependent on high temporal resolution of site occupation and abandonment, clearly identifiable markers of economic interaction and enculturative

traditions, and bioarchaeological evidence of stress. Development of these data will be possible with a comprehensive new analysis of material recovered as a result of previous fieldwork throughout the region and recent NSF-funded CDA research in the lower San Pedro. Synthesizing these data will allow us to document rates of population change locally. Integrating inferences about rates and processes of decline with evidence of changing cultural traditions and health will allow us to evaluate whether gradual population decline and coalescence is an appropriate model for the disappearance of the Hohokam.

PREVIOUS CDA RESEARCH IN THE LOWER SAN PEDRO VALLEY

To reconstruct these complex processes, fine-grained studies are required such as those conducted as part of CDA's research program in the lower (northern) San Pedro Valley (Figure 6A). A program of large-scale survey and small test excavations at 29 sites refined chronology, identified socioeconomic groups, and documented their interaction during the Classic period (1200 to 1450; Doelle et al. 1999). A key contribution of the San Pedro study has been the development of a high-resolution ceramic seriation based on Salado polychrome pottery and late northern intrusive types. This seriation allows the Classic period to be subdivided into at least four 50 to 75 year phases. Using this refined chronology and indices of immigration, we identified the arrival of Kayenta/Tusayan groups from northeast Arizona during the late 1200s. Their presence is indicated by multiple enculturative markers at several sites in the southern portion of the lower valley. These include ceramic and architectural technological styles (Di Peso 1958; Lyons 2003), domestic installations (Lindsay 1987; Lindsay et al. 1968), and ceremonial structures (Gerald 1958, 1975) that can be linked specifically to Kayenta/Tusayan groups.

As immigrants arrived in the lower San Pedro, local communities coalesced into larger settlements, often with defensive characteristics. Paleobotanical data indicates that extensive rockpile fields on the terraces above the floodplain, probably used for agave cultivation (cf. Fish et al. 1990), had fallen out of use by this time. Instead, land-use focused on intensified irrigation agriculture and use of the floodplain near primary settlements. This is demonstrated by the high ubiquity of maize and mesquite beans throughout the period 1300 to 1450, to the near exclusion of agave and other piedmont food resources.

Changing settlement patterns indicate a gradual reduction in the number of villages beginning shortly after 1300. By the late 1300s, many of the southern villages were abandoned and settlement was focused nearer to the San Pedro confluence with Aravaipa Creek and the Gila River to the north. The ceramic assemblages and architectural layout of late villages have parallels at the latest occupations elsewhere in the southern Southwest, suggesting connections throughout the region. By 1425, the sole remaining site in the lower valley was a platform mound village (Flieger Ruin) near the Aravaipa Creek confluence. By around 1450 the entire valley was devoid of archaeologically visible settlement and remained so for nearly 200 years (Bolton 1936; Di Peso 1953; Masse 1981). At this finer chronological resolution, the reduction of Classic period settlement occurred over 100 to 150 years. This decline was a gradual, spatially uneven process rather than an abrupt valley-wide collapse. Similar declines may be observable in other areas of the southern Southwest when viewed at maximum temporal and spatial resolution.

Salado polychrome pottery is also a marker of social and economic interaction that dominated the decorated ceramic assemblage of most sites during the 150-year period of demographic decline. Technologically and stylistically, it has close parallels with Kayenta/Tusayan pottery produced in northeast Arizona (Crown 1994; Lyons 2003). Thus, the reconstruction of Salado polychrome production and exchange is essential to understanding migrant-local interaction. To accomplish this goal, CDA was awarded an NSF grant in 1999 to develop a petrographic model of the San Pedro Valley for determining the sources of sand and lithic materials used to temper ceramic vessels (Castro-Reino et al. 2003; Miksa and Doelle 1998). Sand and lithic samples were used to identify 20 petrofacies, or temper procurement zones within the valley. Using this petrographic model, more than 2000 sherds, each representing an individual vessel, were analyzed from the tested Classic period sites. Results indicate substantial quantities of Salado polychrome vessels were produced at early Kayenta/Tusayan enclaves in the southern portion of the lower valley. These vessels were used within the producing settlements and exchanged to local platform mound communities. Salado polychrome pottery was also produced at the latest villages in the northern portion of the valley, inhabited by the mixed descendants of migrant and local groups. Considering the wide distribution of Salado polychrome pottery in the Southwest, and evidence for multiple production areas with evidence of migration (Crown 1994), the results of the petrographic analysis have implications for the proposed study areas.

Sourcing of obsidian also informed on economic exchange and was the primary method of documenting long-distance interaction. Four hundred of the nearly 500 specimens recovered were

submitted for analysis at the University of California at Berkeley's Archaeological XRF Laboratory. Nearly 80 percent of the sample originated from sources in the Safford Basin or farther east. Notably, only 5 percent was derived from the local Superior source. Analyses indicate virtually no obsidian entering the valley prior to the arrival of the migrants. Hence, it is likely that the migrants maintained relations with groups along the migration route from northeastern Arizona, allowing them to control much of the obsidian exchange.

PLANNED ANALYSES

The proposed research focuses on the tempo and spatial variability of demographic decline and coalescence in the late precontact southern Southwest and the social and environmental factors that drove these processes. Specific methods are described below. We will utilize existing museum collections, including those locally available (e.g., at MNA, the Arizona State Museum, Arizona State University) and collections housed out of state (e.g., at the Peabody Museum at Harvard University). Information will also be gathered from published and unpublished reports and databases (including site inventories curated by the Arizona State Museum, the Bureau of Land Management, and the United States Forest Service). Finally, limited surface collections will be conducted in the secondary research zones.

Chronological and Spatial Patterning in Demographic Decline and Coalescence

We propose to approach temporal and spatial patterning principally through a recently developed seriation of Salado polychrome pottery. The seriation will improve the chronological resolution of existing settlement pattern data, providing a more precise accounting of population during the 1300-1450 interval within each study area, and permitting comparisons among the study areas. Population estimates will be based on these settlement data including information on site size and room counts (Abbott and Foster 2003; Kintigh 1985:21-23; Plog 1975; Schacht 1981). Different rates of decline will be used to infer different demographic processes (Dumond 1997). Many of these data, for large sites, are present in the *Coalescent Communities* database and will be improved as a result of chronological refinement. Information on small sites will be added to this database. These data will be used with environmental information in the GIS to develop a predictive model for estimating demographic trends in unexplored or developed areas (Zubrow 1990). The seriation will also make it possible to group burial populations into more chronologically meaningful units of analysis, facilitating the study of changes in health through time.

The seriation builds upon the Salado polychrome stylistic sequence identified by Crown (1994) and takes into account temporal patterns in vessel form noted by Crown and corroborated by our recent work with Classic period assemblages from the lower San Pedro Valley. Based on her whole vessel study, Crown identified temporally diagnostic styles associated with the three principal Salado polychrome pottery types: Pinto Polychrome, Gila Polychrome, and Tonto Polychrome. Crown's research and our own analyses strongly suggest that a limited number of decorative patterns are associated with the latest period of Salado polychrome production. Furthermore, bowls with recurved rims, a variant of Gila Polychrome called Cliff Polychrome by Harlow (1968), are a late manifestation, post-dating 1350 (based on associated tree-ring dates in other regions). Distinguishing between "standard" Gila Polychrome and Cliff Polychrome sorts late Classic period sites into at least two temporal groupings. Reexamination of existing collections and reports from the perspective of stylistic categories and a form-based seriation promises to yield important results. Based on available published and unpublished data and a cursory examination of existing collections at the Arizona State Museum, the combined style-and-form seriation can be applied fruitfully in all of the proposed study areas.

This work will be complemented by an examination of late ceramics of purported northern origin. The Classic period in the southern Southwest is often subdivided based on the presence of such precisely dated intrusive artifacts which document connections between the Puebloan and Hohokam regions. Subtle differences distinguish the Pueblo III and Pueblo IV period pottery of the Kayenta, Tusayan, and Winslow regions. For example, most reports documenting the presence of these wares lack illustrations and include sparse written descriptions, leaving the accuracy of the typological assignments in doubt. In addition, such "northern types" were often made in the valleys of central and southern Arizona, outside of their areas of origin, as immigrants from the Kayenta and Tusayan regions moved southward (Lindsay 1992; Lyons 2003). Given these facts, our goals are: 1) to positively identify northern intrusives when they are present; 2) to clarify the typology and, therefore, the dating of these specimens; and 3) to establish the

local production of foreign decorative and technological traditions. This last goal flows from a related research focus discussed in the next section.

Causes of Demographic Decline and Coalescence

Our model depends understanding decline and coalescence, and the links between these two processes. This requires consideration of relevant social, economic, physiological, and environmental factors. In each of the study areas, we propose to document: 1) migration; 2) interaction between different cultural groups; 3) environmental trends relating to agricultural production; and 4) bioarchaeological evidence of nutritional stress, trauma, fertility and mortality.

Migration

Within each of the study areas, using the same methods we employed in the lower San Pedro Valley, we will evaluate evidence of migration through material culture patterns that can be attributed to different processes of enculturation (within-group transmission of cultural knowledge; Clark 2001). Recent cross-cultural research indicates that material classes and attributes with low communication potential can be used to identify migrants with enculturative backgrounds different from local groups (Carr 1995a, 1995b; Clark 2001). Guided by these insights, researchers have focused on utilitarian pottery production and wall construction techniques, as well as household features and the organization of domestic space (Lechtman 1977; Lemonnier 1986; Stark et al. 1998). Specifically, the enculturative markers of long-distance migrants in the southern Southwest include perforated plainware plates, redware and plainware bowls with recurved rims, corrugated pottery, slab-lined hearths and entryboxes, kivas, stacked-stone masonry, and roomblock site layout (Clark 2001; Lindsay 1987; Lyons 2003; Woodson 1999).

Painted pottery, a class of material culture with high communication potential, has recently been studied within the enculturationist perspective through a focus on unconscious rules of design composition that reveal bounded learning frameworks (Lyons 2003; Van Keuren 1999). The study of enculturative traditions in pottery making is most fruitfully pursued when paired with provenance data establishing local production (Zedeño 1994). Toward this end, a small sample of Maverick Mountain Series pottery (northern Arizona pottery types made using raw materials local to the southern Southwest; Lyons 2003) will be subjected to petrographic analysis.

Interaction

Our next goal will be to document temporal and spatial trends in interaction. Competition will be documented through evidence of conflict and material culture boundaries, whereas cooperation will be indicated by exchange relationships. Conflict will be measured indirectly from settlement shifts to defensive locations and construction of fortified architecture, and directly from skeletal traces of trauma.

With respect to exchange, in many parts of the Southwest, Kayenta/Tusayan immigrants are strongly associated with Salado polychrome pottery, the dominant late precontact decorated tradition in the region (Crown 1994; Duff 2002; Mills 1998; Mills et al. 1999; Lyons 2003; Zedeño 1994). In the lower San Pedro Valley, migrants were the principal producers of these types (Castro-Reino et al. 2003). Exchange of Salado polychrome pottery between the migrants and their host populations preceded the appearance of late settlements exhibiting a mixing of indigenous and immigrant traditions. This suggests social boundaries had broken down and there was substantial intermarriage between the two groups. The link between immigrants and Salado polychrome pottery production will be explored in all of the proposed study areas.

In order to document local production and exchange we will subject 2000 specimens of Salado polychrome types from the four study areas to binocular microscopic petrological analysis. The sample will be drawn from immigrant enclaves, settlements of indigenous groups, and coalescent villages apparently comprised by the descendants of immigrants and locals. In addition, 100 specimens (a 5% sample) will be thin-sectioned and analyzed with the use of a petrographic microscope in order to verify the temper groupings identified through binocular microscopic analysis. In order to prevent analyzing the same vessel more than once, and to maximize chronological resolution based on vessel form and decorative style, the sherd sample will consist entirely of large rim fragments.

Petrofacies models have already been developed for the Tonto, Phoenix, and Tucson basins, and the San Pedro Valley (as well as the lower Verde Valley), providing broad areal coverage within and adjacent to the study areas (Abbott 2000; Castro-Reino et al. 2003; Heidke et al. 1995; Heidke et al. 1998; Miksa 1995a, 1995b; Miksa and Heidke 1995; Schaller 1994). The proposed research will require the

development of preliminary petrofacies models for the Perry Mesa area and the Safford Basin. However, basic petrological information relevant to ceramic production in the Safford Basin has already been recovered (Brown 1973; Woodson 1995; Wiley 1997). The number of samples proposed for each study area (Table 1) reflects the level of associated archaeological knowledge, and the number of primary and secondary sampling strata identified (see discussion of Study Areas, below).

Table 1. Sample of sherds and obsidian artifacts to be submitted for sourcing.

Study Area	Primary Sampling Strata	Sherds (N)	Obsidian (N)
Phoenix Basin	4 Canal Systems	750	200
Tonto Basin	4 Settlement Clusters	750	250
Safford Basin	10 Sites	300	100
Perry Mesa	10 Settlement Clusters	200	50
TOTAL		2000	600

Previous work in the Safford Basin, the Tonto Basin, and the lower San Pedro Valley indicates that northern immigrants likely retained ties to their homelands, as well as to points along their migration pathways, and controlled the exchange of exotic materials from these places (Rice et al. 1998a; Shackley and Gallop 2002a, 2002b). For these reasons, obsidian tools and debitage recovered from immigrant enclaves, settlements of indigenous groups, and coalescent villages within each of the study areas will be sourced at the Archaeological XRF Laboratory at the University of California at Berkeley (Table 1). The sample proportions assigned to each study area, like those associated with the sherd sample, are based on previous archaeological knowledge of each locus and the number of sampling strata identified. In the case of the Tonto Basin, the sample is larger than that associated with the Phoenix Basin in order to offset the lack of previous sourcing work in the Globe Highlands portion of the Tonto Basin study area.

Environment

We propose to analyze the relationship between agricultural production and demographic decline by placing temporally refined settlement pattern data in an environmental context. The settlement data will be incorporated in a GIS including information on terrain, climate, hydrology, and geology, enabling us to model agricultural potential and labor demand. Important components of this analysis will be:

1) Tree-ring based streamflow retrodictions for the Salt, Gila and Verde rivers and Tonto Creek (Graybill 1989; Graybill et al. 1999; Graybill and Nials 1989; also see Nials and Gregory 1989; Nials et al. 1989);
2) Reconstruction of fluvial cycles of aggradation and incision (Waters and Ravesloot 2001); and
3) A tree-ring based temperature retrodiction (Salzer 2000).

Previous GIS modeling of agricultural catchments and community boundaries has provided important insights into social and economic interaction in the Southwest (Herhan and Hill 1998; Hill 1998a, 1998b; Van West 1997; Van West and Altschul 1994; Van West and Kohler 1996; Varien 1999). We propose to model agricultural production, particularly irrigation and runoff techniques, to evaluate its importance in affecting health and land-use choices. Other GIS studies have shown that productive capacity was not always a limiting factor in Southwestern prehistory, but that spatial and temporal variability of capacity had important consequences for social organization and land-use decisions (Herhan and Hill 1998; Hill 1998a, 1998b; Van West and Kohler 1996). Similarly, the history of land-use and demographic change has had important structuring implications for descendent groups and their land-use decisions (Hill 2000; Ladefoged and Graves 2000; Minnis 1985; Van West and Kohler 1996; Varien 1999). We propose to evaluate the history of social and economic factors affecting agricultural production in order to understand the context of land-use decisions during the final period of occupation and abandonment. We will link the results of these analyses with studies of bioarchaeological evidence bearing on fertility and mortality.

Bioarchaeological Evidence

Seriation of decorated mortuary ceramics will allow us to evaluate trends in demography and pathology. Large burial populations such as those from Pueblo Grande, in the Phoenix basin (Sheridan 2003; Van Gerven and Sheridan 1994), and sites in the Tonto Creek (Clark and Minturn 2001) and Schoolhouse Point Mesa (Turner 1998; Ravesloot and Regan 2000; Regan et al. 1996) areas of the Tonto Basin have been analyzed over the last two decades. In addition, smaller groups recovered as a result of numerous other projects remain to be placed in a regional context. Data from these analyses will be examined for

evidence of nutritional and pathogenic factors that may have contributed to increased mortality or decreased fertility. Such data can now be evaluated for temporal trends throughout the Classic period, and for spatial differences among the core Hohokam area of the Phoenix Basin and peripheral areas such as the Tonto Basin. This information will complement settlement data used to model demographic decline.

Data Synthesis

The results of the proposed analyses will be integrated into the comprehensive *Coalescent Communities* GIS database allowing us to synthesize the evidence and evaluate the test implications described above. Documenting population change at multiple scales through the analysis of changing settlement patterns locally and regionally will be accomplished with time-series analyses such as those shown in Figures 2-4. The GIS will allow us to model pedestrian interaction among communities (e.g. Ruggles and Church 1996; Varien 1999; Wilcox, Gregory, and Hill 2003), costs/benefits of agricultural intensification (e.g. Behrens 1996; Ladefoged and Graves 2000), and site location strategies in an environment of competition and conflict (e.g. Gaffney et al. 1996; Maschner 1996).

Mapping evidence of changing enculturative traditions and the spatial characteristics of final occupations will provide a higher level of understanding of this complex process of coalescence and demographic decline than has previously been possible. Modeling the precontact demography of the southern Southwest requires precise temporal controls and consideration of factors affecting changes in population numbers and density, social and subsistence requirements, and the origins and destinations of migrants at multiple scales. A GIS combining evidence of settlement patterns, land-use, paleoenvironment, the melding of cultural traditions, and bioarchaeological indicators of health will be the most powerful means of organizing these data. Placing these analyses in a regional GIS is the most efficient means of handling the large quantity of information and modeling complex demographic processes.

Research Team Organization

That our central research issue has proved intractable to so many for so long has been carefully considered as our research team was assembled. The following principles were emphasized: 1)The core team must be composed of researchers with diversity of experience, specialized knowledge, and perspectives; 2) The core researchers should be integrated with a complementary group of analysts and consultants; and 3) We are committed to gathering high quality empirical data. The structure of the team reflects the need for collaboration at multiple levels and is conceptualized as three nested spheres:

1) Core synthetic team: Jeffery J. Clark (migration, architecture, Tonto and Safford Basins, San Pedro Valley), J. Brett Hill (GIS, human ecology, demography, agriculture), Patrick D. Lyons (migration, ceramics, Kayenta/Tusayan archaeology, Safford Basin, San Pedro Valley), and David R. Wilcox (political organization, Phoenix Basin, Perry Mesa), with William H. Doelle (demography, Phoenix and Tonto Basins, San Pedro Valley) as coordinator
2) Analytical dyads (each senior researcher teamed with a research assistant): Ceramics: Patrick D. Lyons; Petrology: Elizabeth J. Miksa; Bioarchaeology: Lane Beck; Obsidian: M. Steven Shackley; Geoarchaeology: Fred L. Nials; GIS: J. Brett Hill
3) Synthetic consultants: David R. Abbott (ceramic sourcing and exchange, Phoenix Basin), Jeffrey S. Dean: (demography, paleoenvironment, chronology), Stephen A. Kowalewski (coalescence theory, cross-cultural perspective), and Dean R. Snow (demography, migration, cross-cultural perspective)

THE PROPOSED STUDY AREAS

To discover whether the relationship between coalescence and population decline identified in the San Pedro has explanatory value for understanding demographic decline in the rest of the southern Southwest, the causes, tempo, and spatial variability of these processes will be examined in four additional study areas: the Phoenix Basin, Tonto Basin, Perry Mesa, and Safford Basin. Each of these areas underwent patterns of decline similar to the lower San Pedro Valley and local production of Salado polychrome pottery is indicated in all four study areas (Brown 1973; Crown 1994; Crown et al. 1988; Miksa 1995a). This sample has been selected from among the valleys and basins of the southern Southwest because unique aspects of each area's culture history provide the opportunity to juxtapose different processes of demographic decline.

The Phoenix and Tonto Basins are considered primary research zones because they have been subjected to intensive fieldwork and extensive collections from the late precontact period are available.

Archaeological research in the Perry Mesa area and the Safford Basin has been more limited and these are considered secondary research zones. However, limited data does not equate with low research potential and both areas are critical to understanding demographic decline in the region. Work proposed by this project will greatly augment our knowledge of each.

The Phoenix Basin

The Phoenix Basin (Figure 6B) has been the focus of intensive research for decades, yet a number of issues bearing directly on population loss in this area remain unresolved. The analysis of patterns in the Phoenix Basin will be stratified in terms of the area's four primary late precontact canal systems (Table 1). For example, eight times more Cliff Polychrome was recovered from Los Muertos, in Canal System 1, than Pueblo Grande, in Canal System 2 based on published data (Haury 1945; Peterson 1994a), indicating a later occupation for Los Muertos. Patterning within each system will also be examined where possible, especially directional trends with respect to canal headgates. Preliminary analyses indicate that the proposed seriation will increase the chronological and spatial resolution of the abandonment of canal systems and associated settlements permitting a more precise correlation between demographic decline and the retrodicted streamflow of the Salt River during the 1300-1450 interval (Graybill 1989). In addition, the chronological relationship between the Polvorón and the Civano phases may be resolved, permitting a more accurate interpretation of the material culture patterns associated with each (Chenault 1996, 2000; Craig 1995; Crown and Sires 1984; Doyel 1995; Henderson and Hackbarth 2000; Sires 1984).

As the “Hohokam core” (Wilcox and Sternberg 1983), the Phoenix Basin may have been one of the last areas entered by puebloan migrants (Haury 1945), if indeed they penetrated this area at all. In contrast to the lower San Pedro Valley, demographic decline in the Phoenix Basin may be attributed largely to internal factors, including intrabasinal warfare (Rice 1998), major floods (Gregory 1991), nutritional stress (Kwiatkowski 2003; Sheridan 2003; see also Minnis 1985) and localized populations movements within the basin or from adjacent areas (Abbott and Foster 2003; Henderson 1995). However, perforated plates, an enculturative marker of Kayenta/Tusayan groups (Lyons 2003), have been recovered from Las Colinas (Crown 1981), South Pueblo Blanco (McDonnell et al. 1995), and Los Muertos (Haury 1945). In addition, Phoenix Red, a ceramic type in part defined by a vessel form associated with Kayenta/Tusayan immigrants (Di Peso 1958; Nelson and LeBlanc 1986; Wilson 1998), has been recovered from Las Colinas (Abbott and Gregory 1988; Crown 1981; Crown et al. 1988) and Los Muertos (Brunson 1989). These and other lines of evidence for the presence of puebloan groups in the Phoenix Basin will be evaluated to determine the occurrence and scale of migration.

The Phoenix Basin has also been a showcase for the interpretive potential of the petrofacies approach to ceramic provenance studies (Miksa and Heidke 1995; Schaller 1994). To date, petrographic analysis has focused on brownware and redware pottery and very few Salado polychrome samples have been examined (Abbott 1994, 2000; Miksa 1995a, 1995b; Schaller 1994). The interpretation that all Salado polychrome pottery found in the Phoenix Basin was imported has been challenged based on the results of petrographic analyses at Pueblo Blanco (Miksa 1995a) and chemical sourcing at Las Colinas (Crown 1994; Crown et al. 1988). Additional sourcing of a large sample of specimens from late precontact sites throughout the basin, using the updated petrofacies model (Miksa 1995a, 1995b), will further address this important issue. In addition, a small sample of perforated plates and Phoenix Red specimens will be sourced to determine the possible locations of potters working within the Kayenta/Tusayan technological tradition. Existing data strongly suggest Phoenix Red was made at both Las Colinas (Crown et al. 1988) and Los Muertos (Abbott 2000).

A compilation of obsidian sourcing studies from the Phoenix Basin clearly indicates that there was a dramatic increase in access to this raw material and a diversification of sources during the late precontact period (e.g. Peterson et al. 1997; Marshall 2002). Sources from southern, west-central, and northern Arizona are well-represented (Marshall 2002:Table 19). This diversification may correlate with an increase in the number of different social groups occupying the region, each with different extrabasinal connections (Peterson 1994b). Nearly 25 percent of the analyzed material is derived from northern Arizona, primarily the Government Mountain source near Flagstaff. Important collections from three of the four canal systems have been inadequately sampled based on Marshall's (2002) data. Proposed additional obsidian sourcing would provide more even spatial and temporal coverage with the goal of elucidating spatial variability in extrabasinal contacts at increased chronological resolution.

Finally, published bioarchaeological data from the area will be reviewed for evidence of nutritional stress, trauma, and changes in fertility and mortality during the late precontact era. The large burial

assemblage from Pueblo Grande indicates that the inhabitants of this settlement were experiencing severe nutritional stress during the late 13th and early 14th centuries (Fink 1988; Fink and Merbs 1991; Sheridan 2003; Van Gerven and Sheridan 1994). Comparison with burial populations from other settlements will reveal whether this was a basin-wide phenomenon and whether this stress was alleviated by declining population later in the 14th century.

The Tonto Basin

The Tonto Basin (Figure 6C), which for our purposes includes the adjacent Globe Highlands, was investigated extensively in the 1920s and 1930s by Gila Pueblo Archaeological Foundation (e.g., Gladwin and Gladwin 1930; Gregory 1996; Haury 1932). After a lull of nearly 50 years, the region has been subjected to continuous, intensive excavation for more than three decades. Although initial syntheses have been published (e.g., Clark 2001; Elson 1998; Elson et al. 1995; Rice 1998), the research potential of this vast body of data has merely been scratched.

The Tonto Basin has been variably called the Hohokam northeast periphery (Wood and McAllister 1980) and the Salado heartland (Doyel 1976; Haury 1945). Similar to the lower San Pedro valley, limited puebloan migration in the late 1200s coincided roughly with an initial phase of coalescence associated with platform mound and compound wall construction (Clark 2001; Elson 1998). Unlike the immigrants who established themselves in the San Pedro Valley, those who came to the Tonto Basin were marginalized within the local community. The demographic trajectory of the Tonto Basin is also different from that of the San Pedro, and the Phoenix Basin The Tonto Basin experienced a substantial loss of population ca. 1300. This decline can probably be attributed to emigration by a segment of the population (Doelle 1995). The remaining inhabitants, whose cultural affiliation(s) remain a contested issue (Ciolek-Torrello 1997; Lindauer 1996; Rice and Oliver 1998), coalesced into a few large settlements along upper and lower Tonto Creek, the Salt River and in the Globe Highlands. These four districts constitute the basic units of analysis for the proposed study (Table 1).

Preliminary studies of reports and museum collections strongly suggest patterning in the distribution of Cliff Polychrome and late northern intrusives may seriate both districts and settlements in this study area. Similar to the Phoenix Basin, these seriations can be correlated with streamflow reconstructions available from both Tonto Creek and the Salt River to determine whether environmental factors contributed to the abandonment of settlements along either drainage.

Existing data on ceramic and obsidian exchange suggest at least two contemporaneous communities, each with different extrabasinal connections, were present during the 1300s. The inhabitants of Schoolhouse Point on the Salt River maintained strong connections with the inhabitants of the mountainous regions east and south of the basin. The inhabitants of settlements along Tonto Creek were linked by exchange relationships with groups living on the Colorado Plateau to the north (Hensler 1992, 1998; Rice et al. 1998; Simon and Gosser 2001). Competition and conflict (Oliver 2001) between these two districts may have contributed to the continued downward trend in population during the 1300s. The role played by settlements in the Globe Highlands, which likely harbored Kayenta/Tusayan immigrants during this interval (Lyons 2003), remains unresolved and will be evaluated by this study.

The proposed research will build upon previous work to determine Salado polychrome production areas within the basin and to reconstruct exchange patterns using an existing petrographic model (e.g., Crown 1994; Lyons 2003; Simon 1998; Simon et al. 1998). In addition, the breadth and depth of the small analyzed sample of obsidian from late precontact sites (Rice et al. 1998:119) will be increased to more firmly establish extrabasinal connections suggested for this interval. Reconstructing the social and economic map of the Tonto Basin during the 1300s is essential to understanding the abrupt loss of population that occurred at the beginning of this century and interaction between and within the defined districts that led to the final abandonment of the region by 1450 and perhaps considerably earlier.

Substantial burial populations recovered from contexts dating to the 1200s. suggest that the inhabitants of the Tonto Basin were healthier than Phoenix Basin populations (Minturn 2001; Lincoln-Babb 2001; Turner 1998:181-182). Rather than gradual population loss from declining health and nutrition, emigration may have played a larger role in the demographic decline of the Tonto Basin. Unfortunately, burial populations from 14th century contexts are largely from margins of heavily vandalized cemeteries, limiting their research potential. However, relevant bioarchaeological information will be complied in a database for evaluation and comparison with the Phoenix Basin.

Perry Mesa

Relatively little archaeological research has been conducted in the Perry Mesa area (Figure 6D) in contrast to the Phoenix and Tonto Basins. Although very few sites have been excavated, the study area has been surveyed and all major late precontact sites have been identified. Settlement pattern studies suggest the presence of at least ten late precontact site clusters that may have formed a coherent defensive system (Wilcox et al. 2001a, 2001b). These ten clusters form the basic units of analysis in this proposed study (Table 1). Limited surface collections will be obtained from up to three sites in each settlement cluster, to augment existing collections and ensure adequate analytical samples of Salado polychrome types, red ware, late northern intrusives, and obsidian.

The Perry Mesa defensive system may have protected the inhabitants of the middle Verde River from the densely populated Phoenix Basin (Wilcox et al. 2001a, 2001b). Hence, conflict and warfare may have played an important role in coalescence and population decline in this area. Perry Mesa also provides an opportunity to examine these demographic processes from outside the Hohokam interaction sphere.

Previous work by MNA, Southern Illinois University, and SWCA, Inc. confirms decorated ceramics are rare in this region, but are dominated by Salado polychrome types and northern intrusive ceramics dating to the 1300s (Ahlstrom and Roberts 1995; Fiero et al. 1980; Gumerman and Weed 1976). Phoenix Red, associated with the latest precontact sites elsewhere in the southern Southwest, is also present. A database of these late ceramics and Salado polychrome types will be compiled from existing collections to establish the tempo and spatial variability of population decline in the area as well as the date of final abandonment. Crown (1994) has identified at least one settlement as a potential production center for Gila Polychrome. A preliminary petrographic model will be developed to test this hypothesis, and in conjunction with obsidian sourcing, evaluate material connections among the Perry Mesa site clusters and between Perry Mesa and adjacent areas such as the middle Verde River valley.

The Safford Basin

Considering the broad arable floodplain of the Gila River in this study area, the Safford Basin may have only been exceeded by the Phoenix Basin in population, yet little is known about the precontact occupation of the area, particularly during the 1300-1450 interval (Figure 6E). Available evidence suggests that the Safford Basin was an important cultural crossroads that lay astride a primary communication route connecting the northern and southern Southwest. In the interval preceding the late precontact period, the local material culture displays a bewildering mix of Hohokam, Highland Mogollon, and Mimbres Mogollon traits (Rinker 1998; Rule 1993). During the late precontact period, Kayenta/Tusayan (Woodson 1999) and potentially ancestral Zuni groups (Clark et al. 2003) can be added to this mixture. Hence, the Safford Basin is probably the most culturally diverse of the four study areas.

With the exception of the University of Texas's efforts on the southeast margin of the Safford Basin (Rinker 1998; Woodson 1999), the area is currently lacking comprehensive survey coverage. In addition, many late precontact sites in or near the Gila River Holocene floodplain have long been removed by agricultural activities. A separate Center for Desert Archaeology project, in cooperation with the Bureau of Land Management, will generate an inventory of existing late precontact sites in the area (Neuzil 2003). A sample of these sites will be mapped and surface collected, focusing on Salado polychrome types, late northern intrusive ceramics, obsidian, and enculturative markers of migrant groups (e.g., perforated plates, Maverick Mountain Series types, and Phoenix Red) that will be used in the proposed project. In addition to this sample, collections from previously investigated late precontact sites will be examined (Table 1). A preliminary petrographic model will be developed, based on existing petrological information (e.g., Wiley 1997) and focusing on the known principal areas of late precontact settlement.

Available data strongly suggest that the proposed ceramic seriation will enhance chronological resolution in the area, revealing spatial and temporal trends in population loss and coalescence. The Safford Basin includes a number of sites with robust evidence of the presence of Kayenta/Tusayan immigrants, including Goat Hill Pueblo, Spear Ranch Ruin, and Marijilda Ruin. These migrants established settlements and small communities apart from the local population (Clark et al. 2003; Woodson 1999). Segregation suggests potential hostility between various social groups in the region which may have resulted in substantial population loss by emigration. Alternatively, social boundaries may have broken down as population declined and labor increased in value. If this were the case, the final settlements in the region should be comprised of groups from a variety of cultural backgrounds.

DISSEMINATION OF PROJECT RESULTS

The goals of this project will only be achieved when the results are broadly disseminated to both to the professional community and the general public. The Coalescent Community database contains locational information that is too sensitive to be available on the internet. However, we are discussing creation of an accessible, query-based format with personnel at ARMS, the digital site inventory program for the state of New Mexico. The database will be made available upon request to professional researchers. Furthermore, all artifact data generated by this project will be available on-line at CDA's website. Metadata formats will meet Federal Geographic Data Committee guidelines for spatial data. Our information will also be used to update AZSITE, the Arizona State Museum's statewide archaeological GIS.

Synthetic results of this project will be disseminated to the professional community in several formats:

- A conference that includes a panel of independent researchers
- Presentations at national meetings of the Society for American Archaeology and the American Anthropological Association
- Articles in professional journals such as *American Antiquity, Current Anthropology, Journal of Archaeological Research*, and *Kiva*

The project results will also be presented to the general public through various media:

- An issue of *Archaeology Southwest* will feature project results in an accessible format
- Local meetings attended by avocational archaeologists such as the Arizona Archaeological Council and the Arizona Archaeological Society
- Lectures in Tucson, Phoenix, and smaller communities in southern Arizona will convey our research results and highlight the importance of site preservation
- Presentations to tribal governments and cultural resources staffs of Native American groups with ancestral ties to the study area-minimally the Tohono O'odham, Hopi, Zuni, and Apache

Because they are large, above ground, and associated with abundant decorated pottery, late precontact sites are threatened by vandalism and development. CDA presently owns two late precontact sites, holds conservation easements on another two, and has an agreement to purchase a fifth. Information from this project will guide our continued site preservation efforts and will be shared with organizations such as the Archaeological Conservancy (Doelle 2003). Project results will improve interpretation and management at two large, new National Monuments in the southern Southwest that focus on archaeological resources. Agua Fria National Monument encompasses the Perry Mesa study area and Ironwood Forest National Monument is near the Phoenix Basin study area. The results will also benefit state policymakers through incorporation in the Arizona State Historic Preservation plan via a related CDA initiative.

SUMMARY

How did 40,000 people vanish from the southern Southwest a century before the introduction of European pathogens? This question has both intrigued and vexed archaeologists, anthropologists, and the broader public for more than a century. Advances in method and theory make this an opportune time to reconsider this question. There is reason for optimism that this question will soon be answered, which will yield insights of broad scientific, cultural, and public value.

Our research in the lower San Pedro valley suggests that the large population there did not abandon the region *en masse* at 1450. Demographic decline was considerably more complex and involved many of the processes associated with coalescence, including migration and aggregation. After more than a century of gradual decline, the final abandonment of the valley circa 1450 was by a remnant population comprised of descendants of both local and migrant groups. This scenario forms the basis of our proposed model and test implications.

A complex problem requires multiple analytical strategies and a multi-scalar approach. To test the proposed model in each study area we will use existing collections and data, and conduct surface collections, to: 1) enhance the chronological resolution of demographic reconstructions, 2) assess the occurrence and scale of migration, 3) examine interaction between social groups, 4) reconstruct environment, and 5) track bioarchaeological trends. The tempo and causes of demographic decline will be evaluated in four key study areas: the Phoenix Basin, the Tonto Basin, Perry Mesa, and the Safford Basin. Each area provides a unique perspective on these processes. Although data quality and quantity varies among study areas, consistency in approach will facilitate comparison. The various threads of evidence will by synthesized by a research team with more than century of combined regional and topical experience relevant to resolution of our central question.

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