THE EFFECT OF EUROPEAN CONTACT ON THE HEALTH OF INDIGENOUS POPULATIONS IN TEXAS

A Thesis
by
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THE EFFECT OF EUROPEAN CONTACT ON THE HEALTH
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ABSTRACT

The Effect of European Contact on the Health of Indigenous Populations in Texas. (August 1989)

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Skeletal remains of indigenous peoples from the eighteenth century missions San Juan Capistrano (n=92) and San Francisco Xavier de Horcasitas (n=13), and the prehistoric hunter/gatherer sites Blue Bayou (n=42) and Palm Harbor (n=7), were analyzed for medical disorders and dental attrition to determine the effect of European contact on indigenous populations in Texas.

Mission San Juan Capistrano was active eight times longer than San Xavier (Mission San Juan Capistrano was active for 63 years, San Xavier for eight years), thus the two mission samples represent different lengths of direct, daily contact between Europeans and indigenous populations. The individuals from the short-term contact population exhibit marked occlusal wear (similar to levels in the prehistoric samples); the long-term contact sample shows significantly less wear (p<.05).

A comparison of the frequency of porotic hyperostosis, cribra orbitalia, periosteal infection, hypoplasia, periodontal infection, caries, and abscesses reveals no significant differences between the mission populations (p>.05). A comparison of these conditions in the mission and prehistoric samples reveals significantly greater frequencies of pathological conditions in the mission samples (p<.05).
This supports the hypothesis that contact with Europeans was detrimental to the health of indigenous hunter/gatherer populations in Texas.

Two possible explanations for the similarities in the occurrence of pathological conditions in the mission samples are provided: 1) short- and long-term European contact had the same effect on indigenous populations, or 2) the population undergoing short-term daily contact had previously established contact with Europeans (either direct or indirect), resulting in increased frequencies of pathological conditions over prehistoric populations in Texas.
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CHAPTER I

INTRODUCTION

Recently, a new focus has arisen in the field of paleopathology. Rather than evaluate the health effects of the change in subsistence strategy, which includes diet, food processing and storage techniques, and sanitation habits, from hunting and gathering to agriculture at the time of European contact, researchers are beginning to examine the effect of European contact itself on the health of indigenous populations (Larsen, n.d., 1987b; Larsen and Shavit, 1988; Stodder, 1986; Walker et al., 1989). The purpose of this thesis is to further our understanding of European contact on hunters and gatherers, specifically populations of hunter/gatherers which came into contact with Europeans through the Spanish mission system in Texas.

Within the last ten years, researchers have studied pathological conditions in mission populations in Georgia and California (Larsen, n.d., 1987b; Larsen and Shavit, 1988; Walker et al., 1989) and in pueblo populations in the Southwest (Stodder, 1986). This study focuses on the effect of European contact on health as it applies to indigenous populations in Texas. For this study, four populations, two pre-contact groups and two mission populations, were analyzed.

The historic populations are skeletal samples of indigenous peoples from two Spanish missions: Mission San Juan Capistrano (referred to as San Juan), in Bexar County, and Mission San Francisco

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Xavier de Horcasitas (referred to as San Xavier), in Milam County. The prehistoric populations are from Blue Bayou, in Victoria County, and Palm Harbor, in Aransas County (Fig. 1).

These samples were chosen for this study for several reasons. The material recovered from Mission San Juan Capistrano had previously been analyzed for general demographic and pathological data (Humphreys, 1971), however more work needed to be done on the sample using updated analytical techniques.

The Mission San Juan Capistrano material proved to be an excellent research collection for this study. The mission was small, therefore the small sample size could be analyzed within the framework of the present study. The mission was active for an extended period of time (approximately 63 years), and the sample was predominantly adult. These facts, when combined with the fact that the burials are from the later stage of the mission, indicates that the individuals buried were likely born within the mission system. The effects of contact, it was thought, would be more readily apparent in such a sample than in a sample of individuals newly contacted by Europeans.

A second mission sample, that from Mission San Francisco Xavier de Horcasitas, was added to the study to provide a comparative sample for the contact period. The Mission San Xavier sample was smaller than that from San Juan Capistrano, and represented a much shorter time span of mission life (approximately 8 years), although again, the sample was predominantly adult. It was originally hypothesized that both mission populations could be combined into a single sample
Figure 1. Texas map showing location of sites used in this analysis.
representative of Texas mission Indians, however this hypothesis was proven false, as is shown in Chapter IV. The missions were, therefore, considered separately; Mission San Juan Capistrano is representative of long-term direct, daily contact between indigenous populations and Europeans, while Mission San Xavier is representative of short-term contact.

The analysis of Mission San Xavier also proved critical. The material was excavated in 1968, and had not been cleaned or analyzed as of 1986. It was felt by the author that valuable skeletal information would be lost if the sample was not analyzed, therefore it was added to the mission database used in this study.

The two prehistoric samples of Blue Bayou and Palm Harbor were selected for comparison with the historic mission populations for several reasons. Combined, they represent a reasonable sample of a coastal population; the two sites are among the largest mortuary sites excavated on the Texas Gulf Coast. The coastal environment, although in a different biotic province from the mission sites (Blair, 1950), should nevertheless represent a comparable stress regime to that of the inland environment; the coastal sites are located in an area near the original location of the Coahuiltecan Indian groups, and should adequately reflect the overall health condition of prehistoric Coahuiltecan Indians. The coastal groups also ranged inland up to 100 miles at least part of the year, and were, therefore, exploiting similar resources as the inland populations (Campbell, 1988a; Newcomb, 1961). Also, groups of Coahuiltecs and Tonkawans are thought to have exploited coastal resources from time to time.
(Campbell, 1988a,c; Newcomb, 1961).

Research Objectives

Among the objectives of this research were the estimation of the overall quality of health present in the mission populations, a comparison of health between the two mission populations to distinguish the effects of short-term contact from those of long-term contact, a comparison of each mission and two possibly related prehistoric populations, and the estimation of the effect of European contact (both short- and long-term) upon the health of indigenous populations.

In order to determine the overall health of the four populations in this study, seven pathological conditions present in the skeletal remains were examined: porotic hyperostosis, cribra orbitalia, generalized periosteal infection, periodontal infection, caries, abscessing, and linear enamel hypoplasia. These seven conditions were chosen because they indicate the general level of stress in an individual/population rather than any specific illnesses, and they have been used by previous authors as indicators of general health in a population (Huss-Ashmore et al., 1982; Larsen, 1987b). A change in the frequency of any one of these conditions cannot be used as a measure of change in health; however, when the occurrence of the conditions is examined together, changes in frequency may indicate changes in general population health. These data can then be combined with other data pertaining to the physical, biological, and cultural environments, to aid in determination of the overall level of health of a population.
The overall quality of health in a population can also be determined, in part, by the demographic profile of a population (Larsen, 1987a). Demographic data can give general information on health as well as information on short-term illnesses, such as measles and smallpox, which are generally not manifested skeletally (Ewers, 1973). These illnesses can lead to epidemics, which would be evident in changes in the mortality pattern of a population over a short period of time, as well as in historic records.

Endemic diseases were probably enhanced by the change in lifeways associated with European contact. In the missionization process, indigenous populations were required to relinquish their hunter/gatherer subsistence pattern to congregate in a central area and raise crops for food. They were also forced to relinquish their native religious practices and ideology and to adopt Catholicism as a way of life. Indigenous groups within the system were persecuted if caught practicing non-Catholic ceremonies. The changes in diet, physical, social, and ideological environments, and technology likely combined to reduce the general level of health of the population. This deterioration of health would be apparent in the skeletal populations by an increase in the frequency of stress-related pathological conditions and dental disorders, as well as in changing demographic profiles over time.

In addition to increasing the number and kinds of diseases present in the environment, contact with Europeans may also have led to contact with non-indigenous domestic animals since there is historic evidence that domestic animals such as horses, cattle, sheep,
and goats were raised in the missions (Castaneda, 1938). These animals were a prime source of zoonotic infections such as brucellosis, tetanus, influenza, bovine tuberculosis, and new strains of *Staphylococcus* and *Streptococcus* infections (Van Blerkom, 1985). While some of these infections, such as bovine tuberculosis and some *Staphylococcus* and *Streptococcus* infections, would manifest themselves in the skeleton, many would not. Therefore, in addition to demographic and paleopathological information, historic documentation of farming and ranching activities must also be examined to effectively determine overall health in the mission populations.

The last objective in this research was to estimate the impact of European contact on the health of indigenous peoples in Texas. This objective was accomplished through a series of comparisons of the occurrence of pathological conditions in the two mission populations, the two prehistoric populations, and each mission and the prehistoric populations. The results of these comparisons are presented in Chapter IV.

**Literature Review**

Paleopathology is a relatively new field in archaeology, although descriptions of lesions on bones can be found as far back in archaeological literature as the early 1800s. In the early 1900s there was an expansion in the number of reports which mentioned ancient disease, and by the mid-20th century, paleopathology was well established as a field, although it was still primarily descriptive. Paleopathologists did not begin to focus on the relationship between pathological conditions found on human skeletal remains and the
broader aspects of human adaptation, until recently. The trend in paleopathology today is toward studies of disease in populations, and their effects on adaptation.

To this end, several recent scholars have examined the effect of agriculture on health patterns in populations. In particular, the work of Angel (1984), Buikstra (1984), Cassidy (1984), Cohen and Armelagos (1984), Cook (1984), and Larsen (1987b), illustrate the general trend of research among paleopathologists. The current consensus concerning the effect of agriculture on health is that general population health declined with the adoption of agriculture by former hunting and gathering populations. This decline in health is thought to be the result of a combination of factors, including a restriction of dietary diversity, accompanied by the aggregation of large numbers of people into small areas with poor sanitation. According to Cohen and Armelagos (1984), Cook (1984), and Cassidy (1984), among others, a change in diet from a highly variable hunting and gathering diet containing many different forms of carbohydrates and proteins, to a less variable agricultural diet high in carbohydrates and sugars and low in proteins, leads to an increase in dental disorders and disease as well as an increase in general systemic stress. The aggregation of large populations in confined areas also contributes to general systemic stress, and adds new stressors. Poor sanitation and crowded conditions facilitate the spread of infectious disease and parasites, both of which cause a decline in the overall health of populations. This decline in health has been demonstrated in many locales, including the Illinois River
Valley (Buikstra, 1984; Cook, 1984), the Ohio River Valley (Cassidy, 1984; Perzigian et al., 1984), the Eastern Mediterranean (Angel, 1984); Iran and Iraq (Rathbun and Buikstra, 1984), the Levant (Smith et al., 1984), and Western Europe (Meiklejohn et al., 1984).

The decline in health which followed the change in subsistence strategy from hunting/gathering to agriculture is important for this study because one of the major changes wrought by Europeans in their contact with Native Americans in Central and South Texas was the introduction of agriculture. This thesis does not attempt to separate the changes in health of indigenous populations seen at contact in Texas into those which are primarily, the result of the switch in subsistence strategy and those which are primarily the result of European introduced stresses other than the change in subsistence.

Although authors such as Borah (1976), Cook (1937; 1943; 1973a, b; 1976), Duffy (1953), Ramenofsky (1987), Milner (1980), and others have studied the impact of European intrusion using written records, it has been only recently that paleopathologists have attempted to address the issue of European contact and its effects on population health in North America. Several authors who have also attempted to study the effect of contact on overall population health through and paleopathological analysis include: Bradtmiller (1983, 1985), Clark et al. (1987), Cohen (1987), Danforth (1988), Danforth et al. (1985), Kelley (1985, 1988), Kelley and Robinson (1989), Kelley et al. (1987a, b), Larsen and Shavit (1988), Larsen (1987b, n.d.), Merbs (1989), Owsley et al. (1977), Owsley and Bass (1979), Owsley and Bradtmiller (1983), Owsley and Jantz (1983), Falkovich (1981),
Robinson et al. (1985), Stodder (1986), Walker (n.d.), and Walker et al. (1989). Each of these studies noted some change in health through time, however, the change itself differed in most cases.

Larsen and colleagues (Larsen, 1987b; n.d.; Larsen and Shavit, 1988) examined samples from Santa Catalina de Guale, a mission on St. Catherines Island, Georgia. They found that a change in health was evident over time consequent to European contact on this island. In their skeletal analyses, Larsen and Shavit (1988) studied pathological conditions and demography to determine overall quality of life. The results of their analyses show, however, that overall population health did not decline with European contact; there was, in fact, a slight decline in the frequency of dental disturbances.

Several studies are currently being conducted on the effects of European contact on the Maya; researchers in this area include Cohen (1987), Danforth (1988), and Danforth et al. (1985). These studies also indicate a rise in the level of health with European contact. They state, however, that this "increase in health" could be due to a limited contact with Europeans, and/or to the fact that the Classic Maya (pre-contact) studied were undergoing a period of economic and social collapse, probably causing increased levels of stress in the pre-contact population.

Owsley and coworkers (Bradtmiller, 1983, 1985; Owsley et al., 1977; Owsley and Bass, 1979; Owsley and Bradtmiller, 1983; Owsley and Jantz, 1983, and Palkovich, 1981) are currently researching the post-contact adaptations of the Arikara. These researchers have found that periostitis, osteomyelitis, and trauma increase with long-term
contact, which involved the introduction of the horse and widespread trade between the Arikara and European settlers. This implies a decline in health as contact with Europeans increases.

The effects of European contact with the Narragansett are also being studied. Kelley and coworkers (Clark et al., 1987; Kelley, 1985; 1988; Kelley and Robinson, 1989; Kelley et al., 1987a,b; Robinson et al., 1985) have found that, among the historic Narragansett, the incidence of dental disturbances appears to increase slightly over time. They also document that Narragansett ways of life persisted, although European influence is seen in the burial style and in artifact type and subsistence (Robinson et al., 1985).

In California, Walker and others (Walker, n.d.; Walker et al., 1989) have studied the effects of European contact on California Indians. Their studies document that contact in California caused an increase in the mortality rate due to the infectious diseases imported by the Europeans. There is also evidence for growth retardation among mission Indians due to a diet of introduced cultigens, and for an increase in the amount of intergroup violence among indigenous populations. Walker (n.d.) and Walker et al. (1989) do not make any general conclusions about the overall level of health in California populations after European contact, however.

Storey (1986), also demonstrates an increase in health after contact. Storey examined two sites, a Late Mississippian Mound Complex and an Apalachee mission. The mission sample shows a higher level of overall population health than the Mississippian (pre-contact) populations in the area, even though the pre-contact sample
consisted of high status burials only.

As demonstrated by the results of studies presented above, the effects of contact appear to be heavily influenced by the lifestyle of the pre-contact populations. There does not appear to be a single, overriding effect of contact with Europeans. Pre-contact agricultural populations appear to experience a rise in the overall level of population health, and the introduction of long-term contact through trading appears to have resulted in a decline in overall population health. One fact which must be emphasized, however, is that the studies above rely primarily on indicators of stress caused by chronic conditions, or by short-term stresses in childhood. It has been shown (Ewers, 1973) that mortality increased among indigenous populations in the New World because of European contact. The native populations had no natural immunity to diseases introduced by Europeans, and there are several well documented cases of entire groups dying in epidemics of smallpox, measles, and other foreign diseases. Therefore, although the overall level of health appears to have risen among those who survived contact, with several of these studies, it is not necessarily true that mortality patterns did not change.

Concepts of Health and Disease

While modern clinical definitions of health and disease are generally not suited to archaeological research (Audy, 1971; Audy and Dunn, 1974; Dubos, 1977; Milner, 1982), the concept of health derived by Audy (1971), Audy and Dunn (1974), and Milner (1982), is applicable to archaeological samples. For this study, health is defined as the
ability of the body to maintain a certain equilibrium within physiological limits; health is thus a continuous property measured by the individual's ability to react to chemical, physical, and cultural insults (Audy, 1971). Disease is a state of lowered ability to maintain this equilibrium. The terms are not opposites, rather they describe the ability of the body to respond effectively to environmental and cultural stimuli (Milner, 1982) (Fig. 2). The diseased state, itself a result of reaction to an environmental or cultural insult to the body, results in an individual's reduced ability to react and adapt to further insults. In this sense, disease is synonymous with maladjustment rather than with illness; health and disease are a continuum. Generally, disease is accompanied by diagnostically characteristic signs detectable on a physical or biochemical level, and by symptoms known to the host (Milner, 1982).

Many different agents can contribute to a decline in health in a population (Huss-Ashmore et al., 1982; Larsen, 1987b; Martin et al., 1985; Milner, 1982; Scrimshaw, 1964). These causal agents can be environmental or cultural, and in many cases are a combination of the two. Scrimshaw (1964) discusses the multicausal nature of disease as a tripartite interaction which includes the host organism, the immediate environment, and the infecting agent. The host/pathogen relationship is influenced directly by the environment; therefore a given pathogen will not always contribute to the development of disease in a host. Host reaction, combined with environmental
Figure 2. The health/disease continuum.
factors, may serve to buffer the effect of the pathogen (Scrimshaw, 1964). Scrimshaw (1964) does not discuss the cultural environment in the host/pathogen relationship.

Jerome et al. (1980) use a model similar to the one presented by Scrimshaw (1964) in an ecological approach to nutritional anthropology. With only slight modification, their model can be used to illustrate the relationships between health of an organism, the physical environment, and the cultural environment. Figure 3 presents an ecological model for health of the individual, adapted from the nutrition model presented by Jerome et al. (1980).

Critical to this model is the concept of stress and stressors. For this study, "stress" is defined as the response of the body to any demand, and "stressor" is defined as any natural selective mechanism interfering with the ability of the host to respond to stimuli. In other words, stress is the host response to a stressor. Stressors include both organic (pathogens) and inorganic sources of selection, both environmental and cultural (Selye, 1976).

Selye (1976) defines a stressor as any exogenous or endogenous agent that precipitates a dual response in the host organism: a generalized adaptive response and a specific stress characteristic of the particular stressor. He suggests that an organism which survives the initial contact with the stressor will undergo a period of heightened resistance to the stressor. This period of resistance may be maintained for an extended time, however if the stress continues and is severe, the host will eventually exhaust its reserves and lose its ability to react. The host will reach the point referred to as
"health at the threshold", where an individual is on the brink of some malady (Audy and Dunn, 1974) (Fig. 2). The host will, in short, become diseased (Selye, 1976). This view is similar to that of Audy (1971) and Audy and Dunn (1974), and corresponds well with the definition of health and disease used in this study.

In the model of health presented in Figure 3, the physical environment includes all aspects presented by Jerome et al. (1980): climate, water resources, soil characteristics, and related features. It also includes, however, the stressors present in the environment. If a stressor is not present in the environment, it cannot act on the host. In this study, for example, the contact between Europeans and indigenous peoples brings several stressors not present in the prehistoric environment into play; the effects of these stressors, then, should be visible only in the post-contact populations.

The remaining systems surrounding the individual at the center of the model react to modify the availability of the stressor, the amount of contact between the host and the stressor, and the host reaction to the stressor. The social environment encompasses all societies other than the one to which the host belongs. It is one route through which new stressors are introduced to the physical environment, as well as one method through which the host is exposed to new methods of countering the stressor. The social environment can directly affect the physical environment, as in the example given above, and all of the other systems in the model; it can, therefore, also indirectly affect the interaction between the host and the stressor. Not only did the actual contact with Europeans introduce new stresses through
Figure 3. An ecological approach to health and disease. Adapted from Jerome et al. (1980:13)
modifications in the physical environment; new cultural and ideological stressors were introduced by Europeans as well.

Social organization, as described by Jerome et al. (1980) includes the economic and political structures impacting on the host, at the household level. It can directly affect the stressor/host relationship by limiting contact between the host and the stressor. In the European contact case, the political systems in use by indigenous peoples at the time of contact often limited the actual contact between the individual and the stressor, in this case, Europeans. This did not eliminate all stressors introduced through contact with Europeans, however the social organization buffered the host/stressor contact. Indirectly, social organization can affect the relationship between host and stressor by its interaction with the other systems present in the model. Again, using contact-caused stressors as an example, the other systems are affected by changes in the social organization. Europeans ended the economic independence of some groups through the missionization process; this change in social organization then led to changes in the physical, social, and cultural/ideological environments, thereby adding additional stressors.

Cultural and ideological systems can also have a profound effect on the health of an individual. These systems, according to Jerome et al. (1980) include the individual's ideas about the role of food in health, religious beliefs involving food, food preferences and restrictions, and the use of food in social interactions. For this health model, however, cultural and ideological systems encompass a
slightly different area. The role of food in health is still included in this category, as are religious beliefs. This model encompasses all religious beliefs, however, not just those dealing with food. Every belief may have either a direct or indirect effect on health; the consumption of hallucinogenic materials has a direct effect on health, while the belief that certain foods are unholy may have only an indirect effect on health. A belief in witchcraft can also have a direct effect on health. For example, if an individual believes he has been cursed, he may become diseased through a mental process. This particular effect on health does not rely on any physical stressor. Through the missionization process, Europeans introduced new ideological systems to the indigenous peoples. These new systems were often at odds with the ideology under which the populations were operating, causing many psychological stressors to occur. In this case the stressors were cultural; the stress, however, was manifested physically. Food preferences and restrictions, although cultural in origin in many cases, are included in the diet category in this model.

Technology includes the tools and techniques of food distribution and production (Jerome et al., 1980), as well as housing, living conditions, and the ability to modify the environment to suit the host. Technology has been described as the way in which man adapts his environment to fit his needs. By this definition, it is readily apparent that the host/stressor relationship is directly affected by technology. A change in technology will also introduce new mental stressors into the population, thereby potentially causing a decline in health. Technology also interacts with the other systems
described, such as the social environment, to indirectly affect the health of a population. Technology was altered significantly with the introduction of European techniques and tools. These new tools often resulted in physical trauma to those unfamiliar with their use, and also contributed to changing the social and physical environment in which Native Americans lived. Schroeder (1972:54) has even suggested that in some cases the introduction of metal tools in agriculture had a drastic negative effect on the physical environment; they hastened the erosion of soils, thereby necessitating clearing and use of even more land, thus altering the physical environment even more.

In the model presented by Jerome et al. (1980), diet is the central issue. For the health model, however, diet is considered a separate system, interacting both with the host and with the surrounding systems to affect health. It has been shown by previous authors (c.f. Huss-Ashmore et al., 1982; Larsen, 1987a,b) that diet directly affects the health of an individual. Thus, the status of health in an individual is directly determined by the diet. Indirectly, the diet also affects health through its interaction with other systems. It was mentioned above that religious beliefs concerning food directly contribute to health and disease; these religious beliefs transfer over to the overall diet in a population. Europeans altered the diet of indigenous populations through missionizing them and turning them into agriculturalists, by changing the economic system away from hunting and gathering toward craft specialization and trade, and by altering the physical environment.
Chapter Organization

This thesis is organized to give the reader an introduction to health and disease, and how they are measured in archaeological populations, the sites used in this study, and the results and interpretations of the specific data evaluated. Chapter I presents the research objectives, defines the problem to be discussed in later chapters, and introduces the reader to the concept of health and disease as a continuum. It also includes a review of current literature on the subject of contact populations in the New World. Chapter II, Materials and Methods, introduces the lifestyle of the prehistoric Indian groups in Texas, gives the background information for each of the sites, discusses archaeological recovery techniques used at each site, introduces the reader to the burial samples analyzed, and discusses the methods of analysis. Chapter III begins with a discussion of the uses of paleodemography in paleopathology and health reconstruction, goes on to discuss the problems inherent in paleodemographic reconstructions, discusses sex and age determination methods, and presents the sex and age information for the four sites analyzed in this study. Chapter IV presents the results of the paleopathological analysis, and Chapter V is a discussion of these results, and compares the results of this study with the results achieved in various other studies of contact populations.
CHAPTER II

MATERIALS AND METHODS

The skeletal samples used in this analysis are discussed in this chapter as well as the Indian groups represented, the mission system, the sites, ethnohistory, archaeology, and the methods used in this analysis. All of these are integral parts in the interpretation of health using the ecological model presented in Chapter I (Fig. 3).

The background and ethnohistory include detailed information on the cultural affinity (cultural/ideological and social environments from Fig. 3), the social organization, the physical environment, and the technology and diet of the burial populations. As presented in Figure 3, these components interact with each other, and the individual, to affect overall health. In order to interpret health, therefore, each of these subsystems must be discussed.

The archaeology of the four sites used in this study is equally as important. Paleodemography is determined on the basis of recovered remains; an understanding of the recovery techniques used allows the detection of possible biases in the demographic profile. This, in turn, strengthens the interpretation of overall population health.

Lastly, the methods of analysis are presented. These are perhaps the most important aspects presented in this chapter; they determine what information is collected from the skeletal material, and how that information is used. An incomplete analysis could result in the misinterpretation of the research results.
Texas Prehistory

The environment of South and Central Texas is much the same today as it was during the Late Prehistoric and Early Historic times. There are a wide range of plants and animals available across Texas, but the type and availability varied with area. The availability of surface water also varied between Southwest and Central Texas, as it does today.

There are at least four Indian groups thought to have been present in the areas of the four sites used in this study (Fig. 4). The inferred prehistoric lifeways of each are discussed in this section, followed by a discussion of the Spanish mission system and its impact on the native lifeways, and lastly by a discussion of each site in detail. The information on each of the Indian groups is from Newcomb (1961) unless otherwise noted. Detailed information on the diversity of the diet of these populations prehistorically has been documented in recent faunal analyses (c.f. Steele, 1986a,b; Steele and Mokry, 1985; Steele and Hunter, 1986).

Coahuiltecan

The term "Coahuiltecan" originally referred to a language spoken by numerous hunter/gatherer groups in southern Texas and eastern Mexico at the time of European contact (Hester, 1980). Its use was gradually expanded to apply to all groups within a specific geographic area, and finally to define a cultural entity. Because this cultural entity was defined solely on the basis of language, however, the work of anthropologists and archaeologists studying these hunter/gatherer bands has been difficult. The interrelationships between language and
Figure 4. Texas map showing location of sites and associated Indian groups.
culture are not necessarily connected such that one may change without the other. In this study, therefore, the term Coahuiltecan refers only to the language group; no inferences to cultural similarities between groups in different areas are made solely on the basis of a common language. Similarly, the Coahuiltecan sample used in this study is not assumed to be genetically or culturally related to other groups from different areas which are also referred to as Coahuiltecan.

The Coahuiltecs in the south/central portion of Texas were divided into a large number of small tribes and bands (Swanton, 1952). These bands appear to have been autonomous political units. At least three bands are thought to have been located prehistorically near present-day San Antonio (the location of Mission San Juan Capistrano) prehistorically (Newcomb, 1961; Ruecking, 1954). These loosely affiliated bands are generally referred to as the Payayas (Ruecking, 1954), although Campbell (1988b) feels that the Payaya are a separate linguistic group. Other groups of Coahuilteco speakers include the Orejones, Sayopines, Pamaques, and Piqueques.

The prehistory of the Coahuiltecs in this area of Texas is not well known. They appear to have been hunter/gatherers in other areas of Texas, however, and there is no evidence for prehistoric agriculture anywhere near San Antonio. Therefore, it is generally accepted that this hunting and gathering lifestyle was common among the Coahuiltecan language groups from Mexico into Texas. This hunter/gatherer adaptation would have exploited a variety of foods in the area around present-day San Antonio. The following information is
from Newcomb (1961) and Ruecking (1953; 1954): from historic accounts, and what few archaeological sites that have been found, it appears that deer and javelina were hunted regularly, although smaller game seems to have made up a greater portion of the diet. In fact, Coahuiltecs in this area appear to have eaten almost everything; frogs and lizards appear to have been taboo foods, but everything else seems to have been acceptable, including such items as ant eggs, earth, and deer dung.

The use of traps and pitfalls is well documented for Coahuiltecs, as is communal hunting (Ruecking, 1953). Communal hunting seems to be correlated with ritual events; it is documented in cases where large numbers of animals were required (Ruecking, 1953). This type of hunting seems to have involved only small game, however. Buffalo were hunted whenever they were in the area.

Plant material seems to have made up the predominant portion of Coahuiltec diet, however. Any naturally occurring plant seems to have been selected. Agricultural products were not used at all.

A sexual division of labor existed among most of the Coahuilteco-speaking groups. This division is similar to that found in most hunting and gathering societies; men hunted and women gathered plants and small game. The men also fished, defended the group, manufactured most implements, and were responsible for trade. The remainder of the work was done by women.

The Coahuiltecs were very mobile, moving every few days. This is supported archaeologically by the large number of short-term campsites found in the area. Their movements were likely correlated
with ripening times for various plants.

Communal property was an important aspect of Coahuiltecan lifeways. This property included the range of the band, and all food, although hides generally belonged to the hunter. Private property appears to have belonged solely to the male; even cooking and food gathering equipment. Coahuiltecs appear to have been patrilineal and patrilocal.

The position of leader seems to have been honorary, going to the best warrior in the band. His duties revolved around warfare; in everyday life he did not apparently receive preferential treatment.

There is no evidence for elaborate religious ceremonies, either historically or prehistorically. There are historic references to religious beliefs, but no religious figures other than shamans are noted. It is uncertain whether the position of shaman was full-time, but the shaman did receive recompense for his work. The only elaborate ceremony in Coahuiltecan society was the "mitote", held to commemorate special events. The "mitote" was a dance, usually lasting all night.

Coahuiltecan culture was greatly affected by the environment. The subsistence pattern of this hunting and gathering group inhibited the accumulation of status through property, and led to the social and economic systems in use at the time of contact.

Tonkawa

The word "Tonkawa" is derived from the Indian term "Tonkaweya," meaning "they all stay together," and is not the term used by the people to refer to themselves. For this study, Tonkawa refers to the
multilingual groups of Indians in Central Texas; these groups include, but are not limited to, the Tonkawa proper and the Mayeye, Meghey, Yojaune (may be Wichita), Ervipiame (may be Coahuiltecan), Cavas, Emet, Sana, Toho, and Tohaha (Campbell, 1988c).

Little is known of the prehistoric Tonkawa. From the few archaeological sites excavated which are attributable to the Tonkawa, two cultural affiliations have been proposed. The first, set forth by Newcomb (1961), associates the prehistoric Tonkawa in Texas with the Southern Plains Prehorse Culture Area, while the second, proposed by Sjoberg (1953) and Krieger (1946) associates the Tonkawa with peoples to the south. Because the Tonkawa language is so unique, however, and because there are so few sites attributable to the Tonkawa, neither of these theories can be proven.

It is unknown how long the Tonkawa were in Texas prehistorically. The first contact with Europeans appears to have occurred in 1687, at which time Henri Joutel, a follower of La Salle, contacted the Meghey. At this time, Tonkawan culture had already been impacted by Europeans, however. The first Europeans to directly contact the Tonkawa reported them riding on horses (Bolton, 1915).

It was not until 1690 that the Tonkawa lifestyle was documented, however. At this time Alonso de Leon’s expedition established contact.

Prior to this contact, it is felt that the Tonkawa group was composed of autonomous bands. Each of these bands was led by a chief. After contact, these bands consolidated into what was called the Tonkawa tribe; while each band continued to have a leader, there was
also a head chief for the tribe. This head chief was apparently chosen by the men of the tribe.

The Tonkawa tribe was said to have been split into two divisions, each composed of several totemic matrilineal and matrilocal clans (Kenney, 1897).

Tonkawa appear to have been hunter/gatherers, although their primary sources of food are likely to have changed soon after they adopted the horse. Historically, although not in the heart of buffalo country, the Tonkawa seem to have preferred buffalo to any other meat source. It is felt that the Tonkawa would have moved north, following the buffalo out of Texas, had the Comanche not made this move impossible.

As the buffalo disappeared, reliance on deer, rabbits, skunks, rats, land tortoises, and rattlesnakes increased; the only mammals the Tonkawa appear to have avoided were wolves and coyotes, probably because of religious taboos. Riverine and marine resources were also exploited, as were a large variety of plants, particularly acorns and pecans.

As with other hunter/gatherer groups, a sexual division of labor existed among the Tonkawa, with men hunting and fighting, and women gathering and cooking.

The mobility necessary for this hunting and gathering adaptation also limited the number of material possessions owned by the Tonkawa.

Very little is known about the religious beliefs of the prehistoric Tonkawa, perhaps partly because of the nature of the belief system. Shamans were present in the society, however their
sole purpose seems to have been curing the sick. Religion seems to have been highly individualized.

As with the Coahuiltecs, the Tonkawa were ruled by the environment, and their hunting and gathering adaptation to this environment. Their material possessions were few, and their lifeways reflected their highly mobile nature.

Karankawa

The Karankawa were located along the Texas coast from present day Galveston Bay to present day Corpus Christi Bay. Their territory included the barrier islands as well. At least five groups of Karankawa are known to have inhabited this area historically: the Capoques (Coaque, Coco), the Hans, the Kohanis, the Karankawa proper (Korenkake, Clamcoets, Carancaguacas), and the Kopanos (Copane, Cobanes). These bands shared a common language and material culture, although the bands were apparently autonomous. The Karankawa territory abutted against Coahuiltecan territory, however there does not appear to have been any great mixing of the two cultures.

The territory of the Karankawa falls within what is generally referred to as the Coastal Prairie, characterized by flat, marshy areas, grasslands, and a few lightly wooded areas. Presently, rainfall is scarce during the winter, leading to a lack of available surface water. The area is historically unprofitable for agriculture, and is thought to have changed little since Late Prehistoric and Early Historic times. For these reasons, it is felt that the Karankawa were hunter/gatherers, exploiting terrestrial, riverine, and marine environments at different times during the year.
The Coastal Prairie supports a wide variety of animal and plant life. Deer are common, as are javelina, antelope, bears, and many small mammals. The lagoons and bays along the coast have a plentiful supply of fish, and mussels, oysters, turtles, porpoises, ducks, other aquatic and semi-aquatic birds, and marine plants are available. The coastal hunting and gathering subsistence strategy practiced by the Karankawa was made feasible by their primary mode of transportation: the canoe.

Archaeological sites thought to be representative of the Karankawa include several aspects which lead to the conclusion that the term Karankawa is representative of a cultural group. There is a distinct form of asphaltum-coated pottery commonly found in these sites, and a paucity of projectile points, which suggests that the use of stone points may have been limited during prehistoric times (Campbell, 1952; 1956; Gatschet, 1891; Schaedel, 1949).

The Karankawa were among the first groups contacted by Europeans in Texas. Cabeza de Vaca, a Spaniard stranded on the Texas coast in 1528, was saved by the Karankawa. In 1689, however, the Karankawa massacred a French colony in their territory, and it was not until the early 1700s that Europeans again ventured into Karankawan territory. In 1722 the Spanish began a missionization campaign among the Karankawa, however, these missions were not successful for the most part, however.

The small patrilocal, patrilineal bands appear to have been the only social and political groups among the Karankawa; no tribal political unit ever existed. The bands were headed by leaders who
old power only as long as the advice they gave was acceptable. The
Karankawa are thought to have fought with non-Karankawa; it was not
until European contact that any trade networks were developed between
the Karankawa and non-Karankawan tribes.

The Karankawa appear to have worshipped two major deities, but
ceremonies were few. What ceremonies are recorded in historical
documents are "mitotes", and are similar to the "mitotes" of the
Coahuiltecs.

Atakapa

The Atakapa occupied the area between the eastern margin of Texas
and the Gulf Coast, extending as far east as Louisiana and as far west
as the Nueces River in Southwest Texas (Fig. 4). These groups are
generally classified as belonging to the Southeast cultural
traditions, however, they were peripheral to those traditions, and
show some similarities to the Karankawa of the Western Gulf Culture
Area.

The term Atakapa means, literally, "man-eaters" in Choctaw, and
reflects a linguistic group rather than a cultural one. The language
is thought to be related to others in the Tunican language family.
Several autonomous bands made up the Atakapan tribes, including the
Akokisas (Arkokisa, Orcoquisac), the Patiris, the Bidais, and the
Deadoses.

The Atakapa occupied a land largely ignored by Europeans. The
marshy areas in which they lived were subhumid and low-lying, often
covered with water. Agriculture was, and still is, impossible in most
of the prehistoric Atakapa territory. Inland, agricultural potential
increases, however, and eventually the Atakapa were contacted by the French. Throughout their territory, game was plentiful: bison were present sporadically, along with deer, antelope, shellfish, fish, and wild plants. There is no evidence for prehistoric agriculture among the coastal Atakapan speakers of Texas and Louisiana, although the Bidai groups, associated with the Atakapa by Sjoberg (1951), are often referred to as woodland farmers. The peoples in the area of Mission San Xavier show no evidence of farming, however.

After initial contact by Simars de Bellisle, a Frenchman left on the Texas coast in the early eighteenth century, the French continued to expand their explorations and trade contacts in the Atakapan area. It was not until 1745 that the Spanish began to grow wary of the French influence in this area of Texas and in 1748 the Spanish established several missions for the Atakapa, among them the San Xavier missions. These missions attracted primarily the inland Atakapa, the Bidades and Deadoses, however a few of the coastal Akokisa also came into these missions. These Atakapan speakers were placed in the Mission San Ildefonso (one of the three in the San Xavier mission complex).

The Atakapa appear to have differed widely in their cultures, depending on their geographical location. The coastal tribes followed an adaptation similar to that of the Karankawa, while the inland tribes were much more closely related to the Southeastern cultural tradition of the Caddo. Their geographical location allowed them to at least trade with agricultural peoples, although no evidence of agriculture is present in Atakapan sites in the area of the mission.
Because of these differences in culture, little can be said about Atakapan speakers as a whole other than they practiced a mobile hunting and gathering subsistence strategy.

Spanish Missions in Texas: Their Purpose and Extent

To the Spanish, the mission system served a dual purpose in the New World. First, from a religious perspective, the missions served to carry, "the comforts of religion to the unfortunate natives" (Castaneda, 1936:216). The apostolic zeal of the Franciscan missionaries in the field to Christianize the heathens cannot be denied, although the motivation behind the Church's entire mission program had little to do with spreading the word of God. The second purpose of the mission system was entirely materialistic, and arose not from a desire to convert the natives, but rather from the intent to exploit them (Bolton, 1962).

For this purpose of exploitation, the "encomienda" system was devised in Central America and Mexico. In order to civilize, convert, and exploit the native peoples, and in doing so remove them as an obstacle to the Spanish pioneering effort, the Spanish had to first control the Indians. This control was accomplished by placing the land and the people on it under the "guardianship" of the Spanish landowners. These trustees, who were all secular landowners, were required by law to provide for the protection, religious conversion, and civilization of the Indians. In return, the trustees were given free reign to use the labor of the Indians for profit. To provide the religious instruction for the natives, the trustees were required to support the necessary friars (Bolton, 1962).
The "encomienda" system did not run smoothly, however. The Indians of Central and South America, although generally sedentary, were not convinced of their need to become civilized, and often fled from the trustees. It was soon discovered that the Indians had to be forcibly restrained by the landowners, and the system fell into disuse.

By intent, the "encomienda" system was benevolently exploitative. It was designed for the maximum benefit of Spain, however the intent was not to abuse the natives in the process (Bolton, 1962). The system was easily abused, however, and the obligations of the landowners to protect, civilize, and convert the natives were often forgotten in the quest for profit. Gradually the entire encomienda system was abandoned as a pioneering tool.

As the Spanish moved into North America, the natives with whom they came in contact were more frequently mobile hunter/gatherers, rather than sedentary agriculturalists. Colonists could not easily herd these hunter/gatherers into a settled area. As the Spanish penetrated further north, the task of civilizing and containing the Indians fell more and more to the missionaries.

The missionaries began serving both the Church, in Christianizing the Indians, and the State in containing them and removing the obstacle of new cultures from the path of Spanish intrusion. The missions were designed as frontier institutions, and, whether considered from a religious or a political standpoint, must be considered as such. They were intended to be temporary settlements for native peoples while the Spanish intruded further into North
America. They were agents of the government, designed to extend and hold the "civilized" territory for Spain (Bolton, 1962).

Because they served the government, the missions were funded, and therefore controlled, by the State. The government also furnished troops for the protection of the missionaries and mission Indians. The value of these missions as frontier agents was recognized by the Spanish government; the missions served as explorers, defenders, and promoters of unoccupied areas.

The following accounts of Missions San Juan Capistrano and San Francisco Xavier de Horcasitas demonstrate the purpose, and success, of the Spanish mission system in Texas.

Background and Ethnohistory of Two Spanish Missions in Texas

Mission San Juan Capistrano

In 1718 the royal presidio of San Antonio de Bexar was established, along with the municipal government of the Villa San Fernando de Bexar, and the Mission San Antonio de Valero (later to be known as the Alamo), at the site of the present city of San Antonio (Castaneda, 1932, 1938; Humphreys, 1971; Morfi, 1777; Schuetz, 1968).

A second mission, San José y San Miguel de Aguayo, was founded in 1720, and a third, San Francisco Xavier de Najera, in 1722. In addition, three missions which had originally been established in East Texas were moved to the area in 1731. One of these three relocated missions, San José de los Nazones, originally founded in 1716 in East Texas, was renamed San Juan Capistrano (Castaneda, 1932, 1936, 1938; Humphreys, 1971; Morfi, 1777; Schuetz, 1968).

San José de los Nazones was originally established to serve the
Nazoni and Nadaco peoples in East Texas. These groups were present in the area at the time of contact, and are thought to be associated with the Caddo tribes in East Texas. In 1719 San Jose de los Nazones, along with the other east Texas missions, was abandoned due to fear of French invasion from Louisiana. The mission was.reoccupied in 1721, and abandoned for the final time in 1729 when all east Texas missions were closed because of supply difficulties. Attempts were made to relocate the mission on the San Marcos, Nueces, and Frio Rivers before its new site on the San Antonio River was found (Castaneda, 1938; Schuett, 1968). The mission was rechristened San Juan Capistrano on March 5, 1731, and was refounded to serve the Orejones, Sayopines, Pamaques, and Piqueques, all Coahuitlan-speaking groups located in Southern Texas (Castaneda, 1932, 1936, 1938; Humphreys, 1971; Schuett, 1968).

Fray Mariano Francisco de los Dolores, a friar at Mission San Juan Capistrano, gives a detailed account of mission life. He states that the Indians were given beef once a week, and as much maize as,

"... they need to their complete satisfaction, also they issue beans, squash, watermelons, which in each mission there is care to plant annually..." (Delores, 1762, translated in Schuetz, 1968: 14-29).

Delores (1762) also states that,

"... From their incredible excesses many infirmities are suffered: the infection of syphilis depletes the nations if they are few (in number), without arriving at an advanced age, and even the lighter infirmities are for them very grave for
they don't abstain from harmful food, nor do they guard themselves from water, wind, nor other inclemencies, and without attention to physics, sweat baths, nor other medicines, nor watching some diet, being in this not only the difficulty that they have had and that the missionaries have, but also the desired effect, and this is one of the causes why they do not augment their number: Reflecting further on the newborn from (whose number) many die, because they are never saved; their mothers endeavor to administer to them, with the milk from their breasts, healthful food, but they do not absolutely abstain from harmful things so that the contamination is inevitable, and is counted in the books of administration and records of death." (Dolores, 1762 translated in Schuetz, 1968: 14-29).

Not only did problems exist within Mission San Juan Capistrano, as evidenced in the above account; the local government was also attempting to undermine the San Antonio missions (Schuetz, 1968). The Governor, Carlos Benites Franquis de Lugo, arrived in Texas in September 1736, and immediately began harassing the missions. Eventually, after he had endangered the missions by removing two of the three guards assigned to each, the friars appealed to the Viceroy. This appeal resulted in a warning being issued to Franquis that continued harassment would lead to his suspension. The Viceroy also ordered Franquis to return the guards to the missions. Franquis ignored these orders, continuing his harassment campaign (Castaneda, 1938).
During this time of political strife, disaffected Indians at Missions Concepcion and Capistrano took the opportunity to complain to Governor Franquis of ill-treatment, thereby giving Franquis a reason to publicly harass the missionaries during an investigation (Schuetz, 1968). According to Castaneda (1938), the Indians complained that they were overworked, underfed, and poorly clothed, and that Father Ysasmendi of Espada, the friar in charge, had driven away mission Indians so he could claim they had fled for lack of guards. Runaways, the Indians said, were whipped until they either fainted or died. This testimony was corroborated by Father Juan Recio de Leon, the priest of the Villa de San Fernando and a personal friend of Governor Franquis (Castaneda, 1938). Although it was later proved that the Indian witnesses had been coached in their answers by Father Juan, mission morale had been affected, and by April 1736, Indians had begun abandoning the missions. The Spanish had lost much control, and, when thefts of cattle resulted only in verbal reprimands, the Indians became bolder. By June 7, 1736, Mission Espada had been completely abandoned. Although many of its inhabitants were eventually recaptured, they had shown others that escape was possible (Castaneda, 1938; Schuetz, 1968).

Most of the Indians at Mission San Juan Capistrano fled in 1737. Fray Mariano de los Dolores, the friar in charge of this mission at the time, set out in search of his Indians. However, an Apache raid sent him back, and further searches were postponed until March, when 120 individuals were returned to the mission (Castaneda, 1938).

In 1739 the San Antonio missions, already weakened by dissent
among the Indians and Apache raids, were hit by a smallpox epidemic. This decimated the missions, especially San Juan Capistrano, where the population dropped from 218 to 66 individuals (Castaneda, 1938). By 1740 the mission seemed to have recovered, however, and population rose to 169. New recruits began to replace losses and the missions were again strong enough to withstand Apache raids.

By 1756 San Juan Capistrano was once again a thriving mission. The church, a cloistered convent, and a granary had been built, and the Indians were housed in temporary structures called "jacalets". Corn, cotton, beans, chili, cantaloupe, and watermelons were being cultivated. The mission owned 900 head of cattle, 4,000 head of sheep and goats, 79 horses, 40 mares, and 4 mules. The population had risen to 265 individuals (Castaneda, 1938). Eight hundred thirty eight individuals had been baptized, and 492 had been given Last Sacraments and a Christian burial (Ortiz, 1756 translated in Schuetz, 1968).

The mission apparently functioned normally until the next recorded census in 1762. At this time 203 Indians were in residence, 847 had been baptized, and 645 had received Last Sacrament (Dolores, 1762).

The last twenty years of mission history were years of gradual decline (Schuetz, 1968). By 1780 the missions had accomplished their goal and were being run by Christianized Indians. Nothing was done towards secularization until 1792, however, when the newly elected commissary and prefect of missions under the College of Zacatecas, Fray Manuel Silva, recommended secularization of Valero and reduction of the other four missions to two (Castaneda, 1938). Justices from
San Juan and Espada protested this order on the grounds that the Indians present at the missions had never been on friendly terms with those at Concepcion and San Jose, and that trouble would result if tribes were mixed (Chabot, 1937). In 1794, despite this fear, Don Pedro de Nava, Commandante General de Provincias Internas de Nueva Espana, decreed secularization of missions within his jurisdiction (Castaneda, 1938). At this time, twelve families of Indians succeeded to the ownership of mission lands and properties at San Juan Capistrano. Apparently most of the San Juan Indians had gradually been absorbed into the San Antonio community before secularization. Reflecting in this statement is the fact that there is no evidence of prejudice toward the Indians in San Antonio; soldiers married Indian women, Indians fought side by side with Texans, and no one had qualms over living in the missions with the Indians (Castaneda, 1938).

Mission San Francisco Xavier de Horcasitas

The plan to establish missions on the San Xavier (San Gabriel) River was the first of renewed expansionist activities by the Spanish after a lull during 1731-1745 (Bolton, 1915). Bolton attributes these renewed efforts to the desire to acquire new converts as the tribes near the older missions were depleted, and to protect the borderlands from real or imagined dangers from the French.

The original Spanish mission expedition into the area, led by Father Mariano de los Dolores y Viana, failed to induce local Indians to become missionized in San Antonio (Castaneda, 1938). A delegation of Yojuane, Deadose, Mayeye and Yerbiplame contacted Father Mariano in 1745, however, requesting the establishment of a mission in their
territory. The idea was approved by Father Francisco Xavier Ortiz, who felt that the establishment of this mission, complete with a garrison for protection, would encourage settlement of the area between Los Adaes and San Antonio (Castaneda, 1938). The Indians returned home along with some San Antonio neophytes and the promise that Father Mariano would arrive that winter to set up a mission (Castaneda, 1938).

In January 1746, Father Mariano, accompanied by five soldiers and several mission Indians from San Antonio, was met by representatives of the four tribes mentioned above, as well as representatives of the Cocos (Castaneda, 1938; Starnes, 1966). The Indians from San Antonio were to serve as interpreters and examples to the new recruits.

Approval for the establishment of the mission San Francisco Xavier de Horcasitas was finally given by the Viceroy on February 14, 1747. Ten soldiers from Los Adaes and twelve from Bexar were detailed to the area to protect both the missionaries and the Indians. These soldiers were under orders to cooperate with the missionaries and aid in constructing the necessary buildings for the mission, however, these orders were not followed (Castaneda, 1938).

An appeal was then sent directly to the King of Spain by Father Ortiz. In this appeal Ortiz listed all of the tribes represented and stressed the political advantages of establishing a mission in this location, pointing out that these Indians had been under the influence of the French, as shown by their possession of French firearms. Ortiz believed it would be a distinct advantage in case of hostilities with the French to be friendly with these Indians (Castaneda, 1938).
In December 1747, before the King could take action, the Viceroy ordered three missions to be founded on the San Xavier (San Gabriel) River (Fig. 4), to be erected within eight months. Authorization was given for six missionaries and the purchase of necessary ornaments and supplies. The King gave his approval in January 1748.

In January, armed with official approval and thirty men from La Bahia and Los Adaes, Lieutenant Juan Galvan arrived at San Xavier. A stockade and huts for the soldiers had already been constructed, and there was a good supply of seed, stock, oxen, and clothing. So many Indians had congregated by this time that Father Mariano had to refuse food to anyone not engaged in work connected with the founding of the new mission (Castaneda, 1938).

Sixty Apache attacked the mission on May 2, 1748. The attack was repelled by the soldiers and about 200 mission Indians, but not before two Indians were killed. The remaining Indians were so frightened they left the next day, taking the horses with them (Castaneda, 1938).

The new Governor, Pedro del Barrio y Espriella, upon hearing of the attack, journeyed to San Xavier. He found the soldiers discouraged, and decided that the location of the mission was poorly chosen (Castaneda, 1938). Barrio felt that sending supplies to such a remote place was impossible, and that the Indians were more interested in trade than religion (Castaneda, 1938). He ordered the soldiers to send their families to safer places (Starnes, 1966).

The six missionaries assigned to the missions arrived in June 1748. Supplies, however, did not arrive until December, and no work was done on the missions until that time (Castaneda, 1938).
Mission San Francisco Xavier de Horcasitas, by 1749, housed a total of 213 people of the Mayeye, Yerbipame, and Yojuan groups. In December 1748, Mission San Ildefonso took permanent form and began housing Orcoquisacs, Bidais, and Deadoses; a total of 239 individuals. The third mission, Nuestra Senora de Candelaria, was established in 1749 for the Cocos and their coastal allies (Bolton, 1915). Before this third mission was built, however, the friars felt a presidio and more adequate force of soldiers were necessary (Bolton, 1915). The soldiers present lacked discipline and were a bad example to the Indians. Father Mariano again appealed to the Viceroy for funding of a presidio, and in April 1749 approval was given (Castaneda, 1938).

In the spring of 1749 the Cocos, angered by abuses by the soldiers, left the mission complex. Only a few returned. Because of these abuses, the Indians at the complex would not listen to the friars, and the soldiers refused to help maintain discipline (Castaneda, 1938). Reports began to filter back to San Antonio that the Indians had obtained guns from the French, and that soldiers often visited the Indians to beg a piece of meat or to trade bullets, lead, and powder for food. Very little corn had been harvested at the missions, and the soldiers could not live off the land (Castaneda, 1938). There were wild dances and gambling among both soldiers and Indians. Later in the year, all the Indians left Mission San Ildefonso, and Lt. Galvan refused to look for them (Castaneda, 1938). Governor Barrio also refused to help discipline the Indians, or the soldiers.

Father Benito, a padre at the missions, had left earlier to plead
the case of the missions and to neutralize Barrio. He had little trouble persuading the new fiscal Doctor Andreu to help discredit Barrio. In his report of January 1750, Andreu comments that Barrio had acted without orders, without knowledge of the missionaries, and without experienced help, and that he was untruthful. Andreu suggested that the missions be maintained where they were founded, and that a presidio be authorized, but that an independent agent be sent to determine the location for this presidio (Castaneda, 1938).

The auditor, Altimera, approved of Andreu's opinion, and recommended Captain Jose de Eca y Musquiz for the job. He was also to command the guard at San Xavier (Morfi, 1777). The survey began in July 1749. In his survey Musquiz included a census. Over 153 individuals were counted at Mission San Xavier, with 77 baptisms and 17 deaths. At Mission San Ildefonso 165 individuals were counted, with 151 baptisms and 40 deaths. The third mission, Candelaria, had been unofficially established by this time, and 102 individuals were counted, with 50 baptisms and 13 deaths.

By August 1750 the Indians at San Ildefonso had left the mission in a body. The missionaries suspected French influence in this action (Bolton, 1915).

As a result of Musquiz's survey the presidio for the missions was approved. Captain Felipe de Rabago y Teran was appointed commander, and was instructed to restore the soldiers of the existing garrison to their former presidios and to enlist fifty men and voluntary settlers (Castaneda, 1938). When Rabago arrived there were only 108 Indians at San Xavier, none at San Ildefonso, and 25 at Candelaria (Castaneda,
1938). Rabago abused the Indians, however, and eventually the Cocos left Candelaria altogether (Castaneda, 1938).

In the spring of 1752, the San Xavier River began to dry up. No rain fell, and an epidemic broke out at all three missions. By 1753 so many soldiers and Indians had either died or left the missions that the friars asked permission to relocate the garrison. At this point, only 70 individuals remained at San Ildefonso or Candelaria. None remained at San Xavier. By August 16, 1755 the missions on the San Xavier River had moved to San Marcos (Castaneda, 1938).

Comparison of the Two Missions

The San Xavier mission complex housed at one time representatives of at least four Indian tribes from locations as farflung as Northeastern Mexico (Ervipiame), the Texas coast (Coco), near San Antonio (Coahuiltecan), and Southeast Texas (Bidaí). Therefore, although the burial sample from the mission complex was recovered from a single mission, Mission San Francisco Xavier de Horcasitas, it probably represents several differing cultural and biological groups. This contrasts with the population recovered from Mission San Juan Capistrano, where all the individuals recovered are felt to represent a more homogenous population raised within the mission system.

A second contrast between Missions San Francisco Xavier and San Juan Capistrano may be seen in the length of time each mission was in operation. Mission San Juan Capistrano was active for approximately 63 years, while Mission San Francisco Xavier was active for only eight years. Although it is possible, and even probable, that some of the individuals buried at San Francisco Xavier came from other missions,
and were, in fact, raised within the mission system, this short span of operation, combined with the data on occlusal surface wear recovered in this analysis, it seems probable that the majority of individuals recovered from Mission San Francisco Xavier were hunter/gatherers for most of their lives, and had only for a short period of their lives been associated with the mission system.

A third, and final, contrast between the two missions concerns the diet. As mentioned previously, diet plays an important role in determining health. Records indicate that the individuals at Mission San Juan Capistrano subsisted on a steady diet of agricultural and ranch products, most of which contain a high percentage of carbohydrates, starches, and fats. The San Francisco Xavier population, however, appears to have subsisted primarily on wild foods even while at the mission, based on the information that supplies were continually short and late, and even the soldiers would trade for wild game (Gilmore, 1969).

Materials

Mission San Juan Capistrano

Excavations were conducted at Mission San Juan Capistrano during 1967 as part of the archaeology program of the State Building Commission. The project was conducted jointly by the University of Texas at San Antonio Center for Archaeological Research and the Archdiocese of San Antonio, through an agreement with the Witte Museum, and was under the general supervision of the (then) State Archaeologist Curtis Tunnell. The principle investigator was Mardith K. Schuetz.
The excavation was prompted by plans for the restoration of the mission by the Archdiocese (Schuetz, 1968). Goals of the excavation included the recovery of a sample of artifacts unequivocally Coahuiltecan, recovery of the remains of Coahuiltecans themselves, and recovery of data on building techniques and the building sequence at San Juan Capistrano (Schuetz, 1968).

The following information is from Schuetz (1968). To facilitate descriptions, each room or structure at the Mission was assigned a number (Fig. 5) (Schuetz, 1968). These numbers began with the first room west of the driveway, and continued counter-clockwise around the quadrangle to the stone and adobe house in the east wall. Areas bearing no relation to structures were given area designations.

All excavation was done with hand tools, except for exploratory trenches excavated with a backhoe, and all removed dirt was screened through either 1/4 or 1/2 inch mesh. Fill was removed in arbitrary 6 inch levels, using each room as an excavation unit. Not all rooms were excavated to the same depth, and a given level in one room cannot be absolutely equated with a particular level in another room.

Excavation was begun on January 23, 1967. Between this date and April 14, 1967, two weeks in the field were alternated with two weeks in the lab. During this time rooms 4 through 13 were excavated. The period from April 17 through May 18, 1967 was spent continuously in the field while burials were removed from the old church (also referred to as the unfinished church). The old church, room 26, is located on the east wall of the quadrangle. All burials were recovered from this area.
The primary purpose in excavating the old church was to locate and collect Coahuiltecan burials. For this reason the church was not dug by levels, except in the exploratory backhoe trenches while seeking the general depth of the burials. Only burial fill was screened. Burials were numbered in the order of their discovery. Burial numbers are considered as excavation units, they do not reflect the number of individuals actually interred.

Undisturbed burials were extended, with the skull toward the west and the forearms folded over the ribs. Newer burial pits were often dug through older ones. The dead were clothed when interred, and coffins were used. Nine burials had evidence of rosaries or religious medals with them. According to mission records (Castaneda, 1938) there should be no European burials among these burials.

The burial population recovered from San Juan Capistrano dates to approximately 1760-1785; the individuals recovered were probably born within the mission system (Schuetz, 1968). According to mission records, six groups of Coahuilteco speaking peoples were present at San Juan during this time period (Schuetz, 1968). There is a possibility, however, that several more groups of Coahuilteco speakers were represented at the mission during this time (Campbell, 1988a). The San Juan sample consists of the remains of 92 individuals recovered from 16 interments. The sample contains 25 males, 13 females, and 54 indeterminates; although there is a greater number of males in the sample, there is no apparent bias in the occurrence of pathological conditions. Of the 92 individuals present, 17 are subadults.
Mission San Francisco Xavier de Horcasitas

Excavations were conducted at San Francisco Xavier de Horcasitas during 1968 as part of the archaeology program of the State Building Commission. The project was conducted through an agreement with Southern Methodist University in Dallas and was under the general supervision of the (then) State Archaeologist Curtis Tunnell. The principle investigator was Kathleen K. Gilmore.

Excavations were begun by trenching the area where most Spanish Colonial artifacts were concentrated on the surface. Goals of the excavation were to determine the location of Mission San Francisco Xavier de Horcasitas, Mission San Ildefonso, and Mission Nuestra Senora de Candelaria. Trenches were labelled with letters and features found in the trenches were numbered (Fig. 6) (Gilmore, 1969).

Of the eleven burials discovered during trenching, eight were oriented north-south with the head to the south. Three were oriented east-west with the head to the west. All were extended with arms in various positions around the body. No evidence of coffins was noted. All grave fill was screened, however, no evidence of rosaries or religious medals was noted.

No cross-walls were located in the mission complex, however the burials were likely recovered from below the church floor (Gilmore, 1969).

The material recovered from Mission San Xavier consists of 11 interments, containing the remains of 13 individuals. This sample appears unbiased with regard to the representation of sex, with five males, five females, and three individuals of indeterminate sex. Two
Figure 6. Site map of Mission San Francisco Xavier de Horcasitas.
of the individuals recovered were subadults, both of which were infants.

Blue Bayou

The Blue Bayou site (41VT94) appears to be an extensive prehistoric cemetery. Radiocarbon dates obtained from bones give a combined range of 80 B.C. to A.D. 718, indicating the sample is Terminal Archaic to Late Prehistoric in age (Hester, 1980).

Although there is little evidence to place the human remains within any known historic group, the presence of historic hunter/gatherers in the area of Blue Bayou is well documented (Hester, 1980; Newcomb, 1961). Records indicate two distinct groups in this area historically; the Coahuitltecans and the Karankawa (Hester, 1980; Newcomb, 1961). Tests for biological affinity derived by Finnegan and Marcsik (1979) and Wilkinson (1977) were conducted on the material by Comuzzie (1987); the results of these tests suggest the material is more closely related to the coastal Karankawan groups than to the inland Coahuitltecans.

Excavations were conducted on Blue Bayou during the spring of 1982. Construction activity at the Dupont plant in the area exposed a natural gas pipeline constructed in the 1940s; upon exposing the pipeline, construction ceased. The area began eroding, and the archaeological site was exposed approximately one month after construction work stopped. Avocational archaeologists Bill Birmingham, Dan Will, and Dan Woodrich discovered human remains eroding out of the surface.

Excavation began in May, 1982, almost immediately after the site
was discovered. Field work was conducted by local avocational archaeologists under the direction of Dr. Tom Hester, Al Wesolowsky, and students from the Division of Behavioral and Cultural Sciences and the Center for Archaeological Research (University of Texas at San Antonio). All materials exposed were photographed in situ and mapped (Fig. 7). Several test units were excavated to determine the extent of the site.

According to Huebner (1988), both cultural change and continuity are represented by the site: continuity by the continued use of the cemetery over time, and change by the differential use of space and changing interment styles.

Several burial orientations were noted during excavation; the predominant position was flexed with the head oriented southeast or southwest, a typical pattern for the region during this time period (Hester, 1980; Shafer and Bond, 1985).

The human material from Blue Bayou was originally analyzed by Comuzzie (1987). A reanalysis of pathological lesions and dental attrition was performed in the present study. Remains of approximately 44 individuals were analyzed, 22 of which could be identified to sex: 12 are male and 10 are female. Only four of the individuals are subadults.

Palm Harbor

The sample recovered from 41AS80 appears to represent a pre-contact coastal hunter/gatherer group, possibly Karankawa (Comuzzie et al., 1986).

Only minimal occupational debris was recovered from Palm Harbor,
Figure 7. Site map of Blue Bayou.
indicating a short-term occupation at the site. This may, in turn, indicate a discrete burial location, a cemetery. However, because of the uncontrolled excavation, artifacts which would change this interpretation may have been overlooked.

Human remains were exposed during construction of a building on private property in October, 1980. The remains were recovered by the Aransas County Sheriff’s Department in an uncontrolled excavation. After concluding that the remains were prehistoric, the Sheriff’s Department asked Ed Mokry, an archaeologist in Corpus Christi, to survey the site (Fig. 8).

Because of the uncontrolled excavation, the site was disturbed and the skeletal material was scattered and damaged. The remains removed for examination were inadvertently mixed at the site (Mokry and Fitzpatrick, 1980), and are, therefore, treated as an ossuary sample for this analysis.

Remains of approximately seven individuals were recovered from the site. The material was sexed on a bone by bone basis; approximately 30% of the material was male, 28% was female. These percentages represent four males, two females, and one individual of indeterminate sex. The remains were originally analyzed by Comuzzie et al. (1986), and were reanalyzed for this study.

Analysis

Mission San Juan Capistrano (41BX5) and Mission San Francisco Xavier de Horcasitas (41MM11) were Spanish missions established in central Texas in the mid 1700s. The skeletal populations from the two missions differ both in biological affinity and the actual length
Figure 8. Site map of Palm Harbor
of European contact.

The two prehistoric samples were selected for comparison with the historic mission populations for the several reasons. Combined, they represent a reasonable sample of a coastal population; the two sites are among the largest mortuary sites excavated and previously analyzed on the Texas Gulf Coast. The coastal environment, although in a different biotic province from the mission sites (Blair, 1950), should nevertheless represent a comparable stress regime to that of the inland environment; the coastal sites are located in an area near the original location of the Coahuiltecan Indian groups, and should adequately reflect the overall health condition of prehistoric Coahuiltecan Indians, the coastal groups also ranged inland up to 100 miles at least part of the year, and were, therefore, exploiting similar resources as the inland populations (Campbell, 1988a; Newcomb, 1961), and groups of Coahuiltecas and Tonkawans are thought to have exploited coastal resources from time to time (Campbell, 1988a; Newcomb, 1961).

The analysis of all skeletal material used in the present study focused on the pathological conditions present in each individual. Pathological conditions were defined using Ortner and Putschar (1981) and Steinbock (1976), and were recorded on a bone by bone basis.

Dental disorders were defined following Pindborg (1970).

The remains were analyzed as discrete individuals whenever possible, as diagnosis of many conditions relies heavily on the distribution of the disease in the skeleton (Ortner and Putschar, 1981; Steinbock, 1976). In the case of multiple interments,
individual analysis was not possible, however. Since the San Juan Capistrano material was recovered primarily from mass graves, and the Palm Harbor material was inadvertently mixed at the site, all material was also analyzed on a bone by bone basis following traditional analytical techniques established for ossuary samples (Bass, 1971; Brothwell, 1981).
CHAPTER III

PALEODEMOGRAPHY

Paleodemographic information, such as the age and sex ratios of a population, is frequently used as a basis for health assessment in prehistoric samples (c.f. Larsen, 1982, 1984; Milner, 1982; Palkovich, 1981; Powell, 1985). This information is necessary for determining whether differences in the degree of stress existed between the sexes and/or for different age groups (Buikstra and Mielke, 1975; Larsen, 1988); it provides a frame of reference for evaluating the impact of stressors on subsets of the population.

By evaluating different groups within populations separately, the physical anthropologist is better able to assess the forces that are influencing overall population health. For example, as Scrimshaw (1964, 1975) and Scrimshaw et al. (1968) indicate, and as is illustrated in Figure 3, diet and disease are two of the determinants of health status in a population and, in fact, cannot be separated from one another in many cases. Both have also been linked directly to demography; specific age and sex patterns of mortality are correlated with various subsistence strategies (Buikstra and Mielke, 1985), and many diseases have a greater impact on certain age and sex groups. Their influence on population health and, ultimately, the survival of a population, can best be viewed through a demographic perspective. Skeletal samples provide a record of the nutritional and disease risks, as well as cultural and mechanical activity, on both the individual and population level, and mortality patterns
provide information which enables the physical anthropologist to assess various stressors (Huss-Ashmore et al., 1982).

The adaptation of modern demographic techniques to paleodemography is not without problems, however. Human skeletal remains, though they represent once-living populations, have undergone a variety of both natural and cultural transformation processes from the death assemblage to the recovered assemblage, which may bias the mortality profiles, and may result in a distorted view of the health of past peoples (Bocquet-Appel and Masset, 1982, 1985; Buikstra, 1981; Buikstra and Konigsberg, 1985; Larsen, 1987a,b). While the nature and degree of these distortions in paleodemographic profiles are currently under debate (Bocquet-Appel and Masset, 1982, 1985; Van Gerven and Armelagos, 1983), Van Gerven and Armelagos (1983) have shown that paleodemographic data can be used for more than simple mortality profile construction.

Sex

The determination of the sex of individuals is a major concern in human osteology (Bass, 1971; Steele and Bramblett, 1988; Stewart, 1979). For this reason, techniques of sex determination using almost every major bone in the human skeleton can be found in the literature (cf. Anderson, 1962; Black, 1978a,b; Ditch and Rose, 1972; El-Najjar and McWilliams, 1978; Giles, 1970; Hana and Washburn, 1953; Hanihara, 1959; Iscan and Miller-Shaivitz, 1984; Keen, 1950; Kelley, 1979; Krogman, 1962; MacLauglin and Bruce, 1985; Olivier, 1962; Phencie, 1969; Steele, 1976). Of the elements studied, the pelvis has traditionally provided the most diagnostic indicators of sex (Bass,
1971; Krogman, 1962; Phenice, 1969; Steele and Bramblett, 1988; Stewart, 1979). Most scholars, however, emphasize that whenever possible, a combination of diagnostic elements should be used in order to derive the best assessment. In addition, when analyzing a burial sample, comparative assessments should be made in order to evaluate the degree of sexual dimorphism present in that group.

For this study, visible nonmetric differences in pelvis shape were used to aid in the determination of the sex of the individual whenever possible. In addition, features of the skull and the overall size and robusticity of the individual were also used. While many quantitative techniques have also been derived for estimation of sex on the basis of the skull and dentition, they were not used in this study.

Because the characteristics used in this analysis to assess sex are the result primarily of general differences in size and robusticity, or, in the case of the pelvis, are not readily apparent prior to adolescence, it was not possible to estimate the sex of the subadult individuals. Results of the demographic analysis can be seen in Table 1.

While a sex ratio of 1:1 is expected in a population with no sex bias of any kind, none of the populations used in this study exhibit this 1:1 ratio. Chi-square tests indicate, however, that, with the exception of Mission San Juan Capistrano, the differences in number are not significant. The number of males recovered from Mission San Juan Capistrano is significantly higher than the number of females (p<.05), however the difference does not appear to be reflected in the
Table 1. Number of individuals by sex.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Males</th>
<th>Females</th>
<th>Subadults</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission San Juan Capistrano</td>
<td>25</td>
<td>13</td>
<td>17</td>
<td>92</td>
</tr>
<tr>
<td>Mission San Xavier</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Blue Bayou</td>
<td>12</td>
<td>10</td>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td>Palm Harbor</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
occurrence of pathological conditions in the sample. Determinations of sex for each individual examined are presented in Appendix A.

Age

As with sex determination, estimation of age at death is important in the reconstruction of the demographic profile of a population, and many techniques to estimate the age of individuals are currently in use (cf. Bouvier and Ubelaker, 1977; Erikson, 1982; Gilbert and McKern, 1973; Iscan et al., 1984; Kerley, 1965; 1970; Lovejoy, 1985; Lovejoy et al., 1985a,b; Meindl et al., 1985; Miles, 1963a,b; 1978; Steele and Bramblett, 1988). These include using suture closure in the skull, dental eruption patterns, dental attrition, epiphyseal fusion, and degenerative changes of the pelvis, vertebrae, and long bones.

The assessment of age is often imprecise, however, and depends greatly on the experience of the analyst. Therefore, the skeletal remains examined were assigned to broad age categories rather than specific ages. The skeletal material was assigned whenever possible to the age categories of Fetal, Infancy, Early Childhood, Late Childhood, Adolescence, Young Adulthood, and Old Adulthood (Steele and Bramblett; 1988:6-7). However, due to the fragmentary nature of much of the material, the two adult age categories were combined in the final analysis.

Because the dentition is more commonly preserved than other skeletal material, and is, therefore, recovered more frequently, teeth were commonly used in age estimations. These estimations were then supplemented with evaluations of the pubic symphysis,
degenerative changes of the vertebrae and joints, and epiphyseal closure. In the case of the subadult burials, it was generally possible to assign an age based on the eruption of the teeth (Schour and Massler, 1945). In addition, the fusion of the long bone epiphyses were also used when possible, following Steele and Bramblett (1988). Age estimates for adults were based on dental attrition (Lovejoy, 1985), as well as on degenerative changes in the joints. The degree of attrition was measured primarily on the molars, using criteria and measurements discussed by Lovejoy (1985).

The accuracy of dental attrition in age estimation is currently a point of debate (Lovejoy, 1985). If a single individual is aged solely by dental attrition, a vague approximation of age is all that is possible. Entire populations, however, can be examined systematically, and dental attrition can be a highly accurate indicator of age in such studies (Lovejoy, 1985; Lovejoy et al., 1985a), even in a highly mixed anatomical collection.

In this study, age determination of adults derived from analysis of dental attrition was confirmed with other age estimation techniques whenever possible. Structural changes in the pubic symphysis (Gilbert and McKern, 1973; McKern and Stewart, 1957) and the auricular surface of the ilium (Lovejoy et al., 1985b) were used to estimate age in all individuals for which the os pubis was preserved. The ages derived through this method corresponded to attrition ages in all cases examined, with the exception of individuals present in Mission San Juan Capistrano. The lesser degree of wear present in this agricultural population appeared to consistently underestimate
the age of individuals, compared to the other techniques of age
determination used. Consequently, attrition ages were not used for
Mission San Juan Capistrano.

The age structure of the four populations used in this study is
shown in Table 2. The data suggest that there is a strong bias in the
representation of adults and subadults at all of the sites. The
number of subadults, which in this table includes infants, recovered
from these sites is significantly less than the number of adults.
This is likely a reflection of fewer subadult burials surviving
interment, but it may also reflect different burial practices for
adults and subadults.

When considered together, the age and sex data suggest that,
with the exception of Mission San Juan Capistrano, there is an equal
representation of adult males and females, implying that no biased
selective pressure between the sexes was present. The bias at Mission
San Juan Capistrano is likely to be cultural in nature; the remains
are from a period late in the history of the mission, and the culture
of the indigenous peoples had been drastically altered. Also, the
mission was near secularization, and most families had moved away from
the actual mission grounds. Mission records show a decline in the
number of females baptized in these later years of mission operation;
 unbaptized females could not be buried in consecrated ground,
therefore, they would not have been recovered from the cemetery under
the church.

The occurrence of the seven pathological conditions used in this
study appear to affect males and females equally. The subadults
Table 2. Number of individuals by age.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Adult</th>
<th>Subadult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission San Juan Capistrano</td>
<td>75</td>
<td>17</td>
</tr>
<tr>
<td>Mission San Xavier</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Blue Bayou</td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td>Palm Harbor</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>
recovered, however, exhibit significantly lower frequencies of all of the conditions. This difference could be in part due to the fact that approximately 90% of the subadults recovered were infants. Four of the conditions studied were dental in nature; none of the infants had any erupted teeth, therefore the dental disorders did not have the opportunity to manifest themselves. Of the three nondental condition, cribra orbitalia, porotic hyperostosis, and generalized periosteal infection, only the latter was found on any subadult material, and only in very small amounts. Because of the low representation of subadults burials, however, only the adults were compared in this analysis.
CHAPTER IV

LEVELS OF HEALTH: RESULTS OF THE STUDY

Skeletal material provides one of the most direct indicators of health for archaeological populations (Milner, 1982). Estimations of population health can be obtained by calculating the frequency of those pathological conditions detectable in skeletal populations (Ortner and Putschar, 1981; Steinbock, 1976). These data can then be combined with other data pertaining to the physical, biological, and cultural environments, to develop an overall assessment of health in a population (Milner, 1982; Ortner and Putschar, 1981; Steinbock, 1976).

The pathological conditions assessed in this study are: porotic hyperostosis, cribra orbitalia, generalized periosteal infection, linear enamel hypoplasia, caries, dental abscess, and periodontal infection. This chapter discusses the criteria used to evaluate each of these pathological conditions, and gives the results of the analysis.

Before any of these conditions were examined, occlusal surface wear was compared among each of the four samples used in this study. The original hypothesis proposed in this research was that the mission samples were similar enough to combine into a single sample for purposes of comparison with the two prehistoric samples. To test this hypothesis, occlusal surface wear, divided into the categories of light/medium and heavy, was compared between the two prehistoric samples, the two mission samples, and the prehistoric and mission samples. Wear was chosen to test this hypothesis primarily because
correlations have been made between wear and diet, food preparation techniques, and the use of teeth as tools. Patterns of dental wear have been shown to be useful in differentiating hunter/gatherers from agriculturalists (Molnar, 1971; Schmuker, 1985; Smith, 1972).

The primary subsistence strategy in the missions was agriculture. Mission records indicate corn was the staple crop, although beans and squash were also grown. Items as diverse as watermelons, cantaloupes, and chile were also consumed on a regular basis. Beef and mutton were the primary meats consumed. All of these foods are rich in sugars and carbohydrates, and there is a low grit component to the diet. A minimal amount of occlusal surface wear is expected when foods such as these are consumed on a regular basis, while a high degree of carious activity is expected.

In contrast, wild foods probably consumed by pre-contact populations include deer, javelina, birds, small rodents, cacti, walnuts, pecans, and acorns, and a variety of other plant materials (Castaneda, 1938). These foods, and the preparation techniques used in prehistoric cultures in Texas, generally lead to a high grit content in the diet, and thereby to a high degree of occlusal surface wear. To temper this, however, trade undoubtedly occurred between the Europeans and indigenous groups prior to the establishment of either mission; the extent of this trade, or whether food was traded, is unknown.

Results of the comparison of wear in the two mission populations indicate that wear at Mission San Francisco Xavier is, on the whole, more severe than at Mission San Juan Capistrano (Chi square p<.05).
This difference in wear is easily seen in Fig. 9. The wear is not attributable to sex or age differences between the samples. Occlusal surface wear was then compared in the prehistoric samples of Blue Bayou and Palm Harbor. No significant differences between the two samples were seen in a Chi square test (p > .05), indicating that the samples were similar enough to warrant combining into a single sample for further consideration.

The last two comparisons were between each of the mission samples and the combined prehistoric sample. Mission San Juan Capistrano was significantly different in the occurrence and degree of occlusal surface wear from the prehistoric populations (p < .05), while the Mission San Francisco Xavier sample was not significantly different.

The samples were then compared for the occurrence of the seven pathological conditions used as indicators of overall health. A short description of each condition, and the criteria used to evaluate their presence or absence, are presented below. The descriptions are taken from Ortner and Putschar (1981) and Steinbock (1976) unless otherwise stated.

Porotic Hyperostosis and Cribra Orbitalia

Porotic hyperostosis and cribra orbitalia have long been used as nutritional status indicators (Buikstra, 1984; Buikstra and Cook, 1980; Cassidy, 1980; Cohen and Armelagos, 1984; Cook, 1984; El-Najjar, 1976; El-Najjar et al., 1976; Goodman et al., 1984; Huss-Ashmore et al., 1982; Kent, 1986; Lallo et al., 1977; Larsen, 1984; Lukens, 1975; Martin et al., 1985; Mensforth et al., 1978; Milner, 1982; Ortner and Putschar, 1981; Palkovich, 1987; Reinhard, 1988; Roosevelt, 1984;
Figure 9. Patterns of dental attrition in the two mission samples: (A) Mission San Juan Capistrano; (B) Mission San Francisco Xavier de Horcasitas.
Smith et al., 1984; Steinbock, 1976; Stuart-Macadam, 1985, 1987; Walker, 1985, 1986). Recently, however, it has been shown that porotic hyperostosis and cribra orbitalia are only indicative of general systemic insult rather than of nutritional status specifically; both porotic hyperostosis and cribra orbitalia are thought to be skeletal manifestations of anemia, which has many causes. Regardless of causal factors, these conditions indicate stress to the individual, and therefore can contribute to our understanding of the general health of the mission samples.

The lesions indicative of porotic hyperostosis are found on the skull vault, primarily on the external surface of the parietals above the highest nuchal line. They are highly symmetrical. The lesions are characterized by thinning, and sometimes destruction, of the outer table caused by pressure atrophy produced by hypertrophy of the underlying diploe. This creates a porous, or seive-like appearance on the parietals, caused by exposure of the hypertrophied diploe. Upon healing, the parietals are thicker in the area of the lesions because of the hypertrophy of the diploe, and the reformed outer table is marked with multiple micropores (Fig. 10). Most authors listed above consider porotic hyperostosis to be a manifestation of a childhood condition, however it is also found in adults, generally in a healed, or healing, phase.

Cribra orbitalia, also known as ursura orbitae or hyperostosis spongiosa orbitae, is a symmetrically porous, or seive-like, lesion of the eye orbits. It is present as many small lesions in the anterior portion of the orbital roofs. The condition involves both bone lysis
Figure 10. Pathological conditions: (A) Porotic hyperostosis, cross-sectional view; (B) Porotic hyperostosis, superior view.
and new bone deposition. The hypertrophy of the diploe produces pressure atrophy, as in porotic hyperostosis, and results in an expanded orbital plate. The excess bone extends into the orbital area in severe cases; it does not invade the frontal sinus or endocranial cortex of the orbital roof (Fig. 11).

There are three basic types of cribra orbitalia, representing different degrees of development. The porotic type is characterized by scattered, fine pores, the cribriform type by these small pores coalescing to form larger apertures, and the trabecular type by large, irregular apertures often arranged in radiating patterns. The first two stages are primarily characterized by resorption of the cortical bone, and the third by marked hypertrophy of the diploe. According to Steinbock (1976), the condition occurs in both children and adults.

Generalized Periosteal Infection

Generalized periosteal infection is also indicative of stress on an individual and/or population. According to Ortner and Putschar (1981) and Steinbock (1976), generalized periosteal infection can be caused by several factors, including localized trauma as well as chronic, low grade systemic infection. The presence of generalized periosteal infection, and its distribution in an individual, can indicate systemic stress in an individual, and is, therefore, helpful in determining the health status of a population (Ortner and Putschar, 1981; Steinbock, 1976) (Fig. 12).

Periosteal infection is not itself a disease, but rather a reaction to other insults in the body, including infection and trauma. The inner layer of the periosteum retains osteoblastic capacity
Figure 11. Pathological conditions: Cribra orbitalia.

Figure 12. Pathological conditions: Generalized periosteal infection.
throughout life, and may react to many different insults with the formation of new bone. This new bone initially is deposited as woven bone, which may later be remodelled into lamellar bone. The periosteal bone formation is not always an expression of inflammation, and is not restricted to infection; in many infections, however, periosteal bone formation is one of the significant skeletal changes.

Periosteal infection differs from periostitis, which is a disease of the bone underlying the periosteum, however both result in the same condition on the bone. In this study, generalized periosteal infection is considered to be undifferentiated, nonspecific, periosteal lesions; no differentiation is made between periosteal infection and periostitis.

Generalized periosteal infection is common in archaeological material. There are no unequivocal characteristics of inflammatory periosteal bone, however bone deposited over a long period of time is unevenly distributed and does not involve the entire element. The surface of the periosteal bone tends to be irregular and the thickness is variable. When the reaction is symmetrical, and no sign of trauma is present on the bone, the bone formation is considered indicative of systemic infection.

Dental Disorders

Of the four dental disorders under consideration (linear enamel hypoplasia, caries, abscess, and periodontal infection) only linear enamel hypoplasia is solely an expression of metabolic stress. Larsen (1987a,b) defines hypoplasia as transverse lines in the teeth manifested as horizontal ridges and gullies (Fig. 13). They indicate
Figure 13. Pathological conditions: Linear enamel hypoplasia
periods of metabolic stress occurring during the period when the enamel is being deposited during childhood (El-Najjar et al., 1978; Larsen, 1987a,b; Rose et al., 1985). As with porotic hyperostosis and cribra orbitalia, enamel hypoplasia can be caused by a variety of factors; it is nonetheless an indication of stress in the individual at an early period in the individual's life. Its frequency in a population, therefore, gives insight into the total health condition of the population.

Although periodontal infection is also an indicator of stress, it is more often interpreted as an indicator of oral health, which may in turn be correlated to diet (Huss-Ashmore et al., 1982; Milner, 1982; Ortner and Putschar, 1981; Steinbock, 1976). It is characterized by resorption of the alveolar margin from the cementoenamel junction greater than two millimeters (Fig. 14).

Caries is defined by Newbrun (1982) and Larsen (1987a,b, 1988) as a disease process characterized by demineralization of enamel by organic acids produced by bacterial fermentation of dietary carbohydrates, especially sugars. Caries is also thought to be indicative of diet (Huss-Ashmore et al., 1982; Larsen, 1987a,b, 1988; Ortner and Putschar, 1981; Steinbock, 1976). It is the direct result of lytic activity by bacteria, including lactobacilli and streptococci. When dental caries passes through the enamel into the dentin, the destructive process expands in this softer material, creating a mushroom, or funnel, shaped lesion. Evidence of this funnel quality is indicative of caries and is apparent in X-rays or with a dental probe (Fig. 15).
Figure 14. Pathological conditions: Periodontal infection.

Figure 15. Pathological conditions: Caries.
Two types of caries have been defined by Pindborg (1970): acute, which is associated primarily with young individuals and appears as a chalky spot in early stages, and chronic, which is often seen on interproximal surfaces, and appears as a darker color, varying from yellow to dark brown. The acute form of caries is generally not recognizable in archaeological samples. Untreated caries may result in the destruction of the entire crown, and even the death of the entire tooth. Exposure of the pulp chamber creates a high risk of infection and destruction of the supporting tissue; caries are a leading cause of periodontal infection. Hematogenous dissemination of the infection may also occur, leading to serious health complications.

Both of these dietary indicators are included in this analysis because they may document changes in diet after European contact, and when considered with systemic insult comparisons, may give information on the general change in overall health condition from pre- to post-contact Indian populations.

Caries can also be used as an indicator of metabolic stress (Larsen 1987a,b, 1988). The factors giving rise to the disease include the host (saliva and teeth), the bacteria, and the diet. Factors related to these categories include tooth morphology, enamel defects, occlusal surface wear, food texture, periodontal infection, enamel trace element composition, and geochemistry (Hildebolt et al., 1988; Larsen, 1988; Milner, 1984; Powell, 1985; Schneider, 1986). This report will concentrate on the factors above which could have been influenced not only by diet but also by stress resulting from European contact. These include enamel defects, occlusal surface
wear, and periodontal infection.

Abscessing is closely related to periodontal disease, and is, in fact, often a cause of periodontal infection. It is caused by an infection or disturbance in the alveolar margin. Generally, it is manifested skeletally by a swelling, or perforation, of the alveolar margin (Fig. 16).

Results of the Comparisons

The two mission populations were compared first for the occurrence of osseous and dental pathological conditions. The results of this comparison are presented in Table 3. The percentage of both cribra orbitalia and generalized periosteal infection is significantly higher in Mission San Juan than in Mission San Francisco Xavier (p<.05). The occurrence of porotic hyperostosis is also higher in Mission San Juan, although not at the level of statistical significance.

The seven conditions were then compared in the Blue Bayou and Palm Harbor samples; no significant differences were found in the occurrence of any of the seven conditions (p>.05)(Table 4). This, when combined with the lack of difference noted in the occurrence of dental wear, further strengthened the combining of the samples for further comparison.

The last comparisons were between each of the missions and the combined prehistoric populations. The results of these comparisons (Tables 5 and 6) documented that frequency of all pathological conditions was higher in the mission samples. Statistically
Table 3. Results of the comparison of Mission San Juan Capistrano and Mission San Francisco Xavier de Horcasitas.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>MISSION SAN JUAN CAPISTRANO</th>
<th>MISSION SAN XAVIER</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porotic hyperostosis</td>
<td>59</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Cribrar orbitalia</td>
<td>32</td>
<td>0</td>
<td>+ **)</td>
</tr>
<tr>
<td>Periosteal infection</td>
<td>81</td>
<td>39</td>
<td>+</td>
</tr>
<tr>
<td>Linear enamel hypoplasia</td>
<td>34</td>
<td>63</td>
<td>-</td>
</tr>
<tr>
<td>Caries</td>
<td>28</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>Abscesses</td>
<td>34</td>
<td>63</td>
<td>-</td>
</tr>
<tr>
<td>Periodontal infection</td>
<td>24</td>
<td>13</td>
<td>-</td>
</tr>
</tbody>
</table>

* - = not significant (p > .05)  
**) + = significant (p < .05)
Table 4. Results of the comparison of Blue Bayou and Palm Harbor.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>BLUE BAYOU</th>
<th>PALM HARBOR</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porotic hyperostosis</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Cribrum orbitalia</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Periosteal infection</td>
<td>5</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Linear enamel hypoplasia</td>
<td>10</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Caries</td>
<td>18</td>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>Abscesses</td>
<td>10</td>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>Periodontal infection</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>

* - = not significant (p > .05)
Table 5. Results of the comparison of Mission San Juan Capistrano and the Combined Prehistoric samples.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>MISSION SAN JUAN CAPISTRANO</th>
<th>COMBINED PREHISTORIC SAMPLES</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porotic hyperostosis</td>
<td>59</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Cribra orbitalia</td>
<td>32</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Periosteal infection</td>
<td>81</td>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>Linear enamel hypoplasia</td>
<td>34</td>
<td>8</td>
<td>+</td>
</tr>
<tr>
<td>Caries</td>
<td>28</td>
<td>18</td>
<td>+</td>
</tr>
<tr>
<td>Abscesses</td>
<td>34</td>
<td>10</td>
<td>+</td>
</tr>
<tr>
<td>Periodontal infection</td>
<td>24</td>
<td>0</td>
<td>+</td>
</tr>
</tbody>
</table>

* + = significant (p < .05)
Table 6. Results of the comparison of Mission San Francisco Xavier de Horcasitas and the Combined Prehistoric Samples.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>MISSION SAN XAVIER</th>
<th>COMBINED PREHISTORIC SAMPLES</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porotic hyperostosis</td>
<td>40</td>
<td>0</td>
<td>+ *</td>
</tr>
<tr>
<td>Cribra orbitalia</td>
<td>0</td>
<td>0</td>
<td>- **</td>
</tr>
<tr>
<td>Periosteal infection</td>
<td>39</td>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>Linear enamel hypoplasia</td>
<td>63</td>
<td>8</td>
<td>+</td>
</tr>
<tr>
<td>Caries</td>
<td>50</td>
<td>18</td>
<td>+</td>
</tr>
<tr>
<td>Abscesses</td>
<td>63</td>
<td>10</td>
<td>+</td>
</tr>
<tr>
<td>Periodontal infection</td>
<td>13</td>
<td>0</td>
<td>+</td>
</tr>
</tbody>
</table>

* * = significant (p < .05)
* = not significant (p > .05)
Figure 16. Pathological conditions: Abscesses.
significant differences were found in the occurrence of porotic hyperostosis, periosteal infection, hypoplasia, periodontal disease, caries, and abscesses in both cases. Mission San Juan Capistrano also showed a significant difference in the frequency of cribra orbitalia, while Mission San Francisco Xavier did not.
CHAPTER V

HEALTH STATUS IN TEXAS: AN INTERPRETATION OF THE RESULTS AND SUMMARY OF THE CONCLUSIONS

This chapter provides an interpretation of the osteological analysis of the four samples, and presents, and an overview of health in both prehistoric and historic Texas Indians. In particular, the effects of short- and long-term European contact on Indian populations are examined.

Prehistoric Samples

As documented in Chapter IV, with the exception of dental disorders, the pathological conditions used to indicate stress in the populations rarely occurred in the two prehistoric samples. This suggests that the overall health of hunter/gatherer populations in Texas prior to European contact was generally good. Only the dental disorders of linear enamel hypoplasia, caries, and abscessing were apparent in both prehistoric populations.

Previous researchers have attempted to find a correlation between the subsistence strategy practiced by a population and the occurrence of various disorders, including the dental disorders used in this comparison. This chapter examines the occurrence of linear enamel hypoplasia, caries, and abscessing in the prehistoric samples, and compares the occurrence of these disorders in the prehistoric samples with their occurrence in the historic samples.

The frequency of linear enamel hypoplasia was not significantly different in the two prehistoric samples, although it was higher than
expected for a hunting and gathering population. Linear enamel hypoplasia is a manifestation of an interruption of enamel formation in the tooth bud. The factors implicated in the formation of enamel hypoplasia include hereditary propensities, metabolic disturbances such as malnutrition or vitamin deficiency, an inadequate supply of trace elements such as molybdenum and manganese, localized trauma, localized infection, congenital syphilis, excessive levels of fluoride in the diet, uneven growth rates, and emotional upsets (Brothwell, 1963; Cawson, 1968; Molnar and Ward, 1975; Patterson, 1984; Sarnat and Schour, 1941; Small, 1978; Spouge, 1973). With so many factors influencing linear enamel hypoplasia, its occurrence is best considered to be a general marker of metabolic insult. The occurrence of enamel hypoplasia in the two prehistoric burial samples indicates only that both populations were experiencing similar levels of stress in childhood, although the types of stress may have been very different. The stressors are not defined, nor can they be. The fact that linear enamel hypoplasia occurs, even with a frequency of less than 20%, in these two prehistoric populations, indicates that stressors were affecting the population; these stressors possibly included disorders associated with weaning, food shortages, or any number of short-term interruptions in the lifeways of the prehistoric populations.

Caries usually become more frequent with the shift in subsistence from hunting and gathering to agriculture (Larsen, 1987a,b; Patterson, 1984; Powell, 1985; Turner, 1979). Since cariogenic bacteria thrive on high carbohydrate substrates. Factors such as the physical
consistency of food, often determined by the method of preparation, are also associated with caries (Finn and Glass, 1975; Patterson, 1984; Shaw, 1952; Wells, 1975).

Although a close relationship between diet and carious activity appears to exist, it cannot be assumed that the association is related directly to carbohydrate consumption or to a systemic nutritional effect (Patterson, 1984). According to Patterson (1984) and Finn and Glass (1975), it is the form and frequency of carbohydrate consumption, rather than the amount per se, that determines incidence of carious activity. Thick, sticky foods provide the substrate for plaque formation (Turner, 1979). Conversely, foods that are raw and fibrous, even those which have high carbohydrate levels, reduce the caries incidence both by their cleansing action and by stimulation of saliva production (Patterson, 1984; Turner, 1979). For these reasons, caries is considered a disease associated primarily with agricultural diets and intensive food processing (Patterson, 1984; Turner, 1979).

This assumption has been challenged recently. In the Seminole Sink report, Marks et al. (1985) demonstrated that a hunter/gatherer diet rich in sugars and carbohydrates resulted in a caries incidence at least as high as that in most agricultural populations. In addition, studies conducted on acorns and pecans (Brison, 1974; Creel, 1986; Ofcarcek and Burns, 1971) document that the carbohydrate content of these nuts is as high as the carbohydrate content of corn (Table 7). Presently, acorns and pecans are abundant in the areas in which the two prehistoric sites (Blue Bayou and Palm Harbor) were located; it is probable that these foods were also available prehistorically,
<table>
<thead>
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<th>SOURCE</th>
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<tr>
<td>CORN</td>
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</tr>
<tr>
<td>LIVE OAK ACORN</td>
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</tr>
<tr>
<td>BUR OAK ACORN</td>
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</tr>
<tr>
<td>POST OAK ACORN</td>
<td>80</td>
</tr>
<tr>
<td>BLACKJACK OAK ACORN</td>
<td>67</td>
</tr>
</tbody>
</table>
as were several other foods rich in carbohydrates.

An alternative explanation for the occurrence of caries in the prehistoric samples is suggested by the work of Pollack and Kravitz (1985:159), who state that, "...dental caries is a dietary disease ... cariogenesis may at least be promoted indirectly by ... changes in the composition of saliva. Some of these may well be, in part, nutritionally influenced." Any change in diet could, therefore, cause an increase in carious activity not only through an increase in carbohydrate content of the food, but also through a change in the composition of saliva. This change would not take long to affect the caries rate in a population; it has been demonstrated in modern populations that increases in cariogenesis of over 7% attributable to salivary changes have occurred in less than 36 months (Pollack and Kravitz, 1985).

The high incidence of alveolar abscessing in these prehistoric samples will now be interpreted. Alveolar abscessing is a pathological condition characterized by destruction of alveolar bone caused by various infectious conditions. It is widespread in many Texas archaeological populations (Reinhard et al., 1989; Patterson, 1984). Alveolar abscessing has also been correlated with the adoption of agriculture (Larsen, 1987a; Patterson, 1984; Powell, 1985). Patterson (1984) argues that soft, processed foods reduce cleansing of the teeth, thereby leading to abscessing. However, several studies have shown that fibrous, unprocessed foods still allow the buildup of plaque, although to a lesser degree, depending on the carbohydrate and sugar content of the food (Patterson, 1984; Turner, 1979). For this
reason, a high frequency of abscessing could be found in a hunting and gathering group, as was the case with caries. Since the individuals recovered from both prehistoric sites used in this study were probably subsisting on a high carbohydrate diet (Bolton, 1915; Creel, 1986), the high frequency of abscessing in the prehistoric skeletal samples are plausibly explained.

A second explanation for the high level of abscessing in the prehistoric samples is the association between attrition level and periodontal disease. High levels of attrition can be correlated with high levels of periodontal disease (Rose et al., 1985); periodontal disease can also lead to abscessing.

Historic Samples

The comparison between the historic samples also yielded surprising information. Because the occurrence and degree of occlusal surface wear on the dentition differed significantly between the two mission samples, they were not combined into a single sample representative of "historic mission populations in Texas." This difference in severity of dental wear between the two mission samples required further analysis.

It has been documented previously that attrition and abrasion reflect patterns of usage associated with diet and food processing, as well as other cultural practices (Brace and Molnar, 1967; Cybulski, 1974; Hinton, 1981; Molnar, 1968; 1970; 1971; 1972). Correlations between diet, food preparation techniques, grit content, and dental wear have also been found by previous authors (Davies, 1963; Goldstein, 1932; Leigh, 1925; Molnar, 1971; Scott, 1979; Taylor, 1963;
Turner, 1979). The importance of wear in archeological samples is based, in fact, on this relationship.

Dental wear is a more accurate reflection of subsistence patterns than are fragmentary postcranial remains (Patterson, 1984) and several studies have shown that populations practicing a hunter/gatherer subsistence strategy, which includes the dietary component as well as food processing and storage techniques and sanitation, show higher amounts of both attrition and abrasion than those practicing an agricultural strategy (Molnar, 1971; Smith, 1975).

The statistical difference in dental wear in the two mission samples under consideration in this study, combined with the similarity in wear between Mission San Xavier and the prehistoric samples, and the ethnohistorical information that Mission San Xavier was an active mission for only eight years, suggests that individuals buried at Mission San Xavier practiced a subsistence strategy, which includes not only the types of foods eaten, but also preparation and storage techniques and the sanitary status of the site, similar to that of prehistoric hunter/gatherers in Texas for a major part of their adult lives. In contrast, those individuals recovered from Mission San Juan were agriculturalists for most of their adult lives. Spanish records document that Indian groups in the area of San Xavier prior to the establishment of the mission were subsisting primarily on pecans and acorns (Castaneda, 1938); a heavy amount of occlusal surface wear would be expected due to the high grit content of the diet caused by inherent factors in the food and by preparation techniques (Larsen, 1987a,b; Larsen and Shavit, 1988; Turner, 1979).
The Indians around Mission San Juan prior to its establishment were also hunter/gatherers subsisting on a high fiber diet similar to that in the area of Mission San Juan, and were practicing similar food preparation techniques, so a heavy degree of wear would also be expected at San Juan if the individuals buried at the mission had been practicing a hunting and gathering subsistence strategy for most of their lives. The data lead to the further conclusion that those individuals recovered from San Juan spent most of their lives under the direct, daily influence of Europeans (and their diet and diseases) while those buried at San Xavier spent the majority of their adult lives outside of the sphere of direct European influence, both cultural and physiological.

These conclusions led to a reevaluation of the comparison of the two samples; rather than being a comparison of two similar mission populations, the comparison becomes one of two very different populations. The first, Mission San Juan, represents a population which had direct, daily, long-term contact with Europeans, and which subsisted primarily by agriculture. Mission San Xavier, on the other hand, represents a short-term, daily contact population which had an unknown period of indirect, intermittent contact during which the population subsisted primarily by hunting and gathering.

An increase in generalized periosteal infection and in cribra orbitalia is seen from the short-term contact (hunter/gatherer) to the long-term contact (agricultural) populations. The etiology of cribra orbitalia is currently uncertain, although the condition has been linked with porotic hyperostosis, and therefore with anemia (Ortner
and Putschar, 1981; Steinbock, 1976). At this point, since the etiology is uncertain, this increase in cribra orbitalia should be taken only as a general indicator of stress in the population (Huss-Ashmore et al., 1982; Larsen and Shavit, 1988; Milner, 1984).

Generalized periosteal infection is also attributable only to an unknown metabolic insult. The most common symptom of periostitis present in both populations is subperiosteal deposition of new bone; only in rare cases is apposition of new endosteal bone and an expansion of trabeculae visible in broken diaphyses. Because of the fragmentary nature of the burials, the full extent of this condition cannot be determined, however, the overall pattern of the infectious process is clear. The subperiosteal bone growth appears in most cases to be localized phenomena involving only one or a few skeletal elements. The tibiae are the most frequently affected bones, as has also been reported by Ortner and Putschar (1981) and Steinbock (1976).

In all four of the populations, pathological involvement is often symmetrical, and does not appear to be associated with trauma to the surrounding bone. The condition is, therefore, likely attributable to either infectious disease (possibly such as treponemal infection) or long-term systemic stress (Huss-Ashmore et al., 1982; Lallo et al., 1977; Mensforth et al., 1978; Milner, 1984). Since incidence of periosteal infection is greater in San Juan Capistrano than in San Xavier, the data suggest that chronic stress was more prevalent in the long-term contact population than in the short-term contact population.

Chronic systemic stress can be caused by a multitude of factors,
from parasitism to infectious diseases to nutritional deficiencies (Goodman et al., 1984). Lallo et al., (1977) have shown that the frequency of infectious disease, evidenced by subperiosteal bone deposition, increases with the shift from a hunting/gathering economy to one based more fully on agriculture. Both an increase in population density and a change in subsistence strategy took place at both missions in this study. However, at Mission San Juan, these factors operated over a longer period of time than at San Xavier, beginning in childhood for those burials from the Mission San Juan sample.

According to Goodman et al. (1984), Huss-Ashmore et al. (1982), Lallo et al. (1977), Mensforth et al. (1978), Milner (1984), and Strauss (1978), a synergistic relationship exists between porotic hyperostosis and infectious disease (as evidenced by generalized periosteal infection). Anemia, which causes porotic hyperostosis in some cases, can inhibit the body’s immunological ability (Ortner and Putschar, 1981; Steinbock, 1976; Stuart-Macadam, 1987). Conversely, the early onset of infection can precipitate anemia. One would expect, therefore, to find a significant difference in porotic hyperostosis between the two mission populations, together with the significant difference in periosteal infection, because of their similar relationship to infectious disease. However, the two mission samples did not exhibit a significant difference in the occurrence of porotic hyperostosis.

The presence of a significant difference in the occurrence of periosteal infection between both mission populations and the
prehistoric populations suggests that factors other than those which lead to infectious disease were causing porotic hyperostosis in the San Xavier sample. Porotic hyperostosis is thought to be a manifestation of anemia, and can be the result of many factors, including infection, weanling diarrhea, parasitism, and maize dependency (Buikstra, 1984; Buikstra and Cook, 1980; Cassidy, 1980; Cohen and Armelagos, 1984; Cook, 1984; El-Najjar, 1976; El-Najjar et al., 1976; Goodman et al., 1984; Huss-Ashmore et al., 1982; Kent, 1986; Lallo et al., 1977; Larsen, 1984; Lukens, 1975; Martin et al., 1985; Mensforth et al., 1978; Milner, 1982; Ortner and Putschar, 1981; Palkovich, 1987; Reinhard, 1988; Roosevelt, 1984; Smith et al., 1984; Steinbock, 1976; Stuart-Macadam, 1985, 1987; Walker, 1985, 1986).

These would all explain a high incidence in the long-term contact, fully agricultural sample at Mission San Juan. The almost equally high incidence at the short-term contact, hunting/gathering/farming site of Mission San Xavier is more difficult to explain. However, infection, parasitism, and weanling diarrhea are all possible causes in hunting and gathering populations as well as in agricultural populations.

The lack of significant differences in dental disorders between the two mission populations is also unexpected. However, several possible causes of these dental disorders in hunter/gatherer populations, with the exception of periodontal infection, have been discussed above. The occurrence of periodontal infection can be explained with the same reasons as the occurrence of abscessing: periodontal disease is an infection of the gingival tissue which leads
to alveolar resorption, while abscessing is destruction of bone caused by several infectious conditions. The factors leading to abscessing could also lead to an increase in the occurrence of periodontal infection.

Prehistoric and Historic Samples

Through the above methods, the apparently high frequencies of pathological conditions present in the short-term daily contact, hunter/gatherer population at San Xavier may be plausibly explained. The significant differences between this mission population and the prehistoric hunter/gatherer populations are not as easily inferred. Given the conclusion that the burial sample recovered from Mission San Xavier represents a population of hunter/gatherers who were contacted by Europeans and converted to a mission lifestyle for only a short period of time, a lower frequency of pathological condition would be expected.

The only difference between the prehistoric samples and the sample recovered from Mission San Xavier which could have caused the anomalous status of the mission sample when compared to other hunter/gatherer samples appears to be the European contact which occurred at the mission. The two prehistoric groups appear to have had similar subsistence bases to the San Xavier population prior to contact: although the actual foods eaten were different, the nutritional value of each appeared similar (Creel, 1986), and no other factor severe enough to cause the differences between the populations could be found.

The differences between the prehistoric samples and the sample
recovered from Mission San Juan Capistrano are easily explained by the differing lifestyles; the individuals recovered from Mission San Juan were probably subsisting on agricultural products for their entire lives, therefore a high frequency of all seven conditions examined in this study was expected.

Conclusions

The decline in health seen from the prehistoric samples to the mission samples illustrates well the overall decline in quality of life suffered by indigenous populations in Texas due to the missionization process. Although the supposed intent of the missions was to better the lives of the Indians, the ultimate goal of these institutions was to secure the frontier for the Spanish. They achieved this goal directly by controlling the indigenous populations through the Church, and indirectly adversely effecting the health of Indians in Texas.

This decline in health appears to have required direct, daily contact with Europeans, although the difference in the length of daily contact expressed by the two missions examined in this study does not appear to have been of great importance. The higher rate of all seven pathological conditions used in this study in both mission samples was highly anomalous when compared to prehistoric populations in Texas. This suggests that both short- and long-term contact had similar effects on indigenous populations, at least as suggested by the pathological conditions examined.

This conclusion is tempered only by the possible occurrence of indirect contact between Europeans and individuals who later were
incorporated into Mission San Xavier. The extent of this contact, through trade with other groups, war, or any other means, is unknown. There is no mention in Spanish records of any direct contact through trade between the Indians indigenous to the area around Mission San Xavier prior to its establishment and Europeans, although the French, and perhaps the English, were apparently trading with the Indians in the area on a sporadic basis (Gilmore, 1969). This indirect, sporadic contact would enable European diseases to affect indigenous populations; however, stressors causing long-term, chronic effects such as periosteal infection and porotic hyperostosis would be unlikely to have been introduced by this type of contact. Conditions such as these are either evidence of continuous exposure to stressors rather than short-term, intermittent exposure to stressors. Spanish records indicate very few long-term effects from contact with local populations; their records are filled with the short-term epidemics caused by introduced diseases. This is not to say that stressors causing chronic effects could not have been introduced by sporadic or indirect contact between Indians and Europeans, but rather to point out that the primary effect of this sporadic contact was epidemic in nature (Ewers, 1973). Even indirect contact with Europeans, through middlemen in trade and other methods, caused epidemics in Indian groups. Smallpox, measles, even influenza, decimated many groups which had no direct contact with Europeans.

There are no reports, however, of chronic, systemic ailments caused specifically by a European presence in an indigenous group. These chronic conditions were more likely caused by indirect means,
such as an alteration of the environment for agriculture or the aggregation of people and animals in a central location. In the area of Mission San Xavier, no such alteration or aggregation is noted. The location of the mission was to be on the Spanish frontier; the purpose was to expand Spanish rule into that area of Texas. This implies that Spanish presence was at least limited (in what is now Milam County) during the mid-1700s, therefore the likelihood of direct, daily contact with indigenous populations was slim. As Gilmore (1969) states, "The plan to establish missions on the San Xavier River was the first of renewed expansionist activities by the Spanish. . ." The region in which the mission was founded was known as buffalo hunting territory; agriculture was not present before missionization.

The transition to agriculture during the missionization process undoubtedly had a major effect on the health of native populations, as has been demonstrated in other cases. However, the stressors caused by living in the enclosed environment of a mission, with or without a change in diet, would have had a similar effect. One of the primary changes involved in the adoption of an agricultural way of life is the change from a very mobile existence to a sedentary one. This sedentism creates problems in sanitation, disease and parasite control, and ultimately population health. Coupled with the mental stress of the imposition of different religious, political and social practices, and a regimentation of lifestyles, this change to a sedentary way of life could have resulted in a decline in health without a change in diet. In this study, the effects of contact
cannot be separated from the effects of a change in subsistence from hunting and gathering to agriculture; the prehistoric groups used in this analysis were hunter/gatherers. Future research may concentrate on this problem. For this study, the introduction of agriculture was considered an integral part of the missionization process, and therefore a direct result of European contact.

Comparison with Other Samples

The purpose of this section is to compare the results of this study with other studies conducted on contact populations. The two studies which most closely parallel this research are those conducted by Larsen (n.d.; 1987a,b), Larsen and Shavit (1988), Walker (1985), and Walker et al. (1989); these studies involve contact populations in Georgia and California.

As presented in Chapter IV, the primary effect of contact in Texas was a decline in overall population health. Not only did mortality increase due to introduced diseases and parasites, chronic stress became more prevalent as well. In Georgia and California, however, this increase in the occurrence of skeletal indicators of stress is not apparent.

Larsen and Shavit (1988) examined the effects of European contact on preagricultural and agricultural pre-contact samples. The pre-contact agricultural population, when compared to the contact agricultural population, did not show a higher level of overall health; in fact, a 24% decline in the occurrence of caries was documented from the pre-contact to the contact agricultural samples during the early stages of contact. The incidence of caries rose
dramatically during the late contact period.

A comparison of the pre-contact agricultural sample to a pre-contact preagricultural sample from the same area, however, demonstrated a 50% increase in the occurrence of dental disorders from the preagricultural to the agricultural samples. Larsen and Shavit (1988:8) proposed, therefore, that "... the increase in carious lesions is related primarily to the adoption of and progressive increased focus on maize. " and that "... the reduction in frequency of carious lesions from the pre-contact agricultural period to the early contact period is not of great importance. Rather, the more important changes in frequency of carious lesions occurs prior to European contact with the adoption of maize and late in the contact period." (Larsen and Shavit, 1988:10-11).

Larsen and Shavit (1988) also documented that as the duration of contact increased, the incidence of dental disorders increased. They felt that this increase may be a reflection of the changing demographic profile of the population as time passed; the late contact period sample is composed of generally older individuals in relation to the other samples. Larsen and Shavit (1988) suggested that as age increases, the incidence of caries increases. The difference in demographic profile is significant, and may explain the relatively greater frequency of conditions such as caries.

The late contact period at Santa Catalina de Gaule is one of great social and biological upheaval. According to Larsen and Shavit (1988), during this time, hunting and gathering still played an important role in the diet of indigenous populations, however corn
played an increasingly important role. These data suggest that the increased reliance on corn closely parallels the increase in frequency of occurrence of dental disorders at this site.

On the Pacific coast, Walker (1985) and Walker et al. (1989) also compared pre-contact agricultural populations to contact agricultural populations; they found, unlike Larsen and Shavit (1988), that there was a significant increase in the frequency of occurrence of pathological conditions and dental disorders. Walker et al. (1989) stated that mortality increased with European contact due to infectious disease, increased warfare, and decreased birth rate. Diet and other subsistence strategies also changed with the arrival of Europeans in California; within the mission system the diverse foods of the prehistoric peoples were replaced by corn, wheat, and beans. Trade connections were disrupted, stopping the supply of supplemental resources to the mission populations. The incidence of periosteal infection and linear enamel hypoplasia also increased steadily during the pre-contact period into the contact period, with significant variation in occurrence of these conditions among contemporaneous populations.

Walker et al. (1989) also compared preagricultural samples to the pre-contact agricultural samples, in the same manner as Larsen and Shavit (1988). Like Larsen and Shavit (1988), Walker et al. (1989) found that there was an increase in the occurrence of dental hypoplasia and other indicators of stress from the preagricultural to the agricultural populations. This increase is expected because of the change in subsistence strategies. Unlike Larsen and Shavit
(1988), however, Walker et al. (1989) provided several explanations for the changes noted above. The samples recovered from California were representative of several different groups, living in different areas. Walker et al. (1989) stated that the increase in the frequency of growth disruption seen in the pre-contact samples, may have been due to an increase in the prevalence of infectious disease or malnutrition due to the change in subsistence strategies. They also state that the flow of people and resources increased during this time as trade routes were established between California and the Southwest. This flow of goods and individuals would increase the chances for the transmission of disease among larger groups of people, thereby adding to the decline in health caused by the change in subsistence.

The present study is the first to examine directly the change of hunter/gatherer populations to agricultural mission populations. It uses not only dental indicators, such as the studies by Larsen and Shavit (1988), Danforth (1988), and Danforth et al. (1985), but also incorporates three non-dental indicators of general stress. Because the individuals recovered from the Texas missions had been practicing a hunting and gathering subsistence strategy prior to contact with Europeans, a general decline in the levels of population health were expected. The fact that increases in the frequency of all seven of these conditions are highly significant suggest that, although the stressors introduced by agriculture cannot be differentiated from those introduced solely by the contact with Europeans, other factors of the missionization process added to the stressors introduced with agriculture. Also, in newly opened missions, hunting and gathering
still played a large part in the overall subsistence strategy; crops had to be planted before they could be consumed. The aggregation of large groups of people, the poor sanitation, and a slow, gradual change in diet did, however, accompany the opening of each mission. These factors have been implicated, along with dietary factors, in the decline of health at the origins of agriculture. In Texas, these factors were combined with mental and physical anguish of a drastic change in lifestyle. Therefore, although the effects of each factor in the missionization process cannot be differentiated in this study, it appears that the missionization process as a whole, not only the change in subsistence strategy (as is suggested by Larsen and Shavitz, 1988 and Walker et al., 1989) led to the decline in overall levels of health in Texas. This hypothesis is supported by the lack of difference between a long-term and a short-term mission population; the high frequency of conditions which indicate stress in childhood such as linear enamel hypoplasia and porotic hyperostosis, in a sample of adults in direct, daily contact with Europeans for a period of approximately eight years, suggests that contact of any kind, either direct or indirect, would effect the overall level of health in a population adversely.

There is much opportunity for further work in this area. Future researchers should concentrate on samples where the amount of indirect contact with Europeans is known through written records, and on prehistoric agricultural populations, in order to attempt to decipher the effects of actual contact from the effects of aggregation and a change in subsistence strategy.
Summary

This study investigated the effects of European contact on indigenous populations in Texas. Two prehistoric hunter/gatherer samples and two historic mission samples were examined for the occurrence of seven pathological conditions in order to determine the overall level of population health for each of the samples. The results of a comparison of all four sites show that a general decline in health occurred at the time of European contact. The factors leading to this decline include the adoption of agriculture, an aggregation of people in the missions, the addition of European diseases and parasites into the environment, and a drastic change in lifeways associated with the adoption of a new religious and political system.
LITERATURE CITED


Campbell TN (1988a) Personal communication, The University of Texas at Austin.

Campbell (ed.): The Indians of Southern Texas and Northeastern Mexico: Selected Writings of Thomas Nolan Campbell. Austin: Texas Archeological Research Laboratory, pp. 97-116.


London: J&A Churchill, Ltd.


Cohen MN (1987) Analysis, seriation, and age determination of the Maya at Tipu. Research proposal to the National Science Foundation.


Cook SF (1937) The extent and significance of disease among the Indians of Baja, California, 1697-1773. Ibero-Americana 12.

Cook SF (1943) The contact between the California Indians and white civilization I: the Indian versus the Spanish Mission. Ibero-
Americana 21.

Cook SF (1973a) The significance of disease in the extinction of New

Cook SF (1973b) Interracial warfare and population decline among the

Berkeley:University of California Press.

Creel DG (1986) A Study of Prehistoric Burned Rock Middens in West
Central Texas. PhD Dissertation on file, University of Arizona,
Tucson.

Cybulski JS (1974) Tooth wear and material culture: precontact

Danforth M (1988) Comparison of health patterns in Late Classic and
Colonial Mayan populations using enamel microdefects. PhD
Dissertation on file, Indiana University, Bloomington.

Danforth M, Bennett C, Mekunas H, and Cohen MN (1985) Health and
nutrition of the Colonial Maya at Tipu. Paper presented to the
American Association of Anthropologists, Washington, D.C.

Davies DM (1963) Social custom and habits and their effect on oral

Delores Fray MF de los (1762) Documentos Para la Historia
Eclesiastica y Ceril de la Provincia de Texas o Nuevas
Philipinas, 1720-1729. Coleccian Chimalistac de Libros y
Documentos Acerca de la Nueva Espana, Vol. 12. Ediciones Jose
Porrua Turanzas. Madrid.


Finnegan M and Marcsik A (1979) A non-metric examination of the relationships between osteological remains from Hungary


Kenney MM (1897) Tribal society among Texas Indians. Quarterly of the Texas State Historical Association 1:26-33.


Leigh RW (1925) Dental pathology of Indian tribes of varied


Miles AE (1963b) The dentition in the assessment of individual age in skeletal material. In DR Brothwell (ed.): Dental Anthropology.


Molnar S and Ward SC (1975) Mineral metabolism and microstructural

Morfi Fray A (1777) Spanish settlements and native tribes, 1777-78. Translation by Carlos Castaneda as dissertation, on file in the University of Texas Archives.


Ortiz Fray FX (1756) Razonde la Visita a las Misiones de la Provincia de Texas. 1756. Edited by Vargas Rea, Mexico 1955. Del Frondo Franciscano-Archivo del Museo Paleografiado por el Sr. Raymundo Luna Olmedo.


Owsley DW and Jantz RL (1983) Perinatal longbone length distributions in post-contact Arikara skeletal samples. American Journal of
Physical Anthropology 60:235(Abstract).


Schour I and Massler M (1945) The effects of dietary deficiencies upon


Steele DG (1986b) Analysis of vertebrate faunal remains from 41LK201, Live Oak County, Texas. In CL Highley (ed.): Archaeological


Van Gerven DP and Armelagos GJ (1983) "Farewell to paleodemography?" Rumors of its death have been greatly exaggerated. Journal of Human Evolution 12:353-360.

Walker P (n.d.) Enamel hypoplasia during 5,000 years of southern
California Prehistory. In S Rhine and RT Steinbock (eds.): Health
and Disease in the Prehistoric Southwest 2. Albuquerque: Maxwell
Museum of Anthropology, in press.

Southwest. In C Merbs and R Miller (eds.): Health and Disease in
the Prehistoric Southwest. Tempe: Arizona State University
Anthropological Research Papers No. 34, pp.139-164.

Indian populations. American Journal of Physical Anthropology
62:345-354.

preservation of human skeletal remains. American Journal of
Physical Anthropology 76:183-188.

Walker P, Lambert PM, and DeNiro M (1989) The effects of European
contact on the health of California Indians. In DH Thomas (ed.):
Columbian Consequences, Volume I: Archaeology and History of the
Institution Press, in press.

Wells C (1975) Prehistoric and historic changes in nutritional
diseases and associated conditions. Progress in Food and
Nutrition Science 1:729-779.

Wilkinson RG (1977) Osteological evidence for the identification of
pre-contact Karankawa. In CE Cleland (ed.): Research Essays in
Honor of James B. Griffin, Anthropological Papers 16.
APPENDIX A

BURIAL INFORMATION

Mission San Juan Capistrano

(Presently curated at the University of Texas, San Antonio)

Burial 26B1 (MNI 2)

Material Present: Left and right os coxae, sacrum, left femur,
two right femora, tarsals.

Sex: Both male, based on os coxae morphology and general size and
robusticity.

Age: Both adult, based on epiphyseal fusion and general size and
robusticity.

Pathological Conditions: Possible vitamin deficiency disease
(scurvy) indicated by bending distortions in the sacrum and
left femur. Coccyx fused to sacrum.

Burial 26B2 (MNI 11)

Material Present: Cranial fragments, fragments of clavicles,
scapulae, sterna, humeri, ulnae, several vertebrae, ribs,
several long bones, and a deciduous right canine.

Sex: Indeterminate

Age: All infants and children, based on general size and
robusticity, epiphyseal fusion, presence of a deciduous
tooth.

Pathological Conditions: None observed.

Burial 26B3 (MNI 3)

Material Present: Carpals, metacarpals, phalanges, ribs, unfused
ilium and ischium, tarsals, metatarsals, and phalanges.
Sex: Indeterminate

Age: One adolescent, based on epiphyseal fusion. One adult, based on epiphyseal fusion. One old adult, based on degenerative changes of the joints.

Pathological Conditions: Deterioration of joints in the old adult.

Burial 26B4 (MNI 3)

Material Present: Cranium, ulnae, radii, two right femora, a left and a right tibia, four fibulae (two left and two right), maxillary and mandibular dentition.

Sex: Two males, based on cranial morphology and general size and robusticity. One indeterminate.

Age: Two adults, based on dental attrition and epiphyseal fusion.

One adolescent, based on epiphyseal fusion and general size and robusticity.

Pathological Conditions: Linear enamel hypoplasia on anterior mandibular and maxillary teeth, periosteal infection on tibiae, one adult fibula, the subadult fibulae, ulnae, and radius, and some degeneration on one right femur.

Burial 26B5 (MNI 3)

Material Present: Clavicles, scapulae fragments, fragments of two right and two left humeri, several radii, several ulnae, vertebrae, ribs, os coxa fragment, fragmentary right femur, tibiae, and fibula fragments, tarsals, metatarsals, and phalanges.

Sex: Indeterminate
Age: Two adults, based on epiphyseal fusion. One adolescent, based on epiphyseal fusion.

Pathological Conditions: Periosteal infection and slight bowing of ulnae, radii, and tibiae. Slight lipping on some lumbar vertebrae.

Burial 26B7 (MNI 1)

Material Present: Cranial fragments, right clavicle, left humerus, ulna, and radius, left femur and tibia, right and left fibulae, maxillary and mandibular dentition.

Sex: Male, based on cranial morphology, gonial angle eversion, and general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of dentition.

Pathological Conditions: Nasals fused, periosteal infection on clavicle, femur and fibula, antemortem loss of the right maxillary second incisor and canine, differential wear of maxillary dentition, buccal margin on right maxilla shows evidence of periodontal infection, crown caries on the left and right third mandibular molars.

Burial 26B7A (MNI 2)

Material Present: Cranium, left clavicle, left and right scapulae, left and right humeri, left ulna and radius, vertebrae, several rib fragments, left and right distal fibulae, maxillary dentition.

Sex: One female, based on cranial morphology. One indeterminate.

Age: Both adult, based on eruption and occlusion of the dentition,
epiphyseal fusion and general size and robusticity.

Pathological Conditions: Possible cribra orbitalia, slight degeneration of the joints, dens indentae.

Burial 26B7C (MNI 2)

Material Present: Left clavicle, left and right scapulae, distal portion of sternum, right humerus, distal end of left humerus, right ulna and radius, hand and wrist bones, several vertebrae, several ribs, an almost complete left and right os coxae, right femur, right tibia and fibula, several maxillary teeth (no maxillae), and a mandible.

Sex: One male, based on femoral head size, mandibular size and shape, cranial shape, one female based on sciatic notch width, sub-pubic angle shape, presence of preauricular sulcus, bowl shape of pelvis.

Age: Both adult, based on epiphyseal fusion, general size and robusticity. Age of female also based on morphology of the pubic symphysis to be 25-30 years.

Pathological Conditions: The left metatarsal contains a smooth-walled hole, possibly the result of infection, well healed. Teeth are extremely worn, to pulp in the case of the left maxillary fourth premolar. All mandibular teeth, with the exception of the incisors, were lost antemortem. Significant alveolar resorption has occurred; the tooth sockets are no longer visible.

Burial 26B7D (MNI 1)

Material Present: Cranial fragments, right and left clavicles,
partial left scapula, two small, unfused sternal fragments, right and left humeri, right and left ulnae and radii, several vertebrae, several ribs, right and left os coxae, sacrum, right and left femora, right and left tibiae, right and left fibulae, maxillary dentition, mandible, mandibular dentition.

Sex: Indeterminate

Age: Subadult, 12-15 years based on epiphyseal fusion, vertebral and os coxae fusion, eruption and occlusion of dentition.

Pathological Conditions: Some porosity on right parietal near suture, possibly porotic hyperostosis. Slight periosteal infection on both radii and both tali. Teeth all lightly worn. Reactive bone growth on chin, following around the ramus on both sides.

Burial 26B7ABC2 (MNI 2)

Material Present: Sternal body fragment, left humerus, left proximal ulna, radial diaphysis, several vertebrae, left femur, left and right tibiae, left and right tibiae, two right calcanei.

Sex: Indeterminate

Age: One adult, based on epiphyseal fusion, size and robusticity.

One subadult, based on vertebral fusion and epiphyseal fusion, general size and robusticity.

Pathological Conditions: Slight periosteal infection on left humerus and left femur. Hole in centrum of thoracic vertebra, possibly a cyst. Adult right calcaneus shows
reactive bone growth.

Burial 26B8B (MNI 1)

Material Present: Several vertebrae, several ribs, os coxae fragments.

Sex: Female, based on os coxa morphology.

Age: Adult, on the basis of epiphyseal fusion, presence of degenerative changes on the vertebrae, general size and robusticity.

Pathological Conditions: Degenerative changes on the vertebrae.

Burial 26B8C (MNI 2)

Material Present: left and right clavicles, complete left scapula, partial right scapula, sternal body fragment, fragments of two left and one right humerus, two proximal left and one distal right ulna fragments, radial fragments, several vertebrae, os coxae fragments, fragments of two sacra, left and right femora, left and right tibiae, fibulae fragments.

Sex: One male, based on os coxa morphology, size of femoral head, general size and robusticity. One indeterminate.

Age: Both adult.

Pathological Conditions: None visible due to poor preservation of bone.

Burial 26B9 (MNI 1)

Material Present: Right clavicle, fragments of left clavicle, three vertebrae, several ribs, left and right os coxae, sacrum, right femur, tibia, and fibula, maxilla and
maxillary dentition, mandible and mandibular dentition.

Sex: Male, based on os coxa morphology, mandibular morphology, femoral head diameter, general size and robusticity.

Age: Old adult, based on degeneration of the vertebrae, pubic symphysis morphology, sternal rib end morphology, tooth wear, general size and robusticity.

Pathological Conditions: Degenerative changes on vertebrae, deterioration of os coxae, general degenerative changes around joint areas. Periodontal infection extremely evident on both maxilla and mandible. First maxillary right molar lost antemortem, carious activity evident at root in upper right fourth premolar and upper right third molar. Maxilla covered with reactive bone. Evidence for abscessing in mandible associated with antemortem loss of left lower second molar, carious activity associated with left third lower molar, left lower first molar, right lower first and third molars. Periapical abscess associated with right fourth premolar. Heavy wear on all teeth, although the wear on the left side of the mandible is significantly greater than that on the right.

Burial 26B10 (MNI 1)

Material Present: Left and right clavicles, left scapula, sternum, left humerus, left ulna, distal end of right ulna, left radius, several vertebrae, several ribs, right os coxa, left femur, distal portion of left tibia, left and right fibulae.
Sex: Female, based on femoral head diameter, os coxa morphology, general size and robusticity.

Age: Old adult, based on pubic symphysis (44-54), degenerative changes on the vertebrae and joints, general size and robusticity.

Pathological Conditions: Degenerative changes on the vertebrae and joints, generalized periosteal infection on sternum, femur, and tibiae.

Burial 26B11A (MNI 1)

Material Present: Right clavicle, sternal fragments, left humerus, left and right radii, several vertebrae, several rib fragments, left and right os coxae, sacrum fragments, right femur, left tibia, left and right fibulae, maxillae and maxillary dentition, mandible and mandibular dentition.

Sex: Female, based on os coxa morphology, general size and robusticity, femoral head diameter.

Age: Adult, based on epiphyseal fusion, eruption and occlusion of the third molar, general size and robusticity.

Pathological Conditions: Right shoulder (clavicle) heavily infected. Clavicle mostly destroyed on acromial portion by infection, much reactive bone present along entire length. General periosteal infection on sternum, humerus, tibia, and fibula. Degenerative changes noted on vertebrae. Teeth show little wear. Hypoplasia present on right upper canine and lower incisors.
Burial 26B11B (MNI 5)

Material Present: Cranial fragments, almost complete skull cap, left and right clavicles, scapulae fragments, sternal fragments, right humeral diaphysis, left humeral head, proximal end and diaphysis of left radius, diaphysis of right radius, several vertebrae, os coxae fragments, sacral fragments, four unarticulated maxillae with maxillary dentition.

Sex: Indeterminate

Age: Three adults, based on epiphyseal fusion and eruption and occlusion of the third molars, one child, based on epiphyseal fusion and vertebral fusion, one infant, based on epiphyseal fusion, vertebral fusion, and general size and robusticity. Note: all postcranial material with the exception of the vertebrae and several skull fragments, are adult.

Pathological Conditions: Slight exostosis noted on several adult skull fragments, heavy reactive bone growth on one adult right malar, bifurcated xiphoid process on sternum, general degenerative changes noted on several adult vertebrae, one maxilla heavily infected with billowy and highly perforated reactive bone deposition.

26B11C (MNI 1)

Material Present: Right clavicle, left scapula fragments, sternum, right humerus, right ulna, right radius, small vertebral fragments, several rib fragments, left and right os coxae, sacrum, left femur, left and right tibiae, left and
right fibulae, mandible and mandibular dentition.

Sex: Female, based on os coxa morphology, femoral head diameter, general size and robusticity.

Age: Adult, based on eruption and occlusion of third molar, general size and robusticity.

Pathological Conditions: Generalized periosteal infection on the clavicle, both tibiae, and both fibulae. Periapical abscess associated with lower left first molar, which was probably lost antemortem, right second and third lower molars lost antemortem, resorption of alveolar surface readily apparent, carious activity on lower left second molar, occlusal surface, antemortem break of the lower left second molar hypoconid, subsequent rounding of the broken edge has occurred.

Burial 26Bl1D (MNI 2)

Material Present: Cranial fragments, right clavicle, left and right scapulae, sternum, right humerus, right ulna, left ulna (right articulates well with humerus, left is much smaller and more gracile than right), right radius, several vertebrae and ribs, left ischium and pubis, sacrum, right femur, maxillae and maxillary dentition, mandible and mandibular dentition.

Sex: One female, based on os coxa morphology, general size and robusticity, femoral head diameter. One indeterminate (ulna).

Age: Both adult, based on epiphyseal fusion, eruption and
antemortem loss of third mandibular molars, general size and robusticity.

Pathological Conditions: Possible Tuberculosis: degenerative changes on all vertebrae, especially the thoracic vertebrae. Centra have begun to deteriorate, several centra have cyst-like lesions present, facets have a "cauliflower" appearance on several thoracic and lumbar vertebrae, massive deterioration of dens of the axis. Several "bloated" ribs, slightly enlarged, with some reactive bone present. Some slight degenerative changes noted in the olecranon process of the right ulna, some lipping on the distal end of the right ulna, degenerative changes on the distal end of the right radius. Articular facet for the distal ulna is "cauliflower" shaped. Much deterioration of the os coxa. Apparent area of abscess on the pubis near the acetabulum. Reactive bone present on entire lateral side of pubis. Degenerative changes noted on the sacrum. Some slight lipping on head of femur. Large carious areas on upper right canine, lower right first molar. Upper left fourth premolar, lower third molars lost antemortem. Periapical abscess present above upper right canine. Palate heavily affected by general periodontal infection.

Burial 26B11E (MNI 1)

Material Present: Complete cranium, left and right clavicles, left and right scapulae, sternum, right humerus, left proximal humerus, left and right ulnae, left and right radii,
several vertebrae, several ribs, left and right femora, left
and right tibiae, left and right fibulae, os coxae, maxillae
and maxillary dentition, mandible and mandibular dentition.

Sex: Female, based on general size and robusticity, os coxae
morphology, cranial morphology, femoral head diameter,
mandibular morphology.

Age: Adult, based on general size and robusticity, epiphyseal
fusion, suture closure.

Pathological Conditions: Porotic hyperostosis noted on parietals
and occipital above the highest nuchal line. Generalized
periosteal infection on both femora and both tibiae. Slight
hypoplasia on the upper canines and left central incisor.
Right central incisor lost postmortem. Carious activity at
cementoenamel junction on the upper left third molar and
upper left first molar. Circular caries noted at the
cementoenamel junction on all lower molars with the exception
of the lower right third molar. The lower right first and
second molars also show occlusal surface caries. Possible
areas of abscessing noted on the upper right first molar,
upper left first molar, and upper left incisors and canine.
Lower right third molar unerupted, possibly congenitally
absent: all other third molars erupted, occluding, and
slightly worn. Evidence for periodontal infection in both
the maxillae and the mandible.

Burial 26B11F (MNI 1)

Material Present: Complete cranium, scapula fragments, atlas.
Sex: Female, based on cranial morphology and general size and robusticity.

Age: Adult, based on general size and robusticity, suture closure.

Pathological Conditions: Porotic hyperostosis.

Burial 26B11G (MNI 1)

Material Present: Complete cranium, left radius, 2 vertebrae, rib fragments, femoral fragments, left tibia, left fibula.

Sex: Female, based on cranial morphology and general size and robusticity.

Age: Adult, based on general size and robusticity, suture closure, epiphyseal fusion.

Pathological Conditions: Porotic hyperostosis. Heavy periosteal infection on tibia; bone swollen and bowed.

Burial 26B11H (MNI 1)

Material Present: Left radius, several ribs, pubic symphysis.

Sex: Indeterminate

Age: Adult. If male, 29+ years, if female 30-47 years based on pubic symphysis morphology.

Pathological Conditions: Ribs show heavy degree of infection. Much reactive bone, ribs are "swollen" and "bloated" looking. Possible tuberculosis, however no diagnosis can be made due to lack of other skeletal elements.

Burial 26B(Unidentified, possibly 11) (MNI 1)

Material present: Complete cranium, radial fragments, os coxae, right femur, maxillae and maxillary dentition.

Sex: Male, based on os coxae morphology, cranial morphology,
general size and robusticity.

Age: Adult, based on general size and robusticity, epiphyseal fusion, suture closure.

Pathological Conditions: None noted.

Burial 26B12A (MNI 2)

Material present: Almost complete cranium, left clavicle, scapula fragments, sternum, two right humeri, one left humerus, left and right radii, vertebral fragments, several ribs, right ilium, sacrum, left and right femora, tibiae, and fibulae, maxillary dentition.

Sex: One male, based on os coxa morphology, cranial morphology, femoral head diameter, and general size and robusticity, one indeterminate.

Age: Two adults, based on general size and robusticity, epiphyseal fusion, suture closure.

Pathological Conditions: Porotic hyperostosis, possible cribra orbitalia, degenerative changes of the sternum, extreme attrition on anterior teeth, slight periodontal disease.

Burial 26B12B (MNI 1)

Material present: Right and left clavicles, scapula fragments, sternum, left humerus, left and right ulnae and radii, vertebrae, several ribs, left and right os coxae, sacrum, left and right femora, tibiae, and fibulae, maxillary and mandibular dentition.

Sex: Female, based on os coxa morphology, cranial morphology, and general size and robusticity, femoral head diameter.
Age: Adult, based on epiphyseal fusion, general size and robusticity, and suture closure.

Pathological Conditions: Acromial end of right clavicle flattened and porotic, slight bowing of left humerus with reactive bone, slight periosteal infection on right ulna, both radii. Some slight periosteal infection on ribs. Os coxae are very small. Right ilium shows reactive bone deposition. Linear enamel hypoplasia noted on upper incisors and canines. Abscesses above upper right fourth premolar and upper right canine. Some slight periodontal infection noted on both mandible and maxillae.

Burial 26B12AB (MNI 2)

Material present: single unfused lumbar neural arch, several ribs, maxillary dentition.

Sex: One male, based on mandibular size and shape. One indeterminate.

Age: One adult, based on eruption and occlusion of third molars. One subadult, based on fusion of vertebrae.

Pathological Conditions: Slight hypoplasia on lower canines. Very slight evidence for periodontal infection over right lower canine. Carious activity on lower left and right second molars, impacted lower right third molar, antemortem loss of lower left second molar.

Burial 26B13A (MNI 1)

Material present: Right clavicle, left scapula, right humerus, left radius, several vertebrae, left and right tibiae and
fibulae, mandibular dentition.

Sex: Male, based on general size and robusticity, mandibular morphology and robusticity.

Age: Old adult, based on degenerative changes of the vertebrae and joints, eruption and antemortem loss of third molars, epiphysial fusion.

Pathological Conditions: Periosteal infection on right clavicle, sternal facet is distorted, the acromial end is enlarged and flattened. Periosteal infection also evident on entire length of humerus, giving the bone a bloated look. Cauliflower facets on thoracic and lumbar vertebrae. All vertebrae and joints show degenerative changes including severe lipping. Antemortem loss of lower right molars, lower left third molar, lower right canine and third premolar. Abscesses in the areas of antemortem loss. Carious activity on lower left second molar, lower left fourth premolar, and lower left first molar.

Burial 26B13, B13B (MNI 2)

Material present: Complete cranium, left and right clavicle, left and right scapulae, left and right humeri, left ulna, several rib fragments, os coxae, 2 sacrum fragments, maxillary dentition.

Sex: One male, based on os coxae morphology, general size and robusticity, one indeterminate.

Age: One old adult, based on pubic symphysis morphology, general degenerative changes in the joints, epiphysial fusion, suture
closure, auricular surface morphology, attrition. One indeterminate.

Pathological Conditions: Button osteoma on right portion of frontal. Degenerative changes on the scapulae, sternum, sternal ends of ribs, os coxae, and sacrum. Antemortem loss of upper central incisors, upper right fourth premolar, upper left third and fourth premolars, all upper molars. Abscesses evident in alveolar margin above upper incisors, upper right canine, upper right fourth premolar, upper left canine, upper left first molar. Periodontal infection evident on entire alveolar margin of maxillae. Massive resorption in the areas of antemortem loss.

Burial 26B13C (MNI 1)

Material present: Right clavicle, ulna, and radius, vertebrae, several rib fragments, left and right femora, left patella, left and right tibiae, right fibula.

Sex: Male, based on femoral head diameter, general size and robusticity.

Age: Old adult, based on epiphyseal fusion and degenerative changes on the vertebrae and joints.

Pathological Conditions: Severe degenerative changes on the vertebrae and ribs, some slight periosteal infection on both femora and tibiae.

Burial 26B16A (MNI 2)

Material present: Two crania, left and right clavicles, fragments of both scapulae, sternum, left and right humeri, ulnae, and
radii, several vertebrae, several ribs, left os coxa, sacrum fragments, left and right femora, tibiae, and fibulae.

Sex: One male, based on cranial morphology, general size and robusticity, sacral width, femoral head diameter, one indeterminate.

Age: Male is an old adult, based on epiphyseal fusion, general size and robusticity, degenerative changes on the vertebrae. Indeterminate is an adult, based on epiphyseal fusion, general size and robusticity.

Pathological conditions: One cranium shows evidence for porotic hyperostosis and cribra orbitalia. General degenerative changes of the clavicles, vertebrae, ribs, and joints. Possible dislocated shoulders-articular facets on the scapulae are located above the coracoid process in both cases. Slight periosteal infection of both radii, and all femora, tibiae, and fibulae.

Burial 26B16B (MNI 1)

Material present: Cranium, left clavicle, left and right scapulae, sternum, left proximal humerus, left and right radii, several vertebrae and ribs, right os coxa, right proximal femur, right tibia, maxillary dentition.

Sex: Male, based on cranial morphology, femoral head diameter, general size and robusticity.

Age: Old adult, based on degenerative changes on the vertebrae, epiphyseal fusion, general size and robusticity.

Pathological Conditions: Possible cribra orbitalia, degenerative
changes on the vertebrae, slight degenerative changes on the proximal tibia, periodontal infection, antemortem loss of upper right second and third molars.

**Burial 26B16C (MNI 1)**

Material present: Cranium, left and right clavicles, left and right scapulae, sternum, right humerus, left and right ulnae and radii, all vertebrae, several ribs, left and right os coxae, sacrum, left and right femora, tibiae, and fibulae, maxillary and mandibular dentition.

Sex: Male, based on cranial morphology, general size and robusticity, femoral head diameter, os coxae morphology, sacral width.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Slight occipital deformation, porotic hyperostosis, cribra orbitalia, slight deterioration of lumbar vertebrae, slight periosteal infection on both femora, heavy infection on both tibiae and fibulae. Linear enamel hypoplasia present on upper left canine and both lower canines. Carious activity present on lower right first molar.

**Burial 26B16misc. (MNI 3)**

Material present: Two crania, two right scapulae, right humerus, left and right ulnae and radii, several vertebrae and ribs, two left os coxae, two sacra, left and right femora, tibiae, two left and one right fibulae, maxillary dentition.
Sex: One male, based on cranial morphology, femoral head diameter, os coxae morphology, sacral width, general size and robusticity. Two indeterminates.

Age: All adults, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: One cranium exhibits porotic hyperostosis and cribra orbitalia, abscess associated with upper right central incisor.

*:ial 26B17A (MNI 2)*

Material present: Cranium, left and right clavicles, right scapula, right humerus, ulna, left and right radii, several vertebrae and ribs, right os coxa, right femur, two left tibia, left and right fibulae, maxillary dentition.

Sex: One male, based on cranial morphology, femoral head diameter, os coxa morphology, general size and robusticity. Two indeterminates.

Age: Two adult, based on epiphyseal fusion, general size and robusticity. One subadult (represented by a single tibia), based on epiphyseal fusion and general size and robusticity.

Pathological Conditions: Probable scaphocephaly, cribra orbitalia, severe periosteal infection on left tibia and both fibulae, exostosis on left tibia, possible extra tooth between left central and lateral incisors. Periodontal infection, abscess on upper right first molar, small area of carious activity on right upper third molar.
Burial 26B17B (MNI 1)

Material present: Cranium, left and right femora, left and right tibiae, right fibula, maxillary dentition.

Sex: Female, based on cranial morphology, femoral head diameter, and general size and robusticity.

Age: Young adult, based on epiphyseal fusion, maxillary dental eruption.

Pathological Conditions: None noted.

Burial 26B17A-D (MNI 1)

Material present: Left and right radii, two unfused neural arches, right os coxa, left and right femora, tibiae, and fibulae.

Sex: Indeterminate

Age: Subadult, based on epiphyseal fusion and general size and robusticity.

Pathological Conditions: None noted.

Burial 26B18A (MNI 1)

Material present: Sternum, left and right humeri, ulnae, and radii, several vertebrae, partial left os coxa, left and right femora, right tibia.

Sex: Male, based on os coxa morphology, femoral head diameter, and general size and robusticity.

Age: Young adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Some slight lipping of the proximal tibia.
Burial 26B18B (MNI 1)

Material present: Cranium, left and right clavicles, left and right scapulae, sternum, left and right humeri, ulnae, and radii, several vertebrae, left os coxa, sacrum, right femur, left and right tibiae and fibulae, maxillary and mandibular dentition.

Sex: Female, based on cranial morphology, os coxa morphology, femoral head diameter, and general size and robusticity.

Age: Adult, based on epiphyseal fusion and general size and robusticity.

Pathological Conditions: Very slight periosteal infection on both tibiae.

Burial 26B18C (MNI 1)

Material present: Left and right humeri, left ulna, right radius, several vertebrae and ribs, left and right os coxae, sacrum, left and right femora, two loose maxillary teeth.

Sex: Male, based on os coxae morphology, sacral width, femoral head diameter, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Slight degenerative changes of the vertebrae.

Burial 26B18D (MNI 2)

Material present: Fragments of two crania, left and right scapulae, sternum, left and right humeri and ulnae, left radius, several vertebrae, several ribs, deciduous maxillary
dentition, deciduous and permanent mandibular dentition.

Sex: Both indeterminate.

Age: One adult, based on epiphyseal fusion, general size and robusticity. One subadult, based on epiphyseal fusion, general size and robusticity, presence of deciduous dentition.

Pathological Conditions: None on the adult. Subadult shows a Carabelli's cusp on upper deciduous premolars.

Burial 26BNWCorner (MNI 18)

Material present: Extremely mixed remains of several secondary interments.

Sex: All indeterminate

Age: 15 subadults, all infants, based on epiphyseal fusion, general size and robusticity. Three adults, based on epiphyseal fusion, general size and robusticity, degenerative changes on the vertebrae.

Pathological Conditions: Several adult vertebrae show degenerative changes.

26BSWCorner (MNI 3)

Material present: Extremely mixed and fragmentary remains of several secondary interments.

Sex: Indeterminate

Age: All adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: None noted.
Mission San Francisco Xavier de Horcasitas
(presently curated at Southern Methodist University)

Trench B, Feature 1 (MNI 1)

Material present: Cranial fragments, left and right clavicle fragments, fragmentary scapulae, left and right humeral diaphyses, ulnar and radial fragments, sternal fragments, several vertebrae and ribs, os coxae fragments, left and right femoral, tibial, and fibular fragments, maxillary and mandibular dentition.

Sex: Female, based on os coxae morphology, femoral head diameter, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Some slight periosteal infection on both tibiae, slight linear enamel hypoplasia on the upper lateral incisors and canines, slight periodontal infection on both maxillae and mandible.

Trench C, Feature 1 (MNI 1)

Material present: Cranial fragments, left clavicle, vertebrae and ribs, maxillary and mandibular dentition.

Sex: Indeterminate

Age: Adult, based on general size and robusticity, eruption and attrition of the dentition.

Pathological Conditions: Porotic hyperostosis, linear enamel hypoplasia on upper and lower incisors, upper and lower canines, lower third and fourth premolars, and lower first
molars.

Trench D, Feature 1 (MNI 1)

Material present: Cranium, left and right femora, tibiae, and fibulae, ribs and vertebrae, humeral and ulnar fragments, maxillary and mandibular dentition.

Sex: Male, based on cranial morphology, femoral head diameter, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of dentition.

Pathological Conditions: Periosteal infection on both femora and tibiae.

Trench E, Feature 1 (MNI 1)

Material present: Sternal body, left humerus, right humeral head, left ulna, left and right radial fragments, several vertebrae and ribs, left and right os coxae, sacrum, left and right femora, tibiae, fibulae, and patellae.

Sex: Female, based on os coxae morphology, sacral width, femoral head diameter, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Periosteal infection evident on os coxae around acetabulae and on both tibiae.

Trench F, Feature 2A (MNI 1)

Material present: Cranial fragments, left and right clavicles, scapulae fragments, left and right humeri, ulnae, radii, left and right femora, tibiae, and fibulae, several vertebrae and
ribs, left and right os coxae, maxillary and mandibular
dentition.

Sex: Male, based on os coxae morphology, cranial morphology,
general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and
robusticity, eruption and occlusion of dentition.

Pathological Conditions: Porotic hyperostosis, slight
degenerative changes on the vertebrae, periosteal infection
on both tibiae, linear enamel hypoplasia on all upper teeth,
slight hypoplasia on lower teeth. Carious activity evident
on upper left fourth premolar, upper right third molar.
Impacted lower third molars. Antemortem loss of upper left
molars, upper right fourth premolar and first molar.
Abscessing between upper right central and lateral incisors.
Slight periodontal infection on both maxillae and mandible.

ench F, Feature 2B (MNI 1)

Material present: Cranial fragments, left and right clavicles,
scapulae fragments, left and right humeri, ulnae, and radii,
several vertebrae and ribs, left and right os coxae
fragments, sacrum, left and right femora, tibiae, and
fibulae, maxillary and mandibular dentition

Sex: One female, based on cranial morphology, os coxae
morphology, general size and robusticity.

Age: Adults, based on epiphyseal fusion, general size and
robusticity.

Pathological Conditions: Porotic hyperostosis, slight
degenerative changes in the vertebrae, periosteal infection 
on both femora, tibiae, and fibulae, carious activity on the 
upper left third molar. Antemortem loss of lower second and 
third molars, with alveolar resorption.

ич F, Feature 3 (MNI 1)

Material present: Os coxa fragments, ulnar and humeral fragments, 
vertebral fragments.

Sex: Indeterminate.

Age: Subadult, based on epiphyseal fusion.

Pathological Conditions: None noted.

ич F, Feature 4 (MNI 1)

Material present: Vertebrae, unidentified fragments.

Sex: Indeterminate.

Age: Adult, based on degenerative changes in the vertebrae.

Pathological Conditions: degenerative changes in the vertebrae.

ич F, Feature 6 (MNI 1)

Material present: Large cranial fragments, left and right 
clavicles and scapulae, left and right humeri, ulnae, and 
radii, several vertebrae and ribs, left and right femora, 
tibiae, and fibulae, maxillary and mandibular dentition.

Sex: Female, based on cranial morphology, femoral head diameter, 
general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and 
robusticity, eruption and occlusion of the dentition.

Pathological Conditions: Slight degenerative changes on vertebrae

ич G, Feature 1 (MNI 1) (combined with Trench G, Feature 2)
Material present: Cranial fragments, long bone fragments.

Sex: Indeterminate.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological conditions: Porotic hyperostosis.

ure 5, N121.2/W76.9 (MNI 1)

Material present: Cranial fragments, left and right clavicles, fragments of left and right scapulae, fragmentary sternum, left and right humeri, ulnae, and radii, several vertebrae and ribs, left and right femoral, tibiae, and fibulae fragments, right maxillary dentition, mandibular dentition

Sex: Male, based on cranial morphology, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of the dentition.

Pathological Conditions: Very slight periodontal infection on both maxillae and mandible.

ure 11, N121.2/W76.9 (MNI 1)

Material present: Cranial fragments, fragments of clavicles and scapulae, several ribs, left os coxa, maxillary and mandibular dentition.

Sex: Male, based on cranial morphology, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of dentition.

Pathological Conditions: Slight periodontal infection on both
maxillae and mandible. Carious activity on upper right fourth premolar and lower right third molar.
Blue Bayou

(presently curated at Texas A&M University)

Burial 1 (MNI 1)

Material present: Cranial fragments, left and right femora, unidentified long bone fragments, maxillary dentition.

Sex: Female, based on cranial morphology, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of the dentition.

Pathological Conditions: Carious activity on the upper right lateral incisor, nerve or root damage with associated discoloration of upper right central incisor.

Burial 2 (MNI 1)

Material present: Cranial fragments, left and right humeri, right ulna, left and right radii, right femur, left tibia, maxillary dentition.

Sex: Female, based on cranial morphology, general size and robusticity.

Age: Old adult, based on epiphyseal fusion and obliteration, general size and robusticity.

Pathological Conditions: None noted.

Burial 3 (MNI 1)

Material present: Unidentifiable human bone fragments.

Sex: Indeterminate

Age: Adult, based on general size and robusticity.

Pathological Conditions: None noted.
**Urinal 4 (MNI 1)**

Material present: Left and right radii, left and right femora and tibiae, left patella, os coxae fragments.

Sex: Male, based on os coxae morphology, femoral head diameter, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: None noted.

**Urinal 5 (MNI 3)**

Material present: Cranial fragments, left scapula fragments, left and right humeri, ulnae, and radii, several vertebral and rib fragments, os coxae fragments, sacral fragments, left and right femora, tibiae, and fibulae, right patella, maxillary and mandibular dentition, mandible with dentition, left mandibular fragment with dentition.

Sex: One male, based on cranial morphology, general size and robusticity. Two indeterminates.

Age: Male is adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of the dentition.

Indeterminates are young adult, based on non-eruption of the third molars, general size and robusticity, epiphyseal fusion, and old adult, based on epiphyseal fusion, general size and robusticity, degenerative changes on the vertebrae.

Pathological Conditions: Periosteal infection on left fibula, degeneration of the vertebral column on adult male.
Burial 6 (MNI 1)

Material present: Left ulna fragment, left and right femoral fragments, left and right tibial fragments.

Sex: Indeterminate

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Periosteal infection on right femur.

Burial 7 (MNI 1)

Material present: Femoral fragments, left and right tibiae, left fibula.

Sex: Indeterminate

Age: Adult, based on general size and robusticity.

Pathological Conditions: None noted.

Burial 8 (MNI 1)

Material present: Cranial fragments, left and right humeri, left radius, left ulna, left and right femora and tibiae, maxillary and mandibular dentition.

Sex: Female, based on cranial morphology, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of dentition.

Pathological Conditions: None noted.

Burial 9 (MNI 1)

Material present: Cranium, right humerus, maxillary dentition.

Sex: Male, based on cranial morphology, general size and robusticity.
Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of third molars.

Pathological Conditions: None noted.

trial 10 (MNI 1)

Material present: Cranial fragments, left and right humeri, left radius, maxillary and mandibular dentition.

Sex: Female, based on cranial morphology, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of dentition.

Pathological Conditions: Periodontal infection on both maxillae and mandible, lower right first molar lost antemortem, upper right second molar broken at root antemortem.

trial 11 (MNI 1)

Material present: Left femur, left and right tibiae and fibulae.

Sex: Female, based on general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: None noted.

trial 12 (MNI 1)

Material present: Crania, left humerus, left and right femora, maxillary and mandibular dentition.

Sex: Male, based on cranial morphology, femoral head diameter, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of dentition.
Pathological Conditions: None noted.

rial 13 (MNI 1)
Material present: Unidentified fragments of human bone.
Sex: Indeterminate
Age: Adult, based on general size and robusticity.
Pathological Conditions: None noted.

rial 14 (MNI 1)
Material present: Left mandibular fragment with dentition.
Sex: Male, based on mandibular morphology, general size and robusticity.
Age: Adult, based on eruption and occlusion of the dentition.
Pathological Conditions: None noted.

rial 15 (MNI 1)
Material present: Unidentified long bone fragments.
Sex: Indeterminate
Age: Adult, based on general size and robusticity.
Pathological Conditions: None noted.

rial 16 (MNI 1)
Material present: Cranial fragments, maxillary and mandibular dentition.
Sex: Male, based on cranial morphology, general size and robusticity.
Age: Adult, based on general size and robusticity, eruption and occlusion of the dentition.
Pathological Conditions: Periodontal infection associated with the mandibular first and second molars.
Burial 17 (MNI 1)

Material present: Cranial fragments, left and right femora, tibiae, and fibulae, right patella.

Sex: Male, based on cranial morphology, general size and robusticity, femoral head diameter.

Age: Adult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: None noted.

Burial 18 (MNI 2)

Material present: Cranial fragments, right clavicle, left humerus and ulna, left and right femora and tibiae, right fibula, maxillary and mandibular dentition, right femur.

Sex: One male, based on cranial morphology, femoral head diameter, general size and robusticity. One indeterminate.

Age: Adult, based on general size and robusticity, epiphyseal fusion. Subadult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Periosteal infection on the external auditory meatuses of the old adult male.

Burial 19 (MNI 1)

Material present: Cranial fragments, vertebral and rib fragments, left and right clavicles and humeri, femoral fragments, right tibia and fibula, deciduous maxillary and mandibular dentition.

Sex: Indeterminate

Age: Subadult, based on epiphyseal fusion, general size and
robusticity, presence of deciduous dentition.

Pathological Conditions: None noted.

**Trial 20 (MNI 1)**

Material present: Cranium, left and right humeri, ulnae, and radii, maxillary and mandibular dentition.

Sex: Male, based on cranial morphology, general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of dentition.

Pathological Conditions: Carious activity noted on the upper right third molar and the lower right fourth premolar and second molar. Abscessing around the lower right second molar. Periodontal infection on mandible, along with hypercementosis of the roots.

**Trial 21 (MNI 1)**

Material present: Cranium, right humerus, ulna, and radius, vertebral and rib fragments, right femur, left and right tibiae, deciduous maxillary and mandibular dentition.

Sex: Indeterminate

Age: Subadult, based on epiphyseal fusion, general size and robusticity, presence of deciduous dentition.

Pathological Conditions: Carious activity on the upper right third premolar.

**Trial 22 (MNI 1)**

Material present: Cranial fragments, rib fragments, deciduous and permanent maxillary and mandibular dentition.
Sex: Indeterminate

Age: Subadult, based on general size and robusticity, presence of deciduous dentition.

Pathological Conditions: None noted.

Burial 23 (MNI 3)

Material present: Cranial fragments, left and right clavicles, right scapula, left and right humeri, ulnae, and radii, rib and vertebral fragments, left fibula, maxillary and mandibular dentition, left mandibular fragment, right maxillary fragment, right humerus fragment, left and right clavicles, non-erupted premolar, permanent premolar.

Sex: One female, based on cranial morphology, general size and robusticity. Two indeterminates.

Age: Two adults, based on epiphyseal fusion, general size and robusticity. One subadult, based on the presence of a non-erupted permanent premolar.

Pathological Conditions: The adult of indeterminate sex displays extreme periodontal infection and antemortem tooth loss; only one tooth, a molar, remains in the maxilla. The lower third molars on this same individual are impacted.

Burial 24 (MNI 3)

Material present: Cranium, right clavicle, left and right scapulae, left and right humeri, ulnae, and radii, vertebral and rib fragments, os coxae fragments, sacral fragments, maxillary and mandibular dentition, left zygomatic, sphenoid, right maxilla, cranial fragments, deciduous
dentition, left radius, ulna, femur, and tibia.

Sex: One male, based on cranial morphology, os coxae morphology, general size and robusticity. Two indeterminates.

Age: The male is adult, based on epiphyseal fusion, general size and robusticity, eruption and occlusion of the dentition.

The indeterminates are adult, based on general size and robusticity, and subadult, based on the presence of deciduous dentition.

Pathological Conditions: The adult male shows periodontal infection and abscessing of the anterior portion of the right maxilla caused by probable traumatic damage to the upper right incisors; the crown of the central incisor was lost antemortem. The adult indeterminate individual shows periodontal infection of the right maxilla associated with the premolars.

Burial 25 (MNI 1)

Material present: Cranium, maxillary and mandibular dentition.

Sex: Female, based on cranial morphology, general size and robusticity.

Age: Adult, based on general size and robusticity, eruption and occlusion of the dentition.

Pathological Conditions: Carious activity on the upper left first molar, periodontal infection on the maxillae, possible hypercementosis of the upper first molars.

Burial 26 (MNI 1)

Material present: Burial left in situ.
Sex: Indeterminate

Age: Adult, based on field notes.

Pathological Conditions: None noted by field crew.

Burial 27 (MNI 1)

Material present: Burial left in situ.

Sex: Indeterminate

Age: Infant/Neonate, based on field notes.

Pathological Conditions: None noted by field crew.

Burial 28 (MNI 1)

Material present: Burial left in situ.

Sex: Indeterminate

Age: Subadult, based on field notes.

Pathological Conditions: None noted by field crew.

Burial 29 (MNI 1)

Material present: Right half of cranium, maxillary and mandibular dentition.

Sex: Male, based on cranial morphology, general size and robusticity.

Age: Old adult, based on general size and robusticity, occlusal surface wear.

Pathological Conditions: Periodontal infection of the right portion of the mandible, possible hypercementosis of upper right first molar.

Burial 30 (MNI 1)

Material present: Cranial fragments, rib and vertebral fragments, right scapula, left humerus, maxillary and mandibular
dentition.

Sex: Female, based on cranial morphology, general size and robusticity.

Age: Adult, based on general size and robusticity, eruption and occlusion of dentition.

Pathological Conditions: None noted.

Bone Mass 1 (MNI 1)

Material present: Cranial fragments, upper right central incisor and canine, assorted fragments of human bone.

Sex: Indeterminate

Age: Adult, based on general size and robusticity, permanent dentition.

Pathological Conditions: None noted.

Bone Mass 2 (MNI 2)

Material present: Cranial fragments, right radius, right femur, left and right tibiae, right fibula, lower right second and third molars, left femur, left tibia.

Sex: One female, based on cranial morphology, femoral head diameter, general size and robusticity. One indeterminate.

Age: The female is adult, based on epiphyseal fusion, general size and robusticity, presence of third molar. The indeterminate is subadult, based on general size and robusticity, epiphyseal fusion.

Pathological Conditions: None noted.

Bone Mass 3 (MNI 1)

Material present: Upper right canine, third and fourth premolars,
first and second molars, upper left fourth premolar, 
unidentified fragments of human bone.

Sex: Indeterminate

Age: Adult, based on presence of permanent dentition, general size 
and robusticity.

Pathological Conditions: None noted.

Bone Mass 4 (MNI 2)

Material present: Cranial fragments, right humerus and radius, 
left femur, maxillary dentition, frontal, left temporal.

Sex: One female, based on cranial morphology, femoral head 
diameter, general size and robusticity. One indeterminate

Age: Both are subadults; the female is likely an adolescent, based 
on general size and robusticity, epiphyseal fusion.

Pathological Conditions: The female shows periosteal infection on 
the left femur.

Bone Mass 5 (MNI 1)

Material present: Cranial fragments, left and right radii, right 
ulna, rib fragments, left femur, maxillary and mandibular 
dentition, unidentified long bone shaft.

Sex: Male, based on cranial morphology, femoral head diameter, 
general size and robusticity.

Age: Adult, based on epiphyseal fusion, general size and 
robusticity, eruption and occlusion of the dentition.

Pathological Conditions: Degenerative changes on the right ulna.

Bone Mass 6 (MNI 1)

Material present: Fragments of a right and left adult foot.
Sex: Indeterminate

Age: Adult, based on general size and robusticity.

Pathological Conditions: None noted.
Palm Harbor
(presently curated at Texas A&M University)

Crania (MNI 7)

Sex: Three males, three females, and one indeterminate.

Age: Six adults, one subadult.

Pathological Conditions: (Cranium C) Periodontal infection, antemortem loss of the lower right fourth premolar, the right first and second molars, the left first and second molars, and the left third molar, interproximal grooving of the lower right fourth premolar. (Cranium D) Periosteal bone deposition surrounding the anterior nasal spine, possibly treponemal in origin (Cranium G) Carious activity associated with the upper left canine, abscessing associated with the same tooth.

Vertebral Column (MNI Indeterminate)

Sex: Indeterminate

Age: All adult, based on fusion of vertebral elements, degenerative changes.

Pathological Conditions: Fusion of the several vertebrae, degenerative changes.

Clavicles (MNI 4)

Sex: Indeterminate

Age: Three adults, one juvenile, based on general size and robusticity.

Pathological Conditions: (Clavicle A) Sternal end extremely flat and worn with degenerative changes (Clavicle B) periosteal
infection, (Clavicle E) abnormally depressed area on the surface of the sternal facet.

Scapulae (MNI 4)

Sex: Indeterminate

Age: All adult, based on general size and robusticity.

Pathological Conditions: Degenerative changes, one incidence of periosteal infection.

Sterna (MNI 2)

Sex: Indeterminate

Age: All adult, based on general size and robusticity.

Pathological Conditions: None noted.

Ribs (MNI Indeterminate)

Sex: Indeterminate

Age: Two fragments are subadult, the remainder are adult, based on general size and robusticity.

Pathological Conditions: None noted.

Humeri (MNI 4)

Sex: Indeterminate

Age: All adult, based on epiphyseal fusion, general size and robusticity, degenerative changes.

Pathological Conditions: Degenerative changes in four specimens (three individuals), one possible dislocation of the ulna indicated by a large wear facet on the lateral wall of the olecranon fossa.

Ulnae (MNI 4)

Sex: Indeterminate
Age: Three adults, one subadult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Degenerative changes on two individuals, midshaft fracture on one adult individual.

Radii (MNI 4)

Sex: Indeterminate

Age: Three adults, one subadult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: Periosteal infection on the distal ends of two adult individuals, degenerative changes in two individuals.

Os coxae (MNI 4)

Sex: One male, two females, one indeterminate.

Age: Three adults, one subadult, based on epiphyseal fusion, general size and robusticity.

Pathological Conditions: None noted.

Femora (MNI 5)

Sex: Indeterminate

Age: All adult, based on general size and robusticity, epiphyseal fusion.

Pathological Conditions: Periosteal infection evident on one individual.

Tibiae (MNI 5)

Sex: Indeterminate

Age: All adult, based on general size and robusticity, epiphyseal fusion.
Pathological Conditions: Periosteal infections in five individuals; two cases may be associated with treponemal infections.

Fibulae (MNI 3)

Sex: Indeterminate

Age: All adults, based on general size and robusticity, epiphyseal fusion.

Pathological Conditions: One fibula exhibits periosteal infection, one shows a longitudinal fracture.
VITA

Elizabeth Ann Miller was born April 9, 1964 in Fort Knox, Kentucky, to Thomas and Martha Miller. She attended public school in Texas, and Virginia before moving to Germany in 1974. In Germany, she attended the Bonn American Embassy School in Bonn. The Miller family returned to Texas in 1977, when they settled in Austin. There, Elizabeth graduated from Westlake High School in 1981. The fall of that year she began studies in geology at Texas A&M University; in 1985 she earned her Bachelor of Science degree in that subject. She than began graduate studies in Physical Anthropology in the fall of 1985 at Texas A&M University. During her graduate career, she was employed as a teaching assistant and a lecture instructor by the department of Anthropology. Her permanent address is 1603 Southwood Blvd., Arlington, Texas.