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BIOARCHEOLOGICAL SYNTHESIS for "From the Gulf to the Rio Grande: Human Adaptation in Central, South, and Lower Pecos Texas"

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From the Gulf to the Rio Grande: Human Adaptation in Central, South, and Lower Pecos Texas

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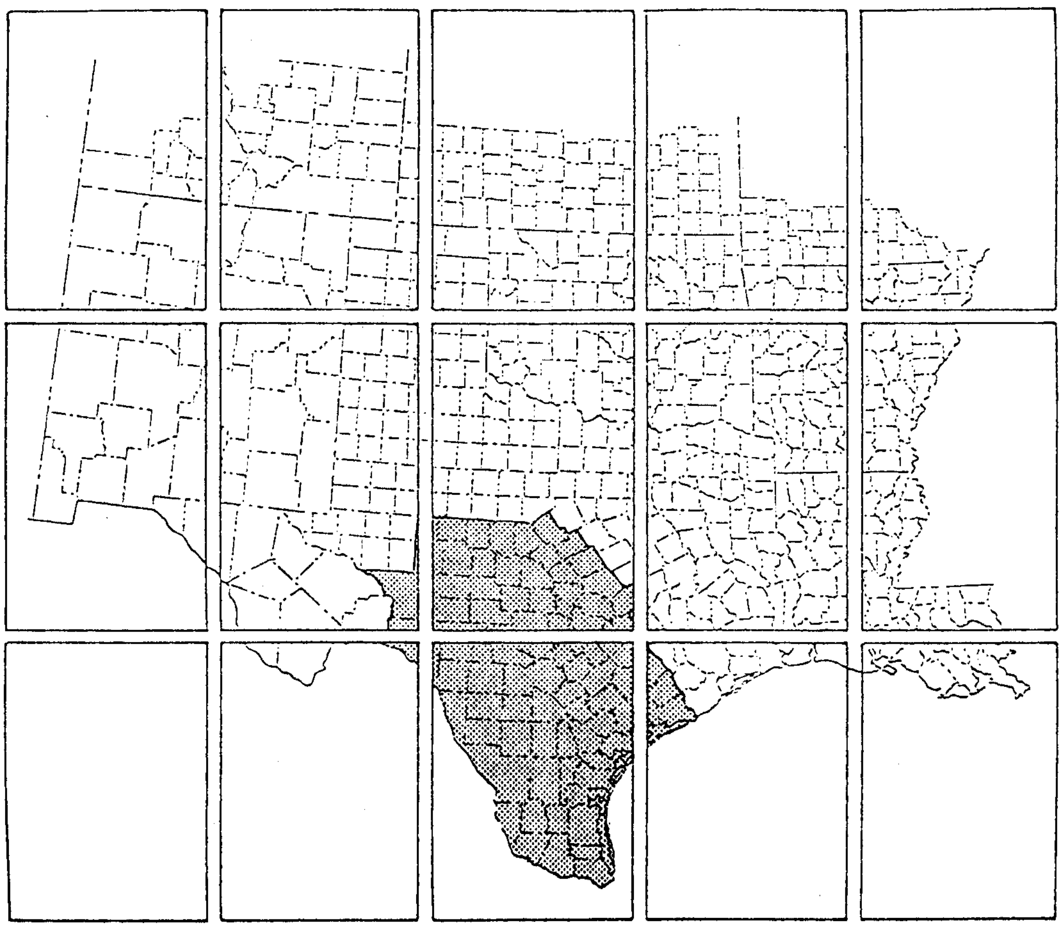

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BIOARCHEOLOGICAL SYNTHESIS

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One of the main problems encountered in the review of the bioarcheology of Region 3 has been the limited number of sites where human skeletal material has been adequately recovered and analyzed. In the preceding chapter it was documented that less than 30% of the burials recovered from recorded sites have been reported in published literature. It was further estimated that of the 323 sites with burials, no more than 80 sites have published detailed bioarcheological reports on the burials recovered. Only 50 of these 80 reports provide individual descriptions of each burial which facilitate subsequent analyses and evaluation.

Four principal reasons probably have led to this minimal utilization of bioarcheological data in anthropological studies of Region 3. First, there have been few trained bioarcheologists with research interests centering on Region 3 skeletal samples. Second, few sites have produced large skeletal samples tempting scholars to undertake detailed bioarcheological analyses. Third, many of the recovered samples have been poorly preserved, and commonly inadequately conserved and curated. And, fourth, in the past rarely did funding agencies encourage bioarcheological research by providing adequate funding for the recovery, conservation, curation, and analysis of human skeletal remains. The result of these difficulties has been the minimal analysis of bioarcheological remains, and the general consensus (usually unspoken) that bioarcheological studies can contribute little to the understanding of our prehistory.

While the problems outlined above are probably evident throughout North America, they seem to be a particular problem in Region 3 because this area primarily has been occupied by hunters and gatherers throughout prehistory. The consequence of this is that population densities have probably been lower than one typically sees in agriculturally based societies, and skeletal samples have accrued more slowly in the earth; thus, fewer large collections are available for excavation and more postmortem deterioration has probably occurred on those samples which do exist.

However, in the OAO area, Burnett et al. (1988) successfully assessed prehistoric adaptive efficiency through paleopathological data, thus utilizing bioarcheological data to assess an issue of general anthropological interest. In their study area, they were able to demonstrate that although adaptive efficiency remained relatively stable, varying infection rates and metabolic disorder rates between sites and subsistence strategies could be identified.

It is the purpose of this study to determine whether the available bioarcheological literature from Region 3 in Texas lends itself to similar study. An analysis of the adaptive efficiencies of prehistoric inhabitants of Region 3 was chosen because it fits the mandates of the broader study and involves the analysis of medical disorders, which is one of the most commonly assessed biological features of reported skeletons. If such a study can be undertaken, a secondary goal is to assess the success of differing prehistoric hunter and gatherer subsistence strategies in various ecological zones within Texas. We have chosen to compare adaptive success between subregions because there appears to have been little change in hunter and gatherer adaptive strategies through time in Texas, even with the great ecological diversity within Region 3.

METHODS

The samples from each adaptive subregion were compared on the basis of sex ratios of recovered skeletal remains, age distributions, and reconstructed life table of the recovered remains and their pathological lesions. In general, this information was gathered whenever possible from the published literature, but in specific circumstances, unpublished analyses were relied upon as well.

For the sex and age of skeletal remains included within the analysis, the information was acquired from unpublished notes on the curated skeletal collection at TARL (these notes were made available to us by Barbara Jackson and James Boone, TARL, University of Texas, Austin) and from those reports and publications which reported specific sex and age estimates for skeletons. All age estimates were converted to the age categories utilized for the analysis of the curated TARL collection (fetal = prior to birth, infant = 0-1 year, child = 1-5 years, older child = 6-10 years, adolescent = 11- 19 years, adult = 20-50 years, and older adult = 50 + years). To generate mortuary tables, the median age for each category was used. For old adults, the median was established at 58 assuming an effective maximum age of 68 years. Table 16 provides a listing of distribution of the sex and ages of the individuals per site for each adaptive region. Table 17 summarizes the sex distributions for each adaptive region, Table 18 summaries the age distributions for each region, and mortuary schedules are listed in Table 20.

Paleopathological information was derived from both published and unpublished sources. Thirty-four sites (Table 19) that included usable paleopathological data were carefully examined and pathological inferences were tabulated into six subcategories: metabolic disorders, dental disorders, degenerative disease, infectious disease, trauma not associated with interpersonal violence, and trauma associated with interpersonal violence. Records of specific lesions or conditions for each disorder subgroup were recorded from the burial reports. Evidence of porotic

TABLE 16
Distribution by age/sex by site

				Older	Adolesc.			Sub–	Adults				
Site	Fetal	Infant	Child	Child	M	F	I	adult	M	F	I	Adult	Total
Coastal Strip													
41 AS 1	0	0	0	0	0	0	3	0	0	1	0	0	4
41 AS 3	0	0	0	0	0	0	1	0	0	0	0	0	1
41 CF 2	0	2	0	0	1	0	2	0	*4	0	1	0	11
41 CF 3	0	0	0	0	1	0	11	2	*22	0	0	0	36
41 CF 5	0	0	0	0	0	0	0	0	*1	0	0	0	1
41 CF 111	0	0	0	0	0	1	2	0	0	0	0	0	3
41 HG 1	0	0	2	1	0	0	1	2	13	0	1	0	21
41 HG 27	0	0	0	0	0	0	1	0	0	0	0	0	1
41 JK 91	0	0	0	0	0	0	1	0	0	0	0	0	1
41 NU 1	0	0	0	0	0	0	0	0	1*	0	0	0	1
41 NU 2	1	10	12	5	0	5*	12	*13	*25	2	1	1	99
41 NU 3	0	0	0	0	0	0	0	0	1*	0	0	0	1
41 NU 8	0	0	0	0	0	0	0	0	1*	0	0	0	1
41 NU 23	0	0	0	0	0	0	0	0	0	1	0	0	1
41 NU 71	0	0	0	0	0	1*	0	0	*2	0	0	0	4
41 SP 1	0	0	0	0	0	0	0	0	1	0	0	0	1
41 SP 78	0	0	0	1	0	0	2	1	*2	0	0	0	6
41 VT 1	0	3	6	8	1	0	16	11	*101	1	3	7	169
41 VT 8	0	0	0	0	0	0	0	1	0	0	0	0	1
41 WY 50	0	0	0	1	0	0	0	0	0	0	0	0	1
41 WY 67	0	0	0	0	0	0	0	0	0	1	0	0	1
TOTAL	1	15	20	16	3	7	52	30	174	6	6	8	365
South Coastal Plain													
41 BP 282	0	1	1	0	1	1	0	0	1	0	0	0	5
Bastrop	0	0	0	0	0	0	1	0	0	0	0	0	1
41 BX 3	0	0	1	0	0	0	4	6	5	0	0	0	16
41 BX 195	0	0	0	0	0	0	0	1	0	0	0	0	1
41 CW 3	0	0	0	1	0	0	0	0	0	0	0	0	1
41 CD 37	0	2	0	0	0	1	2	2	7	0	0	1	15
41 CD 62	0	0	0	0	0	1	1	0	0	0	0	0	2
41 FY 42	0	2	0	1	0	0	2	0	3	0	0	0	8
41 GD 1	0	0	2	2	0	0	3	4	29*	0	0	0	44
41 GD 2	0	1	0	0	0	1	0	1	1	0	0	0	4
41 KA 23	0	0	0	0	0	1	2	2	1	0	0	0	6
41 KY 2/8	0	0	0	0	0	0	1	1	0	0	0	0	2
41 KY 27	0	0	0	0	0	0	1	1	0	0	0	0	2
41 ME 30	0	0	0	0	0	0	0	0	1	0	0	0	1
41 WH 1	0	0	0	0	0	0	0	0	2	0	0	0	2
41 WH 14	0	1	1	0	0	0	4	2	0	0	1	0	9
41 WH 39	0	1	0	3	1	0	5	6	8	4	1	0	31
41 ZV 152	0	0	0	0	0	0	0	1	0	0	0	0	1
TOTAL	0	8	5	7	2	5	26	27	58	4	2	1	151
Central Prairie													
41 BL 3	0	0	5	2	0	0	6	7	17	0	0	2	41
41 BL 28	0	5	0	0	1	0	6	4	2	5	4	0	28
41 BT 1	0	0	0	0	0	0	0	0	1	0	0	0	2
41 BT 7	0	0	0	0	0	0	1	0	0	0	0	0	1
41 BT 10	0	0	0	0	0	0	0	0	2	0	0	0	2
41 BT 48	0	1	0	0	0	0	0	0	0	0	0	0	1
41 BT 55	0	0	0	0	0	0	1	0	0	0	0	0	1
Burnet	0	0	0	0	0	0	0	0	1	0	0	0	1
41 CK 111	0	0	0	0	0	0	1	0	0	0	0	0	1
Coleman	0	0	0	0	0	0	0	0	1	0	0	0	1
Coleman	0	0	0	0	0	0	0	0	1	0	0	0	1
Coleman	0	0	0	0	0	0	0	0	1	0	0	0	1
41 CV 1	0	1	1	0	2	0	3	2	6	0	0	0	18
41 CV 7	0	1	0	0	0	0	1	1	2	0	0	0	7

TABLE 16, continued

Site	Fetal	Infant	Child	Older Child	Adolesc. M	F	I	Sub-adult	Adults M	F	I	Adult	Total
41 CV 14	0	1	3	1	1	0	3	2	5	1	0	0	18
41 CV 17	0	0	0	0	0	0	2	0	5	0	0	0	7
41 CV 44	0	0	0	0	0	0	0	0	1	0	0	0	1
Coryell	0	0	0	0	0	0	0	0	1	0	0	0	1
41 ED 1	0	3	0	0	0	0	0	0	0	0	0	0	3
41 HY 29	0	0	0	0	0	0	2	0	0	0	0	1	3
41 LM 2	0	0	0	0	0	0	0	0	0	1	0	0	1
41 LL 4	0	0	1	0	0	0	0	1	0	0	0	0	2
Mason	0	0	0	0	0	0	0	0	1	0	0	0	1
41 MM 8	0	1	0	0	0	0	1	0	5	0	0	0	7
McCulloch	0	0	0	0	0	0	0	1	0	0	0	0	1
41 MK 26	0	0	0	1	0	0	1	1	0	0	0	0	3
41 RE 1	1	7	3	0	0	0	3	1	4	0	0	1	21
41 RN 1	0	0	1	0	0	0	0	0	0	0	0	1	2
41 SS 2	0	4	0	1	0	0	1	0	0	0	0	0	6
41 TG 12	0	0	0	0	0	0	0	0	1	0	0	0	1
41 TV 4	0	0	0	0	0	0	0	1	0	0	0	0	1
41 TV 5	0	0	0	0	0	0	0	0	1	0	0	0	1
41 TV 26	0	0	0	0	0	0	0	0	1	0	0	0	1
41 TV 36	0	0	0	0	0	0	0	0	1	0	0	0	1
41 TV 41	0	0	0	0	0	0	0	1	0	0	0	0	1
41 TV 47	0	0	0	0	0	0	0	0	1	0	0	0	1
41 TV 48	0	1	0	0	0	0	0	0	0	0	0	0	1
41 TV 88	0	3	0	0	1	2	0	0	12	0	0	0	22
41 TV 102	0	0	0	0	0	0	0	1	0	0	0	0	1
41 TV 103	0	0	0	0	0	0	0	1	0	0	0	0	1
41 TV 134	0	0	0	0	0	0	2	1	1	0	2	0	6
41 TV 164	0	0	0	0	0	0	0	0	1	0	0	0	1
41 TV 886	0	0	0	0	0	0	1	0	0	0	0	0	1
Travis	0	0	0	0	0	0	0	0	1	0	0	0	1
Travis	0	0	0	0	0	0	0	0	0	0	0	1	1
Travis	0	0	0	0	0	0	0	0	1	0	0	0	1
Travis	0	0	0	0	0	0	1	0	0	0	0	0	1
41 WM 1	0	0	0	0	0	0	1	0	0	0	0	0	1
41 WM 5	0	0	0	0	0	0	0	0	0	0	1	0	1
41 WM 6	0	0	0	0	0	0	0	0	1	0	0	0	1
41 WM 8	0	0	0	1	0	0	4	1	0	1	0	0	9
41 WM 9	0	0	0	0	0	0	1	0	0	1	0	0	2
41 WM 10	0	0	0	0	0	0	0	1	2	0	0	1	4
41 WM 15	0	0	0	0	0	0	0	0	2	0	0	0	2
41 WM 23	0	0	0	0	0	0	0	0	1	0	0	0	1
41 WM 139	0	0	0	0	0	0	0	0	3	0	0	0	3
41 WM 230	0	1	4	0	1	0	11	4	0	1	2	0	25
41 WM 268	0	0	0	0	0	0	0	0	2	0	0	0	2
41 WM 235	0	0	0	0	0	0	0	2	0	0	0	0	2
Williamson	0	0	0	0	0	0	0	1	0	0	0	0	1
Williamson	0	0	0	0	0	0	0	1	0	0	0	0	1
Williamson	0	0	0	0	0	0	0	0	1	0	0	0	1
Williamson	0	0	0	0	0	0	0	0	1	0	0	0	1
Williamson	0	0	1	0	0	0	0	0	0	0	0	0	1
Williamson	0	0	0	0	0	0	0	0	1	0	0	0	1
TOTAL	1	29	19	6	6	2	53	35	91	10	9	7	286

TABLE 16, concluded

Site	Fetal	Infant	Child	Older Child	Adolesc. M	.F	I	Sub-adult	Adults M	F	I	Adult	Total
Lower Pecos													
41 VV 1	0	1	0	0	0	0	0	0	0	0	0	0	1
41 VV 35	0	2	0	0	0	0	0	0	0	0	0	0	2
41 VV 55	0	1	1	0	0	0	1	2	3**	0	0	0	7
41 VV 67	0	0	0	0	0	0	1	0	1	0	0	0	2
41 VV 74	0	4	0	0	0	0	1	1	0	1	1	0	8
41 VV 82	1	0	0	0	0	0	1	1	0	3	0	1	9
41 VV 87	0	2	0	0	0	0	0	0	0	0	0	0	2
41 VV 88	0	1	0	0	0	0	0	0	0	0	0	0	1
41 VV 162	0	0	0	0	0	0	2	1	1	1	0	0	5
41 VV 258	0	0	0	0	0	0	2	3	0	0	0	0	6
41 VV 656	0	0	0	0	0	0	1	0	0	0	0	0	1
Val Verde	0	0	0	0	0	0	2	0	0	1	1	0	4
TOTAL	1	11	1	0	0	0	11	8	5	6	2	1	48

* At least one burial in this category is represented by more than one individual.

** At least one burial in this category is represented by more than one individual.

hyperostosis, cribra orbitalia, Harris lines, or enamel hypoplasia was considered evidence of metabolic disorders. Infectious disease included the lesions of osteomyelitis, periostitis, and any specific insults such as possible treponemiasis. Dental disorders included caries, abscessing, dental wear, and antemortem tooth loss. Degenerative disease includes spinal osteoarthritis, osteophytosis, and appendicular osteoarthritis. Fractures of the long bones and ribs, excluding parry fractures, were classified as noninterpersonal violence. Evidence of interpersonal violence includes projectile wounds, cranial fractures, and parry fractures. The use of parry fracture evidence as evidence of interpersonal violence is different from the interpersonal violence classifications used by Burnett et al. (1988) but otherwise we followed their suggestions.

Certain guidelines were established in order to code information consistently from the literature. Bone preservation in many sites was very poor. Consequently, lesions affecting the long bones were coded for only if four complete long bones of the leg and arm were present. With respect to categories affecting the crania (porotic hyperostosis, cribra orbitalia, cranial fracture), crania were included in the counts if it was clear that they were extensively examined by the original author. Tooth wear was coded for only if the wear was reported as being moderate or severe. Temporomandibular joint deterioration was considered to be a degenerative disease for the purposes of this summary and incidence of TMJ deterioration were included in the appendicular osteoarthritis tabulations.

With respect to the Crestmont site analyzed by Vernon (n.d.), we could not determine from the preliminary manuscript the "completeness" of the skeletons. Consequently, to maintain consistency with the rest of the analysis, we estimated as closely as possible the number of skeletons complete enough for analysis based on Vernon's brief description of each burial. This estimation indicates that 23 skeletons were suitable for the study of cranial lesions and 17 were suitable for appendicular lesions. Seven could not be used in the analysis and were not considered. Because we eliminated skeletons from consideration, our total sample (n = 31) for this analysis was smaller than that analyzed by Vernon for determination of percentages. Consequently, we derived higher percentages of osseous lesions than did Vernon.

For dental disorders, we derived incidences from several sources. The occurrence of enamel hypoplasia (5/6) is derived from Vernon's Table 10. The incidences of caries (9/23) and abscesses (3/23) are derived from Vernon's descriptions of individual burials. The incidence of antemortem tooth loss (10/23) was derived both from Vernon's Table 12 and the burial descriptions. Finally, the incidence of tooth wear (13/18) was derived from Vernon's Tables 9 and 11, minus two crania which had no teeth present.

Both individual burials and mixed burials have been described in the reports. With respect to tabulating the data, this presented some difficulties. The mixed burials could not be tabulated as easily as individual burials. Consequently, the number of infected individuals in a mixed burial was subject to interpretation. In such cases, minimum estimates of infected or affected individuals were used in tabulating the data.

The interpretation of pathological data was complicated by several aspects of osteological analysis and recording. The same terms were not consistently used for the same lesions. For example, osteophytosis is rarely scored as such in osteological reports. *Vertebral lipping, arthritis of the centrum,* and *centrum exostoses* probably represent alternate terms for osteophytosis. Consequently, this analysis required some interpretation of written descriptions. In some reports, the location of lesions were noted, but description of the lesions were not. In such cases, it was impossible to place any pathological label on the reported pathology and these were not included in any tabulations. Similarly, certain conditions associated with specific insults such as "saber shins" of treponema infections were noted without specific descriptions of the lesions. Such cases were included in the tabulations although we have some reservations about the validity of our diagnosis from incompletely described lesions.

One additional notation of our method concerns Vernon's (n.d.) analysis. Her thorough descriptions of lesions she identified as osteomyelitis fit more closely lesions we have identified as periostitis. Consequently, for this report, we have reclassified her osteomyelitis cases as periostitis.

Finally, it should be noted that the literature for each subregion was typically examined twice to insure we did not misinterpret the original authors' diagnoses for paleopathological data.

ANALYSIS OF SEX RATIO

Table 17 summarizes the sex ratios for adolescents (estimates based upon individuals 11-19 years of age) and adults. More skeletons were identified as females among the adolescents, although the difference was not significantly different from a predicted ratio of 1:1. Conversely, more of the adults were identified as males, and the greater number of males was significantly different than a predicted 1:1 ratio at the 0.05 level of confidence.

There are several points which can be addressed concerning these sex ratios. While one would predict a sex ratio of 1:1 based upon an equal number of sperm carrying X and Y chromosomes, several factors can alter this ratio. At birth in most populations, more males are born than females. Harrison et al. (1964) reported a range in ratios from 106:100 to 113:100. Similarly, it has been reported that in many hunting and gathering populations and incipient agriculturalists, that female infanticide may also have been practiced, although how frequently is not known. Finally, it has been reported that adolescent females face a high mortality rate during their early child bearing years. The anticipated consequence of all of these are that more males would survive into adulthood, and more females would die during their subadult years. The figures for the adults of the Region 3 sample do not contradict this general view.

The difficulty in wholeheartedly endorsing the proposed model based upon the Region 3 samples, however, is that estimating sex on the basis of preserved skeletal remains may also bias the sample and may do so by misidentifying some of the skeletons as male rather than female. Skeletal remains, unless they are based upon the complete skeleton with pelvis, are usually identified as being male or female on the basis of their perceived size and robusticity. Since coastal strip samples, as examples, have been recognized as markedly robust (Comuzzie et al. 1986; Wilkinson 1973, 1977; Woodbury and Woodbury 1935) the anticipated tendency if errors in sex assessment were made would be towards misidentifying robust females as males.

TABLE 17
Sex Ratios for Population in Area 3

	Adolesc.		Adults	
Area	M	F	M	F
Coastal Strip	3	7	52	30
South Texas Coastal Plains	2	0	27	27
Central Texas Prairie	6	8	53	35
Lower Pecos	0	2	11	8
TOTAL	11	17	142	100

ANALYSIS OF AGE DISTRIBUTION

Table 16 provides the age distributions of each sample within the four adaptive regions, Table 18 summarizes the age data, and Table 20 provides the skeletal mortality schedules for the complete sample as well as for the combined samples from each adaptive region. Figures 45 and 46 illustrate the survivorship and mortality rates respectively, for the four samples, while Figures 47 and 48 illustrate mortality rates and survivorship curves for the total Region 3 compared with a Hopewell sample (based on data from Buikstra 1976), model curves developed by Weiss (1973), and life tables generated by D. Carlson, Department of Anthropology, Texas A&M University.

The mean age at death or life expectancy (Ex(0)) of Table 20) for the samples based upon all individuals recovered (excepting the fetal remains from the lower Pecos) is 29.6 years. The range for the four adaptive regions is from 28.9 to 30.3 years. As comparative figures, Deevey (1960) estimated life expectancies for European Mesolithic and Paleolithic samples as 31.5 and 32.4 years, respectively. Ascadi and Nemeskeri (1970) estimated life expectancies for European Paleolithic, Mesolithic, and Neolithic samples as 19.9, 31.4, and 26.9 years, respectively. Life expectancy for a Hopewell sample was 29.4 years (based upon data provided by Buikstra 1976). Weiss (1973) estimated the life expectancy ranges for hunter and gatherer populations to the Neolithic to be 19-25 years. His estimate was lower than the other researchers because of his attempts to adjust for underrepresentation of subadults in censuses and skeletal series.

TABLE 18
Summary of Age/Distributions for Adaptive Regions

Area	Fetal	Infant	Child	Older Child	Adolescent	Adult	Older Adult	Total
Coastal Strip	1	15	20	16	30	256	20	358
South Texas Coastal Plains	0	8	5	7	7	111	7	146
Central Texas Prairie	1	29	19	6	24	178	26	283
Lower Pecos	1	11	1	0	2	24	9	48
TOTAL	3	63	45	29	64	569	62	835

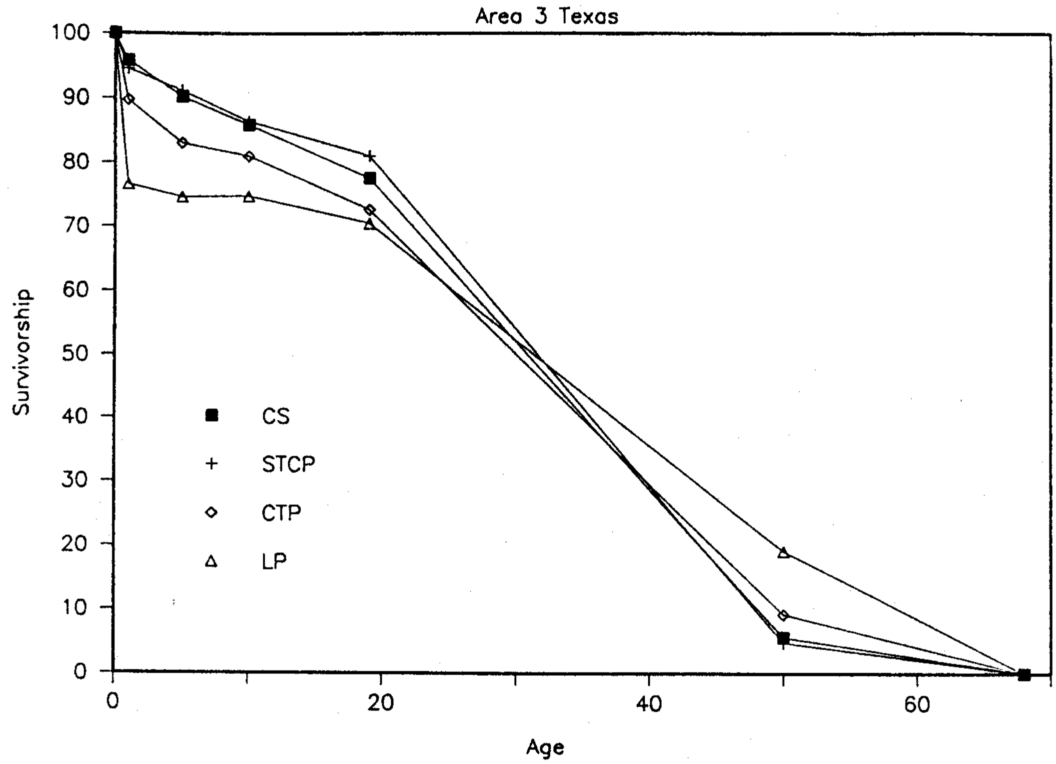

Figure 45. Survivorship rates for the Coastal Strip, South Coastal Plains, Central Plains, and Lower Pecos of Texas

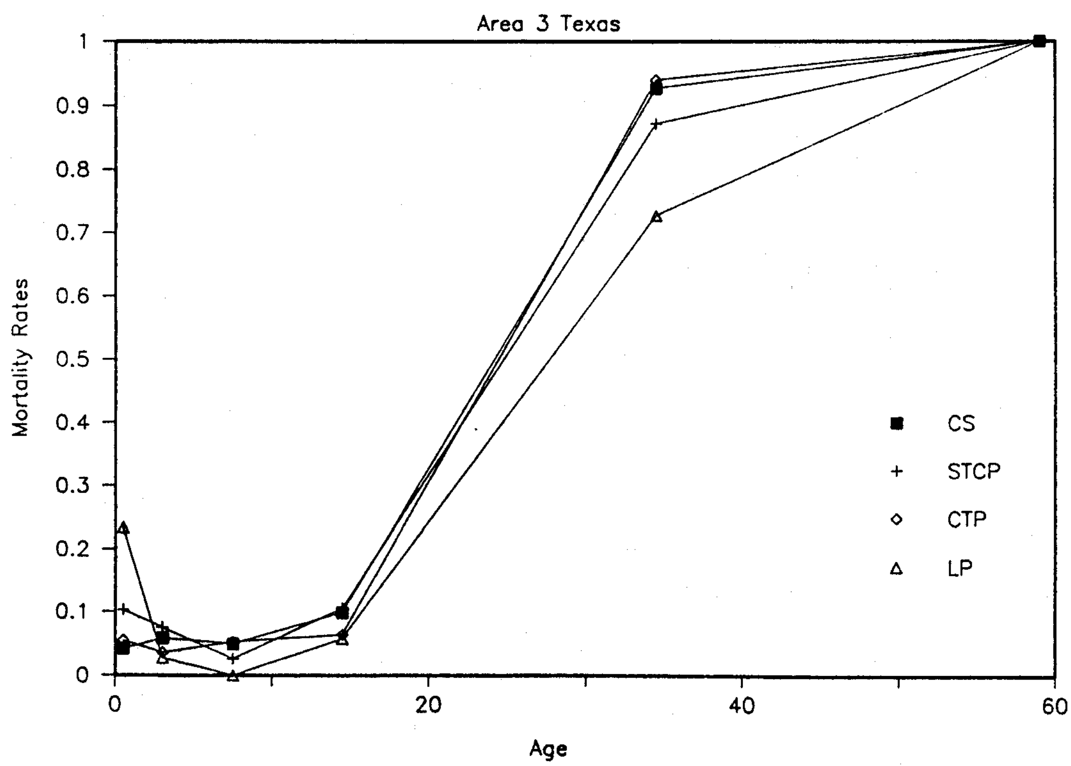

Figure 46. Mortality rates for the Coastal Strip, South Coastal Plains, Central Plains, and Lower Pecos of Texas

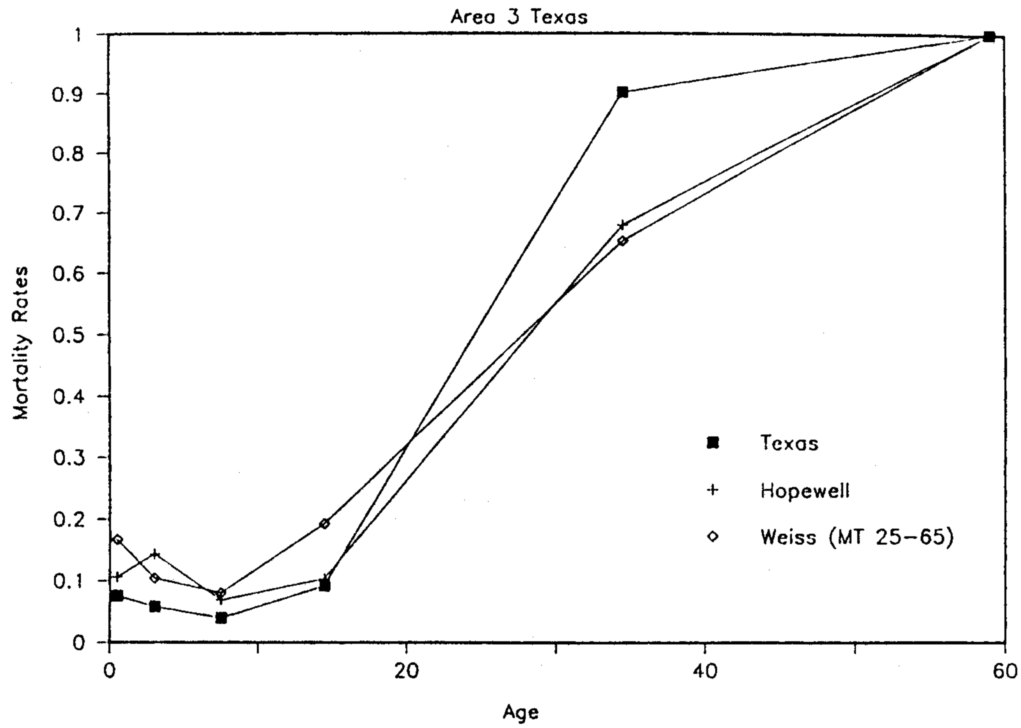

Figure 47. Mortality rates of Texas compared to Hopewell and Weiss

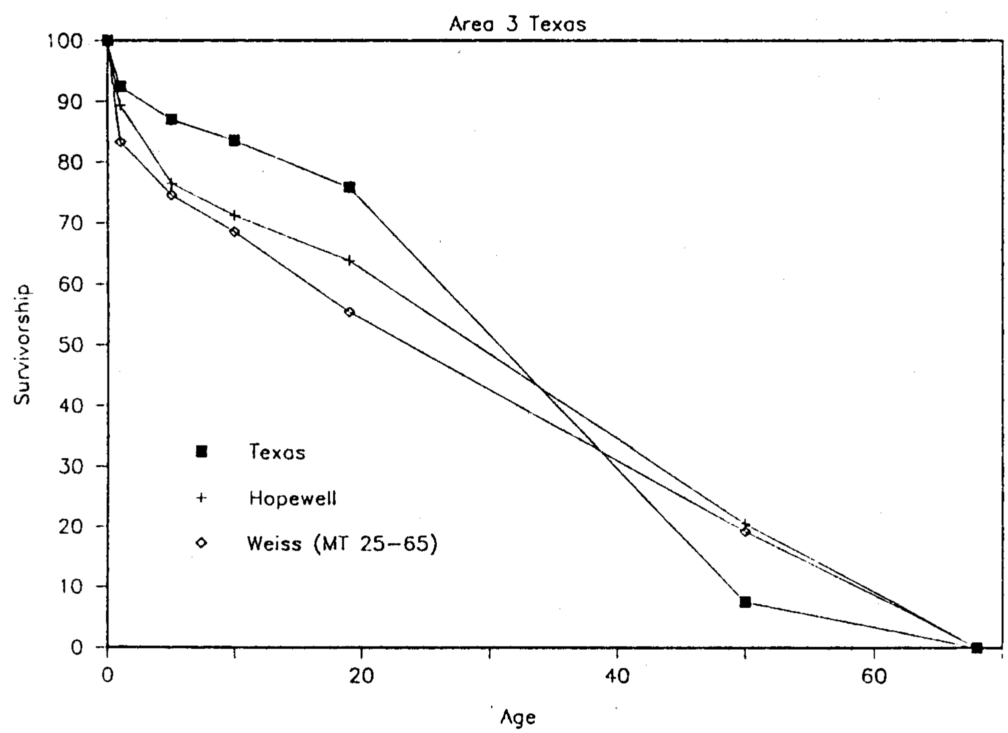

Figure 48. Survivorship rates of Texas compared to Hopewell and Weiss

TABLE 19
Sites Used in Adaptive Analysis of Area 3 Populations

Site Number	Site Name	Citation	Bur.
Coastal Strip			
41 WY 50	Unspecified	Day et al. 1981	1
41 SP 78	Ingleside	Hester and Corbin 1975	5
41 WY 67	Unspecified	Day et al. 1981	1
41 CF 111	Unland	Mallouf and Zavaleta 1979	3
41 AS 80	Palm Harbor	Comuzzie et al. 1986	7
So.Coastal			
41 BX 1	Olmos	Lukowski 1986	12
41 WH 16	Peikert	Copas 1984	8
41 WN 73	Wilson County Project	Steele and Searles n. d.	2
41 LK 21	Lake Vista	Anon. 1961	1
41 BX 26	Hitzfelder Cave	Givens 1968	20
41 CW 3	Cochran	Wesolowsky 1968	1
41 CD 62	Leyendecker	TARL Co. files	1
41 BX 5	Mission San Juan Capistrano	Humphreys 1971	53
41 FY 42	Frisch Auf!	Wesolowsky 1969	4
41 BX 195	Crystal Rivers	Keller 1976	83
41 KA 23	Rudy Haiduk	Harrison 1985	6
41 WH 6	Hudgins #1	TARL Co. files	2
41 WH 39	Crestmont	Vernon n.d.	31
Central Prairie			
41 LM 2	Lynch's Creek Rockshelter	Field 1956	1
41 HY 29	Greenshaw	Wier 1979	2
41 CK 111	Meadow Mountain	Shafer 1969	1
41 BL 28	Aycock Shelter	Watt 1936	18
41 BL 293	Kell Branch	Franciscus et al 1985	2
Unknown	"Gravel Pit Burial"	Watt 1937	2
41 BR 2	Adams Branch	TARL Co. files	1
41 MM 19	C. Camp	TARL Co. files	10
41 WM 230	Loeve-Fox	Prewitt 1974	23
41 WM 7	Mather Farm	Prewitt 1974	1
Lower Pecos			
41 VV 82	Coontail Spin	Benfer and McKern 1968	6
41 VV 258	Langtry Creek BurialCave	Benfer and Benfer 1963	6
41 VV 656	Conejo Shelter	TARL Co. files	1
41 VV 656	Mummy Shelter	Turpin 1986	1
41 VV 620	Seminole Sink	Turpin 1985	21
41 VV 1	Unspecified	Banks and Rutenberg 1982	1

As can be seen from these figures, most scholars who have not attempted to adjust their estimates for the underrepresentation of subadults have estimated life expectancies to be near 30 years of age. Several authors, most notably Weiss (1973 and Cordell et al. (1987), have pointed out, however, that estimating mean age at death for archeological samples is fraught with difficulties. The principal difficulties are that younger individuals are underrepresented in skeletal samples, particularly infants, and the skeletal sample recovered from burial locations, be they recognized cemeteries or habitation sites, may not reflect a random sample of the individuals who died in the population. The consequence of these biases is that life expectancies of hunters and gatherers may be slightly overestimated. We would note, also, that techniques for estimating old adults are problematical. Estimates of older individuals may be underestimated or overestimated. Further, what is estimated for maximum old age will affect the median or mean of the old age cohort. Most researchers estimate maximum effective age for adults to be approximately 68 to 70 years, but not all researchers are consistent in establishing the age range for the old adult cohort.

Figures 45 and 46 illustrate the survivorship curves and the mortality rates for the Texas populations. One of the most notable features of these two figures is the striking similarity of the samples to one another. The lower Pecos sample, the most aberrant sample, shows a higher mortality of the young and a slightly depressed mortality of the adults, but this in all probability is a reflection of the better preservation in the dry rockshelters of the lower Pecos. Here burials commonly found in dry rockshelters are recovered in an excellent state of preservation from dry unconsolidated dust. It is interesting to note in this respect that the central Texas prairie, the area with the next greatest number of rockshelter burials, exhibits the next highest young mortality rate.

Figures 47 and 48 document the similarity of the Region 3 sample to model curves developed by Weiss (1973) and curves developed for a Hopewellian population reported by Buikstra (1976). The Region 3 sample differs primarily in exhibiting a slightly depressed subadult mortality and a slightly elevated adult mortality. Our presumption at this time is that this probably reflects depositional, recovery, and curatoral damage to the Region 3 sample rather than a biological difference in the structure of the living population which they represent.

ANALYSIS OF MEDICAL DISORDERS

The results of the pathological studies are presented in Tables 21-26. There is, in our opinion, variability in the reliability of the differing data sets.

The presence of metabolic disease was measured by the incidence of enamel hypoplasia, Harris lines, porotic hyperostosis, and cribra orbitalia. Enamel hypoplasia and Harris lines are believed to indicate acute phases of metabolic upset due to disease or environmental stress. Porotic hyperostosis and cribra orbitalia probably represent chronic stress due to iron deficiency anemia created by unknown causes.

The utility of the metabolic data (Table 21) is limited by inconsistent scoring for every disorder type. This is especially true of Harris lines. In only two studies, both from the lower Pecos, was roentgenography employed in analysis. Consequently, this category was only scored in the lower Pecos area and cannot be used as a comparative device for all three areas.

TABLE 20
Skeletal Mortality Schedule of Region 3 Samples

	Low	Up	d'x	l'x	dx	lx	qx	Lx	Tx	Ex	Cx	Age
All	0	1	63	832	7.6	100.0	0.076	96.21	2956.79	29.6	3.3	0.5
	1	5	45	769	5.4	92.4	0.059	358.89	2860.58	30.9	12.1	3.0
	5	10	29	724	3.5	87.0	0.040	426.38	2501.68	28.7	14.4	7.5
	10	19	64	695	7.7	83.5	0.092	717.19	2075.30	24.8	24.3	14.5
	19	50	569	631	68.4	75.8	0.902	1291.05	1358.11	17.9	43.7	34.5
	50	68	62	62	7.5	7.5	1.000	67.07	67.07	9.0	2.3	59.0
	Low	Up	d'x	l'x	dx	lx	qx	Lx	Tx	Ex	Cx	Age
Coastal Strip	0	1	15	357	4.2	100.0	0.042	97.90	2978.85	29.8	3.3	0.5
	1	5	20	342	5.6	95.8	0.058	371.99	1880.95	30.1	12.5	3.0
	5	10	16	322	4.5	90.2	0.050	439.78	2508.96	27.8	14.8	7.5
	10	19	30	306	8.4	85.7	0.098	733.61	2069.19	24.1	24.6	14.5
	19	50	256	276	71.7	77.3	0.928	1285.15	1335.57	17.3	43.1	34.5
	50	68	20	20	5.6	5.6	1.000	50.42	50.42	9.0	1.7	59.0
	Low	Up	d'x	l'x	dx	lx	qx	Lx	Tx	Ex	Cx	Age
Coastal Plains	0	1	8	146	5.5	100.0	0.055	97.26	3034.25	30.3	3.2	0.5
	1	5	5	138	3.4	94.5	0.036	371.23	2936.99	31.1	12.2	3.0
	5	10	7	133	4.8	91.1	0.053	443.49	2565.75	28.2	14.6	7.5
	10	19	8	126	5.5	86.3	0.063	752.05	2122.26	24.6	24.8	14.5
	19	50	111	118	76.0	80.8	0.941	1327.05	1370.21	17.0	43.7	34.5
	50	68	7	7	4.8	4.8	1.000	43.15	43.15	9.0	1.4	59.0
	Low	Up	d'x	l'x	dx	lx	qx	Lx	Tx	Ex	Cx	Age
Central Plains	0	1	29	282	10.3	100.0	0.103	94.86	2886.35	28.9	3.3	0.5
	1	5	19	253	6.7	89.7	0.075	345.39	2791.49	31.1	12.0	3.0
	5	10	6	234	2.1	83.0	0.026	409.57	2446.10	29.5	14.2	7.5
	10	19	24	228	8.5	80.9	0.105	689.36	2036.52	25.2	23.9	14.5
	19	50	178	204	63.1	72.3	0.873	1264.18	1347.16	18.6	43.8	34.5
	50	68	26	26	9.2	9.2	1.000	82.98	82.98	9.0	2.9	59.0
	Low	Up	d'x	l'x	dx	lx	qx	Lx	Tx	Ex	Cx	Age
Lower Pecos	0	1	11	47	23.4	100.0	0.234	88.30	2971.28	29.7	3.0	0.5
	1	5	1	36	2.1	76.6	0.028	302.13	2882.98	37.6	10.2	3.0
	5	10	0	35	0.0	74.5	0.000	372.34	2580.85	34.7	12.5	7.5
	10	19	2	35	4.3	74.5	0.057	651.06	2208.51	29.7	21.9	14.5
	19	50	24	33	51.1	70.2	0.727	1385.11	1557.45	22.2	46.6	34.5
	50	68	9	9	19.1	19.1	1.000	172.34	172.34	9.0	5.8	59.0

TABLE 21
Metabolic Disease Expressed Numerically and as Percentages

Specific Pathologies	Coastal Strip		Coastal Plain		Central Texas		Lower Pecos	
Enamel Hypoplasia	5/26	19%	7/19	37%	0/0	--	6/7	86%
Harris Lines	0/0	--	0/0	--	0/0	--	1/2	50%
Porotic Hyperostosis	0/15	0%	9/57	16%	2/23	12%	1/23	4%
Cribra Orbitalia	1/20	5%	1/37	3%	0/23	0%	0/23	0%

First number indicates the actual count of skeletons positive for a specific category.

Second number is a percentage expression of the count.

Enamel hypoplasia is documented in recent reports from the lower Pecos, coastal strip, and south Texas coastal plain. However, the low numbers of individuals studied for the trait from the south Texas coastal plain and lower Pecos diminish the comparative utility of the data. The data at hand, though, suggest that the lower Pecos exhibits a higher incidence of enamel hypoplasia compared to both the coastal strip and the south Texas coastal plains. This suggests that the adaptive strategy in the coastal areas resulted in less acute stress than in the lower Pecos area.

It is likely that the data for the porotic hyperostosis and cribra orbitalia categories do not accurately reflect the actual incidence of these lesions. Although crania and cranial fragments were extensively examined by researchers, it is possible that some reporters were not familiar with this pathology and consequently some cases might have been missed. In identifying porotic hyperostosis, roentgenography is of use. However, roentgenography was rarely employed in Texas paleopathological studies. It appears that the incidence of porotic hyperostosis and cribra orbitalis was greater in the coastal plain. Although these differences are apparent, they may not be real due to analysis inconsistencies and small sample sizes.

Degenerative disease was the most difficult category to assess from the osteological literature. The difficulty lies partially in inconsistent terminology used in the description of vertebral lesions and the lack of descriptions of the lesions. For example, osteophytosis is sometimes described as osteoarthritis of the vertebral centrum or vertebral lipping. It is therefore a questionable point as to whether osteophytosis or osteoarthritis is represented by mention in the literature of vertebral osteoarthritis with no further description. Also, it is difficult to assess from most reports the condition of the vertebrae. Although vertebrae were frequently recovered in excavation, the poor conditions of preservation for most soils in Texas makes it doubtful that osteophytes or evidence of osteoarthritis can be consistently identified in all cases. Poor preservation resulted in a diminished recovery of vertebral elements in all areas except the central Texas area.

Besides the problems noted above for degenerative conditions in the original reports, there exist deficiencies in this analysis that lower the utility of the degenerative disease data. There was no control in this analysis for age of individual. Since degenerative diseases are more commonly present in older individuals, it would have been useful to select specific age brackets for the degenerative disease study. However, the low numbers of individuals that exhibited intact vertebra made age control in this way unfeasible. Secondly, there was no control employed for the age of the site from which a given skeletal sample was excavated. Conceivably, older sites would exhibit more extreme postmortem deterioration which might obliterate the disorders.

Summarizing Table 22, vertebral osteoarthritis appears to be infrequently reported in all regions; osteophytosis present in high frequency in all regions; and appendicular osteoarthritis present in all regions, but noticeably less frequent in the lower Pecos. We can see no regional patterns reflected in this data.

Infectious disease (Table 23) is indicated by periostitis, osteomyelitis, and occasionally specific diagnoses. In the Seminole Sink analysis, the term *bacterial infection* was used to cover infectious disease. The four subregions seem similar in this disorder. This is due to the consistent recovery of long bone shafts in all areas in Region 3. It is the long bones that are frequent foci for bacterial infection.

The data clearly indicate an elevated incidence of infections in the coastal strip and south Texas coastal prairie in contrast to the central Texas prairie and the lower Pecos. Treponemal infection is implicated by the find of "saber" tibiae on the Texas coast. Further work by Jackson supported the diagnosis of treponemiasis as present on the coast of Texas (Rathbun 1980). It appears that the coastal ecosystems were more conducive to the spread of infectious organisms than the other areas. This contradicts Comuzzie et al. (1986) who contended that a small sample from Palm Harbour (41 AS 80) site did not support

TABLE 22
Degenerative Disease Expressed Numerically and as Percentages

Specific Pathologies	Coastal Strip		Coastal Plain		Central Texas		Lower Pecos	
Vertebral Osteoarthritis	1/6	14%	2/32	6%	0/23	0%	1/17	6%
Osteophytosis	4/6	57%	6/32	19%	10/22	45%	6/17	35%
Appendicular Osteoarthritis	2/18	11%	13/31	42%	9/24	38%	1/17	6%

TABLE 23
Infectious Disease Expressed Numberically and as Percentages

Specific Pathologies	Coastal Strip		Coastal Plain		Central Texas		Lower Pecos	
Periostitis	4/25	16%	13/31	42%	3/23	3%	2/34	6%
Osteomyelitis	0/21	0%	0/13	0%	0/23	0%	0/34	0%
Specific Insult	1/22*	4%	0/14	0%	0/22	0%	0/34	0%

*Treponemal Infection

TABLE 24
Dental Disease Expressed Numberically and as Percentages,

Specific Pathologies	Coastal Strip		Coastal Plain		Central Texas		Lower Pecos	
Caries	3/35	9%	12/57	21%	6/44	14%	11/22	50%
Abscess	2/36	6%	9/55	16%	16/45	36%	12/22	55%
Antemortem Tooth Loss	4/36	6%	25/57	44%	10/45	22%	19/22	86%
Toderate/Severe Tooth Wear	21/36	58%	33/52	63%	29/48	60%	14/22	64%

TABLE 25
Accidental and Aggressive Trauma Expressed Numerically and asPercentages

Specific Pathologies	Coastal Strip		Coastal Plain		Central Texas		Lower Pecos	
Accidental Fracture	0/16	0%	1/30	3%	0/21	0%	3/22	14%
Parry Fracture	1/18	6%	1/33	3%	3/23	13%	0/12	0%
Cranial Fracture	1/15	7%	2/67	3%	2/44	5%	1/22	5%
Projectile Wound	1/21	5%	5/37	14%	10/53	19%	0/14	0%

Rathbun et al.'s (1980) hypothesis that coastal populations were under greater pathological stress.

The strongest paleopathological data set represented in Region 3 relate to dental disease (Table 24). For each pathology category, relatively large numbers of skeletons (20) have been studied. Perhaps because of their durability, teeth have received the most attention from anthropologists working in Texas.

For all categories, presence/absence was the basis for comparison. In the case of tooth wear, only moderate to severe wear was scored as a worn tooth.

TABLE 26
Comparison of Prehistoric Coastal Plain Data with Historic Coastal Plain Data

Specific Pathologies	Historic		Prehistoric	
Enamel Hypoplasia	2/13	15%	0/0	–
Harris Lines	0/0	–	0/0	–
Porotic Hyperostosis	0/30	0%	12/40	30%
Vertebral Osteoarthritis	0/15	0%	18/53	34%
Osteophytosis	1/16	6%	0/0	0%
Appendicular Arthritis	2/14	64%	20/53	38%
Periostitis	6/13	46%	3/53	6%
Osteomyelitis	0/13	0%	4/53	8%
Specific Insults (Treponemal)	0/14	0%	4/53	8%
Caries	6/29	21%	20/46	65%
Abscess	6/29	21%	14/40	35%
Antemortem Tooth Loss	13/29	45%	10/40	25%
Dental Wear	15/29	52%	8/40	20%
Accidental Fracture	1/13	8%	3/53	6%
Parry Fracture	0/16	0%	0/53	0%
Cranial Fracture	2/42	5%	0/53	0%
Projectile Wound	4/20	20%	2/13	15/%

Caries incidence appears to be highest in the lower Pecos region and lowest in the coastal strip. Abscessing appears with increasing frequency with increasing distance inland. Antemortem tooth loss follows the caries pattern in the four adaptive areas. Although tooth wear is noted as extreme in the lower Pecos (Marks et al. 1985), the frequencies of tooth wear indicate no pronounced differences between the four areas.

Overall, the data indicate that dental disorders were very low along the Texas coast. Probably due to inland dietary variations, dental disease becomes a larger health problem in the coastal plain, central Texas, and the lower Pecos. Goldstein (1948) reported similar results, noting that samples from west Texas had higher incidences of alveolar abscesses and antemortem tooth loss, and similar caries frequencies to samples from south Texas. Unfortunately, the specific sites from which his samples came were not reported so the comparability of his sample to ours cannot be evaluated.

An attempt was made to identify trauma and separate the evidence into accidental trauma and trauma resulting from interpersonal violence (Table 25). Cranial fractures and parry fractures (fracture of the ulna and/or radius) were considered evidence of interpersonal violence although it is acknowledged that fractures to the forearm can result from accidental means. All other types of fracture were considered to be accidental. Projectile wounds were the strongest evidence of interpersonal violence. The osteological and archeological reports were reviewed for evidence of projectile wounds. Sometimes projectile points were found imbedded in bone or were lying between skeletal elements in a way indicating that a projectile was thrust into the body. This incidence was counted as evidence of projectile wounds. In other cases, projectile points were found in ways that suggested the possibility of wounds. These ambiguous associations were not tabulated.

There are no strong trends in the incidence of accidental, parry, or cranial fractures. However, there is a high incidence of projectile wounds in the south Texas coastal plain and the central Texas prairie. This suggests pronounced interpersonal violence in these areas. In the case of the central Texas prairie where 53 burials were examined for projectile wounds, nearly one in five exhibited such evidence.

In addition to these regional comparisons, a historic mission population from the south Texas coastal plain permits a comparison of prehistoric and historic health in this area (Table 26). The subsistence strategy of the historic population is unknown, but it is assumed that it was a mixed subsistence including agriculture.

The historic skeletal sample exhibits an increase in several pathological categories. These include porotic hyperostosis, osteomyelitis, treponemal infection, vertebral osteoarthritis, caries, and abscess. There are significant decreases in other categories including appendicular osteoarthritis, periostitis, antemortem tooth loss, and tooth wear.

Although paleopathological analysis of prehistoric Texas has been sporadic, remains and consistency between analyses is rare. The summary of literature indicates that paleopathological data can be used to assess the success of hunter and gatherer adaptive strategies in Region 3. However, certain categories of data have severe limitations. In the comparison of adaptive strategies, metabolic disease data, degenerative disease data, and fracture data cannot be used. However, dental pathology, infectious disease data, and projectile wounds do offer the possibility of comparison between areas.

Schmucker (1985) reports that dental pathological data is of value in the comparison of hunter and gatherer subsistence patterns with agricultural subsistence patterns and also between variations of hunter and gatherer subsistence. In a study of California Native Americans, she noted that heavy wear and few caries was associated with diets based largely on marine resources while less wear and more caries typifies acorn-dependent peoples. The present summary of Texas dental pathology supports Schmucker's assertion of the importance of dental data in assessing subsistence pattern. The Texas data indicate that dental disorders were generally low among coastal peoples with increase in caries, abscessing, and antemortem tooth loss among inland populations.

The increase of caries among inland peoples may be due to an increased reliance on foods high in carbohydrate and sugar. For the south Texas coastal plain peoples, pecan- and acorn-dependent subsistence may have been a contributing factor. The diet of the central Texas prairie population resulted in a slight increase in caries, possibly due to the greater utilization of pecans and acorns in the diet and sugar derived from prickly pear fruit. The highest rate of caries occurs in the lower Pecos. Here carbohydrates derived from grass, walnuts, and other plants combined with sugar available from prickly pear fruit, persimmon fruit, mesquite pods, and flowers may have contributed to the high incidence of caries. Turpin et al. (1986:306) in their reconstruction of lower Pecos oral pathology state:

> If decay is the primary cause of tooth loss, specific conditions in the oral cavities, such as the prolonged presence of osmotically active substances which decrease the pH of the saliva (acidity), must have prevailed. This condition could result from a heavy dietary reliance on high carbohydrate plant foods such as the sweet, sticky substances extracted from prickly pear (Winkler 1982) and exacerbated by prolonged chewing of fibrous materials such as sotol or lecheguilla (Marks et al. 1985).

Abscessing can occur from periodontal inflammation or caries (Ortner and Putschar 1981). The increase in abscess incidence from the coastal strip to the coastal plain to central Texas and on into the lower Pecos may reflect both the increase in caries evident in the data and possibly from an increase in periodontal disease. It is of interest that abscess incidence reaches a peak in the lower Pecos where caries have the highest incidence.

Antemortem tooth loss also increases among the interior hunter and gatherer populations away from the coastal strip. The very high incidence in the lower Pecos is probably related to carious loss of teeth.

The dental data are important in assessing the adaptive success in the four regions. The low incidence of dental pathologies other than excessive tooth wear on the coastal strip indicates that the subsistence pattern followed here was well adapted to human dentition. This is in sharp contrast to the lower Pecos where the subsistence pattern resulted in a greater incidence in abscesses and caries. It is of interest that our dental analysis parallels the results of Goldstein's 1948 study with respect to caries, abscess, and tooth loss.

The infectious disease data show that the different environments exposed their inhabitants to varying degrees of infectious organisms. It is predictable that the arid lower Pecos exhibits the lowest level of infectious disease since arid climates are far less conducive to the survival of pathogens than subtropical climates. Moisture is needed to promote the extracorporal survival of many organisms, and the humid, mesic south Texas coastal plain and coastal strip provided such conditions. Furthermore, mesic environments can support more concentrated human populations. This is another factor that promotes the spread of disease. Consequently, the strong evidence of bacterial disease in the coastal evidence is not surprising and reflects a negative aspect of the environment that would detract from successful adaptation.

Finally, the evidence of interpersonal violence in the south Texas coastal plain and central Texas prairie is of interest. In our opinion this evidence unequivocally shows that prehistoric violence was high in these areas.

RECENT DEVELOPMENTS IN TEXAS BIOARCHEOLOGY

The analysis of the literature presented here demonstrates that Texas paleopathological data can provide important data regarding prehistoric and historic adaptation strategies. This is despite several inherent problems in working with hunter and gatherer cemeteries such as small size of cemeteries, slow accrual rate of bodies in cemeteries, sporadic excavation, and variable curation of excavated bones. The poor preservation typical of most Texas soils further limits the potential of extracting pathological data from the area.

Recently, the skeletal collection of the Texas Archaeological Research Laboratory has been organized, preserved, and curated. This will allow rapid access to the collection and facilitate comparative paleopathological analysis. The elements of each skeleton have been inventoried and basic pathological data are provided on the analysis forms.

Exemplary of the potential of this collection in assessing the comparative health status of prehistoric hunter and gatherers is that by Powell (n.d.). Powell selected a sample of skeletons from the coastal strip, south Texas coastal plain, and the central Texas prairie and submitted these to extensive paleopathological analysis. His analysis has provided provocative data regarding prehistoric health and stress. Several pathological conditions were assessed in his analysis. These are porotic hyperostosis/cribra orbitalia, enamel hypoplasia, and osteomyelitis. In the case of porotic hyperostosis/cribra orbitalia, low incidence is typical of the coastal regions and high incidence typifies the central plateau of Texas (analogous to the central Texas region of our study). Enamel hypoplasia shows increasing incidence from the coastal strip to the coastal plain and reaches peak incidence on the plateau. Infectious disease exhibits a high incidence of active cases on the plateau with chronic cases in all three areas. With respect to stress, Powell concludes:

> From the tests, we saw that the coastal and coastal plain groups have moderate success in buffering stress, although they may experience it during seasonal or random intervals. The plateau groups appear to be unsuccessful in preventing the effects of stress in their populations.

Thus we conclude in this summary that certain classes of paleopathological data have comparative validity, especially relating to dentition. However, in general, paleopathological study is in its initial stages in Texas. Region 3 has great potential in providing data regarding adaptive strategy success, but that potential has only recently been established. In the future we will probably see more emphasis on paleopathological research among hunter and gatherer remains in Texas. We also think this review of the literature can provide a springboard to future studies, and we hope, will aid future researchers in gaining access to the literature and the ideas presented therein.