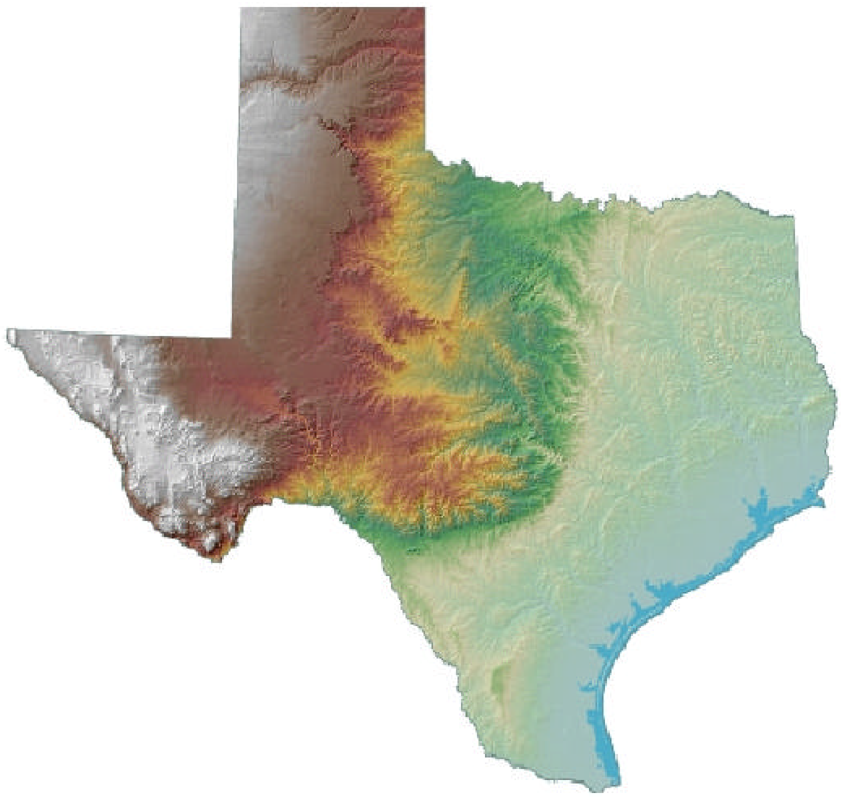
Temporal and Spatial Analysis of Paleoindian and Archaic Site Distribution in the Chihuahuan Desert Region of Texas: Building a GIS for Archaeological Investigations of Landscape Use Patterns



Course Project Final Report
Intermediate GIS, GEOG 4520
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Introduction

This project uses GIS to analyze the distribution of Paleoindian (12,000 – 8,000 ybp) and Archaic (8,000 – 2,000/1,000 ybp) period archaeological sites in the Chihuahuan Desert region of west Texas. The goal is to identify potential temporal or spatial patterning in ancient landscape use in the region by the earliest peoples in the American continent. The project correlates with current research by John D. Seebach, Anthropology Ph.D. student at Southern Methodist University. In the past, Seebach had not employed a GIS in any way. This project, therefore, forms a useful foundation to which further data may be added as his research progresses. The following text provides a brief review of Paleoindian archaeology and ecology literature, along with detailing the methodology and analyses employed, followed by a discussion of results.

The Study Area

The Chihuahuan Desert (Figure 1) is the largest desert in North America, stretching from the Rio Grande Valley in southern New Mexico and the San Simon Valley of southeastern Arizona to just north of Mexico City. It is 1200 miles long and 800 miles wide.

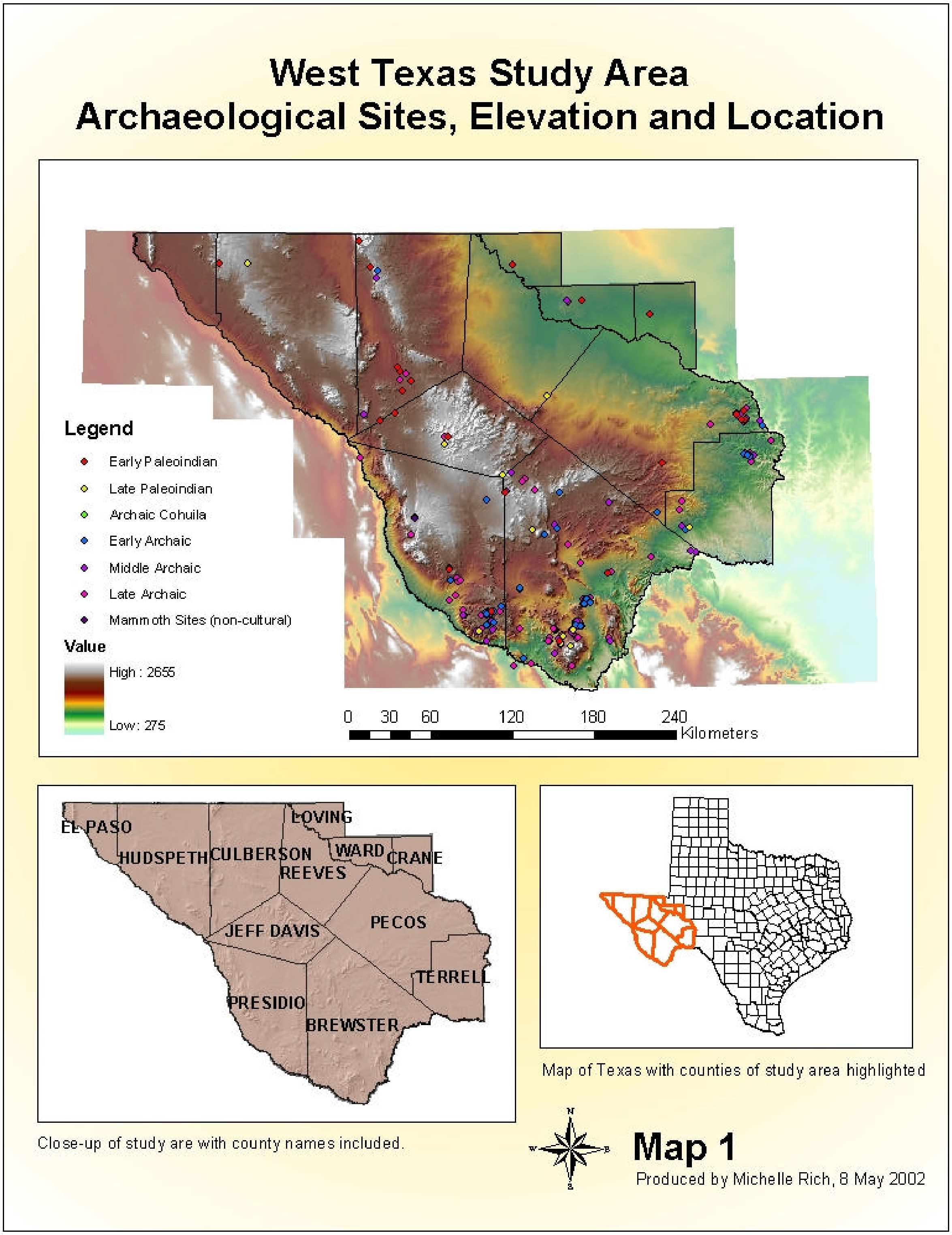
Figure 1. This illustration demonstrates the length and breath of the Chihuahuan Desert, and also it's position relative to Texas, New Mexico, Arizona and Mexico (http://www.cdri.org/Desert/index.html).

In Texas, the Chihuahuan Desert extends into eleven counties: Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, Loving, Pecos, Presidio, Reeves, Terrell and Ward (see Map 1). Nine counties in New Mexico and a single county in Arizona comprise the remainder of the United States segment of the Chihuahuan Desert. A significant portion of the desert is located in Mexico. Unfortunately, archaeological data from northern Mexico are difficult to acquire, when they exist at all. Additionally, a concurrent analysis of the data from Texas, New Mexico and Arizona is impractical considering the infancy of this project. Therefore, while acknowledging that modern day political boundaries have no meaning in prehistory, a pragmatic decision to limit this study to counties in west Texas was implemented. Besides the eleven previously mentioned, Crane County is also included in this study. The Pecos River Valley runs through both Crane and Terrell counties, and is also an important environmental zone to bear in mind when considering how Paleoindian and Archaic hunters and gatherers may have used this region.

Paleoecology

Environmental reconstructions are generally brought to bear on studies of past lifeways. This is because many of the adaptive strategies represented by the material culture remains in the archaeological record can be understood as responses to the environment and its changing conditions. What follows is a brief overview of what is presently known about the environmental conditions during the temporal focus of this study.

The Chihuahuan desert was not always a desert. At the Last Glacial Maximum (LGM) (18,000 ybp), the region was artemesia sage steppe. Mountain range, such as the Davis and Guadelupe mountains, were home to pinyon/juniper forests. These forests were depressed downwards approximately 800 meters into surrounding lowlands (Wells 1966). All of this


West Texas Study Area
Archaeological Sites, Elevation and Location
Legend
Early Paleoindian
Late Paleoindian
Archaic Cohuila
Early Archaic
Middle Archaic
Late Archaic
Mammoth Sites (non-cultural)
Value
High : 2655
Low: 275
0 30 60 120 180 240
Kilometers
EL PASO
HUDSPETH
CULBERSON
LOVING
WARD
CRANE
REEVES
JEFF DAVIS
PECOS
TERRELL
PRESIDIO
BREWSTER
Close-up of study are with county names included.
Map of Texas with counties of study area highlighted
Map 1
Produced by Michelle Rich, 8 May 2002

suggests that in the LGM the Chihuahuan region was better watered and not as hot as today. Evidence indicates arid-adapted biotic communities began evolving during the terminal Pleistocene (approximately 11,500 ybp), coeval with the earliest accepted human occupation of the continent. Over time, xerophytes (e.g. sotol, century plant, crucifixion thorn and prickly pear) increased, available water decreased, tree lines rose and grasslands shrank, with the region achieving relatively modern conditions by approximately 8,000 - 6,000 ybp (Van Devender and Wiseman 1977; Elias and Van Devender 1990; Wells 1966).

Thus, the earliest Paleoindian periods were characterized by a wetter environment with more extensive grasslands, while the Late Paleoindian period was wetter relative to today, but with the presence of desert species on the rise. If, as stated previously, modern conditions in the Chihuahuan desert were reached sometime between 8,000 – 6,000 ybp, than desertification processes were already in play during the Paleoindian era. The Altithermal period, an event that occurred across western North America (Antevs 1955; Holliday 1997), brought a drought to the Trans-Pecos region from approximately 7,400 – 4,500 ybp (Simmons et al. 1989), which corresponds primarily to the Early Archaic period. Dealing with on-going drought would have played a significant role in conditioning the adaptive strategies affecting the subsistence and technology systems of prehistoric people from this time through the remainder of the Archaic period.

Paleoindian and Archaic Periods and their Archaeological Significance

Defined temporally, the Paleoindian period spans from approximately 12,000 – 8,000 years before present (ybp). Sites are found throughout North and South America; and are largely comprised of lithic material (i.e. stone tools) and faunal remains (see Frison 1991, Meltzer 1995 for succinct reviews of Paleoindian archaeology). Other categories of evidence (e.g. pottery, human skeletal remains, buildings of any kind) are non-existent, leaving the archeologist with a scant but intriguing body of data. Elaborate stone tool typologies have been developed and correlated with radiocarbon dates, and specific tool types are recognized as diagnostic of particular complexes corresponding to temporal subdivisions (e.g. Clovis, Folsom, Plainview) within the Paleoindian period. This results in relatively tight chronological control during this period of prehistory, especially in relation to similarly old archaeological complexes worldwide.

Several factors were taken into consideration when establishing the temporal, geographic and topical parameters of this project. First and foremost, extant archaeological evidence is the driving force behind this analysis. The Paleoindian period is considered by some to be merely a time period (as discussed above) and by others to be *a way of life.* When defined as a way of life, Paleoindians are characterized as highly mobile hunters and gatherers, with big game hunting being their primary subsistence strategy (Kelly and Todd 1988). This interpretation has its roots in the means by which Paleoindian sites have historically been located: bones of ancient megafauna are discovered, and excavations ensue with the goal of recovering archaeological material (Meltzer 1995). In opposition to this is the interpretation that Paleoindians did not focus their subsistence efforts disproportionately and pan-continentally on big game, but tailored their strategies to regionally available resources (e.g. Meltzer and Smith 1986; Meltzer 1993).

The Paleoindian occupation of the Chihuahuan Desert is of particular interest for several reasons, which illuminate the logic behind the geographic parameters of this study. As stated by Seebach (n.d.:3):

> "From the perspective of game resources, the onset of aridity reduced forage available to herbivores due to the steady eradication of widespread grasslands. Bison, as the major Paleoindian food source (Hofman and Todd 2001), were probably not as abundant in the region as on the Plains…Deer, a species with fairly unpredictable migration and aggregation patterns, are the largest game animals in the Chihuahuan area today. Indeed, as in any dry environment, the predictability of *most* game resources consumable by humans would have lessened with increasing aridity (Noy-Mier 1973, 1974; Seebach 2001; Sowell 2001)."

Since arid environments would not produce the browse required by large bodied herbivores, it does not follow that the primary subsistence strategy of Paleoindians occupying this region was big game hunting. Thus, the subsistence adaptations of mobile hunters and gatherers may have been vastly different in the Chihuahuan Desert region relative to other areas that have historically been the foci of study (primarily the Great Plains, see Sellards 1952; Wormington 1957; Frison 1991). when the definition of Paleoindian lifeways revolving around big game hunting was institutionalized. Further archaeological study of the Chihuahuan region will help to address this significant interpretive issue. Concomitantly, the Chihuahuan Desert is a good location to study human adaptation to an increasingly arid environment. Both topics are of great importance to scholars of Paleoindian occupation of the North American continent.

Several of these matters are also important when studying the subsequent Archaic (approximately 8,000 – 2,000/1,000 ybp), which spans a great period of time, some 6,000+ years. Archaeological understanding of this time period is problematic, and it is also debated as being either merely a time period or an actual way of life. The Archaic is often defined as much by what *is not* present (distinctive Paleoindian toolkit, Pleistocene megafauna, ceramics, agriculture, villages) as what *is* present (modern species, storage technology, groundstone and other plant processing technologies). The lack of a breadth of diagnostic artifacts typifying the Archaic period may make it difficult to determine when a site should be classified as an Archaic site, or if belongs to the Paleoindian or post-Archaic Protohistoric period. This lack also affects internal divisions within the Archaic period which are overwhelmingly merely temporal (not cultural) divisions. The Early (8,000 – 5,000 ybp), Middle (5,000 – 2,500) and Late Archaic (2,500 – 1,000) periods (after Simmons et al. 1989) display no real adaptive differentiation, until the introduction of the bow and arrow during the latest Archaic, which would have radically changed hunting strategies. To conclude, the primary problems encountered when dealing with both the Paleoindian and Archaic periods stem from working in a time period of such great antiquity. First, this great antiquity is coupled with particular environmental circumstances that seemingly guarantee archaeological remains will be difficult to access, and, secondly, a highly mobile hunting and gathering lifestyle may leave nothing archaeologically but the most ephemeral material traces across the landscape.

Methodology

This project utilizes four data layers in GIS, for which a geodatabase was created to house the relevant analysis layers. All data were collected from Internet sites (see Table 1), and supplied free of charge. All layers were projected to NAD 1983 UTM Zone 13 or 14, and the projections were defined accordingly. The *elevation* layer was compiled from 14 zipped DEM files, which were unzipped, converted to GRID files and merged together in Arc/Info

DATA LAYER	SOURCE	URL
Elevation 1:250,000	USGS Earth Resources Observation Systems (EROS) Data Center	http://edcwww.cr.usgs.gov/glis/hyper/guide/1_dgr_demfig/nh13.html General access: http://edc.usgs.gov/geodata/
County Boundaries 1:250,000	Texas Natural Resource Information System	http://www.tnris.org/DigitalData/data_cat.htm [Administrative Areas]
Vegetation Types	Texas Parks and Wildlife GIS Lab via… Texas Natural Resource Information System	http://www.tpwd.state.tx.us/gis/download.htm http://www.tnris.org/DigitalData/data_cat.htm [Land and Biological Resources]
Archaeological Sites	Texas Historical Commission Texas Archaeological Sites Atlas	http://pedernales.thc.state.tx.us/index.html

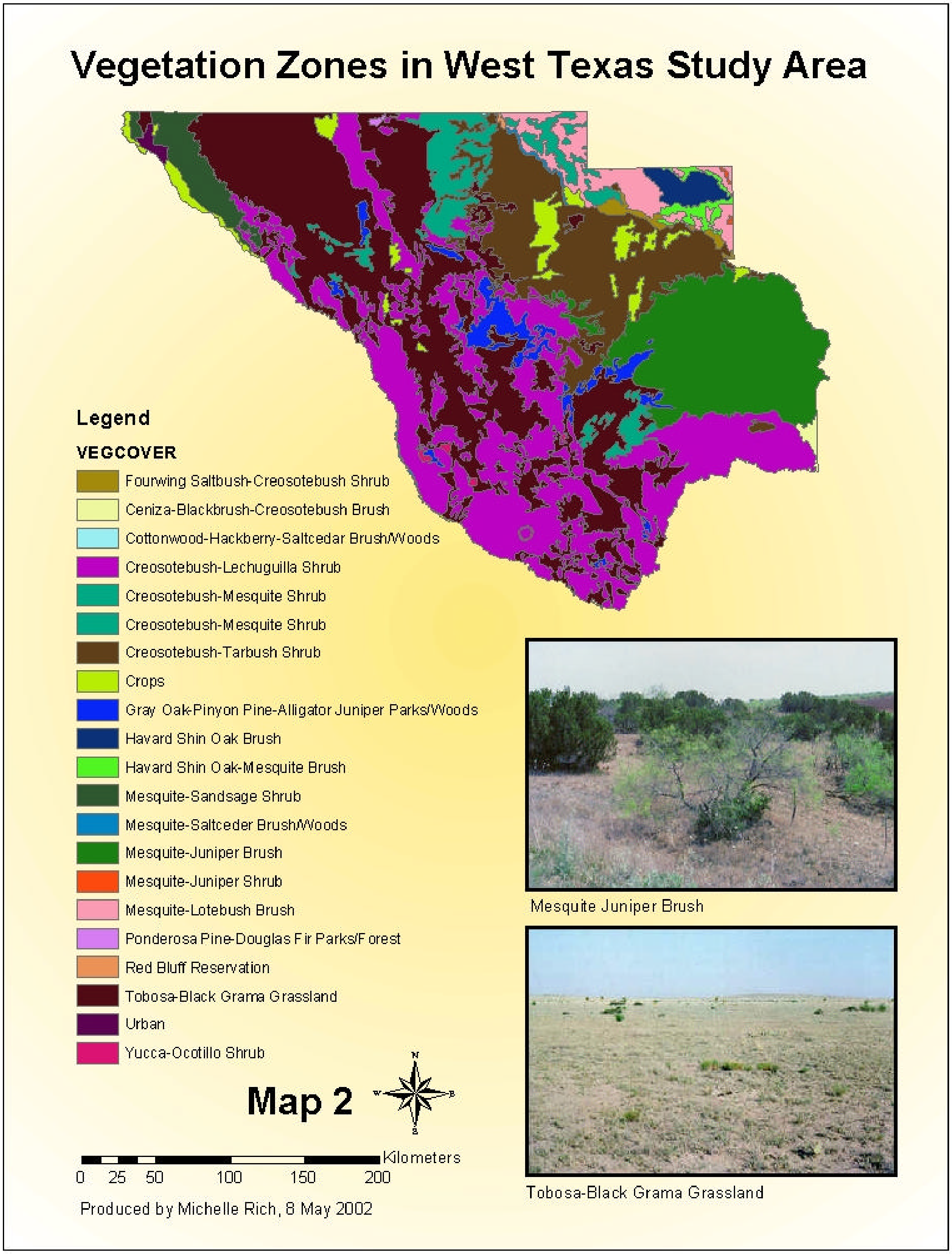
Table 1. Background information on data layers used.

Workstation. C*ounty boundaries* and *vegetation type* layers were downloaded for the entire state of Texas, and clipped to define the study area of the twelve aforementioned counties. It must be understood that modern vegetation distributions are used solely as a proxy for paleo-vegetation maps. Archaeologists are frequently in positions where assumptions about past conditions must be made, however, the Chihuahuan Desert achieved its current state by 8,000 – 6,000 ybp, which overlaps with the Early Archaic period. Thus, Middle and Late Archaic period vegetation is most likely accurately characterized by present day maps. Eighteen different vegetation types are represented in the study area (Map 2), along with three non-vegetation zones comprised by cropland, urban areas and the Red Bluff Reservation (McMahan et al. 1984).

Finally, an *archaeological sites* layer was constructed. This was accomplished by manually compiling two databases using data available in the Texas Historical Commission's online Texas Archaeological Sites Atlas. Terrell and Pecos counties bridge Zones 13 and 14, necessitating separate databases for sites located in each zone for projection purposes. Searching in the Texas Archaeological Sites Atlas can only be done using the following methods:

- Trinomial Search - search for a specific archeological site by state-assigned identification trinomial
- Quad Search - search for sites on a specific USGS quad sheet
- County Search - search for sites in a particular county
- Address Search - view maps of site locations in the vicinity of a known address
- Abstracts Search - search the Abstracts in Contract Archeology Database by author, PI, county, title keyword, etc

These are particularly inefficient search options for researchers looking for sites ascribed to specific time periods, and require all of the information to be individually inspected for each site. Without including El Paso County, the nearly 17,000 records representing a total of 4,825 sites were examined. This intensive search resulting in 200 sites positively attributed to the Paleoindian and Archaic periods. El Paso County contains 4,520 sites and 7,323 records, which, at the present time, still need to be examined. Therefore, for the present inquiry, El Paso County will be omitted.


Vegetation Zones in West Texas Study Area
Legend
VEGCOVER
Fourwing Saltbush-Creosotebush Shrub
Ceniza-Blackbrush-Creosotebush Brush
Cottonwood-Hackberry-Saltcedar Brush/Woods
Creosotebush-Lechuguilla Shrub
Creosotebush-Mesquite Shrub
Creosotebush-Mesquite Shrub
Creosotebush-Tarbush Shrub
Crops
Gray Oak-Pinyon Pine-Alligator Juniper Parks/Woods
Havard Shin Oak Brush
Havard Shin Oak-Mesquite Brush
Mesquite-Sandsage Shrub
Mesquite-Saltceder Brush/Woods
Mesquite-Juniper Brush
Mesquite-Juniper Shrub
Mesquite-Lotebush Brush
Ponderosa Pine-Douglas Fir Parks/Forest
Red Bluff Reservation
Tobosa-Black Grama Grassland
Urban
Yucca-Ocotillo Shrub
Map 2
Kilometers
0 25 50 100 150 200
Produced by Michelle Rich, 8 May 2002
Mesquite Juniper Brush
Tobosa-Black Grama Grassland

Both databases constructed for this study are comprised of identical, small tables containing the archaeological site identification trinomial, zone, northing, easting, time period, and temporally diagnostic lithic types. These were originally constructed in Microsoft Excel and then converted to .dbf. Based on UTM coordinate information, themes were constructed in ArcView 3.2 and then converted to shapefiles and projected accordingly. After the projection was completed, the two datasets representing zones 13 and 14 were merged together.

After some preliminary work with the sites layer in ArcMap, it was apparent the original database's structure was not particularly user friendly. Some site locations represent more than a single time period and must be classified with multiple records to adequately capture the temporal data in multiple layers. This had not been done in the original database. In order to rectify this, the dataset was split into five separate shapefiles base on time period (Early and Late Paleoindian; Early, Middle and Late Archaic). This was done by working with the original sites layer in ArcMap, and using the "select by attributes" layer to capture each of the separate time periods. This was executed for each of the three columns representing time periods (see attribute table for example). As each group of individual sites of a particular time period was selected from all of the three time period columns, I proceeded by right clicking on layer, choosing "data" and then "export data" and adding them to the map as a layer. Once the shapefiles for the various time periods were created (some had up to three), the Geoprocessing Wizard "merge" function was used to create a single layer for each of the five time periods. During this process, four records were also pulled out of the analysis: three representing mammoth remains with no associated cultural material, and one representing an Archaic period site defined by a unique lithic complex not comparable to other material.

Consideration of Archaeological Data

The accuracy of the archaeological sites *database* constructed for this project rests on three factors: 1) my ability to ensure a complete review of the data available on the Texas Historical Commission's website, 2) it's precise entry into the Excel database, and 3) the accuracy of the data included in the THC's Archaeological Sites Atlas. Much of the Paleoindian and Archaic period archaeological data from the Chihuahuan Desert region of Texas merit further analysis, and because records were kept using various data-collection forms, only some of them standardized, the data presented in the Atlas are not uniform for each site. Thus, data exist, but not to the same levels throughout the study region.

These archaeological data have been collected from approximately the 1930's onward, and represent the cumulative efforts of myriad individuals, most notably field archaeologists, and the people who did data entry for the THC. There are some flaws, for example 41BS866 appears to be located in Mexico (note it's location west of the southern tip of Texas, see Map 1) – the northing has an extra digit on the THC data – but it is supposed to be located in Brewster County. This sample should technically be thrown out of the dataset and will be in the future, unless a correct northing can be located. In any event, this is the most comprehensive collection of archaeological sites available, and its representation herein is as exact as possible.

Another issue to take into consideration is the accuracy of the archaeological *record* itself. *Does what we are able to find adequately represent the phenomena of prehistory?* This is essentially an unanswerable question, but most certainly one worth considering. For instance, are the patterns reported herein simply a result of where disproportionately more archaeological fieldwork has been undertaken? The Big Bend National Park, in the southern region of the study area, contains a greater number of archaeological sites (see Map 1) and has undoubtedly been more thoroughly archaeologically surveyed than other represented regions, due to federal funding and park development. At the opposite end of the spectrum, note the lack of sites in Pecos and Reeves counties. In comparison to the Big Bend National Park, there has been relatively little archaeological work here. Furthermore, the nature of dealing with data of this antiquity, particularly during the Paleoindian period, mandates that we expect low numbers of archaeological sites simply as a result of the depths at which they will be located. Sites can occur at depths of two to three meters, perhaps without any evidence of their existence visible on the surface. One alternative to pursue which may address this gap is an examination of soil maps with an eye toward the location of Late Pleistocene/Early Holocene sediments. Areas with these types of sediments are prime locations to search in order to identify Paleoindian period sites.

In sum, the archaeological record is incomplete on several levels. First, we will never be able to find all of the sites that exist. If we could, it would be impossible to excavate them all completely, due to various legalities, and time and funding constraints. Secondly, the archaeological record represents only a fraction of past activities that happened to be preserved. There are certainly other theoretical issues mulled over in archaeological literature time and again (e.g. post depositional perturbations that affect the "integrity" of the archaeological deposits; the fact that what we study is mostly ancient "trash," etc…) and what is presented here should serve simply as statement of awareness regarding the incompleteness of the archaeological record. All archaeologists realize they are dealing with a partial dataset. But, at this juncture, a salient point about archaeological research in western Texas must be made: there is an acute dearth of studies in this region.

To this day, the data presented in Mallouf (1985) are still considered the definitive synthetic statement about archaeology in this region. This is not to imply that Mallouf's work does not merit such credit, it certainly does, but there are very few fields of archaeological research in which data 17 years old is considered “current.” This lack of specific information in the Chihuahuan desert region is surprising, considering the vast amount of research focusing on Paleoindian and Archaic archaeology in general. In part, this deficiency relates to the preconceived notions about what “Paleoindian” means, and the often times ambiguent Archaic period record, both of which were discussed earlier in this paper. However, no Paleoindian archaeological site in this region has been excavated with any thoroughness since the 1930’s (Seebach, pers. comm.), thus no faunal data are available, and there is sparse information regarding local raw material sources (e.g. chert outcrops for flintknapping) in the area. Until this changes, it is imperative to utilize the extant data, which means doing broad temporal and regionally-based analyses such as are presented in this study.

Analysis and Discussion

While the original proposal detailed four questions to pursue during the course of this study, the resultant analysis deals only with three:

1. Are there shifts in landscape use through time? If yes, what might they suggest about adaptation to increasing aridity?
2. Does patterning exist between site location and vegetation zones?
3. Can a redundant landuse pattern be attributed to possible subsistence strategies?

The fourth question regarding the relationship between the lithic complexes represented at each Paleoindian site and relative elevation of site location requires an archaeological sites database with improved organization, and additional data layers. For example, it is evident that lithic tool data are incorporated into the attribute tables, but were not utilized in the course of this study as the organization was cumbersome and made analysis based on the presence of different tool types awkward. Therefore, question four will be investigated after a restructuring of the database is completed

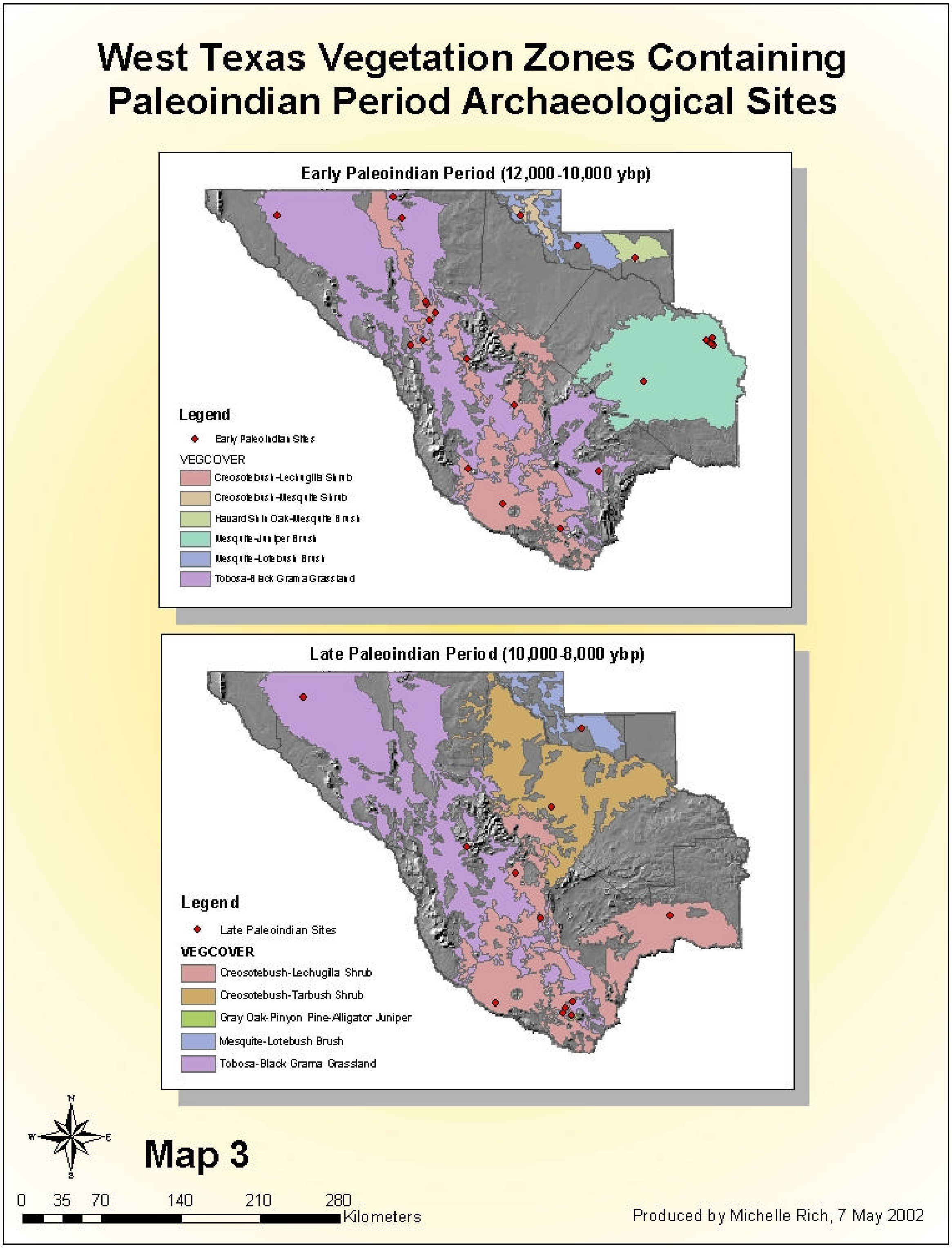
In order to address question one, density maps were created using Spatial Analyst. No population figures are available for the archaeological sites represented, as they are the remnants of camps used by highly mobile hunters and gatherers. Thus, the density maps created for each of the five time periods in question were not for purposes of quantifying population, but to demonstrate, quickly and visually, the relative change in density of sites across the landscape through time. This is a valuable endeavor because most of these sites have never been plotted together on a map, nor have they been reviewed as a collective unit.

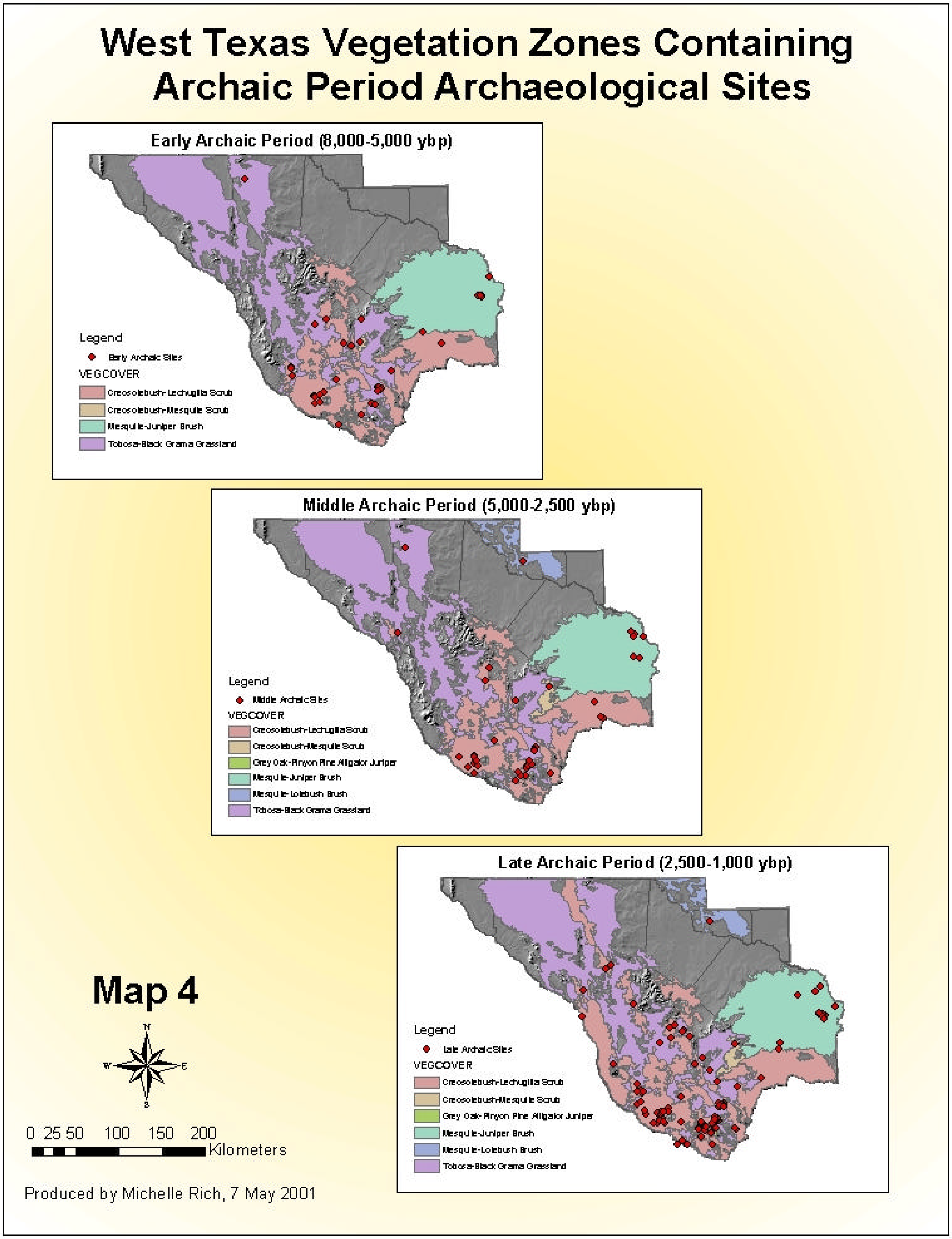
The construction of vegetation maps for the Paleoindian and Archaic periods was executed by using the ArcMap "select by location function." Those areas of the original vegetation map which contained archaeological sites attributed to one of the five time periods in question were selected, and I proceeded by right clicking on the vegetation layer, choosing "data" and then "export data" and adding them to the map as a layer. This resulted in vegetation maps tailored to each of the specific time periods, with only the vegetation zones in which sites were located being represented on the map. After the maps and figures were constructed, Seebach was consulted and discussions of the results ensued. The responses to the three questions below thus represent our collaborative effort.

Are there shifts in landscape use through time? What might they suggest about adaptation to increasing aridity?

A variety of observations derived from the analysis can be made in relation to this question. The topics highlighted with bullet points are some of the most salient.

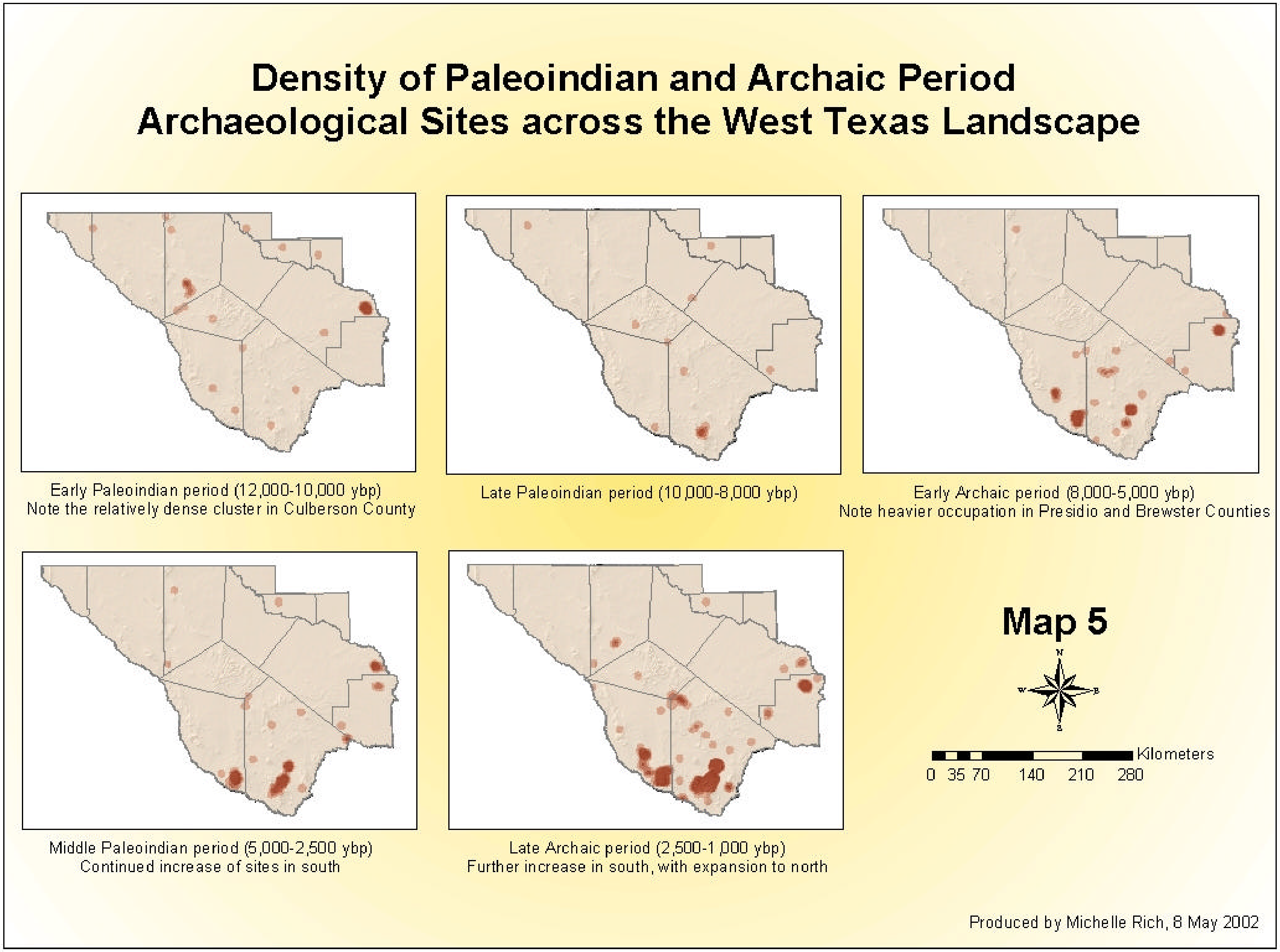
- The Paleoindian vegetation maps (Map 3) demonstrate a slight increase in randomness of their location in relation to vegetation zones relative to the Archaic period maps (Map 4).


West Texas Vegetation Zones Containing Paleoindian Period Archaeological Sites
Early Paleoindian Period (12,000-10,000 ybp)
Legend
Early Paleoindian Sites
VEGCOVER
Creosotebush-Lechugilla Shrub
Creosotebush-Mesquite Shrub
Havard Shin Oak-Mesquite Brush
Mesquite-Juniper Brush
Mesquite-Lotebush Brush
Tobosa-Black Grama Grassland
Late Paleoindian Period (10,000-8,000 ybp)
Legend
Late Paleoindian Sites
VEGCOVER
Creosotebush-Lechugilla Shrub
Creosotebush-Tarbush Shrub
Gray Oak-Pinyon Pine-Alligator Juniper
Mesquite-Lotebush Brush
Tobosa-Black Grama Grassland
N
W
E
S
Map 3
0 35 70 140 210 280
Kilometers
Produced by Michelle Rich, 7 May 2002


West Texas Vegetation Zones Containing
Archaic Period Archaeological Sites
Early Archaic Period (8,000-5,000 ybp)
Legend
Early Archaic Sites
VEGCOVER
Creosolebush-Lechugilla Scrub
Creosolebush-Mesquite Scrub
Mesquite-Juniper Brush
Tobosa-Black Grama Grassland
Middle Archaic Period (5,000-2,500 ybp)
Legend
Middle Archaic Sites
VEGCOVER
Creosolebush-Lechugilla Scrub
Creosolebush-Mesquite Scrub
Grey Oak-Pinyon Pine Alligator Juniper
Mesquite-Juniper Brush
Mesquite-Lotebush Brush
Tobosa-Black Grama Grassland
Late Archaic Period (2,500-1,000 ybp)
Legend
Late Archaic Sites
VEGCOVER
Creosolebush-Lechugilla Scrub
Creosolebush-Mesquite Scrub
Grey Oak-Pinyon Pine Alligator Juniper
Mesquite-Juniper Brush
Mesquite-Lotebush Brush
Tobosa-Black Grama Grassland
Map 4
N
W
E
S
0 25 50 100 150 200
Kilometers
Produced by Michelle Rich, 7 May 2001

This is to be expected, as environments during the Paleoindian period were relatively more homogenous (though becoming warmer) than in later periods of time; therefore, landscape use would be more broadly distributed.

- The cluster of sites visible on during the Early Paleoindian period in southern Culberson County is anomalous (Map 5). This region is unlike the wide-open plains locations where the majority of known Paleoindian sites are found – it is a constricted, hourglass shaped valley. The availability of game to support a hunting and gathering subsistence strategy is unknown, but perhaps this situation is reminiscent of a similar situation in southern Colorado's San Luis Valley, which was heavily occupied during the Folsom period (10,800 – 10,250 ybp). This is also a small valley constricted by bordering mountain ranges. Note this region is then abandoned, save one archaeological site during the Middle Archaic period (Map 5). Speculation as to why this is the case leads to the suggestion that water may be more easily accessed in the southern regions of the study area – particularly during the Altithermal period in the Early Archaic – via the Rio Grande, Rio Conchos and their various tributaries. More drainages and springs are also present in this region (Seebach pers. comm. 2002). This may explain the southern clustering of sites in the Early Archaic, at the expense of a northern presence of any great magnitude (Map 5). During the Late Archaic, as environmental conditions improved in relation to the Altithermal period, populations begin to radiate out of the southern region into the central portion of the study area.
- As stated above, the southern Trans-Pecos in Presidio and Brewster Counties appears as an area of heavy occupation during the Early Archaic phase (Map 5). Throughout the reminder of the Archaic periods it becomes increasingly more densely occupied (Map 5). Map 1 shows this ongoing clustering occurs in areas of higher elevation of Presidio County. This


Density of Paleoindian and Archaic Period
Archaeological Sites across the West Texas Landscape
Early Paleoindian period (12,000-10,000 ybp)
Note the relatively dense cluster in Culberson County
Late Paleoindian period (10,000-8,000 ybp)
Early Archaic period (8,000-5,000 ybp)
Note heavier occupation in Presidio and Brewster Counties
Middle Paleoindian period (5,000-2,500 ybp)
Continued increase of sites in south
Late Archaic period (2,500-1,000 ybp)
Further increase in south, with expansion to north
Map 5
N
W
E
S
Kilometers
0 35 70 140 210 280
Produced by Michelle Rich, 8 May 2002

region may have experienced longer-term settlement due to the many rockshelters scattered throughout the area, thus resulting in greater archaeological visibility. However, the nature of the THC Archaeological Sites Atlas makes it difficult to access information regarding duration of occupation. Brewster County's density of sites during the Archaic period may be due also to the proximity to water in the offshoot canyons of the Rio Grande (Mallouf and Tunnell 1977). There is a noticeable lack of sites along the Rio Grand floodplain, which would have been prime area to utilize in a generally water poor environment. Many post-Archaic Prehistoric period sites have been recorded in this region, and it was suggested by Seebach (pers. comm. 2002) that Paleoindian and Archaic period sites are probably too deeply buried under floodplain sediments to be easily discovered.

Does patterning exist between site location and vegetation zones?

Despite the slight difference between the Paleoindian and Archaic period vegetation maps, the entire series of vegetation maps exhibit a strong, overall emphasis on only eight vegetation zones throughout the 10,000 years represented, out of the eighteen on the original vegetation map. A report on the vegetation types of Texas can be found online at http://www.tpwd.state.tx.us/gis/veg/ (McMahan et al. 1984). The follow descriptions of the eight vegetation zones are from this website. Each picture corresponds to the text above it.

1. Creosotebush-Lechuguilla Shrub
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page4.html#1
Commonly Associated Plants: Mesquite, yucca, lotebush, ocotillo, javelina bush, catclaw, whitethorn acacia, whitebrush, ceniza, allthorn, guayacan, pricklypear, pitaya, tasajillo, chino grama, black grama, fluffgrass, range ratany, skeletonleaf goldeneye, tarbush, mariola.
Distribution: Lower slopes and intermountain valleys of the Trans-Pecos, principally in Jeff Davis, Presidio, and Brewster Counties.

2. Creosotebush-Mesquite Shrub
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page4.html#2
Commonly Associated Plants: Sotol, lechuguilla, catclaw, cholla, plains pricklypear, mormon tea, range ratany, desert sumac, plains bristlegrass, bush muhly, black grama, chino grama, fluffgrass, burrograss, mesa dropseed, purple three-awn, rough menodora, coldenia, mariiola, grassland croton, sickle-pod rushpea.
Distribution: Principally east of the Delaware Mountains in Culberson County, Trans-Pecos.

3. Havard Shin Oak -Mesquite Brush
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page11.html#2
Commonly Associated Plants: Sandsage, catclaw, yucca, giant dropseed, sand dropseed, indiangrass, silver bluestem, sand bluestem, little bluestem, feather plume, Illinois bundleflower, fox glove, yellow evening primrose.
Distribution: Occurs primarily on sandy soils in the western rolling Plains and southwestern High Plains.

4. Mesquite-Juniper Brush
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page7.html#2
Commonly Associated Plants: Lotebush, shin oak, sumac, Texas pricklypear, tasajillo, kidneywood, agarito, redbud, yucca, Lindheimer silktassel, sotol, catclaw, Mexican persimmon, sideoats grama, three-awn, Texas grama, hairy grama, curly mesquite, buffalograss, hairy tridens.
Distribution: Chiefly on mesas and hillsides of the western Edwards Plateau.

5. *Mesquite-Lotebush Brush*
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page7.html#1
Commonly Associated Plants: (Rolling Plains): Yucca, skunkbush sumac, agarito, elbowbush, juniper, tasajillo, cane bluestem, silver bluestem, little bluestem, sand dropseed, Texas grama, sideoats grama, hairy grama, red grama, tobosa, buffalograss, Texas wintergrass, purple three-awn, Engelmann daisy, broom snakeweed, bitterweed.
Distribution: Northern Trans-Pecos, northwestern Edwards Plateau, Rolling Plains and western Cross Timbers and Prairies.

6. *Tobosa-Black Grama Grassland*
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page1.html#1
Commonly Associated Plants: Blue grama, sideoats grama, hairy grama, burrograss, bush muhly, Arizona cottontop, javelina bush, creosote bush, butterflybush, palmella, whitethorn acacia, cholla, broom snakeweed, rough menodora.
Distribution: Principally in low-lying plains in Jeff Davis, Presidio, Brewster, Culberson and Hudspeth Counties in Trans-Pecos.

7. Creosotebush-Tarbush Shrub
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page3.html#2
Commonly Associated Plants: Range ratany, cholla, fourwing saltbush, sotol, mesquite, whitethorn acacia, catclaw, lechuguilla, chino grama, gyp grama, alkali sacaton, false nightshade, false broomweed, jimmyweed.
Distribution: Principally in Pecos and Reeves Counties, Trans-Pecos.

8. Grey Oak-Pinyon Pine-Alligator Juniper Parks/Woods
URL: http://www.tpwd.state.tx.us/gis/veg/pages2/page15.html#2
Commonly Associated Plants: Emory oak, silverleaf oak, Gambel's oak, mountain mahogany, evergreen sumac, mountain snow-berry, Texas madrone, southwestern chokecherry, bullgrass, Pringle needlegrass, finestem needlegrass, pine dropseed, sideoats grama, blue grama, pine muhly, pinyon ricegrass, largeleaf oxalis, heartleaf groundcherry, Torrey anthericum.
Distribution: From about 5,500 to 7,500 feet in the mountains of the Trans-Pecos; principally the Davis Mountains.

While the location of archaeological sites in these eight zones does not preclude logistically organized mobility (Binford 1980) to procure resources in other ecozones, occupational duration sufficient to leave a diagnostic archaeological signature occurs in only these few zones. Certain caveats must be mentioned, such as the fact that sites without diagnostic lithics may exist in areas not emphasized on these maps. These may be evidence of single task foraging forays in prehistory, or areas that are subject to larger numbers of modern-day artifact collectors, or as stated before, areas less completely archaeologically investigated.

Can a redundant landuse pattern be attributed to possible subsistence strategies?

The recurring occupation of only a few vegetation zone types throughout 10,000 years of prehistory suggests a very narrow adaptive niche for Paleoindian and Archaic hunters and gatherers exploiting the Chihuahuan Desert. In turn, this suggests that certain resources, most importantly food and water, were only widely available in the areas redundantly occupied. Further work needs to be done regarding the plants commonly associated with each vegetation zone (included with the photographs of each vegetation type) to determine the resources available to foragers in these, and the potential differences therein. This may also speak to a redundant landuse pattern. In general, water would have been perennially available in the Rio Grande Valley, perhaps especially at it junction with the Rio Conchos in Presidio County. This water richness may explain this region's continuous and relatively heavy occupation throughout the Archaic period.

Directions for Future Research

The discussion presented above represents a small step forward in understanding how the landscape we now perceive as west Texas was utilized during the Paleoindian and Archaic periods. This project has academic importance, and my colleague, John Seebach, and I intend to present this research at the Center for Big Bend Studies Annual Conference next fall, and pursue additional avenues of inquiry. To this end, I co-wrote an internal grant with Dr. Michael Adler, of Southern Methodist University to acquire funds for the Anthropology Department to purchase two copies of ArcView 8 with the Spatial Analyst and 3D Analyst extensions. We were recently awarded the grant, and will be effecting the purchase of the software after the close of the spring semester.

In relation to this project, there are various improvements and additions that may prove useful. First, a reworking of the structure of the original Excel database is required. As mentioned previously, the lithic data in the archaeological sites database need to be reorganized, which is scheduled for this summer. Also, I realized that Paleoindian sites with unspecified lithic tools (as described in the THC data) were classed in with sites identified as Early Paleoindian, a designation securely based on specific diagnostic early lithic types. The sites with unspecified tool types need to be considered separately, since their specific time affiliation within the Paleoindian period is unknown.

Second, additional data layers are required. The incorporation of a water source layer is necessary and may also be insightful. Clearly, the Rio Grande, Rio Conchos and Pecos Rivers would have been attractive large water sources, but smaller rivers and streams may not have been stable enough throughout the past to consider using modern day rivers and streams datasets as proxy. A dataset representing springs might be more useful in that regard. I have already investigated the availability of such a dataset on TNRIS, and with some work hope to incorporate that for analysis purposes as well. Another line of inquiry is raw material sources. If we could acquire data on the location of such resources, path distance and viewshed analysis, for example, might present interesting results in relation to the position of sites across the landscape.

Third, Seebach suggested further analysis to create parameters of "resource potential" by quantifying primary and secondary productivity in the vegetation zone in question should also be implemented. Primary productivity is the amount of new plant biomass growth per year in a particular region, while secondary productivity attempts to quantify the higher trophic levels supportable by a given primary biomass. That is to say, what animals will feed on the plants and then be fed on by larger animals, who, in turn will be preyed upon, ad infinitum.

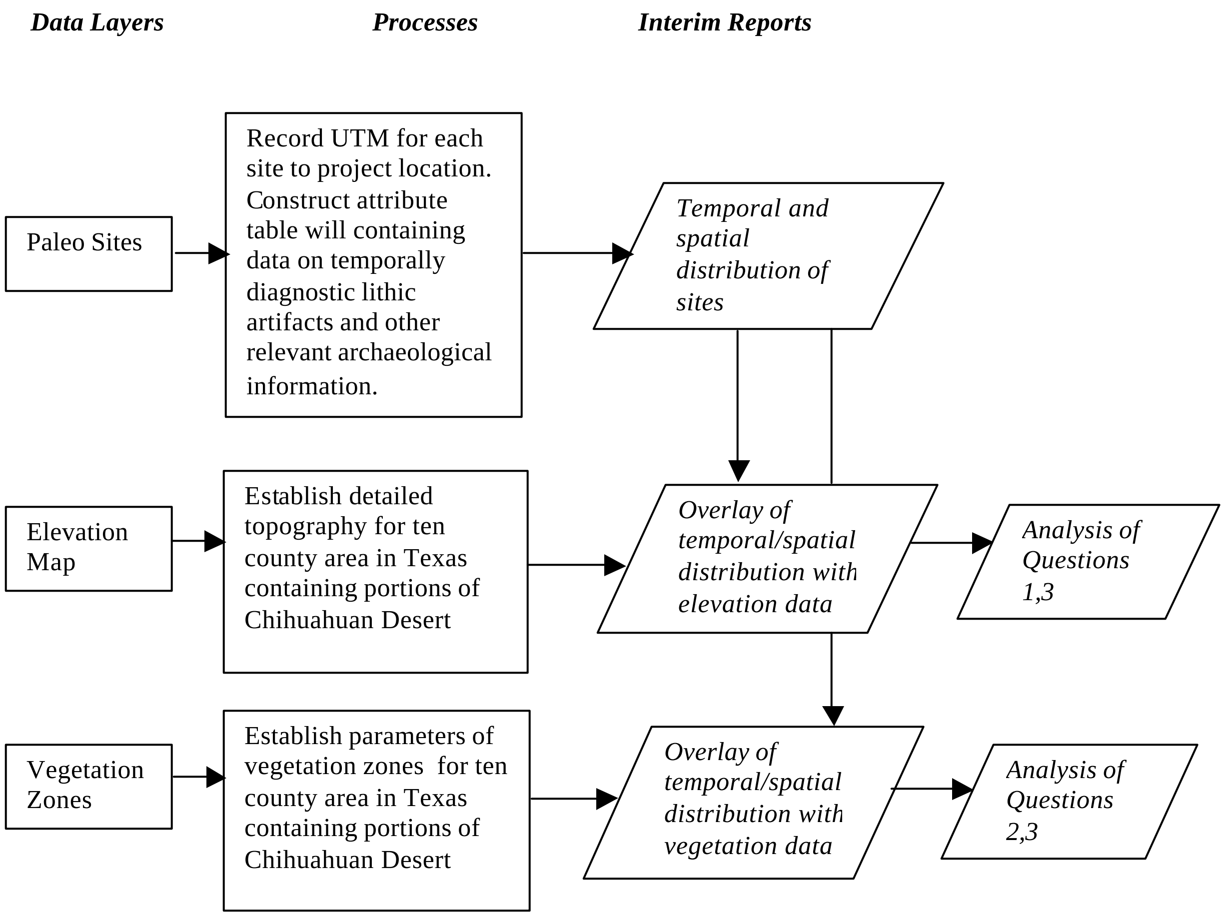
Conclusion

In undertaking this project, the utility of GIS applications in Paleoindian and Archaic period archaeological research has been demonstrated. While some difficulties were encountered and several hurdles have yet to be surmounted, continued development of this project is indeed worth the effort. As evidenced herein, even simple GIS analysis and maps result in a strong foundation for archaeological understanding of past human behavior. The interpretations presented above are the "tip of the iceberg" in regard to the potential resulting from the using GIS a tool to aid in the understanding of patterning in the archaeological record. In sum, this project represents the beginning of what will hopefully become a more richly defined dataset dealing with the Paleoindian and Archaic period occupation of the Chihuahuan Desert region of west Texas.

Flowchart

Temporal and Spatial Analysis of Paleoindian Site Distribution in the Chihuahuan Desert Region of Texas: Building a GIS for Archaeological Investigations of Landscape Use Patterns

Objective: To analyze the distribution of Paleoindian archaeological sites in the Chihuahuan Desert by potentially identifying temporal or spatial patterning in ancient landscape use.



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