Archeology and Late Quaternary Environments of the Southern High Plains

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The Southern High Plains of northwestern Texas and eastern New Mexico (Fig. 9.1) contains a rich record of human occupation and sedimentation spanning the past 11,500 years. The sediments, along with soils and paleontological and paleobotanical remains contained within them, provide evidence of the environmental history of the region. Numerous prehistoric sites are situated throughout the Southern High Plains, including some of the best-known Paleoindian sites in North America. Most archeological sites are single-occupation localities or surface occurrences. Several multiple-occupation sites with good stratigraphic context have been investigated to varying degrees. Early investigators (e.g., Cotter 1937; E. Howard 1935; Sellards 1952; Wendover 1961; Wendover and Hester 1975) focused on the stratigraphy, depositional environments, and paleoenvironments of deposits older than about 8000 B.P. (Paleoindian age), although these sites generally also contained younger strata and archeological remains. These sites include: Lubbock Lake (E. Johnson 1987c), Clovis (Blackwater Draw Locality #1) (J. Hester 1972), San Jon (Roberts 1942), Plainview (Sellards et al. 1947), Marks Beach (Honea 1980), and Lake Theo (Harrison and Killen 1978) (see Fig. 9.1).

Among these sites that have been of interest to archeologists, Lubbock Lake has undergone the most scrutiny. With excavations covering its lengthy Late Quaternary record, Lubbock Lake has produced the most complete site-specific Late Quaternary archeological and environmental data base in the region. Geologic work over the past 25 years (Holliday 1985a, 1993, 1995a; Holliday and Allen 1987; Stafford and Holliday 1981) has produced a well-dated stratigraphic record covering the last 11,500 years. This stratigraphic record is complemented by detailed cultural and zooarchaeological records for the same time period (E. Johnson 1987c, 1993a, 1995a, 1995b; E. Johnson and Holliday 1989). The Lubbock Lake records, in conjunction with data from the other sites, form the data base for modeling the regional culture history and its relationship to paleoenvironmental change.

This chapter reviews the results of investigations into the stratigraphy and cultural history of the Southern High Plains, with supplementary data from other Southern Plains sites immediately adjacent to the region. The time period covered is the Late Quaternary, from the latest Pleistocene through the Holocene, and this interval encompasses five major cultural periods. Paleontological and geoscientific research that began at Lubbock Lake has expanded to encompass the entire region (Holliday 1985b, 1985c, 1989b, 1995c, 1995d, 1997a, 1997b; Holliday et al. 1996; E. Johnson 1986a, 1986b, 1989a, 1991, 1994a; E. Johnson and Shipman 1986, 1993; E. Johnson et al. 1982, 1986, 1987). The Late Quaternary paleoenvironments, therefore, are reconstructed from a regional data base with details from site-specific records.

Regional Setting

The Southern High Plains (or Llano Estacado) is an extensive plateau covering about 120,000 km² and bounded by escarpments on the east, north, and west. The southern portion of the High Plains surface grades into the Edwards Plateau (see Fig. 9.1). The region has a virtually featureless, constructional surface formed by deposition of thick, widespread eolian sediments (Blackwater Draw Formation) during the Pleistocene (Holliday 1989c, 1990; Reeves 1976). These sediments rest on eolian and alluvial deposits of the Ogallala Formation (Miocene-Pliocene) and locally on Pliocene and Pleistocene lacustrine sediments (Caran 1991; Hawley et al. 1976; Reeves 1972).

Slight topographic relief on the High Plains surface is provided by small lake basins, dunes, and dry valleys (Hawley et al. 1976; Holliday 1985b, 1995c, 1995d, 1997b; Holliday et al. 1996; Reeves 1972; Sabin and Holliday 1995; Wendover and Hester 1975). About twenty-five thousand small (less than 5 km²) depressions dot the landscape and contain seasonal lakes or playas. About forty larger (tens of km²) basins, known as salinas, are interspersed throughout the
Haragan 1983; Lotspeich and Everhart 1962).

The historic vegetation of the Southern High Plains is a mixed-prairie grassland, and the dominant native plant community is shortgrass (Blair 1950; Lotspeich and Everhart 1962). Trees are absent except along the escarpments and reentrant canyons. Native plant communities of the region occur in very few areas today, however, because most of the Southern High Plains is under cultivation.

The Southern High Plains has low, even environmental gradients, flat topography, and uniform regional geology. These topographic and geologic conditions prevailed throughout the Late Quaternary, suggesting that past environments were relatively uniform throughout the region and that geomorphic responses to climate were similar and synchronous. This situation, in turn, suggests that long-distance geological and paleoenvironmental correlations can be made with some degree of confidence.

**Cultural and Environmental Chronology**

Five general cultural periods are recognized for the Southern High Plains: Paleoindian (11,500 to 8500 B.P.); Archaic (8500 to 2000 B.P.); Ceramic (2000 B.P. to ca. A.D. 1450); Protohistoric (ca. A.D. 1450 to 1650); and Historic (ca. A.D. 1650 to 1950s). The Paleoindian period includes the latest Pleistocene to the earliest Holocene, when now-extinct mammals were hunted by people. The Archaic, from the latter part of the Early Holocene into the Late Holocene, is characterized by evidence for adaptation to drought and the systematic incorporation of plant use into the subsistence base. The Ceramic period, in the Late Holocene, is marked by the presence of both ceramic artifacts and arrow points. The Protohistoric period covers the time when Europeans were in the region, but their influence was manifested in neither the aboriginal material culture nor in the archeological record. The Historic period is denoted by European material culture in the archeological record, and it includes both aboriginal and Anglo-European occupations.
The environmental history of the past twelve thousand years on the Southern High Plains is divided into three periods based on stratigraphic evidence (Holliday 1985a, 1985b, 1989a, 1995c, 1995d, 1997a). The latest Pleistocene and Early Holocene are presented as a combined period covering the time from 12,000 to 7500 B.P., while the Middle Holocene dates from 7500 to 4500 B.P., and the Late Holocene dates from post-4500 B.P. The boundary between the Early and Middle Holocene previously was set at 6500 B.P. (e.g., E. Johnson and Holliday 1993), based on the Lubbock Lake record. Regional stratigraphic and paleoenvironmental studies have revised the age of the boundary to 7500 B.P. (Holliday 1995d). Environmental reconstructions for these periods are based on paleontological, sedimentological, pedological, and geomorphic data sets.

The chronological presentation in this chapter is based on uncalibrated radiocarbon ages. The chronology is not tree-ring calibrated because: (1) calibrations would confuse comparisons with other dated sequences from the region and surrounding areas, none of which is calibrated; and (2) many of the radiocarbon ages from the draws are in the range of only tentative calibrations (older than 10,000 B.P.) (Becker 1993; Stuiver 1993). Calibration of only part of the sequence is not a useful exercise.

**Paleoindian Period**

The Paleoindian period is subdivided on the basis of distinctive projectile point types (Frison 1991, 1993; Holliday 1997a; Wheat 1972; Wormington 1957) representing cultures that consistently have tightly clustered radiocarbon ages. On the Southern Plains, the Paleoindian period is subdivided into the Clovis (11,500 to 11,000 B.P.), Folsom (10,800 to 10,300 B.P.), and Late Paleoindian (10,000 to 8500 B.P.). The Late Paleoindian includes Plainview (ca. 10,000 B.P.) and Firstview (ca. 8600 B.P.) cultures.

The Late Pleistocene and Early Holocene sediments of most archeological significance are found in the draws that cross the region (see Fig. 9.1). The draws developed during the Pleistocene, probably the result of repeated cutting and filling, but their origin and chronology are poorly known (Holliday 1995c, 1995d). The oldest dated alluvial sediments are twelve thousand to eleven thousand years old. During this time, bedded sand and gravel was deposited in most draws, indicative of competent streams flowing in the drainages (Holliday 1995c, 1995d). Water ceased to flow, and lacustrine deposition, in the form of diatomite and sapropelic mud, began abruptly about 11,000 B.P. in some reaches in a number of draws. Otherwise, the streams continued to flow until about 9500 B.P. (Holliday 1995c, 1995d).

Paleoindian materials are common on the uplands of the Southern High Plains, but in situ finds are relatively rare (Holliday 1997a). The best in situ materials on the uplands are buried in playa fill. The lake basins underwent more or less continuous sedimentation during the Pleistocene period. Due to lack of exposure, however, only a few such sites are known. Many sites are reported from the dune fields, but most of the material is not in context. Reconstruction of the general stratigraphic setting, however, usually is possible. Dune construction began ca. 11,000 to 10,000 B.P., coincident with the Folsom occupation of the region. Episodicolian deposition continued into the Holocene, generally increasing in magnitude and frequency.

The paleoenvironmental record of the Late Pleistocene prior to the Clovis occupation (ca. 25,000 to 11,500 B.P.) only recently has begun to emerge. Data from vertebrate paleontology suggest that very generally, an equitable, humid, maritime-like climate occurred over the Southern High Plains, with cool summers, mild winters, and abundant precipitation (E. Johnson 1993a; Lundelius et al. 1983). Significant areas of open grassland environments existed on the Southern Plains, including parklands and savannas (Bryant 1977; Lundelius et al. 1983). The stratigraphy and stable carbon isotopes of leaves and playas, and limited pollen evidence, indicate that the environment between 25,000 B.P. and 15,000 B.P. alternated between cool/dry and cool/wet conditions, within an overall trend toward cooler and more humid conditions (Holliday 1997b; S. Hall and Valastro 1995). From 15,000 to 11,000 B.P., more frequent fluctuations of temperature and moisture occurred.

The Clovis environment was the final phase of the cooler, more moist conditions of the Late Pleistocene. Vertebrate remains, primarily from Lubbock Lake, indicate an equitable, humid, maritime paleoclimate with a lower mean annual temperature than today: cooler summers and warmer winters that lacked extended freezing conditions (E. Johnson 1986a, 1987b). Open grassland environments (mixed-grass prairie) existed on the uplands with parklands along the draws. Low gradient streams, with emergent vegetation and sedge beds along the banks, meandered through the draws. Mean annual temperature was about 10 to 13°C (E. Johnson 1986a, 1987b) compared to 15°C today (Bomar 1983; Haragan 1983). Summer temperature was lower by at least 5.6°C compared to today, with a winter temperature at or above 0°C (E. Johnson 1986a, 1987b). A winter rainfall pattern may have existed, coupled with cool, dry summers. These climatic conditions produced more effective moisture, lower evaporation rate, and greater humidity than today.

A Clovis age drought was proposed (C. V. Haynes 1991) for the region based on stratigraphic data from the Clovis and Miami sites, with the argument that megafaunal extinctions at the end of the Pleistocene were linked to that drought. This hypothesis is not supported by paleobotanical, paleontological, or other stratigraphic data from the regional draws, dunes, or playas (Holliday 1995c, 1995d, 1997a, 1997b; Holliday et al. 1996). The earliest evidence of warming and drying in the Late Quaternary is from the Folsom period (Holliday 1995d, 1997a, 2000).

Thirteen sites with evidence of Clovis age occupation are known on the Southern High Plains, beyond isolated finds, but only three (see Fig. 9.1) have yielded in situ evidence. Blackwater Draw Locality #1 (J. Hester 1972), the Clovis type site, yielded the most abundant evidence of Clovis occupation in North America. Located in a basin that fed Blackwater Draw, the most extensive area excavated revealed at least five mammoths that represented individual kill or scavenging events (J. J. Saunders 1980). Remains from horse, camel, and bison along with
the mammoth exhibited various lines of evidence of cultural modification and tool use (E. Hughes 1984; E. Johnson 1989a; J. J. Saunders et al. 1990, 1991). Radiocarbon dating of carbonized plants from the bone bed yielded an average age of ca. 11,170 B.P. (J. Hester 1972). Excavations elsewhere at the site yielded evidence of mammoth and bison that were scavenged by Clovis peoples (E. Johnson and Holliday 1997; J. J. Saunders and Daeschler 1994). One of these features was dated to ca. 10,780 B.P. (E. Johnson and Holliday 1997). Several Clovis points from this site were resharpened and reused as butchering tools (E. Johnson 1991).

At Miami (Sellards 1938), the remains of five mammoths (three adults and two juveniles) were found in sediments filling a playa-lake basin. Several interpretations were offered for the site, including a single event kill (J. J. Saunders 1980, 94) and scavenging (Holliday et al. 1994). Cultural modification of the bones was minimal (E. Johnson 1989a), but weathering was extensive (Holliday et al. 1994; E. Johnson and Shipman 1986). Apparent butchery hack marks could not be confirmed by scanning electron microscopy (SEM) analysis (E. Johnson and Shipman 1986). However, their presence would support a scaveng-activity interpretation (see J. J. Saunders and Daeschler 1994). Radiocarbon dates bracketed the Miami bone bed between ca. 11,400 and ca. 10,800 B.P. (Holliday et al. 1994). Clovis points from Miami were resharpened and used as butchering tools (E. Johnson 1991).

The Clovis age occupation level at Lubbock Lake (Fig. 3.2) dates to 11,100 B.P. (Holliday et al. 1983). At least six species of megafauna were processed, with their remains exhibiting cut lines, helical fracture surfaces, dynamic loading points, and evidence of tool use (E. Johnson 1985, 1987a, 1995b; E. Johnson and Holliday 1985; E. Johnson and Shipman 1986). Recovered mammoth limb elements were associated with two large caliche boulders. Mid-diaphyseal impact was used to fracture the humerus and produce radial diaphyseal segments (E. Johnson 1985). Although modified lithic tools were absent, a Clovis point was recovered from a dredge pile (the result of dredging operations that uncovered the site) that overlooked the area where the bone bed was located. The point was resharpened and used as a butchering tool (E. Johnson 1991; E. Johnson and Holliday 1987). The bone bed was subjected to some postdepositional disturbance, but the feature remained essentially in primary context (E. Johnson 1995a; E. Johnson et al. 1987; Kreutzer 1986, 1988).

The Clovis-Folsom transition (ca. 11,000 B.P.) on the Southern High Plains was a time of significant climatic and environmental change that continued into Late Paleoindian times (Holliday 1995c, 1995d, 1997a; E. Johnson 1986a, 1987b; Lundelius et al. 1983). Widespread extinctions denote this transition. Seasonality continued to increase, resulting in continued warming. Vertebrate faunas from Lubbock Lake and Blackwater Draw Locality #1 (E. Johnson 1986a, 1987a) indicate that higher mean annual temperatures and warmer summers prevailed during Folsom times. Winter temperatures were lower than in Clovis times, with sustained below-freezing periods. Minimum and maximum temperatures fluctuated near 21°C from highs greater than 30°C to lows below 0°C (E. Johnson 1986a, 1987b). Perennial streams persisted in the lower reaches of most draws, but marshes and some clear freshwater ponds with weedy growth appeared in the upper reaches (e.g., Blackwater Draw Locality #1) and in a few lower reaches (e.g., Lubbock Lake). Water levels in these ponds fluctuated; the water was centimeters to meters deep or it was at or below the surface, exposing the floor of the draw. The mixed grasslands habitat became dominant, with scattered deciduous trees on the draw slopes and around the ponds. Wet meadow grasses and sedge beds around the ponds graded into better-drained mixed grasslands along the valley floor. By 10,000 B.P., many of the streams ceased to flow and the ponds evolved into muddy marshes. On the uplands, playas and salinas continued to have seasonal, if not perennial, fresh water. Sand sheets formed, mainly on the western half of the Southern High Plains, indicating a regional reduction in vegetative cover (Holliday 1997a). This reduction was the result of warming and drying, marking the waning stages of pluvial conditions.

Folsom sites are numerous in the region (Holliday 1997a). Two sites on the Southern High Plains (Blackwater Draw #1 and Lubbock Lake) and two just off the High Plains (Lipscomb and Lake Theo) are in good stratigraphic context (see Fig. 3.1). At Blackwater Draw Locality #1 (J. Hester 1972), a series of small herds of bison were killed and butchered around the ponded spring waters. Radiocarbon ages date these kills between ca. 10,490 and 10,170 B.P. (J. Hester 1972). At Lake Theo (Harrison and Killen 1978; Buchanan 1998), at least eight to twelve bison were killed and butchered during the fall. An extended stay camp was associated with the bison kill, with transported tools in both activity areas. Expeditious lithic flake tools were common, with extensive use of local toolstone.

Lipscomb (Hofman 1991b; Hofman and Todd 1990; Hofman et al. 1989a, 1991b; Todd et al. 1990) appears to be a single-event, large-scale kill of at least fifty-five bison that took place in the late summer or fall. The topographic setting was on a terrace adjacent to a 2-m deep arroyo that existed at the time (Holliday 1997a). Butchering of the carcasses appears limited, with many still fully articulated. Some of the Folsom points have been reworked to extend their usefulness.
(Hofman 1992). Lipscomb now represents the largest single-event Folsom kill known for the Southern Plains.

At Lubbock Lake, Folsom occupations are represented by a series of bison kills around the marshy edges of ponds. Each kill was of a small cow-calf herd, and the animals were butchered on the spot using both expedient lithic and bone butchering tools (E. Johnson 1987a; E. Johnson and Holliday 1987). Bones were stacked in small piles representing butchering units. Lithic tools were either retouched or utilized amorphous flakes. Production of the bone butchering tools took place in the kill area, and the debris and tools were discarded there (E. Johnson 1985). Folsom points were refashioned and also resharpened for use as butchering tools (E. Johnson and Holliday 1987). Based on one kill analyzed for seasonality data, kills took place in the late fall and early winter (E. Johnson 1987b). The Lubbock Lake Folsom occupation is radiocarbon dated between 10,800 and 10,300 B.P. (Holliday et al. 1983, 1985).

The Late Paleoindian occupation of the Southern High Plains is represented by a variety of unfluted, lanceolate, post-Folsom projectile point styles. The best known are Plainview (Knudson 1983; Sellards et al. 1947) and Firstview (E. Johnson and Holliday 1987; Wheat 1972), but also represented in this group are constricted-stem styles such as Milnesand (E. Johnson et al. 1986; Sellards 1955) and Lubbock (Fig. 9.3; see Knudson et al. 1998).

Late Paleoindian environments are characterized by an intensification of the warming and drying trend that began during Folsom times (Holliday 1997a, 1997b). Effective precipitation decreased and maximum summer temperatures rose. Periodic droughts and disappearing surface water resources denoted the beginning of the trend toward modern climatic conditions. Seasonality was more strongly expressed with greater seasonal temperature fluctuations, decreased effective rainfall, and lowered humidity. Vertebrate faunas at Lubbock Lake indicated that valley-axis wet meadows/freshwater marshlands with emergent vegetation and sedge beds were available, grading into better-drained valley floors and margins with mixed-grass prairie (E. Johnson 1986a, 1987b). A scrub-grasslands, transitional from a mixed-prairie to a desert-plains grasslands, dominated the draws while the uplands probably were a short-grass prairie (E. Johnson 1986a, 1987a). Alkaline marshes began to dominate the floors of the draws by the end of the Paleoindian period (Holliday 1995d). These hydrologic changes resulted both from warming of water and from a reduction in effective precipitation that decreased the discharge of springs and seeps (Holliday 1995d). Deposition of eolian sediments in the draws, and as dunes on the uplands, became increasingly common (Holliday 1997a, 1997b). Playas and salinas held seasonal water as well as locally accumulated eolian sediment (Holliday et al. 1996).

Plainview occupations in good stratigraphic context are known from four sites or near the Southern High Plains (see Fig. 9.1). Plainview points are reported in collections from seven other sites in the region (Holliday 1997a). At the Plainview site (Sellards et al. 1947), the type locality (Fig. 9.4), a thick bone bed was embedded in pond deposits in an abandoned stream channel in Running Water.
Draw (Fig. 9.5). The bone bed represented at least two large-scale kill events that totaled more than one hundred bison. One kill took place in the spring while the other was in the early fall (E. Johnson 1989a). The lithic tool kit consisted primarily of Plainview projectile points (refashioned into butchering knives) with a few amorphous flake tools (Knudson 1983); bone butchering tools were not recognized. Two radiocarbon assays on bone yielded ages of 10,200 B.P. and 9860 B.P. (Speer 1986).

Testing at Lake Theo (Harrison and Killen 1978) yielded Plainview projectile points and other lithic tools and flakes in place stratigraphically above the Folsom occupation. This material may represent a number of camping events, as the lithics were spread out through a 40-cm deposit and no bone was recovered. A radiocarbon assay on soil humates yielded an age of 9950 B.P. (E. Johnson et al. 1982), while assays on bone yielded ages of 9360 B.P. and 8010 B.P. (Harrison and Killen 1978).

At Ryan's site (Hartwell 1991, 1995; Hartwell et al. 1989; E. Johnson et al. 1987), Plainview points (Fig. 9.6), large bifaces, and large flakes were found within lacustrine deposits of a very small, extinct playa that overlooked Yellowhouse Draw. The morphology of the points ranged from pristine to reworked. The site was a plow-disturbed cache (Fig. 9.7).

The Plainview occupation at Lubbock Lake is characterized by the continuation of kills of small herds of bison around the marshy edges of ponds, the clustering or grouping of bones in distinct concentrations, and a change in weaponry design and technology. The practice of resharpening and reusing the points as butchering tools continued. The lithic tool kit was complemented by a bone butchering tool kit made from the bison being processed in the locales. The Plainview occupation at the site is radiocarbon dated to 10,000 B.P. (E. Johnson and Holliday 1980).

Test excavations at Mark's Beach (Honea 1980) uncovered disarticulated remains from a bison in lacustrine deposits. Neither lithic nor bone tools were recovered, but a radiocarbon assay on bone yielded an age of 9920 B.P. (Honea 1980), and a sample of soil humates was dated at ca. 9710 B.P. (Holliday 1995d). Although this material was of Plainview age, whether or not it represents a cultural activity has yet to be determined.

Three Firstview sites have been excavated in the region (see Fig. 9.1). At Blackwater Draw Locality #1 (J. Hester 1972), Firstview occupations are present in the carbonaceous silts (Unit E [Haynes 1975, 1995]), but the stratigraphic, geochronological, and archeological situation of the material is not clear. Only a few radiocarbon ages are available from this unit, but at most it spans the period from ca. 10,500 to 8500 B.P. (Haynes 1995). At least three bison kill/butchering locales were excavated, two in the lower part of the silts and one in the upper part (Agogino et al. 1976; J. Hester 1972), while a possible fourth locale is mentioned in work by Agogino and Rovner (1969).

Nearer the center of the paleo-basin, a
large bone bed in the upper silts contained the remains of numerous bison in association with a suite of projectile points and amorphous lithic flake tools (J. Hester 1972; E. Johnson and Holliday 1997; Sellards 1952). Sellards (1952) based his Portales Complex on this suite of projectile points. Wheat (1972) reexamined the projectile points and concluded that most were resharpened variants of the Firstview design. Bones were jumbled and the deposit may have been trampled. At least three episodes of surface weathering are evident on the elements, indicating more than one kill event (E. Johnson 1986b; E. Johnson and Holliday 1997). Radiocarbon assays yielded ages of ca. 8970 B.P. and ca. 8690 B.P. that did not overlap at 2-sigma (E. Johnson and Holliday 1997). These dates fall within the age range for Firstview on the Southern High Plains (E. Johnson 1987c; E. Johnson and Holliday 1981) and indicate that at least two Firstview occupational events are represented at the Clovis site.

San Jon (Roberts 1942), on the northwestern edge of the Southern High Plains (see Fig. 9.1), was a stratified, multicomponent site (Fig. 9.8) where cultural activities took place along the edge of a playa basin (Fig. 9.9). The “San Jon” bone bed in Area II yielded a minimum of five bison, and articulated limb elements, particularly lower limbs, were common. Presumably, this bone bed represented a small-scale bison kill at the edge of the playa. The one projectile point recovered from the bone bed was the type specimen for the San Jon point (Roberts 1942), and its tip was reworked (Hill et al. 1995). Wheat (1972) subsumed the San Jon type into his Firstview type. Organic sediments from within the bone bed yielded an age of ca. 8360 B.P. (Hill et al. 1995).

At Lubbock Lake, Firstview peoples continued to hunt and butcher small herds of bison at the edge of the marshlands (E. Johnson and Holliday 1981). Bone concentrations and the stacking of elements continued. Bone fracturing was minimal, and therefore, bone tool manufacture and use were reduced and marrow processing was rare. The amorphous lithic flake tools were common, and Firstview points were resharpened and reused as butchering tools. The Firstview occupation at Lubbock Lake was radiocarbon dated to ca. 8600 B.P. (Holliday et al. 1983, 1985).

Fig. 9.7. Excavations at the Ryan site, an extinct small playa on the High Plains surface: a, excavations; b, c, crew working at the Ryan site.
Archaic Period

In the Early Archaic, during the latter part of the Early Holocene, available moisture and humidity levels continued to decrease, reflecting the intensification of the warming and drying trend and more marked seasonality. By the end of the Early Holocene, hard-water alkaline marshes, localized desiccation, and eolian sedimentation characterized deposition in the draws (Holliday 1989b, 1995c, 1995d). Marshes that persisted in the valley axes were surrounded by a treeless mixed-grass prairie. Sedge beds and wet meadows were absent (E. Johnson 1987a; Johnson and Holliday 1986). On the uplands, eolian sediments accumulated as sand dunes, in lunettes, and in playa basins as a result of reduced vegetation cover and drought-induced wind deflation of the High Plains surface.

Little is known about the Early Archaic, and Lubbock Lake (Fig. 9.10) and San Jon are the only excavated sites for this time period. The practice of hunting and butchering small herds of bison continued. A bone concentration representing several individual bison consisted of articulated to semi-articulated segments indicating butchering units. None of the elements had been broken for marrow. Neither lithic nor bone butchering tools were recovered, although numerous re-sharpening flakes indicated the use of several lithic tools. Radiocarbon ages on soil humates date the Early Archaic activity to ca. 8000 B.P. (E. Johnson and Holliday 1989). The camp at San Jon was dated to 8000 B.P. on charcoal.

By about 6000 B.P., the lakes and marshes in the draws had left significant accumulations of marl, but the dominant sediment across the region, in and out of the draws, was wind-blown material (Holliday 1989b, 1995c, 1995d). Eolian sedimentation was episodic but widespread from 9000 B.P. until 5500 B.P., with most areas affected by 6500 B.P. Between 5500 B.P. and 4500 B.P., eolian sedimentation occurred throughout the Southern High Plains. This eolian sedimentation culminated in significant filling of draws, construction of sand dunes, local sedimentation in playa basins, and additions to lunettes throughout the region. This eolian activity marked peak aridity in the Late Quaternary, and the period between 6500 B.P. and 4500 B.P. is known as the Alithermal (Holliday 1989b).

The Alithermal coincides with the Middle Archaic period. Conditions were hot, dry, and dusty (Holliday 1989a; E. Johnson and Holliday 1986). The massive eolian sedimentation that occurred indicates further reduction in vegetation cover, probably due to increased temperatures and decreasing effective moisture in the form of lower effective precipitation (Holliday 1995d, 1997b). Dental abnormalities in bison at this time indicate poor range conditions due to excess grit on the vegetation. The presence of yellow-faced gophers denotes semiarid to arid conditions (E. Johnson 1987b; E. Johnson and Holliday 1986). Open, treeless grasslands covered the valleys, and available surface water decreased considerably. Given the climatic conditions derived from geologic and faunal evidence, a desert-plains grasslands probably existed on the Southern High Plains during the Middle Archaic.
Excavated Middle Archaic materials in good stratigraphic context are documented at five sites (see Fig. 9.10). Three sites yielded evidence for the excavation of wells by prehistoric occupants in the Middle Holocene. At Blackwater Draw Locality #1 (Evans 1951; F. Green 1962) at least nineteen wells are known. At Mustang Springs (Meltzer 1991; Meltzer and Collins 1987) dozens of wells were discovered. Excavations at Marks Beach (Honea 1980) exposed a purported well. A hearth and associated Clear Fork gouge were recovered in Middle Archaic context from substratum 4A at 41LU26 (Bandy et al. 1981; E. Johnson and Holliday 1986).

Despite the harsh conditions, relatively intensive occupation continued throughout this period at Lubbock Lake. At least twenty-eight activity areas are known to include camping events, bison kill/butchering locales, and a large oven probably used for vegetal processing (E. Johnson and Holliday 1986). The oven is a large oval basin filled with ash and capped by a layer of burned caliche cobbles (Fig. 9.11). A broken, worn sandstone metate was found in the rock covering. This feature was radiocarbon dated to ca. 4800 B.P. (E. Johnson and Holliday 1986).

By 4500 B.P., the climate began to ameliorate and return to relatively cooler and more moist conditions that brought about landscape stability and environmental changes that generally have persisted into modern times. Sedimentation ceased, little wind erosion occurred, and a stable vegetation cover returned. Formation of the Lubbock Lake Soil at Lubbock Lake and similar soils at other localities occurred (Holliday 1985c, 1990b, 1995b, 1995c). This landscape stability heralded the establishment of essentially modern conditions and a continental climate. Range conditions improved, and a mixed-grass prairie replaced the probable desert-plains grasslands of the Middle Holocene, both in the draws and on the uplands. Localized marshlands returned to the valley axes with a resurgence of springs; occasional hardwood trees were found in the draws. On the uplands, playas and salinas held seasonal to year-round water (Holliday 1995c, 1995d; Holliday et al. 1996). More extensive surface water was available, indicating more available and effective moisture.

Fig. 9.10. Map of the Southern High Plains with locations of selected post-Paleoindian sites.

Fig. 9.11. Large caliche-capped, basin-shaped pit from the Middle Archaic at the Lubbock Lake Landmark.
Late Archaic archaeological materials rarely are found in stratified contexts because sedimentation during this time was very localized. Only three sites in the region have Late Archaic materials within good stratigraphic context (see Fig. 9.2). The lower midden at Chalk Hollow (Wedel 1975; Lintz 2000) records camping activities from at least three different events dating between 2,000 to 4,000 B.P. Corner- and side-notched Late Archaic points characterize the deposits.

At San Jon in Area III, F. H. H. Roberts, Jr. (1942), excavated a Late Archaic bison kill, the only excavated bison kill site for this time period on the Southern High Plains. A minimum of seven bison were killed and butchered at the edge of the playa. Based on the bone bed distribution map (Hill et al. 1995, fig. 7), skulls and mandibles were common, some articulated limb and vertebral units occurred (presumably representing butchering units), and bones or articulated units were disassociated from each carcass. Organic sediments from the substratum in which the bone bed occurs yielded an age of ca. 3600 B.P. (Hill et al. 1995). The two projectile points associated with the bone bed were not identified as type (Hill et al. 1995).

At Lubbock Lake, the Late Archaic is represented by at least nine occupation surfaces found buried within the A-horizon of the Lubbock Lake Soil. These surfaces are denoted by scattered burned caliche (from disturbed hearths), broken lithic tools, and both diffuse and concentrated lithic flaking debris. These artifacts appear to represent camping activities. Diagnostic artifacts have not been recovered with the occupation surfaces, but a Late Archaic age is based on stratigraphic position and radiocarbon ages associated with the stratigraphic unit (Holliday 1985a; Holliday et al. 1983, 1985). Because this A-horizon represents a stable land surface that existed well into the Ceramic period, Late Archaic and Ceramic age materials may be mixed in the uppermost occupation surfaces. A Late Archaic hearth has been excavated at 41LU29 (E. Johnson 1989b), on the eastern rim of Yellowstone Draw overlooking Lubbock Lake, and a Late Archaic age cache was recovered from 41LU6 in Yellowstone Draw less than 1 km upstream from Lubbock Lake (Buchanan 1995).

Archaeic age deposits have been investigated in the Justiceburg Reservoir (Lake Alan Henry) area on the Double Mountain Fork of the Brazos River, downstream from Lubbock Lake about 97 km. This area is situated in the same drainage system as Lubbock Lake and is just off the Southern High Plains, southeast of Lubbock, on the Rolling Plains. Most sites are in geographically unstratified deposits (D. Boyd et al. 1989, 1990). Site types identified include camp sites, rockshelters, bison processing stations or kill sites, and lithic procurement sites. At least six sites (41GR207, 41GR287, 41GR376, 41GR383, 41GR456, and 41KT49) have been identified as Archaic and another six (41GR741, 41KT33, 41KT34, 41KT52, 41KT53, and 41KT151) as Late Archaic in age based on excavated features (primarily hearths), radiocarbon ages, and artifact types (D. Boyd et al. 1990).

Ceramic Period
The past two thousand years on the Southern High Plains, encompassing the Ceramic, Protohistoric, and Historic periods, were characterized by shifts between ameliorated conditions (similar to the Late Archaic and modern times) and episodic droughts. This pattern of episodic drought continues today and indicates minor departures toward some aridity through increased temperatures and decreased effective moisture. Regionally, the details of this episodic pattern are not clear. Although these droughts appear not to have been severe enough to alter the modern Southern Plains faunal communities, they were severe enough to denude the land of vegetation and cause surface erosion that led to deposition and alteration of the landscape (Holliday 1985a, 1990b; E. Johnson 1987a). However, a range change for the prairie vole (Microtus ochrogaster) is an environmental indicator. Between 1830 and 1240 B.P., this vole reestablished itself on the northern portion of the Southern High Plains (Willey and Hughes 1978b), reflecting the ameliorated, more mesic conditions that prevailed after 4500 B.P. during the Late Archaic and early Ceramic periods. After 1240 B.P., Microtus ochrogaster no longer ranged onto the Southern High Plains. The periodic droughts progressively are less severe, or of shorter duration, or both. Coincident eolian activity in the dune fields records the same events (Holliday 1985c, 1995c, 1995d).

In upper reaches of the draws without spring activity during this time, slope-wash and eolian sedimentation occurred. But in the lower reaches, a spring-fed stream and wet meadow-marshland complex existed along valley axes for the past one thousand years (Holliday 1985a, 1995c, 1995d). Hackberry, native walnut, and mesquite grew along the valley floor and slopes. The local environs were those of a mesquite savanna surrounding a riparian marshland complex (E. Johnson 1987b).

The earlier part of the Ceramic period (ca. 2000 to 1000 B.P.) appears to have been one of transition from traditional Archaic lifeways—denoted by the retention of Archaic point designs—to a newer lifeway signaled by the adoption of technological changes brought about with ceramics and the bow and arrow. Three sites in the region with good stratigraphic context have dart points or mixed dart and arrow point assemblages (see Fig. 9.10). Camping features have been excavated at County Line, Blue Clay, and Deadman’s Shelter (J. Hughes and Willey 1978). At Deadman’s Shelter (Willey and Hughes 1978b), dart and arrow points have been found in association with pottery. Radiocarbon ages of ca. 1740 B.P. and 1830 B.P. are the earliest dates associated with arrow points and pottery in the region. Several bison kills (Twillia, Bell, Strong, Collier, Sitter, Finch, R.O., and Hoover sites) found just east of the Southern High Plains (see Fig. 9.10) contain a variety of Late Archaic point designs with radiocarbon ages that averaged 1387 B.P. (D. Hughes 1977).

This thousand-year transitional period also is characterized by corner-notched Scalvern arrow points and coarse-tempered cordmarked pottery (J. Hughes and Willey 1978). Only a few Scalvern-associated sites are known and they are not well dated. The upper midden at Chalk Hollow (Wedel 1975; Lintz 2002) dated to this time, as did occupation zones at Lake Creek (J. Hughes 1962) and Borger Bridge (J. Hughes and Willey 1978). At Lubbock Lake, this period of occupation is indicated by a hearth with associated camping debris that included a Scalvern point, modern bison remains, lithic tools and flakes, and bone beads (J. H. Kelley 1974). Downstream at
41GR291 (at Justiceburg Reservoir or Lake Alan Henry), a Deadman's point and Scollon points were found associated in a camp occupation (D. Boyd et al., 1990; see also D. Boyd, chapter 10, this volume).

The later Ceramic period (ca. 1000 to 500 B.C.) is characterized by a mixed assemblage of Puebloan trade pottery and Plains lithic tool types. The trade wares are dominated by Mogollon ceramics, representing the eastern variety of the Jornada branch of the Mogollon culture (see Perttula et al. 1995b). Numerous sites are known from this time period, but few occur in good stratigraphic context. Examples are such sites as Jim Arnold (Tunnel 1964), A769 (Harrison and Griffin 1973), Floydada Country Club (Word 1963, 1991), Montgomery (Word 1965), 41CB27 (Parker 1982), Pete Creek, Grape Creek, and Dockum Springs (Parker 1976), 41TY2 (Bave vanis et al. 1997; Pope 1991), the lower level at Slason Dump (Booker and Campbell 1978), Pettree (Riggs 1972), Gresham Lake (Breedling 1971), and Bull Hill (Shawn 1975).

At Lubbock Lake, game animal (modern bison, pronghorn antelope, coyote, and wolf) processing stations are found in serial stratigraphic position. Although these stations lack ceramics, radiocarbon and stratiographic context indicate this latter part of the Ceramic as the period of occupation (E. Johnson 1987a).

Protophistoric Period

Numerous Protophistic sites are known in the region, but again, few occupations are in good stratigraphic context. At Lubbock Lake, numerous occupation levels attest to intense and repeated use of the area. These levels are characterized by Garza points, occur in serial stratigraphic sequence, and have associated radiocarbon ages of 500 to 300 B.C. (Holliday et al. 1983, 1985; E. Johnson et al. 1977). Living surfaces with associated hearths as well as large game animal processing stations occur there.

Less than 1 km downstream from Lubbock Lake, Protophistic Garza occupations within a geologically stratified context have been excavated at 41LU26 and 41LU35 (Bandy et al. 1981). Wheat (1955) investigated a Garza camp site on the uplands overlooking Yellowhouse Canyon in the vicinity of Buffalo Springs Lake. Farther downstream at the Justiceburg Reservoir (Lake Alan Henry) area, several Garza occupations were tested (D. Boyd et al. 1989, 1990), while two sites (Longhorn and Headstream) spanning the Protophistic and Historic periods that may be Garza Complex sites were excavated (D. Boyd et al. 1990, 1993; D. Boyd and Peck 1992). The Garza type site (Runkles 1964) and the Lott site (Runkles and Dorchester 1987), in geologically unstratified context, are situated just off the Southern High Plains along tributaries of the Double Mountain Fork of the Brazos River.

Northeast of Lubbock Lake, in the Running Water Draw system, a Garza occupation within a stratified context was tested at the Floydada Country Club site (Word 1963, 1991) in Blanco Canyon near Floydada. Downstream about 5 km, Garza occupations, mixed in unstratified contexts with earlier and later components, also were investigated at the Montgomery site (Word 1965) and 41CB27 (Baugh 1992; Parker 1982). Northward in lower Tule Canyon, an excavated hearth at 41B183 dates to this time (Katz and Katz 1976), but it lacked diagnostic artifacts. Farther north, Jack T. Hughes (1971) tested a Garza occupation within a stratified context at the Canyon City Club Cave site along Palo Duro Creek at the outskirts of Canyon, Texas. West of Lubbock Lake just off the Southern High Plains, Garza sites (bison kill and camp sites) were excavated on the Mescalero Plains near Bottomless Lake (Speth and Parry 1978, 1980).

Historic Period

Historic period sites in good stratigraphic context are extremely rare on the Southern High Plains. This period is marked by the appearance of European trade goods and modern horse remains. It is subdivided into aboriginal Historic and Anglo-Historic times. At Lubbock Lake, numerous aboriginal Historic occupation levels are characterized by Washita points. These levels occur in serial stratigraphic sequence and have associated radiocarbon ages of 150 to 130 B.C. (Holliday et al. 1983, 1985). Processing stations are similar to ones in the Protophistic and Ceramic periods. They are distinctive, however, in the inclusion of the modern horse as a game animal.

Farther downstream, aboriginal Historic sites have been investigated at 41LU35 (Bandy et al. 1981), 41GR484, 41KT53, and 41KT69 (D. Boyd et al. 1990). Several historic rock art sites are present in the Justiceburg Reservoir (Lake Alan Henry) area (D. Boyd 1992; D. Boyd and Kibler 1993). Historic period glass trade beads from the 1700s have been recovered from 41CB27 (Parker 1982) in Blanco Canyon near Crosbyton and the Headstream site (D. Boyd and Peck 1992; Peck et al. 1993) at Justiceburg Reservoir (Lake Alan Henry). To the north, two probable Comanche sites have been excavated at Mackenzie Reservoir (J. Hughes and Willey 1978) in Tule Canyon, and distinctive hearths and post-1840 glass seed beads were recovered there. At Lubbock Lake, a Comanche occupation is represented by several activity areas that have yielded glass seed beads (Ladkin 1993, 1995), The Codell (Word and Fox 1975) and White (D. Suhm 1961) sites in Floyd and Yoakum Counties also contained glass seed beads.

European occupation of the Southern High Plains began in the middle to late 1800s. The first Europeans were buffalo hunters and U.S. military units, followed by shepherders (pastores), traders, ranchers, and settlers. Few excavations of these sites have been conducted. A buffalo hunter's camp, occupied sometime between 1874 and 1879, was tested at Justiceburg Reservoir (Lake Alan Henry) (41GR528 [see Freeman and Boyd 1990]). The pastores, Hispanic shepherders from New Mexico, began moving into the Canadian River valley in the early 1870s, and by the late 1870s small settlements, such as at Tascosa, were being established in the valley (Archeamber 1946; A. Taylor 1980), with the southernmost settlement at Merrell-Taylor Village (Guiffie 1976) on Quitaque Creek along the escarpment below Palo Duro Canyon. Test excavations and recording of rock corrals at the Ellis site (Hicks and Johnson 2000; Lichi 1994) in Yellowhouse Canyon near Southland, as well as at the Massie site (E. Johnson and Hicks 2000; Lichi 1994; Word 1980: in Blanco Canyon near Floydada, document the transhumance use of the Southern High Plains by the pastores. By the mid-1880s, the pastores had left the region and returned to New Mexico (Rathjen 1973; A. Taylor 1980).

At the northern end of the Southern
High Plains, excavations at Adobe Walls (T. Baker and Harrison 1986) along the Canadian River revealed a wide variety of European goods available to the area's occupants during the late 1860s to 1870s. Along Yellowhouse Draw in the east-central Southern High Plains, Singer Store was a trading post situated at Lubbock Lake from 1883 to 1886 (W. Holden 1974; Hicks 2002). Testing produced artifacts relating to the store and its activities, as well as artifacts attesting to buffalo hunting activity (E. Johnson 1987a; Hicks 2002). Archeological exploration occurred at one of the XIT Ranch headquarters (Jackson 1976) near Hereford.

Just off the Southern Plains in the Justiceburg Reservoir (Lake Alan Henry) area, testing of historic sites (Freeman and Boyd 1990) included that of a shepherder's camp dating from the 1880s (41GR443), several dugouts occupied between the 1880s and 1900 (41GR874, 41GR263, 41GR392, and 41KT150), an 1880s to 1920s line camp (41KT84), several homesteads (41GR250, 41GR474, and 41GR443), ranch headquarters (41GR13), and town building (41GR331).

Investigations at an Anglo-American dump in Lamb County documented two dumping periods at the site, one episode around 1915 and the other centered around 1935 (Hicks et al. 1994). These episodes corresponded with two periods of population increase for the city of Littlefield. At Lubbock Lake, Anglo-American dumps from the early twentieth century were tested. Dumping episodes centered around 1940 and 1955, corresponding to periods of population increase for the city of Lubbock (K. O'Brien 1995).

Summary Discussion

The Late Quaternary archeological and paleoenvironmental records of the Southern High Plains are well preserved in the drawings, dunes, and lake basins of the region. The fill in the drawings historically is most closely linked to the human history of the region because several now-renowned archeological sites have been discovered in these settings. The drawings also provide the most complete and sensitive regional environmental record so far available.

At the beginning of the Paleolithic occupation, the environment of the Southern High Plains was for the most part relatively cool and moist. The draws had perennial flowing water, and lake basins probably had permanent water.

By Folsom times, hydrologic conditions had changed. Less flowing water was available in the draws as spring discharge and runoff declined. Streams were replaced with ponds and marshes. Eolian sedimentation appeared in the stratigraphic record between 11,000 and 10,000 B.P., and eolian deposition in the draws, dunes, and playas became more widespread through the Early Holocene.

This deposition culminated in the Middle Holocene in significant filling of draws and construction of sand dunes. This eolian activity likely marked peak aridity in the Late Quaternary in response to increased temperatures and lower effective precipitation relative to the preceding or following periods. By about forty-five hundred years ago, a change in climate toward more moist and cooler conditions, relative to the Middle Holocene, brought landscape stability and environmental changes that have more or less persisted to the present. This stability resulted in little Late Holocene sedimentation in the region, other than in the draws.

This stratigraphic and paleoenvironmental scheme generally follows earlier reconstructions of the paleoecology of the Southern High Plains (see, e.g., Wendorf 1961; Wendorf and Hester 1975) but differs considerably in detail. The various Late Pleistocene and Early Holocene climatic intervals proposed in earlier schemes are not identifiable in the stratigraphic record now emerging due to problems of dating, stratigraphic correlation, and pollen preservation in the work that led to the earlier schemes (Holliday 1987, 1995d, 1997).

The known archeological record for the Southern High Plains provides a lengthy and rich heritage for the region. People have lived on and used the Southern High Plains for at least eleven thousand years, and perhaps for as long as people have been in the New World. Although varying through time in variety, quality, and plenitude, the environments of the Southern High Plains have provided ample natural resources for the various peoples inhabiting the region. This resource base is spread over large parameteric of seasonality, space, and time, and the abundance or scarcity of such resources as lithic materials, water, and wood on the Southern High Plains has influenced the adaptive responses to environment and environmental change as conditions went from pluvial, to xeric, to mesic. The relationship between environment and the people that occupied that environment, then, potentially could be well defined in such settings.

High-quality lithic materials were a localized resource at best, represented by Alibates agate at the northern edge of the region along the Canadian River and by Tecovas jasper at the eastern edge of the escarpment near Quitaque (e.g., Banks 1990; Holliday and Welty 1981). Ogallala Formation quartzites and cherts (generally of much poorer quality) were available along the escarpment and at localized outcrops within the draws (Holliday and Welty 1981). Due to this limited distribution, imported lithic resources, particularly from central Texas (Edwards Formation chert), played a major role in the adaptive strategies utilized on the Southern High Plains.

Resource availability of wood and water closely mirrored the climatic changes of the region. Both commodities were available regionally and were locally abundant during the Late Pleistocene and Early Holocene but became much more scarce and localized during the Middle Holocene (Holliday 1989b, 1995c, 1995d; E. Johnson 1987b; Melzer 1991). Surface waters in playas and draws increased again in the Late Holocene (Holliday 1995c, 1995d), with limited wood resources available only within the draws (E. Johnson 1987b). An episodic pattern of droughts for about the past two thousand years (Holliday 1985b, 1995c, 1995d, 1997b) undoubtedly affected long-term adaptive strategies. Coupled with the drought pattern for at least the last five hundred years were the steady influx of various groups of nonlocal peoples, from the Athabascans and Comanche to the pastores and Anglo-Americans, and the replacement of the indigenous people.

The long occupation of the Southern High Plains was primarily by hunter-gatherer peoples, presumably practicing a seasonal series of annual activities. In general, Clovis peoples had a broad-spectrum, meat-related subsistence base in
which they were hunting and scavenging a wide variety of game animals. With widespread extinctions, bison became the major game animal of post-Clovis peoples. Later Paleoindian peoples had a very narrow-spectrum, meat-related subsistence base, systematically cropping both small cow-calf herds as well as large mixed herds of bison. By the Middle Holocene, Archaic peoples had a mixed desert plant- and meat-related subsistence base, and they were forced to rely on wells for water in the western and southern part of the Southern High Plains. A mixed plant- and meat-related subsistence base continued throughout Late Holocene Ceramic through aboriginal Historic times, but with more mesic vegetation and abundant surface water (E. Johnson 1987b, 1991, 1994a; E. Johnson and Holliday 1986; Meltzer 1991).

The occupation of the Southern High Plains through time by these hunter-gatherer peoples appears to have been undertaken by small groups of people for both economic (hunting, plant processing, and tool production and rejuvenation) and short-term residential uses, with repeated use of the landscape as well as differential use of landscape features. Key aspects missing from the record are long-term home bases and quarries for lithic resources. Quarries must have existed along the outcrops of Alibates and Tecovas, but they have not been documented. Quarrying of outcrops of Ogallala Formation materials has been documented on the Rolling Plains just off the eastern escarpment in the Brazos River drainage (E. Johnson 1994b).

Various Late Holocene peoples along the Canadian River and associated drainageways, in particular the Antelope Creek peoples (see Brooks, chapter 11, this volume), practiced agriculture that modified or changed lifeways and social organization. This lifeway was brief on the Southern High Plains, being practiced for much less than one thousand years and apparently coming to an end in the A.D. 1400s as outsiders moved into the region. From then on into the 1800s, aboriginal occupation of the northern Southern High Plains was again by hunter-gatherers.

By the 1860s, a quick succession of non-native peoples began using the Southern High Plains for economic purposes and then settling the region. By the late 1870s this intrusion brought the aboriginal occupation of the region to a close. The use of land and other resources changed dramatically from the aboriginal patterns to patterns of the non-native peoples. The buffalo hunters decimated the bison herds while the pastures and ranchers used the plains grasslands to pasture domestic stock (sheep, then cattle). The early settlers plowed the grasslands to raise domesticated crops. By the turn of the twentieth century, towns were being established on the uplands, away from the traditional aboriginal resource bases of the draws and playas.

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