OCS Study
MMS 99-0068

SPATIAL DATA ANALYSIS OF ARTIFACTS REDEPOSITED BY COASTAL EROSION: A CASE STUDY OF MCFADDIN BEACH, TEXAS

VOLUME I

U.S. Department of the Interior
Minerals Management Service

ERRATA SHEET

Page 121 (corrects symbol used for latitude and longitude degrees from □ to °)

Table 10. GPS Coordinates of McFaddin Beach Landmarks

Landmark	Latitude	Longitude	Accuracy
1. Water Tank	29° 39' 30.95" N	94° 06' 7.09" W	± 15 meters
2. Cattle Pens (east)	29° 38' 45.02" N	94° 08' 12.94" W	± 15 meters
3. ARCO Pipeline	29° 37' 16.37" N	94° 11' 59.77" W	± 9 meters
4. Chevron Facility	29° 36' 28" N	94° 14' 01" W	± 30 meters
5. Salt Cedar Tree	29° 35' 27.02" N	94° 16' 42.66" W	± 15 meters
6. Yellow Trailers	29° 34' 44.06" N	94° 18' 31.41" W	± 12 meters
7. Cattle Pens (west)	29° 34' 04.34" N	94° 20' 15.47" W	± 15 meters
8. Intersection of Highways 87 & 124	29° 32' 58" N	94° 23'17" W	± 30 meters

Page 143 (corrects symbols used in equation and in the text discussing the equation)

$\bar{r}_e = 1/(2\sqrt{p})$
where $p = (n-1)/A$
where n is the number of points in the data set
where A is the area in square meters of the study area

Randomness (R) of the spatial distribution of a data set is determined by the actual mean distance to the nearest neighbor ($\bar{r}_o$) for the data set divided by the expected mean distance to the nearest neighbor for a random distribution of the same number of points ($\bar{r}_e$). If the R value is close to 1.0, the distribution is random; if R is less than 1.0, the distribution tends towards clustering; and if R is greater than 1.0, the distribution tends towards regularity.

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by

Melanie J. Stright
Eileen M. Lear
James F. Bennett

Prepared for

U.S. Department of the Interior
Minerals Management Service
Herndon, VA

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SPATIAL DATA ANALYSIS OF ARTIFACTS REDEPOSITED BY COASTAL EROSION: A CASE STUDY OF MCFADDIN BEACH, TEXAS

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ABSTRACT

This study was undertaken to test the proposition that significant archaeological information can be extracted from a secondary deposit of artifacts found along a rapidly eroding coastline. The study area is McFaddin Beach, a 32-kilometer-long stretch of shoreline along the southeast coast of Texas. The artifacts included in the study were collected over a period of 26 years by five local collectors who kept detailed maps and records of each artifact find. The diagnostic artifacts in the study collection represent all cultural periods from Paleoindian to Historic.

The method of analysis used a Geographic Information System, ARC/INFO, to synthesize information on the paleogeography of the coastal area where the lag deposit of artifacts was found and to conduct spatial analysis of the individual artifacts and their attributes. The results of the study indicate that even though the primary archaeological context of the artifacts has been destroyed, by reconstructing the larger paleogeographic context of the eroded sites and studying the attributes and spatial distribution of the artifacts in the lag deposit, some important archaeological conclusions can be drawn.

These conclusions include information on how the prehistoric human populations of the McFaddin Beach area shifted through time and why, the general activities and the lithic procurement strategies of these populations, and the possible locations of the original archaeological sites from which the artifacts were eroded.

ACKNOWLEDGMENTS

This study was funded entirely by the U.S. Department of the Interior, Minerals Management Service, in support of their sand and gravel leasing program. Words truly are inadequate to express my deep gratitude to the following people for their assistance in completing this study.

Without the diligent efforts of Paul Tanner of Port Arthur, Texas, there would have been no useable data upon which to base this study. In 1983, Paul began keeping detailed records of the artifacts he found at McFaddin Beach, including numbering the artifacts, recording each find in a log book, and plotting the artifacts on a base map. Paul also encouraged other collectors to begin keeping similar records. Throughout the study, Paul continued to provide maps, references, photos, and most importantly his ideas, which I hope have been accurately reflected in this final manuscript. I would also like to thank Paul's wife, Nell, for graciously allowing me the use of their home as a base of operations and for always making me feel welcome.

I am also extremely grateful to the other four collectors, whose artifact collections were used in this study, for their diligent efforts in keeping detailed records of their artifact finds, and for entrusting me with their artifact collections for weeks at a time. These include Murray Brown and Joe Coen, both of Groves, Texas; Jessie Fremont of Orange Field, Texas; and Joe Louvier of Port Arthur, Texas.

I am deeply indebted to the following people for their assistance in helping me analyze the artifacts and compile the artifact database. John Greene, archaeologist for the Minerals Management Service, Gulf of Mexico Region, provided invaluable assistance to me in obtaining the GPS positions for the landmarks along McFaddin Beach. John also assisted me in defining the level of mechanical wear and in recording the ultraviolet light responses of the artifacts in the study collection. Larry D. Banks, then Senior Fellow, Institute for the Study of Earth and Man, Southern Methodist University, and Nathan Banks, a graduate student in Anthropology at the University of Texas at Arlington, provided me technical assistance in the identification of the lithic source materials for the artifacts in the study collection. The lithic source identifications were an invaluable addition to the study. Dr. Dee Ann Story, Professor Emeritus in Anthropology, University of Texas at Austin, volunteered her time to assist me in identifying the diagnostic types of the artifacts in the study collection. Dee Ann's assistance contributed immeasurably to the quality of the study results. Dr. Bob Morton of the Bureau of Economic Geology, University of Texas at Austin, provided much needed background information on the geology of the McFaddin Beach area. He also provided me the ARC/INFO coverages of the historic shoreline positions for McFaddin Beach used in the study.

I could not have completed the ARC/INFO analysis for this study without the assistance of James F. Bennett, Environmental Protection Specialist for the Environmental Division, Minerals Management Service, in Herndon, Virginia. Jim was the brains behind some of the more difficult ARC/INFO procedures, such as mathematically correcting the distortion in the collector's artifact locations. Whenever I hit an ARC/INFO wall, Jim was there to pick me up and point me in the right direction.

Words really cannot adequately express the thanks I owe to Eileen Lear, Writer/Editor for the Environmental Division, Minerals Management Service, Herndon, Virginia, who prepared all of the figures, tables, and appendices for the report from my very rough drafts. Eileen spent almost as much time working on the report as I did in writing it. Her professionalism and the quality of her work vastly improved the quality of the report.

Finally, I would like to thank Professors Richard J. Dent and Charles W. McNett of the American University, Washington, D.C., and Dr. Lawrence E. Aten, for their careful review of the study report and for providing suggestions that greatly improved the quality of the final report.

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CHAPTER I

INTRODUCTION

Research Problem

In this study, I test the proposition that after an archaeological site has been severely eroded by wave action, significant archaeological information can be extracted from the lag deposit of durable artifacts remaining. To dismiss such secondary archaeological deposits as of no archaeological value is to further bias, and needlessly so, our understanding of the prehistoric past.

This study employs a Geographic Information System both in the synthesis of existing paleogeographic information for the study area and in conducting spatial analysis of the artifacts in the beach lag deposit. This analysis made it possible to predict the locations of the original archaeological sites from which the artifacts were derived and to interpret those sites in their proper paleoenvironmental context. Furthermore, analysis of the attributes of the individual artifacts, such as diagnostic type, function, lithic source material and degree of resharpening, allowed some general conclusions to be drawn about the prehistoric human groups that lived within the study area. Although the present study is concerned with sites that have been disturbed by wave erosion at the coastline, the general methods employed in this study would be useful for analyzing other secondary deposits of artifacts.

This research is based on a case study of an extensive lag deposit of stone and bone artifacts that have been eroded out of primary context by wave erosion at McFaddin Beach, a 32-kilometer-long stretch of beach along the southeast coast of Texas (Figure 1). Local residents have been collecting artifacts at McFaddin Beach for the last 30 years. There are at least 3,000 artifacts in known collections from McFaddin Beach; however, the present study is limited to an analysis of 880 artifacts in five collections for which the collectors maintained accurate maps and logs of the artifact finds. The artifacts span all cultural periods from Paleoindian to Historic.

Archaeologists have long recognized that the information contained in an archaeological site is derived from both the artifacts and site features as well as from their positions relative to each other and to features in the natural environment. Once this site context has been altered or destroyed, the amount of cultural information that may be obtained from the secondary deposits of artifacts is greatly reduced.

Archaeologists use the terms “primary deposit” and “secondary deposit” to distinguish between undisturbed archaeological site deposits formed by in-place cultural deposition and archaeological materials that have been moved from their primary cultural context by environmental processes. However, this distinction is far too simplistic and leads to the implicit, though often erroneous, assumption that direct correlations can be drawn between archaeological materials in primary context and past human behavior (Schiffer, 1983 and 1987). The corollary of this implicit assumption is that secondary archaeological deposits are of little use in gaining insight into past human behavior.

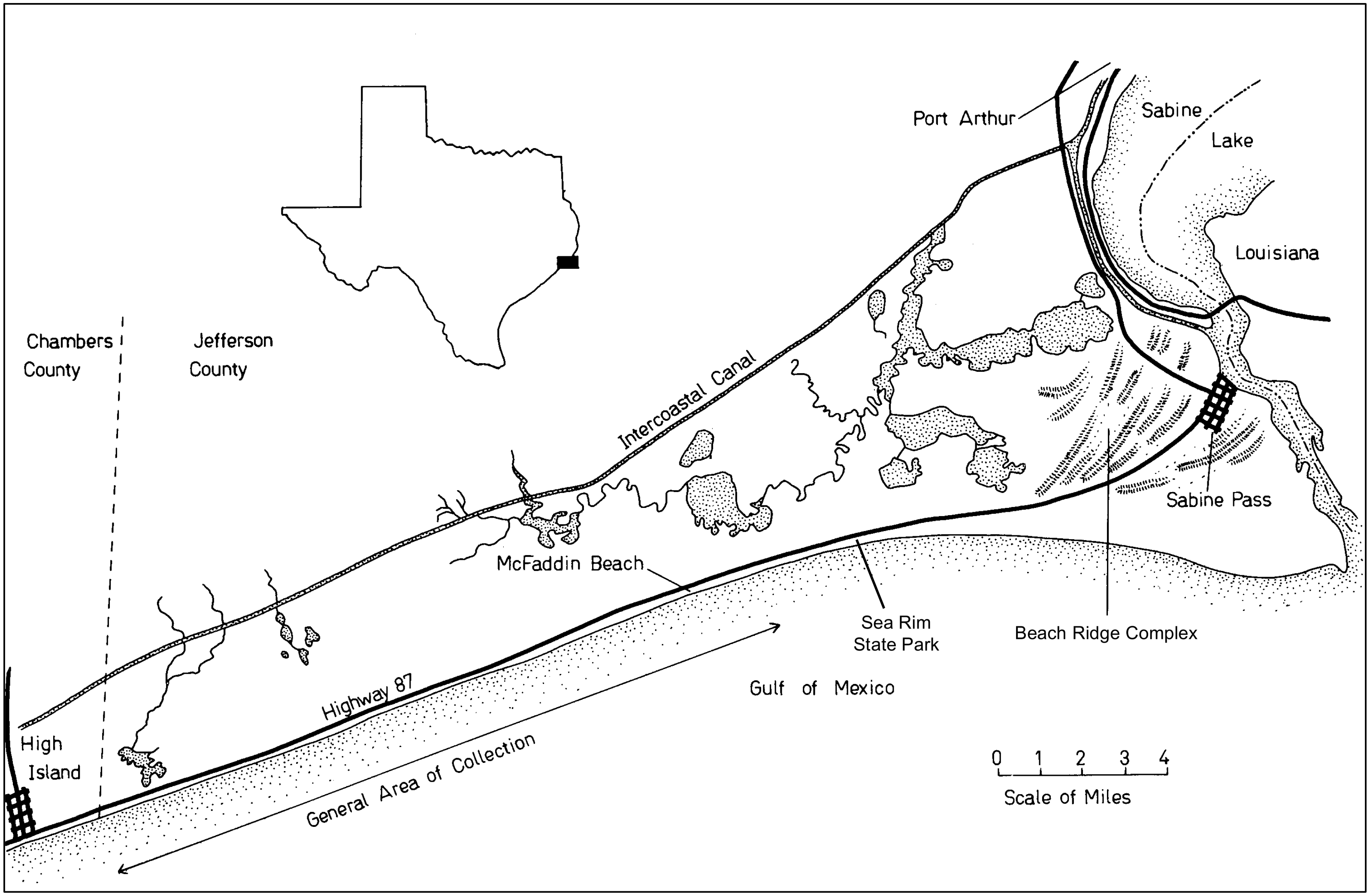

Figure 1. Map of McFaddin Beach (from Long, 1997)

Chapter II contains a review of the existing literature on the archaeological analysis of disturbed site deposits.

Even when the primary context of an archaeological site has been destroyed, the more general paleoenvironmental context of the site can be reconstructed using relevant geological and palynological data. Once reconstructed, the paleoenvironmental context of the disturbed site can provide insights into the prehistoric human behaviors that favored selection of the general area for habitation, resource exploitation, or other human uses. Chapter III is a compilation of available paleoenvironmental information for the McFaddin Beach area.

The very presence (or absence) in the general study area of artifacts of various ages and functions, and manufactured of rock from various lithic sources, can provide information on prehistoric human behaviors such as lithic resource procurement strategies, types of activities that took place within the study area at various time periods, and spheres of cultural contacts. Chapter IV is a discussion of the artifacts that form the study collection, their various attributes, and conclusions that can be drawn from analyzing these artifacts as a group.

It is also possible that some remnant patterning may exist in lag deposits of artifacts. This patterning may provide insights into the location of the original site deposits or may serve to illuminate the way the disturbing agent, in this case wave erosion, has redistributed the artifacts. Chapter V is a discussion of the spatial patterning of the artifacts and their attributes and how these patterns may relate to the original archaeological site locations and to the paleogeography of the study area.

Description of the Study Area

McFaddin Beach is the area along the southeast coast of Texas from Sea Rim State Park west to High Island (Figure 1). The beach has been eroding at an average rate of 3.7 meters per year since 1974 (Morton, 1997). This erosion is caused by several factors: 1) subsidence of the land surface due to the continuing extraction of subsurface fluids (oil and water) from the coastal zone; 2) continued sediment and water loading of the Gulf of Mexico basin and continental shelf; 3) the continued slow eustatic rise in sea level; and 4) low sediment supply to the area (Morton, 1997). The beach is accreting east of McFaddin Beach at Sabine Pass which is marked by a series of beach ridges that began forming approximately 2,800 years ago (Morton, 1988). The beach is also accreting west of McFaddin Beach, just beyond High Island where the Bolivar Peninsula, a barrier spit, is forming across the eastern end of Galveston Bay. Barrier spits form when sediments being transported by the longshore current encounter the cross flow of water being discharged into the ocean from a river or embayment; in this case it is the outflow of the Trinity/San Jacinto Rivers and other major local drainages from Galveston Bay. An extensive fresh-to-brackish-water marsh interspersed with lakes and mud-filled ponds exists just behind the dune line at McFaddin Beach.

The McFaddin Beach area lies along the transition zone between two major physiographic provinces: the Eastern Woodlands and the Southern Great Plains. Therefore, the prehistoric archaeology of the area reflects cultural influences from both the Eastern Woodlands and the Great Plains (Johnson, 1989; Wyckoff and Bartlett, 1995).

Theoretical Framework

There are currently two main schools of thought regarding how archaeological data are to be viewed and interpreted, Processual and Post-Processual. The Processual school of thought views the archaeological record as an objective reality in the present comprised of the static material remains of dynamic human behavior in the past (Binford, 1983 and 1989). According to Binford, the only way to understand the dynamic human behavior that produced the archaeological record is by building Middle Range Theory using ethnographic, ethnohistoric, and experimental data (Binford, 1983). Binford argues that without the building of Middle Range Theory, there is no basis for inferring past human behavior that can be empirically tested. Processual archaeologists consider cultural change to occur in response to external, primarily environmental factors.

Schiffer (1983 and 1987) proposes that the Processualist approach is somewhat simplistic, in that it views the archaeological record as a present static representation of past human behavior from which direct inferences can be drawn. Instead, Schiffer maintains that the archaeological record is not only a record of past material culture, but also of all cultural and natural processes that have intervened to modify those cultural materials since their original deposition. In order to infer past human behavior from archaeological materials, Schiffer maintains that one must first understand and adjust for the cultural and natural processes that have disturbed that record (Schiffer, 1983 and 1987).

The Post-Processual school of thought argues that the archaeological record is not an objective reality that can be measured and recorded, because even in the process of recording archaeological data, the researcher’s personal and cultural biases and perceptions are introduced into the data (Hodder, 1985). Post-Processualists view the archaeological record as a text full of symbolic meanings, to be decoded in the context of the past culture, and cultural changes resulting primarily from social conflict between age groups, the sexes, and clans or lineages.

In comparing and contrasting these two schools of thought, Patrik (1985) suggests that they actually address two different levels of archaeological analysis. The Processual approach focuses on reconstructing the context of past material culture from archaeological materials and paleoenvironmental data. This past cultural context is a prerequisite for the Post-Processualist interpretation of symbolic meaning. Processual and Post-Processual archaeology represent two different levels of analysis. The nature of the archaeological data will determine which approach is more appropriate, or even possible.

The nature of the archaeological data from McFaddin Beach, Texas, most readily lends itself to analysis and interpretation through the Processualist approach, as modified by Schiffer. The original site deposits at McFaddin Beach have been so extensively modified that no primary cultural context remains for any of the artifacts, and the early prehistory of this area is not sufficiently understood to provide a general cultural context upon which to base interpretations (Aten, 1983:99). This understanding of the cultural context would be necessary to employ the Post-Processualist approach. Schiffer's approach is especially suited to the highly disturbed archaeological deposits at McFaddin Beach because it recognizes that the natural environmental processes that have acted to modify the archaeological record must be considered to correctly interpret the archaeological implications of the data.

The Processualist approach does not advocate the "environmental determinism" of cultural systems; however, it does embrace the concept that the environment often constrains the alternatives available to a cultural system. Aten suggests that, due to the extremely dynamic nature of the post-Pleistocene geologic processes acting on the upper Texas coast, environmental constraints played an important role in shaping the prehistoric cultural systems of the upper coast:

> Concurrently with the climatic changes, there also were major alterations taking place in the geographic configuration of the upper coast. Assuming that human populations adapt to limiting conditions in their environment, the extensive geographic and climatic modifications of the period from roughly 12,000-2,000 years ago brought significant stresses to bear on the cultural systems. (Aten, 1983:159)

Methodology

The first phase of this study involved recording 40 different attributes for each of the 880 artifacts in the study collection. Some of the information recorded pertains to prehistoric human behavior (e.g., tool function, lithic source identification, heat-treatment, and resharpening). Other information (e.g., date of find, location, patina, and wear) was recorded primarily for the purpose of understanding the manner in which wave erosion had redistributed the primary site deposits. Eighteen of the attributes recorded are color descriptions of the lithic material, 15 of which use the Munsell color chart designations. The color data were recorded as part of the lithic source identification and also for the purpose of understanding how ultraviolet response of a given lithic material varies with weathering. The information collected for each artifact is discussed in detail in Chapter IV.

Existing information on the paleoenvironment of the study area was also compiled for the purpose of placing the artifacts in their proper paleoenvironmental context. The paleogeographic, paleoshoreline, and paleoclimatic data used in this study are discussed in Chapter III.

I used the Geographic Information System, ARC/INFO workstation version 7.1.2 (Environmental Systems Research Institute, 1997a), to create map layers (coverages) of all artifact and paleoenvironmental data for the study area. The ARC/INFO artifact data file contains discrete UTM X and Y coordinates for each of the 880 artifacts in the study collection. I joined the 40 fields of information (attributes) for each artifact, such as diagnostic type, function, weight, etc., to the coordinate data in the ARC/INFO data file. This allowed me to conduct spatial pattern searches for any combination of the artifact attributes. I also created ARC/INFO coverages that depict various aspects of the study area's paleoenvironment, described in Chapter III. Using ARC/INFO, I was able to analyze spatial relationships between features within a single data layer or between features in multiple layers of different data. Finally, I imported the ARC/INFO data layers (coverages) into ArcView PC version 3.0a (Environmental Systems Research Institute, 1997b), which allowed me to conduct statistical analyses of the spatial patterns observed in the data.

CHAPTER II

CURRENT STATE OF KNOWLEDGE

Previous Research at McFaddin Beach

In 1977, Russell J. Long published a booklet containing photographs of 161 stone and bone tools that had been found by local artifact collectors at McFaddin Beach, Texas (Long, 1977). This publication gave only very general locations for where each artifact had been found (i.e., upper, middle, and lower beach); however, the report does provide a good overview of artifact types that had been found at the beach. In 1975, one of Long's students, Jeffery Russell, wrote his Master's thesis on the faunal material that had been recovered from the beach (Russell, 1975). Russell recorded 38 different taxa of vertebrate fauna, 16 of which are now extinct (Story et al., 1990:182). In 1978, based largely on the information published in Long (1977), the Texas Historical Commission completed site forms for McFaddin Beach and it was given the site number 41JF50.

In 1991, Dee Ann Story, Ellen Sue Turner and one of the local collectors, Paul Tanner, organized a conference on the McFaddin Beach site. This conference, held in Port Arthur, Texas, brought together collectors, avocational archaeologists, and professional archaeologists to view and photograph 27 private artifact collections from McFaddin Beach (Hester et al., 1992). No systematic research effort resulted from this conference; however, as a result of the conference, Turner and Tanner (1994) published new information on the types and numbers of artifacts that had been collected at the beach and a map showing the general areas of artifact concentration.

The first subsurface testing at the McFaddin Beach site was conducted in 1983 by Coastal Environments, Inc., of Baton Rouge, Louisiana (Pearson and Weinstein, 1983). Coastal Environments, Inc., had been contracted to conduct archaeological investigations along a proposed pipeline right-of-way that crossed McFaddin Beach approximately midway between High Island and Sea Rim State Park. Four backhoe trenches were dug: two across the beach deposits, and two within the high marsh behind the dune line. The top of the Pleistocene deposits was encountered at depths of 1.5 to 1.9 meters below the surface. No cultural or faunal material was recovered from the backhoe trenches.

Literature on Disturbed Sites

Since Long's 1977 publication, many archaeologists, including myself, have been aware of the intriguing amount and range of archaeological materials being recovered by local collectors at McFaddin Beach. However, it has been the general consensus that such lag deposits of artifacts from severely disturbed sites have little research value. Indeed, some archaeologists view any archaeological data that are not from undisturbed, buried site contexts as of little use (Moeller, 1983:27, as cited in Lepper and Meltzer, 1991:179).

However, there are no "pristine" primary archaeological deposits; rather all archaeological deposits have been disturbed to some degree by cultural and environmental processes. Further, artifacts, themselves, often have been modified by cultural processes such as reuse and recycling (Schiffer, 1987). The nature and extent of the cultural and environmental processes that have modified the artifact or deposit must be identified, and the effects taken into account in drawing inferences about human behavior from the data.

Published literature on site formation processes (Rick, 1976; Talmage and Chesler, 1977; Bowers, Bonnichsen, and Hoch, 1983; Stein and Farrand, 1985; Schiffer, 1983 and 1987; Goldberg, Nash and Petraglia, 1993) reflects a growing awareness among archaeologists that the effects of natural processes as well as cultural processes must be considered in interpreting the archaeological record. The nature and extent of the natural processes that have contributed to the present configuration of an archaeological deposit must be understood for an accurate interpretation of the cultural material. In some cases, understanding the natural processes that have disturbed an archaeological site may even allow some further reconstruction of the original site configuration.

Most of the existing literature that addresses the problem of analyzing artifacts out of primary context has focused on archaeological deposits disturbed by agricultural activities (Medford, 1972; Roper, 1976; Talmage and Chesler, 1977; Dunnell and Simek, 1995; Shott, 1995) and on localized disturbances of archaeological sites by such natural processes as bioturbation and cryoturbation (Bowers, Bonnichsen, and Hoch, 1983; Schiffer, 1987), stream erosion (Isaac, 1968; Turnbaugh, 1978) and down-slope migration of site deposits (Rick, 1976). However, there is little published literature on the effects of natural processes that operate along the open coastline, such as wave erosion, longshore current transport, and storm surges on archaeological site deposits.

The scant published literature that addresses the effects of shoreline processes on the movement and redistribution of archaeological materials pertains primarily to impounded water bodies, such as lakes and reservoirs, not the open coastline (Lenihan et al., 1981; Will and Clark, 1996). One exception is Reinhardt (1993), who reports on his investigations of artifact distribution patterns at the Pingasagruk site along the north coast of Alaska, where wave erosion has redistributed artifacts from known onshore archaeological site deposits. Reinhardt notes certain consistencies in the size, shape, and density of artifacts that are found in different areas of secondary site deposits, indicating that a sorting process occurs as a result of erosion by marine processes (Reinhardt, 1993:511). Isaac (1968) found that fluvial action also will sort artifacts according to the total surface area and density of the artifact. Turnbaugh, in his study of archaeological sites disturbed by a major flood event in the western Susquehanna River drainage, also concludes that flowing water may sort artifacts according to size, shape, and density (Turnbaugh, 1978:605). There is an extensive body of literature on the movement of sand, silt and clay-sized particles (i.e. less than 2 millimeters in diameter) in the marine environment; however, the much greater size, density, and surface area of most artifacts makes this literature of little use in understanding how artifacts will move in the marine environment.

Although the primary focus of Will's and Clark's research was site erosion along the shoreline of a large impounded water body, Moosehead Lake in western Maine, they also conducted a preliminary experiment on artifact movement at a medium-energy coastal beach in southeastern Maine (Will and Clark, 1996:510). Their experimental findings indicate that: 1) even over relatively short periods of time, artifacts can move tens of meters from their original location; 2) an artifact will continue to move in the shoreline environment until it is either stranded beyond the reach of subsequent wave activity or until it becomes lodged against a larger immovable object; 3) artifacts will tend to move up the beach slope and down the shore in the same direction as the predominant direction of the wind; and 4) the damage to an artifact is proportionate to the amount of time it is exposed to wave action on the exposed beach.

My present research on the secondary deposits of artifacts at McFaddin Beach, Texas, will contribute to our understanding of how durable archaeological materials are redistributed by wave erosion and longshore current transport on the open coastline and also will establish a method for obtaining important archaeological information from such severely disturbed archaeological site deposits.

CHAPTER III

PALEOENVIRONMENTAL SETTING OF THE STUDY AREA

Paleogeography

Relative sea level along the southeast coast of Texas at 11,500 B.P. was approximately 48 meters lower than present (Emery and Garrison, 1967). At that time, McFaddin Beach was an upland area above the ancient Sabine River Valley (Nelson and Bray, 1970). The ancient Sabine River Valley ran east-northeast/west-southwest, roughly paralleling the present coastline (Figure 2). The Sabine River was joined by the Mermentau and Calcasieu Rivers from the east (Nelson and Bray, 1970) and the Trinity and San Jacinto Rivers from the northwest to form one large river that discharged into the Gulf of Mexico (Aten, 1983:117; Thomas and Anderson, 1994). Suter and Berryhill (1985) mapped two relict deltas near the edge of the present continental shelf at a depth of about 200 meters below present sea level. These deltas were probably formed by the collective discharge of these rivers into the Gulf of Mexico during the late Wisconsinan maximum low standin sea level.

Nelson and Bray's map of the drowned and buried valley of the ancient Sabine River indicates two possible tributaries flowing into the valley from the north (Figure 2). There are insufficient seismic and borehole data in the offshore area between the ancient Sabine River Valley, as mapped by Nelson and Bray (1970), and the present shoreline to

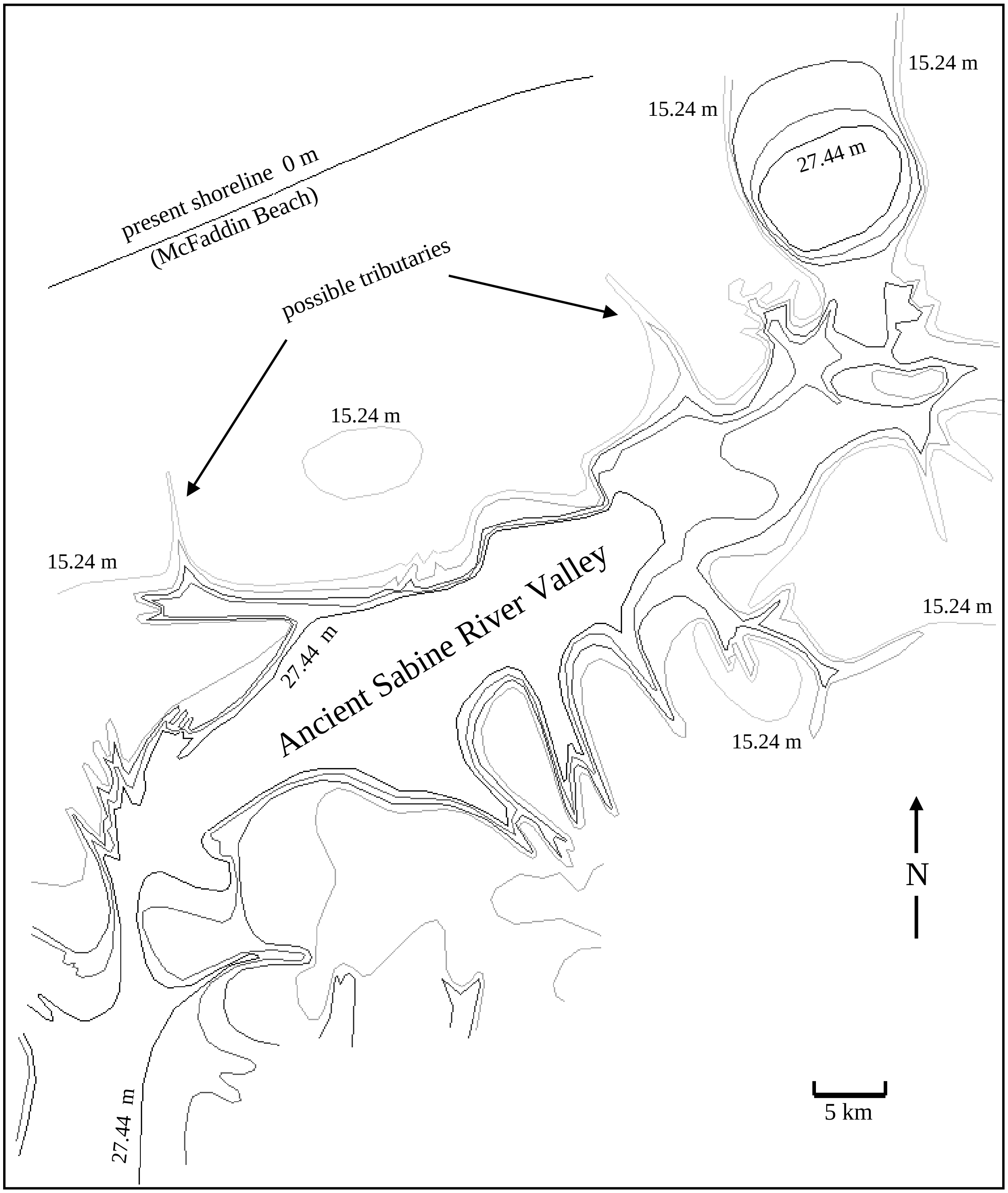

Figure 2. Contour Map of Ancient Sabine River Valley (after Nelson & Bray, 1970) Contours in meters below present mean sea level. Contour interval: 3.05 m.

determine how these possible tributaries may connect with relict late Wisconsinan/early Holocene fluvial systems onshore (Figures 3 and 4). The extensive coastal Holocene marsh deposits also obscure the trends of the late Wisconsinan/early Holocene fluvial systems; however, the numerous lakes and mud-filled ponds within the marsh deposits may be caused by compaction of unconsolidated Holocene fill material within underlying late Wisconsinan/early Holocene fluvial features (Figure 3), thus suggesting their locations. Landward of the Holocene marsh deposits, the interdistributary deposits of the late Pleistocene Trinity River delta also mark low areas where late Wisconsinan/early Holocene drainage systems would have been more likely to develop (Figure 3).

As the late Wisconsinan glaciers melted, sea level along the coast of southeast Texas continued rising until it reached its present elevation and the shoreline was established somewhat inland of its current position (Aten, 1983:124). At approximately 4,000 B.P. the Holocene marsh began forming, building the shoreline out to a position some undetermined distance seaward of its present location (Morton, 1991; Stewart, Morton and Lagoe, 1996). Probably around 3,000 to 2,000 B.P., after the marsh reached its most seaward position, the process of erosion began to dominate, and the shoreline began the current process of eroding landward.

The Holocene marsh overlies the late Pleistocene Beaumont/Prairie formation (Kane, 1959; Aronow, 1971). Between 19,000 and ~4,000 B.P., when sea level was lower due to the late Wisconsinan glaciation, a soil profile developed atop the Beaumont/Prairie surface (personal communication, Robert Morton, Bureau of Economic Geology, University of Texas at Austin, March 19, 1996). This soil layer is the source of

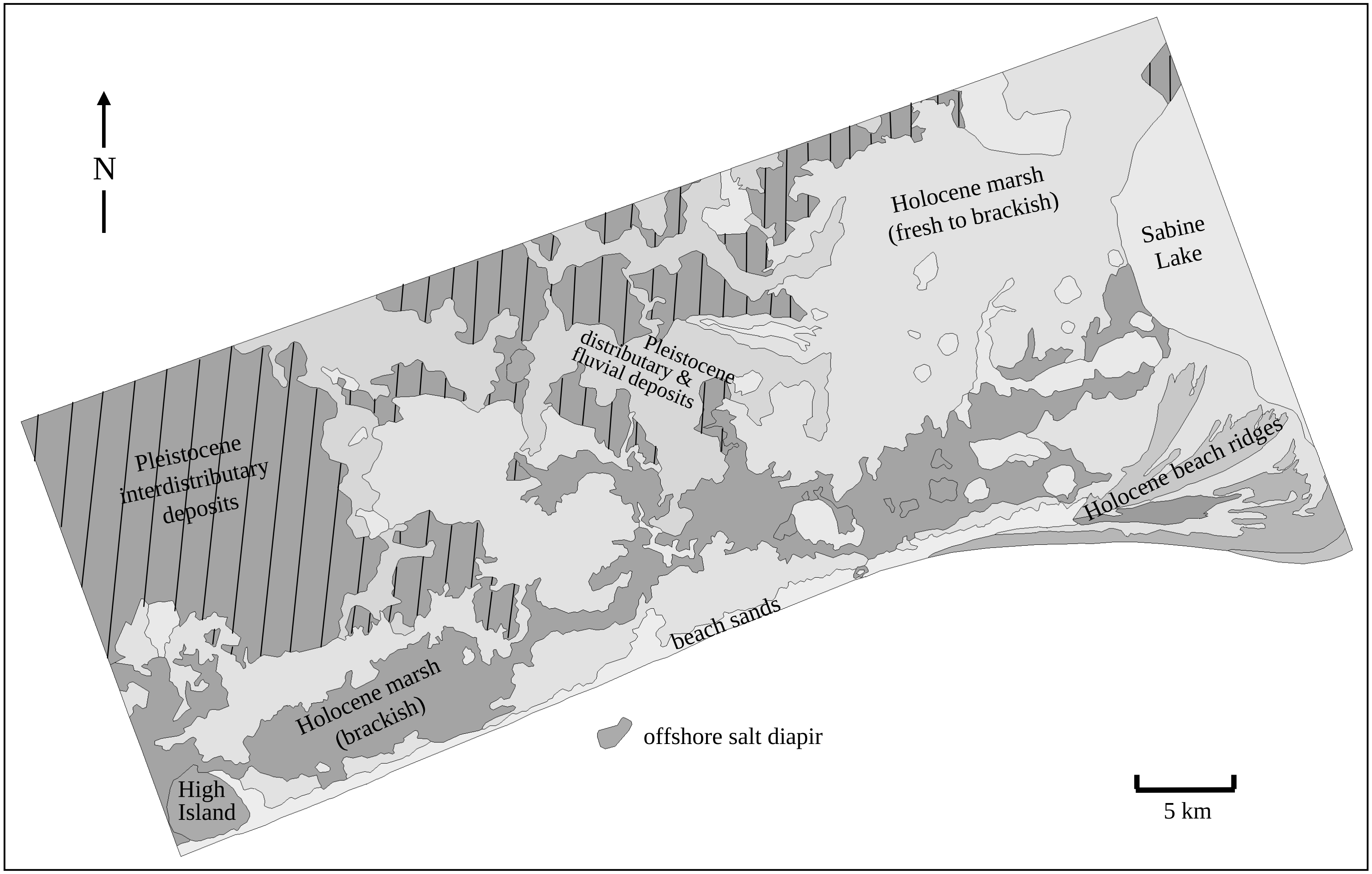

Figure 3. Onshore Geology of McFaddin Beach Area and Offshore Salt Diapir Indicated as Having Surface Expression (after Fisher et al., 1973)

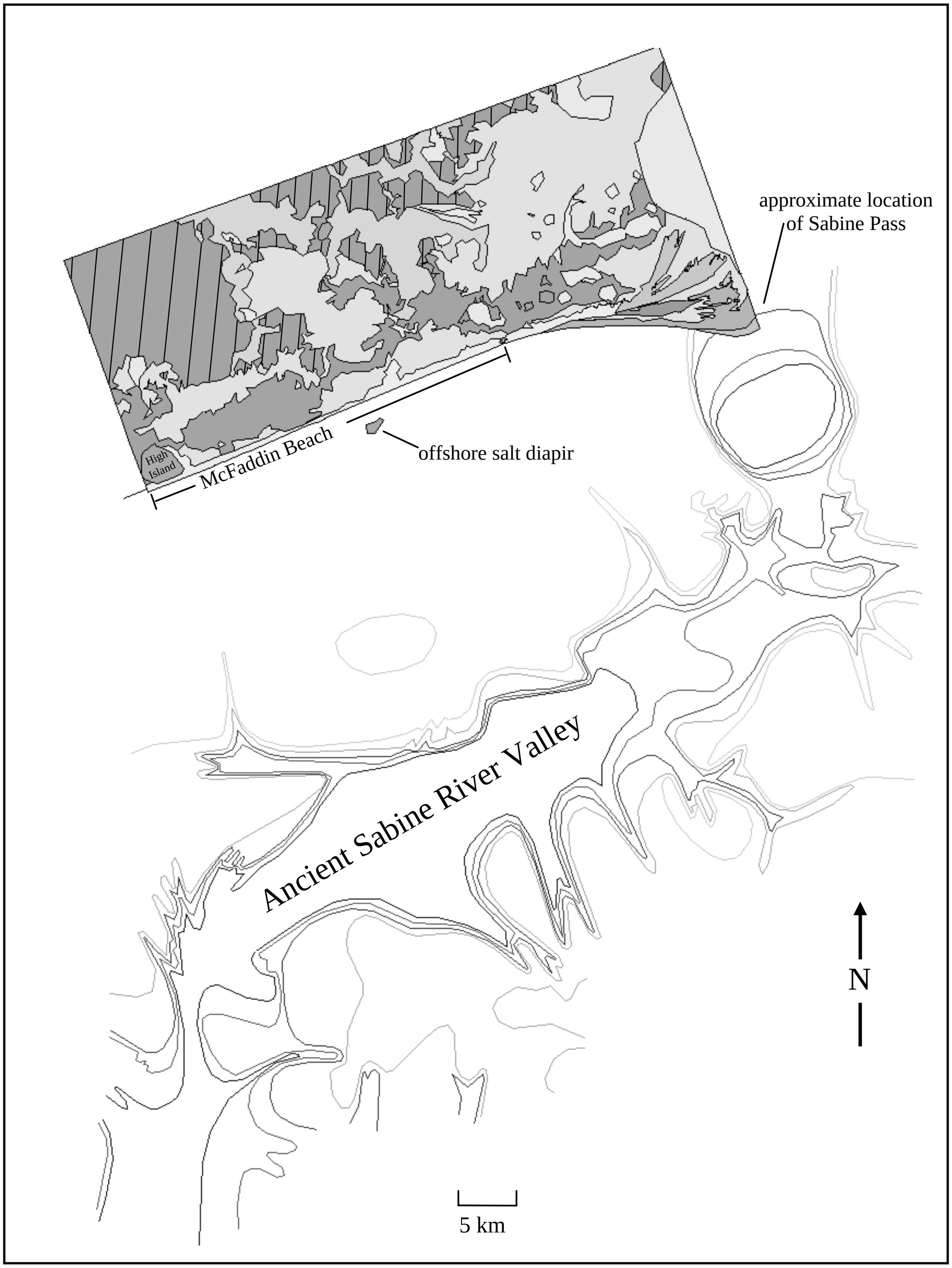

Figure 4. Relationship of Offshore Geology to Onshore Geology at McFaddin Beach

the earlier (dating prior to 4,000 B.P.) artifacts recovered at McFaddin Beach. The artifacts dating after about 4,000 B.P. are eroding from the Holocene marsh deposits.

The Bureau of Economic Geology, University of Texas at Austin, collected a series of geologic cores along the southeast Texas coast in 1992. The locations of these cores are shown in Figure 5. The unpublished geologic descriptions of the cores provided to me by the Bureau of Economic Geology indicate that the contact between the late Pleistocene Beaumont clay deposits and the Holocene marsh deposits is approximately 2.75 meters below the land surface at the location of core number 5, and approximately 3.5 meters below the land surface at core number 6 (Figure 5). Backhoe trenches dug across the beach by Coastal Environments, Inc. (Pearson and Weinstein, 1983) crossed the beach just west of the core number 5 location (Figure 5). The top of the Beaumont clay was encountered at a depth of 1.5 to 1.9 meters below the beach surface in these trenches. The information provided by these limited subsurface investigations suggests that the Holocene deposits generally thicken towards the east. However, it is likely that the thickness of Holocene sediments will vary greatly along the beach, being thickest over the relict late Wisconsinan/early Holocene fluvial channels, and thinnest above the relict interfluve areas.

The Environmental Geologic Atlas for the Texas Coastal Zone, Mineral and Energy Resources Map, Beaumont-Port Arthur Sheet (Fisher, et al., 1973) indicates the presence of a salt diapir approximately 2.4 kilometers offshore McFaddin Beach, midway between Sabine Pass and High Island (Figure 4). This diapir is indicated as having some surface expression (Fisher, et al., 1973). Salt diapirs in the Gulf of Mexico and Gulf

Figure 5. Locations of Geologic Cores (based on data from Bureau of Economic Geology, University of Texas, Austin) and Backhoe Trenches (Pearson and Weinstein, 1983).

Coastal Region result from a deep layer of Jurassic-age salt, which, because of its lower specific gravity and plasticity, squeezes up through the overlying sediments, sometimes reaching the surface and forming a topographic high. This is significant archaeologically because, during the time period prehistoric human populations were in this area and sea level was lower, the diapir could have formed an isolated topographic high in an otherwise broad, flat coastal plain. It is also possible that exposed salt or brine seeps could have been associated with the diapir. Salt was a valuable resource to prehistoric human populations for its function in concentrating game animals, for its use as a preservative, and possibly as a trade item (Brown, 1981). An example of a salt diapir having rock salt exposed at the surface is Avery Island, Louisiana, where archaeological excavations at the Salt Mine Valley Site (16IB23) identified human artifacts associated with a bone bed of extinct Pleistocene vertebrate fossils (Gagliano, 1967 and 1970).

Paleoshorelines

At the height of the late Wisconsinan glaciation, approximately 19,000 years ago, global sea levels were on the order of 120 meters below present sea level (Fairbanks, 1989). As the continental ice masses began to melt, the sea level began rising, reaching its current position by approximately 3,000 B.P.

Relative sea-level curves for the area offshore Texas indicate that relative sea level was approximately 48 meters lower than present at 11,500 B.P., the approximate date of the Clovis occupation of the study area. The Gulf of Mexico shoreline at this time would have been approximately 136 kilometers seaward of its present position.

Table 1 lists the paleoshoreline elevations below present sea level for approximately every 500 years between 11,500 B.P. to 3,000 B.P. These paleoshoreline elevations are based on the relative sea-level curves shown in Figure 6. Figure 7 is a graphic illustration of the approximate location of these paleoshorelines in relation to the present coastline, and the now-buried and submerged ancient Sabine River Valley offshore.

Because of the many potential errors in sea-level data and in using bathymetric contours to estimate the positions of paleoshorelines, the paleoshorelines shown in Figure 7 are only rough approximations of where the paleoshorelines for each time period were actually located.

Method for Reconstructing Paleoshoreline Positions

I used three published relative sea-level curves for the area offshore Texas (Figure 6) to determine the elevation of paleoshorelines over the past 11,500 years in relation to present sea level (Table 1). Relative sea-level curves are based on radiocarbon-dated samples of *in-situ* organic material taken from shallow geologic cores. The organic materials selected for dating are those known to occur only within former shoreline environments (e.g., shells in growth position, certain plant roots, undisturbed brackish-water peat deposits). Relative sea-level curves are constructed by plotting the age (in radiocarbon years before present) and depth (elevation below present sea level) of these *in-situ* organic materials.

Several sea-level curves have been published for the Gulf of Mexico region (Stright, 1995). All of these curves are based on uncorrected and uncalibrated

Table 1. Paleoshoreline Elevations

Age	Elevation	Bathymetric Contour Used	Source
3,000 B.P.	0m (present sea level)	n/a	Nelson and Bray (1970)
5,000 B.P.	-3.0m	n/a	Nelson and Bray (1970)
5,700 B.P.	-6.1m	n/a	Nelson and Bray (1970)
6,000 B.P.	-9.1m	n/a	Nelson and Bray (1970)
6,700 B.P.	-12.2m	n/a	Pearson, et al. (1986)
7,500 B.P.	-15.2m	n/a	Pearson, et al. (1986)
8,000 B.P.	-17.3m	18.0m	Pearson, et al. (1986)
8,500 B.P.	-19.7m	20.0m	Pearson, et al. (1986)
9.000 B.P.	-22.4m	22.0m	Pearson, et al. (1986)
9,500 B.P.	-23.5m	24.0m	Nelson and Bray (1970)
10,000 B.P.	-33.0m	32.0m	Nelson and Bray (1970)
10,500 B.P.	-40.7m	40.0m	Emery and Garrison (1967)
11,000 B.P.	-44.0m	44.0m	Emery and Garrison (1967)
11,500 B.P.	-48.0m	48.0m	Emery and Garrison (1967)

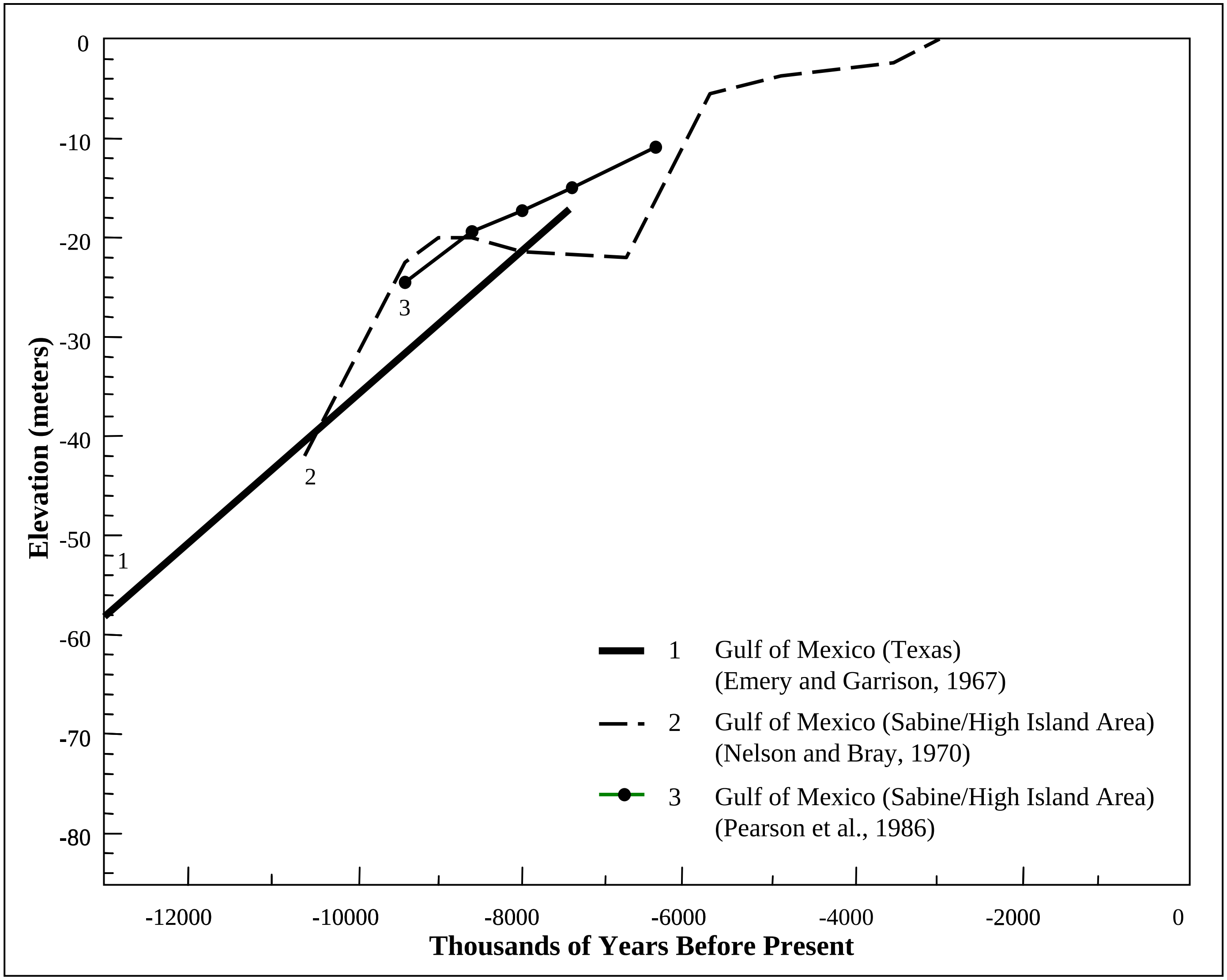

Figure 6. Relative Sea-Level Curves Used in Reconstructing Paleoshoreline Positions for the Study Area

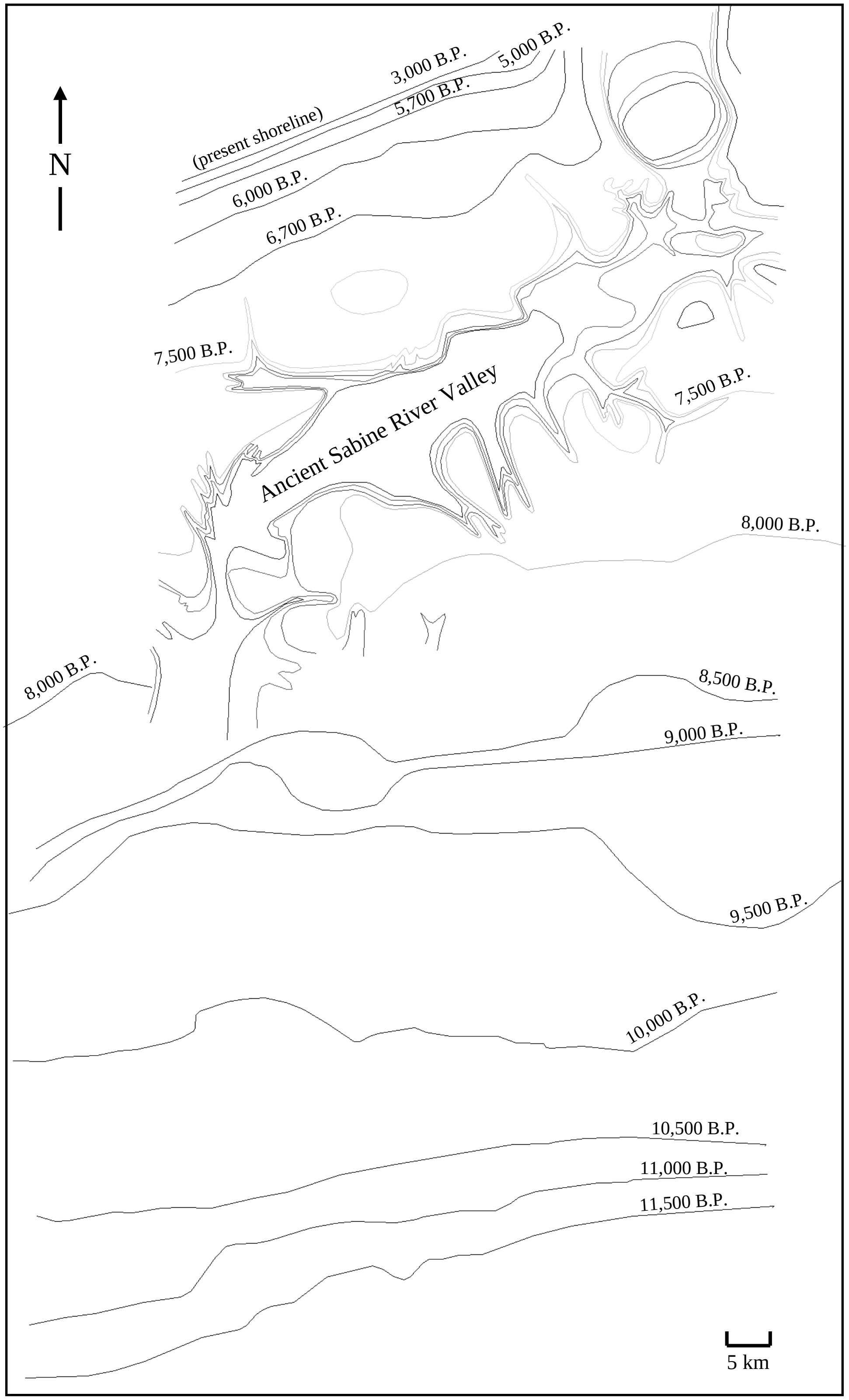

Figure 7. Approximate Paleoshoreline Positions

radiocarbon dates. I chose to use the sea-level curve published by Pearson et al. (1986) as the primary source, followed by the Nelson and Bray (1970) curve and the Emery and Garrison (1967) curve for the following reasons. The curve by Pearson et al. (1986) was constructed from samples collected within the ancient Sabine River Valley, just offshore McFaddin Beach. The Pearson curve corrects apparent inaccuracies in the Nelson and Bray curve due to compaction of dated peat samples, which gave the samples a lower elevation than that of their original environment of deposition. This correction eliminated the apparent reversal in sea level between about 9,000 B.P. and 7,000 B.P. shown in the Nelson and Bray curve (Figure 6). Because the Nelson and Bray curve was also constructed from dated samples collected within the ancient Sabine River Valley offshore McFaddin Beach, I used it to obtain paleoshoreline elevations for those time periods not covered by the Pearson curve. For those time periods prior to 10,500 B.P., I had to use a third curve. There are two published sea-level curves constructed using samples from the Texas continental shelf that cover the period 10,500 B.P. to 11,500 B.P. (Curray, 1960; Emery and Garrison, 1967). I chose to use the curve by Emery and Garrison (1967) because it is based on both salt-marsh peat samples and shallow-water shells, whereas the curve by Curray is based only on shallow-water shell data. Shells are more likely to produce erroneous radiocarbon dates and to be displaced from their original environment of deposition than are the wood fragments in *in-situ* peat deposits.

There are many discrepancies in published relative sea-level curves, even for the same area, possibly because of errors in dating or the use of inappropriate organic samples. However, there is some contradictory evidence to the sea-level curves used in this study that is important to mention. First, there is good evidence for a glacial readvancement, the Two Creeks substage of the late Wisconsinan glaciation, and a resulting drop in sea level between 11,000 B.P. and 10,000 B.P., but published sea-level data are very contradictory on the presence of a sea-level reversal and its magnitude during this time period. Curray (1960) shows sea level dropping to a level of approximately 62 meters below present sea level during this reversal. The effect of such a reversal on the data I have presented in Table 1, and in Figure 7, is that the shorelines between 11,000 B.P. and 10,000 B.P. may actually be at a lower elevation, hence farther offshore than the 11,500 B.P. shoreline. Aten (1983:117) indicates this reversal in his reconstruction of paleoshoreline positions for the area offshore southeast Texas.

The second contradiction to the sea-level data presented here is evidence from the Swan Lake Site (41AS16) in Aransas County, Texas, and from other areas in coastal Texas which suggests that sea level may have fluctuated between its present elevation to as much as 1.5 meters higher than present during the mid to late Holocene (Prewitt, Lisk, and Howard, 1987; Prewitt and Paine, 1988; Paine, 1991; Ricklis and Blum, 1997; Ricklis, 1998). If the southeast coast of Texas also experienced intermittent periods of higher sea level during the mid to late Holocene, it would be expected that there would be a corresponding decrease in artifacts at McFaddin Beach dating from these periods of higher sea level, as the present beach area would have been submerged.

Finally, in their geological investigations of Sabine Lake, Texas, Anderson et al. (1991) obtained two radiocarbon dates on *Rangia* shell lying just above the Pleistocene surface at a depth of 5 meters below present sea level. The two dates indicate that sea level was approximately 5 meters below present sea level sometime between 3,890 ± 120 B.P. and 3,440 ± 140 B.P. These isolated dates suggest that relative sea level along the coast of Texas may have been slightly lower between 5,000 and 3,000 B.P. than indicated by the Nelson and Bray sea-level curve (Figure 6).

The former shoreline environments dating from the late Wisconsinan are usually buried beneath the present seafloor by Holocene sediments. The thicker the sequence of Holocene sediments overlying the late Wisconsinan land surface, the less accurate are bathymetric contours (which indicate the elevation below sea level of the present seafloor) in approximating the geographic location of late Wisconsinan paleoshorelines.

The Holocene sediments overlying the late Wisconsinan land surface outside the incised valley of the ancient Sabine River range from less than 0.6 meters (Nelson and Bray, 1970) to as much as 6.0 meters in thickness at Sabine and Heald Banks (Morton and Gibeaut, 1995). I used the bathymetric contours from the United States Geological Survey/National Oceanographic and Atmospheric Administration (USGS/NOAA) Topographic/Bathymetric Maps (1:250,000 scale) to approximate the geographic positions of paleoshorelines dating between 11,500 B.P. and 8,000 B.P. (Table 1). Because the great detail in the bathymetric contours at Sabine and Heald Banks is only reflective of Holocene sand deposits, I generalized the contours to eliminate needless detail. For the shoreline positions dating from 7,500 B.P. until present, I was able to use the contours on the actual late Wisconsinan land surface as mapped by Nelson and Bray (1970).

Paleoclimate

The study area presently lies in the transition zone between the extreme western extension of the Southeastern Woodlands physiographic province and the eastern edge of the Southern Great Plains (Bryant and Shafer, 1977). Throughout the prehistoric period the boundaries of these two major physiographic provinces have shifted to the east or to the west with changes in climatic conditions from more arid to more humid conditions. Russell's (1975) identification of faunal remains recovered from McFaddin Beach indicates an almost equal number of extinct taxa representing woodland environments and grassland environments (Story et al., 1990:188). Story suggests that this mix of extinct taxa is consistent with a site location on or near a minor tributary (Story et al., 1990:188). It is also consistent with the gradual shifting back and forth of the predominant physiographic province in the vicinity of McFaddin Beach from woodland to grassland in response to shifts in the late Pleistocene and Holocene climate.

In his discussion of the paleoclimatic data for southeast Texas, Aten (1983:135-137) concludes that, during the Late Glacial period (prior to 10,030 B.P.), the climate was an extremely humid environment with minimal seasonal temperature differences. During this period of generally wetter climate, the Great Plains prairie biome terminated well to the west of the study area, and the deciduous forest biome was greatly expanded. During the pre-Boreal and Boreal periods (10,030 - 8,490 B.P.), the environment shifted to a warmer semiarid environment with possibly more pronounced seasonal differences in both temperature and precipitation. This period of reduced precipitation probably resulted in the expansion of grasslands into the study area. The Atlantic period (8,490 - 5,060 B.P.)

marked the postglacial thermal optimum, a period of even warmer and drier conditions across the study area. The sub-Boreal period, beginning at approximately 5,060 B.P., marked the beginning of ameliorating climatic conditions in the study area with increasing precipitation, before reaching essentially modern sub-humid seasonal conditions.

CHAPTER IV

ARTIFACT ANALYSIS

The presence or absence of artifacts of specific diagnostic types, cultural periods, functions, lithic materials, etc. in a specific geographic location such as McFaddin Beach, Texas, can provide important cultural information, even when the artifacts are not found in their primary cultural context. The following analysis addresses three major aspects of the artifacts in the McFaddin Beach collection: 1) the relative abundance of artifacts by cultural period, as inferred from diagnostic type; 2) the types of prehistoric human activities represented for each cultural period as inferred from the identified artifact functions; and 3) the lithic sources of the raw material used in producing the artifacts and how these vary and change through time. A short discussion of resharpened and retooled artifacts is also included because of the relationship between lithic conservation and procurement activity.

The Study Collection

The number of artifacts known to have been recovered over the past 30 years from McFaddin Beach is well over 3,000; however, the artifacts I have used in this study are limited to those for which the collectors had recorded the date of find and location. The study collection consists of 880 artifacts contained in five collections, representing approximately one-third of the total number of artifacts known to have been collected at

McFaddin Beach. The five collections used in this study are owned by Paul Tanner of Port Arthur, Texas; Joe Louvier of Port Arthur, Texas; Joe Coen of Groves, Texas; Murray Brown of Groves, Texas; and Jessie Fremont of Orange Field, Texas.

There were actually a total of 892 artifacts in the five collections examined during this study. However, I used only 880 artifacts in the analysis because 12 of the artifacts did not have their locations recorded and, therefore, they could not be included in the ARC/INFO database. The study collection also contains 7 "artifacts" whose function is defined as "geofact" because it is doubtful that they are even artifacts. They were included in the study because they may represent materials that were transported into the study area by human agency.

Recording Artifact Attributes

I spent a total of 15 weeks between June, 1994, and September, 1996, in southeast Texas analyzing and recording information on the 880 artifacts in the study collection, and obtaining field data at McFaddin Beach. John Greene, archaeologist for the Minerals Management Service, Gulf of Mexico Region, New Orleans, Louisiana, assisted me during 4 of the 15 weeks. Larry D. Banks, Senior Fellow, Institute for the Study of Earth and Man, Southern Methodist University, and Nathan Banks, a graduate student in Anthropology at the University of Texas at Arlington, assisted me in identifying material type, lithic source, cortex type, heat treatment, and Munsell color descriptions for the artifacts. Dee Ann Story, Professor Emeritus in Anthropology, University of Texas at Austin, assisted me in the identification of diagnostic type and function.

Because the artifacts upon which this study is based are held in private collections, I compiled an archival record of the artifacts by photographing all specimens front and back with 100-speed, 35-mm, black-and-white film (see Appendix A). These photographs and their negatives were catalogued and cross-referenced by artifact number to the artifact database.

I recorded the following information for each artifact in the study collection. Appendix B is a copy of the artifact database, and Appendix C contains a complete list of codes used in recording the various attributes of the artifacts.

Artifact Number

The collectors had already numbered their artifacts sequentially and cross-referenced them to their logs and maps. I added a two-character prefix to each artifact in the database to designate the collector. This served two purposes. First, it allowed me to have a unique identifier for each artifact, and, second, it allowed me to identify evidence of collector bias or idiosyncracies.

Date Found

The collectors recorded the date of find for each artifact in their log books. Based on the local geology of the study area, it is assumed that the artifacts have eroded out of primary context at the shoreface. Therefore, the date of find provides a relative time reference for the erosion and secondary deposition of the artifacts. This is particularly true for those artifacts that have only a slight amount of wear, indicating that they have not been exposed to much mechanical weathering since they were eroded out of primary context.

Function

Artifact function was assigned based on the artifact's gross morphology and macroscopic evidence of grinding, wear, polish and pattern of resharpening (Hayden, 1979). There was not sufficient time or resources to conduct microwear analysis of the artifacts in the study collection.

Diagnostic Type/Period/Basal Grinding

With secondarily deposited artifacts the only way to establish age is through accurate identification of the diagnostic type. Because many of the artifacts from McFaddin Beach are heavily resharpened and retooled, I relied most heavily on the characteristics of the base and flaking patterns for type identification. The presence or absence of basal grinding was sometimes impossible to ascertain due to heavy mechanical weathering of some of the artifacts. In these instances the code "U" was entered indicating that the presence of basal grinding is uncertain.

Material Type

Macroscopic identification of the material type was usually possible; however, an 18x hand lens and a binocular microscope also were employed to aid in the identification of the material. The material type may be an important consideration when interpreting the significance and meaning of the level of mechanical and chemical weathering.

Weight/Length/Width/Thickness

I weighed each artifact using an Ohaus Portable Electronic Scale having a capacity of 300 grams and a readability of 0.1 gram. I also recorded the maximum length, width and thickness of each artifact in millimeters. These measurements were taken not only for the typical diagnostic purposes, but also as information that may be pertinent to understanding the dynamics of artifact mobilization and transport in the shoreface environment.

Due to time constraints, other diagnostic measurements such as basal width or stem length were not recorded for the study collection as a whole. These measurements were taken on individual specimens when it was necessary for assigning diagnostic type.

Complete/Reworked

If the artifact was broken, I recorded the portion that was present and whether the break was old or recent, as evidenced by the degree of weathering on the broken edge. If the artifact was obviously reworked, I recorded the degree of this reworking as either "resharpened" or as "heavily resharpened." The difference between "resharpened" and "heavily resharpened" was judged based on: 1) the steepness of the edge angle of the resharpened edges in contrast to what would be a normal edge angle for the artifact type; 2) the amount of disproportion between the dimensions of the hafting element and the remainder of the tool (Shott, 1989:26); and 3) the disproportion between the artifact's length and width in relation to its thickness in contrast to what would be the normal range for its type.

Some of the stone tools from McFaddin Beach had been heavily weathered prior to being reworked into different tools at a later time. These artifacts were coded as "retooled" rather than "resharpened" because the cultural implications of these two activities can be very different. The former is a recycling activity and the latter is a maintenance activity.

Wear

I made a distinction between mechanical weathering (wear) and chemical weathering (patina). Mechanical weathering results from physical processes that tend to average high and low surfaces on the artifact, such as movement against sand grains in the surf zone, and wind erosion. Wear was coded as "Slight", "Moderate", or "Heavy" based on the sharpness of the flake scars and artifact edges. An artifact was defined as having slight wear when artifact edges were still sharp to the touch and flake scars were still sharp and well defined. Artifacts were defined as having moderate wear when the artifact edges and ridges between flake scars were still well defined, but slightly rounded and dulled. Artifacts were defined as having heavy wear when the artifact edges were completely smooth and the flake scars were barely discernable to non-existent.

Patina/Color Difference

Chemical weathering results from chemical processes which alter the chemical composition of the lithic material (Loughnan, 1969; Colman and Dethier, 1986). Chemical weathering was recorded as various types of patina ranging from white and chalky to glazed. I also recorded whether there was a difference in the chemical weathering between the ventral and dorsal side of the artifact.

The various types of patina provide information on the weathering environment of each artifact such as whether it was predominately subaerial or subaqueous. While not technically a patina, the occurrence of stony bryozoan growth on some of the artifacts also was recorded under this category, as it, like the various types of patina, indicates at least one of the environments in which the artifact was weathered.

Lithic Source/Micropaleontology

The source of the raw lithic material used in the manufacture of each artifact was determined through inspection with a 18x hand lens and a binocular microscope. The identifications were carried out under conditions of natural sunlight, unless otherwise noted (see Appendix E). The basic rock type, any diagnostic micropaleontology within the specimen, and comparison to existing lithic source rocks were the key parameters used in making the lithic identifications. For the sake of maintaining the database in a manageable size, hafting residue, which was evident on just a few of the artifacts, was recorded under the database field, "micropaleontology."

UV Short-wave/UV Long-wave Analysis

In 1991 Hofman, Todd, and Collins published a paper in the *Plains Anthropologist* outlining a method whereby ultraviolet light is used as a non-destructive technique to aid in determining the lithic source of stone tools. Table 1 in the paper lists the typical long-wave and short-wave ultraviolet responses for several of the more common sources of knappable chert in Texas, Oklahoma, Kansas, Colorado, and New Mexico. The authors caution that their findings are only preliminary, and that much work remains to be done in documenting the variability in fluorescent response that may occur in samples from the same lithic source and the effects of patination and heat-treatment on ultraviolet response. The authors also stress that comparative samples from known source areas are crucial for the accurate identification of lithic sources based on fluorescent response. At this early stage of its development as a sourcing technique, fluorescence is most appropriately used as a supplemental technique to distinguish between lithic specimens that look similar under natural light, but whose sources are known to have different fluorescent responses.

When I began my research on the lithic materials from McFaddin Beach, I assumed that ultraviolet analysis was going to be my only recourse for attempting lithic source identification for the artifacts. However, having no rock samples from known lithic source areas to use for comparative purposes, my ultraviolet analysis was limited to simply recording the ultraviolet response of each artifact.

This initial phase of the ultraviolet analysis was begun by fluorescing all of the artifacts in the study collection under both long-wave and short-wave ultraviolet light using a UVGL-58 Short-Long Wave Multi-Band lamp. A large piece of matte-finish black construction paper was used as the background when fluorescing the artifacts. After some initial experimentation, 10 artifacts were chosen as controls. These controls adequately represented the range of most of the ultraviolet responses seen in the study collection, and the ultraviolet responses of all other artifacts were referenced to these artifacts. The color descriptions for the short-wave and long-wave responses of the 10 control artifacts are described in Appendix C. Those artifacts that had an ultraviolet response dissimilar to all of the control artifacts were described individually (see Appendix B).

Between July 1995 and September 1996, I contracted Larry Banks to conduct the lithic source identifications for the artifacts in the study collection. Larry provided source rocks from various known lithic sources that could be used as controls for the ultraviolet analysis; however, there was insufficient time to fluoresce all of the artifacts a second time for comparison to the lithic source rocks. Therefore, after Larry identified the lithic sources of the artifacts through microscopic comparison to the source rocks, the artifacts were grouped by lithic source and fluoresced to check for consistency in fluorescent response. Ultraviolet analysis was also used to confirm some of the more uncertain lithic source identifications.

The results of the ultraviolet analysis indicate that chemical weathering has a major effect on the fluorescent response of a rock specimen. As it is the chemistry of the rock that causes it to fluoresce a particular color, chemical weathering which changes the chemistry of the weathered surface may also change its fluorescence. The problem of weathering is very complex, as, depending on the chemistry of the weathering environment, the resultant chemical composition of the weathered surface of the rock, and, therefore, its fluorescence, may vary for the same source rock. Some of the artifacts in the study collection were so extensively weathered that the original source rock could not be observed. Confirmation of the lithic source rock by fluorescence was not possible with these specimens.

Cortex

The lithic analysis also included identification of cortex remnants present on the stone tools. A distinction was made between original cortex from the lithic source area, and pebble cortex that developed as a result of tumbling and weathering in a stream. The chemically weathered surfaces that developed after manufacture of the artifact were classified as patina. The type of cortex suggests very different lithic procurement strategies; one focused on contact with a source area, and the other focused on procuring material that had been transported away from the source area by river systems.

Heat Treatment

Artifacts that appear to be heat-treated were identified based primarily on their red tinge and glossiness. A distinction was made between heat-treated lithic material and heat-damaged artifacts; the latter is characterized by large heat-spalls, pot-lid fractures, and sometimes calcination. The difference is culturally significant, in that heat-treatment was a deliberate activity to improve the workability of the raw lithic material, while heat-damage resulted from particular human use behaviors with reference to the manufactured artifact.

Color Descriptions/Munsell Color Designations

Visual color descriptions referenced to the Munsell Color Charts were recorded for each artifact (Appendix B, Part II). Color codes were recorded for the original raw lithic material (if visible), the weathered (patinated) surface, and the cortex (if present). These color descriptions were useful in identifying the lithic source material, in exploring how weathering affects ultraviolet response and in determining what chemical changes may be responsible for the changes in ultraviolet response due to weathering. The color descriptions of the original raw lithic material could also be used to search for indications of color preferences in lithic material by different cultural groups.

The artifact attribute data were initially entered into a computer using dBase IV+. The database was then imported into ARC/INFO and joined to the artifact spatial coordinates. Because there were no locations recorded for 11 of the artifacts in Murray Brown's collection (BN 4 to BN 14), and one of Paul Tanner's artifacts (TN 214) was found east of the study area, they could not be added to the spatial database. Therefore, only 880 of the 892 artifacts in the five collections are included in the following analysis.

Diagnostic Types

Of the 880 artifacts in the study collection, it was possible to identify the diagnostic types of 487. Table 14 in Appendix D alphabetically lists the diagnostic types of artifacts in the study collection and gives the total number of artifacts for each type. Table 15 in Appendix D lists the artifacts in descending order from the most numerous diagnostic type to the least numerous. Table 15 also indicates the number of artifacts that are definitely of a particular diagnostic type, and the number that are most likely, but not definitely, of that diagnostic type.

Age (Cultural Period)

From the assigned diagnostic type, it was then possible to assign the artifacts to a general cultural period. Table 16 in Appendix D lists the diagnostic types of the artifacts in the study collection by cultural period from the earliest (Paleoindian) to the most recent (Late Prehistoric/Historic). The periods and ages given for each diagnostic type in Table 16 are based primarily on the information provided in “A Field Guide to Stone Artifacts of Texas Indians” (Turner and Hester, 1993). For those artifact types which are more typically found to the east of Texas (e.g. Adena, Hardin and Rice Lobed), I used a second source, “Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States” (Justice, 1987). The ages given for the diagnostic types in both of these reference works are based on uncorrected and uncalibrated radiocarbon dates. In addition to the 487 artifacts that could be assigned to specific diagnostic types, another 45 untyped artifacts could be assigned to a general cultural period. Table 2 lists the total number of artifacts in the study collection by cultural period, and Figure 8 provides a graphic presentation of the information in the table.

As can be seen in Figure 8, the majority of diagnostic artifacts (approximately 43 percent) date to the Paleoindian and Late Paleoindian Periods. Those artifacts representing diagnostic types from the Middle/Transitional Archaic Period (ca. 4,500 B.P. to 1,300 B.P.) are the next most numerous at approximately 15 percent of the total. If those artifact types that represent shorter, discrete periods within the Middle to Transitional Archaic time frame (i.e. Middle Archaic, Middle/Late Archaic, Late Archaic, Late/Transitional Archaic, and Transitional Archaic) are added to the Middle/Transitional Archaic, they total 235 artifacts, or 44 percent of the diagnostic artifacts. Diagnostic

Table 2. Number of Artifacts by Cultural Period

Period*	Definite	Possible	Total
Paleoindian	130	30	160
Late Paleoindian	54	17	71
Late Paleoindian/Early Archaic	13	1	14
Early Archaic	14	1	15
Early/Middle Archaic	2	2	4
Middle Archaic	24	4	28
Middle/Late Archaic	40	5	45
Middle/Transitional Archaic	66	16	82
Late Archaic	19	10	29
Late Archaic/Late Prehistoric	7	4	11
Late/Transitional Archaic	17	6	23
Transitional Archaic	16	0	16
Archaic (Nonspecific)	18	2	20
Late Prehistoric	8	2	10
Late Prehistoric/Historic	3	0	3
Unknown	349	0	349
Totals:	**780**	**100**	**880**

* Chronology after Turner and Hester (1993). Chronology is based on uncorrected and uncalibrated radiocarbon dates.

Paleoindian	11,500-8,000 B.P.	Transitional Archaic	2,300-1,300 B.P.
Early Archaic	8,000-4,500 B.P.	Late Prehistoric	1,300-400 B.P.
Middle Archaic	4,500-3,000 B.P.	Historic	400 - present
Late Archaic	3,000-2,300 B.P.		

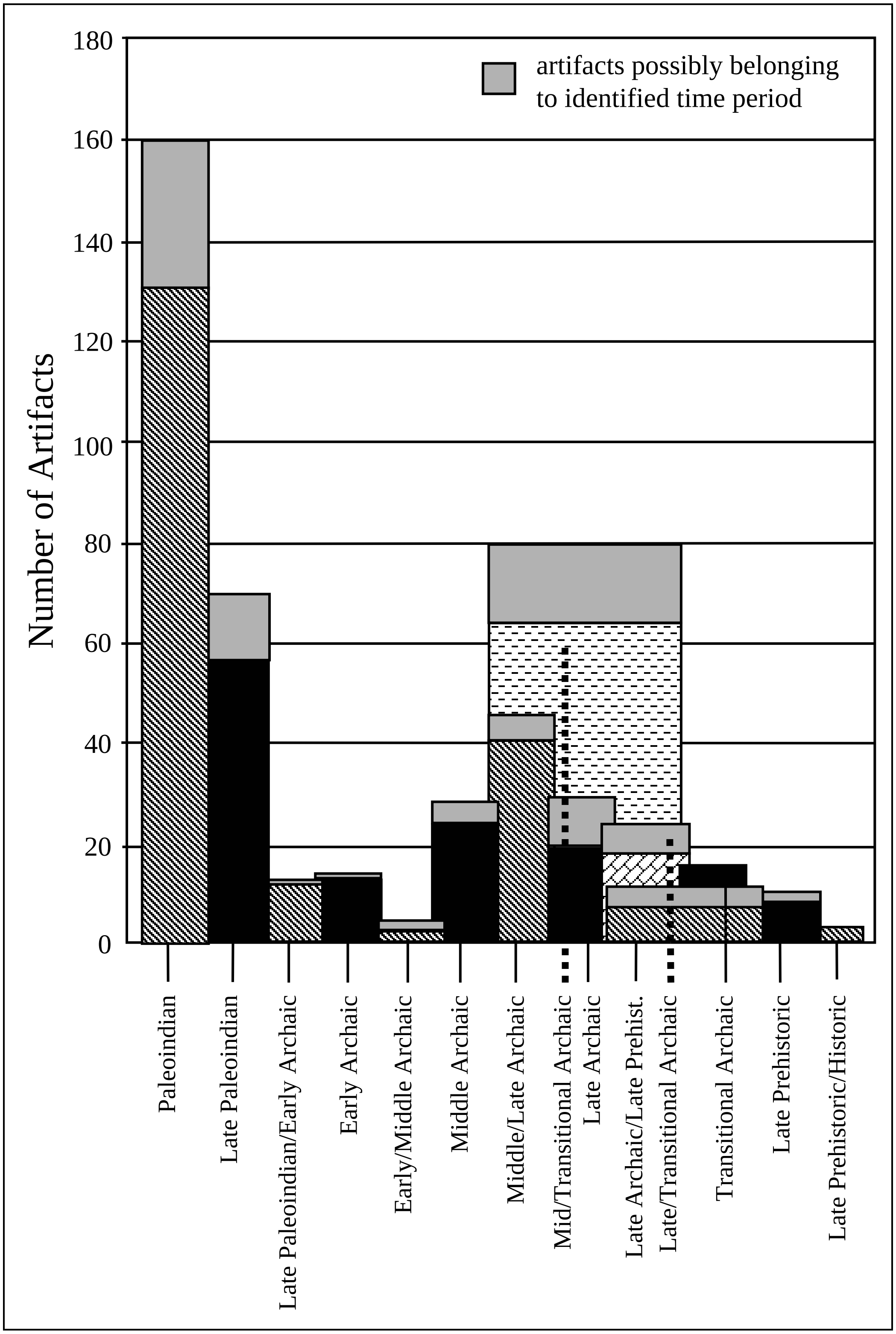

Figure 8. Number of Artifacts by Cultural Period

types representing the Early Archaic (ca. 8,000 to 4,500 B.P.) total only 33, or 6 percent of the diagnostic artifacts, even when those diagnostic types that overlap into the Paleoindian and Middle Archaic are included. Likewise, those diagnostic types representing the Late Prehistoric and Historic Periods (ca. 1,300 to present) total only 13, or 2 percent of the diagnostic artifacts.

Eastern Woodlands versus Southern Great Plains Diagnostic Types

As a whole, the diagnostic artifacts in the study collection are more reflective of the Southeastern Woodlands cultures to the east, rather than the Southern Great Plains cultures. Most of the diagnostic types indicative of Plains-type cultural adaptations (e.g. Folsom, Plainview, Hell Gap, and Scottsbluff) are Paleoindian in age. Most of the artifacts in the study collection that are made out of exotic lithic materials are also Paleoindian in age. This is probably due to the fact that Paleoindian cultures were typically more mobile and wide-ranging than were later, Archaic cultures.

Most of the Clovis points from McFaddin Beach are more reflective of Clovis point styles from Florida and other areas of the Southeast than of classic western Clovis points like those from the type site at Blackwater Draw, New Mexico (letter from Dennis Stanford, Chairman, Department of Anthropology and Director of the Smithsonian Paleoindian Program, to Paul Tanner, dated February 22, 1995). The eastern Clovis points are characterized by broad flake scars covering most of the blade surface, with shorter and steeper flakes along the margins, and incurvate bases (ibid.). On western Clovis points the broad flake scars typically have been removed by subsequent pressure flaking across the blade surfaces (ibid.). One of the Clovis points in the study collection (TN 130) may actually be a Ross County point, as described by Prufer and Baby (1963:15). Ross County points are named for a point style found in Ross County, Ohio, that are similar to, and contemporary with Clovis (Justice, 1987:21).

Artifact Function

Artifact functions can indicate the types of human activities that took place at a given site. Driskell (1986) uses artifact functions, as determined by analysis of the lithic reduction technique and by microwear analysis, to draw conclusions about site functions for highly disturbed plow-zone sites in central Kentucky. The major problems Driskell faced were: 1) because site stratigraphy had been destroyed by plowing, he could not determine whether a particular group of artifacts represented a single or multicomponent site; and 2) a paucity of diagnostic artifacts in his study collections. The combination of these two problems made it difficult for Driskell to determine the time period represented by an identified site function.

In the apparently undifferentiated lag deposit of artifacts from McFaddin Beach, there is not only the uncertainty about whether the artifacts are from single or multicomponent sites, but also the uncertainty about the total number of sites represented. This is particularly problematic because virtually all major cultural periods are represented by the diagnostic artifacts in the McFaddin Beach study collection. However, on the positive side, because there is a relatively high percentage (60 percent) of diagnostic artifacts in the study collection, even with a lack of definable sites, general human activities that took place in the vicinity of the present beach area can be ascribed to specific cultural periods.

Table 3 shows the functions assigned to each artifact in the study collection by cultural period. It is important to note that the functions for the artifacts in the McFaddin Beach study collection were identified based on gross morphology of the tool, including resharpening patterns, and macroscopic inspection for use wear. In the absence of microwear analysis, it is not always possible to accurately determine the artifact function. As has been done throughout the analysis, both the number of artifacts that definitely are of a particular cultural period and those that are possibly of that cultural period are given in Table 3.

Artifacts Indicative of Campsite Activities

General activities that might be carried out at a campsite are indicated by such tools as adzes, gouges, and axes (woodworking), scrapers and awls (hide processing and clothing manufacture), grinding stones, nutting stones, and pottery (food preparation), and gorgets and pendants (personal adornment). The broken proximal ends of projectile points also may be more specifically indicative of campsites because it is the proximal end of a projectile point, broken during use, that would be brought back to the campsite still hafted to the shaft for discard or resharpening. Projectile points fit this category only if the break is old (as evidenced by the same degree and type of patina across the break as was present over the rest of the artifact).

Table 3. Artifact Functions by Cultural Period

Function	Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
AN/NS																															1	**1**
AP																											1* 5	2*			1*	**9**
AX/AZ		1																														**1**
AW																															1* 4	**5**
AW/DR																															1	**1**
AZ	1																															**1**
AZ/GO	1							1																								**2**
BF	2	3	1	1												2	1								5	2					99	**116**
BF/BS																															3	**3**
BF/GV																															1	**1**
BF/KN																			1													**1**
BF/PF		2																													9	**11**

Table 3. Artifact Functions by Cultural Period (continued)

Function	Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
BF/PRF																															1	**1**
BF/SC		1																														**1**
BKN																															1	**1**
BL																															1	**1**
BLCO																															1	**1**
BO																															1	**1**
BPC																															2* 1	**3**
BS/DR/AW																															1	**1**
BST																															1*	**1**
BTF																															1	**1**
BTF/CF		1																														**1**
BTF/GV																															1	1
BTF/UF																															5	5

Table 3. Artifact Functions by Cultural Period (continued)

Function	Paleoindian D	Paleoindian P	Late Paleoindian D	Late Paleoindian P	Late Paleoindian/ Early Archaic D	Late Paleoindian/ Early Archaic P	Early Archaic D	Early Archaic P	Early/ Middle Archaic D	Early/ Middle Archaic P	Middle Archaic D	Middle Archaic P	Middle/ Late Archaic D	Middle/ Late Archaic P	Middle/ Transitional Archaic D	Middle/ Transitional Archaic P	Late Archaic D	Late Archaic P	Late Archaic/ Late Prehistoric D	Late Archaic/ Late Prehistoric P	Late/ Transitional Archaic D	Late/ Transitional Archaic P	Transitional Archaic D	Transitional Archaic P	Archaic (Non-specific) D	Archaic (Non-specific) P	Late Prehistoric D	Late Prehistoric P	Late Prehistoric/ Historic D	Late Prehistoric/ Historic P	Unknown	**Total**
CD																															1	**1**
CO																															1* 1	**2**
CO/USC																															1*	1
CPF																															1	**1**
CR																															1	**1**
DF																															6	**6**
DF/BL/SC																															1	1
DF/BSC																															1	1
DF/KN/HE																															1	**1**
DF/SC		1																													6	7
DF/SP/GV																															1	1
DF/UF																															8	8

Table 3. Artifact Functions by Cultural Period (continued)

Function	Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
DF/USC																															3	3
DF/UT																															1	1
DR	2		2																												7	**11**
DR/SC																															1*	**1**
FG																															4	**4**
FG/GV/BS																															1	**1**
FL																															8	**8**
FL/BL																															1	**1**
FL/BL/UT		1																													1	**2**
FL/BSC																															1	**1**
FL/KN				1																											1	**2**
FL/SC/GV																															1	**1**
FL/USC																															3	**3**
GS																															9	**9**

Table 3. Artifact Functions by Cultural Period (continued)

Function	Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
GT																															1	**1**
GV																															1	**1**
HS																															2* 14	**16**
KN																													3			**3**
MBC																1																**1**
MBC/PRF																															1*	1
PB	1	1*																														**2**
PB/GV		1																														**1**
PB/SC/GV	1																															**1**
PB/USC		4																														**4**
PBCO																															1*	**1**
PBT																															1* 5	**6**

Table 3. Artifact Functions by Cultural Period (continued)

Function	Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
PBT/GV																															1	**1**
PBT/SP																															1	**1**
PD																															1	**1**
PF	1	1		1																												3
PL															1																	**1**
PP	104	5	41	7	11	1	12		2	2	21	3	35	5	58	11	17	9	6	3	13	5	16		10						1* 39	**437**
PP(DE)	2	1	2	2																		1			3		1				9	**21**
PP(IF)				1			2						1		1		1	1			1											**8**
PP(PE)	11		7	2	2						2	1	3		5	1					2										2	**38**
PP/BS	1		1								1		1			1				1	1											**7**
PP/KN	2			1																												**3**
PP/GO															1																	**1**
PP/SC			1																													**1**

Table 3. Artifact Functions by Cultural Period (continued)

Function	Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
PP/SP	1																														1	**1**
PS																															1	**1**
PT																											1					**1**
SC																															1* 4	**5**
SC/GV																															1	**1**
SC/HE		1																														**1**
SNSC		1																														**1**
SPC																															2	**2**
SPC/DR																															1	1
SPC/SC																															1	**1**
UF		4																													16	**20**
UF/BL																															1	**1**

Table 3. Artifact Functions by Cultural Period (continued)

Function	Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
UF/GV																															1	**1**
UK																															5	**5**
USC		1																													8	**9**
USC/HE																															1	**1**
USC/SP																															1	**1**
UT																															5	**5**
UT/FL/BL																															1	**1**
UT/GV																															1	**1**
UT/HE																															1	**1**
UT/SP																															1	**1**
TOTAL	**130**	**30**	**54**	**17**	**13**	**1**	**14**	**1**	**2**	**2**	**24**	**4**	**40**	**5**	**66**	**16**	**19**	**10**	**7**	**4**	**17**	**6**	**16**	**0**	**18**	**2**	**8**	**2**	**3**	**0**	**342****	**873****

D = Definitely of the cultural period
P = Possibly of the cultural period

* = Possibly the identified function
** = 7 "geofacts" of unknown period were omitted from the function table

Table 3. Artifact Functions by Cultural Period (continued)

Function Codes

AN	Anvil
AP	Arrow Point
AW	Awl
AX	Ax
AZ	Adz
BF	Untyped Biface
BKN	Backed Knife
BL	Blade
BLCO	Blade Core
BO	Bobbin
BPC	Bipolar Core
BS	Burin Spall
BSC	Backed Scraper
BST	Bola Stone
BTF	Bifacial Thinning Flake
CD	Chipping Debris
CF	Channel Flake
CO	Core
CPF	Chipped Pebble Fragment
CR	Crescent-Shaped Tool
DF	Decortication Flake
DR	Drill
FG	Chert Fragment
FL	Flake
GF	Geofact (non-artifact)
GO	Gouge
GS	Ground Stone
GT	Gorget
GV	Graver
HE	Hafting Element
HS	Hammerstone
KN	Knife
MBC	Microblade Core
NS	Nutting Stone
PB	Prismatic Blade
PBCO	Pebble Core
PBT	Pebble Tool
PD	Pendant (conically drilled)
PF	Preform
PL	Plummet
PP	Projectile Point
PP(DE)	Projectile Point (distal end)
PP(IF)	Projectile Point (impact fracture)
PP(PE)	Projectile Point (proximal end)
PRF	Perforator
PS	Pitted Stone
PT	Pottery
SC	Scraper
SNSC	Snub-nosed Scraper
SP	Spokeshave
SPC	Split Cobble
UF	Utilized Flake (flake with at least one worked edge or obvious chipping from use)
UK	Unknown
USC	Unifacial Scraper
UT	Unifacial Tool (undetermined function)

Artifacts Indicative of Kill Site Activities

Kill sites may be indicated by the broken distal ends of projectile points if the break is old, or by projectile points with an old impact fracture. It is the distal ends of projectile points, which are sometimes broken off in an animal when the spear shaft is retrieved, that are most prevalent at kill sites. It is also most likely that those projectile points with old impact fractures incurred during active use were damaged by hitting something relatively hard at a significant velocity, such as would occur during hunting. Because the distal ends of projectile points are usually less diagnostic than the proximal ends, 9 of the 21 distal ends of projectile points in the study collection are of unknown cultural period (Table 3).

Wilmsen (1970:78) makes the observation that, at the Blackwater Draw mammoth kill site, tools which had been identified as hammerstones, cores, and broken pebbles, typical of a lithic manufacturing area, may actually have been used in " ... heavy butchering tasks to break limb or rib joints and to prepare bones for marrow extraction." Therefore, hammerstones, cores, and split cobbles, which might be assumed to indicate lithic manufacture activity, may actually have been used at kill sites.

Artifacts Indicative of Lithic Manufacture Activities

Artifacts that are typically used in the manufacture of stone tools include hammerstones, anvils, flake cores, blade cores, pebble cores and bipolar cores. Various types of lithic debitage such as decortication flakes, secondary flakes, and bifacial thinning flakes also indicate lithic manufacture activity. However, as noted above, some of the artifact types included in the lithic manufacture area category, may actually be indicative of kill sites.

Wilmsen (1970) uses the ratio of lithic debitage to tools to identify whether lithic reduction was an important activity at a site. However, in the severely disturbed context of the McFaddin Beach sites, there is a strong bias towards tools as opposed to debitage for the following reasons: 1) many of the collectors thought flakes were not important, so they either didn't pick them up or they picked them up, but did not number or map them, so they could not be included in this study; 2) flakes are generally smaller and harder to spot than are complete tools so they would not be as easily found by collectors; and 3) flakes, especially small ones, would be more easily mobilized and transported by waves and currents; either removing them from the study area or resulting in their burial in the beach deposits (Will and Clark, 1996:510). Despite the factors that would tend to bias the study collection towards less lithic debitage, approximately 2 percent (n = 16) of the artifacts in the study collection are nonutilized flakes (FL), decortication flakes (DF), and bifacial thinning flakes (BTF and BTF/CF) (Table 3).

Because the artifact types that indicate lithic manufacture activity tend to be non-diagnostic, most of the artifacts in this category are of unknown period (see Table 3). Therefore, while a conclusion may be drawn that lithic reduction activity was carried out in the present McFaddin Beach area, it cannot be determined to which specific cultural period or periods this activity relates.

The majority of artifacts in the study collection are not indicative of any specific site type or activity area. For example, artifacts such as knives and blades are equally likely to have been used at both campsites and kill sites. Microwear or residue analysis would be necessary to determine whether such artifacts had been used primarily for butchering activities, or for other cutting purposes more typical of general campsite activities. Tools that may be considered "expedient" such as pebble tools and utilized flakes may be more typical of a kill site where animal processing may have required additional tools immediately due to tool loss, breakage, or exhaustion. However, these expedient tools could also be employed at a campsite.

There are also numerous artifacts in the study collection such as split cobbles, decortication flakes, cores, and preforms that are primarily indicative of a lithic manufacture area, but which have been modified for specific uses more typical of campsite activities such as scrapers, drills, spokeshaves, and gravers. However, like the artifacts in the lithic manufacture area category, the majority of these artifacts are non-diagnostic, and, therefore, cannot be assigned to a specific cultural period.

Projectile points, with the exceptions discussed above, are not specifically indicative of any particular site type. Indeed, it is likely that most projectile points were used for multiple functions. Thirteen of the projectile points in the study collection show definite evidence of having at least one secondary function such as burin, knife, gouge, scraper, or spokeshave (see Table 3).

Discussion

The most serious limitation in using artifacts from severely disturbed sites to draw conclusions about prehistoric human activities arises from the differences in how diagnostic different artifact types are of specific cultural periods. For example, because they are highly stylistic, and often well documented from undisturbed site contexts, the projectile points in the study collection are more diagnostic of particular cultural periods than are most of the other artifact types. As can be seen in Table 3, almost 90 percent of the 517 projectile points could be assigned to a specific cultural period. This bias has the effect of making projectile points appear to be even more dominant in the artifact assemblage for any particular cultural period than, in fact, was probably the case. Also, because projectile points were often multi-purpose tools, without microwear and residue analysis it is difficult to draw conclusions about the types of prehistoric activities or sites these artifacts may represent.

Conversely, lithic debitage and tools used in lithic manufacture are probably the least diagnostic artifacts in the study collection and, without any original site provenience, it is impossible to assign these non-stylistic artifacts such as flakes, cores, and hammerstones to a specific cultural period. This bias results in the appearance that, during any specific cultural period, prehistoric human populations in the McFaddin Beach area were not engaged in lithic manufacturing; even though over 5 percent (n = 49) of the artifacts in the study collection are indicative of lithic manufacture activity.

The lack of provenience for the artifacts in the study collection and the non-diagnostic nature of many of the artifact types greatly hinder the conclusions that may be drawn about prehistoric human activities for the McFaddin Beach area. However, it can be concluded that the artifacts from McFaddin Beach represent a wide range of human activities including hunting, food processing, hide working, woodworking, and lithic manufacture, not just hunting losses and isolated finds.

Lithic Source Analysis

Larry Banks, author of the comprehensive reference work on lithic sources in the Trans-Mississippi South, the Southern Plains, and the adjacent Southwest (Banks, 1990), was contracted for this study to determine the lithic sources of the chipped stone artifacts in the study collection. Banks' identifications for the study collection were based on macroscopic and microscopic inspection, and comparison of the artifacts to control specimens from his extensive collection of rocks from various known lithic sources. Regarding the general availability of raw lithic material along the upper Texas Gulf coastal area, Banks comments in his report:

> The geographic and geologic setting of the McFaddin Beach locality west of the mouth of the Sabine River on the upper Texas Gulf Coast could hardly be positioned in a more disadvantaged area of the United States regarding availability to natural raw materials required for stone tool production. . . . There simply are no rocks of any appreciable size or type commonly found as gravels or otherwise on the upper Texas Gulf Coast. . . . The nearest sources of extensive and abundant quantities of various types of chert are outcrops of the Edwards Group whose nearest proximity of the eastern escarpment of the Edwards Plateau to McFaddin Beach is roughly 274 kilometers (170 miles) to the northwest; the Ouachita Mountains some 400 kilometers (250 miles) to the north; and the Arbuckle Mountains due west of the Ouachita Mountains. (Appendix E:638-639)

Results of the Lithic Source Analysis

Figure 9 shows the locations of the various lithic sources identified for the artifacts in the study collection, and Table 4 shows the lithic source data by cultural period. The sources represented by the numbers on the map (Figure 9) are identified at the end of

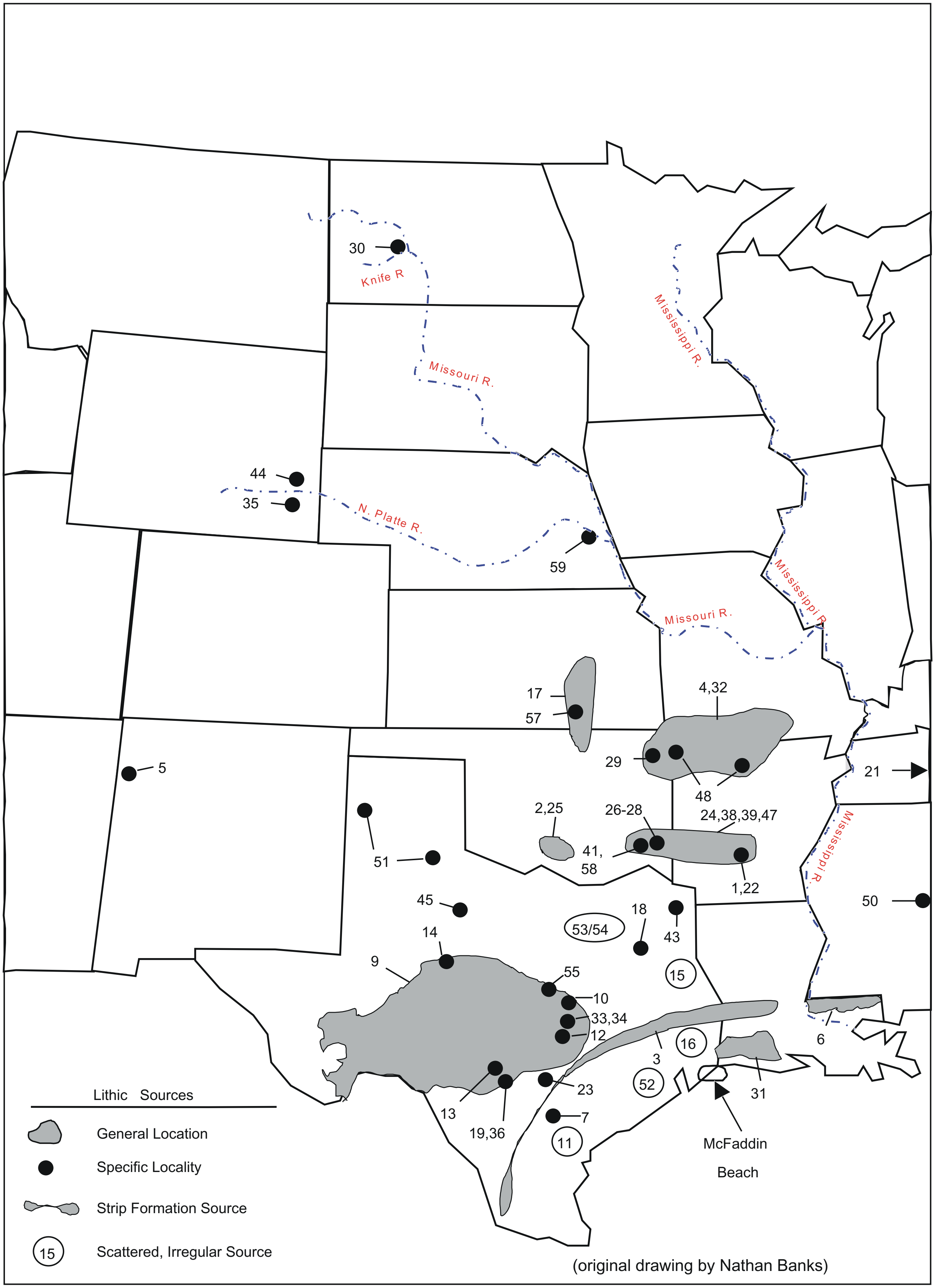

Figure 9. Locations of Lithic Sources Identified for the Study Collection

Table 4. Lithic Sources by Cultural Period

Lithic Source		Paleoindian	Late Paleoindian	Late Paleoindian/ Early Archaic	Early Archaic	Early/ Middle Archaic	Middle Archaic	Middle/ Late Archaic	Middle/ Transitional Archaic	Late Archaic	Late Archaic/ Late Prehistoric	Late/ Transitional Archaic	Transitional Archaic	Archaic (Non-specific)	Late Prehistoric	Late Prehistoric/ Historic	Unknown	**Total**
		D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P		
AKN	D P																1	**1**
ARB	D P	1 1															1	**1** **2**
CAT	D P																	
CF	D P	1																**1**
CH	D P	 1																**1**
CIT D	 P																1	**1**
CRG	D P																1	**1**
EDW	D P	66 15 15 3	33 9 4 2	5 1 1	3 1 1	1 2	15 1 1 2	19 2 3	27 8 4 1	7 3 1 1	4 1 1 1	8 2 2	10	11 1 2	4	2 1	134 20	**395** **66**

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Source	Paleoindian D P	Late Paleoindian D P	Late Paleoindian/ Early Archaic D P	Early Archaic D P	Early/ Middle Archaic D P	Middle Archaic D P	Middle/ Late Archaic D P	Middle/ Transitional Archaic D P	Late Archaic D P	Late Archaic/ Late Prehistoric D P	Late/ Transitional Archaic D P	Transitional Archaic D P	Archaic (Non-specific) D P	Late Prehistoric D P	Late Prehistoric/ Historic D P	Unknown	**Total**
EDW (B) D P				1													**1**
EDWG D P	7 6 1	5 3 1	1			3	6 1	11 1 1	4 3 1		2	1 1				54 4	**108** **9**
EDWG (MQTX) D P								1									**1**
EDW (GT) D P			1													1	**2**
EDW (NB) D P	1																**1**
EDW (S) D P																1	**1**
ETX D P	1								1							1	**3**
ETXG D P	1		1	1		1	1	 1	1							2	**8** **1**

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Source		Paleoindian		Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
		D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
FLC	D																															1	**1**
	P																																
FQ	D	1			1											2																	**4**
	P																1															4	**5**
GRC	D																									1							**1**
	P																																
GR (U)	D			1										1	1	1						1		2								3	**10**
	P	1	1																							1						1	**4**
GSM	D																																
	P																																
HS	D																																
	P															1																	**1**
I-10-3	D																															1	**1**
	P																																
JF	D																																
	P																																

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Source		Paleoindian	Late Paleoindian	Late Paleoindian/ Early Archaic	Early Archaic	Early/ Middle Archaic	Middle Archaic	Middle/ Late Archaic	Middle/ Transitional Archaic	Late Archaic	Late Archaic/ Late Prehistoric	Late/ Transitional Archaic	Transitional Archaic	Archaic (Non-specific)	Late Prehistoric	Late Prehistoric/ Historic	Unknown	**Total**
		D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P	D P		
JOC (L)	D						1							1				**3**
	P	1																
JVS	D																2	**2**
	P																	
JVS (BF)	D		1															**1**
	P																	
JVS (N)	D	1																**1**
	P																	
KKC D		1																**1**
	P																	
KRF	D		1															**2**
	P	1															1	**1**
LAG	D																	
	P	1																**1**
LB	D																1	**1**
	P																	

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Source	Paleoindian	Late Paleoindian	Late Paleoindian/ Early Archaic	Early Archaic	Early/ Middle Archaic	Middle Archaic	Middle/ Late Archaic	Middle/ Transitional Archaic	Late Archaic	Late Archaic/ Late Prehistoric	Late/ Transitional Archaic	Transitional Archaic	Archaic (Non-specific)	Late Prehistoric	Late Prehistoric/ Historic	Unknown	**Total**
LRG D																	
LRG P													1				**1**
MF D	2								1			1					**4**
MF P																	
MIN D																	
MIN P	1																**1**
OMD																2	**2**
OMD P																	
OMN D											1						**1**
OMN P																	
OQ D																1	**1**
OQ P																	
PT D																	
PT P																	
QCSG D						1					1						**2**
QCSG P								1						1			**2**

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Source		Paleoindian	Late Paleoindian		Late Paleoindian/ Early Archaic		Early Archaic		Early/ Middle Archaic		Middle Archaic		Middle/ Late Archaic		Middle/ Transitional Archaic		Late Archaic		Late Archaic/ Late Prehistoric		Late/ Transitional Archaic		Transitional Archaic		Archaic (Non-specific)		Late Prehistoric		Late Prehistoric/ Historic		Unknown	**Total**
		D P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P	D	P		
SD	D																															
	P																															
SGQ	D			1																												**1**
	P																			1											1	**2**
SS	D																															
	P																															
STJ	D																															
	P																															
TAL	D																															
	P																															
TEC	D	3					1								1	1	1														4	**12**
	P	2	1								1		2			2						1			1						4	**13**
TECG	D	1													1																	**2**
	P																															
UG	D																														5	**5**
	P																														1	**1**

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Source		Paleoindian D	Paleoindian P	Late Paleoindian D	Late Paleoindian P	Late Paleoindian/ Early Archaic D	Late Paleoindian/ Early Archaic P	Early Archaic D	Early Archaic P	Early/ Middle Archaic D	Early/ Middle Archaic P	Middle Archaic D	Middle Archaic P	Middle/ Late Archaic D	Middle/ Late Archaic P	Middle/ Transitional Archaic D	Middle/ Transitional Archaic P	Late Archaic D	Late Archaic P	Late Archaic/ Late Prehistoric D	Late Archaic/ Late Prehistoric P	Late/ Transitional Archaic D	Late/ Transitional Archaic P	Transitional Archaic D	Transitional Archaic P	Archaic (Non-specific) D	Archaic (Non-specific) P	Late Prehistoric D	Late Prehistoric P	Late Prehistoric/ Historic D	Late Prehistoric/ Historic P	Unknown	**Total**
UG (O)	D																						1										**1**
	P																																
UG (P)	D																																
	P																															1	**1**
WFC	D													1																			**1**
	P																																
WSF	D																											1					**1**
	P																																
WWC	D	1																															**1**
	P	1																														1	**2**
N/A																																11	**13**
																												2					
UK		19		5		3		6		1		1	1	6	1	11	2	3	2	2	1	2	2			2		2				74	**146**
TOTAL		**128**	**30**	**52**	**16**	**12**	**1**	**13**	**1**	**2**	**2**	**24**	**4**	**39**	**5**	**63**	**16**	**19**	**10**	**7**	**4**	**17**	**6**	**16**	**--**	**18**	**2**	**8** **2**		**3**	**--**	**340**	**860***

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Sources

No.	Code	Source
1.	AKN	Arkansas Novaculite (Hot Springs Region)
2.	ARB	Arbuckle Mountains
3.	CAT	Catahoula
4.	CF	Cotter Formation (NE Oklahoma, NW Arkansas)
5.	CH	Chuska
6.	CIT	Citronelle Gravels (Eastern Louisiana)
7.	CRG	Colorado River Gravels
9.	EDW	Edwards Plateau
10.	EDW(B)	Edwards (Belton Lake)
11.	EDWG	Edwards Gravels
12.	EDW(GT)	Edwards (Georgetown Locality)
13.	EDW(NB)	Edwards (New Braunfels)
14.	EDW(S)	Big Spring Edwards (Segovia)
15.	ETX	East Texas (Tertiary Formation)
16.	ETXG	East Texas Gravels
17.	FLC	Florence Chert, Oklahoma
18.	FQ	Fisher Quartzite
19.	GRC	Guadalupe River Cobble
		(Seguin Specimen Acme-11)
	GR(U)	Gravel Source (Unidentified)
21.	GSM	Great Smoky Mountains (Eastern Tennessee)
22.	HS	Hot Springs, Arkansas
23.	I-10-3	Specimen Collected by Banks (Edwards?)
24.	JF	Jackfork Formation (Ouachita Mountains)
25.	JOC(L)	"Lowrance" Chert from Joins-Oil Creek Formation, Arbuckle Mountains
26.	JVS	Johns Valley Shale, Ouachita Mountains
27.	JVS(BF)	Big Fork Chert, Johns ValleyShale, Ouachita Mountains
28.	JVS(N)	Johns Valley Shale (Nova Chert)
29.	KKC	KeokukChert, W. Ozark Mountains
30.	KRF	Knife River Flint
31.	LAG	Louisiana Gravels
32.	LB	Lower Boone Formation (NE Oklahoma and NW Arkansas)
33.	LRG	Lampasas River Gravel
34.	MF	Marble Falls
35.	MIN	Minnelusa
36.	MQTX	Acme Clay Pit, McQueeny, Texas (Edwards Gravel)
	NA	Not Applicable
38.	OM	Ouachita Mountains
39.	OMN	Ouachita Mountains Novaculite
	OQ	Ogallala Quartzite
41.	PT	Pinetop (Ouachita Mountains)
43.	QCSG	Queen City Sand Gravels

Table 4. Lithic Sources by Cultural Period (continued)

Lithic Sources (continued)

No.	Code	Source
44.	SD	Spanish Diggings
45.	SGQ	Seymour Gravel Quartzites (Eastern Edge of the Llano Estacado)
47.	SS	Stanley Shale Formation (Ouachita Mountains)
48.	STJ	St. Joe Formation (Ozark Mountains)
50.	TAL	Tallahatta
51.	TEC	Tecovas
52.	TECG	Tecovas Gravel
53.	UG	Uvalde Gravels (Cretaceous, North-Central Texas)
54.	UG(O)	Uvalde Gravels (Ogallala)
55.	UG(P)	Uvalde Gravels (Proctor)
	UK	Unknown
57.	WFC	Wreford Chert (Flint Hills, Kansas)
58.	WSF	Wesley Formation, Stanley Group (Ouachita Mountains)
59.	WWC	Weeping Water Creek (SE Nebraska)

Note: Number next to lithic source code refers to its location on maps shown in Figures 9 - 24.

* There were 20 artifacts whose lithic source could be one or the other of the two sources indicated:

Paleoindian	PPT/PSTJ	Middle/Transitional Archaic	PEDW/PTEC
Paleoindian	PTEC/PSD	Unknown	OMN/HS
Late Paleoindian	PEDW/PETXG	Unknown	PCAT/PTAL
Late Paleoindian	SS/JF	Unknown	PEDW/PETXG
Possibly Late Paleoindian	PTEC/PMIN	Unknown	PEDW/PGSM
Late Paleoindian/Early Archaic	PEDWG/PUG	Unknown	PEDW/PKRF
Early Archaic	PEDW/PETXG	Unknown	PEDW/PUG
Middle/Late Archaic	PEDW/PKRF	Unknown	PEDW/PUG
Middle/Transitional Archaic	AKN/PEDW	Unknown	PJVS/PEDW
Middle/Transitional Archaic	JF/SS	Unknown	PTEC/PSTJ

Table 4. The various gravel sources are scattered and difficult to pinpoint on a map, but general locations have been given for these in Figure 9 indicated by an encircled number. Two lithic sources not shown in Figure 9 are GR(U), which are gravels from an unidentified source, and Ogallala Quartzite, which is so widespread across the Plains region that it cannot be pinpointed on a map. As has been done throughout the analysis, both the number of artifacts that definitely are of a particular category and those that are possibly of that category are given in Table 4. This provides a matrix with as many as four numbers for each cultural period and lithic source, indicating whether the identified cultural period and lithic source are either definite (D) or possible (P). Figures 10 through 24 show the geographic distribution of the lithic sources identified for each cultural period. In the following discussion, the number in parentheses after a lithic source is its reference number in Figures 9 through 24.

Edwards Plateau

As would be expected, the extensive Edwards Plateau in central Texas is the predominate lithic source for all cultural periods with 395 of the artifacts definitely being of Edwards Plateau lithic material, and another 66 possibly also being of Edwards material (see Table 4). Nine additional artifacts were identified as definitely being from specific sub-areas of the Edwards Plateau including Belton Lake (no. 10), Georgetown (no. 12), New Braunfels (no. 13), Segovia (no. 14), and Marble Falls (no. 34). As can be seen in Figures 10 through 24, the Edwards Plateau (no. 9) was a lithic source area used during all cultural periods. The easternmost edge of chert outcrops of the Edwards Group is at

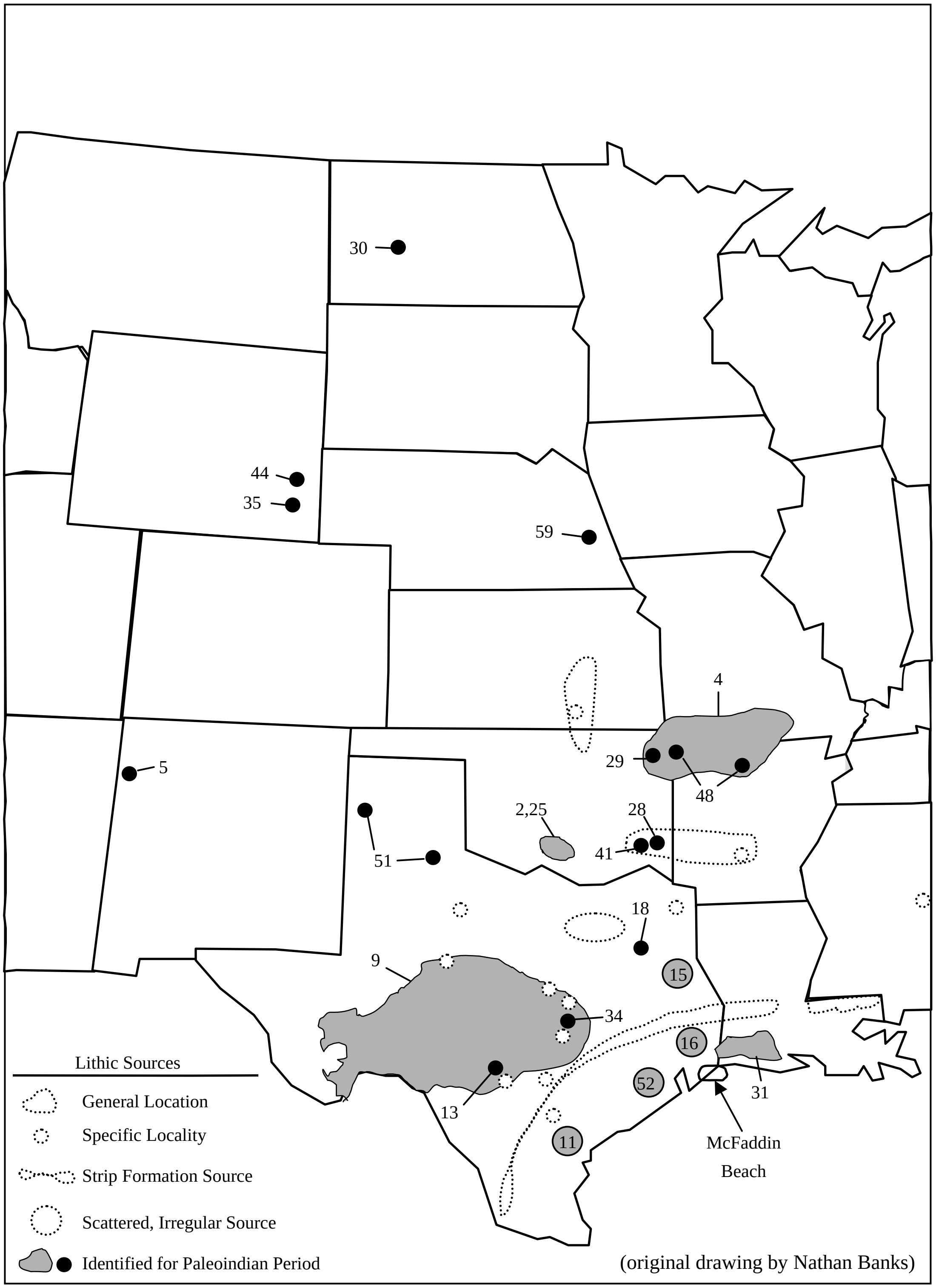

Figure 10. Locations of Lithic Sources Identified for the Paleoindian Period

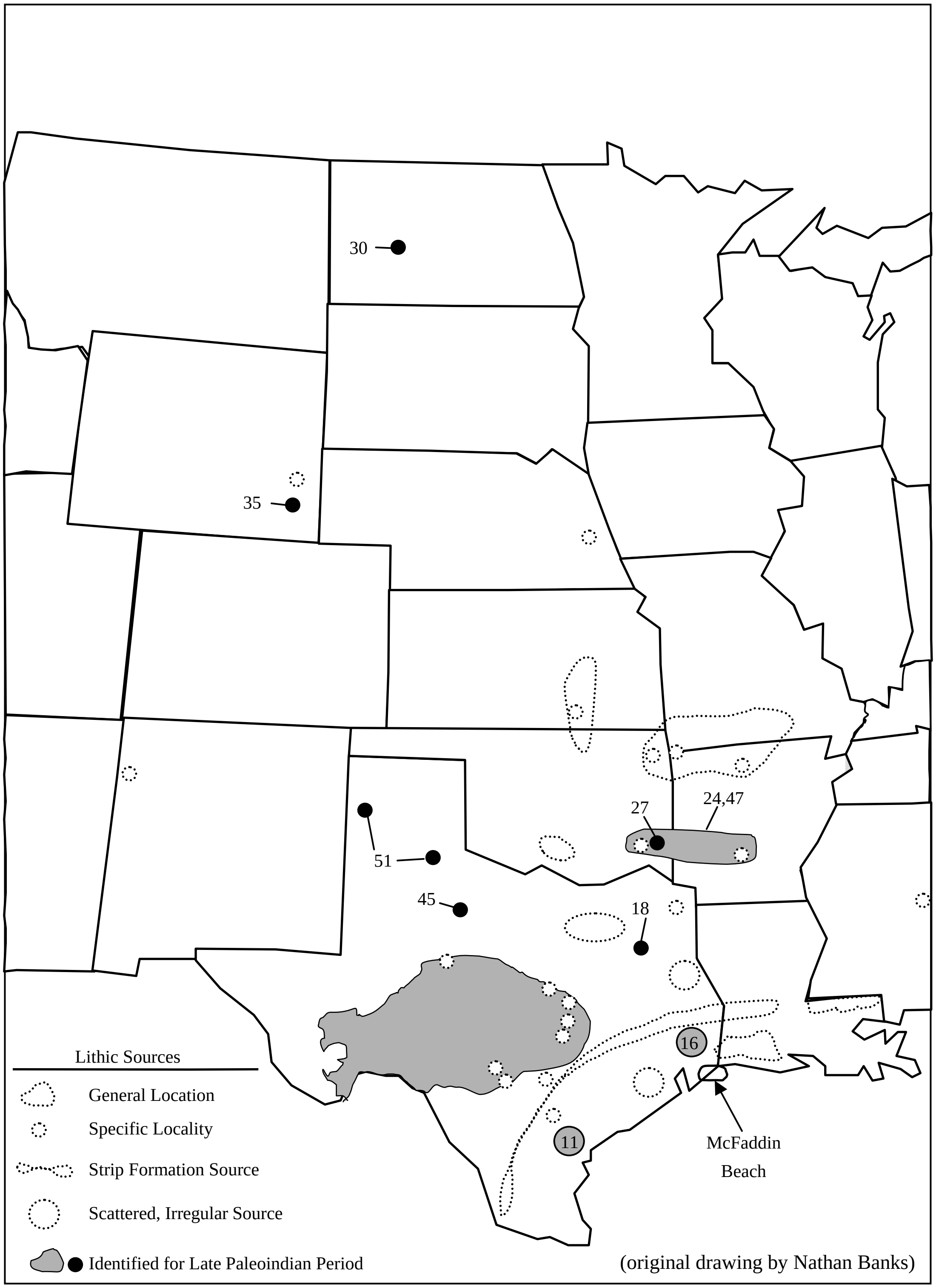

Figure 11. Locations of Lithic Sources Identified for the Late Paleoindian Period

Figure 12. Locations of Lithic Sources Identified for the Late Paleoindian/Early Archaic Period

Figure 13. Locations of Lithic Sources Identified for the Early Archaic Period

Figure 14. Locations of Lithic Sources Identified for the Early/Middle Archaic Period

Figure 15. Locations of Lithic Sources Identified for the Middle Archaic Period

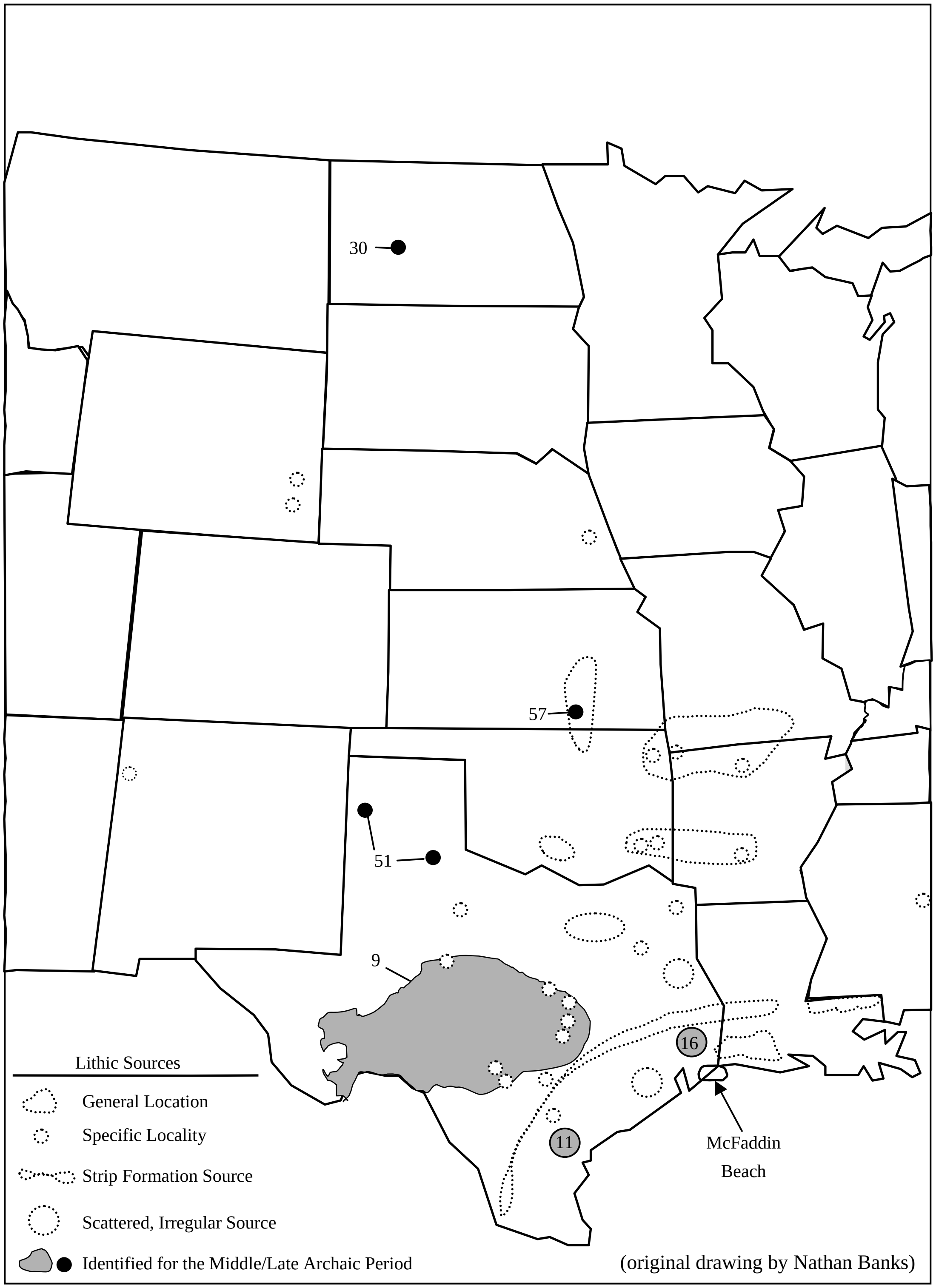

Figure 16. Locations of Lithic Sources Identified for the Middle/Late Archaic Period

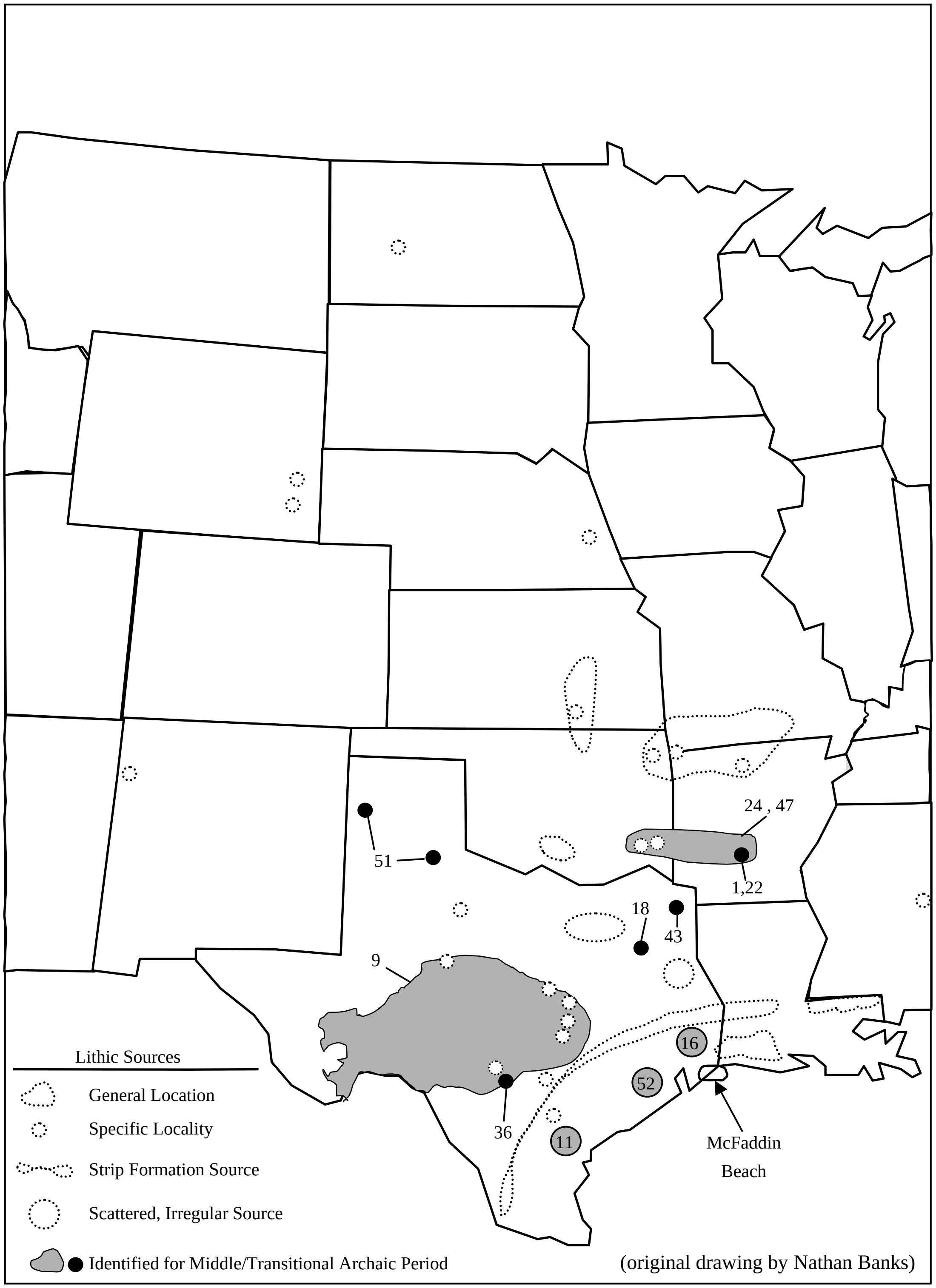

Figure 17. Locations of Lithic Sources Identified for the Middle/TransitionalArchaic Period

Figure 18. Locations of Lithic Sources Identified for the Late Archaic Period

Figure 19. Locations of Lithic Sources Identified for the Late Archaic/Late Prehistoric Period

Figure 20. Locations of Lithic Sources Identified for the Late/Transitional Archaic Period

Figure 21. Locations of Lithic Sources Identified for the Transitional Archaic Period

Figure 22. Locations of Lithic Sources Identified for the Archaic (Non-specific) Period

Figure 23. Locations of Lithic Sources Identified for the Late Prehistoric Period

Figure 24. Locations of Lithic Sources Identified for the Late Prehistoric/Historic Period

the eastern escarpment of the Edwards Plateau, approximately 274 kilometers northwest of the study area (Appendix E:639).

Gravels from the Edwards Plateau

Gravels from the Edwards Plateau are the next most predominant lithic source represented in the study collection (n = 108 definite, and n = 9 possible). Four other artifacts were made of material from specific gravel sources that lie within the Edwards Plateau including Guadalupe River Cobbles (GRC) (no. 19); Lampasas River Gravels (LRG) (no. 33); Edwards gravel, Acme Clay Pit, McQueeny, Texas (MQTX) (no. 36); and Uvalde Gravels (Proctor) (UG(P)) (no. 55). These gravels were transported by one of several river systems (i.e., Neuces, San Antonio, Guadalupe, Colorado, and Brazos) southeastward from the Edwards Plateau towards the Gulf coast (Appendix E:640).

Gravels from the Edwards Plateau were used as a source material for all periods except the Early and Early/Middle Archaic Periods, and those periods that overlapped the Late Prehistoric Period (i.e., Late Archaic/Late Prehistoric, Late Prehistoric, and Late Prehistoric/Historic Periods). The relatively low number of artifacts for each of these periods may be as likely an explanation for this otherwise common source not being represented, as is the possibility that the prehistoric inhabitants of these periods did not use the Edwards Plateau gravels as a source material.

Petrified Wood and Fossil Palm of Unknown Source

There are 61 artifacts in the study collection made of petrified wood and 6 made of fossil palm. There is 1 additional artifact that was identified as possibly being made of petrified palm wood. Of these 68 artifacts, 2 were definitely assigned to an east Texas source (ETX), 4 were assigned to an east Texas gravel source (ETXG), and 3 were assigned to an unknown gravel source. The remaining 59 petrified wood and fossil palm artifacts were placed in the category of unknown lithic source. It is most likely that the source material for these artifacts is coming from the Tertiary-aged deposits of east Texas including the Queen City and Reklaw Formations in the Claiborne Group, the Catahoula Formation (no. 3), and the Flemming Formation, which overlies the Catahoula (Banks, 1990:49-50). It should be noted that unidentified petrified wood was also widely used by prehistoric groups across Louisiana and Mississippi to the east.

Table 5 shows the number of artifacts made out of petrified wood and fossil palm by cultural period, and the percentage this represents of the total number of artifacts for that time period. As in the preceding tables, the percentage is given in relation to both the number of artifacts that are definitely of a particular time period, and also in relation to the combined number of artifacts that are definitely and possibly of that time period.

Although the Paleoindian Period has the most artifacts made of petrified wood and fossil palm (n = 10), when the data are converted to a percentage of the total number of artifacts for each period, the Late Paleoindian/Early Archaic Period (definite = 23.08 percent, definite and possible = 21.43 percent) and Early Archaic Period (definite = 42.86 percent, definite and possible = 40.00 percent) have the highest percentages of artifacts made out of petrified wood. Although the Early/Middle Archaic Period also has a high percentage of petrified wood artifacts (definite = 50.00 percent, definite and possible = 25.00 percent), the total number of artifacts for this period is so low (n = 4) that the

Table 5. Artifacts Made of Petrified Wood and Fossil Palm by Cultural Period

Number of Artifacts by Period D-Definite P-Possible		Number of Artifacts Made of PW/FP	Percentage of Artifacts Made of PW/FP
Paleoindian	D = 130	10*	7.69
	P = 30	0	
	D&P = 160	**10**	**6.25**
Late Paleoindian	D = 54	4	7.41
	P = 17	0	
	D&P = 71	**4**	**5.63**
Late Paleoindian/ Early Archaic	D = 13	3	23.08
	P = 1	0	
	D&P = 14	**3**	**21.43**
Early Archaic	D = 14	6	42.86
	P = 1	0	
	D&P = 15	**6**	**40.00**
Early/ Middle Archaic	D = 2	1	50.00
	P = 2	0	
	D&P = 4	**1**	**25.00**
Middle Archaic	D = 24	1	8.33
	P = 4	1	
	D&P = 28	**2**	**7.14**
Middle/Late Archaic	D = 40	3	10.00
	P = 5	1	
	D&P = 45	**4**	**8.89**
Middle/Transitional Archaic	D = 66	5	7.58
	P = 16	0	
	D&P = 82	**5**	**6.10**
Late Archaic	D = 19	3	15.79
	P = 10	0	
	D&P = 29	**3**	**10.34**
Late Archaic/Late Prehistoric	D = 7	1	14.29
	P = 4	0	
	D&P = 11	**1**	**9.10**
Late/Transitional Archaic	D = 17	2	11.76
	P = 6	0	
	D&P = 23	**2**	**8.70**
Transitional Archaic	D = 16	0	0.00
	P = 0	0	
	D&P = 16	**0**	**0.00**
Archaic (Nonspecific)	D = 18	0	0.00
	P = 2	0	
	D&P = 20	**0**	**0.00**
Late Prehistoric	D = 8	0	0.00
	P = 2	0	
	D&P = 10	**0**	**0.00**
Late Prehistoric/ Historic	D = 3	0	0.00
	P = 0	0	
	D&P = 3	**0**	**0.00**
Unknown	**349**	**27****	**7.74**
Total Number of Artifacts Made from PW/FP		**68**	

* Of the 10 artifacts of the Paleoindian Period, 1 is made of FP

** Of the 27 artifacts of Unknown Period, 6 are made of FP, but 1 is only possibly made of FP percentages are probably not statistically meaningful. Unlike earlier periods, there are no artifacts made out of petrified wood or fossil palm for the Transitional Archaic, Late Prehistoric, and Late Prehistoric/Historic Periods. This probably is only a reflection of the small number of artifacts representing these periods in the study collection.

Tecovas

Tecovas, from the Panhandle of Texas, is the fourth most numerous lithic source identified in the study collection (n = 12 definite, and n = 13 possible). Another 4 artifacts could be Tecovas but are equally as likely to be a second specific source (see note at end of Table 4). The cultural periods that have no artifacts made from Tecovas material are Late Paleoindian/Early Archaic (n = 14), Early/Middle Archaic (n = 4), Late Archaic/Late Prehistoric (n = 11), Transitional Archaic (n = 16), Late Prehistoric (n =10), and Late Prehistoric/Historic (n = 3) (Table 4, and Figures 10-24). With the exception of the Early Archaic Period (n = 15), these are also the cultural periods with the least number of total artifacts. The percentage of artifacts made out of Tecovas for each period where Tecovas is represented is very consistent, ranging between 1.41 percent (Late Paleoindian Period) and 6.67 percent (Early Archaic Period). Therefore, it is possible that the absence of artifacts made out of Tecovas material for certain periods is more a function of the relatively small number of artifacts for those periods in the study collection, rather than being reflective of true prehistoric lithic procurement strategies.

Ouachita Mountains

The lithic sources of the Ouachita Mountains in southeastern Oklahoma and southwestern Arkansas include Arkansas Novaculite (AKN) (no. 1), Hot Springs, Arkansas (HS) (no. 22), the Jackfork Formation (JF) (no. 24), Johns Valley Shale (JVS) (no. 26), including Big Fork Chert (JVS(BF)) (no. 27), and Nova Chert (JVS(N)) (no. 28), Ouachita Mountains Novaculite (OMN) (no. 39), Pinetop (PT) (no. 41), the Stanley Shale Formation (SS) (no. 47), and the Wesley Formation of the Stanley Group (WSF) (no. 58). The general designation for lithic material from the Ouachita Mountains, when no specific source could be defined is Ouachita Mountains (OM) (no. 38).

There are only 16 artifacts in the entire study collection made out of Ouachita Mountain lithic source materials, 2 in the Paleoindian Period (1 definite and 1 possible), 2 definite in the Late Paleoindian Period, 3 in the Middle/Transitional Archaic Period (1 definite and 2 possible), 1 definite in the Late/Transitional Archaic Period, 1 definite in the Late Prehistoric Period, and 7 of unknown period (6 definite and 1 possible) (Table 4). The Ouachita Mountain area does not seem to have been a significant lithic source for any of the prehistoric groups living in the McFaddin Beach area.

Fisher Quartzite

Nine artifacts in the study collection are made out of Fisher Quartzite (FQ) (no. 18) whose source is located at the headwaters of the Sabine River in eastern Texas. Two of these artifacts retain evidence of pebble cortex, indicating that the source material used for the artifacts came from stream cobbles. Of these nine artifacts, one is of Paleoindian age, one is possibly of late Paleoindian age, three are of Middle/Transitional Archaic (two definite and one possible), and four are of unknown period. The three periods identified as having artifacts made out of Fisher Quartzite are also the three periods with the greatest total number of artifacts. Therefore, it is probably not a significant indicator of the exclusive use of the Fisher Quartzite source during these periods, but, rather, is reflective of the larger number of total artifacts for these periods in the study collection.

Ozark Mountains

The lithic sources of the Ozark Mountains of northeastern Oklahoma and northwestern Arkansas, including the Cotter Formation (CF) (no. 4), Keokuk Chert (KKC) (no.29), the Lower Boone Formation (LB) (no. 32) and the St. Joe Formation (STJ) (no. 48) are only represented in the artifacts of Paleoindian age (Figure 10). There are only three Paleoindian-age artifacts from these Ozark Mountain sources, one definite Paleoindian artifact made of material from the Cotter Formation, one possible Paleoindian artifact made of material from Keokuk Chert, and one definite Paleoindian artifact made out of material that is possibly of the St. Joe Formation, but equally likely to be of the Pinetop Formation in the Ouachita Mountains to the south (see note at end of Table 4). There are two additional artifacts in the study collection of unknown cultural period made from Ozark Mountain sources; a biface/preform (TN 184) made from quartzitic chert of the Lower Boone Formation, and an untyped projectile point (LV 287) possibly made from chert of the St. Joe Formation (Table 4). The Ozark Mountains apparently were not a major lithic source area for prehistoric peoples in the McFaddin

Beach area, but it is probably significant that of the five artifacts made out of Ozark Mountain source material, the three that could be assigned to a specific cultural period were all Paleoindian in age.

Arbuckle Mountains

Lithic sources identified for the Arbuckle Mountains of southern Oklahoma include a general Arbuckle Mountain source designation (ARB) (no. 2), and a specific chert source within the Arbuckle Mountains, the Lowrance Chert from the Joins-Oil-Creek Formation (JOC(L)) (no. 25). There are only six artifacts in the study collection identified as being from Arbuckle Mountains sources. Three of these are from the Paleoindian Period (one definite, one possible, and one definitely of Lowrance Chert but only possibly from the Paleoindian Period), one from the Middle Archaic Period, one non-specific Archaic artifact, and one of unknown period (Table 4). The fact that three of the six artifacts identified with Arbuckle Mountain sources are associated with the Paleoindian Period suggests that if this location was ever a significant source for inhabitants of the McFaddin Beach area, it was during this period.

Exotic Lithic Sources

Because there really are no local lithic sources within the study area, for the purposes of this study, the term “exotic” is used to refer to those lithic sources that are greater than 1,000 kilometers from the McFaddin Beach area. As would be expected, the exotic lithic sources identified for the study collection (i.e. Knife River Flint (KRF) (no. 30) in southwestern North Dakota, Minnelusa (MIN) (no. 35) and Spanish Diggings (SD) (no. 44) in southeastern Wyoming, Weeping Water Creek (WWC) (no. 59) in southeastern Nebraska, and Chuska (CH) (no. 5) in western New Mexico) are primarily associated with the Paleoindian and Late Paleoindian Periods (Figures 10 and 11). As can be seen in Table 6, of the 12 artifacts identified as being either definitely or possibly from an exotic lithic source, 4 are of the Paleoindian Period and 2 are identified as possibly being of the Paleoindian Period. Another 2 of the artifacts made out of exotic lithics are from the Late Paleoindian Period (1 definite and 1 possible). One is a Scottsbluff drill (TN 155) that is definitely made out of Knife River Flint (Table 4). The second was less certain, being identified as just possibly being made out of Minnelusa material, but equally likely to be Tecovas material, and it is only possibly of the Late Paleoindian Period (see note at end of Table 4). Other than the 3 artifacts of unknown period, the only exception is 1 artifact, an Epps projectile point, from the Middle/Late Archaic Period that is identified as possibly being made out of Knife River Flint (Table 6); however, it is equally likely to be made out of Edwards chert (see note at end of Table 4). An interesting aspect of this artifact is that it has apparently been made by reworking an earlier artifact. If it is made of Knife River Flint, the material may have been transported to the McFaddin Beach area during Paleoindian times. It is interesting to note that several of the diagnostic artifacts made out of exotic source materials are projectile point styles of the Great Plains (i.e. Plainview, Hell Gap, Scottsbluff) where the lithic sources are located.

Table 6. Artifacts Made from Exotic Lithic Source Materials

Period	Artifact Number	Diagnostic Type	Function	Lithic Source
Paleoindian	FR 30	Dalton	Dart Point	Weeping Water Creek
Paleoindian	LV 195	Plainview	Dart Point	(P) Weeping Water Creek
Paleoindian	TN 168	Plainview	Dart Point	(P) Minnelusa
Paleoindian	LV 14	Hell Gap	Dart Point	(P) Tecovas/(P) Spanish Diggings
(P) Paleoindian	TN 303	Untyped	Flake/Blade/Unifacial Tool	Chuska
(P) Paleoindian	TN 131	(P) Clovis	Dart Point	Knife River Flint
Late Paleoindian	TN 155	Scottsbluff	Drill	Knife River Flint
(P) Late Paleoindian	TN 128	(P) Early Side-Notched	Dart Point	(P) Tecovas/(P) Minnelusa
Middle/Late Archaic	LV 248	Epps	Dart Point	(P) Edwards/(P) Knife River Flint
Unknown	TN 201	Nondiagnostic	Decortication Flake/Scraper	(P) Edwards/(P) Knife River Flint
Unknown	TN 146	Nondiagnostic	Bifacial Thinning Flake/ Utilized Flake	(P) Knife River Flint
Unknown	TN 208	Untyped	Biface	(P) Weeping Water Creek

(P) = Possible

Gravel Sources

The gravel sources represented in the study collection are widespread geographically (Figure 9). Table 7 lists the number of artifacts made from gravel source material by period. In addition to the gravel sources discussed under the section "Gravels from the Edwards Plateau" above, the following gravel sources are included in the tabulations of Table 7: Citronelle Gravels (CIT) (no. 6), Colorado River Gravels (CRG) (no. 7), East Texas Gravels (ETXG) (no. 16), the I-10-3 source (no. 23), Louisiana Gravels (LAG) (no. 31), Queen City Sand Gravels (QCSG) (no. 43), the Seymour Gravel Quartzites, (SGQ) (no. 45), Tecovas Gravels (TECG) (no. 52), Uvalde Gravels (UG) (no. 53), Uvalde Gravels (Ogallala), (UG(O)), (no. 54), and unidentified gravels (GR(U)) which could not be mapped.

All but 20 of the artifacts included in Table 7 were made of material from one of the specific gravel sources listed above. The lithic sources identified for the 20 artifacts tabulated in the next to the last column of Table 7 are not exclusively gravel sources, but the artifacts have remnants of pebble cortex on them indicating a gravel source. It should be noted that there is not a one-to-one correlation between the presence of pebble cortex on an artifact and the identification of a gravel source for the lithic material. Sometimes all of the pebble cortex has been removed during the lithic manufacturing process, and in other instances only remnant weathering bands on the artifact are suggestive of a gravel source. Still in other instances, the material is only known to occur as gravels.

As can be seen in Table 7, 187, or 21.25 percent of the artifacts in the study collection, are from gravel sources. Over 47 percent (n = 89) of the artifacts made from

Table 7. Artifacts from Gravel Sources by Cultural Period

Number of Artifacts by Period		Artifacts from Gravel Sources D	Artifacts from Gravel Sources P	Additional Artifacts with Pebble Cortex	Totals
Paleoindian	D = 130	9	3	2	14
	P = 30	6	1	1	8
	D&P = 160	**15**	**4**	**3**	**22**
Late Paleoindian	D = 54	6	1	0	7
	P = 17	4	1	0	4
	D&P = 71	**10**	**1**	**0**	**11**
Late Paleoindian/ Early Archaic	D = 13	2	1	1	4
	P = 1	0	0	0	0
	D&P = 14	**2**	**1**	**1**	**4**
Early Archaic	D = 14	1	0	0	1
	P = 1	0	0	0	0
	D&P = 15	1	0	0	1
Early/ Middle Archaic	D = 2	0	0	0	0
	P = 2	0	0	0	0
	D&P = 4	**0**	**0**	**0**	**0**
Middle Archaic	D = 24	5	0	0	5
	P = 4	0	0	0	0
	D&P = 28	**5**	**0**	**0**	**5**
Middle/Late Archaic	D = 40	8	0	1	9
	P = 5	2	0	0	2
	D&P = 45	**10**	**0**	**1**	**11**
Middle/Transitional Archaic	D = 66	14	3	1	18
	P = 16	1	0	1	2
	D&P = 82	**15**	**3**	**2**	**20**
Late Archaic	D = 19	5	1	1	7
	P = 10	3	0	0	3
	D&P = 29	**8**	**1**	**1**	**10**
Late Archaic/Late Prehistoric	D = 7	0	0	0	0
	P = 4	0	1	0	1
	D&P = 11	**0**	**1**	**0**	**1**
Late/Transitional Archaic	D = 17	4	0	0	4
	P = 6	1	0	0	1
	D&P = 23	**5**	**0**	**0**	**5**
Transitional Archaic	D = 16	3	2	0	5
	P = 0	0	0	0	0
	D&P = 16	**3**	**2**	**0**	**5**
Archaic (Nonspecific)	D = 18	1	1	0	2
	P = 2	0	0	0	0
	D&P = 20	**1**	**1**	**0**	**2**
Late Prehistoric	D = 8	0	1	0	1
	P = 2	0	0	0	0
	D&P = 10	**0**	**1**	**0**	**1**
Late Prehistoric/ Historic	D = 3	0	0	0	0
	P = 0	0	0	0	0
	D&P = 3	**0**	**0**	**0**	**0**
Unknown	**349**	66	11	12*	89
Total		**141**	**26**	**20**	**187**

D-Definite P-Possible

* 2 only possibly have pebble cortex

gravel source material are of unknown cultural period. The only two periods that have no artifacts made from gravel sources are the Early/Middle Archaic Period and the Late Prehistoric/Historic Period. However, the total number of artifacts for these two periods is so low (n = 4, and n = 3, respectively) that no conclusions about the use of gravel sources during these periods can be drawn. The Paleoindian Period and the Middle/Transitional Archaic Period have the highest totals of artifacts from gravel sources (n = 22, and n = 20, respectively); however, when these are expressed as a percentage of the total number of artifacts for the period, the percentages are 13.75 percent and 24.39 percent, respectively. The periods with the highest percentages of artifacts made from gravel source material are the Late Archaic (34.48 percent) and the Transitional Archaic (31.25 percent).

The conclusion that can be drawn from the information presented in Table 7 is that prehistoric human populations from Paleoindian to Late Prehistoric used gravels as lithic source material. Although the definition of gravel includes boulder-sized rocks (i.e. greater than 256 millimeters in diameter), according to Larry Banks (personal communication, October 7, 1999), few modern flint knappers will use gravels of any size because they are very hard to work, being irregularly shaped and tending to contain flaws. Many of the flaked stone artifacts in the study collection have remnants of pebble cortex. One artifact (TN 275) has pebble cortex on both its ventral and dorsal sides, indicating a lithic manufacture technology capable of producing flaked stone tools even from pebble-sized gravels (i.e., 4 to 64 millimeters in diameter). Perhaps the implication is that, because lithic source material was so scarce in the McFaddin Beach area throughout the prehistoric past, the prehistoric human populations developed the technological specialization necessary to exploit the widespread gravel resources of the area (Andrefsky, 1994). The use of gravel sources may also imply a focus on stream valleys for lithic procurement; however, gravels such as the Uvalde and Citronelle apparently were not transported by terminal Pleistocene or Holocene-age streams (Banks, 1990:56).

Lithic Sources Not Represented in the Study Collection

The absence of certain lithic sources in the study collection may be as archaeologically significant as the identified lithic sources for the McFaddin Beach materials. The absence of Alibates, a notable lithic source located in the Texas Panhandle in close proximity (35 kilometers) to the Tecovas source areas, is very interesting. Although Long (1977) indicates that two of the artifacts shown in his publication of artifacts from McFaddin Beach, a Clovis point and a unifacial scraper, are made of Alibates agate, Dee Ann Story states that her examination of the Clovis point represented in Long's publication indicates that it is made of heat-treated chert from the Edwards Plateau rather than Alibates agate (Story, et al., 1990:188). Banks (1990:55) also states that in a personal communication, Dee Ann Story indicated that both of the pieces identified by Long (1977) as Alibates are actually a heat-treated material (possibly Edwards) that exhibit reddish banding. The absence of Alibates in the study collection for all cultural periods is even more significant considering Banks' assessment that for the Southern Plains area, "Alibates materials probably have received greater distribution temporally and culturally on a geographic basis than any other single chert type ..." (Banks, 1990:91).

Banks (Appendix E:640) suggests that the presence of Tecovas materials at McFaddin Beach and the absence of Alibates materials is possibly due to the Brazos River, which could have carried cobbles of Tecovas material towards the Texas Gulf coast. Neither the Brazos nor any other river would have similarly drained the Alibates source area towards the Gulf coastal plain. Some limited support for this hypothesis is provided by remnants of river cobble cortex on five of the artifacts made out of Tecovas material. The lack of river cobble cortex on the other specimens does not conclusively prove that they were not derived from a gravel source, only that all remnants of the cortex were removed during the manufacturing process.

The other lithic source that is notable by its absence in the study collection is Manning Fused Glass from the Manning Formation. This formation occurs in a band just inland and closely paralleling the Catahoula (Figure 9, no. 3) and Flemming Formations approximately 160 kilometers inland of McFaddin Beach. As such, it is one of the closest bedrock sources of knappable lithic material to the McFaddin Beach area (Appendix E:638).

According to Banks (1990:53), Manning Fused Glass is produced by fusion of volcanic ash due to burning lignite underlying the ash. Brown (1976:193) describes the glass as having a conchoidal fracture very similar to obsidian, which would make it an excellent material for tool manufacture if it were not for the presence of fault planes, voids and inclusions throughout the material. These flaws would have made it difficult to manufacture anything but the smallest tools from the glass.

The known archaeological occurrences of Manning Fused Glass documented by Brown (1976: Figure 3) stretch northeastward from where the Trinity River intersects the Manning Formation to the Sabine River in the vicinity of Kilgore, Texas. These occurrences are mainly north and northeast of the source areas, which themselves are 160 kilometers north of the McFaddin Beach study area (Banks, 1990: Figure 2.1). Banks (1990:54) reports the occurrence of unworked fragments of Manning Fused Glass in the Fort Polk area of west-central Louisiana. Citing the distance of these unworked fragments from the nearest outcrop of the Manning Formation in east Texas, Banks attributes their presence in the Fort Polk area to prehistoric human trade or migration from the source areas.

The diagnostic artifacts made from Manning Fused Glass include San Patrice projectile points, which are the smallest of the Paleoindian-age points in east Texas, and early Caddoan arrow points from the Late Prehistoric Period (Brown, 1976:195-196). Although San Patrice projectile points are the most numerous diagnostic artifact in the McFaddin Beach study collection, none are made from Manning Fused Glass.

Discussion

A total of 516 artifacts in the study collection (58.64 percent) were identified as definitely being made of source materials from the Edwards Plateau or gravels derived from the Edwards Plateau. Another 75 artifacts (8.52 percent) were identified as possibly being made from Edwards Plateau source material or gravels. This finding is not surprising as the Edwards Plateau is the closest source of high quality knappable lithic material to the McFaddin Beach area.

It is also not surprising that the artifacts identified as being made from exotic lithic materials (greater than 1,000 kilometers from the study area) are mostly Paleoindian and late Paleoindian in age. It is interesting to note that four of the five exotic lithic sources occur in proximity to the Missouri River and its tributaries (see Figure 9). The Knife River in southwestern North Dakota is a tributary to the Missouri; the North Platte River in southeastern Wyoming near the Minnelusa and Spanish Diggings sources runs into the Missouri River just south of Omaha, Nebraska, and Weeping Water Creek in southeastern Nebraska also runs into the Missouri River. Although there is no direct river connection between the Missouri River and the McFaddin Beach area, the exotic lithic material found at McFaddin Beach suggests that during Paleoindian times, rivers may have been important routes for exploiting distant lithic sources, either through trade with distant groups, or by travel up the rivers towards the sources where the material could have been procured either from the bedrock source, or as river cobbles. Only one of the exotic lithics (TN 201) (Table 6) retains evidence of river cobble (pebble) cortex. It is a scraper of unknown period made from a decortication flake. Its lithic source is identified as possibly Edwards or possibly Knife River Flint.

The study collection indicates the consistent use of petrified wood and fossil palm wood as a lithic source material throughout all cultural periods up until the Transitional Archaic (ca. 2,300 B.P.) The use of petrified wood and fossil palm, which is often of inferior quality and difficult to work, is probably due to the general scarcity of good quality knappable lithic material in the Upper Texas Gulf Coast. Likewise, the indications from the study collection of the extensive use of various gravels as lithic source materials throughout the prehistoric past at McFaddin Beach probably also reflects this scarcity of high quality lithic material in the general area.

Resharpening and Retooling of Artifacts

Chipped stone artifacts in the study collection that showed obvious evidence of having been reworked were classified as resharpened (R) or as heavily resharpened (H). Artifacts that had been reworked into new artifacts were classified as “retooled” (T). Schiffer (1987:30) also makes this distinction, classifying “resharpening” as a maintenance activity, and “retooling”, in which the original artifact is rechipped into a new tool, as recycling. Both heavy resharpening and retooling of artifacts can indicate prehistoric human conservation of scarce lithic resources (Odell, 1996:62-64). Shott (1989:24) relates the degree of stone tool reduction (resharpening) to its level of curation by prehistoric people stating that reduction and curation should vary directly, since more heavily curated stone tools should be more extensively reduced. One of the factors that affects the degree of curation is the manufacturing cost which is related to the availability of suitable raw lithic material and the degree of elaboration of the finished tool form (Shott, 1989:20).

Table 8 summarizes the number of artifacts that were heavily resharpened or retooled by cultural period, and the percentage that represents of the total number of

Table 8. Artifacts Heavily Reworked or Retooled by Cultural Period

Number of Artifacts by Period D-Definite P-Possible		Artifacts Heavily Reworked Number	Artifacts Heavily Reworked Percent	Artifacts Retooled Number	Artifacts Retooled Percent
Paleoindian	D = 130	20	15.38	9	6.92
	P = 30	3		2	
	D&P = 160	**23**	**14.38**	**11**	**6.88**
Late Paleoindian	D = 54	9	16.67	5	9.26
	P = 17	2		2	
	D&P = 71	**11**	**15.49**	**7**	**9.86**
Late Paleoindian/ Early Archaic	D = 13	6	46.15	0	0.00
	P = 1	0		0	
	D&P = 14	**6**	**42.86**	**0**	**00.0**
Early Archaic	D = 14	5	35.71	1	7.14
	P = 1	0		0	
	D&P = 15	**5**	**33.33**	**1**	**6.67**
Early/ Middle Archaic	D = 2	0	0.00	0	0.00
	P = 2	1		0	
	D&P = 4	**1**	**25.00**	**0**	**0.00**
Middle Archaic	D = 24	6	25.00	0	0.00
	P = 4	0		0	
	D&P = 28	**6**	**21.43**	**0**	**0.00**
Middle/Late Archaic	D = 40	3	7.50	1	2.50
	P = 5	1		0	
	D&P = 45	**4**	**8.89**	**1**	**2.22**
Middle/Transitional Archaic	D = 66	10	15.15	0	0.00
	P = 16	2		2	
	D&P = 82	**12**	**14.63**	**2**	**2.44**
Late Archaic	D = 19	5	26.32	2	10.53
	P = 10	1		0	
	D&P = 29	**6**	**20.69**	**2**	**6.90**
Late Archaic/Late Prehistoric	D = 7	1	14.29	1	14.29
	P = 4	0		1	
	D&P = 11	**1**	**9.09**	**2**	**18.18**
Late/Transitional Archaic	D = 17	8	47.06	0	0.00
	P = 6	2		1	
	D&P = 23	**10**	**43.48**	**1**	**4.35**
Transitional Archaic	D = 16	2	12.50	1	6.25
	P = 0	0		0	
	D&P = 16	**2**	**12.50**	**1**	**6.25**
Archaic (Nonspecific)	D = 18	2	11.11	0	0.00
	P = 2	0		0	
	D&P = 20	**2**	**10.00**	**0**	**0.00**
Late Prehistoric	D = 8	0	0.00	1	12.50
	P = 2	0		0	
	D&P = 10	**0**	**0.00**	**1**	**10.00**
Late Prehistoric/ Historic	D = 3	3	100.00	0	0.00
	P = 0	0		0	
	D&P = 3	**3**	100.00	**0**	0.00
Unknown	**349**	**15**	**4.30**	**16***	**4.58**
Total Artifacts Heavily Reworked/Retooled		**107**	**12.16**	**45**	**5.11**

* 3 of these are only possible retooled

artifacts for the period. These numbers may give some indication of the relative importance prehistoric inhabitants of the McFaddin Beach area placed on conservation of lithic material during various cultural periods. The total number of artifacts for the Early/Middle Archaic Period (n = 4) and for the Late Prehistoric/Historic Period (n = 3) is so low that the percentages in the final column of Table 8 are probably statistically meaningless. Of the remaining cultural periods the Late Paleoindian through Early Archaic (ca. 9,120 to 4,500 B.P.) and Late/Transitional Archaic (ca. 2,750-1,000 B.P.) have the highest percentages of heavily reworked and retooled artifacts.

Table 9 shows the number of artifacts that have been heavily resharpened (H) or retooled (T) broken down by diagnostic type, and what percentage this represents of the total number of artifacts for that diagnostic type. The total number of artifacts for a cultural period may be higher in Table 8 than in Table 9 because Table 9 includes only those artifacts that could be assigned to a specific diagnostic type, while Table 8 also includes untyped and non-diagnostic artifacts. Those diagnostic types having very small sample sizes ($n \leq 2$), and which, therefore, are probably statistically unreliable, are not included in the following discussion.

Table 9 indicates some differences in tool maintenance and recycling strategies between diagnostic types within a cultural period. For instance, Dalton artifacts tend to be more heavily resharpened than artifacts of other diagnostic types within the Paleoindian Period, and the Dalton diagnostic type has the highest overall percentage (48.15 percent) of heavily resharpened and retooled artifacts. Clovis artifacts have a higher proportion of artifacts that have been retooled than any of the other diagnostic types within the

Table 9. Percentage of Artifacts by Diagnostic Type That Have Been Heavily Resharpened or Retooled

Diagnostic Type (Number)	H	T	Total	Percent
Paleoindian				
Clovis (21)	1	4	5	23.81
Folsom (2)	0	0	0	0.00
Dalton (27)	11	2	13	48.15
Plainview (13)	1	0	1	7.69
Hell Gap (3)	1	0	1	33.33
San Patrice (53)	4	1	5	9.43
Early Lanceolate (2)	0	0	0	0.00
Midland (1)	1	0	1	100.00
Palmer (1)	0	0	0	0.00
Pelican (13)	4	0	4	30.77
Albany Biface (1)	0	1	1	100.00
Rice Lobed (2)	0	1	1	50.00
Total	**23**	**9**	**32**	
Late Paleoindian				
Early Side-notched (9)	1	0	1	11.11
Early Stemmed (6)	1	0	1	16.67
Early Stemmed Lanceolate (7)	2	1	3	42.86
Keithville (13)	4	0	4	30.77
Scottsbluff (36)	3	6	9	40.00
Total	**11**	**7**	**18**	
Late Paleoindian/Early Archaic				
Hardin (3)	0	0	0	0.00
Big Sandy (9)	3	0	3	33.33
Angostura (Texas) (2)	2	0	2	100.00
Total	**5**	**0**	**5**	
Early Archaic				
Bell (4)	3	0	3	75.00
Hoxie (1)	0	0	0	0.00
Uvalde (2)	0	0	0	0.00
Wells (1)	1	0	1	100.00
Woden (6)	1	0	1	16.67
Clear Fork Uniface (1)	0	0	0	0.00
Total	**5**	**0**	**5**	

Table 9. Percentage of Artifacts by Diagnostic Type That Have Been Heavily Resharpened or Retooled (continued)

Diagnostic Type (Number)	H	T	Total	Percent
Early/Middle Archaic				
Abasolo (1)	0	0	0	0.00
Johnson/Webb (2)	1	0	1	50.00
Morrill (1)	0	0	0	0.00
Total	**1**	**0**	**1**	
Middle Archaic				
Dawson (12)	5	0	5	41.67
Evans (4)	0	0	0	0.00
Pedernales (1)	1	0	1	100.00
Travis (2)	0	0	0	0.00
Marshall (8)	0	0	0	0.00
Tortugas (1)	0	0	0	0.00
Total	**6**	**0**	**6**	
Middle/Late Archaic				
Afton (1)	0	0	0	0.00
Epps (11)	3	1	4	36.36
Macon (1)	0	0	0	0.00
Motley (5)	0	0	0	0.00
Delhi (5)	0	0	0	0.00
Palmillas (18)	1	0	1	5.55
Snapped-base Stemmed (2)	0	0	0	0.00
Williams (2)	0	0	0	0.00
Total	**4**	**1**	**5**	
Middle/Transitional Archaic				
Gary (27)	5	1	6	22.22
Ellis (26)	6		6	23.08
Kent (15)	1	1	2	13.33
Ponchartrain(11)	0	0	0	0.00
Refugio (1)	0	0	0	0.00
Poverty Point-Type (2)	0	0	0	0.00
Total	**7**	**1**	**14**	

Table 9. Percentage of Artifacts by Diagnostic Type That Have Been Heavily Resharpened or Retooled (continued)

Diagnostic Type (Number)	H	T	Total	Percent
Late Archaic				
Lange (8)	2	0	2	25.00
Castroville (3)	2	0	2	66.67
Elam (3)	0	0	0	0.00
Lange-like (10)	0	0	0	0.00
Kent/Darl/Yarbrough-like (2)	1	1	2	100.00
Total	**5**	**1**	**6**	
Late Archaic/Late Prehistoric				
Godley (10)	1	2	3	30.00
Harvey-Mineola Biface (1)	0	0	0	0.00
Total	**1**	**2**	**3**	
Late/Transitional Archaic				
Adena (2)	0	1	1	50.00
Marcos (3)	3	0	3	100.00
Yarbrough (17)	7	0	7	41.18
Total	**10**	**1**	**11**	
Transitional Archaic				
Ensor (9)	1	0	1	11.11
Figueroa (1)	0	0	0	0.00
Darl (2)	0	1	1	50.00
Edgewood (4)	1	0	1	25.00
Total	**2**	**1**	**3**	
Archaic (Non-specific)				
Archaic Stemmed (3)	0	0	0	0.00
Total	**0**	**0**	**0**	
Late Prehistoric				
Friley (1)	0	0	0	0.00
Scallorn (2)	0	0	0	0.00
Perdiz (1)	0	0	0	0.00
Clifton (2)	0	1	1	50.00
Total	**0**	**1**	**1**	
Late Prehistoric/Historic				
Harahey Knife (3)	3	0	3	100.00
Total	**3**	**0**	**3**	

H - Heavily Resharpened T - Retooled

Paleoindian Period. It interesting to note that one of the four retooled Clovis artifacts (CN 2) is a large fluted point that has been retooled at a much later time into a stemmed point which resembles a Middle/Late Archaic Delhi projectile point. This is one of several instances evident within the study collection where the retooling of an artifact appears to have been undertaken after a considerable lapse of time, as evidenced by differences in the degree of patination between the surface on the original tool, and that on the flake scars caused by the retooling of the artifact.

This evidence suggests that later prehistoric inhabitants in the lithic-poor McFaddin Beach area may have been scavenging earlier artifacts to use as lithic source material. It also implies that the earlier artifacts were being eroded out of their original site contexts during later prehistoric times. In such instances, retooling would not indicate lithic conservation activity on the part of the group that made the original tool, but rather of the group that recycled the earlier artifact as "raw" lithic material. In contrast, in the other diagnostic types having relatively higher percentages of retooled artifacts, Dalton (n = 2) and Scottsbluff (n = 6), and Godley (n = 2), the retooling appears to be the activity of the group that produced the original artifact, in that the original artifact was rechipped into a new tool like a Dalton/Red River Knife or a Scottsbluff drill, after the original tool was broken or resharpened to a point where it could no longer fulfill its original function.

Discussion

Although the artifacts in the McFaddin Beach study collection are from a shoreline lag deposit formed by the erosion of many archaeological sites, analysis of the diagnostic types, functions and lithic source material of the artifacts, when considered in their proper paleoenvironmental context, does produce some useful archaeological information.

The majority of the diagnostic artifacts (43 percent) date to the Paleoindian and Late Paleoindian Periods (ca. 11,500 to 8,000 B.P.) The next most numerous group of diagnostic artifacts (15 percent) are those that date to the Middle/Transitional Archaic Period (ca. 4,500 to 1,300 B.P.) Only 6 percent of the diagnostic artifacts in the study collection are types that fall either wholly or partially within the intervening Early Archaic Period (ca. 8,000 to 4,500 B.P.) The radical changes in the physical environment of the McFaddin Beach area through time may provide some insight into the influences on human population movement into or out of the area.

During the Paleoindian Period the area that is presently McFaddin Beach was an upland approximately 136 kilometers inland of the Gulf of Mexico at 11,500 B.P. and approximately 55 kilometers inland at 8,000 B.P. (Figure 7). The ancestral Sabine River Valley and its tributaries crossed the coastal plain approximately 30 kilometers south of the present McFaddin Beach area, and a salt diapir may have broken the coastal plain in the vicinity of the present beach (Figure 4). At the beginning of the Paleoindian Period, the climate would have been wetter and deciduous forest would have predominated in the study area (Aten, 1983:135). During the latter half of the Paleoindian Period, the climate would have shifted to a warmer semiarid environment which probably resulted in an expansion of grasslands into the study area (Aten, 1983:136).

For the Paleoindian Period this shift from forest to grassland is reflected both in the types of extinct Pleistocene fauna that have been documented at McFaddin Beach (Russell, 1975; Story, 1990:188) and in the mix of Eastern Woodland and Southern Great Plains diagnostic artifact types in the study collection. An alternative, or additional, explanation for both the mix of Pleistocene faunal material (Story, 1990) and diagnostic artifact types (Johnson, 1989) at McFaddin Beach is that the Eastern Woodland biome predominated in the large Sabine River Valley and its tributaries even when the surrounding uplands were grasslands.

Throughout the Paleoindian Period the riverine environments would have provided fresh water, food resources, lithic resources in the form of river cobbles, and an easy transportation corridor. The presence of a salt diapir may have provided a topographic high in an otherwise flat coastal plain, and if salt was exposed at the surface, it would have also provided a draw for game animals, a salt supply for curing meat and hides, and possibly a trade item.

The Early Archaic Period (ca. 8,000 to 4,500 B.P.) roughly corresponds with the Atlantic period (ca 8,490 to 5,060 B.P.), which Aten states was marked by the postglacial thermal optimum (Aten, 1983:136). During this period the Sabine River Valley was becoming drowned by rising sea level and would have formed a large estuary (Nelson and Bray, 1970: Figures 12 and 13). It is likely that human exploitation of this area during the Early Archaic would have focused on the resources of this large estuary. If so, sites of the

Early Archaic Period would tend to be drowned and buried along the margins of this old estuary approximately 30 kilometers offshore. This may explain the paucity of artifacts from this time period in the study collection from McFaddin Beach.

By the Middle/Transitional Archaic the Gulf of Mexico shoreline was near its present position and an extensive coastal marsh was developing across the area. During this period, both the Sabine River Valley and the salt diapir would have been drowned due to rising sea level; however, the new food resources provided by a stabilized shoreline and the coastal marsh may have been the draw for human populations at this time.

The lithic source analysis for the chipped stone artifacts in the study collection indicates a strong regularity in lithic procurement strategy for all cultural periods. The Edwards Plateau in Central Texas was the source for most of the raw lithic material, with petrified wood and fossil palm, probably from the Tertiary formations of East Texas, and gravels from various widely scattered sources being exploited for additional lithic material. Tecovas from the Panhandle of Texas was another common lithic source used by the prehistoric inhabitants of the McFaddin Beach area, but noticeable by its complete absence in the study collection is material from the Alibates source, also in the Panhandle of Texas, very close to the Tecovas source areas. It is possible that Tecovas gravels carried towards the coast by the Brazos River led prehistoric people to the source areas in the Panhandle. No such river drained the Alibates source areas towards the coast.

The exotic lithic source materials (greater than 1,000 kilometers from the McFaddin Beach area) were used almost exclusively by the Paleoindian groups. There is also some indication from the study collection that other distant sources such as the Ozark

Mountains in northeastern Oklahoma and northwestern Arkansas and the Arbuckle Mountains of southern Oklahoma, although not used frequently, were exploited somewhat more by Paleoindian groups than later prehistoric populations.

Almost 60 percent of the artifacts in the study collection are projectile points, several of which show definite evidence of having been used for other purposes such as knife, scraper, spokeshave, and gouge. Even though 90 percent of the projectile points can be assigned to a specific diagnostic type and cultural period, in the absence of microwear or residue analysis it is difficult to draw conclusions about the range of prehistoric activities or sites the projectile points may represent. The other 40 percent of the artifacts represent a wide range of prehistoric human activities such as lithic manufacture, food processing, hide processing, and woodworking; however, the lack of provenience and the non-diagnostic nature of many of these artifact types greatly hinders our ability to ascribe the activities indicated by the artifacts to specific prehistoric cultural periods. Despite these problems, the compilation of artifact types included in the analysis does provide some indication of the types of prehistoric human activities that took place in the McFaddin Beach area. Although the large number of projectile points indicates that hunting, fishing, and food processing were probably the predominant activity for all cultural periods, other activities, such as lithic manufacture, woodworking, and hide processing, are also indicated.

CHAPTER V

SPATIAL DATA ANALYSIS

Entering Spatial Data into ARC/INFO

Collector's Base Maps

There were a number of differences in the methods used by the five collectors in recording their artifact locations and in the base maps they used. Paul Tanner prepared a set of four standard base maps for McFaddin Beach at a scale of 1 inch = 1,760 feet. Map sheet 1 is the easternmost of the map set, and map sheet 4 is the westernmost. In preparing his base maps, Tanner estimated the trend of the shoreline by sighting down the shoreline with a military compass and estimated the distances between landmarks using an odometer. Tanner prepared a second standard base map at a scale of 1 inch = 10,560 feet (2 miles) that shows the entire length of McFaddin Beach on one map. Paul Tanner, Joe Louvier, and Jessie Fremont plotted their artifact locations on the four-sheet set of standard base maps. Joe Coen recorded the location of each artifact find in miles from the closest landmark along the beach. Joe Coen's artifact locations were subsequently plotted on the smaller-scale base map that shows the entire beach on one map. Murray Brown created his own base map by calculating the distances between the various landmarks along the beach and using these as the reference points for plotting his artifacts.

However, unlike Paul Tanner's base maps, Murray's map did not reflect the trend of the shoreline, but rather plotted the shoreline as a straight east-west line. One problem with all of the collector's maps was that, although they were accurate to scale in the distances up and down the beach, the width of the beach was exaggerated by a factor of 20 or more. This exaggeration was necessary in order for the collectors to graphically distinguish the numerous artifact locations.

I weighted the relative accuracy of the artifact locations from 5 to 0, with 5 representing the highest accuracy, and 0 representing no recorded location. The following are the definitions for the various levels in the weighed scale:

5 = Position accurate within 30 meters

4 = Position accurate within 100 meters

3 = Position accurate within 150 meters

2 = Position accurate within 2 kilometers (Error is always that the artifact is plotted farther east than its actual location).

1 = Accuracy uncertain

0 = No location recorded

Because of the collector's familiarity with the beach, and their diligence in recording their artifact finds, my basic assumption is that most of the artifact locations were plotted with a reasonable degree of accuracy. Therefore, I gave the artifact locations an accuracy weighting of 5 with the exceptions that follow:

Murray Brown did not have locations recorded for his artifact numbers 4-14. These 11 artifacts were given a weight of 0, and, therefore, could not be geographically plotted or used in the spatial data analysis. Paul Tanner's artifact number 214 was found east of the easternmost base map, and, therefore, could not be accurately plotted, so it was also given a weight of 0 and not included in the spatial data analysis.

Joe Louvier had possibly mistaken one entrance road to the beach on map sheet 1 for an entrance road approximately 2 kilometers farther west. All artifacts on Louvier's map sheet 1 that fell between these two roads, and artifacts for which the road positions would most likely have been the reference point, rather than the other more obvious landmarks such as the water tank on the extreme eastern end of map sheet 1, and the cattle pens, on the extreme western end of map sheet 1, were given a location accuracy code of 2, meaning position accurate within 2 kilometers. It is unknown whether any or all of the 49 artifacts with the location accuracy code of 2 are misplotted; therefore, no attempt was made to correct the locations. Any errors for these artifacts would be that they are plotted approximately 2 kilometer to the east of their actual locations.

Joe Coen tagged each artifact with a label describing its location as miles east or west of standard landmarks. His descriptions were then used to plot his artifacts on a base map at a later time. Because of the delay in plotting Coen's artifacts, and the fact that they were plotted on the smaller scale base map, Coen's artifacts were given an accuracy weighting of 3.

Jessie Freemont plotted his 36 artifact locations on sheet 1 of Paul Tanner's standard base map set from memory. Because they were plotted on the base map at a much later date than when they were found, Freemont's artifacts were also given an accuracy weighting of 3.

Landmarks/GPS Positions

The collectors used several landmarks to locate themselves along the beach. I recorded GPS (Global Positioning System) positions for six of the collector's landmarks using a Rockwell International Precise Lightweight GPS Receiver. This GPS is a Department of Defense classified unit with an encryption key that allows the unit to unscramble the satellite signals. This system provided position accuracies ranging between ± 9 and ± 15 meters. The datum for all readings is the North American Datum of 1983 (NAD 83), and the GPS unit was operated in fixed mode. I obtained the coordinates for the Chevron facility and for the intersection of State Highways 87 and 124 at the extreme western end of the beach by scaling them off of the USGS 7.5 minute Topographic Quadrangle Maps. I estimate the accuracy of these coordinates to be in the range of ± 30 meters. The locations of the landmarks are shown on Figure 25, and the GPS coordinates for the landmarks and accuracy of the coordinates are listed in Table 10.

ARC/INFO Coverages

Artifact Locations

I used a Summagraphics Microgrid III digitizing board to digitize the artifact locations and the landmarks from the collectors' base maps to create ARC/INFO coverages. Each ARC/INFO coverage needs at least four tic marks with known geographic coordinates; however, each of the four base maps in Paul Tanner's map set had only two landmarks with known geographic coordinates (see Figure 25). Because the beach slants in a northeast-southwest direction, I was able to use a T-square to create a

Figure 25. Landmarks

Table 10. GPS Coordinates of McFaddin Beach Landmarks

Landmark	Latitude	Longitude	Accuracy
1. Water Tank	29° 39' 30.95" N	94° 06' 7.09" W	± 15 meters
2. Cattle Pens (east)	29° 38' 45.02" N	94° 08' 12.94" W	± 15 meters
3. ARCO Pipeline	29° 37' 16.37" N	94° 11' 59.77" W	± 9 meters
4. Chevron Facility	29° 36' 28" N	94° 14' 01" W	± 30 meters
5. Salt Cedar Tree	29° 35' 27.02" N	94° 16' 42.66" W	± 15 meters
6. Yellow Trailers	29° 34' 44.06" N	94° 18' 31.41" W	± 12 meters
7. Cattle Pens (west)	29° 34' 04.34" N	94° 20' 15.47" W	± 15 meters
8. Intersection of Highways 87 & 124	29° 32' 58" N	94° 23'17" W	± 30 meters

rectangle with the two points of known location at the northeast and southwest corners of the rectangle. I then assigned the values to the other two corners of the rectangle, giving each coverage four points of known location. By using the four tic marks as latitude/longitude reference points, ARC/INFO was able to assign each artifact in the digitized coverages a latitude and longitude coordinate. I then used the PROJECT command in ARC/INFO to convert the artifact coverages from geographic (latitude/longitude) values into UTM values (UTM Zone 15). I used the APPEND command in ARC/INFO to join all of the artifact coverages into one coverage containing all of the artifacts in the study collection. I then imported the dBase IV+ file containing all of the recorded information for each artifact into ARC/INFO and joined the imported file to the artifact coverage. At this point all of the attributes recorded for each artifact became part of the spatial database.

As discussed above, the collectors had exaggerated the width of the beach on their base maps by a factor of about 20; therefore, the artifact locations digitized from these base maps did not plot out accurately in relation to the actual shoreline position. Most of the artifacts plotted well seaward of the actual shoreline (Figure 26). In order to compensate for this distortion, ARC/INFO was used to move all artifacts shoreward in a direction perpendicular to the closest shoreline position for that artifact. It was possible to do this because of the relatively straight, uniform trend of the shoreline at McFaddin Beach. More details of this procedure are given in the following section on historic shoreline positions.

Figure 26. Collector's Original Artifact Locations

Historic Shoreline Positions

The Bureau of Economic Geology (BEG), University of Texas at Austin, compiled extensive information on the historic positions of the shoreline along the southeast Texas coast for a coastal erosion study (Morton, 1997). The BEG digitized the shoreline data for the past 30 years from USGS Topographic Quadrangle Maps, and mapped the 1996 shoreline position by using a differential GPS system. The historic shoreline data were already in the form of ARC/INFO coverages, so I was able to directly import them into my project workstation.

The two historic shoreline positions pertinent to my project are the 1974 shoreline and the 1996 shoreline. These two shorelines bracket the dates of find of all but 10 artifacts in the study collection. These 10 artifacts are in Jessie Fremont's collection and were found between 1970 and 1973. The distance between these two shorelines was divided into 22 equal parts. Moving from the 1974 shoreline, landward towards the 1996 shoreline, each dividing line represents the approximate position of the shoreline for each of the years between 1974 and 1996. Using ARC/INFO, it was then possible to mathematically calculate the proper shoreline position of each artifact, based on its year of find. Therefore, even though the beach was migrating landward during the time the collectors were finding their artifacts at McFaddin Beach, it is known that the collectors always found their artifacts along the approximately 25-meter-wide beach. By recreating the correct position of the shoreline for each year, it was possible to use ARC/INFO to actually improve the accuracy of the collector's data so that the landward/seaward dimension of the artifact locations is accurate within approximately ± 25 meters. When plotted against the onshore geology coverage, the artifacts fall slightly inland of the shoreline because the date of the map from which the onshore geology coverage was digitized is 1962. The positions of the artifacts which were found between 1974 and 1996 show the amount of shoreline erosion that occurred between 1962 and 1974 (Figure 27).

Because the McFaddin Beach study area is 32 kilometers long and only about 25 meters wide, when the 880 artifacts are graphically displayed in their corrected locations, there is almost no resolution of the artifact locations in the landward-seaward dimension (Figure 27). To facilitate visual inspection of the artifact distribution, a second ARC/INFO coverage was created in which the distance between the 1974 and 1996 shorelines was artificially expanded in a seaward direction to a width of 3,000 meters. This had the effect of exaggerating the seaward position of the historic shorelines prior to 1996 and the artifacts plotted along those shorelines by a factor of 120. This produced a graphic display where the earliest artifact finds (i.e., 1974) are the most seaward, and the latest artifact finds (i.e., 1996) are the most landward (Figure 28).

Onshore Paleogeography

I traced a portion of the Environmental Geologic Atlas for the Texas Coastal Zone, Environmental Geology Map, Beaumont-Port Arthur Sheet (Fisher, et al., 1973) onto a stable Mylar base, then electronically scanned it to create an ARC/INFO coverage of the onshore geology of the study area (Figure 3). This map of geologic units accurately portrays the locations of late Pleistocene fluvial-deltaic systems, the coastal Holocene marsh deposits that overlay the late Pleistocene surface, and the locations of salt diapirs.

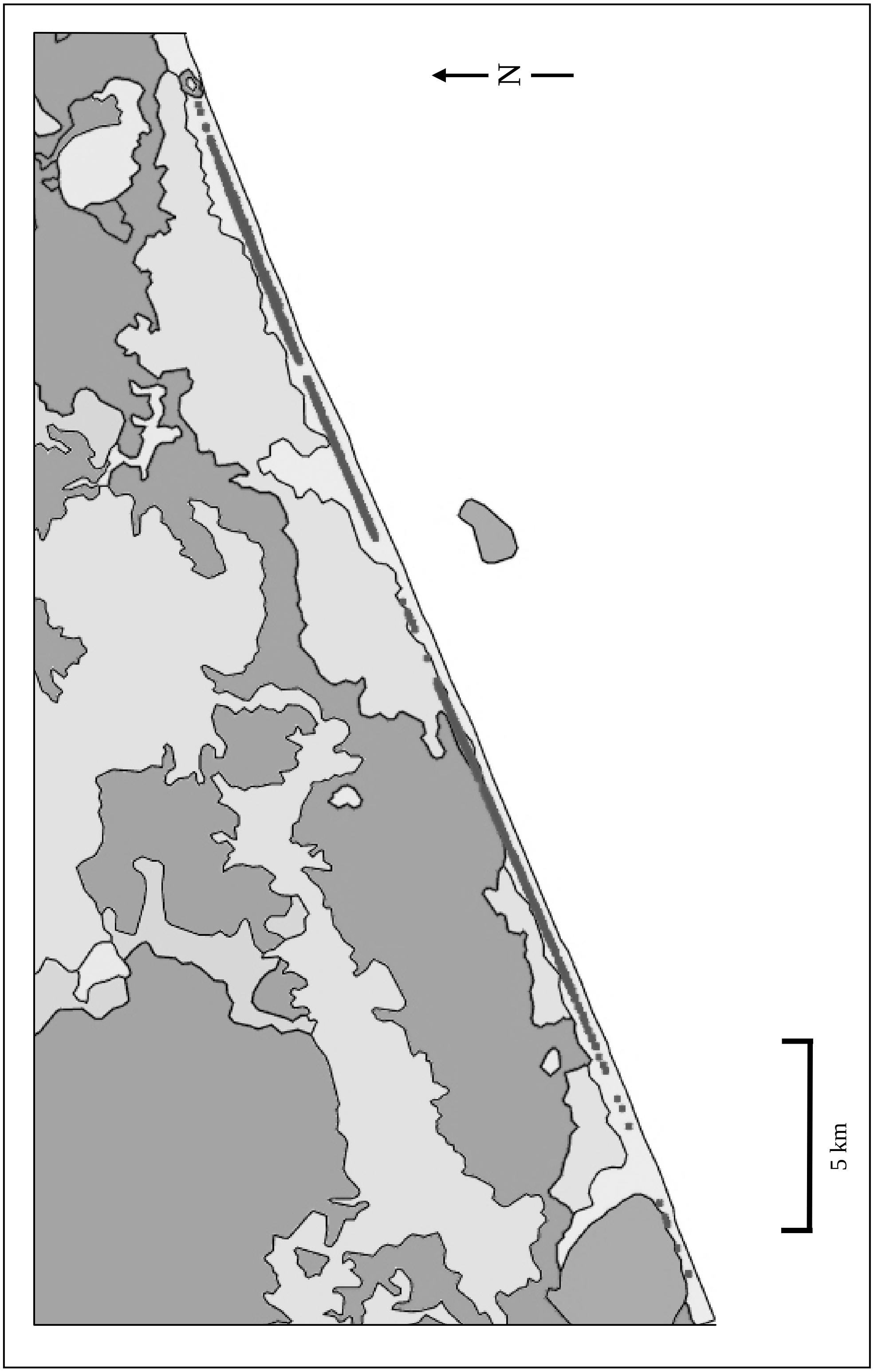

Figure 27. Corrected Locations of Artifacts

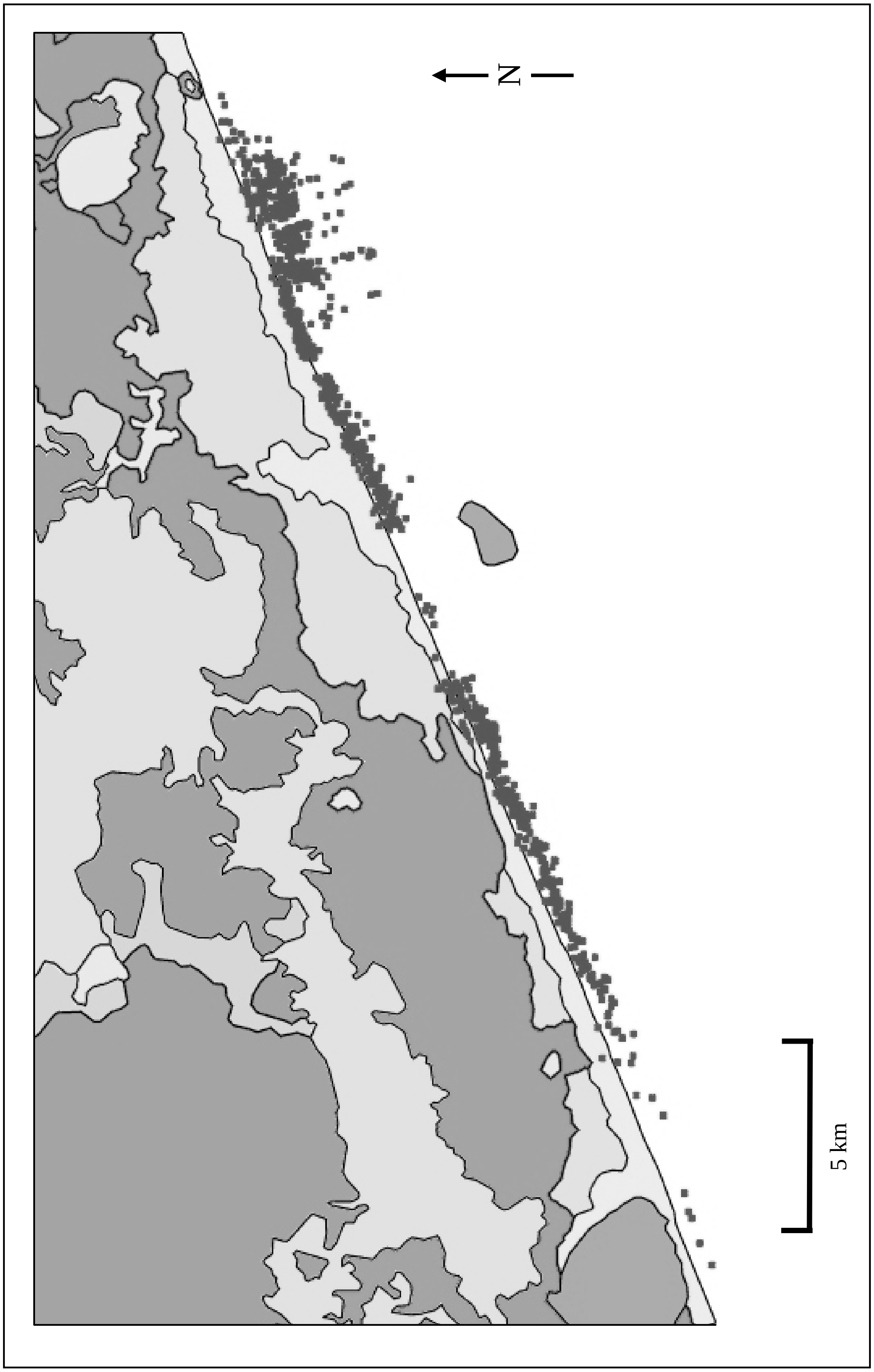

Figure 28. Locations of Artifacts Exaggerated 120X in a Seaward Direction

Offshore Paleogeography

Nelson and Bray (1970) mapped the paleochannel of the ancient Sabine River Valley, which is now submerged and buried offshore the coast of southeast Texas, from high-resolution, shallow-seismic data and borehole data. I transferred the contours of the incised river valley and surrounding late Wisconsinan land surface onto a stable Mylar base, and electronically scanned the image into ARC/INFO (Figure 4). I used the same procedure to scan the position of an offshore salt diapir, which is indicated as having surface expression, from the Environmental Geologic Atlas for the Texas Coastal Zone, Mineral and Energy Resources Map, Beaumont-Port Arthur Sheet (Fisher et al., 1973).

Paleoshoreline Positions

I traced onto a stable Mylar base the bathymetric contours from the USGS/NOAA Topographic/Bathymetric Maps (1:250,000 scale) that approximate the geographic positions of paleoshorelines dating between 11,500 B.P. and 8,000 B.P. (Table 1). Because the great detail in the bathymetric contours at Sabine and Heald Banks is only reflective of Holocene sand deposits, I generalized the contours to eliminate needless detail. For the shoreline positions dating from 7,500 B.P until present, I was able to use contours on the actual late Wisconsinan land surface as mapped by Nelson and Bray (1970). I electronically scanned the traced bathymetric contours into ARC/INFO to create a coverage of paleoshoreline positions dating prior to 8,000 B.P. and appended it to the coverage containing the contours from the map by Nelson and Bray (1970) to create a coverage of paleoshoreline positions for the study area (Figure 7). Because of the many potential errors in sea-level data, and in using bathymetric contours to estimate the positions of paleoshorelines, the paleoshorelines shown in Figure 7 are only rough approximations of where the paleoshorelines for each time period were actually located.

Spatial Patterns

The basic assumptions that will be used in this spatial analysis are: 1) artifacts with only a slight amount of mechanical wear were probably found very close to their original site locations; 2) the direction of artifact movement will be primarily to the west along the coastline in the predominant direction of the longshore current; and 3) the less an artifact weighs, the less wave energy it will take to mobilize and transport it; therefore, other factors being equal, lighter artifacts will tend to have moved farther from their original site locations than heavier artifacts eroded out of the same site.

Because lighter-weight artifacts would be more easily (and frequently) mobilized by wave action, and movement along the shoreline would cause mechanical wear, it would be reasonable to assume that there is a direct correlation between the weight of an artifact and its amount of mechanical wear, with lighter artifacts tending to be more heavily worn than heavier artifacts. Figure 29 is a graph which illustrates the relationship between the degree of mechanical wear and the weight of the artifacts in the study collection. The peaks in all wear categories at the left-hand side of the graph simply indicate that a high percentage of the artifacts in the study collection weigh between 5 and 10 grams. Contrary to expectation, there are even more moderately worn artifacts that weigh 15 grams or less than there are heavily worn artifacts in this category. Only at weights of greater than 30 grams does the expected relationship between weight and wear appear to be indicated by the graph. There are 21 slightly worn artifacts that weigh more than 30

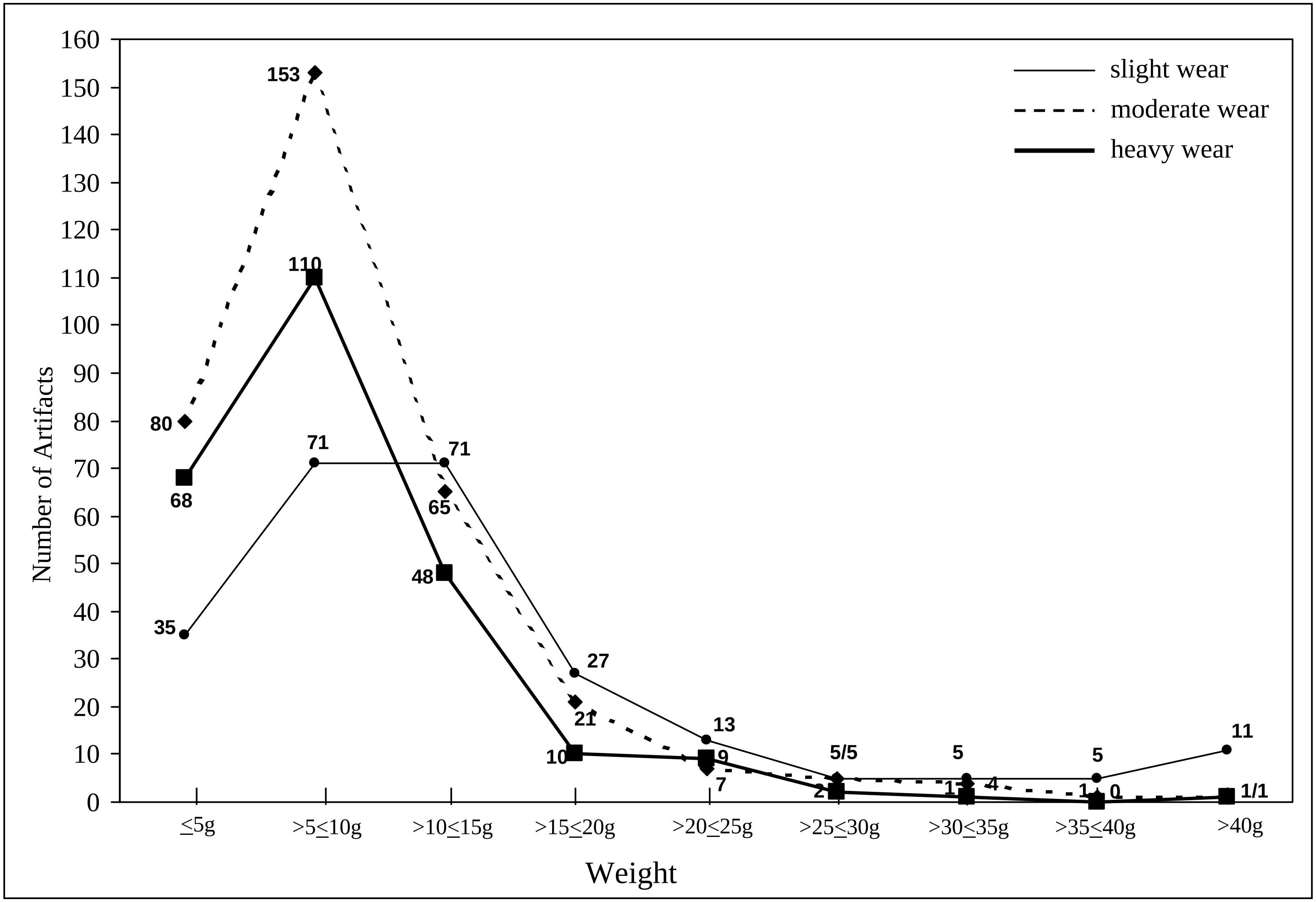

Figure 29. Relationship of Wear to Artifact Weight

grams, but only 2 heavily worn artifacts and 6 moderately worn artifacts that weigh more than 30 grams. This graph does not indicate a strong correlation between the weight of an artifact and its amount of mechanical wear.

There are three primary factors that may result in spatial patterning of artifacts within the study collection: 1) environmental processes that have redistributed the artifacts in a systematic manner, 2) remnant patterning that is indicative of original archaeological site locations, and 3) systematic collector bias. The major artifact attributes that may spatially pattern due to redistribution of the artifacts by environmental processes include date of find, wear, weight, and patina. Because environmental processes will have acted across the entire study area, patterning due to environmental processes will be more evident in the study collection as a whole. The major artifact attributes that may spatially pattern due to cultural factors include cultural period, diagnostic type, and function. Clustering of artifacts by cultural period and/or diagnostic type is likely to be indicative of original archaeological site locations. Collector bias must also be considered in explaining any apparent patterning of the artifacts.

The primary environmental influence which would have redistributed the artifacts after they eroded out of primary context would be the prevailing direction of the winds and the longshore current (Cochrane and Kelly, 1986). The Minerals Management Service collected drifter-buoy data offshore southeast Texas from October 15, 1993, through December 31, 1994. Each drifter buoy contains a GPS receiver that records and transmits its position through time as it is carried along by surface winds and currents. The drifter-buoy data indicate that the predominant direction of the longshore current is in a southwestward direction along the coast from April to September. From October to March, the longshore current is much weaker and moves in the opposite direction. The artifact pattern that might be expected as a result of this seasonal shift in the direction and strength of the longshore current would be for artifacts that are eroded out of primary context between April and September to be transported towards the southwest and to be more heavily worn because of the stronger longshore current.

This generalized circulation pattern is interrupted by major storm events such as tropical storms and hurricanes. According to the historic hurricane tracking charts from the National Oceanic and Atmospheric Administration, National Weather Service, during the period from 1970 to 1996, tropical storms and hurricanes made landfall in the vicinity of McFaddin Beach in 1970, 1971, 1973, 1978, 1979, 1980, 1982, 1983, 1986, 1987, 1989, and 1995. It might be expected that there would be increased beach erosion and, therefore, more artifacts found after these major storm events, particularly those storms that passed west of McFaddin Beach, which would have increased the tidal surge in the study area. However, when reviewing the dates of find and numbers of artifacts found after these storms, there is no apparent correlation between these storm events and increased artifact finds.

Waves can erode to a depth equal to one-half their wavelength (i.e., the distance between wave crests) (Friedman and Sanders, 1978:469). For example, if the wavelength is 20 meters, the wave could erode to a depth of 10 meters, making the zone of potential erosion the distance from the shoreline, out to a water depth of 10 meters. This zone of erosion will vary as the wave conditions vary. Therefore, in the following discussion, when artifacts are said to have eroded out of their primary context, the exact location from which they were eroded is somewhere between the shoreline where they were found and the maximum extent of the offshore area that has been scoured by wave erosion.

Spatial Patterning within the Entire Study Collection

When looking at the spatial distribution of all of the artifacts in the study collection (Figures 27 and 28), a few obvious patterns are evident. A large cluster of artifacts in the extreme eastern portion of the study area, evident in the exaggerated coverage (Figure 28), indicates that the earlier artifact finds were concentrated in the easternmost portion of the study area. When I discussed this pattern with one of the collectors, Paul Tanner, he stated that prior to about 1990, most of the collectors had concentrated their collecting activities on this extreme eastern portion of the beach. In fact, all of Jessie Fremont's 36 artifacts came from this easternmost area. Therefore, this pattern is attributable, at least in part, to collector bias.

Another obvious pattern in the overall artifact distribution is the almost complete and rather large gap (3.9 kilometers) in the artifact distribution in the middle section of the study area (Figures 27 and 28). There are two possible explanations for this gap; one is collector bias, and the other is related to the offshore geology of McFaddin Beach.

The only access to the beach is by Highway 87. After Highway 87 became impassible due to beach erosion, the middle portion of the beach, where the erosion is the most extreme, became more inaccessible. Therefore, the gap in artifact distribution may be due, at least in part, to collector bias. In support of the collector bias explanation is the fact that all seven of the artifacts found in this area were found by the same collector, Joe Louvier. The seven artifacts were also found between June of 1992 and October of 1994, before transit along the entire length of the beach on Highway 87 became impossible. However, when I asked Paul Tanner whether this area was visited less frequently by collectors, he stated that the collectors tended to hunt this area less frequently because they rarely found anything there and it was generally considered a barren area.

An alternative explanation for the mid-beach gap in the artifact distribution may be related to the presence of a salt diapir centered approximately 2.4 kilometers offshore of this “barren area” (Figures 27 and 28). The Environmental Geologic Atlas for the Texas Coastal Zone, Mineral and Energy Resources Map, Beaumont-Port Arthur Sheet (Fisher et al., 1973) indicates that this diapir had some surface expression in the past. There is a slight rise in the elevation of the beach along this middle section, which is evidence that the offshore diapir does, in fact, have surface expression. This slight elevation in the beach may also be one of the reasons that beach erosion is the most severe along this section of the beach at an average rate of almost 5 meters per year (Morton, 1997: Table 2).

As rising sea level inundated the shallow nearshore area about 5,000 to 6,000 years ago, the archaeological sites that existed on the elevated ground of the diapir would have been destroyed by wave erosion. As sea level was rising, the diapir would have refracted waves. As archaeological sites were destroyed by wave erosion on the seaward side of the diapir, artifacts would have been carried by the refracted waves shoreward to either side of the diapir, leaving an “artifact shadow” in the middle. Whether any of the artifacts from sites that were destroyed 5,000 to 6,000 years ago have been incorporated into the more recent lag deposit of artifacts recovered from the beach is uncertain. However, any artifacts that might have been associated with sites situated on or near this diapir would predate about 5,000 B.P., and it is likely that they would be some of the more heavily worn artifacts in the study collection.

Of the seven artifacts that were found in the mid-beach area, only one dates prior to 5,000 B.P. This artifact is a Clear Fork adz/gouge (LV 234) that probably dates to the Early Archaic (ca. 8,000 to 4,500 B.P.) (Figure 30). Because this artifact has only a slight amount of mechanical wear, it is unlikely that it originated from a site associated with the diapir, but, more likely, from a site along the present shoreline where it was found. Only two other of the seven artifacts were diagnostic and could be assigned to specific cultural periods, a Middle/Late Archaic Palmillas projectile point (LV 135) (ca. 4,500 to 2,300 B.P.) and another projectile point classified as “Lange-like” (LV 128), which probably dates to the Late Archaic (ca. 3,000 to 2,300 B.P.) (Figure 30). These two artifacts are late enough that they would have had no association with the diapir and probably originated from sites within the Holocene marsh deposits. The remaining four artifacts include one nondiagnostic unifacial tool (LV 45) and three untyped bifaces (LV 136, LV 242, and LV 243).

There is a second, smaller gap in the overall artifact distribution in the eastern portion of the study area which coincides with the location of one of two steel barriers that had been erected along the beach sometime prior to 1985 (Figure 31). These barriers consisted of steel guardrail sections that were driven vertically into the sand in an attempt

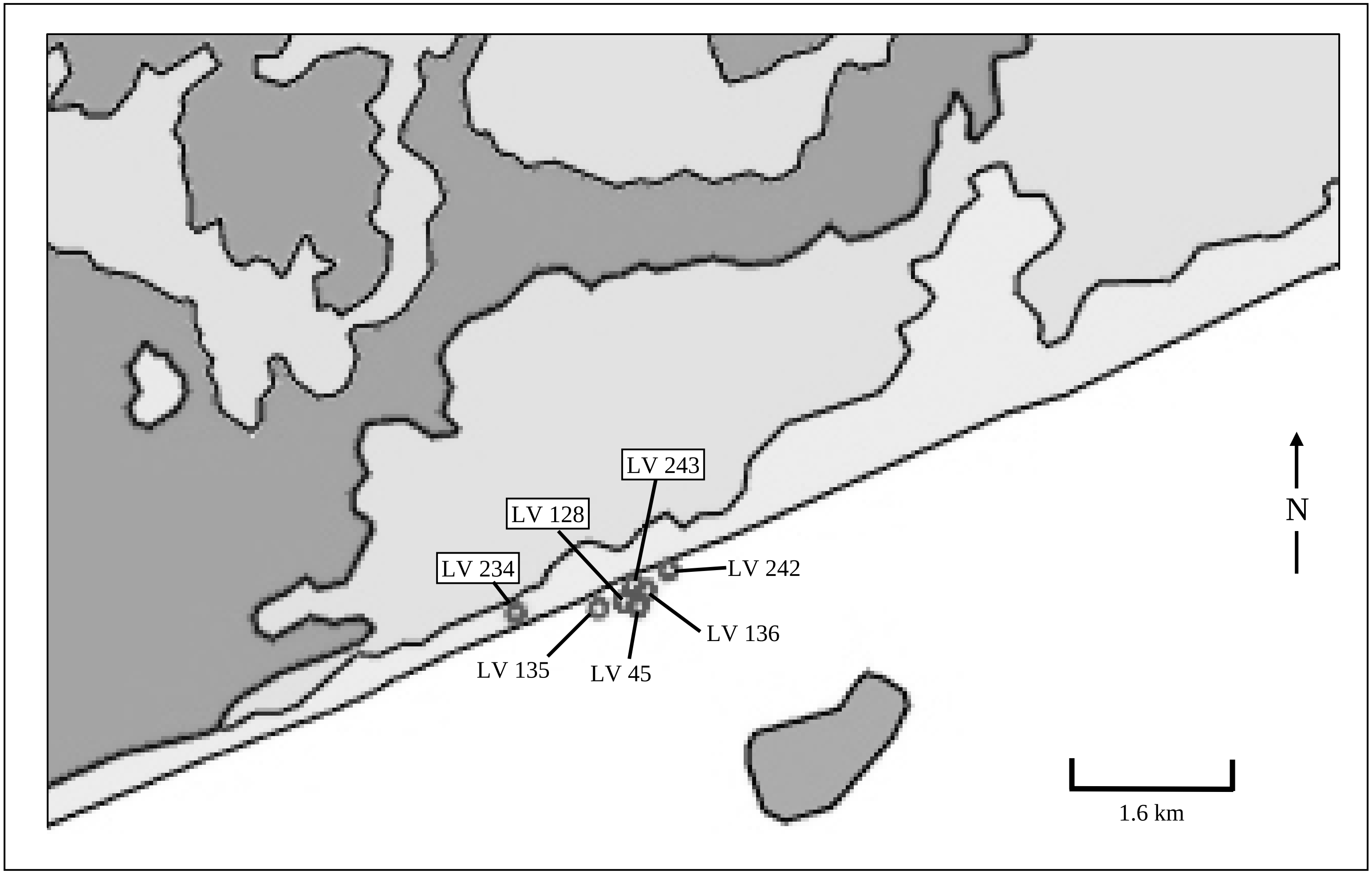

Figure 30. Artifacts Located in “the Gap”

Figure 31. Location of Steel Barriers Along McFaddin Beach

to slow beach erosion. The barriers actually had the opposite effect by focusing the wave energy and increasing erosion at the point where the waves encountered the barriers. This 500-meter gap in artifacts may be due to the presence of the barrier. Artifacts would not have been deposited in this high-energy zone, but would have been carried to either side of the barrier or back offshore. The eastern half of the second barrier, to the west, overlaps the western portion of the mid-beach gap in artifacts by 1 kilometer (Figure 31). This western barrier may be, in part, responsible for the lack of artifacts in the western portion of this mid-beach gap. There is also a very dense area of heavily worn artifacts that coincides with the western end of this barrier (Figure 32) that may be related to the effect of the focused wave energy at the barrier and longshore current transport.

Figures 32, 33, and 34 show the patterning of all artifacts in the study collection by amount of mechanical wear. There are a few general patterns evident that may be related to the environmental processes that have redistributed the artifacts along the shoreline. There are not only less artifacts in the extreme western portion of the study area, but most of them are also moderately to heavily worn, suggesting that they may have been transported westward from their original site locations by the longshore current. In contrast, there is a much heavier concentration of artifacts that are only slightly and moderately worn in the easternmost portion of the study area, suggesting that the artifacts in this area are closer to their original site locations. Six of the seven artifacts in the mid-beach gap are moderately and heavily worn, suggesting that they have been transported into the gap by longshore current. The fact that the easternmost artifacts in this group (LV 45, LV 136, and LV 242) (Figure 30) are moderately worn, and the more western artifacts

Figure 32. Locations of Heavily Worn Artifacts

Figure 33. Locations of Moderately Worn Artifacts

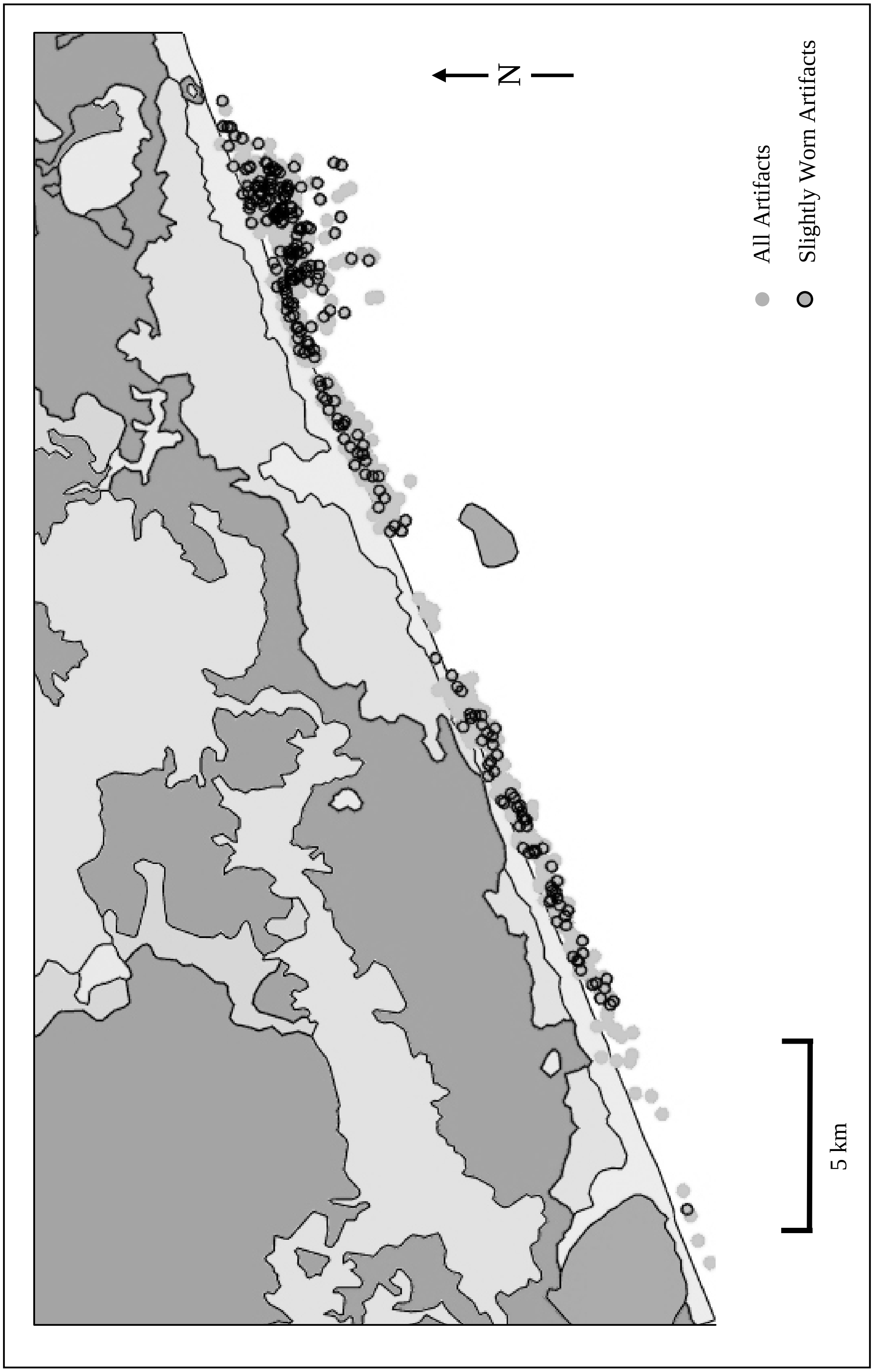

Figure 34. Locations of Slightly Worn Artifacts

(LV 128, LV 135, and LV 243) are heavily worn further suggests that they have been transported into the gap from the east.

Spatial Patterning of Artifacts by Period and Diagnostic Type

The following analysis looks at the spatial patterning of the artifacts in the study collection by general cultural period and by the specific diagnostic types within each cultural period. The goal of this analysis is to try to determine the locations of the original archaeological sites from which the artifacts were derived. Subsequent testing would be required to determine whether any portions of the original sites still exist. The assumptions underlying this analysis are: 1) that artifacts of the same diagnostic type were made by the same cultural group, and, if the artifacts appear to group spatially, it is likely that they originated from the same site; 2) if artifacts have originated from the same site, the least worn artifacts will be the closest to the original site location; and 3) if two artifacts erode out of the same site at the same time, the artifact with the earliest date of find will tend to be less mechanically worn than the artifact with a later date of find.

In addition to artifacts grouping by diagnostic type, it is also possible that sites of different cultural groups but from the same general cultural period may pattern because of similar technologies, subsistence strategies and paleoenvironmental conditions. Finally, it is also possible that sites from all cultural periods may have concentrated in certain locations because of features in the paleoenvironment such as fresh-water streams. The figures showing artifact distributions in the following analysis are derived from the exaggerated coverage shown in Figure 28 for the sake of visual presentation; however, all distances referred to in the text are based on the correct geographic coordinates of the artifacts as shown in Figure 27.

<u>Statistical Analysis of the Spatial Patterning</u>

The artifact data were exported from ARC/INFO and imported into ArcView 3.0a in order to conduct statistical analysis of the spatial data. A statistical program, "Animal Movement Analysis ArcView Extension" by the USGS, Biological Research Division, Alaska Biological Science Center (Hooge and Eichenlaub, 1997), was used to conduct a nearest-neighbor analysis of the artifact data. The program determines the nearest neighbor for each point in the selected data set (r_o), and from this determines the mean nearest-neighbor value for all points in the data set ($\bar{r}_o$). The expected mean distance to the nearest neighbor for a random distribution of the same number of data points within the study area is derived by the following equation:

$$\bar{r}_e = 1/(2\sqrt{p})$$

where $p = (n-1)/A$
where n *is the number of points in the data set*
where A *is the area in square meters of the study area*

Randomness (R) of the spatial distribution of a data set is determined by the actual mean distance to the nearest neighbor ($\bar{r}_o$) for the data set divided by the expected mean distance to the nearest neighbor for a random distribution of the same number of points (r_e). If the $\bar{R}$ value is close to 1.0, the distribution is random; if R is less than 1.0, the distribution tends towards clustering; and if R is greater than 1.0, the distribution tends towards regularity.

A randomly distributed data set indicates that there is no statistically significant spatial patterning in the data. A clustered data set indicates that the mean nearest-neighbor distance for the data set is less than would be expected in a random distribution. Whether the cause of the clustering is remnant patterning indicative of an archaeological site location or of some environmental process that has tended to concentrate the artifacts in certain locations is a matter for interpretation. A regular distribution indicates that the mean nearest-neighbor distance for the data set is greater than would be expected in a clustered or even a random distribution. When a data set contains seven or less data points, the sample size is too small for the computer program to determine the statistical significance of the spatial pattern. Regardless of the type of distribution indicated by the nearest-neighbor analysis, the data set must be visually inspected to interpret the meaning of the statistical result.

Table 11 shows the results of the nearest-neighbor analysis for the artifacts in the study collection by cultural period. Table 12 shows the results of the nearest-neighbor analysis by diagnostic type. As can be seen in Table 11, the only data sets the nearest-neighbor analysis indicated to be clustered were the entire study collection and the Paleoindian Period when both definite and possible Paleoindian artifacts were included in the set. All other data sets came up either random or regular. The lack of statistical clustering in the majority of the data sets is most likely due to the extreme disparity between the length and width of the study area. If there are one or two isolated artifacts in a data set, and the remainder of the artifacts tend to cluster, the average of the distance to the nearest neighbor for all of the points in the set will be greatly increased by the

Table 11. Results of Nearest-Neighbor Analysis for Artifacts by Cultural Period

Period	n	R	Distribution
Entire Study Collection	880	0.46	Clustered
Paleoindian (D&P)	160	0.88	Clustered
Late Paleoindian (D&P)	71	0.97	Random
Paleoindian (D)	130	1.03	Random
Middle/Transitional Archaic (D&P)	82	1.05	Random
Transitional Archaic (D)	16	1.12	Random
Middle/Transitional Archaic (D)	66	1.26	Regular
Late Paleoindian (D)	54	1.30	Regular
Middle/Late Archaic (D&P)	45	1.33	Regular
Late/Transitional Archaic (D&P)	23	1.43	Regular
Middle/Late Archaic (D)	40	1.48	Regular
Middle Archaic (D&P)	28	1.73	Regular
Late/Transitional Archaic (D)	17	1.76	Regular
Middle Archaic (D)	24	1.87	Regular
Late Archaic (D&P)	29	1.96	Regular
Late Archaic (D)	19	2.17	Regular
Late Paleoindian/Early Archaic (D&P)	14	2.34	Regular
Early Archaic (D&P)	15	3.68	Regular

D - Definitely of the Cultural Period
P - Possibly of the Cultural Period
n - number of artifacts in the data set
R - measure of randomness

Table 12. Results of Nearest-Neighbor Analysis for Artifacts by Diagnostic Type

Diagnostic Type	n	R	Distribution
Dalton (D&P)	27	1.18	Random
Pelican (D)	13	1.19	Random
Yarbrough (D)	15	1.21	Random
Epps (D&P)	11	1.24	Random
Epps (D)	10	1.30	Random
Clovis (D&P)	21	1.30	Regular
Ponchartrain (D&P)	11	1.39	Regular
San Patrice (D)	48	1.41	Regular
San Patrice (D&P)	53	1.42	Regular
Kent (D&P)	15	1.50	Regular
Dalton (D)	24	1.51	Regular
Clovis (D)	18	1.56	Regular
Ellis (D&P)	26	1.59	Regular
Ellis (D)	24	1.63	Regular
Scottsbluff (D&P)	36	1.63	Regular
Yarbrough (D&P)	17	1.68	Regular
Dawson (D)	12	1.69	Regular
Palmillas (D&P)	18	1.98	Regular
Gary (D&P)	27	2.02	Regular
Plainview (D)	13	2.04	Regular
Scottsbluff (D)	26	2.04	Regular
Gary (D)	23	2.14	Regular
Keithville (D&P)	13	2.17	Regular
Palmillas (D)	14	2.37	Regular
Ensor (D)	9	2.56	Regular
Keithville (D)	12	2.72	Regular
Godley (D&P)	10	2.87	Regular
Kent (D)	12	2.98	Regular

Table 12. Results of Nearest-Neighbor Analysis for Artifacts by Diagnostic Type (continued)

Diagnostic Type	**n**	**R**	**Distribution**
Lange-like (D)	10	3.19	Regular
Marshall (D&P)	8	3.41	Regular
Big Sandy (D&P)	9	3.91	Regular
Lange (D&P)	8	4.03	Regular
Big Sandy (D)	8	4.14	Regular
Early Side-notched (D&P)	9	4.70	Regular

D - Definitely of the Diagnostic Type
P - Possibly of the Diagnostic Type
n - number of artifacts in the data set
R - measure of randomness

outliers. The smaller the data set in which this occurs, the more pronounced this effect towards regularity will be. Regardless of this possible problem with the nearest-neighbor analysis, the R value obtained for each data set should give a relative indication of its tendency to cluster, with the smaller R values indicating a stronger tendency towards clustering than the larger R values.

Paleoindian Period

Figure 35 shows the spatial distribution of the artifacts that were identified as Paleoindian and those that were identified as only possibly being Paleoindian in age. One point worth noting is that, with just three exceptions in the eastern portion of the study area, the locations of the artifacts identified as only possibly Paleoindian lie in close proximity to artifacts that are definitely Paleoindian. The nearest-neighbor analysis discussed in the preceding section, indicates that the 130 definite Paleoindian artifacts are randomly distributed with an R value of 1.03; however, when the 30 possible Paleoindian artifacts are added to the data set, the R value decreases to 0.88, indicating that the artifacts are clustered.

The study collection contains 12 different diagnostic types that fall within the Paleoindian Period (Table 16, Appendix D). Spatial patterning will not be discussed for the following diagnostic types that are represented by only one or two artifacts: Folsom (LV 129 and TN 89), Early Lanceolate (LV 46 and LV 54), Midland (BN 22), Palmer (LV 214), Albany Biface (LV 159), and Rice Lobed (LV 235 and LV 324).

Figure 35. Locations of Paleoindian Artifacts

Clovis Diagnostic Type

Figure 36 shows the spatial patterning of the Clovis artifacts within the study collection. There is a possible cluster of nine artifacts which span a distance of 3.6 kilometers in the easternmost portion of the study area. Six of the artifacts in this cluster (BN 56, CN 5, FR 34, TN 5 (P), TN 50, and TN 130) have only a slight amount of wear and were found between October 1984 and March 1991. Of the other three artifacts in this cluster, two (TN 86, TN 140) have moderate wear and slight to no patina and were found in February 1988 and May 1990, respectively. The third (TN 131) is only possibly Clovis. It has both heavy wear and heavy patina, and was found in March 1990. Six of the nine artifacts in this cluster are projectile points, while the other three (TN 5, TN 86, and TN 140) are a biface, a preform, and a prismatic blade, respectively, suggesting possible campsite activities. This broad cluster may mark the general location of one or more Clovis sites or isolated hunting losses.

The three artifacts that occur to the west of this easternmost cluster (CN 12, LV 210, and TN 255) are all projectile points with a moderate amount of wear, found between February 1992 and May 1994. The greater wear and later dates of find on these three artifacts suggest that they may have originated closer to the cluster of slightly worn artifacts to the east, then been transported to the west by the longshore current. It should be noted that LV 210 has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual position. If this point actually falls 2 kilometers to the west, it would lie just west of TN 255.

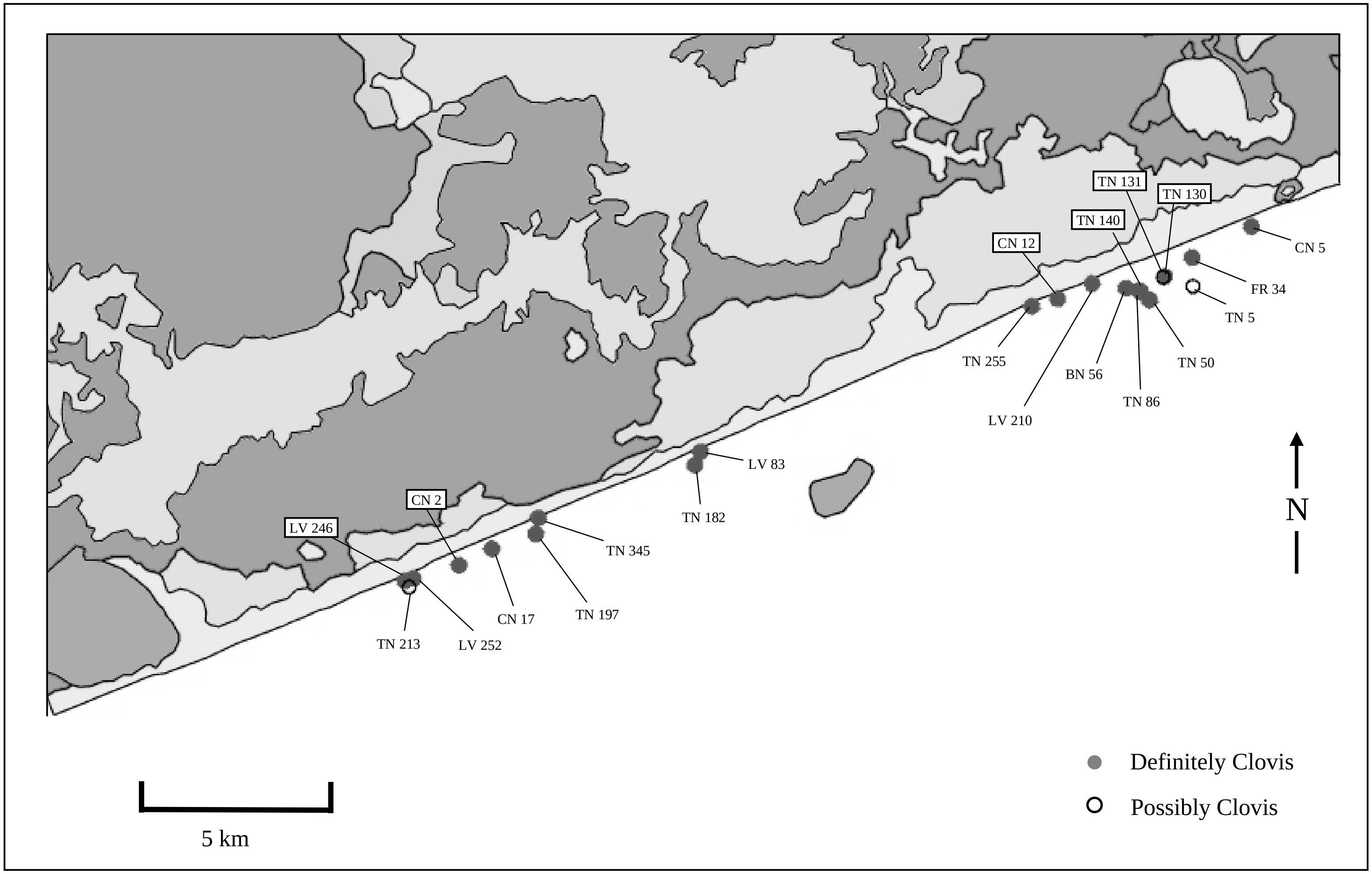

Figure 36. Clovis Artifacts

A group of seven Clovis artifacts occurs in the western portion of the study area. Three of the four westernmost artifacts in this group (CN 2, LV 246, and LV 252) have only a slight amount of wear and were found between May 1990 and November 1994. LV 246 and LV 252 were found only 12 days apart. The fourth artifact in the midst of these three slightly worn artifacts (TN 213) is a bifacial thinning flake/channel flake, and only possibly Clovis. It is heavily worn and was found in May of 1992. The fact that this one artifact is heavily worn may be due to its weight of only 3.6 grams, which would have both contributed to its frequent mobilization by wave action and longshore current and made it more difficult for collectors to find. The three slightly worn artifacts in this group are all projectile points and much heavier; CN 2 weighing 25.3 grams, LV 246 weighing 10.7 grams, and LV 252 weighing 41.6 grams. The three artifacts in the eastern portion of the western cluster (CN 17, TN 197, and TN 345) are all moderately worn projectile points, and were found between February 1992 and December 1995. Because of the weak to nonexistent longshore current which flows to the east, it is unlikely that these artifacts are related to the cluster of slightly worn artifacts to the west. The 1.5 kilometer-long area defined by the three westernmost, slightly worn, artifacts may represent a general site area.

The remaining two Clovis artifacts (LV 83 and TN 182) are projectile points that were found near the mid-beach area. LV 83 has slight wear and slight patina and was found in January 1993. TN 182 is heavily worn and has heavy beach polish and was found in May 1991. Although these two artifacts were found only 200 meters apart, the disparity in wear and dates of find suggests that they may not be related to a single site, particularly since the heavily-worn artifact was found 20 months earlier than the slightly worn artifact.

The results of the nearest-neighbor analysis discussed above indicate that both the group of definite Clovis artifacts and the group of definite and possible Clovis artifacts are regular spatial distributions with R values of 1.51 and 1.30, respectively. However, these R values are some of the lower R values of the diagnostic types analyzed, indicating a relatively stronger tendency towards clustering.

Dalton Diagnostic Type

Figure 37 shows the spatial patterning of the Dalton artifacts within the study collection. The Dalton artifacts are widely distributed throughout the study area in several small clusters or in pairs. The two largest clusters of artifacts occur in the eastern portion of the study area. The easternmost cluster is comprised of three projectile points (FR 30, LV 123, and TN 192). The distance across this cluster is 121 meters. All three of these artifacts are moderately worn, and the dates of find are May 1983, April 1993, and November 1991, respectively. Despite their close spatial association and similar degree of mechanical wear, the wide disparity in their dates of find suggest that they do not originate from only one site. It should also be noted that LV 123 has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location. If its actual location is 2 kilometers to the west, it would place it in the vicinity of TN 135.

Two of the three artifacts (TN 44 and TN 101) found just to the east of this small cluster have only a slight amount of wear and were found in July 1986 and January 1989,

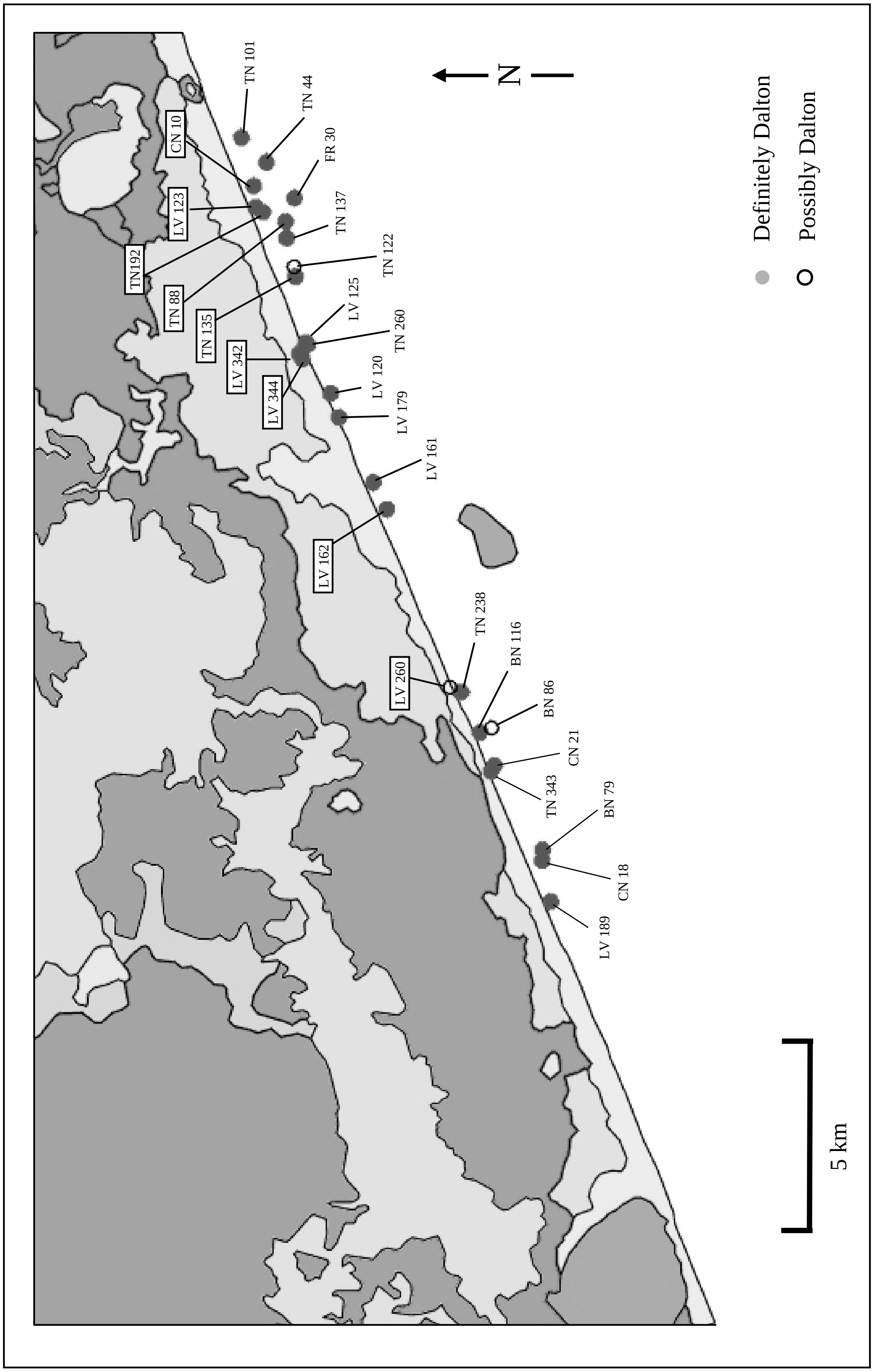

Figure 37. Dalton Artifacts

respectively. TN 44 is a drill and TN 101 is a large Dalton projectile point with extensive stony bryozoan growth on both faces (see Appendix A), suggesting that it lay in the marine environment for an extended period of time before being deposited on the beach. It is possible that these two easternmost, slightly worn Dalton artifacts mark the general location of an original site, and that the moderately and heavily worn projectile points just to the west including CN 10, TN 88, TN 137, and the small cluster of three discussed above, were transported to the west by longshore current before being found.

A second cluster consisting of four projectile points (LV 125, LV 342, LV 344, and TN 260) occurs to the west of the group just discussed. The distance across this cluster is 305 meters. One of the artifacts (TN 260) is only slightly worn and was found in February 1993. The other three have a moderate amount of wear and were found in May 1993, June 1996, and August 1996, respectively. These four artifacts may mark a second general site location.

Of the remaining Dalton artifacts to the west of those already discussed, there are two interesting pairs. LV 161 and LV 162 are both moderately worn projectile points of the Dalton Complex with almost identical weights and dimensions. LV 161 weighs 3.6 grams, and its dimensions are 31 millimeters long, 21 millimeters wide, and 7 millimeters thick; LV 162 weighs 3.1 grams and is 31 millimeters long, 21 millimeters wide, and 6 millimeters thick. Both artifacts are made out of Edwards chert and were found within 2 days of each other in November 1993. The two artifacts were found 748 meters apart. The great similarity of the two artifacts suggest that they may have been derived from the same site of unknown location.

The second pair of artifacts deserving some discussion are two Red River Knives made on broken Dalton projectile points (CN 18 and CN 21). These are the only two Red River Knives in the study collection, and they were found 2.8 kilometers apart within a month of each other (October 2, 1992, and November 2, 1992, respectively). Both are moderately worn and of similar weights and dimensions. CN 18 weighs 4.2 grams and is 33 millimeters long, 27 millimeters wide, and 5 millimeters thick. CN 21 weighs 4.0 grams and is 28 millimeters long, 26 millimeters wide, and 5 millimeters thick. Each has a second Dalton artifact in very close association with it. TN 343, a Dalton adz, lies only 125 meters west of CN 21. It also has a moderate amount of wear but was found much later than CN 21, in December 1995; therefore, it is likely that these two artifacts have no direct association. BN 79, a Dalton projectile point, lies 186 meters east of CN 18. It has only slight mechanical wear and no visible patina. It was found in March 1992, just a few months before CN 18 was found. The westernmost artifact (LV 189) is a Dalton drill found approximately 1 kilometer west of CN 18. LV 189 also has only a slight amount of mechanical wear, which is surprising given its minimal weight of only 2 grams. It is possible that these three artifacts (BN 79, CN 18, and LV 189) mark another general archaeological site location, possibly a campsite.

The results of the nearest-neighbor analysis discussed above indicate that the group of definite Dalton artifacts is a regular distribution with an R value of 1.51; however, when both definite and possible Dalton artifacts are included in the analysis, it indicates a random distribution (i.e., closer to clustered than regular distribution) with an R value of 1.18. This was the lowest R value obtained for any of the diagnostic types analyzed, indicating a relatively stronger tendency towards clustering than any of the other types.

Plainview Diagnostic Type

Figure 38 shows the spatial patterning of the Plainview artifacts within the study collection. All 13 Plainview artifacts are projectile points. There are two clusters of Plainview artifacts in the eastern portion of the study area. The easternmost cluster consists of 3 artifacts (FR 35, TN 22, and TN 141). FR 35 and TN 22 are both only slightly worn and have no visible patina. TN 22 was found in July 1985, and FR 35 was found in May 1992. The third artifact in the cluster, TN 141 has a moderate amount of wear and was found in May 1990. The weight of TN 141 is 6.5 grams, approximately half the weight of FR 35 (11.5 grams) and TN 22 (12.4 grams); a fact that may explain its greater amount of mechanical wear. These three artifacts occur within an area 317 meters across, and suggest the presence of a site in the general vicinity that was eroded at the shoreline over a period of at least 7 years (i.e., 1985 to 1992).

The second cluster in the eastern portion of the study area consists of five artifacts (BN 48, LV 195, TN 56, TN 98, and TN 168) which occur within an area 1.4 kilometers across. Of these five artifacts, TN 56, TN 98, and TN 168 all have only a slight amount of mechanical wear and were found in December 1986, November 1988, and March 1991, respectively. The two artifacts in this cluster slightly to the west (BN 48, and LV 195) have a moderate amount of wear and were found in March 1990 and April 1994, respectively. This cluster, like the one to the east, also suggests an original site that was eroded at the shoreline over a period of years (i.e., 1990 to 1994) with the westernmost

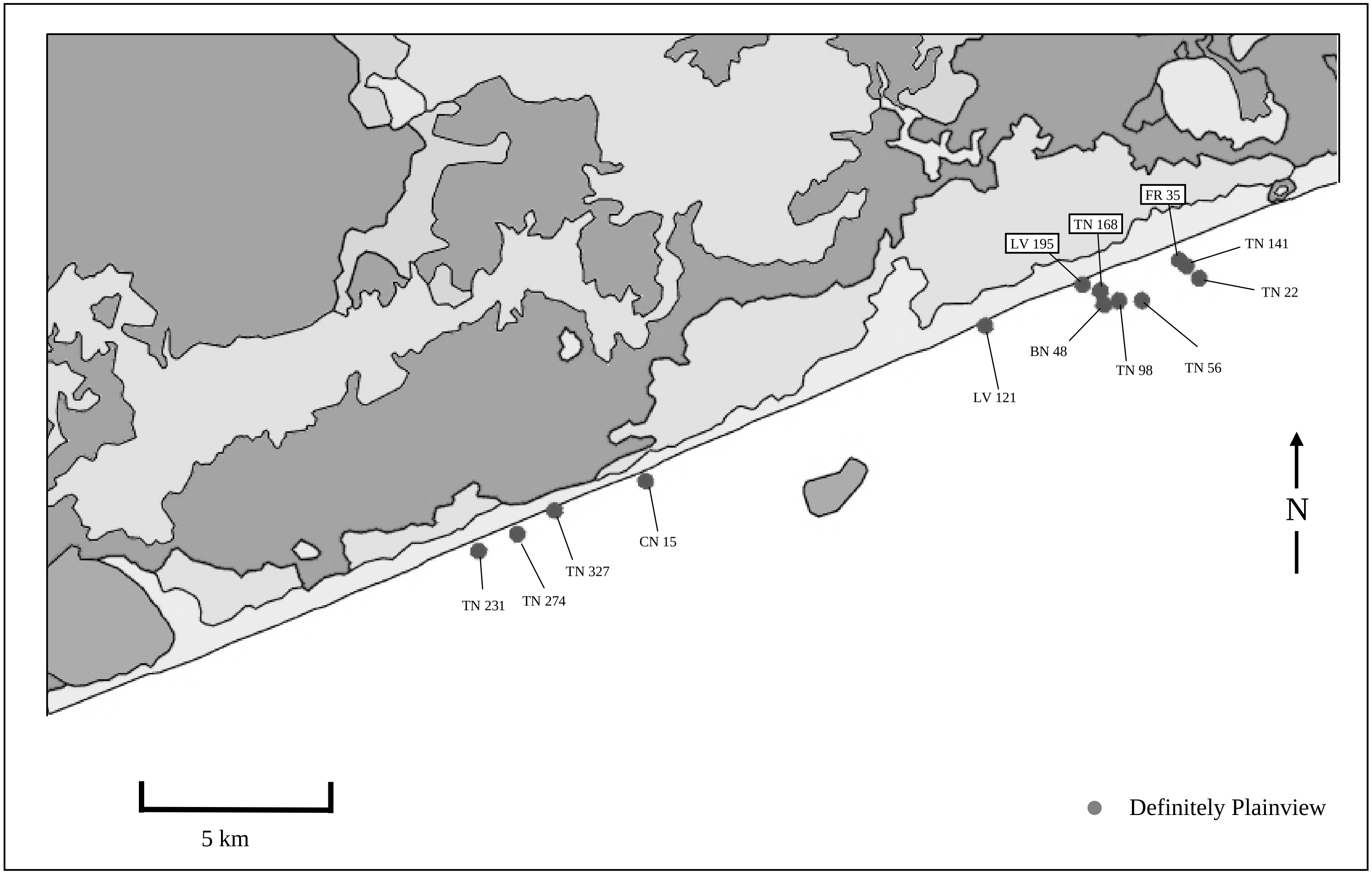

Figure 38. Plainview Artifacts

artifacts in the cluster having more mechanical wear, suggesting longshore current transport to the west from the original site location. It should be noted that LV 195 has an accuracy code of 2 meaning that it may have been misplotted by as much as 2 kilometers to the east of its actual location. If its actual location is 2 kilometers to the west, it would place it just to the east of LV 121.

Of the five Plainview artifacts to the west of these two clusters, three (CN 15, TN 231, and TN 274) have only a slight amount of wear and also slight or no patina. These three artifacts span a distance of 4.7 kilometers and do not appear to cluster. These artifacts also are not particularly heavy, with weights of 6.8 grams, 4.7 grams, and 3.3 grams, respectively; therefore, with only a slight amount of wear and patina, they probably were found very close to their original locations. This suggests that they were isolated hunting losses, rather than artifacts originating from an archaeological site.

The results of the nearest-neighbor analysis indicate that Plainview artifacts are a regular distribution with an R value of 2.04. This data set is a good illustration of the problems with the results of the nearest-neighbor analysis. Of the thirteen artifacts in the Plainview data set, eight form very tight clusters in the eastern portion of the study area, but the other five are rather widely spaced across a very long study area of 32,000 meters. These five, more isolated, artifacts in such a long, narrow study area statistically obscure the clustering of the majority of the artifacts in the eastern portion of the study area.

Hell Gap Diagnostic Type

Figure 39 shows the distribution of Hell Gap artifacts within the study area. There are only three Hell Gap artifacts (all projectile points) in the study collection, but the fact

Figure 39. Hell Gap Artifacts

that two (LV 14 and LV 325) occur within 467 meters of each other may be significant. Of these two artifacts, one (LV 325) is only slightly worn and has no visible patina, and the other (LV 14) is heavily worn. Because the more heavily worn artifact is actually slightly heavier (7.7 grams) and was found much earlier (August 1991) than the slightly worn artifact, which was found in December 1995 and weighs 5.7 grams, it does not appear that they originate from a single site location despite their relatively close occurrence. The third Hell Gap projectile point (CN 7), which occurs 7.1 kilometers to the east of the other two Hell Gap projectile points, is also only slightly worn and has no visible patina. It was found in May of 1991. The amount of wear, dates of find, and locations of these three Hell Gap projectile points suggest that they are probably isolated hunting losses. Because there were only three Hell Gap artifacts in the study collection, a nearest-neighbor analysis could not be run.

San Patrice Diagnostic Type

Figure 40 shows the spatial patterning of the San Patrice artifacts within the study collection. San Patrice is by far the most numerous diagnostic type in the study collection. All but 6 of the 53 San Patrice artifacts are moderately and heavily worn, which may be due, in part, to their typically small size, which would contribute both to being more easily mobilized in the shoreline environment and to collectors not finding them as quickly as larger artifacts. The weight range of the San Patrice artifacts is 1.7 grams to 11.3 grams, with an average weight of 5.1 grams. Because these small, low-density artifacts are more easily mobilized and transported, which would contribute to their degree of mechanical

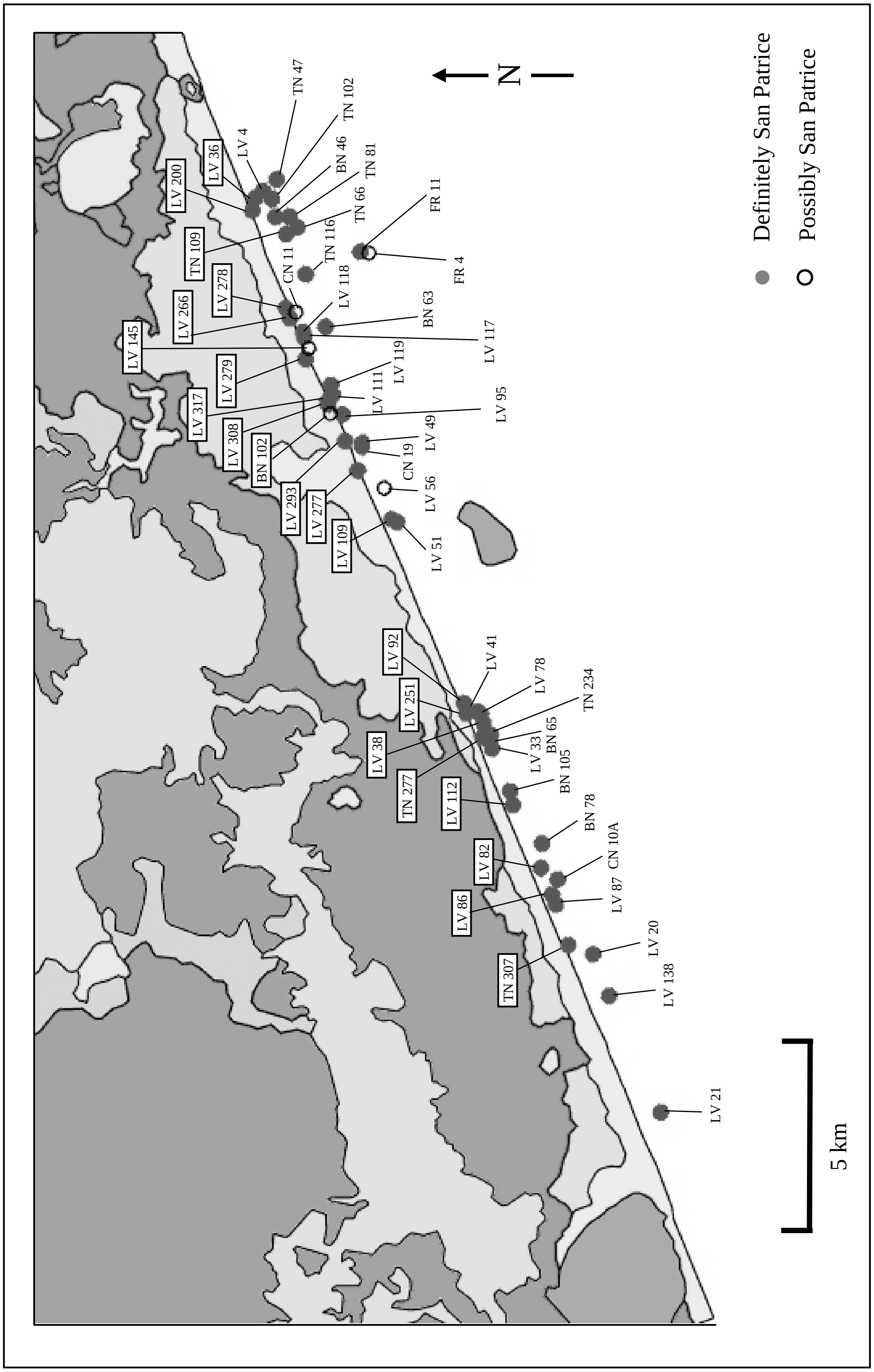

Figure 40. San Patrice Artifacts

wear, the 6 that are only slightly worn may be good indicators of where original archaeological sites are located.

There are several apparent clusters of San Patrice artifacts spread across the study area. The easternmost cluster is comprised of five projectile points (LV 4, LV 36, LV 200, TN 47, and TN 102) spread over a distance of 497 meters. However, it is important to note that three of the artifacts in this cluster (LV 4, LV 36, and LV 200) have an accuracy rating of 2, meaning that they may have been misplotted as much as 2 kilometers east of their actual locations. If the actual locations of these artifacts are 2 kilometers to the west, it would place them in the vicinity of TN 116. Although LV 36 is one of the six San Patrice artifacts that is only slightly worn, the questionable accuracy of its location makes it of less use in determining the location of a site. Of the other two artifacts in this cluster of five, TN 47 weighs 2 grams, is moderately worn, and was found in September 1986; TN 102 weighs 2.6 grams, is heavily worn, has heavy beach polish, and was found in January 1989. The small size and amount of wear on these two artifacts indicates that they probably were tumbled in the surf extensively after being eroded out of their original site context. This and the questionable location of the other three artifacts in this easternmost cluster make it an unlikely indicator of an original site location.

The next cluster occurs just 411 meters west of the easternmost cluster. It consists of four projectile points (BN 46, TN 66, TN 81, and TN 109) in a cluster 453 meters across. One of the artifacts in this cluster, TN 81 was not available for analysis, but its location, description, and date of find are known from the collector's original maps and log book. Of the other three artifacts in this cluster, TN 66 has a slight amount of wear and was found in June 1987, TN 109 has a moderate amount of wear and was found in March 1989, and BN 46 has a moderate amount of wear and was found in February 1990. These four artifacts may mark a general site location.

The third cluster consists of eight artifacts (BN 63, CN 11 (P), LV 117, LV 118, LV 145 (P), LV 266, LV 278, and LV 279) across an area of 1.3 kilometers. All of these artifacts are projectile points except for LV 145, which is a scraper with a hafting element. Six of these artifacts are moderately worn, and one is heavily worn. The only one of these eight artifacts that is slightly worn (LV 278) is the easternmost in the cluster and was found on March 4, 1995. The westernmost artifact in the cluster (LV 279) is moderately worn and was also found on March 4, 1995. The other six artifacts in this cluster were found earlier, between October 1991 and January 1995. It is likely that these artifacts mark a general site location probably centered closer to the location of LV 278 at the easternmost edge of the cluster, with longshore transport to the west accounting for the moderate to heavy wear on the remainder of the artifacts in the cluster.

The forth cluster consists of six projectile points (BN 102 (P), LV 95, LV 111, LV 119, LV 308, and LV 317) in an area 864 meters across. All of the artifacts in this cluster are moderately or heavily worn and were found between February 1993 and October 1995. Ten of the 53 San Patrice artifacts in the study collection (18.9 percent) are the Keithville variety, 3 of which occur in this one cluster. The co-occurrence of a particular variety of San Patrice projectile points in this one location suggests that it may mark a general site location.

The fifth cluster consists of three projectile points (CN 19, LV 49, LV 293) in an area 263 meters across. LV 49 was found in August 1992, is only slightly worn, and has no visible patina. The other two artifacts (CN 19 and LV 293) are both moderately worn with slight patina, and were found in October 1992 and April 1995, respectively. The condition of LV 49 suggests that it was found very near its original location. The other two artifacts having moderate wear, slight patina, and later dates of find may have originated at the same location.

The sixth cluster consists of nine projectile points (BN 65, LV 33, LV 38, LV 41, LV 78, LV 92, LV 251, TN 234, and TN 277) in an area approximately 1.4 kilometers across. Three of the nine artifacts (LV 33, LV 78, and LV 92) are of the Keithville variety. Two of the artifacts towards the center of the cluster are only slightly worn (LV 78, and TN 234) and were found only 8 days apart December 1992. The other artifacts in the cluster are either moderately or heavily worn. Four were found before December 1992, and three were found after that time. These nine artifacts may mark a general site location centered near the two slightly worn artifacts, LV 78 and TN 234.

The seventh, westernmost, cluster consists of five projectile points (BN 78, CN 10A, LV 82, LV 86, and LV 87) in an area 1.5 kilometers across. All five artifacts are moderately worn. Three of the five artifacts (LV 82, LV 86, and LV 87) were found within a 1-week period in January 1993. The other two artifacts were found in December 1991 (CN 10A) and February 1992 (BN 78). That three of the five artifacts in this cluster were found within a 1-week period suggests that this group of artifacts may mark a general site location.

The results of the nearest-neighbor analysis discussed above indicate that the group of definite San Patrice artifacts is a regular distribution with an R value of 1.41. When both definite and possible San Patrice artifacts were included in the analysis the R value shifted only slightly to 1.42. These are some of the lowest R values obtained for any of the diagnostic types analyzed, suggesting a relatively stronger tendency towards clustering.

Pelican Diagnostic Type

Figure 41 shows the spatial patterning of the Pelican artifacts within the study collection. All 13 Pelican artifacts are projectile points. Although Pelican artifacts have one of the lowest R values in the nearest-neighbor analysis (R = 1.19), meaning that they come closer to statistically clustering than artifacts in most of the other diagnostic types, the clusters consist mainly of isolated pairs of artifacts that do not have any apparent patterning in terms of their amount of wear or dates of find. Three of the 7 Pelican artifacts in the eastern portion of the study area (BN 64, TN 74, and LV 318) have only a slight amount of mechanical wear and slight or no visible patina, suggesting that they may have been found very near their original locations. However, these 3 artifacts are widely separated spatially, and in date of find. The easternmost of the 3 (TN 74) was found in November 1987. BN 64 was found almost a kilometer to the west of TN 74 in October 1991. LV 318 was found 4.5 kilometers to the west of BN 64 in October 1995. No apparent patterning indicating a potential site area is evident in the Pelican artifacts in the eastern portion of the study area.

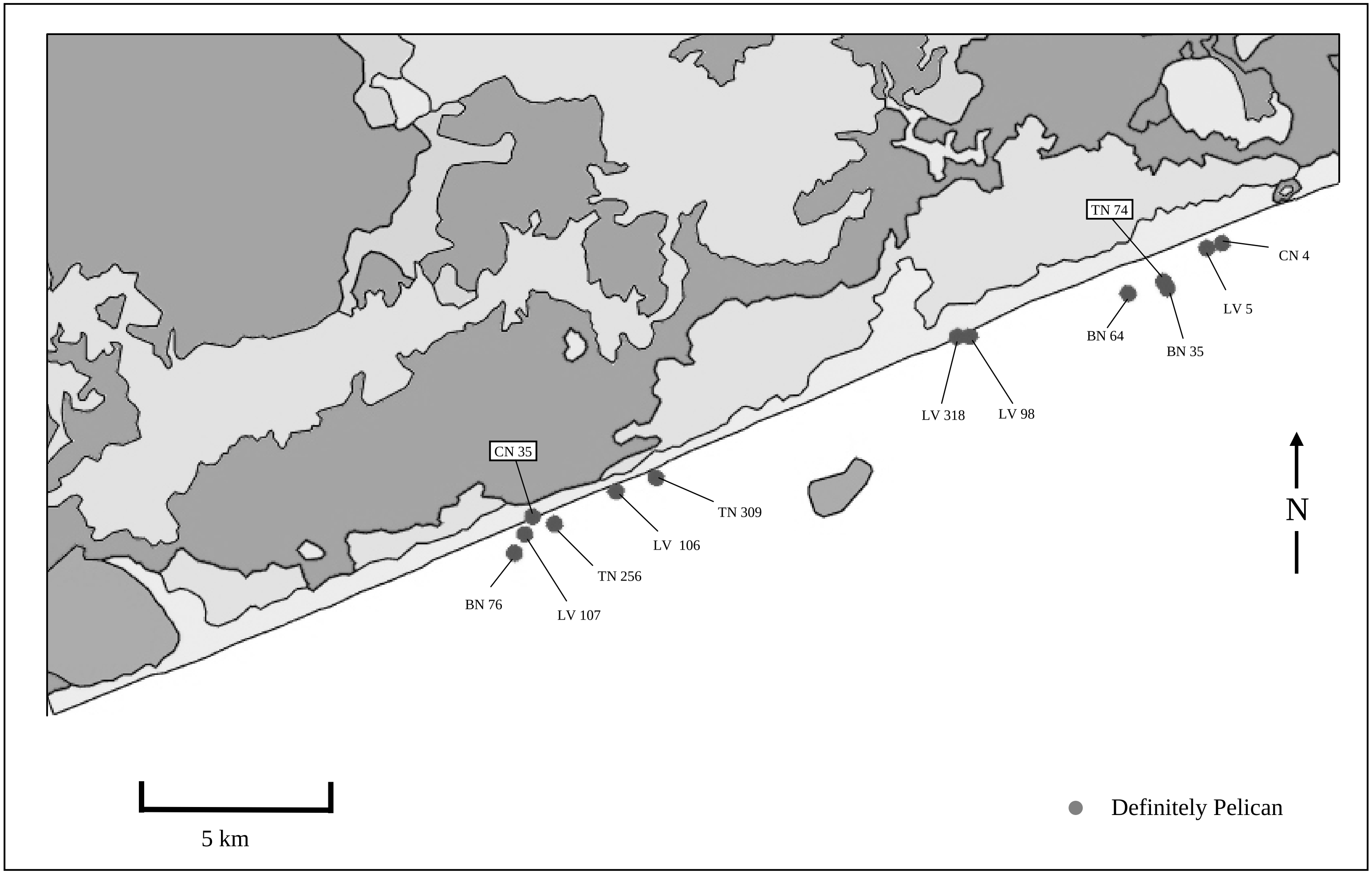

Figure 41. Pelican Artifacts

The four westernmost Pelican artifacts (CN 35, BN 76, LV 107 and TN 256) group within an area 1.2 kilometers in length. Two of these four artifacts (LV 107 and TN 256) have only a slight amount of wear and were found within a few weeks of each other in February and March 1993. Artifact BN 76 is both heavily worn and heavily patinated, and was found a year earlier in February 1992. The other artifact in the cluster, CN 35, is moderately worn and moderately patinated and was found in March 1995. Although there is no consistent patterning in the dates of find and wear on the artifacts in this cluster, it is possible that the two slightly worn artifacts (LV 107 and TN 256), which were found about 860 meters apart, mark the general location of a site.

Figure 42 is a composite map showing the potential site locations for the Paleoindian Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1970 and 1996, after the shoreline had moved significantly inland due to coastal erosion.

Late Paleoindian Period

Figure 43 shows the spatial distribution of the artifacts that were identified as Late Paleoindian and those that were identified as only possibly being Late Paleoindian in age. The locations of the artifacts identified as only possibly Late Paleoindian lie in close proximity to artifacts that are definitely Late Paleoindian with the exception of the 3 westernmost and 2 easternmost possible Late Paleoindian artifacts. The nearest-neighbor analysis indicates that the 54 definite Late Paleoindian artifacts form a regular distribution; however, when the 17 possible Late Paleoindian artifacts are added to the set, the

Figure 42. Locations of Potential Paleoindian Sites

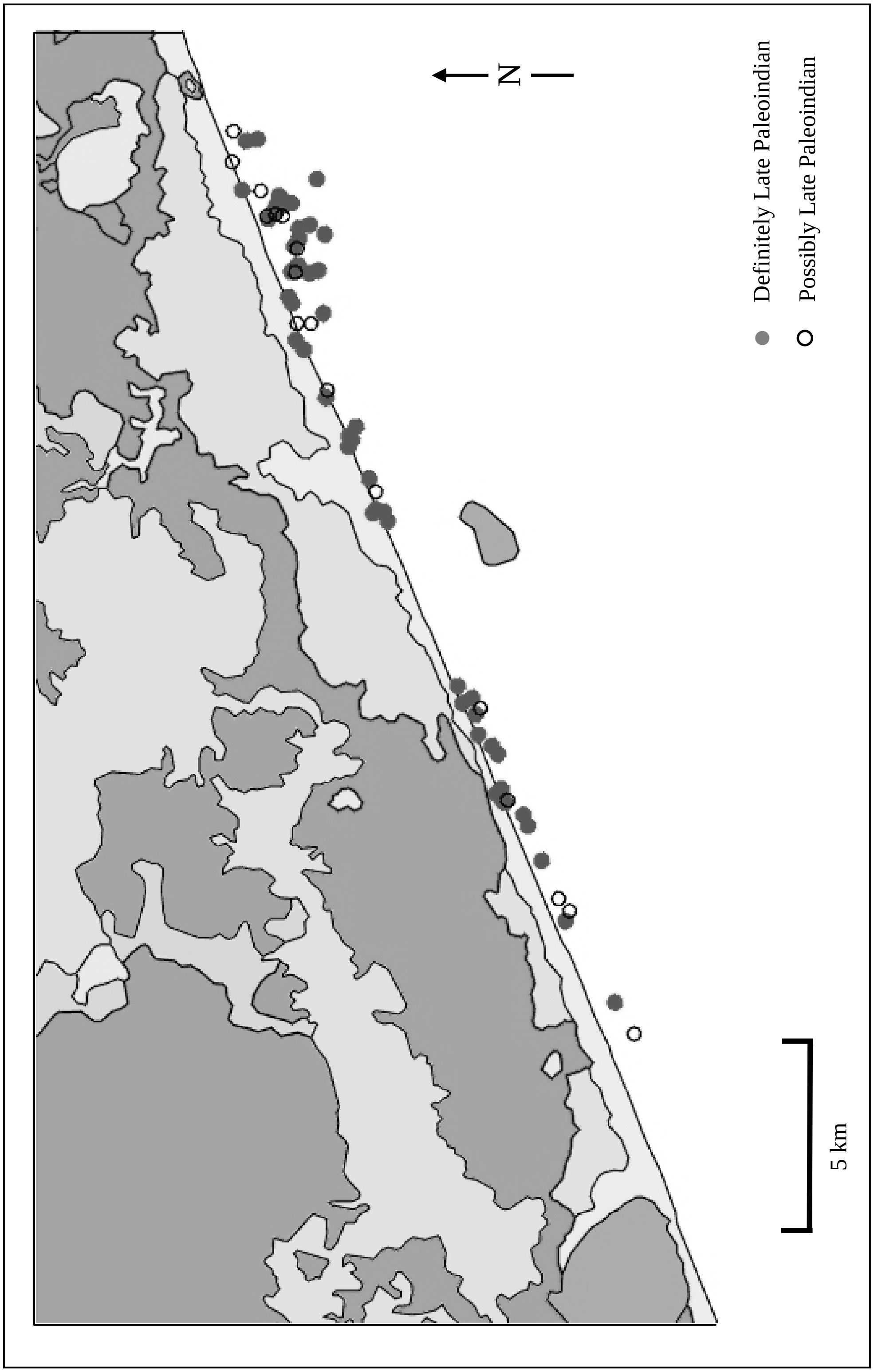

Figure 43. Locations of Late Paleoindian Artifacts

statistical analysis indicates that the artifacts form a random distribution (Table 11). The R values are 1.30 for definite Late Paleoindian artifacts and 0.97 for definite and possible Late Paleoindian artifacts, indicating a relative tendency towards clustering.

The study collection contains five different diagnostic types that fall within the Late Paleoindian Period (Table 16, Appendix D). The following discussion examines the spatial patterning within each of these diagnostic types.

Scottsbluff Diagnostic Type

Figure 44 shows the spatial patterning of the Scottsbluff artifacts within the study collection. The densest grouping of Scottsbluff artifacts occurs in the eastern portion of the study area. This group consists of 8 definite Scottsbluff artifacts (BN 21, TN 4, TN 9, TN 54, TN 142, TN 152, TN 155, and TN 163) and 6 possible Scottsbluff artifacts (BN 57, TN 93, TN 112, TN 150, TN 151, and TN 160). All but 1 of the 14 artifacts in this group have only a slight amount of mechanical wear and slight to no patina. TN 54 has a moderate amount of wear and patina. This cluster covers a distance of 2.2 kilometers, with the 8 definite Scottsbluff artifacts forming a slightly smaller central cluster 1.9 kilometers across. The 8 definite Scottsbluff artifacts were found between October 1984 and March 1991, the 6 possible Scottsbluff artifacts were found between April 1988 and November 1991. The slight amount of wear and patina on these artifacts suggests that they were found near their original site location, or locations, which eroded out over a period of 7 years from 1984 to 1991. Of the 14 artifacts in this cluster, 10 are projectile points, 1 (BN 57) is a projectile point/knife, 1 (TN 4) is an untyped biface, and 2 (TN 155

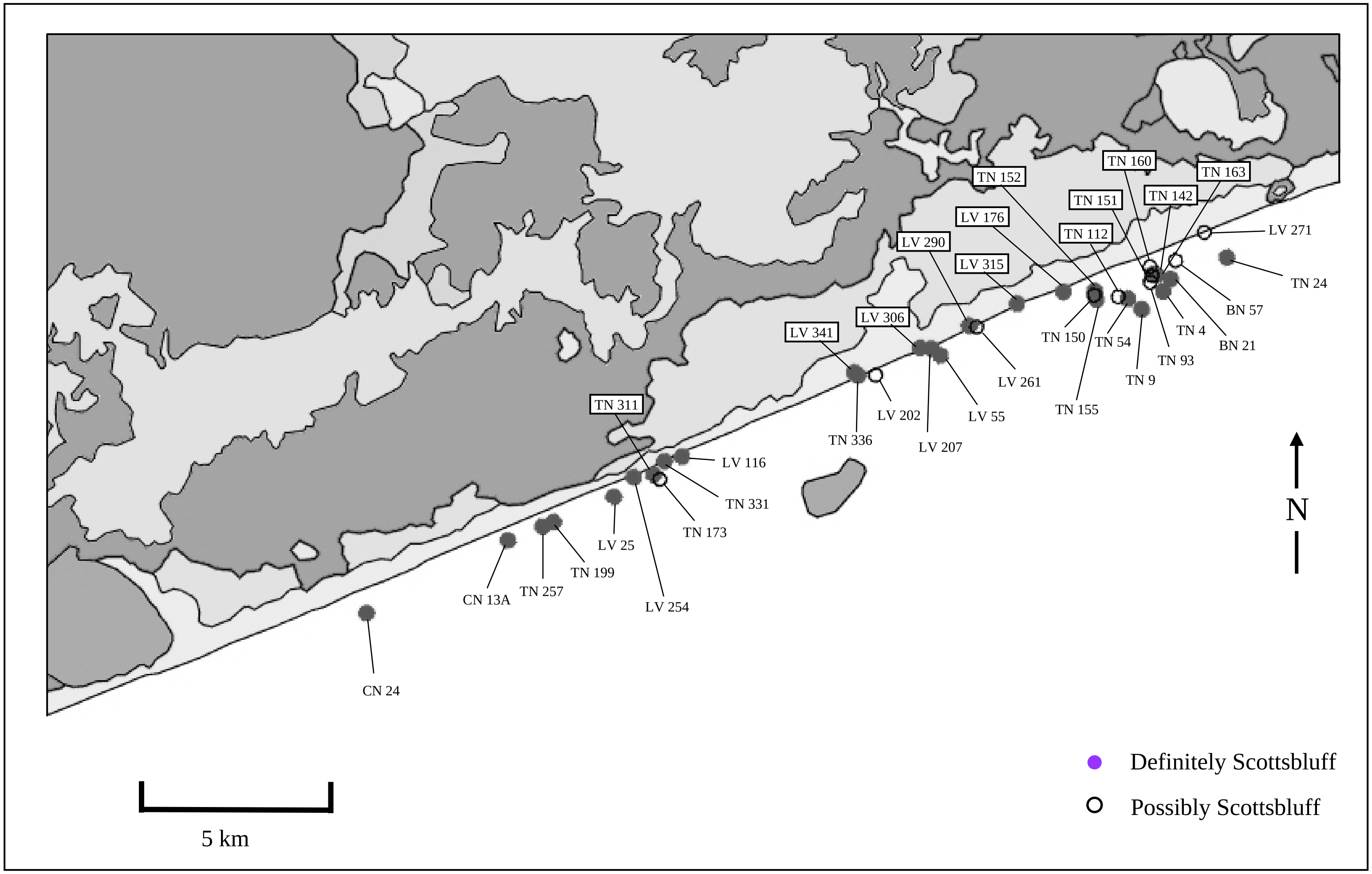

Figure 44. Scottsbluff Artifacts

and TN 163) are drills. The types of artifacts found in this cluster suggest a possible campsite.

The two artifacts (LV 271 and TN 24) that were found approximately 1 kilometer east of this cluster are also slightly worn and have little to no patina. TN 24 is a projectile point that was found in August 1985, and LV 271, which is only possibly Scottsbluff, is a flake/knife found in January 1995. The great disparity in the dates of find of these two artifacts, and the fact that LV 271 is only possibly Scottsbluff, make it unlikely that they are derived from a single site deposit.

The three definite Scottsbluff artifacts (LV 176, LV 315, and LV 290) that were found just to the west of the large cluster are also only slightly worn and have slight to no patina. LV 176 was found 821 meters west of the cluster in December 1993, LV 315 was found another 1.1 kilometers west of LV 176 in October 1995, and LV 290 was found another 1.4 kilometers west of LV 315 in April 1995. The wide spacing of these three artifacts, which are all projectile points, and their virtual lack of wear and patina do not suggest that they originate from a single site, but possibly represent isolated hunting losses. There is a possible Scottsbluff biface just 179 meters east of LV 290. This biface has a moderate amount of mechanical wear and was found in December 1994.

There is a second cluster of three definite Scottsbluff artifacts (LV 55, LV 207, and LV 306) 933 meters west of LV 290. This group of three projectile points spans a distance of 405 meters. LV 55 and LV 207 are both moderately worn and were found in October 1992 and May 1994, respectively. LV 306 is both heavily worn and heavily patinated and was found in June 1995. A third cluster consisting of three projectile points

(LV 202, LV 341, and TN 336) occurs 1.4 kilometers farther west along the beach and spans a distance of 484 kilometers. LV 202 is only possibly Scottsbluff. It is heavily worn with moderate patina and was found in May 1994. LV 341 has both heavy wear and heavy patina and was found on March 20, 1996. TN 336 has moderate wear and slight patina and was found in September 1995. Because the artifacts in both of these small clusters are moderately and heavily worn, and the dates of find within each cluster span a period of almost 3 years, it is unlikely that they mark the locations of original sites. It is interesting to note that the six artifacts in these two, more western, clusters are consistent in having heavier wear, more patina, and later dates of find than the artifacts to the east of them. It is possible that these artifacts originated in sites to the east near the large cluster of slightly worn artifacts discussed above, and were transported to the west by longshore current.

In the western portion of the study area, there is a cluster of five definite Scottsbluff projectile points (LV 25, LV 116, LV 254, TN 311, and TN 331) and one possible Scottsbluff preform (TN 173). These artifacts span a distance of 1.9 kilometers. Three of the artifacts (LV 25, LV 116, and TN 311) have only a slight amount of wear and slight or no patina. These three artifacts were found in March 1992, April 1993, and March 1994, respectively. The other two definite Scottsbluff artifacts were found slightly later, in November 1994 (LV 254) and March 1995 (TN 331). Both are moderately worn and have heavy and slight patina, respectively. The artifact that is only possibly Scottsbluff (TN 173) has the earliest date of find of all of the artifacts in the group (April 1991) and has both heavy wear and heavy patina. Because three of the six artifacts in this cluster have only a slight amount of wear and patina, it is likely that they were found very near their original locations; however, they are spread across a distance of 1.9 kilometers. That the other two definite Scottsbluff artifacts are more worn, found at a slightly later date, and occur in the gaps between the three slightly worn artifacts suggests there may be a site in the general vicinity of this cluster.

Of the small cluster of three artifacts (CN 13A, TN 199, and TN 257) that occurs to the west of this cluster, one (TN 257) is slightly worn but has a heavy amount of patina, and the other two (CN 13A and TN 199) are moderately worn with a slight and moderate amount of patina, respectively. The two moderately worn artifacts were found in March and April of 1992, almost a year before the slightly worn artifact was found in February 1993. The date of find and the amount of wear and patina on these three artifacts do not form any consistent pattern suggestive of the location of a site.

The results of the nearest-neighbor analysis indicate that the group of definite Scottsbluff artifacts is a regular distribution with an R value of 2.04. When both definite and possible Scottsbluff artifacts were included in the analysis, the R value decreased to 1.63 (Table 12). These R values and visual inspection of the distribution of the Scottsbluff artifacts do not indicate strong clustering in the data set as a whole. However, the high number of Scottsbluff artifacts having only slight mechanical wear and patina suggest that these often widely spaced artifacts were found very near their original locations. This pattern may be more indicative of isolated hunting losses than of discrete site areas. However, it is interesting that the 2 artifacts that suggest campsite activities, 2 Scottsbluff drills (TN 155 and TN 163), both occur within the large easternmost cluster of 14 artifacts discussed above as a possible general site location.

Early Side-Notched Diagnostic Type

Figure 45 shows the spatial patterning of the Early Side-Notched artifacts within the study collection. All of the Early Side-Notched artifacts are projectile points. The nearest-neighbor analysis indicates that Early Side-Notched artifacts (both definite and possible) have the highest R value of all diagnostic types in the study collection ($R = 4.70$), meaning that they have the least tendency towards clustering. The two Early Side-Notched artifacts that occur the closest together are LV 329 and TN 128 in the eastern portion of the study area. These artifacts were found only 230 meters apart. LV 329 has a moderate amount of both wear and patina and was found in January 1996. TN 128 is only possibly Early Side-Notched. It has only slight wear and no visible patina and was found in March 1990. The disparity in the wear and dates of find of these two artifacts and the questionable identity of TN 128 suggest that they probably do not derive from a single site. The other two artifacts that were found somewhat close together are FR 22 and LV 53 to the east. These two projectile points were found 841 meters apart, and both have a moderate amount of wear. FR 22 was found in January 1981, and LV 53 was found in September 1992. It should be noted that LV 53 has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location. If its actual location is 2 kilometers to the west, it would still fall more than 1.0 kilometer from the nearest Early Side-Notched artifact. The amount of mechanical wear,

Figure 45. Early Side-Notched Artifacts

the great disparity in the dates of find, and the questionable location of LV 53 make it doubtful that these two artifacts mark the location of an archaeological site.

Early Stemmed Diagnostic Type

Figure 46 shows the spatial patterning of the Early Stemmed artifacts within the study collection. All six of the Early Stemmed artifacts are projectile points. There was an insufficient number of Early Stemmed artifacts to run the nearest-neighbor analysis; however, there is one possible cluster of three Early Stemmed projectile points (LV 328, TN 85, and TN 136) in the easternmost portion of the study area. LV 328 has only a slight amount of wear and was found in December 1995. TN 85 and TN 136 both have a moderate amount of wear and were found in January 1988 and May 1990, respectively. It should be noted that LV 328 has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location. If its actual location is 2 kilometers to the west, it would place it just to the east of TN 115. Because of the disparity in the dates of find of the artifacts in this cluster, and the questionable location of LV 328, it is doubtful that these artifacts mark the location of a site.

Early Stemmed Lanceolate Diagnostic Type

Figure 47 shows the spatial patterning of the Early Stemmed Lanceolate artifacts within the study collection. All seven of the Early Stemmed Lanceolate artifacts are projectile points. There was an insufficient number of Early Stemmed Lanceolate artifacts to run the nearest-neighbor analysis. The seven artifacts are widely spaced along the beach with the exception of two (LV 101 and TN 332), which were found within

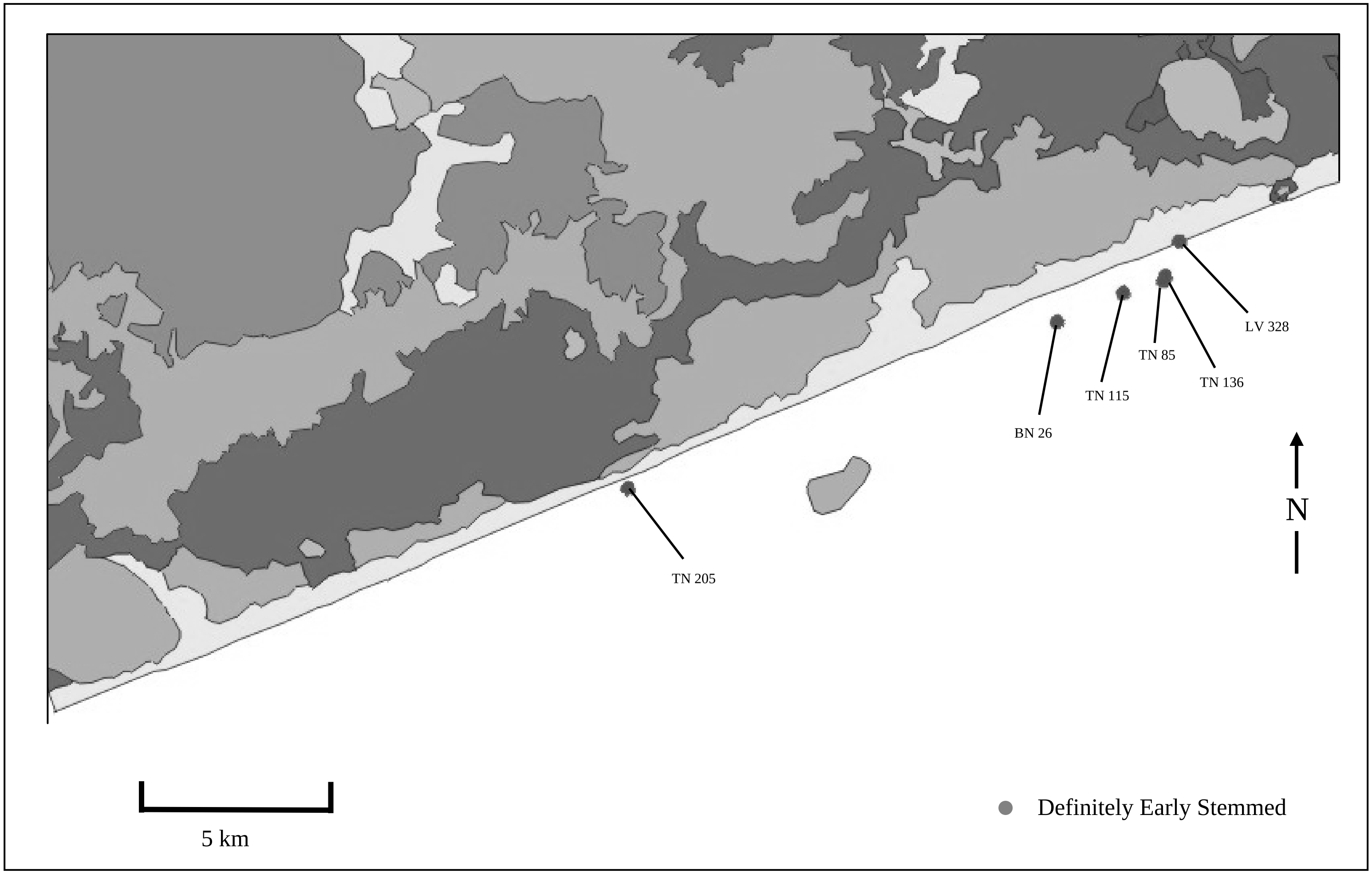

Figure 46. Early Stemmed Artifacts

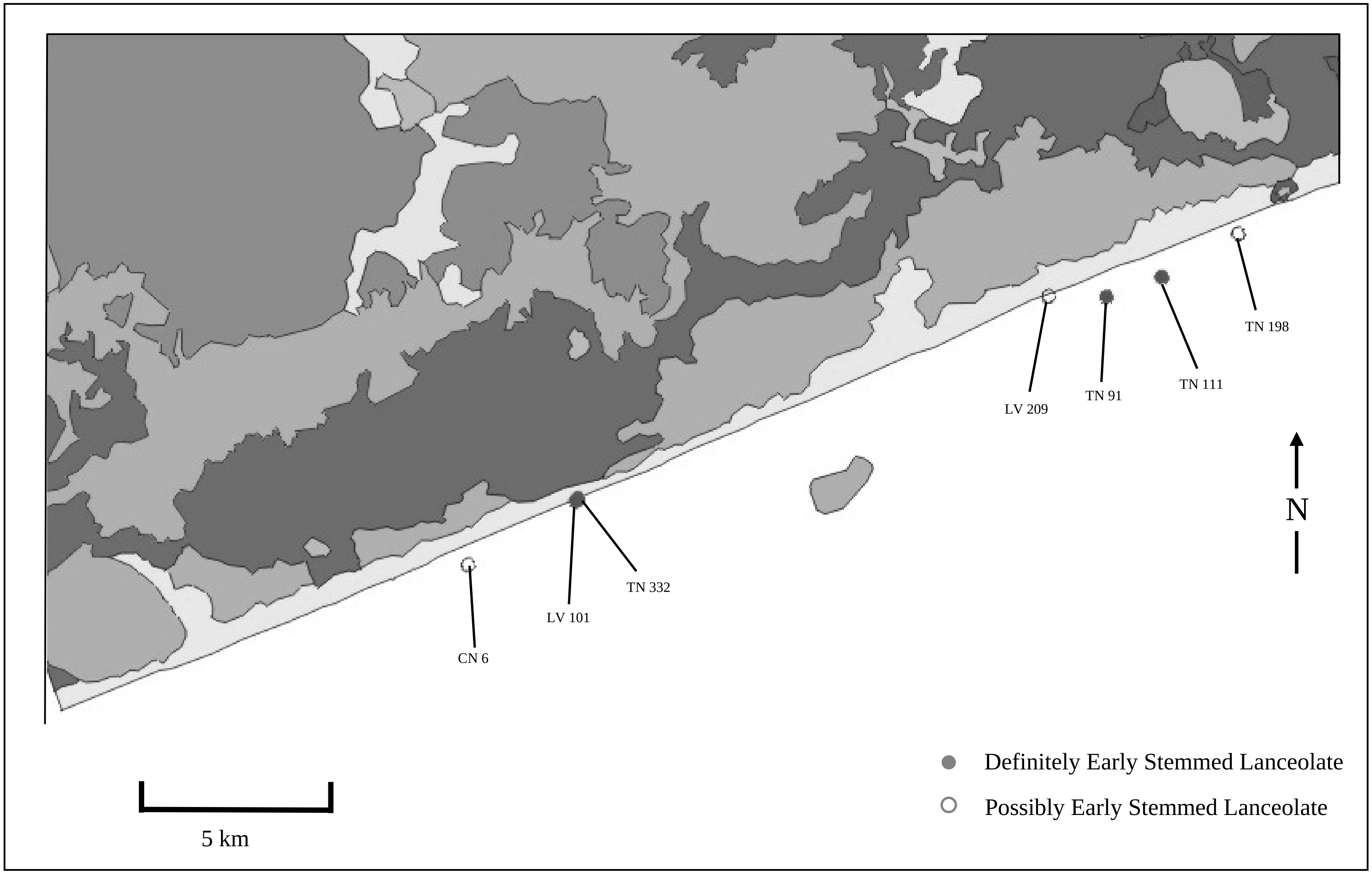

Figure 47. Early Stemmed Lanceolate Artifacts

84 meters of one another in the western portion of the study area. These two artifacts both have a slight amount of wear and were found in February 1993 and March 1995, respectively. Because of their slight wear and close association, it is possible that these two artifacts mark a general site location.

The Early Stemmed Lanceolate artifacts do not indicate strong clustering in the data set as a whole. However, six of the seven artifacts have only slight mechanical wear, and five of these six have slight to no patina, suggesting that these often widely-spaced artifacts were found very near their original locations. This pattern may be more indicative of isolated hunting losses than of discrete site areas.

Keithville Diagnostic Type

Figure 48 shows the spatial patterning of the Keithville artifacts within the study collection. All 13 Keithville artifacts are projectile points. All but 2 of the Keithville projectile points are moderately and heavily worn, which may be due, in part, to their typically small size, which would contribute both to being more easily mobilized in the shoreline environment and to collectors not finding them as quickly as larger artifacts. The weight range of the Keithville artifacts is 1.9 grams to 6.6 grams, with an average weight of 3.8 grams. Because these small, low-density artifacts are more easily mobilized and transported, and, therefore, worn, the two that are only slightly worn may be good indicators of where original archaeological sites are located.

There is a broad group of Keithville projectile points, 2.6 kilometers in length, in the eastern portion of the study area. This group contains a total of six artifacts, two of which (FR 12 and TN 57) have only a slight amount of mechanical wear. These two

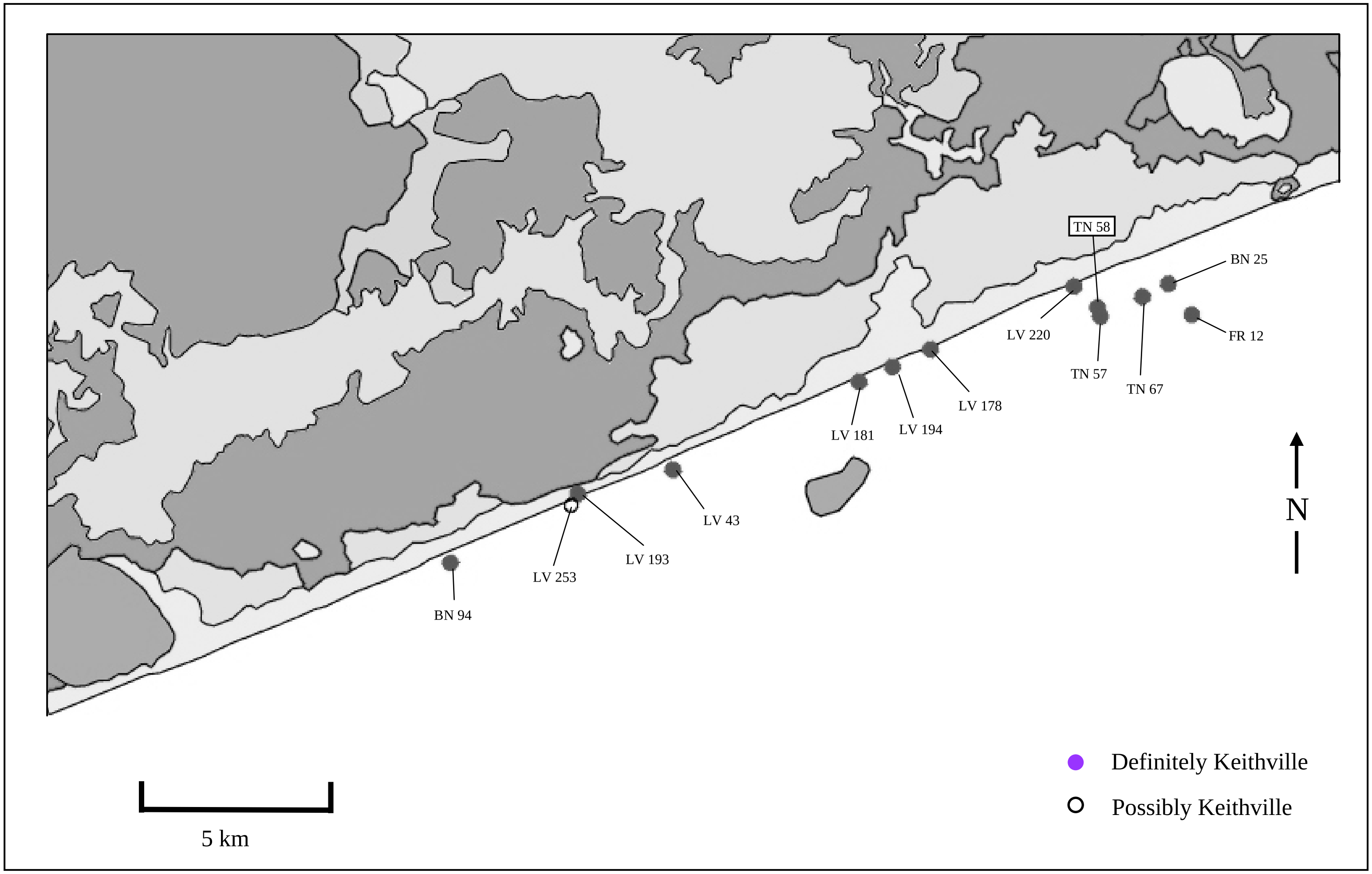

Figure 48. Keithville Artifacts

artifacts were found in March 1975 and December 1986, respectively. Of the other four artifacts in this group (BN 25, LV 220, TN 58, and TN 67), all but BN 25 are moderately worn. BN 25 is heavily worn. These four artifacts were found in January 1987, July 1994, January 1987, and June 1987, respectively. It should be noted that LV 220 has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location. If LV 220 is dropped out of the cluster because of its questionable location, the cluster becomes slightly smaller across (2.2 kilometers), the length of which is defined by the two slightly worn artifacts; the dates of find of the five remaining artifacts in the cluster are more consistent, with four of the five being found in the 6-month period between December 1986 and June 1987. The easternmost artifact in the cluster (FR 12) was found in March 1975, 12 years earlier than the other artifacts in the cluster. If this artifact is dropped out of the cluster because of its much earlier date of find, the distance across the cluster shrinks only slightly to 2.1 kilometers. The wear and dates of find suggest that the four remaining artifacts (BN 25, TN 57, TN 58, and TN 67) may mark the general location of an archaeological site; however, the level of mechanical wear is reversed from what would be expected due to longshore current transport, with the westernmost artifact in the group being slightly worn and the easternmost artifact being heavily worn. Hurricane Bonnie, which crossed the McFaddin Beach area the previous June (1986), may have caused the eastward dispersal of artifacts from a site located in the vicinity of TN 57 and TN 58.

A second group of three artifacts (LV 178, LV 181, and LV 194) occurs 4.3 kilometers to the west of this easternmost group. These three artifacts span a distance of

2 kilometers. LV 178 was found in January 1994 and has heavy wear and moderate patina. LV 181 was found 5 days later in January 1994 and has a moderate amount of wear and exhibits beach polish. LV 194 was found in April 1994 and has heavy wear and moderate patina. The amount of wear and patina on these three artifacts and their very small size (2.5 grams, 3.5 grams, and 1.9 grams, respectively) indicate that they have probably been extensively tumbled in the surf after being eroded out of their primary context. However, this being the case, it is interesting that their dates of find are so close together, suggesting that these three artifacts may mark the general location of an archaeological site.

The other four Keithville artifacts were found in the western portion of the study area. The artifacts are widely spaced except for the two middle artifacts (LV 193 and LV 253) that were found within 280 meters of each other in April 1994 and November 1994, respectively. Both artifacts have a heavy amount of wear, and LV 253 also has a heavy amount of patina. Because of the heavy wear on both of these artifacts and the fact that LV 253 is only possibly Keithville, it is unlikely that these two artifacts mark the location of a site.

The results of the nearest-neighbor analysis indicate that the group of definite Keithville artifacts is a regular distribution with an R value of 2.72. When both definite and possible Keithville artifacts were included in the analysis, the R value decreased to 2.17 (Table 12). These R values and visual inspection of the distribution of the Keithville artifacts do not indicate strong clustering in the data set as a whole. Regardless, two areas discussed above in the eastern portion of the study area could mark very general site areas.

Figure 49 is a composite map showing the potential site locations for the Late Paleoindian Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1975 and 1996 after the shoreline had moved significantly inland due to coastal erosion.

Late Paleoindian/Early Archaic Period

Figure 50 shows the spatial distribution of the artifacts that were identified as Late Paleoindian/Early Archaic and the 1 artifact that was identified as only possibly being Late Paleoindian/Early Archaic in age. The nearest-neighbor analysis indicates that the 14 definite and possible Late Paleoindian/Early Archaic artifacts form a regular distribution with an R value of 2.34 (Table 11). Because there was only 1 possible Late Paleoindian/Early Archaic artifact, a separate nearest-neighbor analysis was not run for only those artifacts that were definitely Late Paleoindian/Early Archaic. This R value is relatively high and does not suggest a tendency towards clustering for the period as a whole.

The study collection contains three different diagnostic types that fall within the Late Paleoindian/Early Archaic Period (Table 16, Appendix D). Spatial patterning will not be discussed for the Angostura diagnostic type because it is represented by only two artifacts (TN 252 and TN 302) spaced 14.8 kilometers apart.

Figure 49. Locations of Potential Late Paleoindian Sites

Figure 50. Locations of Late Paleoindian/Early Archaic Artifacts

Hardin Diagnostic Type

Figure 51 shows the distribution of Hardin artifacts within the study area. There are only three Hardin artifacts (all projectile points) in the study collection. The two Hardin projectile points (FR 1 and LV 152) in the eastern portion of the study area were found 1.4 kilometers apart. Both have a slight amount of mechanical wear and a moderate amount of patina. FR 1 was found in June 1970, and LV 152 was found in August 1993. The great discrepancy in the dates of find of these two artifacts, despite their slight amount of wear, suggests that they did not originate from a single site. The third Hardin projectile point (LV 133) was found in the western portion of the study area. This artifact also has only a slight amount of wear and no visible patina. It was found in May 1993. The slight amount of wear on the three Hardin projectile points, their spatial distribution and dates of find all suggest that they are probably isolated hunting losses, rather than artifacts that originated from an archaeological site. Because there were only three Hardin artifacts in the study collection, a nearest-neighbor analysis could not be run.

Big Sandy Diagnostic Type

Figure 52 shows the distribution of Big Sandy artifacts within the study area. All nine Big Sandy artifacts are projectile points. There is a cluster of three Big Sandy projectile points (BN 28, LV 197, and TN 296) in the eastern portion of the study area. The three artifacts span a distance of 1 kilometer, but BN 28 and LV 197 were found only 215 meters apart. BN 28 has a moderate amount of wear and was found in April 1987. LV 197, which has a heavy amount of wear and moderate patina, was found in April 1994. TN 296 has a moderate amount of wear and slight patina and was found in December 1993. That LV 197, the westernmost artifact in this small cluster, has the

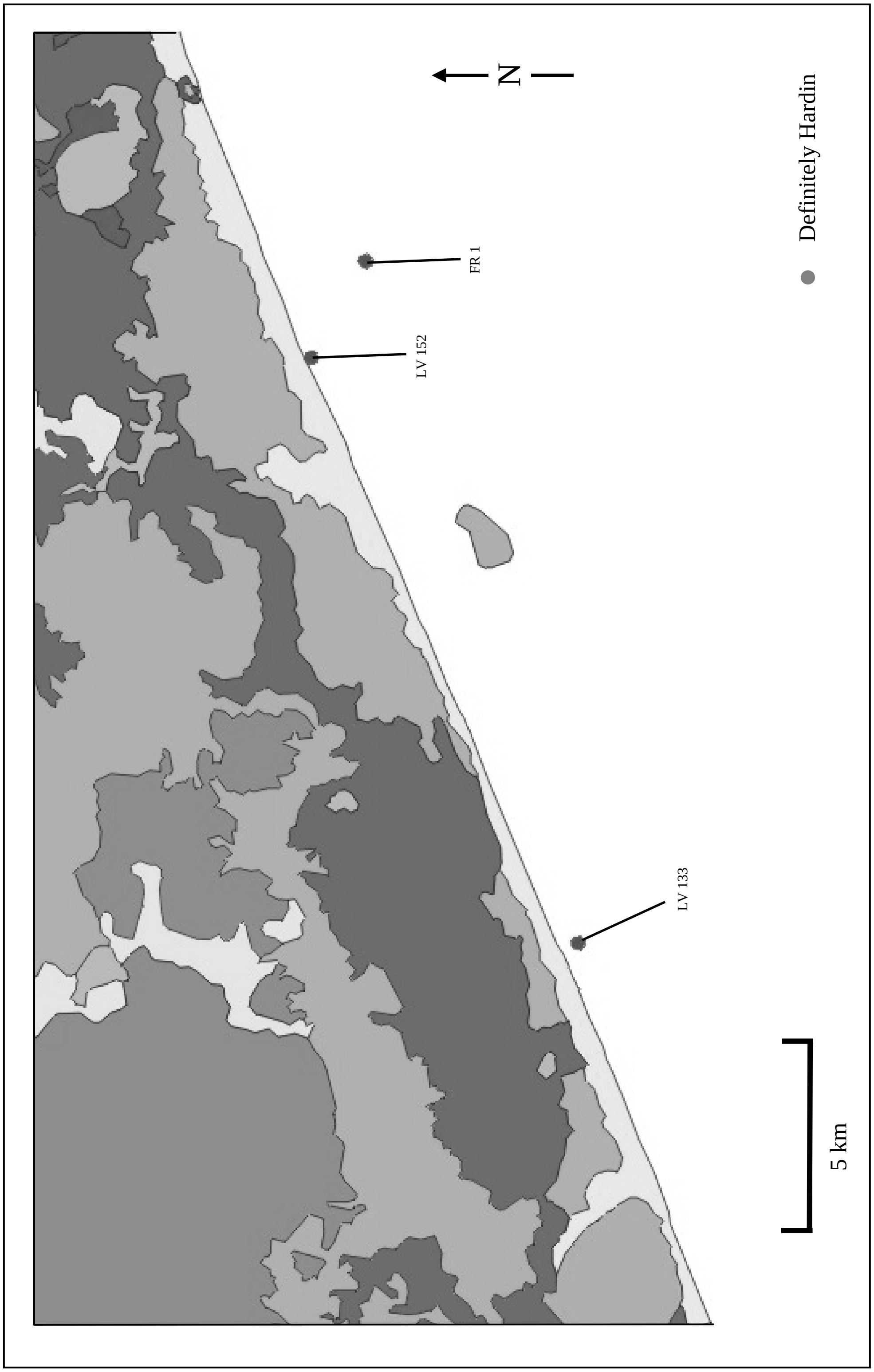

Figure 51. Hardin Artifacts

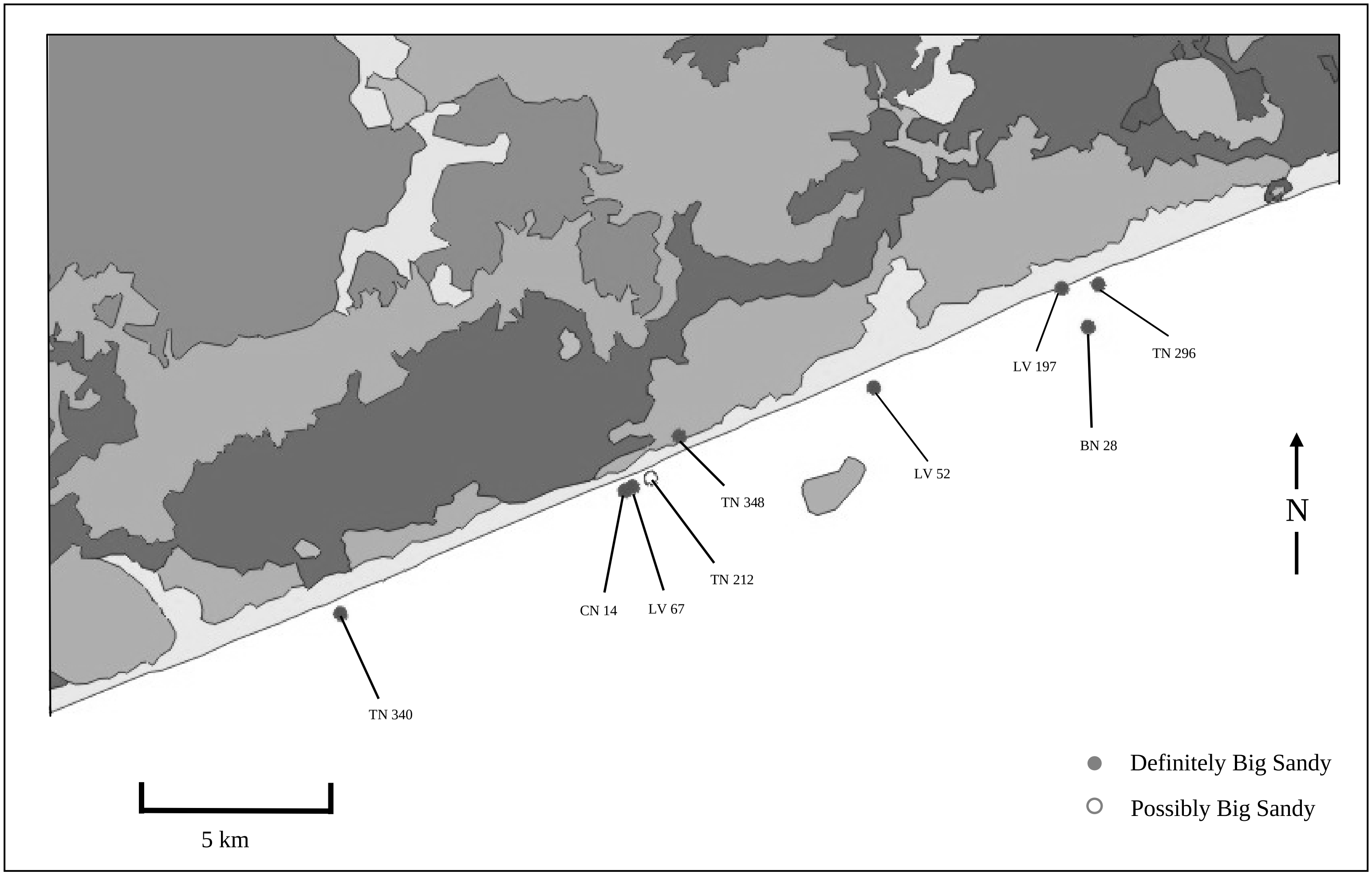

Figure 52. Big Sandy Artifacts

greatest amount of wear and patina and the latest date of find suggests that the two easternmost artifacts, BN 28 and TN 296, could mark the general area of a site and that LV 197 was transported to the west by longshore current.

There is a second cluster of three Big Sandy artifacts (CN 14, LV 67, and TN 212) in the western portion of the study area. This cluster spans a distance of 746 meters. The westernmost artifact (CN 14) has only a slight amount of wear and no visible patina. It was found in April 1992. The other two artifacts in the cluster, both of which have a heavy amount of mechanical wear and heavy patina, were found in May 1992 (TN 212) and November 1992 (LV 67). It should be noted that the easternmost artifact, TN 212, is only possibly Big Sandy. The slightly worn artifact, CN 14, may mark the general location of an archaeological site, and LV 67, which was found 209 meters to the east 7 months later, may have been eroded from the same site. This pattern is suggestive of transport of artifacts to the east which is counter to expectation if the transport is by longshore current, but it could occur during intermittent winter storms. If TN 212 is, in fact, a Big Sandy projectile point, it may also have come from the same site.

The remaining three Big Sandy artifacts (LV 52, TN 340, and TN 348) are rather widely distributed and do not seem to pattern in any way. These may represent isolated hunting losses.

The results of the nearest-neighbor analysis indicate that those artifacts that are definitely Big Sandy form a regular distribution with an R value of 4.14. When the one possible Big Sandy artifact (TN 212) is included in the analysis, the R value is only slightly lower at 3.91. These R values are among the highest for all of the diagnostic types tested, meaning that the Big Sandy artifacts have a relatively lower tendency towards clustering than most of the other diagnostic types in the study collection. This data set is another good illustration of the suspected problems with the results of the nearest-neighbor analysis. Of the nine artifacts in the Big Sandy data set, six fall into two possible clusters, but the other three are so widely spaced that, in such a small data set, they greatly increase the average nearest-neighbor distance for the whole data set.

Figure 53 is a composite map showing the potential site locations for the Late Paleoindian/Early Archaic Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1970 and 1996 after the shoreline had moved significantly inland due to coastal erosion.

Early Archaic Period

Figure 54 shows the spatial distribution of the artifacts that were identified as Early Archaic and the one artifact that was identified as only possibly being Early Archaic in age. The nearest-neighbor analysis indicates that the 15 definite and possible Early Archaic artifacts form a regular distribution with an R value of 3.68 (Table 11). Because there was only one possible Early Archaic artifact, a separate nearest-neighbor analysis was not run for only those artifacts that were definitely Early Archaic. This R value is the highest of all the cultural periods and does not suggest a tendency towards clustering for the period as a whole.

The study collection contains six different diagnostic types that fall within the Early Archaic Period (Table 16, Appendix D). Spatial patterning will not be discussed for

Figure 53. Locations of Potential Late Paleoindian/Early Archaic Sites

Figure 54. Locations of Early Archaic Artifacts

the following diagnostic types that are represented by only one or two artifacts; Clear Fork Uniface (LV 234), Hoxie (LV 186), Wells (LV 127), and Uvalde (LV 13 and LV 203), which were found 23.2 kilometers apart.

Bell Diagnostic Type

Figure 55 shows the distribution of the Bell artifacts within the study area. The four Bell artifacts are all slightly worn projectile points spread across an area of 6.4 kilometers in the eastern portion of the study area. These four artifacts were found between March 1977 and November 1993. The slight amount of mechanical wear on all four projectile points suggests that they were found very near their original locations. This is particularly true for TN 149 which still retains the long, slender ears characteristic of the Bell projectile point (see Appendix A). However, because there is no apparent clustering in these artifacts and they were found over a period of 16 years, they may represent isolated finds rather than the location of an archaeological site. Because there were only four Bell artifacts in the study collection, a nearest-neighbor analysis could not be run.

Woden Diagnostic Type

Figure 56 shows the distribution of the Woden artifacts within the study area. The six Woden artifacts are all projectile points. Five of the six Woden artifacts (BN 82, LV 10, TN 70, TN 84, and TN 90) form a small cluster, 479 meters across, in the eastern portion of the study area. The four easternmost artifacts in the cluster form a very tight cluster only 60 meters across. The westernmost artifact in this cluster (BN 82) is only slightly worn. The other four artifacts in the cluster are moderately to heavily worn. It

Figure 55. Bell Artifacts

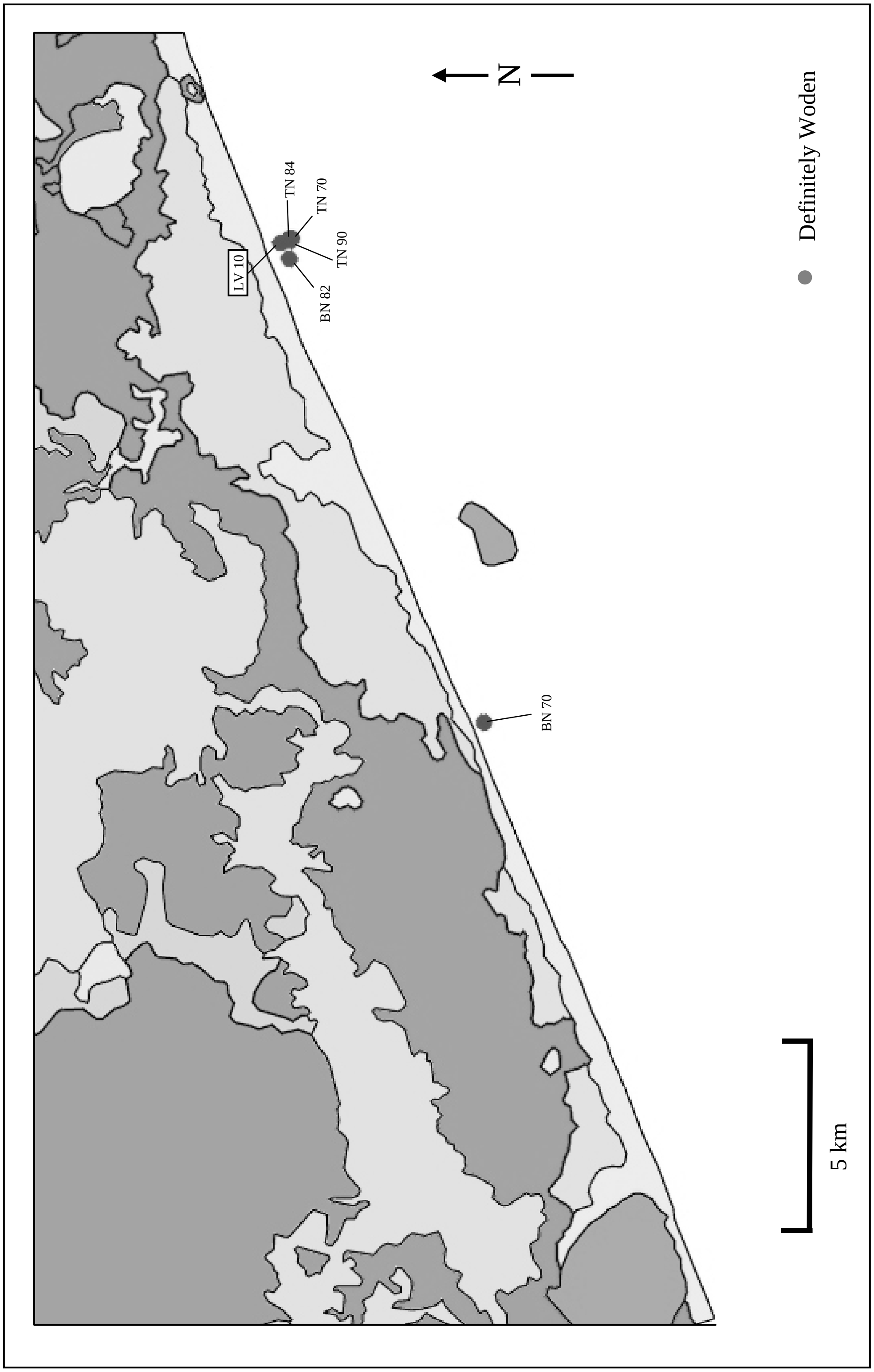

Figure 56. Woden Artifacts

should be noted that LV 10 has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location; however, its close association with the other four Woden points in the cluster suggests that this particular artifact was not misplotted. It should be noted that LV 10 is the only one of the six Woden projectile points that is not made out of petrified wood, which is typical of the Woden diagnostic type (Turner and Hester, 1993:196). It is made out of Tecovas material that is either jasper or quartzite.

The five artifacts in the cluster were found between July 1987 and August 1992. If the westernmost artifact (BN 82) is dropped out of the cluster, and LV 10 is dropped out because the accuracy of its location is somewhat questionable, the three remaining artifacts (TN 70, TN 84, and TN 90) form a very tight cluster of artifacts, 60 meters across, that were found within an 8-month period. It is highly likely that this cluster marks the general location of an archaeological site. Because there were only six Woden artifacts in the study collection, a nearest-neighbor analysis could not be run.

Figure 57 is a composite map showing the one potential site location for the Early Archaic Period identified in the preceding discussion. The potential site location, shown at its true geographic coordinates, appears to be inland because the geologic base map dates from 1962 and the artifacts were found between 1977 and 1993 after the shoreline had moved significantly inland due to coastal erosion.

Early/Middle Archaic Period

Figure 58 shows the distribution of the artifacts that were identified as Early/Middle Archaic in age. There are only two artifacts in the study collection definitely

Figure 57. Location of a Potential Early Archaic Site

from this period: an Abasolo projectile point (LV 345) and a Morrill projectile point (LV 151). These two artifacts were found 5.3 kilometers apart in the eastern portion of the study area. The other two Early/Middle Archaic artifacts are two possible Johnson/Webb projectile points (CN 34 and LV 283). These two artifacts were found 15.6 kilometers apart. There was an insufficient number of artifacts to run the nearest-neighbor analysis on the four Early/Middle Archaic projectile points in the study collection; however, visual inspection of the distribution of these four projectile points does not suggest any clustering. Therefore, no potential site areas for the Early/Middle Archaic Period were identified.

Middle Archaic Period

Figure 59 shows the spatial distribution of the artifacts that were identified as Middle Archaic and those that were identified as only possibly being Middle Archaic in age. The locations of the artifacts identified as only possibly Middle Archaic lie in close proximity to artifacts that are definitely Middle Archaic, possibly strengthening their tentative identification. The nearest-neighbor analysis indicates that the 24 definite Middle Archaic artifacts form a regular distribution with an R value of 1.87. When the 4 possible Middle Archaic artifacts are added to the analysis, the R value decreases slightly to 1.73, indicating a slightly stronger relative tendency towards clustering (Table 11).

The study collection contains six different diagnostic types that fall within the Middle Archaic Period (Table 16, Appendix D). Spatial patterning will not be discussed for the following diagnostic types that are represented by only one or two artifacts:

Figure 58. Locations of Early/Middle Archaic Artifacts

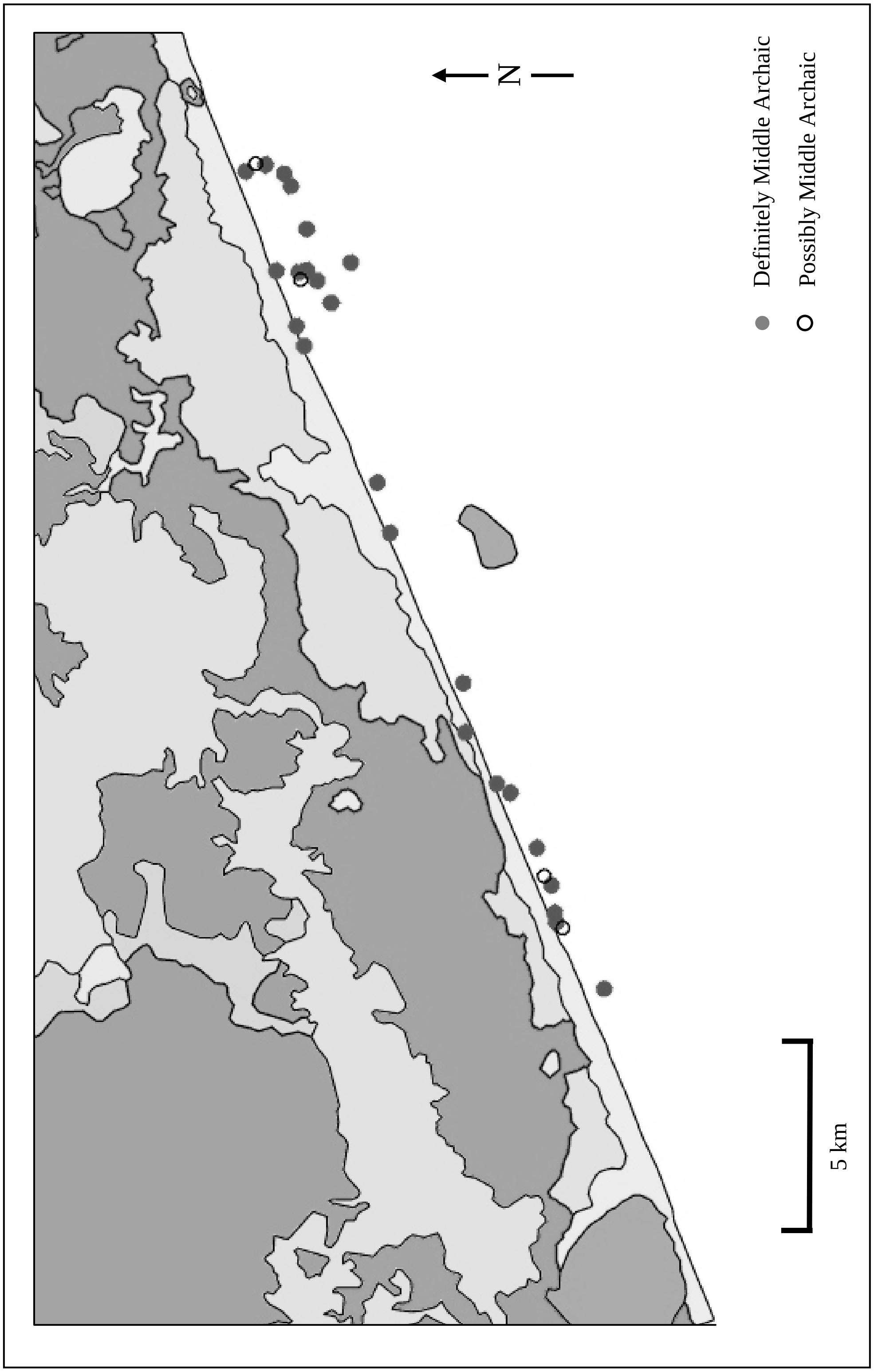

Figure 59. Locations of Middle Archaic Artifacts

Pedernales (LV 258), Tortugas (LV 265), and Travis (BN 89 and CN 25), which were found 17.9 kilometers apart.

Dawson Diagnostic Type

Figure 60 shows the distribution of the Dawson artifacts within the study area. The 12 Dawson artifacts are all projectile points. The easternmost 3 Dawson artifacts (BN 3, TN 23, and TN 200) form a cluster 428 meters across. TN 23 and TN 200, which are both slightly worn and have slight to no patina, were found in July 1985 and March 1992, respectively. The westernmost artifact in the cluster (BN 3) has a moderate amount of wear and was found in June 1985. A fourth artifact (TN 10) about 1.4 kilometers to the west of this cluster also has only a slight amount of wear and patina and was found in April 1985. If the cluster is extended to include this fourth artifact, 3 of the 4 artifacts in the cluster were found within a 3-month period in 1985, and 3 of the artifacts in the cluster have a slight amount of wear and little to no patina, suggesting that this broad cluster may mark the general location of an archaeological site.

A second cluster of three artifacts (FR 21, TN 94, and TN 120) occurs 953 meters to the west of the first cluster. This cluster is 469 meters across. Unlike the more eastern cluster, two of the artifacts in this cluster (FR 21 and TN 120) are heavily worn, one (FR 21) also having heavy patina. The third artifact (TN 94) has both a moderate amount of wear and patina. FR 21 was found in June 1980; TN 94 was found in May 1988, and TN 120 was found in November 1989. The heavier amounts of mechanical wear and patina on the artifacts in this cluster suggest that they may have originated closer to the cluster of less-worn artifacts to the east and been transported to the west by longshore

Figure 60. Dawson Artifacts

current. The dates of find of the artifacts in the two clusters are somewhat consistent with this interpretation.

The five remaining Dawson artifacts (LV 72, LV 124, LV 272, LV 286, and TN 228) occur in the western portion of the study area. These artifacts are widely spaced over a distance of 8.6 kilometers, and there is no apparent pattern to their amount of wear or dates of find. The two artifacts that have only a slight amount of wear (LV 124 and LV 286) were found 2 kilometers apart in April 1993 and March 1995, respectively. These two artifacts may represent isolated hunting losses found very near their original locations of loss.

The results of the nearest-neighbor analysis indicate that the group of Dawson artifacts is a regular distribution with an R value of 1.69 (Table 12). This data set is a good illustration of the problems with the nearest-neighbor analysis. Of the 12 artifacts in the Dawson data set, 6 fall within two relatively small clusters in the eastern portion of the study area, but the other 6 are rather widely spaced across a very long study area of 32,000 meters. These 6 more isolated artifacts in such a long, narrow study area statistically obscure the clustering of the artifacts in the eastern portion of the study area.

Evans Diagnostic Type

Figure 61 shows the distribution of the Evans artifacts within the study area. The four Evans artifacts are all projectile points. These four artifacts are widely distributed across the study area, with the two that are closest together (LV 30 and TN 325) being 1.9 kilometers apart. The easternmost artifact (BN 19) has a moderate amount of wear and was found in November 1985. The other three artifacts (LV 30, LV 230, and TN 325) all have a heavy amount of wear and were found in April 1992, September 1994, and November 1994, respectively. Even though LV 230 and TN 325 were found within 2 months of one another, they were found 12.2 kilometers apart indicating that they almost certainly did not originate from a single archaeological site. There is nothing in the spatial distribution, the dates of find, or amount of wear of these four artifacts suggesting any clustering. Because there were only four Evans artifacts in the study collection, a nearest-neighbor analysis could not be run.

Marshall Diagnostic Type

Figure 62 shows the distribution of the Marshall artifacts within the study area. The eight Marshall artifacts are all projectile points. There is a cluster of three definite Marshall projectile points (BN 44, LV 215, TN 1) and one possible Marshall projectile point (TN 161) in the eastern portion of the study area. This cluster is 1.1 kilometers across. BN 44 has just a slight amount of mechanical wear and was found in September 1989. The other three artifacts all have a moderate amount of wear and were found in December 1983 (TN 1), March 1991 (TN 161), and June 1994 (LV 215). These four artifacts could have eroded from a single archaeological site over a period of 11 years, with the amount of wear being related to how much time elapsed between the artifact eroding out of its original site context and being found by a collector. According to the coastal erosion rates outlined by Morton (1997), the site would have had to be a minimum

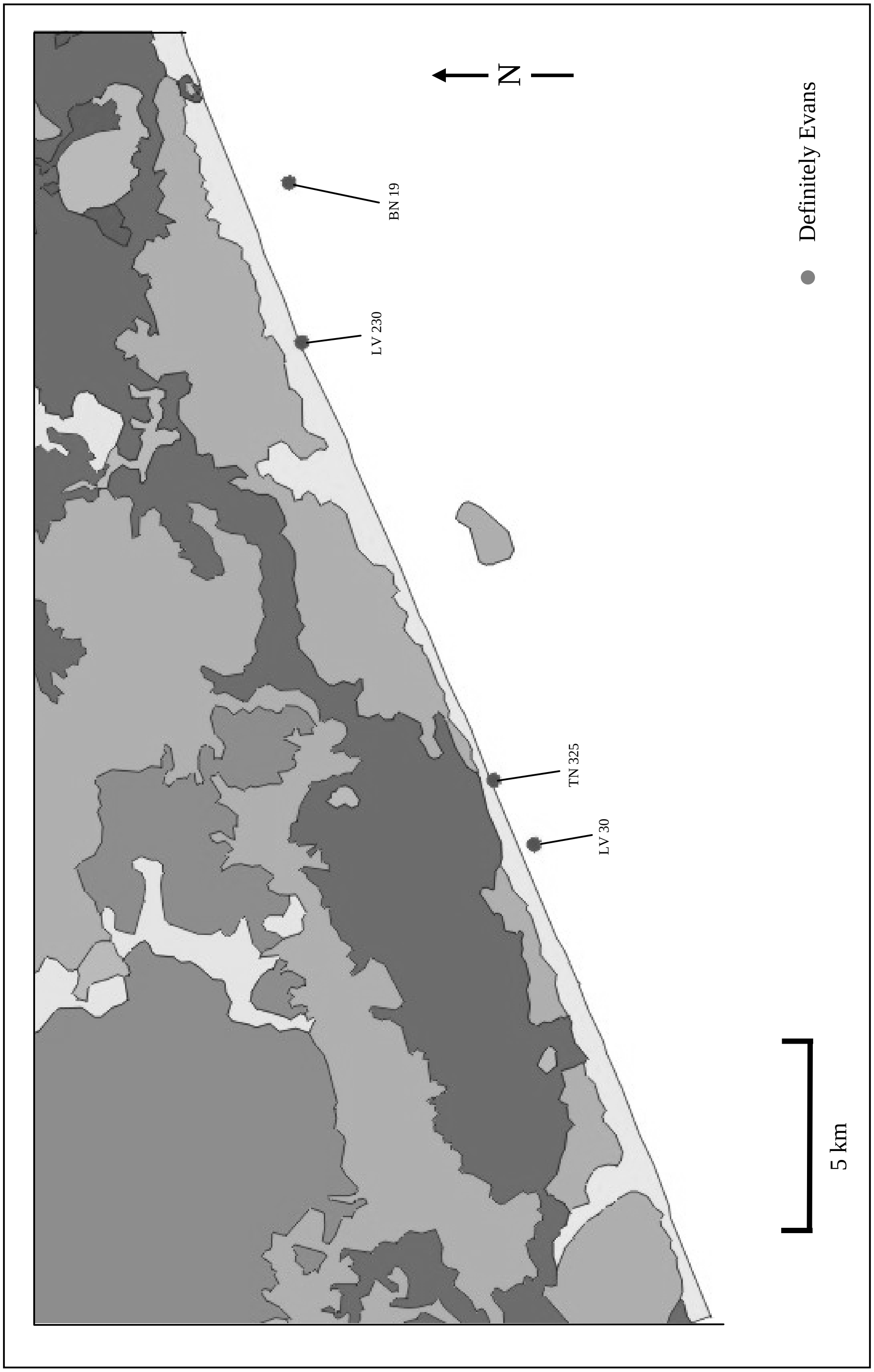

Figure 61. Evans Artifacts

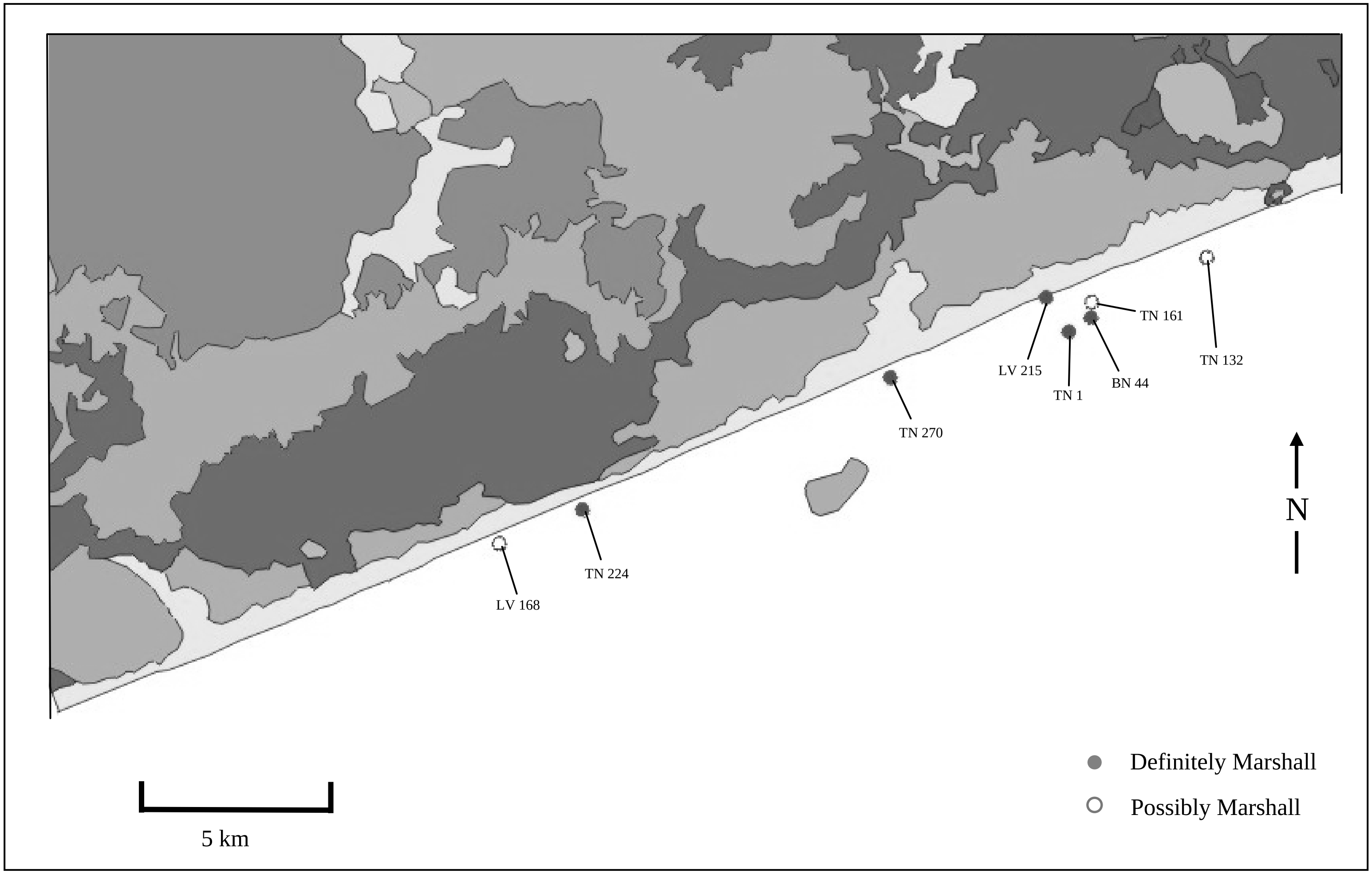

Figure 62. Marshall Artifacts

size of 40 meters in the landward-seaward direction for these four artifacts, found 11 years apart, to have come from the same site.

The four remaining Marshall artifacts (LV 168, TN 132, TN 224, and TN 270) are widely spaced across the study area, and there is no apparent pattern to their amounts of wear or dates of find that would suggest a possible archaeological site location.

There were only five definite Marshall artifacts, which was an insufficient number to run the nearest-neighbor analysis; therefore, the nearest-neighbor analysis was run for both definite and possible Marshall artifacts. The results of the analysis indicate that the Marshall artifacts form a regular distribution with an R value of 3.41. This is a relatively high R value indicating less tendency towards clustering than most of the other diagnostic types analyzed. The very wide spacing of the four artifacts that fall outside of the cluster identified in the eastern portion of the study area are the cause of the very high R value.

Figure 63 is a composite map showing the potential site locations for the Middle Archaic Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1980 and 1995 after the shoreline had moved significantly inland due to coastal erosion.

<u>Middle/Late Archaic Period</u>

Figure 64 shows the spatial distribution of the artifacts that were identified as Middle/Late Archaic and those that were identified as only possibly being Middle/Late

Figure 63. Locations of Potential Middle Archaic Sites

Archaic in age. The locations of the artifacts identified as only possibly Middle/Late Archaic lie in close proximity to artifacts that are definitely Middle/Late Archaic, possibly strengthening their tentative identification. The nearest-neighbor analysis indicates that the 40 definite Middle/Late Archaic artifacts form a regular distribution with an R value of 1.48. When the 5 possible Middle/Late Archaic artifacts are added to the analysis, the R value decreases slightly to 1.33, indicating a slightly stronger relative tendency towards clustering (Table 11).

The study collection contains eight different diagnostic types that fall within the Middle/Late Archaic Period (Table 16, Appendix D). Spatial patterning will not be discussed for the following diagnostic types that are represented by only one or two artifacts: Afton (LV 221), Macon (LV 187), and Williams (LV 205 and LV 327).

Epps Diagnostic Type

Figure 65 shows the distribution of the Epps artifacts within the study area. The 11 Epps artifacts are all projectile points. The 2 Epps projectile points in the eastern portion of the study area (BN 49 and TN 189) were found within 140 meters of one another in March 1990 and October 1991, respectively. Both artifacts have a moderate amount of mechanical wear. The very close spatial association of these 2 Epps projectile points suggests that they may mark the general location of an archaeological site.

The second apparent cluster consists of four Epps projectile points (LV 231, TN 177, TN 186, and TN 246) spanning a distance of 715 meters in the western portion of the study area. TN 186, which has only a slight amount of mechanical wear and slight patina, was found in October 1991. TN 177, slightly to the east, has a moderate amount

Figure 64. Locations of Middle/Late Archaic Artifacts

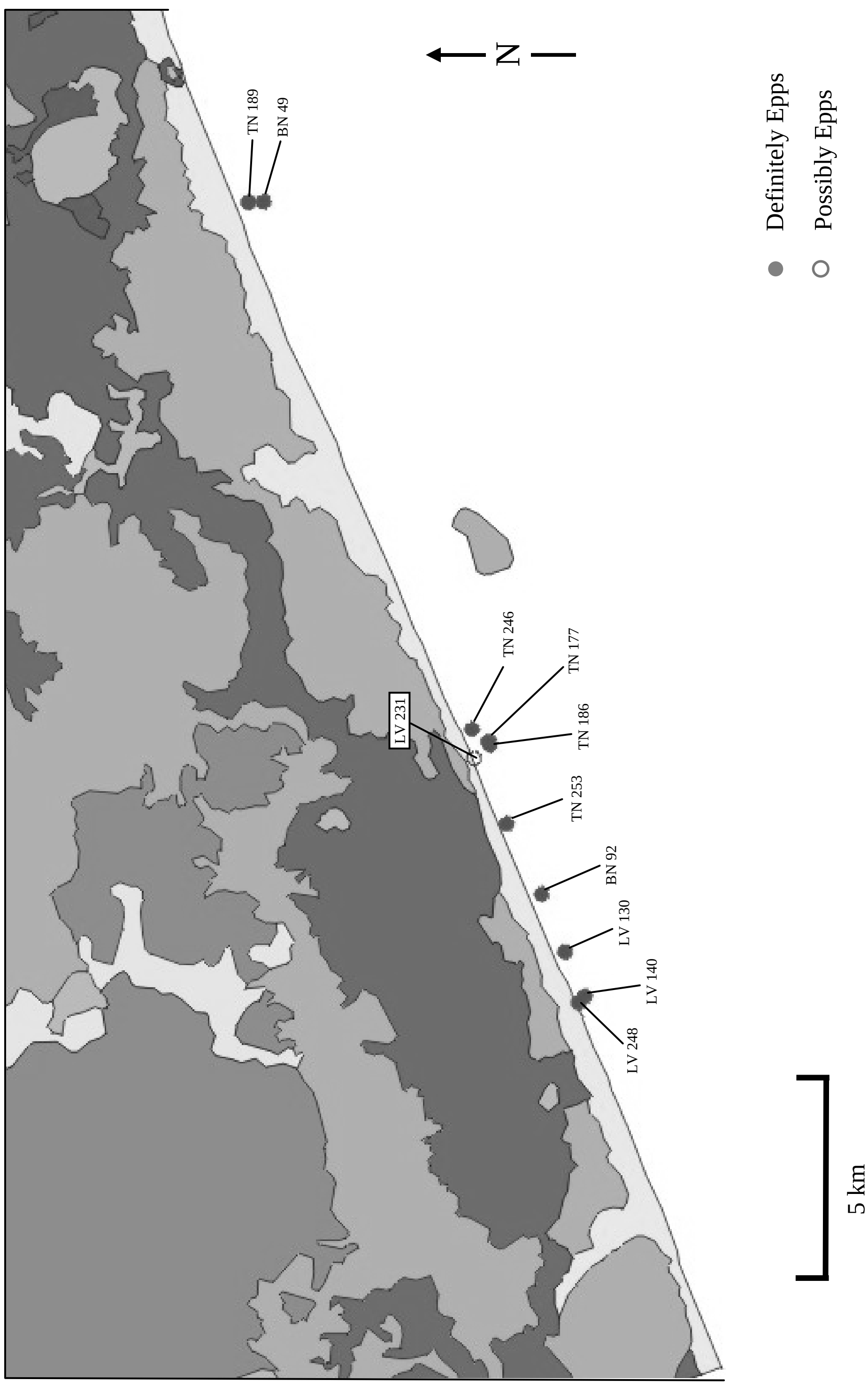

Figure 65. Epps Artifacts

of wear and was found in April 1991. TN 246 has a heavy amount of wear and heavy patina and was found in January 1993. LV 231 is only possibly Epps, but its close spatial association with the other three Epps projectile points suggests that it probably is Epps. It has both a moderate amount of wear and patina and was found in September 1994. These four artifacts probably mark the general location of an archaeological site, centered closer to the location of TN 186, that eroded out over a period of about 3 years from 1991 to 1994.

A third possible cluster consists of three Epps projectile points (LV 130, LV 140, and LV 248) in the extreme western portion of the study area. The easternmost artifact in this cluster (LV 130) has only a slight amount of mechanical wear and no visible patina. It was found in May 1993. The two westernmost artifacts (LV 140 and LV 248) have a moderate amount of mechanical wear and were found only 75 meters apart in June 1993 and October 1994, respectively. This cluster may mark the general location of an archaeological site. The slightly worn artifact (LV 130) in the eastern part of the cluster, may be closer to the original site location, with the two moderately worn artifacts in the western portion of the cluster having been transported to the west by longshore current.

The results of the nearest-neighbor analysis indicate that those artifacts that are definitely Epps form a random distribution with an R value of 1.30. When the one possible Epps artifact is included in the analysis, the R value is slightly lower at 1.24. These are some of the lowest R values obtained for any of the diagnostic types analyzed

(Table 12), indicating a stronger tendency towards clustering relative to most of the other diagnostic types.

Motley Diagnostic Type

Figure 66 shows the distribution of the Motley artifacts within the study area. All five Motley artifacts are projectile points. There is a pair of Motley projectile points (LV 321 and TN 158) in the eastern portion of the study area. TN 158 has a moderate amount of mechanical wear and slight patina. It was found in February 1991. LV 321 has a moderate amount of wear and was found in November 1995. LV 321 is only possibly a Motley artifact, and it also has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location. Because of the questionable identity and location of LV 321 and its much later date of find in comparison to TN 158, it is unlikely that these two artifacts mark the location of an archaeological site.

A second pair of Motley artifacts (BN 67 and LV 75) occurs in the western portion of the study area. BN 67 has a moderate amount of wear and slight patina and was found in October 1991. LV 75 has a heavy amount of wear and moderate patina and was found in December 1992. These two artifacts were found 231 meters apart. The lesser amount of wear and patina and the earlier date of find on BN 67, the easternmost artifact in the pair, would be consistent with both artifacts eroding out of the same site at about the same time, and LV 75 being transported slightly westward by the longshore current before being found. The difference in their weights may account for LV 75 being transported farther, with LV 75 weighing 8.7 grams compared to BN 67, which weighs 14.9 grams.

Figure 66. Motley Artifacts

The remaining Motley projectile point (LV 139) was found 6.8 kilometers west of the pair just discussed. It has only a slight amount of wear and moderate patina and was found in June 1993. This isolated artifact may represent a hunting loss that was found very near its original location. Because there were only five Motley artifacts in the study collection, a nearest-neighbor analysis could not be run.

Delhi Diagnostic Type

Figure 67 shows the distribution of the Delhi artifacts within the study area. All five Delhi artifacts are projectile points. Two of these artifacts (BN 2 and CN 8) were found only 451 meters apart. BN 2 has a heavy amount of wear and moderate patina and was found in January 1985. CN 8 has a moderate amount of wear and was found in May 1991. The amount of wear and the disparity in the dates of find of these two artifacts do not suggest the location of an archaeological site.

The other three Delhi artifacts (LV 35, LV 312, and TN 167) are spread across the study area with no apparent patterning spatially, in amount of wear or in date of find. Because there were only five Delhi artifacts in the study collection, a nearest-neighbor analysis could not be run.

Palmillas Diagnostic Type

Figure 68 shows the distribution of the Palmillas artifacts within the study area. All 18 Palmillas artifacts are projectile points. In the eastern portion of the study area there are three pairs of Palmillas artifacts: BN 29 and TN 87, found 743 meters apart; TN 117 and TN 194, found 642 meters apart; and LV 61 and LV 222, found 211 meters

Figure 67. Delhi Artifacts

apart. The interesting thing about these pairs is that, in all three cases, the westernmost artifact in the pair is only slightly worn, and the more eastern artifact in the pair is either moderately or heavily worn and has a later date of find. This pattern is suggestive of transport of artifacts to the east, which is counter to expectation if the transport is by longshore current, but it could occur during intermittent winter storms. Because each pair of artifacts contains 1 of the 3 Palmillas artifacts having only a slight amount of wear it may be that each pair marks the general location of a site.

A cluster of six artifacts (BN 71, LV 39, TN 188, TN 216, TN 219, and TN 278) measuring 741 meters across occurs in the western portion of the study area. The four westernmost artifacts in this cluster (BN 71, TN 216, TN 219, and TN 278) all have a heavy amount of wear and a moderate amount of patina. The other two artifacts (LV 39 and TN 188) have a moderate amount of wear and moderate to no patina. It is interesting that a group of predominately heavily worn artifacts of the same diagnostic type would cluster, since the heavy mechanical wear suggests a lot of movement in the surf zone. These artifacts were all found between October 1991 and June 1993.

When the location of the steel barriers that were erected on the beach to reduce erosion (Figure 31) is plotted against the distribution of Palmillas artifacts, the western end of the western barrier exactly coincides with the location of the easternmost artifact (LV 39) in this cluster. It is likely that an archaeological site exists in the vicinity of the western end of the barrier, and that the focused wave energy at the barrier caused the artifacts to be subjected to more intensive and constant wave energy than otherwise would have been the case, thereby causing the heavy wear. The artifacts would have eventually

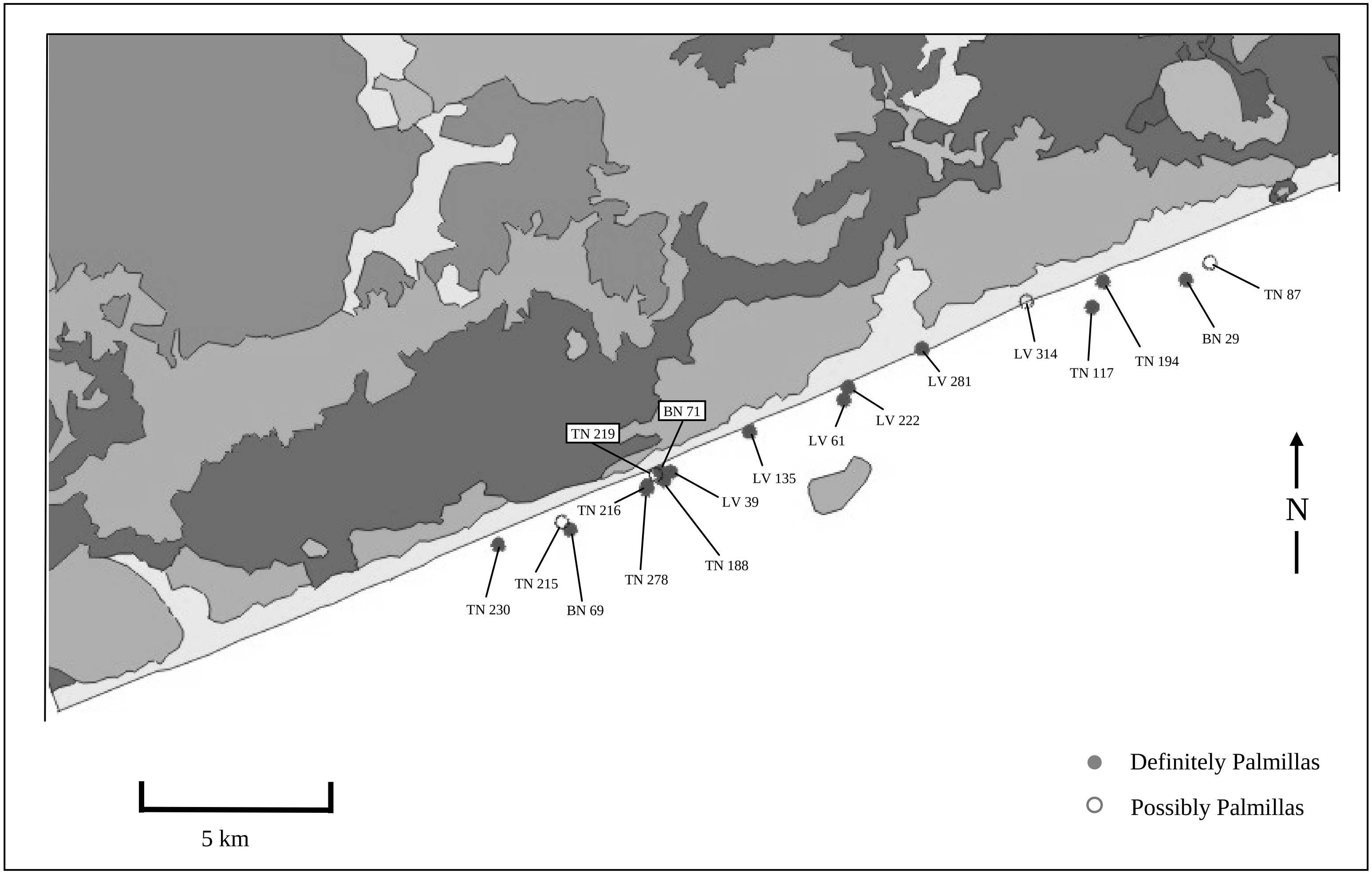

Figure 68. Palmillas Artifacts

been deposited at the western end of the barrier, aided by longshore current transport. If this scenario is correct, the original site would be located just to the east of the easternmost artifact in the cluster (LV 39), at the barrier.

One additional pair of artifacts (BN 69 and TN 215) occurs 2.2 kilometers west of this cluster. The artifacts were found only 121 meters apart; however, both artifacts are heavily worn, and TN 215 is only possibly Palmillas. The heavy wear on these two artifacts and the doubtful identity of TN 215 make it unlikely that these artifacts mark the location of a site.

The results of the nearest-neighbor analysis indicate that the group of definite Palmillas artifacts is a regular distribution with an R value of 2.37. When both definite and possible Palmillas artifacts were included in the analysis, the R value decreased to 1.98 (Table 12). These R values do not indicate strong clustering in the data set as a whole. The Palmillas projectile points are rather widely and evenly distributed across the study area, with the exception of the cluster of six discussed above.

Snapped-Base Stemmed Diagnostic Type

Figure 69 shows the distribution of the Snapped-Base Stemmed artifacts within the study area. Both are projectile points. Although there are only two artifacts of this diagnostic type in the study collection, it is very interesting that both were found within 293 meters of one another. CN 32 has both heavy mechanical wear and heavy patina and was found in April 1994. FR 36 has only a slight amount of mechanical wear and moderate patina and was found 2 years later in April 1996. The heavier wear on CN 32 and its earlier date of find suggest that the site from which these artifacts originated

Figure 69. Snapped-Base Stemmed Artifacts

eroded over a period of several years, beginning sometime before 1994 and continuing until at least 1996. The slight amount of wear on FR 36 and the close association of the two artifacts suggest that these two artifacts may mark the general location of a site. Because there were only two Snapped-Base Stemmed artifacts in the study collection, a nearest-neighbor analysis could not be run.

Figure 70 is a composite map showing the potential site locations for the Middle/Late Archaic Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1985 and 1996 after the shoreline had moved significantly inland due to coastal erosion.

Middle/Transitional Archaic Period

Figure 71 shows the spatial distribution of the artifacts that were identified as Middle/Transitional Archaic and those that were identified as only possibly being Middle/Transitional Archaic in age. The locations of the artifacts identified as only possibly Middle/Transitional Archaic lie in close proximity to artifacts that are definitely Middle/Transitional Archaic in the eastern portion of the study area. However, in the western portion of the study area, 4 of the 5 possible Middle/Transitional Archaic artifacts fall outside the general clusters of definite Middle/Transitional Archaic artifacts. The nearest-neighbor analysis indicates that the 66 definite Middle/Transitional Archaic artifacts form a regular distribution; however, when the 16 possible Middle/Transitional Archaic artifacts are added to the set, the statistical analysis indicates that the artifacts form a random distribution (Table 11). The R values are 1.26 for definite

Figure 70. Locations of Potential Middle/Late Archaic Sites

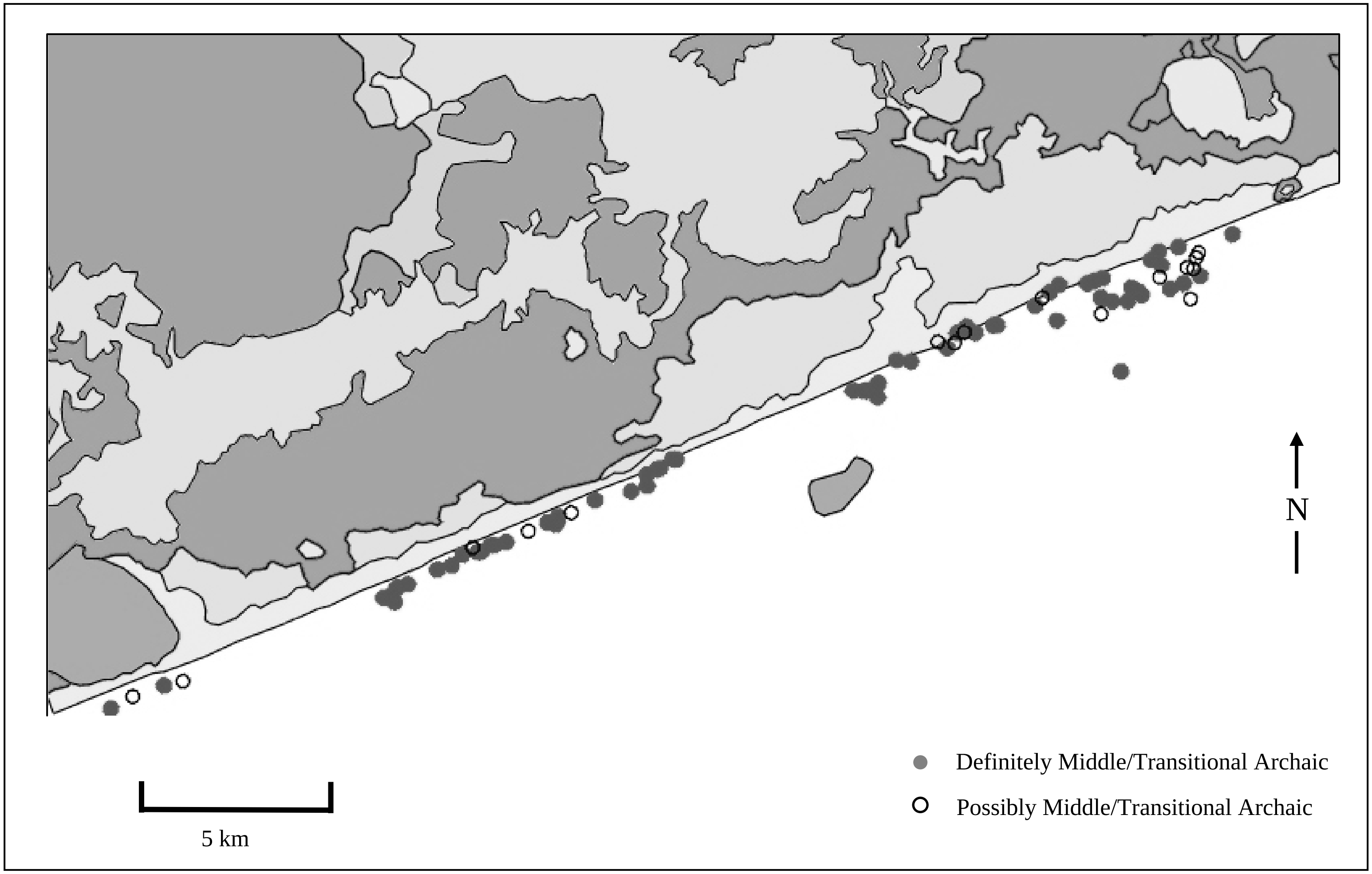

Figure 71. Locations of Middle/Transitional Archaic Artifacts

Middle/Transitional Archaic artifacts and 1.05 for definite and possible Middle/Transitional Archaic artifacts. These R values are relatively low, indicating a tendency towards clustering.

The study collection contains six different diagnostic types that fall within the Middle/Transitional Archaic Period (Table 16, Appendix D). Spatial patterning will not be discussed for the following diagnostic types that are represented by only one or two artifacts: Refugio (LV 1) and Poverty Point-Type (LV 228 and TN NLD6).

Gary Diagnostic Type

Figure 72 shows the distribution of the Gary artifacts within the study area. All 27 Gary artifacts are projectile points. Nine of the 11 Gary artifacts in the eastern portion of the study area fall into two broad groups. The easternmost group is 1.6 kilometers across and consists of 5 artifacts (LV 148, LV 289, LV 303, LV 331, and TN 301). Two of the projectile points in this group (LV 289 and LV 331) have only a slight amount of mechanical wear and slight to no patina. They were found 802 meters apart in April 1995 and January 1996, respectively. However, it should be noted that LV 289 is only possibly a Gary point. Of the other 3 artifacts in the group, LV 303 has a moderate amount of wear and was found in May 1995, and LV 148 and TN 301 both have a heavy amount of wear and were found in July 1993 and December 1993, respectively.

The second group, 1.2 kilometers west of the first group, consists of four artifacts (BN 90, TN 271, TN 282, and LV 304), which span a distance of 1.2 kilometers. All four artifacts in this group have a heavy amount of mechanical wear, and three of the four

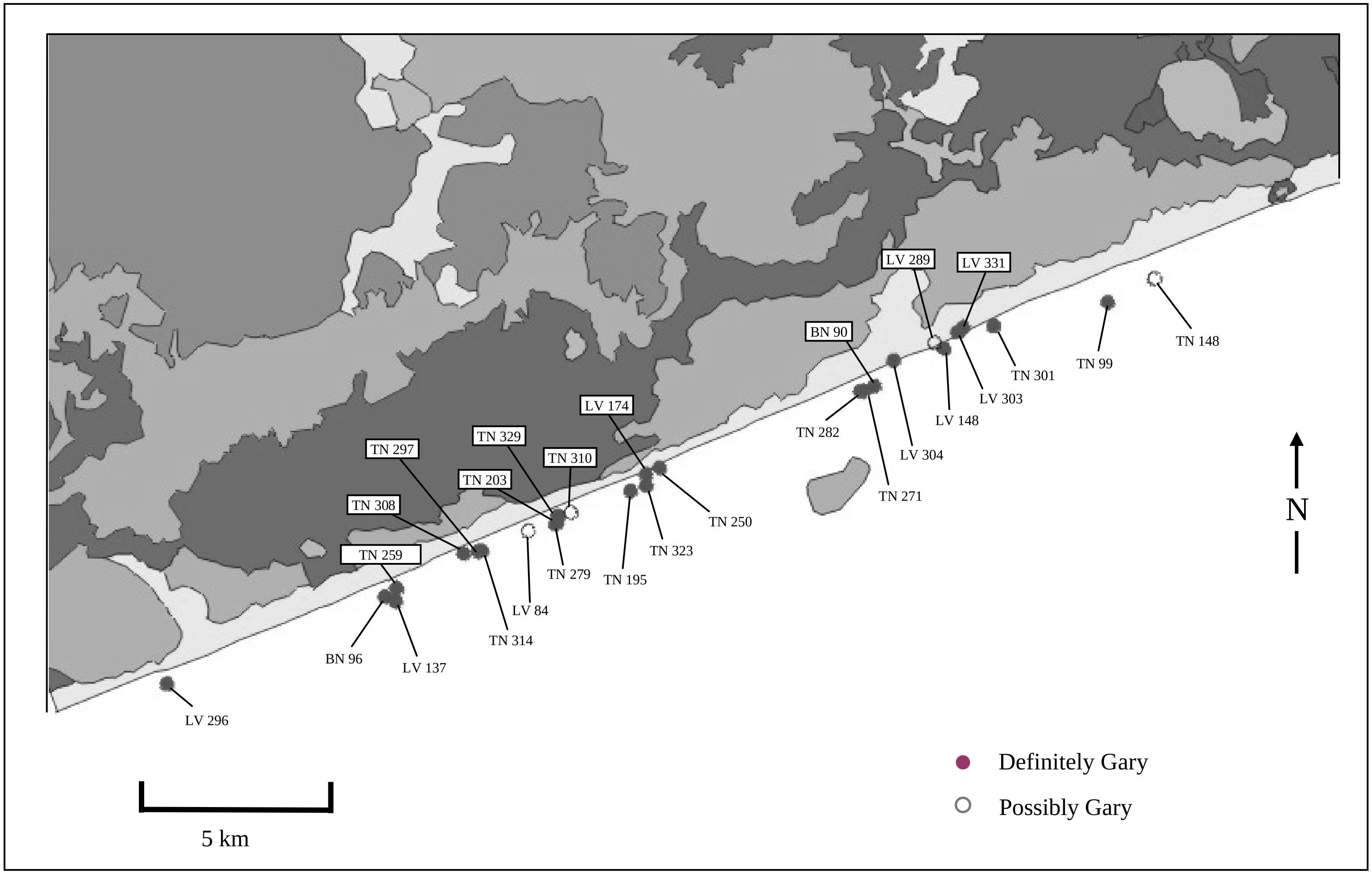

Figure 72. Gary Artifacts

(BN 90, TN 271, and TN 282) were found in April, May, and June of 1993, respectively. The fourth artifact, LV 304, was found in May 1995.

When the nine artifacts in the two broad groups are considered together, the most obvious pattern that emerges is that five of the six artifacts that have heavy mechanical wear were found between April and December 1993. Of the remaining four artifacts that were found between April 1995 and January 1996, one has heavy wear, one has moderate wear, and two have only slight wear. The artifacts with the least amount of mechanical wear were all found in the more eastern cluster. This overall pattern suggests that there may have been an archaeological site in the vicinity of the eastern cluster that began eroding out sometime prior to 1993. The first artifacts that were eroded out of this site became heavily worn as they were transported to the west by longshore current. The artifacts that were found in 1995 and 1996 that had only slight to moderate wear were found very soon after eroding out of the same site.

There are four small clusters of Gary artifacts in the western portion of the study area. The easternmost of these clusters is 981 meters across and consists of four artifacts (LV 174, TN 195, TN 250, and TN 323). These four artifacts are all heavily worn, and three of the four also have a heavy amount of patina. They were found between January 1992 and November 1994. When the location of the steel barriers that were erected on the beach to reduce erosion (Figure 31) is plotted against the distribution of Gary artifacts, the western end of the western barrier lies approximately 165 meters east of the location of the easternmost artifact (TN 250) in this cluster. It is likely that a site exists in the vicinity of the western end of the barrier, and that the focused wave energy at the barrier caused the artifacts to be subjected to more intensive and constant wave energy than otherwise would have been the case, thereby causing the heavy wear. The artifacts were eventually deposited at the western end of the barrier, aided by longshore current transport. If this scenario is correct, the original site would be located just to the east of the easternmost artifact in the cluster (TN 250), at the barrier.

The second cluster in the western portion of the study area consists of four artifacts (TN 203, TN 279, TN 310, and TN 329) spanning a distance of 509 meters. The easternmost of these four artifacts (TN 310) is only possibly a Gary artifact. The two westernmost artifacts in this cluster (TN 203 and TN 279) have only a slight amount of mechanical wear. They were found in March 1992 and June 1993, respectively. The two easternmost artifacts in the cluster (TN 310 and TN 329) have a heavy amount of wear and were found in March 1994 and February 1995, respectively. It is possible that the two westernmost, slightly worn artifacts mark the general location of a site, and that the two more heavily worn artifacts found later, and to the east, originated from the same site, but were transported to the east by storm events counter to the predominately westward-flowing longshore current.

A third cluster of Gary artifacts, 2 kilometers farther west, consists of three projectile points (TN 297, TN 308, and TN 314) in an area 399 meters across. TN 297 has heavy wear and moderate patina and was found in December 1993. TN 308 and TN 314 both have moderate wear and were found in January and April 1994, respectively. Despite the amount of mechanical wear on these three artifacts, their close association and the fact that they were found within a period of only 4 months suggest there may be an archaeological site in their general vicinity.

A fourth cluster of Gary artifacts, 1.9 kilometers to the west of the third cluster, consists of three projectile points (BN 96, LV 137, and TN 259) in an area 362 meters across. Like the cluster just to its east, one of the artifacts (BN 96) has a heavy amount of wear and moderate patina, and the other two artifacts have moderate wear. The three artifacts were found within a period of 8 months from February to October 1993. Despite the amount of mechanical wear on these three artifacts, their close association and the fact that they were found within a period of only 8 months suggest there may be a site in their general vicinity.

The results of the nearest-neighbor analysis indicate that the group of definite Gary artifacts is a regular distribution with an R value of 2.14. When both definite and possible Gary artifacts were included in the analysis, the R value decreased to 2.02 (Table 12). These R values do not indicate strong clustering in the data set as a whole.

Ellis Diagnostic Type

Figure 73 shows the distribution of the Ellis artifacts within the study area. All 26 Ellis artifacts are projectile points. There are several small clusters of Ellis projectile points in the eastern portion of the study area. The easternmost cluster consists of 4 artifacts (LV 18, LV 183, LV 267, and TN 48). Three of the 4 artifacts in this cluster (LV 18, LV 183, and LV 267) have a moderate amount of wear and were found in January 1992, January 1994, and January 1995, respectively. TN 48 has a heavy amount of wear and patina and was found in September 1986. It should be noted that LV 18,

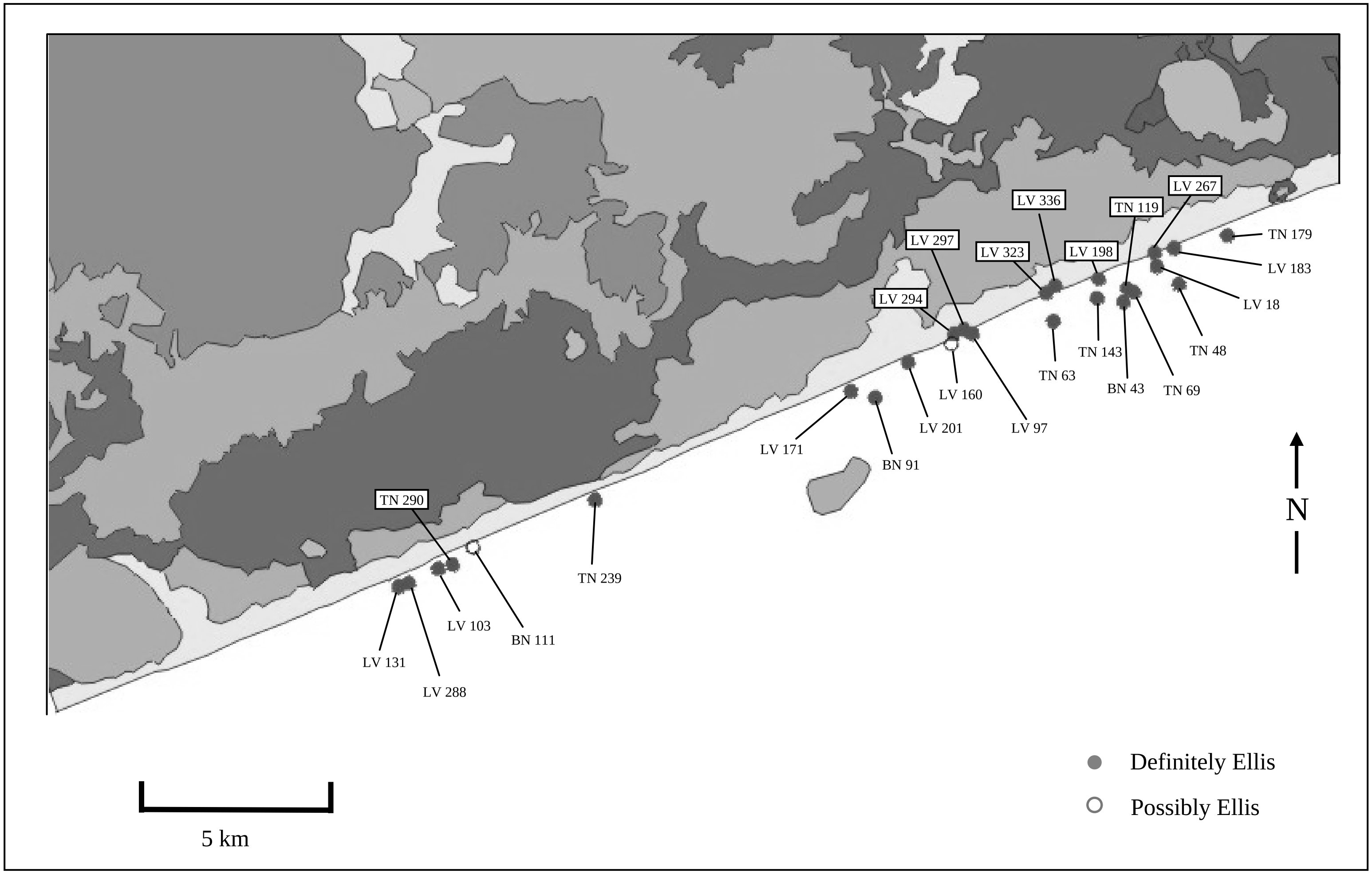

Figure 73. Ellis Artifacts

LV 183, and LV 267 have an accuracy code of 2, meaning that they may have been misplotted as much as 2 kilometers east of their actual locations. Because of the questionable locations of these 3 artifacts and the heavy wear and patina on the fourth artifact in the cluster, it is doubtful that these 4 artifacts mark the location of a site.

The second cluster, 859 meters to the west of the first, consists of five artifacts (BN 43, LV 198, TN 69, TN 119, and TN 143) spanning a distance of 866 meters. Two of the artifacts in the cluster have a heavy amount of wear and heavy patina (BN 43 and LV 198). They were found in September 1989 and April 1994, respectively. The other three artifacts have a moderate amount of wear and were found between June 1987 and May 1990. It should be noted that LV 198 has an accuracy code of 2, meaning that its actual location may be misplotted as much as 2 kilometers to the east of its actual location. If it is omitted from the cluster because of its questionable location, the dates of find of the remaining four artifacts span a period of about 3 years from June 1987 to May 1990. Three of the artifacts are moderately worn, and one is heavily worn. These four artifacts may mark the general location of an archaeological site that was eroded over a period of several years.

The third group of Ellis projectile points (LV 323, LV 336, and TN 63) spans a distance of 403 meters. LV 323 has a moderate amount of wear and was found in November 1995. LV 336 has a heavy amount of wear and moderate patina and was found in February 1996. TN 63 has both a heavy amount of wear and patina and was found in March 1987. As LV 323 and LV 336 were found less than 3 months apart and in very close association, they may have originated from a single site in the general vicinity. TN

63, being both heavily worn and patinated and found almost 9 years earlier, is probably not related to the same archaeological site location.

The fourth cluster consists of four artifacts (LV 97, LV 160, LV 294, and LV 297) and spans a distance of 629 meters. Two of the artifacts in this cluster (LV 97 and LV 160) have only a slight amount of mechanical wear and were found in February 1993 and November 1993, respectively. It should be noted that LV 160 is only possibly an Ellis artifact. The other two artifacts in the cluster (LV 294 and LV 297) both have a moderate amount of wear and were found in April and May 1995, respectively. It is possible that the two slightly worn artifacts found in 1993 mark the general location of an archaeological site, and that the two moderately worn artifacts found later in 1995 eroded from the same site.

Five of the six artifacts in the western portion of the study area (BN 111, LV 103, LV 131, LV 288, and TN 290) form a broad group approximately 2.1 kilometers across. The easternmost artifact (BN 111) was found in November 1994. It is the only artifact in the group with just a slight amount of mechanical wear; however, it is also the only one that is only possibly Ellis. It lies 691 meters east of TN 290, which is moderately worn and was found in October 1993. LV 103 was found 314 meters west of TN 290. It has both a heavy amount of mechanical wear and patina and was found in February 1993. LV 288 was found 912 meters west of LV 103. It also has a heavy amount of wear and patina and was found in April 1995. LV 131 was found only 218 meters west of LV 288. It has a moderate amount of wear and was found in May 1993. Because of the slight amount of mechanical wear on BN 111, it was probably found very near its original site location. If it is, in fact, an Ellis projectile point, it would suggest that the moderately and heavily worn artifacts to the west of it were eroded at different times from the same site and transported to the west by longshore current before being found.

The results of the nearest-neighbor analysis indicate that the group of definite Ellis artifacts is a regular distribution with an R value of 1.63. When both definite and possible Ellis artifacts were included in the analysis the R value decreased slightly to 1.59 (Table 12). These are some of the lower R values obtained for any of the diagnostic types analyzed, indicating a relative tendency towards clustering.

Kent Diagnostic Type

Figure 74 shows the distribution of the Kent artifacts within the study area. All 15 Kent artifacts are projectile points; however, 1 artifact (BN 100) may also have functioned as a gouge. Of the 5 artifacts in the eastern portion of the study area, 4 (LV 9, LV 217, TN 40, and TN 121) have only a slight amount of mechanical wear and slight to no patina; 1 (FR 9) has both moderate wear and patina. FR 9 was found in January 1973, 13 years earlier than the other 4 artifacts. Because of its greater amount of mechanical wear and much earlier date of find, FR 9 is probably not directly associated with the other 4 artifacts. Of the remaining 4 artifacts, 2 (LV 9 and LV 217) have an accuracy code of 2, meaning that they may have been misplotted by as much as 2 kilometers east of their actual locations. LV 9 is also only possibly a Kent artifact. The remaining 2 artifacts in the eastern portion of the study area (TN 40 and TN 121) were found 928 meters apart in February 1986 and February 1990, respectively. Assuming that the slight mechanical wear of these 2 artifacts indicates they were found very near their original locations, it

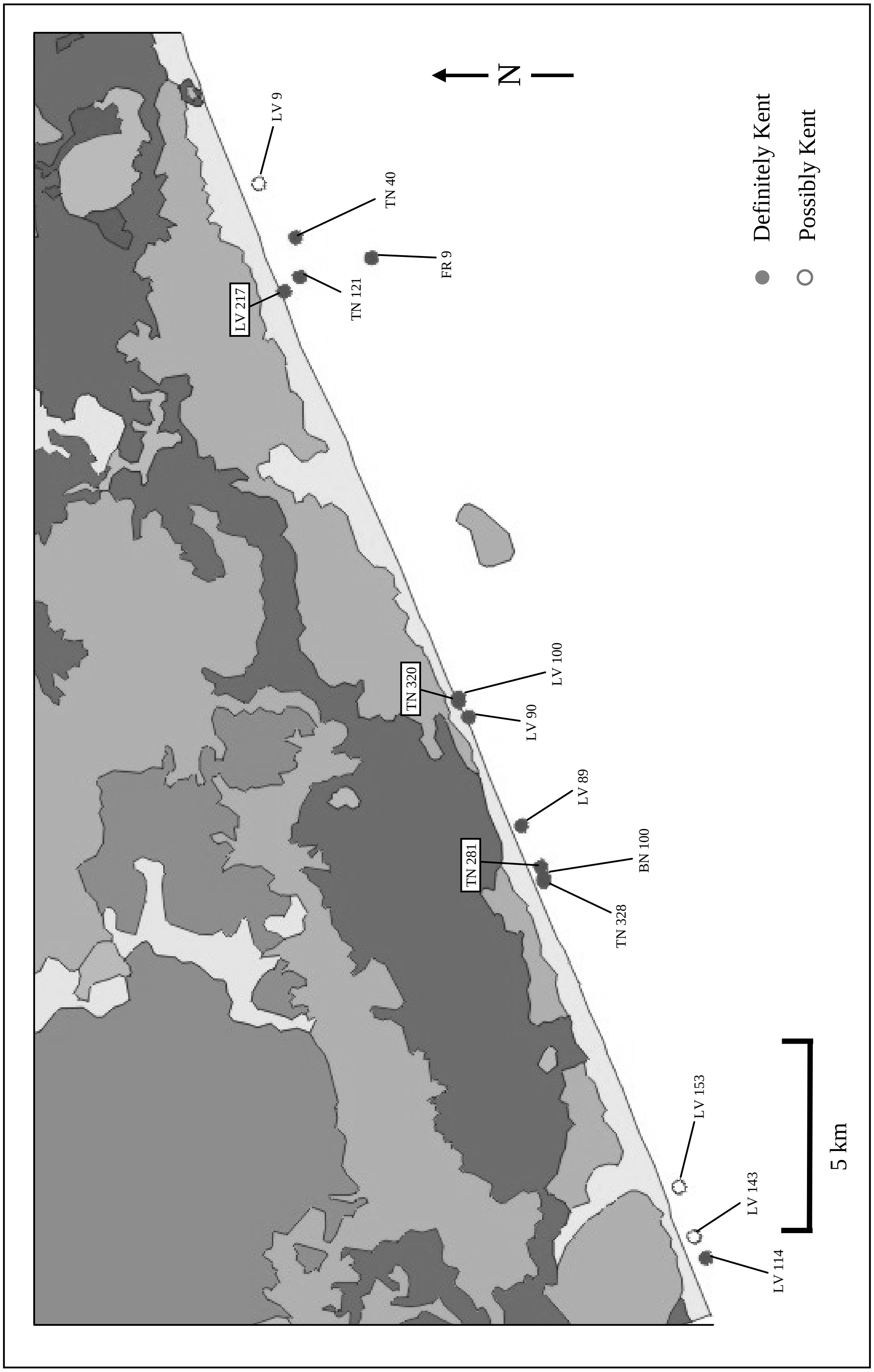

Figure 74. Kent Artifacts

seems unlikely that they originated from one archaeological site, both because of the distance between their locations and the 4-year difference in their dates of find. These 2 artifacts may represent isolated hunting losses that were found near their original locations.

There are two clusters of artifacts in the western portion of the study area. The easternmost consists of three projectile points (LV 90, LV 100, and TN 320), which span a distance of 514 meters. The westernmost of these three artifacts (LV 90) has only a slight amount of mechanical wear and was found on February 1, 1993. LV 100, which has a moderate amount of both wear and patina, was found about 3 weeks later on February 23, 1993. TN 320 has a heavy amount of wear and a moderate amount of patina and was found in October 1994. When the location of the steel barriers that were erected on the beach to reduce erosion (Figure 31) is plotted against the distribution of Kent artifacts, the western end of the western barrier lies approximately 268 meters east of the location of the westernmost artifact (LV 90) in this cluster, which is only slightly worn. The other two artifacts in this cluster, which are more heavily worn, were actually found in front of the barrier. It is likely that a site occurs somewhere in the area between LV 90 and the western end of the barrier, and that the focused wave energy at the barrier caused the two easternmost artifacts in this cluster to be subjected to more intensive and constant wave energy than otherwise would have been the case, thereby causing the moderate to heavy wear.

The second cluster in the western portion of the study area consists of three artifacts (BN 100, TN 281, and TN 328) that span a distance of 403 meters. The easternmost artifact in this cluster (TN 281) has a moderate amount of wear and a slight amount of patina and was found in June 1993. BN 100 has a heavy amount of wear and was found in February 1994. TN 328 has a heavy amount of wear and a moderate amount of patina and was found in January 1995. The wear and dates of find suggest there may be an archaeological site in the vicinity of TN 281, and that the other two artifacts in the cluster were transported a short distance to the west by longshore current, which resulted in their heavier wear.

The results of the nearest-neighbor analysis indicate that the group of definite Kent artifacts is a regular distribution with an R value of 2.98. When the three possible Kent artifacts were included in the analysis, the R value decreased dramatically to 1.50 indicating a much stronger tendency towards clustering in the data set as a whole. This effect is probably due largely to reducing the longest nearest-neighbor distance in the data set from 10.5 kilometers (the distance between LV 114 and TN 328) to 8.6 kilometers (the distance between LV 153 and TN 328).

Ponchartrain Diagnostic Type

Figure 75 shows the distribution of the Ponchartrain artifacts within the study area. All 11 artifacts are projectile points found in the eastern portion of the study area. The 5 easternmost artifacts (BN 1, BN 24, BN 58, FR 27 and TN 52) form a cluster 742 meters across. Three of these projectile points (BN 1, BN 24, and BN 58) are only possibly Ponchartrain. All of the artifacts in this cluster, with the exception of TN 52, have only a slight amount of wear. TN 52 has both heavy wear and heavy patina. The dates of find on the artifacts in this cluster range from March 1982 to February 1991. If the 3 possible Ponchartrain projectile points are, in fact, Ponchartrain, it would indicate that there is an archaeological site in the vicinity of this cluster that eroded out over a period of at least 9 years. According to the coastal erosion rates outlined by Morton (1997), the site would have had to be a minimum of 33 meters in the landward-seaward direction for these 5 artifacts found 9 years apart to have come from the same site.

There are a pair of artifacts (BN 45 and LV 226) that were found 217 meters apart, 1.8 kilometers to the west of the first cluster. However, LV 226 has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers to the east of its actual location. The questionable location of LV 226 and the questionable identity of BN 45, which is only possibly Ponchartrain, make it doubtful that these two artifacts mark the location of a site.

The four remaining artifacts to the west do not appear to cluster. However, the three that are definitely Ponchartrain (CN 9, LV 147, and TN 299) all have only a slight amount of wear. They were found in May 1991, July 1993, and December 1993, respectively. These three artifacts may represent isolated hunting losses that were found very close to their original locations of loss. The fourth artifact (LV 326), only possibly Ponchartrain, is both heavily worn and heavily patinated and was found in December 1995.

There were only six definite Ponchartrain artifacts, an insufficient number to run the nearest-neighbor analysis; therefore, the nearest-neighbor analysis was run for both

Figure 75. Ponchartrain Artifacts

definite and possible Ponchartrain artifacts. The results of the analysis indicate that the Ponchartrain artifacts form a regular distribution with an R value of 1.39. This is one of the lower R values obtained for the diagnostic types analyzed, indicating a relatively stronger tendency towards clustering.

Figure 76 is a composite map showing the potential site locations for the Middle/Transitional Archaic Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1973 and 1996 after the shoreline had moved significantly inland due to coastal erosion.

Late Archaic Period

Figure 77 shows the spatial distribution of the artifacts that were identified as Late Archaic and those that were identified as only possibly being Late Archaic in age. The nearest-neighbor analysis indicates that the 19 definite Late Archaic artifacts form a regular distribution with an R value of 2.17. When the 10 possible Late Archaic artifacts are added to the analysis, the R value decreases to 1.96 (Table 11). These R values are relatively high, indicating that there is little tendency towards clustering. There also does not appear to be a close association between the locations of the definite Late Archaic artifacts and the locations of the possible Late Archaic artifacts (Figure 77).

The study collection contains five different diagnostic types that fall within the Late Archaic Period (Table 16, Appendix D). Spatial patterning will not be discussed for the following diagnostic types that are represented by only two or three artifacts; Kent/Darl/Yarbrough-like (TN 45 and TN 229), and Elam (LV 206, TN 275, and TN

Figure 76. Locations of Potential Middle/Transitional Archaic Sites

Figure 77. Locations of Late Archaic Artifacts

312). The two Kent/Darl/Yarbrough-like artifacts were found 23.6 kilometers apart, and the three Elam artifacts were spread over a distance of 15.5 kilometers.

Lange Diagnostic Type

Figure 78 shows the distribution of the Lange artifacts within the study area. All eight artifacts are projectile points. The two easternmost projectile points (TN 7 and TN 73) were found only 277 meters apart. TN 7 has a slight amount of mechanical wear and was found in March 1985. TN 73 has a moderate amount of mechanical wear and was found in August 1987. The slight wear on TN 7 suggests it was found very close to its original site location. TN 73 may have eroded out of the same site at a slightly later date. These two artifacts may mark the general location of an archaeological site.

A small cluster of three Lange projectile points (LV 196, LV 211, and TN 125) was found 1.9 kilometers to the west. LV 196 has only a slight amount of wear and patina and was found in April 1994. LV 211, only possibly a Lange artifact, has a heavy amount of wear and slight patina and was found in June 1994. TN 125 has a moderate amount of wear and was found in March 1990. The slight amount of wear on LV 196 suggests that it was found close to its original site location; however, it has an accuracy code of 2, meaning that it may have been misplotted as much as 2 kilometers to the east of its actual location. The questionable location of LV 196 and the questionable identity of LV 211 make it doubtful that this cluster of three artifacts marks the location of an archaeological site.

There were only seven definite Lange artifacts, which was an insufficient number to run the nearest-neighbor analysis; therefore, the nearest-neighbor analysis was run for

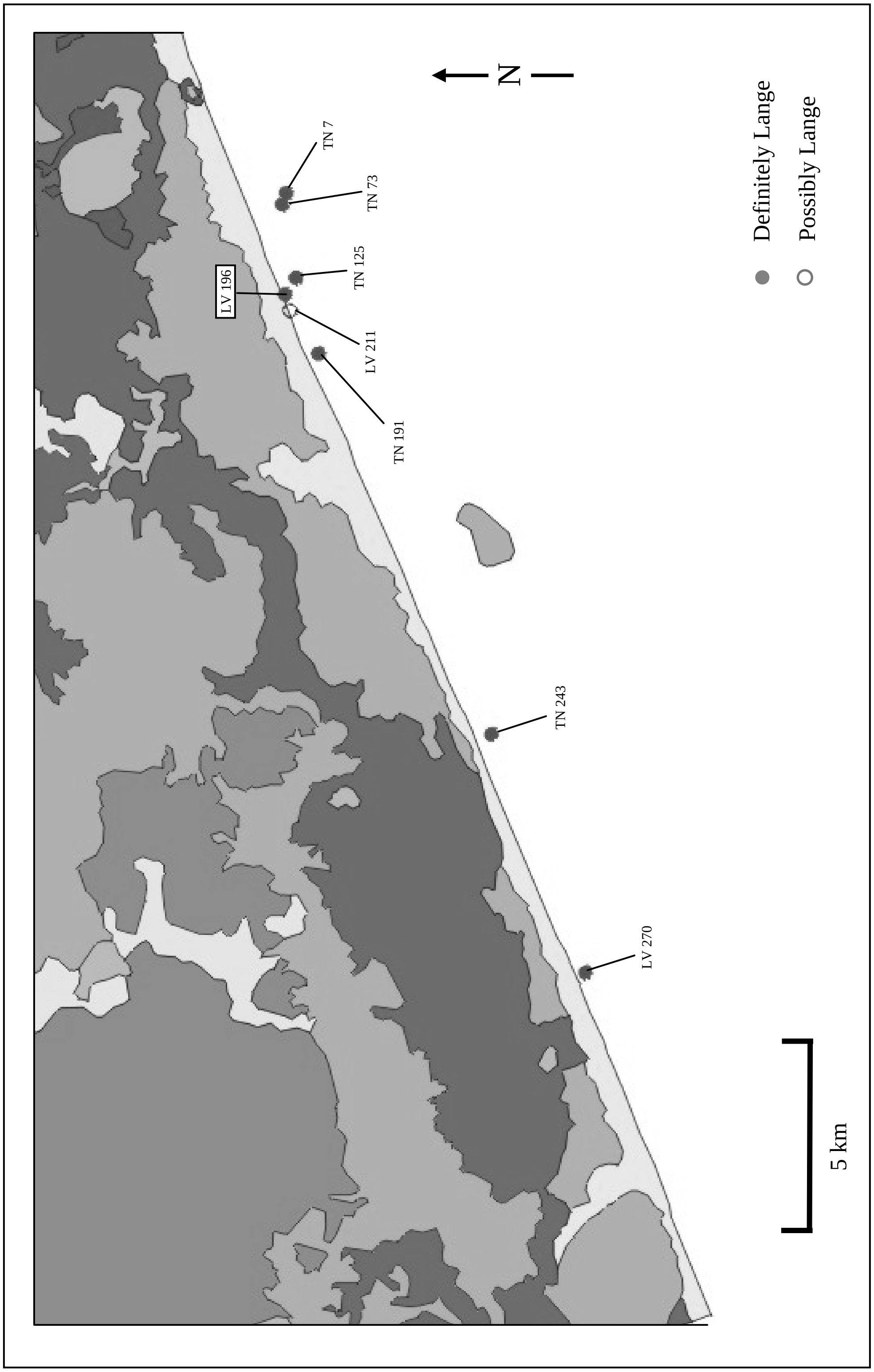

Figure 78. Lange Artifacts

both definite and possible Lange artifacts. The results of the analysis indicate that the Lange artifacts form a regular distribution with an R value of 4.03. This is a very high R value indicating little tendency towards clustering. The small size of the Lange data set (n = 8) and the obviously large nearest-neighbor distances for the two isolated Lange artifacts in the western portion of the study area contributed to the high R value for the data set as a whole, despite the two apparent small clusters in the eastern portion of the study area.

Castroville Diagnostic Type

Figure 79 shows the distribution of the Castroville artifacts within the study area. All three artifacts are projectile points. The easternmost artifact (LV 229) is only possibly Castroville. It has a slight amount of wear and was found in September 1994. Its location has an accuracy of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location. If its actual location is 2 kilometers to the west, it would be located just 190 meters west of TN 129.

TN 129 and TN 193 were found 242 meters apart in March 1990 and December 1991, respectively. TN 129 has a slight amount of wear, and TN 193 has a moderate amount of wear and a slight amount of patina. The close association of these two artifacts, their dates of find, and their amounts of mechanical wear are consistent with them having eroded out of a single site over a short period of time. If LV 229 is, in fact, Castroville, and its actual location of find was just west of TN 129, it also could have come from the same site. Because there are only three Castroville artifacts, a nearest-neighbor analysis could not be run.

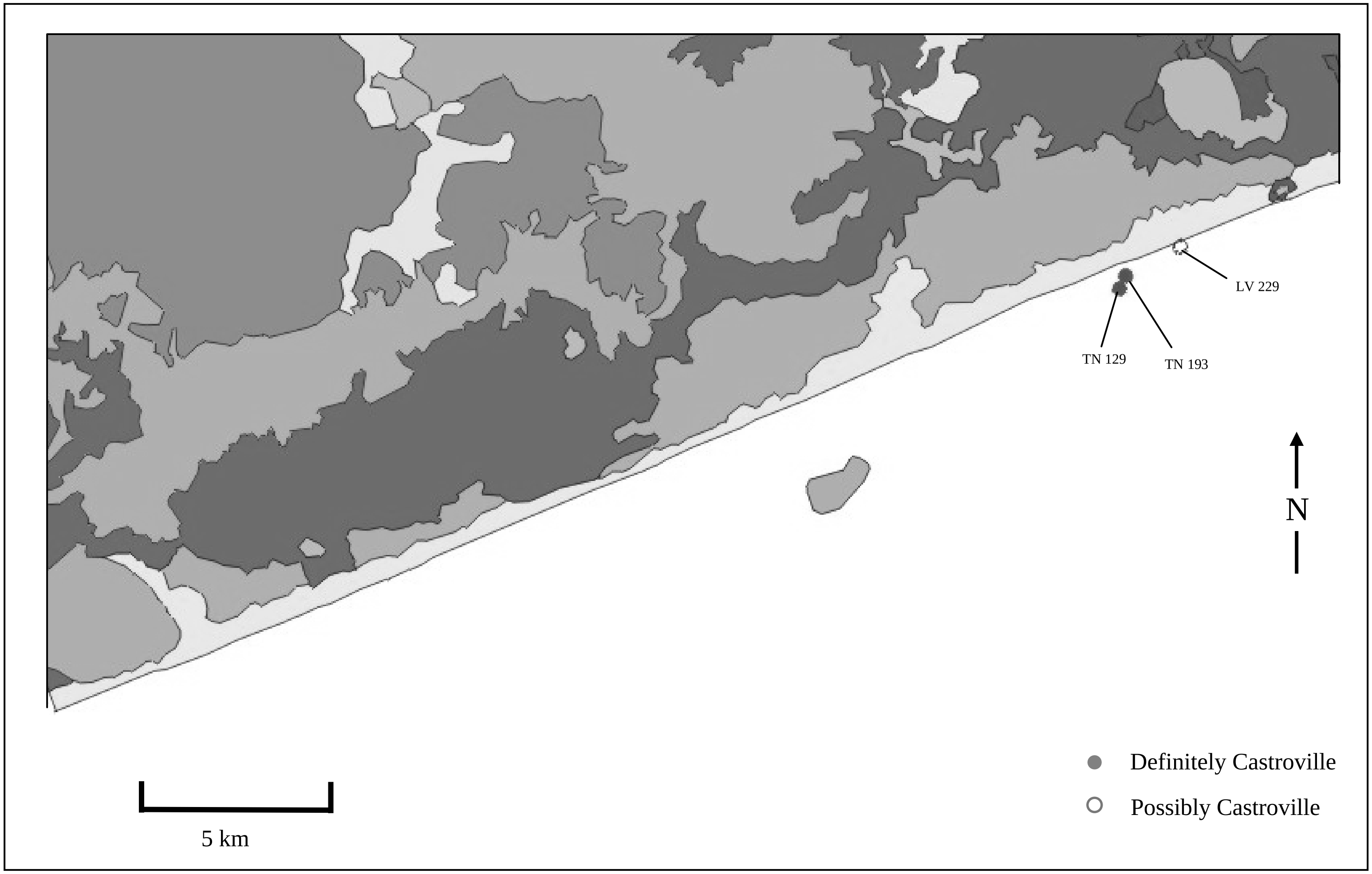

Figure 79. Castroville Artifacts

Lange-Like Diagnostic Type

Figure 80 shows the distribution of the Lange-like artifacts within the study area. All 10 artifacts are projectile points. These 10 projectile points are similar to Lange projectile points, but consistent enough in their differences to possibly be a variant of Lange. They are classified as only possibly Late Archaic because it is only their similarity to Lange that ties them to the Late Archaic Period. This diagnostic type is widely and rather uniformly distributed across the study area. However, there are two pairs (BN 98 and LV 22) and (LV 99 and LV 340) near the center of the study area.

The easternmost pair of Lange-like projectile points (BN 98 and LV 22) were found 347 meters apart in November 1993 and February 1992, respectively. Both are heavily worn indicating that they were probably tumbled in the surf extensively after being eroded out of their primary contexts. Because of their heavy amount of wear, it is unlikely that these two artifacts mark the location of a site. It may just be a coincidence that they were found as close together as they were.

The second pair of Lange-like projectile points (LV 99 and LV 340) were found only 141 meters apart in February 1993 and March 1996, respectively. LV 99 has only a slight amount of mechanical wear and a moderate amount of patina. LV 340 has a moderate amount of wear. The slight amount of wear on LV 99 suggests that it was found very close to its original site location. Although LV 340 was found 3 years later, it may have eroded out of the same site. According to the coastal erosion rates outlined by Morton (1997), the site would have had to be a minimum size of only 14 meters in the

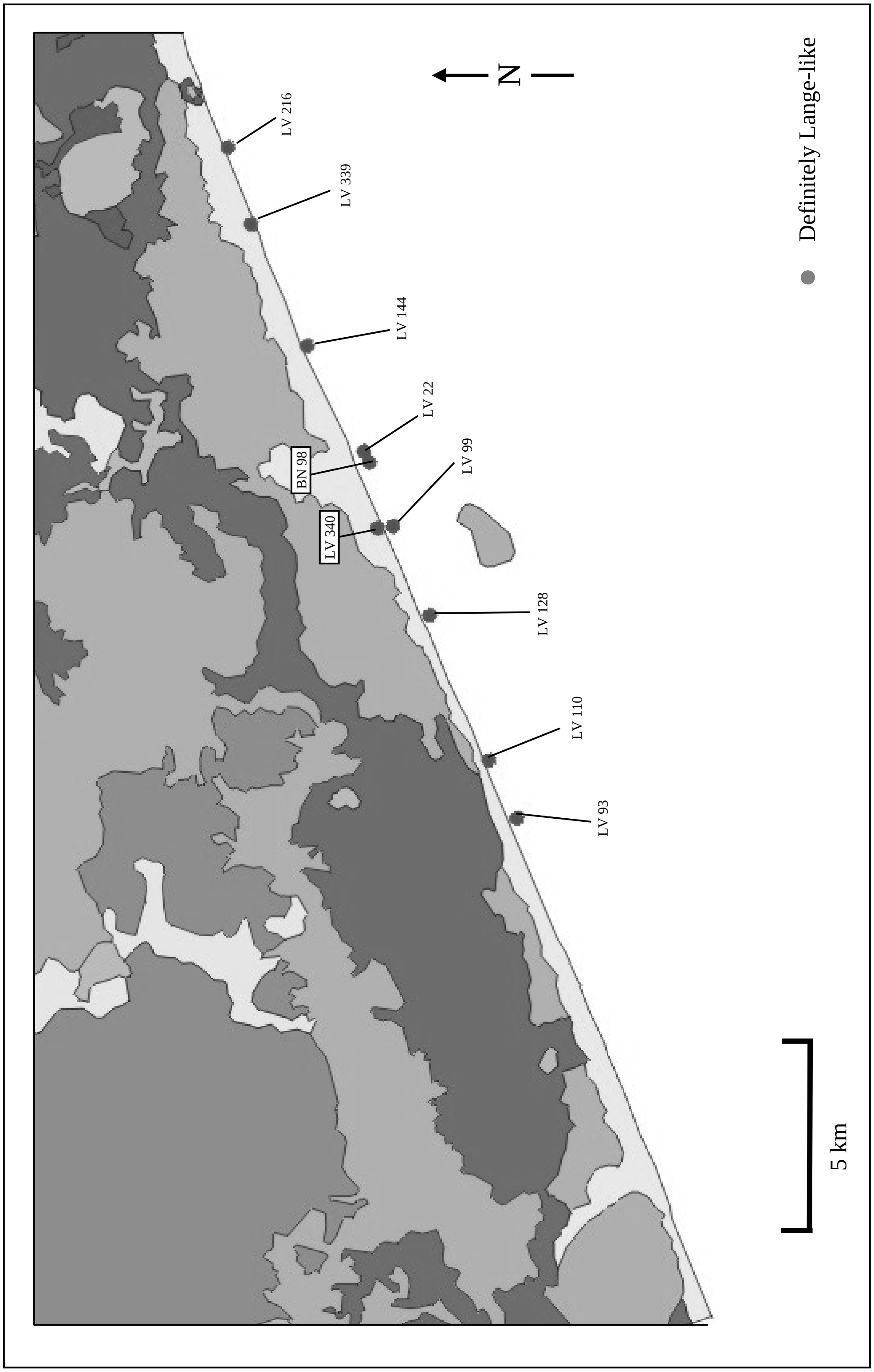

Figure 80. Lange-like Artifacts

landward-seaward direction for these two artifacts found 3 years apart to have come from the same archaeological site.

Of the remaining six Lange-like projectile points, three (LV 110, LV 216, and LV 339) have only a slight amount of wear and may represent isolated hunting losses found very close to their original locations of loss. The location of LV 339 has an accuracy of 2, meaning that it may have been misplotted as much as 2 kilometers east of its actual location. If its actual location is 2 kilometers to the west, it would still be 1.5 kilometers from the nearest Lange-like projectile point (LV 144).

The results of the nearest-neighbor analysis indicate that the 10 Lange-like artifacts form a regular distribution with an R value of 3.19. This R value is among the highest for all of the diagnostic types tested, meaning that the Lange-like artifacts have little tendency towards clustering.

Figure 81 is a composite map showing the potential site locations for the Late Archaic Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1985 and 1996 after the shoreline had moved significantly inland due to coastal erosion.

Late Archaic/Late Prehistoric Period

Figure 82 shows the spatial distribution of the artifacts that were identified as Late Archaic/Late Prehistoric and those that were identified as only possibly being Late Archaic/Late Prehistoric in age. As can be seen in Figure 82, there is little association between the locations of the definite Late Archaic/Late Prehistoric artifacts and the

Figure 81. Locations of Potential Late Archaic Sites

locations of the possible Late Archaic/Late Prehistoric artifacts. Because there were only seven definite and four possible Late Archaic/Late Prehistoric artifacts, a nearest-neighbor analysis was not run.

The study collection contains only two different diagnostic types that fall within the Late Archaic/Late Prehistoric Period (Table 16, Appendix D). There was only one Harvey-Mineola Biface identified in the study collection (TN 313). The spatial patterning of the artifacts in the other diagnostic type, Godley, is discussed below.

Godley Diagnostic Type

Figure 83 shows the distribution of the Godley artifacts within the study area. All 10 artifacts are projectile points. The locations of the 4 possible Godley projectile points are not closely associated with the 6 definite Godley projectile points; the closest being BN 93, which was found 1 kilometer west of LV 88. This lack of association suggests that the artifacts identified as possibly being Godley may, in fact, be misidentified.

Four of the six definite Godley projectile points form a broad group in the western portion of the study area. These four artifacts (CN 16, LV 157, TN 211 and TN 315) span a distance of 2.8 kilometers. The two easternmost artifacts in the group (CN 16 and TN 315) were found 700 meters apart in June 1992 and April 1994, respectively. Both artifacts are heavily worn and also have heavy patina. The two westernmost artifacts in the group (LV 157 and TN 211) were found 751 meters apart. LV 157 has a moderate amount of mechanical wear and was found in October 1993. TN 211 has a heavy amount of wear and heavy beach polish and was found in May 1992. When the location of the steel barriers that were erected on the beach to reduce erosion (Figure 31) is plotted

Figure 82. Locations of Late Archaic/Late Prehistoric Artifacts

Figure 83. Godley Artifacts

against the distribution of Godley artifacts, the western end of the western barrier lies approximately 120 meters east of the location of the easternmost artifact (CN 16) in this cluster. It is possible that an archaeological site occurs at the western end of the barrier and that the focused wave energy at the barrier caused the artifacts eroded out of the site to be subjected to more intensive and constant wave energy than otherwise would have been the case, thereby causing the moderate to heavy wear. The predominant westward-flowing longshore current would then have redistributed the artifacts along the beach to the west of the barrier.

There were only six definite Godley artifacts, which was an insufficient number to run the nearest-neighbor analysis; therefore, the nearest-neighbor analysis was run for both definite and possible Godley artifacts. The results of the analysis indicate that the Godley artifacts form a regular distribution with an R value of 2.87 (Table 12). This is a very high R value indicating little tendency towards clustering.

Figure 84 is a composite map showing a potential site location for the Late Archaic/Late Prehistoric Period identified in the preceding discussion. The potential site location, shown at its true geographic coordinates, appears to be inland because the geologic base map dates from 1962 and the artifacts were found between 1971 and 1994 after the shoreline had moved significantly inland due to coastal erosion.

Late/Transitional Archaic Period

Figure 85 shows the spatial distribution of the artifacts that were identified as Late/Transitional Archaic and those that were identified as only possibly being Late/Transitional Archaic in age. The nearest-neighbor analysis indicates that the 17

Figure 84. Location of a Potential Late Archaic/Late Prehistoric Site

definite Late/Transitional Archaic artifacts form a regular distribution with an R value of 1.76. When the 6 possible Late/Transitional Archaic artifacts are added to the analysis, the R value decreases to 1.43, indicating a slightly stronger relative tendency towards clustering (Table 11).

The study collection contains three different diagnostic types that fall within the Late/Transitional Archaic Period (Table 16, Appendix D). Spatial patterning will not be discussed for the following diagnostic types that are represented by only two or three, widely-spaced artifacts; Adena (TN 276 and TN 283) and Marcos (CN 13, LV 292 and LV 305). The spatial patterning of the artifacts in the third diagnostic type, Yarbrough, is discussed below.

Yarbrough Diagnostic Type

Figure 86 shows the distribution of the Yarbrough artifacts within the study area. All 17 artifacts are projectile points. There are three small clusters of Yarbrough projectile points in the eastern portion of the study area. The first cluster consists of 4 projectile points (TN 6, TN 41, TN 55, and TN 77) spanning a distance of 503 meters. Three of the artifacts in this cluster (TN 6, TN 41, and TN 55) have only a slight amount of mechanical wear. They were found in March 1985, February 1986, and December 1986, respectively. The fourth artifact in the cluster (TN 77) has a moderate amount of wear and patina and was found in December 1987. The 3 slightly worn artifacts were probably found very near their original site location. The fourth artifact with a moderate amount of wear and later date of find probably eroded out of the same site, but was not

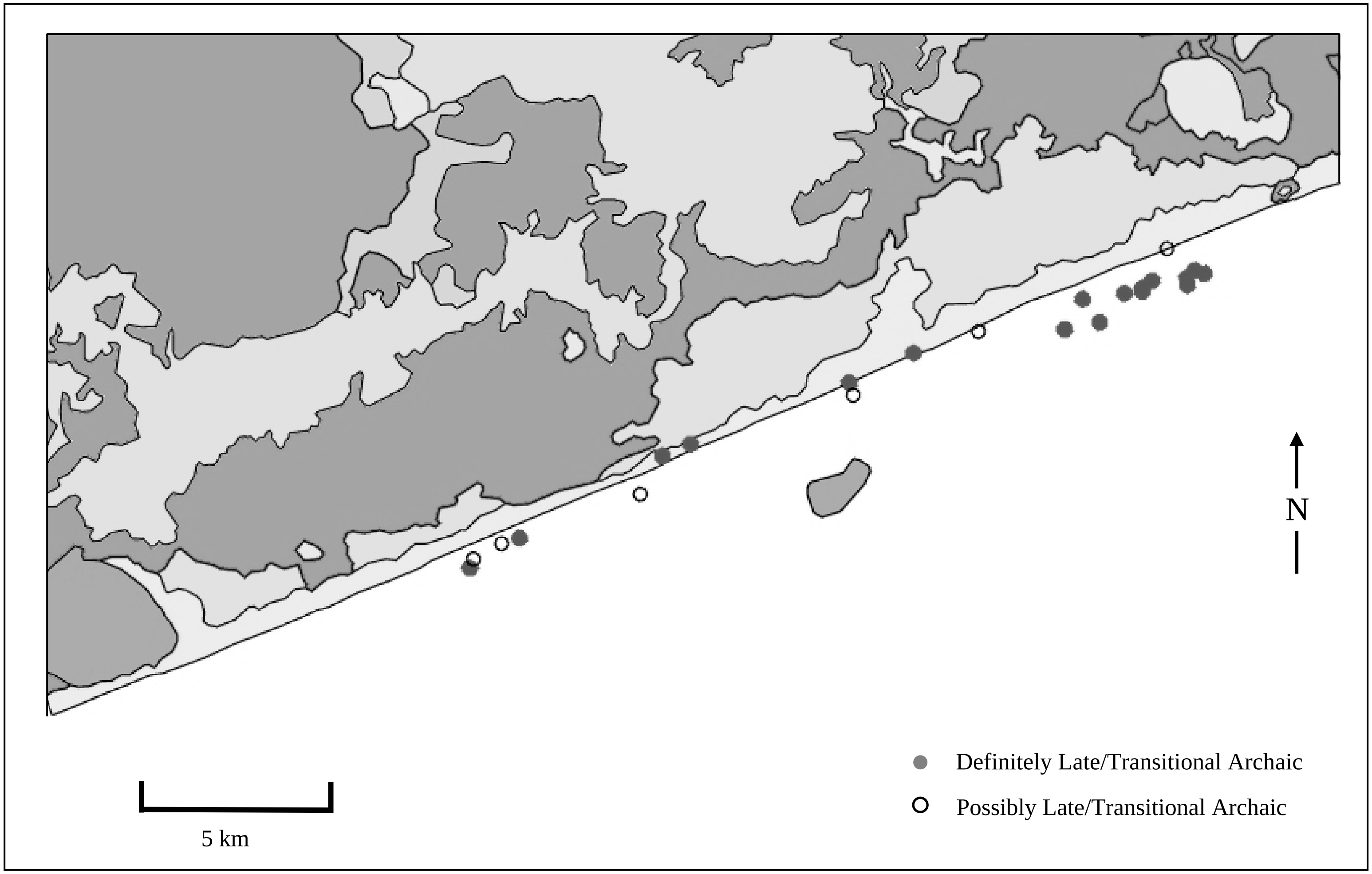

Figure 85. Locations of Late/Transitional Archaic Artifacts

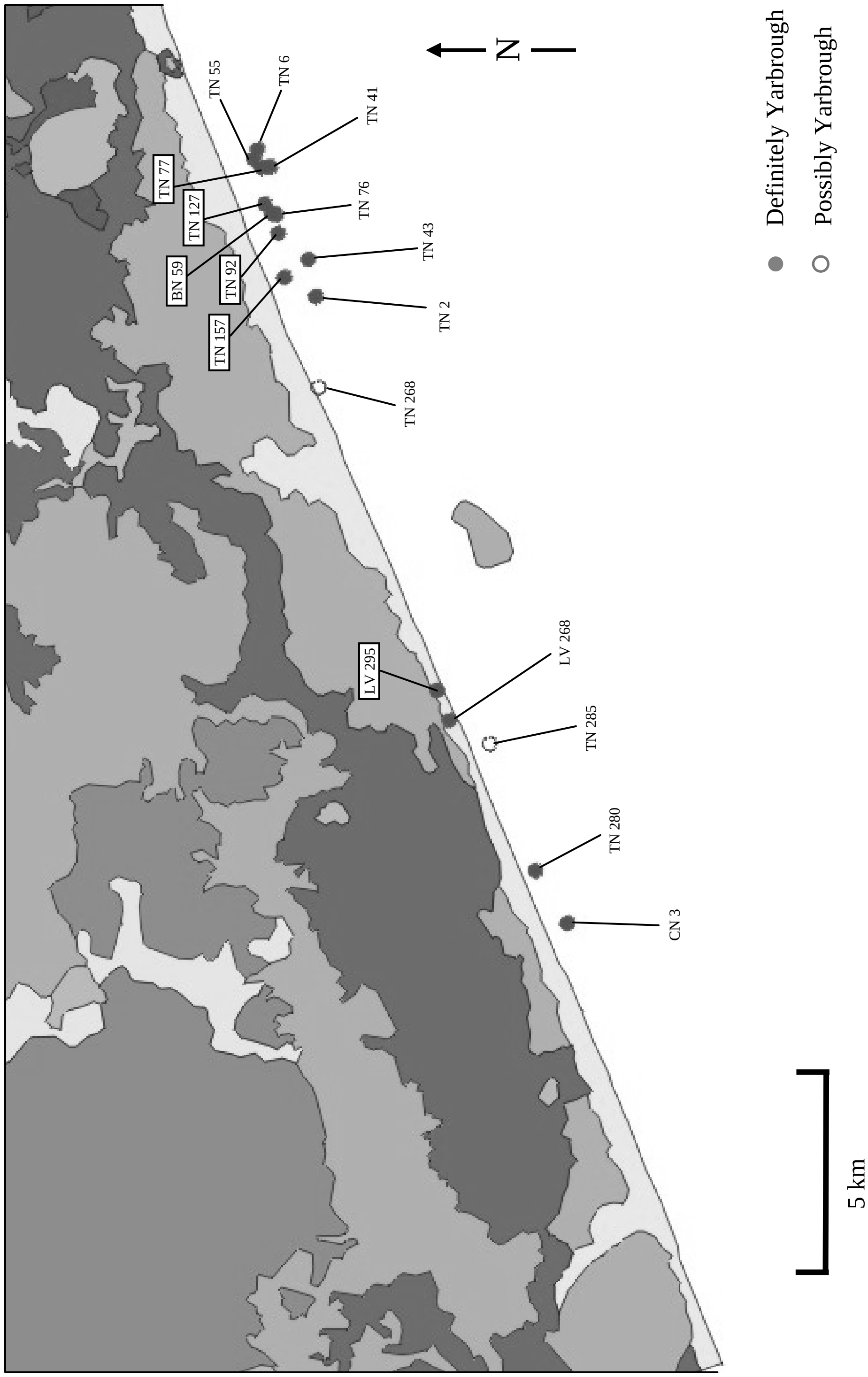

Figure 86. Yarbrough Artifacts

found immediately after being exposed. It is likely that these 4 artifacts mark the location of an original site.

The second cluster is 874 meters west of the first cluster. It consists of four artifacts (BN 59, TN 76, TN 92, and TN 127) spanning a distance of 698 meters. The easternmost artifact in this cluster (TN 127) has only a slight amount of wear and patina and was found in March 1990. The other three artifacts in the cluster (BN 59, TN 76, and TN 92) have a moderate amount of wear and were found in March 1991, December 1987, and April 1988, respectively. The dates of find for the artifacts in this cluster are later than those in the eastern cluster with the exception of TN 76, which was found just 1 week before TN 77 in the cluster to the east. The dates of find and moderate amount of wear on BN 59, TN 76, and TN 92 suggest that these artifacts may have originated from the same site as the artifacts in the eastern cluster, but were subsequently transported to the west by longshore current. The slight amount of wear and patina on TN 127 suggests that it was found very near its original site location, possibly the same site as the three slightly worn artifacts in the cluster to the east; however, assuming that the slightly worn artifacts were not transported far, if at all, from their original site locations, this would necessitate that the archaeological site from which they were derived was almost 1.4 kilometers in the alongshore dimension. Therefore, it is more reasonable to assume that TN 127 is an isolated artifact.

The third cluster is 964 meters west of the second cluster. It consists of a pair of artifacts (TN 43, and TN 157) that were found just 142 meters apart. TN 43 has a moderate amount of wear and was found in March 1986; TN 157 has a heavy amount of wear and was found in February 1992. The amount of wear on these two artifacts and the 6 years difference in their dates of find do not suggest an original site location. A third artifact (TN 2), 560 meters to the west of this pair, is only slightly worn and was found in January 1984. Because TN 2 was found west of the third cluster and not to the east, it is doubtful that it marks an original site from which the other two artifacts were eroded and transported by longshore current. It is more likely just an isolated artifact.

There are five Yarbrough projectile points in the western portion of the study area. The two easternmost (LV 268 and LV 295) were found 792 meters apart in January 1995 and May 1995, respectively. LV 268 has a moderate amount of wear and heavy patina, and LV 295 has a heavy amount of wear and slight patina. When the location of the steel barriers that were erected on the beach to reduce erosion (Figure 31) is plotted against the distribution of Yarbrough artifacts, the location of LV 268 exactly coincides with the western end of the western barrier. The more heavily worn artifact, LV 295, was found to the east along the front of the barrier. It is possible that a site occurs at the western end of the barrier, and that the focused wave energy at the barrier caused the artifacts eroded out of the site to be subjected to more intensive and constant wave energy than otherwise would have been the case, thereby causing the moderate to heavy wear.

The results of the nearest-neighbor analysis indicate that those artifacts that are definitely Yarbrough form a random distribution with an R value of 1.21. This is one of the lowest R values obtained for any of the diagnostic types analyzed (Table 12), indicating a relatively strong tendency towards clustering. When the two possible Yarbrough artifacts are included in the analysis the R value is higher at 1.68, indicating less of a tendency towards clustering. This statistically confirms what is visually evident: that the possible Yarbrough artifacts are not closely associated with the definite Yarbrough artifacts. This result strongly suggests that these two artifacts may, in fact, not be Yarbrough.

Figure 87 is a composite map showing the potential site locations for the Late/Transitional Archaic Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1984 and 1995 after the shoreline had moved significantly inland due to coastal erosion.

<u>Transitional Archaic Period</u>

Figure 88 shows the spatial distribution of the artifacts that were identified as Transitional Archaic in age. The nearest-neighbor analysis indicates that the 16 definite Transitional Archaic artifacts form a random distribution with an R value of 1.12 (Table 11). This is one of the lower R values for the cultural periods analyzed, suggesting a relative tendency towards clustering.

The study collection contains four different diagnostic types that fall within the Transitional Archaic Period (Table 16, Appendix D). There was only one Figueroa artifact (LV 80) identified in the study collection. The spatial patterning of the artifacts in the other three diagnostic types is discussed below.

Figure 87. Locations of Potential Late/Transitional Archaic Sites

Figure 88. Locations of Transitional Archaic Artifacts

Ensor Diagnostic Type

Figure 89 shows the distribution of the Ensor artifacts within the study area. All nine artifacts are projectile points. There is a broad cluster of three projectile points (FR 2, LV 204, and LV 225) in the eastern portion of the study area. All three artifacts have a moderate amount of mechanical wear. FR 2 was found in June 1970; LV 204 was found in May 1994, and LV 225 was found in August 1994. Because FR 2 was found 24 years before the other two artifacts in the cluster were found, it seems unlikely that it is from the same site. However, LV 204 and LV 225 were found only 3 months apart within 690 meters of each other. Although their moderate amount of mechanical wear indicates that they may have been transported (probably to the west by longshore current) after being eroded out of their primary context, these two artifacts may mark the general location of an archaeological site.

The remaining six Ensor artifacts are rather widely distributed across the study area, with the exception of two (LV 85 and LV 233), which were found only 154 meters apart. Both of these artifacts are heavily worn. LV 85 was found in January 1993, and LV 233 was found in September 1994. These two artifacts were found along the front of the western steel barrier that was erected on the beach to reduce erosion (Figure 31). It is possible that a site occurs along the barrier at the location where the two artifacts were found. The focused wave energy at the barrier caused the artifacts eroded out of the site to be subjected to more intensive and constant wave energy than otherwise would have been the case, thereby causing the heavy wear.

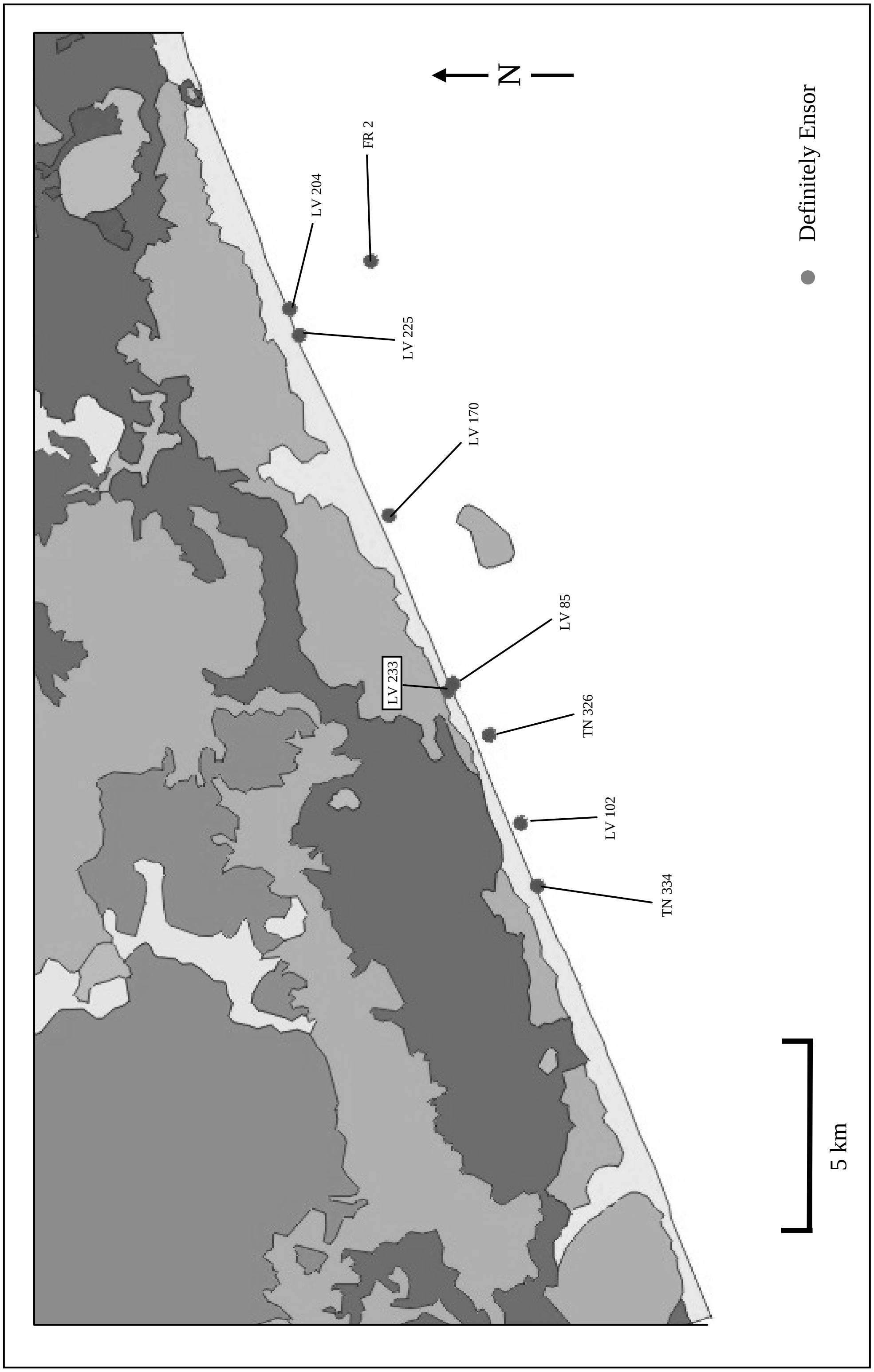

Figure 89. Ensor Artifacts

The results of the nearest-neighbor analysis indicate that the nine Ensor artifacts form a regular distribution with an R value of 2.56. This R value is relatively high, meaning that the Ensor artifacts have little tendency towards clustering.

Darl Diagnostic Type

Figure 90 shows the distribution of the Darl artifacts within the study area. Both artifacts are projectile points. The two Darl projectile points (BN 20 and TN 83) were found only 54 meters apart in February 1986 and January 1988, respectively. Both have only a slight amount of mechanical wear and no visible patina. The close association of these two artifacts and their slight amount of wear suggest that they mark the location of an archaeological site which eroded out over a period of at least 2 years. Because there are only two Darl artifacts, a nearest-neighbor analysis could not be run.

Edgewood Diagnostic Type

Figure 91 shows the distribution of the Edgewood artifacts within the study area. All four artifacts are projectile points. The two easternmost Edgewood projectile points (LV 265A and LV 299) were found only 126 meters apart in January 1995 and May 1995, respectively. However, the location of LV 265A has an accuracy of 2, meaning that it may have been misplotted as much as 2 kilometers to the east of its actual location. LV 265A has a heavy amount of wear, and LV 299 has a moderate amount of wear. The questionable location of LV 265A and the amount of mechanical wear on both artifacts make it very unlikely that they mark the location of a site.

Figure 90. Darl Artifacts

Figure 91. Edgewood Artifacts

The other two Edgewood projectile points were found 5.5 and 14.7 kilometers to the west of the eastern pair and do not pattern in any way. Because there are only four Edgewood artifacts, a nearest-neighbor analysis could not be run.

Figure 92 is a composite map showing the potential site locations for the Transitional Archaic Period identified in the preceding discussion. The potential site locations, shown at their true geographic coordinates, appear to be inland because the geologic base map dates from 1962 and the artifacts were found between 1970 and 1995 after the shoreline had moved significantly inland due to coastal erosion.

Archaic Period (Non-specific)

Figure 93 shows the spatial distribution of the artifacts that were identified as generally being Archaic in age. Seventeen of these 20 artifacts (BN 31, LV 2, LV 15, LV 24, LV 29, LV 32, LV 50, LV 309, LV 337, LV 338, TN 30, TN 51, TN 53, TN 100, TN 104, TN 226, and TN 247) are untyped projectile points and bifaces, 2 of which (LV 24 and TN 226) are only possibly Archaic. The 2 artifacts identified as only possibly being Archaic do not lie particularly close to those artifacts that are definitely Archaic (Figure 93), providing no additional support for their tentative identifications. The remaining three Archaic artifacts (TN 3, TN 28, TN 29) were more specifically identified as Archaic Stemmed.

Because it covers such a general timeframe and most of the artifacts are untyped, this is not an extremely useful category. However, it is interesting to note that 16 of the 20 artifacts in this general Archaic category concentrate within an 8.0 kilometer section of

Figure 92. Locations of Potential Transitional Archaic Sites

Figure 93. Locations of Archaic (Non-specific) Artifacts

the eastern portion of the study area. A nearest-neighbor analysis was not run for this general Archaic period.

Archaic Stemmed Diagnostic Type

Figure 94 shows the locations of the three Archaic Stemmed artifacts, all of which are projectile points. All three projectile points (TN 3, TN 28, and TN 29) have only a slight amount of mechanical wear and slight to no patina. TN 3 was found in March 1984, and TN 28 and TN 29 were found just 1 month apart in September and October 1985, respectively. These latter two artifacts were found only 153 meters apart. TN 3 was found approximately 3.5 kilometers west of the other two artifacts. Because of their slight amount of wear and the fact that they were found only 153 meters apart within a month of each other, TN 28 and TN 29 may mark the general location of an Archaic site. Because there are only three Archaic Stemmed artifacts, a nearest-neighbor analysis could not be run.

Figure 95 shows the true geographic location of this potential Archaic site. The potential site location appears to be inland because the geologic base map dates from 1962 and the artifacts were found between 1984 and 1985 after the shoreline had moved significantly inland due to coastal erosion.

Late Prehistoric Period

Figure 96 shows the spatial distribution of the artifacts that were identified as Late Prehistoric and those that were identified as only possibly being Late Prehistoric in age.

Figure 94. Archaic Stemmed Artifacts

Figure 95. Location of a Potential Archaic Site

The eight definite and two possible Late Prehistoric artifacts are rather widely distributed throughout the study area, and there is little correlation between the locations of the two possible Late Prehistoric artifacts (BN 38 and BN 61) and those that are definitely Late Prehistoric. Both possible Late Prehistoric artifacts are gar scales that may have been used as arrow points; however, the lack of close spatial correlation between these possible artifacts and the Late Prehistoric artifacts does not provide any additional support for their identification as arrow points.

Of the eight definite Late Prehistoric artifacts, one (LV 282) is an untyped arrow point and one (TN 244) is a piece of San Jacinto pottery. The remaining six artifacts were identified as specific diagnostic types of arrow points, with the exception of one of the Clifton artifacts (LV 158) that was classified as a projectile point. This artifact appears to be a Clifton arrow point made on the broken distal end of an earlier projectile point.

The four different diagnostic types that were identified in the study collection include Friley (LV 223), Scallorn (LV 77 (P) and LV 232), Perdiz (LV 122), and Clifton (BN 18 and LV 158). However, because there are only 1 or 2 widely-spaced artifacts for each diagnostic type and no clustering evident in the Late Prehistoric artifacts as a whole, no potential Late Prehistoric site locations can be delineated. Because there were only 10 Late Prehistoric artifacts in the study collection, no nearest-neighbor analysis was run.

Late Prehistoric/Historic Period

Figure 97 shows the spatial distribution of the artifacts that were identified as Late Prehistoric/Historic in age. All three artifacts (BN 34, TN 75, and TN 80) are Harahey Knives found within a 1-month period between December 1987 and January 1988. All

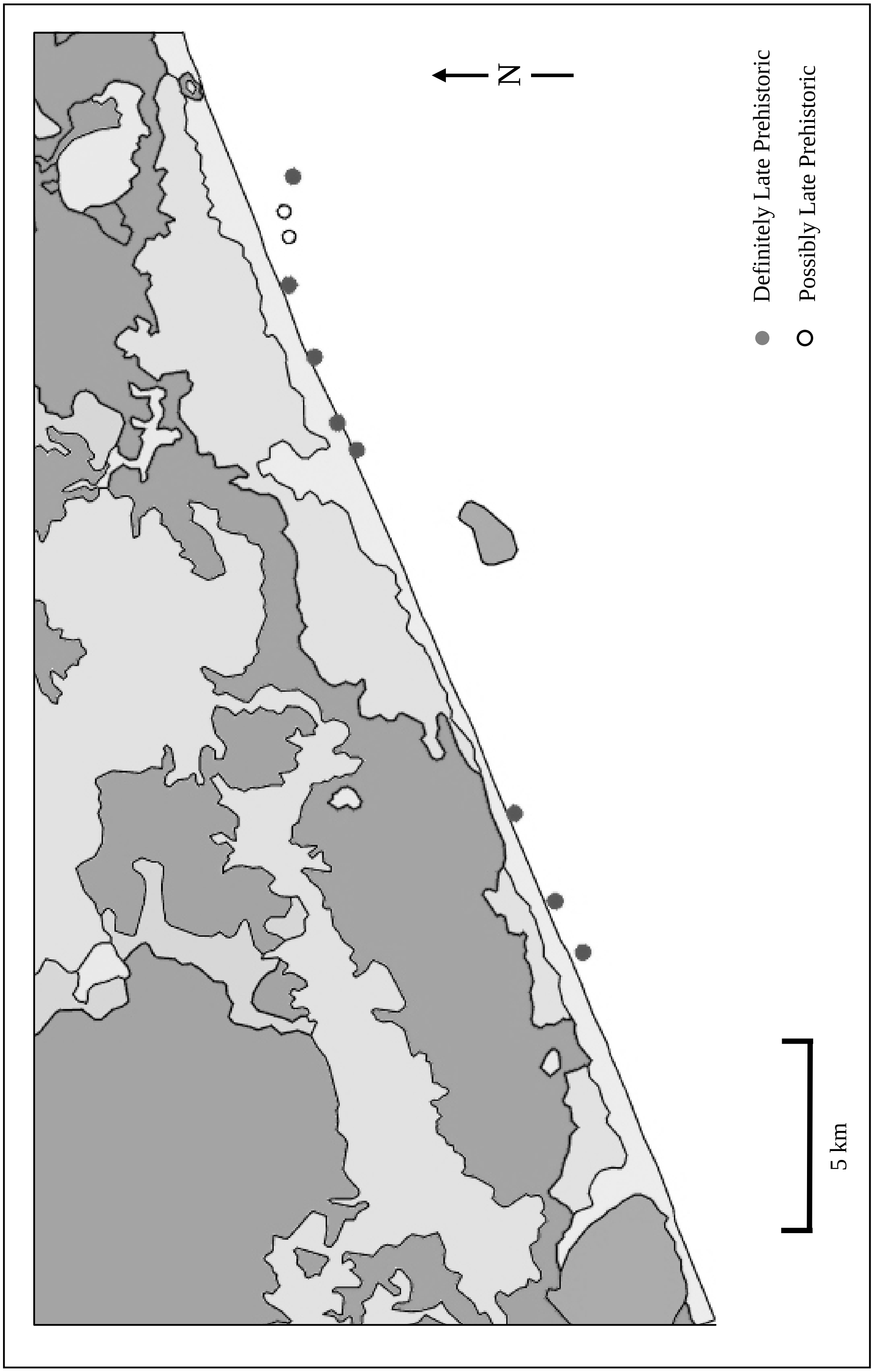

Figure 96. Locations of Late Prehistoric Artifacts

three are heavily reworked, with a moderate amount of wear and a slight amount of patina. BN 34 and TN 75 are both made out of Edwards chert, and TN 80 is possibly made out of Edwards chert. The two easternmost artifacts (BN 34 and TN 75) were found 634 meters apart. TN 80 was found approximately 1.1 kilometers farther west along the beach.

The striking similarity between these three artifacts, and the fact that all three were found within a 1-month period and within a relatively small area, suggest that they may mark the general location of a site. The distance between their locations and their moderate amount of wear probably indicate that they were scattered and transported to some degree after eroding out of their original site location. The transport was probably to the west as a result of the predominant influence of the longshore current. An unnamed tropical storm that crossed the coast just east of Galveston Bay in August 1987 may also have contributed to the exposure and transport of these artifacts. Assuming that there was some westward transport of the artifacts after eroding out of their original site context, the two easternmost artifacts (BN 34 and TN 75) are probably closer to the original site location. Because there were only three Late Prehistoric/Historic artifacts in the study collection, no nearest-neighbor analysis was run.

Figure 98 shows the true geographic location of this potential Late Prehistoric/Historic site. The potential site location appears to be inland because the geologic base map dates from 1962 and the artifacts were found between 1987 and 1988 after the shoreline had moved significantly inland due to coastal erosion.

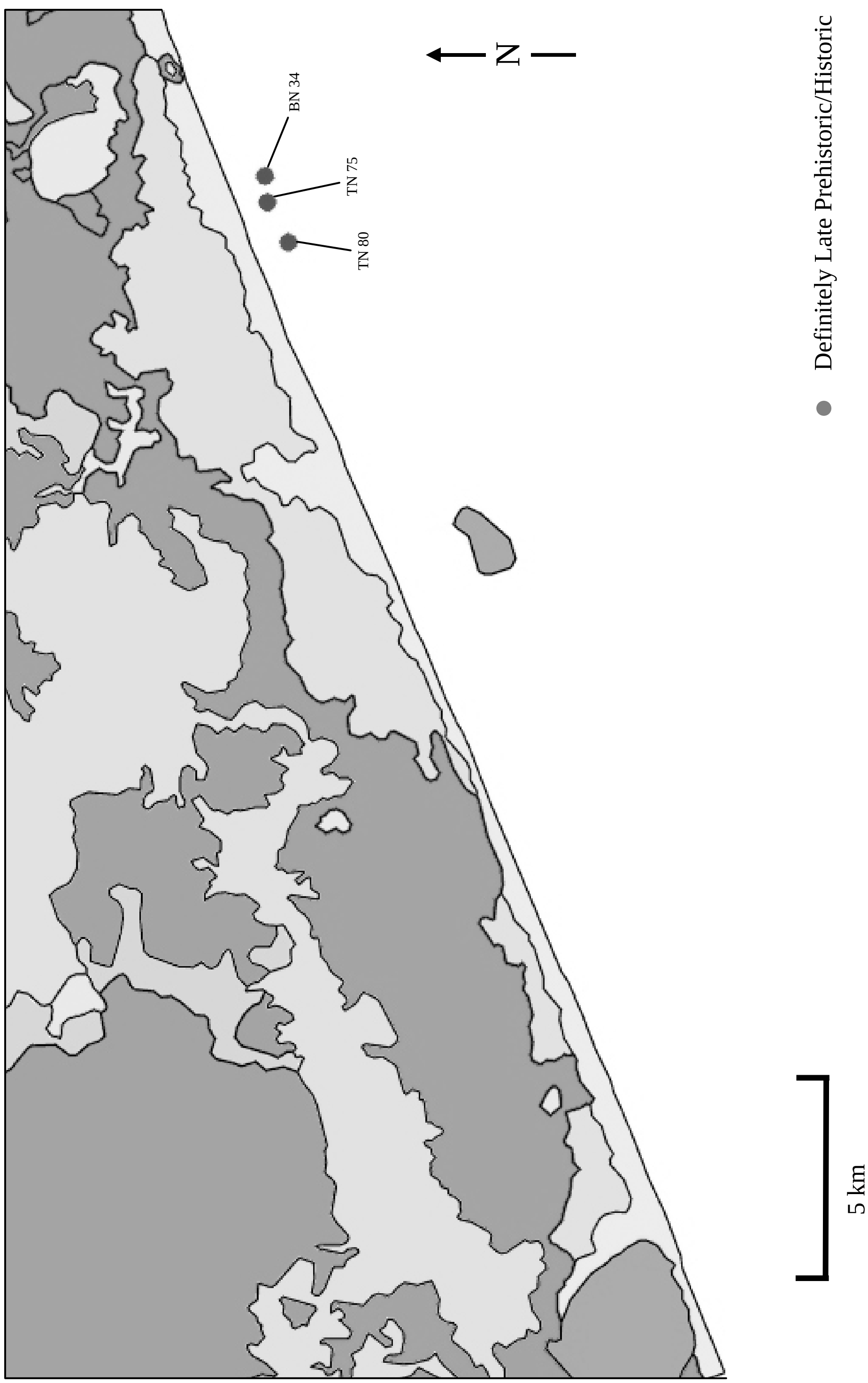

Figure 97. Locations of Late Prehistoric/Historic Artifacts

Discussion

The results of the spatial analysis presented in this chapter indicate that there is some remnant spatial patterning, which suggests the locations of original archaeological sites, in the lag deposit of artifacts recovered from McFaddin Beach. By overlaying all of the potential site locations identified in the above analysis, four broad areas were identified where sites of more than one cultural period may occur (Figure 99). Table 13 shows which cultural periods are represented by the possible sites in each of these four areas of potential site concentrations.

The easternmost area (Area 1) was identified as being the location of potential sites for 12 of the 15 cultural periods analyzed. The only periods not represented in this easternmost area are the Early/Middle Archaic, the Late Archaic/Late Prehistoric Period and the Late Prehistoric Period. Approximately 3 kilometers to the west of the first area is a second area where sites representing 4 of the 15 cultural periods may occur. These 4 periods are Paleoindian, Late Paleoindian, Middle/Late Archaic, and Late Archaic. The third area, approximately 4 kilometers west of the second, contains potential site locations for 7 of the 15 cultural periods analyzed. These include Late Paleoindian, Late Paleoindian/Early Archaic, Middle/Late Archaic, Middle/Transitional Archaic, Late Archaic/Late Prehistoric, Late/Transitional Archaic, and Transitional Archaic. The fourth, westernmost area has potential site locations for 3 of the 15 periods. These are Paleoindian, Middle/Late Archaic, and Middle/Transitional Archaic.

As discussed in Chapter III, the paleogeography of the present McFaddin Beach area was radically changing throughout the 11,500 years represented by the artifacts in the study collection. Therefore, the geographic features and natural resources that drew

Figure 98. Location of a Potential Late Prehistoric/Historic Site

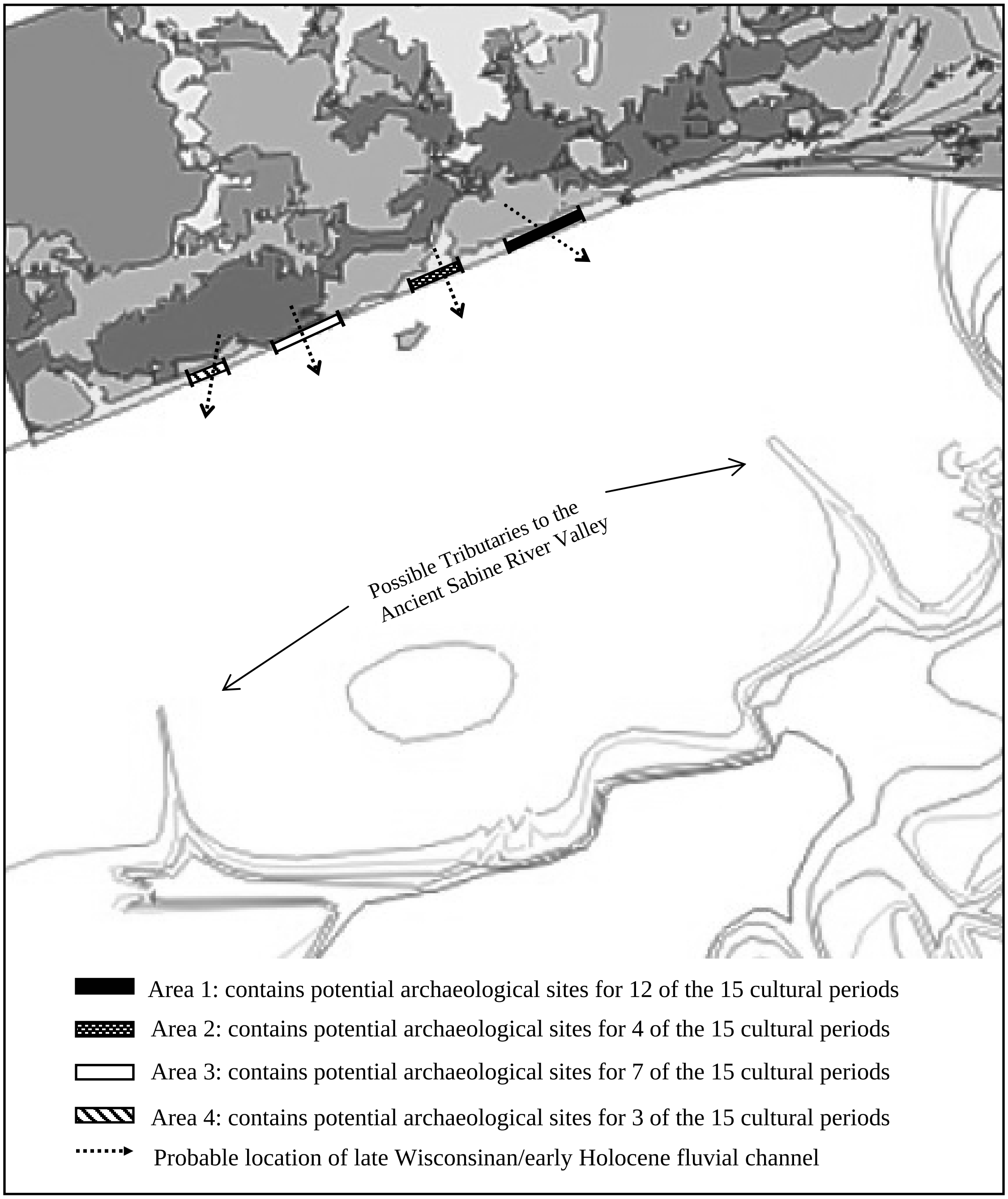

Figure 99. Paleogeography of McFadding Beach Showing Areas Having the Highest Potential for Archaeological Sites

Table 13. Cultural Periods of the Possible Archaeological Sites Within the Four Areas of Site Concentrations (Figure 99)

Period	**Approximate Age**	**Area 1**	**Area 2**	**Area 3**	**Area 4**
Paleoindian	11,500 to 8,000 B.P.	X	X		X
Late Paleoindian		X	X	X	
Late Paleoindian/Early Archaic		X		X	
Early Archaic	8,000 to 4,500 B.P.	X			
Early/Middle Archaic					
Middle Archaic	4,500 to 3,000 B.P.	X			
Middle/Late Archaic		X	X	X	X
Middle/Transitional Archaic		X		X	X
Late Archaic	3,000 to 2,300 B.P.	X	X		
Late Archaic/Late Prehistoric				X	
Late/Transitional Archaic		X		X	
Transitional Archaic	2,300 to 1,300 B.P.	X		X	
Archaic (Non-specific) *		X			
Late Prehistoric	1,300 to 400 B.P.				
Late Prehistoric/Historic		X			

* Potential sites in this category cannot be definitely assigned to any particular time period within the broad time frame of the Archaic.

human populations to a specific area would have changed through time. The cultural periods listed in Table13 seem to fall into four distinct groups (set off by dotted lines) based on changes in the distribution of potential sites among the four areas of potential site concentration shown in Figure 99. These are Paleoindian to Late Paleoindian/Early Archaic with potential sites in all four areas, Early Archaic to Middle Archaic with potential sites only in Area 1, Middle/Late Archaic to Late Archaic with potential sites in all four areas, and Late Archaic/Late Prehistoric to Late Prehistoric/Historic with potential sites only in Areas 1 and 3.

During the Paleoindian to Late Paleoindian/Early Archaic cultural periods (ca. 11,500 to 8,000 B.P.), sea level was much lower, and stream channels would have cut across the present beach area, which was then a broad coastal plain. The most likely location for preserved archaeological sites from this time period would be along the buried banks and terraces of these stream valleys (Kraft et al., 1983:Figure 8). By extension, the concentration of potential archaeological sites from this time period in the four areas shown in Figure 99 may indicate the general locations of buried late Wisconsinan/early Holocene fluvial channels.

Landward of the beach, the courses of these relict stream valleys are obscured by the Holocene marsh deposits and beach sands; however, compaction of the fill sediments in the late Wisconsinan/early Holocene channels beneath the marsh deposits should cause topographic lows on the present land surface. The lowest areas in the coastal marsh are marked by lakes and mud-filled ponds (Figures 3 and 99). Somewhat lower areas in relation to the present marsh surface are probably indicated by the brackish-water marsh deposits as opposed to the freshwater marsh deposits.

Offshore, the contours along the northern flank of the ancient Sabine River Valley, as mapped by Nelson and Bray (1970), suggest the locations of at least two major tributaries flowing into the river valley from the north (Figure 99). If the eastern tributary is projected across Area 1 along the beach, it connects with Star Lake in the Holocene marsh behind the beach. The possible courses of the other late Wisconsinan/early Holocene fluvial channels are not as clearly suggested by the known paleogeography. However, the location of site concentrations on either side of the salt diapir (Area 2 and Area 3) is consistent with the expected locations of relict fluvial channels, if, in fact, the salt diapir had topographic expression during this time period. The topographic high formed by the diapir would have diverted the local drainage system to either side of the diapir. The westernmost area of site concentration (Area 4) may lie along a relict fluvial channel which connected with the western tributary to the ancient Sabine River Valley mapped by Nelson and Bray; however, there is no direct evidence in the paleogeography onshore to support this suggestion.

During the Early Archaic to Middle Archaic cultural periods (ca. 8,000 to 3,000 B.P.), the ancient Sabine River Valley became drowned due to rising sea level and formed a large estuary (Nelson and Bray, 1970:Figures 12 and 13). As sea level continued rising, the ancient estuary also became drowned and buried by marine sediments. The paucity of potential sites from the early part of this time period (ca. 8,000 to 4,500 B.P.) suggests that the focus of human populations at this time may have shifted from river valley resources to estuarine resources. If, in fact, this was the case, most sites from this time period would be drowned and buried offshore along the margins of the ancient Sabine estuary. The latter part of this time period (after 4,500 B.P.) may have been marked by a series of small sea-level fluctuations on the order of ±1.0 to ±1.5 meters. This environment may not have been conducive to the development of stable coastal resources for human subsistence. The few potential sites that were identified for this general time period all occur in the easternmost area (Area 1).

During the Middle/Late Archaic to Late Archaic cultural periods (ca. 3,500 to 2,300 B.P.), the shoreline environment was stabilizing near its present position, and the Holocene marsh was continuing to develop. Prehistoric human groups in the area probably would have focused on the widespread resources of the nearshore and intertidal area, and the extensive Holocene marsh behind the beach. The occurrence of these sites in the same areas as Paleoindian to Late Paleoindian/Early Archaic sites could be related to the locations of the late Wisconsinan/early Holocene fluvial channels postulated above. Compaction of the fill material in the relict stream valleys beneath the beach and marsh deposits may have caused lakes or ponds to form in the overlying deposits. These features would have concentrated certain subsistence resources, such as waterfowl.

During the Late Archaic/Late Prehistoric to Late Prehistoric/Historic cultural periods (ca. 3,000 to 400 B.P.), the Holocene marsh had built to its maximum seaward extent, and the process of erosion began to dominate. The potential sites for this general time period are much fewer in number than for the previous period and concentrate in Area 1 and Area 3.

To confirm the preliminary paleogeographic interpretations suggested above, additional research combining a synthesis of existing shallow seismic data and cores from the offshore area and subsurface testing along the beach and within the Holocene marsh onshore would be necessary. Likewise, subsurface testing by coring or trenching would be necessary to determine whether any intact portions of the original archaeological sites remain at the locations indicated by the above analysis.

CHAPTER VI

CONCLUSIONS

This study was undertaken to test the proposition that significant archaeological information can be extracted from a lag deposit of durable artifacts along an eroding coastline. The results of the study indicate that even though the primary archaeological context of the artifacts has been destroyed, some important archaeological information can be gained by reconstructing the larger paleogeographic context of the eroded sites and studying the attributes and spatial distribution of the artifacts in the lag deposit.

The geography of the study area changed radically during the 11,500-year period represented by the diagnostic artifacts in the study collection. Sea level rose approximately 48 meters during this time, changing the geography of the study area from an upland, 136 kilometers inland of the Gulf of Mexico at 11,500 B.P., to the present shoreline environment backed by a broad coastal marsh by approximately 3,000 B.P. The ancient Sabine River Valley, approximately 30 kilometers south of the present shoreline, became drowned as sea level rose, turning what was a large river valley during Paleoindian times (ca. 11,500 to 8,000 B.P.) into a large estuary during Early Archaic times (ca. 8000 to 4,500 B.P.). As sea level continued to rise, marine waters inundated the estuary, and the present shoreline environment was established. The salt diapir that lies just offshore the present coastline may have been a prominent feature in the otherwise flat prehistoric landscape until it was planed off by wave erosion and inundated by rising sea level approximately 5,000 to 6,000 years ago.

Approximately 43 percent of the diagnostic artifacts in the study collection are Paleoindian and Late Paleoindian in age (ca. 11,500 to 8,000 B.P.). Throughout this period, the riverine environments of the ancient Sabine River Valley and its many tributaries would have provided fresh water, food resources, and an easy route for transportation, including a route to the Gulf of Mexico, 136 kilometers to the south. If the salt diapir just offshore the present beach area had surface expression at this time, it would have provided a topographic high in the otherwise flat coastal plain; if salt was exposed at the surface of the diapir, either as rock salt or brine seeps, it would have also provided a draw for game animals, a salt supply for curing meat and hides, and possibly a trade item.

Only 6 percent of the diagnostic artifacts in the study collection are types that fall either wholly or partially within the Early Archaic Period (ca. 8,000 to 4,500 B.P.). During the Early Archaic Period, the Sabine River Valley was becoming drowned by rising sea level, forming a large estuary (Nelson and Bray, 1970). It is likely that human exploitation of this area during the Early Archaic would have focused on the resources of this large estuary. If so, sites of the Early Archaic Period would be drowned and buried along the margins of this old estuary approximately 30 kilometers offshore. This may explain the paucity of artifacts from this time period in the study collection from McFaddin Beach.

In a 1986 study, Pearson et al., recorded a possible shell midden dating 8,055 $\pm$ 90 B.P. (uncorrected radiocarbon years) (UGa-5450) buried 4.5 to 6.5 meters below the seafloor along the eastern edge of the ancient Sabine River Valley, approximately 16 kilometers offshore the Texas/Louisiana border. This possible buried and inundated shell midden dates to the time period when the Sabine River Valley was being converted into an estuary and is exactly the type of site that would be expected for the Early Archaic Period.

Approximately 15 percent of the diagnostic artifacts in the study collection are types that span the Middle/Transitional Archaic Periods (ca. 4,500 to 1,300 B.P.). By this time, the Gulf of Mexico shoreline was near its present position and an extensive coastal marsh was developing across the area. During this period, both the ancient Sabine River Valley and the salt diapir would have been drowned due to rising sea level; however, the new food resources provided by a stabilized shoreline environment and the coastal marsh may have been the draw for human populations at this time.

The evidence from the central bend area of Texas for possible intermittent high sea stands of 1.0 to 1.5 meters higher than present between approximately 4,500 and 4,000 B.P. should be reflected in a paucity of artifacts for the Middle Archaic Period (ca. 4,500 to 3,000 B.P.) in the McFaddin Beach collection. The only diagnostic type in the study collection that falls wholly within the 4,500 to 4,000 B.P. timeframe is the Travis type (Turner and Hester, 1993:189). Although there were only two Travis projectile points identified in the study collection, these occurrences, outside a dated context, are not strong enough evidence to support or refute the existence of mid to late Holocene high stands in sea level in this area. The other diagnostic types in the study collection that overlap the period of the postulated high stands continued for hundreds of years after the high stands ended (Table 16, Appendix D); therefore, they provide little useful evidence regarding these possible high stands in sea level.

The McFaddin Beach area lies at the boundary of the Southeastern Woodlands and Southern Great Plains physiographic provinces. Shifts in the late Pleistocene and Holocene climate would have caused the gradual shifting back and forth of the predominant physiographic province from woodland to grassland. However, even when grasslands predominated across the study area, the numerous river valleys would have extended the woodland habitats far into the grassland environment. As a whole, the diagnostic artifacts in the study collection are more reflective of the Southeastern Woodlands cultures to the east, rather than the Southern Great Plains cultures. Even the Clovis artifacts in the study collection are more reflective of Clovis point styles from Florida and other areas of the Southeast than of classic western Clovis points. Most of the diagnostic types in the study collection that are representative of Great Plains cultures (e.g., Folsom, Plainview, Hell Gap, and Scottsbluff) are Paleoindian in age.

Although almost 60 percent of the artifacts in the study collection are projectile points, indicating that hunting, fishing, and food processing were probably the predominant activity for all cultural periods, many of the projectile points show evidence of having been used for other functions such as knives, scrapers, spokeshaves, etc. Other activities such as lithic manufacture, woodworking, food processing, and hide processing are also indicated by artifacts in the study collection; however, many of the tools used for these activities (e.g., hammerstones, cores, flakes, and scrapers) are not diagnostic and, therefore, cannot be assigned to any specific cultural period.

The lithic source analysis for the chipped stone artifacts in the study collection indicates a strong regularity in lithic procurement strategy for all cultural periods. The Edwards Plateau in Central Texas was the source for most of the raw lithic material, with petrified wood and fossil palm (probably from the Tertiary formations of East Texas) and gravels from various widely scattered sources being exploited for additional lithic material. The study collection indicates the consistent use of petrified wood and fossil palm wood as a lithic source material throughout all cultural periods up until the Transitional Archaic (ca. 2,300 B.P.). The use of petrified wood and fossil palm, which is often of inferior quality and difficult to work, is probably due to the general scarcity of good quality knappable lithic material in the Upper Texas Gulf Coast. Likewise, the indications from the study collection of the extensive use of various gravels as lithic source materials throughout the prehistoric past at McFaddin Beach probably also reflects this scarcity of high quality lithic material in the immediate area. Many of the flaked stone artifacts in the study collection have remnants of pebble cortex. One artifact (TN 275) has pebble cortex on both its ventral and dorsal sides, indicating a lithic manufacture technology that was capable of producing flaked stone implements from pebble-sized gravels (i.e., 4 to 64 millimeters in diameter).

Tecovas from the Panhandle of Texas was another common lithic source used by the prehistoric inhabitants of the McFaddin Beach area; but, noticeable by its complete absence in the study collection is material from the Alibates source, also in the Panhandle of Texas very close to the Tecovas source areas. It is possible that Tecovas gravels carried towards the coast by the Brazos River led prehistoric people to the source areas in the Panhandle. No such river drained the Alibates source areas towards the coast.

The exotic lithic source materials (greater than 1,000 kilometers from the McFaddin Beach area) were used almost exclusively by the Paleoindian groups. It is interesting to note that four of the five exotic lithic sources occur in proximity to the Missouri River and its tributaries. Although there is no direct river connection between the Missouri River and the McFaddin Beach area, the exotic lithic material found at McFaddin Beach suggests that during Paleoindian times, rivers may have been important routes for exploiting distant lithic sources, either through trade with distant groups or by travel up the rivers towards the source areas where the material could have been procured either from the bedrock source or as river cobbles. There is also some indication from the study collection that other distant sources such as the Ozark Mountains in northeastern Oklahoma and northwestern Arkansas and the Arbuckle Mountains of southern Oklahoma, although not used frequently, were exploited somewhat more by Paleoindian groups than later prehistoric populations.

The results of the spatial analysis indicate that there is some remnant spatial patterning in the lag deposit of artifacts recovered from McFaddin Beach. The apparent clustering of artifacts for some diagnostic types and periods suggests the possible locations of original archaeological sites. However, subsurface testing by coring or trenching would be necessary to confirm the results of the spatial analysis and to determine whether any intact portions of the original archaeological sites remain at the locations indicated by the analysis.

There are four broad areas along the beach where sites of more than one prehistoric cultural period appear to concentrate. These areas of potential site concentrations were connected with features in the offshore and onshore paleogeography to infer the possible locations of late Wisconsinan/early Holocene fluvial channels buried beneath the present beach and Holocene marsh deposits. Additional research combining a synthesis of existing shallow seismic data and cores from the offshore area and subsurface testing along the beach and within the Holocene marsh onshore would be necessary to confirm this preliminary assessment. It is interesting to note that the only subsurface archaeological testing that has been conducted at McFaddin Beach (Pearson and Weinstein, 1983) occurred in the one area along the entire beach (the mid-beach “gap”) where the findings of the present study indicate that archaeological sites are least likely to occur.

The two most significant limitations to the analysis presented in this case study are: 1) the problem in confidently assigning diagnostic types to artifacts devoid of any cultural context; and 2) the almost complete lack of previous research on how objects that are the weight and shape of chipped stone artifacts move in response to wave action and longshore current at the shoreline.

To address the problem of accurately typing the artifacts, a dual designation was carried throughout the analysis whereby artifacts that could be positively assigned to a particular diagnostic type were labeled “definite” and those that were less certain were labeled “possible.” It is hoped that inclusion of the artifact photos in Appendix A and the artifact database in Appendix B will allow other researchers to assess the validity of the identifications that were made for this study.

The second problem, which pertains to the spatial analysis, is not so easily addressed. Complicating the basic lack of information on how artifacts move in the shoreline environment is the complexity of the natural environmental processes operating at the shoreline. The seasonal shift in the direction and strength of the longshore current is punctuated by tropical storm events and hurricanes in the summer, and winter storms during the late fall and winter. As seemed appropriate, some attempt was made in the analysis to identify certain hurricanes and tropical storm events whose timing may have had a significant effect on the observed distribution of certain artifacts.

Despite these shortcomings, the basic assumptions used in the spatial analysis, should remain valid. These assumptions are: 1) artifacts having only a slight amount of mechanical wear probably have not been transported far from their original site location; 2) if artifacts have been transported from their original site locations, the predominant direction of transport will be to the west along the coast, because that is the prevailing direction of the strongest longshore current; and 3) the less an artifact weighs, the less wave energy it will take to mobilize and transport it; therefore, other factors being equal, lighter artifacts will tend to have moved farther from their original site locations than heavier artifacts eroded out of the same site. Through the spatial analysis, it also became clear that the steel barriers that were erected along the beach to prevent beach erosion acted to locally intensify wave energy and erosion.

The goal of this study was to demonstrate a methodology that can be used to obtain useful archaeological information from artifacts derived from severely disturbed archaeological contexts. When it is considered that virtually no archaeological deposit is completely pristine but has been disturbed to some degree by cultural and environmental processes, the nature and extent of those processes need to be identified, and the effects taken into account, before drawing inferences about human behavior from any archaeological site. For the lag deposit of artifacts from McFaddin Beach, the severity of the disturbance was great, and our present understanding of the disturbing process is limited. However, as this research has hopefully demonstrated, it was still possible to extract useful archaeological information.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.